

# PRO SERIES

## DATASHEET PM335/EM235



The PRO Series power analyzers are available in the PM335 panel mount (4-inch round / 92×92mm square cutouts) form factor design and the EM235 DIN-rail form factor design.

This series combines metering and control in one device, providing the ultimate solution for substation / industrial automation, and commercial energy management.

The PRO Series bundles multiple capabilities into one physical device, which ordinarily would be found in several different pieces of equipment.

Featuring a variety of communication interfaces and supporting a multitude of SCADA-driven protocols, these analyzers are extremely versatile and adaptive.

## HIGHLIGHTED FEATURES

- Class 0.2S accuracy (IEC / ANSI)
- AC/DC metering
- Power Quality Analyzer Class A, per IEC 61000-4-30 (Ed. 3.1)
- EN50160 Reports
- IEC 61850
- Dual port Ethernet
- Extra wide range input rating: 1,000V AC/820V DC
- Leakage/residual current detection
- Waveform capture and recording
- Up to 28 digital and analog I/O

## MODELS

**PM335:** Panel mounted meter monitoring voltage, current, power, frequency, and energy measurements, combined with power quality analysis and data logging capabilities. Features a 3.5" TFT color display

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

## CURRENT INPUTS

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

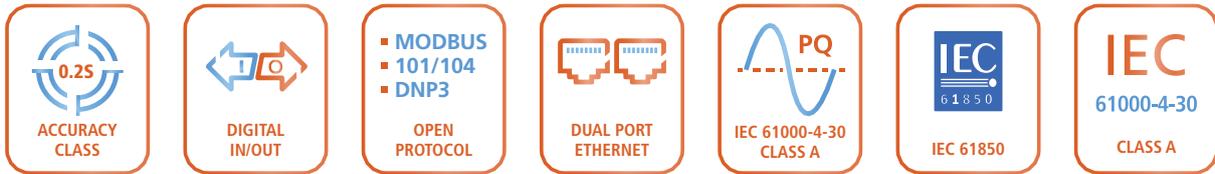
**HACS:** 40mA inputs for SATEC's High Accuracy Current Sensors

**Hall Effect DC Sensors:** utilizing the 40mA HACS inputs for DC Current Measurements

**GWP MV Sensors:** 225mV inputs, interfacing Greenwood Power's MV sensors (current & voltage)



## 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
- **1-ms satellite-synchronized clock** (IRIG-B time-code input - future release)
- **Backup power supply unit**
- **4 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 for three years of retention time

## POWER QUALITY

- Power quality analysis in full compliance with IEC 61000-4-30 Class A, Edition 3.1  
**Built-in statistics and reports per EN50160**
- Sags/Swells (dips / overvoltage), 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 63<sup>rd</sup> 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 4<sup>th</sup> 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 (via 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 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:  $\pm 1\text{mA}$ , 0-20mA, 0-1mA, 4-20mA, 0-5mA,  $\pm 5\text{mA}$

### 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 and IEC 60870-5-101 protocols
- 2 x 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)

# 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	4M $\Omega$
Burden for 400V	$\leq 0.04$ VA
Burden for 120V	$< 0.01$ VA
Isolation	4000V AC @ 1mn
Wire size	up to 14 AWG ( $\leq 2.5$ mm <sup>2</sup> )

### CURRENT INPUTS

#### 1. 1A or 5A from CT secondary (standard)

Operating range	Continuous 10A RMS
Burden	$< 0.2$ VA @ $I_n=1$ A or 5A
Overload withstands	15A RMS continuous, 200A ( $20 \times I_{max}$ ) RMS for $\frac{1}{2}$ 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)

### GWP SENSOR INTERFACE (V/I)

Voltage input	( $3.25/\sqrt{3}$ ) V
Burden	200k $\Omega$ $\pm 1\%$
Connector type	2 wires
Current input	225mV

Burden	$> 20$ k $\Omega$
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 @ 1mn
Internal power supply	24V DC
Scan time	1 ms
Connector type	removable, 5 pins
Wire size	14 AWG (up to 1.5 mm <sup>2</sup> )
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	4000V AC @ 1mn
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 mm <sup>2</sup> )

#### Analog Input (1 AI)

Universal (-1mA to 20mA; range configurable: $\pm 1$ mA, 0...1mA, 0...20mA, 4...20mA etc.)	
Galvanic isolation	4000VAC @ 1mn
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 1.5mm <sup>2</sup> )
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 k $\Omega$ Closed @ Input resistance < 100 $\Omega$
Galvanic isolation	4000V AC @ 1mn
Internal power supply	24V DC
Scan time	1 ms
Connector type	removable, 2 x 5 pins
Wire size	14 AWG (up to 1.5 mm <sup>2</sup> )

#### 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	3000V AC @ 1mn
Between open contacts	750V AC
Operate time	10 ms max.
Release time	5 ms max.
Wire size	14 AWG (up to 1.5 mm <sup>2</sup> )

##### Solid state relay - DRY contact (option2)

4 relays rated at 100mA/800V AC, 1 contact (SPST Form A)

Galvanic isolation	
Between contacts & coil	5000V AC @ 1mn
Between open contacts	800V peak
Operate time	5 ms max.
Release time	5 ms max.
Wire size	14 AWG (up to 1.5 mm <sup>2</sup> )
Update time	1 cycle
Wire size	14 AWG (up to 1.5 mm <sup>2</sup> )

#### 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
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Ranges (manually or remotely programmed)	$\pm 1$ mA, maximum load 10 k $\Omega$ (100% overload) 0-20 mA, maximum load 510 ohm 4-20 mA, maximum load 510 ohm 0-1 mA, maximum load 10 kohm (100% overload)
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Accuracy	0.5% FS
Wire size	14 AWG (up to 1.5 mm <sup>2</sup> )
Terminals Pitch	5 mm

### POWER SUPPLY

Rated input	57.7-277V AC @ 50/60 Hz, 48-290V DC
Tolerance	$\pm 15\%$
Burden	11VA@V AC, 6VA@V DC
Isolation	4000V AC @ 1mn
Wire size	Up to 14 AWG ( $\leq 1.5$ mm <sup>2</sup> )

### 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 ( $\leq 2.5$ mm <sup>2</sup> )

#### 24V DC module

Rated input	9-36V DC
Output	7W
Galvanic isolation	4,000V AC @ 1mn
Isolation	4KV
Terminals Pitch	5 mm
Wire size	14 AWG (up to 1.5 mm <sup>2</sup> )

### COMMUNICATION PORTS

#### COM1

RS-485 optically isolated port. Baud rate up to 115200bps

Isolation	4000V AC @ 1mn
Supported protocols	MODBUS RTU DNP3 SATEC ASCII IEC 60870-5-101

\* Meets standard requirements

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### COM4

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

### 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)

Number of simultaneous    10 (5 MODBUS/TCP + 5  
connections                    DNP3/TCP)

Isolation                      4000V AC @ 1mn

### USB PORT

#### 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

- IEC62053-22:2003, 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 EN55011/22 class B, FCC p.15 class B

## Power Quality

- Designed to comply with:
- EN50160: 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
GWP: dedicated low voltage interface for GWP sensors	GWP
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
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### BUILT-IN I/Os

2 x DI (dry contact) + 1 x SSR output + 1 x Universal AI (-1mA to 20mA)	IOS
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### DISPLAY LANGUAGE

English	EN
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### OPTIONAL PROTOCOLS

IEC 61850 Communication Protocol	850
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## 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

\* Auxiliary power supply required when configured with 3 modules

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