SLOVENSKI STANDARD
oSIST prEN IEC 60747-16-9:2023

01-maj-2023

Polprevodniški elementi - 16-9. del: Mikrovalovna integrirana vezja - Fazni menjalniki

Semiconductor devices - Part 16-9: Microwave integrated circuits - Phase shifters

Ta slovenski standard je istoveten z: **prEN IEC 60747-16-9:2023**

ICS:

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

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47E/803/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: **IEC 60747-16-9 ED1**	
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IEC SC 47E : DISCRETE SEMICONDUCTOR DEVICES

SECRETARIAT: Korea, Republic of	SECRETARY: Mr Hojun Ryu
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.

FUNCTIONS CONCERNED:

☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY

☒ SUBMITTED FOR CENELEC PARALLEL VOTING **Attention IEC-CENELEC parallel voting** The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

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- any relevant patent rights of which they are aware and to provide supporting documentation,
- any relevant “in some countries” clauses to be included should this proposal proceed. Recipients are reminded that the enquiry stage is the final stage for submitting "in some countries" clauses. See AC/22/2007.

TITLE:

Semiconductor devices - Part 16-9: Microwave integrated circuits - Phase shifters

PROPOSED STABILITY DATE: 2028

NOTE FROM TC/SC OFFICERS:

All Observations of Secretariat were agreed in the WG2 online meetings held on 2022-05-18 and 2022-10-27

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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IEC 60747-16-9 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/XX/FDIS	47E/XX/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

185 be found on the IEC website.

186 The committee has decided that the contents of this document will remain unchanged until the
187 stability date indicated on the IEC website under webstore.iec.ch in the data related to the
188 specific document. At this date, the document will be

189 • reconfirmed,
190 • withdrawn,
191 • replaced by a revised edition, or
192 • amended.

SEMICONDUCTOR DEVICES

Part 16-9: Microwave integrated circuits – Phase shifters

1 Scope

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

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 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
reference state
state where the phase difference between input and output of the phase shifter is a particular value

Note 1 to entry: The condition for the reference state shall be specified.

Note 2 to entry: Though the phase difference at the reference state is usually maximum, median, or minimum value of all available phase differences of the phase shifter, the other value can be acceptable.

3.2
phase shift state
state except for the reference state

3.3
transmission loss
L_{trans}
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 transmission loss is expressed in decibels.

3.4
insertion loss
L_{ins}
ratio of the input power to the output power, in the linear region of the power transfer curve P_o(dBm)=f(P_i) in the reference state

Note 1 to entry: In this region, ΔP_o(dBm)=ΔP_i(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 and "in the reference state" has been added.]

3.5
phase shift value
S_{ph}
difference between the phase in the phase shift state and that in the reference state

3.6
phase shift range
R_{ph}
difference between the maximum and minimum phase among all phase shift states and reference state

3.7
phase shift accuracy
S_{acc}
difference between the measured and the nominal phase shift value

3.8
phase shift accuracy root mean square
$S_{acc(RMS)}$
root-mean-square value of the maximum differences between the measured and the nominal phase shift values

3.9
input return loss
$L_{ret(in)}$
ratio of the incident power at the input port to the reflected power at the input port

[SOURCE: IEC 60747-16-6:2019, 3.4]

3.10
output return loss
$L_{ret(out)}$
ratio of the incident power at the output port to the reflected power at the output port

[SOURCE: IEC 60747-16-6:2019, 3.5]

3.11
amplitude flatness
F_{amp}
difference between the maximum and minimum insertion loss value in working frequency range

3.12
transmission loss ripple
L_{rip}
difference between the maximum and minimum transmission loss value among all phase shift states

3.13
input power at 1 dB compression
$P_{i(1dB)}$
input power where the transmission loss increases by 1 dB compared with transmission loss in linear region

[SOURCE: IEC 60747-16-4:2004, 3.4]

3.14
intermodulation distortion
P_n / P_1
ratio of the *n*th order component of the output power to the fundamental component of the output power

Note 1 to entry: The abbreviation "IMD_n" is in common use for the *n*th order intermodulation distortion.

[SOURCE: IEC 60747-4:2007/AMD1:2017, 7.2.19]

3.15
power at the intercept point (for intermodulation products)
$P_{n(IP)}$
output power at intersection between the extrapolated output powers of the fundamental component and the nth order intermodulation components, when the extrapolation is carried out in a diagram showing the output power of the components (in decibels) as a function of the input power (in decibels)

[SOURCE: IEC 60747-16-1:2001, 3.8]

3.16
switching time

3.16.1
turn on time
t_{on}

interval between the lower reference point on the leading edge of the control voltage and the upper reference point on the leading edge of the envelope of output voltage in the linear region of the power transfer curve P_o(dBm)=f(P_i) when the state of phase shifter changes from the reference state to the phase shift state

Note 1 to entry: In this region, ΔP_o(dBm)=ΔP_i(dBm).

Note 2 to entry: Usually the reference is 50% of the amplitude.

[SOURCE: IEC 60747-16-4:2004, 3.6, modified — Note 2 to entry has been added]

3.16.2
turn off time
t_{off}
interval between the upper reference point on the trailing edge of the control voltage and the lower reference point on the trailing edge of the envelope of the output voltage in the linear region of the power transfer curve P_o(dBm)=f(P_i) when the state of phase shifter changes from the reference state to the phase shift state

Note 1 to entry: In this region, ΔP_o(dBm)=ΔP_i(dBm).

Note 2 to entry: Usually the reference is 50% of the amplitude.

[SOURCE: IEC 60747-16-4:2004, 3.7, modified — Note 2 to entry has been added]

4 Essential ratings and characteristics

4.1 General requirements

4.1.1 Circuit identification and types

The identification of type (device name), the category of circuit and technology applied shall be given.

Microwave phase shifters comprise two categories:

- Type A: Digital phase shifters ;
- Type B: Analog phase shifters.

4.1.2 General function description

A general description of the function performed by the microwave integrated circuit phase shifters and the features for the application shall be made.

4.1.3 Manufacturing technology

The manufacturing technology, e.g. semiconductor monolithic integrated circuit, thin film integrated circuit, micro-assembly, etc. shall be stated. This statement shall include details of the semiconductor technologies such as PIN diode, heterostructure field effect transistor (HFET), pseudomorphic high electronic mobility transistor(PHEMT), etc.

IEC 60747-4 shall be referred to for terminology and letter symbols, essential ratings and characteristics and measuring methods of such microwave devices.

4.1.4 Package identification

The following statements shall be made:

a) chip or packaged form;

b) IEC and/or national reference number of the outline drawing, or drawing of non-standard package including terminal numbering;

c) principal package material, for example, metal, ceramic, plastic.

4.2 Application description

4.2.1 Conformance to system and/or interface information

It should be stated whether the integrated circuit conforms to an application system and/or an interface standard or a recommendation.

Detailed information concerning application systems, equipment and circuits such as radar systems, communication systems, Wifi wireless network systems, etc. should also be given.

4.2.2 Overall block diagram

A block diagram of the applied systems should be given if necessary.

4.2.3 Reference data

The most important properties that permit comparison between derivative types should be given.

4.2.4 Electrical compatibility

It should be stated whether the integrated circuit is electrically compatible with other particular integrated circuits, or families of integrated circuits, or whether special interfaces are required.

Details should be given concerning the type of input and output circuits, e.g. input/output impedances, DC block, open-drain, etc. Interchangeability with other devices, if any, should also be given.

4.2.5 Associated devices

If applicable, the following should be stated:

- devices necessary for correct operation (list with type number, name and function);
- peripheral devices with direct interfacing (list with type number, name and function).

4.3 Specification of the function

4.3.1 Detailed block diagram – Functional blocks

A detail block diagram or equivalent circuit information of the integrated circuit microwave phase shifters shall be given. The block diagram shall be composed of the following: