

AS 61869.10:2021



Instrument transformers

Part 10: Additional requirements for low-power passive current transformers (IEC 61869-10:2017 (ED 1.0) MOD)



AS 61869.10:2021

This Australian Standard® was prepared by EL-013, Measurement and Protection Transformers. It was approved on behalf of the Council of Standards Australia on 11 February 2021.

This Standard was published on 26 February 2021.

The following are represented on Committee EL-013:

- Australian Industry Group
- Energy Networks Australia
- Engineers Australia
- National Measurement Institute
- University of South Australia

This Standard was issued in draft form for comment as DR AS 61869.10:2020.

Keeping Standards up-to-date

Ensure you have the latest versions of our publications and keep up-to-date about Amendments, Rulings, Withdrawals, and new projects by visiting:

www.standards.org.au

ISBN 978 1 76113 221 6

Instrument transformers

Part 10: Additional requirements for low-power passive current transformers (IEC 61869-10:2017 (ED 1.0) MOD)

First published as AS 61869.10:2021.



© IEC 2021 — All rights reserved
© Standards Australia Limited 2021

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of either the IEC or the publisher, unless otherwise permitted under the Copyright Act 1968 (Cth). If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please see the contact details on the back cover or the contact us page of the website for further information.

Preface

This Standard was prepared by the Standards Australia Committee EL-013, Measurement and Protection Transformers.

The objective of this document is to specify additional requirements for low-power passive current transformers, used for measurement or protection, and multi-purpose low-power passive current transformers, used for both measurement and protection.

This document is applicable to newly manufactured low-power passive current transformers with analogue output for use with electrical measuring instruments, or electrical protective devices having a rated frequency from 15 Hz to 100 Hz.

This document is an adoption with national modifications, and has been reproduced from, IEC 61869-10:2017, *Instrument transformers — Part 10: Additional requirements for low-power passive current transformers*.

The modifications are additional requirements and are set out in [Appendix ZZ](#), which has been added at the end of the source text.

[Appendix ZZ](#) lists the variation to IEC 61869-10:2017 for the application of this document in Australia.

As this document has been reproduced from an International Standard, the following applies:

- (a) In the source text “this part of 61869” should read “this document”.
- (b) A full point substitutes for a comma when referring to a decimal marker.

Australian or Australian/New Zealand Standards that are identical adoptions of international normative references may be used interchangeably. Refer to the online catalogue for information on specific Standards.

The terms “normative” and “informative” are used in Standards to define the application of the appendices or annexes to which they apply. A “normative” appendix or annex is an integral part of a Standard, whereas an “informative” appendix or annex is only for information and guidance.

NOTES

CONTENTS

| | |
|---|----|
| FOREWORD..... | 4 |
| INTRODUCTION..... | 8 |
| 1 Scope..... | 9 |
| 2 Normative references | 9 |
| 3 Terms and definitions | 10 |
| 3.1 General definitions..... | 10 |
| 3.4 Definitions related to accuracy | 10 |
| 3.7 Index of abbreviations..... | 13 |
| 5 Ratings..... | 13 |
| 5.3 Rated insulation levels and voltages | 13 |
| 5.5 Rated output | 14 |
| 5.6 Rated accuracy class..... | 14 |
| 5.1001 Standard values for rated primary current (I_{pr})..... | 16 |
| 5.1002 standard values for rated extended primary current factor (K_{pcr}) | 16 |
| 5.1003 Standard value of rated continuous thermal current (I_{cth}) | 16 |
| 5.1004 Standard values of rated secondary voltage (U_{sr})..... | 17 |
| 5.1005 Short-time current ratings | 17 |
| 5.1006 Rated phase offset (φ_{or}) | 17 |
| 6 Design and construction | 17 |
| 6.11 Electromagnetic compatibility (EMC)..... | 17 |
| 6.13 Markings..... | 17 |
| 6.601 Requirements for optical transmitting system and optical output link | 19 |
| 6.602 Requirements for electrical transmitting system and electrical wires for output link..... | 19 |
| 6.603 Signal-to-noise ratio..... | 19 |
| 6.604 Failure detection and maintenance announcement..... | 19 |
| 6.605 Operability | 19 |
| 6.606 Reliability and dependability | 19 |
| 6.607 Vibrations | 20 |
| 7 Tests | 20 |
| 7.1 General..... | 20 |
| 7.2 Type tests | 21 |
| 7.4 Special tests | 25 |
| 601 Information to be given with enquiries, tenders and orders | 25 |
| 601.1 Designation..... | 25 |
| 601.2 Dependability..... | 26 |
| Annex 10A (informative) Designation of accuracy class when using the corrected transformation ratio and ratio correction factor..... | 27 |
| 10A.1 General..... | 27 |
| 10A.2 Designation of accuracy class based on rated transformation ratio | 28 |
| 10A.3 Designation of accuracy class based on individual ratio correction factor..... | 28 |
| 10A.4 Example of application | 28 |
| Annex 10B (informative) Principle of operation of Rogowski coils..... | 32 |
| 10B.1 General..... | 32 |
| 10B.2 Principle of operation | 32 |
| 10B.3 Designs | 33 |

| | |
|--|----|
| 10B.4 Accuracy..... | 33 |
| 10B.5 Frequency dependence and response..... | 35 |
| Annex 10C (informative) Principle of operation of low-power iron core current transformers (proportional LPCT)..... | 37 |
| 10C.1 General..... | 37 |
| 10C.2 Principle..... | 37 |
| 10C.3 Accuracy..... | 38 |
| Annex 10D (normative) Test for accuracy with respect to the positioning of the primary conductor..... | 39 |
| 10D.1 General..... | 39 |
| 10D.2 Designation of accuracy class extension..... | 39 |
| 10D.3 Test procedure..... | 40 |
| Bibliography..... | 42 |
| | |
| Figure 1001 – General block diagram of a single-phase low-power passive current transformer..... | 8 |
| Figure 1002 – Marking of terminals..... | 18 |
| Figure 1003 – Test set up for impact of magnetic field from other phases..... | 24 |
| Figure 10A.1 – Accuracy class designation improved based on individual ratio correction factor CF_1 | 28 |
| Figure 10A.2 – Accuracy test of passive LPCT..... | 29 |
| Figure 10A.3 – Accuracy class of 1 % designated based on rated transformation ratio..... | 30 |
| Figure 10A.4 – Accuracy class of 0,1 % designated based on using the ratio correction factor and corrected transformation ratio..... | 31 |
| Figure 10B.1 – Rogowski coil Equivalent Circuits..... | 35 |
| Figure 10B.2 – Integrated and non-integrated Rogowski coil output signals..... | 35 |
| Figure 10B.3 – Rogowski coil frequency dependence test..... | 36 |
| Figure 10C.1 – Principle of iron core current transformer..... | 37 |
| Figure 10C.2 – Equivalent circuit of the iron core current transformer with voltage output..... | 38 |
| Figure 10D.1 – Definition of the angle between the primary conductor and the LPCT..... | 39 |
| $d_{min} = d_{max}$ | 40 |
| Figure 10D.2 – Illustration of the primary conductor position according to the position factor..... | 40 |
| Figure 10D.3 – Accuracy measurement test set up..... | 41 |
| | |
| Table 1001 – Limits of ratio error and phase error for measuring passive LPCT..... | 15 |
| Table 1002 – Limits of errors..... | 16 |
| Table 1003 – Pin assignment for RJ45 connectors used in passive LPCT..... | 19 |
| Table 10 – List of tests..... | 20 |
| Table 1004 – Designation of a passive LPCT..... | 26 |
| Table 10A.1 – Ratio, ratio error based on mean value, and corresponding primary current..... | 29 |
| Table 10A.2 – Measured ratio error, correction factor and ratio error based on ratio correction factor for five passive LPCT..... | 30 |
| Table 10D.1 – Limits for the position of the primary conductor with respect to the passive LPCT..... | 39 |

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INSTRUMENT TRANSFORMERS –

Part 10: Additional requirements for low-power passive current transformers

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 61869-10 has been prepared IEC technical committee 38: Instrument transformers.

This first edition of IEC 61869-10, together with IEC 61869-1, IEC 61869-6, IEC 61869-8 and IEC 61869-9, cancels and replaces the first edition of IEC 60044-8, published in 2002¹. This edition constitutes a technical revision.

The technical changes concern IEC TC 38's decision to restructure the whole set of stand-alone standards in the IEC 60044 series and transform it into a new set of standards composed of general requirements documents and specific requirements documents.

¹ IEC 60044-8 will eventually be replaced by the IEC 61869 series, but until all the relevant parts of the IEC 61869 series will be published, this standard is still in force.

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

| | |
|-------------|------------------|
| FDIS | Report on voting |
| 38/550/FDIS | 38/551/RVD |

Full information on the voting for the approval of this part of IEC 61869 can be found in the report on voting indicated in the above table.

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

This standard is Part 10 of IEC 61869, published under the general title *Instrument transformers*.

This Part 10 is to be read in conjunction with, and is based on, IEC 61869-1:2007, *General requirements* and IEC 61869-6:2016, *Additional general requirements for low-power instrument transformers* – however, the reader is encouraged to use the most recent edition of these documents.

This Part 10 follows the structure of IEC 61869-1:2007 and IEC 61869-6:2016 and supplements or modifies the corresponding clauses.

When a particular subclause of Part 1 or part 6 is not mentioned in this Part 10, that subclause applies. When this part of IEC 61869 states “addition”, “modification” or “replacement”, the relevant text in part 1 or part 6 is to be adapted accordingly.

For additional clauses, subclauses, figures, tables, annexes or note, the following numbering system is used:

- clauses, subclauses, tables, figures and notes that are numbered starting from 1001 are additional to those in Part 1 and Part 6;
- additional annexes are lettered 10A, 10B, etc.

An overview of the planned set of standards at the date of publication of this document is given below. The updated list of standards issued by IEC TC 38 is available on the IEC website.

| PRODUCT FAMILY STANDARDS | PRODUCT STANDARD | PRODUCTS | OLD STANDARD | |
|--|---|---|--|-------------|
| IEC 61869-1 GENERAL REQUIREMENTS | IEC 61869-2 | ADDITIONAL REQUIREMENTS FOR CURRENT TRANSFORMERS | IEC 60044-1 IEC 60044-6 | |
| | IEC 61869-3 | ADDITIONAL REQUIREMENTS FOR INDUCTIVE VOLTAGE TRANSFORMERS | IEC 60044-2 | |
| | IEC 61869-4 | ADDITIONAL REQUIREMENTS FOR COMBINED TRANSFORMERS | IEC 60044-3 | |
| | IEC 61869-5 | ADDITIONAL REQUIREMENTS FOR CAPACITIVE VOLTAGE TRANSFORMERS | IEC 60044-5 | |
| | IEC 61869-6 ADDITIONAL GENERAL REQUIREMENTS FOR LOW-POWER INSTRUMENT TRANSFORMERS | IEC 61869-7 | ADDITIONAL REQUIREMENTS FOR ELECTRONIC VOLTAGE TRANSFORMERS | IEC 60044-7 |
| | | IEC 61869-8 | SPECIFIC REQUIREMENTS FOR ELECTRONIC CURRENT TRANSFORMERS | IEC 60044-8 |
| | | IEC 61869-9 | DIGITAL INTERFACE FOR INSTRUMENT TRANSFORMERS | |
| | | IEC 61869-10 | ADDITIONAL REQUIREMENTS FOR LOW-POWER PASSIVE CURRENT TRANSFORMERS | |
| | | IEC 61869-11 | ADDITIONAL REQUIREMENTS FOR LOW-POWER PASSIVE VOLTAGE TRANSFORMERS | IEC 60044-7 |
| | | IEC 61869-12 | ADDITIONAL REQUIREMENTS FOR COMBINED ELECTRONIC INSTRUMENT TRANSFORMER OR COMBINED LOW-POWER PASSIVE INSTRUMENT TRANSFORMERS | |
| | | IEC 61869-13 | STAND-ALONE MERGING UNIT | |
| | | IEC 61869-14 | ADDITIONAL REQUIREMENTS FOR CURRENT TRANSFORMERS FOR DC APPLICATIONS | |
| | | IEC 61869-15 | ADDITIONAL REQUIREMENTS FOR VOLTAGE TRANSFORMERS FOR DC APPLICATIONS | |

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication 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

Low-power passive current transformers (LPCT) are based on passive technologies without any active electronic components. They can have an output signal proportional to the primary current, for example iron core coils with integrated shunt as a current to voltage converter (primary converter) or they can have an output signal proportional to the derivative of the primary current, for example air-core coils (Rogowski coils). This part of IEC 61869 does not cover the air-core coils with active integrator.

According to a general block diagram given in Figure 601 of IEC 61869-6:2016, the low-power passive current transformers do not use an active primary converter (i.e. without any active electronic component); therefore, there is no need for primary power supply. Additionally, neither the secondary converter nor the secondary power supply is used.

The general block diagram of a low-power passive current transformer is given in Figure 1001.

The applied technology decides which part is necessary for the realization of a low-power passive current transformer, i.e. it is not absolutely necessary that the transmitting cable or primary converter described in Figure 1001 be included in the low-power passive current transformer. The derivative LPCT solution considers only the air-core coil as the primary sensor and the transmission cable as the transmitting system. In this technology, the primary converter is not considered. In case of a proportional LPCT solution, the ferromagnetic-core coil is considered as the primary sensor, a burden resistance connected directly to the coil outputs works as a primary converter and the transmission cable is a transmitting system.

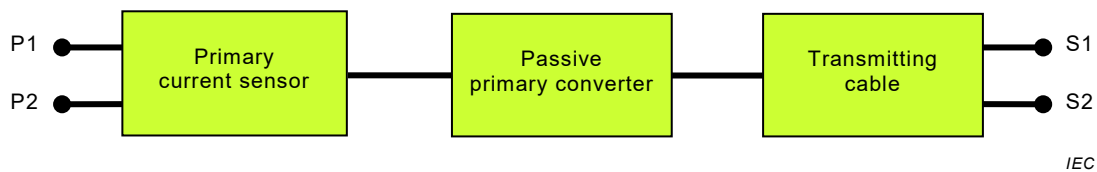


Figure 1001 – General block diagram of a single-phase low-power passive current transformer

INSTRUMENT TRANSFORMERS –

Part 10: Additional requirements for low-power passive current transformers

1 Scope

This part of IEC 61869 is a product standard and covers only additional requirements for low-power passive current transformers. The product standard for low-power passive current transformers comprises IEC 61869-1, together with IEC 61869-6 and this document with specific requirements.

This document is applicable to newly manufactured low-power passive current transformers with analogue output for use with electrical measuring instruments or electrical protective devices having a rated frequency from 15 Hz to 100 Hz.

This document covers low-power passive current transformers used for measurement or protection and multi-purpose low-power passive current transformers used for both measurement and protection.

Subclause 5.6.1001 covers the accuracy requirements that are necessary for low-power passive current transformers for use with electrical measuring instruments.

Subclause 5.6.1002 covers the accuracy requirements that are necessary for low-power passive current transformers for use with electrical protective relays, and particularly for forms of protection in which the prime requirement is to maintain the accuracy up to several times the rated current. If required, the transient accuracy of low-power passive current transformers during fault is also given in 5.6.1002.

Low-power passive current transformers have analogue voltage output only (for digital output or for technology using any kind of active electronic components refer to IEC 61869-8²). Such low-power passive current transformers can include the secondary signal cable (transmitting cable). The principle of operation of derivative low-power passive current transformers using air-core coils (Rogowski coils) is given in Annex 10B and the principle of operation of proportional low-power passive current transformers using iron-core coils with integrated shunt is given in Annex 10C.

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.

Clause 2 of IEC 61869-6:2016 is applicable with the following additions:

IEC 60059, *IEC standard current ratings*

IEC 61869-6:2016, *Instrument transformers – Part 6: Additional general requirements for low-power instrument transformers*

² Under preparation.