IEC 60358-2

Edition 1.0 2013-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Coupling capacitors and capacitor dividers – Part 2: AC or DC single-phase coupling capacitor connected between line and ground for power line carrier-frequency (PLC) application

Condensateurs de couplage et diviseurs capacitifs – Partie 2: Condensateur de couplage monophasé à courant alternatif ou à courant continu connecté entre la ligne et la terre pour application aux liaisons à courant porteur sur lignes d'énergie (CPL)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX R

ICS 29.120.99; 29.240.99; 31.060.70

ISBN 978-2-8322-1038-3

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COUPLING CAPACITORS AND CAPACITOR DIVIDERS –

Part 2: AC or DC single-phase coupling capacitor connected between line and ground for power line carrier-frequency (PLC) application

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International Standard IEC 60358-2 has been prepared by IEC technical committee 33: Power capacitors and their applications.

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

FDIS	Report on voting
33/531/FDIS	33/537/RVD

Full information on the voting for the approval of this standard 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.

A list of all parts in the IEC 60358 series, published under the general title *Coupling capacitors and capacitor dividers*, can be found on the IEC website.

This International Standard is to be used in conjunction with the latest edition of IEC 60358-1 and its amendments. It was established on the basis of the first edition (2012) of that standard.

This Part 2 supplements or modifies the corresponding clauses in IEC 60358-1.

When a particular subclause of Part 1 is not mentioned in this Part 2, that subclause applies as far as is reasonable. Where this Part 2 states “addition” or “replacement”, the relevant text in Part 1 is to be adapted accordingly.

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

– subclauses, tables and figures which are additional to those in Part 1 are numbered starting from 200;
– additional annexes are lettered AA, BB etc.
– as the notes are integrated into the clauses, their numbering starts from 1 as usual.

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.

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INTRODUCTION

This series consists of the following parts:

IEC 60358-1, *Coupling capacitors and capacitor dividers – Part 1: General rules*

IEC 60358-2, *Coupling capacitors and capacitor dividers – Part 2: AC or DC single-phase coupling capacitor connected between line and ground for power line carrier-frequency (PLC) application*

IEC 60358-3[1], *Coupling capacitors and capacitor dividers – Part 3: AC or DC single-phase coupling capacitor connected between line and ground for harmonic-filters applications*

IEC 60358-4[2], *Coupling capacitors and capacitor dividers – Part 4: AC or DC single-phase capacitor-divider and RC-divider connected between line and ground (except for CVT's which belong to IEC 61869 series)*

1 Under consideration.

2 Under consideration.

COUPLING CAPACITORS AND CAPACITOR DIVIDERS –

Part 2: AC or DC single-phase coupling capacitor connected between line and ground for power line carrier-frequency (PLC) application

1 Scope

Clause 1 of IEC 60358-1:2012 is applicable with the following additions:

This part of the IEC 60358 series applies to AC or DC single-phase coupling capacitors, with rated voltage > 1 000 V, connected between line and ground with a low voltage terminal either permanently earthed or connected to a device for power line carrier-frequency (PLC) applications at frequencies from 30 kHz to 500 kHz or similar applications (DC or AC) at power frequencies from 15 Hz to 60 Hz.

The transmission requirements for coupling devices for power line carrier (PLC) systems are defined in IEC 60481.

NOTE Diagrams of coupling capacitors to which this standard applies are given in Figure A.1.

2 Normative references

Clause 2 of IEC 60358-1:2012 is replaced by the following:

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60060-2, *High-voltage test techniques – Part 2: Measuring systems*

IEC 60358-1:2012, *Coupling capacitors and capacitor dividers. – Part 1: General rules*

IEC 60481, *Coupling devices for power line carrier systems*

IEC 61869-5, *Instrument transformers – Part 5: Additional requirements for capacitor voltage transformers*

3 Terms and definitions

Clause 3 of IEC 60358-1:2012 is applicable with the following additions:

For the purposes of this document, the terms and definitions given in Clause 3 of IEC 60358-1:2012, as well as the following apply.

3.200 Carrier-frequency accessories definitions

3.200.1
coupling device
arrangement of elements which contribute to ensure, together with one or more associated coupling capacitors, the transmission, under prescribed conditions, of carrier-frequency signals between one or more conductors of the power line and the carrier-frequency connection

3.200.2
carrier-frequency accessories
circuit element intended to permit the injection of carrier frequency signal and which is connected between the low voltage terminal of a coupling capacitor unit and earth, and having an impedance which is insignificant at the power frequency, but appreciable at carrier frequency

Note 1 to entry: See Figure A.1.

3.200.3
drain coil
inductance which is connected between the low voltage terminal of a coupling capacitor and earth, and whose impedance is insignificant at the power frequency, but has a high value at the carrier frequency

3.200.4
voltage limitation device
element connected between the coupling capacitor and earth to limit the overvoltages which appear across the coupling device.

Note 1 to entry: Overvoltages appear in case of:

a) a short circuit between the high-voltage terminal and earth;

b) where an impulse voltage is applied between the high voltage terminal and earth.

3.200.5
carrier earthing switch
switch for earthing the low voltage terminal

4 Service conditions

Clause 4 of IEC 60358-1:2012 is applicable.

5 Ratings

Clause 5 of IEC 60358-1:2012 is applicable.

6 Design requirements

Clause 6 of IEC 60358-1:2012 is applicable with the following additions:

6.200 Design requirements for coupling capacitor and carrier-frequency accessories

6.200.1 Design requirements for coupling capacitor

Coupling capacitors shall be designed to withstand an additional steady high frequency current of at least 1 A (r.m.s. value of current equivalent to a power of 400 W for a terminal resistance of 400 Ω), without any damage or deterioration.

6.200.2 Design requirements for carrier-frequency accessories

6.200.2.1 General

The carrier-frequency accessories, comprising a drain coil and a protective device, shall be connected between the low voltage terminal of the coupling capacitor and the earth terminal. The connections are typically as shown in Figure A.1.

The requirements for the complete coupling device are specified in IEC 60481.

6.200.2.2 Drain coil

The drain coil shall be designed in such a way, that:

a) for an AC application, the impedance should be as low as possible and in no case exceed 20 Ω at power frequency;

   for a DC application, no standard value is defined; manufacturer and purchaser shall define the impedance value;

b) the current-carrying capability at power frequency is as follows:
   - continuous operation: rated current of capacitor, but not less than 1 A r.m.s.;
   - short-time current: 30 A r.m.s. for 0,2 s;

c) the drain coil shall be able to withstand a 1,2/50 µs impulse voltage whose peak value is twice the value of the impulse spark voltage of the voltage limitation device, but the minimum value should be 10 kV peak (see 10.201.2.2)

d) for a drain coil with iron core, the insulation between winding and iron core shall support 3 kV for 60 s (see 9.2.200.2.1.3).

e) If the maximum fundamental frequency current of the capacitor is higher than 1 A, the continuous operation current for the drain coil should be increased accordingly

f) for a DC application, the grading current of the coupling capacitor shall not saturate the drain coil.

6.200.2.3 Voltage limitation device

A lightning arrester shall be connected as directly as possible between the low voltage terminal of the coupling capacitor and the earth terminals and shall be capable of protecting the coupling device and the carrier-frequency connection.

For AC applications: The AC protection level voltage U_{PL} at power frequency shall be greater than 10 times the maximum AC voltage across the drain coil during rated operation conditions.

The voltage U_{PL} is given by the following formula:

$$U_{PL} \geq 10 \cdot F_V \cdot \frac{U_m}{\sqrt{3}} \cdot (2 \cdot \pi \cdot f_R)^2 \cdot C_R \cdot L_D$$

where

L_D is the value of the drain coil in henry;

F_V is the voltage factor according to IEC 60358-1:2012, Table 2.

NOTE 1 Arresters of the air-gap type or those of the non-linear resistor type are used.

Example:

a) power-frequency withstand test voltage:
   - air-gap arrester: 2 kV r.m.s.,
   - arrester with spark-gap: rated voltage: approx. 1 kV r.m.s.

b) impulse withstand voltage:

– air-gap arrester and arrester with spark-gap: at test impulse voltage of about 4 kV peak with a wave shape 8/20 µs the arrester are able to sustain the peak current of at least 5 kA.

NOTE 2 It is desirable that the arrester be capable of sustaining a power frequency current of at least 5 kA r.m.s. for a period of 0,2 s while ensuring, even if damaged, that the other parts of the coupling device remain adequately protected.

For DC applications:

The DC protection level voltage U_{PL} shall be:

$$U_{PL} \geq 3{,}5\,\text{kV DC}$$

NOTE 3 3,5 kV coming from 2,5 kV AC × √2.

7 Test conditions

Clause 7 of IEC 60358-1:2012 is applicable.

8 Classification of tests

8.1 General

Subclause 8.1 of IEC 60358-1:2012 is applicable with the following addition:

The tests specified in this standard are classified as routine tests, type tests and special tests.

8.2 Routine tests

Subclause 8.2 of IEC 60358-1:2012 is applicable with the following additions:

8.2.200 General

The tests specified in 8.1 apply to coupling capacitors.

8.2.201 Routine tests for carrier frequency accessories

8.2.201.1 Routine test for drain coil

a) current carrying capability test (9.2.200.2.1.1);

b) measurement of the impedance at power frequency (9.2.200.2.1.2);

c) voltage test between winding and iron core (9.2.200.2.1.3).

8.2.201.2 Routine test for voltage limitation devise

AC or DC voltage test (9.2.200.2.2.1).

8.3 Type tests

Subclause 8.3 of IEC 60358-1:2012 is applicable with the following additions:

8.3.200 Type test for coupling capacitor and carrier-frequency accessories

8.3.200.1 Type test for coupling capacitors

a) high frequency capacitance and equivalent series resistance (10.200.1);

b) measurement of the stray capacitance and stray conductance of the low voltage terminal (10.200.2).

8.3.200.2 Type tests for carrier-frequency accessories

8.3.200.2.1 Type tests for drain coil

a) impedance measurement (10.201.2.1);

b) impulse voltage test (10.201.2.2);

c) current capability test (10.201.2.3);

d) short time current test (10.201.2.4).

8.3.200.2.2 Type test for voltage limitation device together with drain coil

a) impulse voltage test (10.201.2.2).

8.4 Special tests

Subclause 8.4 of IEC 60358-1:2012 is applicable.

9 Routine tests

9.1 Tightness of the liquid-filled equipment

Subclause 9.1 of IEC 60358-1:2012 is applicable.

9.2 Electrical routine tests

Subclause 9.2 of IEC 60358-1:2012 is applicable with the following additions:

9.2.200 Electrical tests for coupling capacitor and carrier frequency accessories

9.2.200.1 Routine tests for coupling capacitor

The routine tests on the coupling capacitor are specified in IEC 60358-12012, 8.1. No supplementary test is specified for PLC application for coupling capacitors.

9.2.200.2 Routine tests for carrier frequency accessories

9.2.200.2.1 Routine tests for drain coil

9.2.200.2.1.1 Current carrying capability test

The test shall be carried out, applying for 1 min a power frequency voltage between the terminals of the drain coil. The test voltage shall be adjusted to achieve a current twice the rated current of the capacitor, but not less than 1 A (r.m.s.). No damage shall occur.

9.2.200.2.1.2 Measurement of the impedance at power frequency

The measured value shall be within the range specified by the manufacturer. This test shall be performed after the current carrying capability test.

9.2.200.2.1.3 Voltage test between winding and iron core

The test shall be carried out, applying a 3 kV power frequency voltage between the terminals of the winding and the iron core for 1 min.

9.2.200.2.2 Routine test for voltage limitation devices

The following routine test is specified according to the cases below: