SATEC

# PRO SERIES - DC METERING

## DATASHEET


**PM335** **EM235**

## HIGHLIGHTS

- DC Power & Energy Metering:
  - Class 0.5 accuracy (IEC 62053-41)
  - System accuracy subject to the Hall Effect and UHACS Sensor used
  - *IEC 62053-41 compliance with UHACS (Flux Gate) Sensors
  - Measures up to 3 DC channel inputs
  - Wide range inputs: 0-800V DC Standard
  - Up to 1500V DC with use of SATEC Voltage Ratio Module (VRM)
- Communication:
  - Dual Ethernet Ports
  - Daisy Chain Ethernet
  - RS485
  - IR Port
- Protocols:
  - Modbus
  - IEC 61850
  - DNP3

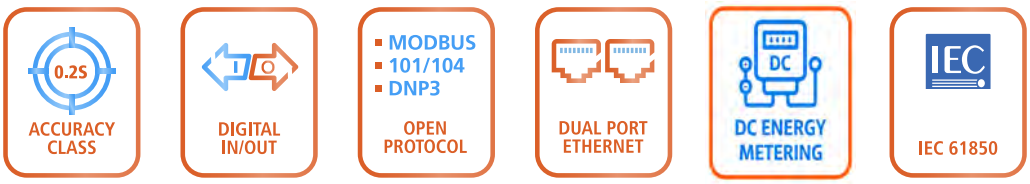
## ADVANCED DC POWER METER

The PRO Series DC Power and Energy Meters are available as an advanced DC meter fully compliant and tested to DC meter standard *IEC 62053-41.

The PRO Series DC measurement system is via Hall Effect Sensors or UHACS (Flux Gate) for up to three (3) channel inputs.

The PRO Series incorporates multiple capabilities for DC metering applications tested to a high international standard.

## MODULAR VERSATILITY

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# MODELS

### PM335-HACS-DC:

Panel mounted DC meter monitoring voltage, current, power, demand and energy measurements with data logging capabilities.

Features a 3.5" TFT colour display

### EM235-HACS-DC:

DIN mounted DC meter monitoring voltage, current, power, demand and energy measurements with data logging capabilities.

Features a 3.5" TFT colour display

# CURRENT INPUTS

### DC Sensors:

Utilising the SATEC HACS input meters for DC Current measurements via

- **Hall Effects Current Sensors**
  - HCS100-S (100A) Split Core
  - HCS1000 (1000A) Solid Core
  - HCS2000-S (2000A) Split Core
- ***UHACS (Flux Gate) Current Sensors**
  - FCS-300 (300A)
  - FCS-600 (600A)
  - FCS-1000 (1000A)
  - FCS-2500-13 (2500A)

*** Certificate of conformity per IEC 62053-41 based on use of UHACS (Flux Gate) Current Sensors**

**Both Hall Effect and UHACS (Flux Gate) Current Sensors require a separate power supply.**

**The FCS-2500-13 UHACS (Flux Gate) Current Sensor requires two (2) power supplies connected in parallel.**

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
- **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
- **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
- **DC Power Meter:** volts, amps, power, energy, demand
- **Demand Meter:** amps and volts
- **Precise Energy & Power Demand Meter:** Time-of-Use (TOU), 16 Summary (totalisation) 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
- **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 Synchronisation**
  - 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

## DC MEASUREMENTS

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

- Three isolated DC voltage inputs (from 10 to 820V DC).
  Optional: up to 1,500V DC (via VRM)
- DC voltage/current accuracy: 0.5%
- Four isolated DC current inputs up to 2500A DC (using SATEC U-HACS or Hall Effect sensors)

## 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-energised
- 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 synchronisation; 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 analogue 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 synchronisation; 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 analogue output module

**4 AO: 4 isolated universal analogue 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

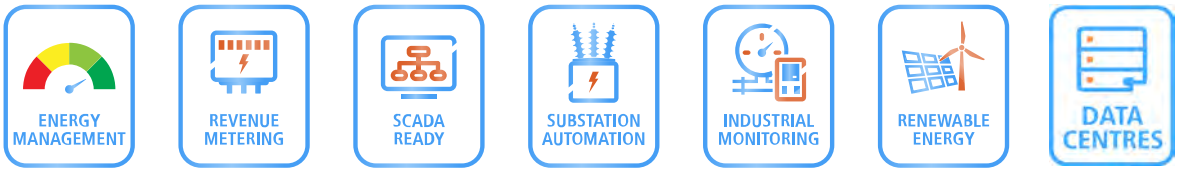
### Standard Communication Ports & protocols

- 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 for direct DC Voltage** | 10-820V DC |
| Input impedance | 4MΩ |
| Isolation | 4000V AC @ 1 min |
| Wire size | Up to 14 AWG (≤ 2.5 mm²) |
| **Operating range up to 1500V DC | Install Voltage Ratio Module (VRM) |

### CURRENT INPUTS

| DC Current Inputs | |
|---|---|
| DC | Via DC Hall Effect Sensors or UHACS (Flux Gate) Sensors |

## DIGITAL/ANALOGUE 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) |

| Analogue 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 |

** Measuring up to 1500V DC is possible via Voltage Ratio Module (VRM)

## 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 $mm^2$) |

### 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:<br>Between contacts & coil<br>Between open contacts | <br>3,000V AC @ 1 min<br>750V AC |
| Operate time | 10 ms max. |
| Release time | 5 ms max. |
| Wire size | 14 AWG (up to 1.5 $mm^2$) |

Solid state relay - DRY contact (option 2)

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

| | |
|---|---|
| Galvanic isolation<br>Between contacts & coil<br>Between open contacts | <br>3,000V AC @ 1min<br>800V peak |
| Operate time | 5 ms max. |
| Release time | 5 ms max. |
| Wire size | 14 AWG (up to 1.5 $mm^2$) |
| Update time | 1 cycle |
| Wire size | 14 AWG (up to 1.5 $mm^2$) |

### DIGITAL INPUTS + DIGITAL OUTPUTS (4 DI + 4RO)

4DI + 2RO combo, per above specifications

### ANALOGUE OUTPUTS (4 AO)

Universal (configurable) isolated analogue outputs

| | |
|---|---|
| Scan time: (manually or remotely programmed) | 1 ms |
| Ranges (manually or remotely programmed) | ±1 mA, maximum load 10 kΩ (100% overload)<br>0-20 mA, maximum load 510 Ω<br>4-20 mA, maximum load 510 Ω<br>0-1 mA, maximum load 10 kΩ (100% overload) |
| Accuracy | 0.5% FS |
| Wire size | Up to 14 AWG (≤ 1.5 $mm^2$) |
| 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 $mm^2$) |

### 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 $mm^2$) |

#### 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 |
| Supported protocols | MODBUS RTU<br>DNP3<br>SATEC ASCII IEC 60870-5-101 |

* Meets standard requirements

### ETHERNET PORT (DUAL / 2 PORTS)

| | |
|---|---|
| Transformer-isolated 10/100 Base-T Ethernet port – RJ45 | |
| Supported protocols: | MODBUS/TCP (Port 502)<br>DNP3/TCP (Port 20000)<br>IEC 60870-5-104 (Port 2404)<br>IEC 61850 (Port 102) SNTP |
| Number of simultaneous connections | 10 (5 MODBUS/TCP + 5 DNP3/TCP) |
| Isolation | 4000V AC @ 1mn |

### INFRARED (IR)

| | |
|---|---|
| InfraRed COM port, Front Panel access with magnetic head | |
| Supported protocols | MODBUS RTU & DNP3<br>IEC 62056-21<br>(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

## 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

# ORDER STRING

## MODELS

| | |
|---|---|
| PM335 Panel-Mount | **PRO-PM335** |
| EM235 DIN-Rail Mount | **PRO-EM235** |
| Transducer Version | **PRO-RPM035** |

## OPTIONS

| | |
|---|---|
| **CURRENT INPUTS** | |
| High Accuracy Current Sensors (HACS), 50/60Hz only | **HACS** |
| **CALIBRATION FOR DC CURRENT (DC)** | |
| DC | **DC** |
| **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 (Maximum of 3 modules)** | |
| 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 Analogue Outputs; configurable range | **4AO** |
| **AUXILIARY POWER SUPPLY (Maximum of 1 module)** | |
| 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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