

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Fixed capacitors for use in electronic equipment –
Part 16: Sectional specification – Fixed metallized polypropylene film dielectric
DC capacitors**

**Condensateurs fixes utilisés dans les équipements électroniques –
Partie 16: Spécification intermédiaire – Condensateurs fixes pour courant
continu à diélectrique en film de polypropylène métallisé**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2019 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.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
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 It also gives information on projects, replaced and withdrawn publications.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.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Fixed capacitors for use in electronic equipment –
Part 16: Sectional specification – Fixed metallized polypropylene film dielectric
DC capacitors**

**Condensateurs fixes utilisés dans les équipements électroniques –
Partie 16: Spécification intermédiaire – Condensateurs fixes pour courant
continu à diélectrique en film de polypropylène métallisé**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.060.30

ISBN 978-2-8322-7334-0

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	6
1 General	8
1.1 Scope	8
1.2 Object.....	8
1.3 Normative references.....	8
1.4 Information to be given in a detail specification.....	9
1.4.1 General	9
1.4.2 Outline drawing and dimensions	9
1.4.3 Mounting	9
1.4.4 Ratings and characteristics.....	10
1.4.5 Marking	10
1.5 Terms and definitions.....	10
1.6 Marking.....	11
1.6.1 General	11
1.6.2 Information for marking.....	11
1.6.3 Marking on capacitors.....	11
1.6.4 Marking on packaging.....	11
2 Preferred ratings and characteristics	12
2.1 Preferred characteristics	12
2.2 Preferred values of ratings.....	12
2.2.1 Nominal capacitance (C_N).....	12
2.2.2 Tolerances on nominal capacitance	12
2.2.3 Nominal capacitance with associated tolerance values	12
2.2.4 Rated voltage (U_R)	12
2.2.5 Category voltage (U_C).....	13
2.2.6 Rated temperature.....	13
3 Quality assessment procedures	13
3.1 Primary stage of manufacture	13
3.2 Structurally similar components	13
3.3 Certified records of released lots	13
3.4 Qualification approval procedures.....	13
3.4.1 General	13
3.4.2 Qualification approval on the basis of the fixed sample size procedures	13
3.5 Quality conformance inspection	20
3.5.1 Formation of inspection lots.....	20
3.5.2 Test schedule	21
3.5.3 Delayed delivery.....	21
3.5.4 Assessment levels	21
4 Test and measurement procedures.....	22
4.1 Visual examination and check of dimensions	22
4.1.1 General	22
4.1.2 Test conditions	22
4.1.3 Requirements	22
4.2 Electrical tests	22
4.2.1 Voltage proof.....	22
4.2.2 Capacitance	23
4.2.3 Tangent of loss angle ($\tan \delta$)	23

4.2.4	Insulation resistance	24
4.2.5	Inductance (if required).....	26
4.2.6	Characteristics depending on temperature (if required).....	26
4.3	Robustness of terminations.....	27
4.3.1	General	27
4.3.2	Initial inspections.....	27
4.3.3	Test method	27
4.3.4	Final inspections.....	27
4.4	Resistance to soldering heat.....	27
4.4.1	General	27
4.4.2	Preconditioning.....	27
4.4.3	Test conditions	27
4.4.4	Final inspections.....	27
4.5	Solderability.....	27
4.5.1	General	27
4.5.2	Preconditioning.....	28
4.5.3	Test conditions	28
4.5.4	Final inspections.....	28
4.6	Rapid change of temperature	28
4.6.1	General	28
4.6.2	Initial inspections.....	28
4.6.3	Test conditions	28
4.6.4	Recovery (if required)	28
4.6.5	Final inspections.....	28
4.7	Vibration	28
4.7.1	General	28
4.7.2	Mounting	28
4.7.3	Test conditions	28
4.7.4	Final inspections.....	29
4.8	Bump (if required).....	29
4.8.1	General	29
4.8.2	Mounting	29
4.8.3	Initial inspections.....	29
4.8.4	Test conditions	29
4.8.5	Final inspections.....	29
4.9	Shock (if required)	29
4.9.1	General	29
4.9.2	Mounting	29
4.9.3	Initial inspections.....	30
4.9.4	Test conditions	30
4.9.5	Final inspections.....	30
4.10	Climatic sequence.....	30
4.10.1	General	30
4.10.2	Initial inspections.....	30
4.10.3	Dry heat	30
4.10.4	Damp heat, cyclic, Test Db, first cycle	30
4.10.5	Cold.....	30
4.10.6	Low air pressure (if required).....	30
4.10.7	Damp heat, cyclic, Test Db, remaining cycles	31

4.11	Damp heat, steady state	31
4.11.1	General	31
4.11.2	Initial inspections	31
4.11.3	Test conditions	31
4.11.4	Recovery (if required)	31
4.11.5	Final inspections.....	32
4.11.6	Humidity robustness grades.....	32
4.12	Endurance	32
4.12.1	General	32
4.12.2	Initial inspections.....	32
4.12.3	Test conditions	32
4.12.4	Recovery	32
4.12.5	Final inspections.....	32
4.13	Charge and discharge.....	32
4.13.1	General	32
4.13.2	Initial inspections.....	32
4.13.3	Test conditions	33
4.13.4	Recovery (if required)	34
4.13.5	Final inspections.....	34
4.14	Component solvent resistance	34
4.15	Solvent resistance of the marking	34
4.16	Sealing	34
Annex A (normative)	Humidity robustness grades for applications, where high stability under high humidity operating conditions is required.....	35
A.1	Scope	35
A.2	Humidity robustness grades	35
A.2.1	Standard.....	35
A.2.2	Grade (I) robustness under humidity	35
A.2.3	Grade (II) robustness under high humidity	35
A.2.4	Grade (III) high robustness under high humidity.....	35
A.3	Indication of humidity robustness grades	36
Bibliography	37
Table 1	– Preferred values.....	11
Table 2	– Preferred combinations of capacitance value series and tolerances	12
Table 3	– Sampling plan for qualification approval tests, assessment level EZ.....	15
Table 4	– Test schedule for qualification approval.....	16
Table 5	– Lot-by-lot inspection	21
Table 6	– Periodic inspection	22
Table 7	– Combinations of test point and test voltage	23
Table 8	– Tangent of loss angle limits, 1 kHz	24
Table 9	– Tangent of loss angle limits, 10 kHz	24
Table 10	– Insulation resistance requirements	25

Table 11 – Temperature coefficient factors 25

Table 12 – Characteristics at lower category temperature 26

Table 13 – Characteristics at upper category temperature 27

Table 14 – Preferred severities 30

Table 15 – Test conditions 32

Table 16 – Lead spacing 33

INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –**Part 16: Sectional specification –
Fixed metallized polypropylene film dielectric 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.

International Standard IEC 60384-16 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 2005. 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: 2016 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.

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

FDIS	Report on voting
40/2686/FDIS	40/2691/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.

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 16: Sectional specification – Fixed metallized polypropylene film dielectric DC capacitors

1 General

1.1 Scope

This part of IEC 60384 applies to fixed capacitors with metallized electrodes and polypropylene dielectric for use in electronic equipment.

These capacitors can have "self-healing properties" depending on conditions of use. They are mainly intended for use with direct voltage.

The maximum power to be applied is 500 var at 50 Hz and the maximum peak voltage is 2 500 V.

The following two grades are covered;

- a) Grade 1: for long-life application;
- b) Grade 2: for general application.

Capacitors for alternating voltage and pulse applications are not included, but are covered by IEC 60384-17.

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

Capacitors for electrical shock hazard protection (covered by IEC 60065) and fluorescent lamp and motor capacitors are also excluded.

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 are of equal or higher performance level, because lower performance levels are not permitted.

1.3 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 60384-1:2016, *Fixed capacitors for use in electronic equipment – Part 1: Generic specification*