Distributed I/O Platform
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SMP™ I/O Distributed I/O Platform

Contents

Powering Business Worldwide

Description

Eaton's SMP I/O platform is the first generation of substation-grade distributed I/O platforms, specially designed to meet modern industry and utility requirements.

It supports binary input and binary output cards, operates with AC or DC voltage, and communicates using the DNP3 protocol over serial RS-485, or TCP/IP using fiber or copper Ethernet. It can be used with the SMP Gateway automation platform, or as a stand-alone I/O module that connects directly to a DNP3 master station.

Eaton relies on the same expertise and high industry standards used to develop our successful SMP Gateway product line to offer a highly reliable,easy to set up and flexible I/O module, at a very competitive price.

Typical applications

The SMP I/O platform deployed as a standalone unit can be connected directly to a DNP3 master station and used for asset monitoring and control with accurate IRIG-B time stamping. Multiple SMP I/O devices can be distributed throughout the substation using an RS-485 multi-drop architecture, or using either copper or fiber Ethernet.

When deployed behind an SMP Gateway automation platform, the SMP I/O platform also adds access to the SMP Gateway advanced logic and HMI's numerous functions like the status dashboard, name plate information, real-time data and the Commissioning Tool, for an enhanced device setup.

Eaton's RTU replacement solution is fully compatible with this I/O platform.

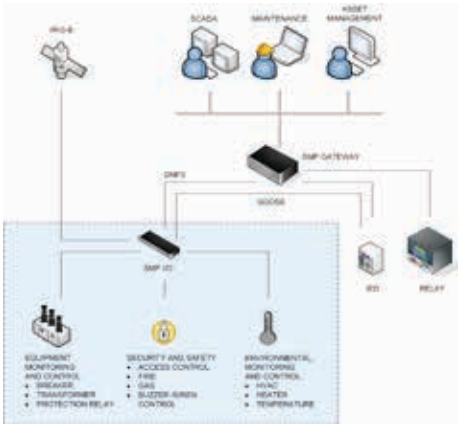

Figure 1. Typical application, deployed behind an SMP Gateway automation platform

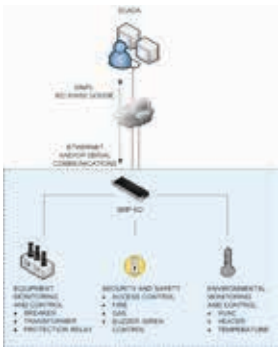

Figure 2. Typical application, deployed as a stand alone unit

Product Overview

The SMP I/O platform is composed of a base unit that can accept up to four field-installable I/O cards. The base unit provides 2 programmable form-C output relays, RS-485 and Ethernet communications interfaces, and an IRIG-B interface.

All wiring is on the rear panel, through removable terminal blocks. The front panel displays the status of the device and the state of all I/O signals. A Local/Remote control disables all control commands from the master station, for operator safety during system maintenance.

When using the SMP Gateway automation platform, besides acting as a DNP3 master, the SMP Gateway extends the capabilities of the SMP I/O by adding the following capabilities:

- Integrate devices using legacy protocols such as MODICON MODBUS, TEJAS, COOPER 2179, or new modern protocols such as IEC 61850 and IEC 60870-5- 104.
- Provide maintenance and engineering users with passthrough access to substation IEDs.
- Support local operation using the SMP Gateway HMI option
- Implement local automation functions using the built-in logic processor and Soft PLC.
- Distribute accurate time using the SMP Gateway automation platform built-in GPS clock option (available on some automation platforms).

General features

Hardware

- Rack-mount (with 1U form factor) and wall-mout models
- Two built-in Form C relays for system alarm (configurable)
- Design for growth with field upgradable I/O cards (total of 32 + 2 I/O per SMP I/O platform)
- No moving part
- System status LEDs

Software

- SMP I/O Manager Software for device management
- Seamless integration with the SMP Gateway

Security

- Built-in firewall to limit connections to specific IP addressses or subnetworks

System

- Error detection features to ensure data integrity
- Integrated watchdog timer
- Internal clock synchronization using IRIG-B
- Local/Remote control button for safe system maintenance

Protocols

- DNP3 Serial or TCP/IP links
- IEC 61850 GOOSE messaging

Benefits

With its robust and scalable design, the SMP I/O platform replaces traditional centralized RTU installations and provides a flexible solution that adapts to evolving automation requirements.

Reliability

The substation-grade SMP I/O meets industrial and utility standards for vibration, electrical surges, fast transients, and extreme temperature ranges. It is also designed to evolve through regular software and firmware updates, ensuring a future-proof automation system.

- Independently certified as per IEC 61850-3 and IEEE1613 standards

Scalablility

Designed for growth, the SMP I/O platform is field-upgradable.

- I/O cards cards can be added in minutes, without removing the unit from the rack.

Productivity

The SMP I/O saves on cabling, commissioning and configuration time, especially when it is used with the SMP Gateway automation platform. Its removable connectors speed up hardware changes.

- Reduced engineering efforts

Accuracy

The SMP I/O's error detection features ensure data integrity between the data point and the control center. It supports IRIG-B synchronization for precise timestamping..

- Independently certified as per IEC 61850-3 and IEEE1613 standards

Product configuration

Flexible inputs and outputs card configuration with up to four (4) field-upgradable I/O cards for a total of 32 + 2 I/Os, making it adaptable to your evolving needs (two 2 form-C relay outputs are available at the base unit rear panel). The wall-mount model has the same same LED, buttons and terminal blocks as the rack-mount model.

I/O configuration card possibilities

I/O card	Possible location	Slot location (rear panel)
Binary output (max 2 cards)	Slot B Slot D	Slot A: top left Slot B: bottom left Slot C: top middle Slot D: bottom middle
Binary input (max 4 cards)	Slot A Slot B Slot C Slot D	
Analog input (max 3 cards)	Slot A Slot B Slot C	

Externally, all card types are similar, with two screw terminals per point. I/O cards can be added and removed using a simple screwdriver, without removing theSMP I/O from the rack. All connections are made through removable terminal blocks. All connectors are keyed to prevent accidental insertions that would damage the I/O module or its peripherals.

The wall mount enclosure provide the same features as the 19" rack mount, uses the same I/O cards, but provides different packaging for different space installation. The front panel can be rotated to accommodate different mounting sides.

I/O features

Analog Inputs

An analog input card has 8 isolated inputs that can be used to measure either voltage or current values. It is designed for DC value measurements only, it is not intended for AC measurements. The analog card is equipped with a Delta-Sigma 16 bits ADC for each channel and is factory calibrated to ensure high accuracy reading over all the operation temperature range.

- 8 input/card (up to 24 analog inputs per SMP I/O)
- In addition to the real-time values, the analog input card provides the minimum and maximum reach for every input. Four alarm and warning threshold values can also be set for every input.
- There are two models of analog input card. The standard and the high isolation models. The following table shows the differences between the models:

Analog input card model	Characteristics
Standard	1500 VAC / 2100 VDC channel to ground isolation
	Can be inserted in slots A, B and/or C. Slot D can still be used to insert any other type of I/O card.
High isolation	1500 VAC / 2100 VDC channel to ground isolation
	1500 VAC / 2100 VDC channel to channel galvanic isolation (each channel is electrically totally independent)
	Can only be inserted in slots A and/or C. Slot B and D can still be used to insert any other type of I/O card.

Binary Inputs

The SMP I/O binary input card provide 8 electrically independent opto-isolated connections. Various binary input card models are available for all commonly used voltage ranges. Cards with different voltage ranges can be installed in the same unit

- 8 input/card (up to 32 binary inputs per SMP I/O)
- Circuitry is specially designed to ensure at least 10% hysteresis at all temperatures, ensuring noise immunity over the complete temperature range.
- An advanced debouncing filter provides additional stability when reading status changes. The inputs can be inverted to support negative-going impulses.
- The optional error detection circuit adds a second independent circuit for each input. If a discrepancy between inputs is detected, a front-panel LED turns red and the data quality is marked as bad.
- Each binary input is mapped to three DNP3 data points that provide: the current state, the count of pulses or transitions and the frozen count.

Binary Outputs

The SMP I/O supports up to 18 control relays. The base unit provides two built-in Form C relays that can be used to report the current system state or control external devices. The SMP I/O binary outputs are specially designed for the power industry. They provide the following characteristics:

- 8 outputs/card (up to 16 + 2 output relays per SMP I/O)
- High load carrying capability reduces the need for interposing relays.

- Each relay output is monitored by an input point that provides the state of a second auxiliary contact. If the auxiliary contact does not match the requested output state, data quality is marked as bad, and the front-panel LED turns red.
- Outputs are protected against single component failure. The relay control circuit is designed so that the failure of a single component cannot accidentally energize the relay.
- Trip/close pair, latch, pulse, pulse to open and pulse to close support

Behavior	Descripton
Trip-close pair	One address is used to control two relays. When the master station sends an Open command, the first relay is pulsed. When the master station sends a Close command, the second relay is pulsed. Trip-close relays are paired as follows: 1- 2, 3-4, 5-6 and 7-8. The two built-in relays can also be paired.
Latch	Energize or de-energize the relay upon reception of a master station command.
Pulse	Energize the relay for a specified duration. The duration can be preset or provided by the master station.
Pulse to open and pulse to close	Two separate addresses are used to control the relay. The master station pulses one address to energize the relay, and a different address to de-energize the relay.

- The current state of each binary output is monitored by an associated binary input. In case of a malfunction, the quality of this input will be marked as bad.

Communications

The SMP I/O is accessible via the DNP3 protocol over RS-485 or TCP/IP. It has one RS-485 serial port and one Ethernet connector (copper or fiber).

The SMP I/O is compatible with any DNP3 master station. It is a level 2 DNP3 device and thus supports report-by-exception for reduced bandwidth usage.

The SMP I/O's clock can be synchronized by the DNP3 protocol, or by an external IRIG-B time source for greater accuracy.

- 1 x RS-485 serial interface
- 1 x 10/100 Mb/s Ethernet port (metallic or fiber LC)
- Secured remote maintenance using transparent connection when used with an SMP Gateway automation platform

Configuration

Configuring the SMP I/O is a simple two-step process. First, you connect the device to your network and configure the communication settings using the SMP I/O Manager application.

Then, you use SMP Config to attach the SMP I/O to an SMP Gateway automation platform and configure the operation of binary outputs and the processing of binary inputs.

You can also use SMP I/O Manager to perform all configuration steps for applications where the SMP I/O is not used with an SMP Gateway automation platform.

SMP I/O Manager software

The SMP I/O Manager software automatically locates all SMP I/O devices connected to the network segment. Select the appropriate SMP I/O and perform the following operations:

- Configure TCP/IP and RS-485 communications settings
- Configure DNP3 settings
- Configure the built-in firewall to limit connections to specific IP addresses or subnetworks
- Possibility to lock the settings to prevent accidental or malevolent configuration changes

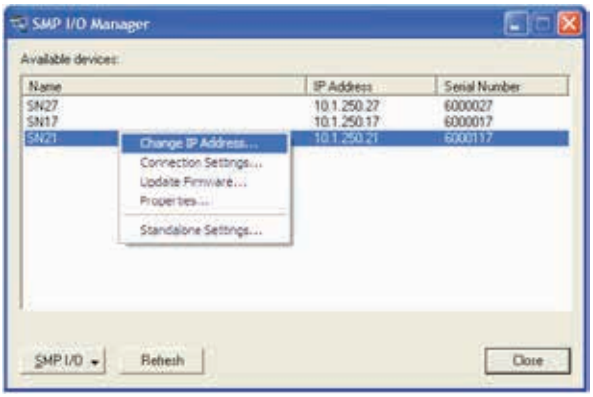

Figure 3. SMP I/O Manager, main window

SMP Tools

The SMP I/O is designed to integrate seamlessly with the SMP Gateway automation platform. The SMP Config tool provides a quick configuration wizard that detects the SMP I/O configuration and automatically sets up all DNP3 indexes, default names and descriptions. You will only need to configure output modes and input processing functions.

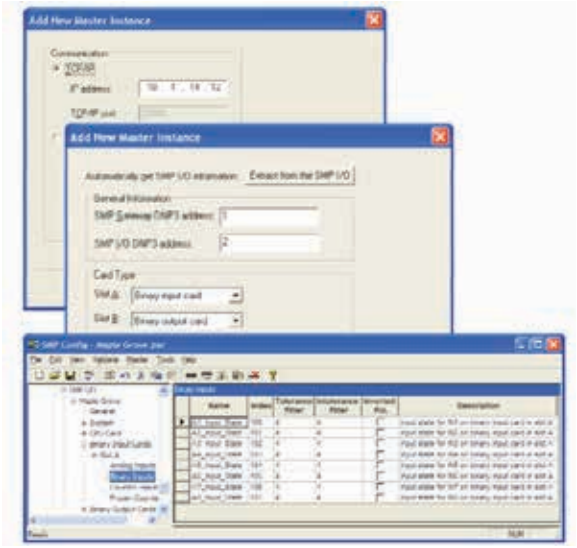

Figure 4. SMP Tool from SMP Manager (SMP Gateway automation platform software application)

The SMP Gateway HMI provides an easy way to view all I/O signals using a standard web browser.

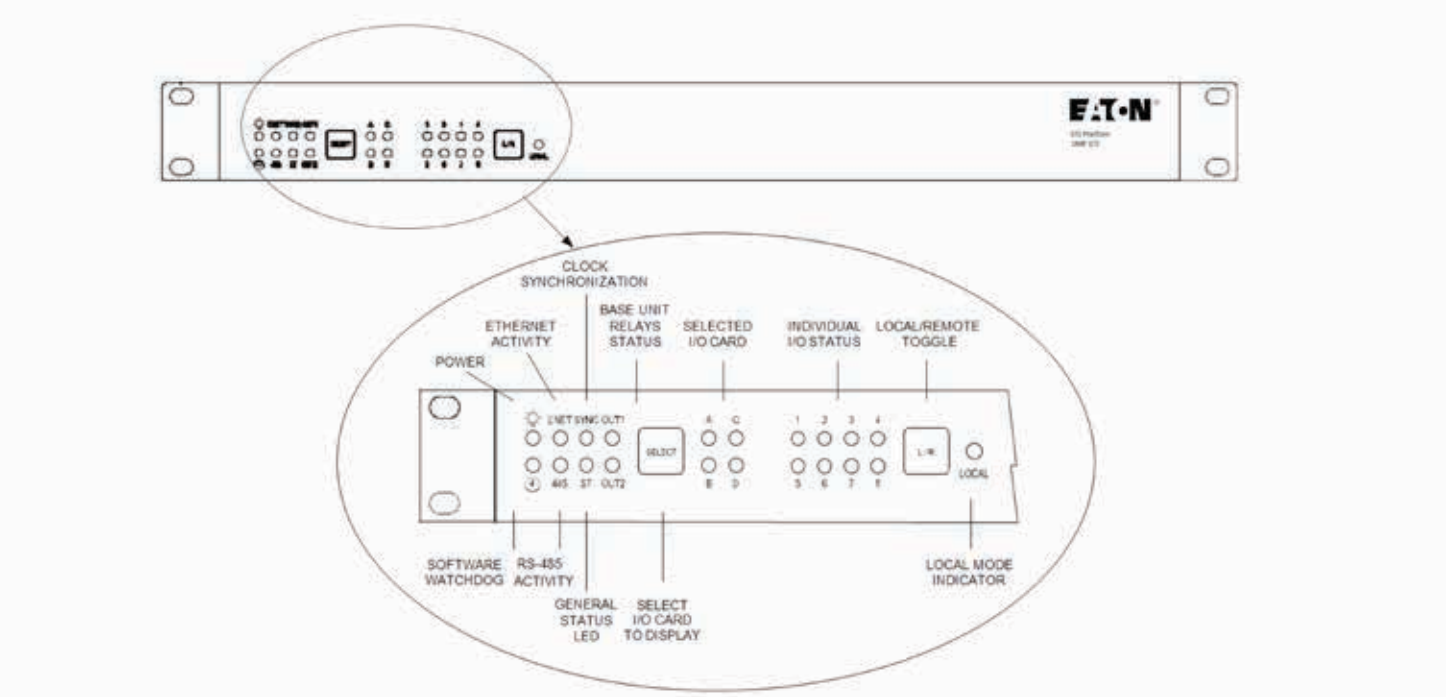

Figure 5. SMP I/O platform front view

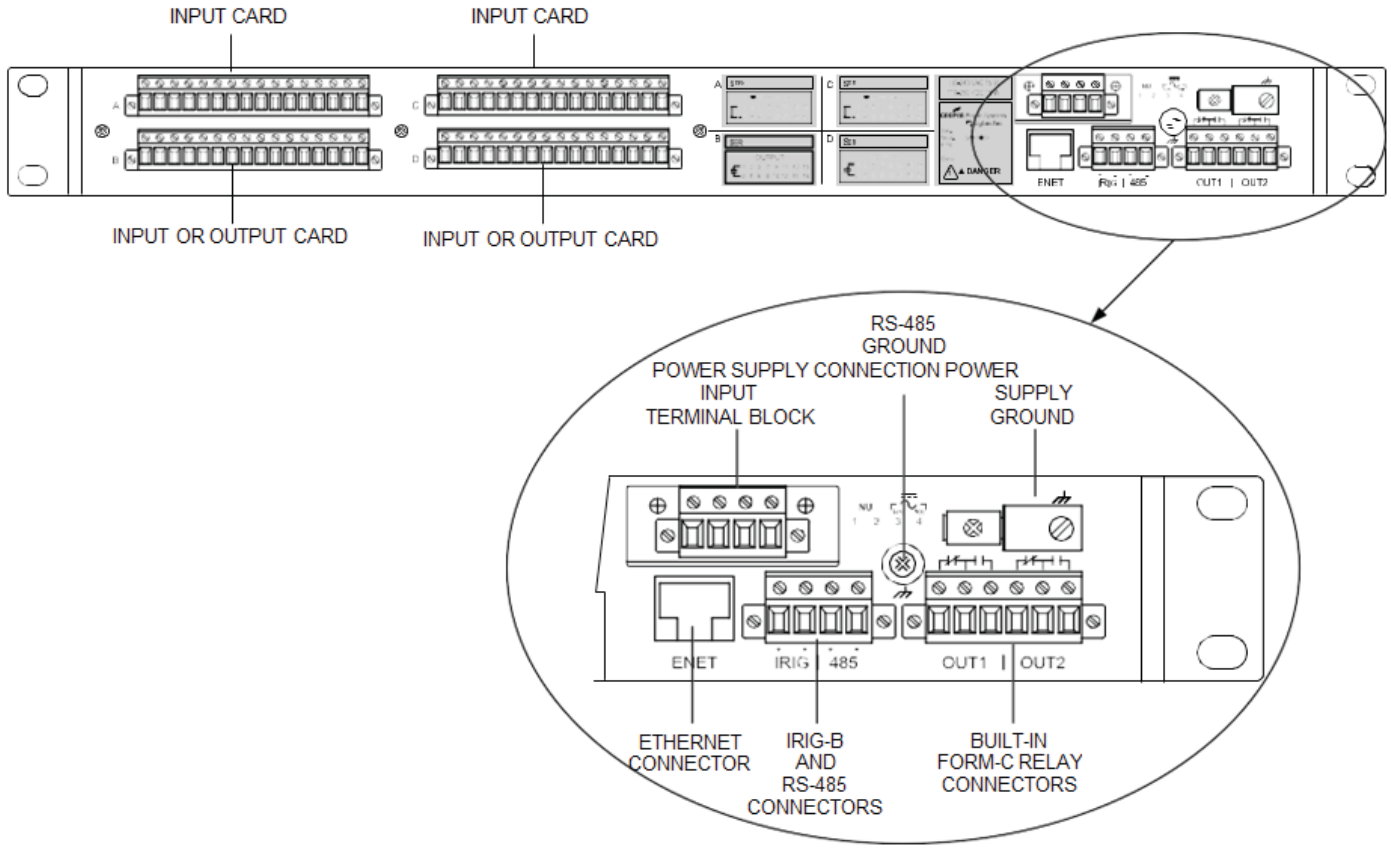

Figure 6. SMP I/O platform rear view

SMP I/O platform specifications

This section presents the complete specifications of the SMP I/O- platform.

Table 1. General specifications

Dimensions **SMP I/O platform**	Rack-mount unit: 1U 1.72 in. H x 19 in. W x 8 in. L 43.6 mm H x 482.6 mm W x 203.2 mm L Wall-mount unit: 4 in. H x 11.9 in. W x 6.85 in. L 101 mm H x 302 mm W x 174 mm L	
Warranty	5 year limited	
Operating temperature	Rack-mount unit: -40 °C to 80 °C* (-40 °F to 176 °F) Wall-mount unit: -40 °C to 75 °C* (-40 °F to 167 °F)	See temperature derating section for continuous maximum operation.
Storage temperature	-40 °C to 85 °C (-40 °F to 185 °F)	
Humidity	5% to 95%, non-condensing	
MTBF	MIL-HDBK-217 Telcordia SR-232	22.5 years at 25°C 35.36 years at 25°C
Maximum altitude	2000 m	
Terminal blocks	I/O connection	300V / 15A max 28-12 AWG Solid Wire 30-12 AWG Stranded Wire Wire screw max torque = 6 in-lbf Terminal block screw max torque = 4 in-lbf

Table 2. Power Supply

Low voltage mode	Rated supply voltage: 24-48 VDC Input voltage range: 18-75 VDC Inrush current: 1.18 A/18 VDC Power consumption: up to 15 watts	
High voltage model	Rated supply voltage: 110-250 VDC / 110-240 VAC Input voltage range: 100-300 VDC / 85-264 VAC Frequency range: 50/60 Hz Inrush current: 18 A/120 VAC, 36 A/230 VAC Power consumption: up to 15 watts	

Table 3. Communication ports

1 Ethernet Port	Rear access	No LED indicators on rear panel
Metallic connectors (standard)	10/100/BASE-TX	RJ-45 connector
Fiber-optic (option)	100BASE-FX, up to 2 km	LC connectors Multimode 1300 nm
Serial Port	1 x RS-485 terminal block connectors	
2-wire RS-485 support (multidrop)	Up to 1200 m (4000ft.) 32 devices	

Table 4. Time Tagging

IRIG-B	Demodulated 2V high level detection Vin max up to 12 VDC Opto-isolated Terminal blocks Current sink at 5 V IRIG-B 5.7 mA Current sink at 12 V IRIG-B; 15.7 mA	

Table 5. Binary Inputs

Independent inputs, opto-isolated	24 VDC 48 VDC 110 VDC 125 VDC 220 VDC 250 VDC	On: 18.3 - 30 VDC, Off: 5.5 VDC On: 37.5 - 60 VDC, Off: 10.5 VDC On: 82.5 – 137.5 VDC, Off: 21.3 VDC On: 91.5 – 156 VDC, Off: 23.5 VDC On: 169.5 - 275VDC, Off: 42.2 VDC On: 187.5 – 312.5 VDC, Off: 46.5 VDC
Current sink	Error Detection Circuit (EDC) input option Non-EDC input option	4 mA maximum 2 mA maximum
Hysteresys ratio	10% noise immunity guarantee	All voltage detection threshold

Table 6. Binary Outputs

Output relays	Form C relays (built-in) Form A relays (output card)	300 VAC/150 VDC, 12.5 J MOV protection across contact pairs
Operating time	Pickup 7 ms typical Dropout 4 ms typical	
Rating	8 A at 250 VAC resistive	All relay types
	10 A at 30 VDC resistive	
	0.4 A at 125 VDC resistive	
	0.2 A at 150 VDC resistive	
	½ HP at 125 VAC	
	¼ HP at 250 VAC	
Rated insulation voltage	300 V RMS	All relay types
Maximum voltage	400 VAC / 150 VDC	All relay types
Continious carry	10A @ 85 °C	All relay types
Maximum load	75 A for 1 second	All relay types
Minimum load	10mA at 5Vdc	All relay types
Cycling capacity (2.5 cycle/second) per IEC 60255-0-20:1974	24 VDC / 0.8 A L/R= 40 ms	All relay types
	48 VDC / 0.5 A L/R= 40 ms	
Breaking capacity (10 000 operations) per IEC 60255-0-20:1974	125 VDC / 0.3 A L/R= 40 ms	All relay types
	150 VDC / 0.2 A L/R= 40 ms	
Make and carry	30 A as per IEEE-C37.90.1989	

Table 7. Analog Inputs

Input range		Operation mode (voltage or current) is configurable via jumpers
Voltage mode	± 10 V	
Current mode	± 4 mA (4 – 20 mA transducers)	Current mode targeted toward 0-1 mA transducers with over-range capability
Input impedance		
Voltage mode	> 100 MΩ	
Current mode	2.5 kΩ	
Resolution	16 Bits	
Accuracy		Factory calibrated
Voltage mode	± 0.02 % of full scale @ 25 °C	±0.0015% / °C
Current mode	± 0.05 % of full scale @ 25 °C	±0.0015% / °C
Accuracy variation	± 0.015 % / °C of full scale @ 25 °C	Customer calibration possible (zero offset)
Isolation		
Standard model	1500 VAC / 2100 VDC channel to ground	
High isolation model (HIM)	1500 VAC / 2100 VDC channel to channel	On the HIM model, each input channel is totally electrically independent (galvanic isolation)
Common Mode Rejection (CMR) @ 50/60 Hz	> 90 dB	

Table 8. Accessories

Jumper straps	Aluminum 6061 Insulating: Black epoxy UL-94V0 8 pos. 0.4 inch pin space Maximum current: 15 A Maximum voltage: 300 V	

Type tests

This section presents all tests that were conducted on the SMP I/O platform.

Table 9. Type tests

Environmental		
Dry heat	IEC 60068-2-2:1974	85°C, 16 hours
Cold	IEC 60068-2-2:1974	-40°C, 24 hours 5 cold boots in 16 hours
Sinusoidal vibration - response	IEC 60255-21-1:1988, Class 1	0.5 g from 10-150 Hz all axis
Sinusoidal vibration – endurance	IEC 60255-21-1:1988, Class 2	2 g from 10-150 Hz all axis
Shock resistance	IEC 60255-21-2:1988, Class 1	5 g all axis powered 15 g all axis
Sinusoidal vibration – seismic	IEC 60255-21-3:1993, Method A, Class 2	2 g all axis powered 10 g all axis
Sinusoidal vibration – stationary	IEC 870-2-2:1996, Class B	1 g and 1.5 g from 2-500 Hz all axis
Damp heat, steady state	IEC 600068-2-78:2001	40°C, 93% relative humidity, 4 days
Damp heat, cyclic	IEC 60068-2-30:1980 + A1:1985	25-55°C, 6 Cycles, 95% relative humidity
Flammability	UL94-V0 UL224 VW-1	System Internal harnesses
Electromagnetic Interference (EMI)		
Impulse	IEC 60255-5:2000 IEEE C37.90-1989	5 kV 0.5 J on supply 5 kV 0.5 J on relay outputs 5 kV 0.5 J on digital inputs 5 kV 0.5 J on IRIG-B inputs 5 kV 0.5 J on analog inputs
Dielectric	IEC 60255-5:2000 IEEE C37.90-1989	2500 VAC - 3500 VDC on relay BO (I/O) 3000 VAC - 4000 VDC on digital inputs 2500 VAC - 4000 VDC on IRIG-B input 500 VAC - 1000 VDC on RJ 45 port 1500 VAC - 2100 VDC on relay CPU 1500 VAC – 2100 VDC on analog inputs
Electrostatic discharge immunity	IEC 61000-4-2: 2001, Level 4 IEC 60255-22-2: 1996 IEEE 37.90.3-2001	8 kV contact on enclosure 8 kV contact on RJ-45 shield 8 kV contact on LC shield 15 kV air on supply contacts 15 kV air on IRIG-B contacts 15 kV air on RS-485 contacts 15 kV air on relay contacts 15 kV air on digital input contacts 15 kV air on analog inputs
Radiated RF immunity	IEC 61000-4-3: 2000, Level 3	10 V/m 80-1000 MHz
Fast transient/burst immunity	IEC 61000-4-4: 1995 + A1: 2000, Level 4	4 kV at 2.5 kHz on supply 2 kV at 5 kHz on all other ports
Surge immunity	IEC 61000-4-5: 2001, Level 4	4 kV common on all ports 2 kV differential on all ports 2 kV common on all analog inputs
Conducted RF immunity	IEC 61000-4-6: 2004, Level 3	140 dBµV (10 Vrms) from 150 kHz to 80 MHz
Magnetic field immunity	IEC 61000-4-8:2001	1000 A/m for 3 seconds 100 A/m for 1 minute
Damp oscillatory wave immunity and surge withstand capability immunity	IEC 61000-4-12: 1995 + A1: 2000, Level 3 IEC 60255-22-1: 2005	2.5 kV common on all ports 1 kV differential on all ports
RF radiated disturbance	IEC CISPR-22: 1997 + A1: 2000, Class A	
RF conducted disturbance	IEC CISPR-22: 1997 + A1: 2000, Class A	
Supply		
Voltage variation immunity for AC equipment	IEC 61000-4-11:1994 + A1: 2001	90 ms without reboot
Polarity inversion for DC equipment	SN-62.1008d: 1997	For 1 minute

Table 9. Type Tests (continued)

Accidental grounding immunity for DC equipment	SN-62.1008d: 1997	
Short interruption for DC equipment	SN-62.1008d: 1997	
Voltage dips for DC equipment	SN-62.1008d: 1997	
Residual wave for DC equipment	SN-62.1008d: 1997	5%PK-PK of VIN at 120 Hz
Accessories		
Jumper strap	IEC 60695-11-5: Flame test IEC 60950-1: Paragraph 2.6.3.4	

Temperature derating

Table 10. Ambient temperature reduction (^{O}C) for I/O cards

Maximum value	Duty factor	BO card	BI card (without EDC)	BI card (with EDC)
6 A	Continuous	7.5	N/A	N/A
3 A	Continuous	5.0	N/A	N/A
0 A	Continuous	2.5	N/A	N/A
250 VDC	Continuous	N/A	5	10
220 VDC	Continuous	N/A	4.5	9
125 VDC	Continuous	N/A	2.5	5
110 VDC	Continuous	N/A	2.25	4.5
48 VDC	Continuous	N/A	1	2
24 VDC	Continuous	N/A	0.5	1

Table 11. Ambient temperature reduction (^{O}C) for analog cards

Analog card type	Rack-mount model Temperature reduction	Wall-mount model Temperature reduction
High-isolation model		
IOA or IOC (1 card)	17 °C	14 °C
IOA + IOC (2 cards)	21 °C	17.5 °C
Standard model		
IOA or IOB or IOC (1 card)	1 °C	1 °C

Note: A, B and C are referring to the expansion card slot identification.

Table 12. Derating table

Configuration	Derating	Details
Rack-Mount enclosure with CPU Board and Copper Ethernet Interface	$\Delta T \geq 5^{o}C$; $Ta = 85^{O}C - (IOA + IOB + IOC + IOD)$ $\Delta T \leq 5^{O}C$; $Ta = 80^{O}C$	ΔT is the SUM of I/O slot temperature derating (IOA + IOB + IOC + IOD) Ta is the ambient temperature A, B and C are referring to the expansion card slot identification
Rack-Mount enclosure with CPU Board and Fiber Ethernet Interface	$\Delta T \geq 17^{O}C$; $Ta = 85^{O}C - (IOA + IOB + IOC + IOD)$	
Wall-Mount Enclosure (All configurations)	$Ta = 75^{O}C - (IOA + IOB + IOC + IOD)$	

Dimension drawings

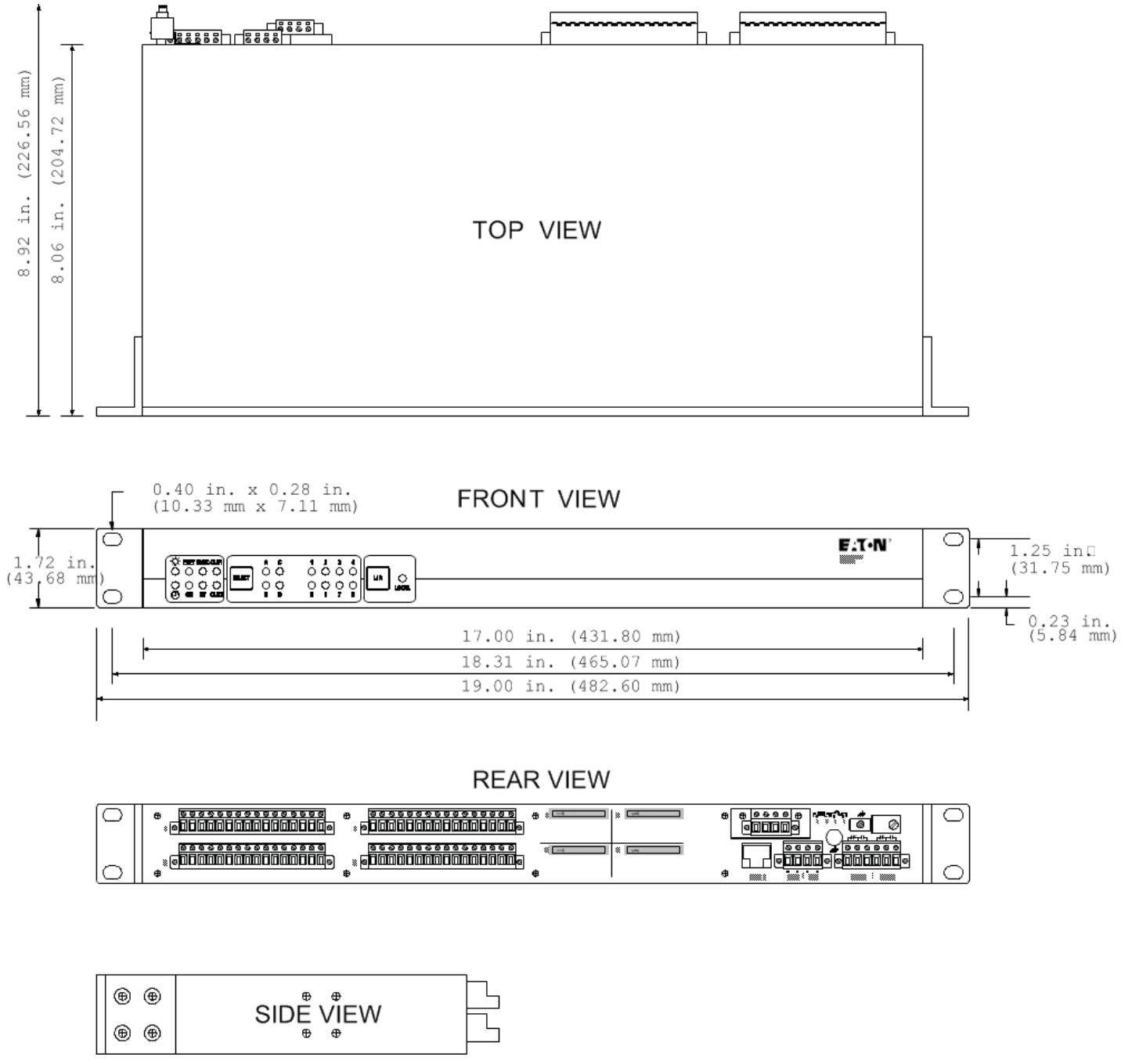

Figure 7. SMP I/O rack-mount unit, dimension drawings

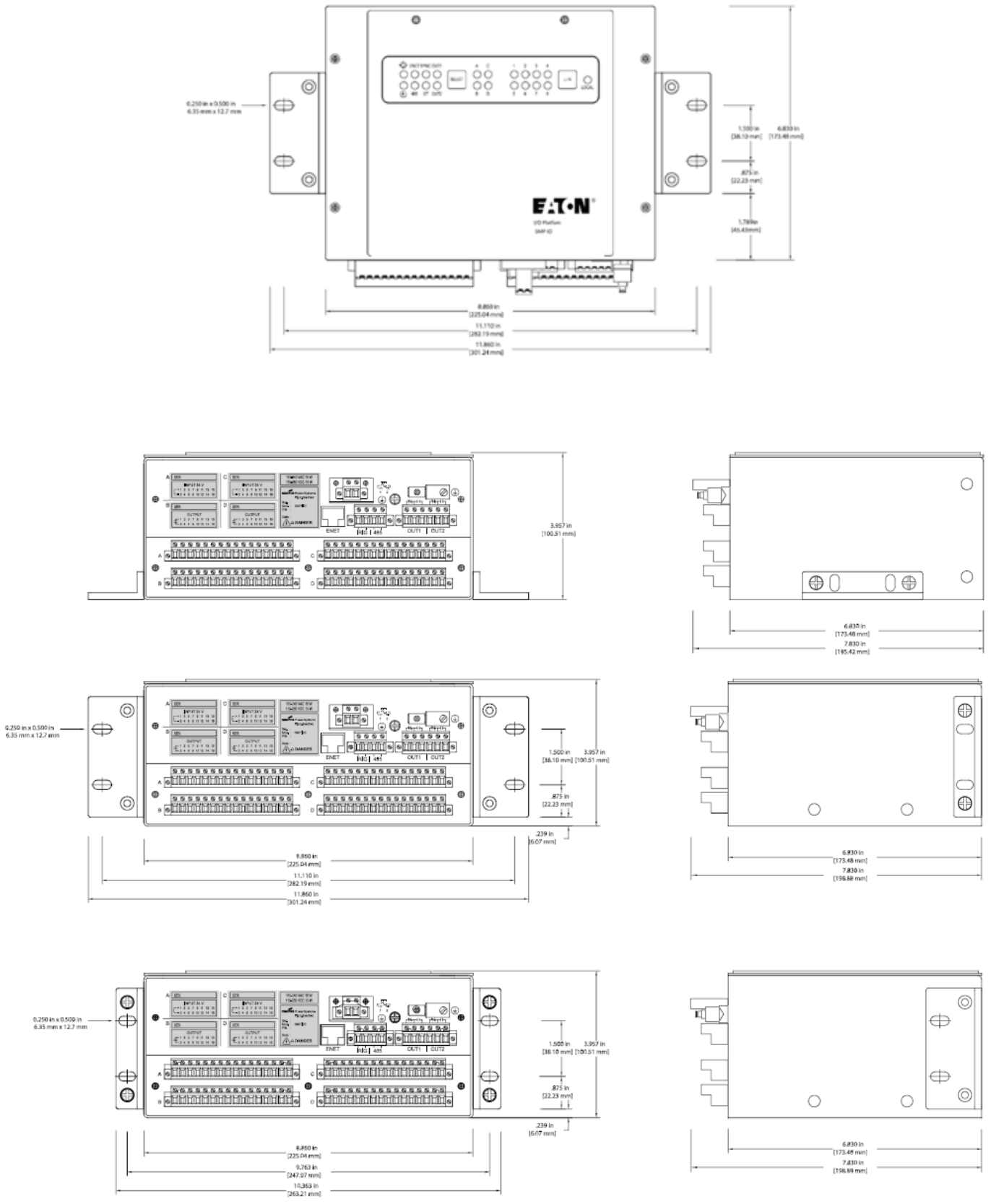

Figure 8. SMP I/O wall-mount unit, dimension drawings

Ordering information

Table 13. Ordering information

Description	P	-	PRTU	-	0	-	1	2	3	4 SlotA	5 SlotB	6 SlotC	7 SlotD	8	9
Mounting															
[R] SMP I/O rack-mount base unit							R								
[A] SMP I/O wall-mount CB base unit (front panel buttom oriented)							A								
[B] SMP I/O wall-mount CL base unit (front panel left oriented)							B								
[C] SMP I/O wall-mount CT base unit (front panel top oriented)							C								
[D] SMP I/O wall-mount CR base unit (front panel right oriented)							D								
Port															
[C] Copper Ethernet								C							
[F] Fiber Ethernet (LC)								F							
Power Supply															
[A] 24-60 VDC									A						
[B] 125-250 VDC / 110-240 VAC									B						
I/O Cards															
[0] empty										0	0	0	0		
[A] 8-Port relay output module											A		A		
[B] 8-Port 24 VDC digital input										B	B	B	B		
[C] 8-Port 48 VDC digital input										C	C	C	C		
[D] 8-Port 110 VDC digital input										D	D	D	D		
[E] 8-Port 125 VDC digital input										E	E	E	E		
[F] 8-Port 220 VDC digital input										F	F	F	F		
[G] 8-Port 250 VDC digital input										G	G	G	G		
[H] 8-Port 24 VDC EDC digital input										H	H	H	H		
[I] 8-Port 48 VDC EDC digital input										I	I	I	I		
[J] 8-Port 110 VDC EDC digital input										J	J	J	J		
[K] 8-Port 125 VDC EDC digital input										K	K	K	K		
[L] 8-Port 220 VDC EDC digital input										L	L	L	L		
[M] 8-Port 250 VDC EDC digital input										M	M	M	M		
[N] 8-Port DC analog input, standard model										N	N	N			
[P] 8-Port DC analog input, high isolation model										P		P			
Options															
[0] NONE														0	
[A] Additional connectivity option (second DNP3 slave)														A	
[B] IEC 61850 GOOSE option														B	
Jumper strap options															
[0] NONE															0
[A] Package of 1 jumper strap															A
[B] Package of 2 jumper strap															B
[C] Package of 3 jumper strap															C
[D] Package of 4jumper strap															D

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