IEC 61557-12

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Standard for Power Metering & Monitoring Devices (PMD)

The 10 key questions

"You cannot manage what you don't measure"

Industry, health, building, IT ... For a large number of activities, boosting energy efficiency and increasing the availability of the electrical installation are major objectives. To understand the operation of an electrical installation and to anticipate any deviation, the parameters that govern the operation of the equipment must be monitored. To do this, appropriate measuring devices need to be installed to collect the measurements. **Power metering and monitoring devices (PMDs)** are perfectly suited to meet these needs.

This document describes the benefits of using **IEC 61557-12** compliant measuring equipment.

1. What is a Power metering & Monitoring Device (PMD)?

Definition in the **IEC 61557-12** standard is:
A PMD is a combination in one or more devices of several functional modules dedicated to metering and monitoring electrical parameters in energy distribution systems or electrical installations, used for applications such as energy efficiency, power monitoring and network performance.
PMD are historically also called power meter, power monitor, power monitor device, power energy monitoring device, power analyzer, multifunction meter, measuring multifunction equipment, energy meter.

IEC 61557-12 specifies requirements for fixed or portable PMDs that measure and monitor the electrical parameters quantities (U, I, P, E, THD…) within electrical distribution systems in single- and three-phase AC or DC networks having rated voltages up to 1 000 V AC or up to 1 500 V DC.

2. Why use PMDs?

Introduction in the **IEC 61557-12** standard is:
Energy distribution systems need to guarantee energy efficiency, availability and network performances in order to address the following challenges:
– sustainable development requirements where energy measurement, for instance, is recognized as an essential element of energy management (ISO 50001), part of the overall drive to reduce carbon emissions and to improve the commercial efficiency of manufacturing, commercial organizations and public services;
– technological evolutions (electronic loads, electronic measuring methods, etc.);
– end-users needs (cost saving, compliance with aspects of building regulations, etc.) regarding electrical energy management as well as other energies, or fluids.
Other functionalities involving several non-electrical parameters are often needed in addition:
– safety and continuity of service;
– energy efficiency of electrical installation;
– evolution of installation standards, for instance over-current detection is now a new requirement for the neutral conductor due to harmonic content.

Monitoring electrical quantities in internal networks with PMDs helps address these challenges.

3. Why is it important to have a standard for PMDs?

Standards reflect international consensus on the technical specification of the characteristics to be fulfilled by the product, system, service or object in question. They

- reflect the best experience of industry, researchers, consumers and regulators worldwide
- cover common needs in most countries
- contribute to the removal of technical barriers to trade.

Measuring the electrical parameters must be sufficiently reliable, accurate and repeatable in the environmental conditions to which the measurement devices will be subjected in the electrical panels, for example:

- increased ambient air temperature
- variation in the voltage and frequency of the grid
- electromagnetic disturbance caused by machines in an industrial environment

To ensure their safety and performance, the measurement devices must be qualified according to tests that are representative of the operating conditions of an installation.

The **IEC 61557-12** standard is the reference standard for measuring devices for monitoring electrical installations. It allows PMDs to address all those requirements.

4. What are the electrical parameters covered by the standard?

The **IEC 61557-12** standard covers all the electrical parameters necessary **for an overall monitoring** of the electrical installation. The following parameters are defined in the standard:

- Active & reactive Energy
- Apparent Energy
- Active & reactive Power
- Apparent Power
- Frequency
- Current & Voltage
- Power factor
- Flicker
- Voltage outages, dips & swells
- Current & voltage THD, harmonics
- Voltage & current unbalance

Depending on the type and quantity of electrical parameters monitored, the standard defines 3 types of PMD:

- PMD-I Energy efficiency
- PMD-II Basic power monitoring
- PMD-III Advanced power monitoring /network performance

The minimum **measurement functions** required per type are listed in Table 1 of the standard.

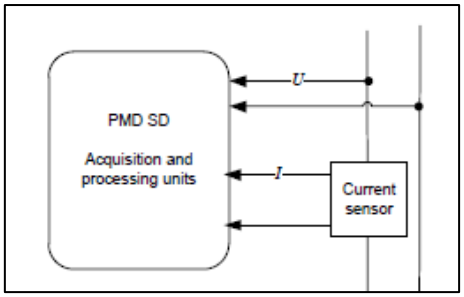
5. What is the structure of a PMD?

A PMD may be fitted with internal or external sensors depending on the applications. **IEC 61557-12** defines the categories of PMDs:

PMD XY

The "**X**" refers to the current sensor and the "**Y**" to the voltage sensor. The "**X**" or "**Y**" will be designated either as "**D**" for internal sensor or "**S**" for external sensor.

For example, a PMD **SD** is a PMD with external current sensors and direct voltage measurement (without external voltage sensors)

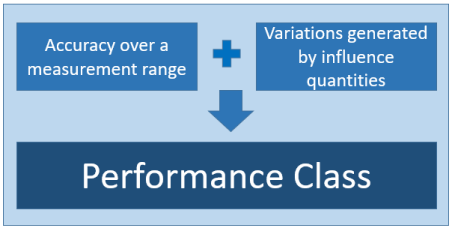


PMDs using dedicated sensors are considered as direct connected PMDs.

6. How to check the accuracy of a PMD?

An accuracy figure, given without information on the associated measuring range and operational conditions, is meaningless. The **IEC 61557-12** standard addresses this concern via the notion of **performance class**.

The **performance class** defines the accuracy of the parameters measured by a PMD (E, P, U, I, THD, harmonics, etc.) over a specified measurement range, while tolerating variations caused by influence quantities. The performance class given for an electrical parameter is checked by specific tests as described in the standard. The metrology laboratory of the manufacturer or a third-party laboratory must carry out these tests.



A **performance class** is an essential characteristic that enables measurement performance levels of PMDs from different manufacturers to be compared. It ensures that users can rely on the quality of the measurements of their PMD subjected to the severe constraints of an electrical installation.

In accordance with **IEC 61557-12** standard, a **performance class** must characterize each parameter measured by the PMD and documented.

7. What is the accuracy of a PMD with a performance class 0,5?

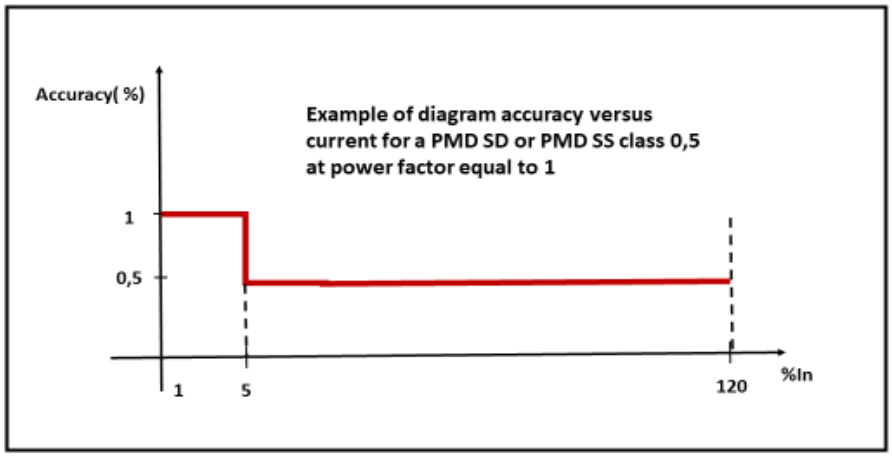
The performance class indicated in the product designation corresponds to the measurement of active or power energy. This class is considered as one of the essential characteristic of the PMD (see example of designation).

A PMD with a performance class of 0,5 in the standard must guarantee a measuring accuracy of 0,5% over a measuring range and with limited variation under influencing factors (temperature, EMC …).

The following diagram shows the active and power energy measurement accuracy requirements for a PMD class 0,5 with external current sensors (PMD SD or PMD SS):

- From 5% to 120% of nominal current In, the accuracy is better than or equal to 0,5%.

- From 1% to 5% of nominal current In, the accuracy is better than or equal to 1%



Example of PMD's designation with main characteristics

PMD-II SD K55 0,5

- Performance class for active energy or power energy: 0,5
- Operating temperature -10 to 55°C
- PMD-II with external current sensors & direct voltage measurement

8. What about equipment embedding a Power Metering and Monitoring Function?

Normative Annex H of the **IEC 61557-12** standard specifies additional requirements and tests for **Power Metering and Monitoring Function** embedded in equipment whose main function is not power metering and monitoring.

Such equipment, as defined in table H.1, include for example uninterruptible power systems (UPS), static transfer systems (STS), circuit breakers, transfer switching equipment (TSE), switches, disconnectors, switch-disconnectors, fuse-combination units, programmable controllers (PLC), inverter for use in photovoltaic power systems, residual current devices (RCDs, RCBOs) and residual current monitoring devices (RCM) .

Only equipment that fulfills all the requirements are compliant to **IEC 61557-12** standard.

9. PMDs and energy efficiency standards?

PMDs are at the heart of many standards related to energy efficiency of organization or electrical installations.

ISO 50001 requires for example to "*implement an energy data collection plan … and its measurement and monitoring equipment*" to enable the organization to demonstrate energy performance improvement. Requirements and principles for the design and implementation of such an energy collection plan are given in **EN 17267** (Energy measurement and monitoring plan).

IEC 60364-8-1 (Low-voltage electrical installations – Energy efficiency) provides recommendations for the implementation of PMDs in low voltage electrical installations for optimizing the overall efficient use of electricity.

10. Your benefits to use IEC 61557-12 compliant devices?

Select devices that comply with the **IEC 61557-12** standard brings you the following key advantages:

- warranted performance accuracy (for all electrical parameters)
- a high quality device in terms of design, robustness and functionality (EMC, IP, operating temperature …)
- the safety of the users in the working environment (IEC 61010)

Understanding what this standard covers and how to read related manufacturer information makes it easier for engineers and other electrical professionals to compare and select the relevant PMD for any given application.

Benefits of measurements for power monitoring application
Source: IEC TR 63213

Electrical quantities to measure	Symbol	Benefits of measurement
Current	I, I_N	Detect overheating or conditions that may lead to nuisance trips.
Voltage	U, V	Detect abnormal supply conditions of sensitive loads (e.g. motors) leading to premature failure.
Frequency	f	Detect abnormal speed of rotating machines.
Individual voltage harmonics, THD_u	U_h, THD_u	Monitor non-positive-sequence harmonics causing overheating of components (motors, transformers, cables, capacitors…), and motor shaft vibrations, resulting in premature failure.
Individual current harmonics, THD_i	I_h THD_i	
Voltage unbalance	U_{nb}	Monitor non-positive-sequence voltage causing motors and generators to overheat and fail prematurely.
Current unbalance	I_{nb}	
Voltage dips, voltage interruptions Voltage swells	U_{dip}, U_{int} U_{swl}	Detect degradation of supply quality before it leads to process stoppages with financial impact.
Power demand or Current demand	P	Optimize the load distribution, determine where new loads may be placed, or which feeder needs to be upgraded to serve the planned capacity.
Load profiles	LP	Detect abnormal load profiles
Reactive power	Q	Detect abnormal reactive power consumption
Apparent power	S	Detect abnormal apparent power consumption

The members of IEC TC 85 WG20 have prepared this supporting document.

This document aims to provide an overview of the benefits of IEC 61557-12 to stakeholders not familiar with this standard.

This document does not replace the official standard IEC 61557-12.

For more information about the different standards noted in this supporting document, see IEC Webstore

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