The documentation and process conversion measures necessary to comply with this document shall be completed by 11 November 2010.

INCH-POUND

MIL-PRF-19500/395K
20 September 2010
SUPERSEDING
MIL-PRF-19500/395J
6 December 2007

PERFORMANCE SPECIFICATION SHEET

* SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, SWITCHING,
TYPES 2N3735, 2N3735L, 2N3737, AND 2N3737UB, JAN, JANTX, JANTXV, JANS,
JANSM, JANSD, JANSP, JANSL, JANSR, JANSF, JANSG, AND JANSH

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 NPN, silicon, switching transistors. Four levels of product assurance are provided for each device type as specified in MIL-PRF-19500 and two levels of product assurance are provided for unencapsulated devices. Provisions for radiation hardness assurance (RHA) to eight radiation levels is provided for JANTXV, JANS, JANHC, and JANKC product assurance levels. 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 (TO-39 and TO-5), figure 2 (TO-46), and figure 3 (2N3737UB).

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

Type	P_T T_A = +25°C	P_T T_C =+25°C	P_T T_{SP} =+25°C	$R_{\theta JA}$	$R_{\theta JC}$	$R_{\theta JSP}$	T_J and T_{STG}
	W	W	W	°C/W	°C/W	°C/mW	°C
2N3735, 2N3735L	1.0 (1)	2.9 (2)	N/A	175	60	N/A	-65 to +200
2N3737	0.5 (3)	1.9 (4)	N/A	350	88	N/A	-65 to +200
2N3737UB	0.5 (5)	N/A	1.9 (4)	325 (6)	N/A	88 (6)	-65 to +200

Types	V_{CBO}	V_{CEO}	V_{EBO}	I_C
	V dc	V dc	V dc	A dc
2N3735, 2N3735L, 2N3737, 2N3737UB	75	40	5	1.5

(1) Derate linearly at 5.71 mW/°C above T_A = +25°C.
(2) Derate linearly at 16.6 mW/°C above T_C = +25°C.
(3) Derate linearly at 2.86 mW/°C above T_A = +25°C.
(4) Derate linearly at 11.3 mW/°C above T_C = +32.8°C.
(5) Derate linearly at 3.07 mW/°C above T_A = +37.5°C.
(6) T_A = +55°C for UB on printed circuit board (PCB), PCB = FR4 .0625 inch (1.59 mm) 1 - layer 1 Oz Cu, horizontal, still air, pads (UB) = .034 inch (0.86 mm) x .048 inch (1.22 mm), $R_{\theta JA}$ with a defined thermal resistance condition included is measured at P_T = 500 mW.

* 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@dscc.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.

Limits	h_{FE3} (1)	$\|h_{fe}\|$	$V_{CE(sat)}$	C_{obo}	Pulse response		
	V_{CE} = 1.0 V dc I_C = 0.5 A dc	V_{CE} = 10 V dc I_C = 50 mA dc f = 100 MHz	I_C = 500 mA dc I_B = 50 mA dc	V_{CB} = 10 V dc I_E = 0 100 kHz ≤ f ≤ 1 MHz	t_d	t_r	t_{off}
			V dc	pF	ns	ns	ns
Min	40	2.5					
Max	140	6.0	0.5	9	8.0	40	60

(1) Pulsed (see 4.5.1).

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.

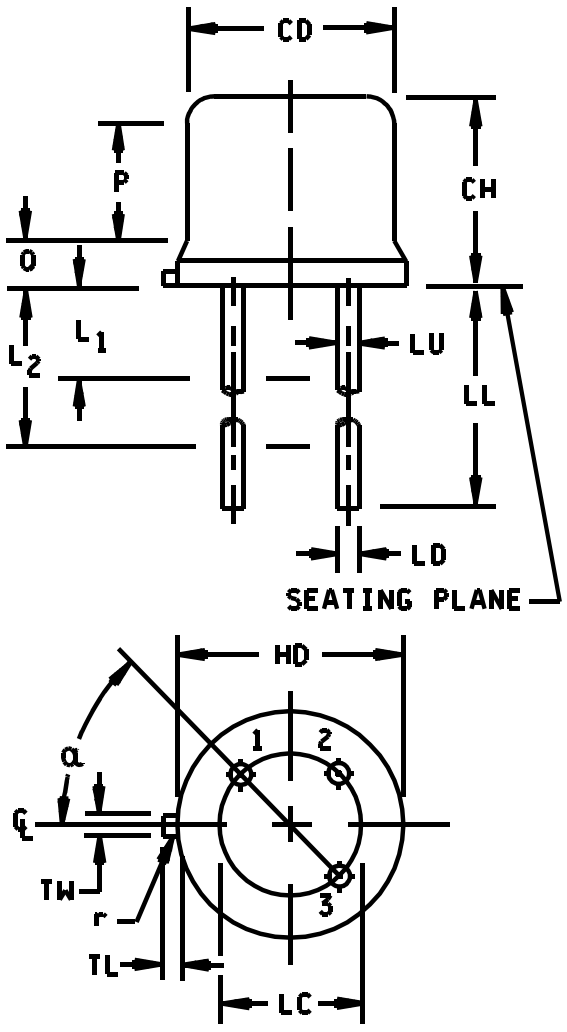


FIGURE 1. Physical dimensions TO-39, TO-5.

2N3735 Dimensions, TO-39

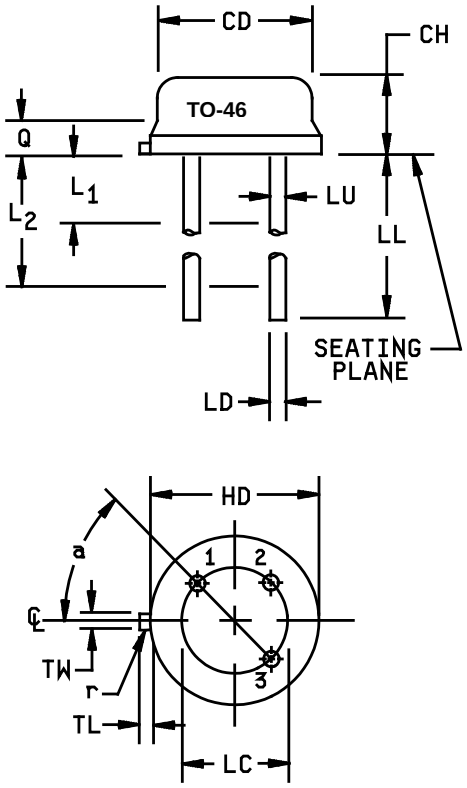
Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.355	7.75	9.02	
CH	.240	.260	6.10	6.60	
HD	.355	.370	9.02	9.40	
LC	.200 TP		5.08 TP		6
LD	.016	.021	0.41	0.53	7
LL	.500	.750	12.70	19.05	7
LU	.016	.019	0.41	0.48	7
L_1		.050		1.27	7
L_2	.250		6.35		7
P	.100		2.54		
TL	.029	.045	0.74	1.14	3
TW	.028	.034	0.71	0.86	9
Q		.040		1.02	4
r		.010		0.25	10
α	45°TP		45°TP		6

2N3735L Dimensions, TO-5

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.355	7.75	9.02	
CH	.240	.260	6.10	6.60	
HD	.355	.370	9.02	9.40	
LC	.200 TP		5.08 TP		6
LD	.016	.021	0.41	0.53	7
LL	1.500	1.750	38.10	44.45	7
LU	.016	.019	0.41	0.48	7
L_1		.050		1.27	7
L_2	.250		6.35		7
P	.100		2.54		
TL	.029	.045	0.74	1.14	3
TW	.028	.034	0.71	0.86	9
Q		.040		1.02	4
r		.010		0.25	10
α	45°TP		45°TP		6

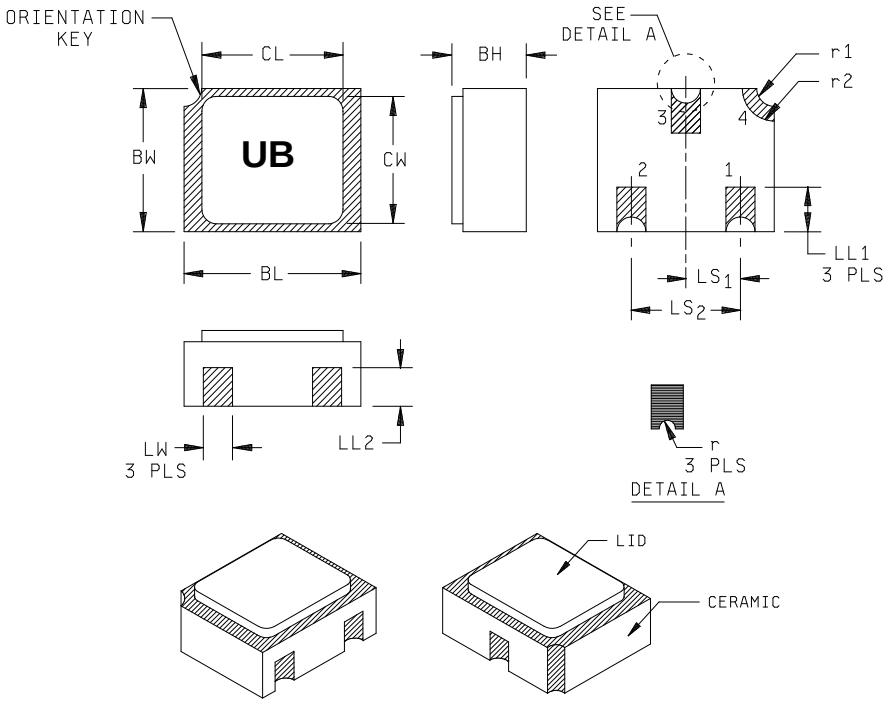
FIGURE 1. Physical dimensions (TO-39, TO-5) - Continued.

Ltr.	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.178	.195	4.52	4.95	
CH	.065	.085	1.65	2.16	
HD	.209	.230	5.31	5.84	
LC	.100 TP		2.54 TP		5
LD	.016	.021	0.41	0.53	
LL	.500	1.750	12.70	44.45	6
LU	.016	.019	0.41	0.48	6
L_1		.050		1.27	6
L_2	.250		6.35		6
Q		.040		1.02	3
TL	.028	.048	0.71	1.22	8
TW	.036	.046	0.91	1.17	4
r		.010		0.25	9
α	45° TP		45° TP		5



NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Symbol TL is measured from HD maximum.
4. Details of outline in this zone are optional.
5. Leads at gauge plane .054 inch (1.37 mm) +.001 inch (0.03 mm) -.000 inch (0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of TP relative to tab. Device may be measured by direct methods or by gauge.
6. Symbol LU applies between L_1 and L_2. Dimension LD applies between L_2 and LL minimum.
7. Lead number three is electrically connected to case.
8. Beyond r maximum, TW shall be held for a minimum length of .011 inch (0.28 mm).
9. Symbol r applied to both inside corners of tab.
10. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.
11. Lead 1 is emitter, lead 2 is base, and lead 3 is collector.

FIGURE 2. Physical dimensions - TO-46 2N3737.



Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
BH	.046	.056	1.17	1.42	
BL	.115	.128	2.92	3.25	
BW	.085	.108	2.16	2.74	
CL		.128		3.25	
CW		.108		2.74	
LL1	.022	.038	0.56	0.96	
LL2	.017	.035	0.43	0.89	
LS_1	.036	.040	0.91	1.02	
LS_2	.071	.079	1.81	2.01	
LW	.016	.024	0.41	0.61	
r		.008		.203	
r1		.012		.305	
r2		.022		.559	

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Hatched areas on package denote metallized areas.
4. Lid material: Kovar.
5. Pad 1 = Base, Pad 2 = Emitter, Pad 3 = Collector, Pad 4 = Shielding connected to the lid.
6. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 3. Physical dimensions for 2N3737UB, surface mount.

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 manufacturer's list (QML) 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.

3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in MIL-PRF-19500, and on figure 1 (TO-39, TO-5), figure 2 (TO-46), and figure 3 (UB) herein.

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, and table I.

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, except for the UB suffix package. Marking on the UB package shall consist of an abbreviated part number, the date code, and the manufacturers symbol or logo. The prefixes JAN, JANTX, JANTXV, and JANS can be abbreviated as J, JX, JV, and JS respectively. The "2N" prefix and the "UB" suffix can also be omitted. 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).

3.8 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 and tables I, II, III and IV).

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 IV tests, the tests specified in table IV 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 (JANTX, JANTXV and JANS 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 impedance, method 3131 of MIL-STD-750 (see 4.3.2).	Thermal impedance, method 3131 of MIL-STD-750 (see 4.3.2).
9	I_{CBO2} and h_{FE3}.	Not applicable.
11	I_{CBO2}; h_{FE3}; ΔI_{CBO2} = 100 percent or 25 nA dc, whichever is greater; Δh_{FE3} = ±15 percent of initial value.	I_{CBO2} and h_{FE3}.
12	See 4.3.1.	See 4.3.1.
13	Subgroups 2 and 3 of table I herein; I_{CBO2} = 100 percent or 25 nA dc, whichever is greater; Δh_{FE3} = ±15 percent of initial value.	Subgroup 2 of table I herein; ΔI_{CBO2} = 100 percent or 25 nA dc, whichever is greater; Δh_{FE3} = ±15 percent of initial value.

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

4.3.1 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 using a minimum P_D = 75 percent of P_T maximum, T_A ambient rated as defined in 1.3. NOTE: No heat sink or forced air cooling on the devices shall be permitted. 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.

4.3.2 Thermal impedance. The thermal impedance measurements shall be performed 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} (and V_H where appropriate). The thermal impedance limit used in screen 3c and table I, subgroup 2 shall be set statistically by the supplier. See table IV, 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 subgroups 1 and 2 of table I herein, inspection only (table E-VIB of MIL-PRF-19500, group B, subgroup 1 is not required to be performed since solderability and resistance to solvents testing is performed in table I 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 table E-VIB (small die flow, JAN, JANTX, and JANTXV). Electrical measurements (end-points) and delta requirements shall be in accordance with table I, subgroup 2 and table II herein; delta requirements only apply to subgroups B4 and B5. See table E-VIC of MIL-PRF-19500 and 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 table II herein.

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

Subgroup	Method	Condition
B3	2037	Test condition A.
B4	1037	V_{CB} = 10 - 30 V dc.
B5	1027	(NOTE: If a failure occurs, resubmission shall be at the test conditions of the original sample). V_{CB} = 10 V dc; $P_D \geq$ 100 percent of maximum rated P_T (see 1.3). Option 1: 96 hours minimum, sample size in accordance with table E-VIA of MIL-PRF-19500, adjust T_A or P_D to achieve T_J = +275°C minimum. Option 2: 216 hours, sample size = 45, c = 0; adjust T_A or P_D to achieve T_J = +225°C minimum.
B6		Not applicable.

4.4.2.2 Group B inspection, table E-VIC (small die flow, JAN, JANTX, and JANTXV). Separate samples may be used for each step. In the event of a group B failure, the manufacturer may pull a new sample at double size from either the failed assembly lot or from another assembly lot from the same wafer lot. If the new "assembly lot" option is exercised, the failed assembly lot shall be scrapped.

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 tests and 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 table II herein; delta requirements only apply to subgroup C6.

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

Subgroup	Method	Condition
C2	2036	Test condition E (not applicable to 2N3737UB).
C6	1026	V_{CB} = 10 - 30 V dc; 1,000 hours; 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. 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, table E-VII (JAN, JANTX, and JANTXV) of MIL-PRF-19500.

Subgroup	Method	Condition
C2	2036	Test condition E (not applicable to 2N3737UB).
C5	3131	$R_{\theta JA}$ and $R_{\theta JC}$ only, as applicable (see 1.3 and 4.5.2).
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 III 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. Group D inspection may also be performed ahead of the screening lot using die selected in accordance with MIL-PRF-19500 and related documents. Alternate package options may also be substituted for the testing provided there is no adverse effect to the fluence profile.

* 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 IV 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 table II.

4.5 Methods 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 Thermal resistance. Thermal resistance measurement shall be performed in accordance with method 3131 of MIL-STD-750 using the guidelines in that method for determining I_M, I_H, and t_H. Measurement delay time t_{MD} = 70 ms max.

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	n = 45 devices, c = 0				
Solderability 3/ 4/	2026	n = 15 leads, c = 0				
Resistance to solvents 3/ 4/ 5/	1022	n = 15 devices, c = 0				
Temp cycling 3/ 4/	1051	Test condition C, 25 cycles n = 22 devices, c = 0				
Hermetic seal 4/ 6/	1071	n = 22 devices, c = 0				
Fine leak Gross leak						
Electrical measurements 4/		Table I, subgroup 2				
Bond strength 3/ 4/	2037	Precondition T_A = +250°C at t = 24 hrs or T_A = +300°C at t = 2 hrs n = 11 wires, c = 0				
Subgroup 2						
Thermal impedance 7/	3131	See 4.3.2	$Z_{\theta JX}$			°C/W
Breakdown voltage collector to emitter	3011	Bias condition D; I_C = 10 mA dc, pulsed (see 4.5.1)	$V_{(BR)CEO}$	40		V dc
Collector to base cutoff current	3036	Bias condition D; $V_{(BR)CBO}$ = 75 V dc	I_{CBO1}		10	µA dc
Emitter to base cutoff current	3061	Bias condition D; $V_{(BR)EBO}$ = 5 V dc	I_{EBO1}		10	µA dc
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 30 V dc	I_{CBO2}		250	nA dc
Collector to emitter cutoff current	3041	Bias condition A; V_{CE} = 30 V dc V_{EB} = 2.0 V dc	I_{CEX1}		200	nA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 4.0 V dc	I_{EBO2}		100	nA dc
Forward current transfer ratio	3076	V_{CE} = 1.0 V dc; I_C = 10 mA dc	h_{FE1}	35		
Forward current transfer ratio	3076	V_{CE} = 1.0 V dc; I_C = 150 mA dc, pulsed (see 4.5.1)	h_{FE2}	40		
Forward current transfer ratio	3076	V_{CE} = 1.0 V dc; I_C = 500 mA dc, pulsed (see 4.5.1)	h_{FE3}	40	140	

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	3076	V_{CE} = 1.5 V dc; I_C = 1.0 A dc, pulsed (see 4.5.1)	h_{FE4}	20	80	
Collector to emitter voltage (saturated)	3071	I_C = 10 mA dc, I_B = 1.0 mA dc	$V_{CE(sat)1}$		0.2	V dc
Collector to emitter voltage (saturated)	3071	I_C = 150 mA dc, I_B = 15 mA dc, pulsed (see 4.5.1)	$V_{CE(sat)2}$		0.3	V dc
Forward current transfer ratio	3076	V_{CE} = 5.0 V dc; I_C = 1.5 A dc, pulsed (see 4.5.1)	h_{FE5}	20		
Collector to emitter voltage (saturated)	3071	I_C = 500 mA dc, I_B = 50 mA dc, pulsed (see 4.5.1)	$V_{CE(sat)3}$		0.5	V dc
Collector to emitter voltage (saturated)	3071	I_C = 1.0 A dc, I_B = 100 mA dc, pulsed (see 4.5.1)	$V_{CE(sat)4}$		0.9	V dc
Base to emitter saturated voltage	3066	Test condition A, I_C = 10 mA dc, I_B = 1.0 mA dc	$V_{BE(sat)1}$		0.8	V dc
Base to emitter saturated voltage	3066	Test condition A, I_C = 150 mA dc, I_B = 15 mA dc, pulsed (see 4.5.1)	$V_{BE(sat)2}$		1.0	V dc
Base to emitter saturated voltage	3066	Test condition A, I_C = 500 mA dc, I_B = 50 mA dc, pulsed (see 4.5.1)	$V_{BE(sat)3}$		1.2	V dc
Base to emitter saturated voltage	3066	Test condition A, I_C = 1.0 A dc, I_B = 100 mA dc, pulsed (see 4.5.1)	$V_{BE(sat)4}$	0.9	1.4	V dc
Subgroup 3						
High-temperature operation:		T_A = +150°C				
Collector to emitter cutoff current	3041	Bias condition A; V_{CE} = 30 V dc, V_{EB} = 2.0 V dc	I_{CEX2}		250	µA dc
Low-temperature operation:		T_A = -55°C				
Forward current transfer ratio	3076	V_{CE} = 1.0 V dc; I_C = 500 mA dc, pulsed (see 4.5.1)	h_{FE6}	15		

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						
Magnitude of common - emitter small-signal short-circuit forward current transfer ratio	3306	V_{CE} = 10 V dc; I_C = 50 mA dc; f = 100 MHz	$\|h_{fe}\|$	2.5	6.0	
Open circuit output capacitance	3236	V_{CB} = 10 V dc, I_E = 0, 100 kHz ≤ f ≤ 1 MHz	C_{obo}		9.0	pF
Input capacitance (output open circuited)	3240	V_{EB} = 0.5 V dc, I_C = 0, 100 kHz ≤ f ≤ 1 MHz	C_{ibo}		80	pF
Pulse response:						
Delay response	3251	Test condition A; V_{CC} = 30 V dc, V_{BE} = 2 V dc, I_C = 1.0 A dc, I_{B1} = 100 mA dc, (see figure 4)	t_d		8.0	ns
Rise time	3251	Test condition A; V_{CC} = 30 V dc, V_{BE} = 2 V dc, I_C = 1.0 A dc, I_{B1} = 100 mA dc, (see figure 4)	t_r		40	ns
Turn-off time	3251	Test condition A; V_{CC} = 30 V dc, I_C = 1.0 A dc, I_{B1} = -I_{B2} = 100 mA dc, (see figure 5)	t_{off}		60	ns
Subgroups 5, 6 and 7						
Not applicable						

1/ For sampling plan, unless otherwise specified see MIL-PRF-19500.
2/ For resubmission of failed subgroup 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/ This test required for the following end-point measurements only: Group B, subgroups 3, 4, and 5 (JANS); group B, see 4.4.2.2 herein, after each step (JAN, JANTX, and JANTXV); group C, subgroup 2 and 6, group E, subgroup 1.

TABLE II. Groups B and C delta measurements. 1/ 2/ 3/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Collector to base cutoff current	3036	Bias condition D, V_{CB} = 30 V dc	ΔI_{CBO2}	100 percent of initial value or 25 nA dc, whichever is greater.		
2.	Forward-current transfer ratio	3076	V_{CE} = 1 V dc, I_C = 500 mA dc, pulsed (see 4.5.1)	Δh_{FE3}	±25 percent change from initial value.		
3.	Collector to emitter voltage (saturated)	3071	I_C = 500 mA dc, I_B = 50 mA dc, pulsed (4.5.1)	$\Delta V_{CE(SAT)3}$	±50 mV dc, change from previous measured value.		

1/ The delta measurements for table E-VIA (JANS) of MIL-PRF-19500 are as follows:
a. Subgroup 4, see table II herein, step 3.
b. Subgroup 5, see table II herein, step 3.

2/ The delta measurements for 4.4.2.2 (JAN, JANTX, JANTXV) are as follows: See table II herein, steps 1 and 2.

3/ The delta measurements for table E-VII of MIL-PRF-19500 are as follows: Subgroup 6, see table II herein, steps 1 and 2 for (JANS).

* TABLE III. Group D inspection.

Inspection 1/ 2/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1 3/						
Neutron irradiation	1017	Neutron exposure V_{CES} = 0V				
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 75 V dc	I_{CBO1}		20	µA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 5 V dc	I_{EBO1}		20	µA dc
Breakdown voltage, collector to emitter	3011	Bias condition D; I_C = 10 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	40		V dc
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 30 V dc	I_{CBO2}		500	nA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 4 V dc	I_{EBO2}		200	nA dc
Collector to emitter cutoff current	3041	Bias condition A; V_{CE} = 30 V dc, V_{EB} = 2 V dc	I_{CEX1}		400	nA dc
Forward-current transfer ratio	3076	V_{CE} = 1 V dc; I_C = 10 mA dc	[h_{FE1}] 4/	[17.5]		
Forward-current transfer ratio	3076	V_{CE} = 1 V dc; I_C = 150 mA dc pulsed (see 4.5.1)	[h_{FE2}] 4/	[20]		
Forward-current transfer ratio	3076	V_{CE} = 1 V dc; I_C = 500 mA dc pulsed (see 4.5.1)	[h_{FE3}] 4/	[20]	140	
Forward-current transfer ratio	3076	V_{CE} = 1.5 V dc; I_C = 1 A dc pulsed (see 4.5.1)	[h_{FE4}] 4/	[10]	80	
Collector-emitter saturation voltage	3071	I_C = 10 mA dc; I_B = 1 mA dc	$V_{CE(sat)1}$		.23	V dc
Collector-emitter saturation voltage	3071	I_C = 150 mA dc; I_B = 15 mA dc pulsed (see 4.5.1)	$V_{CE(sat)2}$		.35	V dc
Forward-current transfer ratio	3076	V_{CE} = 5 V dc; I_C = 1.5 A dc pulsed (see 4.5.1)	[h_{FE5}] 4/	[10]		
Collector-emitter saturation voltage	3071	I_C = 500 mA dc; I_B = 50 mA dc pulsed (see 4.5.1)	$V_{CE(sat)3}$		.58	V dc
Collector-emitter saturation voltage	3071	I_C = 1 A dc; I_B = 100 mA dc pulsed (see 4.5.1)	$V_{CE(sat)4}$		1.04	V dc
Base-emitter saturation voltage	3066	Test condition A; I_C = 10 mA dc; I_B = 1 mA dc	$V_{BE(sat)1}$		.92	V dc
Base-emitter saturation voltage	3066	Test condition A; I_C = 150 mA dc; I_B = 15 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)2}$		1.15	V dc

See footnotes at end of table

* TABLE III. Group D inspection - Continued.

Inspection 1/ 2/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1 - Continued 3/						
Base-emitter saturation voltage	3066	Test condition A; I_C = 500 mA dc; I_B = 50 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)3}$		1.38	V dc
Base-emitter saturation voltage	3066	Test condition A; I_C = 1 A dc; I_B = 100 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)4}$	.9	1.61	V dc
Subgroup 2 3/						
Steady-state total dose irradiation	1019	Gamma exposure V_{CES} = 32 V				
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 75 V dc	I_{CBO1}		20	µA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 5 V dc	I_{EBO1}		20	µA dc
Breakdown voltage, collector to emitter	3011	Bias condition D; I_C = 10 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	40		V dc
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 30 V dc	I_{CBO2}		500	nA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 4 V dc	I_{EBO2}		200	nA dc
Collector to emitter cutoff current	3041	Bias condition A; V_{CE} = 30 V dc, V_{EB} = 2 V dc	I_{CEX1}		400	nA dc
Forward-current transfer ratio	3076	V_{CE} = 1 V dc; I_C = 10 mA dc	[h_{FE1}] 4/	[17.5]		
Forward-current transfer ratio	3076	V_{CE} = 1 V dc; I_C = 150 mA dc pulsed (see 4.5.1)	[h_{FE2}] 4/	[20]		
Forward-current transfer ratio	3076	V_{CE} = 1 V dc; I_C = 500 mA dc pulsed (see 4.5.1)	[h_{FE3}] 4/	[20]	140	
Forward-current transfer ratio	3076	V_{CE} = 1.5 V dc; I_C = 1 A dc pulsed (see 4.5.1)	[h_{FE4}] 4/	[10]	80	
Collector-emitter saturation voltage	3071	I_C = 10 mA dc; I_B = 1 mA dc	$V_{CE(sat)1}$		.23	V dc
Collector-emitter saturation voltage	3071	I_C = 150 mA dc; I_B = 15 mA dc pulsed (see 4.5.1)	$V_{CE(sat)2}$		.35	V dc
Forward-current transfer ratio	3076	V_{CE} = 5 V dc; I_C = 1.5 A dc pulsed (see 4.5.1)	[h_{FE5}] 4/	[10]		
Collector-emitter saturation voltage	3071	I_C = 500 mA dc; I_B = 50 mA dc plused (see 4.5.1)	$V_{CE(sat)3}$		.58	V dc

See footnotes at end of table

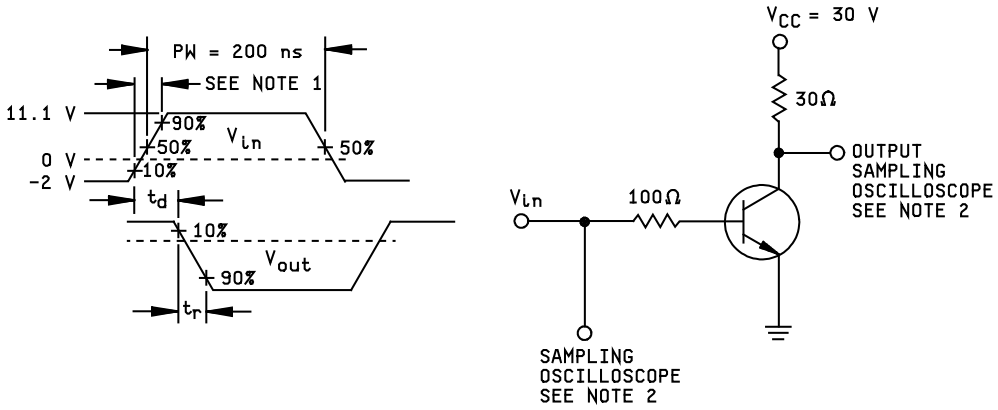
* TABLE III. Group D inspection - Continued.

Inspection 1/ 2/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 2 - Continued 3/						
Collector-emitter saturation voltage	3071	I_C = 1 A dc; I_B = 100 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)4}$		1.04	V dc
Base-emitter saturation voltage	3066	Test condition A; I_C = 10 mA dc; I_B = 1 mA dc	$V_{BE(sat)1}$		.92	V dc
Base-emitter saturation voltage	3066	Test condition A; I_C = 10 mA dc; I_B = 1 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)2}$		1.15	V dc
Base-emitter saturation voltage	3066	Test condition A; I_C = 500 mA dc; I_B = 50 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)3}$		1.38	V dc
Base-emitter saturation voltage	3066	Test condition A; I_C = 1 A dc; I_B = 100 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)4}$	.9	1.61	V dc

1/ Tests to be performed on all devices receiving radiation exposure.
2/ For sampling plan, see MIL-PRF-19500.
3/ See 6.2.e herein.
4/ See method 1019 of MIL-STD-750 for how to determine [h_{FE}] 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.

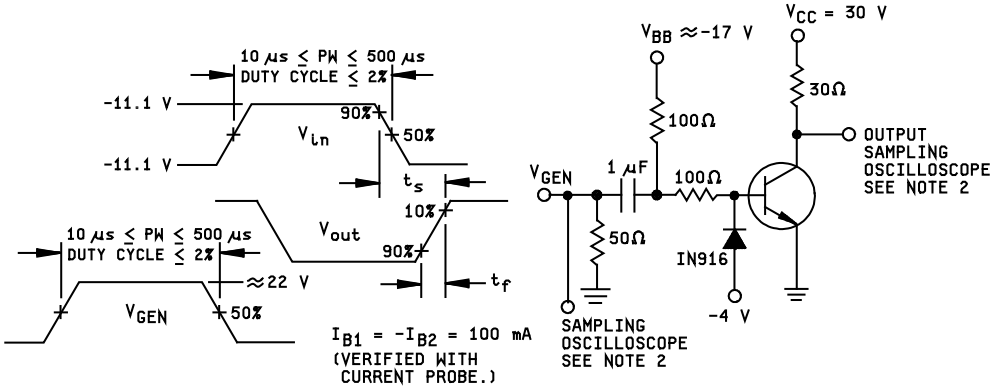
* TABLE IV. Group E inspection (all quality levels) - for qualification only.

Inspection	MIL-STD-750		Sample plan
	Method	Conditions	
Subgroup 1			
Temperature cycling (air to air)	1051	Test condition C, 500 cycles	45 devices c = 0
Hermetic seal Fine leak Gross leak	1071		
Electrical measurements		See table I, subgroup 2 herein	
Subgroup 2			
Intermittent life	1037	V_{CB} = 10 V dc, 6,000 cycles. Adjust device current, or power, to achieve a minimum ΔT_J of +100°C	45 devices c = 0
Electrical measurements		See table I, subgroup 2 herein	
Subgroup 4			
Thermal impedance curves		See MIL-PRF-19500, table E-IX, group E, subgroup 4	
Subgroup 6			
Electrostatic discharge (ESD)	1020		3 devices
Subgroup 8			
Reverse stability	1033	Condition B	45 devices c = 0



NOTES:
1. The rise time (t_r) of the applied pulse shall be ≤ 0.1 ns, duty cycle ≤ 2 percent, and the generator source impedance shall be 50 Ω.
2. Sampling oscilloscope: Z_{in} ≥ 100 kΩ, C_{in} ≤ 12 pF, rise time ≤ 5 ns.

FIGURE 4. Test circuit and waveforms for measuring turn-on.



NOTES:
1. The rise time (t_r) of the applied pulse shall be ≤ 0.1 ns, duty cycle ≤ 2 percent, and the generator source impedance shall be 50 Ω.
2. Sampling oscilloscope: Z_{in} ≥ 100 kΩ, C_{in} ≤ 12 pF, rise time ≤ 5 ns.

FIGURE 5. Test circuit and waveforms for measuring turn-off.

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 designated devices, table III, subgroup 1 testing of group D herein is optional. If subgroup 1 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 Changes from previous issue. The margins of this specification are marked with an asterisk 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, SM
Navy - AS, MC
Air Force - 19, 71, 99

Preparing activity:
DLA - CC

(Project 5961-2010-032)

* 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/ .