

# VIM

The (dual) Voltage Input Module

## MULTI-CIRCUIT LOAD MEASUREMENT OF 2 INDEPENDENT POWER SOURCES

An Application Note



# THE DUAL POWER SOURCE METERING CHALLENGE

In many cases a utility connection involves two voltage sources. For example, this can be the case in a substation equipped with two transformers, or in a facility managing energy import from the grid, and energy export from photovoltaic cells.

Variations in voltage levels between the two power sources can affect both power and energy measurements. This is evident via the active power formula

$P = V * I * \cos \phi$ . This is also especially crucial for determining the angle between voltage and current, denoted by  $\phi$ .

If the angle is not accurately determined, active power, and subsequently active energy cannot be correctly calculated. Accordingly, two voltage sources necessitate two independent voltage measurement sets, normally requiring at least two measuring devices, one per each transformer.



Figure 1: SATEC's Branch Feeder Monitor

# THE MULTI-CIRCUIT BRANCH FEEDER MONITOR

SATEC's Branch Feeder Monitor, or BFM for short (this publication relates to the BFM II only), is a unique solution for simultaneous multi-circuit metering of a multitude of currents/loads, up to 18 three-phase or 54 single-phase (or almost any combination of these) circuits.

However, it was always taken for granted that even the BFM can meter only one power source, and that to monitor 2 different power sources, such as transformers, two separate devices must be installed.



## THE VIM MODULE

The newly introduced (dual) Voltage Input Module (figure 3) makes it possible to measure loads originating from two independent power sources, with one single BFM.

Via the VIM module, which is installed on the BFM, the BFM reads and analyzes an extra set of three-phase voltage inputs, pairing each measured load/current to its power source.

**While using the VIM, the BFM's metering capacity stands at up to 36 current channels.**

Power sources are easily assigned and reassigned using SATEC's Power Analysis Software (PAS, figure 2), which is available for users at no charge.

## LOWERING, YET MORE, THE REDUCED COSTS

The basic concept of the BFM is simplification and cost reduction: implementing one metering unit in the place of up to 18 meters. This saves significantly on hardware, installation

costs, space and maintenance. The VIM module further expands this savings in a direction previously deemed impossible.

Channel Assignments						
#	VIM	Phase L1	Phase L2	Phase L3	CT Primary, A	Label
#1	OFF	I1	I2	I3	100	Transformer A Voltage
#2	ON	I4	I5	I6	200	Transformer B Voltage

Figure 2: Channel assignment with PAS software



Figure 3: The VIM module



# METERING INDEPENDENT POWER SOURCES

## Transformer Efficiency: **Now Included**

Another important application, now possible, is metering and comparing the differences between the power received by the transformer, and that which it in turn supplies.

Without the BFM, to calculate transformer efficiency, it is necessary either to rely on calculated incoming power (although a highly-accurate application available with SATEC's high-end PQ analyzer, the EM720/920) or to install a dedicated meter on the MV side of the transformer.

With the VIM module it is now possible to monitor both sides of the transformer with one BFM unit.

No extra meter installation needed to provide an accurate real-time calculation of transformer losses.

## Inverter Healthcheck: **Included**

By standard, renewable energy applications involve DC to AC inverters.

The BFM's capability for monitoring individual harmonics for each current channel (up to the 25th harmonic, see figure 4 for illustration) is extremely useful in flagging malfunctioning inverters, usually characterized by amplified harmonics.

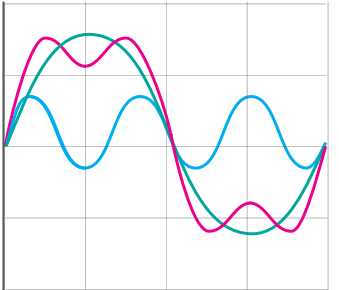


Figure 4: Individual Harmonic Measurement



# MULTI-CIRCUIT MONITORING, BY SATEC

The BFM, now enhanced by the VIM module, does not only perform measurements. Using TCP, serial or 4G communication, it interfaces with SCADA systems over IEC 60870-5-101/104, Modbus or DNP3.0 protocols.

## Flexibility & Adaptability per Project

Utilizing up to 72 digital inputs, the BFM can read external status signals, such as those of circuit breakers, protection relays, or alerts of possibly unauthorized access to the substation, via a limit switch.

Analog inputs enable reading and relaying important information, such as transformer temperature and oil level.

Up to 18 relay outputs can be programmed to perform actions such as opening and closing circuit breakers, or signalling alerts.

The BFM even offers a Digital Fault Recorder (BFM-DFR) version, taking cost-effectiveness to the next level with the ability to record fault current with magnitudes of up to  $40 \times I_n$ .

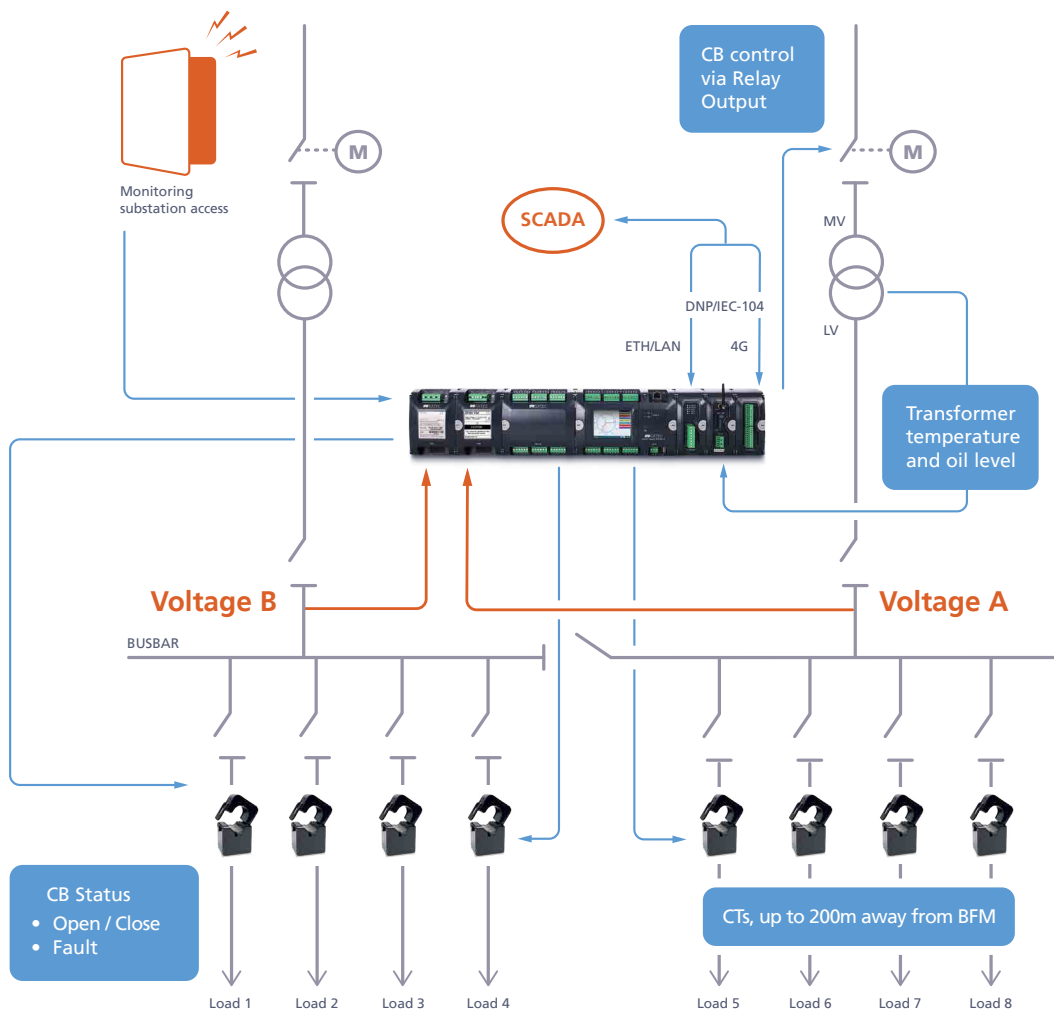


Figure 5: Typical scheme for substation monitoring

# DIGITALIZE YOUR SUBSTATION BY **LUNCH!**

The BFM uses unique High Accuracy Current Sensors (HACS). Ranging from 5A to 3,000A, these highly accurate CTs (up to 0.1% accuracy) are available in solid-core and split-core forms.

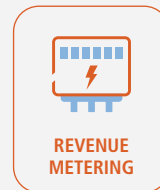
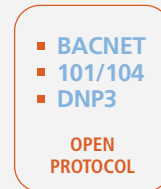
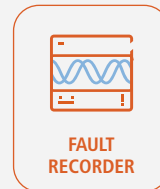
Using split-core CTs, these can be hooked on to the 5A secondary current from the CTs of the substation's protection equipment.

This allows installing the BFM on to existing circuits without powering down the substation!

Taking this into account, the entire installation and digitalization process is extremely simplified, making it rapid and highly cost effective.

**BFM II:** The Branch Feeder Monitor is a unique multi-circuit meter. Combining many advanced measurement and control capabilities and communication features, it is ideal for substation retrofit or multi-tenant billing applications.

- Monitoring up to 54 single-phase or 18 three-phase loads
- Dual Voltage Input: simultaneously assigning current readings to 2 different/independent power sources
- Digital Fault Recorder (optional version)
- Harmonic analysis up to the 25th harmonic
- Up to 72 digital/analog I/O



For further information on this device [BFM II](#) 