

# INTERNATIONAL STANDARD



**Fixed capacitors for use in electronic equipment –  
Part 24: Sectional specification – Fixed tantalum electrolytic surface mount  
capacitors with conductive polymer solid electrolyte**

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

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –****Part 24: Sectional specification – Fixed tantalum electrolytic surface mount capacitors with conductive polymer solid electrolyte**

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International Standard IEC 60384-24 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This third edition cancels and replaces the second edition published in 2015. This edition constitutes a technical revision.

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

- a) Revision of the structure in accordance with ISO/IEC Directives, Part 2:2018, to the extent practicable, and harmonization between other similar kinds of documents.
- b) In addition, Clause 5 and all the tables have been reviewed in order to prevent duplications and contradictions.

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

FDIS	Report on voting
40/2849/FDIS	40/2860/RVD

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.

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

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](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at <http://www.iec.ch/standardsdev/publications>.

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## FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

### Part 24: Sectional specification – Fixed tantalum electrolytic surface mount capacitors with conductive polymer solid electrolyte

#### ~~1~~ **General**

##### **1 Scope**

This part of IEC 60384 applies to fixed tantalum electrolytic surface mount capacitors with conductive polymer solid electrolyte, which are primarily intended for DC applications for use in electronic equipment.

Fixed tantalum electrolytic surface mount capacitors with solid (MnO<sub>2</sub>) electrolyte are not included but are covered by IEC 60384-3.

These capacitors are primarily intended for use in electronic equipment to be mounted directly on substrates for hybrid circuits or to printed boards.

Capacitors for special-purpose applications ~~may~~ can need additional requirements.

##### ~~1.2~~ **Object**

The object of this document is to prescribe preferred ratings and characteristics and to select from IEC 60384-1:2016 the appropriate quality assessment procedures, tests and measuring methods and to give general performance requirements for this type of capacitor. ~~Test severities and requirements prescribed in detail specifications referring to this sectional specification shall be of equal or higher performance level, because lower performance levels are not permitted.~~

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

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

IEC 60384-1:2008/2016, *Fixed capacitors for use in electronic equipment – Part 1: Generic specification*

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 given in IEC 60384-1:2008/2016 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

##### capacitance

<electrolytic capacitor> capacitance of an equivalent circuit whose capacitance and resistance in series is measured with an alternating current having an approximately sinusoidal waveform at a specified frequency

### 4 Preferred ratings and characteristics

#### 4.1 Preferred characteristics

Preferred climatic categories only shall be given in the preferred characteristics.

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 temperature shall be taken from the following:

- lower category temperature:  $-55\text{ °C}$ ;
- upper category temperature:  $+105\text{ °C}$  and  $+125\text{ °C}$ .

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

The upper category temperature shall be  $105\text{ °C}$  or  $125\text{ °C}$  for a rated temperature of  $85\text{ °C}$ .

The upper category temperature shall be  $125\text{ °C}$  for a rated temperature of  $105\text{ °C}$ .

#### 4.2 Preferred values of ratings

##### 4.2.1 Nominal capacitance ( $C_N$ )

Preferred values of nominal capacitance are indicated in microfarad ( $\mu\text{F}$ ).

Preferred values of nominal capacitance shall be taken from the E 12 series of IEC 60063 as follows:

1,0 – 1,2 – 1,5 – 1,8 – 2,2 – 2,7 – 3,3 – 3,9 – 4,7 – 5,6 – 6,8 – 8,2;

and their decimal multiples ( $\times 10^n$ ,  $n$ : integer).

##### 4.2.2 Tolerance on nominal capacitance

Preferred value of tolerance on nominal capacitance is:

$\pm 20\%$ .

### 4.2.3 Rated voltage ( $U_R$ )

Preferred values of rated **direct** DC voltages taken from R10 and R20 series of ISO 3 are:

- from R10: 1,0 – 1,25 – 1,6 – 2,0 – 2,5 – 4,0 – 5,0 – 6,3 – 8,0;
- from R20: 3,5<sup>1</sup>;
- and their decimal multiples ( $\times 10^n$ ,  $n$ : integer).

### 4.2.4 Category voltage ( $U_C$ )

The category voltage for capacitors is given in Table 1 and Table 2.

### 4.2.5 Surge voltage ( $U_{RS}$ or $U_{CS}$ )

The surge voltage shall be 1,15 times the rated or category voltage rounded off to the nearest volt (two significant digits) (see Table 1 and Table 2).

NOTE  $U_{RS}$  is the surge voltage to rated voltage;  
 $U_{CS}$  is the surge voltage to category voltage.

### 4.2.6 Rated temperature

The value of the rated temperature is +85 °C and +105 °C (see Table 1 and Table 2).

**Table 1 – Category and surge voltages**

Values in volts

	Upper category temperature 125 °C / rated temperature 85 °C											
$U_R$	2,0	2,5	4,0	5,0	6,3	8,0	10	12,5	16	20	25	35
$U_C = 0,80 U_R$	1,6	2,0	3,2	4,0	5,0	6,4	8,0	10	13	16	20	28
$U_{RS}$	2,3	2,9	4,6	5,8	7,2	9,2	12	14	18	23	29	40
$U_{CS}$	1,8	2,3	3,7	4,6	5,8	7,4	9,2	12	15	18	23	32

**Table 2 – Category and surge voltages**

Values in volts

	Upper category temperature 125 °C / rated temperature 105 °C or upper category temperature 105 °C / rated temperature 85 °C											
$U_R$	2,0	2,5	4,0	5,0	6,3	8,0	10	12,5	16	20	25	35
$U_C = 0,90 U_R$	1,8	2,3	3,6	4,5	5,7	7,2	9,0	11	14	18	23	32
$U_{RS}$	2,3	2,9	4,6	5,8	7,2	9,2	12	14	18	23	29	40
$U_{CS}$	2,0	2,6	4,1	5,2	6,5	8,2	10	13	16	20	26	36

<sup>1</sup> ISO 3 indicates the value 3,55 for R20.

## 5 Test and measurement procedures

### 5.1 General

Test severities and requirements prescribed in detail specifications referring to this sectional specification are of equal or higher performance level, because lower performance levels are not permitted.

This clause supplements the information given in IEC 60384-1:~~2008~~2016, Clause 4.

### 5.2 Preliminary drying

See IEC 60384-1:~~2008~~2016, 4.3.

### 5.3 Measuring conditions

See IEC 60384-1:~~2008~~2016, 4.2.1.

### 5.4 Mounting

#### 5.4.1 General

See IEC 60384-1:~~2008~~2016, 4.33, with 5.4.2, 5.4.3 and 5.4.4 of this document.

#### 5.4.2 Initial inspections

See Table 4.

#### 5.4.3 Test conditions

The test method shall be the reflow method and reflow temperature profile specified in the detail specification.

#### 5.4.4 Final inspections and requirements

See Table 4.

### 5.5 Visual examination and check of dimensions

#### 5.5.1 General

See IEC 60384-1:~~2008~~2016, 4.4, with 5.5.2 and 5.5.3 of this document.

#### 5.5.2 Visual examination and check of dimensions

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.

#### 5.5.3 Requirements

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

## 5.6 Electrical tests

### 5.6.1 Leakage current

#### 5.6.1.1 General

See IEC 60384-1:20082016, 4.9, with 5.6.1.2 and 5.6.1.3 of this document.

#### 5.6.1.2 Measuring conditions

The rated voltage shall be applied across the capacitor and its protective resistor placed in series with the capacitor to limit the charging current.

The protective resistor shall have a value of 1 000  $\Omega$ .

#### 5.6.1.3 Requirements

See Table 4.

### 5.6.2 Capacitance

#### 5.6.2.1 General

See IEC 60384-1:20082016, 4.7, with 5.6.2.2 and 5.6.2.3 of this document.

#### 5.6.2.2 Measuring conditions

Unless otherwise specified in the detail specifications, the capacitance shall be measured at a frequency of 100 Hz or 120 Hz.

The peak alternating voltage actually applied across the capacitor terminations shall not exceed 0,5 V (RMS).

A DC bias voltage of 0,7 V to 1,0 V may be applied during the measurement to avoid negative voltage application to the capacitor by the applied AC voltage.

The inaccuracy of the measuring instruments shall not exceed  $\pm 2$  % of the limit specified in the detail specification, whether this is given as an absolute value or as a change of capacitance.

#### 5.6.2.3 Requirements

See Table 4.

### 5.6.3 Tangent of loss angle ( $\tan \delta$ )

#### 5.6.3.1 General

See IEC 60384-1:20082016, 4.8.1, with 5.6.3.2 and 5.6.3.3 of this document.

#### 5.6.3.2 Measuring conditions

The measurement shall be under the conditions as specified in 5.6.2.2.

The inaccuracy of the measuring equipment shall not exceed 0,01 in absolute value.

#### 5.6.3.3 Requirements

See Table 4.

#### 5.6.4 Equivalent series resistance (ESR) (if required)

##### 5.6.4.1 General

See IEC 60384-1:20082016, 4.8.2, with 5.6.4.2 and 5.6.4.3 of this document.

##### 5.6.4.2 Measuring conditions

Unless otherwise specified in the detail specifications, test conditions are as follows:

- temperature: 20 °C ± 2 °C;
- applied voltage: peak AC value ≤ 0,5 V (RMS);
- voltage frequency: 100 kHz ± 10 kHz.

The error of measurement shall not exceed 5 % of the requirement, or 0,02 Ω, whichever is the greater.

##### 5.6.4.3 Requirements

See Table 4.

#### 5.7 Resistance to soldering heat

##### 5.7.1 General

See IEC 60384-1:20082016, 4.14, with 5.7.2 to 5.7.5 of this document.

##### 5.7.2 Initial inspections

See Table 4.

##### 5.7.3 Test conditions

The test method shall be the reflow method, and the reflow temperature profile shall be specified in the detail specification.

##### 5.7.4 Recovery

The recovery period shall be 24 h ± 2 h.

##### 5.7.5 Final inspections and requirements

After recovery, the capacitors shall be visually examined under normal lighting and approximately 10× magnification and measured electrical characteristics given in Table 4.

#### 5.8 Solderability

##### 5.8.1 General

See IEC 60384-1:20082016, 4.15, with 5.8.2 of this document.

##### 5.8.2 Final inspections and requirements

See Table 4.

#### 5.9 Shear test

See IEC 60384-1:20082016, 4.34.