MILITARY STANDARD

PARAMETERS TO BE CONTROLLED FOR THE SPECIFICATION OF MICROCIRCUITS

TO ALL HOLDERS OF MIL-STD-1331:

1. THE FOLLOWING PAGES OF MIL-STD-1331 HAVE BEEN REVISED AND SUPERSEDE THE PAGES LISTED:

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
iii	19 August 1970	iii	10 January 1969
1	19 August 1970	1	10 January 1969
2	10 January 1969	(Reprinted without change)	10 January 1969
3	10 January 1969	(Reprinted without change)	10 January 1969
4	19 August 1970	4	10 January 1969
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7	19 August 1970	7/8	10 January 1969
9	19 August 1970	9	10 January 1969
10	19 August 1970	10	10 January 1969
11	19 August 1970	11	10 January 1969
12	19 August 1970	12	10 January 1969
13	19 August 1970	13	10 January 1969
14	19 August 1970	14	10 January 1969
15	19 August 1970	15	10 January 1969
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2. THE FOLLOWING PAGE IS TO BE ADDED:

NEW PAGE	DATE
8	19 August 1970

3. RETAIN THIS NOTICE AND INSERT BEFORE THE TABLE OF CONTENTS.

Preparing activity:
Navy - EC

Agent:
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FSC 5962

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1. SCOPE

1.1 Scope. This standard describes the parameters required as a minimum for the specification of microcircuits. Parameters, rather than circuits, are considered because circuits vary with the manufacturers involved. Further, circuit designs should be subject to change if improvement results as long as the affected designs are compatible and fully interchangeable. The specific objectives of this document are as follows:

a. To provide the minimum parameters that shall be specified to ensure adequate evaluation of circuit design and performance.
b. To provide maximum commonality of parameters for purposes of test and measurement, within and between major classes of microcircuit types and to allow the recognition of interface problems between types of microcircuits.
c. To provide standard abbreviations, definitions and symbols pertinent to the specification of microcircuits.
d. To promote maximum interchangeability and compatibility between microcircuit types.

2. REFERENCED DOCUMENTS

2.1 The following documents of the issue in effect on the date of invitation for bids or request for proposal, form a part of this standard to the extent specified herein.

SPECIFICATION
MILITARY

MIL-M-55565	Microcircuits, Packaging of

STANDARDS
MILITARY

MIL-STD-806	Graphic Symbols For Logic Diagrams
MIL-STD-883	Test Methods and Procedures for Microelectronics
MIL-STD-1313	Microelectronic Terms and Definitions

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. TERMS, LETTER SYMBOLS, ABBREVIATIONS, AND DEFINITIONS

3.1 For the purpose of this standard, the terms, letter symbols, abbreviations, and definitions of Appendix A shall apply.

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4. REQUIREMENTS

4.1 General. The applicable procurement documents prepared for the procurement of microcircuits shall include, as a minimum, the parameters described herein specified as a function of temperature and any other pertinent conditions as associated with the applicable microcircuit category. The procurement document shall also contain the additional parameters and controls, if any, required for assurance of interchangeability in specific applications. The procurement document shall also identify which parameters are to be tested on a 100 percent basis and which allow sampling. Accept/reject limits for parameter values and acceptable quality levels, where applicable, shall also be included. The terminology and symbols used in the procurement document shall conform to those used herein. The generic term "microcircuit" used in this standard includes all categories of construction as defined in MIL-STD-1313. Where MIL-STD-883 provides test methods for the parameters identified in section 5 or specified in the applicable procurement document, the appropriate test method of MIL-STD-883 shall be used for the measurement or control of those parameters and such use shall be governed by the applicable general requirements of MIL-STD-883.

4.2 Requirements for standardized parameters. In order to best fit the microcircuit user's needs for a standardized set of parameters, the following requirements have been established.

a. All important circuit parameters shall be described.
b. The symbology shall be descriptive of the measured parameters.
c. Test parameters for a given microcircuit type or function shall be specified in such a manner as to be independent of the internal microcircuit construction or the application of the microcircuit.

For logic circuits:

d. Positive current shall be defined as conventional current flow into a device terminal.
e. The limiting terms "min" (minimum) and "max" (maximum) shall be considered to apply to magnitudes only and the sign shall be indicated.
f. V_x shall be considered to be a positive voltage at terminal x with respect to ground or 0 volts. V_{xy} shall be considered to be a positive voltage at terminal x with respect to terminal y.
g. Parameter limits shall be specified under the least favorable appropriate conditions of temperature, biases, supply voltages, signals, and loading within the applicable range of each test condition.

4.3 General items to be controlled. The following items shall be specified for all microcircuit specifications:

a. Storage temperatures (minimum and maximum limits).
b. Lead or Case operating temperature extremes (minimum and maximum limits).
c. Mechanical outline and dimensions.
d. Terminal designations.
e. Maximum terminal voltage and current (all supplies, inputs, outputs, nodes).
f. Dynamic electrical parameters (see section 5).
g. Static electrical parameters (see section 5).
h. Mechanical and environmental integrity.
i. Quality assurance levels and reliability.
j. Packaging and packing (refer to MIL-M-55565).
k. Logic diagram, logic equations and truth table (for digital microcircuits). (Logic symbols shall be in accordance with MIL-STD-806.)
l. Complex input and output impedance characteristics when applicable.
m. Maximum thermal resistance for the complete microcircuit to the lead or case.
n. Maximum power dissipation per function and for the complete microcircuit.

5. ELECTRICAL PARAMETERS TO BE CONTROLLED

5.1 In all specifications or applicable procurement documents for microcircuits, all applicable electrical parameters of tables I, II, and III shall be specified together with limits and conditions of measurement, and where indicated, the test methods of MIL-STD-883 shall apply. Where "X" appears, the parameter shall be specified, but no MIL-STD-883 test method exists. Standard test methods are being developed.

TABLE I. Dynamic electrical parameters (digital microcircuits).

Specify input test conditions: V_{IH} min, V_{IH} max, V_{IL} min, or V_{IL} max				
Parameter	Symbol	Test method, MIL-STD-883: Gating	Test method, MIL-STD-883: Bistable and monostable	Remarks
Propagation delay time, low to high level output	t_{PLH}	3003	X	
Propagation delay time, high to low level output	t_{PHL}	3003	X	
Transition time, high to low level output	t_{THL}	3004	X	
Transition time, low to high level output	t_{TLH}	3004	X	
Power supply current drain vs. frequency		X	X	
Output pulse width (monostable only)				
Terminal capacitance		3012		Where terminal capacitance is regarded as critical to the application.
AC noise margin	V_N	3013		Where noise margin is regarded as critical to the application.

NOTE: Forcing conditions which shall be specified (as applicable) for monostable or bistable digital microcircuits are as follows: Asynchronous input, minimum pulse width; Minimum clock pulse width; Clock levels, high and low; Clock repetition rate; Clock level, transition times; Timing relationships of input signals.

TABLE II. Static electrical parameters (digital microcircuits).

Specify input test conditions: V_{IH} min, V_{IH} max, V_{IL} min, or V_{IL} max

Parameter	Symbol	Test method MIL-STD-883	Remarks
High level output voltage	V_{OH} max and min	3006	
Low level output voltage	V_{OL} max and min	3007	
High level input current	I_{IH} max and min	3010	
Low level input current	I_{IL} max and min	3009	
High level output current	I_{OH} max and min	X	Measure in conjunction with V_{OH}
Low level output current	I_{OL} max only	X	Measure in conjunction with V_{OL}
Output short circuit current	I_{OS} max and min	3011	
Collector cut-off current	I_{CEX} max only	X	
Noise margin	V_N	3013	Where noise margin is regarded as critical to the application.
Low level supply current drain	I_{CCL}, I_{DDL}, I_{EEL}, etc	3005	
High level supply current drain	I_{CCH}, I_{DDH}, I_{EEH}, etc	3005	
Breakdown voltage	BV	3008	Where applicable
Where node terminals exist:			
a. High level node current	I_{INH}	3010	At specified V_{INH}
b. Low level node current	I_{INL}	3009	At specified V_{INL}

TABLE III. Electrical parameters for amplifiers.

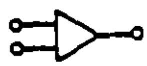
		Amplifier types and configurations		
		Differential, video, RF, general purpose	Operational, wide band, IF, audio frequency	Audio frequency, video, IF, RF, wide band, HF, general purpose
				
Parameters	Symbol	MIL-STD-883 test method		
AC unbalance voltage	V_{OU}	X		
Automatic gain control range	AGC	4007	4007	4007
Bandwidth (small signal)	BW	4004	4004	4004
Common-mode input voltage range	V_{ICR}	4003	4003	
Common-mode output voltage	V_{OC}	4003		
Common-mode rejection ratio	CMRR	4003	4003	
Common-mode voltage amplification	A_{VC}	4003	4003	
DC power dissipation	P_D	4005	4005	4005
Differential input impedance	Z_{id}	4004	4004	
Differential voltage amplification	A_{VD} A_{vd}	4004	4004	
Input bias current	I_{IB}	4001	4001	
Input bias current temperature sensitivity	$\Delta I_{IB}/\Delta T$	4001	4001	
Input offset current	I_{IO}	4001	4001	
Input offset current temperature sensitivity	$\Delta I_{IO}/\Delta T$	4001	4001	
Input offset voltage	V_{IO}	4001	4001	
Input offset voltage temperature sensitivity	$\Delta V_{IO}/\Delta T$	4001	4001	
Maximum output voltage swing	V_{OPP}	4004	4004	4004
Single-ended input voltage range	V_{ISR}	X	X	X
Noise figure	NF	4006	4006	4006
Differential output impedance	Z_{od}	4005	4005	4005

TABLE III. Electrical parameters for amplifiers - Continued.

Parameters	Symbol	Amplifier types and configurations		
		Differential, video, RF, general purpose	Operational, wide band, IF, audio frequency	Audio frequency, video, IF, RF, wide band, HF, general purpose
				
		MIL-STD-883 test method		
Single-ended output impedance	Z_{os}	4005	4005	4005
Output offset voltage	V_{OO}	X	X	X
Phase margin	Φ_m		4002	4002
Power gain or insertion power gain	G_P or G_p		4006	4006
Power supply rejection ratio	PSRR	4003	4003	
Quiescent input voltage	V_I			X
Quiescent output voltage	V_O			X
Single-ended input impedance	Z_{is}	4004	4004	4004
Single-ended voltage amplification	A_{VS} A_{vs}	4004	4004	4004
Slew rate	SR		4002	
Total harmonic distortion	THD	4004	4004	4004
Transient response	TR		X	
Maximum output swing bandwidth	B_{OM}			
Overload recovery time	t_{or}			

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Custodians:
Army - EL
Navy - EC
Air Force - 17

Review activities:
Army - EL, MU, MI
Navy - AS, OS
Air Force - 10, 11, 26, 85
NASA - HQ (KR)
DSA - ES

User activities:
Army - ME, AV
Navy - CG, MC, SH
Air Force - 1, 13, 18, 19, 23, 25, 71, 80

Preparing activity:
Navy - EC

Agent:
DSA - ES

(Project 5962-0016)

APPENDIX A

TERMS, LETTER SYMBOLS, ABBREVIATIONS, AND DEFINITIONS

10. SCOPE

10.1 This appendix contains terms, letter symbols, abbreviations, and definitions for use with microcircuits.

20. GENERAL GUIDELINES FOR LETTER SYMBOLS AND ABBREVIATIONS

20.1 Letter symbols and abbreviations defined.

20.1.1 Letter symbols. A letter symbol is a character which is used to designate an electrical or physical quantity or parameter, or units of measurement. This use occurs most frequently in mathematical equations, specifications, and commercial data. The following chart will illustrate the primary distinction between quantity symbols and unit of measurement symbols.

Quantity	Quantity symbol	Unit of measurement	Unit symbol
Current	I, i	ampere	A 1/
Voltage	V, v	volt	V
Power	P, p	watt	W
Resistance	R, r	ohm	Ω 2/
Impedance	Z, z	ohm	Ω 2/
Capacitance	C, c	farad	F
Inductance	L (upper-case only)	henry	H
Time	t (lower-case only)	second	s
Temperature	T (upper-case only)	degree	°C or °F 3/
Gain (power)	G (upper-case only)	decibel 4/	dB 4/
Amplification (voltage or current)	A (upper-case only)	(numeric) 5/	5/

1/ The unit symbol "A" is used with the metric system of multiplier prefixes; for example, "A" for microamperes.
2/ Ohm should not be abbreviated in text. The unit symbol "Ω" may be used elsewhere with the metric system of multiplier prefixes.
3/ The unit symbol for degrees "kelvin" is "K" (without the °).
4/ Alternatively, power gain may be expressed as a dimensionless ratio.
5/ Alternatively, voltage and current amplification may be expressed in decibels (unit symbol "dB") provided the impedances associated with the numerator and denominator of the ratio are equal.

20.1.2 Abbreviations. An abbreviation is a shortened form of a word or word combination. Abbreviations do not encompass letter symbols or graphic symbols. Subscripts and superscripts are not used in abbreviations.

20.2 Criteria and conventions for letter symbols and abbreviations.

20.2.1 Primary symbol. The symbol used to designate a quantity or parameter. An abbreviation may be used as the primary symbol. The primary symbol may be modified by subscripts or superscripts except when the primary symbol is an abbreviation (see 20.1.2).

20.2.2 Secondary symbol. A subscript or superscript, referred to as the secondary symbol, may be used to modify the primary symbol except when the primary symbol is an abbreviation (see 20.1.2). The secondary symbol is used to designate special values of states, points, parts, times, etc. An abbreviation may be used as a subscript (secondary symbol).

20.2.3 Primary and secondary symbol combined. A letter symbol containing both primary and secondary letters has a unique meaning. This meaning is not the meaning associated with the primary symbol alone or the secondary symbol alone, but the combination meaning formed from both.

20.2.4 Descriptive information. Descriptive information concerning a letter symbol may be added in parentheses after and on the same line as the secondary symbol. The abbreviations "max" and "min" are excluded from this rule. These designate limit values and are not considered to be part of the symbol itself.

20.2.5 Commonly used specific subscript abbreviations. Terminal and value abbreviations shall be as shown below:

Bias	B
Common-mode	C (second subscript)
Differential	D (second subscript)
High logic level	H
Input	I (first subscript)
Low logic level	L
Maximum (peak) value 1/	M 1/
Node	N
Output	O (first subscript)
Offset	O (second subscript)
Single-ended	S
Short-circuit	S

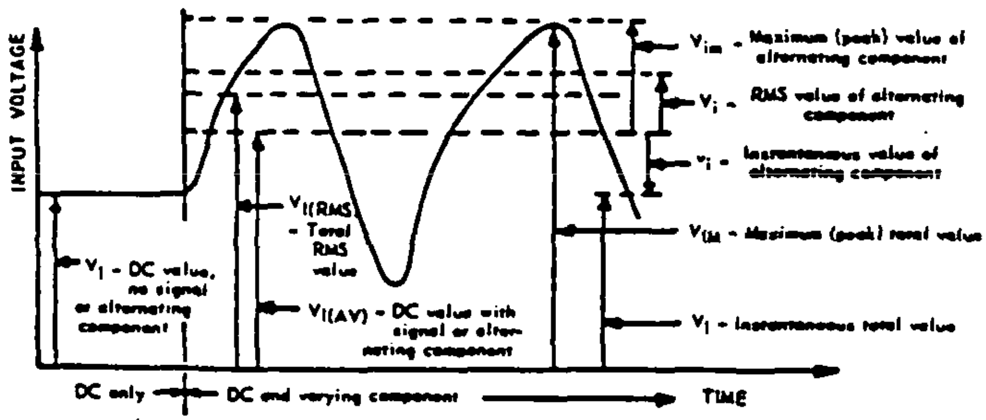
1/ This refers to the peak value on a waveform, not to the maximum-limit value. See 20.3.2.

20.3 Principles of applications.

20.3.1 Primary symbols and secondary symbols.

PRIMARY SYMBOLS	
Use lower-case letters for:	Use upper-case letters for:
1. Instantaneous or instantaneous total values of current, voltage, or power which vary with time. Examples: i, v, p (See illustration 20.3.2)	1. DC, RMS, RMS total, maximum (peak), or average values of current, voltage, or power. Examples: I, V, P (See illustration 20.3.2)
2. Values of four-pole matrix parameters (ratios of terminal electrical quantities), or other resistances, impedances, admittances, etc, inherent in the device. Example: z_{id}	2. Values of four-pole matrix parameters (ratios of terminal electrical quantities), or other resistances, impedances, admittances, etc, in the external circuits. Examples: R_O, Z_I
SECONDARY SYMBOLS	
Use lower-case letters for:	Use upper-case letters for:
1. Instantaneous, RMS, or maximum (peak) varying component values. Examples: v_i, V_i, V_{im}	1. Instantaneous total values, maximum (peak) total values, average, DC, or RMS total values. Examples: v_I, V_{IM}, $V_{I(AV)}$, V_I, $V_{I(RMS)}$
2. Small-signal values of parameters. Example: A_{vs}	2. Static values and large-signal values of parameters. Example: A_{VS}

20.3.2 Illustration, input voltage symbols.



30. TERMS AND DEFINITIONS APPLICABLE TO ALL MICROCIRCUITS

30.1 Maximum limit. The highest-magnitude limit of a range of some quantity. For logic levels only, the most positive (least negative) limit.

30.2 Minimum limit. The lowest-magnitude limit of a range of some quantity. For logic levels only, the least positive (most negative) limit.

30.3 Maximum supply voltage (V_{CC} max, V_{DD} max, V_{EE} max, etc). The maximum supply voltage that may be applied for which operation of the microcircuit within specification limits is guaranteed.

30.4 Minimum supply voltage (V_{CC} min, V_{DD} min, V_{EE} min, etc). The minimum supply voltage that may be applied for which operation of the microcircuit within specification limits is guaranteed.

30.5 Absolute maximum supply voltage. The maximum supply voltage that may be applied without hazard of permanently altering the characteristics of the microcircuit.

30.6 Terminal capacitance. The term "terminal-to-ground capacitance" is preferred.

40. DIGITAL MICROCIRCUITS

40.1 General terms and definitions.

40.1.1 High level. The level which is the most positive of the two logic levels.

40.1.2 Low level. The level which is the most negative of the two logic levels.

40.1.3 Negative logic. The logic is termed negative when logic ZERO state is assigned to the HIGH level and logic ONE state to the LOW level.

40.1.4 Positive logic. The logic is termed positive when logic ONE state is assigned to the HIGH level and logic ZERO state to the LOW level.

40.1.5 Truth table. A tabulation relating all output logic levels to all possible combinations of input logic levels for sufficient successive time intervals (t_n, t_n+1) to completely characterize the static and dynamic functions of the logic microcircuit, expressed in logic levels or appropriate symbols.

40.2 Letter symbols, terms, and definitions relating to characteristics and operating conditions.

40.2.1 Minimum asynchronous input pulse width (APW). The smallest pulse width for which stable transition of logic levels, according to the truth table, is guaranteed when the asynchronous inputs are returned to their noncontrolling levels.

40.2.2 Minimum clock pulse width (CPW). The smallest pulse width for which stable transition of logic levels, according to the truth table, is guaranteed when the clock goes through the required sequence.

40.2.3 Minimum and maximum clock repetition rates (CRR). The lowest and highest rates at which clock pulses may repeat logic levels for which stable transition of logic levels, according to the truth table, is guaranteed when the clock goes through its required sequence.

40.2.4 High-level supply current (I_{CCH}, I_{DDH}, I_{EEH}, etc). The current flowing into* a supply terminal of a microcircuit when all the outputs are at a high-level voltage.

*Current flowing out of a terminal may be considered as a negative quantity.

40.2.5 Low-level supply current (I_{CCL}, I_{DDL}, I_{EEL}, etc). The current flowing into* a supply terminal of a microcircuit when all the outputs are at a low-level voltage.

40.2.6 Maximum collector cut-off current (I_{CEX}). The maximum forced current measured at the collector of an output transistor without a current source (pull-up) that will produce a specified high-level output voltage.

40.2.7 High-level input current (I_{IH}). The current flowing into* an input when a specified high-level voltage is applied to that input.

40.2.8 Low-level input current (I_{IL}). The current flowing into* an input when a specified low-level voltage is applied to that input.

40.2.9 High-level node input current (I_{INH}). The current flowing into* an input node with a specified high-level voltage applied to that node.

40.2.10 Low-level node input current (I_{INL}). The current flowing into* an input node with a specified low-level voltage applied to that node.

40.2.11 High-level output current (I_{OH}). The current flowing into* the output at a specified high-level output voltage.

40.2.12 Low-level output current (I_{OL}). The current flowing into* the output at a specified low-level output voltage.

40.2.13 Output short-circuit current (I_{OS}). The current which flows into* an output when the output is short circuited to ground with the specified conditions applied to establish the output logic level farthest from ground potential.

40.2.14 Input signals timing relationships (ITR) (synchronous, asynchronous, and clock). The time relationship which must exist between input signals as a necessary condition to ensure compliance with the truth table. Time must be specified from positive- or negative-going edges of the clock pulse.

40.2.15 Propagation delay time, high-to-low-level output (t_{PHL}). The time between the specified reference points on the input and output voltage waveforms with the specified output changing from the defined high level to the defined low level. The reference points on both the input and output waveforms are the same value which is midway between the maximum low-level input voltage (V_{IL} max) and the minimum high-level input voltage (V_{IH} min).

40.2.16 Propagation delay time, low-to-high-level output (t_{PLH}). The time between the specified reference points on the input and output voltage waveforms with the specified output changing from the defined low level to the defined high level. The reference points on both the input and output waveforms are the same value which is midway between the maximum low-level input voltage (V_{IL} max) and the minimum high-level input voltage (V_{IH} min).

40.2.17 Transition time, high-to-low-level output (t_{THL}). The time between a specified high-level voltage and a specified low-level voltage on the output voltage waveform with the specified output changing from the defined high level to the defined low level.

40.2.18 Transition time, low-to-high-level output (t_{TLH}). The time between a specified low-level voltage and a specified high-level voltage on the output voltage waveform with the specified output changing from the defined low level to the defined high level.

*Current flowing out of a terminal may be considered as a negative quantity.

40.2.19 Minimum and maximum clock-level transition times (t_{TC}). The shortest and longest transition times of a clock pulse for which stable transition of logic levels, according to the truth table, is guaranteed when the clock goes through its required sequence.

40.2.20 Minimum and maximum clock levels, high and low (V_{CH} and V_{CL}). The lowest and highest magnitudes of clock voltages, for both high and low levels, for which stable transition of logic levels, according to the truth table, is guaranteed when the clock goes through its required sequence at the specified maximum repetition rate.

40.2.21 Maximum high-level input voltage (V_{IH} max). The most positive (least negative) value of high-level input voltage for which operation of the logic element within specification limits is guaranteed.

40.2.22 Minimum high-level input voltage (V_{IH} min). The least positive (most negative) value of high-level input voltage for which operation of the logic element within specification limits is guaranteed.

40.2.23 Maximum low-level input voltage (V_{IL} max). The most positive (least negative) value of low-level input voltage for which operation of the logic element within specification limits is guaranteed.

40.2.24 Minimum low-level input voltage (V_{IL} min). The least positive (most negative) value of low-level input voltage for which operation of the logic element within specification limits is guaranteed.

40.2.25 Maximum high-level node input voltage (V_{INH} max). The most positive (least negative) value of high-level node voltage for which operation of the logic element within specification limits is guaranteed.

40.2.26 Minimum high-level node input voltage (V_{INH} min). The least positive (most negative) value of high-level node voltage for which operation of the logic element within specification limits is guaranteed.

40.2.27 Maximum low-level node input voltage (V_{INL} max). The most positive (least negative) value of low-level node voltage for which operation of the logic element within specification limits is guaranteed.

40.2.28 Minimum low-level node input voltage (V_{INL} min). The least positive (most negative) value of low-level node voltage for which operation of the logic element within specification limits is guaranteed.

40.2.29 Noise margin (V_N). The voltage amplitude of extraneous signal which can be algebraically added to the noise-free worst-case "input" level before the output voltage deviates from the allowable logic voltage levels. The term "input" is used here to refer to logic input terminals, power supply terminals, or ground reference terminals.

4.2.30 High-level output voltage (V_{OH}). The voltage level at an output terminal for a specified output current with the specified conditions applied to establish a high level at the output.

4.2.31 Low-level output voltage (V_{OL}). The voltage level at the output terminal for a specified output current with the specified conditions applied to establish a low level at the output.

50. LINEAR (ANALOG) MICROCIRCUITS

50.1 General terms and definitions.

50.1.1 Balanced amplifier. An amplifier having one output is considered balanced when the quiescent DC output voltage is reduced to zero or a specified level. An amplifier having two outputs is considered balanced when the difference between the quiescent DC output voltages is reduced to zero or a specified level.

50.2 Letter symbols, terms, and definitions relating to characteristics.

50.2.1 Automatic gain control range (AGC range). The maximum change in gain expressed in dB which may be achieved by application of a specified range of DC voltages to the AGC input.

50.2.2 Common-mode voltage amplification (A_{VC} or A_{vc})†. The ratio of the change in voltage at the output terminal with respect to ground (or change in voltage between the output terminals) to the change in common-mode input voltage with the differential input voltage held constant.

50.2.3 Differential voltage amplification (A_{VD} or A_{vd})†. The ratio of the change in voltage at the output terminal with respect to ground (or change in voltage between the output terminals) to the change in differential input voltage with the common-mode input voltage held constant.

50.2.4 Single-ended voltage amplification (A_{VS} or A_{vs})†. The ratio of the change in single-ended output voltage of a differential amplifier to the change in single-ended input voltage.

50.2.5 Bandwidth (B or BW). The range of frequencies within which the gain of the amplifier is not more than 3 dB below the value of the midband gain. Midband gain is the gain at a specified frequency or the average gain over a specified frequency range.

50.2.6 Maximum-output-swing bandwidth (B_{OM}). The range of frequencies within which the maximum-output-voltage swing is above a specified value (or a specified load impedance.

50.2.7 Common-mode rejection ratio (CMRR). The ratio of the differential voltage amplification to the common-mode voltage amplification.

50.2.8 Noise factor (F). The ratio of the total noise power delivered to the load to the noise power that would be delivered to the load if the only output noise component were due to the thermal noise of the input source resistance at a temperature of 290° K.

50.2.9 Power gain or insertion power gain (G_P or G_p)†. The ratio, usually expressed in dB, of the signal power delivered to the load(s) to the signal power delivered to the input(s). (dB = 10 log P_{load}/P_{in}).

50.2.10 Transducer power gain (G_T or G_t)†. The ratio, usually expressed in dB, of the signal power delivered to the load(s) to the signal power available from the source. (dB = 10 log P_{load}/P_{source}).

50.2.11 Input bias current (I_{IB}). The current into* the input or the average of the currents into* the inputs when the device is in the quiescent or balanced state.

50.2.12 Input offset current (I_{IO}). The difference between the currents into* the input terminals of a differential-input device in the quiescent or balanced state.

† Upper-case subscripts indicate large-signal quantities; lower-case subscripts indicate small-signal quantities.
* Current flowing out of a terminal may be considered as a negative quantity.

50.2.13 Noise figure (NF). Noise factor expressed in decibels.

50.2.14 DC power dissipation (P_D). The total DC power supplied to a device less any power delivered from the device to a load.

50.2.15 Power supply rejection ratio (PSRR or $\Delta V_{IO}/\Delta V_{CC}$ $\Delta V_{IO}/\Delta V_{DD}$, etc). 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.

50.2.16 Slew rate (SR). The time rate of change of the closed-loop amplifier output voltage for a step-signal input. Normally, slew rate is measured using the largest input voltage step for which the amplifier performance remains linear with feedback adjusted for unity gain.

50.2.17 Total harmonic distortion (THD). The ratio, expressed in percent, of the RMS voltage of all harmonics present in the output to the total RMS voltage of the output for a pure sine wave input. The RMS voltages are measured at an output terminal with respect to ground.

50.2.18 Transient response (TR). The closed-loop step function response of an amplifier under small-signal conditions.

50.2.19 Overload recovery time (t_{or}). The time required for an amplifier to recover its ability to perform amplification within stated specification limits after the output voltage amplitude has been distorted by the application of a specified input voltage in excess of rated amplitude.

50.2.20 Quiescent input voltage (V_I). The DC voltage at the input of an amplifier with reference to a common terminal, normally ground, with no signal applied to the input.

50.2.21 Common-mode input voltage (V_{IC}). The components of the voltages at two input terminals which are identical in phase and amplitude.

50.2.22 Common-mode input voltage range (V_{ICR}). The range of common-mode voltages which, if exceeded, will cause the total harmonic distortion of the amplifier to exceed a specified maximum value.

50.2.23 Differential input voltage (V_{ID}). The difference between the two voltages applied to the input terminals of an amplifier.

50.2.24 Input offset voltage (V_{IO}). The DC voltage which must be applied between the input terminals to force the quiescent DC output voltage to zero or other specified level.

50.2.25 Single-ended input voltage (V_{IS}). The signal voltage which is applied to one input of a differential amplifier with the other input terminal at signal ground.

50.2.26 Single-ended input voltage range (V_{ISR}). The range of single-ended input voltage which, if exceeded on any input terminal, will cause the total harmonic distortion of the amplifier to exceed a specified maximum value.

50.2.27 Quiescent output voltage (V_O). The DC voltage at an output terminal with reference to a common terminal, normally ground, when no signal is applied to the input.

50.2.28 Common-mode output voltage (V_{OC}). The difference between the AC voltages present at two output terminals (or the output terminal and ground for amplifiers with one output) when signals of identical phase and amplitude are applied to the input terminals.

50.2.29 Differential output voltage (V_{OD}). The difference between the voltages present at the two output terminals when a differential input voltage is applied to the input terminals of an amplifier.

50.2.30 Output offset voltage (V_{OO}). The difference between the DC voltages present at two output terminals (or the output terminal and ground for amplifiers with one output) when the input terminals are grounded.

50.2.31 Maximum output voltage swing (V_{OPP}). The maximum peak-to-peak output voltage which can be obtained without waveform clipping when the quiescent DC output voltage is set at a specified reference level.

50.2.32 Single-ended output voltage (V_{OS}). The signal voltage present between one output terminal and ground of an amplifier having differential outputs.

50.2.33 AC unbalance voltage (V_{OU}). The difference between the peak values of the AC voltages at the two outputs when the amplifier is operating in the maximum-output-voltage-swing condition.

50.2.34 Differential input impedance (z_{id}). The small-signal impedance between two ungrounded input terminals of a differential amplifier.

50.2.35 Single-ended input impedance (z_{is}). The small-signal impedance between one input terminal of a differential amplifier and ground with the other input terminal AC grounded.

50.2.36 Differential output impedance (z_{od}). The small-signal impedance between two ungrounded output terminals of a differential amplifier.

50.2.37 Single-ended output impedance (z_{os}). The small-signal impedance between one output terminal of a differential amplifier and ground with the other output terminal AC grounded.

50.2.38 Input bias current temperature sensitivity ($\Delta I_{IB}/\Delta T$). The ratio of the change in the input bias current to the change in circuit temperature for a constant output voltage. This is an average value for a specified current range.

50.2.39 Input offset current temperature sensitivity ($\Delta I_{IO}/\Delta T$). The ratio of the change of input offset current to the change of circuit temperature for a constant output voltage. This is an average value for a specified current range.

50.2.40 Input offset voltage temperature sensitivity ($\Delta V_{IO}/\Delta T$). The ratio of the change of input offset voltage to the change of circuit temperature for a constant output voltage. This is an average value for a specified temperature range.

50.2.41 Phase margin (Φ_m). A figure equal to 180 degrees minus the absolute value of the phase shift measured around the loop at that frequency at which the magnitude of the loop gain is unity.

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