

# expertmeter™

## EM720



 **SATEC**  
*Powerful Solutions*

# High Performance Revenue Meter Cutting Edge Power Quality Analyzer Fast Transient Recorder



The **eXpertmeter™ EM720** is a state of the art power quality grid meter designed for utilities as well as for major industrial and commercial consumers. This all-in-one intelligent electronic device combines class 0.2S revenue meter capabilities with high-end power quality analysis, transient and fault recording functions, event & data logging and waveform recording. The meter complies with all appropriate energy meter and power quality analyzer standards.

The **EM720** is an ideal cost-effective solution for high and medium voltage grid applications. The instrument enables to limit space and communication infrastructure requirements to save installation costs and to improve overall system reliability.

The **EM720** has unique communication capabilities allowing wire or wireless communication to SCADA, automatic meter reading systems (AMR), SATEC's **eXpertpower™** and local network.

The **eXpertmeter™ EM720** can serve as a main utility owned revenue meter or as a test meter owned by major industrial or commercial energy consumer to support complex energy supply contracts that include commitment to power quality standards. The **EM720** allows utility engineers and managers to process early excursion warnings, supporting timely corrective actions.

The instrument allows C&I facility technical staff precise multi-tariff sub-metering. It also provides a comprehensive capability to monitor and analyze electrical and power quality data in order to prevent equipment failures due to power quality standards violation and electric faults.

Together with SATEC's **eXpertpower™** web service the **eXpertmeter™ EM720** represents a total integrated solution for revenue metering and advanced power quality analysis.

## Main Applications

### 1 Utilities

Metering/Billing, Automation & Power Quality

- State of the art instrument bridging utility automation, metering/billing, and power quality applications
- High performance grid meter at connection points between utilities (such as transmission and distribution utilities) or between utility and major energy consumers at high/medium voltage
- Utility owned main revenue meter for major industrial and commercial energy consumers
- Comprehensive power quality analysis according to the most demanding IEC 61000-4-30 Class A (as well as many important power quality features beyond the standard) for automation and metering technical staff
  - Monitor power quality at connection points for early excursion warnings and proper corrective actions
  - Manage complicated power supply contracts including power quality commitments
  - Get ready for government power quality regulations

### 2 Commercial & Industrial Energy Consumers

- High performance test revenue meter for sub-metering and resolving power quality disputes with utilities
- Metering and power quality data for monitoring and control

# Models

The eXpertmeter™ models offer energy meter class 0.2S (IEC 62053-22), power quality analyzer (IEC 61000-4-30 class A), transient recorder (power master EM720T) fault recorder, basic electric measurements, control functions, event/data recording and waveform recording.

All models offer a choice between *fast communication* module (Ethernet + USB + RS232/RS485) and *slow communication* module (RS232/RS485). Additional communication modules can be added (up to 3 modules per device).



## EM720 Basic



## EM720T Power Master Transient recorder model

## Input/Output

- On board 4 fast digital inputs for synchronization/status/counter functions - 1ms sampling rate
- Optional module 2 digital input and 2 KYZ digital outputs (2DI / 2DO)

## Hot Swap Modules

State-of-the-art communication capabilities enabled by the EM720's innovative field-replaceable hot swap concept.

- RS232/RS485 (includes IRIG-B)
- Ethernet + USB + RS232/RS485
- Cellular GPRS modem
- 2DI/2DO module
- Auxiliary 24 VDC Power supply
- Auxiliary AC/DC Power supply

## Communication

- On-board Infrared port (Modbus RTU/ASCII and DNP3.0 protocols)
  - Supports IEC 62056-21/61 standard—hardware and protocol specifications for local meter data exchange
- One of the following modules:
  - Fast communication module
    - Ethernet 10/100 Base-T port (Modbus/TCP or DNP3.0/TCP protocols, up to five non-intrusive simultaneous connections, Telnet service port)
    - USB 1.1 full speed device port (Modbus RTU protocol, 12 Mbps) for fast local communications and data retrieving
  - Slow communication module
    - Versatile RS-232/485 universal serial communications port (up to 115,200 bps, Modbus RTU/ASCII and DNP3.0 protocols)
    - 1-ms satellite-synchronized clock - IRIG-B format time-code input
- Optional module cellular GPRS modem (Modbus/TCP or DNP3.0/TCP protocols)
- Optional IEC 61850 protocol
- Reading of another meter output
- Instrument firmware easy upgrade, using SATEC's PAS software by any communication port



## Hot Swap Modules



# High Performance Revenue Meter

The **EM720** is a high precision, multi-purpose 4 quadrants meter used for active, reactive, and apparent energy/demand measurement and recording. The meter is intended for grid applications in generation, transmission and distribution utilities. It is also designed for major industrial and commercial consumers. The meter is class 0.2S approved according to IEC 62053-22 and designed according to even higher internal SATEC standards.

The meter delivers precision, reliability and long-term stability. With its all-in-one concept, the **EM720** is an answer to constantly increasing cost-effectiveness requirement in precise metering of large energy quantities. The **EM720** provides Time Of Use (TOU) tariffs to meet any billing requirements (8 tariffs, 4 seasons). The

instrument also provides multi-functional three phase power meter with voltage, current (including measured neutral current), power, energy, power factor, frequency, voltage/current unbalance, load profile, and other measurements on-board. More than 100 parameters can be logged with real time stamps.

The **EM720** is equipped with anti-vandalism and anti-tampering features. All necessary communication applications are covered by a modular architecture and hot swap communication modules. This modularity also offers a full freedom of choice for deployment of new technologies. The device supports various communication protocols.



- Meets 0.1% accuracy
- Active energy: class 0.2S precision according to IEC 62053-22
- Time Of Use (TOU) tariffs to meet any billing requirements (8 tariffs, 4 seasons)
- Unique anti-vandalism & anti-tampering features
- Transformer and transmission line losses calculation
- Built-in self accuracy test
- Energy and power demand meter
- Block and sliding demands
- Accumulation of energy pulses from external watt-meters
- High precision 3-phase power meter
  - Voltage
  - Current
  - Power
  - Power factor
  - Voltage/current unbalance
  - Neutral current
  - Energy
  - Frequency
  - Load profile

# Power Quality Analyzer

## Cutting Edge Power Quality Analyzer & Recorder With Unique Back-up Rechargeable Battery

The **EM720** is among the most advanced power quality analyzers and recorders on the market. The instrument is a product of SATEC's 20 years of experience in the creation of power quality instruments. The **EM720** is designed to fully comply with the most demanding industry standard, IEC 61000-4-30 Class A. It provides power quality reports and statistics according to EN50160, complimented by comprehensive power quality event/data log with waveforms (3 voltage and 4 current inputs

for waveform recording) available for detailed PQ event analysis. Unique back-up battery (~2.5 hours retention time) or/and auxiliary power supply allow full readiness for any power quality event, including major dips and interruptions. The individual harmonics and inter-harmonics are analyzed according to IEC 61000-4-7. The instrument also supports directional power harmonics analysis. The flicker is measured and analyzed according to IEC 61000-4-15.

- 
- Power quality analysis and reading according to IEC 61000-4-30 Class A
    - Sags/swells (dips/overvoltages), interruptions, frequency variations
    - Flicker, voltage unbalance, harmonic and interharmonic voltages
    - Programmable thresholds and hysteresis
  - Built-in EN50160 statistics & reports
  - Back-up battery and/or auxiliary power supply for recording major dips & interruptions
  - Harmonics & Inter-harmonics according to IEC 61000-4-7
    - Harmonic & interharmonic volts and amps
  - Directional power harmonics and power factor phasors
  - Voltage and current THD coefficients
  - Symmetrical components
  - Flicker measurement according to IEC 61000-4-15
  - Waveform recording
    - Selectable sampling rate up to 256 samples/cycle
  - Power quality event recorder
  - Event recorder for logging internal diagnostic events, control events and I/O operations
  - Waveform & data recorder
- 

**expertpower™**

The **eXpertmeter™ EM720** is backed by **eXpertpower™**, SATEC's web-based energy management service.

**eXpertpower™** collects, archives, and analyzes energy and power quality data while allowing multiple users to view this data in reports, tables, graphs, waveforms, and charts.

**eXpertpower™** introduces a mechanism for identifying, following-up and solving power system problems, from anywhere, anytime—via the web. It also enables effective creation and implementation of the customer's energy saving plan.

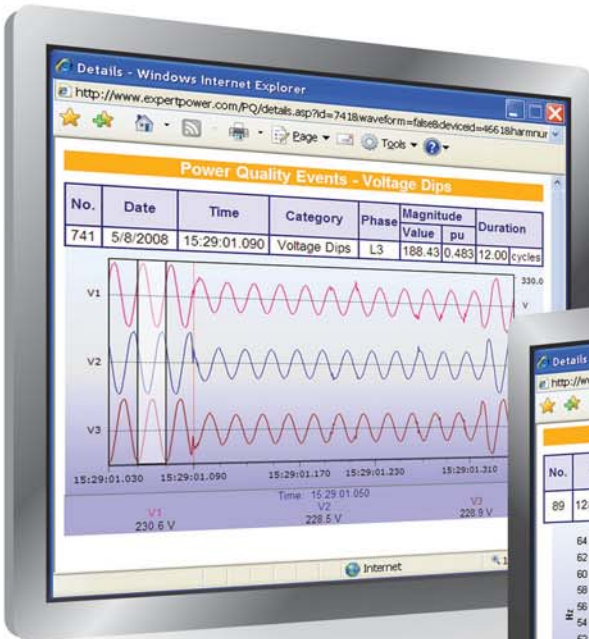
On the basis of raw data provided by the **EM720**, **eXpertpower™** provides the following features:

- Automatic billing
- Bill comparison
- Power quality event log and waveforms
- Power quality reports and statistics (complies with EN50160)
- Weekly/monthly analysis to follow up energy saving plans
- Reports and trend monitoring
- Real time data monitoring
- Alarms via cellular phone, pager and e-mail
- Export to PDF for reports and billing

# Power Quality Events

expertpower™

VOLTAGE DIP



FREQUENCY VARIATION



SHORT INTERRUPTION



HIGH INDIVIDUAL HARMONICS



# Transient & Fault Recorder

The **EM720** provides state-of-the-art fast transient recording capability. Transient pulses as short as 20 $\mu$ s at 50 Hz (17 $\mu$ s at 60 Hz) can be reliably recorded and analyzed. The **EM720** can record such short pulses by a separate electronic channel with a sampling rate of 1024 samples/cycle. The transient amplitude is recorded relative to the ground in accordance with the strict definitions of power quality standards (EN50160). The instrument can measure transient pulses with

an amplitude of up to 2 kV (withstands up to 6 kV). Four voltage waveforms (3 phases & neutral relative to the ground) are recorded at 1024 samples/cycle to complement the waveforms recorded by the power quality channel.

The fault recorder provides 4 measured and recorded currents (including measured neutral current) up to 50A (10In). The event log is complemented by waveform recording.

- 
- Reliable recording of short transients—20 $\mu$ s at 50Hz (17 $\mu$ s at 60Hz)
  - Transients measured relative to ground
    - Special ground input
  - Measures up to 2kV pulses. Withstands up to 6kV
  - 4 fast waveform recorders
    - Sampling rate of 1024 samples per cycle
    - 3 phase and neutral voltage waveforms relative to ground
  - Digital Fault Recorder
    - Onboard fault detector
    - Programmable fault thresholds and hysteresis
    - Up to 50 amps fault currents (10xIn)
    - Zero-sequence currents and volts
    - 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
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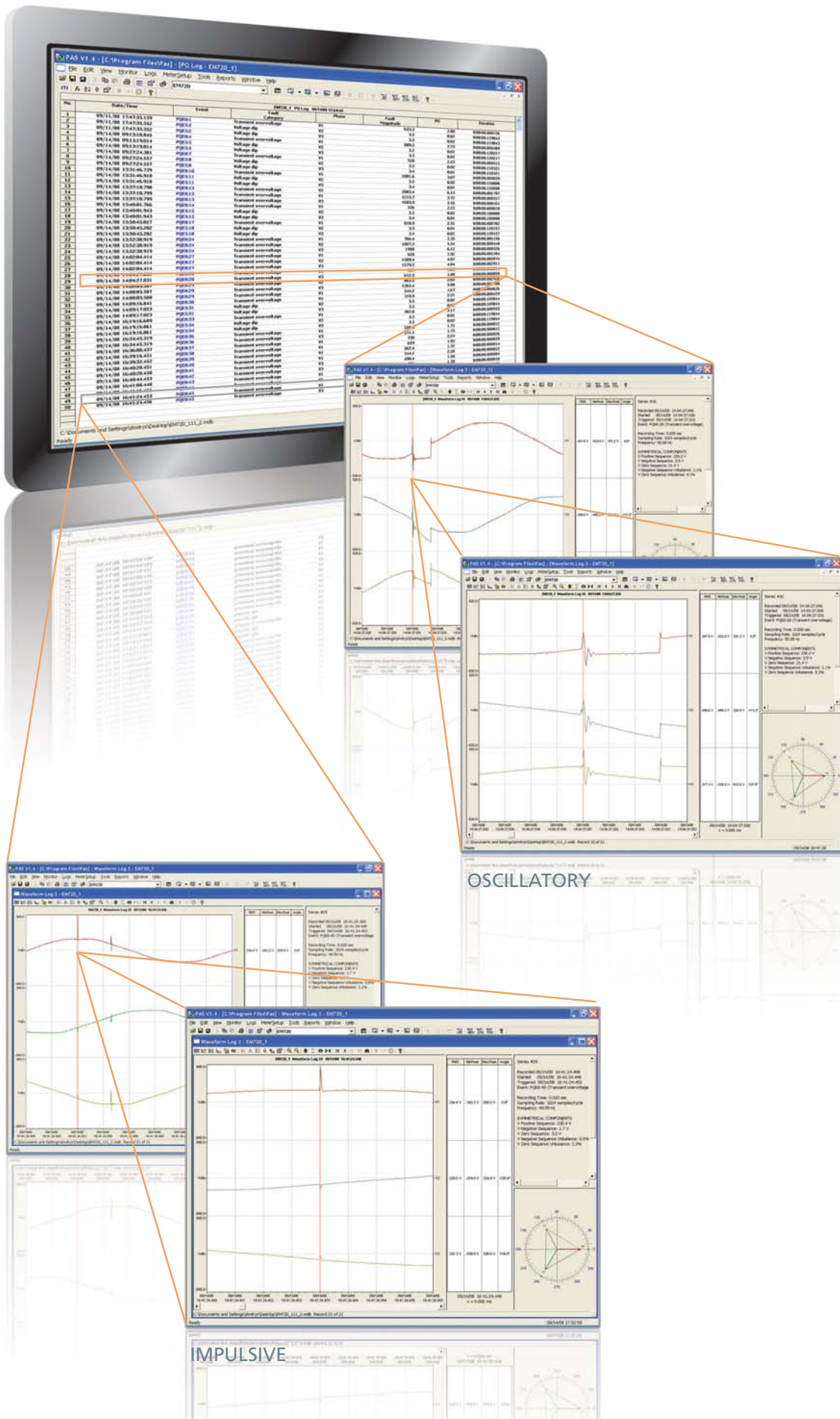
## PAS

**PAS** is SATEC's application and set-up software tool for use with all SATEC instruments. The multi-purpose **PAS** software provides the following features:

- Direct data access for status monitoring and analysis
- Simple off-line instrument set-up
- Automatic polling of devices
- Automatic power quality reports
- Sophisticated analysis functions: event/data logs, trends, waveforms, harmonic spectrum, harmonics power direction, phasor diagrams, automatic power quality characterization, EN50160 power quality statistics, updated TOU settings, uploading set points & more
- Extensive graphic and report capabilities
- Instrument firmware upgrade
- Easy export to spreadsheets, Word and Excel

# Short Transient Events

PAS





# Standard Compliance

## ACCURACY

- Active energy IEC 62053-22, class 0.25
- Reactive energy, class 0.55  
(under conditions as per IEC 62053-22 @  $0 \leq |PF| \leq 0.9$ )

## POWER QUALITY

- IEC 61000-4-7 class I: Harmonics and interharmonics measurement
- IEC 61000-4-15: Flicker measurement
- IEC 61000-4-30 class A: Power quality measurement methods
- EN50160: Voltage characteristics of electricity supplied by distribution networks
- IEC 61038: Real time clock backup and accuracy

## POWER CONSUMPTION

- IEC 62053-61 class I: Multi-function meter power consumption—3W/15VA per phase

## EMC

- IEC 61000-4-2/IEC 62052-11: Electrostatic discharge, 15KV/8KV—air/contact
- IEC 61000-4-3/IEC 62052-11: Electromagnetic RF fields, 10V/m and 30V/m @ 80MHz - 1000MHz
- IEC 61000-4-4/IEC 62052-11: Fast transients burst, 4KV on current and voltage circuits and 2 KV for auxiliary circuits
- IEC 61000-4-5/IEC 62052-11: Surge 4KV on current and voltage circuits and 1 KV for auxiliary circuits
- IEC 61000-4-6/IEC 62052-11: Conducted Radio-frequency, 10V @ 0.15MHz—80MHz
- IEC 61000-4-8: Power frequency magnetic field
- IEC 61000-4-12: Damped oscillatory waves, CMM 2.5KV and DFM 1KV @ 100KHz and 1MHz

## IEC 529: IP54 (NEMA type 13): Enclosure protection

## Emission (radiated/conducted)

- EN55022: 1994 Class A (CISPR 22)
- FCC p.15 Class A
- Construction—IEC 62052-11

## SAFETY

- IEC/EN 61010-1

## INSULATION

- IEC 62052-11, protective class II: Insulation impulse 6KV/500 Ins @ 1.2/50 Ins
- IEC 62053-22, protective class II: AC voltage tests related to ground, 4 KV r.m.s. @ 1min

## ATMOSPHERIC ENVIRONMENT

- Operational ambient temperature range: -40°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
- IEC 62052-11 (ref. IEC 60068-2-6): Vibration
- Frequency range: 10Hz to 150Hz
- Transition frequency: 60Hz
- Constant movement amplitude 0.075mm,  $f < 60\text{Hz}$
- Constant acceleration 9.8 m/s<sup>2</sup> (1g),  $f > 60\text{Hz}$
- IEC 62052-11 (ref. IEC 60068-2-27): Shock
- Half sine pulse
- Peak acceleration: 30g (300 m/s<sup>2</sup>)
- Additional Transport vibration and shocks:
  - Longitudinal acceleration 2.0 g
  - Vertical acceleration 1.2 g
  - Transversal acceleration 1.2 g

# Main Features

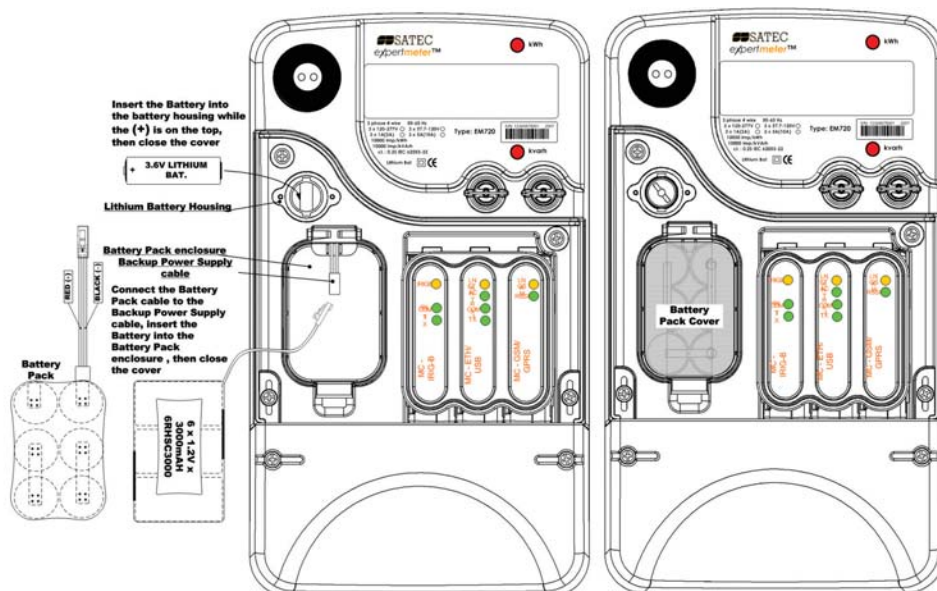
The eXpertmeter™ EM720 combines in a single sealed enclosure (BS7856 standard) the following devices:

- Precise Class 0.2S four quadrant energy and power demand meter (meets even more demanding SATEC internal 0.1% accuracy standard), multiple tariffs & Time-of-Use (TOU, 16 summary energy and demand registers, accumulation of energy pulses from external watt-meters, block and sliding demands), transformer and line losses, unique anti-tampering, anti-vandalism and self-test functions
- Power quality analyzer and recorder
  - Sags/swells (dips/over-voltages)
  - Interruptions
  - Frequency variations
  - Flicker according to IEC 61000-4-15
  - Voltage unbalance
  - Harmonics and inter-harmonics according to IEC 61000-4-7 Class I
  - Statistics and reports according to EN50160
  - Programmable thresholds and hysteresis
  - 3 voltage and 4 current waveforms (including neutral current)
  - Selectable sampling rate up to 256 samples/cycle
- Fast transient over-voltages recorder (>20 μs at 50 Hz) on the basis of independent hardware channel
  - Sampling rate of 1024 samples per cycle
  - Measuring transients relative to the ground
  - 4 additional voltage waveforms captured (including neutral voltage relative to the ground)
- Digital fault detector and recorder
  - Up to 50 Amps fault currents (10xI<sub>n</sub>)
  - Zero-sequence currents and voltages
  - Current and voltage unbalance
  - Measured neutral current
  - Fault currents magnitude and duration
  - Programmable fault thresholds and hysteresis

- Event Recorder for logging internal diagnostics events, control events and I/O operations
- High performance 3-phase power meter (volts, amps, powers, power factors, unbalance, neutral current)
- Demand Meter
- 16 programmable timers from 1/2 cycle to 24 hours for periodic recording and triggering operations on a time basis
- NiMH rechargeable backup battery (up to 2.5 hour retention time)
- Auxiliary DC or AC/DC power supply option
- Three slots for hot swap field installable optional modules
- Graphic LCD display

## Communication Options

- Built-in infrared port (Modbus RTU/ASCII and DNP3.0 protocols). Supports IEC 62056-21/61 standard—hardware and protocol specifications for local meter data exchange
- Versatile RS232/485- universal serial communications port (up to 115,200 bps, Modbus RTU/ASCII and DNP3.0 protocols)
- Ethernet 10/100 Base-T port (Modbus/TCP or DNP3.0/TCP protocols)
- USB 1.1 full speed device port (Modbus RTU protocol, 12 Mb ps) for fast local communications and data retrieving
- Optional GPRS cellular modem (Modbus/TCP or DNP3.0/TCP protocols)
- Optional IEC 61850 substation automation protocol
- 1 ms satellite-synchronized clock—IRIG-B format time-code input
- Instrument firmware easy upgrade, using PAS software by any communication port

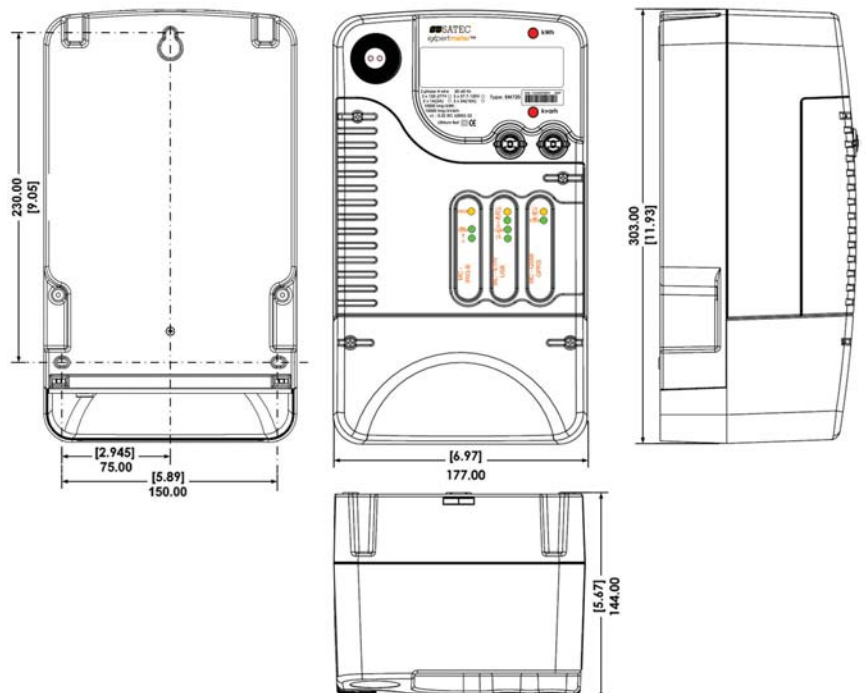


# Measurement Specifications

| Parameter                       | Full Scale@ Input Range                | Accuracy  |                  |   | Range  |
|---------------------------------|--|---|------------------|---|--|
|                                 |  | % Reading   | % FS             | Conditions  |  |
| Voltage V1-V3                   | 230/400 x PT ratio @ 230V              | 0.05  | ± 0.05           | 1% up to 140%                                     | 0 up to 999,000 V                            |
| Voltage V4 (calculated)         | 230/400 x PT ratio @ 230V              |   | ± 0.5            | 5% up to 140%                                     |  |
| Voltage V1-V3                   | 69/120 x PT ratio                      | 0.1   | ± 0.05           | 1% up to 140%                                     | 0 up to 999,000 V                            |
| Voltage V4 (calculated)         | 69/120 x PT ratio                      |   | ± 0.5            | 5% up to 140%                                     |  |
| Line current I1- I4             | CT primary current                     | ± 0.06  | ± 0.06           | 1% up to 200% In                                  | 0 up to 100,000 A                            |
| Fault current I1- I4            | CT primary current                     | ± 0.5   | -                | 200% - 1000% In                                   | 0 up to 100,000 A                            |
| Active power                    | 3xV FSxCT/1000                         | 0.2   | 0.02             | PF  ≥ 0.5 *                                       | -10,000,000 kW to +10,000,000+ kW            |
| Reactive power                  | 3xV FSxCT/1000                         | 0.3   | 0.04             | PF  ≥ 0.9 *                                       | -10,000,000 kvar to +10,000,000 kvar         |
| Apparent power                  | 3xV FSxCT/1000                         | 0.2   | 0.02             | PF  ≥ 0.5 *                                       | 0 to 10,000,000 kVA                          |
| Power factor                    | 1.000                                  |   | 0.3              | PF  ≥ 0.5, I ≥ 2% FSI                             | -0.999 to +1.000                             |
| Frequency                       | 50 Hz<br>60 Hz                         | -<br>-  | ± 0.02<br>± 0.02 | 40-65 Hz<br>45- 70 Hz                             | 40.00 up to 64.99 Hz<br>45.00 up to 69.99 Hz |
| Total Harmonic Distortion, THD  | 999.9                                  | 1.5   | 0.1              | THD ≥ 1%,<br>V (I) ≥ 10% FSV (FSI)                | 0 to 999.9                                   |
| Total Demand Distortion, TDD, % | 100                                    |   | 1.5              | TDD ≥ 1%,<br>I ≥ 10% FSI                          | 0 to 100                                     |
| Active energy Import & Export   |  | IEC 62053-22 Class 0.2S   |                  |   | 0 to 999,999.99 MWh                          |
| Reactive energy Import & Export |  | Class 0.5S under conditions as per IEC 62053-22:2003 @ 0 ≤  PF  ≤ 0.9 |                  |   | 0 to 999,999.99 Mvarh                        |
| Apparent energy                 |  | Class 0.2S under conditions as per IEC 62053-22:2003                  |                  |   | 0 to 999,999.99 MVAh                         |
| Symmetrical components          | Voltage FS<br>Current FS<br>Current FS | 1.0<br>1.0<br>3.0   |                  | 10% - 120% FS<br>10% - 200% FS<br>200% - 1000% FS | As voltage<br>As current<br>± 180.0          |
| Phasor angles                   |  | 1 degree  |                  | *   |  |

\* @80% to 120% of voltage FS, 2% to 200% of current FS and frequency 50/60 Hz

# Physical Dimensions



## EM720 ORDER STRING

### MODELS

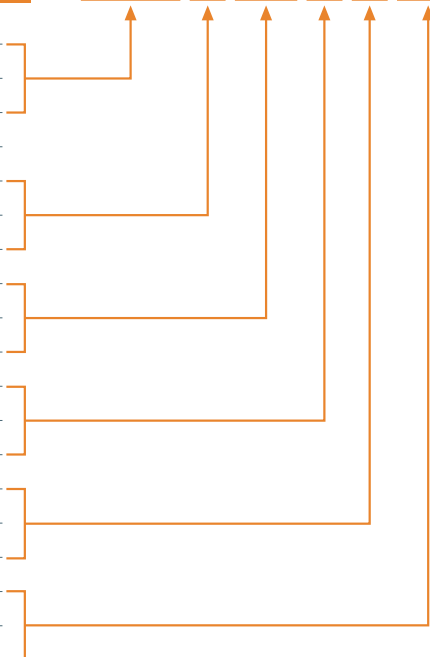
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|-------------------------------|--------|
| EM720—Basic                   | EM720  |
| EM720T—Transient Power Master | EM720T |

### OPTIONS

|  |       |
|--|-------|
| <b>RECHARGEABLE BATTERY</b>                            |       |
| Without battery  | 0     |
| With battery   | B     |
| <b>CALLIBRATION AT</b>                                 |       |
| 50 Hz  | 50HZ  |
| 60 Hz  | 60HZ  |
| <b>CURRENT INPUTS</b>                                  |       |
| 5 Ampere   | 5     |
| 1 Ampere   | 1     |
| <b>VOLTAGE INPUTS</b>                                  |       |
| 480V AC (L-L)  | 480V  |
| 120V AC (L-L)  | 120V  |
| <b>COMMUNICATION</b> (Must order one of the following) |       |
| RS232/485 IRIG-B Low Speed                             | IRIGB |
| Ethernet / USB / RS232/485 High Speed                  | ETH   |



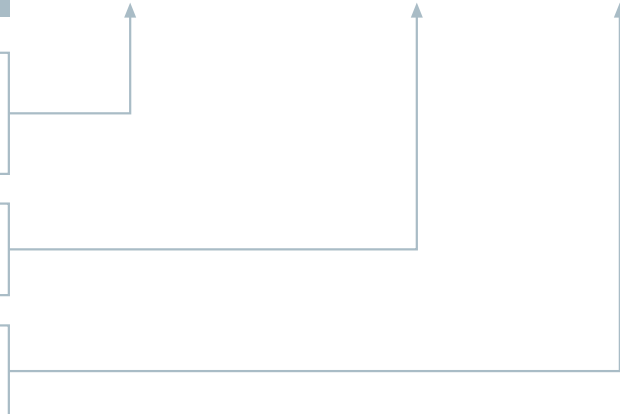
See **Optional Modules** below



## OPTIONAL MODULES

Maximum 3 modules per instrument total, including 1 standard module

|   |       |             |
|---|-------|-------------|
| <b>1. COMMUNICATIONS</b>                      |       | <b>COMM</b> |
| No additional communication module            | 0     | }           |
| RS232/485—IRIG-B Low Speed                    | IRIGB |             |
| Ethernet / USB / RS232/485 High Speed         | ETH   |             |
| GPRS/GSM                                      | GPRS  |             |
| <b>2. AUXILIARY POWER SUPPLY</b>              |       | <b>AUX</b>  |
| No auxiliary power supply                     | 0     | }           |
| 24 VDC  | 24    |             |
| 88-265V AC and 90-290V DC                     | ACDC  |             |
| <b>3. DIGITAL INPUT / OUTPUT - 2DI/2DO</b>    |       | <b>DIO</b>  |
| No additional digital input/output            | 0     | }           |
| Relay Output (form C) 250VAC/5A               | EMR   |             |
| Solid state relay output (form A) 250VAC/0.1A | SSR   |             |



## DISTRIBUTOR

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