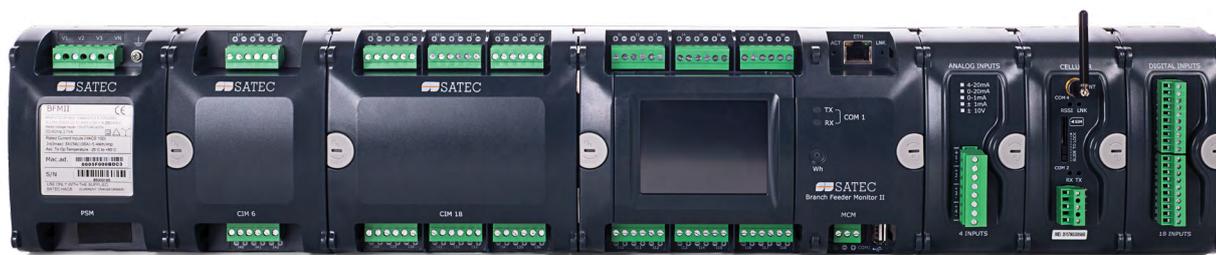


BFM-II

DATASHEET



Multi-Circuit Revenue Meter Digital Fault Recorder

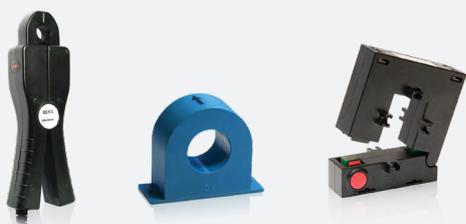
Suitable for both new and retrofit projects, SATEC's Branch Feeder Monitor is a multi-circuit power meter, monitoring up to 18 three-phase power circuits.

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.

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)

Application Versatility



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 ± 1 mA 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 mm ²)
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 mm ²)
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 mm ²), 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 mm ²).
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 > 16k Ω
Closed @ input resistance < 10k Ω

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) \pm 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 \leq 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, 1.2/50 μ s – 8/20 μ s, 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/50 Ω @ 1.2/50 μ s
- 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 $+60^{\circ}\text{C}$
- Operational ambient temperature range: -40°C to $+70^{\circ}\text{C}$
- Long-term damp heat withstand according to IEC 68-2-3 <95% (non-condensing), $+40^{\circ}\text{C}$
- Transport and storage temperature range: -40°C to $+85^{\circ}\text{C}$
- 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: 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 I _{max} = 10,000A (HACS primary current)
Line current	Instrument current transformer CTs I _L = 100A	0.2	0.005	1 to 100% FS	0 to I _{max} = 10,000A (HACS primary current) Starting current: 0.1% FS
Active power	$2 \times V_{max} \times I_L / 1000$, kW	1	0.02	PF ≥ 0.5	-120.000 to 120.000 kW
Reactive power	$2 \times V_{max} \times I_L / 1000$, kvar	1	0.02	PF ≤ 0.9	-120.000 to 120.000 kvar
Apparent power	$2 \times V_{max} \times I_L / 1000$, 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 ^a		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

- 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
- Specifications assume: voltage and current waveforms with THD ≤ 5% for kvar, kVA and PF; reference operating temperature: 20°C-24°C
- Measurement error is typically less than the maximum error indicated here
- 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). **HACS**
Requires ordering of up to 18 HACS

5A split core remote high accuracy current sensor (HACS). **RS5**
Requires ordering of up to 18 CS055

Use of 3VAC current clamps (should be purchased locally) **FLEX**

Calibration at Frequency

50 Hz **50HZ**

60 Hz **60HZ**

Display options

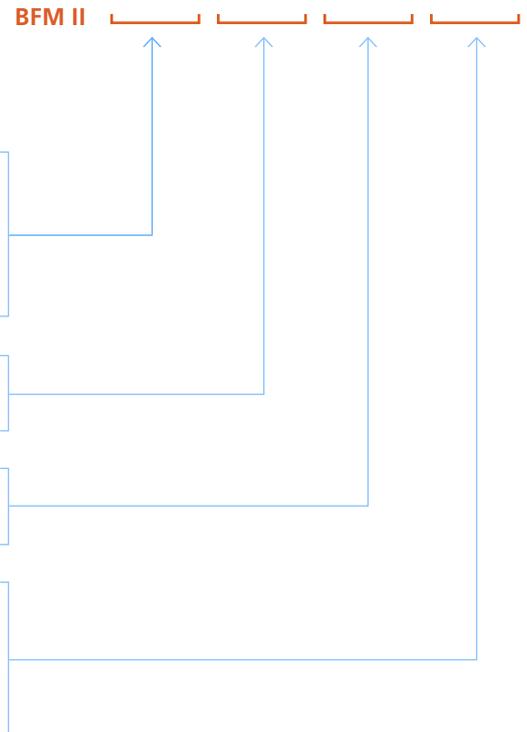
Detachable Graphic Display Module **G**

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**

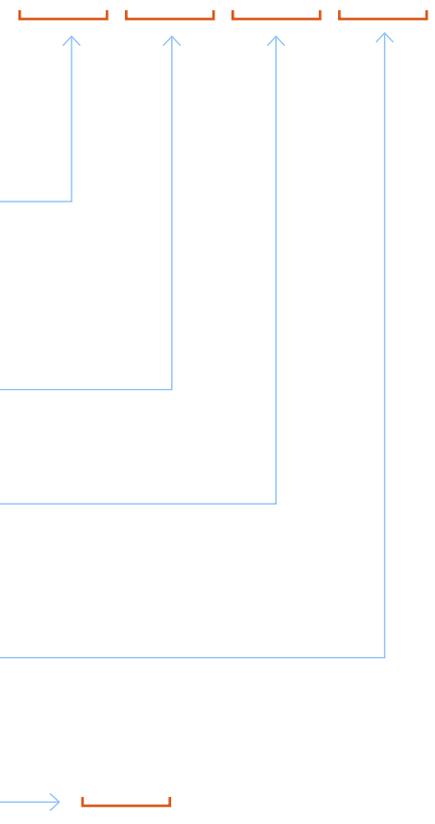
Testing and Certificate

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 - $\pm 1\text{mA}$ **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

