

EM720

expertmeter™

HIGH PERFORMANCE REVENUE METER

 **SATEC**
Powerful Solutions



TRANSIENT & FAULT RECORDER

POWER QUALITY ANALYZER

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



Main Applications

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 a 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
 - Power meter IED with IEC 61850 communication protocol for substation automation

Commercial & Industrial Energy Consumers

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

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 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 offers C&I facility technical staff precise multi-tariff sub-metering. It also provides a comprehensive capability for monitoring and analyzing 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 EM720 represents a total integrated solution for revenue metering and advanced power quality analysis.

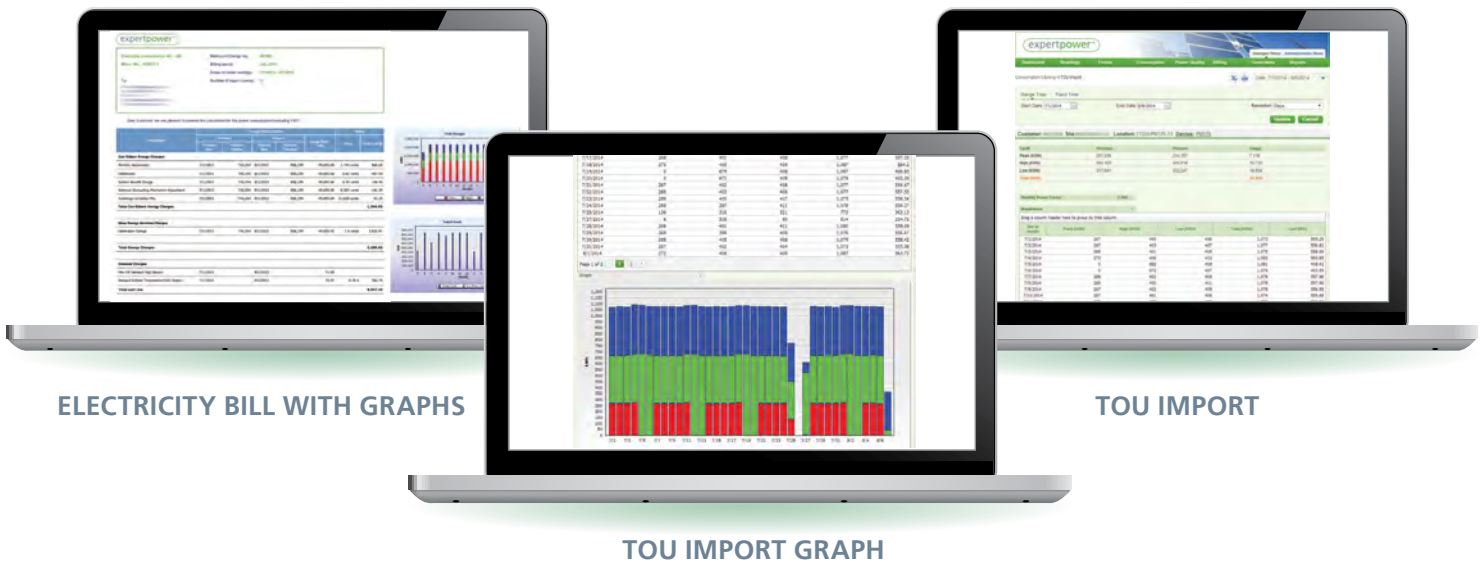
High Performance Revenue Meter

The EM720 is a high precision, multi-purpose 4-quadrant 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 to comply with the most demanding requirements.

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

tariffs, 4 seasons). The instrument also functions as a 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 deploying 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 loss 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 development 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, GOST13109 or GOST54149 (per country delivered to), complimented by comprehensive power quality event/data log with waveforms (3 voltage and 4 current inputs for waveform

recording) available for detailed power quality event analysis. The unique back-up battery (~2.5 hours retention time) and/or auxiliary power supply provides 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.

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- 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 statistics & reports for EN50160, GOST13109 or GOST54149 (per country delivered to)
 - 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



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

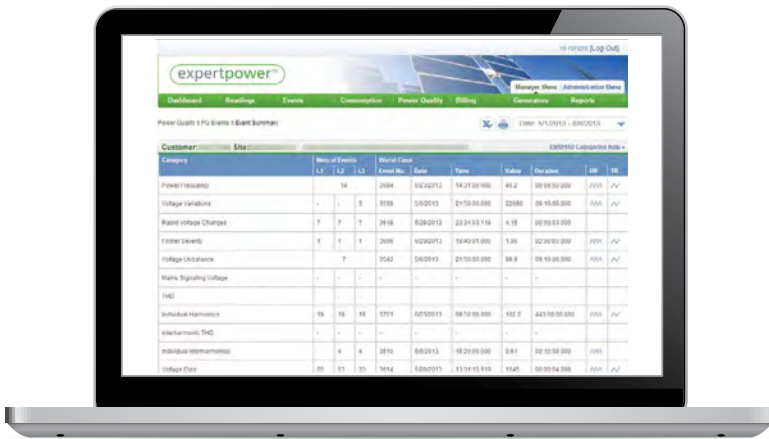
ExpertPower™ collects, archives, and analyzes energy and power quality data while allowing multiple users to view the data in reports, tables, graphs, waveforms, and charts. ExpertPower™ introduces a mechanism for identifying, following-up and solving power system problems, from anywhere, anytime—via the web. It also enables the 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 (compliant 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

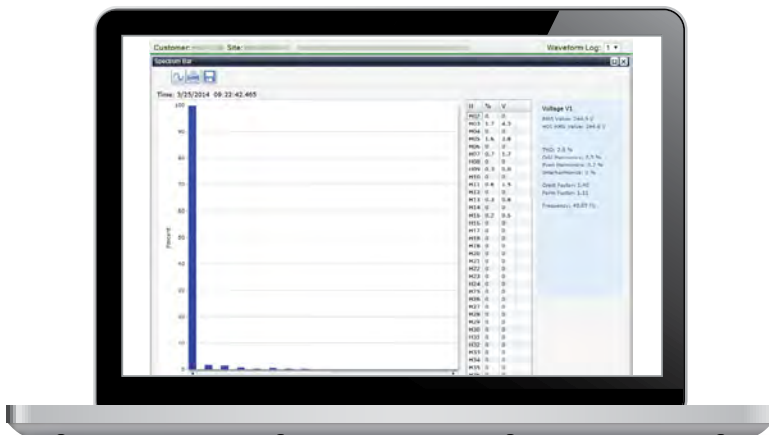
expertpower™



EVENT SUMMARY



EVENT SUMMARY GRAPH



SPECTRUM BAR



RMS PLOT

Transient & Fault Recorder

The EM720 provides a state-of-the-art fast transient recording capability. Transient pulses as short as 20 μ s at 50Hz (17 μ s at 60Hz) 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 2kV (withstands up to 6kV). 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 (10xIn). The event log is complemented by waveform recording.

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- Reliable recording of short transients— 20 μ s at 50Hz (17 μ 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
 - On-board 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



IMPULSIVE

OSCILLATORY

Standard Compliance

ACCURACY

- Active energy IEC 62053-22, class 0.2S
- Reactive energy, class 0.5S
(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
- GOST 13109
- GOST R 54149-2010

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 2kV for auxiliary circuits
- IEC 61000-4-5 / IEC 62052-11: Surge 4kV on current and voltage circuits and 1kV 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, 4kV 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/s² (1g), $f > 60\text{Hz}$
- IEC 62052-11 (ref. IEC 60068-2-27): Shock
 - Half sine pulse
 - Peak acceleration: 30g (300 m/s²)
 - Additional Transport vibration and shocks:
 - Longitudinal acceleration 2.0g
 - Vertical acceleration 1.2g
 - Transversal acceleration 1.2g

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.

Both models offer a choice between fast communication module (Ethernet + USB + RS-232/RS-485) and slow communication module (RS-232/RS-485). 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)

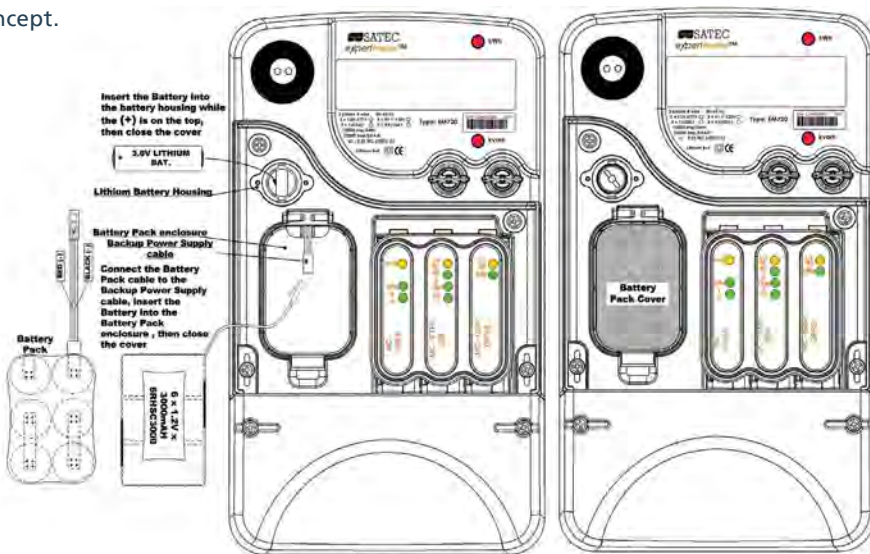
Hot Swap Modules

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

- RS-232/RS-485 (includes IRIG-B)
- Ethernet + USB + RS-232/RS-485
- Cellular GPRS modem
- 2DI/2DO module
- Auxiliary 24V DC 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
- Easy upgrade for instrument firmware, using SATEC's PAS software via any communication port



Main Features

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

- Precise Class 0.2S four-quadrant energy and power demand meter (meets the more demanding 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 (>20µs at 50Hz) 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 (10xIn)
 - 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 ½ 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

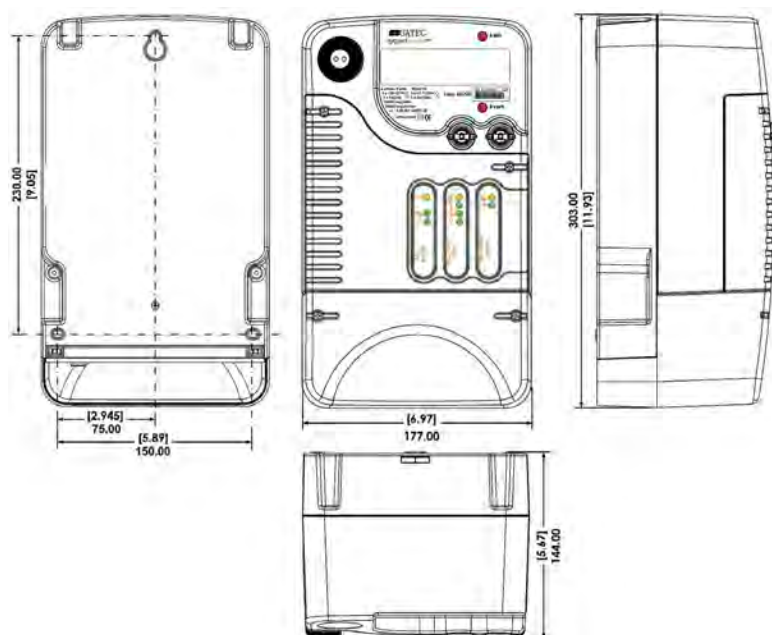
- Built-in infrared port (Modbus RTU/ASCII and DNP3.0 protocols). Supports IEC 62056-21/61 standard—hardware and protocol specifications for local meter data exchange
- Versatile RS-232/485—universal serial communications port (up to 115,200 bps, Modbus RTU/ASCII and DNP3.0 protocols)
- Ethernet 10/100 Base-T port (Modbus/TCP or DNP3.0/TCP protocols)
- USB 1.1 full speed device port (Modbus RTU protocol, 12Mbps) 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 ⁽¹⁾			RANGE
		% READING	% FS	CONDITIONS	
Voltage V1-V3	230/400 x PT ratio @ 230V	0.05	± 0.05	1% up to 140%	0 up to 999,000V
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 999,000V
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% I _n	0 up to 100,000A
Fault current I1- I4	CT primary current	± 0.5	-	200%-1000% I _n	0 up to 100,000A
Active power	3xV FSxCT/1000	0.2	0.02	PF ≥ 0.5 *	-10,000,000 to +10,000,000kW
Reactive power	3xV FSxCT/1000	0.3	0.04	PF ≥ 0.9 *	-10,000,000 to +10,000,000kvar
Apparent power	3xV FSxCT/1000	0.2	0.02	PF ≥ 0.5 *	0 to 10,000,000kVA
Power factor	1.000		0.3	PF ≥ 0.5, I ≥ 2% FSI	-0.999 to +1.000
Frequency	50Hz	-	± 0.02	40-65Hz	40.00 up to 64.99Hz
	60Hz	-	± 0.02	45- 70Hz	45.00 up to 69.99Hz
Total Harmonic Distortion, THD	999.9	1.5	0.1	THD ≥ 1%, V (I) ≥ 10% FSV (FSI)	0 to 999.9
Total Demand Distortion, TDD, %	100		1.5	TDD ≥ 1%, I ≥ 10% FSI	0 to 100
Active energy Import & Export		IEC 62053-22 Class 0.2S			0 to 999,999.99MWh
Reactive energy Import & Export		Class 0.5S under conditions as per IEC 62053-22:2003 @ 0 ≤ PF ≤ 0.9			0 to 999,999.99Mvarh
Apparent energy		Class 0.2S under conditions as per IEC 62053-22:2003			0 to 999,999.99MVAh
Symmetrical components	Voltage FS	1.0		10%-120% FS	As voltage
	Current FS	1.0		10%-200% FS	As current
	Current FS	3.0		200%-1000% FS	± 180.0
Phasor angles		1 degree			*

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

Physical Dimensions



EM720 ORDER STRING

MODEL

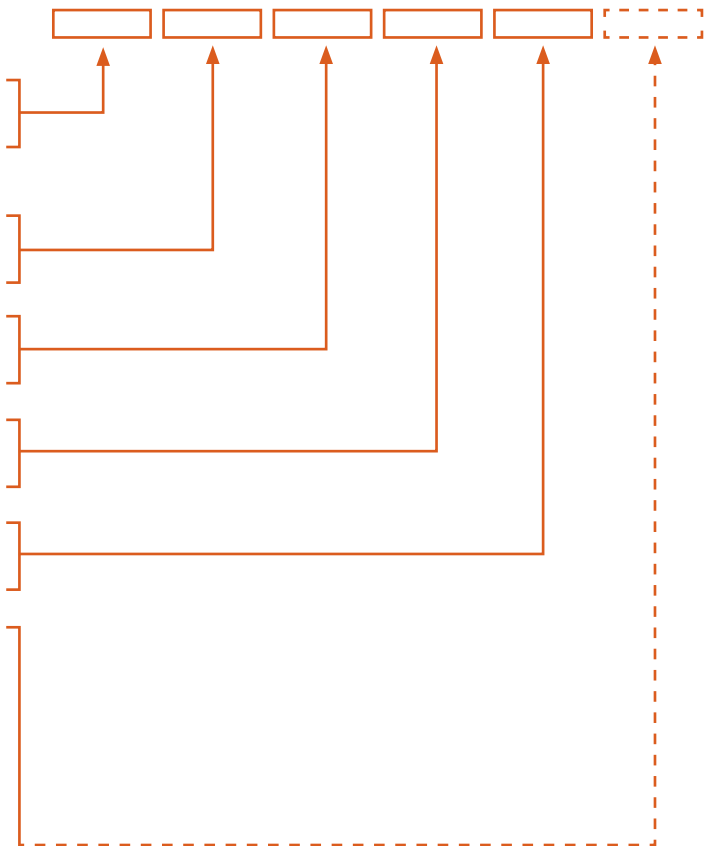
Basic Model	EM720
Transient Power Master	EM720T

OPTIONS

VOLTAGE INPUTS	
480V AC (L-L)	480V
120V AC (L-L)	120V
CURRENT INPUTS	
5 Ampere	5
1 Ampere	1
CALIBRATION AT FREQUENCY	
50Hz	50HZ
60Hz	60HZ
RECHARGEABLE BATTERY	
Without Battery	-
With Battery (up to 6 hours)	B

OPTIONAL MODULES (see notes)

[1] Default communication: IRIG-B, IR and RS-232/485	IRIG
[1] Default communication plus USB, Ethernet and 2 nd RS-232/485 (2 cards)	IRIG-ETH
[1] Default communication plus USB, Ethernet and 2 nd RS-232/485 with IEC 61850 protocol support (2 cards)	IRIG-ETH-850
[1] Replacing the IRIG-B on the default communication card with USB and Ethernet	ETH
[1] Replacing the IRIG-B on the default communication card with USB, Ethernet and IEC 61850 protocol support	ETH-850
[2] 2G GPRS (GSM)	GSM
[3] 2 DI/2 Relay Output (Form C) 250V AC/5A 250V AC/0.1A	DIOR
[3] 2 DI/2 Solid State Relay Output (Form A) 250V AC/0.1A	DIOS
[4] Aux. PS: 88-265V AC and 90-290V DC	AUX-ACDC
[4] Aux. PS: 24V DC	AUX-24



NOTES

Maximum 3 cards per device, with the following limitations:

- [1] Select only one of the #[1] options
- [2] Maximum 1 GSM module per device
- [3] Maximum 2 I/O modules per device
- [4] Maximum 1 Aux. Power Supply module per device

www.satec-global.com

HEADQUARTERS

SATEC INC.
North & South America
 10 Milltown Court
 Union, NJ 07083, USA

Tel. 1-888-OK-SATEC
 Local 908-686-9510
 Fax. 908-686-9520
sales@satec-global.com

SATEC LTD.
Europe & Africa
 P.O. Box 45022
 Jerusalem 9145001, Israel

Tel. 972-2-541-1000
 Fax. 972-2-581-2371
satec@satec-global.com

SATEC CHINA
Asia
 No. 25 Ganluyuan Nanli
 Beijing, China 100123

Tel. +86-10-8559-0609
 Fax. +86-10-8559-0609
china@satec-global.com

SATEC (AUSTRALIA) PTY LTD
Oceania
 P.O. Box 82
 Mulgoa, NSW 2745, Australia

Tel. 61-2-4774-2959
 Fax. 61-2-4774-0249
sales@satec-global.com.au