

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

INCH-POUND

MIL-PRF-19500/391M
20 September 2010
SUPERSEDING
MIL-PRF-19500/391L
15 January 2008

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, LOW-POWER
TYPES 2N3019, 2N3019S, 2N3057A, 2N3700, AND 2N3700UB, JAN, JANTX, JANTXV,
JANS, JANSM, JANSJ, JANSR, JANSF, JANSK, JANSH, JANHCA, JANHCB,
JANKCA, JANKCB, JANKCBM, JANKCD, JANKCP, JANKCL, JANKCR, JANKCF, JANKCG, AND JANKCH

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. Provisions for radiation hardness assurance (RHA) to three radiation levels is provided for 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, 2N3019 (TO-5) and 2N3019S (similar to TO-39), figure 2, 2N3057A (TO-46), figure 3, 2N3700 (TO-18), figure 4, 2N3700UB, figure 5, JANHCA2N3700 and JANKCA2N3700, and figure 6, JANHCB2N3700 and JANKCB2N3700.

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

| I_c | V_{CBO} | V_{EBO} | V_{CEO} | T_J and T_{STG} |
|-------------|-------------|-------------|-------------|---------------------|
| <u>A dc</u> | <u>V dc</u> | <u>V dc</u> | <u>V dc</u> | <u>°C</u> |
| 1 | 140 | 7 | 80 | -65 to +200 |

* 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@dsc.dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database. at <https://assist.daps.dla.mil>.

MIL-PRF-19500/391M

1.3 Maximum ratings. Unless otherwise specified, $T_A = +25^\circ\text{C}$. - Continued.

| Types | P_T $T_A = +25^\circ\text{C}$ (1) (2) | P_T $T_C = +25^\circ\text{C}$ (1) (2) | P_T $T_{SP(1S)} = +25^\circ\text{C}$ (1) (2) | $R_{\theta JA}$ (2) (3) (4) | $R_{\theta JC}$ (2) (3) | $R_{\theta JSP(1S)}$ (2) (3) |
|----------|---|---|--|--------------------------------|-----------------------------|---------------------------------|
| | $\frac{W}{}$ | $\frac{W}{}$ | $\frac{W}{}$ | $\frac{^\circ\text{C/W}}{}$ | $\frac{^\circ\text{C/W}}{}$ | $\frac{^\circ\text{C/W}}{}$ |
| 2N3019 | 0.800 | 5 | N/A | 195 | 30 | N/A |
| 2N3019S | 0.800 | 5 | N/A | 195 | 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 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 11 for the UB package and use $R_{\theta JA}$.

1.4 Primary electrical characteristics.

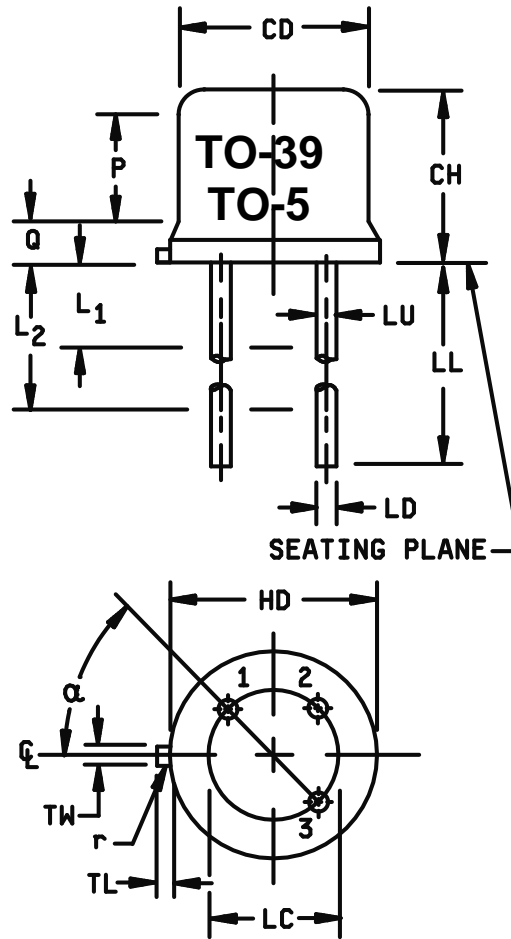
| Limits | h_{FE1} $V_{CE} = 10\text{ V dc}$ $I_C = 150\text{ mA dc}$ | h_{FE2} $V_{CE} = 10\text{ V dc}$ $I_C = 0.1\text{ mA dc}$ | h_{FE3} (1) $V_{CE} = 10\text{ V dc}$ $I_C = 10\text{ mA dc}$ | h_{FE4} (1) $V_{CE} = 10\text{ V dc}$ $I_C = 500\text{ mA dc}$ |
|--------|--|--|---|--|
| Min | 100 | 50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

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

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

(1) Pulsed, see 4.5.1.

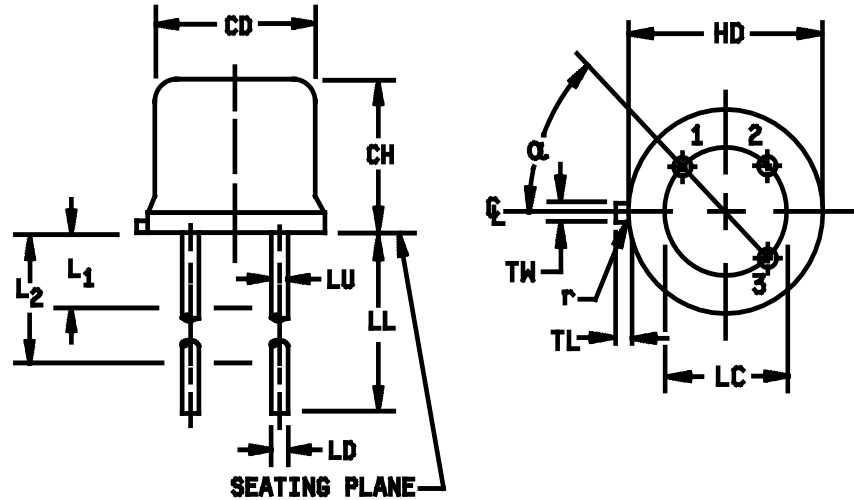
| Symbol | Dimensions | | | | Notes |
|----------------|------------|------|-------------|-------|----------|
| | Inches | | Millimeters | | |
| | Min | Max | Min | Max | |
| CD | .305 | .335 | 7.75 | 8.51 | |
| CH | .240 | .260 | 6.10 | 6.60 | |
| HD | .335 | .370 | 8.51 | 9.40 | |
| LC | .200 TP | | 5.08 TP | | 6 |
| LD | .016 | .021 | 0.41 | 0.53 | 7, 8 |
| LL | .500 | .750 | 12.70 | 19.05 | 7, 8, 12 |
| LU | .016 | .019 | 0.41 | 0.48 | 7, 8 |
| L ₁ | | .050 | | 1.27 | 7, 8 |
| L ₂ | .250 | | 6.35 | | 7, 8 |
| Q | | .050 | | 1.27 | 5 |
| TL | .029 | .045 | 0.74 | 1.14 | 4 |
| TW | .028 | .034 | 0.71 | 0.86 | 3 |
| r | | .010 | | 0.25 | 10 |
| α | 45° TP | | 45° TP | | 6 |
| P | .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 -.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 L₁ and L₂. Dimension LD applies between L₂ and minimum. Diameter is uncontrolled in L₁ 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 ϕ x 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.
15. Lead 1 = emitter, lead 2 = base, lead 3 = collector.

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



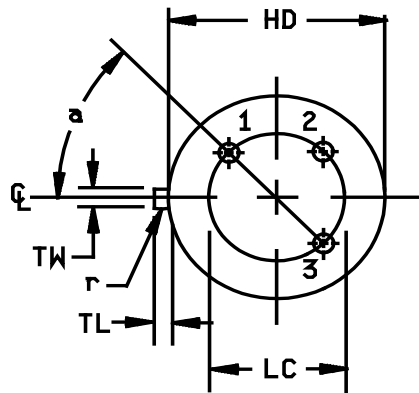
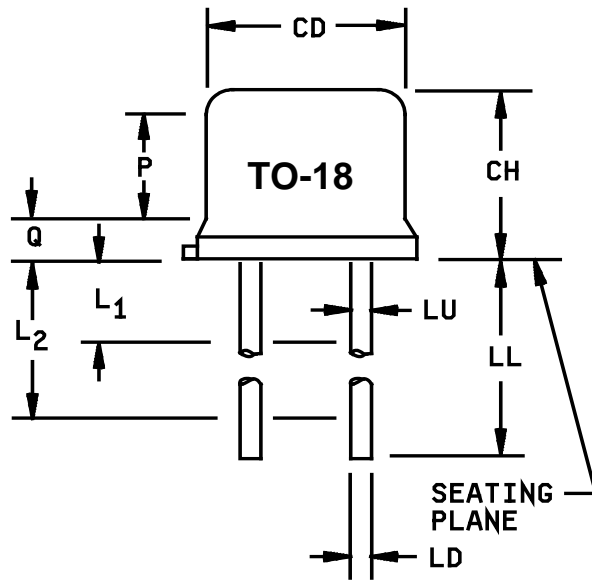
| Symbol | Dimensions | | | | Note |
|----------|------------|-------|-------------|-------|--------|
| | Inches | | Millimeters | | |
| | Min | Max | Min | Max | |
| CD | .178 | .195 | 4.52 | 4.95 | |
| CH | .065 | .085 | 1.65 | 2.16 | |
| HD | .209 | .230 | 5.31 | 5.84 | |
| LC | .100 TP | | 2.54 TP | | 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 L₁ and L₂. Dimension LD applies between L₂ and LL minimum. Diameter is uncontrolled in L₁ and beyond LL minimum.
7. All three leads.
8. The collector shall be internally connected to the case.
9. 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 | | | | | |

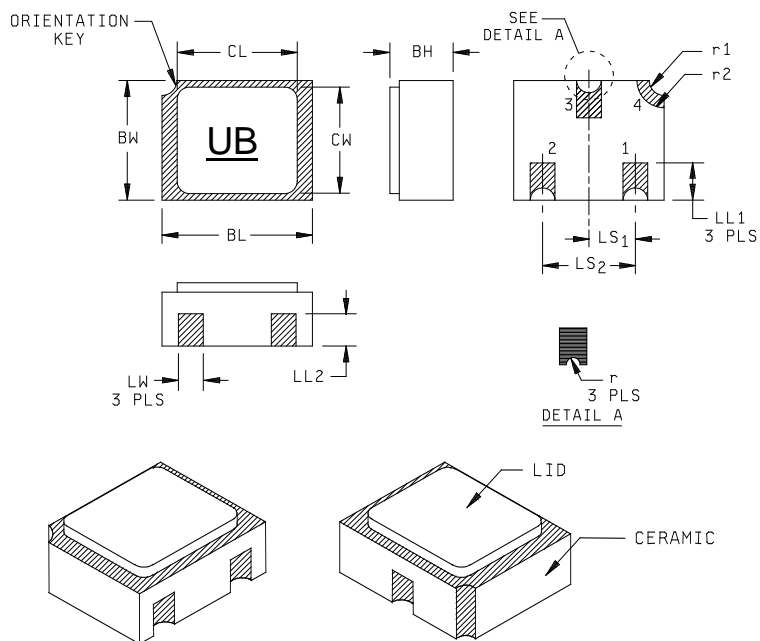


NOTES:

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 inch (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 L₁ and L₂. Dimension LD applies between L₂ and LL minimum. Diameter is uncontrolled in L₁ 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 ϕ x symbology.
12. Lead 1 = emitter, lead 2 = base, lead 3 = collector.

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

MIL-PRF-19500/391M

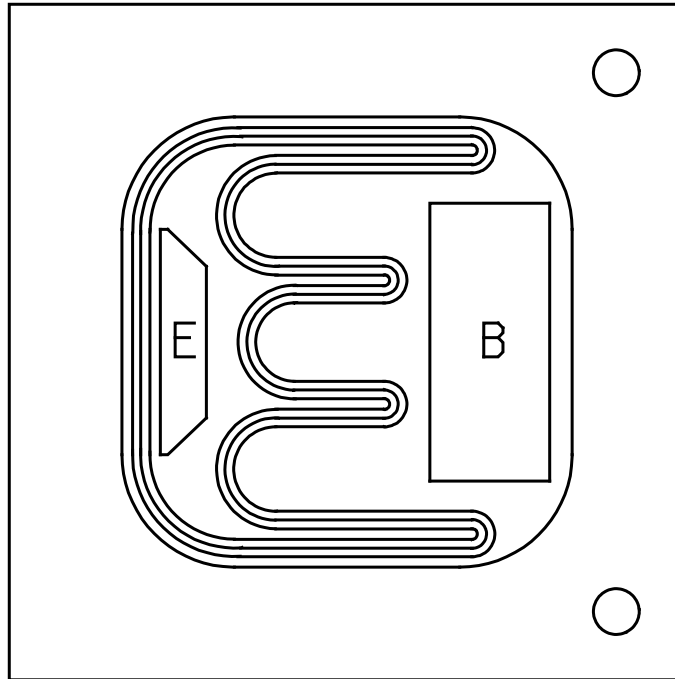


| Symbol | Dimensions | | | | Note | Symbol | Dimensions | | | | Note |
|--------|------------|------|-------------|------|------|--------|------------|------|-------------|------|------|
| | Inches | | Millimeters | | | | Inches | | Millimeters | | |
| | Min | Max | Min | Max | | | Min | Max | Min | 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 | | .128 | | 3.25 | | r | | .008 | | 0.20 | |
| CW | | .108 | | 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:

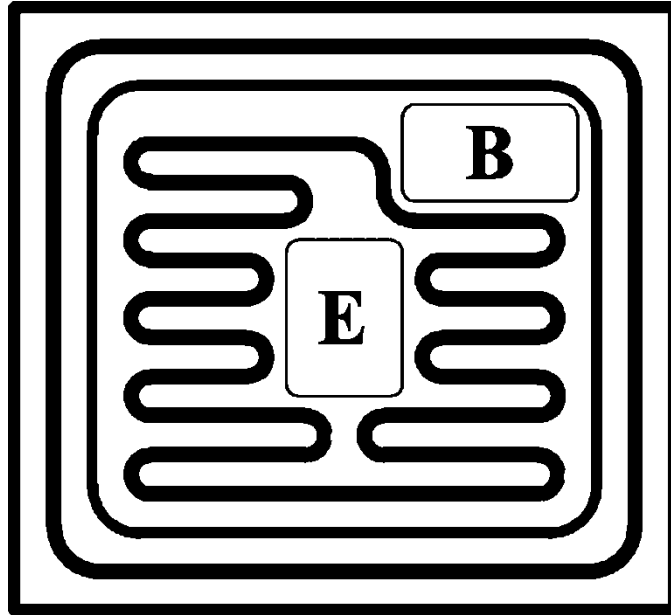
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Hatched areas on package denote metallized areas.
4. Pad 1 = Base, Pad 2 = Emitter, Pad 3 = Collector, Pad 4 = Shielding connected to the lid.
5. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

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, 6,500 ±1,950 Å.
Top metal: Aluminum, 12,000 Å minimum; 14,500 Å nominal.
Back side: Collector.
Glassivation: SiO₂, 7,500 ±1,500 Å.

FIGURE 5. JANHCA and JANKCA die (2N3700 and 2N3019) dimensions.



1. Chip size.....024 x .026 inch \pm .002 inch (0.610 X 0.660 \pm 0.051 millimeter).
2. Chip thickness.....010 inch \pm .0015 inch (0.254 \pm 0.0381 millimeter).
3. Top metal.....Aluminum 15,000Å minimum, 18,000Å nominal.
4. Back metal.....Gold:3,500Å minimum, 5,000Å nominal.
5. Backside.....Collector.
6. Bonding pad.....B = .004 inch x .006 inch (0.102 X 0.152 millimeter).
E = .004 inch x .0055 inch (0.102 X 0.140 millimeter).

FIGURE 6. JANHCB and JANKCB 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 <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 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 and as follows.

PCB Printed circuit board.
R_{θJA} Thermal resistance junction to ambient.
R_{θJC} Thermal resistance junction to case.
R_{θJSP(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) figure 5 (JANHCA, JANKCA), and figure 6 (JANHCB, JANKCB) 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 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, 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, 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. 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 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 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 | 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_{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; Δh_{FE1} = ± 15 percent. | I_{CES1} and h_{FE1} . |
| 12 | See 4.3.1. | See 4.3.1. |
| 13 | Subgroups 2 and 3 of table I herein; ΔI_{CES1} = 100 percent of initial value or 5 nA dc, whichever is greater; Δh_{FE1} = ± 15 percent. | Subgroup 2 of table I herein; ΔI_{CES1} = 100 percent of initial value or 5 nA dc, whichever is greater; Δh_{FE1} = ± 15 percent. |

(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. 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. Use method 3100 of MIL-STD-750 to measure T_J .

4.3.2 Thermal impedance measurements. 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_{MD} (and V_C where appropriate). Measurement delay time (t_{MD}) = 70 μ s max. See table III, 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 group A1 and A2 inspection only (table E-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.

MIL-PRF-19500/391M

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 herein. Electrical measurements (end-points) shall be in accordance with group A, subgroup 2. 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.

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

| <u>Subgroup</u> | <u>Method</u> | <u>Condition</u> |
|-----------------|---------------|--|
| 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 | 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 E-VIa, adjust T_A or P_D to achieve $T_J = +275^\circ\text{C}$ minimum. Option 2: 216 hours minimum, sample size = 45, $c = 0$; adjust T_A or P_D to achieve $T_J = +225^\circ\text{C}$ minimum. |
| B5 | 2037 | Test condition D. |
| 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 failure mode has been implemented and the devices from the wafer lot are screened to eliminate the failure mode.

| <u>Step</u> | <u>Method</u> | <u>Condition</u> |
|-------------|---------------|--|
| 1 | 1026 | Steady-state life: 1,000 hours minimum, $V_{CB} = 10$ V dc, power shall be applied to achieve $T_J = +150^\circ\text{C}$ minimum using a minimum of $P_D = 75$ percent of maximum rated P_T as defined in 1.3. $n = 45$ devices, $c = 0$. The sample size may be increased and the test time decreased 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 | Blocking life: $T_A = +150^\circ\text{C}$, $V_{CB} = 80$ percent rated voltage, without exceeding max rated V_{CEO} . 48 hours minimum. $n = 45$ devices, $c = 0$. |
| 3 | 1032 | High-temperature life (non-operating), $t = 340$ hours, $T_A = +200^\circ\text{C}$. $n = 22$, $c = 0$. |

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

- a. For JAN, JANTX and JANTXV samples shall be selected randomly from a minimum of three wafers (or from each wafer in the lot) from each wafer lot. For JANS, samples shall be selected from each inspection lot. See MIL-PRF-19500.
- b. Shall 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 E-VIa, subgroups B4 and B5 for JANS, and table E-VIc, 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 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.

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

| <u>Subgroup</u> | <u>Method</u> | <u>Condition</u> |
|-----------------|---------------|--|
| C2 | 2036 | Test condition E; not applicable for UB devices. |
| C5 | 3131 | See 1.3. $R_{\theta JC}$ is applicable for all devices except UB. $R_{\theta JA}$ is 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 $T_J = +150^\circ\text{C}$ 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 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.

| <u>Subgroup</u> | <u>Method</u> | <u>Condition</u> |
|-----------------|---------------|---|
| C2 | 2036 | Test condition E; not applicable for UB devices. |
| C5 | 3131 | See 1.3, $R_{\theta JC}$ is applicable for all devices except UB. $R_{\theta JA}$ is applicable for UB devices. |
| 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.

* 4.4.4 Group D inspection. Conformance inspection for hardness assured JANS, JANJ, 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. 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 as specified in table III herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

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

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

4.5.2 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:

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

MIL-PRF-19500/391M

TABLE I. Group A inspection.

| Inspection <u>1/</u> | MIL-STD-750 | | Symbol | Limit | | Unit |
|---|-------------|---|----------------------|-------|-----|-------|
| | Method | Conditions | | Min | Max | |
| <u>Subgroup 1 2/</u> | | | | | | |
| Visual and mechanical examination <u>3/</u> | 2071 | n = 45 devices, c = 0 | | | | |
| Solderability <u>3/ 4/</u> | 2026 | n = 15 leads, c = 0 | | | | |
| Resistance to solvents <u>3/ 4/ 5/</u> | 1022 | n = 15 devices, c = 0 | | | | |
| Temp cycling <u>3/ 4/</u> | 1051 | Test condition C, 25 cycles n = 22 devices, c = 0 | | | | |
| Hermetic seal <u>4/</u> | 1071 | n = 22 devices, c = 0 | | | | |
| Fine leak Gross leak | | | | | | |
| Electrical measurements <u>4/</u> | | Group A, subgroup 2 | | | | |
| Bond strength <u>3/ 4/</u> | 2037 | Precondition T _A = +250°C at t = 24 hrs or T _A = +300°C at t = 2 hrs, n = 11 wires, c = 0 | | | | |
| <u>Subgroup 2</u> | | | | | | |
| Thermal impedance | 3131 | See 4.3.2 | Z _{θJX} | | | °C/W |
| Collector to base cutoff current | 3036 | Bias condition D; V _{CB} = 140 V dc | I _{CB01} | | 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 | 300 | |
| 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 | 300 | |

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

| Inspection 1/ | MIL-STD-750 | | Symbol | Limit | | Unit |
|--|-------------|---|--------------------|-------|-----|------------------|
| | Method | Conditions | | Min | Max | |
| <u>Subgroup 2</u> - Continued | | | | | | |
| Forward current transfer ratio | 3076 | $V_{CE} = 10 \text{ V dc}; I_C = 1 \text{ A dc};$ pulsed (see 4.5.1) | h_{FE5} | 15 | | |
| Collector to emitter voltage (saturated) | 3071 | $I_C = 150 \text{ mA dc}; I_B = 15 \text{ mA dc};$ pulsed (see 4.5.1) | $V_{CE(sat)1}$ | | 0.2 | V dc |
| Collector to emitter voltage (saturated) | 3071 | $I_C = 500 \text{ mA dc}; I_B = 50 \text{ mA dc};$ pulsed (see 4.5.1) | $V_{CE(sat)2}$ | | 0.5 | V dc |
| Base to emitter voltage (saturated) | 3066 | Test condition A; $I_C = 150 \text{ mA dc};$ $I_B = 15 \text{ mA dc};$ pulsed (see 4.5.1) | $V_{BE(sat)}$ | | 1.1 | V dc |
| <u>Subgroup 3</u> | | | | | | |
| High-temperature operation | | $T_A = +150^\circ\text{C}$ | | | | |
| Collector to emitter cutoff current | 3041 | Bias condition C; $V_{CE} = 90 \text{ V dc}$ | I_{CES2} | | 5 | $\mu\text{A dc}$ |
| Low-temperature operation | | $T_A = -55^\circ\text{C}$ | | | | |
| Forward current transfer ratio | 3076 | $V_{CE} = 10 \text{ V dc}; I_C = 150 \text{ mA dc};$ pulsed (see 4.5.1) | h_{FE6} | 40 | | |
| <u>Subgroup 4</u> | | | | | | |
| Small-signal short-circuit forward-current transfer ratio | 3206 | $V_{CE} = 5 \text{ V dc}; I_C = 1 \text{ mA dc},$ $f = 1 \text{ kHz}$ | h_{fe} | 80 | 400 | |
| Magnitude of small-signal short-circuit forward-current transfer ratio | 3306 | $V_{CE} = 10 \text{ V dc}; I_C = 50 \text{ mA dc};$ $f = 20 \text{ MHz}$ | $ h_{fe} $ | 5 | 20 | |
| Input capacitance (output open circuited) | 3240 | $V_{EB} = 0.5 \text{ V dc}; I_C = 0;$ $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$ | C_{ibo} | | 60 | pF |
| Open circuit output capacitance | 3236 | $V_{CB} = 10 \text{ V dc}; I_E = 0;$ $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$ | C_{obo} | | 12 | pF |
| Noise figure | 3246 | $V_{CE} = 10 \text{ V dc}; I_C = 100 \mu\text{A dc};$ $R_g = 1 \text{ k}\Omega;$ power bandwidth = 200 Hz $f = 1 \text{ kHz}$ | NF | | 4 | dB |
| Collector to base time constant | | $V_{CB} = 10 \text{ V dc}; I_C = 10 \text{ mA dc};$ $f = 79.8 \text{ MHz}$ (see 4.5.2) | $r'_{b,Cc}$ | | 400 | ps |
| Pulse response | | See figure 20 | $t_{on} + t_{off}$ | | 30 | ns |

See footnotes at end of table.

MIL-PRF-19500/391M

TABLE I. Group A inspection - Continued.

| Inspection <u>1/</u> | MIL-STD-750 | | Symbol | Limit | | Unit |
|--|-------------|--|--------|-------|-----|------|
| | Method | Conditions | | Min | Max | |
| <u>Subgroup 5</u> | | | | | | |
| Safe operating area (continuous dc) | 3051 | $T_C = +25^\circ\text{C}$; $t = 10 \text{ ms}$, 1 cycle (see figure 21) | | | | |
| <u>Test 1</u> | | $V_{CE} = 10 \text{ V dc}$; | | | | |
| 2N3019, 2N3019S | | $I_C = 500 \text{ mA dc}$ | | | | |
| 2N3057A, 2N3700, 2N3700UB | | $I_C = 180 \text{ mA dc}$ | | | | |
| <u>Test 2</u> | | $V_{CE} = 40 \text{ V dc}$; | | | | |
| 2N3019, 2N3019S | | $I_C = 125 \text{ mA dc}$ | | | | |
| 2N3057A, 2N3700, 2N3700UB | | $I_C = 45 \text{ mA dc}$ | | | | |
| <u>Test 3</u> | | $V_{CE} = 80 \text{ V dc}$; | | | | |
| 2N3019, 2N3019S | | $I_C = 60 \text{ mA dc}$ | | | | |
| 2N3057A, 2N3700, 2N3700UB | | $I_C = 22.5 \text{ mA dc}$ | | | | |
| Electrical measurements | | See table I, subgroup 2 herein | | | | |
| Safe operating area (continuous dc) | 3051 | $T_C = +25^\circ\text{C}$; $t = 10 \text{ ms}$, 1 cycle (see figure 21) | | | | |
| <u>Subgroups 6 and 7</u> | | | | | | |
| 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.

MIL-PRF-19500/391M

* TABLE II. Group D inspection.

| Inspection <u>1/ 2/ 3/</u> | MIL-STD-750 | | Symbol | Limit | | Unit |
|--|-------------|---|-----------------------|-------|------|------------|
| | Method | Conditions | | Min | Max | |
| <u>Subgroup 1 4/</u> | | | | | | |
| Neutron irradiation | 1017 | Neutron exposure $V_{CES} = 0$ V | | | | |
| Collector to base cutoff current | 3036 | Bias condition D; $V_{CB} = 140$ V dc | I_{CBO1} | | 20 | μ A dc |
| Emitter to base cutoff current | 3061 | Bias condition D; $V_{EB} = 7$ V dc | I_{EBO1} | | 20 | μ A 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} | | 20 | nA dc |
| Emitter to base cutoff current | 3061 | Bias condition D; $V_{EB} = 5$ V dc | I_{EBO2} | | 20 | nA dc |
| Forward-current transfer ratio | 3076 | $V_{CE} = 10$ V dc; $I_C = 150$ mA dc | $[h_{FE1}]$ <u>5/</u> | [50] | 300 | |
| Forward-current transfer ratio | 3076 | $V_{CE} = 10$ V dc; $I_C = 0.1$ mA dc | $[h_{FE2}]$ <u>5/</u> | [25] | 300 | |
| Forward-current transfer ratio | 3076 | $V_{CE} = 10$ V dc; $I_C = 10$ mA dc | $[h_{FE3}]$ <u>5/</u> | [45] | | |
| Forward-current transfer ratio | 3076 | $V_{CE} = 10$ V dc; $I_C = 500$ mA dc | $[h_{FE4}]$ <u>5/</u> | [25] | 300 | |
| Forward-current transfer ratio | 3076 | $V_{CE} = 10$ V dc; $I_C = 1$ A dc | $[h_{FE5}]$ <u>5/</u> | [7.5] | | |
| Collector-emitter saturation voltage | 3071 | $I_C = 150$ mA dc; $I_B = 15$ mA dc (see 4.5.1) | $V_{CE(sat)1}$ | | .23 | V dc |
| Collector-emitter saturation voltage | 3071 | $I_C = 500$ mA dc; $I_B = 50$ mA dc (see 4.5.1) | $V_{CE(sat)2}$ | | .58 | 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) | $V_{BE(sat)}$ | | 1.27 | V dc |

See footnotes at end of table.

MIL-PRF-19500/391M

* TABLE II. Group D inspection - Continued.

| Inspection <u>1/</u> <u>2/</u> <u>3/</u> | MIL-STD-750 | | Symbol | Limit | | Unit |
|--|-------------|---|-----------------------|-------|------|------------|
| | Method | Conditions | | Min | Max | |
| <u>Subgroup 2</u> | | | | | | |
| Total dose irradiation | 1019 | Gamma exposure $V_{CES} = 64$ V | | | | |
| Collector to base cutoff current | 3036 | Bias condition D; $V_{CB} = 140$ V dc | I_{CBO1} | | 20 | μ A dc |
| Emitter to base cutoff current | 3061 | Bias condition D; $V_{EB} = 7$ V dc | I_{EBO1} | | 20 | μ A 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} | | 20 | nA dc |
| Emitter to base cutoff current | 3061 | Bias condition D; $V_{EB} = 5$ V dc | I_{EBO2} | | 20 | nA dc |
| Forward-current transfer ratio | 3076 | $V_{CE} = 10$ V dc; $I_C = 150$ mA dc | $[h_{FE1}]$ <u>5/</u> | [50] | 300 | |
| Forward-current transfer ratio | 3076 | $V_{CE} = 10$ V dc; $I_C = 0.1$ mA dc | $[h_{FE2}]$ <u>5/</u> | [25] | 300 | |
| Forward-current transfer ratio | 3076 | $V_{CE} = 10$ V dc; $I_C = 10$ mA dc | $[h_{FE3}]$ <u>5/</u> | [45] | | |
| Forward-current transfer ratio | 3076 | $V_{CE} = 10$ V dc; $I_C = 500$ mA dc | $[h_{FE4}]$ <u>5/</u> | [25] | 300 | |
| Forward-current transfer ratio | 3076 | $V_{CE} = 10$ V dc; $I_C = 1$ A dc | $[h_{FE5}]$ <u>5/</u> | [7.5] | | |
| Collector-emitter saturation voltage | 3071 | $I_C = 150$ mA dc; $I_B = 15$ mA dc; (see 4.5.1) | $V_{CE(sat)1}$ | | .23 | V dc |
| Collector-emitter saturation voltage | 3071 | $I_C = 500$ mA dc; $I_B = 50$ mA dc; (see 4.5.1) | $V_{CE(sat)2}$ | | .58 | 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) | $V_{BE(sat)}$ | | 1.27 | V 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 UB, suffix versions unless otherwise noted.

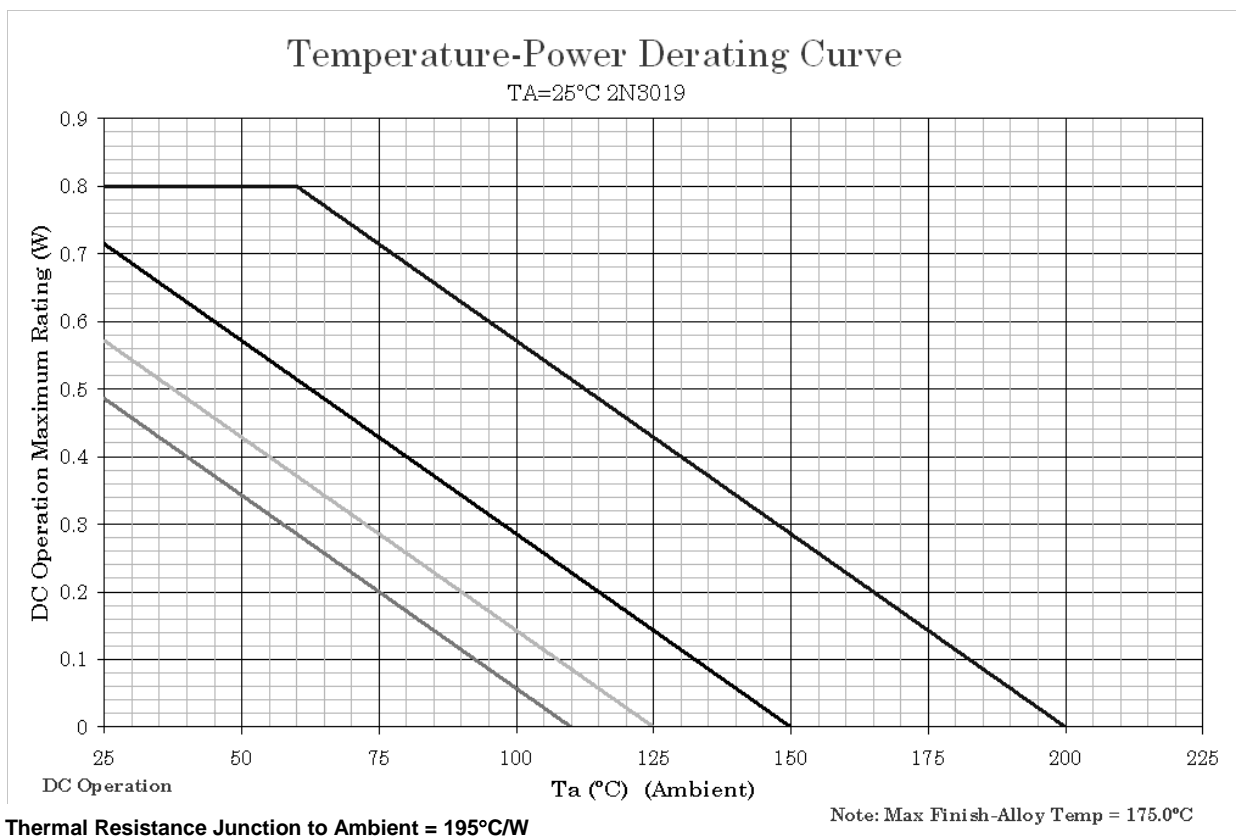
4/ See 6.2.e herein.

5/ 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.

MIL-PRF-19500/391M

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

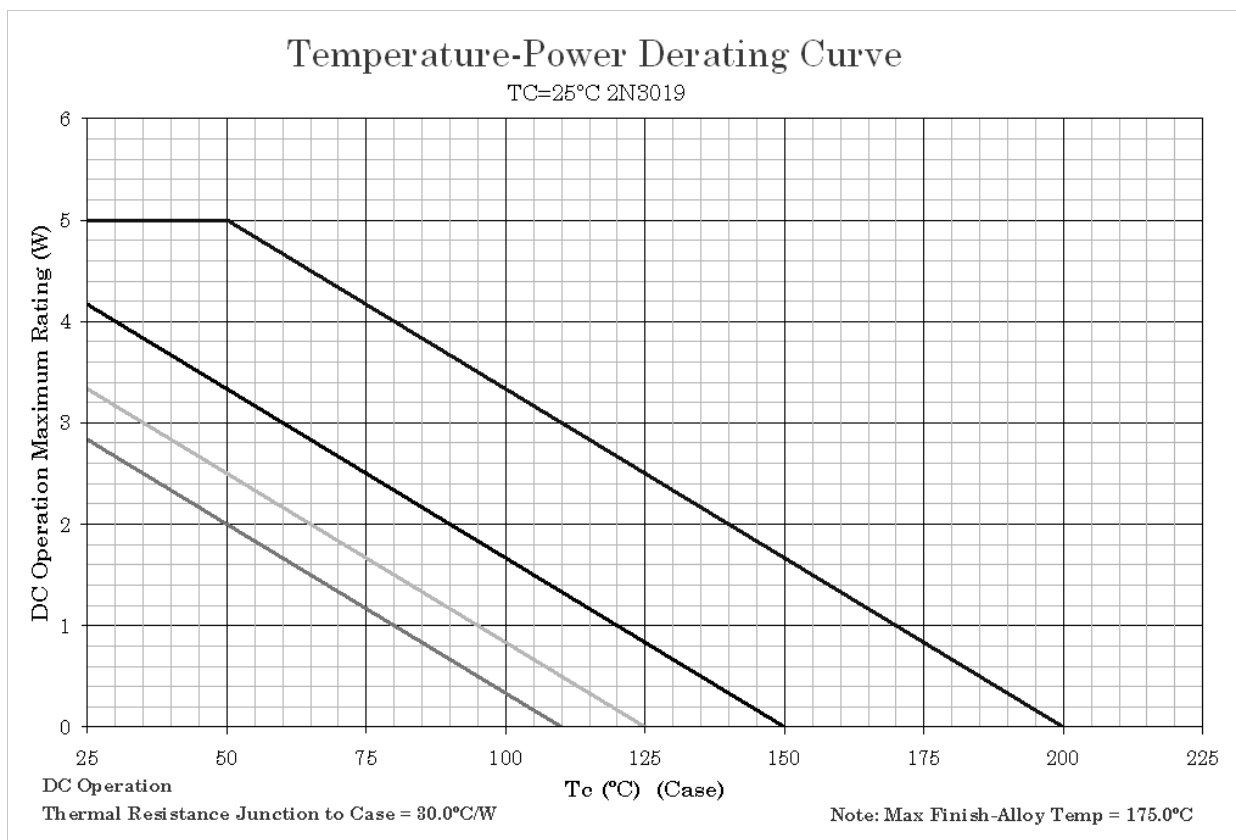
| Inspection | MIL-STD-750 | | Qualification |
|-------------------------------------|-------------|---|----------------------|
| | Method | Conditions | |
| <u>Subgroup 1</u> | | | 45 devices c = 0 |
| Temperature cycling (air to air) | 1051 | Test condition C, 500 cycles. | |
| Hermetic seal | | | |
| Fine leak Gross leak | 1071 | | |
| Electrical measurements | | See table I, subgroup 2 herein. | |
| <u>Subgroup 2</u> | | | 45 devices c = 0 |
| Intermittent life | 1037 | V _{CB} = 10 V dc, 6,000 cycles. | |
| Electrical measurements | | See table I, subgroup 2 herein. | |
| <u>Subgroups 4</u> | | | |
| Thermal resistance | 3131 | R _{θJSP(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). R _{θJSP(AM)} need be calculated only. | 15 devices, c = 0 |
| Thermal impedance curves | | See MIL-PRF-19500, table E-IX, group E, subgroup 4. | Sample Size N/A |
| <u>Subgroups 5</u> | | | |
| Not applicable | | | |
| <u>Subgroup 6</u> | | | |
| ESD | 1020 | | 3 devices c = 0 |
| <u>Subgroup 8</u> | | | 45 devices c = 0 |
| Reverse stability | 1033 | Condition B. | |



NOTES:

1. This is the true inverse of the worst case thermal resistance value. All devices are capable of operating at $\leq T_J$ specified on this curve. Any parallel line to this curve will intersect the appropriate power for the desired maximum T_J allowed.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq +150^\circ\text{C}$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq +125^\circ\text{C}$, and $+110^\circ\text{C}$ to show power rating where most users want to limit T_J in their application.

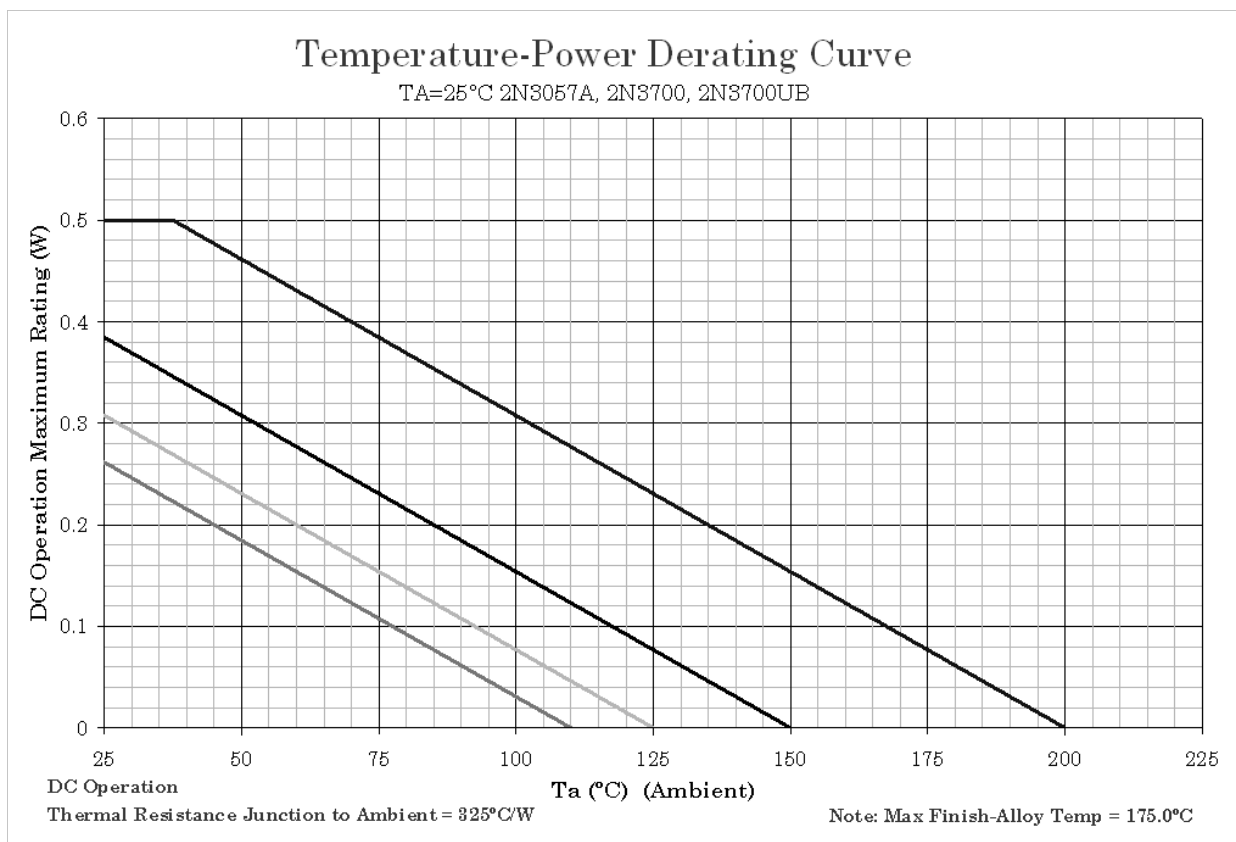
FIGURE 7. Derating for 2N3019 ($R_{\theta JA}$) PCB (TO-5 and TO-39).



NOTES:

1. This is the true inverse of the worst case thermal resistance value. All devices are capable of operating at $\leq T_J$ specified on this curve. Any parallel line to this curve will intersect the appropriate power for the desired maximum T_J allowed.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq +150^\circ\text{C}$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq +125^\circ\text{C}$, and $+110^\circ\text{C}$ to show power rating where most users want to limit T_J in their application.

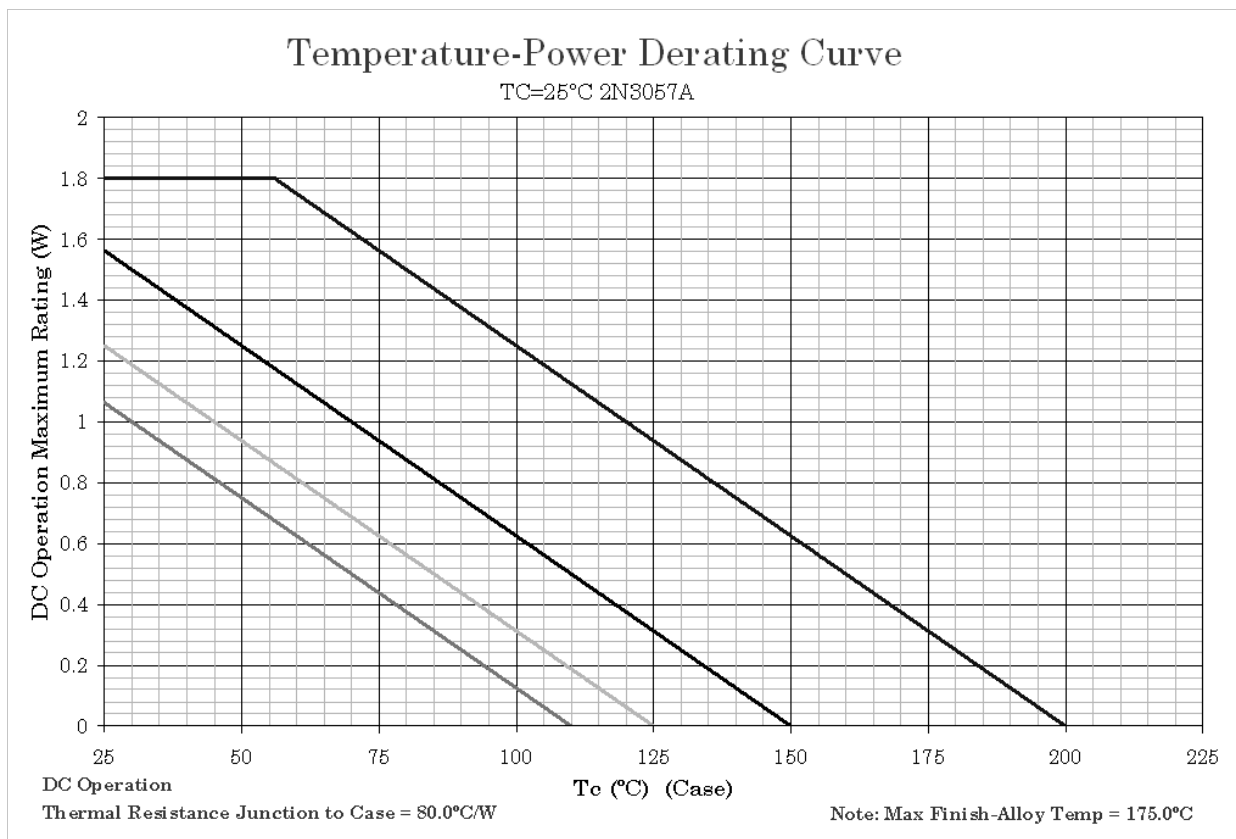
FIGURE 8. Derating for 2N3019 ($R_{\theta JC}$), base case mounted (TO-5 and TO-39).



NOTES:

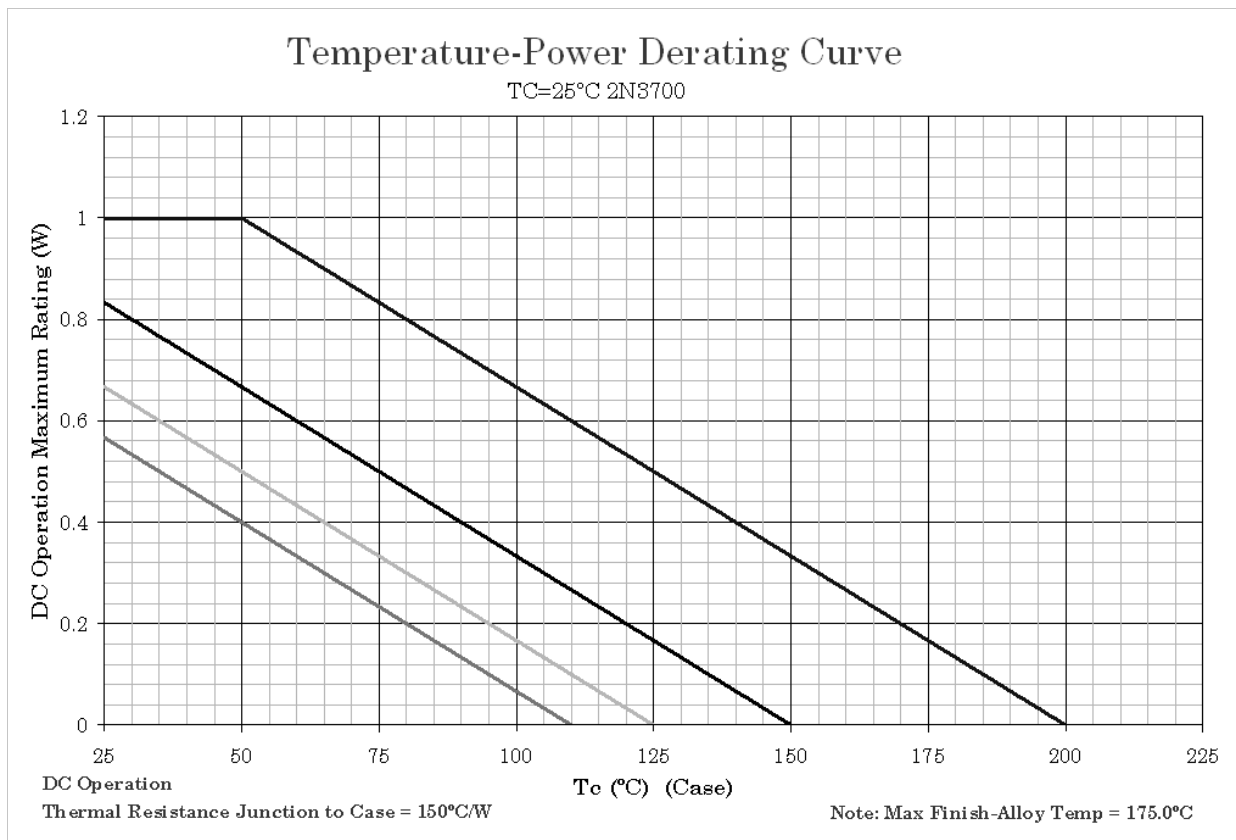
1. This is the true inverse of the worst case thermal resistance value. All devices are capable of operating at $\leq T_J$ specified on this curve. Any parallel line to this curve will intersect the appropriate power for the desired maximum T_J allowed.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq +150^\circ\text{C}$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq +125^\circ\text{C}$, and $+110^\circ\text{C}$ to show power rating where most users want to limit T_J in their application.

FIGURE 9. Derating for 2N3057A, 2N3700, and 2N3700UB ($R_{\theta JA}$) leads .125 inch (3.175 mm).

**NOTES:**

1. This is the true inverse of the worst case thermal resistance value. All devices are capable of operating at $\leq T_J$ specified on this curve. Any parallel line to this curve will intersect the appropriate power for the desired maximum T_J allowed.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq +150^\circ\text{C}$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq +125^\circ\text{C}$, and $+110^\circ\text{C}$ to show power rating where most users want to limit T_J in their application.

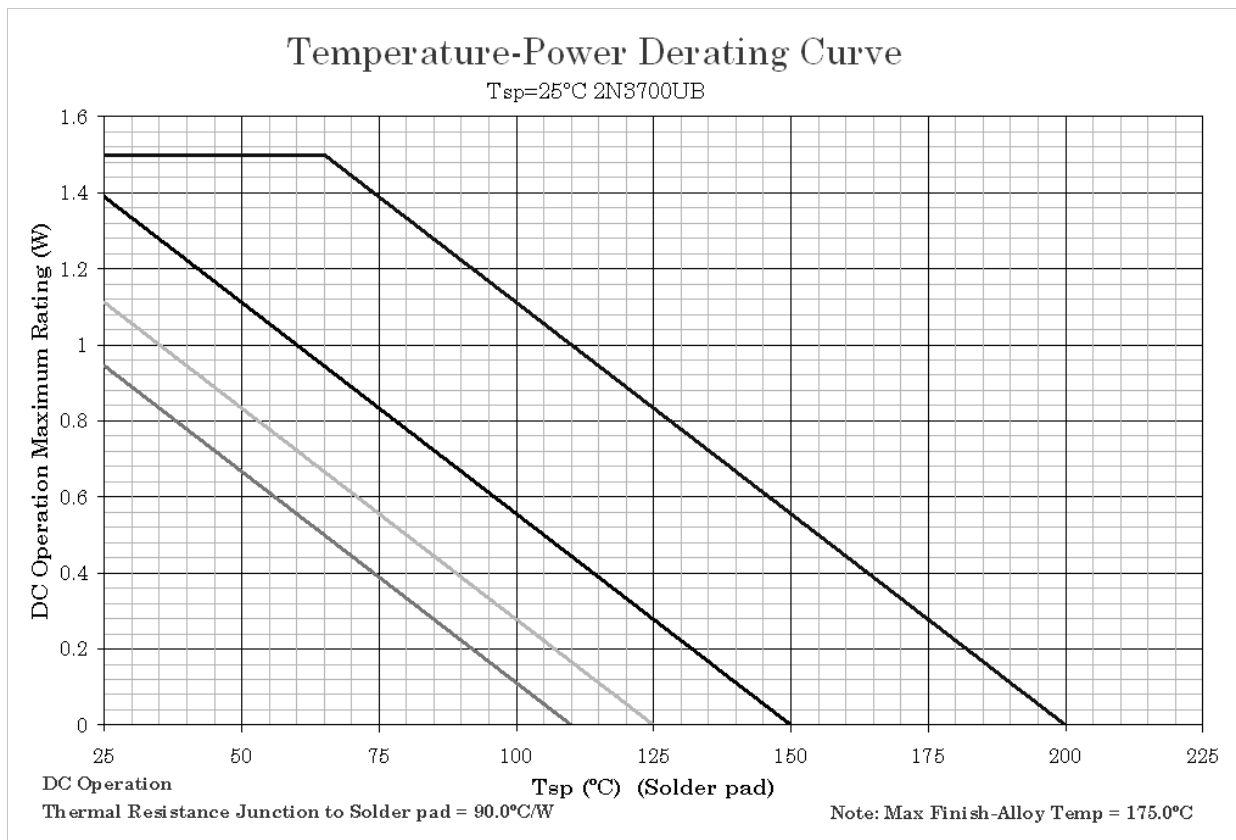
FIGURE 10. Derating for 2N3057A ($R_{\theta JC}$) (TO-46), base case mounted.



NOTES:

1. This is the true inverse of the worst case thermal resistance value. All devices are capable of operating at $\leq T_J$ specified on this curve. Any parallel line to this curve will intersect the appropriate power for the desired maximum T_J allowed.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq +150^\circ\text{C}$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq +125^\circ\text{C}$, and $+110^\circ\text{C}$ 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. This is the true inverse of the worst case thermal resistance value. All devices are capable of operating at $\leq T_J$ specified on this curve. Any parallel line to this curve will intersect the appropriate power for the desired maximum T_J allowed.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq +150^\circ\text{C}$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq +125^\circ\text{C}$, and $+110^\circ\text{C}$ to show power rating where most users want to limit T_J in their application.

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

Maximum Thermal Impedance

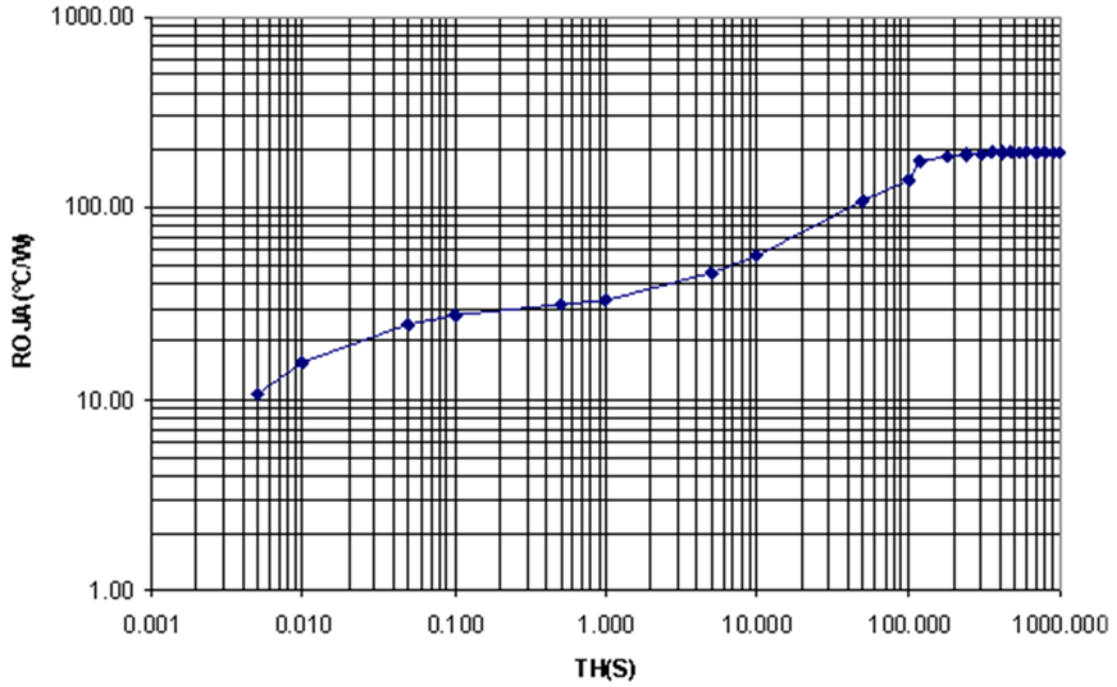


FIGURE 13. Thermal impedance graph ($R_{\theta JA}$) for 2N3019 (TO-5 and TO-39).

Maximum Thermal Impedance

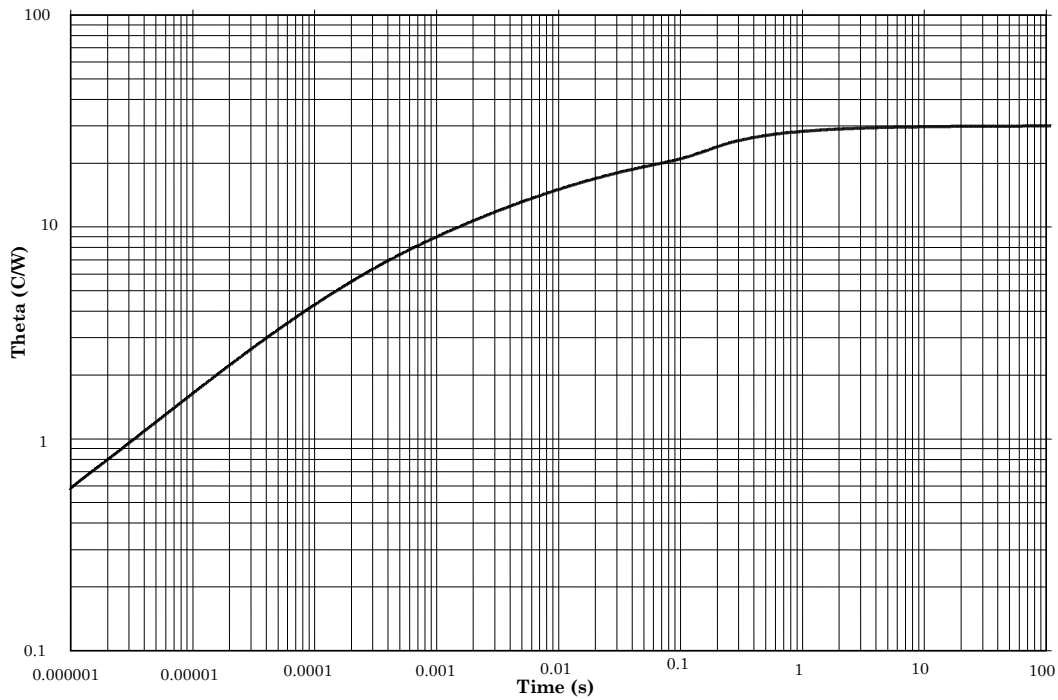


FIGURE 14. Thermal impedance graph ($R_{\theta JC}$) for 2N3019 (TO-5 and TO-39).

Maximum Thermal Impedance

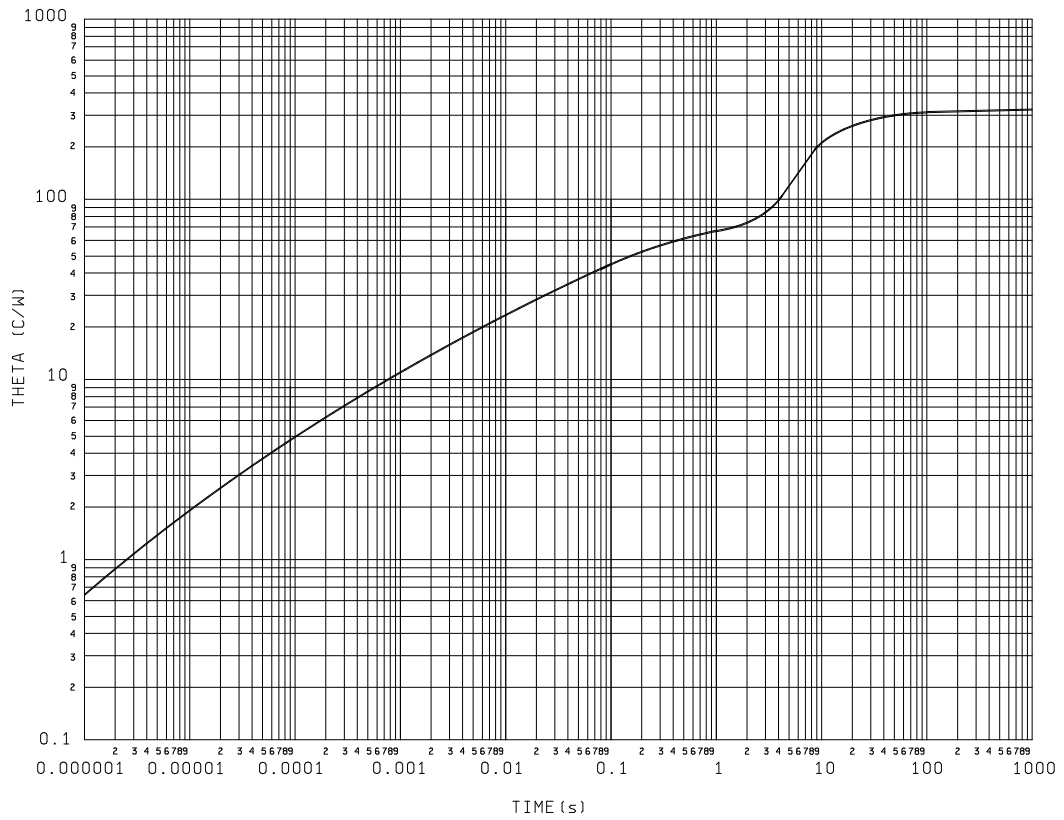


FIGURE 15. Thermal impedance graph ($R_{\theta JA}$) 2N3057A (TO-46).

Maximum Thermal Impedance

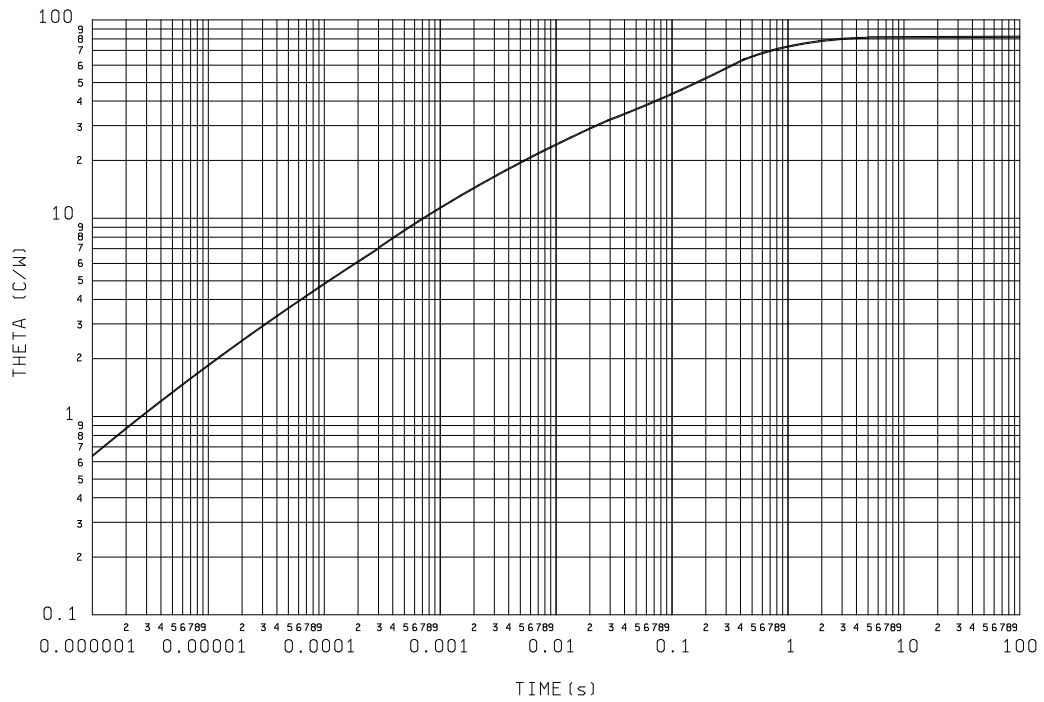


FIGURE 16. Thermal impedance graph ($R_{\theta jc}$) for 2N3057A (TO-46).

Maximum Thermal Impedance

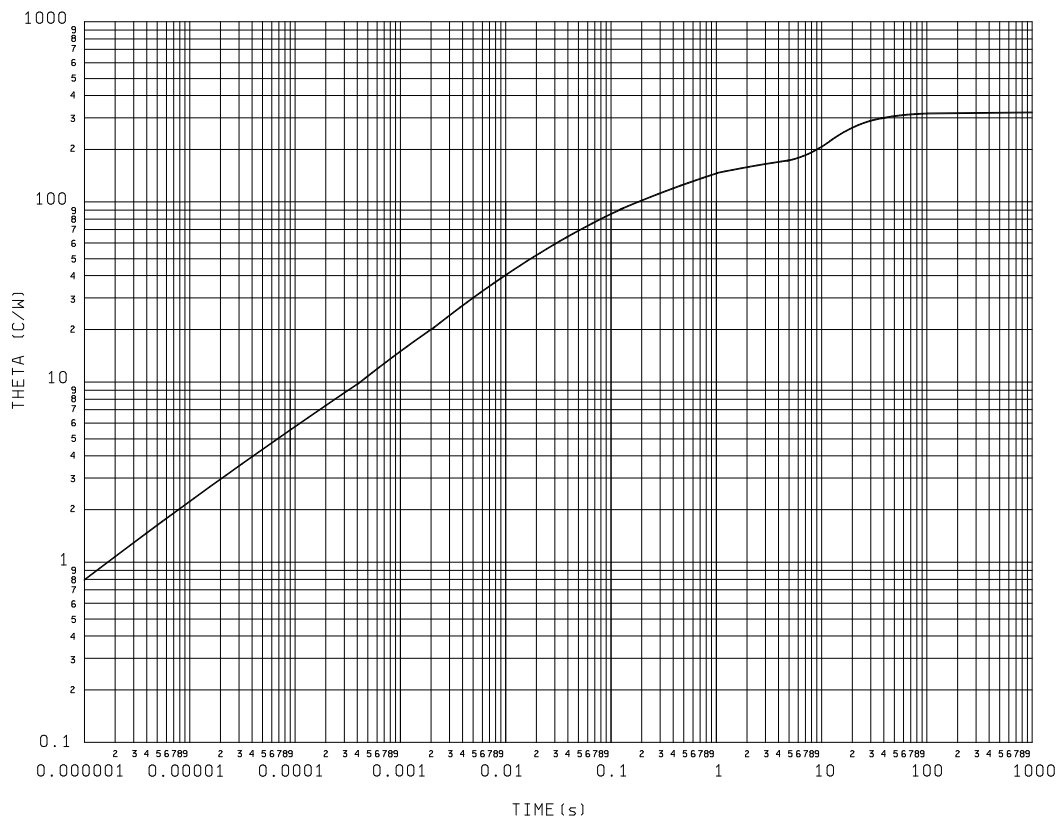


FIGURE 17. Thermal impedance graph ($R_{\theta JA}$) for 2N3700 (TO-18).

Maximum Thermal Impedance

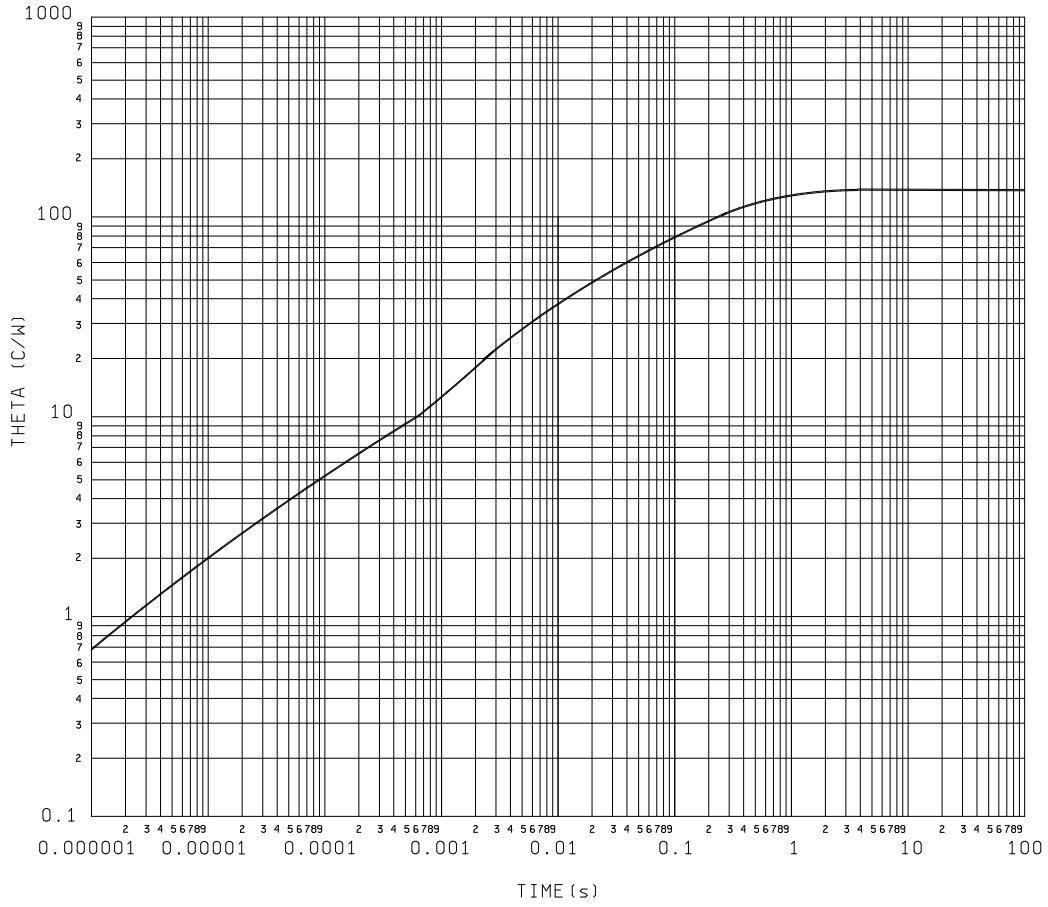


FIGURE 18. Thermal impedance graph ($R_{\theta JC}$) for 2N3700 (TO-18).

Maximum Thermal Impedance

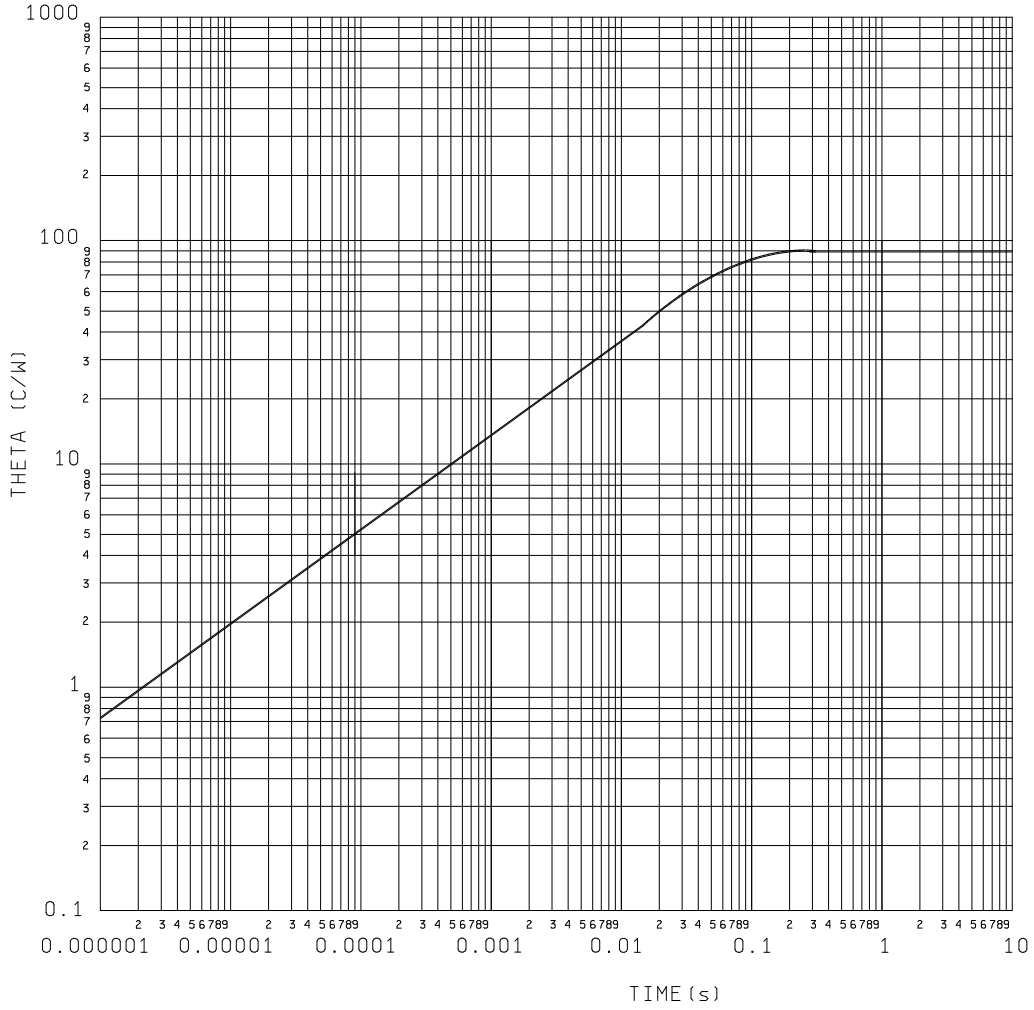
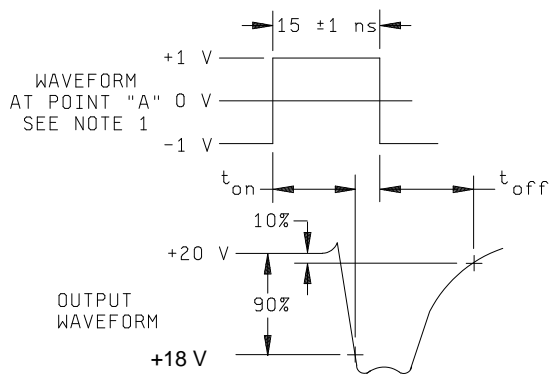
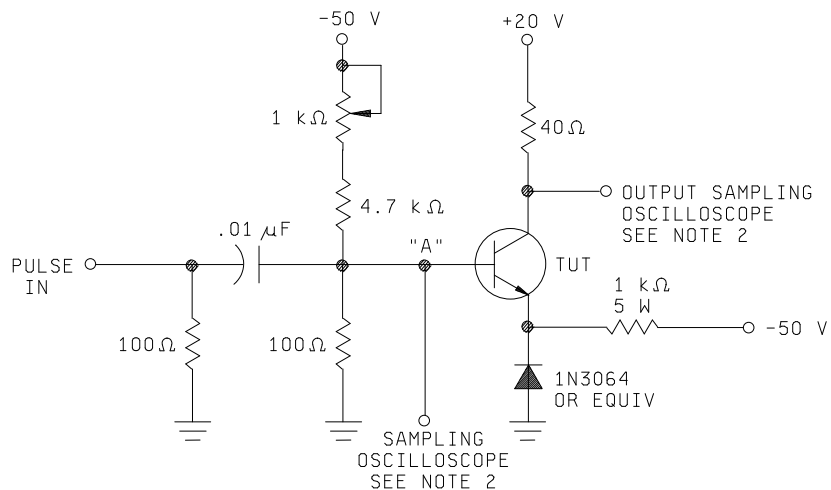


FIGURE 19. Thermal impedance graph ($R_{\theta JSP(S)}$) for 2N3700 (UB).

MIL-PRF-19500/391M



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: $Z_{IN} \geq 100$ k Ω , $C_{IN} \leq 12$ pF, rise time ≤ 2.0 ns.

FIGURE 20. Non-saturated switching-time test circuit.

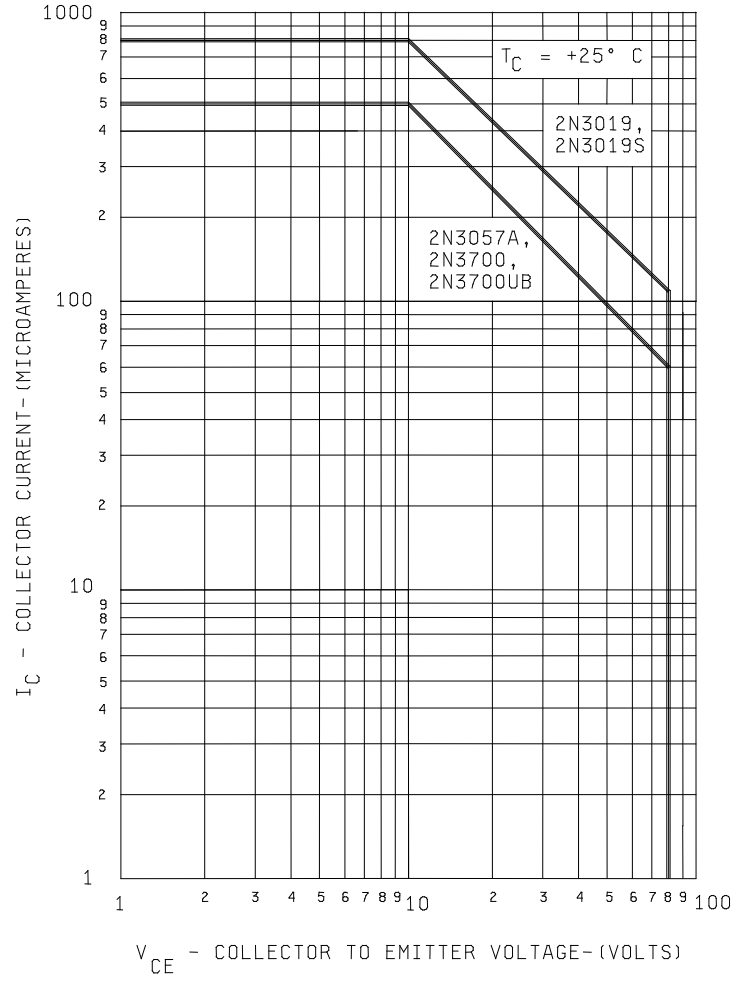


FIGURE 21. Maximum safe operating graph (10 ms).

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When 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 JANHCA2N3700) will be identified on the QML.

| Die ordering information | | |
|--------------------------|------------------------------|------------------------------|
| PIN | Manufacturer | |
| | 34156 | 43611 |
| 2N3700 | JANHCA2N3700 JANKCA2N3700 | JANHCB2N3700 JANKCB2N3700 |
| 2N3019 | JANHCA2N3019 JANKCA2N3019 | |

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

Preparing activity:

DLA - CC

(Project 5961-2010-031)

Review activities:

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

* 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> .