

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

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

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

<https://standards.iteh.ai/catalog/standards/sist/5e572f3a-2513-45bd-9005-a18e90f6bdde/iec-60747-16-8-2022>



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IEC 60747-16-8

Edition 1.0 2022-11

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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 31.080.99

ISBN 978-2-8322-6117-0

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## SEMICONDUCTOR DEVICES –

Part 16-8: Microwave integrated circuits –  
Limiters

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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](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

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# 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]

### 3.2 input return loss

$L_{\text{ret(in)}}$

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]

### 3.3 output return loss

$L_{\text{ret(out)}}$

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]

### 3.4 input power at 1dB compression

$P_{i(1\text{dB})}$

input power where the insertion loss increases by 1 dB compared with insertion loss in linear region

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

### 3.5 output power at 1dB compression

$P_{o(1\text{dB})}$

output power where the insertion loss increases by 1 dB compared with insertion loss in linear region

[SOURCE: IEC 60747-16-4:2004, 3.5] IEC 60747-16-8:2022

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### 3.6 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]

### 3.7 power at the intercept point

$P_n(\text{IP})$

<for intermodulation products> output power at intersection between the extrapolated output powers of the fundamental component and the  $n$ <sup>th</sup> 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]

### 3.8 output leakage power

#### 3.8.1 leakage power for continuous wave

$P_{\text{leak(cw)}}$

output power at limiter off state

### 3.8.2 spike leakage power for pulse wave

$P_{\text{leak(spike)}}$

instantaneous maximum output power at pulsed input power

### 3.8.3 flat leakage power for pulse wave

$P_{\text{leak(flat)}}$

output power in constant region after pulse wave input

### 3.9 response time

$t_{\text{res}}$

interval between the starting time of leakage and the starting time of the constant output voltage region

### 3.10 recovery time

$t_{\text{rec}}$

time required for the insertion loss to recover within 3 dB after the large power input

## 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.

#### 4.1.2 General function description

A general description of the function performed by the microwave integrated circuit limiters 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 Schottky-barrier diode, PIN diode, transistor, 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.

#### 4.1.5 Main application

The main application should be stated, if necessary. If the device has restrictive applications, these should be stated here.

## 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 very small aperture terminal (VSAT) systems, broadcasting satellite (BS) receivers, microwave landing 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 limiters shall be given. The block diagram shall be composed of the following:

- a) functional blocks;
- b) mutual interconnections among the functional blocks;
- c) individual functional units within the functional blocks;
- d) mutual interconnections among the individual functional blocks;
- e) function of each external connection;
- f) inter-dependence between the separate functional blocks.

The block diagram shall identify the function of each external connection and, where no ambiguity can arise, also show the terminal symbols and/or numbers. If the encapsulation has metallic parts, any connection to them from external terminals shall be indicated. The connections with any associated external electrical elements shall be stated, where necessary.

As additional information, the complete electrical circuit diagram can be reproduced, but not necessarily with indications of the values of the circuit components. The graphical symbol for the function shall be given. Rules governing such diagrams can be obtained from IEC 60617.

### 4.3.2 Identification and function of terminals

All terminals shall be identified on the block diagram (supply terminals, input or output terminals, input/output terminals).

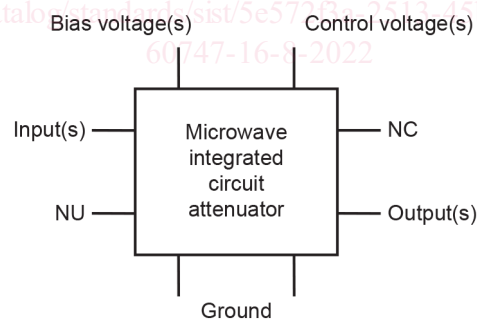
The terminal functions shall be indicated in Table 1.

**Table 1 – Function of terminals**

Terminal number	Terminal symbol	Terminal designation <sup>a</sup>	Function <sup>b</sup>	Function of terminal	
				input/output identification <sup>c</sup>	Type of input/output circuits <sup>d</sup>
<sup>a</sup> A terminal designation to indicate the function of the terminal shall be given. Supply terminals, ground terminals, blank terminals (with abbreviation NC), non-usable terminals (with abbreviation NU) shall be distinguished.					
<sup>b</sup> A brief indication of the terminal function shall be given: <ul style="list-style-type: none"> <li>– each function of multi-role terminals, i.e. terminals having multiple functions;</li> <li>– each function of integrated circuit selected by mutual pin connections, programming and/or application of function selection data to the function selection pin, such as mode selection pin.</li> </ul>					
<sup>c</sup> Input, output, input/output and multiplex output terminals shall be distinguished.					
<sup>d</sup> The type of input and output circuit, e.g. input/output impedances, with or without DC block, etc., shall be distinguished.					

If the baseplate of the package is used as a ground terminal, the type of ground, e.g. analog ground, digital ground, shall be stated in the column of Function in Table 1.

#### EXAMPLE



IEC

### 4.3.3 Function description

The function performed by the circuit shall be specified, including the following information:

- basic function;
- relation to external terminals;
- operation mode (e.g., set-up method, preference, etc.);
- interruption handling.

#### 4.4 Limiting values (absolute maximum rating system)

##### 4.4.1 Requirements

These limiting values shall contain the following:

- any interdependence of limiting conditions shall be specified;
- if externally connected and/or attached elements, for example heatsinks, have an influence on the values of the ratings, the ratings shall be prescribed for the integrated circuit with the elements connected and/or attached;
- if limiting values are exceeded for transient overload, the permissible excess and their durations shall be specified;
- where minimum and maximum values differ during programming of the device, this shall be stated;
- all voltages are referenced to a specified reference terminal ( $U_{SS}$ , ground, etc.);
- if maximum and/or minimum values are quoted, the manufacturer shall indicate whether he refers to the absolute magnitude or to the algebraic value of the quantity;
- the ratings given shall cover the operation of the multi-function integrated circuit over the specified range of operating temperatures. Where such ratings are temperature-dependent, this dependence shall be indicated.

##### 4.4.2 Electrical limiting values

Electrical limiting values shall be specified as shown in Table 2.

**Table 2 – Electrical limiting values**

Parameters	Min.	Max.
Bias voltage(s) (where appropriate)	+	+
Bias current(s) (where appropriate)		+
Control supply voltage(s) (where appropriate)	+	+
Control supply current(s) (where appropriate)		+
Terminal voltage(s) (where appropriate)	+	+
Terminal current(s) (where appropriate)		+
Input power		+
Power dissipation		+
It is necessary to select either bias voltage(s) or bias current(s), either terminal voltage(s) or terminal current(s).		

The detail specification can indicate those values within Table 3 below.

**Table 3 – Electrical limiting values in detail specification**

Parameters <sup>a, b</sup>	Symbols	Min.	Max.	Unit
<sup>a</sup> Where appropriate, in accordance with the type of circuit considered. <sup>b</sup> For power supply voltage range: <ul style="list-style-type: none"> <li>– limiting value(s) of the continuous voltage(s) at the supply terminal(s) with respect to a special electrical reference point;</li> <li>– where appropriate, limiting value between specified supply terminals;</li> <li>– when more than one voltage supply is required, a statement shall be made as to whether the sequence in which these supplies are applied is significant: if so, the sequence shall be stated;</li> <li>– when more than one supply is needed, the combinations of ratings for these supply voltages and currents shall be stated.</li> </ul>				

#### 4.4.3 Temperatures

The detail specification can indicate the following temperature values within Table 4:

- a) operating temperature (ambient or reference-point temperature);
- b) storage temperature;
- c) channel temperature;
- d) lead temperature (for soldering).

**Table 4 – Temperatures**

Parameters <sup>a</sup>	Symbols	Min.	Max.	Unit
<sup>a</sup> Where appropriate, in accordance with the type of circuit considered.				

#### 4.5 Operating conditions (within the specified operating temperature range)

Operating conditions are not to be inspected, but may be used for quality assessment purpose.

- a) power supplies – positive and/or negative values (where appropriate);
- b) initialization sequences (where appropriate), if special initialization sequences are necessary, power supply sequencing and initialization procedure shall be specified;
- c) input voltage(s) (where appropriate);
- d) output current(s) (where appropriate);
- e) voltage and/or current of other terminal(s);
- f) external elements (where appropriate);
- g) operating temperature range.

#### 4.6 Electrical characteristics

The characteristics shall apply over the full operating temperature range, unless otherwise specified. Each characteristic shall be stated either:

- a) over the specified range of operating temperatures, or
- b) at a temperature of 25 °C, and at maximum and minimum operating temperatures.