The documentation and process conversion measures necessary to comply with this document shall be completed by 30 April 2012.

INCH-POUND

MIL-PRF-19500/336L
30 January 2012
SUPERSEDING
MIL-PRF-19500/336K
25 April 2008

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, UNITIZED, DUAL-TRANSISTOR, PNP, SILICON, TYPES 2N3810, 2N3810L, 2N3810U, 2N3811, 2N3811L, AND 2N3811U, JAN, JANTX, JANTXV, JANS, JANSM, JANSD, JANSP, JANSL, JANSR, JANHCF, JANHCG, JANSH, JANHCA, JANHCB, JANKCA, JANKCB, JANKAM, JANKAD, JANKAP, JANKAL, JANKAR, JANKCAF, JANKCAG, AND JANKCAH

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 PNP, silicon transistors as one dual unit. Four levels of product assurance are provided for each encapsulated device type as specified in MIL-PRF-19500, and two levels of product assurance are provided for each unencapsulated device type. Radiation hardness assurance (RHA) level designators “M”, “D”, “P“, “L”, “R”, “F”, “G”, and “H” are appended to the device prefix to identify devices, which have passed RHA requirements.

1.2 Physical dimensions. See figure 1 (similar to TO-78), figures 2 and 3 for unencapsulated devices, and figure 4 for U devices.

* 1.3 Maximum ratings, unless otherwise specified, T_C =+25°C.

Type	I_C	V_{CBO}	V_{CEO}	V_{EBO}
	mA dc	V dc	V dc	V dc
All types	50	60	60	5

P_T (1) T_A = +25°C		P_T (2) T_C = +25°C		$R_{\theta JA}$		$R_{\theta JC}$ (3)		T_J and T_{STG}
One section	Both sections	One section	Both sections	One section	Both sections	One section	Both sections	
mW	mW	mW	mW	°C/W	°C/W	°C/W	°C/W	°C
(4) 200	(4) 350	300	450	875	500	583	350	-65 to +200

(1) For T_A > +25°C, derate linearly 1.143 mW/°C, one section; 2.000 mW/°C, both sections. See figure 5 and 6.
(2) For T_C > +25°C, derate linearly 1.714 mW/°C, one section; 2.571 mW/°C, both sections.
* (3) For TO-78 devices only.
* (4) For non-thermal conductive PCB or unknown PCB surface mount conditions in free air, substitute figures 5 and 6 for the U package and use $R_{\theta JA}$.

* Comments, suggestions, or questions on this document should be addressed to DLA Land and Maritime, ATTN: VAC, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to Semiconductor@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.daps.dla.mil .

1.4 Primary electrical characteristics at T_A = +25°C, pulsed (see 4.5.2).

Limit	h_{FE3} through h_{FE4}		$\lvert h_{fe} \rvert_2$	$V_{BE(sat)\,2}$	$V_{CE(sat)\,2}$
	V_{CE} = 5 V dc; I_C = 100 μA dc Through I_C = 1 mA dc		V_{CE} = 5 V dc; I_C = 1 mA dc; f = 100 MHz	I_C = 1 mA dc; I_B = 100 μA dc	I_C = 1 mA dc; I_B = 100 μA dc
	2N3810 2N3810L	2N3811 2N3811L		V dc	V dc
Minimum	150	300	1		
Maximum	450	900	5	0.8	0.25

1.5 Primary electrical matching characteristics of each individual section.

Limit	$\frac{h_{FE3-1}}{h_{FE3-2}}$	$\lvert V_{BE1} - V_{BE2} \rvert_2$	$\lvert \Delta (V_{BE1} - V_{BE2}) \Delta T_A \rvert 1$	$\lvert \Delta (V_{BE1} - V_{BE2}) \Delta T_A \rvert 2$
	V_{CE} = 5 V dc; I_C = 100 μA dc (1)	V_{CE} = 5 V dc; I_C = 100 μA dc	V_{CE} = 5 V dc I_C = 100 μA dc T_A = +25°C and –55°C	V_{CE} = 5 V dc; I_C = 100 μA dc T_A = +125°C and +25°C
		mV dc	mV dc	mV dc
Minimum	0.9			
Maximum	1.0	3	0.8	1.0

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

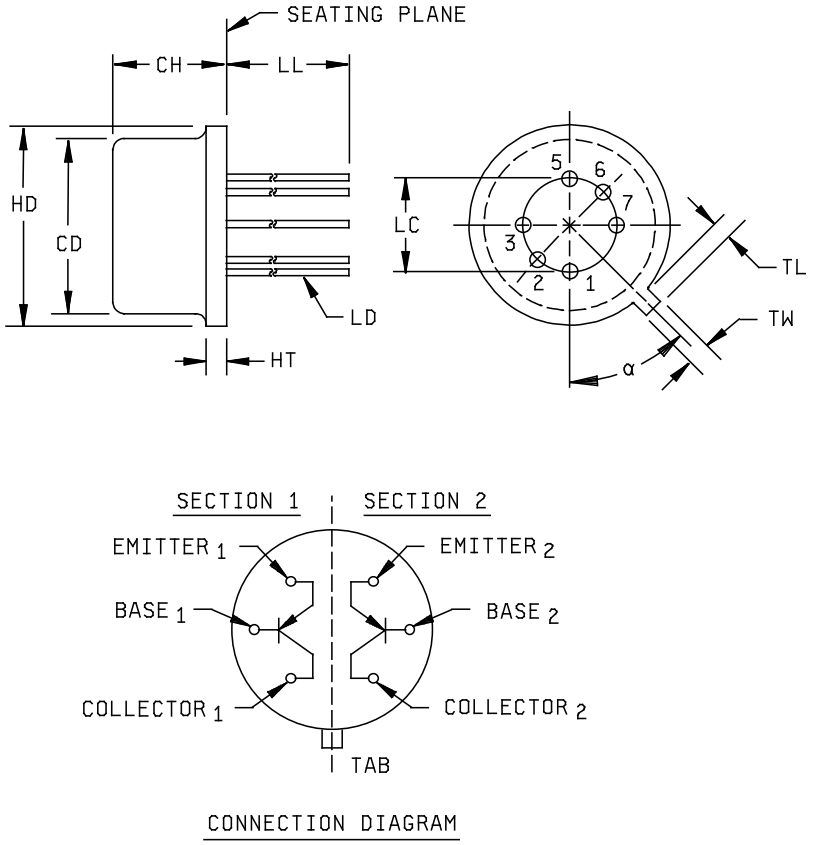
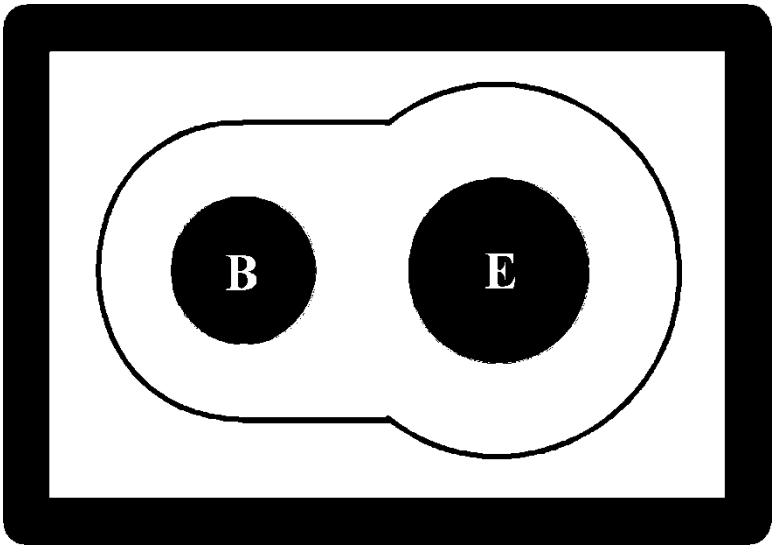


FIGURE 1. Physical dimensions (similar to TO-78).

LTR	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.335	7.75	8.51	
CH	.150	.185	3.81	4.70	
HD	.335	.370	8.51	9.40	
HT	.009	.041	0.23	1.04	
LC	.200 BSC		5.08 BSC		
LD	.016	.021	0.41	0.53	10
LL	See notes 10, 11, and 13				
α	45°TP		45°TP		9
TL	.029	.045	0.74	1.14	5, 6
TW	.028	.034	0.71	0.86	4, 5

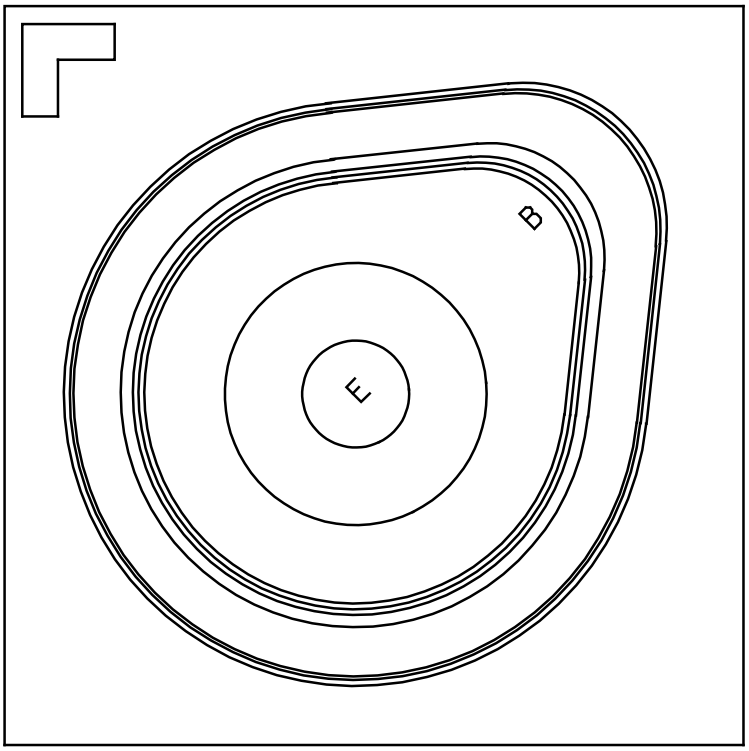
NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Refer to rules for dimensioning Semiconductor Product Outlines included in Publication No. 95.
4. Lead number 4 and 8 omitted on this variation.
5. TW must be held to a minimum length of .021 inch (0.53 mm).
6. LL measured from maximum HD.
7. Details of outline in this zone optional.
8. CD shall not vary more than .010 inch (0.25mm) in zone P. This zone is controlled for automatic handling.
9. Leads at gauge plane .054 - .055 inch (1.37 – 1.40 mm) below seating plane shall be within .007 (0.18 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.
10. LD applies to LL minimum.
11. r (radius) applies to both inside corners of tab.
12. For transistor types 2N3810 and 2N3811, LL is .500 inch (12.70 mm) minimum, and .750 inch (19.05 mm) maximum. (TO-99).
13. For transistor types 2N3810L and 2N3811L, LL is 1.500 inches (38.10 mm) minimum, and 1.750 inches (44.45 mm) maximum.
14. In accordance with AMSE Y14.5M, diameters are equivalent to ϕx symbology.
15. Leads 3 and 5 = emitter, leads 2 and 6 = base, leads 1 and 7 = collector.

FIGURE 1. Physical dimensions (similar to TO-78) – Continued.



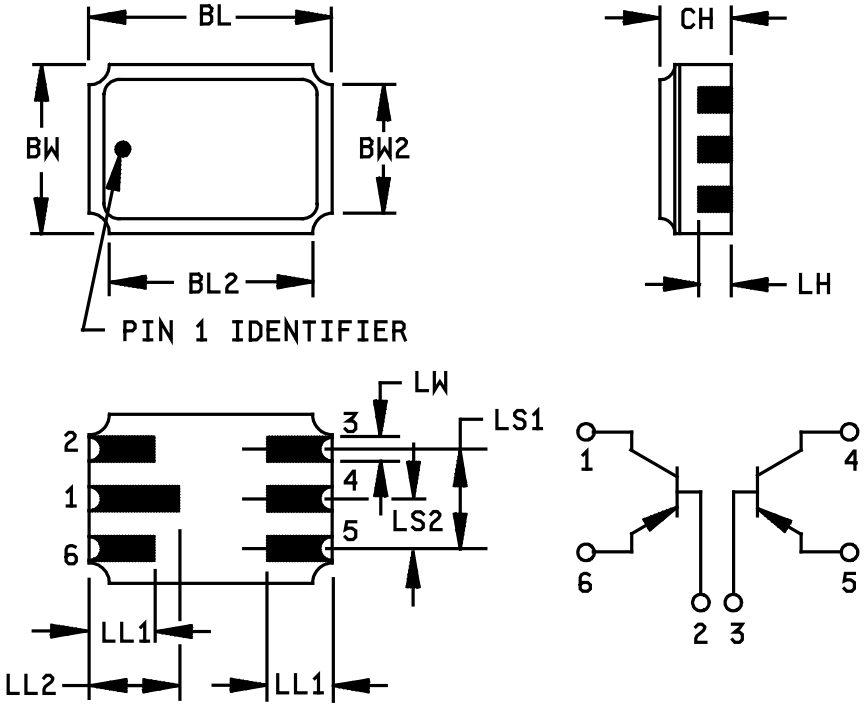
1. Chip size..... .015 x .019 inch ±.001 inch (0.38 x 0.48 mm ±0.025 mm).
2. Chip thickness..... .010 ±0.0015 inch (0.25 ±0.038 mm).
3. Top metal..... Aluminum 15,000 Å minimum, 18,000 Å nominal.
* 4. Back metal..... A. Gold 3,000 Å minimum, 5,000 Å nominal.
5. Backside..... Collector.
6. Bonding pad.....B = .003 inch (0.07 mm), E = .004 inch (0.10 mm) diameter.
* 7. Passivation……Si_3N_4 (Silicon Nitride) 5,600 Å minimum, 8,000 Å nominal.

* FIGURE 2. JANHC and JANKC A-version die dimensions.



Die size:	.018 x .018 inch (0.457 X 0.457 mm).
Die thickness:	.008 ±.0016 inch (0.20 ±0.041 mm).
Base pad:	.0025 inch diameter (0.064 mm).
Emitter pad:	.003 inch diameter (0.076 mm).
Back metal:	Gold, 6,500 ±1,950 Å.
Top metal:	Aluminum, 19,500 ±2,500 Å.
Back side:	Collector.
Glassivation:	SiO_2, 7,500 ±1,500 Å.

FIGURE 3. JANHC and JANKC B-version die dimensions.



Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.240	.250	6.10	6.35
BL2		.250		6.35
BW	.165	.175	4.19	4.45
BW2		.175		4.45
CH	.044	.080	1.12	2.03
LH	.026	.039	0.66	0.99
LL1	.060	.070	1.52	1.78
LL2	.082	.098	2.08	2.49
LS1	.095	.105	2.41	2.67
LS2	.045	.055	1.14	1.40
LW	.022	.028	0.56	0.71

Pin no.	Transistor
1	Collector no. 1
2	Base no. 1
3	Base no. 2
4	Collector no. 2
5	Emitter no. 2
6	Emitter no. 1

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. In accordance with AMSE Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 4. Physical dimensions (2N3810U and 2N3811U).

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 https://assist.daps.dla.mil/quicksearch or https://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. Unless otherwise noted herein or in the contract, 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.

$\frac{H_{FE3-1}}{h_{FE3-2}}$	Static forward-current-gain-ratio. The matching ratio of the static forward-current transfer ratios of each section.
$\lvert V_{BE1} - V_{BE2} \rvert$	Absolute value of base-emitter-voltage differential between the individual sections.
$\lvert \Delta V_{BE1-2}\ (T1) - \Delta V_{BE1-2}\ (T2) \rvert$	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. The interface and physical dimensions shall be as specified in MIL-PRF-19500, and on figure 1 (similar to TO-78), figures 2 and 3 for unencapsulated devices, and figure 4 for U devices.

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 Radiation hardness assurance (RHA). Radiation hardness assurance requirements, PIN designators, and test levels shall be as defined in MIL-PRF-19500.

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

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

3.8 Marking. Marking shall be in accordance with MIL-PRF-19500. The radiation hardened designator M, D, P, L, R, F, G, or H shall immediately precede (or replace) the device “2N” identifier (depending upon degree of abbreviation required).

3.9 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 and tables I, II, and III).

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

4.2.1 JANHC and JANKC qualification. JANHC and JANKC qualification inspection shall be in accordance with MIL-PRF-19500.

4.2.2 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 III tests, the tests specified in table III herein that were not performed in the prior revision shall be performed on the first inspection lot of this revision to maintain qualification.

4.2.2.1 Group E thermal response. With extremely small junction devices such as this one, a true thermal impedance cannot be measured, only calculated. While “thermal response” has been substituted for “thermal impedance” herein, the terms, units and procedure as essentially unchanged. Each supplier shall submit a thermal response ($Z_{\theta JX}$) histogram of the entire qualification lot. The histogram data shall be taken prior to the removal of devices that are atypical for thermal response. Thermal response curves (from $Z_{\theta JX}$ test pulse time to $R_{\theta JX}$ minimum steady-state time) of the best device in the qual lot and the worst device in the qual lot (that meets the supplier proposed screening limit), or from the thermal grouping, shall be submitted. The optimal test conditions and proposed initial thermal response screening limit shall be provided in the qualification report. Data indicating how the optimal test conditions were derived for $Z_{\theta JX}$ shall also be submitted. The proposed maximum thermal response $Z_{\theta JX}$ screening limit shall be submitted. The qualifying activity may approve a different $Z_{\theta JX}$ limit for conformance inspection end-point measurements as applicable. Equivalent data, procedures, or statistical process control plans may be used for part, or all, of the above requirements. The approved thermal response conditions and limit for $Z_{\theta JX}$ shall be used by the supplier in screening and table I, subgroup 2. The approved thermal resistance conditions for $R_{\theta JX}$ shall be used by the supplier for conformance inspection. For product families with similar thermal characteristics based on the same physical and thermal die, package, and construction combination (thermal grouping), the supplier may use the same thermal response curves.

* 4.3 Screening (JANS, JANTX, and JANTXV levels only). Screening shall be in accordance with table E-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 E-IV of MIL-PRF-19500)	Measurement	
	JANS level	JANTX and JANTXV levels
(1) 3c	Thermal response, method 3131 of MIL-STD-750. See 4.3.3.	Thermal response, method 3131 of MIL-STD-750. See 4.3.3.
9	I_{CBO2}, h_{FE4}	Not applicable
10	24 hours minimum	24 hours minimum
11	I_{CBO2}; h_{FE4}; ΔI_{CBO2} = 100 percent of initial value or 5 nA dc, whichever is greater. Δh_{FE4} = ±15 percent.	I_{CBO2} ,h_{FE4}
12	See 4.3.2	See 4.3.2
13	Subgroups 2 and 3 of table I herein; ΔI_{CBO2} = 100 percent of initial value or 5 nA dc, whichever is greater; Δh_{FE4} = ±15 percent.	Subgroup 2 and the base emitter voltage (non-saturated) (absolute value of differential-change with temperature) tests of subgroup 3 of table I herein; ΔI_{CBO2} = 100 percent of initial value or 5 nA dc, whichever is greater; Δh_{FE4} = ±15 percent.

* (1) Shall be performed anytime after temperature cycling, screen 3a; TX and TXV do not need to be repeated in screening requirements.

4.3.1 Screening (JANHC and JANKC). Screening of JANHC and JANKC die shall be in accordance with MIL-PRF-19500, “Discrete Semiconductor Die/Chip Lot Acceptance”. Burn-in duration for the JANKC level follows JANS requirements; the JANHC follows JANTX requirements.

4.3.2 Power burn-in conditions. Power burn-in conditions are as follows: V_{CB} = 10 – 30 V dc. Power shall be applied to achieve T_J = 135°C minimum and using a minimum P_D = 75 percent of P_T maximum rated as defined in 1.3. With approval of the qualifying activity and preparing activity, alternate burn-in criteria (hours, bias conditions, T_J, and mounting conditions) may be used for JANTX and JANTXV quality levels. A justification demonstrating equivalence is required. In addition, the manufacturing site’s burn-in data and performance history will be essential criteria for burn-in modification approval.

4.3.3 Thermal response. For very small junction devices, such as this, the term “thermal response” shall be used in lieu of “thermal impedance” although measurements shall be performed the same way as thermal impedance in accordance with method 3131 of MIL-STD-750 using the guidelines in that method for determining I_M, I_H, t_H, t_{SW} (V_C and V_H where appropriate). Measurement delay time (t_{MD}) = 70 μs max. See group E, subgroup 4 herein.

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 subgroup 1 and 2, of table I herein, inspection only (table E-Vib, group B, subgroup 1 is not required to be performed since solderability and resistance to solvents testing is performed in A1 herein).

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 tests and conditions specified for subgroup testing in table E-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 4.5.3 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 4.5.3 herein.

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

Subgroup	Method	Condition
B4	1037	V_{CB} = 10 V dc, 2,000 cycles, adjust device current, or power, to achieve a minimum ΔT_J of +100°C.
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.) Option 1: 96 hours minimum sample size in accordance with MIL-PRF-19500, table E-Via, adjust T_A or P_D to achieve T_J = +275°C minimum. Option 2: 216 hours minimum, sample size = 45, c = 0; adjust T_A or P_D to achieve a T_J = +225°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.

Step	Method	Condition
1	1026	Steady-state life: 1,000 hours minimum, V_{CB} = 10 V dc, power shall be applied to achieve T_J = +150°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°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°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. Shall 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 E-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 4.5.3 herein.

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

Subgroup	Method	Condition
C2	2036	Test condition E; (not applicable for U devices).
C5	3131	$R_{\theta JA}$ and $R_{\theta JC}$ only, as applicable (see 1.3) and 4.3.3 herein.
C6	1026	1,000 hours at V_{CB} = 10 V dc; power shall be applied to achieve T_J = +150°C minimum and a minimum of P_D = 75 percent of maximum rated P_T as defined in 1.3 n = 45, 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.

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

Subgroup	Method	Condition
C2	2036	Test condition E; not applicable for U device.
C5	3131	$R_{\theta JA}$ and $R_{\theta JC}$ only, as applicable (see 1.3) and 4.3.3 herein.
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 table I tests herein for conformance inspection. When the final lead finish is solder or any plating prone to oxidation at high temperature, the samples for C6 life test may be pulled prior to the application of final lead finish. 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 D inspection. Conformance inspection for hardness assured JANS, and JANTXV types shall include the group D tests specified in table II herein. These tests shall be performed as required in accordance with MIL-PRF-19500 and method 1019 of MIL-STD-750, for total ionizing dose or method 1017 of MIL-STD-750 for neutron fluence as applicable (see 6.2 herein), except group D, subgroup 2 may be performed separate from other subgroups. Alternate package options may also be substituted for the testing provided there is no adverse effect to the fluence profile or to the total dose response from molecular hydrogen in the package. Any alternate package should be tested for molecular hydrogen using method 1018 of MIL-STD-750. If hydrogen is detected, total dose testing shall be performed in the alternate package.

4.4.5 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-IX of MIL-PRF-19500 and as specified in table III herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein; delta measurements shall be in accordance with the applicable steps of 4.5.3.

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

4.5.1 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.

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

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

Step	Inspection	MIL-STD-750		Symbol	Limit	Unit
		Method	Conditions			
1	Collector-base cutoff current	3036	Bias condition D, V_{CB} = 50 V dc	ΔI_{CB02} (1)	100 percent of initial value or 8 nA dc, whichever is greater.	
2	Forward current transfer ratio	3076	V_{CE} = 5 V dc; I_C = 1 mA dc; pulsed see 4.5.2	Δh_{FE4} (1)	±25 percent change from initial reading.	

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

4.5.4 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.

4.5.5 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.

4.5.6 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.

4.5.7 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 4.5.6 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:

$$\left| (V_{BE1} - V_{BE2})\ T1 - (V_{BE1} - V_{BE2})\ T2 \right|$$

4.5.8 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.

4.5.9 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.

* TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1 2/						
Visual and mechanical examination 3/	2071					
Solderability 2/ 3/ 4/	2026	n = 15 leads, c = 0				
Resistance to solvents 3/ 4/ 5/	1022	n = 15 devices, c = 0				
Temp cycling 2/ 3/ 4/	1051	Test condition C, 25 cycles. N = 22 devices, c = 0				
Hermetic seal 4/ 6/ Fine leak Gross leak	1071	n = 22 devices, c = 0				
Electrical measurements 4/		Table I, subgroup 2				
Bond strength 2/ 3/ 4/	2037	Precondition T_A = +250°C at t = 24 hours or T_A = +300°C at t = 2 hours n = 11 wires, c = 0				
Decap internal visual (design verification)	2075	n = 4 devices, c = 0				
Subgroup 2						
Thermal response	3131	See 4.3.3.	$Z_{\theta JX}$			°C/W
Collector to base cutoff current	3036	Bias condition D, V_{CB} = 60 V dc (see 4.5.2)	I_{CBO1}		10	µA dc
Breakdown voltage, collector to emitter	3011	Bias condition D; I_C = 100 µA dc; pulsed (see 4.5.2)	$V_{(BR)CEO}$	60		V dc
Emitter to base cutoff current	3061	Bias condition D, V_{EB} = 5 V dc	I_{EBO1}		10	µA dc
Collector to base cutoff current	3036	Bias condition D, V_{CB} = 50 V dc	I_{CBO2}		10	nA dc
Emitter to base cutoff current	3061	Bias condition D, V_{EB} = 4 V dc	I_{EBO2}		10	nA dc
Forward-current transfer ratio 2N3811, 2N3811L, U only	3076	V_{CE} = 5 V dc; I_C = 1 µA dc	h_{FE1}	75		

See footnotes at end of table.

* TABLE I. Group A inspection – Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 2 – Continued						
Forward-current transfer ratio 2N3810, 2N3810L, U 2N3811, 2N3811L, U	3076	V_{CE} = 5 V dc; I_C = 10 μA dc	h_{FE2}	 100 225		
Forward-current transfer ratio 2N3810, 2N3810L, U 2N3811, 2N3811L, U	3076	V_{CE} = 5 V dc; I_C = 100 μA dc	h_{FE3}	 150 300	 450 900	
Forward-current transfer ratio 2N3810, 2N3810L, U 2N3811, 2N3811L, U	3076	V_{CE} = 5 V dc; I_C = 1 mA dc	h_{FE4}	 150 300	 450 900	
Forward-current transfer ratio 2N3810, 2N3810L, U 2N3811, 2N3811L, U	3076	V_{CE} = 5 V dc; I_C = 10 mA dc	h_{FE5}	 125 250		
Collector to emitter voltage (saturated)	3071	I_C = 100 μA dc, I_B = 10 μA dc	$V_{CE(sat)1}$		0.2	V dc
Collector to emitter voltage (saturated)	3071	I_C = 1 mA dc, I_B = 100 μA dc	$V_{CE(sat)2}$		0.25	V dc
Base-emitter voltage (saturated)	3066	Test condition A; I_C = 100 μA dc, I_B = 10 μA dc	$V_{BE(sat)1}$		0.7	V dc
Base-emitter voltage (saturated)	3066	Test condition A; I_C = 1 mA dc, I_B = 100 μA dc	$V_{BE(sat)2}$		0.8	V dc
Base-emitter voltage (nonsaturated)	3066	Test condition B; V_{CE} = 5 V dc; I_C = 100 μA dc	$V_{BE(ON)}$		0.7	V dc
Forward-current transfer ratio (gain ratio)	3076	V_{CE} = 5 V dc; I_C = 100 μA dc (see 4.5.5)	h_{FE3-1} / h_{FE3-2}	0.9	1.1	
Base emitter voltage (nonsaturated) (absolute value of differential) 7/	3066	Test condition B V_{CE} = 5 V dc; I_C = 10 μA dc (see 4.5.6)	$\lvert V_{BE1} - V_{BE2} \rvert 1$		5	mV dc
Base emitter voltage (nonsaturated) (absolute value of differential) 7/	3066	Test condition B V_{CE} = 5 V dc; I_C = 100 μA dc (see 4.5.6)	$\lvert V_{BE1} - V_{BE2} \rvert 2$		3	mV 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	
Subgroup 2 – Continued						
Base emitter voltage (nonsaturated) (absolute value of differential) 7/	3066	Test condition B V_{CE} = 5 V dc; I_C = 10 mA dc (see 4.5.6)	$\lvert V_{BE1} - V_{BE2} \rvert 3$		5	mV dc
Subgroup 3						
High temperature operation:		T_A = +150°C				
Base emitter voltage (absolute value of differential-change with temperature)	3066	Test condition B V_{CE} = 5 V dc; I_C = 100 μA dc T_A = +125°C and +25°C (see 4.5.7)	$\lvert \Delta V_{BE1} - V_{BE2} \Delta T_A \rvert 2$		1.0	mV dc
Collector to base cutoff current	3036	Bias condition D, V_{CB} = 50 V dc	I_{CBO3}		10	μA dc
Low-temperature operation:		T_A = -55°C				
Forward-current transfer ratio	3076	V_{CE} = 5 V dc; I_C = 100 μA dc	h_{FE6}			
2N3810, 2N3810L, U 2N3811, 2N3811L, U				60 100		
Base emitter voltage (absolute value of differential-change with temperature)	3066	Test condition B V_{CE} = 5 V dc; I_C = 100 μA dc T_A = +25°C and -55°C (see 4.5.7)	$\lvert \Delta V_{BE1} - V_{BE2} \Delta T_A \rvert 1$		0.8	mV dc
Subgroup 4						
Open circuit output capacitance	3236	V_{CB} = 5 V dc; I_E = 0; 100 kHz ≤ f ≤ 1 MHz	C_{obo}		5	pF
Input capacitance (output open-circuited)	3240	V_{EB} = 0.5 V dc; I_C = 0; 100 kHz ≤ f ≤ 1 MHz	C_{ibo}		8	pF
Magnitude of small-signal short-circuit forward-current transfer ratio	3306	V_{CE} = 5 V dc; I_C = 500 μA dc f = 30 MHz	$\lvert h_{FE} \rvert 1$	1.0		
Magnitude of small-signal short-circuit forward-current transfer ratio	3306	V_{CE} = 5 V dc; I_C = 1 mA dc f = 100 MHz	$\lvert h_{FE} \rvert 2$	1.0	5	

See footnotes at end of table.

* TABLE I. Group A inspection – Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 4 – Continued						
Small-signal short- circuit forward current transfer ratio	3206	V_{CE} = 10 V dc; I_C = 1 mA dc f = 1 kHz	h_{fe}			
2N3810, 2N3810L, U				150	600	
2N3811, 2N3811L, U				300	900	
Small-signal short-circuit input impedance	3201	V_{CE} = 10 V dc; I_C = 1 mA dc; f = 1 kHz	h_{ie}			
2N3810, 2N3810L, U				3	30	kΩ
2N3811, 2N3811L, U				3	40	kΩ
Small-signal open-circuit output admittance	3216	V_{CE} = 10 V dc; I_C = 1 mA dc; f = 1 kHz	h_{oe}	5	60	μmhos
Small-signal open-circuit reverse-voltage transfer ratio	3211	V_{CE} = 10 V dc; I_C = 1 mA dc; f = 1 kHz	h_{re}		$25x10^{-4}$	
Noise figure	3246	V_{CE} = 10 V dc; I_C = 100 μA dc; Rg = 3 kΩ, f = 100 Hz (see 4.5.8)	F1			
2N3810, 2N3810L, U					7	dB
2N3811, 2N3811L, U					4	dB
Noise figure	3246	V_{CE} = 10 V dc; I_C = 100 μA dc; Rg = 3 kΩ, f = 1 kHz (see 4.5.8)	F2			
2N3810, 2N3810L, U					3	dB
2N3811, 2N3811L, U					1.5	dB
Noise figure	3246	V_{CE} = 10 V dc; I_C = 100 μA dc; Rg = 3 kΩ, f = 10 kHz (see 4.5.8)	F3			
2N3810, 2N3810L, U					2.5	dB
2N3811, 2N3811L, U					2.0	dB
Noise figure (wideband)	3246	V_{CE} = 10 V dc; I_C = 100 μA dc; Rg = 3 kΩ, noise bandwidth 10 Hz to 15.7 kHz (see 4.5.9)	F1			
2N3810, 2N3810L, U					3.5	dB
2N3811, 2N3811L, U					2.5	dB
Subgroup 5 and 6						
Not applicable						

1/ For sampling plan see MIL-PRF-19500.
2/ For resubmission of failed test in subgroup 1 of table I, double the sample size of the failed test or sequence of tests. A failure in table I, subgroup 1 shall not require retest of the entire subgroup. Only the failed test shall be rerun upon submission.
3/ Separate samples may be used.
4/ Not required for JANS devices.
5/ Not required for laser marked devices.
6/ This hermetic seal test is an end-point to temp-cycling in addition to electrical measurements.
7/ When using table I, subgroup 2, as electrical end-points, this test is only required for JANS end-points, except subgroups C2 and C3.

TABLE II. Group D inspection.

Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1 4/						
Neutron irradiation	1017	Neutron exposure V_{CES} = 0V				
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 60 V dc	I_{CBO1}		20	µA dc
Breakdown voltage, collector to emitter	3011	Bias condition D; I_C = 100 µA dc; pulsed (see 4.5.2)	$V_{(BR)CEO}$	60		V dc
Emitter to base cutoff current	3061	Bias condition D, V_{EB} = 5 V dc	I_{EBO1}		20	µA dc
Collector to base cutoff current	3036	Bias condition D, V_{CB} = 50 V dc	I_{CBO2}		20	nA dc
Emitter to base cutoff current	3061	Bias condition D, V_{EB} = 4 V dc	I_{EBO2}		20	nA dc
Forward-current transfer ratio 2N3811, 2N3811L, U only	3076	V_{CE} = 5 V dc; I_C = 1 µA dc	[h_{FE1}] 5/	[37.5]		
Forward-current transfer ratio 2N3810, 2N3810L, U 2N3811, 2N3811L, U	3076	V_{CE} = 5 V dc; I_C = 10 µA dc	[h_{FE2}] 5/	 [50] [112.5]		
Forward-current transfer ratio 2N3810, 2N3810L, U 2N3811, 2N3811L, U	3076	V_{CE} = 5 V dc; I_C = 100 µA dc	[h_{FE3}] 5/	 [75] [150]	 450 900	
Forward-current transfer ratio 2N3810, 2N3810L, U 2N3811, 2N3811L, U	3076	V_{CE} = 5 V dc; I_C = 1 mA dc	[h_{FE4}] 5/	 [75] [150]	 450 900	
Forward-current transfer ratio 2N3810, 2N3810L, U 2N3811, 2N3811L, U	3076	V_{CE} = 5 V dc; I_C = 10 mA dc	[h_{FE5}] 5/	 [62.5] [125]		
Collector to emitter voltage (saturated)	3071	I_C = 100 µA dc, I_B = 10 µA dc	$V_{CE(sat)1}$		0.23	V dc
Collector to emitter voltage (saturated)	3071	I_C = 1 mA dc, I_B = 100 µA dc	$V_{CE(sat)2}$		0.29	V dc
Base-emitter voltage (saturated)	3066	Test condition A; I_C = 100 µA dc, I_B = 10 µA dc	$V_{BE(sat)1}$		0.81	V dc
Base-emitter voltage (saturated)	3066	Test condition A; I_C = 1 mA dc, I_B = 100 µA dc	$V_{BE(sat)2}$		0.92	V dc

See footnotes at end of table.

TABLE II. Group D inspection – Continued.

Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1 – Continued						
Base-emitter voltage (nonsaturated)	3066	Test condition B; V_{CE} = 5 V dc; I_C = 100 μA dc	$V_{BE(ON)}$		0.81	V dc
Forward-current transfer ratio (gain ratio)	3076	V_{CE} = 5 V dc; I_C = 100 μA dc (see 4.5.5)	h_{FE3-1} / h_{FE3-2}	0.8	1.2	
Base emitter voltage (nonsaturated) (absolute value of differential) 7/	3066	Test condition B V_{CE} = 5 V dc; I_C = 10 μA dc (see 4.5.6)	$\|V_{BE1} - V_{BE2}\|1$		10	mV dc
Base emitter voltage (nonsaturated) (absolute value of differential) 7/	3066	Test condition B V_{CE} = 5 V dc; I_C = 100 μA dc (see 4.5.6)	$\|V_{BE1} - V_{BE2}\|2$		6	mV dc
Base emitter voltage (nonsaturated) (absolute value of differential) 7/	3066	Test condition B V_{CE} = 5 V dc; I_C = 10 mA dc (see 4.5.6)	$\|V_{BE1} - V_{BE2}\|3$		10	mV dc
Subgroup 2						
Total dose irradiation	1019	Gamma exposure V_{CES} = 48 V				
Breakdown voltage, collector to emitter	3011	Bias condition D; I_C = 100 μA dc; pulsed (see 4.5.2)	$V_{(BR)CEO}$	60		V dc
Emitter to base cutoff current	3061	Bias condition D, V_{EB} = 5 V dc	I_{EBO1}		20	μA dc
Collector to base cutoff current	3036	Bias condition D, V_{CB} = 50 V dc	I_{CBO2}		20	nA dc
Emitter to base cutoff current	3061	Bias condition D, V_{EB} = 4 V dc	I_{EBO2}		20	nA dc
Forward-current transfer ratio 2N3811, 2N3811L, U only	3076	V_{CE} = 5 V dc; I_C = 1 μA dc	[h_{FE1}] 5/	[37.5]		
Forward-current transfer ratio 2N3810, 2N3810L, U 2N3811, 2N3811L, U	3076	V_{CE} = 5 V dc; I_C = 10 μA dc	[h_{FE2}] 5/	[50] [112.5]		
Forward-current transfer ratio 2N3810, 2N3810L, U 2N3811, 2N3811L, U	3076	V_{CE} = 5 V dc; I_C = 100 μA dc	[h_{FE3}] 5/	[75] [150]	450 900	

See footnotes at end of table.

TABLE II. Group D inspection – Continued.

Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 2 – Continued.						
Forward-current transfer ratio 2N3810, 2N3810L, U 2N3811, 2N3811L, U	3076	V_{CE} = 5 V dc; I_C = 1 mA dc	[h_{FE4}] 5/	 [75] [150]	 450 900	
Forward-current transfer ratio 2N3810, 2N3810L, U 2N3811, 2N3811L, U	3076	V_{CE} = 5 V dc; I_C = 10 mA dc	[h_{FE5}] 5/	 [62.5] [125]		
Collector to emitter voltage (saturated)	3071	I_C = 100 μA dc, I_B = 10 μA dc	$V_{CE(sat)1}$		0.23	V dc
Collector to emitter voltage (saturated)	3071	I_C = 1 mA dc, I_B = 100 μA dc	$V_{CE(sat)2}$		0.29	V dc
Base-emitter voltage (saturated)	3066	Test condition A; I_C = 100 μA dc, I_B = 10 μA dc	$V_{BE(sat)1}$		0.81	V dc
Base-emitter voltage (saturated)	3066	Test condition A; I_C = 1 mA dc, I_B = 100 μA dc	$V_{BE(sat)2}$		0.92	V dc
Base-emitter voltage (nonsaturated)	3066	Test condition B; V_{CE} = 5 V dc; I_C = 100 μA dc	$V_{BE(ON)}$		0.81	V dc
Forward-current transfer ratio (gain ratio)	3076	V_{CE} = 5 V dc; I_C = 100 μA dc (see 4.5.5)	h_{FE3-1} / h_{FE3-2}	0.8	1.2	
Base emitter voltage (nonsaturated) (absolute value of differential) 7/	3066	Test condition B V_{CE} = 5 V dc; I_C = 10 μA dc (see 4.5.6)	$\lvert V_{BE1} - V_{BE2} \rvert 1$		10	mV dc
Base emitter voltage (nonsaturated) (absolute value of differential) 7/	3066	Test condition B V_{CE} = 5 V dc; I_C = 100 μA dc (see 4.5.6)	$\lvert V_{BE1} - V_{BE2} \rvert 2$		6	mV dc
Base emitter voltage (nonsaturated) (absolute value of differential) 7/	3066	Test condition B V_{CE} = 5 V dc; I_C = 10 mA dc (see 4.5.6)	$\lvert V_{BE1} - V_{BE2} \rvert 3$		10	mV dc

1/ Tests to be performed on all devices receiving radiation exposure.
2/ For sampling plan, see MIL-PRF-19500.
3/ Electrical characteristics apply to the corresponding U suffix versions unless otherwise noted.
4/ See 6.2.e herein.
5/ See method 1019 of MIL-STD-750 for how to determine [h_{FR}] by first calculating the delta ($1/h_{FE}$) from the pre- and Post-radiation h_{FE}. Notice the [h_{FE}] is not the same as h_{FE} and cannot be measured directly. The [h_{FE}] value can never exceed the pre-radiation minimum h_{FE} that it is based upon.

* TABLE III. Group E inspection (all quality levels) – for qualification or re-qualification only.

Inspection	MIL-STD-750		Qualification
	Method	Conditions	
Subgroup 1			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 table I, subgroup 2 and 4.5.3 herein	
Subgroup 2			45 devices c = 0
Intermittent life	1037	Intermittent operation life: V_{CB} = 10 V dc, 6,000 cycles	
Electrical measurements		See table I, subgroup 2 and 4.5.3 herein	
Subgroup 4			Sample size N/A
Thermal response curves		See MIL-PRF-19500, table E-IX, group E, subgroup 4	
Subgroup 5			
Not applicable			
Subgroup 6			11 devices
Electrostatic discharge (ESD)	1020		
Subgroup 8			45 devices c = 0
Reverse stability	1033	Condition B	

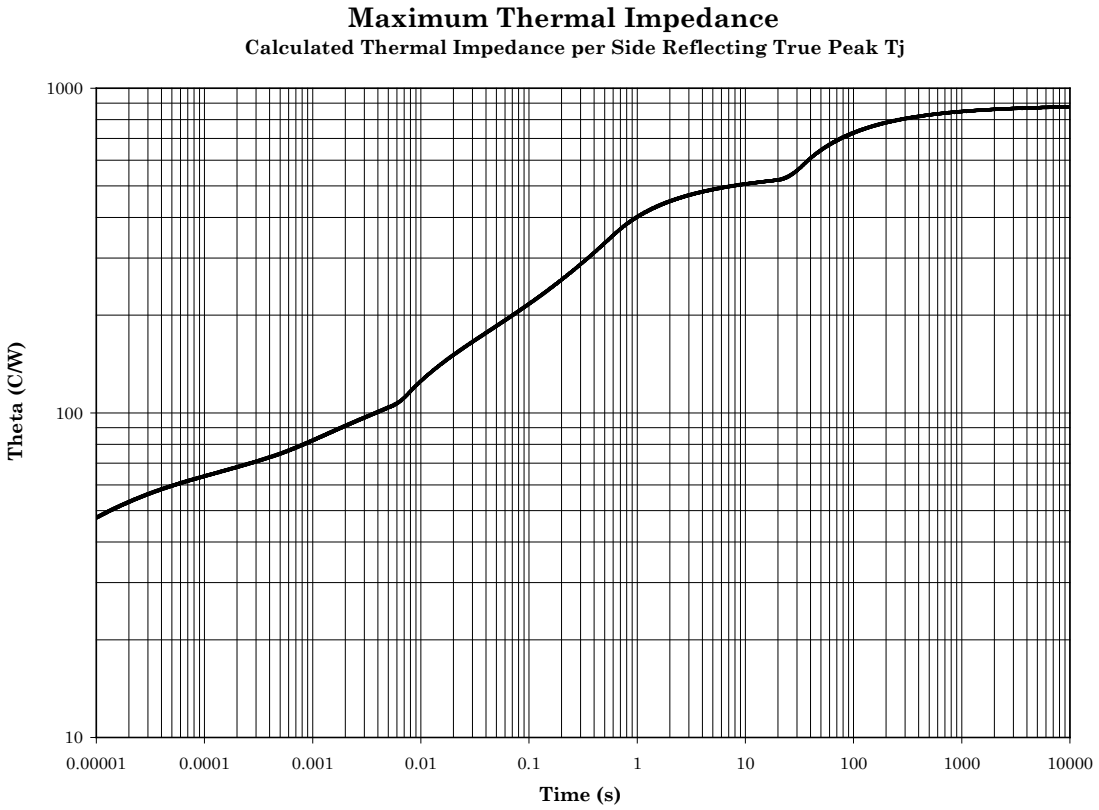


FIGURE 5. For each side: Thermal resistance = 875°C/W, Pt = 200 mW.

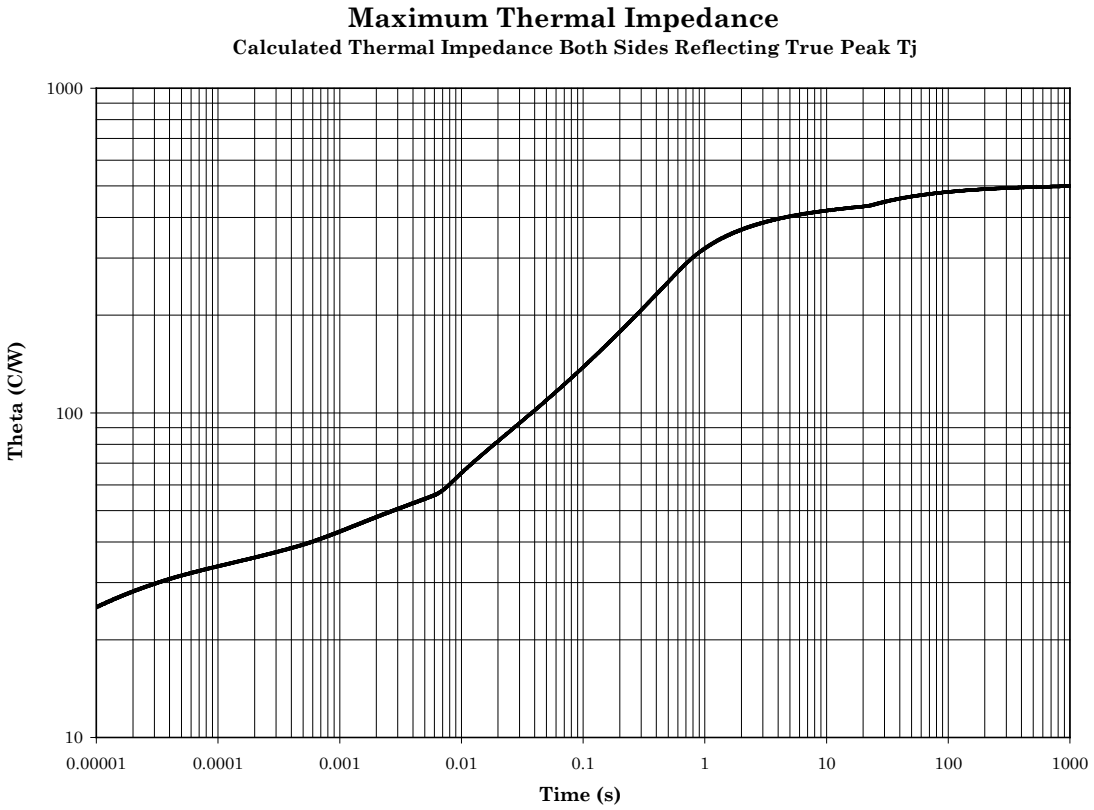


FIGURE 6. Both sides: Thermal resistance = 500°C/W, Pt = 350 mW.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When 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. The notes specified in MIL-PRF-19500 are applicable to this specification.)

6.1 Intended use. Semiconductors 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 this specification.

b. Packaging requirements (see 5.1).

c. Lead finish (see 3.4.1).

d. Product assurance level and type designator.

e. For acquisition of RHA designed devices, table II, subgroup 1 testing of group D is optional. If subgroup 1 testing is desired, it must be specified in the contract.

* 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 DLA Land and Maritime, ATTN: VQE, P.O. Box 3990, Columbus, OH 43218-3990 or e-mail vqe.chief@dla.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.daps.dla.mil .

6.4 Suppliers of JANHC and JANKC die. The qualified JANHC and JANKC suppliers with the applicable letter version (example JANHCA2N3810) will be identified on the QML.

Die ordering information		
PIN	Manufacturer	
	43611	34156
2N3810 2N3811	JANHCA2N3810 JANKCA2N3811	JANHCB2N3810 JANKCB2N3811

6.5 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 - 85
NASA - NA
DLA - CC

Review activities:
Army - AR, AV, MI
Navy - AS, MC
Air Force - 19, 71, 99

Preparing activity:
DLA - CC

(Project 5961-2010-106)

* 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 https://assist.daps.dla.mil.