The PM180 is a high performance power quality analyzer which can simultaneously host several applications.

Versatile functionality is enabled by a unique modular design, allowing the hot-swap of a variety of add-on cards.

Thus, the analyzer combines and substitutes multiple other devices, saving cost and space and mitigating complexity.

**Accuracy**: Class 0.2 / 0.2S per IEC 62053-22 / ANSI (*Class 0.2S Revenue/Check Meter)

**Communication**
- IEC 61850; IEC 60870-5-101/104; DNP3; Modbus
- Interfaces: RS485; ETH
- Optional ports: IRIG-B; 2nd ETH; 3G/4G cellular; Fiber Optic ETH (TXFX)

**Fast Transient Sampling**
Transient Recorder: 1024 samples/cycle

**Control**
I/O: Up to 48 digital and analog I/O

**APPLICATIONS**
- Class A (Ed. 3) power quality analyzer
- IEC 61850 for the digital substation
- Fault Recorder (In X 40)
- Phasor Measurement Unit per IEEE C37.118.1, P-Class and M-Class
- Bay Controller
- Sequence of Events
- Class 0.2S Revenue grade accuracy for check meter functionality

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PM180

Standard communication: Ethernet, RS-485, USB & IRIG-B

Wide range of digital & analog I/Os

Auxiliary PS

Four galvanically isolated voltage channels

Four galvanically isolated current channels up to 40xIn

APPLICATIONS

PM180 + RGM180

PM180 + RDM180

PQ

POWER QUALITY

SUBSTATION AUTOMATION

FAULT RECORDER

PMU/WAMS

INDUSTRIAL MONITORING

RENEWABLE ENERGY

SCADA READY
MULTI-FUNCTION POWER & ENERGY METER

- Real-time cycle-by-cycle measurement of true RMS voltage, current, power, demand & energy
- Exceeding Class 0.2S accuracy for energy metering (kWh, per IEC 62053-22 / ANSII C12.20)
- Advanced Time of Use (TOU) feature: 16 Energy sources, including external digital pulses, up to 4 seasons, 4 daily profiles and 8 Tariffs changes per day; flexible automatic 10-year calendar; suitable for complex billing schemes
- KYZ or KY output
- LED indicator for calibration and testing (via optional display)
- Vector diagram and symmetrical components
- IRIG-B / SNTP / DI time synchronization
- 256 MB memory for data-logging
- 4 decimal resolution for frequency readings

POWER QUALITY

- 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 63rd harmonic
- Voltage and current THD coefficients
- Symmetrical components
- Programmable thresholds and hysteresis
- Built-in statistics and reports per IEEE 1159, EN50160, GOST 13109 or GOST 54149 (market dependent)
- Redundant auxiliary power supply for recording major dips and interruptions
- V-I angle, current TDD coefficients and K-Factors
- Waveform, power factor & phasor data recorder
- Power quality event recorder
- Event recorder for logging internal diagnostic events, control events and I/O operations
- Selectable sampling rate up to 256 / 1024 (fast transients >78/65μs @ 50/60Hz )
- Disturbance Direction Detection: indicating upstream or downstream direction of sags and swells

IEC 61850

- IEC 61850 implemented per Edition 2
- Remote switch control and monitoring via IEC 61850 protocol
- Inter-device GOOSE communications for remote interlocking
- GOOSE Publisher Setup, GOOSE Subscriber Setup and Report Dead-bands
- Configuration of IEC 61850: IED properties, datasets and reports
BAY CONTROLLER (BCU)

- Monitoring and control capabilities for 2 circuit breakers and 14 circuit switches
- One-pole and three-pole switch position monitoring, using two or six contacts
- One control output for switch closing
- Two synchronous control outputs for switch opening devices with one and two opening coils
- Select-close control output for secure switch closing operations
- Two select-open control outputs for secure switch opening operations
- Configurable command pulse duration
- Option for adaptive pulses controlled via setpoint control logic
- Supervision of command execution & reporting on operation termination
- Interlocking logic
- Secure timed-out interlocking bypass logic
- Indication of non-controllable breaker trips
- Switch position substitution option
- Counting of breaker and switch operations
- Logging close / open operations and switch position changes
- Local switch control via setpoint control logic
- Configuration tools: PLC configurator based on IEC 61131-3 protocol, using Functional Block Diagram (FBD) or Ladder Diagram (LD)

DIGITAL FAULT RECORDER

- Programmable fault threshold and hysteresis
- Direct reading of fault currents of up to 200 Amps (40 X In, from CT secondary)
- Dual current inputs: from measurement CT and protection CT connection (optional)
- Zero-sequence currents and voltages
- Current and voltage unbalance
- Under-voltage, neutral current
- Ready-for-use fault reports—fault currents magnitude and duration, coincident volts magnitude, fault waveforms and RMS trace
- Selectable pre-fault / post-fault recording length
- Programmable post fault on any internal and/or external trigger condition
- Disturbance capture recording
- Distance to fault calculation
- Waveforms from multiple locations
- View faults and receive alerts via SATEC’s Expertpower software platform: https://www.satec-global.com/ExpertPower

DISTANCE TO FAULT CALCULATION

Compensation for CT / PT errors, resulting in average accuracy of 0.5% (depending on PT, CT and time synchronization accuracy)

- Supported line configurations
  - Single line
  - Parallel lines
  - Partially parallel lines
  - A line with a branch
- Required parameters
  - Line/s configuration
  - Line/s parameters (impedance, length, etc.)
  - Compensation parameters for CT & PT
- Detected Faults
  - Three-phase short circuit
  - Two-phase short circuit
  - Two-phase short circuit to ground
  - Single-phase short circuit to ground
  - Single-phase open wire
- Fault detection information
  - Fault classification (type and phase/s)
  - Distance to fault (km or miles)
  - Duration of fault
PHASOR MEASUREMENT UNIT (PMU)

- IEEE C37.118.1 M-Class and P-Class
- IEEE C37.118.1 three-phase voltage and current phasor measurements synchronized to a common UTC time reference (e.g. GPS), using an IRIG-B timecode source or an IEEE 1588 PTPv2 master clock source
- IEEE C37.118.1 synchronous frequency and Rate of Change of Frequency (ROCOF) measurements
- Expected total vector error (TVE): less than 0.5%
- Streaming of phasor data over Ethernet using IEC 61850-9-2 multicast sampled value (SV)
- Streaming rate: from 1 to 50 or 60 frames/s @ 50 or 60Hz, respectively
- IEEE C37.118.2 commanded client-server UDP and TCP data transmission and 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)
- 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 upon IEC 61850-9-2 and IEC 61850-90-5 guidelines

DATA LOGGING, WAVEFORM RECORDING & PLC PROGRAMMING

- Onboard memory: 256 MB
- Programmable controller: up to 64 control setpoints, up to 8 conditions OR, AND, arithmetical functions logic, extensive triggers, programmable thresholds and delays, relay control, event-driven data recording
- 8 fast waveform recorders: simultaneous 8 channel AC, one DC: up to 48 digital inputs in a single plot
- Waveform sampling rate: 32, 64, 128 or 256 samples per cycle; up to 20 pre-fault cycles (2 cycles of 1024 samples per cycle or 4 cycles with 512 samples per cycle with Transient Module)
- 3.5 min. of continuous waveform recording
- 1ms resolution for digital inputs
- 16 fast Data Recorders (16 parameters on each data log): From ½ cycle RMS to 2 hour RMS envelopes; up to 20 pre/post-fault cycles; programmable data logs on a periodic basis and on internal or external trigger
- 32 digital internal counters
- 16 programmable timers (½ cycle to 24 hours)

WIDE RANGE VOLTAGE INPUTS

- Three galvanically isolated AC voltage inputs. Impulse dielectric withstand: 6kV
- Nominal voltage: 100-828V AC (L-L)
WIDE RANGE CURRENT INPUTS

- 4 dual purpose current inputs (3 phase + Neutral current), calibrated to 1A or 5A nominal:
  - Class 0.2S revenue grade accuracy:
    - up to 4 × nominal current (4A and 20A, respectively; designed for measurement CTs’ secondary current)
  - Basic Fault current reading:
    - up to 10 × nominal current (10A and 50A, respectively, designed for protection CTs’ secondary current)
- Fault Recorder Modules:
  - Extended Fault Current reading: up to 40 × nominal current (200A, designed for protection CTs’ secondary current)

REAL-TIME CLOCK & SYNCHRONIZATION

- Real-Time Clock with maximum 5 seconds drift per month @ 25°C
- 1ms time resolution per IRIG-B time code input or satellite clock for common time base
- Periodic clock synchronization from an SNTP server, as SNTP client
- Time sync from digital input with 1ms accuracy

DIGITAL & ANALOG I/O MODULES

3 expansion slots for a wide range of plug-in modules, up to 48 DI / 24 DO / 12 AI / 12 AO or various combinations

- DI16: 16 high-speed digital inputs (dry contact or 24/125/250V DC)
- RLY8: 8
- 8DIOR: 8 digital inputs (24/125/250V DC) and 4 digital outputs (Electro Mechanical Relay or Solid State Relay)
- 4AIO: four analog inputs and four analog outputs (internal power supply); selection of 0-20mA, 4-20mA, 0-1mA or ±1mA output for inputs/outputs; ½ cycle update time

COMMUNICATION INTERFACES

- Built-in: RS-485 and Ethernet
- Optional:
  - TXFX (fiber optic)
  - 2G/3G/4G cellular modem
  - 2nd Ethernet port

COMMUNICATION PROTOCOLS

- Modbus RTU, ASCII, DNP 3.0, IEC 60870-5-101/104
- Optional: IEC 61850
### TECHNICAL SPECIFICATIONS

#### INPUT RATINGS

**VOLTAGE INPUTS**

**MODEL WITH AUX. POWER SUPPLY**

<table>
<thead>
<tr>
<th>Installation</th>
<th>Category III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage (L-N/L-L)</td>
<td>57/100V AC, 277/480V AC, 400/690V AC</td>
</tr>
<tr>
<td>Operating range</td>
<td>Direct input / input via PT up to 828V AC</td>
</tr>
</tbody>
</table>

**Burden**

- 480V L-N: 0.3VA
- 277V L-N: 0.1VA
- 120V L-N: 0.02VA

**Over-voltage withstand**

- 1000V AC continuous
- 2500V AC @ 1 second

**Galvanic isolation**

- 4kV AC @ 1 min. Impulse dielectric withstand 6kV

**Input impedance**

- 1 MΩ

**Wire size**

- up to 10 AWG (up to 6mm²)

**Terminal Pitch**

- 7.5 mm

#### CURRENT INPUTS

**STANDARD INPUTS FROM CT SECONDARY**

| Current ratings | » 1A input<br>» 5A input |
| Guaranteed accuracy: | per IEC 62053-22 up to 2 X In @ Class 0.25<br>per ANSI up to 4 X In @ Class 0.2 |

**Continuous overload**

- up to 10 X above nominal currents

**CONNECTION VIA SPLIT CORE SENSORS TO CT SECONDARY (HACS CS1S)**

| Current ratings | » 1A input<br>» 5A input |
| Continuous overload | up to 20 X above nominal currents |
| Burden | < 0.15 VA @ 5A<br> < 0.02 VA @ 1A |

**HACS SENSORS**

- 40mA inputs, designated for SATEC’s HACS (100-3,000A, see HACS product page)

**FLEX CLAMPS**

- 3V AC inputs for 3rd party flex clamps

### POWER SUPPLY

#### MAIN POWER SUPPLY

- Withstanding insulation 4kV AC @ 1mn

#### AD/DC POWER SUPPLY (STANDARD)

- L/+ N/ - AND GND
- Rated input 50-290V AC (50/60 Hz)
- Max. power 10W (Burden: <20VA)

**Wire size**

- up to 12 AWG (2.5mm²)

**Terminal pitch**

- 7.5 mm, three pins

#### AUXILIARY POWER SUPPLY (MODULE)

- Withstanding insulation 4kV AC @ 1mn

**AC/DC Option**

- L/+ N/- and GND
- Rated input 50-290V AC (50/60 Hz)
- 40-290V DC

**Low DC/DC (12/24) option**

- (+), (-) and GND
- Rated input 9.6-35V DC, Maximum Power 20W (Burden: <40VA)

**Wire size**

- Up to 12 AWG (2.5 mm²)

**Terminal pitch**

- 7.5 mm, three pins

### IRIG-B TIME SYNC

**PORT ON CPU MODULE**

- Optically isolated IRIG-B port for GPS time synchronization
- Recommended cable 51Ω low loss - RG58A/U (Belden 8219 or equivalent)
- Recommended GPS time code generator Masterclock GPS-200A

### BUILT IN COMMUNICATION

#### SERIAL COMMUNICATION (RS-485)

- Max. baud rate 115.2 kb/s
- Optical isolation 4000V AC (L-G) @ 1 min.
- Max. cable length 1000 m

**Protocols**

- MODBUS RTU/ASCII
- DNP 3.0
- IEC 60870 -5-101 (option)

**2nd com (RS485)**

- available with GSM / fiber optic

**Connector Type**

- removable, captured-wire, 4 terminals

**Wire size**

- up to 12 AWG (up to 2.5 mm²)

---

**Attention**: the device may house up to 3 additional modules of choice from those mentioned below.
### ETHERNET PORT
- Transformer-isolated 10/100BaseT Ethernet port
- Withstanding insulation: 4kV AC @ 1 mn
- Supported protocols: Modbus/TCP (Port 502), IEC 60870-5-104 (port 2404), IEC 61850, DNP3/TCP (Port 20000)
- Num. of simultaneous connections: 5 (2 Modbus/TCP + 2 DNP3/TCP + IEC 61850)
- Connector type: RJ45 modular

### USB PORT
- Isolated USB 1.1 port
- Withstanding insulation: 4kV AC @ 1 mn
- Connector type: A male, standard USB cable, max. Length 2 meters
- Supported protocols: MODBUS RTU

### OPTIONAL COMMUNICATION
#### CELLULAR PORT (MODULE)
- Supported protocols: Modbus/TCP (Port 502), DNP3/TCP (Port 20000)
- Connector type: SMA
- Withstanding insulation: 2.5kV AC @ 1 mn

#### FIBER OPTIC ETH PORT (MODULE)
- Transformer-isolated 10/100BaseT Ethernet port
- Withstanding insulation: 4kV AC @ 1 mn
- Supported protocols: Modbus/TCP (Port 502), IEC 60870-5-104 (port 2404), DNP3/TCP (Port 20000), IEC 61850
- Num. of simultaneous connections: 5 (2 Modbus/TCP + 2 DNP3/TCP + IEC 61850)
- Connector type: RJ45 modular

### INFRA RED COMMUNICATION
- Optional optical IEC/ANSI head, available on-board RGM remote display.
- Baud rate: Up to 15.200 kb/s
- Protocols: MODBUS RTU/ASCII, DNP3.0

### SECOND SERIAL COMMUNICATION (RS-485)
- Available on IRIG-B module.
- Specs: identical to built-in serial port (above).

### OPTIONAL I/O MODULES
#### 8 RELAYS
- Electromechanical; SPST Form A
- Contact ratings:
  - 8A @ 250V AC
  - 5A @ 30V DC
  - 0.25A @ 250V DC
  - 5A @ 24V DC
- Galvanic isolation: 4kV AC @ 1 min
- Operate time: 10ms max
- Release time: 5ms max
- Update time: ½ cycle
- Wire size: 12 AWG (up to 2.5 mm²)
- Terminal pitch: 3.81mm

#### 16 DIGITAL INPUTS
- Optically isolated
- Sensitivity:
  - open @ input resistance >16kΩ
  - closed @ input resistance <10kΩ
- Galvanic isolation: 4kV rms @1 min
- Scan time:
  - 1 ms @ 60Hz, 1.25 ms @ 50Hz
- Connector type: Removable, 5 pins
- Wire size: 12AWG (up to 2.5 mm²)
- Terminal pitch: 3.81 mm

### WET CONTACT SENSING OPTIONS
- External power supply: 24/48/125/250V DC

### DRY CONTACT SENSING OPTION
- Internal power supply: 24V DC
**COMBO: 8 DIGITAL INPUTS + 4 RELAY OUTPUTS**

- **Galvanic isolation**: 4kV rms @ 1 min
- **Wire size**: 12AWG (up to 2.5 mm²)
- **Terminal pitch**: 3.81 mm

**DIGITAL INPUTS**

- **Sensitivity**:
  - Open: @ input resistance >16kΩ
  - Closed: @ input resistance <10kΩ

**WET CONTACT SENSING OPTIONS**

- **External power supply**: 24/48/125/250V DC

**DRY CONTACT SENSING OPTION**

- **Internal power supply**: 24V DC

**RELAY OPTIONS**

- **EMR (Electro Mechanic Relay) @ 250V/5A**
- **SSR (Solid State Relay) @ 1500V/20mA**
  - **Operate time**: 10ms max
  - **Release time**: 5ms max

**4 ANALOG INPUTS + 4 ANALOG OUTPUTS**

- **Optically isolated**
  - Module rating:
    - ±1 mA, max. load 10 kΩ
    - 0-20 mA, max. load 510Ω
    - 4-20 mA, max. load 510Ω
    - 0-1 mA, max. load 10 kΩ (100% overload)
  - Identical for inputs/outputs
  - Power supply: Internal
  - Accuracy: 0.5% FS
  - Update time: 2 cycles
  - Connector type: Removable, 5 pins
  - Wire size: 12 AWG (up to 2.5 mm²)
  - Terminal pitch: 3.81 mm

**ADDITIONAL MODULES**

**FAST TRANSIENT RECORDER**

- **Measuring range**: Up to 2kV AC
- **High impedance input**: 10 MΩ, withstanding insulation: 4kV AC @ 1min
- **Wire size**: Up to 10 AWG (up to 6 mm²)
- **Terminal pitch**: 7.5 mm

**DIGITAL FAULT RECORDER**

**VIA SPLIT CORE SENSORS (HACS CS25) CLAMPED ON TO PROTECTION CT SECONDARY**

- **Fault currents measured**: Up to 200A RMS @ In = 5A (40 x In)
- **Accuracy**: Class 1
- **Burden**: < 0.15 VA
- **Wire size**: 10 AWG (2.5 to 6 mm²)
- **Terminal pitch**: 9.5mm
- **Overload**: Continuous: 200A RMS
  - 1 second: 1000A

**IRIG B**

- **Optically isolated IRIG-B port for GPS time synchronization**
  - **Recommended cable**: 51Ω low loss - RG58A/U (Belden 8219 or equivalent), BNC connector
  - **Recommended GPS time code generator**: Masterclock GPS-200A
  - **Second RS-422/485 COM port included**

**PHASOR MEASUREMENT UNIT**

- **Per IEEE C37.118.1-4**
- **IMPORTANT NOTE**: Should be assembled on unit with min. Version No. N3 and min. firmware version No. v31.x.38.
- **Must be housed next to current module only.**

**OTHER CHARACTERISTICS**

**REAL-TIME CLOCK & SYNCHRONIZATION**

- **Real-Time clock with maximum 5 seconds drift**
  - per month @ 25°C
  - **1ms time resolution per IRIG-B time code**

**CONSTRUCTION**

- **Mounting**: DIN Rail mount / panel mount / 19" rack installation.
  - Complies with EN50022
- **Dimensions [WxHxD]**: 220 x 152 x 210mm
- **Weight**: 2.5kg (5.51 Lb)

**ENVIRONMENTAL CONDITIONS**

- **Operational**: -25°C to 60°C / -13°F to 140°F
- **Storage**: -30°C to 85°C / -22°F to 185°F
STANDARDS COMPLIANCE

- Harmonized standards to which conformity is declared: EN55011:1991; EN50082 1:1992; EN61010-1:1993; A2/1995
- ANSI C37.90.1 Surge Withstand Capability (SWC)
- EN50081-2 Generic Emission Standard: Industrial Environment
- EN50082-2 Generic Immunity Standard: Industrial Environment
- EN55022: Class A
- IEC 61000-6-2
- IEC 61000-6-4
- IEC 60255-5
- IEC 60255-22

ACCURACY

- Active Energy: Class 0.2S per IEC/AS 62053-22
- Reactive Energy: Class 0.5S (under conditions as per IEC 62053-24:2014 @ 0 ≤ |PF| ≤ 0.9)

POWER QUALITY

- EN50160: Power Quality in European Electricity Supply Networks
- IEEE 1159: Power Quality Recorder in US
- GOST 13109: Electric energy, Electromagnetic compatibility of technical equipment, Power quality limits in public electrical systems

EMC IMMUNITY

- GOST 54149: 2010: Electric energy, Electromagnetic compatibility of technical equipment, Power quality limits in public electrical systems
- IEC 61000-4-7, Harmonics and inter-harmonics measurement
- IEC 61000-4-15, Flicker measurement
- IEC 61000-4-30 class A, Power quality measurement methods
- IEC 62054-21: Real time clock backup, RTC accuracy ± 2ppm @ 23°C

- IEC 61000-4-2, IEC 60255-22-2: Electrostatic discharge, 15kV/8kV – air/contact
- IEC 61000-4-3, IEC 60255-22-3: Radiated Immunity, 10V/m and 30V/m @ 80 MHz – 1000 MHz
- IEC 61000-4-4, IEC 60255-22-4: Fast Transients burst, 4KV on current and voltage circuits and 2 KV for auxiliary circuits
- IEC 61000-4-5, IEC 60255-22-5: Surge 6KV on current, voltage circuits and power supply
- IEEE C62.41.2-2002: high voltage line surges
  - 100 kHz ring wave – 6kV @ 0.5kA
  - 1.2/50 microsecond – 8/20 microsecond Combination Wave – 6kV @ 3kA
- IEC 61000-4-6, IEC 62052-11: Conducted Radio-frequency, 10V @ 0.15 MHz – 80MHz
- IEC 61000-4-8: Magnetic Field
- IEC 61000-4-12, IEC 62052-11, IEEE C37.90.1: 2002: Oscillatory waves, CMM 2.5KV & DFM 1KV @ 100KHz and 1MHz
EMISSION (RADIATED / CONDUCTED)

- EN55022, IEC 60255-22: Class A

CONSTRUCTION

Safety
- Meets IEC/UL 61010-1 and UL94 V-0

Insulation
- IEC 62052-11:
  - Insulation impulse 6KV/500Ω @ 1.2/50 μs
- IEC 62052-11, IEC 61010-1: AC voltage tests related to ground, 4 kV AC @ 1mn

Atmospheric Environment
- Operational ambient temperature range: −30°C to +70°C
- Long-term damp heat withstand according to IEC 68-2-3 <95%, +40°C
- Transport and storage temperature range: −40°C to +85°C

Vibration
- IEC 60255-21-1:
  - Vibration Response, Table I, Class-2
- IEC 60255-21-1:
  - Vibration Endurance, Table II, Class-1

Mechanical Shock
- IEC 60255-21-2: Shock, Table II, Class-1
- IEC 60255-21-2: Bump, Table III, Class-1

Seismic Vibration
- IEC 60255-21-3: Bump, Table III, Class-1

Panel Display protection
- IEC 60529: IP54 (NEMA type 13)

Instrument protection
- IEC 60529: IP30 (NEMA type 13)

1. Only for PM180-5A and PM180-1A models (internal CT), PM180-DFR model accuracy meets class 1
### OPTIONS

#### DISPLAY
- Transducer version - no display. Includes DIN rail mounting kit **X**
- Graphic color display - 5.7" touchscreen **G**
- Graphic color display - 5.7" touchscreen with DIN rail mounting kit and 3m/10ft remote cable **G-DIN**
- 3 line ultra bright LED display **D**
- 3 line ultra bright LED display with DIN rail mounting kit and 3m/10ft remote cable **D-DIN**
- Multi window ultra bright LED display with 12 values and 1 text window. Includes DIN rail mounting kit **M**

#### VOLTAGE INPUTS
- 690V AC Nominal Voltage Input **-**
- 120V AC Nominal Voltage Input **U**

#### CURRENT INPUTS
- 50A, calibrated to 5A (Class 0.2S Accuracy) **S**
- 10A, calibrated to 1A (Class 0.2S Accuracy) **1**
- 100A Split Core HACS (set of 4), Calibrated to 5A (Class 1 Accuracy) **CS1S**
- 100A Split Core Handheld Clamp HACS (set of 4), Ø13mm opening, Calibrated to 5A (Class 1 Accuracy) **CS1H**
- Use of any High Accuracy Current Sensors (HACS), without overcurrent. Requires ordering of 4 HACS **HACS**
- Use of 3V AC current clamps (should be purchased locally) **FLEX**

#### FREQUENCY
- 50 Hz **50Hz**
- 60 Hz **60Hz**

#### ACCURACY AND POWER QUALITY STANDARD
- ANSI C12.20 - USA Standard IEEE1159 Full Power Quality **A**
- IEC 62053-22 - European Standard EN50160 Full Power Quality **E**
- GOST13109 / GOST54149 - Russian Standard **G**

#### POWER SUPPLY - MAIN
- 85-265V AC and 88-290V DC (Default) **ACDC**

#### COMMUNICATION STANDARD
- Default: Modbus RTU, Modbus TCP, DNP 3.0, DNP/TCP, IEC 60870-5-101 and -104 **-**
- Default communication plus IEC 61850 (SISCO) **850**
OPTIONAL PLUG-IN MODULES

Maximum 3 additional modules per device

**PHASOR MEASUREMENT UNIT** (max. 1 module per device)
PMU with Transient Recorder including PTP (IEEE 1588) PMU

**TRANSIENT RECORDER MODULE** (max. 1 module per unit)
4 voltage channels, up to 2kV and 1024 samples/cycle TRM-180

**FAULT RECORDER MODULE** (max. 1 module per unit)
4 current channels, up to 200A, via 4 HACS CTs (included) as follows:
- 4 x solid core CTs (Ø 23 aperture) DFR-CS2-180
- 4 x split core CTs (Ø 23 aperture) DFR-CS2S-180
- 4 x split core CTs (Ø 33 aperture) DFR-CS2SL-180

**DIGITAL INPUTS** (max. 48 Digital Inputs per unit)
- DI 16 Dry Contacts DI16-DRC-180
- DI 16 24V DC DI16-24V-180
- DI 16 125V DC DI16-125V-180
- DI 16 250V DC DI16-250V-180

**RELAY OUTPUTS** (max. 24 Relay Outputs per unit)
- 8 Relays RLY8-180
- 8DI/4RO EMR DRC 8DIOR-DRC
- 8DI/4RO SSR DRC 8DIOS-DRC
- 8DI/4RO EMR 24V 8DIOR-24
- 8DI/4RO SSR 24V 8DIOS-24
- 8DI/4RO EMR 125V 8DIOR-125
- 8DI/4RO SSR 125V 8DIOS-125
- 8DI/4RO EMR 250V 8DIOR-250
- 8DI/4RO SSR 250V 8DIOS-250

**COMMUNICATION**
- BNC IRIG-B and 2nd RS-422/485 port IRIG-180
- Fiber Optic Ethernet (TXFX), redundant Ethernet and 2nd RS-422/485 port TXFX-180
- 3G GSM Modem T3G-180
- 4G Modem T4x-180
  - x: G=Europe; V=Verizon (US); A=AT&T (US); T=Telstra (AUS)

**4 ANALOG INPUT / 4 ANALOG OUTPUT MODULE** (max. 12AI/12AO per unit)
- +/- 1mA (0+/-.1) 4AIO1-180
- 0-20 mA (0-10-20) 4AIO2-180
- 0-1 mA (0-0.51) 4AIO3-180
- 4-20 mA (4-12-20) 4AIO4-180

**4 ANALOG INPUT** (max. 12AI per unit)
- +/- 10V 4AIV-180

**AUXILIARY POWER SUPPLY** (max. 1 modules per unit)
- AUX. P.S. 85-265V AC and 40-300V DC BACDC-180
- AUX. P.S. 9.5-36 V DC B21DC-180

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