

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures –

Part 12: Performance measuring and monitoring devices (PMD)

Sécurité électrique dans les réseaux de distribution basse tension de 1 000 V c.a. et 1 500 V c.c. – Dispositifs de contrôle, de mesure ou de surveillance de mesures de protection –

Partie 12: Dispositifs de mesure et de surveillance des performances (PMD)



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL SAFETY IN LOW VOLTAGE DISTRIBUTION SYSTEMS UP TO 1 000 V a.c. AND 1 500 V d.c. – EQUIPMENT FOR TESTING, MEASURING OR MONITORING OF PROTECTIVE MEASURES –

Part 12: Performance measuring and monitoring devices (PMD)

FOREWORD

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The text of this standard is based on the following documents:

FDIS	Report on voting
85/311/FDIS	85/312/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This standard is to be used in conjunction with IEC 61557-1 (unless otherwise specified).

A list of all parts of the IEC 61557 series, published under the general title *Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

Withdrawn

INTRODUCTION

As a complement to protection measures, it becomes more and more necessary to measure different electrical parameters, in order to monitor the required performances in energy distribution systems due to:

- installation standards evolutions, for instance over current detection is now a new requirement for the neutral conductor due to harmonic content;
- technological evolutions (electronic loads, electronic measuring methods, etc.);
- end-users needs (cost saving, compliance with aspects of building regulations, etc..);
- safety and continuity of service;
- sustainable development requirements where energy measurement for instance is recognised as an essential element of energy management, part of the overall drive to reduce carbon emissions and to improve the commercial efficiency of manufacturing, commercial organisations and public services.

The devices on the current market have different characteristics, which need a common system of references. Therefore there is a need for a new standard in order to facilitate the choices of the end-users in terms of performance, safety, interpretation of the indications, etc. This standard provides a basis by which such devices can be specified and described, and their performance evaluated.

Withdawn

ELECTRICAL SAFETY IN LOW VOLTAGE DISTRIBUTION SYSTEMS UP TO 1 000 V a.c. AND 1 500 V d.c. – EQUIPMENT FOR TESTING, MEASURING OR MONITORING OF PROTECTIVE MEASURES –

Part 12: Performance measuring and monitoring devices (PMD)

1 Scope

This part of IEC 61557 specifies requirements for combined performance measuring and monitoring devices that measure and monitor the electrical parameters within electrical distribution systems. These requirements also define the performance, in single and three-phase a.c. or d.c. systems having rated voltages up to 1 000 V a.c. or up to 1 500 V d.c.

These devices are fixed installed or portable. They are intended to be used indoors and/or outdoors. This standard is not applicable for:

- electricity metering equipment that complies with IEC 62053-21, IEC 62053-22 and IEC 62053-23. Nevertheless, uncertainties defined in this standard for active and reactive energy measurement are derived from those defined in the IEC 62053 standards series.
- simple remote relays or simple monitoring relays.

This standard is intended to be used in conjunction with IEC 61557-1 (unless otherwise specified), which specifies the general requirements for measuring and monitoring equipment, as required in IEC 60364-6.

The standard does not include the measurement and monitoring of electrical parameters defined in Parts 2 to 9 of IEC 61557 or in IEC 62020.

Combined performance measuring and monitoring devices (PMD), as defined in this standard, give additional safety information, which aids the verification of the installation and enhances the performance of the distribution systems. For instance, those devices help to check if the level of harmonics is still compliant with the wiring systems as required in IEC 60364-5-52.

The combined performance measuring and monitoring devices (PMD) for electrical parameters described in this standard are used for general industrial and commercial applications. A PMD-A is a specific PMD complying with requirements of IEC 61000-4-30 class A, which may be used in "power quality assessment" applications.

NOTE 1 Generally such types of devices are used in the following applications or for the following general needs:

- energy management inside the installation;
- monitoring and/or measurement of electrical parameters that may be required or usual;
- measurement and/or monitoring of the quality of energy.

NOTE 2 A measuring and monitoring device of electrical parameters usually consists of several functional modules. All or some of the functional modules are combined in one device. Examples of functional modules are mentioned below:

- measurement and indication of several electrical parameters simultaneously;

- energy measurement and/or monitoring, and also sometimes compliance with aspects of building regulations;
- alarms functions;
- power quality (harmonics, over/undervoltages, voltage dips and swells, etc).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2: Tests – Tests B: Dry heat*

IEC 60068-2-30, *Environmental testing – Part 2-30 – Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60364-6, *Low-voltage electrical installations – Part 6: Verification*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-15, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 15: Flickermeter – Functional and design specifications*

IEC 61000-4-30:2003, *Electromagnetic compatibility (EMC) – Part 4-30: Testing and measurement techniques – Power quality measurement methods*

IEC 61010 (all parts), *Safety requirements for electrical equipment for measurement, control, and laboratory use*

IEC 61010-1:2001, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

IEC 61326-1:2005, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements*

IEC 61557-1:2007, *Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 1: General requirements*

IEC 62053-21:2003, *Electricity metering equipment (a.c.) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2)*

IEC 62053-22:2003, *Electricity metering equipment (a.c.) – Particular Requirements – Part 22: Static meters for active energy (classes 0,2 S and 0,5 S)*

IEC 62053-23:2003, *Electricity metering equipment (a.c.) – Particular requirements – Part 23: Static meters for reactive energy (classes 2 and 3)*

IEC 62053-31:1998, *Electricity metering equipment (a.c.) – Particular requirements – Part 31: Pulse output devices for electromechanical and electronic meters (two wires only)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61557-1, unless otherwise specified in this standard, and the following terms and definitions apply.

3.1 General definitions

3.1.1

performance measuring and monitoring device

PMD

combination in one or more devices of several functional modules dedicated to measuring and monitoring electrical parameters in energy distribution systems or electrical installations. A PMD can be used in connection with sensors (see 4.3)

A PMD that complies with class B as defined in IEC 61000-4-30 is also covered by this definition.

NOTE 1 Under the generic term “monitoring” are also included functions of recording, alarm management etc.

NOTE 2 These devices may include power quality functions.

3.1.2

PMD-A

PMD in which all power quality assessment functions comply with measurement methods and performance requirements according to class A of IEC 61000-4-30 and with complementary requirements (safety, EMC, temperature range, complementary influence quantities, ...) of this standard

NOTE If this device is used for checking the compliance to the connection agreement with a network operator, it should be installed at the interface point between the installation and the network.

3.1.3

power quality assessment functions

power quality functions whose measurement methods are defined in IEC 61000-4-30

3.1.4

specified external sensor

sensor that is chosen in such a way that, connected to a PMD without sensors, the system performance class complies with 4.4.2

3.1.5

current sensor

CS

electrical, magnetic, optical or other device intended to transmit a signal corresponding to the current flowing through the primary circuit of this device

NOTE A current transformer (CT) is in general a magnetic current sensor.

3.1.6

compliance voltage

value of the voltage that can be developed at the output of a current generator while conforming to the requirement of the uncertainty specification for that output

NOTE This definition applies to current analogue output signals.

3.1.7 voltage sensor VS

electrical, magnetic, optical or other device intended to transmit a signal corresponding to the voltage across the primary terminals of this device

NOTE A voltage transformer (VT) is in general a magnetic voltage sensor.

3.1.8 self-powered PMD

equipment able to work without an auxiliary power supply

NOTE 1 Self powered PMD have no provision for power supply terminals.

NOTE 2 Self powered PMD includes equipment powered from measurement inputs, internal batteries, or other internal power sources (internal photo-voltaic sources, etc.).

3.1.9 auxiliary power supply

external power supply, either a.c. or d.c. that powers the PMD through dedicated terminals separated from the measurement inputs of the PMD

3.2 Definitions related to uncertainty and performance

3.2.1 reference conditions

appropriate set of specified values and/or ranges of values of influence quantities under which the smallest permissible uncertainties of a measuring instrument are specified

NOTE The ranges specified for the reference conditions, called reference ranges, are not wider, and are usually narrower, than the ranges specified for the rated operating conditions.

[IEC 60359, definition 3.3.10]

3.2.2 intrinsic uncertainty

uncertainty of a measuring instrument when used under reference conditions. In this standard, it is a percentage of the measured value defined in its rated range and with the other influence quantities under reference conditions, unless otherwise stated

[IEC 60359, definition 3.2.10, modified]

3.2.3 influence quantity

quantity which is not the subject of the measurement and whose change affects the relationship between the indication and the result of the measurement

NOTE 1 Influence quantities can originate from the measured system, the measuring equipment or the environment [IEV].

NOTE 2 As the calibration diagram depends on the influence quantities, in order to assign the result of a measurement it is necessary to know whether the relevant influence quantities lie within the specified range [IEV].

[IEC 60359, definition 3.1.14 modified]

3.2.4 variation (due to a single influence quantity)

difference between the value measured under reference conditions and any value measured within the influence range

NOTE The other performance characteristics and the other influence quantities should stay within the ranges specified for the reference conditions.

3.2.5

(rated) operating conditions

set of conditions that must be fulfilled during the measurement in order that a calibration diagram may be valid

NOTE Beside the specified measuring range and rated operating ranges for the influence quantities, the conditions may include specified ranges for other performance characteristics and other indications that cannot be expressed as ranges of quantities.

[IEC 60359, definition 3.3.13]

3.2.6

operating uncertainty

uncertainty under the rated operating conditions

NOTE The operating instrumental uncertainty, like the intrinsic one, is not evaluated by the user of the instrument, but is stated by its manufacturer or calibrator. The statement may be expressed by means of an algebraic relation involving the intrinsic instrumental uncertainty and the values of one or several influence quantities, but such a relation is just a convenient means of expressing a set of operating instrumental uncertainties under different operating conditions, not a functional relation to be used for evaluating the propagation of uncertainty inside the instrument.

[IEC 60359, definition 3.2.11, modified]

3.2.7

overall system uncertainty

uncertainty including the instrumental uncertainty of several separated instruments (sensors, wires, measuring instrument, etc.) under the rated operating conditions

3.2.8

function performance class

performance of a single function without external sensors, expressed as a percentage and depending on function intrinsic uncertainty and on variations due to influence quantities

NOTE In this standard, C stands for function performance class.

3.2.9

system performance class

performance of a single function including specified external sensors expressed as a percentage and depending on function intrinsic uncertainty and on variations due to influence quantities

NOTE In this standard, C stands also for system performance class.

3.2.10

rated frequency

f_n

value of the frequency in accordance with which the relevant performance of the PMD is fixed

NOTE f_n stands for nominal frequency in IEC 61557-1.

3.2.11

rated current

I_n

value of current in accordance with which the relevant performance of an PMD operated by an external current sensor (PMD Sx) is fixed

[IEV 314-07-02, modified]

NOTE I_n stands for nominal current in IEC 61557-1.

3.2.12

basic current

I_b

value of current in accordance with which the relevant performance of a direct connected PMD (PMD Dx) is fixed

[IEC 62052-11, definition 3.5.1.2, modified]

3.2.13

starting current

I_{st}

lowest value of the current at which the PMD starts and continues to register

[IEC 62052-11, definition 3.5.1.1, modified]

3.2.14

maximum current

I_{max}

highest value of current at which the PMD meets the uncertainty requirements of this standard

[IEC 62052-11, definition 3.5.2, modified]

3.2.15

rated voltage

U_n

value of the voltage in accordance with which the relevant performances of the PMD are fixed. Depending on the distribution system and its connection to the PMD, this voltage can be either the phase to phase voltage or the phase to neutral voltage

NOTE U_n stands for nominal voltage in IEC 61557-1.

3.2.16

nominal voltage

U_{nom}

a suitable approximate value of voltage used to designate or identify a system

[IEV 601-01-21]

3.2.17

minimum voltage

U_{min}

lowest value of voltage at which the PMD meets the uncertainty requirements of this standard

3.2.18

maximum voltage

U_{max}

highest value of voltage at which the PMD meets the uncertainty requirements of this standard

3.2.19

declared input voltage

U_{din}

value obtained from the declared supply voltage by a transducer ratio

[IEC 61000-4-30, definition 3.2]

**3.2.20
residual voltage**

U_{resid}
minimum value of U recorded during a voltage dip or interruption

NOTE The residual voltage is expressed as a value in volts, or as a percentage or per unit value of the rated voltage.

[IEC 61000-4-30, definition 3.25, modified]

**3.2.21
demand value**

average value of a quantity over a specified period of time

**3.2.22
peak demand value**

highest demand value (positive or negative) since the beginning of the measurement or the last reset

**3.2.23
thermal demand**

emulation of a thermal demand meter that provides an exponentially time lagged demand, given a constant load, the indication reading 90% of the actual demand in a specified time

NOTE Time is specified by manufacturer, usually 15 min.

**3.2.24
three-phase average value**

in a three- or four-wire system, the arithmetical average of each phase value

**3.2.25
maximum value**

highest value measured or calculated since the beginning of the measurement or the last reset

**3.2.26
minimum value**

lowest value measured or calculated since the beginning of the measurement or last reset

**3.2.27
interval**

period of time used by the PMD to integrate r.m.s. or instantaneous values in order to calculate demand values

3.3 Definitions related to electric phenomena**3.3.1
phase current**

I

value of the current flowing in each phase of an electrical distribution system

**3.3.2
neutral current**

I_N

value of neutral current of an electrical distribution system

3.3.3

phase to phase voltage line to line voltage

U

the voltage between phases

[IEV 601-01-29]

3.3.4

phase to neutral voltage line to neutral voltage

V

voltage between a phase in a polyphase system and the neutral point

[IEV 601-01-30]

3.3.5

frequency

f

value of measured frequencies in an electrical distribution system

3.3.6

power factor

PF

under periodic conditions, ratio of the absolute value of the active power to the apparent power

NOTE This power factor is not the displacement power factor.

[IEV 131-11-46, modified]

3.3.7

amplitude of harmonic current

I_h

value of the amplitude of the current at harmonic frequencies in the spectrum obtained from a Fourier transform of a time function

3.3.8

amplitude of harmonic voltage

U_h

value of the amplitude of the voltage at harmonic frequencies in the spectrum obtained from a Fourier transform of a time function

3.3.9

stationary harmonics (voltage and current)

harmonic content of the signal with the amplitude variation of each harmonic component remaining constant within $\pm 0,1$ % of the amplitude of the fundamental

3.3.10

quasi-stationary harmonics (voltage and current)

harmonic content of the signal with the amplitude variation of each harmonic component of each contiguous 10/12 cycles window remaining within $\pm 0,1$ % of the fundamental

3.3.11

sub-harmonics (voltage and current)

interharmonic component of harmonic order lower than one

NOTE In this standard sub-harmonic components are restricted to ranks being reciprocal of integers.

[IEV 551-20-10, modified]

3.3.12**flicker**

impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time

[IEV 161-08-13]

3.3.13**voltage dip**

temporary reduction of the voltage at a point in the electrical distribution system below a defined threshold

NOTE 1 Interruptions are a special case of a voltage dip. Post-processing may be used to distinguish between voltage dips and interruptions.

NOTE 2 In some areas of the world a voltage dip is referred to as sag. The two terms are considered interchangeable; however, this standard will only use the term voltage dip.

[IEC 61000-4-30, definition 3.30, modified]

3.3.14**voltage swell**

temporary increase of the voltage at a point in the electrical distribution system above a defined threshold

[IEC 61000-4-30, definition 3.31, modified]

3.3.15**voltage interruption**

reduction of the voltage at a point in the electrical distribution system below a defined interruption threshold

3.3.16**amplitude and phase unbalanced voltage**

condition in a three-phase system in which the r.m.s. values of the line voltages (fundamental component), or the phase angles between consecutive line voltages, are not all equal

NOTE 1 The degree of the inequality is usually expressed as the ratios of the negative-sequence and zero-sequence components to the positive-sequence component.

NOTE 2 In this standard, voltage unbalance is considered in relation to three-phase systems.

[IEV 161-08-09, modified]

3.3.17**amplitude unbalanced voltage**

condition in a three-phase system in which the r.m.s. values of the line voltages (fundamental component) are not all equal. Relative phase between the line voltages is not taken into account.

NOTE In this standard, voltage unbalance is considered in relation to three-phase systems.

[IEV 161-08-09, modified]

3.3.18**transient overvoltage**

short-duration overvoltage of few milliseconds or less, oscillatory or non-oscillatory, usually highly damped.

[IEV 604-03-13]

NOTE 1 Transient overvoltages may be immediately followed by temporary overvoltages. In such cases the two overvoltages are considered as separate events.

NOTE 2 IEC 60071-1 defines three types of transient overvoltages, namely slow-front overvoltages, fast-front overvoltages and very fast-front overvoltages according to their time to peak, tail or total duration, and possible superimposed oscillations.

3.3.19

mains signalling voltage

signals transmitted by energy suppliers on public networks for network management purposes, such as the control of some categories of load.

NOTE Technically, mains signalling is a source of interharmonics voltages. In this case, however, the signal voltage is intentionally impressed on a selected part of the supply system. The voltage and frequency of the emitted signal are pre-determined, and the signal is transmitted at particular times.

3.4 Definitions related to measurement techniques

3.4.1

zero blind measurement

measurement technique where the measurement is performed continuously. For digital techniques and for a given sampling rate, no sample shall be missing in the measurement processing.

NOTE When zero blind measurement techniques are used, no assumption is made regarding the stability of the signal, in opposition with non-zero blind measurement techniques, where the signal is considered to be stable during the time where no measurement is done.

3.5 Notations

3.5.1 Functions

Symbol	Function
P	total active power
E_a	total active energy
Q_A / Q_V	total reactive power arithmetic / total reactive power vector
E_{rA} / E_{rV}	total reactive energy arithmetic / total reactive energy vector
S_A / S_V	total apparent power arithmetic / total apparent power vector
E_{apA} / E_{apV}	total apparent energy arithmetic / total apparent energy vector
f	frequency
I	phase current including I_p (current on Line p)
I_N / I_{Nc}	measured neutral current / calculated neutral current
U	voltage including U_{pg} (line p to line g voltage) and V_p (line p to neutral voltage)
U_{din}	declared input voltage [IEC 61000-4-30]
PF_A / PF_V	power factor arithmetic / power factor vector
NOTE $PF_V = \cos(\varphi)$ when no harmonics are present	
P_{st} / P_{lt}	short term flicker / long term flicker
U_{dip}	voltage dips including $U_{pg \text{ dip}}$ (line p to line g) and $V_{p \text{ dip}}$ (line p to neutral)
U_{swl}	voltage swells including $U_{pg \text{ swl}}$ (line p to line g) and $V_{p \text{ swl}}$ (line p to neutral)
U_{tr}	transients overvoltage including $U_{pg \text{ tr}}$ (line p to line g) and $V_{p \text{ tr}}$ (line p to neutral)
U_{int}	voltage Interruption including $U_{pg \text{ int}}$ (line p to line g) and $V_{p \text{ int}}$ (line p to neutral)
U_{nb}	voltage Unbalance phase and amplitude including $V_{p \text{ nb}}$ (line p to neutral)
U_{nba}	voltage Unbalance amplitude including $V_{p \text{ nba}}$ (line p to neutral)
U_h	voltage harmonics including $U_{pg \text{ h}}$ (line p to line g) and $V_{p \text{ h}}$ (line p to neutral)
THD_u	total harmonic distortion voltage related to fundamental
$THD-R_u$	total harmonic distortion voltage related to r.m.s. value

I_h	current harmonics including $I_{p\ h}$ (harmonics on line p)
THD_i	total harmonic current related to fundamental
$THD-R_i$	total harmonic current related to r.m.s. value
Msv	mains signalling voltage

3.5.2 Symbols and abbreviations

$\%U_n$	percentage of U_n
$\%I_n$	percentage of I_n
$\%I_b$	percentage of I_b

3.5.3 Indices

a	active
r	reactive
ap	apparent
n	rated
b	basic
nom	nominal
N	neutral
c	calculated
h	harmonic
i	current
u	voltage
dip	dips
swl	swells
tr	transient
int	interruption
nb	unbalance
nba	amplitude unbalance
A	arithmetic
V	vectorial
min	minimum value
max	maximum value
avg	average value
peak	peak value
resid	residual

4 Requirements

4.1 General requirements

The following requirements as well as those given in IEC 61557-1 shall apply unless otherwise specified hereafter.

For safety requirements, IEC 61010-1, applicable parts of IEC 61010 and additional requirements specified hereafter shall apply.

For electromagnetic compatibility (EMC) requirements, IEC 61326-1 shall apply unless otherwise specified hereafter. For immunity, Table 2 of IEC 61326-1 (Immunity test requirements for equipment intended for use in industrial locations) shall apply. For emission either class A or class B limits as defined in IEC 61326-1 shall apply.

NOTE Guidance for requirements applicable to PMD-A or/and PMD is given in Annex E.

4.2 PMD general architecture

Organisation of the measurement chain: the electrical quantity to be measured may be either directly accessible, as it is generally the case in low-voltage systems, or accessible via measurement sensors like voltage sensors (VS) or current sensors (CS).

Figure 1 below shows the common organisation of a PMD.

In some cases when a PMD does not include the sensors, their associated uncertainties are not considered. When a PMD includes the sensors, their associated uncertainties are considered.

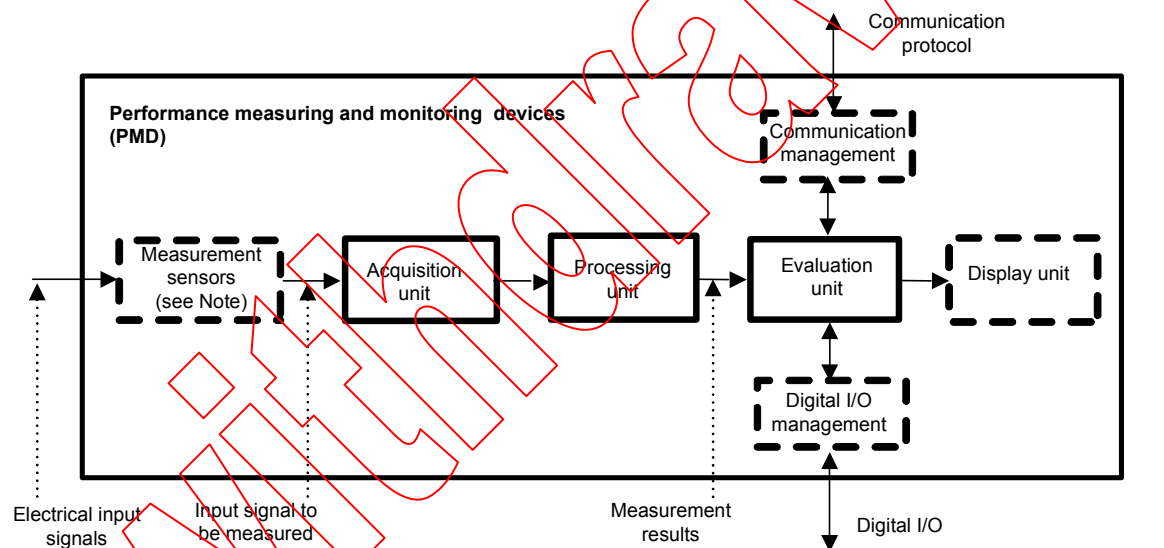


Figure 1 – PMD generic measurement chain

IEC 1272/07

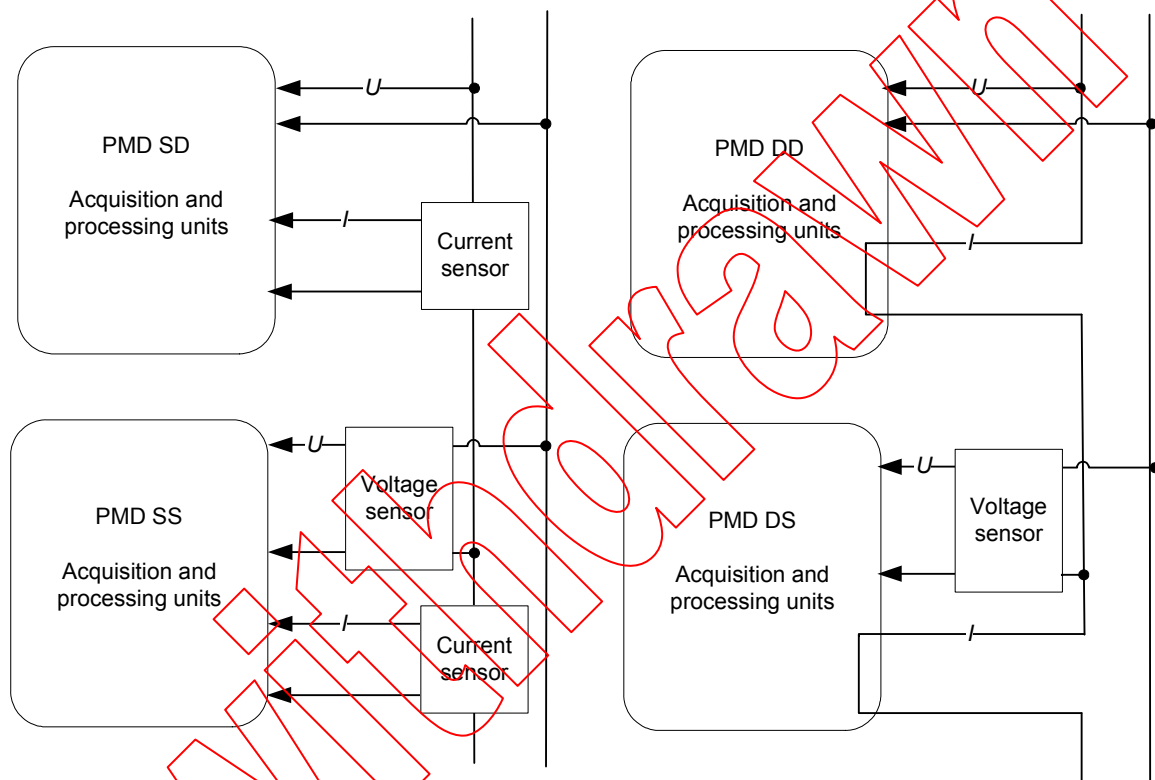
NOTE It is not necessary that the parts in the dotted lines shown in Figure 1 be included in the PMD.

4.3 Classification of PMD

PMD either can have an internal sensor, or may need an external sensor, as shown in Figure 2. Depending on these characteristics, PMD can be split in 4 categories as defined in Table 1.

Table 1 – Classification of PMD

		Current measurement	
		Sensor operated PMD (current sensors out of PMD) → PMD Sx	Direct connected PMD (current sensors in PMD) → PMD Dx
Voltage measurement	Direct connected PMD (voltage sensors in PMD) → PMD xD	PMD SD (Semi-direct insertion)	PMD DD (Direct insertion)
	Sensor operated PMD (voltage sensors out of PMD) → PMD xS	PMD SS (Indirect insertion)	PMD DS (Semi-direct insertion)



IEC 1273/07

NOTE A PMD specified as a PMD Dx (respectively PMD xD) can sometimes under certain conditions be used as a PMD Sx (respectively PMD xS) when used with external sensors provided that it complies with both requirements of PMD Sx and Dx (respectively PMD xS and xD).

Figure 2 – Description of different types of PMD

4.4 List of applicable performance classes

4.4.1 List of applicable function performance classes for PMD without external sensors

Table 2 specifies the list of allowed performance classes for a PMD without external sensors:

Table 2 – List of applicable function performance classes for PMD without external sensors

0,02	0,05	0,1	0,2	0,5	1	1,5	2	2,5	3	5	10	20
------	------	-----	-----	-----	---	-----	---	-----	---	---	----	----

4.4.2 List of applicable system performance classes for PMD with external sensors

Table 3 specifies the list of allowed performance classes for a system including a PMD and its external sensors:

Table 3 – List of applicable system performance classes for PMD with external sensors

0,02	0,05	0,1	0,2	0,5	1	1,5	2	2,5	3	5	10	20
------	------	-----	-----	-----	---	-----	---	-----	---	---	----	----

It is not allowed to specify a system performance class without specified external sensors.

The requirements for the system performance for a PMD with a specified external sensor are the same as for a direct connected PMD.

NOTE When a PMD Sx or a PMD xS is used with specified external sensors, the system performance class is based on the measured intrinsic uncertainty.

When the sensors are not specified, the system performance class is equal to the uncertainty calculated according to Annex D.

4.5 Operating and reference conditions for PMD

4.5.1 Reference conditions

Table 4 gives the reference conditions for testing.

Table 4 – Reference conditions for testing

Conditions	Reference conditions
Operating temperature	23 °C ± 2 °C or otherwise specified by manufacturer
Relative humidity	40 % to 60 % RH
Auxiliary supply voltage	Rated power supply voltage ±1 %
Phases	Three phases available ^a
Voltages unbalance	≤ 0,1 % ^a
External continuous magnetic field	≤ 40 A/m d.c. ≤ 3 A/m ac at 50/60 Hz
D.c. component on voltage and current	None
Waveform	Sinusoidal
Frequency	Rated frequency (50 Hz or 60 Hz) ±0,2 % ^b
^a Required only in the case of three-phase systems.	
^b PMD should use the standard rated frequencies of 50 Hz or 60 Hz, where possible, although other rated frequencies, or rated frequency ranges, including d.c., may be specified.	

4.5.2 Rated operating conditions

The tables below give the conditions in which functions shall be performed according to their specifications.

4.5.2.1 Rated temperature operating conditions for portable equipment

Table 5 gives the rated operating temperature for portable PMD:

Table 5 – Rated operating temperatures for portable equipment

	K40 temperature class of PMD
Rated operating range (with specified uncertainty)	0 °C to +40 °C
Limit range of operation (no hardware failures)	–10 °C to +55 °C
Limit range for storage and shipping	–25 °C to +70 °C

4.5.2.2 Rated temperature operating conditions for fixed installed equipment

Table 6 gives the rated operating temperature for fixed installed PMD:

Table 6 – Rated operating temperatures for fixed installed equipment

	K55 temperature class of PMD	K70 temperature class of PMD	Kx^b temperature class of PMD
Rated operating range (with specified uncertainty)	–5 °C to +55 °C	–25 °C to +70 °C	Above +70 °C and/or under –25 °C ^a
Limit range of operation (no hardware failures)	–5 °C to +55 °C	–25 °C to +70 °C	Above +70 °C and/or under –25 °C ^a
Limit range for storage and shipping	–25 °C to +70 °C	–40 °C to +85 °C	Acc. to manufacturer specification ^a
^a Limits are to be defined by manufacturer according to the application.			
^b Kx stands for extended conditions.			

4.5.2.3 Rated humidity and altitude operating conditions

Table 7 gives the rated operating humidity and altitude for portable and fixed installed PMD:

Table 7 – Humidity and altitude operating conditions

	Standard conditions	Extended conditions
Rated operating range (with specified uncertainty)	0 to 75 % RH ^b	0 to above 75 % RH ^{a b}
Limit range of operation for 30 days/year	0 to 90 % RH ^b	0 to above 90 % RH ^{a b}
Limit range for storage and shipping	0 to 90 % RH ^b	0 to above 90 % RH ^{a b}
Altitude	0 to 2 000 m	0 to above 2000 m ^a
^a Limits are to be defined by manufacturer according to the application.		
^b Relative humidity values are specified without condensation.		

The limits of relative humidity as a function of ambient temperature are shown in Figure 3.

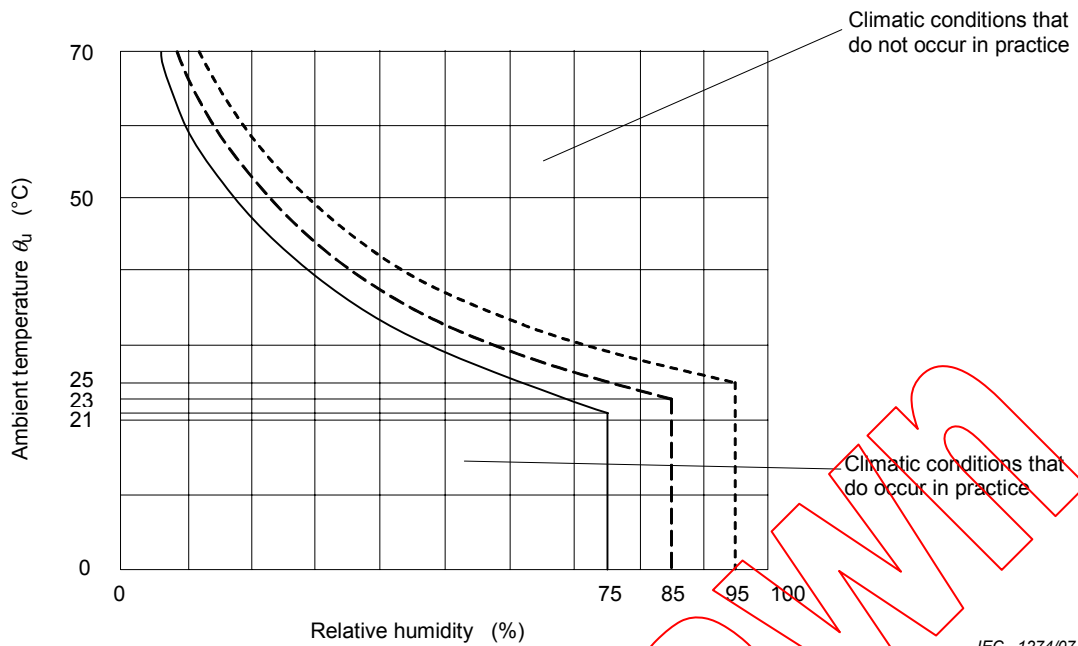


Figure 3 – Relationship between ambient air temperature and relative humidity

4.6 Start-up conditions

Measurement readings shall be available via communications or local user interface 15 s after applying power supply. If the start-up is longer than 15 s, manufacturers shall specify the maximum time until measurement quantities shall be available via communications or local user interface after power supply is applied.

When no communication or local user interface is available, this requirement shall be verified according to the test procedure given in 6.1.14.

4.7 Requirements for PMD functions (except PMD-A)

Subclause 4.7 describes a list of functions. Depending on the purpose of the measurement, all or a subset of the functions listed shall be measured.

All functions implemented in the product and covered by this standard shall comply with the requirements of this standard.

4.7.1 Active power (P) and active energy (E_a) measurements

4.7.1.1 Techniques

See Annex A.

Zero blind measurement is required.

4.7.1.2 Rated range of operation

The intrinsic uncertainty requirements shall apply within the following rated range:

$$80 \% U_n < U < 120 \% U_n$$

4.7.1.3 Intrinsic uncertainty table

The intrinsic uncertainty under reference conditions shall not exceed limits given in Table 8:

Table 8 – Intrinsic uncertainty table for active power and active energy measurement

Specified measuring range		Power factor ^d	Intrinsic uncertainty limits for PMD of function performance class C ^{a b c}		Unit
Value of current for Direct connected PMD Dx	Value of current for Sensor operated PMD Sx		for C < 1	for C ≥ 1	
$2\% I_b \leq I < 10\% I_b$	$1\% I_n \leq I < 5\% I_n$	1	$\pm 2,0 \times C$	No requirement	%
$5\% I_b \leq I < 10\% I_b$	$2\% I_n \leq I < 5\% I_n$	1	No requirement	$\pm (1,0 \times C + 0,5)$	%
$10\% I_b \leq I \leq I_{max}$	$5\% I_n \leq I \leq I_{max}$	1	$\pm 1,0 \times C$	$\pm 1,0 \times C$	%
$5\% I_b \leq I < 20\% I_b$	$2\% I_n \leq I < 10\% I_n$	0,5 inductive 0,8 capacitive	$\pm (1,7 \times C + 0,15)$ $\pm (1,7 \times C + 0,15)$	No requirement No requirement	%
$10\% I_b \leq I < 20\% I_b$	$5\% I_n \leq I < 10\% I_n$	0,5 inductive 0,8 capacitive	No requirement No requirement	$\pm (1,0 \times C + 0,5)$ $\pm (1,0 \times C + 0,5)$	%
$20\% I_b \leq I \leq I_{max}$	$10\% I_n \leq I \leq I_{max}$	0,5 inductive 0,8 capacitive	$\pm (1,0 \times C + 0,1)$ $\pm (1,0 \times C + 0,1)$	$\pm 1,0 \times C$ $\pm 1,0 \times C$	%
^a The permitted values for active energy function performance class C are: 0,2 – 0,5 – 1 – 2, the permitted values for active power function performance class C are: 0,1 – 0,2 – 0,5 – 1 – 2 – 2,5. ^b The permitted values and formula to calculate the system performance class of a PMD with an external current sensor or voltage sensor are given in Annex D. ^c For active energy measurement class 1 and 2 of this standard, the uncertainty limits of classes 1 and 2 defined in Table 6 of IEC 62053-21 can be used as well as the uncertainty limits given in this table. For active energy measurement class 0,2 and 0,5 of this standard, the uncertainty limits of class 0,2S and 0,5S defined in Table 4 of IEC 62053-22 can be used as well as the uncertainty limits given in this table. ^d In reference conditions, signals are sinusoidal, so in this case power factor = cos φ.					

4.7.1.4 Limits of variations due to influence quantities

The additional variations due to influence quantities with respect to reference conditions as given in 4.5.1, shall not exceed the limits for the relevant performance class given in the Table 9:

Table 9 – Influence quantities for active power and active energy measurement

Influence quantities	Influence type	Influence range	Specified measuring range ^e		Power factor ^j	Temperature coefficient for PMD of function performance class C ^{a b}		Unit
			Value of current for Direct connected PMD D _x ^f	Value of current for Sensor operated PMD S _x ^f		for C < 1	for C ≥ 1	
Ambient temperature		according to rated operating range of Table 5 & Table 6	10 % I _b ≤ I ≤ I _{max} 20 % I _b ≤ I ≤ I _{max}	5 % I _n ≤ I ≤ I _{max} 10 % I _n ≤ I ≤ I _{max}	1 0,5 inductive	0,05 x C 0,1 x C	0,05 x C 0,07 x C	% / K % / K
						Limits of variation for PMD of function performance class C ^{a b}		
						for C < 1	for C ≥ 1	
Auxiliary power supply voltage ^l		rated voltage ±15 %	10 % I _b	10 % I _n	1	0,1 x C	0,1 x C	%
Voltage		80 % U _n < U < 120 % U _n	5 % I _b ≤ I ≤ I _{max} 10 % I _b ≤ I ≤ I _{max}	2 % I _n ≤ I ≤ I _{max} 5 % I _n ≤ I ≤ I _{max}	1 0,5 inductive	0,3 x C + 0,04 0,6 x C + 0,08	0,3 x C + 0,4 0,5 x C + 0,5	% %
Frequency		rated frequency ±2 %	5 % I _b ≤ I ≤ I _{max} 10 % I _b ≤ I ≤ I _{max}	2 % I _n ≤ I ≤ I _{max} 5 % I _n ≤ I ≤ I _{max}	1 0,5 inductive	0,3 x C + 0,04 0,3 x C + 0,04	0,3 x C + 0,2 0,3 x C + 0,4	% %
Reversed phase sequence		---	10 % I _b	10 % I _n	1	0,15 x C + 0,02	1,5	%
Voltage unbalance		0 to 10 %	I _b	I _n	1	1,5 x C + 0,2	2,0 x C	%
Phase missing ^f		one or 2 phases missing	I _b	I _n	1	2,0 x C	2,0 x C	%
Harmonic components in the current and voltage circuits		voltage, 5th harmonic: 10 % current, 5th harmonic: 40 %	50 % I _{max}	50 % I _{max}	1	0,4 x C + 0,3	0,2 x C + 0,6	%

Table 9 (continued)

Influence quantities		Specified measuring range ^e		Power factor ^j	Temperature coefficient for PMD of function performance class C ^{a,b}		Unit
Influence type	Influence range	Value of current for Direct connected PMD Dx ^f	Value of current for Sensor operated PMD Sx ^f				
Odd harmonics in the a.c. current circuit	see g	50 % I _b	50 % I _n	1	3,0 x C	3,0 x C	%
Sub harmonic in the a.c. current circuit	see g	50 % I _b	50 % I _n	1	3,0 x C	3,0 x C	%
Common mode voltage rejection on isolated current inputs ^k	0 to maximum voltage to earth (depending on measuring category) ⁱ	10 % I _b	5 % I _n	1	1,0 x C	0,5 x C	%
Permanent a.c. magnetic induction of external origin 0,5 mT ^{c,d,h}	see c and d	I _b	I _n	1	2,0	1,0 x C + 1,0	%
Electromagnetic RF fields ^{c,d}	see c and d	I _b	I _n	1	3,4 x C + 0,3	1,0 x C + 1,0	%
Conducted disturbances, induced by radio frequency fields ^{c,d}	see c and d	I _b	I _n	1	3,4 x C + 0,3	1,0 x C + 1,0	%

a The permitted values for active energy function performance class C are: 0,2 – 0,5 – 1 – 2, the permitted values for active power function performance class C are: 0,1 – 0,2 – 0,5 – 1 – 2 – 2,5

b For active energy measurement class 1 and 2 of this standard, the variation limits of class 1 and 2 defined in Table 8 of IEC 62053-21 can be used as well as the uncertainty limits given in this table. For active energy measurement class 0,2 and 0,5 of this standard, the variation limits of class 0,2 S and 0,5 S defined in Table 6 of IEC 62053-22 can be used as well as the uncertainty limits given in this table.

c EMC levels and test conditions are defined in IEC 61326 standard relating to industrial location.

d The EMC influence quantities are applicable only for energy measurements.

e Currents are balanced unless otherwise specified.

f Not applicable to self powered PMD.

g See clause 6.

h A magnetic induction of external origin of 0,5 mT produced by a current of the same frequency as that of the voltage applied to the PMD and under the most unfavourable conditions of phase and direction shall not cause a variation exceeding the values shown in this table.

i Measuring category is defined in IEC 61010-2-030, for instance 300 V common mode voltage for 300 V cat III.

j In reference conditions, signals are sinusoidal, so in this case power factor = cos φ.

k current inputs are connected internally or externally to the ground, this requirement is not applicable.

l these limits are settled for a PMD powered by mains supply voltage. In the case of a larger range of the supply voltage a.c or d.c., tests shall be done at least at lower input value and upper input value of this range. In any case, PMD shall comply with the requirement for all the specified supply voltage ranges.

4.7.1.5 Starting and no-load condition

4.7.1.5.1 Start-up of the PMD

See subclause 4.6.

4.7.1.5.2 No load condition (only for energy measurement)

When the voltage is applied with no current flowing in the current circuit, the test output of the PMD shall not produce more than one pulse.

For this test, the current circuit shall be open-circuit and a voltage of 115 % of the rated voltage shall be applied to the voltage circuit.

NOTE In the case of outside shunt, only the input circuit of the PMD shall be opened.

The minimum test period Δt shall be:

PMD types	Minimum test period Δt for no load condition	
	for $C < 1$	for $C \geq 1$
PMD	$\Delta t = \frac{((100 / C) + 400) \times 10^6}{k \times m \times U_n \times I_{\max}} \text{ min}$	$\Delta t = \frac{((240 / C) + 360) \times 10^6}{k \times m \times U_n \times I_{\max}} \text{ min}$

where

C is the function performance class;

k is the number of pulses emitted by the output device of the PMD per kilowatt-hour (imp/kWh);

m is the number of measuring elements;

U_n is the rated voltage in volts;

$I_{\max}$ is the maximum current in amperes.

For transformer-operated PMD with primary or half-primary registers, the constant k shall correspond to the secondary values (voltage and current).

4.7.1.5.3 Starting current

The PMD shall start and continue to register at the starting current values (and in the case of three-phase meters, with balanced load) shown in Table 10.

When starting conditions are met (according to Table 10), intrinsic uncertainty shall be between –40 % and +90 % of measured values.

If the PMD is designed for the measurement of energy in both directions, then this test shall be applied with energy flowing in each direction.

Table 10 – Starting current for active power and active energy measurement

PMD types	Power factor ^a	Starting current for PMD of function performance class C	
		for C < 1	for C ≥ 1
PMD Dx	1	$2 \times 10^{-3} \times I_b$	$(C + 3) \times 10^{-3} \times I_b$
PMD Sx	1	$1 \times 10^{-3} \times I_n$	$(C + 1) \times 10^{-3} \times I_n$

^a In reference conditions, signals are sinusoidal, so in this case power factor = cos φ.

4.7.2 Reactive power (Q_A , Q_V) and reactive energy (E_{rA} , E_{rV}) measurements

4.7.2.1 Techniques

See Annex A.

Zero blind measurement is required.

4.7.2.2 Rated range of operation

The intrinsic uncertainty requirements shall apply within the following rated range:

$$80 \% U_n < U < 120 \% U_n$$

4.7.2.3 Intrinsic uncertainty table

The intrinsic uncertainty under reference conditions shall not exceed limits given in Table 11:

Table 11 – Intrinsic uncertainty table for reactive power and reactive energy measurement

Specified measuring range		sin φ (inductive or capacitive)	Intrinsic uncertainty limits for PMD of function performance class C ^{a b c}		Unit
value of current for Direct connected PMD Dx	value of current for Sensor operated PMD Sx		for C < 3	for C ≥ 3	
$5 \% I_b \leq I < 10 \% I_b$	$2 \% I_n \leq I < 5 \% I_n$	1	$\pm 1,25 \times C$	$\pm 1,33 \times C$	%
$10 \% I_b \leq I \leq I_{max}$	$5 \% I_n \leq I \leq I_{max}$	1	$\pm 1,0 \times C$	$\pm 1,0 \times C$	%
$10 \% I_b \leq I < 20 \% I_b$	$5 \% I_n \leq I < 10 \% I_n$	0,5	$\pm 1,25 \times C$	$\pm 1,33 \times C$	%
$20 \% I_b \leq I \leq I_{max}$	$10 \% I_n \leq I \leq I_{max}$	0,5	$\pm 1,0 \times C$	$\pm 1,0 \times C$	%
$20 \% I_b \leq I \leq I_{max}$	$10 \% I_n \leq I \leq I_{max}$	0,25	$\pm 1,25 \times C$	$\pm 1,33 \times C$	%

^a The permitted values for reactive energy function performance class C are: 2 – 3; the permitted values for reactive power function performance class C are: 1 – 2 – 3.

^b The permitted values and formula to calculate the system performance class of a PMD with an external current sensor or voltage sensor are given in Annex D.

^c For reactive energy measurement class 2 and 3 of this standard, the uncertainty limits of class 2 and 3 defined in Table 6 of IEC 62053-23 can be used as well as the uncertainty limits given in this table.

4.7.2.4 Limits of variation due to influence quantities

The additional variations due to change of influence quantities with respect to reference conditions as given in 4.5.1, shall not exceed the limits for the relevant performance class given in Table 12:

Table 12 – Influence quantities for reactive power and reactive energy measurement

Influence type	Influence quantities	Specified measuring range ^d		$\sin \varphi$ (inductive or capacitive)	Temperature coefficient for PMD of function performance class C ^{a,e}		Unit
		Value of current for <u>Direct</u> connected PMD Dx	Value of current for <u>Sensor</u> operated PMD Sx		for C < 3	for C ≥ 3	
Ambient temperature	Influence range According to rated operating range of Table 5 & Table 6	10 % $I_b \leq I \leq I_{max}$ 20 % $I_b \leq I \leq I_{max}$	5 % $I_n \leq I \leq I_{max}$ 10 % $I_n \leq I \leq I_{max}$	1 0,5	0,05 × C 0,075 × C	0,05 × C 0,08 × C	% / K % / K
					Limits of variation for PMD of function performance class C ^{a,b}		
					for C < 3	for C ≥ 3	
Auxiliary power supply voltage ^f							
Voltage	Rated voltage ±15 % 80 % $U_n < U < 120$ % U_n	10 % I_b	10 % I_n	1	0,1 × C	0,1 × C	%
Frequency	Rated frequency ±2 %	5 % $I_b \leq I \leq I_{max}$ 10 % $I_b \leq I \leq I_{max}$	2 % $I_n \leq I \leq I_{max}$ 5 % $I_n \leq I \leq I_{max}$	1 0,5 inductive	0,5 × C 0,75 × C	0,66 × C 1,0 × C	% %
Permanent a.c. magnetic induction of external origin 0,5mT ^{b,c}	see ^b and ^c	5 % $I_b \leq I \leq I_{max}$ 10 % $I_b \leq I \leq I_{max}$	2 % $I_n \leq I \leq I_{max}$ 5 % $I_n \leq I \leq I_{max}$	1 0,5 inductive	1,25 × C 1,25 × C	2,5 2,5	%
Electromagnetic RF fields ^{b,c}	see ^b and ^c	I_b	I_n	1	1,5 × C	3,0	%
Conducted disturbances, induced by radio frequency fields ^{b,c}	see ^b and ^c	I_b	I_n	1	1,5 × C	3,0	%
		I_b	I_n	1	1,5 × C	3,0	%

^a The permitted values for reactive energy function performance class C are: 2 – 3; the permitted values for reactive power function performance class C are: 1 – 2 – 3.

^b EMC levels and test conditions are defined in IEC 61326 standard relating to industrial location.

^c The EMC influence quantities are applicable only for energy measurements.

^d Currents are balanced unless otherwise specified.

^e For reactive energy measurement class 2 and 3 of this standard, the variation limits of class 2 and 3 defined in Table 8 of IEC 62053-23 can be used as well as the uncertainty limits given in this table.

^f These limits are settled for a PMD powered by mains supply voltage. In the case of a larger range of the supply voltage a.c. or d.c., tests shall be done at least at lower input value and upper input value of this range. In any case, PMD shall comply with the requirement for all the specified supply voltage ranges.

4.7.2.5 Starting and no-load condition

4.7.2.5.1 Start-up of the PMD

See subclause 4.6.

4.7.2.5.2 No load condition

When the voltage is applied with no current flowing in the current circuit, the test output of the PMD shall not produce more than one pulse.

For this test, the current circuit shall be open-circuit and a voltage of 115 % of the rated voltage shall be applied to the voltage circuit.

NOTE In case of outside shunt, only the input circuit shall be open circuited.

The minimum test period Δt shall be:

PMD types	Minimum test period Δt for no load condition	
	for $C < 3$	for $C \geq 3$
PMD	$\Delta t = \frac{((240 / C) + 360) \times 10^6}{k \times m \times U_n \times I_{\max}} \text{ min}$	$\Delta t = \frac{((1080 / C) - 60) \times 10^6}{k \times m \times U_n \times I_{\max}} \text{ min}$

where

C is the function performance class;

k is the number of pulses emitted by the output device of the PMD per kilovar-hour (imp/kvarh);

m is the number of measuring elements;

U_n is the rated voltage in volts;

$I_{\max}$ is the maximum current in amperes.

For transformer-operated PMD with primary or half-primary registers, the constant k shall correspond to the secondary values (voltage and current).

4.7.2.5.3 Starting current

The PMD shall start and continue to register at the starting current values (and in case of three-phase meters, with balanced load) shown in Table 13.

When starting conditions are met (according to Table 13) intrinsic uncertainty shall be between –40 % and +90 % of measured values.

If the PMD is designed for the measurement of energy in both directions, then this test shall be applied with energy flowing in each direction.

Table 13 – Starting current for reactive energy measurement

PMD types	$\sin \phi$ (inductive or capacitive)	Starting current for PMD of function performance class C	
		for $C < 3$	for $C \geq 3$
PMD Dx	1	$(C + 3) \times 10^{-3} \times I_b$	$(5 \times C - 5) \times 10^{-3} \times I_b$
PMD Sx	1	$(C + 1) \times 10^{-3} \times I_n$	$(2 \times C - 1) \times 10^{-3} \times I_n$

4.7.3 Apparent power (S_A , S_V) and apparent energy (E_{apA} , E_{apV}) measurements

4.7.3.1 Techniques

See Annex A.

Zero blind measurement is required.

4.7.3.2 Rated range of operation

The intrinsic uncertainty requirements shall apply within the following rated range:

$$80 \% U_n < U < 120 \% U_n$$

4.7.3.3 Intrinsic uncertainty table

The intrinsic uncertainty under reference conditions shall not exceed the limits given in Table 14:

Table 14 – Intrinsic uncertainty table for apparent power and apparent energy measurement

Specified measuring range		Intrinsic uncertainty limits for PMD of function performance class C ^{a b}		Unit
Value of current for <u>Direct connected</u> PMD Dx	Value of current for <u>Sensor operated</u> PMD Sx	for $C < 1$	for $C \geq 1$	
$5 \% I_b < I \leq 10 \% I_b$	$2 \% I_n < I \leq 5 \% I_n$	$\pm 2,0 \times C$	$\pm (1,0 \times C + 0,5)$	%
$10 \% I_b < I \leq I_{max}$	$5 \% I_n < I \leq I_{max}$	$\pm 1,0 \times C$	$\pm 1,0 \times C$	%

^a The permitted values for function performance class C are: 0,2 – 0,5 – 1 – 2

^b The permitted values and formula to calculate the system performance class of a PMD with an external current sensor or voltage sensor are given in Annex D.

4.7.3.4 Limits of variation due to influence quantities

The additional variations due to change of influence quantities with respect to reference conditions as given in 4.5.1, shall not exceed the limits for the relevant performance class given in Table 15:

Table 15 – Influence quantities for apparent power and apparent energy measurement

Influence type	Influence quantities	Specified measuring range ^d		Power factor ^e	Temperature coefficient for PMD of function performance class C ^a		Unit
		Value of current for Direct connected PMD Dx	Value of current for Sensor operated PMD Sx		for C < 1	for C ≥ 1	
Ambient temperature	According to rated operating range of Table 5 and Table 6	$10\% I_b \leq I \leq I_{max}$	$5\% I_n \leq I \leq I_{max}$	1	$0,05 \times C$	$0,05 \times C$	% / K
Auxiliary power supply voltage ^f	Rated voltage $\pm 15\%$	$10\% I_b$	$10\% I_n$	1	$0,1 \times C$	$0,1 \times C$	%
Voltage	$80\% U_n < U < 120\% U_n$	$5\% I_b \leq I \leq I_{max}$ $10\% I_b \leq I \leq I_{max}$	$2\% I_n \leq I \leq I_{max}$ $5\% I_n \leq I \leq I_{max}$	1 0,5 inductive	$0,3 \times C + 0,04$ $0,6 \times C + 0,08$	$0,3 \times C + 0,4$ $0,5 \times C + 0,5$	%
Continuous magnetic induction of external origin 0,5mT ^{c d}	see c and d	I_b	I_n	1	2,0	$1,0 \times C + 1,0$	%
Electromagnetic RF fields ^{c d}	see c and d	I_b	I_n	1	$3,4 \times C + 0,3$	$1,0 \times C + 1,0$	%
Conducted disturbances, induced by radio frequency fields ^{c d}	see c and d	I_b	I_n	1	$3,4 \times C + 0,3$	$1,0 \times C + 1,0$	%

^a The permitted values for function performance class C are: 0,2 – 0,5 – 1 – 2.
^b EMC levels and test conditions are defined in IEC 61326 standard relating to industrial location.
^c The EMC influence quantities are applicable only for energy measurements.
^d Currents are balanced unless otherwise specified.
^e In reference conditions, signals are sinusoidal, so in this case power factor = cos φ.
 These limits are settled for a PMD powered by mains supply voltage. In the case of a larger range of the supply voltage a.c or d.c., tests shall be done at least at lower input value and upper input value of this range. In any case, PMD shall comply with the requirement for all the specified supply voltage ranges.

4.7.4 Frequency (f) measurements

4.7.4.1 Techniques

Zero blind measurement is not required.

4.7.4.2 Rated range of operation

The intrinsic uncertainty requirements shall apply within the following rated range:

- Voltage: 50 % U_n to U_{max} ; or
- Current: for PMD Dx: 20 % I_b to I_{max} , for PMD Sx: 10 % I_n to I_{max}

NOTE Frequency is usually measured from voltage function of PMD; current rated range of operation has to be considered only if this function does not exist in the PMD.

4.7.4.3 Intrinsic uncertainty table

The intrinsic uncertainty under reference conditions shall not exceed limits given in Table 16:

Table 16 – Intrinsic uncertainty table for frequency measurement

Specified measuring range	Intrinsic uncertainty limits for PMD of function performance class C ^{a b}	Unit
45 Hz to 55 Hz or 55 Hz to 65 Hz	$\pm 1,0 \times C$	%
^a The permitted values for function performance class C are: 0,02 – 0,05 – 0,1 – 0,2 – 0,5.		
^b The permitted values and formula to calculate the system performance class of a PMD with an external CS or VS are given in Annex D.		

4.7.4.4 Limits of variation due to influence quantities

The additional variations due to change of influence quantities with respect to reference conditions as given in 4.5.1, shall not exceed the limits for the relevant performance class given in Table 17:

Table 17 – Influence quantities for frequency measurement

Influence quantities		Temperature coefficient for PMD of function performance class C ^a	Unit
Influence type	Influence range or influence level		
Ambient temperature	According to rated operating range of Table 5 and Table 6	$0,1 \times C$	% / K
		Limits of variation for PMD of function performance class C^a	
Voltage	50 % U_n to U_{max}	$0,2 \times C$	%
Harmonics in the voltage circuits ^b	3 rd harmonic 10 % 5 th harmonic 12 % 7 th harmonic 10 % 9 th harmonic 3 % 11 th harmonic 7 % 13 th harmonic 6 % 15 th harmonic 1 %	$0,2 \times C$	%
^a The permitted values for function performance class C are: 0,02 – 0,05 – 0,1 – 0,2 – 0,5			
^b All harmonics components have the same relative phase, but in opposite phase referred to the fundamental.			

4.7.5 R.m.s. phase current (I) and neutral current (I_N , I_{Nc}) measurements

4.7.5.1 Techniques

See Annex A.

Zero blind measurement is not required.

4.7.5.2 Rated range of operation

The intrinsic uncertainty requirements shall apply within the rated ranges given in Table 18 and Table 19:

4.7.5.2.1 Rated range of operation for phase current

Table 18 – Rated range of operation for phase current measurement

PMD types	Specified measuring range	Minimum bandwidth (harmonic)	Crest factor
PMD Sx	10 % I_n to 120 % I_n	45 Hz to 15 times rated frequency or d.c. and 45 Hz to 15 times rated frequency	2
PMD Dx	20 % I_b to I_{max}	45 Hz to 15 times rated frequency or d.c. and 45 Hz to 15 times rated frequency	2

4.7.5.2.2 Rated range of operation for measured neutral current (with a sensor) and calculated neutral current (from phase currents)

Table 19 – Rated range of operation for neutral current measurement

PMD types	Specified measuring range	Minimum bandwidth (harmonic)	Crest factor
PMD Sx	10 % I_n to 120 % I_n	45 Hz to 15 times rated frequency or d.c. and 45 Hz to 15 times rated frequency	2
PMD Dx	20 % I_b to I_{max}	45 Hz to 15 times rated frequency or d.c. and 45 Hz to 15 times rated frequency	2

NOTE The nominal current of the neutral current sensor may be different from the one for phase current sensor.

4.7.5.3 Intrinsic uncertainty table

The intrinsic uncertainty under reference conditions shall not exceed limits given in Table 20, Table 21 and Table 22.

4.7.5.3.1 Intrinsic uncertainty table for phase current

Table 20 – Intrinsic uncertainty table for phase current

Specified measuring range		Intrinsic uncertainty limits for PMD of function performance class C ^{a b}	Unit
value of current for Direct connected PMD Dx	value of current for Sensor operated PMD Sx		
$20 \% I_b \leq I \leq I_{\max}$	$10 \% I_n \leq I \leq I_{\max}$	$\pm 1,0 \times C$	%
^a The permitted values for function performance class C are: 0,05 – 0,1 – 0,2 – 0,5 – 1 – 2. ^b The permitted values and formula to calculate the system performance class of a PMD with an external current sensor are given in Annex D.			

4.7.5.3.2 Intrinsic uncertainty table for measured neutral current (with a sensor)

Table 21 – Intrinsic uncertainty table for neutral current measurement

Specified measuring range		Intrinsic uncertainty limits for PMD of function performance class C ^{a b}	Unit
value of current for Direct connected PMD Dx	value of current for Sensor operated PMD Sx		
$20 \% I_b \leq I_N \leq I_{\max}$	$10 \% I_n \leq I_N \leq I_{\max}$	$\pm 1,0 \times C$	%
^a The permitted values for function performance class C are: 0,2 – 0,5 – 1 – 2. ^b The permitted values and formula to calculate the system performance class of a PMD with an external current sensor are given in Annex D.			

4.7.5.3.3 Intrinsic uncertainty table for calculated neutral current (from phase currents)

Table 22 – Intrinsic uncertainty table for neutral current calculation

Specified measuring range		Intrinsic uncertainty limits for PMD of function performance class C ^{a b d}	Unit
value of current for Direct connected PMD Dx	value of current for Sensor operated PMD Sx		
$20 \% I_b \leq I_p^c \leq I_{\max}$	$10 \% I_n \leq I_p^c \leq I_{\max}$	$\pm 1,0 \times C$	% ^c
^a The permitted values for function performance class C are: 0,1 – 0,2 – 0,5 – 1 – 2. ^b The permitted values and formula to calculate the system performance class of a PMD with an external current sensor are given in Annex D. ^c Uncertainty shall be expressed as a percentage of the phase current, whose current is the largest. ^d Performance class C refers to Phase current performance class.			

4.7.5.4 Limits of variation due to influence quantities

The additional variations due to change of influence quantities with respect to reference conditions as given in 4.5.1, shall not exceed the limits for the relevant performance class given in Table 23:

Table 23 – Influence quantities for phase current and neutral current measurement

Influence quantities		Specified measuring range ^b		Temperature coefficient for PMD of function performance class C ^a	Unit
Influence type	Influence range	For current <u>Direct</u> connected PMD Dx	For current Sensor operated PMD Sx		
Ambient temperature	According to rated operating range of Table 5 and Table 6	$20\% I_b \leq I \leq I_{max}$	$10\% I_n \leq I \leq I_{max}$	$0,05 \times C$	% / K
				Limits of variation for PMD of function performance class C ^a	
Auxiliary power supply voltage ^c	Rated voltage $\pm 15\%$	$20\% I_b$	$10\% I_n$	$0,1 \times C$	%

^a The permitted values for function performance class C for measured neutral current are: 0,2 – 0,5 – 1 – 2 The permitted values for function performance class C for calculated neutral current are: 0,1 – 0,2 – 0,5 – 1 – 2.

^b Influence quantities for phase current are defined with balanced currents in three-phase distribution system.

^c These limits are settled for a PMD powered by mains supply voltage. In the case of a larger range of the supply voltage a.c or d.c., tests shall be done at least at lower input value and upper input value of this range. In any case, PMD shall comply with the requirement for all the specified supply voltage ranges.

4.7.6 R.m.s. voltage (U) measurements

4.7.6.1 Technique

See Annex A.

Zero blind measurement is not required.

4.7.6.2 Rated range of operation

The intrinsic uncertainty requirements shall apply within the rated ranges given in Table 24:

Table 24 – Rated range of operation for r.m.s. voltage measurement

PMD types	Specified measuring range	Minimum bandwidth (harmonic)	Crest factor
PMD xS	20 % U_n to 120 % U_n see NOTE	45 Hz to 15 times rated frequency or d.c. and 45 Hz to 15 times rated frequency	1,5
PMD xD	As specified by manufacturer	45 Hz to 15 times rated frequency or d.c. and 45 Hz to 15 times rated frequency	1,5

NOTE Between 20% of U_n and 50% of U_n , PMD using frequency detection circuits not operating in all the rated range can measure voltage with the last consistent measured value of frequency.

4.7.6.3 Intrinsic uncertainty table

The intrinsic uncertainty under reference conditions shall not exceed limits given in Table 25:

Table 25 – Intrinsic uncertainty table for r.m.s. voltage measurement

Specified measuring range		Intrinsic uncertainty limits for PMD of function performance class $C^{a,b}$	Unit
Value of voltage for Direct connected PMD xD	Value of voltage for Sensor operated PMD xS		
$U_{min} \leq U \leq U_{max}^c$	$U_{min} \leq U \leq U_{max}^c$	$\pm 1,0 \times C$	%

^a The permitted values for function performance class C are: 0,05 – 0,1 – 0,2 – 0,5 – 1 – 2

^b The permitted values and formula to calculate the system performance class of a PMD with an external CS or VS are given in Annex D.

^c Manufacturer can define U_{max} and U_{min} , taking into account minimum measuring range of Table 24.

4.7.6.4 Limits of variation due to influence quantities

The additional variations due to change of influence quantities with respect to reference conditions as given in 4.5.1, shall not exceed the limits for the relevant performance class given in Table 26:

Table 26 – Influence quantities for r.m.s. voltage measurement

Influence quantities		Specified measuring range ^b		Temperature coefficient for PMD of function performance class C ^a	Unit
Influence type	Influence range	value of voltage for <u>D</u> irect connected PMD xD	value of voltage for <u>S</u> ensor operated PMD xS		
Ambient temperature	According to rated operating range of Table 5 and Table 6	$U_{\min} \leq U \leq U_{\max}$	$U_{\min} \leq U \leq U_{\max}$	$0,05 \times C$	% / K
				Limits of variation for PMD of function performance class C ^a	
Auxiliary power supply voltage ^c	Rated voltage $\pm 15\%$	$U_{\min} \leq U \leq U_{\max}$	$U_{\min} \leq U \leq U_{\max}$	$0,1 \times C$	%

^a The permitted values for function performance class C are: $0,1 - 0,2 - 0,5 - 1 - 2$.
^b Manufacturer can define $U_{\max}$ and $U_{\min}$, taking into account specified measuring range of Table 24.
^c These limits are settled for a PMD powered by mains supply voltage. In the case of a large dynamic supply voltage a.c or d.c., tests shall be done at least at lower input value and upper input value of this range. In any case, PMD shall comply with the requirement for all the specified supply voltage ranges.

4.7.7 Power factor (PF_A , PF_V) measurements

4.7.7.1 Techniques

See Annex A.

4.7.7.2 Rated range of operation

The intrinsic uncertainty requirements shall apply within the following rated ranges:

- Voltage: 50 % U_n to U_{max} or;
- Current: for PMD Dx: 20 % I_b to I_{max}
for PMD Sx: 10 % I_n to I_{max}

4.7.7.3 Intrinsic uncertainty table

The intrinsic uncertainty under reference conditions shall not exceed limits given in Table 27:

Table 27 – Intrinsic uncertainty table for power factor measurement

Specified measuring range	Intrinsic uncertainty limits for PMD of function performance class C ^{a b}	Unit
From 0,5 inductive to 0,8 capacitive	$\pm 0,1 \times C$	^c
^a The permitted values for function performance class C are: 0,5 – 1 – 2 – 5 – 10. ^b The permitted values and formula to calculate the system performance class of a PMD with an external current sensor or voltage sensor are given in Annex D. ^c No units.		

4.7.7.4 Limits of variation due to influence quantities

The additional variations from intrinsic uncertainties shall be calculated according to Table 9 and Table 15 for power factor 1 and 0,5 inductive, within the rated ranges of operation, taking into account the worst case combination of uncertainties.

4.7.8 Short term flicker (P_{st}) and long term flicker (P_{lt}) measurements

4.7.8.1 Techniques

See IEC 61000-4-15.

4.7.8.2 Rated range of operation

The intrinsic uncertainty requirements shall apply within the following rated range:

- Voltage: 80 % U_n to U_{max}

4.7.8.3 Intrinsic uncertainty table

The intrinsic uncertainty under reference conditions shall not exceed limits given in Table 28:

Table 28 – Intrinsic uncertainty table for flicker measurement

Specified measuring range	Intrinsic uncertainty limits for PMD of function performance class C ^a	Unit
From 0,4 to 2	$\pm 1,0 \times C$	%
^a The permitted values for function performance class C are: 0,5 – 1 – 2 – 5 – 10.		

4.7.9 Voltage dip (U_{dip}) and voltage swell (U_{swl}) measurements

4.7.9.1 Techniques

See Annex A. Zero blind measurement is required.

Requirements in 5.4 of IEC 61000-4-30 apply, with the following modifications:

- in this part, either a fixed reference voltage or a sliding reference voltage with a one-minute time constant first order filter are required as threshold value for voltage dips or voltage swells detection;
- in this part, a synchronisation on zero crossing of voltage fundamental is not required.

4.7.9.2 Rated range of operation

The intrinsic uncertainty requirements shall apply within the rated ranges given in Table 29:

Table 29 – Rated range of operation for voltage dips and swells measurement

PMD types	Minimum threshold range settable for voltage dip	Minimum threshold range settable for voltage swell
PMD xS	From 5 % U_n to 100 % U_n	from 100 % U_n to 120 % U_n
PMD xD	As specified by manufacturer	as specified by manufacturer

Minimum detectable duration shall be equal at least to one period of the measured voltage.

4.7.9.3 Intrinsic uncertainty table

The intrinsic uncertainty under reference conditions shall not exceed limits given in Table 30:

Table 30 – Intrinsic uncertainty table for voltage dips and swells measurement

Specified measuring range	Intrinsic uncertainty limits for PMD of function performance class C ^{a b c}	Unit
Dips, residual voltage and swells overvoltage	$\pm 1,0 \times C$	% U_n
Dips duration and swells duration	One period at the network frequency	ms ^d
^a The permitted values for function performance class C are: 0,1 – 0,2 – 0,5 – 1 – 2. ^b The permitted values and formula to calculate the system performance class of a PMD with an external voltage sensor are given in Annex D. ^c The uncertainty of a dip or swell duration is equal to the dip or swell commencement uncertainty (half a cycle) plus the dip or swell conclusion uncertainty (half a cycle). ^d This is a fixed uncertainty.		

4.7.9.4 Limits of variation due to influence quantities

The additional variations due to change of influence quantities with respect to reference conditions as given in 4.5.1, shall not exceed the limits for the relevant performance class given in Table 31:

Table 31 – Influence quantities for dips and swells measurement

Influence type	Influence quantities		Specified measuring range ^b value of voltage for Sensor operated PMD xS	Temperature coefficient for PMD of function performance class C ^a	Unit
	Influence range	value of voltage for Direct connected PMD xD			
Ambient temperature	according to rated operating range of Table 5 and Table 6	$U_{\min} \leq U \leq U_{\max}$	$U_{\min} \leq U \leq U_{\max}$	$0,05 \times C$	% / K
				Limits of variation for PMD of function performance class C ^a	
Auxiliary power supply voltage ^c	rated voltage $\pm 15\%$	$U_{\min} \leq U \leq U_{\max}$	$U_{\min} \leq U \leq U_{\max}$	$0,1 \times C$	% U_n
Frequency	rated frequency $\pm 10\%$	$U_{\min} \leq U \leq U_{\max}$	$U_{\min} \leq U \leq U_{\max}$	$0,5 \times C$	% U_n

^a The permitted values for function performance class C are: 0,1 – 0,2 – 0,5 – 1 – 2.

^b Manufacturer can define $U_{\max}$ and $U_{\min}$, taking into account minimum measuring range of Table 29.

^c These limits are settled for a PMD powered by mains supply voltage. In the case of a larger range of the supply voltage a.c or d.c., tests shall be done at least at lower input value and upper input value of this range. In any case, PMD shall comply with the requirement for all the specified supply voltage ranges.

4.7.10 Transients overvoltage (U_{tr}) measurements

4.7.10.1 Techniques

See Annex A of IEC 61000-4-30.

Zero blind measurement is required.

Reference waveform: 1,2/50 μ s as defined in IEC 61000-4-5

4.7.10.2 Rated range of operation

The intrinsic uncertainty requirements shall apply within the rated ranges given in Table 32.

4.7.10.3 Intrinsic uncertainty table

The intrinsic uncertainty under reference conditions shall not exceed limits given in Table 32:

Table 32 – Intrinsic uncertainty table for transient overvoltage measurement

Specified measuring range for PMD of function performance class C	Intrinsic uncertainty limits for PMD	Resolution for duration measurement ^b
0 to U_{tr} ^a	$\pm 3,0 \% \times U_{tr}$	5 μ s
^a The recommended values for the specified measuring range are 6 kV – 4 kV – 2,5 kV – 1,5 kV – 0,8 kV.		
^b Duration measurement is optional. If it is provided, it shall be made at 50 % of the peak value of the transient.		

4.7.11 Voltage interruption (U_{int}) measurements

4.7.11.1 Techniques

See Annex A.

Zero blind measurement is required.

Subclause 5.4 of IEC 61000-4-30 applies excepted that, in this part, a synchronisation on zero crossing of voltage fundamental is not required.

NOTE This measurement is possible only if the neutral wire is connected to the PMD.

4.7.11.2 Rated range of operation

The manufacturer shall choose at least one value for the threshold of voltage interruption detection included in the range 1 % to 5 % of U_n .

Minimum detectable duration shall be equal at least to one period of the measured voltage.

4.7.11.3 Intrinsic uncertainty table

The intrinsic uncertainty under reference conditions shall not exceed limits given in Table 33:

Table 33 – Intrinsic uncertainty table for voltage interruption measurement

Specified measuring range	Intrinsic uncertainty limits for PMD of function performance class C ^{a b}	Unit
Interruptions from 0 % to 5 % of U_n	$\pm 1,0 \times C$	% U_n
Interruption duration	Less than two periods at the network frequency	ms ^c

^a The permitted values for function performance class C are: 0,1 – 0,2 – 0,5 – 1 – 2.
^b The permitted values and formula to calculate the system performance class of a PMD with an external voltage sensor are given in Annex D.
^c This is a fixed uncertainty.

4.7.12 Voltage unbalance (U_{nb} , U_{nba}) measurements

4.7.12.1 Techniques

Zero blind measurement is not required.

According to manufacturer specification, one of the following functions shall be implemented:

- amplitude voltage unbalance (U_{nba}): see Annex A
- amplitude and phase voltage unbalance (U_{nb}): see IEC 61000-4-30

4.7.12.2 Rated range of operation

The intrinsic uncertainty requirements shall apply within the following rated range:

- between 80 % and 120 % of U_n

4.7.12.3 Intrinsic uncertainty table

The intrinsic uncertainty under reference conditions shall not exceed limits given in Table 34:

Table 34 – Intrinsic uncertainty table for voltage unbalance measurement

Indicated range of U_{nb} or U_{nba}	Intrinsic uncertainty limits for PMD of function performance class C ^a	Resolution	Unit
0 % to 10 %	$\pm 1 \times C$ ^b	$\pm 0,1$	%

^a The permitted values for function performance class C are: 0,2 – 0,5 – 1.
^b The diagram below shows an example of uncertainty limits for class 0,5:

Intrinsic uncertainty limits for PMD of function performance class 0,5

4.7.13 Voltage harmonics (U_h) and voltage THD (THD_u and $THD-R_u$) measurements

4.7.13.1 Techniques

Manufacturer shall specify sampling frequency, number of ranks, windows and filtering methods, aggregation method.

NOTE 1 IEC 61000-4-7 compliance is not mandatory.

Zero blind measurement is not required.

NOTE 2 When zero blind measurement is not implemented, only stationary and quasi-stationary harmonics can be measured.

4.7.13.2 Rated range of operation

The intrinsic uncertainty requirements shall apply within the rated range given in Table 35:

Table 35 – Rated range of operation for voltage harmonics measurement

PMD types	Minimum bandwidth	Fundamental frequency range
PMD	15 times rated frequency	45 Hz to 65 Hz

4.7.13.3 Intrinsic uncertainty table

The uncertainty indicated in Table 36 and Table 37 applies for a single tone stationary harmonic signal over the whole working conditions.

Table 36 – Intrinsic uncertainty table for voltage harmonics measurement

Specified measuring range	Intrinsic uncertainty limits for PMD of function performance class C ^{a b}	Unit
$U_h > 3 \times U_n \times C / 100$	$\pm 5,0$	% U_h
$U_h \leq 3 \times U_n \times C / 100$	$\pm 0,15 \times C$	% U_n
^a The permitted values for function performance class C are: 1 – 2 – 5. ^b The permitted values and formula to calculate the system performance class of a PMD with an external voltage sensor are given in Annex D.		

Table 37 – Intrinsic uncertainty table for voltage THD_u or $THD-R_u$ measurement

Specified measuring range for voltage THD	Intrinsic uncertainty limits for PMD of function performance class C ^{a b}	Unit
0 % to 20 %	$\pm 0,3 \times C$ ^c	point ^c
^a The permitted values for function performance class C are: 1 – 2 – 5. ^b The permitted values and formula to calculate the system performance class of a PMD with an external voltage sensor are given in Annex D. ^c $0,3 \times C$ is a constant uncertainty. For example with 10 % of THD, if $C = 1$, the measured value may be between 9,7 and 10,3.		

4.7.14 Current harmonics (I_h) and current THD (THD_i and $THD-R_i$) measurements

4.7.14.1 Techniques

According to manufacturer specification: sampling frequency, number of ranks, windows and filtering methods, aggregation method.

Zero blind measurement is not required.

NOTE When zero blind measurement is not implemented, only stationary and quasi-stationary harmonics can be measured.

4.7.14.2 Rated range of operation

The intrinsic uncertainty requirements shall apply within the rated range given in Table 38:

Table 38 – Rated range of operation for current harmonics measurement

PMD types	Minimum bandwidth	Fundamental frequency range
PMD	15 times rated frequency	45 Hz to 65 Hz

4.7.14.3 Intrinsic uncertainty table

The uncertainty indicated in Table 39 and Table 40 apply for a single tone stationary harmonic signal over the whole working condition.

Table 39 – Intrinsic uncertainty table for current harmonics measurement

PMD types	Specified measuring range	Intrinsic uncertainty limits for PMD of function performance class C ^{a b}	Unit
PMD-Sx	$I_h > 10 \times I_n \times C / 100$	$\pm 5,0$	$\% I_h$
	$I_h \leq 10 \times I_n \times C / 100$	$\pm 0,5 \times C$	$\% I_n$
PMD-Dx	$I_h > 10 \times I_b \times C / 100$	$\pm 5,0$	$\% I_h$
	$I_h \leq 10 \times I_b \times C / 100$	$\pm 0,5 \times C$	$\% I_b$
^a The permitted values for function performance class C are: 1 – 2 – 5. ^b The permitted values and formula to calculate the system performance class of a PMD with an external current sensor are given in Annex D.			

Table 40 – Intrinsic uncertainty table for current THD_i and $THD-R_i$ measurement

Specified measuring range	Intrinsic uncertainty limits for PMD of function performance class C ^{a b}	Unit
0 % to 100 %	$\pm 0,3 \times C$ ^c	point ^c
100 % to 200 %	$\pm 0,3 \times C \times THD / 100$ ^d	point ^c
^a The permitted values for function performance class C are: 1 – 2 – 5. ^b The permitted values and formula to calculate the system performance class of a PMD with an external current sensor are given in Annex D. ^c $0,3 \times C$ is an absolute uncertainty. For example with 10 % of THD, if $C = 1$, the measured value may be between 9,7 and 10,3. ^d THD is the measured value of current THD expressed in %.		

4.7.15 Minimum, maximum, peak, three-phases average and demand measurements

4.7.15.1 Rated range of operation

Manufacturer shall specify rated range of operation.

4.7.15.2 Intrinsic uncertainty table

Uncertainty on these values (minimum, maximum, ...) shall be the same as those from the corresponding measurements used to calculate these values.

For instance, a PMD claiming a class C performance on power measurement shall have to comply with the same performance class C for the power demand measurement if any.

Calculation methods are specified in Annex B.

4.8 Requirements for PMD-A functions

Measuring uncertainties, measuring methods, measuring ranges, testing methods shall comply with IEC 61000-4-30 class A, and the complementary characteristics given in Table 41 below.

Depending on the purpose of the measurement, all or a subset of the functions listed in Table 41 shall be measured.

NOTE For contractual applications, all functions listed in Table 41 may be necessary.

Any "power quality assessment function" of a PMD-A shall comply with the measurement methods and measurement uncertainty defined for class A in IEC 61000-4-30.

Each function shall comply with IEC 61000-4-30 within operating conditions specified in 4.5.2 of this standard.