

INTERNATIONAL STANDARD

IEC 60747-16-1

Edition 1.1

2007-03

Edition 1:2001 consolidated with amendment 1:2007

Semiconductor devices –

Part 16-1: Microwave integrated circuits – Amplifiers

© IEC 2007 — Copyright - all rights reserved

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 the publisher.

International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references	6
3 Terminology	6
4 Essential ratings and characteristics.....	9
4.1 General.....	9
4.2 Application related description.....	10
4.3 Specification of the function	10
4.4 Limiting values (absolute maximum rating system)	12
4.5 Operating conditions (within the specified operating temperature range)	14
4.6 Electrical characteristics.....	14
4.7 Mechanical and environmental ratings, characteristics and data.....	16
4.8 Additional information.....	16
5 Measuring methods	17
5.1 General.....	17
5.2 Linear (power) gain (G_{lin})	17
5.3 Linear (power) gain flatness (ΔG_{lin})	19
5.4 Power gain (G_p).....	20
5.5 (Power) gain flatness (ΔG_p)	20
5.6 (Maximum available) gain reduction (ΔG_{red})	21
5.7 Limiting output power ($P_{o(ltg)}$)	22
5.8 Output power (P_o)	23
5.9 Output power at 1 dB gain compression ($P_{o(1dB)}$)	24
5.10 Noise figure (F)	25
5.11 Intermodulation distortion (two-tone) (P_1/P_n).....	27
5.12 Power at the intercept point (for intermodulation products) ($P_{n(IP)}$)	29
5.13 Magnitude of the input reflection coefficient (input return loss) ($ S_{11} $)	30
5.14 Magnitude of the output reflection coefficient (output return loss) ($ S_{22} $)	31
5.15 Magnitude of the reverse transmission coefficient (isolation) ($ S_{12} $).....	35
5.16 Conversion coefficient of amplitude modulation to phase modulation ($\alpha_{(AM-PM)}$)	36
5.17 Group delay time ($t_{d(grp)}$).....	38
5.18 Power added efficiency	39
5.19 n th order harmonic distortion ratio (P_1/P_{nth})	41
5.20 Output noise power (P_N).....	42
5.21 Spurious intensity under specified load VSWR (P_o/P_{sp})	44
5.22 Adjacent channel power ratio ($P_{o(mod)}/P_{adj}$)	46
6 Verifying methods.....	49
6.1 Load mismatch tolerance (Ψ_L).....	49
6.2 Source mismatch tolerance (Ψ_S)	52
6.3 Load mismatch ruggedness (Ψ_R).....	55

Figure 1 – Circuit for the measurements of linear gain	17
Figure 2 – Basic circuit for the measurement of the noise figure	25
Figure 3 – Basic circuit for the measurements of two-tone intermodulation distortion	27
Figure 4 – Circuit for the measurements of magnitude of input/output reflection coefficient (input/output return loss)	30
Figure 5 – Circuit for the measurement of output reflection coefficient	33
Figure 6 – Circuit for the measurement of isolation	35
Figure 7 – Basic circuit for the measurement of $\alpha_{(AM-PM)}$	36
Figure 8 – Circuit for the measurement of the power added efficiency.....	39
Figure 9 – Circuit for the measurements of the n th order harmonic distortion ratio	41
Figure 10 – Circuit diagram for the measurement of the output noise power	43
Figure 11 – Circuit diagram for the measurement of the spurious intensity.....	45
Figure 12 – Circuit for the measurement of the adjacent channel power ratio.....	47
Figure 13 – Circuit for the verification of load mismatch tolerance in method 1	50
Figure 14 – Circuit for the verification of load mismatch tolerance in method 2	51
Figure 15 – Circuit for the verification of source mismatch tolerance in method 1.....	53
Figure 16 – Circuit for the verification of source mismatch tolerance in method 2.....	54
Figure 17 – Circuit for the verification of load mismatch ruggedness	55

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SEMICONDUCTOR DEVICES –

Part 16-1: Microwave integrated circuits – Amplifiers

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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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.

International Standard IEC 60747-16-1 has been prepared by subcommittee 47E: Discrete semiconductor devices, of IEC technical committee 47: Semiconductor devices.

This consolidated version of IEC 60747-16-1 consists of the first edition (2001) [documents 47E/200/FDIS and 47E/204/RVD] and its amendment 1 (2007) [documents 47E/305/FDIS and 47E/317/RVD].

The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience.

It bears the edition number 1.1.

A vertical line in the margin shows where the base publication has been modified by amendment 1.

The committee has decided that the contents of the base publication and its amendments will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this standard may be issued at a later date.

SEMICONDUCTOR DEVICES –

Part 16-1: Microwave integrated circuits – Amplifiers

1 Scope

This part of IEC 60747 provides the terminology, the essential ratings and characteristics, as well as the measuring methods for integrated circuit microwave power amplifiers.

2 Normative references

The following referenced documents are indispensable for the application 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 60617:2001, *Graphical symbols for diagrams*

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

IEC 60747-4:-, *Semiconductor devices – Discrete devices – Part 4: Microwave diodes and transistors*¹

IEC 60747-7:2000, *Semiconductor devices – Part 7: Bipolar transistors*

IEC 60747-16-2:2001, *Semiconductor devices – Part 16-2: Microwave integrated circuits – Frequency prescalers*

IEC 60747-16-4:2004, *Semiconductor devices – Part 16-4: Microwave integrated circuits – Switches*

IEC 60748-2:1997, *Semiconductor devices – Integrated circuits – Part 2: Digital integrated circuits*

IEC 60748-3:1986, *Semiconductor devices – Integrated circuits – Part 3: Analogue integrated circuits*

IEC 60748-4:1997, *Semiconductor devices – Integrated circuits – Part 4: Interface integrated circuits*

IEC/TS 61340-5-1:1998, *Electrostatics - Part 5-1: Protection of electronic devices from electrostatic phenomena - General requirements*

IEC/TS 61340-5-2:1999, *Electrostatics - Part 5-2: Protection of electronic devices from electrostatic phenomena - User guide*

¹ The second edition of IEC 60747-4, which is cited in this standard, and to which terms introduced in this amendment refer, is currently in preparation (ADIS).