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Responsible committee: PEL/85 Measuring equipment for electrical and electromagnetic quantities

Interested committees:

Title: BS EN IEC 61557-12-2 Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC -
Equipment for testing, measuring or monitoring of protective measures

Part 12-2: Functional test procedure for PMD and EPMF

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

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2025-01-10

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2025-04-04

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IEC TC 85 : MEASURING EQUIPMENT FOR ELECTRICAL AND ELECTROMAGNETIC QUANTITIES

SECRETARIAT:

China

SECRETARY:

Ms Guiju HAN

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 13, TC 22, SC 22H, SC 23E, TC 38, SC 65B, TC 82, TC 95, SC 121A

HORIZONTAL FUNCTION(S):

ASPECTS CONCERNED:

Energy Efficiency, Safety

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TITLE:

Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 12-2: Functional test procedure for PMD and EPMF

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRICAL SAFETY IN LOW VOLTAGE DISTRIBUTION SYSTEMS UP TO
1 000 V AC AND 1 500 V DC – EQUIPMENT FOR TESTING, MEASURING OR
MONITORING OF PROTECTIVE MEASURES****Part 12-2: Functional test procedure****FOREWORD**

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The text of this **International Standard** is based on the following documents:

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

219
220 Full information on the voting for its approval can be found in the report on voting indicated in
221 the above table.

222 The language used for the development of this **International Standard** is **English**.

223 This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in
224 accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement available
225 at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are
226 described in greater detail at www.iec.ch/publications.

227 The committee has decided that the contents of this document will remain unchanged until the
228 stability date indicated on the IEC website under webstore.iec.ch in the data related to the
229 specific document. At this date, the document will be

- 230 • reconfirmed,
231 • withdrawn,
232 • replaced by a revised edition, or
233 • amended.

234

235

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

Part 12-2: Functional test procedure

1 Scope

This part of IEC 61557-12 specifies functional type tests for Power metering and monitoring devices (PMD) compliant to IEC 61557-12.

This part needs to be used in conjunction with IEC 61557-12.

This document does not cover safety tests, EMC tests, climatic test and mechanical tests covered by IEC 61557-12.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test*

IEC 61000-4-19, *Electromagnetic compatibility (EMC) - Part 4-19: Testing and measurement techniques - Test for immunity to conducted, differential mode disturbances and signalling in the frequency range 2 kHz to 150 kHz at a.c. power ports*

IEC 61000-4-30:2015, *Electromagnetic compatibility (EMC) – Part 4-30: Testing and measurement techniques – Power quality measurement methods*

IEC 61010-1:2010, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*
IEC 61010-1:2010/AMD1:2016

IEC 61010-2-030:2017, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: Particular requirements for testing and measuring circuits*

IEC 61326-1:2020, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements*

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

274 **3 Terms and definitions**

275 For the purposes of this document, the terms and definitions given in IEC 61557-12 and the
276 following apply.

277 ISO and IEC maintain terminology databases for use in standardization at the following
278 addresses:

- 279 • IEC Electropedia: available at <https://www.electropedia.org/>
- 280 • ISO Online browsing platform: available at <https://www.iso.org/obp>

282 **3.1 Definitions related to performance class verification**

283 **3.1.1**

284 **reference conditions**

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

287 Note 1 to entry: The ranges specified for the reference conditions, called reference ranges, are not wider, and are
288 usually narrower, than the ranges specified for the rated operating conditions.

289 [SOURCE: IEC 60359:2001, 3.3.10]

290 **3.1.2**

291 **measurand**

292 quantity subjected to measurement, evaluated in the state assumed by the measured system
293 during the measurement itself

294 [SOURCE: IEC 60359:2001, 3.1.1, modified – the notes have been removed.]

295 **3.1.3**

296 **measurement uncertainty**

297 uncertainty of measurement
298 uncertainty

299 non-negative parameter characterizing the dispersion of the quantity values being attributed
300 to a measurand, based on the information used

301 [SOURCE: ISO/IEC GUIDE 99:2007, 2.26, modified – the notes have been removed.]

302 **3.1.4**

303 **error**

304 discrepancy between a computed, observed or measured value or condition, and the true,
305 specified or theoretically correct value or condition

306 [SOURCE: IEC 192-03-02, modified – note has been removed.]

3.1.5**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 to entry: Influence quantities can originate from the measured system, the measuring equipment or the environment [IEV].

Note 2 to entry: 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].

[SOURCE: IEC 60359:2001, 3.1.14, modified – note 3 has been removed.]

3.1.6**variation**

<under single influence quantity> difference between the value measured under reference conditions and any value measured within the influence range

Note 1 to entry: The other performance characteristics and the other influence quantities should stay within the ranges specified for the reference conditions.

3.1.7**rated operating conditions**

set of conditions that must be fulfilled during the measurement

[SOURCE: IEC 60359:2001, 3.3.13, modified and note has been removed]

3.1.8**register**

electromechanical or electronic device which stores and displays the information representing the measured energy

Note 1 to entry: In static meters, the register comprises both memory and display.

Note 2 to entry: A single display may be used with multiple electronic memories to form multiple registers.

[SOURCE: IEC 60050-300:2001, 314-07-09]

3.1.9**reference standard****reference meter**

meter used to measure the unit of electrical quantities, designed and operated to obtain the highest accuracy and stability in a controlled laboratory environment and traceable to national or international primary standards

3.1.10**calibrator**

source used to verify the unit of electrical quantities, designed and operated to obtain the highest accuracy and stability in a controlled laboratory environment and traceable to national or international primary standards

3.2 Symbols and abbreviations

AEL acceptable error limits (under reference conditions)

ALV acceptable limits of variation (due to influence quantities)

DUT device under test

EUT equipment under test
pdf Probability density function
PMD power monitoring device
ppm parts per million

4 General testing requirements

4.1 Reference conditions for testing

Table 1 – 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 DC ≤ 3 A/m AC at 50/60 Hz
DC 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 DC, may be specified.	

4.2 System topology

In case of measuring devices for three phase systems, the test shall be based on a 4-wire topology whenever influence quantities address voltage dips, swells, and unbalance.

4.3 Stabilization time

The time duration specified for each test in this document does not include the stabilization time of both the test equipment and the device under test.

4.4 Device under test

The device under test (DUT) or meter under test (MUT) shall be representative of the device in production.

4.5 Test equipment

4.5.1 General

As specified, in annex E, the conventional true value is typically estimated using a reference meter. The accuracy of the reference meter should typically be better than the expected accuracy of the PMD under test, by at least a factor 10.

See recommendations specified in **Error! Reference source not found..**

4.5.2 Principle 1

The results provided by the PMD under test are verified against a reference meter.

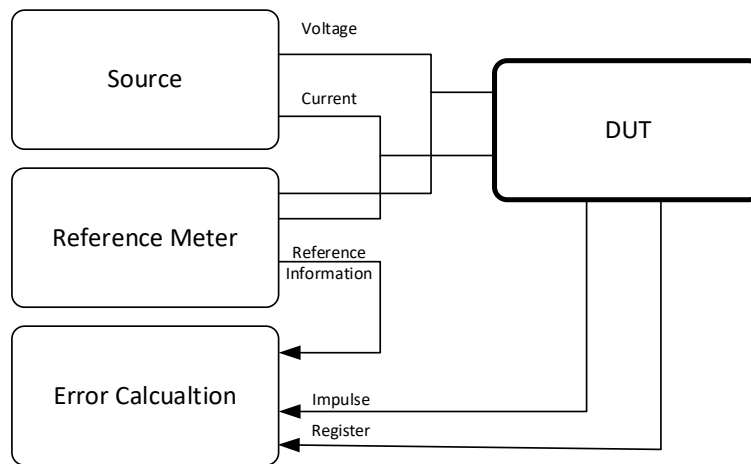


Figure 1 – Example: power source and reference meter

4.5.3 Principle 2

The results provided by the PMD under test are verified against a calibrator.

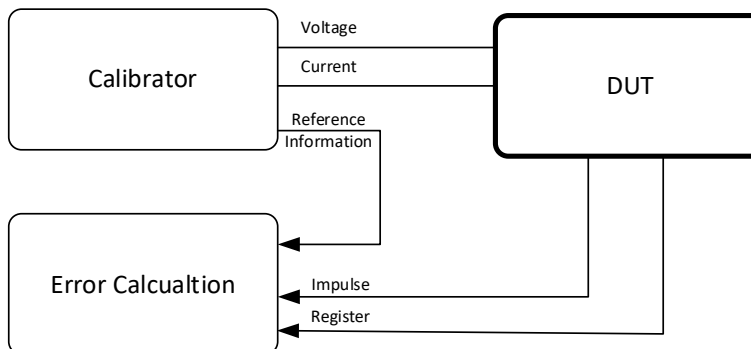


Figure 2 – Example: calibrator

4.6 Test report

Testing equipment and its calibration date shall be specified in the test report and in the declaration of conformity.

NOTE - A model of declaration of conformity is provided in **Error! Reference source not found.**

4.7 Resolution for energy

1Wh minimum.

4.8 Test interface

This document does not provide a “standardised” test interface, e.g. Modbus.

This document does not provide a unified frequency of delivered values.

5 Specific testing requirements

5.1 General

5.1.1 Introduction

As a general principle, each line of the uncertainty tables in Clause 4 and clause 5 of IEC 61557-12 shall be associated to a test.

The test procedure specified in clause 6 is recommended.

NOTE - This test procedure will be made mandatory for next edition.

5.1.2 Nominal values and range of values

All combinations of nominal values for PMD (I_n , U_n , f_n) shall be declared and tested.

NOTE 1 – Some examples are provided in Annex F.

5.1.3 Measurement functions

The list of functions specified in IEC 61557-12 is summarized in Table 2. The measurement functions specified in technical documentation shall be tested according to IEC 61557-12.

Table 2 – Summary of AC measurement functions and related specifications

Measurement functions	Time dependent	Requirements defined in IEC 61557-12:CD#1					
		Clause	Measurement method		Performance class		Other items
			Gaples	Method specification	AEL (under reference conditions)	ALV (due to influence quantities)	
Active power ^{ab}	---	4.8.2	X	Table B.2	Table 9	Table 10	Table 12
Active energy ^a	X					Table 11	Table 13
Reactive power ^{ab}	---	4.8.3	X	Table B.2	Table 14	Table 15	Table 16
Reactive energy ^a	X						Table 17
Apparent power ^{ab}	---	4.8.4	X	Table B.2	Table 18	Table 19	---
Apparent energy ^a	X						
Frequency	---	4.8.5	---	Table B.2	Table 20	Table 21	---
Phase current ^a	---	4.8.6	---	Table B.2	Table 24	Table 27	Table 22
Neutral current	---				Table 25	Table 27	Table 23
Neutral current calculated	---				Table 26	Table 27	---
Voltage ^a	---	4.8.7	---	Table B.2	Table 29	Table 30	Table 28
Power factor ^a	---	4.8.8	---	Annex C	Table 31	---	---
Flicker	---	4.8.9	---	IEC 61000-4-15	Table 32	---	---
Dips and swells ^b	X	4.8.10	X	---	Table 34	Table 35	Table 33
Interruptions ^b	X	4.8.11	X	---	Table 36	---	---
Voltage transients ^b	X	4.8.12	X	IEC 61000-4-30	Table 37	---	---
Voltage unbalance	---	4.8.13	---	IEC 61000-4-30	Table 38	---	---
Harmonic voltage ^a	---	4.8.14	---	---	Table 40	---	Table 39

THDu ^a	---	4.8.14	---	---	Table 41	---	---
Current unbalance	---	4.8.15	---	IEC 61000-4-30	Table 42	---	---
Harmonic current ^a	---	4.8.16	---	---	Table 44	---	Table 43
THDi ^a	---	4.8.16	---	---	Table 45	---	---
Minimum, maximum, peak, 3-phases average ^a	---	4.8.17	---	Annex D	---	---	---
Demand ^a	X	4.8.17		Annex D	---	---	---
^a Depending on product features, measurement can be Total, Phase 1, Phase 2 and Phase 3.							
^b Gapless measurement of Power, dips, swells, interruption is verified via energy measurement.							

The list of complementary functions specified in IEC 61557-12 is summarized in Table 3. Complementary measurement functions specified in technical documentation shall be tested according to IEC 61557-12.

Table 3 – Complementary information about minimum, maximum, peak and demand functions

Item	Time dependant	Total	Phase 1	Phase 2	Phase 3
Minimum	X	a	a	a	a
Maximum	X	a	a	a	a
Peak	X	a	a	a	a
Demand (sliding block 15 min)	X	a	a	a	a
Three-phase average	---	a	---	---	---
Thermal current demand (or bi-metal current demand)	X	b	b	b	b
^a To be verified for measurement functions specified in the technical documentation, among the following list: active power, reactive power, current, voltage and frequency, when these parameters are made available					
^b To be verified for measurement functions specified in the technical documentation, among the following list: phase current					

5.1.4 Test criteria

The below test criteria defined in Table 4 apply.

Table 4 – Test criteria

Criteria name	definition
C1	Check AEL and ALV of related functions (if available in the device under test) as defined in Table 2.
C2	Check value related to minimum, maximum, peak, demand as defined in Table 3

5.1.5 Performance class verification

Error! Reference source not found. shall be applied for performance class verification.

NOTE –Some test points can request much more, in particular in the case there is noise in the measurement.

6 Test procedure

6.1 General

6.1.1 Numbering of tests

Information about the numbering of tests is provided in **Error! Reference source not found.**, clause F.2.

6.1.2 Notations for ranges (current, voltages, ...)

The notations defined in Table 5, related to the test points defined in clause 6.1.3, apply:

Table 5 – Example of notations for current ranges

Notation		Meaning
$[P6-P8]_{10}$ for current ^a	P2 for voltage	For voltage = value of P2, current shall be set from value of P6 to value of P8, with steps of $[(P6 - P8) / 9]$, making 10 test points total, see NOTE.
$[P6-P8]_5$ for current ^a	P3 for voltage	For voltage = value of P3, current shall be set from value of P6 to $(P8 \times 0,9)$, with steps of $[(P6 - (P8 \times 0,9)) / 4]$, making 5 test points total.
$[P5-P10]_{20}$ for current, P2 for Power factor	$[P2-P5]_8$ for voltage	For voltage = value of P2 to value of P5 with steps of $[(P5 - P2) / 7]$, making 8 test points: - Current shall be set from value of P5 to value of P10, with steps of $[(P10 - P5) / 19]$, making 20 test points total. - Power Factor is set to P2 At total, there are then $8 \times 20 = 160$ test points.
^a A minimum of 3 test points shall be specified		
NOTE - In this example, test point P7 does not need to be used despite it is in between P6 and P8.		

6.1.3 Test points

The below Table 6, Table 7, Table 8 and Table 9 define the different testing points that shall be applied according to the test procedures defined in the following sections.

By default, when a specific parameter is not specified in a test specification, then test points P1 shall be considered for this parameter.

6.1.3.1 Test points for electrical power system

Table 6 – Test points for current

Parameter	Testing point P1	Testing point P2	Testing point P3	Testing point P4	Testing point P5	Testing point P6	Testing point P7	Testing point P8	Testing point P9	Testing point P10
Current (direct connected PMD)										
phase 1	I_n	I_{start}	I_{min}	$0,02 I_n$	$0,05 I_n$	$0,1 I_n$	$0,2 I_n$	$0,5 I_n$	$0,5 I_{max}$	I_{max}
phase 2	I_n	I_{start}	I_{min}	$0,02 I_n$	$0,05 I_n$	$0,1 I_n$	$0,2 I_n$	$0,5 I_n$	$0,5 I_{max}$	I_{max}
phase 3	I_n	I_{start}	I_{min}	$0,02 I_n$	$0,05 I_n$	$0,1 I_n$	$0,2 I_n$	$0,5 I_n$	$0,5 I_{max}$	I_{max}
Current (sensor operated PMD)										
phase 1	I_n	I_{start}	I_{min}	$0,01 I_n$	$0,02 I_n$	$0,05 I_n$	$0,1 I_n$	$0,5 I_n$	$0,5 I_{max}$	I_{max}
phase 2	I_n	I_{start}	I_{min}	$0,02 I_n$	$0,02 I_n$	$0,05 I_n$	$0,1 I_n$	$0,5 I_n$	$0,5 I_{max}$	I_{max}
phase 3	I_n	I_{start}	I_{min}	$0,01 I_n$	$0,02 I_n$	$0,05 I_n$	$0,1 I_n$	$0,5 I_n$	$0,5 I_{max}$	I_{max}
Parameter	Testing point P11	Testing point P12	Testing point P13	Testing point P14	Testing point P15	Testing point P16	Testing point P17	Testing point P18	Testing point P19	Testing point P20
Current (direct connected PMD)										
phase 1	$I_{max} / \sqrt{2}$									
phase 2										
phase 3										
Current (sensor operated PMD)										
phase 1	---									
phase 2										
phase 3										

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Table 7 – Test points for voltage

Parameter	Testing point P1	Testing point P2	Testing point P3	Testing point P4	Testing point P5	Testing point P6	Testing point P7	Testing point P8	Testing point P9	Testing point P10
Voltage (direct connected PMD)		Table 28				4.8.13	4.8.13	4.8.13	4.8.2.5.2 4.8.3.5.2	
phase 1	U_n	U_{min}	50 % U_n	80 % U_n	120 % U_n	80 % U_n	120 % U_n	110 % U_n	115 % U_n	U_{max}
phase 2	U_n	U_{min}	50 % U_n	80 % U_n	120 % U_n	87 % U_n	112 % U_n	100 % U_n	115 % U_n	U_{max}
phase 3	U_n	U_{min}	50 % U_n	80 % U_n	120 % U_n	93 % U_n	108 % U_n	90 % U_n	115 % U_n	U_{max}
Voltage (sensor operated PMD)		Table 28				4.8.13	4.8.13	4.8.13	4.8.2.5.2 4.8.3.5.2	
phase 1	U_n	20 % U_n	50 % U_n	80 % U_n	120 % U_n	80 % U_n	120 % U_n	110 % U_n	115 % U_n	U_{max}
phase 2	U_n	20 % U_n	50 % U_n	80 % U_n	120 % U_n	87 % U_n	112 % U_n	100 % U_n	115 % U_n	U_{max}
phase 3	U_n	20 % U_n	50 % U_n	80 % U_n	120 % U_n	93 % U_n	108 % U_n	90 % U_n	115 % U_n	U_{max}

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