

INCH-POUND
MIL-M-38510/108A
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SUPERSEDING
MIL-M-38510/108 (USAF)
9 April 1976

MILITARY SPECIFICATION
MICROCIRCUITS, LINEAR, TRANSISTOR ARRAYS, MONOLITHIC SILICON

This specification is approved for use by all Departments and Agencies of the Department of Defense.

Inactive for new design as of 10 July 1995

The requirements for acquiring the product herein shall consist of this specification sheet and MIL-PRF 38535

1. SCOPE

1.1 Scope. This specification covers the detail requirements for monolithic silicon transistor arrays. Two product assurance classes and a choice of case outlines and lead finishes are provided and are reflected in the complete part number. For this product, the requirements of MIL-M-38510 have been superseded by MIL-PRF-38535, (see 6.3)

1.2 Part or Identifying Number (PIN). The PIN should be in accordance with MIL-PRF-38535, and as specified herein.

1.2.1 Device types. The device types should be as follows:

<u>Device type</u>	<u>Circuit</u>
01	Two isolated NPN transistors and one NPN Darlington connected pair, general purpose.
02	Three isolated NPN transistors and one NPN differentially connected pair, general purpose.

1.2.2 Device class. The device class should be the product assurance level as defined in MIL-PRF-38535.

1.2.3 Case outline. The case outline should be as designated in MIL-STD-1835 and as follows:

<u>Outline letter</u>	<u>Descriptive designator</u>	<u>Terminals</u>	<u>Package style</u>
A 1/	GDFP5-F14 or CDFP6-F14	14	Flat pack
C	GDIP1-T14 or CDIP2-T14	14	Dual-in-line
D	GDFP1-F14 or CDFP2-F14	14	Flat pack
M	MACY1-X12	12	Can

1/ Inactive package case outline.

Comments, suggestions, or questions on this document should be addressed to: Commander, Defense Supply Center Columbus, ATTN: DSCC-VAS, 3990 East Broad St., Columbus, OH 43216-5000, or emailed to bipolar@dsccl.dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil.

1.3 Absolute maximum ratings. 1/

Collector – base voltage	40 V dc	2/
Collector – emitter voltage.....	15 V dc	2/
Collector – substrate voltage	60 V dc	3/
Emitter – base voltage	5 V dc	2/
Power dissipation	300 mW	2/
Collector current	50 mA	2/
Storage temperature range	-65°C to +150°C	
Junction temperature	+175°C	
Lead temperature (soldering, 60 seconds)	+300°C	

1.4 Recommended operating conditions.

Collector – base voltage	32 V dc	2/
Collector – emitter voltage.....	12 V dc	2/
Ambient operating temperature range	-55°C ≤ T _A ≤ +125°C	

1.5 Power and thermal characteristics.

<u>Case outline</u>	<u>Maximum allowable power dissipation</u>	<u>Maximum θ_{JC}</u>	<u>Maximum θ_{JA}</u>
A, D, M	350 mW @ T _A = 125°C	60°C/W	140°C/W
C	400 mW @ T _A = 125°C	40°C/W	120°C/W

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-38535 - Integrated Circuits (Microcircuits) Manufacturing, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-883 - Test Method Standard for Microelectronics.
 MIL-STD-1835 - Interface Standard Electronic Component Case Outlines.

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or www.dodssp.daps.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein the text of this document shall takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

1/ The collector of each transistor is isolated from the substrate by an integral diode. The substrate must be connected to the most negative point in the external circuit to maintain isolation between transistors and to provide for normal transistor action.
 2/ Rating applies to each transistor within the array.
 3/ Does not apply to Q₅ of device type 02, refer to V_{CEO} rating.

3. REQUIREMENTS

3.1 Qualification. Microcircuits furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturers list before contract award (see 4.3 and 6.4).

3.2 Item requirements. The individual item requirements shall be in accordance with MIL-PRF-38535 and as specified herein or as modified in the device manufacturer's Quality Management (QM) plan. The modification in the QM plan shall not affect the form, fit, or function as described herein. This slash sheet has been modified to allow the manufacturer to use the alternate die/fabrication requirements of paragraph A.3.2.2 of MIL-PRF-38535 or other alternative approved by the Qualifying Activity.

3.3 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-PRF-38535 and herein.

3.3.1 Circuit diagrams and terminal connections. The logic diagram and terminal connections shall be as specified on figure 1.

3.3.2 Schematic circuits. The schematic circuits shall be maintained by the manufacturer and made available to the qualifying activity and the preparing activity (DSCC-VA) upon request.

3.3.4 Case outlines. The case outlines shall be as specified in 1.2.3.

3.4 Lead material and finish. The lead material and finish shall be in accordance with MIL-PRF-38535 (see 6.6).

3.5 Electrical performance characteristics. The electrical performance characteristics are as specified in table I, and apply over the full recommended ambient operating temperature range, unless otherwise specified.

3.6 Electrical test requirements. Electrical test requirements for each device class shall be the subgroups specified in table II. The electrical tests for each subgroup are described in table III.

3.7 Marking. Marking shall be in accordance with MIL-PRF-38535.

3.7.1 Certification/compliance mark. The certification mark for device classes Q and V shall be a "QML" or "Q" as required in MIL-PRF-38535. For class Q product built in accordance with A.3.2.2 of MIL-PRF-38535 or other alternative approved by the Qualifying Activity, the "QD" certification mark shall be used in place of the "QML" or "Q" certification mark.

3.8 Microcircuit group assignment. The devices covered by this specification shall be in microcircuit group number 53 (see MIL-PRF-38535, appendix A).

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions	Temperature range	Device type	Limits <u>1/</u>		Unit
					Min	Max	
Breakdown voltage, collector to base	$V_{(BR)CBO}$	$I_C = 10 \mu A, I_E = 0$	$-55^\circ C \leq T_A \leq +125^\circ C$	01, 02	40		V
Breakdown voltage, collector to emitter	$V_{(BR)CEO}$	$I_C = 1 \text{ mA}, I_B = 0$	$-55^\circ C \leq T_A \leq +125^\circ C$	01, 02	15		V
Breakdown voltage, collector to substrate <u>2/</u>	$V_{(BR)CUO}$	$I_C = 10 \mu A$	$-55^\circ C \leq T_A \leq +125^\circ C$	01, 02	60		V
Breakdown voltage, emitter to base <u>2/</u>	$V_{(BR)EBO}$	$I_E = 10 \mu A, I_C = 0$	$-55^\circ C \leq T_A \leq +125^\circ C$	01, 02	5.0		V
Collector to base cutoff current	I_{CBO}	$V_{CB} = 35 \text{ V}, I_E = 0$	$-55^\circ C \leq T_A \leq +25^\circ C$	01, 02		10	nA
			$T_A = +125^\circ C$			0.2	μA
Collector to emitter cutoff current	I_{CEO}	$V_{CE} = 10 \text{ V}, I_B = 0$	$-55^\circ C \leq T_A \leq +25^\circ C$	01, 02		10	nA
			$T_A = +125^\circ C$			1.0	μA
Collector to emitter cutoff current (Darlington pair) <u>3/</u>	$I_{CEO(D)}$	$V_{CE} = 10 \text{ V}, I_B = 0$	$-55^\circ C \leq T_A \leq +25^\circ C$	01		20	nA
			$T_A = +125^\circ C$			50	μA
Collector to substrate cutoff current <u>2/</u>	I_{CUO}	$V_{CU} = 40 \text{ V}$	$-55^\circ C \leq T_A \leq +25^\circ C$	01, 02		10	nA
			$T_A = +125^\circ C$			200	
Emitter to base cutoff current	I_{EBO}	$V_{EB} = 4 \text{ V}, I_C = 0$	$-55^\circ C \leq T_A \leq +25^\circ C$	01, 02		10	nA
			$T_A = +125^\circ C$			200	
Collector to emitter voltage (saturated)	$V_{CE(sat)}$	$I_C = 10 \text{ mA}, I_B = 1 \text{ mA}$	$-55^\circ C \leq T_A \leq +25^\circ C$	01, 02		0.400	V
			$T_A = +125^\circ C$			0.600	
Base emitter voltage (saturated)	$V_{BE(sat)}$	$I_C = 10 \text{ mA}, I_B = 1 \text{ mA}$	$+25^\circ C \leq T_A \leq +125^\circ C$	01, 02		1.0	V
			$T_A = -55^\circ C$			1.1	
Base emitter voltage (unsaturated)	V_{BE}	$V_{CE} = 3 \text{ V}, I_E = -1 \text{ mA}$	$T_A = +25^\circ C$	01, 02	0.600	0.800	V
			$T_A = +125^\circ C$		0.450	0.650	
			$T_A = -55^\circ C$		0.750	0.950	
Base emitter voltage (unsaturated)	V_{BE}	$V_{CE} = 3 \text{ V}, I_E = -10 \text{ mA}$	$T_A = +25^\circ C$	01, 02		0.900	V
			$T_A = +125^\circ C$			0.750	
			$T_A = -55^\circ C$			1.000	
Base emitter voltage (unsaturated), Darlington pair <u>3/</u>	$V_{BE(D)}$	$V_{CE} = 3 \text{ V}, I_E = -1 \text{ mA}$	$T_A = +25^\circ C$	01	1.100	1.500	V
			$T_A = +125^\circ C$		0.700	1.100	
			$T_A = -55^\circ C$		1.500	1.900	
Base emitter voltage (unsaturated), Darlington pair <u>3/</u>	$V_{BE(D)}$	$V_{CE} = 3 \text{ V}, I_E = -10 \text{ mA}$	$T_A = +25^\circ C$	01		1.600	V
			$T_A = +125^\circ C$			1.200	
			$T_A = -55^\circ C$			2.00	
Input offset voltage, differential pair <u>4/</u>	$ V_{BEQ1} - V_{BEQ2} $	$V_{CE} = 3 \text{ V}, I_E = -1 \text{ mA}$	$T_A = +25^\circ C$	01, 02		2.0	mV
			$-55^\circ C \leq T_A \leq +125^\circ C$			3.0	
Input offset voltage for pairs of isolated transistors <u>5/ 6/ 7/</u>	$ V_{BEQA} - V_{BEQB} $	$V_{CE} = 3 \text{ V}, I_E = -1 \text{ mA}$	$T_A = +25^\circ C$	01, 02		2.0	mV
			$-55^\circ C \leq T_A \leq +125^\circ C$			3.0	

See footnotes at end of table.

TABLE I. Electrical performance characteristics – Continued.

Test	Symbol	Conditions	Temperature range	Device type	Limits ^{1/}		Unit
					Min	Max	
Temperature coefficient of base emitter voltage <u>5/ 8/</u>	$\Delta V_{BE}/\Delta T$	$V_{CE} = 3 \text{ V}, I_E = -1 \text{ mA}$	$-55^\circ\text{C} \leq T_A \leq +25^\circ\text{C}$	01	-2.2	-1.5	mV/°C
				02	-2.2	-1.3	
			$+25^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	01	-2.2	-1.5	
				02	-2.2	-1.3	
Temperature coefficient of base emitter voltage, Darlington pair <u>3/ 8/</u>	$\Delta V_{BE(D)}/\Delta T$	$V_{CE} = 3 \text{ V}, I_E = -1 \text{ mA}$	$-55^\circ\text{C} \leq T_A \leq +25^\circ\text{C}$	01	-5.0	-3.5	mV/°C
			$+25^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		-5.0	-3.5	
Temperature coefficient of input offset voltage <u>5/ 9/</u>	$(\Delta V_{BEQA} - V_{BEQB})/\Delta T$	$V_{CE} = 3 \text{ V}, I_E = -1 \text{ mA}$	$-55^\circ\text{C} \leq T_A \leq +25^\circ\text{C}$	01, 02		15	$\mu\text{V}/^\circ\text{C}$
			$+25^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			15	
Static forward current transfer ratio (beta)	h_{FE}	$V_{CE} = 3 \text{ V}, I_C = 10 \mu\text{A}$	$+25^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	01, 02	45		
			$T_A = -55^\circ\text{C}$		25		
Static forward current transfer ratio (beta)	h_{FE}	$V_{CE} = 3 \text{ V}, I_C = 1 \text{ mA}$	$+25^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	01	70	300	
			$T_A = -55^\circ\text{C}$		40		
			$+25^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	02	70		
			$T_A = -55^\circ\text{C}$		40		
Static forward current transfer ratio (beta)	h_{FE}	$V_{CE} = 3 \text{ V}, I_C = 10 \text{ mA}$	$+25^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	01, 02	60		
			$T_A = -55^\circ\text{C}$		35		
Magnitude of static beta ratio for any two isolated transistors <u>5/ 6/ 7/</u>	h_{FEQA}/h_{FEQB}	$V_{CE} = 3 \text{ V}, I_C = 1 \text{ mA}$	$T_A = +25^\circ\text{C}$	01, 02	0.9	1.1	
			$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		0.85	1.15	
Static forward current transfer ratio, Darlington pair <u>3/</u>	$h_{FE(D)}$	$V_{CE} = 3 \text{ V}, I_C = 1 \text{ mA}$	$+25^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	01	4000		
			$T_A = -55^\circ\text{C}$		2500		
Static forward current transfer ratio, Darlington pair <u>3/</u>	$h_{FE(D)}$	$V_{CE} = 3 \text{ V}, I_C = 100 \mu\text{A}$	$+25^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	01	2500		
			$T_A = -55^\circ\text{C}$		1500		
Low frequency, small signal, forward current transfer ratio	h_{fe}	$V_{CE} = 3 \text{ V}, I_C = 1 \text{ mA}$	$T_A = -55^\circ\text{C}$	01, 02	35		
			$+25^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		60		
Gain-bandwidth product	f_t	See figure 4	$T_A = +25^\circ\text{C}$	01, 02	300		MHz
Delay time	t_d	See figure 2	$T_A = +25^\circ\text{C}$	01, 02		100	ns
			$T_A = -55^\circ\text{C}, +125^\circ\text{C}$			160	
Rise time	t_r	See figure 2	$T_A = +25^\circ\text{C}$	01, 02		50	ns
			$T_A = -55^\circ\text{C}, +125^\circ\text{C}$			80	
Storage time	t_s	See figure 2	$T_A = +25^\circ\text{C}$	01, 02		200	ns
			$T_A = -55^\circ\text{C}, +125^\circ\text{C}$			300	

See footnotes at end of table.

TABLE I. Electrical performance characteristics – Continued.

Test	Symbol	Conditions	Temperature range	Device type	Limits <u>1/</u>		Unit
					Min	Max	
Fall time	t_f	See figure 2	$T_A = +25^\circ\text{C}$	01, 02		80	ns
			$T_A = -55^\circ\text{C}, +125^\circ\text{C}$			125	
Channel separation	C.S.	See figure 3	$T_A = +25^\circ\text{C}$	01, 02	80		dB

1/ Limits apply to each transistor within the array, unless otherwise specified.

2/ Does not apply to Q_5 of device type 02.

3/ Applies only to Darlington pair (Q_3, Q_4) of device type 01.

4/ Applies only to differential pair (Q_1, Q_2) of device type 02.

5/ Does not apply to Darlington pair (Q_3, Q_4) of device type 01.

6/ Does not apply to differential pair (Q_1, Q_2) of device type 02.

7/ Applies for pairs (Q_1, Q_2) of device type 01 and for pairs (Q_1, Q_3), (Q_1, Q_4), (Q_1, Q_5) of device type 02.

8/ $(V_{BE} @ 125^\circ\text{C} - V_{BE} @ 25^\circ\text{C}) / (125^\circ\text{C} - 25^\circ\text{C})$, $(V_{BE} @ 25^\circ\text{C} - V_{BE} @ -55^\circ\text{C}) / (25^\circ\text{C} - (-55^\circ\text{C}))$

9/ $(|V_{BEQA} - V_{BEQB}| @ 125^\circ\text{C} - |V_{BEQA} - V_{BEQB}| @ 25^\circ\text{C}) / (125^\circ\text{C} - 25^\circ\text{C})$,

$(|V_{BEQA} - V_{BEQB}| @ 25^\circ\text{C} - |V_{BEQA} - V_{BEQB}| @ -55^\circ\text{C}) / (25^\circ\text{C} - (-55^\circ\text{C}))$

TABLE II. Electrical test requirements.

MIL-PRF-38535 test requirements	Subgroups (see table III)	
	Class S devices	Class B devices
Interim electrical parameters	1	1
Final electrical test parameters	1*, (2, 3, 4)**	1*, (2, 3, 4)**
Group A test requirements	1,2,3,4,5,6 7,9,10,11	1, 2, 3, 4
Group B electrical test parameters when using the method 5005 QCI option	1,2,3 and table IV delta limits	N/A
Group C end-point electrical parameters	1,2,3 and table IV delta limits	1,2,3 and table IV delta limits
Group D end-point electrical parameters	1,2,3	1,2,3

*PDA applies to subgroup 1

** $\Delta V_{BE}/\Delta T$ and $(\Delta|V_{BEQA} - V_{BEQB}|)/\Delta T$ test as specified in table III herein for group A, subgroups 2 and 3, and t_f tests as specified in table III herein for group A, subgroup 4, are not required for final electrical tests (for device 02 only) but shall be performed for group A sample testing.

4. VERIFICATION.

4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with MIL-PRF-38535 or as modified in the device manufacturer's Quality Management (QM) plan. The modification in the QM plan shall not effect the form, fit, or function as function as described herein.

4.2 Screening. Screening shall be in accordance with MIL-PRF-38535, and shall be conducted on all devices prior to qualification and quality conformance inspection. The following additional criteria shall apply:

- a. The burn-in test duration, test condition, and test temperature, or approved alternatives shall be as specified in the device manufacturer's QM plan in accordance with MIL-PRF-38535. The burn-in test circuit shall be maintained under document control by the device manufacturer's Technology Review Board (TRB) in accordance with MIL-PRF-38535 and shall be made available to the acquiring or preparing activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in test method 1015 of MIL-STD-883.
- b. Burn-in test (method 1015 of MIL-STD-883) 1/.

Test condition	B		A <u>2/</u>	
Product assurance class	S	B	S	B
T _A minimum	125°C	125°C	250°C	200°C
t minimum	240 hours	168 hours	16 hours or 200°C 168 hours	16 hours

Notes:

- 1/ The vertical columns of this table establish alternate combinations of test conditions from which the manufacturer may choose any one for a given product assurance class, at their option, unless otherwise specified in the procurement documentation. The same condition shall be used for all devices in a given inspection lot and the same condition shall be used for both burn-in (when applicable), and operating life test for any given inspection lot. Alternate 2 for stabilization bake and high temperature storage tests shall be used only when test condition A has been selected, and alternate 1 shall be used when test condition B has been selected.
- 2/ When accelerated test condition A is used, the centrifuge test and hermeticity tests of method 5004 of MIL-STD-883 shall be performed, in that order, subsequent to the burn-in test and before the final electrical test of method 5004 of MIL-STD-883.

- c. Reverse bias burn-in (method 1015 of MIL-STD-883). This screen shall apply to class S only.

Test condition	A
Product assurance class	S
T _A minimum	150°C
t minimum	72 hours

- d. Interim and final electrical test parameters shall be as specified in table II, except interim electrical parameters test prior to burn-in is optional at the discretion of the manufacturer.
- e. Additional screening for space level product shall be as specified in MIL-PRF-38535.

4.3 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-38535.

4.4 Technology Conformance inspection (TCI). Technology conformance inspection shall be in accordance with MIL-PRF-38535 and herein for groups A, B, C, and D inspections (see 4.4.1 through 4.4.4).

4.4.1 Group A inspection. Group A inspection shall be in accordance with table III of MIL-PRF-38535 and as follows:

- a. Tests shall be as specified in table II herein.
- b. Subgroup 8 shall be omitted.

4.4.2 Group B inspection. Group B inspection shall be in accordance with table II of MIL-PRF-38535.

4.4.3 Group C inspection. Group C inspection shall be in accordance with table IV of MIL-PRF-38535 and as follows:

- a. End point electrical parameters shall be as specified in table II herein.
- b. The steady-state life test duration, test condition, and test temperature, or approved alternatives shall be as specified in the device manufacturer's QM plan in accordance with MIL-PRF-38535. The burn-in test circuit shall be maintained under document control by the device manufacturer's Technology Review Board (TRB) in accordance with MIL-PRF-38535 and shall be made available to the acquiring or preparing activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in test method 1005 of MIL-STD-883.
- c. Operating life test (method 1005 of MIL-STD-883) 1/.

Test condition	B		A <u>2/</u>	
	S	B	S	B
Product assurance class	S	B	S	B
T _A minimum	125°C	125°C	250°C	200°C
t minimum	1000 hours	1000 hours	100 hours or 200°C 1000 hours	100 hours
Sample size series number	5	5	10	10

Note:

1/ The vertical columns of this table establish alternate combinations of test conditions from which the manufacturer may choose any one for a given product class, at their option, unless otherwise specified in the procurement documentation.

2/ See 4.2b.

- d. Steady state reverse bias (method 1005 of MIL-STD-883).

Test condition	A
Product assurance class	S
T _A minimum	150°C
t minimum	72 hours
Sample size series number	5

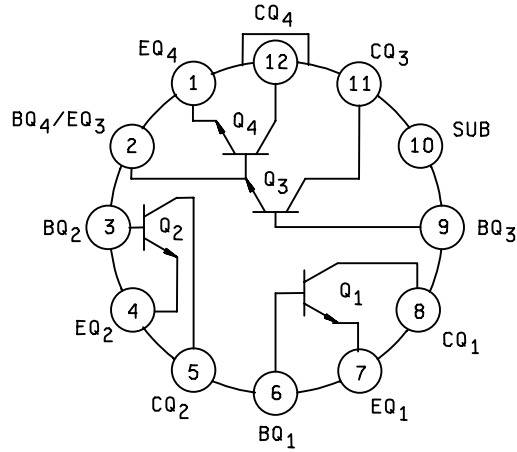
4.4.4 Group D inspection. Group D inspection shall be in accordance with table V of MIL-PRF-38535. End point electrical parameters shall be as specified in table II herein.

4.5 Methods of inspection. Methods of inspection shall be specified as follows.

4.5.1 Voltage and current. All voltage values given are referenced to the microcircuit ground terminals. Currents given are conventional current and positive when flowing into the referenced terminal.

Device type 01

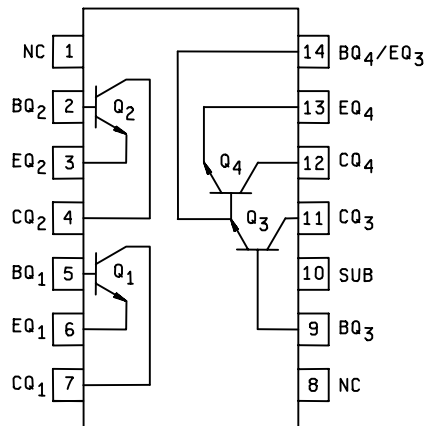
Case M



12 lead can (top view)

Device type 01

Cases A, C, D

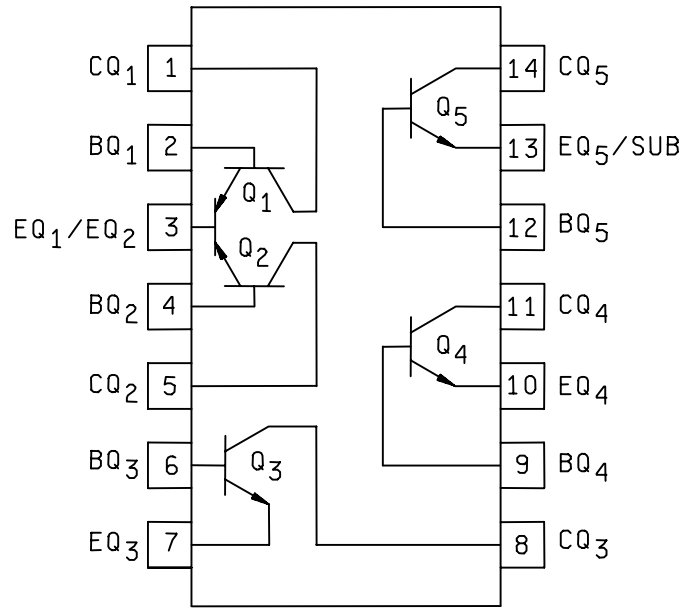


14 lead flat pack or dual-in-line (top view)

Figure 1. Circuit diagrams and terminal connections.

Device type 02

Cases A, C, D



14 lead flat pack or dual-in-line (top view)

Figure 1. Circuit diagrams and terminal connections – Continued.

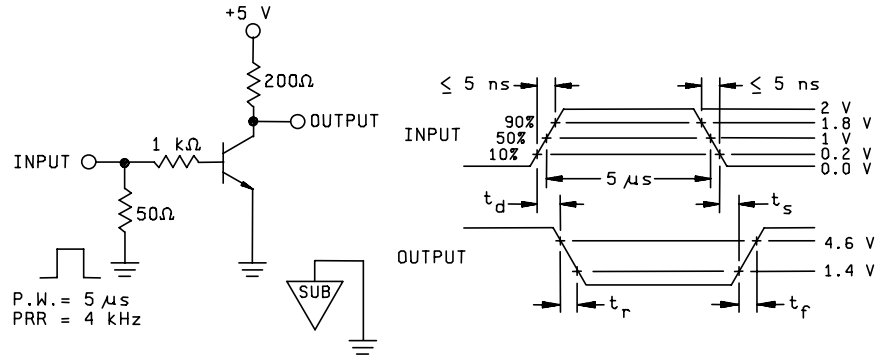
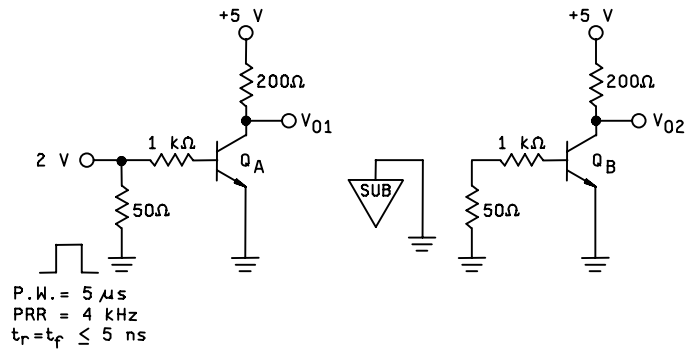


FIGURE 2. Switching time test circuit and waveforms.



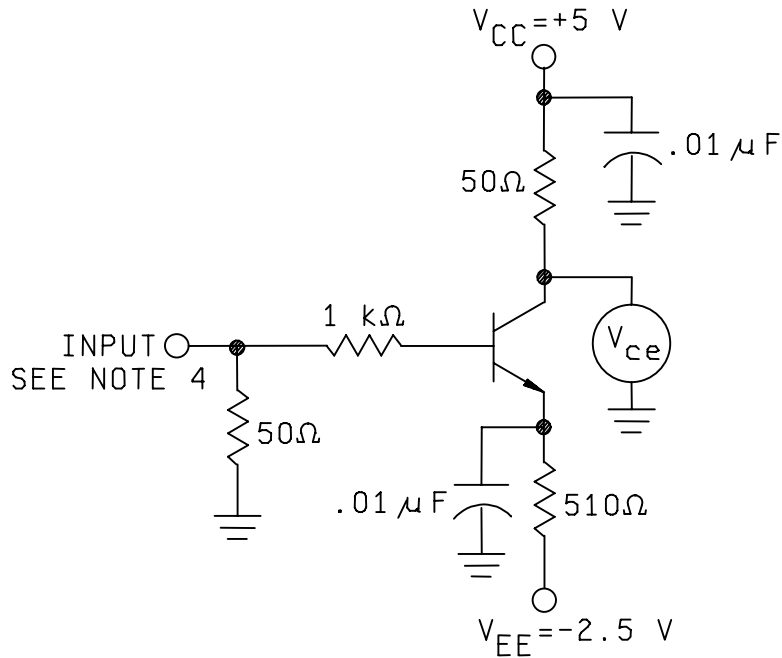
Notes:

1.

Device type	QA	QB
01	Q1	Q2
02	Q3	Q4

2. Measure V_{01} , V_{02} , (volts peak)
3. Isolation = $20 \log (V_{01}/V_{02})$

FIGURE 3. Channel separation test circuit.



Notes:

1. The input shall be a 100 MHz signal containing only the fundamental frequency (THD \leq 0.5%).
2. Connect the substrate to -2.5 V.
3. With the device removed from the circuit, a shorting link is placed between the base and collector and the input signal adjusted for 1.0 mV rms on the high impedance voltmeter V_{ce} . The shorting link is then removed. The device is placed in the circuit and the reading on the voltmeter V_{ce} equal to the magnitude of h_{fe} .
4. $f_t = 100 \text{ MHz} \times h_{fe}$

FIGURE 4. Gain-bandwidth product (f_t) test circuit.

TABLE III. Group A inspection for device type 01.
Terminal conditions (pins not designated may be H ≥ 2.0 V, or L ≤ 0.8 V, or open)

Subgroup	Symbol	Cases A,C,D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Limits		Unit				
																	Measured terminal	Min		Max			
1 T _A = +25°C	V(BR)CBO	Case M	-		3	BQ2	GND					9	10	11	12	13	14						
			Test no.	NC				BQ1	GND				BQ3	SUB	CQ3	CQ4	EQ4	2					
			1																				
			3																				
V	(BR)CEO	2	4																				
			5																				
			6																				
			7																				
			8																				
			9																				
			10																				
			11																				
V	(BR)CEO	2	12																				
			13																				
			14																				
			15																				
			16																				
			17																				
V	CBO		18																				
			19																				
			20																				
			21																				
			22																				
			23																				
			24																				
			25																				
I	CEO		26																				
			27																				
			28																				
			29																				
			30																				
			31																				
			32																				
			33																				
I	CE(SAT)		34																				
			35																				
			36																				
			37																				
			38																				
			39																				
V	BE(SAT)		40																				
			41																				
			42																				
			43																				
			44																				
			45																				
V	BE		46																				
			47																				
			48																				
			49																				
			50																				
			51																				

TABLE III. Group A inspection for device type 01 – Continued.
Terminal conditions (pins not designated may be H ≥ 2.0 V, or L ≤ 0.8 V, or open)

Subgroup	Symbol	Cases A,C,D	Terminal conditions														Limits				
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	Measured terminal	Min	Max	Unit	
2 T _A = +125°C	I _{CEO}	Case M	-	3	BQ2	EQ2	CQ2	BQ1	EQ1	CQ1	NC	BQ3	SUB	CQ3	CQ4	EQ4	2	CQ1	0.2	μA	
		Test no.	NC	BQ2	EQ2	CQ2	BQ1	EQ1	CQ1	NC	BQ3	SUB	CQ3	CQ4	EQ4	BQ4/EQ3		CQ1			
		68					GND			35 V			GND								
					35 V									"					CQ2	"	"
												GND		"	35 V				CQ3	"	"
			GND											"		35 V		GND	CQ4	"	"
											10 V				"				CQ1	1.0	"
		72							GND					"					CQ2	"	"
		71				10 V								"					CQ3	"	"
		73												"	10 V			GND	CQ4	"	"
I _{CE(ON)}	I _{CE(ON)}	76											"	10 V	10 V	GND	CQ3,CQ4	50	"		
		77											"					CQ1	200	nA	
		78				40 V							"					CQ2	"	"	
												"	40 V				CQ3	"	"		
												"		40 V			CQ4	"	"		

79

80

TABLE III. Group A inspection for device type 01 – Continued.
Terminal conditions (pins not designated may be H ≥ 2.0 V, or L ≤ 0.8 V, or open)

Subgroup	Symbol	Cases A,C,D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Limits		Note			
			Case M	Test no.	Case M	Test no.	Case M	Test no.	Case M	Test no.	Case M	Test no.	Case M	Test no.	Case M	Test no.	Case M	Test no.		Measured terminal	Min	Max
2 T _A = +125°C	$ V_{BEQ1} - V_{BEQ2} $	99	NC	BQ2	EQ2	CQ2	BQ1	EQ1	CQ1	NC	BQ3	SUB	GND				-	3.0	mV	1		
	$\Delta V_{BE}/\Delta T$	100										"	"				-	-2.2	-1.5	mV/°C	2	
		101										"	"				-	"	"	"	3	
		102										"	"				-	"	"	"	4	
		103										"	"				-	"	"	"	5	
"	$\Delta V_{BE}/\Delta T$	104										"	"				-	-5.0	-3.5	"	6	
"	$(\Delta V_{BEQ1} - V_{BEQ2})/\Delta T$	105										"	"				-	"	15.0	$\mu V/°C$	7	
h 3 T _A = -55°C	FEQ1	106					I _B	GND	3 V/ 1 mA			"	"				BQ1	70	300		8	
	FEQ2	107		B	GND	3 V/ 1 mA						"	"				BQ2	70	300		8	
	FEQ1/h _{FEQ2}	108										"	"				-	0.85	1.15		9	
	V _{BE(sat)}	109	I				1 mA	GND	10 mA			"	"				BQ1		1.100	V		
	"	110										"	"				BQ2			"		
	"	111									1 mA	"	"	10 mA			BQ3			"		
	"	112										"	"		10 mA	GND	BQ4			"		
	BE	113					I _B	GND/ -1 mA	3 V				"	"				BQ1	0.750	0.950	V	
	"	114											"	"				BQ2	0.750	0.950	"	

NOTES:

1. Calculate $(V_{89} - V_{90}) \times 10^3$
2. Calculate $(V_{89} - V_{42}) \times 10^3/100$
3. Calculate $(V_{90} - V_{43}) \times 10^3/100$
4. Calculate $(V_{91} - V_{44}) \times 10^3/100$
5. Calculate $(V_{92} - V_{45}) \times 10^3/100$
6. Calculate $(V_{97} - V_{50}) \times 10^3/100$
7. Calculate $(V_{99} - V_{52}) \times 10^3/100$
8. $h_{FE} = 1 \text{ mA}/I_B$
9. Calculate $h_{FE}(106)/h_{FE}(107)$

V

TABLE III. Group A inspection for device type 01 - Continued.
Terminal conditions (pins not designated may be H ≥ 2.0 V, or L ≤ 0.8 V, or open)

Subgroup	Symbol	Cases A,C,D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Limits			Note	
																	Measured terminal	Min	Max		Unit
3 T _A = -55°C	h _{FE(D)}	Case M	-	3	EQ2	CQ2	BQ1	EQ1	CQ1	NC	BQ3	SUB	CQ3	CQ4	EQ4	2					
	FE(D)	Test no.	NC	BQ2							l _b	GND	CQ4	3 V/ 1 mA	GND						10
4 T _A = 25°C	h _{FE}						l _b	GND	3 V/ 1 mA		l _b	"	CQ4	3 V/ 100 μA	GND						11
	FE			l _b	GND	3 V/ 1 mA						"									12
h	f _t											"									13
	f _t																				14
	f _t																				14
	f _t																				14
5 T _A = +125°C	h _{FE}						l _b	GND	3 V/ 1 mA			GND									12
	h _{FE}			l _b	GND	3 V/ 1 mA						"									13
6 T _A = -55°C	h _{FE}						l _b	GND	3 V/ 1 mA			"									12
	h _{FE}			l _b	GND	3 V/ 1 mA						"									13

NOTES:

- 10. h_{FE(D)} = 1 mA/I_{BQ3}
- 11. h_{FE(D)} = 100 μA/I_{BQ3}
- 12. Adjust I_b until I_c = 1.1 mA
- 13. h_{FE} = 0.1 mA/ΔI_b
- 14. f = 100 MHz, measure h_{FE}, f_t = 100 h_{FE} (see figure 4)

TABLE III. Group A inspection for device type 01 - Continued.
Terminal conditions (pins not designated may be H ≥ 2.0 V, or L ≤ 0.8 V, or open)

Subgroup	Symbol	Cases A,C,D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Limits			Note		
																	Measured terminal	Min	Max		Unit	
7 T _A = +25°C	C.S.	145	NC	BQ2	EQ2	CQ2	BQ1	EQ1	CQ1	NC	BQ3	SUB	CQ3	CQ4	EQ4		CQ2	80		dB	1	
	9 T _A = +25°C	t _d	146										"					CQ1	100	100	ns	2
		t _d	147										"					CQ2	100	100	"	"
		t _r	148										"					CQ1	50	50	"	"
		t _r	149										"					CQ2	50	50	"	"
		t _s	150										"					CQ1	200	200	"	"
		t _s	151										"					CQ2	200	200	"	"
		t _f	152										"					CQ1	80	80	"	"
		t _f	153										"					CQ2	80	80	"	"
		t _d	154										"					CQ1	160	160	"	"
10 T _A = +125°C	t _d	155										"					CQ2	160	160	"	"	
	t _r	156										"					CQ1	80	80	"	"	
	t _r	157										"					CQ2	80	80	"	"	
	t _s	158										"					CQ1	300	300	"	"	
	t _s	159										"					CQ2	300	300	"	"	
	t _f	160										"					CQ1	125	125	"	"	
	t _f	161										"					CQ2	125	125	"	"	
	t _d	162										"					CQ1	160	160	"	"	
	t _d	163										"					CQ2	160	160	"	"	
	t _r	164										"					CQ1	80	80	"	"	
11 T _A = -55°C	t _r	165										"					CQ2	80	80	"	"	
	t _s	166										"					CQ1	300	300	"	"	
	t _s	167										"					CQ2	300	300	"	"	
	t _f	168										"					CQ1	125	125	"	"	
	t _f	169										"					CQ2	125	125	"	"	

NOTES:
1. See figure 3.
2. See figure 2.

TABLE III. Group A inspection for device type 02.
Terminal conditions (pins not designated may be H ≥ 2.0 V, or L ≤ 0.8 V, or open)

Subgroup	Symbol	Cases A,C,D Test no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Measured terminal	Limits		
			CQ1	BQ1	EQ1, 2	BQ2	CQ2	BQ3	EQ3	CQ3	BQ4	EQ4	CQ4	BQ5	EQ5/SUB	CQ5		Min	Max	Unit
1	V _{BRICEO}	1	10 μA	GND													CQ1	40		V
	"	2				GND	10 μA										CQ2	"		"
	"	3						GND		10 μA							CQ3	"		"
	"	4									GND		10 μA				CQ4	"		"
	"	5												GND			CQ5	"		"
	V _{BRICEO}	6	1 mA		GND											10 μA	CQ1	15		"
"	"	7			GND												CQ2	"		"
"	"	8							GND	1 mA							CQ3	"		"
"	"	9															CQ4	"		"
"	"	10															CQ5	"		"
"	(BR)C ₁₀	11	10 μA														CQ1	60		"
"	"	12										10 μA					CQ2	"		"
"	"	13															CQ3	"		"
V	"	14											10 μA				CQ4	"		"
"	V _{BRICEO}	15															EQ1	5.0		"
"	"	16															EQ2	"		"
"	"	17	GND					GND									EQ3	"		"
"	"	18															EQ4	"		"
"	"	19									GND						EQ5	"		"
"	I _{CBO}	20	35 V											GND	10 μA		CQ1		10	nA
"	"	21						GND									CQ2			"
"	"	22															CQ3			"
"	"	23															CQ4			"
"	"	24															CQ5			"
"	I _{CEO}	25	10 V														CQ1			"
"	"	26										10 V					CQ2			"
"	"	27															CQ3			"
"	"	28															CQ4			"
"	"	29															CQ5			"

TABLE III. Group A inspection for device type 02 – Continued.
Terminal conditions (pins not designated may be H ≥ 2.0 V, or L ≤ 0.8 V, or open)

Subgroup	Symbol	Cases A,C,D Test no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Limits		
			CQ1	BQ1	EQ1,2	BQ2	CQ2	BQ3	EQ3	CQ3	BQ4	EQ4	CQ4	BQ5	EQ5/SUB	CQ5	Measured terminal	Min	Max
1 T _A = +25°C	I _{CUO}	30	40 V														CQ1	10	nA
	"	31				40 V											CQ2	"	"
"	I _{EBO}	32						40 V									CQ3	"	"
		33									40 V						CQ4	"	"
	34		GND	4 V													EQ1	"	"
	35			4 V	GND												EQ2	"	"
	36								4 V								EQ3	"	"
	37										GND						EQ4	"	"
	38																EQ5	"	"
	39	CE(ssl)		10 mA	GND													CQ1	0.400
"	"	40			GND	1 mA											CQ2	"	"
		41																CQ3	"
V	"	42									1 mA						CQ4	"	"
		43															CQ5	"	"
"	BE(ssl)	44	10 mA	1 mA	GND									1 mA			BQ1	1.000	"
	"	45			GND	1 mA	10 mA										BQ2	"	"
	"	46						1 mA	GND	10 mA							BQ3	"	"
	"	47									1 mA						BQ4	"	"
V	"	48											1 mA			BQ5	"	"	

"

TABLE III. Group A inspection for device type 02 – Continued.
Terminal conditions (pins not designated may be H ≥ 2.0 V, or L ≤ 0.8 V, or open)

Subgroup	Symbol	Cases A,C,D		2	3	4	5	6	7	8	9	10	11	12	13	14	Measured terminal	Limits		Note
		Test no.	CQ1															Min	Max	
1 T _A = +25°C	V _{BE}	49	3 V	BQ1	EQ1, 2	BQ2	CQ2	BQ3	EQ3	CQ3	BQ4	EQ4	CQ4	BQ5	EQ5/ SUB	CQ5	BQ1	0.600	0.800	V
	"	50	GND/ -1 mA	l _b	GND/ -1 mA	l _b	3 V										BQ2	"	"	"
	"	51	GND/ -1 mA						GND/ -1 mA		3 V						BQ3	"	"	"
"		52									l _b	GND/ -1 mA	3 V			BQ4	"	"	"	"
"		53												l _b	GND/ -1 mA	BQ5	"	"	"	"
"		54	3 V	l _b	GND/ -10 mA										GND	BQ1	0.900	"	"	"
"		55			GND/ -10 mA	l _b	3 V									BQ2	"	"	"	"
"		56				l _b			GND/ -10 mA	3 V						BQ3	"	"	"	"
"		57									l _b	GND/ -10 mA	3 V			BQ4	"	"	"	"
"		58												l _b	GND/ -10 mA	BQ5	"	"	"	"
"	V _{BEQ1} - V _{BEQ2}	59													GND	"	"	2.0	mV	1
"	V _{BEQ1} - V _{BEQ3}	60														"	"	"	"	2
IV	V _{BEQ1} - V _{BEQ4}	61														"	"	"	"	3
IV	V _{BEQ1} - V _{BEQ5}	62														"	"	"	"	4
IV	FE	63	3 V/ 10 μA	l _b	GND											BQ1	45	"	"	5
		64			GND	l _b	3 V/ 10 μA									BQ2	"	"	"	5
h		65				l _b			GND	3 V/ 10 μA						BQ3	"	"	"	5
"		66									l _b		3 V/ 10 μA			BQ4	"	"	"	5
"		67												l _b		BQ5	"	"	"	5
"		68	3 V/ 1 mA	l _b	GND											BQ1	70	"	"	6

NOTES:

1. Calculate |V₄₉ - V₅₀|
2. Calculate |V₄₉ - V₅₁|
3. Calculate |V₄₉ - V₅₂|
4. Calculate |V₄₉ - V₅₃|
5. h_{FE} = 10 μA/l_b
6. h_{FE} = 1 mA/l_b

TABLE III. Group A inspection for device type 02 – Continued.
Terminal conditions (pins not designated may be H ≥ 2.0 V, or L ≤ 0.8 V, or open)

Subgroup	Symbol	Cases A,C,D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Measured terminal	Limits		Note		
																		Min	Max		Unit	
1 T _A = +25°C	h _{FE}	Test no.	CQ1	BQ1	EQ1, 2	BQ2	CQ2	BQ3	EQ3	CQ3	BQ4	EQ4	CQ4	BQ5	EQ5/ SUB	CQ5	BQ2	70		1		
			69		GND	lb	3 V/ 1 mA	lb		GND	3 V/ 1 mA							BQ3	"		1	
			70																BQ4	"		1
			71									lb	GND	3 V/ 1 mA					BQ5	"		1
			72													lb		3 V/ 1 mA	BQ1	60		2
			73			GND	lb												BQ2	"		2
			74			GND	lb		3 V/ 10 mA										BQ3	"		2
			75							lb	GND	3 V/ 10 mA							BQ4	60		2
2 T _A = +125°C	FEQ1/h _{FEQ2}	Test no.															BQ5	60		2		
			76								lb	GND	3 V/ 10 mA					--	0.9	1.1	3	
			77															--	"	"	4	
			78															--	"	"	5	
			79															--	"	"	6	
			80																CQ1	200	nA	
			81																CQ2	"	"	
			82			35 V	GND		GND	35 V									CQ3	"	"	
"	I _{GB0}	Test no.															CQ4	"	"			
			83															CQ5	"	"		
			84							GND												
			85									GND		35 V								
"	"	Test no.																				
			86																			

- NOTES:
1. h_{FE} = 1 mA/lb
 2. h_{FE} = 10 mA/lb
 3. h_{FE(68)}/h_{FE(69)}
 4. h_{FE(68)}/h_{FE(70)}
 5. h_{FE(68)}/h_{FE(71)}
 6. h_{FE(68)}/h_{FE(72)}

TABLE III. Group A inspection for device type 02 – Continued.
Terminal conditions (pins not designated may be H ≥ 2.0 V, or L ≤ 0.8 V, or open)

Subgroup	Symbol	Cases A,C,D Test no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Limits		Note	
			CQ1	BQ1	EQ1,2	BQ2	CQ2	BQ3	EQ3	CQ3	BQ4	EQ4	CQ4	BQ5	EQ5/ SUB	CQ5	Measured terminal	Min		Max
2	I _{CEO}	87	10 V		GND										GND		CQ1	1.0		μA
		88			GND		10 V										CQ2	"		"
		89							GND	10 V							CQ3	"		"
		90										GND	10 V				CQ4	"		"
"		91														10 V	CQ5	"		"
"	I _{CEO}	92	40 V														CQ1	200		"
"		93					40 V										CQ2	"		"
"		94								40 V							CQ3	"		"
I		95											40 V				CQ4	"		"
"		96		GND	4 V												EQ1	"		"
"		97			4 V	GND											EQ2	"		"
"		98						GND	4 V								EQ3	"		"
I		99															EQ4	"		"
"	V _{CE(Ext)}	100	10 mA	1 mA	GND											10 mA	CQ5	0.600		V
"		101			GND	1 mA	10 mA										CQ2	"		"
"		102						1 mA	GND	10 mA							CQ3	"		"
"		103									1 mA	GND	10 mA				CQ4	"		"
"		104												1 mA			CQ5	"		"
"	BE	105	3 V	I _B	GND/ -1 mA												BQ1	0.450	0.650	"
"		106			GND/ -1 mA	I _B	3 V										BQ2	"	"	"
"		107						I _B	GND/ -1 mA	3 V							BQ3	"	"	"
V		108									I _B	GND/ -1 mA	3 V				BQ4	"	"	"
"		109												I _B	GND/ -1 mA	3 V	BQ5	"	"	"
"		110	3 V	I _B	GND/ -10 mA										GND		BQ1	0.750		"
"		111			GND/ -10 mA	I _B	3 V										BQ2	"	"	"
"		112						I _B	GND/ -10 mA	3 V							BQ3	"	"	"
"		113									I _B	GND/ -10 mA	3 V				BQ4	"	"	"

TABLE III. Group A inspection for device type 02 – Continued.
Terminal conditions (pins not designated may be H ≥ 2.0 V, or L ≤ 0.8 V, or open)

Subgroup	Symbol	Cases A,C,D			Cases A,C,D										Limits			Note			
		Test no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Measured terminal		Min	Max	Unit
2 T _A = +125°C	V _{BE}	114	CQ1	BQ1	EQ1, 2	BQ2	CQ2	BQ3	EQ3	CQ3	BQ4	EQ4	CQ4	BQ5	EQ5/ SUB	CQ5	BQ5	0.750		V	1
	V _{BEQ1} - V _{BEQ2}	115																3.0		mV	2
	V _{BEQ1} - V _{BEQ3}	116																			3
	V _{BEQ1} - V _{BEQ4}	117																			4
	V _{BEQ1} - V _{BEQ5}	118																			5
	ΔV _{BE} /ΔT	119																-2.2	-1.3	mV/°C	6
		120																			7
		121																			8
		122																			9
		123																			10
h	(Δ V _{BEQ1} - V _{BEQ2})/ΔT	124																			11
	(Δ V _{BEQ1} - V _{BEQ3})/ΔT	125																			12
	(Δ V _{BEQ1} - V _{BEQ4})/ΔT	126																			13
	(Δ V _{BEQ1} - V _{BEQ5})/ΔT	127																			14
	f _{FE}	128	3 V/ 1 mA	I _B	GND	I _B															14
	"	129			GND	I _B	3 V/ 1 mA														14
		130						I _B	GND	3 V/ 1 mA	I _B	GND									14
		131																			14
		132																			14
		133																			15
	134																			16	
	135																			17	
	136																			18	

- h NOTES:
1. Calculate |V₁₀₅ - V₁₀₆|
 2. Calculate |V₁₀₅ - V₁₀₇|
 3. Calculate |V₁₀₅ - V₁₀₈|
 4. Calculate |V₁₀₅ - V₁₀₉|
 5. Calculate V₁₀₅ - V₄₉/100
 6. Calculate V₁₀₆ - V₅₀/100
 7. Calculate V₁₀₇ - V₅₁/100
 8. Calculate V₁₀₈ - V₅₂/100
 9. Calculate V₁₀₉ - V₅₃/100
 10. Calculate |V₁₁₅ - V₅₉/100
 11. Calculate |V₁₁₆ - V₆₀/100
 12. Calculate |V₁₁₇ - V₆₁/100
 13. Calculate |V₁₁₈ - V₆₂/100
 14. h_{FE} = 1 mA/I_B
 15. Calculate h_{FE}(128)/h_{FE}(129)
 16. Calculate h_{FE}(128)/h_{FE}(130)
 17. Calculate h_{FE}(128)/h_{FE}(131)
 18. Calculate h_{FE}(128)/h_{FE}(132)

TABLE III. Group A inspection for device type 02 – Continued.
Terminal conditions (pins not designated may be H ≥ 2.0 V, or L ≤ 0.8 V, or open)

Subgroup	Symbol	Cases A,C,D Test no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Measured terminal	Limits		Note	
			CQ1	BQ1	EQ1, 2	BQ2	CQ2	BQ3	EQ3	CQ3	BQ4	EQ4	CQ4	BQ5	EQ5/ SUB	CQ5		Min	Max		Unit
3	$V_{BE(EST)}$	137	10 mA	1 mA	GND		10 mA								GND		BQ1	1.100		V	
"		138			GND	1 mA									"		BQ2	"		"	
"		139					1 mA	10 mA	GND						"		BQ3	"		"	
"		140									1 mA	GND	10 mA		"		BQ4	"		"	
"		141												1 mA	"	10 mA	BQ5	"		"	
"	V_{BE}	142	3 V	I_B	GND/ -1 mA										"		BQ1	0.750	0.950	"	
"		143		I_B	GND/ -1 mA	I_B	3 V								"		BQ2	"		"	
"		144						I_B	GND/ -1 mA	3 V					"		BQ3	"		"	
"		145									I_B	-1 mA	3 V		"		BQ4	"		"	
"		146										GND/ -1 mA		I_B	"		BQ5	"		"	
"		147	3 V	I_B	GND/ -10 mA										GND/ -1 mA	3 V	BQ1	1.000		"	
"		148			GND/ -10 mA	I_B	3 V								"		BQ2	"		"	
"		149						I_B	GND/ -10 mA	3 V					"		BQ3	"		"	
"		150									I_B	-10 mA	3 V		"		BQ4	"		"	
"		151										GND/ -10 mA		I_B	"	3 V	BQ5	"		"	
"	$V_{BE1} - V_{BE02}$	152													GND/ -10 mA		--	3.0	mV	1	
"	$V_{BE01} - V_{BE03}$	153													"		--	"	"	2	
IV	$V_{BE01} - V_{BE04}$	154													"		--	"	"	3	
IV	$V_{BE01} - V_{BE05}$	155													"		--	"	"	4	
IV	$\Delta V_{BE}/\Delta T$	156													"		--	-2.2	-1.3	mV/°C	5
IV		157													"		--	"	"	"	6
"		158													"		--	"	"	"	7
"		159													"		--	"	"	"	8
"		160													"		--	"	"	"	9

NOTES:

1. Calculate $|V_{142} - V_{143}| \times 10^3$
2. Calculate $|V_{142} - V_{144}| \times 10^3$
3. Calculate $|V_{142} - V_{146}| \times 10^3$
4. Calculate $|V_{142} - V_{146}| \times 10^3$
5. Calculate $(V_{49} - V_{142}) \times 10^3/80$
6. Calculate $(V_{50} - V_{143}) \times 10^3/80$
7. Calculate $(V_{51} - V_{144}) \times 10^3/80$
8. Calculate $(V_{52} - V_{145}) \times 10^3/80$
9. Calculate $(V_{53} - V_{146}) \times 10^3/80$

TABLE III. Group A inspection for device type 02 – Continued.
Terminal conditions (pins not designated may be H ≥ 2.0 V, or L ≤ 0.8 V, or open)

Subgroup	Symbol	Cases A,C,D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Limits		Note	
																	Measured terminal	Min		Max
3 T _A = -55°C	$(\Delta V_{BEQ1} - V_{BEQ2})/\Delta T$	161	CQ1	BQ1	EQ1,2	BQ2	CQ2	BQ3	EQ3	CQ3	BQ4	EQ4	CQ4	BQ5	EQ5/ SUB	CQ5	--	15.0	μV/°C	1
	$(\Delta V_{BEQ1} - V_{BEQ3})/\Delta T$	162															--	"	"	2
	$(\Delta V_{BEQ1} - V_{BEQ4})/\Delta T$	163															--	"	"	3
	$(\Delta V_{BEQ1} - V_{BEQ5})/\Delta T$	164															--	"	"	4
h	FE	165	3 V/ 1 mA	I _b	GND											BQ1	40			5
	"	166			GND	I _b	3 V/ 1 mA									BQ2	"			5
		167					I _b		GND	3 V/ 1 mA						BQ3	"			5
h		168									I _b	GND	3 V/ 1 mA			BQ4	"			5
		169												I _b		BQ5	"			5
"	h_{FEQ1}/h_{FEQ2}	170														--	0.85	1.15		6
"	$FEQ1/h_{FEQ3}$	171														--	"	"		7
"	$FEQ1/h_{FEQ4}$	172														--	"	"		8
h	$FEQ1/h_{FEQ5}$	173														--	"	"		9
4 T _A = +25°C	h _{fe}	174	3 V/ 1 mA	I _b	GND											BQ1	60			10
	h _{fe}	175			GND	I _b	3 V/ 1 mA									BQ2	60			10
h	h _{fe}	176						I _b	GND	3 V/ 1 mA						BQ3	60			10

NOTES:

1. Calculate $|V_{59} - V_{152}| \times 10^3/80$
2. Calculate $|V_{60} - V_{153}| \times 10^3/80$
3. Calculate $|V_{61} - V_{154}| \times 10^3/80$
4. Calculate $|V_{62} - V_{155}| \times 10^3/80$
5. $h_{FE} = 1 \text{ mA}/I_b$
6. Calculate $h_{FE}(165)/h_{FE}(166)$
7. Calculate $h_{FE}(165)/h_{FE}(167)$
8. Calculate $h_{FE}(165)/h_{FE}(168)$
9. Calculate $h_{FE}(165)/h_{FE}(169)$
10. Adjust I_b until IC = 1.1 mA, $h_{FE} = 0.1 \text{ mA}/\Delta I_b$

TABLE III. Group A inspection for device type 02 – Continued.
Terminal conditions (pins not designated may be H ≥ 2.0 V, or L ≤ 0.8 V, or open)

Subgroup	Symbol	Cases A,C,D Test no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Measured terminal	Limits		Note
			CQ1	BQ1	EQ1,2	BQ2	CQ2	BQ3	EQ3	CQ3	BQ4	EQ4	CQ4	BQ5	EQ5/ SUB	CQ5		Min	Max	
4 T _A = +25°C	h _{fe}	177									lb	GND	3 V/ 1 mA		GND		BQ4	60		1
	h _{fe}	178												lb	GND	3 V/ 1 mA	BQ5	60		1
	f _t	179															CQ1	300	MHz	2
	"	180															CQ2	"		2
		181															CQ3	"		2
		182															CQ4	"		2
		183															CQ5	"		2
5 ⁿ T _A = +125°C	h _{fe}	184			GND										GND		BQ1	60		1
	"	185			GND	lb	3 V/ 1 mA								"		BQ2	"		"
	"	186					lb		GND	3 V/ 1 mA					"		BQ3	"		"
	"	187									lb	GND	3 V/ 1 mA		"		BQ4	"		"
	"	188												lb	"	3 V/ 1 mA	BQ5	"		"
5 ⁿ T _A = -55°C	h _{fe}	189			GND												BQ1	35		"
	"	190			GND	lb	3 V/ 1 mA								"		BQ2	"		"
	"	191					lb		GND	3 V/ 1 mA					"		BQ3	"		"
	"	192									lb	GND	3 V/ 1 mA		"		BQ4	"		"
	"	193												lb	"	3 V/ 1 mA	BQ5	"		"
7 ⁿ T _A = +25°C	C.S.	194														CQ4	80	dB	3	

NOTES:

1. Adjust I_b until I_c = 1.1 mA, h_{fe} = 0.1 mA/ΔI_b
2. f = 100 MHz, measure h_{fe}, f_t = 100h_{fe} (see figure 4)
3. See figure 3.

TABLE III. Group A inspection for device type 02 – Continued.
Terminal conditions (pins not designated may be H ≥ 2.0 V, or L ≤ 0.8 V, or open)

Subgroup	Symbol	Cases A,C,D Test no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Limits		Note		
			CQ1	BQ1	EQ1, 2	BQ2	CQ2	BQ3	EQ3	CQ3	BQ4	EQ4	CQ4	BQ5	EQ5/ SUB	CQ5	Measured terminal	Min		Max	Unit
9 T _A = +25°C	t _d	195													GND			100	ns	1	
		196													"				"	"	"
"	"	197													"				"	"	"
		198													"				"	"	"
"	"	199													"				"	"	"
		200													"				50	"	"
"	t _r	201													"				"	"	"
		202													"				"	"	"
"	"	203													"				"	"	"
		204													"				"	"	"
"	t _s	205													"				200	"	"
		206													"				"	"	"
"	"	207													"				"	"	"
		208													"				"	"	"
"	"	209													"				"	"	"
		210													"				80	"	"
"	t _f	211													"				"	"	"
		212													"				"	"	"
"	"	213													"				"	"	"
		214													"				"	"	"

NOTES:
1. See figure 2.

"

TABLE III. Group A inspection for device type 02 – Continued.
Terminal conditions (pins not designated may be H ≥ 2.0 V, or L ≤ 0.8 V, or open)

Subgroup	Symbol	Cases A,C,D		1	2	3	4	5	6	7	8	9	10	11	12	13	14	Limits			Note
		Test no.	CQ1															BQ1	EQ1,2	BQ2	
10 T _A = +125°C	t _d	215	CQ1													GND	CQ5		160	ns	1
	"	216														"	CQ2		"	"	"
"	"	217														"	CQ3		"	"	"
	"	218														"	CQ4		"	"	"
	"	219														"	CQ5		"	"	"
	"	220														"	CQ1	80	"	"	"
"	t _r	221														"	CQ2		"	"	"
	"	222														"	CQ3		"	"	"
"	"	223														"	CQ4		"	"	"
	"	224														"	CQ5		"	"	"
"	t _s	225														"	CQ1	300	"	"	"
	"	226														"	CQ2		"	"	"
"	"	227														"	CQ3		"	"	"
	"	228														"	CQ4		"	"	"
"	"	229														"	CQ5		"	"	"
	"	230														"	CQ1	125	"	"	"
"	t _f	231														"	CQ2		"	"	"
	"	232														"	CQ3		"	"	"
"	"	233														"	CQ4		"	"	"
	"	234														"	CQ5		"	"	"

NOTES:
1. See figure 2.

TABLE III. Group A inspection for device type 02 – Continued.
Terminal conditions (pins not designated may be H ≥ 2.0 V, or L ≤ 0.8 V, or open)

Subgroup	Symbol	Cases A,C,D Test no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Limits			Note	
			CQ1	BQ1	EQ1,2	BQ2	CQ2	BQ3	EQ3	CQ3	BQ4	EQ4	CQ4	BQ5	EQ5/ SUB	CQ5	Measured terminal	Min	Max		Unit
11 T _A = -55°C	t _d	235													GND			160	ns	1	
		236													"			"	"	"	"
"	"	237													"			"	"	"	"
		238													"			"	"	"	"
"	"	239													"			"	"	"	"
		240													"			80	"	"	"
"	t _r	241													"			"	"	"	"
		242													"			"	"	"	"
"	"	243													"			"	"	"	"
		244													"			"	"	"	"
"	t _s	245													"			300	"	"	"
		246													"			"	"	"	"
"	"	247													"			"	"	"	"
		248													"			"	"	"	"
"	"	249													"			"	"	"	"
		250													"			125	"	"	"
"	t _f	251													"			"	"	"	"
		252													"			"	"	"	"
"	"	253													"			"	"	"	"
		254													"			"	"	"	"

NOTES: 1. See figure 2

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4.5.2 Life test cooldown procedure. When devices are measured at 25°C following application of the operating life or burn-in test condition, they shall be cooled to within 10°C of their power stable condition room temperature prior to removal of the bias.

Table IV. Groups B and C end point electrical parameters ($T_A = 25^\circ\text{C}$).

Test	Device types 01 and 02	
	Limit	Delta
V_{BE}	0.600 V min 0.800 V max	± 0.010 V
$ V_{BEQA} - V_{BEQB} $	2.0 mV	
h_{FE}	70 min 300 max <u>1/</u>	$\pm 10\%$

1/ The 300 max limit applies to device type 01 only.

5. PACKAGING

5.1 Packaging requirements. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Service or Defense Agency, or within the military service's system command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

6.1 Intended use. Microcircuits conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of the specification.
- b. Complete part number (see 1.2).
- c. Requirements for delivery of one copy of the quality conformance inspection data pertinent to the device inspection lot to be supplied with each shipment by the device manufacturer, if applicable.
- d. Requirements for certificate of compliance, if applicable.
- e. Requirements for notification of change of product or process to acquiring activity in addition to notification of the qualifying activity, if applicable.
- f. Requirements for failure analysis (including required test condition of MIL-STD-883, method 5003), corrective action and reporting of results, if applicable.
- g. Requirements for product assurance options.
- h. Requirements for special carriers, lead lengths, or lead forming, if applicable. These requirements should not affect the part number. Unless otherwise specified, these requirements will not apply to direct purchase by or direct shipment to the Government.
- i. Requirements for "JAN" marking.
- j. Packaging requirements (see 5.1).

6.3 Superseding information. The requirements of MIL-M-38510 have been superseded to take advantage of the available Qualified Manufacturer Listing (QML) system provided by MIL-PRF-38535. Previous references to MIL-M-38510 in this document have been replaced by appropriate references to MIL-PRF-38535. All technical requirements now consist of this specification and MIL-PRF-38535. The MIL-M-38510 specification sheet number and PIN have been retained to avoid adversely impacting existing government logistics systems and contractor's parts lists.

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers List QML-38535 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from DSCC-VQ, 3990 E. Broad Street, Columbus, Ohio 43123-1199.

6.5 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-PRF-38535, MIL-HDBK-1331, and as follows:.

$V_{(BR)CUO}$ ----- Breakdown voltage, collector to substrate
 I_{CUO} ----- Collector to substrate cutoff current
 V_{CU} ----- Collector to substrate voltage (dc)

6.6 Logistic support. Lead materials and finishes (see 3.3) are interchangeable. Unless otherwise specified, microcircuits acquired for Government logistic support will be acquired to device class B (see 1.2.2), lead material and finish A (see 3.4). Longer length leads and lead forming should not affect the part number.

6.7 Substitutability. The cross-reference information below is presented for the convenience of users. Microcircuits covered by this specification will functionally replace the listed generic-industry type. Generic-industry microcircuit types may not have equivalent operational performance characteristics across military temperature ranges or reliability factors equivalent to MIL-M-38510 device types and may have slight physical variations in relation to case size. The presence of this information should not be deemed as permitting substitution of generic-industry types for MIL-M-38510 types or as a waiver of any of the provisions of MIL-PRF-38535.

<u>Military device type</u>	<u>Generic-industry type</u>
01	3018A
02	3045

6.8 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Custodians: Army – CR Navy - EC Air Force - 11 DLA – CC	Preparing activity: DLA - CC Project 5962-1990
Review activities: Air Force - 19	