

Australian Standard® 2547.2.3—1987

SEMICONDUCTOR DEVICES— Part 2.3—INTEGRATED CIRCUITS— ANALOGUE



STANDARDS ASSOCIATION OF AUSTRALIA

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AUSTRALIAN STANDARD

**SEMICONDUCTOR DEVICES—
Part 2.3
INTEGRATED CIRCUITS—
ANALOGUE**

AS 2547.2.3—1987

First published 1987

See also preface

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PREFACE

This standard was prepared by the Association's Committee on Semiconductors and Devices. It is reproduced from IEC 748.3-1986 and is one of the standards prepared by IEC/TC 47, Semiconductor Devices.

This standard is one of a series of standards published under the generic designation AS 2547. This standard supersedes

—the existing AS 2547 series (published in 1982 and 1983 and identical to equivalent parts of IEC 147 published between 1966 and 1981);

—AS C366, Part 4—1978 and Part 5—1978 (equivalent to IEC 147-4, IEC 147-5 and IEC 147-5A);

—AS C367 (endorsement of IEC 148-1969); and

—AS 1967 (identical to IEC 147-1D and 1E).

The purpose of IEC 747 is to reorganize the material originally presented in the IEC 147* and IEC 148† series on semiconductor devices and letter symbols representing them, into a device oriented publication. This is now republished as follows:

(a) Specific requirements for integrated circuits—now IEC 748.

(b) Mechanical and climatic test methods—now IEC 749.

It was in view of the above reorganization that Committee TE/12 agreed to integrate the entire series into one series of Australian standards using the generic designation AS 2547. The relationship with the three IEC standards is as follows:

(i) Part 1.1 onwards—identical with the IEC 747 series.

(ii) Part 2.1 onwards—identical with the IEC 748 series.

(iii) Part 3—identical with IEC 749.

For the purpose of this Australian standard and all other standards in this AS 2547 series, the text of the reproduced IEC Publications should be modified as follows:

A. *Terminology.* The words 'Australian Standard' should replace the words 'IEC Publication' wherever they appear.

B. *Cross-references.* The reference to IEC Publications should be replaced by references to the appropriate Australian Standards as follows:

<i>References to IEC Publications</i>		<i>Appropriate Australian Standard</i>	
IEC 27	Letter symbols to be used in electrical technology	AS 1046	Letter Symbols for Use in Electrotechnology
IEC 50	International Electro-technical Vocabulary	AS 1852	International Electro-technical Vocabulary
IEC 191	Mechanical standardization of semiconductor devices	AS C379	Mechanical Standardization of Semiconductor Devices
IEC 319	Presentation of reliability data on electronic components	AS 2350	Presentation of Reliability Data on Electronic and Similar Components
IEC 747	Semiconductor devices. Discrete devices and integrated circuits	AS 2547	Semiconductor Devices
747.1	Part 1—General	1.1	Discrete Devices—General
747.2	Part 2—Rectifier diodes	1.2	Discrete Devices—Rectifier Diodes
747.3	Signalling (including switching) and regulating diodes	1.3	Discrete Devices—Signalling (Including Switching) and Regulating Diodes
747.4	R.F. Diodes	1.4	Discrete Devices—R.F. Diodes
747.5	Optoelectronic devices	1.5	Discrete Devices—Optoelectronic Devices

* IEC 147, Essential ratings and characteristics of semiconductor devices and general principles of measuring methods.

† IEC 148, Letter symbols for semiconductor devices and integrated microcircuits.

747.6	Thyristors	1.6	Discrete Devices—Thyristors
747.7	Bipolar transistors	1.7	Discrete Devices—Bipolar Transistors
747.8	Field-effect transistors	1.8	Discrete Devices—Field-effect Transistors
747.9	Miscellaneous devices	1.9	Discrete Devices—Miscellaneous Devices
747.10	Generic specification for discrete devices and integrated circuits (QC 700 000)	1.10	Generic Specification for Discrete Devices and Integrated Circuits (QC 700 000)
747.11	Sectional specification for discrete devices (QC 750 000)	1.11	Sectional Specification for Discrete Devices (QC 750 000)
IEC 748	Semiconductor Devices. Integrated circuits	AS 2547	Semiconductor Devices.
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IEC 748.2	Digital integrated circuits	2.2	Integrated Circuits—Digital
IEC 748.3	Analogue integrated circuits	2.3	Integrated Circuits—Analogue
IEC 748.4	Interface integrated circuits	2.4	Integrated Circuits—Interface
IEC 749	Semiconductor devices. Mechanical and climatic test methods	3.1	Mechanical and Climatic Test Methods

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STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard
for
SEMICONDUCTOR DEVICES

PART 2.3—INTEGRATED CIRCUITS—ANALOGUE

CHAPTER I: GENERAL

1. Introductory note

As a rule, it will be necessary to use Publications 747-1 and 748-1 together with the present publication. In Publications 747-1 and 748-1, the user will find all basic information on:

- terminology;
- letter symbols;
- essential ratings and characteristics;
- measuring methods;
- acceptance and reliability.

The sequence of the different chapters in the present publication is in accordance with Publication 747-1, Chapter III, Sub-clause 2.1.

2. Purpose

The present publication gives standards on the following sub-categories of analogue integrated circuits:

- operational amplifiers (having two inputs and one output);
- audioamplifiers, videoamplifiers and multichannel amplifiers for telecommunications;
- R.F. and I.F. amplifiers;
- voltage and current regulators;
- analogue signal switching circuits.

CHAPTER II: TERMINOLOGY AND LETTER SYMBOLS

1. General terms

1.1 *Voltage regulator*

An integrated circuit that operates so that the load voltage remains relatively independent of load current or input voltage fluctuations.

Note. — The range of load current can usually be extended by the use of additional external components.

1.2 *Current regulator*

An integrated circuit that operates so that the load current remains relatively independent of load resistance or input voltage fluctuations.

Note. — The range of load resistance can usually be extended by the use of additional external components.

2. Terms related to ratings and characteristics

2.1 *Linear amplifiers*

2.1.1 *Differential-mode voltage amplification* (of a differential input linear amplifier) A_{VD} , A_{Vd}

The ratio of the change in the magnitude of the output voltage to the change in the magnitude of the differential input voltage under specified conditions.

2.1.2 *Common-mode voltage amplification* (of a differential input linear amplifier) A_{VC} , A_{Vc}

The ratio of the change in the magnitude of the output voltage to the change in the magnitude of the input voltage, the latter being applied equally and in phase to each input terminal, under specified conditions.

2.1.3 *Common-mode rejection ratio* (of a differential input linear amplifier) k_{CMR}

The ratio of the differential-mode voltage amplification to the common-mode voltage amplification, under the same specified conditions.

2.1.4 *Input offset voltage* V_{IO}

The d.c. voltage required to be applied between the input terminals of a differential amplifier for specified input and output circuits to cause the output voltage to attain a specified level, usually zero.

Note. — When the amplifier has balanced outputs, the specified output voltage refers to the difference in voltage between these outputs.

2.1.5 *Input offset current I_{IO}*

The d.c. current which has a value equal to the difference in the currents in the two input terminals which will cause the output voltage to attain a specified level, usually zero. The operating conditions, particularly output circuit, must be specified.

Note. — When the amplifier has balanced outputs, the specified output voltage refers to the difference in voltage between these outputs.

2.1.6 *(Equivalent) input drift*

The change in the input d.c. voltage or d.c. current (but with reversed sign) necessary to compensate for a change in output d.c. voltage or d.c. current, caused by a specified change of supply voltage, time, temperature or other environmental conditions.

2.1.7 *Mean temperature coefficient of input offset voltage α_{VIO}*

The quotient of the change of input offset voltage and the specified change of temperature causing it, all other conditions remaining constant.

2.1.8 *Mean temperature coefficient of input offset current α_{IIO}*

The quotient of the change of input offset current and the specified change of temperature causing it, all other conditions remaining constant.

2.1.9 *Average (mean) bias current I_{IB}*

The arithmetic average of the currents into specified differential input terminals when the device is in a quiescent state.

2.1.10 *Input impedance*

a) *single-ended z_{is}*

– the impedance from each input to the electrical reference point;

b) *differential (-mode) z_{id}*

– the impedance between two inputs;

c) *common-mode z_{ic}*

– the impedance between inputs in parallel and the electrical reference point.

2.1.11 *Output impedance*

a) *single-ended z_{os}*

– the impedance from each output to the electrical reference point,

b) *differential (-mode) z_{od}*

– the impedance between two outputs.

2.1.12 *Maximum output voltage swing (of a linear amplifier) V_{OPP}*

The maximum peak-to-peak output voltage which can be obtained without exceeding a specified distortion, when the quiescent d.c. output voltage is set to a specified reference level.

2.1.13 *Common-mode input voltage range*

The range of common-mode input voltage which, if exceeded, may cause the amplifier to cease to function within specification and/or cause irreversible change of characteristics.

2.1.14 *Maximum rate of change of the output voltage S_{VOM}*

The time rate of change of the output voltage (dv/dt) at the instant when that rate of change is largest in response to a specified step-function change of the input signal.

2.1.15 *Average rate of change of the output voltage S_{VOAV}*

For a step-function change of the input signal, the quotient of a specified large change of the output voltage and the time interval corresponding to that output voltage change.

2.1.16 *Delay time t_d*

The time interval between a step-function change of the input signal level and the instant at which the magnitude of the output signal passes through a specified value which is close to its initial value.

Note. — See Note 1 below.

2.1.17 *Slope time (rise time, fall time) t_r , t_f*

For a step-function change of the input signal level, the time interval between the end of the delay time and that instant at which the magnitude of the output signal first passes through a specified value close to its final value.

Note. — See Note 1 below.

2.1.18 *Ripple time t_{rip}*

For a step-function change of the input signal level, the time interval between the end of the slope time and that instant at which the magnitude of the output signal reaches, for the last time, a specified level range containing the final output signal level.

2.1.19 *Ripple tolerance*

The level range which is specified as containing the final value of the output signal.

Note. — The ripple tolerance is equal to 2ε (or $\pm\varepsilon$). (See ripple time and Figure 1)

2.1.20 *Total response time t_{tot}*

The sum of delay time, slope time and ripple time.

Note 1. — The level normally specified for the end of the delay time (the beginning of the slope time) is 10%, that for the end of the slope time (the beginning of the ripple time) is 90%. The difference between the initial and final steady-state values of the output signal is defined as 100%.

The level range specified for containing the final value of the output signal is $100\% \pm \varepsilon$, where ε should be stated. See Figure 1.

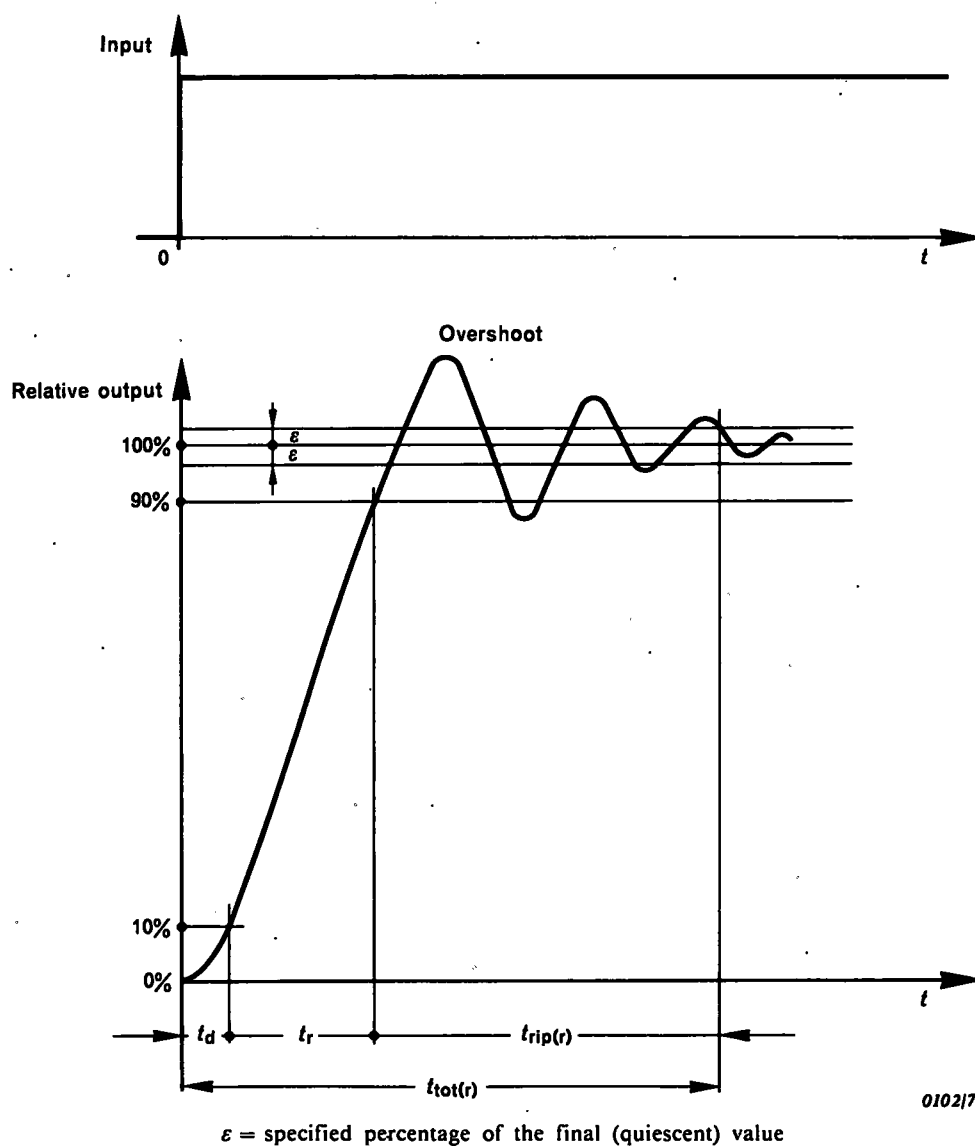
2.1.21 Overshoot factor k_{ov}

Ratio of:

- 1) the largest deviation of the output signal value from its final steady-state value, after a step-function change of the input signal.

to:

- 2) the absolute value of the difference between the steady-state output signal values before and after the step-function change of the input signal.



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FIGURE 1

2.1.22 Differential gain (error)

In a video amplifier, the difference between:

- 1) the ratio of the output amplitudes of a small high-frequency sinewave signal at two stated levels of a low-frequency signal on which it is superimposed, and:
- 2) unity.

Notes 1. — In this definition, “level” means a specified position on an amplitude scale applied to a signal waveform.

2. — The low-frequency and high-frequency signals should be specified.

3. — Differential gain may be expressed in per cent by multiplying the above difference by 100.

4. — Differential gain may be expressed in decibels by multiplying the common logarithm of the ratio described in Item 1) of this sub-clause by 20.

2.1.23 *Differential phase (error)*

In a video amplifier, the difference in output phase of a small high-frequency sinewave signal at two stated levels of a low-frequency signal on which it is superimposed.

Notes 1. — In this definition, “level” means a specified position on an amplitude scale applied to a signal waveform.

2. — The low-frequency and high-frequency signals should be specified.

2.1.24 *Supply-voltage sensitivity k_{SVS}*

The absolute value of the ratio of the change in input offset voltage to the corresponding change in value of one power-supply voltage, with all remaining power-supply voltages held constant.

2.1.25 *Supply-voltage rejection ratio k_{SVR}*

The absolute value of the ratio of the change in one power-supply voltage to the resulting change in input offset voltage, with all remaining power-supply voltages held constant.

2.1.26 *Input voltage operating range*

The range of the input voltage for which the amplifier functions within its specification.

2.1.27 *Input current operating range*

That range of the input current for which the amplifier functions within its specification.

2.1.28 *Output voltage operating range*

That range of the output voltage for which the amplifier functions within its specification.

2.1.29. *Output current operating range*

That range of the output current for which the amplifier functions within its specification.

2.1.30 *Common-mode input voltage V_{IC}*

The average of the two input voltages.

2.1.31 *Differential-mode input voltage; differential input voltage V_{ID}*

The input signal voltage between the differential input terminals.

2.1.32 *Frequency of unity (open-loop) amplification f_1*

The frequency at which the modulus of the voltage or current open-loop amplification is equal to unity.

Note. — There may be more than one frequency of unity (open-loop) amplification.

2.1.33 *Extrapolated unity-gain frequency f_T*

The product of the modulus of the voltage amplification $|A_v|$ and the frequency of measurement, this frequency being so chosen that $|A_v|$ is decreasing at a slope of approximately 6 dB per octave.

2.1.34 *Open-loop cut-off frequency (of an operational amplifier) f_{co}*

The frequency at which the modulus of the open-loop voltage amplification has decreased to $\frac{1}{\sqrt{2}}$ of its low-frequency value.

2.2 *Voltage and current regulators*

2.2.1 *Voltages*

2.2.1.1 *Output transient overshoot voltage V_{om}*

The difference between the peak value of the transient output voltage and the final steady-state output voltage following a specified step change of any condition applied.

Note. — Examples of such conditions that may be specified:

- a) input voltage;
- b) output current;
- c) control input;
- d) reference voltage.

2.2.1.2 *Feedback sense voltage v_{FB}*

A voltage that is a function of the output voltage and is used, with or without external components, for feedback control of the regulator.

2.2.1.3 *Current-limiting voltage V_{CL}*

The value of the voltage applied between specified terminals at which limiting of the output current commences.

Note. — Usually, this voltage is derived from the output load current.

2.2.1.4 *Reference voltage V_{REF}*

The voltage with which the feedback sense voltage is compared in order to control the regulator.

Note. — This voltage may be derived from an internal or external network.

2.2.1.5 *Output noise voltage V_{no} , V_{nopp}*

The noise voltage at the output of the regulator arising from the device only.

Note. — This voltage may be expressed as either a root-mean-square or a peak-to-peak value.

2.2.1.6 *Input regulation range*

The range of input voltages for which input regulation or input stabilization coefficients are specified.

2.2.2 *Currents*

2.2.2.1 *Stand-by current*

The supply current drawn by the regulator with no output load.

2.2.2.2 *Short-circuit current*

The output current with the output shorted to ground or to another specified reference voltage.

2.2.3 *Regulation coefficients, stabilization coefficients*

2.2.3.1 *Input regulation coefficient (of a voltage regulator)*

The relative change in output voltage for a specified change in input voltage, other conditions being held constant.

$$\Delta V_o / V_o$$

2.2.3.2 *Input stabilization coefficient (of a voltage regulator)*

The ratio of the relative change in output voltage to a specified relative change in input voltage, other conditions being held constant.

$$\frac{\Delta V_o / V_o}{\Delta V_i / V_i}$$

2.2.3.3 *Input regulation coefficient (of a current regulator)*

The relative change in output current for a specified change in input voltage, other conditions being held constant.

$$\Delta I_o / I_o$$

2.2.3.4 *Input stabilization coefficient (of a current regulator)*

The ratio of the relative change in output current to a specified relative change in input voltage, other conditions being held constant.

$$\frac{\Delta I_o / I_o}{\Delta V_i / V_i}$$

2.2.3.5 *Load regulation coefficient (of a current regulator)*

The relative change in output voltage for a specified change in output current, other conditions being held constant.

$$\Delta V_o / V_o$$

2.2.3.6 *Load stabilization coefficient (of a voltage regulator)*

The ratio of the relative change in output voltage to a specified relative change in output current, other conditions being held constant.

$$\frac{\Delta V_o / V_o}{\Delta I_o / I_o}$$

2.2.3.7 *Load regulation coefficient (of a current regulator)*

The relative change in output current for a specified change in output voltage, other conditions being held constant.

$$\Delta I_o / I_o$$

2.2.3.8 *Load stabilization coefficient (of a current regulator)*

The ratio of the relative change in output current to a specified relative change in load resistance, other conditions being held constant.

$$\frac{\Delta I_o / I_o}{\Delta R_L / R_L}$$

2.2.4 *Sundry quantities*

2.2.4.1 *Temperature coefficient of regulated output voltage (of a voltage regulator)*

The ratio of the relative change in output voltage to a specified change in temperature, other conditions being held constant.

$$\frac{\Delta V_o / V_o}{\Delta T}$$

2.2.4.2 *Temperature coefficient of regulated output current (of a current regulator)*

The ratio of the relative change in output current to a specified change in temperature, other conditions being held constant.

$$\frac{\Delta I_o / I_o}{\Delta T}$$

2.2.4.3 *Input transient recovery time*

The time interval between a specified step-function change of the input voltage and the instant when the magnitude of the output voltage (or current) enters for the last time a specified range containing the final output level.

2.2.4.4 *Load transient recovery time*

The time interval between a specified step-function change of the load and the instant when the magnitude of the output voltage (or current) enters for the last time a specified range containing the final output level.

2.2.4.5 *Ripple rejection ratio*

The ratio of the peak-to-peak input ripple voltage to the peak-to-peak output ripple voltage.

2.2.4.6 Output voltage drift $\Delta V_{o(t)}$

The change in output voltage for a specified long period of time, other conditions being held constant.

2.2.4.7 Output current drift $\Delta I_{o(t)}$

The change in output current for a specified long period of time, other conditions being held constant.

2.3 Analogue signal switching circuits

Under consideration.

3. Letter symbols

3.1 Amplifiers

Name and designation	Letter symbol	Remarks
3.1.1 Voltages and currents		
Input offset voltage	V_{IO}	
Maximum output voltage swing	V_{OPP}	
Input offset current	I_{IO}	
Bias current of an input terminal	$I_{IB}; I_{IB1}; I_{IB2}$	
Average (mean) bias current	I_{IB}	
Common-mode input d.c. voltage	V_{IC}	
Differential-mode input d.c. voltage	V_{ID}	
3.1.2 Electrical parameters		
Input impedance: – single-ended – differential (-mode) – common-mode	Z_{is} Z_{id} Z_{ic}	
Output impedance: – single-ended – differential (-mode)	Z_{os} Z_{od}	
3.1.3 Switching times (see Figure 2)		
Delay time	$t_d; t_{dr}; t_{df}$	
Slope time: – rise time – fall time	t_r t_f	
Ripple time	$t_{rip}; t_{rip(r)}; t_{rip(f)}$	
Total response time	$t_{tot}; t_{tot(r)}; t_{tot(f)}$	

Name and designation	Letter symbol	Remarks
3.1.4 Sundry quantities		
Differential-mode voltage amplification	$A_{VD}; A_{vd}$	
Common-mode voltage amplification	$A_{VC}; A_{vc}$	
Maximum rate of change of the output voltage	S_{VOM}	
Average rate of change of the output voltage	S_{VOAV}	
Mean temperature coefficient of input offset voltage	α_{VIO}	
Mean temperature coefficient of input offset current	α_{IIO}	
Overshoot factor	k_{ov}	
Frequency of unity (open-loop) amplification	f_1	
Supply-voltage sensitivity	k_{SVS}	
Supply-voltage rejection ratio	k_{SVR}	The abbreviations SVRR, SVR and PSRR are in common use for this quantity
Common-mode rejection ratio	k_{CMR}	The abbreviations CMRR and CMR are in common use for this quantity
Extrapolated unity-gain frequency	f_T	
Open-loop cut-off frequency (of an operational amplifier)	f_{co}	

3.2 Voltage and current regulators

Name and designation	Letter symbol	Remarks
3.2.1 Voltages		
Output transient overshoot voltage a) due to an input voltage step b) due to an output current step	V_{om} $V_{om(VI)}$ $V_{om(IO)}$	
Feedback sense voltage	V_{FB}	
Current-limiting voltage	V_{CL}	
Reference voltage	V_{REF}	
Output noise voltage: root-mean-square peak-to-peak	V_{no} V_{nopp}	
3.2.2 Currents Under consideration.		

Name and designation	Letter symbol	Remarks
3.2.3 Regulation coefficients, stabilization coefficients. No special letter symbols are given. If necessary, the formulae given together with the definitions of the terms (see Sub-clause 2.2) may be used.		
3.2.4 Sundry quantities		
Output voltage drift	$\Delta V_{o(t)}$	
Output current drift	$\Delta I_{o(t)}$	

3.3 Analogue signal switching circuits

Under consideration.

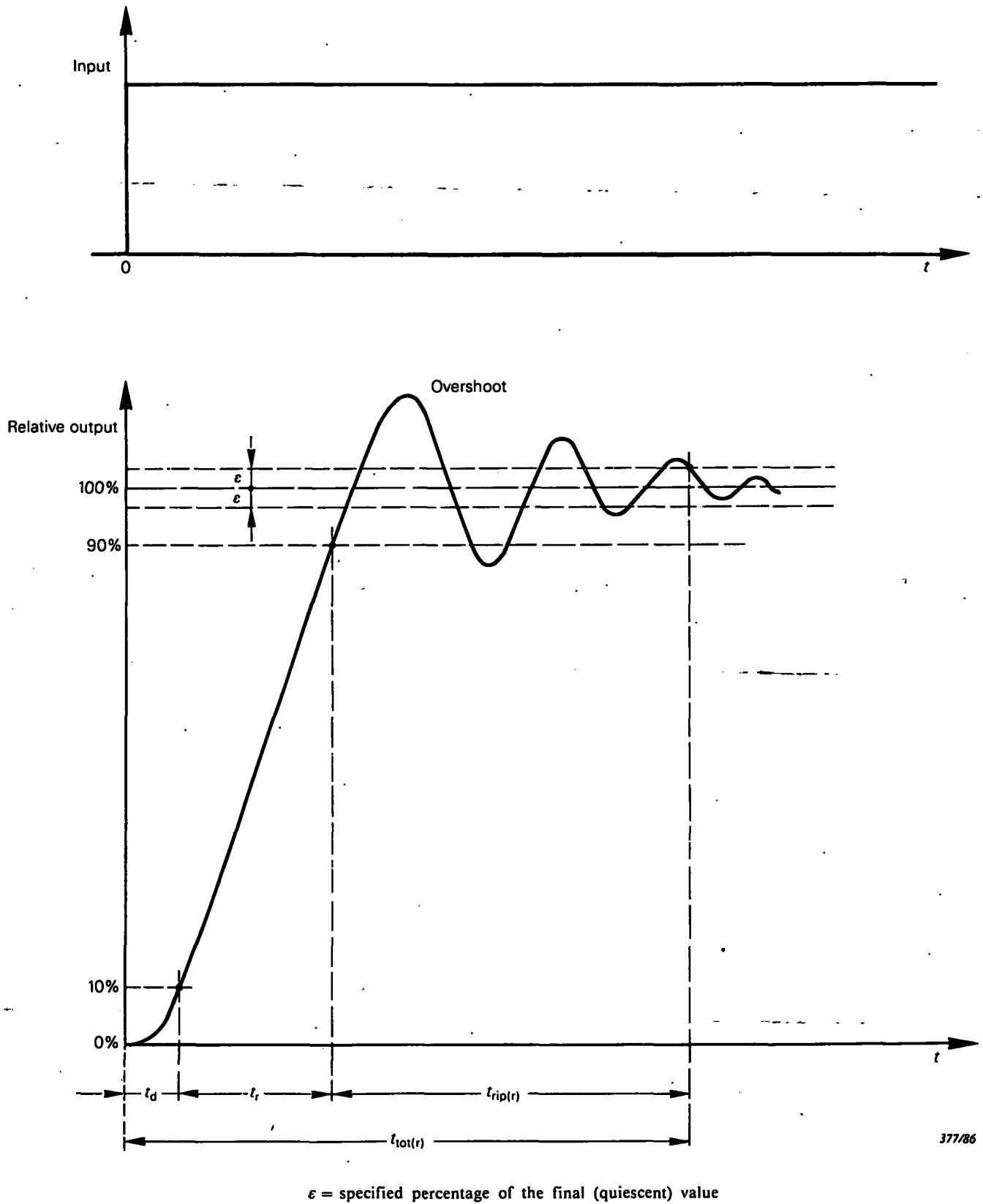


FIGURE 2

CHAPTER III: ESSENTIAL RATINGS AND CHARACTERISTICS

SECTION ONE — STANDARD FORMAT FOR THE PRESENTATION OF PUBLISHED DATA

1. Function

A general description of the function performed by the analogue circuit.

2. Description of circuit

2.1 *Technology*

The technology used in the manufacture should be stated, e.g. semiconductor monolithic integrated circuit, thin film integrated circuit, hybrid integrated circuit, micro-assembly etc.

2.2 *Details of outline and encapsulation*

2.2.1 IEC and/or national reference number of the outline drawing.

2.2.2 Method of encapsulation.

2.2.3 Marking: the drawing of the case with the marking should be reproduced.

2.3 *Block-diagram and terminal connections*

The block-diagram and the identification of the connections should be shown on the same drawing. If the encapsulation has metallic parts, any connection to them from external terminals should be indicated. The connections with any associated external electrical elements should be stated (see also Clause 5).

As additional information, the complete electrical diagram can be reproduced, including significant parasitic elements, but not necessarily with indications of the values of the circuit components.

3. Ratings (limiting values)

The ratings given must cover the operation of the integrated circuit over the specified range of operating temperatures.

Where such ratings are temperature dependent, this dependence should be indicated.

3.1 *Electrical limiting values*

The absolute limiting values (including polarity) for voltages and/or currents and/or impedances, together with any other limiting conditions, should be stated for the various terminals, with respect to a reference terminal.

3.2 *Temperatures*

Limiting values of operating temperature and storage temperature.

3.3 *Power dissipation (where appropriate)*

Maximum value over the operating temperature range.

4. Recommended operating conditions (within the specified operating temperature range)

For all the sub-clauses of Clause 4 below, the variation with temperature should be stated, where appropriate.

4.1 *Power supplies*

Polarities, values and tolerances for voltages or currents and, where appropriate, impedances.

4.2 *Input terminals*

Polarities and characteristics of the input signals or of the generator.

4.3 *Output terminals*

Characteristics of loads.

4.4 *External elements*

Values and tolerances for the external elements that must be associated with the circuit.

5. Electrical characteristics

Electrical characteristics should be stated as follows:

- a) If external elements are essential for the operation of the circuit, the electrical characteristics should include the effect of such external elements.
- b) If external elements are optional only, the electrical characteristics should be given for the integrated circuit alone. The effect of adding specified external elements on the characteristics should then be indicated in application data.

5.1 *Characteristics at 25 °C (ambient or reference-point temperature)*

5.1.1 Power (or supply current) consumption.

5.1.2 Input characteristics.

5.1.3 Output characteristics.

5.1.4 Forward transfer characteristics.

5.1.5 Reverse transfer characteristics (where appropriate).

5.1.6 Interaction between the different terminals of the device (where appropriate).

5.1.7 Noise (where appropriate).

5.2 *Effects of variations of temperature and supply voltages on the essential characteristics (where appropriate)*

6. Mechanical characteristics and other data

Under consideration. Clause 7 of Publication 747-1, Chapter VI, applies.

7. Application data

Information concerning the variations of the characteristics given in Sub-clause 5.1 with supply voltage, temperature, source and load impedances, may be given.

Any other pertinent information concerning particular applications may be given.

SECTION TWO — OPERATIONAL AMPLIFIERS (HAVING TWO INPUTS AND ONE OUTPUT)

1. Function

Amplifier intended to effect mathematical operations when used in a closed loop.

The characteristics of an operational amplifier approximate those of an ideal amplifier which may be either a voltage or a current type amplifier.

The ideal voltage amplifier is characterized by:

- an infinite voltage gain;
- an infinite input impedance;
- a zero output impedance;
- a bandwidth starting from zero frequency.

The ideal current amplifier is characterized by:

- an infinite current gain,
- a zero input impedance,
- an infinite output impedance,
- a bandwidth starting from zero frequency.

Note. — The characteristics of an operational amplifier are such that it can be used for many applications other than those given above.

2. Description of circuit

2.1 Technology

The technology used in the manufacture should be stated, e.g.: semiconductor monolithic integrated circuit, thin film integrated circuit, hybrid integrated circuit, micro-assembly, etc.

2.2 Details of outline and encapsulation

2.2.1 IEC and/or national reference number of the outline drawing.

2.2.2 Method of encapsulation.

2.2.3 Marking: the drawing of the case with the marking should be reproduced.

2.3 Block-diagram and terminal connections

The block-diagram and the identification of the connections should be shown on the same drawing. If the encapsulation has metallic parts, any connection to them from external terminals should be indicated. The connections with any associated external electrical elements should be stated (see also Clause 5).

As additional information, the complete electrical diagram can be reproduced, including significant parasitic elements, but not necessarily with indications of the values of the circuit components.

3. Ratings (limiting values)

The ratings given must cover the operation of the integrated circuit over the specified range of operating temperatures.

Where such ratings are temperature-dependent, this dependence should be indicated.

3.1 Electrical limiting values

3.1.1 Power supply voltage(s)

- a) Maximum value(s) and polarity(ies).
- b) Maximum permissible ripple on the supply voltage(s).
- c) Maximum values of transients or spurious signals from the supplies for a specified time duration.
- d) Maximum value of the voltage between a common supply terminal and case or reference terminal, where appropriate.

Note. — The sequence of the application of supply voltages should be given, where appropriate.

3.1.2 Power supply current(s)

- a) Maximum values, where appropriate.
- b) Maximum values for a specified duration (external fault conditions), where appropriate.

3.1.3 Input terminal voltages

Maximum values, with respect to a common reference terminal, including bias voltages.

Maximum value between input terminals.

3.1.4 Output terminal voltages

Maximum values, with respect to a common reference terminal, including bias voltages.

3.1.5 *Input terminal currents*

Maximum values, including bias currents.

3.1.6 *Output terminal currents*

Maximum values, including bias currents.

3.1.7 *Impedances (where appropriate)*

Maximum values for the impedances of the supplies to which the circuit is connected.

3.1.8 *Short-circuit conditions (where appropriate)*

Maximum duration of a short-circuit between terminals or between terminals and ground.

3.2 *Temperatures***3.2.1 *Operating temperatures***

Minimum and maximum values of ambient or reference-point operating temperature.

3.2.2 *Storage temperatures*

Minimum and maximum values.

3.3 *Power dissipation (where appropriate)*

Maximum value over the operating temperature range.

4. Recommended operating conditions (within the specified operating temperature range)

For all the sub-clauses of Clause 4 below, the variation with temperature should be stated, where appropriate.

4.1 *Power supplies***4.1.1 Polarities, values and tolerances for voltages or currents and, where appropriate, impedances.****4.1.2 Nominal value(s) of the supply current(s).****4.1.3 Maximum value(s) of the impedance(s) of the supplies, where appropriate.****4.2 *Input terminals*****4.2.1 Value(s) of the voltage(s) and/or current(s) of the input signal or of the signal generator.****4.2.2 Value(s) of the bias on the input terminals, where appropriate.****4.3 *Output terminals*****4.3.1 Nominal value(s) of the voltage(s) and/or current(s) of the output signal and of the load impedance.**

4.3.2 Value(s) of the bias on the output terminals, where appropriate.

4.4 External elements

Values and tolerances for the external elements that must be associated with the circuit.

5. Electrical characteristics

Electrical characteristics should be stated as follows:

- a) If external elements are essential for the operation of the circuit, the electrical characteristics should include the effect of such external elements.
- b) If external elements are optional only, the electrical characteristics should be given for the integrated circuit alone. The effect of adding specified external elements on the characteristics should then be indicated in application data.

5.1 Characteristics at 25 °C (ambient or reference-point temperature)

5.1.1 Power (or supply current) consumption (P_{tot})

Typical value under specified conditions.

5.1.2 Input characteristics

5.1.2.1 Input impedance or admittance

Minimum and maximum values for specified values of:

- load impedance;
- measuring frequency;
- input signal amplitude.

5.1.2.2 Magnitude of input offset voltage and/or current (V_{IO} , I_{IO})

Maximum values for specified values of source resistances, if they affect the values of these characteristics.

5.1.2.3 Input bias current (I_{IB})

Maximum value for zero or specified voltage in common mode.

5.1.2.4 (Equivalent) input drift

Maximum value under specified conditions.

5.1.2.5 Common-mode rejection ratio (k_{CMR})

Minimum or maximum value for specified values of:

- amplitude of input signal in common mode;
- output voltage with zero input signal in common mode;
- supply voltage(s);

- frequency;
- adjustment of the gain control (if it exists);
- load and source impedances.

5.1.2.6 *Common-mode input voltage range*

Minimum and maximum values for specified values of:

- supply voltage(s);
- load and source impedance(s);
- common-mode rejection ratio;
- additional components to be connected externally.

5.1.3 *Output characteristics*

5.1.3.1 *Output impedance or admittance*

Minimum and/or maximum values for specified values of:

- supply voltage(s);
- source impedance;
- frequency;
- output signal amplitude.

5.1.3.2 *Maximum rate of change of the output voltage (for large-signal operation) (S_{VOM})*

Typical and, where appropriate, minimum value(s) under specified conditions.

Note. — The rise and/or fall time of the input pulse should be negligible compared to the slope time of the operational amplifier.

5.1.3.3 *Output voltage swing (V_{OPP})*

Typical and minimum values for specified supply voltage and load resistance and, where appropriate, for a specified value of total distortion.

5.1.3.4 *Short-circuit output current*

Minimum and, where appropriate, maximum values for specified values of:

- supply voltage(s);
- differential and common-mode input voltages;
- duration of the short-circuit, where appropriate.

5.1.4 *Forward transfer characteristics*

5.1.4.1 *Open-loop gain*

Minimum and maximum values for specified values of:

- supply voltage(s);
- frequency;
- adjustment of the gain control (if it exists);
- load and source impedance(s);
- amplitude of the output signal at which the gain is measured.

5.1.4.2 Operation with sinusoidal and/or pulse signals

Maximum and/or minimum values for one or more of the following characteristics:

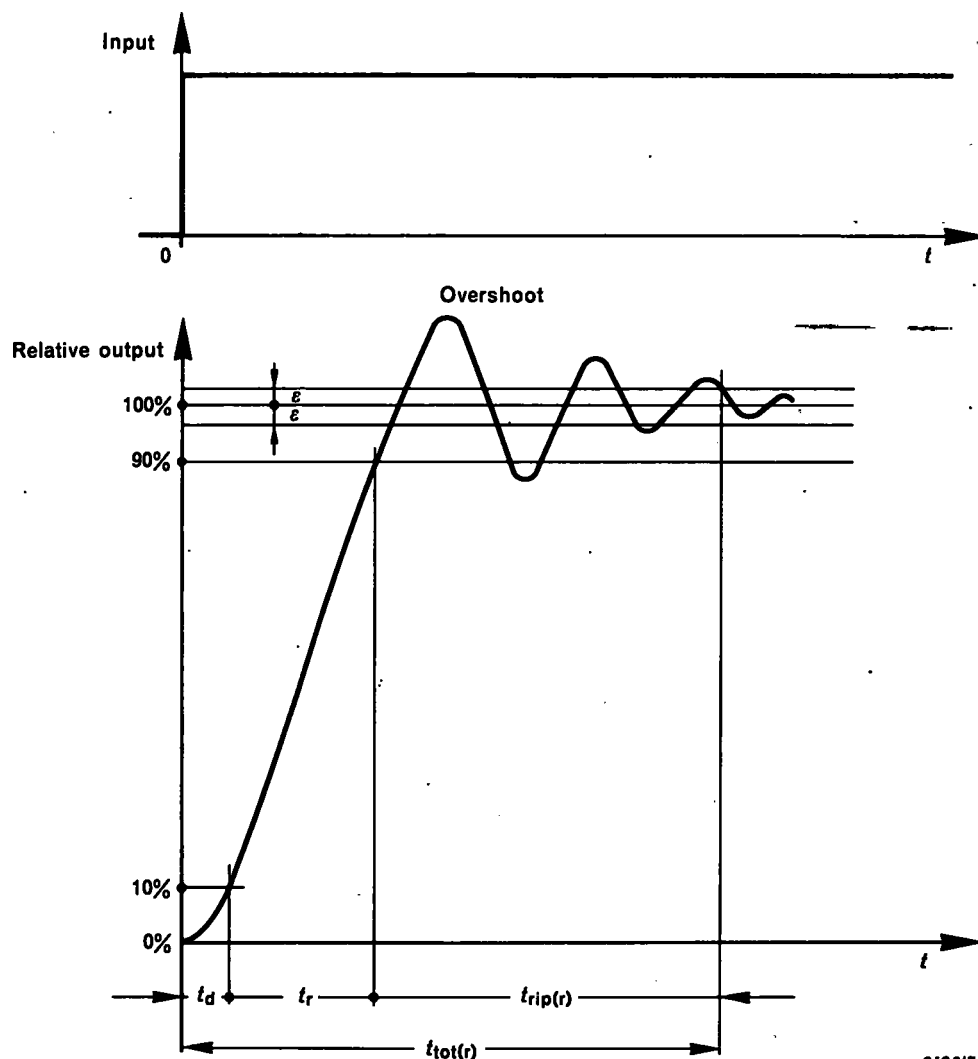
- frequency for which the open-loop gain has decreased by 3 dB from its low frequency value;
- frequency for unity gain;
- pulse response time.

5.1.4.3 Response times

The following times shall be specified:

- delay time: t_d
- slope time: t_r (or t_f)
- ripple time: t_{rip}
- total response time: t_{tot}

Only three of these four parameters shall be stated (see Figure 3 below).



ϵ = specified percentage of the final (quiescent) value

FIG. 3. — Example of response times of linear amplifiers.

These parameters should be stated as follows:

Typical and, where appropriate, maximum value under the following specified conditions:

- unity-gain configuration;
- input and feedback resistance values with which unity-gain configuration is realized;
- phase compensating conditions (configuration and values of the compensating network, if any);
- load conditions (configuration and values of the loading network);
- level of input signal.

Note. — The rise time of the input pulse should be negligible compared to the slope time of the operational amplifier.

5.1.4.4 *Overshoot (k_w)*

See Figure 3.

Maximum value under the same specified conditions as the response times.

5.1.4.5 *Upper limiting frequency for full output voltage swing (where appropriate)*

Typical and minimum values, for specified values of:

- supply voltage(s);
- unity-gain inverter configuration;
- input and feedback resistances with which unity-gain configuration is obtained;
- phase compensating conditions (configuration and values of the components of the compensating network, if any);
- load conditions (configuration and values of the components of the loading network);
- distortion factor of the output signal;
- output voltage.

5.1.5 *Reverse transfer characteristics*

Not appropriate.

5.1.6 *Interaction between the amplifier and the supply lines*

The following information should be given under appropriate specified conditions:

- a) Maximum signal from the amplifier to the supply lines.
- b) The transfer characteristic from the supplies to the input of the amplifier.
- c) The impedance of the amplifier at the supply terminals.

This should be specified both for steady state and transient conditions.

5.1.7 *Noise (where appropriate)*

Maximum value.

The noise should be specified in terms of noise factor or in terms of equivalent input voltage and/or current, for specified values of supply voltage(s), source resistance, frequency and bandwidth.

5.1.8 *Cross-talk attenuation (for multiple amplifiers)*

Minimum value for specified values of:

- supply voltage(s);
- amplitude of output signal;
- signal frequency;
- load and source impedances;
- additional components to be connected externally;
- conditions for other amplifiers.

5.2 *Effects of variations of temperature or supply voltages on the essential characteristics* (quoted in Sub-clause 5.1 of Section Two)

The changes in the following characteristics with temperature and supply voltages should be stated.

This information should be given either for the typical value of the characteristic or for the limit (maximum or minimum) value of the characteristic.

This information should normally be given as application data for the device, and not as acceptance criteria for acceptance against a specification. The data called for in Sub-clause 5.2.1 should be given at a specified value of supply voltage(s) and the data required in Sub-clause 5.2.2 should be given at a temperature of 25 °C.

5.2.1 *Variation with temperature*

- a) Power (or supply current) consumption (Sub-clause 5.1.1).
- b) Input offset voltage and/or current (Sub-clause 5.1.2.2).
- c) Input bias current (Sub-clause 5.1.2.3).
- d) Common-mode rejection ratio (Sub-clause 5.1.2.5).
- e) Open-loop gain (Sub-clause 5.1.4.1).

5.2.2 *Variation with supply voltage(s)*

- a) Power (or supply current) consumption (Sub-clause 5.1.1).
- b) Output voltage swing (Sub-clause 5.1.3.3).
- c) Open-loop gain (Sub-clause 5.1.4.1).

Note. — Additional information regarding the variation of certain parameters with supply voltage(s) may also be given.

6. Mechanical characteristics and other data

Clause 7 of Publication 747-1, Chapter VI, applies.

7. Application data

Information concerning the variations of the characteristics given in Sub-clause 5.1 with supply voltage, temperature, source and load impedances, may be given.

Any other pertinent information concerning particular applications may be given, e.g. curves of the typical variation of input or output impedances or admittances versus frequency, the other specified conditions remaining unchanged.

Any external elements to be associated with the integrated circuit should be referred to its terminals. These external elements should appear in two distinct tables:

- the first table should include the associated elements which are specific to a function, or which determine an operation;
- the second table should include the associated elements which serve as correcting elements.

Each table should include three columns:

- in the first column, the integrated circuit terminals concerned should be identified;
- in the second column, the nature of the external elements concerned should be indicated (for example: RC network);
- in the third column, the resulting characteristics of the integrated circuit plus the external elements should be indicated.

SECTION THREE — AUDIOAMPLIFIERS, VIDEOAMPLIFIERS AND MULTICHANNEL AMPLIFIERS FOR TELECOMMUNICATIONS

1. Function

Amplifiers intended for functions in audio, video and telecommunication equipment.

Note. — The following provisions apply to the three categories of amplifiers, unless otherwise stated.

2. Description of circuit

2.1 *Technology*

The technology used in the manufacture should be stated, e.g.: semiconductor monolithic integrated circuit, thin film integrated circuit, hybrid integrated circuit, micro-assembly, etc.

2.2 *Details of outline and encapsulation*

2.2.1 IEC and/or national reference number of the outline drawing.

2.2.2 Method of encapsulation.

2.2.3 Marking: the drawing of the case with the marking should be reproduced.

2.3 Block-diagram and terminal connections

The block-diagram and the identification of the connections should be shown on the same drawing. If the encapsulation has metallic parts, any connection to them from external terminals should be indicated. The connections with any associated external electrical elements should be stated (see also Clause 5).

As additional information, the complete electrical diagram can be reproduced, including significant parasitic elements, but not necessarily with indications of the value of the circuit components.

3. Ratings (limiting values)

The ratings given must cover the operation of the integrated circuit over the specified range of operating temperatures.

Where such ratings are temperature-dependent, this dependence should be indicated.

If externally connected elements have an influence on the ratings, the ratings should be given for the amplifier with the elements connected.

3.1 Electrical limiting values

3.1.1 Power supply voltage(s)

a) Maximum value(s) and polarity(ies).

b) Maximum value of the voltage between a common supply terminal and case or reference terminal, where appropriate.

Note. — The sequence of the application of supply voltages should be given, where appropriate.

3.1.2 Input terminal voltage(s) and/or current(s)

Maximum values.

3.1.3 Output terminal voltage(s) and/or current(s)

Maximum values.

3.2 Temperatures

3.2.1 Operating temperatures

Minimum and maximum values of ambient or reference-point operating temperature.

3.2.2 Storage temperatures

Minimum and maximum values.

3.3 *Power dissipation (where appropriate)*

Maximum value over the operating temperature range.

4. Recommended operating conditions (within the specified operating temperature range)

For all the sub-clauses of Clause 4 below, the variation with temperature should be stated, where appropriate.

4.1 *Power supplies*

Polarities, values and tolerances for voltages and/or currents.

4.2 *Input terminals*

4.2.1 Value(s) of the voltage(s) and/or current(s) of the input signal or of the impedance of the signal source.

4.2.2 Value(s) of the bias on the input terminals, where appropriate.

4.3 *Output terminals*

4.3.1 Nominal value(s) of the voltage(s) and/or current(s) of the output signal and of the load impedance.

4.3.2 Value(s) of the bias on the output terminals, where appropriate.

4.4 *External elements*

Values and tolerances for the external elements that must be associated with the circuit.

5. Electrical characteristics

Electrical characteristics should be stated as follows:

- a) If external elements are essential for the operation of the circuit, the electrical characteristics should include the effect of such external elements.
- b) If external elements are optional only, the electrical characteristics should be given for the integrated circuit alone. The effect of adding specified external elements on the characteristics should then be indicated in application data.

5.1 *Characteristics at 25 °C (ambient or reference-point temperature)*

5.1.1 *Power (or supply current) consumption (P_{tot})*

Typical value under specified conditions.

5.1.2 *Input characteristics*

5.1.2.1 *Input impedance or admittance*

In the case of high (low) impedance: typical and minimum (maximum) values of input impedance, or: typical and maximum (minimum) values of input admittance as function of frequency in the specified frequency range and under specified conditions.

In the case of impedance matching: the minimum return loss for the specified resistance in the specified frequency range and under specified conditions.

Note. — Return loss (in dB) = $20 \log_{10} \frac{Z+R}{Z-R}$

where Z is the impedance and R the specified resistance.

To characterize the input characteristics, scattering parameters s may be used, where appropriate.

5.1.2.2 *Input bias current (where appropriate) (I_B)*

Typical and maximum values under specified conditions.

5.1.2.3 *Supply voltage rejection ratio (where appropriate) (k_{SVR})*

Maximum value over the operating temperature range.

5.1.2.4 *Offset voltage and/or current (where appropriate) (V_{IO} , I_{IO})*

Maximum value.

5.1.2.5 *Mean temperature coefficient of offset voltage or current (where appropriate) (α_{VIO} , α_{IIO})*

Maximum value over the operating temperature range.

5.1.3 *Output characteristics*

5.1.3.1 *Output impedance or admittance*

In the case of low (high) impedance: typical and maximum (minimum) values of output impedance, or: typical and minimum (maximum) values of output admittance as function of frequency in the specified frequency range and under specified conditions.

In the case of impedance matching: the minimum return loss for a specified resistance in the specified frequency range and under specified conditions.

5.1.3.2 *Maximum signal output*

Minimum value of the output signal current, voltage or power for specified values of:

- distortion;
- load impedance;
- signal frequency;
- supply voltage(s);
- adjustment of gain control (if it exists).

Minimum overload point, under the same specified conditions, for multichannel amplifiers.

Note. — For the latter, see C.C.I.T.T. — White Book, Vol. III — Mar Del Plata 1968 — G 223 Item 6, p. 5.

5.1.4 Forward transfer characteristics

5.1.4.1 Voltage gain, or current gain, or forward transadmittance, or power gain, for specified values of:

- supply voltage(s);
- frequency;
- load and source impedance(s);
- adjustment of gain control (if it exists);
- amplitude of the output signal at which the gain is measured.

The parameter should be measured at an input signal lower than the A.G.C. threshold. Minimum and typical values should be specified.

5.1.4.2 Cut-off frequency, 3 dB point (for audio and video amplifiers only) (f_c)

Maximum value of low frequency, 3 dB point, and minimum value of high frequency, 3 dB point.

For amplifiers transmitting the d.c. component, high cut-off frequency only.

5.1.4.3 Gain and phase (and/or group-delay) versus frequency under specified conditions.

a) Gain

Minimum and maximum values of voltage amplification and/or current amplification and/or power gain versus frequency, under specified conditions, for example, as shown in Figure 4.

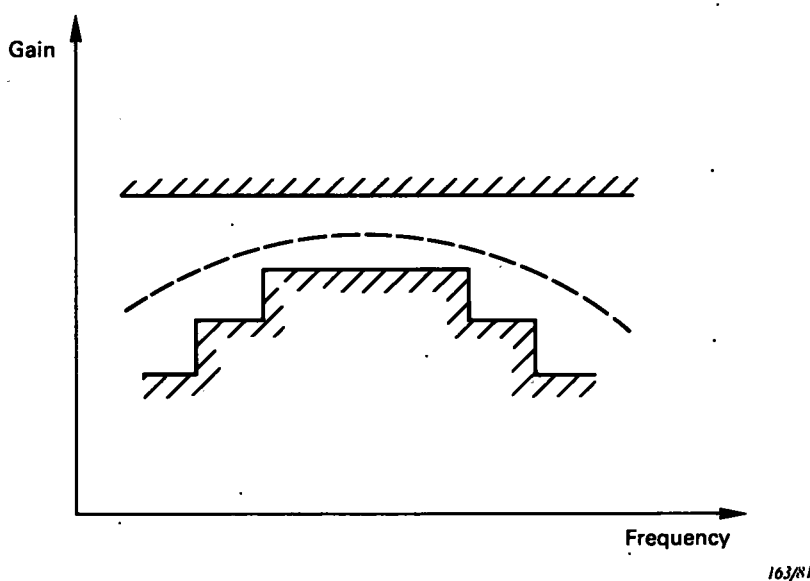
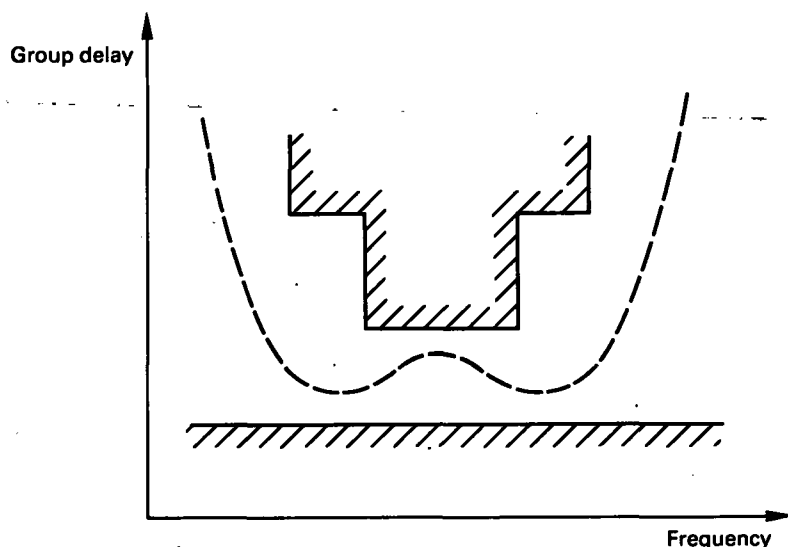


FIG. 4. — Minimum and maximum values for gain versus frequency.

b) Phase

Where appropriate, minimum and maximum phase and or group-delay (envelope-delay), under the conditions specified for gain versus frequency, for example, as shown in Figure 5.



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FIG. 5. — Minimum and maximum values for group-delay versus frequency.

5.1.5 Reverse transfer characteristics

Under consideration for multichannel amplifiers.

5.1.6 Interaction between the amplifier and the supply lines

For multichannel amplifiers and, where appropriate, for video amplifiers.

Under consideration.

5.1.7 Noise (where appropriate)

Maximum value.

The noise should be specified in terms of noise factor or in terms of equivalent input voltage and/or current, for specified values of supply voltage(s), source resistance, frequency and bandwidth.

5.1.8 Distortion

Distortion under specified conditions, especially: load impedance, output signal level, fundamental and component frequencies, supply voltage(s) and adjustment of gain control (if it exists).

- Maximum total harmonic distortion (for audio amplifiers only).
- Maximum harmonic distortion for the second and, where appropriate, for the third harmonic.
- Maximum intermodulation for the second and, where appropriate, for the third and higher order products (for video and multichannel amplifiers only).

- *Differential phase (error) and differential gain (error)* (for videoamplifiers only).

Maximum and/or typical values of differential phase (error) and differential gain (error) for specified values of:

- frequencies and levels of both low-frequency signal and superimposed high-frequency signal;
- load impedance.

5.1.9 *Pulse characteristics (where appropriate)*

Under consideration.

5.2 *Effects of variation of temperature and supply voltages on the essential characteristics* (quoted in Sub-clause 5.1 of Section Three)

The changes in the following characteristics with temperature and supply voltages should be stated.

This information should be given either for the typical value of the characteristic or for the limit (maximum or minimum) value of the characteristic.

This information should normally be given as application data for the device, and not as acceptance criteria for acceptance against a specification. The data called for in Sub-clause 5.2.1 should be given at a specified value of supply voltage(s) and the data required in Sub-clause 5.2.2 should be given at a temperature of 25 °C.

5.2.1 *Variation with temperature*

- a) Power (or supply current) consumption (Sub-clause 5.1.1).
- b) Input impedance or admittance (Sub-clause 5.1.2.1).
Magnitude and, where appropriate, real and/or imaginary part.
- c) Input bias current, when specified (Sub-clause 5.1.2.2).
- d) Offset voltage and/or current, when specified (Sub-clause 5.1.2.4).
- e) Output impedance or admittance (Sub-clause 5.1.3.1).
Magnitude and, where appropriate, real and/or imaginary part (not applicable for audioamplifiers).
- f) Gain (Sub-clause 5.1.4.1).
- g) Distortion (Sub-clause 5.1.8).

Where appropriate, total harmonic distortion (for audio and videoamplifiers) and maximum intermodulation (for multi-channel amplifiers).

5.2.2 *Variation with supply voltages*

- a) Power (or supply current) consumption (Sub-clause 5.1.1).
- b) Maximum signal output (Sub-clause 5.1.3.2).
- c) Gain (Sub-clause 5.1.4.1).
- d) Distortion (Sub-clause 5.1.8).

Where appropriate, total harmonic distortion (for audio and video amplifiers) and maximum intermodulation (for multi-channel amplifiers).

6. Mechanical characteristics and other data

Clause 7 of Publication 747-1, Chapter VI, applies.

7. Application data

Information concerning the variations of the characteristics given in Sub-clause 5.1 with supply voltage, temperature, source and load impedance may be given.

Any other pertinent information concerning particular applications may be given, e.g. optimum resistance of the generator for a minimum noise factor.

SECTION FOUR — R.F. AND I.F. AMPLIFIERS

1. Function

An amplifier intended to be used for radio frequency or intermediate frequency sections of communications and television or radio receivers. — — —

Types of amplifiers included are those having a gain control function or a limiter function: in the case of a gain control function, the control may either be determined entirely within the integrated circuit (A.G.C.) or be determined by the application of external control signals to a specified terminal.

2. Description of circuit

2.1 Technology

The manufacturing technology should be stated, for example, semiconductor monolithic integrated circuit, thin film integrated circuit, hybrid integrated circuit, micro-assembly, etc.

2.2 Details of outline and encapsulation

2.2.1 IEC and/or national reference number of the outline drawing.

2.2.2 Method of encapsulation.

2.3 Block-diagram and terminal connections

The block-diagram and the identification of the connections should be shown on the same drawing. If the encapsulation has metallic parts, any connection to them from

external terminals should be indicated. The connections with any associated external electrical element should be stated (see also Clause 5).

As additional information, the complete electrical diagram can be reproduced, including significant parasitic elements, but not necessarily with indications of the values of the circuit components.

3. Ratings (limiting values)

The ratings given must cover the operation of the integrated circuit over the specified range of operating temperatures.

Where such ratings are temperature-dependent, this dependence should be indicated:

If externally connected elements have an influence on the ratings, the ratings should be given for the amplifier with the external elements connected.

3.1 *Electrical limiting values*

3.1.1 *Power supply voltage(s)*

- a) Maximum value(s) and polarity(ies).
- b) Maximum permissible ripple on the supply voltage(s).
- c) Maximum values of transients or spurious signals from the supplies for a specified time duration.
- d) Maximum value of the voltage between a common supply terminal and the case or a reference terminal, where appropriate.

Note. — The sequence of the application of supply voltages should be given, where appropriate.

3.1.2 *Input terminal voltage(s) and/or current(s)*

Maximum values with respect to a common reference terminal.

3.1.3 *Output terminal voltage(s) and/or current(s)*

Maximum values with respect to a common reference terminal.

3.1.4 *Other terminal voltage(s) and/or current(s) (for example A.G.C. terminal)*

Maximum values with respect to a common reference terminal.

3.2 *Temperatures*

3.2.1 *Operating temperatures*

Minimum and maximum values of ambient or reference-point operating temperature.

3.2.2 *Storage temperatures*

Minimum and maximum values.