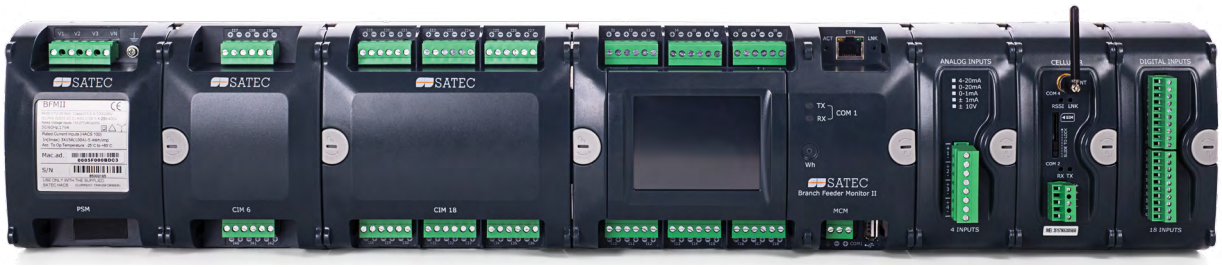
SATEC

BFM-II

DATASHEET

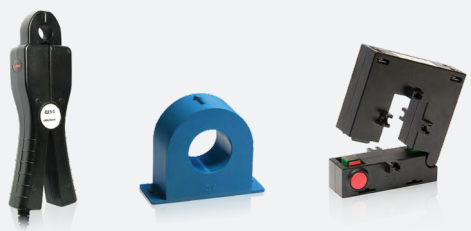


Multi-Circuit Revenue Meter
Digital Fault Recorder

Suitable for both new and retrofit projects, SATEC's Branch Feeder Monitor is a multi-circuit power meter, monitoring up to 18 three-phase power circuits.

The BFM-II utilizes High Accuracy Current Sensors (*HACS*) and is ideal for a wide range of applications, from monitoring medium-voltage substations through commercial multi-tenant billing in shopping centers or office buildings.

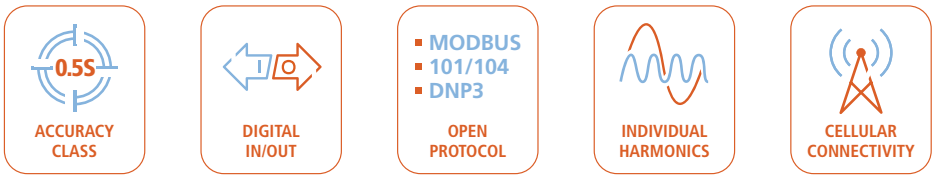
Application Versatility



Highlights

- Modular multi-circuit: metering up to 54 single-phase / 18 three-phase current channels
- DFR version:
  40 channel waveform recording @ 40 x I_n
- Revenue meter: anti-tamper design
- Communication
  - Built-in ports: RS485; ETH
  - Optional: 4G cellular
  - Open protocol: Modbus RTU; DNP3.0; BACnet; IEC 60870-5-101/104
- Modular digital & analog I/O
  Up to 72 I/O reading pulse output, CB status, analog parameters, etc.
- Dual input voltage: measuring two parallel 3-phase power sources
- Multi-option Current Inputs:
  - 40mA for SATEC's *HACS* CTs (100-3,000A)
  - Special input: clip-on 5A *HACS* for retrofit
  - 100mA inputs for 3rd party CTs (not supplied by SATEC)

Features Available Per Channel



Multifunctional 3-Phase Smart Meter

- True RMS volts, amps, power, power factor, neutral current and frequency, and many more
- Ampere/Volt demand meter
- 50/60 Hz measurements

Waveform & Fault Recorder

Independent product; limited to 12 three-phase current channels.

- Digital Fault Recording with pre / post fault waveform capture on 36 current channels and 4 voltage channels
- Time-tagged fault events included in fault event report
- Triggered externally through device digital inputs or internally from embedded fault detector
- Automatic detection of fault category using the sub-cycle measurements.
- Fault triggers include programmable thresholds and hysteresis, adjustable for specific substation conditions
- Recording input waveforms and long-duration RMS trends during fault

Billing/TOU Energy Meter

- Accuracy Class 0.5S/0.5 per IEC 62053-22 / ANSI
- Four-quadrant active and reactive energy poly-phase static meter
- Three-phase total and per phase energy measurements; active, reactive and apparent energy counters
- Time-of-Use, 8 energy/demand registers x 8 tariffs, 4 seasons x 4 types of days, 8 tariff changes per day, easily programmable tariff schedule
- Automatic 120-day daily profile for energy and maximum demand readings (total and tariff registers) for each submeter
- Easily programmable tariff calendar schedule
- Automatic logging of daily energy and maximum demand profiles (total & TOU)

Harmonic Analyzer

- Individual voltage & current harmonic spectrum and harmonic angles up to 25th order harmonic
- Voltage and current THD, TDD and K-Factor

Programmable Logical Controller

- Embedded programmable controller
- 4 control set points; programmable thresholds and delays
- Relay output control
- 1-cycle response time

Event and Data Recording

- Non-volatile memory for timestamped event and data recording for each channel
- Event recorder for logging internal diagnostic events and setup changes
- Two data recorders; 2 separate programmable data logs, on a periodic basis, per channel

Voltage Inputs

- Direct measurement 0-561V AC
- Dual Input Voltage: a second set of 3-phase voltage inputs (VIM module) is available for measurement of a parallel power source. Each set of measured currents is ascribed to one of the two voltage sets.

Note:

using the VIM module limits the instrument's capacity to 36 current channels

Current Input Options

The BFM II features unique milliamp inputs. Each current-input module is ordered for individual compatibility with one of the three CT options below.
Modules may be mixed and matched within the 18- 54 circuit channels. Each module is specified to host only one of these 3 input options:

- HACS: 40mA input designed for SATEC HACS CTs (100-3000A options)
- RS5: 40mA input designated for 5A split-core HACS for reading 5A from CT secondary, ideal for retrofit installation
- Flex: for interfacing 3VAC current sensor output

Digital and analog I/O

- Available I/O modules
  - **9DI:** nine digital inputs (dry contact / 24/125/250V DC). 1-cycle update time; unlatched, latched, pulse and KYZ operation; energy pulses
  - **18DI:** eighteen digital inputs (max. 4 per device)
  - **4AI**: four analog inputs; selection of 0-20mA, 4-20mA, 0-1mA and ±1mA output; 2 cycle update time
  - **9RO**: nine form A relay outputs (max. 2 modules per device)

Communication

- On-board interfaces
  - Standard 2-wire RS-485
  - ETH 10/100 Base-T
- Cellular (optional)
  - 4G modem
- Client (Modbus/TCP over ETH or 4G)
  - TCP notification client for communicating events or periodic reports to remote server
  - Expertpower client on subscription basis
- Communication protocols
  - Modbus RTU
  - SATEC ASCII
  - DNP 3.0
  - IEC 60870-5-101 (optional)
  - IEC 60870-5-104 (optional)

Display

Optional 3.5" touch screen display with backlight

Meter Security

3-level password access to meter setups and data

Upgradeable Firmware

Easy upgrading via serial or ETH ports

Software Support

- Includes comprehensive Power Analysis Software (PAS) for configuration and data acquisition
- SATEC's Expertpower web-based energy management platform (subscription)
- Any 3rd party software supporting open-protocol

Technical specifications

Input Ratings

Voltage Inputs

Main voltage module & VIM module	
Installation	Category III
Nominal voltage	277/480V AC
Voltage range tolerance	±15%
Input impedance	0.35MΩ
Measurement burden, when powered by AUX power supply:	
Burden for 277V	≈ 0.08 VA
Burden for 120V	≈ 0.02 VA
Measurement burden, when powered by measurement inputs:	
Burden for 277V	≈ 24 VA
Burden for 120V	≈ 16 VA
Galvanic Isolation, withstanding insulation	4kV AC @ 1min
Connector Type	Removable, 4 terminals
Wire Size	Up to 10 AWG (up to 6 mm²)
Terminal pitch	10 mm

Ac Current Inputs

The BFM II is compatible with SATEC High Accuracy Current Sensors (HACS) only. These CTs, supplied as solid-core or split-core, range from **5A to 3,000A primary input**.

⚠Caution

Connecting the device's built-in current inputs (5mA for RS5 and 40mA for other HACS) with standard 1A or 5A outputs will irreparably harm your device!

For full HACS specs please see the HACS datasheet.

Burden	< 0.15 VA
Recommended wire size	18 AWG (1 mm²)
Isolation	600V
Terminal pitch	5 mm

Power Supply

Unit may be self-energized from voltage inputs OR by AUX. power supply module

Self-energized

Three or single-phase operation from any phase	
Nominal voltage	120/208 – 277/480V AC (L-N/L-L)
Input range	70-561V AC 50/60 Hz
Burden for 277V	< 17 VA

AUX power supply module

Withstanding Insulation	4kV AC @ 1mn
AC/DC Power Supply	L/+, N/- and GND
@ Operating temperature of -25°C to 60°C	
Rated input	50-290V AC 50/60 Hz 40-290V DC
Max. Power output	10W
@ Operating temperature range of -40°C to 70°C	
Rated input	50-290V AC @ 50/60 Hz 90-290V DC
Max. Power output	10W
Recommended Wire Size	18 AWG (1 mm²), 600V isolation
Terminal pitch	7.5 mm, three pins

Built-In Communication

Serial Communication (Rs-485)

Serial RS-485 optically isolated port	
Isolation	4kV AC @ 1 min
Connector Type	Removable, 3 terminals
Terminal pitch	5 mm
Wire Size	up to 12 AWG (up to 2.5 mm²).
Baud Rate	up to 115,200 bps
Supported Protocols	MODBUS RTU/ASCII, DNP 3.0

Ethernet Port

Transformer-isolated	10/100Base-T port
Isolation	4kV AC @ 1 min
Connector Type	RJ45 modular
Supported Protocols	MODBUS TCP (Port 502), DNP3/ TCP (port 20000)
Number of simultaneous connections (sockets): 5	
SNTP – time synchronization	

USB Port

Isolated USB 1.1 port	
Withstanding Insulation	4kV AC @ 1 min
Connector Type	A male, standard USB cable, max. Length 2 meters
Supported protocols	MODBUS RTU

Optional Modular Communication

Cellular Modem

4G with fallback to 2G/3G per network	
Withstanding isolation	4kV AC @ 1 min
Connector type	SMA
Supported Protocols	MODBUS TCP (Port 502), DNP 3.0/TCP (Port 20000)

Display Com / Connector

Serial TTL RS-232 non-isolated port for connecting to the Graphic Display Module	
Baud rate	up to 460,800 bps
Supported protocols	MODBUS RTU

Optional Modular I/O

18 Digital Inputs - 9/18 Di (Up To 4 Modules)

Optically isolated input, dry contact sensing (voltage-free) Internal power supply 5 VDC	
Sensitivity	Open @ input resistance > 16kΩ Closed @ input resistance < 10kΩ
Scan time	½ cycle
Wire size	12 AWG (up to 2.5 mm²)
Terminal pitch	3.81 mm

9 relay output

SPST Form A	
Contact rating	5A @ 250V AC 5A @ 30V DC
Update time	1 cycle
Recommended wire size	18 AWG (1 mm²), 600V isolation
Terminal pitch	3.81 mm

4 Analog Inputs

Ranges (upon order)	±1 mA (100% overload) 0-20 mA 4-20 mA 0-1 mA (100% overload)
Accuracy	0.5% FS
Scan time	2 cycles
Withstanding insulation	4kV AC @ 1 min
Recommended wire size	18 AWG (1 mm²), 600V isolation
Terminal pitch	3.81 mm

Real-time Clock

Accuracy: Maximum error of 5 sec/month @ 25°C

Graphical Display Module – GDM (option)

3.5 inch touch-panel LCD graphic TFT display	
Resolution	320 x 240
Operating temperature	-20°C - +70°C
Communication	Serial TTL RS-232 non-isolated port

Environmental Conditions

Operating temp.	-30°C to +70°C (-22°F to 158°F)
Storage temperature	-40°C to +85°C (-40°F to 185°F)
Humidity	0 to 95% non condensing
Altitude	≤ 2000m

Construction

Overall Dimensions

Width	278 mm / 10.94” (18 channels) 554 mm / 21.81” (54 channels)
Height	128 mm / 5.04"
Depth	72.5 mm / 2.85"
Weight	1.6kg (36 channels)
Mounting	DIN-rail mount

Materials

Enclosure	Reinforced Polycarbonate
Panels	Polycarbonate
PCB	FR4 (UL94-V0)
Terminals	PBT (UL94-V0)
Plug-in connectors	Polyamide PA6.6 (UL94-V0)
Packaging case	Carton and Stratocell (Polyethylene Foam) Brackets
Labels	Polyester film (UL94-V0)

Standards Compliance

EMC per IEC 62052-11, IEC 62053-22, ANSI C12.1 and ANSI C12.20

- IEC61000-4-2: Electrostatic discharge, 15/– air/contact
- IEC61000-4-3: Electromagnetic RF Fields, 10V/m @ 80MHz – 1000MHz
- IEC61000-4-4: Fast Transients burst, 4KV on current and voltage circuits and 2 KV for auxiliary circuits
- IEC61000-4-5: Surge 6KV on current and voltage circuits and 1 KV for auxiliary circuits
- IEC61000-4-6: Conducted Radio-frequency, 10V @ 0.15MHz – 80MHz
- IEC61000-4-8: Power Frequency Magnetic Field
- IEC61000-4-12: Damped oscillatory waves, 2.5kV CM and 1kV DM
- ANSI C12.1 – 4.7.3.3.1: 100kHz Ring Wave surge, 6kV @ 0.5kA (per IEEE C62.41.2-2002)
- ANSI C12.1 – 4.7.3.3.2: line surge, 1.2/50µs – 8/20µs, 6kV @ 3kA (per IEEE C62.41.2-2002)
- ANSI C12.1 – 4.7.3.11: SWC 2.5kV (per IEEE 37.90.1)
- CISPR 22 – class B

Insulation

- IEC 62052-11 (per NMI M6-1): Insulation impulse 12 kV/50Ω @ 1.2/50 µs
- IEC 62053-22: AC voltage tests related to ground, 4 kV AC @ 1mn, for power and signal ports (above 40V), or according to UL 61010-1/916 for basic and/or double insulation and Installation Category III

Safety

- UL 916
- NMI M6-1

Accuracy

- IEC/AZ 62053-22, class 0.5S
- ANSI C12.20-2010, Class 100, 400, accuracy 0.5%

Atmospheric Environment

- Accuracy Operational ambient temperature range: –25°C to +60°C
- Operational ambient temperature range: –40°C to +70°C
- Long-term damp heat withstand according to IEC 68-2-3 <95% (non-condensing), +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 < 60Hz
  - Constant acceleration 9.8 m/s2 (1g), f > 60Hz
- IEC 62052-11(ref. IEC 60068-2-27): Shock
  - Half sine pulse
  - Peak acceleration: 30gn (300 m/s2)
  - Additional Transport vibration and shocks:
    - Longitudinal acceleration: 2.0 g
    - Vertical acceleration: 1.2 g
    - Transversal acceleration: 1.2 g
- IEC 60529: IP50

Measurement Specifications

Parameter	Full Scale @ Input Range	Accuracy			Range
		% Reading	% FS	Conditions	
Voltage	VL = 120V VL = 230V	0.1	0.005	100 to 300 V	0 to Imax = 10,000A (HACS primary current)
Line current	Instrument current transformer CTs I_L = 100A	0.2	0.005	1 to 100% FS	0 to Imax = 10,000A (HACS primary current) Starting current: 0.1% FS
Active power	2 × Vmax × I_L/1000, kW	1	0.02	|PF| ≥ 0.5	-120.000 to 120.000 kW
Reactive power	2 × Vmax × I_L/1000, kvar	1	0.02	|PF| ≤ 0.9	-120.000 to 120.000 kvar
Apparent power	2 × Vmax × I_L/1000, kVA	1	0.02	|PF| ≥ 0.5	0 to 120.000 kVA
Power factor	1.0	-	1.0	|PF| ≥ 0.5, I ≥ 2% FSI	-0.999 to +1.000
Frequency		0.02	-	50 Hz: 39.00 to 65.00 Hz 60 Hz: 45.00 to 70.00 Hz	39 Hz up to 70 Hz
Active energy import[4]		Class 0.5 under conditions as per IEC/AS 62053-22 Class 0.5 under conditions as per ANSI C12, IEC 61557-12			0 to 99,999,999.9 kWh
Reactive energy import/ export		Class 0.5 under conditions as per IEC/AS 62053-24|PF| ≤ 0.9			0 to 99,999,999.9 kvarh
Apparent energy		Class 0.5 under conditions as per IEC 61557-12			0 to 99,999,999.9 kVAh

FS: full scale (voltage or current)

Notes

1. Accuracy is expressed as ± (percentage of reading + percentage of full scale) ±1 digit. This does not include inaccuracies introduced by the user's potential and current transformers. Accuracy calculated at 1-second average
2. Specifications assume: voltage and current waveforms with THD ≤ 5% for kvar, kVA anvd PF; reference operating temperature: 20°C-24°C
3. Measurement error is typically less than the maximum error indicated here
4. Accuracy of the device complies with IEC 62053-22 class 0.5S standard using solid-core HACS, and Class 1 when using split-core HACS

Order String

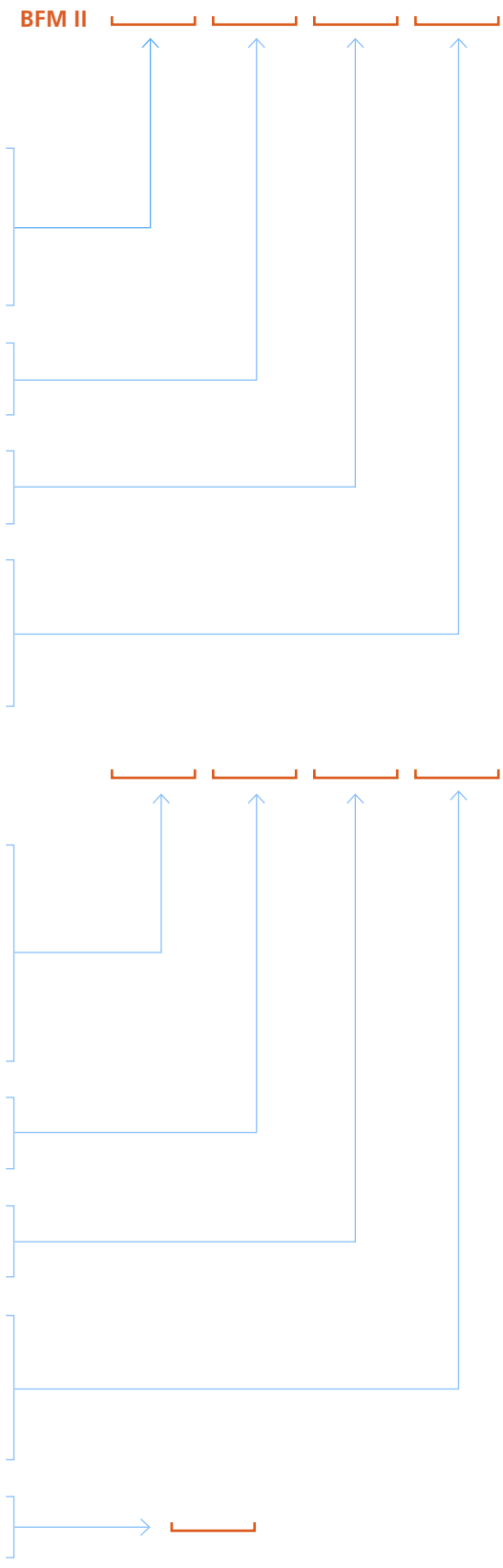
BFM-II Branch Feeder Monitor	**BFM II**

Options

Current for standard 18 channels	
100A to 3000A High Accuracy Current Sensors (HACS). Requires ordering of up to 18 HACS	**HACS**
5A split core remote high accuracy current sensor (HACS). Requires ordering of up to 18 CS05S	**RS5**
Use of 3VAC current clamps (should be purchased locally)	**FLEX**
Calibration at Frequency	
50 Hz	**50HZ**
60 Hz	**60HZ**
Display options	
Detachable Graphic Display Module	**G**
Blank Panel	**X**
Testing and Certificate	
Full functional test, calibration at various work loads & detailed test report	**-**
Full functional test, calibration at various work loads & detailed test report plus ISO 17025 and ILAC certified calibration certificate	**CC**

Optional Modules (Ordered Separately)

Current Input Module (CIM) up to 2 CIM modules per device **No more than 1 CIM per instrument when employing VIM module**	
6 current input module (CIM 6) - HACS version	**C6H-BFM II**
6 current input module (CIM 6) - RS5 version	**C6R-BFM II**
6 current input module (CIM 6) - FLEX version	**C6F-BFM II**
18 current input module (CIM 18) - HACS version	**C18H-BFM II**
18 current input module (CIM 18) - RS5 version	**C18R-BFM II**
18 current input module (CIM 18) - FLEX version	**C18F-BFM II**
Voltage Input Module (VIM) 1 VIM only per device	
Additional 3-phase Voltage Input Module - 50Hz	**VIM50Hz**
Additional 3-phase Voltage Input Module - 60Hz	**VIM60Hz**
Calibration at Frequency	
50 Hz	**50HZ**
60 Hz	**60HZ**
Testing and Certificate	
Full functional test, calibration at various work loads & detailed test report	**-**
Full functional test, calibration at various work loads & detailed test report plus ISO 17025 and ILAC certified calibration certificate	**CC**
Extension	
Extension cable for connecting optional modules remotely	**EXT-BFM II**



Order String

Optional Modules (Ordered Separately)

Communication Options	
4G Modem, supplied with bendable antenna	**T4G-BFM II**
I/O options	
9 Digital Inputs Module - Dry Contact	**DI9-DRC-BFM II**
9 Digital Inputs Module - 24VDC	**DI9-24V-BFM II**
9 Digital Inputs Module - 125VDC	**DI9-125V-BFM II**
9 Digital Inputs Module - 250VDC	**DI9-250V-BFM II**
18 Digital Inputs Module - Dry Contact	**DI18-DRC-BFM II**
18 Digital Inputs Module - 24VDC	**DI18-24V-BFM II**
18 Digital Inputs Module - 125VDC	**DI18-125V-BFM II**
18 Digital Inputs Module - 250VDC	**DI18-250V-BFM II**
9 Form A Relay Outputs Module **max. 2 modules per device**	**RLY9-BFM II**
4 Analog Inputs Module - ±1mA	**AI1-BFM II**
4 Analog Inputs Module - 0-20mA	**AI2-BFM II**
4 Analog Inputs Module - 0-1mA	**AI3-BFM II**
4 Analog Inputs Module - 4-20mA	**AI4-BFM II**
Auxiliary Power Supply Max. 1 Module per BFM II	
Auxiliary Power Supply 50-290V AC, 40*-290V DC	**AUX-ACDC-BFM II**

Max. 4 modules per BFM-II

* Above 60°C - minimum 90V DC