

INTERNATIONAL STANDARD



**Fixed capacitors for use in electronic equipment –
Part 23: Sectional specification – Fixed metallized polyethylene naphthalate film
dielectric surface mount DC capacitors**

Document Preview

[IEC 60384-23:2023](#)

<https://standards.iteh.ai/catalog/standards/iec/8b26e96a-c24e-496f-8ee0-6ccdd2d4538b/iec-60384-23-2023>



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2023 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

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

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

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

International Standards
Document Preview

[IEC 60384-23:2023](https://standards.iteh.ai/catalog/standards/iec/8b26e96a-c24e-496f-8ee0-6ccdd2d4538b/iec-60384-23-2023)

<https://standards.iteh.ai/catalog/standards/iec/8b26e96a-c24e-496f-8ee0-6ccdd2d4538b/iec-60384-23-2023>



IEC 60384-23

Edition 3.0 2023-02
REDLINE VERSION

INTERNATIONAL STANDARD



Fixed capacitors for use in electronic equipment –
Part 23: Sectional specification – Fixed metallized polyethylene naphthalate film
dielectric surface mount DC capacitors

Document Preview

[IEC 60384-23:2023](https://standards.iteh.ai/catalog/standards/iec/8b26e96a-c24e-496f-8ee0-6ccdd2d4538b/iec-60384-23-2023)

<https://standards.iteh.ai/catalog/standards/iec/8b26e96a-c24e-496f-8ee0-6ccdd2d4538b/iec-60384-23-2023>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 31.060.10

ISBN 978-2-8322-6452-2

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	5
1 General.....	8
1 Scope.....	8
1.2 Object.....	8
2 Normative references	8
3 Terms and definitions	9
4 Preferred ratings and characteristics	9
4.1 Preferred characteristics climatic categories	9
4.2 Preferred values of ratings.....	9
4.2.1 Nominal capacitance (C_N)	9
4.2.2 Tolerance on nominal capacitance.....	10
4.2.3 Rated voltage (U_R).....	10
4.2.4 Category voltage (U_C).....	10
4.2.5 Rated temperature.....	10
5 Test and measurement procedures.....	11
5.1 General.....	11
5.2 Mounting.....	11
5.2.1 Initial inspections.....	11
5.2.2 Mounting method.....	11
5.2.3 Final inspections after mounting.....	11
5.3 Visual examination and check of dimensions	11
5.3.1 General	11
5.3.2 Visual examination and check of dimensions	11
5.3.3 Requirements	11
5.4 Electrical tests.....	11
5.4.1 Voltage proof.....	11
5.4.2 Capacitance	12
5.4.3 Tangent of loss angle ($\tan \delta$)	12
5.4.4 Insulation resistance.....	13
5.5 Shear test.....	14
5.5.1 General	14
5.5.2 Final inspections.....	14
5.6 Substrate bending test.....	15
5.6.1 General	15
5.6.2 Initial inspections.....	15
5.6.3 Final inspections and requirements.....	15
5.7 Resistance to soldering heat.....	15
5.7.1 General	15
5.7.2 Initial inspections.....	15
5.7.3 Test conditions	15
5.7.4 Recovery	15
5.7.5 Final inspections and requirements.....	15
5.8 Solderability.....	16
5.8.1 General	16
5.8.2 Test conditions	16
5.8.3 Final inspections and requirements.....	16

5.9	Rapid change of temperature	16
5.9.1	General	16
5.9.2	Initial inspections	16
5.9.3	Test conditions	16
5.9.4	Final inspections and requirements	16
5.10	Climatic sequence	16
5.10.1	General	16
5.10.2	Initial inspections	16
5.10.3	Dry heat	17
5.10.4	Damp heat, cyclic, test Db, first cycle	17
5.10.5	Cold	17
5.10.6	Damp heat, cyclic, test Db, remaining cycles	17
5.10.7	Recovery	17
5.10.8	Final inspections and requirements	17
5.11	Damp heat, steady state	17
5.11.1	General	17
5.11.2	Initial inspections	17
5.11.3	Test conditions	17
5.11.4	Recovery	17
5.11.5	Final inspections and requirements	18
5.12	Endurance	18
5.12.1	General	18
5.12.2	Initial inspections	18
5.12.3	Test conditions	18
5.12.4	Final inspections and requirements	18
5.13	Charge and discharge	19
5.13.1	General	19
5.13.2	Initial inspections	19
5.13.3	Test conditions	19
5.13.4	Recovery	19
5.13.5	Final inspections and requirements	19
5.14	Component solvent resistance (if required)	19
5.14.1	General	19
5.14.2	Final inspections and requirements	19
5.15	Solvent resistance of marking (if required applicable)	19
5.15.1	General	19
5.15.2	Final inspections and requirements	19
6	Marking	19
6.1	General	20
6.2	Information for marking	20
6.3	Marking on capacitors	20
6.4	Marking on packaging	20
7	Information to be given in a detail specification	20
7.1	General	20
7.2	Outline drawing and dimensions	20
7.3	Mounting	21
7.4	Ratings and characteristics	21
7.4.1	General	21
7.4.2	Nominal capacitance range	21

7.4.3	Particular characteristics	21
7.4.4	Soldering	21
7.5	Marking.....	21
8	Quality assessment procedures	22
8.1	Primary stage of manufacture	22
8.2	Structurally similar components	22
8.3	Certified test records of released lots.....	22
8.4	Qualification approval procedures.....	22
8.4.1	General	22
8.4.2	Qualification approval on the basis of the fixed sample size procedure	22
Annex A (normative) Quality conformance inspection.....		37
A.1	Formation of inspection lots	37
A.1.1	Groups A and B inspection	37
A.1.2	Group C inspection	37
A.2	Test schedule	37
A.3	Delayed delivery	37
A.4	Assessment levels	37
Annex X (informative) Cross-references to the previous edition of this document.....		45
Bibliography.....		46
Table 1 – Percentage limit of the rated voltage at AC voltage frequency		10
Table 2 – Test voltages.....		12
Table 3 – Tangent of loss angle limits.....		13
Table 4 – Requirements regarding insulation resistance		14
Table 5 – Correction factor dependent on test temperature.....		14
Table 6 – Endurance test conditions for Grade 1 and Grade 2 capacitors		18
Table 7 – Endurance test conditions for Grade 3 capacitors.....		18
Table 8 – Test and sampling plan for qualification approval Assessment level EZ.....		24
Table 9 – Test schedule for qualification approval.....		25
Table A.1 – Lot-by-lot inspection.....		38
Table A.2 – Periodic tests inspection		40
Table X.1 – Cross-reference		45

iTeh Standards

(<https://standards.itih.ai>)

Document Preview

IEC 60384-23:2023

<https://standards.itih.ai/catalog/standards/iec/85/iec-60384-23-406f8ee0-6ccdd2d4538b/iec-60384-23-2023>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –**Part 23: Sectional specification –
Fixed metallized polyethylene naphthalate film
dielectric surface mount DC capacitors**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60384-23:2015. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 60384-23 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment. It is an International Standard.

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) this edition includes the following significant technical changes with respect to the previous edition: revision of all parts of the document based on the ISO/IEC Directives, Part 2:2021, 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;
- d) in Subclause 5.2 (Mounting), the Subclauses 5.2.1, 5.2.2 and 5.2.3 have been added;
- e) in Subclause 5.5 (Shear test), the Subclauses 5.5.1 and 5.5.2 have been added;
- f) in Subclause 5.14 (Component solvent resistance), the Subclauses 5.14.1 and 5.14.2 have been added. In Table 8 and Table A.2, test 5.14 has been moved before 5.7.5 (Final inspections and requirements) in Group 1A and in Subgroup C1;
- g) In Subclause 5.15 (Solvent resistance of marking), the Subclauses 5.15.1 and 5.15.2 have been added;
- h) tangent of loss angle measurement has been added to the resistance to soldering heat test;
- i) lot-by-lot and periodical inspection tables including requirements have been moved to Annex A;
- j) revised Inspection Level (IL) of A1 subgroup.

The text of this International Standard is based on the following documents:

Draft	Report on voting
40/2983/FDIS	40/3019/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.

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 web site.

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. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under 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.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

[IEC 60384-23:2023](https://standards.iteh.ai/catalog/standards/iec/8b26e96a-c24e-496f-8ee0-6ccdd2d4538b/iec-60384-23-2023)

<https://standards.iteh.ai/catalog/standards/iec/8b26e96a-c24e-496f-8ee0-6ccdd2d4538b/iec-60384-23-2023>

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 23: Sectional specification – Fixed metallized polyethylene naphthalate film dielectric surface mount DC capacitors

~~1~~ **General**

1 Scope

This part of IEC 60384 is applicable to fixed surface mount capacitors for direct current, with metallized electrodes and polyethylene naphthalate dielectric for use in electronic equipment. These capacitors have metallized connecting pads or soldering strips and are intended to be mounted directly onto printed boards or onto substrates for hybrid circuits. These capacitors ~~may~~ can have "self-healing properties" depending on conditions of use. They are primarily intended for applications where the AC component is small with respect to the rated voltage.

~~Capacitors for radio interference suppression are not included, they are covered by IEC 60384-14.~~

~~1.2~~ **Object**

~~The object of this standard is to prescribe~~ This part of IEC 60384 specifies preferred ratings and characteristics, selects from IEC 60384-1:2021 the appropriate quality assessment procedures, tests and measuring methods and gives general performance requirements for this type of capacitor. Test severities and requirements ~~prescribed~~ specified in detail specifications referring to this sectional specification ~~shall be~~ are of an equal or higher performance level. Lower performance levels are not permitted.

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

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 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 60384-1:2008/2021, *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 of IEC 60384-1:2008/2021, and the following apply.

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

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

3.1

~~performance~~ grade 1 capacitors

<long-life> capacitors for long-life applications with stringent requirements for the electrical parameters

3.2

~~performance~~ grade 2 capacitors

<general purpose> capacitors for general applications for which the stringent requirements for grade 1 capacitors are not necessary

3.3

~~performance~~ grade 3 capacitors

<low temperature, miniature type> miniature type capacitors having a rated temperature of 85°C and for which less stringent requirements than for grade 2 capacitors are acceptable

4 Preferred ratings and characteristics

4.1 Preferred ~~characteristics~~ climatic categories

The values given in detail specifications ~~shall preferably~~ should be selected from the following.

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

The lower and upper category temperature 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 (only grade 3), +100 °C, +125 °C and +155 °C.

Duration of the damp heat, steady state test: ~~4, 10,~~ 21 days and 56 days.

~~With continuous operation at 125 °C in excess of the endurance test time, accelerated ageing has to be considered (see detail specification).~~

At continuous operation at 155 °C beyond the endurance test time, accelerated ageing shall be carried out (see detail specification).

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

4.2 Preferred values of ratings

4.2.1 Nominal capacitance (C_N)

Preferred values of nominal capacitance shall be taken from the E6 series of IEC 60063:

1,0 – 1,5 – 2,2 – 3,3 – 4,7 and 6,8 and their decimal multiples ($\times 10^n$, $n = \text{integer}$).

If other values are required, they ~~shall preferably~~ should be chosen from the E12 series.

4.2.2 Tolerance on nominal capacitance

The preferred tolerances on the nominal capacitance are $\pm 5\%$, $\pm 10\%$ and $\pm 20\%$.

4.2.3 Rated voltage (U_R)

The preferred values of rated voltage shall be taken from R10 series of ISO 3 are:

1,0 – 1,6 – 2,5 – 4,0 – 5,0 – 6,3 and their decimal multiples ($\times 10^n$, n : integer).

The sum of the DC voltage and the peak AC voltage applied to the capacitor ~~should~~ shall not exceed the rated voltage.

The value of the peak AC voltage ~~should~~ shall not exceed the percentages of the rated voltage at the frequencies stated in Table 1 and should not be greater than 280 V, unless otherwise specified in the detail specification.

Table 1 – Percentage limit of the rated voltage at AC voltage frequency

AC voltage frequency	Percentage limit of the rated voltage
Hz	%
50	20
100	15
1 000	3
10 000	1

4.2.4 Category voltage (U_C)

The category voltage for Grade 1 and Grade 2 capacitors is:

- for upper category temperature 125 °C: $0,8 U_R$;
- for upper category temperature 155 °C: $0,5 U_R$.

The category voltage for Grade 3 capacitors is:

- for upper category temperature 100 °C: $0,8 U_R$;
- for upper category temperature 125 °C: $0,5 U_R$.

4.2.5 Rated temperature

Grade 1 and Grade 2 capacitors

The standard value of rated temperature is 100 °C.

Grade 3 capacitors

The standard value of rated temperature is 85 °C.

5 Test and measurement procedures

5.1 General

This Clause 5 supplements the information given in the relevant clauses of IEC 60384-1:20082021.

5.2 Mounting

5.2.1 Initial inspections

The capacitance shall be measured in accordance with 5.4.2.

The tangent of loss angle shall be measured in accordance with 5.4.3.

5.2.2 Mounting method

See IEC 60384-1:20082021, 5.5.

5.2.3 Final inspections after mounting

After recovery, the capacitors shall be visually examined and measured and shall meet the requirements given in Table 9.

The measurement values are used as initial inspection values in subgroups 3.1, 3.2, 3.3 and 3.4 in Table 8 and in subgroups C3.1, C3.2, C3.3 and C3.4 in Table A.2.

5.3 Visual examination and check of dimensions

5.3.1 General

See IEC 60384-1:20082021, 7.1 with the details of 5.3.2 and 5.3.3.

5.3.2 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.

5.3.3 Requirements

The capacitors shall be examined to verify that the materials, design, construction, physical dimensions and workmanship are in accordance with the applicable requirements given in the detail specification.

5.4 Electrical tests

5.4.1 Voltage proof

5.4.1.1 General

See IEC 60384-1:20082021, 6.2 with the details of 5.4.1.2, 5.4.1.3 and 5.4.1.4.

5.4.1.2 Test circuit

Delete the capacitor C_1 .

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.

5.4.1.3 Test conditions

The voltages given in Table 2 shall be applied between terminals, the measuring points 1a) of IEC 60384-1:20082021, Table 3, for a duration of 1 min for qualification approval testing and for a duration of 1 s for the lot-by-lot quality conformance testing.

Table 2 – Test voltages

Measuring point	Test voltage
1a)	Grade 1: 1,6 U_R
	Grade 2: 1,4 U_R
	Grade 3: 1,4 U_R

5.4.1.4 Requirements

There shall be no breakdown or flashover during the test.

NOTE The occurrence of self-healing breakdowns during the application of the test voltages is allowed.

5.4.2 Capacitance

5.4.2.1 General

See IEC 60384-1:20082021, 6.3 with the details of 5.4.2.2 and 5.4.2.3.

5.4.2.2 Measuring conditions

The capacitance shall be measured at, or corrected to, a frequency of 1 kHz. For nominal capacitance values > 10 μ F, 50 Hz to 120 Hz may be used.

The applied peak voltage at 1 kHz shall not exceed 3 % of the rated voltage, and the applied peak voltage at 50 Hz to 120 Hz shall not exceed 20 % of the rated voltage with a maximum of 100 V (70 V RMS).

5.4.2.3 Requirements

The capacitance shall be within the specified tolerance.

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

5.4.3.1 General

See IEC 60384-1:20082021, 6.4 with the details of 5.4.3.2, 5.4.3.3, 5.4.3.4 and 5.4.3.5.