



IEC 62828-1

Edition 2.0 2026-06

# INTERNATIONAL STANDARD

---

**Reference conditions and procedures for testing industrial and process  
measurement transmitters -  
Part 1: General procedures for all types of transmitters**

## CONTENTS

FOREWORD .....	4
INTRODUCTION .....	6
1 Scope .....	7
2 Normative references .....	7
3 Terms, definitions and abbreviated terms .....	8
3.1 Terms and definitions .....	8
3.1.1 Terms related to accuracy .....	8
3.1.2 Terms related to uncertainty .....	14
3.1.3 Terms regarding operation and practical installation .....	15
3.1.4 Terms related to test procedures .....	16
3.2 Abbreviated terms .....	16
3.3 Reference to IEC Common Data Dictionary .....	17
4 General description of the PMT .....	17
5 Reference test conditions .....	17
5.1 General .....	17
5.2 Standard reference test conditions .....	18
5.2.1 General .....	18
5.2.2 Environmental test conditions .....	18
5.2.3 Power supply conditions .....	18
5.2.4 Load conditions .....	19
5.2.5 Mounting positions .....	19
5.3 Reference test conditions for ambient and process quantities influencing operation .....	19
5.3.1 General .....	19
5.3.2 Process conditions .....	19
5.3.3 Environmental atmospheric conditions .....	19
5.3.4 Mechanical vibration .....	20
5.3.5 Shock .....	21
5.3.6 Power supply .....	21
5.3.7 Electromagnetic compatibility (EMC) .....	21
6 Test procedures .....	22
6.1 General .....	22
6.1.1 Overview .....	22
6.1.2 Classification of the tests .....	22
6.1.3 Preparation of the tests .....	23
6.1.4 Preliminary assessment .....	24
6.2 Type tests at standard reference test conditions .....	31
6.2.1 General .....	31
6.2.2 Accuracy and related factors .....	31
6.2.3 Static behaviour .....	37
6.2.4 Dynamic behaviour .....	41
6.3 Type tests at operating reference test conditions .....	46
6.3.1 General .....	46
6.3.2 Ambient temperature effects .....	46
6.3.3 Ambient relative humidity effects .....	48
6.3.4 Vibration effects .....	48

6.3.5	Shock effects.....	50
6.3.6	Accelerated operational life test.....	50
6.3.7	EMC tests.....	50
6.3.8	Further test procedures .....	51
6.3.9	Additional tests for digital transmitters .....	51
6.4	Routine tests.....	52
6.5	Acceptance, integration, periodic and maintenance tests .....	52
6.5.1	General .....	52
6.5.2	Periodical verification .....	52
6.5.3	Periodical calibration .....	52
7	Test report.....	53
7.1	General.....	53
7.2	Test documentation .....	53
7.3	Total probable error .....	53
Annex A	(informative) General description of a PMT .....	55
A.1	General description of a PMT.....	55
A.2	Sensor subsystem .....	56
A.3	Data processing.....	56
A.4	Output subsystem .....	56
A.5	Human interface .....	57
A.6	External system interface.....	57
A.7	Power supply assembly.....	57
Annex B	(informative) Tests at the standard reference conditions .....	58
Annex C	(Informative) Tests at ambient and process reference conditions for influence quantities.....	60
Annex D	(informative) Function block testing .....	62
D.1	General.....	62
D.2	General qualitative checks .....	62
D.3	Time-dependent function blocks.....	62
D.4	Time-independent function blocks.....	62
Annex E	(informative) Total probable error calculation .....	63
Annex F	(informative) Product documentation.....	64
F.1	General.....	64
F.2	Technical datasheet.....	64
F.3	User manual .....	67
F.4	Safety manual.....	67
F.5	Storage, transportation and installation.....	67
F.5.1	General .....	67
F.5.2	Storage conditions .....	67
F.5.3	Transportation conditions .....	67
F.5.4	Mounting position .....	68
F.5.5	Process connections.....	68
F.5.6	Mechanical connections.....	68
F.5.7	Output connections.....	68
F.6	Calibration certificates .....	68
Annex G	(informative) Example of signal current range for a 4 to 20 mA PMT.....	69
G.1	Measuring span .....	69
G.2	Underrange.....	69

G.3	Overrange.....	69
G.4	Low alarm .....	70
G.5	High alarm .....	70
	Bibliography.....	71
Figure 1	– Principle diagram illustrating the definitions of warm-up time, settling time and output signal .....	12
Figure 2	– Block diagram of a generic PMT.....	17
Figure 3	– Error curves corresponding to the example of Table 17.....	35
Figure 4	– Example of limit operation region in terms of output load resistance versus supply voltage.....	39
Figure 5	– Example of response with overshoot to a step input.....	42
Figure 6	– Example of response without overshoot to a step input.....	43
Figure 7	– Example 1 of frequency response .....	44
Figure 8	– Example 2 of frequency response .....	45
Figure 9	– Example of diagram of the compensation options.....	47
Figure 10	– Example of an input signal and the corresponding output signal.....	50
Figure A.1	– Schematic block diagram of an analogue industrial and process measurement transmitter (example).....	55
Figure G.1	– Signal current range of a 4 mA to 20 mA transmitter.....	69
Table 1	– Environmental test conditions.....	18
Table 2	– Common ambient temperatures ranges .....	20
Table 3	– Common ambient relative humidity ranges .....	20
Table 4	– Vibration test levels.....	21
Table 5	– Power supply ranges for voltage and frequency.....	21
Table 6	– Example of number of measurement cycles and number and position of test points.....	23
Table 7	– Example of settings of span and lower range value adjustments for analogue devices .....	23
Table 8	– Checklist for assessing functionality.....	25
Table 9	– Checklist for assessing configurability .....	26
Table 10	– Checklist for assessing hardware configuration .....	27
Table 11	– Checklist for assessing adjustment and tuning procedures .....	27
Table 12	– Checklist for assessing operability.....	28
Table 13	– Checklist for assessing dependability .....	29
Table 14	– Checklist for assessing technical support .....	30
Table 15	– Example of functions listing for a temperature compensated single variable PMT (differential pressure) .....	30
Table 16	– Example of functions listing for a temperature compensated multi-variable PMT (differential pressure plus pressure and temperature) .....	31
Table 17	– Example table of PMT errors .....	34
Table B.1	– Summary of the tests at the reference conditions .....	58
Table C.1	– Summary of the tests for influence quantities at the operating conditions.....	60
Table F.1	– Example of compilation of technical data for a generic PMT .....	65

INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

**Reference conditions and procedures for testing industrial  
and process measurement transmitters -  
Part 1: General procedures for all types of transmitters**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 62828-1 has been prepared by subcommittee 65B: Measurement and control devices, of IEC Technical Committee 65: Industrial-process measurement, control and automation. It is an International Standard.

This second edition cancels and replaces the first edition published in 2017. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) informative Annexes E, F, G and H have been removed;
- b) a new informative Annex G "Example of signal current for a 4 mA to 20 mA PMT" has been introduced (it has been moved from IEC 62828-2:2017 to this document);

- c) the definitions of warm-up time, settling time and output signal have been moved from IEC 62828-4:2020 to this document;
- d) The definitions of “inaccuracy” and “accuracy” have been reworked;
- e) The clause regarding test report has been reworked.

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

Draft	Report on voting
65B/1306/FDIS	65B/1320/RVD

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

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

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

A list of all parts in the IEC 62828 series, published under the general title *Reference conditions and procedures for testing industrial and process measurement transmitters*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under [webstore.iec.ch](http://webstore.iec.ch) in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

## INTRODUCTION

Most of the current IEC standards on industrial and process measurement transmitters are rather old and were developed having in mind devices based on analogue technologies. Today's digital industrial and process measurement transmitters are quite different from those analogue transmitters: they include more functions and newer interfaces, both towards the computing section (mostly digital electronic) and towards the measuring section (mostly mechanical). Even if some standards dealing with digital process measurement transmitters already exist, they are not sufficient, since some aspects of the performance are not covered by appropriate test methods.

In addition, existing IEC test standards for industrial and process measurement transmitters are spread over many documents, so that for manufacturers and users it is difficult, impractical and time-consuming to identify and select all the standards to be applied to a device measuring a specific process quantity (pressure, temperature, flow, level, etc.).

To help manufacturers and users, it was decided to review, complete and reorganize the relevant IEC standards and to create a more suitable, effective and comprehensive standard series that provides in a systematic way all the necessary specifications and tests required for different industrial and process measurement transmitters.

To solve the issues mentioned above and to provide an added value for the stakeholders, the new standard series on industrial and process measurement transmitters covers the following main aspects:

- applicable normative references;
- specific terms and definitions;
- typical configurations and architectures for the various types of industrial and process measurement transmitters;
- hardware and software aspects;
- interfaces (to the process, to the operator, to the other measurement and control devices);
- physical, mechanical and electrical requirements and relevant tests; clear definition of the test categories: type tests, acceptance tests and routine tests;
- performance (its specification, tests and verification);
- environmental protection, hazardous areas application, functional safety, etc.;
- structure of the product documentation.

To cover in a systematic way all the topics to be addressed, the standard series is organized in several parts. At the moment of the publication of this document, the IEC 62828 consists of the following parts:

- *Part 1: General procedures for all types of transmitters;*
- *Part 2: Specific procedures for pressure transmitters;*
- *Part 3: Specific procedures for temperature transmitters;*
- *Part 4: Specific procedures for level transmitters;*
- *Part 5: Specific procedures for flow transmitters.*

## 1 Scope

This Part of IEC 62828 establishes a general framework for defining reference conditions and test procedures applicable for assessing the measurement performances of all types of industrial and process measurement transmitters (PMTs) used in measuring and control systems for industrial process and machinery.

For the purpose of this document, an analogue PMT is a process measurement transmitter with only analogue current and/or voltage output(s), irrespective the technology adopted and the complexity of the circuitry. All the other process measurement transmitters, with digital output(s) only or with hybrid analogue and digital output(s), are considered to be digital PMTs.

This document constitutes a common reference for the other parts of the IEC 62828 series.

Specific test procedures and additional requirements for given types of PMTs (pressure, temperature, level, flow, etc.) are covered by other parts of this series.

Sensing devices according to the IEC 60947 series are excluded from the scope of this document.

NOTE 1 In industrial and process applications, to indicate the process measurement transmitters, it is common also to use the terms "industrial transmitters", or "process transmitters".

NOTE 2 For better clarity, when the complete definition "industrial and process measurement transmitter" makes the sentence too long in this document, the short term "transmitter", or PMT, is used instead.

## 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 2-2: Tests - Test B: Dry heat*

IEC 60068-2-6, *Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27, *Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock*

IEC 60068-2-78, *Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state*

IEC 60654-1, *Industrial-process measurement and control equipment - Operating conditions - Part 1: Climatic conditions*

IEC 60654-3, *Operating conditions for industrial-process measurement and control equipment - Part 3: Mechanical influences*

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

IEC 61326 (all parts), *Electrical equipment for measurement, control and laboratory use - EMC requirements*

IEC 61499 (all parts), *Function blocks*

## Bibliography

IEC 60050-300:2001, *International Electrotechnical Vocabulary (IEV) - Part 300: Electrical and electronic measurements and measuring instruments - Part 311: General terms relating to measurements - Part 312: General terms relating to electrical measurements - Part 313: Types of electrical measuring instruments - Part 314: Specific terms according to the type of instrument*

IEC 60050-300:2001/AMD1:2015

IEC 60050-300:2001/AMD2:2016

IEC 60050-300:2001/AMD3:2017

IEC 60050-300:2001/AMD4:2020

IEC 60068-2-31, *Environmental testing - Part 2-31: Tests - Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60079 (all parts), *Explosive atmospheres*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP code)*

IEC 60529:1989/AMD1:1999

IEC 60529:1989/AMD2:2013

IEC 60654-2, *Operating conditions for industrial-process measurement and control equipment - Part 2: Power*

IEC 60654-4, *Operating conditions for industrial-process measurement and control equipment - Part 4: Corrosive and erosive influences*

IEC 60721-3-1, *Classification of environmental conditions - Part 3-1: Classification of groups of environmental parameters and their severities - Storage*

IEC 60721-3-2, *Classification of environmental conditions - Part 3-2: Classification of groups of environmental parameters and their severities - Transportation and Handling*

IEC 61158 (all parts), *Industrial communication networks - Fieldbus specifications*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61511 (all parts), *Functional safety - Safety instrumented systems for the process industry sector*

IEC 61784-1 (all parts), *Industrial networks - Profiles - Fieldbus profiles*

IEC 61784-2 (all parts), *Industrial networks - Profiles - Part 2-3: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3*

IEC 61784-5 (all parts), *Industrial communication networks - Profiles - Installation of fieldbuses*

IEC 61804-2, *Function blocks (FB) for process control and electronic device description language (EDDL) - Part 2: Specification of FB concept*

IEC 61918, *Industrial communication networks - Installation of communication networks in industrial premises*

IEC 61987, *IEC Common Data Dictionary*, available at <http://cdd.iec.ch>

IEC 61987-1:2024, *Industrial-process measurement and control - Data structures and elements in process equipment catalogues - Part 1: Generic structures for measuring equipment*

IEC 61987-10:2009, *Industrial-process measurement and control - Data structures and elements in process equipment catalogues - Part 10: List of Properties (LOPs) for Industrial-Process Measurement and Control for Electronic Data Exchange - Fundamentals*

IEC 61987-11:2016, *Industrial-process measurement and control - Data structures and elements in process equipment catalogues - Part 11: List of properties (LOPs) of measuring equipment for electronic data exchange - Generic structures*

IEC 61987-12:2016, *Industrial-process measurement and control - Data structures and elements in process equipment catalogues - Part 12: Lists of properties (LOPs) for flow measuring equipment for electronic data exchange*

IEC 61987-13, *Industrial-process measurement and control - Data structures and elements in process equipment catalogues - Part 13: Lists of properties (LOP) for pressure measuring equipment for electronic data exchange*

IEC 61987-14:2016, *Industrial-process measurement and control - Data structures and elements in process equipment catalogues - Part 14: Lists of properties (LOPs) for temperature measuring equipment for electronic data exchange*

IEC 61987-15:2016, *Industrial-process measurement and control - Data structures and elements in process equipment catalogues - Part 15: Lists of properties (LOPs) for level measuring equipment for electronic data exchange*

IEC 62061, *Safety of machinery - Functional safety of safety-related control systems*

IEC TS 62098:2000, *Evaluation methods for microprocessor-based instruments*

IEC 62262:2002, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

IEC 62381, *Automation systems in the process industry - Factory acceptance test (FAT), site acceptance test (SAT) and site integration test (SIT)*

IEC 62382:2024, *Control systems in the process industry - Electrical and instrumentation loop check*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement - Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO 10012, *Quality management - Requirements for measurement management systems*

CISPR 11 *Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement*

OIML D 10:2007, *Guidelines for the determination of calibration intervals of measuring instruments*

UKAS, M3003:2007, *The expression of uncertainty and confidence in measurement*

Calibration Handbook of Measuring Instruments, A. Brunelli, ISA Editor, USA 2017