Digital Energy

DART Product Family
Product Description, Information and Specification

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Introduction

Purpose of this Document

The purpose of this document is to fully describe the capabilities of the DART Product Family. GE Energy Services staff and customers should use the document to specify, design and test systems which employ DART products. This document supersedes any other literature that may contain product information on the DART.

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Chapter 1: Guideform Specification

Fault detection, transducer-less metering, SCADA and communications for one, two or three feeders shall be provided in one accurate, efficient and easy to use intelligent electronic device (IED) suitable for incorporation into a feeder control system.

1.1 Fault Detection

The fault detector shall be capable of:

- Alarming over-current, breaker operation and breaker lockout by monitoring voltage and current quantities.

- Discriminating between load and source side faults for accurate fault location.

- Monitoring radial or networked feeders.

- Being configured on a per feeder basis since different feeders may have different ratings.

- Alarming on a per phase basis line to line and/or line to ground faults for the purposes of conducting post-fault analysis and taking remedial action.

- Operating on peak values rather than RMS values.

- Reporting alarms as latched or fleeting. In latched mode, the alarms shall be cleared via SCADA. In fleeting mode, the alarms shall be cleared once the event has cleared. Latched mode frees the dispatcher from having to review historical alarms during a fault. Fleeting mode is useful when an upstream platform is used to operate on the fault detector data prior to reporting to the dispatcher.

- Alarming voltage unbalance that can be used to deduce broken conductors and alarming neutral faults, which can be used to deduce load imbalance.

- Reporting alarms as sequence of events (SOE) for post-fault analysis or change of state (COS) for reducing communication traffic.

1.2   Metering

Metering capabilities shall include:

- Monitoring up to 12 AC voltage and current inputs directly from PTs, CTs and line post sensors without the need for transducers. A lack of transducers results in reduced capital, maintenance and engineering costs, greater reliability and accuracy.

- Calculating values using a digital signal processor (DSP) by sampling the input waveforms 21 times per power line cycle.

- Reporting per phase voltage, current, phase angle and power factor.

- Reporting per feeder real power, reactive power and power factor.

- Reporting per feeder export and import energy.

- A resolution of 12 bits plus sign and over-range.

1.3   SCADA

SCADA capabilities shall include:

- A real-time, multi-tasking, pre-emptive, event-driven operating system.

- 16 digital inputs in two groups of eight configurable as simple status, COS, SOE or accumulators.

- SOE resolution of 10 msec.

- 8 control relays with an option to expand to an additional 8 control relays.

- 1 DC analog input with multiple input options.

- Reporting of current direction.

1.4   Communications

Communication capabilities shall include:

- Compatibility with any communication link.

- A real time communication port that speaks DNP 3.0 and a maintenance port compatible with a VT100 terminal.

- An optional, on-board, 202/CCITT V.23 modem.

- Support for RTS, CTS and DCD hand-shaking lines with configurable settings to offer maximum flexibility for system integration.

- Unsolicited report by exception (URBX) with a collision avoidance algorithm to increase the URBX communication efficiency. URBX shall be under the control of SCADA. URBX shall be available for all real and software inputs and outputs. ACCURACY

The IED's accuracy shall be assessed by measuring its reliability, robustness and safety. The IED shall:

- Have a mean time between failures (MTBF) of 40,000 hours.

- Comply with IEC electromagnetic compatibility (EMC) requirements for CE mark and applicable IEEE EMC standards.

- Be validated by an installed base of over 6000 units and over 100 different customers world-wide.

- Incorporate single point of failure and select-check-before operate control integrity.

- Include optically isolated communication ports and digital inputs.

- Have a dielectric strength of 1500 VDC between any communication port and ground and input/output line and ground.

- Be able to withstand 14 times nominal current on the CT inputs for one second without damage.

- Be able to withstand 4 times nominal current on the CT inputs continuously without damage.

- Be able to withstand 2 times nominal voltage on the PT inputs continuously without damage.

- Operate from –40C to +80C in environments of 100% condensing humidity without environmental control equipment such as fans and/or heaters.

- Be accompanied by documentation that details the verification methodologies and results for all specifications.

1.5 Efficiency

The IED shall operate for 48 hours from an 8 Amp-hour battery. At the end of the 48 hour period, the battery must contain 30% of its original charge.

1.6 Ease of Use

The IED shall:

- Not require any scheduled maintenance.

- Support configuration upload and download via the maintenance and real time ports.

- Permit the user to enter PT and CT nominal and actual ratings that will be applied as correction factors to the measured data.

- Have an optional on-board digital input display.

- Have an indicator for microprocessor health.

- Have an indicator for the on-board local/remote switch.

- Have a battery test that can be executed automatically or configured for execution on a monthly basis.

- Connect to field inputs and outputs using quick disconnect terminal blocks to reduce the chances of wiring errors during field replacement.

- Require less than 10 minutes to field repair.

- Be configurable using a configuration system with drop-down menus.

- Not require a PC to configure the communication address.

Chapter 2: Ordering DART Series Products

2.1   DART Logic Module

To order a DART logic module, order the appropriate product part number:

Part Number	Description
512-0001	12V status wetting for both status groups
512-0002	24V status wetting for both status groups
512-0007	24V for group 1/12V status wetting for group 2
512-0008	12V for group 1/24V status wetting for group 2

Table 1 DART Logic Module Part Numbers

2.2   DART Termination Module

To order a DART termination module, order the appropriate product part number:

In the following table, X/Y indicates the number of voltage and current inputs (e.g. 3/3 = single feeder, three phase voltage and current monitoring). Other abbreviations are listed below:

S&C	Developed for the S&C voltage sensor
FP	Developed for the Fisher-Pierce 1301 current only sensor
SD	Developed for the Square D LSCV-110-122 current/voltage line post sensor
NGK	Developed for the NGK optical current sensor
L	Developed for the Lindsey line post sensor
Z	input impedance

		Nominal Current Input Signal (AMPS OR VOLTS RMS)						
		1 A	5 A	10 V	2.4 V HI Z	5 V HI Z	10 V HI Z	11.67 V
Nominal Voltage Input Signal (VOLTS RMS)	5.7		3/3 S&C 517-0185					
			6/6 S&C 517-0186					
			3/9 S&C 517-0187					
	69		3/3 517-0200					
			6/6 517-0201					
			3/9 517-0202					
	120	3/3 517-0311	3/3 517-0197	3/3 517-0308				1/3 FP 517-0265
		6/6 517-0312	6/6 517-0198	6/6 517-0309				
		3/9 517-0313	3/9 517-0199	3/9 517-0310				
	220	3/3 517-0422	3/3 517-0419					
		6/6 517-0423	6/6 517-0420					
		3/9 517-0424	3/9 517-0421					
	0.75 HI Z				3/3 SD 517-0264			
	7.5 HI Z		3/3 L 517-0317				3/3 L 517-0320	
			6/6 L 517-0318				6/6 L 517-0321	
			3/9 L 517-0319				3/9 L 517-0322	
	120 HI Z					3/3 NGK 517-0314	3/3 L 517-0255	
						6/6 NGK 517-0315	6/6 L 517-0256	
						3/9 NGK 517-0316	3/9 L 517-0257	

Table 2 Nominal Current Input Signal

2.3   DART DC Analog Input Module

To order the DC analog input module, specify the appropriate product part number:

Part Number	Description
540-0400	Temperature Input
540-0401	+/- 15V
540-0402	+/- 30V
540-0403	+/- 1mA
540-0404	+/- 5 mA
540-0405	+/- 20 mA
540-0406	+/- 1.25 mA
540-0407	+/- 5V
540-0409	+/- 1.5 mA
540-0410	+/- 60V

Table 3 DC Analog Input Module Part Numbers

2.4   Other Components

Part Number	Description
540-0167	DART MODEM
540-0193	DART Control Expansion
540-0191	DART LED Status Display
976-0122	Logic module to analog termination cable

Table 4 Other Components Part Numbers

Chapter 3: Product Description

3.1 Hardware Architecture

The DART Product Family is composed of components that are assembled to form discrete modules. These modules are integrated within an enclosure to form a complete IED assembly. Illustrated below is the over-all architecture of the DART Product Family.
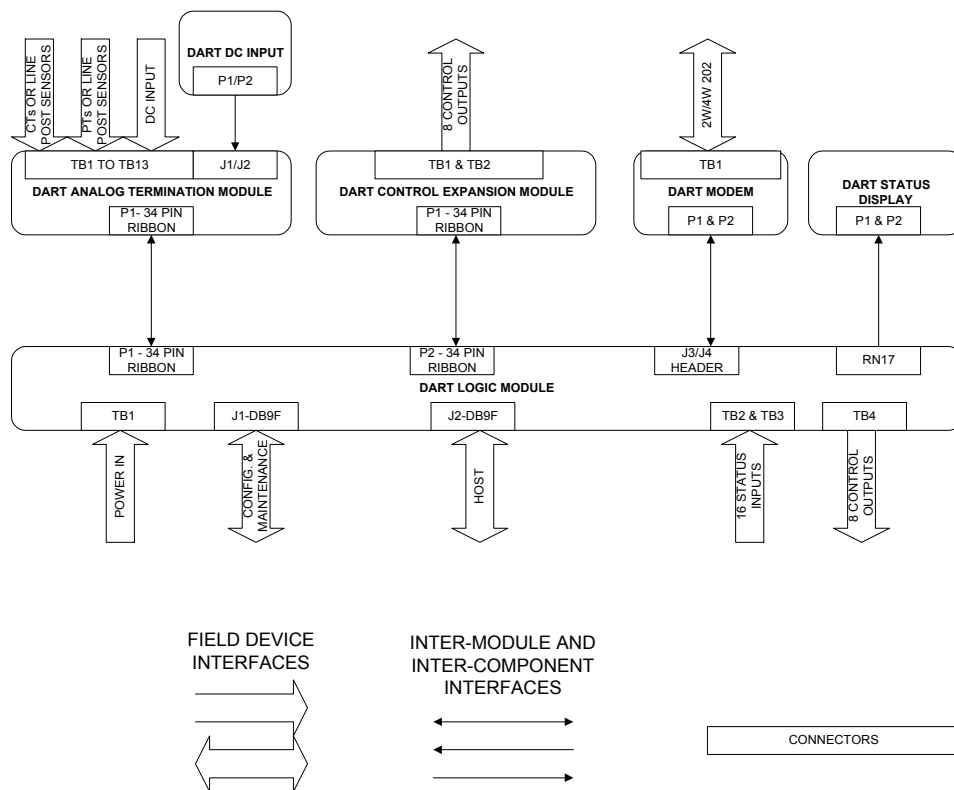
Figure 1 IED Assembly

3.1.1 DART Logic Module

The DART logic module contains six major functional blocks: the power supply, the status inputs, the control outputs, the analog input processing section, communications and the microcontroller. The DART logic module contains pre-programmed instructions for the digital signal processor (DSP) and Motorola microcontroller in EPROM. Application specific configuration instructions are contained in the on-board EEPROM. The DART logic module is made up of one printed circuit board, which employs through-hole technology.
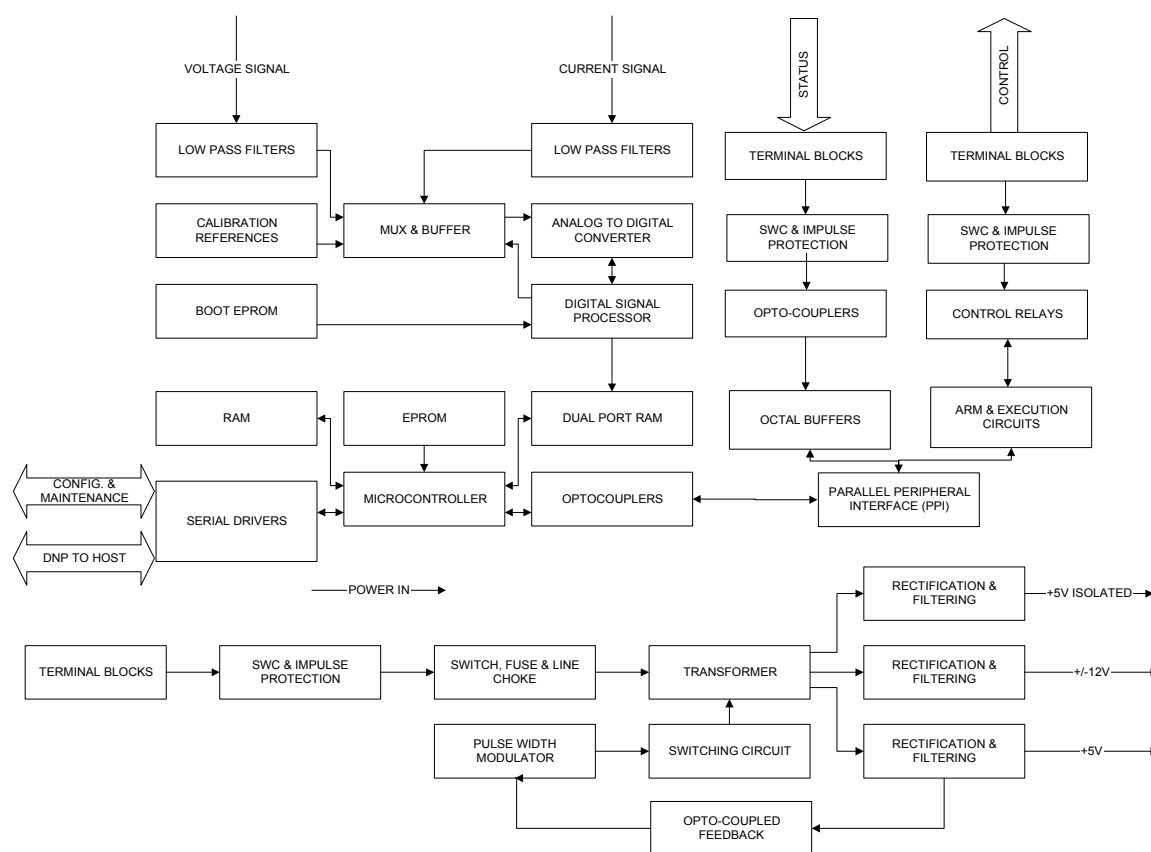
Figure 2 DART Logic Module

3.1.2 DART Analog Termination Module

The DART analog termination module normalizes the PT, CT or line post sensor inputs for use by the DART logic module.
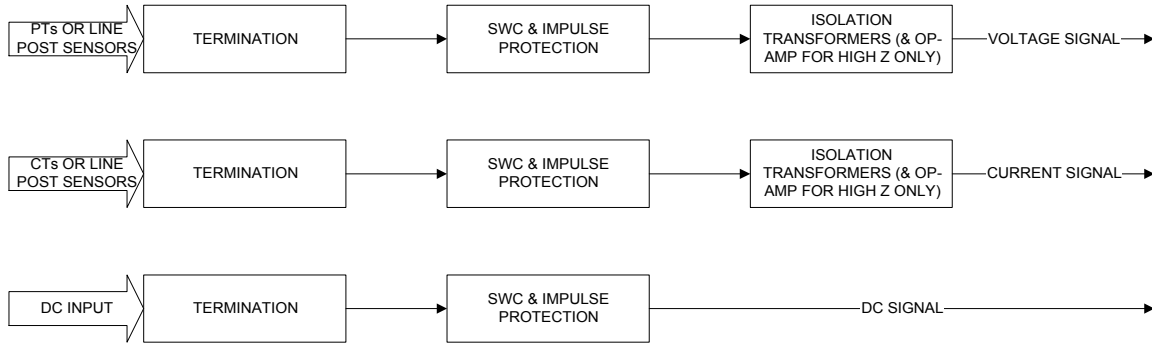
Figure 3 DART Analog Termination Module

3.1.3 DART Modem

The DART modem provides a two or four wire Bell 202 or CCITT V.23 interface at 1200 baud. The DART modem mounts on the DART logic module with its two header connectors.
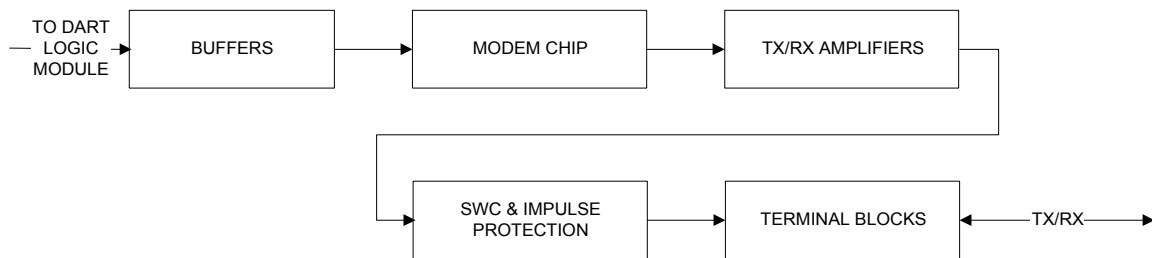
Figure 4 DART Modem

3.1.4 DART Control Expansion Module

The DART control expansion module allows the user to expand the DART's control output section from 8 relays to 16. The expansion module also has status display LEDs. The expansion module is mounted on stand-offs above the DART logic module and connects to the logic module via a ribbon cable.
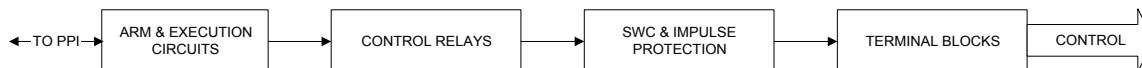
Figure 5 DART Control Expansion Module

3.1.5 DART DC Analog Input Module

The DC analog input module allows the user to monitor one DC input (e.g. battery voltage) or temperature. This module mounts on the DART analog termination module with its two header connectors.

3.1.6 DART Status Display Module

The DART status display module gives visual indication of the status inputs via LEDs. This board mounts on the DART logic module using IC sockets.

3.2   Software Architecture

3.2.1 Software Background

Because of the rigorous requirements of automation applications, the DART is designed to operate reliably in time-critical situations and to respond quickly to unscheduled changes in its environment. This is possible because the DART uses a real-time operating system, which, by the use of software features like multi-tasking and interrupts, can carry out a complex set of inter-related and inter-dependent activities within strict time limits.

3.2.2 Software Context

Software for the DART is divided into digital signal processing (DSP) software and operating software. Use of assembly language reduces the memory requirements and decreases execution time. The DSP software is used to calculate AC signal parameters. The operating software is responsible for DNP3.0 communications, the maintenance program, I/O processing and the fault detector.

The DART uses memory in the form of EPROM, EEPROM, and RAM. EPROM is used to store the DSP and operating software. The application-specific configuration is stored in EEPROM. RAM is used for storing tables and variables during program execution. The following software context diagram illustrates the software environment for the DART.
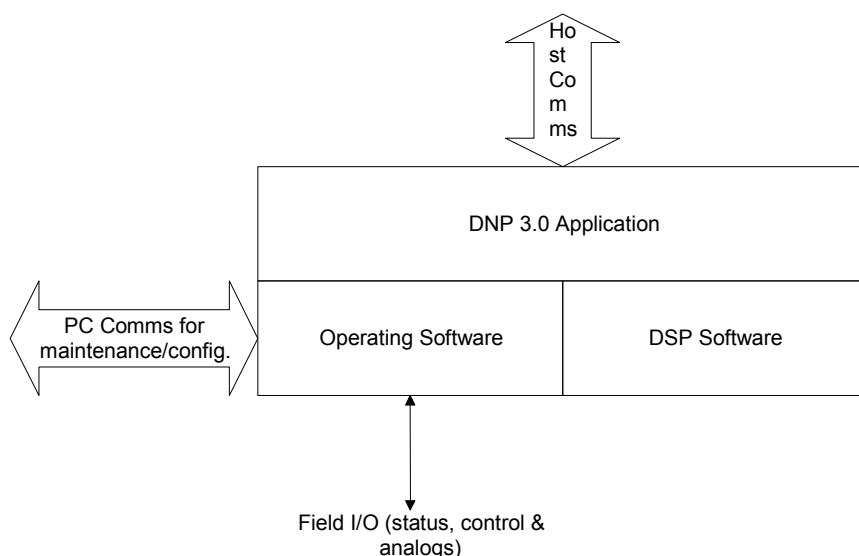
Figure 6 Software Environment of the DART

3.3 Electromagnetic Immunity

Pole-top IEDs (Intelligent Electronic Devices) are subjected to a wide spectrum of electromagnetic disturbances. This paper discusses the specific design measures that were implemented on the GE Energy Services DART to achieve electromagnetic immunity.

To enjoy high availability and a long lifecycle, pole-top IEDs must be immune to conducted and radiated interference. Conducted and radiated interference may be in the form of transient or steady state variations. Transient variations result from capacitor bank switching, lightning strokes, short circuits, open circuits, sags, swells, electrostatic discharge and spurious noise sources. Steady state variations result from conducted noise, radiated emissions due to various communication media and time-varying electric and magnetic fields.

These disturbances were foremost in the minds of the DART architect and the following specific measures were taken to design for, implement and verify immunity into each and every DART sub-system:

- Identification of worldwide, recognised standards that properly reflected the utility field environment. These standards represented quantitative goals, that when complied to, represented a higher than normal degree of immunity. The selected standards are described in the DART PRPI document.

- Design approaches that seeked to maximize immunity to the disturbances described in these standards. These approaches include:

  - Multi-layered printed circuit boards with large, well-isolated ground, analog and digital power planes as well as over-size tracks to minimize noise and increase stability.

  - Physical and optical isolation between sensitive electronic components and the field interface.

  - Stiff on-board power supply with a Faraday shield around the switching transformer's core.

  - Component placement and printed circuit board layout geometry that provides the shortest exit path for disturbances for oscillatory transients that are applied in positive or negative polarities.

  - Transformer isolated AC analog inputs. The transformers resist low frequency disturbances such as the kind caused by capacitor bank switching and slow down higher frequency content such as that contained in lightning strokes.

- A scheme that protects against high frequency transients AND limits the voltage impressed across upstream components. High dielectric constant, paper capacitors with excellent self-healing properties and low inductance characteristics shunt high frequency transients that are impressed in common or normal modes. Fast acting, high energy, metal oxide varistors (MOVs) clamp the incoming energy. These large surface area MOVs permit repetitive transients to be dissipated without loss of performance. In addition to this front-line protection, the secondaries of the AC transformers contain clamping MOVs and capacitors with shunting diodes.

Verification activities included tests at the factory and accredited facilities that specialised in such testing. Tests methods, apparatus set-up and results have been documented for most products in the DART Family and are available to the public.The true testament to the DART's robustness can be found in its in-field performance.

Chapter 4: Product Specification

4.1 Engine

Microprocessors	Motorola 68HC11, 8 bit, 2 MHz
	Analog Devices ADSP-2105 digital signal processor, 16/24 bit, 8 MHz
Memory	68HC11: 32K bytes EPROM, 30K bytes SRAM, 256 bytes RAM, 512 bytes EEPROM
	ADSP-2105: 8K bytes boot EPROM, 1K x 24 bit internal program RAM, 512 x 16-bit internal data RAM, 8K x 24 bit external program RAM
	2 K bytes dual-ported RAM shared between the 68HC11 and the ADSP-2105
Indicators	68HC11 red run LED; normal = 5 pulses/sec, fault = 1 pulse/2 sec
Time clock drift	+/- 360 msec per hour @ 25 degrees C (higher accuracy clock is available for special orders)

4.2 Analog Processing Sub-System

Number of feeders	up to three
A/D references	three internal, autocalibrating, high accuracy references; no adjustments required
Sampling rate	21 times per cycle
Resolution	12-bit plus sign and overrange

4.3 AC Voltage Inputs

Input measurement range	up to 1.33 times nominal
Type	transducerless; signal is transformer coupled to logic module
Burden	0.05 VA maximum (low Z versions)
	800 K Ohms to 1.5 M Ohms @ 60 Hz and nominal voltage for HI Z versions
Accuracy (@ 25 degrees C)	+/- 0.2% of full scale
Termination configuration	line and common for each phase
Power system configuration	grounded wye
Power frequency	50 Hz/60 Hz
Overload rating	2 times nominal continuous

4.4 AC Current Inputs

Input measurement range	up to 2.5 times nominal
Type	transducerless; signal is transformer coupled to logic module
Burden	0.5 VA maximum for CT interface; 500 K Ohms to 1.5 M Ohms @ 60 Hz and nominal voltage for HI Z versions
Accuracy (@ 25 degrees C)	+/- 0.2% of full scale

Accuracy is ultimately dependent on the transfer function of the line sensing device.

Termination configuration	line and common for each phase
Power system configuration	grounded wye
Power frequency	50 Hz/60 Hz
Overload rating	4 times nominal continuous; 14 times nominal for 1 second. Higher ratings are available for special orders.

4.5   DC Analog Input

Accuracy	+/	5V input:	+/	0.05V
	+/	15V input:	+/	0.2V
	+/	30V input:	+/	0.3V
	+/	60V input:	+/	0.75V
Current input:	+/	(range/4095)*75 Amps		

4.6   Status Inputs

Number of inputs	sixteen
Number of groups	two groups of eight
Input wetting	12VDC or 24VDC
Type	optically isolated
Burden	5 mA typical
Thresholds (@ 25 deg. C)	12VDC nominal: on > 9VDC, off < 6VDC
	24VDC nominal: on > 18VDC, off < 12VDC
Overload (@ 25 deg. C)	2 times nominal
Rating	reverse polarity protected
Visual indicators	via DART status display module or control expansion module options; one red LED per status point which illuminates when the point is energized
Configurable parameters	16-bit pulse counters configurable on all points (point-by-point)
	COS configurable point-by-point
	Time tagging SOE with 10-msec resolution configurable on point-by-point
Scan rate and debounce	scanned every 10 msec
	20 msec debounce (2 scans)

4.7 Control Outputs

Number of outputs	four trip/close relay pairs (8 relays); expandable to 8 trip/close relay pairs (16 relays) via DART control expansion module
Contact rating	N.O. Contacts: 5 A @ 28VDC (200,000 operations)
Contact rating	N.C. Contacts: 3 A @ 28VDC (200,000 operations)
Contact rating	N.O. Contacts: 10 A/1 sec. @ 28VDC (50,000 ops.)
Contact configuration	form C
Configurable parameters	contact duration from 10 msec to 10 min in 10 msec increments
Security features	single point of failure integrity; select-check-before operate functionality; control enable/disable switch with red LED indicator (on indicates enabled); maximum one relay operation at any one time

4.8 Communications

4.8.1 Host Port

Protocol	DNP 3.0 Level 1 subset (not yet independently verified)

4.8.1.1 Digital Interface

Speed	75 baud to 9600 baud
Hand-shaking	TX, RX, RTS, CTS, DCD
Connection	RS232; DB9F

4.8.1.2 Analog Interface (via optional DART modem)

Speed	1200 baud		
Modes	2-wire/4-wire frequency shift keying via header jumper		
Compatibility	Bell 202/CCITT V.23 compatible via header jumper		
Transmit output	-15 dBm to –9 dBm (fixed)		
Receive input	-40 dBm (minimum); adjustable receive bias		
TX/RX impedance	600 Ohm +/- 2%		
Frequencies	Bell 202	Mark	1200+/- 5 Hz
		Space	2200+/- 5 Hz
	CCITT V.23	Mark	1300+/- 5 Hz
		Space	2100+/- 5 Hz

4.8.2 Maintenance/Configuration Port

Speed	2400 baud
Hand-shaking	TX, RX
Connection	RS232; DB9F

4.8.3 Site Addressing

Size	16-bit; 65536 discrete addresses
Method	via header jumpers

4.9 Power Supply

User controls	on/off switch
Topology	flyback
Method of control	pulse width modulation
Input voltage	9VDC to 36VDC
Input power	2 Watts (without installed options)
Protection	MDL 1A fuse
Inrush current	700 mA

4.10 Physical

Weight	DART logic module	1 pound
	DART analog termination board	2 pounds
	DART control expansion	1 pound
	DART modem	¼ pound
	DART LED status display	¼ pound
	DART DC analog input	¼ pound
Mounting	DART logic board – 13.5" long x 12.6" wide; mounts via	holes located on periphery
	DART analog termination board – 8" long x 12.6" wide; mounts via holes located on periphery	
	DART modem – mounts on the DART logic module via two header connectors	
	DART LED status display – mounts on the DART logic module via two header connectors	
	DART DC analog input – mounts on the DART termination module via two header connectors	
Terminations	Removable Phoenix screw compression with AWG #12 wire capacity	
Manufacturing technology	through-hole	

4.11 Environmental

Operating ambient	
Temperature	-40 deg. C to +80 deg. C
Humidity	DART logic module, analog termination module and DART Charger: 100% condensing (conformal coated)
	All other modules: less than 95% non-condensing

4.12 Reliability Prediction

MTBF 44,230 hours (5 years); consult document STRP-003/1.0 for further information

4.13 Standards & Protection

All of the following verification tests were conducted with the described components mounted in an outdoor enclosure and wired to GE Energy Services wiring standards. See the legend at the end of this section for an explanation of the codes found in the chart. The components may meet specifications that are not listed in the chart. Additional verification testing can be conducted at the user's request:

Table 5 Verification Tests

Standards Body	Standard	Component					
		WD DART	WT DART	DART Charger	CPM	DART DC Input	DART Modem
ANSI/IEEE	C37.90.1-1989 SWC & Fast Transient.	1	1	5	5	5	5
	C62.41-1980 Category B 1.2 X 50 us 6KV, 8 X 20 us 3 kA, 0.5 X 100 kHz 6KV/500 A.	1	1	5	5	5	5
	1500VDC dielectric.	1	1	5	5	5	5
Directive 89/336/EEC (EMC): EN 50082-2 (susceptibility) **The EUT maintained performance criteria A.**	EN 61000-4-2 (IEC1000-4-2) Electrostatic discharge immunity test: 4KV contact discharge; 4KV coupling planes discharge; 8KV air discharge.	2	2	2	2	2	6
	EN 61000-4-3 (IEC1000-4-3) Radiated radio frequency electromagnetic field immunity test: a) 10V/m, 80% amplitude modulated with 1KHz, carrier of 80 – 1000 MHz b) 10 V/m, 50% duty cycle pulse modulated with a 200 Hz tone, carrier of 900+/- 5 MHz.	2	2	2	2	2	6
	EN 61000-4-4 (IEC1000-4-4) Electrical fast transients: 2KV (on all lines).	2	2	2	2	2	6
	EN 61000-4-5 (IEC1000-4-5) Surge immunity test Power Lines: 4KV common mode; 2KV differential mode.	2	2	2	2	2	6
Directive 89/336/EEC (EMC): EN 50082-2 (susceptibility) **The EUT** maintained performance criteria A.	EN 61000-4-6 (IEC1000-4-6) Immunity to conducted disturbances induced by radio-frequency fields: 10VRMS (on every line, including ground strap), 80% amplitude modulated with 1KHz, carrier of 0.150 – 80 MHz.	2	2	2	2	2	6
	ENV 50140 (ENV50204) Radio electro-magnetic field transmitted by radio telephones. Immunity test: 10V/m, 50% duty cycle pulse modulated with a 200 Hz tone, carrier of 895 – 905 MHz.	2	2	2	2	2	6

Standards Body	Standard	Component					
		WD DART	WT DART	DART Charger	CPM	DART DC Input	DART Modem
Directive 89/336/EEC (EMC): EN 50081-2 (emission)	EN 55011 (CISPR11) Limits and Methods of measurement of radio disturbances characteristic of Industrial Scientifical Medical radio frequency equipment. a. RADIATED (classB): 30 – 230 Mhz, 40.45dBuV/m at 3m; 230 – 1000 Mhz, 47.45dbuV/m at 3m. b.CONDUCTED (class B): 150KHZ – 500KHZ, limit from 56dBuV to 46 dBuV; 500KHz – 5MHz, 46 dBuV (constant) ; 5MHz – 30 MHz, 50 dBuV (constant)	2	2	2	2	2	6
LAPEM (Mexico)	Vibration: 10 Hz-500 Hz with an acceleration of 0.5 g with a change rate of one eighth per minute for 90 minutes.	3	3	3	6	6	6
	Fast transient: 1Mhz – 1.5MHz, 2KV to 3KV	3	3	3	6	6	6
	Radiated radio frequency electromagnetic field immunity test: 10 V/m Amplitude modulated 90%, 10KHz square wave, from 25 – 1000 MHz (carrier); 100% modulation keying test.	3	3	3	3	6	6
	Sensitivity to broadband emissions: 1 V/m/MHz for five minutes.	3	3	3	3	6	6
	Radiated emissions: 1 V/m/MHz, from 10 KHz to 1000 MHz.	3	3	3	3	6	6
	2 minute spark test both polarities.	3	3	3	6	6	6
	16 hour, 60C dry heat	3	3	3	6	6	6
	100 hour, 60C burn-in	3	3	3	6	6	6
	50 mm free fall on concrete without functional damage	3	3	3	6	6	6
GE Energy Services	Analog accuracy, status & control functionality and communications accuracy as a function of temperature and input supply variance: -40C to +80C	4	4	4	5	5	5

Legend:

1. Refer to document number Gen-0020.

2. Refer to document title "Project No. 324A24".

3. Refer to document titles "Report No. K3042-011/97" & "Report No. 324A16-R01".

4. Refer to document title "Qualification type test log for WESDAC DART" .

5. Verified but documentation is not available.

6. Not verified.

4.14 Calculated Data

Calculated data is a function of the firmware set. The standard firmware set provides the following data.

4.14.1 Analog Values

Specifications referenced to line sensing device secondaries.

Units	Raw values	
Per phase	RMS current and voltage	
	Phase angle	(range: 0 to +/- 180 degrees)
	Power factor	(range: -0.5 to +0.5)
Per feeder	reactive power	(range: configurable from 1802 VARs to 6000 VARs)
Real power		(range: configurable from 1802 W to 6000W)
	Power factor	(range: -0.5 to +0.5)
	Neutral current	
	Voltage sum	

Table 6 Analog Values

4.14.2 Pseudo Status Points

Per phase   overcurrent

breaker operation

lockout

backfeed

current direction

Per feeder   neutral fault

voltage and current unbalance

4.14.3 Accumulators

Export and import Wh and VARh 32 bit accumulators (contents retained in RAM); range: configurable from 1,116,691 Wh/VARh to 3,722,304 Wh/VARh.

4.15 Standard Firmware

Key functions supported by the standard firmware include:

- Data frame timeout.

- Data link confirm timeout.

- Application confirm timeout.

- Data link retries.

- Hayes modem: phone number, setup string, idle time before hanging up.

- Data collision avoidance: minimum link idle time (half-duplex line) and maximum random delay before message is transmitted.

- 8 group addresses.

- Configurable user octets per frame.

- Unsolicited message tries.

- Unsolicited messages can be enabled for class 1, class 2 and/or class 3 data.

- Classes can be assigned to COS, SOE and/or changed analogs.

- Unsolicited analogs support individual magnitude thresholds for RMS voltage, RMS current, power factor, Watts/VARs, phase angle, voltage vector sum and current vector sum. Global qualification consists of a maximum change period and minimum number of changes.

- Fault detectors are configured on a per feeder basis. Modes supported include forward faults with backfeed (for radial distribution systems) and forward and reverse faults without backfeed (for networks).

- Fault detector points can be configured for SOE or COS on a global basis.

- The fault detectors supports fleeting or latched alarms on a global basis. Latching is cleared through a pseudo control.

- Battery test can be enabled to automatically test the batteries once every 30 days.

4.16 Configuration Software

Name   DART Configuration System

System requirements   IBM PC or compatible computer (XT or higher), DOS or Windows 3.x, communication cable

Features   menu-driven using arrow keys

create new configuration

retrieve and update a saved configuration

upload a configuration

configure the host port and fault detector

configure the status inputs

configure the control outputs

choose feeder configuration, CT/VT corrections, Watt/Var scaling

log file which displays the point descriptors and points

4.17 Maintenance Software

Name   DARTMAINT

System requirements   IBM PC or compatible computer (XT or higher), terminal emulation software that can emulate a VT100 or compatible terminal, DOS or Windows 3.x, communication cable

Features   command driven

help screen

display memory

store to memory

reset

bulk erase EEPROM

display analog values

arm a control point

operate a control point

display status input states

display fault detector states

4.18 Product Documentation

Standard   Product Description, Information and Specification, Installation Manual,
                   DARTMAINT User's Guide, DART Configuration System User's Guide

Quantity of product documentation is defined on a per contract basis. Documentation for additional contract deliverables is arranged on a per contract basis.