



SLOVENSKI STANDARD
SIST EN IEC 60747-16-7:2023

01-marec-2023

Polprevodniški elementi - 16-7. del: Mikrovalovna integrirana vezja - Blažilniki (IEC 60747-16-7:2022)

Semiconductor devices - Part 16-7: Microwave integrated circuits - Attenuators (IEC 60747-16-7:2022)

Halbleiterbauelemente - Teil 16-7: Integrierte Mikrowellenverstärker - Schaltdämpfer (IEC 60747-16-7:2022)

Dispositifs à semiconducteurs - Partie 16-7: Circuits intégrés hyperfréquences - Atténuateurs (IEC 60747-16-7:2022)

Ta slovenski standard je istoveten z: EN IEC 60747-16-7:2023

ICS:

31.080.01	Polprevodniški elementi (naprave) na splošno	Semiconductor devices in general
31.200	Integrirana vezja, mikroelektronika	Integrated circuits. Microelectronics

SIST EN IEC 60747-16-7:2023

en

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN IEC 60747-16-7

January 2023

ICS 31.080.99

English Version

**Semiconductor devices - Part 16-7: Microwave integrated
circuits - Attenuators
(IEC 60747-16-7:2022)**

Dispositifs à semiconducteurs - Partie 16-7: Circuits
intégrés hyperfréquences - Atténuateurs
(IEC 60747-16-7:2022)

Halbleiterbauelemente - Teil 16-7: Integrierte
Mikrowellenverstärker - Schalungsdämpfer
(IEC 60747-16-7:2022)

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

EN IEC 60747-16-7:2023 (E)**European foreword**

The text of document 47E/794/FDIS, future edition 1 of IEC 60747-16-7, 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 60747-16-7:2023.

The following dates are fixed:

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- latest date by which the national standards conflicting with the (dow) 2026-01-03 document have to be withdrawn

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 60747-16-7:2022 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 16-7: Microwave integrated circuits – Attenuators**

**Dispositifs à semiconducteurs –
Partie 16-7: Circuits intégrés hyperfréquences – Atténuateurs**

<https://standards.iteh.ai/catalog/standards/sist/980cbabe-8794-4888-b3ba-f46ab9d2cd8e/sist-en-iec-60747-16-7-2023>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.080.99

ISBN 978-2-8322-6116-3

**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.....	10
4.1 General requirements	10
4.1.1 Circuit identification and types	10
4.1.2 General function description	11
4.1.3 Manufacturing technology.....	11
4.1.4 Package identification.....	11
4.2 Application description	11
4.2.1 Conformance to system and/or interface information	11
4.2.2 Overall block diagram	11
4.2.3 Reference data	11
4.2.4 Electrical compatibility	11
4.2.5 Associated devices	12
4.3 Specification of the function	12
4.3.1 Detailed block diagram – Functional blocks	12
4.3.2 Identification and function of terminals.....	12
4.3.3 Function description	13
4.4 Limiting values (absolute maximum rating system).....	13
4.4.1 Requirements	13
4.4.2 Electrical limiting values	13
4.4.3 Temperatures	14
4.5 Operating conditions (within the specified operating temperature range).....	15
4.6 Electrical characteristics	15
4.7 Mechanical and environmental ratings, characteristics and data	15
4.8 Additional information	16
5 Measuring methods	16
5.1 General.....	16
5.1.1 General precautions	16
5.1.2 Characteristic impedance	16
5.1.3 Handling precautions	16
5.1.4 Types	16
5.2 Transmission loss (L_{trans}) and insertion loss (L_{ins}).....	17
5.2.1 Purpose.....	17
5.2.2 Measuring methods	17
5.3 Attenuation value (A_{att}).....	20
5.3.1 Purpose.....	20
5.3.2 Measuring methods	20
5.4 Attenuation range (A_{ran}).....	22
5.4.1 Purpose.....	22
5.4.2 Measuring methods	22
5.5 Attenuation accuracy (A_{aur}), Attenuation accuracy (RMS) ($A_{aur}(RMS)$).....	24
5.5.1 Purpose.....	24
5.5.2 Measuring methods	24

5.6	Input return loss ($L_{ret(in)}$)	26
5.6.1	Purpose	26
5.6.2	Measuring methods	26
5.7	Output return loss ($L_{ret(out)}$)	29
5.7.1	Purpose	29
5.7.2	Measuring methods	29
5.8	Input power at n dB compression ($P_{i(ndB)}$).....	31
5.8.1	Purpose	31
5.8.2	Circuit diagram	31
5.8.3	Principle of measurement	31
5.8.4	Circuit description and requirements.....	31
5.8.5	Precautions to be observed	31
5.8.6	Measurement procedure	31
5.8.7	Specified conditions.....	31
5.9	Intermodulation distortion (two-tone)(P_n/P_1)	32
5.9.1	Purpose	32
5.9.2	Circuit diagram	32
5.9.3	Principle of measurement	32
5.9.4	Circuit description and requirements.....	33
5.9.5	Precautions to be observed	33
5.9.6	Measurement procedure	33
5.9.7	Specified conditions.....	33
5.10	Power at the intercept point (for intermodulation products) ($P_n(IP)$)	34
5.10.1	Purpose	34
5.10.2	Circuit diagram	34
5.10.3	Principle of measurement	34
5.10.4	Circuit description and requirements.....	34
5.10.5	Precautions to be observed	34
5.10.6	Measurement procedure	34
5.10.7	Specified conditions.....	34
5.11	Relative phase shift (θ_{rel})	35
5.11.1	Purpose	35
5.11.2	Circuit diagram	35
5.11.3	Principle of measurement	35
5.11.4	Circuit description and requirements.....	35
5.11.5	Precautions to be observed	35
5.11.6	Measurement procedure	36
5.11.7	Specified conditions.....	36
5.12	Turn on time(t_{on}), turn off time(t_{off}), rise time($t_r(out)$), fall time($t_f(out)$)	36
5.12.1	Purpose	36
5.12.2	Circuit diagram	36
5.12.3	Principle of measurement	36
5.12.4	Circuit description and requirements.....	38
5.12.5	Precautions to be observed	38
5.12.6	Measurement procedure	38
5.12.7	Specified conditions.....	38
5.13	Control voltage sensitivity (S_{Vcont}).....	38

5.13.1	Purpose	38
5.13.2	Measuring methods	38
	Bibliography	41
	Figure 1 – Circuit diagram for the measurement of the transmission loss and insertion loss (method 1)	17
	Figure 2 – Circuit diagram for the measurement of the scattering parameters	19
	Figure 3 – Circuit diagram for the measurement of the return loss (method 1)	27
	Figure 4 – Circuit diagram for the measurement of intermodulation distortion	32
	Figure 5 – Circuit diagram for the measurement of response times and switching times	36
	Figure 6 – Input and output waveforms	37
	Table 1 – Function of terminals	12
	Table 2 – Electrical limiting values	14
	Table 3 – Electrical limiting values in detail specification	14
	Table 4 – Temperatures	14
	Table 5 – Electrical characteristics	15

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN IEC 60747-16-7:2023](https://standards.iteh.ai/catalog/standards/sist/980cbabe-8794-4888-b3ba-f46ab9d2cd8e/sist-en-iec-60747-16-7-2023)

<https://standards.iteh.ai/catalog/standards/sist/980cbabe-8794-4888-b3ba-f46ab9d2cd8e/sist-en-iec-60747-16-7-2023>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SEMICONDUCTOR DEVICES –

**Part 16-7: Microwave integrated circuits –
Attenuators**

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 60747-16-7 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/794/FDIS	47E/798/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.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN IEC 60747-16-7:2023](https://standards.iteh.ai/catalog/standards/sist/980cbabe-8794-4888-b3ba-f46ab9d2cd8e/sist-en-iec-60747-16-7-2023)

<https://standards.iteh.ai/catalog/standards/sist/980cbabe-8794-4888-b3ba-f46ab9d2cd8e/sist-en-iec-60747-16-7-2023>

SEMICONDUCTOR DEVICES –

Part 16-7: Microwave integrated circuits – Attenuators

1 Scope

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

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/AMD 1:2010

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

reference state

thru state

state of minimum attenuation

3.2

attenuation state

state in which the attenuation is greater than that in the reference state