



SLOVENSKI STANDARD
oSIST prEN IEC 60688:2023
01-december-2023

Električni merilni pretvorniki za pretvarjanje izmeničnih električnih veličin v analogne ali digitalne signale

Electrical measuring transducers for converting AC and DC electrical quantities to analogue or digital signals

iTeh Standards
(<https://standards.iteh.ai>)

Ta slovenski standard je istoveten z: **prEN IEC 60688:2023**

[oSIST prEN IEC 60688:2023](https://standards.iteh.ai/catalog/standards/sist/d11cb9db-a5ff-45e7-b5d3-e05414794d04/osist-pren-iec-60688-2023)

<https://standards.iteh.ai/catalog/standards/sist/d11cb9db-a5ff-45e7-b5d3-e05414794d04/osist-pren-iec-60688-2023>

ICS:

17.220.20	Merjenje električnih in magnetnih veličin	Measurement of electrical and magnetic quantities
-----------	---	---

oSIST prEN IEC 60688:2023

en,fr,de



85/892/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: IEC 60688 ED5	
DATE OF CIRCULATION: 2023-09-29	CLOSING DATE FOR VOTING: 2023-12-22
SUPERSEDES DOCUMENTS: 85/888/RR	

IEC TC 85 : MEASURING EQUIPMENT FOR ELECTRICAL AND ELECTROMAGNETIC QUANTITIES	
SECRETARIAT: China	SECRETARY: Ms Guiju HAN
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 13, SC 23K, TC 38, TC 66	PROPOSED HORIZONTAL STANDARD: <input type="checkbox"/> Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: <input type="checkbox"/> EMC <input type="checkbox"/> ENVIRONMENT <input type="checkbox"/> QUALITY ASSURANCE <input type="checkbox"/> SAFETY	
<input checked="" type="checkbox"/> SUBMITTED FOR CENELEC PARALLEL VOTING Attention IEC-CENELEC parallel voting The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	<input type="checkbox"/> NOT SUBMITTED FOR CENELEC PARALLEL VOTING

<https://standards.iteh.ai/catalog/standards/sist/d11eb9db-a5ff-45e7-b5d3-e05414794d04/osist-pren-iec-60688-2023>

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Recipients of this document are invited to submit, with their comments, notification of any relevant "In Some Countries" clauses to be included should this proposal proceed. Recipients are reminded that the CDV stage is the final stage for submitting ISC clauses. (See [AC/22/2007](#) or [NEW GUIDANCE DOC](#)).

TITLE:

Electrical measuring transducers for converting AC and DC electrical quantities to analogue or digital signals

PROPOSED STABILITY DATE: 2028

NOTE FROM TC/SC OFFICERS:

Copyright © 2023 International Electrotechnical Commission, IEC. All rights reserved. It is permitted to download this electronic file, to make a copy and to print out the content for the sole purpose of preparing National Committee positions. You may not copy or "mirror" the file or printed version of the document, or any part of it, for any other purpose without permission in writing from IEC.

CONTENTS

FOREWORD.....	9
INTRODUCTION.....	11
1 Scope.....	12
2 Normative references	13
3 Terms and definitions	14
3.1 General terms	14
3.2 Terms describing transducers	15
3.3 Terms describing transducers according to the measurand	17
3.4 Terms describing transducers according to their output load	18
3.5 Nominal values	18
3.6 Terms describing transducers with provisions to be adjusted by users	19
3.7 Influence quantities and reference conditions.....	20
3.8 Errors and variations.....	20
3.9 Accuracy, accuracy class, class index.....	21
3.10 Terms related to primary of transducers.....	21
3.11 Terms related to secondary output of transducers.....	22
4 Environmental conditions.....	22
5 Ratings.....	22
6 Requirements for design and construction	22
6.1 General.....	22
6.1.1 Transducer general architecture	22
6.1.2 Classification of transducers (TRD)	23
6.2 Safety requirements.....	23
6.2.1 General	23
6.2.2 Protection against electric shocks.....	24
6.2.3 Protection against mechanical hazards	25
6.2.4 Resistance to mechanical stress.....	25
6.2.5 Protection against the spread of fire	25
6.2.6 Equipment temperature limits and resistance to heat	25
6.2.7 Protection against hazards from fluids	26
6.2.8 Protection against radiation, including laser sources, and against sonic and ultrasonic pressure	26
6.2.9 Protection against liberated gases and substances, explosion and implosion	26
6.2.10 Components and subassemblies.....	26
6.2.11 Protection by interlocks	26
6.2.12 Hazards resulting from application	26
6.2.13 Risk assessment	26
6.3 EMC requirements	26
6.3.1 General	26
6.3.2 Immunity requirements	27
6.3.3 Emission requirements	28
6.4 Climatic requirements	29

6.5	Mechanical requirements	29
6.6	Functional requirements.....	29
6.7	Marking requirements	29
6.8	Documentation requirements	29
7	Type tests	29
8	Routine tests	29
Annex A (normative) Requirements for TRD1.....		30
A.1	Scope	30
A.2	Normative references.....	30
A.3	Terms and definitions.....	30
A.4	Environmental conditions	30
A.5	Ratings	30
A.6	Requirements for design and construction of TRD1.....	31
A.6.1	General	31
A.6.2	Safety requirements	31
A.6.3	EMC requirements	31
A.6.4	Climatic requirements	31
A.6.5	Mechanical requirements	31
A.6.6	Functional requirements	31
A.6.7	Marking requirements	39
A.6.8	Documentation requirements	41
A.7	Type tests for TRD1	42
A.7.1	General	42
A.7.2	General additional requirements for type tests for TRD1.....	42
A.7.3	Variations due to auxiliary supply voltage	42
A.7.4	Variations due to auxiliary supply frequency	43
A.7.5	Variations due to ambient temperature	44
A.7.6	Variations due to the frequency of the input quantity(ies).....	45
A.7.7	Variations due to the input voltage	45
A.7.8	Variations due to the input current	46
A.7.9	Variations due to power factor	47
A.7.10	Variation due to output load.....	48
A.7.11	Variations due to distortion of the input quantity(ies).....	48
A.7.12	Variation due to magnetic field of external origin.....	49
A.7.13	Variation due to unbalanced currents.....	50
A.7.14	Variation due to interaction between measuring elements.....	50
A.7.15	Variation due to self-heating	51
A.7.16	Variation due to continuous operation.....	52
A.7.17	Variation due to common mode interference	52
A.7.18	Variation due to series mode interference.....	53
A.7.19	Permissible excessive inputs	53
A.7.20	Impulse voltage tests	54
A.7.21	High frequency disturbance test.....	54
A.7.22	Test for temperature rise	54
A.7.23	Other tests.....	54
Annex B (normative) Requirements for TRD2.....		55

B.1	Scope	55
B.2	Normative references	55
B.3	Terms and definitions	55
B.4	Environmental conditions	55
B.4.1	General	55
B.4.2	Normal environmental conditions	55
B.5	Ratings for TRD2	56
B.5.1	General	56
B.5.2	Input ratings	56
B.5.3	Output ratings	58
B.5.4	General ratings	59
B.6	Requirements for design and construction of TRD2	60
B.6.1	General	60
B.6.2	Safety requirements	60
B.6.3	EMC requirements	60
B.6.4	Climatic requirements	60
B.6.5	Mechanical requirements	61
B.6.6	Functional requirements	65
B.6.7	Marking requirements	73
B.6.8	Documentation requirements	74
B.7	Type tests of TRD2	75
B.7.1	General	75
B.7.2	Safety tests	75
B.7.3	EMC tests	75
B.7.4	Climatic tests	76
B.7.5	Mechanical tests	78
B.7.6	Functional tests	88
B.7.7	Verification of markings and documentation	96
B.7.8	Short-time currents tests	96
B.7.9	Inter-turn overvoltage tests	97
B.7.10	Anti-aliasing tests	98
B.7.11	Test with harmonics and at low frequencies	98
B.8	Routine tests for TRD2	99
B.8.1	General	99
B.8.2	Accuracy tests	99
B.8.3	Verification of markings	99
B.8.4	Safety tests	99
B.8.5	Inter-turn overvoltage tests	99
Annex C (normative)	Interface coding	100
C.1	General	100
C.2	Characteristics of interface connection	100
C.3	Coding of rated output values for transducers	100
C.4	Coding of auxiliary power supply for transducers	102
C.5	Coding of transfer function curves for transducers	103
C.6	Interface full coding for output of transducers	103
C.6.1	General	103

C.6.2	Examples of interface codes and most common interface codes	104
Annex D (Informative)	Anti-aliasing requirements	106
Annex E (normative)	Requirements for the measurement of harmonics and low frequencies	108
E.1	General	108
E.2	Requirements for accuracy class extension WBm0	108
E.3	Requirements for accuracy class extension WBm1	109
E.4	Requirements for accuracy class extension WBm2	109
E.5	Requirements for accuracy class extension WBm3	110
Annex F (normative)	Markings of terminals of TRD2	111
F.1	Marking of terminals for TRD2 monitoring AC current	111
F.2	Marking of terminals for TRD2 monitoring voltage	111
Annex G (informative)	Guidance related to cables, busbars and bare conductors within an installation	113
G.1	Insulation of cables	113
G.2	Temperature of cables and busbars	113
G.2.1	Cables	113
G.2.2	Busbars	113
Annex H (informative)	Guidance related to overvoltage categories and measurement categories	114
H.1	Concept of overvoltage category	114
H.2	Approach of IEC 60664-1 for primary circuits of TRD2	114
H.2.1	General	114
H.2.2	Examples with IEC 60664-1:2020, for primary measuring circuits, OVC III, PD 2, altitude under 2 000 m, inhomogeneous field	114
H.3	Approach of IEC 61010 for primary circuits of TRD2	115
H.3.1	General	115
H.3.2	Example with IEC 61010-2-030:2017, for primary measuring circuits, OVC III, PD 2, altitude under 2 000 m, inhomogeneous field	115
H.4	Approach for secondary circuits of TRD2	116
Annex I (informative)	Examples of clamping units and relationship between clamping unit and connecting device	117
I.1	Clamping unit in a connecting device	117
I.2	Examples of clamping units	118
Bibliography	123
Figure 1	– Transducer (TRD) architecture example	23
Figure A.1	– Transfer function curve A	35
Figure A.2	– Transfer function curve B	36
Figure A.3	– Transfer function curve C	36
Figure A.4	– Transfer function curve D	37
Figure A.5	– Transfer function curve E	37
Figure B.1	– Relationship between ambient air temperature and relative humidity	60
Figure B.2	– Dimensions	62
Figure B.3	– Accuracy limits of a TRD2-IAC (a) and TRD2-IDC (b)	67

Figure B.4- Definition of the angle between primary conductor and the equipment.....	71
Figure B.5 – Definition of the primary conductor position according to the position factor.....	71
Figure B.6 – Gauges of form A and form B.....	82
Figure B.7 – Test equipment for flexion test.....	85
Figure B.8 – Measurement of the step response time.....	91
Figure B.9 – Temperature cycle accuracy test.....	93
Figure B.10 – Test set up for impact of magnetic field from other phases.....	94
Figure B.11 – Accuracy measurement test set up	95
Figure D.1 – Digital data acquisition system example.....	106
Figure D.2 – Frequency response mask for metering accuracy class 1 ($f_r = 60$ Hz, $f_s = 4\ 800$ Hz).....	107
Figure I.2 – Screw clamping units	118
Figure I.3 – Pillar clamping units.....	119
Figure I.4 – Stud clamping units.....	120
Figure I.5 – Saddle clamping units	121
Figure I.6 – Lug clamping units	122
Figure I.7 – Mantle clamping units	122
Table 1 – Functional classification of transducers with minimal required functions	23
Table 2 – Definition of ports	27
Table 3 – Performance criteria for EMC immunity tests.....	28
Table A.1 – Usage groups.....	30
Table A.2 – Relationship between the limits of intrinsic error, expressed as a percentage of the fiducial value, and the class index	31
Table A.3 – Pre-conditioning.....	32
Table A.4 – Reference conditions of the influence quantities and tolerances for testing purposes.....	32
Table A.5 – Reference conditions relative to the measurand	33
Table A.6 – Examples of marking relating to the reference conditions and nominal range of use for temperature.....	40
Table A.7 – Symbols for marking transducers	41
Table A.8 – Permissible variations due to AC auxiliary supply.....	43
Table A.9 – Permissible variations due to DC auxiliary supply	43
Table A.10 – Permissible variations due to auxiliary supply frequency	44
Table A.11 – Permissible variations due to ambient temperature	44
Table A.12 – Permissible variations due to the frequency of input quantity	45
Table A.13 – Permissible variations due to the input voltage.....	46
Table A.14 – Permissible variations due to the input current	47
Table A.15 – Permissible variations due to power factor	47
Table A.16 – Permissible variations due to output load	48
Table A.17 – Permissible variations due to distortion of input quantities.....	49
Table A.18 – Permissible variations due to magnetic field of external origin.....	50

Table A.19 – Permissible variations due to unbalance currents	50
Table A.20 – Permissible variations due to interactions between measuring elements	51
Table A.21 – Permissible variations due to self-heating	52
Table A.22 – Permissible variations due to continuous operation	52
Table A.23 – Permissible variations due to series mode interference	53
Table B.1 – Environmental conditions parameters	55
Table B.2 – Preferred rated burden for TRD2 with an AC or DC voltage output, or a frequency output	58
Table B.3 – Rated burden for TRD2 with an AC or DC current output	58
Table B.4 – Rated temperatures for TRD2	59
Table B.5 – Rated humidity classes	59
Table B.6 – Examples of terminal lugs for equipment connected to copper conductors	61
Table B.7 - Nominal cross-sections of round copper conductors and approximate relationship between mm ² and AWG/kcmil sizes	62
Table B.8 – Minimum values for Maximum Cross Section of Conductors up to 400 A inclusive	63
Table B.9 – Minimum values for Maximum Cross Section of conductors from 400 A and up to 800 A inclusive	64
Table B.10 – Minimum values for Maximum Cross Section for copper bars for currents above 400 A and up to 3 150 A inclusive	65
Table B.11 – Limits for relative error and phase error for TRD2-IAC	66
Table B.12 – Limits of error for TRD2-IDC	66
Table B.13 – Limits of relative error for TRD2-UAC	69
Table B.14 – Limits of relative error for TRD2-UDC	69
Table B.15 - Limits for the position of the primary conductor with respect to the equipment	70
Table B.16 – RJ45 connector pinout	72
Table B.17 – Temperature tests	77
Table B.18 – Tightening torques for the verification of the mechanical strength of screw-type terminals	79
Table B.19 – Maximum conductor cross-sections and corresponding gauges	80
Table B.20 – Relationship between conductor cross-section and diameter	81
Table B.21 – Test values for flexion and pull-out tests for round copper conductors	84
Table B.22 – Test values for pull-out test for flat copper conductors	86
Table B.23 – Test copper conductors for test currents up to 400 A inclusive	86
Table B.24 – Test copper conductors for test currents above 400 A and up to 800 A inclusive	87
Table B.25 – Test copper bars for test currents above 400 A and up to 3 150 A inclusive	88
Table B.26 – Burden values for basic accuracy tests	89
Table C.1 – Coding of interface connection	100
Table C.2 – Rated AC RMS voltage output	101
Table C.3 – Rated DC voltage output	101

Table C.4 – Rated range of DC voltage output	101
Table C.5 – Rated AC RMS current output less than 1A.....	101
Table C.6 – Rated range of DC current output	102
Table C.7 – Rated frequency output.....	102
Table C.8 – Rated pulse density output.....	102
Table C.9 – Coding of power supply for transducers supplied from measuring instrument via the connector	103
Table C.10 – Coding of external power supply for transducers	103
Table C.11 – Coding of transfer function curves for TRD1.....	103
Table C.12 – Interface full coding for output of transducers	104
Table C.13 – Examples of interface codes and most common interface codes	104
Table D.1 – Anti-aliasing filter	106
Table E.1 – Limits of error for harmonics – Accuracy class extension WBm0	108
Table E.2 – Limits of errors for harmonics – Accuracy class extension WBm1.....	109
Table E.3 – Limits of errors for harmonics – Accuracy class extension WBm2.....	109
Table E.4 – Limits of errors for supra-harmonics – Accuracy class extension WBm3.....	110
Table F.1 – Marking of terminals for TRD2 monitoring current.....	111
Table F.2 – Marking of terminals for TRD2 monitoring voltage	112
Table H.1 – Clearances according to IEC 60664-1:2020	114
Table H.2 – Creepage distances according to IEC 60664-1:2020	115
Table H.3 – Clearances according to IEC 61010-2-030:2017	115
Table H.4 – Creepage distances according to IEC 61010-2-030:2017	116

Document Preview

[oSIST prEN IEC 60688:2023](https://standards.iteh.ai/catalog/standards/sist/d11cb9db-a5ff-45e7-b5d3-e05414794d04/osist-pren-iec-60688-2023)

<https://standards.iteh.ai/catalog/standards/sist/d11cb9db-a5ff-45e7-b5d3-e05414794d04/osist-pren-iec-60688-2023>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL MEASURING TRANSDUCERS FOR CONVERTING AC AND DC ELECTRICAL QUANTITIES TO ANALOGUE OR DIGITAL SIGNALS

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.

IEC 60688 has been prepared by IEC technical committee 85: Measuring equipment for electrical and electromagnetic quantities. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 2021. This edition constitutes a technical revision.

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

- a) updating normative references;
- b) updating definitions;
- c) updating structure;
- d) adding DC power measurement.

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

Draft	Report on voting
85/XXX/FDIS	85/XXX/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. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

In this document, the following print types are used:

- requirements and definitions: in roman type;
- NOTES: in smaller roman type;
- *compliance: in italic type.*

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 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 document 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.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24

INTRODUCTION

Energy distribution systems need to guarantee energy efficiency, availability, and network performance to address the following challenges:

- meet sustainable development requirements, where energy measurement is necessary to identify sources of energy savings, and to improve the energy performance of manufacturing, commercial organisations, and public services,
- adjust to technological evolutions (electronic loads, electronic measuring methods...);
- address end-user needs (cost saving, compliance building regulations...) regarding electrical energy management,
- ensure safety and continuity of service,
- adjust to the evolution of installation standards,
- meet the needs of new applications for DC systems (photovoltaic, electrical vehicle, DC distribution, ...).

Monitoring electrical quantities in internal networks contributes to address these challenges.

To set up this monitoring, transducers:

- perform the measurement of different types of electrical quantities,
- convert AC and DC electrical quantities to analogue or digital signals,
- can be combined with measuring equipment to monitor and analyse electrical quantities.

NOTE Some of the terms used in this document are different from those used in IEC 60051 (all parts) due to the fundamental differences between indicating instruments and measuring transducers.

Document Preview

[oSIST prEN IEC 60688:2023](https://standards.iteh.ai/catalog/standards/sist/d11cb9db-a5ff-45e7-b5d3-e05414794d04/osist-pren-iec-60688-2023)

<https://standards.iteh.ai/catalog/standards/sist/d11cb9db-a5ff-45e7-b5d3-e05414794d04/osist-pren-iec-60688-2023>

ELECTRICAL MEASURING TRANSDUCERS FOR CONVERTING AC AND DC ELECTRICAL QUANTITIES TO ANALOGUE OR DIGITAL SIGNALS

1 Scope

This document applies to transducers (TRD) with electrical inputs and outputs for making measurements of AC or DC electrical quantities. The output signal can be in the form of an analogue or digital signal.

This document applies to measuring transducers used for converting electrical quantities such as:

- current,
- voltage,
- active power,
- reactive power,
- power factor,
- phase angle,
- frequency,
- harmonics or total harmonic distortion, and
- apparent power
- DC power

to an output signal.

NOTE The above electrical quantities include AC and/or DC components.

This document applies

- a) if the fundamental frequency of the input(s) lies between 0 Hz and 1 500 Hz,
- b) to the electrical measuring transducer if it is part of a system for the measurement of an electrical or non-electrical quantity,
- c) to transducers for use in a variety of applications such as telemetry and process control and in one of a number of defined environments.

This document is not applicable for:

- instrument transformers that comply with IEC 61869 (all parts),
- transmitters for use in industrial process application that complies with IEC 60770 (all parts), and
- power metering and monitoring devices (PMD) that comply with IEC 61557-12
- meters that comply with IEC 62053 series
- handheld sensors
- residual current monitoring devices (RCMs) that comply with IEC 62020-1
- residual current detecting devices (RDC-DD) that comply with IEC 62955
- in-cable control and protection devices (IC-CPDs) that comply with IEC 62752
- modular residual current devices (MRCDs) that comply with IEC 60947-2, Annex M.