

© Copyright SEK Svensk Elstandard. Reproduction in any form without permission is prohibited.

Industriell processtyrning – Referensförhållanden och metoder vid provning av mätgivare – Del 4: Särskilda metoder för nivågivare

*Reference conditions and procedures for testing industrial and process measurement transmitters –
Part 4: Specific procedures for level transmitters*

Som svensk standard gäller europastandarden EN IEC 62828-4:2020. Den svenska standarden innehåller den officiella engelska språkversionen av EN IEC 62828-4:2020.

Nationellt förord

Europastandarden EN IEC 62828-4:2020

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 62828-4, First edition, 2020 - Reference conditions and procedures for testing industrial and process measurement transmitters - Part 4: Specific procedures for level transmitters**

utarbetad inom International Electrotechnical Commission, IEC.

Standarden ska användas tillsammans med SS-EN IEC 62828-1, utgåva 1, 2018.

Standarder underlättar utvecklingen och höjer elsäkerheten

Det finns många fördelar med att ha gemensamma tekniska regler för bl a mätning, säkerhet och provning och för utförande, skötsel och dokumentation av elprodukter och elanläggningar.

Genom att utforma sådana standarder blir säkerhetsfordringar tydliga och utvecklingskostnaderna rimliga samtidigt som marknadens acceptans för produkten eller tjänsten ökar.

Många standarder inom elområdet beskriver tekniska lösningar och metoder som åstadkommer den elsäkerhet som föreskrivs av svenska myndigheter och av EU.

SEK är Sveriges röst i standardiseringsarbetet inom elområdet

SEK Svensk Elstandard svarar för standardiseringen inom elområdet i Sverige och samordnar svensk medverkan i internationell och europeisk standardisering. SEK är en ideell organisation med frivilligt deltagande från svenska myndigheter, företag och organisationer som vill medverka till och påverka utformningen av tekniska regler inom elektrotekniken.

SEK samordnar svenska intressenters medverkan i SEKs tekniska kommittéer och stödjer svenska experters medverkan i internationella och europeiska projekt.

Stora delar av arbetet sker internationellt

Utformningen av standarder sker i allt väsentligt i internationellt och europeiskt samarbete. SEK är svensk nationalkommitté av International Electrotechnical Commission (IEC) och Comité Européen de Normalisation Electrotechnique (CENELEC).

Standardiseringsarbetet inom SEK är organiserat i referensgrupper bestående av ett antal tekniska kommittéer som speglar hur arbetet inom IEC och CENELEC är organiserat.

Arbetet i de tekniska kommittéerna är öppet för alla svenska organisationer, företag, institutioner, myndigheter och statliga verk. Den årliga avgiften för deltagandet och intäkter från försäljning finansierar SEKs standardiseringsverksamhet och medlemsavgift till IEC och CENELEC.

Var med och påverka!

Den som deltar i SEKs tekniska kommittéarbete har möjlighet att påverka framtida standarder och får tidig tillgång till information och dokumentation om utvecklingen inom sitt teknikområde. Arbetet och kontakterna med kollegor, kunder och konkurrenter kan gynnsamt påverka enskilda företags affärsutveckling och bidrar till deltagarnas egen kompetensutveckling.

Du som vill dra nytta av dessa möjligheter är välkommen att kontakta SEKs kansli för mer information.

SEK Svensk Elstandard

Box 1284
164 29 Kista
Tel 08-444 14 00
www.elstandard.se

ICS 17.200.20; 25.040.40

English Version

Reference conditions and procedures for testing industrial and process measurement transmitters - Part 4: Specific procedures for level transmitters
(IEC 62828-4:2020)

Conditions de référence et procédures pour l'essai des transmetteurs de mesure industriels et de processus - Partie 4: Procédures spécifiques pour les transmetteurs de niveau
(IEC 62828-4:2020)

Referenzbedingungen und Testmethoden für Industrie- und Prozessmessgrößenumformer - Teil 4: Spezielle Testmethoden für Füllstandmessumformer
(IEC 62828-4:2020)

This European Standard was approved by CENELEC on 2020-09-22. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 65B/1178(F)/FDIS, future edition 1 of IEC 62828-4, prepared by SC 65B "Measurement and control devices" of IEC/TC 65 "Industrial-process measurement, control and automation" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62828-4:2020.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2021-06-22
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2023-09-22

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 62828-4:2020 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60529:1989 NOTE Harmonized as EN 60529:1991 (not modified)

IEC 60947-5-6:1999 NOTE Harmonized as EN 60947-5-6:2000 (not modified)

IEC 61140:2016 NOTE Harmonized as EN 61140:2016 (not modified)

IEC 61298-1:2008 NOTE Harmonized as EN 61298-1:2008 (not modified)

IEC 61298-2:2008 NOTE Harmonized as EN 61298-2:2008 (not modified)

IEC 61298-3:2008 NOTE Harmonized as EN 61298-3:2008 (not modified)

IEC 61987-1:2006 NOTE Harmonized as EN 61987-1:2007 (not modified)

IEC 61987-11:2016 NOTE Harmonized as EN 61987-11:2017 (not modified)

IEC 61987-15 NOTE Harmonized as EN 61987-15

IEC 62683-1:2017 NOTE Harmonized as EN 62683-1:2017 (not modified)

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60068-2-6	2007	Environmental testing - Part 2-6: Tests Test Fc: Vibration (sinusoidal)	-EN 60068-2-6	2008
IEC 60068-2-27	2008	Environmental testing - Part 2-27: Tests Test Ea and guidance: Shock	-EN 60068-2-27	2009
IEC 60068-2-64	2008	Environmental testing - Part 2-64: Tests Test Fh: Vibration, broadband random and guidance	-EN 60068-2-64	2008
IEC 61326-2-3	2012	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 2-3: Particular requirements - Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning	EN 61326-2-3	2013
IEC 62828-1	2017	Reference conditions and procedures for testing industrial and process measurement transmitters - Part 1: General procedures for all types of transmitters	EN IEC 62828-1	2018
IEC 62828-2	2017	Reference conditions and procedures for testing industrial and process measurement transmitters - Part 2: Specific procedures for pressure transmitters	EN IEC 62828-2	2018

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references	8
3 Terms and definitions	8
3.1 Basic definitions.....	9
3.2 Level transmitter definitions	11
3.2.2 Pressure-based level transmitter definitions.....	11
3.2.4 Float level transmitter definitions	12
3.2.6 Microwave/Radar level transmitter definitions	12
3.2.7 Optical based level transmitter definitions.....	12
3.2.9 Capacitance and admittance level transmitter definitions	13
3.2.10 Mechanical level transmitter definitions	13
3.2.11 Electrical resistance level transmitter definitions.....	14
3.3 Measurement parameters	14
3.4 Influence quantity definitions.....	14
3.5 Reference to the IEC common data dictionary (CDD).....	15
4 General description of main types of level transmitters	16
4.1 General.....	16
4.2 Pressure-based level transmitters	16
4.3 Microwave/radar level transmitter	18
4.3.1 General	18
4.3.2 Free-space radar level transmitter	18
4.3.3 Guided-wave radar level transmitter	19
5 Reference test conditions	20
5.1 General.....	20
5.2 Standard reference test conditions.....	20
5.2.1 General	20
5.2.2 Environmental test conditions	20
5.2.3 Power supply conditions	21
5.2.4 Load conditions	21
5.2.5 Mounting positions for testing	21
5.3 Reference test conditions for ambient and process quantities influencing operation	21
5.3.1 General	21
5.3.2 Process conditions	22
5.3.3 Environmental atmospheric conditions	22
5.3.4 Mechanical vibration	23
5.3.5 Shock, drop and topple	23
5.3.6 Power supply	23
5.3.7 Electromagnetic compatibility (EMC)	23
5.4 Reference design criteria	23
5.4.1 General	23
5.4.2 Enclosure protection against solid, liquid (IP) and impact (IK).....	23
5.4.3 Enclosure protection against corrosive and erosive influences.....	23
5.4.4 Electrical safety (insulation resistance, dielectric strength)	24
5.4.5 Hazardous environment (for application in explosive atmosphere)	24

5.4.6	Functional safety	24
6	Test procedures	24
6.1	General.....	24
6.1.1	Overview	24
6.1.2	Specific test setups and procedures	25
6.2	Type tests at standard reference conditions	28
6.2.1	General	28
6.2.2	Accuracy and related factors	29
6.2.3	Static behaviour.....	30
6.2.4	Dynamic behaviour	31
6.3	Type tests at operating reference test conditions	31
6.3.1	General	31
6.3.2	Ambient temperature effects	31
6.3.3	Ambient relative humidity effects	32
6.3.4	Vibration effects	32
6.3.5	Shock, drop and topple	32
6.3.6	Accelerated operational life test.....	32
6.3.7	EMC tests.....	32
6.3.8	Further test procedures	32
6.3.9	Additional test for digital transmitters	32
6.4	Routine tests.....	32
6.5	Acceptance, integration, periodic and maintenance tests	32
6.5.1	General	32
6.5.2	Periodical verification	32
6.5.3	Periodical calibration	32
7	Test report and technical documentation	32
7.1	Test report	32
7.2	Technical documentation	33
7.3	Total probable error TPE.....	33
7.3.1	General	33
7.3.2	Specific errors	33
Annex A (informative)	Main characteristics for level transmitters	34
A.1	Properties of level transmitter classes.....	34
A.1.1	General	34
A.1.2	Pressure-based level transmitter	34
A.1.3	Microwave/Radar level transmitter	36
A.2	Product properties	42
A.2.1	Library of properties used in the device classes.....	42
A.2.2	Value lists of properties	46
Annex B (informative)	Example for the calculation of the TPE based on 7.3 and the MRU and MRE	48
B.1	Overview of the parameters used for the error calculation.....	48
B.2	Example test report pressure-based level transmitter	48
B.2.1	General	48
B.2.2	Test protocol	48
B.2.3	DUT characteristics	48
B.2.4	TPE calculation	49
B.2.5	MRU calculation	50

B.3	Sub test processes	51
B.3.1	Inaccuracy test	51
B.3.2	Ambient temperature effect test	52
B.3.3	Process temperature effect test	53
B.3.4	Long-term stability test	54
	Bibliography	56
	Figure 1 – Principle diagram of time values and their meanings	10
	Figure 2 – Principles of pressure-based level transmitters	18
	Figure 3 – Free-space radar level transmitter	19
	Figure 4 – Guided-wave radar level transmitter	20
	Figure 5 – Schematic example of a test set-up for pressure PMT	25
	Figure 6 – Typical test set-up for radar level transmitter	26
	Figure 7 – Test setup simulated targets and simulated environment	27
	Figure 8 – Example of test setup for wet test	28
	Table 1 – Environmental test conditions	21
	Table 2 – Influence quantities for the various level measurement principles	22
	Table 3 – Number of measurement cycles and number and position of test points	24
	Table 4 – Example of statement of maximum error	29
	Table A.1 – Pressure-based level transmitter	34
	Table A.2 – Free-space radar level transmitter	37
	Table A.3 – Guided-wave radar level transmitter	39
	Table A.4 – Library of properties used in the device classes	42
	Table A.5 – Value lists of properties	47
	Table B.1 – Abbreviated terms	48
	Table B.2 – DUT characteristics	49
	Table B.3 – TPE calculation	49
	Table B.4 – MRU calculation	50
	Table B.5 – Reference test devices	51
	Table B.6 – Reference test conditions	51
	Table B.7 – Test results	52
	Table B.8 – Reference test equipment	52
	Table B.9 – Reference test conditions	53
	Table B.10 – Test results	53
	Table B.11 – Reference test equipment	53
	Table B.12 – Reference test conditions	54
	Table B.13 – Test results	54
	Table B.14 – Reference test equipment	55
	Table B.15 – Reference test conditions	55
	Table B.16 – Test results	55

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**REFERENCE CONDITIONS AND PROCEDURES FOR TESTING
INDUSTRIAL AND PROCESS MEASUREMENT TRANSMITTERS –**
Part 4: Specific procedures for level 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) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62828-4 has been prepared by subcommittee 65B: Measurement and control devices, of IEC technical committee 65: Industrial-process measurement, control and automation.

The IEC 62828 series cancels and replaces the IEC 60770 series and proposes revisions for the IEC 61298 series.

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

FDIS	Report on voting
65B/1178/FDIS	65B/1182/RVD

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

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

This International Standard is to be used in conjunction with IEC 62828-1:2017.

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 "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Most of the current IEC standards on industrial 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) and towards the measuring section (mostly mechanical). Even if some standards dealing with digital transmitters already exist, they are not sufficient, since some aspects of the performance are not covered by appropriate test methods.

In addition, the existing IEC test standards for industrial and process measurement transmitters are spread over many documents, so that for manufacturers and users it was 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, level, flow, etc.).

To help the manufacturers and users, it was decided to review, complete and reorganize the existing IEC standards on the industrial and process measurement transmitters and to create a more suitable, effective and comprehensive standard series that provides, in a systematic way, all the needed specifications and tests for the 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 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;
- performances (their specification, tests and verification);
- environmental protection, hazardous areas application, functional safety, etc.;
- structure of the technical documentation.

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

- IEC 62828-1: *General procedures for all types of transmitters*
- IEC 62828-2: *Specific procedures for pressure transmitters*
- IEC 62828-3: *Specific procedures for temperature transmitters*
- IEC 62828-4: *Specific procedures for level transmitters*
- IEC 62828-5: *Specific procedures for flow transmitters*

In preparing the IEC 62828 series (all parts), many test procedures were taken, with the necessary improvements, from the IEC 61298 series. As the IEC 61298 series is currently applicable to all process measurement and control devices, when the IEC 62828 series is completed, the IEC 61298 series will be revised to harmonize it with the IEC 62828 series, taking out from its scope the industrial and process measurement transmitters. During the time when the scope of the IEC 61298 series is being updated, the new IEC 62828 series takes precedence for industrial and process measurement transmitters.

When the IEC 62828 series is published, the IEC 60770 series will be withdrawn.

REFERENCE CONDITIONS AND PROCEDURES FOR TESTING INDUSTRIAL AND PROCESS MEASUREMENT TRANSMITTERS –

Part 4: Specific procedures for level transmitters

1 Scope

This part of IEC 62828 establishes specific procedures for testing level transmitters used in measuring and control systems for industrial process and machinery control systems. For general test procedures, reference is to be made to IEC 62828-1:2017, applicable to all types of transmitters.

Throughout this document, the term "industrial transmitters" covers all types of transmitters used in measuring and control systems for industrial processes and for machinery.

The requirements of this document are applicable to all level measurement principles.

Detailed description of transmitters is given for two main principles for improved clarity.

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 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-64:2008, *Environmental testing – Part 2-64: Tests – Test Fh: Vibration, broadband random and guidance*

IEC 61326-2-3:2012, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-3: Particular requirements – Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning*

IEC 62828-1:2017, *Reference conditions and procedures for testing industrial and process measurement transmitters – Part 1: General procedures for all types of transmitters*

IEC 62828-2:2017, *Reference conditions and procedures for testing industrial and process measurement transmitters – Part 2: Specific procedures for pressure transmitters*