SATEC

WIND ENERGY METERING APPLICATIONS

Unstable prices of fossil fuels drive the public and private sectors in search of alternative, reliable and affordable energy sources. Environmental awareness, successfully lobbied in government, politics and finance, plays no less of a role.

Solar and wind energy are the two most prominent renewable energy sources. Various types of wind turbines account for over 1,400TWh globally (2019), roughly twice as much as solar energy.[1]

The power produced by wind turbines normally involves several current conversions by inverters, along its way to the grid. thus, metering DC and AC current are both essential for monitoring inverter efficiency and general health-check.

SATEC has been providing over 3,000 units annually for wind-power applications, supplying 5 out of the top 10 global manufacturers.

FEATURES DELIVERED BY SATEC'S SOLUTION

- **Fast parameter calculation**: every cycle / half cycle (PM180)
- **Fast communication response**: 20ms (10ms / PM180) response time @ 115.2kbps
- **High accuracy**:
  PRO Series: Class 0.2S for energy, 0.002% for frequency (per osv. See figure 1)
- **Communication interfaces**:
  RS485, ETH, CAN, 3G/4G, PROFIBUS
- Communication protocols: Modbus, DNP3, IEC 61850 (Ed. 2), 101/104, PROFIBUS
- **Environmental durability**: -40° ~ 85°C
- **Wide range voltage input**: 15-828V AC
- Configurable set-point alarms
- Up to 27 digital and analog I/O
- PRO meters: Full power quality report (EN50160/IEEE1159) and event analysis
- Phasor Measurement Unit for microgrid sync
- Assignable Modbus registers

[1] https://www.windpowermonthly.com/article/1686734/wind-leads-global-renewable-energy-generation

Wind Applications Utilizing SATEC Analyzers

Monitoring the production of wind power requires rigorous, high-frequency monitoring of the parameters of the power generated. Another challenge is the fact that most modern inverters output the power at 800V AC, higher than the rating of standard metering devices.

TOWER BASE CONTROL PANEL APPLICATION

In most cases, one unit of SATEC's PRO Series power meter is used to monitor each turbine. Occasionally, the PRO meter is used for local energy consumption in the facility as well.

Monitoring includes: voltage, frequency, power, power factor, energy harmonics, symmetrical components and more.

ADVANCED APPLICATIONS

For advanced requirements of syncing microgrids with the national grid via a Wide Area Monitoring System (IEEE C37.118), SATEC offers its PM180 advanced analyzer, featuring a Phasor Measurement Unit module.

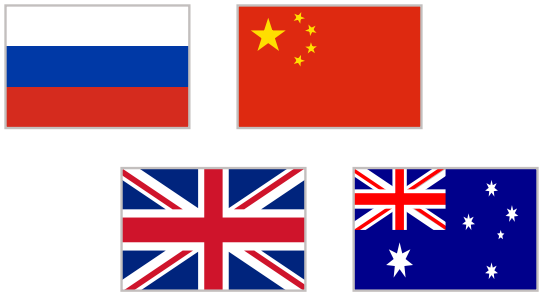
The PM180 also features a module for detection of fast transients (@ 1024 samples / cycle).

PM180 measurements are performed every half-cycle and are delivered at a 10ms response time.

PRO EM235

PM180

Frequency Monitoring Regulation & Application



The nature of the complicated integration of wind or photo-voltaic energy into the utility grid requires rigorous monitoring of the frequency of both generated power and grid frequency to which the power is introduced. To prevent damage, deviation from the allowed range is usually followed by the requirement to self-disconnect from the grid.

Accordingly, to allow a micro-grid to interface regional infrastructure, it must be equipped with means of establishing its generated frequency.

Over the past few years utility regulation has been formulating standards for frequency monitoring. There are several examples for this:

AUSTRALIA

FCAS requirements specify Market Ancillary Services Specification in a similar manner: "Measurements of local frequency must have a measurement range of at least the range defined by the operational frequency tolerance band, error of less than or equal to 0.01 Hz, and resolution of less than or equal to 0.0025 Hz"

CHINA

The System Operator requires receiving frequency data in 3 decimal resolution.

RUSSIA

The System Operator of United Power Systems (SO UPS) requires receiving frequency data in 3 decimal resolution.

UNITED KINGDOM

In the UK, regulation pertaining micro-grids is termed Dynamic Containment (see figure 2). One of the requirements included is for providing frequency and power data at 20 times per second and frequency with resolution of 3 decimal places.

Date & Time	FREQ (Hz) one cycle average @ 3-decimal res.	FREQ (Hz) one second average @ 4-decimal res.
10/12/21 16:22:40.852	50.005	49.9997
10/12/21 16:22:40.872	50.000	49.9997
10/12/21 16:22:40.892	50.000	49.9997
10/12/21 16:22:40.912	50.000	49.9997
10/12/21 16:22:40.932	50.000	49.9997
10/12/21 16:22:40.952	50.000	49.9998
10/12/21 16:22:40.972	50.000	49.9998
10/12/21 16:22:40.992	50.000	49.9998
10/12/21 16:22:41.012	49.992	49.9998
10/12/21 16:22:41.032	50.002	49.9998

Figure 1 Frequency ocv and osv test results for the PRO EM325

SATEC Compliance with Frequency-Reading Requirements

1. Calculating frequency every cycle
2. Providing frequency readings in 3-decimal 0.001Hz resolution
3. Providing frequency calculations over fast communication, from 20ms, over Modbus / IEC 61850 and more

Field	Description	Example
Unit	Unique identifier assigned to the Response Unit (DCU)	ABCDE
t	ISO 8601 timestamp in UTC including milliseconds	2020-08-04T16:56:46.500Z
f_hz	Input frequency in Hz to 3 decimal places	49.992
baseline_mw	Baseline in MW to 4 decimal places	5.1256
p_mw	Measured active power output or demand in MW to 4 decimal places	10.5678
soe_import_mwh	State of energy (MWh) – (Capacity to Import) to 4 decimal places	17.6125
soe_export_mwh	State of energy (MWh) – (Capacity to Export) to 4 decimal places	12.5175
availability	Flag field to indicate availability of the unit. 0 = Unavailable 1 = Available	1

Figure 2 Metering requirements per Dynamic Containment