SATEC

PHASOR MEASUREMENT UNIT

PER IEEE C37.118.1

Additional Analyzer Features

- 0.2S — ACCURACY CLASS
- I/O — DIGITAL IN/OUT
- IEC 61000-4-30 — CLASS A
- Modbus 101/104 DNP3 — OPEN PROTOCOL
- PQ — WAVEFORM CAPTURE/LOGGING
- IEC 61850 — IEC 61850
- CELLULAR CONNECTIVITY
- FIBER OPTIC

HIGHLIGHTS

- Full IEEE C37.118.1 compliance, for both:
  - M – Class
  - P – Class
- Full interoperability, featuring:
  - IEEE C37.118.2 protocol
  - IEC 61850-9-2 protocol
  - 5 streaming slots (UDP and TCP protocol)
- Optional split-core CT for easy installation – no outage needed!
- Versatile micro-sec resolution time sync:
  - PTP
  - IRIG-B

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Wide Area Monitoring Systems

From the start, electrical power has been supplied via a multi-level electrical grid. Like a great neural map, it is elaborate and interconnected. Whereas the classical grid used to be operated in a centralized state-run fashion, the modern grid includes many micro-grids, which are independently operated energy sources, thus introducing complex challenges.

As an ecosystem, the slightest disturbance generated in any specific location can instigate an event resulting in full power outage. This entails a triple challenge, which is met through rigorous and reliable monitoring and data streaming:

- preventing such events through responsive control
- minimizing downtime by quick analysis and response
- post-event analysis, enabling planning and future prevention

Microsecond timestamped monitoring of voltage and current and the derivatives of grid frequency (Rate of Change of Frequency) are enough for being able to trace the origin of an event or to plot an imminent one. The requirements for this tracking have been regulated in the IEEE C37.118.1 Standard for Synchrophasor Measurement for Power Systems.

M-Class vs. P-Class monitoring

When implementing a Wide Area Monitoring System (WAMS), a system operator is aiming at one, or all, of the 3 options mentioned above. However, the corresponding product and configuration must be employed.

M-Class (Metering Class) measurements are highly accurate since extremely advanced filtering is employed to reject misleading components of harmonics and other oscillations.

However, this filtering also results in delayed data streaming, making it unfit for responsive control. Accordingly, to enable control, P-Class (Protection Class) monitoring is used, involving less filtering, thus increasing streaming speed considerably, enabling responsive control.

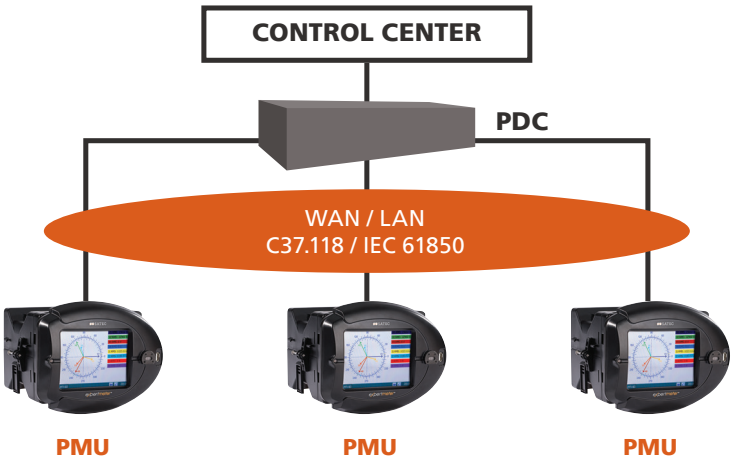

Figure 1: typical WAMS/PMU layout

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The PM180 PMU

The PM180 is a class A Edition 3 certified (NMI, NL) power quality analyzer. Designed as a modular device, it can house up to 3 additional add-on modules which allow for a variety of functionality. This includes Digital Fault Recorder

SATEC offers its Phasor Measurement Unit, or PMU in short, as a module for the PM180 analyzer. This module includes also fast transient recording at 1024 samples per cycle. Combining the PM180's all-in-one functionalities and features, our PMU stands out as a unique solution.

This module provides synchro-phasor and frequency measurements, and real-time cyclic exchange of synchronized phasor data with any 3rd party substation phasor data concentrator (PDC) and WAMS system.

- IEEE C37.118.1-2011, IEEE C37.118.1a-2014 and IEC/IEEE 60255-118-1:2018 P-Class and M-class performance compliance
- IEEE C37.118.1 3-phase V/I phasor measurements synchronized to a common UTC time reference (e.g. GPS), using an IRIG-B timecode source or an IEEE 1588 PTPv2 master clock source
- IEEE C37.118.1 synchronous frequency and Rate of Change of Frequency (ROCOF) measurements
- Expected total vector error (TVE): less than 0.05%
- Streaming rate: 1 to 50 or 60 frames/s @ 50 or 60Hz, respectively
- IEEE C37.118.2 client-server UDP and TCP data transmission; spontaneous UDP data transmission over IP protocol
- Optional IEEE C37.118.2 frame extensions with analog data (total active, reactive and apparent power and power factor) and digital status data (up to 32 inputs)
- Phasor data streaming over Ethernet using IEC 61850-9-2 multicast sampled value (SV) service with IEEE C37.118.2 compliant mapping of synchrophasor data in accordance with IEC 61850-9-2 and IEC 61850-90-5 guidelines
- 5 data streaming slots for continuous synchrophasor data streaming via unicast UDP or/and TCP connections

A **Wide** Area Monitoring System In a very **thin** card

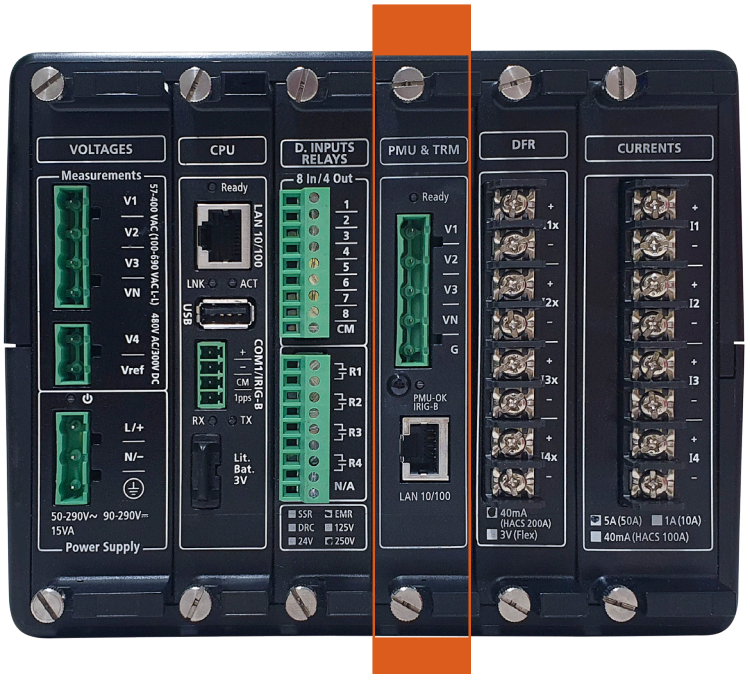

Figure 2: the PMU unit housed in the PM180 analyzer, along with fault recording and digital I/O modules

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M-CLASS AND P-CLASS CONFIGURATION

The PM180 PMU features advanced anti-aliasing filters, complying with the M-Class requirements. All the same, it can be configured to bypass these filters, rendering it a P-Class unit featuring the necessary speed for responsive control.

MULTIPLE PROTOCOL COMMUNICATION

The IEEE PMU standards sets its own protocol, the IEEE C37.118.2, which SATEC has implemented in this product. Likewise, SATEC has implemented the IEC 61850-9-2 protocol which is popular in the field of substation automation.

On the LAN/WAN level the PM180 PMU enables the usage of both TCP and UDP protocols. The TCP being more precise by guaranteeing data integrity and UDP forgoing transmission acknowledgment thus allowing faster data streaming.

For protection and control applications, where speed is the key, UDP will usually be utilized. For in-depth event analysis, where data integrity is of essence and speed matters less, TCP will normally be the choice.

EASY INSTALLATION - NO OUTAGE NEEDED!

Standard PM180 current inputs are rated 1A or 5A. Optionally, The PM180 features integral split-core CTs (HACS), designed to clip-on to live 5A or 1A secondary currents from protection CTs. This way there is no need for any downtime when performing installation, thus immensely simplifying retrofit, avoiding the headache involved in a planned outage.

VERSATILE TIME-SYNC

The PM180 analyzer is equipped with an IRIG-B input, for reading a GPS clock. Alternatively, PTP time sync is also supported via the ETH port on the PMU module. Both options correspond with the microsecond resolution required for meeting the IEEE C37.118.1 standard.

FULL CONFIGURABILITY

The IEEE PMU standard stipulates the reporting rates, specified by the amount of frames per second as 10, 25 or 50 for 50 Hz systems and 10, 12, 15, 20, 30 and 60 for 60 Hz systems. Our PMU allows all these reporting rates, including lower rates from 1 to 6 (see figure 3).

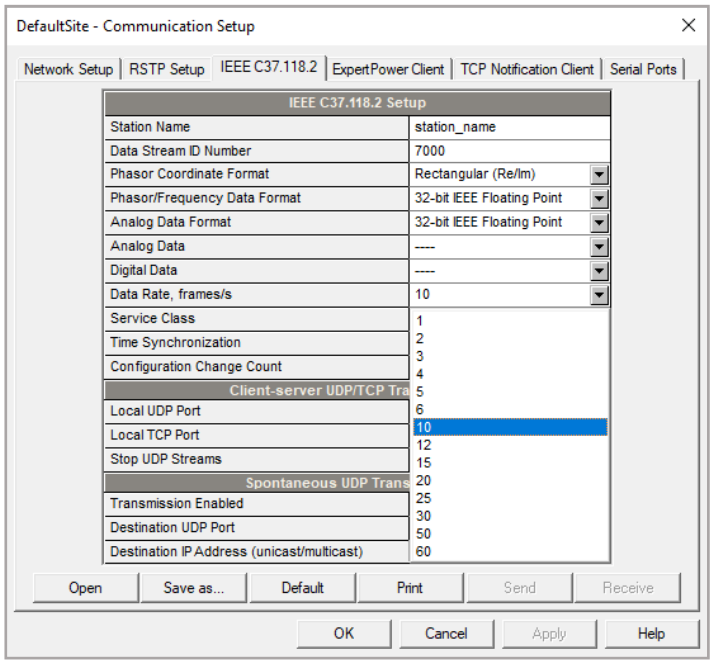

Figure 3: PM180 configuration for IEEE C37.118.2 streaming