

Fixed inductors for electromagnetic interference
suppression - Part 1: Generic specification

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN IEC 60938-1:2021 sisaldab Euroopa standardi EN IEC 60938-1:2021 ingliskeelset teksti.	This Estonian standard EVS-EN IEC 60938-1:2021 consists of the English text of the European standard EN IEC 60938-1:2021.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 06.08.2021.	Date of Availability of the European standard is 06.08.2021.
Standard on kättesaadav Eesti Standardimis- ja Akrediteerimiskeskusest.	The standard is available from the Estonian Centre for Standardisation and Accreditation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 29.100.10, 31.020

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardimis- ja Akrediteerimiskeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardimis- ja Akrediteerimiskeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardimis- ja Akrediteerimiskeskusega: Koduleht www.evs.ee; telefon 605 5050; e-post info@evs.ee

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation and Accreditation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation and Accreditation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation and Accreditation:

Homepage www.evs.ee; phone +372 605 5050; e-mail info@evs.ee

English Version

**Fixed inductors for electromagnetic interference suppression -
Part 1: Generic specification
(IEC 60938-1:2021)**

Inductances fixes d'antiparasitage - Partie 1: Spécification
générique
(IEC 60938-1:2021)

Drosseln zur Unterdrückung elektromagnetischer
Störungen - Teil 1: Fachgrundspezifikation
(IEC 60938-1:2021)

This European Standard was approved by CENELEC on 2021-07-21. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 40/2834/FDIS, future edition 3 of IEC 60938-1, prepared by IEC/TC 40 "Capacitors and resistors for electronic equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60938-1:2021.

The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2022-04-21 level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the (dow) 2024-07-21 document have to be withdrawn

This document supersedes EN 60938-1:1999 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

The text of the International Standard IEC 60938-1:2021 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 61558-1 NOTE Harmonized as EN IEC 61558-1

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60027	series	Letter symbols to be used in electrical technology	EN IEC 60027	series
IEC 60050	series	International electrotechnical vocabulary (IEV)		
IEC 60060-1	-	High-voltage test techniques - Part 1: General definitions and test requirements	EN 60060-1	-
IEC 60062	-	Marking codes for resistors and capacitors	EN 60062	-
IEC 60068-1	-	Environmental testing - Part 1: General and guidance	EN 60068-1	-
IEC 60068-2-1	-	Environmental testing - Part 2-1: Tests Test A: Cold	EN 60068-2-1	-
IEC 60068-2-2	-	Environmental testing - Part 2-2: Tests Test B: Dry heat	EN 60068-2-2	-
IEC 60068-2-6	-	Environmental testing - Part 2-6: Tests Test Fc: Vibration (sinusoidal)	EN 60068-2-6	-
IEC 60068-2-13	-	Environmental testing - Part 2-13: Tests Test M: Low air pressure	EN IEC 60068-2-13	-
IEC 60068-2-14	-	Environmental testing - Part 2-14: Tests Test N: Change of temperature	EN 60068-2-14	-
IEC 60068-2-17	-	Basic environmental testing procedures Part 2-17: Tests - Test Q: Sealing	EN 60068-2-17	-
IEC 60068-2-20	-	Environmental testing - Part 2-20: Tests Test T: Test methods for solderability and resistance to soldering heat of devices with leads	EN IEC 60068-2-20	-
IEC 60068-2-21	-	Environmental testing - Part 2-21: Tests Test U: Robustness of terminations and integral mounting devices	EN 60068-2-21	-
IEC 60068-2-27	-	Environmental testing - Part 2-27: Tests Test Ea and guidance: Shock	EN 60068-2-27	-

IEC 60068-2-30	-	Environmental testing - Part 2-30: Tests -EN 60068-2-30 Test Db: Damp heat, cyclic	-
IEC 60068-2-45	-	Basic environmental testing procedures -EN 60068-2-45 Part 2-45: Tests - Test XA and guidance: Immersion in cleaning solvents	-
IEC 60068-2-58	-	Environmental testing - Part 2-58: Tests -EN 60068-2-58 Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)	-
IEC 60068-2-78	-	Environmental testing - Part 2-78: Tests -EN 60068-2-78 Test Cab: Damp heat, steady-state	-
IEC 60335-1	-	Household and similar electrical appliances- - Part 1: General requirements	-
IEC 60617	-	Graphical symbols for diagrams	-
IEC 60695-2-11	-	Fire hazard testing - Part 2-11:EN 60695-2-11 Glowing/hot-wire based test methods - Glow-wire flammability test method for end products (GWEPT)	-
IEC 60695-2-12	-	Fire hazard testing - Part 2-12:EN 60695-2-12 Glowing/hot-wire based test methods - Glow-wire flammability index (GWFI) test method for materials	-
IEC 60695-2-13	-	Fire hazard testing - Part 2-13:EN 60695-2-13 Glowing/hot-wire based test methods - Glow-wire ignition temperature (GWIT) test method for materials	-
IEC 60695-10-2	-	Fire hazard testing - Part 10-2: AbnormalEN 60695-10-2 heat - Ball pressure test method	-
IEC 60695-11-10	-	Fire hazard testing - Part 11-10: TestEN 60695-11-10 flames - 50 W horizontal and vertical flame test methods	-
IEC 60695-11-20	-	Fire hazard testing - Part 11-20: TestEN 60695-11-20 flames - 500 W flame test method	-
IEC 80000-6	-	Quantities and units - Part 6:EN 80000-6 Electromagnetism	-
CISPR 17	-	Methods of measurement of theEN 55017 suppression characteristics of passive EMC filtering devices	-

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Fixed inductors for electromagnetic interference suppression –
Part 1: Generic specification**

**Inductances fixes d'antiparasitage –
Partie 1: Spécification générique**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2021 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.

IEC online collection - oc.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 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

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.

IEC online collection - oc.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

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.

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Fixed inductors for electromagnetic interference suppression –
Part 1: Generic specification**

**Inductances fixes d'antiparasitage –
Partie 1: Spécification générique**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.100.10; 31.020

ISBN 978-2-8322-9883-1

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.....	4
INTRODUCTION.....	6
1 Scope.....	8
2 Normative references	8
3 Terms, definitions and conventions.....	9
3.1 Terms and definitions.....	9
3.2 Conventions.....	11
4 General requirements	11
4.1 General.....	11
4.2 Preferred values	12
4.2.1 General	12
4.2.2 Rated current.....	12
4.2.3 Temperature de-rated current	12
4.3 Information to be given in a detail specification	12
4.3.1 General	12
4.3.2 Outline drawing and dimensions	12
4.3.3 Mounting	13
4.3.4 Ratings and characteristics.....	13
4.4 Insulated inductors.....	13
4.5 Marking.....	13
5 Tests and measurement procedures	14
5.1 General.....	14
5.2 Standard atmospheric conditions	14
5.3 Visual examination.....	14
5.4 Insulation resistance	14
5.5 Voltage test	15
5.6 Inductance	16
5.7 Resistance.....	16
5.8 Insertion loss	16
5.9 Temperature rise	16
5.10 Impulse voltage.....	16
5.11 Endurance	17
5.12 Robustness of terminations.....	17
5.13 Vibration	17
5.14 Shock	17
5.15 Resistance to soldering heat.....	18
5.16 Solderability.....	20
5.16.1 General	20
5.16.2 Preconditioning.....	20
5.16.3 Test procedure	21
5.16.4 Final inspection, measurements, and requirements.....	21
5.17 Rapid change of temperature	21
5.18 Container sealing.....	21
5.19 Climatic sequence.....	21
5.19.1 General	21
5.19.2 Dry heat	21

5.19.3	Damp heat, cyclic, test Db, first cycle	22
5.19.4	Cold.....	22
5.19.5	Low air pressure	22
5.19.6	Damp heat, cyclic, test Db, remaining cycles	22
5.20	Damp heat, steady state	23
5.21	Passive flammability	23
5.22	Glow wire.....	23
5.23	Ball pressure.....	23
5.24	Component solvent resistance	23
5.25	Solvent resistance of marking	24
Annex A (normative)	Measuring points for electrical tests and measurements.....	25
A.1	General.....	25
A.2	Foil method.....	25
A.3	Method for inductors with mounting devices	25
A.4	V-block method.....	26
Annex B (normative)	Requirements for earth inductors	27
Annex C (normative)	Example of a suitable circuit for the voltage endurance test	28
Annex X (informative)	Cross-references to the previous edition of this document.....	29
Bibliography		31
Figure 1	– Relevant specification	7
Figure 2	– Relation between ambient temperature and applied current	12
Figure 3	– Temperature profile for reflow simulation.....	19
Figure A.1	– Examples how to connect electrical tests	26
Figure C.1	– Test circuit for endurance voltage	28
Table 1	– Standard atmospheric conditions.....	14
Table 2	– Measuring voltage for insulation resistance testing.....	15
Table 3	– Temperatures for reflow simulation with different solder paste alloy types	20
Table 4	– Number of remaining cycles for damp heat.....	22
Table A.1	– Measuring points for electrical tests	25
Table B.1	– Minimum copper cross-sectional area of earth inductor's winding	27

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIXED INDUCTORS FOR ELECTROMAGNETIC
INTERFERENCE SUPPRESSION –****Part 1: Generic specification****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.

IEC 60938-1 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 1999. This edition constitutes a technical revision.

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

- a) material tests added;
- b) improved readability and clear separation between test descriptions in the generic spec and requirements in the sectional specification;
- c) creepage and clearance requirements are now defined in sectional specifications only;
- d) AC testing for voltage test included.

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

FDIS	Report on voting
40/2834/FDIS	40/2851/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 60938 series, published under the general title *Fixed inductors for electromagnetic interference suppression*, 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. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/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.

INTRODUCTION

The specification system for fixed inductors for electromagnetic interference suppression is structured in a hierarchical system consisting of the following specification types.

Generic specification

The generic specification covers all subjects mainly common to the family of fixed inductors for electromagnetic interference suppression, such as terminology, methods of measurement and tests. Where the individual subjects require the prescription conditions or parameters specific to the particular sub-family or type of inductor, such prescriptions are required to be given by one of the subordinate specifications.

For the scope of fixed inductors, the numeric reference to the generic specification is IEC 60938-1.

Sectional specification

Sectional specifications cover all subjects additional to those given in the generic specification, which are specific to a defined sub-group of fixed inductors for electromagnetic interference suppression. These subjects normally are preferred values for dimensions and characteristics, relevant prescriptions for test methods given in the generic specification, prescriptions for sampling and for the preparation of specimen, recommended test severities and preferred acceptance criteria. The sectional specification also outlines the structure and scope of the test schedules, which are to be applied in all subordinate detail specifications.

For the scope of fixed inductors for electromagnetic interference suppression, the numeric reference to the only sectional specification is 60938-2 for line chokes.

Detail specification

Detail specifications give directly, or by making reference to other specifications, all information necessary to completely describe a given type and range of fixed inductors for electromagnetic interference suppression, including prescriptions of all values for dimensions and characteristics. They also give all information required for all applied test severities and acceptance criteria, and the completed test schedules.

Detail specifications can be either specifications within the IEC system, another specification system linked to IEC, or specified by the manufacturer or user.

Blank detail specification

The hierarchical system of specifications can be supplemented by one or more blank detail specifications to a sectional specification, which are used to ensure a uniform presentation of detail specifications. The blank detail specifications provide the specification writer with a template on the layout to be adopted and on the information to be given and with guidance for the preparation of detail specifications in line with the requirements of the superior generic or sectional specifications. Blank detail specifications are not considered to be relevant specifications since they do not themselves describe any particular component.

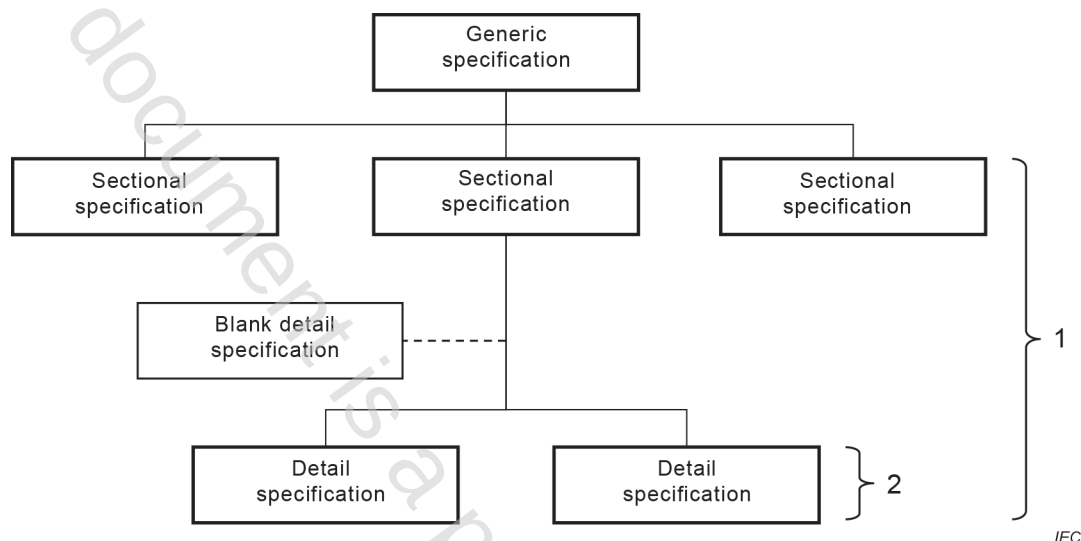
The presence of an established hierarchical specification system with blank detail specifications permits the preparation of detail specifications, even outside of the relevant IEC technical committee.

For the scope of fixed inductors for electromagnetic interference suppression, the numeric references to blank detail specifications are, for example, IEC 60938-2-1, if related to the sectional specification IEC 60938-2.

Relevant specification

In this system, the term "relevant specification" addresses subordinate specifications containing specific requirements, where applicable (see Figure 1).

Any generic or sectional specification can use abstract and universal references to subordinate specifications of either hierarchical level by use of the expression "relevant specification".



Key

- 1) Indicates the range of "relevant specifications" to the superior generic specification, where applicable.
- 2) Indicates the range of "relevant specifications" to the superior sectional specification, where applicable.

Figure 1 – Relevant specification