

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fixed capacitors for use in electronic equipment –
Part 13: Sectional specification – Fixed polypropylene film dielectric metal foil
DC capacitors

Condensateurs fixes utilisés dans les équipements électroniques –
Partie 13: Spécification intermédiaire – Condensateurs fixes pour courant
continu à diélectrique en film de polypropylène à armatures en feuilles
métalliques



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FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –**Part 13: Sectional specification – Fixed polypropylene
film dielectric metal foil DC capacitors**

FOREWORD

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International Standard IEC 60384-13 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This fifth edition cancels and replaces the fourth edition published in 2011. This edition constitutes a technical revision.

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

- a) revision of all parts of the document based on the ISO/IEC Directives, Part 2:2018, and harmonization with other similar kinds of documents;
- b) the document structure has been organized to follow new sectional specification structure decided in TC 40;
- c) revised tables and Clause 5 so as to prevent duplications and contradictions.

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

FDIS	Report on voting
40/2751/FDIS	40/2759/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.

The list of all parts of the IEC 60384 series, under the general title *Fixed capacitors for use in electronic equipment*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://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- withdrawn,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.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[IEC 60384-13:2020](#)

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FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 13: Sectional specification – Fixed polypropylene film dielectric metal foil DC capacitors

1 Scope

This part of IEC 60384 specifies preferred ratings and characteristics, selects from IEC 60384-1:2016 the appropriate quality assessment procedures, tests and measuring methods, and gives general performance requirements for this type of capacitor. Test severities and requirements specified in detail specifications referring to this sectional specification are of an equal or higher performance level. Lower performance levels are not permitted.

This part of IEC 60384 applies to fixed direct current capacitors, using as dielectric a polypropylene film with electrodes of thin metal foils. The capacitors covered by this document are intended for use in electronic equipment.

Capacitors for electromagnetic interference suppression are not included, but are covered by IEC 60384-14.

iTeh STANDARD PREVIEW

2 Normative references (standards.iteh.ai)

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 60062, *Marking codes for resistors and capacitors*

IEC 60063, *Preferred number series for resistors and capacitors*

IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60384-1:2016, *Fixed capacitors for use in electronic equipment – Part 1: Generic specification*

IEC 60417, *Graphical symbols for use on equipment*
(available at <http://www.graphicalsymbols.info/equipment>)

IEC 61193-2:2007, *Quality assessment systems – Part 2: Selection and use of sampling plans for inspection of electronic components and packages*

ISO 3, *Preferred numbers – Series of preferred numbers*

3 Terms and definitions

For the purposes of this document, the terms and definitions of IEC 60384-1:2016, and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

stability class

tolerance on the temperature coefficient together with the permissible change of capacitance after defined tests

Note 1 to entry: The stability class is stated in the detail specification.

Note 2 to entry: Table 2 shows the preferred stability classes.

3.2

rated voltage

U_R

maximum DC voltage that can be applied continuously to a capacitor at the rated temperature

4 Preferred ratings and characteristics

4.1 Preferred climatic categories

4.1.1 General

The values given in detail specifications shall preferably be selected from the following:

The capacitors covered by this sectional specification are classified into climatic categories in accordance with the general rules given in IEC 60068-1:2013, Annex A.

The lower and upper category temperatures and the duration of the damp heat, steady-state test shall be chosen from the following:

- lower category temperature: –55 °C, –40 °C and –25 °C.
- upper category temperature: +85 °C, +100 °C and +105 °C.
- duration of the damp heat, steady-state test: 21 days and 56 days.

The severities for the cold and dry heat tests are the lower and upper category temperatures, respectively.

4.1.2 Assisted drying

Conditions for assisted drying are:

- time period between 1 h and 6 h;
- temperature (55 ± 2) °C;
- relative humidity not exceeding 20 %.

4.2 Preferred values of ratings

4.2.1 Nominal capacitance (C_N)

Preferred values of nominal capacitance shall be chosen from the E series of IEC 60063, which are given in Table 1, and their decimal multiples ($\times 10^n$, where n is an integer).

4.2.2 Tolerance on nominal capacitance

The preferred tolerances on the nominal capacitance are ± 20 %; ± 10 %; ± 5 %; ± 2 %; ± 1 %.

4.2.3 Nominal capacitance with associated tolerance values

For preferred combinations of capacitance series and tolerances, see Table 1.

Table 1 – Preferred combinations of capacitance series and tolerance

Preferred combinations	
Series	Tolerances
E 6	±20 %
E 12	±10 %
E 24	±5 %
E 48	±2 %
E 96	±1 %

In all cases, the minimum tolerance is ±1 pF. Additional values of capacitance outside the E 96 range and additional tolerances may be specified.

4.2.4 Rated voltage (U_R)

The preferred values of rated voltages are: 40 V, 63 V, 100 V, 160 V, 250 V and their decimal multiples. These values conform to the basic series of preferred values R 5 given in ISO 3.

The sum of the DC voltage and the peak AC voltage applied to the capacitor shall not exceed the rated voltage. The value of the peak AC voltage shall not exceed the following percentages of the rated voltage at the frequencies stated, and should not be greater than 280 V:

		IEC 60384-13:2020
50 Hz:	20 %	https://standards.iteh.ai/catalog/standards/sist/b9061087-738f-4227-82c9-11b004a48e3e/iec-60384-13-2020
100 Hz:	15 %	
1 000 Hz:	3 %	
10 000 Hz:	1 %	

unless otherwise specified in the detail specification.

4.2.5 Stability classes in relation to temperature coefficients and change of capacitance

Preferred values of temperature coefficients (α) with associated tolerances and preferred values of permissible change of capacitance and also preferred combinations of these values defined as stability classes are given in Table 2.

The table is not valid for capacitance values smaller than 50 pF.

Table 2 – Preferred values and combinations

Stability class	Temperature coefficient α and tolerance in parts per million per degree Kelvin $10^{-6}/K$					Permissible change of capacitance ^a Upper category temperature		
	-80	-100	-125	-160	-250	85 °C	100 °C	105 °C
1	±40	±50	±60	±80	±120	±(0,5 % + 0,5 pF)	±(1 % + 0,5 pF)	±(1 % + 0,5 pF)
2		±100	±125	±160	±250	±(1 % + 1 pF)	±(2 % + 1 pF)	±(2 % + 1 pF)
3				±160	±250	±(2 % + 2 pF)	±(5 % + 2 pF)	±(5 % + 2 pF)

^a Permissible change of capacitance after each of the following tests;

- resistance to soldering heat;
- rapid change of temperature;
- vibration;
- bump or shock;
- damp heat, cyclic;
- damp heat, steady state;
- endurance.

4.2.6 Category voltage (U_C)

At 85 °C, the category voltage is equal to the rated voltage (U_R). For upper category temperature of 100 °C, the category voltage is equal to 0,7 U_R , and for 105 °C equal to 0,6 U_R .

4.2.7 Rated temperature (standards.iteh.ai)

The standard value of rated temperature is 85 °C.

[IEC 60384-13:2020](https://standards.iteh.ai/catalog/standards/sist/b9061087-738f-4227-82c9-116004a48c5c/iec-60384-13-2020)

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5 Test and measurement procedures and performance requirements

5.1 Visual examination and check of dimensions

5.1.1 General

See IEC 60384-1:2016, 4.4, with the details in 5.1.2 and 5.1.3.

5.1.2 Examination methods

Visual examination shall be carried out with suitable equipment with approximately 10× magnification and lighting appropriate to the specimen under test and the quality level required.

The operator should have available facilities for incident or transmitted illumination, as well as an appropriate measuring facility.

The capacitors shall be examined to verify that the materials, design, construction and physical dimensions are appropriate.

5.1.3 Requirements

See Table 9.

The workmanship shall be in accordance with the applicable requirements given in the detail specification.

5.2 Electrical tests

5.2.1 Voltage proof

5.2.1.1 General

See IEC 60384-1:2016, 4.6, with the details in 5.2.1.2 to 5.2.1.4.

5.2.1.2 Test circuit

The product of R_1 and the nominal capacitance of the capacitor under test (C_x) shall be smaller than or equal to 1 s and greater than 0,01 s.

R_1 includes the internal resistance of the power supply.

R_2 shall limit the discharge current to a value equal to or less than 1 A.

5.2.1.3 Test conditions

The voltages given in Table 3 shall be applied between the measuring points (from IEC 60384-1:2016, Table 3) for a period of 1 min for qualification approval testing and at measuring point 1a) for a period of 1 s for the lot-by-lot quality conformance testing.

Table 3 – Test voltages

Test point	Test voltage
1a)	$2 U_R$
1b) and 1c)	$2 U_R$ with a minimum of 400 V

5.2.1.4 Requirement

IEC 60384-13:2020

[https://standards.iteh.ai/catalog/standards/sist/b9061087-738f-4227-82c9-](https://standards.iteh.ai/catalog/standards/sist/b9061087-738f-4227-82c9-11b004a48e3e/iec-60384-13-2020)

[11b004a48e3e/iec-60384-13-2020](https://standards.iteh.ai/catalog/standards/sist/b9061087-738f-4227-82c9-11b004a48e3e/iec-60384-13-2020)

There shall be no breakdown or flashover during the test.

5.2.2 Capacitance

5.2.2.1 General

See IEC 60384-1:2016, 4.7, with the details in 5.2.2.2 and 5.2.2.3.

5.2.2.2 Measuring conditions

The capacitance shall be measured for

- a) nominal capacitance $C_N \leq 1\,000$ pF:
 - For measuring purposes: 1 MHz \pm 0,2 MHz or 100 kHz \pm 20 kHz.
 - For referee purposes: 1 MHz \pm 0,2 MHz.
- b) nominal capacitance $C_N > 1\,000$ pF:
 - For measuring purposes: 1 kHz \pm 0,2 kHz or 10 kHz \pm 2 kHz.
 - For referee purposes: 1 kHz \pm 0,2 kHz.

The peak value of applied voltage shall not exceed 3 % of the rated voltage or 5 V, whichever is smaller.

5.2.2.3 Requirements

The capacitance shall be within the specified tolerance.

For capacitors with a value of less than 10 pF or of more than 1 µF, the method of measurement and the limits shall be given in the detail specification.

5.2.3 Tangent of loss angle ($\tan \delta$)

5.2.3.1 General

See IEC 60384-1:2016, 4.8, with the details in 5.2.3.2 and 5.2.3.3.

5.2.3.2 Measuring conditions

Tangent of loss angle shall be measured, and the values recorded (for reference purposes).

The measuring frequency shall be same as that used for the capacitance measurement in 5.2.2.2.

The accuracy of the measuring instruments shall be such that the measuring error does not exceed 10^{-4} .

5.2.3.3 Requirement for measurements

The tangent of the loss angle shall not exceed the following limits.

at 1 MHz or 100 kHz: 10×10^{-4} for $C_N \leq 1\,000$ pF

at 1 kHz or 10 kHz: 5×10^{-4} for $1\,000$ pF $< C_N \leq 0,1$ µF

at 1 kHz: 10×10^{-4} for $C_N > 0,1$ µF

When the nominal capacitance is 10 pF or less or higher than 1 µF, the limits shall be given in the detail specification.

<https://standards.iteh.ai/catalog/standards/sist/b9061087-738f-4227-82c9-11b004a48e3e/iec-60384-13-2020>

5.2.4 Insulation resistance

5.2.4.1 General

See IEC 60384-1:2016, 4.5, with the details in 5.2.4.2 to 5.2.4.4.

5.2.4.2 Preconditioning

Prior to the test, capacitors shall be carefully cleaned to remove any contamination. Care shall be taken to maintain cleanliness in the test chambers and during post-test measurements.

Before measurement, the capacitor shall be fully discharged. The product of the resistance of the discharge circuit and the nominal capacitance of the capacitor under test shall be $\geq 0,01$ s or any other value stated in the detail specification.

5.2.4.3 Measuring conditions

The measuring voltage shall be in accordance with IEC 60384-1:2016, 4.5.2.

The measuring points shall be in accordance with IEC 60384-1:2016, Table 3.

The voltage shall be applied immediately at the correct value through the internal resistance of the voltage source. The product of the internal resistance and the nominal capacitance of the capacitor shall be smaller than 1 s or any other value stated in the detail specification.

5.2.4.4 Requirements

The insulation resistance shall meet the requirements in Table 4.

Table 4 – Insulation resistance

Measuring points in accordance with IEC 60384-1:2016, Table 3	Requirements		
	Minimum RC product (R = insulation resistance between the terminations C_N = nominal capacitance) s	Minimum insulation resistance between the terminations MΩ	Minimum insulation resistance between terminations and case MΩ
	$C_N > 0,1 \mu\text{F}$	$C_N \leq 0,1 \mu\text{F}$	
1a)	10 000	100 000	-
1b) and 1c)	–	–	100 000

NOTE For stability class 3, a minimum insulation resistance value of 30 000 MΩ is permitted.

5.2.4.5 Correction factors

When the test is carried out at a temperature other than 20 °C, the result shall, when necessary, be corrected to 20 °C by multiplying the result of the measurement by the appropriate correction factor. In case of doubt, measurement at 20 °C is decisive. The correction factors in Table 5 can be considered as an average for polypropylene film dielectric metal foil capacitors.

Table 5 – Correction factor dependent on test temperature

Temperature °C	Correction factor
15	0,75
20	1,00
25	1,25
30	1,75
35	2,00

5.2.5 Characteristics depending on temperature (if required in the detail specification)

5.2.5.1 General

See IEC 60384-1:2016, 4.24.1, with the details in 5.2.5.2 and 5.2.5.3.

5.2.5.2 Measurement conditions

The capacitors shall be dried before the testing (see IEC 60384-1:2016, 4.3).

The capacitance measurements shall be carried out during one temperature cycle at points a) (20 °C = comparison temperature), b) (lower category temperature), d) (20 °C = comparison temperature), f) (upper category temperature) and g) (20 °C = comparison temperature).

5.2.5.3 Requirements

The change of capacitance during and after the temperature cycle (temperature coefficient and temperature cyclic drift of capacitance) shall be within the limits of the relevant stability class and upper category temperature in accordance with Table 2.