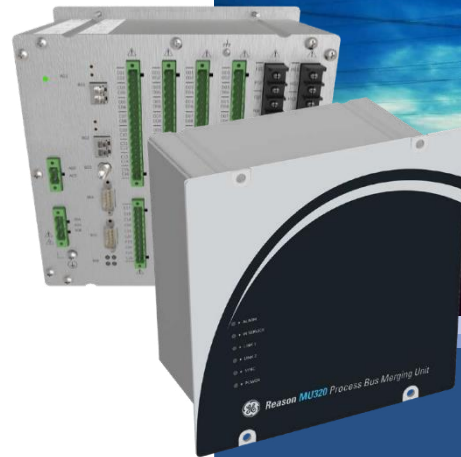


Reason MU320

Extended Version



Analog and digital, fast and accurate: Process Interface Unit for Digital Substations

MU320E is the Process Interface Unit (PIU) with analog and binary interfaces for full switchyard modelling, control and digitalization using IEC 61850 standards and protocols such as Sampled Values (SV) and GOOSE.

The MU320E unlocks the full value of a completely digital substation, acting as the I/O interface to every bay IED, particularly for protective relays and bay control units. Limiting the field wiring just up to the MU320E reduces project complexity by reducing cabling and physical connections. Bay IEDs can use data from redundant MU320E units, increasing system availability. Bay IEDs can also be quickly replaced as no field wiring is involved. The MU320E has the additional benefit of improving CT performance and cost through a lower connected burden and a reduction in the number of CT cores required for an application.

Key Benefits

- Compact form factor supports field installation options into circuit breakers cabinets, marshalling kiosks and metal-clad switchgear.
- 6 slots for I/O cards allow multiple applications. Apply as Merging Unit, Remote I/O device or PIU. Right size and point count for all types of application.
- Card slots for 2 CT/VT analog boards supports application on breaker-and-a-half lines, dual distribution feeders, and combination protection and metering installations.
- Optional metering accuracy CT/VT analog board for revenue metering and power quality applications.
- 2 SV streams possible (one per CT/VT analog board). Each stream can be protection (80 s/c) or power quality (256 s/c) SV streams.
- Full integration into the digital substation through 2 Ethernet ports, support for Parallel Redundancy Protocol (PRP) high availability networks, and IEEE 1588 Precision Time Protocol.
- Full IEC 61850 Edition 2, including support for Test mode and Simulation. Multiple logical devices to integrate multiple circuit breakers and disconnectors in one MU320E.

Applications

- Process Interface Unit for full bay digitization.
- Standalone Merging Unit for conventional instrument transformers.
- Remote I/O (RIO) device for interfacing to primary equipment such as circuit breakers and disconnectors.
- Bay unit for GE B30X distributed bus bar protection system.
- Revenue accuracy and power quality metering applications.
- Breaker-and-a-half line terminals using a single PIU device.
- Two feeders in a single PIU device.

High I/O Density & Flexibility

- MU320E stands as a ½ 19" and low depth device, perfect to be placed in enclosure kiosks in the yard.
- Up to 6 flexible slots for Analog and Binary I/O.
- Up to 16 Analog Inputs 8CT/8VT.
- Several combination options up to 96 Binary Inputs or up to 48 Binary outputs.
- A single box for Metering and Protection purposes.

Switchyard Interface

- IEC61850 dedicated data modelling for Circuit Breakers, Circuit Switches and Current and Voltage Transformers.
- Simple interface to connect Binary I/O and GOOSE points to Switchyard devices data model.

IEC 61850 Edition 2 & Test mode

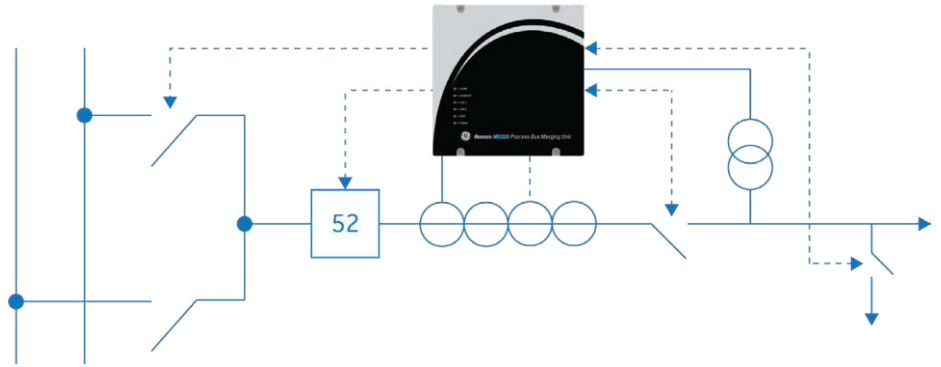
- Operation modes On, Test, Blocked, Test/Blocked and Off
- Operation modes independently configurable per Logical Device (LD)

Ease-of-Use

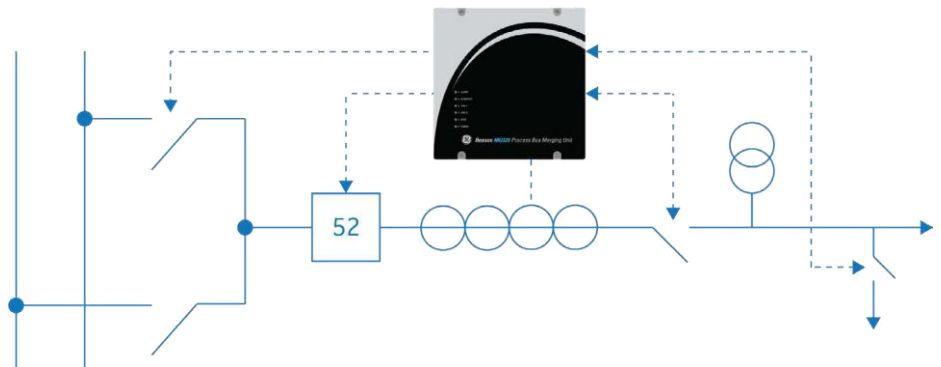
- Clean, simple and functional IED Configurator Tool (ICT)
- Software configurable binary input voltage level
- Intuitive IEC 61113-3 based logic.



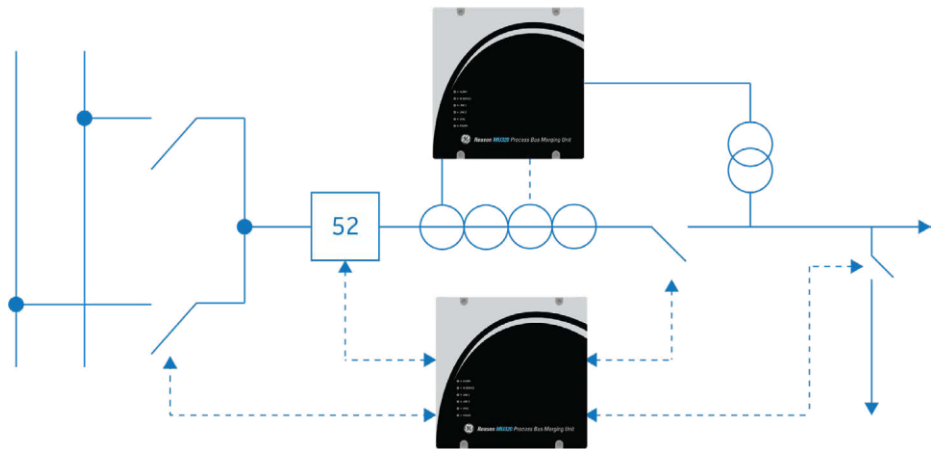
PROCESS INTERFACE UNIT



REMOTE I/O V



SEPARATE



Flexibility

By integrating binary inputs, outputs and analogue connections into one box, the MU320E offers a cost-effective solution for a multitude of bay configurations. Up to two buses and two lines may be monitored per box with a flexible configuration of up to 96 binary inputs or 48 binary outputs

Future Proof and Interoperable

The MU320E complies with the IEC 61850-9-2 Light Edition (LE) implementation guideline, which guarantees its interoperability. This was tested and approved by the global testing and certification company TUV SUD according to the Implementation Guideline for Digital Interfaces to Instrument Transformers.

Furthermore, measurements of each CT/VT set may be broadcasted in protection and measurement profiles, allowing multiple protection, automation, and control applications. Covering the gap between conventional and digital substations serves to future-proof substation technologies.

Test Modes

IEC 61850 edition 2 provides standard mechanisms for testing purposes, reducing commissioning complexity and allowing new bay installations without affecting substation operation.

MU320E is fully compatible to IEC 61850 ed. 2 allowing users to independently configure mode and behavior of each logical device allowing them to operate as: *On, Test, Blocked, Test/Blocked and Off*.

A safer substation

Transmitting the instrument transformers' measurements digitally through optical fibers eliminates the risk of inadvertent mishandling of the current and voltage circuits and makes the relay room a safer work environment, eliminating hazards and reducing the risk of personnel injury.

Reduce the engineering effort and cost

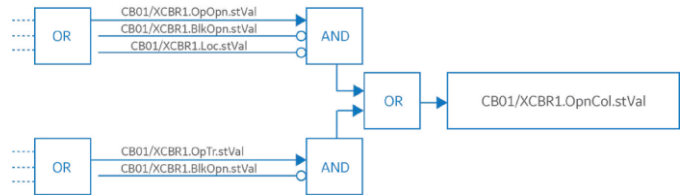
The use of Process Bus with the MU320E drastically reduces the need for trenches, ducts, glands, cable trays and copper hardwiring, as the information is exchanged among IEDs using fiber optic cables and ethernet switches.

Fewer cables to manage also means reduced engineering complexity as extensive wiring schematics are replaced by standardized version-controlled configuration files. Future reconfigurations are automatically documented by the IED configuration tool.

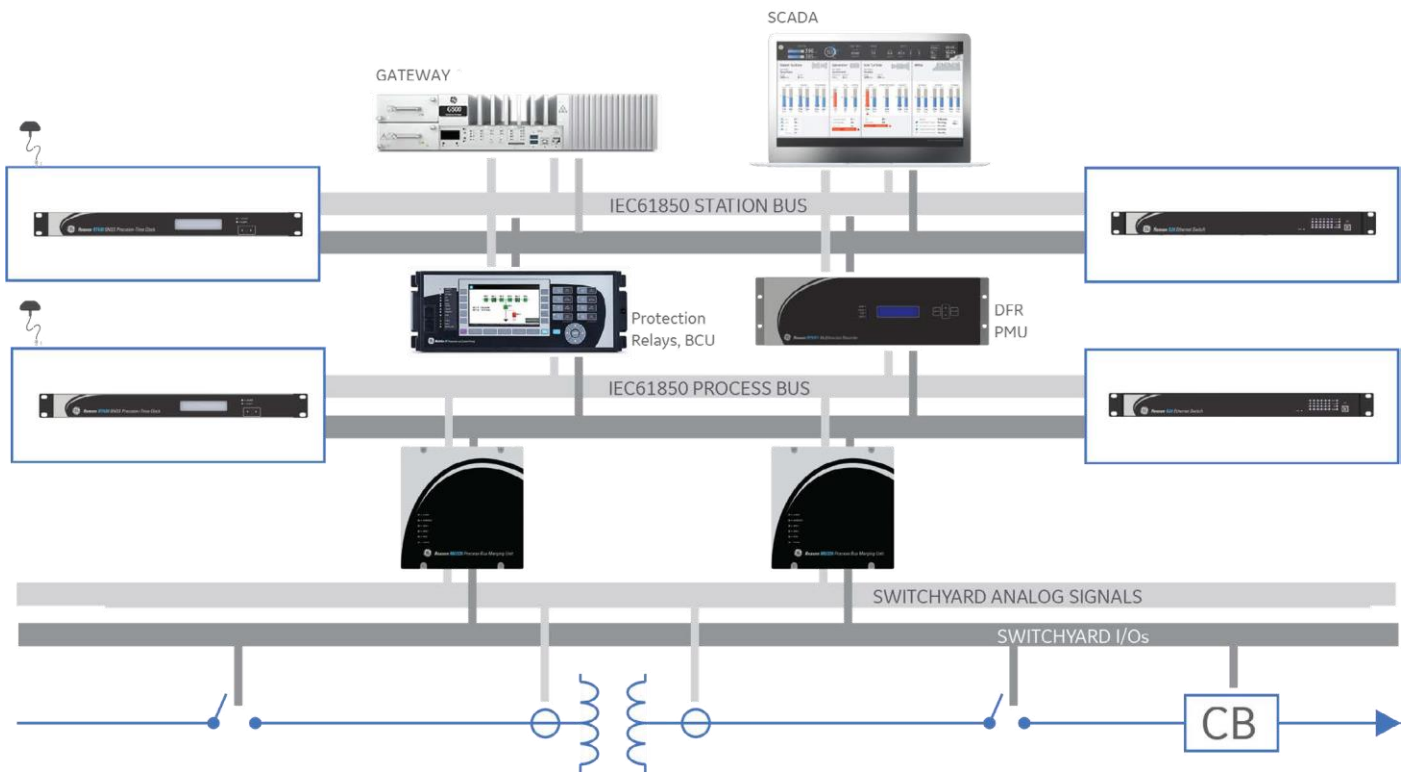
Switchyard modelling and digitization

The Process Interface Unit MU320E stands as the device responsible to be the physical to digital interface for primary equipment, including the possibility to represent them through the IEC 61850-7-4 data model, in a way that the MU320E becomes the extension of the CT/ VT, circuit breakers and disconnectors through the logical nodes TCTR, TVTR, XCBR and XSWI.

Through simple user interface IEC 61113-3 based logic it is possible to connect MU320E physical and digital inputs to its data model and digital outputs, allowing the true Switchyard digitization.



Example application of IEC 61850 Architecture



Improved Reliability

Power systems applications are mission critical systems, where the industry standard is to offer inherent redundancy in the schemes applied. The Reason MU320E provides unsurpassed reliability, as a flexible, redundant solution. The Ethernet connections support the IEC standard Parallel Redundancy Protocol (PRP), where a redundant star-connected topology allows zero-time - or bumpless – recovery. The shallow case design makes it easy to deploy MU320E in main and backup, or dual main applications, each connected to different cores of the line CTs and individual protection.

MU320 is the first of its class to manage both PRP redundancy and IEEE 1588 PTP operating together in the substation architecture. Profit from a single redundant network for higher reliability in communication and synchronization simultaneously.

Functions and IEC61850 data modeling

One of the main advances brought by IEC 61850 is the way it allows the IEDs to standardize their model through elements such as *Logical Nodes* and *Control Blocks*. The main functions that the MU320E supports in this regard are:

LN	DESCRIPTION
LTMS	Time synchronization supervision
LTIM	Local time supervision
LCCH	Physical ethernet communication channel supervision
LGOS	GOOSE subscription supervision
GGIO	Generic Process I/O covering all binary I/O available
SIMG	Gas Insulation medium supervision*
SIML	Liquid Insulation medium supervision*
XCBR	Circuit Breaker modeling – Supervision and operation
XSWI	Circuit Switch modeling – Supervision and control
TCTR	Current Transformer modelling – Samples available through Sampled Values
TVTR	Voltage Transformer modelling – Samples available through Sampled Values



TECHNICAL SPECIFICATION

Power Supply 125-250 Vdc, 110-240 Vac

Operating nominal voltage	125-250 Vdc, 110-240 Vac
Frequency	50/60 Hz \pm 3Hz
Operating voltage range	100-300 Vdc, 88-264 Vac
Power Consumption	35W @ 0.45A, 80VA @ 0.9A
Connector	3 pin: positive (phase), negative (neutral) and ground

Power Supply 48Vdc

Operating nominal voltage	48 Vdc
Operating voltage range	38 - 60 Vdc
Power Consumption	45W @ 0.7A
Connector	3 pin: positive, negative and ground

Optical Irig-B Input

Signal	IRIG-B004
Wavelength	820 nm
Fiber type	Multimode 62.5 / 125 μ m and 50 / 125 μ m
Connector	ST
Sensitivity	- 24 dBm

Serial Port

Interface	RS232
Use	Device configuration and license upgrade
Bit Rate	115200 bps
Connector	DB9 (female), standard DTE

In Service Contact

Description	Dry contact relay, normally closed
Switching Voltage	250 V (AC and DC)
Permissible current continuous	5 A
Maximum voltage	300 (AC and DC)
Making Capacity	15 A, 4 sec
Breaking Capacity	40W Resistive, 25 W/VA L/R = 50ms
Dropout time	< 5 ms
Withstand voltages across open contacts	1000V rms
Permissible short time value for 0.2s	30A

Analog Acquisition

Resolution	16 bits
Acquisition rate	80 and 256 ppc
Sampling Frequency	50Hz: 4000/12800 Hz 60Hz: 4800/15360 Hz
Group delay	< 1.1ms
Bandwidth	DC to 1 kHz

Current Inputs

Characteristic	Standard Input (P5)			Standard Input (P1)			High accuracy Inputs (ME)		
Nominal Current (In)	5 A			1 A			1 A		
Nominal frequency	50/60Hz			50/60Hz			50/60Hz		
Accuracy	Range	Error	Phase Error	Range	Error	Phase Error	Range	Error	Phase Error
	0.05 In ... 0.2In	< \pm 2.5% rd	< \pm 90' (\pm 1.5°)	0.05 In ... 0.2In	< \pm 2.5% rd	< \pm 90' (\pm 1.5°)	0.05 In ... 0.2In	< \pm 0.6% rd	< \pm 15' (\pm 0.3°)
	0.2In ... 0.8In	< \pm 0.75% rd	< \pm 45' (\pm 0.75°)	0.2In ... 0.8In	< \pm 0.75% rd	< \pm 45' (\pm 0.75°)	0.2In ... 0.8In	< \pm 0.2% rd	< \pm 8' (\pm 0.15°)
	0.8In ... 4In	< \pm 0.5% rd	< \pm 30' (\pm 0.5°)	0.8In ... 4In	< \pm 0.5% rd	< \pm 30' (\pm 0.5°)	0.8In ... 4In	< \pm 0.1% rd	< \pm 30' (\pm 0.1°)
Burden In	< 0.05VA			< 0.01 VA			< 0.02 VA		
Continuous overload	20A (4 x In)			4A (4 x In)			10 A (10 x In)		
AC current thermal withstand 1 s (Ith rms)	200A (40 x In)			40A (40x In)			20 A (20 x In)		
Insulation	> 2.2 kVrms			> 2.2 kVrms			> 2,2 kVrms		

*rd – Indicate errors of reading values

Voltage Inputs

Characteristic	Standard Inputs			High accuracy Inputs		
Nominal Voltage (Vn)	115 V			115 V		
Voltage Range	10 – 460V			10 – 230V		
Nominal frequency	50/60Hz			50/60Hz		
Accuracy	Range	Amplitude Error	Phase Error	Range	Amplitude Error	Phase Error
	0.08Vn ... 2Vn	< \pm 0.5% rd	< \pm 20' (\pm 0.35°)	0.08Vn ... 2Vn	< \pm 0.1% rd	< \pm 5' (\pm 0.1°)
Burden Vn	< 0.1VA			< 0.1VA		
Continuous overload	230 V (2 x Vn)			230 V (2 x Vn)		
Maximum overload (1 s)	460 V (4 x Vn)			460 V (4 x Vn)		
Insulation	> 3,5 kV			> 3,5 kV		

*rd – Indicate errors of reading values

Synchronization

Accuracy	< 1μs
Drift when not locked	±0.016PPM (1.44 milliseconds/day)
Max Holdover	60s

Environment Conditions

Operating temperature (continuous)	-40 °C (-40 °F) ... +55°C (+131°F)
Tested as per IEC 60068-2-1:2013	-40°C (-40°F)
Tested as per IEC 60068-2-2:2013	+85°C (+185°F)
Relative humidity	0 ... 95 %, noncondensing
Temporarily permissible temperature under operation	-40 °C (-40 °F) ... +70°C (+158°F) (Tested for 96 hours with 50% of binary I/O continuously activated)

Enclosure Protection IEC 60529

Front flush mounted with panel	IP40
Rear and sides	IP10

Optical Ethernet Ports

Interface	100BASE-FX
Bitrate	100 Mbps
Wavelength	1300 nm
Connector	LC
Fiber type	Multimode 62.5 / 125 or 50 / 125 μm
Emission power	-20 dBm
Sensitivity	-32 dBm
Maximum applicable power	-14 dBm

Binary Output

Description	Dry contact relay. Form-C or Form-A
Maximum Switching Voltage	300 Vdc
Maximum continuous current	5A
Make and short-time carry current	30A, 0.2s
Breaking Capacity	40 W Resistive, 25 W/VA L/R = 40ms
Operation time	< 5 ms, under minimum load of 1A
Dropout time	< 15 ms
Withstand voltages across open contacts	1000V rms
Protection device across contacts	MOV (Metal Oxide Varistor) Rated @ 250Vac/320Vdc

High Speed High Break Binary Output

Description	Form-A High Speed High Break contact using IGBT technology
Maximum switching voltage	300 Vdc
Maximum continuous current	10 A
Make and short-time carry current	30A, 0.2s
Breaking Capacity	Maximum 10A @ L/R = 40ms
Operation time	< 0.2 ms
Dropout time	< 25 ms
Protection device across contacts	MOV (Metal Oxide Varistor) Rated @ 250Vac/320Vdc
Max Number of operation	10000

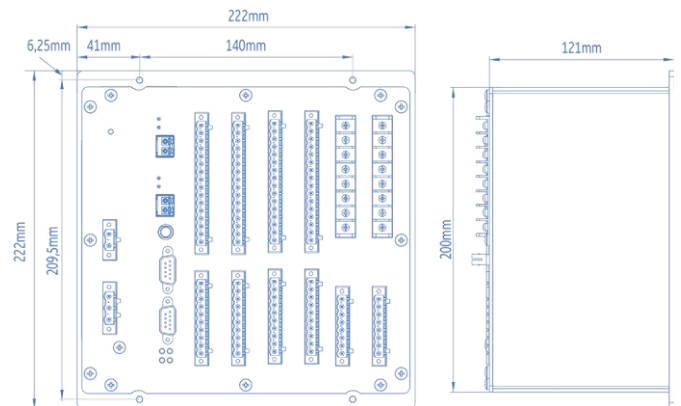
Binary Input

Nominal Voltage	24 V	48 V	125 V	250 V
Level Low	08 V	10 V	40 V	75 V
Level High	17 V	19 V	85 V	160 V
Impedance	15kΩ	16kΩ	82kΩ	164kΩ
Burden	< 0.05 W	< 0.2 W	< 0.25 W	< 0.5 W
Continuous Overload ¹	50 V	100 V	170 V	340 V

¹ The digital inputs are protected against continuous reverse polarity for the nominal voltage.

Dimensions and Weight

Height	222 mm / 8.7 in (5 U)
Width	222 mm / 8.7 in (½ 19")
Depth	121 mm / 4.7 in
Weight	< 3.5 kg (< 7.72 lb)



Type Test

EMC tests were performed according to IEC 60255-26 referring to the following

Electrostatic discharge	IEC 61000-4-2:2008	6kV contact / 8kV air (level 3)
RF immunity	IEC 61000-4-3:2006	10 V/m (level 3)
Fast transient disturbance	IEC 61000-4-4:2012	Zone A - 4kV @ 5kHz
Surge immunity	IEC 61000-4-5:2005	Zone A Differential mode: 4kV Common mode: 2kV
Conducted RF immunity	IEC 61000-4-6:2008	10 V/m (level 3) 0.15 MHz to 80 MHz
Power magnetic immunity	IEC 61000-4-8:2009	30A/m continuous - 300A/m @ 1s (level 4)
Voltage dip, short interruptions and voltage variation immunity tests	IEC 61000-4-11:2004	AC dips (residual%) 0% - 1/1 cycles (50/60Hz) 40% - 10/12 cycles (50/60Hz) 70% - 25/30 cycles (50/60Hz) AC interrupt (residual%) 0% - 250/300 cycles (50/60Hz)
	IEC 61000-4-29:2000	DC dips (residual%) 0% - 10ms 40% - 200ms 70% - 500ms DC interrupt (residual%) 0% - 5s
Power Frequency	IEC 61000-4-16:1998	Zone A Differential mode: 150Vrms Common mode: 300Vrms
Voltage ripple	IEC 61000-4-17:1999	Test level: 15 % of rated dc. value Test frequency: 100/120Hz, sinusoidal waveform
Damped oscillatory wave immunity test	IEC 61000-4-18:2006	Voltage oscillation frequency: 1MHz Differential mode: 1kV peak voltage Common mode 2,5kV peak voltage
Gradual Startup	IEC 60255-26:2013	Shut-down ramp: 60s Power off: 5min. Start-up ramp: 60s
Radio-frequency disturbance	CISPR11:2009 (below 1GHz)	Radiated emission below 1GHz - class A 30 MHz to 230 MHz 40 dB(μV/m) quasi peak at 10 m 50dB (μV/m) quasi peak at 3m 230 MHz to 1 000 MHz 47 dB(μV/m) quasi peak at 10 m 57dB (μV/m) quasi peak at 3m
Radiated emission	CISPR22:2008 (above 1GHz)	1 to 3 GHz - 56dB(μV/m) Average; 76dB (μV/m) peak at 3m 3 to 6 GHz - 60dB(μV/m) Average; 80dB (μV/m) peak at 3m
Conducted emission	CISPR22:2008	0.15MHz to 0,50MHz; 79dB(μV) quasi peak; 66dB(μV) average 0.5MHz to 30MHz; 73dB(μV) quasi peak; 60dB(μV) average

Safety tests

IEC 60255-27:2013	Impulse – 5kV Dielectric withstand – 2.2 kVrms Insulation resistance > 100MΩ @ 500 Vdc
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Environmental tests

IEC 60068-2-1	-40°C, 16 hours (Cold operational)
IEC 60068-2-1	-40°C, 16 hours (Cold storage)
IEC 60068-2-2	+85°C, 16 hours (Dry heat)
IEC 60068-2-2	+85°C, 16 hours (Dry heat operational)
IEC 60068-2-2	+85°C, 16 hours (Dry heat storage)
IEC 60068-2-30	+25°C ± 3°C – 95% ±3% RH +55°C ± 2°C – 93% ±3% RH 6 of 24 hours (12h + 12h) cycles
IEC 60068-2-14	-40°C to 55°C / 9 hours / 2 cycles (Change of temperature)
IEC 60068-2-78	+40°C ±2°C –93% ±3% RH –10 days (Damp heat)
IEC 60255-21-1	Vibration Response and Endurance Class 2
IEC 60255-21-2	Shock Response and Endurance Class 1
IEC 60255-21-2	Bump Class 1
IEC 60255-21-3	Seismic Class 2

MU320E is a product RoHS 3 Compliant

MU320E Ordering

Model Type	MU320	*	*	*	*	*	*	*	*	*	X	04	S	E	MU320 Integrated Merging Unit - Extended Version
Slot A - Power Supply	1 3														48 Vdc 125-250 Vdc / 110-240 Vac
Slot B - Hardware Options		O													Two duplex LC-type connector 100BASE-FX Ethernet interfaces
Slot C - Binary I/O			B3 B4 B5 B6 XX												16 x 24V/48V/125V/250V binary inputs 6 x 24V/48V/125V/250V binary inputs and 8 x binary outputs 6 x 24V/48V/125V/250V binary inputs and 4 x Form C + 2 x NO binary outputs 6 x 24/48/125/250 V binary inputs and 8 x High Speed Form A binary outputs Not Installed
Slot D - Binary I/O				B3 B4 B5 B6 XX											16 x 24V/48V/125V/250V binary inputs 6 x 24V/48V/125V/250V binary inputs and 8 x binary outputs 6 x 24V/48V/125V/250V binary inputs and 4 x Form C + 2 x NO binary outputs 6 x 24/48/125/250 V binary inputs and 8 x High Speed Form A binary outputs Not Installed
Slot E - Binary I/O/Slot 1					B3 B4 B5 B6 XX										16 x 24V/48V/125V/250V binary inputs 6 x 24V/48V/125V/250V binary inputs and 8 x binary outputs 6 x 24V/48V/125V/250V binary inputs and 4 x Form C + 2 x NO binary outputs 6 x 24/48/125/250 V binary inputs and 8 x High Speed Form A binary outputs Not Installed
Slot F - Binary I/O/Slot 2						B3 B4 B5 B6 XX									16 x 24V/48V/125V/250V binary inputs 6 x 24V/48V/125V/250V binary inputs and 8 x binary outputs 6 x 24V/48V/125V/250V binary inputs and 4 x Form C + 2 x NO binary outputs 6 x 24/48/125/250 V binary inputs and 8 x High Speed Form A binary outputs Not Installed
Slot G - Flexible I/O options							B3 B4 B5 B6 ME P1 P5 XX								16 x 24V/48V/125V/250V binary inputs 6 x 24V/48V/125V/250V binary inputs and 8 x binary outputs 6 x 24V/48V/125V/250V binary inputs and 4 x Form C + 2 x NO binary outputs 6 x 24/48/125/250 V binary inputs and 8 x High Speed Form A binary outputs 4 x VT 115V and 4 x CT 1/5 A RMS measurement analog inputs 4 x VT 115V and 4 x CT 1 A RMS protection analog inputs 4 x VT 115V and 4 x CT 5 A RMS protection analog inputs Not Installed
Slot H - Flexible I/O options							B3 B4 B5 B6 ME P1 P5 XX								16 x 24V/48V/125V/250V binary inputs 6 x 24V/48V/125V/250V binary inputs and 8 x binary outputs 6 x 24V/48V/125V/250V binary inputs and 4 x Form C + 2 x NO binary outputs 6 x 24/48/125/250 V binary inputs and 8 x High Speed Form A binary outputs 4 x VT 115V and 4 x CT 1/5 A RMS measurement analog inputs 4 x VT 115V and 4 x CT 1 A RMS protection analog inputs 4 x VT 115V and 4 x CT 5 A RMS protection analog inputs Not Installed
Functions and Application									A B						Standard Integrated Merging Unit PRP redundant Integrated Merging Unit
Reserved											X				Not Used
Firmware Version												04			Latest available firmware - 04
Coating													S		Standard Conformal Coating
Hardware Design Suffix														E	Extended version

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imagination at work

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