

The documentation and process conversion measures necessary to comply with this document shall be completed by 18 March 2005.

INCH-POUND

MIL-PRF-19500/270J  
 18 December 2004  
 SUPERSEDING  
 MIL-PRF-19500/270H  
 24 July 2003

\* PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, UNITIZED, DUAL-TRANSISTOR, NPN,  
 SILICON, TYPES 2N2060 AND 2N2060L,  
 JAN, JANTX, JANTXV, AND JANS

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

\* The requirements for acquiring the product described herein shall consist of  
 this specification sheet and MIL-PRF-19500.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for two electrically isolated, matched NPN, silicon transistors as one dual unit. Four levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (similar to TO-77 or TO-99).

1.3 Maximum ratings unless otherwise specified  $T_A = +25^\circ\text{C}$ .

$P_{T1}$ $T_A = +25^\circ\text{C}$		$P_{T2}$ $T_C = +25^\circ\text{C}$		$I_C$	$V_{CB0}$	$V_{CE0}$	$V_{EB0}$	$T_{STG}$ and $T_J$
One section (1)	Both sections (2)	One section (1)	Both sections (2)					
<u>mW</u>	<u>mW</u>	<u>W</u>	<u>W</u>	<u>mA dc</u>	<u>V dc</u>	<u>V dc</u>	<u>V dc</u>	<u>°C</u>
540	600	1.5	2.12	500	100	60	7	-65 to +200

- (1) For  $T_A > +25^\circ\text{C}$ , derate linearly 3.08 mW/°C one section, 3.48 mW/°C both sections.
- (2) For  $T_C > +25^\circ\text{C}$ , derate linearly 8.6 mW/°C one section, 12.1 mW/°C both sections.

\* Comments, suggestions, or questions on this document should be addressed to Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to [Semiconductor@dsc.dla.mil](mailto:Semiconductor@dsc.dla.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <http://assist.daps.dla.mil>.

\* 1.4 Primary electrical characteristics.

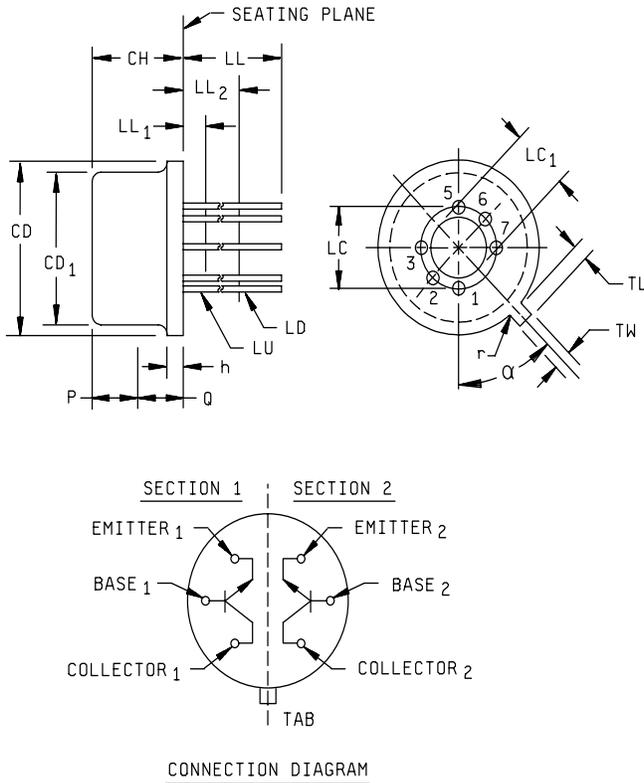
	$h_{FE1}$	$h_{FE2}$	$h_{FE3}$	$h_{FE4}$ (1)	$ h_{fe} $	$V_{CE(sat)}$	$V_{BE(sat)}$
Limit	$V_{CE} = 5 \text{ V dc}$ $I_C = 10 \mu\text{A dc}$	$V_{CE} = 5 \text{ V dc}$ $I_C = 100 \mu\text{A dc}$	$V_{CE} = 5 \text{ V dc}$ $I_C = 1 \text{ mA dc}$	$V_{CE} = 5 \text{ V dc}$ $I_C = 10 \text{ mA dc}$	$V_{CE} = 10 \text{ V dc}$ $I_C = 50 \text{ mA dc}$ $f = 20 \text{ MHz}$	$I_C = 50 \text{ mA dc}$ $I_B = 5 \text{ mA dc}$	$I_C = 50 \text{ mA dc}$ $I_B = 5 \text{ mA dc}$
Min	25	30	40	50	3	<u>V dc</u>	<u>V dc</u>
Max	75	90	120	150	25	0.3	0.9

(1) Pulsed (see 4.5.1).

1.5 Primary electrical matching characteristics of each individual section.

	$\frac{h_{FE2-1}}{h_{FE2-2}}$ (1)	$ V_{BE1} - V_{BE2} $	$ \Delta(V_{BE1} - V_{BE2}) \Delta T_A 1$	$ \Delta(V_{BE1} - V_{BE2}) \Delta T_A 2$
Limit	$V_{CE} = 5 \text{ V dc};$ $I_C = 100 \mu\text{A dc}$ <u>1/</u>	$V_{CE} = 5 \text{ V dc};$ $I_C = 100 \mu\text{A dc}$	$V_{CE} = 5 \text{ V dc};$ $I_C = 100 \mu\text{A dc}$ $T_A = +25^\circ\text{C and } -55^\circ\text{C}$	$V_{CE} = 5 \text{ V dc};$ $I_C = 100 \mu\text{A dc}$ $T_A = +125^\circ\text{C and } +25^\circ\text{C}$
Min	0.9	<u>mV dc</u>	<u>mV dc</u>	<u>mV</u>
Max	1.0	5	0.8	1.0

(1) The larger number will be placed in the denominator.



Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.335	.370	8.51	9.40	
CD <sub>1</sub>	.305	.335	7.75	8.51	
CH	.150	.260	3.81	6.60	
LC	.200 TP		5.08 TP		9
LC <sub>1</sub>	.140	.160	3.56	4.06	
LD	.016	.021	0.41	0.53	10
LL	See notes 10, 12, and 13				
LL <sub>1</sub>		.050		1.27	10
LL <sub>2</sub>	.250		6.35		10
LU	.016	.019	0.41	0.48	10
P	.100		2.54		8
Q		.050		1.27	7
TL	.029	.045	0.74	1.14	5, 6
TW	.028	.034	0.71	0.86	4, 5
h	.009	.041	0.23	1.04	
r		.010		0.25	11
α	45°TP		45°TP		9

NOTES:

- Dimensions are in inches.
- Millimeters are given for general information only.
- Refer to rules for dimensioning semiconductor product outlines included in Publication No. 95.
- Lead number 4 and 8 omitted on this variation.
- Beyond r, TW must be held to a minimum length of .021 inch (.53 mm).
- TL measured from maximum CD.
- Details of outline in this zone optional.
- CD<sub>1</sub> shall not vary more than .010 inch (.25 mm) in zone P. This zone is controlled for automatic handling.
- Leads at gauge plane .054 - .055 inch (1.37 - 1.40 mm) below seating plane shall be within .007 inch (.18 mm) radius of true position (TP) at a maximum material condition (MMC) relative to the tab at MMC. The device may be measured by direct methods or by the gauge and gauging procedure described on gauge drawing GS-1.
- LU applies between LL<sub>1</sub> and LL<sub>2</sub> LD applies between LL<sub>2</sub> and LL minimum. Diameter is uncontrolled in LL<sub>1</sub> and beyond minimum.
- r (radius) applies to both inside corners of tab.
- For transistor types 2N2060, LL is .500 inch (12.70 mm) minimum, and .750 inch (19.05 mm) maximum.
- For transistor types 2N2060L, LL is 1.500 inches (38.10 mm) minimum, and 1.750 inches (44.45 mm) maximum.
- In accordance with ASME Y14.5M, diameters are equivalent to φx symbology.

\* FIGURE 1. Physical dimensions.

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, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document 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-19500 - Semiconductor Devices, General Specification for.

\* DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-750 - Test Methods for Semiconductor Devices.

\* (Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch> or <http://assist.daps.dla.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 document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General. The individual item requirements shall be as specified in MIL-PRF-19500 and as modified herein.

3.2 Qualification. Devices 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 4.2 and 6.3).

3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500 and as follows.

$\frac{h_{FE-1}}{h_{FE-2}}$  ..... Static forward-current-gain-ratio. The matching ratio of the static forward-current transfer ratios of each section.

$|V_{BE1} - V_{BE2}|$  ..... Absolute value of base-emitter-voltage differential between the individual sections.

$|\Delta(V_{BE1} - V_{BE2}) \Delta T_A|$  ..... Absolute value of the algebraic difference between the base-emitter-voltage differentials between the individual sections at two different temperatures.

3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in MIL-PRF-19500, and on figure 1.

3.4.1 Lead finish. Lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

3.5 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4, 1.5, and table I herein.

3.6 Electrical test requirements. The electrical test requirements shall be as specified in table I.

3.7 Marking. Marking shall be in accordance with MIL-PRF-19500.

3.8 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

#### 4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Screening (see 4.3).
- c. Conformance inspection (see 4.4).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

\* 4.2.1 Group E qualification. Group E inspection shall be performed for qualification or re-qualification only. In case qualification was awarded to a prior revision of the specification sheet that did not request the performance of table II tests, the tests specified in table II herein that were not performed in the prior revision shall be performed on the first inspection lot of this revision to maintain qualification.

\* 4.3 Screening (JANS, JANTX, and JANTXV levels only). Screening shall be in accordance with table IV of MIL-PRF-19500 and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table IV of MIL-PRF-19500)	Measurement	
	JANS level	JANTX and JANTXV levels
3c	Thermal impedance (see 4.3.2)	Thermal impedance (see 4.3.2)
7	Optional	Optional
9	$I_{CBO2}$ , $\frac{h_{FE2-1}}{h_{FE2-2}}$ , and $h_{FE3}$	Not applicable
10	48 hours minimum	48 hours minimum
11	$I_{CBO2}$ , $\frac{h_{FE2-1}}{h_{FE2-2}}$ , and $h_{FE3}$  $\Delta I_{CBO2} = 100$ percent of initial value or 2 nA dc, whichever is greater.  $\Delta h_{FE3} = \pm 15$ percent	$I_{CBO2}$ and $h_{FE3}$
12	See 4.3.1 240 hours minimum	See 4.3.1 80 hours minimum
13	Subgroups 2 and 3 of table I herein; $\Delta I_{CBO2} = 100$ percent of initial value or 2 nA dc, whichever is greater. $\Delta h_{FE3} = \pm 15$ percent	Subgroup 2 of table I herein; $\Delta I_{CBO2} = 100$ percent of initial value or 2 nA dc, whichever is greater. $\Delta h_{FE3} = \pm 15$ percent
13(a)	Method 1016 of MIL-STD-750, test condition A (collector to collector) $R_{C1-C2} = 10^9$ ohms minimum.	Not applicable
14	Required	Required

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows:

- a. JANS level (all device types) .....  $V_{CB} = 10 - 40$  V dc,  $P_T = 300$  mW (each section) at  $T_A = +25^\circ\text{C} \pm 3^\circ\text{C}$ .  
 $V_{CB} = 10 - 40$  V dc,  $P_T = 600$  mW (both sections) at  $T_A = +25^\circ\text{C} \pm 3^\circ\text{C}$ .
- b. JANTX and JANTXV levels  
(all device types).....  $V_{CB} = 10 - 40$  V dc,  $P_T = 300$  mW (each section) at  $T_A = +25^\circ\text{C} \pm 3^\circ\text{C}$ .  
 $V_{CB} = 10 - 40$  V dc,  $P_T = 600$  mW (both sections) at  $T_A = +25^\circ\text{C} \pm 3^\circ\text{C}$ .

NOTE: No heat sink or forced air-cooling on the devices shall be permitted.

4.3.2 Thermal impedance ( $Z_{\theta JX}$  measurements). The  $Z_{\theta JX}$  measurements shall be performed in accordance with method 3131 of MIL-STD-750.

- a.  $I_M$  measurement current-----5 mA.
- b.  $I_H$  forward heating current -----200 mA (min).
- c.  $t_H$  heating time -----25 - 30 ms.
- d.  $t_{md}$  measurement delay time -----60  $\mu$ s max.
- e.  $V_{CE}$  collector-emitter voltage -----10 V dc minimum

The maximum limit for  $Z_{\theta JX}$  under these test conditions are  $Z_{\theta JX} (\text{max}) = 72^\circ\text{C/W}$ .

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein. If alternate screening is being performed in accordance with MIL-PRF-19500, a sample of screened devices shall be submitted to and pass the requirements of group A1 and A2 inspection only (table VIb, group B, subgroup 1 is not required to be performed again if group B has already been satisfied in accordance with 4.4.2).

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500, and table I herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIa (JANS) of MIL-PRF-19500 and 4.4.2.1. Electrical measurements (end-points) and delta requirements shall be in accordance with table I, subgroup 2 and 4.5.9 herein. See 4.4.2.2 for JAN, JANTX, and JANTXV group B testing. Electrical measurements (end-points) and delta requirements for JAN, JANTX, and JANTXV shall be after each step in 4.4.2.2 and shall be in accordance with table I, subgroup 2 and 4.5.9 herein.

4.4.2.1 Group B inspection, table VIa (JANS) of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
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B4	1037	$V_{CB} = 10$ V dc.
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B5	1027	$V_{CB} = 10$ V dc; $P_D \geq 100$ percent of maximum rated $P_T$ (see 1.3). (NOTE: If a failure occurs, resubmission shall be at the test conditions of the original sample.)
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Option 1: 96 hours minimum sample size in accordance with MIL-PRF-19500, table VIa, adjust  $T_A$  or  $P_D$  to achieve  $T_J = +275^\circ\text{C}$  minimum.

Option 2: 216 hours minimum, sample size = 45,  $c = 0$ ; adjust  $T_A$  or  $P_D$  to achieve a  $T_J = +225^\circ\text{C}$  minimum.

\* 4.4.2.2 Group B inspection, (JAN, JANTX, and JANTXV). Separate samples may be used for each step. In the event of a lot failure, the resubmission requirements of MIL-PRF-19500 shall apply. In addition, all catastrophic failures during CI shall be analyzed to the extent possible to identify root cause and corrective action. Whenever a failure is identified as wafer lot and /or wafer processing related, the entire wafer lot and related devices assembled from the wafer lot shall be rejected unless an appropriate determined corrective action to eliminate the failures mode has been implemented and the devices from the wafer lot are screened to eliminate the failure mode.

<u>Step</u>	<u>Method</u>	<u>Condition</u>
1	1026	Steady-state life: 1,000 hours, $V_{CB} = 10$ V dc, power shall be applied to achieve $T_J = +150^\circ\text{C}$ minimum using a minimum of $P_D = 75$ percent of maximum rated $P_T$ as defined in 1.3. $n = 45$ devices, $c = 0$ . The sample size may be increased and the test time decreased as long as the devices are stressed for a total of 45,000 device hours minimum, and the actual time of test is at least 340 hours.
2	1048	Blocking life, $T_A = +150^\circ\text{C}$ , $V_{CB} = 80$ percent of rated voltage, 48 hours minimum. $n = 45$ devices, $c = 0$ .
3	1032	High-temperature life (non-operating), $t = 340$ hours, $T_A = +200^\circ\text{C}$ . $n = 22$ , $c = 0$ .

4.4.2.3 Group B sample selection. Samples selected from group B inspection shall meet all of the following requirements:

- a. For JAN, JANTX, and JANTXV samples shall be selected randomly from a minimum of three wafers (or from each wafer in the lot) from each wafer lot. For JANS, samples shall be selected from each inspection lot. See MIL-PRF-19500.
- b. Must be chosen from an inspection lot that has been submitted to and passed table I, subgroup 2, conformance inspection. When the final lead finish is solder or any plating prone to oxidation at high temperature, the samples for life test (subgroups B4 and B5 for JANS, and group B for JAN, JANTX, and JANTXV) may be pulled prior to the application of final lead finish.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-PRF-19500, and in 4.4.3.1 (JANS), and 4.4.3.2 (JAN, JANTX, and JANTXV) herein for group C testing. Electrical measurements (end-points) and delta requirements shall be in accordance with table I, subgroup 2 and 4.5.9 herein.

4.4.3.1 Group C inspection, table VII (JANS) of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition E.
C6	1026	Steady-state life: 1,000 hours, $V_{CB} = 10$ dc, power shall be applied to achieve $T_J = +150^\circ\text{C}$ minimum using a minimum of $P_D = 75$ percent of maximum rated $P_T$ as defined in 1.3. $n = 45$ devices, $c = 0$ . The sample size may be increased and the test time decreased so long as the devices are stressed for a total of 45,000 device hours minimum, and the actual time of test is at least 340 hours.

4.4.3.2 Group C inspection, table VII (JAN, JANTX, and JANTXV) of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition E.
C6		Not applicable

4.4.3.3 Group C sample selection. Samples for subgroups in group C shall be chosen at random from any inspection lot containing the intended package type and lead finish procured to the same specification which is submitted to and passes group A tests for conformance inspection. Testing of a subgroup using a single device type enclosed in the intended package type shall be considered as complying with the requirements for that subgroup.

4.4.4 Group E Inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IX of MIL-PRF-19500, appendix E and as specified in table II herein.

4.5 Method of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

4.5.2 Testing of units. All specified electrical tests, including electrical measurements (end-points) and delta requirement tests, shall be performed equally on both sections of the transistor types covered herein, except where the electrical characteristic being evaluated applies to the transistor as a device entity.

4.5.3 Disposition of leads when testing characteristics of each section. During the measurement of the characteristic of each section, the leads of the section not under test shall be open-circuited.

4.5.4 Forward-current-gain ratio. The value for the forward-current-gain ratio for each individual section of a dual unit shall be measured using method 3076 of MIL-STD-750. The forward-current-gain ratio shall be calculated by dividing one of the values by the other. If possible, this ratio shall be measured directly to improve accuracy.

4.5.5 Base-emitter-voltage differential. The base-emitter-voltage differential shall be determined by connecting the emitters of the individual sections together, applying specified electrical test conditions to each individual section in accordance with method 3066 of MIL-STD-750, test condition B, and measuring the absolute value of the voltage between the bases of the individual sections of a dual unit.

4.5.6 Base-emitter-voltage differential change with temperature. The value of the base-emitter-voltage differential shall be measured at the two specified temperatures in accordance with 4.5.5 except that the identities of the individual sections shall be maintained. The absolute value of the algebraic difference between the values at the two temperature extremes shall be calculated. A mathematical formula for this parameter is:

$$| (V_{BE1} - V_{BE2})_{T1} - (V_{BE1} - V_{BE2})_{T2} |$$

4.5.7 Noise figure test. Noise figure shall be measured using a model No. 2173C/2181 Quan Tech Laboratories test set, or equivalent. Conditions shall be as specified in table I.

4.5.8 Noise figure (wideband) test. Wideband noise figure shall be measured using a model No. 512 Quan Tech Laboratories test set, or equivalent. Conditions shall be as specified in table I.

4.5.9 Delta requirements. Delta requirements shall be as specified below:

Step	Inspection	MIL-STD-750		Symbol	Limit
		Method	Conditions		
1.	Forward-current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}$ ; $I_C = 1 \text{ mA dc}$	$\Delta h_{FE3}$	$\pm 25$ percent change from initial reading.
2.	Collector to base cutoff current	3036	Bias condition D; $V_{CB} = 80 \text{ V dc}$	$\Delta I_{CBO2}$ (1)	100 percent or 2 nA dc, whichever is greater.
3.	Saturation voltage and resistance (collector to emitter voltage)	3071	$I_C = 50 \text{ mA dc}$ , $I_B = 5 \text{ mA dc}$	$\Delta V_{CE(sat)}$ (2)	$\pm 50 \text{ mV dc}$ from initial reading.
4.	Base emitter voltage (nonsaturated) (absolute value of differential - change with temperature)	3066	Test condition B; $V_{CE} = 5 \text{ V dc}$ , $I_C = 100 \mu\text{A dc}$ , $T_A = +25^\circ\text{C}$ and $-55^\circ\text{C}$ (see 4.5.6)	$ \Delta(V_{BE1} - V_{BE2})\Delta T_A _2$ (2)	0.80 mV dc maximum
5.	Base emitter voltage (nonsaturated) (absolute value of differential - change with temperature)	3066	Test condition B; $V_{CE} = 5 \text{ V dc}$ , $I_C = 100 \mu\text{A dc}$ , $T_A = +25^\circ\text{C}$ and $+125^\circ\text{C}$ (see 4.5.6)	$ \Delta(V_{BE1} - V_{BE2})\Delta T_A _2$ (2)	1.0 mV dc maximum

(1) Devices which exceed the table I limits for this test shall not be accepted.

(2) JANS only.

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\* TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1 2/</u>						
Visual and mechanical examination <u>3/</u>	2071	n = 45 devices, c = 0				
Solderability <u>3/ 4/</u>	2026	n = 15 leads, c = 0				
Resistance to solvents <u>3/ 4/ 5/</u>	1022	n = 15 devices, c = 0				
Temp cycling <u>3/ 4/</u>	1051	Test condition C, 25 cycles. n = 22 devices, c = 0				
Hermetic seal <u>4/</u> Fine leak Gross leak	1071	n = 22 devices, c = 0				
Electrical measurements, <u>4/</u>		Table I, subgroup 2				
Bond strength <u>3/ 4/</u>	2037	Precondition T <sub>A</sub> = +250°C at t = 24 hrs or T <sub>A</sub> = 300°C at t = 2 hrs n = 11 wires, c = 0				
<u>Subgroup 2</u>						
Thermal impedance	3131	See 4.3.2	Z <sub>θJX</sub>			°C/W
Collector to base cutoff current	3036	Bias condition D, V <sub>CB</sub> = 100 V dc	I <sub>CBO1</sub>		10	μA dc
Breakdown voltage, collector to emitter	3011	Bias condition B, I <sub>C</sub> = 10 mA dc R <sub>BE</sub> ≤ 10 ohms, pulsed (see 4.5.1)	V <sub>(BR)CER</sub>	80		V dc
Breakdown voltage, collector to emitter	3011	Bias condition D, I <sub>C</sub> = 30 mA dc pulsed (see 4.5.1)	V <sub>(BR)CEO</sub>	60		V dc
Emitter to base cutoff current	3061	Bias condition D, V <sub>EB</sub> = 7 V dc	I <sub>EBO1</sub>		10	μA dc
Collector to base cutoff current	3036	Bias condition D; V <sub>CB</sub> = 80 V dc	I <sub>CBO2</sub>		2	nA dc
Emitter to base cutoff current	3061	Bias condition D, V <sub>EB</sub> = 5 V dc	I <sub>EBO2</sub>		2	nA dc
Saturation voltage and resistance	3071	I <sub>C</sub> = 50 mA dc; I <sub>B</sub> = 5 mA dc	V <sub>CE(sat)</sub>		0.3	V dc
Base emitter voltage (saturated)	3066	Test condition A, I <sub>C</sub> = 50 mA dc; I <sub>B</sub> = 5 mA dc	V <sub>BE(sat)</sub>		0.9	V dc

See footnotes at end of table.

\* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u> - Continued						
Forward-current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}; I_C = 10 \text{ } \mu\text{A dc}$	$h_{FE1}$	25	75	
Forward-current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}; I_C = 100 \text{ } \mu\text{A dc}$	$h_{FE2}$	30	90	
Forward-current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}; I_C = 1 \text{ mA dc}$	$h_{FE3}$	40	120	
Forward-current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}; I_C = 10 \text{ mA dc};$ pulsed (see 4.5.1)	$h_{FE4}$	50	150	
Forward-current transfer ratio (gain ratio)	3076	$V_{CE} = 5 \text{ V dc}; I_C = 100 \text{ } \mu\text{A dc};$ pulsed (see 4.5.1)	$\frac{h_{FE2-1}}{h_{FE2-2}}$ 6/	0.9	1.0	
Forward-current transfer ratio (gain ratio)	3076	$V_{CE} = 5 \text{ V dc}; I_C = 1.0 \text{ mA dc};$ pulsed (see 4.5.1)	$\frac{h_{FE3-1}}{h_{FE3-2}}$ 6/	0.9	1.0	
Absolute value of base emitter-voltage differential	3066	Test condition B; $V_{CE} = 5 \text{ V dc};$ $I_C = 100 \text{ } \mu\text{A dc}$ (see 4.5.5)	$ V_{BE} - V_{BE2} $ 1		5	mV dc
Absolute value of base emitter-voltage differential	3066	Test condition B; $V_{CE} = 5 \text{ V dc};$ $I_C = 1 \text{ mA dc}$ (see 4.5.5)	$ V_{BE} - V_{BE2} $ 2		5	mV dc
Base-emitter-voltage (nonsaturated) (absolute value of differential change with temperature)	3066	Test condition B; $V_{CE} = 5 \text{ V dc};$ $I_C = 100 \text{ } \mu\text{A dc}$ (see 4.5.5) $T_A = +25^\circ\text{C}$ and $-55^\circ\text{C}$ (see 4.5.6)	$ \Delta(V_{BE1} - V_{BE2})\Delta T_A $ 1		.8	mV dc
Base-emitter-voltage (nonsaturated) (absolute value of differential change with temperature)	3066	Test condition B, $V_{CE} = 5 \text{ V dc};$ $I_C = 100 \text{ } \mu\text{A dc};$ $T_A = +25^\circ\text{C}$ and $+125^\circ\text{C}$ (see 4.5.6)	$ \Delta(V_{BE1} - V_{BE2})\Delta T_A $ 2		1	mV dc
<u>Subgroup 3</u>						
High temperature operation:		$T_A = +150^\circ\text{C}$				
Collector to base cutoff current	3036	Bias condition D, $V_{CB} = 80 \text{ V dc}$	$I_{CBO3}$		10	$\mu\text{A dc}$
Low temperature operation:		$T_A = -55^\circ\text{C}$				
Forward-current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}; I_C = 100 \text{ } \mu\text{A dc}$	$h_{FE5}$	10		
<u>Subgroup 4</u>						
Small-signal short-circuit forward-current transfer ratio	3206	$V_{CE} = 5 \text{ V dc}; I_C = 1 \text{ mA dc};$ $f = 1 \text{ kHz}$	$h_{fe}$	50	150	

See footnotes at end of table.

\* TABLE I. Group A inspection - Continued.

Inspection <sup>1/</sup>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4 - Continued</u>						
Common emitter small-signal short-circuit forward-current transfer ratio	3306	$V_{CE} = 10 \text{ V dc}; I_C = 50 \text{ mA dc}; f = 20 \text{ MHz}$	$ h_{fe} $	3	25	
Small-signal short-circuit input impedance	3201	$V_{CB} = 5 \text{ V dc}; I_C = 1 \text{ mA dc}; f = 1 \text{ kHz}$	$h_{ib}$	20	30	$\Omega$
Small-signal short circuit input impedance	3201	$V_{CE} = 5 \text{ V dc}; I_C = 1 \text{ mA dc}; f = 1 \text{ kHz}$	$h_{ie}$	1,000	4,000	$\Omega$
Small-signal open-circuit output admittance	3216	$V_{CE} = 5 \text{ V dc}; I_C = 1 \text{ mA dc}; f = 1 \text{ kHz}$	$h_{oe}$	0	16	$\mu\text{mhos}$
Output capacitance (input open circuited)	3236	$V_{CB} = 10 \text{ V dc}; I_E = 0; 100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	$C_{obo}$		15	pF
Input capacitance (output open circuited)	3240	$V_{EB} = 0.5 \text{ V dc}; I_E = 0; 100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	$C_{ibo}$		85	pF
Noise figure	3246	$V_{CE} = 10 \text{ V dc}; I_C = 300 \mu\text{A dc}; R_g = 510 \Omega; f = 1 \text{ kHz}$ (see 4.5.7)	F1		8	dB
Noise figure	3246	$V_{CE} = 10 \text{ V dc}; I_C = 300 \mu\text{A dc}; R_g = 1 \text{ k}\Omega; f = 10 \text{ kHz}$ (see 4.5.7)	F2		8	dB
Collector to collector leakage		Test condition (see 4.5.3) $V_{(\text{collector 1 to collector 2})} = 100 \text{ V dc}$	$I_{(\text{collector 1 to collector 2})}$		100	nA dc

<sup>1/</sup> For sampling plan, see MIL-PRF-19500.

<sup>2/</sup> For resubmission of failed test in subgroup 1, double the sample size of the failed test or sequence of tests. A failure in subgroup 1 of table I shall not require retest of the entire subgroup. Only the failed test shall be rerun upon submission.

<sup>3/</sup> Separate samples may be used.

<sup>4/</sup> Not required for JANS devices.

<sup>5/</sup> Not required for laser marked devices.

<sup>6/</sup> The larger number will be placed in the denominator.

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\* TABLE II. Group E inspection (all quality levels) - for qualification and requalification only.

Inspection	MIL-STD-750		Qualification
	Method	Conditions	
<u>Subgroup 1</u>			45 devices c = 0
Temperature cycling (air to air)	1051	Test condition C, 500 cycles	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See subgroup 2 of table I and 4.5.9 herein.	
<u>Subgroup 2</u>			45 devices c = 0
Intermittent life	1037	Intermittent operation life: $V_{CB} = 10$ V dc, 6,000 cycles	
Electrical measurements		See subgroup 2 of table I and 4.5.9 herein.	
<u>Subgroup 4</u>			
Thermal impedance curves		Each supplier shall submit their qual-lot average and design thermal impedance curves. In addition, optimal test conditions and $Z_{\theta JX}$ limit shall be provided to the qualifying activity in the qualification report.	Sample size N/A
<u>Subgroup 5</u>			
Not applicable			
<u>Subgroup 6</u>			3 devices c = 0
ESD	1020		
<u>Subgroup 8</u>			45 devices c = 0
Reverse stability	1033	Condition A for devices $\geq 400$ V, Condition B for devices $< 400$ V.	

## 5. PACKAGING

5.1 Packaging. 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 activities within the Military Service or Defense Agency, or within the Military Service's system commands. 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

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

\* 6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Packaging requirements (see 5.1).
- c. Lead finish (see 3.4.1).
- d. Product assurance level and type designator.

\* 6.3 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 19500) 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 orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: DSCC/VQE, P.O. Box 3990, Columbus, OH 43218-3990 or e-mail [vqe.chief@dla.mil](mailto:vqe.chief@dla.mil).

6.4 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:  
Army - CR  
Navy - EC  
Air Force - 11  
DLA - CC

Preparing activity:  
DLA - CC  
  
(Project 5961-2929)

Review activities:  
Army - AR, AV, MI, SM  
Navy - AS, MC, OS, SH  
Air Force - 19, 99

\* NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <http://assist.daps.dla.mil> .