IEC 61869-14

Edition 1.0 2018-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Instrument transformers –
Part 14: Additional requirements for current transformers for DC applications

Transformateurs de mesure –
Partie 14: Exigences supplémentaires concernant les transformateurs de courant pour application en courant continu

IEC 61869-14:2018-07(en-fr)

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INTERNATIONAL
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INSTRUMENT TRANSFORMERS –

Part 14: Additional requirements for current transformers for DC applications

FOREWORD

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International Standard IEC 61869-14 has been prepared by IEC technical committee 38: Instrument transformers.

The text of this standard is based on the following documents:

FDIS	Report on voting
38/560/FDIS	38/565/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.

A list of all parts in the IEC 61869 series, published under the general title *Instrument transformers*, can be found on the IEC website.

This Part 14 is to be used 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 editions.

This Part 14 follows the structure of IEC 61869-1:2007 and IEC 61869-6:2016 and supplements or modifies their corresponding clauses.

When a subclause of Part 1 or Part 6 is not mentioned in this Part 14, that subclause applies. When this standard 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 notes, the following numbering system is used:

- clauses, subclauses, tables, figures and notes that are numbered starting from 1401 are additional to those in Part 1 and Part 6;
- additional annexes are lettered 14A, 14B, 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 at the website: www.iec.ch

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- withdrawn,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

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INTRODUCTION

General

This document applies to current transformers intended to be used in DC applications with at least one of the following functions:

- measure DC current (with significant harmonics);
- withstand DC voltage.

Depending on the position of the current transformer on the DC system, different kinds of application exist, which are briefly described below, together with the approximate voltage or current wave shape.

Line-commutated converters (LCC)

Line-commutated converters (LCC) are based on thyristor converters (see Figure 1401). They are characterized by a single direction of current flow, and a voltage polarity reversal possibility. Significant voltage and current harmonics exist up to frequencies of about 3 kHz to 4 kHz.

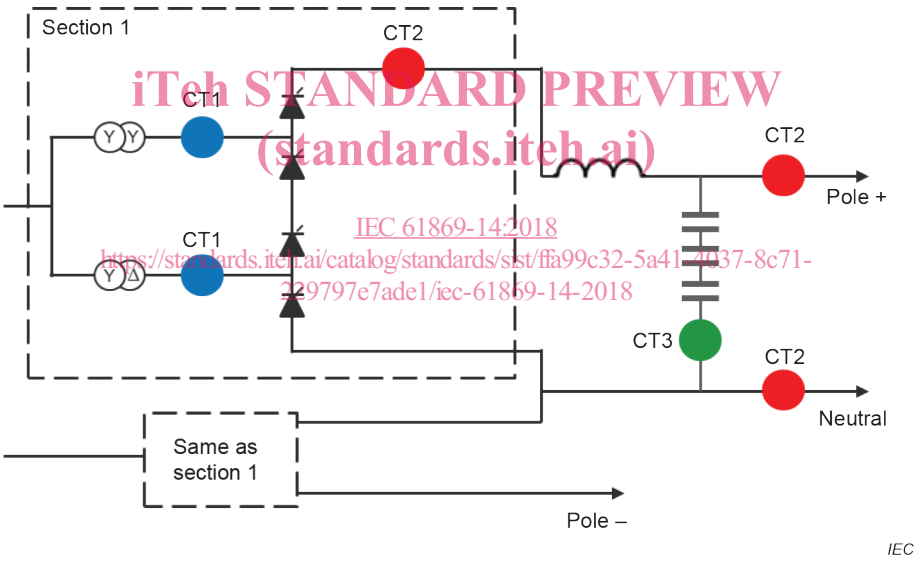


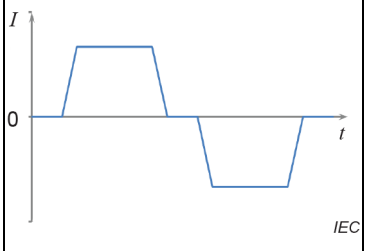
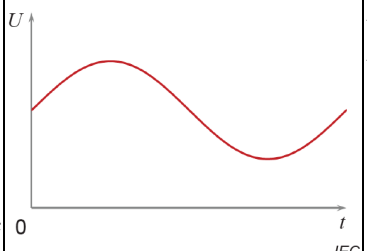
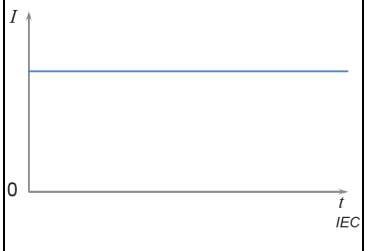
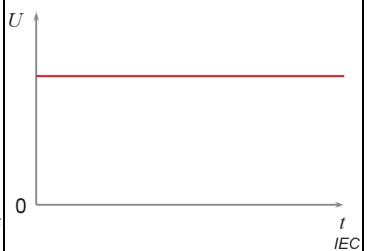
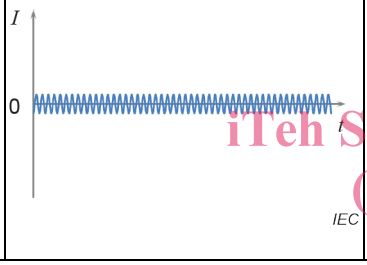
Figure 1401 – Example of LCC scheme

We distinguish three different current-measurement functions:

- CT1: measurement of the current at the AC side of the converter;
- CT2: measurement of the current at the DC side of the converter;
- CT3: measurement of the current in the DC filter.

Table 1401 gives an overview of the current and voltage waveshapes as well as the main characteristics of the different applications of the CT.

Table 1401 – Current and voltage in current transformers for LCC application

	Current	Voltage	Characteristics
CT1			AC current AC + DC voltage Large amount of current harmonics Mainly for protection purposes
CT2			Pure DC application High-accuracy measurement Harmonics measurement Metering, control and protection purposes
CT3			DC voltage stress with harmonics DC current = 0 Harmonics measurement Mainly for protection purposes

Voltage-source converters (VSC)

Voltage-source converters (VSC) are based on transistor converters. They are characterized by a bi-directional current flow and a single voltage polarity. Voltage and current harmonics exist up to frequencies of about 20 kHz.

Two variants of VSC schemes exist: symmetrical monopoles (using one single converter) and asymmetrical monopole or bipole (with one converter for each polarity).

Both schemes are shown in Figure 1402 and Figure 1403.

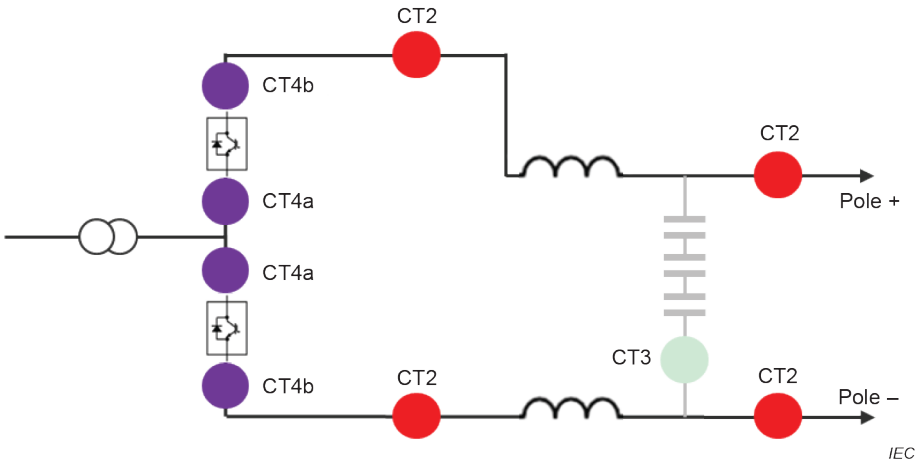


Figure 1402 – Typical scheme for VSC – symmetrical monopole

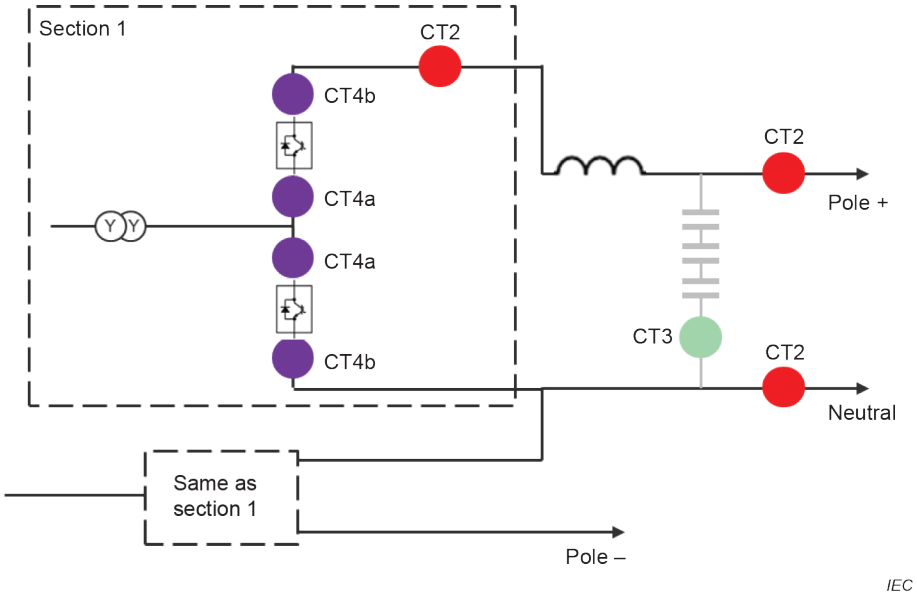


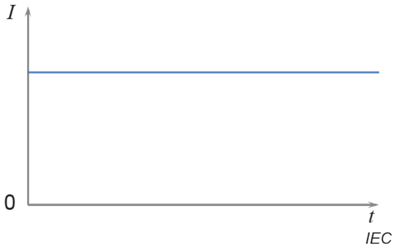
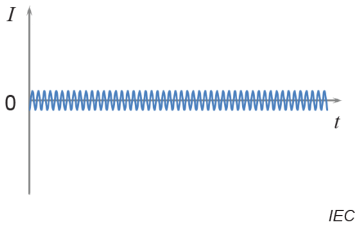
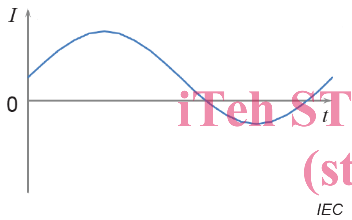
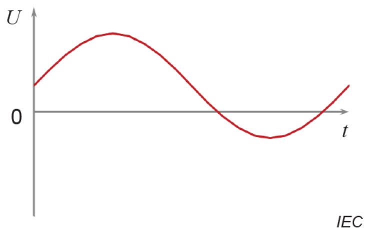
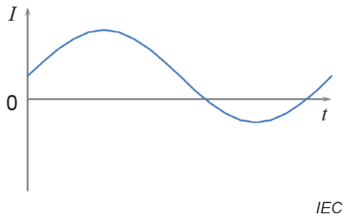
Figure 1403 – Typical scheme for VSC – asymmetrical monopole or bipole

We distinguish three different current-measurement functions:

- CT4: measurement of the current in the transistor branches of the converter. The CT can be placed before (CT4a) or after the transistor branch (CT4b);
- CT2: measurement of the current at the DC side of the converter;
- CT3: measurement of the current in the DC filter (not always present in this scheme).

Table 1402 gives an overview of the current and voltage waveshapes as well as the main characteristics of the different applications of the CT.

Table 1402 – Current and voltage in current transformers for VSC application

	Current	Voltage	Characteristics
CT2			Pure DC application High accuracy measurement Harmonics measurement Metering, control and protection purposes Short step response time
CT3			DC voltage stress DC current = 0 Harmonics measurement Mainly for protection purposes
CT4a		Symmetrical monopole:  Asymmetrical monopoles / bipoles: 	Pure AC voltage or DC + AC voltage DC + AC current High-accuracy measurement Short step response time
CT4b			DC voltage stress DC + AC current High-accuracy measurement Short step response time

INSTRUMENT TRANSFORMERS –

Part 14: Additional requirements for current transformers for DC applications

1 Scope

This part of IEC 61869 provides all requirements specific to current transformers to be used in DC applications (DCCTs), whatever the technology used. The output signal can be analogue or digital.

It is applicable to newly manufactured current transformers used for measuring, protection and/or control applications in DC power systems with a rated voltage above 1,5 kV.

The general configuration of a single-pole low-power instrument transformer is described in Figure 601 of IEC 61869-6:2016.

The DCCTs intended for current measurement in the transistor branch of the VSC valve (referred to as CT4a and CT4b in Figure 1403 and Table 1402) are not covered by this document, and will be considered in a future revision.

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 and modifications:

IEC TS 60815-4:2016, *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 4: Insulators for DC systems*

IEC TS 61245:2015, *Artificial pollution tests on high-voltage ceramic and glass insulators to be used on DC systems*

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

IEC 61869-9:2016, *Instrument transformers – Part 9: Digital interface for instrument transformers*

3 Terms and definitions

Clause 3 of IEC 61869-1:2007, of IEC 61869-6:2016 and of IEC 61869-9:2016 are applicable with the following additions and modifications.

3.1 General definitions

3.1.1401
instrument transformer for DC application
instrument transformer intended to be used in DC applications with at least one of the following functions:

- measure DC current or DC voltage (with significant harmonics);
- withstand DC voltage.

3.1.1402
current transformer for DC application
DCCT
instrument transformer for DC application in which the secondary signal, under normal conditions of use, is substantially proportional to the primary current

Note 1 to entry: The different applications are described in the introduction.

3.2 Definitions related to dielectric ratings

3.2.2
highest voltage for equipment
U_m

Definition 3.2.2 of IEC 61869-1:2007 is replaced by the following one:

highest value of DC voltage for which the equipment is designed to operate continuously, in respect of its insulation as well as other characteristics that relate to this voltage

3.3 Definitions related to current ratings

3.3.1401
DC overload current
overcurrent occurring in an electric circuit, which is not caused by a short-circuit or an earth fault

Note 1 to entry: The DC overload current is specified by the customer in terms of value and duration.

[SOURCE: IEC 60050-826:2004, 826-11-15, modified – “DC” added in the term and Note 1 to entry added.]

3.3.1402
short-time overload current
I_{sov}
DC overload current occurring for a duration shorter than one minute

3.3.1403
long-time overload current
I_{lov}
DC overload current occurring for a duration of minutes or hours

Note 1 to entry: Different values of long-time overload can be specified for different durations.

3.3.1404
maximum peak fault current
I_{sc}
maximum peak value of current occurring during a fault condition of the DC power system

3.4 Definitions related to accuracy

3.4.1401
Absolute error
ε_A
error (expressed in A) that a current transformer introduces into the measurement and which arises from the fact that the actual transformation ratio is not equal to the rated transformation ratio

Note 1 to entry: The absolute error is defined by the following formula:

$$\varepsilon_A = K_r \cdot U_s - I_p$$

where

K_r is the rated transformation ratio;

I_p is the DC value of the actual primary current in steady state;

U_s is the DC value of the output voltage.

3.5 Definitions related to other ratings

3.5.1401
step response
duration between the instant when the measurand (or quantity supplied) is subjected to a specified abrupt change and the instant when the indication (or quantity supplied) reaches, and remains within specified limits of, its final steady-state value

Note 1 to entry: See graphical explanation in Figure 1404.