SATEC

PMU PRO

DATASHEET

The PMU PRO is an advanced phasor measurement unit (P-Class & M-Class), based on the familiar PRO Series look-and-feel.

The Synchrophasor data is available over Ethernet via IEEE C37.118.2 data stream or IEC 61850-9-2 sampled values.

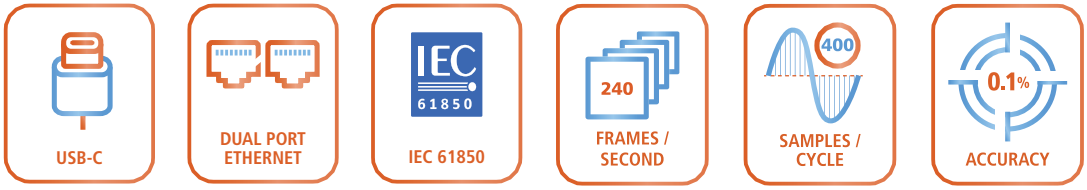
High accuracy time sync is achieved via IRIG-B or Precision Time Protocol (PTP) version 2.

HIGHLIGHTED FEATURES

- Advanced IEEE C37.118.2 support
- IEC 61850-9-2
- Supports 1-240 data frames/sec
- 1µs time stamp accuracy
- IRIG-B/PTP v2 (IEEE1588) time sync
- Dual port Ethernet
- Optional RS485 communication

Modular Versatility

FEATURES



PHASOR MEASUREMENT UNIT

- IEEE C37.118.1-2011, IEEE C37.118.1a-2014 and IEC/IEEE 60255-118-1:2018 P-Class and M-class performance compliance
- IEEE C37.118.1 compliant three-phase voltage, current, and positive and negative sequence phasor measurements synchronized to a common UTC time reference
- IEEE C37.118.1 synchronous frequency and Rate of Change of Frequency (ROCOF) measurements
- Clock synchronization to a UTC time reference using an IRIG-B timecode source or an IEEE 1588 PTPv2 master clock source
- IEEE C37.118.2 commanded client-server UDP and TCP data transmission and spontaneous UDP data transmission over IP protocol
- IEEE C37.118.2 reporting rates from 1 to 200/240 frames/s
- IEEE C37.118.2 data extensions with analog data (total fundamental active, reactive and apparent power and displacement power factor), and digital status data
- Streaming of phasor data over Ethernet, using the IEC 61850-9-2 multicast sampled value (SV) service with IEEE C37.118.2 compliant mapping of synchrophasor data, based on IEC 61850-9-2 and IEC 61850-9-5 guidelines
- Expected steady-state total vector error (TVE): < 0.05%
- Streaming rate: 1 to 200 or 240 frames/sec @ 50 or 60Hz, respectively
- IEEE C37.118.2
  - Time-stamped measurements, including phasor estimates, frequency deviation from nominal frequency or actual frequency, and rate of change of frequency (ROCOF), are sent in synchrophasor data frames
  - 32-bit IEEE floating-point format or 16-bit scaled integer numbers. In integer format, data conversion factors are provided in IEEE C37.118.2 configuration frames
  - Client-server UDP and TCP data transmission; spontaneous UDP data transmission over IP protocol
  - Optional IEEE C37.118.2 frame extensions with analog data (total active, reactive and apparent power and power factor) and digital status data (up to 32 inputs)
  - Support of CFG-1, CFG-2 and CFG-3 configuration frames.
  - In spontaneous UDP data transmission mode, CFG-2 or CFG-3 configuration frames can be sent spontaneously without explicit user command. When enabled, a configuration frame is sent periodically every 30 seconds

- Five data streaming slots for continuous synchrophasor data streaming, via unicast UDP or/and TCP connections

LOGGING, RECORDING & PROGRAMMING

- Programmable controller: up to 32 control setpoints and half-cycle scan time
- OR, AND, arithmetical functions logic, extensive triggers, programmable thresholds and delays, relay control, and event-driven data recording
- Event recorder for logging internal diagnostic events, power faults and operations of the logic controller and digital I/O
- Eight data recorders with programmable datasets for data logging on a periodic basis and on any internal or external trigger
- 32 digital counters for counting internal events and pulses from external sources
- 16 interval timers with programmable periods from half cycle to 24 hours for periodic recording and triggering timed operations

VARIABLE CURRENT INPUTS

- 5A
- 1A

VOLTAGE MEASUREMENT INPUTS

- Measurement category: CAT III
- Operating range: up to 277/480 VAC +25%

POWER SUPPLY

Rated input 57.7-277V AC / 48-290V DC

DISPLAY

- High contrast 1.77" TFT color graphics display with configurable backlight
- Multilanguage support

COMMUNICATION AND I/O OPTIONS

The PRO PMU features a large range of communication and I/O capabilities, as below:

Up to 4 Expansion Modules Side by Side

- Up to 2 expansion modules: self-energized
- 3 expansion modules: requires AUX power supply module

Built-in I/O Ports

- **2 optically isolated inputs**: 24V DC dry contact; programmable de-bounce time from 1ms to 1s; control setpoints, 1pps time synchronization; 1ms sampling rate
- **1 Solid State Relay output**: unlatched, latched and pulse operations, fail-safe operation for alarm notifications; programmable pulse width; direct remote relay control through communications
- **1 optically isolated analog input**: 1mA to 20mA

Optional Digital I/O Modules

- **8 DI: 8 optically isolated digital input options**
  - Dry contacts
  - 24/48/125/250V AC/DC wet inputs. Programmable de-bounce time from 1ms to 1s; 1ms sampling rate; control setpoints, pulse counters and Energy / TOU sub-system, 1pps time synchronization; 1ms sampling rate
- **4RO: 4 relays**: Electro-Mechanic (EMR) or Solid State (SSR) relay option. Unlatched, latched and pulse operations, fail-safe operation for alarm notifications, programmable pulse width, and direct remote relay control through communications
- **4DI + 2RO Combo:** per above specifications

Optional Analog Output Module

4 AO: 4 isolated universal analog outputs configurable for the following ranges: ±1mA, 0-20mA, 0-1mA, 4-20mA, 0-5mA, ±5mA

Optional Auxiliary Power Supply Modules

These power supply modules are designed to successfully power the whole device on their own, including up to three extra modules (I/O) Options:

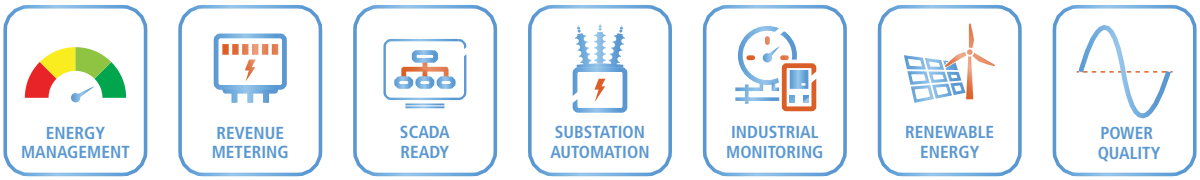
- 88-264V AC / 90-290V DC
- 24V DC (9-36V DC)

COMMUNICATION OPTIONS

Standard Communication Ports & Protocols

- Serial communication port; RS-485, up to 115200 bps, MODBUS RTU/ASCII, DNP3.0 and IEC 60870-5-101 protocols
- 2 × Ethernet 10/100 Base-T port, supporting Modbus/TCP, DNP3/TCP, IEC 60870-5-104, and IEC 61850, IEEE C37.118.2 and IEEE 1588 (PTPv2), up to 10 non-intrusive simultaneous connections per Ethernet port
- USB 2.0 port (type C)

APPLICATIONS



TECHNICAL SPECIFICATIONS

INPUT RATINGS

VOLTAGE INPUTS

Measurement category	CAT III
Operating range	277/480 VAC +25%
Input impedance	4MΩ
Over-voltage withstand	continuous: 1,000V AC 1 second: 2,000V AC
Burden	for 120V < 0.01VA for 400V ≤ 0.04VA
Isolation	4,000V AC @ 1min
Wire size	up to 10 AWG (4.5 mm²)
Connector type	4 pins, plug-in

CURRENT INPUTS

Measurement category	CAT III
Galvanic isolation	4,000V AC @ 1 min
Wire size	up to 10 AWG (4.5 mm²)

5A

Operating range	10A RMS continuous
Burden	< 0.2 VA @ 5 A (with 10 AWG wire and 1 m long)
Overload withstand	15A RMS continuous, 200A RMS for 1/2 second (with 10 AWG section wire)

1A

Operating range	continuous 2A RMS
Burden	< 0.2 VA @ 1 A (with 10 AWG wire and 1 m long)
Overload withstand	3A RMS continuous, 40A RMS for 1/2 second (with 10 AWG section wire)

POWER SUPPLY

Rated input	57.7-277V AC @ 50/60 Hz, 48-290V DC
Tolerance	±15%
Burden	11VA@V AC, 6VA @ V DC
Isolation	4000V AC @ 1mn
Wire size	Up to 14 AWG (≤1.5 mm²)

AUXILIARY POWER SUPPLY (AS MODULE)

AC/DC module

Rated input	88-264V AC / 90-290V DC
Output	5W
Burden	15VA
Withstanding	4kV AC @ 1min
Wiring	L/+, N/-
Terminals Pitch	5 mm
Wire size	up to 12 AWG (≤ 2.5 mm²)

24V DC module

Rated input	9-36V DC
Output	7W
Galvanic isolation	4,000V AC @ 1min
Isolation	4KV
Terminals Pitch	5 mm
Wire size	14 AWG (up to 1.5 mm2)

DIGITAL/ANALOG I/O

BUILT-IN (OPTIONAL)

Digital Inputs (2 DI)

Dry Contacts, internally wetted	@ 24V DC
Galvanic isolation	4000V AC @ 1mn
Internal power supply	24V DC

Scan time	1 ms
Connector type	removable, 5 pins
Wire size	14 AWG (up to 1.5 mm²)
Terminal pitch	5mm

Digital Output (1 DO)

Solid State relay	
1 relays rated at 0.15A/250 V AC/DC, 1 contact (SPST Form A)	
Galvanic isolation	4,000V AC @ 1min
Operate time	1 ms max.
Release time	0.25 ms max.
Update time	1 cycle
Connector type	removable, 4 pins
Wire size	14 AWG (up to 1.5 mm²)

Analog Input (1 AI)

Universal (-1mA to 20mA; range configurable: ±1mA, 0…1mA, 0…20mA, 4…20mA etc.)	
Galvanic isolation	4,000V AC @ 1min
Scan time	1 ms
Connector type	removable, 5 pins
Wire size	14 AWG (up to 1.5mm²)
Accuracy	< 0.5% FS
Terminal pitch	5mm

ADD-ON MODULES

Digital Inputs (8 DI)

Dry Contacts, internally wetted	@ 24V DC
Wet contact	@ 250V DC (8DI only)
Sensitivity	Open @ input resistance >100 kΩ Closed @ Input resistance < 100Ω
Galvanic isolation	4,000V AC @ 1min
Internal power supply	24V DC
Scan time	1 ms
Connector type	removable, 2 x 5 pins
Wire size	14 AWG (up to 1.5 mm²)

Digital Outputs (4 DO)

Electromechanical relay - DRY contact (option 1)

4 relays rated at 5A/250V AC; 5A/30V DC, 1 contact (SPST Form A)	
Galvanic isolation: Between contacts & coil Between open contacts	 3000V AC @ 1mn 750V AC
Operate time	10 ms max.
Release time	5 ms max.
Wire size	14 AWG (up to 1.5 mm²)

Solid state relay - DRY contact (option2)

4 relays rated at 100mA/800V AC, 1 contact (SPST Form A)	
Galvanic isolation Between contacts & coil Between open contacts	 5,000V AC @ 1min 800V peak
Operate time	5 ms max.
Release time	5 ms max.
Wire size	14 AWG (up to 1.5 mm²)
Update time	1 cycle
Wire size	14 AWG (up to 1.5 mm²)

Digital Inputs + Digital Outputs (4 Di + 4ro)

4DI + 2RO combo, per above specifications	

Analog Outputs (4 Ao)

Universal (configurable) isolated analog outputs

Scan time: (manually or remotely programmed)	1 ms
Ranges (manually or remotely programmed)	±1 mA, maximum load 10 kΩ (100% overload) 0-20 mA, maximum load 510Ω 4-20 mA, maximum load 510Ω 0-1 mA, maximum load 10kΩ (100% overload)
Accuracy	0.5% FS
Wire size	14 AWG (up to 1.5 mm2)
Terminals Pitch	5 mm

COMMUNICATION PORTS

COM1

RS-485 optically isolated port	
Baud rate	2400 to 115200 bps.
Isolation	4,000V AC @ 1min
Supported protocols	MODBUS RTU DNP3 MODBUS ASCII
Connector type: 2 pins, plug-in Wire size: up to 14 AWG (up to 1.5 mm²)	

ETHERNET PORT (DUAL / 2 PORTS)

Transformer-isolated 10/100 Base-T Ethernet port – RJ45	
Supported protocols:	MODBUS/TCP (Port 502) DNP3/TCP (Port 20,000) IEC 60870-5-104 (Port 2404) IEC 61850 (Port 102) PTP v2 (IEEE1588) time sync IEEE C37.118.2
Number of simultaneous connections	10 (5 MODBUS/TCP + 5 DNP3/TCP)

Isolation	4,000V AC @ 1min
USB Port	
Full speed USB 2.0 port	
Isolation	4,000 VAC 1 min
Connector type	USB Type C
Supported protocols	Modbus/TCP
IRIG-B Port	
Optically isolated IRIG-B port	
Timecode signal	unmodulated (pulse-width coded), 100 pps
Signal level	unbalanced 5V
Timecode format	B004/B005
Isolation	4,000 VAC 1 min
Connector type	plug-in
Recommended cable	510 Ωhm low loss RG58A/U (Belden 8219 or equivalent)

ADDITIONAL SPECIFICATIONS

REAL-TIME CLOCK

Built-in real-time clock with battery backup	
Accuracy, calibrated	< 5 ppm at 23°C
Battery type	CR1632 3V Lithium button cell
Time retention	5 years (typical)

LOG MEMORY

16GB memory for long-term data recording	

DISPLAY

1.77" color TFT LCD display Resolution	128 x 160 pixels 2
diagnostic LEDs Keypad	4 push buttons

ENVIRONMENTAL CONDITIONS

Operating temp.	-25°C to 55°C (-13°F to 131°F)
No HW failure	-40°C to +70°C (40°F to 158°F)
No display failure	-20°C to +70°C (4°F to 158°F)
Storage temperature	-30°C to +85°C (22°F to 185°F)
Humidity	0 to 95% RH non condensing
Altitude	up to 2,000 m (6561 ft) above sea level
Degree of protection	IP51

CONSTRUCTION

Weight	0.70kg (1.54 lb.)
Dimensions (PMU230, without expansion modules)	89.5 × 72 × 90 mm

MATERIALS

Case enclosure	Plastic PC/ABS blend
Display body	Plastic PC/ABS blend
Front panel	Plastic PC
PCB	FR4 (UL94-V0)
Terminals	PBT (UL94-V0)
Plug-in connectors	Polyamide PA6.6 (UL94-V0)
Labels	Polyester film (UL94-V0)

STANDARDS COMPLIANCE

Accuracy:

- IEEE C37.118.1, IEEE C37.118.1a and IEC/IEEE 60255-118-1 P and M performance classes

Electromagnetic Immunity:

- Comply with IEC 61000-6-2:
- IEC 61000-4-2 level 3: Electrostatic Discharge
- IEC 61000-4-3 level 3: Radiated Electromagnetic RF Fields
- IEC 61000-4-4 level 3: Electric Fast Transient
- IEC 61000-4-5 level 3: Surge
- IEC 61000-4-6 level 3: Conducted Radio Frequency
- IEC 61000-4-8: Power Frequency Magnetic Field
- Meets ANSI/IEEE C37.90.1: Fast Transient SWC

Electromagnetic Emission:

- Comply with IEC 61000-6-4: Radiated/ Conducted class A
- Comply with IEC CISPR 22: Radiated/ Conducted class A

Safety:

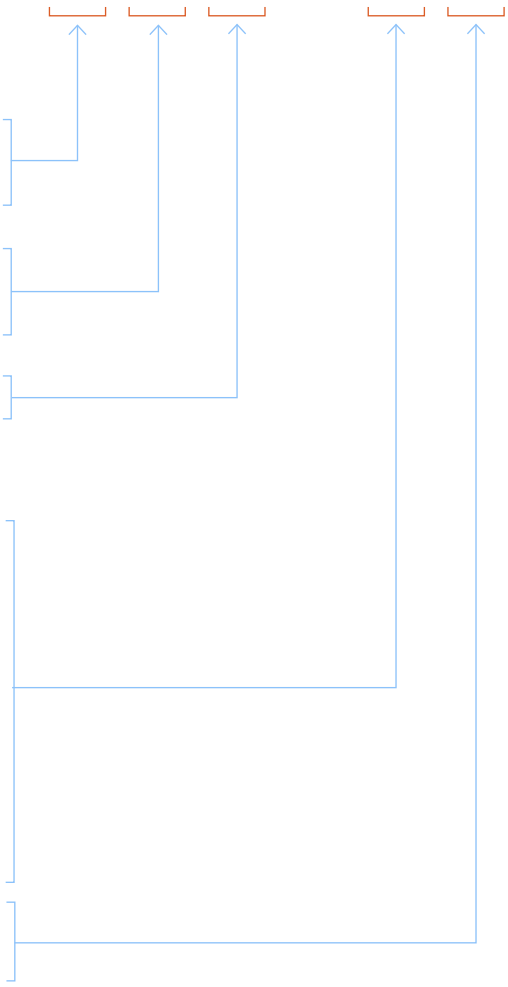
- Meets IEC 61010-1: 2006
- UL listed File No. E472110
- UL listing covers the base unit, the optional modules are not a part of UL listing

AC and Impulse Insulation:

- Meets IEC 62052-11: 4000VAC during 1 minute, 6KV/500Ω @ 1.2/50 µs impulse
- Degree of protection: IP51

ORDER STRING

PMU PRO DIN-rail Mount Phasor Measurement Unit	**PMU PRO**
OPTIONS	
CURRENT INPUTS	
5 Ampere	**5A**
1 Ampere	**1A**
CALIBRATION AT FREQUENCY	
50 Hz	**50HZ**
60 Hz	**60HZ**
POWER SUPPLY	
88-320V AC / 40-290V DC	**ACDC**
OPTIONAL MODULES*	
I/O (MAX. 3 MODULES PER DEVICE)	
4 Relay Outputs - 250V / 5A AC	**EMR4**
4 SSR Outputs - 250V / 0.1A AC	**SSR4**
4 Digital inputs (Dry Contact @ 24V DC) + 2 SSR outputs	**4DIOS-DRC**
4 Digital inputs (Dry Contact @ 24V DC) + 2 EMR outputs	**4DIOR-DRC**
8 Digital Inputs - Dry Contact	**DI8-DRC**
8 Digital Inputs - 24, 48, 125, 250 V DC	**DI8-24, 48, 125, 250 V**
4 Analog Outputs; configurable range	**4AO**
AUXILIARY POWER SUPPLY (MAX. 1 PER DEVICE)	
AUX. P.S. AC/DC 88-264V AC / 90-290V DC	**AUX-ACDC**
24V DC (9-36V DC)	**AUX-24DC**



To discuss the SATEC PMU Pro, please contact our energy management experts on:

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