



BSI Standards Publication

Semiconductor devices

Part 16-8: Microwave integrated circuits — Limiters

National foreword

This British Standard is the UK implementation of EN 60747-16-8:2023. It is identical to IEC 60747-16-8:2022.

The UK participation in its preparation was entrusted to Technical Committee EPL/47, Semiconductors.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

This publication has been prepared under a mandate given to the European Standards Organizations by the European Commission and the European Free Trade Association. It is intended to support requirements of the EU legislation detailed in the European Foreword. A European Annex, usually Annex ZA or ZZ, describes how this publication relates to that EU legislation.

For the Great Britain market (England, Scotland and Wales), if UK Government has designated this publication for conformity with UKCA marking (or similar) legislation, it may contain an additional National Annex. Where such a National Annex exists, it shows the correlation between this publication and the relevant UK legislation. If there is no National Annex of this kind, the relevant Annex ZA or ZZ in the body of the European text will indicate the relationship to UK regulation applicable in Great Britain. References to EU legislation may need to be read in accordance with the UK designation and the applicable UK law. Further information on designated standards can be found at www.bsigroup.com/standardsandregulation.

For the Northern Ireland market, UK law will continue to implement relevant EU law subject to periodic confirmation. Therefore Annex ZA/ZZ in the European text, and references to EU legislation, are still valid for this market.

UK Government is responsible for legislation. For information on legislation and policies relating to that legislation, consult the relevant pages of www.gov.uk.

© The British Standards Institution 2023
Published by BSI Standards Limited 2023

ISBN 978 0 539 13178 9

ICS 31.080.99; 31.200

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2023.

Amendments/corrigenda issued since publication

Date

Text affected

English Version

Semiconductor devices - Part 16-8: Microwave integrated
circuits - Limiters
(IEC 60747-16-8:2022)

Dispositifs à semiconducteurs - Partie 16-8: Circuits
intégrés hyperfréquences - Limiteurs
(IEC 60747-16-8:2022)

Halbleiterbauelemente - Teil 16-8: Integrierte Mikrowellen-
Verstärker - Schaltungsbegrenzer
(IEC 60747-16-8:2022)

This European Standard was approved by CENELEC on 2023-01-03. 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, Türkiye 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 47E/793/FDIS, future edition 1 of IEC 60747-16-8, prepared by SC 47E "Discrete semiconductor devices" of IEC/TC 47 "Semiconductor devices" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60747-16-8:2023.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2023-10-03
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2026-01-03

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 60747-16-8:2022 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standard indicated:

IEC 60747-16-1:2001	NOTE Harmonized as EN 60747-16-1:2002 (not modified)
IEC 60747-16-1:2001/AMD1:2007	NOTE Harmonized as EN 60747-16-1:2002/A1:2007 (not modified)
IEC 60747-16-1:2001/AMD2:2017	NOTE Harmonized as EN 60747-16-1:2002/A2:2017 (not modified)
IEC 60747-16-4:2004	NOTE Harmonized as EN 60747-16-4:2004 (not modified)
IEC 60747-16-4:2004/AMD1:2009	NOTE Harmonized as EN 60747-16-4:2004/A1:2011 (not modified)
IEC 60747-16-4:2004/AMD2:2017	NOTE Harmonized as EN 60747-16-4:2004/A2:2017 (not modified)
IEC 60747-16-6:2019	NOTE Harmonized as EN IEC 60747-16-6:2019 (not modified)

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 60747-1	2006	Semiconductor devices - Part 1: General	-	-
+ A1	2010		-	-
IEC 60747-4	-	Semiconductor devices - Discrete devices -- Part 4: Microwave diodes and transistors		-
IEC 61340-5-1	-	Electrostatics - Part 5-1: Protection of electronic devices from electrostatic phenomena - General requirements	EN 61340-5-1	-
IEC/TR 61340-5-2	-	Electrostatics - Part 5-2: Protection of electronic devices from electrostatic phenomena - User guide	-	-

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Semiconductor devices –
Part 16-8: Microwave integrated circuits – Limiters**

**Dispositifs à semiconducteurs –
Partie 16-8: Circuits intégrés hyperfréquences – Limiteurs**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.080.99

ISBN 978-2-8322-6117-0

**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.....	5
1 Scope.....	7
2 Normative references	7
3 Terms and definitions	7
4 Essential ratings and characteristics.....	9
4.1 General requirements	9
4.1.1 Circuit identification and types	9
4.1.2 General function description	9
4.1.3 Manufacturing technology	9
4.1.4 Package identification.....	9
4.1.5 Main application	9
4.2 Application description	10
4.2.1 Conformance to system and/or interface information	10
4.2.2 Overall block diagram	10
4.2.3 Reference data	10
4.2.4 Electrical compatibility	10
4.2.5 Associated devices	10
4.3 Specification of the function	10
4.3.1 Detailed block diagram – Functional blocks	10
4.3.2 Identification and function of terminals.....	11
4.3.3 Function description	11
4.4 Limiting values (absolute maximum rating system).....	12
4.4.1 Requirements	12
4.4.2 Electrical limiting values	12
4.4.3 Temperatures	13
4.5 Operating conditions (within the specified operating temperature range).....	13
4.6 Electrical characteristics	13
4.7 Mechanical and environmental ratings, characteristics and data	14
4.8 Additional information	14
5 Measuring methods	15
5.1 General.....	15
5.1.1 General precautions	15
5.1.2 Characteristic impedance	15
5.1.3 Handling precautions	15
5.1.4 Types	15
5.2 Insertion loss (L_{ins})	15
5.2.1 Purpose.....	15
5.2.2 Measuring methods	15
5.3 Input return loss ($L_{ret(in)}$)	18
5.3.1 Purpose.....	18
5.3.2 Measuring methods	19
5.4 Output return loss ($L_{ret(out)}$)	21
5.4.1 Purpose.....	21
5.4.2 Measuring methods	21
5.5 Input power at 1dB compression ($P_{i(1dB)}$) and output power at 1dB compression ($P_{o(1dB)}$)	22

5.5.1	Purpose	24
5.5.2	Circuit diagram	24
5.5.3	Principle of measurement	24
5.5.4	Circuit description and requirements	24
5.5.5	Precautions to be observed	24
5.5.6	Measurement procedure	24
5.5.7	Specified conditions	25
5.6	Intermodulation distortion (two-tone) (P_n/P_1)	25
5.6.1	Purpose	25
5.6.2	Circuit diagram	25
5.6.3	Principle of measurement	26
5.6.4	Circuit description and requirements	26
5.6.5	Precautions to be observed	26
5.6.6	Measurement procedure	27
5.6.7	Specified conditions	27
5.7	Power at the intercept point (for intermodulation products) ($P_n(IP)$)	27
5.7.1	Purpose	27
5.7.2	Circuit diagram	27
5.7.3	Principle of measurement	27
5.7.4	Circuit description and requirements	27
5.7.5	Precautions to be observed	27
5.7.6	Measurement procedure	28
5.7.7	Specified conditions	28
5.8	Leakage power for continuous wave ($P_{leak(cw)}$)	28
5.8.1	Purpose	28
5.8.2	Circuit diagram	28
5.8.3	Principle of measurement	29
5.8.4	Circuit description and requirements	29
5.8.5	Precautions to be observed	29
5.8.6	Measurement procedure	29
5.8.7	Specified conditions	30
5.9	Spike leakage power for pulse wave ($P_{leak(spike)}$) and flat leakage power for pulse wave ($P_{leak(flat)}$)	30
5.9.1	Purpose	30
5.9.2	Circuit diagram	30
5.9.3	Principle of measurement	30
5.9.4	Circuit description and requirements	30
5.9.5	Precautions to be observed	30
5.9.6	Measurement procedure	30
5.9.7	Specified conditions	31
5.10	Response time (t_{res})	31
5.10.1	Purpose	31
5.10.2	Circuit diagram	31
5.10.3	Principle of measurement	31
5.10.4	Circuit description and requirements	32
5.10.5	Precautions to be observed	32
5.10.6	Measurement procedure	32
5.10.7	Specified conditions	

5.11	Recovery time(t_{rec}).....	33
5.11.1	Purpose	33
5.11.2	Circuit diagram	33
5.11.3	Principle of measurement	33
5.11.4	Circuit description and requirements.....	34
5.11.5	Precautions to be observed	34
5.11.6	Measurement procedure	34
5.11.7	Specified conditions.....	35
	Bibliography.....	36
	Figure 1 – Circuit diagram for the measurement of the insertion loss (method 1)	16
	Figure 2 – Circuit diagram for the measurement of the scattering parameters	17
	Figure 3 – Circuit diagram for the measurement of the input return loss (method 1).....	19
	Figure 4 – Circuit diagram for the measurement of the output return loss (method 1).....	22
	Figure 5 – Circuit diagram for the measurement of intermodulation distortion	25
	Figure 6 – Circuit diagram for the measurement of output leakage power	29
	Figure 7 – Circuit diagram for the measurement of response time.....	31
	Figure 8 – Spike leakage voltage and flat leakage voltage vs. time	32
	Figure 9 – Circuit diagram for the measurement of recovery time.....	33
	Figure 10 – Pulse envelope and continuous wave envelope vs. Time.....	34
	Table 1 – Function of terminals	11
	Table 2 – Electrical limiting values	12
	Table 3 – Electrical limiting values in detail specification	13
	Table 4 – Temperatures	13
	Table 5 – Electrical characteristics.....	14

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SEMICONDUCTOR DEVICES –

**Part 16-8: Microwave integrated circuits –
Limiters**

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 60747-16-8 has been prepared by subcommittee 47E: Discrete semiconductor devices, of IEC technical committee 47: Semiconductor devices. It is an International Standard.

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

Draft	Report on voting
47E/793/FDIS	47E/799/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.

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.

A list of all parts in the IEC 60747 series, published under the general title *Semiconductor devices*, 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 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.

SEMICONDUCTOR DEVICES –

Part 16-8: Microwave integrated circuits – Limiters

1 Scope

This part of IEC 60747 specifies the terminology, essential ratings and characteristics, and measuring methods of microwave integrated circuit limiters.

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 60747-1:2006, *Semiconductor devices – Part 1: General*
IEC 60747-1:2006/AMD1:2010

IEC 60747-4, *Semiconductor devices – Discrete devices – Part 4: Microwave diodes and transistors*

IEC 61340-5-1, *Electrostatics – Part 5-1: Protection of electronic devices from electrostatic phenomena – General requirements*

IEC TR 61340-5-2, *Electrostatics – Part 5-2: Protection of electronic devices from electrostatic phenomena – User guide*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological 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

insertion loss

L_{ins}

ratio of the input power to the output power, in the linear region of the power transfer curve
 $P_o(\text{dBm}) = f(P_i)$

Note 1 to entry: In this region, $\Delta P_o(\text{dBm}) = \Delta P_i(\text{dBm})$.

Note 2 to entry: Usually the insertion loss is expressed in decibels.

[SOURCE: IEC 60747-16-4:2004/AMD 1:2009, 3.1, modified – “at the switched on port” has been deleted]