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Grid Solutions

MiCOM P40 Agile

P94V

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Feeder Management IED

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CHAPTER 1

INTRODUCTION

1 CHAPTER OVERVIEW

This chapter provides some general information about the technical manual and an introduction to the device(s) described in this technical manual.

This chapter contains the following sections:

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Product Scope 6
Features and Functions 7
Logic Diagrams 9
Functional Overview 11

2 DISCLAIMER

It is the responsibility of the user to verify and validate the suitability of all GE Grid Automation products. This equipment must be used within its design limits. The proper application including the configuration and setting of this product to suit the power system assets is the responsibility of the user, who is also required to ensure that all local or regional safety guidelines are adhered to. Incorrect application of this product could risk damage to property/the environment, personal injuries or fatalities and shall be the sole responsibility of the person/entity applying and qualifying the product for use.

The content of this document has been developed to provide guidance to properly install, configure and maintain this product for its intended applications. This guidance is not intended to cover every possible contingency that may arise during commissioning, operation, service, or maintenance activities. Should you encounter any circumstances not clearly addressed in this document, please contact your local GE service site.

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2.1 TARGET AUDIENCE

This manual is aimed towards all professionals charged with installing, commissioning, maintaining, troubleshooting, or operating any of the products within the specified product range. This includes installation and commissioning personnel as well as engineers who will be responsible for operating the product.

The level at which this manual is written assumes that installation and commissioning engineers have knowledge of handling electronic equipment. Also, system and protection engineers have a thorough knowledge of protection systems and associated equipment.

2.2 TYPOGRAPHICAL CONVENTIONS

The following typographical conventions are used throughout this manual.

- The names for special keys appear in capital letters.
  For example: ENTER
- When describing software applications, menu items, buttons, labels etc as they appear on the screen are written in bold type.
  For example: Select **Save** from the file menu.
- Filenames and paths use the courier font
  For example: `Example\File.text`
- Special terminology is written with leading capitals
  For example: Sensitive Earth Fault
- If reference is made to the IED's internal settings and signals database, the menu group heading (column) text is written in upper case italics
  For example: The *SYSTEM DATA* column
- If reference is made to the IED's internal settings and signals database, the setting cells and DDB signals are written in bold italics
  For example: The ***Language*** cell in the *SYSTEM DATA* column
- If reference is made to the IED's internal settings and signals database, the value of a cell's content is written in the Courier font
  For example: The ***Language*** cell in the *SYSTEM DATA* column contains the value *`English`*

2.3 NOMENCLATURE

Due to the technical nature of this manual, many special terms, abbreviations and acronyms are used throughout the manual. Some of these terms are well-known industry-specific terms while others may be special product-specific terms used by General Electric. The first instance of any acronym or term used in a particular chapter is explained. In addition, a separate glossary is available on the General Electric website, or from the General Electric contact centre.

We would like to highlight the following changes of nomenclature however:

- The word 'relay' is no longer used to describe the device itself. Instead, the device is referred to as the 'IED' (Intelligent Electronic Device), the 'device', or the 'product'. The word 'relay' is used purely to describe the electromechanical components within the device, i.e. the output relays.
- British English is used throughout this manual.
- The British term 'Earth' is used in favour of the American term 'Ground'.

2.4 COMPLIANCE

The device has undergone a range of extensive testing and certification processes to ensure and prove compatibility with all target markets. A detailed description of these criteria can be found in the Technical Specifications chapter.

3 PRODUCT SCOPE

The P94V Voltage and Frequency IED has been designed for the protection of a wide range of overhead lines and underground cables for distribution voltage level. The P94V provides integral overvoltage/undervoltage and overfrequency/underfrequency detection.

In addition to the protection features, the devices include a comprehensive range of non-protection features to aid with power system diagnosis and fault analysis.

The P94V can be used in various applications, depending on the chosen firmware. There are two different models according to which firmware is installed: P94VB, P94VP

- The P94VB is the base device for general application
- The P94VP is for check synchronising applications
- The P94VR provides all the features of the P94VP but also provides Autoreclose functionality

All models are available with a range of Input/Output options, which are described in the hardware design chapter and summarised in the ordering options.

A major advantage of the P40 Agile platform is its backward compatibility with the K-series products. The P40 Agile products have been designed such that the case, back panel terminal layout and pin-outs are identical to their K-series predecessors and can be retrofitted without the usual overhead associated with replacing and rewiring devices. This allows easy upgrade of the protection system with minimum impact and minimum shutdown time of the feeder.

3.1 ORDERING OPTIONS

All current models and variants for this product are defined in an interactive spreadsheet called the CORTEC. This is available on the company website.

Alternatively, you can obtain it via the Contact Centre at:

contact.centre@ge.com

A copy of the CORTEC is also supplied as a static table in the Appendices of this document. However, it should only be used for guidance as it provides a snapshot of the interactive data taken at the time of publication.

4 FEATURES AND FUNCTIONS

4.1 PROTECTION FUNCTIONS

The P94V models offer the following protection functions:

ANSI	IEC 61850	Protection Function	P94VB	P94VP	P94VR
25		Check synchronising	No	Yes	Yes
27	VtpPhsPTUV	Undervoltage	3 stages	3 stages	3 stages
47		Negative sequence overvoltage	Yes	Yes	Yes
59	VtpPhsPTOV	Overvoltage	3 stages	3 stages	3 stages
59N	VtpResPTOV	Residual Overvoltage	3 stages	3 stages	3 stages
81O	FrqPTOF	Overfrequency	Yes	Yes	Yes
81U	FrqPTUF	Underfrequency	Yes	Yes	Yes
81df/dt		Rate of change of frequency (df/dt)	Yes	Yes	Yes
81RF	DfpPFRC	Frequency supervised rate of change of frequency	No	Yes	Yes
81RAV	DfpPFRC	Frequency supervised average rate of change of frequency	No	Yes	Yes
81R		Load Restoration	No	Yes	Yes
81V	DfpPFRC	Undervoltage blocking of frequency protection	Yes	Yes	Yes
		Rate of change of voltage (dv/dt)	No	Yes	Yes
79	RREC	Autoreclose (3 phases)	No	No	Yes
		Programmable curves	Yes	Yes	Yes
		CB Monitoring	Yes	Yes	Yes
86		Latching output contacts (Lockout)	Yes	Yes	Yes

4.2 CONTROL FUNCTIONS

Feature	IEC 61850	ANSI
Power-up diagnostics and continuous self-monitoring		
Fully customizable menu texts		
Function keys	FnkGGIO	
Alternative setting groups (4)		
Programmable LEDs	LedGGIO	
Programmable hotkeys		
Watchdog contacts		
Read-only mode		
NERC compliant cyber-security		
Programmable allocation of digital inputs and outputs		
Control inputs	PloGGIO1	
Graphical programmable scheme logic (PSL)		
Circuit breaker control, status & condition monitoring	XCBR	52
Trip circuit and coil supervision		
CT supervision (only for products with VT inputs)		
Fault locator (only for products with VT inputs)	RFLO	

4.3 MEASUREMENT FUNCTIONS

The device offers the following measurement functions:

Measurement Function	Details
Measurements (Exact range of measurements depend on the device model)	Measured currents and calculated sequence and RMS currents Measured voltages and calculated sequence and RMS voltages Power and energy quantities Peak, fixed and rolling demand values Frequency measurements Others measurements
Disturbance records (waveform capture, oscillography) Channels / duration each or total / samples per cycle	9 / 10, 5 / 24
Fault Records	10
Maintenance Records	10
Event Records / Event logging	2048
Time Stamping of Opto-inputs	Yes

4.4 FUNCTIONAL OVERVIEW

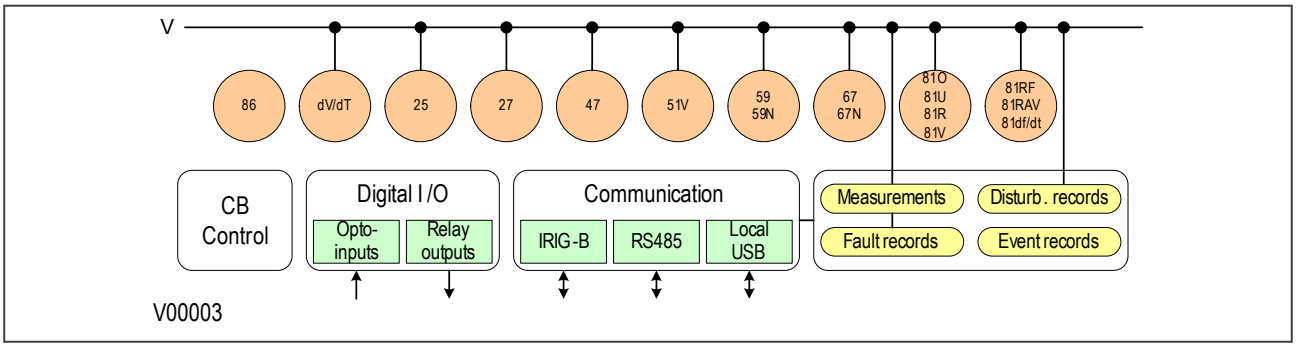


Figure 1: Functional Overview

4.5 COMMUNICATION FUNCTIONS

The device offers the following communication functions:

Communication Function	Details
Local HMI	Yes
Multi-language HMI (English, French, German, Italian, Portuguese, Spanish, Russian)	Yes
Front port	USB
1st rear port	RS485 or IRIG-B
2nd rear port (optional)	RS485 or IRIG-B or single channel Ethernet or dual redundant Ethernet
Serial Protocols available	IEC 60870-5-103, MODBUS, Courier, DNP3
Ethernet Protocols available	IEC 61850, DNP3 over Ethernet, PRP, HSR
Virtual inputs	64
Cyber-security	Yes
Enhanced Studio (S1 Agile)	Yes

5 LOGIC DIAGRAMS

This technical manual contains many logic diagrams, which should help to explain the functionality of the device. Although this manual has been designed to be as specific as possible to the chosen product, it may contain diagrams, which have elements applicable to other products. If this is the case, a qualifying note will accompany the relevant part.

The logic diagrams follow a convention for the elements used, using defined colours and shapes. A key to this convention is provided below. We recommend viewing the logic diagrams in colour rather than in black and white. The electronic version of the technical manual is in colour, but the printed version may not be. If you need coloured diagrams, they can be provided on request by calling the contact centre and quoting the diagram number.

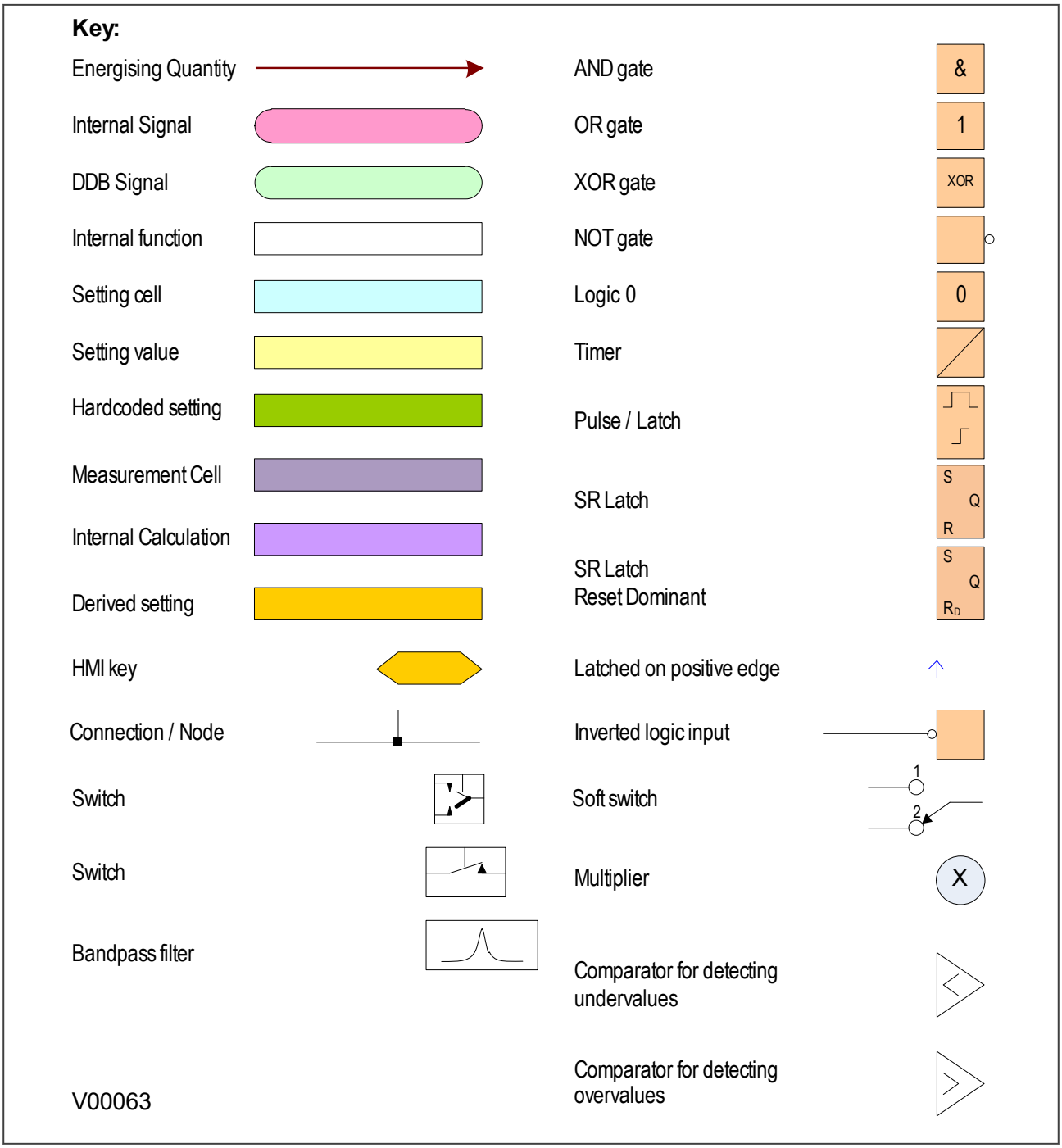


Figure 2: Key to logic diagrams

6 FUNCTIONAL OVERVIEW

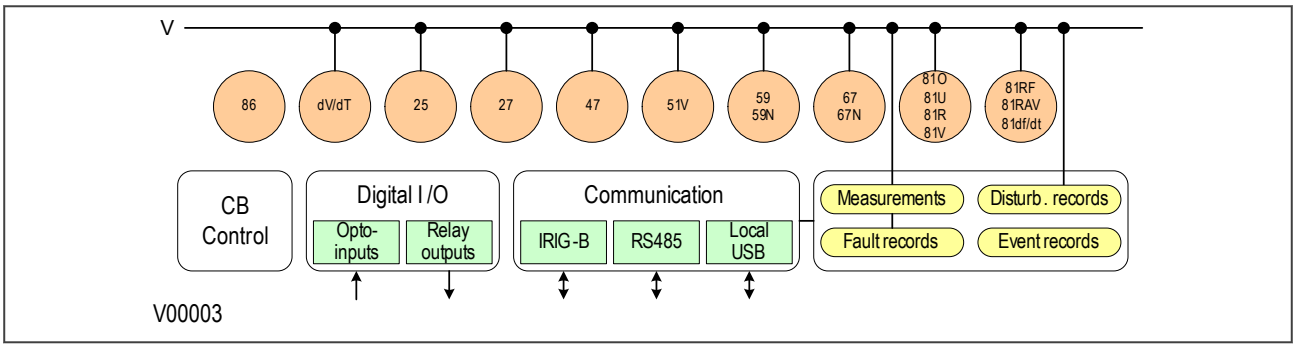


Figure 3: Functional Overview

CHAPTER 2

SAFETY INFORMATION

1 CHAPTER OVERVIEW

This chapter provides information about the safe handling of the equipment. The equipment must be properly installed and handled in order to maintain it in a safe condition and to keep personnel safe at all times. You must be familiar with information contained in this chapter before unpacking, installing, commissioning, or servicing the equipment.

This chapter contains the following sections:

Chapter Overview 15
Health and Safety 16
Symbols 17
Installation, Commissioning and Servicing 18
Decommissioning and Disposal 24
Regulatory Compliance 25

2 HEALTH AND SAFETY

Personnel associated with the equipment must be familiar with the contents of this Safety Information.

When electrical equipment is in operation, dangerous voltages are present in certain parts of the equipment. Improper use of the equipment and failure to observe warning notices will endanger personnel.

Only qualified personnel may work on or operate the equipment. Qualified personnel are individuals who are:

- familiar with the installation, commissioning, and operation of the equipment and the system to which it is being connected.
- familiar with accepted safety engineering practises and are authorised to energise and de-energise equipment in the correct manner.
- trained in the care and use of safety apparatus in accordance with safety engineering practises
- trained in emergency procedures (first aid).

The documentation provides instructions for installing, commissioning and operating the equipment. It cannot, however cover all conceivable circumstances. In the event of questions or problems, do not take any action without proper authorisation. Please contact your local sales office and request the necessary information.

3 SYMBOLS

Throughout this manual you will come across the following symbols. You will also see these symbols on parts of the equipment.

Caution:
Refer to equipment documentation. Failure to do so could result in damage to the equipment

Warning:
Risk of electric shock

Warning:
Risk of damage to eyesight

Earth terminal. *Note: This symbol may also be used for a protective conductor (earth) terminal if that terminal is part of a terminal block or sub-assembly.*

Protective conductor (earth) terminal

Instructions on disposal requirements

Note:
The term 'Earth' used in this manual is the direct equivalent of the North American term 'Ground'.

4 INSTALLATION, COMMISSIONING AND SERVICING

4.1 LIFTING HAZARDS

Many injuries are caused by:

- Lifting heavy objects
- Lifting things incorrectly
- Pushing or pulling heavy objects
- Using the same muscles repetitively

Plan carefully, identify any possible hazards and determine how best to move the product. Look at other ways of moving the load to avoid manual handling. Use the correct lifting techniques and Personal Protective Equipment (PPE) to reduce the risk of injury.

4.2 ELECTRICAL HAZARDS

Caution:
All personnel involved in installing, commissioning, or servicing this equipment must be familiar with the correct working procedures.

Caution:
Consult the equipment documentation before installing, commissioning, or servicing the equipment.

Caution:
Always use the equipment as specified. Failure to do so will jeopardise the protection provided by the equipment.

Warning:
Removal of equipment panels or covers may expose hazardous live parts. Do not touch until the electrical power is removed. Take care when there is unlocked access to the rear of the equipment.

Warning:
Isolate the equipment before working on the terminal strips.

Warning:
Use a suitable protective barrier for areas with restricted space, where there is a risk of electric shock due to exposed terminals.

Caution:
Disconnect power before disassembling. Disassembly of the equipment may expose sensitive electronic circuitry. Take suitable precautions against electrostatic voltage discharge (ESD) to avoid damage to the equipment.

Warning:
NEVER look into optical fibres or optical output connections. Always use optical power meters to determine operation or signal level.

Warning:
Testing may leave capacitors charged to dangerous voltage levels. Discharge capacitors by reducing test voltages to zero before disconnecting test leads.

Caution:
Operate the equipment within the specified electrical and environmental limits.

Caution:
Before cleaning the equipment, ensure that no connections are energised. Use a lint free cloth dampened with clean water.

Note:
Contact fingers of test plugs are normally protected by petroleum jelly, which should not be removed.

4.3 UL/CSA/CUL REQUIREMENTS

The information in this section is applicable only to equipment carrying UL/CSA/CUL markings.

Caution:
Equipment intended for rack or panel mounting is for use on a flat surface of a Type 1 enclosure, as defined by Underwriters Laboratories (UL).

Caution:
To maintain compliance with UL and CSA/CUL, install the equipment using UL/CSA-recognised parts for: cables, protective fuses, fuse holders and circuit breakers, insulation crimp terminals, and replacement internal batteries.

4.4 FUSING REQUIREMENTS

Caution:
Where UL/CSA listing of the equipment is required for external fuse protection, a UL or CSA Listed fuse must be used for the auxiliary supply. The listed protective fuse type is: Class J time delay fuse, with a maximum current rating of 15 A and a minimum DC rating of 250 V dc (for example type AJT15).

Caution:
Where UL/CSA listing of the equipment is not required, a high rupture capacity (HRC) fuse type with a maximum current rating of 16 Amps and a minimum dc rating of 250 V dc may be used for the auxiliary supply (for example Red Spot type NIT or TIA).
For P50 models, use a 1A maximum T-type fuse.
For P60 models, use a 4A maximum T-type fuse.

Caution:
Digital input circuits should be protected by a high rupture capacity NIT or TIA fuse with maximum rating of 16 A. for safety reasons, current transformer circuits must never be fused. Other circuits should be appropriately fused to protect the wire used.

Caution:
CTs must NOT be fused since open circuiting them may produce lethal hazardous voltages

4.5 EQUIPMENT CONNECTIONS

Warning:
Terminals exposed during installation, commissioning and maintenance may present a hazardous voltage unless the equipment is electrically isolated.

Caution:
Tighten M4 clamping screws of heavy duty terminal block connectors to a nominal torque of 1.3 Nm.
Tighten captive screws of terminal blocks to 0.5 Nm minimum and 0.6 Nm maximum.

Caution:
Always use insulated crimp terminations for voltage and current connections.

Caution:
Always use the correct crimp terminal and tool according to the wire size.

Caution:
Watchdog (self-monitoring) contacts are provided to indicate the health of the device on some products. We strongly recommend that you hard wire these contacts into the substation's automation system, for alarm purposes.

4.6 PROTECTION CLASS 1 EQUIPMENT REQUIREMENTS

Caution:
Earth the equipment with the supplied PCT (Protective Conductor Terminal).

Caution:
Do not remove the PCT.

Caution:
The PCT is sometimes used to terminate cable screens. Always check the PCT's integrity after adding or removing such earth connections.

Caution:
Use a locknut or similar mechanism to ensure the integrity of stud-connected PCTs.

Caution:
The recommended minimum PCT wire size is 2.5 mm² for countries whose mains supply is 230 V (e.g. Europe) and 3.3 mm² for countries whose mains supply is 110 V (e.g. North America). This may be superseded by local or country wiring regulations.
For P60 products, the recommended minimum PCT wire size is 6 mm². See product documentation for details.

Caution:
The PCT connection must have low-inductance and be as short as possible.

Caution:
All connections to the equipment must have a defined potential. Connections that are pre-wired, but not used, should be earthed, or connected to a common grouped potential.

4.7 PRE-ENERGISATION CHECKLIST

Caution:
Check voltage rating/polarity (rating label/equipment documentation).

Caution:
Check CT circuit rating (rating label) and integrity of connections.

Caution:
Check protective fuse or miniature circuit breaker (MCB) rating.

Caution:
Check integrity of the PCT connection.

Caution:
Check voltage and current rating of external wiring, ensuring it is appropriate for the application.

4.8 PERIPHERAL CIRCUITRY

Warning:
Do not open the secondary circuit of a live CT since the high voltage produced may be lethal to personnel and could damage insulation. Short the secondary of the line CT before opening any connections to it.

Note:
For most General Electric equipment with ring-terminal connections, the threaded terminal block for current transformer termination is automatically shorted if the module is removed. Therefore external shorting of the CTs may not be required. Check the equipment documentation and wiring diagrams first to see if this applies.

Caution:
Where external components such as resistors or voltage dependent resistors (VDRs) are used, these may present a risk of electric shock or burns if touched.

Warning:
Take extreme care when using external test blocks and test plugs such as the MMLG, MMLB and P990, as hazardous voltages may be exposed. Ensure that CT shorting links are in place before removing test plugs, to avoid potentially lethal voltages.

Warning:
Data communication cables with accessible screens and/or screen conductors, (including optical fibre cables with metallic elements), may create an electric shock hazard in a sub-station environment if both ends of the cable screen are not connected to the same equipotential bonded earthing system.

To reduce the risk of electric shock due to transferred potential hazards:

i. The installation shall include all necessary protection measures to ensure that no fault currents can flow in the connected cable screen conductor.

ii. The connected cable shall have its screen conductor connected to the protective conductor terminal (PCT) of the connected equipment at both ends. This connection may be inherent in the connectors provided on the equipment but, if there is any doubt, this must be confirmed by a continuity test.

iii. The protective conductor terminal (PCT) of each piece of connected equipment shall be connected directly to the same equipotential bonded earthing system.

iv. If, for any reason, both ends of the cable screen are not connected to the same equipotential bonded earth system, precautions must be taken to ensure that such screen connections are made safe before work is done to, or in proximity to, any such cables.

v. No equipment shall be connected to any download or maintenance circuits or connectors of this product except temporarily and for maintenance purposes only.

vi. Equipment temporarily connected to this product for maintenance purposes shall be protectively earthed (if the temporary equipment is required to be protectively earthed), directly to the same equipotential bonded earthing system as the product.

Warning:
Small Form-factor Pluggable (SFP) modules which provide copper Ethernet connections typically do not provide any additional safety isolation. Copper Ethernet SFP modules must only be used in connector positions intended for this type of connection.

4.9 UPGRADING/SERVICING

Warning:
Do not insert or withdraw modules, PCBs or expansion boards from the equipment while energised, as this may result in damage to the equipment. Hazardous live voltages would also be exposed, endangering personnel.

Caution:
Internal modules and assemblies can be heavy and may have sharp edges. Take care when inserting or removing modules into or out of the IED.

5 DECOMMISSIONING AND DISPOSAL

Caution:
Before decommissioning, completely isolate the equipment power supplies (both poles of any dc supply). The auxiliary supply input may have capacitors in parallel, which may still be charged. To avoid electric shock, discharge the capacitors using the external terminals before decommissioning.

Caution:
Avoid incineration or disposal to water courses. Dispose of the equipment in a safe, responsible and environmentally friendly manner, and if applicable, in accordance with country-specific regulations.

6 REGULATORY COMPLIANCE

Compliance with the European Commission Directive on EMC and LVD is demonstrated using a technical file.

CE

6.1 EMC COMPLIANCE: 2014/30/EU

The product specific Declaration of Conformity (DoC) lists the relevant harmonised standard(s) or conformity assessment used to demonstrate compliance with the EMC directive.

6.2 LVD COMPLIANCE: 2014/35/EU

The product specific Declaration of Conformity (DoC) lists the relevant harmonized standard(s) or conformity assessment used to demonstrate compliance with the LVD directive.

Safety related information, such as the installation I overvoltage category, pollution degree and operating temperature ranges are specified in the Technical Data section of the relevant product documentation and/or on the product labelling.

Unless otherwise stated in the Technical Data section of the relevant product documentation, the equipment is intended for indoor use only. Where the equipment is required for use in an outdoor location, it must be mounted in a specific cabinet or housing to provide the equipment with the appropriate level of protection from the expected outdoor environment.

6.3 R&TTE COMPLIANCE: 2014/53/EU

Radio and Telecommunications Terminal Equipment (R&TTE) directive 2014/53/EU.

Conformity is demonstrated by compliance to both the EMC directive and the Low Voltage directive, to zero volts.

6.4 UL/CUL COMPLIANCE

If marked with this logo, the product is compliant with the requirements of the Canadian and USA Underwriters Laboratories.

The relevant UL file number and ID is shown on the equipment.

c UL us

CHAPTER 3

HARDWARE DESIGN

1 CHAPTER OVERVIEW

This chapter provides information about the product's hardware design.

This chapter contains the following sections:

Chapter Overview 29
Hardware Architecture 30
Mechanical Implementation 32
Terminal Connections 36
Front Panel 37

2 HARDWARE ARCHITECTURE

The main components comprising devices based on the P40Agile platform are as follows:

- The housing, consisting of a front panel and connections at the rear
- The Main processor module consisting of the main CPU (Central Processing Unit), memory and an interface to the front panel HMI (Human Machine Interface)
- An I/O board consisting of output relay contacts and digital opto-inputs
- Communication modules
- Power supply

All modules are connected by a parallel data and address bus, which allows the processor module to send and receive information to and from the other modules as required. There is also a separate serial data bus for conveying sampled data from the input module to the CPU. These parallel and serial databuses are shown as a single interconnection module in the following figure, which shows typical modules and the flow of data between them.

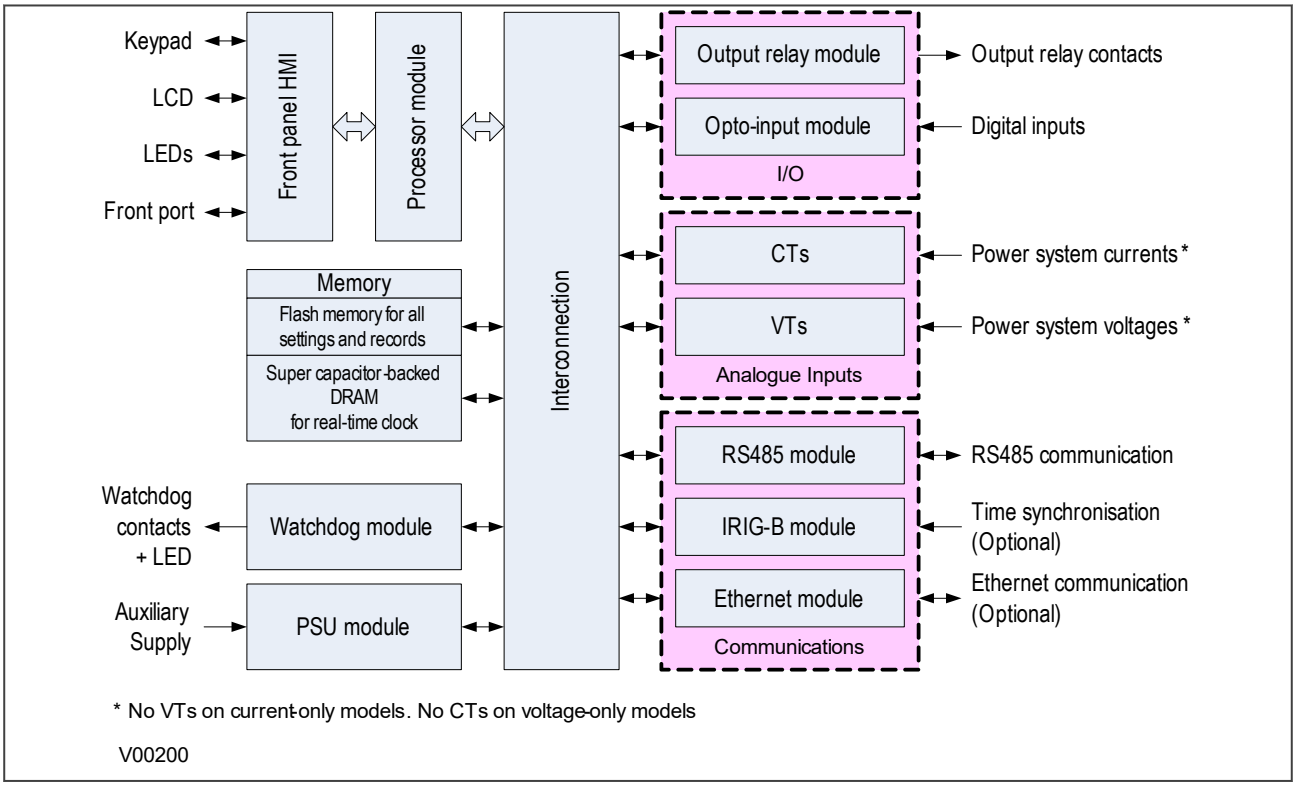


Figure 4: Hardware design overview

2.1 MEMORY AND REAL TIME CLOCK

The IED contains flash memory for storing the following operational information:

- Fault, Maintenance and Disturbance Records
- Events
- Alarms
- Measurement values
- Latched trips
- Latched contacts

Flash memory is non-volatile and therefore no backup battery is required.

A dedicated Supercapacitor keeps the on board real time clock operational for up to four days after power down.

3 MECHANICAL IMPLEMENTATION

All products based on the P40Agile platform have common hardware architecture. The hardware comprises two main parts; the cradle and the housing.

The cradle consists of the front panel which is attached to a carrier board into which all of the hardware boards and modules are connected. The products have been designed such that all the boards and modules comprising the product are fixed into the cradle and are not intended to be removed or inserted after the product has left the factory.

The housing comprises the housing metalwork and connectors at the rear into which the boards in the cradle plug into.

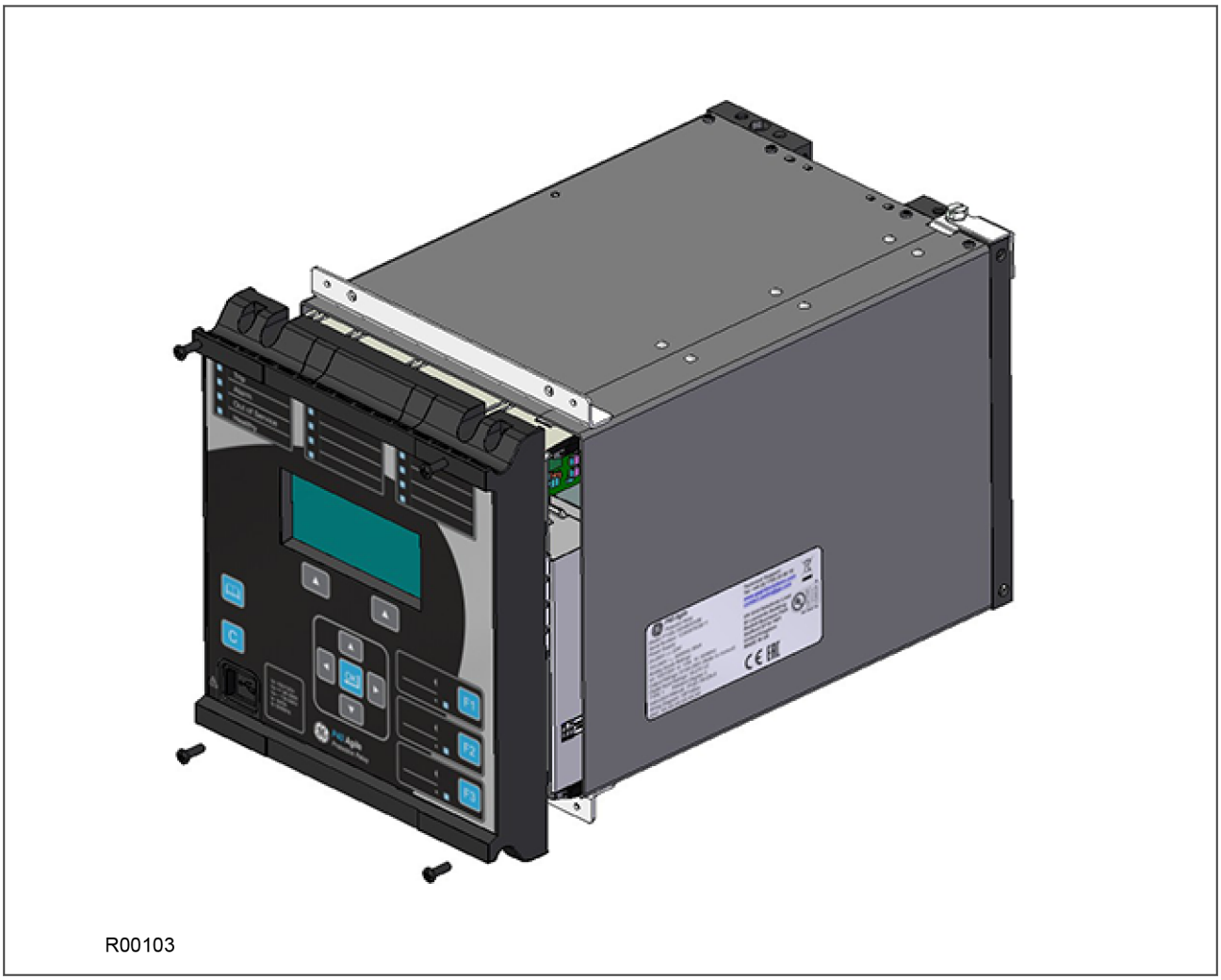


Figure 5: Exploded view of IED

3.1 HOUSING VARIANTS

The P40 Agile range of products are implemented in one of three case sizes. Case dimensions for industrial products usually follow modular measurement units based on rack sizes. These are: U for height and TE for width, where:

- 1U = 1.75 inches = 44.45 mm
- 1TE = 0.2 inches = 5.08 mm

The products are available in panel-mount or standalone versions. All products are nominally 4U high. This equates to 177.8 mm or 7 inches.

The cases are pre-finished steel with a conductive covering of aluminium and zinc. This provides good grounding at all joints, providing a low resistance path to earth that is essential for performance in the presence of external noise.

The case width depends on the product type and its hardware options. There are three different case widths for the described range of products: 20TE, 30TE and 40TE. The products in the P40Agile range can be used as a K-series refit and the cases, cradle, and pin-outs are completely inter-compatible. The case dimensions and compatibility criteria are as follows:

Case width (TE)	Case width (mm)	Equivalent K series
20TE	102.4 mm (4 inches)	KCGG140/142
30TE	154.2 mm (6 inches)	KCEG140/142
40TE	203.2 mm (8 inches)	KCEG140/142

3.2 20TE REAR PANEL

The 20TE rear panel consists of two MIDOS heavy duty terminal blocks.

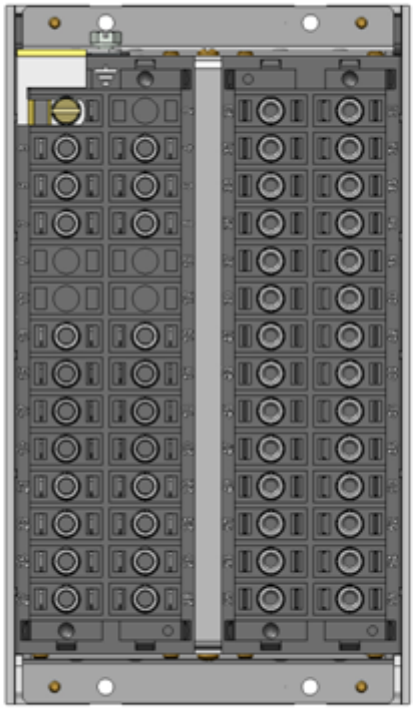
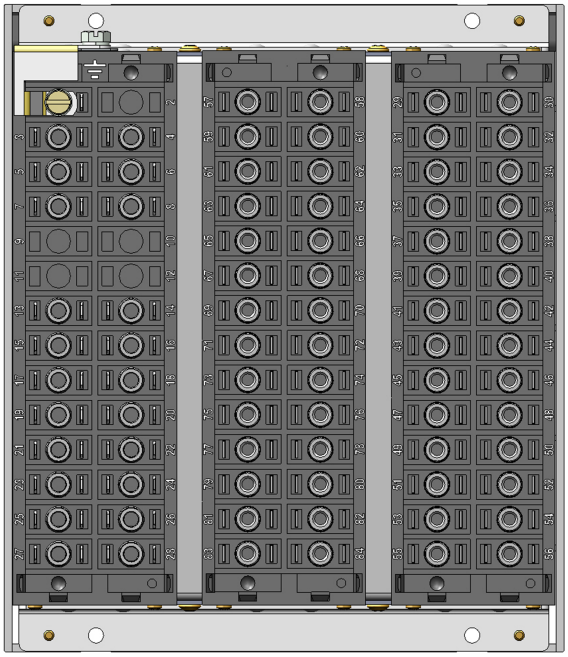


Figure 6: 20TE rear panel

3.3 30TE REAR PANEL

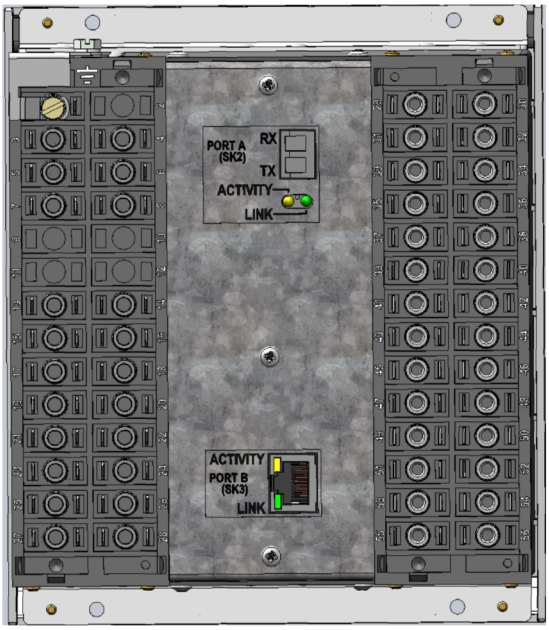
The 30TE rear panel consists of either:

- Three MIDOS heavy duty terminal blocks
- Two MIDOS heavy duty terminal blocks and a communication board
- Two MIDOS heavy duty terminal blocks and a blanking panel



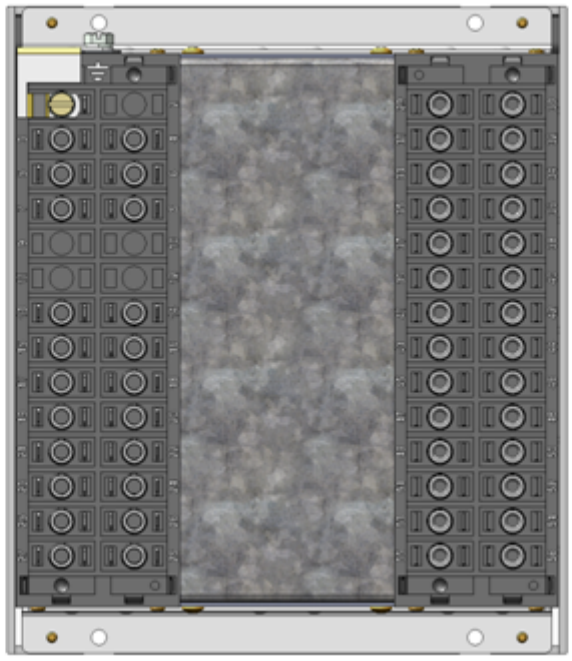
R00203

Figure 7: 30TE Three-MIDOS block rear panel



R00204

Figure 8: 30TE Two-MIDOS block + communications rear panel



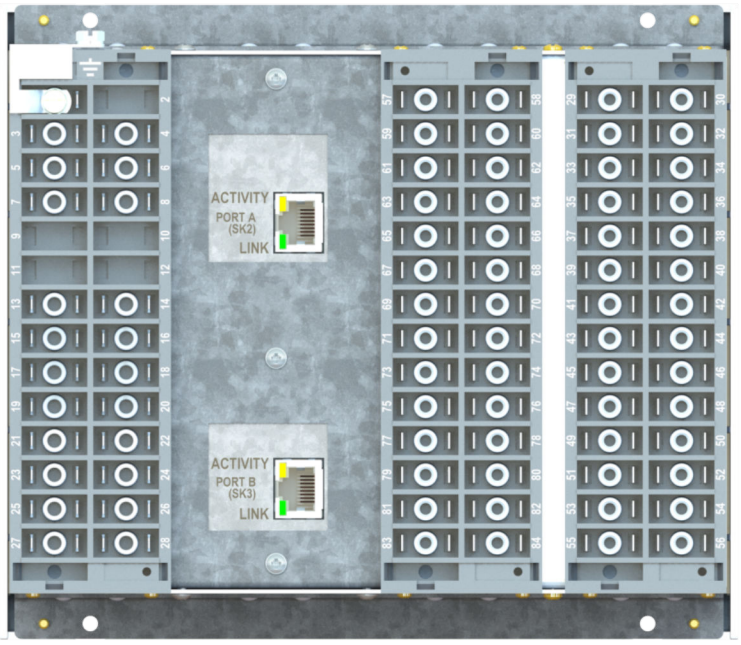
R00222

Figure 9: 30TE Two-MIDOS block + blanking plate

3.4 40TE REAR PANEL

The 40TE rear panel consists of:

- Three MIDOS heavy duty terminal blocks and a communication board



R00288

Figure 10: 40TE Three-MIDOS block + communications rear panel

4 TERMINAL CONNECTIONS

4.1 I/O OPTIONS

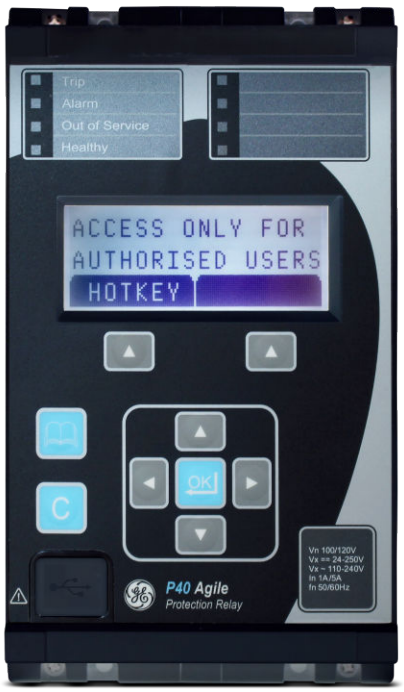
Component	I/O option A	I/O option B	I/O option C	I/O option D	I/O option E	I/O option F	I/O option G	I/O option H	I/O option J
Digital inputs	8 (1 group of 3 and 1 group of 5)	11 (2 groups of 3 and 1 group of 5)	11 (1 group of 3, 1 group of 5 and 3 individual)	13 (1 group of 3 and 2 groups of 5)	3 (1 group of 3)	6 (1 group of 3 and 3 individual)	7 1 group of 5 and 2 individual)	10 1 group of 3, 1 group of 5 and 2 individual)	12 (2 groups of 5 and 2 individual)
Output relays	8 (NO)	12 (NO)	12 (11 NO, 1 NC)	12 (NO)	4 (NO)	8 (7 NO, 1 NC)	8 (NO)	12 (NO)	12 (NO)

Note:
I/O options C, F, G, H and J are suitable for Trip Circuit Supervision (TCS) applications.

Note:
For details of terminal connections, refer to the Wiring Diagrams Appendix.

5 FRONT PANEL

5.1 20TE FRONT PANEL



R00100

Figure 11: Front panel (20TE)

The figures show the front panels for the 20TE variant.

It consists of:

- LCD display
- Keypad
- USB port
- 4 x fixed function tri-colour LEDs
- 4 x programmable tri-colour LEDs

5.2 30TE FRONT PANEL

R00101

Figure 12: Front panel (30TE)

The figures show the front panels for the 30TE variant.

It consists of:

- LCD display
- Keypad
- USB port
- 4 x fixed function tri-colour LEDs
- 8 x programmable tri-colour LEDs
- 3 x function keys
- 3 x tri-colour LEDs for the function keys

5.3 40TE FRONT PANEL

R00102

Figure 13: Front panel (40TE)

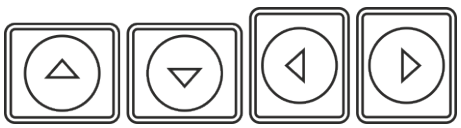
The figure shows the front panel for the 40TE variant.

It consists of:

- LCD display
- Keypad
- USB port
- 4 x fixed function tri-colour LEDs
- 8 x programmable tri-colour LEDs
- 3 x function keys
- 3 x tri-colour LEDs for the function keys

5.4 KEYPAD

The keypad consists of the following keys:

4 arrow keys to navigate the menus (organised around the Enter key)	
An enter key for executing the chosen option	

A clear key for clearing the last command	
A read key for viewing larger blocks of text (arrow keys now used for scrolling)	
2 hot keys for scrolling through the default display and for control of setting groups. These are situated directly below the LCD display.	

5.5 LIQUID CRYSTAL DISPLAY

The LCD is a high resolution monochrome display with 16 characters by 3 lines and controllable back light.

5.6 USB PORT

The USB port is situated on the front panel in the bottom left hand corner, and is used to communicate with a locally connected PC. It has two main purposes:

- To transfer settings information to/from the PC from/to the device.
- For downloading firmware updates and menu text editing.

The port is intended for temporary connection during testing, installation and commissioning. It is not intended to be used for permanent SCADA communications. This port supports the Courier communication protocol only. Courier is a proprietary communication protocol to allow communication with a range of protection equipment, and between the device and the Windows-based support software package.

You can connect the unit to a PC with a USB cable up to 5 m in length.

The inactivity timer for the front port is set to 15 minutes. This controls how long the unit maintains its level of password access on the front port. If no messages are received on the front port for 15 minutes, any password access level that has been enabled is cancelled.

Note:
The front USB port does not support automatic extraction of event and disturbance records, although this data can be accessed manually.

Caution:
When not in use, always close the cover of the USB port to prevent contamination.

5.7 FIXED FUNCTION LEDS

Four fixed-function LEDs on the left-hand side of the front panel indicate the following conditions.

- Trip (Red) switches ON when the IED issues a trip signal. It is reset when the associated fault record is cleared from the front display. Also the trip LED can be configured as self-resetting.
- Alarm (Yellow) flashes when the IED registers an alarm. This may be triggered by a fault, event or maintenance record. The LED flashes until the alarms have been accepted (read), then changes to constantly ON. When the alarms are cleared, the LED switches OFF.
- Out of service (Yellow) is ON when the IED's functions are unavailable.
- Healthy (Green) is ON when the IED is in correct working order, and should be ON at all times. It goes OFF if the unit's self-tests show there is an error in the hardware or software. The state of the healthy LED is reflected by the watchdog contacts at the back of the unit.

5.8 FUNCTION KEYS

The programmable function keys are available for custom use for some models.

Factory default settings associate specific functions to these keys, but by using programmable scheme logic, you can change the default functions of these keys to fit specific needs. Adjacent to these function keys are programmable LEDs, which are usually set to be associated with their respective function keys.

5.9 PROGRAMABLE LEDS

The device has a number of programmable LEDs. All of the programmable LEDs on the unit are tri-colour and can be set to RED, YELLOW or GREEN.

In the 20TE case, four programmable LEDs are available. In 30TE and 40TE, eight are available.

CHAPTER 4

SOFTWARE DESIGN

1 CHAPTER OVERVIEW

This chapter describes the software design of the IED.

This chapter contains the following sections:

Chapter Overview 45
Software Design Overview 46
System Level Software 47
Platform Software 49
Protection and Control Functions 50

2 SOFTWARE DESIGN OVERVIEW

The range of products based on the P40 Agile platform can be conceptually categorised into several elements as follows:

- The system level software
- The platform software
- The protection and control software

These elements are not distinguishable to the user, and the distinction is made purely for the purposes of explanation.

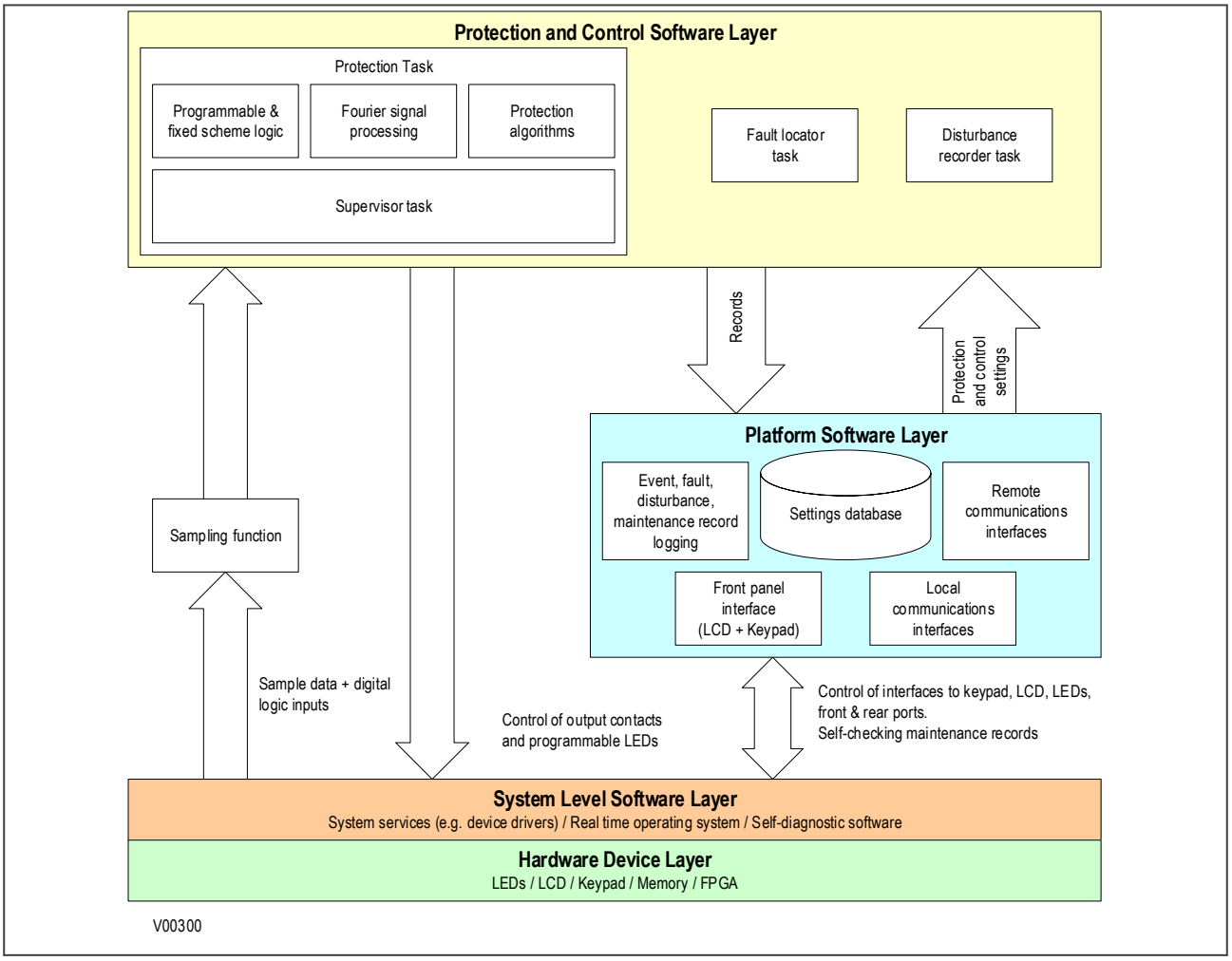


Figure 14: Software structure

The software can be divided into a number of functions as illustrated above. Each function is further broken down into a number of separate tasks. These tasks are then run according to a scheduler. They are run at either a fixed rate or they are event driven. The tasks communicate with each other as required.

3 SYSTEM LEVEL SOFTWARE

3.1 REAL TIME OPERATING SYSTEM

The real-time operating system is used to schedule the processing of the various tasks. This ensures that they are processed in the time available and in the desired order of priority. The operating system also plays a part in controlling the communication between the software tasks.

3.2 SYSTEM SERVICES SOFTWARE

The system services software provides the layer between the hardware and the higher-level functionality of the platform software and the protection and control software. For example, the system services software provides drivers for items such as the LCD display, the keypad and the remote communication ports. It also controls things like the booting of the processor and the downloading of the processor code into RAM at startup.

3.3 SELF-DIAGNOSTIC SOFTWARE

The device includes several self-monitoring functions to check the operation of its hardware and software while in service. If there is a problem with the hardware or software, it should be able to detect and report the problem, and attempt to resolve the problem by performing a reboot. In this case, the device would be out of service for a short time, during which the 'Healthy' LED on the front of the device is switched OFF and the watchdog contact at the rear is ON. If the restart fails to resolve the problem, the unit takes itself permanently out of service; the 'Healthy' LED stays OFF and watchdog contact stays ON.

If a problem is detected by the self-monitoring functions, the device attempts to store a maintenance record to allow the nature of the problem to be communicated to the user.

The self-monitoring is implemented in two stages: firstly a thorough diagnostic check which is performed on boot-up, and secondly a continuous self-checking operation, which checks the operation of the critical functions whilst it is in service.

3.4 STARTUP SELF-TESTING

The self-testing takes a few seconds to complete, during which time the IED's measurement, recording, control, and protection functions are unavailable. On a successful start-up and self-test, the 'Healthy' state LED on the front of the device is switched on. If a problem is detected during the start-up testing, the device remains out of service until it is manually restored to working order.

The operations that are performed at start-up are:

1. System boot
2. System software initialisation
3. Platform software initialisation and monitoring

3.4.1 SYSTEM BOOT

The integrity of the Flash memory is verified using a checksum before the program code and stored data is loaded into RAM for execution by the processor. When the loading has been completed, the data held in RAM is compared to that held in the Flash memory to ensure that no errors have occurred in the data transfer and that the two are the same. The entry point of the software code in RAM is then called. This is the IED's initialisation code.

3.4.2 SYSTEM LEVEL SOFTWARE INITIALISATION

The initialization process initializes the processor registers and interrupts, starts the watchdog timers (used by the hardware to determine whether the software is still running), starts the real-time operating system and creates and starts the supervisor task. In the initialization process the device checks the following:

- The status of the supercapacitor (which is used to back up the SRAM)
- The integrity of the non-volatile memory, which is used to store event, fault and disturbance records
- The operation of the LCD controller
- The watchdog operation

At the conclusion of the initialization software the supervisor task begins the process of starting the platform software.

3.4.3 PLATFORM SOFTWARE INITIALISATION AND MONITORING

When starting the platform software, the IED checks the following:

- The integrity of the data held in non-volatile memory (using a checksum)
- The operation of the real-time clock
- The optional IRIG-B function (if applicable)
- The presence and condition of the input board
- The analog data acquisition system (it does this by sampling the reference voltage)

At the successful conclusion of all of these tests the unit is entered into service and the application software is started up.

3.5 CONTINUOUS SELF-TESTING

When the IED is in service, it continually checks the operation of the critical parts of its hardware and software. The checking is carried out by the system services software and the results are reported to the platform software. The functions that are checked are as follows:

- The Flash memory containing all program code and language text is verified by a checksum
- The code and constant data held in system memory is checked against the corresponding data in Flash memory to check for data corruption
- The system memory containing all data other than the code and constant data is verified with a checksum
- The integrity of the digital signal I/O data from the opto-isolated inputs and the output relay coils is checked by the data acquisition function every time it is executed.
- The operation of the analog data acquisition system is continuously checked by the acquisition function every time it is executed. This is done by sampling the reference voltages
- The operation of the optional Ethernet board is checked by the software on the main processor card. If the Ethernet board fails to respond an alarm is raised and the card is reset in an attempt to resolve the problem.
- The operation of the optional IRIG-B function is checked by the software that reads the time and date from the board

In the event that one of the checks detects an error in any of the subsystems, the platform software is notified and it attempts to log a maintenance record.

If the problem is with the supercapacitor or IRIG-B board, the device continues in operation. For problems detected in any other area, the device initiates a shutdown and re-boot, resulting in a period of up to 10 seconds when the functionality is unavailable.

A restart should clear most problems that may occur. If, however, the diagnostic self-check detects the same problem that caused the IED to restart, it is clear that the restart has not cleared the problem, and the device takes itself permanently out of service. This is indicated by the ‘‘health-state’ LED on the front of the device, which switches OFF, and the watchdog contact which switches ON.

4 PLATFORM SOFTWARE

The platform software has three main functions:

- To control the logging of records generated by the protection software, including alarms, events, faults, and maintenance records
- To store and maintain a database of all of the settings in non-volatile memory
- To provide the internal interface between the settings database and the user interfaces, using the front panel interface and the front and rear communication ports

4.1 RECORD LOGGING

The logging function is used to store all alarms, events, faults and maintenance records. The records are stored in non-volatile memory to provide a log of what has happened. The IED maintains four types of log on a first in first out basis (FIFO). These are:

- Alarms
- Event records
- Fault records
- Maintenance records

The logs are maintained such that the oldest record is overwritten with the newest record. The logging function can be initiated from the protection software. The platform software is responsible for logging a maintenance record in the event of an IED failure. This includes errors that have been detected by the platform software itself or errors that are detected by either the system services or the protection software function. See the Monitoring and Control chapter for further details on record logging.

4.2 SETTINGS DATABASE

The settings database contains all the settings and data, which are stored in non-volatile memory. The platform software manages the settings database and ensures that only one user interface can modify the settings at any one time. This is a necessary restriction to avoid conflict between different parts of the software during a setting change.

Changes to protection settings and disturbance recorder settings, are first written to a temporary location SRAM memory. This is sometimes called 'Scratchpad' memory. These settings are not written into non-volatile memory immediately. This is because a batch of such changes should not be activated one by one, but as part of a complete scheme. Once the complete scheme has been stored in SRAM, the batch of settings can be committed to the non-volatile memory where they will become active.

4.3 INTERFACES

The settings and measurements database must be accessible from all of the interfaces to allow read and modify operations. The platform software presents the data in the appropriate format for each of the interfaces (LCD display, keypad and all the communications interfaces).

5 PROTECTION AND CONTROL FUNCTIONS

The protection and control software processes all of the protection elements and measurement functions. To achieve this it has to communicate with the system services software, the platform software as well as organise its own operations.

The protection task software has the highest priority of any of the software tasks in the main processor board. This ensures the fastest possible protection response.

The protection and control software provides a supervisory task, which controls the start-up of the task and deals with the exchange of messages between the task and the platform software.

5.1 ACQUISITION OF SAMPLES

After initialization, the protection and control task waits until there are enough samples to process. The acquisition of samples on the main processor board is controlled by a 'sampling function' which is called by the system services software.

This sampling function takes samples from the input module and stores them in a two-cycle FIFO buffer. The sample rate is 24 samples per cycle. This results in a nominal sample rate of 1,200 samples per second for a 50 Hz system and 1,440 samples per second for a 60 Hz system. However the sample rate is not fixed. It tracks the power system frequency as described in the next section.

5.2 FREQUENCY TRACKING

The device provides a frequency tracking algorithm so that there are always 24 samples per cycle irrespective of frequency drift within a certain frequency range (see technical specifications). If the frequency falls outside this range, the sample rate reverts to its default rate of 1200 Hz for 50 Hz or 1440 Hz for 60 Hz.

The frequency tracking of the analog input signals is achieved by a recursive Fourier algorithm which is applied to one of the input signals. It works by detecting a change in the signal's measured phase angle. The calculated value of the frequency is used to modify the sample rate being used by the input module, in order to achieve a constant sample rate per cycle of the power waveform. The value of the tracked frequency is also stored for use by the protection and control task.

The frequency tracks off any voltage or current in the order VA, VB, VC, IA, IB, IC, down to 10%Vn for voltage and 5%In for current.

5.3 FOURIER SIGNAL PROCESSING

When the protection and control task is re-started by the sampling function, it calculates the Fourier components for the analog signals. Although some protection algorithms use some Fourier-derived harmonics (e.g. second harmonic for magnetizing inrush), most protection functions are based on the Fourier-derived fundamental components of the measured analog signals. The Fourier components of the input current and voltage signals are stored in memory so that they can be accessed by all of the protection elements' algorithms.

The Fourier components are calculated using single-cycle Fourier algorithm. This Fourier algorithm always uses the most recent 24 samples from the 2-cycle buffer.

Most protection algorithms use the fundamental component. In this case, the Fourier algorithm extracts the power frequency fundamental component from the signal to produce its magnitude and phase angle. This can be represented in either polar format or rectangular format, depending on the functions and algorithms using it.

The Fourier function acts as a filter, with zero gain at DC and unity gain at the fundamental, but with good harmonic rejection for all harmonic frequencies up to the nyquist frequency. Frequencies beyond this nyquist frequency are known as alias frequencies, which are introduced when the sampling frequency becomes less than twice the frequency component being sampled. However, the Alias frequencies are significantly attenuated by an anti-aliasing filter (low pass filter), which acts on the analog signals before they are sampled. The ideal cut-off point of an anti-aliasing low pass filter would be set at:

(samples per cycle) × (fundamental frequency)/2

At 24 samples per cycle, this would be nominally 600 Hz for a 50 Hz system, or 720 Hz for a 60 Hz system.

The following figure shows the nominal frequency response of the anti-alias filter and the Fourier filter for a 24-sample single cycle fourier algorithm acting on the fundamental component:

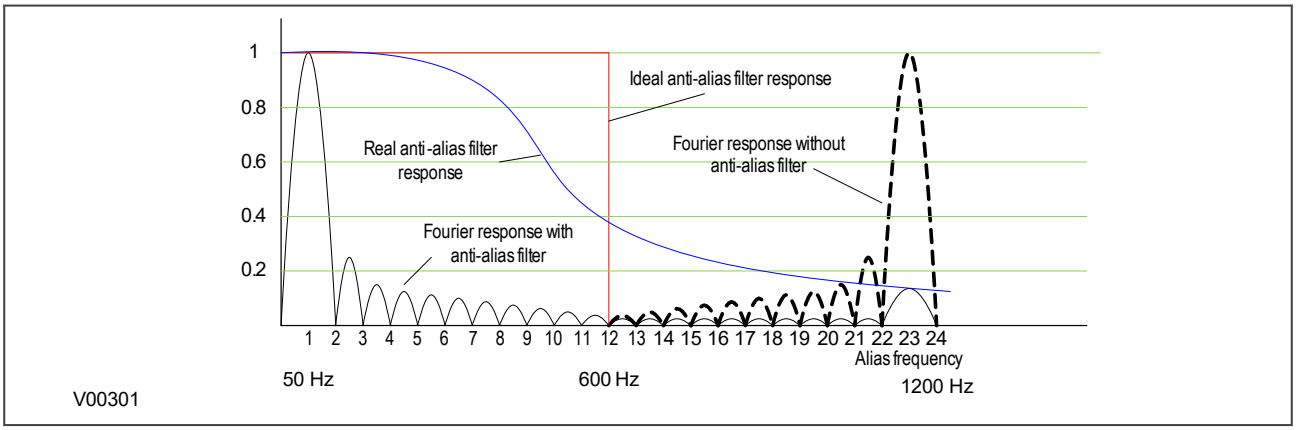


Figure 15: Frequency Response (indicative only)

5.4 PROGRAMMABLE SCHEME LOGIC

The purpose of the programmable scheme logic (PSL) is to allow you to configure your own protection schemes to suit your particular application. This is done with programmable logic gates and delay timers. To allow greater flexibility, different PSL is allowed for each of the four setting groups.

The input to the PSL is any combination of the status of the digital input signals from the opto-isolators on the input board, the outputs of the protection elements such as protection starts and trips, and the outputs of the fixed protection scheme logic (FSL). The fixed scheme logic provides the standard protection schemes. The PSL consists of software logic gates and timers. The logic gates can be programmed to perform a range of different logic functions and can accept any number of inputs. The timers are used either to create a programmable delay, and/or to condition the logic outputs, such as to create a pulse of fixed duration on the output regardless of the length of the pulse on the input. The outputs of the PSL are the LEDs on the front panel of the relay and the output contacts at the rear.

The execution of the PSL logic is event driven. The logic is processed whenever any of its inputs change, for example as a result of a change in one of the digital input signals or a trip output from a protection element. Also, only the part of the PSL logic that is affected by the particular input change that has occurred is processed. This reduces the amount of processing time that is used by the PSL. The protection & control software updates the logic delay timers and checks for a change in the PSL input signals every time it runs.

The PSL can be configured to create very complex schemes. Because of this PSL design is achieved by means of a PC support package called the PSL Editor. This is available as part of the settings application software MiCOM S1 Agile.

5.5 EVENT RECORDING

A change in any digital input signal or protection element output signal is used to indicate that an event has taken place. When this happens, the protection and control task sends a message to the supervisor task to indicate that an event is available to be processed and writes the event data to a fast buffer controlled by the supervisor task. When the supervisor task receives an event record, it instructs the platform software to create the appropriate log in non-volatile memory (flash memory). The operation of the record logging to SRAM is slower than the supervisor buffer. This means that the protection software is not delayed waiting for the records to be logged by the platform software. However, in the rare case when a large number of records to be logged are created in a short period of time, it is possible that some will be lost, if the supervisor buffer is full before the platform software is able to create a new log in SRAM. If this occurs then an event is logged to indicate this loss of information.

Maintenance records are created in a similar manner, with the supervisor task instructing the platform software to log a record when it receives a maintenance record message. However, it is possible that a maintenance record may be triggered by a fatal error in the relay in which case it may not be possible to successfully store a maintenance record, depending on the nature of the problem.

For more information, see the Monitoring and Control chapter.

5.6 DISTURBANCE RECORDER

The disturbance recorder operates as a separate task from the protection and control task. It can record the waveforms of the calibrated analog channels, plus the values of the digital signals. The recording time is user selectable up to a maximum of 10.5 seconds. The disturbance recorder is supplied with data by the protection and control task once per cycle, and collates the received data into the required length disturbance record. The disturbance records can be extracted using application software or the SCADA system, which can also store the data in COMTRADE format, allowing the use of other packages to view the recorded data.

For more information, see the Monitoring and Control chapter.

5.7 FAULT LOCATOR

The fault locator uses 12 cycles of the analog input signals to calculate the fault location. The result is returned to the protection and control task, which includes it in the fault record. The pre-fault and post-fault voltages are also presented in the fault record. When the fault record is complete, including the fault location, the protection and control task sends a message to the supervisor task to log the fault record.

The Fault Locator is not available on all models.

5.8 FUNCTION KEY INTERFACE

The function keys interface directly into the PSL as digital input signals. A change of state is only recognized when a key press is executed on average for longer than 200 ms. The time to register a change of state depends on whether the function key press is executed at the start or the end of a protection task cycle, with the additional hardware and software scan time included. A function key press can provide a latched (toggled mode) or output on key press only (normal mode) depending on how it is programmed. It can be configured to individual protection scheme requirements. The latched state signal for each function key is written to non-volatile memory and read from non-volatile memory during relay power up thus allowing the function key state to be reinstated after power-up, should power be inadvertently lost.

CHAPTER 5

CONFIGURATION

1 CHAPTER OVERVIEW

Each product has different configuration parameters according to the functions it has been designed to perform. There is, however, a common methodology used across the entire product series to set these parameters.

Some of the communications setup can only be carried out using the HMI, and cannot be carried out using settings applications software. This chapter includes concise instructions of how to configure the device, particularly with respect to the communications setup, as well as a description of the common methodology used to configure the device in general.

This chapter contains the following sections:

Chapter Overview 55

Settings Application Software 56

Using the HMI Panel 57

Date and Time Configuration 67

Settings Group Selection 70

2 SETTINGS APPLICATION SOFTWARE

To configure this device you will need to use the Settings Application Software. The settings application software used in this range of IEDs is called MiCOM S1 Agile. It is a collection of software tools, which is used for setting up and managing the IEDs.

Although you can change many settings using the front panel HMI, some of the features cannot be configured without the Settings Application Software; for example the programmable scheme logic, or IEC61850 communications.

If you do not already have a copy of the Settings Application Software, you can obtain it from General Electric contact centre.

To configure your product, you will need a data model that matches your product. When you launch the Settings Application Software, you will be presented with a panel that allows you to invoke the “Data Model Manager”. This will close the other aspects of the software in order to allow an efficient import of the chosen data model. If you don’t have, or can’t find, the data model relating to your product, please call the General Electric contact centre.

When you have loaded all the data models you need, you should restart the Settings Application Software and start to create a model of your system using the “System Explorer” panel.

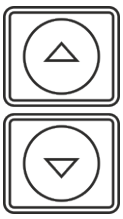
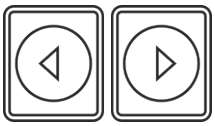
The software is designed to be intuitive, but help is available in an online help system and also the Settings Application Software user guide P40-M&CR-SAS-UG-EN-n, where 'Language' is a 2 letter code designating the language version of the user guide and 'n' is the latest version of the settings application software.

3 USING THE HMI PANEL

Using the HMI, you can:

- Display and modify settings
- View the digital I/O signal status
- Display measurements
- Display fault records
- Reset fault and alarm indications

The keypad provides full access to the device functionality using a range of menu options. The information is displayed on the LCD.

Keys	Description	Function
	Up and down cursor keys	To change the menu level or change between settings in a particular column, or changing values within a cell
	Left and right cursor keys	To change default display, change between column headings, or changing values within a cell
	ENTER key	For changing and executing settings
	Hotkeys	For executing commands and settings for which shortcuts have been defined
	Cancel key	To return to column header from any menu cell
	Read key	To read alarm messages
	Function keys (not all models)	For executing user programmable functions

Note:
As the LCD display has a resolution of 16 characters by 3 lines, some of the information is in a condensed mnemonic form.

3.1 NAVIGATING THE HMI PANEL

The cursor keys are used to navigate the menus. These keys have an auto-repeat function if held down continuously. This can be used to speed up both setting value changes and menu navigation. The longer the key is held pressed, the faster the rate of change or movement.

The navigation map below shows how to navigate the menu items.

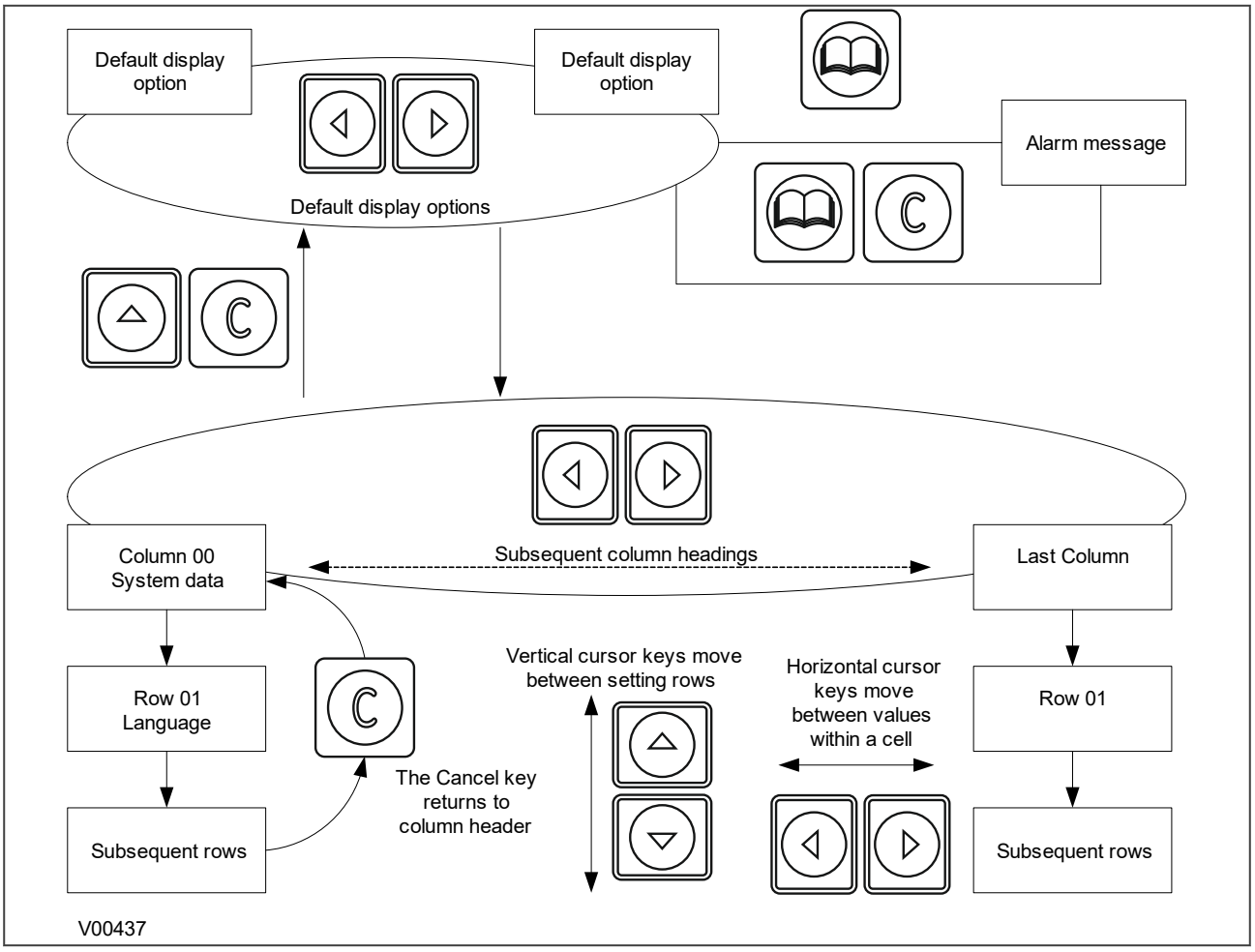


Figure 16: Navigating the HMI

3.2 GETTING STARTED

When you first start the IED, it will go through its power up procedure. After a few seconds it will settle down into one of the top level menus. There are two menus at this level:

- The Alarms menu for when there are alarms present
- The default display menu for when there are no alarms present.

If there are alarms present, the yellow Alarms LED will be flashing and the menu display will read as follows:

```
Alarms / Faults
Present
HOTKEY
```

Even though the device itself should be in full working order when you first start it, an alarm could still be present, for example, if there is no network connection for a device fitted with a network card. If this is the case, you can read the alarm by pressing the 'Read' key.

```
ALARMS
NIC Link Fail
```

If the device is fitted with an Ethernet card, you will first need to connect the device to an active Ethernet network to clear the alarm and get the default display.

If there are other alarms present, these must also be cleared before you can get into the default display menu options.

3.3 DEFAULT DISPLAY

The HMI contains a range of possible options that you can choose to be the default display. The options available are:

NERC Compliant banner

If the device is a cyber-security model, it will provide a NERC-compliant default display. If the device does not contain the cyber-security option, this display option is not available.

```
ACCESS ONLY FOR
AUTHORISED USERS
HOTKEY
```

Date and time

For example:

```
11:09:15
23 Nov 2011
HOTKEY
```

Description (user-defined)

For example:

```
Description
MiCOM P14NB
HOTKEY
```

Plant reference (user-defined)

For example:

```
Plant Reference
MiCOM
HOTKEY
```

Access Level

For example:

```
Access Level
3
HOTKEY
```

In addition to the above, there are also displays for the system voltages, currents, power and frequency etc., depending on the device model.

3.4 DEFAULT DISPLAY NAVIGATION

The following diagram is an example of the default display navigation. In this example, we have used a cyber-secure model. This is an example only and may not apply in its entirety to all models. The actual display options available depend on the exact model.

Use the horizontal cursor keys to step through from one display to the next.

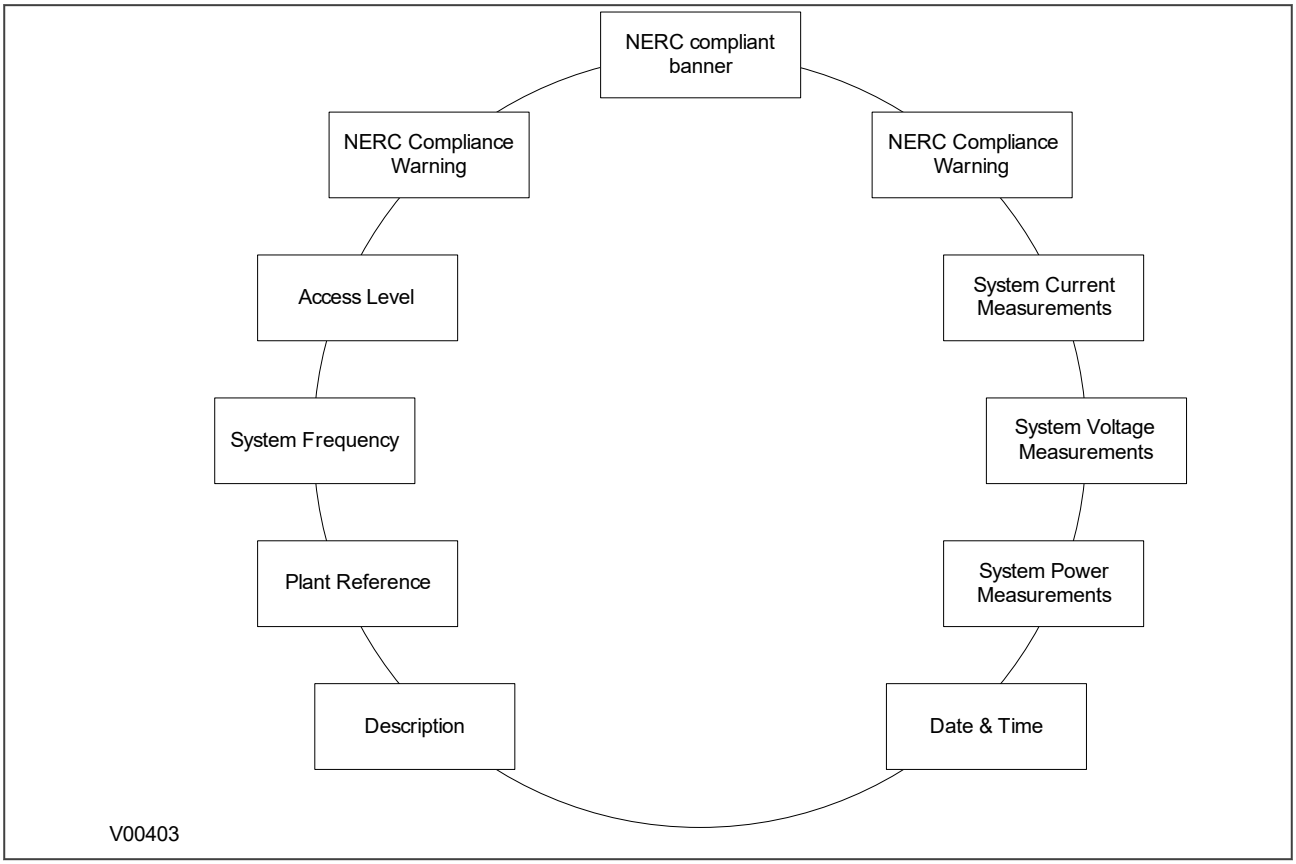
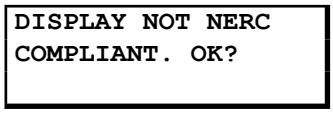


Figure 17: Default display navigation

If the device is cyber-secure but is not yet configured for NERC compliance (see Cyber-security chapter), a warning will appear when moving from the "NERC compliant" banner. The warning message is as follows:



You will have to confirm with the **Enter** button before you can go any further.

Note:
Whenever the IED has an uncleared alarm the default display is replaced by the text Alarms/ Faults present. You cannot override this default display. However, you can enter the menu structure from the default display, even if the display shows the Alarms/Faults present message.

3.5 PASSWORD ENTRY

Configuring the default display (in addition to modification of other settings) requires level 3 access. You will be prompted for a password before you can make any changes, as follows. The default level 3 password is AAAA.

1. A flashing cursor shows which character field of the password can be changed. Press the up or down cursor keys to change each character (tip: pressing the up arrow once will return an upper case "A" as required by the default level 3 password).
2. Use the left and right cursor keys to move between the character fields of the password.
3. Press the **Enter** key to confirm the password. If you enter an incorrect password, an invalid password message is displayed then the display reverts to ***Enter password***. On entering a valid password a message appears indicating that the password is correct and which level of access has been unlocked. If this level is sufficient to edit the selected setting, the display returns to the setting page to allow the edit to continue. If the correct level of password has not been entered, the password prompt page appears again.
4. To escape from this prompt press the **Clear** key. Alternatively, enter the password using the ***Password*** setting in the *SYSTEM DATA* column. If the keypad is inactive for 15 minutes, the password protection of the front panel user interface reverts to the default access level.

To manually reset the password protection to the default level, select ***Password***, then press the CLEAR key instead of entering a password.

Note:
In the SECURITY CONFIG column, you can set the maximum number of attemps, the time window in which the failed attempts are counted and the time duration for which the user is blocked.

3.6 PROCESSING ALARMS AND RECORDS

If there are any alarm messages, they will appear on the default display and the yellow alarm LED flashes. The alarm messages can either be self-resetting or latched. If they are latched, they must be cleared manually.

1. To view the alarm messages, press the **Read** key. When all alarms have been viewed but not cleared, the alarm LED changes from flashing to constantly on, and the latest fault record appears (if there is one).
2. Scroll through the pages of the latest fault record, using the cursor keys. When all pages of the fault record have been viewed, the following prompt appears.

```
Press Clear To
Reset Alarms
```

3. To clear all alarm messages, press the **Clear** key. To return to the display showing alarms or faults present, and leave the alarms uncleared, press the **Read** key.
4. Depending on the password configuration settings, you may need to enter a password before the alarm messages can be cleared.
5. When all alarms are cleared, the yellow alarm LED switches off. If the red LED was on, this will also be switched off.

Note:
*To speed up the procedure, you can enter the alarm viewer using the **Read** key and subsequently pressing the **Clear** key. This goes straight to the fault record display. Press the **Clear** key again to move straight to the alarm reset prompt, then press the **Clear** key again to clear all alarms.*

3.7 MENU STRUCTURE

Settings, commands, records and measurements are stored in a local database inside the IED. When using the Human Machine Interface (HMI) it is convenient to visualise the menu navigation system as a table. Each item in the menu is known as a cell, which is accessed by reference to a column and row address. Each column and row is assigned a 2-digit hexadecimal numbers, resulting in a unique 4-digit cell address for every cell in the database. The main menu groups are allocated columns and the items within the groups are allocated rows, meaning a particular item within a particular group is a cell.

There are three types of cell:

- Settings: this is for parameters that can be set to different values
- Commands: this is for commands to be executed
- Data: this is for measurements and records to be viewed, which are not settable

Note:
Sometimes the term "Setting" is used generically to describe all of the three types.

The table below, provides an example of the menu structure:

SYSTEM DATA (Col 00)	VIEW RECORDS (Col 01)	MEASUREMENTS 1 (Col 02)	...
Language (Row 01)	"Select Event [0...n]" (Row 01)	IA Magnitude (Row 01)	...
Password (Row 02)	Menu Cell Ref (Row 02)	IA Phase Angle (Row 02)	...
Sys Fn Links (Row 03)	Time & Date (Row 03)	IB Magnitude (Row 03)	...
...	...	...	...

It is convenient to specify all the settings in a single column, detailing the complete Courier address for each setting. The above table may therefore be represented as follows:

Setting	Column	Row	Description
SYSTEM DATA	**00**	**00**	**First Column definition**
Language (Row 01)	00	01	First setting within first column
Password (Row 02)	00	02	Second setting within first column
Sys Fn Links (Row 03)	00	03	Third setting within first column
...	...	...	
VIEW RECORDS	**01**	**00**	**Second Column definition**
Select Event [0...n]	01	01	First setting within second column
Menu Cell Ref	01	02	Second setting within second column
Time & Date	01	03	Third setting within second column
...	...	...	
MEASUREMENTS 1	**02**	**00**	**Third Column definition**
IA Magnitude	02	01	First setting within third column
IA Phase Angle	02	02	Second setting within third column
IB Magnitude	02	03	Third setting within third column
...	...	...	

The first three column headers are common throughout much of the product ranges. However the rows within each of these column headers may differ according to the product type. Many of the column headers are the same for all products within the series. However, there is no guarantee that the addresses will be the same for a particular column header. Therefore you should always refer to the product settings documentation and not make any assumptions.

3.8 CHANGING THE SETTINGS

1. Starting at the default display, press the **Down** cursor key to show the first column heading.
2. Use the horizontal cursor keys to select the required column heading.
3. Use the vertical cursor keys to view the setting data in the column.
4. To return to the column header, either press the Up cursor key for a second or so, or press the **Clear** key once. It is only possible to move across columns at the column heading level.
5. To return to the default display, press the Up cursor key or the **Clear** key from any of the column headings. If you use the auto-repeat function of the Up cursor key, you cannot go straight to the default display from one of the column cells because the auto-repeat stops at the column heading.
6. To change the value of a setting, go to the relevant cell in the menu, then press the **Enter** key to change the cell value. A flashing cursor on the LCD shows that the value can be changed. You may be prompted for a password first.
7. To change the setting value, press the **Up** and **Down** cursor keys. If the setting to be changed is a binary value or a text string, select the required bit or character to be changed using the horizontal cursor keys.

8. Press the **Enter** key to confirm the new setting value or the **Clear** key to discard it. The new setting is automatically discarded if it is not confirmed within 15 seconds.
9. For protection group settings and disturbance recorder settings, the changes must be confirmed before they are used. When all required changes have been entered, return to the column heading level and press the Down cursor key. Before returning to the default display, the following prompt appears.

```
Update settings?
ENTER or CLEAR
```

10. Press the **Enter** key to accept the new settings or press the **Clear** key to discard the new settings.

Note:
*For the protection group and disturbance recorder settings, if the menu time-out occurs before the changes have been confirmed, the setting values are discarded. Control and support settings, howeverr, are updated immediately after they are entered, without the **Update settings?** prompt.*

3.9 DIRECT ACCESS (THE HOTKEY MENU)

For settings and commands that need to be executed quickly or on a regular basis, the IED provides a pair of keys directly below the LCD display. These so called **Hotkeys** can be used to execute specified settings and commands directly.

The functions available for direct access using these keys are:

- Setting group selection
- Control inputs
- Circuit Breaker (CB) control functions

The availability of these functions is controlled by the ***Direct Access*** cell in the *CONFIGURATION* column. There are four options: `Disabled`, `Enabled`, `CB Ctrl only` and `Hotkey only`.

For the Setting Group selection and Control inputs, this cell must be set to either `Enabled` or `Hotkey only`. For CB Control functions, the cell must be set to `Enabled` or `CB Ctrl only`.

3.9.1 SETTING GROUP SELECTION USING HOTKEYS

In some models you can use the hotkey menu to select the settings group. By default, only Setting group 1 is enabled. Other setting groups will only be available if they are first enabled. To be able to select a different setting group, you must first enable them in the *CONFIGURATION* column.

To access the hotkey menu from the default display, you press the key directly below the HOTKEY text on the LCD. The following screen will appear.

```
←User32 STG GP→
HOTKEY MENU
              EXIT
```

Use the right cursor keys to enter the *SETTING GROUP* menu.

```
←Menu User01→
SETTING GROUP 1
Nxt Grp Select
```

Select the setting group with ***Nxt Grp*** and confirm by pressing ***Select***. If neither of the cursor keys is pressed within 20 seconds of entering a hotkey sub menu, the device reverts to the default display.

3.9.2 CONTROL INPUTS

The control inputs are user-assignable functions. You can use the *CTRL I/P CONFIG* column to configure the control inputs for the hotkey menu. In order to do this, use the first setting ***Hotkey Enabled*** cell to enable or disable any of the 32 control inputs. You can then set each control input to latched or pulsed and set its command to *On/Off*, *Set/Reset*, *In/Out*, or *Enabled/Disabled*.

By default, the hotkey is enabled for all 32 control inputs and they are set to *Set/Reset* and are *Latched*.

To access the hotkey menu from the default display, you press the key directly below the HOTKEY text on the LCD. The following screen will appear.

```
←User32 STG GP→
HOTKEY MENU
              EXIT
```

Press the right cursor key twice to get to the first control input, or the left cursor key to get to the last control input.

```
←STP GP User02→
Control Input 1
EXIT SET
```

Now you can execute the chosen function (Set/Reset in this case).

If neither of the cursor keys is pressed within 20 seconds of entering a hotkey sub menu, the device reverts to the default display.

3.9.3 CIRCUIT BREAKER CONTROL

You can open and close the controlled circuit breaker with the hotkey to the right, if enabled as described above. By default, hotkey access to the circuit breakers is disabled.

If hotkeyaccess to the circuit breakers has been enabled, the bottom right hand part of the display will read "Open or Close" depending on whether the circuit breaker is closed or open respectively:

For example:

```
Plant Reference
MiCOM
HOTKEY  CLOSE
```

To close the circuit breaker (in this case), press the key directly below CLOSE. You will be given an option to cancel or confirm.

```
Execute
CB CLOSE
Cancel Confirm
```

More detailed information on this can be found in the Monitoring and Control chapter.

3.10 FUNCTION KEYS

Most products have a number of function keys for programming control functionality using the programmable scheme logic (PSL).

Each function key has an associated programmable tri-colour LED that can be programmed to give the desired indication on function key activation.

These function keys can be used to trigger any function that they are connected to as part of the PSL. The function key commands are in the *FUNCTION KEYS* column.

The first cell down in the *FUNCTION KEYS* column is the ***Fn Key Status*** cell. This contains a binary string, which represents the function key commands. Their status can be read from this binary string.

```
FUNCTION KEYS
Fn Key Status
0000000000
```

The next cell down (***Fn Key 1***) allows you to activate or disable the first function key (1). The ***Lock*** setting allows a function key to be locked. This allows function keys that are set to *Toggled* mode and their DDB signal active 'high', to be locked in their active state, preventing any further key presses from deactivating the associated function. Locking a function key that is set to the Normal mode causes the associated DDB signals to be permanently off. This safety feature prevents any inadvertent function key presses from activating or deactivating critical functions.

```
FUNCTION KEYS
Fn Key 1
Unlocked
```

The next cell down (***Fn Key 1 Mode***) allows you to set the function key to *Normal* or *Toggled*. In the Toggle mode the function key DDB signal output stays in the set state until a reset command is given, by activating the function key on the next key press. In the Normal mode, the function key DDB signal stays energised for as long as the function key is pressed then resets automatically. If required, a minimum pulse width can be programmed by adding a minimum pulse timer to the function key DDB output signal.

```
FUNCTION KEYS
Fn Key 1 Mode
Toggled
```

The next cell down (***Fn Key 1 Label***) allows you to change the label assigned to the function. The default label is *Function key 1* in this case. To change the label you need to press the enter key and then change the text on the bottom line, character by character. This text is displayed when a function key is accessed in the function key menu, or it can be displayed in the PSL.

```
FUNCTION KEYS
Fn Key 1 Label
Function Key 1
```

Subsequent cells allow you to carry out the same procedure as above for the other function keys.

The status of the function keys is stored in non-volatile memory. If the auxiliary supply is interrupted, the status of all the function keys is restored. The IED only recognises a single function key press at a time and a minimum key press duration of approximately 200 ms is required before the key press is recognised. This feature avoids accidental double presses.

4 DATE AND TIME CONFIGURATION

The date and time setting will normally be updated automatically by the chosen UTC (Universal Time Co-ordination) time synchronisation mechanism when the device is in service. You can also set the date and time manually using the ***Date/Time*** cell in the *DATE AND TIME* column.

4.1 USING AN SNTP SIGNAL

When using SNTP to maintain the clock, the IED must first be connected to the SNTP server, which should be energized and functioning.

1. In the *DATE AND TIME* column, check that either the ***Primary Source*** or ***Secondary Source*** setting is set to *SNTP*.
2. Ensure that the IED is receiving valid time synchronisation messages by checking that the ***SNTP Status*** cell reads *Server 1 OK* or *Server 2 OK*.
3. Check that the ***Act. Time Source*** cell reads *SNTP*. This indicates that the IED is using PTP as the source for its time. Note that If IRIG-B or PTP have been selected as the Primary Source, these must first be disconnected before the device can switch to SNTP as the active source.
4. Once the IED is using SNTP as the active time source, adjust the time offset of the universal coordinated time on the SNTP Server equipment, so that local time is displayed.
5. Check that the time, date and month are correct in the ***Date/Time*** cell.

4.2 USING AN IRIG-B SIGNAL

When using IRIG-B to maintain the clock, the IED must first be connected to the timing source equipment (usually a P594/RT430), which should be energized and functioning.

1. In the *DATE AND TIME* column, check that either the ***Primary Source*** or ***Secondary Source*** setting is set to *IRIG-B*.
2. Ensure the IED is receiving the IRIG-B signal by checking that ***IRIG-B Status*** cell reads *Active*
3. Check that the ***Act. Time Source*** cell reads *IRIG-B*. This indicates that the IED is using IRIG-B as the source for its time. Note that If SNTP or PTP have been selected as the Primary Source, these must first be disconnected before the device can switch to IRIG-B as the active source.
4. Once the IED is using IRIG-B as the active time source, adjust the time offset of the universal coordinated time (satellite clock time) on the satellite clock equipment, so that local time is displayed.
5. Check that the time, date and month are correct in the ***Date/Time*** cell. The IRIG-B signal does not contain the current year so this also needs to be set manually in this cell.
6. If the auxiliary supply fails, the time and date are maintained by the supercapacitor. Therefore, when the auxiliary supply is restored, you should not have to set the time and date again. To test this, remove the IRIG-B signal, and then remove the auxiliary supply. Leave the device de-energized for approximately 30 seconds. On re-energization, the time should be correct.
7. Reconnect the IRIG-B signal.

4.3 USING AN IEEE 1588 PTP SIGNAL

When using IEEE 1588 PTP to maintain the clock, the IED must first be connected to the PTP Grandmaster, which should be energized and functioning.

1. In the *DATE AND TIME* column, check that either the ***Primary Source*** or ***Secondary Source*** setting is set to *PTP*.
2. Set the ***Domain Number*** setting. The domain defines which clocks the IED will use for synchronisation. Therefore this number must match the domain used by the other clocks on the network.

3. Ensure that the IED is receiving valid time synchronisation messages by checking that the ***PTP Status*** cell reads `Valid Master`.
4. Check that ***Act. Time Source*** cell reads `PTP`. This indicates that the IED is using PTP as the source for its time. Note that If IRIG-B or SNTP have been selected as the Primary Source, these must first be disconnected before the device can switch to PTP as the active source.
5. Once the IED is using PTP as the active time source, adjust the time offset of the universal coordinated time on the Master Clock equipment, so that local time is displayed.
6. Check that the time, date and month are correct in the ***Date/Time*** cell.

4.4 WITHOUT A TIMING SOURCE SIGNAL

If the time and date is not being maintained by an IRIG-B, PTP or SNTP signal, in the *DATE AND TIME* column, ensure that both the ***Primary Source*** and ***Secondary Source*** are set to `NONE`.

1. Check that ***Act. Time Source*** cell reads `Free Running`.
2. Set the date and time to the correct local time and date using the Date/Time cell or the serial protocol.
3. If the auxiliary supply fails, the time and date are maintained by the supercapacitor. Therefore, when the auxiliary supply is restored, you should not have to set the time and date again. To test this, remove the auxiliary supply. Leave the device de-energized for approximately 30 seconds. On re-energization, the time should be correct.

4.5 TIME ZONE COMPENSATION

The UTC time standard uses Greenwich Mean Time as its standard. Without compensation, the date and time would be displayed on the device irrespective of its location.

You may wish to display the local time corresponding to its geographical location. You can do this with the settings ***LocalTime Enable*** and ***LocalTime Offset***.

The ***LocalTime Enable*** has three setting options; `Disabled`, `Fixed`, and `Flexible`.

With `Disabled`, no local time zone is maintained. Time synchronisation from any interface will be used to directly set the master clock. All times displayed on all interfaces will be based on the master clock with no adjustment.

With `Fixed`, a local time zone adjustment is defined using the ***LocalTime Offset*** setting and all non-IEC 61850 interfaces, which uses the Simple Network Time Protocol (SNTP), are compensated to display the local time.

With `Flexible`, a local time zone adjustment is defined using the ***LocalTime Offset*** setting. The non-local and non-IEC 61850 interfaces can be set to either the UTC zone or the local time zone. The local interfaces are always set to the local time zone and the Ethernet interface is always set to the UTC zone.

The interfaces where you can select between UTC and Local Time are the serial interfaces RP1, RP2, DNP over Ethernet (if applicable) and Tunnelled Courier (if applicable). This is achieved by means of the following settings, each of which can be set to UTC or Local.:

- RP1 Time Zone
- RP2 Time Zone
- DNPOE Time Zone
- Tunnel Time Zone

The ***LocalTime Offset*** setting allows you to enter the local time zone compensation from -12 to + 12 hours at 15 minute intervals.

4.6 DAYLIGHT SAVING TIME COMPENSATION

It is possible to compensate for Daylight Saving time using the following settings

- DST Enable
- DST Offset
- DST Start
- DST Start Day
- DST Start Month
- DST Start Mins
- DST End
- DST End Day
- DST End Month
- DST End Mins

These settings are described in the *DATE AND TIME* settings table in the configuration chapter.

5 SETTINGS GROUP SELECTION

You can select the setting group using opto inputs, a menu selection, and for some models the hotkey menu or function keys. You choose which method using the Setting Group setting in the *CONFIGURATION* column. There are two possibilities; Select via Menu, or Select via PSL. If you choose ***Select via Menu***, you set the settings group using the ***Active Settings*** setting or with the hotkeys. If you choose ***Select via PSL*** , you set the settings group with DDB signals according to the following table:

SG Select 1X	SG Select X1	Selected Setting Group
0	0	1
0	1	2
1	0	3
1	1	4

Each setting group has its own PSL. Once a PSL configuration has been designed it can be allocated to any one of the 4 setting groups. When downloading or extracting a PSL configuration, you will be prompted to enter the required setting group to which it will allocated.

CHAPTER 6

VOLTAGE PROTECTION FUNCTIONS

1 CHAPTER OVERVIEW

The device provides a wide range of voltage protection functions. This chapter describes the operation of these functions including the principles, logic diagrams and applications.

This chapter contains the following sections:

Chapter Overview 73
Undervoltage Protection 74
Overvoltage Protection 77
Rate of Change of Voltage Protection 80
Residual Overvoltage Protection 82
Negative Sequence Overvoltage Protection 90
Positive Sequence Undervoltage Protection 92
Positive Sequence Overvoltage Protection 93
Moving Average Voltage Functions 94

2 UNDERVOLTAGE PROTECTION

Undervoltage conditions may occur on a power system for a variety of reasons, some of which are outlined below:

- Undervoltage conditions can be related to increased loads, whereby the supply voltage will decrease in magnitude. This situation would normally be rectified by voltage regulating equipment such as AVRs (Auto Voltage Regulators) or On Load Tap Changers. However, failure of this equipment to bring the system voltage back within permitted limits leaves the system with an undervoltage condition, which must be cleared.
- If the regulating equipment is unsuccessful in restoring healthy system voltage, then tripping by means of an undervoltage element is required.
- Faults occurring on the power system result in a reduction in voltage of the faulty phases. The proportion by which the voltage decreases is dependent on the type of fault, method of system earthing and its location. Consequently, co-ordination with other voltage and current-based protection devices is essential in order to achieve correct discrimination.
- Complete loss of busbar voltage. This may occur due to fault conditions present on the incomer or busbar itself, resulting in total isolation of the incoming power supply. For this condition, it may be necessary to isolate each of the outgoing circuits, such that when supply voltage is restored, the load is not connected. Therefore, the automatic tripping of a feeder on detection of complete loss of voltage may be required. This can be achieved by a three-phase undervoltage element.
- Where outgoing feeders from a busbar are supplying induction motor loads, excessive dips in the supply may cause the connected motors to stall, and should be tripped for voltage reductions that last longer than a pre-determined time.

2.1 UNDERVOLTAGE PROTECTION IMPLEMENTATION

Undervoltage Protection is implemented in the *VOLT PROTECTION* column of the relevant settings group. The Undervoltage parameters are contained within the sub-heading *UNDERVOLTAGE*.

The product provides three stages of Undervoltage protection with independent time delay characteristics.

Stages 1 and 3 provide a choice of operate characteristics, where you can select between:

- An IDMT characteristic
- A range of user-defined curves
- DT (Definite Time)

You set this using the ***V<1 Function*** and ***V<3 Function*** cells depending on the stage.

The IDMT characteristic is defined by the following formula:

$$t = K/(M-1)$$

where:

- K = Time multiplier setting
- t = Operating time in seconds
- M = Measured voltage / IED setting voltage

The undervoltage stages can be configured either as phase-to-neutral or phase-to-phase voltages in the ***V< Measure't mode*** cell.

There is no Timer Hold facility for Undervoltage.

Stage 2 can have definite time characteristics only. This is set in the ***V<2*** status cell.

Three stages are included in order to provide multiple output types, such as alarm and trip stages. Alternatively, different time settings may be required depending upon the severity of the voltage dip. For example, motor loads will be able to cope with a small voltage dip for a longer time than a major one.

Outputs are available for single or three-phase conditions via the ***V< Operate Mode*** cell for each stage.

2.2 UNDERVOLTAGE PROTECTION LOGIC

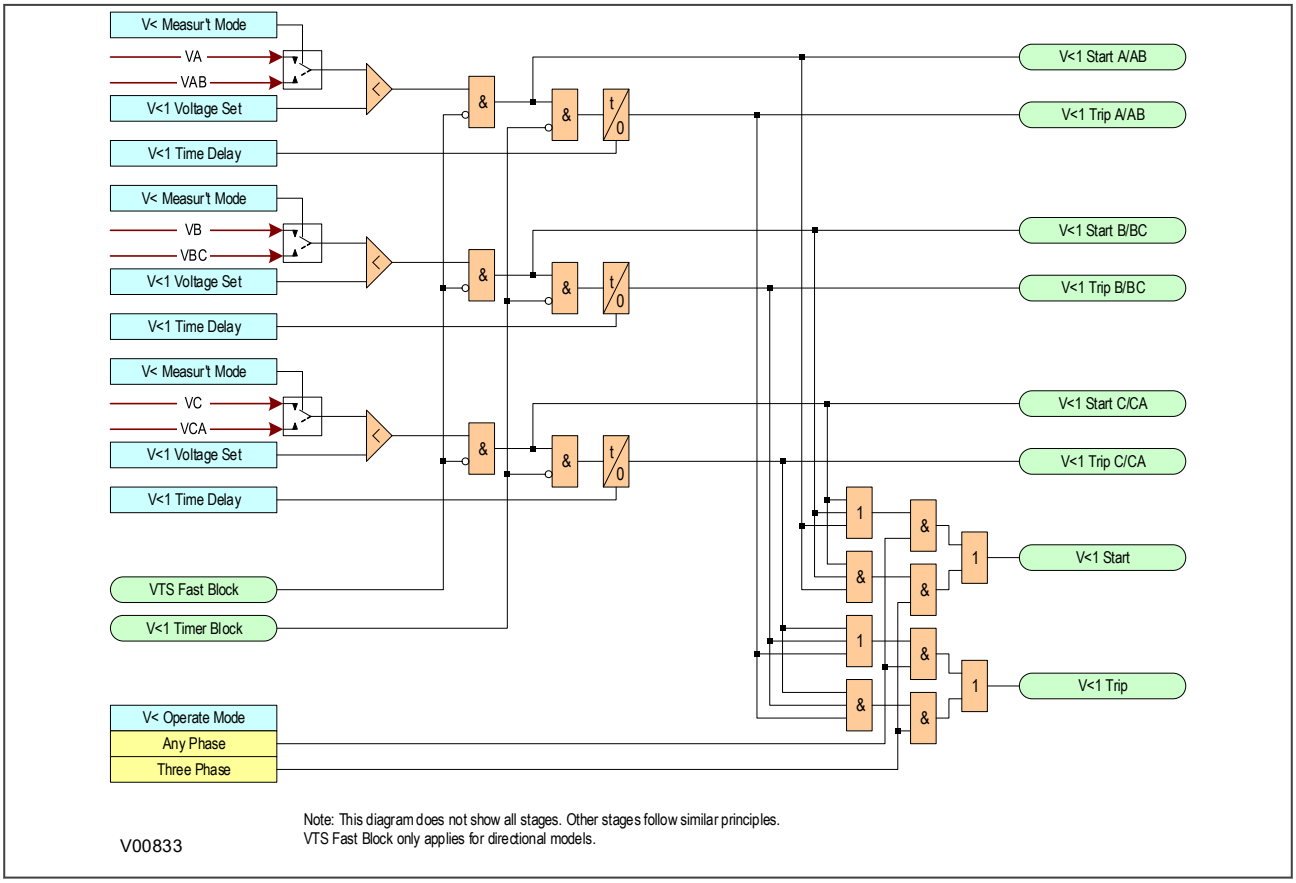


Figure 18: Undervoltage - single and three phase tripping mode (single stage)

The Undervoltage protection function detects when the voltage magnitude for a certain stage falls short of a set threshold. If this happens a ***Start*** signal, signifying the "Start of protection", is produced. This ***Start*** signal is applied to the timer module to produce the ***Trip*** signal, which can be blocked by the undervoltage timer block signal (***V<(n) Timer Block***). For each stage, there are three Phase undervoltage detection modules, one for each phase. The three ***Start*** signals from each of these phases are OR'd together to create a 3-phase Start signal (***V<(n) Start***), which can be be activated when any of the three phases start (Any Phase), or when all three phases start (Three Phase), depending on the chosen ***V< Operate Mode*** setting.

The outputs of the timer modules are the trip signals which are used to drive the tripping output relay. These tripping signals are also OR'd together to create a 3-phase Trip signal, which are also controlled by the ***V< Operate Mode*** setting.

If any one of the above signals is low, or goes low before the timer has counted out, the timer module is inhibited (effectively reset) until the blocking signal goes high.

2.3 APPLICATION NOTES

2.3.1 UNDERVOLTAGE SETTING GUIDELINES

In most applications, undervoltage protection is not required to operate during system earth fault conditions. If this is the case you should select phase-to-phase voltage measurement, as this quantity is less affected by single-phase voltage dips due to earth faults.

The voltage threshold setting for the undervoltage protection should be set at some value below the voltage excursions that may be expected under normal system operating conditions. This threshold is dependent on the system in question but typical healthy system voltage excursions may be in the order of 10% of nominal value.

The same applies to the time setting. The required time delay is dependent on the time for which the system is able to withstand a reduced voltage.

If motor loads are connected, then a typical time setting may be in the order of 0.5 seconds.

3 OVERVOLTAGE PROTECTION

Overvoltage conditions are generally related to loss of load conditions, whereby the supply voltage increases in magnitude. This situation would normally be rectified by voltage regulating equipment such as AVRs (Auto Voltage Regulators) or On Load Tap Changers. However, failure of this equipment to bring the system voltage back within permitted limits leaves the system with an overvoltage condition which must be cleared.

Note:
During earth fault conditions on a power system there may be an increase in the healthy phase voltages. Ideally, the system should be designed to withstand such overvoltages for a defined period of time.

3.1 OVERVOLTAGE PROTECTION IMPLEMENTATION

Overvoltage Protection is implemented in the *VOLT PROTECTION* column of the relevant settings group. The Overvoltage parameters are contained within the sub-heading *OVERVOLTAGE*.

The product provides three stages of overvoltage protection with independent time delay characteristics.

Stages 1 and 3 provide a choice of operate characteristics, where you can select between:

- An IDMT characteristic
- A range of user-defined curves
- DT (Definite Time)

You set this using the ***V>1 Function*** and ***V>3 Function*** cells depending on the stage.

The IDMT characteristic is defined by the following formula:

$$t = K/(M - 1)$$

where:

- K = Time multiplier setting
- t = Operating time in seconds
- M = Measured voltage setting voltage (***V> Voltage Set***)

The overvoltage stages can be configured either as phase-to-neutral or phase-to-phase voltages in the ***V> Measure't mode*** cell.

There is no Timer Hold facility for Overvoltage.

Stage 2 has definite time characteristics only. This is set in the ***V>2 status*** cell.

Three stages are included in order to provide multiple output types, such as alarm and trip stages. Alternatively, different time settings may be required depending upon the severity of the voltage increase.

Outputs are available for single or three-phase conditions via the ***V> Operate Mode*** cell for each stage.

3.2 OVERVOLTAGE PROTECTION LOGIC

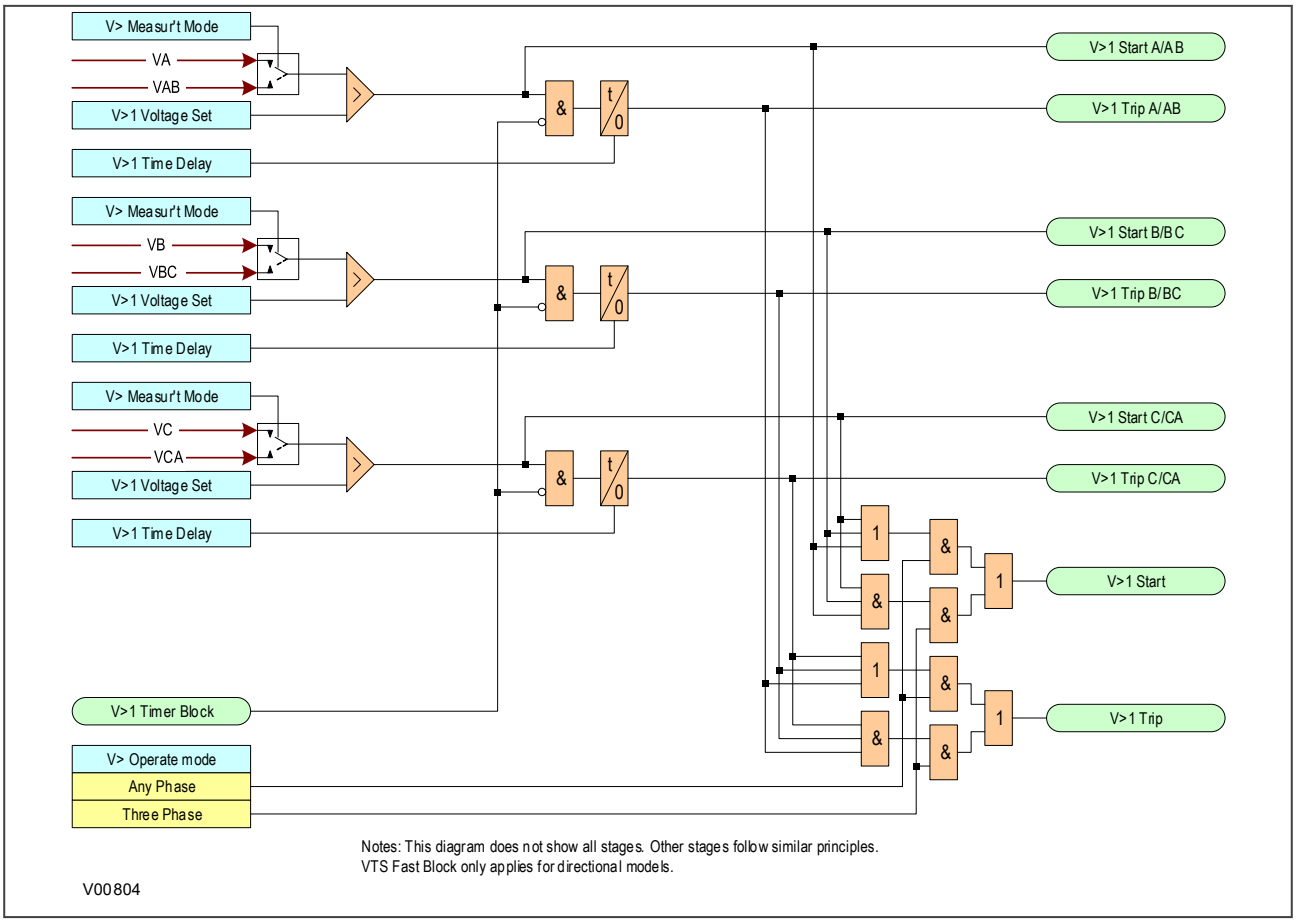


Figure 19: Overvoltage - single and three phase tripping mode (single stage)

The Overvoltage protection function detects when the voltage magnitude for a certain stage exceeds a set threshold. If this happens a ***Start*** signal, signifying the "Start of protection", is produced. This start signal is applied to the timer module to produce the ***Trip*** signal, which can be blocked by the overvoltage timer block signal (***V>(n) Timer Block***). For each stage, there are three Phase overvoltage detection modules, one for each phase. The three ***Start*** signals from each of these phases are OR'd together to create a 3-phase Start signal (***V>(n) Start***), which can then be activated when any of the three phases start (Any Phase), or when all three phases start (Three Phase), depending on the chosen ***V> Operate Mode*** setting.

The outputs of the timer modules are the trip signals which are used to drive the tripping output relay. These tripping signals are also OR'd together to create a 3-phase Trip signal, which are also controlled by the ***V> Operate Mode*** setting.

If any one of the above signals is low, or goes low before the timer has counted out, the timer module is inhibited (effectively reset) until the blocking signal goes high.

3.3 APPLICATION NOTES

3.3.1 OVERVOLTAGE SETTING GUIDELINES

The provision of multiple stages and their respective operating characteristics allows for a number of possible applications:

- Definite Time can be used for both stages to provide the required alarm and trip stages.
- Use of the IDMT characteristic allows grading of the time delay according to the severity of the overvoltage. As the voltage settings for both of the stages are independent, the second stage could then be set lower than the first to provide a time-delayed alarm stage.
- If only one stage of overvoltage protection is required, or if the element is required to provide an alarm only, the remaining stage may be disabled.

This type of protection must be co-ordinated with any other overvoltage devices at other locations on the system.

4 RATE OF CHANGE OF VOLTAGE PROTECTION

Where there are very large loads, imbalances may occur, which could result in rapid decline in system voltage. The situation could be so bad that shedding one or two stages of load would be unlikely to stop this rapid voltage decline. In such a situation, standard undervoltage protection will normally have to be supplemented with protection that responds to the rate of change of voltage. An element is therefore required, which identifies the high rate of decline of voltage and adapts the load shedding scheme accordingly.

Such protection can identify voltage variations occurring close to nominal voltage thereby providing early warning of a developing voltage problem. The element can also be used as an alarm to warn operators of unusually high system voltage variations.

Rate of Change of Voltage protection is also known as dv/dt protection.

4.1 RATE OF CHANGE OF VOLTAGE PROTECTION IMPLEMENTATION

The dv/dt protection functions can be found in the the *VOLT PROTECTION* column under the sub-heading *DV/DT PROTECTION*. The dv/dt protection consists of four independent stages, which can be configured as either `Phase-Phase` or `Phase-Neutral` using the ***dv/dt Meas mode*** cell.

4.2 RATE OF CHANGE OF VOLTAGE LOGIC

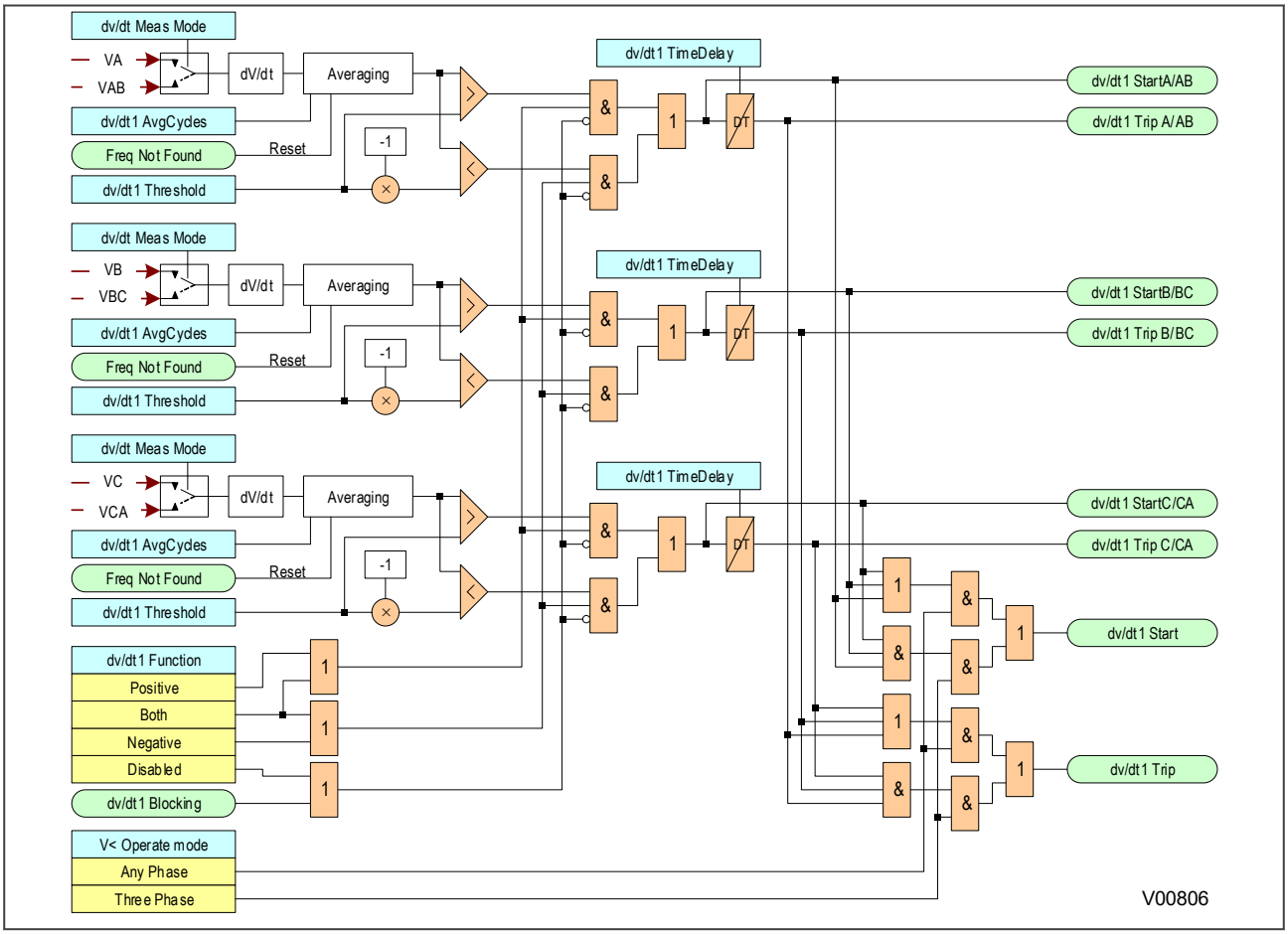


Figure 20: Rate of Change of Voltage protection logic

The dv/dt logic works by differentiating the RMS value of each phase voltage input, which can be with respect to neutral, or respect to another phase depending on the selected measurement mode. This differentiated value is

then averaged over a number of cycles, determined by the setting ***dv/dt1 AvgCycles*** and comparing this with a threshold (***dv/dt1 Threshold***) in both the positive and negative directions. A start signal is produced depending on the selected direction (positive, negative or both), set by the setting ***dv/dt1 Function***, which can also disable the function on a per stage basis. Each stage can also be blocked by the DDB signal ***dv/dt1 Blocking***. The trip signal is produced by passing the Start signal through a DT timer.

The function also produces three-phase Start and Trip signals, which can be set to *Any Phase* (where any of the phases can trigger the start) or *Three Phase* (where all three phases are required to trigger the start). The averaging buffer is reset either when the stage is disabled or no frequency is found (***Freq Not Found*** DDB signal).

5 RESIDUAL OVERVOLTAGE PROTECTION

On a healthy three-phase power system, the sum of the three-phase to earth voltages is nominally zero, as it is the vector sum of three balanced vectors displaced from each other by 120°. However, when an earth fault occurs on the primary system, this balance is upset and a residual voltage is produced. This condition causes a rise in the neutral voltage with respect to earth. Consequently this type of protection is also commonly referred to as 'Neutral Voltage Displacement' or NVD for short.

This residual voltage may be derived (from the phase voltages) or measured (from a measurement class open delta VT). Derived values will normally only be used where the model does not support measured functionality (a dedicated measurement class VT). If a measurement class VT is used to produce a measured Residual Voltage, it cannot be used for other features such as Check Synchronisation.

This offers an alternative means of earth fault detection, which does not require any measurement of current. This may be particularly advantageous in high impedance earthed or insulated systems, where the provision of core balanced current transformers on each feeder may be either impractical, or uneconomic, or for providing earth fault protection for devices with no current transformers.

5.1 RESIDUAL OVERVOLTAGE PROTECTION IMPLEMENTATION

Residual Overvoltage Protection is implemented in the *RESIDUAL O/V NVD* column of the relevant settings group.

Some applications require more than one stage. For example an insulated system may require an alarm stage and a trip stage. It is common in such a case for the system to be designed to withstand the associated healthy phase overvoltages for a number of hours following an earth fault. In such applications, an alarm is generated soon after the condition is detected, which serves to indicate the presence of an earth fault on the system. This gives time for system operators to locate and isolate the fault. The second stage of the protection can issue a trip signal if the fault condition persists.

The product provides three stages of Residual Overvoltage protection with independent time delay characteristics.

Stages 1 and 3 provide a choice of operate characteristics, where you can select between:

- An IDMT characteristic
- A range of user-defined curves
- DT (Definite Time)

The IDMT characteristic is defined by the following formula:

$$t = K/(M - 1)$$

where:

- K= Time multiplier setting
- t = Operating time in seconds
- M = Derived residual voltage setting voltage (***VN> Voltage Set***)

You set this using the ***VN>1 Function*** and ***VN>3 Function*** cells depending on the stage.

Stages 1 and 3 also provide a Timer Hold facility as described in Timer Hold facility

Stage 2 can have definite time characteristics only. This is set in the ***VN>2 status*** cell

The residual voltage may be derived from the phase voltages (Vres = Va + Vb +Vc) or measured from the 4th VT input.

In the *CT AND VT RATIOS* column, the ***VN Input*** setting may be set to `Measured` or `Derived`, this is used to select the type of neutral voltage.

The device derives the residual voltage internally from the three-phase voltage inputs supplied from either a 5-limb VT or three single-phase VTs. These types of VT design provide a path for the residual flux and consequently permit

the device to derive the required residual voltage. In addition, the primary star point of the VT must be earthed. Three-limb VTs have no path for residual flux and are therefore unsuitable for this type of protection.

5.2 RESIDUAL OVERVOLTAGE LOGIC

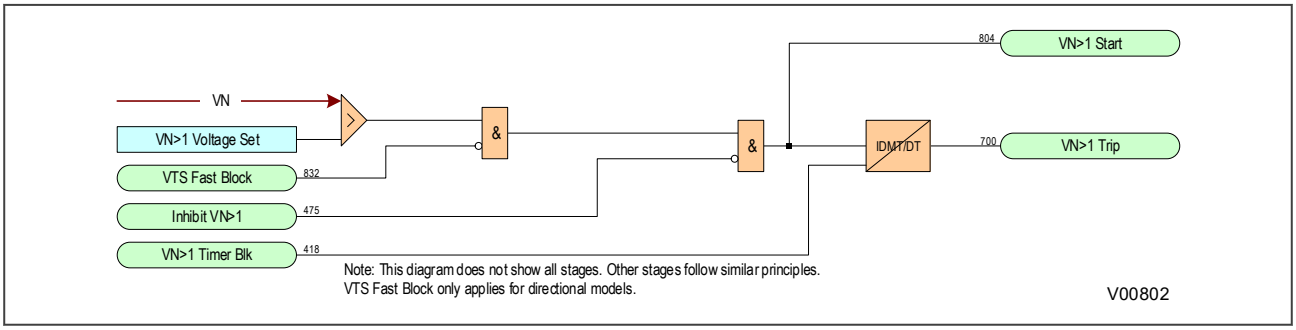


Figure 21: Residual Overvoltage logic

The Residual Overvoltage module (VN>) is a level detector that detects when the voltage magnitude exceeds a set threshold, for each stage. When this happens, the comparator output produces a ***Start*** signal (***VN>(n) Start***), which signifies the "Start of protection". This ***Start*** signal is applied to the timer module. The output of the timer module is the ***VN> (n) Trip*** signal which is used to drive the tripping output relay.

5.3 APPLICATION NOTES

5.3.1 CALCULATION FOR SOLIDLY EARTHED SYSTEMS

Consider a Phase-A to Earth fault on a simple radial system.

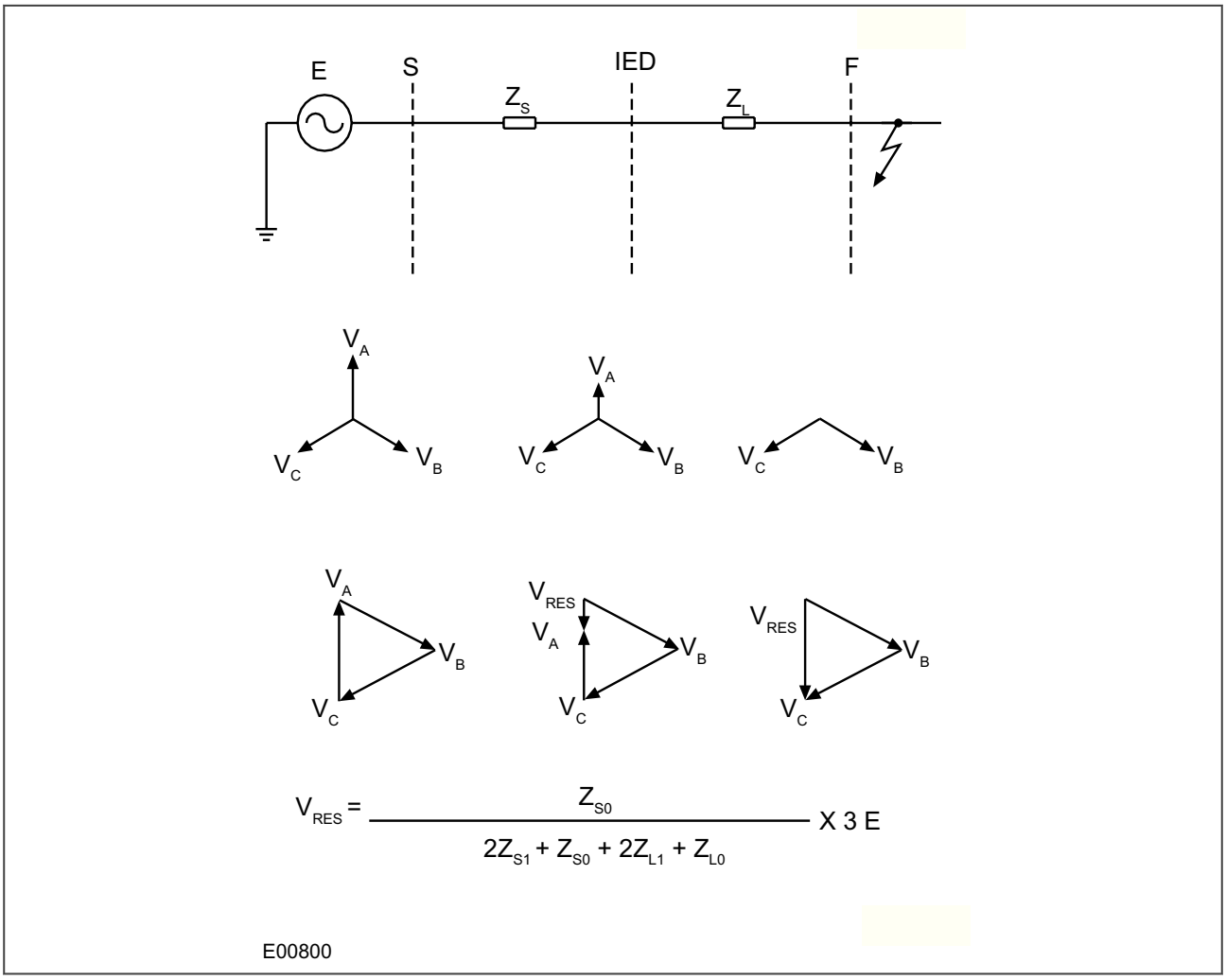


Figure 22: Residual voltage for a solidly earthed system

As can be seen from the above diagram, the residual voltage measured on a solidly earthed system is solely dependent on the ratio of source impedance behind the protection to the line impedance in front of the protection, up to the point of fault. For a remote fault far away, the Z_S/Z_L: ratio will be small, resulting in a correspondingly small residual voltage. Therefore, the protection only operates for faults up to a certain distance along the system. The maximum distance depends on the device setting.

5.3.2 CALCULATION FOR IMPEDANCE EARTHED SYSTEMS

Consider a Phase-A to Earth fault on a simple radial system.

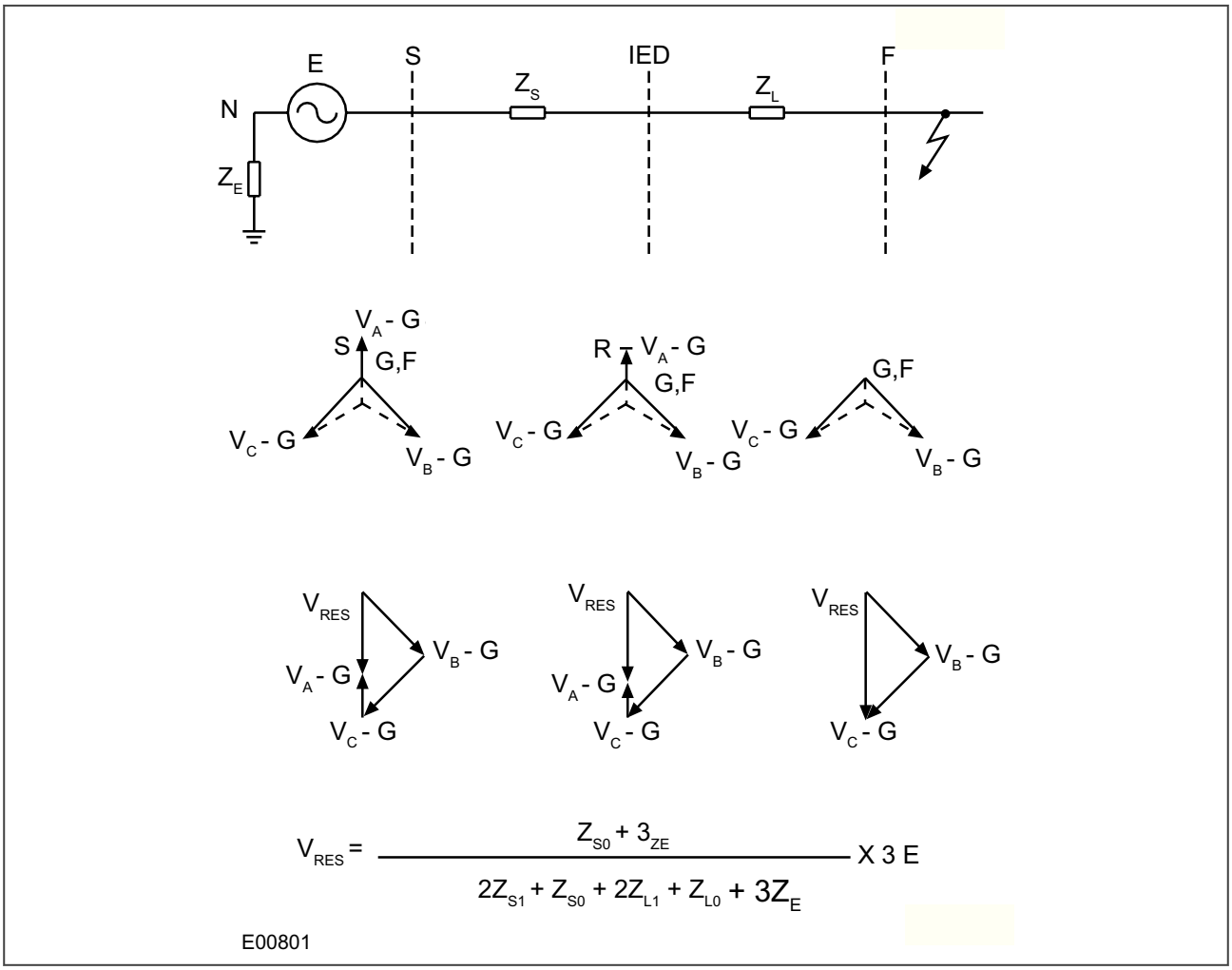


Figure 23: Residual voltage for an impedance earthed system

An impedance earthed system will always generate a relatively large degree of residual voltage, as the zero sequence source impedance now includes the earthing impedance. It follows then that the residual voltage generated by an earth fault on an insulated system will be the highest possible value (3 x phase-neutral voltage), as the zero sequence source impedance is infinite.

5.3.3 NEUTRAL VOLTAGE DISPLACEMENT (NVD) PROTECTION APPLIED TO CONDENSER BUSHINGS (CAPACITOR CONES)

Voltage Transformers are not fitted at distribution levels, due to their expense. Instead, capacitor cones, or condenser bushings, may be used at 11kV and 33kV substations to provide a neutral voltage displacement output to a suitable protection device.

Often, bushings are starred together, and the star point used to provide the displacement voltage to the device, as seen in the diagram, below.

Warning:
As protection method requires the device to be placed in a primary circuit location, all relevant safety measures must be in place.

Warning:
When operating in areas with restricted space, suitable protective barriers must be used where there is a risk of electric shock due to exposed terminals.

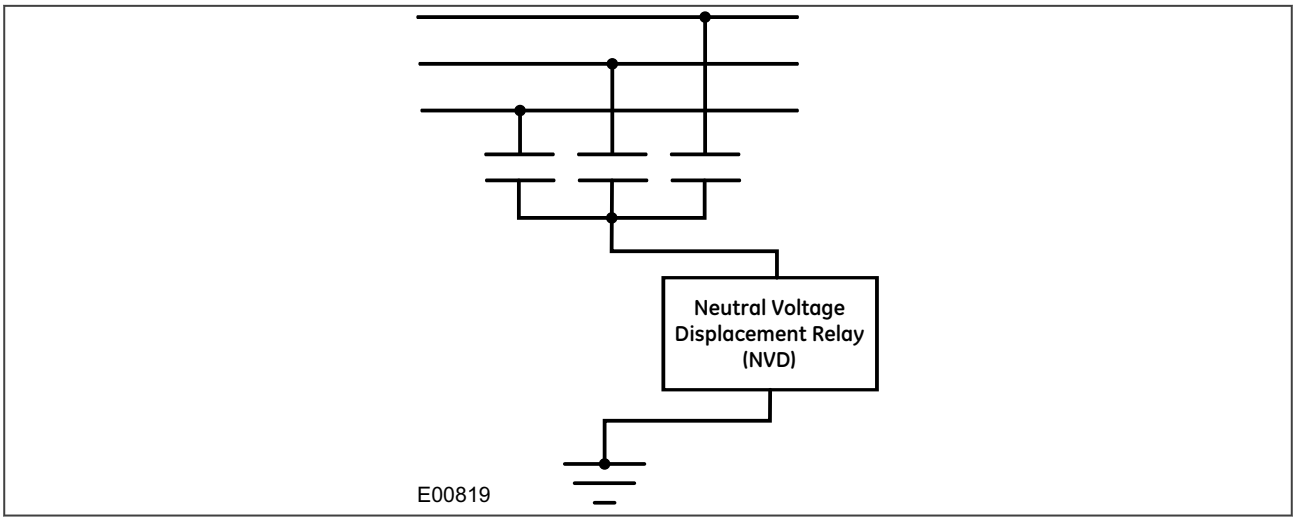


Figure 24: Star connected condenser bushings

Calculations for Condenser Bushing Systems

Consider a single-phase fault to ground on B-Phase:

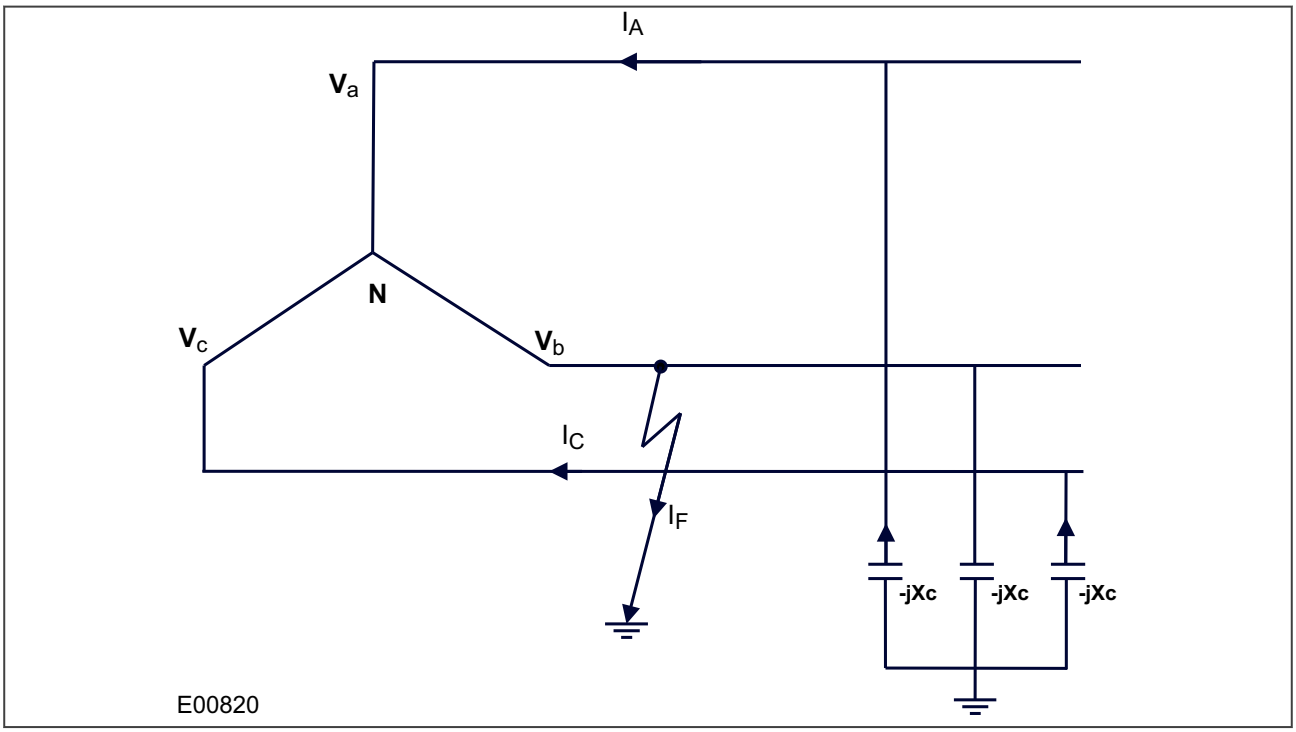


Figure 25: Theoretical earth fault in condenser bushing system

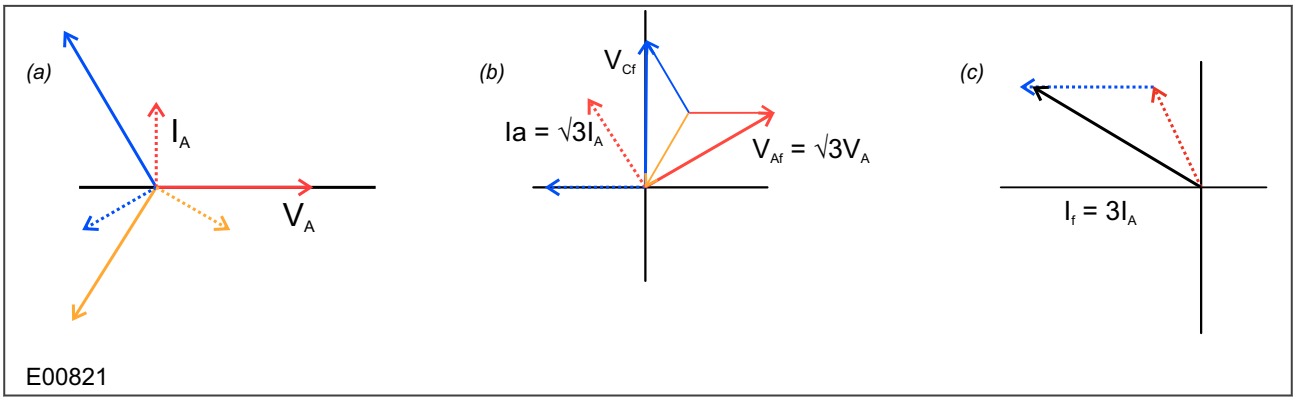


Figure 26: Condenser bushing system vectors

In the figure above:

(a) Shows three healthy voltages, three capacitor currents that lead their respective voltages by 90° and sum to zero,

(b) Shows B phase earthed, A and C voltages are √3 times their healthy magnitude & at 60° to each other, giving correspondingly altered capacitor currents Ia and Ic.

The vector sum of the A & C phase capacitor currents is:

$$I_f = \sqrt{3} \times Ia,$$

$$= \sqrt{3} \times \sqrt{3} \times I_A,$$

$$= 3 \times I_A$$

Therefore, the total fault current I_f equals three times a single capacitor healthy condition current I_A.

(c) Shows the vector sum of the fault condition I_f.

Therefore, I_f is the current which will flow in the Neutral Displacement Relay under fault conditions (neglecting the impedance of the relay itself).

For example, for a 60pF capacitor on a 33kV system, the single capacitor healthy condition current I_A is given by:

$$I_A = V_A / X_C$$

$$= V_A / (1/2\pi fC)$$

$$= \frac{33 \times 10^3}{\sqrt{3}} / (1/(2 \times \pi \times 50 \times 60 \times 10^{-12}))$$

$$= 0.359mA$$

Therefore, the total fault current which would flow in an NVD relay (neglecting the impedance of the relay itself):

$$I_f = 3 \times 0.359 = 1.08mA$$

The table below shows the total fault current I_f for a 60pF capacitor, and also I_f for a 90pF capacitor, and for a 150pF capacitor.

C (pF)	60.00	90.00	150.00
Xc (MΩ)	53.08	35.39	21.23
VA (kV)	19.00	19.00	19.00
IA (mA)	0.359	0.539	0.898
If (mA)	1.08	1.62	2.69

Where If is the total fault current which would flow in an NVD relay (neglecting the impedance of the relay itself), then knowing this current (If) and the input impedance of the relay (Rr) we can calculate the voltage produced across it (Vr) during a fault condition:

$$Vr = If \times Rr$$

Therefore, we would recommend setting the relay to less than half this voltage:

$$Vs < Vr/2$$

Practical Application

In practice, the device's input impedance varies with voltage, which will have some effect on actual settings. Therefore, we recommend the use a 23½kΩ resistor combination in parallel with this input, to fix the impedance. This value is achieved by the use of two 47kΩ resistors in parallel. Utilising two resistors in parallel also gives increased security.

The resistors used must have a continuous working voltage rating of 5kVdc minimum and a minimum power rating of 1W.

Warning:
There is the risk of high voltage developing on removal of the device or PCB from its case. Fixed resistors on the device input will prevent this, but we would also recommend use of an externally connected shorting contact.

Note:
A suitable shorting contact is available on each device. Please see diagram, below.

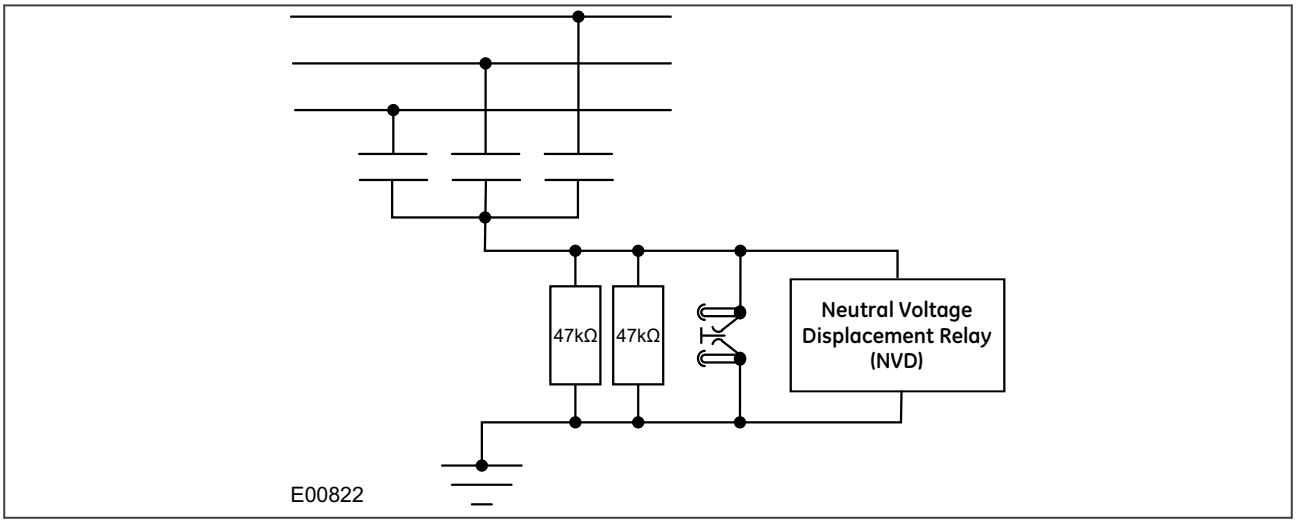


Figure 27: Device connection with resistors and shorting contact

Voltage Setting

The device has a minimum setting of 1V, which should provide a sensitive enough setting for most applications. The operating voltage to be applied can be calculated for various capacitor ratings, shown in calculations provided above.

For maximum settings for various capacitors (assuming 23½kΩ resistance applied in conjunction with the device), see the table below.

C (pF)	60.00	90.00	150.00

Xc (MΩ)	53.08	35.39	21.23
VA (kV)	19.00	19.00	19.00
If (mA)	1.08	1.62	2.69
Rr (kΩ)*	19	19	19
Vr (V)	20	30	51
Vs (V)	10.00	15.00	25.00

*Relay and Resistor Combination

Wiring Diagram

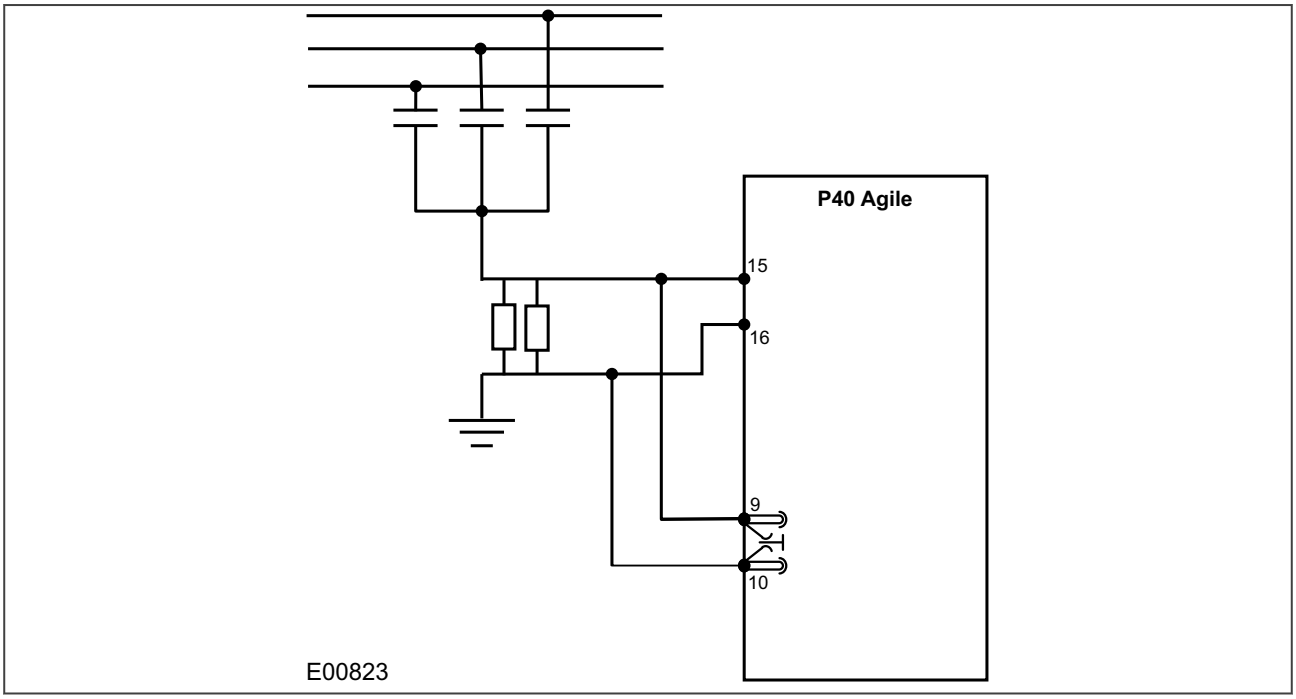


Figure 28: Device connection P14D/P94V

5.3.4 SETTING GUIDELINES

The voltage setting applied to the elements is dependent on the magnitude of residual voltage that is expected to occur during the earth fault condition. This in turn is dependent on the method of system earthing employed.

Also, you must ensure that the protection setting is set above any standing level of residual voltage that is present on the system.

6 NEGATIVE SEQUENCE OVERVOLTAGE PROTECTION

Where an incoming feeder is supplying rotating plant equipment such as an induction motor, correct phasing and balance of the supply is essential. Incorrect phase rotation will result in connected motors rotating in the wrong direction. For directionally sensitive applications, such as elevators and conveyor belts, it is unacceptable to allow this to happen.

Imbalances on the incoming supply cause negative phase sequence voltage components. In the event of incorrect phase rotation, the supply voltage would effectively consist of 100% negative phase sequence voltage only.

6.1 NEGATIVE SEQUENCE OVERVOLTAGE IMPLEMENTATION

Negative Sequence Overvoltage Protection is implemented in the *NEG SEQUENCE O/V* column of the relevant settings group.

The device includes one Negative Phase Sequence Overvoltage element with two stages. Only Definite time is possible.

This element monitors the input voltage rotation and magnitude (normally from a bus connected voltage transformer) and may be interlocked with the motor contactor or circuit breaker to prevent the motor from being energised whilst incorrect phase rotation exists.

The element is enabled using the ***V2>1 status*** and ***V2>2 status*** cells.

6.2 NEGATIVE SEQUENCE OVERVOLTAGE LOGIC

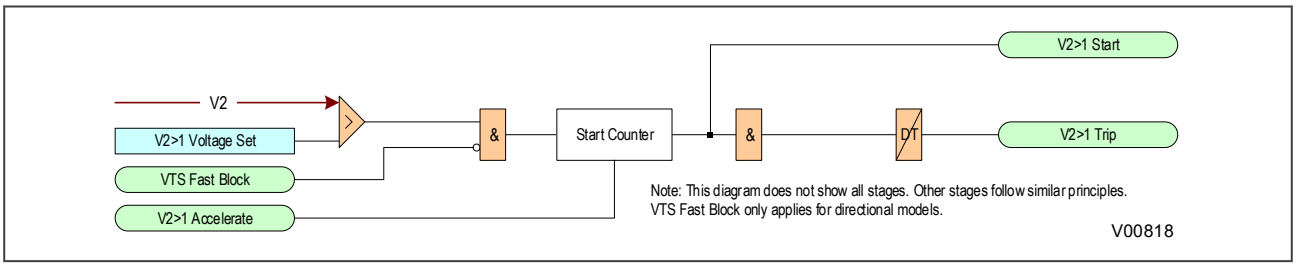


Figure 29: Negative Sequence Overvoltage logic

The Negative Voltage Sequence Overvoltage module detects when the voltage magnitude exceeds a set threshold. When this happens, the comparator output Overvoltage Module produces a ***Start*** signal (e.g. for stage 1: ***V2>1 Start***), which signifies the "Start of protection". This ***Start*** signal is applied to the DT timer module. The output of the DT timer module is the trip signal which is used to drive the tripping output relay.

The ***V2>1 Accelerate*** signal accelerates the operating time of the function, by reducing the number of confirmation cycles needed to start the function. At 50 Hz, this means the protection Start is reduced by 20 ms.

6.3 APPLICATION NOTES

6.3.1 SETTING GUIDELINES

The primary concern is usually the detection of incorrect phase rotation (rather than small imbalances), therefore a sensitive setting is not required. The setting must be higher than any standing NPS voltage, which may be present due to imbalances in the measuring VT, device tolerances etc.

A setting of approximately 15% of rated voltage may be typical.

Note:
*Standing levels of NPS voltage (V2) are displayed in the **V2 Magnitude** cell of the MEASUREMENTS 1 column.*

The operation time of the element depends on the application, but a typical setting would be in the region of 5 seconds.

7 POSITIVE SEQUENCE UNDERVOLTAGE PROTECTION

7.1 POSITIVE SEQUENCE UNDERVOLTAGE IMPLEMENTATION

Positive Sequence Undervoltage Protection is implemented under the *POS SEQ U/V* heading in the *VOLT PROTECTION* Voltage column of the relevant settings group.

The product provides two stages of Positive Sequence Undervoltage protection with independent time delay characteristics.

Stage 1 provides a choice of operate characteristics, where you can select between:

- An IDMT characteristic
- DT (Definite Time)

You set this using the ***V1<1 Function*** cell.

The IDMT characteristic is defined by the following formula:

$$t = K/(M-1)$$

where:

- K = Time multiplier setting
- t = Operating time in seconds
- M = Measured voltage / IED setting voltage

There is no Timer Hold facility for Undervoltage.

Stage 2 can have definite time characteristics only. This is set in the ***V1<2*** status cell.

Two stages are included in order to provide multiple output types, such as alarm and trip stages.

7.2 POSITIVE SEQUENCE UNDERVOLTAGE LOGIC

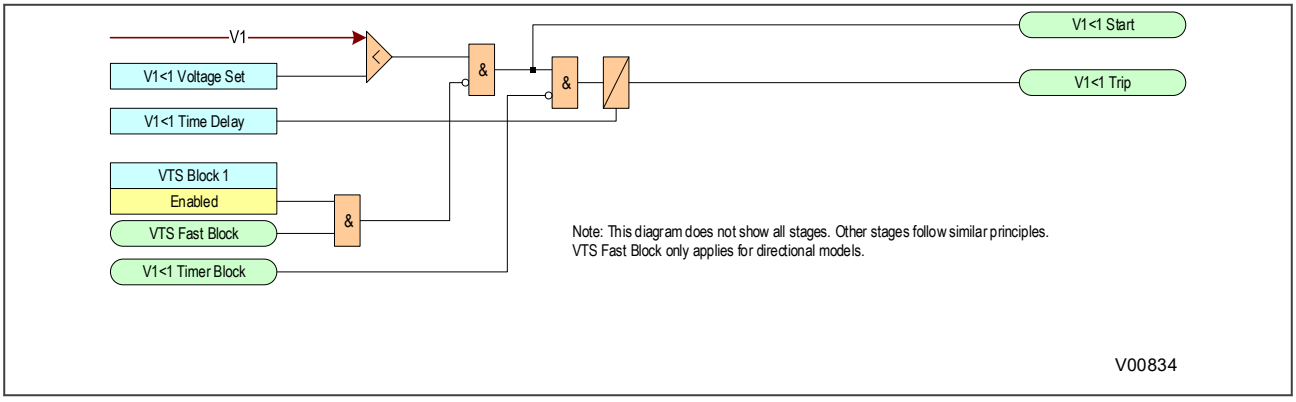


Figure 30: Positive Sequence Undervoltage logic

8 POSITIVE SEQUENCE OVERVOLTAGE PROTECTION

8.1 POSITIVE SEQUENCE OVERVOLTAGE IMPLEMENTATION

Positive Sequence Overvoltage Protection is implemented under the *POS SEQ O/V* heading in the *VOLT PROTECTION* Voltage column of the relevant settings group.

The product provides two stages of Positive Sequence Overvoltage protection with independent time delay characteristics.

Stage 1 provides a choice of operate characteristics, where you can select between:

- An IDMT characteristic
- DT (Definite Time)

You set this using the ***V1>1 Function*** cell.

The IDMT characteristic is defined by the following formula:

$$t = K/(M-1)$$

where:

- K = Time multiplier setting
- t = Operating time in seconds
- M = Measured voltage / IED setting voltage

There is no Timer Hold facility for Positive Sequence Overvoltage.

Stage 2 can have definite time characteristics only. This is set in the ***V1>2 status*** cell.

Two stages are included in order to provide multiple output types, such as alarm and trip stages.

8.2 POSITIVE SEQUENCE OVERVOLTAGE LOGIC

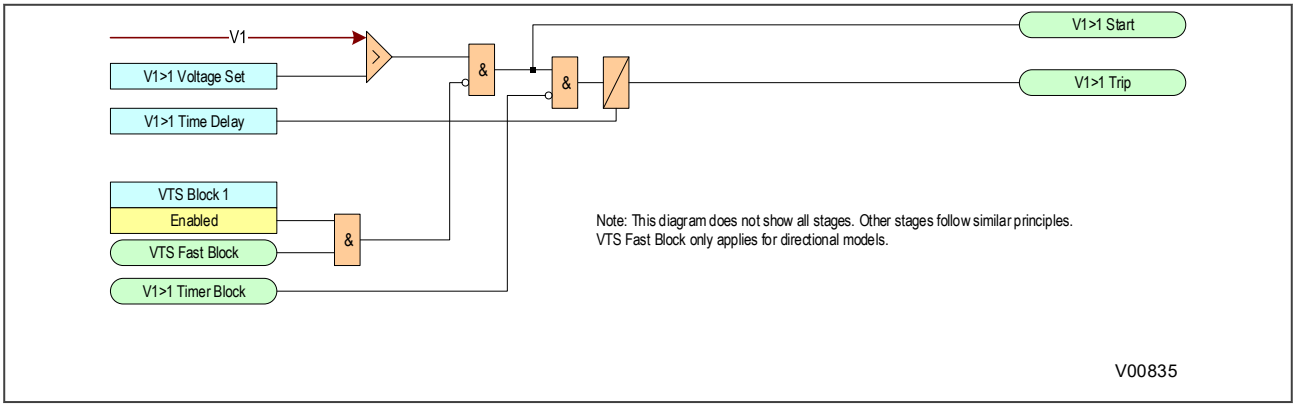


Figure 31: Positive Sequence Overvoltage logic

9 MOVING AVERAGE VOLTAGE FUNCTIONS

Moving average voltage functions are available for:

- Undervoltage (Vavg<)
- Overvoltage (Vavg>)
- Zero Sequence Voltage (V0avg>)
- Positive Sequence Voltage (V1Avg>)
- Negative Sequence Voltage (V2Avg>)

The voltage is sampled at 5 Hz (one sample every 200 ms for a 50 Hz system). The refresh period is 3 seconds, meaning 15 samples are collected every refresh period. The average voltage for the previous 10 minutes is calculated, displayed as measurements and used as energising quantities for the protection functions. The folllowing quantities are provided:

VA Mov Average: A-phase RMS average voltage

VB Mov Average: B-phase RMS average voltage

VC Mov Average: C-phase RMS average voltage

V0 Mov Average: Zero Sequence average voltage magnitude

V1 Mov Average: Positive Sequence average voltage magnitude

V2 Mov Average: Negative Sequence average voltage magnitude

9.1 MOVING AVERAGE UNDERVOLTAGE LOGIC

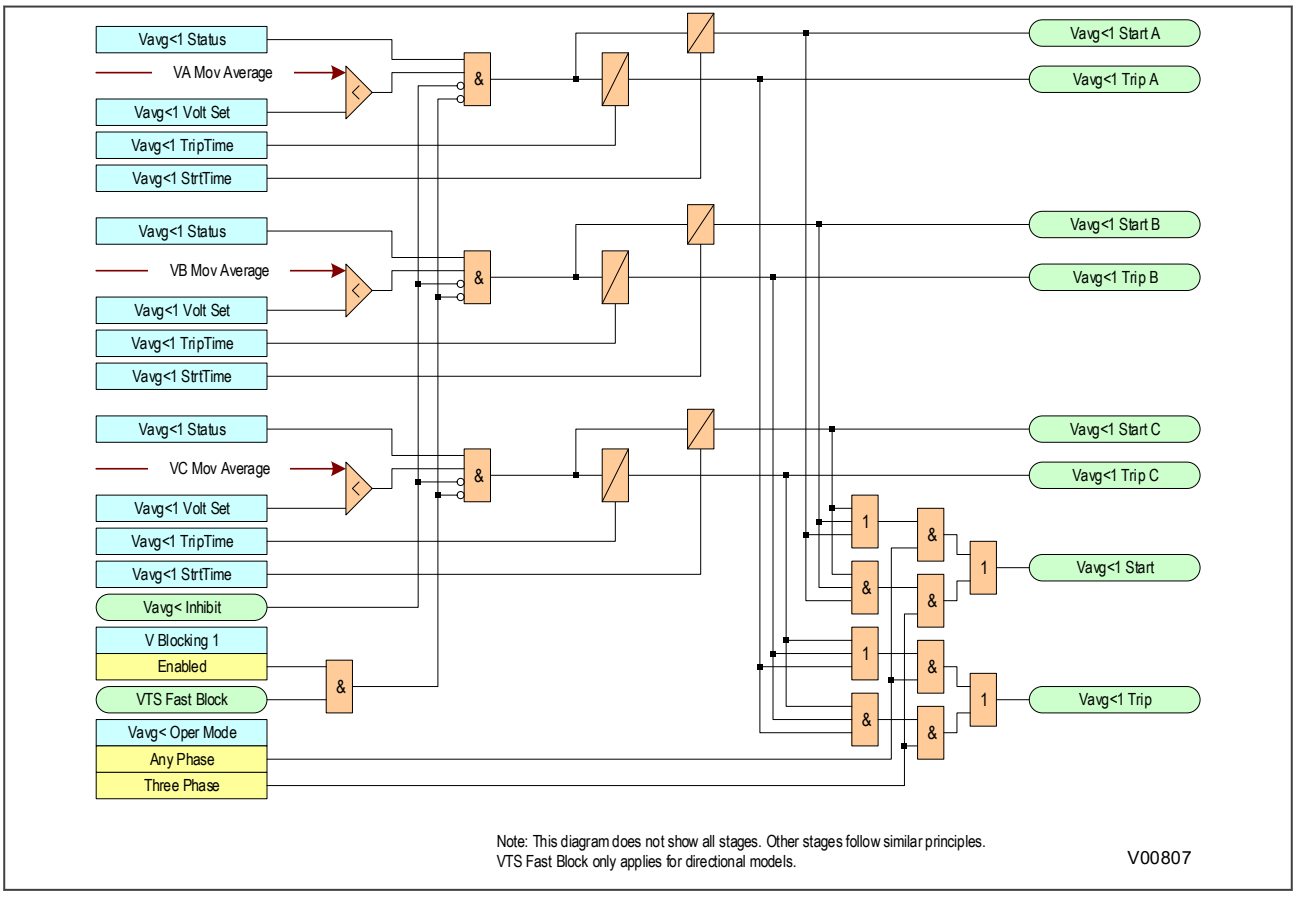


Figure 32: Moving Average undervoltage logic

9.2 MOVING AVERAGE OVERVOLTAGE LOGIC

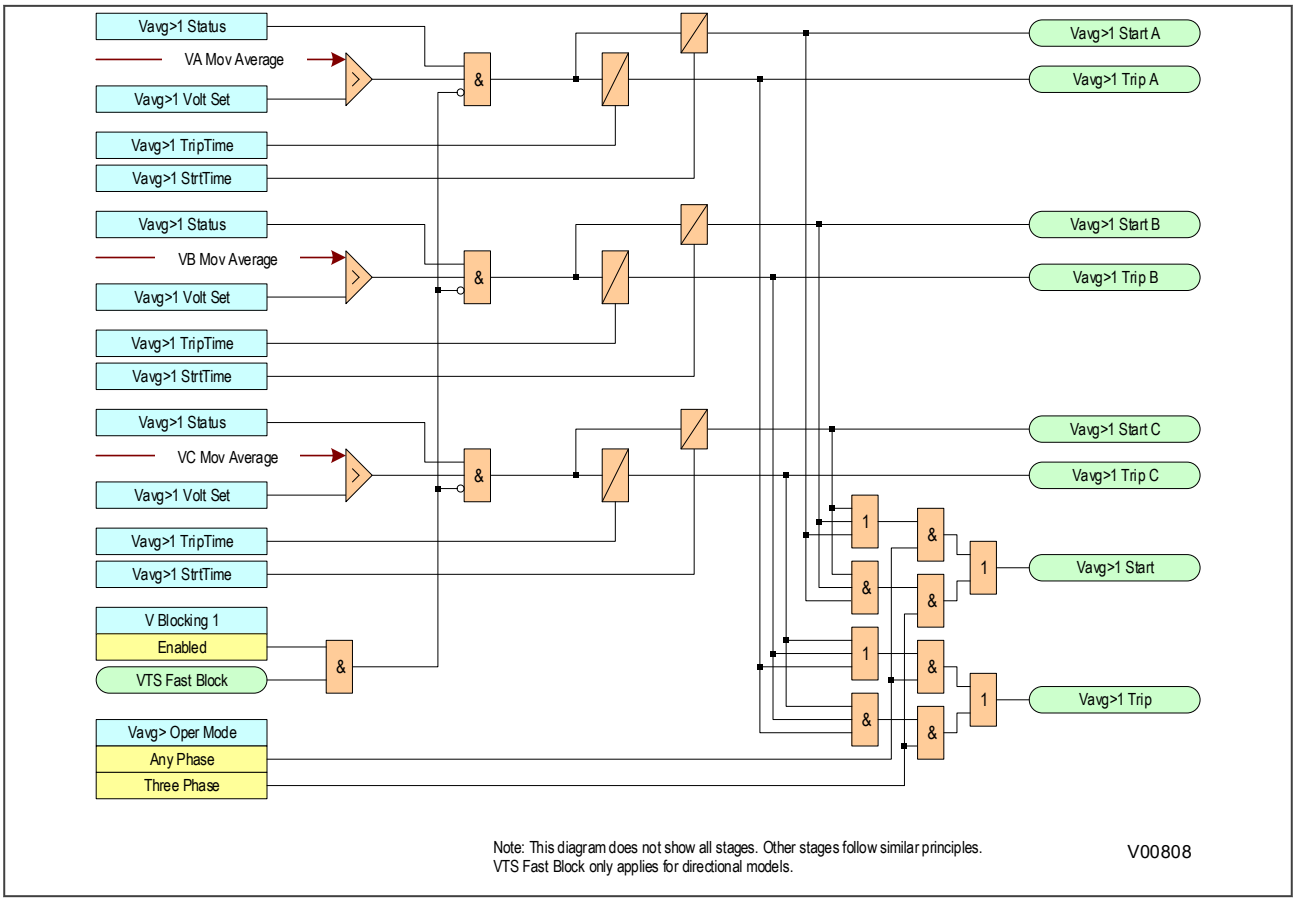


Figure 33: Moving Average overvoltage logic

9.3 MOVING AVERAGE ZERO SEQUENCE VOLTAGE LOGIC

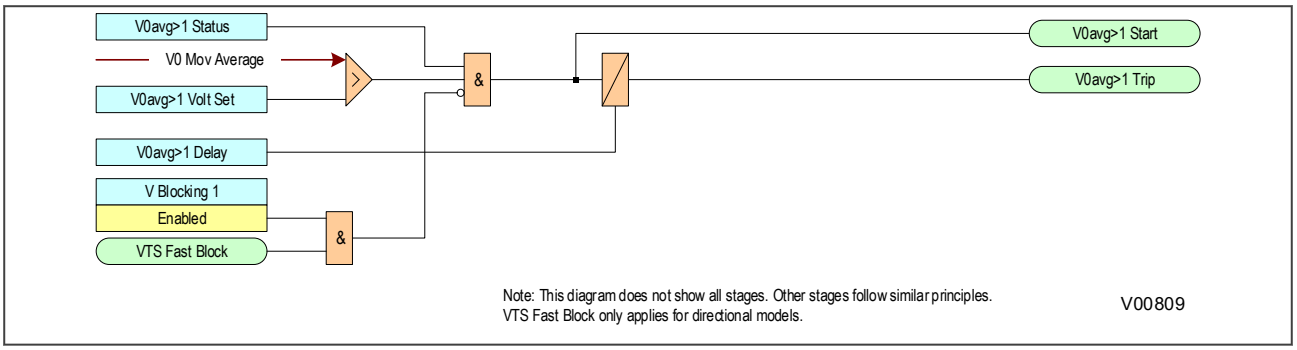


Figure 34: Moving Average zero sequence voltage logic

9.4 MOVING AVERAGE POSITIVE SEQUENCE VOLTAGE LOGIC

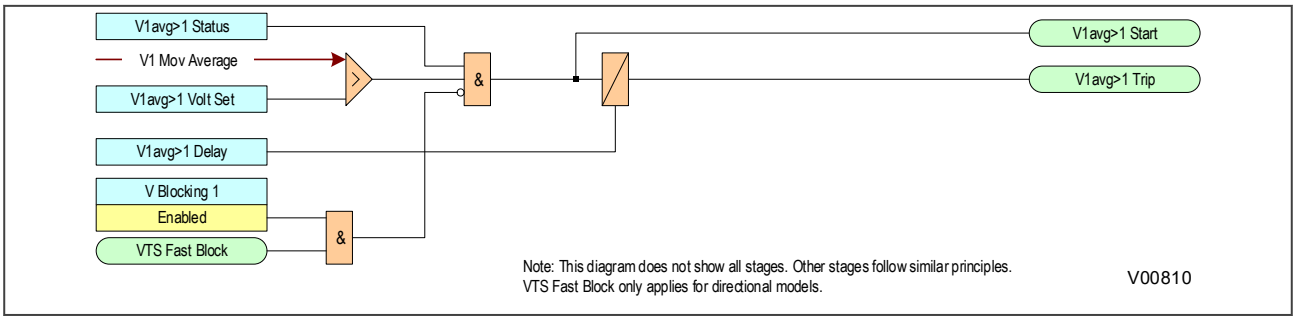


Figure 35: Moving Average positive sequence voltage logic

9.5 MOVING AVERAGE NEGATIVE SEQUENCE VOLTAGE LOGIC

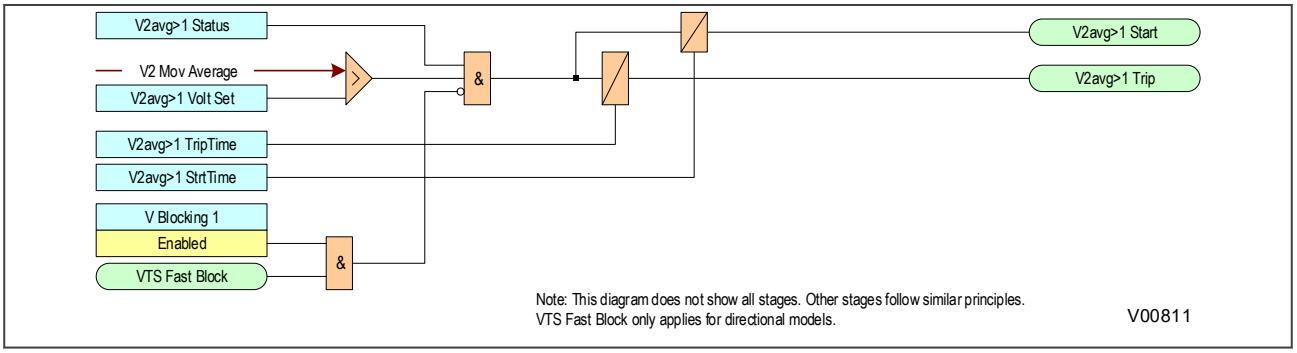


Figure 36: Moving Average negative sequence voltage logic

CHAPTER 7

FREQUENCY PROTECTION FUNCTIONS

1 CHAPTER OVERVIEW

The device provides a range of frequency protection functions. This chapter describes the operation of these functions including the principles, logic diagrams and applications.

This chapter contains the following sections:

Chapter Overview 99
Frequency Protection Overview 100
Underfrequency Protection 101
Overfrequency Protection 103
Independent R.O.C.O.F Protection 105
Frequency-supervised R.O.C.O.F Protection 107
Average Rate of Change of Frequency Protection 110
Load Shedding and Restoration 113

2 FREQUENCY PROTECTION OVERVIEW

Power generation and utilisation needs to be well balanced in any industrial, distribution or transmission network. These electrical networks are dynamic entities, with continually varying loads and supplies, which are continually affecting the system frequency. Increased loading reduces the system frequency and generation needs to be increased to maintain the frequency of the supply. Conversely decreased loading increases the system frequency and generation needs to be reduced. Sudden fluctuations in load can cause rapid changes in frequency, which need to be dealt with quickly.

Unless corrective measures are taken at the appropriate time, frequency decay can go beyond the point of no return and cause widespread network collapse, which has dire consequences.

Protection devices capable of detecting low frequency conditions are generally used to disconnect unimportant loads in order to re-establish the generation-to-load balance. However, with such devices, the action is initiated only after the event and this form of corrective action may not be effective enough to cope with sudden load increases that cause large frequency decays in very short times. In such cases a device that can anticipate the severity of frequency decay and act to disconnect loads before the frequency reaches dangerously low levels, are very effective in containing damage. This is called instantaneous rate of change of frequency protection (ROCOF).

During severe disturbances, the frequency of the system oscillates as various generators try to synchronise to a common frequency. The measurement of instantaneous rate of change of frequency can be misleading during such a disturbance. The frequency decay needs to be monitored over a longer period of time to make the correct decision for load shedding. This is called average rate of change of frequency protection.

Normally, generators are rated for a particular band of frequency. Operation outside this band can cause mechanical damage to the turbine blades. Protection against such contingencies is required when frequency does not improve even after load shedding steps have been taken. This type of protection can be used for operator alarms or turbine trips in case of severe frequency decay.

2.1 FREQUENCY PROTECTION IMPLEMENTATION

Frequency Protection is implemented in the *FREQ PROTECTION* column of the relevant settings group.

The device includes 9 stages for the following frequency protection methods:

- Underfrequency Protection: abbreviated to f+t<
- Overfrequency Protection: abbreviated to f+t>
- Independent Rate of Change of Frequency Protection: abbreviated to Independent R.O.C.O.F, or df/dt+t
- Frequency-supervised Rate of Change of Frequency Protection: abbreviated to Frequency-supervised R.O.C.O.F, or f+df/dt
- Average Rate of Change of Frequency Protection: abbreviated to Average R.O.C.O.F, or f+Df/Dt (note the uppercase 'D')
- Load Shedding and Restoration

Each stage can be disabled or enabled with the ***Stage (n)*** setting. The frequency protection can also be blocked by an undervoltage condition if required.

3 UNDERFREQUENCY PROTECTION

A reduced system frequency implies that the net load is in excess of the available generation. Such a condition can arise, when an interconnected system splits, and the load left connected to one of the subsystems is in excess of the capacity of the generators in that particular subsystem. Industrial plants that are dependent on utilities to supply part of their loads will experience underfrequency conditions when the incoming lines are lost.

Many types of industrial loads have limited tolerances on the operating frequency and running speeds (e.g. synchronous motors). Sustained underfrequency has implications on the stability of the system, whereby any subsequent disturbance may damage equipment and even lead to blackouts. It is therefore essential to provide protection for underfrequency conditions.

3.1 UNDERFREQUENCY PROTECTION IMPLEMENTATION

The following settings are relevant for underfrequency:

- ***Stg (n) f+t Status***: determines whether the stage is underfrequency, overfrequency, or disabled
- ***Stg (n) f+t Freq***: defines the frequency pickup setting
- ***Stg (n) f+t Time***: sets the time delay

3.2 UNDERFREQUENCY PROTECTION LOGIC

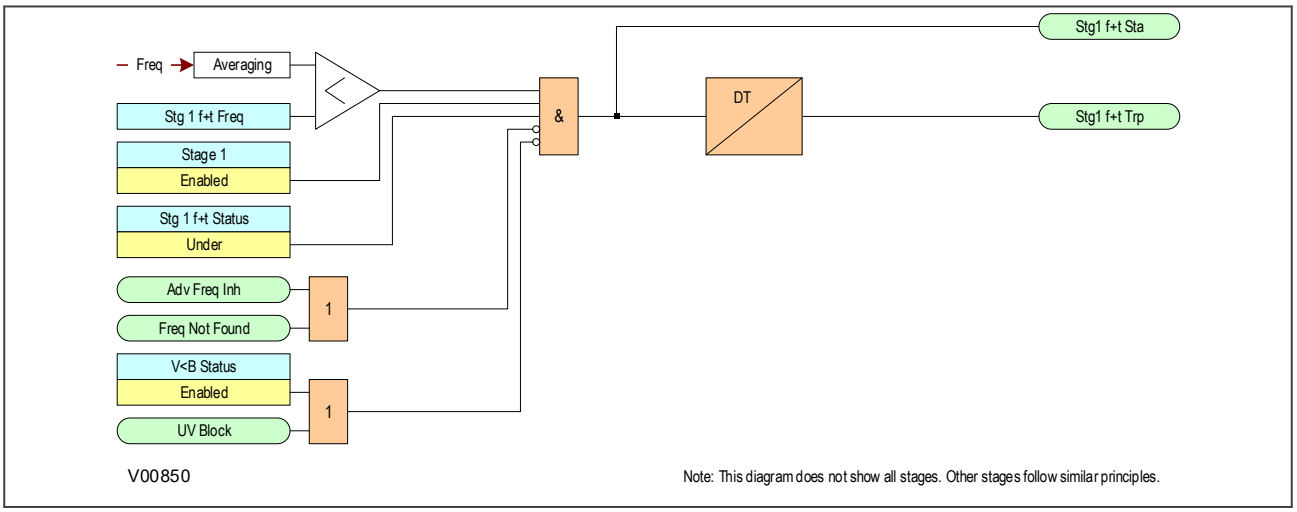


Figure 37: Underfrequency logic (single stage)

If the frequency is below the setting and not blocked the DT timer is started. If the frequency cannot be determined, the function is blocked.

3.3 APPLICATION NOTES

3.3.1 SETTING GUIDELINES

In order to minimise the effects of underfrequency, a multi-stage load shedding scheme may be used with the plant loads prioritised and grouped. During an underfrequency condition, the load groups are disconnected sequentially, with the highest priority group being the last one to be disconnected.

The effectiveness of each load shedding stage depends on the proportion of power deficiency it represents. If the load shedding stage is too small compared with the prevailing generation deficiency, then there may be no improvement in the frequency. This should be taken into account when forming the load groups.

Time delays should be sufficient to override any transient dips in frequency, as well as to provide time for the frequency controls in the system to respond. These should not be excessive as this could jeopardize system stability. Time delay settings of 5 - 20 s are typical.

An example of a four-stage load shedding scheme for 50 Hz systems is shown below:

Stage	Element	Frequency Setting (Hz)	Time Setting (Sec)
1	Stage 1(f+t)	49.0	20 s
2	Stage 2(f+t)	48.6	20 s
3	Stage 3(f+t)	48.2	10 s
4	Stage 4(f+t)	47.8	10 s

The relatively long time delays are intended to provide sufficient time for the system controls to respond. This will work well in a situation where the decline of system frequency is slow. For situations where rapid decline of frequency is expected, this load shedding scheme should be supplemented by rate of change of frequency protection elements.

4 OVERFREQUENCY PROTECTION

An increased system frequency arises when the mechanical power input to a generator exceeds the electrical power output. This could happen, for instance, when there is a sudden loss of load due to tripping of an outgoing feeder from the plant to a load centre. Under such conditions, the governor would normally respond quickly to obtain a balance between the mechanical input and electrical output, thereby restoring normal frequency. Overfrequency protection is required as a backup to cater for cases where the reaction of the control equipment is too slow.

4.1 OVERFREQUENCY PROTECTION IMPLEMENTATION

The following settings are relevant for overfrequency:

- ***Stg (n) f+t Status***: determines whether the stage is underfrequency, overfrequency, or disabled
- ***Stg (n) f+t Freq***: defines the frequency pickup setting
- ***Stg (n) f+t Time***: sets the time delay

4.2 OVERFREQUENCY PROTECTION LOGIC

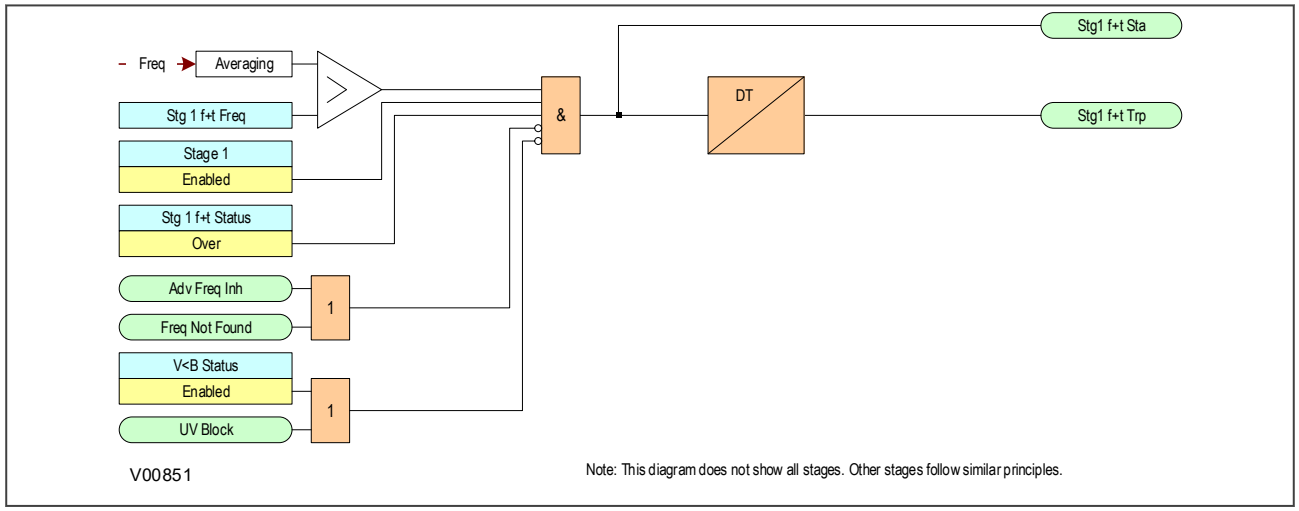


Figure 38: Overfrequency logic (single stage)

If the frequency is above the setting and not blocked, the DT timer is started and after this has timed out, the trip is produced. If the frequency cannot be determined, the function is blocked.

4.3 APPLICATION NOTES

4.3.1 SETTING GUIDELINES

Following changes on the network caused by faults or other operational requirements, it is possible that various subsystems will be formed within the power network. It is likely that these subsystems will suffer from a generation/load imbalance. The "islands" where generation exceeds the existing load will be subject to overfrequency conditions. Severe over frequency conditions may be unacceptable to many industrial loads, since running speeds of motors will be affected. The overfrequency element can be suitably set to sense this contingency.

An example of two-stage overfrequency protection is shown below using stages 5 and 6 of the f+t elements. However, settings for a real system will depend on the maximum frequency that equipment can tolerate for a given period of time.

Stage	Element	Frequency Setting (Hz)	Time Setting (Sec.)
1	Stage 5(f+t)	50.5	30
2	Stage 6(f+t)	51.0	20

The relatively long time delays are intended to provide time for the system controls to respond and will work well in a situation where the increase of system frequency is slow.

For situations where rapid increase of frequency is expected, the protection scheme above could be supplemented by rate of change of frequency protection elements.

In the system shown below, the generation in the MV bus is sized according to the loads on that bus, whereas the generators linked to the HV bus produce energy for export to utility. If the links to the grid are lost, the generation will cause the system frequency to rise. This rate of rise could be used to isolate the MV bus from the HV system.

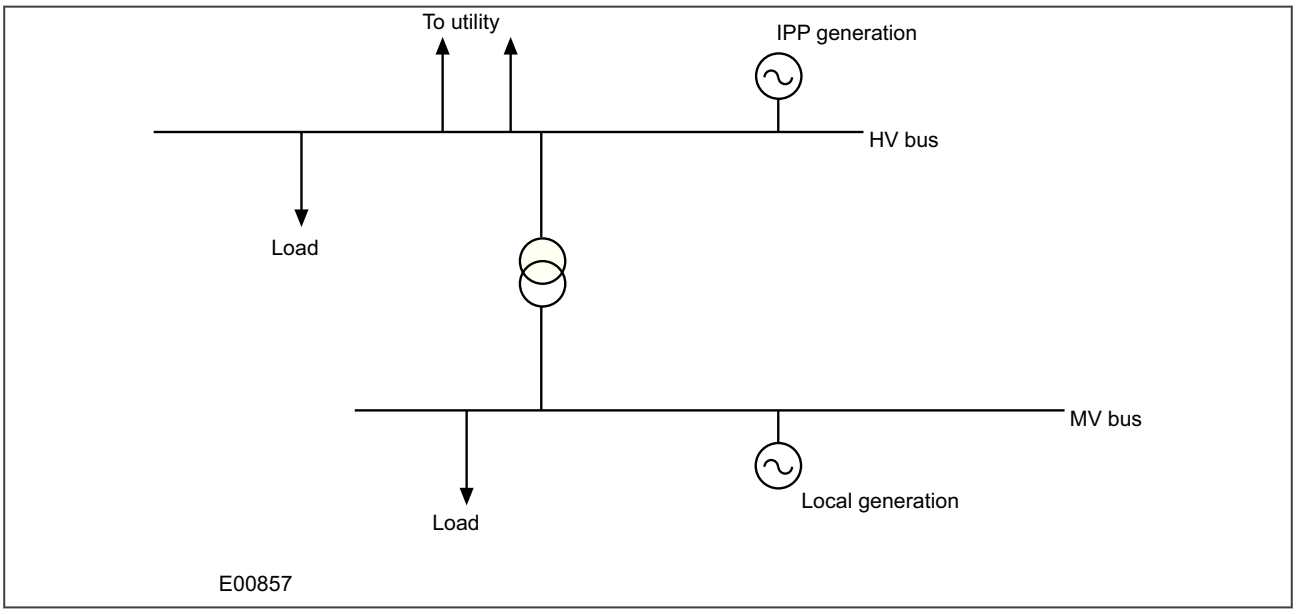


Figure 39: Power system segregation based upon frequency measurements

5 INDEPENDENT R.O.C.O.F PROTECTION

Where there are very large loads, imbalances may occur that result in rapid decline in system frequency. The situation could be so bad that shedding one or two stages of load is unlikely to stop this rapid frequency decline. In such a situation, standard underfrequency protection will normally have to be supplemented with protection that responds to the rate of change of frequency. An element is therefore required which identifies the high rate of decline of frequency, and adapts the load shedding scheme accordingly.

Such protection can identify frequency variations occurring close to nominal frequency thereby providing early warning of a developing frequency problem. The element can also be used as an alarm to warn operators of unusually high system frequency variations.

5.1 INDEPENENT R.O.C.O.F PROTECTION IMPLEMENTATION

The device provides nine independent stages of protection. Each stage can respond to either rising or falling frequency conditions. This depends on whether the frequency threshold is set above or below the system nominal frequency. For example, if the frequency threshold is set above nominal frequency, the rate of change of frequency setting is considered as positive and the element will operate for rising frequency conditions. If the frequency threshold is set below nominal frequency, the setting is considered as negative and the element will operate for falling frequency conditions.

The following settings are relevant for df/dt+t protection:

- ***df/dt+t (n) Status***: determines whether the stage is for falling or rising frequency conditions
- ***df/dt+t (n) Set***: defines the rate of change of frequency pickup setting
- ***df/dt+t (n) Time***: sets the time delay

5.2 INDEPENDENT R.O.C.O.F PROTECTION LOGIC

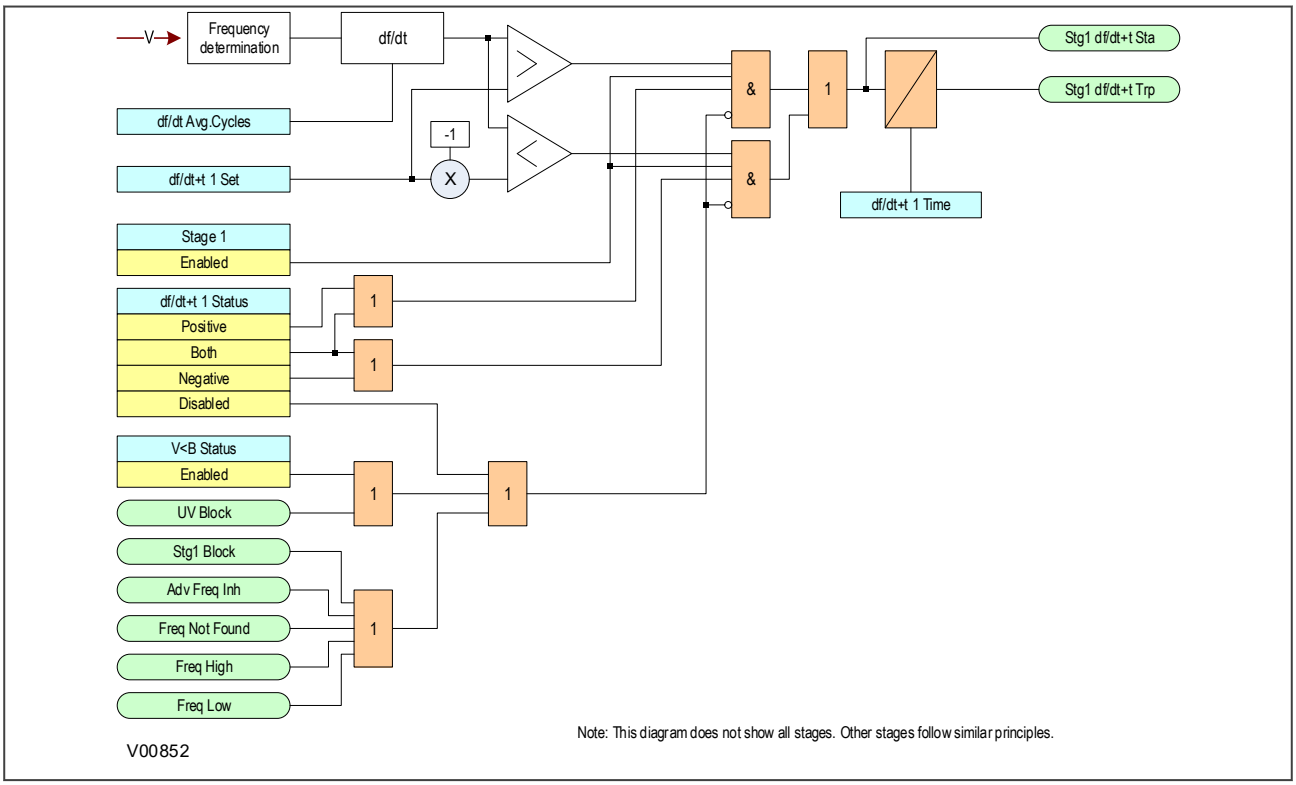


Figure 40: Independent rate of change of frequency logic (single stage)

5.3 APPLICATION NOTES

5.3.1 SETTING GUIDELINES

Considerable care should be taken when setting this element because it is not supervised by a frequency setting. Setting of the time delay or increasing the number of df/dt averaging cycles will improve stability but this is traded against reduced tripping times.

It is likely that this element would be used in conjunction with other frequency based protection elements to provide a scheme that accounts for severe frequency fluctuations. An example scheme is shown below:

	Frequency "f+t [81U/81O]" Elements		Frequency Supervised Rate of Change of Frequency "f+df/dt [81RF]" Elements	
Stage	Frequency Setting (Hz)	Time Setting (Sec.)	Frequency Setting (Hz)	Rate of Change of Frequency Setting (Hz/ Sec.)
1	49	20	49.2	1.0
2	48.6	20	48.8	1.0
3	48.2	10	48.4	1.0
4	47.8	10	48.0	1.0
5	-	-	-	-

Stage	Rate of Change of Frequency "df/dt+t [81R]" Elements	
	Rate of Change of Frequency Setting (Hz/Sec.)	Time Setting (Sec.)
1	-	-
2	-	-
3	-3.0	0.5
4	-3.0	0.5
5	-3.0	0.1

In this scheme, tripping of the last two stages is accelerated by using the independent rate of change of frequency element. If the frequency starts falling at a high rate (> 3 Hz/s in this example), then stages 3 & 4 are shed at around 48.5 Hz, with the objective of improving system stability. Stage 5 serves as an alarm and gives operators advance warning that the situation is critical.

6 FREQUENCY-SUPERVISED R.O.C.O.F PROTECTION

Frequency-supervised Rate of Change of Frequency protection works in a similar way to Independent Rate of change of Frequency Protection. The only difference is that with frequency supervision, the actual frequency itself is monitored and the protection operates when both the rate of change of frequency AND the frequency itself go outside the set limits.

Frequency-supervised Rate of Change of Frequency protection is also known as f+df/dt protection.

6.1 FREQUENCY-SUPERVISED R.O.C.O.F IMPLEMENTATION

The device provides nine independent stages of protection. Each stage can respond to either rising or falling frequency conditions. This depends on whether the frequency threshold is set above or below the system nominal frequency. For example, if the frequency threshold is set above nominal frequency, the rate of change of frequency setting is considered as positive and the element will operate for rising frequency conditions. If the frequency threshold is set below nominal frequency, the setting is considered as negative and the element will operate for falling frequency conditions.

The following settings are relevant for f+ df/dt protection:

- ***f+df/dt 1 Status***: determines whether the stage is for falling or rising frequency conditions
- ***f+df/dt 1 freq***: defines the frequency pickup setting
- ***f+df/dt 1 df/dt***: defines the rate of change of frequency pickup setting

The device will also indicate when an incorrect setting has been applied if the frequency threshold is set to the nominal system frequency. There is no intentional time delay associated with this element, but time delays could be applied using the PSL if required.

6.2 FREQUENCY-SUPERVISED R.O.C.O.F LOGIC

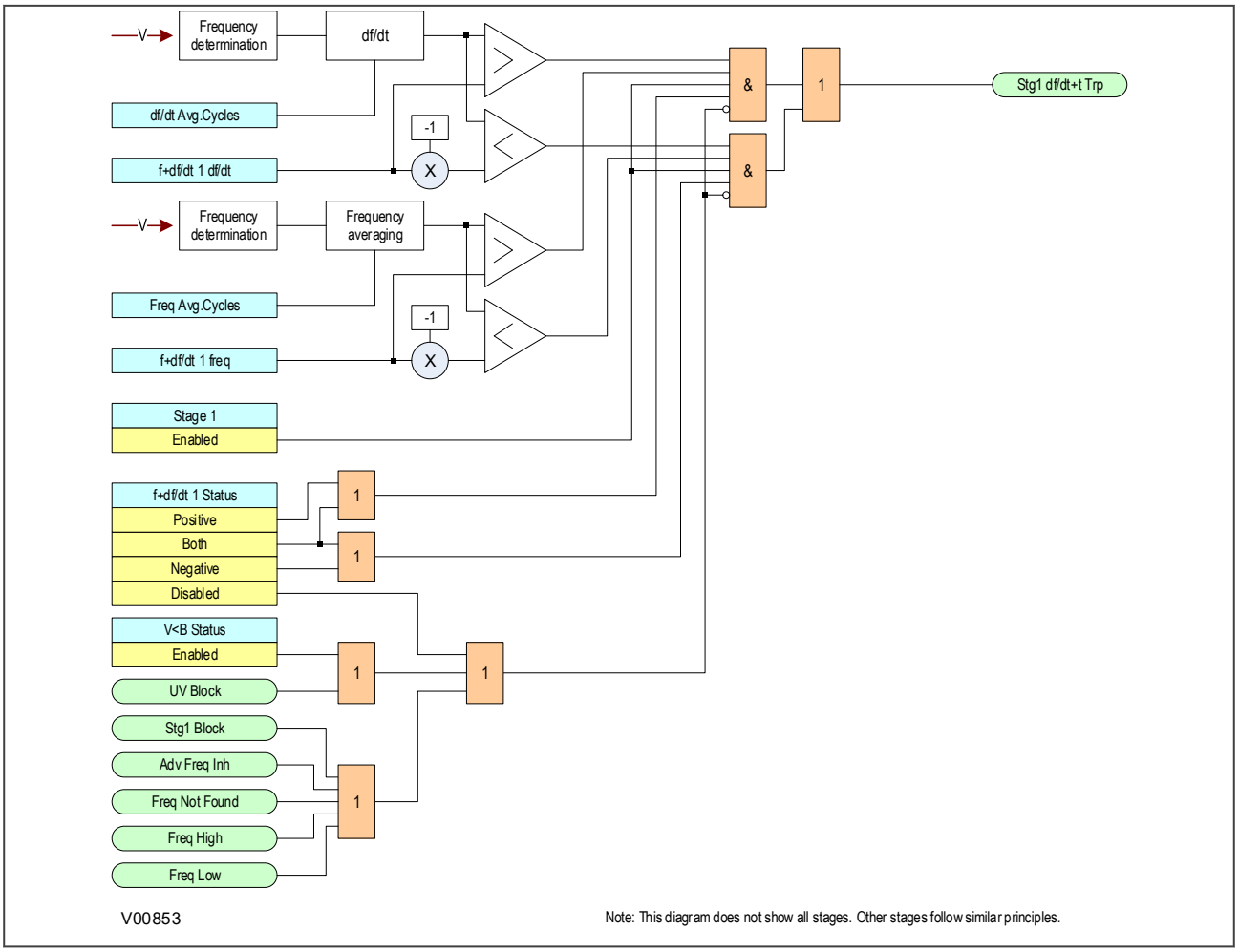


Figure 41: Frequency-supervised rate of change of frequency logic (single stage)

6.3 APPLICATION NOTES

6.3.1 FREQUENCY-SUPERVISED R.O.C.O.F EXAMPLE

In the load shedding scheme below, we assume that for falling frequency conditions, the system can be stabilised at frequency f2 by shedding a stage of load. For slow rates of decay, this can be achieved using the underfrequency protection element set at frequency f1 with a suitable time delay. However, if the generation deficit is substantial, the frequency will rapidly decrease and it is possible that the time delay imposed by the underfrequency protection will not allow for frequency stabilisation. In this case, the chance of system recovery will be enhanced by disconnecting the load stage based on a measurement of rate of change of frequency and bypassing the time delay.

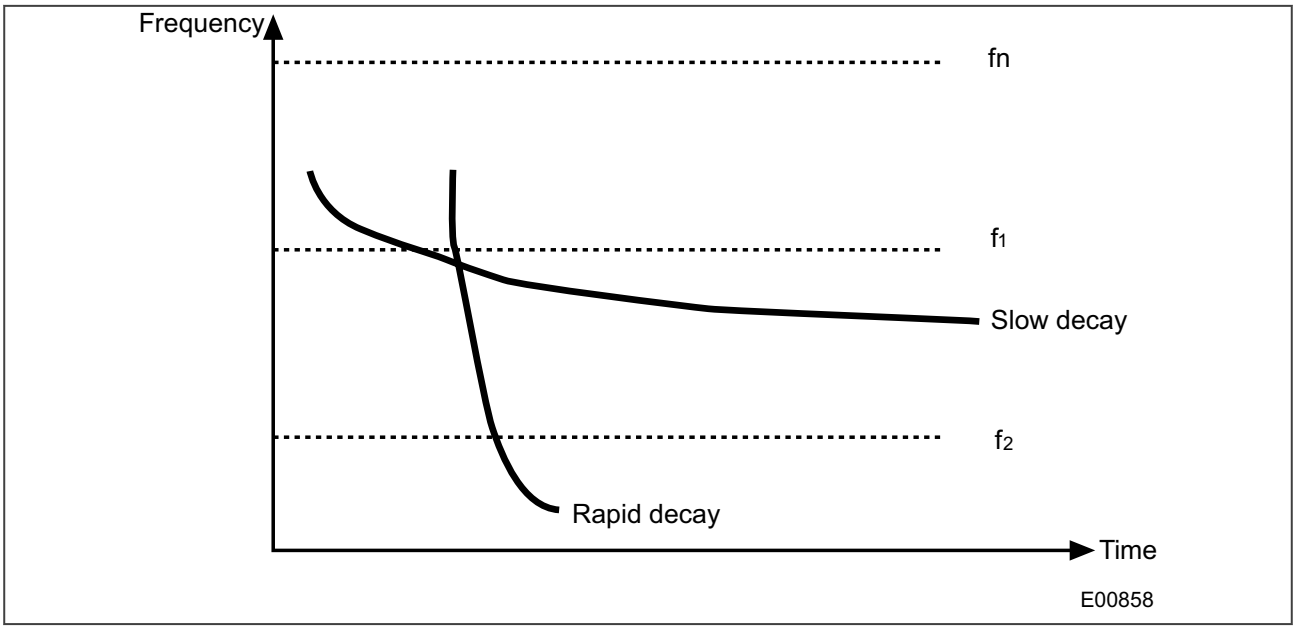


Figure 42: Frequency supervised rate of change of frequency protection

6.3.2 SETTING GUIDELINES

We recommend that the frequency supervised rate of change of frequency protection (f+df/dt) element be used in conjunction with the time delayed frequency protection (f+t) elements.

A four stage high speed load shedding scheme may be configured as indicated below, noting that in each stage, both the "f+t" and the "f+df/dt" elements are enabled.

	Frequency "f+t [81U/81O]" Elements		Frequency Supervised Rate of Change of Frequency "f+df/dt [81RF]" Elements	
Stage	Frequency Setting (Hz)	Time Setting (Sec.)	Frequency Setting (Hz)	Rate of Change of Frequency Setting (Hz/sec.)
1	49	20	49	1.0
2	48.6	20	48.6	1.0
3	48.2	10	48.2	1.0
4	47.8	10	47.8	1.0

It may be possible to further improve the speed of load shedding by changing the frequency setting on the f+df/dt element. In the settings outlined below, the frequency settings for this element have been set slightly higher than the frequency settings for the f+t element. This difference will allow for the measuring time, and will result in the tripping of the two elements at approximately the same frequency value. Therefore, the slow frequency decline and fast frequency decline scenarios are independently monitored and optimised without sacrificing system security.

	Frequency "f+t [81U/81O]" Elements		Frequency Supervised Rate of Change of Frequency "f+df/dt [81RF]" Elements	
Stage	Frequency Setting (Hz)	Time Setting (Sec.)	Frequency Setting (Hz)	Rate of Change of Frequency Setting (Hz/sec.)
1	49	20	49.2	1.0
2	48.6	20	48.8	1.0
3	48.2	10	48.4	1.0
4	47.8	10	48.0	1.0

7 AVERAGE RATE OF CHANGE OF FREQUENCY PROTECTION

Owing to the complex dynamics of power systems, variations in frequency during times of generation-to-load imbalance are highly non-linear. Oscillations will occur as the system seeks to address the imbalance, resulting in frequency oscillations typically in the order of 0.1 Hz to 1 Hz, in addition to the basic change in frequency.

The independent and frequency-supervised rate of change of frequency elements use an instantaneous measurement of the rate of change of frequency, based on a 3-cycle, filtered, rolling average technique. Due to the oscillatory nature of frequency excursions, this instantaneous value can sometimes be misleading, either causing unexpected operation or excessive instability. For this reason, the device also provides an element for monitoring the longer term frequency trend, thereby reducing the effects of non-linearity in the system.

Average Rate of Change of Frequency protection is also known as f+Df/Dt protection (note the upper-case "D").

7.1 AVERAGE R.O.C.O.F PROTECTION IMPLEMENTATION

The device provides nine independent stages of average rate of change of frequency protection. Each stage can respond to either rising or falling frequency conditions. This depends on whether the frequency threshold is set above or below the system nominal frequency. For example, if the frequency threshold is set above nominal frequency, the rate of change of frequency setting is considered as positive and the element will operate for rising frequency conditions. If the frequency threshold is set below nominal frequency, the setting is considered as negative and the element will operate for falling frequency conditions.

When the measured frequency crosses the supervising frequency threshold, a timer is initiated. At the end of this time period, the frequency difference is evaluated and if this exceeds the setting, a trip output is given.

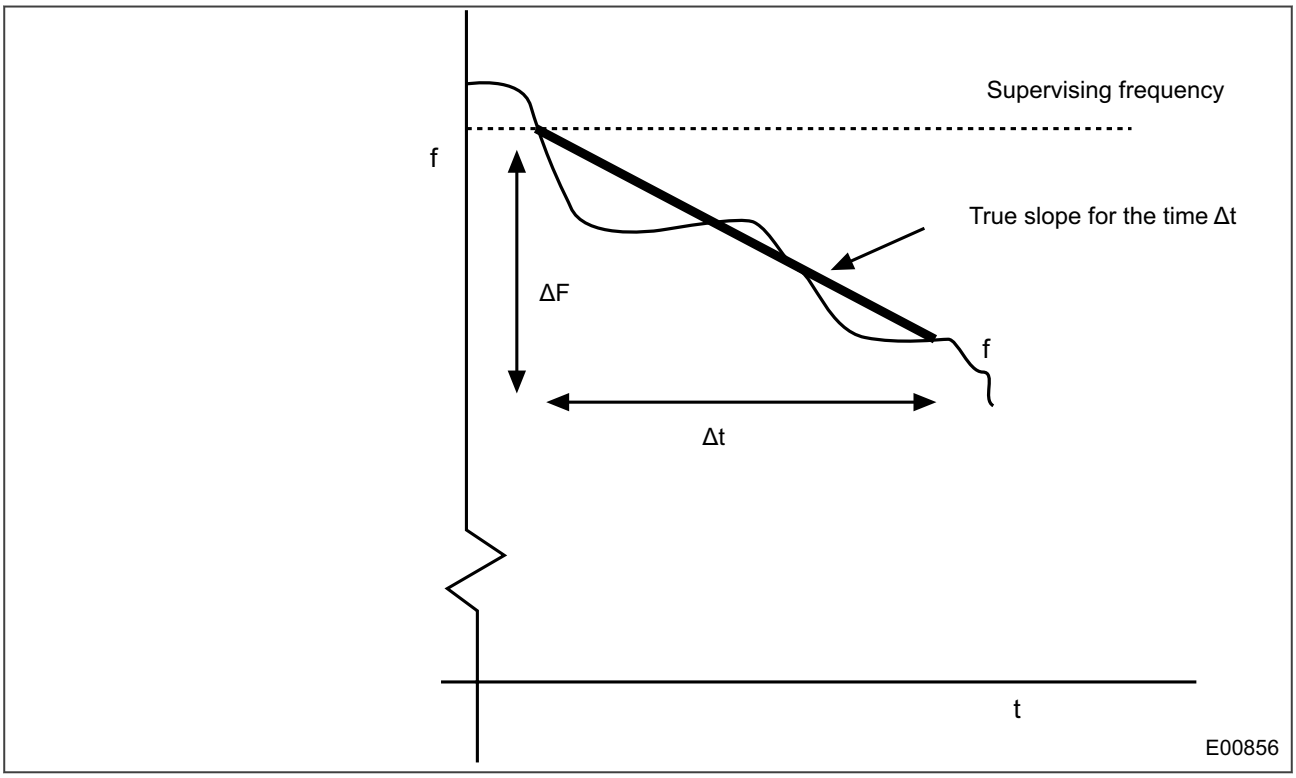


Figure 43: Average rate of change of frequency characteristic

After time Δt, the element is blocked from further operation until the frequency recovers to a value above the supervising frequency threshold. If the element has operated, the trip DDB signal will be ON until the frequency recovers to a value above the supervising frequency threshold.

The average rate of change of frequency is then measured based on the frequency difference, Δf over the settable time period, Δt.

The following settings are relevant for Df/Dt protection:

- ***f+Df/Dt (n) Status***: determines whether the stage is for falling or rising frequency conditions
- ***f+Df/Dt (n) Freq***: defines the frequency pickup setting
- ***f+Df/Dt (n) Dfreq***: defines the change in frequency that must be measured in a set time period
- ***f+Df/Dt (n) Dtime***: sets the time period over which the frequency is monitiored

7.2 AVERAGE R.O.C.O.F LOGIC

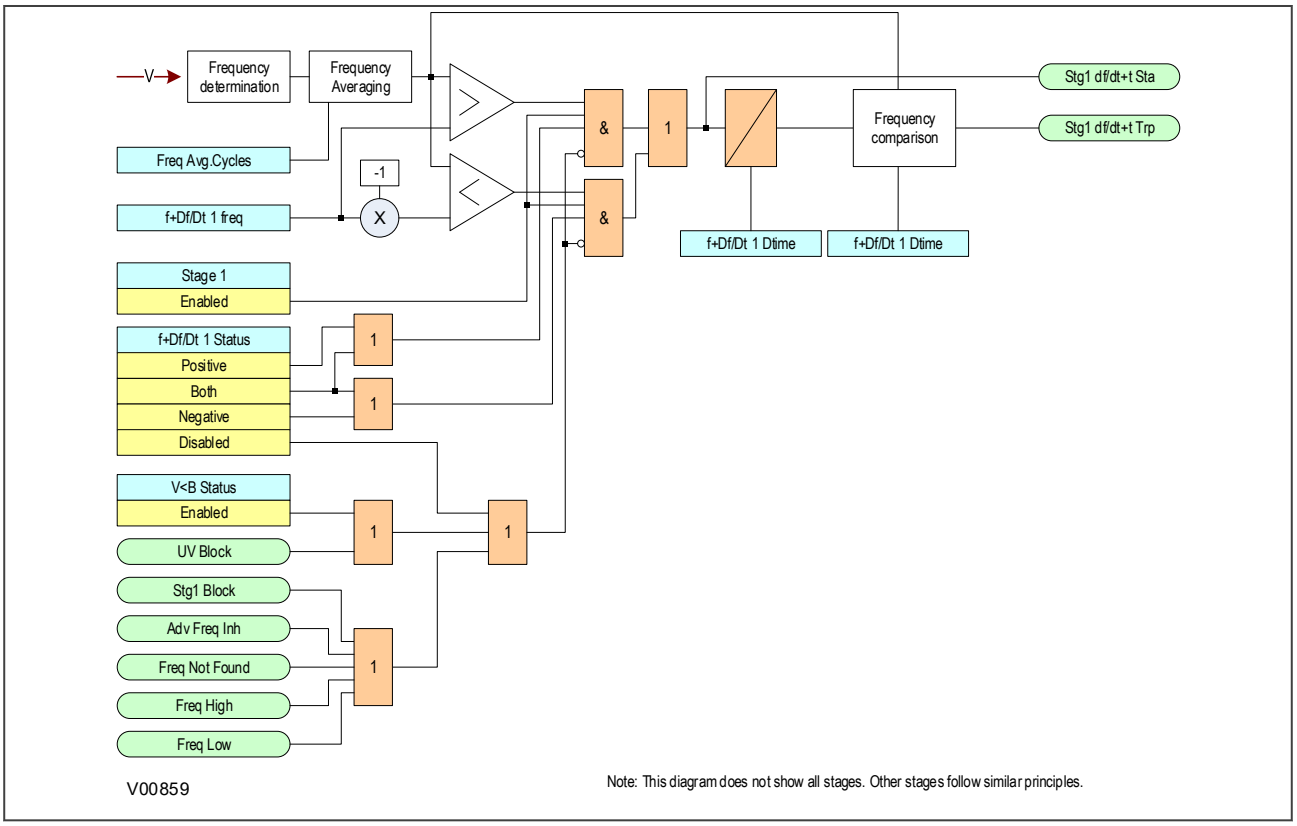


Figure 44: Average rate of change of frequency logic (single stage)

7.3 APPLICATION NOTES

7.3.1 SETTING GUIDELINES

The average rate of change of frequency element can be set to measure the rate of change over a short period as low as 20 ms (1 cycle @ 50 Hz) or a relatively long period up to 2 s (100 cycles @ 50 Hz). With a time setting, Dt, towards the lower end of this range, the element becomes similar to the frequency supervised rate of change function, "f+df/dt". With high Dt settings, the element acts as a frequency trend monitor.

Although the element has a wide range of setting possibilities we recommend that the Dt setting is set greater than 100 ms to ensure the accuracy of the element.

A possible four stage load shedding scheme using the average rate of change frequency element is shown in the following table:

	Frequency "f+t [81U/81O]" Elements		Average Rate of Change of Frequency "f+Df/Dt [81RAV]" Elements		
Stage	(f+t) f Frequency Setting (Hz)	(f+t) t Time Setting (Sec.)	(f+Df/Dt) f Frequency Setting (Hz)	(f+Df/Dt) Df Frequency Diff Setting, (Hz)	(f+Df/Dt) Dt Time Period, (Sec.)
1	49	20	49	0.5	0.5
2	48.6	20	48.6	0.5	0.5
3	48.2	10	48.2	0.5	0.5
4	47.8	10	47.8	0.5	0.5

In the above scheme, the faster load shed decisions are made by monitoring the frequency change over 500 ms. Therefore tripping takes place more slowly than in schemes employing frequency-supervised df/dt, but the difference is not very much at this setting. If the delay jeopardises system stability, then the scheme can be improved by increasing the independent "f" setting. Depending on how much this value is increased, the frequency at which the "f+Df/Dt" element will trip also increases and so reduces the time delay under more severe frequency fluctuations. For example, with the settings shown below, the first stage of load shedding would be tripped approximately 300 msecs after 49.0 Hz is reached and at a frequency of approximately 48.7 Hz.

	Frequency "f+t [81U/81O]" Elements		Average Rate of Change of Frequency "f+Df/Dt [81RAV]" Elements		
Stage	(f+t) f Frequency Setting (Hz)	(f+t) t Time Setting (Sec)	(f+Df/Dt) f Frequency Setting (Hz)	(f+Df/Dt) Df Frequency Diff Setting (Hz)	(f+Df/Dt) Dt Time Period, (Sec.)
1	49	20	49.2	0.5	0.5 s
2	48.6	20	48.8	0.5	0.5 s
3	48.2	10	48.4	0.5	0.5 s
4	47.8	10	48.0	0.5	0.5 s

8 LOAD SHEDDING AND RESTORATION

The goal of load shedding is to stabilise a falling system frequency. As the system stabilises and the generation capability improves, the system frequency will recover to near normal levels and after some time delay it is possible to consider the restoration of load onto the healthy system. However, load restoration needs to be performed carefully and systematically so that system stability is not jeopardized again.

In the case of industrial plants with captive generation, load restoration should be linked to the available generation since connecting additional load when the generation is still inadequate, will only result in declining frequency and more load shedding. If the in-plant generation is insufficient to meet the load requirements, then load restoration should be interlocked with recovery of the utility supply.

Whilst load shedding leads to an improvement in the system frequency, the disconnected loads need to be reconnected after the system is stable again. Loads should only be restored if the frequency remains stable for some period of time (minor frequency excursions can be ignored during this time period). The number of load restoration steps is normally less than the load shedding steps to reduce repeated disturbances while restoring load.

8.1 LOAD RESTORATION IMPLEMENTATION

The device uses the measurement of system frequency as the main criteria for load restoration. For each stage of load restoration, it is necessary that the same stage of load shedding has occurred previously and that no elements within that stage are configured for overfrequency or rising frequency conditions. If load shedding has not previously occurred, the load restoration for that stage is inactive.

The device provides nine independent stages of Load Restoration. It is implemented in the *FREQ PROTECTION* column of the relevant settings group. The following settings are relevant for Load Restoration:

- ***Restore(n) Status***: determines whether the stage is disabled or enabled
- ***Restore(n) Freq***: defines the frequency pickup setting
- ***Restore(n) Time***: Timer period for which the measured frequency must be higher than the stage restoration.
- ***Holding Timer***: Sets the holding timer value

8.2 HOLDING BAND

Load restoration for a given stage begins when the system frequency rises above the ***Restore(n) Freq*** setting for that stage and the stage restoration timer ***Restore(n) Time*** is initiated. If the system frequency remains above the frequency setting for the set time delay, load restoration of that stage will be triggered.

Unfortunately, frequency recovery profiles are highly non-linear and it would be reasonably common for the system frequency to fall transiently below the restoration frequency threshold. If the restoration timer immediately reset whenever a frequency dip occurred, it is likely that load restoration would never be successful. For this reason, the protection has a "holding band". This holding band is a region defined by the restoration frequency and the highest frequency setting used in the load shedding elements for that stage. The difference between these two settings must always be greater than 0.02 Hz, otherwise a ***Wrong Setting*** alarm will be generated. Whenever the system frequency dips into the holding band, operation of the stage restoration timer is suspended until the frequency rises above the restoration frequency setting, at which point timing will continue. If the system frequency dip is sufficiently large to cause any frequency element to start or trip in this stage, i.e. if the frequency falls below the lower limit of the holding band, the restoration timer will immediately be reset. This is demonstrated below.

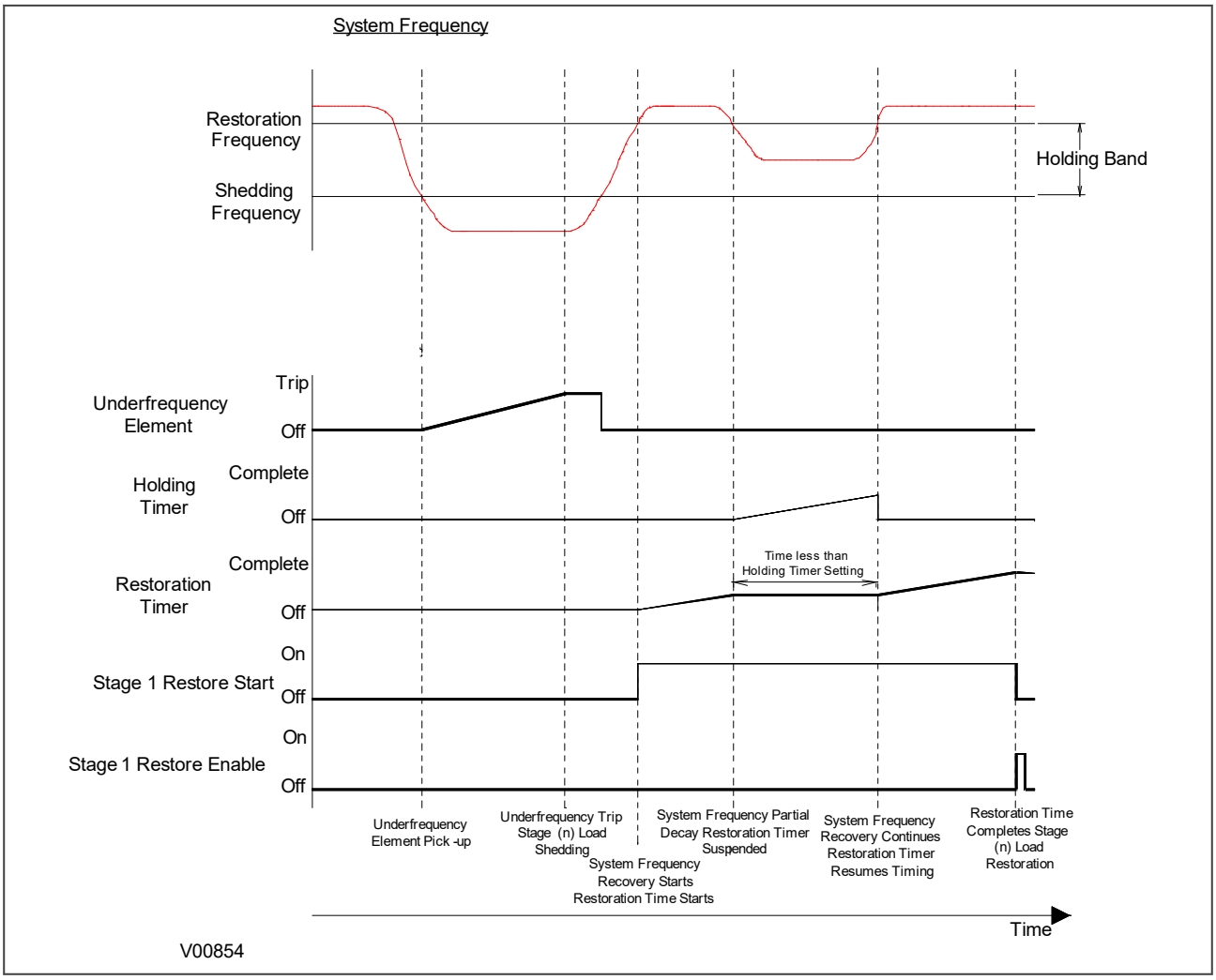


Figure 45: Load restoration with short deviation into holding band

If the system frequency remains in the holding band for too long it is likely that other system frequency problems are occurring and it would be prudent to reset the restoration timer for that stage. For this reason, as soon as the system frequency is measured to be within the holding band, the "Holding Timer" is initiated. If the system frequency doesn't leave the holding band before the holding timer setting has been exceeded, the load restoration time delay for that stage is immediately reset.

Note:
The holding timer has a common setting for all stages of load restoration.

An example of the case when the time in the holding band is excessive is shown below.

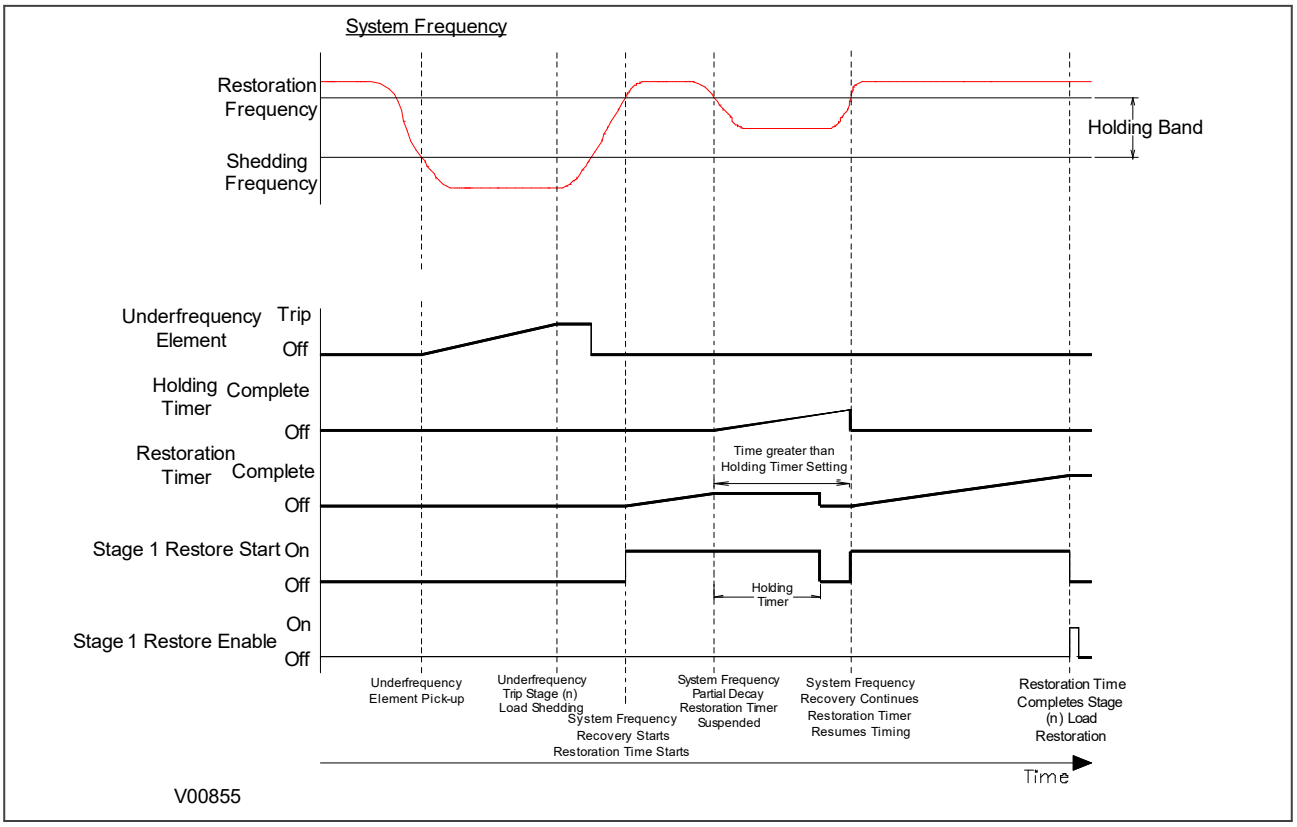


Figure 46: Load restoration with long deviation into holding band

8.3 LOAD RESTORATION LOGIC

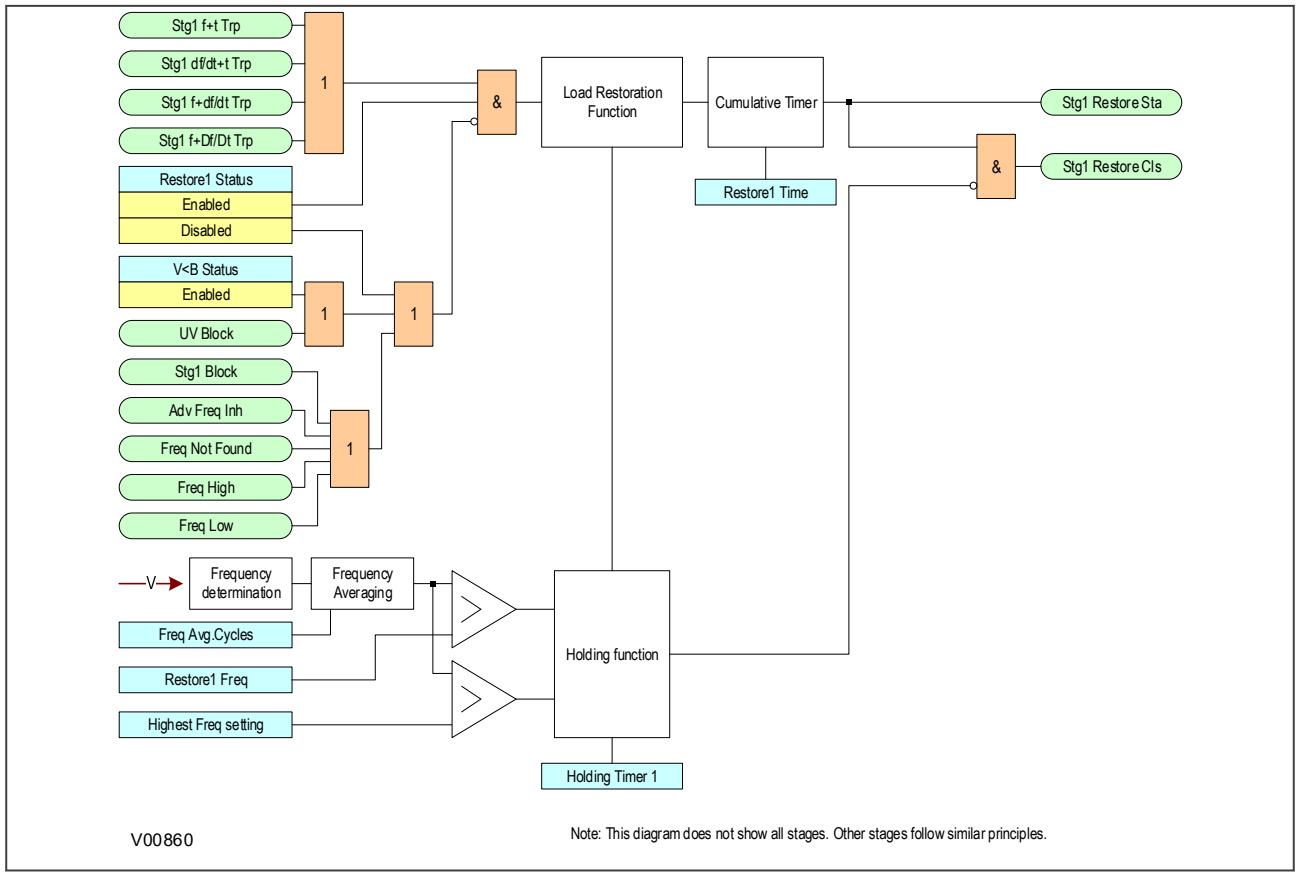


Figure 47: Load Restoration logic

8.4 APPLICATION NOTES

8.4.1 SETTING GUIDELINES

A four stage, single frequency load restoration scheme is shown below. The frequency setting has been chosen such that there is sufficient separation between the highest load shed frequency and the restoration frequency to prevent any possible hunting. A restoration frequency setting closer to nominal frequency may be chosen if an operating frequency of 49.3 Hz is unacceptable.

Stage	Restoration Frequency Setting (Hz)	Restoration Time Delay (secs)	Holding Time Delay (secs)
1	49.3 Hz	240 sec	20 sec
2	49.3 Hz	180 sec	20 sec
3	49.3 Hz	120 sec	20 sec
4	49.3 Hz	60 sec	20 sec

In this scheme, the time delays ensure that the most critical loads are reconnected (assuming that the higher stages refer to more important loads). By restoring the load sequentially, system stability should normally be maintained. These time settings are system dependent; higher or lower settings may be required depending on the particular application.

It is possible to set up restoration schemes involving multiple frequencies. This allows faster restoration of loads, but there is the possibility of continuous system operation at frequencies far removed from the nominal. A typical scheme using two frequencies is illustrated below:

Stage	Restore Freq. Restoration Frequency Setting (Hz)	Restore DelayRestoration Time Delay (S)	Holding Time Delay (S)
1	49.5 Hz	120 sec	20 sec
2	49.5 Hz	60 sec	20 sec
3	49.0 Hz	120 sec	20 sec
4	49.0 Hz	60 sec	20 sec

Staggered time settings may be used in this scheme as well, but the time separation among the restoration of stages will be a function of the frequency recovery pattern. Time coordinated restoration can only be guaranteed for those stages with a common restoration frequency setting.

CHAPTER 8

AUTORECLOSE

1 CHAPTER OVERVIEW

Selected models of this product provide sophisticated Autoreclose (AR) functionality. The purpose of this chapter is to describe the operation of this functionality including the principles, logic diagrams and applications.

This chapter contains the following sections:

Chapter Overview 121
Introduction to 3-phase Autoreclose 122
Implementation 123
Autoreclose Function Inputs 124
Autoreclose Function Outputs 127
Autoreclose Function Alarms 129
Autoreclose Operation 130
Setting Guidelines 146

2 INTRODUCTION TO 3-PHASE AUTORECLOSE

It is known that approximately 80 - 90% of faults are transient in nature. This means that most faults do not last long and are self-clearing. A common example of a transient fault is an insulator flashover, which may be caused for example by lightning, clashing conductors or wind-blown debris.

A transient fault, such as an insulator flashover, is a self-clearing 'non-damage' fault. The flashover will cause one or more circuit breakers to trip, but it may also have the effect of clearing the fault. If the fault clears itself, the fault does not recur when the line is re-energised.

The remaining 10 – 20% of faults are either semi-permanent or permanent. A small tree branch falling on the line could cause a semi-permanent fault. Here the cause of the fault would not be removed by the immediate tripping of the circuit, but could be burnt away during a time-delayed trip. Permanent faults could be broken conductors, transformer faults, cable faults or machine faults, which must be located and repaired before the supply can be restored.

In the majority of fault incidents, if the faulty line is immediately tripped out, and time is allowed for the fault arc to deionise, reclosure of the circuit breakers will result in the line being successfully re-energised.

Autoreclose schemes are used to automatically reclose a circuit breaker a set time after it has been opened due to operation of a protection element.

On HV/MV distribution networks, autoreclosing is applied mainly to radial feeders, where system stability problems do not generally arise. The main advantages of using Autoreclose are:

- Minimal interruption in supply to the consumer
- Reduction of operating costs - fewer man hours in repairing fault damage and the possibility of running unattended substations
- With Autoreclose, instantaneous protection can be used which means shorter fault durations. This in turn means less fault damage and fewer permanent faults

Autoreclosing provides an important benefit on circuits using time-graded protection, in that it allows the use of instantaneous protection to provide a high speed first trip. With fast tripping, the duration of the power arc resulting from an overhead line fault is reduced to a minimum. This lessens the chance of damage to the line, which might otherwise cause a transient fault to develop into a permanent fault. Using instantaneous protection also prevents blowing of fuses in teed feeders, as well as reducing circuit breaker maintenance by eliminating pre-arc heating.

When instantaneous protection is used with autoreclosing, the scheme is normally arranged to block the instantaneous protection after the first trip. Therefore, if the fault persists after re-closure, the time-graded protection will provide discriminative tripping resulting in the isolation of the faulted section. However, for certain applications, where the majority of the faults are likely to be transient, it is common practise to allow more than one instantaneous trip before the instantaneous protection is blocked.

Some schemes allow a number of re-closures and time-graded trips after the first instantaneous trip, which may result in the burning out and clearance of semi-permanent faults. Such a scheme may also be used to allow fuses to operate in teed feeders where the fault current is low.

When considering feeders that are partly overhead line and partly underground cable, any decision to install auto-reclosing should be subject to analysis of the data (knowledge of the frequency of transient faults). This is because this type of arrangement probably has a greater proportion of semi-permanent and permanent faults than for purely overhead feeders. In this case, the advantages of autoreclosing are small. It can even be disadvantageous because re-closing on to a faulty cable is likely to exacerbate the damage.

3 IMPLEMENTATION

Autoreclose functionality is a software option, which is selected when ordering the device, so this description only applies to models with this option.

The P94V does not have any CT inputs, therefore Autoreclose cannot be initiated by an internal current protection function. It can only be initiated by an external signal originating from another device such as a P14N, P14D, or P14x. In this case, the relevant opto-input would be mapped to the DDB signal ***Ext AR Prot Strt*** and ***Ext AR Prot Trip***.

The Autoreclose function for P40Agile products with current protection (P14D and P14N) can be started by their internal SEF protection function which produces an internal SEF Protection Start signal and an internal SEF Protection Trip signal. These in turn are used to drive internal AR SEF logic. There is one external DDB signal associated with the SEF logic, which is the Block SEF Protection DDB signal (***AR Blk SEF***).

The P94V does not provide SEF protection, therefore cannot provide internal SEF protection Start and Trip signals. However, it is highly desirable to a) keep the Autoreclose internal logic identical to the other products in the range, and b) continue providing the ***AR Blk SEF*** DDB signal in case it needs to be used externally. This allows the device to be used as an independent Autoreclose device, which can interact with all Alstom products without any reduction of functionality.

For these reasons, the P94V provides two additional DDB signals - ***Ext AR SEF Start*** and ***Ext AR SEF Trip***. These external signals can start and trip the internal AR SEF logic, which can consequently produce an ***AR Blk SEF*** DDB signal. This signal is therefore available for sending to an external device or feeding back to the initiating device, if so desired.

The Autoreclose-specific settings are contained in the *AUTORECLOSE* column. In addition to the settings contained in this column, the Autoreclose function may also need some settings in other columns such as *CB CONTROL* and *SYSTEM CHECKS*, as well as in the blocking cells of relevant protection columns.

The Autoreclose function can be set to perform a single-shot, two-shot, three-shot or four-shot cycle. You select this by the ***Number of Shots*** cell in the *AUTORECLOSE* column. You can also initiate a separate Autoreclose cycle for the SEF protection, with a different number of shots, selected by the ***Number SEF Shots*** cell. Dead times for all shots can be adjusted independently.

The dead time starts in one of two cases; when the circuit breaker has tripped, or when the protection has reset. You select which method with the ***Start Dead t On*** setting.

At the end of the relevant dead time, a ***CB close 3ph*** signal is given, providing it is safe for the circuit breaker to close. This is determined by checking that certain system conditions are met as specified by the **System *Checks*** functionality.

It is safe to close the circuit breaker providing that:

- only one side of the circuit breaker is live (either dead line / live bus, or live line / dead bus), or
- if both bus and line sides of the circuit breaker are live, the system voltages are synchronised.

In addition, the energy source powering the circuit breaker (for example the closing spring) must be fully charged. This is indicated from the ***CB Healthy*** DDB input.

When the CB has closed, the reclaim time starts. If the circuit breaker does not trip again, the Autoreclose function resets at the end of the set reclaim time. If the protection operates during the reclaim time the device either advances to the next shot in the Autoreclose cycle, or if all reclose attempts have been made, goes to lockout.

CB Status signals must also be available, so the default setting for ***CB Status Input*** in the *CB CONTROL* column, should be modified according to the application. The default PSL requires 52A, 52B and CB Healthy logic inputs, so a setting of both **52A and 52B** would be required for the ***CB Status Input*** if used with the default PSL.

4 AUTORECLOSE FUNCTION INPUTS

The Autoreclose function has several logic inputs, which can be mapped to any of the opto-inputs or to one or more of the DDB output signals generated by the PSL. The functions of these inputs are described below.

4.1 CB HEALTHY

It is necessary to establish if there is sufficient energy in the circuit breaker (spring charged, gas pressure healthy, etc.) before the CB can be closed. This ***CB Healthy*** input is used to ensure this before initiating a ***CB closed 3ph*** command. If on completion of the dead time, the ***CB Healthy*** input is low, and remains low for a period given by the ***CB Healthy Time*** timer, lockout will result and the circuit breaker will remain open.

The majority of circuit breakers are only capable of providing a single trip-close-trip cycle, in which case the ***CB Healthy*** signal would stay low after one Autoreclose shot, resulting in lockout.

This check can be disabled by not allocating an opto-input for the ***CB Healthy*** signal, whereby the signal defaults to a High state.

4.2 BLOCK AR

The ***Block AR*** input blocks the Autoreclose function and causes a lockout. It can be used when protection operation without Autoreclose is required. A typical example is on a transformer feeder, where Autoreclose may be initiated by the feeder protection but blocked by the transformer protection.

4.3 RESET LOCKOUT

The ***Reset Lockout*** input can be used to reset the Autoreclose function following lockout. It also resets any Autoreclose alarms, provided that the signals that initiated the lockout have been removed.

4.4 AR AUTO MODE

The ***AR Auto Mode*** input is used to select the Auto operating mode. In this mode, the Autoreclose function is in service.

4.5 AR LIVELINE MODE

The ***AR LiveLine Mode*** input is used to select the Live Line operating mode when Autoreclose is out of service and all blocking of instantaneous protection by Autoreclose is disabled. This operating mode takes precedence over all other operating modes for safety reasons, as it indicates that utility personnel are working near live equipment.

4.6 TELECONTROL MODE

The ***Telecontrol*** input is used to select the Telecontrol operating mode so that the Auto and Non-auto modes of operation can be selected remotely.

4.7 LIVE/DEAD CCTS OK (LIVE/DEAD CIRCUITS OK)

The ***LiveDead Ccts OK*** signal is a signal indicating the status of the Live Line / Dead Bus or Live Bus / Dead Line system conditions (High = OK, Low = Not OK). The logic required can be derived in the PSL from the Live Line, Dead Line, Live Bus and Dead Bus signals in the System Check logic (if applicable), or it can come from an external source depending on the application.

4.8 AR SYS CHECKS (AR SYSTEM CHECKS)

The ***AR Sys Checks*** signal can be mapped from the system checks output ***SysChks Inactive***, to enable auto-reclosing without any system checks, providing the ***System Checks*** setting in the *CONFIGURATION* column is

disabled. This mapping is not essential, because the ***No System Checks*** setting in the *AUTORECLOSE* column can be enabled to achieve the same effect.

This DDB can also be mapped to an opto-input, to allow the IED to receive a signal from an external system monitoring device, indicating that the system conditions are suitable for CB closing. This should not normally be necessary, since the IED has comprehensive built in system check functionality.

4.9 EXT AR PROT START (EXTERNAL AR PROTECTION START)

The ***Ext AR Prot Strt*** signal allows Autoreclose initiation by a Start from a separate protection device.

4.10 EXT AR PROT TRIP (EXTERNAL AR PROTECTION TRIP)

The ***Ext AR Prot Trip*** signal allows Autoreclose initiation by a Trip from a separate protection device.

4.11 EXT AR SEF START (EXTERNAL AR SEF START)

The ***Ext AR SEF Strt*** signal allows Autoreclose initiation by a SEF Start from a separate protection device.

4.12 EXT AR SEF TRIP (EXTERNAL AR SEFTRIP)

The ***Ext AR SEF Trip*** signal allows Autoreclose initiation by a SEF Trip from a separate protection device.

To allow this, you must map the signal in PSL as follows:

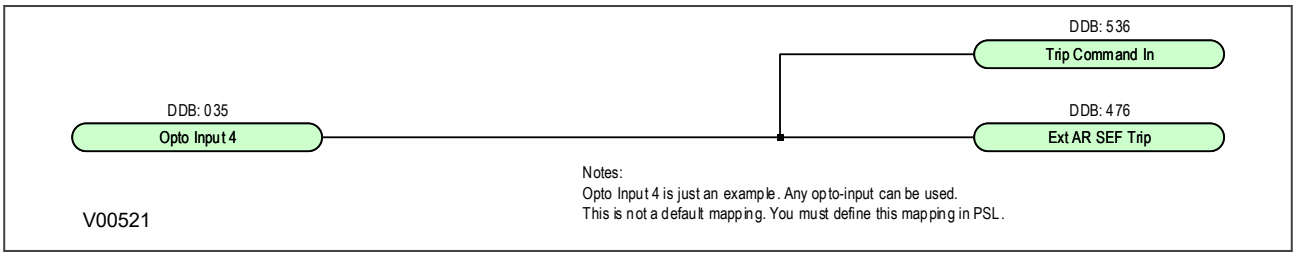


Figure 48: Mapping the external SEF protection signal in PSL

4.13 DAR COMPLETE (DELAYED AUTORECLOSE COMPLETE)

Some utilities require Delayed Autoreclose (DAR) functionality.

The ***DAR Complete*** signal can, if required, be mapped in PSL to provide a short pulse when a CB Close command is given at the end of the dead time. If ***DAR Complete*** is activated during an Autoreclose cycle, the output signal ***DAR in Progress*** resets, even though the reclaim time may still be running, and ***AR in Progress*** remains set until the end of the reclaim time.

For most applications, ***DAR complete*** can be ignored (not mapped in PSL). In such cases, **DAR in *Progress*** operates and resets in parallel with ***AR in Progress***.

4.14 CB IN SERVICE (CIRCUIT BREAKER IN SERVICE)

The ***CB In Service*** signal must remain asserted when protection operates if autoreclose is to be initiated. For most applications, it can be mapped to ***CB Closed 3ph***. More complex PSL mapping can be programmed if required, for example where it is necessary to confirm not only that the CB is closed but also that the line and/or bus VT is actually live up to the instant of protection operation.

4.15 AR RESTART

In some applications, it is sometimes necessary to initiate an Autoreclose cycle by means of connecting an external signal to an opto-input. This would be when the normal interlock conditions are not all satisfied, i.e. when

the CB is open and the associated feeder is dead. If the ***AR Restart*** input is mapped to an opto-input, activation of that opto-input will initiate an Autoreclose cycle irrespective of the status of the ***CB in Service*** input, provided the other interlock conditions, are still satisfied.

4.16 DT OK TO START (DEAD TIME OK TO START)

This is an optional extra interlock in the dead time initiation logic. In addition to the CB being open and the protection reset, ***DT OK To Start*** has to be set high to allow the dead time function to be primed after an AR cycle has started. Once the dead time function is primed, this signal has no further affect – the dead time function stays primed even if the signal subsequently goes low. A typical PSL mapping for this input is from the ***Dead Line*** signal from the System Check logic. This would enable dead time priming only when the feeder has gone dead after CB tripping. If this extra dead time priming interlock is not required, ***DT OK To Start*** can be left unmapped, and it will default to a high state.

4.17 DEADTIME ENABLED

This is an optional interlock in the dead time logic. This signal has to be high to allow the dead time to run. If this signal goes low, the dead time stops and resets, but stays primed, and will restart from zero when it goes high again. A typical PSL mapping is from the ***CB Healthy*** input or from selected signals from the System Check logic. It could also be mapped to an opto-input to provide a 'hold off' function for the follower CB in a 'master/follower' application with 2 CBs. If this optional interlock is not required, ***DeadTime Enabled*** can be left unmapped, and it will default to a high state.

4.18 AR INIT TRIPTEST (INITIATE TRIP TEST)

If ***AR Init TripTest*** is mapped to an opto-input, and that input is activated momentarily, the IED generates a CB trip output via ***AR Trip Test***. The default PSL then maps this to output to the trip output relay and initiates an Autoreclose cycle.

4.19 AR SKIP SHOT 1

If ***AR Skip Shot 1*** is mapped to an opto-input, and that input is activated momentarily, the IED logic will cause the Autoreclose sequence counter to increment by 1. This will decrease the available number of reclose shots and will lockout the re-closer.

4.20 INH RECLAIM TIME (INHIBIT RECLAIM TIME)

If ***Inh Reclaim Time*** is mapped to an opto-input, and that input is active at the start of the reclaim time, the IED logic will cause the reclaim timers to be blocked.

5 AUTORECLOSE FUNCTION OUTPUTS

The Autoreclose function has several logic outputs, which can be assigned to output relay contacts, monitor bits in the *COMMISSION TESTS* column, or the PSL. The functions of these outputs are described below.

5.1 AR IN PROGRESS

This signal is present during the complete re-close cycle from the start of protection to the end of the reclaim time or lockout.

5.2 DAR IN PROGRESS

This operates together with the ***AR In Progress*** signal at the start of Autoreclose. If ***DAR Complete*** does not operate, ***DAR in Progress*** remains operated until ***AR In Progress*** resets at the end of the cycle. If ***DAR Complete*** goes high during the Autoreclose cycle, ***DAR in Progress*** resets.

5.3 SEQUENCE COUNTER STATUS DDB SIGNALS

During each Autoreclose cycle a sequence Counter increments by 1 after each fault trip and resets to zero at the end of the cycle.

- ***AR SeqCounter 0*** is set when the counter is at zero
- ***AR SeqCounter 1*** is set when the counter is at 1
- ***AR SeqCounter 2*** is set when the counter is at 2
- ***AR SeqCounter 3*** is set when the counter is at 3
- ***AR SeqCounter 4*** is set when the counter is at 4

5.4 SUCCESSFUL CLOSE

The ***Successful Close*** output indicates that an Autoreclose cycle has been successfully completed. A successful Autoreclose signal is given after the protection has tripped the CB and it has reclosed successfully. The successful Autoreclose output is reset at the next CB trip or from one of the reset lockout methods.

5.5 AR IN SERVICE

The ***AR In Service*** output indicates whether the Autoreclose is in or out of service. Autoreclose is In Service when the device is in ***Auto*** mode and Out of Service when in the ***Non Auto*** and ***Live Line*** modes.

5.6 AR BLK MAIN PROT (BLOCK MAIN PROTECTION)

The ***AR Blk Main Prot*** signal blocks the DT-only stages (instantaneous stages) of the main current protection elements. These are ***I>3, I>4, I>6, IN1>3, IN1>4, IN2>3,*** and ***IN2>4.*** You block the instantaneous stages for each trip of the Autoreclose cycle using the Overcurrent and Earth Fault 1 and 2 settings, ***I> Blocking, IN1> Blocking, IN2> Blocking*** and the ***Trip 1 Main, Trip 2 Main, Trip 3 Main, Trip 4 Main*** and ***Trip 5 Main*** settings.

5.7 AR BLK SEF PROT (BLOCK SEF PROTECTION)

The ***AR Blk SEF Prot*** signal blocks the DT-only stages (instantaneous stages) of the SEF protection elements. These are ***ISEF>3***, and ***ISEF>4***. You block the instantaneous SEF stages for each trip of the Autoreclose cycle using the *SEF PROTECTION* setting ***ISEF> Blocking***, and the ***Trip 1 SEF***, ***Trip 2 SEF***, ***Trip 3 SEF***, ***Trip 4 SEF*** and ***Trip 5 SEF*** settings.

5.8 RECLOSE CHECKS

The ***Reclose Checks*** output indicates that the AR System Checks are in progress.

5.9 DEADTIME IN PROG

The ***DeadTime in Prog*** output indicates that the dead time is in progress. This signal is set when ***Reclose Checks*** is set AND input ***Dead TimeEnabled*** is high. This may be useful during commissioning to check the operation of the Autoreclose cycle.

5.10 DT COMPLETE (DEAD TIME COMPLETE)

DT *Complete* (Dead time complete) operates at the end of the set dead time, and remains operated until either the scheme resets at the end of the reclaim time or a further protection operation or Autoreclose initiation occurs. It can be applied purely as an indication, or included in PSL mapping to logic input ***DAR Complete***.

5.11 AR SYNC CHECK (AR SYNCHRONISATION CHECK)

AR Sync Check indicates that the Autoreclose Synchronism checks are satisfactory. This is when either of the synchronisation check modules (CS1 or CS2), confirms an In-Synchronism condition.

5.12 AR SYSCHECKS OK (AR SYSTEM CHECKS OK)

AR SysChecks OK indicates that the Autoreclose System checks are satisfactory. This is when any selected system check condition (synchronism check, live bus/dead line etc.) is confirmed.

This DDB signal ihas the number 463 and is an output from the Autoreclose function (i.e. a PSL input). It should not be confused with DDB signal 403, which is an input to the Autoreclose function (i.e. a PSL output).

5.13 AUTO CLOSE

The ***Auto Close*** output indicates that the Autoreclose logic has issued a `Close` signal to the CB. This output feeds a signal to the control close pulse timer and remains on until the CB has closed. This signal may be useful during commissioning to check the operation of the Autoreclose cycle.

5.14 PROTECTION LOCKT (PROTECTION LOCKOUT)

Protection Lockt (Protection Lockout) operates if ***AR lockout*** is triggered by protection operation either during the inhibit period following a manual CB close or when the device is in ***Non-auto*** or ***Live Line*** mode.

5.15 RESET LCKOUT ALM (RESET LOCKOUT ALARM)

Reset Lckout Alm operates when the device is in ***Non-auto mode***, if the ***Reset Lockout*** setting is set to `Select Non Auto`.

5.16 RECLAIM IN PROG

Reclaim in Prog output indicates that a reclaim timer is in progress and will drop-off once the reclaim timer resets.

5.17 RECLAIM COMPLETE

Reclaim Complete operates at the end of the set reclaim time and is a fast reset. To maintain the output indication a dwell timer has to be implemented in PSL.

6 AUTORECLOSE FUNCTION ALARMS

The following DDB signals will produce an alarm. These are described below.

6.1 AR NO SYS CHECK

The ***AR No Sys Check*** alarm indicates that the system voltages are not suitable for autoreclosing at the end of the system check time (setting ***Sys Check Time***), leading to a lockout condition. This alarm is latched and must be reset manually.

6.2 AR CB UNHEALTHY

The ***AR CB Unhealthy*** alarm indicates that the **CB *Healthy*** input was not energised at the end of the *CB Healthy Time*, leading to a lockout condition. This alarm is latched and must be reset manually.

6.3 AR LOCKOUT

The ***AR Lockout*** alarm indicates that the device is in a lockout status and that further re-close attempts will not be made. This alarm can configured to reset automatically (self-reset) or manually as determined by the setting ***Reset Lockout by*** in the *CB CONTROL* column.

7 AUTORECLOSE OPERATION

The Autoreclose function is a complex function consisting of several modules interacting with one another. This is described in terms of separate logic diagrams, which link together by means of Internal signals (depicted by the pink-coloured boxes. To help you with the analysis of the various Autoreclose modules, the following table describes how these internal signals link up in the various logic diagrams. Each internal signal is allocated with an ID, and the diagrams on which they appear are also identified.

Internal signal ID	Input to AR function	Appearing in diagrams	Output from AR function	Appearing in diagrams
1	Autoreclose Disabled	V00505, V00507	Autoreclose Disabled	V00501
2	Live Line Mode	V00505, V00507, V00514	Live Line Mode	V00501
3	Non Auto Mode	V00505, V00507, V00514	Non Auto Mode	V00501
4	Auto Mode (int)	V00505, V00507, V00512	Auto Mode (int)	V00501
5	Main Protection Start	V00504, V00505, V00507, V00511, V00512	Main Protection Start	V00502
6	SEF Protection Start	V00504, V00505, V00511, V00512	SEF Protection Start	V00502
7	Main Protection Trip	V00505, V00513, V00514	Main Protection Trip	V00503
8	SEF Protection Trip	V00505, V00507, V00513, V00514	SEF Protection Trip	V00503
9	Block Autoreclose	V00513	Block Autoreclose	V00515
10	SC Count >= Main Shots	V00504	SC Count >= Main Shots	V00505
11	SC Count >= SEF Shots	V00504	SC Count >= SEF Shots	V00505
12	Main High Shots	V00505, V00513	Main High Shots	V00504
13	SEF High Shots	V00505, V00513	SEF High Shots	V00504
14	Autoreclose Inhibit	V00505, V00507, V00514	Autoreclose Inhibit	V00512
15	Autoreclose Start	V00508, V00509, V00511, V00513	Autoreclose Start	V00505
16	Autoreclose Initiate	V00508, V00513	Autoreclose Initiate	V00505
17	SC Count > 4	V00506	SC Count > 4	V00505
18	Block Main Prot Trips	V00507	Block Main Prot Trips	V00506
19	Block SEF Prot Trips	V00507	Block SEF Prot Trips	V00506
20	Hold Reclaim Output	V00511	Hold Reclaim Output	V00509

7.1 OPERATING MODES

The Autoreclose function has three operating modes:

- Auto Mode: Autoreclose is in service
- Non-auto Mode: Autoreclose is out of service AND the chosen protection functions are blocked if setting ***AR Deselected*** = `Block Inst Prot.`
- Live Line Mode: Autoreclose is out of service, but protection functions are NOT blocked, even if setting ***AR Deselected*** = `Block Inst Prot.`

Note:
Live Line Mode provides extra security for live line working on the protected feeder.

The Autoreclose function must first be enabled in the *CONFIGURATION* column. You can then select the operating mode according to application requirements. The basic method of mode selection is determined by the setting ***AR Mode Select*** in the *AUTORECLOSE* column, as summarised in the following table:

AR Mode Select Setting	Description
Command Mode	Auto or Non-auto mode selection is determined by the command cell ***Autoreclose Mode*** in the *CB CONTROL* column.
Opto Set Mode	Auto or Non-auto mode selection is determined by an opto-input mapped to ***AR Auto Mode*** If the ***AR Auto Mode*** input is high, Auto operating mode is selected. If the ***AR Auto Mode*** input is low, Non-Auto operating mode is selected.
User Set Mode	Auto or Non-auto mode selection is controlled by the ***Telecontrol Mode*** input. If the ***Telecontrol Mode*** input is high, the setting ***Autoreclose Mode*** in the *CB CONTROL* column is used to select Auto or Non Auto operating mode. If the ***Telecontrol Mode*** input is low, it behaves as for the `Opto Set Mode` setting.
Pulse Set Mode	Auto or Non-auto mode selection is determined by the falling edge of ***AR Auto Mode*** signal. If the Telecontrol input is high, the operating mode is toggled between Auto and Non Auto Mode on the falling edge of the ***AR Auto Mode*** signal as it goes low. The Auto Mode pulses are produced by the SCADA system. If the Telecontrol input is low, it behaves as for the ***Opto Set Mode*** setting.

The Live Line Mode is controlled by ***AR LiveLine Mode***. If this is high, the scheme is forced into Live Line Mode irrespective of the other signals.

7.1.1 FOUR-POSITION SELECTOR SWITCH IMPLEMENTATION

It is quite common for some utilities to apply a four position selector switch to control the mode of operation. This application can be implemented using the DDB signals ***AR LiveLine Mode***, ***AR Auto Mode*** and ***Telecontrol Mode***. This is demonstrated in the following diagram.

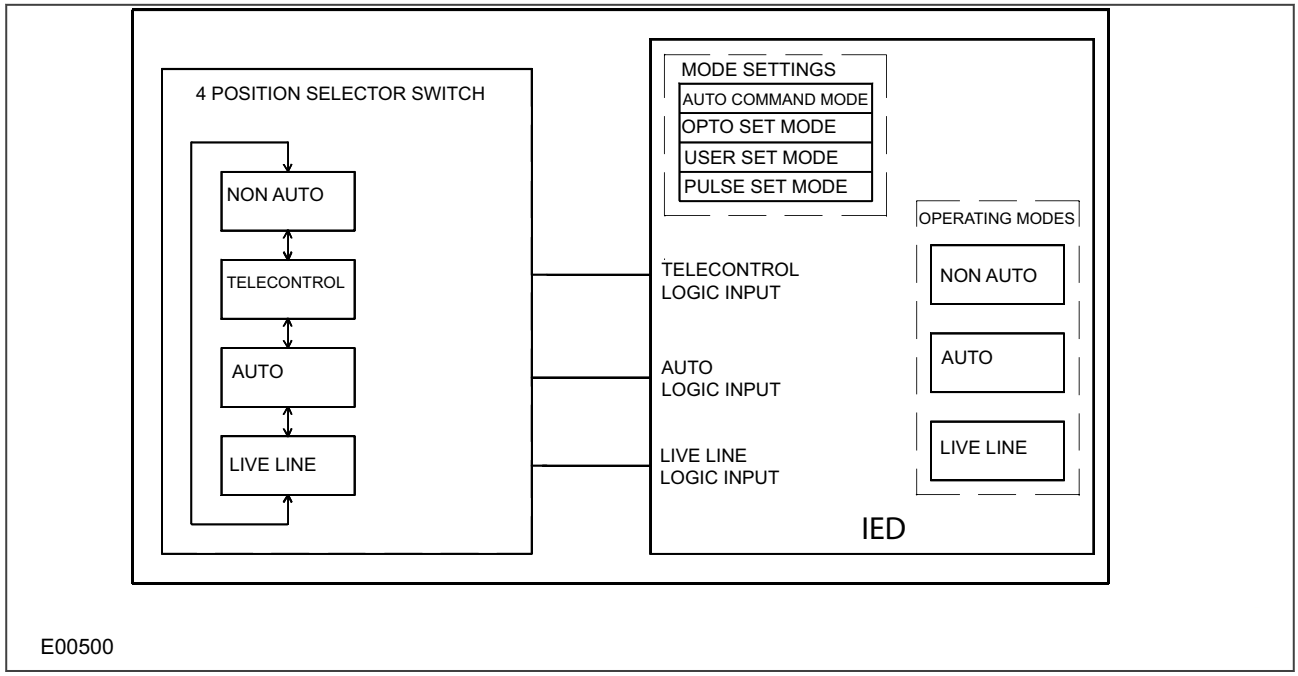


Figure 49: Four-position selector switch implementation

The required logic truth table for this arrangement is as follows:

Switch position	AR Auto Mode	Telecontrol Mode	AR Live Line Mode
Non-auto	0	0	0
Telecontrol	0 or SCADA pulse	1	0
Auto	1	0	0
Live Line	0	0	1

7.1.2 OPERATING MODE SELECTION LOGIC

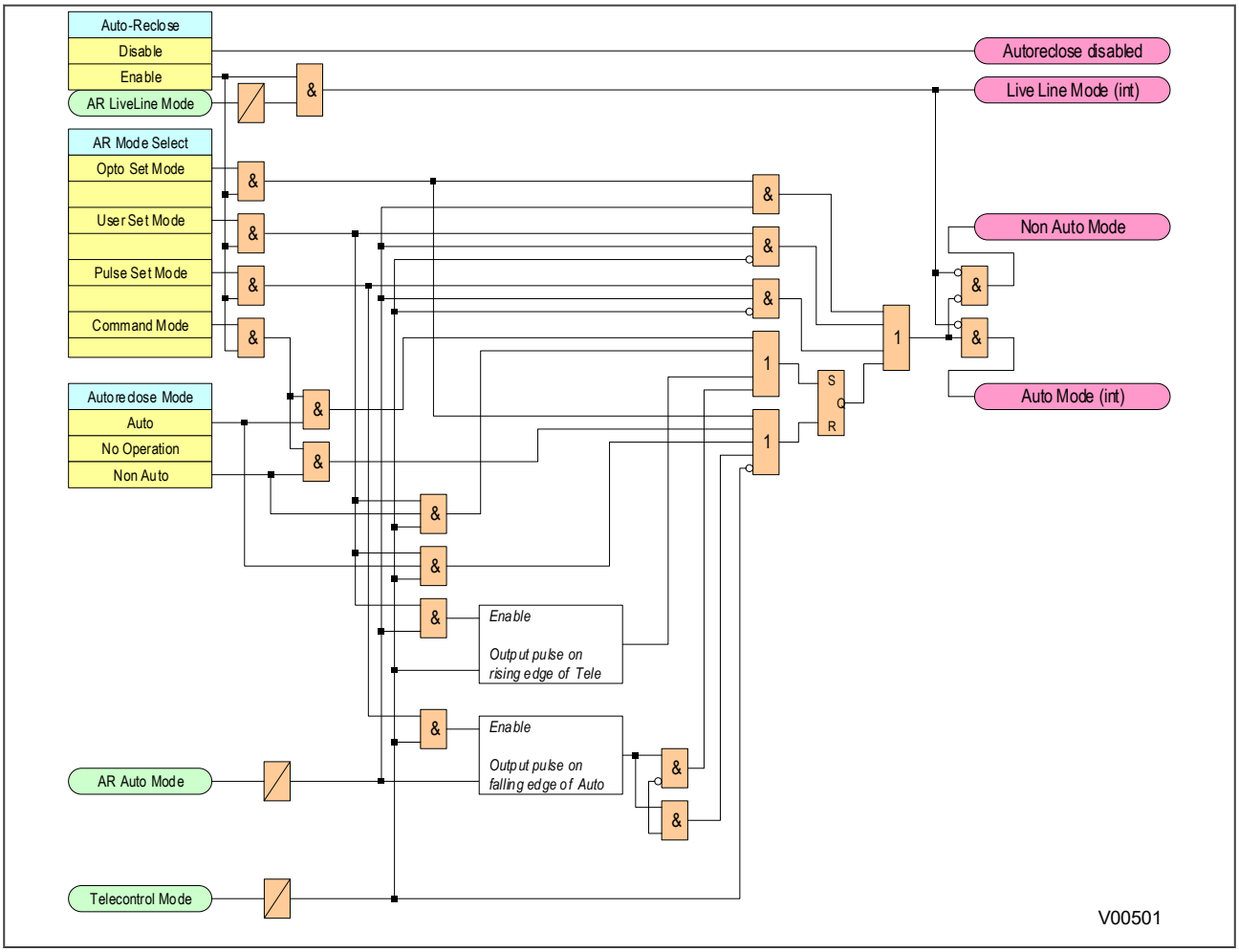


Figure 50: Autoreclose mode select logic

The mode selection logic includes a 100 ms delay for ***Auto Mode***, ***Telecontrol*** and ***Live Line*** logic inputs, to ensure a predictable change of operating modes. This is of particular importance for the case when the four position switch does not have 'make-before-break' contacts. The logic also ensures that when the switch is moved from Auto or Non-Auto position to Telecontrol, the scheme remains in the previously selected mode (Auto or Non-Auto) until a different mode is selected by remote control.

For applications where live line operating mode and remote selection of Auto/Non-auto modes are not required, a simple two position switch can be arranged to activate ***Auto Mode*** input. In this case, the ***Live Line*** and ***Telecontrol*** inputs would be unused.

7.2 AUTORECLOSE INITIATION

In the P94V, the Autoreclose function can only be initiated by an external device. To do this, the following DDB signals should be mapped to opto-inputs:

- ***Ext AR Prot Trip***
- ***Ext AR Prot Strt***

In addition, the setting ***Ext Prot*** should be set to `Initiate Main AR`.

Although a protection start and a protection trip can initiate an AR cycle, several checks still have to be performed before the initialisation signal is given. Some of the checks are listed below:

- ***Auto Mode*** has been selected
- ***Live line mode*** is disabled
- The number of main protection and SEF shots have not been reached
- Sequence co-ordination is enabled (for protection start to initiate AR. This is not necessary if a protection trip is doing the initiating)
- The ***CB Ops Lockout*** DDB signal is not set
- The ***CB in Service*** DDB signal is high

7.2.1 START SIGNAL LOGIC

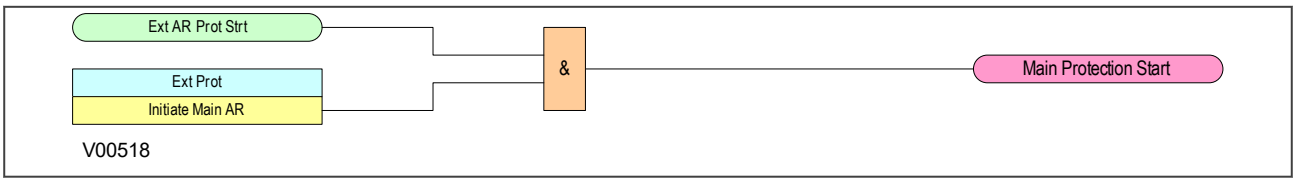


Figure 51: Start signal logic

7.2.2 TRIP SIGNAL LOGIC

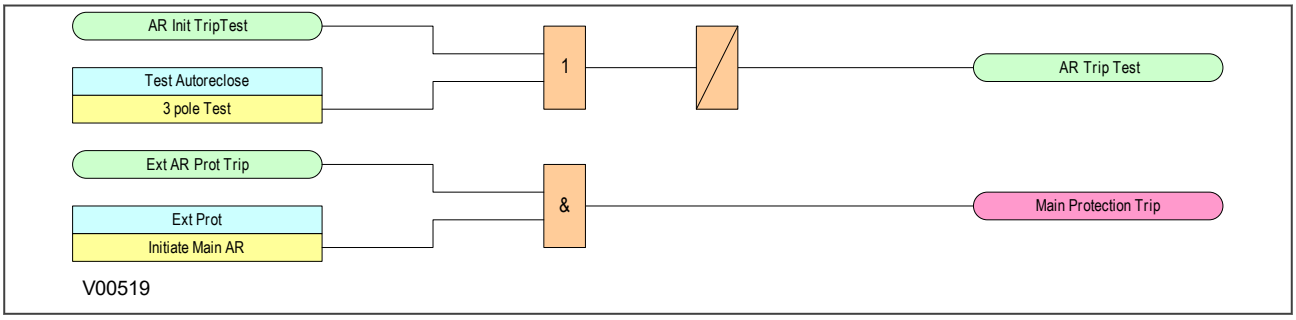


Figure 52: Trip signal logic

7.2.3 BLOCKING SIGNAL LOGIC

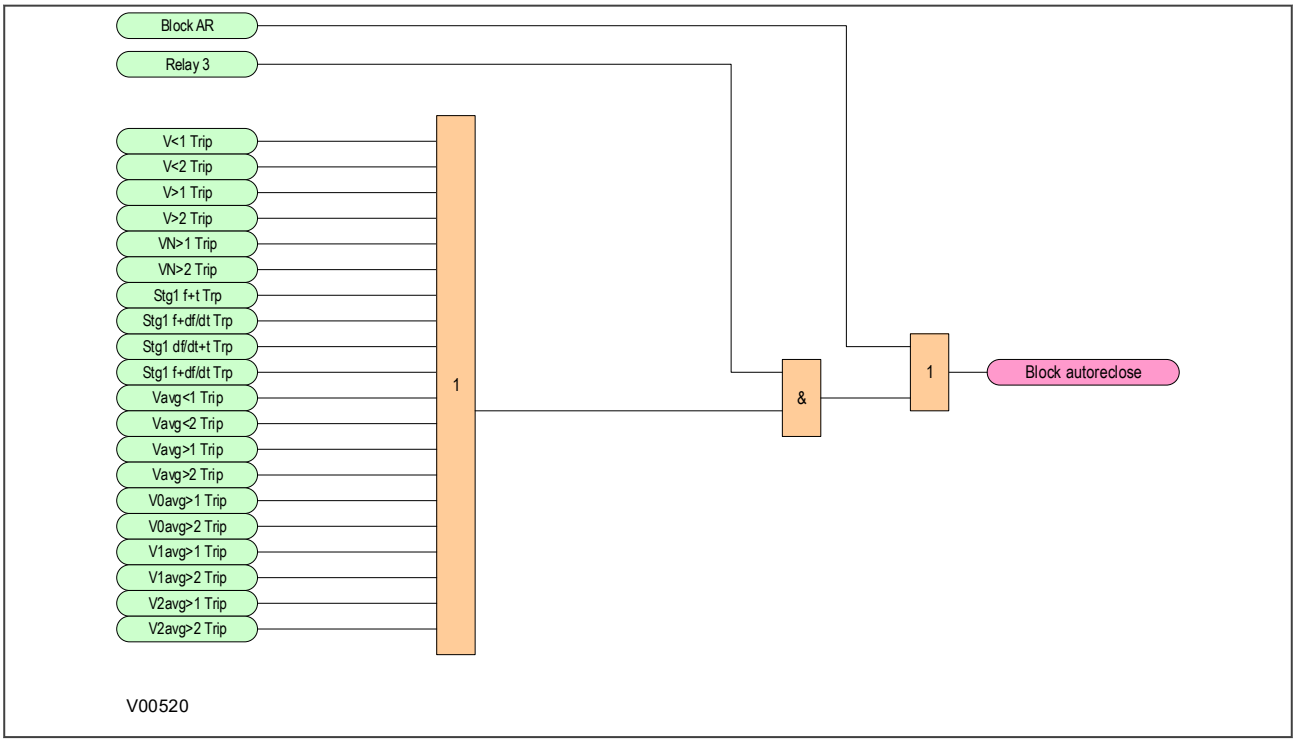


Figure 53: Blocking signal logic

7.2.4 SHOTS EXCEEDED LOGIC

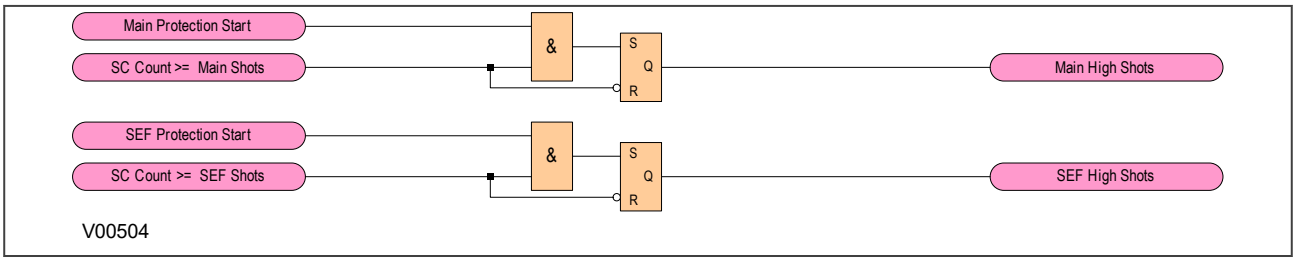


Figure 54: Shots Exceeded logic

7.2.5 AR INITIATION LOGIC

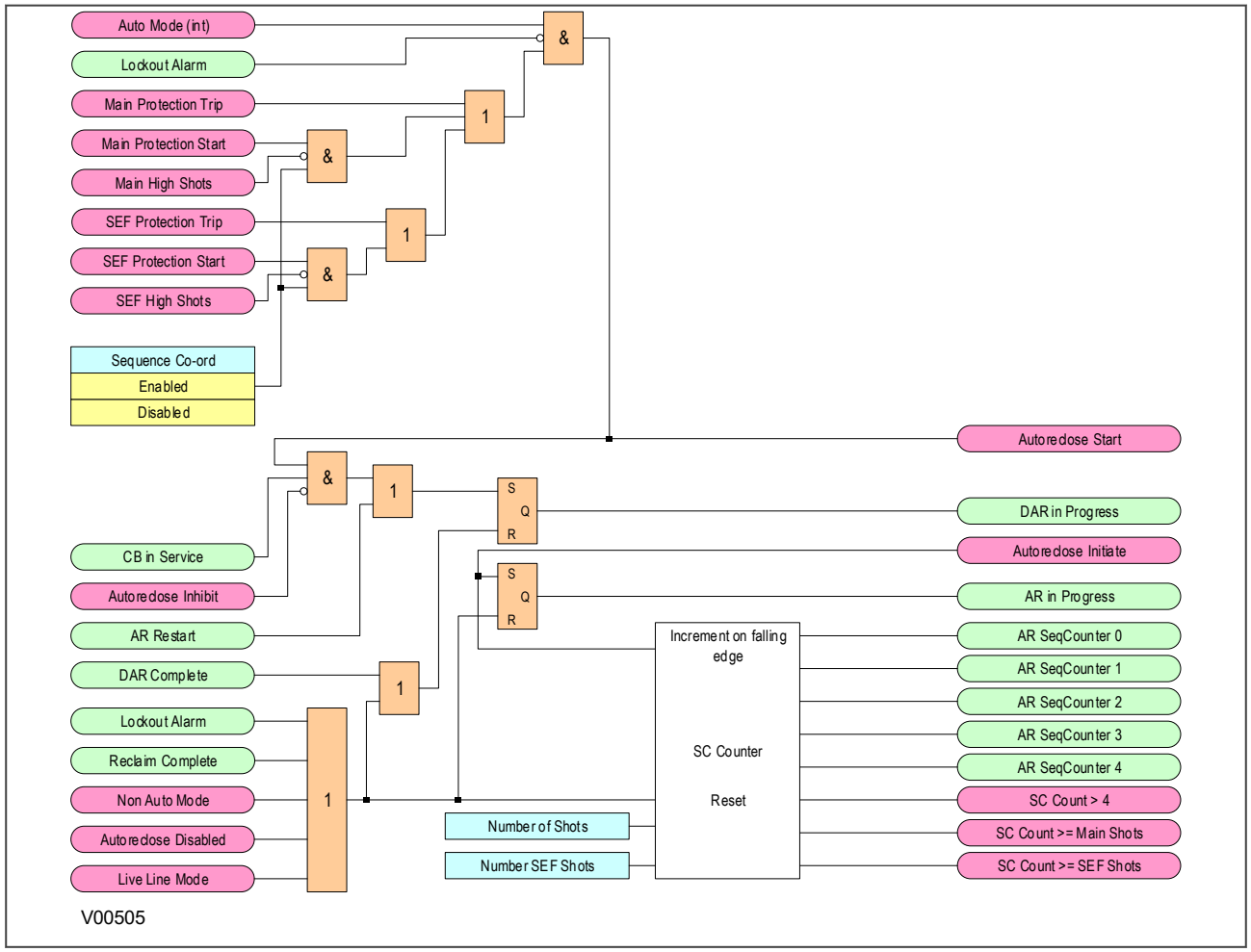


Figure 55: AR initiation logic

7.3 BLOCKING INSTANTANEOUS PROTECTION FOR SELECTED TRIPS

Instantaneous protection may be blocked or not blocked for each trip in an Autoreclose cycle. This is selected using the ***Trip (n) Main*** and ***Trip (n) SEF*** settings, where n is the number of the trip in the autoreclose cycle. These allow the instantaneous elements of phase, earth fault and SEF protection to be selectively blocked for a CB trip sequence. For example, if ***Trip 1 Main*** is set to `No Block` and ***Trip 2 Main*** is set to `Block Inst Prot`, the instantaneous elements of the phase and earth fault protection will be available for the first trip but blocked afterwards for the second trip during the Autoreclose cycle. The logic for this is shown below.

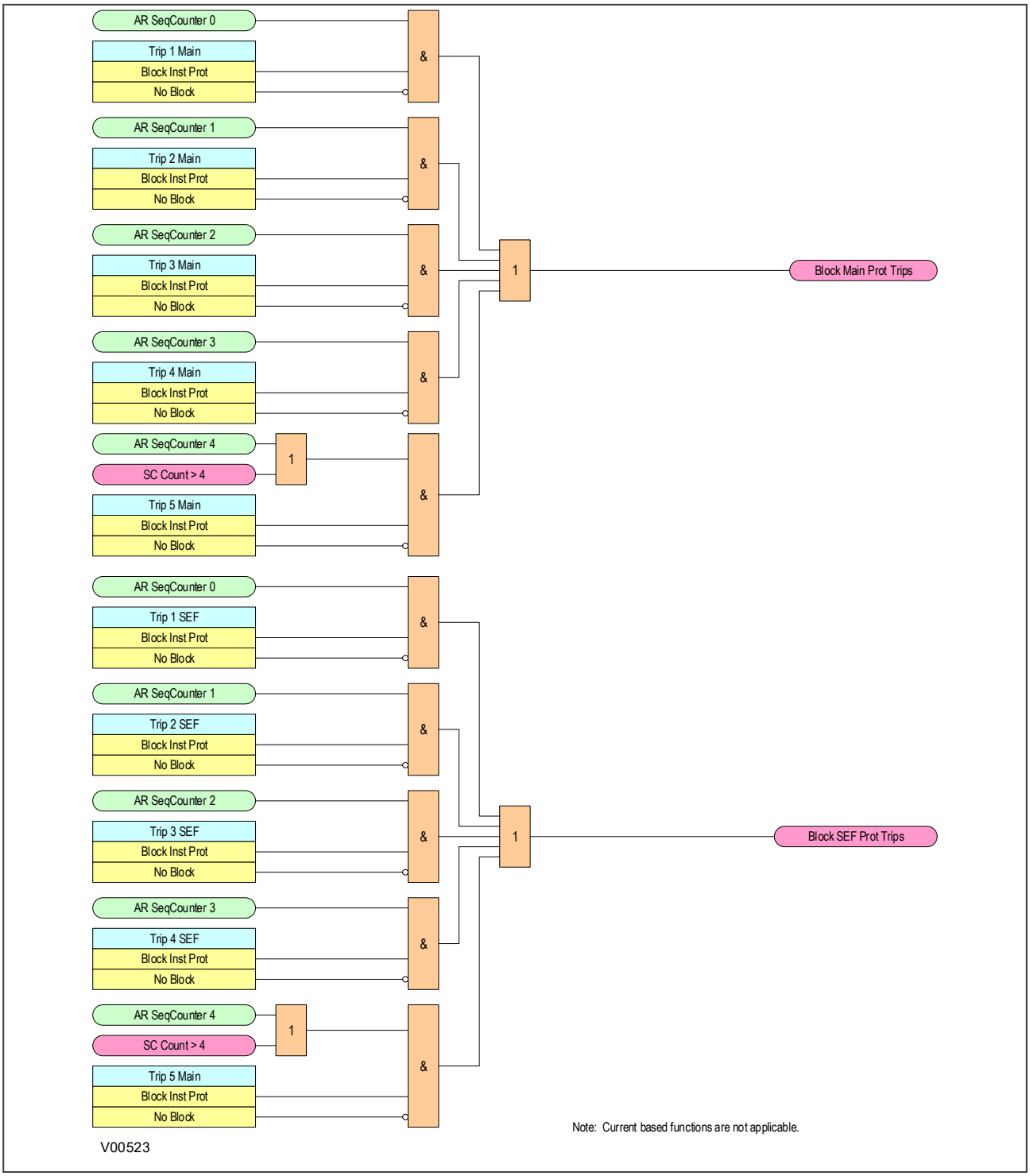


Figure 56: Blocking instantaneous protection for selected trips

7.4 BLOCKING INSTANTANEOUS PROTECTION FOR LOCKOUTS

Instantaneous protection can also be blocked for certain lockout conditions:

It is blocked when the CB maintenance lockout counter or excessive fault frequency lockout has reached its penultimate value.

For example, if the setting ***No. CB Ops Lock*** in the *CB MONITOR SETUP* column is set to 100 and the ***No. CB Ops Maint*** = '99', the instantaneous protection can be blocked to ensure that the last CB trip before lockout will be due

to discriminative protection operation. This is controlled using the ***EFF Maint Lock*** setting (Excessive Fault Frequency maintenance lockout). If this is set to `Block Inst Prot`, the instantaneous protection will be blocked for the last CB Trip before lockout occurs.

Instantaneous protection can also be blocked when the IED is locked out, using the ***AR Lockout*** setting. It can also be blocked after a manual close using the ***Manual Close*** setting. When the IED is in the Non-auto mode it can be blocked by using the ***AR Deselected*** setting. The logic for these features is shown below.

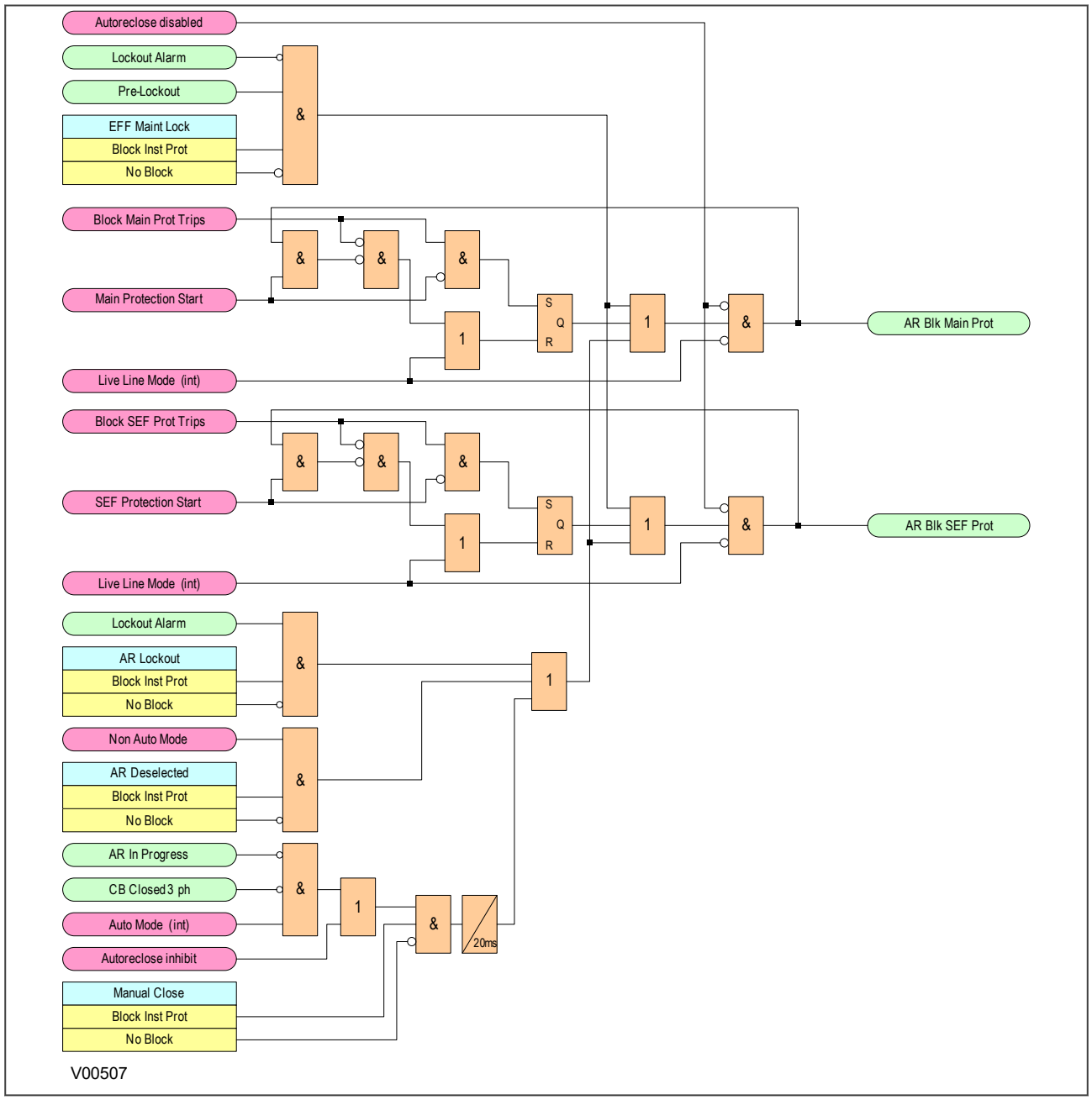


Figure 57: Blocking instantaneous protection for lockouts

7.5 DEAD TIME CONTROL

When the setting ***CS AR Immediate*** is enabled, immediate re-closure of the circuit breaker is allowed providing that both sides of the circuit breaker are live and in synchronism at any time after the dead time has started. This allows for quicker load restoration, as it is not necessary to wait for the full dead time to expire.

If ***CS AR Immediate*** is disabled, or neither Line nor Bus are live, the dead timer will continue to run, if the ***DeadTime Enabled*** signal is high. The ***DeadTime Enabled*** function could be mapped to an opto-input to indicate that the circuit breaker is healthy. Mapping the ***DeadTime Enabled*** function in PSL increases the flexibility by allowing it to be triggered by other conditions such as Live Line/Dead Bus. If ***DeadTime Enabled*** is not mapped in PSL, it defaults to high, so the dead time can run.

The dead time control logic is shown below.

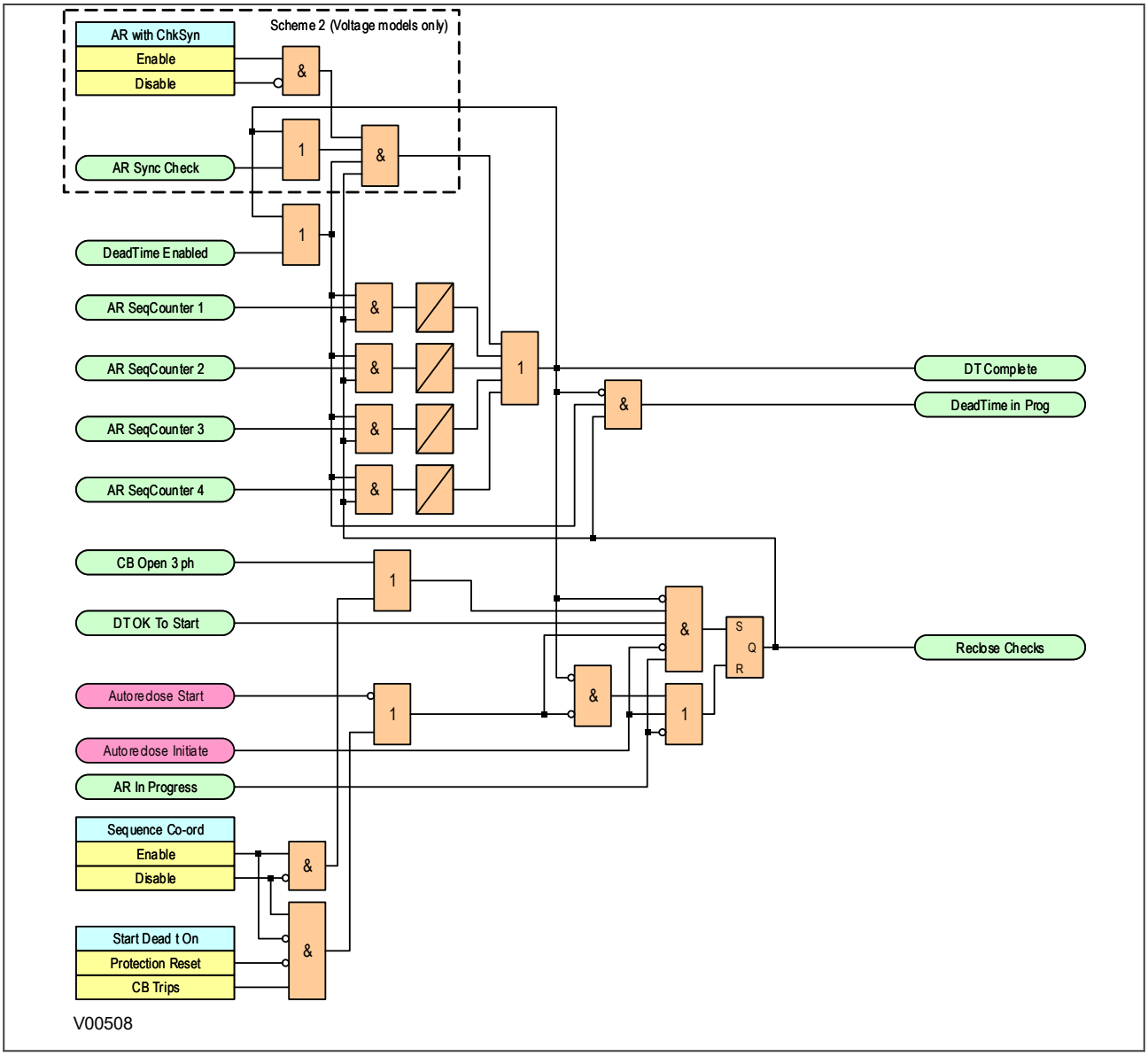


Figure 58: Dead Time Control logic

7.5.1 AR CB CLOSE CONTROL

Once the dead time is completed or a synchronism check is confirmed, the ***Auto Close*** signal is given, provided both the ***CB Healthy*** and the ***System Checks*** are satisfied. The ***Auto Close*** signal triggers a CB Close command via the CB Control functionality.

The AR CB Close Control Logic is as follows:

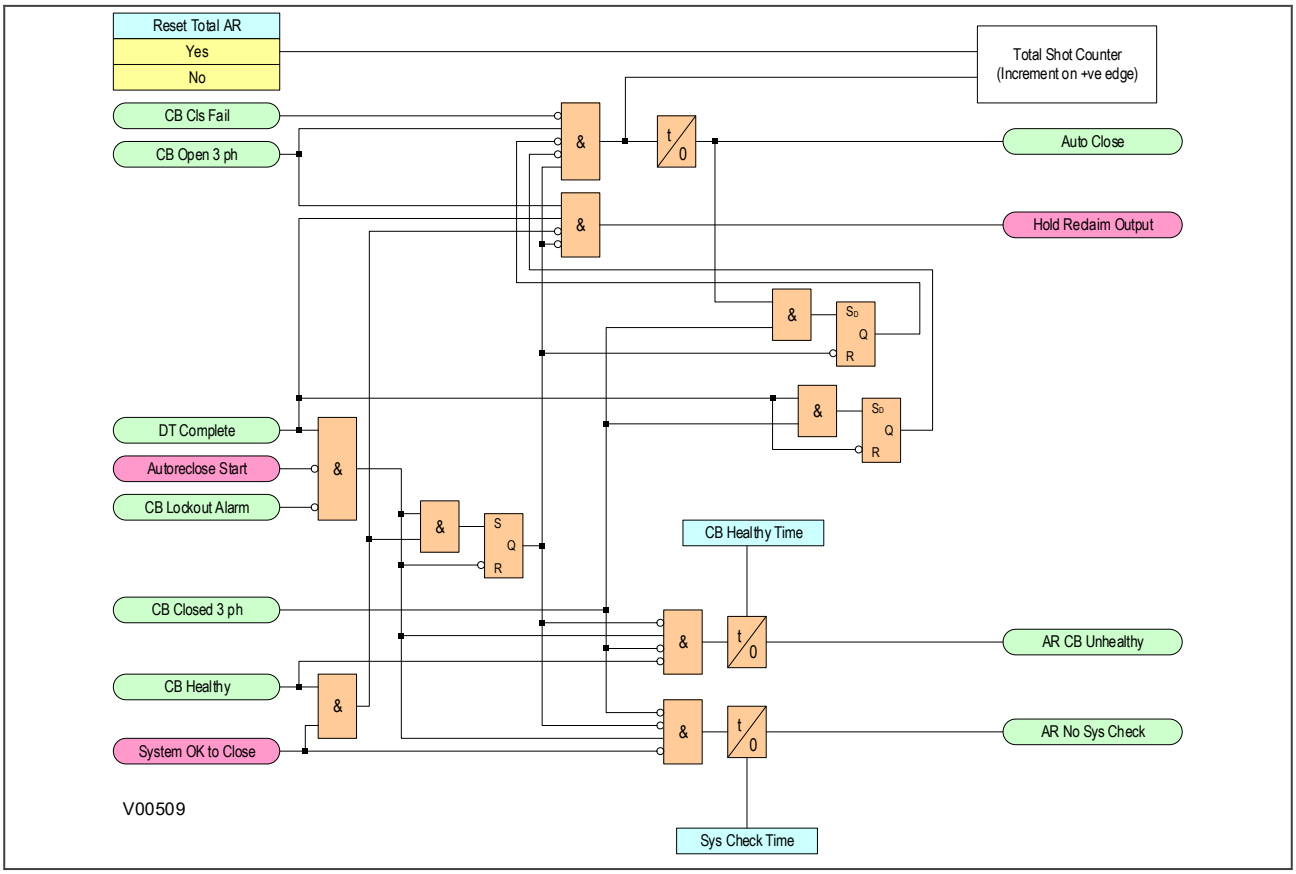


Figure 59: AR CB Close Control logic

7.6 AR SYSTEM CHECKS

The permission to initiate an Autoreclose depends on the following AR system check settings. These are found in the *AUTORECLOSE* column under the *AR SYSTEM CHECKS* sub-heading and are not to be confused with the main system check settings in the *SYSTEM CHECKS* column.

The *AR SYSTEM CHECKS* are as follows:

- ***Live/Dead Ccts***: When enabled this setting will give an ***AR Check OK*** signal when the ***LiveDead Ccts OK*** signal is high. This logic input DDB would normally be mapped in PSL to appropriate combinations of Line Live, Line Dead, Bus Live and Bus Dead DDB signals.
- ***No System Checks***: When enabled this setting completely disables system checks thus allowing Autoreclose initiation under any system conditions.
- ***SysChk on Shot 1***: Can be used to disable system checks on the first AR shot.
- ***AR with ChkSyn***: Only allows Autoreclose when the system satisfies the Check Sync Stage 1 (CS1) settings in the main *SYSTEM CHECKS* menu.
- ***AR with SysSyn***: Only allows Autoreclose when the system satisfies the Check Sync Stage 2 (CS2) settings in the main *SYSTEM CHECKS* menu.

The AR System Check logic is as follows:

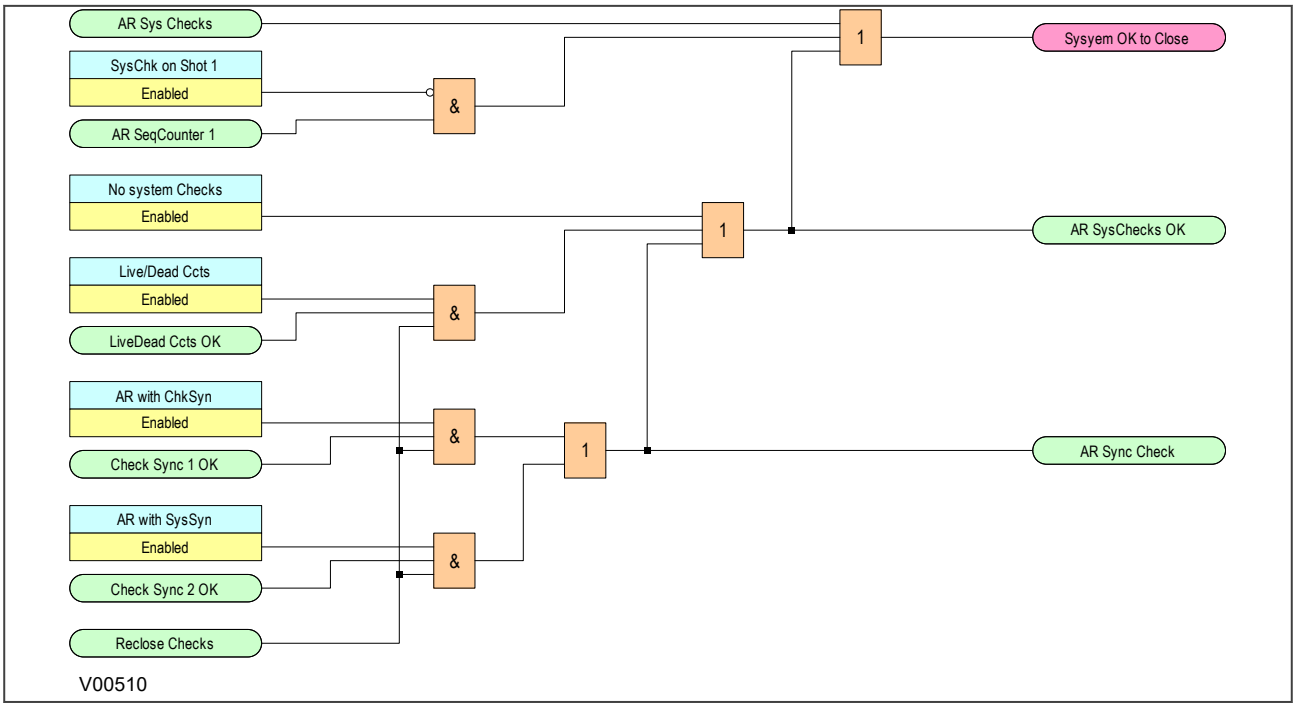


Figure 60: AR System Check logic

7.7 RECLAIM TIMER INITIATION

The ***tReclaim Extend*** setting allows you to control whether the timer is suspended from the protection start contacts or not. When a setting of `No Operation` is used, the reclaim timer operates from the instant the CB is closed and will continue until the timer expires. The ***Reclaim Time*** must therefore be set in excess of the time-delayed protection operating time, to ensure that the protection can operate before the Autoreclose function is reset.

For certain applications it is advantageous to set ***tReclaim Extend*** to `On Prot Start`. This facility allows the operation of the reclaim timer to be suspended after CB re-closure by a signal from the main protection start or SEF protection start signals. This feature ensures that the reclaim time cannot time out and reset the Autoreclose before the time delayed protection has operated.

Since the reclaim timer will be suspended, it is unnecessary to use a timer setting in excess of the protection operating time, therefore a short reclaim time can be used. Short reclaim time settings can help to prevent unnecessary lockout for a succession of transient faults in a short period, for example during a thunderstorm.

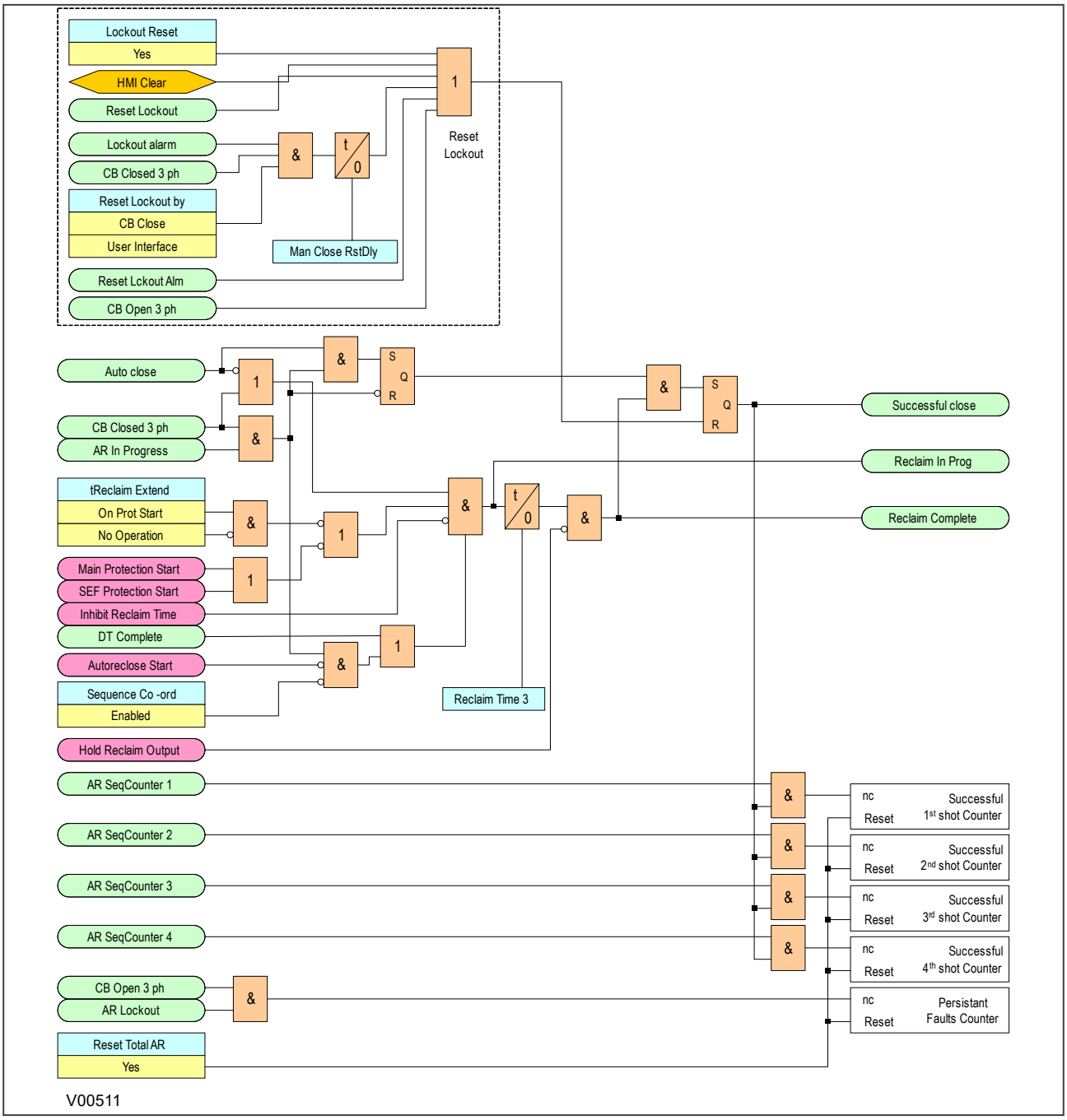


Figure 61: Reclaim Time logic

7.8 AUTORECLOSE INHIBIT

To ensure that autoreclosing is not initiated for a manual CB closure on to a pre-existing fault (switch on to fault), the ***AR on Man Close*** setting can be set to Inhibited. With this setting, Autoreclose initiation is inhibited for a period equal to setting ***AR Inhibit Time*** following a manual CB closure. The logic for AR Inhibit is as follows:

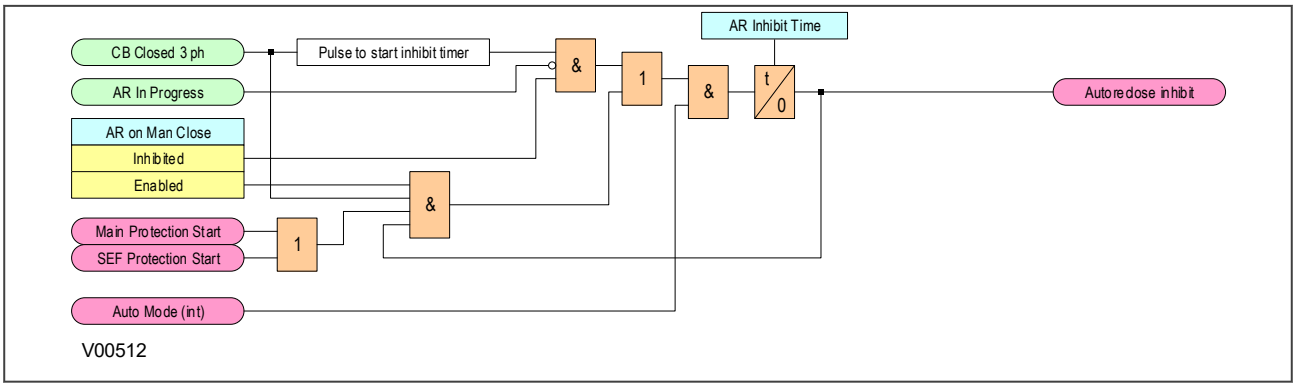


Figure 62: AR Initiation inhibit

If a protection operation occurs during the inhibit period, Autoreclose is not initiated. A further option is provided by setting ***Man Close on Flt***. If this is set to `Lockout`, Autoreclose is locked out (***AR Lockout***) for a fault during the inhibit period following manual CB closure. If ***Man Close on Flt*** is set to `No Lockout`, the CB trips without reclosure, but Autoreclose is not locked out.

You may need to block selected fast non-discriminating protection in order to obtain fully discriminative tripping during the AR initiation inhibit period following CB manual close. You can do this by setting ***Manual Close*** to `Block Inst Prot`. A `No Block` setting will enable all protection elements immediately on CB closure.

If setting ***AR on Man Close*** is set to `Enabled`, Autoreclose can be initiated immediately on CB closure, and settings ***AR Inhibit Time***, ***Man Close on Flt*** and ***Manual Close*** are irrelevant.

7.9 AUTORECLOSE LOCKOUT

If protection operates during the reclaim time following the final reclose attempt, the IED is driven to lockout and the Autoreclose function is disabled until the lockout condition is reset. This produces the alarm, ***AR Lockout***. The ***Block AR*** input blocks Autoreclose and causes a lockout if Autoreclose is in progress.

Autoreclose lockout can also be caused by the CB failing to close due to an unhealthy circuit breaker (CB springs not charged or low gas pressure) or if there is no synchronisation between the system voltages. These two conditions are indicated by the alarms ***CB Unhealthy*** and ***AR No Sys Check*** This is shown in the AR Lockout logic diagram as follows:

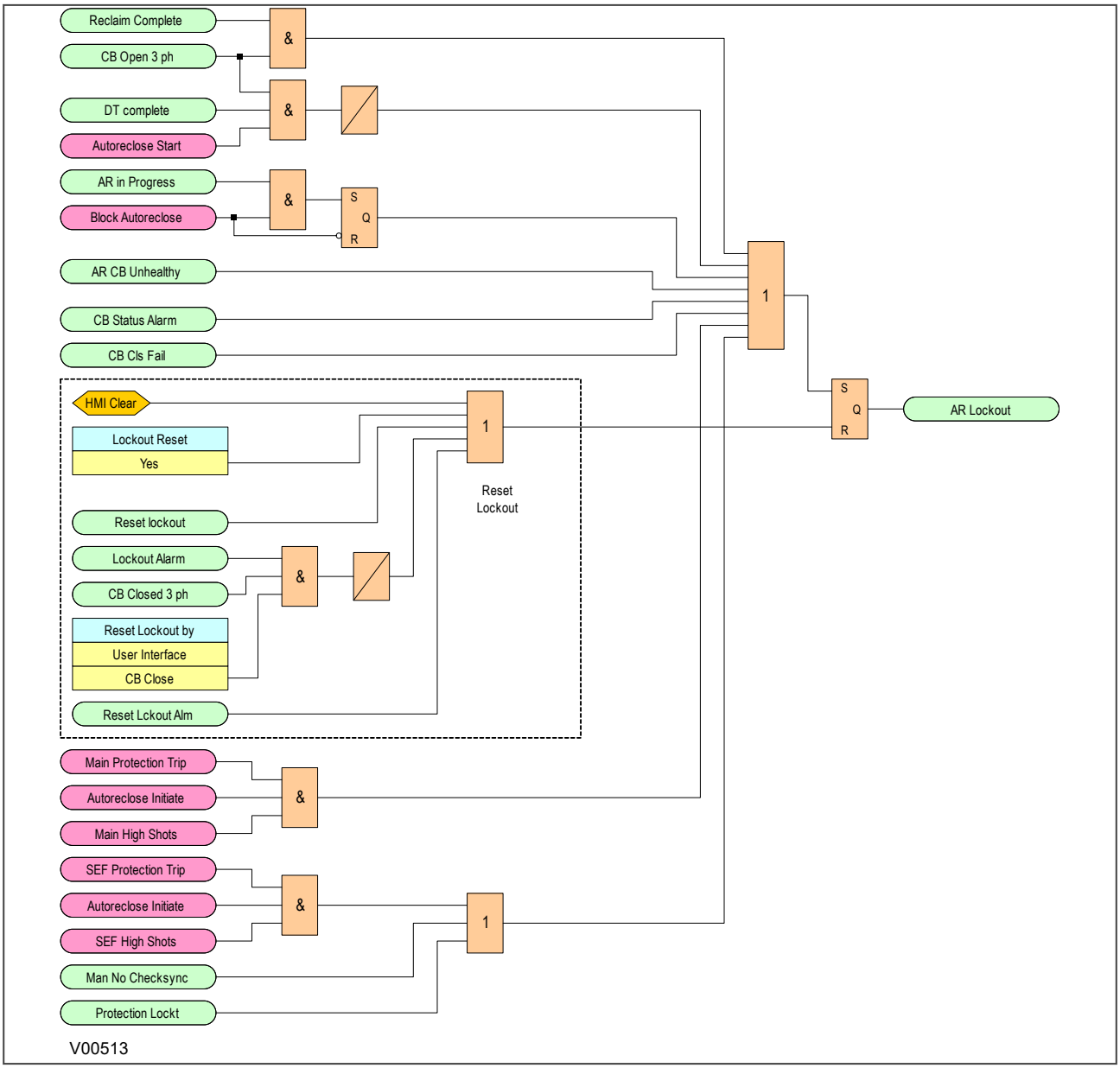


Figure 63: Overall Lockout logic

AR lockout may also be due to a protection operation when the IED is in the Live Line or Non-auto modes when the setting ***Trip AR Inactive*** is set to `Lockout`. Autoreclose lockout can also be caused by a protection operation after manual closing during the ***AR Inhibit Time*** when the ***Man Close on Flt*** setting is set to `Lockout`. This is shown as follows:

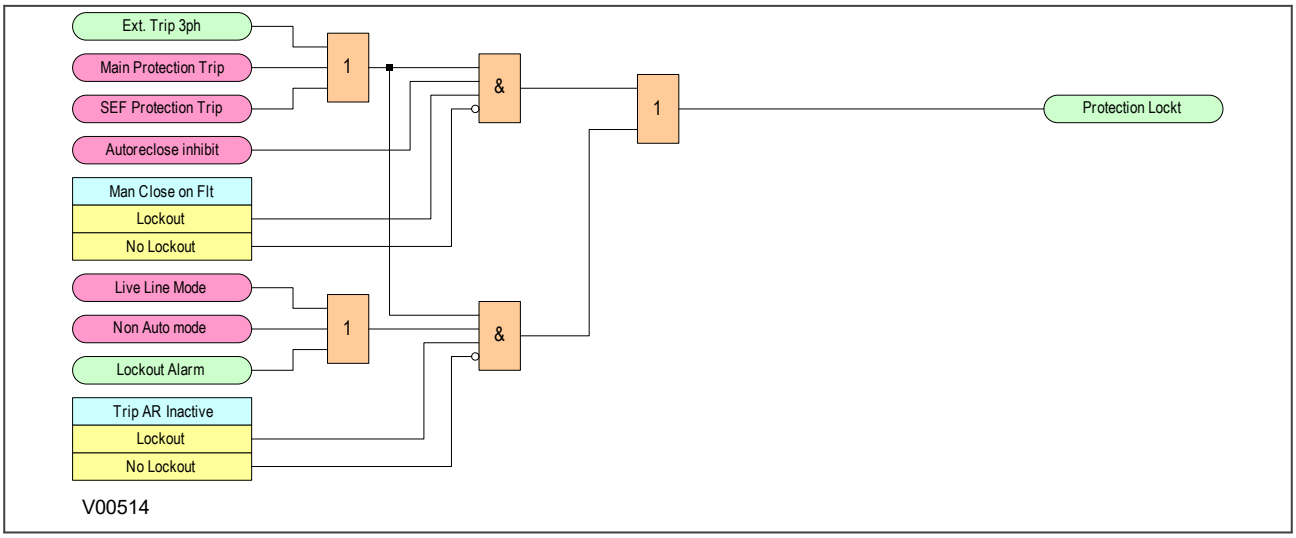


Figure 64: Lockout for protection trip when AR is not available

Note:
Lockout can also be caused by the CB condition monitoring functions in the CB MONITOR SETUP column.

The ***Reset Lockout*** input can be used to reset the Autoreclose function following lockout and reset any Autoreclose alarms, provided that the signals that initiated the lockout have been removed. Lockout can also be reset from the clear key or the command ***Lockout Reset*** from the *CB CONTROL* column.

There are two different ***Reset Lockout by*** settings. One in the *CB CONTROL* column and one in the *AUTORECLOSE* column.

The ***Reset Lockout by*** setting in the *CB CONTROL* column is used to enable or disable reset of lockout automatically from a manual close after the manual close time ***Man Close RstDly***.

The ***Reset Lockout by*** setting in the *AUTORECLOSE* column is used to enable/disable the resetting of lockout when the IED is in the Non-auto operating mode. The reset lockout methods are summarised in the following table:

Reset Lockout Method	When Available?
User Interface via the Clear key. Note: This will also reset all other protection flags	Always
User interface via *CB CONTROL* command Lockout Reset	Always
Opto-input Reset lockout	Always
Following a successful manual close if *CB CONTROL* setting Reset Lockout by is set to `CB Close`	Only when set
By selecting Non-Auto mode, provided *AUTORECLOSE* setting Reset Lockout by is set to `Select NonAuto`	Only when set

7.10 SEQUENCE CO-ORDINATION

The ***Sequence Co-ord*** setting in the *AUTORECLOSE* menu allows sequence co-ordination with other protection devices, such as downstream pole-mounted reclosers.

The main protection start or SEF protection start signals indicate when fault current is present, advance the sequence count by one and start the dead time, whether the CB is open or closed. When the dead time is complete and the protection start inputs are low, the reclaim timer is initiated.

You should program both the upstream and downstream Autoreclose IEDs with the same number of shots to lockout and number of instantaneous trips before instantaneous protection is blocked. This will ensure that for a persistent downstream fault, both Autoreclose IEDs will be on the same sequence count and will block

instantaneous protection at the same time. When sequence co-ordination is disabled, the circuit breaker has to be tripped to start the dead time, and the sequence count is advanced by one.

When using sequence co-ordination for some applications such as downstream pole-mounted reclosers, it may be desirable to re-enable instantaneous protection when the recloser has locked out. When the downstream recloser has locked out there is no need for discrimination. This allows you to have instantaneous, then IDMT, then instantaneous trips again during an Autoreclose cycle. Instantaneous protection may be blocked or not blocked for each trip in an Autoreclose cycle using the ***Trip (n) Main*** and ***Trip (n) SEF*** settings, where n is the number of the trip in the autoreclose cycle.

7.11 SYSTEM CHECKS FOR FIRST RECLOSE

The ***SysChk on Shot 1*** setting in the *SYSTEM CHECKS* sub menu of the *AUTORECLOSE* column is used to enable or disable system checks for the first reclose attempt in an Autoreclose cycle. This may be preferred when high speed Autoreclose is applied, to avoid the extra time for a synchronism check. Subsequent reclose attempts in a multi-shot cycle will, however, still require a synchronism check.

8 SETTING GUIDELINES

8.1 NUMBER OF SHOTS

There are no clear cut rules for defining the number of shots for a particular application. Generally medium voltage systems use only two or three shot Autoreclose schemes. However, in certain countries, for specific applications, a four-shot scheme is used. A four-shot scheme has the advantage that the final dead time can be set sufficiently long to allow any thunderstorms to pass before reclosing for the final time. This arrangement prevents unnecessary lockout for consecutive transient faults.

Typically, the first trip, and sometimes the second, will result from instantaneous protection. Since most faults are transient, the subsequent trips will be time delayed, all with increasing dead times to clear semi-permanent faults.

An important consideration is the ability of the circuit breaker to perform several trip-close operations in quick succession and the affect of these operations on the circuit maintenance period.

On EHV transmission circuits with high fault levels, only one re-closure is normally applied, because of the damage that could be caused by multiple re-closures.

8.2 DEAD TIMER SETTING

The choice of dead time is dependent on the system. The main factors that can influence the choice of dead time are:

- Stability and synchronism requirements
- Operational convenience
- Load
- The type of circuit breaker
- Fault deionising time
- The protection reset time

8.2.1 STABILITY AND SYNCHRONISM REQUIREMENTS

It may be that the power transfer level on a specific feeder is such that the systems at either end of the feeder could quickly fall out of synchronism if the feeder is opened. If this is the case, it is usually necessary to reclose the feeder as quickly as possible to prevent loss of synchronism. This is called high speed autoreclosing (HSAR). In this situation, the dead time setting should be adjusted to the minimum time necessary. This time setting should comply with the minimum dead time limitations imposed by the circuit breaker and associated protection, which should be enough to allow complete deionisation of the fault path and restoration of the full voltage withstand level. Typical HSAR dead time values are between 0.3 and 0.5 seconds.

On a closely interconnected transmission system, where alternative power transfer paths usually hold the overall system in synchronism even when a specific feeder opens, or on a radial supply system where there are no stability implications, it is often preferred to leave a feeder open for a few seconds after fault clearance. This allows the system to stabilise, and reduces the shock to the system on re-closure. This is called slow or delayed auto-reclosing (DAR). The dead time setting for DAR is usually selected for operational convenience.

8.2.2 OPERATIONAL CONVENIENCE

When HSAR is not required, the dead time chosen for the first re-closure following a fault trip is not critical. It should be long enough to allow any resulting transients resulting to decay, but not so long as to cause major inconvenience to consumers who are affected by the loss of the feeder. The setting chosen often depends on service experience with the specific feeder.

Typical first shot dead time settings on 11 kV distribution systems are 5 to 10 seconds. In situations where two parallel circuits from one substation are carried on the same towers, it is often arranged for the dead times on the

two circuits to be staggered, e.g. one at 5 seconds and the other at 10 seconds, so that the two circuit breakers do not reclose simultaneously following a fault affecting both circuits.

For multi-shot Autoreclose cycles, the second shot and subsequent shot dead times are usually longer than the first shot, to allow time for semi-permanent faults to burn clear, and for the CB to recharge. Typical second and third shot dead time settings are 30 seconds and 60 seconds respectively.

8.2.3 LOAD REQUIREMENTS

Some types of electrical load might have specific requirements for minimum and/or maximum dead time, to prevent damage and minimise disruption. For example, synchronous motors are only capable of tolerating extremely short supply interruptions without losing synchronism. In practise it is desirable to disconnect the motor from the supply in the event of a fault; the dead time would normally be sufficient to allow a controlled shutdown. Induction motors, on the other hand, can withstand supply interruptions up to typically 0.5 seconds and re-accelerate successfully.

8.2.4 CIRCUIT BREAKER

For HSAR, the minimum dead time of the power system will depend on the minimum time delays imposed by the circuit breaker during a tripping and reclose operation.

After tripping, time must be allowed for the mechanism to reset before applying a closing pulse, otherwise the circuit breaker might fail to close correctly. This resetting time will vary depending on the circuit breaker, but is typically 0.1 seconds.

Once the mechanism has reset, a CB Close signal can be applied. The time interval between energising the closing mechanism and making the contacts is called the closing time. A solenoid closing mechanism may take up to 0.3 seconds. A spring-operated breaker, on the other hand, can close in less than 0.1 seconds.

Where HSAR is required, for the majority of medium voltage applications, the circuit breaker mechanism reset time itself dictates the minimum dead time. This would be the mechanism reset time plus the CB closing time. A solenoid mechanism is not suitable for high speed Autoreclose as the closing time is generally too long.

For most circuit breakers, after one reclosure, it is necessary to recharge the closing mechanism energy source before a further reclosure can take place. Therefore the dead time for second and subsequent shots in a multi-shot sequence must be set longer than the spring or gas pressure recharge time.

8.2.5 FAULT DE-IONISATION TIME

For HSAR, the fault deionising time may be the most important factor when considering the dead time. This is the time required for ionised air to disperse around the fault position so that the insulation level of the air is restored. You cannot accurately predict this, but you can obtain an approximation from the following formula:

Deionising time = (10.5 + ((system voltage in kV)/34.5))/frequency

Examples:

At 66 kV 50 Hz, the deionising time is approximately 0.25 s

At 132 kV 60 Hz, the deionising time is approximately 0.29 s

8.2.6 PROTECTION RESET TIME

It is essential that any time-graded protection fully resets during the dead time, so that correct time discrimination will be maintained after reclosing on to a fault. For HSAR, instantaneous reset of protection is required. However at distribution level, where the protection is predominantly made up of overcurrent and earth fault devices, the protection reset time may not be instantaneous. In the event that the circuit breaker recloses on to a fault and the protection has not fully reset, discrimination may be lost with the downstream protection. To avoid this condition the dead time must be set in excess of the slowest reset time of either the local device or any downstream protection.

Typical 11/33 kV dead time settings are as follows:

1st dead time = 5 - 10 seconds

2nd dead time = 30 seconds

3rd dead time = 60 - 180 seconds

4th dead time = 1 - 30 minutes

8.3 RECLAIM TIMER SETTING

A number of factors influence the choice of the reclaim timer:

- Supply continuity: Large reclaim times can result in unnecessary lockout for transient faults.
- Fault incidence/Past experience: Small reclaim times may be required where there is a high incidence of lightning strikes to prevent unnecessary lockout for transient faults.
- Spring charging time: For HSAR the reclaim time may be set longer than the spring charging time to ensure there is sufficient energy in the circuit breaker to perform a trip-close-trip cycle. For delayed Autoreclose there is no need as the dead time can be extended by an extra CB healthy check window time if there is insufficient energy in the CB. If there is insufficient energy after the check window time the IED will lockout.
- Switchgear maintenance: Excessive operation resulting from short reclaim times can mean shorter maintenance periods. A minimum reclaim time of more than 5 seconds may be needed to allow the circuit breaker time to recover after a trip and close before it can perform another trip-close-trip cycle. This time will depend on the circuit breaker's duty rating.

The reclaim time must be long enough to allow any time-delayed protection initiating Autoreclose to operate. Failure to do so would result in premature resetting of the Autoreclose scheme and re-enabling of instantaneous protection. If this condition arose, a permanent fault would effectively look like a number of transient faults, resulting in continuous autoreclosing, unless additional measures are taken such as excessive fault frequency lockout protection.

Sensitive earth fault protection is applied to detect high resistance earth faults and usually has a long time delay, typically 10 - 15 seconds. This longer time may have to be taken into consideration, if autoreclosing from SEF protection. High resistance earth faults are rarely transient and may be a danger to the public. It is therefore common practise to block Autoreclose by operation of sensitive earth fault protection and lockout the circuit breaker.

A typical 11/33 kV reclaim time is 5 - 10 seconds. This prevents unnecessary lockout during thunderstorms. However, reclaim times of up to 60 - 180 seconds may be used elsewhere in the world.

CHAPTER 9

MONITORING AND CONTROL

1 CHAPTER OVERVIEW

As well as providing a range of protection functions, the product includes comprehensive monitoring and control functionality.

This chapter contains the following sections:

Chapter Overview 151
Event Records 152
Disturbance Recorder 160
Measurements 161
CB Condition Monitoring 162
CB State Monitoring 163
Circuit Breaker Control 165
System Checks 170
Switch Status and Control 177

2 EVENT RECORDS

General Electric devices record events in an event log. This allows you to establish the sequence of events that led up to a particular situation. For example, a change in a digital input signal or protection element output signal would cause an event record to be created and stored in the event log. This could be used to analyse how a particular power system condition was caused. These events are stored in the IED's non-volatile memory. Each event is time tagged.

The event records can be displayed on an IED's front panel but it is easier to view them through the settings application software. This can extract the events log from the device and store it as a single .evt file for analysis on a PC.

The event records are detailed in the *VIEW RECORDS* column. The first event (0) is always the latest event. After selecting the required event, you can scroll through the menus to obtain further details.

If viewing the event with the settings application software, simply open the extracted event file. All the events are displayed chronologically. Each event is summarised with a time stamp obtained from the ***Time & Date*** cell) and a short description relating to the event obtained from the ***Event Text*** cell). You can expand the details of the event by clicking on the **+** icon to the left of the time stamp.

The following table shows the correlation between the fields in the setting application software's event viewer and the cells in the menu database.

Field in Event Viewer	Equivalent cell in menu DB	Cell reference	User settable?
Left hand column header	VIEW RECORDS → Time & Date	01 03	No
Right hand column header	VIEW RECORDS → Event Text	01 04	No
Description	SYSTEM DATA → Description	00 04	Yes
Plant reference	SYSTEM DATA → Plant Reference	00 05	Yes
Model number	SYSTEM DATA → Model Number	00 06	No
Address	Displays the Courier address relating to the event	N/A	No
Event type	VIEW RECORDS → Menu Cell Ref	01 02	No
Event Value	VIEW RECORDS → Event Value	01 05	No
Evt Unique Id	VIEW RECORDS → Evt Unique ID	01 FE	No

The device is capable of storing up to 2048 event records.

In addition to the event log, there are two additional logs which contain duplicates of the last 10 maintenance records and the last 10 fault records. The purpose of this is to provide convenient access to the most recent fault and maintenance events.

2.1 EVENT TYPES

There are several different types of event:

- Opto-input events (Change of state of opto-input)
- Contact events (Change of state of output relay contact)
- Alarm events
- Fault record events
- Standard events
- Security events

Standard events are further sub-categorised internally to include different pieces of information. These are:

- Protection events (starts and trips)
- Maintenance record events
- Platform events

Note:
The first event in the list (event 0) is the most recent event to have occurred.

2.1.1 OPTO-INPUT EVENTS

If one or more of the opto-inputs has changed state since the last time the protection algorithm ran (which runs at several times per cycle), a new event is created, which logs the logic states of all opto-inputs. You can tell which opto-input has changed state by comparing the new event with the previous one.

The description of this event type, as shown in the ***Event Text*** cell is always `Logic Inputs #` where # is the batch number of the opto-inputs. This is '1', for the first batch of opto-inputs and '2' for the second batch of opto-inputs (if applicable).

The event value shown in the ***Event Value*** cell for this type of event is a binary string. This shows the logical states of the opto-inputs, where the Least Significant Bit (LSB), on the right corresponds to the first opto-input `Input L1`.

The same information is also shown in the ***Opto I/P Status*** cell in the *SYSTEM DATA* column. This information is updated continuously, whereas the information in the event log is a snapshot at the time when the event was created.

2.1.2 CONTACT EVENTS

If one or more of the output relays (also known as output contacts) has changed state since the last time the protection algorithm ran (which runs at several times per cycle), a new event is created, which logs the logic states of all output relays. You can tell which output relay has changed state by comparing the new event with the previous one.

The description of this event type, as shown in the ***Event Text*** cell is always `Output Contacts #` where # is the batch number of the output relay contacts. This is '1', for the first batch of output contacts and '2' for the second batch of output contacts (if applicable).

The event value shown in the ***Event Value*** cell for this type of event is a binary string. This shows the logical states of the output relays, where the LSB (on the right) corresponds to the first output contact `Output R1`.

The same information is also shown in the ***Relay O/P Status*** cell in the *SYSTEM DATA* column. This information is updated continuously, whereas the information in the event log is a snapshot at the time when the event was created.

2.1.3 ALARM EVENTS

The IED monitors itself on power up and continually thereafter. If it notices any problems, it will register an alarm event.

The description of this event type, as shown in the ***Event Text*** cell is cell dependent on the type of alarm and will be one of those shown in the following tables, followed by `OFF` or `ON`.

The event value shown in the ***Event Value*** cell for this type of event is a 32 bit binary string. There are one or more banks 32 bit registers, depending on the device model. These contain all the alarm types and their logic states (`ON` or `OFF`).

The same information is also shown in the ***Alarm Status (n)*** cells in the *SYSTEM DATA* column. This information is updated continuously, whereas the information in the event log is a snapshot at the time when the event was created.

Alarm Status 1

Bit No.	Bit Mask 2nd register, 1st register	Alarm Description
Bit 0	0x0000, 0x0001	Thermal Lockout
Bit 1	0x0000, 0x0002	HIF Alarm
Bit 2	0x0000, 0x0004	SG-opto Invalid ON/OFF
Bit 3	0x0000, 0x0008	Prot'n Disabled ON/OFF
Bit 4	0x0000, 0x0010	F out of Range ON/OFF
Bit 5	0x0000, 0x0020	VT Fail Alarm ON/OFF
Bit 6	0x0000, 0x0040	CT Fail Alarm ON/OFF
Bit 7	0x0000, 0x0080	CB Fail Alarm ON/OFF
Bit 8	0x0000, 0x0100	I^ Maint Alarm ON/OFF
Bit 9	0x0000, 0x0200	I^ Lockout Alarm ON/OFF
Bit 10	0x0000, 0x0400	CB Ops Maint ON/OFF
Bit 11	0x0000, 0x0800	CB Ops Lockout ON/OFF
Bit 12	0x0000, 0x1000	CB Op Time Maint ON/OFF
Bit 13	0x0000, 0x2000	CB Op Time Lock ON/OFF
Bit 14	0x0000, 0x4000	Fault Freq Lock ON/OFF
Bit15	0x0000, 0x8000	CB Status Alarm ON/OFF
Bit 16	0x0001, 0x0000	Man CB Trip Fail ON/OFF
Bit17	0x0002, 0x0000	Man CB Cls Fail ON/OFF
Bit 18	0x0004, 0x0000	Man CB Unhealthy ON/OFF
Bit 19	0x0008, 0x0000	Man No Checksync ON/OFF
Bit 20	0x0010, 0x0000	A/R Lockout ON/OFF
Bit 21	0x0020, 0x0000	A/R CB Unhealthy ON/OFF
Bit 22	0x0040, 0x0000	A/R No Checksync ON/OFF
Bit 23	0x0080, 0x0000	System Split ON/OFF
Bit 24	0x0100, 0x0000	UV Block ON/OFF
Bit 25	0x0200, 0x0000	User Alarm 1 ON/OFF
Bit 26	0x0400, 0x0000	User Alarm 2 ON/OFF
Bit 27	0x0800, 0x0000	User Alarm 3 ON/OFF
Bit 28	0x1000, 0x0000	User Alarm 4 ON/OFF
Bit 29	0x2000, 0x0000	User Alarm 5 ON/OFF
Bit 30	0x4000, 0x0000	User Alarm 6 ON/OFF
Bit 31	0x8000, 0x0000	User Alarm 7 ON/OFF

Alarm Status 2

Bit No.	Bit Mask 2nd register, 1st register	Alarm Description
Bit 1	0x0000, 0x0001	Time Betwe Start (motor protection models only)
Bit 2	0x0000, 0x0002	Hot Start Nb. (motor protection models only)
Bit 3	0x0000, 0x0004	Cold Start Nb. (motor protection models only)

Bit No.	Bit Mask 2nd register, 1st register	Alarm Description
Bit 4	0x0000, 0x0008	Antibkspin Alarm (motor protection models only)
Bit 5	0x0000, 0x0010	User Alarm 8
Bit 6	0x0000, 0x0020	User Alarm 9
Bit 7	0x0000, 0x0040	User Alarm 10
Bit 8	0x0000, 0x0080	User Alarm 11
Bit 9	0x0000, 0x0100	User Alarm 12
Bit 10	0x0000, 0x0200	User Alarm 13
Bit 11	0x0000, 0x0400	User Alarm 14
Bit 12	0x0000, 0x0800	User Alarm 15
Bit 13	0x0000, 0x1000	User Alarm 16
Bit 14	0x0000, 0x2000	User Alarm 17
Bit 15	0x0000, 0x4000	User Alarm 18
Bit 16	0x0000, 0x8000	User Alarm 19
Bit 17	0x0001, 0x0000	User Alarm 20
Bit 18	0x0002, 0x0000	User Alarm 21
Bit 19	0x0004, 0x0000	User Alarm 22
Bit 20	0x0008, 0x0000	User Alarm 23
Bit 21	0x0010, 0x0000	User Alarm 24
Bit 22	0x0020, 0x0000	User Alarm 25
Bit 23	0x0040, 0x0000	User Alarm 26
Bit 24	0x0080, 0x0000	User Alarm 27
Bit 25	0x0100, 0x0000	User Alarm 28
Bit 26	0x0200, 0x0000	User Alarm 29
Bit 27	0x0400, 0x0000	User Alarm 30
Bit 28	0x0800, 0x0000	User Alarm 31
Bit 29	0x1000, 0x0000	User Alarm 32
Bit 30	0x2000, 0x0000	MR User Alarm 33
Bit 31	0x4000, 0x0000	MR User Alarm 34
Bit 32	0x8000, 0x0000	MR User Alarm 35

Alarm Status 3

Bit No.	Bit Mask 2nd register, 1st register	Alarm Description
Bit 1	0x00000001	DC Supply Fail
Bit 2	0x00000002	Unused
Bit 3	0x00000004	Unused
Bit 4	0x00000008	GOOSE IED Absent
Bit 5	0x00000010	NIC Not Fitted
Bit 6	0x00000020	NIC No Response

Bit No.	Bit Mask 2nd register, 1st register	Alarm Description
Bit 7	0x00000040	NIC Fatal Error
Bit 8	0x00000080	Unused
Bit 9	0x00000100	Bad TCP/IP Cfg.
Bit 10	0x00000200	Unused
Bit 11	0x00000400	NIC Link Fail
Bit 12	0x00000800	NIC SW Mis-Match
Bit 13	0x00001000	IP Addr Conflict
Bit 14	0x00002000	Unused
Bit 15	0x00004000	Unused
Bit 16	0x00008000	Unused
Bit 17	0x00010000	Unused
Bit 18	0x00020000	Unused
Bit 19	0x00040000	Bad DNP Settings
Bit 20	0x00080000	Unused
Bit 21	0x00100000	Unused
Bit 22	0x00200000	Unused
Bit 23	0x00400000	Unused
Bit 24	0x00800000	Unused
Bit 25	0x01000000	Unused
Bit 26	0x02000000	Unused
Bit 27	0x04000000	Unused
Bit 28	0x08000000	Unused
Bit 29	0x10000000	Unused
Bit 30	0x20000000	Unused
Bit 31	0x40000000	Unused
Bit 32	0x80000000	Unused

Alarm Status 4

Alarm Status 4 setting values are reserved.

User Alarms

Bit No.	Bit Mask 2nd register, 1st register	Alarm Description
Bit 1	0x0000,0x0001	User Alarm 1 (0=Self-reset, 1=Manual reset)
Bit 2	0x0000,0x0002	User Alarm 2 (0=Self-reset, 1=Manual reset)
Bit 3	0x0000,0x0004	User Alarm 3 (0=Self-reset, 1=Manual reset)
Bit 4	0x0000,0x0008	User Alarm 4 (0=Self-reset, 1=Manual reset)
Bit 5	0x0000,0x0010	User Alarm 5 (0=Self-reset, 1=Manual reset)
Bit 6	0x0000,0x0020	User Alarm 6 (0=Self-reset, 1=Manual reset)

Bit No.	Bit Mask 2nd register, 1st register	Alarm Description
Bit 7	0x0000,0x0040	User Alarm 7 (0=Self-reset, 1=Manual reset)
Bit 8	0x0000,0x0080	User Alarm 8 (0=Self-reset, 1=Manual reset)
Bit 9	0x0000,0x0100	User Alarm 9 (0=Self-reset, 1=Manual reset)
Bit 10	0x0000,0x0200	User Alarm 10 (0=Self-reset, 1=Manual reset)
Bit 11	0x0000,0x0400	User Alarm 11 (0=Self-reset, 1=Manual reset)
Bit 12	0x0000,0x0800	User Alarm 12 (0=Self-reset, 1=Manual reset)
Bit 13	0x0000,0x1000	User Alarm 13 (0=Self-reset, 1=Manual reset)
Bit 14	0x0000,0x2000	User Alarm 14 (0=Self-reset, 1=Manual reset)
Bit 15	0x0000,0x4000	User Alarm 15 (0=Self-reset, 1=Manual reset)
Bit 16	0x0000,0x8000	User Alarm 16 (0=Self-reset, 1=Manual reset)
Bit 17	0x0001,0x0000	User Alarm 17 (0=Self-reset, 1=Manual reset)
Bit 18	0x0002,0x0000	User Alarm 18 (0=Self-reset, 1=Manual reset)
Bit 19	0x0004,0x0000	User Alarm 19 (0=Self-reset, 1=Manual reset)
Bit 20	0x0008,0x0000	User Alarm 20 (0=Self-reset, 1=Manual reset)
Bit 21	0x0010,0x0000	User Alarm 21 (0=Self-reset, 1=Manual reset)
Bit 22	0x0020,0x0000	User Alarm 22 (0=Self-reset, 1=Manual reset)
Bit 23	0x0040,0x0000	User Alarm 23 (0=Self-reset, 1=Manual reset)
Bit 24	0x0080,0x0000	User Alarm 24 (0=Self-reset, 1=Manual reset)
Bit 25	0x0100,0x0000	User Alarm 25 (0=Self-reset, 1=Manual reset)
Bit 26	0x0200,0x0000	User Alarm 26 (0=Self-reset, 1=Manual reset)
Bit 27	0x0400,0x0000	User Alarm 27 (0=Self-reset, 1=Manual reset)
Bit 28	0x0800,0x0000	User Alarm 28 (0=Self-reset, 1=Manual reset)
Bit 29	0x1000,0x0000	User Alarm 29 (0=Self-reset, 1=Manual reset)
Bit 30	0x2000,0x0000	User Alarm 30 (0=Self-reset, 1=Manual reset)
Bit 31	0x4000,0x0000	User Alarm 31 (0=Self-reset, 1=Manual reset)
Bit 32	0x8000,0x0000	User Alarm 32 (0=Self-reset, 1=Manual reset)

Note:
User Alarms 1 to 32 are fully settable in the USER ALARMS column:

Note:
Alarm texts can be changed via menu

Note:
Alarm types can changed via menu (Self-reset or Manual reset

2.1.4 FAULT RECORD EVENTS

An event record is created for every fault the IED detects. This is also known as a fault record.

The event type description shown in the ***Event Text*** cell for this type of event is always `Fault Recorded`.

The IED contains a separate register containing the latest fault records. This provides a convenient way of viewing the latest fault records and saves searching through the event log. You access these fault records using the ***Select Fault*** setting, where fault number 0 is the latest fault.

A fault record is triggered by the ***Fault REC TRIG*** signal DDB, which is assigned in the PSL. The fault recorder records the values of all parameters associated with the fault for the duration of the fault. These parameters are stored in separate Courier cells, which become visible depending on the type of fault.

The fault recorder stops recording only when:

The Start signal is reset AND the undercurrent is ON OR the Trip signal is reset, as shown below:

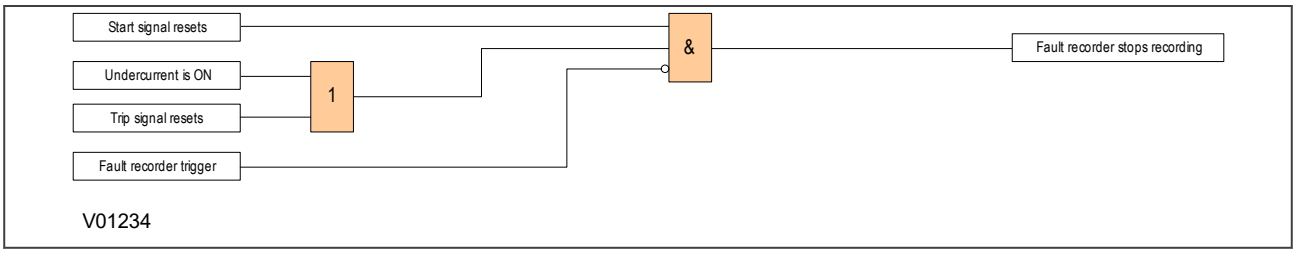


Figure 65: Fault recorder stop conditions

The event is logged as soon as the fault recorder stops. The time stamp assigned to the fault corresponds to the start of the fault. The timestamp assigned to the fault record event corresponds to the time when the fault recorder stops.

Note:
We recommend that you do not set the triggering contact to latching. This is because if you use a latching contact, the fault record would not be generated until the contact has been fully reset.

2.1.5 MAINTENANCE EVENTS

Internal failures detected by the self-test procedures are logged as maintenance records. Maintenance records are special types of standard events.

The event type description shown in the ***Event Text*** cell for this type of event is always `Maint Recorded`.

The ***Event Value*** cell also provides a unique binary code.

The IED contains a separate register containing the latest maintenance records. This provides a convenient way of viewing the latest maintenance records and saves searching through the event log. You access these fault records using the ***Select Maint*** setting.

The maintenance record has a number of extra menu cells relating to the maintenance event. These parameters are ***Maint Text***, ***Maint Type*** and ***Maint Data***. They contain details about the maintenance event selected with the ***Select Maint*** cell.

2.1.6 PROTECTION EVENTS

The IED logs protection starts and trips as individual events. Protection events are special types of standard events.

The event type description shown in the ***Event Text*** cell for this type of event is dependent on the protection event that occurred. Each time a protection event occurs, a DDB signal changes state. It is the name of this DDB signal followed by 'ON' or 'OFF' that appears in the ***Event Text*** cell.

The ***Event Value*** cell for this type of event is a 32 bit binary string representing the state of the relevant DDB signals. These binary strings can also be viewed in the *COMMISSION TESTS* column in the relevant DDB batch cells.

Not all DDB signals can generate an event. Those that can are listed in the *RECORD CONTROL* column. In this column, you can set which DDBs generate events.

2.1.7 SECURITY EVENTS

An event record is generated each time a setting that requires an access level is executed.

The event type description shown in the ***Event Text*** cell displays the type of change.

2.1.8 PLATFORM EVENTS

Platform events are special types of standard events.

The event type description shown in the ***Event Text*** cell displays the type of change.

3 DISTURBANCE RECORDER

The disturbance recorder feature allows you to record selected current and voltage inputs to the protection elements, together with selected digital signals. The digital signals may be inputs, outputs, or internal DDB signals. The disturbance records can be extracted using the disturbance record viewer in the settings application software. The disturbance record file can also be stored in the COMTRADE format. This allows the use of other packages to view the recorded data.

The integral disturbance recorder has an area of memory specifically set aside for storing disturbance records. The number of records that can be stored is dependent on the recording duration. The minimum duration is 0.1 s and the maximum duration is 10.5 s.

When the available memory is exhausted, the oldest records are overwritten by the newest ones.

Each disturbance record consists of a number of analogue data channels and digital data channels. The relevant CT and VT ratios for the analogue channels are also extracted to enable scaling to primary quantities.

The fault recording times are set by a combination of the ***Duration*** and ***Trigger Position*** cells. The ***Duration*** cell sets the overall recording time and the ***Trigger Position*** cell sets the trigger point as a percentage of the duration. For example, the default settings show that the overall recording time is set to 1.5 s with the trigger point being at 33.3% of this, giving 0.5 s pre-fault and 1 s post fault recording times.

With the ***Trigger Mode*** set to *Single*, if further triggers occurs whilst a recording is taking place, the recorder will ignore the trigger. However, with the ***Trigger Mode*** set to *Extended*, the post trigger timer will be reset to zero, extending the recording time.

You can select any of the IED's analogue inputs as analogue channels to be recorded. You can also map any of the opto-inputs output contacts to the digital channels. In addition, you may also map a number of DDB signals such as Starts and LEDs to digital channels.

You may choose any of the digital channels to trigger the disturbance recorder on either a low to high or a high to low transition, via the ***Input Trigger*** cell. The default settings are such that any dedicated trip output contacts will trigger the recorder.

It is not possible to view the disturbance records locally via the front panel LCD. You must extract these using suitable setting application software such as MiCOM S1 Agile.

4 MEASUREMENTS

4.1 MEASURED QUANTITIES

The device measures directly and calculates a number of system quantities, which are updated every second. You can view these values in the relevant MEASUREMENT columns or with the Measurement Viewer in the settings application software. Depending on the model, the device may measure and display some or more of the following quantities:

- Measured and calculated analogue current and voltage values
- Power and energy quantities
- Peak, fixed and rolling demand values
- Frequency measurements
- Thermal measurements

4.1.1 MEASURED AND CALCULATED VOLTAGES

The device measures phase-to-phase and phase-to-neutral voltage values. The values are produced by sampling the analogue input quantities, converting them to digital quantities to present the magnitude and phase values. Sequence quantities are produced by processing the measured values. These are also displayed as magnitude and phase angle values.

These measurements are contained in the *MEASUREMENTS 1* column.

4.1.2 FREQUENCY MEASUREMENTS

The device produces a range of frequency statistics and measurements relating to the Frequency Protection function. These include Check synchronisation and Slip frequency measurements found in the *MEASUREMENTS 1* column, Rate of Change of Frequency measurements found in the *MEASUREMENTS 3* column, and Frequency Protection statistics found in the *FREQUENCY STAT.* column.

The device produces the slip frequency measurement by measuring the rate of change of phase angle between the bus and line voltages, over a one-cycle period. The slip frequency measurement assumes the bus voltage to be the reference phasor.

4.1.3 OTHER MEASUREMENTS

Depending on the model, the device produces a range of other measurements such as thermal measurements.

These measurements are contained in the *MEASUREMENTS 3* column.

4.2 MEASUREMENT SETUP

You can define the way measurements are set up and displayed using the *MEASURE'T SETUP* column and the measurements are shown in the relevant MEASUREMENTS tables.

4.3 OPTO-INPUT TIME STAMPING

Each opto-input sample is time stamped within a tolerance of +/- 1 ms with respect to the Real Time Clock. These time stamps are used for the opto event logs and for the disturbance recording. The device needs to be synchronised accurately to an external clock source such as an IRIG-B signal or a master clock signal provided in the relevant data protocol.

For both the filtered and unfiltered opto-inputs, the time stamp of an opto-input change event is the sampling time at which the change of state occurred. If multiple opto-inputs change state at the same sampling interval, these state changes are reported as a single event.

5 CB CONDITION MONITORING

The device records various statistics related to each circuit breaker trip operation, allowing an accurate assessment of the circuit breaker condition to be determined. The circuit breaker condition monitoring counters are incremented every time the device issues a trip command.

These statistics are available in the *CB CONDITION* column. The menu cells are counter values only, and cannot be set directly. The counters may be reset, however, during maintenance. This is achieved with the setting ***Reset CB Data.***

Note:
When in Commissioning test mode the CB condition monitoring counters are not updated.

5.1 APPLICATION NOTES

5.1.1 SETTING THE THRESHOLDS FOR THE NUMBER OF OPERATIONS

Every circuit breaker operation results in some degree of wear for its components. Therefore routine maintenance, such as oiling of mechanisms, may be based on the number of operations. Suitable setting of the maintenance threshold will allow an alarm to be raised, indicating when preventative maintenance is due. Should maintenance not be carried out, the device can be set to lockout the autoreclose function on reaching a second operations threshold (***No. CB ops Lock***). This prevents further reclosure when the circuit breaker has not been maintained to the standard demanded by the switchgear manufacturer's maintenance instructions.

Some circuit breakers, such as oil circuit breakers (OCBs) can only perform a certain number of fault interruptions before requiring maintenance attention. This is because each fault interruption causes carbonising of the oil, degrading its dielectric properties. The maintenance alarm threshold (setting ***No. CB Ops Maint***) may be set to indicate the requirement for oil dielectric testing, or for more comprehensive maintenance. Again, the lockout threshold ***No. CB Ops Lock*** may be set to disable autoreclosure when repeated further fault interruptions could not be guaranteed. This minimises the risk of oil fires or explosion.

5.1.2 SETTING THE THRESHOLDS FOR THE OPERATING TIME

Slow CB operation indicates the need for mechanism maintenance. Alarm and lockout thresholds (***CB Time Maint*** and ***CB Time Lockout***) are provided to enforce this. They can be set in the range of 5 to 500 ms. This time relates to the interrupting time of the circuit breaker.

5.1.3 SETTING THE THRESHOLDS FOR EXCESSSIVE FAULT FREQUENCY

Persistent faults will generally cause autoreclose lockout, with subsequent maintenance attention. Intermittent faults such as clashing vegetation may repeat outside of any reclaim time, and the common cause might never be investigated. For this reason it is possible to set a frequent operations counter, which allows the number of operations ***Fault Freq Count*** over a set time period ***Fault Freq Time*** to be monitored. A separate alarm and lockout threshold can be set.

6 CB STATE MONITORING

CB State monitoring is used to verify the open or closed state of a circuit breaker. Most circuit breakers have auxiliary contacts through which they transmit their status (open or closed) to control equipment such as IEDs. These auxiliary contacts are known as:

- 52A for contacts that follow the state of the CB
- 52B for contacts that are in opposition to the state of the CB

This device can be set to monitor both of these types of circuit breaker state indication. If the state is unknown for some reason, an alarm can be raised.

Some CBs provide both sets of contacts. If this is the case, these contacts will normally be in opposite states. Should both sets of contacts be open, this would indicate one of the following conditions:

- Auxiliary contacts/wiring defective
- Circuit Breaker (CB) is defective
- CB is in isolated position

Should both sets of contacts be closed, only one of the following two conditions would apply:

- Auxiliary contacts/wiring defective
- Circuit Breaker (CB) is defective

If any of the above conditions exist, an alarm will be issued after a 5 s time delay. An output contact can be assigned to this function via the programmable scheme logic (PSL). The time delay is set to avoid unwanted operation during normal switching duties.

In the CB CONTROL column there is a setting called ***CB Status Input***. This cell can be set at one of the following four options:

- None
- 52A
- 52B
- Both 52A and 52B

Where *None* is selected no CB status is available. Where only 52A is used on its own then the device will assume a 52B signal opposite to the 52A signal. Circuit breaker status information will be available in this case but no discrepancy alarm will be available. The above is also true where only a 52B is used. If both 52A and 52B are used then status information will be available and in addition a discrepancy alarm will be possible, according to the following table:

Auxiliary Contact Position		CB State Detected	Action
52A	52B		
Open	Closed	Breaker open	Circuit breaker healthy
Closed	Open	Breaker closed	Circuit breaker healthy
Closed	Closed	CB failure	Alarm raised if the condition persists for greater than 5 s
Open	Open	State unknown	Alarm raised if the condition persists for greater than 5 s

6.1 CB STATE MONITORING LOGIC

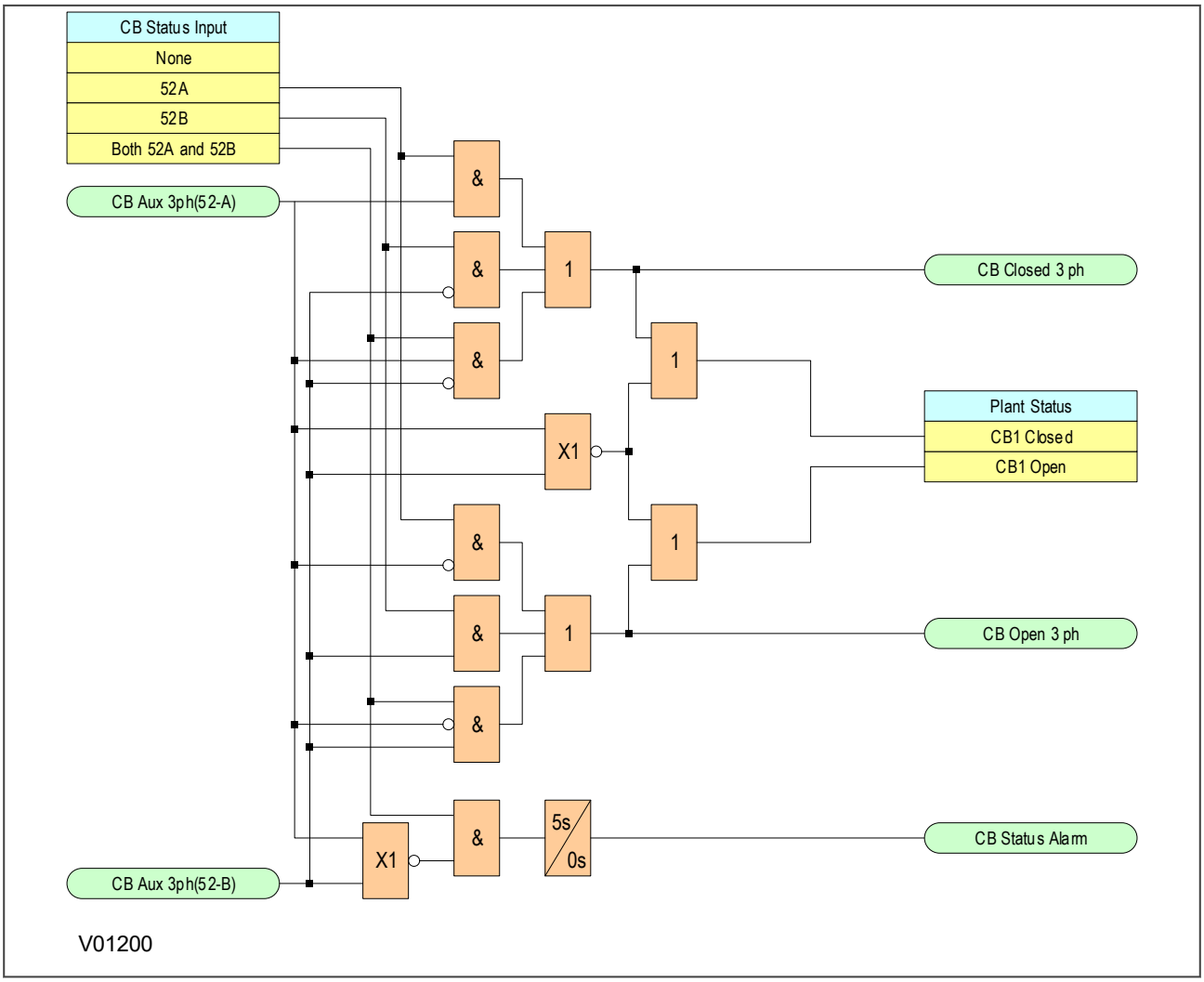


Figure 66: CB State Monitoring logic

7 CIRCUIT BREAKER CONTROL

Although some circuit breakers do not provide auxiliary contacts, most provide auxiliary contacts to reflect the state of the circuit breaker. These are:

- CBs with 52A contacts (where the auxiliary contact follows the state of the CB)
- CBs with 52B contacts (where the auxiliary contact is in the opposite state from the state of the CB)
- CBs with both 52A and 52B contacts

Circuit Breaker control is only possible if the circuit breaker in question provides auxiliary contacts. The ***CB Status Input*** cell in the *CB CONTROL* column must be set to the type of circuit breaker. If no CB auxiliary contacts are available then this cell should be set to `None`, and no CB control will be possible.

For local control, the ***CB control by*** cell should be set accordingly.

The output contact can be set to operate following a time delay defined by the setting ***Man Close Delay***. One reason for this delay is to give personnel time to safely move away from the circuit breaker following a CB close command.

The control close cycle can be cancelled at any time before the output contact operates by any appropriate trip signal, or by activating the ***Reset Close Dly*** DDB signal.

The length of the trip and close control pulses can be set via the ***Trip Pulse Time*** and **Close Pulse Time** settings respectively. These should be set long enough to ensure the breaker has completed its open or close cycle before the pulse has elapsed.

If an attempt to close the breaker is being made, and a protection trip signal is generated, the protection trip command overrides the close command.

The ***Reset Lockout by*** setting is used to enable or disable the resetting of lockout automatically from a manual close after the time set by ***Man Close RstDly***.

If the CB fails to respond to the control command (indicated by no change in the state of CB Status inputs) an alarm is generated after the relevant trip or close pulses have expired. These alarms can be viewed on the LCD display, remotely, or can be assigned to output contacts using the programmable scheme logic (PSL).

> *Note:*
> *The **CB Healthy Time** and **Sys Check time** set under this menu section are applicable to manual circuit breaker operations only. These settings are duplicated in the AUTORECLOSE menu for autoreclose applications.*

The ***Lockout Reset*** and ***Reset Lockout by*** settings are applicable to CB Lockouts associated with manual circuit breaker closure, CB Condition monitoring (Number of circuit breaker operations, for example) and autoreclose lockouts.

The device includes the following options for control of a single circuit breaker:

- The IED menu (local control)
- The Hotkeys (local control)
- The function keys (local control)
- The opto-inputs (local control)
- SCADA communication (remote control)

7.1 CB CONTROL USING THE IED MENU

You can control manual trips and closes with the ***CB Trip/Close*** command in the *SYSTEM DATA* column. This can be set to `No Operation`, `Trip`, or `Close` accordingly.

For this to work you have to set the ***CB control by*** cell to option 1 *Local*, option 3 *Local + Remote*, option 5 *Opto+Local*, or option 7 *Opto+Local+Remote* in the *CB CONTROL* column.

7.2 CB CONTROL USING THE HOTKEYS

The hotkeys allow you to manually trip and close the CB without the need to enter the *SYSTEM DATA* column. For this to work you have to set the ***CB control by*** cell to option 1 *Local*, option 3 *Local+Remote*, option 5 *Opto +Local*, or option 7 *Opto+Local+Remote* in the *CB CONTROL* column.

CB control using the hotkey is achieved by pressing the right-hand button directly below LCD screen. This button is only enabled if:

- The ***CB Control by*** setting is set to one of the options where local control is possible (option 1,3,5, or 7)
- The ***CB Status Input*** is set to '52A', '52B', or 'Both 52A and 52B'

If the CB is currently closed, the command text on the bottom right of the LCD screen will read *Trip*. Conversely, if the CB is currently open, the command text will read *Close*.

If you execute a *Trip*, a screen with the CB status will be displayed once the command has been completed. If you execute a *Close*, a screen with a timing bar will appear while the command is being executed. This screen also gives you the option to cancel or restart the close procedure. The time delay is determined by the ***Man Close Delay*** setting in the *CB CONTROL* menu. When the command has been executed, a screen confirming the present status of the circuit breaker is displayed. You are then prompted to select the next appropriate command or exit.

If no keys are pressed for a period of 5 seconds while waiting for the command confirmation, the device will revert to showing the CB Status. If no key presses are made for a period of 25 seconds while displaying the CB status screen, the device will revert to the default screen.

To avoid accidental operation of the trip and close functionality, the hotkey CB control commands are disabled for 10 seconds after exiting the hotkey menu.

The hotkey functionality is summarised graphically below:

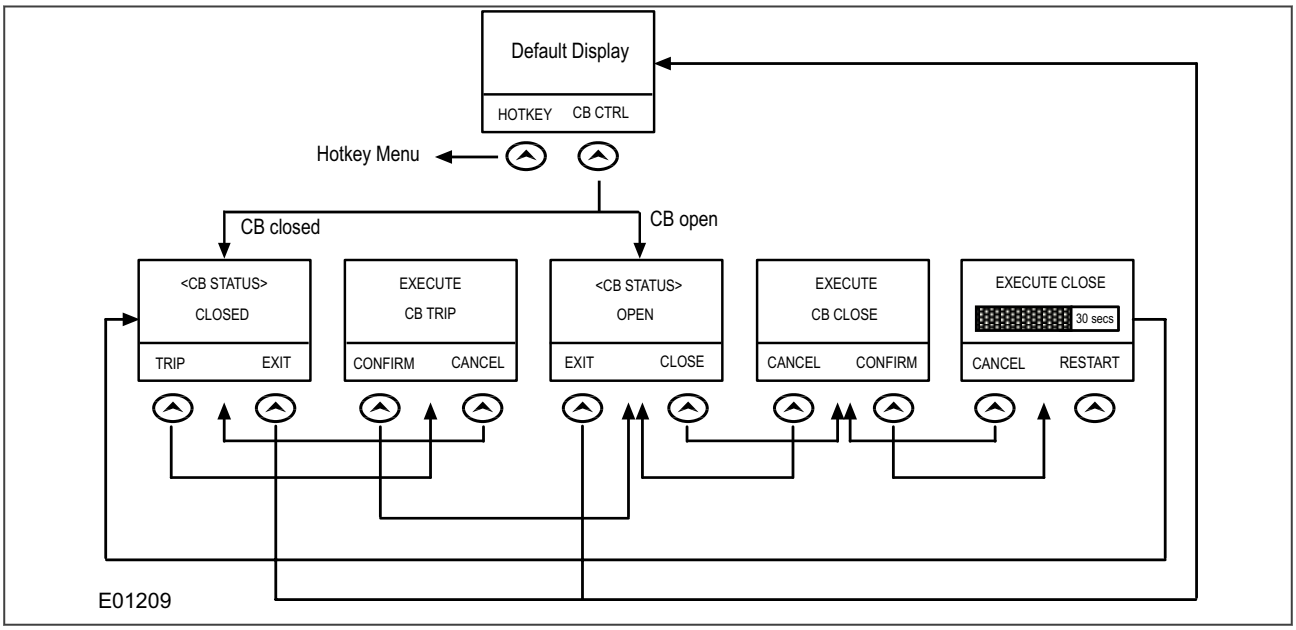


Figure 67: Hotkey menu navigation

7.3 CB CONTROL USING THE FUNCTION KEYS

For most models, you can also use the function keys to allow direct control of the circuit breaker. This has the advantage over hotkeys, that the LEDs associated with the function keys can indicate the status of the CB. The

default PSL is set up such that Function key 2 initiates a trip and Function key 3 initiates a close. For this to work you have to set the CB control by cell to option 5 *Opto+Local*, or option 7 *Opto+Local+Remote* in the *CB CONTROL* column.

As shown below, function keys 2 and 3 have already been assigned to CB control in the default PSL.

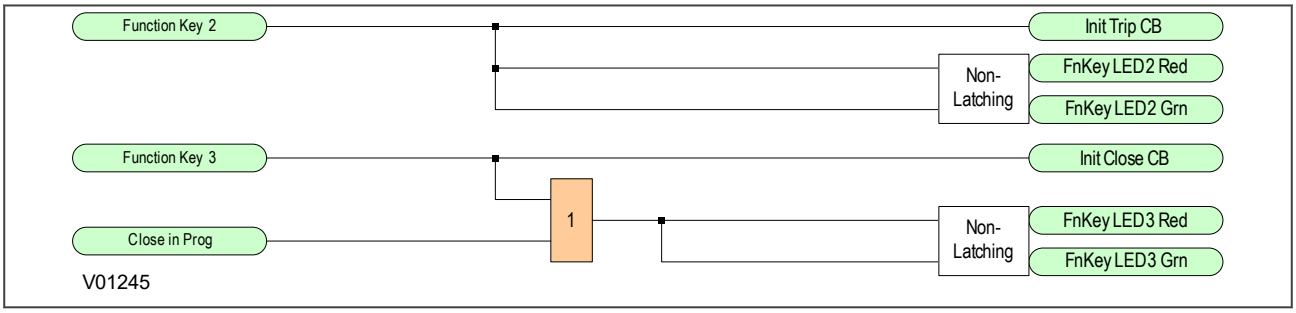


Figure 68: Default function key PSL

The programmable function key LEDs have been mapped such that they will indicate yellow whilst the keys are activated.

Note:
Not all models provide function keys.

7.4 CB CONTROL USING THE OPTO-INPUTS

Certain applications may require the use of push buttons or other external signals to control the various CB control operations. It is possible to connect such push buttons and signals to opto-inputs and map these to the relevant DDB signals.

For this to work, you have to set the ***CB control by*** cell to option 4 *opto*, option 5 *Opto+Local*, option 6 *Opto +Remote*, or option 7 *Opto+Local+Remote* in the *CB CONTROL* column.

7.5 REMOTE CB CONTROL

Remote CB control can be achieved by setting the ***CB Trip/Close*** cell in the *SYSTEM DATA* column to trip or close by using a command over a communication link.

For this to work, you have to set the ***CB control by*** cell to option 2 *Remote*, option 3 *Local+Remote*, option 6 *Opto+remote*, or option 7 *Opto+Local+Remote* in the *CB CONTROL* column.

We recommend that you allocate separate relay output contacts for remote CB control and protection tripping. This allows you to select the control outputs using a simple local/remote selector switch as shown below. Where this feature is not required the same output contact(s) can be used for both protection and remote tripping.

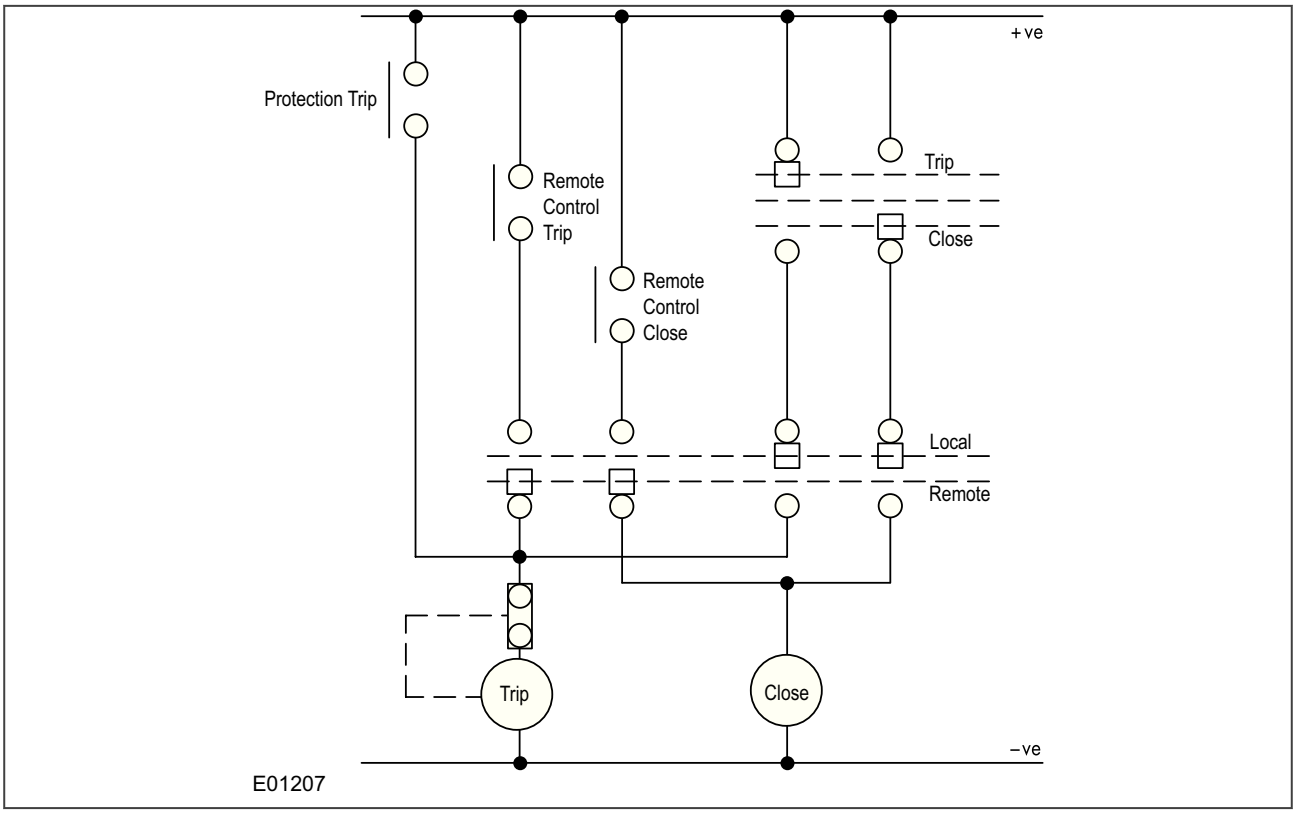


Figure 69: Remote Control of Circuit Breaker

7.6 SYNCHRONISATION CHECK

Where the check synchronism function is set, this can be enabled to supervise manual circuit breaker Close commands. A circuit breaker Close command will only be issued if the Check Synchronisation criteria are satisfied. A time delay can be set with the setting ***Sys Check time.*** If the Check Synchronisation criteria are not satisfied within the time period following a Close command the device will lockout and alarm.

7.7 CB HEALTHY CHECK

A CB Healthy check is available if required. This facility accepts an input to one of the opto-inputs to indicate that the breaker is capable of closing (e.g. that it is fully charged). A time delay can be set with the setting ***CB Healthy Time***. If the CB does not indicate a healthy condition within the time period following a Close command, the device will lockout and alarm.

7.8 CB CONTROL LOGIC

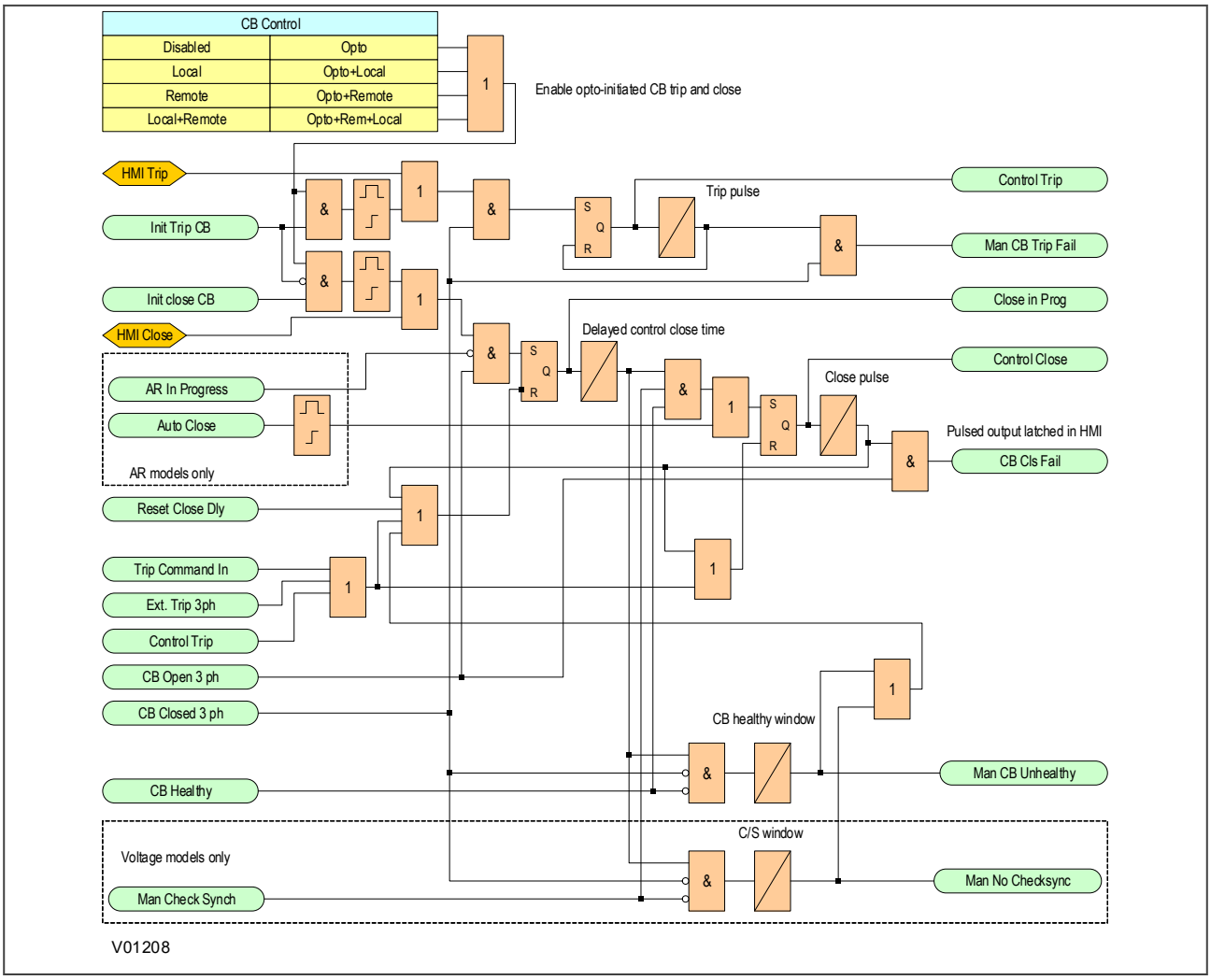


Figure 70: CB Control logic

8 SYSTEM CHECKS

In some situations it is possible for both "bus" and "line" sides of a circuit breaker to be live when a circuit breaker is open - for example at the ends of a feeder that has a power source at each end. Therefore, it is normally necessary to check that the network conditions on both sides are suitable, before closing the circuit breaker. This applies to both manual circuit breaker closing and autoreclosing. If a circuit breaker is closed when the line and bus voltages are both live, with a large phase angle, frequency or magnitude difference between them, the system could be subjected to an unacceptable shock, resulting in loss of stability, and possible damage to connected machines.

The System Checks functionality involves monitoring the voltages on both sides of a circuit breaker, and if both sides are live, performing a synchronisation check to determine whether any differences in voltage magnitude, phase angle or frequency are within permitted limits.

The pre-closing system conditions for a given circuit breaker depend on the system configuration, and for autoreclosing, on the selected autoreclose program. For example, on a feeder with delayed autoreclosing, the circuit breakers at the two line ends are normally arranged to close at different times. The first line end to close usually has a live bus and a dead line immediately before reclosing. The second line end circuit breaker now sees a live bus and a live line.

If there is a parallel connection between the ends of the tripped feeder the frequencies will be the same, but any increased impedance could cause the phase angle between the two voltages to increase. Therefore just before closing the second circuit breaker, it may be necessary to perform a synchronisation check, to ensure that the phase angle between the two voltages has not increased to a level that would cause unacceptable shock to the system when the circuit breaker closes.

If there are no parallel interconnections between the ends of the tripped feeder, the two systems could lose synchronism altogether and the frequency at one end could "slip" relative to the other end. In this situation, the second line end would require a synchronism check comprising both phase angle and slip frequency checks.

If the second line-end busbar has no power source other than the feeder that has tripped; the circuit breaker will see a live line and dead bus assuming the first circuit breaker has re-closed. When the second line end circuit breaker closes the bus will charge from the live line (dead bus charge).

8.1 SYSTEM CHECKS IMPLEMENTATION

The System Checks function provides *Live/Dead Voltage Monitoring*, two stages of *Check Synchronisation* and *System Split* indication.

The System Checks function is enabled or disabled by the ***System Checks*** setting in the *CONFIGURATION* column. If ***System Checks*** is disabled, the *SYSTEM CHECKS* menu becomes invisible, and a ***SysChks Inactive*** DDB signal is set.

8.1.1 VT CONNECTIONS

The device provides inputs for a three-phase "Main VT" and at least one single-phase VT for check synchronisation or residual voltage. Depending on the primary system arrangement, the Main VT may be located on either the line-side of the busbar-side of the circuit breaker, with the 4th VT on the other. Normally, the Main VT is located on the line-side (as per the default setting), but this is not always the case. For this reason, a setting is provided where you can define this. This is the ***Main VT Location*** setting, which is found in the *CT AND VT RATIOS* column.

The 4th VT may be connected to one of the phase-to-phase voltages or phase-to-neutral voltages. This needs to be defined using the ***CS Input*** setting in the *CT AND VT RATIOS* column. Options are, A-B, B-C, C-A, A-N, B-N, or C-N.

8.1.2 VOLTAGE MONITORING

The settings in the *VOLTAGE MONITORS* sub-heading in the *SYSTEM CHECKS* column allow you to define the threshold at which a voltage is considered live, and a threshold at which the voltage is considered dead. These thresholds apply to both line and bus sides. If the measured voltage falls below the ***Dead Voltage*** setting, a DDB signal is generated (***Dead Bus***, or ***Dead Line***, depending on which side is being measured). If the measured voltage

exceeds the ***Live Voltage*** setting, a DDB signal is generated (***Live Bus***, or ***Live Line***, depending on which side is being measured).

8.1.3 CHECK SYNCHRONISATION

The device provides two stages of Check Synchronisation. The first stage (CS1) is intended for use in synchronous systems. This means, where the frequencies and phase angles of both sides are compared and if the difference is within set limits, the circuit breaker is allowed to close. The second stage (CS2) is similar to stage, but has an additional adaptive setting. The second stage CS2 is intended for use in asynchronous systems, i.e. where the two sides are out of synchronism and one frequency is slipping continuously with respect to another. If the closing time of the circuit breaker is known, the CB Close command can be issued at a definite point in the cycle such that the CB closes at the point when both sides are in phase.

In situations where it is possible for the voltages on either side of a circuit breaker to be either synchronous or asynchronous, both CS1 and CS2 can be enabled to provide a CB Close signal if either set of permitted closing conditions is satisfied.

Each stage can also be set to inhibit circuit breaker closing if selected blocking conditions such as overvoltage, undervoltage or excessive voltage magnitude difference are detected. CS2 requires the phase angle difference to be decreasing in magnitude before permitting the circuit breaker to close. CS2 has an optional "Adaptive" closing feature, which issues the permissive close signal when the predicted phase angle difference immediately prior to the instant of circuit breaker main contacts closing (i.e. after CB Close time) is as close as practicable to zero.

Slip frequency is the rate of change of phase between each side of the circuit breaker, which is measured by the difference between the voltage signals on either side of the circuit breaker.

Having two system synchronism check stages available allows the circuit breaker closing to be enabled under different system conditions (for example, low slip / moderate phase angle, or moderate slip / small phase angle).

The settings specific to Check Synchronisation are found under the sub-heading *CHECK SYNC* in the *SYSTEM CHECKS* column. The only difference between the CS1 settings and the CS2 settings is that ***CS2 Slip Control*** setting has an option for predictive closure of CB (*Freq + CB Comp*).

8.1.4 CHECK SYNCRONISATION VECTOR DIAGRAM

The following vector diagram represents the conditions for the System Check functionality. The Dead Volts setting is represented as a circle around the origin whose radius is equal to the maximum voltage magnitude, whereby the voltage can be considered dead. The nominal line voltage magnitude is represented by a circle around the origin whose radius is equal to the nominal line voltage magnitude. The minimum voltage magnitude at which the system can be considered as Live, is the magnitude difference between the bus and line voltages.

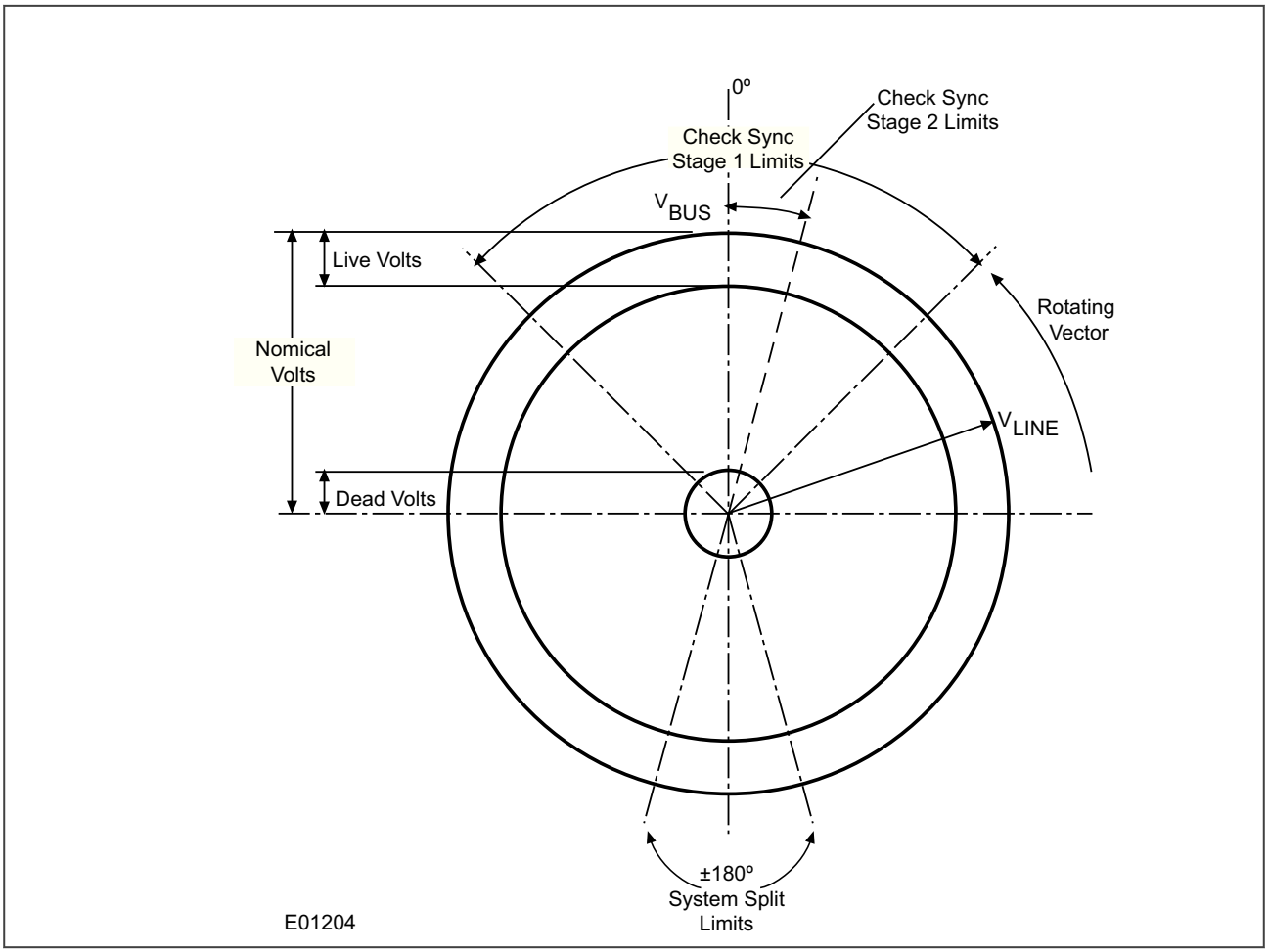


Figure 71: Check Synchronisation vector diagram

8.1.5 SYSTEM SPLIT

If the line side and bus side are of the same frequency (i.e. in synchronism) but have a large phase angle between them (180° +/- the set limits), the system is said to be 'Split'. If this is the case, the device will detect this and issue an alarm signal indicating this.

The settings specific to System Split functionality are found under the sub-heading *SYSTEM SPLIT* in the *SYSTEM CHECKS* column.

8.2 SYSTEM CHECK LOGIC

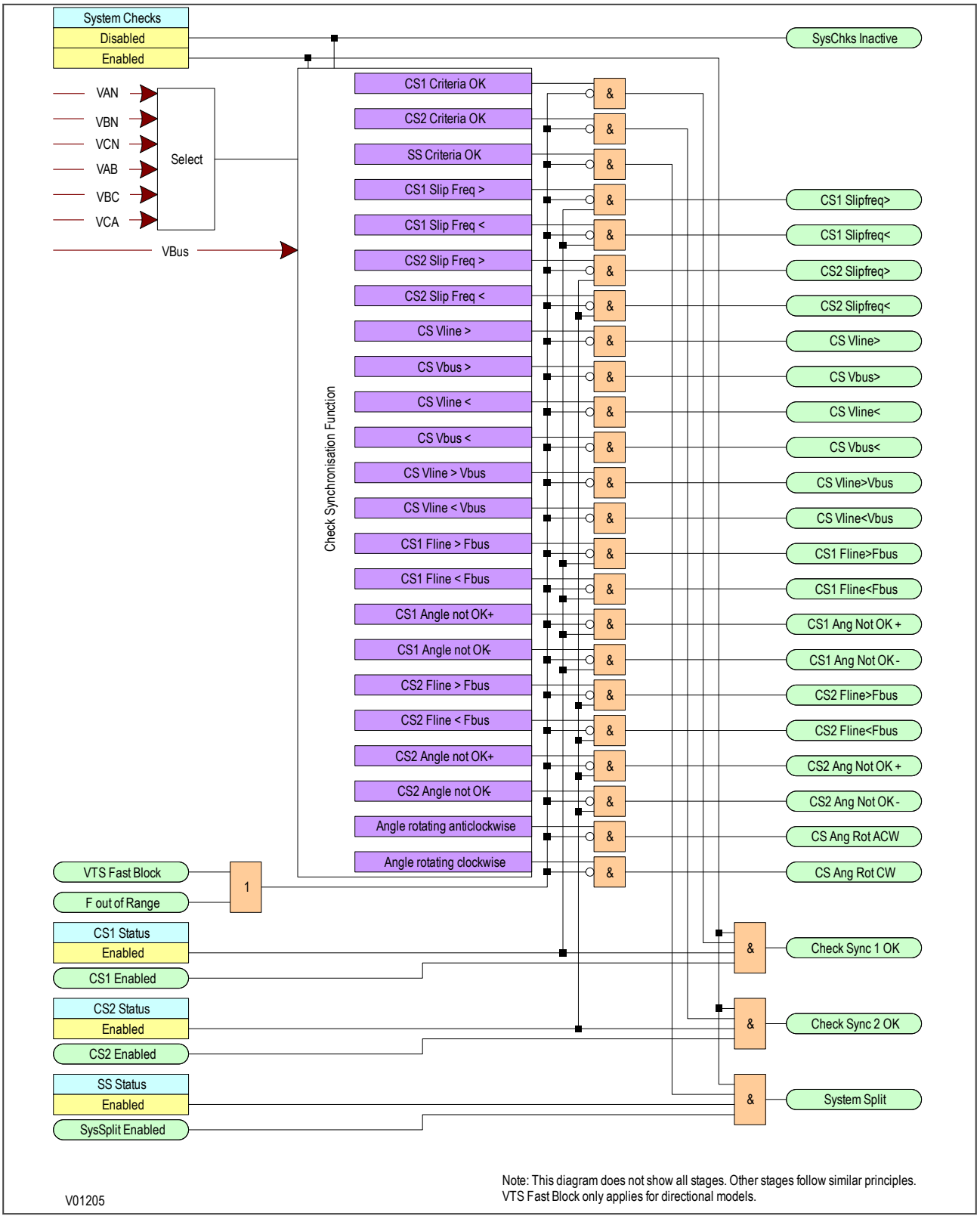


Figure 72: System Check logic

8.3 SYSTEM CHECK PSL

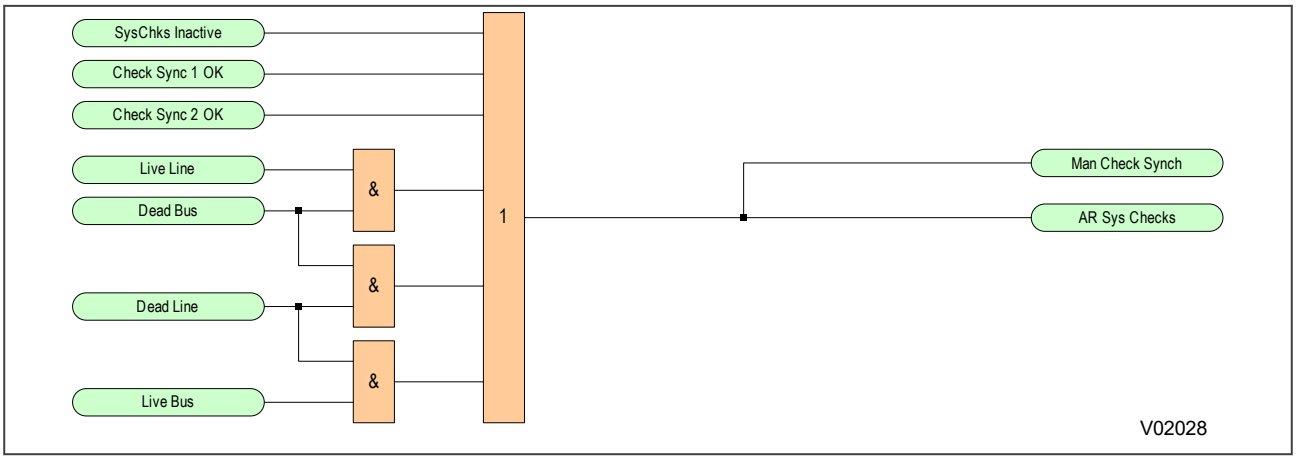


Figure 73: System Check PSL

8.4 APPLICATION NOTES

8.4.1 SLIP CONTROL

Slip control can be achieved by timer, by frequency or by both. The settings CS1 Slip Control and CS2 Slip Control are used to determine which type of slip control is to be used. As the device supports direct measurement of frequency, you would normally use frequency.

If you are using Slip Control by Timer, the combination of Phase Angle and Timer settings determines an effective maximum slip frequency, calculated as:

$$2A/360T - for\ CS1$$

$$A/360T - for\ CS2$$

where:

- A = Phase Angle setting in degrees
- T = Slip Timer setting in seconds

Examples

For CS1, where the Phase Angle setting is 30° and the Timer setting is 3.3 s, the “slipping” vector has to remain within +/- 30° of the reference vector for at least 3.3 seconds. Therefore a synchronisation check output will not be given if the slip is greater than 2 x 30° in 3.3 seconds.

Therefore, the maximum slip frequency = 2x30/360x3.3 = 0.0505 hz.

For CS2, where the Phase Angle setting is 10° and the Timer setting is 0.1 sec., the slipping vector has to remain within 10° of the reference vector, with the angle decreasing, for 0.1 sec. When the angle passes through zero and starts to increase, the synchronisation check output is blocked. Therefore an output will not be given if the slip is greater than 10° in 0.1 second.

Therefore, the maximum slip frequency = 10/360x0.1 = 0.278 Hz.

Slip control by Timer is not practical for “large slip/small phase angle” applications, because the timer settings required are very small, sometimes less than 0.1 seconds. For these situations, slip control by frequency is better.

If Slip Control by Frequency + Timer is selected, for an output to be given, the slip frequency must be less than BOTH the set Slip Freq. value and the value determined by the Phase Angle and Timer settings.

8.4.2 USE OF CHECK SYNC 2 AND SYSTEM SPLIT

Check Sync 2 (CS2) and System Split functions are included for situations where the maximum permitted slip frequency and phase angle for synchronism checks can change due to adverse system conditions. A typical application is on a closely interconnected system, where synchronism is normally retained when a feeder is tripped. But under some circumstances, with parallel interconnections out of service, the feeder ends can drift out of synchronism when the feeder is tripped. Depending on the system and machine characteristics, the conditions for safe circuit breaker closing could be, for example:

Condition 1: For synchronized systems, with zero or very small slip:

- Slip <50 mHz; phase angle <30°

Condition 2: For unsynchronized systems, with significant slip:

- Slip < 250 mHz; phase angle <10° and decreasing

By enabling both CS1 and CS2, the device can be configured to allow CB closure if either of the two conditions is detected.

For manual circuit breaker closing with synchronism check, some utilities might prefer to arrange the logic to check initially for condition 1 only. However, if a System Split is detected before the condition 1 parameters are satisfied, the device will switch to checking for condition 2 parameters instead, based on the assumption that a significant degree of slip must be present when system split conditions are detected. This can be arranged by suitable PSL logic, using the System Check DDB signals.

8.4.3 PREDICTIVE CLOSURE OF CIRCUIT BREAKER

The setting ***CS2 Slip Control*** setting contains an option (freq + CB comp) for compensating the time taken to close the CB. When set to provide CB Close Time compensation, a predictive approach is used to close the circuit breaker ensuring that closing occurs at close to 0º therefore minimising the impact to the power system. The actual closing angle is subject to the constraints of the existing product architecture, i.e. the protection task runs twice per power system cycle, based on frequency tracking over the frequency range of 40 Hz to 70 Hz.

8.4.4 VOLTAGE AND PHASE ANGLE CORRECTION

For the Check Synchronisation function, the device needs to convert measured secondary voltages into primary voltages. In some applications, VTs either side of the circuit breaker may have different VT Ratios. In such cases, a magnitude correction factor is required.

There are some applications where the main VT is on the HV side of a transformer and the 4th VT (used for Check Sync) is on the LV side, or vice-versa. If the vector group of the transformer is not "0", the voltages are not in phase, so phase correction is also necessary.

The correction factors are as follows and are located in the *CT AND VT RATIOS* column:

- 4th VT V kSM, where kSM is the voltage correction factor.
- 4th VT Phase kSA, where kSA is the angle correction factor.

Assuming the ***C/S input*** setting is A-N, then:

The line and bus voltage magnitudes are matched if $V_{a\ sec} = V_{cs\ sec} \times$ 4th VT V kSA

The line and bus voltage angles are matched if $\angle V_{a\ sec} = \angle V_{cs\ sec}$ + 4th VT Phase kSA

The following application scenarios show where the voltage and angular correction factors are applied to match different VT ratios:

Scenario	Physical Ratios (ph-N Values)				Setting Ratios				CS Correction Factors	
	Main VT Ratio		4th VT Ratio		Main VT Ratio (ph-ph) Always		4th VT Ratio		kSM	kSA
	Pri (kV)	Sec (V)	Pri (kV)	Sec (V)	Pri (kV)	Sec (V)	Pri (kV)	Sec (V)		
1	220/√3	110/√3	132/√3	100/√3	220	110	132	100	1.1	30º
2	220/√3	110/√3	220/√3	110	220	110	127	110	0.577	0º
3	220/√3	110/√3	220/√3	110/3	220	110	381	110	1.732	0º

9 SWITCH STATUS AND CONTROL

All P40 Agile products support Switch Status and Control for up to 8 switchgear elements in an IEC61850 substation. The device is able to monitor the status of and control up to eight switches. The types of switch that can be controlled are:

- Load Break switch
- Disconnector
- Earthing Switch
- High Speed Earthing Switch

Consider the following feeder bay:

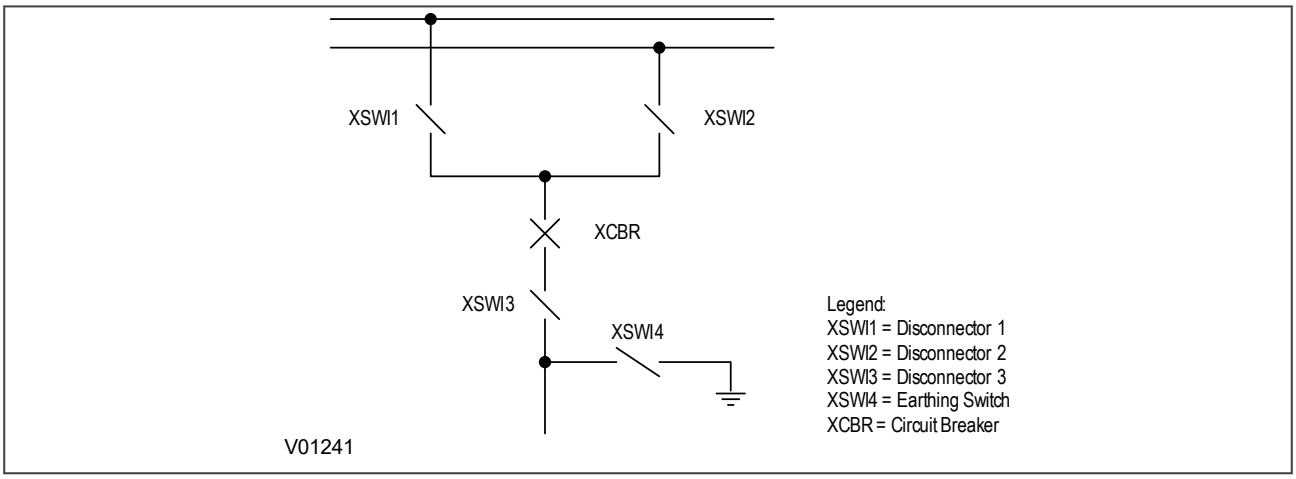


Figure 74: Representation of typical feeder bay

This bay shows four switches of the type LN XSWI and one circuit breaker of type LN XCBR. In this example, the switches XSWI1 – XSWI3 are disconnectors and XCSWI4 is an earthing switch.

For the device to be able to control the switches, the switches must provide auxiliary contacts to indicate the switch status. For convenience, the device settings refer to the auxiliary contacts as 52A and 52B, even though they are not circuit breakers.

There are eight sets of settings in the *SWITCH CONTROL* column, which allow you to set up the Switch control, one set for each switch. These settings are as follows:

SWITCH1 Type

This setting defines the type of switch. It can be a load breaking switch, a disconnector, an earthing switch or a high speed earthing switch.

SWI1 Status Inpt

This setting defines the type of auxiliary contacts that will be used for the control logic. For convenience, the device settings refer to the auxiliary contacts as 52A and 52B, even though they are not circuit breakers. "A" contacts match the status of the primary contacts, whilst "B" contacts are of the opposite polarity.

SWI1 Control by

This setting determines how the switch is to be controlled. This can be Local (using the device directly) remote (using a communications link), or both.

SWI1 Trip/Close

This is a command to directly trip or close the switch.

SWI1 Trp Puls T and ***SWI1 Cls Puls T***

These settings allow you to control the width of the open and close pulses.

SWI1 Sta Alrm T

This setting allows you to define the duration of wait timer before the relay raises a status alarm.

SWI1 Trp Alrm T and ***SWI1 Cls Alrm T***

These settings allow you to control the delay of the open and close alarms when the final switch status is not in line with expected status.

SWI1 Operations

This is a data cell, which displays the number of switch operations that have taken place. It is an accumulator, which you can reset using the ***Reset SWI1 Data*** setting

Reset SWI1 Data

This setting resets the switch monitoring data.

Note:
Settings for switch 1 are shown, but settings for all other switch elements are the same.

9.1 SWITCH STATUS LOGIC

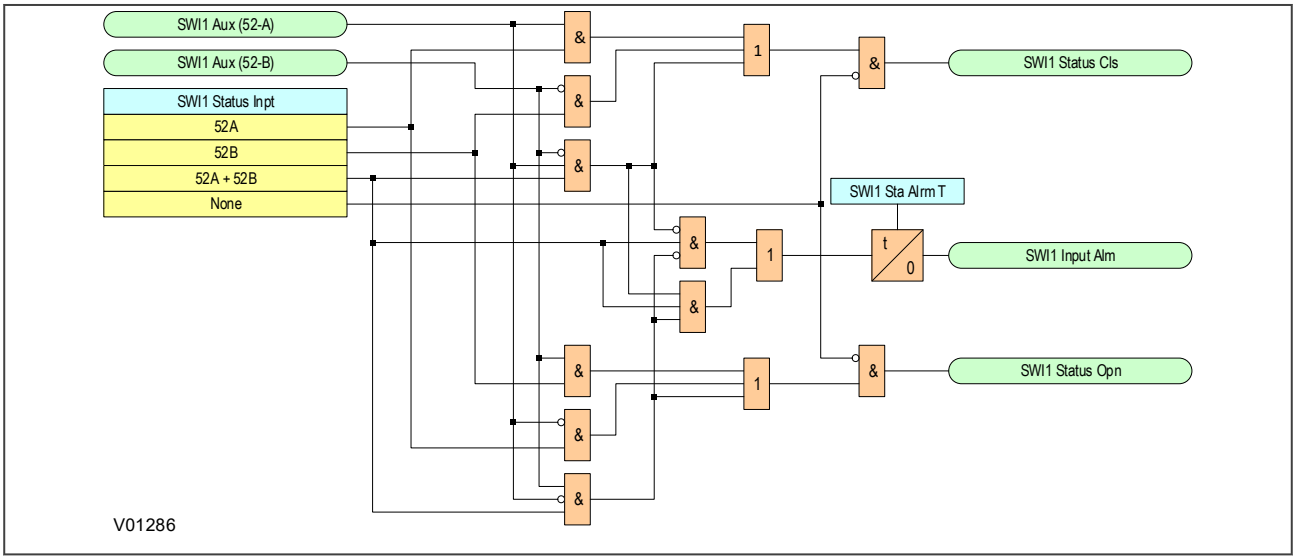


Figure 75: Switch Status logic

9.2 SWITCH CONTROL LOGIC

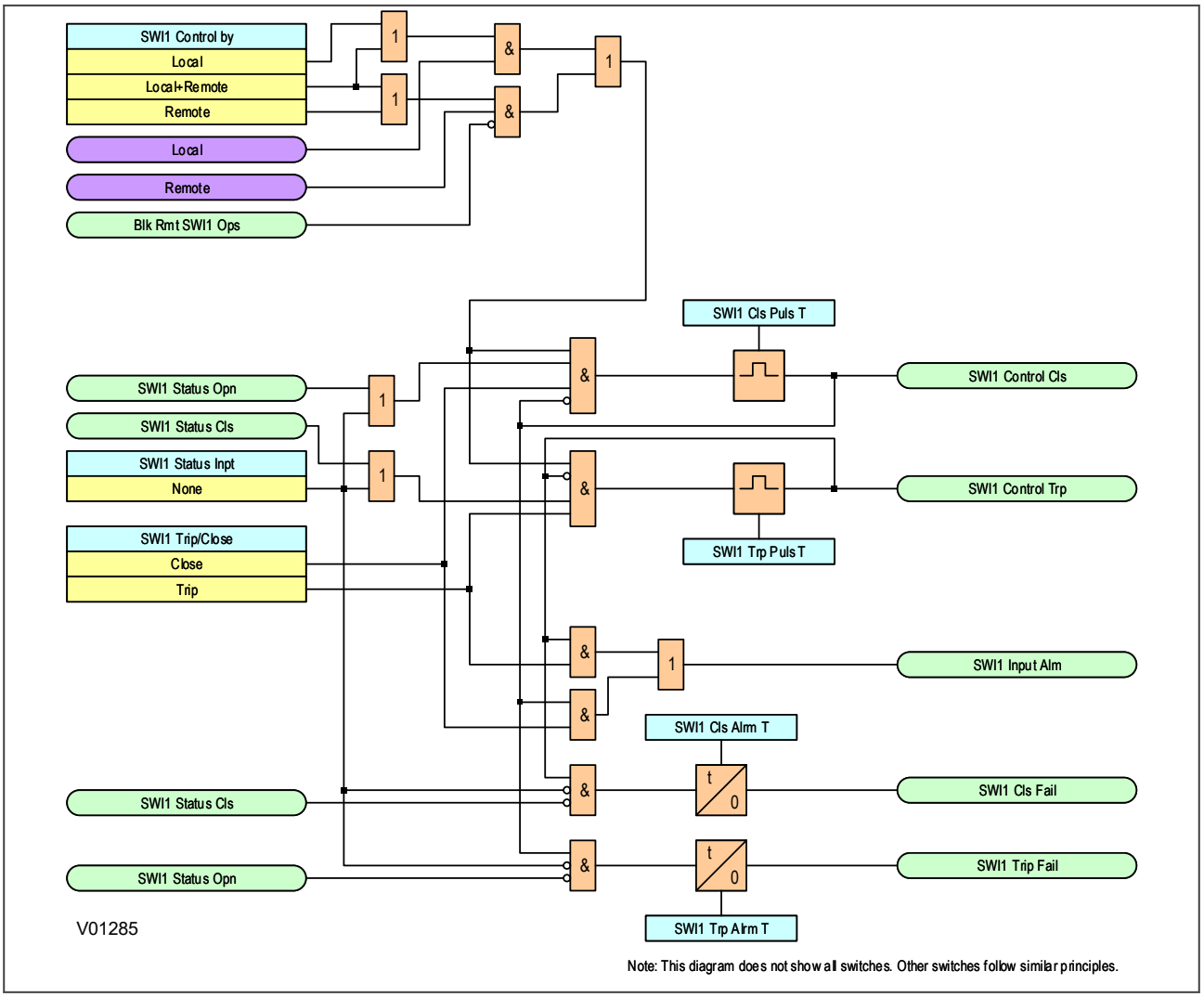


Figure 76: Switch Control logic

CHAPTER 10

SUPERVISION

1 CHAPTER OVERVIEW

This chapter describes the supervison functions.

This chapter contains the following sections:

Chapter Overview 183
DC Supply Monitor 184
Trip Circuit Supervision 186

2 DC SUPPLY MONITOR

This product can be powered using either a DC or AC supply. As a DC supply is normally used, a DC Supply Monitoring feature is included to indicate the DC supply status. The nominal DC Station supply is 48 V DC, which is provided by a bank of batteries. It is sometimes possible for this nominal supply to fall below or rise above acceptable operational limits. If the voltage is too high, it may indicate overcharging. If the voltage is too low, it may indicate a failing battery.

In such cases it is very useful to have DC supply monitoring functionality. The P40 Agile products provide such functionality by measuring the auxiliary DC supply fed into the device and processing this information using settings to define certain limits. In addition, the DC Auxiliary Supply value can be displayed on the front panel LCD to a resolution of 0.1 V DC. The measuring range is from 19 V DC to 300 V DC.

2.1 DC SUPPLY MONITOR IMPLEMENTATION

The P40Agile products provide three DC supply monitoring zones; zone 1, zone 2, and zone 3. This allows you to have multiple monitoring criteria. Each zone must be configured to correspond to either an overvoltage condition or an undervoltage condition. A single zone cannot be configured to provide an alarm for both undervoltage and overvoltage conditions. Typically, you would configure zones 1 and 2 for undervoltage conditions, whereby the lowest limit is set very low, and zone 3 for an overvoltage condition whereby the upper limit is very high.

This is best illustrated diagrammatically:

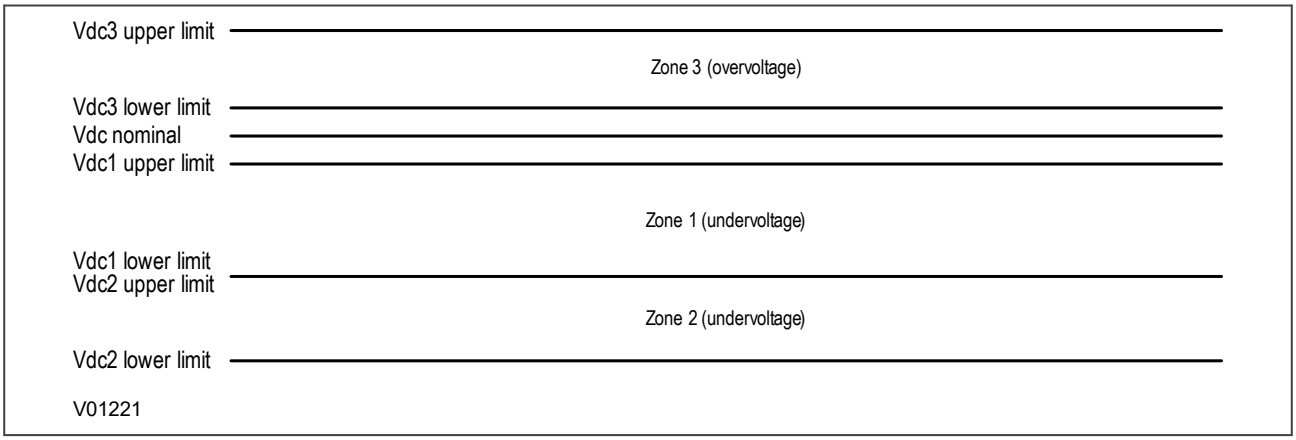


Figure 77: DC Supply Monitor zones

It is possible to have overlapping zones whereby zone 2 upper limit is lower than zone 1 lower limit in the above example.

The DC Supply Monitoring function is implemented using settings in the *DC SUP. MONITOR* column. There are three sets of settings; one for each of the zones. The settings allow you to:

- Enable or disable the function for each zone
- Set a lower voltage limit for each zone
- Set an upper voltage limit for each zone
- Set a time delay for each zone

2.2 DC SUPPLY MONITOR LOGIC

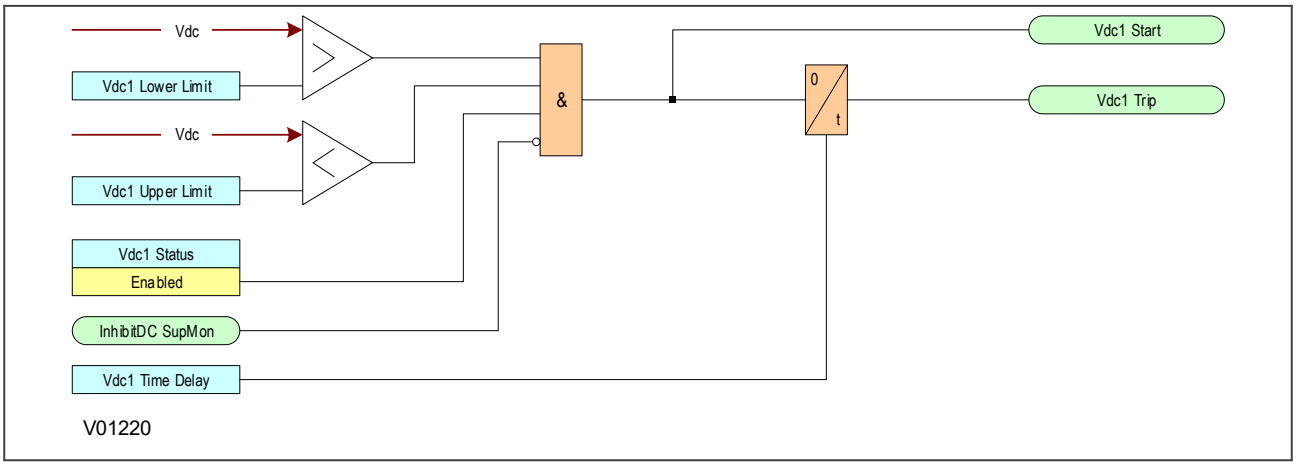


Figure 78: DC Supply Monitor logic

The diagram above shows the DC supply monitoring logic for stage 1 only. Stages 2 and 3 are identical in principle.

The logic function will work when the ***Vdc1 status*** setting cell is `Enabled` and the DC Supply Monitoring inhibit signal (***InhibitDC SupMon***) is low.

If the auxiliary supply voltage (Vdc) exceeds the lower limit AND falls below the upper limit, the voltage is in the healthy zone and a Start signal is generated.

The Vdc(n) Trip signals from all stages are OR'd together to produce an alarm signal ***DC Supply Fail***.

Note:
The device's supercapacitor uses Vdc to provide charge and so may cause the voltage to dip below the Vdc lower limit (19.2 V) during a system power-up sequence if fully discharged. This will trigger a lockout error. In this case, it will be necessary to allow the supercapacitor to charge before attempting another power-up sequence. The supercapacitor may take several minutes to become fully charged, depending on the AC/DC supply specification. With the supercapacitor charged, the next relay power cycle will clear the lockout and the relay will boot and operate normally.

3 TRIP CIRCUIT SUPERVISION

In most protection schemes, the trip circuit extends beyond the IED enclosure and passes through components such as links, relay contacts, auxiliary switches and other terminal boards. Such complex arrangements may require dedicated schemes for their supervision.

There are two distinctly separate parts to the trip circuit; the trip path, and the trip coil. The trip path is the path between the IED enclosure and the CB cubicle. This path contains ancillary components such as cables, fuses and connectors. A break in this path is possible, so it is desirable to supervise this trip path and to raise an alarm if a break should appear in this path.

The trip coil itself is also part of the overall trip circuit, and it is also possible for the trip coil to develop an open-circuit fault.

This product supports a number of trip circuit supervision (TCS) schemes.

3.1 TRIP CIRCUIT SUPERVISION SCHEME 1

This scheme provides supervision of the trip coil with the CB open or closed, however, it does not provide supervision of the trip path whilst the breaker is open. The CB status can be monitored when a self-reset trip contact is used. However, this scheme is incompatible with latched trip contacts, as a latched contact will short out the opto-input for a time exceeding the recommended Delayed Drop-off (DDO) timer setting of 400 ms, and therefore does not support CB status monitoring. If you require CB status monitoring, further opto-inputs must be used.

Note:
A 52a CB auxiliary contact follows the CB position. A 52b auxiliary contact is the opposite.

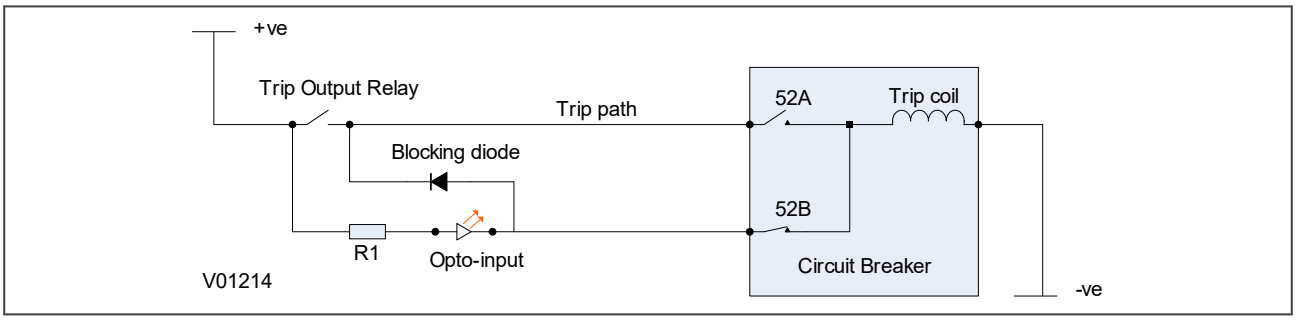


Figure 79: TCS Scheme 1

When the CB is closed, supervision current passes through the opto-input, blocking diode and trip coil. When the CB is open, supervision current flows through the opto-input and into the trip coil via the 52b auxiliary contact. This means that *Trip Coil* supervision is provided when the CB is either closed or open, however *Trip Path* supervision is only provided when the CB is closed. No supervision of the trip path is provided whilst the CB is open (pre-closing supervision). Any fault in the trip path will only be detected on CB closing, after a 400 ms delay.

3.1.1 RESISTOR VALUES

The supervision current is a lot less than the current required by the trip coil to trip a CB. The TCS opto-input limits this supervision current to less than 10 mA. If the TCS opto-input were to be short-circuited however, it could be possible for the supervision current to reach a level that could trip the CB. For this reason, a resistor R1 is often used to limit the current in the event of a short-circuited TCS opto-input. This limits the current to less than 60 mA. The table below shows the appropriate resistor value and voltage setting for this scheme.

Trip Circuit Voltage	Resistor R1
24/27	620 Ohms at 2 Watts
30/34	820 Ohms at 2 Watts
48/54	1.2 kOhms at 5 Watts
110/125	2.7 kOhms at 10 Watts
220/250	5.2 kOhms at 15 Watts

Warning:
If your IED has Opto Mode settings available in the *OPTO CONFIG* column, these MUST be set to *TCS* for any corresponding Opto Inputs(s) used for Trip Circuit Supervision.

3.1.2 PSL FOR TCS SCHEME 1

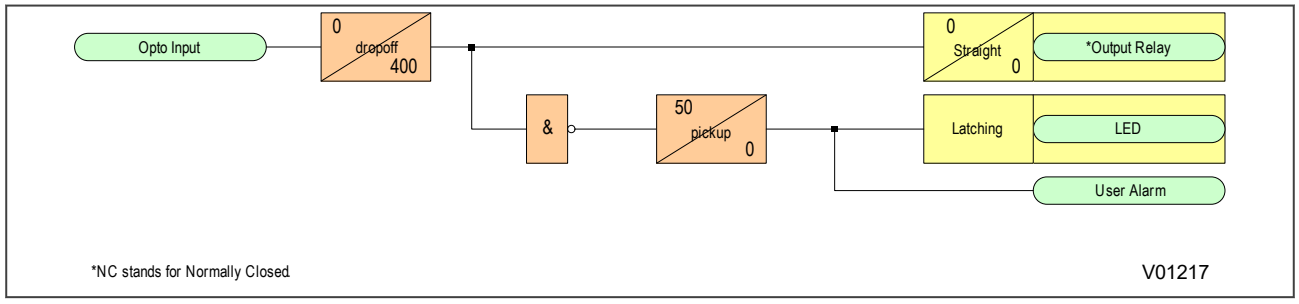


Figure 80: PSL for TCS Scheme 1

The opto-input can be used to drive a Normally Closed Output Relay, which in turn can be used to drive alarm equipment. The signal can also be inverted to drive a latching programmable LED and a user alarm DDB signal.

The DDO timer operates as soon as the opto-input is energised, but will take 400 ms to drop off/reset in the event of a trip circuit failure. The 400 ms delay prevents a false alarm due to voltage dips caused by faults in other circuits or during normal tripping operation when the opto-input is shorted by a self-reset trip contact. When the timer is operated the NC (normally closed) output relay opens and the LED and user alarms are reset.

The 50 ms delay on pick-up timer prevents false LED and user alarm indications during the power up time, following a voltage supply interruption.

3.2 TRIP CIRCUIT SUPERVISION SCHEME 2

This scheme provides supervision of the trip coil with the breaker open or closed but does not provide pre-closing supervision of the trip path. However, using two opto-inputs allows the IED to correctly monitor the circuit breaker status since they are connected in series with the CB auxiliary contacts. This is achieved by assigning one opto-input to the 52a contact and another opto-input to the 52b contact. Provided the ***CB Status*** setting in the *CB CONTROL* column is set to `Both 52A and 52B`, the IED will correctly monitor the status of the breaker. This scheme is also fully compatible with latched contacts as the supervision current will be maintained through the 52b contact when the trip contact is closed.

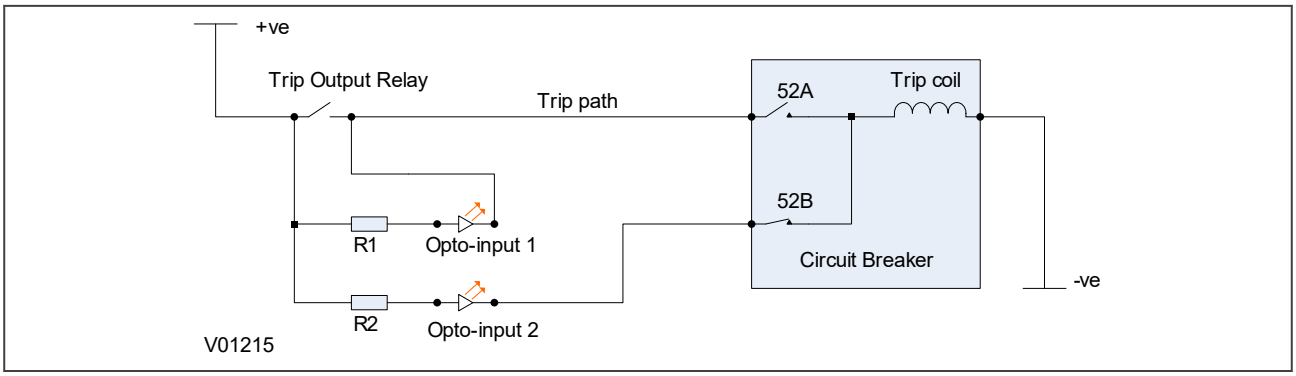


Figure 81: TCS Scheme 2

When the breaker is closed, supervision current passes through opto input 1 and the trip coil. When the breaker is open current flows through opto input 2 and the trip coil. No supervision of the trip path is provided whilst the breaker is open. Any fault in the trip path will only be detected on CB closing, after a 400 ms delay.

3.2.1 RESISTOR VALUES

As with scheme 1, optional resistors R1 and R2 can be added to prevent tripping of the CB if either TCS opto-input is shorted. The table below shows the appropriate resistor value and voltage setting for this scheme.

Trip Circuit Voltage	Resistor R1 and R2
24/27	620 Ohms at 2 Watts
30/34	820 Ohms at 2 Watts
48/54	1.2 kOhms at 5 Watts
110/125	2.7 kOhms at 10 Watts
220/250	5.2 kOhms at 15 Watts

Warning:
If your IED has Opto Mode settings available in the *OPTO CONFIG* column, these MUST be set to *TCS* for any corresponding Opto Inputs(s) used for Trip Circuit Supervision.

3.2.2 PSL FOR TCS SCHEME 2

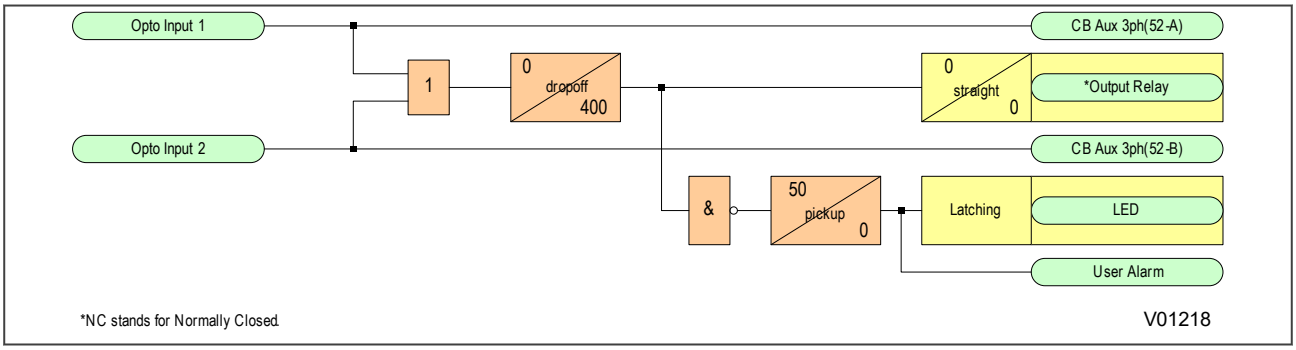


Figure 82: PSL for TCS Scheme 2

In TCS scheme 2, both opto-inputs must be low before a trip circuit fail alarm is given.

3.3 TRIP CIRCUIT SUPERVISION SCHEME 3

TCS Scheme 3 is designed to provide supervision of the trip coil with the breaker open or closed. It provides pre-closing supervision of the trip path. Since only one opto-input is used, this scheme is not compatible with latched trip contacts. If you require CB status monitoring, further opto-inputs must be used.

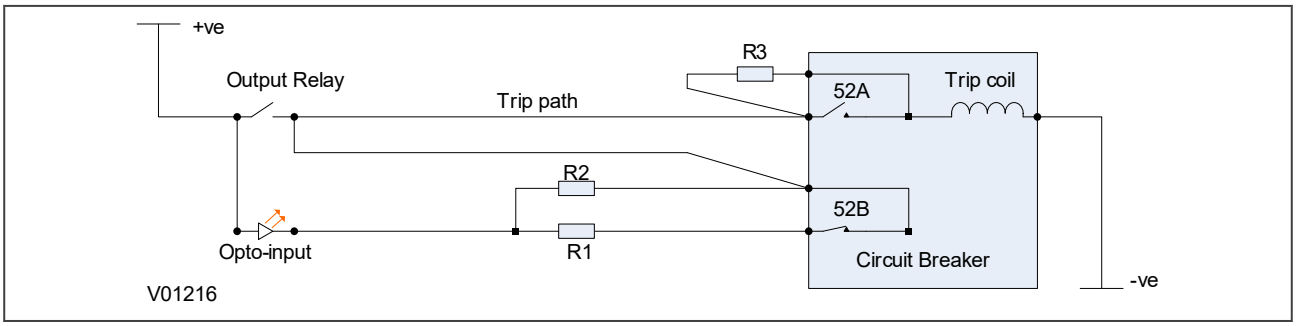


Figure 83: TCS Scheme 3

When the CB is closed, supervision current passes through the opto-input, resistor R2 and the trip coil. When the CB is open, current flows through the opto-input, resistors R1 and R2 (in parallel), resistor R3 and the trip coil. The supervision current is maintained through the trip path with the breaker in either state, therefore providing pre-closing supervision.

3.3.1 RESISTOR VALUES

As with TCS schemes 1 and 2, resistors R1 and R2 are used to prevent false tripping, if the TCS opto-input is accidentally shorted. However, unlike the other two schemes, this scheme is dependent on the position and value of these resistors. Removing them would result in incomplete trip circuit monitoring. The table below shows the resistor values and voltage settings required for satisfactory operation.

Trip Circuit Voltage	Resistor R1 and R2	Resistor R3
24/27	620 Ohms at 2 Watts	330 Ohms at 5 Watts
30/34	820 Ohms at 2 Watts	430 Ohms at 5 Watts
48/54	1.2 kOhms at 5 Watts	620 Ohms at 10 Watts
110/125	2.7 kOhms at 10 Watts	1.5 k Ohms at 15 Watts
220/250	5.2 kOhms at 15 Watts	2.7 k Ohms at 25 Watts

Warning:
If your IED has Opto Mode settings available in the *OPTO CONFIG* column, these MUST be set to *TCS* for any corresponding Opto Inputs(s) used for Trip Circuit Supervision.

3.3.2 PSL FOR TCS SCHEME 3

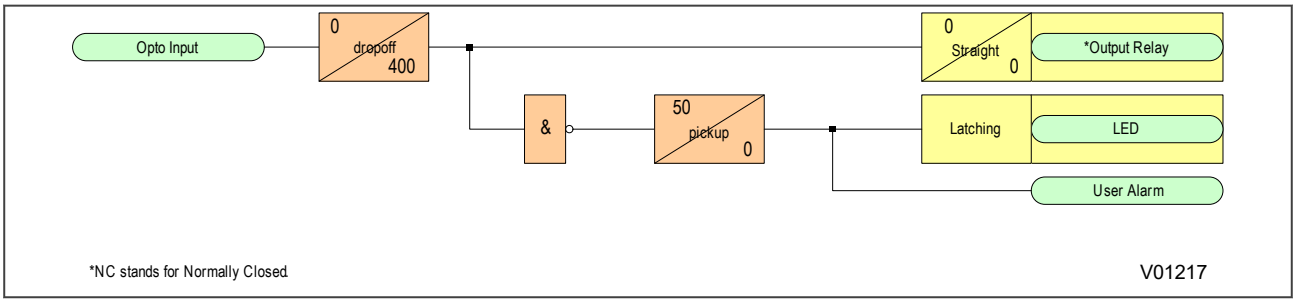


Figure 84: PSL for TCS Scheme 3

3.4 TRIP CIRCUIT SUPERVISION SCHEME 4

Scheme 4 is identical to that offered by MVAX31 (a Trip Circuit Supervision relay) and consequently is fully compliant with ENA Specification H7. To achieve this compliance, there are eight settings in the *OPTO CONFIG* column. Two of these settings (***Opto 1 Mode*** to ***Opto 11 Mode***--dependant on I/O option chosen) must be set to `TCS` before the scheme can be used, with any remaining opto-input set to `Normal` as required.

In the diagram below, Opto-input 1 and Opto-input 2 would correlate to one of the above-mentioned opto-inputs.

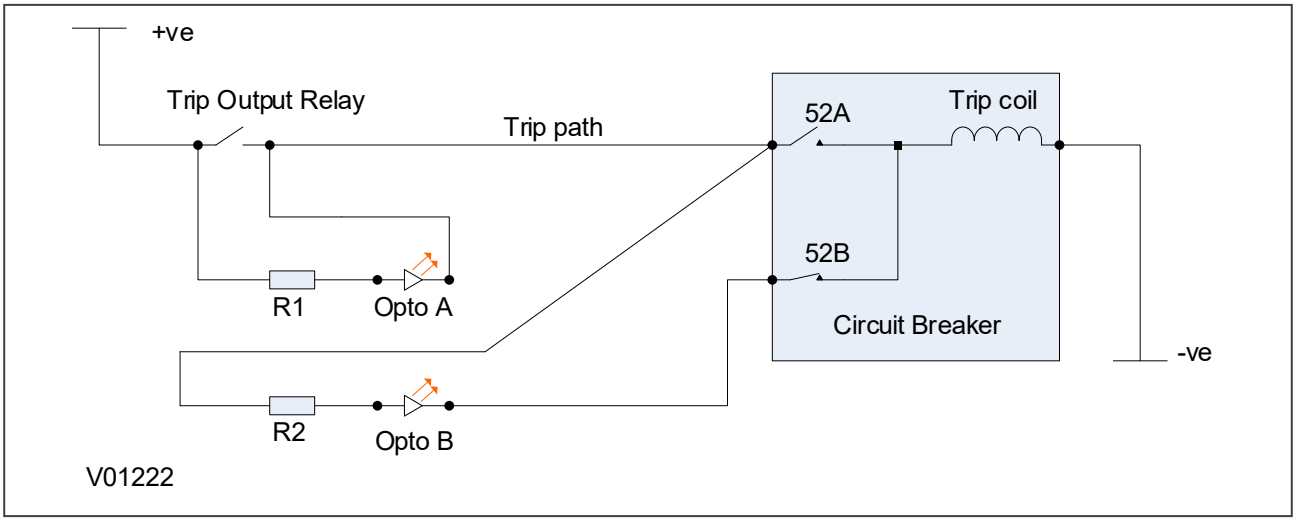


Figure 85: TCS Scheme 4

Under normal non-fault conditions, a current of 2 mA flows through one of the following paths:

a) Post Close Supervision: When the CB is in a closed state, the current flows through R1, Opto A, Contact 52A and the trip coil.

b) Pre-close Supervision: When the CB is in an open state, the current flows through R1, Opto A, Contact 52B, Opto B and the trip coil.

c) Momentary Tripping with Self-reset Contact: When a self-reset trip contact is in a closed state, the current flows through the trip contact, contact 52A and the trip coil.

d) Tripping with Latched Contact: When a latched trip contact is used and when it is in a closed state, the current flows through the trip contact, Contact 52A, the trip coil, then changing to the path trip contact, R2, Contact 52B, Opto B and the trip coil.

A current of 2 mA through the Trip Coil is insufficient to cause operation of the Trip Contact, but large enough to energise the opto-inputs. Under this condition both of the opto-inputs will output logic 1, so the output relay (TCS health) will be closed and the User Alarm will be off. If a break occurs in the trip circuit, the current ceases to flow, resulting in both opto-inputs outputting logic 0. This will open the output relay and energise the user alarm.

Recommended Scheme Opto Connections and Settings

I/O option G or J		I/O Option F			I/O Option C		
Opto Input 1 (Mode Setting)	Opto Input 2 (Mode Setting)	Opto Input 4 (Mode Setting)	Opto Input 5 (Mode Setting)	Opto Input 6 (Mode Setting)	Opto Input 9 (Mode Setting)	Opto Input 10 (Mode Setting)	Opto Input 11 (Mode Setting)
Opto A (TCS)	Opto B (TCS)	Opto A (TCS)	Opto B (TCS)	- (NORMAL)	Opto A (TCS)	Opto B (TCS)	- (NORMAL)
					I/O Option H		

3.4.1 RESISTOR VALUES

The TCS opto-inputs sink a constant current of 2 mA.The values of external resistors R1 and R2 are chosen to limit the current to a maximum of 60 mA in the event that a TCS opto-input becomes shorted. The values of these resistors depend on the trip circuit voltage.

Trip Circuit Voltage	Resistor R1 and R2 (ohms)
24/27	620 Ohms at 2 Watts
30/34	820 Ohms at 2 Watts
48/54	1.2 kOhms at 5 Watts
110/125	2.7 kOhms at 10 Watts
220/250	5.2 kOhms at 15 Watts

For the momentary tripping condition, none of the opto-inputs are energised. To tide over this normal CB operation, a dropoff time delay of about 400 ms is added in the PSL.

Warning:
If your IED has Opto Mode settings available in the *OPTO CONFIG* column, these MUST be set to *TCS* for any corresponding Opto Inputs(s) used for Trip Circuit Supervision.

3.4.2 PSL FOR TCS SCHEME 4

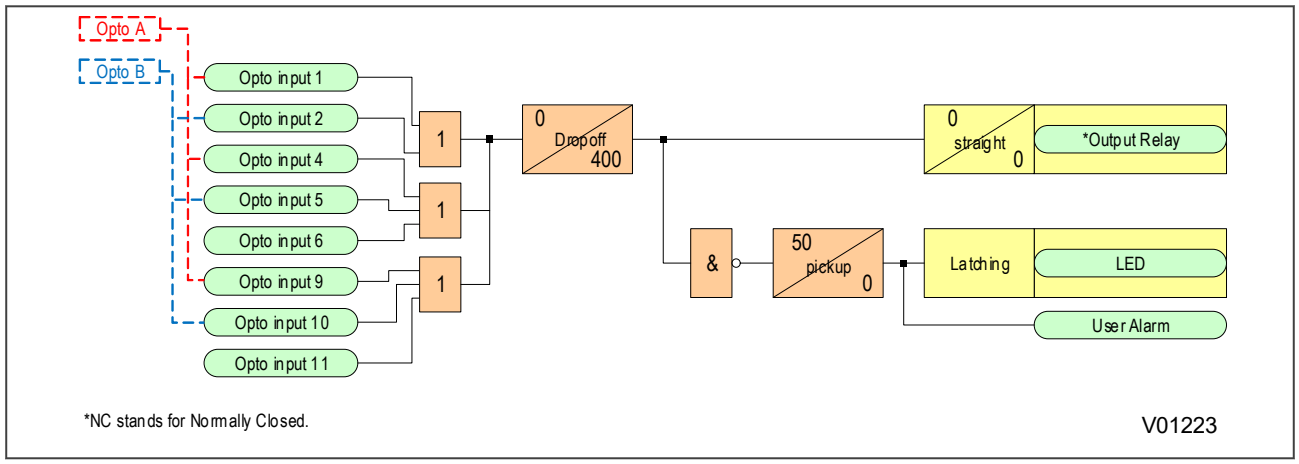


Figure 86: PSL for TCS Scheme 4

CHAPTER 11

DIGITAL I/O AND PSL CONFIGURATION

1 CHAPTER OVERVIEW

This chapter introduces the PSL (Programmable Scheme Logic) Editor, and describes the configuration of the digital inputs and outputs. It provides an outline of scheme logic concepts and the PSL Editor. This is followed by details about allocation of the digital inputs and outputs, which require the use of the PSL Editor. A separate "Settings Application Software" document is available that gives a comprehensive description of the PSL, but enough information is provided in this chapter to allow you to allocate the principal digital inputs and outputs.

This chapter contains the following sections:

Chapter Overview 195
Configuring Digital Inputs and Outputs 196
Scheme Logic 197
Configuring the Opto-Inputs 199
Assigning the Output Relays 200
Fixed Function LEDs 201
Configuring Programmable LEDs 202
Function Keys 204
Control Inputs 205
Inter-PSL Inputs and Outputs 206

2 CONFIGURING DIGITAL INPUTS AND OUTPUTS

Configuration of the digital inputs and outputs in this product is very flexible. You can use a combination of settings and programmable logic to customise them to your application. You can access some of the settings using the keypad on the front panel, but you will need a computer running the settings application software to fully interrogate and configure the properties of the digital inputs and outputs.

The settings application software includes an application called the PSL Editor (Programmable Scheme Logic Editor). The PSL Editor lets you allocate inputs and outputs according to your specific application. It also allows you to apply attributes to some of the signals such as a drop-off delay for an output contact.

In this product, digital inputs and outputs that are configurable are:

- Optically isolated digital inputs (opto-inputs). These can be used to monitor the status of associated plant.
- Output relays. These can be used for purposes such as initiating the tripping of circuit breakers, providing alarm signals, etc..
- Programmable LEDs. The number and colour of the programmable LEDs varies according to the particular product being applied.
- Function keys and associated LED indications. These are not provided on all products, but where they are, each function key has an associated tri-colour LED.
- IEC 61850 GOOSE inputs and outputs. These are only provided on products that have been specified for connection to an IEC61850 system, and the details of the GOOSE are presented in the documentation on IEC61850.

3 SCHEME LOGIC

The product is supplied with pre-loaded Fixed Scheme Logic (FSL) and Programmable Scheme Logic (PSL).

The Scheme Logic is a functional module within the IED, through which all mapping of inputs to outputs is handled. The scheme logic can be split into two parts; the Fixed Scheme Logic (FSL) and the Programmable Scheme Logic (PSL). It is built around a concept called the digital data bus (DDB). The DDB encompasses all of the digital signals (DDBs) which are used in the FSL and PSL. The DDBs included digital inputs, outputs, and internal signals.

The FSL is logic that has been hard-coded in the product. It is fundamental to correct interaction between various protection and/or control elements. It is fixed and cannot be changed.

The PSL gives you a facility to develop custom schemes to suit your application if the factory-programmed default PSL schemes do not meet your needs. Default PSL schemes are programmed before the product leaves the factory. These default PSL schemes have been designed to suit typical applications and if these schemes suit your requirements, you do not need to take any action. However, if you want to change the input-output mappings, or to implement custom scheme logic, you can change these, or create new PSL schemes using the PSL editor.

The PSL consists of components such as logic gates and timers, which combine and condition DDB signals.

The logic gates can be programmed to perform a range of different logic functions. The number of inputs to a logic gate are not limited. The timers can be used either to create a programmable delay or to condition the logic outputs. Output contacts and programmable LEDs have dedicated conditioners.

The PSL logic is event driven. Only the part of the PSL logic that is affected by the particular input change that has occurred is processed. This minimises the amount of processing time used by the PSL ensuring industry leading performance.

The following diagram shows how the scheme logic interacts with the rest of the IED.

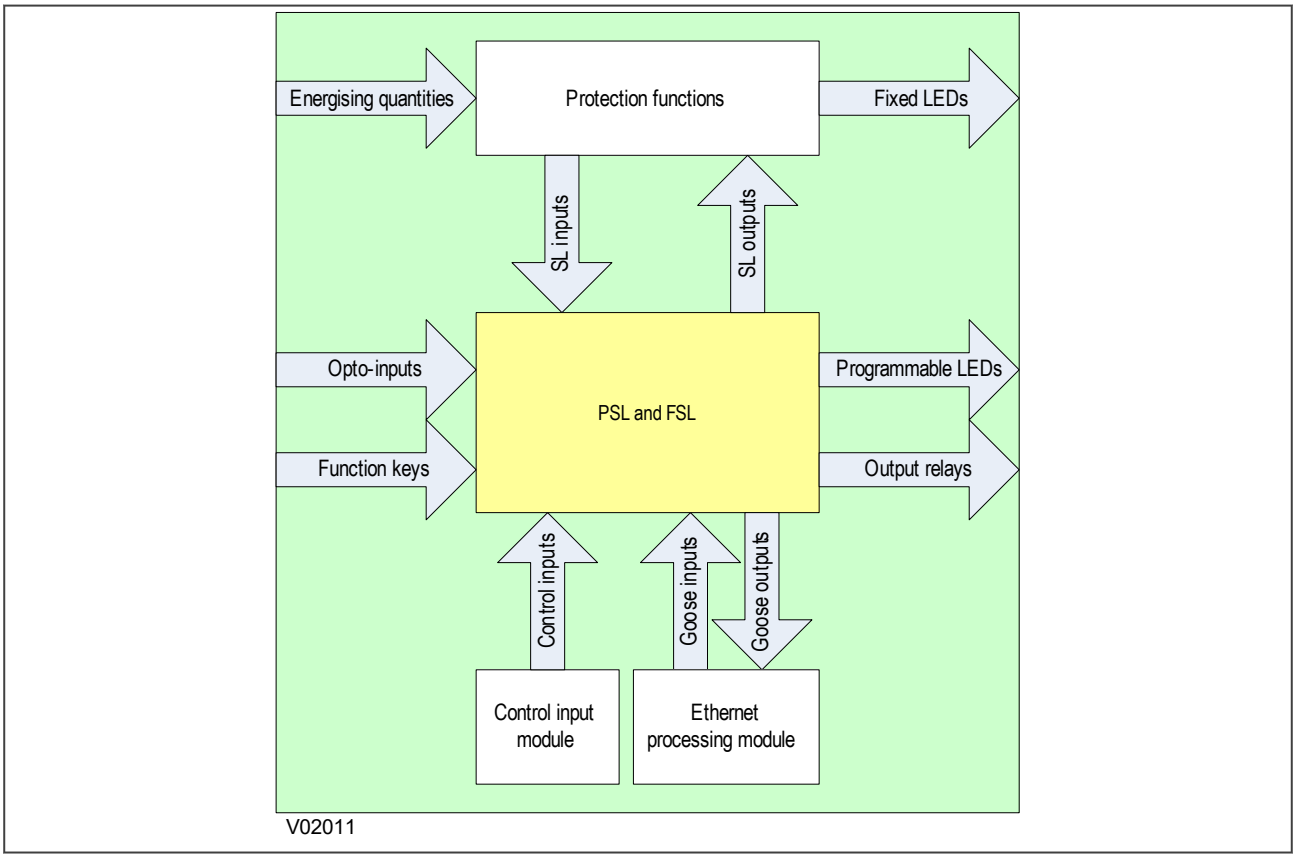


Figure 87: Scheme Logic Interfaces

3.1 PSL EDITOR

The Programmable Scheme Logic (PSL) is a module of programmable logic gates and timers in the IED, which can be used to create customised logic to qualify how the product manages its response to system conditions. The IED's digital inputs are combined with internally generated digital signals using logic gates, timers, and conditioners. The resultant signals are then mapped to digital outputs signals including output relays and LEDs.

The PSL Editor is a tool in the settings application software that allows you to create and edit scheme logic diagrams. You can use the default scheme logic which has been designed to suit most applications, but if it does not suit your application you can change it. If you create a different scheme logic with the software, you need to upload it to the device to apply it.

3.2 PSL SCHEMES

Your product is shipped with default scheme files. These can be used without modification for most applications, or you can choose to use them as a starting point to design your own scheme. You can also create a new scheme from scratch. To create a new scheme, or to modify an existing scheme, you will need to launch the settings application software. You then need to open an existing PSL file, or create a new one, for the particular product that you are using, and then open a PSL file. If you want to create a new PSL file, you should select **File** then **New** then **Blank scheme...** This action opens a default file appropriate for the device in question, but deletes the diagram components from the default file to leave an empty diagram with configuration information loaded. To open an existing file, or a default file, simply double-click on it.

3.3 PSL SCHEME VERSION CONTROL

To help you keep track of the PSL loaded into products, a version control feature is included. The user interface contains a *PSL DATA* column, which can be used to track PSL modifications. A total of 12 cells are contained in the *PSL DATA* column; 3 for each setting group.

Grp(n) PSL Ref: When downloading a PSL scheme to an IED, you will be prompted to enter the relevant group number and a reference identifier. The first 32 characters of the reference identifier are displayed in this cell. The horizontal cursor keys can scroll through the 32 characters as the LCD display only displays 16 characters.

Example:

```
Grp(n) PSL Ref
```

Date/time: This cell displays the date and time when the PSL scheme was downloaded to the IED.

Example:

```
18 Nov 2002
08:59:32.047
```

Grp(n) PSL ID: This cell displays a unique ID number for the downloaded PSL scheme.

Example:

```
Grp(n) PSL ID
ID - 2062813232
```

4 CONFIGURING THE OPTO-INPUTS

The number of optically isolated status inputs (opto-inputs) depends on the specific model supplied. The use of the inputs will depend on the application, and their allocation is defined in the programmable scheme logic (PSL). In addition to the PSL assignment, you also need to specify the expected input voltage. Generally, all opto-inputs will share the same input voltage range, but if different voltage ranges are being used, this device can accommodate them.

In the *OPTO CONFIG* column there is a global nominal voltage setting. If all opto-inputs are going to be energised from the same voltage range, you select the appropriate value with this setting. If you select `Custom` in the setting, then the cells ***Opto Input 1***, ***Opto Input 2***, etc. become visible. You use these cells to set the voltage ranges for each individual opto-input.

If you are using the recommended settings application software (MiCOM S1 Agile), the product's DC supply monitoring function detects the DC supply voltage and provides some automation for setting for the global nominal voltage. This feature is found by right clicking on **Device**, then selecting **Supervise Device → Auto-setup of Opto Voltage**. This automatic detection only works for DC inputs.

Within the *OPTO CONFIG* column there are also settings to control the filtering applied to the inputs, as well as the pick-up/drop-off characteristic.

The filter control setting provides a bit string with a bit associated with all opto-inputs. Setting the bit to '1' means that a half-cycle filter is applied to the inputs. This helps to prevent incorrect operation in the event of power system frequency interference on the wiring. Setting the field to '0' removes the filter and provides for faster operation. You should note that removing the filter reduces the AC immunity. that means it is less effective at filtering out-of-band interference.

The ***Characteristic*** setting is a single setting that applies to all the opto-inputs. It is used to set the pick-up/drop-off ratios of the input signals.

By default the drop-off is 60% of the maximum DC input value and the pick-up threshold is 80% of the minimum DC input value. You can change this to other available thresholds if required. Other available thresholds are 50% - 70% and 58% - 75%.

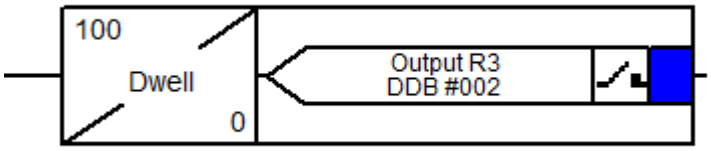
5 ASSIGNING THE OUTPUT RELAYS

Relay contact action is controlled using the PSL. DDB signals are mapped in the PSL and drive the output relays. The driving of an output relay is controlled by means of a relay output conditioner. Several choices are available for how output relay contacts are conditioned. For example, you can choose whether operation of an output relay contact is latched, has delay on pick-up, or has a delay on drop-off. You make this choice in the **Contact Properties** window associated with the output relay conditioner.

To map an output relay in the PSL you should use the Contact Conditioner button in the toolbar to import it. You then condition it according to your needs. The output of the conditioner respects the attributes you have assigned.

The toolbar button for a Contact Conditioner looks like this:

The PSL contribution that it delivers looks like this:



Note:
Contact Conditioners are only available if they have not all been used. In some default PSL schemes, all Contact Conditioners might have been used. If that is the case, and you want to use them for something else, you will need to re-assign them.

On the toolbar there is another button associated with the relay outputs. The button looks like this:

This is the "Contact Signal" button. It allows you to put replica instances of a conditioned output relay into the PSL, preventing you having to make cross-page connections which might detract from the clarity of the scheme.

6 FIXED FUNCTION LEDS

Four fixed-function LEDs on the left-hand side of the front panel indicate the following conditions.

- Trip (Red) switches ON when the IED issues a trip signal. It is reset when the associated fault record is cleared from the front display. Also the trip LED can be configured as self-resetting.
- Alarm (Yellow) flashes when the IED registers an alarm. This may be triggered by a fault, event or maintenance record. The LED flashes until the alarms have been accepted (read), then changes to constantly ON. When the alarms are cleared, the LED switches OFF.
- Out of service (Yellow) is ON when the IED's functions are unavailable.
- Healthy (Green) is ON when the IED is in correct working order, and should be ON at all times. It goes OFF if the unit's self-tests show there is an error in the hardware or software. The state of the healthy LED is reflected by the watchdog contacts at the back of the unit.

6.1 TRIP LED LOGIC

When a trip occurs, the trip LED is illuminated. It is possible to reset this with a number of ways:

- Directly with a reset command (by pressing the Clear Key)
- With a reset logic input
- With self-resetting logic

You enable the automatic self-resetting with the ***Sys Fn Links*** cell in the *SYSTEM DATA* column. A '0' disables self resetting and a '1' enables self resetting.

The reset occurs when the circuit is reclosed and the ***Any Pole Dead*** signal has been reset for three seconds providing the ***Any Start*** signal is inactive. The reset is prevented if the ***Any Start*** signal is active after the breaker closes.

The Trip LED logic is as follows:

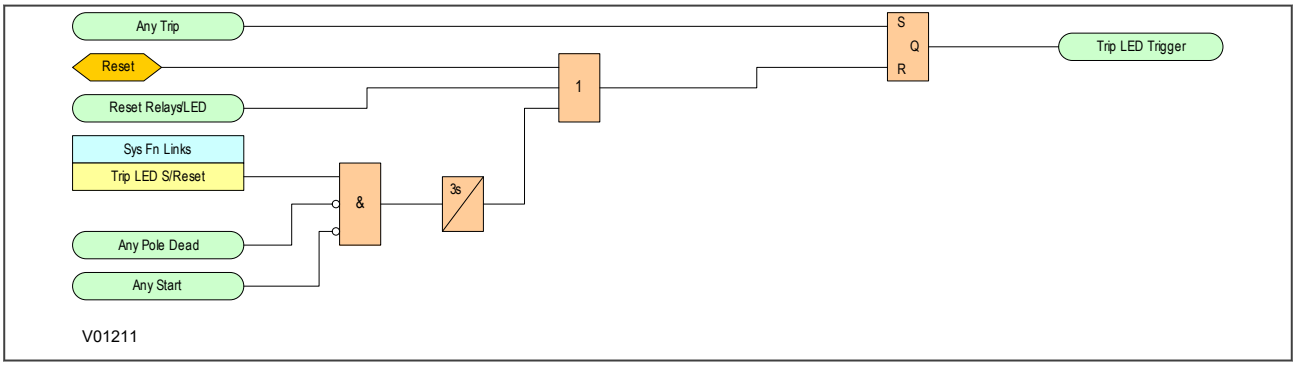


Figure 88: Trip LED logic

7 CONFIGURING PROGRAMMABLE LEDS

There are three types of programmable LED signals which vary according to the model being used. These are:

- Single-colour programmable LED. These are red when illuminated.
- Tri-colour programmable LED. These can be illuminated red, green, or amber.
- Tri-colour programmable LED associated with a Function Key. These can be illuminated red, green, or amber.

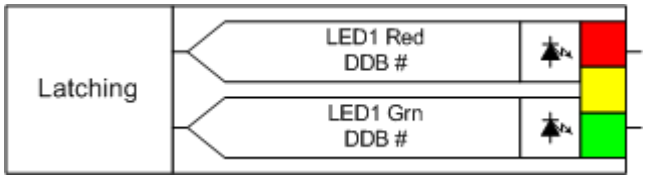
DDB signals are mapped in the PSL and used to illuminate the LEDs. For single-coloured programmable LEDs there is one DDB signal per LED. For tri-coloured LEDs there are two DDB signals associated with the LED. Asserting ***LED # Grn*** will illuminate the LED green. Asserting ***LED # Red*** will illuminate the LED red. Asserting both DDB signals will illuminate the LED amber.

The illumination of an LED is controlled by means of a conditioner. Using the conditioner, you can decide whether the LEDs reflect the real-time state of the DDB signals, or whether illumination is latched pending user intervention.

To map an LED in the PSL you should use the LED Conditioner button in the toolbar to import it. You then condition it according to your needs. The output(s) of the conditioner respect the attribute you have assigned.

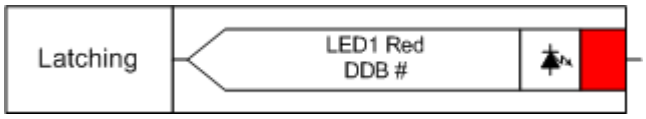
The toolbar button for a tri-colour LED looks like this:

The PSL contribution that it delivers looks like this:



The toolbar button for a single-colour LED looks like this:

The PSL contribution that it delivers looks like this.



Note:
LED Conditioners are only available if they have not all been used up, and in some default PSL schemes they might be. If that is the case and you want to use them for something else, you will need to re-assign them.

On the toolbar there is another button associated with the LEDs. For a tri-coloured LED the button looks like this:

For a single-colour LED it looks like this:

It is the "LED Signal" button. It allows you to put replica instances of a conditioned LED into the PSL, preventing you having to make cross-page connections which might detract from the clarity of the scheme.

Note:
All LED DDB signals are always shown in the PSL Editor. However, the actual number of LEDs depends on the device hardware. For example, if a small 20TE device has only 4 programmable LEDs, LEDs 5-8 will not take effect even if they are mapped in the PSL.

8 FUNCTION KEYS

For most models, a number of programmable function keys are available. This allows you to assign function keys to control functionality via the programmable scheme logic (PSL). Each function key is associated with a programmable tri-colour LED, which you can program to give the desired indication on activation of the function key.

These function keys can be used to trigger any function that they are connected to as part of the PSL. The function key commands are found in the *FUNCTION KEYS* column.

Each function key is associated with a DDB signal as shown in the DDB table. You can map these DDB signals to any function available in the PSL.

The ***Fn Key Status*** cell displays the status (energised or de-energised) of the function keys by means of a binary string, where each bit represents a function key starting with bit 0 for function key 1.

Each function key has three settings associated with it, as shown:

- ***Fn Key (n)***, which enables or disables the function key
- ***Fn Key (n) Mode***, which allows you to configure the key as toggled or normal
- ***Fn Key (n) label***, which allows you to define the function key text that is displayed

The ***Fn Key (n)*** cell is used to enable (unlock) or disable (unlock) the function key signals in PSL. The Lock setting has been provided to prevent further activation on subsequent key presses. This allows function keys that are set to `Toggled` mode and their DDB signal active 'high', to be locked in their active state therefore preventing any further key presses from deactivating the associated function. Locking a function key that is set to the "Normal" mode causes the associated DDB signals to be permanently off. This safety feature prevents any inadvertent function key presses from activating or deactivating critical functions.

When the ***Fn Key (n) Mode*** cell is set to `Toggle`, the function key DDB signal output will remain in the set state until a reset command is given. In the `Normal` mode, the function key DDB signal will remain energised for as long as the function key is pressed and will then reset automatically. In this mode, a minimum pulse duration can be programmed by adding a minimum pulse timer to the function key DDB output signal.

The ***Fn Key Label*** cell makes it possible to change the text associated with each individual function key. This text will be displayed when a function key is accessed in the function key menu, or it can be displayed in the PSL.

The status of all function keys are recorded in non-volatile memory. In case of auxiliary supply interruption their status will be maintained.

> *Note:*
> *All function key DDB signals are always shown in the PSL Editor. However, the actual number of function keys depends on the device hardware. For example, if a small 20TE device has no function keys, the function key DDBs mapped in the PSL will not take effect.*

9 CONTROL INPUTS

The control inputs are software switches, which can be set or reset locally or remotely. These inputs can be used to trigger any PSL function to which they are connected. There are three setting columns associated with the control inputs: *CONTROL INPUTS*, *CTRL I/P CONFIG* and *CTRL I/P LABELS*. These are listed in the Settings and Records appendix at the end of this manual.

10 INTER-PSL INPUTS AND OUTPUTS

To make the design of PSL schemes easier, P40 Agile provides a range of DDB signals for conncting PSL Inputs to PSL Outputs. these are called Inter-PSL inputs and outputs. This facility allows you to map many PSL input signals to a single Inter-PSL output signal, many PSL output signals to a single Inter-PSL input signal, and to join the Inter-PSL input signal to an Inter-PSL output signal. The Inter-PSL input signals can also be used to directly trigger the Disturbance Recorder.

CHAPTER 12

COMMUNICATIONS

1 CHAPTER OVERVIEW

This product supports Substation Automation System (SAS), and Supervisory Control and Data Acquisition (SCADA) communication. It embraces the evolution of communications technologies, since microprocessor technologies were introduced into protection, control, and monitoring devices - now known as Intelligent Electronic Devices for the substation (IEDs).

All products support rugged serial communications for SCADA and SAS applications. Optionally, any product can support Ethernet communications for more advanced SCADA and SAS applications.

This chapter contains the following sections:

Chapter Overview 209
Communication Interfaces 210
Serial Communication 211
Standard Ethernet Communication 214
Redundant Ethernet Communication 215
Data Protocols 221
Read Only Mode 265
Time Synchronisation 267

2 COMMUNICATION INTERFACES

The MiCOM P40 Agile products have a number of standard and optional communication interfaces. The standard and optional hardware and protocols are summarised below:

Port	Availability	Physical Layer	Use	Data Protocols
Front	Standard	USB	Local settings Firmware download	Courier
Rear serial port 1	Standard	RS485 / K-Bus	SCADA Remote settings IRIG-B	Courier, MODBUS, IEC 60870-5-103, DNP3.0
Rear serial port 2 (order option)	Optional	RS485	SCADA Remote settings IRIG-B	Courier
Rear Ethernet port	Optional	Ethernet/copper	SCADA Remote settings	Courier, DNP3.0 over Ethernet, IEC 61850 (order option)
Rear Ethernet port	Optional	Ethernet/fibre	SCADA Remote settings	Courier or DNP3.0 over Ethernet (order option)

Note:
Optional communication boards are always fitted into slot C and only slot C.
It is only possible to fit one optional communications board, therefore Serial and Ethernet communications are mutually exclusive.

3 SERIAL COMMUNICATION

The physical layer standards that are used for serial communications for SCADA purposes are:

- Universal Serial Bus (USB)
- EIA(RS)485 (often abbreviated to RS485)
- K-Bus (a proprietary customization of RS485)

USB is a relatively new standard, which replaces EIA(RS232) for local communication with the IED (for transferring settings and downloading firmware updates)

RS485 is similar to RS232 but for longer distances and it allows daisy-chaining and multi-dropping of IEDs.

K-Bus is a proprietary protocol quite similar to RS485, but it cannot be mixed on the same link as RS485. Unlike RS485, K-Bus signals applied across two terminals are not polarised.

It is important to note that these are not data protocols. They only describe the physical characteristics required for two devices to communicate with each other.

For a description of the K-Bus standard see K-Bus and General Electric's K-Bus interface guide reference R6509.

A full description of the RS485 is available in the published standard.

3.1 UNIVERSAL SERIAL BUS

The USB port is used for connecting computers locally for the purposes of transferring settings, measurements and records to/from the computer to the IED and to download firmware updates from a local computer to the IED.

3.2 EIA(RS)485 BUS

The RS485 two-wire connection provides a half-duplex, fully isolated serial connection to the IED. The connection is polarized but there is no agreed definition of which terminal is which. If the master is unable to communicate with the product, and the communication parameters match, then it is possible that the two-wire connection is reversed.

The RS485 bus must be terminated at each end with 120 Ω 0.5 W terminating resistors between the signal wires.

The RS485 standard requires that each device be directly connected to the actual bus. Stubs and tees are forbidden. Loop bus and Star topologies are not part of the RS485 standard and are also forbidden.

Two-core screened twisted pair cable should be used. The final cable specification is dependent on the application, although a multi-strand 0.5 mm^2 per core is normally adequate. The total cable length must not exceed 1000 m. It is important to avoid circulating currents, which can cause noise and interference, especially when the cable runs between buildings. For this reason, the screen should be continuous and connected to ground at one end only, normally at the master connection point.

The RS485 signal is a differential signal and there is no signal ground connection. If a signal ground connection is present in the bus cable then it must be ignored. At no stage should this be connected to the cable's screen or to the product's chassis. This is for both safety and noise reasons.

It may be necessary to bias the signal wires to prevent jabber. Jabber occurs when the signal level has an indeterminate state because the bus is not being actively driven. This can occur when all the slaves are in receive mode and the master is slow to turn from receive mode to transmit mode. This may be because the master is waiting in receive mode, in a high impedance state, until it has something to transmit. Jabber causes the receiving device(s) to miss the first bits of the first character in the packet, which results in the slave rejecting the message and consequently not responding. Symptoms of this are; poor response times (due to retries), increasing message error counts, erratic communications, and in the worst case, complete failure to communicate.

3.2.1 EIA(RS)485 BIASING REQUIREMENTS

Biasing requires that the signal lines be weakly pulled to a defined voltage level of about 1 V. There should only be one bias point on the bus, which is best situated at the master connection point. The DC source used for the bias must be clean to prevent noise being injected.

Note:
Some devices may be able to provide the bus bias, in which case external components would not be required.

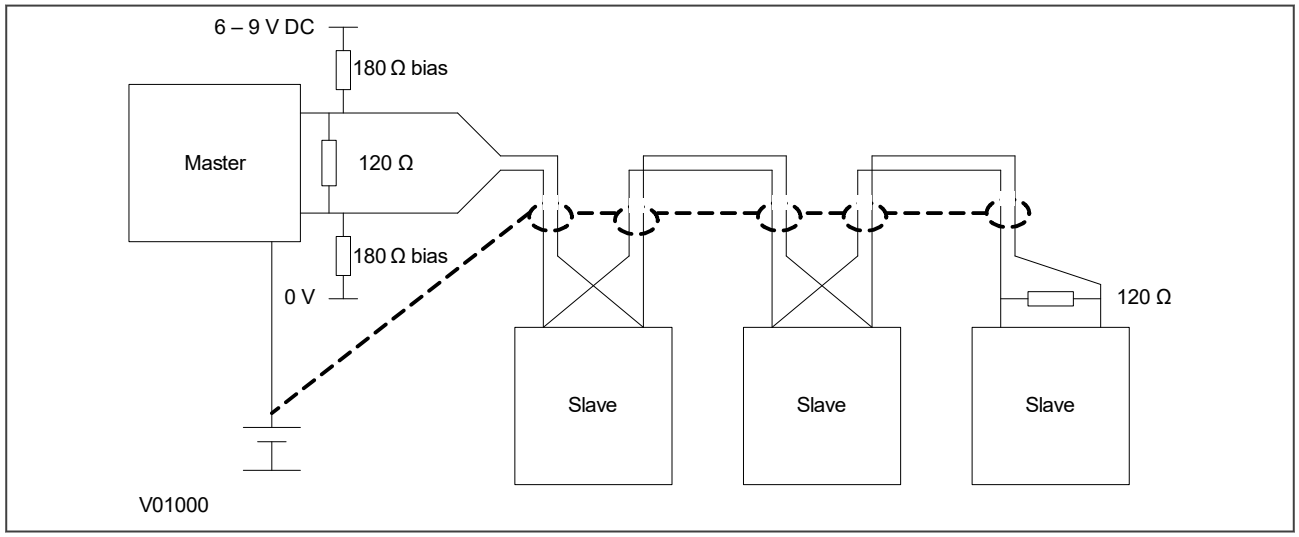


Figure 89: RS485 biasing circuit

Warning:
It is extremely important that the 120 Ω termination resistors are fitted. Otherwise the bias voltage may be excessive and may damage the devices connected to the bus.

3.3 K-BUS

K-Bus is a robust signalling method based on RS485 voltage levels. K-Bus incorporates message framing, based on a 64 kbps synchronous HDLC protocol with FM0 modulation to increase speed and security.

The rear interface is used to provide a permanent connection for K-Bus, which allows multi-drop connection.

A K-Bus spur consists of up to 32 IEDs connected together in a multi-drop arrangement using twisted pair wiring. The K-Bus twisted pair connection is non-polarised.

It is not possible to use a standard EIA(RS)232 to EIA(RS)485 converter to convert IEC 60870-5 FT1.2 frames to K-Bus. A protocol converter, namely the KITZ101 or KITZ102, must be used for this purpose. Please consult General Electric for information regarding the specification and supply of KITZ devices. The following figure demonstrates a typical K-Bus connection.

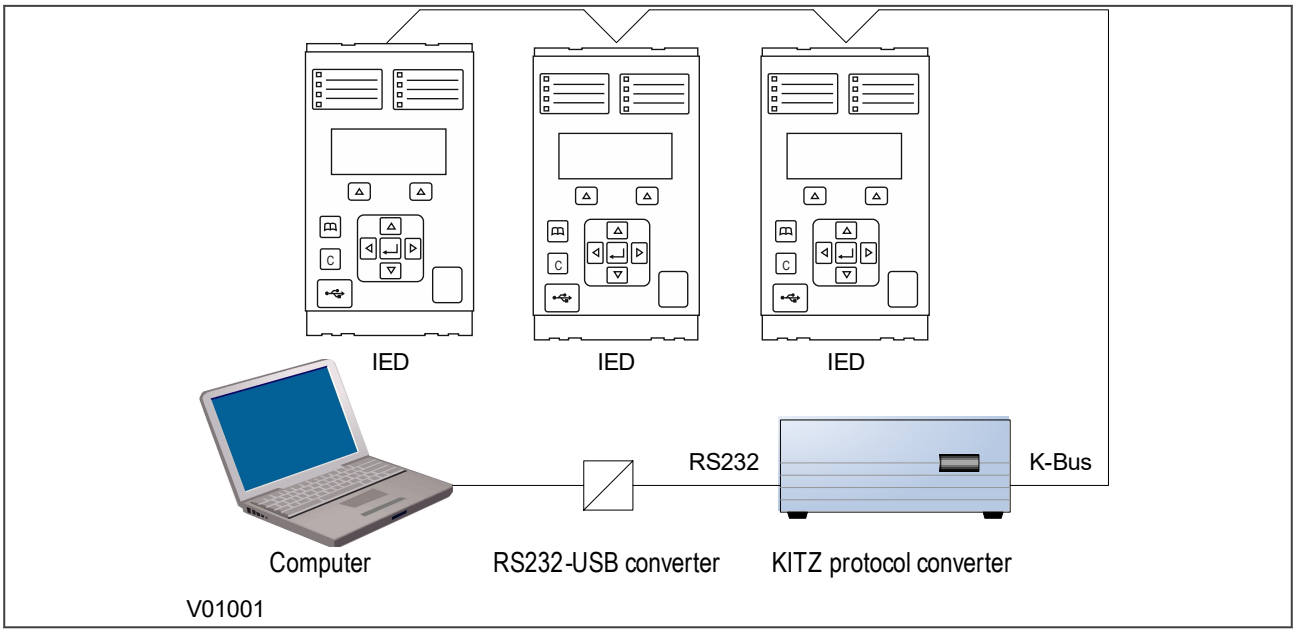


Figure 90: Remote communication using K-Bus

Note:
An RS232-USB converter is only needed if the local computer does not provide an RS232 port.

Further information about K-Bus is available in the publication R6509: K-Bus Interface Guide, which is available on request.

4 STANDARD ETHERNET COMMUNICATION

The Ethernet interface is required for either IEC 61850 and/or DNP3 over Ethernet (protocol must be selected at time of order). With either of these protocols, the Ethernet interface also offers communication with MiCOM S1 for remote configuration and record extraction.

Fibre optic connection is recommended for use in permanent connections in a substation environment, as it offers advantages in terms of noise rejection. The fibre optic port provides 100 Mbps communication and uses type LC connectors.

The device can also be connected to either a 10Base-T or a 100Base-TX Ethernet hub or switch using the RJ45 port. The port automatically senses which type of hub is connected. Due to noise and interference reasons, this connection type is only recommended for short-term connections over a short distance.

The pins on the RJ45connector are as follows:

Pin	Signal name	Signal definition
1	TXP	Transmit (positive)
2	TXN	Transmit (negative)
3	RXP	Receive (positive)
4	-	Not used
5	-	Not used
6	RXN	Receive (negative)
7	-	Not used
8	-	Not used

5 REDUNDANT ETHERNET COMMUNICATION

Redundancy is required where a single point of failure cannot be tolerated. It is required in critical applications such as substation automation. Redundancy acts as an insurance policy, providing an alternative route if one route fails.

Ethernet communication redundancy is available for most General Electric products, using a Redundant Ethernet facility. This is an in-built Network Interface Card (NIC), which incorporates an integrated Ethernet switch. The interface provides two Ethernet transmitter/receiver pairs, both of which are for the same physical medium (two copper, or two fibre). In addition to the two Ethernet transmitter/receiver pairs, the REB provides link activity indication.

Both industry standard PRP (Parallel Redundancy Protocol) and HSR (High-availability Seamless Redundancy) protocols are available by ordering option.

5.1 SUPPORTED PROTOCOLS

One of the key requirements of substation redundant communications is "bumpless" redundancy. This means the ability to transfer from one communication path to another without noticeable consequences. Standard protocols of the time could not meet the demanding requirements of network availability for substation automation solutions. Switch-over times were unacceptably long. For this reason, companies developed proprietary protocols. More recently, however, standard protocols, which support bumpless redundancy (namely PRP and HSR) have been developed and ratified.

P40Agile version 56 onwards supports redundant Ethernet. Variants for each of the following protocols are available:

- PRP (Parallel Redundancy Protocol)
- HSR (High-availability Seamless Redundancy)

PRP and HSR are open standards, so their implementation is compatible with any standard PRP or HSR device respectively. PRP provides "bumpless" redundancy.

5.2 PARALLEL REDUNDANCY PROTOCOL

PRP (Parallel Redundancy Protocol) is defined in IEC 62439-3. PRP provides bumpless redundancy and meets the most demanding needs of substation automation. The PRP implementation of the REB is compatible with any standard PRP device.

PRP uses two independent Ethernet networks operating in parallel. PRP systems are designed so that there should be no common point of failure between the two networks, so the networks have independent power sources and are not connected together directly.

Devices designed for PRP applications have two ports attached to two separate networks and are called Doubly Attached Nodes (DAN). A DAN has two ports, one MAC address and one IP address.

The sending node replicates each frame and transmits them over both networks. The receiving node processes the frame that arrives first and discards the duplicate. Therefore there is no distinction between the working and backup path. The receiving node checks that all frames arrive in sequence and that frames are correctly received on both ports.

Devices such as printers that have a single Ethernet port can be connected to either of the networks but will not directly benefit from the PRP principles. Such devices are called Singly Attached Nodes (SAN). For devices with a single Ethernet port that need to connect to both LANs, this can be achieved by employing Ethernet Redundancy Boxes (sometimes abbreviated to RedBox). Devices with a single Ethernet port that connect to both LANs by means of a RedBox are known as Virtual DAN (VDAN).

The figure below summarises DAN, SAN, VDAN, LAN, and RedBox connectivity.

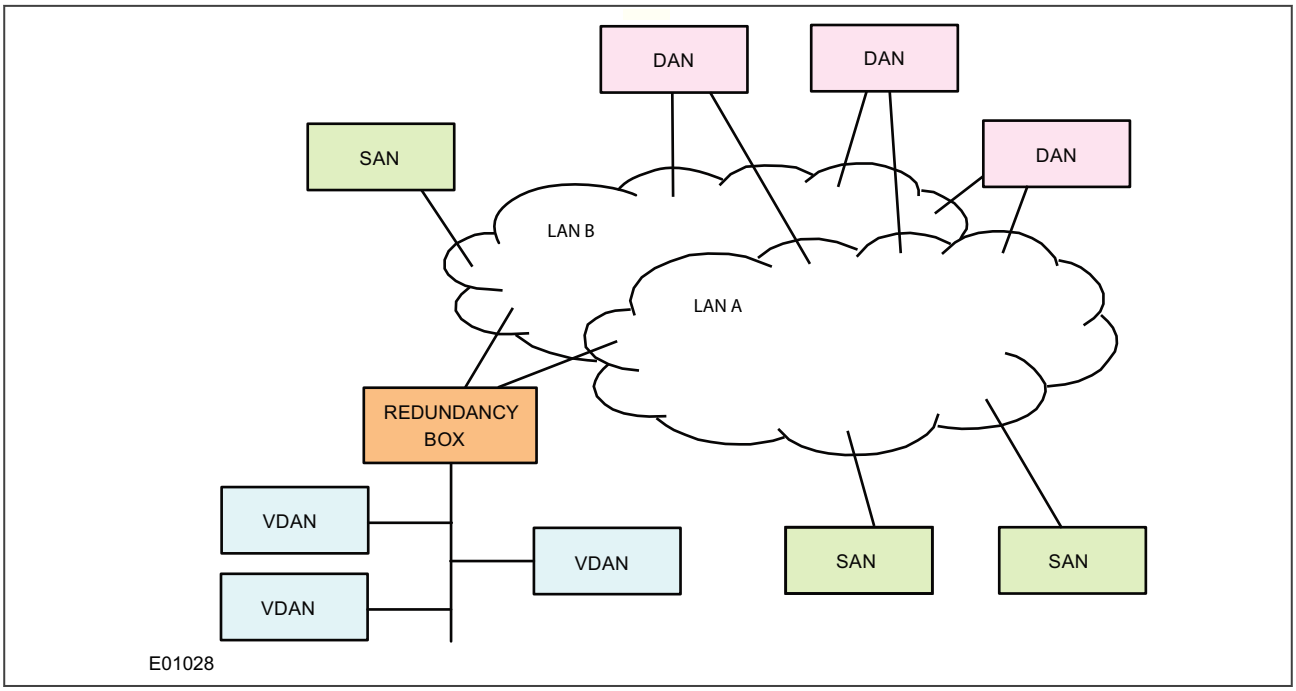


Figure 91: IED attached to separate LANs

In a DAN, both ports share the same MAC address so it does not affect the way devices talk to each other in an Ethernet network (Address Resolution Protocol at layer 2). Every data frame is seen by both ports.

When a DAN sends a frame of data, the frame is duplicated on both ports and therefore on both LAN segments. This provides a redundant path for the data frame if one of the segments fails. Under normal conditions, both LAN segments are working and each port receives identical frames.

5.3 HIGH-AVAILABILITY SEAMLESS REDUNDANCY (HSR)

HSR is standardized in IEC 62439-3 (clause 5) for use in ring topology networks. Similar to PRP, HSR provides bumpless redundancy and meets the most demanding needs of substation automation. HSR has become the reference standard for ring-topology networks in the substation environment. The HSR implementation of the redundancy Ethernet board (REB) is compatible with any standard HSR device.

HSR works on the premise that each device connected in the ring is a doubly attached node running HSR (referred to as DANH). Similar to PRP, singly attached nodes such as printers are connected via Ethernet Redundancy Boxes (RedBox).

5.3.1 HSR MULTICAST TOPOLOGY

When a DANH is sending a multicast frame, the frame (C frame) is duplicated (A frame and B frame), and each duplicate frame A/B is tagged with the destination MAC address and the sequence number. The frames A and B differ only in their sequence number, which is used to identify one frame from the other. Each frame is sent to the network via a separate port. The destination DANH receives two identical frames, removes the HSR tag of the first frame received and passes this (frame D) on for processing. The other duplicate frame is discarded. The nodes forward frames from one port to the other unless it was the node that injected it into the ring.

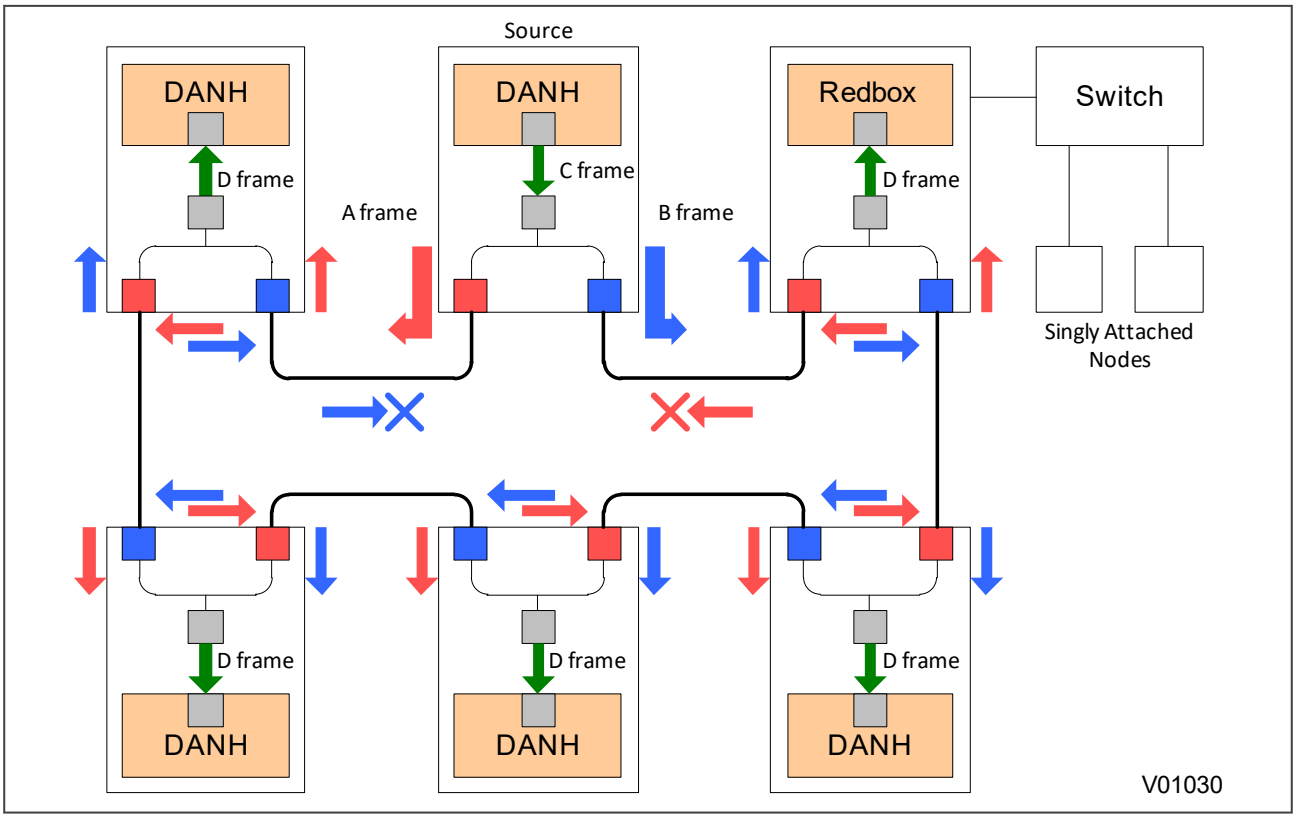


Figure 92: HSR multicast topology

Only about half of the network bandwidth is available in HSR for multicast or broadcast frames because both duplicate frames A & B circulate the full ring.

5.3.2 HSR UNICAST TOPOLOGY

With unicast frames, there is just one destination and the frames are sent to that destination alone. All non-recipient devices simply pass the frames on. They do not process them in any way. In other words, D frames are produced only for the receiving DANH. This is illustrated below.

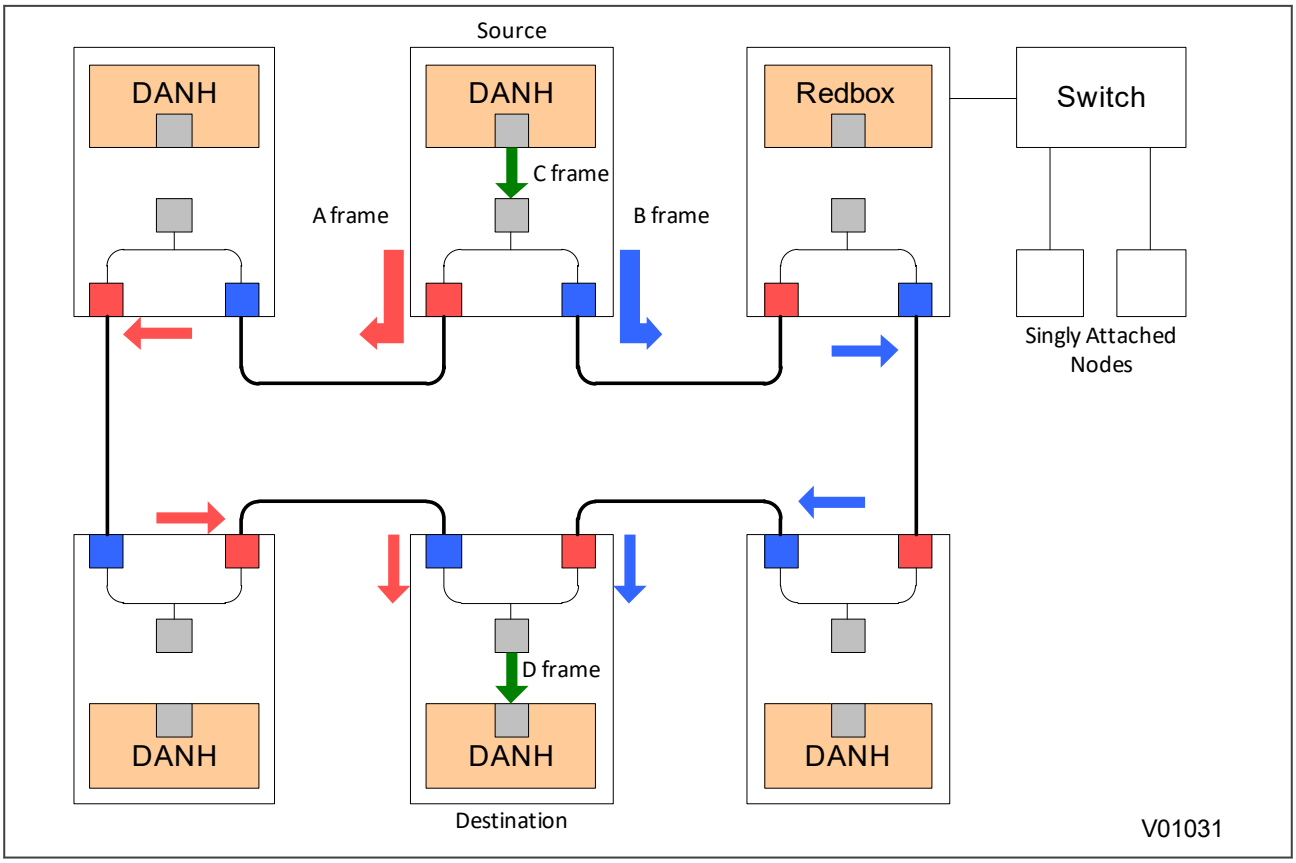


Figure 93: HSR unicast topology

For unicast frames, the whole bandwidth is available as both frames A & B stop at the destination node.

5.3.3 HSR APPLICATION IN THE SUBSTATION

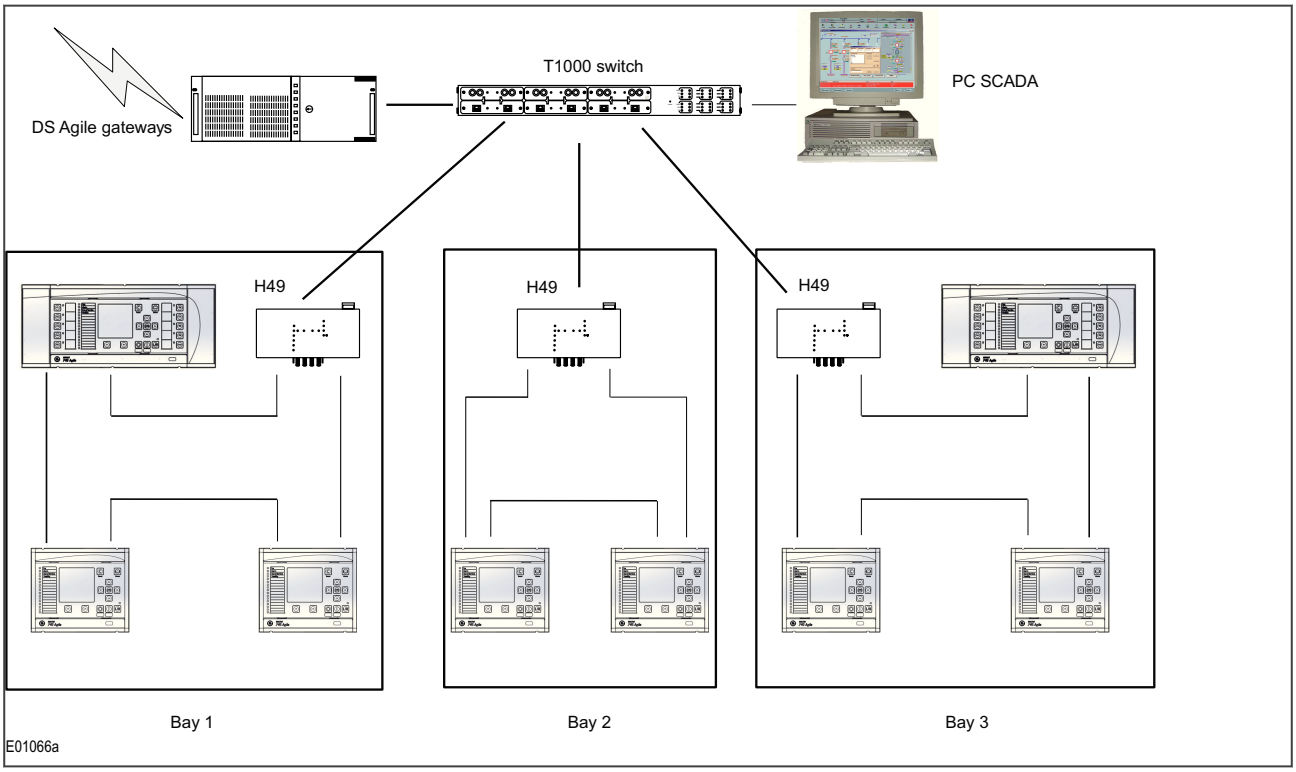


Figure 94: HSR application in the substation

5.4 RAPID SPANNING TREE PROTOCOL

RSTP is a standard used to quickly reconnect a network fault by finding an alternative path. It stops network loops whilst enabling redundancy. It can be used in star or ring connections as shown in the following figure.

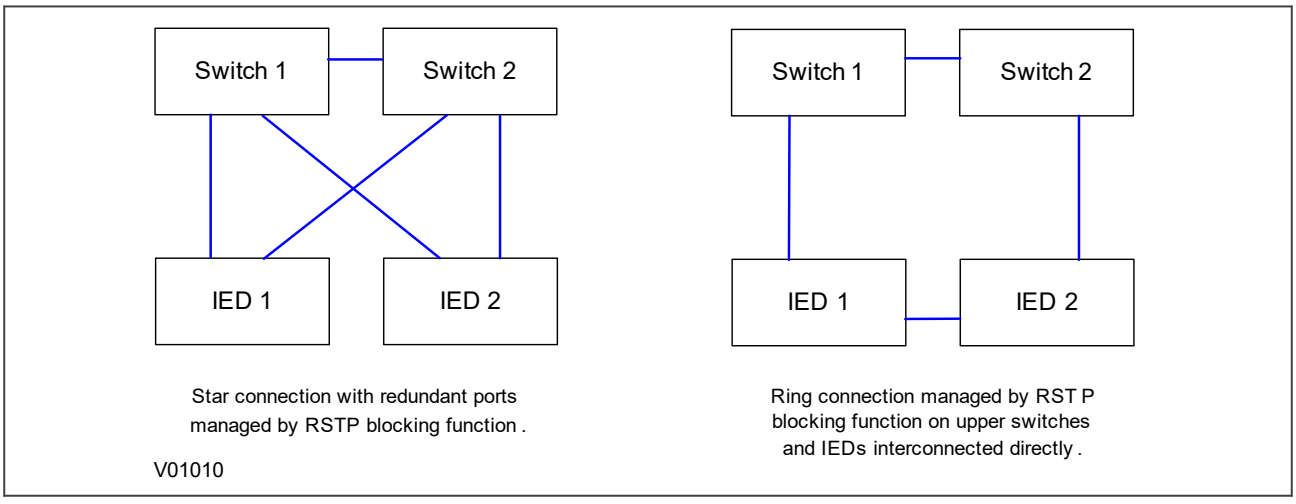


Figure 95: IED attached to redundant Ethernet star or ring circuit

The RSTP implementation in this product is compatible with any devices that use RSTP.

RSTP can recover network faults quickly, but the fault recovery time depends on the number of devices on the network and the network topology. A typical figure for the fault recovery time is 300ms. Therefore, RSTP cannot achieve the “bumpless” redundancy that some other protocols can.

Refer to IEEE 802.1D 2004 standard for detailed information about the oepration of the protocol.

5.5 CONFIGURING IP ADDRESS

The redundant Ethernet facility does not have any special IP address configuration requirements. There is just one IP address for the device, which can be configured using the IEC61850 configurator as for a standard Ethernet device.

The IED configurator will automatically display the PRP/HSR configuration parameters.

6 DATA PROTOCOLS

The products supports a wide range of protocols to make them applicable to many industries and applications. The exact data protocols supported by a particular product depend on its chosen application, but the following table gives a list of the data protocols that are typically available.

SCADA data protocols

Data Protocol	Layer 1 protocol	Description
Courier	K-Bus, RS485, Ethernet, USB	Standard for SCADA communications developed by General Electric.
MODBUS	RS485	Standard for SCADA communications developed by Modicon.
IEC 60870-5-103	RS485	IEC standard for SCADA communications
DNP 3.0	RS485, Ethernet	Standard for SCADA communications developed by Harris. Used mainly in North America.
IEC 61850	Ethernet	IEC standard for substation automation. Facilitates interoperability.

The relationship of these protocols to the lower level physical layer protocols are as follows:

Data Protocols	IEC 60870-5-103 MODBUS DNP3.0 Courier	IEC 61850 DNP3.0 Courier	Courier	Courier
Data Link Layer	EIA(RS)485	Ethernet	USB	K-Bus
Physical Layer	Copper or Optical Fibre			

6.1 COURIER

This section should provide sufficient detail to enable understanding of the Courier protocol at a level required by most users. For situations where the level of information contained in this manual is insufficient, further publications (R6511 and R6512) containing in-depth details about the protocol and its use, are available on request.

Courier is a General Electric proprietary communication protocol. Courier uses a standard set of commands to access a database of settings and data in the IED. This allows a master to communicate with a number of slave devices. The application-specific elements are contained in the database rather than in the commands used to interrogate it, meaning that the master station does not need to be preconfigured. Courier also provides a sequence of event (SOE) and disturbance record extraction mechanism.

6.1.1 PHYSICAL CONNECTION AND LINK LAYER

In the P40 Agile products, Courier can be used with three physical layer protocols: K-Bus, EIA(RS)485 and USB.

Three connection options are available for Courier:

- The front USB port - for connection to Settings application software on, for example, a laptop
- Rear serial port 1 - for permanent SCADA connection via RS485 or K-Bus
- The optional rear serial port 2 - for permanent SCADA connection via RS485 or K-Bus

The IED address and baud rate can be selected using the front panel menu or by a suitable application such as MiCOM S1 Agile.

6.1.2 COURIER DATABASE

The Courier database is two-dimensional and resembles a table. Each cell in the database is referenced by a row and column address. Both the column and the row can take a range from 0 to 255 (0000 to FFFF Hexadecimal.

Addresses in the database are specified as hexadecimal values, for example, 0A02 is column 0A row 02. Associated settings or data are part of the same column. Row zero of the column has a text string to identify the contents of the column and to act as a column heading.

The product-specific menu databases contain the complete database definition.

6.1.3 SETTINGS CATEGORIES

There are two main categories of settings in protection IEDs:

- Control and support settings
- Protection settings

With the exception of the Disturbance Recorder settings, changes made to the control and support settings are implemented immediately and stored in non-volatile memory. Changes made to the Protection settings and the Disturbance Recorder settings are stored in 'scratchpad' memory and are not immediately implemented. These need to be committed by writing to the ***Save Changes*** cell in the *CONFIGURATION* column.

6.1.4 SETTING CHANGES

Courier provides two mechanisms for making setting changes. Either method can be used for editing any of the settings in the database.

Method 1

This uses a combination of three commands to perform a settings change:

First, enter Setting mode: This checks that the cell is settable and returns the limits.

1. Preload Setting: This places a new value into the cell. This value is echoed to ensure that setting corruption has not taken place. The validity of the setting is not checked by this action.
2. Execute Setting: This confirms the setting change. If the change is valid, a positive response is returned. If the setting change fails, an error response is returned.
3. Abort Setting: This command can be used to abandon the setting change.

This is the most secure method. It is ideally suited to on-line editors because the setting limits are extracted before the setting change is made. However, this method can be slow if many settings are being changed because three commands are required for each change.

Method 2

The Set Value command can be used to change a setting directly. The response to this command is either a positive confirm or an error code to indicate the nature of a failure. This command can be used to implement a setting more rapidly than the previous method, however the limits are not extracted. This method is therefore most suitable for off-line setting editors such as MiCOM S1 Agile, or for issuing preconfigured control commands.

6.1.5 EVENT EXTRACTION

You can extract events either automatically (rear serial port only) or manually (either serial port). For automatic extraction, all events are extracted in sequential order using the Courier event mechanism. This includes fault and maintenance data if appropriate. The manual approach allows you to select events, faults, or maintenance data as desired.

6.1.5.1 AUTOMATIC EVENT RECORD EXTRACTION

This method is intended for continuous extraction of event and fault information as it is produced. It is only supported through the rear Courier port.

When new event information is created, the ***Event*** bit is set in the ***Status*** byte. This indicates to the Master device that event information is available. The oldest, non-extracted event can be extracted from the IED using the ***Send Event*** command. The IED responds with the event data.

Once an event has been extracted, the ***Accept Event*** command can be used to confirm that the event has been successfully extracted. When all events have been extracted, the ***Event*** bit is reset. If there are more events still to be extracted, the next event can be accessed using the ***Send Event*** command as before.

6.1.5.2 MANUAL EVENT RECORD EXTRACTION

The *VIEW RECORDS* column (location 01) is used for manual viewing of event, fault, and maintenance records. The contents of this column depend on the nature of the record selected. You can select events by event number and directly select a fault or maintenance record by number.

Event Record Selection ('Select Event' cell: 0101)

This cell can be set the number of stored events. For simple event records (Type 0), cells 0102 to 0105 contain the event details. A single cell is used to represent each of the event fields. If the event selected is a fault or maintenance record (Type 3), the remainder of the column contains the additional information.

Fault Record Selection ('Select Fault' cell: 0105)

This cell can be used to select a fault record directly, using a value between 0 and 4 to select one of up to five stored fault records. (0 is the most recent fault and 4 is the oldest). The column then contains the details of the fault record selected.

Maintenance Record Selection ('Select Maint' cell: 01F0)

This cell can be used to select a maintenance record using a value between 0 and 4. This cell operates in a similar way to the fault record selection.

If this column is used to extract event information, the number associated with a particular record changes when a new event or fault occurs.

Event Types

The IED generates events under certain circumstances such as:

- Change of state of output contact
- Change of state of opto-input
- Protection element operation
- Alarm condition
- Setting change
- Password entered/timed-out

Event Record Format

The IED returns the following fields when the Send Event command is invoked:

- Cell reference
- Time stamp
- Cell text
- Cell value

The Menu Database contains tables of possible events, and shows how the contents of the above fields are interpreted. Fault and Maintenance records return a Courier Type 3 event, which contains the above fields plus two additional fields:

- Event extraction column
- Event number

These events contain additional information, which is extracted from the IED using column B4. Row 01 contains a ***Select Record*** setting that allows the fault or maintenance record to be selected. This setting should be set to the

event number value returned in the record. The extended data can be extracted from the IED by uploading the text and data from the column.

6.1.6 DISTURBANCE RECORD EXTRACTION

The stored disturbance records are accessible through the Courier interface. The records are extracted using column (B4).

The ***Select Record*** cell can be used to select the record to be extracted. Record 0 is the oldest non-extracted record. Older records which have already been extracted are assigned positive values, while younger records are assigned negative values. To help automatic extraction through the rear port, the IED sets the ***Disturbance*** bit of the ***Status*** byte, whenever there are non-extracted disturbance records.

Once a record has been selected, using the above cell, the time and date of the record can be read from the ***Trigger Time*** cell (B402). The disturbance record can be extracted using the block transfer mechanism from cell B40B and saved in the COMTRADE format. The settings application software software automatically does this.

6.1.7 PROGRAMMABLE SCHEME LOGIC SETTINGS

The programmable scheme logic (PSL) settings can be uploaded from and downloaded to the IED using the block transfer mechanism.

The following cells are used to perform the extraction:

- ***Domain*** cell (B204): Used to select either PSL settings (upload or download) or PSL configuration data (upload only)
- ***Sub-Domain*** cell (B208): Used to select the Protection Setting Group to be uploaded or downloaded.
- ***Version*** cell (B20C): Used on a download to check the compatibility of the file to be downloaded.
- ***Transfer Mode*** cell (B21C): Used to set up the transfer process.
- ***Data Transfer*** cell (B120): Used to perform upload or download.

The PSL settings can be uploaded and downloaded to and from the IED using this mechanism. The settings application software must be used to edit the settings. It also performs checks on the validity of the settings before they are transferred to the IED.

6.1.8 TIME SYNCHRONISATION

The time and date can be set using the time synchronization feature of the Courier protocol. The device will correct for the transmission delay. The time synchronization message may be sent as either a global command or to any individual IED address. If the time synchronization message is sent to an individual address, then the device will respond with a confirm message. If sent as a global command, the (same) command must be sent twice. A time synchronization Courier event will be generated/produced whether the time-synchronization message is sent as a global command or to any individual IED address.

If the clock is being synchronized using the IRIG-B input then it will not be possible to set the device time using the Courier interface. An attempt to set the time using the interface will cause the device to create an event with the current date and time taken from the IRIG-B synchronized internal clock.

6.1.9 COURIER CONFIGURATION

To configure the device:

1. Select the *CONFIGURATION* column and check that the ***Comms settings*** cell is set to `Visible`.
2. Select the *COMMUNICATIONS* column.

3. Move to the first cell down (***RP1 protocol***). This is a non-settable cell, which shows the chosen communication protocol – in this case *Courier*.

```
COMMUNICATIONS
RP1 Protocol
Courier
```

4. Move down to the next cell (***RP1 Address***). This cell controls the address of the RP1 port on the device. Up to 32 IEDs can be connected to one spur. It is therefore necessary for each IED to have a unique address so that messages from the master control station are accepted by one IED only. Courier uses an integer number between 1 and 254 for the Relay Address. It is set to 255 by default, which has to be changed. It is important that no two IEDs share the same address.

```
COMMUNICATIONS
RP1 Address
100
```

5. Move down to the next cell (***RP1 InactivTimer***). This cell controls the inactivity timer. The inactivity timer controls how long the IED waits without receiving any messages on the rear port before revoking any password access that was enabled and discarding any changes. For the rear port this can be set between 1 and 30 minutes.

```
COMMUNICATIONS
RP1 Inactivtimer
10.00 mins.
```

6. If the optional fibre optic connectors are fitted, the ***RP1 PhysicalLink*** cell is visible. This cell controls the physical media used for the communication (Copper or Fibre optic).

```
COMMUNICATIONS
RP1 PhysicalLink
Copper
```

7. Move down to the next cell (***RP1 Card Status***). This cell is not settable. It displays the status of the chosen physical layer protocol for RP1.

```
COMMUNICATIONS
RP1 Card Status
K-Bus OK
```

8. Move down to the next cell (***RP1 Port Config***). This cell controls the type of serial connection. Select between K-Bus or RS485.

```
COMMUNICATIONS
RP1 Port Config
K-Bus
```

9. If using EIA(RS)485, the next cell (***RP1 Comms Mode***) selects the communication mode. The choice is either IEC 60870 FT1.2 for normal operation with 11-bit modems, or 10-bit no parity. If using K-Bus this cell will not appear.

```
COMMUNICATIONS
RP1 Comms Mode
IEC 60870 FT1.2
```

10. If using EIA(RS)485, the next cell down controls the baud rate. Three baud rates are supported; 9600, 19200 and 38400. If using K-Bus this cell will not appear as the baud rate is fixed at 64 kbps.

```
COMMUNICATIONS
RP1 Baud rate
19200
```

6.2 IEC 60870-5-103

The specification IEC 60870-5-103 (Telecontrol Equipment and Systems Part 5 Section 103: Transmission Protocols), defines the use of standards IEC 60870-5-1 to IEC 60870-5-5, which were designed for communication with protection equipment.

This section describes how the IEC 60870-5-103 standard is applied to the Px40 platform. It is not a description of the standard itself. The level at which this section is written assumes that the reader is already familiar with the IEC 60870-5-103 standard.

This section should provide sufficient detail to enable understanding of the standard at a level required by most users.

The IEC 60870-5-103 interface is a master/slave interface with the device as the slave device. The device conforms to compatibility level 2, as defined in the IEC 60870-5-103.standard.

The following IEC 60870-5-103 facilities are supported by this interface:

- Initialization (reset)
- Time synchronization
- Event record extraction
- General interrogation
- Cyclic measurements
- General commands
- Disturbance record extraction
- Private codes

6.2.1 PHYSICAL CONNECTION AND LINK LAYER

There is just one option for IEC 60870-5-103:

- Rear serial port 1- for permanent SCADA connection via RS485

The IED address and baud rate can be selected using the front panel menu or by a suitable application such as MiCOM S1 Agile.

6.2.2 INITIALISATION

Whenever the device has been powered up, or if the communication parameters have been changed a reset command is required to initialize the communications. The device will respond to either of the two reset commands; Reset CU or Reset FCB (Communication Unit or Frame Count Bit). The difference between the two commands is that the Reset CU command will clear any unsent messages in the transmit buffer, whereas the Reset FCB command does not delete any messages.

The device will respond to the reset command with an identification message ASDU 5. The Cause of Transmission (COT) of this response will be either Reset CU or Reset FCB depending on the nature of the reset command. The content of ASDU 5 is described in the IEC 60870-5-103 section of the Menu Database, available from General Electric separately if required.

In addition to the above identification message, it will also produce a power up event.

6.2.3 TIME SYNCHRONISATION

The time and date can be set using the time synchronization feature of the IEC 60870-5-103 protocol. The device will correct for the transmission delay as specified in IEC 60870-5-103. If the time synchronization message is sent as a send/confirm message then the device will respond with a confirm message. A time synchronization Class 1 event will be generated/produced whether the time-synchronization message is sent as a send confirm or a broadcast (send/no reply) message.

If the clock is being synchronized using the IRIG-B input then it will not be possible to set the device time using the IEC 60870-5-103 interface. An attempt to set the time via the interface will cause the device to create an event with the current date and time taken from the IRIG-B synchronized internal clock.

6.2.4 SPONTANEOUS EVENTS

Events are categorized using the following information:

- Function type
- Information Number

The IEC 60870-5-103 profile in the Menu Database contains a complete listing of all events produced by the device.

6.2.5 GENERAL INTERROGATION (GI)

The GI request can be used to read the status of the device, the function numbers, and information numbers that will be returned during the GI cycle. These are shown in the IEC 60870-5-103 profile in the Menu Database.

6.2.6 CYCLIC MEASUREMENTS

The device will produce measured values using ASDU 9 on a cyclical basis, this can be read from the device using a Class 2 poll (note ADSU 3 is not used). The rate at which the device produces new measured values can be controlled using the measurement period setting. This setting can be edited from the front panel menu or using MiCOM S1 Agile. It is active immediately following a change.

The device transmits its measurands with maximum value of 2.4 times the rated value of the measurement.

6.2.7 COMMANDS

A list of the supported commands is contained in the Menu Database. The device will respond to other commands with an ASDU 1, with a cause of transmission (COT) indicating 'negative acknowledgement'.

6.2.8 TEST MODE

It is possible to disable the device output contacts to allow secondary injection testing to be performed using either the front panel menu or the front serial port. The IEC 60870-5-103 standard interprets this as 'test mode'. An

event will be produced to indicate both entry to and exit from test mode. Spontaneous events and cyclic measured data transmitted whilst the device is in test mode will have a COT of 'test mode'.

6.2.9 DISTURBANCE RECORDS

The disturbance records are stored in uncompressed format and can be extracted using the standard mechanisms described in IEC 60870-5-103.

> *Note:*
> *IEC 60870-5-103 only supports up to 8 records.*

6.2.10 COMMAND/MONITOR BLOCKING

The device supports a facility to block messages in the monitor direction (data from the device) and also in the command direction (data to the device). Messages can be blocked in the monitor and command directions using one of the two following methods

- The menu command ***RP1 CS103Blcking*** in the *COMMUNICATIONS* column
- The DDB signals Monitor Blocked and Command Blocked

6.2.11 IEC 60870-5-103 CONFIGURATION

To configure the device:

1. Select the *CONFIGURATION* column and check that the ***Comms settings*** cell is set to `Visible`.
2. Select the *COMMUNICATIONS* column.
3. Move to the first cell down (***RP1 Protocol***). Set this to the table cell, which shows the chosen communication protocol – in this case `IEC 60870-5-103`.

```
COMMUNICATIONS
RP1 Protocol
IEC 60870-5-103
```

4. Move down to the next cell (***RP1 Address***). This cell controls the IEC 60870-5-103 address of the IED. Up to 32 IEDs can be connected to one spur. It is therefore necessary for each IED to have a unique address so that messages from the master control station are accepted by one IED only. IEC 60870-5-103 uses an integer number between 0 and 254 for the address. It is important that no two IEDs have the same IEC 60870 5 103 address. The IEC 60870-5-103 address is then used by the master station to communicate with the IED.

```
COMMUNICATIONS
RP1 address
162
```

5. Move down to the next cell (***RP1 Baud Rate***). This cell controls the baud rate to be used. Two baud rates are supported by the IED, `9600 bits/s` and `19200 bits/s`. Make sure that the baud rate selected on the IED is the same as that set on the master station.

```
COMMUNICATIONS
RP1 Baud rate
9600 bits/s
```

6. Move down to the next cell (***RP1 Meas Period***). The next cell down controls the period between IEC 60870-5-103 measurements. The IEC 60870-5-103 protocol allows the IED to supply measurements at regular intervals. The interval between measurements is controlled by this cell, and can be set between 1 and 60 seconds.

```
COMMUNICATIONS
RP1 Meas Period
30.00 s
```

7. If the optional fibre optic connectors are fitted, the ***RP1 PhysicalLink*** cell is visible. This cell controls the physical media used for the communication (Copper or Fibre optic).

```
COMMUNICATIONS
RP1 PhysicalLink
Copper
```

8. The next cell down (***RP1 CS103Blcking***) can be used for monitor or command blocking.

```
COMMUNICATIONS
RP1 CS103Blcking
Disabled
```

9. There are three settings associated with this cell; these are:

Setting:	Description:
Disabled	No blocking selected.
Monitor Blocking	When the monitor blocking DDB Signal is active high, either by energising an opto input or control input, reading of the status information and disturbance records is not permitted. When in this mode the device returns a "Termination of general interrogation" message to the master station.
Command Blocking	When the command blocking DDB signal is active high, either by energising an opto input or control input, all remote commands will be ignored (i.e. CB Trip/Close, change setting group etc.). When in this mode the device returns a "negative acknowledgement of command" message to the master station.

6.3 DNP 3.0

This section describes how the DNP 3.0 standard is applied in the product. It is not a description of the standard itself. The level at which this section is written assumes that the reader is already familiar with the DNP 3.0 standard.

The descriptions given here are intended to accompany the device profile document that is included in the Menu Database document. The DNP 3.0 protocol is not described here, please refer to the documentation available from the user group. The device profile document specifies the full details of the DNP 3.0 implementation. This is the standard format DNP 3.0 document that specifies which objects; variations and qualifiers are supported. The device profile document also specifies what data is available from the device using DNP 3.0. The IED operates as a DNP 3.0 slave and supports subset level 2, as described in the DNP 3.0 standard, plus some of the features from level 3.

The DNP 3.0 protocol is defined and administered by the DNP Users Group. For further information on DNP 3.0 and the protocol specifications, please see the DNP website (www.dnp.org).

6.3.1 PHYSICAL CONNECTION AND LINK LAYER

DNP 3.0 can be used with two physical layer protocols: EIA(RS)485, or Ethernet.

Several connection options are available for DNP 3.0

- Rear serial port 1 - for permanent SCADA connection via RS485
- The rear Ethernet RJ45 port on the optional Ethernet board - for permanent SCADA Ethernet connection
- The rear Ethernet fibre port on the optional Ethernet board - for permanent SCADA Ethernet connection

With DNP3 Over Ethernet, a maximum of 10 Clients can be configured. They are configured using the DNP3 Configurator

The IED address and baud rate can be selected using the front panel menu or by a suitable application such as MiCOM Agile.

When using a serial interface, the data format is: 1 start bit, 8 data bits, 1 stop bit and optional configurable parity bit.

6.3.2 OBJECT 1 BINARY INPUTS

Object 1, binary inputs, contains information describing the state of signals in the IED, which mostly form part of the digital data bus (DDB). In general these include the state of the output contacts and opto-inputs, alarm signals, and protection start and trip signals. The 'DDB number' column in the device profile document provides the DDB numbers for the DNP 3.0 point data. These can be used to cross-reference to the DDB definition list. See the relevant Menu Database document. The binary input points can also be read as change events using Object 2 and Object 60 for class 1-3 event data.

Note:
For the DNP Events to be transmitted it is mandatory to have the corresponding DDBs of the Configured Point Index to be included in the Courier Event Record. The RECORD CONTROL Menu lists all the DDBs, and the mask settings control their inclusion/exclusion as a Courier Event.

6.3.3 OBJECT 10 BINARY OUTPUTS

Object 10, binary outputs, contains commands that can be operated using DNP 3.0. Therefore the points accept commands of type pulse on (null, trip, close) and latch on/off as detailed in the device profile in the relevant Menu Database document, and execute the command once for either command. The other fields are ignored (queue, clear, trip/close, in time and off time).

There is an additional image of the Control Inputs. Described as Alias Control Inputs, they reflect the state of the Control Input, but with a dynamic nature.

- If the Control Input DDB signal is already SET and a new DNP SET command is sent to the Control Input, the Control Input DDB signal goes momentarily to RESET and then back to SET.
- If the Control Input DDB signal is already RESET and a new DNP RESET command is sent to the Control Input, the Control Input DDB signal goes momentarily to SET and then back to RESET.

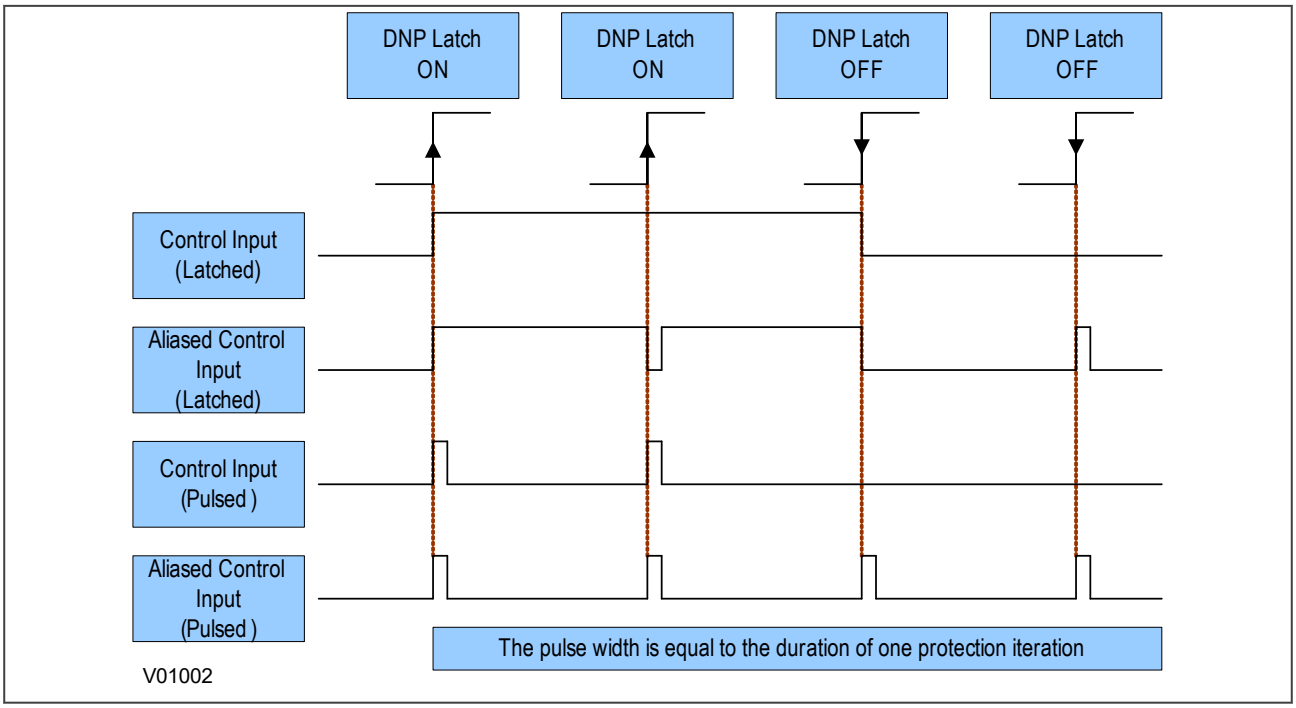


Figure 96: Control input behaviour

Many of the IED's functions are configurable so some of the Object 10 commands described in the following sections may not be available. A read from Object 10 reports the point as off-line and an operate command to Object 12 generates an error response.

Examples of Object 10 points that maybe reported as off-line are:

- Activate setting groups: Ensure setting groups are enabled
- CB trip/close: Ensure remote CB control is enabled
- Reset NPS thermal: Ensure NPS thermal protection is enabled
- Reset thermal O/L: Ensure thermal overload protection is enabled
- Reset RTD flags: Ensure RTD Inputs is enabled
- Control inputs: Ensure control inputs are enabled

6.3.4 OBJECT 20 BINARY COUNTERS

Object 20, binary counters, contains cumulative counters and measurements. The binary counters can be read as their present 'running' value from Object 20, or as a 'frozen' value from Object 21. The running counters of object 20 accept the read, freeze and clear functions. The freeze function takes the current value of the object 20 running counter and stores it in the corresponding Object 21 frozen counter. The freeze and clear function resets the Object 20 running counter to zero after freezing its value.

Binary counter and frozen counter change event values are available for reporting from Object 22 and Object 23 respectively. Counter change events (Object 22) only report the most recent change, so the maximum number of events supported is the same as the total number of counters. Frozen counter change events (Object 23) are generated whenever a freeze operation is performed and a change has occurred since the previous freeze command. The frozen counter event queues store the points for up to two freeze operations.

6.3.5 OBJECT 30 ANALOGUE INPUT

Object 30, analogue inputs, contains information from the IED's measurements columns in the menu. All object 30 points can be reported as 16 or 32-bit integer values with flag, 16 or 32-bit integer values without flag, as well as short floating point values.

Analogue values can be reported to the master station as primary, secondary or normalized values (which takes into account the IED's CT and VT ratios), and this is settable in the *COMMUNICATIONS* column in the IED. Corresponding deadband settings can be displayed in terms of a primary, secondary or normalized value. Deadband point values can be reported and written using Object 34 variations.

The deadband is the setting used to determine whether a change event should be generated for each point. The change events can be read using Object 32 or Object 60. These events are generated for any point which has a value changed by more than the deadband setting since the last time the data value was reported.

Any analogue measurement that is unavailable when it is read is reported as offline. For example, the frequency would be offline if the current and voltage frequency is outside the tracking range of the IED. All Object 30 points are reported as secondary values in DNP 3.0 (with respect to CT and VT ratios).

6.3.6 OBJECT 40 ANALOGUE OUTPUT

The conversion to fixed-point format requires the use of a scaling factor, which is configurable for the various types of data within the IED such as current, voltage, and phase angle. All Object 40 points report the integer scaling values and Object 41 is available to configure integer scaling quantities.

6.3.7 OBJECT 50 TIME SYNCHRONISATION

Function codes 1 (read) and 2 (write) are supported for Object 50 (time and date) variation 1. The DNP Need Time function (the duration of time waited before requesting another time sync from the master) is supported, and is configurable in the range 1 - 30 minutes.

If the clock is being synchronized using the IRIG-B input then it will not be possible to set the device time using the Courier interface. An attempt to set the time using the interface will cause the device to create an event with the current date and time taken from the IRIG-B synchronized internal clock.

6.3.8 DNP3 DEVICE PROFILE

This section describes the specific implementation of DNP version 3.0 within General Electric MiCOM P40 Agile IEDs for both compact and modular ranges.

The devices use the DNP 3.0 Slave Source Code Library version 3 from Triangle MicroWorks Inc.

This document, in conjunction with the DNP 3.0 Basic 4 Document Set, and the DNP Subset Definitions Document, provides complete information on how to communicate with the devices using the DNP 3.0 protocol.

This implementation of DNP 3.0 is fully compliant with DNP 3.0 Subset Definition Level 2. It also contains many Subset Level 3 and above features.

6.3.8.1 DNP3 DEVICE PROFILE TABLE

The following table provides the device profile in a similar format to that defined in the DNP 3.0 Subset Definitions Document. While it is referred to in the DNP 3.0 Subset Definitions as a "Document", it is just one component of a total interoperability guide. This table, in combination with the subsequent Implementation and Points List tables should provide a complete interoperability/configuration guide for the device.

The following table provides the device profile in a similar format to that defined in the DNP 3.0 Subset Definitions Document. While it is referred to in the DNP 3.0 Subset Definitions as a "Document", it is just one component of a total interoperability guide. This table, in combination with the subsequent Implementation and Points List tables should provide a complete interoperability/configuration guide for the device.

DNP 3.0 Device Profile Document	
Vendor Name:	General Electric
Device Name:	MiCOM P40Agile Protection Relays – compact and modular range
Models Covered:	All models

DNP 3.0 Device Profile Document	
Highest DNP Level Supported*: *This is the highest DNP level FULLY supported. Parts of level 3 are also supported	For Requests: Level 2 For Responses: Level 2
Device Function:	Slave
Notable objects, functions, and/or qualifiers supported in addition to the highest DNP levels supported (the complete list is described in the DNP 3.0 Implementation Table): For static (non-change event) object requests, request qualifier codes 00 and 01 (start-stop), 07 and 08 (limited quantity), and 17 and 28 (index) are supported in addition to the request qualifier code 06 (no range (all points)) Static object requests sent with qualifiers 00, 01, 06, 07, or 08 will be responded with qualifiers 00 or 01 Static object requests sent with qualifiers 17 or 28 will be responded with qualifiers 17 or 28 For change-event object requests, qualifiers 17 or 28 are always responded 16-bit and 32-bit analogue change events with time may be requested The read function code for Object 50 (time and date) variation 1 is supported Analogue Input Deadbands, Object 34, variations 1 through 3, are supported Floating Point Analogue Output Status and Output Block Objects 40 and 41 are supported Sequential file transfer, Object 70, variations 2 through 7, are supported Device Attribute Object 0 is supported	
Maximum Data Link Frame Size (octets):	Transmitted: 292 Received: 292
Maximum Application Fragment Size (octets)	Transmitted: Configurable (100 to 2048). Default 2048 Received: 249
Maximum Data Link Retries:	Fixed at 2
Maximum Application Layer Retries:	None
Requires Data Link Layer Confirmation:	Configurable to Never or Always
Requires Application Layer Confirmation:	When reporting event data (Slave devices only) When sending multi-fragment responses (Slave devices only)
Timeouts while waiting for:	
Data Link Confirm:	Configurable
Complete Application Fragment:	None
Application Confirm:	Configurable
Complete Application Response:	None
Others:	
Data Link Confirm Timeout:	Configurable from 0 (Disabled) to 120s, default 10s.
Application Confirm Timeout:	Configurable from 1 to 120s, default 2s.
Select/Operate Arm Timeout:	Configurable from 1 to 10s, default 10s.
Need Time Interval (Set IIN1-4):	Configurable from 1 to 30, default 10min.
Application File Timeout	60 s
Analog Change Event Scan Period:	Fixed at 0.5s
Counter Change Event Scan Period	Fixed at 0.5s
Frozen Counter Change Event Scan Period	Fixed at 1s
Maximum Delay Measurement Error:	2.5 ms
Time Base Drift Over a 10-minute Interval:	7 ms
Sends/Executes Control Operations:	
Write Binary Outputs:	Never
Select/Operate:	Always
Direct Operate:	Always

DNP 3.0 Device Profile Document	
Direct Operate - No Ack:	Always
Count > 1	Never
Pulse On	Always
Pulse Off	Sometimes
Latch On	Always
Latch Off	Always
Queue	Never
Clear Queue	Never
Note: Paired Control points will accept Pulse On/Trip and Pulse On/Close, but only single point will accept the Pulse Off control command.	
Reports Binary Input Change Events when no specific variation requested:	Configurable to send one or the other
Reports time-tagged Binary Input Change Events when no specific variation requested:	Binary input change with time
Sends Unsolicited Responses:	Never
Sends Static Data in Unsolicited Responses:	Never No other options are permitted
Default Counter Object/Variation:	Configurable, Point-by-point list attached Default object: 20 Default variation: 1
Counters Roll Over at:	32 bits
Sends multi-fragment responses:	Yes
Sequential File Transfer Support:	
Append File Mode	No
Custom Status Code Strings	No
Permissions Field	Yes
File Events Assigned to Class	No
File Events Send Immediately	Yes
Multiple Blocks in a Fragment	No
Max Number of Files Open	1

6.3.8.2 DNP3 IMPLEMENTATION TABLE

The implementation table provides a list of objects, variations and control codes supported by the device:

Object			Request (Library will parse)				Response (Library will respond with)			
Object Number	Variation Number	Description	Function Codes (dec)		Qualifier Codes (hex)		Function Codes (dec)		Qualifier Codes (hex)	
1	0	Binary Input (Variation 0 is used to request default variation)	1 22	(read) (assign class)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)				
1	1 (default - see note 1)	Binary Input	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
1	2	Binary Input with Flag	1	(read)	00, 01 06 07, 08 17, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)

Object			Request (Library will parse)				Response (Library will respond with)			
Object Number	Variation Number	Description	Function Codes (dec)		Qualifier Codes (hex)		Function Codes (dec)		Qualifier Codes (hex)	
2	0	Binary Input Change - Any Variation	1	(read)	06 07, 08	(no range, or all) (limited qty)				
2	1	Binary Input Change without Time	1	(read)	06 07, 08	(no range, or all) (limited qty)	129	response	17, 28	(index)
2	2	Binary Input Change with Time	1	(read)	06 07, 08	(no range, or all) (limited qty)	129	response	17, 28	(index)
10	0	Binary Output Status - Any Variation	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)				
10	2 (default - see note 1)	Binary Output Status	1	(read)	00, 01 06 07, 08 17, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
12	1	Control Relay Output Block	3 4 5 6	(select) (operate) (direct op) (dir. op, noack)	17, 28	(index)	129	response		echo of request
20	0	Binary Counter - Any Variation	1 22	(read) (assign class)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)				
			7 8 9 10	(freeze) (freeze noack) (freeze clear) (frz. cl. Noack)	00, 01 06 07, 08	(start-stop) (no range, or all) (limited qty)				
20	1	32-Bit Binary Counter with Flag	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
20	2	16-Bit Binary Counter with Flag	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
20	5 (default - see note 1)	32-Bit Binary Counter without Flag	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
20	6	16-Bit Binary Counter without Flag	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
21	0	Frozen Counter - Any Variation	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)				
21	1	32-Bit Frozen Counter with Flag	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
21	2	16-Bit Frozen Counter with Flag	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
21	5	32-Bit Frozen Counter with Time of Freeze	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 1)
21	6	16-Bit Frozen Counter with Time of Freeze	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) 17, 28 (index - see note 1)
21	9 (default - see note 1)	32-Bit Frozen Counter without Flag	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)

Object			Request (Library will parse)				Response (Library will respond with)			
Object Number	Variation Number	Description	Function Codes (dec)		Qualifier Codes (hex)		Function Codes (dec)		Qualifier Codes (hex)	
21	10	16-Bit Frozen Counter without Flag	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
`22	0	Counter Change Event - Any Variation	1	(read)	06 07, 08	(no range, or all) (limited qty)				
22	1 (default - see note 1)	32-Bit Counter Change Event without Time	1	(read)	06 07, 08	(no range, or all) (limited qty)	129	response	17, 28	(index)
22	2	16-Bit Counter Change Event without Time	1	(read)	06 07, 08	(no range, or all) (limited qty)	129	response	17, 28	(index)
22	5	32-Bit Counter Change Event with Time	1	(read)	06 07, 08	(no range, or all) (limited qty)	129	response	17, 28	(index)
22	6	16-Bit Counter Change Event with Time	1	(read)	06 07, 08	(no range, or all) (limited qty)	129	response	17, 28	(index)
23	0	Frozen Counter Event (Variation 0 is used to request default variation)	1	(read)	06 07, 08	(no range, or all) (limited qty)				
23	1 (default - see note 1)	32-Bit Frozen Counter Event	1	(read)	06 07, 08	(no range, or all) (limited qty)	129	response	17, 28	(index)
23	2	16-Bit Frozen Counter Event	1	(read)	06 07, 08	(no range, or all) (limited qty)	129	response	17, 28	(index)
23	5	32-Bit Frozen Counter Event with Time	1	(read)	06 07, 08	(no range, or all) (limited qty)	129	response	17, 28	(index)
23	6	16-Bit Frozen Counter Event with Time	1	(read)	06 07, 08	(no range, or all) (limited qty)	129	response	17, 28	(index)
30	0	Analog Input - Any Variation	1 22	(read) (assign class)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)				
30	1	32-Bit Analog Input	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
30	2	16-Bit Analog Input	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
30	3 (default - see note 1)	32-Bit Analog Input without Flag	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
30	4	16-Bit Analog Input without Flag	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
30	5	Short floating point	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
32	0	Analog Change Event - Any Variation	1	(read)	06 07, 08	(no range, or all) (limited qty)				
32	1 (default - see note 1)	32-Bit Analog Change Event without Time	1	(read)	06 07, 08	(no range, or all) (limited qty)	129	response	17, 28	(index)
32	2	16-Bit Analog Change Event without Time	1	(read)	06 07, 08	(no range, or all) (limited qty)	129	response	17, 28	(index)
32	3	32-Bit Analog Change Event with Time	1	(read)	06 07, 08	(no range, or all) (limited qty)	129	response	17, 28	(index)
32	4	16-Bit Analog Change Event with Time	1	(read)	06 07, 08	(no range, or all) (limited qty)	129	response	17, 28	(index)
32	5	Short floating point Analog Change Event without Time	1	(read)	06 07, 08	(no range, or all) (limited qty)	129	response	17, 28	(index)
32	7	Short floating point Analog Change Event with Time	1	(read)	06 07, 08	(no range, or all) (limited qty)	129	response	17, 28	(index)

Object			Request (Library will parse)				Response (Library will respond with)			
Object Number	Variation Number	Description	Function Codes (dec)		Qualifier Codes (hex)		Function Codes (dec)		Qualifier Codes (hex)	
34	0	Analog Input Deadband (Variation 0 is used to request default variation)	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)				
34	1	16 Bit Analog Input Deadband	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
			2	(write)	00, 01 07, 08 17, 27, 28	(start-stop) (limited qty) (index)				
34	2 (default - see note 1)	32 Bit Analog Input Deadband	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
			2	(write)	00, 01 07, 08 17, 27, 28	(start-stop) (limited qty) (index)				
34	3	Short Floating Point Analog Input Deadband	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
			2	(write)	00, 01 07, 08 17, 27, 28	(start-stop) (limited qty) (index)				
40	0	Analog Output Status (Variation 0 is used to request default variation)	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)				
40	1 (default - see note 1)	32-Bit Analog Output Status	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
40	2	16-Bit Analog Output Status	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
40	3	Short Floating Point Analog Output Status	1	(read)	00, 01 06 07, 08 17, 27, 28	(start-stop) (no range, or all) (limited qty) (index)	129	response	00, 01 17, 28	(start-stop) (index - see note 2)
41	1	32-Bit Analog Output Block	3 4 5 6	(select) (operate) (direct op) (dir. op, noack)	17, 28 27	(index) (index)	129	response		echo of request
41	2	16-Bit Analog Output Block	3 4 5 6	(select) (operate) (direct op) (dir. op, noack)	17, 28 27	(index) (index)	129	response		echo of request
41	3	Short Floating Point Analog Output Block	3 4 5 6	(select) (operate) (direct op) (dir. op, noack)	17, 27, 28	(index)	129	response		echo of request
50	1 (default - see note 1)	Time and Date	1	(read)	07	(limited qty = 1)	129	response	07	(limited qty = 1)
			2	(write)	07	(limited qty = 1)				
60	0	Not defined								
60	1	Class 0 Data	1	(read)	06	(no range, or all)				
60	2	Class 1 Data	1	(read)	06 07, 08	(no range, or all) (limited qty)				
			22	(assign class)	06	(no range, or all)				
60	3	Class 2 Data	1	(read)	06 07, 08	(no range, or all) (limited qty)				
			22	(assign class)	06	(no range, or all)				
60	4	Class 3 Data	1	(read)	06 07, 08	(no range, or all) (limited qty)				

Object			Request (Library will parse)				Response (Library will respond with)			
Object Number	Variation Number	Description	Function Codes (dec)		Qualifier Codes (hex)		Function Codes (dec)		Qualifier Codes (hex)	
			22	(assign class)	06	(no range, or all)				
70	0	File Event - Any Variation	1	(read)	06 07, 08	(no range, or all) (limited qty)				
			22	(assign class)	06	(no range, or all)				
70	2	File Authentication	29	(authenticate)	5b	(free-format)	129	response		5B (free-format)
70	3	File Command	25 27	(open) (delete)	5b	(free-format)				
70	4	File Command Status	26 30	(close) (abort)	5b	(free-format)	129	response		5B (free-format)
70	5	File Transfer	1	(read)	5b	(free-format)	129	response		5B (free-format)
70	6	File Transfer Status					129	response		5B (free-format)
70	7	File Descriptor	28	(get file info)	5b	(free-format)	129	response		5B (free-format)
80	1	Internal Indications	1	(read)	00, 01	(start-stop)	129	response	00, 01	(start-stop)
		No Object (function code only)	13	(cold restart)						
		No Object (function code only)	14	(warm restart)						
		No Object (function code only)	23	(delay meas.)						

Note:
A Default variation refers to the variation responded to when variation 0 is requested and/or in class 0, 1, 2, or 3 scans.

Note:
For static (non-change-event) objects, qualifiers 17 or 28 are only responded to when a request is sent with qualifiers 17 or 28, respectively. Otherwise, static object requests sent with qualifiers 00, 01, 06, 07, or 08, will be responded to with qualifiers 00 or 01. For change-event objects, qualifiers 17 or 28 are always responded to.

6.3.8.3 DNP3 INTERNAL INDICATIONS

The following table lists the DNP3.0 Internal Indications (IIN) and identifies those that are supported by the device.

The IIN form an information element used to convey the internal states and diagnostic results of a device. This information can be used by a receiving station to perform error recovery or other suitable functions. The IIN is a two-octet field that follows the function code in all responses from the device. When a request cannot be processed due to formatting errors or the requested data is not available, the IIN is always returned with the appropriate bits set.

Bit	Indication	Description	Supported
Octet 1			
0	All stations message received	Set when a request is received with the destination address of the all stations address (6553510). It is cleared after the next response (even if a response to a global request is required). This IIN is used to let the master station know that a "broadcast" message was received by the relay.	Yes

Bit	Indication	Description	Supported
1	Class 1 data available	Set when data that has been configured as Class 1 data is ready to be sent to the master. The master station should request this class data from the relay when this bit is set in a response.	Yes
2	Class 2 data available	Set when data that has been configured as Class 2 data is ready to be sent to the master. The master station should request this class data from the relay when this bit is set in a response.	Yes
3	Class 3 data available	Set when data that has been configured as Class 3 data is ready to be sent to the master. The master station should request this class data from the relay when this bit is set in a response.	Yes
4	Time-synchronization required	The relay requires time synchronization from the master station (using the Time and Date object). This IIN is cleared once the time has been synchronized. It can also be cleared by explicitly writing a 0 into this bit of the Internal Indication object.	Yes
5	Local	Set when some or all of the relays digital output points (Object 10/12) are in the Local state. That is, the relays control outputs are NOT accessible through the DNP protocol. This IIN is clear when the relay is in the Remote state. That is, the relays control outputs are fully accessible through the DNP protocol.	No
6	Device in trouble	Set when an abnormal condition exists in the relay. This IIN is only used when the state cannot be described by a combination of one or more of the other IIN bits.	No
7	Device restart	Set when the device software application restarts. This IIN is cleared when the master station explicitly writes a 0 into this bit of the Internal Indications object.	Yes
Octet 2			
0	Function code not implemented	The received function code is not implemented within the relay.	Yes
1	Requested object(s) unknown	The relay does not have the specified objects or there are no objects assigned to the requested class. This IIN should be used for debugging purposes and usually indicates a mismatch in device profiles or configuration problems.	Yes
2	Out of range	Parameters in the qualifier, range or data fields are not valid or out of range. This is a 'catch-all' for application request formatting errors. It should only be used for debugging purposes. This IIN usually indicates configuration problems.	Yes
3	Buffer overflow	Event buffer(s), or other application buffers, have overflowed. The master station should attempt to recover as much data as possible and indicate to the user that there may be lost data. The appropriate error recovery procedures should be initiated by the user.	Yes
4	Already executing	The received request was understood but the requested operation is already executing.	
5	Bad configuration	Set to indicate that the current configuration in the relay is corrupt. The master station may download another configuration to the relay.	Yes
6	Reserved	Always returned as zero.	
7	Reserved	Always returned as zero.	

6.3.8.4 DNP3 RESPONSE STATUS CODES

When the device processes Control Relay Output Block (Object 12) requests, it returns a set of status codes; one for each point contained within the original request. The complete list of codes appears in the following table:

Code Number	Identifier Name	Description
0	Success	The received request has been accepted, initiated, or queued.
1	Timeout	The request has not been accepted because the 'operate' message was received after the arm timer (Select Before Operate) timed out. The arm timer was started when the select operation for the same point was received.
2	No select	The request has not been accepted because no previous matching 'select' request exists. (An 'operate' message was sent to activate an output that was not previously armed with a matching 'select' message).
3	Format error	The request has not been accepted because there were formatting errors in the control request ('select', 'operate', or 'direct operate').
4	Not supported	The request has not been accepted because a control operation is not supported for this point.
5	Already active	The request has not been accepted because the control queue is full or the point is already active.
6	Hardware error	The request has not been accepted because of control hardware problems.
7	Local	The request has not been accepted because local access is in progress.
8	Too many operations	The request has not been accepted because too many operations have been requested.
9	Not authorized	The request has not been accepted because of insufficient authorization.
127	Undefined	The request not been accepted because of some other undefined reason.

Note:
Code numbers 10 through to 126 are reserved for future use.

6.3.9 DNP3 CONFIGURATION

To configure the device:

1. Select the *CONFIGURATION* column and check that the ***Comms settings*** cell is set to `Visible`.
2. Select the *COMMUNICATIONS* column.
3. Move to the first cell down (***RP1 protocol***). This is a non-settable cell, which shows the chosen communication protocol – in this case `DNP3.0`.

```
COMMUNICATIONS
RP1 Protocol
DNP3.0
```

4. Move down to the next cell (***RP1 Address***). This cell controls the DNP3.0 address of the IED. Up to 32 IEDs can be connected to one spur, therefore it is necessary for each IED to have a unique address so that messages from the master control station are accepted by only one IED. DNP3.0 uses a decimal number between 1 and 65519 for the Relay Address. It is important that no two IEDs have the same address.

```
COMMUNICATIONS
RP1 Address
1
```

5. Move down to the next cell (***RP1 Baud Rate***). This cell controls the baud rate to be used. Six baud rates are supported by the IED 1200 bps, 2400 bps, 4800 bps, 9600 bps, 19200 bps and 38400 bps. Make sure that the baud rate selected on the IED is the same as that set on the master station.

```
COMMUNICATIONS
RP1 Baud rate
9600 bits/s
```

6. Move down to the next cell (***RP1 Parity***). This cell controls the parity format used in the data frames. The parity can be set to be one of *None*, *Odd* or *Even*. Make sure that the parity format selected on the IED is the same as that set on the master station.

```
COMMUNICATIONS
RP1 Parity
None
```

7. If the optional fibre optic connectors are fitted, the ***RP1 PhysicalLink*** cell is visible. This cell controls the physical media used for the communication (Copper or Fibre optic).

```
COMMUNICATIONS
RP1 PhysicalLink
Copper
```

8. Move down to the next cell (***RP1 Time Sync***). This cell affects the time synchronisation request from the master by the IED. It can be set to *enabled* or *disabled*. If enabled it allows the DNP3.0 master to synchronise the time on the IED.

```
COMMUNICATIONS
RP1 Time Sync
Enabled
```

6.3.9.1 DNP3 CONFIGURATOR

A PC support package for DNP3.0 is available as part of the supplied settings application software (MiCOM S1 Agile) to allow configuration of the device's DNP3.0 response. The configuration data is uploaded from the device to the PC in a block of compressed format data and downloaded in a similar manner after modification. The new DNP3.0 configuration takes effect after the download is complete. To restore the default configuration at any time, from the *CONFIGURATION* column, select the ***Restore Defaults*** cell then select *All Settings*.

In MiCOM S1 Agile, the DNP3.0 data is shown in three main folders, one folder each for the point configuration, integer scaling and default variation (data format). The point configuration also includes screens for binary inputs, binary outputs, counters and analogue input configuration.

If the device supports DNP Over Ethernet, the configuration related settings are done in the folder **DNP Over Ethernet**.

6.3.10 DNP3 UNSOLICITED REPORTING

In previous versions, DNP3 only supports data transmission based on poll requests from the master station. From this version onwards, a new mode of transmission called Unsolicited Reporting is supported. This is a mode of operation where the outstation spontaneously transmits a response without having received a specific request for data. This mode is useful when the system has many outstations and the master requires notification as soon as possible after a change occurs. Rather than waiting for a master station polling cycle, the outstation transmits the change immediately. It is thus event driven rather than poll driven.

This feature requires a new group of settings, which are found under the DNP SETTINGS column (Courier cell range 1B). These can be found in the settings tables available as an interactive PDF at the back of the manual.

Note:
We advise you not to enable Unsolicited Reporting on a serial multi-drop line. This is due the fact that collisions may result from multiple IEDs reporting concurrent events. If Unsolicited Reporting is enabled on a serial line, we recommend connecting only one IED per master link. This restriction is not applicable if DNP3 Over Ethernet is used.

6.4 MODBUS

This section describes how the MODBUS standard is applied to the Px40 platform. It is not a description of the standard itself. The level at which this section is written assumes that the reader is already familiar with the MODBUS standard.

The MODBUS protocol is a master/slave protocol, defined and administered by the MODBUS Organization For further information on MODBUS and the protocol specifications, please see the Modbus web site (www.modbus.org).

6.4.1 PHYSICAL CONNECTION AND LINK LAYER

Only one option is available for connecting MODBUS

- Rear serial port 1 - for permanent SCADA connection via EIA(RS)485

The MODBUS interface uses 'RTU' mode communication rather than 'ASCII' mode as this provides more efficient use of the communication bandwidth. This mode of communication is defined by the MODBUS standard.

The IED address and baud rate can be selected using the front panel menu or by a suitable application such as MiCOM Agile.

When using a serial interface, the data format is: 1 start bit, 8 data bits, 1 parity bit with 1 stop bit, or 2 stop bits (a total of 11 bits per character).

6.4.2 MODBUS FUNCTIONS

The following MODBUS function codes are supported:

- 01: Read Coil Status
- 02: Read Input Status
- 03: Read Holding Registers
- 04: Read Input Registers
- 06: Preset Single Register
- 08: Diagnostics
- 11: Fetch Communication Event Counter
- 12: Fetch Communication Event Log
- 16: Preset Multiple Registers 127 max

These are interpreted by the MiCOM IED in the following way:

- 01: Read status of output contacts (0xxxx addresses)
- 02: Read status of opto inputs (1xxxx addresses)
- 03: Read setting values (4xxxx addresses)
- 04: Read measured values (3xxxx addresses
- 06: Write single setting value (4xxxx addresses)
- 16: Write multiple setting values (4xxxx addresses)

6.4.3 RESPONSE CODES

MCode	MODBUS Description	MiCOM Interpretation
01	Illegal Function Code	The function code transmitted is not supported by the slave.

MCode	MODBUS Description	MiCOM Interpretation
02	Illegal Data Address	The start data address in the request is not an allowable value. If any of the addresses in the range cannot be accessed due to password protection then all changes within the request are discarded and this error response will be returned. Note: If the start address is correct but the range includes non-implemented addresses this response is not produced.
03	Illegal Value	A value referenced in the data field transmitted by the master is not within range. Other values transmitted within the same packet will be executed if inside range.
06	Slave Device Busy	The write command cannot be implemented due to the database being locked by another interface. This response is also produced if the software is busy executing a previous request.

6.4.4 REGISTER MAPPING

The device supports the following memory page references:

- Memory Page: Interpretation
- 0xxxx: Read and write access of the output relays
- 1xxxx: Read only access of the opto inputs
- 3xxxx: Read only access of data
- 4xxxx: Read and write access of settings

where xxxx represents the addresses available in the page (0 to 9999).

A complete map of the MODBUS addresses supported by the device is contained in the relevant menu database, which is available on request.

Note:
The "extended memory file" (6xxxx) is not supported.

Note:
MODBUS convention is to document register addresses as ordinal values whereas the actual protocol addresses are literal values. The MiCOM relays begin their register addresses at zero. Therefore, the first register in a memory page is register address zero. The second register is register address 1 and so on.

Note:
The page number notation is not part of the address.

6.4.5 EVENT EXTRACTION

The device supports two methods of event extraction providing either automatic or manual extraction of the stored event, fault, and maintenance records.

6.4.5.1 AUTOMATIC EVENT RECORD EXTRACTION

The automatic extraction facilities allow all types of record to be extracted as they occur. Event records are extracted in sequential order including any fault or maintenance data that may be associated with the event.

The MODBUS master can determine whether the device has any events stored that have not yet been extracted. This is performed by reading the status register 30001 (G26 data type). If the event bit of this register is set then the device has non-extracted events available. To select the next event for sequential extraction, the master station writes a value of 1 to the record selection register 40400 (G18 data type). The event data together with any fault/ maintenance data can be read from the registers specified below. Once the data has been read, the event record can be marked as having been read by writing a value of '2' to register 40400.

6.4.5.2 MANUAL EVENT RECORD EXTRACTION

There are three registers available to manually select stored records and three read-only registers allowing the number of stored records to be determined.

- 40100: Select Event
- 40101: Select Fault
- 40102: Select Maintenance Record

For each of the above registers a value of 0 represents the most recent stored record. The following registers can be read to indicate the numbers of the various types of record stored.

- 30100: Number of stored records
- 30101: Number of stored fault records
- 30102: Number of stored maintenance records

Each fault or maintenance record logged causes an event record to be created. If this event record is selected, the additional registers allowing the fault or maintenance record details will also become populated.

6.4.5.3 RECORD DATA

The location and format of the registers used to access the record data is the same whether they have been selected using either automatic or manual extraction.

Event Description	MODBUS Address	Length	Comments
Time and Date	30103	4	See G12 data type description
Event Type	30107	1	See G13 data type description
Event Value	30108	2	Nature of value depends on event type. This will contain the status as a binary flag for contact, opto-input, alarm, and protection events.
MODBUS Address	30110	1	This indicates the MODBUS register address where the change occurred. Alarm 30011 Relays 30723 Optos 30725 Protection events – like the relay and opto addresses this will map onto the MODBUS address of the appropriate DDB status register depending on which bit of the DDB the change occurred. These will range from 30727 to 30785. For platform events, fault events and maintenance events the default is 0.
Event Index	30111	1	This register will contain the DDB ordinal for protection events or the bit number for alarm events. The direction of the change will be indicated by the most significant bit; 1 for 0 – 1 change and 0 for 1 – 0 change.
Additional Data Present	30112	1	0 means that there is no additional data. 1 means fault record data can be read from 30113 to 30199 (number of registers depends on the product). 2 means maintenance record data can be read from 30036 to 30039.

If a fault record or maintenance record is directly selected using the manual mechanism then the data can be read from the register ranges specified above. The event record data in registers 30103 to 30111 will not be available.

It is possible using register 40401(G6 data type) to independently clear the stored relay event/fault and maintenance records. This register also provides an option to reset the device indications, which has the same effect on the relay as pressing the clear key within the alarm viewer using the HMI panel menu.

6.4.6 DISTURBANCE RECORD EXTRACTION

The IED provides facilities for both manual and automatic extraction of disturbance records.

Records extracted over MODBUS from Px40 devices are presented in COMTRADE format. This involves extracting an ASCII text configuration file and then extracting a binary data file.

Each file is extracted by reading a series of data pages from the IED The data page is made up of 127 registers, giving a maximum transfer of 254 bytes per page.

The following set of registers is presented to the master station to support the extraction of uncompressed disturbance records:

MODBUS registers

MODBUS Register	Name	Description
3x00001	Status register	Provides the status of the relay as bit flags: b0: Out of service b1: Minor self test failure b2: Event b3: Time synchronization b4: Disturbance b5: Fault b6: Trip b7: Alarm b8 to b15: Unused A '1' on b4 indicates the presence of a disturbance
3x00800	No of stored disturbances	Indicates the total number of disturbance records currently stored in the relay, both extracted and non-extracted.
3x00801	Unique identifier of the oldest disturbance record	Indicates the unique identifier value for the oldest disturbance record stored in the relay. This is an integer value used in conjunction with the 'Number of stored disturbances' value to calculate a value for manually selecting records.
4x00250	Manual disturbance record selection register	This register is used to manually select disturbance records. The values written to this cell are an offset of the unique identifier value for the oldest record. The offset value, which ranges from 0 to the Number of stored disturbances - 1, is added to the identifier of the oldest record to generate the identifier of the required record.
4x00400	Record selection command register	This register is used during the extraction process and has a number of commands. These are: b0: Select next event b1: Accept event b2: Select next disturbance record b3: Accept disturbance record b4: Select next page of disturbance data b5: Select data file
3x00930 - 3x00933	Record time stamp	These registers return the timestamp of the disturbance record.
3x00802	No of registers in data page	This register informs the master station of the number of registers in the data page that are populated.
3x00803 - 3x00929	Data page registers	These 127 registers are used to transfer data from the relay to the master station. They are 16-bit unsigned integers.
3x00934	Disturbance record status register	The disturbance record status register is used during the extraction process to indicate to the master station when data is ready for extraction. See next table.
4x00251	Data file format selection	This is used to select the required data file format. This is reserved for future use.

Note:
Register addresses are provided in reference code + address format. E.g. 4x00001 is reference code 4x, address 1 (which is specified as function code 03, address 0x0000 in the MODBUS specification).

The disturbance record status register will report one of the following values:

Disturbance record states

State	Description
Idle	This will be the state reported when no record is selected; such as after power on or after a record has been marked as extracted.
Busy	The relay is currently processing data.
Page ready	The data page has been populated and the master station can now safely read the data.
Configuration complete	All of the configuration data has been read without error.
Record complete	All of the disturbance data has been extracted.
Disturbance overwritten	An error occurred during the extraction process where the disturbance being extracted was overwritten by a new record.
No non-extracted disturbances	An attempt was made by the master station to automatically select the next oldest non-extracted disturbance when all records have been extracted.
Not a valid disturbance	An attempt was made by the master station to manually select a record that did not exist in the relay.
Command out of sequence	The master station issued a command to the relay that was not expected during the extraction process.

6.4.6.1 MANUAL EXTRACTION PROCEDURE

The procedure used to extract a disturbance manually is shown below. The manual method of extraction does not allow for the acceptance of disturbance records.

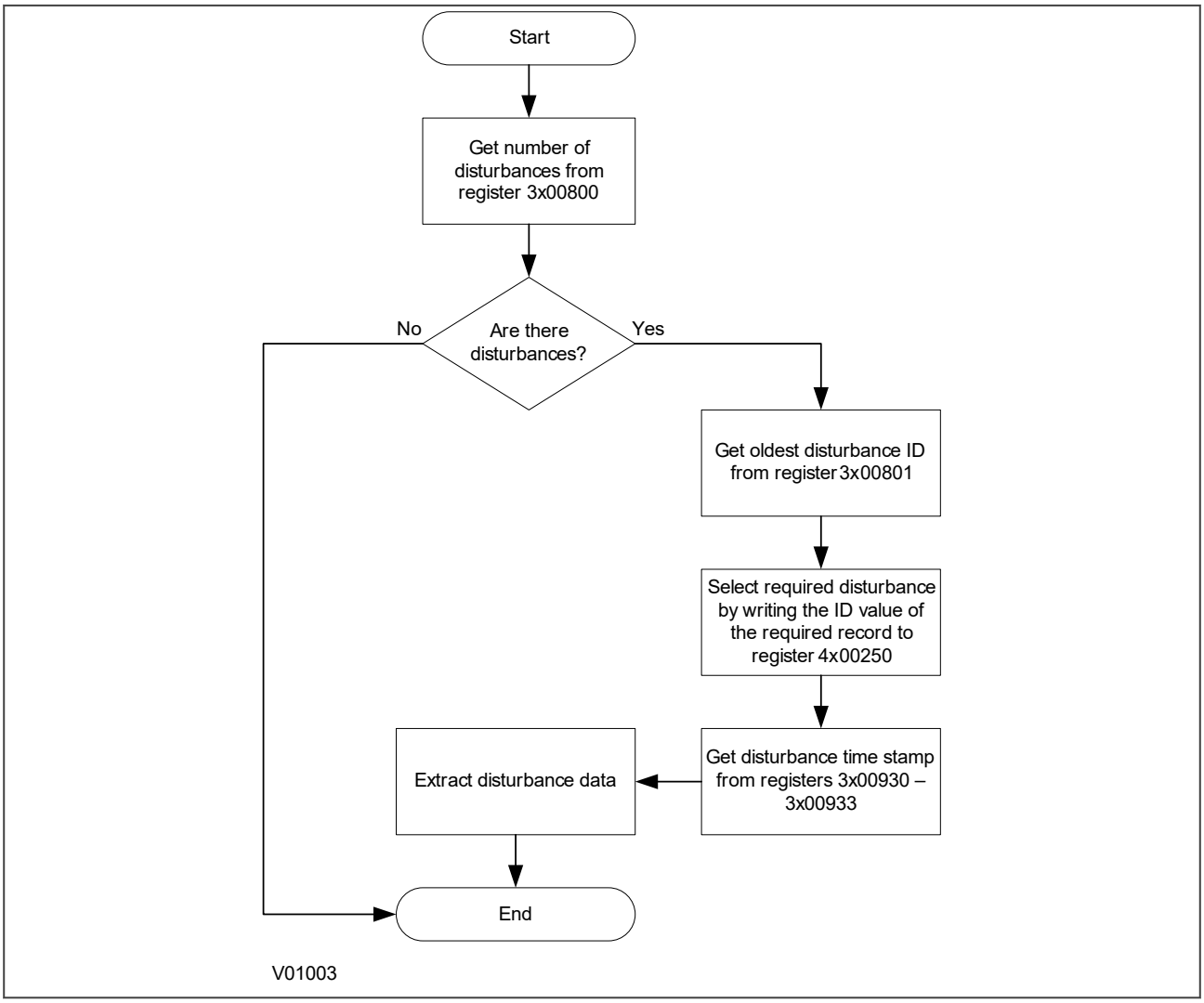


Figure 97: Manual selection of a disturbance record

6.4.6.2 AUTOMATIC EXTRACTION PROCEDURE

There are two methods that can be used for automatically extracting disturbances:

Method 1

Method 1 is simpler and is better at extracting single disturbance records (when the disturbance recorder is polled regularly).

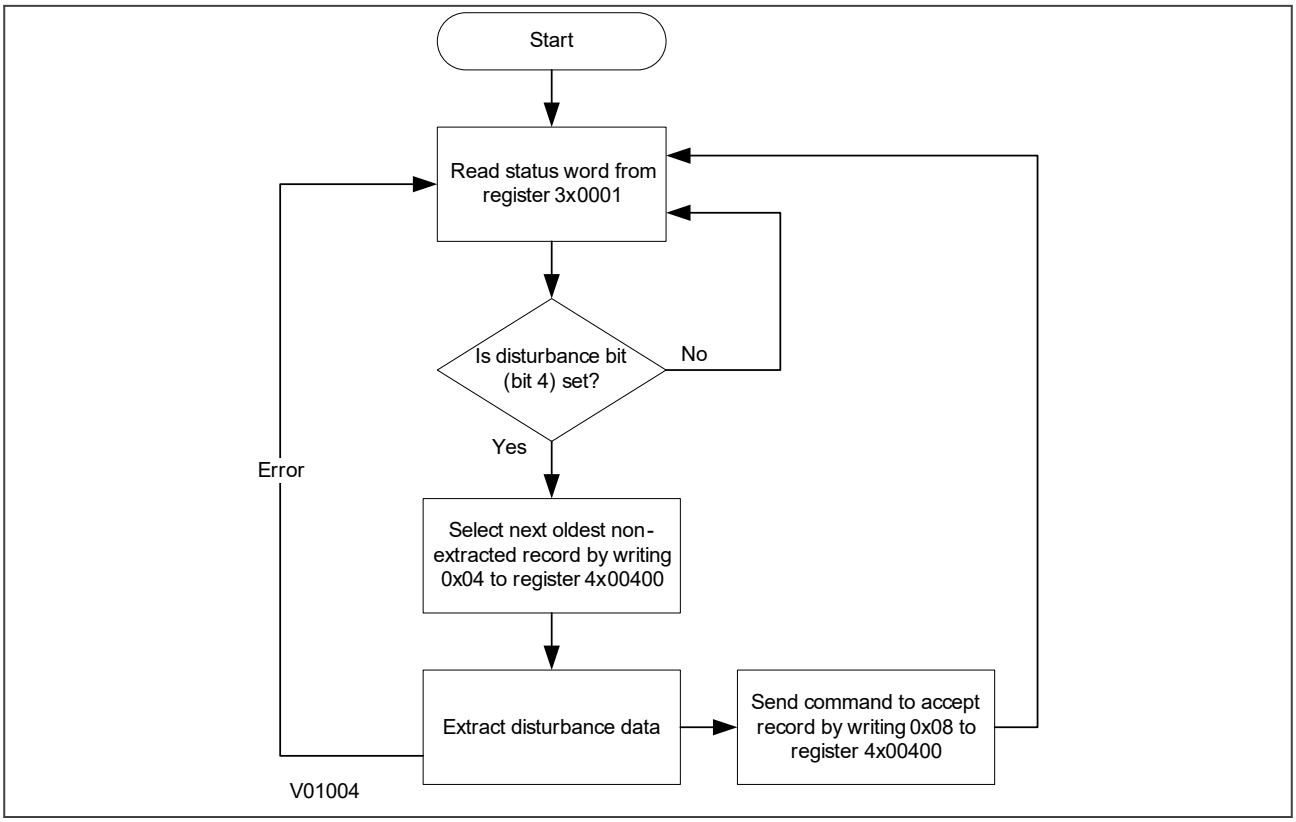


Figure 98: Automatic selection of disturbance record - method 1

Method 2

Method 2 is more complex to implement but is more efficient at extracting large quantities of disturbance records. This may be useful when the disturbance recorder is polled only occasionally and therefore may have many stored records.

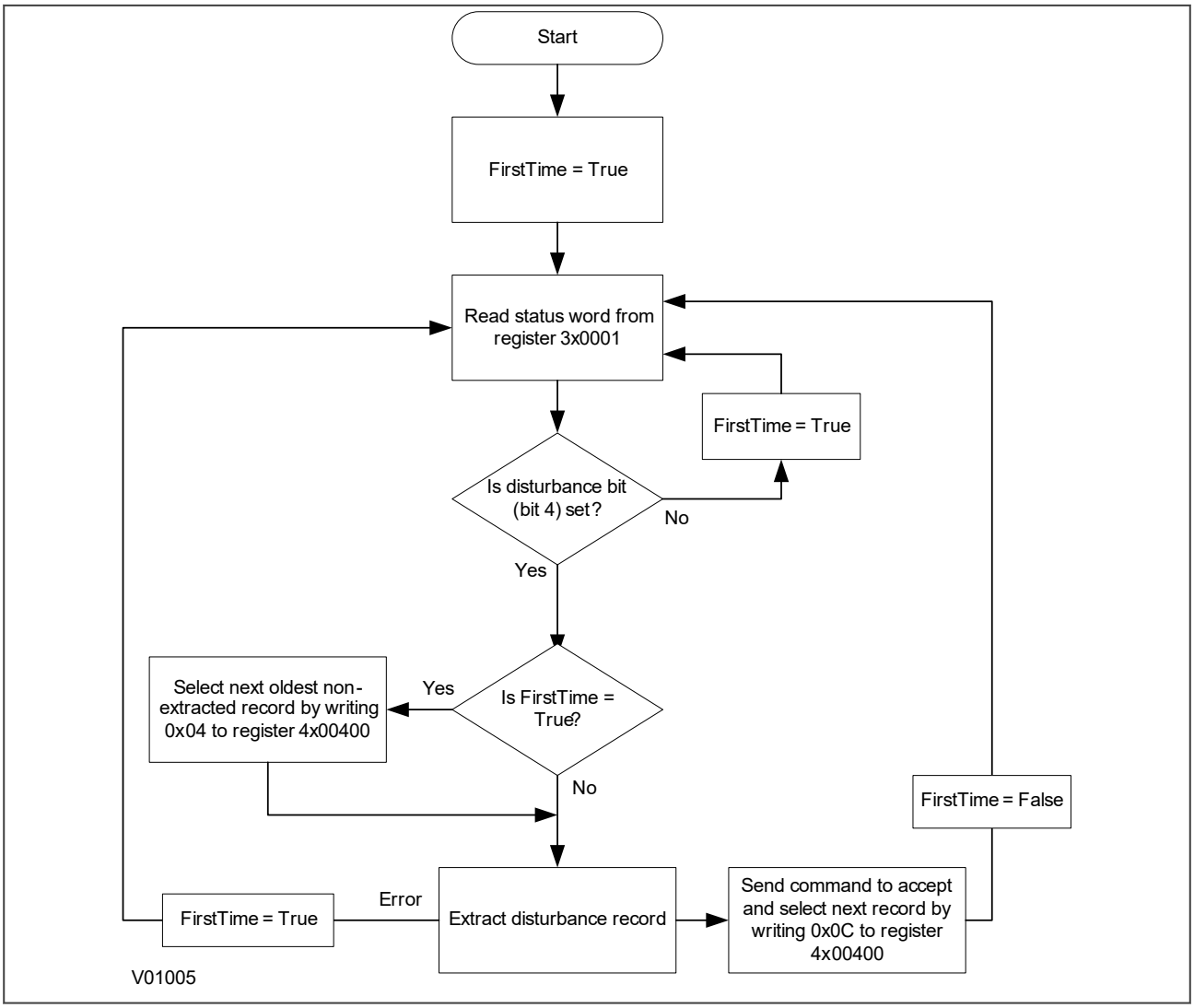


Figure 99: Automatic selection of disturbance record - method 2

6.4.6.3 EXTRACTING THE DISTURBANCE DATA

The extraction of the disturbance record is a two-stage process that involves extracting the configuration file first and then the data file. The configuration file must be extracted first, followed by the data file:

Extracting the Comtrade configuration file

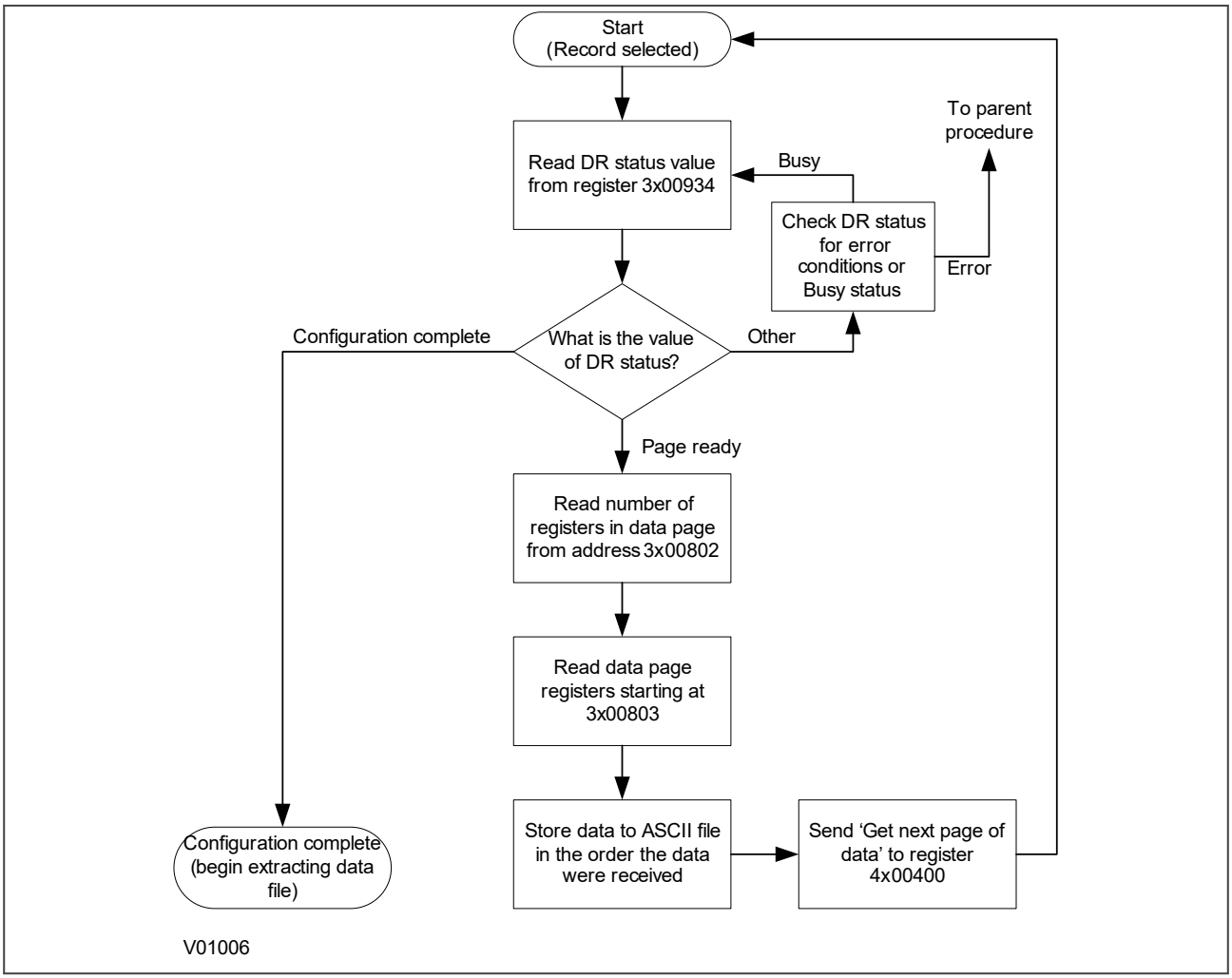


Figure 100: Configuration file extraction

Extracting the comtrade data file

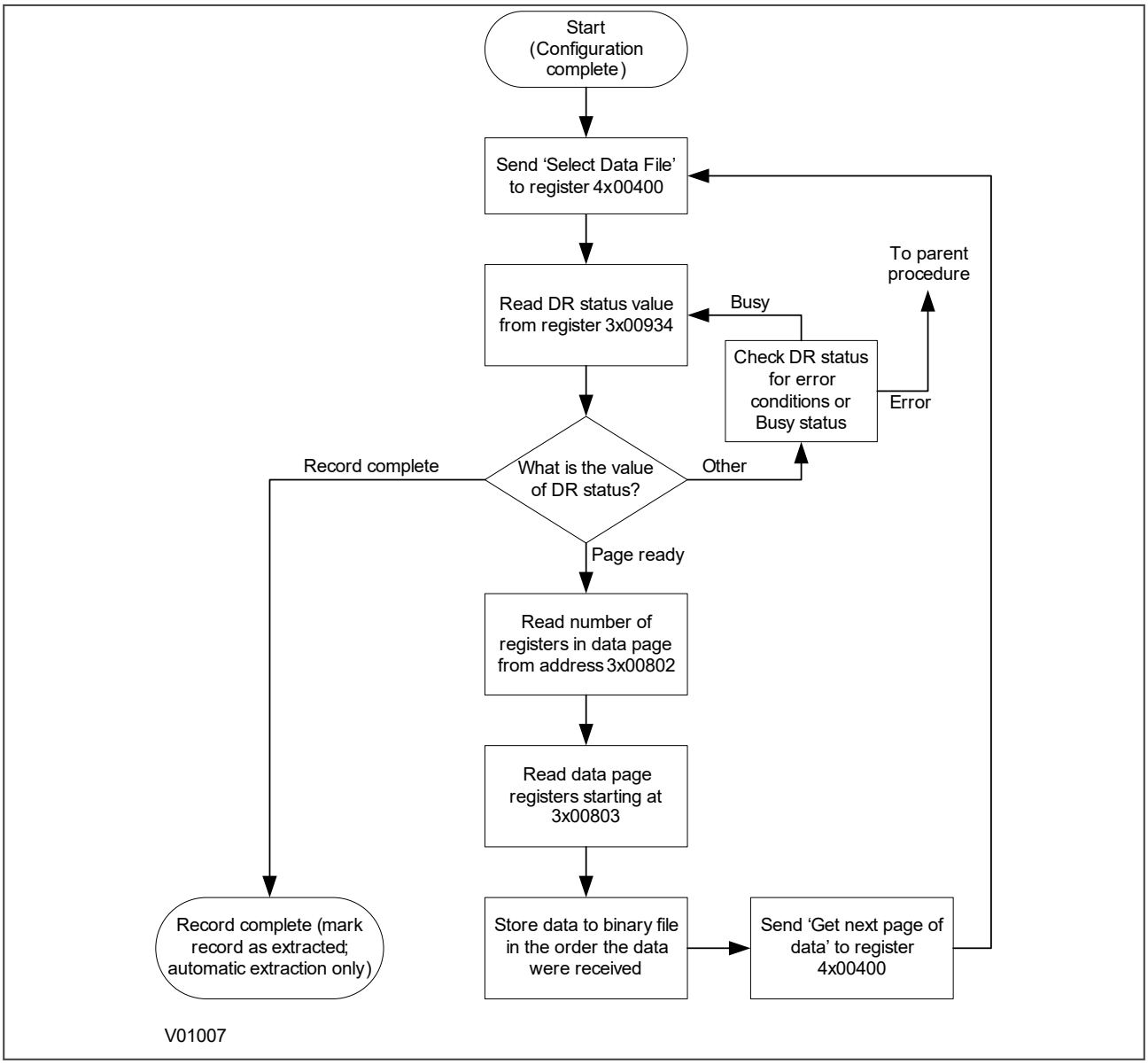


Figure 101: Data file extraction

During the extraction of the COMTRADE files, an error may occur, which will be reported on the DR Status register 3x00934. In this case, you must take action to re-start the record extraction or to abort according to the table below.

Value	State	Description
0	Idle	This will be the state reported when no record is selected; such as after power on or after a record has been marked as extracted.
1	Busy	The relay is currently processing data.
2	Page ready	The data page has been populated and the master station can now safely read the data.
3	Configuration complete	All of the configuration data has been read without error.
4	Record complete	All of the disturbance data has been extracted.
5	Disturbance overwritten	An error occurred during the extraction process where the disturbance being extracted was overwritten by a new record.

Value	State	Description
6	No unextracted disturbances	An attempt was made by the master station to automatically select the next oldest unextracted disturbance when all records have been extracted.
7	Not a valid disturbance	An attempt was made by the master station to manually select a record that did not exist in the relay.
8	Command out of sequence	The master station issued a command to the relay that was not expected during the extraction process.

6.4.7 SETTING CHANGES

All the IED settings are 4xxxx page addresses. The following points should be noted when changing settings:

- Settings implemented using multiple registers must be written to using a multi-register write operation.
- The first address for a multi-register write must be a valid address. If there are unmapped addresses within the range being written to, the data associated with these addresses will be discarded.
- If a write operation is performed with values that are out of range, the illegal data response will be produced. Valid setting values within the same write operation will be executed.
- If a write operation is performed, which attempts to change registers requiring a higher level of password access than is currently enabled then all setting changes in the write operation will be discarded.

6.4.8 PASSWORD PROTECTION

The following registers are available to control password protection:

Function	MODBUS Registers
Password entry	4x00001 to 4x00002 and 4x20000 to 4x20003
Setting to change password level 1 (4 character)	4x00023 to 4x00024
Setting to change password level 1 (8 character)	4x20008 to 4x20011
Setting to change password level 2	4x20016 to 4x20019
Setting to change password level 3	4x20024 to 4x20027
Can be read to indicate current access level	3x00010

6.4.9 PROTECTION AND DISTURBANCE RECORDER SETTINGS

Setting changes to either of these areas are stored in a scratchpad area and will not be used by the IED unless confirmed. Register 40405 can be used either to confirm or abort the setting changes within the scratchpad area.

The IED supports four groups of protection settings. The MODBUS addresses for each of the four groups are repeated within the following address ranges.

- Group 1: 4x1000 - 4x2999
- Group 2: 4x3000 - 4x4999
- Group 3: 4x5000 - 4x6999
- Group 4: 4x7000 - 4x8999

In addition to the basic editing of the protection setting groups, the following functions are provided:

- Default values can be restored to a setting group or to all of the relay settings by writing to register 4x0402.
- It is possible to copy the contents of one setting group to another by writing the source group to register 40406 and the target group to 4x0407.

The setting changes performed by either of the two operations defined above are made to the scratchpad area. These changes must be confirmed by writing to register 4x0405.

The active protection setting groups can be selected by writing to register 40404. An illegal data response will be returned if an attempt is made to set the active group to one that has been disabled.

6.4.10 TIME SYNCHRONISATION

The date-time data type G12 allows *real* date and time information to be conveyed to a resolution of 1 ms. The structure of the data type is compliant with the IEC 60870-5-4 **Binary Time 2a** format.

The seven bytes of the date/time frame are packed into four 16-bit registers and are transmitted in sequence starting from byte 1. This is followed by a null byte, making eight bytes in total.

Register data is usually transmitted starting with the highest-order byte. Therefore byte 1 will be in the high-order byte position followed by byte 2 in the low-order position for the first register. The last register will contain just byte 7 in the high order position and the low order byte will have a value of zero.

G12 date & time data type structure

	Bit Position							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
1	m7	m6	m5	m4	m3	m2	m1	m0
2	m15	m14	m13	m12	m11	m10	m9	m8
3	IV	R	I5	I4	I3	I2	I1	I0
4	SU	R	R	H4	H3	H2	H1	H0
5	W2	W1	W0	D4	D3	D2	D1	D0
6	R	R	R	R	M3	M2	M1	M0
7	R	Y6	Y5	Y4	Y3	Y2	Y1	Y0

Key to table:

- m = milliseconds: 0 to 59,999
- I = minutes: 0 to 59
- H = hours: 0 to 23
- W = day of the week: 1 to 7 starting from Monday
- D = day of the month: 1 to 31
- M = month of the year: 1 to 12 starting from January
- Y = year of the century: 0 to 99
- R = reserved: 0
- SU = summertime: 0 = GMT, 1 = summertime
- IV = invalid: 0 = invalid value, 1 = valid value

Since the range of the data type is only 100 years, the century must be deduced. The century is calculated as the one that will produce the nearest time value to the current date. For example: 30-12-99 is 30-12-1999 when received in 1999 & 2000, but is 30-12-2099 when received in 2050. This technique allows 2 digit years to be accurately converted to 4 digits in a ±50 year window around the current date.

The invalid bit has two applications:

- It can indicate that the date-time information is considered inaccurate, but is the best information available.
- It can indicate that the date-time information is not available.

The summertime bit is used to indicate that summertime (day light saving) is being used and, more importantly, to resolve the alias and time discontinuity which occurs when summertime starts and ends. This is important for the correct time correlation of time stamped records.

The day of the week field is optional and if not calculated will be set to zero.

The concept of time zone is not catered for by this data type and hence by the relay. It is up to the end user to determine the time zone. Normal practice is to use UTC (universal co-ordinated time).

6.4.11 POWER AND ENERGY MEASUREMENT DATA FORMATS

The power and energy measurements are available in two data formats:

Data Type G29: an integer format using 3 registers

Data Type G125: a 32 bit floating point format using 2 registers

The G29 registers are listed in the first part of the *MEASUREMENTS 2* column of the Courier database. The G125 equivalents appear at the end of the *MEASUREMENTS 2* column.

Data type G29

Data type G29 consists of three registers:

The first register is the per unit (or normalised) power or energy measurement. It is a signed 16 bit quantity. This register is of Data Type G28.

The second and third registers contain a multiplier to convert the per unit value to a real value. These are unsigned 32-bit quantities. These two registers together are of Data Type G27.

Thee overall power or energy value conveyed by the G29 data type is therefore G29 = G28 x G27.

The IED calculates the G28 per unit power or energy value as:

G28 = (measured secondary quantity/CT *secondary)(110V/(VT secondary).*

Since data type G28 is a signed 16-bit integer, its dynamic range is constrained to +/- 32768. You should take this limitation into consideration for the energy measurements, as the G29 value will saturate a long time before the equivalent G125 does.

The associated G27 multiplier is calculated as:

G27 = (CT primary)(VT primary/110V) when primary value measurements are selected

and

G27 = (CT secondary)(VT secondary/110V) when secondary value measurements are selected.

Due to the required truncations from floating point values to integer values in the calculations of the G29 component parts and its limited dynamic range, we only recommend using G29 values when the MODBUS master cannot deal with the G125 IEEE754 floating point equivalents.

> *Note:*
> *The G29 values must be read in whole multiples of three registers. It is not possible to read the G28 and G27 parts with separate read commands.*

Example of Data Type G29

Assuming the CT/VT configurations are as follows:

- Main VT Primary 6.6 kV
- Main VT Secondary 110 V
- Phase CT Primary 3150 A
- Phase CT Secondary 1 A

The Three-phase Active Power displayed on the measurement panel on the front display of the IED would be 21.94 MW

The registers related to the Three-phase Active Power are: 3x00327, 3x00328, 3x00329

Register Address	Data read from these registers	Format of the data
3x00327	116	G28
3x00328	2	G27

Register Address	Data read from these registers	Format of the data
3x00329	57928	G27

The Equivalent G27 value = [2^{16} * Value in the address 3x00328 + Value in the address 3x00329] = 216*2 + 57928 = 189000

The Equivalent value of power G29 = G28 * Equivalent G27 =116 * 189000 =21.92 MW

Note:
The above calculated value (21.92 MW) is same as the power value measured on the front panel display.

Data type G125

Data type G125 is a short float IEEE754 floating point format, which occupies 32 bits in two consecutive registers. The high order byte of the format is in the first (low order) register and the low order byte in the second register.

The value of the G125 measurement is as accurate as the IED's ability to resolve the measurement after it has applied the secondary or primary scaling factors. It does not suffer from the truncation errors or dynamic range limitations associated with the G29 data format.

6.4.12 MODBUS CONFIGURATION

To configure the device:

1. Select the *CONFIGURATION* column and check that the ***Comms settings*** cell is set to `Visible`.
2. Select the *COMMUNICATIONS* column.
3. Move to the first cell down (***RP1 protocol***). This is a non settable cell, which shows the chosen communication protocol – in this case `Modbus`.

```
COMMUNICATIONS
RP1 Protocol
Modbus
```

4. Move down to the next cell (***RP1 Address***). This cell controls the Modbus address of the IED. Up to 32 IEDs can be connected to one spur, therefore it is necessary for each IED to have a unique address so that messages from the master control station are accepted by only one IED. Modbus uses a decimal number between 1 and 247 for the Relay Address. It is important that no two IEDs have the same address.

```
COMMUNICATIONS
RP1 Address
1
```

5. Move down to the next cell (***RP1 InactivTimer***). This cell controls the inactivity timer. The inactivity timer controls how long the IED waits without receiving any messages on the rear port before it reverts to its default state, including revoking any password access that was enabled. For the rear port this can be set between 1 and 30 minutes.

```
COMMUNICATIONS
RP1 Inactivtimer
10.00 mins
```

6. Move down to the next cell (***RP1 Baud Rate***). This cell controls the baud rate to be used. Six baud rates are supported by the IED 1200 bits/s, 2400 bits/s, 4800 bits/s, 9600 bits/s, 19200 bits/s and 38400 bits/s. Make sure that the baud rate selected on the IED is the same as that set on the master station.

```
COMMUNICATIONS
RP1 Baud rate
9600 bits/s
```

7. Move down to the next cell (***RP1 Parity***). This cell controls the parity format used in the data frames. The parity can be set to be one of *None*, *Odd* or *Even*. Make sure that the parity format selected on the IED is the same as that set on the master station.

```
COMMUNICATIONS
RP1 Parity
None
```

8. Move down to the next cell (***Modbus IEC Time***). This cell controls the order in which the bytes of information are transmitted. There is a choice of Standard or Reverse. When *Standard* is selected the time format complies with IEC 60870-5-4 requirements such that byte 1 of the information is transmitted first, followed by bytes 2 through to 7. If *Reverse* is selected the transmission of information is reversed.

```
COMMUNICATIONS
Modbus IEC Time
Standard
```

6.5 IEC 61850

This section describes how the IEC 61850 standard is applied to General Electric products. It is not a description of the standard itself. The level at which this section is written assumes that the reader is already familiar with the IEC 61850 standard.

IEC 61850 is the international standard for Ethernet-based communication in substations. It enables integration of all protection, control, measurement and monitoring functions within a substation, and additionally provides the means for interlocking and inter-tripping. It combines the convenience of Ethernet with the security that is so essential in substations today.

There are two editions of most parts of the IEC 61850 standard; edition 1 and edition 2. The edition which this product supports depends on the Software Version.

Software Version 70 onwards provides an IEC 61850 Edition 2 compatible implementation.

From Software Version 90 onwards, it is possible to select between edition 1 and edition 2. Switching between edition 1 and edition 2 is described in the Selection of the IEC 61850 Edition section.

An additional section detailing the enhancements in edition 2 models is documented later in this chapter, if applicable.

6.5.1 BENEFITS OF IEC 61850

The standard provides:

- Standardised models for IEDs and other equipment within the substation
- Standardised communication services (the methods used to access and exchange data)
- Standardised formats for configuration files
- Peer-to-peer communication

The standard adheres to the requirements laid out by the ISO OSI model and therefore provides complete vendor interoperability and flexibility on the transmission types and protocols used. This includes mapping of data onto

Ethernet, which is becoming more and more widely used in substations, in favour of RS485. Using Ethernet in the substation offers many advantages, most significantly including:

- Ethernet allows high-speed data rates (currently 100 Mbps, rather than tens of kbps or less used by most serial protocols)
- Ethernet provides the possibility to have multiple clients
- Ethernet is an open standard in every-day use
- There is a wide range of Ethernet-compatible products that may be used to supplement the LAN installation (hubs, bridges, switches)

6.5.2 IEC 61850 INTEROPERABILITY

A major benefit of IEC 61850 is interoperability. IEC 61850 standardizes the data model of substation IEDs, which allows interoperability between products from multiple vendors.

An IEC 61850-compliant device may be interoperable, but this does not mean it is interchangeable. You cannot simply replace a product from one vendor with that of another without reconfiguration. However, the terminology is pre-defined and anyone with prior knowledge of IEC 61850 should be able to integrate a new device very quickly without having to map all of the new data. IEC 61850 brings improved substation communications and interoperability to the end user, at a lower cost.

6.5.3 THE IEC 61850 DATA MODEL

The data model of any IEC 61850 IED can be viewed as a hierarchy of information, whose nomenclature and categorization is defined and standardized in the IEC 61850 specification.

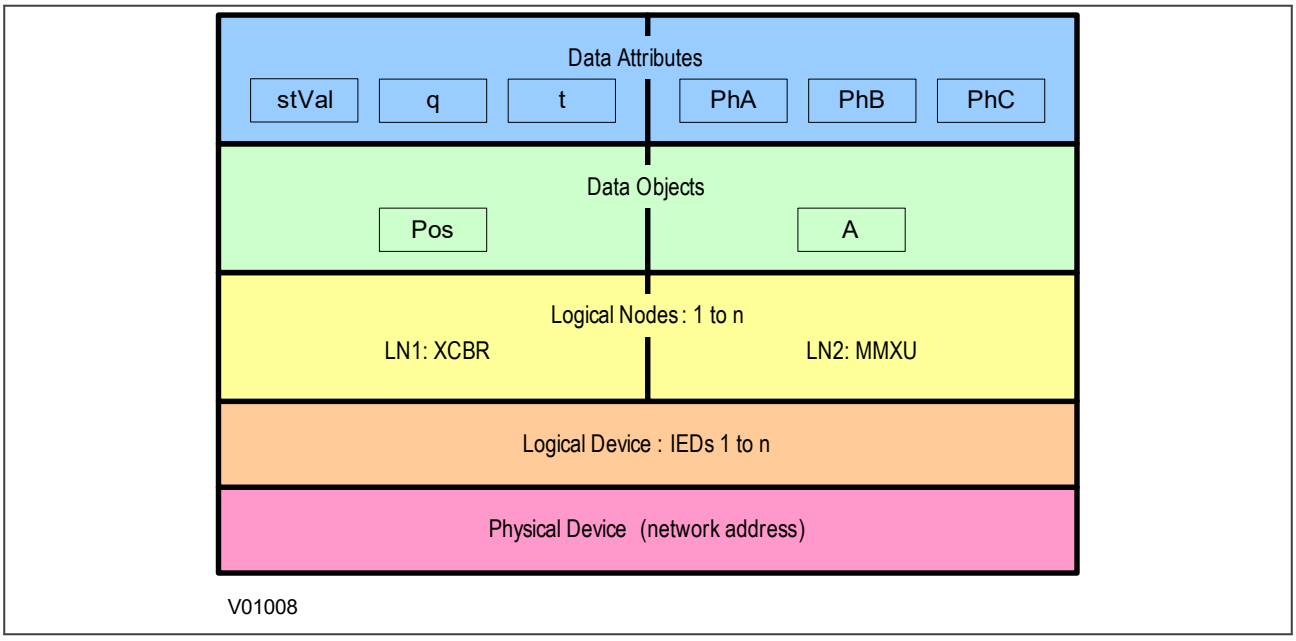


Figure 102: Data model layers in IEC 61850

The levels of this hierarchy can be described as follows:

Data Frame format

Layer	Description
Physical Device	Identifies the actual IED within a system. Typically the device's name or IP address can be used (for example Feeder_1 or 10.0.0.2.
Logical Device	Identifies groups of related Logical Nodes within the Physical Device. For the MiCOM IEDs, 5 Logical Devices exist: Control, Measurements, Protection, Records, System.

Layer	Description
Wrapper/Logical Node Instance	Identifies the major functional areas within the IEC 61850 data model. Either 3 or 6 characters are used as a prefix to define the functional group (wrapper) while the actual functionality is identified by a 4 character Logical Node name suffixed by an instance number. For example, XCBR1 (circuit breaker), MMXU1 (measurements), FrqPTOF2 (overfrequency protection, stage 2).
Data Object	This next layer is used to identify the type of data you will be presented with. For example, Pos (position) of Logical Node type XCBR.
Data Attribute	This is the actual data (measurement value, status, description, etc.). For example, stVal (status value) indicating actual position of circuit breaker for Data Object type Pos of Logical Node type XCBR.

6.5.4 IEC 61850 IN MICOM IEDS

IEC 61850 is implemented by use of a separate Ethernet card. This Ethernet card manages the majority of the IEC 61850 implementation and data transfer to avoid any impact on the performance of the protection functions.

To communicate with an IEC 61850 IED on Ethernet, it is necessary only to know its IP address. This can then be configured into either:

- An IEC 61850 client (or master), for example a bay computer (MiCOM C264)
- An HMI
- An MMS browser, with which the full data model can be retrieved from the IED, without any prior knowledge of the IED

The IEC 61850 compatible interface standard provides capability for the following:

- Read access to measurements
- Refresh of all measurements at a standard rate.
- Generation of non-buffered and buffered reports on change of status or measurement
- SNTP time synchronization over an Ethernet link. (This is used to synchronize the IED's internal real time clock.
- GOOSE peer-to-peer communication
- Disturbance record extraction by IEC 61850 MMS file transfer. The record is extracted as an ASCII format COMTRADE file
- Controls (Direct and Select Before Operate)

Note:
Setting changes are not supported in the current IEC 61850 implementation. Currently these setting changes are carried out using the settings application software.

6.5.5 IEC 61850 DATA MODEL IMPLEMENTATION

The data model naming adopted in the IEDs has been standardised for consistency. Therefore the Logical Nodes are allocated to one of the five Logical Devices, as appropriate.

The data model is described in the Model Implementation Conformance Statement (MICS) document, which is available as a separate document.

6.5.6 IEC 61850 COMMUNICATION SERVICES IMPLEMENTATION

The IEC 61850 communication services which are implemented in the IEDs are described in the Protocol Implementation Conformance Statement (PICS) document, which is available as a separate document.

6.5.7 IEC 61850 PEER-TO-PEER (GOOSE) COMMUNICATIONS

The implementation of IEC 61850 Generic Object Oriented Substation Event (GOOSE) enables faster communication between IEDs offering the possibility for a fast and reliable system-wide distribution of input and output data values. The GOOSE model uses multicast services to deliver event information. Multicast messaging means that messages are sent to selected devices on the network. The receiving devices can specifically accept frames from certain devices and discard frames from the other devices. It is also known as a publisher-subscriber system. When a device detects a change in one of its monitored status points it publishes a new message. Any device that is interested in the information subscribes to the data it contains.

6.5.8 MAPPING GOOSE MESSAGES TO VIRTUAL INPUTS

Each GOOSE signal contained in a subscribed GOOSE message can be mapped to any of the virtual inputs within the PSL. The virtual inputs allow the mapping to internal logic functions for protection control, directly to output contacts or LEDs for monitoring.

An IED can subscribe to all GOOSE messages but only the following data types can be decoded and mapped to a virtual input:

- BOOLEAN
- BSTR2
- INT16
- INT32
- INT8
- UINT16
- UINT32
- UINT8

6.5.8.1 IEC 61850 GOOSE CONFIGURATION

All GOOSE configuration is performed using the IEC 61850 Configurator tool available in the MiCOM S1 Agile software application.

All GOOSE publishing configuration can be found under the **GOOSE Publishing** tab in the configuration editor window. All GOOSE subscription configuration parameters are under the **External Binding** tab in the configuration editor window.

Settings to enable GOOSE signalling and to apply Test Mode are available using the HMI.

6.5.9 ETHERNET FUNCTIONALITY

IEC 61850 **Associations** are unique and made between the client and server. If Ethernet connectivity is lost for any reason, the associations are lost, and will need to be re-established by the client. The IED has a **TCP_KEEPALIVE** function to monitor each association, and terminate any which are no longer active.

The IED allows the re-establishment of associations without disruption of its operation, even after its power has been removed. As the IED acts as a server in this process, the client must request the association. Uncommitted settings are cancelled when power is lost, and reports requested by connected clients are reset. The client must re-enable these when it next creates the new association to the IED.

6.5.9.1 ETHERNET DISCONNECTION

IEC 61850 **Associations** are unique and made between the client and server. If Ethernet connectivity is lost for any reason, the associations are lost, and will need to be re-established by the client. The IED has a **TCP_KEEPALIVE** function to monitor each association, and terminate any which are no longer active.

6.5.9.2 LOSS OF POWER

The IED allows the re-establishment of associations without disruption of its operation, even after its power has been removed. As the IED acts as a server in this process, the client must request the association. Uncommitted settings are cancelled when power is lost, and reports requested by connected clients are reset. The client must re-enable these when it next creates the new association to the IED.

6.5.10 IEC 61850 CONFIGURATION

You cannot configure the device for IEC 61850 edition 1 using the HMI panel on the product. For this you must use the IEC 61850 Configurator, which is part of the settings application software. If the device is compatible with edition 2, however, you can configure it with the HMI. To configure IEC61850 edition 2 using the HMI, you must first enable the IP From HMI setting, after which you can set the media (copper or fibre), IP address, subnet mask and gateway address.

IEC 61850 allows IEDs to be directly configured from a configuration file. The IED's system configuration capabilities are determined from an IED Capability Description file (ICD), supplied with the product. By using ICD files from the products to be installed, you can design, configure and test (using simulation tools), a substation's entire protection scheme before the products are installed into the substation.

To help with this process, the settings application software provides an IEC 61850 Configurator tool, which allows the pre-configured IEC 61850 configuration file to be imported and transferred to the IED. As well as this, you can manually create configuration files for all products, based on their original IED capability description (ICD file).

Other features include:

- The extraction of configuration data for viewing and editing.
- A sophisticated error checking sequence to validate the configuration data before sending to the IED.

Note:
Some configuration data is available in the IEC61850 CONFIG. column, allowing read-only access to basic configuration data.

6.5.10.1 IEC 61850 CONFIGURATION BANKS

There are two configuration banks:

- Active Configuration Bank
- Inactive Configuration Bank

Any new configuration sent to the IED is automatically stored in the inactive configuration bank, therefore not immediately affecting the current configuration.

Following an upgrade, the IEC 61850 Configurator tool can be used to transmit a command, which authorises activation of the new configuration contained in the inactive configuration bank. This is done by switching the active and inactive configuration banks. The capability of switching the configuration banks is also available using the *IEC61850 CONFIG.* column of the HMI.

The SCL Name and Revision attributes of both configuration banks are available in the *IEC61850 CONFIG.* column of the HMI.

6.5.10.2 IEC 61850 NETWORK CONNECTIVITY

Configuration of the IP parameters and SNTP (Simple Network Time Protocol) time synchronisation parameters is performed by the IEC 61850 Configurator tool. If these parameters are not available using an SCL (Substation Configuration Language) file, they must be configured manually.

Every IP address on the Local Area Network must be unique. Duplicate IP addresses result in conflict and must be avoided. Most IEDs check for a conflict on every IP configuration change and at power up and they raise an alarm if an IP conflict is detected.

The IED can be configured to accept data from other networks using the ***Gateway*** setting. If multiple networks are used, the IP addresses must be unique across networks.

6.5.11 IEC 61850 EDITION 2

Many parts of the IEC 61850 standard have now been released as the second edition. This offers some significant enhancements including:

- Improved interoperability
- Many new logical nodes
- Better defined testing; it is now possible to perform off-line testing and simulation of functions

Edition 2 implementation requires use of version 3.8 of the IEC 61850 configurator, which is installed with version 2.0.1 of MiCOM S1 Agile.

6.5.11.1 BACKWARD COMPATIBILITY

IEC61850 System - Backward compatibility

An Edition 1 IED can operate with an Edition 2 IEC 61850 system, provided that the Edition 1 IEDs do not subscribe to GOOSE messages with data objects or data attributes which are only available in Edition 2.

The following figure explains this concept:

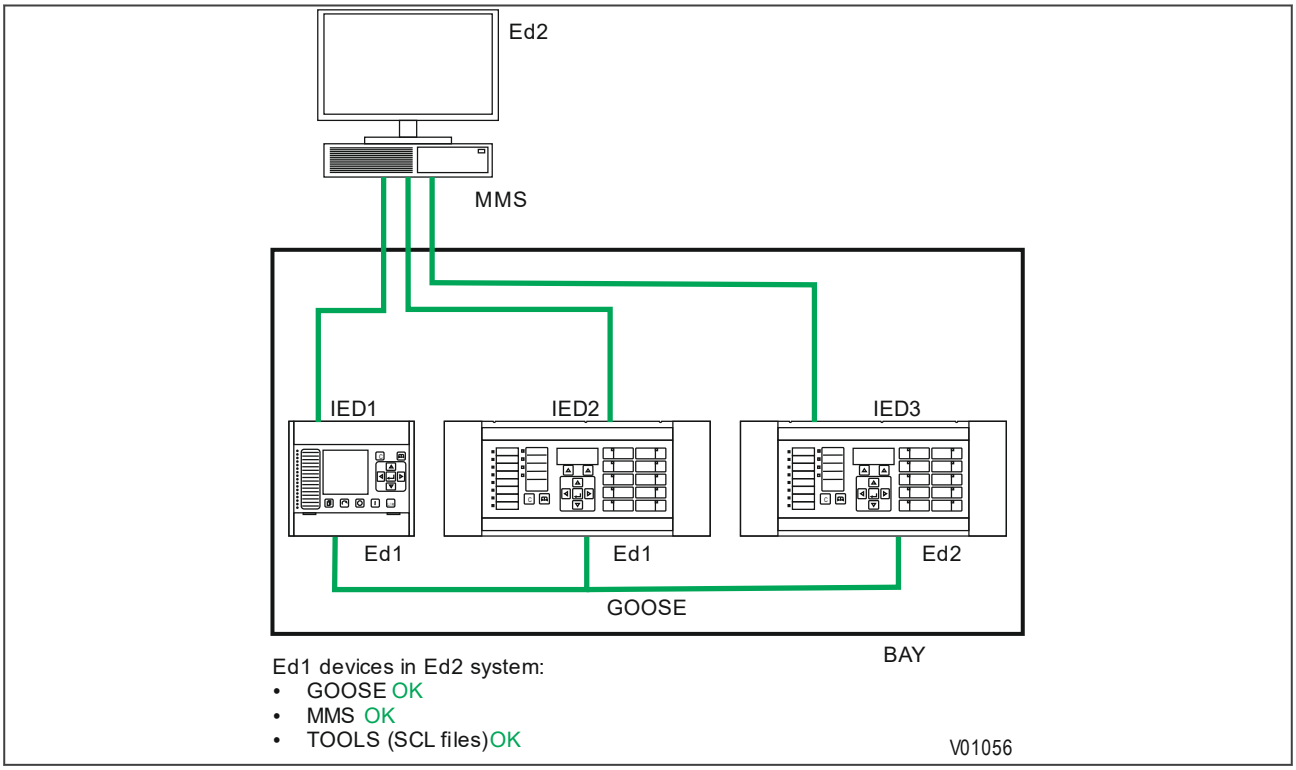


Figure 103: Edition 2 system - backward compatibility

An Edition 2 IED cannot normally operate within an Edition 1 IEC 61850 system. An Edition 2 IED can work for GOOSE messaging in a mixed system, providing the client is compatible with Edition 2.

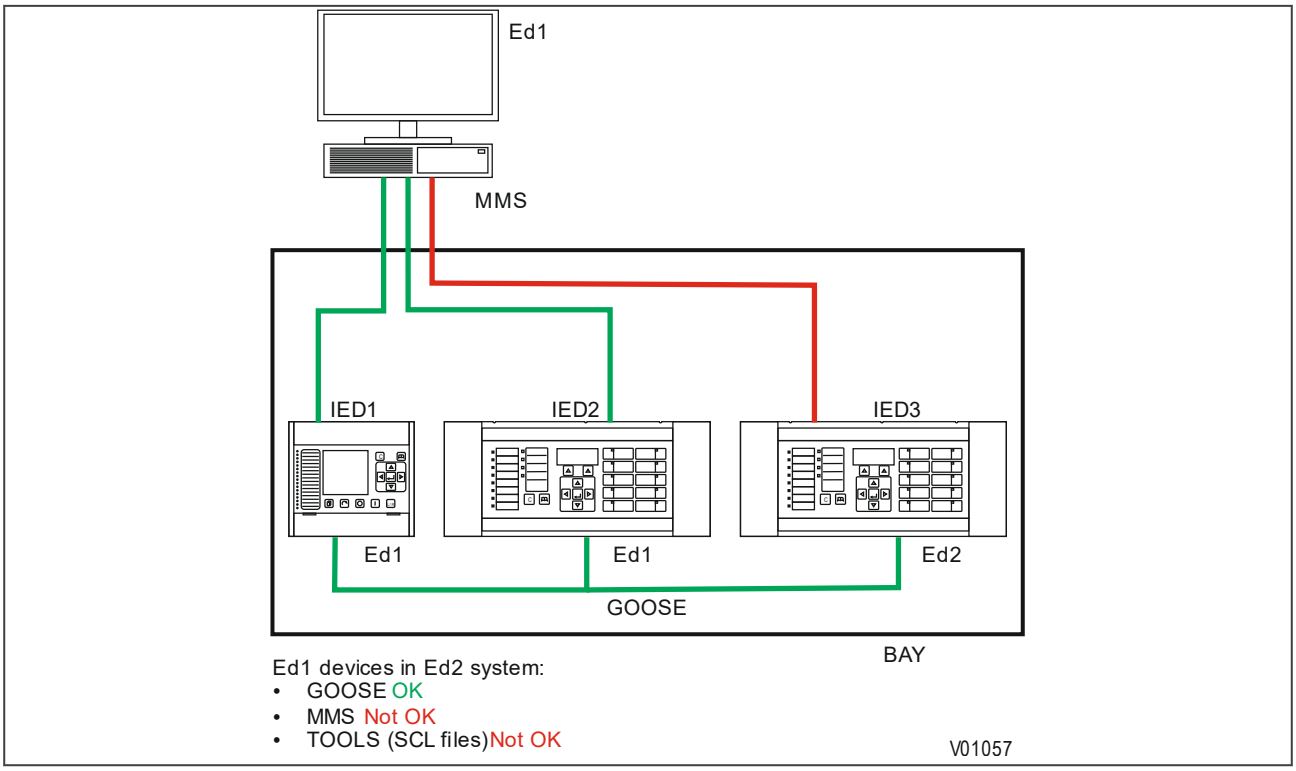


Figure 104: Edition 1 system - forward compatibility issues

6.5.11.2 EDITION-2 COMMON DATA CLASSES

The following common data classes (CDCs) are new to Edition 2 and therefore should not be used in GOOSE control blocks in mixed Edition 1 and Edition 2 systems

- Histogram (HST)
- Visible string status (VSS)
- Object reference setting (ORG)
- Controllable enumerated status (ENC)
- Controllable analogue process value (APC)
- Binary controlled analogue process value (BAC)
- Enumerated status setting (ENG)
- Time setting group (TSG)
- Currency setting group (CUG)
- Visible string setting (VSG)
- Curve shape setting (CSG)

Of these, only ENS and ENC types are available from a MiCOM P40 IED when publishing GOOSE messages, so Data Objects using these Common Data Classes should not be published in mixed Edition 1 and Edition 2 systems.

For compatibility between Edition 1 and Edition 2 IEDs, SCL files using SCL schema version 2.1 must be used. For a purely Edition 2 system, use the schema version 3.1.

6.6 CONCURRENT IEC 61850 AND DNP3.0 OPERATION

No Redundancy

Simultaneous IEC 61850 and DNP3.0 operation may be achieved using single or dual IP addresses.

Where concurrent IEC61850 & DNP3 uses a dual IP address configuration (defined via ordering option), Port A is dedicated to IEC 61850 (configured with or without SNTP), and Port B is dedicated to DNP3.0. Configuration settings are applied via IED Configurator Communications and DNP Over Ethernet Settings respectively. In this case, no Redundancy option is available.

Note:
SNTP may only be configured via the IED Configurator tool.

Note:
When concurrent IEC61850 & DNP3 uses a dual IP address configuration, the Redundancy list in the IED Configurator tool is visible but ineffective.

Where concurrent IEC61850 & DNP3 uses a single IP address setup with no redundancy required, configuration settings are applied via the IED Configurator and DNP3 settings respectively, with Redundancy set to NONE.

With Redundancy

Simultaneous IEC 61850 and DNP3.0 with FAILOVER, RSTP, PRP or HSP Redundancy is only possible where concurrent IEC61850 & DNP3 uses a single IP address. With Redundancy set to FAILOVER, either Port A or B may be selected, but when set to RSTP, PRP or HSR redundancy protocols, IEC 61850 and DNP3.0 communications (configured with or without SNTP) no port is specified.

Note:
Redundancy and SNTP may only be configured via the IED Configurator tool.

Note:
The IP address, Subnet and Gateway may be set with either configuration tool, (IED Configurator Communications or DNP3 Over Ethernet settings), but only the last values sent will be configured, as only one IP address/Subnet/Gateway is used in a single IP Address setup. It is therefore recommended that the same IP address is entered into both configuration tools.

To confirm the network interface protocol is set to concurrent IEC 61850 and DNP3, navigate to the device's *COMMUNICATIONS* column and check that ***NIC Protocol*** is set to `IEC61850 & DNP3`:

```
COMMUNICATIONS
NIC Protocol
IEC61850 & DNP3
```

To confirm the IP address setting for IEC 61850, navigate to the Device's *IEC61850 CONFIG.* column and check the ***IP Address*** setting:

```
IEC61850 CONFIG.
IP Address
192.168.1.1
```

To confirm the IP address setting for DNP, navigate to the Device's *DNP SETTINGS* column and check the ***IP Address*** setting:

Note:
It is recommended that a maximum of two communication protocols are configured to operate concurrently.

7 READ ONLY MODE

With IEC 61850 and Ethernet/Internet communication capabilities, security has become an important issue. For this reason, all relevant General Electric IEDs have been adapted to comply with the latest cyber-security standards.

In addition to this, a facility is provided which allows you to enable or disable the communication interfaces. This feature is available for products using Courier, IEC 60870-5-103, or IEC 61850.

7.1 IEC 60870-5-103 PROTOCOL BLOCKING

If Read-Only Mode is enabled for RP1 or RP2 with IEC 60870-5-103, the following commands are blocked at the interface:

- Write parameters (=change setting) (private ASDUs)
- General Commands (ASDU20), namely:
  - INF16 auto-recloser on/off
  - INF19 LED reset
  - Private INFs (for example: CB open/close, Control Inputs)

The following commands are still allowed:

- Poll Class 1 (Read spontaneous events)
- Poll Class 2 (Read measurands)
- GI sequence (ASDU7 'Start GI', Poll Class 1)
- Transmission of Disturbance Records sequence (ASDU24, ASDU25, Poll Class 1)
- Time Synchronisation (ASDU6)
- General Commands (ASDU20), namely:
  - INF23 activate characteristic 1
  - INF24 activate characteristic 2
  - INF25 activate characteristic 3
  - INF26 activate characteristic 4

Note:
For IEC 60870-5-103, Read Only Mode function is different from the existing Command block feature.

7.2 COURIER PROTOCOL BLOCKING

If Read-Only Mode is enabled for RP1 or RP2 with Courier, the following commands are blocked at the interface:

- Write settings
- All controls, including:
  - Reset Indication (Trip LED)
  - Operate Control Inputs
  - CB operations
  - Auto-reclose operations
  - Reset demands
  - Clear event/fault/maintenance/disturbance records
  - Test LEDs & contacts

The following commands are still allowed:

- Read settings, statuses, measurands
- Read records (event, fault, disturbance)
- Time Synchronisation
- Change active setting group

7.3 IEC 61850 PROTOCOL BLOCKING

If Read-Only Mode is enabled for the Ethernet interfacing with IEC 61850, the following commands are blocked at the interface:

- All controls, including:
  - Enable/disable protection
  - Operate Control Inputs
  - CB operations (Close/Trip, Lock)
  - Reset LEDs

The following commands are still allowed:

- Read statuses, measurands
- Generate reports
- Extract disturbance records
- Time synchronisation
- Change active setting group

7.4 READ-ONLY SETTINGS

The following settings are available for enabling or disabling Read Only Mode.

- RP1 Read Only
- RP2 Read Only (only for products that have RP2)
- NIC Read Only (where Ethernet is available)

7.5 READ-ONLY DDB SIGNALS

The remote read only mode is also available in the PSL using three dedicated DDB signals:

- RP1 Read Only
- RP2 Read Only (only for products that have RP2)
- NIC Read Only (where Ethernet is available)

Using the PSL, these signals can be activated by opto-inputs, Control Inputs and function keys if required.

8 TIME SYNCHRONISATION

In modern protection schemes it is necessary to synchronise the IED's real time clock so that events from different devices can be time stamped and placed in chronological order. This is achieved in various ways depending on the chosen options and communication protocols.

- Using the IRIG-B input (if fitted)
- Using the SNTP time protocol (for Ethernet IEC 61850 versions + DNP3 OE)
- By using the time synchronisation functionality inherent in the data protocols

8.1 DEMODULATED IRIG-B

IRIG stands for Inter Range Instrumentation Group, which is a standards body responsible for standardising different time code formats. There are several different formats starting with IRIG-A, followed by IRIG-B and so on. The letter after the "IRIG" specifies the resolution of the time signal in pulses per second (PPS). IRIG-B, the one which we use has a resolution of 100 PPS. IRIG-B is used when accurate time-stamping is required.

The following diagram shows a typical GPS time-synchronised substation application. The satellite RF signal is picked up by a satellite dish and passed on to receiver. The receiver receives the signal and converts it into time signal suitable for the substation network. IEDs in the substation use this signal to govern their internal clocks and event recorders.

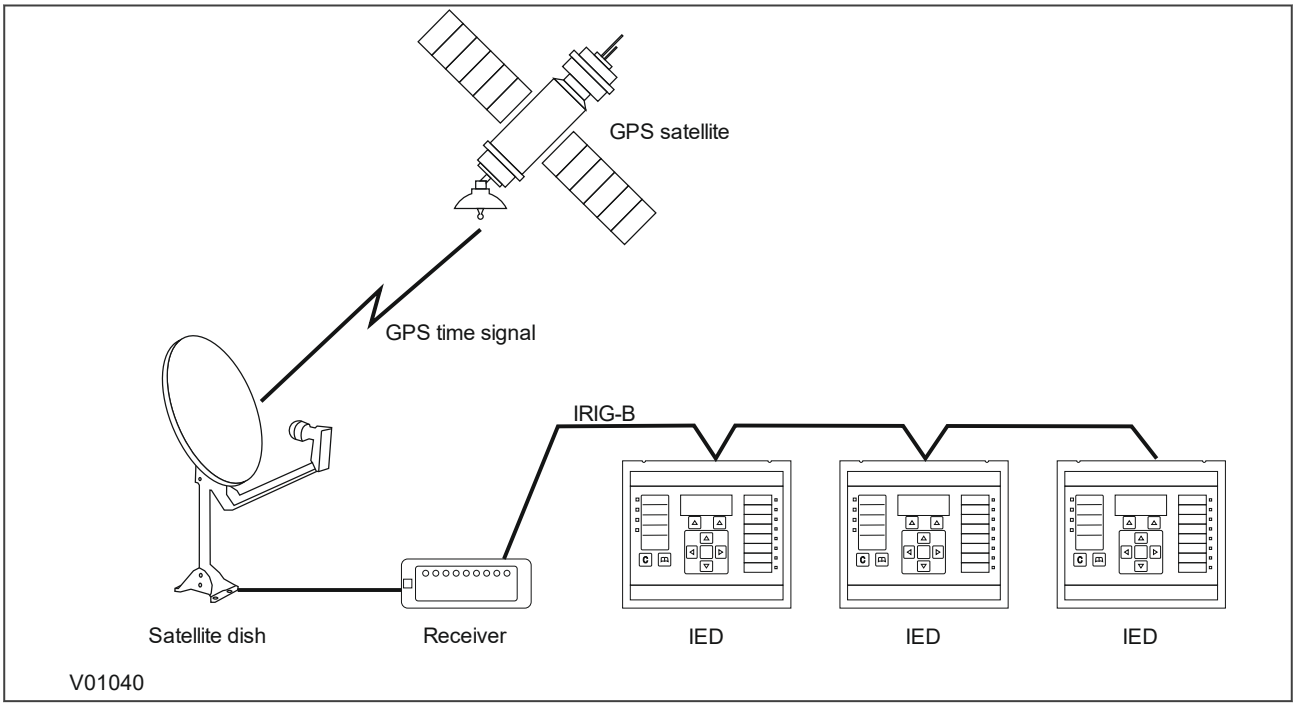


Figure 105: GPS Satellite timing signal

The IRIG-B time code signal is a sequence of one second time frames. Each frame is split up into ten 100 mS slots as follows:

- Time-slot 1: Seconds
- Time-slot 2: Minutes
- Time-slot 3: Hours
- Time-slot 4: Days
- Time-slot 5 and 6: Control functions
- Time-slots 7 to 10: Straight binary time of day

The first four time-slots define the time in BCD (Binary Coded Decimal). Time-slots 5 and 6 are used for control functions, which control deletion commands and allow different data groupings within the synchronisation strings. Time-slots 7-10 define the time in SBS (Straight Binary Second of day).

8.1.1 DEMODULATED IRIG-B IMPLEMENTATION

All models have the option of accepting a demodulated IRIG-B input. This is a hardware option and it uses the same terminals as the RP1 (or RP2 if applicable) inputs. You cannot have IRIG-B and a serial port in the same slot. This means 20Te models cannot have both IRIG-B time synchronisation and serial communications capability. For 30TE and 40TE models however, it is possible to have IRIG-B in one slot and a serial port in another, provided this option is ordered.

To set the device to use IRIG-B, use the setting ***IRIG-B Sync*** cell in the *DATE AND TIME* column. This can be set to `None` (for no IRIG-B), `RP1` (for the option where IRIG-B uses terminals 54 and 56) and `RP2` (for the option where IRIG-B uses terminals 82 and 84)

The IRIG-B status can be viewed in the ***IRIG-B Status*** cell in the *DATE AND TIME* column.

8.2 SNTP

SNTP is used to synchronise the clocks of computer systems over packet-switched, variable-latency data networks, such as IP. SNTP can be used as the time synchronisation method for models using IEC 61850 over Ethernet.

The device is synchronised by the main SNTP server. This is achieved by entering the IP address of the SNTP server into the IED using the IEC 61850 Configurator software described in the settings application software manual. A second server is also configured with a different IP address for backup purposes.

This function issues an alarm when there is a loss of time synchronisation on the SNTP server. This could be because there is no response or no valid clock signal.

The HMI menu does not contain any configurable settings relating to SNTP, as the only way to configure it is using the IEC 61850 Configurator. However it is possible to view some parameters in the *COMMUNICATIONS* column under the sub-heading SNTP parameters. Here you can view the SNTP server addresses and the SNTP poll rate in the cells ***SNTP Server 1***, ***SNTP Server 2*** and ***SNTP Poll rate*** respectively.

The SNTP time synchronisation status is displayed in the ***SNTP Status*** cell in the *DATE AND TIME* column.

8.2.1 LOSS OF SNTP SERVER SIGNAL ALARM

This function issues an alarm when there is a loss of time synchronization on the SNTP server. It is issued when the SNTP sever has not detected a valid time synchronisation response within its 5 second window. This is because there is no response or no valid clock. The alarm is mapped to IEC 61850.

8.3 TIME SYNCHRONISATION USING THE COMMUNICATION PROTOCOLS

All communication protocols have in-built time synchronisation mechanisms. If an external time synchronisation mechanism such as IRIG-B, SNTP, or IEEE 1588 PTP is not used to synchronise the devices, the time synchronisation mechanism within the relevant serial protocol is used. The real time is usually defined in the master station and communicated to the relevant IEDs via one of the rear serial ports using the chosen protocol. It is also possible to define the time locally using settings in the *DATE AND TIME* column.

The time synchronisation for each protocol is described in the relevant protocol description section.

CHAPTER 13

CYBER-SECURITY

1 DISCLAIMER

GE Grid Automation products are digital devices designed to be installed and operated in utility substations & industrial plant environments and connected to secure private networks. GE IEDs should not be connected to the public internet.

GE strongly recommends that users protect their digital devices using a defense-in-depth strategy which will protect their products, their network, their systems and interfaces against cyber security threats. This includes, but is not limited to, placing digital devices inside the control system network security perimeter, deploying and maintaining access controls, monitoring and intrusion detection, security awareness training, security policies, network segmentation and firewalls installation, strong and active password management, data encryption, antivirus and other mitigating applicable technologies.

GE IEDs are available with standard features, and in some products additional optional software options, which provide cyber security mechanisms to help users protect against cyber security intrusion. GE strongly recommends using all available cyber security options.

For additional details and recommendations on how to protect the GE IEDs, please see Cyber Security sections of the manuals. GE Grid Solutions may also provide additional instructions and recommendations to users from time to time relating to IED and cyber security threats or vulnerabilities.

It is the users' sole responsibility to make sure that all GE Grid Automation IEDs are installed and operated considering its cyber security capabilities, security context, and the instructions and recommendations provided to the user relating to GE IEDs. Users assume all risks and liability associated with damages or losses incurred in connection with any and all cyber security incidences.

IT IS THE SOLE RESPONSIBILITY OF THE USER TO SECURE THEIR NETWORK AND ASSOCIATED DEVICES AGAINST CYBER SECURITY INTRUSIONS OR ATTACKS. GE GRID AUTOMATION AND ITS AFFILIATES ARE NOT LIABLE FOR ANY DAMAGES AND/OR LOSSES ARISING FROM OR RELATED TO SUCH SECURITY INTRUSION OR ATTACKS.

2 OVERVIEW

In the past, substation networks were traditionally isolated and the protocols and data formats used to transfer information between devices were often proprietary.

For these reasons, the substation environment was very secure against cyber-attacks. The terms used for this inherent type of security are:

- Security by isolation (if the substation network is not connected to the outside world, it cannot be accessed from the outside world).
- Security by obscurity (if the formats and protocols are proprietary, it is very difficult to interpret them).

However, note that these are not recognised defences against attackers.

The increasing sophistication of protection schemes, coupled with the advancement of technology and the desire for vendor interoperability, has resulted in standardisation of networks and data interchange within substations. Today, devices within substations use standardised protocols for communication. Furthermore, substations can be interconnected with open networks, such as the internet or corporate-wide networks, which use standardised protocols for communication. This introduces a major security risk making the grid vulnerable to cyber-attacks, which could in turn lead to major electrical outages.

Clearly, there is now a need to secure communication and equipment within substation environments. This chapter describes the security measures that have been put in place for our range of Intelligent Electronic Devices (IEDs).

Note:
Cyber-security compatible devices do not enforce NERC compliance, they merely facilitate it. It is the responsibility of the user to ensure that compliance is adhered to as and when necessary.

This chapter contains the following sections:

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The Need for Cyber-Security 273
Standards 274
Cyber-Security Implementation 278

3 THE NEED FOR CYBER-SECURITY

Cyber-security provides protection against unauthorised disclosure, transfer, modification, or destruction of information or information systems, whether accidental or intentional. To achieve this, there are several security requirements:

- Confidentiality (preventing unauthorised access to information)
- Integrity (preventing unauthorised modification)
- Availability/Authentication (preventing the denial of service and assuring authorised access to information)
- Non-repudiation (preventing the denial of an action that took place)
- Traceability/Detection (monitoring and logging of activity to detect intrusion and analyse incidents)

The threats to cyber-security may be unintentional (e.g. natural disasters, human error), or intentional (e.g. cyber-attacks by hackers).

Good cyber-security can be achieved with a range of measures, such as closing down vulnerability loopholes, implementing adequate security processes and procedures and providing technology to help achieve this.

Examples of vulnerabilities are:

- Indiscretions by personnel (users keep passwords on their computer)
- Bad practice (users do not change default passwords, or everyone uses the same password to access all substation equipment)
- Bypassing of controls (users turn off security measures)
- Inadequate technology (substation is not firewalled)

Examples of availability issues are:

- Equipment overload, resulting in reduced or no performance
- Expiry of a certificate preventing access to equipment

To help tackle these issues, standards organisations have produced various standards. Compliance with these standards significantly reduces the threats associated with lack of cyber-security.

4 STANDARDS

There are several standards, which apply to substation cyber-security. The standards currently applicable to General Electric IEDs are NERC and IEEE1686.

Standard	Country	Description
NERC CIP (North American Electric Reliability Corporation)	USA	Framework for the protection of the grid critical Cyber Assets
BDEW (German Association of Energy and Water Industries)	Germany	Requirements for Secure Control and Telecommunication Systems
ANSI ISA 99	USA	ICS oriented then Relevant for EPU completing existing standard and identifying new topics such as patch management
IEEE 1686	International	International Standard for substation IED cyber-security capabilities
IEC 62351	International	Power system data and Comm. protocol
ISO/IEC 27002	International	Framework for the protection of the grid critical Cyber Assets
NIST SP800-53 (National Institute of Standards and Technology)	USA	Complete framework for SCADA SP800-82and ICS cyber-security
CPNI Guidelines (Centre for the Protection of National Infrastructure)	UK	Clear and valuable good practices for Process Control and SCADA security

4.1 NERC COMPLIANCE

The North American Electric Reliability Corporation (NERC) created a set of standards for the protection of critical infrastructure. These are known as the CIP standards (Critical Infrastructure Protection). These were introduced to ensure the protection of 'Critical Cyber Assets', which control or have an influence on the reliability of North America's electricity generation and distribution systems.

These standards have been compulsory in the USA for several years now. Compliance auditing started in June 2007, and utilities face extremely heavy fines for non-compliance.

NERC CIP standards

CIP standard	Description
CIP-002-1 Critical Cyber Assets	Define and document the Critical Assets and the Critical Cyber Assets
CIP-003-1 Security Management Controls	Define and document the Security Management Controls required to protect the Critical Cyber Assets
CIP-004-1 Personnel and Training	Define and Document Personnel handling and training required protecting Critical Cyber Assets
CIP-005-1 Electronic Security	Define and document logical security perimeters where Critical Cyber Assets reside. Define and document measures to control access points and monitor electronic access
CIP-006-1 Physical Security	Define and document Physical Security Perimeters within which Critical Cyber Assets reside
CIP-007-1 Systems Security Management	Define and document system test procedures, account and password management, security patch management, system vulnerability, system logging, change control and configuration required for all Critical Cyber Assets
CIP-008-1 Incident Reporting and Response Planning	Define and document procedures necessary when Cyber-security Incidents relating to Critical Cyber Assets are identified
CIP-009-1 Recovery Plans	Define and document Recovery plans for Critical Cyber Assets

4.1.1 CIP 002

CIP 002 concerns itself with the identification of:

- Critical assets, such as overhead lines and transformers
- Critical cyber assets, such as IEDs that use routable protocols to communicate outside or inside the Electronic Security Perimeter; or are accessible by dial-up

Power utility responsibilities:	General Electric's contribution:
Create the list of the assets	We can help the power utilities to create this asset register automatically. We can provide audits to list the Cyber assets

4.1.2 CIP 003

CIP 003 requires the implementation of a cyber-security policy, with associated documentation, which demonstrates the management's commitment and ability to secure its Critical Cyber Assets.

The standard also requires change control practices whereby all entity or vendor-related changes to hardware and software components are documented and maintained.

Power utility responsibilities:	General Electric's contribution:
To create a Cyber-security Policy	We can help the power utilities to have access control to its critical assets by providing centralized Access control. We can help the customer with its change control by providing a section in the documentation where it describes changes affecting the hardware and software.

4.1.3 CIP 004

CIP 004 requires that personnel with authorized cyber access or authorized physical access to Critical Cyber Assets, (including contractors and service vendors), have an appropriate level of training.

Power utility responsibilities:	General Electric's contribution:
To provide appropriate training of its personnel	We can provide cyber-security training

4.1.4 CIP 005

CIP 005 requires the establishment of an Electronic Security Perimeter (ESP), which provides:

- The disabling of ports and services that are not required
- Permanent monitoring and access to logs (24x7x365)
- Vulnerability Assessments (yearly at a minimum)
- Documentation of Network Changes

Power utility responsibilities:	General Electric's contribution:
To monitor access to the ESP To perform the vulnerability assessments To document network changes	To disable all ports not used in the IED To monitor and record all access to the IED

4.1.5 CIP 006

CIP 006 states that Physical Security controls, providing perimeter monitoring and logging along with robust access controls, must be implemented and documented. All cyber assets used for Physical Security are considered critical and should be treated as such:

Power utility responsibilities:	General Electric's contribution:
Provide physical security controls and perimeter monitoring. Ensure that people who have access to critical cyber assets don't have criminal records.	General Electric cannot provide additional help with this aspect.

4.1.6 CIP 007

CIP 007 covers the following points:

- Test procedures
- Ports and services
- Security patch management
- Antivirus
- Account management
- Monitoring
- An annual vulnerability assessment should be performed

Power utility responsibilities:	General Electric's contribution:
To provide an incident response team and have appropriate processes in place	Test procedures, we can provide advice and help on testing. Ports and services, our devices can disable unused ports and services Security patch management, we can provide assistance Antivirus, we can provide advise and assistance Account management, we can provide advice and assistance Monitoring, our equipment monitors and logs access

4.1.7 CIP 008

CIP 008 requires that an incident response plan be developed, including the definition of an incident response team, their responsibilities and associated procedures.

Power utility responsibilities:	General Electric's contribution:
To provide an incident response team and have appropriate processes in place.	General Electric cannot provide additional help with this aspect.

4.1.8 CIP 009

CIP 009 states that a disaster recovery plan should be created and tested with annual drills.

Power utility responsibilities:	General Electric's contribution:
To implement a recovery plan	To provide guidelines on recovery plans and backup/restore documentation

4.2 IEEE 1686-2013

IEEE 1686-2013 is an IEEE Standard for substation IEDs' cyber-security capabilities. It proposes practical and achievable mechanisms to achieve secure operations.

The following features described in this standard apply:

- Passwords are 8 characters long and can contain upper-case, lower-case, numeric and special characters.
- Passwords are never displayed or transmitted to a user.
- IED functions and features are assigned to different password levels. The assignment is fixed.

- The audit trail is recorded, listing events in the order in which they occur, held in a circular buffer.
- Records contain all defined fields from the standard and record all defined function event types where the function is supported.
- No password defeat mechanism exists. Instead a secure recovery password scheme is implemented.
- Unused ports (physical and logical) may be disabled.

5 CYBER-SECURITY IMPLEMENTATION

The General Electric IEDs have always been and will continue to be equipped with state-of-the-art security measures. Due to the ever-evolving communication technology and new threats to security, this requirement is not static. Hardware and software security measures are continuously being developed and implemented to mitigate the associated threats and risks.

This section describes the current implementation of cyber-security. This is valid for the release of platform software to which this manual pertains. This current cyber-security implementation is known as Cyber-security Phase 1.

At the IED level, these cyber-security measures have been implemented:

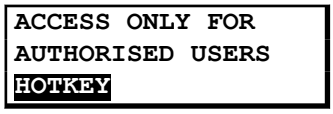
- NERC-compliant default display
- Four-level access
- Enhanced password security
- Password recovery procedure
- Disabling of unused physical and logical ports
- Inactivity timer
- Security events management

External to the IEDs, the following cyber-security measures have been implemented:

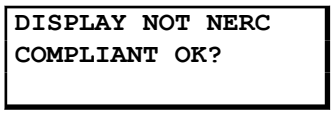
- Antivirus
- Security patch management

5.1 NERC-COMPLIANT DISPLAY

For the device to be NERC-compliant, it must provide the option for a NERC-compliant default display. The default display that is implemented in our cyber-security concept contains a warning that the IED can be accessed by authorised users. You can change this if required with the ***User Banner*** setting in the *SECURITY CONFIG* column.



If you try to change the default display from the NERC-compliant one, a further warning is displayed:



The default display navigation map shows how NERC-compliance is achieved with the product's default display concept.

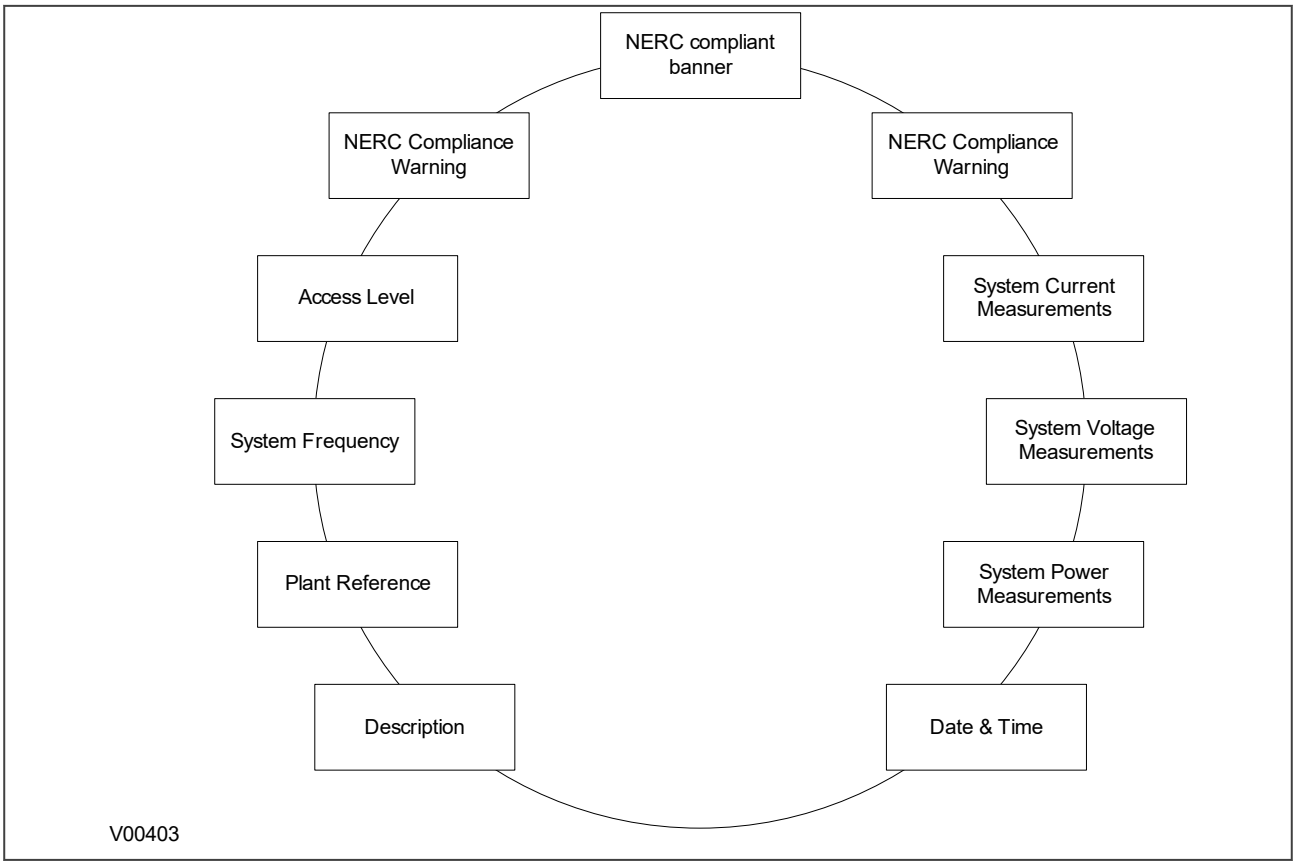


Figure 106: Default display navigation

5.2 FOUR-LEVEL ACCESS

The menu structure contains four levels of access, three of which are password protected.

Password levels

Level	Meaning	Read Operation	Write Operation
0	Read Some Write Minimal	SYSTEM DATA column: Description Plant Reference Model Number Serial Number S/W Ref. Access Level Security Feature SECURITY CONFIG column: User Banner Attempts Remain Blk Time Remain Fallback PW level Security Code (UI only)	Password Entry LCD Contrast (UI only)
1	Read All Write Few	All data and settings are readable. Poll Measurements	All items writeable at level 0. Level 1 Password setting Extract Disturbance Record Select Event, Main and Fault (upload) Extract Events (e.g. via MiCOM S1 Studio)

Level	Meaning	Read Operation	Write Operation
2	Read All Write Some	All data and settings are readable. Poll Measurements	All items writeable at level 1. Setting Cells that change visibility (Visible/Invisible). Setting Values (Primary/Secondary) selector Commands: Reset Indication Reset Demand Reset Statistics Reset CB Data / counters Level 2 Password setting
3	Read All Write All	All data and settings are readable. Poll Measurements	All items writeable at level 2. Change all Setting cells Operations: Extract and download Setting file. Extract and download PSL Extract and download MCL61850 (IEC61850 CONFIG) Auto-extraction of Disturbance Recorder Courier/Modbus Accept Event (auto event extraction, e.g. via A2R) Commands: Change Active Group setting Close / Open CB Change Comms device address. Set Date & Time Switch MCL banks / Switch Conf. Bank in UI (IEC61850 CONFIG) Enable / Disable Device ports (in SECURITY CONFIG column) Level 3 password setting

5.2.1 BLANK PASSWORDS

A blank password is effectively a zero-length password. Through the front panel it is entered by confirming the password entry without actually entering any password characters. Through a communications port the Courier and Modbus protocols each have a means of writing a blank password to the IED. A blank password disables the need for a password at the level that this password is applied.

Blank passwords have a slightly different validation procedure. If a blank password is entered through the front panel, the following text is displayed, after which the procedure is the same as already described:

```
BLANK PASSWORD
ENTERED CONFIRM
```

Blank passwords cannot be configured if the lower level password is not blank.

Blank passwords affect the fall back level after inactivity timeout or logout.

The 'fallback level' is the password level adopted by the IED after an inactivity timeout, or after the user logs out. This will be either the level of the highest-level password that is blank, or level 0 if no passwords are blank.

5.2.2 PASSWORD RULES

- Default passwords are blank for Level 1 and are AAAA for Levels 2 and 3
- Passwords may be any length between 0 and 8 characters long
- Passwords may or may not be NERC compliant
- Passwords may contain any ASCII character in the range ASCII code 33 (21 Hex) to ASCII code 122 (7A Hex) inclusive
- Only one password is required for all the IED interfaces

5.2.3 ACCESS LEVEL DDBS

In addition to having the 'Access level' cell in the 'System data' column (address 00D0), the current level of access for each interface is also available for use in the Programming Scheme Logic (PSL) by mapping to these Digital Data Bus (DDB) signals:

- ***HMI Access Lvl 1***
- ***HMI Access Lvl 2***
- ***HMI Access Lvl 3***
- ***FPort AccessLvl1***
- ***FPort AccessLvl2***
- ***FPort AccessLvl3***
- ***RPrt1 AccessLvl1***
- ***RPrt1 AccessLvl2***
- ***RPrt1 AccessLvl3***
- ***RPrt2 AccessLvl1***
- ***RPrt2 AccessLvl2***
- ***RPrt2 AccessLvl3***

Key:

HMI = Human Machine Interface

FPort = Front Port

RPrt = Rear Port

Lvl = Level

5.3 ENHANCED PASSWORD SECURITY

Cyber-security requires strong passwords and validation for NERC compliance.

5.3.1 PASSWORD STRENGTHENING

NERC compliant passwords have the following requirements:

- At least one upper-case alpha character
- At least one lower-case alpha character
- At least one numeric character
- At least one special character (%,$...)
- At least six characters long

5.3.2 PASSWORD VALIDATION

The IED checks for NERC compliance. If the password is entered through the front panel, this is briefly displayed on the LCD.

If the entered password is NERC compliant, the following text is displayed.

```
NERC COMPLIANT
P/WORD WAS SAVED
```

If the password entered is not NERC-compliant, the user is required to actively confirm this, in which case the non-compliance is logged.

If the entered password is not NERC compliant, the following text is displayed:

```
NERC COMPLIANCE
NOT MET CONFIRM?
```

On confirmation, the non-compliant password is stored and the following acknowledgement message is displayed for 2 seconds.

```
NON-NERC P/WORD
SAVED OK
```

If the action is cancelled, the password is rejected and the following message is displayed for 2 seconds.

```
NON-NERC P/WORD
NOT SAVE
```

If the password is entered through a communications port using Courier or Modbus protocols, the device will store the password, irrespective of whether it is NERC-compliant or not. It then uses appropriate response codes to inform the client of the NERC-compliancy status. You can then choose to enter a new NERC-compliant password or accept the non-NERC compliant password just entered.

5.3.3 PASSWORD BLOCKING

You are locked out temporarily, after a defined number of failed password entry attempts. Each invalid password entry attempt decrements the 'Attempts Remain' data cell by 1. When the maximum number of attempts has been reached, access is blocked. If the attempts timer expires, or the correct password is entered *before* the 'attempt count' reaches the maximum number, then the 'attempts count' is reset to 0.

An attempt is only counted if the attempted password uses only characters in the valid range, but the attempted password is not correct (does not match the corresponding password in the IED). Any attempt where one or more characters of the attempted password are not in the valid range will not be counted.

Once the password entry is blocked, a 'blocking timer' is started. Attempts to access the interface while the 'blocking timer' is running results in an error message, irrespective of whether the correct password is entered or not. Once the 'blocking timer' has expired, access to the interface is unblocked and the attempts counter is reset to zero.

If you try to enter the password while the interface is blocked, the following message is displayed for 2 seconds.

```
NOT ACCEPTED
ENTRY IS BLOCKED
```

A similar response occurs if you try to enter the password through a communications port.

The parameters can then be configured using the ***Attempts Limit***, ***Attempts Timer*** and ***Blocking Timer*** settings in the *SECURITY CONFIG* column.

Password blocking configuration

Setting	Cell col row	Units	Default Setting	Available Setting
Attempts Limit	25 02		3	0 to 3 step 1

Setting	Cell col row	Units	Default Setting	Available Setting
Attempts Timer	25 03	Minutes	2	1 to 3 step 1
Blocking Timer	25 04	Minutes	5	1 to 30 step 1

5.4 PASSWORD RECOVERY

If you mislay a device's password, they can be recovered. To obtain the recovery password you must contact the Contact Centre and supply the Serial Number and its Security Code. The Contact Centre will use these items to generate a Recovery Password.

The security code is a 16-character string of upper case characters. It is a read-only parameter. The device generates its own security code randomly. A new code is generated under the following conditions:

- On power up
- Whenever settings are set back to default
- On expiry of validity timer (see below)
- When the recovery password is entered

As soon as the security code is displayed on the LCD, a validity timer is started. This validity timer is set to 72 hours and is not configurable. This provides enough time for the contact centre to manually generate and send a recovery password. The Service Level Agreement (SLA) for recovery password generation is one working day, so 72 hours is sufficient time, even allowing for closure of the contact centre over weekends and bank holidays.

To prevent accidental reading of the IED security code, the cell will initially display a warning message:

```
PRESS ENTER TO
READ SEC. CODE
```

The security code is displayed on confirmation. The validity timer is then started. The security code can only be read from the front panel.

5.4.1 ENTRY OF THE RECOVERY PASSWORD

The recovery password is intended for recovery only. It is not a replacement password that can be used continually. It can only be used once – for password recovery.

Entry of the recovery password causes the IED to reset all passwords back to default. This is all it is designed to do. After the passwords have been set back to default, it is up to the user to enter new passwords. Each password should be appropriate for its intended function, ensuring NERC compliance, if required.

On this action, the following message is displayed:

```
PASSWORDS HAVE
BEEN SET TO
DEFAULT
```

The recovery password can be applied through any interface, local or remote. It will achieve the same result irrespective of which interface it is applied through.

5.4.2 PASSWORD ENCRYPTION

The IED supports encryption for passwords entered remotely. The encryption key can be read from the IED through a specific cell available only through communication interfaces, not the front panel. Each time the key is read the IED generates a new key that is valid only for the next password encryption write. Once used, the key is invalidated

and a new key must be read for the next encrypted password write. The encryption mechanism is otherwise transparent to the user.

5.5 DISABLING PHYSICAL PORTS

It is possible to disable unused physical ports. A level 3 password is needed to perform this action.

To prevent accidental disabling of a port, a warning message is displayed according to whichever port is required to be disabled. For example if rear port 1 is to be disabled, the following message appears:

```
REAR PORT 1 TO BE
DISABLED.CONFIRM
```

The following ports can be disabled, depending on the model.

- Front port (***Front Port*** setting)
- Rear port 1 (***Rear Port 1*** setting)
- Rear port 2 (***Rear Port 2*** setting)
- Ethernet port (***Ethernet*** setting)

Note:
It is not possible to disable a port from which the disabling port command originates.

Note:
We do not generally advise disabling the physical Ethernet port.

5.6 DISABLING LOGICAL PORTS

It is possible to disable unused logical ports. A level 3 password is needed to perform this action.

Note:
The port disabling setting cells are not provided in the settings file. It is only possible to do this using the HMI front panel.

The following protocols can be disabled:

- IEC 61850 (***IEC61850*** setting)
- DNP3 Over Ethernet (***DNP3 OE*** setting)
- Courier Tunnelling (***Courier Tunnel*** setting)

Note:
If any of these protocols are enabled or disabled, the Ethernet card will reboot.

5.7 SECURITY EVENTS MANAGEMENT

To implement NERC-compliant cyber-security, a range of Event records need to be generated. These log security issues such as the entry of a non-NERC-compliant password, or the selection of a non-NERC-compliant default display.

Security event values

Event Value	Display
PASSWORD LEVEL UNLOCKED	USER LOGGED IN ON {int} LEVEL {n}
PASSWORD LEVEL RESET	USER LOGGED OUT ON {int} LEVEL {n}
PASSWORD SET BLANK	P/WORD SET BLANK BY {int} LEVEL {p}
PASSWORD SET NON-COMPLIANT	P/WORD NOT-NERC BY {int} LEVEL {p}
PASSWORD MODIFIED	PASSWORD CHANGED BY {int} LEVEL {p}
PASSWORD ENTRY BLOCKED	PASSWORD BLOCKED ON {int}
PASSWORD ENTRY UNBLOCKED	P/WORD UNBLOCKED ON {int}
INVALID PASSWORD ENTERED	INV P/W ENTERED ON <int}
PASSWORD EXPIRED	P/WORD EXPIRED ON {int}
PASSWORD ENTERED WHILE BLOCKED	P/W ENT WHEN BLK ON {int}
RECOVERY PASSWORD ENTERED	RCVY P/W ENTERED ON {int}
IED SECURITY CODE READ	IED SEC CODE RD ON {int}
IED SECURITY CODE TIMER EXPIRED	IED SEC CODE EXP -
PORT DISABLED	PORT DISABLED BY {int} PORT {prt}
PORT ENABLED	PORT ENABLED BY {int} PORT {prt}
DEF. DISPLAY NOT NERC COMPLIANT	DEF DSP NOT-NERC
PSL SETTINGS DOWNLOADED	PSL STNG D/LOAD BY {int} GROUP {grp}
DNP SETTINGS DOWNLOADED	DNP STNG D/LOAD BY {int}
TRACE DATA DOWNLOADED	TRACE DAT D/LOAD BY {int}
IEC61850 CONFIG DOWNLOADED	IED CONFG D/LOAD BY {int}
USER CURVES DOWNLOADED	USER CRV D/LOAD BY {int} GROUP {crv}
PSL CONFIG DOWNLOADED	PSL CONFG D/LOAD BY {int} GROUP {grp}
SETTINGS DOWNLOADED	SETTINGS D/LOAD BY {int} GROUP {grp}
PSL SETTINGS UPLOADED	PSL STNG UPLOAD BY {int} GROUP {grp}

Event Value	Display
DNP SETTINGS UPLOADED	DNP STNG UPLOAD BY {int}
TRACE DATA UPLOADED	TRACE DAT UPLOAD BY {int}
IEC61850 CONFIG UPLOADED	IED CONFG UPLOAD BY {int}
USER CURVES UPLOADED	USER CRV UPLOAD BY {int} GROUP {crv}
PSL CONFIG UPLOADED	PSL CONFG UPLOAD BY {int} GROUP {grp}
SETTINGS UPLOADED	SETTINGS UPLOAD BY {int} GROUP {grp}
EVENTS HAVE BEEN EXTRACTED	EVENTS EXTRACTED BY {int} {nov} EVNTS
ACTIVE GROUP CHANGED	ACTIVE GRP CHNGE BY {int} GROUP {grp}
CS SETTINGS CHANGED	C & S CHANGED BY {int}
DR SETTINGS CHANGED	DR CHANGED BY {int}
SETTING GROUP CHANGED	SETTINGS CHANGED BY {int} GROUP {grp}
POWER ON	POWER ON -
SOFTWARE_DOWNLOADED	S/W DOWNLOADED -

where:

- int is the interface definition (UI, FP, RP1, RP2, TNL, TCP)
- prt is the port ID (FP, RP1, RP2, TNL, DNP3, IEC, ETHR)
- grp is the group number (1, 2, 3, 4)
- crv is the Curve group number (1, 2, 3, 4)
- n is the new access level (0, 1, 2, 3)
- p is the password level (1, 2, 3)
- nov is the number of events (1 – nnn)

Each new event has an incremented unique number, therefore missing events appear as ‘gap’ in the sequence. The unique identifier forms part of the event record that is read or uploaded from the IED.

Note:
It is no longer possible to clear Event, Fault, Maintenance, and Disturbance Records.

5.8 LOGGING OUT

If you have been configuring the IED, you should 'log out'. Do this by going up to the top of the menu tree. When you are at the Column Heading level and you press the Up button, you may be prompted to log out with the following display:

```
DO YOU WANT TO
LOG OUT?
```

You will only be asked this question if your password level is higher than the fallback level.

If you confirm, the following message is displayed for 2 seconds:

```
LOGGED OUT
Access Level #
```

Where # is the current fallback level.

If you decide not to log out, the following message is displayed for 2 seconds.

```
LOGOUT CANCELLED
Access Level #
```

where # is the current access level.

CHAPTER 14

INSTALLATION

1 CHAPTER OVERVIEW

This chapter provides information about installing the product.

This chapter contains the following sections:

Chapter Overview 291
Handling the Goods 292
Mounting the Device 293
Cables and Connectors 298
Case Dimensions 302

2 HANDLING THE GOODS

Our products are of robust construction but require careful treatment before installation on site. This section discusses the requirements for receiving and unpacking the goods, as well as associated considerations regarding product care and personal safety.

Caution:
Before lifting or moving the equipment you should be familiar with the Safety Information chapter of this manual.

2.1 RECEIPT OF THE GOODS

On receipt, ensure the correct product has been delivered. Unpack the product immediately to ensure there has been no external damage in transit. If the product has been damaged, make a claim to the transport contractor and notify us promptly.

For products not intended for immediate installation, repack them in their original delivery packaging.

2.2 UNPACKING THE GOODS

When unpacking and installing the product, take care not to damage any of the parts and make sure that additional components are not accidentally left in the packing or lost. Do not discard any CDROMs or technical documentation (where included). These should accompany the unit to its destination substation and put in a dedicated place.

The site should be well lit to aid inspection, clean, dry and reasonably free from dust and excessive vibration. This particularly applies where installation is being carried out at the same time as construction work.

2.3 STORING THE GOODS

If the unit is not installed immediately, store it in a place free from dust and moisture in its original packaging. Keep any dehumidifier bags included in the packing. The dehumidifier crystals lose their efficiency if the bag is exposed to ambient conditions. Restore the crystals before replacing it in the carton. Ideally regeneration should be carried out in a ventilating, circulating oven at about 115°C. Bags should be placed on flat racks and spaced to allow circulation around them. The time taken for regeneration will depend on the size of the bag. If a ventilating, circulating oven is not available, when using an ordinary oven, open the door on a regular basis to let out the steam given off by the regenerating silica gel.

On subsequent unpacking, make sure that any dust on the carton does not fall inside. Avoid storing in locations of high humidity. In locations of high humidity the packaging may become impregnated with moisture and the dehumidifier crystals will lose their efficiency.

The device can be stored between –25° to +70°C for unlimited periods or between -40°C to + 85°C for up to 96 hours (see technical specifications).

2.4 DISMANTLING THE GOODS

If you need to dismantle the device, always observe standard ESD (Electrostatic Discharge) precautions. The minimum precautions to be followed are as follows:

- Use an antistatic wrist band earthed to a suitable earthing point.
- Avoid touching the electronic components and PCBs.

3 MOUNTING THE DEVICE

The products are available in the following forms

- For flush panel and rack mounting
- For retrofitting K-series models
- Software only (for upgrades)

3.1 FLUSH PANEL MOUNTING

Panel-mounted devices are flush mounted into panels using M4 SEMS Taptite self-tapping screws with captive 3 mm thick washers (also known as a SEMS unit).

Caution:
Do not use conventional self-tapping screws, because they have larger heads and could damage the faceplate.

Alternatively, you can use tapped holes if the panel has a minimum thickness of 2.5 mm.

For applications where the product needs to be semi-projection or projection mounted, a range of collars are available.

If several products are mounted in a single cut-out in the panel, mechanically group them horizontally or vertically into rigid assemblies before mounting in the panel.

Caution:
Do not fasten products with pop rivets because this makes them difficult to remove if repair becomes necessary.

3.1.1 RACK MOUNTING

Panel-mounted variants can also be rack mounted using single-tier rack frames (our part number FX0021 001), as shown in the figure below. These frames are designed with dimensions in accordance with IEC 60297 and are supplied pre-assembled ready to use. On a standard 483 mm (19 inch) rack this enables combinations of case widths up to a total equivalent of size 80TE to be mounted side by side.

The two horizontal rails of the rack frame have holes drilled at approximately 26 mm intervals. Attach the products by their mounting flanges using M4 Taptite self-tapping screws with captive 3 mm thick washers (also known as a SEMS unit).

Caution:
Risk of damage to the front cover molding. Do not use conventional self-tapping screws, including those supplied for mounting MiDOS products because they have slightly larger heads.

Once the tier is complete, the frames are fastened into the racks using mounting angles at each end of the tier.

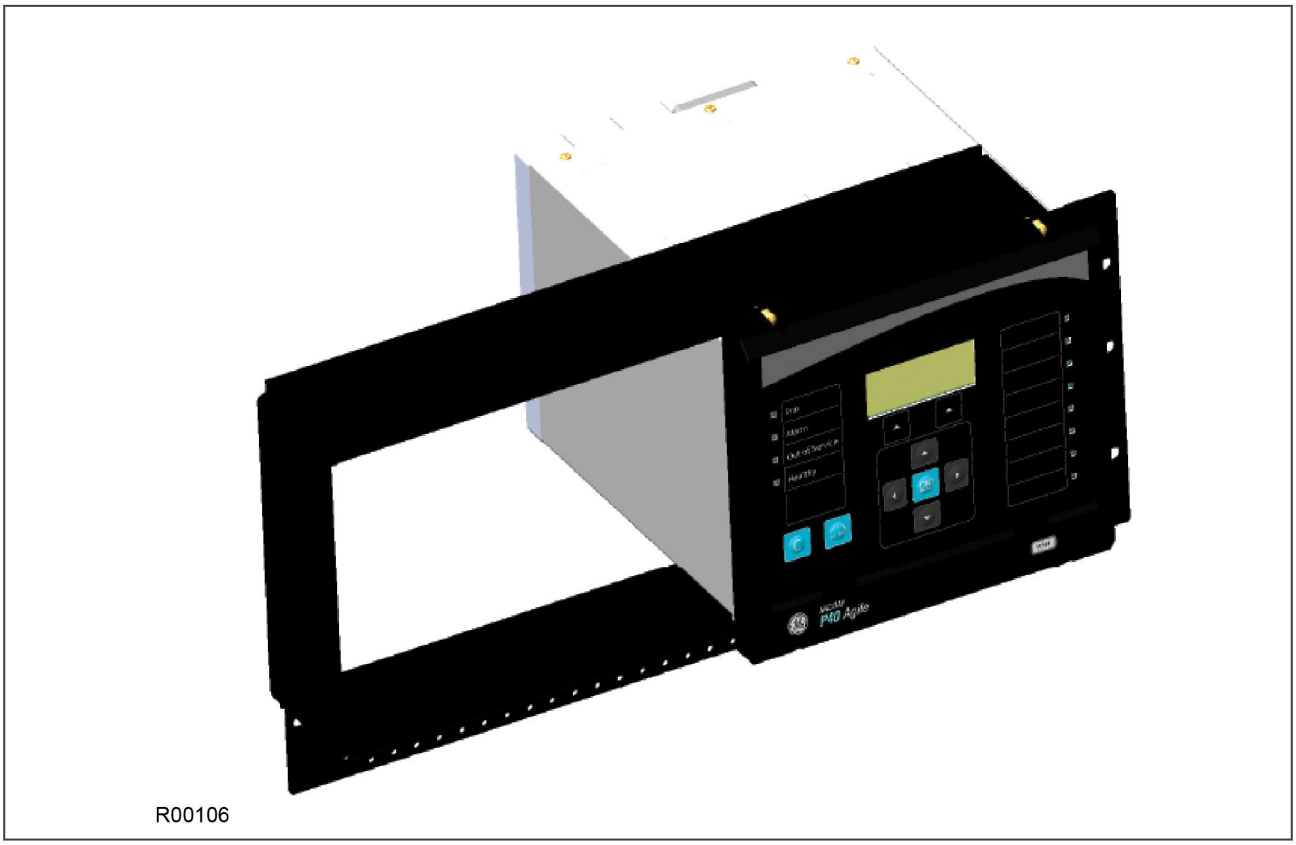


Figure 107: Rack mounting of products

Products can be mechanically grouped into single tier (4U) or multi-tier arrangements using the rack frame. This enables schemes using products from different product ranges to be pre-wired together before mounting.

Use blanking plates to fill any empty spaces. The spaces may be used for installing future products or because the total size is less than 80TE on any tier. Blanking plates can also be used to mount ancillary components. The part numbers are as follows:

Case size summation	Blanking plate part number
5TE	GJ2028 001
10TE	GJ2028 002
15TE	GJ2028 003
20TE	GJ2028 004
25TE	GJ2028 005
30TE	GJ2028 006
35TE	GJ2028 007
40TE	GJ2028 008
60TE	GJ2028 012
80TE	GJ2028 016

3.2 K-SERIES RETROFIT

A major advantage of the P40 Agile platform is its backward compatibility with the K-series products. The P40 Agile products have been designed such that the case, back panel terminal layout and pin-outs are identical to their K-series predecessors and can be retrofitted without the usual overhead associated with replacing and rewiring

devices. This allows easy upgrade of the protection system with minimum impact and minimum shutdown time of the feeder.

The equivalencies of the models are as follows:

Case width (TE)	Case width (mm)	Equivalent K series	Products
20TE	102.4 mm (4 inches)	KCGG140/142	P14N
30TE	154.2 mm (6 inches)	KCEG140/142	P14D

The old K-series products can be removed by sliding the cradle out of the case. The new P40 Agile cradle can then be inserted into the old case as shown below:

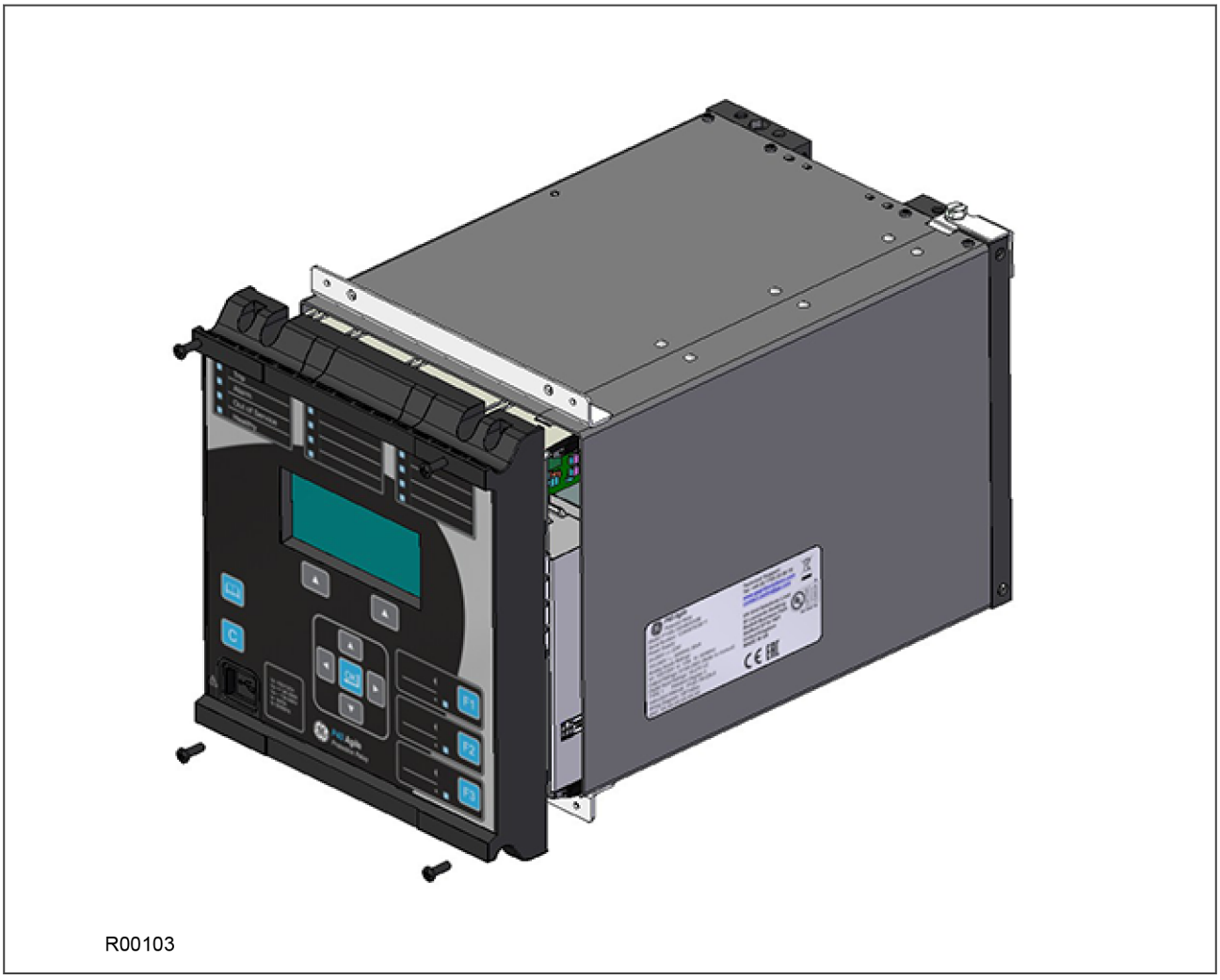


Figure 108: Inserting cradle into case

Before withdrawing the cradle it is important to:

- Check the existing case for any damage
- Check the wiring is in good condition, especially the earth wiring
- Check the continuity of the earth connection to the cublicle earthing bar.

If there is any doubt as to the integrity of any of these aspects, contact your local representative.

Caution:
After removing the K-series product from its case, refit it into the case that came with your device, for storage or reuse in another location.

A K-series device provides a 48 V DC field voltage between terminals 7 and 8. This field voltage is intended for driving auxiliary equipment such as opto-inputs. P40 Agile devices DO NOT provide this field voltage. For this reason, P40 Agile retrofit devices have internal shorting links between terminals 7 and 13, and terminals 8 and 14 respectively. The intention of this is to provide the auxiliary supply voltage to terminals 7 and 8 in lieue of the field voltage.

Caution:
The voltage on terminals 7 and 8 mirrors that of the auxiliary supply voltage. Therefore, if the auxiliary supply voltage on terminals 13 and 14 is not 48 V DC, then the voltage on terminals 7 and 8 is also not 48 V DC.

Caution:
When retrofitting a K-series device, ensure the load on terminals 7 and 8 is limited to a maximum of 5A. A jumplead with a 5A ceramic timelag fuse is fitted internally.
If the internal fuse link opens while in operation you need to return the relay to the factory for repair. Do not perform an on-site repair.

If specified at the time of order, the internal fuselink will be fitted to terminals 7 and 8. If not, the device will be provided with two external shorting links to be installed in the field.

Warning:
Make sure all power sources to the K-series terminals are turned off or isolated before you begin installing the shorting links to terminals 7 and 8.

3.2.1 CONVENTIONS

The P40 Agile products have different conventions from the K-series products when it comes to numbering some hardware components. It is very important that you are aware of this. This is just a matter of convention and does not affect the terminal compatibility.

The equivalencies are as follows:

Component	P40 Agile products	K-series products
Output relay	RL1	RL0
Output relay	RL2	RL1
Output relay	RL3	RL2
Output relay	RL4	RL3
Output relay	RL5	RL4
Output relay	RL6	RL5
Output relay	RL7	RL6
Output relay	RL8	RL7
Opto-input	L1	L0
Opto-input	L2	L1

Component	P40 Agile products	K-series products
Opto-input	L3	L2
Opto-input	L4	L3
Opto-input	L5	L4
Opto-input	L6	L5
Opto-input	L7	L6
Opto-input	L8	L7

3.3 SOFTWARE ONLY

It is possible to upgrade an existing device by purchasing software only (providing the device is already fitted with the requisite hardware).

There are two options for software-only products:

- Your device is sent back to the General Electric factory for upgrade.
- The software is sent to you for upgrade. Please contact your local representative if you wish to procure the services of a commissioning engineer to help you with your device upgrade.

Note:
Software-only products are licensed for use with devices with specific serial numbers.

Caution:
Do not attempt to upgrade an existing device if the software has not been licensed for that speciific device.

4 CABLES AND CONNECTORS

This section describes the type of wiring and connections that should be used when installing the device. For pin-out details please refer to the Hardware Design chapter or the wiring diagrams.

Caution:
Before carrying out any work on the equipment you should be familiar with the Safety Section and the ratings on the equipment's rating label.

4.1 TERMINAL BLOCKS

The device uses MiDOS terminal blocks as shown below.

Figure 109: MiDOS terminal block

The MiDOS terminal block consists of up to 28 x M4 screw terminals. The wires should be terminated with rings using 90° ring terminals, with no more than two rings per terminal. The products are supplied with sufficient M4 screws.

M4 90° crimp ring terminals are available in three different sizes depending on the wire size. Each type is available in bags of 100.

Part number	Wire size	Insulation color
ZB9124 901	0.25 - 1.65 mm^2 (22 – 16 AWG)	Red
ZB9124 900	1.04 - 2.63 mm^2 (16 – 14 AWG)	Blue

4.2 POWER SUPPLY CONNECTIONS

These should be wired with 1.5 mm PVC insulated multi-stranded copper wire terminated with M4 ring terminals.

The wire should have a minimum voltage rating of 300 V RMS.

Caution:
Protect the auxiliary power supply wiring with a maximum 16 A high rupture capacity (HRC) type NIT or TIA fuse.

4.3 EARTH CONNNECTION

Every device must be connected to the cubicle earthing bar using the M4 earth terminal.

Use a wire size of at least 2.5 mm^2 terminated with a ring terminal.

Due to the physical limitations of the ring terminal, the maximum wire size you can use is 6.0 mm^2 using ring terminals that are not pre-insulated. If using pre insulated ring terminals, the maximum wire size is reduced to 2.63 mm^2 per ring terminal. If you need a greater cross-sectional area, use two wires in parallel, each terminated in a separate ring terminal.

The wire should have a minimum voltage rating of 300 V RMS.

Note:
To prevent any possibility of electrolytic action between brass or copper ground conductors and the rear panel of the product, precautions should be taken to isolate them from one another. This could be achieved in several ways, including placing a nickel-plated or insulating washer between the conductor and the product case, or using tinned ring terminals.

4.4 VOLTAGE TRANSFORMER CONNECTIONS

Voltage transformers should be wired with 2.5 mm^2 PVC insulated multi-stranded copper wire terminated with M4 ring terminals.

The wire should have a minimum voltage rating of 300 V RMS.

4.5 WATCHDOG CONNECTIONS

These should be wired with 1 mm PVC insulated multi-stranded copper wire terminated with M4 ring terminals.

The wire should have a minimum voltage rating of 300 V RMS.

4.6 EIA(RS)485 AND K-BUS CONNECTIONS

For connecting the EIA(RS485) / K-Bus ports, use 2-core screened cable with a maximum total length of 1000 m or 200 nF total cable capacitance.

A typical cable specification would be:

- Each core: 16/0.2 mm^2 copper conductors, PVC insulated
- Nominal conductor area: 0.5 mm^2 per core
- Screen: Overall braid, PVC sheathed

To guarantee the performance specifications, you must ensure continuity of the screen, when daisy chaining the connections. The device is supplied with an earth link pack (part number ZA0005092) consisting of an earth link and a self-tapping screw to facilitate this requirement.

The earth link is fastened to the Midos block just below terminal number 56 as shown:

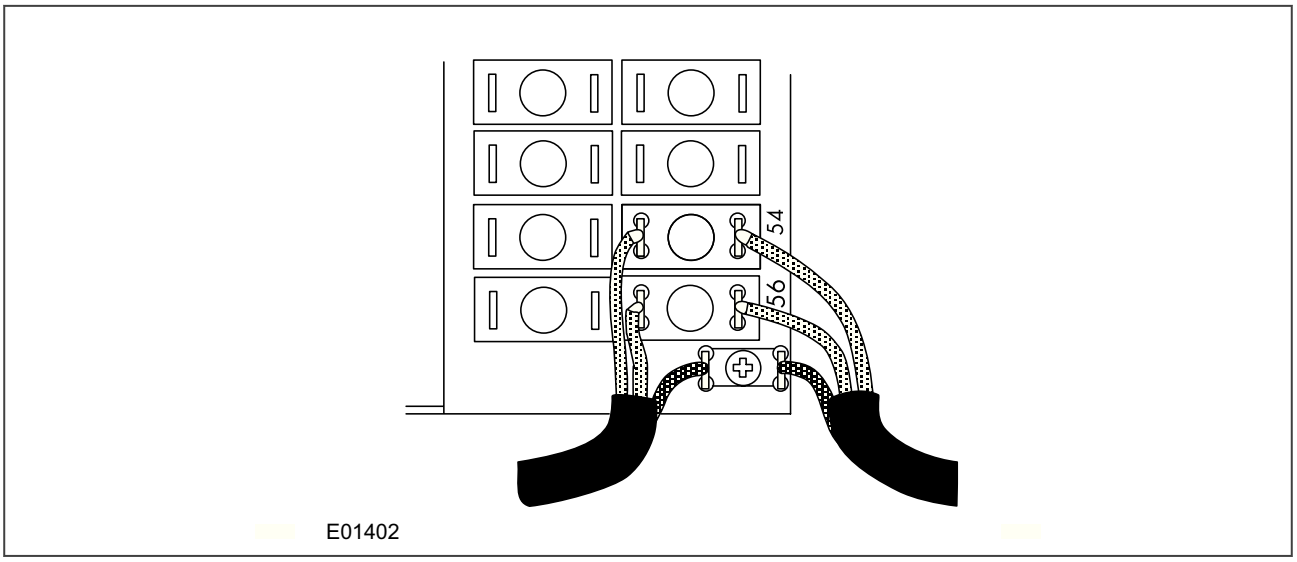


Figure 110: Earth link for cable screen

There is no electrical connection of the cable screen to the device. The link is provided purely to link together the two cable screens.

4.7 IRIG-B CONNECTION

The optional IRIG-B input uses the same terminals as the EIA(RS)485 port RP1. It is therefore apparent that RS485 communications and IRIG-B input are mutually exclusive.

A typical cable specification would be:

- Each core: 16/0.2 mm^2 copper conductors, PVC insulated
- Nominal conductor area: 0.5 mm^2 per core
- Screen: Overall braid, PVC sheathed

4.8 OPTO-INPUT CONNECTIONS

These should be wired with 1 mm^2 PVC insulated multi-stranded copper wire terminated with M4 ring terminals.

Each opto-input has a selectable preset ½ cycle filter. This makes the input immune to noise induced on the wiring. This can, however slow down the response. If you need to switch off the ½ cycle filter, either use double pole switching on the input, or screened twisted cable on the input circuit.

Caution:
Protect the opto-inputs and their wiring with a maximum 16 A high rupture capacity (HRC) type NIT or TIA fuse.

4.9 OUTPUT RELAY CONNECTIONS

These should be wired with 1 mm PVC insulated multi-stranded copper wire terminated with M4 ring terminals.

4.10 ETHERNET METALLIC CONNECTIONS

If the device has a metallic Ethernet connection, it can be connected to either a 10Base-T or a 100Base-TX Ethernet hub. Due to noise sensitivity, we recommend this type of connection only for short distance connections, ideally where the products and hubs are in the same cubicle. For increased noise immunity, CAT 6 (category 6) STP (shielded twisted pair) cable and connectors can be used.

The connector for the Ethernet port is a shielded RJ-45. The pin-out is as follows:

Pin	Signal name	Signal definition
1	TXP	Transmit (positive)
2	TXN	Transmit (negative)
3	RXP	Receive (positive)
4	-	Not used
5	-	Not used
6	RXN	Receive (negative)
7	-	Not used
8	-	Not used

4.11 ETHERNET FIBRE CONNECTIONS

We recommend the use of fibre-optic connections for permanent connections in a substation environment. The 100 Mbps fibre optic port is based on the 100BaseFX standard and uses type LC connectors. They are compatible with 50/125 µm or 62.5/125 µm multimode fibres at 1300 nm wavelength.

4.12 USB CONNECTION

The IED has a type B USB socket on the front panel. A standard USB printer cable (type A one end, type B the other end) can be used to connect a local PC to the IED. This cable is the same as that used for connecting a printer to a PC.

5 CASE DIMENSIONS

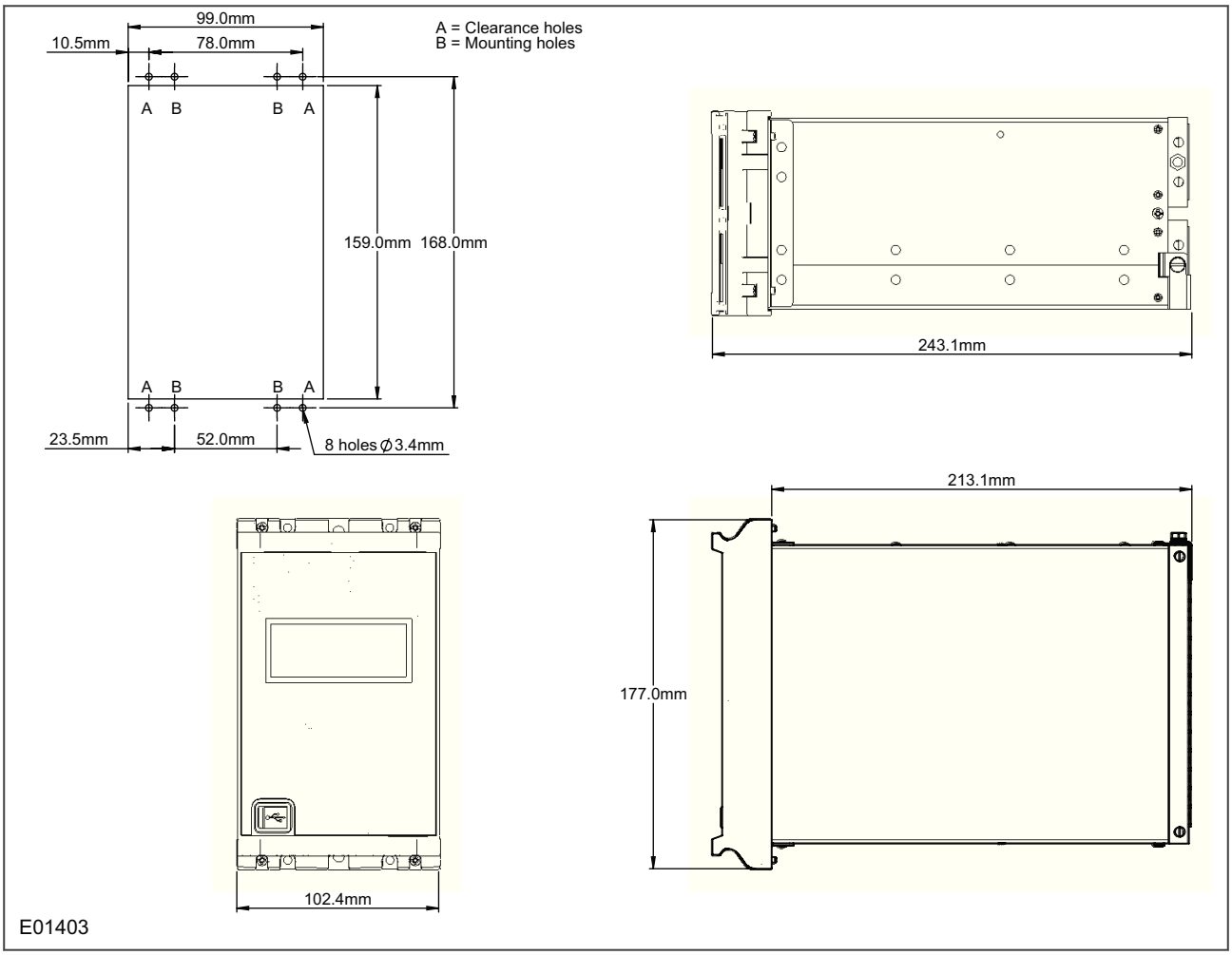


Figure 111: 20TE case dimensions

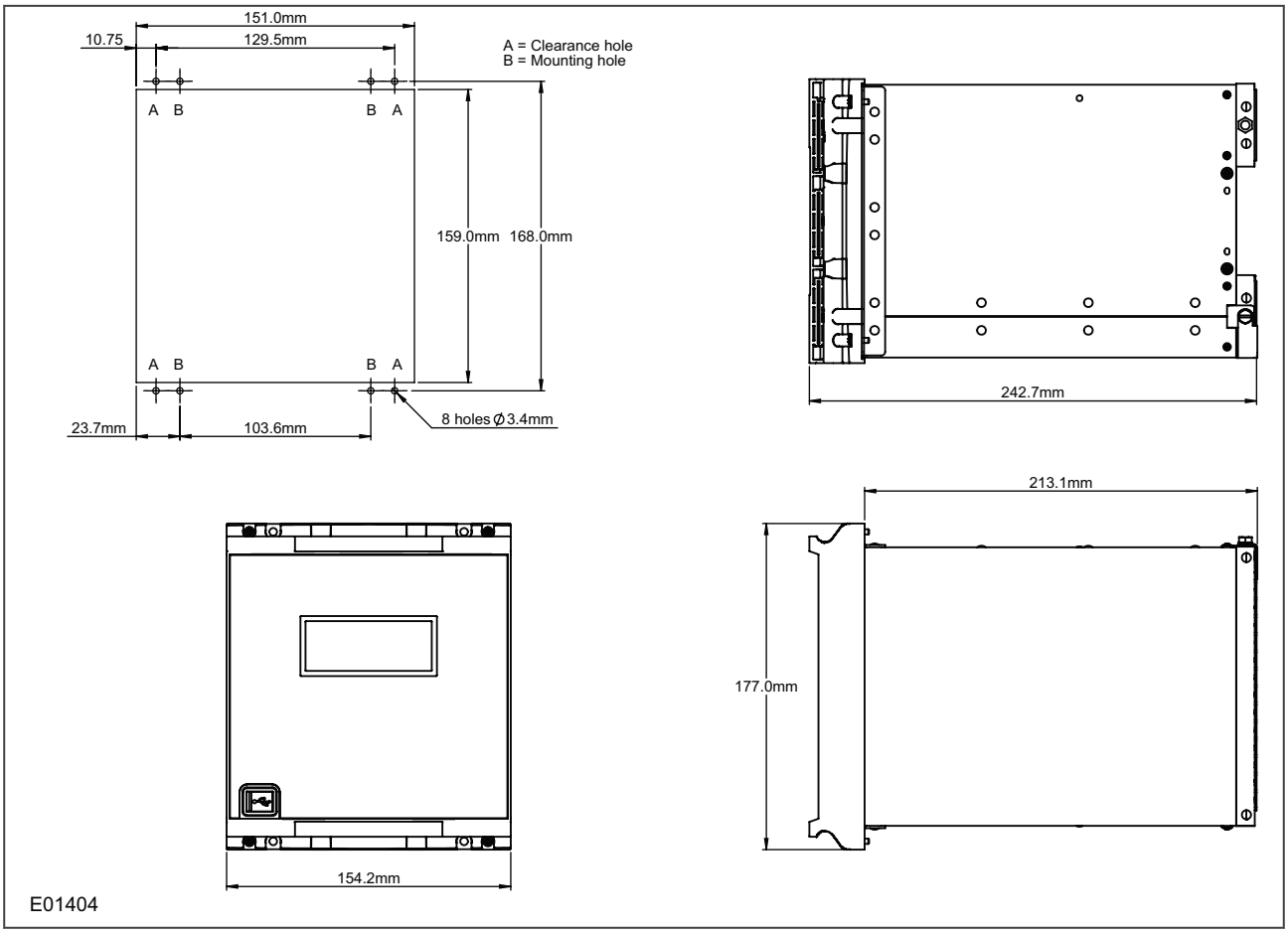


Figure 112: 30TE case dimensions

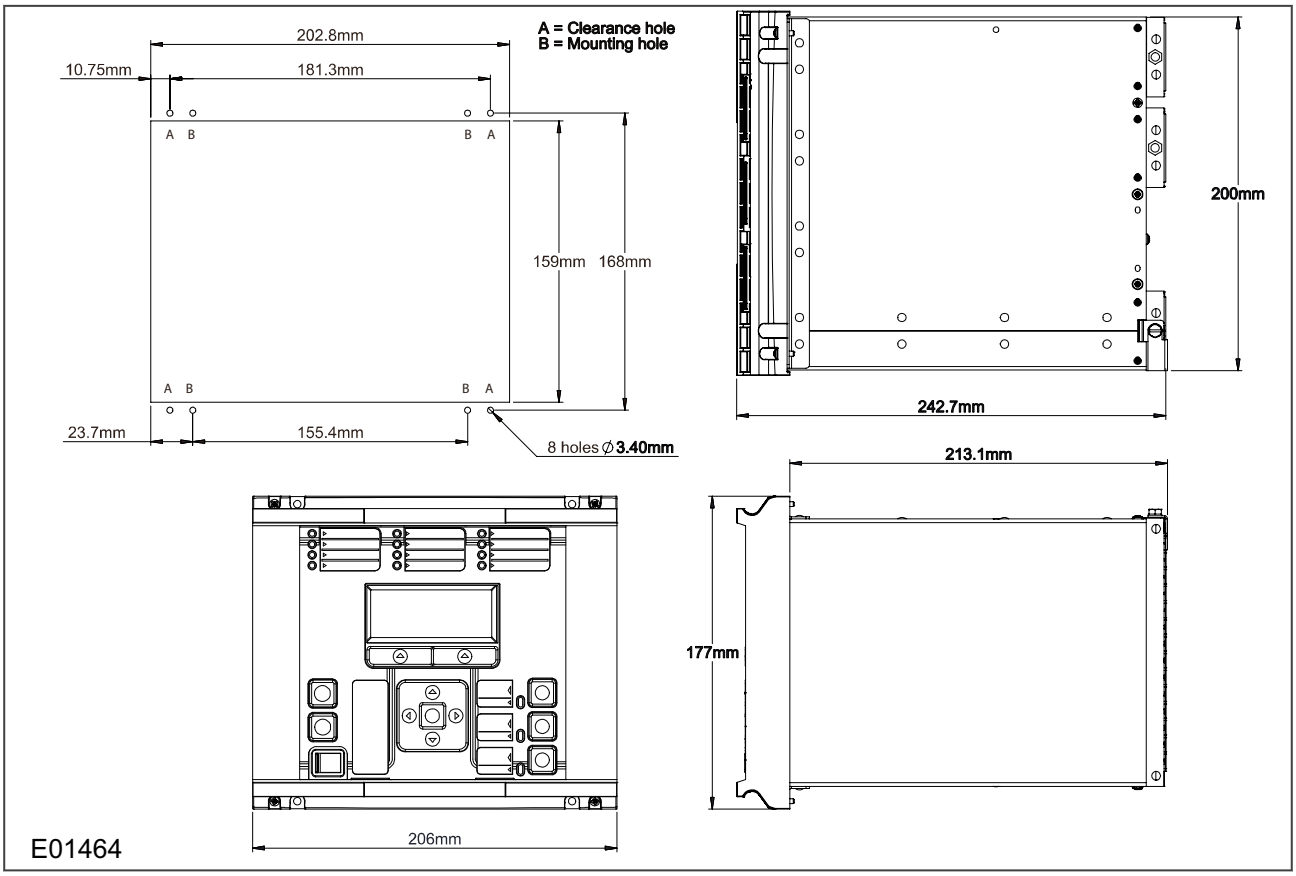


Figure 113: 40TE case dimensions

CHAPTER 15

COMMISSIONING INSTRUCTIONS

1 CHAPTER OVERVIEW

This chapter contains the following sections:

Chapter Overview 307
General Guidelines 308
Commissioning Test Menu 309
Commissioning Equipment 311
Product Checks 313
Setting Checks 319
IEC 61850 Edition 2 Testing 321
Protection Timing Checks 327
Onload Checks 329
Final Checks 330

2 GENERAL GUIDELINES

General Electric IEDs are self-checking devices and will raise an alarm in the unlikely event of a failure. This is why the commissioning tests are less extensive than those for non-numeric electronic devices or electro-mechanical relays.

To commission the devices, you (the commissioning engineer) do not need to test every function. You need only verify that the hardware is functioning correctly and that the application-specific software settings have been applied. You can check the settings by extracting them using the settings application software, or by means of the front panel interface (HMI panel).

The menu language is user-selectable, so you can change it for commissioning purposes if required.

Note:
Remember to restore the language setting to the customer's preferred language on completion.

Caution:
Before carrying out any work on the equipment you should be familiar with the contents of the Safety Section or Safety Guide SFTY/4LM as well as the ratings on the equipment's rating label.

3 COMMISSIONING TEST MENU

The IED provides several test facilities under the *COMMISSION TESTS* menu heading. There are menu cells that allow you to monitor the status of the opto-inputs, output relay contacts, internal Digital Data Bus (DDB) signals and user-programmable LEDs. This section describes these commissioning test facilities.

3.1 OPTO I/P STATUS CELL (OPTO-INPUT STATUS)

This cell can be used to monitor the status of the opto-inputs while they are sequentially energised with a suitable DC voltage. The cell is a binary string that displays the status of the opto-inputs where '1' means energised and '0' means de-energised. If you move the cursor along the binary numbers, the corresponding label text is displayed for each logic input.

3.2 RELAY O/P STATUS CELL (RELAY OUTPUT STATUS)

This cell can be used to monitor the status of the relay outputs. The cell is a binary string that displays the status of the relay outputs where '1' means energised and '0' means de-energised. If you move the cursor along the binary numbers, the corresponding label text is displayed for each relay output.

The cell indicates the status of the output relays when the IED is in service. You can check for relay damage by comparing the status of the output contacts with their associated bits.

> *Note:*
> *When the **Test Mode** cell is set to `Contacts Blocked`, the relay output status indicates which contacts would operate if the IED was in-service. It does not show the actual status of the output relays, as they are blocked.*

3.3 TEST PORT STATUS CELL

This cell displays the status of the DDB signals that have been allocated in the ***Monitor Bit*** cells. If you move the cursor along the binary numbers, the corresponding DDB signal text string is displayed for each monitor bit.

By using this cell with suitable monitor bit settings, the state of the DDB signals can be displayed as various operating conditions or sequences are applied to the IED. This allows you to test the Programmable Scheme Logic (PSL).

3.4 MONITOR BIT 1 TO 8 CELLS

The eight Monitor Bit cells allows you to select eight DDB signals that can be observed in the Test Port Status cell.

Each Monitor Bit cell can be assigned to a particular DDB signal. You set it by entering the required DDB signal number from the list of available DDB signals.

3.5 TEST MODE CELL

This cell allows you to perform secondary injection testing. It also lets you test the output contacts directly by applying menu-controlled test signals.

To go into test mode, select the `Test Mode` option in the ***Test Mode*** cell. This takes the IED out of service causing an alarm condition to be recorded and the ***Out of Service*** LED to illuminate. This also freezes any information stored in the *CB CONDITION* column. In IEC 60870-5-103 versions, it changes the Cause of Transmission (COT) to Test Mode.

In Test Mode, the output contacts are still active. To disable the output contacts you must select the `Contacts Blocked` option.

Once testing is complete, return the device back into service by setting the ***Test Mode*** Cell back to `Disabled`.

Caution:
When the cell is in Test Mode, the Scheme Logic still drives the output relays, which could result in tripping of circuit breakers. To avoid this, set the *Test Mode* cell to *`Contacts Blocked`*.

Note:
`Test mode` and *`Contacts Blocked`* *mode can also be selected by energising an opto-input mapped to the Test Mode signal, and the Contact Block signal respectively.*

3.6 TEST PATTERN CELL

The ***Test Pattern*** cell is used to select the output relay contacts to be tested when the ***Contact Test*** cell is set to *`Apply Test`*. The cell has a binary string with one bit for each user-configurable output contact, which can be set to '1' to operate the output and '0' to not operate it.

3.7 CONTACT TEST CELL

When the *`Apply Test`* command in this cell is issued, the contacts set for operation change state. Once the test has been applied, the command text on the LCD will change to ***No Operation*** and the contacts will remain in the Test state until reset by issuing the *`Remove Test`* command. The command text on the LCD will show ***No Operation*** after the *`Remove Test`* command has been issued.

Note:
*When the **Test Mode** cell is set to `Contacts Blocked` the **Relay O/P Status** cell does not show the current status of the output relays and therefore cannot be used to confirm operation of the output relays. Therefore it will be necessary to monitor the state of each contact in turn.*

3.8 TEST LEDS CELL

When the *`Apply Test`* command in this cell is issued, the user-programmable LEDs illuminate for approximately 2 seconds before switching off, and the command text on the LCD reverts to ***No Operation***.

3.9 RED AND GREEN LED STATUS CELLS

These cells contain binary strings that indicate which of the user-programmable red and green LEDs are illuminated when accessing from a remote location. A '1' indicates that a particular LED is illuminated.

Note:
*When the status in both **Red LED Status** and **Green LED Status** cells is '1', this indicates the LEDs illumination is yellow.*

4 COMMISSIONING EQUIPMENT

Specialist test equipment is required to commission this product. We recognise three classes of equipment for commissioning :

- Recommended
- Essential
- Advisory

Recommended equipment constitutes equipment that is both necessary, and sufficient, to verify correct performance of the principal protection functions.

Essential equipment represents the minimum necessary to check that the product includes the basic expected protection functions and that they operate within limits.

Advisory equipment represents equipment that is needed to verify satisfactory operation of features that may be unused, or supplementary, or which may, for example, be integral to a distributed control/automation scheme. Operation of such features may, perhaps, be more appropriately verified as part of a customer defined commissioning requirement, or as part of a system-level commissioning regime.

4.1 RECOMMENDED COMMISSIONING EQUIPMENT

The minimum recommended equipment is a multifunctional three-phase AC current and voltage injection test set featuring :

- Controlled three-phase AC current and voltage sources,
- Transient (dynamic) switching between pre-fault and post-fault conditions (to generate delta conditions),
- Dynamic impedance state sequencer (capable of sequencing through 4 impedance states),
- Integrated or separate variable DC supply (0 - 250 V)
- Integrated or separate AC and DC measurement capabilities (0-440V AC, 0-250V DC)
- Integrated and/or separate timer,
- Integrated and/or separate test switches.

In addition, you will need :

- A portable computer, installed with appropriate software to liaise with the equipment under test (EUT). Typically this software will be proprietary to the product's manufacturer (for example MiCOM S1 Agile).
- Suitable electrical test leads.
- Electronic or brushless insulation tester with a DC output not exceeding 500 V
- Continuity tester
- Verified application-specific settings files

4.2 ESSENTIAL COMMISSIONING EQUIPMENT

As an absolute minimum, the following equipment is required:

- AC current source coupled with AC voltage source
- Variable DC supply (0 - 250V)
- Multimeter capable of measuring AC and DC current and voltage (0-440V AC, 0-250V DC)
- Timer
- Test switches
- Suitable electrical test leads
- Continuity tester

4.3 ADVISORY TEST EQUIPMENT

Advisory test equipment may be required for extended commissioning procedures:

- Current clamp meter
- Multi-finger test plug:
  - P992 for test block type P991
  - MMLB for test block type MMLG blocks
- Electronic or brushless insulation tester with a DC output not exceeding 500 V
- KITZ K-Bus - EIA(RS)232 protocol converter for testing EIA(RS)485 K-Bus port
- EIA(RS)485 to EIA(RS)232 converter for testing EIA(RS)485 Courier/MODBUS/IEC60870-5-103/DNP3 port
- A portable printer (for printing a setting record from the portable PC) and or writeable, detachable memory device.
- Phase angle meter
- Phase rotation meter
- Fibre-optic power meter.
- Fibre optic test leads (minimum 2). 10m minimum length, multimode 50/125 µm or 62.5µm terminated with BFOC (ST) 2.5 connectors for testing the fibre-optic RP1 port.

5 PRODUCT CHECKS

These product checks are designed to ensure that the device has not been physically damaged prior to commissioning, is functioning correctly and that all input quantity measurements are within the stated tolerances.

If the application-specific settings have been applied to the IED prior to commissioning, you should make a copy of the settings. This will allow you to restore them at a later date if necessary. This can be done by:

- Obtaining a setting file from the customer.
- Extracting the settings from the IED itself, using a portable PC with appropriate setting software.

If the customer has changed the password that prevents unauthorised changes to some of the settings, either the revised password should be provided, or the original password restored before testing.

Note:
If the password has been lost, a recovery password can be obtained from General Electric.

5.1 PRODUCT CHECKS WITH THE IED DE-ENERGISED

Warning:
The following group of tests should be carried out without the auxiliary supply being applied to the IED and, if applicable, with the trip circuit isolated.

The current and voltage transformer connections must be isolated from the IED for these checks. If a P991 test block is provided, the required isolation can be achieved by inserting test plug type P992. This open circuits all wiring routed through the test block.

Before inserting the test plug, you should check the scheme diagram to ensure that this will not cause damage or a safety hazard (the test block may, for example, be associated with protection current transformer circuits). The sockets in the test plug, which correspond to the current transformer secondary windings, must be linked before the test plug is inserted into the test block.

If a test block is not provided, the voltage transformer supply to the IED should be isolated by means of the panel links or connecting blocks. The line current transformers should be short-circuited and disconnected from the IED terminals. Where means of isolating the auxiliary supply and trip circuit (for example isolation links, fuses and MCB) are provided, these should be used. If this is not possible, the wiring to these circuits must be disconnected and the exposed ends suitably terminated to prevent them from being a safety hazard.

5.1.1 VISUAL INSPECTION

Caution:
Check the rating information provided with the device. Check that the IED being tested is correct for the line or circuit.

Carefully examine the IED to see that no physical damage has occurred since installation.

Ensure that the case earthing connections (bottom left-hand corner at the rear of the IED case) are used to connect the IED to a local earth bar using an adequate conductor.

5.1.2 INSULATION

Insulation resistance tests are only necessary during commissioning if explicitly requested.

Isolate all wiring from the earth and test the insulation with an electronic or brushless insulation tester at a DC voltage not exceeding 500 V. Terminals of the same circuits should be temporarily connected together.

The insulation resistance should be greater than 100 MΩ at 500 V.

On completion of the insulation resistance tests, ensure all external wiring is correctly reconnected to the IED.

5.1.3 EXTERNAL WIRING

Caution:
Check that the external wiring is correct according to the relevant IED and scheme diagrams. Ensure that phasing/phase rotation appears to be as expected.

The auxiliary DC voltage supply uses terminals 13 (supply positive) and 14 (supply negative). Unlike the K-series products, the P40Agile series does not provide a field voltage supply. For K-series retrofit applications where pin-to-pin compatibility is required, the equivalent P40 Agile products emulate the field voltage supply by having internal links between pins 7 and 13, and pins 8 and 14, respectively.

5.1.4 WATCHDOG CONTACTS

Using a continuity tester, check that the Watchdog contacts are in the following states:

Terminals	De-energised contact
3 - 5	Closed
4 - 6	Open

5.1.5 POWER SUPPLY

The IED can accept a nominal DC voltage from 24 V DC to 250 V DC, or a nominal AC voltage from 110 V AC to 240 V AC at 50 Hz or 60 Hz. Ensure that the power supply is within this operating range. The power supply must be rated at 12 Watts or more.

Warning:
Do not energise the IED or interface unit using the battery charger with the battery disconnected as this can irreparably damage the power supply circuitry.

Caution:
Energise the IED only if the auxiliary supply is within the specified operating ranges. If a test block is provided, it may be necessary to link across the front of the test plug to connect the auxiliary supply to the IED.

5.2 PRODUCT CHECKS WITH THE IED ENERGISED

Warning:
The current and voltage transformer connections must remain isolated from the IED for these checks. The trip circuit should also remain isolated to prevent accidental operation of the associated circuit breaker.

The following group of tests verifies that the IED hardware and software is functioning correctly and should be carried out with the supply applied to the IED.

5.2.1 WATCHDOG CONTACTS

Using a continuity tester, check that the Watchdog contacts are in the following states:

Terminals	Energised contact
3 - 5	Open
4 - 6	Closed

5.2.2 TEST LCD

The Liquid Crystal Display (LCD) is designed to operate in a wide range of substation ambient temperatures. For this purpose, the IEDs have an ***LCD Contrast*** setting. The contrast is factory pre-set, but it may be necessary to adjust the contrast to give the best in-service display.

To change the contrast, you can increment or decrement the ***LCD Contrast*** cell in the *CONFIGURATION* column.

Caution:
Before applying a contrast setting, make sure that it will not make the display so light or dark such that menu text becomes unreadable. It is possible to restore the visibility of a display by downloading a setting file, with the LCD Contrast set within the typical range of 7 - 11.

5.2.3 DATE AND TIME

The date and time is stored in non-volatile memory. If the values are not already correct, set them to the correct values. The method of setting will depend on whether accuracy is being maintained by the IRIG-B port or by the IED's internal clock.

When using IRIG-B to maintain the clock, the IED must first be connected to the satellite clock equipment (usually an RT430), which should be energised and functioning.

1. Set the IRIG-B Sync cell in the *DATE AND TIME* column to `Enabled`.
2. Ensure the IED is receiving the IRIG-B signal by checking that cell IRIG-B Status reads `Active`.
3. Once the IRIG-B signal is active, adjust the time offset of the universal co coordinated time (satellite clock time) on the satellite clock equipment so that local time is displayed.
4. Check that the time, date and month are correct in the Date/Time cell. The IRIG-B signal does not contain the current year so it will need to be set manually in this cell.
5. Reconnect the IRIG-B signal.

If the time and date is not being maintained by an IRIG-B signal, ensure that the IRIG-B Sync cell in the *DATE AND TIME* column is set to `Disabled`.

1. Set the date and time to the correct local time and date using Date/Time cell or using the serial protocol.

5.2.4 TEST LEDS

On power-up, all LEDs should first flash yellow. Following this, the green "Healthy" LED should illuminate indicating that the device is healthy.

The IED's non-volatile memory stores the states of the alarm, the trip, and the user-programmable LED indicators (if configured to latch). These indicators may also illuminate when the auxiliary supply is applied.

If any of these LEDs are ON then they should be reset before proceeding with further testing. If the LEDs successfully reset (the LED goes off), no testing is needed for that LED because it is obviously operational.

5.2.5 TEST ALARM AND OUT-OF-SERVICE LEDS

The alarm and out of service LEDs can be tested using the *COMMISSION TESTS* menu column.

1. Set the ***Test Mode*** cell to `Contacts Blocked`.
2. Check that the out of service LED illuminates continuously and the alarm LED flashes.

It is not necessary to return the ***Test Mode*** cell to `Disabled` at this stage because the test mode will be required for later tests.

5.2.6 TEST TRIP LED

The trip LED can be tested by initiating a manual circuit breaker trip. However, the trip LED will operate during the setting checks performed later. Therefore no further testing of the trip LED is required at this stage.

5.2.7 TEST USER-PROGRAMMABLE LEDS

To test these LEDs, set the Test LEDs cell to `Apply Test`. Check that all user-programmable LEDs illuminate.

5.2.8 TEST OPTO-INPUTS

This test checks that all the opto-inputs on the IED are functioning correctly.

The opto-inputs should be energised one at a time. For terminal numbers, please see the external connection diagrams in the "Wiring Diagrams" chapter. Ensuring correct polarity, connect the supply voltage to the appropriate terminals for the input being tested.

The status of each opto-input can be viewed using either the ***Opto I/P Status*** cell in the *SYSTEM DATA* column, or the ***Opto I/P Status*** cell in the *COMMISSION TESTS* column.

A '1' indicates an energised input and a '0' indicates a de-energised input. When each opto-input is energised, one of the characters on the bottom line of the display changes to indicate the new state of the input.

5.2.9 TEST OUTPUT RELAYS

This test checks that all the output relays are functioning correctly.

1. Ensure that the IED is still in test mode by viewing the ***Test Mode*** cell in the *COMMISSION TESTS* column. Ensure that it is set to `Contacts Blocked`.
2. The output relays should be energised one at a time. To select output relay 1 for testing, set the Test Pattern cell as appropriate.
3. Connect a continuity tester across the terminals corresponding to output relay 1 as shown in the external connection diagram.
4. To operate the output relay set the Contact Test cell to `Apply Test`.
5. Check the operation with the continuity tester.
6. Measure the resistance of the contacts in the closed state.
7. Reset the output relay by setting the Contact Test cell to `Remove Test`.
8. Repeat the test for the remaining output relays.
9. Return the IED to service by setting the Test Mode cell in the *COMMISSION TESTS* menu to `Disabled`.

5.2.10 TEST SERIAL COMMUNICATION PORT RP1

You need only perform this test if the IED is to be accessed from a remote location with a permanent serial connection to the communications port. The scope of this test does not extend to verifying operation with connected equipment beyond any supplied protocol converter. It verifies operation of the rear communication port (and if applicable the protocol converter) and varies according to the protocol fitted.

5.2.10.1 CHECK PHYSICAL CONNECTIVITY

The rear communication port RP1 is presented on terminals 54 and 56. Screened twisted pair cable is used to make a connection to the port. The cable screen should be connected to the earth link just below pin 56:

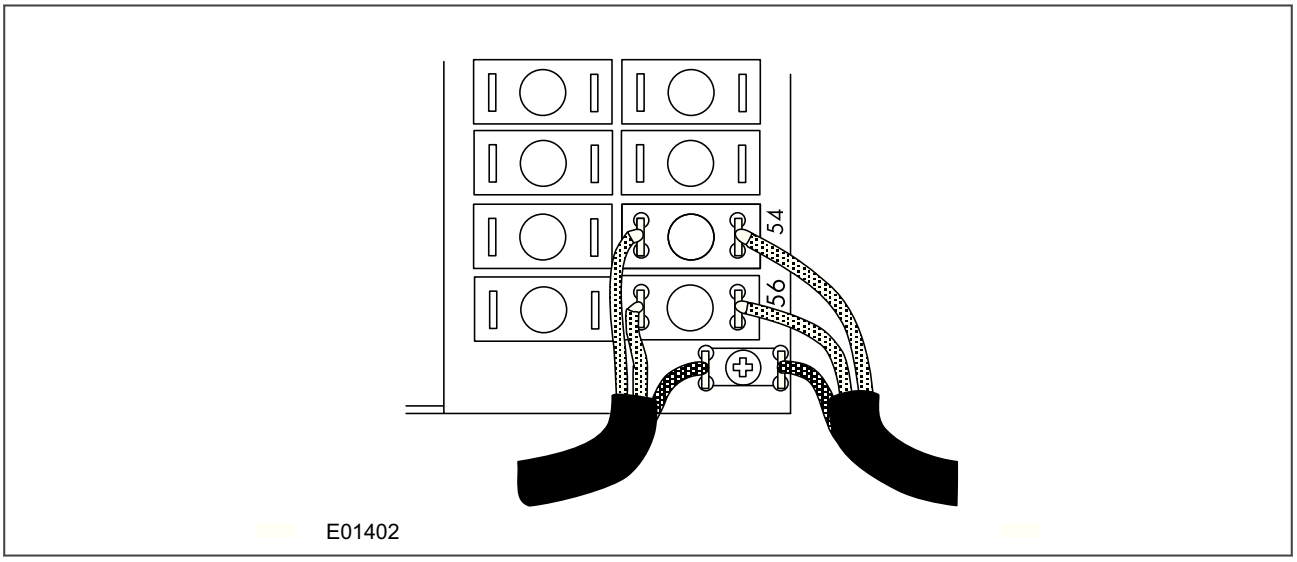


Figure 114: RP1 physical connection

For K-Bus applications, pins 54 and 56 are not polarity sensitive and it does not matter which way round the wires are connected. EIA(RS)485 is polarity sensitive, so you must ensure the wires are connected the correct way round (pin 54 is positive, pin 56 is negative).

If K-Bus is being used, a Kitz protocol converter (KITZ101, KITZ102 OR KITZ201) will have been installed to convert the K-Bus signals into RS232. Likewise, if RS485 is being used, an RS485-RS232 converter will have been installed. In the case where a protocol converter is being used, a laptop PC running appropriate software (such as MiCOM S1 Agile) can be connected to the incoming side of the protocol converter. An example for K-bus to RS232 conversion is shown below. RS485 to RS232 would follow the same principle, only using a RS485-RS232 converter. Most modern laptops have USB ports, so it is likely you will also require a RS232 to USB converter too.

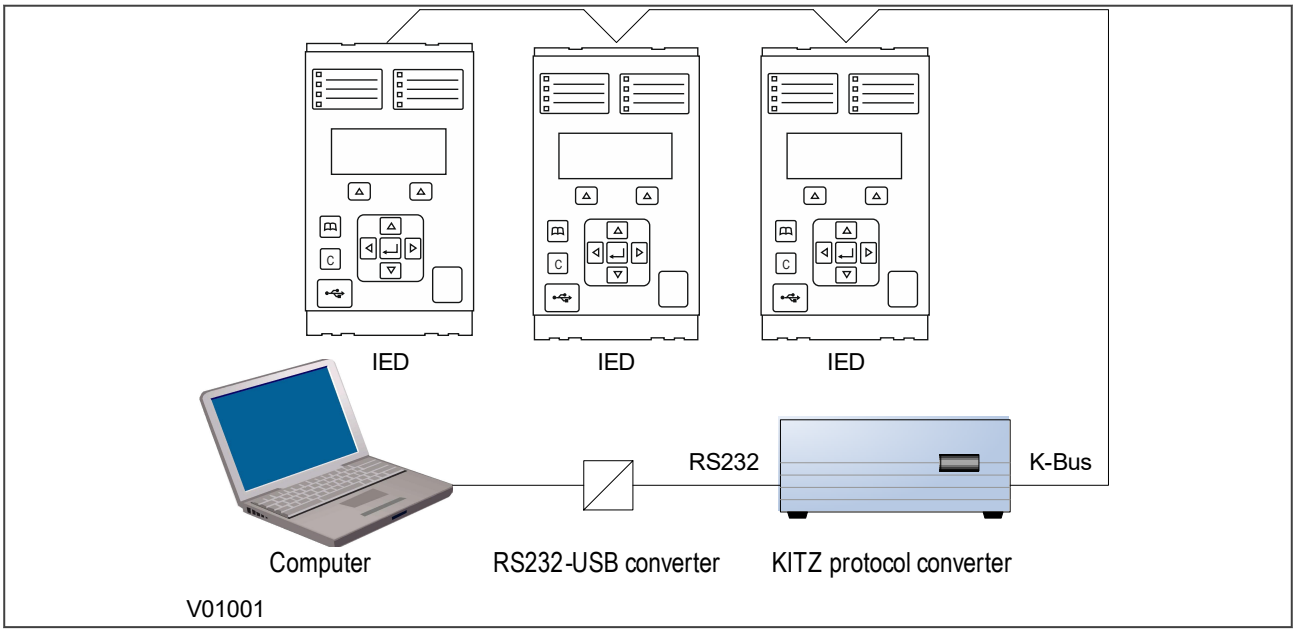


Figure 115: Remote communication using K-bus

5.2.10.2 CHECK LOGICAL CONNECTIVITY

The logical connectivity depends on the chosen data protocol, but the principles of testing remain the same for all protocol variants:

1. Ensure that the communications baud rate and parity settings in the application software are set the same as those on the protocol converter.
2. For Courier models, ensure that you have set the correct RP1 address
3. Check that communications can be established with this IED using the portable PC/Master Station.

5.2.11 TEST SERIAL COMMUNICATION PORT RP2

RP2 is only available on selected models. If applicable, this test is the same as for RP1 only the relevant terminals are 82 and 84.

5.2.12 TEST ETHERNET COMMUNICATION

For products that employ Ethernet communications, we recommend that testing be limited to a visual check that the correct ports are fitted and that there is no sign of physical damage.

If there is no board fitted or the board is faulty, a NIC link alarm will be raised (providing this option has been set in the ***NIC Link Report*** cell in the *COMMUNICATIONS* column).

5.2.13 TEST VOLTAGE INPUTS

This test verifies that the voltage measurement inputs are configured correctly.

1. Apply rated voltage to each voltage transformer input in turn
2. Check its magnitude using a multimeter or test set readout. The corresponding reading can then be checked in the *MEASUREMENTS 1* column.
3. Record the value displayed. The measured voltage values will either be in primary or secondary Volts. If the Local Values cell in the *MEASURE'T SETUP* column is set to `Primary`, the values displayed should be equal to the applied voltage multiplied by the corresponding voltage transformer ratio (set in the *CT AND VT RATIOS* column) as shown below. If the Local Values cell is set to `Secondary`, the value displayed should be equal to the applied voltage.

Caution:
If a PC connected to the IED using the rear communications port is being used to display the measured current, the process will be similar. However, the setting of the Remote Values cell in the *MEASURE'T SETUP* column will determine whether the displayed values are in primary or secondary Amperes.

Cell in MEASUREMENTS 1	Corresponding VT ratio (in *CT AND VT RATIOS* column)
VAN magnitude VBN magnitude VCN magnitude	Main VT Primary / Main VT Sec'y
4th VT Voltage Mag	4th VT Primary / 4th VT Secondary

6 SETTING CHECKS

The setting checks ensure that all of the application-specific settings (both the IED's function and programmable scheme logic settings) have been correctly applied.

> *Note:*
> *If applicable, the trip circuit should remain isolated during these checks to prevent accidental operation of the associated circuit breaker.*

6.1 APPLY APPLICATION-SPECIFIC SETTINGS

There are two different methods of applying the settings to the IED

- Transferring settings to the IED from a pre-prepared setting file using MiCOM S1 Agile
- Enter the settings manually using the IED's front panel HMI

6.1.1 TRANSFERRING SETTINGS FROM A SETTINGS FILE

This is the preferred method for transferring function settings. It is much faster and there is a lower margin for error.

1. Connect a PC running the Settings Application Software to the IED's front port, or a rear Ethernet port. Alternatively connect to the rear Courier communications port, using a KITZ protocol converter if necessary.
2. Power on the IED
3. Enter the IP address of the device if it is Ethernet enabled
4. Right-click the appropriate device name in the System Explorer pane and select **Send**
5. In the **Send to** dialog select the setting files and click **Send**

> *Note:*
> *The device name may not already exist in the system shown in **System Explorer**. In this case, perform a **Quick Connect** to the IED, then manually add the settings file to the device name in the system. Refer to the Settings Application Software help for details of how to do this.*

6.1.2 ENTERING SETTINGS USING THE HMI

1. Starting at the default display, press the Down cursor key to show the first column heading.
2. Use the horizontal cursor keys to select the required column heading.
3. Use the vertical cursor keys to view the setting data in the column.
4. To return to the column header, either press the Up cursor key for a second or so, or press the **Cancel** key once. It is only possible to move across columns at the column heading level.
5. To return to the default display, press the Up cursor key or the Cancel key from any of the column headings. If you use the auto-repeat function of the Up cursor key, you cannot go straight to the default display from one of the column cells because the auto-repeat stops at the column heading.
6. To change the value of a setting, go to the relevant cell in the menu, then press the **Enter** key to change the cell value. A flashing cursor on the LCD shows that the value can be changed. You may be prompted for a password first.
7. To change the setting value, press the vertical cursor keys. If the setting to be changed is a binary value or a text string, select the required bit or character to be changed using the left and right cursor keys.

8. Press the **Enter** key to confirm the new setting value or the **Clear** key to discard it. The new setting is automatically discarded if it is not confirmed within 15 seconds.
9. For protection group settings and disturbance recorder settings, the changes must be confirmed before they are used. When all required changes have been entered, return to the column heading level and press the down cursor key. Before returning to the default display, the following prompt appears.

```
Update settings?
ENTER or CLEAR
```

10. Press the **Enter** key to accept the new settings or press the **Clear** key to discard the new settings.

Note:
If the menu time-out occurs before the setting changes have been confirmed, the setting values are also discarded.
Control and support settings are updated immediately after they are entered, without the Update settings prompt.
It is not possible to change the PSL using the IED's front panel HMI.

Caution:
Where the installation needs application-specific PSL, the relevant .psl files, must be transferred to the IED, for each and every setting group that will be used. If you do not do this, the factory default PSL will still be resident. This may have severe operational and safety consequences.

7 IEC 61850 EDITION 2 TESTING

7.1 USING IEC 61850 EDITION 2 TEST MODES

In a conventional substation, functionality typically resides in a single device. It is usually easy to physically isolate these functions, as the hardwired connects can simply be removed. Within a digital substation architecture however, functions may be distributed across many devices. This makes isolation of these functions difficult, because there are no physical wires that can be disconnected on a Ethernet network. Logical isolation of the various functions is therefore necessary.

With devices that support IEC 61850 Edition 2, it is possible to use a test mode to conduct online testing, which helps with the situation. The advantages of this are as follows:

- The device can be placed into a test mode, which can disable the relay outputs when testing the device with test input signals.
- Specific protection and control functions can be logically isolated.
- GOOSE messages can be tagged so that receiving devices can recognise they are test signals.
- An IED receiving simulated GOOSE or Sampled Value messages from test devices can differentiate these from normal process messages, and be configured to respond appropriately.

7.1.1 IED TEST MODE BEHAVIOUR

IEC 61850 Edition 2 defines how the IED responds to test messages in the IED test modes, and whether the relay output contacts are activated or not.

You can select the mode of operation of the P40 IED by:

- Using the front panel HMI, with the setting ***IED Test Mode*** under the *COMMISSION TESTS* column.
- Using an IEC 61850 MMS control service to ***System/LLN0.Mod***
- Using an opto-input via PSL with the signal ***Block Contacts***

The following table summarises the P40 IED behaviour under the different modes:

IED Test Mode Setting	IEC 61850 Mod	Result
Disabled	on	• Normal IED behaviour • IED only responds to incoming GOOSE and SV messages with quality q.test = false
Test	test	• Protection remains enabled • IED responds to incoming GOOSE and SV messages with both quality q.test = true and q.test = false • Relay output contacts are still active • IEC 61850 message outputs have 'quality' q.test = true • IED responds to incoming IEC 61850 MMS messages with only quality q.test = true
Contacts Blocked	test/blocked	• Protection remains enabled • IED responds to incoming GOOSE and SV messages with both quality q.test = true and q.test = false • Relay output contacts are disabled • IEC 61850 message outputs have quality q.test = true • IED responds to incoming IEC 61850 MMS messages with only quality q.test = true

Setting the Test or Contacts Blocked mode puts the whole IED into test mode. The IEC 61850 data object ***Beh*** in all Logical Nodes (except LPHD and any protection Logical Nodes that have Beh = 5 (off) due to the function being disabled) will be set to 3 (test) or 4 (test/blocked) as applicable.

7.2 SIMULATED INPUT BEHAVIOUR

Simulated GOOSE messages can be used during testing.

The ***Subscriber Sim*** setting in the *COMMISSION TESTS* column controls whether a device listens to simulated signals or to real ones. An IEC 61850 control service to System/LPHD.Sim can also be used to change this value.

The device may be presented with both real signals and test signals. An internal state machine is used to control how the device switches between signals:

- The IED will continue subscribing to the 'real' GOOSE1 (in green) until it receives the first simulated GOOSE 1 (in red). This will initiate subscription changeover.
- After changeover to this new state, the IED will continue to subscribe to the simulated GOOSE 1 message (in red). Even if this simulated GOOSE 1 message disappears, the real GOOSE 1 message (in green) will still not be processed. This means all Virtual Inputs derived from the GOOSE 1 message will go to their default state.
- The only way to bring the IED out of this state is to set the ***Subscriber Sim*** setting back to False. The IED will then immediately stop processing the simulated messages and start processing real messages again.
- During above steps, IED1 will continuously process the real GOOSE 2 and GOOSE 3 messages as normal because it has not received any simulated messages for these that would initiate a changeover.

The process is represented in the following figure:

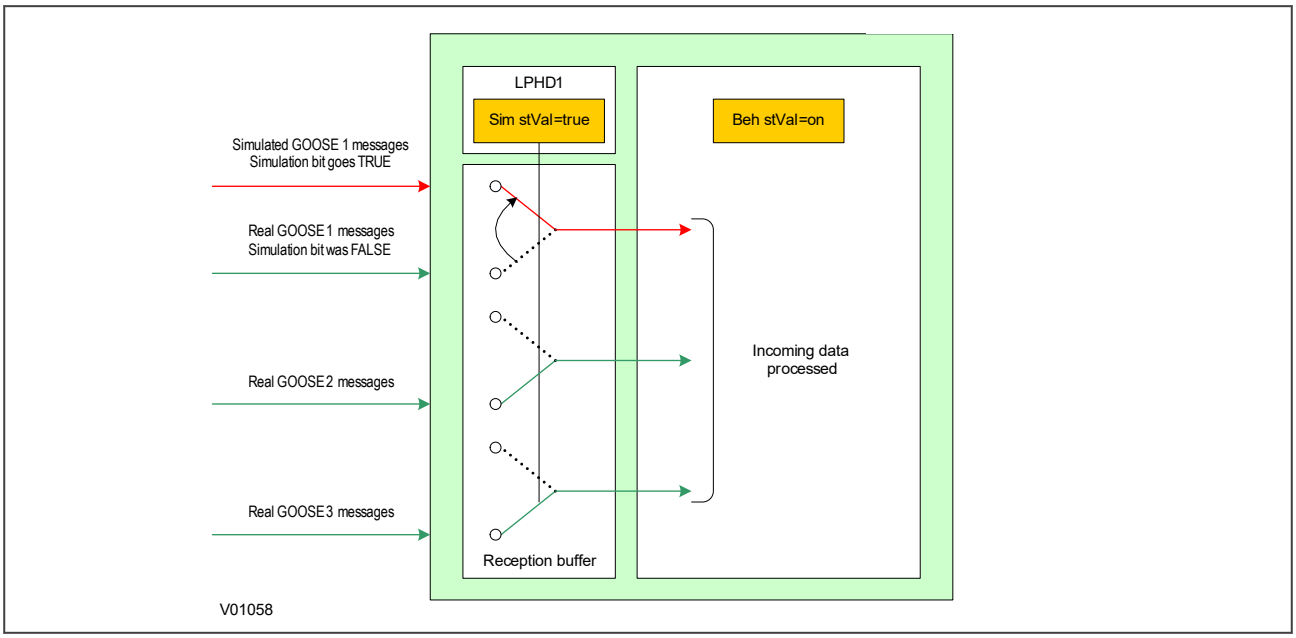


Figure 116: Simulated input behaviour

7.3 TESTING EXAMPLES

These examples show how you test the IED with and without simulated values. Depending on the IED Test Mode, it may respond by operating plant (for example by tripping the circuit breaker) or it may not operate plant.

7.3.1 TEST PROCEDURE FOR REAL VALUES

This procedure is for testing with real values without operating plant.

1. Set device into 'Contacts Blocked' Mode
   Select *COMMISSION TESTS* → ***IED Test Mode*** → `Contacts Blocked`
2. Confirm new behaviour has been enabled
   View *COMMISSION TESTS* → ***IED Mod/Beh***, and check that it shows `Test-blocked`
3. Ensure the device Simulation Listening Mode is disabled
   Select *COMMISSION TESTS* → ***Subscriber Sim*** = `Disabled`
4. Inject real GOOSE signals using a test device. The device will continue to listen to 'real' GOOSE messages and ignore simulated messages received.
5. Verify function based on test signal outputs
   Binary outputs (e.g. CB trips) will not operate. All transmitted GOOSE and MMS data items will be tagged with the 'quality' parameter set to 'test', so that the receiver understands that they have been issued by a device under test and can respond accordingly. This is summarised in the following diagram

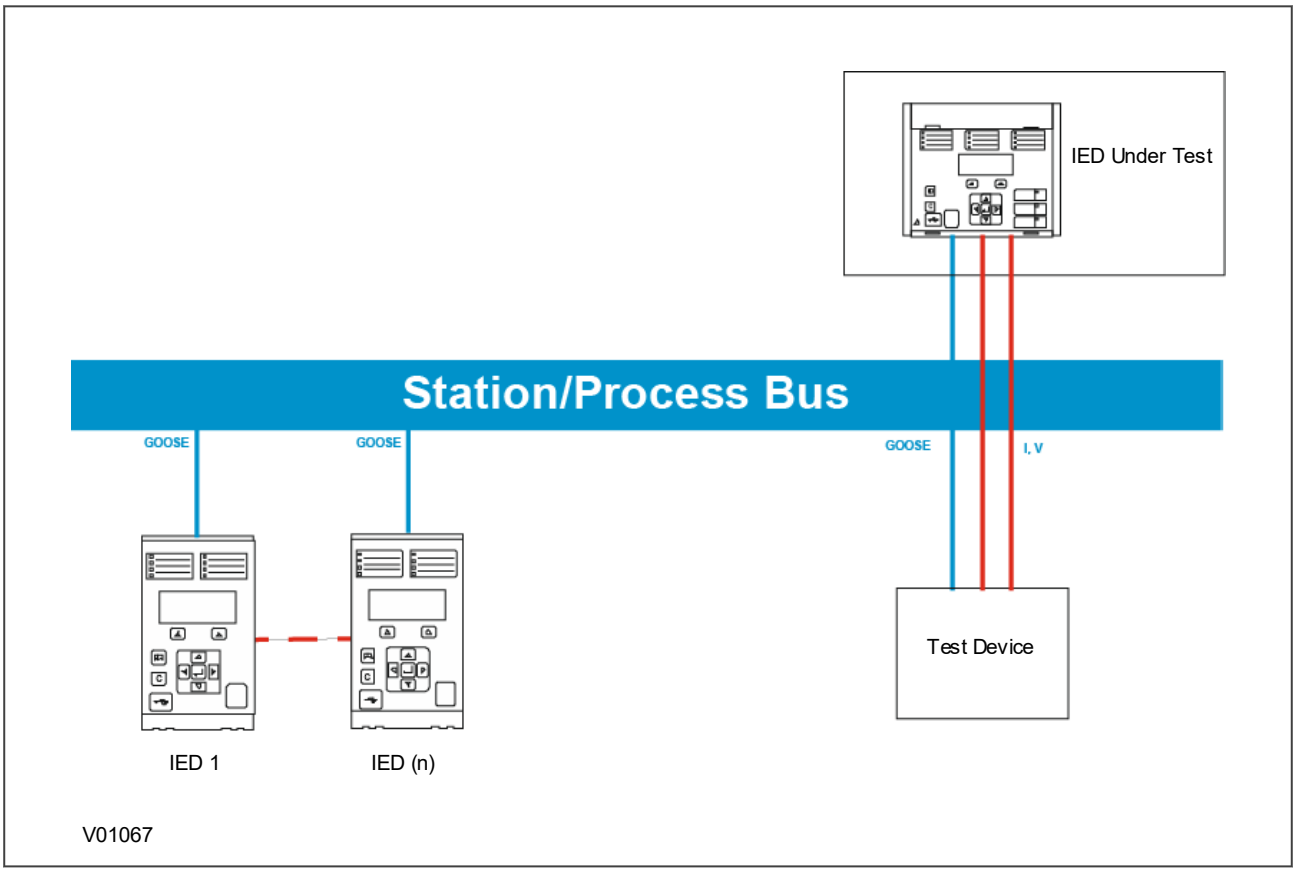


Figure 117: Test example 1

7.3.2 TEST PROCEDURE FOR SIMULATED VALUES - NO PLANT

This procedure is for testing with simulated values without operating plant.

1. Set device into 'Contacts Blocked' Mode
   Select *COMMISSION TESTS* → ***IED Test Mode*** → `Contacts Blocked`
2. Confirm new behaviour has been enabled
   View *COMMISSION TESTS* → ***IED Mod/Beh***, and check that it shows `test-blocked`

3. Set device into Simulation Listening Mode

   Select *COMMISSION TESTS* → ***Subscriber Sim*** = *Enabled*

4. Inject simulated GOOSE signals using a test device connected to the Ethernet network. The device will continue to listen to 'real' GOOSE messages until a simulated message is received. Once the simulated messages are received, the corresponding 'real' messages are ignored until the device is taken out of test mode. Each message is treated separately.

5. Verify function based on test signal outputs

   Binary outputs (e.g. CB trips) will not operate. All transmitted GOOSE and MMS data items will be tagged with the 'quality' parameter set to 'test', so that the receiver understands that they have been issued by a device under test and can respond accordingly. This is summarised in the following diagram

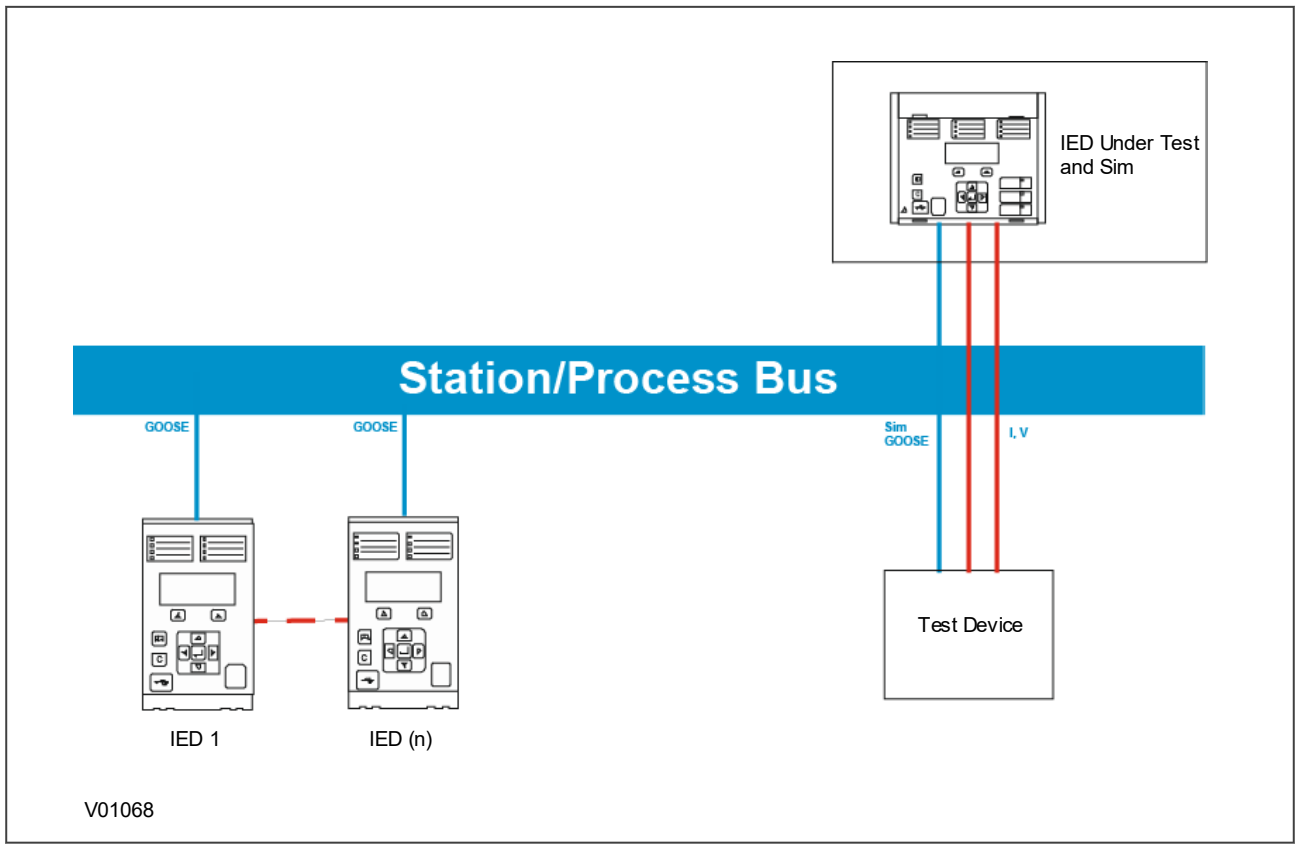


Figure 118: Test example 2

7.3.3 TEST PROCEDURE FOR SIMULATED VALUES - WITH PLANT

This procedure is for testing with simulated values with operating plant.

1. Set device into 'Contacts Blocked' Mode

   Select *COMMISSION TESTS* → ***IED Test Mode*** → *Test*

2. Confirm new behaviour has been enabled

   View *COMMISSION TESTS* → ***IED Mod/Beh***, and check that it shows *Test*

3. Set device into Simulation Listening Mode

   Select *COMMISSION TESTS* → ***Subscriber Sim*** = *Enabled*

4. Inject simulated GOOSE signals using a test device connected to the Ethernet network.

   The device will continue to listen to 'real' GOOSE messages until a simulated message is received. Once the simulated messages are received, the corresponding 'real' messages are ignored until the device is taken out of IED test mode. Each message is treated separately, but sampled values are considered as a single message.

5. Verify function based on test signal outputs.

   Binary outputs (e.g. CB trips) will operate as normal. All transmitted GOOSE and MMS data items will be tagged with the 'quality' parameter set to 'test', so that the receiver understands that they have been issued by a device under test and can respond accordingly. This is summarised in the following diagram:

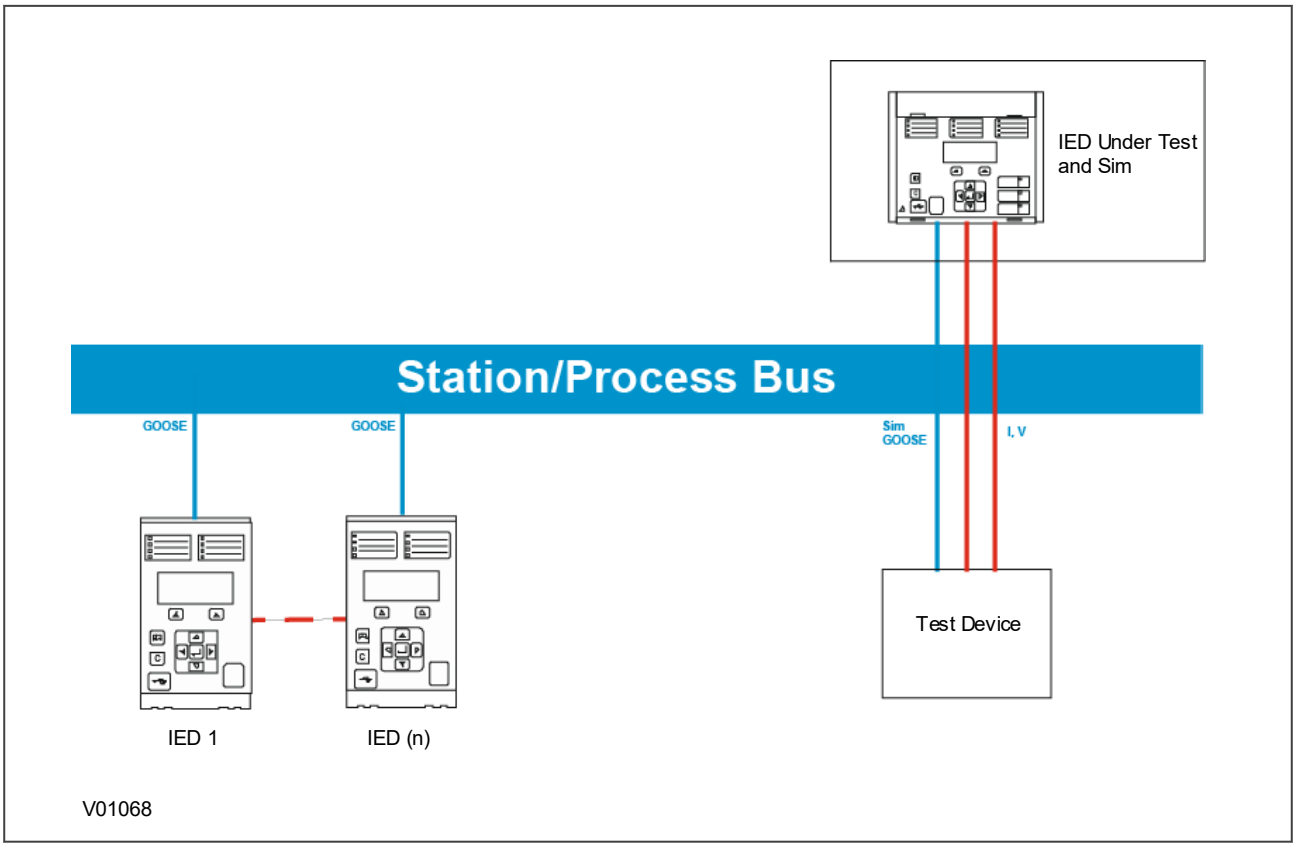


Figure 119: Test example 3

7.3.4 CONTACT TEST

The ***Apply Test*** command in this cell is used to change the state of the contacts set for operation.

If the device has been put into 'Contact Blocked' mode using an input signal (via the ***Block Contacts*** DDB signal) then the ***Apply Test*** command will not execute. This is to prevent a device that has been blocked by an external process having its contacts operated by a local operator using the HMI.

If the ***Block Contacts*** DDB is not set and the ***Apply Test*** command in this cell is issued, contacts change state and the command text on the LCD changes to *No Operation*. The contacts remain in the Test state until reset by issuing the ***Remove Test*** command. The command text on the LCD shows *No Operation* after the ***Remove Test*** command has been issued.

Note:
*When the **IED Test Mode** cell is set to Contacts Blocked, the **Relay O/P Status** cell does not show the current status of the output relays so cannot be used to confirm operation of the output relays. Therefore it is necessary to monitor the state of each contact in turn.*

8 PROTECTION TIMING CHECKS

There is no need to check every protection function. Only one protection function needs to be checked as the purpose is to verify the timing on the processor is functioning correctly.

8.1 UNDERVOLTAGE CHECK

If the undervoltage protection function is being used, one of the relevant V<(n) stages should be tested.

1. In the *CONFIGURATION* column, disable all protection elements other than the one being tested.
2. Make a note of which elements need to be re-enabled after testing.
3. Connect the test circuit
4. Perform the test
5. Check the Operating time

8.2 CONNECTING THE TEST CIRCUIT

1. Use the PSL to determine which output relay will operate when an undervoltage trip occurs.
2. Use the output relay assigned to ***Trip Output A***.
3. Use the PSL to map the protection stage under test directly to an output relay.

> *Note:*
> *If using the default PSL, use output relay 3 as this is already mapped to the DDB signal* ***Trip Command Out****.*

4. Connect the output relay so that its operation will trip the test set and stop the timer.
5. Connect the voltage output of the test set to the A-phase voltage transformer input.
6. Ensure that the timer starts when the voltage is applied.

8.3 PERFORMING THE TEST

1. Ensure that the setting ***V< Operate Mode*** in the *VOLT PROTECTION* column is set to *ANY PHASE*.
2. Ensure that the timer is reset.
3. Apply a voltage of half the setting shown in the ***V<1 Voltage Set*** cell under the *UNDERVOLTAGE* heading column in the *VOLT PROTECTION* column.
4. Note the time displayed when the timer stops.
5. Check that the red trip LED has illuminated.

8.4 CHECK THE OPERATING TIME

Check that the operating time recorded satisfies the equation t = K/(1-M), where:

- K = Time Multiplier setting
- t = operating time
- M = derived residual voltage setting (***VN< voltage set***)

For all characteristics, allowance must be made for the accuracy of the test equipment being used.

> *Note:*
> *For definite time and inverse characteristics there is an additional delay of up to 0.02 second and 0.08 second respectively. You may need to add this the IED's acceptable range of operating times.*

Caution:
On completion of the tests, you must restore all settings that were disabled for testing purposes.

9 ONLOAD CHECKS

The objectives of the on-load checks are to:

- Confirm the external wiring to the voltage inputs is correct
- Check the phase rotation
- Check the magnitudes of the phase voltages and the check synchronisation voltage

These checks can only be carried out if there are no restrictions preventing the energisation of the plant, and the other devices in the group have already been commissioned.

Remove all test leads and temporary shorting links, then replace any external wiring that has been removed to allow testing.

Warning:
If any external wiring has been disconnected for the commissioning process, replace it in accordance with the relevant external connection or scheme diagram.

9.1 CONFIRM VOLTAGE CONNECTIONS

1. Using a multimeter, measure the voltage transformer secondary voltages to ensure they are correctly rated.
2. Check that the system phase rotation is correct using a phase rotation meter.
3. Compare the values of the secondary phase voltages with the measured values, which can be found in the *MEASUREMENTS 1* menu column.

Cell in MEASUREMENTS 1 Column	Corresponding VT ratio in CT AND VT RATIOS column
VAB Magnitude ***VBC Magnitude*** ***VCA Magnitude*** ***VAN Magnitude*** ***VBN Magnitude*** ***VCN Magnitude***	Main VT Primary / Main VT Sec'y
C/S Voltage Mag.	4th VT Primary / 4th VT Secondary

If the ***Local Values*** cell is set to `Secondary`, the values displayed should be equal to the applied secondary voltage. The values should be within 1% of the applied secondary voltages. However, an additional allowance must be made for the accuracy of the test equipment being used.

If the ***Local Values*** cell is set to `Primary`, the values displayed should be equal to the applied secondary voltage multiplied the corresponding voltage transformer ratio set in the *CT AND VT RATIOS* column. The values should be within 1% of the expected values, plus an additional allowance for the accuracy of the test equipment being used.

10 FINAL CHECKS

1. Remove all test leads and temporary shorting leads.
2. If you have had to disconnect any of the external wiring in order to perform the wiring verification tests, replace all wiring, fuses and links in accordance with the relevant external connection or scheme diagram.
3. The settings applied should be carefully checked against the required application-specific settings to ensure that they are correct, and have not been mistakenly altered during testing.
4. Ensure that all protection elements required have been set to *Enabled* in the *CONFIGURATION* column.
5. Ensure that the IED has been restored to service by checking that the ***Test Mode*** cell in the *COMMISSION TESTS* column is set to *Disabled*.
6. If the IED is in a new installation or the circuit breaker has just been maintained, the circuit breaker maintenance and current counters should be zero. These counters can be reset using the ***Reset All Values*** cell. If the required access level is not active, the device will prompt for a password to be entered so that the setting change can be made.
7. If the menu language has been changed to allow accurate testing it should be restored to the customer's preferred language.
8. If a P991/MMLG test block is installed, remove the P992/MMLB test plug and replace the cover so that the protection is put into service.
9. Ensure that all event records, fault records, disturbance records, alarms and LEDs and communications statistics have been reset.

Note:
Remember to restore the language setting to the customer's preferred language on completion.

CHAPTER 16

MAINTENANCE AND TROUBLESHOOTING

1 CHAPTER OVERVIEW

The Maintenance and Troubleshooting chapter provides details of how to maintain and troubleshoot products based on the Px4x and P40Agile platforms. Always follow the warning signs in this chapter. Failure to do so may result injury or defective equipment.

Caution:
Before carrying out any work on the equipment you should be familiar with the contents of the Safety Section or the Safety Guide SFTY/4LM and the ratings on the equipment's rating label.

The troubleshooting part of the chapter allows an error condition on the IED to be identified so that appropriate corrective action can be taken.

If the device develops a fault, it is usually possible to identify which module needs replacing. It is not possible to perform an on-site repair to a faulty module.

If you return a faulty unit or module to the manufacturer or one of their approved service centres, you should include a completed copy of the Repair or Modification Return Authorization (RMA) form.

This chapter contains the following sections:

Chapter Overview 333
Maintenance 334
Troubleshooting 336

2 MAINTENANCE

2.1 MAINTENANCE CHECKS

In view of the critical nature of the application, General Electric products should be checked at regular intervals to confirm they are operating correctly. General Electric products are designed for a life in excess of 20 years.

The devices are self-supervising and so require less maintenance than earlier designs of protection devices. Most problems will result in an alarm, indicating that remedial action should be taken. However, some periodic tests should be carried out to ensure that they are functioning correctly and that the external wiring is intact. It is the responsibility of the customer to define the interval between maintenance periods. If your organisation has a Preventative Maintenance Policy, the recommended product checks should be included in the regular program. Maintenance periods depend on many factors, such as:

- The operating environment
- The accessibility of the site
- The amount of available manpower
- The importance of the installation in the power system
- The consequences of failure

Although some functionality checks can be performed from a remote location, these are predominantly restricted to checking that the unit is measuring the applied currents and voltages accurately, and checking the circuit breaker maintenance counters. For this reason, maintenance checks should also be performed locally at the substation.

Caution:
Before carrying out any work on the equipment you should be familiar with the contents of the Safety Section or the Safety Guide SFTY/4LM and the ratings on the equipment's rating label.

2.1.1 ALARMS

First check the alarm status LED to see if any alarm conditions exist. If so, press the Read key repeatedly to step through the alarms.

After dealing with any problems, clear the alarms. This will clear the relevant LEDs.

2.1.2 OPTO-ISOLATORS

Check the opto-inputs by repeating the commissioning test detailed in the Commissioning chapter.

2.1.3 OUTPUT RELAYS

Check the output relays by repeating the commissioning test detailed in the Commissioning chapter.

2.1.4 MEASUREMENT ACCURACY

If the power system is energised, the measured values can be compared with known system values to check that they are in the expected range. If they are within a set range, this indicates that the A/D conversion and the calculations are being performed correctly. Suitable test methods can be found in Commissioning chapter.

Alternatively, the measured values can be checked against known values injected into the device using the test block, (if fitted) or injected directly into the device's terminals. Suitable test methods can be found in the Commissioning chapter. These tests will prove the calibration accuracy is being maintained.

2.2 REPLACING THE UNIT

If your product should develop a fault while in service, depending on the nature of the fault, the watchdog contacts will change state and an alarm condition will be flagged. In the case of a fault, you should normally replace the cradle which slides easily out of the case. This can be done without disturbing the scheme wiring.

In the unlikely event that the problem lies with the wiring and/or terminals, then you must replace the complete device, rewire and re-commission the device.

Caution:
If the repair is not performed by an approved service centre, the warranty will be invalidated.

Caution:
Before carrying out any work on the equipment, you should be familiar with the contents of the Safety Information section of this guide or the Safety Guide SFTY/4LM, as well as the ratings on the equipment's rating label. This should ensure that no damage is caused by incorrect handling of the electronic components.

Warning:
Before working at the rear of the unit, isolate all voltage supplying it.

To replace the cradle without disturbing the case and wiring:

1. Remove the faceplate.
2. Carefully withdraw the cradle from the front.
3. To reinstall the unit, follow the above instructions in reverse, ensuring that each terminal block is relocated in the correct position and all connections are replaced. The terminal blocks are labelled alphabetically with 'A' on the left hand side when viewed from the rear.

Once the unit has been reinstalled, it should be re-commissioned as set out in the Commissioning chapter.

2.3 CLEANING

Warning:
Before cleaning the device, ensure that all AC and DC supplies and transformer connections are isolated, to prevent any chance of an electric shock while cleaning.

Only clean the equipment with a lint-free cloth dampened with clean water. Do not use detergents, solvents or abrasive cleaners as they may damage the product's surfaces and leave a conductive residue.

3 TROUBLESHOOTING

3.1 SELF-DIAGNOSTIC SOFTWARE

The device includes several self-monitoring functions to check the operation of its hardware and software while in service. If there is a problem with the hardware or software, it should be able to detect and report the problem, and attempt to resolve the problem by performing a reboot. In this case, the device would be out of service for a short time, during which the 'Healthy' LED on the front of the device is switched OFF and the watchdog contact at the rear is ON. If the restart fails to resolve the problem, the unit takes itself permanently out of service; the 'Healthy' LED stays OFF and watchdog contact stays ON.

If a problem is detected by the self-monitoring functions, the device attempts to store a maintenance record to allow the nature of the problem to be communicated to the user.

The self-monitoring is implemented in two stages: firstly a thorough diagnostic check which is performed on boot-up, and secondly a continuous self-checking operation, which checks the operation of the critical functions whilst it is in service.

3.2 POWER-UP ERRORS

If the IED does not appear to power up, use the following checks to determine whether the fault is in the external wiring, auxiliary fuse, IED power supply module or IED front panel.

Test	Check	Action
1	Measure the voltage on terminals 13 and 14. Verify the voltage level and polarity against the rating label	If the auxiliary voltage is correct, go to test 2. Otherwise check the wiring and fuses in the auxiliary supply.
2	Check the LEDs and LCD backlight switch on at power-up. Also check the N/O (normally open) watchdog contact on terminals 4 and 6 to see if they close.	If the LEDs and LCD backlight switch on, or the Watchdog contacts close and no error code is displayed, the error is probably on the main processor board. If the LEDs and LCD backlight do not switch on and the N/O Watchdog contact does not close, the fault is probably in the IED power supply module.

3.3 ERROR MESSAGE OR CODE ON POWER-UP

The IED performs a self-test during power-up. If it detects an error, a message appears on the LCD and the power-up sequence stops. If the error occurs when the IED application software is running, a maintenance record is created and the device reboots.

Test	Check	Action
1	Is an error message or code permanently displayed during power up?	If the IED locks up and displays an error code permanently, go to test 2. If the IED prompts for user input, go to test 3. If the IED reboots automatically, go to test 4.
2	Record displayed error and re-apply IED supply.	Record whether the same error code is displayed when the IED is rebooted, then contact the local service centre stating the error code and product details.
3	The IED displays a message for corrupt settings and prompts for the default values to be restored for the affected settings.	The power-up tests have detected corrupted IED settings. Restore the default settings to allow the power-up to complete, and then reapply the application-specific settings.

Test	Check	Action
4	The IED resets when the power-up is complete. A record error code is displayed.	Programmable scheme logic error due to excessive execution time. If the IED powers up successfully, check the programmable logic for feedback paths. Other error codes relate to software errors on the main processor board, contact the local service centre.

3.4 OUT OF SERVICE LED ON AT POWER-UP

Test	Check	Action	
1	Using the IED menu, confirm the Commission Test or Test Mode setting is Enabled. If it is not Enabled, go to test 2.	If the setting is Enabled, disable the test mode and make sure the Out of Service LED is OFF.	
2	Select the *VIEW RECORDS* column then view the last maintenance record from the menu.	Check for the H/W Verify Fail maintenance record. This indicates a discrepancy between the IED model number and the hardware. Examine the ***Maint Data***; cell. This indicates the causes of the failure using bit fields: Bit Meaning	
		0	The application 'type' field in the Cortec does not match the software ID
		1	The 'subset' field in the model number does not match the software ID
		2	The 'platform' field in the model number does not match the software ID
		3	The 'product type' field in the model number does not match the software ID
		4	The 'protocol' field in the Cortec does not match the software ID
		5	The 'model' field in the Cortec does not match the software ID
		6	The first 'software version' field in the does not match the software ID
		7	The second 'software version' field in the Cortec does not match the software ID
		8	No VTs are fitted
		9	No CTs are fitted
		10	No Earth CT is fitted
		11	No SEF CT is fitted

3.5 ERROR CODE DURING OPERATION

The IED performs continuous self-checking. If the IED detects an error it displays an error message, logs a maintenance record and after a short delay resets itself. A permanent problem (for example due to a hardware fault) is usually detected in the power-up sequence. In this case the IED displays an error code and halts. If the problem was transient, the IED reboots correctly and continues operation. By examining the maintenance record logged, the nature of the detected fault can be determined.

3.6 MAL-OPERATION DURING TESTING

3.6.1 FAILURE OF OUTPUT CONTACTS

An apparent failure of the relay output contacts can be caused by the configuration. Perform the following tests to identify the real cause of the failure. The self-tests verify that the coils of the output relay contacts have been energized. An error is displayed if there is a fault in the output relay board.

Test	Check	Action
1	Is the Out of Service LED ON?	If this LED is ON, the relay may be in test mode or the protection has been disabled due to a hardware verify error.
2	Examine the Contact status in the Commissioning section of the menu.	If the relevant bits of the contact status are operated, go to test 4; if not, go to test 3.
3	Examine the fault record or use the test port to check the protection element is operating correctly.	If the protection element does not operate, check the test is correctly applied. If the protection element operates, check the programmable logic to make sure the protection element is correctly mapped to the contacts.
4	Using the Commissioning or Test mode function, apply a test pattern to the relevant relay output contacts. Consult the correct external connection diagram and use a continuity tester at the rear of the relay to check the relay output contacts operate.	If the output relay operates, the problem must be in the external wiring to the relay. If the output relay does not operate the output relay contacts may have failed (the self-tests verify that the relay coil is being energized). Ensure the closed resistance is not too high for the continuity tester to detect.

3.6.2 FAILURE OF OPTO-INPUTS

The opto-isolated inputs are mapped onto the IED's internal DDB signals using the programmable scheme logic. If an input is not recognized by the scheme logic, use the ***Opto I/P Status*** cell in the *COMMISSION TESTS* column to check whether the problem is in the opto-input itself, or the mapping of its signal to the scheme logic functions.

If the device does not correctly read the opto-input state, test the applied signal. Verify the connections to the opto-input using the wiring diagram and the nominal voltage settings in the *OPTO CONFIG* column. To do this:

1. Select the nominal battery voltage for all opto-inputs by selecting one of the five standard ratings in the ***Global Nominal V*** cell.
2. Select `Custom` to set each opto-input individually to a nominal voltage.
3. Using a voltmeter, check that the voltage on its input terminals is greater than the minimum pick-up level (See the Technical Specifications chapter for opto pick-up levels).

If the signal is correctly applied, this indicates failure of an opto-input, in which case the complete cradle should be replaced.

3.6.3 INCORRECT ANALOGUE SIGNALS

If the measured analogue quantities do not seem correct, use the measurement function to determine the type of problem. The measurements can be configured in primary or secondary terms.

1. Compare the displayed measured values with the actual magnitudes at the terminals.
2. Check the correct terminals are used.
3. Check the CT and VT ratios set are correct.
4. Check the phase displacement to confirm the inputs are correctly connected.

3.7 PSL EDITOR TROUBLESHOOTING

A failure to open a connection could be due to one or more of the following:

- The IED address is not valid (this address is always 1 for the front port)
- Password in not valid

- Communication set-up (COM port, Baud rate, or Framing) is not correct
- Transaction values are not suitable for the IED or the type of connection
- The connection cable is not wired correctly or broken
- The option switches on any protocol converter used may be incorrectly set

3.7.1 DIAGRAM RECONSTRUCTION

Although a scheme can be extracted from an IED, a facility is provided to recover a scheme if the original file is unobtainable.

A recovered scheme is logically correct but much of the original graphical information is lost. Many signals are drawn in a vertical line down the left side of the canvas. Links are drawn orthogonally using the shortest path from A to B. Any annotation added to the original diagram such as titles and notes are lost.

Sometimes a gate type does not appear as expected. For example, a single-input AND gate in the original scheme appears as an OR gate when uploaded. Programmable gates with an inputs-to-trigger value of 1 also appear as OR gates

3.7.2 PSL VERSION CHECK

The PSL is saved with a version reference, time stamp and CRC check (Cyclic Redundancy Check). This gives a visual check whether the default PSL is in place or whether a new application has been downloaded.

3.8 REPAIR AND MODIFICATION PROCEDURE

Please follow these steps to return an Automation product to us:

1. Get the Repair and Modification Return Authorization (RMA) form
   An electronic version of the RMA form is available from the following:
   contact.centre@ge.com
2. Fill in the RMA form
   Fill in only the white part of the form.
   Please ensure that all fields marked **(M)** are completed such as:
   - Equipment model
   - Model No. and Serial No.
   - Description of failure or modification required (please be specific)
   - Value for customs (in case the product requires export)
   - Delivery and invoice addresses
   - Contact details

3. Send the RMA form to your local contact
   For a list of local service contacts worldwide, email us at:
   contact.centre@ge.com
4. The local service contact provides the shipping information
   Your local service contact provides you with all the information needed to ship the product:
   - Pricing details
   - RMA number
   - Repair centre address

   If required, an acceptance of the quote must be delivered before going to the next stage.
5. Send the product to the repair centre
   - Address the shipment to the repair centre specified by your local contact
   - Make sure all items are packaged in an anti-static bag and foam protection
   - Make sure a copy of the import invoice is attached with the returned unit
   - Make sure a copy of the RMA form is attached with the returned unit
   - E-mail or fax a copy of the import invoice and airway bill document to your local contact.

CHAPTER 17

TECHNICAL SPECIFICATIONS

1 CHAPTER OVERVIEW

This chapter describes the technical specifications of the product.

This chapter contains the following sections:

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Performance of Frequency Protection Functions 348
Performance of Monitoring and Control Functions 351
Measurements and Recording 352
Regulatory Compliance 353
Mechanical Specifications 354
Ratings 355
Power Supply 356
Input/Output Connections 357
Environmental Conditions 359
Type Tests 360
Electromagnetic Compatibility 362

2 INTERFACES

2.1 FRONT USB PORT

Front USB port	
Use	For local connection to laptop for configuration purposes and firmware downloads
Connector	USB type B
Isolation	Isolation to ELV level
Constraints	Maximum cable length 5 m

2.2 REAR SERIAL PORT 1

Rear serial port 1 (RP1)	
Use	For SCADA communications (multi-drop)
Standard	EIA(RS)485, K-bus
Connector	General purpose block, M4 screws (2 wire)
Cable	Screened twisted pair (STP)
Supported Protocols *	Courier, IEC-60870-5-103, DNP3.0, MODBUS
Isolation	Isolation to SELV level
Constraints	Maximum cable length 1000 m

* Not all models support all protocols - see ordering options

2.3 IRIG-B PORT

IRIG-B Interface (De-modulated)	
Use	External clock synchronization signal
Standard	IRIG 200-98 format B00X
Terminal type	MiDOS
Connector	General purpose block, M4 screws (2 wire)
Cable type	Screened twisted pair (STP)
Isolation	Isolation to SELV level
Accuracy	< +/- 1 s per day

2.4 REAR ETHERNET PORT COPPER

Rear Ethernet port using CAT 5/6/7 wiring	
Main Use	Substation Ethernet communications
Communication protocol	10BaseT/100BaseTX
Connector	RJ45
Cable type	Screened twisted pair (STP)
Isolation	1 kV
Supported Protocols	IEC 61850, DNP3.0 OE
Constraints	Maximum cable length 100 m

2.5 REAR ETHERNET PORT - FIBRE

Rear Ethernet port using fibre-optic cabling	
Main Use	IEC 61850 or DNP3 OE SCADA communications
Connector	UNI SONET OC-3 LC (1 each for Tx and Rx)
Communication protocol	100 BaseFX
Fibre type	Multimode 50/125 µm or 62.5/125 µm
Supported Protocols	IEC 61850, DNP3.0 OE
Wavelength	1300 nm

2.5.1 100 BASE FX RECEIVER CHARACTERISTICS

Parameter	Sym	Min.	Typ.	Max.	Unit
Input Optical Power Minimum at Window Edge	PIN Min. (W)		-33.5	–31	dBm avg.
Input Optical Power Minimum at Eye Center	PIN Min. (C)		-34.5	-31.8	Bm avg.
Input Optical Power Maximum	PIN Max.	-14	-11.8		dBm avg.

Conditions: TA = 0°C to 70°C

2.5.2 100 BASE FX TRANSMITTER CHARACTERISTICS

Parameter	Sym	Min.	Typ.	Max.	Unit
Output Optical Power BOL 62.5/125 µm NA = 0.275 Fibre EOL	PO	-19 -20	-16.8	-14	dBm avg.
Output Optical Power BOL 50/125 µm NA = 0.20 Fibre EOL	PO	-22.5 -23.5	-20.3	-14	dBm avg.
Optical Extinction Ratio				10 -10	% dB
Output Optical Power at Logic "0" State	PO			-45	dBm avg.

Conditions: TA = 0°C to 70°C

3 PERFORMANCE OF VOLTAGE PROTECTION FUNCTIONS

3.1 UNDERVOLTAGE PROTECTION

Pick-up (IDMT and DT)	Setting +/- 5%
Drop-off (IDMT and DT)	1.02 x Setting +/-5%
IDMT operate	+/- 3.5% or 40 ms, whichever is greater (<10 V) +/- 5% or 40 ms, whichever is greater (>10 V)
Disnegagement	<40 ms
DT operate	+/- 2% or 50 ms, whichever is greater
DT reset	Setting +/- 5%
Repeatability	+/- 1%

3.2 OVERVOLTAGE PROTECTION

IDMT pick-up	Setting +/- 2%
DT pick-up	Setting +/- 1%
Drop-off (IDMT and DT)	0.98 x Setting +/-5%
IDMT operate	+/-5% or 50 ms
Disengagement	< 40 ms
DT operate	+/- 2% or 50 ms, whichever is greater
DT reset	Setting +/- 5%
Repeatability	+/- 5%

3.3 RESIDUAL OVERVOLTAGE PROTECTION

IDMT pick-up	1.05 x Setting +/- 5%
DT pick-up	Setting +/- 5%
Drop-off (IDMT and DT)	0.95 x Setting +/-5%
IDMT operate	+/- 5% or 65 ms, whichever is greater
Disengagement	< 35 ms
DT operate	+/- 2% or 70 ms or whichever is greater
DT reset	Setting +/- 5%
Repeatability	<10%

3.4 NEGATIVE SEQUENCE VOLTAGE PROTECTION

Accuracy	
Pick-up	Setting +/- 5%
Drop-off	0.95 x Setting +/-5%

Accuracy	
DT operate (normal operation)	+/- 5% or 70 ms, whichever is greater (<45 Hz) +/- 2% or 65 ms, whichever is greater (45 Hz - 70 Hz)
DT operate (accelerated)	+/- 5% or 50 ms, whichever is greater (<45 Hz) +/- 2% or 45 ms, whichever is greater (45 Hz - 70 Hz)
Repeatability	+/- 1%

3.5 RATE OF CHANGE OF VOLTAGE PROTECTION

Accuracy for 110 V VT	
Tolerance	1% or 0.07, whichever is greater
Pick-up	Setting +/- tolerance
Drop-off for positive direction	(Setting – 0.07)+/- tolerance
Drop-off for negative direction	(Setting + 0.07)+/- tolerance
Operating time at 50 Hz	(Average cycle x 20) +60 ms
Reset time at 50 Hz	40 ms

4 PERFORMANCE OF FREQUENCY PROTECTION FUNCTIONS

4.1 OVERFREQUENCY PROTECTION

Accuracy	
Pick-up	Setting +/- 10 mHz
Drop-off	Setting -20 mHz +/- 10 mHz
Operating timer	+/- 2% or 50 ms, whichever is greater

Operating and Reset time	
Operating time (Fs/Ff ratio less than 2)	<125 ms
Operating time (Fs/Ff ratio between 2 and 30)	<150 ms
Operating time (Fs/Ff ratio greater than 30)	<200 ms
Reset time	<200 ms

Reference conditions: Tested using step changed in frequency with Freq. Av Cycles setting = 0 and no intentional time delay.

Fs = start frequency – frequency setting

Ff = frequency setting – end frequency

4.2 UNDERFREQUENCY PROTECTION

Accuracy	
Pick-up	Setting +/- 10 mHz
Drop-off	Setting + 20 mHz +/- 10 mHz
Operating timer	+/- 2% or 50 ms, whichever is greater

Operating and Reset time	
Operating time (Fs/Ff ratio less than 2)	<100 ms
Operating time (Fs/Ff ratio between 2 and 6)	<160 ms
Operating time (Fs/Ff ratio greater than 6)	<230 ms
Reset time	<200 ms

Reference conditions: Tested using step changed in frequency with Freq. Av Cycles setting = 0 and no intentional time delay.

Fs = start frequency – frequency setting

Ff = frequency setting – end frequency

4.3 SUPERVISED RATE OF CHANGE OF FREQUENCY PROTECTION

Accuracy	
Pick-up (f)	Setting +/- 10 mHz
Pick-up (df/dt)	Setting +/- 3% or +/- 10 mHz/s, whichever is greater
Drop-off (f, underfrequency)	(Setting + 20 mHz) +/- 10 mHz

Accuracy	
Drop-off (f, overfrequency)	(Setting - 20 mHz) +/- 10 mHz
Drop-off (df/dt, falling, for settings between 10 mHz/s and 100 mHz/s)	(Setting + 5 mHz/s) +/- 10 mHz/s
Drop-off (df/dt, falling, for settings greater than 100 mHz/s)	(Setting + 50 mHz/s) +/- 5% or +/- 55 mHz/s, whichever is greater
Drop-off (df/dt, rising, for settings between 10 mHz/s and 100 mHz/s)	(Setting - 5 mHz/s) +/- 10 mHz/s
Drop-off (df/dt, rising, for settings greater than 100 mHz/s)	(Setting - 50 mHz/s) +/- 5% or +/- 55 mHz/s, whichever is greater

Operating and Reset time	
Instantaneous operating time (Freq AvCycles setting = 0)	<125 ms
Reset time time (df/dt AvCycles setting = 0)	<400 ms

4.4 INDEPENDENT RATE OF CHANGE OF FREQUENCY PROTECTION

Accuracy	
Pick-up (df/dt)	Setting +/- 3% or +/- 10 mHz/s, whichever is greater
Drop-off (df/dt, falling, for settings between 10 mHz/s and 100 mHz/s)	(Setting + 5 mHz/s) +/- 10 mHz/s
Drop-off (df/dt, falling, for settings greater than 100 mHz/s)	(Setting + 50 mHz/s) +/- 5% or +/- 55 mHz/s, whichever is greater
Drop-off (df/dt, rising, for settings between 10 mHz/s and 100 mHz/s)	(Setting - 5 mHz/s) +/- 10 mHz/s
Drop-off (df/dt, rising, for settings greater than 100 mHz/s)	(Setting - 50 mHz/s) +/- 5% or +/- 55 mHz/s, whichever is greater
Operating timer	+/- 2% or 50 ms, whichever is greater

Operating and Reset time	
Operating time (for ramps 2 x setting or greater)	<200 ms
Operating time (for ramps 1.3 x setting or greater)	<300 ms
Reset time time (df/dt AvCycles setting = 0 for df/dt settings greater than 0.1 Hz/s and no intentional time delay)	<250 ms

Reference Conditions: Tested with df/dt Average Cycles = 0 for df/dt settings greater than 0.1 Hz/s, and no intentional time delay.

4.5 AVERAGE RATE OF CHANGE OF FREQUENCY PROTECTION

Accuracy	
Pick-up (f)	Setting +/- 10 mHz
Pick-up (Df/Dt)	Setting +/- 100 mHz/s
Drop-off (falling)	(Setting + 20 mHz) +/- 10 mHz
Drop-off (rising)	(Setting - 20 mHz) +/- 10 mHz
Operating timer	+/- 2% or 30 ms, whichever is greater

Operating time	
Operating time (Freq. Av Cycles setting = 0)	<125 ms

Reference conditions: To maintain accuracy, the minimum time delay setting should be:

Dt> 0.375 x Df + 0.23 (f0r Df setting <1 Hz)

Dt> 0.156 x Df + 0.47 (for Df setting >= 1 Hz)

4.6 LOAD RESTORATION

Pick-up	Setting +/- 2.5%
Drop-off	0.95% x Setting +/- 2.5%
Restoration timer	+/- 2% or 50 ms, whichever is greater
Holding timer	+/- 2% or 50 ms, whichever is greater

5 PERFORMANCE OF MONITORING AND CONTROL FUNCTIONS

5.1 PSL TIMERS

Output conditioner timer	Setting +/- 2% or 50 ms, whichever is greater
Dwell conditioner timer	Setting +/- 2% or 50 ms, whichever is greater
Pulse conditioner timer	Setting +/- 2% or 50 ms, whichever is greater

5.2 DC SUPPLY MONITOR

Measuring Range	19 V-310 V ±5%
Tolerance	±1.5 V for 19-100 V ±2% for 100-200 V ±2.5% for 200-300 V
Pickup	100% of Setting ± Tolerance *
Dropoff	Hysteresis 2% 102% of Setting ± Tolerance for the upper limit * 98% of Setting ± Tolerance for the lower limit *
Operate Time	Setting ± (2% or 500 ms whichever is greater)
Disengagement Time	< 250 ms

Note:
** Tested at 21°C*

6 MEASUREMENTS AND RECORDING

6.1 GENERAL

General Measurement Accuracy	
General measurement accuracy	Typically +/- 1%, but +/- 0.5% between 0.2 - 2 In/Vn
Voltage magnitude	0.05 to 2 Vn +/- 1.0% of reading
Voltage phase	0° to 360° +/- 0.5° (0.2 to 2 Vn) 0° to 360° +/- 1° (0.05 to 2 Vn)
Frequency	40 to 70 Hz +/- 0.025 Hz

6.2 DISTURBANCE RECORDS

Disturbance Records Measurement Accuracy	
Minimum record duration	0.1 s
Maximum record duration	10.5 s
Minimum number of records at 10.5 seconds	15
Magnitude and relative phases accuracy	±5% of applied quantities
Duration accuracy	±2%
Trigger position accuracy	±2% (minimum Trigger 100 ms)

6.3 EVENT, FAULT AND MAINTENANCE RECORDS

Event, Fault & Maintenance Records	
Record location	Flash memory
Viewing method	Front panel display or MiCOM S1 Agile
Extraction method	Extracted via the USB port
Number of Event records	Up to 2048 time tagged event records
Number of Fault Records	Up to 10
Number of Maintenance Records	Up to 10

7 REGULATORY COMPLIANCE

Compliance with the European Commission Directive on EMC and LVD is demonstrated using a technical file.

CE

7.1 EMC COMPLIANCE: 2014/30/EU

The product specific Declaration of Conformity (DoC) lists the relevant harmonised standard(s) or conformity assessment used to demonstrate compliance with the EMC directive.

7.2 LVD COMPLIANCE: 2014/35/EU

The product specific Declaration of Conformity (DoC) lists the relevant harmonized standard(s) or conformity assessment used to demonstrate compliance with the LVD directive.

Safety related information, such as the installation I overvoltage category, pollution degree and operating temperature ranges are specified in the Technical Data section of the relevant product documentation and/or on the product labelling.

Unless otherwise stated in the Technical Data section of the relevant product documentation, the equipment is intended for indoor use only. Where the equipment is required for use in an outdoor location, it must be mounted in a specific cabinet or housing to provide the equipment with the appropriate level of protection from the expected outdoor environment.

7.3 R&TTE COMPLIANCE: 2014/53/EU

Radio and Telecommunications Terminal Equipment (R&TTE) directive 2014/53/EU.

Conformity is demonstrated by compliance to both the EMC directive and the Low Voltage directive, to zero volts.

7.4 UL/CUL COMPLIANCE

If marked with this logo, the product is compliant with the requirements of the Canadian and USA Underwriters Laboratories.

The relevant UL file number and ID is shown on the equipment.

c UL us

8 MECHANICAL SPECIFICATIONS

8.1 PHYSICAL PARAMETERS

Physical Measurements	
Case Types	20TE 30TE 40TE
Weight (20TE case)	2 kg – 3 kg (depending on chosen options)
Weight (30TE case)	3 kg – 4 kg (depending on chosen options)
Weight (40TE case)	5.5 kg
Dimensions in mm (w x h x l) (20TE case)	W: 102.4mm H: 177.0mm D: 243.1mm
Dimensions in mm (w x h x l) (30TE case)	W: 154.2mm H: 177.0mm D: 243.1mm
Dimensions in mm (w x h x l) (40TE case)	W: 206.0mm H: 177.0mm D: 243.1mm
Mounting	Panel, rack, or retrofit

8.2 ENCLOSURE PROTECTION

Against dust and dripping water (front face)	IP52 as per IEC 60529:1989/A2:2013
Protection against dust (whole case)	IP50 as per IEC 60529:1989/A2:2013
Protection for sides of the case (safety)	IP30 as per IEC 60529:1989/A2:2013
Protection for rear of the case (safety)	IP10 as per IEC 60529:1989/A2:2013

8.3 MECHANICAL ROBUSTNESS

Vibration test per EN 60255-21-1:1998	Response: class 2, Endurance: class 2
Shock and bump immunity per EN 60255-21-2:1988	Shock response: class 2, Shock withstand: class 1, Bump withstand: class 1
Seismic test per EN 60255-21-3: 1993	Class 2

8.4 TRANSIT PACKAGING PERFORMANCE

Primary packaging carton protection	ISTA 1C
Vibration tests	3 orientations, 7 Hz, amplitude 5.3 mm, acceleration 1.05g
Drop tests	10 drops from 610 mm height on multiple carton faces, edges and corners

9 RATINGS

9.1 AC MEASURING INPUTS

AC Measuring Inputs	
Nominal frequency	50 Hz or 60 Hz (settable)
Operating range	40 Hz to 70 Hz
Phase rotation	ABC or CBA

9.2 VOLTAGE TRANSFORMER INPUTS

AC Voltage	
Nominal voltage	100 V to 120 V
Nominal burden per phase	< 0.1 VA at Vn
Thermal withstand	Continuous: 2 x Vn, 10 s: 2.6 x Vn

10 POWER SUPPLY

10.1 AUXILIARY POWER SUPPLY VOLTAGE

Nominal operating range	24-250 V DC +/-20% 110-240 V AC -20% + 10%
Maximum operating range	19 to 300 V DC
Frequency range for AC supply	45 – 65 Hz
Ripple	<15% for a DC supply (compliant with IEC 60255-11:2008)

10.2 NOMINAL BURDEN

Quiescent burden	20TE	5 W max.
	30TE	6 W max.
	30TE with 2nd rear communications	6.2 W max.
	30TE with Ethernet or TCS	7 W max.
	40TE	8 W max.
Additions for energised relay outputs		0.26 W per output relay
Opto-input burden	24 V	0.065 W max.
	48 V	0.125 W max.
	110 V	0.36 W max.
	220 V	0.9 W max.

10.3 AUXILIARY POWER SUPPLY INTERRUPTION

Standard	IEC 60255-11:2008 (dc) IEC 61000-4-11:2004 (ac)			
	Quiescent / half load		Full load	
	19.2 V – 110 V dc	>110 V dc	19.2 V – 110 V dc	>110 V dc
20TE	50 ms	100 ms	50 ms	100 ms
30TE	50 ms	100 ms	30 ms	50 ms
30TE with 2nd rear communications	30 ms	100 ms	20 ms	50 ms
30TE with Ethernet or TCS	50 ms	100 ms	20 ms	100 ms
30TE with Redundant Ethernet Board	50 ms	100 ms	10 ms	100 ms
40TE with 2nd rear communications	20 ms	100 ms	10 ms*	50 ms

* for voltages > 48 V dc

Note:
Maximum loading = all inputs/outputs energised. Quiescent or 1/2 loading = 1/2 of all inputs/outputs energised.

11 INPUT/OUTPUT CONNECTIONS

11.1 ISOLATED DIGITAL INPUTS

Opto-isolated digital inputs (opto-inputs)	
Compliance	ESI 48-4
Rated nominal voltage	24 to 250 V dc
Operating range	19 to 265 V dc
Withstand	300 V dc
Recognition time with half-cycle ac immunity filter removed	< 2 ms
Recognition time with filter on	< 12 ms

11.1.1 NOMINAL PICKUP AND RESET THRESHOLDS

Nominal battery voltage	Logic levels: 60-80% DO/PU	Logic Levels: 50-70% DO/PU	Logic Levels: 58-75% DO/PU
24/27 V	Logic 0 < 16.2V, Logic 1 > 19.2V	Logic 0 <12V, Logic 1 > 16.8V	Logic 0 <15.7V, Logic 1 > 18V
30/34	Logic 0 < 20.4V, Logic 1 > 24V	Logic 0 < 15V, Logic 1 > 21V	Logic 0 < 19.7V, Logic 1 > 22.5V
48/54	Logic 0 < 32.4V, Logic 1 > 38.4V	Logic 0 < 24V, Logic 1 > 33.6V	Logic 0 < 31.3V, Logic 1 > 36V
110/125	Logic 0 < 75V, Logic 1 > 88V	Logic 0 < 55.V, Logic 1 > 77V	Logic 0 < 72.5V, Logic 1 > 82.5V
220/250	Logic 0 < 150V, Logic 1 > 176V	Logic 0 < 110V, Logic 1 > 154V	Logic 0 < 145V, Logic 1 > 165V

Note:
Filter is required to make the opto-inputs immune to induced AC voltages.

11.2 STANDARD OUTPUT CONTACTS

Compliance	In accordance with IEC 60255-1:2009
Use	General purpose relay outputs for signalling, tripping and alarming
Rated voltage	300 V
Maximum continuous current	10 A
Short duration withstand carry	30 A for 3 s 250 A for 30 ms
Make and break, dc resistive	50 W
Make and break, dc inductive	62.5 W (L/R = 50 ms)
Make and break, ac resistive	2500 VA resistive (cos phi = unity)
Make and break, ac inductive	2500 VA inductive (cos phi = 0.7)
Make and carry, dc resistive	30 A for 3 s, 10000 operations (subject to a maximum load of 7500W))
Make, carry and break, dc resistive	4 A for 1.5 s, 10000 operations (subject to the above limit for make and break, dc resistive load)
Make, carry and break, dc inductive	0.5 A for 1 s, 10000 operations (subject to the above limit for make and break, dc inductive load)
Make, carry and break ac resistive	30 A for 200 ms, 2000 operations (subject to the above limits)

Make, carry and break ac inductive	10 A for 1.5 s, 10000 operations (subject to the above limits)
Loaded contact	10000 operations min.
Unloaded contact	100000 operations min.
Operate time	< 5 ms
Reset time	< 10 ms

11.3 WATCHDOG CONTACTS

Use	Non-programmable contacts for relay healthy/relay fail indication
Breaking capacity, dc resistive	30 W
Breaking capacity, dc inductive	15 W (L/R = 40 ms)
Breaking capacity, ac inductive	375 VA inductive (cos phi = 0.7)

11.4 SHORTING LINK

Maximum operating voltage	300Vrms, 300Vdc
Maximum operating current	20A

12 ENVIRONMENTAL CONDITIONS

12.1 AMBIENT TEMPERATURE RANGE

Compliance	IEC 60255-27: 2013
Test Method	IEC 60068-2-1:2007 and IEC 60068-2-2 2007
Operating temperature range	-25°C to +55°C (continuous)
Storage and transit temperature range	-25°C to +70°C (continuous)

12.2 TEMPERATURE ENDURANCE TEST

Temperature Endurance Test	
Test Method	IEC 60068-2-1: 2007 and 60068-2-2: 2007
Operating temperature range	-40°C (96 hours) +70°C (96 hours)
Storage and transit temperature range	-40°C (96 hours) +85°C (96 hours)

12.3 AMBIENT HUMIDITY RANGE

Compliance	IEC 60068-2-78: 2012 and IEC 60068-2-30: 2005
Durability	56 days at 93% relative humidity and +40°C
Damp heat cyclic	six (12 + 12) hour cycles, 93% RH, +25 to +55°C

12.4 CORROSIVE ENVIRONMENTS

Compliance, Industrial corrosive environment/poor environmental control	IEC 60068-2-42: 2003, IEC 60068-2-43: 2003, IEC 60068-2-52: 1996
Sulphur Dioxide, IEC 60068-2-42: 2003	21 days exposure to elevated concentrations (25ppm) of SO_2 at 75% relative humidity and +25°C
Hydrogen Sulphide, IEC 60068-2-43: 2003	21 days exposure to elevated concentrations (10ppm) of H_2S at 75% relative humidity and +25°C
Salt mist, IEC 60068-2-52: 1996	7 days, KB severity 3

13 TYPE TESTS

13.1 INSULATION

Compliance	IEC 60255-27: 2013
Insulation resistance	> 100 M ohm at 500 V DC (Using only electronic/brushless insulation tester)

13.2 CREEPAGE DISTANCES AND CLEARANCES

Compliance	IEC 60255-27: 2013
Pollution degree	3
Overvoltage category	III
Impulse test voltage (not RJ45)	5 kV
Impulse test voltage (RJ45)	1 kV

13.3 HIGH VOLTAGE (DIELECTRIC) WITHSTAND

IEC Compliance	IEC 60255-27: 2005
Between independent opto-inputs or Vx and other circuits	2.82kV dc for 1 minute
Between all other independent circuits	2 kV ac rms for 1 minute
Between Vx or opto-inputs, and protective earth terminal	2.82kV dc for 1 minute
Between all other independent circuits and protective earth terminal	2 kV ac rms for 1 minute
Across open watchdog contacts	1 kV ac rms for 1 minute
Across open contacts of changeover output relays	1 kV ac rms for 1 minute
Between all RJ45 contacts and protective earth terminal	1 kV ac rms for 1 minute
Between all screw-type EIA(RS)485 contacts and protective earth terminal	1 kV ac rms for 1 minute
ANSI/IEEE Compliance	ANSI/IEEE C37.90-2005
Across open contacts of normally open output relays	1.5 kV ac rms for 1 minute
Across open contacts of normally open changeover output relays	1 kV ac rms for 1 minute
Across open watchdog contacts	1 kV ac rms for 1 minute

13.4 IMPULSE VOLTAGE WITHSTAND TEST

Compliance	IEC 60255-27: 2013
Between all independent circuits	Front time: 1.2 µs, Time to half-value: 50 µs, Peak value: 5 kV, 0.5 J
Between terminals of all independent circuits	Front time: 1.2 µs, Time to half-value: 50 µs, Peak value: 5 kV, 0.5 J
Between all independent circuits and protective earth conductor terminal	Front time: 1.2 µs, Time to half-value: 50 µs, Peak value: 5 kV, 0.5 J

Note:
Exceptions are communications ports and normally-open output contacts, where applicable.

14 ELECTROMAGNETIC COMPATIBILITY

14.1 1 MHZ BURST HIGH FREQUENCY DISTURBANCE TEST

Compliance	IEC 60255-26:2013
Common-mode test voltage (level 3)	2.5 kV
Differential test voltage (level 3)	1.0 kV

14.2 DAMPED OSCILLATORY TEST

Compliance	EN61000-4-18: 2011: Level 3, 100 kHz and 1 MHz. Level 4: 3 MHz, 10 MHz and 30 MHz, IEC 60255-26:2013
Common-mode test voltage (level 3)	2.5 kV
Common-mode test voltage (level 4)	4.0 kV
Differential mode test voltage	1.0 kV

14.3 IMMUNITY TO ELECTROSTATIC DISCHARGE

Compliance	IEC 60255-26:2013
Class 4 Condition (20TE, 30TE)	15 kV discharge in air to user interface, display, and exposed metalwork 8 kV contact discharge to communication ports and exposed metalwork
Class 3 Condition (40TE)	6 kV contact discharge to communication ports and exposed metalwork

14.4 ELECTRICAL FAST TRANSIENT OR BURST REQUIREMENTS

Compliance	IEC 60255-26:2013, IEC 61000-4-4:2012
Applied to communication inputs	Amplitude: 2 kV, burst frequency 5 kHz and 100 KHz (level 4)
Applied to power supply and all other inputs except for communication inputs	Amplitude: 4 kV, burst frequency 5 kHz and 100 KHz (level 4)

14.5 SURGE WITHSTAND CAPABILITY

Compliance	IEEE/ANSI C37.90.1: 2012
Condition 1	4 kV fast transient and 2.5 kV oscillatory applied common mode and differential mode to opto inputs, output relays, CTs, VTs, power supply
Condition 2	4 kV fast transient and 2.5 kV oscillatory applied common mode to communications, IRIG-B

14.6 SURGE IMMUNITY TEST

Compliance	IEC 60255-26:2013, IEC 61000-4-5:2014+AMD1:2017
Pulse duration	Time to half-value: 1.2/50 µs
Between all groups and protective earth conductor terminal	Amplitude 4 kV
Between terminals of each group (excluding communications ports, where applicable)	Amplitude 2 kV

14.7 IMMUNITY TO RADIATED ELECTROMAGNETIC ENERGY

Compliance	IEC 60255-26:2013, IEC 61000-4-3:2006 + A2:2010
Frequency band	80 MHz to 3.0 GHz
Spot tests at	80, 160, 380, 450, 900, 1850, 2150 MHz
Test field strength	10 V/m
Test using AM	1 kHz @ 80%
Compliance	IEEE/ANSI C37.90.2: 2004
Frequency band	80 MHz to 1 GHz
Spot tests at	80, 160, 380, 450 MHz
Waveform	1 kHz @ 80% am and pulse modulated
Field strength	35 V/m

14.8 RADIATED IMMUNITY FROM DIGITAL COMMUNICATIONS

Compliance	IEC 61000-4-3:2006 + A2:2010
Frequency bands	800 to 960 MHz, 1.4 to 2.0 GHz
Test field strength	30 V/m
Test using AM	1 kHz / 80%

14.9 RADIATED IMMUNITY FROM DIGITAL RADIO TELEPHONES

Compliance	IEC 60255-26:2013, IEC 61000-4-3:2006 + A2:2010
Frequency bands	900 MHz and 1.89 GHz
Test field strength	10 V/m

14.10 IMMUNITY TO CONDUCTED DISTURBANCES INDUCED BY RADIO FREQUENCY FIELDS

Compliance	IEC 60255-26:2013, IEC 61000-4-6:2013 Level 3
Frequency bands	150 kHz to 80 MHz

Test disturbance voltage	10 V rms
Test using AM	1 kHz @ 80%
Spot tests	27 MHz and 68 MHz

14.11 MAGNETIC FIELD IMMUNITY

Compliance	IEC 61000-4-8:2009 Level 5 IEC 61000-4-9:2016 Level 5 IEC 61000-4-10:2016 Level 5
IEC 61000-4-8 test	100 A/m applied continuously, 1000 A/m applied for 3 s
IEC 61000-4-9 test	1000 A/m applied in all planes
IEC 61000-4-10 test	100 A/m applied in all planes at 100 kHz/1 MHz with a burst duration of 2 seconds

14.12 CONDUCTED EMISSIONS

Compliance	IEC 60255-26:2013, EN 55032: 2015+A1:2020
Power supply test 1	0.15 - 0.5 MHz, 79 dBµV (quasi peak) 66 dBµV (average)
Power supply test 2	0.5 – 30 MHz, 73 dBµV (quasi peak) 60 dBµV (average)
RJ45 test 1 (where applicable)	0.15 - 0.5 MHz, 97 dBµV (quasi peak) 84 dBµV (average)
RJ45 test 2 (where applicable)	0.5 – 30 MHz, 87 dBµV (quasi peak) 74 dBµV (average)

14.13 RADIATED EMISSIONS

Compliance	IEC 60255-26:2013
Test 1	30 – 230 MHz, 40 dBµV/m at 10 m measurement distance
Test 2	230 – 1 GHz, 47 dBµV/m at 10 m measurement distance
Test 3	1 – 2 GHz, 76 dBµV/m at 10 m measurement distance

14.14 POWER FREQUENCY

Compliance	IEC 60255-26:2013
Opto-inputs (Compliance is achieved using the opto-input filter)	300 V common-mode (Class A) 150 V differential mode (Class A)

Note:
Compliance is achieved using the opto-input filter.

APPENDIX A

ORDERING OPTIONS

Information Required with Order :

Variants	Order Number												
	1 - 4	5	6	7	8	9	10	11	12-13	14	15		
Model Type													
Voltage/Frequency Protection IED - Voltage	P94V												
Application													
Base (with measured NVD)		B											
Check Synch (with derived NVD)		P											
Check Synch + Autoreclose (with derived NVD)		R											
Current/Voltage Transformers													
Voltage Only			1										
Hardware Options													
EIA RS485/IRIG-B (demodulated)	20TE/30TE			1									
EIA RS485/IRIG-B (demodulated) and Ethernet - Single channel Fibre/Copper (setting configurable as Failover*)	30TE			6									
EIA RS485/IRIG-B (demodulated) and EIA RS485	30TE			8									
EIA RS485/IRIG-B (demodulated) and Dual Redundant Copper Ethernet: 2x RJ45 Copper (setting configurable as Failover)	30TE/40TE			A									
EIA RS485/IRIG-B (demodulated) and Dual Redundant Fibre Ethernet: 2x multimode fibre (setting configurable as Failover)	30TE/40TE			B									
EIA RS485/IRIG-B (demodulated) and Dual Redundant Copper Ethernet: 2x RJ45 Copper (setting configurable as RSTP)	30TE/40TE			C									
EIA RS485/IRIG-B (demodulated) and Dual Redundant Fibre Ethernet: 2x multimode fibre (setting configurable as RSTP)	30TE/40TE			D									
EIA RS485/IRIG-B (demodulated) and Dual Redundant Copper Ethernet: 2x RJ45 Copper (setting configurable as PRP or HSR)	30TE/40TE			E									
EIA RS485/IRIG-B (demodulated) and Dual Redundant Fibre Ethernet: 2x multimode fibre (setting configurable as PRP or HSR)	30TE/40TE			F									
40TE only - EIA RS485, EIA RS485/IRIG-B (demodulated) and Dual Redundant Copper Ethernet: 2x RJ45 Copper (setting configurable as Failover)	40TE			G									
40TE only - EIA RS485, EIA RS485/IRIG-B (demodulated) and Dual Redundant Fibre Ethernet: 2x multimode fibre (setting configurable as Failover)	40TE			H									
40TE only - EIA RS485, EIA RS485/IRIG-B (demodulated) and Dual Redundant Copper Ethernet: 2x RJ45 Copper (setting configurable as RSTP)	40TE			J									
40TE only - EIA RS485, EIA RS485/IRIG-B (demodulated) and Dual Redundant Fibre Ethernet: 2x multimode fibre (setting configurable as RSTP)	40TE			K									
40TE only - EIA RS485, EIA RS485/IRIG-B (demodulated) and Dual Redundant Copper Ethernet: 2x RJ45 Copper (setting configurable as PRP or HSR)	40TE			L									
40TE only - EIA RS485, EIA RS485/IRIG-B (demodulated) and Dual Redundant Fibre Ethernet: 2x multimode fibre (setting configurable as PRP or HSR)	40TE			M									
EIA RS485/IRIG-B (demodulated) and Dual Copper Ethernet: 2x RJ45 Copper (dual IP)	30TE/40TE			N									
EIA RS485/IRIG-B (demodulated) and Dual Redundant Fibre Ethernet: 2x multimode fibre (dual IP)	30TE/40TE			P									
EIA RS485, EIA RS485/IRIG-B (demodulated) and Dual Copper Ethernet: 2x RJ45 Copper (dual IP)	40TE			Q									
EIA RS485, EIA RS485/IRIG-B (demodulated) and Dual Redundant Fibre Ethernet: 2x multimode fibre (dual IP)	40TE			R									
I/O Options													
Standard (8 logic inputs + 8 relay outputs)	20TE/30TE				A								
Total (11 logic inputs + 12 relay outputs)	30TE/40TE				B								
Total (11 logic inputs + 12 relay outputs) suitable for trip circuit supervision	30TE/40TE				C								
Total (13 logic inputs + 12 relay outputs)	30TE/40TE				D								
Total (3 logic inputs + 4 relay outputs)	30TE				E								
Total (7 logic inputs + 8 relay outputs) suitable for trip circuit supervision	20TE/30TE				G								
Total (10 logic inputs + 12 relay outputs) suitable for trip circuit supervision *	40TE				H								
Total (12 logic inputs + 12 relay outputs) suitable for trip circuit supervision *	40TE				J								

* Please contact Product manager

Communication Protocol	
Courier	1
Modbus	2
IEC60870-5-103 (VDEW)	3
DNP3.0	4
IEC 61850 over Ethernet and Courier via rear RS485	6
IEC 61850 over Ethernet and IEC60870-5-103 via rear RS485	7
DNP3.0 over Ethernet and Courier via rear RS485	8
IEC 61850 over Ethernet and Modbus via rear RS485	9
IEC 61850 over Ethernet and DNP3.0 via rear RS485	A
IEC61850 over Ethernet + DNP3.0 over Ethernet and Courier via RS485	B
IEC61850 over Ethernet + DNP3.0 over Ethernet and Modbus via RS485	C
IEC61850 over Ethernet + DNP3.0 over Ethernet and IEC60870-5-103 via RS485	D
Case	
20TE Flush (no function keys, 4 programmable LEDs)	B
30TE Flush (3 function keys with LEDs, 8 programmable LEDs)	C
Software only	0
30TE Flush (Additional shorting link)	6
40TE Flush (3 function keys with LEDs, 8 programmable LEDs)	D
Language	
Multilingual (English, French, German, Spanish)	0
Multilingual (English, Russian, Italian, Portuguese)	6
Chinese, English or French via HMI, with English or French only via Communications port	C
Software Reference	
Unless specified the latest version will be delivered	**
Customisation/Regionalisation	
Default	0
Customer specific	A
Hardware Design Suffix	
Initial release	A

APPENDIX B

SETTINGS AND SIGNALS

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
SYSTEM DATA	00.00		
This column contains general system settings and records			
Language	00.01	English	English Francais Deutsch Espanol *[Indexed String]*
This setting defines the default language used by the device for ordering option language = 0			
Language	00.01	English	English Italiano Portuguêse PYCCKÕÖ *[Indexed String]*
This setting defines the default language used by the device for ordering option language = 6			
Password	00.02		4 registers for writing 8 character password Each register contains a pair of characters Each register is formatted as follows:- first character of a pair second character of a pair Each character is in the Courier range 33 - 122 *[ASCII Password (4 chars)* *ASCII Password (8 chars)]*
This setting defines the plain text password.			
Sys Fn Links	00.03	0	Trip LED S/Reset (1 = enable self reset) *[Binary Flag (1) Indexed String]*
This setting allows the fixed function trip LED to be self resetting (set to 1 to extinguish the LED after a period of healthy restoration of load current). Only bit 0 is used.			
Description	00.04	MiCOM P14N MiCOM P14D MiCOM P94V	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
In this cell, you can enter and edit a 16 character IED description.			
Plant Reference	00.05	MiCOM	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell, you can enter and edit a 16 character plant description.			
Model Number	00.06	Model Number	Model Number *[ASCII Text (16 chars)]*
This cell displays the IED model number. This cannot be edited.			
Serial Number	00.08	Serial Number	Serial Number *[ASCII Text (7 chars)]*
This cell displays the IED serial number. This cannot be edited			
Frequency	00.09	50	50 or 60 *[Unsigned Integer (16 bits)]*
This cell sets the mains frequency to either 50 Hz or 60 Hz			
Comms Level	00.0A	2	Comms Level *[Unsigned Integer (16 bits)]*
This cell displays the Courier communications conformance level			
Relay Address	00.0B	255	From 0 to 255 in steps of 1 *[Unsigned Integer (16 bits)]*
This cell sets the first rear port IED address. Available settings are dependent on the protocol. This setting can also be made in the COMMUNICATIONS column.			
Relay Address	00.0B	1	From 1 to 247 in steps of 1 *[Unsigned Integer (16 bits)]*
This cell sets the first rear port IED address. Available settings are dependent on the protocol. This setting can also be made in the COMMUNICATIONS column.			
Relay Address	00.0B	1	From 0 to 254 in steps of 1 *[Unsigned Integer (16 bits)]*
This cell sets the first rear port IED address. Available settings are dependent on the protocol. This setting can also be made in the COMMUNICATIONS column.			
Relay Address	00.0B	1	From 0 to 65519 in steps of 1 *[Unsigned Integer (16 bits)]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This cell sets the first rear port IED address. Available settings are dependent on the protocol. This setting can also be made in the COMMUNICATIONS column.			
Plant Status	00.0C		CB1 Open CB1 Closed *[Binary Flag (16 bits)]*
This cell displays the circuit breaker plant status. The first two bits are used. One to indicate the 52A state and one to indicate the 52B state.			
Control Status	00.0D		Control Status *[Binary Flag (16 bits)]*
This cell is not used			
Active Group	00.0E	1	Active Group *[Unsigned Integer (16 bits)]*
This cell displays the active settings group			
CB Trip/Close	00.10	No Operation	No Operation Trip Close *[Indexed String]*
Supports trip and close commands if enabled in the Circuit Breaker Control menu.			
CB Trip/Close	00.10	No Operation	No Operation Trip Close *[Indexed String]*
Supports trip and close commands if enabled in the Circuit Breaker Control menu.			
Software Ref. 1	00.11		Software Ref. 1 *[ASCII Text (16 chars)]*
This cell displays the IED software version including the protocol and IED model.			
Software Ref. 2	00.12		Software Ref. 2 *[ASCII Text (16 chars)]*
This cell displays the software version of the Ethernet card for models equipped with IEC 61850.			
Opto I/P Status	00.20		Opto 1 Input State (0=Off, 1=Energised) Opto 2 Input State (0=Off, 1=Energised) Opto 3 Input State (0=Off, 1=Energised) Opto 4 Input State (0=Off, 1=Energised) Opto 5 Input State (0=Off, 1=Energised) Opto 6 Input State (0=Off, 1=Energised) Opto 7 Input State (0=Off, 1=Energised) Opto 8 Input State (0=Off, 1=Energised) Opto 9 Input State (0=Off, 1=Energised) Opto 10 Input State (0=Off, 1=Energised) Opto 11 Input State (0=Off, 1=Energised) Opto 12 Input State (0=Off, 1=Energised) Opto 13 Input State (0=Off, 1=Energised) Opto 14 Input State (0=Off, 1=Energised) Opto 15 Input State (0=Off, 1=Energised) Opto 16 Input State (0=Off, 1=Energised) Opto 17 Input State (0=Off, 1=Energised) Opto 18 Input State (0=Off, 1=Energised) Opto 19 Input State (0=Off, 1=Energised) Opto 20 Input State (0=Off, 1=Energised) Opto 21 Input State (0=Off, 1=Energised) Opto 22 Input State (0=Off, 1=Energised) Opto 23 Input State (0=Off, 1=Energised) Opto 24 Input State (0=Off, 1=Energised) Opto 25 Input State (0=Off, 1=Energised) Opto 26 Input State (0=Off, 1=Energised) Opto 27 Input State (0=Off, 1=Energised) Opto 28 Input State (0=Off, 1=Energised) Opto 29 Input State (0=Off, 1=Energised) Opto 30 Input State (0=Off, 1=Energised) Opto 31 Input State (0=Off, 1=Energised) Opto 32 Input State (0=Off, 1=Energised) *[Binary Flag (32 bits) Indexed String]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This cell displays the status of the available opto-inputs. This information is also available in the COMMISSIONING TESTS column			
Relay O/P Status	00.21		Relay 1 (0=Not Operated, 1=Operated) Relay 2 (0=Not Operated, 1=Operated) Relay 3 (0=Not Operated, 1=Operated) Relay 4 (0=Not Operated, 1=Operated) Relay 5 (0=Not Operated, 1=Operated) Relay 6 (0=Not Operated, 1=Operated) Relay 7 (0=Not Operated, 1=Operated) Relay 8 (0=Not Operated, 1=Operated) Relay 9 (0=Not Operated, 1=Operated) Relay 10 (0=Not Operated, 1=Operated) Relay 11 (0=Not Operated, 1=Operated) Relay 12 (0=Not Operated, 1=Operated) Relay 13 (0=Not Operated, 1=Operated) Relay 14 (0=Not Operated, 1=Operated) Relay 15 (0=Not Operated, 1=Operated) Relay 16 (0=Not Operated, 1=Operated) Relay 17 (0=Not Operated, 1=Operated) Relay 18 (0=Not Operated, 1=Operated) Relay 19 (0=Not Operated, 1=Operated) Relay 20 (0=Not Operated, 1=Operated) Relay 21 (0=Not Operated, 1=Operated) Relay 22 (0=Not Operated, 1=Operated) Relay 23 (0=Not Operated, 1=Operated) Relay 24 (0=Not Operated, 1=Operated) Relay 25 (0=Not Operated, 1=Operated) Relay 26 (0=Not Operated, 1=Operated) Relay 27 (0=Not Operated, 1=Operated) Relay 28 (0=Not Operated, 1=Operated) Relay 29 (0=Not Operated, 1=Operated) Relay 30 (0=Not Operated, 1=Operated) Relay 31 (0=Not Operated, 1=Operated) Relay 32 (0=Not Operated, 1=Operated) *[Binary Flag (32 bits) Indexed String]*
This cell displays the status of the available output relays.			
Alarm Status 1	00.22		Thermal Lockout HIF Alarm SG-opto Invalid Prot'n Disabled F out of Range VT Fail Alarm CT Fail Alarm CB Fail Alarm I^ Maint Alarm I^ Lockout Alarm CB Ops Maint CB Ops Lockout CB Op Time Maint CB Op Time Lock Fault Freq Lock CB Status Alarm Man CB Trip Fail Man CB Cls Fail Man CB Unhealthy Man No Checksync A/R Lockout A/R CB Unhealthy A/R No Checksync System Split UV Block User Alarm 1 User Alarm 2 User Alarm 3

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			User Alarm 4 User Alarm 5 User Alarm 6 User Alarm 7 *[Binary Flag (32 bits) Indexed String]*
This cell displays the status of the first 32 alarms as a binary string, including fixed and user settable alarms. This information is repeated for system purposes. This cell uses data type G96-1.			
Opto I/P Status	00.30		Opto 1 Input State (0=Off, 1=Energised) Opto 2 Input State (0=Off, 1=Energised) Opto 3 Input State (0=Off, 1=Energised) Opto 4 Input State (0=Off, 1=Energised) Opto 5 Input State (0=Off, 1=Energised) Opto 6 Input State (0=Off, 1=Energised) Opto 7 Input State (0=Off, 1=Energised) Opto 8 Input State (0=Off, 1=Energised) Opto 9 Input State (0=Off, 1=Energised) Opto 10 Input State (0=Off, 1=Energised) Opto 11 Input State (0=Off, 1=Energised) Opto 12 Input State (0=Off, 1=Energised) Opto 13 Input State (0=Off, 1=Energised) Opto 14 Input State (0=Off, 1=Energised) Opto 15 Input State (0=Off, 1=Energised) Opto 16 Input State (0=Off, 1=Energised) Opto 17 Input State (0=Off, 1=Energised) Opto 18 Input State (0=Off, 1=Energised) Opto 19 Input State (0=Off, 1=Energised) Opto 20 Input State (0=Off, 1=Energised) Opto 21 Input State (0=Off, 1=Energised) Opto 22 Input State (0=Off, 1=Energised) Opto 23 Input State (0=Off, 1=Energised) Opto 24 Input State (0=Off, 1=Energised) Opto 25 Input State (0=Off, 1=Energised) Opto 26 Input State (0=Off, 1=Energised) Opto 27 Input State (0=Off, 1=Energised) Opto 28 Input State (0=Off, 1=Energised) Opto 29 Input State (0=Off, 1=Energised) Opto 30 Input State (0=Off, 1=Energised) Opto 31 Input State (0=Off, 1=Energised) Opto 32 Input State (0=Off, 1=Energised) *[Binary Flag (32 bits) Indexed String]*
This cell display the status of the available opto-inputs. This information is repeated for system purposes.			
Relay O/P Status	00.40		High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits) Indexed String]*
This cell displays the status of the available output relays. This information is repeated for system purposes.			
Alarm Status 1	00.50		Thermal Lockout HIF Alarm SG-opto Invalid Prot'n Disabled F out of Range VT Fail Alarm CT Fail Alarm CB Fail Alarm I^ Maint Alarm I^ Lockout Alarm CB Ops Maint CB Ops Lockout CB Op Time Maint CB Op Time Lock Fault Freq Lock CB Status Alarm

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Man CB Trip Fail Man CB Cls Fail Man CB Unhealthy Man No Checksync A/R Lockout A/R CB Unhealthy A/R No Checksync System Split UV Block User Alarm 1 User Alarm 2 User Alarm 3 User Alarm 4 User Alarm 5 User Alarm 6 User Alarm 7 *[Binary Flag (32 bits) Indexed String]*
This cell displays the status of the first 32 alarms as a binary string, including fixed and user settable alarms. This information is repeated for system purposes. This cell uses data type G96-1.			
Alarm Status 3	00.52		DC Supply Fail GOOSE IED Absent NIC Not Fitted NIC No Response NIC Fatal Error Bad TCP/IP Cfg. NIC Link Fail NIC SW Mis-Match IP Addr Conflict Port A Link Fail Port B Link Fail DREB Set.Invalid Bad DNP Settings SNTP Failure PTP Failure *[Binary Flag (32 bits) Indexed String]*
This cell displays the status of the third set of alarms as a binary string, including fixed and user settable alarms. This cell uses data type G228.			
User Alarms	00.54		User Alarm 1 (0=Self-reset, 1=Manual reset) User Alarm 2 (0=Self-reset, 1=Manual reset) User Alarm 3 (0=Self-reset, 1=Manual reset) User Alarm 4 (0=Self-reset, 1=Manual reset) User Alarm 5 (0=Self-reset, 1=Manual reset) User Alarm 6 (0=Self-reset, 1=Manual reset) User Alarm 7 (0=Self-reset, 1=Manual reset) User Alarm 8 (0=Self-reset, 1=Manual reset) User Alarm 9 (0=Self-reset, 1=Manual reset) User Alarm 10 (0=Self-reset, 1=Manual reset) User Alarm 11 (0=Self-reset, 1=Manual reset) User Alarm 12 (0=Self-reset, 1=Manual reset) User Alarm 13 (0=Self-reset, 1=Manual reset) User Alarm 14 (0=Self-reset, 1=Manual reset) User Alarm 15 (0=Self-reset, 1=Manual reset) User Alarm 16 (0=Self-reset, 1=Manual reset) User Alarm 17 (0=Self-reset, 1=Manual reset) User Alarm 18 (0=Self-reset, 1=Manual reset) User Alarm 19 (0=Self-reset, 1=Manual reset) User Alarm 20 (0=Self-reset, 1=Manual reset) User Alarm 21 (0=Self-reset, 1=Manual reset) User Alarm 22 (0=Self-reset, 1=Manual reset) User Alarm 23 (0=Self-reset, 1=Manual reset) User Alarm 24 (0=Self-reset, 1=Manual reset) User Alarm 25 (0=Self-reset, 1=Manual reset) User Alarm 26 (0=Self-reset, 1=Manual reset) User Alarm 27 (0=Self-reset, 1=Manual reset)

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			User Alarm 28 (0=Self-reset, 1=Manual reset) User Alarm 29 (0=Self-reset, 1=Manual reset) User Alarm 30 (0=Self-reset, 1=Manual reset) User Alarm 31 (0=Self-reset, 1=Manual reset) User Alarm 32 (0=Self-reset, 1=Manual reset) *[Binary Flag (32 bits) Indexed String]*
This cell displays the status of the third set of alarms as a binary string, including fixed and user settable alarms. This cell uses data type G268.			
Build Date&Time	00.60	Build Date & Time	Build Date&Time *[ASCII Text (16 chars)]*
This cell displays the build date & time. This cannot be edited.			
Access Level	00.D0		Level 0 - Logged Out. Level 1 - Password required for level 2. Level 2 - Password required for level 3. Level 3 - No Password required. *[Unsigned Integer (16 bits)]*
This cell displays the current access level.			
Password Level 1	00.D2	blank	4 registers for writing 8 character password Each register contains a pair of characters Each register is formatted as follows:- first character of a pair second character of a pair Each character is in the Courier range 33 - 122 *[ASCII Password (8 chars)]*
This setting allows you to change password level 1.			
Password Level 1	00.D2	blank	4 registers for writing 8 character password Each register contains a pair of characters Each register is formatted as follows:- first character of a pair second character of a pair Each character is in the Courier range 33 - 122 *[ASCII Password (8 chars)]*
This setting allows you to change password level 1 for Modbus only.			
Password Level 2	00.D3	AAAA	4 registers for writing 8 character password Each register contains a pair of characters Each register is formatted as follows:- first character of a pair second character of a pair Each character is in the Courier range 33 - 122 *[ASCII Password (8 chars)]*
This setting allows you to change password level 2.			
Password Level 2	00.D3	AAAA	4 registers for writing 8 character password Each register contains a pair of characters Each register is formatted as follows:- first character of a pair second character of a pair Each character is in the Courier range 33 - 122 *[ASCII Password (8 chars)]*
This setting allows you to change password level 2 for Modbus only.			
Password Level 3	00.D4	AAAA	4 registers for writing 8 character password Each register contains a pair of characters Each register is formatted as follows:- first character of a pair second character of a pair Each character is in the Courier range 33 - 122 *[ASCII Password (8 chars)]*
This setting allows you to change password level 3.			
Password Level 3	00.D4	AAAA	4 registers for writing 8 character password Each register contains a pair of characters Each register is formatted as follows:- first character of a pair second character of a pair

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Each character is in the Courier range 33 - 122 *[ASCII Password (8 chars)]*
This setting allows you to change password level 3 for Modbus only.			
Security Feature	00.DF		Security Feature *[Unsigned Integer (16-bits)]*
This setting displays the level of cyber security implemented, 1 = phase 1.			
Password	00.E1		4 registers for writing encrypted password Registers can contain any bit pattern. *[Encrypted Password (8 chars)]*
This cell allows you to enter the encrypted password. It is not visible via the user interfaced.			
Password Level 1	00.E2	blank	4 registers for writing encrypted password Registers can contain any bit pattern. *[Encrypted Password (8 chars)]*
This setting allows you to change the encrypted password level 1. This is not visible via the user interface.			
Password Level 2	00.E3	AAAA	4 registers for writing encrypted password Registers can contain any bit pattern. *[Encrypted Password (8 chars)]*
This setting allows you to change the encrypted password level 2. This is not visible via the user interface.			
Password Level 3	00.E4	AAAA	4 registers for writing encrypted password Registers can contain any bit pattern. *[Encrypted Password (8 chars)]*
This setting allows you to change the encrypted password level 3. This is not visible via the user interface.			
VIEW RECORDS	01.00		
This column contains information about records. Most of these cells are not editable.			
Select Event [0...n]	01.01	0	From 0 to 2048 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting selects the required event record. A value of 0 corresponds to the latest event, 1 the second latest and so on.			
Menu Cell Ref	01.02	(From Record)	Menu Cell Ref *[Cell Reference]*
This cell indicates the type of event			
Time & Date	01.03	(From Record)	Time & Date *[IEC870 Date & Time]*
This cell shows the Time & Date of the event, given by the internal Real Time Clock.			
Event Text	01.04		Event Text *[ASCII Text (32 chars)]*
This cell shows the description of the event - up to 32 Characters over 2 lines.			
Event Value	01.05		Event Value *[Unsigned Integer (32 bits)]*
This cell displays a 32 bit binary flag representing the event.			
Select Fault [0...n]	01.06	0	From 0 to 9 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting selects the required fault record from those stored. A value of 0 corresponds to the latest fault and so on.			
Faulted Phase	01.07		Start A Start B Start C Start N Trip A Trip B Trip C Trip N *[Binary Flag (8 bits)]*
This cell displays the faulted phase.			
Start Elements 1	01.08		General Start Start I>1 Start I>2 Start I>3 Start I>4 Start BrokenLine Start IN1>1 Start IN1>2

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Start IN1>3 Start IN1>4 Start IN2>1 Start IN2>2 Start IN2>3 Start IN2>4 Start ISEF>1 Start ISEF>2 Start ISEF>3 Start ISEF>4 Start NVD VN>1 Start NVD VN>2 Thermal Alarm Start V2>1 Start V<1 Start V<2 Start V< A/AB Start V< B/BC Start V< C/CA Start V>1 Start V>2 Start V> A/AB Start V> B/BC Start V> C/CA *[Binary Flag (32 bits)* *Indexed String]*
This cell displays the status of the first set of 32 start signals.			
Start Elements 2	01.09		Start NVD VN>3 Start V<3 Start V>3 Start NVD VN>4 Start NVD VN<1 Start NVD VN<2 Start YN> Start GN> Start BN> Start df/dt>1 Start df/dt>2 Start df/dt>3 Start df/dt>4 Start I2>1 Start I2>2 Start I2>3 Start I2>4 Start I>5 Start I>6 Power>1 Start Power>2 Start Power> A Start Power> B Start Power> C Start Power<1 Start Power<2 Start Power< A Start Power< B Start Power< C Start SensP1 Start A SensP2 Start A Start V2>2 *[Binary Flag (32 bits)* *Indexed String]*
This cell displays the status of the second set of 32 start signals.			
Start Elements 3	01.0A		Start F 1

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Start F 2 Start F 3 Start F 4 Start F 5 Start F 6 Start F 7 Start F 8 Start F 9 Start df/dt+t 1 Start df/dt+t 2 Start df/dt+t 3 Start df/dt+t 4 Start df/dt+t 5 Start df/dt+t 6 Start df/dt+t 7 Start df/dt+t 8 Start df/dt+t 9 Sta DelF/DelT 1 Sta DelF/DelT 2 Sta DelF/DelT 3 Sta DelF/DelT 4 Sta DelF/DelT 5 Sta DelF/DelT 6 Sta DelF/DelT 7 Sta DelF/DelT 8 Sta DelF/DelT 9 dv/dt1 Start dv/dt2 Start dv/dt StartA/AB dv/dt StartB/BC dv/dt StartC/CA *[Binary Flag (32 bits)* *Indexed String]*
This cell displays the status of the third set of 32 start signals.			
Start Elements 4	01.0B		dv/dt3 Start dv/dt4 Start Vdc1 Start Vdc2 Start Vdc3 Start WDE>1 Fwd Start WDE>1 Rev Start WDE>2 Fwd Start WDE>2 Rev Start Start Vavg<1 Start Vavg<2 Start Vavg< PhA Start Vavg< PhB Start Vavg< PhC Start Vavg>1 Start Vavg>2 Start Vavg> PhA Start Vavg> PhB Start Vavg> PhC Start V0avg>1 Start V0avg>2 Start V1avg>1 Start V1avg>2 Start V2avg>1 Start V2avg>2 Start V1<1 Start V1<2 Start V1>1 Start V1>2

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Start Rev. Power *[Binary Flag (32 bits)* *Indexed String]*
This cell displays the status of the fourth set of 32 start signals.			
Trip Elements 1	01.0C		Any Trip Trip I>1 Trip I>2 Trip I>3 Trip I>4 Trip Broken Line Trip IN1>1 Trip IN1>2 Trip IN1>3 Trip IN1>4 Trip IN2>1 Trip IN2>2 Trip IN2>3 Trip IN2>4 Trip ISEF>1 Trip ISEF>2 Trip ISEF>3 Trip ISEF>4 Trip IREF> Trip NVD VN>1 Trip NVD VN>2 Trip Thermal Trip V2>1 Trip I>5 Trip I>6 Trip V2>2 *[Binary Flag (32 bits)* *Indexed String]*
This cell displays the status of the first set of 32 trip signals.			
Trip Elements 2	01.0D		Trip V<1 Trip V<2 Trip V< A/AB Trip V< B/BC Trip V< C/CA Trip V>1 Trip V>2 Trip V> A/AB Trip V> B/BC Trip V> C/CA Trip V<3 Trip V>3 Trip NVD VN>3 Trip NVD VN>4 Trip NVD VN<1 Trip NVD VN<2 Trip YN> Trip GN> Trip BN> Trip df/dt>1 Trip df/dt>2 Trip df/dt>3 Trip df/dt>4 Trip I2>1 Trip I2>2 Trip I2>3 Trip I2>4 *[Binary Flag (32 bits)* *Indexed String]*
This cell displays the status of the second set of 32 trip signals.			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
Trip Elements 3	01.0E		Trip F 1 Trip F 2 Trip F 3 Trip F 4 Trip F 5 Trip F 6 Trip F 7 Trip F 8 Trip F 9 Trip df/dt+t 1 Trip df/dt+t 2 Trip df/dt+t 3 Trip df/dt+t 4 Trip df/dt+t 5 Trip df/dt+t 6 Trip df/dt+t 7 Trip df/dt+t 8 Trip df/dt+t 9 Trip DelF/DelT 1 Trip DelF/DelT 2 Trip DelF/DelT 3 Trip DelF/DelT 4 Trip DelF/DelT 5 Trip DelF/DelT 6 Trip DelF/DelT 7 Trip DelF/DelT 8 Trip DelF/DelT 9 Vdc1 Trip Vdc2 Trip Vdc3 Trip *[Binary Flag (32 bits)* *Indexed String]*
This cell displays the status of the third set of 32 trip signals.			
Trip Elements 4	01.0F		Trip f+df/dt 1 Trip f+df/dt 2 Trip f+df/dt 3 Trip f+df/dt 4 Trip f+df/dt 5 Trip f+df/dt 6 Trip f+df/dt 7 Trip f+df/dt 8 Trip f+df/dt 9 dv/dt1 Trip dv/dt2 Trip dv/dt Trip A/AB dv/dt Trip B/BC dv/dt Trip C/CA Power>1 Trip Power>2 Trip Power> A Trip Power> B Trip Power> C Trip Power<1 Trip Power<2 Trip Power< A Trip Power< B Trip Power< C Trip SensP1 Trip A SensP2 Trip A dv/dt3 Trip dv/dt4 Trip FA HIF CHA HIF

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			WDE>1 Fwd Fault WDE>2 Fwd Fault *[Binary Flag (32 bits)* *Indexed String]*
This cell displays the status of the fourth set of 32 trip signals.			
Fault Alarms	01.10		CB Fail 1 CB Fail 2 VTS CTS VDep OC CLP AR Trip 1 AR Trip 2 AR Trip 3 AR Trip 4 AR Trip 5 DC Supply Fail *[Binary Flag (32 bits)* *Indexed String]*
This cell displays the status of the fault alarm signals.			
Fault Time	01.11		Fault Time *[IEC870 Date & Time]*
This cell displays the time and date of the fault			
Active Group	01.12		Active Group *[Unsigned Integer (16 bits)]*
This cell displays the active settings group			
System Frequency	01.13		System Frequency *[Courier Number (frequency)]*
This cell displays the system frequency			
Fault Duration	01.14		Fault Duration *[Courier Number (time-seconds)]*
This cell displays the duration of the fault time			
CB Operate Time	01.15		CB Operate Time *[Courier Number (time-seconds)]*
This cell displays the CB operate time			
Relay Trip Time	01.16		Relay Trip Time *[Courier Number (time-seconds)]*
This cell displays the time from protection start to protection trip			
VAB	01.1E		VAB *[Courier Number (voltage)]*
This cell displays VA with respect to VB			
VBC	01.1F		VBC *[Courier Number (voltage)]*
This cell displays VB with respect to VC			
VCA	01.20		VCA *[Courier Number (voltage)]*
This cell displays VC with respect to VA			
VAN	01.26		VAN *[Courier Number (voltage)]*
This cell displays VA with respect to Neutral			
VBN	01.27		VBN *[Courier Number (voltage)]*
This cell displays VB with respect to Neutral			
VCN	01.28		VCN *[Courier Number (voltage)]*
This cell displays VC with respect to Neutral			
VN Derived	01.29		VN Derived *[Courier Number (voltage)]*
This cell displays the derived Earth fault voltage			
VN Measured	01.29		VN Measured

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Courier Number (voltage)]
This cell displays the measured Earth fault voltage			
DC Supply Mag	01.30		DC Supply Mag *[Courier Number (voltage)]*
This cell displays the Auxiliary Supply Voltage level			
Trip Elements 5	01.32		Trip Vavg<1 Trip Vavg<2 Trip Vavg< phA Trip Vavg< phB Trip Vavg< phC Trip Vavg>1 Trip Vavg>2 Trip Vavg> phA Trip Vavg> phB Trip Vavg> phC Trip V0avg>1 Trip V0avg>2 Trip V1avg>1 Trip V1avg>2 Trip V2avg>1 Trip V2avg>2 Trip V1<1 Trip V1<2 Trip V1>1 Trip V1>2 Trip Rev. Power Trip Tstart> Trip Tstall> Run Trip Tstall> St. Trip Vdip Trip V Shift *[Binary Flag (32 bits)* *Indexed String]*
This cell displays the status of the fifth set of 32 trip signals.			
Select Maint [0...n]	01.F0	Manual override to select a fault record.	From 0 to 9 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting selects the required maintenance report from those stored. A value of 0 corresponds to the latest report.			
Maint Text	01.F1		Maint Text *[ASCII Text (32 chars)]*
This cell displays the description of the maintenance record			
Maint Type	01.F2		Maint Type *[Unsigned Integer (32 bits)]*
This is the type of maintenance record			
Maint Data	01.F3		Maint Data *[Unsigned Integer (32 bits)]*
This is the maintenance record data (error code)			
Evt Iface Source	01.FA		Evt Iface Source *[Unsigned Integer (16 bits)]*
This cell displays the interface on which the event was logged			
Evt Access Level	01.FB		Evt Access Level *[Unsigned Integer (16 bits)]*
Any security event that indicates that it came from an interface action, such as disabling a port, will also record the access level of the interface that initiated the event. This access level is displayed in this cell.			
Evt Extra Info	01.FC		Evt Extra Info *[Unsigned Integer (16 bits)]*
This cell provides supporting information for the event and can vary between the different event types.			
Evt Unique Id	01.FE		Evt Unique Id *[Unsigned Integer (32 bits)]*
This cell displays the unique event ID associated with the event.			
Reset Indication	01.FF	No	No Yes

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Indexed String]
This command resets the trip LED indications provided that the relevant protection element has reset.			
MEASUREMENTS 1	02.00		
This column contains measurement parameters			
VAB Magnitude	02.14		VAB Magnitude *[Courier Number (voltage)]*
This cell displays the A-phase voltage magnitude with respect to B-phase (VAB)			
VAB Phase Angle	02.15		VAB Phase Angle *[Courier Number (angle)]*
This cell displays the VAB phase angle			
VBC Magnitude	02.16		VBC Magnitude *[Courier Number (voltage)]*
This cell displays the B-phase voltage magnitude with respect to C-phase (VBC)			
VBC Phase Angle	02.17		VBC Phase Angle *[Courier Number (angle)]*
This cell displays the VBC phase angle			
VCA Magnitude	02.18		VCA Magnitude *[Courier Number (voltage)]*
This cell displays the C-phase voltage magnitude with respect to A-phase (VCA)			
VCA Phase Angle	02.19		VCA Phase Angle *[Courier Number (angle)]*
This cell displays the VCA phase angle			
VAN Magnitude	02.1A		VAN Magnitude *[Courier Number (voltage)]*
This cell displays the A-phase voltage magnitude with respect to Neutral (VAN)			
VAN Phase Angle	02.1B		VAN Phase Angle *[Courier Number (angle)]*
This cell displays the VAN phase angle			
VBN Magnitude	02.1C		VBN Magnitude *[Courier Number (voltage)]*
This cell displays the B-phase voltage magnitude with respect to Neutral (VBN)			
VBN Phase Angle	02.1D		VBN Phase Angle *[Courier Number (angle)]*
This cell displays the VBN phase angle			
VCN Magnitude	02.1E		VCN Magnitude *[Courier Number (voltage)]*
This cell displays the C-phase voltage magnitude with respect to Neutral (VCN)			
VCN Phase Angle	02.1F		VCN Phase Angle *[Courier Number (angle)]*
This cell displays the VCN phase angle			
VN Mag	02.22		VN Mag *[Courier Number (voltage)]*
This cell displays the neutral voltage magnitude (can be measured or derived according to cell [0A 16])			
VN Ang	02.23		VN Ang *[Courier Number (angle)]*
This cell displays the neutral phase angle (can be measured or derived according to cell [0A 16])			
V1 Magnitude	02.24		V1 Magnitude *[Courier Number (voltage)]*
This cell displays the positive sequence voltage magnitude			
V2 Magnitude	02.25		V2 Magnitude *[Courier Number (voltage)]*
This cell displays the negative sequence voltage magnitude			
V0 Magnitude	02.26		V0 Magnitude *[Courier Number (voltage)]*
This cell displays the zero sequence voltage magnitude			
V0 Magnitude	02.26		V0 Magnitude *[Courier Number (voltage)]*
This cell displays the zero sequence voltage magnitude			
VAN RMS	02.27		VAN RMS

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Courier Number (voltage)]
This cell displays the A-phase RMS voltage with respect to Neutral (VAN)			
VBN RMS	02.28		VBN RMS *[Courier Number (voltage)]*
This cell displays the B-phase RMS voltage with respect to Neutral (VAN)			
VCN RMS	02.29		VCN RMS *[Courier Number (voltage)]*
This cell displays the C-phase RMS voltage with respect to Neutral (VAN)			
Vr Antibacks Mag	02.2A		Vr Antibacks Mag *[Courier Number (voltage)]*
This cell displays the C-phase RMS voltage with respect to Neutral (VAN)			
Frequency	02.2D		Frequency *[Courier Number (frequency)]*
This cell displays the system frequency			
C/S Voltage Mag	02.2E		C/S Voltage Mag *[Courier Number (voltage)]*
This cell displays the Check Synchronisation voltage magnitude			
C/S Voltage Ang	02.2F		C/S Voltage Ang *[Courier Number (angle)]*
This cell displays the Check Synchronisation voltage phase angle			
C/S Bus-Line Ang	02.30		C/S Bus-Line Ang *[Courier Number (angle)]*
This cell displays the Check Synchronisation bus-to-line phase angle			
Slip Frequency	02.31		Slip Frequency *[Courier Number (frequency)]*
This cell displays the slip frequency			
C/S Bus-Line Mag	02.3A		C/S Bus-Line Mag *[Courier Number (voltage)]*
This cell displays the Check Synchronisation bus-to-line magnitude			
V1 Magnitude	02.46		V1 Magnitude *[Courier Number (voltage)]*
This cell displays the positive sequence voltage magnitude			
V1 Phase Angle	02.47		V1 Phase Angle *[Courier Number (angle)]*
This cell displays the positive sequence voltage phase angle			
V2 Magnitude	02.48		V2 Magnitude *[Courier Number (voltage)]*
This cell displays the negative sequence voltage magnitude			
V2 Phase Angle	02.49		V2 Phase Angle *[Courier Number (angle)]*
This cell displays the negative sequence voltage phase angle			
V0 Magnitude	02.4A		V0 Magnitude *[Courier Number (voltage)]*
This cell displays the zero sequence voltage magnitude			
V0 Magnitude	02.4A		V0 Magnitude *[Courier Number (voltage)]*
This cell displays the zero sequence voltage magnitude			
V0 Phase Angle	02.4B		V0 Phase Angle *[Courier Number (angle)]*
This cell displays the zero sequence voltage phase angle			
MEASUREMENTS 2	03.00		
This column contains measurement parameters			
VA Mov Average	03.28		VA Mov Average *[Courier Number (voltage)]*
A-phase RMS average voltage with respect to Neutral (VAN)			
VB Mov Average	03.29		VB Mov Average *[Courier Number (voltage)]*
B-phase RMS average voltage with respect to Neutral (VBN)			
VC Mov Average	03.2A		VC Mov Average

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Courier Number (voltage)]
C-phase RMS average voltage with respect to Neutral (VCN)			
V0 Mov Average	03.2B		V0 Mov Average *[Courier Number (voltage)]*
Zero sequence voltage magnitude average			
V1 Mov Average	03.2C		V1 Mov Average *[Courier Number (voltage)]*
Positive sequence voltage magnitude average			
V2 Mov Average	03 .2D		V2 Mov Average *[Courier Number (voltage)]*
Negative sequence voltage magnitude average			
V Average	03.49		V Average *[Courier Number (voltage)]*
This cell displays the average of VA, VB, VC			
% V2 / V Average	03.4B		% V2 / V Average *[Courier Number (percentage)]*
This cell displays the percentage of V2 / V Average			
MEASUREMENTS 3	04.00		
This column contains measurement parameters			
df/dt	04.0E		df/dt *[Courier Number (Hz/sec)]*
This cell displays the rate of change of frequency			
DC Supply Mag	04.20		DC Supply Mag *[Courier Number (voltage)]*
This cell displays the Auxiliary Supply Voltage level			
FREQUENCY STAT	05.00		
This column contains frequency protection statistical parameters			
Stg1 f+t Sta	05.01		Stg1 f+t Sta *[Unsigned Integer (16 bits)]*
Number of f+t starts for Stage 1			
Stg1 f+t Trp	05.02		Stg1 f+t Trp *[Unsigned Integer (16 bits)]*
Number of f+t trips for Stage 1			
Stg1 f+df/dt Trp	05.03		Stg1 f+df/dt Trp *[Unsigned Integer (16 bits)]*
Number of f+df/dt trips for Stage 1			
Stg1 df/dt+t Sta	05.04		Stg1 df/dt+t Sta *[Unsigned Integer (16 bits)]*
Number of df/dt+t starts for Stage 1			
Stg1 df/dt+t Trp	05.05		Stg1 df/dt+t Trp *[Unsigned Integer (16 bits)]*
Number of df/dt trips for Stage 1			
Stg1 f+Df/Dt Sta	05.06		Stg1 f+Df/Dt Sta *[Unsigned Integer (16 bits)]*
Number of f+DF/DT starts for Stage 1			
Stg1 f+Df/Dt Trp	05.07		Stg1 f+Df/Dt Trp *[Unsigned Integer (16 bits)]*
Number of f+DF/DT trips for Stage 1			
Stg1 Revn Date	05.08		Stg1 Revn Date *[IEC870 Date & Time]*
Stage 1 Revision Date			
Stg2 f+t Sta	05.0A		Stg2 f+t Sta *[Unsigned Integer (16 bits)]*
Number of f+t starts for Stage 2			
Stg2 f+t Trp	05.0B		Stg2 f+t Trp *[Unsigned Integer (16 bits)]*
Number of f+t trips for Stage 2			
Stg2 f+df/dt Trp	05.0C		Stg2 f+df/dt Trp *[Unsigned Integer (16 bits)]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
Number of f+df/dt trips for Stage 2			
Stg2 df/dt+t Sta	05.0D		Stg2 df/dt+t Sta *[Unsigned Integer (16 bits)]*
Number of df/dt+t starts for Stage 2			
Stg2 df/dt+t Trp	05.0E		Stg2 df/dt+t Trp *[Unsigned Integer (16 bits)]*
Number of df/dt trips for Stage 2			
Stg2 f+Df/Dt Sta	05.0F		Stg2 f+Df/Dt Sta *[Unsigned Integer (16 bits)]*
Number of f+DF/DT starts for Stage 2			
Stg2 f+Df/Dt Trp	05.10		Stg2 f+Df/Dt Trp *[Unsigned Integer (16 bits)]*
Number of f+DF/DT trips for Stage 2			
Stg2 Revn Date	05.11		Stg2 Revn Date *[IEC870 Date & Time]*
Stage 2 Revision Date			
Stg3 f+t Sta	05.13		Stg3 f+t Sta *[Unsigned Integer (16 bits)]*
Number of f+t starts for Stage 3			
Stg3 f+t Trp	05.14		Stg3 f+t Trp *[Unsigned Integer (16 bits)]*
Number of f+t trips for Stage 3			
Stg3 f+df/dt Trp	05.15		Stg3 f+df/dt Trp *[Unsigned Integer (16 bits)]*
Number of f+df/dt trips for Stage 3			
Stg3 df/dt+t Sta	05.16		Stg3 df/dt+t Sta *[Unsigned Integer (16 bits)]*
Number of df/dt+t starts for Stage 3			
Stg3 df/dt+t Trp	05.17		Stg3 df/dt+t Trp *[Unsigned Integer (16 bits)]*
Number of df/dt trips for Stage 3			
Stg3 f+Df/Dt Sta	05.18		Stg3 f+Df/Dt Sta *[Unsigned Integer (16 bits)]*
Number of f+DF/DT starts for Stage 3			
Stg3 f+Df/Dt Trp	05.19		Stg3 f+Df/Dt Trp *[Unsigned Integer (16 bits)]*
Number of f+DF/DT trips for Stage 3			
Stg3 Revn Date	05.1A		Stg3 Revn Date *[IEC870 Date & Time]*
Stage 3 Revision Date			
Stg4 f+t Sta	05.1C		Stg4 f+t Sta *[Unsigned Integer (16 bits)]*
Number of f+t starts for Stage 4			
Stg4 f+t Trp	05.1D		Stg4 f+t Trp *[Unsigned Integer (16 bits)]*
Number of f+t trips for Stage 4			
Stg4 f+df/dt Trp	05.1E		Stg4 f+df/dt Trp *[Unsigned Integer (16 bits)]*
Number of f+df/dt trips for Stage 4			
Stg4 df/dt+t Sta	05.1F		Stg4 df/dt+t Sta *[Unsigned Integer (16 bits)]*
Number of df/dt+t starts for Stage 4			
Stg4 df/dt+t Trp	05.20		Stg4 df/dt+t Trp *[Unsigned Integer (16 bits)]*
Number of df/dt trips for Stage 4			
Stg4 f+Df/Dt Sta	05.21		Stg4 f+Df/Dt Sta *[Unsigned Integer (16 bits)]*
Number of f+DF/DT starts for Stage 4			
Stg4 f+Df/Dt Trp	05.22		Stg4 f+Df/Dt Trp

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Unsigned Integer (16 bits)]
Number of f+DF/DT trips for Stage 4			
Stg4 Revn Date	05.23		Stg4 Revn Date *[IEC870 Date & Time]*
Stage 4 Revision Date			
Stg5 f+t Sta	05.25		Stg5 f+t Sta *[Unsigned Integer (16 bits)]*
Number of f+t starts for Stage 5			
Stg5 f+t Trp	05.26		Stg5 f+t Trp *[Unsigned Integer (16 bits)]*
Number of f+t trips for Stage 5			
Stg5 f+df/dt Trp	05.27		Stg5 f+df/dt Trp *[Unsigned Integer (16 bits)]*
Number of f+df/dt trips for Stage 5			
Stg5 df/dt+t Sta	05.28		Stg5 df/dt+t Sta *[Unsigned Integer (16 bits)]*
Number of df/dt+t starts for Stage 5			
Stg5 df/dt+t Trp	05.29		Stg5 df/dt+t Trp *[Unsigned Integer (16 bits)]*
Number of df/dt trips for Stage 5			
Stg5 f+Df/Dt Sta	05.2A		Stg5 f+Df/Dt Sta *[Unsigned Integer (16 bits)]*
Number of f+DF/DT starts for Stage 5			
Stg5 f+Df/Dt Trp	05.2B		Stg5 f+Df/Dt Trp *[Unsigned Integer (16 bits)]*
Number of f+DF/DT trips for Stage 5			
Stg5 Revn Date	05.2C		Stg5 Revn Date *[IEC870 Date & Time]*
Stage 5 Revision Date			
Stg6 f+t Sta	05.2E		Stg6 f+t Sta *[Unsigned Integer (16 bits)]*
Number of f+t starts for Stage 6			
Stg6 f+t Trp	05.2F		Stg6 f+t Trp *[Unsigned Integer (16 bits)]*
Number of f+t trips for Stage 6			
Stg6 f+df/dt Trp	05.30		Stg6 f+df/dt Trp *[Unsigned Integer (16 bits)]*
Number of f+df/dt trips for Stage 6			
Stg6 df/dt+t Sta	05.31		Stg6 df/dt+t Sta *[Unsigned Integer (16 bits)]*
Number of df/dt+t starts for Stage 6			
Stg6 df/dt+t Trp	05.32		Stg6 df/dt+t Trp *[Unsigned Integer (16 bits)]*
Number of df/dt trips for Stage 6			
Stg6 f+Df/Dt Sta	05.33		Stg6 f+Df/Dt Sta *[Unsigned Integer (16 bits)]*
Number of f+DF/DT starts for Stage 6			
Stg6 f+Df/Dt Trp	05.34		Stg6 f+Df/Dt Trp *[Unsigned Integer (16 bits)]*
Number of f+DF/DT trips for Stage 6			
Stg6 Revn Date	05.35		Stg6 Revn Date *[IEC870 Date & Time]*
Stage 6 Revision Date			
Stg7 f+t Sta	05.37		Stg7 f+t Sta *[Unsigned Integer (16 bits)]*
Number of f+t starts for Stage 7			
Stg7 f+t Trp	05.38		Stg7 f+t Trp *[Unsigned Integer (16 bits)]*
Number of f+t trips for Stage 7			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
Stg7 f+df/dt Trp	05.39		Stg7 f+df/dt Trp *[Unsigned Integer (16 bits)]*
Number of f+df/dt trips for Stage 7			
Stg7 df/dt+t Sta	05.3A		Stg7 df/dt+t Sta *[Unsigned Integer (16 bits)]*
Number of df/dt+t starts for Stage 7			
Stg7 df/dt+t Trp	05.3B		Stg7 df/dt+t Trp *[Unsigned Integer (16 bits)]*
Number of df/dt trips for Stage 7			
Stg7 f+Df/Dt Sta	05.3C		Stg7 f+Df/Dt Sta *[Unsigned Integer (16 bits)]*
Number of f+DF/DT starts for Stage 7			
Stg7 f+Df/Dt Trp	05.3D		Stg7 f+Df/Dt Trp *[Unsigned Integer (16 bits)]*
Number of f+DF/DT trips for Stage 7			
Stg7 Revn Date	05.3E		Stg7 Revn Date *[IEC870 Date & Time]*
Stage 7 Revision Date			
Stg8 f+t Sta	05.40		Stg8 f+t Sta *[Unsigned Integer (16 bits)]*
Number of f+t starts for Stage 8			
Stg8 f+t Trp	05.41		Stg8 f+t Trp *[Unsigned Integer (16 bits)]*
Number of f+t trips for Stage 8			
Stg8 f+df/dt Trp	05.42		Stg8 f+df/dt Trp *[Unsigned Integer (16 bits)]*
Number of f+df/dt trips for Stage 8			
Stg8 df/dt+t Sta	05.43		Stg8 df/dt+t Sta *[Unsigned Integer (16 bits)]*
Number of df/dt+t starts for Stage 8			
Stg8 df/dt+t Trp	05.44		Stg8 df/dt+t Trp *[Unsigned Integer (16 bits)]*
Number of df/dt trips for Stage 8			
Stg8 f+Df/Dt Sta	05.45		Stg8 f+Df/Dt Sta *[Unsigned Integer (16 bits)]*
Number of f+DF/DT starts for Stage 8			
Stg8 f+Df/Dt Trp	05.46		Stg8 f+Df/Dt Trp *[Unsigned Integer (16 bits)]*
Number of f+DF/DT trips for Stage 8			
Stg8 Revn Date	05.47		Stg8 Revn Date *[IEC870 Date & Time]*
Stage 8 Revision Date			
Stg9 f+t Sta	05.49		Stg9 f+t Sta *[Unsigned Integer (16 bits)]*
Number of f+t starts for Stage 9			
Stg9 f+t Trp	05.4A		Stg9 f+t Trp *[Unsigned Integer (16 bits)]*
Number of f+t trips for Stage 9			
Stg9 f+df/dt Trp	05.4B		Stg9 f+df/dt Trp *[Unsigned Integer (16 bits)]*
Number of f+df/dt trips for Stage 9			
Stg9 df/dt+t Sta	05.4C		Stg9 df/dt+t Sta *[Unsigned Integer (16 bits)]*
Number of df/dt+t starts for Stage 9			
Stg9 df/dt+t Trp	05.4D		Stg9 df/dt+t Trp *[Unsigned Integer (16 bits)]*
Number of df/dt trips for Stage 9			
Stg9 f+Df/Dt Sta	05.4E		Stg9 f+Df/Dt Sta *[Unsigned Integer (16 bits)]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
Number of f+DF/DT starts for Stage 9			
Stg9 f+Df/Dt Trp	05.4F		Stg9 f+Df/Dt Trp *[Unsigned Integer (16 bits)]*
Number of f+DF/DT trips for Stage 9			
Stg9 Revn Date	05.50		Stg9 Revn Date *[IEC870 Date & Time]*
Stage 9 Revision Date			
Reset Statistics	05.52	No Operation	No Operation All Stage 1 Stage 2 Stage 3 Stage 4 Stage 5 Stage 6 Stage 7 Stage 8 Stage 9 *[Indexed String]*
This command resets the statistics on a stage by stage basis or for all stages at once			
CB CONDITION	06.00		
This column contains CB condition monitoring measured parameters			
CB Operations	06.01		CB Operations *[Unsigned Integer (16 bits)]*
This cell displays the number of CB Operations			
CB Operate Time	06.05		CB Operate Time *[Courier Number (time-seconds)]*
This cell displays the CB Operate Time			
Reset CB Data	06.06	No	No Yes *[Indexed String]*
This cell resets the CB condition monitoring data			
CB CONTROL	07.00		
This column controls the circuit Breaker Control configuration			
CB Control by	07.01	Disabled	Disabled Local Remote Local+Remote Opto Opto+local Opto+Remote Opto+Rem+local *[Indexed String]*
This setting selects the type of circuit breaker control to be used			
Close Pulse Time	07.02	0.5	From 0.1 to 50 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of the close pulse within which the CB should close when a close command is issued.			
Trip Pulse Time	07.03	0.5	From 0.1 to 5 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of the trip pulse within which the CB should trip when a manual or protection trip command is issued.			
Man Close Delay	07.05	10	From 0.01 to 600 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the delay time before the close pulse is executed.			
CB Healthy Time	07.06	5	From 0.01 to 9999 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the time period in which a CB needs to indicate a healthy condition before it closes. If the CB does not indicate a healthy condition in this time period following a close command then the IED will lockout and alarm.			
Sys Check Time	07.07	5	From 0.01 to 9999 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets a time delay for manual closure with System Check Synchronizing. If the System Check Synchronizing criteria are not satisfied			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
in this time period following a close command, the IED will lockout and produce an alarm.			
Lockout Reset	07.08	No	No Yes *[Indexed String]*
This command resets the Autoreclose Lockout.			
Reset Lockout by	07.09	CB Close	User Interface CB Close *[Indexed String]*
This setting defines whether the Lockout signal is to be reset by the user interface or a CB Close signal.			
Man Close RstDly	07.0A	5	From 0.1 to 600 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the time delay before the Lockout state can be reset following a manual closure.			
Autoreclose Mode	07.0B	No Operation	No Operation Auto Non Auto *[Indexed String]*
This command changes the Autoreclose mode			
AR Status	07.0E		Auto Mode Non-auto Mode Live Line *[Indexed String]*
This cell displays the Autoreclose - In Service or Out of Service			
Total Reclosures	07.0F		Total Reclosures *[Unsigned Integer (16 bits)]*
This cell displays the number of successful reclosures.			
Reset Total AR	07.10	No	No Yes *[Indexed String]*
This command allows you to reset the Autoreclose counters.			
CB Status Input	07.11	None	None 52A 52B Both 52A and 52B *[Indexed String]*
Setting to define the type of circuit breaker contacts that will be used for the circuit breaker control logic. Form A contacts match the status of the circuit breaker primary contacts, form B are opposite to the breaker status.			
1 Shot Clearance	07.12		1 Shot Clearance *[Unsigned Integer (16 bits)]*
This cell displays the total number of successful clearances after 1 shot			
2 Shot Clearance	07.13		2 Shot Clearance *[Unsigned Integer (16 bits)]*
This cell displays the total number of successful clearances after 2 shots			
3 Shot Clearance	07.14		3 Shot Clearance *[Unsigned Integer (16 bits)]*
This cell displays the total number of successful clearances after 3 shots			
4 Shot Clearance	07.15		4 Shot Clearance *[Unsigned Integer (16 bits)]*
This cell displays the total number of successful clearances after 4 shots			
Persistent Fault	07.16		Persistent Fault *[Unsigned Integer (16 bits)]*
This cell displays the total number of unsuccessful clearances after which the Autoreclose went into lockout.			
Shot1 Recloses	07.20		Shot1 Recloses *[Unsigned Integer (16 bits)]*
This cell displays the total number of single-shot shot reclose attempts			
Shot234 Recloses	07.21		Shot234 Recloses *[Unsigned Integer (16 bits)]*
This cell displays the total number of multi-shot reclose attempts			
DATE AND TIME	08.00		
This column contains Date and Time stamp settings			
Date/Time	08.01		

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This setting defines the IED's current date and time.			
IRIG-B Sync	08.04	None	None RP1 RP2 *[Indexed String]*
This setting enables or disables IRIG-B synchronisation and defines which rear port is to be used as an IRIG-B input.			
IRIG-B Status	08.05		Disabled Signal Healthy No Signal *[Indexed String]*
This cell displays the IRIG-B status			
Primary Source	08.08	PTP	IRIG-B None SNTP PTP *[Indexed String]*
Sets the primary time synchronisation source			
Secondary Source	08.09	None	IRIG-B None SNTP PTP *[Indexed String]*
Sets the secondary time synchronisation source			
Domain Number	08.0F	0	From 0 to 127 in steps of 1 *[Integers]*
Assigns the PTP domain number. A domain is grouping of PTP clocks that synchronise to each other on a network. This provides a way of implementing independent synchronisation of PTP clocks on a shared network			
Act. Time Source	08.10		IRIG-B None SNTP PTP *[Indexed String]*
Displays the active time synchronisation source being used. 'Free Running' means the IED is not synchronised with any normal time-server, including IRIG-B, PTP or SNTP. The IED relies solely on its internal clock.			
PTP Status	08.12		Not Master Found Illegal Master Valid master *[Indexed String]*
IEC61850 versions only. Displays the status of PTP time synchronisation No Master Found = No PTP master can be found, the IED has not received a valid 'Announce' message. Illegal Master = Master clock is not valid, typically this will occur when the clock is not using the correct epoch Valid Master = At least valid one master clock is available			
SNTP Status	08.13		Disabled Trying Server 1 Trying Server 2 Server 1 OK Server 2 OK No Response No Valid Clock *[Indexed String]*
This cell displays the SNTP time synchronisation status for IEC61850 or DNP3 over Ethernet versions.			
LocalTime Enable	08.20	Fixed	Disabled Fixed Flexible *[Indexed String]*
Disabled: No local time zone will be maintained Fixed - Local time zone adjustment can be defined (all interfaces) Flexible - Local time zone adjustment can be defined (non-local interfaces)			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
LocalTime Offset	08.21	0	From -720 to 720 in steps of 15 *[Courier Number (time-minutes)]*
This setting specifies the offset for the local time zone from -12 hours to +12 hrs in 15 minute intervals. This adjustment is applied to the time based on the UTC/GMT master clock.			
DST Enable	08.22	Enabled	Disabled Enabled *[Indexed String]*
This setting turns daylight saving time adjustment on or off.			
DST Offset	08.23	60	30 or 60 *[Courier Number (time-minutes)]*
This setting defines the daylight saving offset used for the local time adjustment.			
DST Start	08.24	Last	First Second Third Fourth Last *[Indexed String]*
This setting specifies the week of the month in which daylight saving time adjustment starts.			
DST Start Day	08.25	Sunday	Sunday Monday Tuesday Wednesday Thursday Friday Saturday *[Indexed String]*
This setting specifies the day of the week in which daylight saving time adjustment starts			
DST Start Month	08.26	March	January February March April May June July August September October November December *[Indexed String]*
This setting specifies the month in which daylight saving time adjustment starts			
DST Start Mins	08.27	60	From 0 to 1425 in steps of 15 *[Courier Number (time-minutes)]*
Setting to specify the time of day in which daylight saving time adjustment starts. This is set relative to 00:00 hrs on the selected day when time adjustment is to start			
DST End	08.28	Last	First Second Third Fourth Last *[Indexed String]*
This setting specifies the week of the month in which daylight saving time adjustment ends			
DST End Day	08.29	Sunday	Sunday Monday Tuesday Wednesday Thursday Friday Saturday *[Indexed String]*
This setting specifies the day of the week in which daylight saving time adjustment ends.			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
DST End Month	08.2A	October	January February March April May June July August September October November December *[Indexed String]*
This setting specifies the month in which daylight saving time adjustment ends.			
DST End Mins	08.2B	60	From 0 to 1425 in steps of 15 *[Courier Number (time-minutes)]*
This setting specifies the time of day in which daylight saving time adjustment ends. This is set relative to 00:00 hrs on the selected day when time adjustment is to end.			
RP1 Time Zone	08.30	Local	UTC Local *[Indexed String]*
Setting for the rear port 1 interface to specify if time synchronisation received will be local or universal time co-ordinated.			
RP2 Time Zone	08.31	Local	UTC Local *[Indexed String]*
Setting for the rear port 2 interface to specify if time synchronisation received will be local or universal time co-ordinated			
CONFIGURATION	09.00		
This column contains the general configuration options			
Restore Defaults	09.01	No Operation	No Operation All Settings Setting Group 1 Setting Group 2 Setting Group 3 Setting Group 4 *[Indexed String]*
This setting restores the chosen setting groups to factory default values. Note: Restoring defaults to all settings may result in communication via the rear port being disrupted if the new (default) settings do not match those of the master station.			
Setting Group	09.02	Select via Menu	Select via Menu Select via Opto *[Indexed String]*
This setting allows you to choose whether the setting group changes are to be initiated via an Opto-input or the HMI menu.			
Active Settings	09.03	Group 1	Group 1 Group 2 Group 3 Group 4 *[Indexed String]*
This setting selects the active settings group.			
Save Changes	09.04	No Operation	No Operation Save Abort *[Indexed String]*
This command saves all IED settings.			
Copy From	09.05	Group 1	Group 1 Group 2 Group 3 Group 4 *[Indexed String]*
This setting copies settings from a selected setting group.			
Copy To	09.06	No Operation	No Operation Group 1 Group 2

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Group 3 Group 4 *[Indexed String]*
This command allows the displayed settings to be copied to a selected setting group.			
Setting Group 1	09.07	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables settings Group 1.			
Setting Group 2	09.08	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables settings Group 2.			
Setting Group 3	09.09	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables settings Group 3.			
Setting Group 4	09.0A	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables settings Group 4.			
System Config	09.0B	Visible	Invisible Visible *[Indexed String]*
This setting hides or unhides the System Config menu.			
Residual O/V NVD	09.16	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the Residual Overvoltage Protection function.			
Neg Sequence O/V	09.18	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the Negative Sequence Overvoltage Protection function.			
Volt Protection	09.1D	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the Voltage protection.			
DC SupplyMonitor	09.1F	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the DC Supply Monitoring supervision function.			
System Checks	09.23	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the System Checks function (Check Synchronisation and Voltage Monitor).			
Auto-Reclose	09.24	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the Autoreclose function.			
Auto-Reclose	09.24	Disabled	Disabled *[Indexed String]*
This setting disables the Autoreclose function for some models			
Input Labels	09.25	Visible	Invisible Visible *[Indexed String]*
This setting hides or unhides the Input Labels menu from the IED display.			
Output Labels	09.26	Visible	Invisible Visible *[Indexed String]*
This setting hides or unhides the Output Labels menu from the IED display.			
Freq Protection	09.27	Enabled	Disabled

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Enabled *[Indexed String]*
This setting enables or disables the Frequency Protection function.			
CT & VT Ratios	09.28	Visible	Invisible Visible *[Indexed String]*
This setting hides or unhides the Transformer Ratios menu from the IED display.			
Record Control	09.29	Invisible	Invisible Visible *[Indexed String]*
This setting hides or unhides the Record Control menu from the IED display.			
Disturb Recorder	09.2A	Invisible	Invisible Visible *[Indexed String]*
This setting hides or unhides the Disturbance Recorder menu from the IED display.			
Measure't Setup	09.2B	Invisible	Invisible Visible *[Indexed String]*
This setting hides or unhides the Measurement Setup menu from the IED display.			
Comms Settings	09.2C	Visible	Invisible Visible *[Indexed String]*
This setting hides or unhides the Communication Settings menu from the IED display.			
Commission Tests	09.2D	Visible	Invisible Visible *[Indexed String]*
This setting hides or unhides the Commission Tests menu from the IED display.			
Setting Values	09.2E	Primary	Primary Secondary *[Indexed String]*
This setting determines the reference for all settings dependent on the transformer ratios; either referenced to the primary or the secondary.			
Control Inputs	09.2F	Visible	Invisible Visible *[Indexed String]*
Activates the Control Input status and operation menu further on in the IED setting menu.			
Ctrl I/P Config	09.35	Visible	Invisible Visible *[Indexed String]*
Sets the Control Input Configuration menu visible further on in the IED setting menu.			
Ctrl I/P Labels	09.36	Visible	Invisible Visible *[Indexed String]*
Sets the Control Input Labels menu visible further on in the IED setting menu.			
Direct Access	09.39	Enabled	Disabled Enabled Hotkey Only CB Ctrl Only *[Indexed String]*
This setting enables or disables direct control of the Circuit Breakers from the IED's hotkeys.			
Function Key	09.50	Visible	Invisible Visible *[Indexed String]*
This setting enables or disables the Function Key menu.			
PSL Timers	09.54	Invisible	Invisible Visible *[Indexed String]*
This setting enables or disables the PSL Timers menu.			
Switch Control	09.60	Disabled	Disabled Enabled *[Indexed String]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
Activates the user switch Input status and operation menu.			
DT Timer HystBeh	09.70	Freeze	Freeze Count *[Indexed String]*
RP1 Read Only	09.FB	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables Read Only Mode for Rear Port 1.			
RP2 Read Only	09.FC	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables Read Only Mode for Rear Port 2.			
NIC Read Only	09.FD	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables Read Only Mode of the Network Interface Card for Ethernet models.			
LCD Contrast	09.FF	13	From 0 to 31 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the LCD contrast.			
CT AND VT RATIOS	0A.00		
This column contains settings for Current and Voltage Transformer ratios			
Main VT Primary	0A.01	110	From 100 to 1000000 in steps of 1 *[Courier Number (voltage)]*
This setting sets the main voltage transformer input primary voltage.			
Main VT Sec'y	0A.02	110	From 40 to 140 in steps of 0.1 *[Courier Number (voltage)]*
This setting sets the main voltage transformer input secondary voltage.			
4th VT Primary	0A.03	110	From 100 to 1000000 in steps of 1 *[Courier Number (voltage)]*
This setting sets the 4th VT voltage transformer input primary voltage. This 4th VT input can be used for System Check Synchronism or for Measured Residual Overvoltage Protections.			
4th VT Secondary	0A.04	110	From 40 to 140 in steps of 0.1 *[Courier Number (voltage)]*
This setting sets the 4th VT voltage transformer input secondary voltage. This 4th VT input can be used for System Check Synchronism or for Measured Residual Overvoltage Protections.			
4th VT Primary	0A.05	110	From 100 to 1000000 in steps of 1 *[Courier Number (voltage)]*
This setting sets the 4th VT voltage transformer input primary voltage. This 4th VT input can be used for Remanent Overvoltage or for Measured Residual Overvoltage Protections.			
4th VT Secondary	0A.06	110	From 40 to 200 in steps of 0.1 *[Courier Number (voltage)]*
This setting sets the 4th VT voltage transformer input secondary voltage. This 4th VT input can be used for Remanent Overvoltage or for Measured Residual Overvoltage Protections.			
C/S Input	0A.0F	A-N	A-N B-N C-N A-B B-C C-A *[Indexed String]*
This setting selects the System Check Synchronism Input voltage measurement.			
Main VT Location	0A.10	Line	Line Bus *[Indexed String]*
This setting defines the Main VT Location.			
C/S V kSM	0A.14	1	From 0.1 to 5 in steps of 0.001 *[Courier Number (decimal)]*
This setting sets the voltage magnitude correction factor for check synchronism in case of different VT ratios.			
C/S Phase kSA	0A.15	0	From -150 to 180 in steps of 30

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Courier Number (angle)]
This setting sets the phase angle correction factor for check synchronism.			
VN Input	0A.16	Derived	Measured Derived *[Indexed String]*
This cell indicates that VN Input is measured or derived.			
VN Input	0A.16	Measured	Measured Derived *[Indexed String]*
This cell indicates that VN Input is measured or derived.			
RECORD CONTROL	0B.00		
This column contains settings for Record Controls.			
Alarm Event	0B.04	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the generation of an event on alarm. Disabling this setting means that no event is generated for alarms.			
Relay O/P Event	0B.05	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the generation of an event for a change of state of output relay contact. Disabling this setting means that no event will be generated for any change in logic output state.			
Opto Input Event	0B.06	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the generation of an event for a change of state of opto-input. Disabling this setting means that no event will be generated for any change in logic input state.			
General Event	0B.07	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the generation of general events. Disabling this setting means that no general events are generated.			
Fault Rec Event	0B.08	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the generation of fault record events. Disabling this setting means that no event will be generated for any fault that produces a fault record.			
Maint Rec Event	0B.09	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the generation of maintenance record events. Disabling this setting means that no event will be generated for any occurrence that produces a maintenance record.			
Protection Event	0B.0A	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the generation of protection events. Disabling this setting means that any operation of protection elements will not be logged as an event.			
DDB 31 - 0	0B.40	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 63 - 32	0B.41	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 95 - 64	0B.42	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
DDB 127 - 96	0B.43	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 159 - 128	0B.44	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 191 - 160	0B.45	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 223 - 192	0B.46	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 255 - 224	0B.47	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 287 - 256	0B.48	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 319 - 288	0B.49	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 351 - 320	0B.4A	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 383 - 352	0B.4B	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 415 - 384	0B.4C	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 447 - 416	0B.4D	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 479 - 448	0B.4E	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 511 - 480	0B.4F	0xFFFFFFFF	High order word of long stored in 1st register

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 543 - 512	0B.50	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 575 - 544	0B.51	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 607 - 576	0B.52	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 639 - 608	0B.53	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 671 - 640	0B.54	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 703 - 672	0B.55	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 735 - 704	0B.56	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 767 - 736	0B.57	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 799 - 768	0B.58	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 831 - 800	0B.59	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 863 - 832	0B.5A	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 895 - 864	0B.5B	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 927 - 896	0B.5C	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 959 - 928	0B.5D	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 991 - 960	0B.5E	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1023 - 992	0B.5F	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1055 - 1024	0B.60	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1087 - 1056	0B.61	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1119 - 1088	0B.62	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1151 - 1120	0B.63	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1183 - 1152	0B.64	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1215 - 1184	0B.65	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1247 - 1216	0B.66	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1279 - 1248	0B.67	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Binary Flag (32 bits)]
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1311 - 1280	0B.68	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1343 - 1312	0B.69	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1375 - 1344	0B.6A	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1407 - 1376	0B.6B	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1439 - 1408	0B.6C	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1471 - 1440	0B.6D	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1503 - 1472	0B.6E	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1535 - 1504	0B.6F	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1567 - 1536	0B.70	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1599 - 1568	0B.71	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1631 - 1600	0B.72	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1663 - 1632	0B.73	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1695 - 1664	0B.74	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1727 - 1696	0B.75	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1759- 1728	0B.76	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1791- 1760	0B.77	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1823 - 1792	0B.78	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1855 - 1824	0B.79	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1887 - 1856	0B.7A	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1919 - 1888	0B.7B	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1951 - 1920	0B.7C	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 1983 - 1952	0B.7D	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 2015 - 1984	0B.7E	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			
DDB 2047 - 2016	0B.7F	0xFFFFFFFF	High order word of long stored in 1st register Low order word of long stored in 2nd register Example 123456 stored as 123456 *[Binary Flag (32 bits)]*
These signals can be included or excluded from being stored as a Courier event record (assuming the DDB is capable of creating an event)			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
DISTURB RECORDER	0C.00		
This column contains settings for the Disturbance Recorder			
Duration	0C.01	1.5	From 0.1 to 10.5 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the overall recording time.			
Trigger Position	0C.02	33.3	From 0 to 100 in steps of 0.1 *[Courier Number (percentage)]*
This setting sets the trigger point as a percentage of the duration. For example, the default setting, which is set to 33.3% (of 1.5s) gives 0.5s pre-fault and 1s post fault recording times.			
Trigger Mode	0C.03	Single	Single Extended *[Indexed String]*
When set to single mode, if a further trigger occurs whilst a recording is taking place, the recorder will ignore the trigger. However, if this has been set to Extended, the post trigger timer will be reset to zero, thereby extending the recording time.			
Analog Channel 1	0C.04	VA	VA VB VC 4th V IA IB IC IN - ISEF Frequency *[Indexed String]*
This setting selects any available analogue input to be assigned to this channel.			
Analog Channel 2	0C.05	VB	VA VB VC 4th V IA IB IC IN - ISEF Frequency *[Indexed String]*
This setting selects any available analogue input to be assigned to this channel.			
Analog Channel 3	0C.06	VC	VA VB VC 4th V IA IB IC IN - ISEF Frequency *[Indexed String]*
This setting selects any available analogue input to be assigned to this channel.			
Analog Channel 4	0C.07	V Checksync	VA VB VC 4th V IA IB IC IN - ISEF Frequency *[Indexed String]*
This setting selects any available analogue input to be assigned to this channel.			
Analog Channel 4	0C.07	V N	VA VB VC

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			4th V IA IB IC IN - ISEF Frequency *[Indexed String]*
This setting selects any available analogue input to be assigned to this channel.			
Analog Channel 5	0C.08	Analog 5 Unused	VA VB VC 4th V IA IB IC IN - ISEF Frequency *[Indexed String]*
This setting selects any available analogue input to be assigned to this channel.			
Analog Channel 6	0C.09	Analog 6 Unused	VA VB VC 4th V IA IB IC IN - ISEF Frequency *[Indexed String]*
This setting selects any available analogue input to be assigned to this channel.			
Analog Channel 7	0C.0A	Analog 7 Unused	VA VB VC 4th V IA IB IC IN - ISEF Frequency *[Indexed String]*
This setting selects any available analogue input to be assigned to this channel.			
Analog Channel 8	0C.0B	Analog 8 Unused	VA VB VC 4th V IA IB IC IN - ISEF Frequency *[Indexed String]*
This setting selects any available analogue input to be assigned to this channel.			
Analog Channel 9	0C.0C	Frequency	VA VB VC 4th V IA IB IC IN - ISEF Frequency *[Indexed String]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This setting selects any available analogue input to be assigned to this channel.			
Digital Input 1	0C.0D	Output R1	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 1 Trigger	0C.0E	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 2	0C.0F	Output R2	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 2 Trigger	0C.10	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 3	0C.11	Output R3	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 3 Trigger	0C.12	Trigger L/H	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 4	0C.13	Output R4	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 4 Trigger	0C.14	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 5	0C.15	Output R5	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 5 Trigger	0C.16	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 6	0C.17	Output R6	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 6 Trigger	0C.18	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 7	0C.19	Output R7	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 7 Trigger	0C.1A	No Trigger	No Trigger

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 8	0C.1B	Output R8	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 8 Trigger	0C.1C	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 9	0C.1D	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 9 Trigger	0C.1E	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 10	0C.1F	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 10 Trigger	0C.20	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 11	0C.21	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 11 Trigger	0C.22	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 12	0C.23	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 12 Trigger	0C.24	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 13	0C.25	Input L1	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 13 Trigger	0C.26	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 14	0C.27	Input L2	From 0 to DDB Size in steps of 1 *[Indexed String]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 14 Trigger	0C.28	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 15	0C.29	Input L3	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 15 Trigger	0C.2A	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 16	0C.2B	Input L4	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 16 Trigger	0C.2C	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 17	0C.2D	Input L5	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 17 Trigger	0C.2E	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 18	0C.2F	Input L6	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 18 Trigger	0C.30	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 19	0C.31	Input L7	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 19 Trigger	0C.32	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 20	0C.33	Input L8	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 20 Trigger	0C.34	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
Digital Input 21	0C.35	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.			
Input 21 Trigger	0C.36	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 22	0C.37	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 22 Trigger	0C.38	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 23	0C.39	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 23 Trigger	0C.3A	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 24	0C.3B	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 24 Trigger	0C.3C	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 25	0C.3D	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.			
Input 25 Trigger	0C.3E	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 26	0C.3F	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 26 Trigger	0C.40	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 27	0C.41	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 27 Trigger	0C.42	No Trigger	No Trigger Trigger L/H Trigger H/L

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Indexed String]
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 28	0C.43	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 28 Trigger	0C.44	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 29	0C.45	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 29 Trigger	0C.46	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 30	0C.47	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 30 Trigger	0C.48	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 31	0C.49	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 31 Trigger	0C.4A	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 32	0C.4B	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Input 32 Trigger	0C.4C	No Trigger	No Trigger Trigger L/H Trigger H/L *[Indexed String]*
This setting defines whether the digital input is triggered and if so, the trigger polarity (low to high or high to low).			
Digital Input 33	0C.4D	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 34	0C.4E	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 35	0C.4F	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 36	0C.50	Unused	From 0 to DDB Size in steps of 1

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Indexed String]
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 37	0C.51	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 38	0C.52	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 39	0C.53	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 40	0C.54	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 41	0C.55	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 42	0C.56	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 43	0C.57	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 44	0C.58	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 45	0C.59	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 46	0C.5A	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 47	0C.5B	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 48	0C.5C	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 49	0C.5D	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 50	0C.5E	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 51	0C.5F	Unused	From 0 to DDB Size in steps of 1

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Indexed String]
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 52	0C.60	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 53	0C.61	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 54	0C.62	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 55	0C.63	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 56	0C.64	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 57	0C.65	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 58	0C.66	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 59	0C.67	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 60	0C.68	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 61	0C.69	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 62	0C.6A	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 63	0C.6B	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
Digital Input 64	0C.6C	Unused	From 0 to DDB Size in steps of 1 *[Indexed String]*
The digital channels may monitor any of the opto-inputs, output relay contacts and other internal digital signals, such as protection starts, LEDs etc. This setting assigns the digital channel to any one of these.			
MEASURE'T SETUP	0D.00		
This column contains settings for the measurement setup			
Default Display	0D.01	Banner	User Banner 3Ph Voltage Date and Time

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Description Plant Reference Frequency Access Level DC Supply Mag *[Indexed String]*
This cell is used to show the default display option.			
Local Values	0D.02	Primary	Primary Secondary *[Indexed String]*
This setting controls whether local measured values (via HMI or front port) are displayed as primary or secondary quantities.			
Remote Values	0D.03	Primary	Primary Secondary *[Indexed String]*
This setting controls whether remote measured values (via rear comms ports) are displayed as primary or secondary quantities.			
Measurement Ref	0D.04	VA	VA VB VC *[Indexed String]*
This setting sets the phase reference for all angular measurements (for Measurements 1 only).			
Remote2 Values	0D.0B	Primary	Primary Secondary *[Indexed String]*
The setting defines whether the values measured via the Second Rear Communication port are displayed in primary or secondary terms.			
COMMUNICATIONS	0E.00		
This column contains general communications settings			
RP1 Protocol	0E.01		Courier IEC60870-5-103 Modbus DNP 3.0 *[Indexed String]*
This setting sets the address of RP1.			
RP1 Address	0E.02	255	From 0 to 255 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the address of RP1.			
RP1 Address	0E.02	1	From 1 to 247 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the address of RP1.			
RP1 Address	0E.02	1	From 0 to 254 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the address of RP1.			
RP1 Address	0E.02	1	From 0 to 65519 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the address of RP1.			
RP1 InactivTimer	0E.03	15	From 1 to 30 in steps of 1 *[Courier Number (time-minutes)]*
This setting defines the period of inactivity on RP1 before the IED reverts to its default state.			
RP1 Baud Rate	0E.04	19200	9600 bits/s 19200 bits/s 38400 bits/s *[Indexed String]*
This setting sets the communication speed between the IED RP1 port and the master station. It is important that both IED and master station are set at the same speed setting. This cell is applicable for the non-Courier protocols. Build = Modbus			
RP1 Baud Rate	0E.04	19200	9600 bits/s 19200 bits/s *[Indexed String]*
This setting sets the communication speed between the IED RP1 port and the master station. It is important that both IED and master station are set at the same speed setting. This cell is applicable for the non-Courier protocols. Build = CS103			
RP1 Baud Rate	0E.04	19200	1200 bits/s 2400 bits/s

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			4800 bits/s 9600 bits/s 19200 bits/s 38400 bits/s *[Indexed String]*
This setting sets the communication speed between the IED RP1 port and the master station. It is important that both IED and master station are set at the same speed setting. This cell is applicable for the non-Courier protocols. Build = DNP3.0			
RP1 Parity	0E.05	None	Odd Even None *[Indexed String]*
This setting controls the parity format used in the data frames of RP1. It is important that both IED and master station are set with the same parity setting.			
RP1 Meas Period	0E.06	15	From 1 to 60 in steps of 1 *[Courier Number (time-seconds)]*
This setting controls the time interval that the IED will use between sending measurement data to the master station for IEC60870-5-103 versions.			
RP1 Time Sync	0E.08	Disabled	Disabled Enabled *[Indexed String]*
This setting is for DNP3.0 versions only. If set to Enabled the master station can be used to synchronize the time on the IED via RP1. If set to Disabled either the internal free running clock or IRIG-B input are used.			
Modbus IEC Time	0E.09	Standard	Standard IEC (Existing format) Reverse IEC (Company agreed format) *[Indexed String]*
When 'Standard IEC' is selected the time format complies with IEC60870-5-4 requirements such that byte 1 of the information is transmitted first, followed by bytes 2 through to 7. If 'Reverse' is selected the transmission of information is reversed.			
RP1 CS103Blcking	0E.0A	Disabled	Disabled Monitor Blocking Command Blocking *[Indexed String]*
This cell sets the blocking type for IEC60870-5-103. With monitor blocking, reading of the status information and disturbance records is not permitted. When in this mode the IED returns a "termination of general interrogation" message to the master station			
RP1 Card Status	0E.0B		K-Bus OK EIA485 OK IRIG-B *[Indexed String]*
This setting displays the communication type and status of RP1			
RP1 Port Config	0E.0C	EIA485 (RS485)	K-Bus EIA485 (RS485) *[Indexed String]*
This setting selects the type of physical protocol for RP1 - either K-bus or RS485.			
RP1 Comms Mode	0E.0D	IEC60870 FT1.2	IEC60870 FT1.2 10-Bit No Parity *[Indexed String]*
This setting determines the serial communication mode.			
RP1 Baud Rate	0E.0E	19200	9600 bits/s 19200 bits/s 38400 bits/s *[Indexed String]*
This cell controls the communication speed between IED and master station. It is important that both IED and master station are set at the same speed setting. This cell is applicable for the Courier protocol.			
Meas Scaling	0E.0F	Primary	Normalised Primary Secondary *[Indexed String]*
This setting determines the scaling type of analogue quantities - in terms of primary, secondary or normalised, for DNP3 models			
Message Gap (ms)	0E.10	0	From 0 to 50 in steps of 1 *[Courier Number (time-ms)]*
This setting allows the master station to have an interframe gap. DNP 3.0 versions only			
DNP Need Time	0E.11	10	From 1 to 30 in steps of 1

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Courier Number (time-minutes)]
This setting sets the duration of time waited before requesting another time sync from the master. DNP 3.0 versions only.			
DNP App Fragment	0E.12	2048	From 100 to 2048 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the maximum message length (application fragment size) transmitted by the IED for DNP 3.0 versions.			
DNP App Timeout	0E.13	2	From 1 to 120 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the maximum waiting time between sending a message fragment and receiving confirmation from the master. DNP 3.0 versions only.			
DNP SBO Timeout	0E.14	10	From 1 to 10 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the maximum waiting time between receiving (sending?) a select command and awaiting an operate confirmation from the master. DNP 3.0 versions only.			
DNP Link Timeout	0E.15	0	From 0 to 120 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the maximum waiting time for a Data Link Confirm from the master. A value of 0 means data link support disabled. DNP 3.0 versions only.			
Class 0 Poll	0E.16	0	Running Counters Frozen Counters *[Indexed String]*
This setting is for DNP3.0 versions only. In response to a Class 0 poll, an outstation device shall report either the count value or the frozen count value.			
NIC Protocol	0E.1F		UCA 2.0 UCA 2.0 GOOSE IEC61850 DNP3 IEC61850+DNP3 *[Indexed String]*
This cell indicates which Ethernet protocols are used on the rear Ethernet port.			
NIC MAC Address	0E.22	Ethernet MAC Address	NIC MAC Address *[ASCII Text (17 chars)]*
This setting displays the MAC address of the rear Ethernet port, if applicable.			
NIC Tunl Timeout	0E.64	5.00 min	From 1 to 30 in steps of 1 *[Courier Number (time-minutes)]*
This setting sets the maximum waiting time before an inactive tunnel to the application software is reset. DNP 3.0 over Ethernet versions only.			
NIC Link Report	0E.6A	Alarm	Alarm Event None *[Indexed String]*
This setting defines how a failed or unfitted network link is reported. DNP 3.0 over Ethernet versions only.			
REAR PORT2 (RP2)	0E.80		
The settings in this sub-menu are for models with a second communications port (RP2).			
RP2 Protocol	0E.81	Courier	Courier IEC60870-5-103 Modbus DNP 3.0 *[Indexed String]*
This cell displays the communications protocol relevant to main communication port (RP2) of the chosen IED model.			
RP2 Card Status	0E.84		K-Bus OK EIA485 OK IRIG-B *[Indexed String]*
This setting displays the communication type and status of RP2, if applicable			
RP2 Port Config	0E.88	EIA485 (RS485)	K-Bus EIA485 (RS485) *[Indexed String]*
This setting selects the type of physical protocol for RP2 - either K-bus or RS485.			
RP2 Comms Mode	0E.8A	IEC60870 FT1.2	IEC60870 FT1.2 10-Bit No Parity *[Indexed String]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This setting determines the serial communication mode.			
RP2 Address	0E.90	255	From 0 to 255 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the address of RP2.			
RP2 InactivTimer	0E.92	15	From 1 to 30 in steps of 1 *[Courier Number (time-minutes)]*
This setting defines the period of inactivity on RP2 before the IED reverts to its default state.			
RP2 Baud Rate	0E.94	19200	9600 bits/s 19200 bits/s 38400 bits/s *[Indexed String]*
This setting sets the communication speed between the IED RP2 port and the master station. It is important that both IED and master station are set at the same speed setting.			
NIC Protocol	0E.A0		UCA 2.0 UCA 2.0 GOOSE IEC61850 DNP3 IEC61850+DNP3 *[Indexed String]*
This cell indicates DNP 3.0 over Ethernet are used on the rear Ethernet port.			
IP Address	0E.A1	0.0.0.0	IP Address *[ASCII Text (16 chars)]*
This cell displays the IED's IP address. DNP over Ethernet versions only.			
Subnet Address	0E.A2	0.0.0.0	Subnet Address *[ASCII Text (16 chars)]*
This cell displays the LAN's subnet address on which the IED is located. DNP 3.0 over Ethernet versions only.			
NIC MAC Address	0E.A3	Ethernet MAC Address	NIC MAC Address *[ASCII Text (17 chars)]*
This setting displays the MAC address of the rear Ethernet port, if applicable.			
Gateway	0E.A4	0.0.0.0	Gateway *[ASCII Text (16 chars)]*
This cell displays the LAN's gateway address on which the IED is located. DNP 3.0 over Ethernet versions only.			
DNP Time Synch	0E.A5	Disabled	Disabled Enabled *[Indexed String]*
If set to 'Enabled' the DNP3.0 master station can be used to synchronise the IED's time clock. If set to 'Disabled' either the internal free running clock, or IRIG-B input are used. DNP 3.0 over Ethernet versions only.			
Meas Scaling	0E.A6	Primary	Normalised Primary Secondary *[Indexed String]*
This setting determines the scaling type of analogue quantities - in terms of primary, secondary or normalised, for DNP3 models.			
NIC Tunl Timeout	0E.A7	5	From 1 to 30 in steps of 1 *[Courier Number (time-minutes)]*
This setting sets the maximum waiting time before an inactive tunnel to the application software is reset. DNP 3.0 over Ethernet versions only.			
NIC Link Report	0E.A8	Alarm	Alarm Event None *[Indexed String]*
This setting defines how a failed or unfitted network link is reported. DNP 3.0 over Ethernet versions only.			
Media	0E.A9		Media Unknown RJ45 FO RJ45 Port A RJ45 Port B FO Port A FO Port B RJ45 Redundant FO Redundant *[Indexed String]*
Displays the communication media of the Ethernet port that is currently in use.			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
DNP 3.0 over Ethernet versions only.			
SNTP PARAMETERS	0E.AA		
The settings in this sub-menu are for models using DNP3 over Ethernet.			
SNTP Server 1	0E.AB	0.0.0.0	SNTP Server 1 *[Courier Number (time-minutes)]*
This cell indicates the SNTP Server 1 address. DNP 3.0 over Ethernet versions only.			
SNTP Server 2	0E.AC	0.0.0.0	SNTP Server 2 *[Indexed String]*
This cell indicates the SNTP Server 2 address. DNP 3.0 over Ethernet versions only.			
SNTP Poll Rate	0E.AD	64s	SNTP Poll Rate *[Courier Number (time-seconds)]*
This cell displays the SNTP poll rate interval in seconds. DNP 3.0 over Ethernet versions only.			
DNP Need Time	0E.B1	10	From 1 to 30 in steps of 1 *[Courier Number (time-minutes)]*
This setting sets the duration of time waited before requesting another time sync from the master. DNP 3.0 versions only.			
DNP App Fragment	0E.B2	2048	From 100 to 2048 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the maximum message length (application fragment size) transmitted by the IED for DNP 3.0 versions.			
DNP App Timeout	0E.B3	2	From 1 to 120 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the maximum waiting time between sending a message fragment and receiving confirmation from the master. DNP 3.0 versions only.			
DNP SBO Timeout	0E.B4	10	From 1 to 10 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the maximum waiting time between receiving a select command and awaiting an operate confirmation from the master. DNP 3.0 versions only.			
Class 0 Poll	0E.B5	0	Running Counters Frozen Counters *[Indexed String]*
This setting is for DNP3.0 versions only. In response to a Class 0 poll, an outstation device shall report either the count value or the frozen count value.			
Redundancy	0E.CE		NONE FAILOVER RSTP PRP HSR *[Indexed String]*
The settings is to indicate the type of Ethernet redundancy currently active			
RSTP	0E.D0		
The settings in this sub-menu are for models using RSTP			
Bridge MAC Address	0E.D1	0.0.0.0	Bridge MAC Address *[ASCII Text (17 chars)]*
This setting displays the Bridge MAC address of the device as per RSTP protocol			
Bridge Priority	0E.D2	32768	Bridge Priority *[Unsigned Integer (32 bits)]*
This setting displays the Bridge Priority configured in the device			
Root MAC Address	0E.D3	0.0.0.0	Root MAC Address *[ASCII Text (17 chars)]*
This setting displays the MAC address of the Root device as per RSTP protocol			
Root Priority	0E.D4	0	Root Priority *[Unsigned Integer (32 bits)]*
This setting displays the Root Priority of the Root device as per RSTP protocol			
Root Path Cost	0E.D5	0	Root Path Cost *[Unsigned Integer (32 bits)]*
This setting displays the Root Path Cost based on the RSTP network link speed			
Root Port	0E.D6	0	Unknown Port A Port B *[Indexed String]*
This setting displays the Root Port based on the root path cost in RSTP network.			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
Root Max Age	0E.D7	0	Root Max Age *[Courier Number (time-seconds)]*
This setting displays the maximum age timer which specifies the maximum expected arrival time of hello BPDUs			
Root Hello Time	0E.D8	0	Root Hello Time *[Courier Number (time-seconds)]*
This setting displays the Hello time during which RSTP BPDUs are sent out			
RootForwardDelay	0E.D9	0	RootForwardDelay *[Courier Number (time-seconds)]*
This setting displays the Forward delay for the RSTP ports to be in FORWARDING State			
Port A State	0E.DA	Discarding	Unknown Disabled Discarding Learning Forwarding *[Indexed String]*
This setting displays the RSTP States DISCARDING, LEARNING or FORWARDING for Port A			
Port B State	0E.DB	Discarding	Unknown Disabled Discarding Learning Forwarding *[Indexed String]*
This setting displays the RSTP States DISCARDING, LEARNING or FORWARDING for Port B			
COMMISSION TESTS	0F.00		
This column contains commissioning test settings			
Opto I/P Status	0F.01		Opto 1 Input State (0=Off, 1=Energised) Opto 2 Input State (0=Off, 1=Energised) Opto 3 Input State (0=Off, 1=Energised) Opto 4 Input State (0=Off, 1=Energised) Opto 5 Input State (0=Off, 1=Energised) Opto 6 Input State (0=Off, 1=Energised) Opto 7 Input State (0=Off, 1=Energised) Opto 8 Input State (0=Off, 1=Energised) Opto 9 Input State (0=Off, 1=Energised) Opto 10 Input State (0=Off, 1=Energised) Opto 11 Input State (0=Off, 1=Energised) Opto 12 Input State (0=Off, 1=Energised) Opto 13 Input State (0=Off, 1=Energised) Opto 14 Input State (0=Off, 1=Energised) Opto 15 Input State (0=Off, 1=Energised) Opto 16 Input State (0=Off, 1=Energised) Opto 17 Input State (0=Off, 1=Energised) Opto 18 Input State (0=Off, 1=Energised) Opto 19 Input State (0=Off, 1=Energised) Opto 20 Input State (0=Off, 1=Energised) Opto 21 Input State (0=Off, 1=Energised) Opto 22 Input State (0=Off, 1=Energised) Opto 23 Input State (0=Off, 1=Energised) Opto 24 Input State (0=Off, 1=Energised) Opto 25 Input State (0=Off, 1=Energised) Opto 26 Input State (0=Off, 1=Energised) Opto 27 Input State (0=Off, 1=Energised) Opto 28 Input State (0=Off, 1=Energised) Opto 29 Input State (0=Off, 1=Energised) Opto 30 Input State (0=Off, 1=Energised) Opto 31 Input State (0=Off, 1=Energised) Opto 32 Input State (0=Off, 1=Energised) *[Binary Flag (16 bits) Indexed String]*
This cell displays the status of the available opto-inputs.			
Relay O/P Status	0F.02		Relay 1 (0=Not Operated, 1=Operated) Relay 2 (0=Not Operated, 1=Operated) Relay 3 (0=Not Operated, 1=Operated)

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Relay 4 (0=Not Operated, 1=Operated) Relay 5 (0=Not Operated, 1=Operated) Relay 6 (0=Not Operated, 1=Operated) Relay 7 (0=Not Operated, 1=Operated) Relay 8 (0=Not Operated, 1=Operated) Relay 9 (0=Not Operated, 1=Operated) Relay 10 (0=Not Operated, 1=Operated) Relay 11 (0=Not Operated, 1=Operated) Relay 12 (0=Not Operated, 1=Operated) Relay 13 (0=Not Operated, 1=Operated) Relay 14 (0=Not Operated, 1=Operated) Relay 15 (0=Not Operated, 1=Operated) Relay 16 (0=Not Operated, 1=Operated) Relay 17 (0=Not Operated, 1=Operated) Relay 18 (0=Not Operated, 1=Operated) Relay 19 (0=Not Operated, 1=Operated) Relay 20 (0=Not Operated, 1=Operated) Relay 21 (0=Not Operated, 1=Operated) Relay 22 (0=Not Operated, 1=Operated) Relay 23 (0=Not Operated, 1=Operated) Relay 24 (0=Not Operated, 1=Operated) Relay 25 (0=Not Operated, 1=Operated) Relay 26 (0=Not Operated, 1=Operated) Relay 27 (0=Not Operated, 1=Operated) Relay 28 (0=Not Operated, 1=Operated) Relay 29 (0=Not Operated, 1=Operated) Relay 30 (0=Not Operated, 1=Operated) Relay 31 (0=Not Operated, 1=Operated) Relay 32 (0=Not Operated, 1=Operated) *[Binary Flag (32 bits) Indexed String]*
This cell displays the status of the available output relays. Warning; When in Test Mode, this cell cannot be used to confirm operation of the output relays, therefore it will be necessary to monitor the state of each contact in turn.			
Test Port Status	0F.03		Test Port Status *[Binary Flag (8 bits) Indexed String]*
This cell displays the logic state of the DDB signals that have been allocated in the 'Monitor Bit' cells.			
Monitor Bit 1	0F.05	640	From 0 to 2047 in steps of 1 *[Unsigned Integer (16 bits)]*
The 'Monitor Bit' cells allow the user to select which DDB signals can be observed in the 'Test Port Status' cell.			
Monitor Bit 2	0F.06	642	From 0 to 2047 in steps of 1 *[Unsigned Integer (16 bits)]*
The 'Monitor Bit' cells allow the user to select which DDB signals can be observed in the 'Test Port Status' cell.			
Monitor Bit 3	0F.07	644	From 0 to 2047 in steps of 1 *[Unsigned Integer (16 bits)]*
The 'Monitor Bit' cells allow the user to select which DDB signals can be observed in the 'Test Port Status' cell.			
Monitor Bit 4	0F.08	646	From 0 to 2047 in steps of 1 *[Unsigned Integer (16 bits)]*
The 'Monitor Bit' cells allow the user to select which DDB signals can be observed in the 'Test Port Status' cell.			
Monitor Bit 5	0F.09	648	From 0 to 2047 in steps of 1 *[Unsigned Integer (16 bits)]*
The 'Monitor Bit' cells allow the user to select which DDB signals can be observed in the 'Test Port Status' cell.			
Monitor Bit 6	0F.0A	650	From 0 to 2047 in steps of 1 *[Unsigned Integer (16 bits)]*
The 'Monitor Bit' cells allow the user to select which DDB signals can be observed in the 'Test Port Status' cell.			
Monitor Bit 7	0F.0B	652	From 0 to 2047 in steps of 1 *[Unsigned Integer (16 bits)]*
The 'Monitor Bit' cells allow the user to select which DDB signals can be observed in the 'Test Port Status' cell.			
Monitor Bit 8	0F.0C	654	From 0 to 2047 in steps of 1 *[Unsigned Integer (16 bits)]*
The 'Monitor Bit' cells allow the user to select which DDB signals can be observed in the 'Test Port Status' cell.			
Test Mode	0F.0D	Disabled	Disabled

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Test Mode Contacts Blocked *[Indexed String]*
This cell is used to allow secondary injection testing to be performed on the IED without operation of the trip contacts. It also enables a facility to directly test the output contacts by applying menu controlled test signals			
Test Pattern	0F.0E	0x0	Relay 1 (0=Not Operated, 1=Operated) Relay 2 (0=Not Operated, 1=Operated) Relay 3 (0=Not Operated, 1=Operated) Relay 4 (0=Not Operated, 1=Operated) Relay 5 (0=Not Operated, 1=Operated) Relay 6 (0=Not Operated, 1=Operated) Relay 7 (0=Not Operated, 1=Operated) Relay 8 (0=Not Operated, 1=Operated) Relay 9 (0=Not Operated, 1=Operated) Relay 10 (0=Not Operated, 1=Operated) Relay 11 (0=Not Operated, 1=Operated) Relay 12 (0=Not Operated, 1=Operated) Relay 13 (0=Not Operated, 1=Operated) Relay 14 (0=Not Operated, 1=Operated) Relay 15 (0=Not Operated, 1=Operated) Relay 16 (0=Not Operated, 1=Operated) Relay 17 (0=Not Operated, 1=Operated) Relay 18 (0=Not Operated, 1=Operated) Relay 19 (0=Not Operated, 1=Operated) Relay 20 (0=Not Operated, 1=Operated) Relay 21 (0=Not Operated, 1=Operated) Relay 22 (0=Not Operated, 1=Operated) Relay 23 (0=Not Operated, 1=Operated) Relay 24 (0=Not Operated, 1=Operated) Relay 25 (0=Not Operated, 1=Operated) Relay 26 (0=Not Operated, 1=Operated) Relay 27 (0=Not Operated, 1=Operated) Relay 28 (0=Not Operated, 1=Operated) Relay 29 (0=Not Operated, 1=Operated) Relay 30 (0=Not Operated, 1=Operated) Relay 31 (0=Not Operated, 1=Operated) Relay 32 (0=Not Operated, 1=Operated) *[Binary Flag (32 bits)]*
This cell is used to select the output relay contacts that will be tested when the 'Contact Test' cell is set to 'Apply Test'.			
Contact Test	0F.0F	No Operation	No Operation Apply Test Remove Test *[Indexed String]*
This command changes the state of the output relay contacts in the Test Pattern cell. After the test has been applied the command text on the LCD changes to 'No Operation' and the contacts will remain in the Test State until reset.			
Test LEDs	0F.10	No Operation	No Operation Apply Test *[Indexed String]*
This command illuminates the user-programmable LEDs for approximately 2 seconds, before they extinguish and the command text on the LCD reverts to 'No Operation'.			
Red LED Status	0F.15		Red LED Status *[Binary Flag(18)]*
This cell indicates which of the user-programmable red LEDs are illuminated.			
Green LED Status	0F.16		Green LED Status *[Binary Flag(18)]*
This cell indicates which of the user-programmable green LEDs are illuminated.			
DDB 31 - 0	0F.20		DDB 31 - 0 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 63 - 32	0F.21		DDB 63 - 32 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
DDB 95 - 64	0F.22		DDB 95 - 64 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 127 - 96	0F.23		DDB 127 - 96 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 159 - 128	0F.24		DDB 159 - 128 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 191 - 160	0F.25		DDB 191 - 160 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 223 - 192	0F.26		DDB 223 - 192 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 255 - 224	0F.27		DDB 255 - 224 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 287 - 256	0F.28		DDB 287 - 256 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 319 - 288	0F.29		DDB 319 - 288 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 351 - 320	0F.2A		DDB 351 - 320 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 383 - 352	0F.2B		DDB 383 - 352 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 415 - 384	0F.2C		DDB 415 - 384 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 447 - 416	0F.2D		DDB 447 - 416 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 479 - 448	0F.2E		DDB 479 - 448 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 511 - 480	0F.2F		DDB 511 - 480 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 543 - 512	0F.30		DDB 543 - 512 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 575 - 544	0F.31		DDB 575 - 544 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 607 - 576	0F.32		DDB 607 - 576 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 639 - 608	0F.33		DDB 639 - 608 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 671 - 640	0F.34		DDB 671 - 640 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 703 - 672	0F.35		DDB 703 - 672 *[Binary Flag(32)]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This cell displays the logic state of the DDB signals			
DDB 735 - 704	0F.36		DDB 735 - 704 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 767 - 736	0F.37		DDB 767 - 736 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 799 - 768	0F.38		DDB 799 - 768 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 831 - 800	0F.39		DDB 831 - 800 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 863 - 832	0F.3A		DDB 863 - 832 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 895 - 864	0F.3B		DDB 895 - 864 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 927 - 896	0F.3C		DDB 927 - 896 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 959 - 928	0F.3D		DDB 959 - 928 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 991 - 960	0F.3E		DDB 991 - 960 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 1023 - 992	0F.3F		DDB 1023 - 992 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 1055 - 1024	0F.40		DDB 1055 - 1024 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 1087 - 1056	0F.41		DDB 1087 - 1056 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 1119 - 1088	0F.42		DDB 1119 - 1088 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 1151 - 1120	0F.43		DDB 1151 - 1120 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 1183 - 1152	0F.44		DDB 1183 - 1152 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 1215 - 1184	0F.45		DDB 1215 - 1184 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 1247 - 1216	0F.46		DDB 1247 - 1216 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 1279 - 1248	0F.47		DDB 1279 - 1248 *[Binary Flag(32)]*
This cell displays the logic state of the DDB signals			
DDB 1311 - 1280	0F.48		DDB 1311 - 1280 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1343 - 1312	0F.49		DDB 1343 - 1312

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Binary Flag (32 bits)]
This cell displays the logic state of the DDB signals			
DDB 1375 - 1344	0F.4A		DDB 1375 - 1344 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1407 - 1376	0F.4B		DDB 1407 - 1376 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1439 - 1408	0F.4C		DDB 1439 - 1408 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1471 - 1440	0F.4D		DDB 1471 - 1440 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1503 - 1472	0F.4E		DDB 1503 - 1472 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1535 - 1504	0F.4F		DDB 1535 - 1504 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1567 - 1536	0F.50		DDB 1567 - 1536 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1599 - 1568	0F.51		DDB 1599 - 1568 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1631 - 1600	0F.52		DDB 1631 - 1600 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1663 - 1632	0F.53		DDB 1663 - 1632 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1695 - 1664	0F.54		DDB 1695 - 1664 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1727 - 1696	0F.55		DDB 1727 - 1696 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1759- 1728	0F.56		DDB 1759- 1728 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1791- 1760	0F.57		DDB 1791- 1760 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1823 - 1792	0F.58		DDB 1823 - 1792 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1855 - 1824	0F.59		DDB 1855 - 1824 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1887 - 1856	0F.5A		DDB 1887 - 1856 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1919 - 1888	0F.5B		DDB 1919 - 1888 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 1951 - 1920	0F.5C		DDB 1951 - 1920 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
DDB 1983 - 1952	0F.5D		DDB 1983 - 1952 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 2015 - 1984	0F.5E		DDB 2015 - 1984 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
DDB 2047 - 2016	0F.5F		DDB 2047 - 2016 *[Binary Flag (32 bits)]*
This cell displays the logic state of the DDB signals			
CB MONITOR SETUP	10.00		
This column contains Circuit Breaker monitoring parameters			
No. CB Ops Maint	10.06	Alarm Disabled	Alarm Disabled Alarm Enabled *[Indexed String]*
This setting activates the 'number of CB operations' maintenance alarm.			
No. CB Ops Maint	10.07	10	From 1 to 10000 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the threshold for the 'Number of CB operations' alarm.			
No. CB Ops Lock	10.08	Alarm Disabled	Alarm Disabled Alarm Enabled *[Indexed String]*
This setting activates the 'number of CB operations' lockout alarm.			
No. CB Ops Lock	10.09	20	From 1 to 10000 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the threshold for the 'number of CB operations' lockout. Note: The IED can be set to lockout the Autoreclose function on reaching a second operations threshold.			
CB Time Maint	10.0A	Alarm Disabled	Alarm Disabled Alarm Enabled *[Indexed String]*
This setting activates the 'CB operate time' maintenance alarm.			
CB Time Maint	10.0B	0.1	From 0.005 to 0.5 in steps of 0.001 *[Courier Number (time-seconds)]*
This setting sets the threshold for the allowable accumulated CB interruption time before maintenance should be carried out			
CB Time Lockout	10.0C	Alarm Disabled	Alarm Disabled Alarm Enabled *[Indexed String]*
This setting activates the 'CB operate time' lockout alarm.			
CB Time Lockout	10.0D	0.2	From 0.005 to 0.5 in steps of 0.001 *[Courier Number (time-seconds)]*
This setting sets the threshold for the allowable accumulated CB interruption time before lockout.			
Fault Freq Lock	10.0E	Alarm Disabled	Alarm Disabled Alarm Enabled *[Indexed String]*
This setting enables or disables the 'excessive fault frequency' alarm.			
Fault Freq Count	10.0F	10	From 1 to 9999 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets a 'CB frequent operations' counter that monitors the number of operations over a set time period.			
Fault Freq Time	10.10	3600	From 0 to 9999 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the time period over which the CB operations are to be monitored. Should the set number of trip operations be accumulated within this time period, an alarm can be raised.			
OPTO CONFIG	11.00		
This column contains opto-input configuration settings			
Global Nominal V	11.01	48/54V	24/27V 30/34V 48/54V 110/125V 220/250V Custom *[Indexed String]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This setting sets the nominal DC voltage for all opto-inputs. The Custom setting allows you to set each opto-input to any voltage value individually.			
Opto Input 1	11.02	48/54V	24/27V 30/34V 48/54V 110/125V 220/250V *[Indexed String]*
This cell sets the nominal voltage for opto-input 1			
Opto Input 2	11.03	48/54V	24/27V 30/34V 48/54V 110/125V 220/250V *[Indexed String]*
This cell sets the nominal voltage for opto-input 2			
Opto Input 3	11.04	48/54V	24/27V 30/34V 48/54V 110/125V 220/250V *[Indexed String]*
This cell sets the nominal voltage for opto-input 3			
Opto Input 4	11.05	48/54V	24/27V 30/34V 48/54V 110/125V 220/250V *[Indexed String]*
This cell sets the nominal voltage for opto-input 4			
Opto Input 5	11.06	48/54V	24/27V 30/34V 48/54V 110/125V 220/250V *[Indexed String]*
This cell sets the nominal voltage for opto-input 5			
Opto Input 6	11.07	48/54V	24/27V 30/34V 48/54V 110/125V 220/250V *[Indexed String]*
This cell sets the nominal voltage for opto-input 6			
Opto Input 7	11.08	48/54V	24/27V 30/34V 48/54V 110/125V 220/250V *[Indexed String]*
This cell sets the nominal voltage for opto-input 7			
Opto Input 8	11.09	48/54V	24/27V 30/34V 48/54V 110/125V 220/250V *[Indexed String]*
This cell sets the nominal voltage for opto-input 8			
Opto Input 9	11.0A	48/54V	24/27V 30/34V 48/54V

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			110/125V 220/250V *[Indexed String]*
This cell sets the nominal voltage for opto-input 9			
Opto Input 10	11.0B	48/54V	24/27V 30/34V 48/54V 110/125V 220/250V *[Indexed String]*
This cell sets the nominal voltage for opto-input 10			
Opto Input 11	11.0C	48/54V	24/27V 30/34V 48/54V 110/125V 220/250V *[Indexed String]*
This cell sets the nominal voltage for opto-input 11			
Opto Input 12	11.0D	48/54V	24/27V 30/34V 48/54V 110/125V 220/250V *[Indexed String]*
This cell sets the nominal voltage for opto-input 12			
Opto Input 13	11.0E	48/54V	24/27V 30/34V 48/54V 110/125V 220/250V *[Indexed String]*
This cell sets the nominal voltage for opto-input 13			
Opto Filter Cntl	11.50	0xFFFFFFFF	Opto 1 Input State (0=Off, 1=Energised) Opto 2 Input State (0=Off, 1=Energised) Opto 3 Input State (0=Off, 1=Energised) Opto 4 Input State (0=Off, 1=Energised) Opto 5 Input State (0=Off, 1=Energised) Opto 6 Input State (0=Off, 1=Energised) Opto 7 Input State (0=Off, 1=Energised) Opto 8 Input State (0=Off, 1=Energised) Opto 9 Input State (0=Off, 1=Energised) Opto 10 Input State (0=Off, 1=Energised) Opto 11 Input State (0=Off, 1=Energised) Opto 12 Input State (0=Off, 1=Energised) Opto 13 Input State (0=Off, 1=Energised) Opto 14 Input State (0=Off, 1=Energised) Opto 15 Input State (0=Off, 1=Energised) Opto 16 Input State (0=Off, 1=Energised) Opto 17 Input State (0=Off, 1=Energised) Opto 18 Input State (0=Off, 1=Energised) Opto 19 Input State (0=Off, 1=Energised) Opto 20 Input State (0=Off, 1=Energised) Opto 21 Input State (0=Off, 1=Energised) Opto 22 Input State (0=Off, 1=Energised) Opto 23 Input State (0=Off, 1=Energised) Opto 24 Input State (0=Off, 1=Energised) Opto 25 Input State (0=Off, 1=Energised) Opto 26 Input State (0=Off, 1=Energised) Opto 27 Input State (0=Off, 1=Energised) Opto 28 Input State (0=Off, 1=Energised) Opto 29 Input State (0=Off, 1=Energised) Opto 30 Input State (0=Off, 1=Energised)

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Opto 31 Input State (0=Off, 1=Energised) Opto 32 Input State (0=Off, 1=Energised) *[Binary Flag (32 bits) Indexed String]*
This setting determines whether the in-built noise filter is off or on for each opto-input.			
Characteristic	11.80	Standard 60%-80%	Standard 60%-80% 50% - 70% 58% - 75% *[Indexed String]*
This setting selects the opto-inputs' pick-up and drop-off characteristics.			
Opto 1 Mode	11.88	Normal	Normal TCS *[Indexed String]*
This setting selects the opto-input's mode of operation; either normal opto or Trip Circuit Supervision (TCS). Valid for I/O option G and J only.			
Opto 2 Mode	11.89	Normal	Normal TCS *[Indexed String]*
This setting selects the opto-input's mode of operation; either normal opto or Trip Circuit Supervision (TCS). Valid for I/O option G and J only.			
Opto 4 Mode	11.8B	Normal	Normal TCS *[Indexed String]*
This setting selects the opto-input's mode of operation; either normal opto or Trip Circuit Supervision (TCS). Valid for I/O option F only.			
Opto 5 Mode	11.8C	Normal	Normal TCS *[Indexed String]*
This setting selects the opto-input's mode of operation; either normal opto or Trip Circuit Supervision (TCS). Valid for I/O option F only.			
Opto 6 Mode	11.8D	Normal	Normal TCS *[Indexed String]*
This setting selects the opto-input's mode of operation; either normal opto or Trip Circuit Supervision (TCS). Valid for I/O option F only.			
Opto 9 Mode	11.90	Normal	Normal TCS *[Indexed String]*
This setting selects the opto-input's mode of operation; either normal opto or Trip Circuit Supervision (TCS). Valid for I/O option C and H only.			
Opto 10 Mode	11.91	Normal	Normal TCS *[Indexed String]*
This setting selects the opto-input's mode of operation; either normal opto or Trip Circuit Supervision (TCS). Valid for I/O option C and H only.			
Opto 11 Mode	11.92	Normal	Normal TCS *[Indexed String]*
This setting selects the opto-input's mode of operation; either normal opto or Trip Circuit Supervision (TCS). Valid for I/O option C only.			
CONTROL INPUTS	12.00		
This column contains settings for the type of control input			
Ctrl I/P Status 1	12.01	0x00000000	Control Input 1 (0 = Reset, 1 = Set) Control Input 2 (0 = Reset, 1 = Set) Control Input 3 (0 = Reset, 1 = Set) Control Input 4 (0 = Reset, 1 = Set) Control Input 5 (0 = Reset, 1 = Set) Control Input 6 (0 = Reset, 1 = Set) Control Input 7 (0 = Reset, 1 = Set) Control Input 8 (0 = Reset, 1 = Set) Control Input 9 (0 = Reset, 1 = Set) Control Input 10 (0 = Reset, 1 = Set) Control Input 11 (0 = Reset, 1 = Set) Control Input 12 (0 = Reset, 1 = Set) Control Input 13 (0 = Reset, 1 = Set) Control Input 14 (0 = Reset, 1 = Set) Control Input 15 (0 = Reset, 1 = Set) Control Input 16 (0 = Reset, 1 = Set) Control Input 17 (0 = Reset, 1 = Set) Control Input 18 (0 = Reset, 1 = Set)

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Control Input 19 (0 = Reset, 1 = Set) Control Input 20 (0 = Reset, 1 = Set) Control Input 21 (0 = Reset, 1 = Set) Control Input 22 (0 = Reset, 1 = Set) Control Input 23 (0 = Reset, 1 = Set) Control Input 24 (0 = Reset, 1 = Set) Control Input 25 (0 = Reset, 1 = Set) Control Input 26 (0 = Reset, 1 = Set) Control Input 27 (0 = Reset, 1 = Set) Control Input 28 (0 = Reset, 1 = Set) Control Input 29 (0 = Reset, 1 = Set) Control Input 30 (0 = Reset, 1 = Set) Control Input 31 (0 = Reset, 1 = Set) Control Input 32 (0 = Reset, 1 = Set) *[Binary Flag (32 bits) Indexed String]*
This cell sets or resets the first batch of 32 Control Inputs by scrolling and changing the status of selected bits. Alternatively, each of the 32 Control inputs can be set and reset using the individual Control Input cells.			
Ctrl I/P Status 2	12.02	0x00000000	Control Input 33 (0 = Reset, 1 = Set) Control Input 34 (0 = Reset, 1 = Set) Control Input 35 (0 = Reset, 1 = Set) Control Input 36 (0 = Reset, 1 = Set) Control Input 37 (0 = Reset, 1 = Set) Control Input 38 (0 = Reset, 1 = Set) Control Input 39 (0 = Reset, 1 = Set) Control Input 40 (0 = Reset, 1 = Set) Control Input 41 (0 = Reset, 1 = Set) Control Input 42 (0 = Reset, 1 = Set) Control Input 43 (0 = Reset, 1 = Set) Control Input 44 (0 = Reset, 1 = Set) Control Input 45 (0 = Reset, 1 = Set) Control Input 46 (0 = Reset, 1 = Set) Control Input 47 (0 = Reset, 1 = Set) Control Input 48 (0 = Reset, 1 = Set) Control Input 49 (0 = Reset, 1 = Set) Control Input 50 (0 = Reset, 1 = Set) Control Input 51 (0 = Reset, 1 = Set) Control Input 52 (0 = Reset, 1 = Set) Control Input 53 (0 = Reset, 1 = Set) Control Input 54 (0 = Reset, 1 = Set) Control Input 55 (0 = Reset, 1 = Set) Control Input 56 (0 = Reset, 1 = Set) Control Input 57 (0 = Reset, 1 = Set) Control Input 58 (0 = Reset, 1 = Set) Control Input 59 (0 = Reset, 1 = Set) Control Input 60 (0 = Reset, 1 = Set) Control Input 61 (0 = Reset, 1 = Set) Control Input 62 (0 = Reset, 1 = Set) Control Input 63 (0 = Reset, 1 = Set) Control Input 64 (0 = Reset, 1 = Set) *[Binary Flag (32 bits) Indexed String]*
This cell sets or resets the second batch of 32 Control Inputs by scrolling and changing the status of selected bits. Alternatively, each of the 32 Control inputs can be set and reset using the individual Control Input cells.			
Control Input 1	12.10	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 1			
Control Input 2	12.11	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 2			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
Control Input 3	12.12	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 3			
Control Input 4	12.13	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 4			
Control Input 5	12.14	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 5			
Control Input 6	12.15	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 6			
Control Input 7	12.16	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 7			
Control Input 8	12.17	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 8			
Control Input 9	12.18	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 9			
Control Input 10	12.19	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 10			
Control Input 11	12.1A	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 11			
Control Input 12	12.1B	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 12			
Control Input 13	12.1C	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 13			
Control Input 14	12.1D	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 14			
Control Input 15	12.1E	No Operation	No Operation

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Set Reset *[Indexed String]*
This command sets or resets Control Input 15			
Control Input 16	12.1F	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 16			
Control Input 17	12.20	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 17			
Control Input 18	12.21	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 18			
Control Input 19	12.22	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 19			
Control Input 20	12.23	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 20			
Control Input 21	12.24	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 21			
Control Input 22	12.25	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 22			
Control Input 23	12.26	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 23			
Control Input 24	12.27	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 24			
Control Input 25	12.28	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 25			
Control Input 26	12.29	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 26			
Control Input 27	12.2A	No Operation	No Operation Set

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Reset *[Indexed String]*
This command sets or resets Control Input 27			
Control Input 28	12.2B	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 28			
Control Input 29	12.2C	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 29			
Control Input 30	12.2D	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 30			
Control Input 31	12.2E	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 31			
Control Input 32	12.2F	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 32			
Control Input 33	12.30	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 33			
Control Input 34	12.31	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 34			
Control Input 35	12.32	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 35			
Control Input 36	12.33	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 36			
Control Input 37	12.34	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 37			
Control Input 38	12.35	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 38			
Control Input 39	12.36	No Operation	No Operation Set Reset

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Indexed String]
This command sets or resets Control Input 39			
Control Input 40	12.37	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 40			
Control Input 41	12.38	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 41			
Control Input 42	12.39	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 42			
Control Input 43	12.3A	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 43			
Control Input 44	12.3B	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 44			
Control Input 45	12.3C	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 45			
Control Input 46	12.3D	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 46			
Control Input 47	12.3E	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 47			
Control Input 48	12.3F	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 48			
Control Input 49	12.40	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 49			
Control Input 50	12.41	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 50			
Control Input 51	12.42	No Operation	No Operation Set Reset *[Indexed String]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This command sets or resets Control Input 51			
Control Input 52	12.43	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 52			
Control Input 53	12.44	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 53			
Control Input 54	12.45	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 54			
Control Input 55	12.46	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 55			
Control Input 56	12.47	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 56			
Control Input 57	12.48	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 57			
Control Input 58	12.49	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 58			
Control Input 59	12.4A	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 59			
Control Input 60	12.4B	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 60			
Control Input 61	12.4C	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 61			
Control Input 62	12.4D	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 62			
Control Input 63	12.4E	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 63			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
Control Input 64	12.4F	No Operation	No Operation Set Reset *[Indexed String]*
This command sets or resets Control Input 64			
CTRL I/P CONFIG	13.00		
This column contains configuration settings for the control inputs.			
Hotkey Enabled 1	13.01	0xFFFFFFFF	Control Input 1 Control Input 2 Control Input 3 Control Input 4 Control Input 5 Control Input 6 Control Input 7 Control Input 8 Control Input 9 Control Input 10 Control Input 11 Control Input 12 Control Input 13 Control Input 14 Control Input 15 Control Input 16 Control Input 17 Control Input 18 Control Input 19 Control Input 20 Control Input 21 Control Input 22 Control Input 23 Control Input 24 Control Input 25 Control Input 26 Control Input 27 Control Input 28 Control Input 29 Control Input 30 Control Input 31 Control Input 32 *[Binary Flag (32 bits) Indexed String]*
This setting allows the control inputs to be individually assigned to the Hotkey menu. The hotkey menu allows the control inputs to be set, reset or pulsed without the need to enter the CONTROL INPUTS column.			
Hotkey Enabled 2	13.02	0xFFFFFFFF	Control Input 33 Control Input 34 Control Input 35 Control Input 36 Control Input 37 Control Input 38 Control Input 39 Control Input 40 Control Input 41 Control Input 42 Control Input 43 Control Input 44 Control Input 45 Control Input 46 Control Input 47 Control Input 48 Control Input 49 Control Input 50 Control Input 51 Control Input 52

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Control Input 53 Control Input 54 Control Input 55 Control Input 56 Control Input 57 Control Input 58 Control Input 59 Control Input 60 Control Input 61 Control Input 62 Control Input 63 Control Input 64 *[Binary Flag (32 bits) Indexed String]*
This setting allows the control inputs to be individually assigned to the Hotkey menu. The hotkey menu allows the control inputs to be set, reset or pulsed without the need to enter the CONTROL INPUTS column.			
Control Input 1	13.10	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 1	13.11	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 2	13.14	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 2	13.15	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 3	13.18	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 3	13.19	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 4	13.1C	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 4	13.1D	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 5	13.20	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 5	13.21	SET/RESET	ON/OFF SET/RESET

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 6	13.24	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 6	13.25	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 7	13.28	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 7	13.29	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 8	13.2C	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 8	13.2D	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 9	13.30	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 9	13.31	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 10	13.34	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 10	13.35	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 11	13.38	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 11	13.39	SET/RESET	ON/OFF SET/RESET IN/OUT

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 12	13.3C	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 12	13.3D	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 13	13.40	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 13	13.41	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 14	13.44	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 14	13.45	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 15	13.48	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 15	13.49	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 16	13.4C	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 16	13.4D	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 17	13.50	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 17	13.51	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Indexed String]
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 18	13.54	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 18	13.55	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 19	13.58	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 19	13.59	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 20	13.5C	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 20	13.5D	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 21	13.60	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 21	13.61	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 22	13.64	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 22	13.65	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 23	13.68	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 23	13.69	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 24	13.6C	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 24	13.6D	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 25	13.70	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 25	13.71	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 26	13.74	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 26	13.75	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 27	13.78	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 27	13.79	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 28	13.7C	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 28	13.7D	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 29	13.80	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 29	13.81	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
Control Input 30	13.84	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 30	13.85	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 31	13.88	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 31	13.89	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 32	13.8C	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 32	13.8D	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 33	13.90	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 33	13.91	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 34	13.93	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 34	13.94	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 35	13.96	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 35	13.97	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 36	13.99	Latched	Latched

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 36	13.9A	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 37	13.9C	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 37	13.9D	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 38	13.9F	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 38	13.A0	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 39	13.A2	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 39	13.A3	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 40	13.A5	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 40	13.A6	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 41	13.A8	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 41	13.A9	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 42	13.AB	Latched	Latched Pulsed

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Indexed String]
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 42	13.AC	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 43	13.AE	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 43	13.AF	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 44	13.B1	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 44	13.B2	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 45	13.B4	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 45	13.B5	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 46	13.B7	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 46	13.B8	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 47	13.BA	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 47	13.BB	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 48	13.BD	Latched	Latched Pulsed *[Indexed String]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 48	13.BE	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 49	13.C0	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 49	13.C1	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 50	13.C3	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 50	13.C4	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 51	13.C6	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 51	13.C7	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 52	13.C9	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 52	13.CA	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 53	13.CC	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 53	13.CD	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 54	13.CF	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
Ctrl Command 54	13.D0	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 55	13.D2	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 55	13.D3	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 56	13.D5	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 56	13.D6	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 57	13.D8	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 57	13.D9	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 58	13.DB	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 58	13.DC	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 59	13.DE	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 59	13.DF	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 60	13.E1	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 60	13.E2	SET/RESET	ON/OFF

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 61	13.E4	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 61	13.E5	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 62	13.E7	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 62	13.E8	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 63	13.EA	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 63	13.EB	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
Control Input 64	13.ED	Latched	Latched Pulsed *[Indexed String]*
This setting configures the control input as either 'latched' or 'pulsed'.			
Ctrl Command 64	13.EE	SET/RESET	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED *[Indexed String]*
This setting allows you to select the text to be displayed on the hotkey menu.			
FUNCTION KEYS	17.00		
This column contains the function key definitions (only available for 30TE case).			
Fn Key Status	17.01	0	Fn Key Status *[Binary Flag (10 bits) Indexed String]*
This cell displays the status of each function key			
Fn Key 1	17.02	Unlocked	Disabled Unlocked Locked *[Indexed String]*
This setting activates function key 1. The 'Lock' setting allows a function key, which is in toggle mode, to be locked in its current active state.			
Fn Key 1 Mode	17.03	Toggled	Normal Toggled *[Indexed String]*
This setting sets the function key mode. In 'Toggle' mode, a single key press set sand latches the function key output to 'high' or 'low' in the PSL. In 'Normal' mode the function key output remains high as long as key is pressed.			
Fn Key 1 Label	17.04	Function Key 1	From 32 to 163 in steps of 1

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[ASCII Text (16 chars)]
This setting lets you change the function key text to something more suitable for the application.			
Fn Key 2	17.05	Unlocked	Disabled Unlocked Locked *[Indexed String]*
This setting activates function key 2. The 'Lock' setting allows a function key, which is in toggle mode, to be locked in its current active state.			
Fn Key 2 Mode	17.06	Normal	Normal Toggled *[Indexed String]*
This setting sets the function key mode. In 'Toggle' mode, a single key press set sand latches the function key output to 'high' or 'low' in the PSL. In 'Normal' mode the function key output remains high as long as key is pressed.			
Fn Key 2 Label	17.07	Function Key 2	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
This setting lets you change the function key text to something more suitable for the application.			
Fn Key 3	17.08	Unlocked	Disabled Unlocked Locked *[Indexed String]*
This setting activates function key 3. The 'Lock' setting allows a function key, which is in toggle mode, to be locked in its current active state.			
Fn Key 3 Mode	17.09	Normal	Normal Toggled *[Indexed String]*
This setting sets the function key mode. In 'Toggle' mode, a single key press set sand latches the function key output to 'high' or 'low' in the PSL. In 'Normal' mode the function key output remains high as long as key is pressed.			
Fn Key 3 Label	17.0A	Function Key 3	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
This setting lets you change the function key text to something more suitable for the application.			
IEC61850 CONFIG.	19.00		
This column contains settings for the IEC61850 IED Configurator			
Switch Conf.Bank	19.05	No Action	No Action Switch Banks *[Indexed String]*
This command allows you to switch between the current configuration, held in the Active Memory Bank to the configuration held in the Inactive Memory Bank.			
Restore MCL	19.0A	No Action	No Action Restore MCL *[Indexed String]*
This command lets you restore the MCL (MiCOM Control Language).			
Active Conf.Name	19.10	Not Available	Active Conf.Name *[ASCII Text]*
This cell displays the name of the configuration in the Active Memory Bank (usually taken from the SCL file).			
Active Conf.Rev	19.11	Not Available	Active Conf.Rev *[ASCII Text]*
This cell displays the configuration revision number of the configuration in the Active Memory Bank (usually taken from the SCL file).			
Inact.Conf.Name	19.20	Not Available	Inact.Conf.Name *[ASCII Text]*
This cell displays the name of the configuration in the Inactive Memory Bank (usually taken from the SCL file).			
Inact.Conf.Rev	19.21	Not Available	Inact.Conf.Rev *[ASCII Text]*
This cell displays the configuration revision number of the configuration in the Inactive Memory Bank (usually taken from the SCL file).			
IP PARAMETERS	19.30		
The data in this sub-heading relates to the IEC61850 IP parameters			
IP Address	19.31	0.0.0.0	IP Address *[ASCII Text]*
This cell displays the IED's IP address.			
Subnet mask	19.32	0.0.0.0	Subnet mask *[ASCII Text]*
This cell displays the subnet mask, which defines the subnet on which the IED is located.			
Gateway	19.33	0.0.0.0	Gateway

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[ASCII Text]
This cell displays the gateway address of the LAN on which the IED is located.			
Media	19.34		Media Unknown RJ45 FO RJ45 Port A RJ45 Port B FO Port A FO Port B RJ45 Redundant FO Redundant *[Indexed String]*
IEC 61850 versions only. Displays the communication media of the Ethernet port that is currently in use.			
SNTP PARAMETERS	19.40		
The data and settings under this sub-heading relate to the IEC61850 SNTP parameters			
SNTP Server 1	19.41	0.0.0.0	SNTP Server 1 *[ASCII Text]*
This cell displays the IP address of the primary SNTP server.			
SNTP Server 2	19.42	0.0.0.0	SNTP Server 2 *[ASCII Text]*
This cell displays the IP address of the secondary SNTP server.			
IEC 61850 SCL	19.50		
IEC61850 versions only.			
IED Name	19.51	Not Available	IED Name *[ASCII Text]*
This setting displays the unique IED name used on the IEC 61850 network (usually taken from the SCL file).			
IEC 61850 GOOSE	19.60		
IEC61850 versions only.			
GoEna	19.70	0x00	From 0x00 to 0xFF in steps of 1 *[Binary Flag (8 bits)]*
This setting enables the GOOSE publisher settings.			
Test Mode	19.71	0x00	From 0x00 to 0xFF in steps of 1 *[Binary Flag (8 bits)]*
This setting enables or disables the Test flag in the GOOSE message. With '0', the Test flag is not set. With '1', the Test flag is set. Indicates that the message is in test mode and should not be used for operational purposes.			
NIC MAC Address	19.82	Ethernet MAC Address	NIC MAC Address *[ASCII Text (17 chars)]*
This setting displays the MAC address of the rear Ethernet port A in case IEC61850+DNP3 comms and dual IP used			
DNP SETTINGS	1B.00		
This column contains settings for the DNP Configurator			
Dest Address	1B.01	1	From 0 to 255 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting is for DNP3.0 versions only.Address of Master Device to send the unsolicited response to			
Unso Mode	1B.02	0	ON OFF *[Indexed String]*
This setting is for DNP3.0 versions only.When unsolicited response is configure off, the device shall never send an unsolicited response, but otherwise responds to master requests			
Unso Retry	1B.03	3	From 0 to 5 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting is for DNP3.0 versions only. The setting is the number of retries that an outstation transmits in each unsolicited response series if it does not receive confirmation back from the master.			
Unso Response	1B.04	2	From 1 to 30 in steps of 1 *[Courier Number (time-seconds)]*
This setting is for DNP3.0 versions only. The setting is the amount of time that the outstation shall wait for an Application Layer confirmation back from the master.			
Unso Offline Time	1B.05	30	From 1 to 60 in steps of 1 *[Courier Number (time-seconds)]*
This setting is for DNP3.0 versions only. If an unsolicited response has been retried (Number of Unsolicited retries) without a confirmation then			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
this parameter defines the time interval between unsolicited retries from that point forward			
Unso Class1 Event	1B.06	5	From 1 to 100 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting is for DNP3.0 versions only. The unsolicited message will send if the class 1 event number is larger than this parameter.			
Unso Class1 Delay	1B.07	3	From 0.1 to 5 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting is for DNP3.0 versions only. The unsolicited message of class 1 events will send after the delay time.			
Unso Class2 Event	1B.08	5	From 1 to 100 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting is for DNP3.0 versions only. The unsolicited message will send if the class 2 event number is larger than this parameter.			
Unso Class2 Delay	1B.09	3	From 0.1 to 5 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting is for DNP3.0 versions only. The unsolicited message of class 2 events will send after the delay time.			
Unso Class3 Event	1B.0A	5	From 1 to 100 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting is for DNP3.0 versions only. The unsolicited message will send if the class 3 event number is larger than this parameter.			
Unso Class3 Delay	1B.0B	3	From 0.1 to 5 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting is for DNP3.0 versions only. The unsolicited message of class 3 events will send after the delay time.			
Backoff Max Time	1B.0C	0.5	From 0 to 0.5 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting is for DNP3.0 versions only. The setting sets the maximum back off time			
Backoff Min Time	1B.0D	0	From 0 to 0.5 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting is for DNP3.0 versions only. The setting sets the minimum back off time			
Dest Address	1B.21	1	From 0 to 255 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting is for DNP3.0 over Ethernet versions only.Address of Master Device to send the unsolicited response to			
Unso Mode	1B.22	0	ON OFF *[Indexed String]*
This setting is for DNP3.0 over Ethernet versions only.When unsolicited response is configure off, the device shall never send an unsolicited response, but otherwise responds to master requests			
Unso Retry	1B.23	3	From 0 to 5 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting is for DNP3.0 over Ethernet versions only. The setting is the number of retries that an outstation transmits in each unsolicited response series if it does not receive confirmation back from the master.			
Unso Response	1B.24	2	From 1 to 30 in steps of 1 *[Courier Number (time-seconds)]*
This setting is for DNP3.0 over Ethernet versions only. The setting is the amount of time that the outstation shall wait for an Application Layer confirmation back from the master.			
Unso Offline Time	1B.25	30	From 1 to 60 in steps of 1 *[Courier Number (time-seconds)]*
This setting is for DNP3.0 over Ethernet versions only. If an unsolicited response has been retried (Number of Unsolicited retries) without a confirmation then this parameter defines the time interval between unsolicited retries from that point forward			
Unso Class1 Event	1B.26	5	From 1 to 100 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting is for DNP3.0 over Ethernet versions only. The unsolicited message will send if the class 1 event number is larger than this parameter.			
Unso Class1 Delay	1B.27	3	From 0.1 to 5 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting is for DNP3.0 over Ethernet versions only. The unsolicited message of class 1 events will send after the delay time.			
Unso Class2 Event	1B.28	5	From 1 to 100 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting is for DNP3.0 over Ethernet versions only. The unsolicited message will send if the class 2 event number is larger than this parameter.			
Unso Class2 Delay	1B.29	3	From 0.1 to 5 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting is for DNP3.0 over Ethernet versions only. The unsolicited message of class 2 events will send after the delay time.			
Unso Class3 Event	1B.2A	5	From 1 to 100 in steps of 1

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Unsigned Integer (16 bits)]
This setting is for DNP3.0 over Ethernet versions only. The unsolicited message will send if the class 3 event number is larger than this parameter.			
Unso Class3 Delay	1B.2B	3	From 0.1 to 5 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting is for DNP3.0 over Ethernet versions only. The unsolicited message of class 3 events will send after the delay time.			
Backoff Max Time	1B.2C	0.5	From 0 to 0.5 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting is for DNP3.0 over Ethernet versions only. The setting sets the maximum back off time			
Backoff Min Time	1B.2D	0	From 0 to 0.5 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting is for DNP3.0 over Ethernet versions only. The setting sets the minimum back off time			
IP Address	1B.A1	0.0.0.0	IP Address *[ASCII Text]*
This cell displays the IED's IP address for port B (in case IEC61850+DNP3OE comms)			
Subnet mask	1B.A2	0.0.0.0	Subnet mask *[ASCII Text]*
This cell displays the subnet mask, which defines the subnet on which the IED is located.			
DNP MAC Address	1B.A3	Ethernet MAC Address	DNP MAC Address *[ASCII Text (17 chars)]*
This setting displays the MAC address of the rear Ethernet port A in case IEC61850+DNP3 comms and dual IP used			
Gateway	1B.A4	0.0.0.0	Gateway *[ASCII Text]*
This cell displays the gateway address of the LAN on which the IED is located.			
DNP Time Synch	1B.A5	Disabled	Disabled Enabled *[Indexed String]*
If set to 'Enabled' the DNP3.0 master station can be used to synchronise the IED's time clock. If set to 'Disabled' either the internal free running clock, or IRIG-B input are used. DNP 3.0 over Ethernet versions only.			
Meas Scaling	1B.A6	Primary	Normalised Primary Secondary *[Indexed String]*
This setting determines the scaling type of analogue quantities - in terms of primary, secondary or normalised, for DNP3 models.			
Media	1B.A9		Media Unknown RJ45 FO RJ45 Port A RJ45 Port B FO Port A FO Port B RJ45 Redundant FO Redundant *[Indexed String]*
IEC 61850 versions only. Displays the communication media of the Ethernet port that is currently in use.			
DNP Need Time	1B.B1	10	From 1 to 30 in steps of 1 *[Courier Number (time-minutes)]*
This setting sets the duration of time waited before requesting another time sync from the master. DNP 3.0 versions only.			
DNP App Fragment	1B.B2	2048	From 100 to 2048 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the maximum message length (application fragment size) transmitted by the IED for DNP 3.0 versions.			
DNP App Timeout	1B.B3	2	From 1 to 120 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the maximum waiting time between sending a message fragment and receiving confirmation from the master. DNP 3.0 versions only.			
DNP SBO Timeout	1B.B4	10	From 1 to 10 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the maximum waiting time between receiving a select command and awaiting an operate confirmation from the master. DNP 3.0 versions only.			
Class 0 Poll	1B.B5	0	Running Counters

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Frozen Counters *[Indexed String]*
This setting is for DNP3.0 versions only. In response to a Class 0 poll, an outstation device shall report either the count value or the frozen count value.			
SWITCH CONTROL	22.00		
This column controls the user switch operation configuration			
SWITCH 1	22.01		SWITCH 1 *[Indexed String]*
This cell indicates that setting below are for Switch 1			
SWITCH1 Type	22.02	Load Break	Load Break Disconnector Earthing SWI HiSpeed Ear SWI *[Indexed String]*
Switch type			
SWI1 Status Inpt	22.03	None	None 52A 52B Both 52A+52B *[Indexed String]*
Setting to define the type of circuit breaker contacts that will be used for the circuit breaker control logic. Form A contacts match the status of the circuit breaker primary contacts, form B are opposite to the breaker status.			
SWI1 Control by	22.04	Disabled	Disabled Local Remote Local+Remote *[Indexed String]*
This setting selects the type of switch control to be used			
SWI1 Trip/Close	22.05	No Operation	No Operation Trip Close *[Indexed String]*
Supports trip and close commands if enabled in the user switch Control menu.			
SWI1 Trp Puls T	22.06	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of the close pulse within which the userswitch should close when a close command is issued.			
SWI1 Cls Puls T	22.07	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of the trip pulse within which the user switch should trip when a manual or protection trip command is issued.			
SWI1 Trp Alrm T	22.08	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise alarm when a close command is issued.			
SWI1 Cls Alrm T	22.09	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise alarm when a protection trip command is issued.			
SWI1 Sta Alrm T	22.0A	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise a status alarm.			
SWI1 Operations	22.0B		SWI1 Operations *[Indexed String]*
This cell displays the number of switch Operations			
Reset SWI1 Data	22.0C	No	No Yes *[Indexed String]*
This cell resets the switch condition monitoring data			
SWITCH 2	22.0D		SWITCH 2 *[Indexed String]*
This cell indicates that setting below are for Switch 1			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
SWITCH2 Type	22.0E	Load Break	Load Break Disconnector Earthing SWI HiSpeed Ear SWI *[Indexed String]*
Switch type			
SWI2 Status Inpt	22.0F	None	None 52A 52B Both 52A+52B *[Indexed String]*
Setting to define the type of circuit breaker contacts that will be used for the circuit breaker control logic. Form A contacts match the status of the circuit breaker primary contacts, form B are opposite to the breaker status.			
SWI2 Control by	22.10	Disabled	Disabled Local Remote Local+Remote *[Indexed String]*
This setting selects the type of switch control to be used			
SWI2 Trip/Close	22.11	No Operation	No Operation Trip Close *[Indexed String]*
Supports trip and close commands if enabled in the user switch Control menu.			
SWI2 Trp Puls T	22.12	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of the close pulse within which the userswitch should close when a close command is issued.			
SWI2 Cls Puls T	22.13	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of the trip pulse within which the user switch should trip when a manual or protection trip command is issued.			
SWI2 Trp Alrm T	22.14	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise alarm when a close command is issued.			
SWI2 Cls Alrm T	22.15	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise alarm when a protection trip command is issued.			
SWI2 Sta Alrm T	22.16	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise a status alarm.			
SWI2 Operations	22.17		SWI2 Operations *[Indexed String]*
This cell displays the number of switch Operations			
Reset SWI2 Data	22.18	No	No Yes *[Indexed String]*
This cell resets the switch condition monitoring data			
SWITCH 3	22.19		SWITCH 3 *[Indexed String]*
This cell indicates that setting below are for Switch 1			
SWITCH3 Type	22.1A	Load Break	Load Break Disconnector Earthing SWI HiSpeed Ear SWI *[Indexed String]*
Switch type			
SWI3 Status Inpt	22.1B	None	None 52A 52B Both 52A+52B

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Indexed String]
Setting to define the type of circuit breaker contacts that will be used for the circuit breaker control logic. Form A contacts match the status of the circuit breaker primary contacts, form B are opposite to the breaker status.			
SWI3 Control by	22.1C	Disabled	Disabled Local Remote Local+Remote *[Indexed String]*
This setting selects the type of switch control to be used			
SWI3 Trip/Close	22.1D	No Operation	No Operation Trip Close *[Indexed String]*
Supports trip and close commands if enabled in the user switch Control menu.			
SWI3 Trp Puls T	22.1E	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of the close pulse within which the userswitch should close when a close command is issued.			
SWI3 Cls Puls T	22.1F	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of the trip pulse within which the user switch should trip when a manual or protection trip command is issued.			
SWI3 Trp Alrm T	22.20	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise alarm when a close command is issued.			
SWI3 Cls Alrm T	22.21	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise alarm when a protection trip command is issued.			
SWI3 Sta Alrm T	22.22	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise a status alarm.			
SWI3 Operations	22.23		SWI3 Operations *[Indexed String]*
This cell displays the number of switch Operations			
Reset SWI3 Data	22.24	No	No Yes *[Indexed String]*
This cell resets the switch condition monitoring data			
SWITCH 4	22.25		SWITCH 4 *[Indexed String]*
This cell indicates that setting below are for Switch 1			
SWITCH4 Type	22.26	Load Break	Load Break Disconnector Earthing SWI HiSpeed Ear SWI *[Indexed String]*
Switch type			
SWI4 Status Inpt	22.27	None	None 52A 52B Both 52A+52B *[Indexed String]*
Setting to define the type of circuit breaker contacts that will be used for the circuit breaker control logic. Form A contacts match the status of the circuit breaker primary contacts, form B are opposite to the breaker status.			
SWI4 Control by	22.28	Disabled	Disabled Local Remote Local+Remote *[Indexed String]*
This setting selects the type of switch control to be used			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
SWI4 Trip/Close	22.29	No Operation	No Operation Trip Close *[Indexed String]*
Supports trip and close commands if enabled in the user switch Control menu.			
SWI4 Trp Puls T	22.2A	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of the close pulse within which the userswitch should close when a close command is issued.			
SWI4 Cls Puls T	22.2B	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of the trip pulse within which the user switch should trip when a manual or protection trip command is issued.			
SWI4 Trp Alrm T	22.2C	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise alarm when a close command is issued.			
SWI4 Cls Alrm T	22.2D	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise alarm when a protection trip command is issued.			
SWI4 Sta Alrm T	22.2E	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise a status alarm.			
SWI4 Operations	22.2F		SWI4 Operations *[Indexed String]*
This cell displays the number of switch Operations			
Reset SWI4 Data	22.30	No	No Yes *[Indexed String]*
This cell resets the switch condition monitoring data			
SWITCH 5	22.31		SWITCH 5 *[Indexed String]*
This cell indicates that setting below are for Switch 1			
SWITCH5 Type	22.32	Load Break	Load Break Disconnector Earthing SWI HiSpeed Ear SWI *[Indexed String]*
Switch type			
SWI5 Status Inpt	22.33	None	None 52A 52B Both 52A+52B *[Indexed String]*
Setting to define the type of circuit breaker contacts that will be used for the circuit breaker control logic. Form A contacts match the status of the circuit breaker primary contacts, form B are opposite to the breaker status.			
SWI5 Control by	22.34	Disabled	Disabled Local Remote Local+Remote *[Indexed String]*
This setting selects the type of switch control to be used			
SWI5 Trip/Close	22.35	No Operation	No Operation Trip Close *[Indexed String]*
Supports trip and close commands if enabled in the user switch Control menu.			
SWI5 Trp Puls T	22.36	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of the close pulse within which the userswitch should close when a close command is issued.			
SWI5 Cls Puls T	22.37	0.5	From 0.1 to 60 in steps of 0.01

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Courier Number (time-seconds)]
This setting defines the duration of the trip pulse within which the user switch should trip when a manual or protection trip command is issued.			
SWI5 Trp Alrm T	22.38	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise alarm when a close command is issued.			
SWI5 Cls Alrm T	22.39	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise alarm when a protection trip command is issued.			
SWI5 Sta Alrm T	22.3A	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise a status alarm.			
SWI5 Operations	22.3B		SWI5 Operations *[Indexed String]*
This cell displays the number of switch Operations			
Reset SWI5 Data	22.3C	No	No Yes *[Indexed String]*
This cell resets the switch condition monitoring data			
SWITCH 6	22.3D		SWITCH 6 *[Indexed String]*
This cell indicates that setting below are for Switch 1			
SWITCH6 Type	22.3E	Load Break	Load Break Disconnector Earthing SWI HiSpeed Ear SWI *[Indexed String]*
Switch type			
SWI6 Status Inpt	22.3F	None	None 52A 52B Both 52A+52B *[Indexed String]*
Setting to define the type of circuit breaker contacts that will be used for the circuit breaker control logic. Form A contacts match the status of the circuit breaker primary contacts, form B are opposite to the breaker status.			
SWI6 Control by	22.40	Disabled	Disabled Local Remote Local+Remote *[Indexed String]*
This setting selects the type of switch control to be used			
SWI6 Trip/Close	22.41	No Operation	No Operation Trip Close *[Indexed String]*
Supports trip and close commands if enabled in the user switch Control menu.			
SWI6 Trp Puls T	22.42	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of the close pulse within which the userswitch should close when a close command is issued.			
SWI6 Cls Puls T	22.43	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of the trip pulse within which the user switch should trip when a manual or protection trip command is issued.			
SWI6 Trp Alrm T	22.44	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise alarm when a close command is issued.			
SWI6 Cls Alrm T	22.45	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise alarm when			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
a protection trip command is issued.			
SWI6 Sta Alrm T	22.46	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise a status alarm.			
SWI6 Operations	22.47		SWI6 Operations *[Indexed String]*
This cell displays the number of switch Operations			
Reset SWI6 Data	22.48	No	No Yes *[Indexed String]*
This cell resets the switch condition monitoring data			
SWITCH 7	22.49		SWITCH 7 *[Indexed String]*
This cell indicates that setting below are for Switch 1			
SWITCH7 Type	22.4A	Load Break	Load Break Disconnector Earthing SWI HiSpeed Ear SWI *[Indexed String]*
Switch type			
SWI7 Status Inpt	22.4B	None	None 52A 52B Both 52A+52B *[Indexed String]*
Setting to define the type of circuit breaker contacts that will be used for the circuit breaker control logic. Form A contacts match the status of the circuit breaker primary contacts, form B are opposite to the breaker status.			
SWI7 Control by	22.4C	Disabled	Disabled Local Remote Local+Remote *[Indexed String]*
This setting selects the type of switch control to be used			
SWI7 Trip/Close	22.4D	No Operation	No Operation Trip Close *[Indexed String]*
Supports trip and close commands if enabled in the user switch Control menu.			
SWI7 Trp Puls T	22.4E	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of the close pulse within which the userswitch should close when a close command is issued.			
SWI7 Cls Puls T	22.4F	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of the trip pulse within which the user switch should trip when a manual or protection trip command is issued.			
SWI7 Trp Alrm T	22.50	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise alarm when a close command is issued.			
SWI7 Cls Alrm T	22.51	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise alarm when a protection trip command is issued.			
SWI7 Sta Alrm T	22.52	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise a status alarm.			
SWI7 Operations	22.53		SWI7 Operations *[Indexed String]*
This cell displays the number of switch Operations			
Reset SWI7 Data	22.54	No	No Yes

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Indexed String]
This cell resets the switch condition monitoring data			
SWITCH 8	22.55		SWITCH 8 *[Indexed String]*
This cell indicates that setting below are for Switch 1			
SWITCH8 Type	22.56	Load Break	Load Break Disconnector Earthing SWI HiSpeed Ear SWI *[Indexed String]*
Switch type			
SWI8 Status Inpt	22.57	None	None 52A 52B Both 52A+52B *[Indexed String]*
Setting to define the type of circuit breaker contacts that will be used for the circuit breaker control logic. Form A contacts match the status of the circuit breaker primary contacts, form B are opposite to the breaker status.			
SWI8 Control by	22.58	Disabled	Disabled Local Remote Local+Remote *[Indexed String]*
This setting selects the type of switch control to be used			
SWI8 Trip/Close	22.59	No Operation	No Operation Trip Close *[Indexed String]*
Supports trip and close commands if enabled in the user switch Control menu.			
SWI8 Trp Puls T	22.5A	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of the close pulse within which the userswitch should close when a close command is issued.			
SWI8 Cls Puls T	22.5B	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of the trip pulse within which the user switch should trip when a manual or protection trip command is issued.			
SWI8 Trp Alrm T	22.5C	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise alarm when a close command is issued.			
SWI8 Cls Alrm T	22.5D	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise alarm when a protection trip command is issued.			
SWI8 Sta Alrm T	22.5E	0.5	From 0.1 to 60 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the duration of wait timer before the relay raise a status alarm.			
SWI8 Operations	22.5F		SWI8 Operations *[Indexed String]*
This cell displays the number of switch Operations			
Reset SWI8 Data	22.60	No	No Yes *[Indexed String]*
This cell resets the switch condition monitoring data			
SECURITY CONFIG	25.00		
This column contains settings for the Cyber Security configuration			
User Banner	25.01	ACCESS ONLY FOR AUTHORISED USERS	From 32 to 234 in steps of 1 *[ASCII Text (32 chars)]*
With this setting, you can enter text for the NERC compliant banner.			
Attempts Limit	25.02	3	From 0 to 3 in steps of 1 *[Unsigned Integer (16 bits)]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This setting defines the maximum number of failed password attempts before action is taken.			
Attempts Timer	25.03	2	From 1 to 3 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting defines the time window used in which the number of failed password attempts is counted.			
Blocking Timer	25.04	5	From 1 to 30 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting defines the time duration for which the user is blocked, after exceeding the maximum attempts limit.			
Front Port	25.05	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the physical Front Port.			
Rear Port 1	25.06	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the primary physical rear port (RP1).			
Rear Port 2	25.07	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the secondary physical rear port (RP2).			
Ethernet Port	25.08	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the physical Ethernet Port			
Courier Tunnel	25.09	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the logical tunnelled Courier port			
IEC61850	25.0A	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the logical IEC61850 port.			
DNP3 OE	25.0B	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the logical DNP3 over Ethernet port.			
Attempts Remain	25.11		Attempts Remain *[Unsigned Integer (16 bits)]*
This cell displays the number of password attempts remaining			
Blk Time Remain	25.12		Blk Time Remain *[Unsigned Integer (16 bits)]*
This cell displays the remaining blocking time.			
Fallbck PW level	25.20		Level 0 - Logged Out. Level 1 - Password required for level 2. Level 2 - Password required for level 3. Level 3 - No Password required. *[Unsigned Integer (16 bits)]*
This cell displays the password level adopted by the IED after an inactivity timeout, or after the user logs out. This will be either the level of the highest level password that is blank, or level 0 if no passwords are blank.			
UserBannerPw Lvl	25.25	3	Disabled Enabled *[Indexed String]*
This setting decide the password level required for the user in order to be able to change the default screen.			
Security Code	25.FF		Security Code *[ASCII Text]*
This cell displays the 16-character security code required when requesting a recovery password. UI only cell.			
USER ALARMS	28.00		
This column contains settings for the User Alarms			
Manual Reset	28.01	0x00000000	From 0x00000000 to 0xFFFFFFFF in steps of 1 *[Binary Flag (32 bits)]*
Set the user alarm is manual reset or self reset			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
Labels	28.10	Sub-Heading	
This sub-heading contains the user alarm labels			
User Alarm 1	28.11	User Alarm 1	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 2	28.12	User Alarm 2	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 3	28.13	User Alarm 3	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 4	28.14	User Alarm 4	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 5	28.15	User Alarm 5	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 6	28.16	User Alarm 6	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 7	28.17	User Alarm 7	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 8	28.18	User Alarm 8	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 9	28.19	User Alarm 9	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 10	28.1A	User Alarm 10	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 11	28.1B	User Alarm 11	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 12	28.1C	User Alarm 12	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 13	28.1D	User Alarm 13	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 14	28.1E	User Alarm 14	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 15	28.1F	User Alarm 15	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 16	28.20	User Alarm 16	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 17	28.21	User Alarm 17	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 18	28.22	User Alarm 18	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 19	28.23	User Alarm 19	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
User Alarm 20	28.24	User Alarm 20	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 21	28.25	User Alarm 21	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 22	28.26	User Alarm 22	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 23	28.27	User Alarm 23	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 24	28.28	User Alarm 24	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 25	28.29	User Alarm 25	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 26	28.2A	User Alarm 26	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 27	28.2B	User Alarm 27	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 28	28.2C	User Alarm 28	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 29	28.2D	User Alarm 29	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 30	28.2E	User Alarm 30	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 31	28.2F	User Alarm 31	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
User Alarm 32	28.30	User Alarm 32	From 32 to 163 in steps of 1 *[ASCII Text (16 chars)]*
Here you can set a text label to describe each user alarm			
CTRL I/P LABELS	29.00		
This column contains settings for the Control Input Labels			
Control Input 1	29.01	Control Input 1	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 2	29.02	Control Input 2	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 3	29.03	Control Input 3	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 4	29.04	Control Input 4	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 5	29.05	Control Input 5	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 6	29.06	Control Input 6	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 7	29.07	Control Input 7	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 8	29.08	Control Input 8	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 9	29.09	Control Input 9	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 10	29.0A	Control Input 10	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 11	29.0B	Control Input 11	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 12	29.0C	Control Input 12	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 13	29.0D	Control Input 13	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 14	29.0E	Control Input 14	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 15	29.0F	Control Input 15	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 16	29.10	Control Input 16	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 17	29.11	Control Input 17	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 18	29.12	Control Input 18	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 19	29.13	Control Input 19	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 20	29.14	Control Input 20	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 21	29.15	Control Input 21	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 22	29.16	Control Input 22	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 23	29.17	Control Input 23	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 24	29.18	Control Input 24	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 25	29.19	Control Input 25	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 26	29.1A	Control Input 26	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 27	29.1B	Control Input 27	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 28	29.1C	Control Input 28	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 29	29.1D	Control Input 29	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 30	29.1E	Control Input 30	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 31	29.1F	Control Input 31	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 32	29.20	Control Input 32	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 33	29.21	Control Input 1	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 34	29.22	Control Input 2	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 35	29.23	Control Input 3	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 36	29.24	Control Input 4	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 37	29.25	Control Input 5	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 38	29.26	Control Input 6	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 39	29.27	Control Input 7	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 40	29.28	Control Input 8	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 41	29.29	Control Input 9	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 42	29.2A	Control Input 10	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 43	29.2B	Control Input 11	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 44	29.2C	Control Input 12	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 45	29.2D	Control Input 13	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 46	29.2E	Control Input 14	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 47	29.2F	Control Input 15	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 48	29.30	Control Input 16	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 49	29.31	Control Input 17	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 50	29.32	Control Input 18	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 51	29.33	Control Input 19	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 52	29.34	Control Input 20	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 53	29.35	Control Input 21	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 54	29.36	Control Input 22	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 55	29.37	Control Input 23	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 56	29.38	Control Input 24	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 57	29.39	Control Input 25	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 58	29.3A	Control Input 26	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 59	29.3B	Control Input 27	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 60	29.3C	Control Input 28	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 61	29.3D	Control Input 29	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 62	29.3E	Control Input 30	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 63	29.3F	Control Input 31	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
Control Input 64	29.40	Control Input 32	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
In this cell you can enter a text label to describe the control input. This text is displayed when a control input is accessed by the hotkey menu and in the programmable scheme logic description of the control input.			
DC SUP. MONITOR	2A.00		
This column contains settings for DC Voltage Supply Supervision			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
DC ZONE ONE	2A.01		
The settings under this sub-heading apply to zone 1			
Vdc1 Status	2A.02	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the DC Supply Monitoring supervision function for zone 1			
Vdc1 Lower Limit	2A.03	88	From 19 to 300 in steps of 1 *[Courier Number (voltage)]*
This setting set the lower threshold for the ZONE setting.			
Vdc1 Upper Limit	2A.04	99	From 19 to 300 in steps of 1 *[Courier Number (voltage)]*
This setting sets the upper threshold for the ZONE setting.			
Vdc1 Time Delay	2A.05	0.4	From 0 to 7200 in steps of 0.1 *[Courier Number (time-seconds)]*
This setting sets the pickup/drop-off for the trip signal of the ZONE Supply Monitoring.			
DC ZONE TWO	2A.11		
The settings under this sub-heading apply to zone 2			
Vdc2 Status	2A.12	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the DC Supply Monitoring supervision function for zone 2			
Vdc2 Lower Limit	2A.13	77	From 19 to 300 in steps of 1 *[Courier Number (voltage)]*
This setting set the lower threshold for the ZONE setting.			
Vdc2 Upper Limit	2A.14	88	From 19 to 300 in steps of 1 *[Courier Number (voltage)]*
This setting sets the upper threshold for the ZONE setting.			
Vdc2 Time Delay	2A.15	0.4	From 0 to 7200 in steps of 0.1 *[Courier Number (time-seconds)]*
This setting sets the pickup/drop-off for the trip signal of the ZONE Supply Monitoring.			
DC ZONE THREE	2A.21		
The settings under this sub-heading apply to zone 3			
Vdc3 Status	2A.22	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the DC Supply Monitoring supervision function for zone 3			
Vdc3 Lower Limit	2A.23	121	From 19 to 300 in steps of 1 *[Courier Number (voltage)]*
This setting set the lower threshold for the ZONE setting.			
Vdc3 Upper Limit	2A.24	238	From 19 to 300 in steps of 1 *[Courier Number (voltage)]*
This setting sets the upper threshold for the ZONE setting.			
Vdc3 Time Delay	2A.25	0.4	From 0 to 7200 in steps of 0.1 *[Courier Number (time-seconds)]*
This setting sets the pickup/drop-off for the trip signal of the ZONE Supply Monitoring.			
GROUP 1: SYSTEM CONFIG	30.00		
This column contains settings for setting the phase rotation and 2nd harmonic blocking			
Phase Sequence	30.02	Standard ABC	Standard ABC Reverse ACB *[Indexed String]*
This setting sets the phase rotation to standard (ABC) or reverse (ACB). Warning: This will affect the positive and negative sequence quantities calculated by the IED as well as other functions that are dependant on phase quantities.			
GROUP 1: RESIDUAL O/V NVD	3B.00		
This column contains settings for Residual Overvoltage (Neutral Voltage Displacement)			
VN Input	3B.01	Derived	Measured Derived *[Indexed String]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This cell indicates that VN Input is always derived from 3 phase			
VN>1 Function	3B.02	DT	Disabled DT IDMT Def User Curve 1 Def User Curve 2 Def User Curve 3 Def User Curve 4 *[Indexed String]*
This setting determines the tripping characteristic for the first stage residual overvoltage element.			
VN>1 Voltage Set	3B.03	5	From 1*V1 to 80*V1 in steps of 0.1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the first stage.			
VN>1 Voltage Set	3B.03	5	From 1*V3 to 80*V3 in steps of 0.1*V3 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the first stage.			
VN>1 Time Delay	3B.04	5	From 0 to 1200 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operate time delay for the first stage.			
VN>1 TMS	3B.05	1	From 0.5 to 100 in steps of 0.5 *[Courier Number (decimal)]*
This setting sets the time multiplier setting for the IDMT characteristic.			
VN>1 tReset	3B.06	0	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the DT reset time.			
VN>2 Status	3B.07	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the second stage SEF element. There is no choice of curves because this stage is DT only.			
VN>2 Voltage Set	3B.08	10	From 1*V1 to 80*V1 in steps of 0.1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the second stage.			
VN>2 Voltage Set	3B.08	10	From 1*V3 to 80*V3 in steps of 0.1*V3 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the second stage.			
VN>2 Time Delay	3B.09	10	From 0 to 1200 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operate time delay for the second stage.			
VN>3 Function	3B.0A	Disabled	Disabled DT IDMT Def User Curve 1 Def User Curve 2 Def User Curve 3 Def User Curve 4 *[Indexed String]*
This setting determines the tripping characteristic for the third stage residual overvoltage element.			
VN>3 Voltage Set	3B.0B	5	From 1*V1 to 80*V1 in steps of 0.1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the third stage.			
VN>3 Voltage Set	3B.0B	5	From 1*V3 to 80*V3 in steps of 0.1*V3 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the third stage.			
VN>3 Time Delay	3B.0C	5	From 0 to 1200 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operate time delay for the third stage.			
VN>3 TMS	3B.0D	1	From 0.5 to 100 in steps of 0.5 *[Courier Number (decimal)]*
This setting sets the time multiplier setting for the IDMT characteristic.			
VN>3 tReset	3B.0E	0	From 0 to 100 in steps of 0.01

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Courier Number (time-seconds)]
This setting sets the DT reset time.			
VN>4 Status	3B.10	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the second stage SEF element. There is no choice of curves because this stage is DT only.			
VN>4 Voltage Set	3B.11	10	From 1*V1 to 80*V1 in steps of 0.1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the second stage.			
VN>4 Voltage Set	3B.11	10	From 1*V3 to 80*V3 in steps of 0.1*V3 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the second stage.			
VN>4 Time Delay	3B.12	10	From 0 to 1200 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operate time delay for the second stage.			
VN<1 Function	3B.30	DT	Disabled DT IDMT Def User Curve 1 Def User Curve 2 Def User Curve 3 Def User Curve 4 *[Indexed String]*
This setting determines the tripping characteristic for the first stage residual undervoltage element.			
VN<1 Voltage Set	3B.31	5	From 1*V1 to 150*V1 in steps of 0.5*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the first stage.			
VN<1 Voltage Set	3B.31	5	From 1*V3 to 150*V3 in steps of 0.5*V3 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the first stage.			
VN<1 Time Delay	3B.32	5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operate time delay for the first stage.			
VN<1 TMS	3B.33	1	From 0.5 to 100 in steps of 0.5 *[Courier Number (decimal)]*
This setting sets the time multiplier setting for the IDMT characteristic.			
VN<1 tReset	3B.34	0	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the DT reset time.			
VN<2 Status	3B.40	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the second stage SEF element. There is no choice of curves because this stage is DT only.			
VN<2 Voltage Set	3B.41	10	From 1*V1 to 150*V1 in steps of 0.5*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the second stage.			
VN<2 Voltage Set	3B.41	10	From 1*V3 to 150*V3 in steps of 0.5*V3 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the second stage.			
VN<2 Time Delay	3B.42	10	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operate time delay for the second stage.			
GROUP 1: NEG SEQUENCE O/V	3D.00		
This column contains settings for Negative Sequence overvoltage protection (NPSOV)			
V2>1 Status	3D.01	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the first stage for NPSOV.			
V2>1 Voltage Set	3D.02	15	From 1*V1 to 110*V1 in steps of 0.1*V1

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Courier Number (voltage)]
This setting sets the pick-up threshold for the first stage for the NPSOV protection element.			
V2>1 Time Delay	3D.03	5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operate time-delay for the first stage for the NPSOV protection element.			
V2>2 Status	3D.11	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the second stage for NPSOV.			
V2>2 Voltage Set	3D.12	15	From 1*V1 to 110*V1 in steps of 0.1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the second stage for the NPSOV protection element.			
V2>2 Time Delay	3D.15	5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operate time-delay for the second stage for the NPSOV protection element.			
GROUP 1: VOLT PROTECTION	42.00		
This column contains settings for Voltage protection			
UNDERVOLTAGE	42.01		
The settings under this sub-heading relate to undervoltage			
V< Measur't Mode	42.02	Phase-Phase	Phase-Phase Phase-Neutral *[Indexed String]*
This set determines the voltage input mode - phase-to-phase or phase-to-neutral.			
V< Operate Mode	42.03	Any Phase	Any Phase Three Phase *[Indexed String]*
This setting determines whether any one of the phases or all three of the phases has to satisfy the undervoltage criteria before a decision is made.			
V<1 Function	42.04	DT	Disabled DT IDMT Def User Curve 1 Def User Curve 2 Def User Curve 3 Def User Curve 4 *[Indexed String]*
This setting determines the tripping characteristic for the first stage undervoltage element.			
V<1 Voltage Set	42.05	80	From 5*V1 to 120*V1 in steps of 0.1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the first stage undervoltage element.			
V<1 Time Delay	42.06	10	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the DT time delay for the first stage undervoltage element.			
V<1 TMS	42.07	1	From 0.5 to 100 in steps of 0.5 *[Courier Number (decimal)]*
This is the Time Multiplier Setting to adjust the operate time of IEC IDMT curves.			
V<2 Status	42.09	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the second stage undervoltage element. There is no choice of curves because this stage is DT only.			
V<2 Voltage Set	42.0A	60	From 5*V1 to 120*V1 in steps of 0.1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the second stage undervoltage element.			
V<2 Time Delay	42.0B	5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the DT time delay for the second stage undervoltage element.			
V<3 Function	42.0D	Disabled	Disabled DT IDMT

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Def User Curve 1 Def User Curve 2 Def User Curve 3 Def User Curve 4 *[Indexed String]*
This setting determines the tripping characteristic for the third stage undervoltage element.			
V<3 Voltage Set	42.0E	80	From 5*V1 to 120*V1 in steps of 0.1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the third stage undervoltage element.			
V<3 Time Delay	42.0F	10	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the DT time delay for the third stage undervoltage element.			
V<3 TMS	42.10	1	From 0.5 to 100 in steps of 0.5 *[Courier Number (decimal)]*
This is the Time Multiplier Setting to adjust the operate time of IEC IDMT curves.			
OVERVOLTAGE	42.12		
The settings under this sub-heading relate to Overvoltage			
V> Measur't Mode	42.13	Phase-Phase	Phase-Phase Phase-Neutral *[Indexed String]*
This set determines the voltage input mode - phase-to-phase or phase-to-neutral.			
V> Operate Mode	42.14	Any Phase	Any Phase Three Phase *[Indexed String]*
This setting determines whether any one of the phases or all three of the phases has to satisfy the overvoltage criteria before a decision is made.			
V>1 Function	42.15	DT	Disabled DT IDMT Def User Curve 1 Def User Curve 2 Def User Curve 3 Def User Curve 4 *[Indexed String]*
This setting determines the tripping characteristic for the first stage overvoltage element.			
V>1 Voltage Set	42.16	130	From 10*V1 to 200*V1 in steps of 0.1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the first stage overvoltage element.			
V>1 Time Delay	42.17	10	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the DT time delay for the first stage overvoltage element.			
V>1 TMS	42.18	1	From 0.5 to 100 in steps of 0.5 *[Courier Number (decimal)]*
This is the Time Multiplier Setting to adjust the operate time of IEC IDMT curves.			
V>2 Status	42.19	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the second stage overvoltage element. There is no choice of curves because this stage is DT only.			
V>2 Voltage Set	42.1A	150	From 10*V1 to 200*V1 in steps of 0.1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the second stage overvoltage element.			
V>2 Time Delay	42.1B	0.5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the DT time delay for the second stage overvoltage element.			
V>3 Function	42.1C	Disabled	Disabled DT IDMT Def User Curve 1 Def User Curve 2 Def User Curve 3

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Def User Curve 4 *[Indexed String]*
This setting determines the tripping characteristic for the third stage overvoltage element.			
V>3 Voltage Set	42.1D	130	From 10*V1 to 200*V1 in steps of 0.1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the third stage overvoltage element.			
V>3 Time Delay	42.1E	10	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the DT time delay for the third stage overvoltage element.			
V>3 TMS	42.1F	1	From 0.5 to 100 in steps of 0.5 *[Courier Number (decimal)]*
This is the Time Multiplier Setting to adjust the operate time of IEC IDMT curves.			
DV/DT PROTECTION	42.20		
The settings under this sub-heading relate to rate of change of voltage			
dv/dt Meas Mode	42.21	Phase-Phase	Phase-Phase Phase-Neutral *[Indexed String]*
This set determines the voltage input mode - phase-to-phase or phase-to-neutral.			
dv/dt1 Function	42.22	Disabled	Disabled Negative Positive Both *[Indexed String]*
This setting determines the tripping direction for the first stage of dv/dt element - either disabled, for a rising voltage (positive), or a falling voltage (negative).			
dv/dt1 Function	42.22	Disabled	Disabled *[Indexed String]*
This setting determines the tripping direction for the first stage of dv/dt element - either disabled, for a rising voltage (positive), or a falling voltage (negative).			
dv/dt1 Oper Mode	42.23	Any Phase	Any Phase Three Phase *[Indexed String]*
This setting determines whether any one of the phases or all three of the phases has to satisfy the dv/dt criteria before a decision is made.			
dv/dt1 AvgCycles	42.24	10	From 5 to 50 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the number of averaging cycles for the first stage dv/dt element.			
dv/dt1 Threshold	42.25	10	From 0.5*V1 to 200*V1 in steps of 0.5*V1 *[Courier Number (voltage/second)]*
This setting sets the voltage threshold for the first stage dv/dt element.			
dv/dt1 TimeDelay	42.26	0.5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the DT time delay for the first stage dv/dt element.			
dv/dt1 tRESET	42.27	0.03	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting determines the Reset time for the Definite Time Reset characteristic			
dv/dt2 Function	42.28	Disabled	Disabled Negative Positive Both *[Indexed String]*
This setting determines the tripping direction for the second stage of dv/dt element - either disabled, for a rising voltage (positive), or a falling voltage (negative).			
dv/dt2 Function	42.28	Disabled	Disabled *[Indexed String]*
This setting determines the tripping direction for the second stage of dv/dt element - either disabled, for a rising voltage (positive), or a falling voltage (negative).			
dv/dt2 Oper Mode	42.29	Any Phase	Any Phase Three Phase *[Indexed String]*
This setting determines whether any one of the phases or all three of the phases has to satisfy the dv/dt criteria before a decision is made.			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
dv/dt2 AvgCycles	42.2A	5	From 5 to 50 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the number of averaging cycles for the second stage dv/dt element.			
dv/dt2 Threshold	42.2B	50	From 0.5*V1 to 200*V1 in steps of 0.5*V1 *[Courier Number (voltage/second)]*
This setting sets the voltage threshold for the second stage dv/dt element.			
dv/dt2 TimeDelay	42.2C	0.3	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the DT time delay for the second stage dv/dt element.			
dv/dt2 tRESET	42.2D	0.03	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting determines the Reset time for the Definite Time Reset characteristic			
dv/dt3 Function	42.2E	Disabled	Disabled Negative Positive Both *[Indexed String]*
This setting determines the tripping direction for the third stage of dv/dt element - either disabled, for a rising voltage (positive), or a falling voltage (negative).			
dv/dt3 Function	42.2E	Disabled	Disabled *[Indexed String]*
This setting determines the tripping direction for the third stage of dv/dt element - either disabled, for a rising voltage (positive), or a falling voltage (negative).			
dv/dt3 Oper Mode	42.2F	Any Phase	Any Phase Three Phase *[Indexed String]*
This setting determines whether any one of the phases or all three of the phases has to satisfy the dv/dt criteria before a decision is made.			
dv/dt3 AvgCycles	42.30	10	From 5 to 50 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the number of averaging cycles for the third stage dv/dt element.			
dv/dt3 Threshold	42.31	10	From 0.5*V1 to 200*V1 in steps of 0.5*V1 *[Courier Number (voltage/second)]*
This setting sets the voltage threshold for the third stage dv/dt element.			
dv/dt3 TimeDelay	42.32	0.5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the DT time delay for the third stage dv/dt element.			
dv/dt3 tRESET	42.33	0.03	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting determines the Reset time for the Definite Time Reset characteristic			
dv/dt4 Function	42.34	Disabled	Disabled Negative Positive Both *[Indexed String]*
This setting determines the tripping direction for the fourth stage of dv/dt element - either disabled, for a rising voltage (positive), or a falling voltage (negative).			
dv/dt4 Function	42.34	Disabled	Disabled *[Indexed String]*
This setting determines the tripping direction for the fourth stage of dv/dt element - either disabled, for a rising voltage (positive), or a falling voltage (negative).			
dv/dt4 Oper Mode	42.35	Any Phase	Any Phase Three Phase *[Indexed String]*
This setting determines whether any one of the phases or all three of the phases has to satisfy the dv/dt criteria before a decision is made.			
dv/dt4 AvgCycles	42.36	5	From 5 to 50 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the number of averaging cycles for the fourth stage dv/dt element.			
dv/dt4 Threshold	42.37	50	From 0.5*V1 to 200*V1 in steps of 0.5*V1 *[Courier Number (voltage/second)]*
This setting sets the voltage threshold for the fourth stage dv/dt element.			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
dv/dt4 TimeDelay	42.38	0.3	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the DT time delay for the fourth stage dv/dt element.			
dv/dt4 tRESET	42.39	0.03	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting determines the Reset time for the Definite Time Reset characteristic			
AVG UNDERVOLTAGE	42.40		
Sub-heading: Settings below are related to average undervoltage			
Vavg< Oper Mode	42.41	Any Phase	Any Phase Three Phase *[Indexed String]*
This setting determines whether any one of the phases or all three of the phases has to satisfy the average undervoltage criteria before decision			
Vavg<1 Status	42.42	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the first stage average undervoltage element. There is no choice of curves because this stage is DT only.			
Vavg<1 Volt Set	42.43	80	From 10*V1 to 120*V1 in steps of 1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the first stage average undervoltage element.			
Vavg<1 Stt Time	42.44	0	From 0 to 600 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the DT start time delay for the first stage average undervoltage element.			
Vavg<1 Trip Time	42.45	10	From 0 to 600 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the DT trip time delay for the first stageaverage undervoltage element.			
Vavg<2 Status	42.4A	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the second stage average undervoltage element. There is no choice of curves because this stage is DT only.			
Vavg<2 Volt Set	42.4B	60	From 10*V1 to 120*V1 in steps of 1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the first stage average undervoltage element.			
Vavg<2 Stt Time	42.4C	0	From 0 to 600 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the DT start time delay for the second stage average undervoltage element.			
Vavg<2 Trip Time	42.4D	10	From 0 to 600 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the DT trip time delay for the second stage average undervoltage element.			
AVG OVERVOLTAGE	42.50		
Sub-heading: Settings below are related to average overvoltage			
Vavg> Oper Mode	42.51	Any Phase	Any Phase Three Phase *[Indexed String]*
This setting determines whether any one of the phases or all three of the phases has to satisfy the average overvoltage criteria before decision.			
Vavg>1 Status	42.52	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the first stage average overvoltage element. There is no choice of curves because this stage is DT only.			
Vavg>1 Volt Set	42.53	130	From 40*V1 to 185*V1 in steps of 1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the first stage average overvoltage element.			
Vavg>1 Stt Time	42.54	0	From 0 to 600 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the DT start time delay for the first stage average overvoltage element.			
Vavg>1 Trip Time	42.55	10	From 0 to 600 in steps of 1 *[Courier Number (time-seconds)]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This setting sets the DT trip time delay for the first stage average overvoltage element.			
Vavg>2 Status	42.5A	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the second stage average overvoltage element. There is no choice of curves because this stage is DT only.			
Vavg>2 Volt Set	42.5B	150	From 40*V1 to 185*V1 in steps of 1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the second stage average overvoltage element.			
Vavg>2 Stt Time	42.5C	0	From 0 to 600 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the DT start time delay for the second stage average overvoltage element.			
Vavg>2 Trip Time	42.5D	10	From 0 to 600 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the DT trip time delay for the second stage average overvoltage element.			
AVG ZERO SEQ O/V	42.60		
Sub-heading: Settings below are related to average zero sequence overvoltage			
V0avg>1 Status	42.61	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the first stage "avg zero seq O/V" element. There is no choice of curves because this stage is DT only.			
V0avg>1 Volt Set	42.62	15	From 1*V1 to 110*V1 in steps of 1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the first stage average zero sequence overvoltage element.			
V0avg>1 Delay	42.63	10	From 0 to 600 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the DT time delay for the first stage "avg zero seq O/V" element.			
V0avg>2 Status	42.6A	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the second stage "avg zero seq O/V" element. There is no choice of curves because this stage is DT only.			
V0avg>2 Volt Set	42.6B	15	From 1*V1 to 110*V1 in steps of 1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the second stage "avg zero seq O/V" element.			
V0avg>2 Delay	42.6C	10	
This setting sets the DT time delay for the second stage "avg zero seq O/V" element.			
AVG POS SEQ O/V	42.70		
Sub-heading: Settings below are related to average positive sequence over voltage			
V1avg>1 Status	42.71	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the first stage "avg pos seq O/V" element. There is no choice of curves because this stage is DT only.			
V1avg>1 Volt Set	42.72	130	From 40*V1 to 185*V1 in steps of 1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the first stage "avg pos seq O/V" element.			
V1avg>1 Delay	42.73	10	From 0 to 600 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the DT time delay for the first stage "avg pos seq O/V" element.			
V1avg>2 Status	42.7A	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the second stage "avg pos seq O/V" element. There is no choice of curves because this stage is DT only.			
V1avg>2 Volt Set	42.7B	130	From 40*V1 to 185*V1 in steps of 1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the second stage "avg pos seq O/V" element.			
V1avg>2 Delay	42.7C	10	From 0 to 600 in steps of 1

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Courier Number (time-seconds)]
This setting sets the DT time delay for the second stage of "avg pos seq O/V" element.			
AVG NEG SEQ O/V	42.80		
Sub-heading: Settings below are related to average negative sequence over voltage			
V2avg>1 Status	42.81	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the first stage "avg neg seq O/V" element. There is no choice of curves because this stage is DT only.			
V2avg>1 Volt Set	42.82	15	From 1*V1 to 110*V1 in steps of 1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the first stage "avg neg seq O/V" element.			
V2avg>1 Stt Time	42.83	0	From 0 to 600 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the DT start time delay for the first stage "avg neg seq O/V" element.			
V2avg>1 Trp Time	42.84	10	From 0 to 600 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the DT trip time delay for the first stage "avg neg seq O/V" element.			
V2avg>2 Status	42.8A	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the second stage "avg neg seq O/V" element. There is no choice of curves because this stage is DT only.			
V2avg>2 Volt Set	42.8B	15	From 1*V1 to 110*V1 in steps of 1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the second stage "avg neg seq O/V" element.			
V2avg>2 Stt Time	42.8C	0	From 0 to 600 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the DT start time delay for the second stage "avg neg seq O/V" element.			
V2avg>2 Trp Time	42.8D	10	From 0 to 600 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the DT trip time delay for the second stage "avg neg seq O/V" element.			
POS SEQ U/V	42.A0		
The settings under this sub-heading relate to positive sequence undervoltage			
V1<1 Function	42.A1	Disabled	Disabled DT IDMT *[Indexed String]*
This setting determines the tripping characteristic for the first stage positive sequence undervoltage element.			
V1<1 Voltage Set	42.A2	80	From 5*V1 to 120*V1 in steps of 0.1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the first stage positive sequence undervoltage element.			
V1<1 Time Delay	42.A3	10	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the DT time delay for the first stage positive sequence undervoltage element.			
V1<1 TMS	42.A4	1	From 0.5 to 100 in steps of 0.5 *[Courier Number (decimal)]*
This is the Time Multiplier Setting to adjust the operate time of IEC IDMT curves.			
V1<2 Status	42.A9	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the second stage positive sequence undervoltage element. There is no choice of curves because this stage is DT only.			
V1<2 Voltage Set	42.AA	60	From 5*V1 to 120*V1 in steps of 0.1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the second stage positive sequence undervoltage element.			
V1<2 Time Delay	42.AB	5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the DT time delay for the second stage positive sequence undervoltage element.			
POS SEQ O/V	42.B0		

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
The settings under this sub-heading relate to Overvoltage			
V1>1 Function	42.B1	Disabled	Disabled DT IDMT *[Indexed String]*
This setting determines the tripping characteristic for the first stage positive sequence overvoltage element.			
V1>1 Voltage Set	42.B2	130	From 5*V1 to 200*V1 in steps of 0.1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the first stage positive sequence overvoltage element.			
V1>1 Time Delay	42.B3	10	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the DT time delay for the first stage positive sequence overvoltage element.			
V1>1 TMS	42.B4	1	From 0.5 to 100 in steps of 0.5 *[Courier Number (decimal)]*
This is the Time Multiplier Setting to adjust the operate time of IEC IDMT curves.			
V1>2 Status	42.B9	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the second stage positive sequence overvoltage element. There is no choice of curves because this stage is DT only.			
V1>2 Voltage Set	42.BA	150	From 5*V1 to 200*V1 in steps of 0.1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the second stage positive sequence overvoltage element.			
V1>2 Time Delay	42.BB	0.5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the DT time delay for the second stage positive sequence overvoltage element.			
V Shift Status	42.C1	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the voltage vector shift protection.			
V Shift Angle	42.C2	10	From 2 to 30 in steps of 1 *[Courier Number (angle)]*
This setting sets the voltage vector shift angle threshold			
GROUP 1: SYSTEM CHECKS	48.00		
This column contains settings for the Voltage Monitors and the Check Synchronism function.			
VOLTAGE MONITORS	48.14		
The settings under this sub-heading relate to Voltage Monitors			
Live Voltage	48.15	32	From 1*V1 to 132*V1 in steps of 0.5*V1 *[Courier Number (voltage)]*
This setting sets the minimum voltage threshold above which a line or bus is considered 'Live'.			
Dead Voltage	48.16	13	From 1*V1 to 132*V1 in steps of 0.5*V1 *[Courier Number (voltage)]*
This setting sets the maximum voltage threshold below which a line or bus is considered 'Dead'.			
CHECK SYNC.	48.17		
The settings under this sub-heading relate to Check Synchronism.			
CS1 Status	48.18	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the first stage Check Synchronism element.			
CS1 Phase Angle	48.19	20	From 5 to 90 in steps of 1 *[Courier Number (angle)]*
This setting sets the maximum phase angle difference between the line and bus voltage for the first stage Phase Angle check to be satisfactory.			
CS1 Slip Control	48.1A	Frequency	None Timer Frequency Both *[Indexed String]*
This setting determines whether the first stage Slip Control is by slip frequency, by timer, or a combination of both.			
CS1 Slip Freq	48.1B	0.05	From 0.001 to 2 in steps of 0.001

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Courier Number (frequency)]
This setting sets the maximum frequency difference between the line and bus voltage for the first stage Slip Frequency check to be satisfactory.			
CS1 Slip Timer	48.1C	1	From 0 to 99 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the minimum operate time delay for the first stage Check Synchronism element.			
CS2 Status	48.1D	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the second stage Check Synchronism element.			
CS2 Phase Angle	48.1E	20	From 5 to 90 in steps of 1 *[Courier Number (angle)]*
This setting sets the maximum phase angle difference between the line and bus voltage for the second stage Phase Angle check to be satisfactory.			
CS2 Slip Control	48.1F	Frequency	None Timer Frequency Timer + Freq Freq + CB Comp *[Indexed String]*
This setting determines whether the second stage Slip Control is by slip frequency, by timer, or a combination of both.			
CS2 Slip Freq	48.20	0.05	From 0.001 to 2 in steps of 0.001 *[Courier Number (frequency)]*
This setting sets the maximum frequency difference between the line and bus voltage for the second stage Slip Frequency check to be satisfactory.			
CS2 Slip Timer	48.21	1	From 0 to 99 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the minimum operate time delay for the second stage Check Synchronism element.			
CS Undervoltage	48.22	54	From 10 to 132 in steps of 0.5 *[Courier Number (voltage)]*
This setting sets the check sync undervoltage threshold			
CS Overvoltage	48.23	130	From 40 to 185 in steps of 0.5 *[Courier Number (voltage)]*
This setting sets the check sync overvoltage threshold			
CS Diff Voltage	48.24	6.5	From 1 to 132 in steps of 0.5 *[Courier Number (voltage)]*
This setting sets the maximum voltage magnitude difference between the line and bus, which is allowed for the check to be satisfactory.			
CS Voltage Block	48.25	V<	None V< V> Vdiff> V< and V> V< and Vdiff> V> and Vdiff> V< V> and Vdiff> *[Indexed String]*
This setting determines which condition or conditions must be satisfied in order for the Check Synchronism condition to be satisfactory. The setting is an 8-bit binary string (data type G41).			
SYSTEM SPLIT	48.26		
The settings under this sub-heading relate to System Split condition (System Split is where a line and bus are detected, which are not possible to synchronise).			
SS Status	48.27	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the System Split function.			
SS Phase Angle	48.28	120	From 90 to 175 in steps of 1 *[Courier Number (angle)]*
This setting sets the maximum phase angle difference between the line and bus voltage, which must be exceeded for the System Split condition to be satisfied.			
SS Under V Block	48.29	Enabled	Disabled Enabled

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Indexed String]
This setting activates the undervoltage blocking.			
SS Undervoltage	48.2A	54	From 10 to 132 in steps of 0.5 *[Courier Number (voltage)]*
This setting sets an undervoltage threshold above which the line and bus voltage must be, to satisfy the System Split condition.			
SS Timer	48.2B	1	From 0 to 99 in steps of 0.01 *[Courier Number (time-seconds)]*
The System Split output remains set for as long as the System Split criteria are true, or for a minimum period equal to the System Split Timer setting, whichever is longer.			
CB Close Time	48.2F	0.05	From 0 to 0.5 in steps of 0.001 *[Courier Number (time-seconds)]*
This setting sets the CB closing time, from receipt of a CB close command until the main contacts touch.			
GROUP 1: AUTORECLOSE	49.00		
This column contains settings for Autoreclose (AR)			
AR Mode Select	49.01	Command Mode	Command Mode Opto Set Mode User Set Mode Pulse Set Mode *[Indexed String]*
This setting determines the Autoreclose mode.			
Number of Shots	49.02	1	From 1 to 4 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the required number of Autoreclose cycles for Overcurrent trips.			
Number SEF Shots	49.03	0	From 0 to 4 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the number of required Autoreclose cycles for SEF trips.			
Sequence Co-ord	49.04	Disabled	Disabled Enabled *[Indexed String]*
This setting enables the sequence co-ordination function to ensure the correct protection grading between an upstream and downstream re-closing device.			
CS AR Immediate	49.05	Disabled	Disabled Enabled *[Indexed String]*
This setting allows immediate re-closure of the circuit breaker provided both sides of the circuit breaker are live and in synchronism at any time after the dead time has started.			
Dead Time 1	49.06	10	From 0.01 to 300 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the dead time for the first Autoreclose cycle.			
Dead Time 2	49.07	60	From 0.01 to 300 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the dead time for the second Autoreclose cycle.			
Dead Time 3	49.08	180	From 0.01 to 9999 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the dead time for the third Autoreclose cycle.			
Dead Time 4	49.09	180	From 0.01 to 9999 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the dead time for the fourth Autoreclose cycle.			
CB Healthy Time	49.0A	5	From 0.01 to 9999 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the CB lockout time			
Start Dead t On	49.0B	Protection Reset	Protection Reset CB Trips *[Indexed String]*
This setting determines whether the dead time has started when the circuit breaker trips or when the protection trip resets.			
tReclaim Extend	49.0C	No Operation	On Prot Start No Operation *[Indexed String]*
This setting allows the user to control whether the reclaim timer is suspended by the protection start contacts or not (i.e. whether the IED is			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
permitted to reclaim if a fault condition is present and will be cleared in a long time-scale).			
Reclaim Time 1	49.0D	180	From 1 to 600 in steps of 0.01 *[Courier Number (time-seconds)]*
Sets the Autoreclose reclaim time for the first Autoreclose cycle.			
Reclaim Time 2	49.0E	180	From 1 to 600 in steps of 0.01 *[Courier Number (time-seconds)]*
Sets the Autoreclose reclaim time for the second Autoreclose cycle.			
Reclaim Time 3	49.0F	180	From 1 to 600 in steps of 0.01 *[Courier Number (time-seconds)]*
Sets the Autoreclose reclaim time for the third Autoreclose cycle.			
Reclaim Time 4	49.10	180	From 1 to 600 in steps of 0.01 *[Courier Number (time-seconds)]*
Sets the Autoreclose reclaim time for the fourth Autoreclose cycle.			
AR Inhibit Time	49.11	5	From 0.01 to 600 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting defines the inhibit time before Autoreclose is initiated following a manual CB closure.			
AR Lockout	49.12	No Block	No Block Block Inst Prot *[Indexed String]*
This setting is used to block instantaneous protection if the IED has undergone Autoreclose Lockout.			
EFF Maint Lock	49.13	No Block	No Block Block Inst Prot *[Indexed String]*
This setting is used to block instantaneous protection for the last circuit breaker trip before lockout occurs.			
AR Deselected	49.14	No Block	No Block Block Inst Prot *[Indexed String]*
This setting allows the instantaneous protection to be blocked when Autoreclose is in non-auto mode of operation.			
Manual Close	49.15	No Block	No Block Block Inst Prot *[Indexed String]*
This setting is used to block instantaneous protection when the circuit breaker is closed manually whilst there is no auto-reclose sequence in progress or Autoreclose is inhibited.			
Trip 1 Main	49.16	No Block	No Block Block Inst Prot *[Indexed String]*
The Trip (n) Main settings are used to selectively block the instantaneous elements of phase and earth fault protection elements for a circuit breaker trip sequence.			
Trip 2 Main	49.17	Block Inst Prot	No Block Block Inst Prot *[Indexed String]*
The Trip (n) Main settings are used to selectively block the instantaneous elements of phase and earth fault protection elements for a circuit breaker trip sequence.			
Trip 3 Main	49.18	Block Inst Prot	No Block Block Inst Prot *[Indexed String]*
The Trip (n) Main settings are used to selectively block the instantaneous elements of phase and earth fault protection elements for a circuit breaker trip sequence.			
Trip 4 Main	49.19	Block Inst Prot	No Block Block Inst Prot *[Indexed String]*
The Trip (n) Main settings are used to selectively block the instantaneous elements of phase and earth fault protection elements for a circuit breaker trip sequence.			
Trip 5 Main	49.1A	Block Inst Prot	No Block Block Inst Prot *[Indexed String]*
The Trip (n) Main settings are used to selectively block the instantaneous elements of phase and earth fault protection elements for a circuit breaker trip sequence.			
Trip 1 SEF	49.1B	Block Inst Prot	No Block Block Inst Prot

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Indexed String]
The Trip (n) SEF settings are used to selectively block the instantaneous elements of sensitive earth fault protection elements for a circuit breaker trip sequence.			
Trip 2 SEF	49.1C	Block Inst Prot	No Block Block Inst Prot *[Indexed String]*
The Trip (n) SEF settings are used to selectively block the instantaneous elements of sensitive earth fault protection elements for a circuit breaker trip sequence.			
Trip 3 SEF	49.1D	Block Inst Prot	No Block Block Inst Prot *[Indexed String]*
The Trip (n) SEF settings are used to selectively block the instantaneous elements of sensitive earth fault protection elements for a circuit breaker trip sequence.			
Trip 4 SEF	49.1E	Block Inst Prot	No Block Block Inst Prot *[Indexed String]*
The Trip (n) SEF settings are used to selectively block the instantaneous elements of sensitive earth fault protection elements for a circuit breaker trip sequence.			
Trip 5 SEF	49.1F	Block Inst Prot	No Block Block Inst Prot *[Indexed String]*
The Trip (n) SEF settings are used to selectively block the instantaneous elements of sensitive earth fault protection elements for a circuit breaker trip sequence.			
Man Close on Flt	49.20	Lockout	No Lockout Lockout *[Indexed String]*
This setting decides whether the AR should lockout or not after a Manual Close on Fault operation.			
Trip AR Inactive	49.21	No Lockout	No Lockout Lockout *[Indexed String]*
When AR is inactive (Non-auto, or Live Line mode), this setting determines whether The AR should be locked out or not.			
Reset Lockout by	49.22	User Interface	User Interface Select NonAuto *[Indexed String]*
This setting is used to determine the method by which the Lockout is reset.			
AR on Man Close	49.24	Inhibited	Enabled Inhibited *[Indexed String]*
If this is set to 'Enabled', autoreclosing can be initiated immediately on circuit breaker closure, overriding the settings AR Inhibit Time, Man Close on Flt and Manual Close.			
Sys Check Time	49.25	5	From 0.01 to 9999 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the amount of time set for System Checks for Autoreclose operation.			
AR Skip Shot 1	49.26	Disabled	Disabled Enabled *[Indexed String]*
When enabled this setting allows the Autoreclose sequence counter to be incremented by one via a DDB input signal. This will therefore decrease the number of available re-close shots.			
AR INITIATION	49.28		
The settings under this sub-heading relate to Autoreclose initiation			
Ext Prot	49.3C	Initiate Main AR	No Action Initiate Main AR *[Indexed String]*
This setting determines if external protection inputs initiates auto-reclose. This must be mapped in programmable scheme logic.			
SEF Ext Prot	49.3F	Initiate SEF AR	No Action Initiate Main AR Initiate SEF AR *[Indexed String]*
This setting determines the impact of the external sensitive earth fault overcurrent protection on AR operation. Before this setting is used, however, an opto-input must be mapped to the DDB signal Ext AR SEF Trip (476) and Trip Command In (536) in PSL.			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
SYSTEM CHECKS	49.40		
The settings under this sub-heading relate to Autoreclose system checks			
AR with ChkSyn	49.41	Disabled	Disabled Enabled *[Indexed String]*
This setting enables/disables Autoreclose with check synchronisation for Check Sync stage 1 (CS1)			
AR with SysSyn	49.42	Disabled	Disabled Enabled *[Indexed String]*
This setting enables/disables Autoreclose with check synchronisation for Check Sync stage 2 (CS2)			
Live/Dead Ccts	49.43	Disabled	Disabled Enabled *[Indexed String]*
When enabled, this setting will produce an "AR Check Ok" DDB signal when the Live/Dead Ccts DDB signal is high.			
No System Checks	49.44	Enabled	Disabled Enabled *[Indexed String]*
When enabled this setting completely disables system checks thus allowing Autoreclose initiation without system checks.			
SysChk on Shot 1	49.45	Enabled	Disabled Enabled *[Indexed String]*
This setting is used to enable/disable system checks for the first auto-reclose shot.			
GROUP 1: INPUT LABELS	4A.00		
This column contains settings for the opto-input Labels			
Opto Input 1	4A.01	Input L1	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for opto-input 1			
Opto Input 2	4A.02	Input L2	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for opto-input 2			
Opto Input 3	4A.03	Input L3	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for opto-input 3			
Opto Input 4	4A.04	Input L4	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for opto-input 4			
Opto Input 5	4A.05	Input L5	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for opto-input 5			
Opto Input 6	4A.06	Input L6	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for opto-input 6			
Opto Input 7	4A.07	Input L7	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for opto-input 7			
Opto Input 8	4A.08	Input L8	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for opto-input 8			
Opto Input 9	4A.09	Input L9	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for opto-input 9			
Opto Input 10	4A.0A	Input L10	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for opto-input 10			
Opto Input 11	4A.0B	Input L11	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for opto-input 11			
Opto Input 12	4A.0C	Input L12	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This setting defines the label for opto-input 12			
Opto Input 13	4A.0D	Input L13	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for opto-input 13			
GROUP 1: OUTPUT LABELS	4B.00		
This column contains settings for the output relay labels			
Relay 1	4B.01	Output R1	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for output relay 1			
Relay 2	4B.02	Output R2	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for output relay 2			
Relay 3	4B.03	Output R3	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for output relay 3			
Relay 4	4B.04	Output R4	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for output relay 4			
Relay 5	4B.05	Output R5	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for output relay 5			
Relay 6	4B.06	Output R6	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for output relay 6			
Relay 7	4B.07	Output R7	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for output relay 7			
Relay 8	4B.08	Output R8	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for output relay 8			
Relay 9	4B.09	Output R9	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for output relay 9			
Relay 10	4B.0A	Output R10	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for output relay 10			
Relay 11	4B.0B	Output R11	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for output relay 11			
Relay 12	4B.0C	Output R12	From 32 to 234 in steps of 1 *[ASCII Text (16 chars)]*
This setting defines the label for output relay 12			
GROUP 1: FREQ PROTECTION	4D.00		
This column contains settings for frequency protection.			
Freq Avg.Cycles	4D.01	5	From 0 to 48 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the number of power system cycles that are used to average the frequency measurement.			
df/dt Avg.Cycles	4D.02	5	From 0 to 48 in steps of 1 *[Unsigned Integer (16 bits)]*
This setting sets the number of power system cycles that are used to average the rate of change of frequency measurement.			
V<B Status	4D.03	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the undervoltage blocking of the frequency protection elements.			
V<B Voltage Set	4D.04	25*V1	From 10*V1 to 120*V1 in steps of 1*V1 *[Courier Number (voltage)]*
This setting sets the pick-up threshold for the undervoltage blocking element.			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
V<B Measur Mode	4D.05	Phase-Phase	Phase-Phase Phase-Neutral *[Indexed String]*
This set determines the mode for the measured input voltage that will be used for the undervoltage blocking: phase-to-phase or phase-to-neutral.			
V<B Operate Mode	4D.06	Three Phase	Any Phase Three Phase *[Indexed String]*
This setting determines whether any one of the phases or all three of the phases has to satisfy the undervoltage criteria before a decision is made.			
Stage 1	4D.07	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the first stage of frequency protection.			
Stg 1 f+t Status	4D.08	Under	Disabled Under Over *[Indexed String]*
This setting selects either underfrequency or overfrequency protection, or disables it for this stage.			
Stg 1 f+t Freq	4D.09	49	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the first stage frequency protection element.			
Stg 1 f+t Time	4D.0A	2	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operating time delay for the first stage frequency protection element.			
df/dt+t 1 Status	4D.0B	Negative	Disabled Negative Positive Both *[Indexed String]*
This setting disables or determines the tripping direction for the first stage independent rate of change of frequency protection (df/dt+t).			
df/dt+t 1 Set	4D.0C	2	From 0.01 to 15 in steps of 0.01 *[Courier Number (Hz/sec)]*
This setting sets the rate of change of frequency threshold for the first stage.			
df/dt+t 1 Time	4D.0D	0.5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operating time delay for the first stage rate of change of frequency protection element.			
f+df/dt 1 Status	4D.0E	Negative	Disabled Negative Positive Both *[Indexed String]*
This setting disables or determines the tripping direction for the first stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+df/dt 1 Status	4D.0E	Disabled	Disabled *[Indexed String]*
This setting disables or determines the tripping direction for the first stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+df/dt 1 freq	4D.0F	49	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the first stage frequency-supervised rate of change of frequency protection element.			
f+df/dt 1 df/dt	4D.10	1	From 0.01 to 15 in steps of 0.01 *[Courier Number (Hz/sec)]*
This setting sets the df/dt threshold for the first stage frequency-supervised rate of change of frequency.			
f+Df/Dt 1 Status	4D.11	Disabled	Disabled Under Over *[Indexed String]*
This setting selects either underfrequency or overfrequency protection for the average rate of change of frequency (Df/Dt), or disables it for this stage.			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
f+Df/Dt 1 Status	4D.11	Disabled	Disabled *[Indexed String]*
This setting selects either underfrequency or overfrequency protection for the average rate of change of frequency (Df/Dt), or disables it for this stage.			
f+Df/Dt 1 freq	4D.12	49	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the first stage average rate of change of frequency protection element.			
f+Df/Dt 1 Dfreq	4D.13	1	From 0.1 to 15 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the change in frequency that must be measured in the set time for the first stage average rate of change of frequency protection element.			
f+Df/Dt 1 Dtime	4D.14	0.5	From 0.02 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the time period in which an excessive change in frequency must be measured for the first stage average rate of change of frequency protection element.			
Restore1 Status	4D.15	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the first stage of load restoration.			
Restore1 Status	4D.15	Disabled	Disabled *[Indexed String]*
This setting enables or disables the first stage of load restoration.			
Restore1 Freq	4D.16	49.5	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the first stage of load restoration, above which the associated load restoration time can start.			
Restore1 Time	4D.17	240	From 0 to 7200 in steps of 0.25 *[Courier Number (time-seconds)]*
This setting sets the time period for which the measured frequency must be higher than the first stage restoration frequency setting to permit load restoration.			
Holding Timer 1	4D.18	5	From 1 to 7200 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the holding time of the first stage load restoration.			
Stg 1 UV Block	4D.19	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the undervoltage blocking of the first stage load restoration element.			
Stage 2	4D.1A	Enabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the second stage of frequency protection.			
Stg 2 f+t Status	4D.1B	Under	Disabled Under Over *[Indexed String]*
This setting selects either underfrequency or overfrequency protection, or disables it for this stage.			
Stg 2 f+t Freq	4D.1C	48.6	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the second stage frequency protection element.			
Stg 2 f+t Time	4D.1D	2	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operating time delay for the second stage frequency protection element.			
df/dt+t 2 Status	4D.1E	Negative	Disabled Negative Positive Both *[Indexed String]*
This setting disables or determines the tripping direction for the second stage independent rate of change of frequency protection (df/dt+t).			
df/dt+t 2 Set	4D.1F	2	From 0.01 to 15 in steps of 0.01 *[Courier Number (Hz/sec)]*
This setting sets the rate of change of frequency threshold for the second stage.			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
df/dt+t 2 Time	4D.20	0.5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operating time delay for the second stage rate of change of frequency protection element.			
f+df/dt 2 Status	4D.21	Negative	Disabled Negative Positive Both *[Indexed String]*
This setting disables or determines the tripping direction for the second stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+df/dt 2 Status	4D.21	Disabled	Disabled *[Indexed String]*
This setting disables or determines the tripping direction for the second stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+df/dt 2 freq	4D.22	48.6	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the second stage frequency-supervised rate of change of frequency protection element.			
f+df/dt 2 df/dt	4D.23	1	From 0.01 to 15 in steps of 0.01 *[Courier Number (Hz/sec)]*
This setting sets the df/dt threshold for the second stage frequency-supervised rate of change of frequency.			
f+Df/Dt 2 Status	4D.24	Disabled	Disabled Under Over *[Indexed String]*
This setting selects either underfrequency or overfrequency protection for the average rate of change of frequency (Df/Dt), or disables it for this stage.			
f+Df/Dt 2 Status	4D.24	Disabled	Disabled *[Indexed String]*
This setting selects either underfrequency or overfrequency protection for the average rate of change of frequency (Df/Dt), or disables it for this stage.			
f+Df/Dt 2 freq	4D.25	49	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the second stage average rate of change of frequency protection element.			
f+Df/Dt 2 Dfreq	4D.26	1	From 0.1 to 15 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the change in frequency that must be measured in the set time for the second stage average rate of change of frequency protection element.			
f+Df/Dt 2 Dtime	4D.27	0.5	From 0.02 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the time period in which an excessive change in frequency must be measured for the second stage average rate of change of frequency protection element.			
Restore2 Status	4D.28	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the second stage of load restoration.			
Restore2 Status	4D.28	Disabled	Disabled *[Indexed String]*
This setting enables or disables the second stage of load restoration.			
Restore2 Freq	4D.29	49.5	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the second stage of load restoration, above which the associated load restoration time can start.			
Restore2 Time	4D.2A	180	From 0 to 7200 in steps of 0.25 *[Courier Number (time-seconds)]*
This setting sets the time period for which the measured frequency must be higher than the second stage restoration frequency setting to permit load restoration.			
Holding Timer 2	4D.2B	5	From 1 to 7200 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the holding time of the second stage load restoration.			
Stg 2 UV Block	4D.2C	Disabled	Disabled Enabled

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Indexed String]
This setting enables or disables the undervoltage blocking of the second stage load restoration element.			
Stage 3	4D.2D	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the third stage of frequency protection.			
Stg 3 f+t Status	4D.2E	Disabled	Disabled Under Over *[Indexed String]*
This setting selects either underfrequency or overfrequency protection, or disables it for this stage.			
Stg 3 f+t Freq	4D.2F	48.2	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the third stage frequency protection element.			
Stg 3 f+t Time	4D.30	2	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operating time delay for the third stage frequency protection element.			
df/dt+t 3 Status	4D.31	Disabled	Disabled Negative Positive Both *[Indexed String]*
This setting disables or determines the tripping direction for the third stage independent rate of change of frequency protection (df/dt+t).			
df/dt+t 3 Set	4D.32	2	From 0.01 to 15 in steps of 0.01 *[Courier Number (Hz/sec)]*
This setting sets the rate of change of frequency threshold for the third stage.			
df/dt+t 3 Time	4D.33	0.5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operating time delay for the third stage rate of change of frequency protection element.			
f+df/dt 3 Status	4D.34	Disabled	Disabled Negative Positive Both *[Indexed String]*
This setting disables or determines the tripping direction for the third stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+df/dt 3 Status	4D.34	Disabled	Disabled *[Indexed String]*
This setting disables or determines the tripping direction for the third stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+df/dt 3 freq	4D.35	48.2	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the third stage frequency-supervised rate of change of frequency protection element.			
f+df/dt 3 df/dt	4D.36	1	From 0.01 to 15 in steps of 0.01 *[Courier Number (Hz/sec)]*
This setting sets the df/dt threshold for the third stage frequency-supervised rate of change of frequency.			
f+Df/Dt 3 Status	4D.37	Disabled	Disabled Under Over *[Indexed String]*
This setting selects either underfrequency or overfrequency protection for the average rate of change of frequency (Df/Dt), or disables it for this stage.			
f+Df/Dt 3 Status	4D.37	Disabled	Disabled *[Indexed String]*
This setting selects either underfrequency or overfrequency protection for the average rate of change of frequency (Df/Dt), or disables it for this stage.			
f+Df/Dt 3 freq	4D.38	48.5	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the third stage average rate of change of frequency protection element.			
f+Df/Dt 3 Dfreq	4D.39	1	From 0.1 to 15 in steps of 0.01

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Courier Number (frequency)]
This setting sets the change in frequency that must be measured in the set time for the third stage average rate of change of frequency protection element.			
f+Df/Dt 3 Dtime	4D.3A	0.5	From 0.02 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the time period in which an excessive change in frequency must be measured for the third stage average rate of change of frequency protection element.			
Restore3 Status	4D.3B	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the third stage of load restoration.			
Restore3 Status	4D.3B	Disabled	Disabled *[Indexed String]*
This setting enables or disables the third stage of load restoration.			
Restore3 Freq	4D.3C	49.5	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the third stage of load restoration, above which the associated load restoration time can start.			
Restore3 Time	4D.3D	120	From 0 to 7200 in steps of 0.25 *[Courier Number (time-seconds)]*
This setting sets the time period for which the measured frequency must be higher than the third stage restoration frequency setting to permit load restoration.			
Holding Timer 3	4D.3E	5	From 1 to 7200 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the holding time of the third stage load restoration.			
Stg 3 UV Block	4D.3F	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the undervoltage blocking of the third stage load restoration element.			
Stage 4	4D.40	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the fourth stage of frequency protection.			
Stg 4 f+t Status	4D.41	Disabled	Disabled Under Over *[Indexed String]*
This setting selects either underfrequency or overfrequency protection, or disables it for this stage.			
Stg 4 f+t Freq	4D.42	47.8	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the fourth stage frequency protection element.			
Stg 4 f+t Time	4D.43	2	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operating time delay for the fourth stage frequency protection element.			
df/dt+t 4 Status	4D.44	Disabled	Disabled Negative Positive Both *[Indexed String]*
This setting disables or determines the tripping direction for the fourth stage independent rate of change of frequency protection (df/dt+t).			
df/dt+t 4 Set	4D.45	2	From 0.01 to 15 in steps of 0.01 *[Courier Number (Hz/sec)]*
This setting sets the rate of change of frequency threshold for the fourth stage.			
df/dt+t 4 Time	4D.46	0.5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operating time delay for the fourth stage rate of change of frequency protection element.			
f+df/dt 4 Status	4D.47	Disabled	Disabled Negative Positive Both *[Indexed String]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This setting disables or determines the tripping direction for the fourth stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+df/dt 4 Status	4D.47	Disabled	Disabled *[Indexed String]*
This setting disables or determines the tripping direction for the fourth stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+df/dt 4 freq	4D.48	47.8	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the fourth stage frequency-supervised rate of change of frequency protection element.			
f+df/dt 4 df/dt	4D.49	1	From 0.01 to 15 in steps of 0.01 *[Courier Number (Hz/sec)]*
This setting sets the df/dt threshold for the fourth stage frequency-supervised rate of change of frequency.			
f+Df/Dt 4 Status	4D.4A	Disabled	Disabled Under Over *[Indexed String]*
This setting selects either underfrequency or overfrequency protection for the average rate of change of frequency (Df/Dt), or disables it for this stage.			
f+Df/Dt 4 Status	4D.4A	Disabled	Disabled *[Indexed String]*
This setting selects either underfrequency or overfrequency protection for the average rate of change of frequency (Df/Dt), or disables it for this stage.			
f+Df/Dt 4 freq	4D.4B	48.5	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the fourth stage average rate of change of frequency protection element.			
f+Df/Dt 4 Dfreq	4D.4C	1	From 0.1 to 15 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the change in frequency that must be measured in the set time for the fourth stage average rate of change of frequency protection element.			
f+Df/Dt 4 Dtime	4D.4D	0.5	From 0.02 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the time period in which an excessive change in frequency must be measured for the fourth stage average rate of change of frequency protection element.			
Restore4 Status	4D.4E	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the fourth stage of load restoration.			
Restore4 Status	4D.4E	Disabled	Disabled *[Indexed String]*
This setting enables or disables the fourth stage of load restoration.			
Restore4 Freq	4D.4F	49	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the fourth stage of load restoration, above which the associated load restoration time can start.			
Restore4 Time	4D.50	240	From 0 to 7200 in steps of 0.25 *[Courier Number (time-seconds)]*
This setting sets the time period for which the measured frequency must be higher than the fourth stage restoration frequency setting to permit load restoration.			
Holding Timer 4	4D.51	5	From 1 to 7200 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the holding time of the fourth stage load restoration.			
Stg 4 UV Block	4D.52	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the undervoltage blocking of the fourth stage load restoration element.			
Stage 5	4D.53	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the fifth stage of frequency protection.			
Stg 5 f+t Status	4D.54	Disabled	Disabled Under

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Over *[Indexed String]*
This setting selects either underfrequency or overfrequency protection, or disables it for this stage.			
Stg 5 f+t Freq	4D.55	47.4	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the fifth stage frequency protection element.			
Stg 5 f+t Time	4D.56	2	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operating time delay for the fifth stage frequency protection element.			
df/dt+t 5 Status	4D.57	Disabled	Disabled Negative Positive Both *[Indexed String]*
This setting disables or determines the tripping direction for the fifth stage independent rate of change of frequency protection (df/dt+t).			
df/dt+t 5 Set	4D.58	2	From 0.01 to 15 in steps of 0.01 *[Courier Number (Hz/sec)]*
This setting sets the rate of change of frequency threshold for the fifth stage.			
df/dt+t 5 Time	4D.59	0.5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operating time delay for the fifth stage rate of change of frequency protection element.			
f+df/dt 5 Status	4D.5A	Disabled	Disabled Negative Positive Both *[Indexed String]*
This setting disables or determines the tripping direction for the fifth stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+df/dt 5 Status	4D.5A	Disabled	Disabled *[Indexed String]*
This setting disables or determines the tripping direction for the fifth stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+df/dt 5 freq	4D.5B	47.4	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the fifth stage frequency-supervised rate of change of frequency protection element.			
f+df/dt 5 df/dt	4D.5C	1	From 0.01 to 15 in steps of 0.01 *[Courier Number (Hz/sec)]*
This setting sets the df/dt threshold for the fifth stage frequency-supervised rate of change of frequency.			
f+Df/Dt 5 Status	4D.5D	Disabled	Disabled Under Over *[Indexed String]*
This setting selects either underfrequency or overfrequency protection for the average rate of change of frequency (Df/Dt), or disables it for this stage.			
f+Df/Dt 5 Status	4D.5D	Disabled	Disabled *[Indexed String]*
This setting selects either underfrequency or overfrequency protection for the average rate of change of frequency (Df/Dt), or disables it for this stage.			
f+Df/Dt 5 freq	4D.5E	48	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the fifth stage average rate of change of frequency protection element.			
f+Df/Dt 5 Dfreq	4D.5F	1	From 0.1 to 15 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the change in frequency that must be measured in the set time for the fifth stage average rate of change of frequency protection element.			
f+Df/Dt 5 Dtime	4D.60	0.5	From 0.02 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the time period in which an excessive change in frequency must be measured for the fifth stage average rate of change of frequency protection element.			
Restore5 Status	4D.61	Disabled	Disabled

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Enabled *[Indexed String]*
This setting enables or disables the fifth stage of load restoration.			
Restore5 Status	4D.61	Disabled	Disabled *[Indexed String]*
This setting enables or disables the fifth stage of load restoration.			
Restore5 Freq	4D.62	49	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the fifth stage of load restoration, above which the associated load restoration time can start.			
Restore5 Time	4D.63	180	From 0 to 7200 in steps of 0.25 *[Courier Number (time-seconds)]*
This setting sets the time period for which the measured frequency must be higher than the fifth stage restoration frequency setting to permit load restoration.			
Holding Timer 5	4D.64	5	From 1 to 7200 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the holding time of the fifth stage load restoration.			
Stg 5 UV Block	4D.65	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the undervoltage blocking of the fifth stage load restoration element.			
Stage 6	4D.66	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the sixth stage of frequency protection.			
Stg 6 f+t Status	4D.67	Disabled	Disabled Under Over *[Indexed String]*
This setting selects either underfrequency or overfrequency protection, or disables it for this stage.			
Stg 6 f+t Freq	4D.68	47	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the sixth stage frequency protection element.			
Stg 6 f+t Time	4D.69	2	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operating time delay for the sixth stage frequency protection element.			
df/dt+t 6 Status	4D.6A	Disabled	Disabled Negative Positive Both *[Indexed String]*
This setting determines the tripping direction for the sixth stage of dv/dt element - either disabled, for a rising frequency (positive), or a falling frequency (negative) for the sixth stage independent rate of change of frequency protection (df/dt+t).			
df/dt+t 6 Set	4D.6B	2	From 0.01 to 15 in steps of 0.01 *[Courier Number (Hz/sec)]*
This setting sets the rate of change of frequency threshold for the sixth stage.			
df/dt+t 6 Time	4D.6C	0.5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operating time delay for the sixth stage rate of change of frequency protection element.			
f+df/dt 6 Status	4D.6D	Disabled	Disabled Negative Positive Both *[Indexed String]*
This setting disables or determines the tripping direction for the sixth stage independent rate of change of frequency protection (df/dt+t).			
f+df/dt 6 Status	4D.6D	Disabled	Disabled *[Indexed String]*
This setting sets the rate of change of frequency threshold for the sixth stage.			
f+df/dt 6 freq	4D.6E	47	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the operating time delay for the sixth stage rate of change of frequency protection element.			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
f+df/dt 6 df/dt	4D.6F	1	From 0.01 to 15 in steps of 0.01 *[Courier Number (Hz/sec)]*
This setting disables or determines the tripping direction for the sixth stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+Df/Dt 6 Status	4D.70	Disabled	Disabled Under Over *[Indexed String]*
This setting disables or determines the tripping direction for the sixth stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+Df/Dt 6 Status	4D.70	Disabled	Disabled *[Indexed String]*
This setting selects either underfrequency or overfrequency protection for the average rate of change of frequency (Df/Dt), or disables it for this stage.			
f+Df/Dt 6 freq	4D.71	48	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the sixth stage average rate of change of frequency protection element.			
f+Df/Dt 6 Dfreq	4D.72	1	From 0.1 to 15 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the change in frequency that must be measured in the set time for the sixth stage average rate of change of frequency protection element.			
f+Df/Dt 6 Dtime	4D.73	0.5	From 0.02 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the time period in which an excessive change in frequency must be measured for the sixth stage average rate of change of frequency protection element.			
Restore6 Status	4D.74	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the sixth stage of load restoration.			
Restore6 Status	4D.74	Disabled	Disabled *[Indexed String]*
This setting enables or disables the sixth stage of load restoration.			
Restore6 Freq	4D.75	49	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the sixth stage of load restoration, above which the associated load restoration time can start.			
Restore6 Time	4D.76	120	From 0 to 7200 in steps of 0.25 *[Courier Number (time-seconds)]*
This setting sets the time period for which the measured frequency must be higher than the sixth stage restoration frequency setting to permit load restoration.			
Holding Timer 6	4D.77	5	From 1 to 7200 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the holding time of the sixth stage load restoration.			
Stg 6 UV Block	4D.78	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the undervoltage blocking of the sixth stage load restoration element.			
Stage 7	4D.79	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the seventh stage of frequency protection.			
Stg 7 f+t Status	4D.7A	Disabled	Disabled Under Over *[Indexed String]*
This setting selects either underfrequency or overfrequency protection, or disables it for this stage.			
Stg 7 f+t Freq	4D.7B	46.6	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the seventh stage frequency protection element.			
Stg 7 f+t Time	4D.7C	2	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This setting sets the operating time delay for the seventh stage frequency protection element.			
df/dt+t 7 Status	4D.7D	Disabled	Disabled Negative Positive Both *[Indexed String]*
This setting disables or determines the tripping direction for the seventh stage independent rate of change of frequency protection (df/dt+t).			
df/dt+t 7 Set	4D.7E	2	From 0.01 to 15 in steps of 0.01 *[Courier Number (Hz/sec)]*
This setting sets the rate of change of frequency threshold for the seventh stage.			
df/dt+t 7 Time	4D.7F	0.5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operating time delay for the seventh stage rate of change of frequency protection element.			
f+df/dt 7 Status	4D.80	Disabled	Disabled Negative Positive Both *[Indexed String]*
This setting disables or determines the tripping direction for the seventh stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+df/dt 7 Status	4D.80	Disabled	Disabled *[Indexed String]*
This setting disables or determines the tripping direction for the seventh stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+df/dt 7 freq	4D.81	46.6	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the seventh stage frequency-supervised rate of change of frequency protection element.			
f+df/dt 7 df/dt	4D.82	1	From 0.01 to 15 in steps of 0.01 *[Courier Number (Hz/sec)]*
This setting sets the df/dt threshold for the seventh stage frequency-supervised rate of change of frequency.			
f+Df/Dt 7 Status	4D.83	Disabled	Disabled Under Over *[Indexed String]*
This setting selects either underfrequency or overfrequency protection for the average rate of change of frequency (Df/Dt), or disables it for this stage.			
f+Df/Dt 7 Status	4D.83	Disabled	Disabled *[Indexed String]*
This setting selects either underfrequency or overfrequency protection for the average rate of change of frequency (Df/Dt), or disables it for this stage.			
f+Df/Dt 7 freq	4D.84	47.5	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the seventh stage average rate of change of frequency protection element.			
f+Df/Dt 7 Dfreq	4D.85	1	From 0.1 to 15 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the change in frequency that must be measured in the set time for the seventh stage average rate of change of frequency protection element.			
f+Df/Dt 7 Dtime	4D.86	0.5	From 0.02 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the time period in which an excessive change in frequency must be measured for the seventh stage average rate of change of frequency protection element.			
Restore7 Status	4D.87	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the seventh stage of load restoration.			
Restore7 Status	4D.87	Disabled	Disabled *[Indexed String]*
This setting enables or disables the seventh stage of load restoration.			
Restore7 Freq	4D.88	49	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This setting sets the pick-up threshold for the seventh stage of load restoration, above which the associated load restoration time can start.			
Restore7 Time	4D.89	100	From 0 to 7200 in steps of 0.25 *[Courier Number (time-seconds)]*
This setting sets the time period for which the measured frequency must be higher than the seventh stage restoration frequency setting to permit load restoration.			
Holding Timer 7	4D.8A	5	From 1 to 7200 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the holding time of the seventh stage load restoration.			
Stg 7 UV Block	4D.8B	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the undervoltage blocking of the seventh stage load restoration element.			
Stage 8	4D.8C	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the eighth stage of frequency protection.			
Stg 8 f+t Status	4D.8D	Disabled	Disabled Under Over *[Indexed String]*
This setting selects either underfrequency or overfrequency protection, or disables it for this stage.			
Stg 8 f+t Freq	4D.8E	50.5	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the eighth stage frequency protection element.			
Stg 8 f+t Time	4D.8F	2	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operating time delay for the eighth stage frequency protection element.			
df/dt+t 8 Status	4D.90	Disabled	Disabled Negative Positive Both *[Indexed String]*
This setting disables or determines the tripping direction for the eighth stage independent rate of change of frequency protection (df/dt+t).			
df/dt+t 8 Set	4D.91	2	From 0.01 to 15 in steps of 0.01 *[Courier Number (Hz/sec)]*
This setting sets the rate of change of frequency threshold for the eighth stage.			
df/dt+t 8 Time	4D.92	0.5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operating time delay for the eighth stage rate of change of frequency protection element.			
f+df/dt 8 Status	4D.93	Disabled	Disabled Negative Positive Both *[Indexed String]*
This setting disables or determines the tripping direction for the eighth stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+df/dt 8 Status	4D.93	Disabled	Disabled *[Indexed String]*
This setting disables or determines the tripping direction for the eighth stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+df/dt 8 freq	4D.94	50.5	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the eighth stage frequency-supervised rate of change of frequency protection element.			
f+df/dt 8 df/dt	4D.95	1	From 0.01 to 15 in steps of 0.01 *[Courier Number (Hz/sec)]*
This setting sets the df/dt threshold for the eighth stage frequency-supervised rate of change of frequency.			
f+Df/Dt 8 Status	4D.96	Disabled	Disabled Under Over *[Indexed String]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This setting selects either underfrequency or overfrequency protection for the average rate of change of frequency (Df/Dt), or disables it for this stage.			
f+Df/Dt 8 Status	4D.96	Disabled	Disabled *[Indexed String]*
This setting selects either underfrequency or overfrequency protection for the average rate of change of frequency (Df/Dt), or disables it for this stage.			
f+Df/Dt 8 freq	4D.97	50.5	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the eighth stage average rate of change of frequency protection element.			
f+Df/Dt 8 Dfreq	4D.98	1	From 0.1 to 15 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the change in frequency that must be measured in the set time for the eighth stage average rate of change of frequency protection element.			
f+Df/Dt 8 Dtime	4D.99	0.5	From 0.02 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the time period in which an excessive change in frequency must be measured for the eighth stage average rate of change of frequency protection element.			
Restore8 Status	4D.9A	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the eighth stage of load restoration.			
Restore8 Status	4D.9A	Disabled	Disabled *[Indexed String]*
This setting enables or disables the eighth stage of load restoration.			
Restore8 Freq	4D.9B	49	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the eighth stage of load restoration, above which the associated load restoration time can start.			
Restore8 Time	4D.9C	80	From 0 to 7200 in steps of 0.25 *[Courier Number (time-seconds)]*
This setting sets the time period for which the measured frequency must be higher than the eighth stage restoration frequency setting to permit load restoration.			
Holding Timer 8	4D.9D	5	From 1 to 7200 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the holding time of the eighth stage load restoration.			
Stg 8 UV Block	4D.9E	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the undervoltage blocking of the eighth stage load restoration element.			
Stage 9	4D.9F	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the ninth stage of frequency protection.			
Stg 9 f+t Status	4D.A0	Disabled	Disabled Under Over *[Indexed String]*
This setting selects either underfrequency or overfrequency protection, or disables it for this stage.			
Stg 9 f+t Freq	4D.A1	51	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the ninth stage frequency protection element.			
Stg 9 f+t Time	4D.A2	2	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operating time delay for the ninth stage frequency protection element.			
df/dt+t 9 Status	4D.A3	Disabled	Disabled Negative Positive Both *[Indexed String]*
This setting disables or determines the tripping direction for the ninth stage independent rate of change of frequency protection (df/dt+t).			
df/dt+t 9 Set	4D.A4	2	From 0.01 to 15 in steps of 0.01

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Courier Number (Hz/sec)]
This setting sets the rate of change of frequency threshold for the ninth stage.			
df/dt+t 9 Time	4D.A5	0.5	From 0 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the operating time delay for the ninth stage rate of change of frequency protection element.			
f+df/dt 9 Status	4D.A6	Disabled	Disabled Negative Positive Both *[Indexed String]*
This setting disables or determines the tripping direction for the ninth stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+df/dt 9 Status	4D.A6	Disabled	Disabled *[Indexed String]*
This setting disables or determines the tripping direction for the ninth stage frequency-supervised rate of change of frequency protection (f+df/dt).			
f+df/dt 9 freq	4D.A7	51	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the ninth stage frequency-supervised rate of change of frequency protection element.			
f+df/dt 9 df/dt	4D.A8	1	From 0.01 to 15 in steps of 0.01 *[Courier Number (Hz/sec)]*
This setting sets the df/dt threshold for the ninth stage frequency-supervised rate of change of frequency.			
f+Df/Dt 9 Status	4D.A9	Disabled	Disabled Under Over *[Indexed String]*
This setting selects either underfrequency or overfrequency protection for the average rate of change of frequency (Df/Dt), or disables it for this stage.			
f+Df/Dt 9 Status	4D.A9	Disabled	Disabled *[Indexed String]*
This setting selects either underfrequency or overfrequency protection for the average rate of change of frequency (Df/Dt), or disables it for this stage.			
f+Df/Dt 9 freq	4D.AA	51	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the ninth stage average rate of change of frequency protection element.			
f+Df/Dt 9 Dfreq	4D.AB	1	From 0.1 to 15 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the change in frequency that must be measured in the set time for the ninth stage average rate of change of frequency protection element.			
f+Df/Dt 9 Dtime	4D.AC	0.5	From 0.02 to 100 in steps of 0.01 *[Courier Number (time-seconds)]*
This setting sets the time period in which an excessive change in frequency must be measured for the ninth stage average rate of change of frequency protection element.			
Restore9 Status	4D.AD	Disabled	Disabled Enabled *[Indexed String]*
This setting enables or disables the ninth stage of load restoration.			
Restore9 Status	4D.AD	Disabled	Disabled *[Indexed String]*
This setting enables or disables the ninth stage of load restoration.			
Restore9 Freq	4D.AE	49	From 40.1 to 69.9 in steps of 0.01 *[Courier Number (frequency)]*
This setting sets the pick-up threshold for the ninth stage of load restoration, above which the associated load restoration time can start.			
Restore9 Time	4D.AF	60	From 0 to 7200 in steps of 0.25 *[Courier Number (time-seconds)]*
This setting sets the time period for which the measured frequency must be higher than the ninth stage restoration frequency setting to permit load restoration.			
Holding Timer 9	4D.B0	5	From 1 to 7200 in steps of 1 *[Courier Number (time-seconds)]*
This setting sets the holding time of the ninth stage load restoration.			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
Stg 9 UV Block	4D.B1	Disabled	0 or 1 *[Indexed String]*
This setting enables or disables the undervoltage blocking of the ninth stage load restoration element.			
GROUP 1: PSL TIMERS	4E.00		
This column contains settings for frequency protection.			
Timer 1	4E.01	0	See 50300.3110.004 *[Courier Number (time-ms)]*
This setting sets PSL timer #1			
Timer 2	4E.02	0	See 50300.3110.004 *[Courier Number (time-ms)]*
This setting sets PSL timer #2			
Timer 3	4E.03	0	See 50300.3110.004 *[Courier Number (time-ms)]*
This setting sets PSL timer #3			
Timer 4	4E.04	0	See 50300.3110.004 *[Courier Number (time-ms)]*
This setting sets PSL timer #4			
Timer 5	4E.05	0	See 50300.3110.004 *[Courier Number (time-ms)]*
This setting sets PSL timer #5			
Timer 6	4E.06	0	See 50300.3110.004 *[Courier Number (time-ms)]*
This setting sets PSL timer #6			
Timer 7	4E.07	0	See 50300.3110.004 *[Courier Number (time-ms)]*
This setting sets PSL timer #7			
Timer 8	4E.08	0	See 50300.3110.004 *[Courier Number (time-ms)]*
This setting sets PSL timer #8			
Timer 9	4E.09	0	See 50300.3110.004 *[Courier Number (time-ms)]*
This setting sets PSL timer #9			
Timer 10	4E.0A	0	See 50300.3110.004 *[Courier Number (time-ms)]*
This setting sets PSL timer #10			
Timer 11	4E.0B	0	See 50300.3110.004 *[Courier Number (time-ms)]*
This setting sets PSL timer #11			
Timer 12	4E.0C	0	See 50300.3110.004 *[Courier Number (time-ms)]*
This setting sets PSL timer #12			
Timer 13	4E.0D	0	See 50300.3110.004 *[Courier Number (time-ms)]*
This setting sets PSL timer #13			
Timer 14	4E.0E	0	See 50300.3110.004 *[Courier Number (time-ms)]*
This setting sets PSL timer #14			
Timer 15	4E.0F	0	See 50300.3110.004 *[Courier Number (time-ms)]*
This setting sets PSL timer #15			
Timer 16	4E.10	0	See 50300.3110.004 *[Courier Number (time-ms)]*
This setting sets PSL timer #16			
Domain	B2.04	PSL Settings	PSL Settings PSL Configuration *[Indexed String]*
Sub-Domain	B2.08	Group 1	Group 1 Group 2

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			Group 3 Group 4 *[Indexed String]*
Version	B2.0C	256	From 0 to 65535 in steps of 1 *[Unsigned Integer (16 bits)]*
Transfer Mode	B2.1C	6	Prepare Rx Complete Rx Prepare Tx Complete Tx Rx Prepared Tx Prepared OK Error *[Indexed String]*
Data Transfer	B2.20		
Select Record Number - n	B4.01	0	From -199 to 199 in steps of 1 *[Unsigned Integer]*
Trigger Time	B4.02		Trigger Time *[IEC870 Date & Time]*
Active Channels	B4.03		Active Channels *[Binary Flag]*
Channel Types	B4.04		Channel Types *[Binary Flag]*
Channel Offsets	B4.05		Channel Offsets *[Courier Number (decimal)]*
Channel Scaling	B4.06		Channel Scaling *[Courier Number (decimal)]*
Channel SkewVal	B4.07		Channel SkewVal *[Integer]*
Channel MinVal	B4.08		Channel MinVal *[Integer]*
Channel MaxVal	B4.09		Channel MaxVal *[Integer]*
Compression Format	B4.0A	1	Compression Format *[Unsigned Integer (16 bits)]*
Upload Compression Record	B4.0B		Upload Compression Record *[Unsigned Integer (16 bits)]*
No. Of Samples	B4.10		No. Of Samples *[Unsigned Integer]*
Trig Position	B4.11		Trig Position *[Unsigned Integer]*
Time Base	B4.12		Time Base *[Courier Number (time-seconds)]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
Sample Timer	B4.14		Sample Timer *[Unsigned Integer]*
Dist. Channel 1	B4.20		Dist. Channel 1 *[Integer]*
Dist. Channel 2	B4.21		Dist. Channel 2 *[Integer]*
Dist. Channel 3	B4.22		Dist. Channel 3 *[Integer]*
Dist. Channel 4	B4.23		Dist. Channel 4 *[Integer]*
Dist. Channel 5	B4.24		Dist. Channel 5 *[Integer]*
Dist. Channel 6	B4.25		Dist. Channel 6 *[Integer]*
Dist. Channel 7	B4.26		Dist. Channel 7 *[Integer]*
Dist. Channel 8	B4.27		Dist. Channel 8 *[Integer]*
Dist. Channel 9	B4.28		Dist. Channel 9 *[Integer]*
Dist. Channel 10	B4.29		Dist. Channel 10 *[Integer]*
Dist. Channel 11	B4.2A		Dist. Channel 11 *[Integer]*
Dist. Channel 12	B4.2B		Dist. Channel 12 *[Integer]*
Dist. Channel 13	B4.2C		Dist. Channel 13 *[Integer]*
Dist. Channel 29	B4.3C		Dist. Channel 29 *[Binary Flag]*
Dist. Channel 30	B4.3D		Dist. Channel 30 *[Binary Flag]*
Dist. Channel 31	B4.3E		Dist. Channel 31 *[Binary Flag]*
Dist. Channel 32	B4.3F		Dist. Channel 32 *[Binary Flag]*
PSL DATA	B7.00		
This column contains information about the Programmable Scheme Logic			
Grp1 PSL Ref	B7.01		Grp1 PSL Ref *[ASCII Text (32 chars)]*

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
This setting displays the Group 1 PSL reference			
Date/Time	B7.02		Date/Time *[IEC870 Date & Time]*
This setting displays the date and time the PSL was created			
Grp1 PSL ID	B7.03		Grp1 PSL ID *[Unsigned Integer (32 bits)]*
This setting displays the Group 1 PSL ID			
Grp2 PSL Ref	B7.11		Grp2 PSL Ref *[ASCII Text (32 chars)]*
This setting displays the Group 2 PSL reference			
Date/Time	B7.12		Date/Time *[IEC870 Date & Time]*
This setting displays the date and time the PSL was created			
Grp2 PSL ID	B7.13		Grp2 PSL ID *[Unsigned Integer (32 bits)]*
This setting displays the Group 2 PSL ID			
Grp3 PSL Ref	B7.21		Grp3 PSL Ref *[ASCII Text (32 chars)]*
This setting displays the Group 3 PSL reference			
Date/Time	B7.22		Date/Time *[IEC870 Date & Time]*
This setting displays the date and time the PSL was created			
Grp3 PSL ID	B7.23		Grp3 PSL ID *[Unsigned Integer (32 bits)]*
This setting displays the Group 3 PSL ID			
Grp4 PSL Ref	B7.31		Grp4 PSL Ref *[ASCII Text (32 chars)]*
This setting displays the Group 4 PSL reference			
Date/Time	B7.32		Date/Time *[IEC870 Date & Time]*
This setting displays the date and time the PSL was created			
Grp4 PSL ID	B7.33		Grp4 PSL ID *[Unsigned Integer (32 bits)]*
This setting displays the Group 4 PSL ID			
USER CURVES DATA	B8.00		
This column contains settings and data for the user curves			
Curve 1 Name	B8.01	Def User Curve 1	Curve 1 Name *[ASCII Text (32 Chars)]*
This cell displays the name of user curve 1			
Date & Time	B8.02		Date & Time *[IEC 870 Date & Time]*
This cell displays the date and time the user curve was downloaded to the IED			
Curve 1 ID	B8.03		Curve 1 ID *[Unsigned Integer (16 bits)]*
This cell displays the ID of user curve 1			
UsrCrv1 Vrsn	B8.04	Operate Curve	Operate Curve Reset Curve UV Operate Curve *[Indexed String]*
This setting sets the curve type; either operate or reset.			
Curve 2 Name	B8.11	Def User Curve 2	Curve 2 Name *[ASCII Text (32 Chars)]*
This cell displays the name of user curve 2			
Date & Time	B8.12		Date & Time *[IEC 870 Date & Time]*
This cell displays the date and time the user curve was downloaded to the IED			
Curve 2 ID	B8.13		Curve 2 ID *[Unsigned Integer (16 bits)]*
This cell displays the ID of user curve 2			

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
UsrCrv2 Vrsn	B8.14	Operate Curve	Operate Curve Reset Curve UV Operate Curve *[Indexed String]*
This setting sets the curve type; either operate or reset.			
Curve 3 Name	B8.21	Def User Curve 3	Curve 3 Name *[ASCII Text (32 Chars)]*
This cell displays the name of user curve 3			
Date & Time	B8.22		Date & Time *[IEC 870 Date & Time]*
This cell displays the date and time the user curve was downloaded to the IED			
Curve 3 ID	B8.23		Curve 3 ID *[Unsigned Integer (16 bits)]*
This cell displays the ID of user curve 3			
UsrCrv3 Vrsn	B8.24	Reset Curve	Operate Curve Reset Curve UV Operate Curve *[Indexed String]*
This setting sets the curve type; either operate or reset.			
UsrCrv3 Vrsn	B8.24	Reset Curve	Operate Curve Reset Curve UV Operate Curve Th Operate Curve Th Reset Curve *[Indexed String]*
This setting sets the curve type; either operate or reset.			
Curve 4 Name	B8.31	Def User Curve 4	Curve 4 Name *[ASCII Text (32 Chars)]*
This cell displays the name of user curve 4			
Date & Time	B8.32		Date & Time *[IEC 870 Date & Time]*
This cell displays the date and time the user curve was downloaded to the IED			
Curve 4 ID	B8.33		Curve 4 ID *[Unsigned Integer (16 bits)]*
This cell displays the ID of user curve 4			
UsrCrv4 Vrsn	B8.34	Reset Curve	Operate Curve Reset Curve UV Operate Curve *[Indexed String]*
This setting sets the curve type; either operate or reset.			
UsrCrv4 Vrsn	B8.34	Reset Curve	Operate Curve Reset Curve UV Operate Curve Th Operate Curve Th Reset Curve *[Indexed String]*
This setting sets the curve type; either operate or reset.			
COMMS SYS DATA	BF.00		
Dist Record Cntrl Ref	BF.01	B300	Dist Record Cntrl Ref *[Menu Cell(2)]*
Dist Record Extract Ref	BF.02	B400	Dist Record Extract Ref *[Menu Cell(2)]*
Setting Transfer	BF.03		
Reset Demand Timers	BF.04		
Block Transfer Ref	BF.06	B200	Block Transfer Ref

MENU TEXT	COL.ROW	DEFAULT SETTING	AVAILABLE OPTIONS
DESCRIPTION			
			[Menu Cell(2)]
Read Only Mode	BF.07		Read Only Mode *[Menu Cell]*
Encryption Key	BF.10		Encryption Key *[Foreign Data]*
Connected i/face	BF.11		Connected i/face *[Unsigned Integer (16 bit)]*
Security Column	BF.12		Security Column *[Menu Cell]*
Port Disable	BF.13		Port Disable *[Menu Cell]*
Port Disable end	BF.14		Port Disable end *[Menu Cell]*
PW Entry Needed	BF.15		PW Entry Needed *[Unsigned Integer (32 bits)]*
ETHERNET STATUS	F0.00		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
0	Relay 1	DDB_OUTPUT_RELAY_1
DDB signal connected to output relay contact 1		
1	Relay 2	DDB_OUTPUT_RELAY_2
DDB signal connected to output relay contact 2		
2	Relay 3	DDB_OUTPUT_RELAY_3
DDB signal connected to output relay contact 3		
3	Relay 4	DDB_OUTPUT_RELAY_4
DDB signal connected to output relay contact 4		
4	Relay 5	DDB_OUTPUT_RELAY_5
DDB signal connected to output relay contact 5		
5	Relay 6	DDB_OUTPUT_RELAY_6
DDB signal connected to output relay contact 6		
6	Relay 7	DDB_OUTPUT_RELAY_7
DDB signal connected to output relay contact 7		
7	Relay 8	DDB_OUTPUT_RELAY_8
DDB signal connected to output relay contact 8		
8	Relay 9	DDB_OUTPUT_RELAY_9
DDB signal connected to output relay contact 9		
9	Relay 10	DDB_OUTPUT_RELAY_10
DDB signal connected to output relay contact 10		
10	Relay 11	DDB_OUTPUT_RELAY_11
DDB signal connected to output relay contact 11		
11	Relay 12	DDB_OUTPUT_RELAY_12
DDB signal connected to output relay contact 12		
32	Opto Input 1	DDB_OPTO_ISOLATOR_1
DDB signal connected to opto-input 1		
33	Opto Input 2	DDB_OPTO_ISOLATOR_2
DDB signal connected to opto-input 2		
34	Opto Input 3	DDB_OPTO_ISOLATOR_3
DDB signal connected to opto-input 3		
35	Opto Input 4	DDB_OPTO_ISOLATOR_4
DDB signal connected to opto-input 4		
36	Opto Input 5	DDB_OPTO_ISOLATOR_5
DDB signal connected to opto-input 5		
37	Opto Input 6	DDB_OPTO_ISOLATOR_6
DDB signal connected to opto-input 6		
38	Opto Input 7	DDB_OPTO_ISOLATOR_7
DDB signal connected to opto-input 7		
39	Opto Input 8	DDB_OPTO_ISOLATOR_8
DDB signal connected to opto-input 8		
40	Opto Input 9	DDB_OPTO_ISOLATOR_9
DDB signal connected to opto-input 9		
41	Opto Input 10	DDB_OPTO_ISOLATOR_10
DDB signal connected to opto-input 10		
42	Opto Input 11	DDB_OPTO_ISOLATOR_11
DDB signal connected to opto-input 11		
43	Opto Input 12	DDB_OPTO_ISOLATOR_12
DDB signal connected to opto-input 12		
44	Opto Input 13	DDB_OPTO_ISOLATOR_13
DDB signal connected to opto-input 13		
72	Relay Cond 1	DDB_OUTPUT_CON_1
DDB signal connected to output relay conditioner 1		
73	Relay Cond 2	DDB_OUTPUT_CON_2
DDB signal connected to output relay conditioner 2		
74	Relay Cond 3	DDB_OUTPUT_CON_3
DDB signal connected to output relay conditioner 3		
75	Relay Cond 4	DDB_OUTPUT_CON_4
DDB signal connected to output relay conditioner 4		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
76	Relay Cond 5	DDB_OUTPUT_CON_5
DDB signal connected to output relay conditioner 5		
77	Relay Cond 6	DDB_OUTPUT_CON_6
DDB signal connected to output relay conditioner 6		
78	Relay Cond 7	DDB_OUTPUT_CON_7
DDB signal connected to output relay conditioner 7		
79	Relay Cond 8	DDB_OUTPUT_CON_8
DDB signal connected to output relay conditioner 8		
80	Relay Cond 9	DDB_OUTPUT_CON_9
DDB signal connected to output relay conditioner 9		
81	Relay Cond 10	DDB_OUTPUT_CON_10
DDB signal connected to output relay conditioner 10		
82	Relay Cond 11	DDB_OUTPUT_CON_11
DDB signal connected to output relay conditioner 11		
83	Relay Cond 12	DDB_OUTPUT_CON_12
DDB signal connected to output relay conditioner 12		
112	Timer in 1	DDB_TIMERIN_1
DDB signal connected to timer 1 input		
113	Timer in 2	DDB_TIMERIN_2
DDB signal connected to timer 2 input		
114	Timer in 3	DDB_TIMERIN_3
DDB signal connected to timer 3 input		
115	Timer in 4	DDB_TIMERIN_4
DDB signal connected to timer 4 input		
116	Timer in 5	DDB_TIMERIN_5
DDB signal connected to timer 5 input		
117	Timer in 6	DDB_TIMERIN_6
DDB signal connected to timer 6 input		
118	Timer in 7	DDB_TIMERIN_7
DDB signal connected to timer 7 input		
119	Timer in 8	DDB_TIMERIN_8
DDB signal connected to timer 8 input		
120	Timer in 9	DDB_TIMERIN_9
DDB signal connected to timer 9 input		
121	Timer in 10	DDB_TIMERIN_10
DDB signal connected to timer 10 input		
122	Timer in 11	DDB_TIMERIN_11
DDB signal connected to timer 11 input		
123	Timer in 12	DDB_TIMERIN_12
DDB signal connected to timer 12 input		
124	Timer in 13	DDB_TIMERIN_13
DDB signal connected to timer 13 input		
125	Timer in 14	DDB_TIMERIN_14
DDB signal connected to timer 14 input		
126	Timer in 15	DDB_TIMERIN_15
DDB signal connected to timer 15 input		
127	Timer in 16	DDB_TIMERIN_16
DDB signal connected to timer 16 input		
128	Timer out 1	DDB_TIMEROUT_1
DDB signal connected to timer 1 output		
129	Timer out 2	DDB_TIMEROUT_2
DDB signal connected to timer 2 output		
130	Timer out 3	DDB_TIMEROUT_3
DDB signal connected to timer 3 output		
131	Timer out 4	DDB_TIMEROUT_4
DDB signal connected to timer 4 output		
132	Timer out 5	DDB_TIMEROUT_5
DDB signal connected to timer 5 output		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
133	Timer out 6	DDB_TIMEROUT_6
DDB signal connected to timer 6 output		
134	Timer out 7	DDB_TIMEROUT_7
DDB signal connected to timer 7 output		
135	Timer out 8	DDB_TIMEROUT_8
DDB signal connected to timer 8 output		
136	Timer out 9	DDB_TIMEROUT_9
DDB signal connected to timer 9 output		
137	Timer out 10	DDB_TIMEROUT_10
DDB signal connected to timer 10 output		
138	Timer out 11	DDB_TIMEROUT_11
DDB signal connected to timer 11output		
139	Timer out 12	DDB_TIMEROUT_12
DDB signal connected to timer 12 output		
140	Timer out 13	DDB_TIMEROUT_13
DDB signal connected to timer 13 output		
141	Timer out 14	DDB_TIMEROUT_14
DDB signal connected to timer 1 4 output		
142	Timer out 15	DDB_TIMEROUT_15
DDB signal connected to timer 15 output		
143	Timer out 16	DDB_TIMEROUT_16
DDB signal connected to timer 16 output		
144	Fault REC TRIG	DDB_FAULT_RECORDER_START
This DDB triggers the fault recorder		
145	SG-opto Invalid	DDB_ILLEGAL_OPTO_SETTINGS_GROUP
This DDB signal indicates that the Setting Group selection via opto-input is invalid		
146	Prot'n Disabled	DDB_OOS_ALARM
This DDB signal indicates an Out-of-Service condition		
147	F out of Range	DDB_FREQ_ALARM
This DDB signal indicates a 'Frequency out of range' condition		
153	CB Ops Maint	DDB_MAINTENANCE_ALARM
This DDB signal indicates that the number of CB operations has exceeded the set maintenance threshold		
154	CB Ops Lockout	DDB_MAINTENANCE_LOCKOUT
This DDB signal initiates a CB lockout when the set maintenance threshold has been exceeded		
155	CB Op Time Maint	DDB_EXCESSIVE_OP_TIME_ALARM
This DDB signal indicates that the total amount of CB operating time has exceeded the set maintenance threshold		
156	CB Op Time Lock	DDB_EXCESSIVE_OP_TIME_LOCKOUT
This DDB signal initiates a CB lockout when the set CB operating time threshold has been exceeded		
157	Fault Freq Lock	DDB_EFF_LOCKOUT
This DDB signal initiates a CB lockout when the set Excessive Fault Frequency threshold has been exceeded		
158	CB Status Alarm	DDB_CB_STATUS_ALARM
This DDB signal indicates that the CB is in an invalid state		
159	Man CB Trip Fail	DDB_CB_FAILED_TO_TRIP
This DDB signal indicates that the CB has failed to trip following manual trip		
160	CB Cls Fail	DDB_CB_FAILED_TO_CLOSE
This DDB signal indicates that the CB has failed to close		
161	Man CB Unhealthy	DDB_CONTROL_CB_UNHEALTHY
This DDB signal indicates that the CB is unhealthy		
162	Man No Checksync	DDB_CONTROL_NO_CHECK_SYNC
This DDB signal indicates that there is no check synchronization while closing		
163	AR Lockout	DDB_AR_LOCKOUT
This DDB signal indicates that the AR did not result in successful reclosure and locks out further reclose attempts		
164	AR CB Unhealthy	DDB_AR_CB_UNHEALTHY
The scheme has waited for the "CB HEALTHY" signal for the HEALTHY WINDOW time.		
165	AR No Sys Check	DDB_AR_NO_SYS_CHECK
The scheme has waited for the "SYSTEM OK TO CLOSE" input for the SYSTEM CHECK WINDOW time		
166	System Split	DDB_SYSTEM_SPLIT_ALARM
This DDB signal is the System Split alarm		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
167	UV Block	DDB_UNDERVOLTAGE_BLOCK
This DDB blocks the undervoltage element		
168	User Alarm 1	DDB_USER_ALARM_1
This DDB signal can be configured as a user-defined Alarm		
169	User Alarm 2	DDB_USER_ALARM_2
This DDB signal can be configured as a user-defined Alarm		
170	User Alarm 3	DDB_USER_ALARM_3
This DDB signal can be configured as a user-defined Alarm		
171	User Alarm 4	DDB_USER_ALARM_4
This DDB signal can be configured as a user-defined Alarm		
172	User Alarm 5	DDB_USER_ALARM_5
This DDB signal can be configured as a user-defined Alarm		
173	User Alarm 6	DDB_USER_ALARM_6
This DDB signal can be configured as a user-defined Alarm		
174	User Alarm 7	DDB_USER_ALARM_7
This DDB signal can be configured as a user-defined Alarm		
175	User Alarm 8	DDB_USER_ALARM_8
This DDB signal can be configured as a user-defined Alarm		
176	User Alarm 9	DDB_USER_ALARM_9
This DDB signal can be configured as a user-defined Alarm		
177	User Alarm 10	DDB_USER_ALARM_10
This DDB signal can be configured as a user-defined Alarm		
178	User Alarm 11	DDB_USER_ALARM_11
This DDB signal can be configured as a user-defined Alarm		
179	User Alarm 12	DDB_USER_ALARM_12
This DDB signal can be configured as a user-defined Alarm		
180	User Alarm 13	DDB_USER_ALARM_13
This DDB signal can be configured as a user-defined Alarm		
181	User Alarm 14	DDB_USER_ALARM_14
This DDB signal can be configured as a user-defined Alarm		
182	User Alarm 15	DDB_USER_ALARM_15
This DDB signal can be configured as a user-defined Alarm		
183	User Alarm 16	DDB_USER_ALARM_16
This DDB signal can be configured as a user-defined Alarm		
184	User Alarm 17	DDB_USER_ALARM_17
This DDB signal can be configured as a user-defined Alarm		
185	User Alarm 18	DDB_USER_ALARM_18
This DDB signal can be configured as a user-defined Alarm		
186	User Alarm 19	DDB_USER_ALARM_19
This DDB signal can be configured as a user-defined Alarm		
187	User Alarm 20	DDB_USER_ALARM_20
This DDB signal can be configured as a user-defined Alarm		
188	User Alarm 21	DDB_USER_ALARM_21
This DDB signal can be configured as a user-defined Alarm		
189	User Alarm 22	DDB_USER_ALARM_22
This DDB signal can be configured as a user-defined Alarm		
190	User Alarm 23	DDB_USER_ALARM_23
This DDB signal can be configured as a user-defined Alarm		
191	User Alarm 24	DDB_USER_ALARM_24
This DDB signal can be configured as a user-defined Alarm		
192	User Alarm 25	DDB_USER_ALARM_25
This DDB signal can be configured as a user-defined Alarm		
193	User Alarm 26	DDB_USER_ALARM_26
This DDB signal can be configured as a user-defined Alarm		
194	User Alarm 27	DDB_USER_ALARM_27
This DDB signal can be configured as a user-defined Alarm		
195	User Alarm 28	DDB_USER_ALARM_28
This DDB signal can be configured as a user-defined Alarm		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
196	User Alarm 29	DDB_USER_ALARM_29
This DDB signal can be configured as a user-defined Alarm		
197	User Alarm 30	DDB_USER_ALARM_30
This DDB signal can be configured as a user-defined Alarm		
198	User Alarm 31	DDB_USER_ALARM_31
This DDB signal can be configured as a user-defined Alarm		
199	User Alarm 32	DDB_USER_ALARM_32
This DDB signal can be configured as a user-defined Alarm		
200	MR User Alarm 33	DDB_USER_ALARM_33
This DDB signal can be configured as manual reset alarm		
201	MR User Alarm 34	DDB_USER_ALARM_34
This DDB signal can be configured as manual reset alarm		
202	MR User Alarm 35	DDB_USER_ALARM_35
This DDB signal can be configured as manual reset alarm		
220	VN>1 Timer Blk	DDB_RESOV_1_TIMER_BLOCK
This DDB signal blocks the first stage Residual Overvoltage time delay		
221	VN>2 Timer Blk	DDB_RESOV_2_TIMER_BLOCK
This DDB signal blocks the second stage Residual Overvoltage time delay		
222	V<1 Timer Block	DDB_PUV_1_TIMER_BLOCK
This DDB signal blocks the first stage Phase Undervoltage time delay		
223	V<2 Timer Block	DDB_PUV_2_TIMER_BLOCK
This DDB signal blocks the second stage Phase Undervoltage time delay		
224	V>1 Timer Block	DDB_POV_1_TIMER_BLOCK
This DDB signal blocks the first stage Phase Overvoltage time delay		
225	V>2 Timer Block	DDB_POV_2_TIMER_BLOCK
This DDB signal blocks the second stage Phase Overvoltage time delay		
227	Ext. Trip 3ph	DDB_EXTERNAL_TRIP_3PH
This DDB signal receives an external three-phase trip signal		
228	CB Aux 3ph(52-A)	DDB_CB_THREE_PHASE_52A
This DDB signal is the 3-phase 52A signal (signal indicating state of CB)		
229	CB Aux 3ph(52-B)	DDB_CB_THREE_PHASE_52B
This DDB signal is the 3-phase 52B signal (signal indicating inverse state of CB)		
230	CB Healthy	DDB_CB_HEALTHY
This DDB signal indicates that the CB is healthy.		
232	Init Trip CB	DDB_LOGIC_INPUT_TRIP
This DDB signals the circuit breaker to open		
233	Init Close CB	DDB_LOGIC_INPUT_CLOSE
This DDB signals the circuit breaker to open		
234	Reset Close Dly	DDB_RESET_CB_CLOSE_DELAY
This DDB signal resets the Manual CB Close Time Delay		
235	Reset Relays/LED	DDB_RESET_RELAYS_LEDS
This DDB resets all latched output relays and LEDs		
237	Reset Lockout	DDB_RESET_LOCKOUT
This DDB Resets a lockout condition		
238	Reset CB Data	DDB_RESET_ALL_VALUES
This DDB resets the CB Maintenance Values		
239	Block AR	DDB_BLOCK_AR
This DDB signal blocks the Autoreclose function		
240	AR LiveLine Mode	DDB_LIVE_LINE_MODE
This DB indicates that the autoreclose function is in Live Line mode		
241	AR Auto Mode	DDB_AUTO_MODE
This DB indicates that the autoreclose function is in Auto mode		
242	Telecontrol Mode	DDB_TELECONTROL_MODE
This DB indicates that the autoreclose function is in Telecontrol mode		
274	VN>1 Trip	DDB_RESOV_1_TRIP
This DDB signal is the first stage Residual Overvoltage trip signal		
275	VN>2 Trip	DDB_RESOV_2_TRIP
This DDB signal is the second stage Residual Overvoltage trip signal		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
277	V2> Trip	DDB_NEGSEQOV_TRIP
This DDB signal is the negative Sequence Overvoltage trip signal		
278	V<1 Trip	DDB_PUV_1_3PH_TRIP
This DDB signal is the first stage three-phase or any-phase Undervoltage trip signal		
279	V<1 Trip A/AB	DDB_PUV_1_PH_A_TRIP
This DDB signal is the first stage A-phase Undervoltage trip signal		
280	V<1 Trip B/BC	DDB_PUV_1_PH_B_TRIP
This DDB signal is the first stage B-phase Undervoltage trip signal		
281	V<1 Trip C/CA	DDB_PUV_1_PH_C_TRIP
This DDB signal is the first stage C-phase Undervoltage trip signal		
282	V<2 Trip	DDB_PUV_2_3PH_TRIP
This DDB signal is the second stage three-phase or any-phase Undervoltage trip signal		
283	V<2 Trip A/AB	DDB_PUV_2_PH_A_TRIP
This DDB signal is the second stage A-phase Undervoltage trip signal		
284	V<2 Trip B/BC	DDB_PUV_2_PH_B_TRIP
This DDB signal is the second stage B-phase Undervoltage trip signal		
285	V<2 Trip C/CA	DDB_PUV_2_PH_C_TRIP
This DDB signal is the second stage C-phase Undervoltage trip signal		
286	V>1 Trip	DDB_POV_1_3PH_TRIP
This DDB signal is the first stage three-phase or any-phase Overvoltage trip signal		
287	V>1 Trip A/AB	DDB_POV_1_PH_A_TRIP
This DDB signal is the first stage A-phase Overvoltage trip signal		
288	V>1 Trip B/BC	DDB_POV_1_PH_B_TRIP
This DDB signal is the first stage B-phase Overvoltage trip signal		
289	V>1 Trip C/CA	DDB_POV_1_PH_C_TRIP
This DDB signal is the first stage C-phase Overvoltage trip signal		
290	V>2 Trip	DDB_POV_2_3PH_TRIP
This DDB signal is the second stage three-phase or any-phase Overvoltage trip signal		
291	V>2 Trip A/AB	DDB_POV_2_PH_A_TRIP
This DDB signal is the second stage A-phase Overvoltage trip signal		
292	V>2 Trip B/BC	DDB_POV_2_PH_B_TRIP
This DDB signal is the second stage B-phase Overvoltage trip signal		
293	V>2 Trip C/CA	DDB_POV_2_PH_C_TRIP
This DDB signal is the second stage C-phase Overvoltage trip signal		
294	Any Start	DDB_ANY_START
This DDB signal is the Any Start signal originating from the fixed scheme logic		
327	VN>1 Start	DDB_RESOV_1_START
This DDB signal is the first stage Residual Overvoltage start signal		
328	VN>2 Start	DDB_RESOV_2_START
This DDB signal is the second stage Residual Overvoltage start signal		
330	V2> Start	DDB_NEGSEQOV_START
This DDB signal is the Negative Sequence Overvoltage start signal		
331	V<1 Start	DDB_PUV_1_3PH_START
This DDB signal is the first stage three-phase or any-phase Undervoltage start signal		
332	V<1 Start A/AB	DDB_PUV_1_PH_A_START
This DDB signal is the first stage A-phase Phase Undervoltage start signal		
333	V<1 Start B/BC	DDB_PUV_1_PH_B_START
This DDB signal is the first stage B-phase Phase Undervoltage start signal		
334	V<1 Start C/CA	DDB_PUV_1_PH_C_START
This DDB signal is the first stage C-phase Phase Undervoltage start signal		
335	V<2 Start	DDB_PUV_2_3PH_START
This DDB signal is the second stage three-phase or any-phase Undervoltage start signal		
336	V<2 Start A/AB	DDB_PUV_2_PH_A_START
This DDB signal is the second stage A-phase Phase Undervoltage start signal		
337	V<2 Start B/BC	DDB_PUV_2_PH_B_START
This DDB signal is the second stage B-phase Phase Undervoltage start signal		
338	V<2 Start C/CA	DDB_PUV_2_PH_C_START
This DDB signal is the second stage C-phase Phase Undervoltage start signal		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
339	V>1 Start	DDB_POV_1_3PH_START
This DDB signal is the first stage three-phase or any-phase Overvoltage start signal		
340	V>1 Start A/AB	DDB_POV_1_PH_A_START
This DDB signal is the first stage A-phase Phase Overvoltage start signal		
341	V>1 Start B/BC	DDB_POV_1_PH_B_START
This DDB signal is the first stage B-phase Phase Overvoltage start signal		
342	V>1 Start C/CA	DDB_POV_1_PH_C_START
This DDB signal is the first stage C-phase Phase Overvoltage start signal		
343	V>2 Start	DDB_POV_2_3PH_START
This DDB signal is the second stage three-phase or any-phase Overvoltage start signal		
344	V>2 Start A/AB	DDB_POV_2_PH_A_START
This DDB signal is the second stage A-phase Phase Overvoltage start signal		
345	V>2 Start B/BC	DDB_POV_2_PH_B_START
This DDB signal is the second stage B-phase Phase Overvoltage start signal		
346	V>2 Start C/CA	DDB_POV_2_PH_C_START
This DDB signal is the second stage C-phase Phase Overvoltage start signal		
355	Control Trip	DDB_CONTROL_TRIP
This DDB signal tells the CB to trip		
356	Control Close	DDB_CONTROL_CLOSE
This DDB signal tells the CB to close		
357	Close in Prog	DDB_CONTROL_CLOSE_IN_PROGRESS
This DDB signal indicates that CB closure is in progress		
358	AR Blk Main Prot	DDB_AR_BLOCK_MAIN_PROTECTION
This DDB signal, generated by the Autoreclose function, blocks the Main Protection elements (POC, EF1, EF2, NPSOC)		
359	AR Blk SEF Prot	DDB_AR_BLOCK_SEF_PROTECTION
This DDB signal, generated by the Autoreclose function, blocks the SEF Protection element (POC, EF1, EF2, NPSOC)		
360	AR In Progress	DDB_AR_3_POLE_IN_PROGRESS
This DDB signal indicates that three-pole Autoreclose is in progress		
361	AR In Service	DDB_AR_IN_SERVICE
This DDB signal indicates that Autoreclose is in or out of service (auto, or non-auto mode)		
362	AR SeqCounter 0	DDB_SEQ_COUNT_0
This DDB signal indicates that the AR has not been initiated		
363	AR SeqCounter 1	DDB_SEQ_COUNT_1
This DDB signal indicates that the AR function is in its first shot		
364	AR SeqCounter 2	DDB_SEQ_COUNT_2
This DDB signal indicates that the AR function is in its second shot		
365	AR SeqCounter 3	DDB_SEQ_COUNT_3
This DDB signal indicates that the AR function is in its third shot		
366	AR SeqCounter 4	DDB_SEQ_COUNT_4
This DDB signal indicates that the AR function is in its fourth shot		
367	Successful Close	DDB_AR_SUCCESSFUL_RECLOSE
This DDB signal indicates a successful reclosure		
368	DeadTime in Prog	DDB_DEAD_TIME_IN_PROGRESS
This DDB signal indicates that the Autoreclose dead time is in progress		
369	Protection Lockt	DDB_AR_PROTECTION_LOCKOUT
This DB signal locks out the Autoreclose function		
370	Reset Lckout Alm	DDB_AR_RESET_LOCKOUT_ALARM
This DDB signal indicates that a lockout has been reset.		
371	Auto Close	DDB_AUTO_CLOSE
This DDB signal tells the CB to close, originating from Autoreclose only. This DDB signal has a fixed reset time.		
372	AR Trip Test	DDB_AR_TRIP_TEST
This DDB signal is used to test the Autoreclose function Autoreclose trip test		
378	CB Open 3 ph	DDB_CB_OPEN
This DDB signal indicates that the CB is open on all 3 phases		
379	CB Closed 3 ph	DDB_CB_CLOSED
This DDB signal indicates that the CB is closed on all 3 phases		
402	Man Check Synch	DDB_SYNC_CTRL_SYS_CHECK_OK
This DDB signal initiates a manual Checks Synch		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
403	AR Sys Checks	DDB_SYNC_AR_SYS_CHECK_OK
This DDB signal tells the Autoreclose that the system checks are satisfied.		
404	Lockout Alarm	DDB_CB_LOCKOUT_ALARM
This DDB signal is the Composite circuit breaker Lockout Alarm		
406	Freq High	DDB_FREQ_ABOVE_RANGE_LIMIT
This DDB signal indicates that the frequency is above 70Hz		
407	Freq Low	DDB_FREQ_BELOW_RANGE_LIMIT
This DDB signal indicates that the frequency is below 40Hz		
408	Stop Freq Track	DDB_FREQ_STOP_TRACK
This DDB signal stops frequency Tracking		
409	Start N	DDB_EF_START
This DDB signal is the composite EF Start signal used in the FSL		
411	Freq Not Found	DDB_FREQ_NOT_FOUND
This DDB signal indicates that no frequency has been found		
439	Ext AR Prot Trip	DDB_EXT_AR_PROT_TRIP
This DDB can initiate an Autoreclose sequence from an external trip		
440	Ext AR Prot Strt	DDB_EXT_AR_PROT_START
This DDB informs the Autoreclose function of an external start		
441	Test Mode	DDB_TEST_MODE
This DDB signal initiates the test mode		
443	Live Line	DDB_SYSCHECKS_LINE_LIVE
This DDB signal indicates a Live Line		
444	Dead Line	DDB_SYSCHECKS_LINE_DEAD
This DDB signal indicates a Dead Line		
445	Live Bus	DDB_SYSCHECKS_BUS_LIVE
This DDB signal indicates a Live Bus		
446	Dead Bus	DDB_SYSCHECKS_BUS_DEAD
This DDB signal indicates a Dead Bus		
447	Check Sync 1 OK	DDB_CHECKSYNC_1_OK
This DDB signal indicates that Check Synchronism stage 1 (CS1) is OK		
448	Check Sync 2 OK	DDB_CHECKSYNC_2_OK
This DDB signal indicates that Check Synchronism stage 2 (CS2) is OK		
449	SysChks Inactive	DDB_SYSCHECKS_INACTIVE
This DDB signal indicates that all System Checks are inactive		
450	CS1 Enabled	DDB_CHECKSYNC_1_ENABLED
This DDB signal enables CS1		
451	CS2 Enabled	DDB_CHECKSYNC_2_ENABLED
This DDB signal enables CS2		
452	SysSplit Enabled	DDB_SYSTEM_SPLIT_ENABLED
This DDB signal enables System Split		
453	DAR Complete	DDB_DAR_COMPLETE
This DDB signal resets the AR in Progress 1 signal		
454	CB in Service	DDB_CB_IN_SERVICE
This DDB signal indicates that the Circuit Breaker is in service		
455	AR Restart	DDB_AR_RESTART
This DDB signal triggers a Restart of the Autoreclose initiation process		
456	DAR In Progress	DDB_AR_IP_1
This DDB signal indicates that delayed Auto-Reclose is in progress		
457	DeadTime Enabled	DDB_DEADTIME_ENABLE
This DDB signal enables the Dead Time timers		
458	DT OK To Start	DDB_DEADTIME_OK_TO_START
This DDB signal tells the AR that it is OK to start the Autoreclose Dead Timer.		
459	DT Complete	DDB_DEADTIME_COMPLETE
This DDB signal indicates that the Autoreclose Dead Time is complete		
460	Reclose Checks	DDB_ARCHECKS_IN_PROGRESS
This DDB signal indicates that Autoreclose system checks are in progress		
461	LiveDead Ccts OK	DDB_AR_LIVEDEAD_CCTS_OK
This DDB informs the AR function that there is a Live/Dead circuit condition		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
462	AR Sync Check	DDB_AR_SYNC_CHECK
This DDB signal indicates that the Autoreclose Synchronisation Check is OK		
463	AR SysChecks OK	DDB_AR_SYSTEMCHECKS_OK
This DDB signal indicates that the Autoreclose System Checks are is OK		
464	AR Init TripTest	DDB_INIT_AR_TRIP_TEST
This DDB signal initiates an Autoreclose trip test.		
465	103 MonitorBlock	DDB_MONITOR_BLOCKING
This DDB signal enables the Monitor Blocking for the IEC60870-103 protocol		
466	103 CommandBlock	DDB_COMMAND_BLOCKING
This DDB signal enables the Command Blocking for the IEC60870-103 protocol		
471	CS1 Slipfreq>	DDB_CS1_SLIP_ABOVE_SETTING
This DDB signal indicates that the CS1 Slip frequency is above the set threshold		
472	CS1 Slipfreq<	DDB_CS1_SLIP_BELOW_SETTING
This DDB signal indicates that the CS1 Slip frequency is below the set threshold		
473	CS2 Slipfreq>	DDB_CS2_SLIP_ABOVE_SETTING
This DDB signal indicates that the CS2 Slip frequency is above the set threshold		
474	CS2 Slipfreq<	DDB_CS2_SLIP_BELOW_SETTING
This DDB signal indicates that the CS2 Slip frequency is below the set threshold		
476	Ext AR SEF Trip	DDB_EXT_AR_SEF_PROT_TRIP
External Initiate SEF AR Protection Trip		
477	Ext AR SEF Start	DDB_EXT_AR_SEF_PROT_START
External Initiate SEF AR Protection Start		
479	VN> Inhibit	DDB_RESOV_INHIBIT
VN> Inhibit		
480	VN> Inhibit	DDB_RESUV_INHIBIT
VN< Inhibit		
489	CS Vline<	DDB_SYSCHECKS_VLINE_UV
This DDB signal indicates that the line voltage is less than the Check Synchronism Undervoltage threshold		
490	CS Vbus<	DDB_SYSCHECKS_VBUS_UV
This DDB signal indicates that the bus voltage is less than the Check Synchronism Undervoltage threshold		
491	CS Vline>	DDB_SYSCHECKS_VLINE_OV
This DDB signal indicates that the line voltage is more than the Check Synchronism Overvoltage threshold		
492	CS Vbus>	DDB_SYSCHECKS_VBUS_OV
This DDB signal indicates that the bus voltage is more than the Check Synchronism Overvoltage threshold		
493	CS Vline>Vbus	DDB_SYSCHECKS_VLINE_DIFF_HIGH
This DDB signal indicates that the line voltage is greater than the bus voltage + the CS diff voltage setting		
494	CS Vline<Vbus	DDB_SYSCHECKS_VBUS_DIFF_HIGH
This DDB signal indicates that the bus voltage is greater than the line voltage + the CS diff voltage setting		
495	CS1 Fline>Fbus	DDB_CS1_LINE_FREQ_GT_BUS_FREQ
This DDB signal indicates that the line frequency is greater than the bus frequency + the CS1 slip frequency setting		
496	CS1 Fline<Fbus	DDB_CS1_LINE_FREQ_LT_BUS_FREQ
This DDB signal indicates that the bus frequency is greater than the line frequency + the CS1 slip frequency setting		
497	CS1 Ang Not OK +	DDB_CS1_ANG_NOT_OK_POS
This DDB signal indicates that the line angle has crossed 0 degrees into the 0 to 180 quadrant.		
498	CS1 Ang Not OK -	DDB_CS1_ANG_NOT_OK_NEG
This DDB signal indicates that the line angle has crossed 0 degrees into the 0 to -180 quadrant.		
517	V2> Accelerate	DDB_ACCELERATE_NPSOV
This DDB reduces the pickup delay of the negative sequence overvoltage function.		
518	Trip LED Trigger	DDB_TRIP_LED_TRIGGER
This DDB triggers the fixed trip LED		
519	CS2 Fline>Fbus	DDB_CS2_LINE_FREQ_GT_BUS_FREQ
This DDB signal indicates that the line frequency is greater than the bus frequency + the CS2 slip frequency setting		
520	CS2 Fline<Fbus	DDB_CS2_LINE_FREQ_LT_BUS_FREQ
This DDB signal indicates that the bus frequency is greater than the line frequency + the CS2 slip frequency setting		
521	CS2 Ang Not OK +	DDB_CS2_ANG_NOT_OK_POS
This DDB signal indicates that the line angle has crossed 0 degrees into the 0 to 180 quadrant.		
522	CS2 Ang Not OK -	DDB_CS2_ANG_NOT_OK_NEG
This DDB signal indicates that the line angle has crossed 0 degrees into the 0 to -180 quadrant.		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
523	CS Ang Rot ACW	DDB_SYSCHECKS_ANG_ACW
This DDB signal indicates that the Line/Bus phase angle is rotating anti-clockwise		
524	CS Ang Rot CW	DDB_SYSCHECKS_ANG_CW
This DDB signal indicates that the Line/Bus phase angle is rotating clockwise		
525	Blk Rmt. CB Ops	DDB_BLOCK_REMOTE_CB_OPS
This DDB signal blocks remote CB Trip and Close commands.		
526	SG Select x1	DDB_SG_SELECTOR_X1
This DDB signal sets the setting group		
527	SG Select 1x	DDB_SG_SELECTOR_1X
This DDB signal sets the setting group		
530	AR Skip Shot 1	DDB_AR_SKIP_SHOT_1
This DDB signal forces the Autoreclose function to skip shot 1 of a reclose sequence.		
531	Logic 0 Ref.	DDB_LOGIC_0
This DDB signal is a logic 0 for use in the programmable scheme logic. It never changes state.		
532	Inh Reclaim Time	DDB_AR_INHIBIT_RECLAIM_TIME
This DDB signal inhibits the Autoreclose Reclaim Timer		
533	Reclaim In Prog	DDB_AR_RECLAIM_IN_PROGRESS
This DDB signal indicates that the Autoreclose Reclaim Time is in progress		
534	Reclaim Complete	DDB_AR_RECLAIM_TIME_COMPLETE
This DDB signal indicates that the Autoreclose Reclaim Time is complete		
536	Trip Command In	DDB_ANY_TRIP
This DDB signal is the Trip Command In signal, which triggers the fixed trip LED and is mapped to the Trip Command Out signal in the FSL.		
537	Trip Command Out	DDB_TRIP_INITIATE
This is the Trip Command Out signal, which is mapped to the trip relay in the default PSL		
542	RP1 Read Only	DDB_RP1_READ_ONLY
This DDB signal enables Read-only mode for rear port 1 (RP1)		
543	RP2 Read Only	DDB_RP2_READ_ONLY
This DDB signal enables Read-only mode for the optional rear port 2 (RP2)		
544	NIC Read Only	DDB_NIC_READ_ONLY
This DDB signal enables Read-only mode for the optional network interface Card (NIC)		
545	dv/dt1 StartA/AB	DDB_DVDT_1_PH_A_START
This DDB signal is the first stage dv/dt start signal for phase A-N or A-B		
546	dv/dt1 StartB/BC	DDB_DVDT_1_PH_B_START
This DDB signal is the first stage dv/dt start signal for phase B-N or B-C		
547	dv/dt1 StartC/CA	DDB_DVDT_1_PH_C_START
This DDB signal is the first stage dv/dt start signal for phase C-N or C-A		
548	dv/dt1 Start	DDB_DVDT_1_START
This DDB signal is the first stage dv/dt start signal for any phase or three-phase (select with setting).		
549	dv/dt2 StartA/AB	DDB_DVDT_2_PH_A_START
This DDB signal is the second stage dv/dt start signal for phase A-N or A-B		
550	dv/dt2 StartB/BC	DDB_DVDT_2_PH_B_START
This DDB signal is the second stage dv/dt start signal for phase B-N or B-C		
551	dv/dt2 StartC/CA	DDB_DVDT_2_PH_C_START
This DDB signal is the second stage dv/dt start signal for phase C-N or C-A		
552	dv/dt2 Start	DDB_DVDT_2_START
This DDB signal is the second stage dv/dt start signal for any phase or three-phase (select with setting).		
553	dv/dt1 Trip A/AB	DDB_DVDT_1_PH_A_TRIP
This DDB signal is the first stage dv/dt trip signal for phase A-N or A-B		
554	dv/dt1 Trip B/BC	DDB_DVDT_1_PH_B_TRIP
This DDB signal is the first stage dv/dt trip signal for phase B-N or B-C		
555	dv/dt1 Trip C/CA	DDB_DVDT_1_PH_C_TRIP
This DDB signal is the first stage dv/dt trip signal for phase C-N or C-A		
556	dv/dt1 Trip	DDB_DVDT_1_TRIP
This DDB signal is the first stage dv/dt trip signal for any phase or three-phase (select with setting).		
557	dv/dt2 Trip A/AB	DDB_DVDT_2_PH_A_TRIP
This DDB signal is the second stage dv/dt trip signal for phase A-N or A-B		
558	dv/dt2 Trip B/BC	DDB_DVDT_2_PH_B_TRIP
This DDB signal is the second stage dv/dt trip signal for phase B-N or B-C		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
559	dv/dt2 Trip C/CA	DDB_DVDT_2_PH_C_TRIP
This DDB signal is the second stage dv/dt trip signal for phase C-N or C-A		
560	dv/dt2 Trip	DDB_DVDT_2_TRIP
This DDB signal is the second stage dv/dt trip signal for any phase or three-phase (select with setting).		
561	dv/dt1 Blocking	DDB_DVDT_1_BLOCK
This DDB signal blocks the first stage dv/dt protection.		
562	dv/dt2 Blocking	DDB_DVDT_2_BLOCK
This DDB signal blocks the second stage dv/dt protection.		
587	dv/dt3 StartA/AB	DDB_DVDT_3_PH_A_START
This DDB signal is the third stage dv/dt start signal for phase A-N or A-B		
588	dv/dt3 StartB/BC	DDB_DVDT_3_PH_B_START
This DDB signal is the third stage dv/dt start signal for phase B-N or B-C		
589	dv/dt3 StartC/CA	DDB_DVDT_3_PH_C_START
This DDB signal is the third stage dv/dt start signal for phase C-N or C-A		
590	dv/dt3 Start	DDB_DVDT_3_START
This DDB signal is the third stage dv/dt start signal for any phase or three-phase (select with setting).		
591	dv/dt4 StartA/AB	DDB_DVDT_4_PH_A_START
This DDB signal is the fourth stage dv/dt start signal for phase A-N or A-B		
592	dv/dt4 StartB/BC	DDB_DVDT_4_PH_B_START
This DDB signal is the fourth stage dv/dt start signal for phase B-N or B-C		
593	dv/dt4 StartC/CA	DDB_DVDT_4_PH_C_START
This DDB signal is the fourth stage dv/dt start signal for phase C-N or C-A		
594	dv/dt4 Start	DDB_DVDT_4_START
This DDB signal is the fourth stage dv/dt start signal for any phase or three-phase (select with setting).		
595	dv/dt3 Trip A/AB	DDB_DVDT_3_PH_A_TRIP
This DDB signal is the third stage dv/dt trip signal for phase A-N or A-B		
596	dv/dt3 Trip B/BC	DDB_DVDT_3_PH_B_TRIP
This DDB signal is the third stage dv/dt trip signal for phase B-N or B-C		
597	dv/dt3 Trip C/CA	DDB_DVDT_3_PH_C_TRIP
This DDB signal is the third stage dv/dt trip signal for phase C-N or C-A		
598	dv/dt3 Trip	DDB_DVDT_3_TRIP
This DDB signal is the third stage dv/dt trip signal for any phase or three-phase (select with setting).		
599	dv/dt4 Trip A/AB	DDB_DVDT_4_PH_A_TRIP
This DDB signal is the fourth stage dv/dt trip signal for phase A-N or A-B		
600	dv/dt4 Trip B/BC	DDB_DVDT_4_PH_B_TRIP
This DDB signal is the fourth stage dv/dt trip signal for phase B-N or B-C		
601	dv/dt4 Trip C/CA	DDB_DVDT_4_PH_C_TRIP
This DDB signal is the fourth stage dv/dt trip signal for phase C-N or C-A		
602	dv/dt4 Trip	DDB_DVDT_4_TRIP
This DDB signal is the fourth stage dv/dt trip signal for any phase or three-phase (select with setting).		
603	dv/dt3 Blocking	DDB_DVDT_3_BLOCK
This DDB signal blocks the third stage dv/dt protection.		
604	dv/dt4 Blocking	DDB_DVDT_4_BLOCK
This DDB signal blocks the fourth stage dv/dt protection.		
605	VN>3 Start	DDB_RESOV_3_START
This DDB signal is the third stage Residual Overvoltage start signal		
606	VN>3 Trip	DDB_RESOV_3_TRIP
This DDB signal is the third stage Residual Overvoltage trip signal		
607	VN>3 Timer Blk	DDB_RESOV_3_TIMER_BLOCK
This DDB signal blocks the third stage Residual Overvoltage time delay		
608	V<3 Start	DDB_PUV_3_3PH_START
This DDB signal is the third stage three-phase or any-phase Phase Undervoltage start signal		
609	V<3 Start A/AB	DDB_PUV_3_PH_A_START
This DDB signal is the third stage A-phase Phase Undervoltage start signal		
610	V<3 Start B/BC	DDB_PUV_3_PH_B_START
This DDB signal is the third stage B-phase Phase Undervoltage start signal		
611	V<3 Start C/CA	DDB_PUV_3_PH_C_START
This DDB signal is the third stage C-phase Phase Undervoltage start signal		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
612	V<3 Trip	DDB_PUV_3_3PH_TRIP
This DDB signal is the first stage three-phase or any-phase Phase Undervoltage trip signal		
613	V<3 Trip A/AB	DDB_PUV_3_PH_A_TRIP
This DDB signal is the first stage A-phase Phase Undervoltage trip signal		
614	V<3 Trip B/BC	DDB_PUV_3_PH_B_TRIP
This DDB signal is the first stage B-phase Phase Undervoltage trip signal		
615	V<3 Trip C/CA	DDB_PUV_3_PH_C_TRIP
This DDB signal is the first stage C-phase Phase Undervoltage trip signal		
616	V>3 Start	DDB_POV_3_3PH_START
This DDB signal is the third stage three-phase or any-phase Phase Overvoltage start signal		
617	V>3 Start A/AB	DDB_POV_3_PH_A_START
This DDB signal is the third stage A-phase Phase Overvoltage start signal		
618	V>3 Start B/BC	DDB_POV_3_PH_B_START
This DDB signal is the third stage B-phase Phase Overvoltage start signal		
619	V>3 Start C/CA	DDB_POV_3_PH_C_START
This DDB signal is the third stage C-phase Phase Overvoltage start signal		
620	V>3 Trip	DDB_POV_3_3PH_TRIP
This DDB signal is the first stage three-phase or any-phase Phase Overvoltage trip signal		
621	V>3 Trip A/AB	DDB_POV_3_PH_A_TRIP
This DDB signal is the first stage A-phase Phase Overvoltage trip signal		
622	V>3 Trip B/BC	DDB_POV_3_PH_B_TRIP
This DDB signal is the first stage B-phase Phase Overvoltage trip signal		
623	V>3 Trip C/CA	DDB_POV_3_PH_C_TRIP
This DDB signal is the first stage C-phase Phase Overvoltage trip signal		
624	V<3 Timer Block	DDB_PUV_3_TIMER_BLOCK
This DDB signal blocks the third stage Phase Undervoltage time delay		
625	V>3 Timer Block	DDB_POV_3_TIMER_BLOCK
This DDB signal blocks the third stage Phase Overvoltage time delay		
640	LED1 Red	DDB_OUTPUT_TRI_LED_1_RED
DDB signal indicates that the red LED is active		
641	LED1 Grn	DDB_OUTPUT_TRI_LED_1_GRN
DDB signal indicates that the green LED is active		
642	LED2 Red	DDB_OUTPUT_TRI_LED_2_RED
DDB signal indicates that the red LED is active		
643	LED2 Grn	DDB_OUTPUT_TRI_LED_2_GRN
DDB signal indicates that the green LED is active		
644	LED3 Red	DDB_OUTPUT_TRI_LED_3_RED
DDB signal indicates that the red LED is active		
645	LED3 Grn	DDB_OUTPUT_TRI_LED_3_GRN
DDB signal indicates that the green LED is active		
646	LED4 Red	DDB_OUTPUT_TRI_LED_4_RED
DDB signal indicates that the red LED is active		
647	LED4 Grn	DDB_OUTPUT_TRI_LED_4_GRN
DDB signal indicates that the green LED is active		
648	LED5 Red(30TE)	DDB_OUTPUT_TRI_LED_5_RED
DDB signal indicates that the red LED is active		
649	LED5 Grn(30TE)	DDB_OUTPUT_TRI_LED_5_GRN
DDB signal indicates that the green LED is active		
650	LED6 Red(30TE)	DDB_OUTPUT_TRI_LED_6_RED
DDB signal indicates that the red LED is active		
651	LED6 Grn(30TE)	DDB_OUTPUT_TRI_LED_6_GRN
DDB signal indicates that the green LED is active		
652	LED7 Red(30TE)	DDB_OUTPUT_TRI_LED_7_RED
DDB signal indicates that the red LED is active		
653	LED7 Grn(30TE)	DDB_OUTPUT_TRI_LED_7_GRN
DDB signal indicates that the green LED is active		
654	LED8 Red(30TE)	DDB_OUTPUT_TRI_LED_8_RED
DDB signal indicates that the red LED is active		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
655	LED8 Grn(30TE)	DDB_OUTPUT_TRI_LED_8_GRN
DDB signal indicates that the green LED is active		
656	FnKey LED1 Red	DDB_OUTPUT_TRI_LED_9_RED
DDB signal indicates that the red Function Key LED is active		
657	FnKey LED1 Grn	DDB_OUTPUT_TRI_LED_9_GRN
DDB signal indicates that the green Function Key LED is active		
658	FnKey LED2 Red	DDB_OUTPUT_TRI_LED_10_RED
DDB signal indicates that the red Function Key LED is active		
659	FnKey LED2 Grn	DDB_OUTPUT_TRI_LED_10_GRN
DDB signal indicates that the green Function Key LED is active		
660	FnKey LED3 Red	DDB_OUTPUT_TRI_LED_11_RED
DDB signal indicates that the red Function Key LED is active		
661	FnKey LED3 Grn	DDB_OUTPUT_TRI_LED_11_GRN
DDB signal indicates that the green Function Key LED is active		
676	LED1 Con R	DDB_TRI_LED_RED_CON_1
This DDB signal drives the red LED Conditioner 1		
677	LED1 Con G	DDB_TRI_LED_GRN_CON_1
This DDB signal drives the green LED Conditioner 1		
678	LED2 Con R	DDB_TRI_LED_RED_CON_2
This DDB signal drives the red LED Conditioner 2		
679	LED2 Con G	DDB_TRI_LED_GRN_CON_2
This DDB signal drives the green LED Conditioner 2		
680	LED3 Con R	DDB_TRI_LED_RED_CON_3
This DDB signal drives the red LED Conditioner 3		
681	LED3 Con G	DDB_TRI_LED_GRN_CON_3
This DDB signal drives the green LED Conditioner 3		
682	LED4 Con R	DDB_TRI_LED_RED_CON_4
This DDB signal drives the red LED Conditioner 4		
683	LED4 Con G	DDB_TRI_LED_GRN_CON_4
This DDB signal drives the green LED Conditioner 4		
684	LED5 Con R(30TE)	DDB_TRI_LED_RED_CON_5
This DDB signal drives the red LED Conditioner 5		
685	LED5 Con G(30TE)	DDB_TRI_LED_GRN_CON_5
This DDB signal drives the green LED Conditioner 5		
686	LED6 Con R(30TE)	DDB_TRI_LED_RED_CON_6
This DDB signal drives the red LED Conditioner 6		
687	LED6 Con G(30TE)	DDB_TRI_LED_GRN_CON_6
This DDB signal drives the green LED Conditioner 6		
688	LED7 Con R(30TE)	DDB_TRI_LED_RED_CON_7
This DDB signal drives the red LED Conditioner 7		
689	LED7 Con G(30TE)	DDB_TRI_LED_GRN_CON_7
This DDB signal drives the green LED Conditioner 7		
690	LED8 Con R(30TE)	DDB_TRI_LED_RED_CON_8
This DDB signal drives the red LED Conditioner 8		
691	LED8 Con G(30TE)	DDB_TRI_LED_GRN_CON_8
This DDB signal drives the green LED Conditioner 8		
692	FnKey LED1 ConR	DDB_TRI_LED_RED_CON_9
This DDB signal drives the red Function Key LED Conditioner 1		
693	FnKey LED1 ConG	DDB_TRI_LED_GRN_CON_9
This DDB signal drives the green Function Key LED Conditioner 1		
694	FnKey LED2 ConR	DDB_TRI_LED_RED_CON_10
This DDB signal drives the red Function Key LED Conditioner 2		
695	FnKey LED2 ConG	DDB_TRI_LED_GRN_CON_10
This DDB signal drives the green Function Key LED Conditioner 2		
696	FnKey LED3 ConR	DDB_TRI_LED_RED_CON_11
This DDB signal drives the red Function Key LED Conditioner 3		
697	FnKey LED3 ConG	DDB_TRI_LED_GRN_CON_11
This DDB signal drives the red Function Key LED Conditioner 3		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
712	Function Key 1	DDB_FN_KEY_1
DDB signal indicates that Function key 1 is active		
713	Function Key 2	DDB_FN_KEY_2
DDB signal indicates that Function key 2 is active		
714	Function Key 3	DDB_FN_KEY_3
DDB signal indicates that Function key 3 is active		
762	Vdc1 Start	DDB_ZONE_1_VDC_START
This DDB signal is the DC Supply Monitoring Zone 1 Start signal		
763	Vdc2 Start	DDB_ZONE_2_VDC_START
This DDB signal is the DC Supply Monitoring Zone 2 Start signal		
764	Vdc3 Start	DDB_ZONE_3_VDC_START
This DDB signal is the DC Supply Monitoring Zone 3 Start signal		
765	Vdc1 Trip	DDB_ZONE_1_VDC_TRIP
This DDB signal is the DC Supply Monitoring Zone 1 Trip signal		
766	Vdc2 Trip	DDB_ZONE_2_VDC_TRIP
This DDB signal is the DC Supply Monitoring Zone 2 Trip signal		
767	Vdc3 Trip	DDB_ZONE_3_VDC_TRIP
This DDB signal is the DC Supply Monitoring Zone 3 Trip signal		
768	InhibitDC SupMon	DDB_DC_SUPPLY_MON_INHIBIT
This DDB signal is the DC Supply Monitoring Inhibit Signal		
769	DC Supply Fail	DDB_DC_SUPPLY_MON_ALARM
This DDB signal is the DC Supply Monitoring Alarm Signal		
771	GOOSE IED Absent	DDB_GOOSE_MISSING_IED_ALARM
This is a GOOSE alarm indicating that the IED is absent.		
780	IP Addr Conflict	DDB_IP_ADDRESS_CONFLICT_ALARM
This DDB signal indicates that there is an IP Address conflict		
781	Port A Link Fail	DDB_NIC_LINK_PORT_A_FAIL_ALARM
This DDB signal indicates that Port A has no link		
782	Port B Link Fail	DDB_NIC_LINK_PORT_B_FAIL_ALARM
This DDB signal indicates that Port B has no link		
783	DREB Set.Invalid	DDB_NIC_SETTING_INVALID_ALARM
This DDB signal indicates that the redundancy settings are not valid for this IED model no		
788	SNTP Failure	DDB_SNTP_FAIL_ALARM
SNTP Alarm		
790	PTP Failure	DDB_PTP_FAIL_ALARM
IEEE 1588 PTP time synchronisation failure alarm		
800	Control Input 1	DDB_CONTROL_1
This DDB signal is a control input signal		
801	Control Input 2	DDB_CONTROL_2
This DDB signal is a control input signal		
802	Control Input 3	DDB_CONTROL_3
This DDB signal is a control input signal		
803	Control Input 4	DDB_CONTROL_4
This DDB signal is a control input signal		
804	Control Input 5	DDB_CONTROL_5
This DDB signal is a control input signal		
805	Control Input 6	DDB_CONTROL_6
This DDB signal is a control input signal		
806	Control Input 7	DDB_CONTROL_7
This DDB signal is a control input signal		
807	Control Input 8	DDB_CONTROL_8
This DDB signal is a control input signal		
808	Control Input 9	DDB_CONTROL_9
This DDB signal is a control input signal		
809	Control Input 10	DDB_CONTROL_10
This DDB signal is a control input signal		
810	Control Input 11	DDB_CONTROL_11
This DDB signal is a control input signal		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
811	Control Input 12	DDB_CONTROL_12
This DDB signal is a control input signal		
812	Control Input 13	DDB_CONTROL_13
This DDB signal is a control input signal		
813	Control Input 14	DDB_CONTROL_14
This DDB signal is a control input signal		
814	Control Input 15	DDB_CONTROL_15
This DDB signal is a control input signal		
815	Control Input 16	DDB_CONTROL_16
This DDB signal is a control input signal		
816	Control Input 17	DDB_CONTROL_17
This DDB signal is a control input signal		
817	Control Input 18	DDB_CONTROL_18
This DDB signal is a control input signal		
818	Control Input 19	DDB_CONTROL_19
This DDB signal is a control input signal		
819	Control Input 20	DDB_CONTROL_20
This DDB signal is a control input signal		
820	Control Input 21	DDB_CONTROL_21
This DDB signal is a control input signal		
821	Control Input 22	DDB_CONTROL_22
This DDB signal is a control input signal		
822	Control Input 23	DDB_CONTROL_23
This DDB signal is a control input signal		
823	Control Input 24	DDB_CONTROL_24
This DDB signal is a control input signal		
824	Control Input 25	DDB_CONTROL_25
This DDB signal is a control input signal		
825	Control Input 26	DDB_CONTROL_26
This DDB signal is a control input signal		
826	Control Input 27	DDB_CONTROL_27
This DDB signal is a control input signal		
827	Control Input 28	DDB_CONTROL_28
This DDB signal is a control input signal		
828	Control Input 29	DDB_CONTROL_29
This DDB signal is a control input signal		
829	Control Input 30	DDB_CONTROL_30
This DDB signal is a control input signal		
830	Control Input 31	DDB_CONTROL_31
This DDB signal is a control input signal		
831	Control Input 32	DDB_CONTROL_32
This DDB signal is a control input signal		
832	Virtual Input 1	DDB_GOOSEIN_1
This DDB signal is a GOOSE virtual input		
833	Virtual Input 2	DDB_GOOSEIN_2
This DDB signal is a GOOSE virtual input		
834	Virtual Input 3	DDB_GOOSEIN_3
This DDB signal is a GOOSE virtual input		
835	Virtual Input 4	DDB_GOOSEIN_4
This DDB signal is a GOOSE virtual input		
836	Virtual Input 5	DDB_GOOSEIN_5
This DDB signal is a GOOSE virtual input		
837	Virtual Input 6	DDB_GOOSEIN_6
This DDB signal is a GOOSE virtual input		
838	Virtual Input 7	DDB_GOOSEIN_7
This DDB signal is a GOOSE virtual input		
839	Virtual Input 8	DDB_GOOSEIN_8
This DDB signal is a GOOSE virtual input		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
840	Virtual Input 9	DDB_GOOSEIN_9
This DDB signal is a GOOSE virtual input		
841	Virtual Input 10	DDB_GOOSEIN_10
This DDB signal is a GOOSE virtual input		
842	Virtual Input 11	DDB_GOOSEIN_11
This DDB signal is a GOOSE virtual input		
843	Virtual Input 12	DDB_GOOSEIN_12
This DDB signal is a GOOSE virtual input		
844	Virtual Input 13	DDB_GOOSEIN_13
This DDB signal is a GOOSE virtual input		
845	Virtual Input 14	DDB_GOOSEIN_14
This DDB signal is a GOOSE virtual input		
846	Virtual Input 15	DDB_GOOSEIN_15
This DDB signal is a GOOSE virtual input		
847	Virtual Input 16	DDB_GOOSEIN_16
This DDB signal is a GOOSE virtual input		
848	Virtual Input 17	DDB_GOOSEIN_17
This DDB signal is a GOOSE virtual input		
849	Virtual Input 18	DDB_GOOSEIN_18
This DDB signal is a GOOSE virtual input		
850	Virtual Input 19	DDB_GOOSEIN_19
This DDB signal is a GOOSE virtual input		
851	Virtual Input 20	DDB_GOOSEIN_20
This DDB signal is a GOOSE virtual input		
852	Virtual Input 21	DDB_GOOSEIN_21
This DDB signal is a GOOSE virtual input		
853	Virtual Input 22	DDB_GOOSEIN_22
This DDB signal is a GOOSE virtual input		
854	Virtual Input 23	DDB_GOOSEIN_23
This DDB signal is a GOOSE virtual input		
855	Virtual Input 24	DDB_GOOSEIN_24
This DDB signal is a GOOSE virtual input		
856	Virtual Input 25	DDB_GOOSEIN_25
This DDB signal is a GOOSE virtual input		
857	Virtual Input 26	DDB_GOOSEIN_26
This DDB signal is a GOOSE virtual input		
858	Virtual Input 27	DDB_GOOSEIN_27
This DDB signal is a GOOSE virtual input		
859	Virtual Input 28	DDB_GOOSEIN_28
This DDB signal is a GOOSE virtual input		
860	Virtual Input 29	DDB_GOOSEIN_29
This DDB signal is a GOOSE virtual input		
861	Virtual Input 30	DDB_GOOSEIN_30
This DDB signal is a GOOSE virtual input		
862	Virtual Input 31	DDB_GOOSEIN_31
This DDB signal is a GOOSE virtual input		
863	Virtual Input 32	DDB_GOOSEIN_32
This DDB signal is a GOOSE virtual input		
864	Virtual Input 33	DDB_GOOSEIN_33
This DDB signal is a GOOSE virtual input		
865	Virtual Input 34	DDB_GOOSEIN_34
This DDB signal is a GOOSE virtual input		
866	Virtual Input 35	DDB_GOOSEIN_35
This DDB signal is a GOOSE virtual input		
867	Virtual Input 36	DDB_GOOSEIN_36
This DDB signal is a GOOSE virtual input		
868	Virtual Input 37	DDB_GOOSEIN_37
This DDB signal is a GOOSE virtual input		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
869	Virtual Input 38	DDB_GOOSEIN_38
This DDB signal is a GOOSE virtual input		
870	Virtual Input 39	DDB_GOOSEIN_39
This DDB signal is a GOOSE virtual input		
871	Virtual Input 40	DDB_GOOSEIN_40
This DDB signal is a GOOSE virtual input		
872	Virtual Input 41	DDB_GOOSEIN_41
This DDB signal is a GOOSE virtual input		
873	Virtual Input 42	DDB_GOOSEIN_42
This DDB signal is a GOOSE virtual input		
874	Virtual Input 43	DDB_GOOSEIN_43
This DDB signal is a GOOSE virtual input		
875	Virtual Input 44	DDB_GOOSEIN_44
This DDB signal is a GOOSE virtual input		
876	Virtual Input 45	DDB_GOOSEIN_45
This DDB signal is a GOOSE virtual input		
877	Virtual Input 46	DDB_GOOSEIN_46
This DDB signal is a GOOSE virtual input		
878	Virtual Input 47	DDB_GOOSEIN_47
This DDB signal is a GOOSE virtual input		
879	Virtual Input 48	DDB_GOOSEIN_48
This DDB signal is a GOOSE virtual input		
880	Virtual Input 49	DDB_GOOSEIN_49
This DDB signal is a GOOSE virtual input		
881	Virtual Input 50	DDB_GOOSEIN_50
This DDB signal is a GOOSE virtual input		
882	Virtual Input 51	DDB_GOOSEIN_51
This DDB signal is a GOOSE virtual input		
883	Virtual Input 52	DDB_GOOSEIN_52
This DDB signal is a GOOSE virtual input		
884	Virtual Input 53	DDB_GOOSEIN_53
This DDB signal is a GOOSE virtual input		
885	Virtual Input 54	DDB_GOOSEIN_54
This DDB signal is a GOOSE virtual input		
886	Virtual Input 55	DDB_GOOSEIN_55
This DDB signal is a GOOSE virtual input		
887	Virtual Input 56	DDB_GOOSEIN_56
This DDB signal is a GOOSE virtual input		
888	Virtual Input 57	DDB_GOOSEIN_57
This DDB signal is a GOOSE virtual input		
889	Virtual Input 58	DDB_GOOSEIN_58
This DDB signal is a GOOSE virtual input		
890	Virtual Input 59	DDB_GOOSEIN_59
This DDB signal is a GOOSE virtual input		
891	Virtual Input 60	DDB_GOOSEIN_60
This DDB signal is a GOOSE virtual input		
892	Virtual Input 61	DDB_GOOSEIN_61
This DDB signal is a GOOSE virtual input		
893	Virtual Input 62	DDB_GOOSEIN_62
This DDB signal is a GOOSE virtual input		
894	Virtual Input 63	DDB_GOOSEIN_63
This DDB signal is a GOOSE virtual input		
895	Virtual Input 64	DDB_GOOSEIN_64
This DDB signal is a GOOSE virtual input		
923		DDB_PSLINT_1
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
924		DDB_PSLINT_2
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
925		DDB_PSLINT_3
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
926		DDB_PSLINT_4
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
927		DDB_PSLINT_5
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
928		DDB_PSLINT_6
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
929		DDB_PSLINT_7
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
930		DDB_PSLINT_8
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
931		DDB_PSLINT_9
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
932		DDB_PSLINT_10
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
933		DDB_PSLINT_11
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
934		DDB_PSLINT_12
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
935		DDB_PSLINT_13
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
936		DDB_PSLINT_14
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
937		DDB_PSLINT_15
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
938		DDB_PSLINT_16
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
939		DDB_PSLINT_17
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
940		DDB_PSLINT_18
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
941		DDB_PSLINT_19
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
942		DDB_PSLINT_20
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
943		DDB_PSLINT_21
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
944		DDB_PSLINT_22
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
945		DDB_PSLINT_23
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
946		DDB_PSLINT_24
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
947		DDB_PSLINT_25
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
948		DDB_PSLINT_26
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
949		DDB_PSLINT_27
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
950		DDB_PSLINT_28
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
951		DDB_PSLINT_29
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
952		DDB_PSLINT_30
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
953		DDB_PSLINT_31
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
954		DDB_PSLINT_32
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
955		DDB_PSLINT_33
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
956		DDB_PSLINT_34
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
957		DDB_PSLINT_35
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
958		DDB_PSLINT_36
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
959		DDB_PSLINT_37
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
960		DDB_PSLINT_38
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
961		DDB_PSLINT_39
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
962		DDB_PSLINT_40
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
963		DDB_PSLINT_41
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
964		DDB_PSLINT_42
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
965		DDB_PSLINT_43
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
966		DDB_PSLINT_44
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
967		DDB_PSLINT_45
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
968		DDB_PSLINT_46
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
969		DDB_PSLINT_47
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
970		DDB_PSLINT_48
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
971		DDB_PSLINT_49
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
972		DDB_PSLINT_50
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
973		DDB_PSLINT_51
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
974		DDB_PSLINT_52
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
975		DDB_PSLINT_53
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
976		DDB_PSLINT_54
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
977		DDB_PSLINT_55
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
978		DDB_PSLINT_56
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
979		DDB_PSLINT_57
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
980		DDB_PSLINT_58
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
981		DDB_PSLINT_59
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
982		DDB_PSLINT_60
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
983		DDB_PSLINT_61
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
984		DDB_PSLINT_62
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
985		DDB_PSLINT_63
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
986		DDB_PSLINT_64
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
987		DDB_PSLINT_65
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
988		DDB_PSLINT_66
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
989		DDB_PSLINT_67
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
990		DDB_PSLINT_68
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
991		DDB_PSLINT_69
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
992		DDB_PSLINT_70
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
993		DDB_PSLINT_71
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
994		DDB_PSLINT_72
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
995		DDB_PSLINT_73
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
996		DDB_PSLINT_74
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
997		DDB_PSLINT_75
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
998		DDB_PSLINT_76
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
999		DDB_PSLINT_77
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1000		DDB_PSLINT_78
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1001		DDB_PSLINT_79
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1002		DDB_PSLINT_80
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1003		DDB_PSLINT_81
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1004		DDB_PSLINT_82
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1005		DDB_PSLINT_83
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1006		DDB_PSLINT_84
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1007		DDB_PSLINT_85
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1008		DDB_PSLINT_86
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1009		DDB_PSLINT_87
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1010		DDB_PSLINT_88
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1011		DDB_PSLINT_89
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1012		DDB_PSLINT_90
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1013		DDB_PSLINT_91
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1014		DDB_PSLINT_92
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1015		DDB_PSLINT_93
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1016		DDB_PSLINT_94
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1017		DDB_PSLINT_95
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1018		DDB_PSLINT_96
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1019		DDB_PSLINT_97
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1020		DDB_PSLINT_98
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1021		DDB_PSLINT_99
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1022		DDB_PSLINT_100
This DDB signal is assigned to a PSL node used internally, and is defined by the Programmable Scheme Logic		
1024	Virtual Output 1	DDB_GOOSEOUT_1
This DDB signal is a GOOSE virtual output		
1025	Virtual Output 2	DDB_GOOSEOUT_2
This DDB signal is a GOOSE virtual output		
1026	Virtual Output 3	DDB_GOOSEOUT_3
This DDB signal is a GOOSE virtual output		
1027	Virtual Output 4	DDB_GOOSEOUT_4
This DDB signal is a GOOSE virtual output		
1028	Virtual Output 5	DDB_GOOSEOUT_5
This DDB signal is a GOOSE virtual output		
1029	Virtual Output 6	DDB_GOOSEOUT_6
This DDB signal is a GOOSE virtual output		
1030	Virtual Output 7	DDB_GOOSEOUT_7
This DDB signal is a GOOSE virtual output		
1031	Virtual Output 8	DDB_GOOSEOUT_8
This DDB signal is a GOOSE virtual output		
1032	Virtual Output 9	DDB_GOOSEOUT_9
This DDB signal is a GOOSE virtual output		
1033	Virtual Output10	DDB_GOOSEOUT_10
This DDB signal is a GOOSE virtual output		
1034	Virtual Output11	DDB_GOOSEOUT_11
This DDB signal is a GOOSE virtual output		
1035	Virtual Output12	DDB_GOOSEOUT_12
This DDB signal is a GOOSE virtual output		
1036	Virtual Output13	DDB_GOOSEOUT_13
This DDB signal is a GOOSE virtual output		
1037	Virtual Output14	DDB_GOOSEOUT_14
This DDB signal is a GOOSE virtual output		
1038	Virtual Output15	DDB_GOOSEOUT_15
This DDB signal is a GOOSE virtual output		
1039	Virtual Output16	DDB_GOOSEOUT_16
This DDB signal is a GOOSE virtual output		
1040	Virtual Output17	DDB_GOOSEOUT_17
This DDB signal is a GOOSE virtual output		
1041	Virtual Output18	DDB_GOOSEOUT_18
This DDB signal is a GOOSE virtual output		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1042	Virtual Output19	DDB_GOOSEOUT_19
This DDB signal is a GOOSE virtual output		
1043	Virtual Output20	DDB_GOOSEOUT_20
This DDB signal is a GOOSE virtual output		
1044	Virtual Output21	DDB_GOOSEOUT_21
This DDB signal is a GOOSE virtual output		
1045	Virtual Output22	DDB_GOOSEOUT_22
This DDB signal is a GOOSE virtual output		
1046	Virtual Output23	DDB_GOOSEOUT_23
This DDB signal is a GOOSE virtual output		
1047	Virtual Output24	DDB_GOOSEOUT_24
This DDB signal is a GOOSE virtual output		
1048	Virtual Output25	DDB_GOOSEOUT_25
This DDB signal is a GOOSE virtual output		
1049	Virtual Output26	DDB_GOOSEOUT_26
This DDB signal is a GOOSE virtual output		
1050	Virtual Output27	DDB_GOOSEOUT_27
This DDB signal is a GOOSE virtual output		
1051	Virtual Output28	DDB_GOOSEOUT_28
This DDB signal is a GOOSE virtual output		
1052	Virtual Output29	DDB_GOOSEOUT_29
This DDB signal is a GOOSE virtual output		
1053	Virtual Output30	DDB_GOOSEOUT_30
This DDB signal is a GOOSE virtual output		
1054	Virtual Output31	DDB_GOOSEOUT_31
This DDB signal is a GOOSE virtual output		
1055	Virtual Output32	DDB_GOOSEOUT_32
This DDB signal is a GOOSE virtual output		
1056	Quality VIP 1	DDB_VIP_QUALITY_1
This DDB signal is a GOOSE Virtual input Quality bit		
1057	Quality VIP 2	DDB_VIP_QUALITY_2
This DDB signal is a GOOSE Virtual input Quality bit		
1058	Quality VIP 3	DDB_VIP_QUALITY_3
This DDB signal is a GOOSE Virtual input Quality bit		
1059	Quality VIP 4	DDB_VIP_QUALITY_4
This DDB signal is a GOOSE Virtual input Quality bit		
1060	Quality VIP 5	DDB_VIP_QUALITY_5
This DDB signal is a GOOSE Virtual input Quality bit		
1061	Quality VIP 6	DDB_VIP_QUALITY_6
This DDB signal is a GOOSE Virtual input Quality bit		
1062	Quality VIP 7	DDB_VIP_QUALITY_7
This DDB signal is a GOOSE Virtual input Quality bit		
1063	Quality VIP 8	DDB_VIP_QUALITY_8
This DDB signal is a GOOSE Virtual input Quality bit		
1064	Quality VIP 9	DDB_VIP_QUALITY_9
This DDB signal is a GOOSE Virtual input Quality bit		
1065	Quality VIP 10	DDB_VIP_QUALITY_10
This DDB signal is a GOOSE Virtual input Quality bit		
1066	Quality VIP 11	DDB_VIP_QUALITY_11
This DDB signal is a GOOSE Virtual input Quality bit		
1067	Quality VIP 12	DDB_VIP_QUALITY_12
This DDB signal is a GOOSE Virtual input Quality bit		
1068	Quality VIP 13	DDB_VIP_QUALITY_13
This DDB signal is a GOOSE Virtual input Quality bit		
1069	Quality VIP 14	DDB_VIP_QUALITY_14
This DDB signal is a GOOSE Virtual input Quality bit		
1070	Quality VIP 15	DDB_VIP_QUALITY_15
This DDB signal is a GOOSE Virtual input Quality bit		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1071	Quality VIP 16	DDB_VIP_QUALITY_16
This DDB signal is a GOOSE Virtual input Quality bit		
1072	Quality VIP 17	DDB_VIP_QUALITY_17
This DDB signal is a GOOSE Virtual input Quality bit		
1073	Quality VIP 18	DDB_VIP_QUALITY_18
This DDB signal is a GOOSE Virtual input Quality bit		
1074	Quality VIP 19	DDB_VIP_QUALITY_19
This DDB signal is a GOOSE Virtual input Quality bit		
1075	Quality VIP 20	DDB_VIP_QUALITY_20
This DDB signal is a GOOSE Virtual input Quality bit		
1076	Quality VIP 21	DDB_VIP_QUALITY_21
This DDB signal is a GOOSE Virtual input Quality bit		
1077	Quality VIP 22	DDB_VIP_QUALITY_22
This DDB signal is a GOOSE Virtual input Quality bit		
1078	Quality VIP 23	DDB_VIP_QUALITY_23
This DDB signal is a GOOSE Virtual input Quality bit		
1079	Quality VIP 24	DDB_VIP_QUALITY_24
This DDB signal is a GOOSE Virtual input Quality bit		
1080	Quality VIP 25	DDB_VIP_QUALITY_25
This DDB signal is a GOOSE Virtual input Quality bit		
1081	Quality VIP 26	DDB_VIP_QUALITY_26
This DDB signal is a GOOSE Virtual input Quality bit		
1082	Quality VIP 27	DDB_VIP_QUALITY_27
This DDB signal is a GOOSE Virtual input Quality bit		
1083	Quality VIP 28	DDB_VIP_QUALITY_28
This DDB signal is a GOOSE Virtual input Quality bit		
1084	Quality VIP 29	DDB_VIP_QUALITY_29
This DDB signal is a GOOSE Virtual input Quality bit		
1085	Quality VIP 30	DDB_VIP_QUALITY_30
This DDB signal is a GOOSE Virtual input Quality bit		
1086	Quality VIP 31	DDB_VIP_QUALITY_31
This DDB signal is a GOOSE Virtual input Quality bit		
1087	Quality VIP 32	DDB_VIP_QUALITY_32
This DDB signal is a GOOSE Virtual input Quality bit		
1088	Quality VIP 33	DDB_VIP_QUALITY_33
This DDB signal is a GOOSE Virtual input Quality bit		
1089	Quality VIP 34	DDB_VIP_QUALITY_34
This DDB signal is a GOOSE Virtual input Quality bit		
1090	Quality VIP 35	DDB_VIP_QUALITY_35
This DDB signal is a GOOSE Virtual input Quality bit		
1091	Quality VIP 36	DDB_VIP_QUALITY_36
This DDB signal is a GOOSE Virtual input Quality bit		
1092	Quality VIP 37	DDB_VIP_QUALITY_37
This DDB signal is a GOOSE Virtual input Quality bit		
1093	Quality VIP 38	DDB_VIP_QUALITY_38
This DDB signal is a GOOSE Virtual input Quality bit		
1094	Quality VIP 39	DDB_VIP_QUALITY_39
This DDB signal is a GOOSE Virtual input Quality bit		
1095	Quality VIP 40	DDB_VIP_QUALITY_40
This DDB signal is a GOOSE Virtual input Quality bit		
1096	Quality VIP 41	DDB_VIP_QUALITY_41
This DDB signal is a GOOSE Virtual input Quality bit		
1097	Quality VIP 42	DDB_VIP_QUALITY_42
This DDB signal is a GOOSE Virtual input Quality bit		
1098	Quality VIP 43	DDB_VIP_QUALITY_43
This DDB signal is a GOOSE Virtual input Quality bit		
1099	Quality VIP 44	DDB_VIP_QUALITY_44
This DDB signal is a GOOSE Virtual input Quality bit		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1100	Quality VIP 45	DDB_VIP_QUALITY_45
This DDB signal is a GOOSE Virtual input Quality bit		
1101	Quality VIP 46	DDB_VIP_QUALITY_46
This DDB signal is a GOOSE Virtual input Quality bit		
1102	Quality VIP 47	DDB_VIP_QUALITY_47
This DDB signal is a GOOSE Virtual input Quality bit		
1103	Quality VIP 48	DDB_VIP_QUALITY_48
This DDB signal is a GOOSE Virtual input Quality bit		
1104	Quality VIP 49	DDB_VIP_QUALITY_49
This DDB signal is a GOOSE Virtual input Quality bit		
1105	Quality VIP 50	DDB_VIP_QUALITY_50
This DDB signal is a GOOSE Virtual input Quality bit		
1106	Quality VIP 51	DDB_VIP_QUALITY_51
This DDB signal is a GOOSE Virtual input Quality bit		
1107	Quality VIP 52	DDB_VIP_QUALITY_52
This DDB signal is a GOOSE Virtual input Quality bit		
1108	Quality VIP 53	DDB_VIP_QUALITY_53
This DDB signal is a GOOSE Virtual input Quality bit		
1109	Quality VIP 54	DDB_VIP_QUALITY_54
This DDB signal is a GOOSE Virtual input Quality bit		
1110	Quality VIP 55	DDB_VIP_QUALITY_55
This DDB signal is a GOOSE Virtual input Quality bit		
1111	Quality VIP 56	DDB_VIP_QUALITY_56
This DDB signal is a GOOSE Virtual input Quality bit		
1112	Quality VIP 57	DDB_VIP_QUALITY_57
This DDB signal is a GOOSE Virtual input Quality bit		
1113	Quality VIP 58	DDB_VIP_QUALITY_58
This DDB signal is a GOOSE Virtual input Quality bit		
1114	Quality VIP 59	DDB_VIP_QUALITY_59
This DDB signal is a GOOSE Virtual input Quality bit		
1115	Quality VIP 60	DDB_VIP_QUALITY_60
This DDB signal is a GOOSE Virtual input Quality bit		
1116	Quality VIP 61	DDB_VIP_QUALITY_61
This DDB signal is a GOOSE Virtual input Quality bit		
1117	Quality VIP 62	DDB_VIP_QUALITY_62
This DDB signal is a GOOSE Virtual input Quality bit		
1118	Quality VIP 63	DDB_VIP_QUALITY_63
This DDB signal is a GOOSE Virtual input Quality bit		
1119	Quality VIP 64	DDB_VIP_QUALITY_64
This DDB signal is a GOOSE Virtual input Quality bit		
1120	PubPres VIP 1	DDB_VIP_PUB_PRES_1
GOOSE Virtual input 1 publisher bit		
1121	PubPres VIP 2	DDB_VIP_PUB_PRES_2
GOOSE Virtual input 2 publisher bit		
1122	PubPres VIP 3	DDB_VIP_PUB_PRES_3
GOOSE Virtual input 3 publisher bit		
1123	PubPres VIP 4	DDB_VIP_PUB_PRES_4
GOOSE Virtual input 4 publisher bit		
1124	PubPres VIP 5	DDB_VIP_PUB_PRES_5
GOOSE Virtual input 5 publisher bit		
1125	PubPres VIP 6	DDB_VIP_PUB_PRES_6
GOOSE Virtual input 6 publisher bit		
1126	PubPres VIP 7	DDB_VIP_PUB_PRES_7
GOOSE Virtual input 7 publisher bit		
1127	PubPres VIP 8	DDB_VIP_PUB_PRES_8
GOOSE Virtual input 8 publisher bit		
1128	PubPres VIP 9	DDB_VIP_PUB_PRES_9
GOOSE Virtual input 9 publisher bit		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1129	PubPres VIP 10	DDB_VIP_PUB_PRES_10
GOOSE Virtual input 10 publisher bit		
1130	PubPres VIP 11	DDB_VIP_PUB_PRES_11
GOOSE Virtual input 11 publisher bit		
1131	PubPres VIP 12	DDB_VIP_PUB_PRES_12
GOOSE Virtual input 12 publisher bit		
1132	PubPres VIP 13	DDB_VIP_PUB_PRES_13
GOOSE Virtual input 13 publisher bit		
1133	PubPres VIP 14	DDB_VIP_PUB_PRES_14
GOOSE Virtual input 14 publisher bit		
1134	PubPres VIP 15	DDB_VIP_PUB_PRES_15
GOOSE Virtual input 15 publisher bit		
1135	PubPres VIP 16	DDB_VIP_PUB_PRES_16
GOOSE Virtual input 16 publisher bit		
1136	PubPres VIP 17	DDB_VIP_PUB_PRES_17
GOOSE Virtual input 17 publisher bit		
1137	PubPres VIP 18	DDB_VIP_PUB_PRES_18
GOOSE Virtual input 18 publisher bit		
1138	PubPres VIP 19	DDB_VIP_PUB_PRES_19
GOOSE Virtual input 19 publisher bit		
1139	PubPres VIP 20	DDB_VIP_PUB_PRES_20
GOOSE Virtual input 20 publisher bit		
1140	PubPres VIP 21	DDB_VIP_PUB_PRES_21
GOOSE Virtual input 21 publisher bit		
1141	PubPres VIP 22	DDB_VIP_PUB_PRES_22
GOOSE Virtual input 22 publisher bit		
1142	PubPres VIP 23	DDB_VIP_PUB_PRES_23
GOOSE Virtual input 23 publisher bit		
1143	PubPres VIP 24	DDB_VIP_PUB_PRES_24
GOOSE Virtual input 24 publisher bit		
1144	PubPres VIP 25	DDB_VIP_PUB_PRES_25
GOOSE Virtual input 25 publisher bit		
1145	PubPres VIP 26	DDB_VIP_PUB_PRES_26
GOOSE Virtual input 26 publisher bit		
1146	PubPres VIP 27	DDB_VIP_PUB_PRES_27
GOOSE Virtual input 27 publisher bit		
1147	PubPres VIP 28	DDB_VIP_PUB_PRES_28
GOOSE Virtual input 28 publisher bit		
1148	PubPres VIP 29	DDB_VIP_PUB_PRES_29
GOOSE Virtual input 29 publisher bit		
1149	PubPres VIP 30	DDB_VIP_PUB_PRES_30
GOOSE Virtual input 30 publisher bit		
1150	PubPres VIP 31	DDB_VIP_PUB_PRES_31
GOOSE Virtual input 31 publisher bit		
1151	PubPres VIP 32	DDB_VIP_PUB_PRES_32
GOOSE Virtual input 32 publisher bit		
1152	PubPres VIP 33	DDB_VIP_PUB_PRES_33
GOOSE Virtual input 33 publisher bit		
1153	PubPres VIP 34	DDB_VIP_PUB_PRES_34
GOOSE Virtual input 34 publisher bit		
1154	PubPres VIP 35	DDB_VIP_PUB_PRES_35
GOOSE Virtual input 35 publisher bit		
1155	PubPres VIP 36	DDB_VIP_PUB_PRES_36
GOOSE Virtual input 36 publisher bit		
1156	PubPres VIP 37	DDB_VIP_PUB_PRES_37
GOOSE Virtual input 37 publisher bit		
1157	PubPres VIP 38	DDB_VIP_PUB_PRES_38
GOOSE Virtual input 38 publisher bit		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1158	PubPres VIP 39	DDB_VIP_PUB_PRES_39
GOOSE Virtual input 39 publisher bit		
1159	PubPres VIP 40	DDB_VIP_PUB_PRES_40
GOOSE Virtual input 40 publisher bit		
1160	PubPres VIP 41	DDB_VIP_PUB_PRES_41
GOOSE Virtual input 41 publisher bit		
1161	PubPres VIP 42	DDB_VIP_PUB_PRES_42
GOOSE Virtual input 42 publisher bit		
1162	PubPres VIP 43	DDB_VIP_PUB_PRES_43
GOOSE Virtual input 43 publisher bit		
1163	PubPres VIP 44	DDB_VIP_PUB_PRES_44
GOOSE Virtual input 44 publisher bit		
1164	PubPres VIP 45	DDB_VIP_PUB_PRES_45
GOOSE Virtual input 45 publisher bit		
1165	PubPres VIP 46	DDB_VIP_PUB_PRES_46
GOOSE Virtual input 46publisher bit		
1166	PubPres VIP 47	DDB_VIP_PUB_PRES_47
GOOSE Virtual input 47 publisher bit		
1167	PubPres VIP 48	DDB_VIP_PUB_PRES_48
GOOSE Virtual input 48 publisher bit		
1168	PubPres VIP 49	DDB_VIP_PUB_PRES_49
GOOSE Virtual input 49 publisher bit		
1169	PubPres VIP 50	DDB_VIP_PUB_PRES_50
GOOSE Virtual input 50 publisher bit		
1170	PubPres VIP 51	DDB_VIP_PUB_PRES_51
GOOSE Virtual input 51 publisher bit		
1171	PubPres VIP 52	DDB_VIP_PUB_PRES_52
GOOSE Virtual input 52 publisher bit		
1172	PubPres VIP 53	DDB_VIP_PUB_PRES_53
GOOSE Virtual input 53 publisher bit		
1173	PubPres VIP 54	DDB_VIP_PUB_PRES_54
GOOSE Virtual input 54 publisher bit		
1174	PubPres VIP 55	DDB_VIP_PUB_PRES_55
GOOSE Virtual input 55 publisher bit		
1175	PubPres VIP 56	DDB_VIP_PUB_PRES_56
GOOSE Virtual input 56 publisher bit		
1176	PubPres VIP 57	DDB_VIP_PUB_PRES_57
GOOSE Virtual input 57 publisher bit		
1177	PubPres VIP 58	DDB_VIP_PUB_PRES_58
GOOSE Virtual input 58 publisher bit		
1178	PubPres VIP 59	DDB_VIP_PUB_PRES_59
GOOSE Virtual input 59 publisher bit		
1179	PubPres VIP 60	DDB_VIP_PUB_PRES_60
GOOSE Virtual input 60 publisher bit		
1180	PubPres VIP 61	DDB_VIP_PUB_PRES_61
GOOSE Virtual input 61 publisher bit		
1181	PubPres VIP 62	DDB_VIP_PUB_PRES_62
GOOSE Virtual input 62 publisher bit		
1182	PubPres VIP 63	DDB_VIP_PUB_PRES_63
GOOSE Virtual input 63 publisher bit		
1183	PubPres VIP 64	DDB_VIP_PUB_PRES_64
GOOSE Virtual input 64 publisher bit		
1184	HMI Access Lvl 1	DDB_UIPASSWORD_ONE
level 1 access for HMI interface		
1185	HMI Access Lvl 2	DDB_UIPASSWORD_TWO
level 2 access for HMI interface		
1186	FPort AccessLvl1	DDB_FCURPASSWORD_ONE
level 1 access for the front port interface		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1187	FPort AccessLvl2	DDB_FCURPASSWORD_TWO
level 2 access for the front port interface		
1188	RPrt1 AccessLvl1	DDB_REMOTEPASSWORD_ONE
level 1 access for the rear port 1 interface		
1189	RPrt1 AccessLvl2	DDB_REMOTEPASSWORD_TWO
level 2 access for the rear port 1 interface		
1190	RPrt2 AccessLvl1	DDB_REMOTE2PASSWORD_ONE
level 1 access for the rear port 2 interface		
1191	RPrt2 AccessLvl2	DDB_REMOTE2PASSWORD_TWO
level 2 access for the rear port 2 interface		
1192	HMI Access Lvl 3	DDB_UIPASSWORD_THREE
level 3 access for HMI interface		
1193	FPort AccessLvl3	DDB_FCURPASSWORD_THREE
Level 3 access for the front port interface		
1194	RPrt1 AccessLvl3	DDB_REMOTEPASSWORD_THREE
level 3 access for the rear port 1 interface		
1195	RPrt2 AccessLvl3	DDB_REMOTE2PASSWORD_THREE
level 3 access for the rear port 2 interface		
1200	Monitor bit 1	DDB_MONITOR1
This DDB signal can be assigned to any other DDB for commissioning purposes		
1201	Monitor bit 2	DDB_MONITOR2
This DDB signal can be assigned to any other DDB for commissioning purposes		
1202	Monitor bit 3	DDB_MONITOR3
This DDB signal can be assigned to any other DDB for commissioning purposes		
1203	Monitor bit 4	DDB_MONITOR4
This DDB signal can be assigned to any other DDB for commissioning purposes		
1204	Monitor bit 5	DDB_MONITOR5
This DDB signal can be assigned to any other DDB for commissioning purposes		
1205	Monitor bit 6	DDB_MONITOR6
This DDB signal can be assigned to any other DDB for commissioning purposes		
1206	Monitor bit 7	DDB_MONITOR7
This DDB signal can be assigned to any other DDB for commissioning purposes		
1207	Monitor bit 8	DDB_MONITOR8
This DDB signal can be assigned to any other DDB for commissioning purposes		
1240	Reset Demand	DDB_RESET_DEMAND
This DDB signal resets Demand Period		
1248	Control Input 33	DDB_CONTROL_33
This DDB signal is a control input signal		
1249	Control Input 34	DDB_CONTROL_34
This DDB signal is a control input signal		
1250	Control Input 35	DDB_CONTROL_35
This DDB signal is a control input signal		
1251	Control Input 36	DDB_CONTROL_36
This DDB signal is a control input signal		
1252	Control Input 37	DDB_CONTROL_37
This DDB signal is a control input signal		
1253	Control Input 38	DDB_CONTROL_38
This DDB signal is a control input signal		
1254	Control Input 39	DDB_CONTROL_39
This DDB signal is a control input signal		
1255	Control Input 40	DDB_CONTROL_40
This DDB signal is a control input signal		
1256	Control Input 41	DDB_CONTROL_41
This DDB signal is a control input signal		
1257	Control Input 42	DDB_CONTROL_42
This DDB signal is a control input signal		
1258	Control Input 43	DDB_CONTROL_43
This DDB signal is a control input signal		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1259	Control Input 44	DDB_CONTROL_44
This DDB signal is a control input signal		
1260	Control Input 45	DDB_CONTROL_45
This DDB signal is a control input signal		
1261	Control Input 46	DDB_CONTROL_46
This DDB signal is a control input signal		
1262	Control Input 47	DDB_CONTROL_47
This DDB signal is a control input signal		
1263	Control Input 48	DDB_CONTROL_48
This DDB signal is a control input signal		
1264	Control Input 49	DDB_CONTROL_49
This DDB signal is a control input signal		
1265	Control Input 50	DDB_CONTROL_50
This DDB signal is a control input signal		
1266	Control Input 51	DDB_CONTROL_51
This DDB signal is a control input signal		
1267	Control Input 52	DDB_CONTROL_52
This DDB signal is a control input signal		
1268	Control Input 53	DDB_CONTROL_53
This DDB signal is a control input signal		
1269	Control Input 54	DDB_CONTROL_54
This DDB signal is a control input signal		
1270	Control Input 55	DDB_CONTROL_55
This DDB signal is a control input signal		
1271	Control Input 56	DDB_CONTROL_56
This DDB signal is a control input signal		
1272	Control Input 57	DDB_CONTROL_57
This DDB signal is a control input signal		
1273	Control Input 58	DDB_CONTROL_58
This DDB signal is a control input signal		
1274	Control Input 59	DDB_CONTROL_59
This DDB signal is a control input signal		
1275	Control Input 60	DDB_CONTROL_60
This DDB signal is a control input signal		
1276	Control Input 61	DDB_CONTROL_61
This DDB signal is a control input signal		
1277	Control Input 62	DDB_CONTROL_62
This DDB signal is a control input signal		
1278	Control Input 63	DDB_CONTROL_63
This DDB signal is a control input signal		
1279	Control Input 64	DDB_CONTROL_64
This DDB signal is a control input signal		
1280	FreqProt Inhibit	DDB_ADV_FREQ_INHIBIT
This DDB inhibits frequency protection		
1281	Stg1 f+t Sta	DDB_STG1_F_T_START
This DDB signal is the start signal for the first stage Frequency protection element.		
1282	Stg1 f+t Trp	DDB_STG1_F_T_TRIP
This DDB signal is the trip signal for the first stage Frequency protection element.		
1283	Stg1 f+df/dt Trp	DDB_STG1_F_DFDT_TRIP
This DDB signal is the trip signal for the first stage Frequency-Supervised Rate-of-Change-of-Frequency protection element.		
1284	Stg1 df/dt+t Sta	DDB_STG1_DFDT_T_START
This DDB signal is the start signal for the first stage Independent Rate-of-Change-of-Frequency protection element.		
1285	Stg1 df/dt+t Trp	DDB_STG1_DFDT_T_TRIP
This DDB signal is the trip signal for the first stage Independent Rate-of-Change-of-Frequency protection element.		
1286	Stg1 f+Df/Dt Sta	DDB_STG1_F_DELF_DELT_START
This DDB signal is the start signal for the first stage Average Rate-of-Change-of-Frequency protection element.		
1287	Stg1 f+Df/Dt Trp	DDB_STG1_F_DELF_DELT_TRIP
This DDB signal is the trip signal for the first stage Average Rate-of-Change-of-Frequency protection element.		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1288	Stg1 Block	DDB_STG1_ADV_FREQ_BLOCK
This DDB signal blocks all first stage Frequency protection elements		
1291	Stg1 Restore Cls	DDB_STG1_RESTORE_CLOSE
This DDB signal closes the first stage Load Restoration		
1292	Stg1 Restore Sta	DDB_STG1_RESTORE_START
This DDB signal starts the first stage Load Restoration		
1295	Stg2 f+t Sta	DDB_STG2_F_T_START
This DDB signal is the start signal for the second stage Frequency protection element.		
1296	Stg2 f+t Trp	DDB_STG2_F_T_TRIP
This DDB signal is the trip signal for the second stage Frequency protection element.		
1297	Stg2 f+df/dt Trp	DDB_STG2_F_DFDT_TRIP
This DDB signal is the trip signal for the second stage Frequency-Supervised Rate-of-Change-of-Frequency protection element.		
1298	Stg2 df/dt+t Sta	DDB_STG2_DFDT_T_START
This DDB signal is the start signal for the second stage Independent Rate-of-Change-of-Frequency protection element.		
1299	Stg2 df/dt+t Trp	DDB_STG2_DFDT_T_TRIP
This DDB signal is the trip signal for the second stage Independent Rate-of-Change-of-Frequency protection element.		
1300	Stg2 f+Df/Dt Sta	DDB_STG2_F_DELF_DELT_START
This DDB signal is the start signal for the second stage Average Rate-of-Change-of-Frequency protection element.		
1301	Stg2 f+Df/Dt Trp	DDB_STG2_F_DELF_DELT_TRIP
This DDB signal is the trip signal for the second stage Average Rate-of-Change-of-Frequency protection element.		
1302	Stg2 Block	DDB_STG2_ADV_FREQ_BLOCK
This DDB signal blocks all second stage Frequency protection elements		
1305	Stg2 Restore Cls	DDB_STG2_RESTORE_CLOSE
This DDB signal closes the second stage Load Restoration		
1306	Stg2 Restore Sta	DDB_STG2_RESTORE_START
This DDB signal starts the second stage Load Restoration		
1309	Stg3 f+t Sta	DDB_STG3_F_T_START
This DDB signal is the start signal for the third stage Frequency protection element.		
1310	Stg3 f+t Trp	DDB_STG3_F_T_TRIP
This DDB signal is the trip signal for the third stage Frequency protection element.		
1311	Stg3 f+df/dt Trp	DDB_STG3_F_DFDT_TRIP
This DDB signal is the trip signal for the third stage Frequency-Supervised Rate-of-Change-of-Frequency protection element.		
1312	Stg3 df/dt+t Sta	DDB_STG3_DFDT_T_START
This DDB signal is the start signal for the third stage Independent Rate-of-Change-of-Frequency protection element.		
1313	Stg3 df/dt+t Trp	DDB_STG3_DFDT_T_TRIP
This DDB signal is the trip signal for the third stage Independent Rate-of-Change-of-Frequency protection element.		
1314	Stg3 f+Df/Dt Sta	DDB_STG3_F_DELF_DELT_START
This DDB signal is the start signal for the third stage Average Rate-of-Change-of-Frequency protection element.		
1315	Stg3 f+Df/Dt Trp	DDB_STG3_F_DELF_DELT_TRIP
This DDB signal is the trip signal for the third stage Average Rate-of-Change-of-Frequency protection element.		
1316	Stg3 Block	DDB_STG3_ADV_FREQ_BLOCK
This DDB signal blocks all third stage Frequency protection elements		
1319	Stg3 Restore Cls	DDB_STG3_RESTORE_CLOSE
This DDB signal closes the third stage Load Restoration		
1320	Stg3 Restore Sta	DDB_STG3_RESTORE_START
This DDB signal starts the third stage Load Restoration		
1323	Stg4 f+t Sta	DDB_STG4_F_T_START
This DDB signal is the start signal for the fourth stage Frequency protection element.		
1324	Stg4 f+t Trp	DDB_STG4_F_T_TRIP
This DDB signal is the trip signal for the fourth stage Frequency protection element.		
1325	Stg4 f+df/dt Trp	DDB_STG4_F_DFDT_TRIP
This DDB signal is the trip signal for the fourth stage Frequency-Supervised Rate-of-Change-of-Frequency protection element.		
1326	Stg4 df/dt+t Sta	DDB_STG4_DFDT_T_START
This DDB signal is the start signal for the fourth stage Independent Rate-of-Change-of-Frequency protection element.		
1327	Stg4 df/dt+t Trp	DDB_STG4_DFDT_T_TRIP
This DDB signal is the trip signal for the fourth stage Independent Rate-of-Change-of-Frequency protection element.		
1328	Stg4 f+Df/Dt Sta	DDB_STG4_F_DELF_DELT_START
This DDB signal is the start signal for the fourth stage Average Rate-of-Change-of-Frequency protection element.		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1329	Stg4 f+Df/Dt Trp	DDB_STG4_F_DELF_DELT_TRIP
This DDB signal is the trip signal for the fourth stage Average Rate-of-Change-of-Frequency protection element.		
1330	Stg4 Block	DDB_STG4_ADV_FREQ_BLOCK
This DDB signal blocks all fourth stage Frequency protection elements		
1333	Stg4 Restore Cls	DDB_STG4_RESTORE_CLOSE
This DDB signal closes the fourth stage Load Restoration		
1334	Stg4 Restore Sta	DDB_STG4_RESTORE_START
This DDB signal starts the fourth stage Load Restoration		
1337	Stg5 f+t Sta	DDB_STG5_F_T_START
This DDB signal is the start signal for the fifth stage Frequency protection element.		
1338	Stg5 f+t Trp	DDB_STG5_F_T_TRIP
This DDB signal is the trip signal for the fifth stage Frequency protection element.		
1339	Stg5 f+df/dt Trp	DDB_STG5_F_DFDT_TRIP
This DDB signal is the trip signal for the fifth stage Frequency-Supervised Rate-of-Change-of-Frequency protection element.		
1340	Stg5 df/dt+t Sta	DDB_STG5_DFDT_T_START
This DDB signal is the start signal for the fifth stage Independent Rate-of-Change-of-Frequency protection element.		
1341	Stg5 df/dt+t Trp	DDB_STG5_DFDT_T_TRIP
This DDB signal is the trip signal for the fifth stage Independent Rate-of-Change-of-Frequency protection element.		
1342	Stg5 f+Df/Dt Sta	DDB_STG5_F_DELF_DELT_START
This DDB signal is the start signal for the fifth stage Average Rate-of-Change-of-Frequency protection element.		
1343	Stg5 f+Df/Dt Trp	DDB_STG5_F_DELF_DELT_TRIP
This DDB signal is the trip signal for the fifth stage Average Rate-of-Change-of-Frequency protection element.		
1344	Stg5 Block	DDB_STG5_ADV_FREQ_BLOCK
This DDB signal blocks all fifth stage Frequency protection elements		
1347	Stg5 Restore Cls	DDB_STG5_RESTORE_CLOSE
This DDB signal closes the fifth stage Load Restoration		
1348	Stg5 Restore Sta	DDB_STG5_RESTORE_START
This DDB signal starts the fifth stage Load Restoration		
1351	Stg6 f+t Sta	DDB_STG6_F_T_START
This DDB signal is the start signal for the sixth stage Frequency protection element.		
1352	Stg6 f+t Trp	DDB_STG6_F_T_TRIP
This DDB signal is the trip signal for the sixth stage Frequency protection element.		
1353	Stg6 f+df/dt Trp	DDB_STG6_F_DFDT_TRIP
This DDB signal is the trip signal for the sixth stage Frequency-Supervised Rate-of-Change-of-Frequency protection element.		
1354	Stg6 df/dt+t Sta	DDB_STG6_DFDT_T_START
This DDB signal is the start signal for the sixth stage Independent Rate-of-Change-of-Frequency protection element.		
1355	Stg6 df/dt+t Trp	DDB_STG6_DFDT_T_TRIP
This DDB signal is the trip signal for the sixth stage Independent Rate-of-Change-of-Frequency protection element.		
1356	Stg6 f+Df/Dt Sta	DDB_STG6_F_DELF_DELT_START
This DDB signal is the start signal for the sixth stage Average Rate-of-Change-of-Frequency protection element.		
1357	Stg6 f+Df/Dt Trp	DDB_STG6_F_DELF_DELT_TRIP
This DDB signal is the trip signal for the sixth stage Average Rate-of-Change-of-Frequency protection element.		
1358	Stg6 Block	DDB_STG6_ADV_FREQ_BLOCK
This DDB signal blocks all sixth stage Frequency protection elements		
1361	Stg6 Restore Cls	DDB_STG6_RESTORE_CLOSE
This DDB signal closes the sixth stage Load Restoration		
1362	Stg6 Restore Sta	DDB_STG6_RESTORE_START
This DDB signal starts the sixth stage Load Restoration		
1365	Stg7 f+t Sta	DDB_STG7_F_T_START
This DDB signal is the start signal for the seventh stage Frequency protection element.		
1366	Stg7 f+t Trp	DDB_STG7_F_T_TRIP
This DDB signal is the trip signal for the seventh stage Frequency protection element.		
1367	Stg7 f+df/dt Trp	DDB_STG7_F_DFDT_TRIP
This DDB signal is the trip signal for the seventh stage Frequency-Supervised Rate-of-Change-of-Frequency protection element.		
1368	Stg7 df/dt+t Sta	DDB_STG7_DFDT_T_START
This DDB signal is the start signal for the seventh stage Independent Rate-of-Change-of-Frequency protection element.		
1369	Stg7 df/dt+t Trp	DDB_STG7_DFDT_T_TRIP
This DDB signal is the trip signal for the seventh stage Independent Rate-of-Change-of-Frequency protection element.		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1370	Stg7 f+Df/Dt Sta	DDB_STG7_F_DELF_DELT_START
This DDB signal is the start signal for the seventh stage Average Rate-of-Change-of-Frequency protection element.		
1371	Stg7 f+Df/Dt Trp	DDB_STG7_F_DELF_DELT_TRIP
This DDB signal is the trip signal for the seventh stage Average Rate-of-Change-of-Frequency protection element.		
1372	Stg7 Block	DDB_STG7_ADV_FREQ_BLOCK
This DDB signal blocks all seventh stage Frequency protection elements		
1375	Stg7 Restore Cls	DDB_STG7_RESTORE_CLOSE
This DDB signal closes the seventh stage Load Restoration		
1376	Stg7 Restore Sta	DDB_STG7_RESTORE_START
This DDB signal starts the seventh stage Load Restoration		
1379	Stg8 f+t Sta	DDB_STG8_F_T_START
This DDB signal is the start signal for the eighth stage Frequency protection element.		
1380	Stg8 f+t Trp	DDB_STG8_F_T_TRIP
This DDB signal is the trip signal for the eighth stage Frequency protection element.		
1381	Stg8 f+df/dt Trp	DDB_STG8_F_DFDT_TRIP
This DDB signal is the trip signal for the eighth stage Frequency-Supervised Rate-of-Change-of-Frequency protection element.		
1382	Stg8 df/dt+t Sta	DDB_STG8_DFDT_T_START
This DDB signal is the start signal for the eighth stage Independent Rate-of-Change-of-Frequency protection element.		
1383	Stg8 df/dt+t Trp	DDB_STG8_DFDT_T_TRIP
This DDB signal is the trip signal for the eighth stage Independent Rate-of-Change-of-Frequency protection element.		
1384	Stg8 f+Df/Dt Sta	DDB_STG8_F_DELF_DELT_START
This DDB signal is the start signal for the eighth stage Average Rate-of-Change-of-Frequency protection element.		
1385	Stg8 f+Df/Dt Trp	DDB_STG8_F_DELF_DELT_TRIP
This DDB signal is the trip signal for the eighth stage Average Rate-of-Change-of-Frequency protection element.		
1386	Stg8 Block	DDB_STG8_ADV_FREQ_BLOCK
This DDB signal blocks all eighth stage Frequency protection elements		
1389	Stg8 Restore Cls	DDB_STG8_RESTORE_CLOSE
This DDB signal closes the eighth stage Load Restoration		
1390	Stg8 Restore Sta	DDB_STG8_RESTORE_START
This DDB signal starts the eighth stage Load Restoration		
1393	Stg9 f+t Sta	DDB_STG9_F_T_START
This DDB signal is the start signal for the ninth stage Frequency protection element.		
1394	Stg9 f+t Trp	DDB_STG9_F_T_TRIP
This DDB signal is the trip signal for the ninth stage Frequency protection element.		
1395	Stg9 f+df/dt Trp	DDB_STG9_F_DFDT_TRIP
This DDB signal is the trip signal for the ninth stage Frequency-Supervised Rate-of-Change-of-Frequency protection element.		
1396	Stg9 df/dt+t Sta	DDB_STG9_DFDT_T_START
This DDB signal is the start signal for the ninth stage Independent Rate-of-Change-of-Frequency protection element.		
1397	Stg9 df/dt+t Trp	DDB_STG9_DFDT_T_TRIP
This DDB signal is the trip signal for the ninth stage Independent Rate-of-Change-of-Frequency protection element.		
1398	Stg9 f+Df/Dt Sta	DDB_STG9_F_DELF_DELT_START
This DDB signal is the start signal for the ninth stage Average Rate-of-Change-of-Frequency protection element.		
1399	Stg9 f+Df/Dt Trp	DDB_STG9_F_DELF_DELT_TRIP
This DDB signal is the trip signal for the ninth stage Average Rate-of-Change-of-Frequency protection element.		
1400	Stg9 Block	DDB_STG9_ADV_FREQ_BLOCK
This DDB signal blocks all ninth stage Frequency protection elements		
1403	Stg9 Restore Cls	DDB_STG9_RESTORE_CLOSE
This DDB signal closes the ninth stage Load Restoration		
1404	Stg9 Restore Sta	DDB_STG9_RESTORE_START
This DDB signal starts the ninth stage Load Restoration		
1405	Restore Reset	DDB_RESTORE_RESET
This DDB signal resets all Load Restoration stages		
1406	Reset Stats	DDB_RESET_STATISTICS
This DDB signal resets all statistics counters		
1450	User Alarm in 1	DDB_USER_ALARM_INPUT_1
User Alarm		
1451	User Alarm in 2	DDB_USER_ALARM_INPUT_2
User Alarm		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1452	User Alarm in 3	DDB_USER_ALARM_INPUT_3
User Alarm		
1453	User Alarm in 4	DDB_USER_ALARM_INPUT_4
User Alarm		
1454	User Alarm in 5	DDB_USER_ALARM_INPUT_5
User Alarm		
1455	User Alarm in 6	DDB_USER_ALARM_INPUT_6
User Alarm		
1456	User Alarm in 7	DDB_USER_ALARM_INPUT_7
User Alarm		
1457	User Alarm in 8	DDB_USER_ALARM_INPUT_8
User Alarm		
1458	User Alarm in 9	DDB_USER_ALARM_INPUT_9
User Alarm		
1459	User Alarm in 10	DDB_USER_ALARM_INPUT_10
User Alarm		
1460	User Alarm in 11	DDB_USER_ALARM_INPUT_11
User Alarm		
1461	User Alarm in 12	DDB_USER_ALARM_INPUT_12
User Alarm		
1462	User Alarm in 13	DDB_USER_ALARM_INPUT_13
User Alarm		
1463	User Alarm in 14	DDB_USER_ALARM_INPUT_14
User Alarm		
1464	User Alarm in 15	DDB_USER_ALARM_INPUT_15
User Alarm		
1465	User Alarm in 16	DDB_USER_ALARM_INPUT_16
User Alarm		
1466	User Alarm in 17	DDB_USER_ALARM_INPUT_17
User Alarm		
1467	User Alarm in 18	DDB_USER_ALARM_INPUT_18
User Alarm		
1468	User Alarm in 19	DDB_USER_ALARM_INPUT_19
User Alarm		
1469	User Alarm in 20	DDB_USER_ALARM_INPUT_20
User Alarm		
1470	User Alarm in 21	DDB_USER_ALARM_INPUT_21
User Alarm		
1471	User Alarm in 22	DDB_USER_ALARM_INPUT_22
User Alarm		
1472	User Alarm in 23	DDB_USER_ALARM_INPUT_23
User Alarm		
1473	User Alarm in 24	DDB_USER_ALARM_INPUT_24
User Alarm		
1474	User Alarm in 25	DDB_USER_ALARM_INPUT_25
User Alarm		
1475	User Alarm in 26	DDB_USER_ALARM_INPUT_26
User Alarm		
1476	User Alarm in 27	DDB_USER_ALARM_INPUT_27
User Alarm		
1477	User Alarm in 28	DDB_USER_ALARM_INPUT_28
User Alarm		
1478	User Alarm in 29	DDB_USER_ALARM_INPUT_29
User Alarm		
1479	User Alarm in 30	DDB_USER_ALARM_INPUT_30
User Alarm		
1480	User Alarm in 31	DDB_USER_ALARM_INPUT_31
User Alarm		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1481	User Alarm in 32	DDB_USER_ALARM_INPUT_32
User Alarm		
1599		DDB_PSLINT_101
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1600		DDB_PSLINT_102
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1601		DDB_PSLINT_103
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1602		DDB_PSLINT_104
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1603		DDB_PSLINT_105
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1604		DDB_PSLINT_106
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1605		DDB_PSLINT_107
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1606		DDB_PSLINT_108
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1607		DDB_PSLINT_109
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1608		DDB_PSLINT_110
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1609		DDB_PSLINT_111
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1610		DDB_PSLINT_112
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1611		DDB_PSLINT_113
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1612		DDB_PSLINT_114
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1613		DDB_PSLINT_115
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1614		DDB_PSLINT_116
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1615		DDB_PSLINT_117
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1616		DDB_PSLINT_118
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1617		DDB_PSLINT_119
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1618		DDB_PSLINT_120
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1619		DDB_PSLINT_121
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1620		DDB_PSLINT_122
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1621		DDB_PSLINT_123
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1622		DDB_PSLINT_124
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1623		DDB_PSLINT_125
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1624		DDB_PSLINT_126
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1625		DDB_PSLINT_127
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1626		DDB_PSLINT_128
This DDB signal can be defined by the user in the Programmable Scheme Logic		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1627		DDB_PSLINT_129
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1628		DDB_PSLINT_130
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1629		DDB_PSLINT_131
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1630		DDB_PSLINT_132
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1631		DDB_PSLINT_133
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1632		DDB_PSLINT_134
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1633		DDB_PSLINT_135
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1634		DDB_PSLINT_136
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1635		DDB_PSLINT_137
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1636		DDB_PSLINT_138
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1637		DDB_PSLINT_139
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1638		DDB_PSLINT_140
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1639		DDB_PSLINT_141
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1640		DDB_PSLINT_142
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1641		DDB_PSLINT_143
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1642		DDB_PSLINT_144
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1643		DDB_PSLINT_145
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1644		DDB_PSLINT_146
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1645		DDB_PSLINT_147
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1646		DDB_PSLINT_148
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1647		DDB_PSLINT_149
This DDB signal can be defined by the user in the Programmmable Scheme Logic		
1648		DDB_PSLINT_150
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1649		DDB_PSLINT_151
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1650		DDB_PSLINT_152
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1651		DDB_PSLINT_153
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1652		DDB_PSLINT_154
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1653		DDB_PSLINT_155
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1654		DDB_PSLINT_156
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1655		DDB_PSLINT_157
This DDB signal can be defined by the user in the Programmable Scheme Logic		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1656		DDB_PSLINT_158
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1657		DDB_PSLINT_159
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1658		DDB_PSLINT_160
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1659		DDB_PSLINT_161
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1660		DDB_PSLINT_162
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1661		DDB_PSLINT_163
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1662		DDB_PSLINT_164
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1663		DDB_PSLINT_165
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1664		DDB_PSLINT_166
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1665		DDB_PSLINT_167
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1666		DDB_PSLINT_168
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1667		DDB_PSLINT_169
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1668		DDB_PSLINT_170
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1669		DDB_PSLINT_171
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1670		DDB_PSLINT_172
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1671		DDB_PSLINT_173
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1672		DDB_PSLINT_174
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1673		DDB_PSLINT_175
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1674		DDB_PSLINT_176
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1675		DDB_PSLINT_177
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1676		DDB_PSLINT_178
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1677		DDB_PSLINT_179
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1678		DDB_PSLINT_180
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1679		DDB_PSLINT_181
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1680		DDB_PSLINT_182
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1681		DDB_PSLINT_183
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1682		DDB_PSLINT_184
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1683		DDB_PSLINT_185
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1684		DDB_PSLINT_186
This DDB signal can be defined by the user in the Programmable Scheme Logic		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1685		DDB_PSLINT_187
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1686		DDB_PSLINT_188
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1687		DDB_PSLINT_189
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1688		DDB_PSLINT_190
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1689		DDB_PSLINT_191
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1690		DDB_PSLINT_192
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1691		DDB_PSLINT_193
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1692		DDB_PSLINT_194
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1693		DDB_PSLINT_195
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1694		DDB_PSLINT_196
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1695		DDB_PSLINT_197
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1696		DDB_PSLINT_198
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1697		DDB_PSLINT_199
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1698		DDB_PSLINT_200
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1699		DDB_PSLINT_201
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1700		DDB_PSLINT_202
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1701		DDB_PSLINT_203
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1702		DDB_PSLINT_204
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1703		DDB_PSLINT_205
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1704		DDB_PSLINT_206
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1705		DDB_PSLINT_207
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1706		DDB_PSLINT_208
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1707		DDB_PSLINT_209
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1708		DDB_PSLINT_210
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1709		DDB_PSLINT_211
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1710		DDB_PSLINT_212
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1711		DDB_PSLINT_213
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1712		DDB_PSLINT_214
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1713		DDB_PSLINT_215
This DDB signal can be defined by the user in the Programmable Scheme Logic		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1714		DDB_PSLINT_216
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1715		DDB_PSLINT_217
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1716		DDB_PSLINT_218
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1717		DDB_PSLINT_219
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1718		DDB_PSLINT_220
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1719		DDB_PSLINT_221
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1720		DDB_PSLINT_222
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1721		DDB_PSLINT_223
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1722		DDB_PSLINT_224
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1723		DDB_PSLINT_225
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1724		DDB_PSLINT_226
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1725		DDB_PSLINT_227
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1726		DDB_PSLINT_228
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1727		DDB_PSLINT_229
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1728		DDB_PSLINT_230
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1729		DDB_PSLINT_231
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1730		DDB_PSLINT_232
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1731		DDB_PSLINT_233
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1732		DDB_PSLINT_234
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1733		DDB_PSLINT_235
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1734		DDB_PSLINT_236
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1735		DDB_PSLINT_237
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1736		DDB_PSLINT_238
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1737		DDB_PSLINT_239
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1738		DDB_PSLINT_240
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1739		DDB_PSLINT_241
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1740		DDB_PSLINT_242
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1741		DDB_PSLINT_243
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1742		DDB_PSLINT_244
This DDB signal can be defined by the user in the Programmable Scheme Logic		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1743		DDB_PSLINT_245
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1744		DDB_PSLINT_246
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1745		DDB_PSLINT_247
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1746		DDB_PSLINT_248
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1747		DDB_PSLINT_249
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1748		DDB_PSLINT_250
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1749		DDB_PSLINT_251
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1750		DDB_PSLINT_252
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1751		DDB_PSLINT_253
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1752		DDB_PSLINT_254
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1753		DDB_PSLINT_255
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1754		DDB_PSLINT_256
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1755		DDB_PSLINT_257
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1756		DDB_PSLINT_258
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1757		DDB_PSLINT_259
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1758		DDB_PSLINT_260
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1759		DDB_PSLINT_261
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1760		DDB_PSLINT_262
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1761		DDB_PSLINT_263
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1762		DDB_PSLINT_264
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1763		DDB_PSLINT_265
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1764		DDB_PSLINT_266
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1765		DDB_PSLINT_267
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1766		DDB_PSLINT_268
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1767		DDB_PSLINT_269
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1768		DDB_PSLINT_270
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1769		DDB_PSLINT_271
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1770		DDB_PSLINT_272
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1771		DDB_PSLINT_273
This DDB signal can be defined by the user in the Programmable Scheme Logic		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1772		DDB_PSLINT_274
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1773		DDB_PSLINT_275
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1774		DDB_PSLINT_276
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1775		DDB_PSLINT_277
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1776		DDB_PSLINT_278
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1777		DDB_PSLINT_279
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1778		DDB_PSLINT_280
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1779		DDB_PSLINT_281
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1780		DDB_PSLINT_282
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1781		DDB_PSLINT_283
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1782		DDB_PSLINT_284
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1783		DDB_PSLINT_285
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1784		DDB_PSLINT_286
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1785		DDB_PSLINT_287
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1786		DDB_PSLINT_288
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1787		DDB_PSLINT_289
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1788		DDB_PSLINT_290
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1789		DDB_PSLINT_291
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1790		DDB_PSLINT_292
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1791		DDB_PSLINT_293
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1792		DDB_PSLINT_294
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1793		DDB_PSLINT_295
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1794		DDB_PSLINT_296
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1795		DDB_PSLINT_297
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1796		DDB_PSLINT_298
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1797		DDB_PSLINT_299
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1798		DDB_PSLINT_300
This DDB signal can be defined by the user in the Programmable Scheme Logic		
1799	Vavg<1 Start	DDB_AVG_UV_1_3PH_START
1st Stage Avg Phase U/V Start 3ph		
1800	Vavg<1 Start A	DDB_AVG_UV_1_PH_A_START
1st Stage Avg Phase U/V Start A		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1801	Vavg<1 Start B	DDB_AVG_UV_1_PH_B_START
1st Stage Avg Phase U/V Start B		
1802	Vavg<1 Start C	DDB_AVG_UV_1_PH_C_START
1st Stage Avg Phase U/V Start C		
1803	Vavg<2 Start	DDB_AVG_UV_2_3PH_START
2nd Stage Avg Phase U/V Start 3ph		
1804	Vavg<2 Start A	DDB_AVG_UV_2_PH_A_START
2nd Stage Avg Phase U/V Start A		
1805	Vavg<2 Start B	DDB_AVG_UV_2_PH_B_START
2nd Stage Avg Phase U/V Start B		
1806	Vavg<2 Start C	DDB_AVG_UV_2_PH_C_START
2nd Stage Avg Phase U/V Start C		
1807	Vavg>1 Start	DDB_AVG_OV_1_3PH_START
1st Stage Avg Phase O/V Start 3ph		
1808	Vavg>1 Start A	DDB_AVG_OV_1_PH_A_START
1st Stage Avg Phase O/V Start A		
1809	Vavg>1 Start B	DDB_AVG_OV_1_PH_B_START
1st Stage Avg Phase O/V Start B		
1810	Vavg>1 Start C	DDB_AVG_OV_1_PH_C_START
1st Stage Avg Phase O/V Start C		
1811	Vavg>2 Start	DDB_AVG_OV_2_3PH_START
2nd Stage Avg Phase O/V Start 3ph		
1812	Vavg>2 Start A	DDB_AVG_OV_2_PH_A_START
2nd Stage Avg Phase O/V Start A		
1813	Vavg>2 Start B	DDB_AVG_OV_2_PH_B_START
2nd Stage Avg Phase O/V Start B		
1814	Vavg>2 Start C	DDB_AVG_OV_2_PH_C_START
2nd Stage Avg Phase O/V Start C		
1815	V0avg>1 Start	DDB_AVG_V0_1_START
1st Stage Avg Zero Seq O/V Start		
1816	V0avg>2 Start	DDB_AVG_V0_2_START
2nd Stage Avg Zero Seq O/V Start		
1817	V1avg>1 Start	DDB_AVG_V1_1_START
1st Stage Avg Pos Seq O/V Start		
1818	V1avg>2 Start	DDB_AVG_V1_2_START
2nd Stage Avg Pos Seq O/V Start		
1819	V2avg>1 Start	DDB_AVG_V2_1_START
1st Stage Avg Neg Seq O/V Start		
1820	V2avg>2 Start	DDB_AVG_V2_2_START
2nd Stage Avg Neg Seq O/V Start		
1821	Vavg<1 Trip	DDB_AVG_UV_1_3PH_TRIP
1st Stage Avg Phase U/V Trip 3ph		
1822	Vavg<1 Trip A	DDB_AVG_UV_1_PH_A_TRIP
1st Stage Avg Phase U/V Trip A		
1823	Vavg<1 Trip B	DDB_AVG_UV_1_PH_B_TRIP
1st Stage Avg Phase U/V Trip B		
1824	Vavg<1 Trip C	DDB_AVG_UV_1_PH_C_TRIP
1st Stage Avg Phase U/V Trip C		
1825	Vavg<2 Trip	DDB_AVG_UV_2_3PH_TRIP
2nd Stage Avg Phase U/V Trip 3ph		
1826	Vavg<2 Trip A	DDB_AVG_UV_2_PH_A_TRIP
2nd Stage Avg Phase U/V Trip A		
1827	Vavg<2 Trip B	DDB_AVG_UV_2_PH_B_TRIP
2nd Stage Avg Phase U/V Trip B		
1828	Vavg<2 Trip C	DDB_AVG_UV_2_PH_C_TRIP
2nd Stage Avg Phase U/V Trip C		
1829	Vavg>1 Trip	DDB_AVG_OV_1_3PH_TRIP
1st Stage Avg Phase O/V Trip 3ph		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1830	Vavg>1 Trip A	DDB_AVG_OV_1_PH_A_TRIP
1st Stage Avg Phase O/V Trip A		
1831	Vavg>1 Trip B	DDB_AVG_OV_1_PH_B_TRIP
1st Stage Avg Phase O/V Trip B		
1832	Vavg>1 Trip C	DDB_AVG_OV_1_PH_C_TRIP
1st Stage Avg Phase O/V Trip C		
1833	Vavg>2 Trip	DDB_AVG_OV_2_3PH_TRIP
2nd Stage Avg Phase O/V Trip 3ph		
1834	Vavg>2 Trip A	DDB_AVG_OV_2_PH_A_TRIP
2nd Stage Avg Phase O/V Trip A		
1835	Vavg>2 Trip B	DDB_AVG_OV_2_PH_B_TRIP
2nd Stage Avg Phase O/V Trip B		
1836	Vavg>2 Trip C	DDB_AVG_OV_2_PH_C_TRIP
2nd Stage Avg Phase O/V Trip C		
1837	V0avg>1 Trip	DDB_AVG_V0_1_TRIP
1st Stage Avg Zero Seq O/V Trip		
1838	V0avg>2 Trip	DDB_AVG_V0_2_TRIP
2nd Stage Avg Zero Seq O/V Trip		
1839	V1avg>1 Trip	DDB_AVG_V1_1_TRIP
1st Stage Avg Pos Seq O/V Trip		
1840	V1avg>2 Trip	DDB_AVG_V1_2_TRIP
2nd Stage Avg Pos Seq O/V Trip		
1841	V2avg>1 Trip	DDB_AVG_V2_1_TRIP
1st Stage Avg Neg Seq O/V Trip		
1842	V2avg>2 Trip	DDB_AVG_V2_2_TRIP
2nd Stage Avg Neg Seq O/V Trip		
1843	Inter PSL 1 IN	DDB_INTER_PSL_1_IN
Inter PSL 1 Input		
1844	Inter PSL 2 IN	DDB_INTER_PSL_2_IN
Inter PSL 2 Input		
1845	Inter PSL 3 IN	DDB_INTER_PSL_3_IN
Inter PSL 3 Input		
1846	Inter PSL 4 IN	DDB_INTER_PSL_4_IN
Inter PSL 4 Input		
1847	Inter PSL 5 IN	DDB_INTER_PSL_5_IN
Inter PSL 5 Input		
1848	Inter PSL 6 IN	DDB_INTER_PSL_6_IN
Inter PSL 6 Input		
1849	Inter PSL 7 IN	DDB_INTER_PSL_7_IN
Inter PSL 7 Input		
1850	Inter PSL 8 IN	DDB_INTER_PSL_8_IN
Inter PSL 8 Input		
1851	Inter PSL 9 IN	DDB_INTER_PSL_9_IN
Inter PSL 9 Input		
1852	Inter PSL 10 IN	DDB_INTER_PSL_10_IN
Inter PSL 10 Input		
1853	Inter PSL 11 IN	DDB_INTER_PSL_11_IN
Inter PSL 11 Input		
1854	Inter PSL 12 IN	DDB_INTER_PSL_12_IN
Inter PSL 12 Input		
1855	Inter PSL 13 IN	DDB_INTER_PSL_13_IN
Inter PSL 13 Input		
1856	Inter PSL 14 IN	DDB_INTER_PSL_14_IN
Inter PSL 14 Input		
1857	Inter PSL 15 IN	DDB_INTER_PSL_15_IN
Inter PSL 15 Input		
1858	Inter PSL 16 IN	DDB_INTER_PSL_16_IN
Inter PSL 16 Input		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1859	Inter PSL 17 IN	DDB_INTER_PSL_17_IN
Inter PSL 17 Input		
1860	Inter PSL 18 IN	DDB_INTER_PSL_18_IN
Inter PSL 18 Input		
1861	Inter PSL 19 IN	DDB_INTER_PSL_19_IN
Inter PSL 19 Input		
1862	Inter PSL 20 IN	DDB_INTER_PSL_20_IN
Inter PSL 20 Input		
1863	Inter PSL 21 IN	DDB_INTER_PSL_21_IN
Inter PSL 21 Input		
1864	Inter PSL 22 IN	DDB_INTER_PSL_22_IN
Inter PSL 22 Input		
1865	Inter PSL 23 IN	DDB_INTER_PSL_23_IN
Inter PSL 23 Input		
1866	Inter PSL 24 IN	DDB_INTER_PSL_24_IN
Inter PSL 24 Input		
1867	Inter PSL 25 IN	DDB_INTER_PSL_25_IN
Inter PSL 25 Input		
1868	Inter PSL 26 IN	DDB_INTER_PSL_26_IN
Inter PSL 26 Input		
1869	Inter PSL 27 IN	DDB_INTER_PSL_27_IN
Inter PSL 27 Input		
1870	Inter PSL 28 IN	DDB_INTER_PSL_28_IN
Inter PSL 28 Input		
1871	Inter PSL 29 IN	DDB_INTER_PSL_29_IN
Inter PSL 29 Input		
1872	Inter PSL 30 IN	DDB_INTER_PSL_30_IN
Inter PSL 30 Input		
1873	Inter PSL 31 IN	DDB_INTER_PSL_31_IN
Inter PSL 31 Input		
1874	Inter PSL 32 IN	DDB_INTER_PSL_32_IN
Inter PSL 32 Input		
1875	Inter PSL 1 OUT	DDB_INTER_PSL_1_OUT
Inter PSL 1 Output		
1876	Inter PSL 2 OUT	DDB_INTER_PSL_2_OUT
Inter PSL 2 Output		
1877	Inter PSL 3 OUT	DDB_INTER_PSL_3_OUT
Inter PSL 3 Output		
1878	Inter PSL 4 OUT	DDB_INTER_PSL_4_OUT
Inter PSL 4 Output		
1879	Inter PSL 5 OUT	DDB_INTER_PSL_5_OUT
Inter PSL 5 Output		
1880	Inter PSL 6 OUT	DDB_INTER_PSL_6_OUT
Inter PSL 6 Output		
1881	Inter PSL 7 OUT	DDB_INTER_PSL_7_OUT
Inter PSL 7 Output		
1882	Inter PSL 8 OUT	DDB_INTER_PSL_8_OUT
Inter PSL 8 Output		
1883	Inter PSL 9 OUT	DDB_INTER_PSL_9_OUT
Inter PSL 9 Output		
1884	Inter PSL 10 OUT	DDB_INTER_PSL_10_OUT
Inter PSL 10 Output		
1885	Inter PSL 11 OUT	DDB_INTER_PSL_11_OUT
Inter PSL 11 Output		
1886	Inter PSL 12 OUT	DDB_INTER_PSL_12_OUT
Inter PSL 12 Output		
1887	Inter PSL 13 OUT	DDB_INTER_PSL_13_OUT
Inter PSL 13 Output		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1888	Inter PSL 14 OUT	DDB_INTER_PSL_14_OUT
Inter PSL 14 Output		
1889	Inter PSL 15 OUT	DDB_INTER_PSL_15_OUT
Inter PSL 15 Output		
1890	Inter PSL 16 OUT	DDB_INTER_PSL_16_OUT
Inter PSL 16 Output		
1891	Inter PSL 17 OUT	DDB_INTER_PSL_17_OUT
Inter PSL 17 Output		
1892	Inter PSL 18 OUT	DDB_INTER_PSL_18_OUT
Inter PSL 18 Output		
1893	Inter PSL 19 OUT	DDB_INTER_PSL_19_OUT
Inter PSL 19 Output		
1894	Inter PSL 20 OUT	DDB_INTER_PSL_20_OUT
Inter PSL 20 Output		
1895	Inter PSL 21 OUT	DDB_INTER_PSL_21_OUT
Inter PSL 21 Output		
1896	Inter PSL 22 OUT	DDB_INTER_PSL_22_OUT
Inter PSL 22 Output		
1897	Inter PSL 23 OUT	DDB_INTER_PSL_23_OUT
Inter PSL 23 Output		
1898	Inter PSL 24 OUT	DDB_INTER_PSL_24_OUT
Inter PSL 24 Output		
1899	Inter PSL 25 OUT	DDB_INTER_PSL_25_OUT
Inter PSL 25 Output		
1900	Inter PSL 26 OUT	DDB_INTER_PSL_26_OUT
Inter PSL 26 Output		
1901	Inter PSL 27 OUT	DDB_INTER_PSL_27_OUT
Inter PSL 27 Output		
1902	Inter PSL 28 OUT	DDB_INTER_PSL_28_OUT
Inter PSL 28 Output		
1903	Inter PSL 29 OUT	DDB_INTER_PSL_29_OUT
Inter PSL 29 Output		
1904	Inter PSL 30 OUT	DDB_INTER_PSL_30_OUT
Inter PSL 30 Output		
1905	Inter PSL 31 OUT	DDB_INTER_PSL_31_OUT
Inter PSL 31 Output		
1906	Inter PSL 32 OUT	DDB_INTER_PSL_32_OUT
Inter PSL 32 Output		
1907	V1< Inhibit	DDB_PSUV_INHIBIT
Pos Seq U/V Inhibit		
1908	V1<1 Timer Block	DDB_PSUV_1_TIMER_BLOCK
1st Stage Pos Seq U/V Timer Block		
1909	V1<1 Start	DDB_PSUV_1_START
1st Stage Pos Seq U/V Start		
1910	V1<1 Trip	DDB_PSUV_1_TRIP
1st Stage Pos Seq U/V Trip		
1911	V1<2 Timer Block	DDB_PSUV_2_TIMER_BLOCK
2nd Stage Pos Seq U/V Timer Block		
1912	V1<2 Start	DDB_PSUV_2_START
2nd Stage Pos Seq U/V Start		
1913	V1<2 Trip	DDB_PSUV_2_TRIP
2nd Stage Pos Seq U/V Trip		
1914	V1> Inhibit	DDB_PSOV_INHIBIT
Pos Seq O/V Inhibit		
1915	V1>1 Timer Block	DDB_PSOV_1_TIMER_BLOCK
1st Stage Pos Seq O/V Timer Block		
1916	V1>1 Start	DDB_PSOV_1_START
1st Stage Pos Seq O/V Start		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1917	V1>1 Trip	DDB_PSOV_1_TRIP
1st Stage Pos Seq O/V Trip		
1918	V1>2 Timer Block	DDB_PSOV_2_TIMER_BLOCK
2nd Stage Pos Seq O/V Timer Block		
1919	V1>2 Start	DDB_PSOV_2_START
2nd Stage Pos Seq O/V Start		
1920	V1>2 Trip	DDB_PSOV_2_TRIP
2nd Stage Pos Seq O/V Trip		
1921	V2>2 Start	DDB_NEGSEQOV_2_START
2nd Stage Negative Sequence O/V Start		
1922	V2>2 Trip	DDB_NEGSEQOV_2_TRIP
2nd Stage Negative Sequence O/V Trip		
1923	Vavg< Inhibit	DDB_AVG_UV_INHIBIT
Avg Phase U/V Inhibit		
1950	Test Mode Info	DDB_TEST_MODE_INFO
Test Mode In progress		
1959	SWI1 Aux (52-A)	DDB_SWI1_STATUS_INPUT_52A
This DDB signal is the 3-phase 52A signal (signal indicating state of switch 1)		
1960	SWI1 Aux (52-B)	DDB_SWI1_STATUS_INPUT_52B
This DDB signal is the 3-phase 52B signal (signal indicating inverse state of switch 1)		
1961	SWI1 Input Alm	DDB_SWI1_STATUS_ALARM
This DDB signal indicates that the switch 1 is in an invalid state		
1962	SWI2 Aux (52-A)	DDB_SWI2_STATUS_INPUT_52A
This DDB signal is the 3-phase 52A signal (signal indicating state of switch 2)		
1963	SWI2 Aux (52-B)	DDB_SWI2_STATUS_INPUT_52B
This DDB signal is the 3-phase 52B signal (signal indicating inverse state of switch 2)		
1964	SWI2 Input Alm	DDB_SWI2_STATUS_ALARM
This DDB signal indicates that the switch 2 is in an invalid state		
1965	SWI3 Aux (52-A)	DDB_SWI3_STATUS_INPUT_52A
This DDB signal is the 3-phase 52A signal (signal indicating state of switch 3)		
1966	SWI3 Aux (52-B)	DDB_SWI3_STATUS_INPUT_52B
This DDB signal is the 3-phase 52B signal (signal indicating inverse state of switch 3)		
1967	SWI3 Input Alm	DDB_SWI3_STATUS_ALARM
This DDB signal indicates that the switch 3 is in an invalid state		
1968	SWI4 Aux (52-A)	DDB_SWI4_STATUS_INPUT_52A
This DDB signal is the 3-phase 52A signal (signal indicating state of switch 4)		
1969	SWI4 Aux (52-B)	DDB_SWI4_STATUS_INPUT_52B
This DDB signal is the 3-phase 52B signal (signal indicating inverse state of switch 4)		
1970	SWI4 Input Alm	DDB_SWI4_STATUS_ALARM
This DDB signal indicates that the switch 4 is in an invalid state		
1971	SWI5 Aux (52-A)	DDB_SWI5_STATUS_INPUT_52A
This DDB signal is the 3-phase 52A signal (signal indicating state of switch 5)		
1972	SWI5 Aux (52-B)	DDB_SWI5_STATUS_INPUT_52B
This DDB signal is the 3-phase 52B signal (signal indicating inverse state of switch 5)		
1973	SWI5 Input Alm	DDB_SWI5_STATUS_ALARM
This DDB signal indicates that the switch 5 is in an invalid state		
1974	SWI6 Aux (52-A)	DDB_SWI6_STATUS_INPUT_52A
This DDB signal is the 3-phase 52A signal (signal indicating state of switch 6)		
1975	SWI6 Aux (52-B)	DDB_SWI6_STATUS_INPUT_52B
This DDB signal is the 3-phase 52B signal (signal indicating inverse state of switch 6)		
1976	SWI6 Input Alm	DDB_SWI6_STATUS_ALARM
This DDB signal indicates that the switch 6 is in an invalid state		
1977	SWI7 Aux (52-A)	DDB_SWI7_STATUS_INPUT_52A
This DDB signal is the 3-phase 52A signal (signal indicating state of switch 7)		
1978	SWI7 Aux (52-B)	DDB_SWI7_STATUS_INPUT_52B
This DDB signal is the 3-phase 52B signal (signal indicating inverse state of switch 7)		
1979	SWI7 Input Alm	DDB_SWI7_STATUS_ALARM
This DDB signal indicates that the switch 7 is in an invalid state		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
1980	SWI8 Aux (52-A)	DDB_SWI8_STATUS_INPUT_52A
This DDB signal is the 3-phase 52A signal (signal indicating state of switch 8)		
1981	SWI8 Aux (52-B)	DDB_SWI8_STATUS_INPUT_52B
This DDB signal is the 3-phase 52B signal (signal indicating inverse state of switch 8)		
1982	SWI8 Input Alm	DDB_SWI8_STATUS_ALARM
This DDB signal indicates that the switch 8 is in an invalid state		
1983	SWI1 Control Trp	DDB_SWI1_CONTROL_TRIP
This DDB signal tells the switch 1 to trip		
1984	SWI1 Control Cls	DDB_SWI1_CONTROL_CLOSE
This DDB signal tells the switch 1 to close		
1985	SWI2 Control Trp	DDB_SWI2_CONTROL_TRIP
This DDB signal tells the switch 2 to trip		
1986	SWI2 Control Cls	DDB_SWI2_CONTROL_CLOSE
This DDB signal tells the switch 2 to close		
1987	SWI3 Control Trp	DDB_SWI3_CONTROL_TRIP
This DDB signal tells the switch 3 to trip		
1988	SWI3 Control Cls	DDB_SWI3_CONTROL_CLOSE
This DDB signal tells the switch 3 to close		
1989	SWI4 Control Trp	DDB_SWI4_CONTROL_TRIP
This DDB signal tells the switch 4 to trip		
1990	SWI4 Control Cls	DDB_SWI4_CONTROL_CLOSE
This DDB signal tells the switch 4 to close		
1991	SWI5 Control Trp	DDB_SWI5_CONTROL_TRIP
This DDB signal tells the switch 5 to trip		
1992	SWI5 Control Cls	DDB_SWI5_CONTROL_CLOSE
This DDB signal tells the switch 5 to close		
1993	SWI6 Control Trp	DDB_SWI6_CONTROL_TRIP
This DDB signal tells the switch 6 to trip		
1994	SWI6 Control Cls	DDB_SWI6_CONTROL_CLOSE
This DDB signal tells the switch 6 to close		
1995	SWI7 Control Trp	DDB_SWI7_CONTROL_TRIP
This DDB signal tells the switch 7 to trip		
1996	SWI7 Control Cls	DDB_SWI7_CONTROL_CLOSE
This DDB signal tells the switch 7 to close		
1997	SWI8 Control Trp	DDB_SWI8_CONTROL_TRIP
This DDB signal tells the switch 8 to trip		
1998	SWI8 Control Cls	DDB_SWI8_CONTROL_CLOSE
This DDB signal tells the switch 8 to close		
1999	Blk Rmt SWI1 Ops	DDB_BLK_REMOTE_SWI1_OPS
This DDB signal blocks remote switch 1 Trip and Close		
2000	Blk Rmt SWI2 Ops	DDB_BLK_REMOTE_SWI2_OPS
This DDB signal blocks remote switch 2 Trip and Close		
2001	Blk Rmt SWI3 Ops	DDB_BLK_REMOTE_SWI3_OPS
This DDB signal blocks remote switch 3 Trip and Close		
2002	Blk Rmt SWI4 Ops	DDB_BLK_REMOTE_SWI4_OPS
This DDB signal blocks remote switch 4 Trip and Close		
2003	Blk Rmt SWI5 Ops	DDB_BLK_REMOTE_SWI5_OPS
This DDB signal blocks remote switch 5 Trip and Close		
2004	Blk Rmt SWI6 Ops	DDB_BLK_REMOTE_SWI6_OPS
This DDB signal blocks remote switch 6 Trip and Close		
2005	Blk Rmt SWI7 Ops	DDB_BLK_REMOTE_SWI7_OPS
This DDB signal blocks remote switch 7 Trip and Close		
2006	Blk Rmt SWI8 Ops	DDB_BLK_REMOTE_SWI8_OPS
This DDB signal blocks remote switch 8 Trip and Close		
2007	SWI1 Status Opn	DDB_SWI1_STATUS_OPEN
This DDB signal is assigned to output the switch1 status-Open		
2008	SWI1 Status Cls	DDB_SWI1_STATUS_CLOSE
This DDB signal is assigned to output the switch1 status-Close		

ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
2009	SWI2 Status Opn	DDB_SWI2_STATUS_OPEN
This DDB signal is assigned to output the switch2 status-Open		
2010	SWI2 Status Cls	DDB_SWI2_STATUS_CLOSE
This DDB signal is assigned to output the switch2 status-Close		
2011	SWI3 Status Opn	DDB_SWI3_STATUS_OPEN
This DDB signal is assigned to output the switch3 status-Open		
2012	SWI3 Status Cls	DDB_SWI3_STATUS_CLOSE
This DDB signal is assigned to output the switch3 status-Close		
2013	SWI4 Status Opn	DDB_SWI4_STATUS_OPEN
This DDB signal is assigned to output the switch4 status-Open		
2014	SWI4 Status Cls	DDB_SWI4_STATUS_CLOSE
This DDB signal is assigned to output the switch4 status-Close		
2015	SWI5 Status Opn	DDB_SWI5_STATUS_OPEN
This DDB signal is assigned to output the switch5 status-Open		
2016	SWI5 Status Cls	DDB_SWI5_STATUS_CLOSE
This DDB signal is assigned to output the switch5 status-Close		
2017	SWI6 Status Opn	DDB_SWI6_STATUS_OPEN
This DDB signal is assigned to output the switch6 status-Open		
2018	SWI6 Status Cls	DDB_SWI6_STATUS_CLOSE
This DDB signal is assigned to output the switch6 status-Close		
2019	SWI7 Status Opn	DDB_SWI7_STATUS_OPEN
This DDB signal is assigned to output the switch7 status-Open		
2020	SWI7 Status Cls	DDB_SWI7_STATUS_CLOSE
This DDB signal is assigned to output the switch7 status-Close		
2021	SWI8 Status Opn	DDB_SWI8_STATUS_OPEN
This DDB signal is assigned to output the switch8 status-Open		
2022	SWI8 Status Cls	DDB_SWI8_STATUS_CLOSE
This DDB signal is assigned to output the switch8 status-Close		
2023	SWI1 Trip Fail	DDB_SWI1_FAILED_TO_TRIP
This DDB signal indicates that the switch 1 has failed to trip		
2024	SWI1 Cls Fail	DDB_SWI1_FAILED_TO_CLOSE
This DDB signal indicates that the switch 1 has failed to close		
2025	SWI2 Trip Fail	DDB_SWI2_FAILED_TO_TRIP
This DDB signal indicates that the switch 2 has failed to trip		
2026	SWI2 Cls Fail	DDB_SWI2_FAILED_TO_CLOSE
This DDB signal indicates that the switch 2 has failed to close		
2027	SWI3 Trip Fail	DDB_SWI3_FAILED_TO_TRIP
This DDB signal indicates that the switch 3 has failed to trip		
2028	SWI3 Cls Fail	DDB_SWI3_FAILED_TO_CLOSE
This DDB signal indicates that the switch 3 has failed to close		
2029	SWI4 Trip Fail	DDB_SWI4_FAILED_TO_TRIP
This DDB signal indicates that the switch 4 has failed to trip		
2030	SWI4 Cls Fail	DDB_SWI4_FAILED_TO_CLOSE
This DDB signal indicates that the switch 4 has failed to close		
2031	SWI5 Trip Fail	DDB_SWI5_FAILED_TO_TRIP
This DDB signal indicates that the switch 5 has failed to trip		
2032	SWI5 Cls Fail	DDB_SWI5_FAILED_TO_CLOSE
This DDB signal indicates that the switch 5 has failed to close		
2033	SWI6 Trip Fail	DDB_SWI6_FAILED_TO_TRIP
This DDB signal indicates that the switch 6 has failed to trip		
2034	SWI6 Cls Fail	DDB_SWI6_FAILED_TO_CLOSE
This DDB signal indicates that the switch 6 has failed to close		
2035	SWI7 Trip Fail	DDB_SWI7_FAILED_TO_TRIP
This DDB signal indicates that the switch 7 has failed to trip		
2036	SWI7 Cls Fail	DDB_SWI7_FAILED_TO_CLOSE
This DDB signal indicates that the switch 7 has failed to close		
2037	SWI8 Trip Fail	DDB_SWI8_FAILED_TO_TRIP
This DDB signal indicates that the switch 8 has failed to trip		

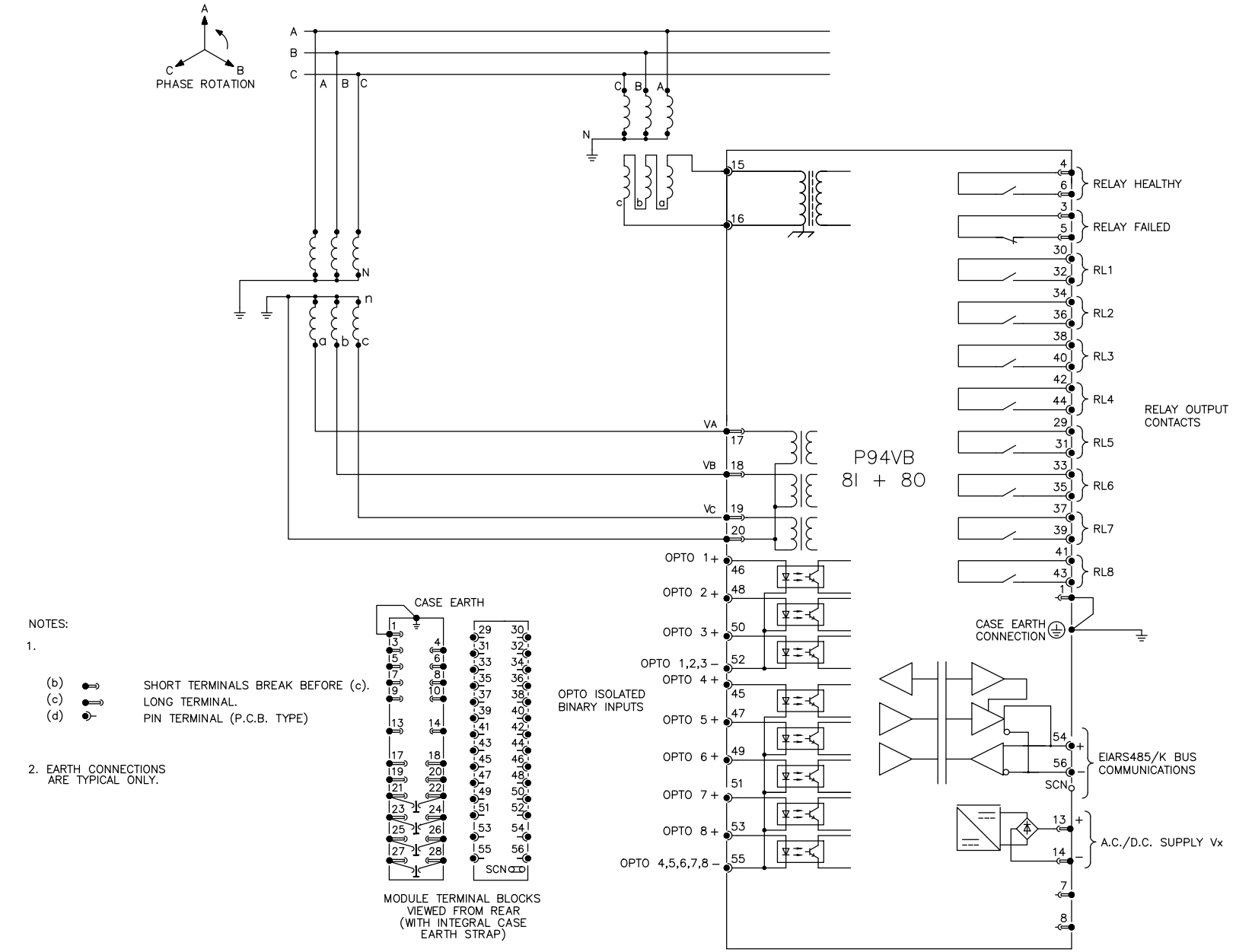
ORDINAL	SIGNAL NAME	ELEMENT NAME
DESCRIPTION		
2038	SWI8 Cls Fail	DDB_SWI8_FAILED_TO_CLOSE
This DDB signal indicates that the switch 8 has failed to close		

APPENDIX C

WIRING DIAGRAMS

MODEL	CORTEC OPTION*	EXTERNAL CONNECTION DIAGRAM TITLE	DRAWING-SHEET	ISSUE
P94V	IO option A	VOLTAGE AND FREQUENCY IED WITH SEPARATE RESIDUAL VOLTAGE INPUT (8 I/P & 8 O/P)	10P94V01-1	C
		VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONIZING (8 I/P & 8 O/P) VOLTAGE & FREQUENCY IED (8I/P & 8O/P) FOR KAVR & KAVS RETROFIT (KAVR/KAVS Case)	10P94V02-1 10P94V02-2	C B3
		VOLTAGE & FREQUENCY IED WITH RESIDUAL VOLTAGE I/P (8 I/P & 8 O/P) WITH ETHERNET & SHORTING LINK VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE I/P (8 I/P & 8 O/P) WITH DUAL COPPER ETHERNET & SHORTING LINK VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE I/P (8 I/P & 8 O/P) WITH DUAL FIBRE ETHERNET & SHORTING LINK	10P94V03-1 10P94V03-2 10P94V03-3	E C C
		VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (8 I/P & 8 O/P) WITH ETHERNET VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (8 I/P & 8 O/P) WITH DUAL COPPER ETHERNET VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (8 I/P & 8 O/P) WITH DUAL FIBRE ETHERNET	10P94V04-1 10P94V04-2 10P94V04-3	D C C
	IO option B	VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (11 I/P & 12 O/P) WITH 2 RS485 VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (11 I/P & 12 O/P) WITH 2 RS485 & ETHERNET VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (11 I/P & 12 O/P) WITH 2 RS485 & DUAL COPPER ETHERNET VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (11 I/P & 12 O/P) WITH 2 RS485 & DUAL FIBRE ETHERNET	10P94V05-1 10P94V05-2 10P94V05-3 10P94V05-4	C C C C
		VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (11 I/P & 12 O/P) WITH 2 RS485 VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (11 I/P & 12 O/P) WITH 2 RS485 & ETHERNET VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (11 I/P & 12 O/P) WITH 2 RS485 & DUAL COPPER ETHERNET VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (11 I/P & 12 O/P) WITH 2 RS485 & DUAL FIBRE ETHERNET	10P94V06-1 10P94V06-2 10P94V06-3 10P94V06-4	C C C C
	IO option C	VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (11 I/P & 12 O/P) WITH TCS VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (11 I/P & 12 O/P) WITH TCS & ETHERNET VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (11 I/P & 12 O/P) WITH TCS & DUAL COPPER ETHERNET VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (11 I/P & 12 O/P) WITH TCS & DUAL FIBRE ETHERNET	10P94V07-1 10P94V07-2 10P94V07-3 10P94V07-4	C C C C
		VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (11 I/P & 12 O/P) WITH TCS VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (11 I/P & 12 O/P) WITH TCS & ETHERNET VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (11 I/P & 12 O/P) WITH TCS & DUAL COPPER ETHERNET VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (11 I/P & 12 O/P) WITH TCS & DUAL FIBRE ETHERNET	10P94V08-1 10P94V08-2 10P94V08-3 10P94V08-4	C C C C
	IO option D	VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (13 I/P & 12 O/P) VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (13 I/P & 12 O/P) & ETHERNET VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (13 I/P & 12 O/P) & DUAL COPPER ETHERNET VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (13 I/P & 12 O/P) & DUAL FIBRE ETHERNET	10P94V09-1 10P94V09-2 10P94V09-3 10P94V09-4	C C C C
		VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (13 I/P & 12 O/P) VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (13 I/P & 12 O/P) & ETHERNET VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (13 I/P & 12 O/P) & DUAL COPPER ETHERNET VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (13 I/P & 12 O/P) & DUAL FIBRE ETHERNET	10P94V10-1 10P94V10-2 10P94V10-3 10P94V10-4	C C C C
	IO option E	VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (3 I/P & 4 O/P)	10P94V11-1	C
	IO option F	VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (6 I/P & 8 O/P) WITH TCS	10P94V12-1	C
	IO option E	VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (3 I/P & 4 O/P)	10P94V13-1	C
	IO option F	VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (6 I/P & 8 O/P)	10P94V14-1	C
	IO option H	VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (10 I/P & 12 O/P) WITH 2 RS485 VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (10 I/P & 12 O/P) WITH 2 RS485 & ETHERNET VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (10 I/P & 12 O/P) WITH 2 RS485 & DUAL COPPER ETHERNET VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (10 I/P & 12 O/P) WITH 2 RS485 & DUAL FIBRE ETHERNET	10P94V15-1 10P94V15-2 10P94V15-3 10P94V15-4	C C C C
		VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (10 I/P & 12 O/P) WITH 2 RS485 VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (10 I/P & 12 O/P) WITH 2 RS485 & ETHERNET VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (10 I/P & 12 O/P) WITH 2 RS485 & DUAL COPPER ETHERNET VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (10 I/P & 12 O/P) WITH 2 RS485 & DUAL FIBRE ETHERNET	10P94V16-1 10P94V16-2 10P94V16-3 10P94V16-4	C C C C
	IO option J	VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (12 I/P & 12 O/P) VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (12 I/P & 12 O/P) & ETHERNET VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (12 I/P & 12 O/P) & DUAL COPPER ETHERNET VOLTAGE AND FREQUENCY IED WITH RESIDUAL VOLTAGE INPUT (12 I/P & 12 O/P) & DUAL FIBRE ETHERNET	10P94V17-1 10P94V17-2 10P94V17-3 10P94V17-4	C C C C
		VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (12 I/P & 12 O/P) VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (12 I/P & 12 O/P) & ETHERNET VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (12 I/P & 12 O/P) & DUAL COPPER ETHERNET VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (12 I/P & 12 O/P) & DUAL FIBRE ETHERNET	10P94V18-1 10P94V18-2 10P94V18-3 10P94V18-4	C C C C

* When selecting applicable connection diagram(s), it may be helpful to reference the appropriate model's CORTEC.



NOTES:

1.

(b) SHORT TERMINALS BREAK BEFORE (c).
(c) LONG TERMINAL.
(d) PIN TERMINAL (P.C.B. TYPE)

2. EARTH CONNECTIONS ARE TYPICAL ONLY.

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH SEPARATE RESIDUAL VOLTAGE INPUT (8 I/P & 8 O/P)	
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Date: 12/12/2011	Chkd: K.VENKATARAMAN			Next Sht: -

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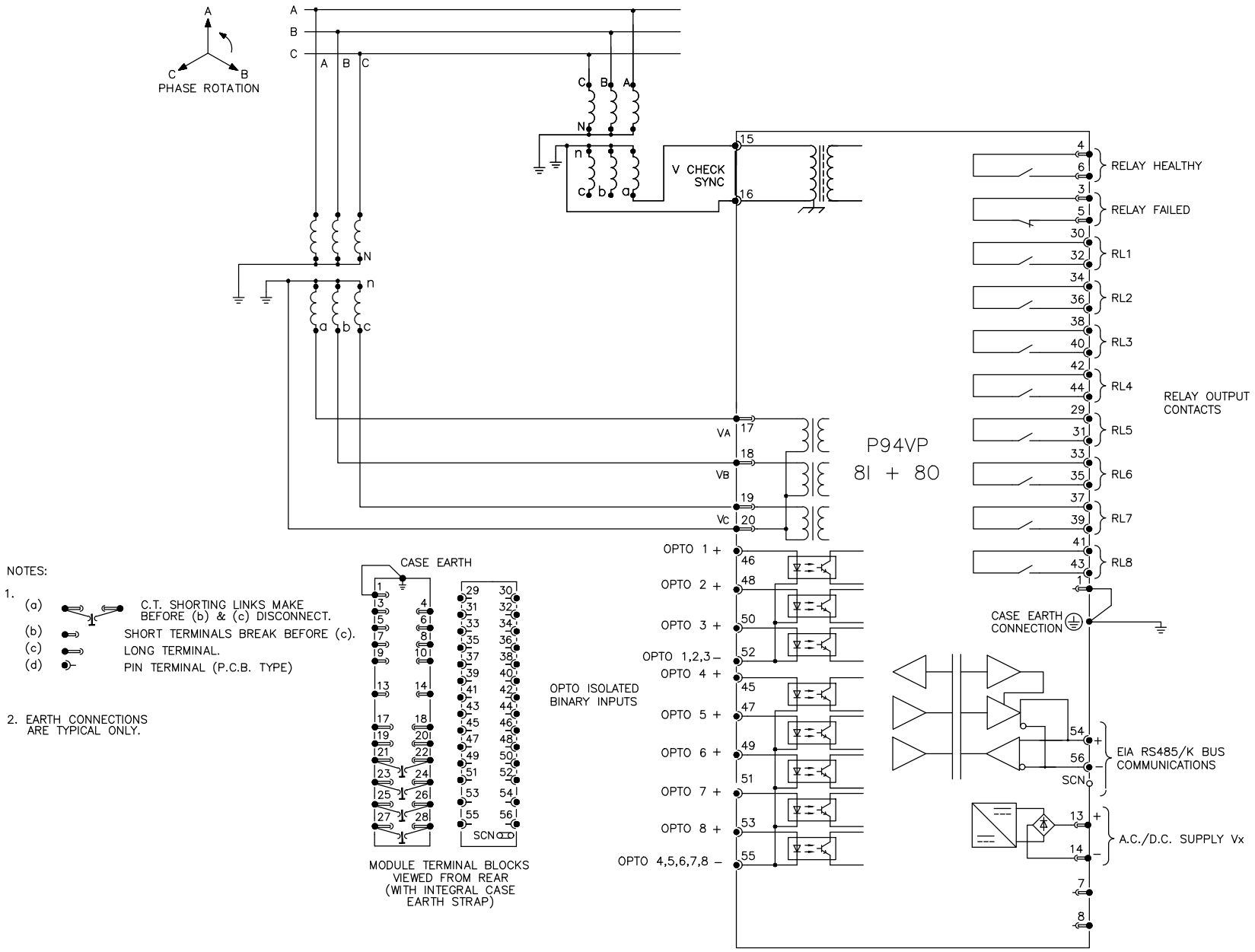

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONIZING (8 I/P & 8 O/P)		
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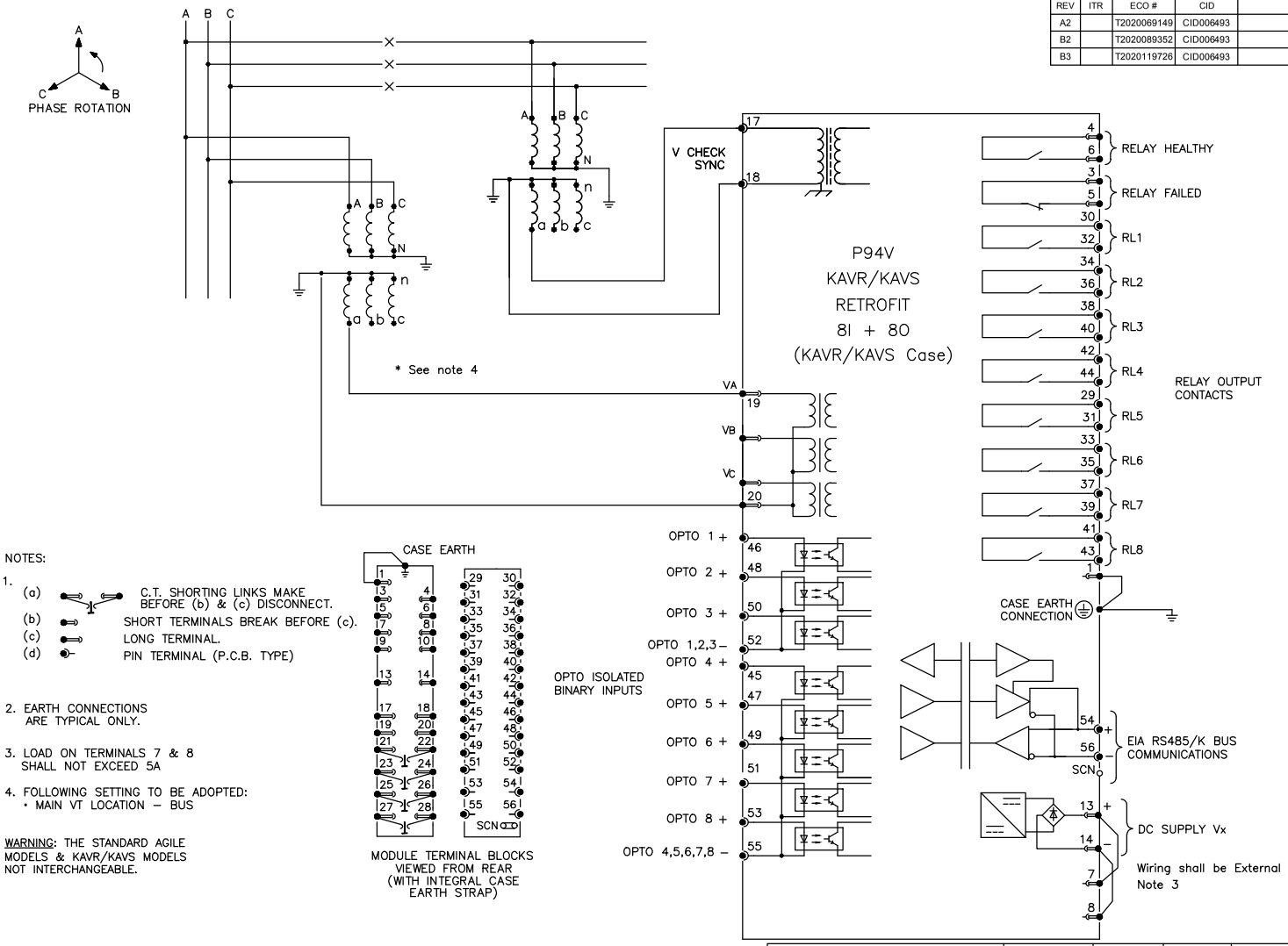
Date: 12/12/2011	Chkd: K.VENKATARAMAN			Next Sht: -	

REVISION HISTORY						
REV	ITR	ECO #	CID	DESCRIPTION	DD/MM/YY	APPROVED
A2		T2020069149	CID006493		23/06/20	-
B2		T2020089352	CID006493		24/08/20	-
B3		T2020119726	CID006493		03/12/20	-



NOTES:

1. (a) C.T. SHORTING LINKS MAKE BEFORE (b) & (c) DISCONNECT.
   (b) SHORT TERMINALS BREAK BEFORE (c).
   (c) LONG TERMINAL.
   (d) PIN TERMINAL (P.C.B. TYPE)
2. EARTH CONNECTIONS ARE TYPICAL ONLY.
3. LOAD ON TERMINALS 7 & 8 SHALL NOT EXCEED 5A
4. FOLLOWING SETTING TO BE ADOPTED:
   • MAIN VT LOCATION – BUS

WARNING: THE STANDARD AGILE MODELS & KAVR/KAVS MODELS NOT INTERCHANGEABLE.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE (TBS)		NAME	DD/MM/YY
INTERPRET DIM TOLERANCE PER ASME Y14.5/ISO BS8888	DRAWN		
TOLERANCE MM: 1 PL +/- 2 PL +/- ANGLE +/-	CHECKED		
TOLERANCE INCH: 1 PL +/- .X 2 PL +/- .XX 3 PL +/- .XXX ANGLE +/- 0.5 DEG	APPROVED		23/06/20
THIRD ANGLE PROJECTION	MATERIAL:		
CTQ (Critical to Quality) MAJOR TBD INSPECTION TBD	FINISH:		
	NEXT STAGE: 3		
	SCALE:		

Grid Solutions
GE Power Management
AV. PINOA 10, 48170 ZAMUDIO (SPAIN)

TITLE:	STATUS:
P94V VOLTAGE & FREQUENCY IED (8I/P & 8O/P) FOR KAVR & KAVS RETROFIT (KAVR/KAVS Case)	

SIZE:	DWG.NO.	REV.	ITR.
	10P94V02	B3	

PART NUMBER: SHEET 2

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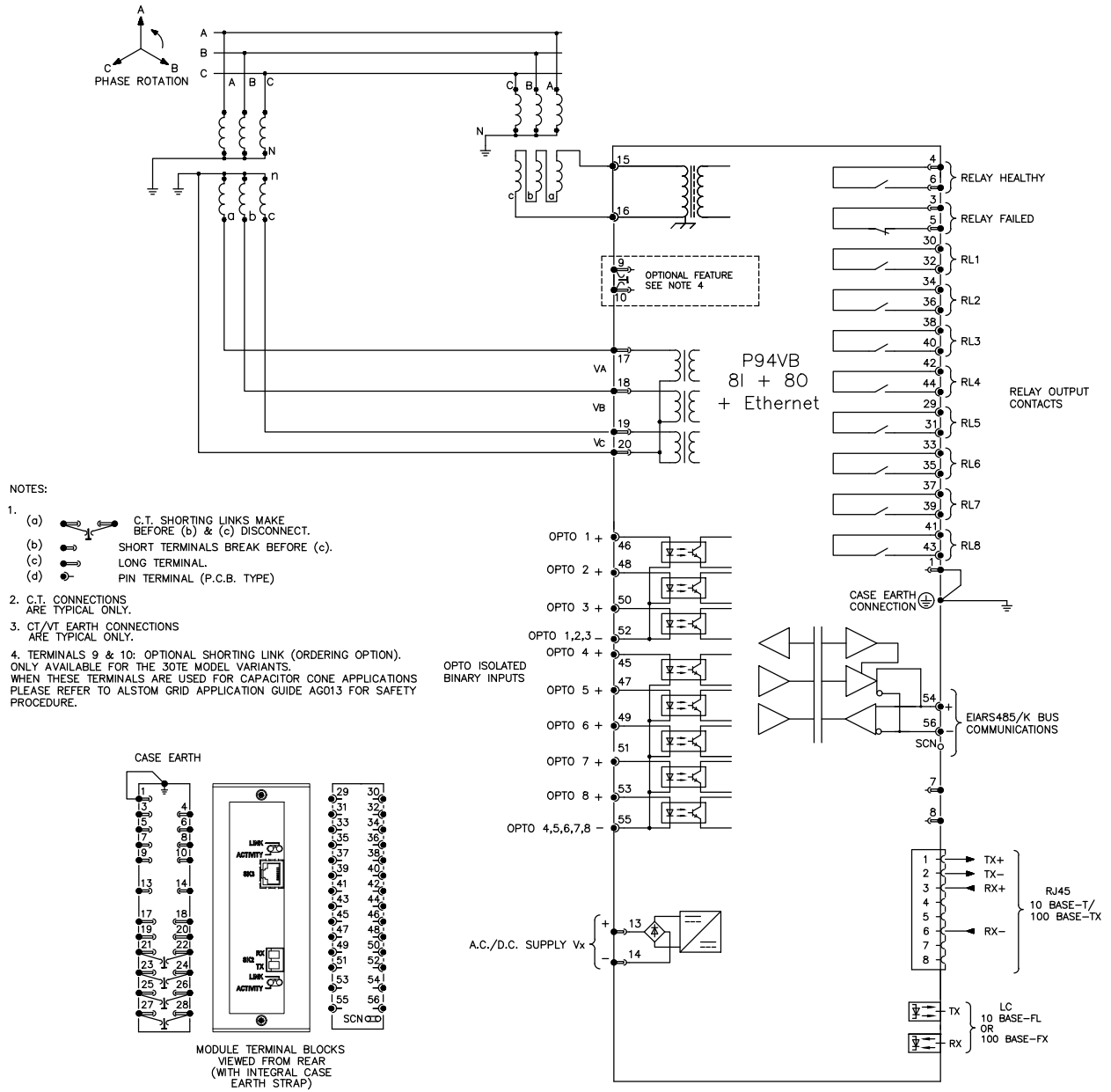

NOTES:

1. (a) C.T. SHORTING LINKS MAKE BEFORE (b) & (c) DISCONNECT.
   (b) SHORT TERMINALS BREAK BEFORE (c).
   (c) LONG TERMINAL.
   (d) PIN TERMINAL (P.C.B. TYPE)
2. C.T. CONNECTIONS ARE TYPICAL ONLY.
3. CT/VT EARTH CONNECTIONS ARE TYPICAL ONLY.
4. TERMINALS 9 & 10: OPTIONAL SHORTING LINK (ORDERING OPTION). ONLY AVAILABLE FOR THE 30TE MODEL VARIANTS. WHEN THESE TERMINALS ARE USED FOR CAPACITOR CONE APPLICATIONS PLEASE REFER TO ALSTOM GRID APPLICATION GUIDE AG013 FOR SAFETY PROCEDURE.

Issue: E	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE & FREQUENCY IED- SEPARATE RESIDUAL VOLTAGE I/P (8 I/P & 8 O/P) WITH ETHERNET & OPTIONAL SHORTING LINK	
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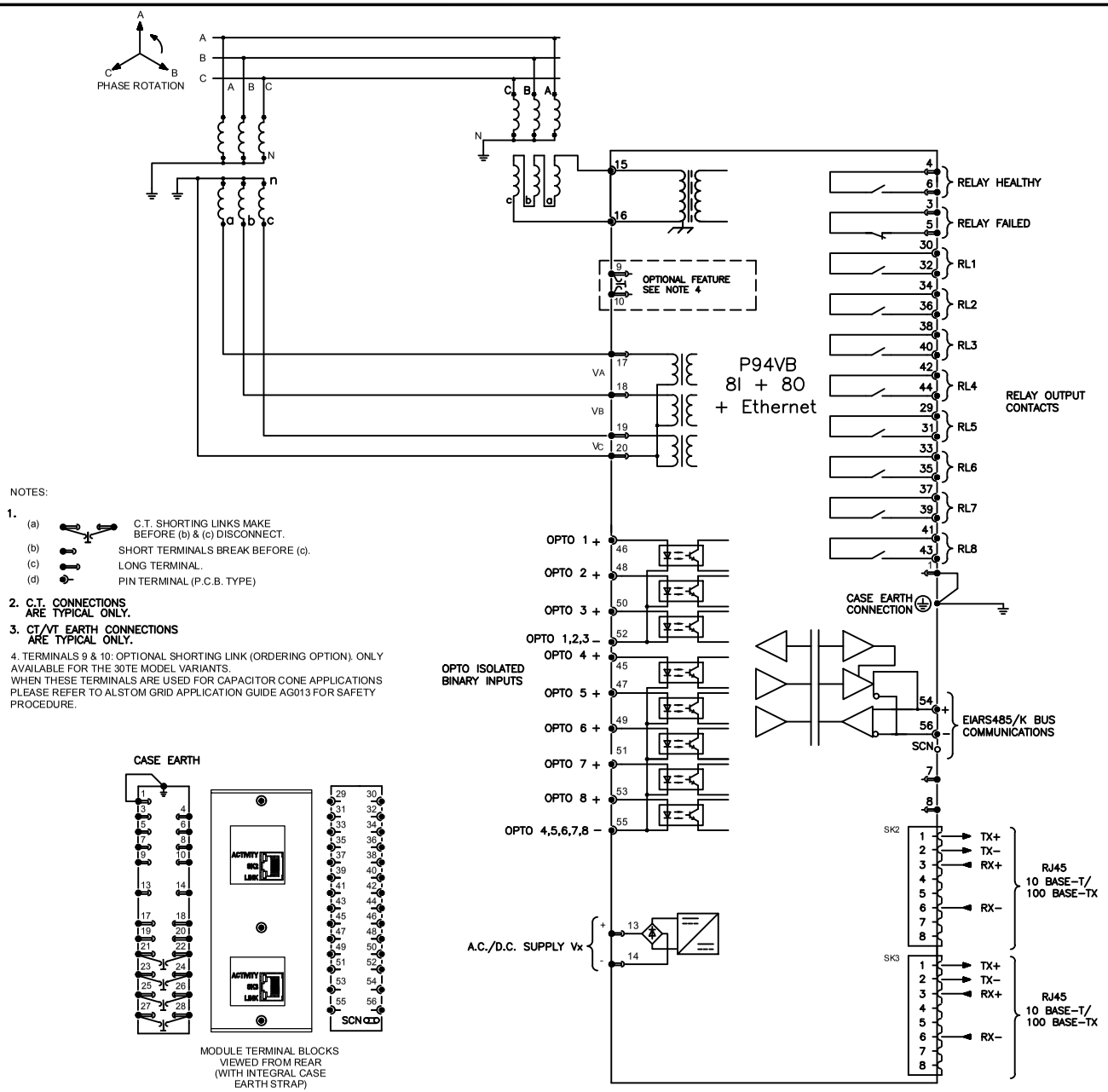

NOTES:

1.
   (a) C.T. SHORTING LINKS MAKE BEFORE (b) & (c) DISCONNECT.
   (b) SHORT TERMINALS BREAK BEFORE (c).
   (c) LONG TERMINAL.
   (d) PIN TERMINAL (P.C.B. TYPE)

2. C.T. CONNECTIONS ARE TYPICAL ONLY.

3. CT/VT EARTH CONNECTIONS ARE TYPICAL ONLY.

4. TERMINALS 9 & 10: OPTIONAL SHORTING LINK (ORDERING OPTION). ONLY AVAILABLE FOR THE 30TE MODEL VARIANTS.
WHEN THESE TERMINALS ARE USED FOR CAPACITOR CONE APPLICATIONS PLEASE REFER TO ALSTOM GRID APPLICATION GUIDE AG013 FOR SAFETY PROCEDURE.

Issue: C	Revision: CID006234 Outlines updated to GE Format	Title: P94V VOLTAGE & FREQUENCY IED-SEPARATE RESIDUAL VOLTAGE I/P (8I/P & 8O/P),DUAL COPPER ETHERNET,OPTIONAL SHORTING LINK	
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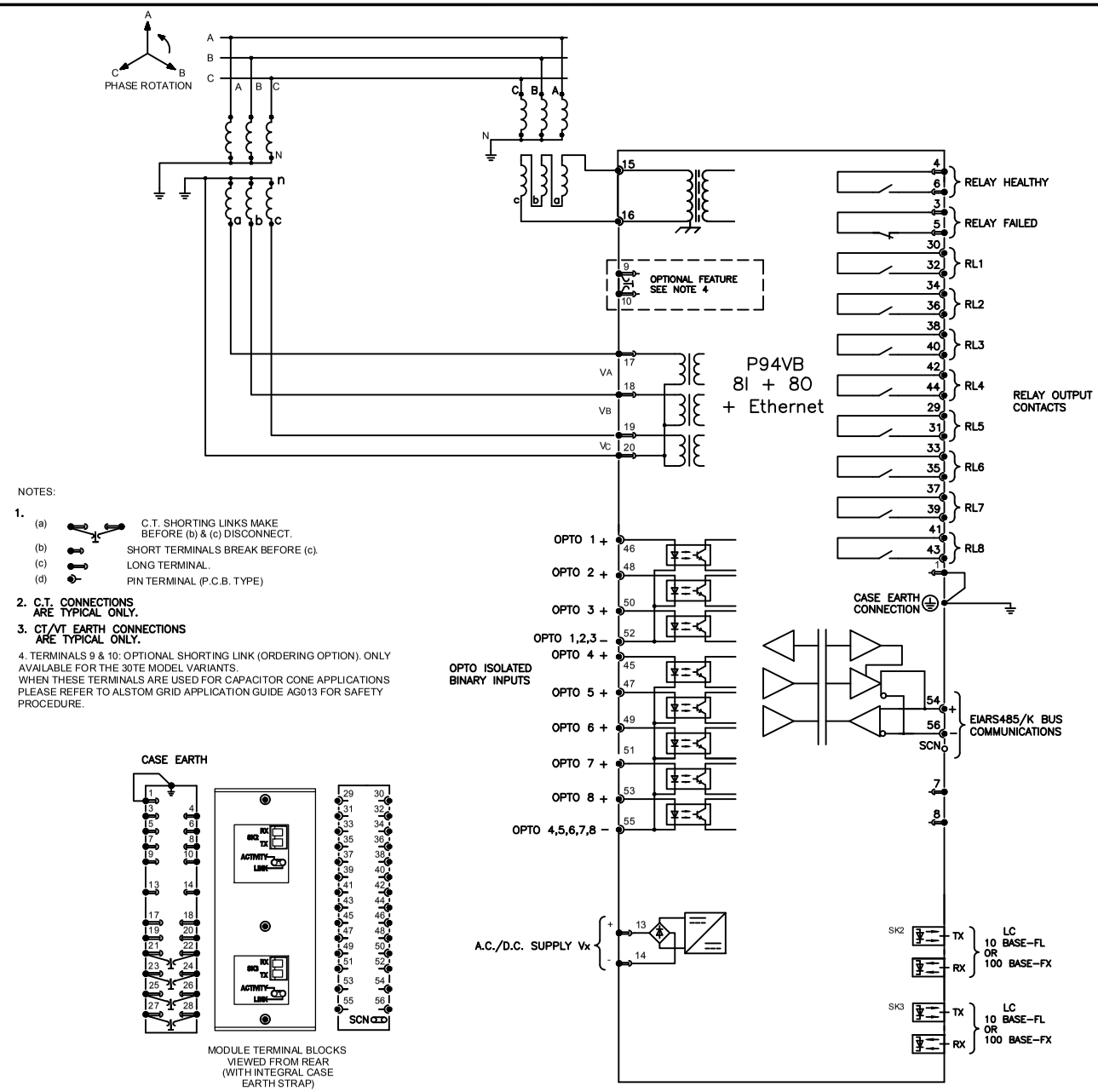

NOTES:

1.
   (a) C.T. SHORTING LINKS MAKE BEFORE (b) & (c) DISCONNECT.
   (b) SHORT TERMINALS BREAK BEFORE (c).
   (c) LONG TERMINAL.
   (d) PIN TERMINAL (P.C.B. TYPE)

2. C.T. CONNECTIONS ARE TYPICAL ONLY.

3. CT/VT EARTH CONNECTIONS ARE TYPICAL ONLY.

4. TERMINALS 9 & 10: OPTIONAL SHORTING LINK (ORDERING OPTION). ONLY AVAILABLE FOR THE 30TE MODEL VARIANTS.
WHEN THESE TERMINALS ARE USED FOR CAPACITOR CONE APPLICATIONS PLEASE REFER TO ALSTOM GRID APPLICATION GUIDE AG013 FOR SAFETY PROCEDURE.

MODULE TERMINAL BLOCKS
VIEWED FROM REAR
(WITH INTEGRAL CASE
EARTH STRAP)

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE & FREQUENCY IED-SEPARATE RESIDUAL VOLTAGE I/P (8I/P & 8O/P), DUAL FIBRE ETHERNET & OPTIONAL SHORTING LINK	
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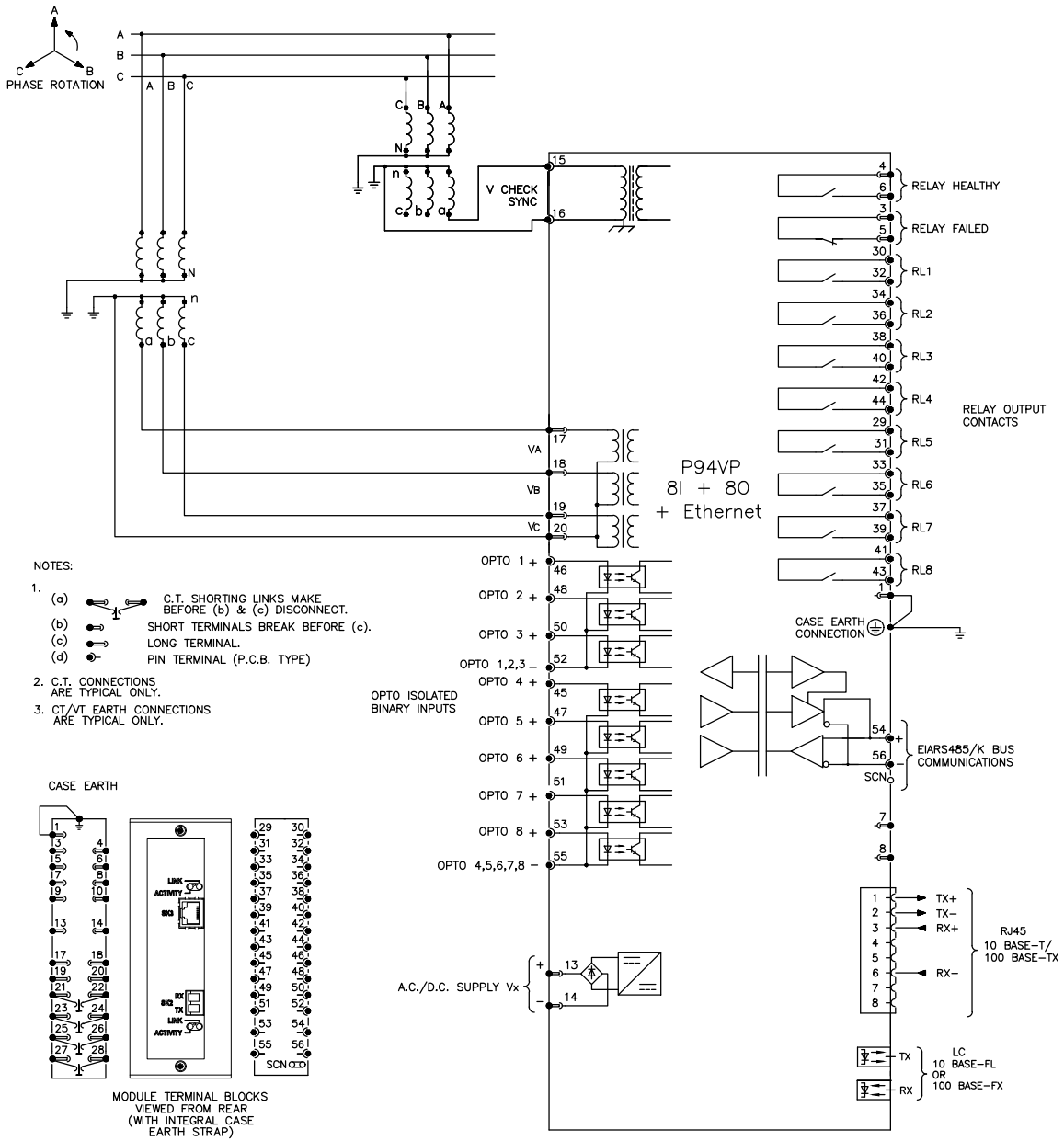

Issue: D	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (8 I/P & 8 O/P) WITH ETHERNET		
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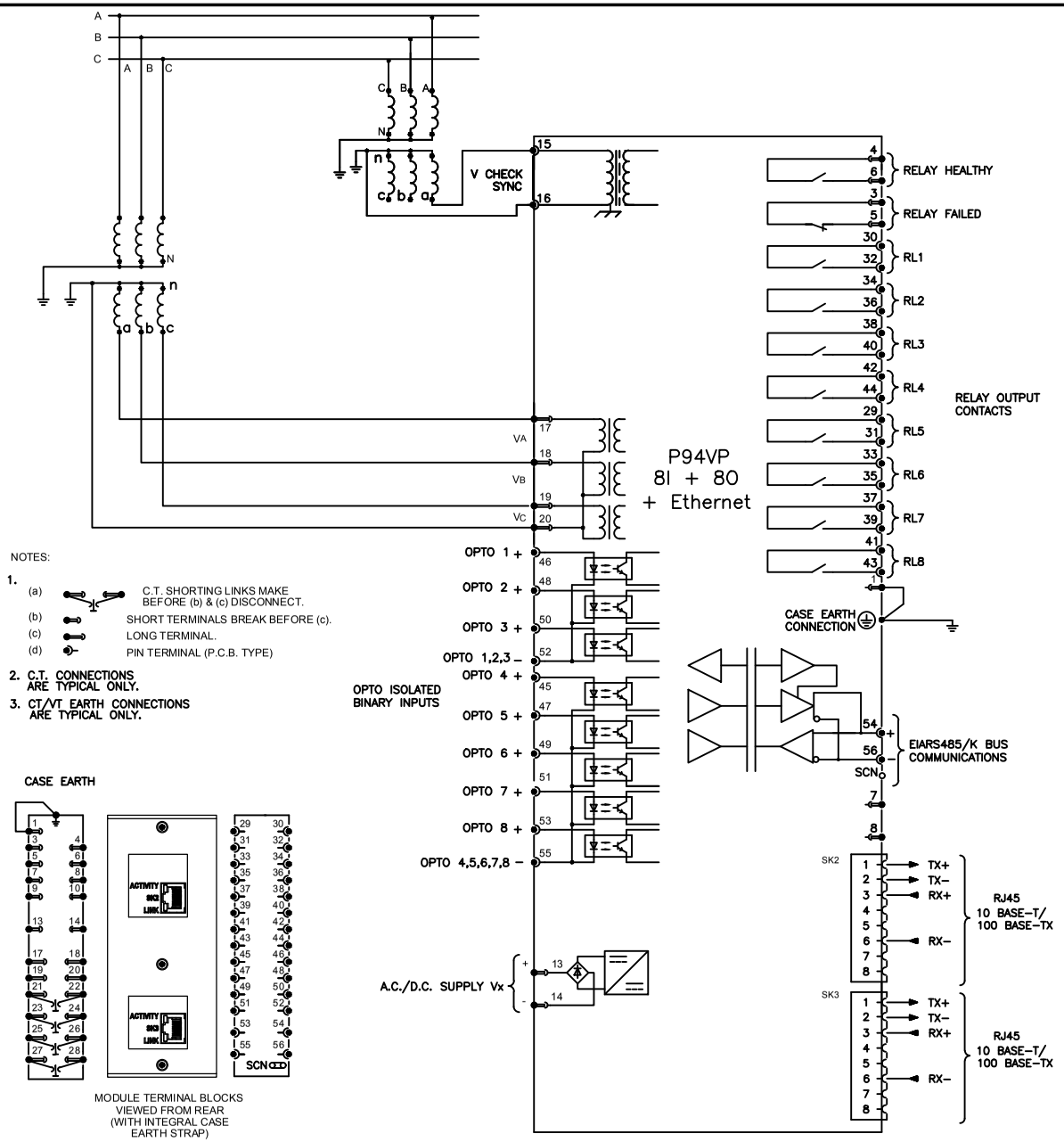

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE & FREQUENCY IED WITH CHECK SYNCHRONISING (8 I/P & 8 O/P) WITH DUAL COPPER ETHERNET	
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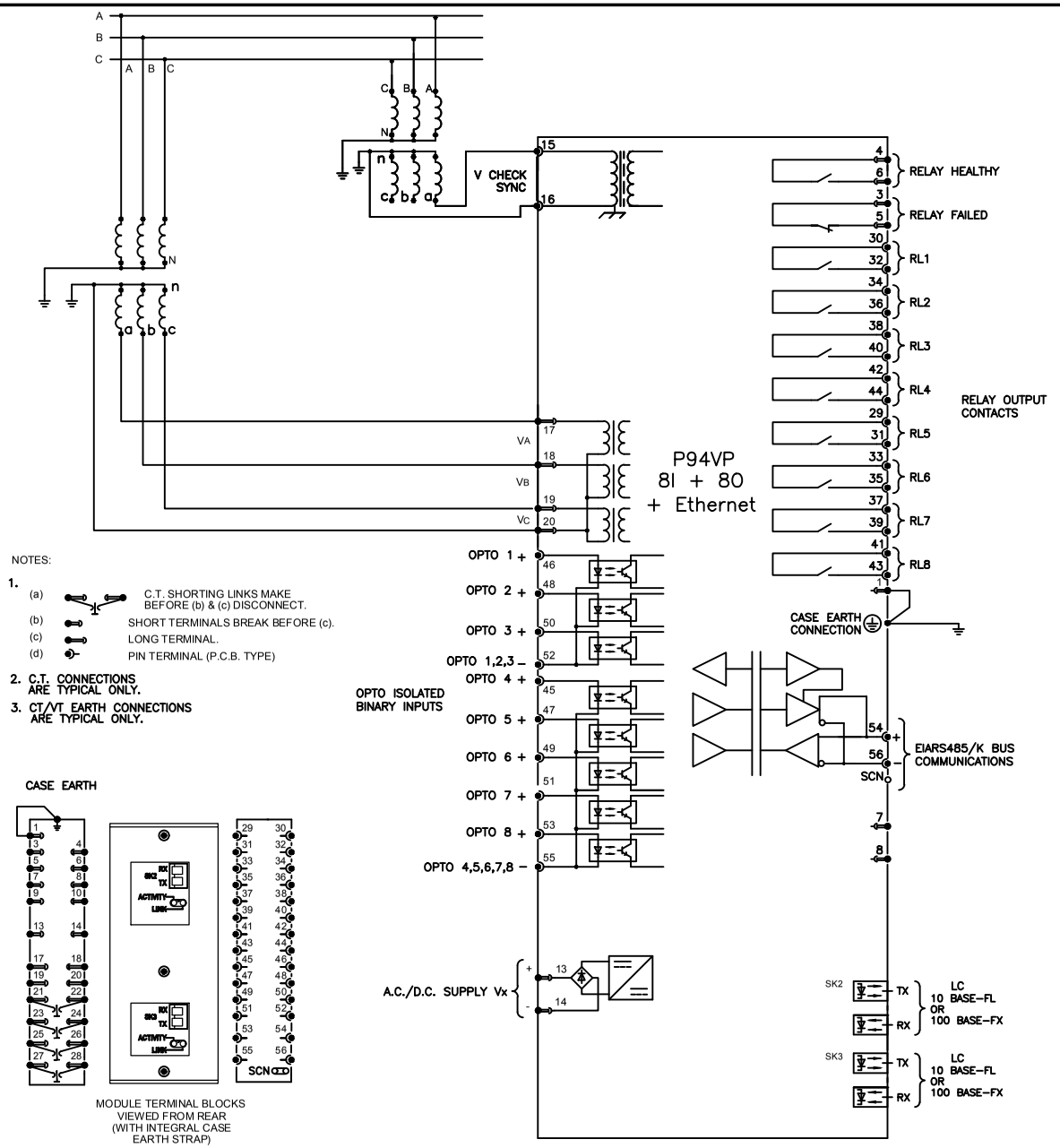

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE & FREQUENCY IED WITH CHECK SYNCHRONISING (8 I/P & 8 O/P) WITH DUAL FIBRE ETHERNET	
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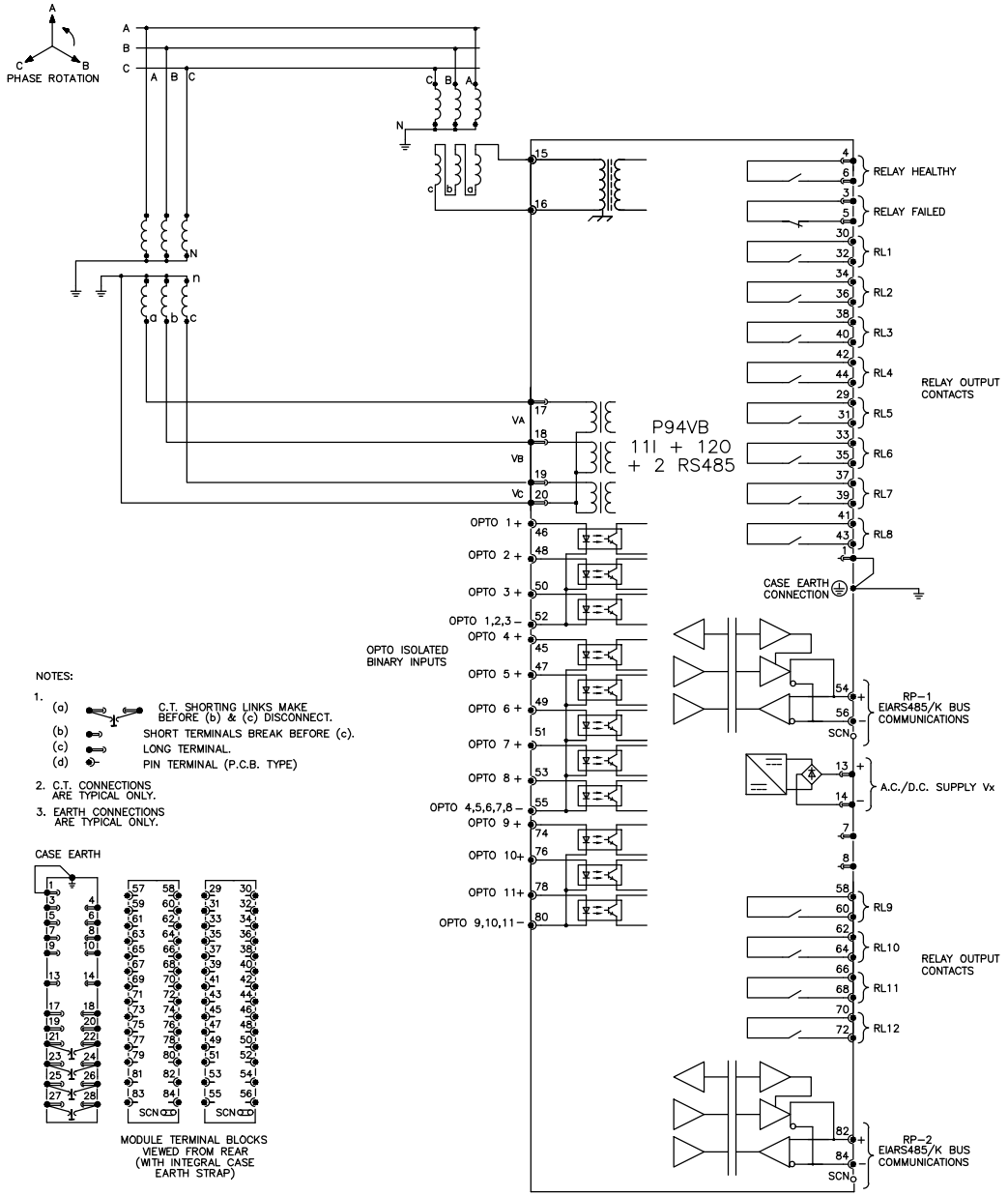

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH SEPARATE RESIDUAL VOLTAGE INPUT (11 I/P & 12 O/P) WITH 2 RS485		
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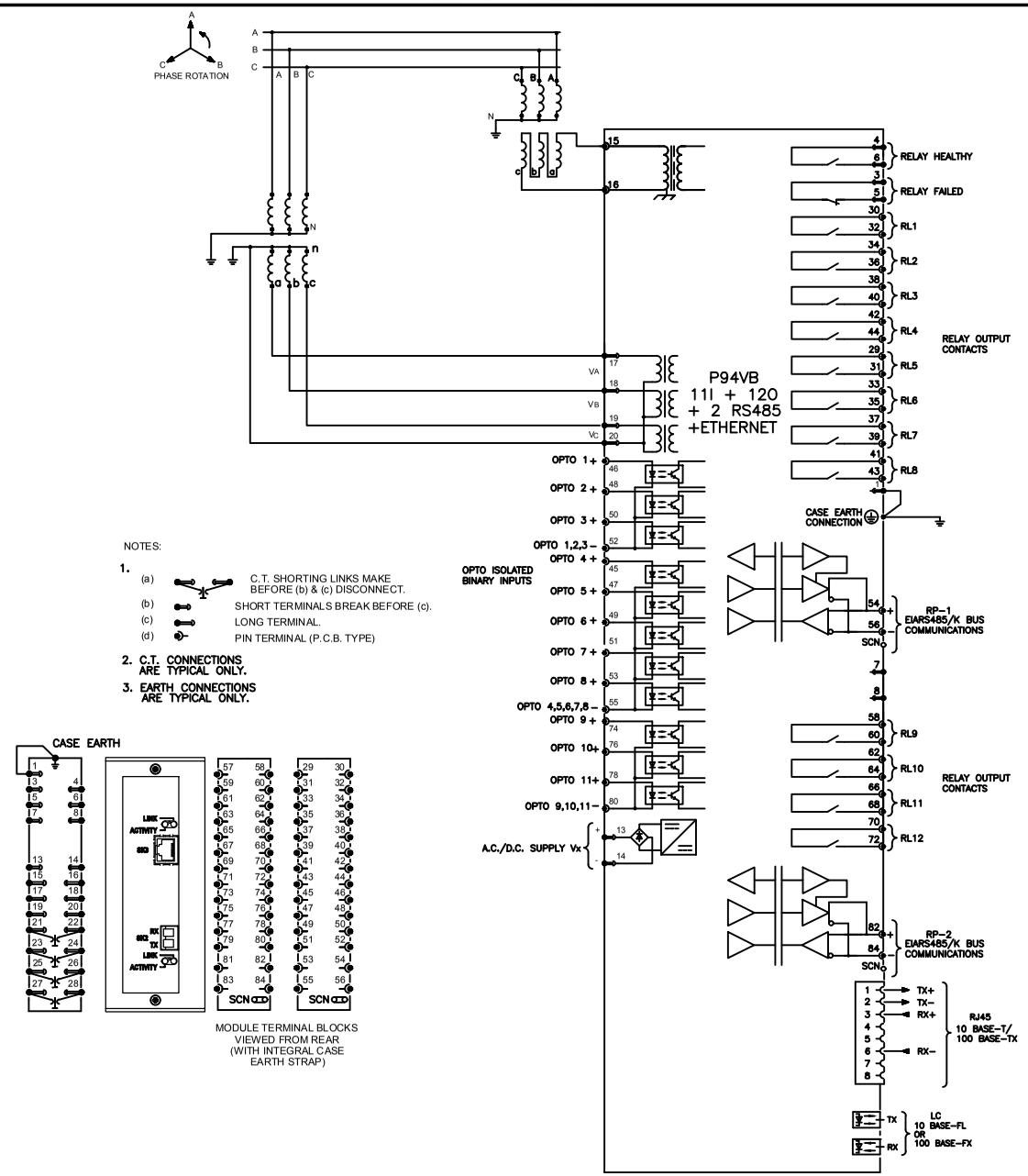

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH SEPARATE RESIDUAL VOLTAGE INPUT (11 I/P & 12 O/P) WITH 2 RS485 & ETHERNET		
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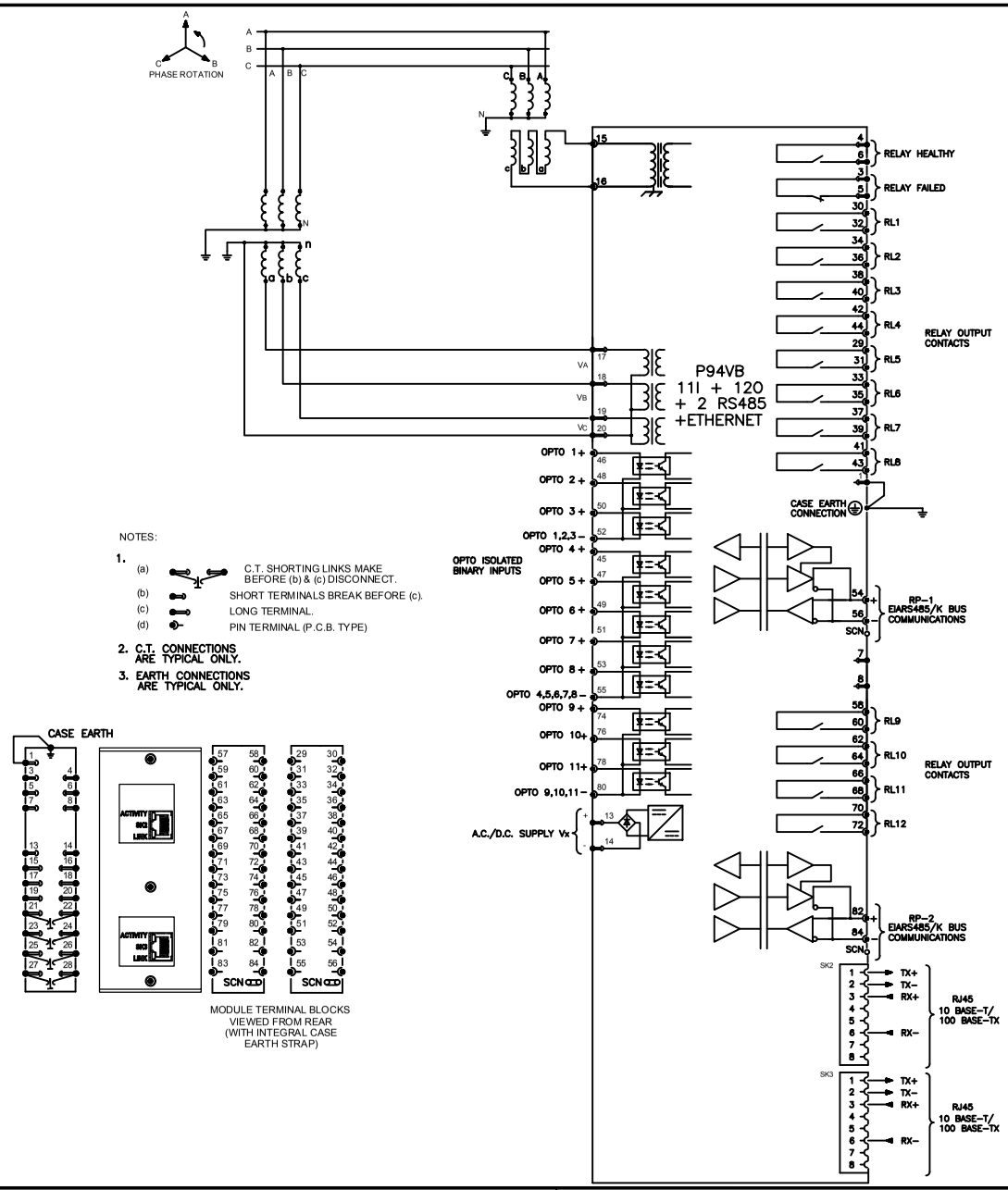

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE & FREQ.IED WITH SEPARATE RESIDUAL VOLTAGE INPUT (11 I/P & 12 O/P) WITH 2 RS485 & DUAL COPPER ETHERNET	
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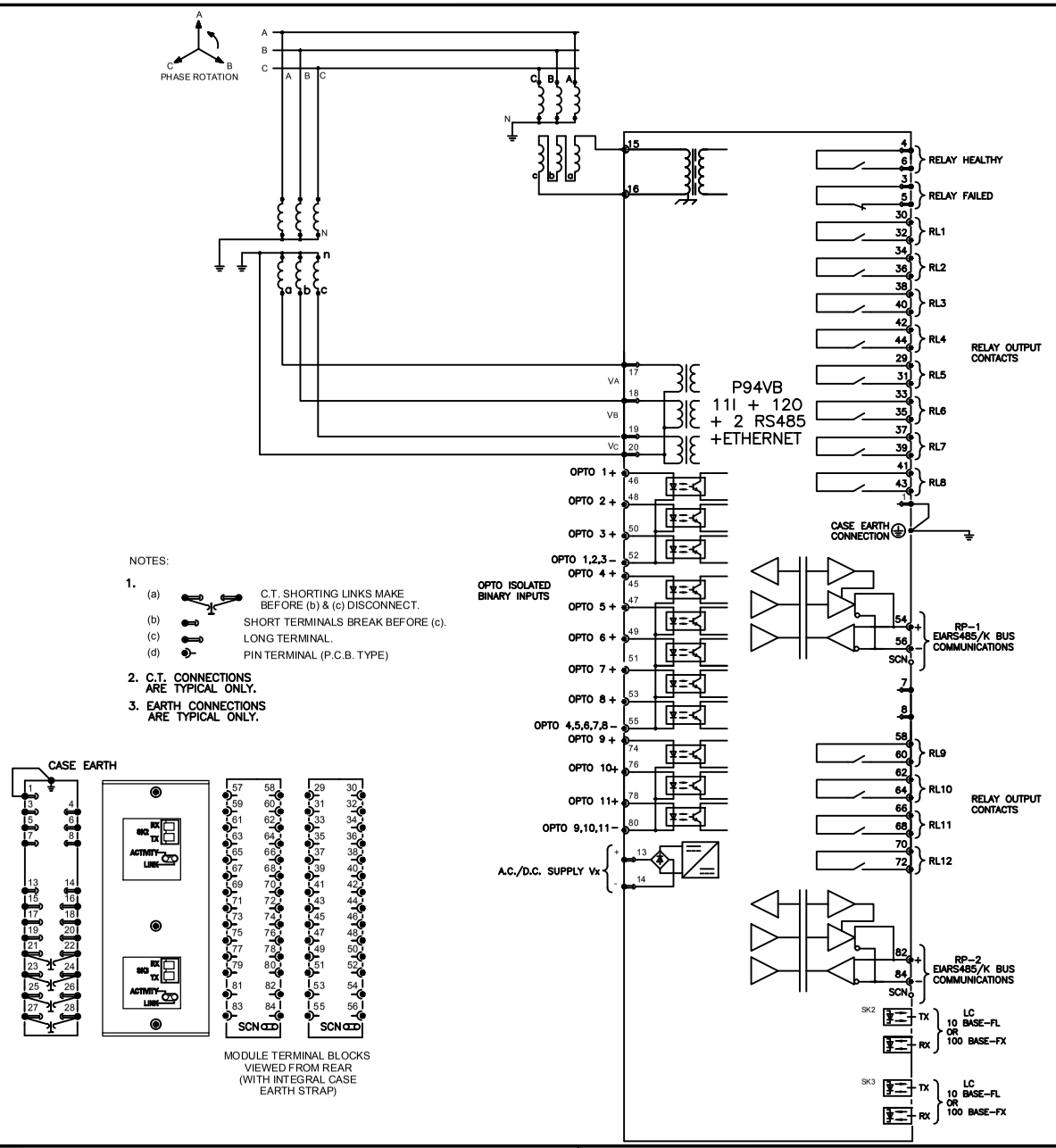

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE & FREQ. IED WITH SEPARATE RESIDUAL VOLTAGE INPUT (11 I/P & 12 O/P) WITH 2 RS485 & DUAL FIBRE ETHERNET	
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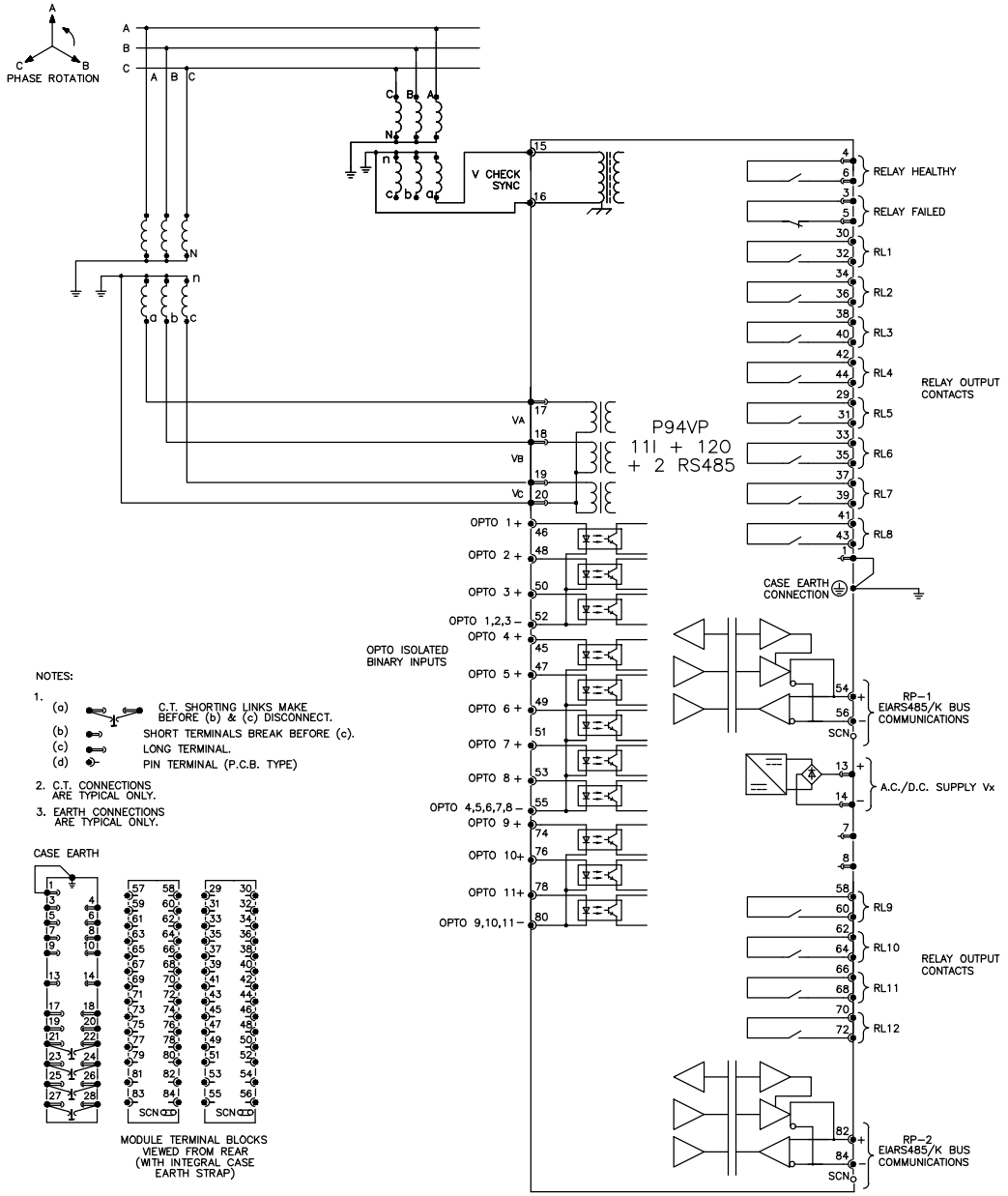

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (11 I/P & 12 O/P) WITH 2 RS485		
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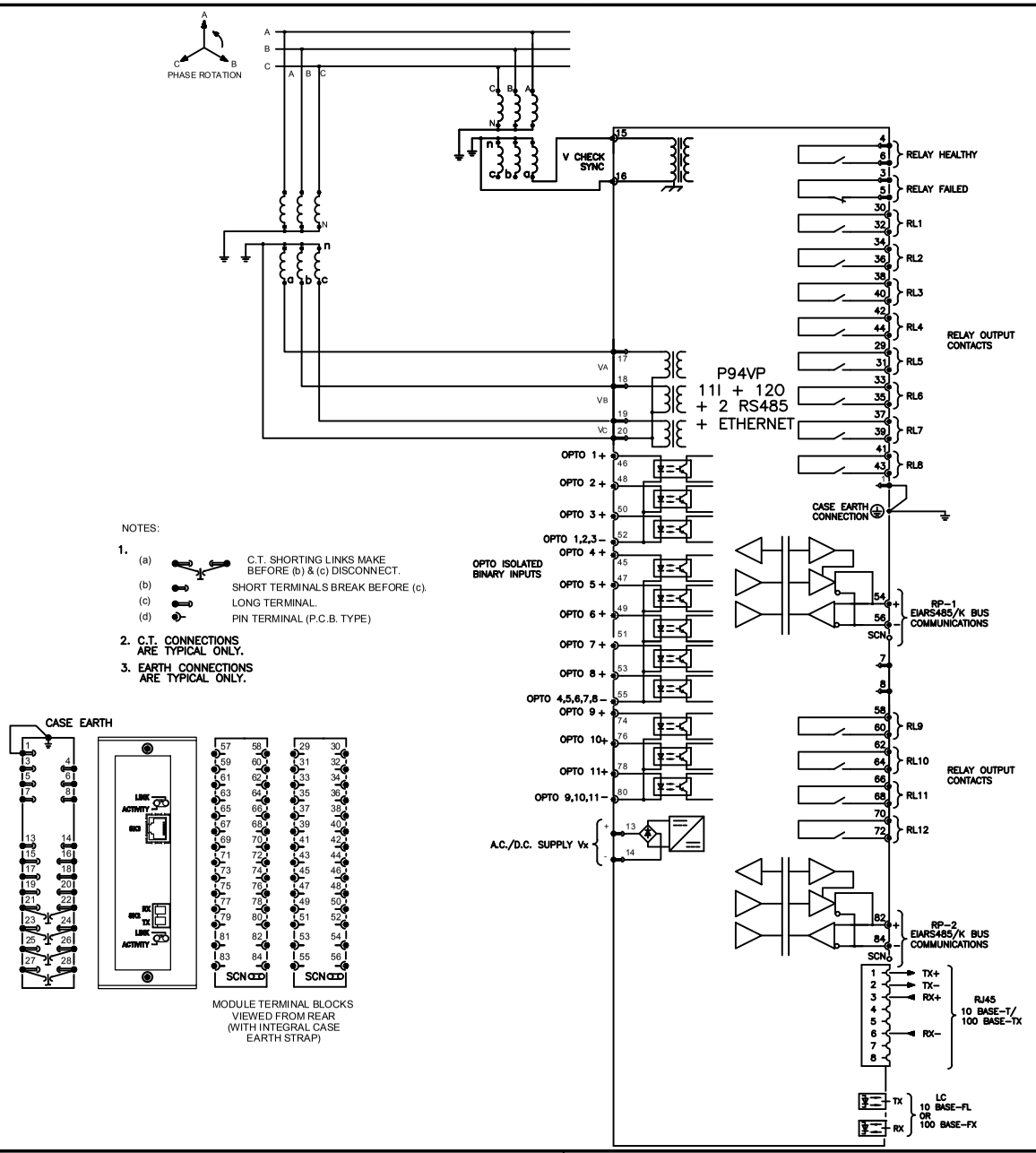

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE & FREQUENCY IED WITH CHECK SYNCH. (11 I/P & 12 O/P) WITH 2 RS485 & ETHERNET		
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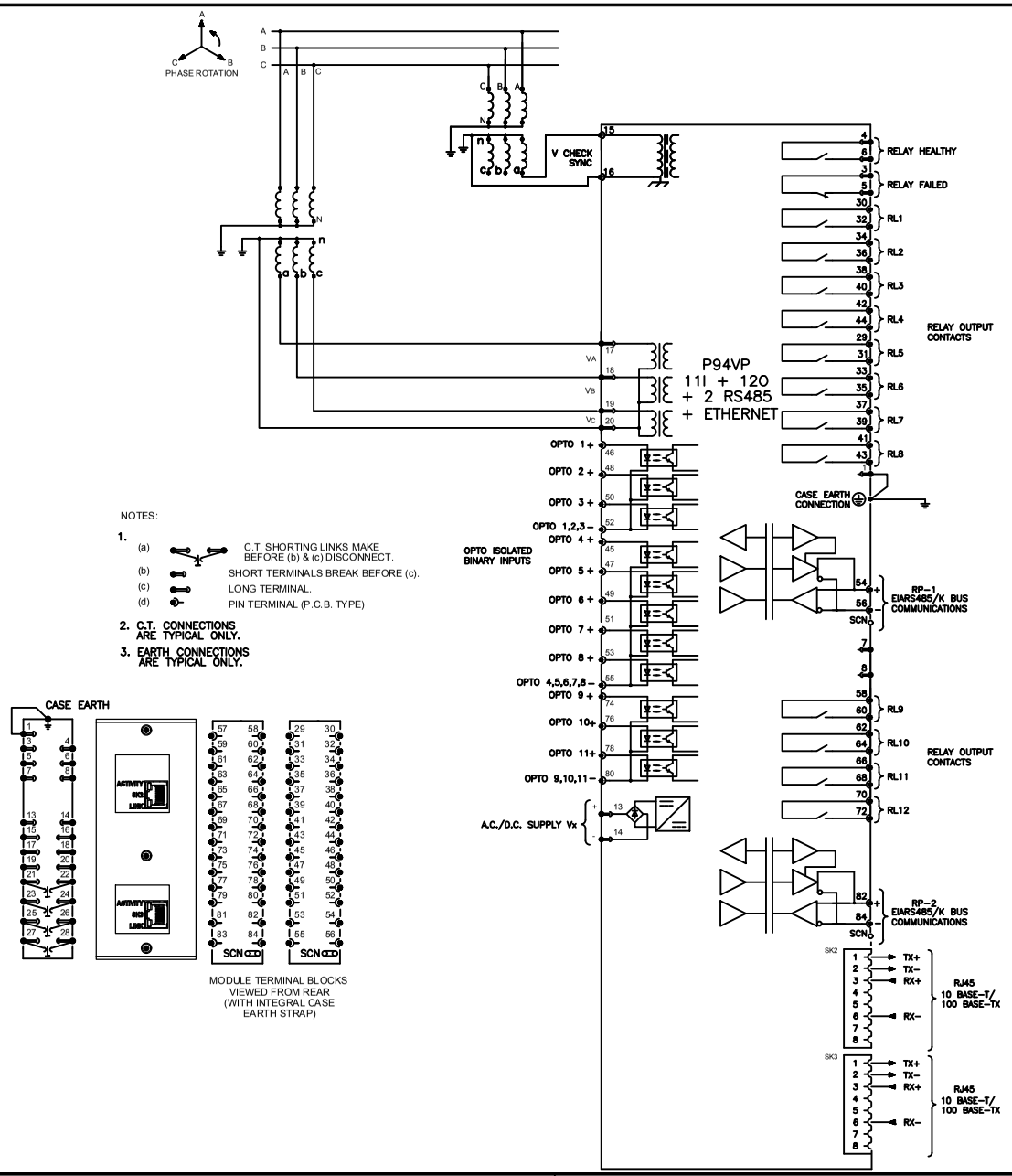

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE & FREQUENCY IED WITH CHECK SYNCH. (11 I/P & 12 O/P) WITH 2 RS485 & DUAL COPPER ETHERNET		
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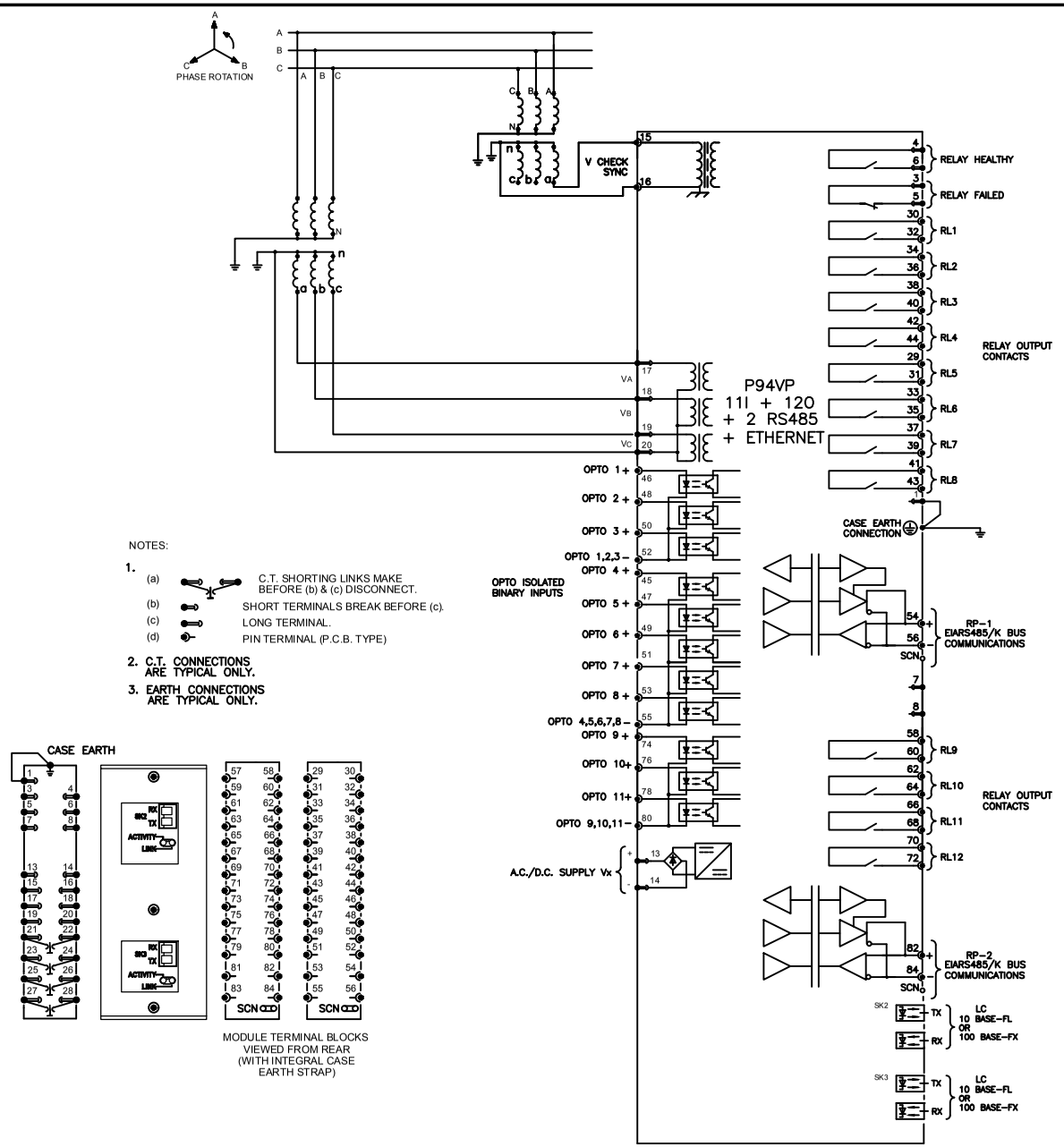

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE & FREQUENCY IED WITH CHECK SYNCH. (11 I/P & 12 O/P) WITH 2 RS485 & DUAL FIBRE ETHERNET	
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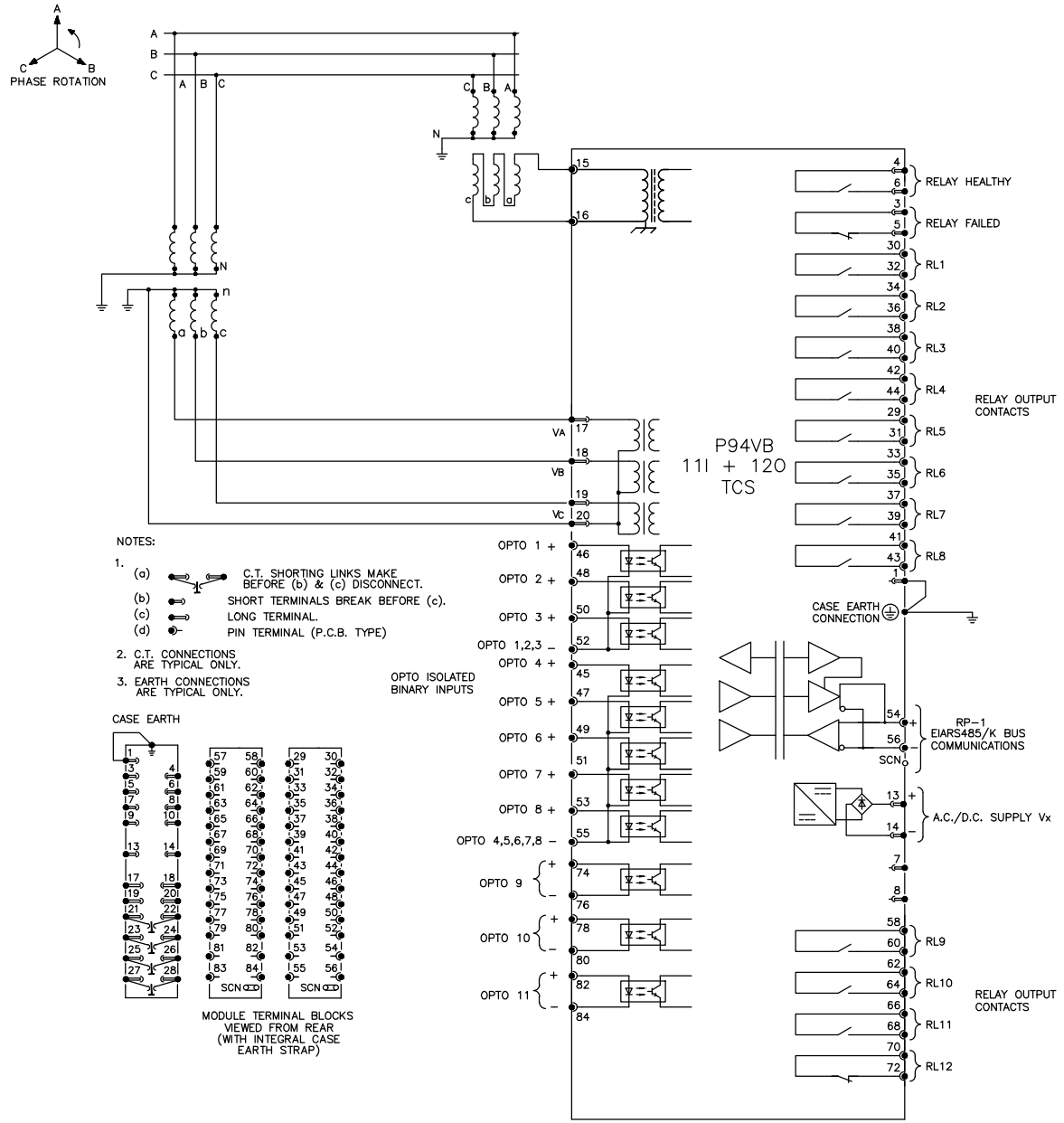

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH SEPARATE RESIDUAL VOLTAGE INPUT (11 I/P & 12 O/P) WITH TCS		
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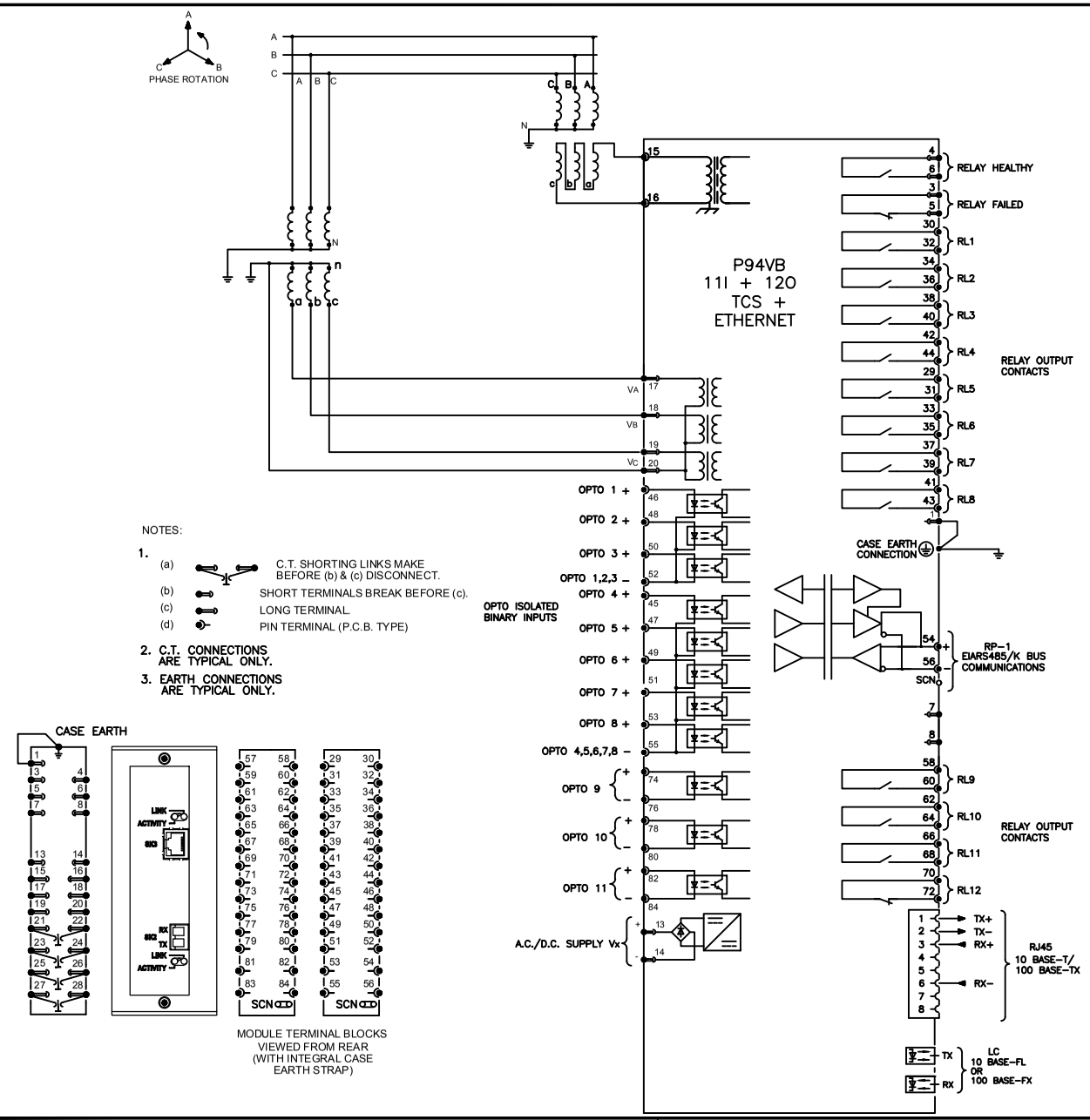
Date: 30/08/2013	Chkd: K.VENKATARAMAN			Next Sht: -	



Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE & FREQUENCY IED WITH SEPARATE RESIDUAL VOLTAGE INPUT (11 I/P & 12 O/P) WITH TCS & ETHERNET		
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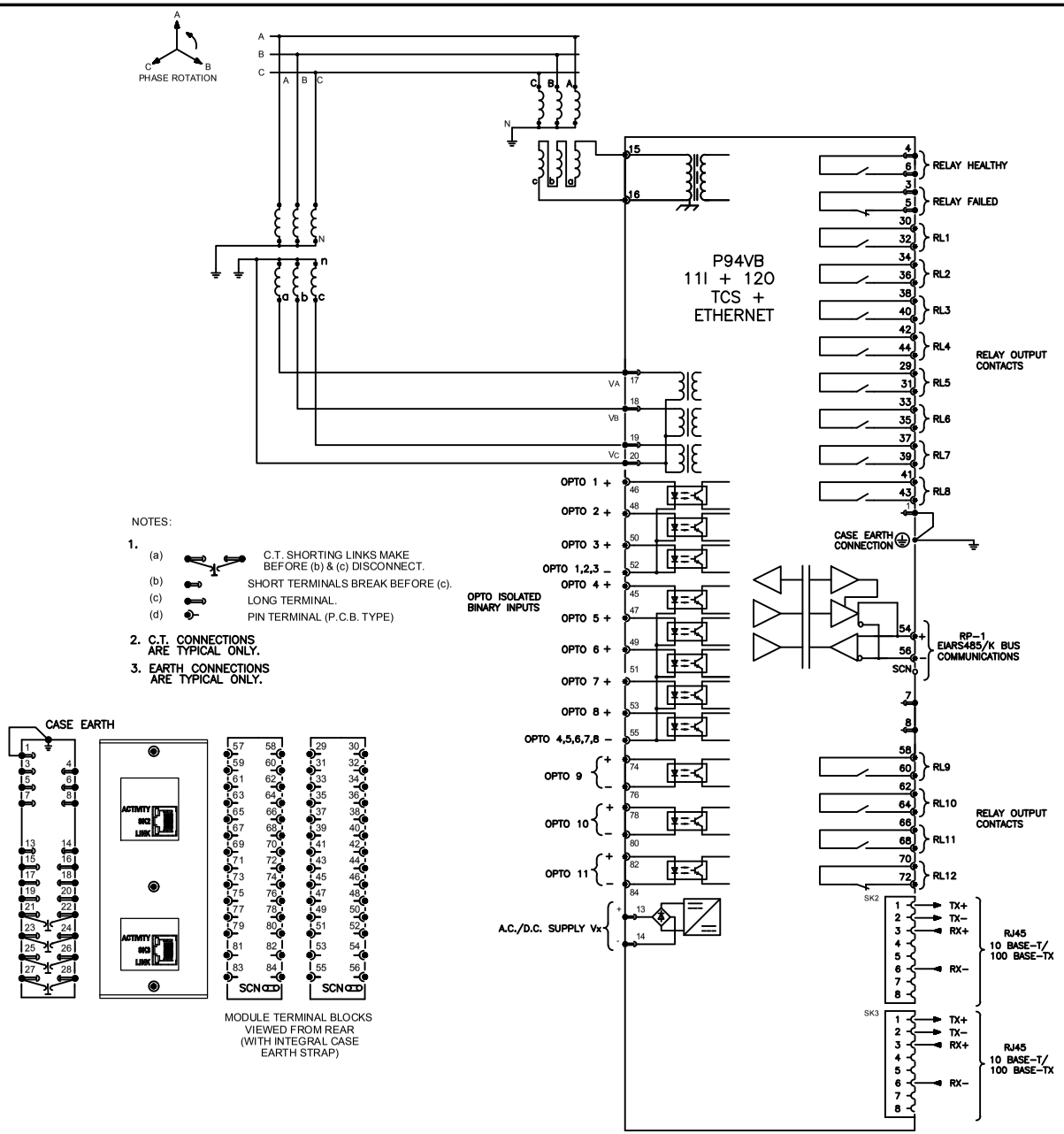

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE & FREQ.IED WITH SEPARATE RESIDUAL VOLTAGE INPUT (11 I/P & 12 O/P) WITH TCS & DUAL COPPER ETHERNET		
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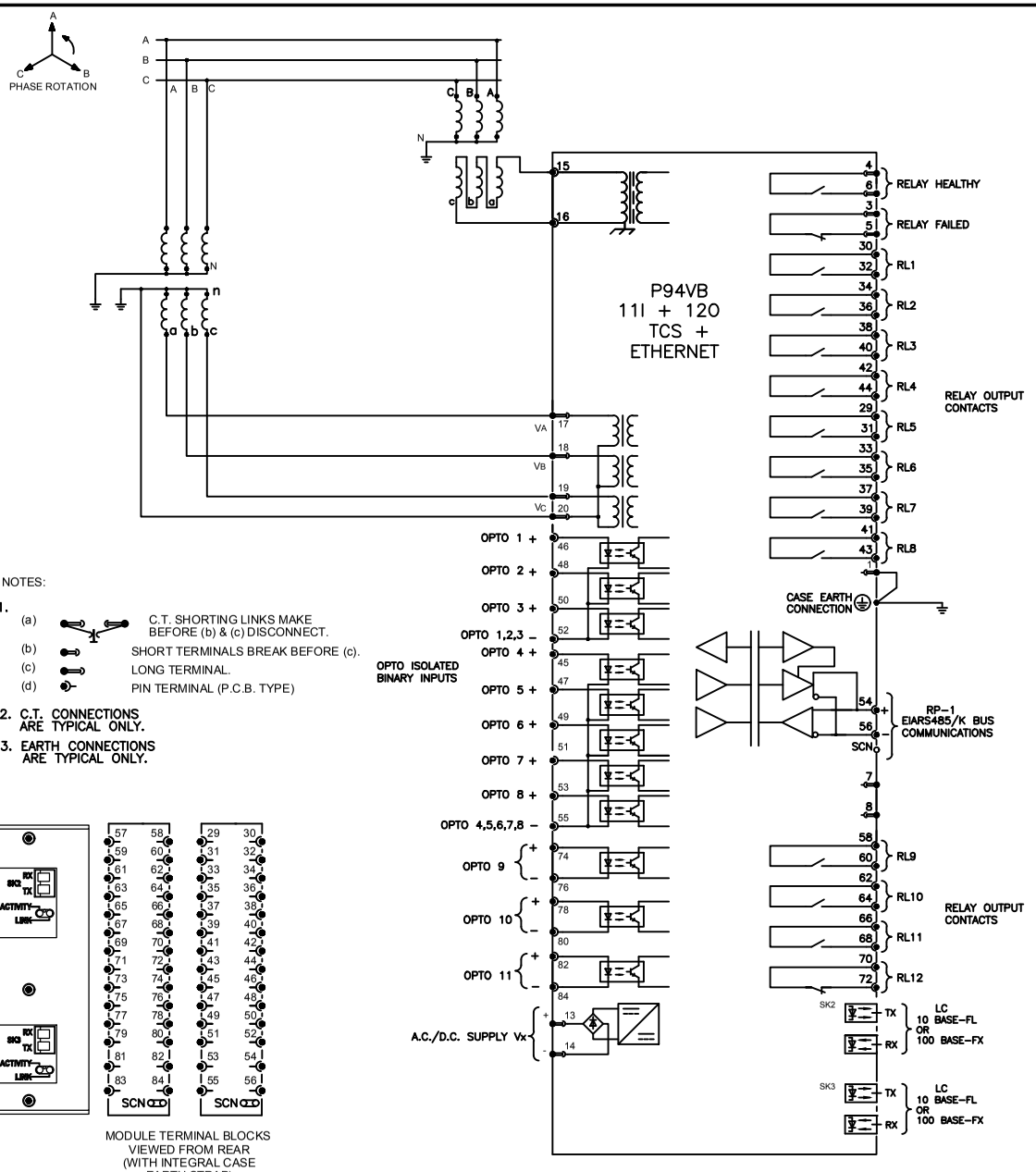

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE & FREQUENCY IED WITH SEPARATE RESIDUAL VOLTAGE I/P (11 I/P & 12 O/P) WITH TCS & DUAL FIBRE ETHERNET	
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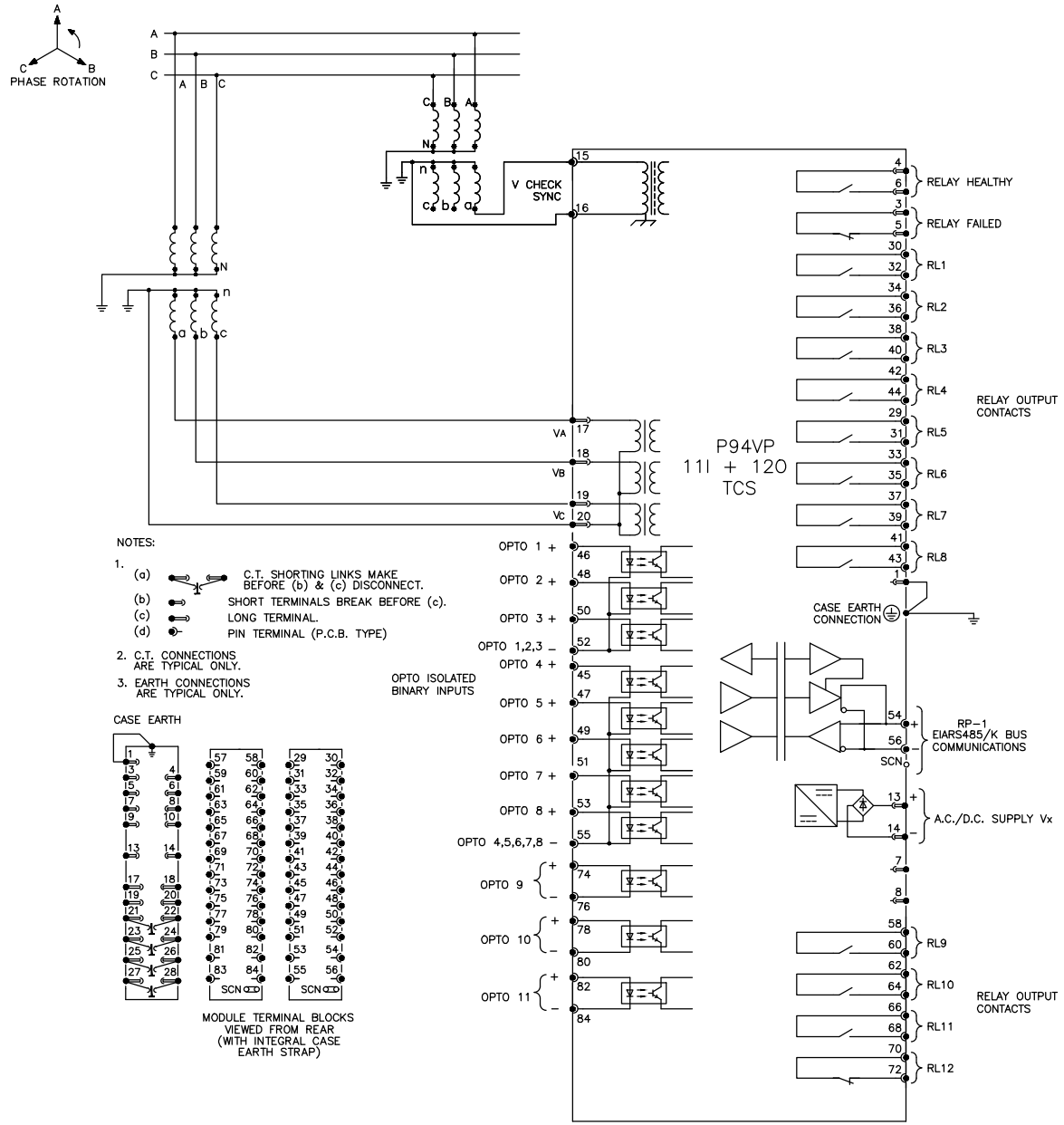

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (11 I/P & 12 O/P) WITH TCS		
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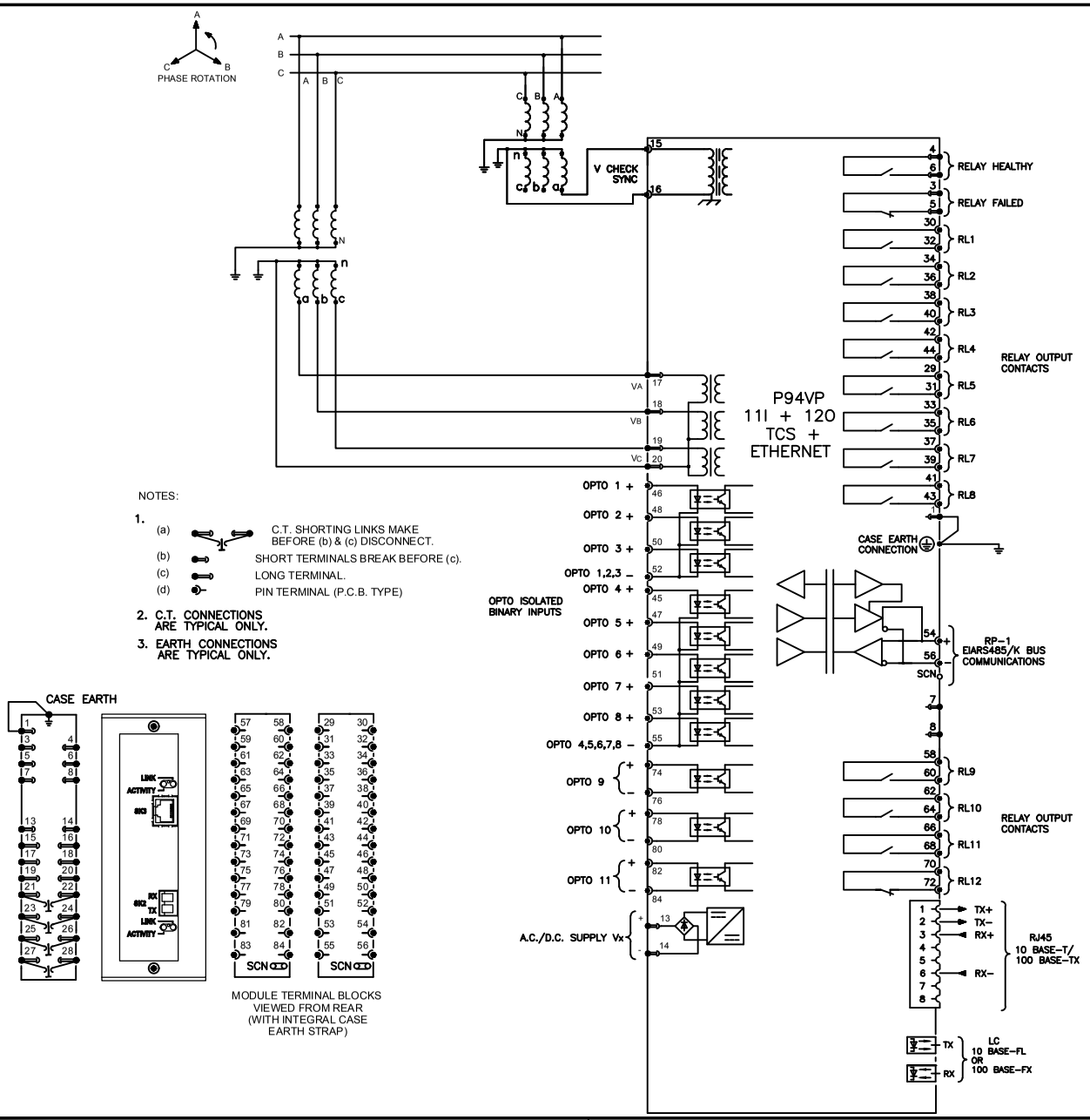

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (11 I/P & 12 O/P) WITH TCS & ETHERNET	
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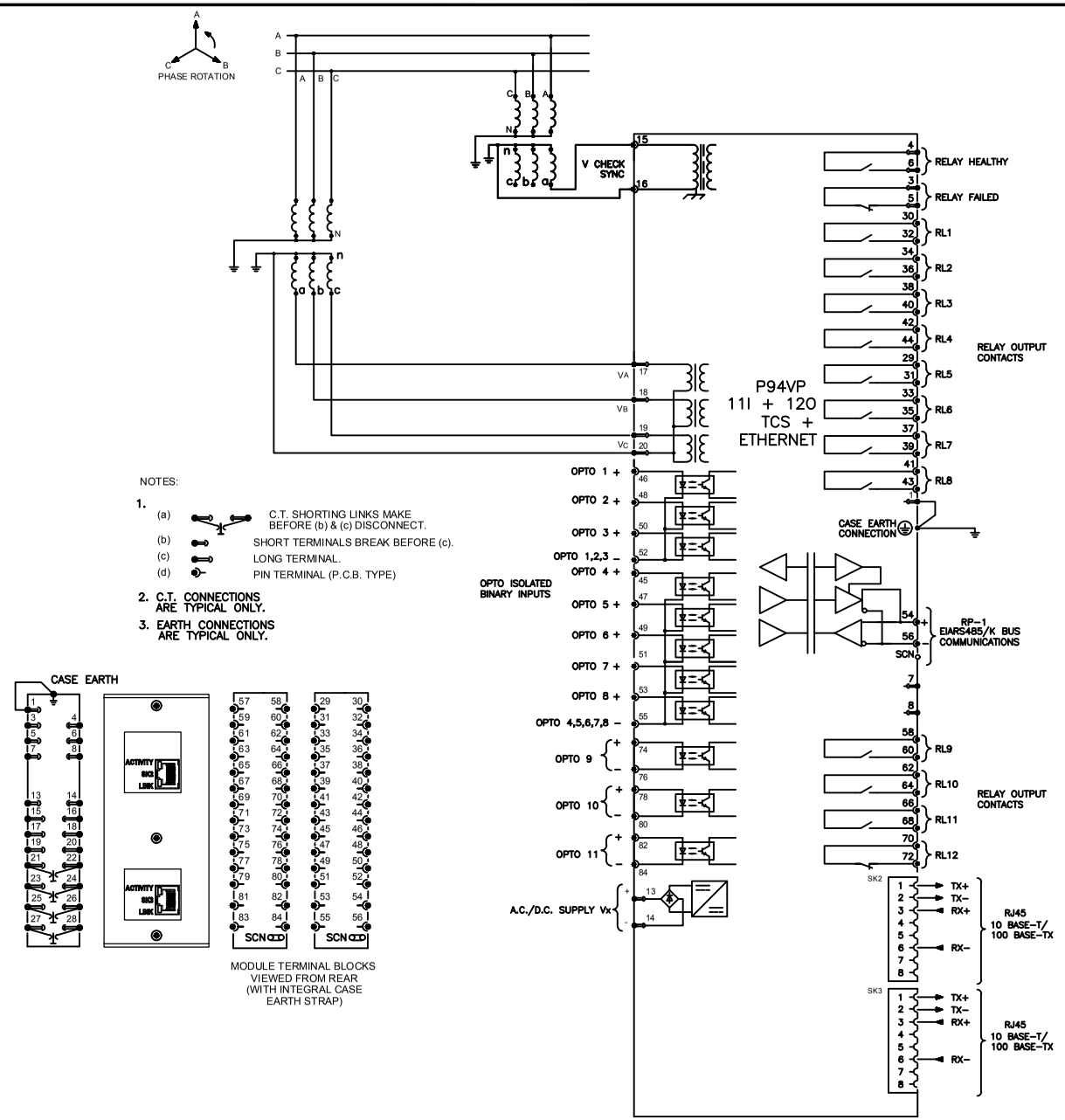

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE & FREQUENCY IED WITH CHECK SYNCHRONISING (11 I/P & 12 O/P) WITH TCS & DUAL COPPER ETHERNET		
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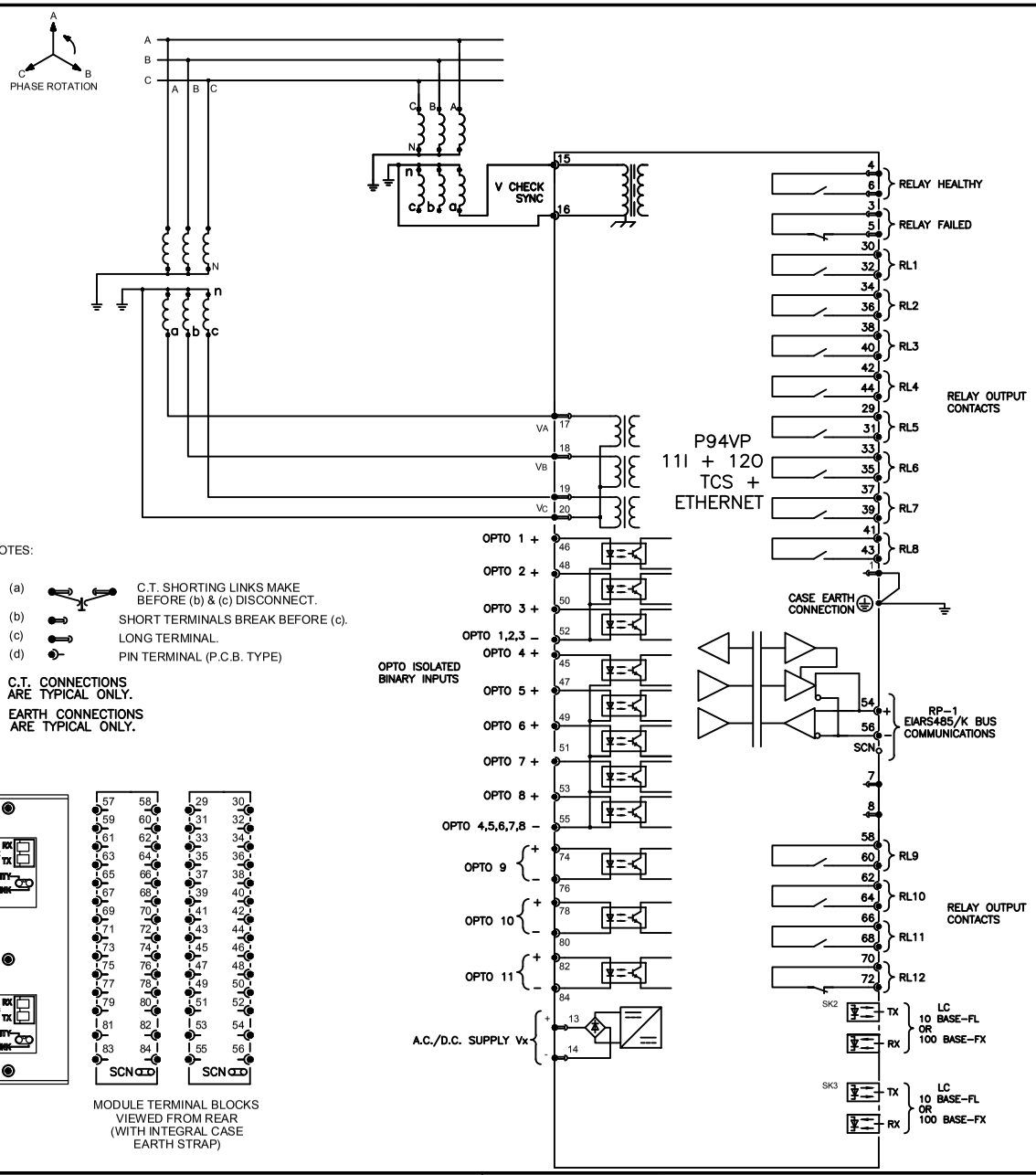

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH CHECK SYNCH. (11 I/P & 12 O/P) WITH TCS & DUAL FIBRE ETHERNET		
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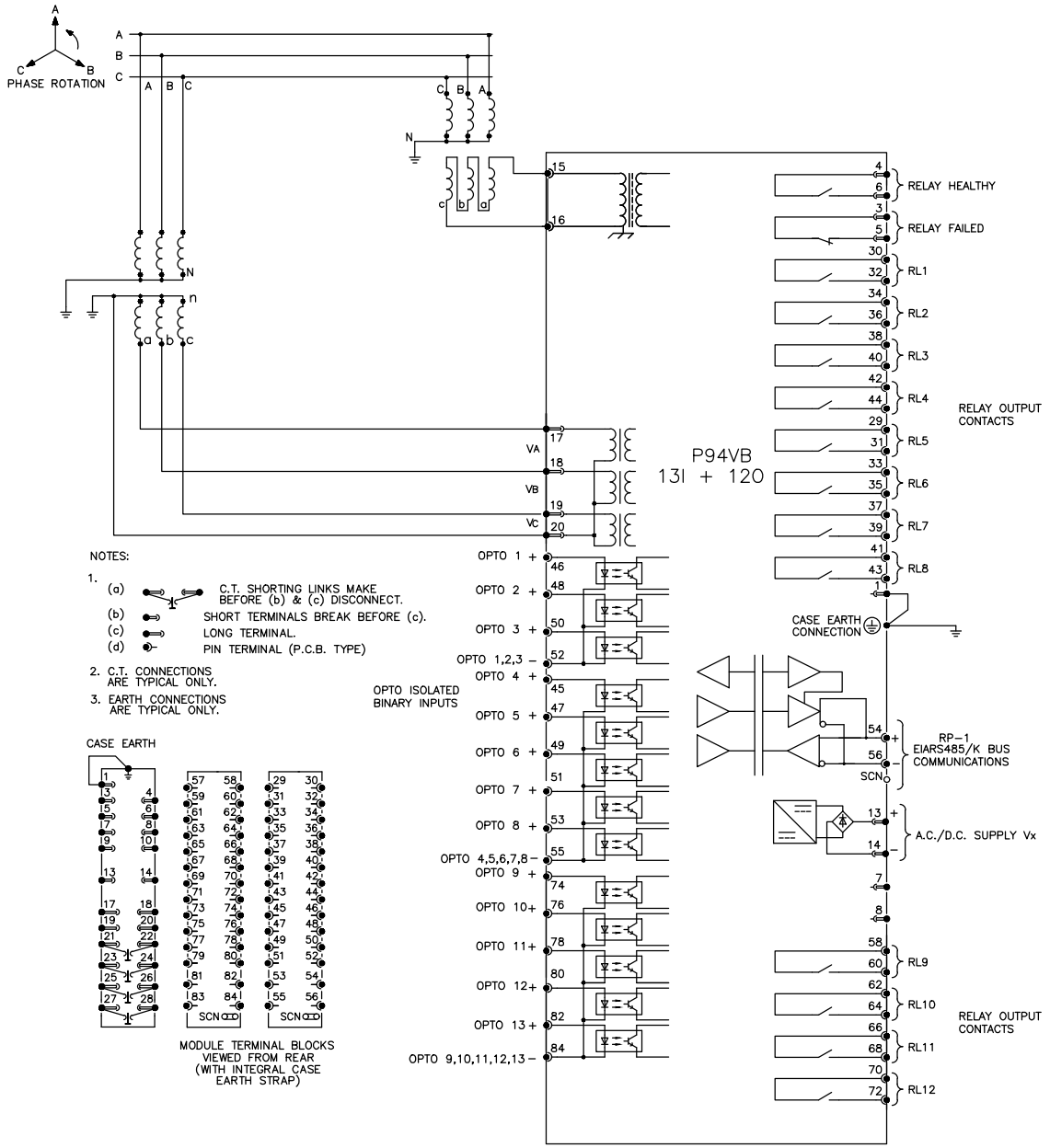

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH SEPERATE RESIDUAL VOLTAGE INPUT (13 I/P & 12 O/P)		
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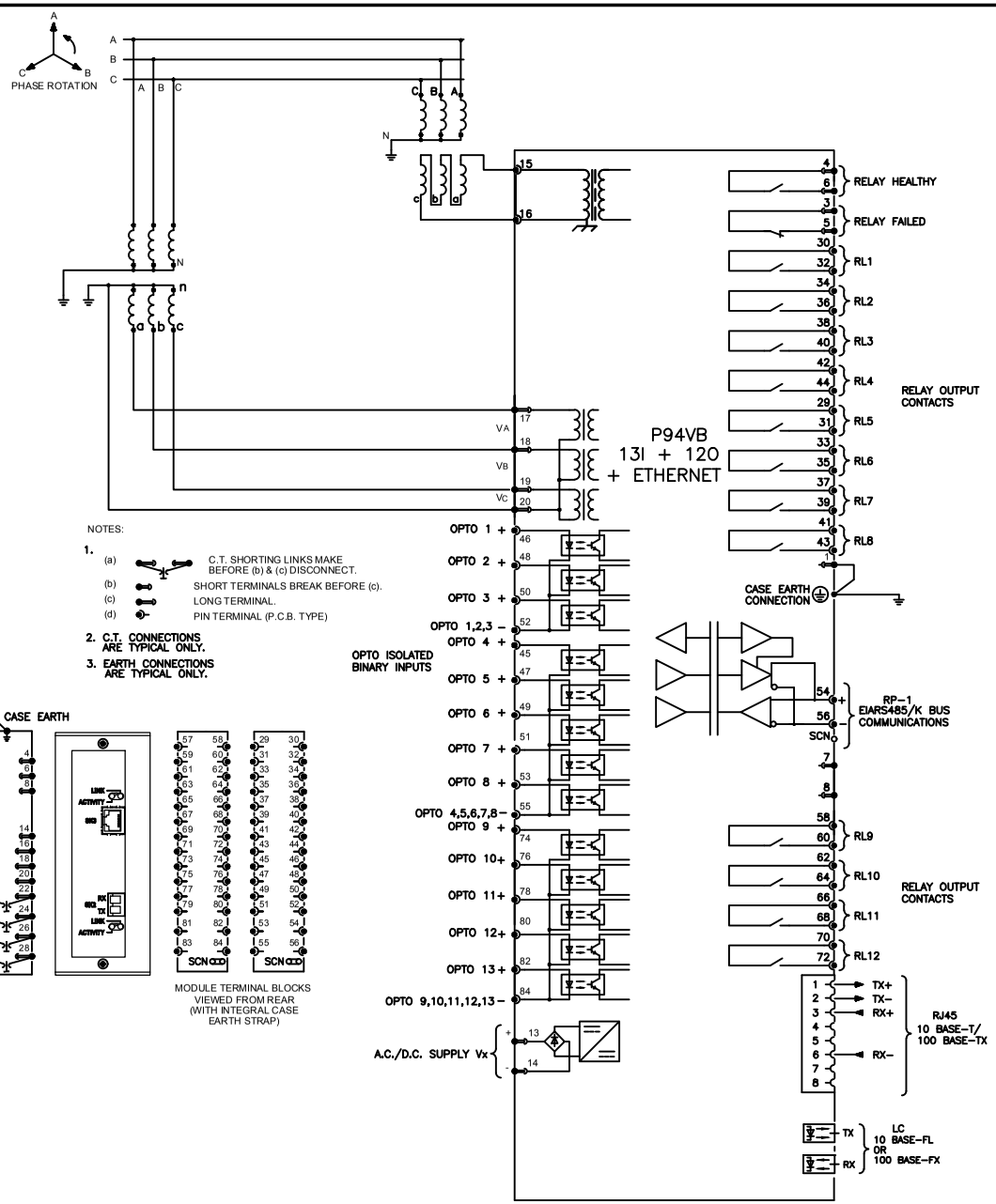

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH SEPERATE RESIDUAL VOLTAGE INPUT (13 I/P & 12 O/P) & ETHERNET		
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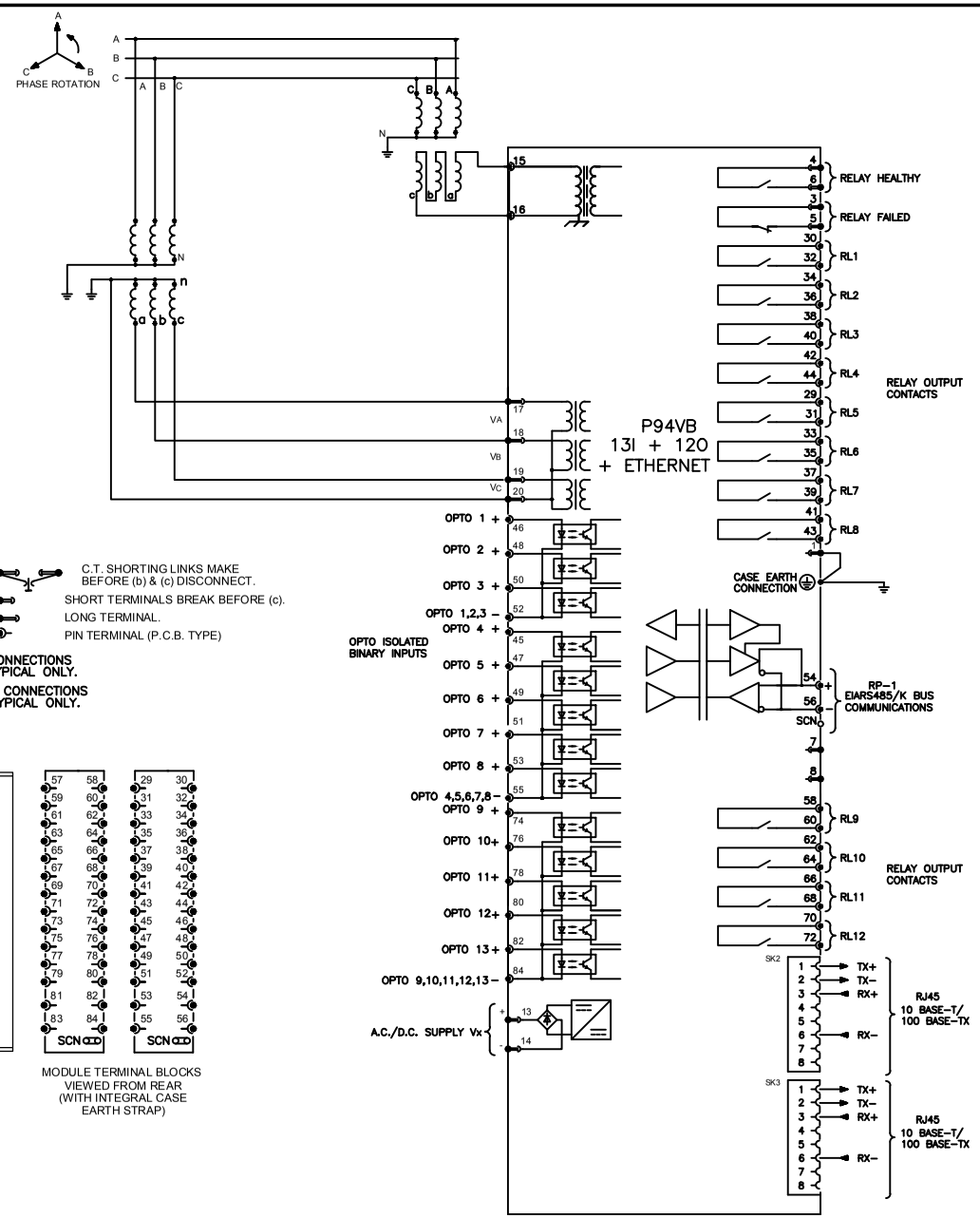

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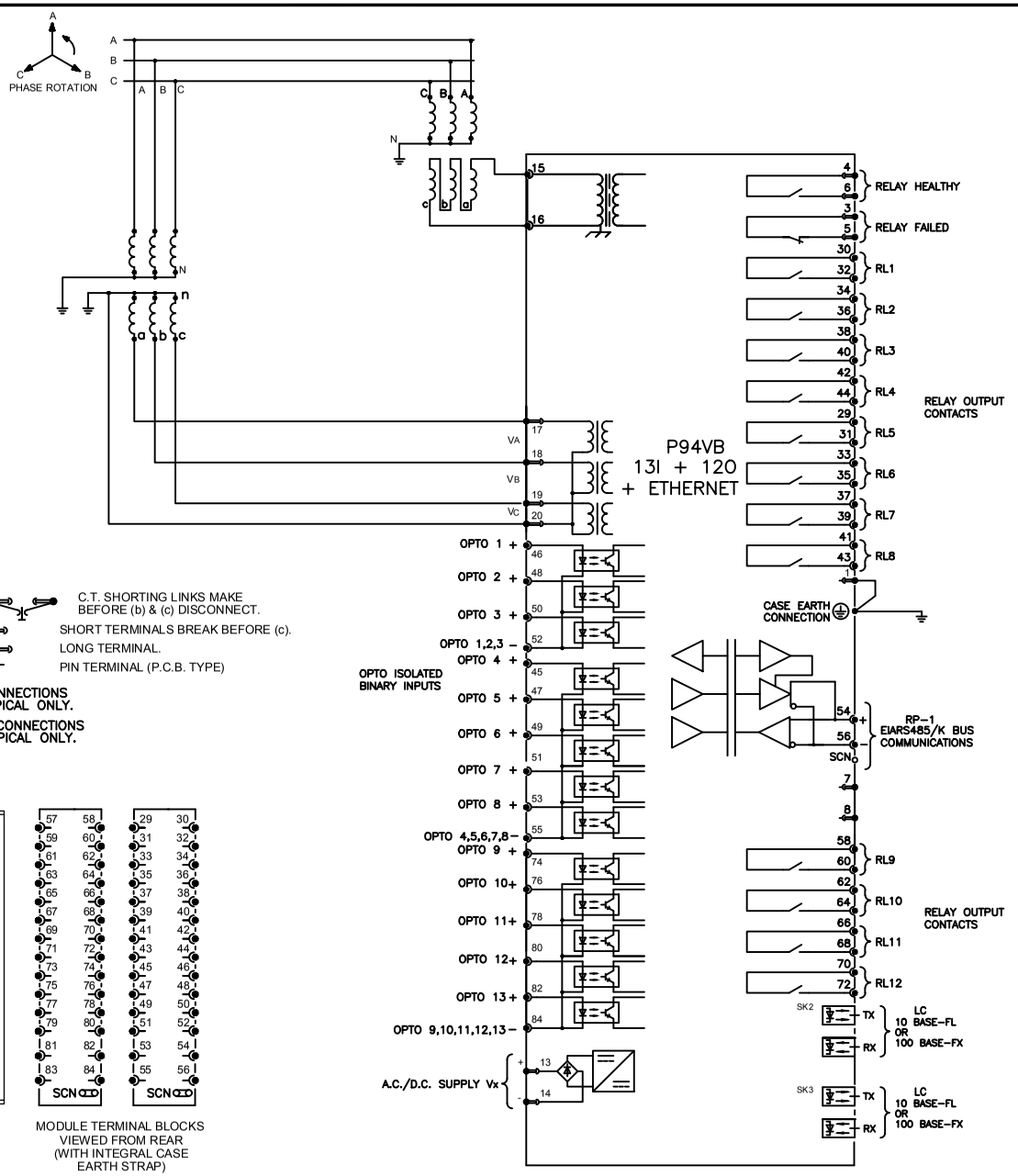
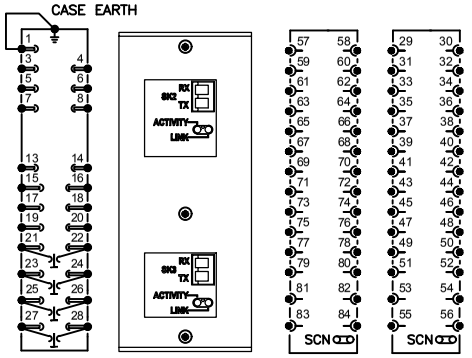


NOTES:

1. (a) C.T. SHORTING LINKS MAKE BEFORE (b) & (c) DISCONNECT.
   (b) SHORT TERMINALS BREAK BEFORE (c).
   (c) LONG TERMINAL.
   (d) PIN TERMINAL (P.C.B. TYPE)
2. C.T. CONNECTIONS ARE TYPICAL ONLY.
3. EARTH CONNECTIONS ARE TYPICAL ONLY.



MODULE TERMINAL BLOCKS
VIEWED FROM REAR
(WITH INTEGRAL CASE
EARTH STRAP)

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE & FREQUENCY IED WITH SEPERATE RESIDUAL VOLTAGE INPUT (13 I/P & 12 O/P) & DUAL FIBRE ETHERNET		
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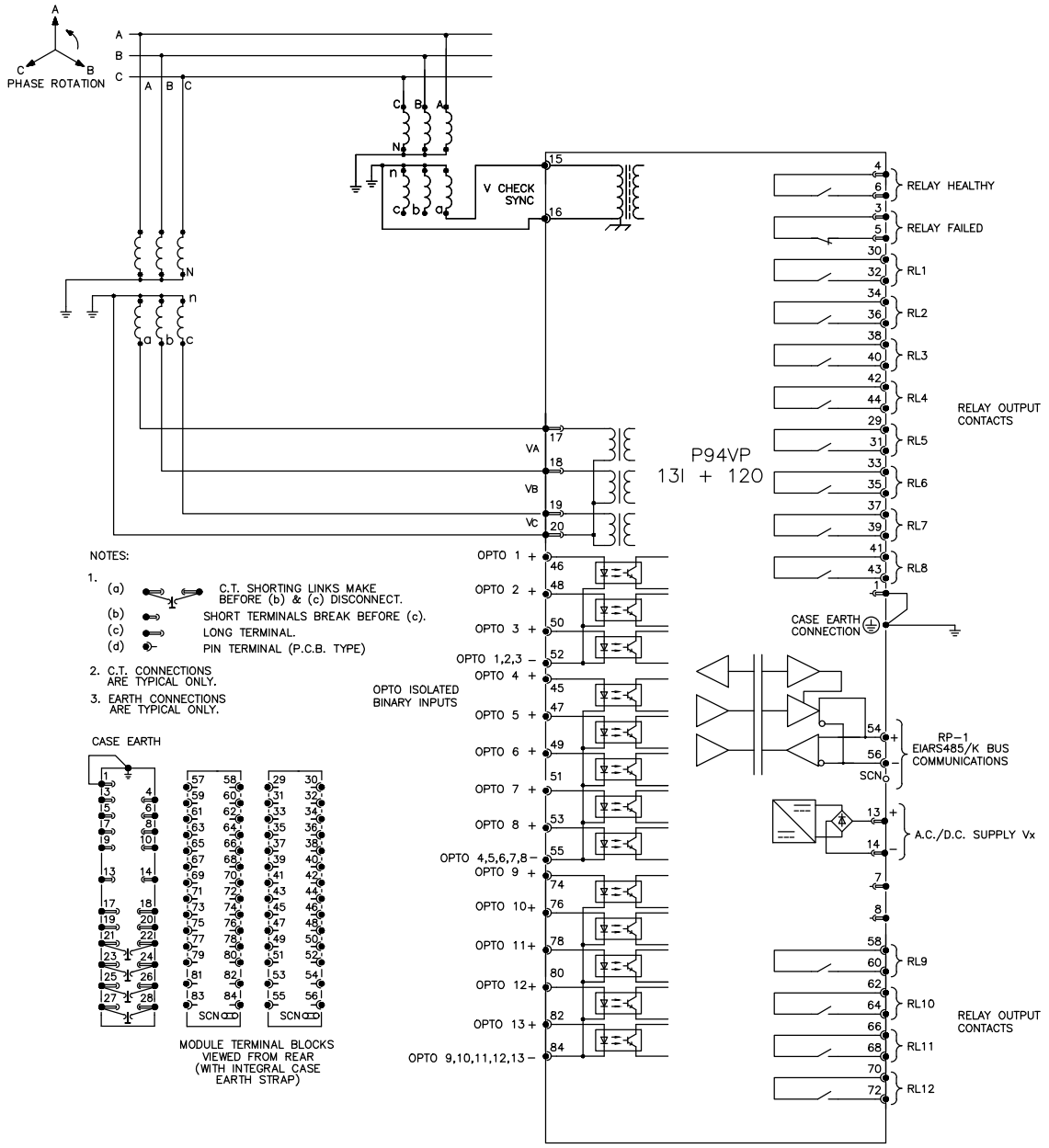

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (13 I/P & 12 O/P)		
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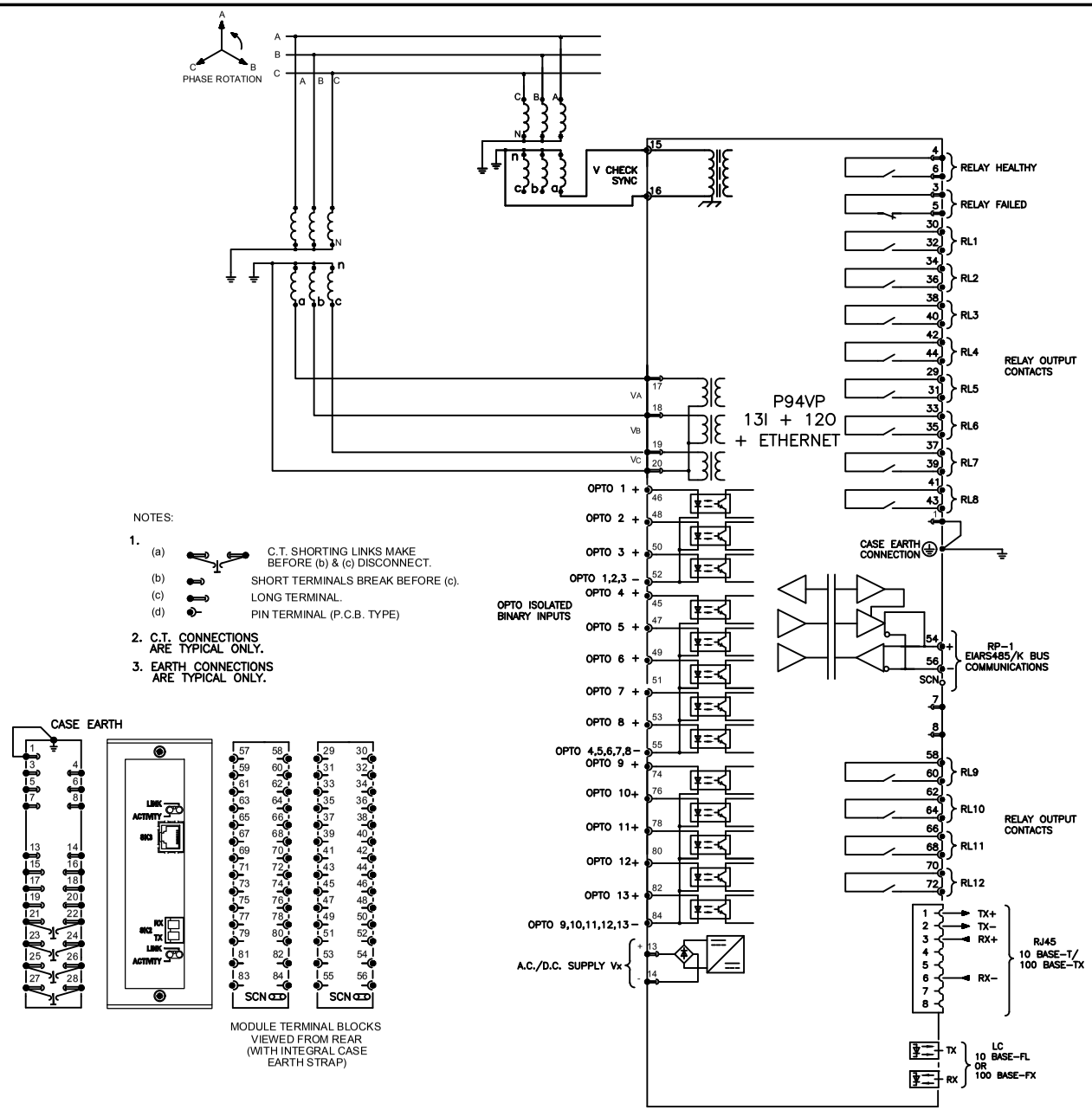

NOTES:

1.
(a) C.T. SHORTING LINKS MAKE BEFORE (b) & (c) DISCONNECT.
(b) SHORT TERMINALS BREAK BEFORE (c).
(c) LONG TERMINAL.
(d) PIN TERMINAL (P.C.B. TYPE)

2. C.T. CONNECTIONS ARE TYPICAL ONLY.
3. EARTH CONNECTIONS ARE TYPICAL ONLY.

MODULE TERMINAL BLOCKS VIEWED FROM REAR (WITH INTEGRAL CASE EARTH STRAP)

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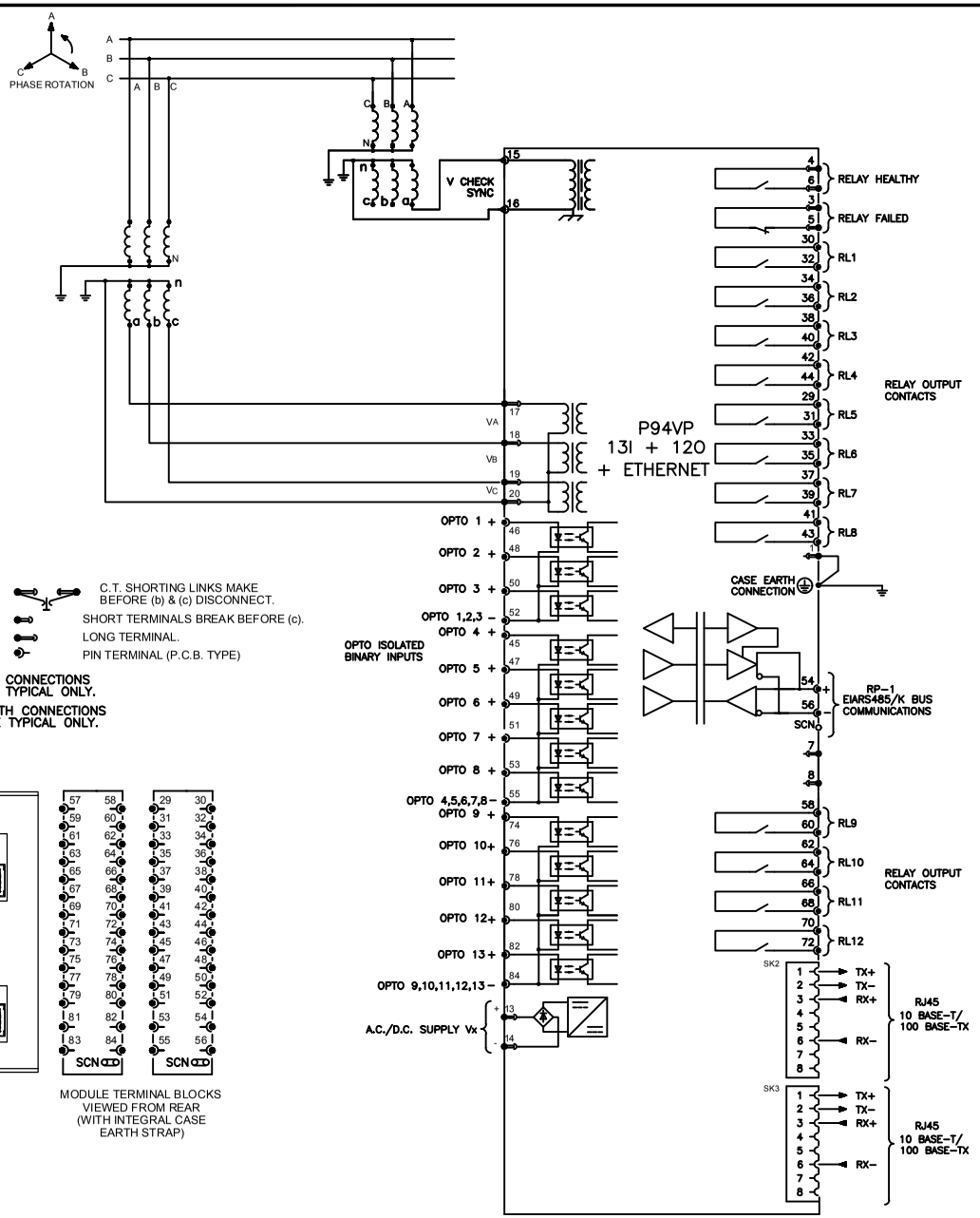

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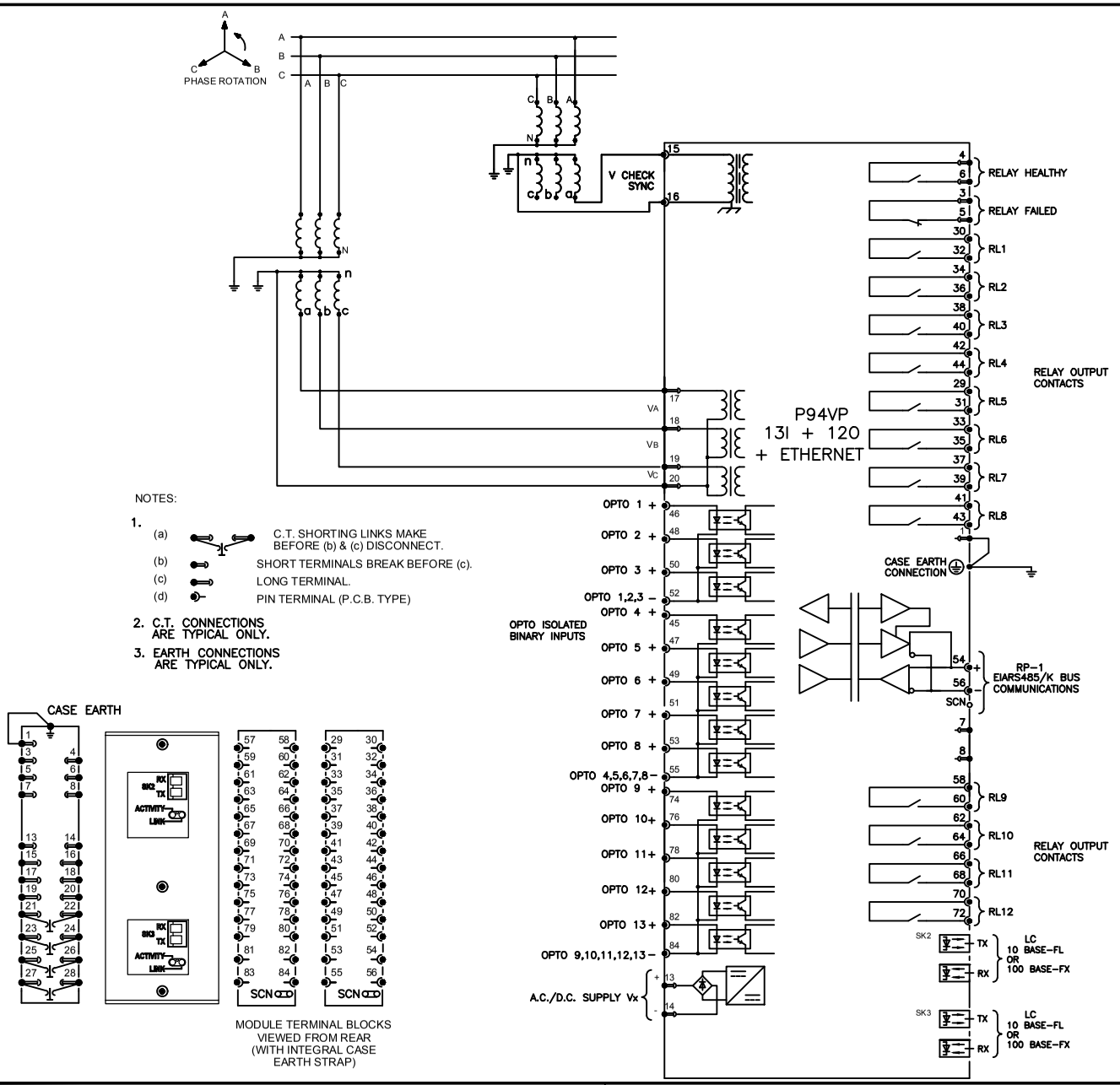

NOTES:

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MODULE TERMINAL BLOCKS VIEWED FROM REAR (WITH INTEGRAL CASE EARTH STRAP)

Issue: C	Revision: CID006234 Outlines updated to GE Format	Title: P94V VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (13 I/P & 12 O/P) & DUAL FIBRE ETHERNET	
Date: 4/30/2020	Name: S.J.BURTON	Drg No: 10P94V10	Sht: 4
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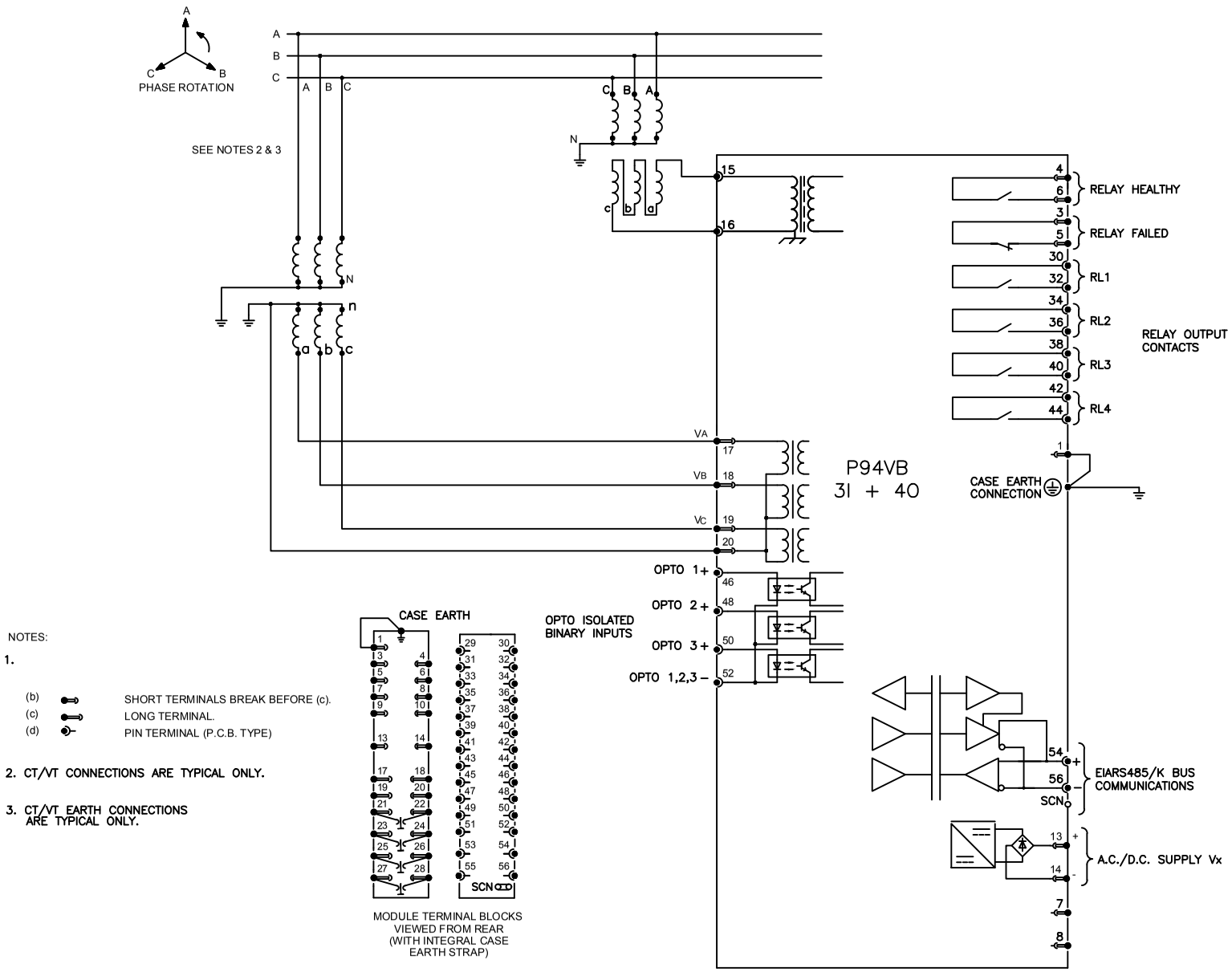

NOTES:

1.

(b) SHORT TERMINALS BREAK BEFORE (c).
(c) LONG TERMINAL.
(d) PIN TERMINAL (P.C.B. TYPE)

2. CT/VT CONNECTIONS ARE TYPICAL ONLY.

3. CT/VT EARTH CONNECTIONS ARE TYPICAL ONLY.

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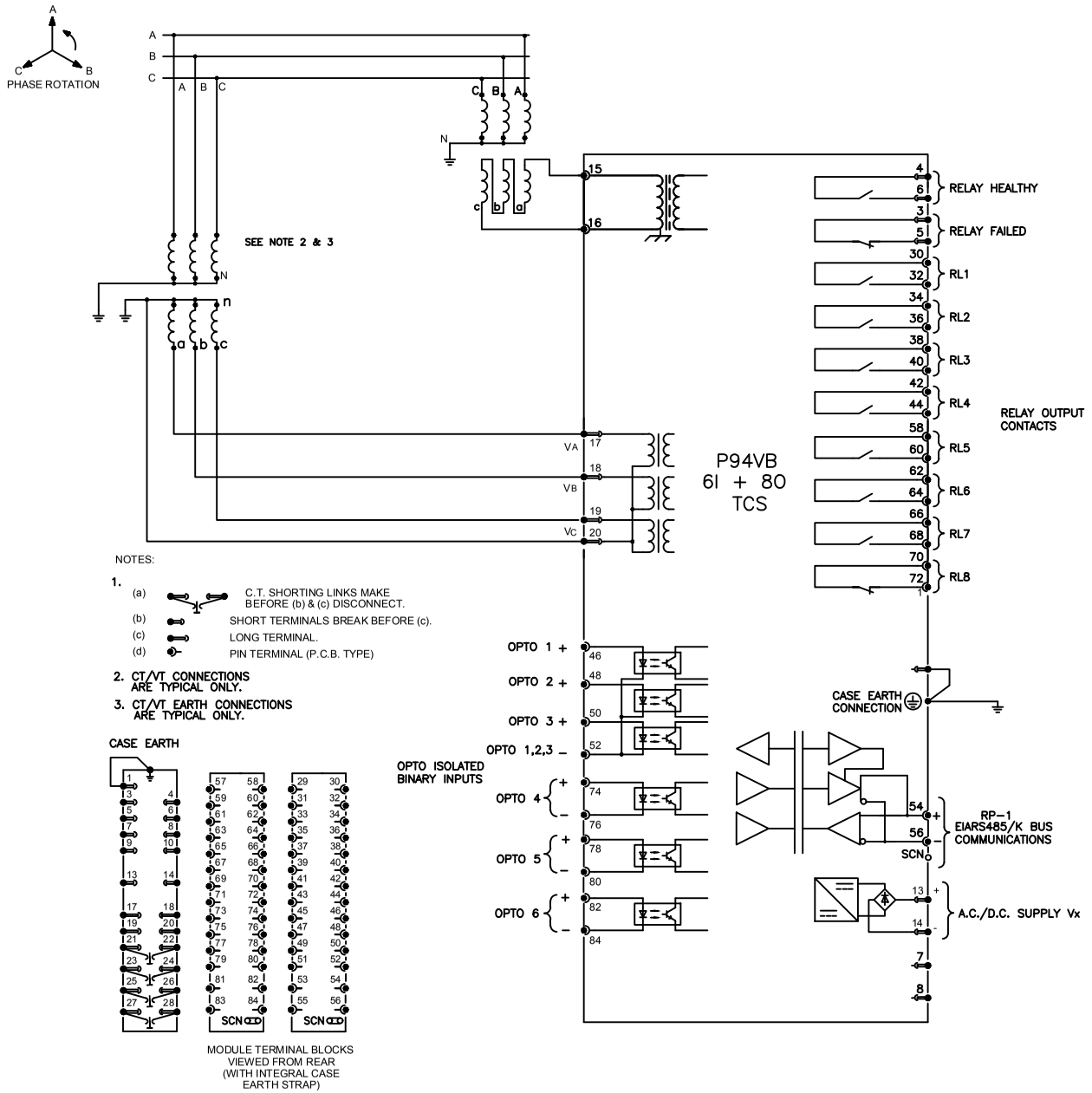

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH SEPARATE RESIDUAL VOLTAGE INPUT (6I/P & 8O/P) WITH TCS		
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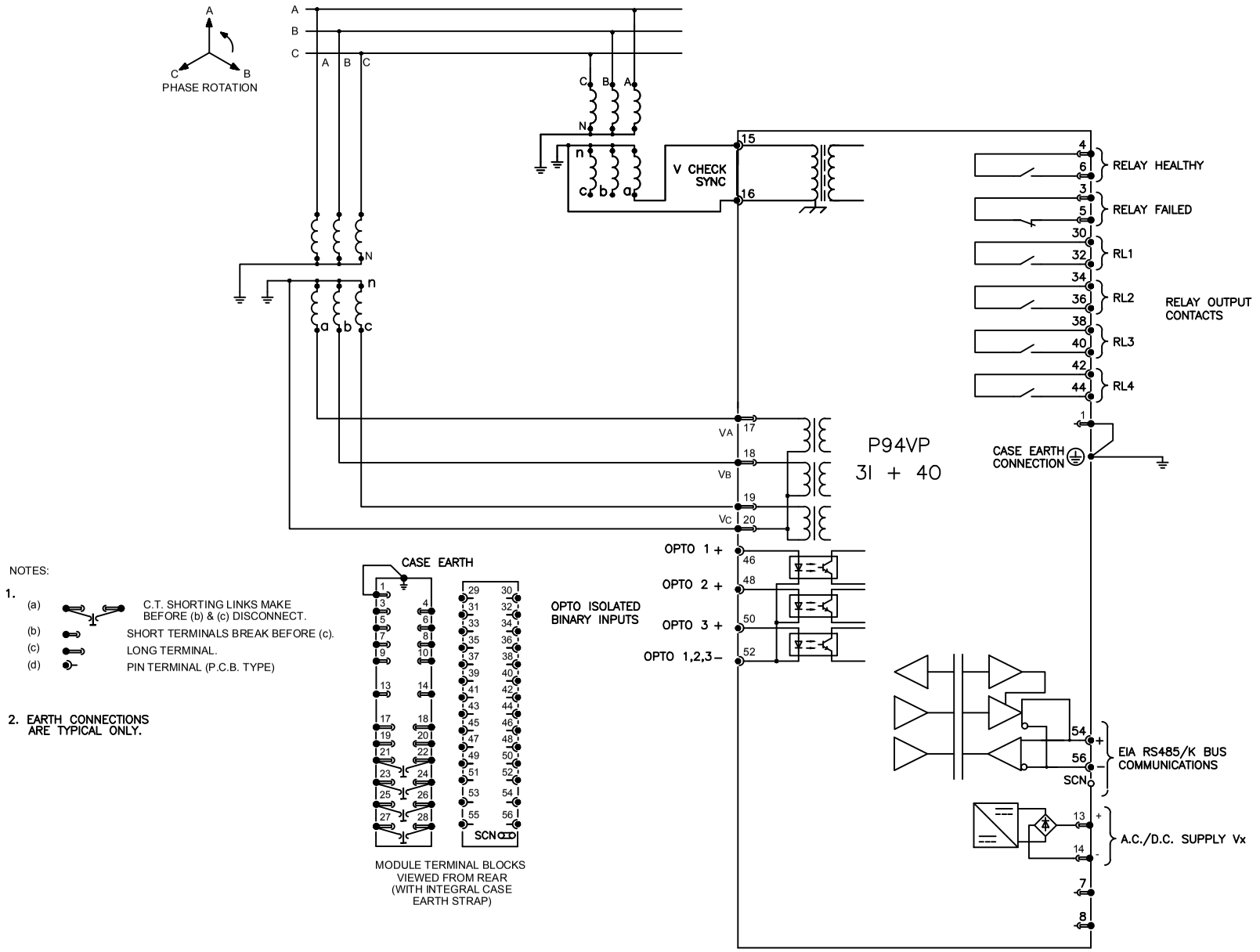

NOTES:

1.
(a) C.T. SHORTING LINKS MAKE BEFORE (b) & (c) DISCONNECT.
(b) SHORT TERMINALS BREAK BEFORE (c).
(c) LONG TERMINAL.
(d) PIN TERMINAL (P.C.B. TYPE)

2. EARTH CONNECTIONS ARE TYPICAL ONLY.

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (3 I/P & 4 O/P)		
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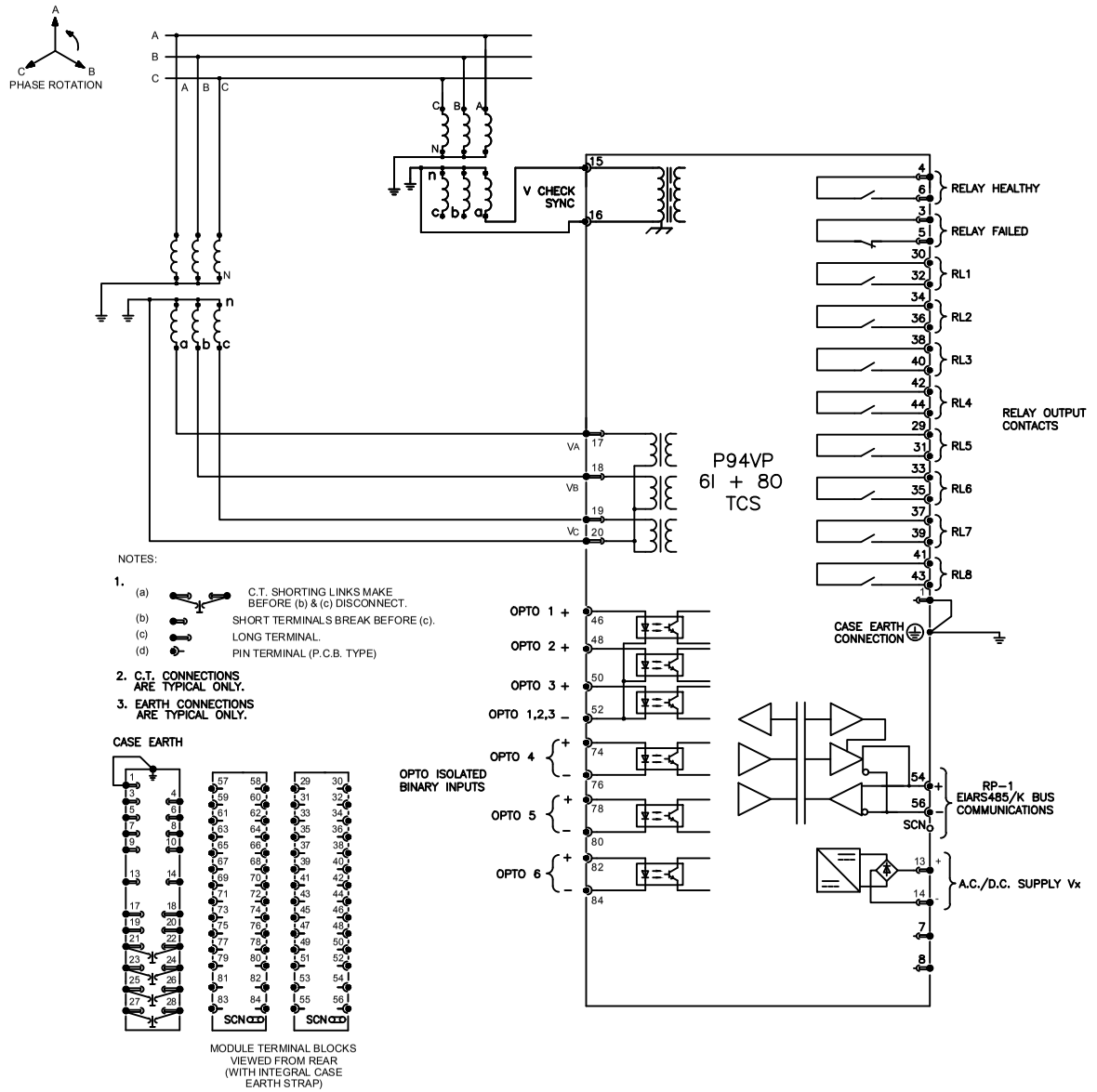

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (6 I/P & 8 O/P)		
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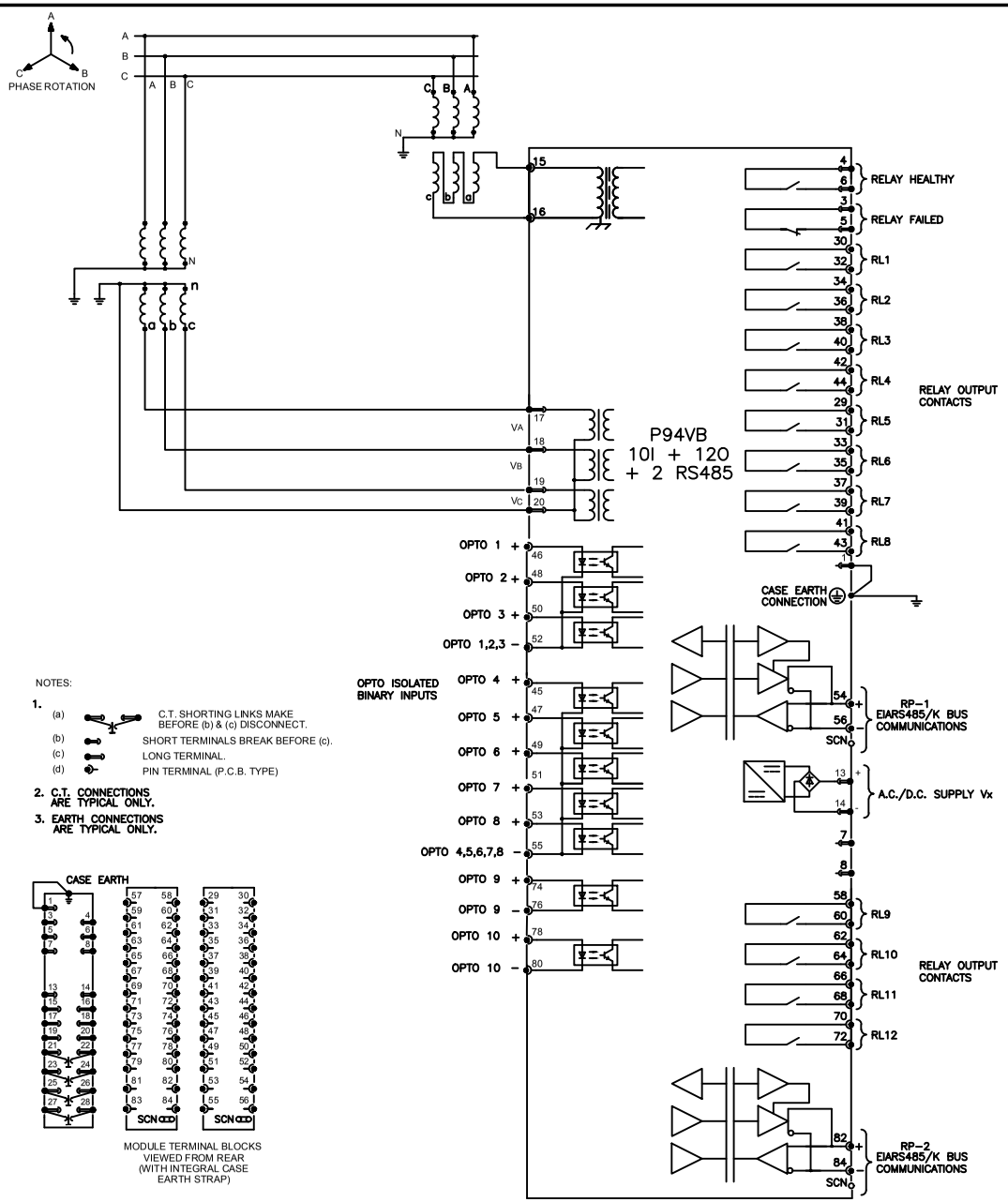

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH SEPARATE RESIDUAL VOLTAGE INPUT (10 I/P & 12 O/P) WITH 2 RS485		
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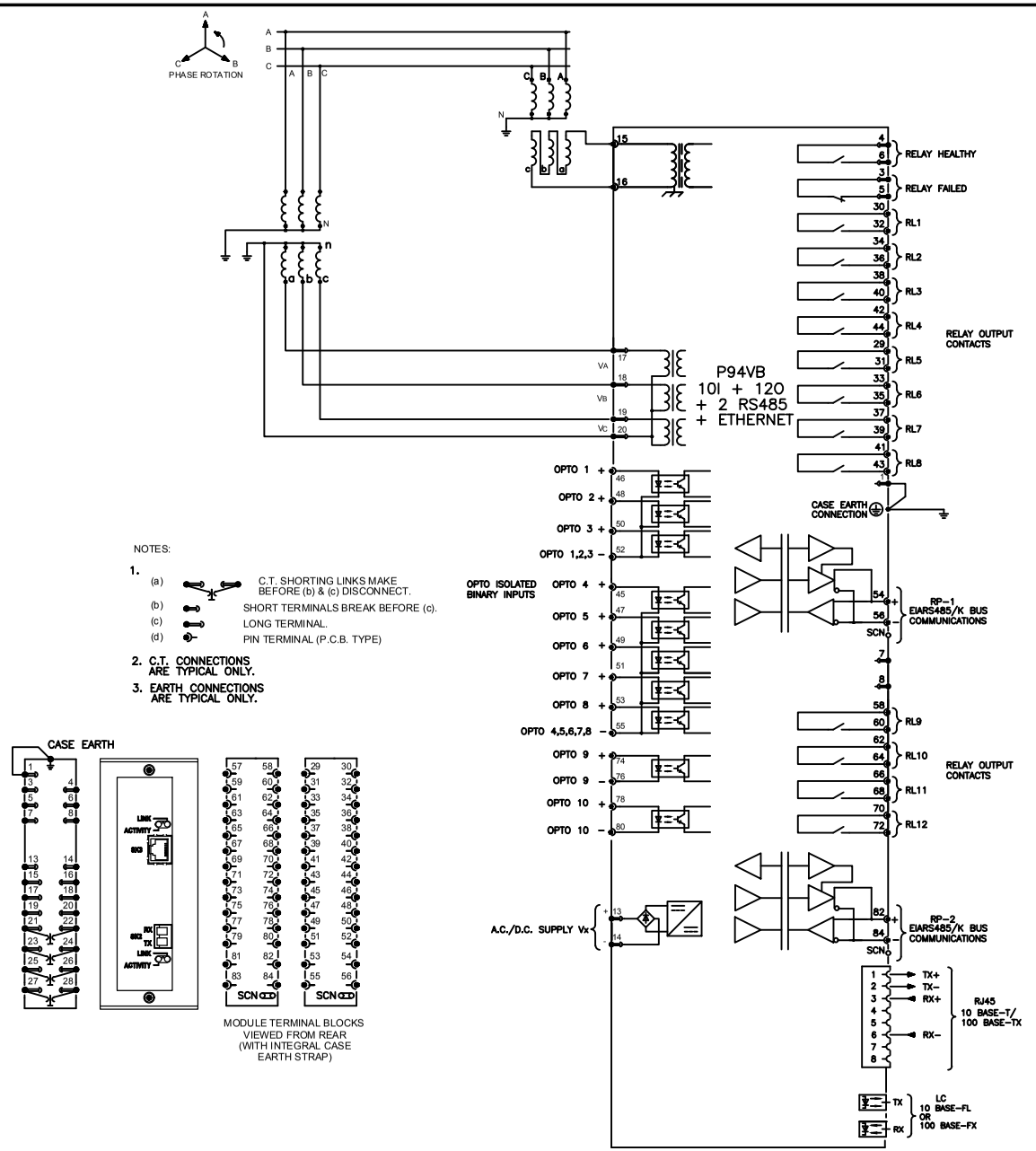

NOTES:

1.
(a) C.T. SHORTING LINKS MAKE BEFORE (b) & (c) DISCONNECT.
(b) SHORT TERMINALS BREAK BEFORE (c).
(c) LONG TERMINAL.
(d) PIN TERMINAL (P.C.B. TYPE)

2. C.T. CONNECTIONS ARE TYPICAL ONLY.

3. EARTH CONNECTIONS ARE TYPICAL ONLY.

MODULE TERMINAL BLOCKS VIEWED FROM REAR (WITH INTEGRAL CASE EARTH STRAP)

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH SEPARATE RESIDUAL VOLTAGE INPUT (10 I/P & 12 O/P) WITH 2 RS485 & ETHERNET		
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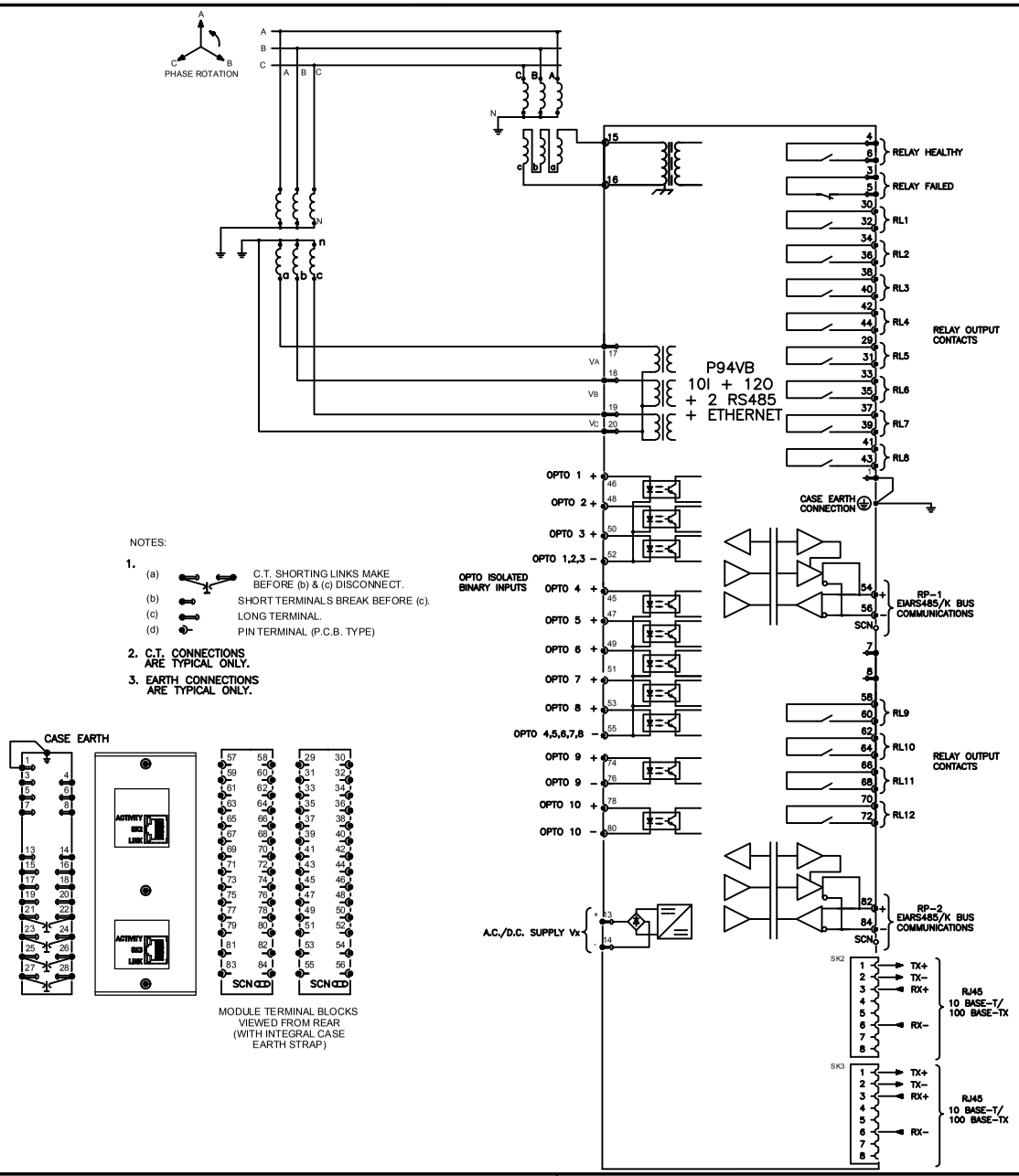

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE & FREQ. IED WITH SEPARATE RESIDUAL VOLTAGE INPUT (10 I/P & 12 O/P) 2 RS485 & DUAL COPPER ETHERNET		
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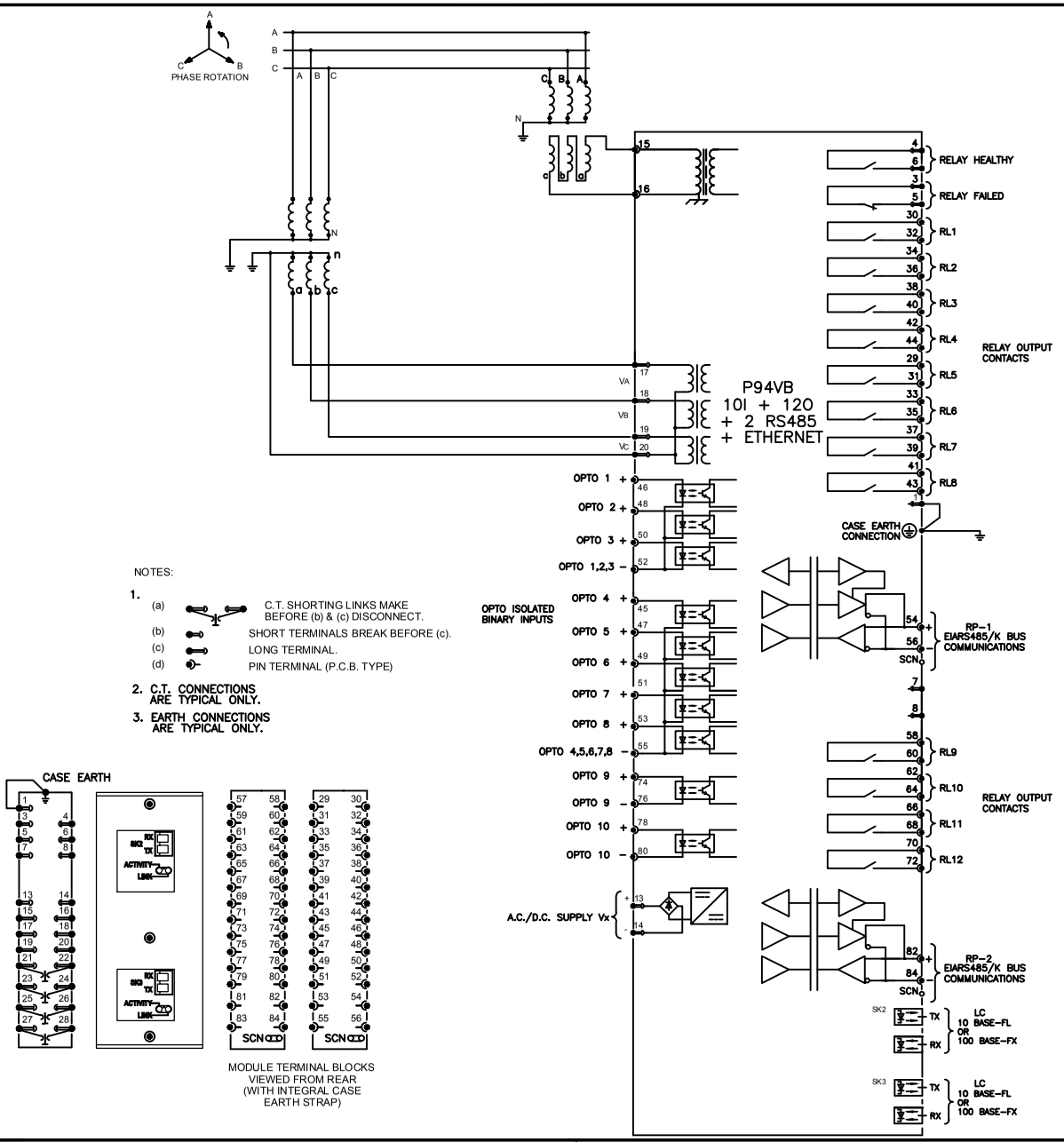

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH SEPARATE RESIDUAL VOLTAGE INPUT (10 I/P 12 O/P) 2 RS485 & DUAL FIBRE ETHERNET		
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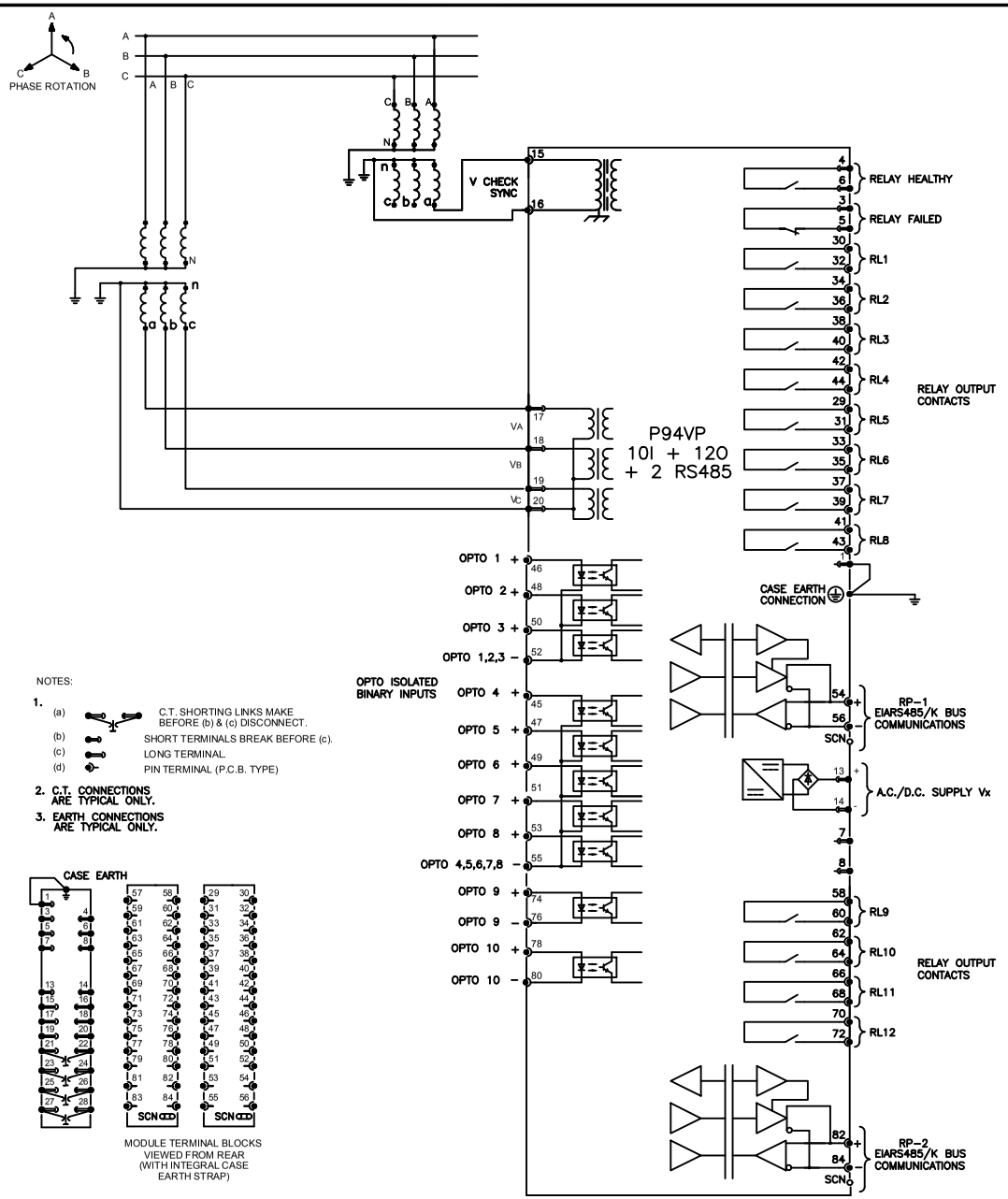

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (10 I/P & 12 O/P) WITH 2 RS485	
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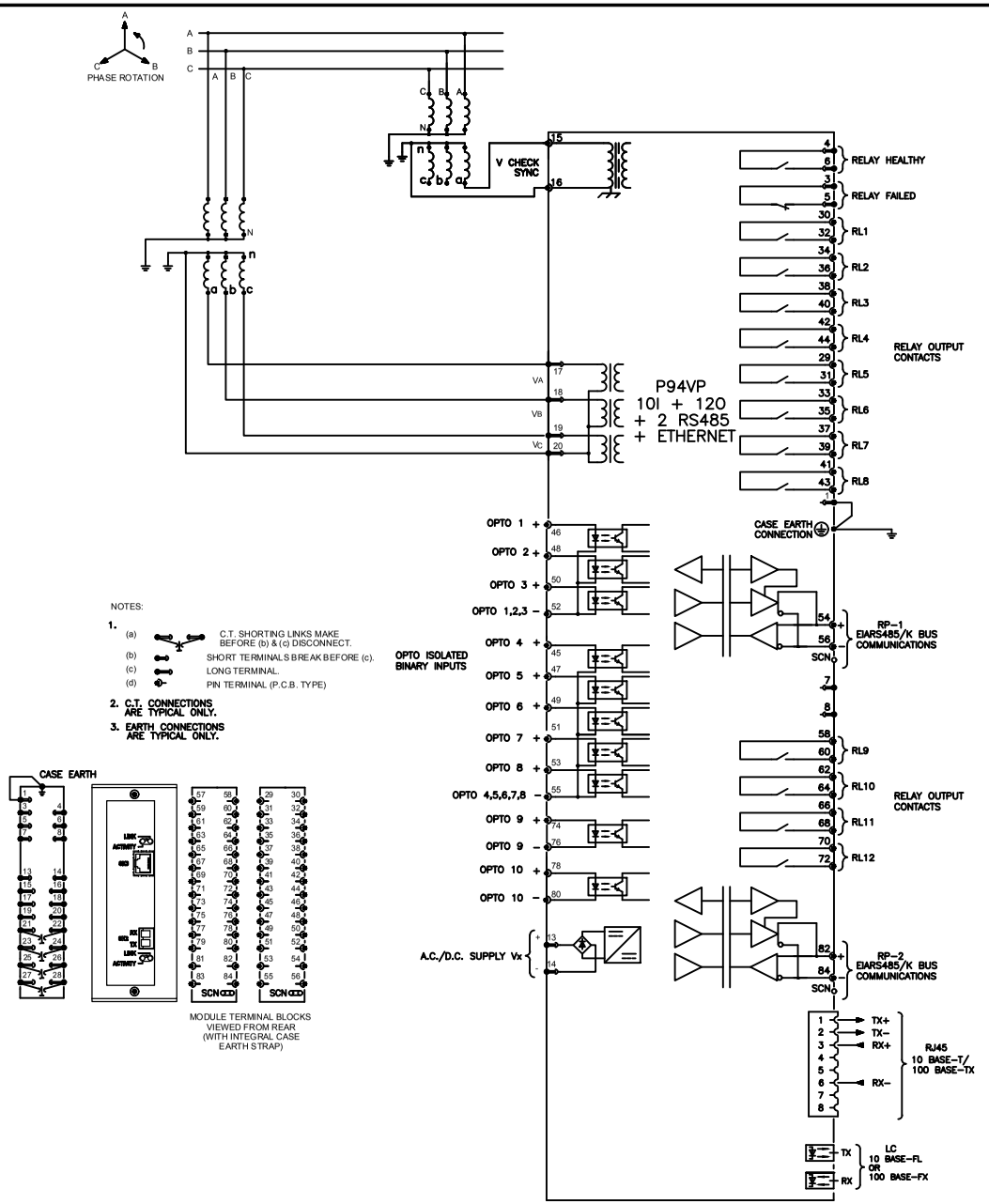

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (10 I/P & 12 O/P) WITH 2 RS485 & ETHERNET	
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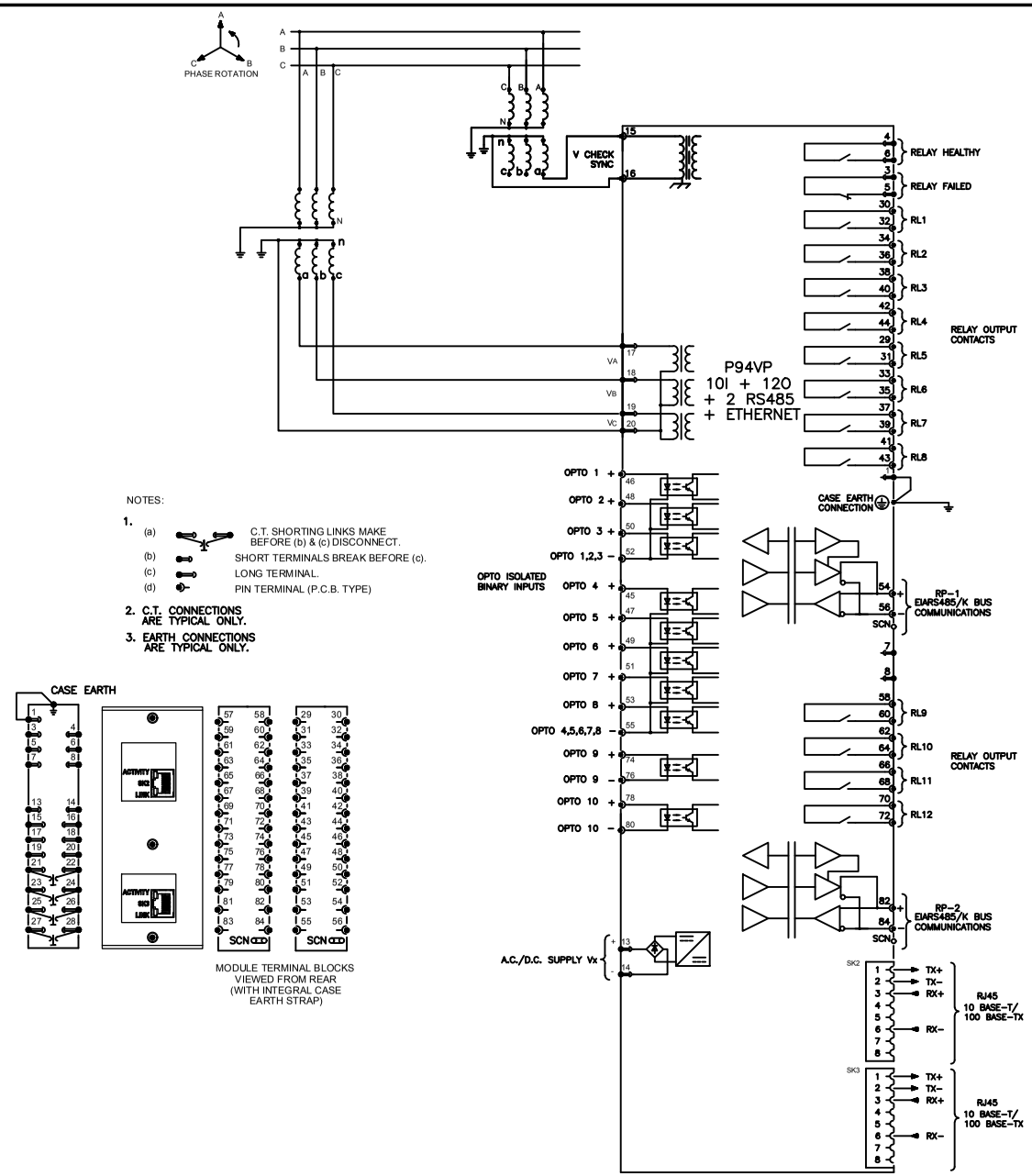

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH CHECK SYNCH. (10 I/P & 12 O/P) WITH 2 RS485 & DUAL COPPER ETHERNET		
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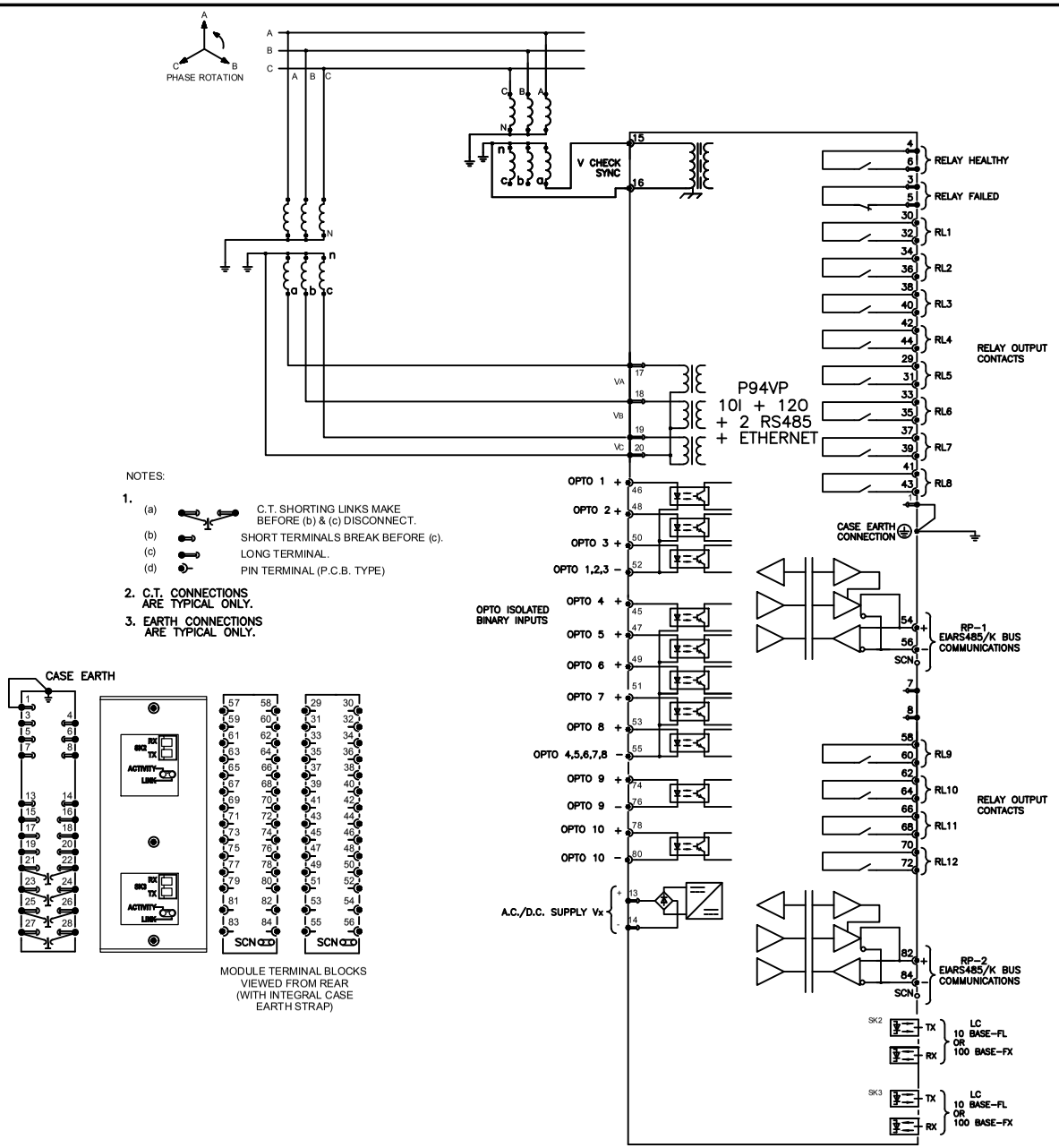

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH CHECK SYNCH. (10 I/P & 12 O/P) WITH 2 RS485 & DUAL FIBRE ETHERNET		
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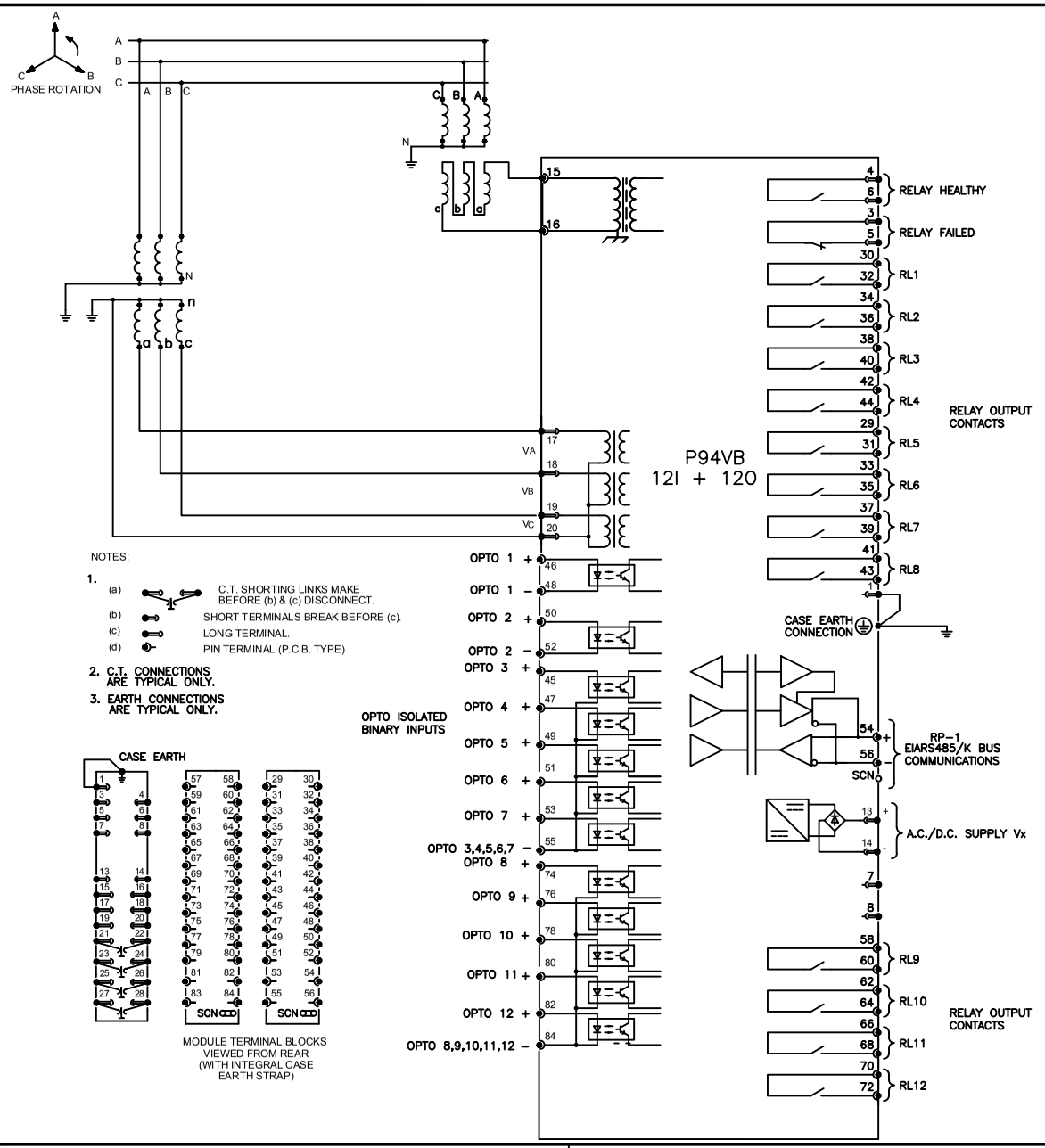

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH SEPERATE RESIDUAL VOLTAGE INPUT (12 I/P & 12 O/P)	
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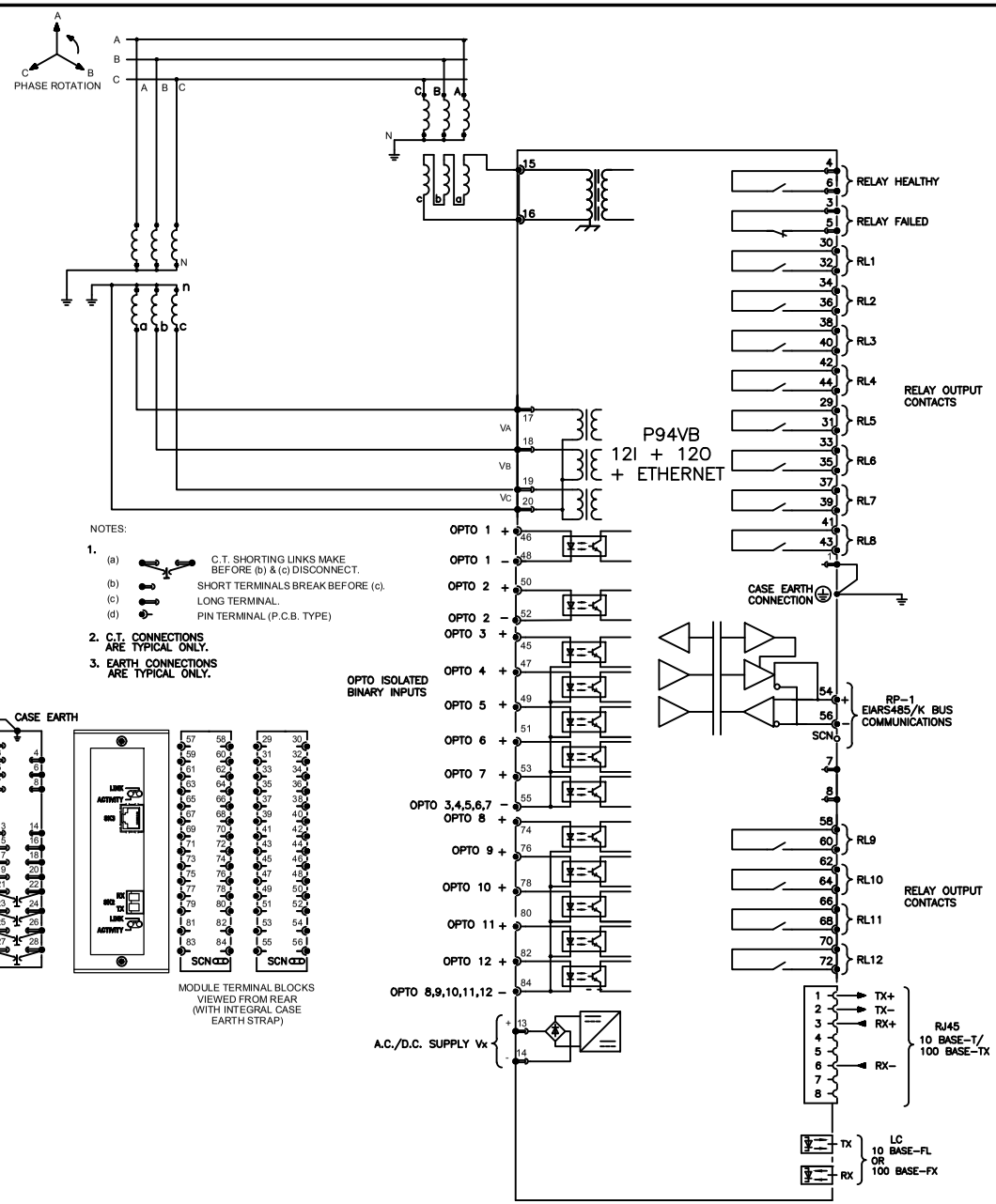

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH SEPERATE RESIDUAL VOLTAGE INPUT (12 I/P & 12 O/P) & ETHERNET		
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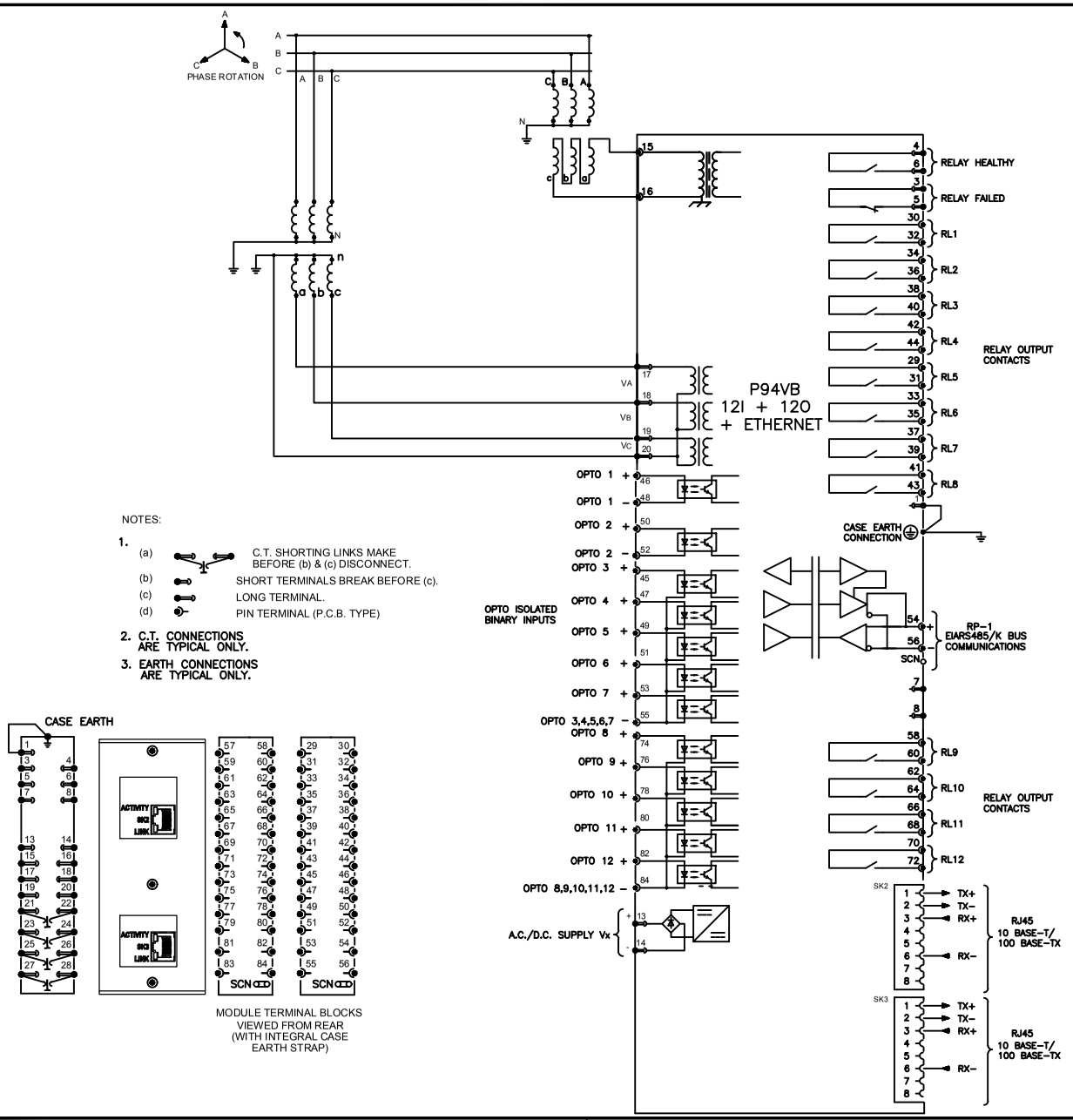

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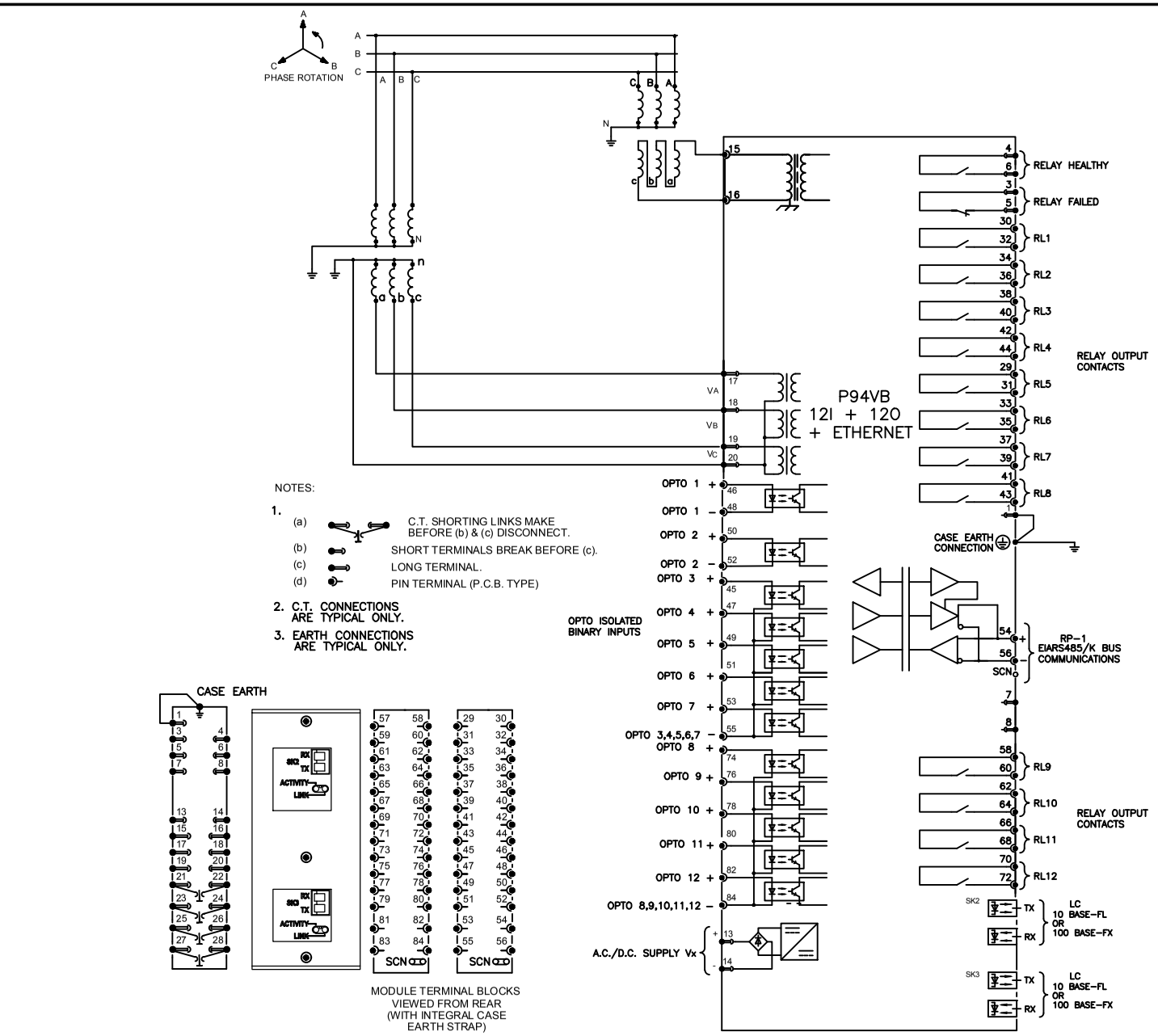

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE & FREQUENCY IED WITH SEPERATE RESIDUAL VOLTAGE INPUT (12 I/P & 12 O/P) & DUAL FIBRE ETHERNET	
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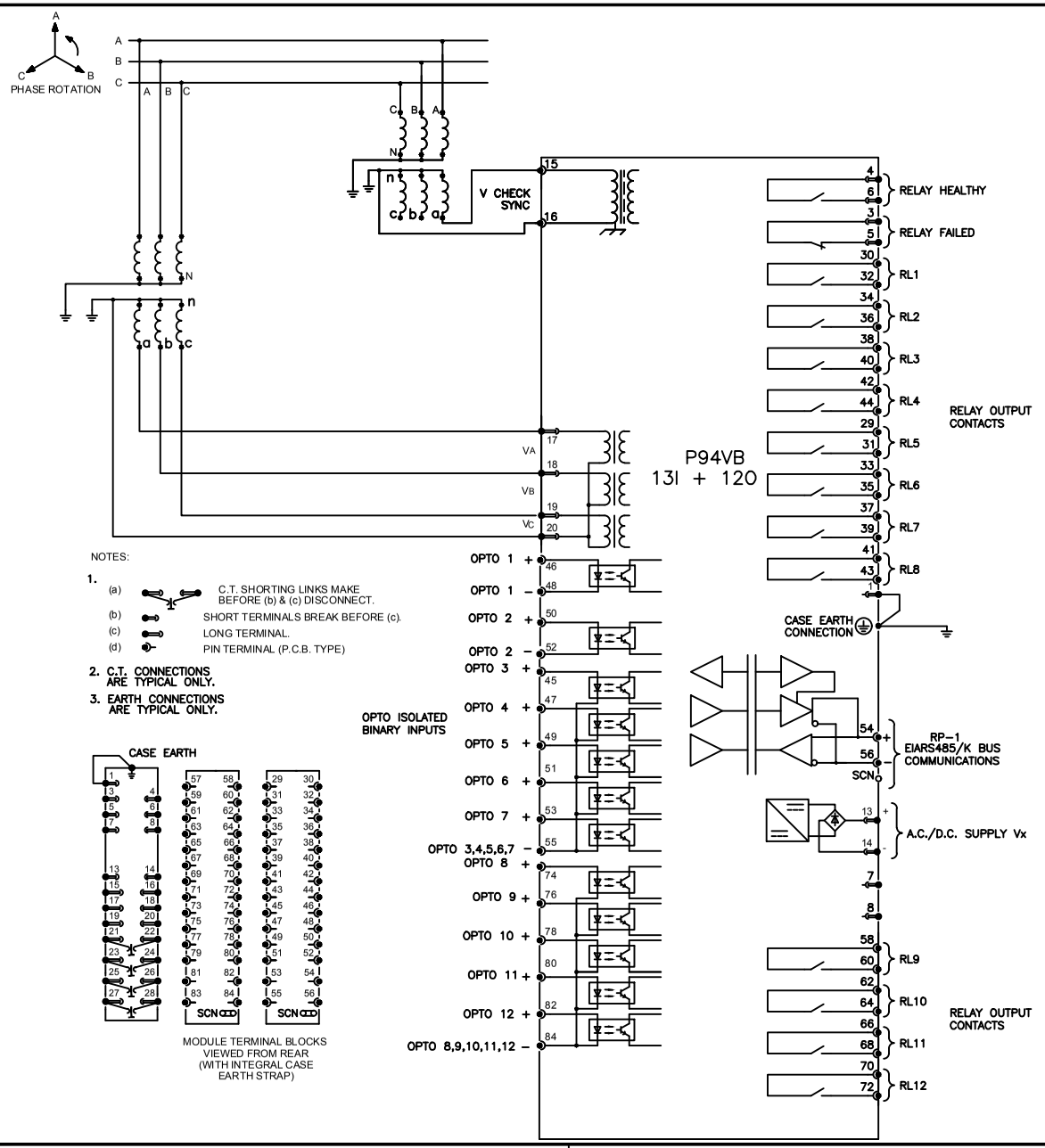

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (12 I/P & 12 O/P)	
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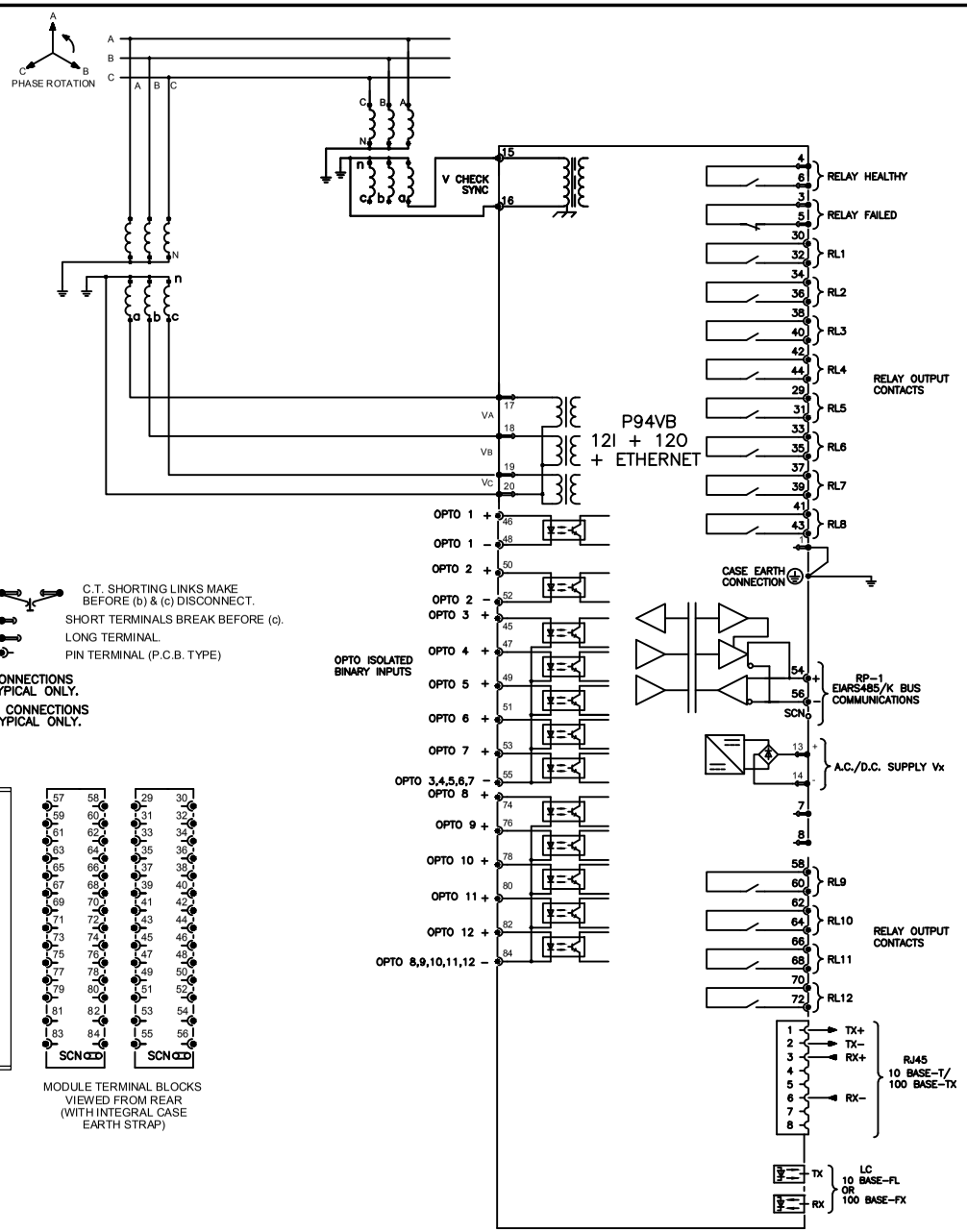

NOTES:

1. (a) C.T. SHORTING LINKS MAKE BEFORE (b) & (c) DISCONNECT.
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2. C.T. CONNECTIONS ARE TYPICAL ONLY.
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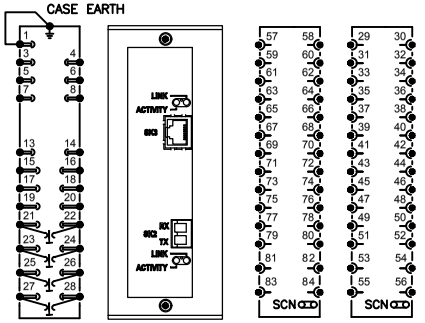

MODULE TERMINAL BLOCKS VIEWED FROM REAR (WITH INTEGRAL CASE EARTH STRAP)

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH CHECK SYNCHRONISING (12 I/P & 12 O/P) & ETHERNET	
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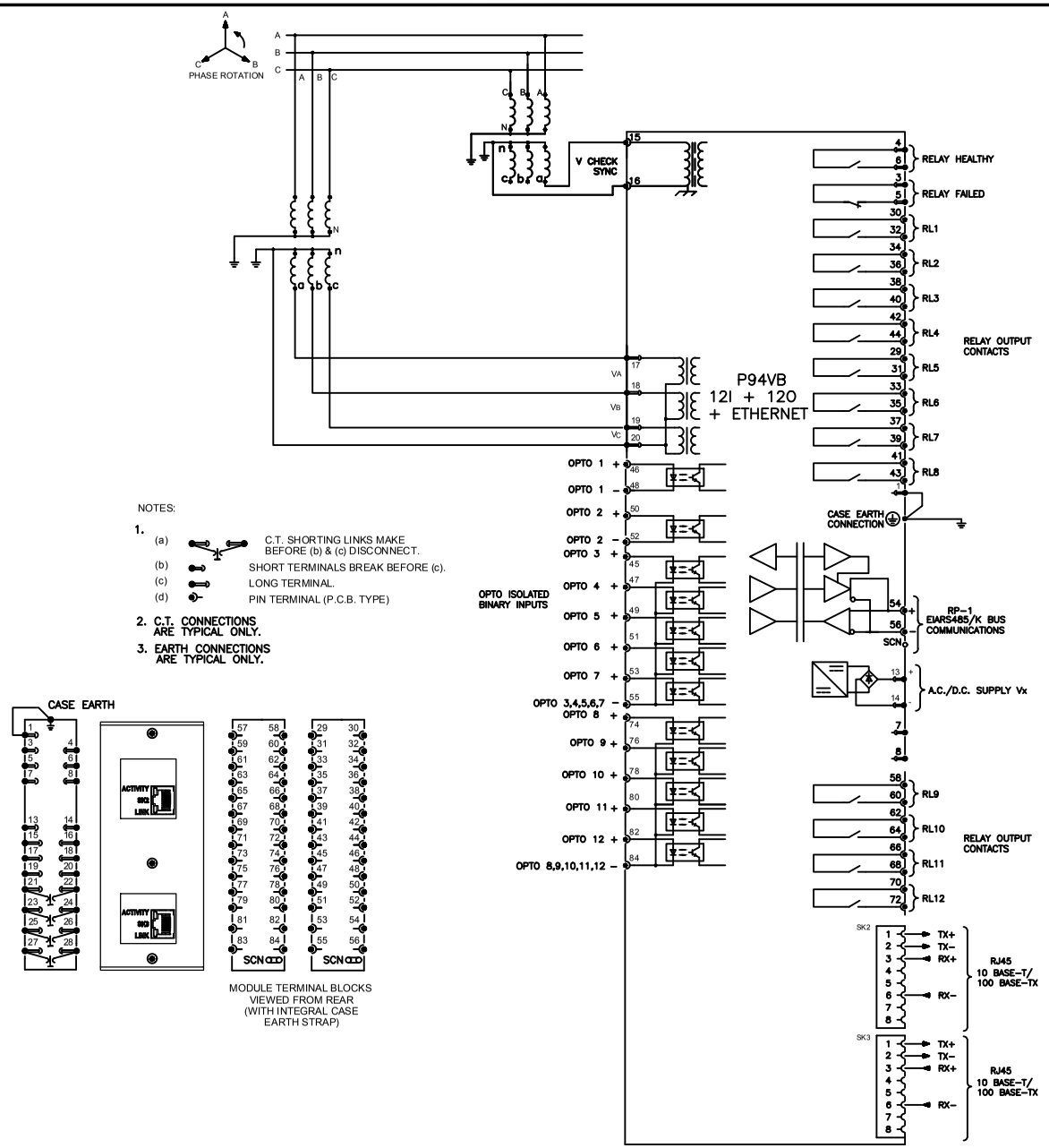

Issue: C	Revision: CID006234 Outlines updated to GE Format		Title: P94V VOLTAGE AND FREQUENCY IED WITH CHECK SYNCH. (12 I/P & 12 O/P) & DUAL COPPER ETHERNET		
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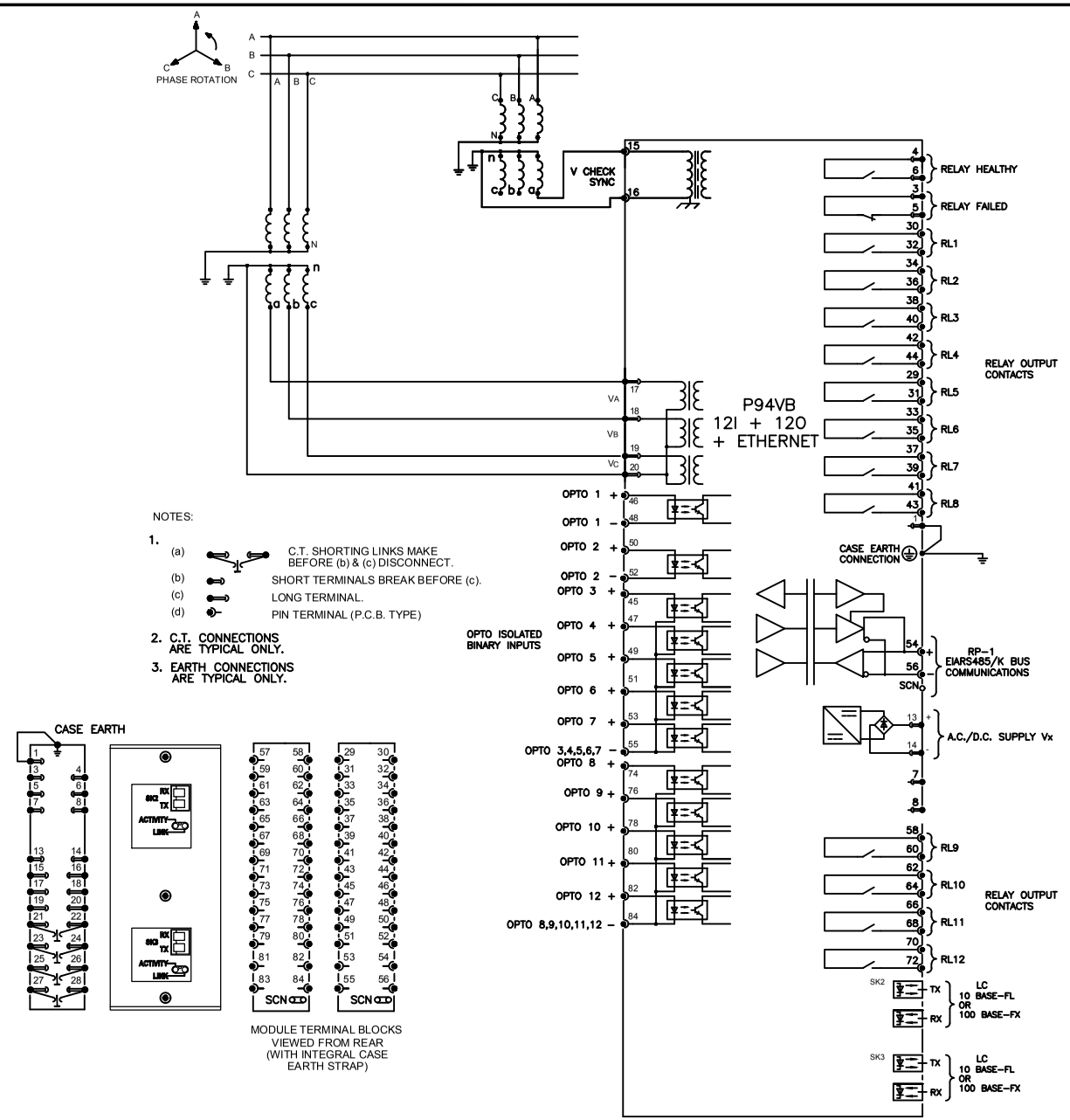

NOTES:

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APPENDIX D

VERSION HISTORY

1 HARDWARE AND SOFTWARE VERSION HISTORY

S/W Version Major	S/W Version Minor	H/W Version	Original Date of Issue	Description of Changes	Technical Documentation
50	H	A	April 2013	▪ Original Issue	TG8612C
50	J	A	June 2015	▪ Fix for Error/Lockout 7104:2000/reboot ▪ IEC 61850 - Connection/Disconnection issues ▪ DNP3oE Versions - Courier Tunnelling does not work (AGP140-46) ▪ Ethernet application (IEC61850 + DNP3oe) crashes if a Courier tunnel is continuously opened/closed ▪ Object 0 variations: 219, 222, 245 and 247 are incorrect ▪ QNX kernel can delay user threads for up to 10ms ▪ IEC61850 Select Before Operate Incorrect Behaviour ▪ With e-terra SCADA system, the P40 Agile data model extraction stops at Measurements/PriFouMMXU1$CF ▪ Unextracted events are lost on RP1, following relay reboot, using a DNPOE build ▪ Incorrect response to Object 2 Variation 3 request for Binary Input Event with Relative Time ▪ IEEE Floats are wrong at MODBUS interface ▪ Downloading a settings file reverts settings temporarily to setting group 1 ▪ P94V operation on UF ▪ DNP3OE Versions - Command management during IED disconnection/connection ▪ CB Fail trip may fail to operate under faults with DC transient offsets ▪ IEC 61850 Client disassociation while reading PloGGIO1$CO block in P14D IEDs ▪ IEC61850 Measurements negative values rounding error ▪ Agile latch reset when setting group is changed ▪ Undervoltage programmable curve not using standard template used by other Px4x relays ▪ The VCO Status, cell [3582], for the Voltage Controlled Overcurrent isn't updated after a change. The change takes effect after a power cycle or change to V Dep OC V<1 Set ▪ ISEF, IEF and anything related are not scaled properly when the CT ratio is 5A ▪ EF directional function failed to trip ▪ Fix for P14DH 53A IEC61850-8-1 Level B Conformance Issue	P14D-B/G/L/Z-TM-EN-1 P14N-B/Z-TM-EN-1 P94V-B/P-TM-EN-1
50	K	A	April 2016	▪ DNPoE Application stops running after many days of Polling ▪ DNPOE: After multiple DI and AI events at the same time, the relay Ethernet board seems locked ▪ FA Steady Fault - Incorrect Assertion ▪ P14DZ HiF Function asserting incorrectly (CHA HiF) ▪ Incorrect Burst Count - HiF Detection ▪ High Impedance Fault maloperation ▪ HIF CHA Hysteresis is not correctly set ▪ HIF Burst Threshold is not reset after the adaptive threshold is disabled	

S/W Version Major	S/W Version Minor	H/W Version	Original Date of Issue	Description of Changes	Technical Documentation
50	L	A	April 2017	▪ Permanent ethernet communication loss in P40 Agile relays ▪ Maintenance record generated every time Gateway is configured in DNP configuration ▪ CS1 and CS2 does not work independently when CB Comp enabled for CS2	
50	M	A	March 2018	▪ Flash change due to obsolescence	
51	A	A	September 2013	▪ Ethernet Enhancements for the P94V ▪ New model P14DA ▪ Neutral Admittance Protection for the P14DL and P14DZ ▪ Selectable Measured/Derived NVD ▪ Undervoltage programmable curve not using standard template used by other Px4x relays ▪ With e-terra SCADA system, the P40 Agile data model extraction stops at Measurements/PriFouMMXU1$CF ▪ When using SBOns control model for the data 'Control/XCBR1COLock' and both Check Conditions are set the Agile relay is dropping the connection to the client ▪ DNP ALSTOM rebranding in dnpev_devattr.h ▪ Unextracted events are lost on RP1, following relay reboot, using a DNPoE build ▪ Incorrect response to Object 2 Variation 3 request for Binary Input Event with Relative Time ▪ ISEF, IEF and anything related are not scaled properly when the CT ratio is 5A ▪ IEEE Floats are wrong at MODBUS interface ▪ Ethernet application (IEC61850 + DNP3oE) stops running if a Courier tunnel is continuously opened/closed (as done by S1 Agile Measurements viewer)	P14D-TM-EN-1 P14N-TM-EN-1 P94V-TM-EN-1
51	B	A	November 2013	▪ EF directional function fail to trip ▪ The VCO Status, cell [3582], for the Voltage Controlled Overcurrent isn't updated after a change. The change takes effect after a power cycle or change to V Dep ▪ Object 0 variations: 219, 222, 245 & 247 are incorrect	P14D-TM-EN-1 P14N-TM-EN-1 P94V-TM-EN-1
51	C	A	June 2014	▪ PWM duty cycle change for opto input drive circuit	
51	D	A	March 2018	▪ Flash change due to obsolescence	
52	B	A	November 2013	▪ Chinese HMI added ▪ The DDB 1599-1798 display “PSL internal 001-200“, but DDB 923-1022 still display "PSL internal 001- 100". Have duplicate content. ▪ The VCO Status isn't updated after a change. The edited change does take effect after a power-cycle or a change to "V Dep OC V<1 Set" cell 3583 ▪ Object 0 variations: 219, 222, 245 and 247 are incorrect	P14D-TM-EN-1 P14N-TM-EN-1 P94V-TM-EN-1
52	C	A	March 2018	▪ Flash change due to obsolescence	
53	A	A	April 2014	▪ Add P14DH variant with Wattmetric Directional Earthfault protection ▪ The .lng files generated by building and the .LNG files used by S1 Agile are inconsistent ▪ Incorrect Russian translations for DDB_CONTROL_TRIP & DDB_CONTROL_CLOSE	P14D-TM-EN-3 P14N-TM-EN-3 P94V-TM-EN-3

S/W Version Major	S/W Version Minor	H/W Version	Original Date of Issue	Description of Changes	Technical Documentation
53	A	A	April 2014	▪ Fix for P14DH 53A IEC61850-8-1 Level B Conformance Issue ▪ Inconsistent language text strings between P40Agile and P14x	P14D-TM-EN-3 P14N-TM-EN-3 P94V-TM-EN-3
53	B	A	April 2014	▪ CB Fail trip may fail to operate under faults with DC transient offsets ▪ Integrate new FPGA version	P14D-TM-EN-3 P14N-TM-EN-3 P94V-TM-EN-3
53	C	A	April 2014	▪ Fix for Error/Lockout 7104:2000/reboot ▪ The LCD display year is 2080 but in the disturbance and event records it is 1980 ▪ Using S1 Agile changing values to the Voltage Transformer does not change the corresponding values in Residual O/V NVD column ▪ Line length mismatch between value sent from S1 Agile and the value received in the relay ▪ DNP3oE Setting Files - GoEna is visible ▪ Values under High impedance menu do not show values in primary when relay is set to primary in S1	P14D-TM-EN-3 P14N-TM-EN-3 P94V-TM-EN-3
53	D	A	August 2015	▪ Very sharp pick current level lead relay tripping on IREF	
53	E	A	April 2017	▪ IEC 61850 - Connection/Disconnection issues ▪ DNP3oE Versions - Courier Tunnelling does not work ▪ DNPOE: After multiple DI and AI events at the same time, the relay Ethernet board seems locked ▪ DNPoE Application stops running after many days of Polling ▪ Permanent ethernet communication loss in P40 Agile relays ▪ TCP disrupts after around 206 days of continuous use ▪ P14DZ HiZ Function asserting incorrectly (CHA HiF) ▪ Incorrect Burst Count - HiF Detection ▪ HiF FA Steady Fault - Incorrect Assertion ▪ HIF CHA Hysteresis is not correctly set ▪ HIF Burst Threshold is not reset after the adaptive threshold is disabled ▪ Maintenance Record generated everytime Gateway is configured in DNP configuration ▪ CS1 and CS2 does not work independently whey CB Comp enabled for CS2	
53	F	A	April 2018	▪ Flash change due to obsolescence	
54	A	A	December 2014	▪ New opto threshold for Russian requirement ▪ New reduced I/O option (3I/4O in 20TE and 6I/8O in 30TE) ▪ IEC 61850 client disassociation while reading PloGGIO1$CO block in P14D IEDs ▪ IEC 61850 incorrect Courier cell mapping to TotWh and TotVArh in MMTR LNs ▪ IEC61850 measurements negative values rounding error	P14D-TM-EN-4.1 P14N-TM-EN-4.1 P94V-TM-EN-4.1

S/W Version Major	S/W Version Minor	H/W Version	Original Date of Issue	Description of Changes	Technical Documentation
54	B	A	April 2015	▪ Agile Relay failure: Error/Lockout 7104:2000/reboot ▪ The LCD display year is 2080 but in the disturbance and event records it is 1980 ▪ Using S1 Agile changing values to the Voltage Transformer does not change the corresponding values in Residual ▪ O/V NVD column ▪ Line length mismatch between value sent from S1 Agile and the value received in the relay ▪ DNP3oE Setting Files - GoEna is visible ▪ Values under high impedance menu do not show values in primary when relay is set to primary in S1	P14D-TM-EN-4.1 P14N-TM-EN-4.1 P94V-TM-EN-4.1
54	C	A	April 2017	▪ IEC 61850 - Connection/Disconnection issues ▪ DNP3oE Versions - Courier Tunnelling does not work ▪ DNPoE: After multiple DI and AI events at the same time, the relay Ethernet board seems locked ▪ Permanent Ethernet communication loss in P40 Agile relays ▪ TCP disrupts after around 206 days of continuous use ▪ P14DZ HiZ Function asserting incorrectly (CHA HiF) ▪ Incorrect Burst Count - HiF Detection ▪ FA Steady Fault - Incorrect Assertion ▪ HIF CHA Hysteresis is not correctly set ▪ HIF Burst Threshold is not reset after the adaptive threshold is disabled ▪ Maintenance Record generated every time Gateway is configured in DNP configuration	
54	D	A	April 2018	▪ Flash change due to obsolescence	
55	A	A	November 2015	▪ CS1 and CS2 does not work independently whey CB Comp enabled for CS2 ▪ To retrofit legacy products KAVR100, KAVS and KVTR ▪ Pin to pin retrofit solution for KMPC130 ▪ Compliance to CEI 0-16 requirements in P14D/P94V ▪ New communication protocol options - 1) IEC61850 over Ethernet + MODBUS via RS485, 2) IEC 61850 over Ethernet + DNP3.0 via RS485 ▪ Settable k factor in Thermal overload ▪ Fault locator setting improvements ▪ Earth Fault (EF1) setting 10mA minimum threshold ▪ DNP3.0 Unsolicited message reporting ▪ PSL timer setting ▪ New extra shorting link ordering option – for capacitor cone NVD application & alarm on IED removal ▪ Compliance to Russian Rosseti requirements ▪ NCIT column visibility incorrect. ▪ Write 'AAAA' into cell 0x0002 failed with a reply code 05(CS103_GRC_SETTING_OUT_OF_RANGE) ▪ Generated MICS document for IEC 61850 protocol contains 'IEC61850' instead of 'IEC 61850".	P14D-TM-EN-5 P14N-TM-EN-5 P94V-TM-EN-5

S/W Version Major	S/W Version Minor	H/W Version	Original Date of Issue	Description of Changes	Technical Documentation
55	A	A	November 2015	▪ Status report over IEC61850 not in line with DDB signals ▪ actVal Data Attribute now finalised as INT32 requirement in SCL (Edition 1 Only) ▪ Values under High impedance menu do not show values in primary when relay is set to primary in S1 ▪ Pending Reports when BufTm>0? Ed1 ▪ Agile latch reset when setting group is changed ▪ Connection/Disconnection issues ▪ Class 0 should be configurable to select either Counter or corresponding Frozen Counter ▪ DNP3oE Versions - Courier Tunnelling does not work ▪ For DNPOE build, the frozen counter always keeps the same value with the static counter without accepting a Freeze command ▪ The behaviour of frozen counter is different between DNP3 and DNPOE before the freeze command is sent ▪ DNPoE: After multiple DI and AI events at the same time, the relay Ethernet board seems locked ▪ IEC 61850 Interoperability problem when a client writes to any/all unsupported Trigger Options ▪ ICD file corrections ▪ 8.333Hz is displayed in the first generated Fault Record after relay reboot ▪ Underfrequency function enhancements and fixes ▪ SecRmsMMXU1 showing values in primary, not secondary ▪ IEC 61850: incorrect Courier cell mapping to TotWh and TotVArh in MMTR LNs ▪ CB Fail trip may fail to operate under faults with DC transient offsets ▪ "FUNCTION KEYS" column is visible for 20TE devices in P14 Agile data model ▪ Default GOOSE “Min Cycle Time” is wrong ▪ Visibility of setting "I>1 TMS" and "I>1 Time Dial" is wrong in Group 2 ▪ EPATR-B curve ▪ High Impedance Fault issue ▪ DNP3OE Versions - Command management during IED disconnection/connection ▪ Freq Avg Cycles & df/dt Avg Cycles should use power cycle instead of PCON calls cycles ▪ The unit of Records/RFLO1/CF/FltDiskm is incorrect ▪ Very sharp pick current level lead relay tripping on IREF ▪ The error message" Runtime Error C991:3011" appears on P14N relay when viewing the cells in overcurrent column from HMI ▪ Column [4E00] PSL TIMERS is invisible from relay ▪ Default Setting of Relay is in-consistent to Look & Feel ▪ P94VR Look & Feel consistency check issues via courier interface ▪ “Ethernet failover” option displays in IED Configurator ▪ New settings Moving average cells ([42 41] -> [42 2D]) are not working in MODBUS ▪ When downloading firmware to the P14DZ relay and power cycling, error message - "Runtime Error 2e0b:0101" appears and relay reboots	P14D-TM-EN-5 P14N-TM-EN-5 P94V-TM-EN-5

S/W Version Major	S/W Version Minor	H/W Version	Original Date of Issue	Description of Changes	Technical Documentation
55	A	A	November 2015	▪ Language translations of all new DDBs and settings are in English apart from French ▪ The display of the cell [0341][0345][0347][0343] misses a sign minus on MODBUS protocol, and the value of new adding cells can't be taken ▪ SecAvgMSTA.Volts4.rang.max.f is not configurable ▪ The IEC61850 communication disconnect when BRCB with special configuration is Enabled ▪ Trip elements 5 is missing in fault record of DNP protocol ▪ CTS operations when [4609] CTS VN< Inhibit is not satisfied ▪ Command "Reset Total Autoreclosures" is missing for P94VR DNP Object 10 ▪ DNP Binary Input 42 and Binary Input 299 could not be set when DDB 167 "UV Block" is ON ▪ Wrong DDB mapping for DA VtpAvgPTOV2.Str.PhsC ▪ When browsing Fault Record from HMI, Avg O/V Start operates unexpectedly when AVG OVER VOLT protection is disabled ▪ FUN number should be 164 instead of 162 for DDB #549 "dv/dt2 StartA/AB" in L & F "IEC60870-5-103" spread sheet ▪ MODBUS address of all DDBs in "Alarm status 2" and "Alarm status 3" are incorrect ▪ Menu text errors in 55A version ▪ Look & Feel Start Elements, Trip Elements available options, "Fault Record" spread sheet need update ▪ Data Group MODBUS missing, MODBUS Number of steps shift from cell [420D] V<3 Function to [4211] V<3 Poledead Inh in Look & Feel ▪ Max value 10Hz could not be set to cells f+Df/Dt x Dfreq(x=1 to 9) via MODBUS protocol ▪ The mapping "Measurements/SecMSTA1MXAvVAr3magf" was wrong, mapping corrected to the cell [0342]("+3Ph VAr Fix Dem") ▪ The new Average voltage protections keep running even if 091D is disabled ▪ FAULT RECORD Start CN and Trip CN are missing from UI when two stages of average voltage protections are both enabled in case of three phase faults ▪ BRCB - Wrong response when client sets an unknow EntryID value before enable it ▪ DO sequence error in ICD file ▪ MODBUS Start, Data Group MODBUS, MODBUS Number of steps, MODBUS registers are incorrect for Frequency Protection Stage 9 cells in L&F ▪ In Unsolicited mode, the measured unsolicited response time is 5s greater than the setting [1B 04] - "Unso Response" value ▪ The cell text of these cells [4201][4220][4240][4250] are not consistent with look&feel file ▪ The cell [30 11] Dir Char Setting exist in P94VR ▪ MODBUS address error in L&F for cell [03 28] ~ [03 2D] ▪ Missing translation for DDB (ordinal:1799-1842) in Look & Feel file ▪ The "ASDU Type" in "Fault Record" that's extracted by Px40VDEW is not consistent with look & feel file ▪ The format of Build Date&Time is not correct	P14D-TM-EN-5 P14N-TM-EN-5 P94V-TM-EN-5

S/W Version Major	S/W Version Minor	H/W Version	Original Date of Issue	Description of Changes	Technical Documentation
55	B	A	October 2016	▪ The values of DDBs (1717~1720) read via IEC61850 cannot be updated after downloading the new PSL ▪ The fault record can't be extracted via CS103 protocol if the previous fault record terminated by "Reset CU" ▪ DNPoE Application crash after many days of Polling ▪ Ethernet communication loss in P40 Agile relays ▪ After enabling the BRCB, the first integrity report comes out around 10s when the integrity time is set to be 3s under certain pre-steps ▪ Incorrect Burst Count - HiF Detection ▪ FA Steady Fault - Incorrect Assertion ▪ HIF CHA Hysteresis is not correctly set ▪ HIF Burst Threshold is not reset after the adaptive threshold is disabled	
55	C	A	April 2018	▪ Flash change due to obsolescence	
56	A	A	February 2016	▪ PRP/HSR/FailOver redundancy (new hardware boards) Configurable Fail-over in DNP3 ▪ DDB 781/782 doesn't show the real status when the alarm “Port A Link Fail” or "Port B Link Fail" show in HMI ▪ The status of DDB 783 is “OFF” issue	P14D-TM-EN-6.1 P14N-TM-EN-6.1 P94V-TM-EN-6.1
56	B	A	October 2016	▪ Ethernet communication lost after some time when deadbands for reporting set very small ▪ Maintenance record generated every time gateway is configured in DNP3.0 configuration ▪ CS1 and CS2 does not work independently whey CB Comp enabled for CS2	
56	C	A	June 2017	▪ HiF Function enhancements ▪ DNP3oE enhancements	
56	D	A	March 2018	▪ Flash change due to obsolescence	
57	A	A	May 2015	▪ RSTP redundancy (new hardware boards) ▪ PCCN/Electre features ▪ Enhancements for Italy CEI 0-16 ▪ Fix for DNP3 memory leak ▪ The values of DDBs (1717~1720) read via IEC61850 cannot be updated after downloading the new PSL ▪ The fault record can't be extracted via CS103 protocol if the previous fault record terminated by "Reset CU" ▪ DNP Over Ethernet Application stops running after many days of Polling ▪ DDB #146 "Prot'n Disabled" events are read as "test mode" via CS103 protocol. ▪ The new under voltage Average voltage protections doesn't use POLEDEAD similar to the standard under voltage ▪ Ext AR SEF Trip could not block AR when [493F] SEF Ext Prot is set to "Block AR". ▪ The VTS Fast Block can not block the AVG undervoltage;AVG overvoltage;AVG ZERO SEQ O/V;AVG POS SEQ O/V and AVG NEG SEQ O/V ▪ DDB #167 UV Block should not be visible on P14DA	P14D-TM-EN-7 P14N-TM-EN-7 P94V-TM-EN-7

S/W Version Major	S/W Version Minor	H/W Version	Original Date of Issue	Description of Changes	Technical Documentation
57	A	A	May 2015	▪ After enabling the BRCB, the first integrity report comes out around 10s when the integrity time is set to be 3s under certain pre-steps ▪ IEC 61850 client sets unsupported TrgOps must have response+ (Tissue 780) ▪ Incorrect Burst Count - HiF Detection ▪ FA Steady Fault - Incorrect Assertion ▪ HIF CHA Hysteresis is not correctly set ▪ HIF Burst Threshold is not reset after the adaptive threshold is disabled	
57	B	A	April 2017	▪ Ethernet communication loss in P40 Agile relays ▪ Maintenance Record Generated every time Gateway is configured in DNP configuration	
57	C	A	March 2018	▪ Flash change due to obsolescence	
60	A	A	December 2016	CLONE - CS1 and CS2 does not work independently whey CB Comp enabled for CS2 ▪ Voltage vector shift ▪ Switch Status and control ▪ IEC61850 Fault Records ▪ Code Review Report - Bad task priority change in DSP DTC transmit task ▪ Permanent ethernet communication loss in P40 Agile relays ▪ DDB #146 ""Prot'n Disabled"" events are read as ""test mode"" via CS103 protocol ▪ No events read from CS103 protocol for DDB #441 ""Test Mode"", DDB #771 ""GOOSE IED Absent"", DDB #780 ▪ ""IP Addr Conflict"", DDB #1200 ""Monitor bit 1"" to DDB #1207 ""Monitor bit 8"" ▪ RSTP is non-responsive at 10Mbps ▪ Output relay RL1 contact does not persist on P14DH model after reboot	P14D-TM-EN-8 P14N-TM-EN-8 P94V-TM-EN-8
60	B	A	March 2018	▪ Flash change due to obsolescence	
61	A	A	April 2017	Introduction of 40TE models ▪ TEFD new algorithm ▪ Vn input implementation change ▪ New In RMS measurement ▪ 64 Virtual Inputs ▪ Editable user alarms ▪ Maintenance Record Generated Every time Gateway is configured in DNP configuration ▪ CS1 and CS2 does not work independently whey CB Comp enabled for CS2	P14D-TM-EN-9
61	B	A	November 2017	P40 Agile Motor release ▪ Fix for SEF Directional protection working when multiple stages activated	P14D-TM-EN-9 P14N-TM-EN-9 P94V-TM-EN-9 P24xM-TM-EN-1

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61	C	A	March 2018	Flash change due to obsolescence	
61	D	A	February 2019	▪ DDR clock synchronization activation ▪ Fix for communication loss in DNPoE ▪ Fix for IEC103 communication stops and relay reboot ▪ Fix for DNP3 memory leak	
62	A	A	September 2018	▪ Concurrent Ethernet protocol support: IEC61850 and DNPoE in Feeder and Motor models ▪ Fix for unexpected behaviour when 103 communication is active and a protection function is triggered ▪ Fix for DNP3 memory leak	P14D-TM-EN-10.1 P14N-TM-EN-10.1 P94V-TM-EN-10.1 P24xM-TM-EN-2
62	B	A	February 2019	▪ DDR clock synchronization activation	
62	C	A	April 2019	▪ Fix for overfrequency element - Maloperation with normal frequency when specific harmonics are present ▪ Fix for frequency protection element - zero crossing algorithm weakness	
62	D	A	October 2019	▪ Fix for reboots/lockouts caused by I/O maintenance records ▪ Fix for DNP3.0 Communication: When sending an Assign Class request immediately followed by a Class poll relay reboots	P14D-TM-EN-10.2 P14N-TM-EN-10.2 P94V-TM-EN-10.2
62	F	A	January 2021	▪ Enhancement: All models updated to meet new IEC61850 Ed1 certification requirements ▪ Fix for manual reset latches causing logic to remain high after power cycle ▪ Fix for IRIG-B status: DNP3 Data point not updating & relay Event Missing for "No Signal" ▪ When self-test routine detects an internal power failure, a restart happens and output relays will be disabled-fixed ▪ Fix for Events corruption involving S1 Agile crash when trying to extract events ▪ Fix for corrupted RSTP FPGA bin file replaced with the correct one ▪ Fix for DNPoE counters issue ▪ IEC61850 stack resized (was producing errors 0x0B0903BB & 0xFFF2)	
62	G	A	January 2022	▪ Fix for Cyber security vulnerability on TMW Library for DNP3.0 ▪ Fix for P14DL- Out of Service flag Set in RP1 Courier Communication when Relay is Healthy ▪ Fix for Cold Load Pick-up when enabled, it's blocking "inhibiting" PWH ▪ NAND Flash change due to obsolescence	
64	A	A	October 21	▪ Enhancement: PTP Time synchronization support ▪ Enhancement: Max fault current data in fault records ▪ Enhancement: PWH In derived option ▪ Enhancement: SNTP fail alarm in Alarms and IEC61850 ▪ Enhancement: Adding password level control for HMI default screens ▪ Goose enhancement & optimized Goose configuration ▪ Improvement in DT timer hysteresis behaviour	P14D-TM-EN-12 P14N-TM-EN-12 P94V-TM-EN-12 P24xM-TM-EN-2.1

S/W Version Major	S/W Version Minor	H/W Version	Original Date of Issue	Description of Changes	Technical Documentation
64	A	A	October 21	▪ Fix for Low impedance REF tripping incorrectly ▪ Fix for Cold Load Pick-up when enabled, it's blocking "inhibiting" PWH ▪ Fix for DNPOE communication which fails when Counter points are configured ▪ Fix for Cyber security vulnerability on TMW Library for DNP3.0	P14D-TM-EN-12 P14N-TM-EN-12 P94V-TM-EN-12 P24xM-TM-EN-2.1
64	B	A	January 22	▪ NAND Flash change due to obsolescence	
70	B	A	March 2021	▪ Enhancement: P14DL compliance with IEC61850 Ed2 for 2 communication protocols: 61850 & 61850 + IEC103 ▪ Enhancement: RcdMade as Transient data point ▪ Fix for manual reset latches cause logic to remain high after power cycle ▪ Fix for incorrect values reported to MODBUS Master Station ▪ Fix for Low impedance REF trips incorrectly when phase CT saturates heavily ▪ Fix for GOOSE schemes which do not work with more than 32 APPID	P14DEd2-TM-EN-11
70	C	A	June 2023	▪ Enhancement: P14NB and P94VR compliance with IEC61850 Ed2 for 2 communication protocols: 61850 & 61850 + IEC103 ▪ Enhancement: Additional communication option support in P14DL model ▪ New NAND Flash driver due to obsolescence ▪ Fix for IRIG-B status not updating correctly in DNP3.0 ▪ Fix for DNPOE communication, which fails when counter points are configured ▪ Fix for Out of Service flag Set in RP1 Courier Communication when Relay is Healthy ▪ Fix for RSTP communication issues ▪ Fix for relay reboot caused while modifying UI settings	P14DEd2-TM-EN-11.2 P14NEd2-TM-EN-13 P94VEd2-TM-EN-13

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P94VEd2-TM-EN-13