SATEC

PRO SERIES

DATASHEET

PM335 EM235

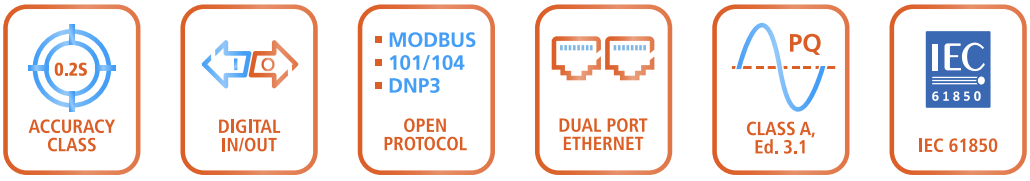
ADVANCED POWER METER & POWER QUALITY ANALYZER

The PRO Series analyzers are available as advanced power meters or as full Class A Ed. 3.1 power quality analyzers. They bundle multiple capabilities, ordinarily found in several different pieces of equipment, into one physical device.

HIGHLIGHTS

- Power & Energy Metering:
  - Class 0.2S accuracy (IEC / ANSI)
  - AC / DC metering
  - Wide range inputs: 1,000V AC / 820V DC
  - Leakage / residual current detection
- Power Quality (PQ version):
  - Class A Ed. 3.1 per IEC 61000-4-30
  - EN 50160 reports
  - IEEE 519 Harmonic analysis
- Communication:
  - IEC 61850 Ed. 2
  - Dual port Ethernet

MODULAR VERSATILITY



MODELS

PM335: panel-mounted meter monitoring voltage, current, power, frequency and energy measurements with data logging capabilities. Features a 3.5" TFT color display

PM335-PQ-A: all features above, including Class A Ed. 3.1 power quality analysis per IEC 61000-4-30 and EN 50160 reports

EM235: All features as above, in DIN-rail form factor with a 1.77" TFT display

EM235-PQ-A: all features above, including Class A Ed. 3.1 power quality analysis per IEC 61000-4-30 and EN 50160 reports

CURRENT INPUTS

1A or 5A: from CT secondary (standard)

HACS: 40mA inputs for SATEC's High Accuracy Current Sensors

DC Sensors: utilizing the 40mA HACS inputs for DC Current Measurements via SATEC's U-HACS sensors or Hall Effect sensors

MV Sensors: designated inputs for interfacing MV Sensors manufactured by international vendors

3.5"(49x73mm) LCD

Dual TCP/IP, RS-485, USB-C, 2DI, 1DO, 1AI

1.8"(28x35mm) LCD

Top: Communication & I/Os

Bottom: All power connections

Up to 4 add-on modules

Anti-tamper sealed enclosure

PRO Series modules

Fastening latch

50mm deep, 92×92 square or 4" round cutout fits type-tested switchboards with add-on modules

FEATURES

- **Up to 26 external digital triggers** from protection relays; onboard zero-sequence currents and volts, current and voltage unbalance; fault waveforms and fast RMS trace; cross triggering between multiple devices via digital inputs for synchronous event capture and recording
- **Three and 4 decimal resolution for** frequency readings
- **Event recorder** for logging internal diagnostics events, control events, and I/O operations
- **16 Data recorders:** Programmable Data Logs on a periodic basis and on any internal or external trigger
- **8 Fast Waveform recorders**: 7-channel (V1-V3, I1-I4) simultaneous recording; selectable AC sampling rate of 32, 64, 128 or 256 samples per cycle; 20 pre-fault cycles; synchronized waveforms from multiple devices in a single plot; exporting waveforms in COMTRADE and PQDIF file formats is possible via PAS software
- **Embedded Programmable Controller**: 64 control setpoints, OR/AND logic, extensive triggers, programmable thresholds and delays, relay control, event-driven data recording, cross triggering between multiple devices via ethernet for synchronous event capture and recording – up to sixteen triggering channels
- **3-phase Power meter**: true RMS, volts, amps, powers, power factors, unbalance, and neutral current
- **Four-quadrant active & reactive energy** polyphase meter: Class 0.2S IEC 62053-22 / Class 0.2 C12.20
- **Demand Meter**: amps, volts and harmonic demands
- **Precise Energy & Power Demand Meter**: Time-of-Use (TOU), 16 Summary (totalization) and TOU energy and demand registers for substation energy management; accumulation of energy pulses from external watt-meters; block and sliding demands; up to 64 energy sources
- **Harmonic Analyzer, per IEC 61000-4-7:** Up to 63rd harmonic for volts and amps; THD for volts and amps, TDD, K-factor, interharmonics for volts and amps, directional power harmonics and power factor
- **Phasor, symmetrical components**
- **32 digital counters** for counting pulses from external sources and internal events
- **16 programmable timers** from 1/2 cycle to 24 hours for periodic recording and triggering operations on a time basis
- **High Precision Time Synchronization**
  - SNTP
  - 1 pps via digital input
  - IRIG-B time-code input (future release)
- **Backup power supply unit**
- **3 daisy-chain slots** for plug-in I/O/COM modules
- **Expertpower client** for MODBUS/TCP communication with either a Remote or Local (Stand Alone) SATEC's Expertpower server
- **TCP notification client** for communicating with a remote MODBUS/TCP server on events or periodically on a time basis, with any IP enabled communication port
- **16GB memory** for long-term waveform and data recording
- **Real Time Clock**; Internal clock with battery backup with three-year retention

POWER QUALITY

PQ Version (EM235/PM335-PRO-PQ-A)

- Power quality analysis in full compliance with IEC 61000-4-30 Class A, Edition 3.1
- Built-in statistics and reports per EN 50160
- IEEE 519 Harmonic analysis

All Models

- Sags / swells (dips / overvoltages), interruptions, frequency variations, voltage variations
- Flicker (according to IEC 61000-4-15)
- Voltage unbalance
- Voltage and current individual harmonics (according to IEC 61000-4-7), interharmonics and directional power harmonics (load/source) up to the 63rd harmonic
- Voltage and current THD coefficients
- Vector diagram and symmetrical components
- Programmable thresholds and hysteresis
- Redundant auxiliary power supply for recording major dips and interruptions
- V-I angle, current TDD coefficients and K-Factors
- Waveform and data recording; phasor display
- Power quality event recorder
- Event recorder for logging internal diagnostic events, control events and I/O operations
- Selectable sampling rate up to 256 samples per cycle

AC MEASUREMENTS

The PRO Series is provided with fully isolated AC inputs for connecting to AC feeders:

- Three isolated AC voltage inputs (Rating: 10-1000V AC (L-L) @ 50/60 Hz)
- Four isolated AC current inputs (see pg. 2 for options)
- Leakage current detection: accurate calculation of residual current is enabled via a 4th current input to monitor the neutral current line. Accordingly, alerts and control thresholds can be configured in response to leakage current detected

DC MEASUREMENTS

The PRO Series measures DC voltage and current, calculating DC Power.

- Three isolated DC voltage inputs (from 10 to 820V DC). Optional: up to 1,500V DC (via adapter)
- DC voltage accuracy: 0.2%
- Four isolated DC current inputs up to 3000A DC (using SATEC U-HACS or Hall Effect sensors)
- DC current accuracy: 0.2%

COMMUNICATION AND I/O OPTIONS

The PRO Series meters feature 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

Optional Built-in I/O Ports

- **2 optically isolated inputs**: 24V DC dry contact; programmable debounce time from 1 ms to 1 sec; control setpoints, 1 pps

time synchronization; 1 ms 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**: configurable universal range (±1mA / 0-1mA, 0-20mA, 4-20mA, etc.)

Optional digital i/o modules

- **8 DI: 8 optically isolated digital input options**
  - Dry contacts
  - 24/48/125/250V AC/DC wet inputs. Programmable debounce time from 1 ms to 1 sec; 1 ms sampling rate; control setpoints, pulse counters and Energy / TOU sub-system, 1 pps time synchronization; 1 ms 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

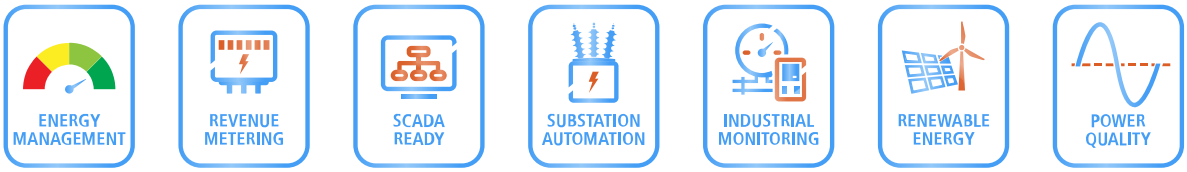
Standard Communication Ports & protocols

- Serial communication port; RS-485, up to 115,200 bps, MODBUS RTU/ASCII, DNP3.0, SNTP 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 protocols, up to 10 non-intrusive simultaneous connections per Ethernet port
- Infrared port (19,200 bps) supporting Modbus and DNP3 protocols for local meter data exchange
- USB 2.0 port (type C)

MOUNTING

- PM335: panel mount; compatible with 4'' round or 92 × 92 mm square cutouts
- EM235: DIN-rail mount

APPLICATIONS



TECHNICAL SPECIFICATIONS

INPUT RATINGS

VOLTAGE INPUTS

Operating range *	0-600V AC (L-N) 0-1,000VAC (L-L)
Operating range for direct DC Voltage**	10-820V DC
Input impedance	4MΩ
Burden for 400V	≤ 0.04VA
Burden for 120V	< 0.01VA
Isolation	4000V AC @ 1 min
Wire size	up to 14 AWG (≤ 2.5 mm²)

CURRENT INPUTS

1. 1A or 5A from CT secondary (standard)	
Operating range	Continuous 10A RMS
Burden	< 0.2 VA @ In=1A or 5A
Overload withstand	15A RMS continuous, 200A (20 × Imax) RMS for ½ second
Optional inputs	
2. DC	0-20 mA input for DC Hall Effect Sensors
3. HACS	0-20mA inputs for solid or split core CTs (SATEC High Accuracy Current Sensors)

LPCT SENSOR INTERFACE (V/I)

Voltage input	(3.25/√3) V
Burden	200kΩ ±1%
Connector type	2 wires
Current input	225mV
Burden	>20kΩ
Connector type	2 wires

DIGITAL/ANALOG I/O

BUILT-IN (OPTIONAL)

Digital Inputs (2 DI)	
Dry Contacts, internally wetted	@ 24V DC
Galvanic isolation	4000V AC @ 1 min
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	5 mm
Digital Output (1 DO)	
Solid State relay	
Relay rated at 0.15A/250 V AC/DC, 1 contact (SPST Form A)	
Galvanic isolation	4000V AC @ 1 min
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

* 1. UL listing covers nominal voltage up to 277/480V AC (L-N/L-L)
2. Min. L-N value for accurate detection is 6V
Min. L-L value for accurate detection is 10V

** Measuring up to 1,500V DC is possible via adapter

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 @ 1 min
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	 3,000V AC @ 1 min 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 (option 2)

4 relays rated at 100mA/800V AC, 1 contact (SPST Form A)	
Galvanic isolation Between contacts & coil Between open contacts	 3,000V 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 510 Ω 4-20 mA, maximum load 510 Ω 0-1 mA, maximum load 10 kΩ (100% overload)
Accuracy	0.5% FS
Wire size	Up to 14 AWG (≤ 1.5 mm²)
Terminals pitch	5 mm

POWER SUPPLY

Rated input	57.7-277V AC @ 50/60 Hz, 48-290V DC
Tolerance	±15%
Burden	11VA@V AC, 6VA@V DC
Isolation	4,000V AC @ 1 min
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)

COMMUNICATION PORTS

SERIAL

RS-485 optically isolated port. Baud rate up to 115,200 bps	
Isolation	4,000V AC @ 1 min

* Meets standard requirements

Supported protocols	MODBUS RTU DNP3 SATEC ASCII IEC 60870-5-101

ETHERNET PORT (DUAL / 2 PORTS)

Transformer-isolated 10/100 Base-T Ethernet port – RJ45

Supported protocols:	MODBUS/TCP (Port 502) DNP3/TCP (Port 20000) IEC 60870-5-104 (Port 2404) IEC 61850 (Port 102) SNTP
Number of simultaneous connections	10 (5 MODBUS/TCP + 5 DNP3/TCP)
Isolation	4000V AC @ 1mn

IR

InfraRed COM port, Front Panel access with magnetic head

Supported protocols	MODBUS RTU & DNP3 IEC 62056-21 (for local meter data exchange)
Isolation	4000V AC @ 1mn

USB PORT

Full speed USB 2.0 port	
Isolation	4,000 VAC 1 min
Connector type	USB Type C
Supported protocols	Modbus/TC

ADDITIONAL SPECIFICATIONS

REAL-TIME CLOCK

Accuracy	Typical error ±15 seconds per month / < 5 minutes/ year @ 25˚C

LOG MEMORY

16GB memory for long-term waveform and data recording

DISPLAY

PM335 - 3.5" LCD TFT color Display, 320×480 dots resolution

EM235 - 1.77" LCD TFT color Display, 120×160 dots resolution

ENVIRONMENTAL CONDITIONS

Operating temp.	-40°C to +70°C (40°F to 158°F)
Display op. temp.	-25°C to +70°C (4°F to 158°F)
Storage temperature	-40°C to +85°C (40°F to 185°F)
Humidity	0 to 95% RH non condensing
Degree of protection	IP51

CONSTRUCTION

Weight	0.70kg (1.54 lb.)
Dimensions (PM335)	108.6 × 74.7 × 113.3 mm
Dimensions (EM235)	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)

* Meets standard requirements

STANDARDS COMPLIANCE

Electromagnetic Immunity

- IEC 62052-11, CLC/TR 50579 (conducted disturbances 2-150kHz), IEEE C62.41 and C37.90.1
- 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
- ANSI/IEEE C37.90.1: Fast Transient SWC

Environmental

- IEC 60529: Protection
- IEC 60068-2-1: Cold
- IEC 60068-2-2: Dry Heat
- IEC 60068-2-30: Damp Heat
- IEC 60068-2-5: Solar Radiation

Accuracy

- IEC 62053-22:2003, Class 0.2S
- IEC 62053-24:2014, Class 0.5S
- ANSI C12.20 –2015, Class 10 (0.2%)

Electromagnetic Emission

- IEC 61000-6-4* Radiated/Conducted Class B
- IEC CISPR 22* Radiated/Conducted Class B
- Emission per EN 55011/22 Class B, FCC p.15 Class B

Power Quality

- Designed to comply with:
- EN 50160: Power Quality in European Electricity Supply Networks
- IEC 61000-4-7: Harmonics and inter-harmonics measurement
- IEC 61000-4-15: Flicker measurement
- IEC 61000-4-30 class A (Ed. 3.1): Power quality measurement methods

Safety/Construction

- IEC 61010, IEC 62052-11 & IEC 61557-12
- UL61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements , Edition 3, Revision Date 07/19/2019
- CSA C22.2 No. 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements, Edition 3, Revision Date 11/2018
- AC Impulse Insulation: Meets IEC 62052-11:4000V AC for 1 minute, 6KV/500Ω @ 1.2/50 µs impulse
- IEC 60068-2-6: Vibration (sinusoidal)
- IEC 60068-2-27: Shock Test
- IEC 60068-2-75: Hammer Test
- AS 62052-11*
- NMI M6-1*

ORDER STRING

MODELS

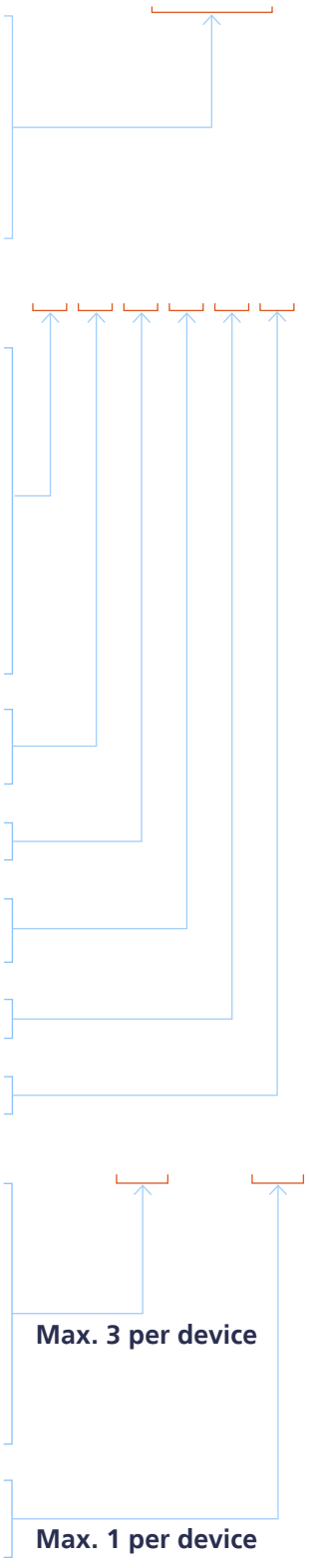
PM335 Panel-mount Power Meter	**PRO-PM335-PQ**
EM235 DIN-rail Mount Power Meter	**PRO-EM235-PQ**
Transducer Version	**PRO-RPM035-PQ**
PM335 Panel-mount PQ Analyzer, Class A (Ed. 3.1)	**PRO-PM335-PQ-A**
EM235 DIN-rail Mount PQ Analyzer, Class A (Ed. 3.1)	**PRO-EM235-PQ-A**
Transducer Version PQ Analyzer, Class A (Ed. 3.1)	**PRO-RPM035-PQ-A**

OPTIONS

CURRENT INPUTS	
5 Ampere	**5A**
1 Ampere	**1A**
5A split core remote high accuracy current sensor (HACS), 50/60Hz only	**RS5**
High Accuracy Current Sensors (HACS), 50/60Hz only	**HACS**
Pole Top Sensor Interface - 0-10V (Voltage& Current)	**PTS**
Pole Top Sensor Interface - 0-10V (Voltage), Current - 5A	**PTS-5**
LPCT: dedicated low voltage interface for MV sensors	**LPCT**
3V AC inputs for Rogowski current clamps	**FLEX**
CALIBRATION AT FREQUENCY	
50 Hz	**50HZ**
60 Hz	**60HZ**
POWER SUPPLY	
88-320V AC / 40-290V DC	**ACDC**
BUILT-IN I/O	
2 x DI (dry contact) + 1 x SSR output + 1 x Universal AI (-1mA to 20mA)	**IOS**
DISPLAY LANGUAGE	
English	**EN**
OPTIONAL PROTOCOLS	
IEC 61850 Communication Protocol	**850**

OPTIONAL MODULES*

I/O	
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	
AUX. P.S. AC/DC 88-264V AC / 90-290V DC	**AUX-ACDC**
24V DC (9-36V DC)	**AUX-24DC**



* Auxiliary power supply required when configured with 3 modules