IEC 60384-24

Edition 2.0 2015-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

Condensateurs fixes utilisés dans les équipements électroniques – Partie 24: Spécification intermédiaire – Condensateurs fixes électrolytiques au tantale pour montage en surface à électrolyte solide en polymère conducteur

IEC 60384-24:2015-07(en-fr)

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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

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

This second edition cancels and replaces the first edition published in 2006 and 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 2:2011 (sixth edition) to the extent practicable, and harmonization between other similar kinds of documents.
b) In addition, Clause 4 and all the tables have been reviewed in order to prevent duplications and contradictions.

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

FDIS	Report on voting
40/2382/FDIS	40/2395/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.

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 publication will remain unchanged until the stability date indicated on the IEC website 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- withdrawn,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.

The contents of the Corrigendum 1 of December 2016 have been included in this copy.

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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

1.1 Scope

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

Fixed tantalum electrolytic surface mount capacitors with solid (MnO_2) 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 need additional requirements.

1.2 Object

The object of this standard is to prescribe preferred ratings and characteristics and to select from IEC 60384-1 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.

1.3 Normative references

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 60063, *Preferred number series for resistors and capacitors*

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

IEC 60384-1:2008, *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*

1.4 Information to be given in a detail specification

1.4.1 General

Detail specifications shall be derived from the blank detail specification.

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Detail specifications shall not specify requirements inferior to those of the generic, sectional or blank detail specification. When more severe requirements are included, they shall be listed in 1.9 of the detail specification and indicated in the test schedules, for example, by an asterisk.

The information given in 1.4.2 may, for convenience, be presented in tabular form.

The following information shall be given in each detail specification and the values quoted shall preferably be selected from those given in the appropriate clause of this sectional specification.

1.4.2 Outline drawing and dimensions

There shall be an illustration of the capacitors as an aid to easy recognition and for comparison of the capacitors with others.

Dimensions and their associated tolerances, which affect interchangeability and mounting, shall be given in the detail specification. All dimensions shall preferably be stated in millimetres; however, when the original dimensions are given in inches, the converted metric dimensions in millimetres shall be added.

The numerical values of the body shall be given as follows:

– for general: the width, length and height.

The numerical values of the terminals shall be given as follows:

– for terminals: the width, length and spacing.

When the configuration is other than described above, the detail specification shall state such dimensional information as will adequately describe the capacitor.

1.4.3 Mounting

The method of mounting for tests and measurements are given in 4.3. The detail specification shall specify the methods of mounting for normal use.

1.4.4 Ratings and characteristics

1.4.4.1 General

The ratings and characteristics shall be given in accordance with the relevant clauses of this specification, together with the following.

1.4.4.2 Nominal capacitance range

See 2.2.1.

When products approved to the detail specification have different nominal capacitance ranges, the following statement should be added:

“The nominal capacitance range available in each voltage range is given in the register of approvals, available for example on the IECQ on-line certificate system website www.iecq.org”.

1.4.4.3 Particular characteristics

Additional characteristics may be listed when they are considered necessary to specify adequately the component for design and application purposes.

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1.4.4.4 Soldering

The detail specification shall specify the test methods, severities and requirements applicable for the solderability and the resistance to soldering heat tests.

1.4.5 Marking

The detail specification shall specify the content of the marking on the capacitor and on the packaging. When there are deviations from 1.6, these shall be given in the detail specification.

1.5 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60384-1:2008 apply.

1.6 Marking

1.6.1 General

See IEC 60384-1:2008, 2.4, with the following details.

1.6.2 Information for marking

The information given in the marking is normally selected from the following list; the relative importance of each item is indicated by its position in the list:

a) polarity of the terminations (unless identified by the construction);
b) rated voltage (d.c. voltage may be indicated by the symbol ⎓ or ⎯);
c) nominal capacitance;
d) category temperature;
e) tolerance on nominal capacitance;
f) year and month (or, year and week) of manufacture;
g) manufacturer's name and/or trademark;
h) manufacturer's type designation;
i) reference to the detail specification.

1.6.3 Marking on capacitors

Polarity of the terminations shall be marked. Other elements are marked as necessary.

Any marking shall be legible and not easily smeared or removed by rubbing with the finger.

1.6.4 Marking on packaging

The packaging containing the capacitors should be clearly marked with all the information listed in 1.6.2 as necessary.

2 Preferred ratings and characteristics

2.1 Preferred characteristics

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

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

The lower and upper category temperature shall be taken from the following:

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lower category temperature: –55 °C;

upper category temperature: +105 °C and +125 °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°C or 125 °C for a rated temperature of 85 °C.

The upper category temperature shall be 125 °C for a rated temperature of 105 °C.

2.2 Preferred values of ratings

2.2.1 Nominal capacitance (C_N)

Preferred values of nominal capacitance are shown unit of microfarad (μF).

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

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).

2.2.2 Tolerance on nominal capacitance

Preferred value of tolerance on nominal capacitance is:

–20 % to +20 %.

2.2.3 Rated voltage (U_R)

Preferred values of rated direct voltages taken from R 10 and R 20 series of ISO 3 are:

– from R 10: 1,0 – 1,25 – 1,6 – 2,0 – 2,5 – 4,0 – 5,0 – 6,3 – 8,0;
– from R 20: 3,5;

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

2.2.4 Category voltage (U_C)

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

2.2.5 Surge voltage (U_{RS} or U_{CS})

The surge voltage shall be 1,15 times the rated or category voltage rounded off (significant digit of 2) to the nearest volt (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.

2.2.6 Rated temperature

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

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Table 1 – Category and surge voltages

Dimensions in volt

	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

Dimensions in volt

	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

3 Quality assessment procedures

3.1 Primary stage of manufacture

The primary stage of manufacture is the forming of the oxide layer.

3.2 Structurally similar components

Capacitors, considered as being structurally similar, are capacitors produced with similar processes and materials, though they may be of different case sizes and values.

3.3 Certified test records of released lots

The information required in IEC 60384-1:2008, Q.9 shall be made available when prescribed in the detail specification and when requested by a purchaser. After the endurance test, the required parameters are the capacitance change, tangent of loss angle, equivalent series resistance, and leakage current.

3.4 Qualification approval procedures

3.4.1 General

The procedures for qualification approval testing are given in IEC 60384-1:2008, Q.5.

The schedule to be used for qualification approval testing on the basis of lot-by-lot and periodic tests is given in 3.5. The procedure using a fixed sample size schedule is given in 3.4.2 and 3.4.3.

3.4.2 Qualification approval on the basis of the fixed sample size procedure

The fixed sample size procedure is described in IEC 60384-1:2008, Q.5.3, list item b). The sample shall be representative of the range of capacitors for which approval is sought. The sample may be the whole or the part of the range given in the detail specification.

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The sample shall consist of four specimens having the maximum and minimum voltages and for these voltages the maximum and minimum case size. When there are more than four case sizes, an intermediate case size shall also be tested. In each of these case size/voltage combinations (values), the maximum capacitance shall be chosen. Thus, for the approval of a range, testing is required of either four or six values. When the range consists of less than four values, the number of specimens to be tested shall be that required for four values.

Two (for 6 values) or three (for 4 values) per value may be used as replacements for specimens, which are non-conforming because of incidents not attributable to the manufacturer.

The numbers given in Group 0 assume that all groups are applicable. If this is not so, the numbers may be reduced accordingly.

When additional groups are introduced into the qualification approval test schedule, the number of specimens required for Group 0 shall be increased by the same number as that required for the additional groups.

Table 3 gives the number of samples to be tested in each group or subgroup together with the permissible number of non-conforming items for qualification approval tests.

3.4.3 Tests

The complete series of tests specified in Table 3 and Table 4 are required for the approval of capacitors covered by one detail specification. The tests of each group shall be carried out in the order given.

The whole sample shall be subjected to the tests of Group 0 and then divided for the other groups.

Specimens found to be non-conforming in the tests of Group 0 shall not be used for the other groups.

Approval is granted when the number of non-conforming items is zero.

Table 3 and Table 4 together form the fixed sample size test schedule for the qualification approval on the basis of the fixed sample size procedure.

Table 3 gives the number of the samples or permissible non-conforming items for each tests or test groups.

Table 4 gives a summary of the test conditions and performance requirements, and choices of the test conditions and performance requirements in the detail specification.

The test conditions and performance requirements for the qualification approval on the basis of the fixed sample size procedure should be identical to those for quality conformance inspections given in the detail specification.

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Table 3 – Sampling plan for qualification approval, assessment level EZ

Group no.	Test	Subclause	Number of specimens n[d]	Permissible number of non-conforming items c
0	High surge current [c]	4.18	120+12[f]	0
	Visual examination	4.4		
	Dimensions	4.4		
	Leakage current	4.5.1		
	Capacitance	4.5.2		
	Tangent of loss angle	4.5.3		
	Equivalent series resistance [c]	4.5.4		
	Spare specimens			
1A	Resistance to soldering heat	4.6	12	0
	Component solvent resistance [c]	4.16		
1B	Solderability	4.7	12	0
	Solvent resistance of marking [c]	4.17		
2	Substrate bending test [e]	4.9	12	0
3[a]	Mounting	4.3	84	0[b]
	Visual examination	4.4.2		
	Leakage current	4.5.1		
	Capacitance	4.5.2		
	Tangent of loss angle	4.5.3		
	Equivalent series resistance [c]	4.5.4		
3.1	Shear test	4.8	12	0
	Rapid change of temperature	4.10		
	Climatic sequence	4.11		
3.2	Damp heat, steady state	4.12	12	0
3.3	Characteristics at high and low temperature	4.13	12	0
	Surge voltage	4.14		
3.4	Endurance	4.15	36	0
3.5	Storage at high temperature	4.19	12	0

[a] The values of these inspections serve as initial inspections for the tests of Group 3.

[b] The capacitors found non-conforming after mounting shall not be taken into account when calculating the non-conforming items for the following tests. They shall be replaced by spare capacitors.

[c] If required.

[d] For case size/voltage combinations, see 3.4.2.

[e] Not applicable to capacitors, which shall be mounted on alumina substrates only, according to their detail specification.

[f] Spare specimens.

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Table 4 – Test schedule for qualification approval *(1 of 6)*

Subclause number and test[a], inspection items	D or ND[b]	Conditions of test[a] and measurements	Number of specimens (n) and permissible number of non-conforming items (c)	Performance requirements[a]
GROUP 0	ND		See Table 3	
4.18 High surge current[e]		See IEC 60384-1:2008, 4.39		See detail specification
4.4.2 Visual examination		See 4.4.2		Legible marking and as specified in the detail specification
4.4 Dimension (detail)		See 4.4.2		See detail specification
4.5.1 Leakage current		See 4.5.1.2		≤0,1 $C_N U_R$ or 10 µA, whichever is the greater (at 20 °C ± 2 °C) [d]
4.5.2 Capacitance		See 4.5.2.2		Within specified tolerance
4.5.3 Tangent of loss angle (tan δ)		See 4.5.3.2		See detail specification
4.5.4 Equivalent series resistance [e]		See 4.5.4.2		See detail specification
GROUP 1A	D		See Table 3	
4.6 Resistance to soldering heat		See 4.6.3		
4.6.2 Initial inspections				
Capacitance		See 4.5.2.2		
4.6.4 Recovery		See 4.6.4		
4.6.5 Final inspections				
Visual examination		See 4.6.5		There shall be no signs of remarkable damage Dissolution of the end face plating (leaching) shall not exceed 25 % of the length of the edge concerned
Capacitance		See 4.5.2.2		See detail specification
Tangent of loss angle		See 4.5.3.2		See detail specification
Leakage current		See 4.5.1.2		See detail specification
4.16 Component solvent resistance [e]		See IEC 60384-1:2008, 4.31		See IEC 60384-1:2008, 4.31

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Table 4 *(2 of 6)*

Subclause number and test[a], inspection items	D or ND[b]	Conditions of test[a] and measurements	Number of specimens (n) and permissible number of non-conforming items (c)	Performance requirements[a]
GROUP 1B	D		See Table 3	
4.7 Solderability		See IEC 60384-1:2008, 4.15		
4.7.2 Final inspections				
Visual examination		See 4.4.2		There shall be no signs of damage. Areas to be soldered shall be covered with a new solder coating with no more than a small amount of scattered imperfections such as pinholes or un-wetted or de-wetted areas. These imperfections shall not be concentrated in one area. An area in which plating does not exist such as the tip of the terminal shall not be evaluated.
4.17 Solvent resistance of the marking [c,e]		See IEC 60384-1:2008, 4.32		See IEC 60384-1:2008, 4.32
GROUP 2	D		See Table 3	
4.9 Substrate bending test [e]		See 4.9.3		
4.9.2 Initial inspections				
Capacitance		See 4.5.2.2		
4.9.4 Final inspections				
Visual examination		See 4.4.2		No visible damage
Capacitance (with printed board in bent position)				See detail specification
GROUP 3	D		See Table 3	
4.3 Mounting		See 4.3.3		
4.3.2 Initial inspections				
Capacitance		See 4.5.2.2		
4.3.4 Final inspections				
Visual examination		See 4.4.2		No visible damage
Leakage current		See 4.5.1.2		See detail specification
Capacitance		See 4.5.2.2		$\lvert\Delta C/C\rvert < 8$ % of value measured in 4.3.2
Tangent of loss angle		See 4.5.3.2		See detail specification
Equivalent series resistance [e]		See 4.5.4.2		See detail specification

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Table 4 *(3 of 6)*

Subclause number and test[a], inspection items	D or ND[b]	Conditions of test[a] and measurements	Number of specimens (n) and permissible number of non-conforming items (c)	Performance requirements[a]
GROUP 3.1	D		See Table 3	
4.8 Shear test		See IEC 60384-1:2008, 4.34		
4.10 Rapid change of temperature		See 4.10.3		
4.10.2 Initial inspections				
Capacitance		See 4.5.2.2		
4.10.4 Recovery		See 4.10.4		
4.10.5 Final inspections				
Leakage current		See 4.5.1.2		See detail specification
Capacitance		See 4.5.2.2		$\lvert\Delta C/C\rvert \leq 10$ % of the value measured in 4.10.2
Tangent of loss angle		See 4.5.3.2		See detail specification
4.11 Climatic sequence		See IEC 60384-1:2008, 4.21		
4.11.2 Initial inspections				
Capacitance		See 4.5.2.2		
4.11.3 Dry heat		See 4.11.3		
4.11.4 Damp heat, cyclic, test Db, first cycle		See IEC 60384-1:2008, 4.21.3		
4.11.5 Cold		See 4.11.5		
4.11.6 Damp heat, cyclic, test Db, remaining cycles		See IEC 60384-1:2008, 4.21.6		
4.11.7 Recovery		See 4.11.7		
4.11.8 Final inspections				
Visual examination		See 4.4.2		No visible damage Legible marking
Capacitance		See 4.5.2.2		$\lvert\Delta C/C\rvert \leq 20$ % of the value measured in 4.11.2
Tangent of loss angle		See 4.5.3.2		See detail specification

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Table 4 *(4 of 6)*

Subclause number and test[a], inspection items	D or ND[b]	Conditions of test[a] and measurements	Number of specimens (n) and permissible number of non-conforming items (c)	Performance requirements[a]
GROUP 3.2	D		See Table 3	
4.12 Damp heat, steady state		See 4.12.3		
4.12.2 Initial inspections				
Capacitance		See 4.5.2.2		
4.12.4 Recovery		See 4.12.4		
4.12.5 Final inspections				
Visual examination		See 4.4.2		No visible damage Legible marking
Leakage current		See 4.5.1.2		See detail specification
Capacitance		See 4.5.2.2		−20 % < $\lvert\Delta C/C\rvert$ < +40 % of the value measured in 4.12.2
Tangent of loss angle		See 4.5.3.2		See detail specification
GROUP 3.3	D			
4.13 Characteristics at high and low temperature		See IEC 60384-1:2008, 4.29		
Step 1: 20 °C				
Leakage current		See 4.5.1.2		
Capacitance		See 4.5.2.2		
Tangent of loss angle		See 4.5.3.2		
Step 2: −55 °C (lower category temperature)				
Capacitance		See 4.5.2.2		See detail specification
Tangent of loss angle		See 4.5.3.2		See detail specification
Step 3: 20 °C				
Leakage current		See 4.5.1.2		See detail specification
Capacitance		See 4.5.2.2		$\lvert\Delta C/C\rvert \leq 5$ % of the value measured in step 1
Tangent of loss angle		See 4.5.3.2		See detail specification
Step 4: 85 °C				
Leakage current		See 4.5.1.2		See detail specification
Capacitance		See 4.5.2.2		See detail specification
Step 5: upper category temperature				
Leakage current (with U_R)		See 4.5.1.2		See detail specification
Capacitance		See 4.5.2.2		See detail specification
Tangent of loss angle		See 4.5.3.2		See detail specification
Step 6: 20 °C				
Leakage current		See 4.5.1.2		See detail specification
Capacitance		See 4.5.2.2		$\lvert\Delta C/C\rvert \leq 5$ % of the value measured in step 1
Tangent of loss angle		See 4.5.3.2		See detail specification

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