The documentation and process conversion measures necessary to comply with this document shall be completed by 9 April 2004.

INCH-POUND

MIL-PRF-19500/391J
9 December 2004
SUPERSEDING
MIL-PRF-19500/391H
30 April 2003

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, LOW-POWER TYPES 2N3019, 2N3019S, 2N3057A, 2N3700, AND 2N3700UB JAN, JANTX, JANTXV, JANS, JANHCA AND JANKCA

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, low-power transistors. Four levels of product assurance are provided for each device type as specified in MIL-PRF-19500. Two levels of product assurance are provided for the unencapsulated device type 2N3700.

1.2 Physical dimensions. See figure 1, 2N3019 (TO-5) and 2N3019S (similar to TO-39), figure 2, 2N3057A (TO-46), figure 3, 2N3700 (TO-18), figure 4, 2N3700UB, and figure 5, JANHCA2N3700 and JANKCA2N3700.

1.3 Maximum ratings unless otherwise specified T_A = +25°C.

I_C	V_{CBO}	V_{EBO}	V_{CEO}	T_J and T_{STG}
A dc	V dc	V dc	V dc	°C
1	140	7	80	-65 to +200

Types	P_T T_A = +25°C (1) (2)	P_T T_C = +25°C (1) (2)	P_T $T_{SP(IS)}$ = +25°C (1) (2)	$R_{\theta JA}$ (2) (3) (4)	$R_{\theta JC}$ (2) (3)	$R_{\theta JSP(IS)}$ (2) (3)
	W	W	W	°C/W	°C/W	°C/W
2N3019	0.800	5	N/A	175	30	N/A
2N3019S	0.800	5	N/A	175	30	N/A
2N3057A	0.500	1.8	N/A	325	80	N/A
2N3700	0.500	1	N/A	325	150	N/A
2N3700UB	0.500	N/A	1.5	325	N/A	90

(1) For derating, see figures 6, 7, 8, 9, 10, 11, and 12.
(2) See 3.3.
(3) For thermal curves, see figures 13, 14, 15, 16, 17, 18, and 19.
(4) For non-thermal conductive PCB or unknown PCB surface mount conditions in free air, substitute figures 7 and 12 for the UB package and use $R_{\theta JA}$.

* 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@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 http://assist.daps.dla.mil .

AMSC N/A FSC 5961

1.4 Primary electrical characteristics.

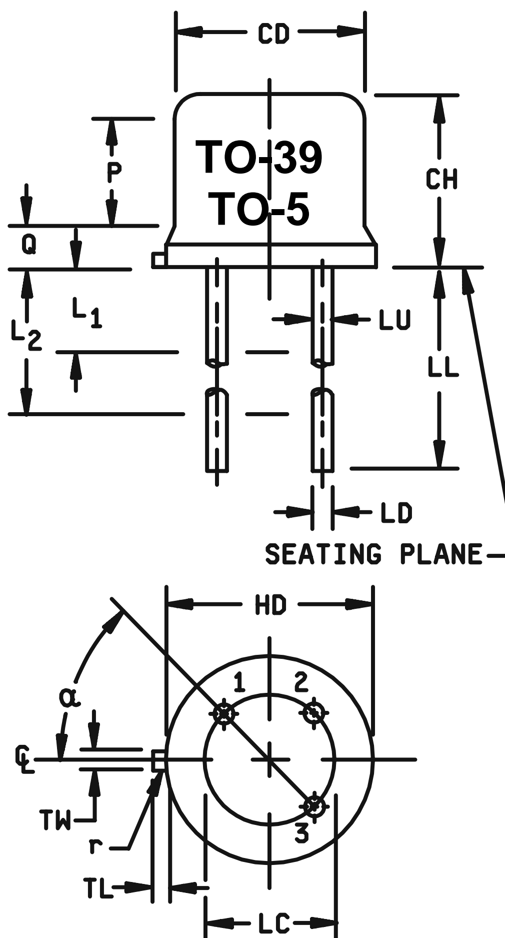
Limits	h_{FE1} V_{CE} = 10 V dc I_C = 150 mA dc	h_{FE2} V_{CE} = 10 V dc I_C = 0.1 mA dc	h_{FE3} (1) V_{CE} = 10 V dc I_C = 10 mA dc	h_{FE4} (1) V_{CE} = 10 V dc I_C = 500 mA dc
Min	100	50	90	50
Max	300	200		200

Types	Limit	h_{FE5} (1) V_{CE} = 10 V dc I_C = 1 A dc	$\|h_{fe}\|$ f = 20 MHz V_{CE} = 10 V dc I_C = 50 mA dc	C_{obo} 100 kHz ≤ f ≤ 1 MHz V_{CB} = 10 V dc I_E = 0
		V dc		pF
2N3019, 2N3019S 2N3057A, 2N3700 2N3700UB	Min	15	5	
	Max		20	12

Types	Limits	$V_{CE(sat)1}$ (1) I_C = 150 mA dc I_B = 15 mA dc	$V_{CE(sat)2}$ (1) I_C = 500 mA dc I_B = 50 mA dc	$V_{BE(sat)}$ (1) I_C = 150 mA dc I_B = 15 mA dc
		V dc	V dc	V dc
2N3019, 2N3019S 2N3057A, 2N3700 2N3700UB	Min			
	Max	0.2	0.5	1.1

(1) Pulsed, see 4.5.1.

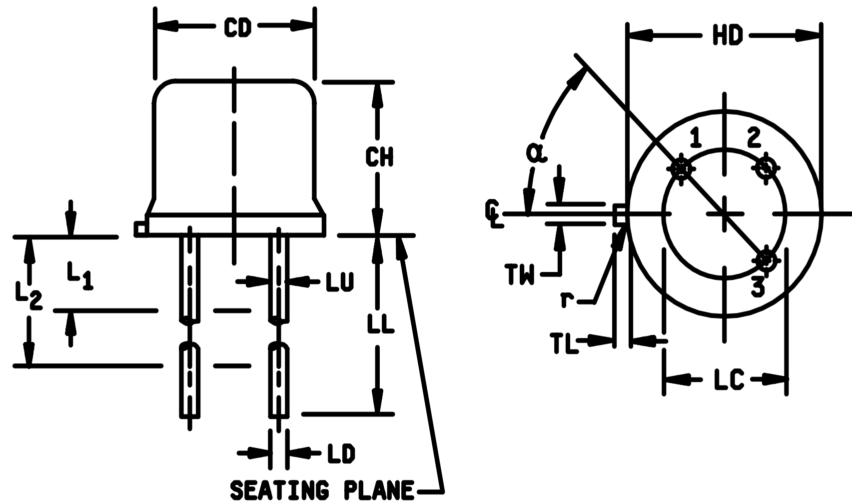
Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	0.305	0.335	7.75	8.51	
CH	0.240	0.260	6.10	6.60	
HD	0.335	0.370	8.51	9.40	
LC	0.200 TP		5.08 TP		6
LD	0.016	0.021	0.41	0.53	7, 8
LL	0.500	0.750	12.70	19.05	7, 8, 12
LU	0.016	0.019	.041	0.48	7, 8
L_1	---	0.050	---	1.27	7, 8
L_2	0.250	---	6.35	---	7, 8
Q	---	0.050	---	1.27	5
TL	0.029	0.045	0.74	1.14	4
TW	0.028	0.034	0.71	0.86	3
r	---	0.010	---	0.25	10
α	45° TP		45° TP		6
P	0.100		2.54		



NOTES:

1. Dimension are in inches.
2. Millimeters are given for general information only.
3. Beyond r (radius) maximum, TW shall be held for a minimum length of .011 (0.28 mm).
4. Dimension TL measured from maximum HD.
5. Body contour optional within zone defined by HD, CD, and Q.
6. Leads at gauge plane .054 +.001 -.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods.
7. Dimension LU applies between L_1 and L_2. Dimension LD applies between L_2 and minimum. Diameter is uncontrolled in L_1 and beyond LL minimum.
8. All three leads.
9. The collector shall be internally connected to the case.
10. Dimension r (radius) applies to both inside corners of tab.
11. In accordance with ASME Y14.5M, diameters are equivalent to Nx symbology.
12. For "S" suffix devices, dimension LL is 0.500 (12.70 mm) minimum, 0.750 (19.05 mm) maximum.
13. "S" suffix devices, dimension LL is 0.50 (12.70 mm) minimum, 0.75 (19.05 mm) maximum.
14. "L" suffix devices, dimension LL is 1.500 (38.10 mm) minimum, 1.750 (44.45 mm) maximum. 13.
15. Lead 1 = emitter, lead 2 = base, lead 3 = collector.

FIGURE 1. Physical dimensions for device types 2N3019 (TO-5) and 2N3019S (TO-39).

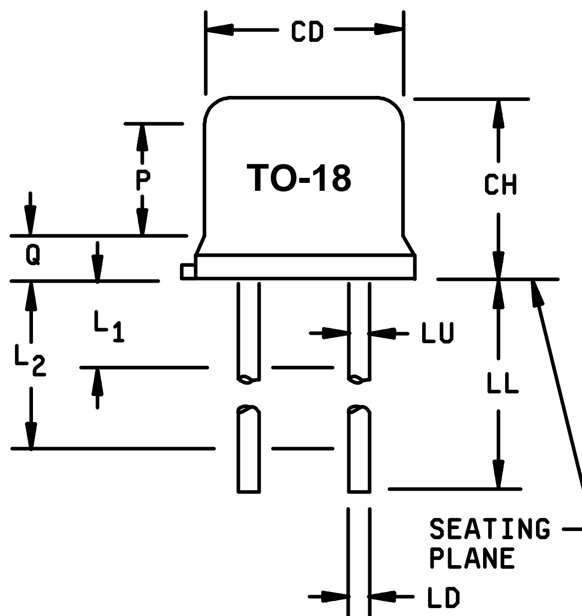


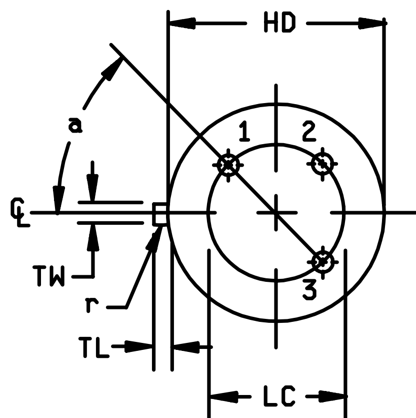
Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.178	.195	4.52	4.95	
CH	.065	.085	1.65	2.16	
HD	.209	.230	5.31	5.84	
LC	.100 TP		2.54 TP		6
LD	.016	.021	0.41	0.53	7
LL	.500	1.750	12.70	44.45	7
LU	.016	.019	0.41	0.48	7
L1		.050		1.27	7
L2	.250		6.35		7
TL	.028	.048	0.71	1.22	3
TW	.036	.046	0.91	1.17	2
r		.007		0.18	10, 11
α	45° TP		45° TP		6

NOTES:
1. Dimension are in inches.
2. Millimeters are given for general information only.
3. Beyond r (radius) maximum, TW shall be held for a minimum length of .011 inch (0.28 mm).
4. Dimension TL measured from maximum HD.
5. Leads at gauge plane .054 +.001 -.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods.
6. Dimension LU applies between L_1 and L_2. Dimension LD applies between L_2 and LL minimum. Diameter is uncontrolled in L_1 and beyond LL minimum.
7. All three leads.
8. The collector shall be internally connected to the case.
7. Dimension r (radius) applies to both inside corners of tab.
10. In accordance with ASME Y14.5M, diameters are equivalent to φx symbology.
11. Lead 1 = emitter, lead 2 = base, lead 3 = collector.

FIGURE 2. Physical dimensions for 2N3057A (TO-46).

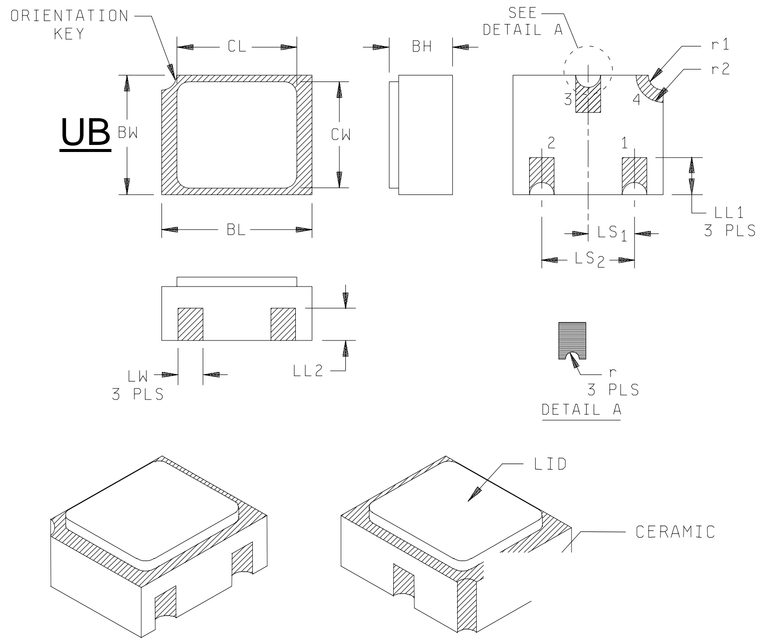
Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.178	.195	4.52	4.95	
CH	.170	.210	4.32	5.33	
HD	.209	.230	5.31	5.84	
LC	.100 TP		2.54 TP		6
LD	.016	.021	0.41	0.53	7,8
LL	.500	.750	12.70	19.05	7,8
LU	.016	.019	0.41	0.48	7,8
L1		.050		1.27	7,8
L2	.250		6.35		7,8
P	.100		2.54		
Q		.030		0.76	5
TL	.028	.048	0.71	1.22	3,4
TW	.036	.046	0.91	1.17	3
r		.010		0.25	10
α	45° TP		45° TP		6
1, 2, 9, 11, 12					





NOTES:
1. Dimension are in inches.
2. Millimeters are given for general information only.
3. Beyond r (radius) maximum, TH shall be held for a minimum length of .011 (0.28 mm).
4. Dimension TL measured from maximum HD.
5. Body contour optional within zone defined by HD, CD, and Q.
6. Leads at gauge plane .054 +.001 -.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods or by the gauge and gauging procedure shown in figure 2.
7. Dimension LU applies between L_1 and L_2. Dimension LD applies between L_2 and LL minimum. Diameter is uncontrolled in L_1 and beyond LL minimum.
8. All three leads.
9. The collector shall be internally connected to the case.
10. Dimension r (radius) applies to both inside corners of tab.
11. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.
12. Lead 1 = emitter, lead 2 = base, lead 3 = collector.

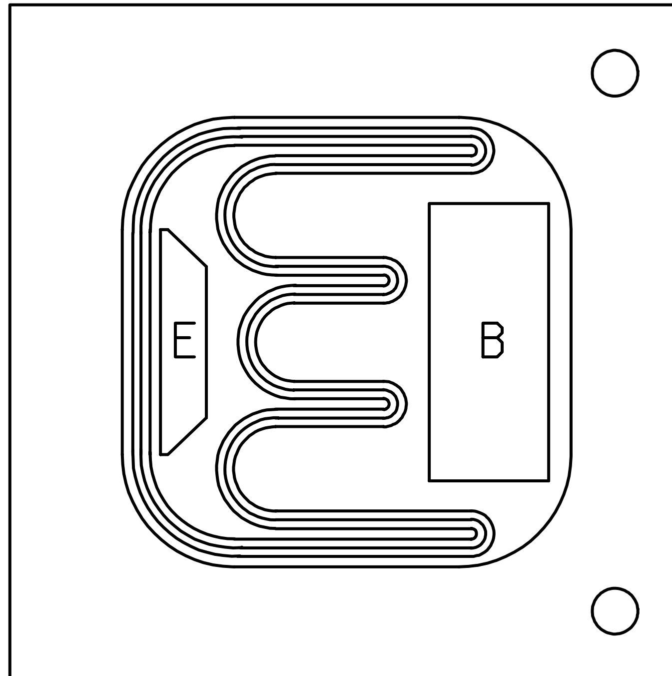
FIGURE 3. Physical dimensions for type 2N3700 (TO-18).



Symbol	Dimensions				Note	Symbol	Dimensions				Note
	Inches		Millimeters				Inches		Millimeters		
	Min	Max	Min	Max			Min	Max	Min	Max	
BH	.046	.056	1.17	1.42		LS1	.035	.039	0.89	0.99	
BL	.115	.128	2.92	3.25		LS2	.071	.079	1.80	2.01	
BW	.085	.108	2.16	2.74		LW	.016	.024	0.41	0.61	
CL	.115	.128	2.92	3.25		r		.008		0.20	
CW	.085	.108	2.16	2.74		r1		.012		0.31	
LL1	.022	.038	0.56	0.96		r2		.022		0.56	
LL2	.017	.035	0.43	0.89							

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

* FIGURE 4. Physical dimensions, surface mount (2N3700UB).



Die size:	.030 x .030 inch (0.762 x 0.762 mm).
Die thickness:	.008 ±.0016 inch (0.2032 mm ±0.04064 mm).
Base pad:	.004 x .010 inch (0.1016 mm x 0.254 mm).
Emitter pad:	.0023 x .007 inch (0.05842 mm x 0.1778 mm).
Back metal:	Gold, 6500 ± 1950 Ang.
Top metal:	Aluminum, 12,000 Ang. minimum; 14,500 Ang. nominal.
Back side:	Collector.
Glassivation:	SiO_2, 7500 ±1500 Ang.

FIGURE 5. JANHCA and JANKCA die (2N3700) 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 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 manufacturer's list (QML) before contract award (see 4.2 and 6.4).

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

PCB .... Printed circuit board.
$R_{\theta JA}$ .... Thermal resistance junction to ambient.
$R_{\theta JC}$ .... Thermal resistance junction to case.
$R_{\theta JSP(IS)}$ .... Thermal resistance junction to solder pads (infinite sink mount to PCB).
$T_{SP(IS)}$...................... Temperature of solder pads (infinite sink mount to PCB).
UB.......................... Surface mount case outlines (see figure 4).

3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in MIL-PRF-19500, and on figure 1 (2N3019, TO-5, 2N3019S, TO-39), figure 2 (2N3057A, TO-46), figure 3 (2N3700, TO-18), figure 4 (2N3700UB, surface mount) and figure 5 (JANHCA, JANKCA) 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 can also be omitted.

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

* 4.3 Screening (JANTX, JANTXV, and JANS 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	JANTX and JANTXV levels
* 3c	Thermal impedance method 3131 of MIL-STD-750. See 4.3.2. (1)	Thermal impedance method 3131 of MIL-STD-750. See 4.3.2. (1)
7	Optional	Optional
9	I_{CES1} and h_{FE1}	Not applicable
10	48 hours minimum	48 hours minimum
11	I_{CES1}; h_{FE1}; ΔI_{CES1} = 100 percent of initial value or 5 nA dc, whichever is greater; $\Delta h_{FE1} = \pm 15$ percent.	I_{CES1} and h_{FE1}
12	See 4.3.1	See 4.3.1
13	Subgroups 2 & 3 of table I herein; ΔI_{CES1} = 100 percent of initial value or 5 nA dc, whichever is greater; $\Delta h_{FE1} = \pm 15$ percent.	Subgroup 2 of table I herein; ΔI_{CES1} = 100 percent of initial value or 5 nA dc, whichever is greater; $\Delta h_{FE1} = \pm 15$ percent.
14	Required	Required

(1) Thermal impedance limits shall not exceed figures 13, 14, 15, 16, 17, 18, and 19.

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows: T_A = room ambient as defined in the general requirements of 4.5 of MIL-STD-750. V_{CB} = 10 - 30 V dc, power shall be applied to achieve $T_J = +135°C$ minimum and minimum power dissipation of P_D = 75 percent of maximum rated P_T as defined in 1.3.

* 4.3.2 Thermal impedance ($Z_{\theta JX}$ measurements). See figures 13, 14, 15, 16, 17, 18, and 19. The $Z_{\theta JX}$ 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_{MD} (and V_C where appropriate). The $Z_{\theta JX}$ limit used in 4.3, screen 3c and the subgroup 2 of table I shall comply with the thermal impedance graph in figures 13, 14, 15, 16, 17, 18, and 19 (less than or equal to the curve value at the same t_H time) and/or shall be less than the process determined statistical maximum limit as outlined in method 3131 of MIL-STD-750.

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 tests and conditions specified for subgroup testing in table VIa (JANS) of MIL-PRF-19500 and 4.4.2.1 herein. Electrical measurements (end-points) shall be in accordance with group A, subgroup 2. Delta requirements shall be in accordance with the steps of table III herein as specified in the notes for table III. See 4.4.2.2 herein for JAN, JANTX, and JANTXV group B testing. Electrical measurements (end-points) for JAN, JANTX, and JANTXV shall be after each step in 4.4.2.2 and shall be in accordance with table I, group A, subgroup 2. Delta requirements shall be in accordance with the steps of table III herein as specified in the notes for table III.

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

Subgroup	Method	Condition
B4	1037	V_{CB} = 10 V dc, 2,000 cycles.
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 MIL-PRF-19500, table 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 T_J = +225°C minimum.
B5	2037	Test condition A.
B6		Not applicable.

* 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.

Step	Method	Condition
1	1026	Steady-state life: 1000 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 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.
2	1048	HTRB: Test condition A, 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. Must be chosen from an inspection lot that has been submitted to and passed table I, group A, 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 (table VIa, subgroups B4 and B5 for JANS, and table VIb, 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 VII of MIL-PRF-19500, and in 4.4.3.1 herein (JANS). See 4.4.3.2 herein for JAN, JANTX, and JANTXV group C testing. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2. Delta requirements shall be in accordance with the steps of table III herein as specified in the notes for table III.

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

Subgroup	Method	Condition
C2	2036	Test condition E; not applicable for UB devices.
C6	1026	1,000 hours, V_{CB} = 10 V dc, power and ambient temperature shall be applied to the device to achieve T_J = +150°C minimum, and minimum power dissipation of 75 percent of max rated P_T (see 1.3 herein); n = 45, 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, (JAN, JANTX, and JANTXV), table VII of MIL-PRF-19500.

Subgroup	Method	Condition
C2	2036	Test condition E; not applicable for UB devices.
C5	3131	See 1.3, $R_{\theta JC.}$
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, group A 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. Delta requirements shall be in accordance with the steps of table III herein as specified in the notes for table III.

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table IX of MIL-PRF-19500 as specified in table II herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta requirements shall be in accordance with the steps of table III herein as specified in the notes for table III.

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 Collector-base time constant. This parameter may be determined by applying an rf signal voltage of 1.0 volt (rms) across the collector-base terminals, and measuring the ac voltage drop (V_{eb}) with a high- impedance rf voltmeter across the emitter-base terminals. With f = 79.8 MHz used for the 1.0 volt signal, the following computation applies:

r'_b , $C_{c(ps)}$ = 2 X V_{eb} (millivolts)

* 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/	1071	n = 22 devices, c = 0				
Fine leak Gross leak						
Electrical measurements 4/		Group A, 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	3131	See 4.3.2.	$Z_{\theta JX}$			°C/W
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 140 V dc	I_{CBO1}		10	µA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 7 V dc	I_{EBO1}		10	µA dc
Collector to emitter breakdown voltage	3011	Bias condition D; I_C = 30 mA dc pulsed (see 4.5.1)	$V_{(BR)CEO}$	80		V dc
Collector to emitter cutoff current	3041	Bias condition C; V_{CE} = 90 V dc	I_{CES1}		10	nA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 5 V dc	I_{EBO2}		10	nA dc
Forward current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 150 mA dc; pulsed (see 4.5.1)	h_{FE1}	100	300	
Forward current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 0.1 mA dc; pulsed (see 4.5.1)	h_{FE2}	50	200	
Forward current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 10 mA dc; pulsed (see 4.5.1)	h_{FE3}	90		
Forward current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 500 mA dc; pulsed (see 4.5.1)	h_{FE4}	50	200	

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} = 10 V dc; I_C = 1 A dc; pulsed (see 4.5.1)	h_{FE5}	15		
Collector to emitter voltage (saturated)	3071	I_C = 150 mA dc; I_B = 15 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)1}$		0.2	V dc
Collector to emitter voltage (saturated)	3071	I_C = 500 mA dc; I_B = 50 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)2}$		0.5	V dc
Base to emitter voltage (saturated)	3066	Test condition A; I_C = 150 mA dc; I_B = 15 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)}$		1.1	V dc
Subgroup 3						
High-temperature operation		T_A = +150°C				
*Collector to emitter cutoff current	3041	Bias condition C; V_{CE} = 90 V dc	I_{CES2}		5	μA dc
Low-temperature operation		T_A = -55°C				
Forward current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 150 mA dc; pulsed (see 4.5.1)	h_{FE6}	40		
Subgroup 4						
Small-signal short- circuit forward-current transfer ratio	3206	V_{CE} = 5 V dc; I_C = 1 mA dc, f = 1 kHz	h_{fe}	80	400	
Magnitude of small- signal short-circuit forward-current transfer ratio	3306	V_{CE} = 10 V dc; I_C = 50 mA dc; f = 20 MHz	$\|h_{fe}\|$	5	20	
Input capacitance (output open circuited)	3240	V_{EB} = 0.5 V dc; I_C = 0; 100 kHz ≤ f ≤ 1 MHz	C_{ibo}		60	pF
Open circuit output capacitance	3236	V_{CB} = 10 V dc; I_E = 0; 100 kHz ≤ f ≤ 1 MHz	C_{obo}		12	pF
Noise figure	3246	V_{CE} = 10 V dc; I_C = 100 μA dc; R_g = 1 kΩ; power bandwidth = 200 Hz	NF		4	dB
Collector to base time constant		V_{CB} = 10 V dc; I_C = 10 mA dc; f = 79.8 MHz (see 4.5.2)	r'_bC_c		400	ps
*Pulse response		See figure 20	$t_{on} + t_{off}$		30	ns

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 5						
*Safe operating area (continuous dc)	3051	T_C = +25°C; t = 10 ms, 1 cycle (see figure 21)				
Test 1		V_{CE} = 10 V dc;				
2N3019, 2N3019S		I_C = 500 mA dc				
2N3057A, 2N3700, 2N3700UB		I_C = 180 mA dc				
Test 2		V_{CE} = 40 V dc;				
2N3019, 2N3019S		I_C = 125 mA dc				
2N3057A, 2N3700, 2N3700UB		I_C = 45 mA dc				
Test 3		V_{CE} = 80 V dc;				
2N3019, 2N3019S		I_C = 60 mA dc				
2N3057A, 2N3700, 2N3700UB		I_C = 22.5 mA dc				
Electrical measurements		See table I, subgroup 2 herein				
*Safe operating area (continuous dc)	3051	T_C = +25°C; t = 10 ms, 1 cycle (see figure 21)				
Subgroups 6 and 7						
Not applicable						

1/ For sampling plan see MIL-PRF-19500.
2/ For resubmission of failed test in subgroup A1, double the sample size of the failed test or sequence of tests. A failure in table I, group A, 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.

* TABLE II. Group E inspection (all quality levels) – for qualification and 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			
Fine leak Gross leak	1071		
Electrical measurements		See table I, subgroup 2 herein.	
Subgroup 2			45 devices c = 0
Intermittent life	1037	V_{CB} = 10 V dc, 6,000 cycles.	
Electrical measurements		See table I, subgroup 2 herein.	
Subgroups 4			
Thermal resistance	3131	$R_{\theta JSP(IS)}$ can be calculated but shall be measured once in the same package with a similar die size to confirm calculations (may apply to multiple slash sheets).	15 devices, c = 0
Thermal impedance curves		Each supplier shall submit their qual-lot average and design maximum thermal impedance curves. In addition, the optimal test conditions and $Z_{\theta JX}$ limit shall be provided to the qualifying activity in the qualification report.	sample size N/A
Subgroups 5			
Not applicable			
Subgroup 6			
ESD	1020		3 devices c = 0
Subgroup 8			45 devices c = 0
Reverse stability	1033	Condition A for devices ≥ 400 V Condition B for devices < 400 V	

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

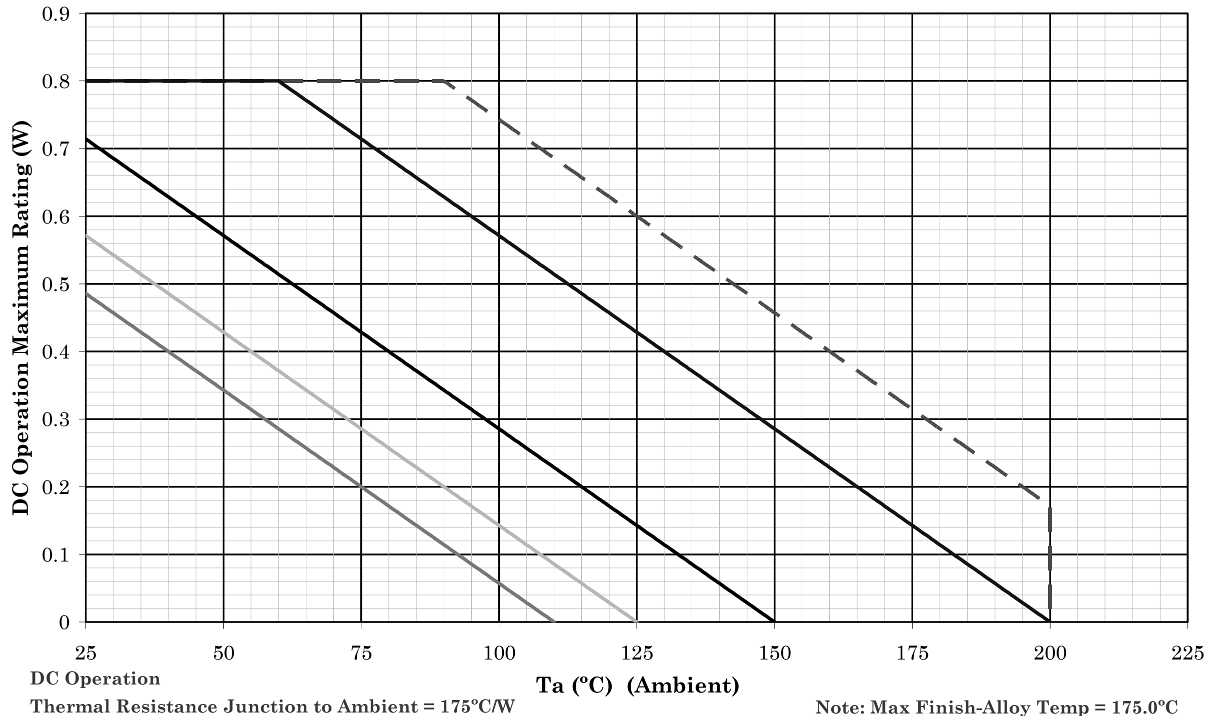
Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Collector-emitter cutoff current	3041	Bias condition C; V_{CE} = 90 V dc; pulsed (see 4.5.1)	ΔI_{CES1}	±100 percent of initial value or 8 nA dc, whichever is greater.		
2.	Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 0.1 mA dc; pulsed (see 4.5.1)	Δh_{FE2}	±25 percent change from initial reading.		
3.	Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 150 mA dc; pulsed (see 4.5.1)	Δh_{FE1}	±25 percent change from initial reading.		
4.	Collector-emitter voltage (saturated)	3071	I_C = 150 mA dc; I_B = 15 mA dc; pulsed (see 4.5.1)	$\Delta V_{CE(sat)1}$ 4/	±50 mV dc change from previous measured value.		

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

2/ The delta measurements for group B, (JAN, JANTX, and JANTXV), see 4.4.2.2 herein, are as follows: Steps 1 and 2 of 4.4.2.2 herein, see table III herein, steps 1, 3 and 4.

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

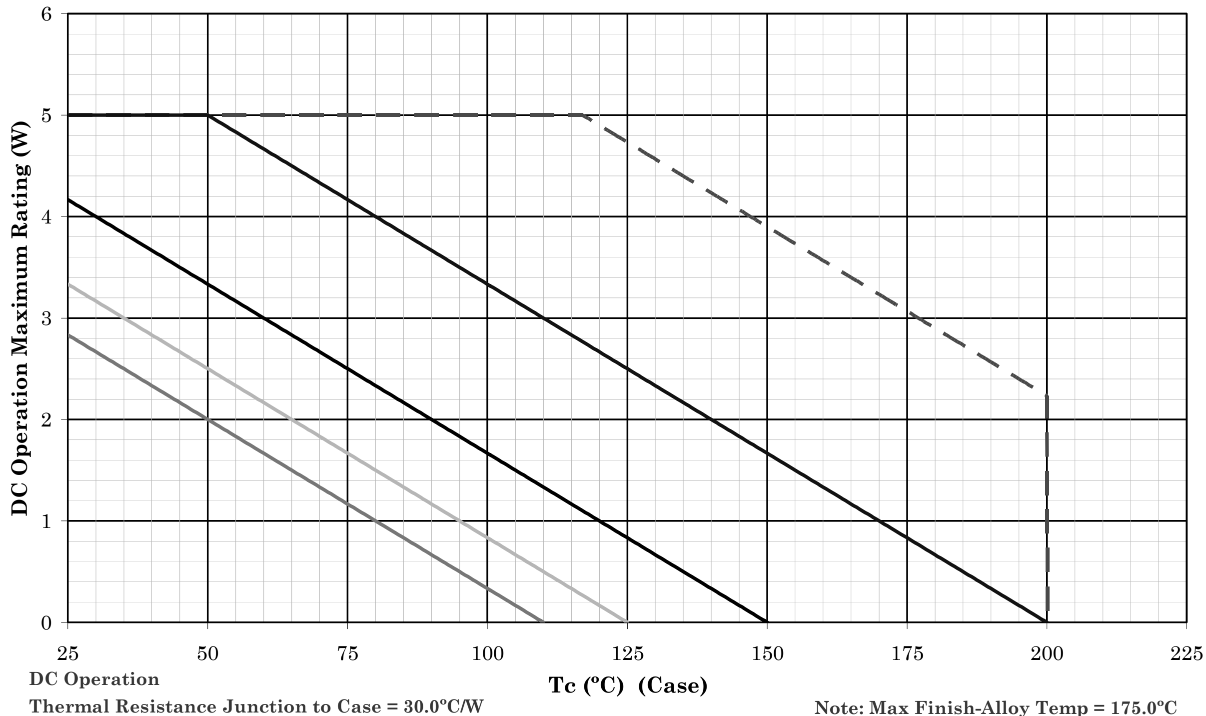
4/ Measured within .125 inch (3.175 mm) from the body of the device.



NOTES:

1. Top curve is thermal runaway loci and cannot be used as a derate design curve because it exceeds the maximum ratings for this part. Operating under this curve using these mounting conditions assures the device will not have a thermal runaway. This is the true inverse of the worst case thermal resistance value extrapolated out to the thermal runaway point.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq +150°C$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq +125°C$, and +110°C to show power rating where most users want to limit T_J in their application.

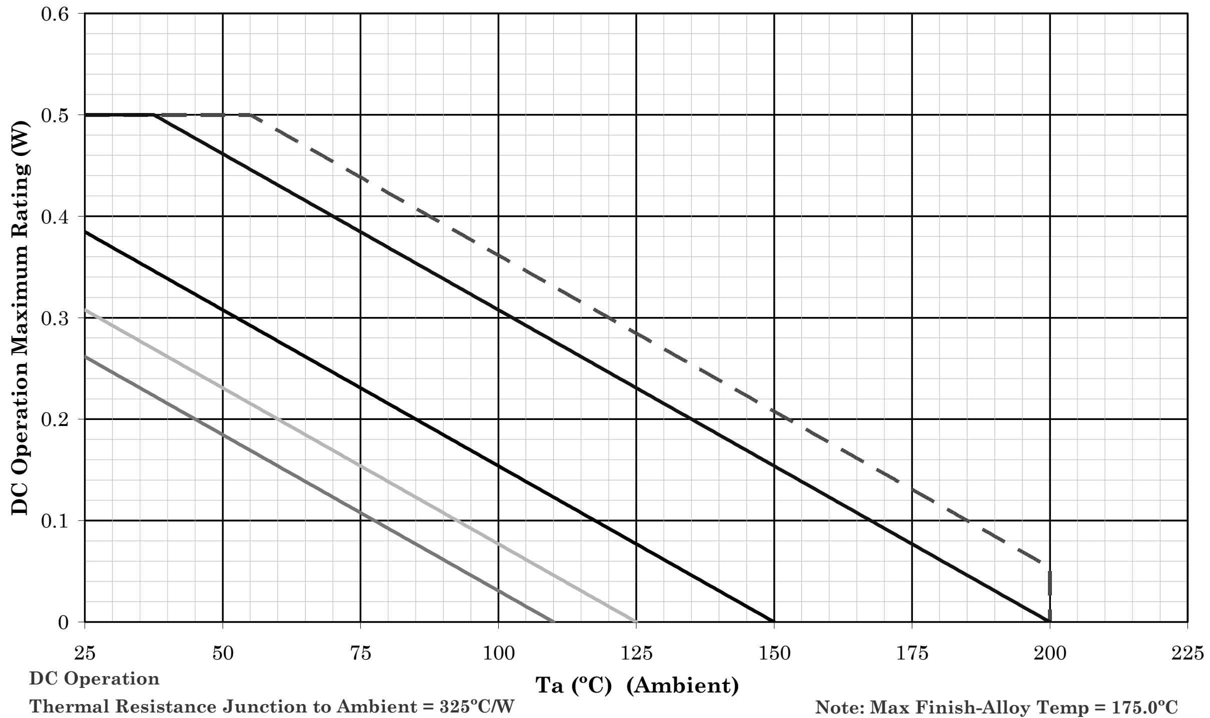
* FIGURE 6. Derating for 2N3019 ($R_{\theta JA}$) PCB (TO-5 and TO-39).



NOTES:

1. Top curve is thermal runaway loci and cannot be used as a derate design curve because it exceeds the maximum ratings for this part. Operating under this curve using these mounting conditions assures the device will not have a thermal runaway. This is the true inverse of the worst case thermal resistance value extrapolated out to the thermal runaway point.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq +150°C$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq +125°C$, and +110°C to show power rating where most users want to limit T_J in their application.

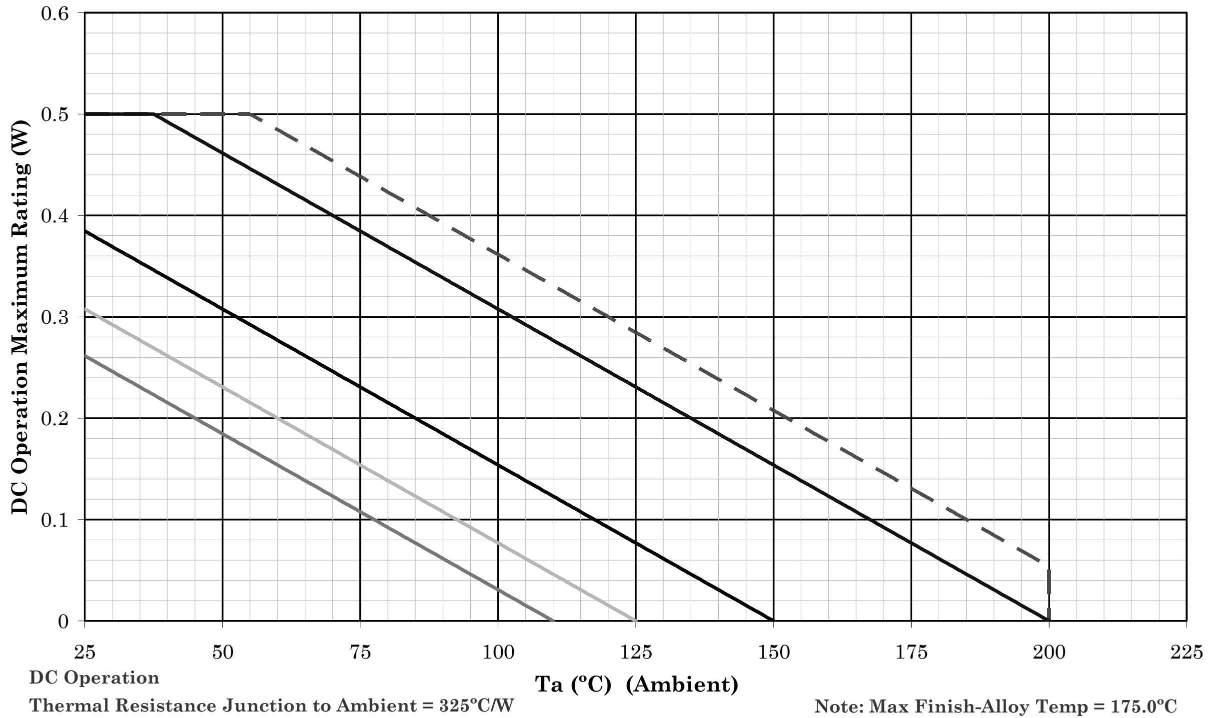
* FIGURE 7. Derating for 2N3019 ($R_{\theta JC}$), base case mounted (TO-5 and TO-39).



NOTES:

1. Top curve is thermal runaway loci and cannot be used as a derate design curve because it exceeds the maximum ratings for this part. Operating under this curve using these mounting conditions assures the device will not have a thermal runaway. This is the true inverse of the worst case thermal resistance value extrapolated out to the thermal runaway point.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq +150°C$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq +125°C$, and +110°C to show power rating where most users want to limit T_J in their application.

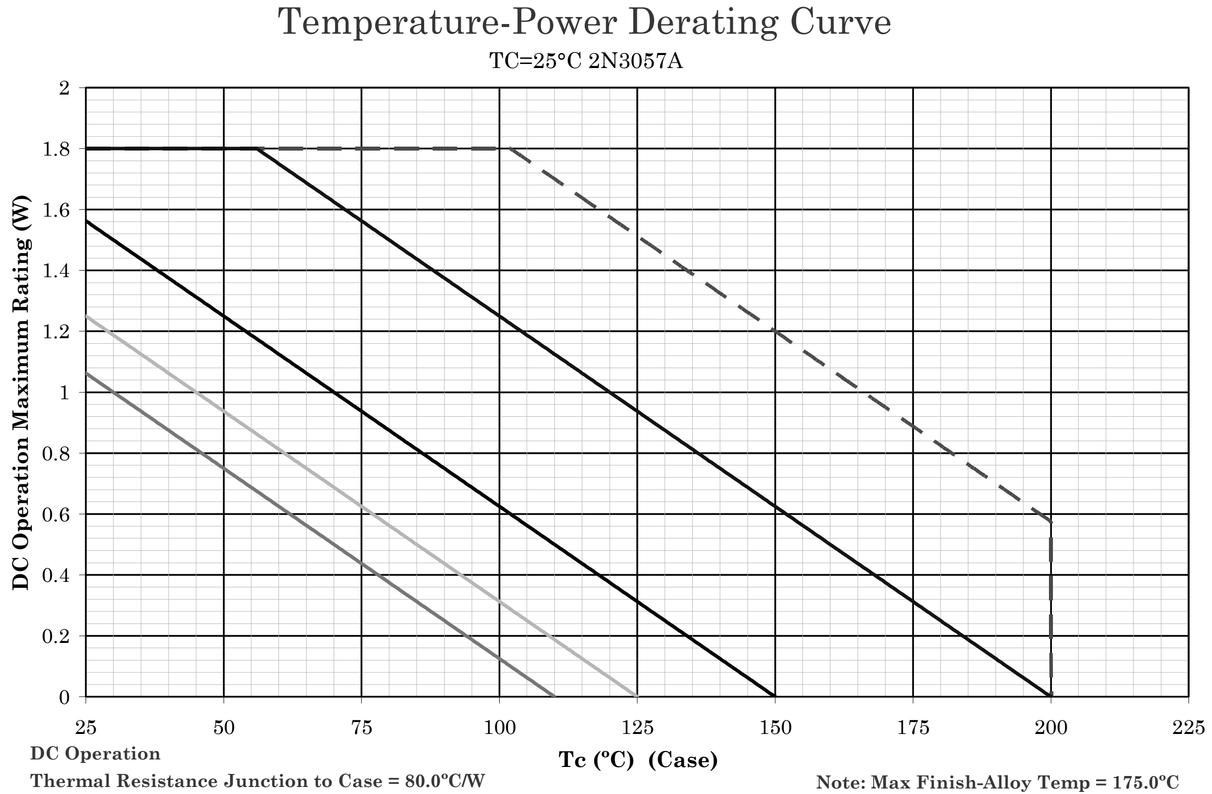
*FIGURE 8. Derating for 2N3700 ($R_{\theta JA}$) (TO-18), leads .125 inch.



NOTES:

1. Top curve is thermal runaway loci and cannot be used as a derate design curve because it exceeds the maximum ratings for this part. Operating under this curve using these mounting conditions assures the device will not have a thermal runaway. This is the true inverse of the worst case thermal resistance value extrapolated out to the thermal runaway point.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq +150°C$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq +125°C$, and +110°C to show power rating where most users want to limit T_J in their application.

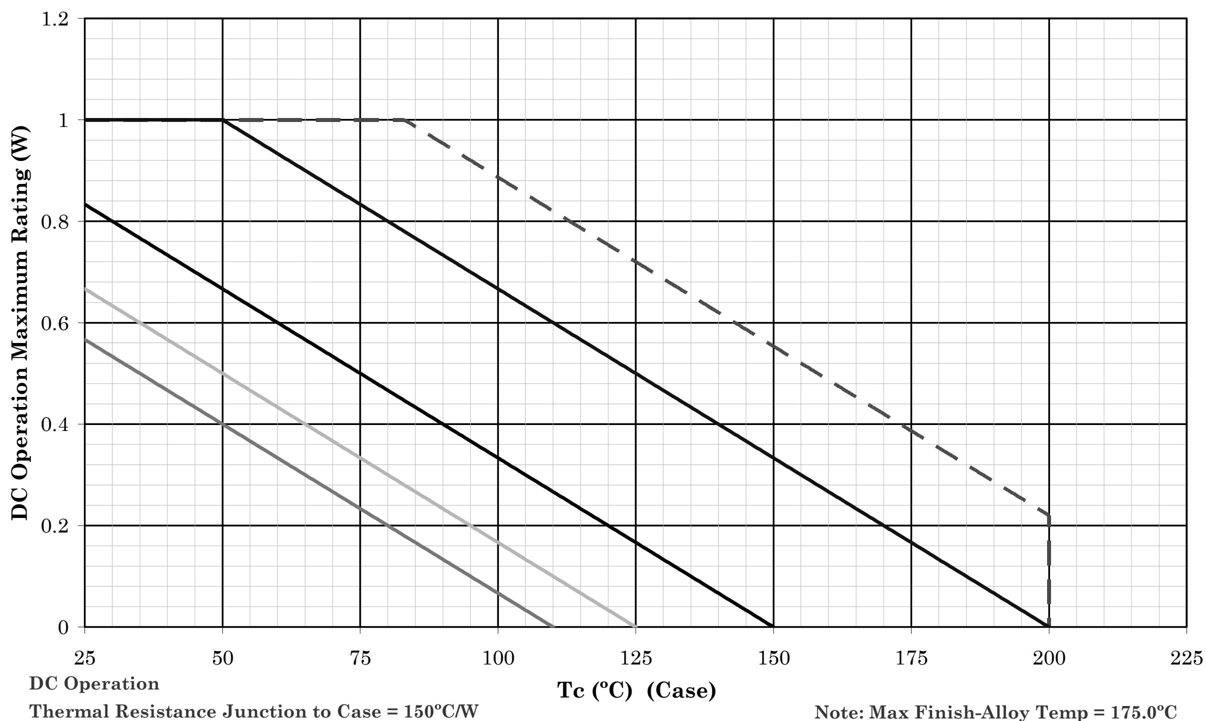
*FIGURE 9. Derating for 2N3057A ($R_{\theta JA}$) (TO-46), leads .125 inch.



NOTES:

1. Top curve is thermal runaway loci and cannot be used as a derate design curve because it exceeds the maximum ratings for this part. Operating under this curve using these mounting conditions assures the device will not have a thermal runaway. This is the true inverse of the worst case thermal resistance value extrapolated out to the thermal runaway point.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq +150°C$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq +125°C$, and +110°C to show power rating where most users want to limit T_J in their application.

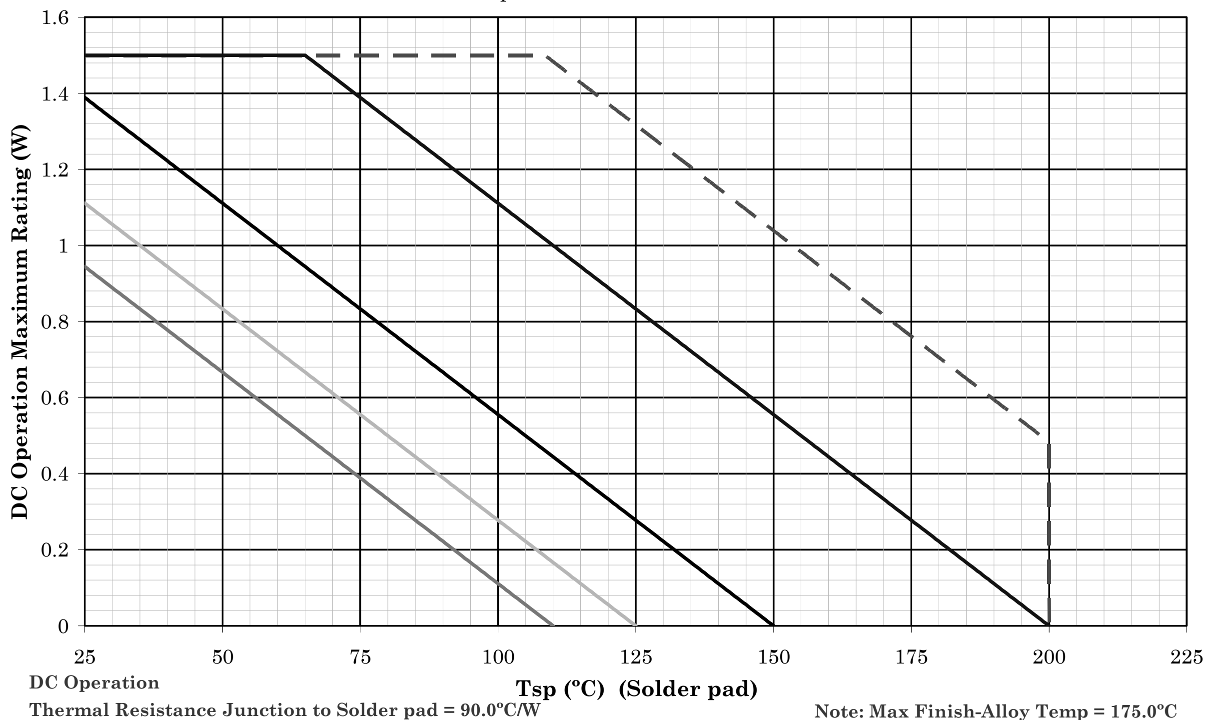
* FIGURE 10. Derating for 2N3057A ($R_{\theta Jc}$) (TO-46), base case mounted.



NOTES:

1. Top curve is thermal runaway loci and cannot be used as a derate design curve because it exceeds the maximum ratings for this part. Operating under this curve using these mounting conditions assures the device will not have a thermal runaway. This is the true inverse of the worst case thermal resistance value extrapolated out to the thermal runaway point.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq +150°C$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq +125°C$, and +110°C to show power rating where most users want to limit T_J in their application.

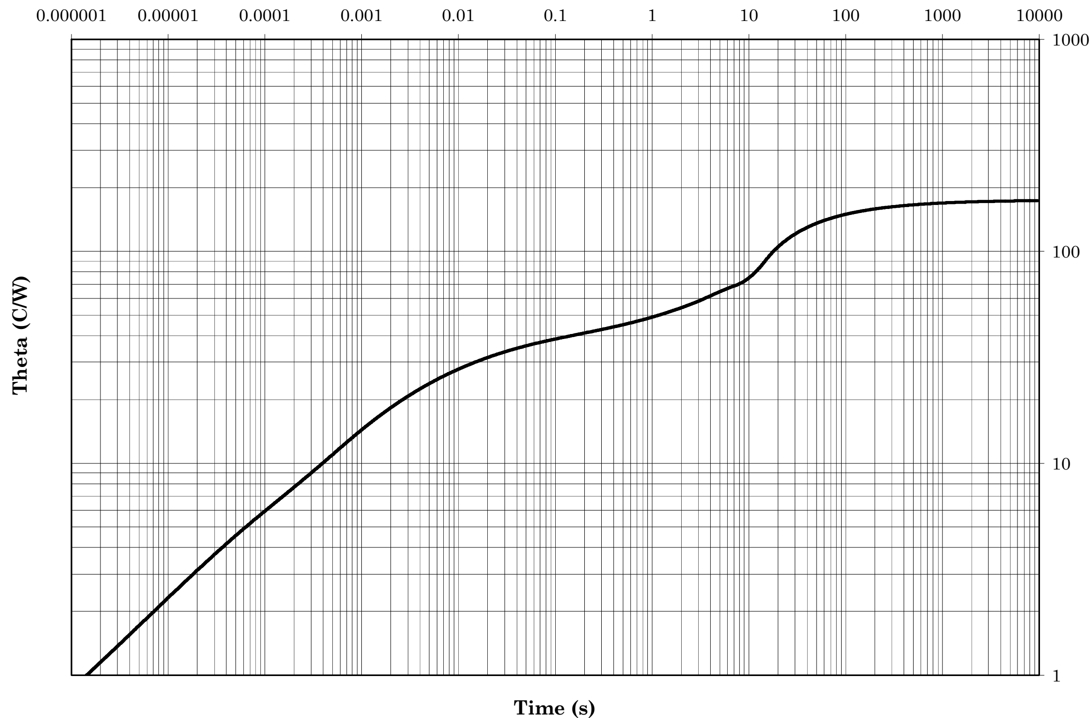
*FIGURE 11. Derating for 2N3700 ($R_{\theta JC}$) (TO-18), base case mounted.



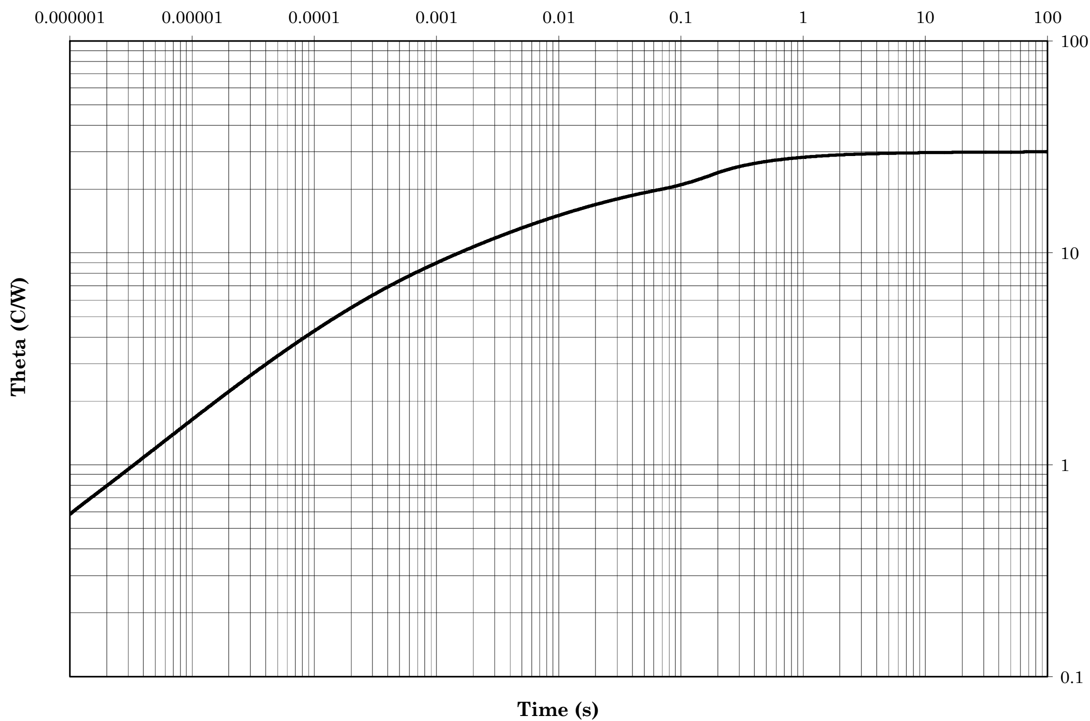
NOTES:

1. Top curve is thermal runaway loci and cannot be used as a derate design curve because it exceeds the maximum ratings for this part. Operating under this curve using these mounting conditions assures the device will not have a thermal runaway. This is the true inverse of the worst case thermal resistance value extrapolated out to the thermal runaway point.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq +150°C$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq +125°C$, and +110°C to show power rating where most users want to limit T_J in their application.

* FIGURE 12. Derating for 2N3700UB ($R_{\theta JSP(IS)}$), infinite sink 3-points.

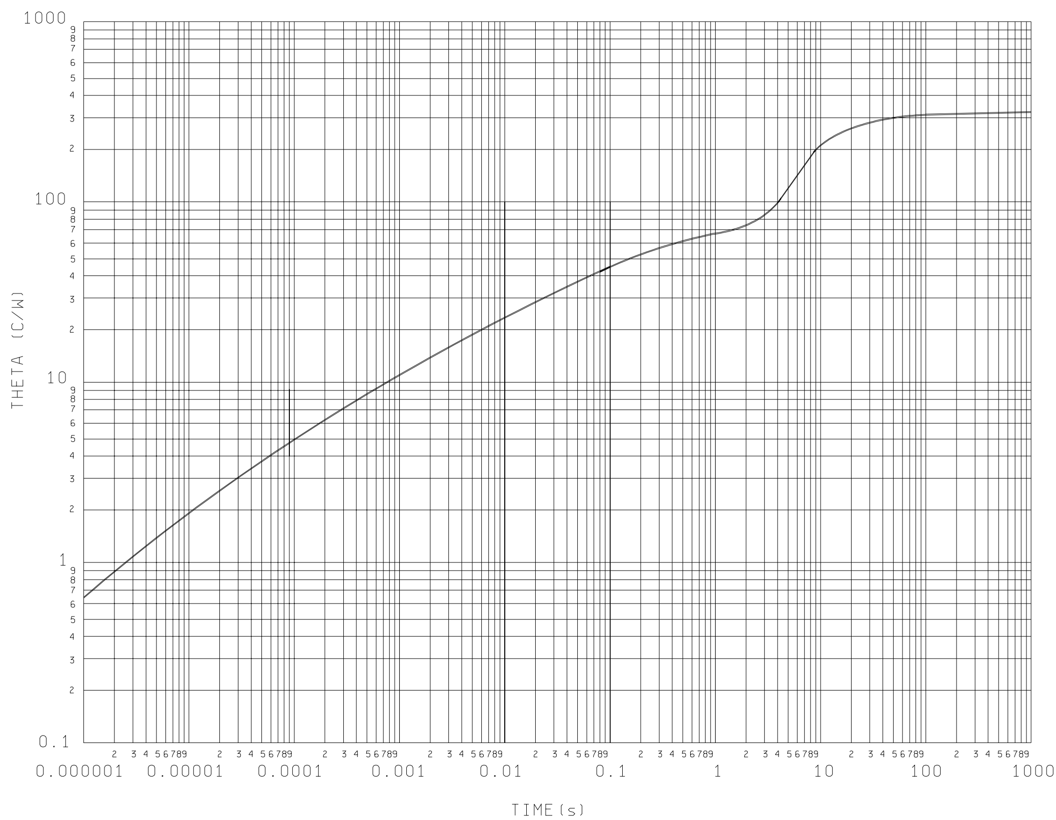


* FIGURE 13. Thermal impedance graph ($R_{\theta JA}$) for 2N3019 (TO-5 and TO-39).



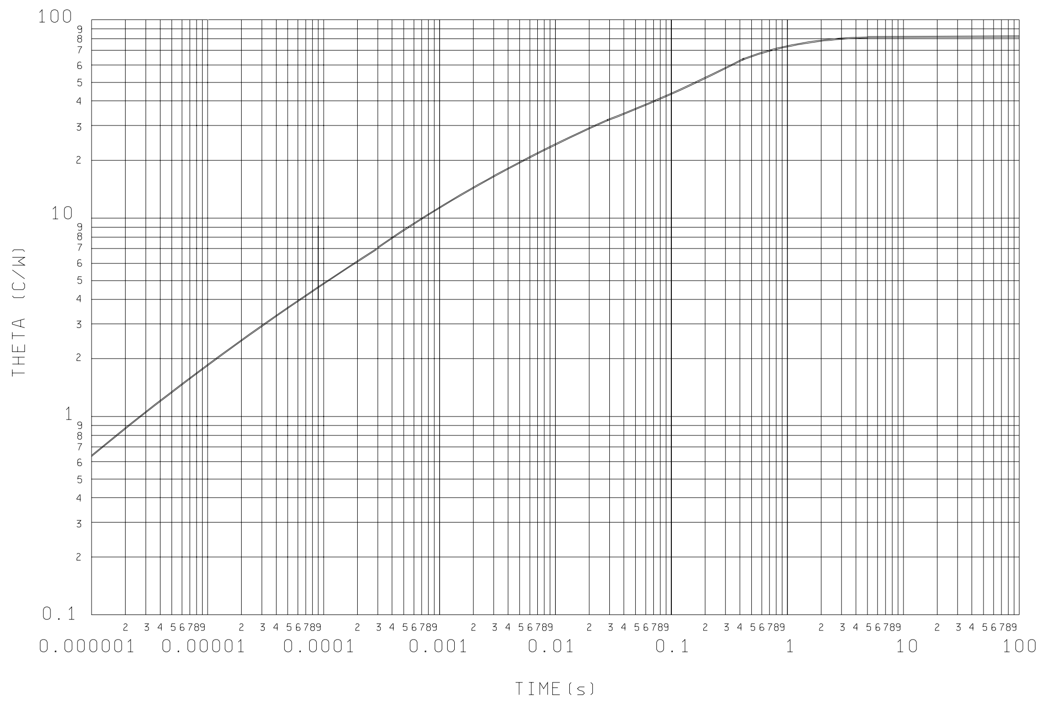
* FIGURE 14. Thermal impedance graph ($R_{\theta JC}$) for 2N3019 (TO-5 AND TO-39).

MAXIMUM THERMAL IMPEDANCE



* FIGURE 15. Thermal impedance graph ($R_{\theta JA}$) 2N3057A (TO-46).

MAXIMUM THERMAL IMPEDANCE



* FIGURE 16. Thermal impedance graph ($R_{\theta Jc}$) for 2N3057A (TO-46).

MAXIMUM THERMAL IMPEDANCE

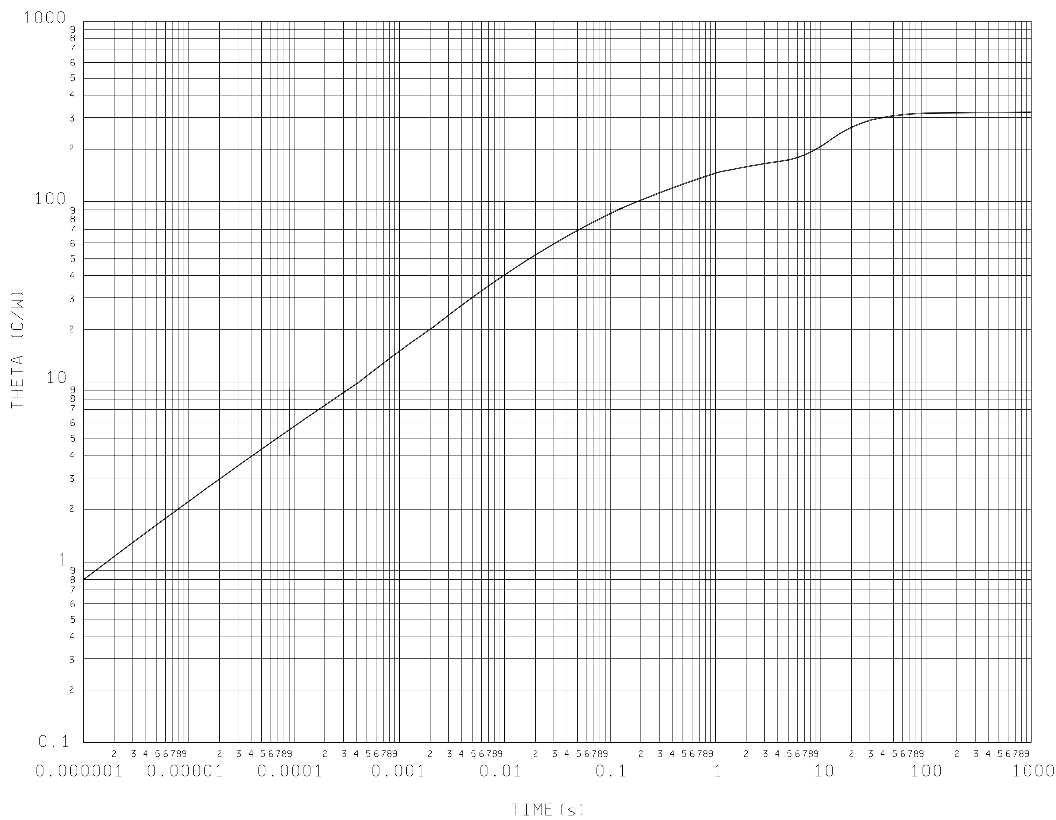


*FIGURE 17. Thermal impedance graph ($R_{\theta JA}$) for 2N3700 (TO-18).

MAXIMUM THERMAL IMPEDANCE

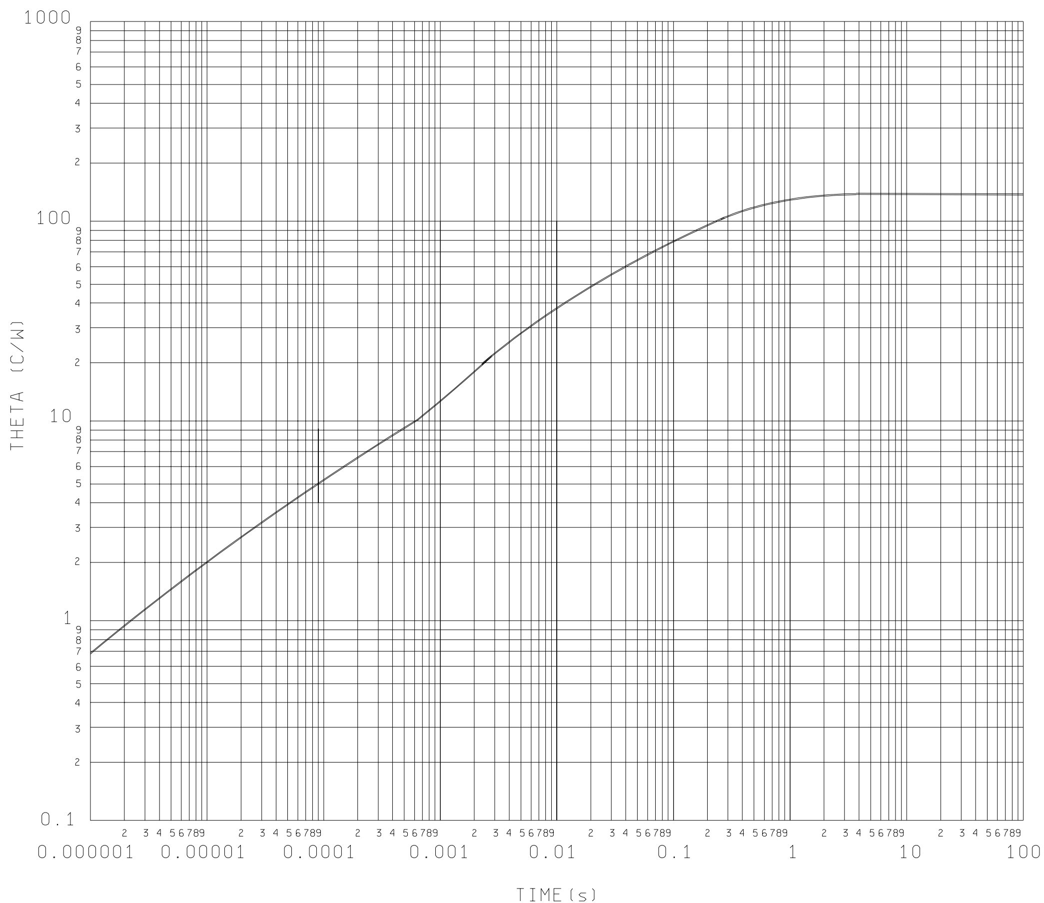


*FIGURE 18. Thermal impedance graph ($R_{\theta JC}$) for 2N3700 (TO-18).

MAXIMUM THERMAL IMPEDANCE

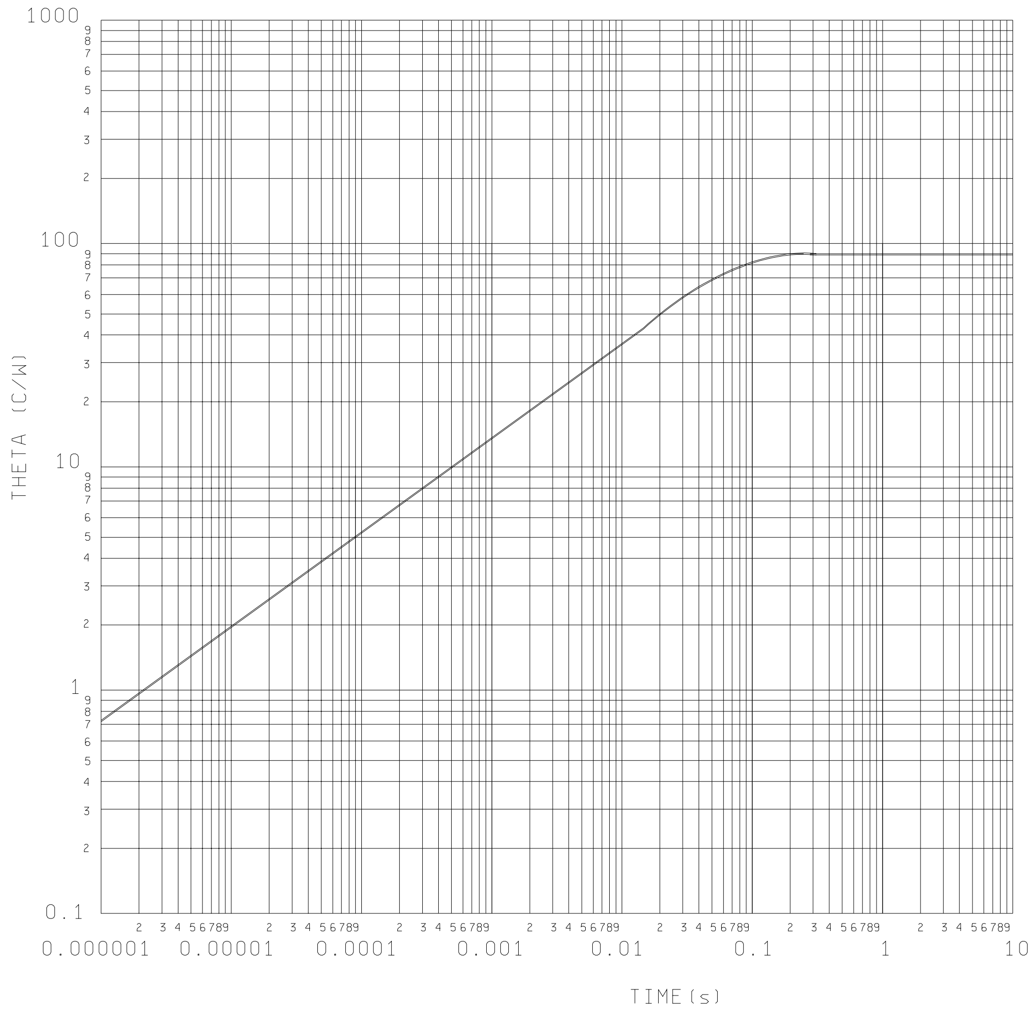
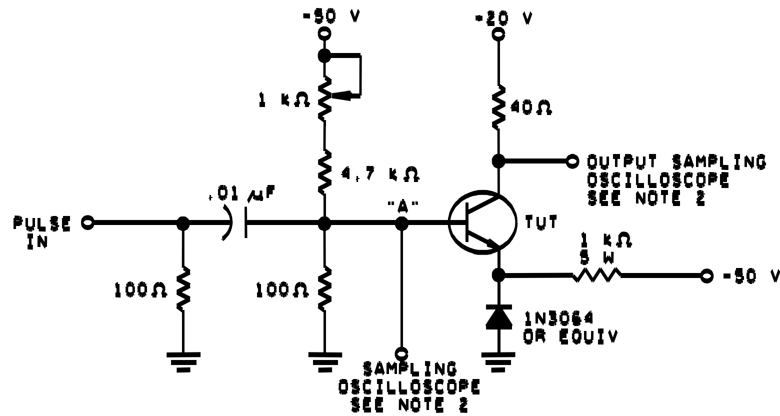
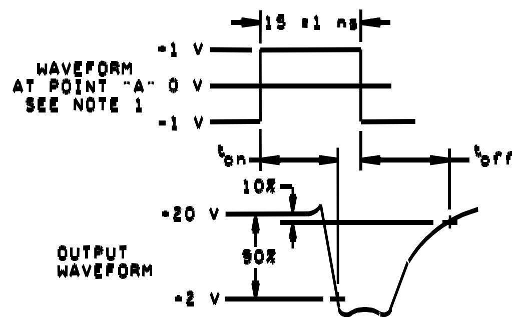


*FIGURE 19. Thermal impedance graph ($R_{\theta JSP(IS)}$) for 2N3700 (UB).





NOTES:

1. The rise time (t_r) of the applied pulse shall be ≤ 2.0 ns, duty cycle ≤ 2 percent and the generator source impedance shall be 50 ohms.
2. Sampling oscilloscope: Z_{IN} ≥ 100 kΩ, C_{IN} ≤ 12 pF, rise time ≤ 2.0 ns.

*FIGURE 20. Nonsaturated switching-time test circuit.

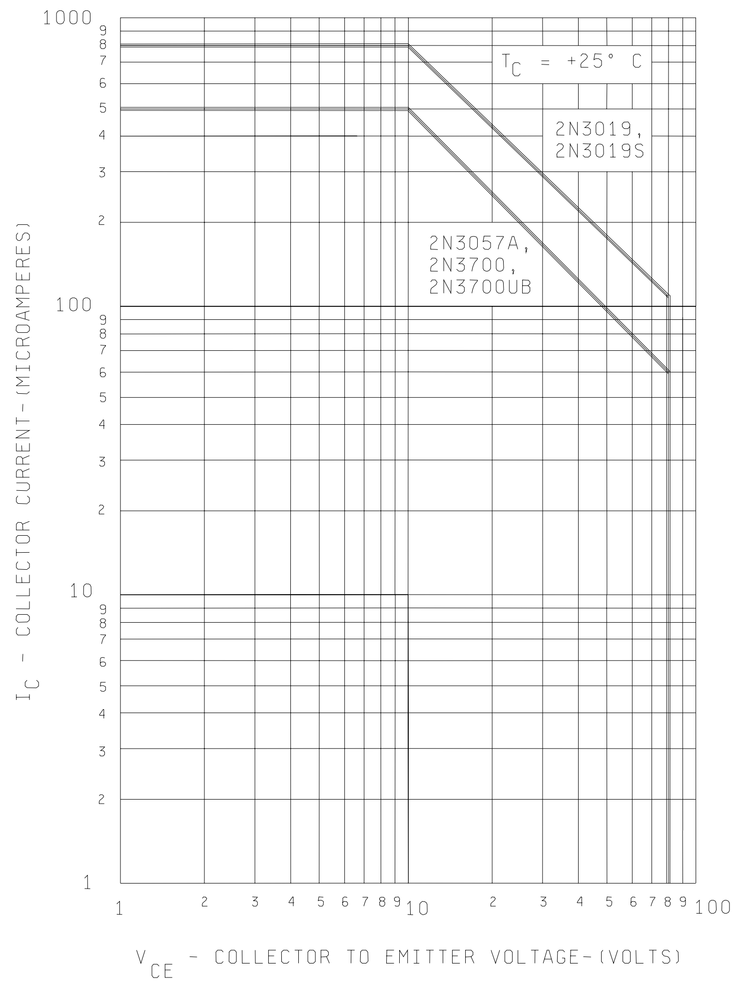


*FIGURE 21. Maximum safe operating graph (10 ms).

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. The acquisition requirements are as specified in MIL-PRF-19500.

6.3 Suppliers of JANHC and JANKC die. The qualified JANHC and JANKC suppliers with the applicable letter version (example JANHCA2N3700) will be identified on the QML.

Die ordering information	
PIN	Manufacturer
	34156
2N3700	JANHCA2N3700 JANKCA2N3700

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers List (QML 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.

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 - 11
NASA - NA
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2963)

Review activities:
Army - AR, MI, SM
Navy - AS, MC
Air Force - 19

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