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INTERNATIONAL STANDARD

colour inside

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

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ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60688:2012. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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

This fourth edition cancels and replaces the third edition published in 2012. 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) additional requirements for specific transducers used for LV monitoring applications;

c) creation of interface coding to ease selection by the end-user.

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

CDV	Report on voting
85/748/CDV	85/781/RVC

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.

INTRODUCTION

New transducers can now be equipped with microprocessors that utilise digital data processing, communication methods and auxiliary sensors. This makes them more complex than conventional analogue transducers and gives them considerable added value.

The class index system of classification used in this document is based upon IEC 60051 (all parts). Under this system, the permitted variations of the output signal due to varying influence quantities – ambient temperature, voltage, frequency, etc. – are implicit in the classification.

For those unfamiliar with the class index system, a word of warning is necessary. If, for example, a transducer is classified as class 1, it does not mean that the error under practical conditions of use will be within ±1 % of the actual value of the output or ±1 % of the full output value. It means that the error should not exceed ±1 % of the fiducial value under closely specified conditions. If the influence quantities are varied between the limits specified by the nominal ranges of use, a variation of amount comparable with the value of the class index may be incurred for each influence quantity.

The permissible error of a transducer under working conditions is the sum of the permissible intrinsic error and of the permissible variations due to each of the influence quantities. However, the actual error is likely to be much smaller because not all of the influence quantities are likely to be simultaneously at their most unfavourable values and some of the variations may cancel one another. It is important that these facts be taken into consideration when specifying transducers for a particular purpose.

Furthermore, 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.

All statements of performance are related to the output which is governed by two basic terms:

– "the nominal value", which may have a positive or a negative sign or both;
– "the span", which is the range of values of the output signal from maximum positive to maximum negative, if appropriate.

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

1 Scope

This document applies to transducers with electrical inputs and outputs for making measurements of AC or DC electrical quantities. The output signal ~~may~~ can be in the form of an analogue direct current, an analog direct voltage or in digital form. ~~In this case, that part of the transducer utilized for communication purposes will need to be compatible with the external system.~~

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

to an output signal.

This document is not applicable for

– instrument transformers that comply with ~~IEC 60044 series~~ IEC 61869 (all parts);
– transmitters for use in industrial process application that comply with IEC 60770 (all parts), and
– performance measuring and monitoring devices (PMD) that comply with IEC 61557-12:2018.

Within the measuring range, the output signal is a function of the measurand. An auxiliary supply ~~may~~ can be needed.

This document applies

a) if the nominal frequency of the input(s) lies between 0 Hz and 1 500 Hz,
b) ~~if a measuring transducer is part of a system for the measurement of a non-electrical quantity, this standard may be applied to the electrical measuring transducer, if it otherwise falls within the scope of this standard~~
to the electrical measuring transducer if it is part of a system for the measurement of a non-electrical quantity, and if it otherwise falls within the scope of this document, and
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 intended:

– to specify the terminology and definitions relating to transducers whose main application is in industry,

– to unify the test methods used in evaluating transducer performance, and
– to specify accuracy limits and output values for transducers.

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 60051-1:1997, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 1: Definitions and general requirements common to all parts*~~

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 60255-151, *Measuring relays and protection equipment - Part 151: Functional requirements for over/under current protection*

~~IEC 60417, *Graphical symbols for use on equipment*~~

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

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: ~~Special~~ Particular requirements for equipment having testing ~~and~~ or measuring circuits*

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

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

IEC 61557-12:2018, *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: ~~Performance measuring~~ Power metering and monitoring devices (PMD)*

IEC 61558-1:2017, *Safety of transformers, reactors, power supply units and combinations thereof - Part 1: General requirements and tests*

~~NOTE Please refer to the Bibliography for the list of informative references.~~

IEC 60688

Edition 4.0 2021-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

Transducteurs électriques de mesure convertissant les grandeurs électriques alternatives ou continues en signaux analogiques ou numériques



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

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

This fourth edition cancels and replaces the third edition published in 2012. 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) additional requirements for specific transducers used for LV monitoring applications;
c) creation of interface coding to ease selection by the end-user.

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

CDV	Report on voting
85/748/CDV	85/781/RVC

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;

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INTRODUCTION

New transducers can now be equipped with microprocessors that utilise digital data processing, communication methods and auxiliary sensors. This makes them more complex than conventional analogue transducers and gives them considerable added value.

The class index system of classification used in this document is based upon IEC 60051 (all parts). Under this system, the permitted variations of the output signal due to varying influence quantities – ambient temperature, voltage, frequency, etc. – are implicit in the classification.

For those unfamiliar with the class index system, a word of warning is necessary. If, for example, a transducer is classified as class 1, it does not mean that the error under practical conditions of use will be within ±1 % of the actual value of the output or ±1 % of the full output value. It means that the error should not exceed ±1 % of the fiducial value under closely specified conditions. If the influence quantities are varied between the limits specified by the nominal ranges of use, a variation of amount comparable with the value of the class index may be incurred for each influence quantity.

The permissible error of a transducer under working conditions is the sum of the permissible intrinsic error and of the permissible variations due to each of the influence quantities. However, the actual error is likely to be much smaller because not all of the influence quantities are likely to be simultaneously at their most unfavourable values and some of the variations may cancel one another. It is important that these facts be taken into consideration when specifying transducers for a particular purpose.

Furthermore, 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.

All statements of performance are related to the output which is governed by two basic terms:

– "the nominal value", which may have a positive or a negative sign or both;
– "the span", which is the range of values of the output signal from maximum positive to maximum negative, if appropriate.

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

1 Scope

This document applies to transducers 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 direct current, an analog direct voltage or in digital form.

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

to an output signal.

This document is not applicable for

– instrument transformers that comply with IEC 61869 (all parts),
– transmitters for use in industrial process application that comply with IEC 60770 (all parts), and
– performance measuring and monitoring devices (PMD) that comply with IEC 61557-12:2018.

Within the measuring range, the output signal is a function of the measurand. An auxiliary supply can be needed.

This document applies

a) if the nominal 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 a non-electrical quantity, and if it otherwise falls within the scope of this document, and
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 intended:

– to specify the terminology and definitions relating to transducers whose main application is in industry,
– to unify the test methods used in evaluating transducer performance, and
– to specify accuracy limits and output values for transducers.

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, *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 60255-151, *Measuring relays and protection equipment - Part 151: Functional requirements for over/under current protection*

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

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 equipment having testing or measuring circuits*

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

IEC 61557-12:2018, *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: Power metering and monitoring devices (PMD)*

IEC 61558-1:2017, *Safety of transformers, reactors, power supply units and combinations thereof - Part 1: General requirements and tests*

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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TRANSDUCTEURS ÉLECTRIQUES DE MESURE CONVERTISSANT LES GRANDEURS ÉLECTRIQUES ALTERNATIVES OU CONTINUES EN SIGNAUX ANALOGIQUES OU NUMÉRIQUES

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L'IEC 60688 a été établie par le comité d'études 85 de l'IEC: Équipement de mesure des grandeurs électriques et électromagnétiques. Il s'agit d'une Norme internationale.

Cette quatrième édition annule et remplace la troisième édition parue en 2012. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) mise à jour des références normatives;
b) exigences supplémentaires pour les transducteurs spécifiques utilisés pour les applications de surveillance de la BT (basse tension)
c) création d'un codage d'interface pour faciliter la sélection par l'utilisateur final.

Le texte de cette Norme internationale est issu des documents suivants:

CDV	Rapport de vote
85/748/CDV	85/781/RVC

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/standardsdev/publications.

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– NOTES: petits caractères romains;

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INTRODUCTION

Les nouveaux transducteurs peuvent maintenant être équipés de microprocesseurs utilisant des signaux numériques, des méthodes de communication, des capteurs auxiliaires. Ceci les rend plus complexes que des transducteurs de mesure analogique conventionnels et leur donne une valeur ajoutée considérable.

Le système de classification par indice de classe utilisé dans le présent document est fondé sur la série IEC 60051. Dans ce système, les variations admises du signal de sortie dues aux variations des grandeurs d'influence – température ambiante, tension, fréquence, etc. – sont prises en compte dans la classification.

Il est nécessaire d'attirer l'attention sur les particularités de ce système par indice de classe. Si, par exemple, un transducteur est de Classe 1, cela ne veut pas dire que, dans les conditions pratiques d'utilisation, l'erreur sera à ±1 % du signal de sortie, ou à ±1 % de la pleine échelle. Cela signifie qu'il convient que l'erreur ne dépasse pas ±1 % de la valeur conventionnelle pour des conditions strictement spécifiées. Lorsque les grandeurs d'influence varient entre les limites spécifiées du domaine nominal d'utilisation, il peut se produire une variation de la valeur comparable à la valeur de l'indice de classe, et cela pour chaque grandeur d'influence.

L'erreur admissible d'un transducteur dans les conditions de fonctionnement est la somme de l'erreur intrinsèque admissible et des variations admissibles dues à chacune des grandeurs d'influence. Cependant, l'erreur réelle est probablement beaucoup plus faible, car il est peu probable que les grandeurs d'influence prennent simultanément leurs valeurs les plus défavorables, certaines des variations pouvant s'annuler l'une l'autre. Il est donc important de prendre ces faits en considération dans la spécification d'un transducteur pour une application particulière.

D'autre part, certains des termes utilisés dans le présent document sont différents de ceux utilisés dans la série IEC 60051 en raison des différences fondamentales qui existent entre les appareils indicateurs et les transducteurs de mesure.

Toutes les déclarations relatives aux performances sont rapportées à la grandeur de sortie, laquelle est régie par deux éléments fondamentaux:

– "la valeur nominale", qui peut être, selon le cas, positive, négative ou bien positive et négative;
– "l'intervalle de sortie", qui est la plage des valeurs du signal de sortie, depuis la valeur maximale positive jusqu'à la valeur maximale négative, le cas échéant.

TRANSDUCTEURS ÉLECTRIQUES DE MESURE CONVERTISSANT LES GRANDEURS ÉLECTRIQUES ALTERNATIVES OU CONTINUES EN SIGNAUX ANALOGIQUES OU NUMÉRIQUES

1 Domaine d'application

Le présent document s'applique aux transducteurs à grandeurs d'entrées et de sorties électriques destinés à mesurer des grandeurs électriques alternatives ou continues. Le signal de sortie peut être sous la forme d'un courant continu analogique ou d'une tension continue analogique ou d'un signal numérique.

Le présent document s'applique aux transducteurs de mesure destinés à convertir des grandeurs électriques, telles que:

– le courant,
– la tension,
– la puissance active,
– la puissance réactive,
– le facteur de puissance,
– l'angle de phase,
– la fréquence,
– les harmoniques ou la distorsion harmonique totale, et
– la puissance apparente

en signal de sortie.

Le présent document ne s'applique pas:

– aux transformateurs de mesure conformes à la série IEC 61869,
– aux transmetteurs utilisés dans le processus industriel conformes à la série IEC 60770, et
– aux dispositifs de mesure et de surveillance des performances (PMD – *performance measuring and monitoring device*) conformes à l'IEC 61557-12:2018.

Dans l'étendue de mesure, le signal de sortie varie en fonction du mesurande. Une alimentation auxiliaire peut être nécessaire.

Le présent document s'applique:

a) si la fréquence nominale de la ou des grandeurs d'entrée est comprise entre 0 Hz et 1 500 Hz;
b) à un transducteur de mesure électrique appartenant à une chaîne de mesure d'une grandeur non électrique, et si, par ailleurs, celui-ci relève du domaine d'application du présent document, et
c) aux transducteurs destinés à une utilisation générale, par exemple à la télémesure, à la commande de processus et dans un des nombreux environnements spécifiés.

Le présent document a pour objet:

– de spécifier la terminologie et les définitions relatives aux transducteurs dont l'application principale relève du domaine de l'industrie,
– d'unifier les méthodes d'essai utilisées pour évaluer les performances des transducteurs, et

– de spécifier les limites de précision et les valeurs de sortie des transducteurs.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60068-2-6, *Essais d'environnement - Partie 2-6: Essais - Essai Fc: Vibrations (sinusoïdales)*

IEC 60068-2-27, *Essais d'environnement - Partie 2: Essais - Essai Ea et guide: Chocs*

IEC 60255-151, *Relais de mesure et dispositifs de protection - Partie 151: Exigences fonctionnelles pour les protections à minimum et maximum de courant*

IEC 61010 (toutes les parties), *Règles de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire*

IEC 61010-1:2010, *Règles de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire - Partie 1: Exigences générales*
IEC 61010-1:2010/AMD1:2016

IEC 61010-2-030:2017, *Exigences de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire - Partie 2-030: Exigences particulières pour les appareils équipés de circuits d'essai ou de mesure*

IEC 61326-1:2020, *Matériel électrique de mesure, de commande et de laboratoire - Exigences relatives à la CEM - Partie 1: Exigences générales*

IEC 61557-12:2018, *Sécurité électrique dans les réseaux de distribution basse tension jusqu'à 1 000 V c.a. et 1 500 V c.c. - Dispositifs de contrôle, de mesure ou de surveillance de mesures de protection - Partie 12: Dispositifs de comptage et de surveillance du réseau électrique (PMD)*

IEC 61558-1:2017, *Sécurité des transformateurs, bobines d'inductance, blocs d'alimentation et des combinaisons de ces éléments - Partie 1: Exigences générales et essais*