

The documentation and process conversion measures necessary to comply with this document shall be completed by 7 July 2011.

## INCH-POUND

MIL-PRF-19500/253L  
7 April 2011  
SUPERSEDING  
MIL-PRF-19500/253K  
3 July 2008

## PERFORMANCE SPECIFICATION SHEET

\* SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, LOW-POWER, TYPES 2N930 AND 2N930UB, JAN, JANTX, JANTXV, JANS, JANHC, JANKC, JANSM, JANSD, JANSF, JANSL, JANSR, JANSF, JANSG, JANSH, JANHC, JANHCM, JANHCD, JANHCP, JANHCL, JANHCR, JANHCF, JANHCG, JANHCH, JANKC, JANKCM, JANKCD, JANKCP, JANKCL, JANKCR, JANKCF, JANKCG, AND JANKCH

MIL-PRF-19500/253 is inactive for new design after 3 June 2004.  
For new design use MIL-PRF-19500/376.

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

1.2 **Physical dimensions.** See [figure 1](#) (TO-18), [figure 2](#) (UB, surface mount), and figures 3, 4, and 5 (die).

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

$V_{CBO}$	$V_{CEO}$	$V_{EBO}$	$I_C$	$T_J$ and $T_{STG}$
<u><math>V_{dc}</math></u>	<u><math>V_{dc}</math></u>	<u><math>V_{dc}</math></u>	<u><math>mA_{dc}</math></u>	<u>°C</u>
60	45	6	30	-65 to +200

Types	$P_T$ (1) $T_A = +25^\circ C$	$P_T$ (1) $T_C = +25^\circ C$	$P_T$ (1) $T_{SP} = +25^\circ C$	$R_{\theta JA}$ (2)	$R_{\theta JC}$ (2)	$R_{\theta JSP(IS)}$ (2)
	<u>mW</u>	<u>mW</u>	<u>mW</u>	<u>°C/W</u>	<u>°C/W</u>	<u>°C/W</u>
2N930	360	360	N/A	485	150	N/A
2N930UB	N/A	N/A	360	325 (3)	N/A	95

(1) For derating, see figures 6, 7, 8, and 9.

(2) For thermal impedance curves see figures 10, 11, and 12.

\* (3) Mounted on FR-4 base material PCB (1 ounce copper) with contacts 20 mils larger than package pads.

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

1.4 Primary electrical characteristics.

Limits	$h_{FE1}$ (1)	$h_{FE2}$ (1)	$C_{obo}$	$ h_{fe} $	$V_{BE(SAT)}$ (1)	$V_{CE(SAT)}$ (1)
	$V_{CE} = 5 \text{ V dc}$ $I_C = 10 \mu\text{A dc}$	$V_{CE} = 5 \text{ V dc}$ $I_C = 500 \mu\text{A dc}$	$V_{CB} = 5 \text{ V dc}$ $I_E = 0$ $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	$V_{CE} = 5 \text{ V dc}$ $I_C = 500 \mu\text{A dc}$ $f = 30 \text{ MHz}$	$I_C = 10 \text{ mA dc}$ $I_B = 0.5 \text{ mA dc}$	$I_C = 10 \text{ mA dc}$ $I_B = 0.5 \text{ mA dc}$
Min Max	100 300	150	$pE$ 8.0	1.5 6.0	0.6 1.0	0.6 1.0

(1) Pulsed (see 4.5.1).

## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, and 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, and 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.

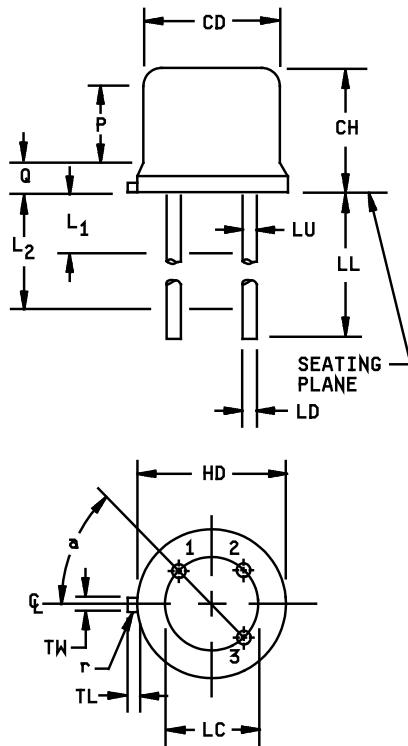
## DEPARTMENT OF DEFENSE STANDARDS

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.

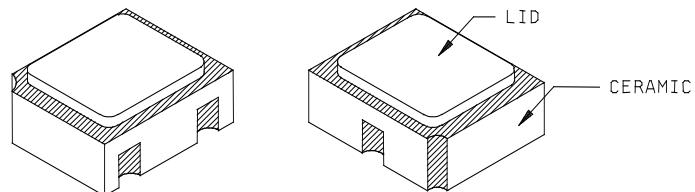
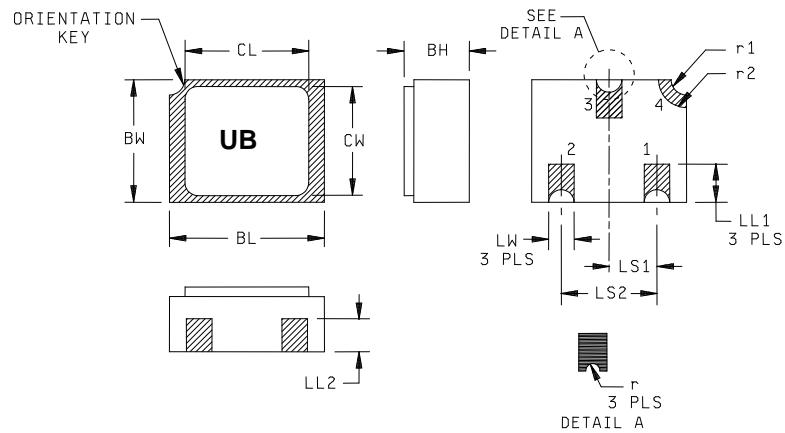
Symbol	Dimensions				Note	
	Inches		Millimeters			
	Min	Max	Min	Max		
CD	.178	.195	4.52	4.95		
CH	.170	.210	4.32	5.33		
HD	.209	.230	5.31	5.84		
LC	.100 TP		2.54 TP		6	
LD	.016	.021	0.41	0.53	7,8	
LL	.500	.750	12.70	19.05	7,8	
LU	.016	.019	0.41	0.48	7,8	
L <sub>1</sub>		.050		1.27	7,8	
L <sub>2</sub>	.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	
$\alpha$		45° TP		45° TP	6	



## NOTES:

1. Dimension are in inches.
2. Millimeters are given for general information only.
3. Beyond r (radius) maximum, TL 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.
7. Dimension LU applies between L<sub>1</sub> and L<sub>2</sub>. Dimension LD applies between L<sub>2</sub> and LL minimum. Diameter is uncontrolled in L<sub>1</sub> 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 AMSE Y14.5M, diameters are equivalent to  $\phi x$  symbology.
12. Lead 1 = emitter, lead 2 = base, lead 3 = collector.

FIGURE 1. Physical dimensions (similar to TO-18).

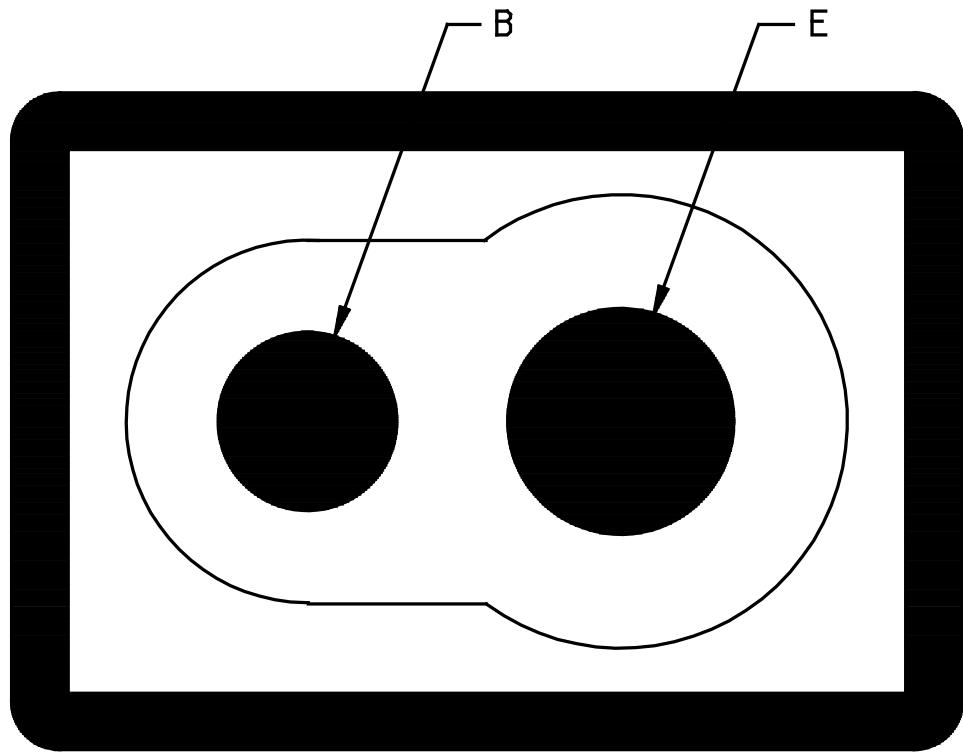


Symbol	Dimensions				Note	
	Inches		Millimeters			
	Min	Max	Min	Max		
BH	.046	.056	1.17	1.42		
BL	.115	.128	2.92	3.25		
BW	.085	.108	2.16	2.74		
CL		.128		3.25		
CW		.108		2.74		
LL1	.022	.038	0.56	0.9		
LL2	.017	.035	0.43	0.89		
LS1	.036	.040	0.91	1.02		
LS2	.071	.079	1.81	2.01		
LW	.016	.024	0.41	0.61		
r		.008		.203		
r1		.012		.305		
r2		.022		.559		

## NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Hatched areas on package denote metallized areas.
4. 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  $\phi x$  symbology.

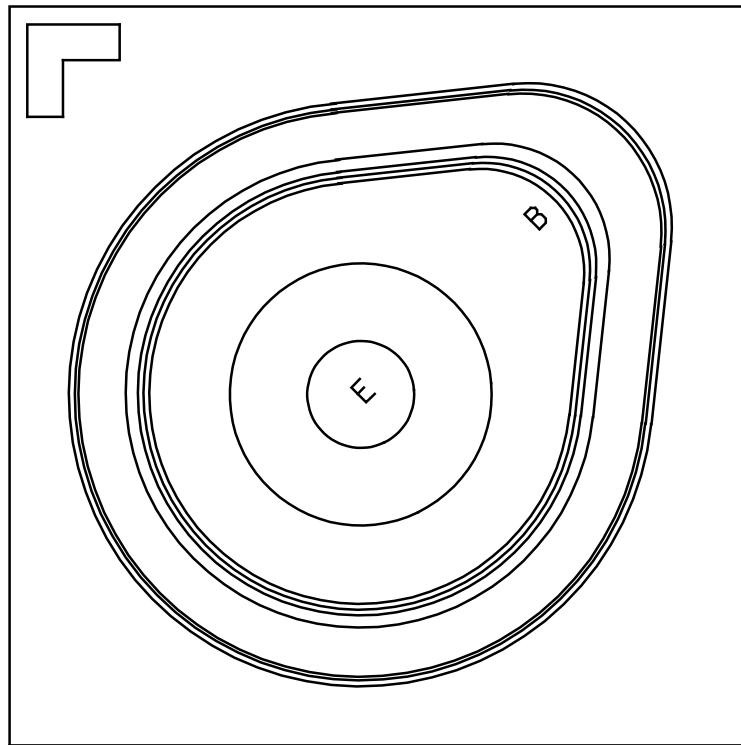
FIGURE 2. Physical dimensions, surface mount (2N930UB).



NOTES:

1. Chip size .015 x .019 inch  $\pm .001$  inch. (0.381 X 0.483  $\pm .0254$  mm)
2. Chip thickness .010  $\pm .0015$  inch. (0.254  $\pm .038$  mm).  
Aluminum 15,000 $\text{\AA}$  minimum, 18,000 $\text{\AA}$  nominal.
3. Top metal A. Gold 3,500  $\text{\AA}$  minimum, 5,000  $\text{\AA}$  nominal.
4. Back metal Collector.
5. Backside B = .003 inch (0.076 mm), E = .004 inch (0.101 mm) diameter.
6. Bonding pad Si<sub>3</sub>N<sub>4</sub> (Silicon Nitride) 5,600  $\text{\AA}$  min, 8,000  $\text{\AA}$  nom.
7. Passivation

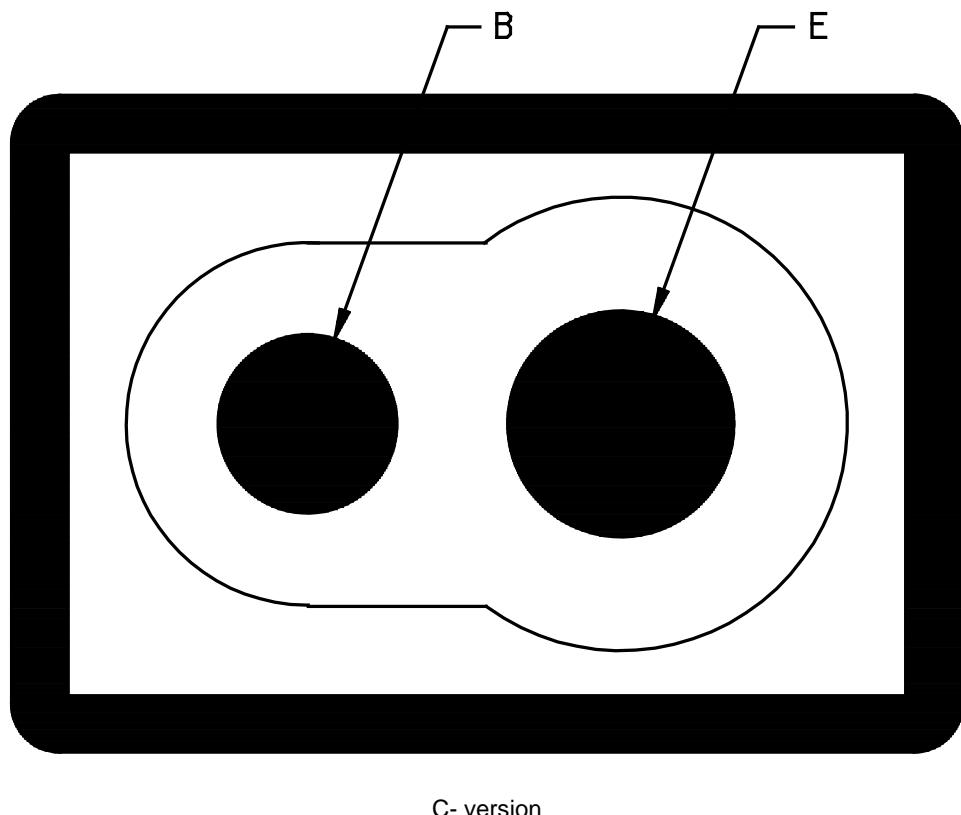
FIGURE 3. Physical dimensions, JANHCA die.



B-version

Die size:	.018 x .018 inch (0.4572 x 0.4572 mm).
Die thickness:	.008 $\pm$ 0.0016 inch (0.2032 $\pm$ 0.04064 mm).
Base pad:	.0025 inch (0.0635 mm) diameter.
Emitter pad:	.003 inch (0.0762 mm) diameter.
Back metal:	Gold, 6,500 $\pm$ 1,950 Å.
Top metal:	Aluminum, 19,500 $\pm$ 2,500 Å.
Back side:	Collector.
Glassivation:	SiO <sub>2</sub> , 7,500 $\pm$ 1,500 Å.

FIGURE 4. Physical dimensions, JANHCB and JANKCB die.



C- version

NOTES:

1. Chip size	.015 x .019 inch $\pm$ .001 inch. (0.381 X 0.483 $\pm$ 0.0254 mm)
2. Chip thickness	.010 $\pm$ .0015 inch. (0.254 $\pm$ 0.038 mm).
3. Top metal	Aluminum 10,000 $\text{\AA}$ minimum, 12,000 $\text{\AA}$ nominal.
4. Back metal	A. Gold 3,500 $\text{\AA}$ minimum, 5,000 $\text{\AA}$ nominal.
5. Backside	Collector.
6. Bonding pad	B = .003 inch (0.076 mm), E = .004 inch (0.101 mm) diameter.
7. Passivation	SiO <sub>2</sub> (Silicon Oxide) 6,300 $\text{\AA}$ min, 9,000 $\text{\AA}$ nom.

FIGURE 5. Physical dimensions, JANKCC die.

### 3. REQUIREMENTS

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

3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturers list before contract award (see [4.2](#) and [6.3](#)).

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

$R_{\theta JA}$	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).
UB	Surface mount case outlines (see <a href="#">figure 2</a> ).

3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in MIL-PRF-19500, and on [figure 1](#) (TO-18), [figure 2](#) (UB, surface mount), and figures 3, 4, and 5 (die).

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. Electrical test requirements shall be as specified in [table I](#).

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

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, III, and IV).

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

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

\* 4.2.2 Group E qualification. Group E inspection shall be performed for qualification or re-qualification only. In case qualification was awarded to a prior revision of the specification sheet that did not request the performance of **table III** tests, the tests specified in **table III** herein that were not performed in the prior revision shall be performed on the first inspection lot of this revision to maintain qualification.

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

Screen (see table E-IV of MIL-PRF-19500)	Measurement	Measurement
	JANS levels	JANTX and JANTXV levels
3c	Thermal impedance, method 3131 of MIL-STD-750, see <a href="#">4.3.3</a> .	Thermal impedance, method 3131 of MIL-STD-750, see <a href="#">4.3.3</a> .
7	Optional.	Optional.
9	$I_{CBO2}$ , $h_{FE2}$ .	Not applicable.
10	48 hours minimum.	48 hours minimum.
11	$I_{CBO2}$ , $h_{FE2}$ $\Delta I_{CBO2} = 100$ percent of initial value or 5 nA dc, whichever is greater; $\Delta h_{FE2} = \pm 25$ percent.	$I_{CBO2}$ , $h_{FE2}$
12	See <a href="#">4.3.1</a> .	See <a href="#">4.3.1</a> .
13	Subgroups 2 and 3 of <b>table I</b> herein; $\Delta I_{CBO2} = 100$ percent of initial value or 5 nA dc, whichever is greater; $\Delta h_{FE2} = \pm 25$ percent.	Subgroup 2 of <b>table I</b> herein; $\Delta I_{CBO2} = 100$ percent of initial value or 5 nA dc, whichever is greater; $\Delta h_{FE2} = \pm 25$ percent.
14	Required	Required

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  $T_J = +135^\circ\text{C}$  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. 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. This option is limited to plants who are at least transitional (QML) approved or have an approved technical review board (TRB).

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

4.3.3 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). The thermal impedance limit used in [4.3](#), screen 3c and the subgroup 2 of **table I** shall comply with the thermal impedance graph in figures 9, 10, and 11 (less than or equal to the curve value at the same  $t_H$  time) and 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 inspections 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.

\* 4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the tests and conditions specified for subgroup testing in table E-VIa (JANS) of MIL-PRF-19500 and 4.4.2.1. Electrical measurements (end-points) and delta requirements shall be in accordance with group A, subgroup 2 and [table IV](#) herein: delta requirements only apply to subgroups B4, and B5. See 4.4.2.2 for JAN, JANTX, and JANTXV group B testing. Electrical measurements (end-points) and delta requirements for JAN, JANTX, and JANTXV shall be after each step in 4.4.2.2 and shall be in accordance with group A, subgroup 2 and [table IV](#) herein.

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

Subgroup   Method   Condition

B4      1037       $V_{CB} = 10 \text{ V dc.}$

B5      1027       $V_{CB} = 10 \text{ V dc; } P_D \geq 100 \text{ percent of maximum rated } P_T$  (see 1.3). (NOTE: If a failure occurs, resubmission shall be at the test conditions of the original sample.)

Option 1: 96 hours minimum sample size in accordance with MIL-PRF-19500, table E-VIa, adjust  $T_A$  or  $P_D$  to achieve  $T_J = +275^\circ\text{C}$  minimum.

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

4.4.2.2 Group B inspection, (JAN, JANTX, and JANTXV). Separate samples may be used for each step. In the event of a lot failure, the resubmission requirements of MIL-PRF-19500 shall apply. In addition, all catastrophic failures during CI, conformance inspection, shall be analyzed to the extent possible to identify root cause and corrective action.

Step   Method   Condition

1      1026      Steady-state life: 1,000 hours minimum,  $V_{CB} = 10 \text{ V dc}$ , power shall be applied to achieve  $T_J = +150^\circ\text{C}$  minimum using a minimum of  $P_D = 75 \text{ percent of maximum rated } P_T$  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:  $T_A = +150^\circ\text{C}$ ,  $V_{CB} = 80 \text{ percent rated voltage}$ . 48 hours minimum.  $n = 45$  devices,  $c = 0$ .

3      1032      High-temperature life (non-operating),  $t = 340 \text{ hours}$ ,  $T_A = +200^\circ\text{C}$ .  $n = 22$ ,  $c = 0$ .

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](#), subgroup 2, conformance inspection. When the final lead finish is solder or any plating prone to oxidation at high temperature, the samples for life test (subgroups B4 and B5 for JANS, and group B for JAN, JANJ, JANTX, and JANTXV) may be pulled prior to the application of final lead finish.

\* 4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the tests and conditions specified for subgroup testing in table E-VII of MIL-PRF-19500, and in [4.4.3.1](#) (JANS) and [4.4.3.2](#) (JAN, JANTX, and JANTXV) herein for group C testing. Electrical measurements (end-points) and delta requirements shall be in accordance with group A, subgroup 2 and [table IV](#) herein; delta requirements only apply to subgroup C6.

4.4.3.1 Group C inspection (JANS), 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	$R_{0JA}$ and $R_{0JC}$ only, as applicable (see 1.3) and applied thermal impedance curves.
C6	1026	1,000 hours at $V_{CB} = 10$ V dc; power shall be applied to achieve $T_J = +150^\circ\text{C}$ minimum and a minimum of $P_D = 75$ percent of maximum rated $P_T$ as defined in <a href="#">1.3</a> $n = 45$ , $c = 0$ . The ample 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	$R_{0JA}$ and $R_{0JC}$ only, as applicable (see <a href="#">1.3</a> ).
C6		Not applicable.

4.4.3.3 Group C sample selection. Samples for subgroups in group C shall be chosen at random from any inspection lot containing the intended package type and lead finish procured to the same specification which is submitted to and passes [table I](#) tests herein for conformance inspection. When the final lead finish is solder or any plating prone to oxidation at high temperature, the samples for C6 life test may be pulled prior to the application of final lead finish. Testing of a subgroup using a single device type enclosed in the intended package type shall be considered as complying with the requirements for that subgroup.

\* 4.4.4 Group D inspection. Conformance inspection for hardness assured JANS and JANTXV types shall include the group D tests specified in [table II](#) herein. These tests shall be performed as required in accordance with MIL-PRF-19500 and method 1019 of MIL-STD-750, for total ionizing dose or method 1017 of MIL-STD-750 for neutron fluence as applicable (see [6.2.e](#) 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.

\* 4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-IX of MIL-PRF-19500 and as specified in [table III](#) herein. Electrical measurements (end-points) shall be in accordance with [table I](#), subgroup 2 herein.

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

TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1 2/</u>						
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				
Temperature cycling 3/ 4/	1051	Test condition C, 25 cycles. n = 22 devices, c = 0				
Hermetic seal 4/ 6/ Fine leak Gross leak	1071	n = 22 devices, c = 0				
Electrical measurements		<a href="#">Table I</a> , subgroup 2				
Bond strength 3/ 4/	2037	Precondition $T_A = +250^\circ\text{C}$ at $t = 24$ hrs or $T_A = 300^\circ\text{C}$ at $t = 2$ hrs n = 11 wires, c = 0				
Decap internal visual (design verification) 4/	2075	n = 4 device, c = 0				
<u>Subgroup 2</u>						
Thermal impedance	3131	See <a href="#">4.3.3</a>	$Z_{0\text{JX}}$			°C/W
Collector to base cutoff current	3036	Bias condition D, $V_{CB} = 60$ V dc	$I_{CBO1}$	10		μA dc
Emitter to base cutoff current	3061	Bias condition D, $V_{EB} = 6$ V dc	$I_{EBO1}$	10		μA dc
Breakdown voltage, collector to emitter	3011	Bias condition D; $I_C = 10$ mA dc; pulsed (see <a href="#">4.5.1</a> )	$V_{(\text{BR})\text{CEO}}$	45		V dc
Collector to emitter cutoff current	3041	Bias condition C; $V_{CE} = 45$ V dc	$I_{CES1}$	2.0		nA dc
Collector to emitter cutoff current	3041	Bias condition C; $V_{CE} = 5$ V dc	$I_{CEO}$	2.0		nA dc
Emitter to base cutoff current	3061	Bias condition D; $V_{EB} = 5$ V dc	$I_{EBO2}$	5		nA dc

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2 - continued.</u>						
Collector to base cutoff current	3036	Bias condition D; $V_{CB} = 45$ V dc	$I_{CBO2}$		10	nA dc
Forward-current transfer ratio	3076	$V_{CE} = 5$ V dc; $I_C = 10$ $\mu$ A dc; Pulsed (see 4.5.1)	$h_{FE1}$	100	300	
Forward-current transfer ratio	3076	$V_{CE} = 5$ V dc; $I_C = 500$ $\mu$ A dc; Pulsed (see 4.5.1)	$h_{FE2}$	150		
Forward-current transfer ratio	3076	$V_{CE} = 5$ V dc; $I_C = 10$ mA dc	$h_{FE3}$		600	
Collector-emitter saturation voltage	3071	$I_C = 10$ mA dc; $I_B = 0.5$ mA dc; pulsed (see 4.5.1)	$V_{CE(sat)}$		1.0	V dc
Base-emitter saturation voltage	3066	Test condition A; $I_C = 10$ mA dc; $I_B = 0.5$ mA dc; pulsed (see 4.5.1)	$V_{BE(sat)}$	0.6	1.0	V dc
<u>Subgroup 3</u>						
High temperature operation		$T_A = +150^\circ\text{C}$				
Collector to base cutoff current	3036	Bias condition C; $V_{CE} = 45$ V dc; pulsed (see 4.5.1)	$I_{CES2}$		10	$\mu$ A dc
Low temperature operation		$T_A = -55^\circ\text{C}$				
Forward-current transfer ratio	3076	$V_{CE} = 5$ V dc; $I_C = 10$ $\mu$ A dc	$h_{FE4}$	20		
<u>Subgroup 4</u>						
Small-signal short-circuit forward current transfer ratio	3206	$V_{CE} = 5$ V dc; $I_C = 1$ mA dc; $f = 1$ kHz	$h_{fe}$	150	600	
Magnitude of small-signal short- circuit forward current transfer ratio	3306	$V_{CE} = 5$ V dc; $I_C = 500$ $\mu$ A dc; $f = 30$ MHz	$ h_{fe} $	1.5	6.0	
Open circuit output capacitance	3236	$V_{CB} = 5$ V dc; $I_E = 0$ ; $100$ kHz $\leq f \leq 1$ MHz	$C_{obo}$		8	pF

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 4</u> - continued.						
Noise figure	3246	$V_{CE} = 5 \text{ V dc}$ ; $I_C = 10 \mu\text{A dc}$ ; $R_g = 10 \text{ k}\Omega$ $f = 100\text{Hz}$ $f = 1 \text{ kHz}$ $f = 10 \text{ kHz}$	NF		5 3 3	dB dB dB
Test 1						
Test 2						
Test 3						
Small-signal open-circuit output admittance	3216	$V_{CB} = 5 \text{ V dc}$ ; $I_E = 1.0 \text{ mA dc}$ ; $f = 1 \text{ kHz}$	$h_{ob}$	0	1.0	mhos
Small-signal open-circuit reverse voltage transfer ratio	3211	$V_{CB} = 5 \text{ V dc}$ ; $I_E = 1.0 \text{ mA dc}$ ; $f = 1 \text{ kHz}$	$h_{rb}$		$6 \times 10^{-4}$	
Small-signal short-circuit input impedance	3201	$V_{CB} = 5 \text{ V dc}$ ; $I_E = 1.0 \text{ mA dc}$ ; $f = 1 \text{ kHz}$	$h_{ib}$	25	32	$\Omega$
<u>Subgroups 5 and 6</u>						
Not applicable						

- 1/ For sampling plan, unless otherwise specified, see MIL-PRF-19500.
- 2/ For resubmission of failed subgroup 1, of [table I](#), double the sample size of the failed test or sequence of tests. A failure in [table I](#), subgroup 1 shall not require retest of the entire subgroup. Only the failed test shall be rerun upon submission.
- 3/ Separate samples may be used.
- 4/ Not required for JANS devices.
- 5/ Not required for laser marked devices.
- 6/ This hermetic seal test is an end-point to temp-cycling in addition to electrical measurements.

\* TABLE II. Group D inspection and end-point limits.

Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Limits		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; $V_{CB} = 60$ V dc	$I_{CBO1}$		20	$\mu\text{A}$ dc
Emitter to base cutoff current	3061	Bias condition D; $V_{EB} = 6.0$ V dc	$I_{EBO1}$		20	$\mu\text{A}$ dc
Breakdown voltage, collector to emitter	3011	Bias condition D; $I_C = 10$ mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	45		V dc
Collector to emitter cutoff current	3041	Bias condition C; $V_{CE} = 45$ V	$I_{CES1}$		4.0	$\eta\text{A}$ dc
Collector to emitter cutoff current	3041	Bias condition D; $V_{CE} = 5$ V	$I_{CEO}$		4.0	$\eta\text{A}$ dc
Emitter to base cutoff current	3061	Bias condition D; $V_{EB} = 5.0$ V dc	$I_{EBO2}$		10	$\eta\text{A}$ dc
Collector to base cutoff current	3036	Bias condition D; $V_{CB} = 45$ V dc	$I_{CBO2}$		20	$\eta\text{A}$ dc
Forward-current transfer ratio	3076	$V_{CE} = 5$ V dc, $I_C = 10$ $\mu\text{A}$ dc; pulsed (see 4.5.1)	$[h_{FE1}] 5/$	[50]	300	
Forward-current transfer ratio	3076	$V_{CE} = 5$ V dc, $I_C = 500$ $\mu\text{A}$ dc; pulsed (see 4.5.1)	$[h_{FE2}] 5/$	[75]		
Forward-current transfer ratio	3076	$V_{CE} = 5$ V dc, $I_C = 10$ mA dc	$h_{FE3}$		600	
Collector-emitter saturation voltage	3071	$I_C = 10$ mA dc; $I_B = 0.5$ mA dc; pulsed (see 4.5.1)	$V_{CE(sat)}$		1.15	V dc
Base-emitter saturation voltage	3066	Test condition A; $I_C = 10$ mA dc; $I_B = 0.5$ mA dc; pulsed (see 4.5.1)	$V_{BE(sat)}$	0.6	1.15	V dc

See footnotes at end of table.

\* TABLE II. Group D inspection and end-point limits - Continued.

Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u>						
Steady-state total dose irradiation	1019	Gamma exposure $V_{CES} = 36$ V				
Collector to base cutoff current	3036	Bias condition D; $V_{CB} = 60$ V dc	$I_{CBO1}$		20	$\mu$ A dc
Emitter to base cutoff current	3061	Bias condition D; $V_{EB} = 6.0$ V dc	$I_{EBO1}$		20	$\mu$ A dc
Breakdown voltage, collector to emitter	3011	Bias condition D; $I_C = 10$ mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	45		V dc
Collector to emitter cutoff current	3041	Bias condition C; $V_{CE} = 45$ V	$I_{CES1}$		4.0	$\eta$ A dc
Collector to emitter cutoff current	3041	Bias condition D; $V_{CE} = 5$ V	$I_{CEO}$		4.0	$\eta$ A dc
Emitter to base cutoff current	3061	Bias condition D; $V_{EB} = 5.0$ V dc	$I_{EBO2}$		10	$\eta$ A dc
Collector to base cutoff current	3036	Bias condition D; $V_{CB} = 45$ V dc	$I_{CBO2}$		20	$\eta$ A dc
Forward-current transfer ratio	3076	$V_{CE} = 5$ V dc, $I_C = 10$ $\mu$ A dc; pulsed (see 4.5.1)	$[h_{FE1}]$ 5/	[50]	300	
Forward-current transfer ratio	3076	$V_{CE} = 5$ V dc, $I_C = 500$ $\mu$ A dc; pulsed (see 4.5.1)	$[h_{FE2}]$ 5/	[75]		
Forward-current transfer ratio	3076	$V_{CE} = 5$ V dc, $I_C = 10$ mA dc	$h_{FE3}$		600	
Collector-emitter saturation voltage	3071	$I_C = 10$ mA dc; $I_B = 0.5$ mA dc; pulsed (see 4.5.1)	$V_{CE(sat)}$		1.15	V dc
Base-emitter saturation voltage	3066	Test condition A; $I_C = 10$ mA dc; $I_B = 0.5$ mA dc; pulsed (see 4.5.1)	$V_{BE(sat)}$	0.6	1.15	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 AL, UA, UB, and UBC 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.

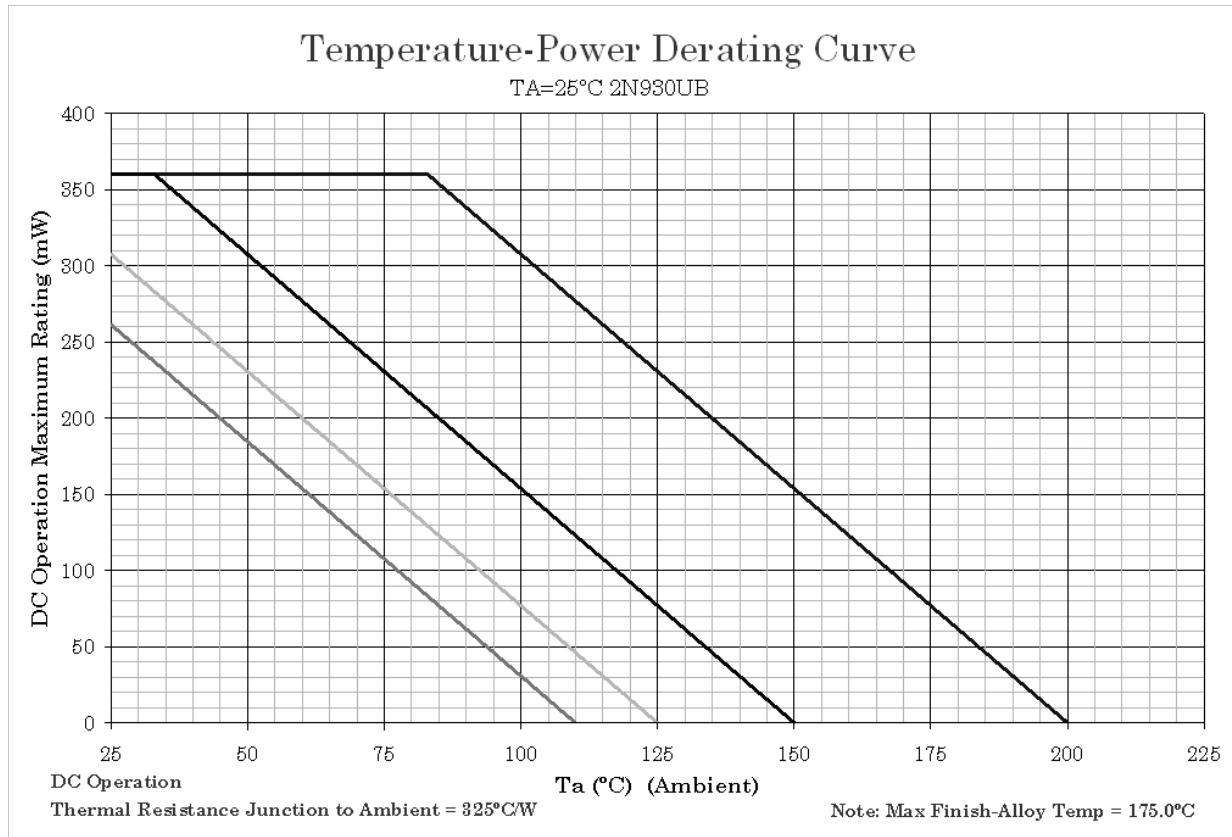
\* TABLE III. Group E inspection (all quality levels) - for qualification or re-qualification only.

Inspection	MIL-STD-750		Qualification
	Method	Conditions	
<u>Subgroup 1</u>			
Temperature cycling (air to air)	1051	Test condition C, 500 cycles.	45 devices c = 0
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See <a href="#">table I</a> , subgroup 2 and <a href="#">table IV</a> herein.	
<u>Subgroup 2</u>			
Intermittent life	1037	Intermittent operation life: $V_{CB} = 10$ V dc, 6,000 cycles.	45 devices c = 0
Electrical measurements		See <a href="#">table I</a> , subgroup 2 and <a href="#">table IV</a> herein.	
<u>Subgroup 4</u>			
Thermal impedance curves		See MIL-PRF-19500, table E-IX, group E, subgroup 4.	
<u>Subgroup 5</u>			
Not applicable			
<u>Subgroup 6</u>			
Electrostatic discharge (ESD)	1020		11 devices c = 0
<u>Subgroup 8</u>			
Reverse stability	1033	Condition B.	45 devices c = 0

\* TABLE IV. Groups B, C, and E delta measurements.

Step	Inspection	MIL-STD-750		Symbol	Limit	Unit
		Method	Conditions			
1	Collector-base cutoff current	3036	Bias condition D, $V_{CB} = 45$ V dc	$\Delta I_{CB02}$ 1/	100 percent of initial value or 5 nA dc, whichever is greater.	
2	Forward current transfer ratio	3076	$V_{CE} = 5$ V dc; $I_C = 500$ $\mu$ A dc; pulsed see 4.5.1.	$\Delta h_{FE2}$ 1/	$\pm 25$ percent change from initial reading.	

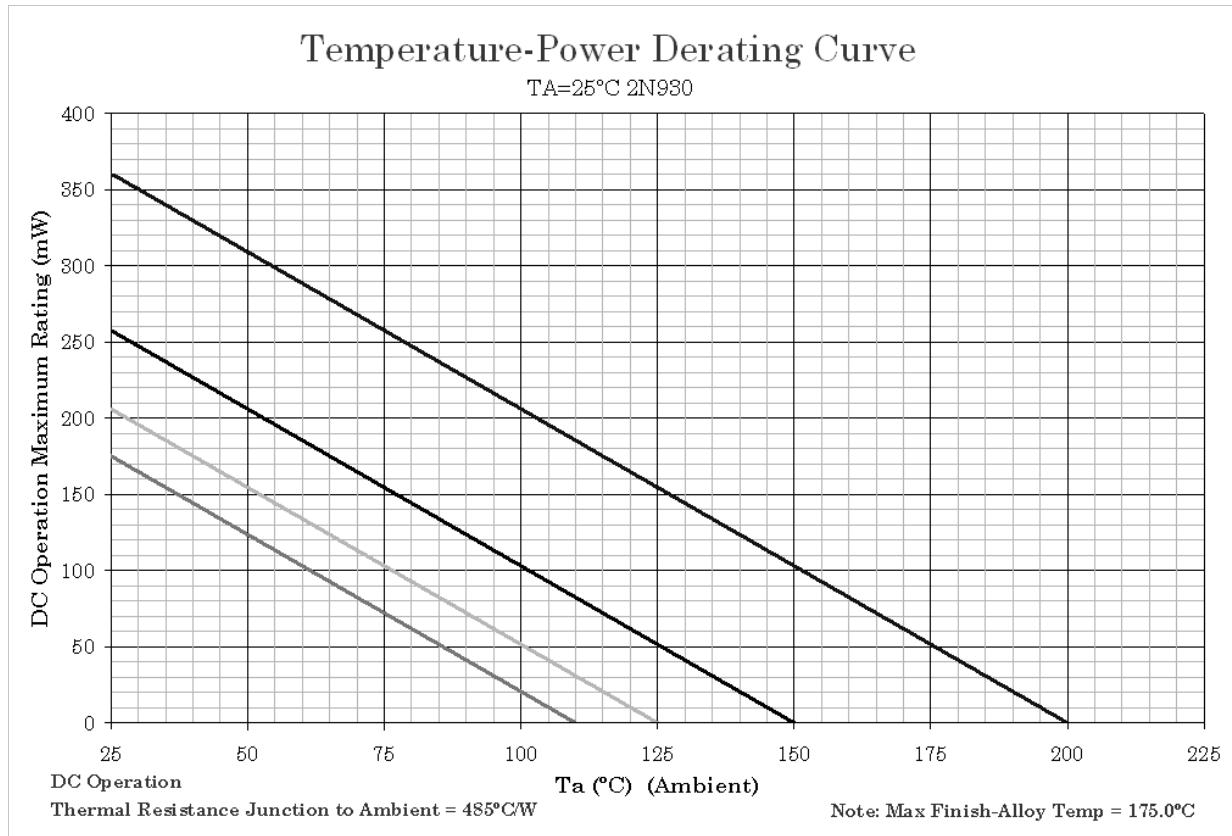
1/ Devices which exceed the [table I](#) limits for this test shall not be accepted.



## 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 temperature ( $T_J \leq 200^\circ\text{C}$ ) 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.

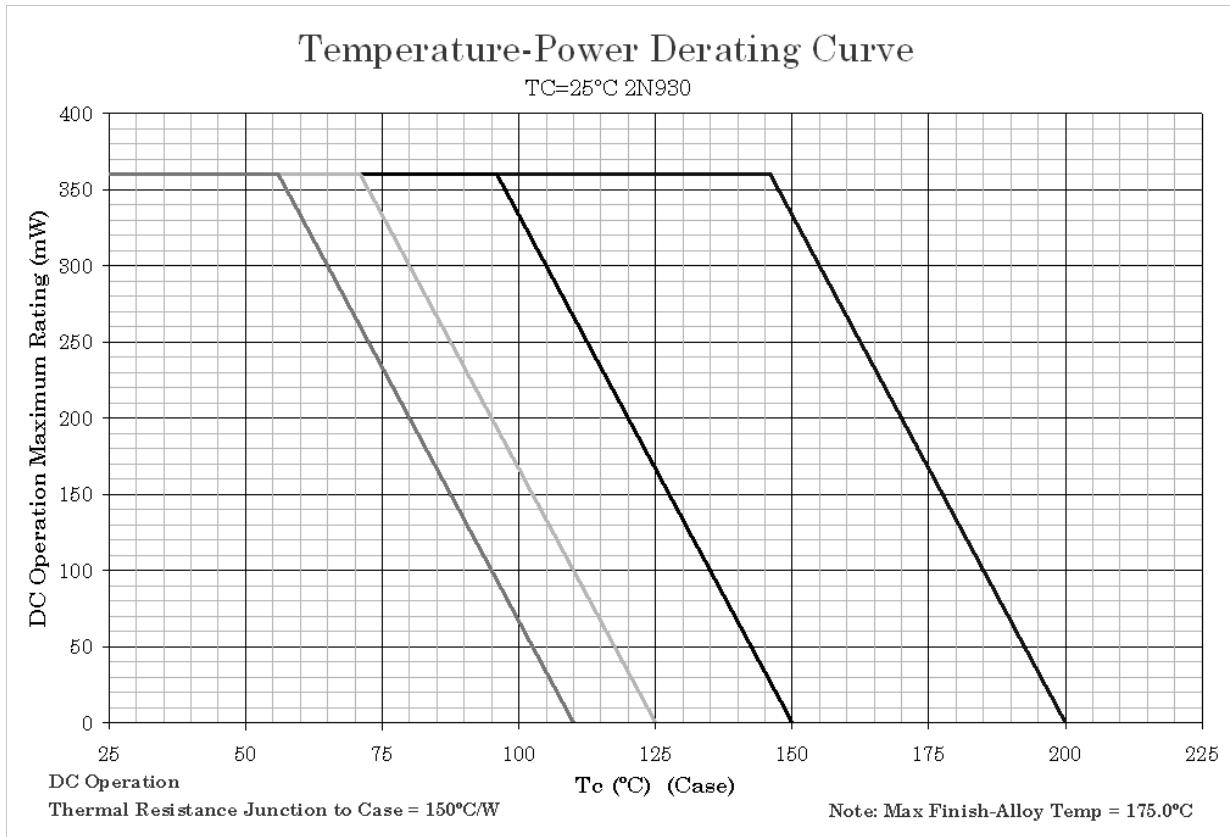
FIGURE 6. Temperature-power derating for 2N930 (UB package).



## 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 temperature ( $T_J \leq 200^\circ\text{C}$ ) 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.

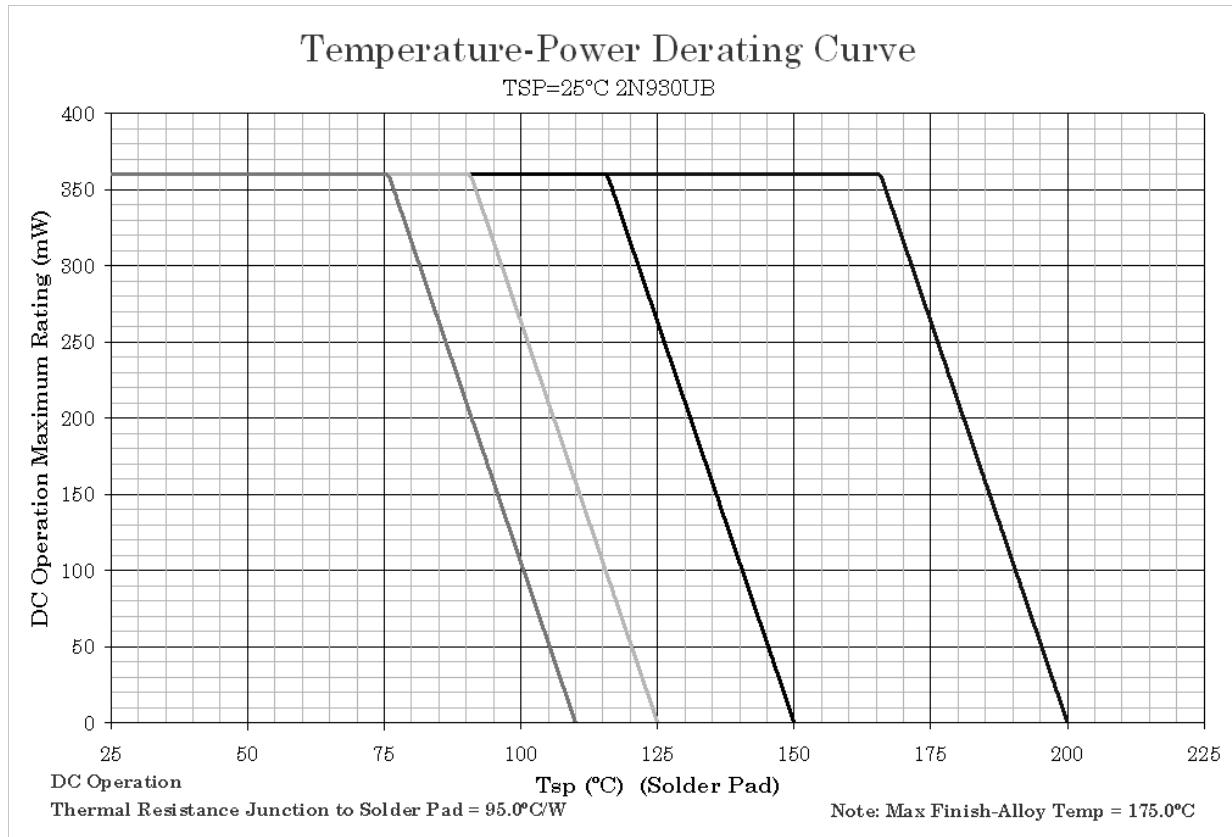
FIGURE 7. Temperature-power derating for 2N930 (TO-18 package).



## 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 temperature ( $T_J \leq 200^\circ\text{C}$ ) 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. Temperature-power derating for 2N930 (TO-18 package case base 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 temperature ( $T_J \leq 200^\circ\text{C}$ ) 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. Temperature-power derating for 2N930UB (UB).

**Maximum Thermal Impedance**

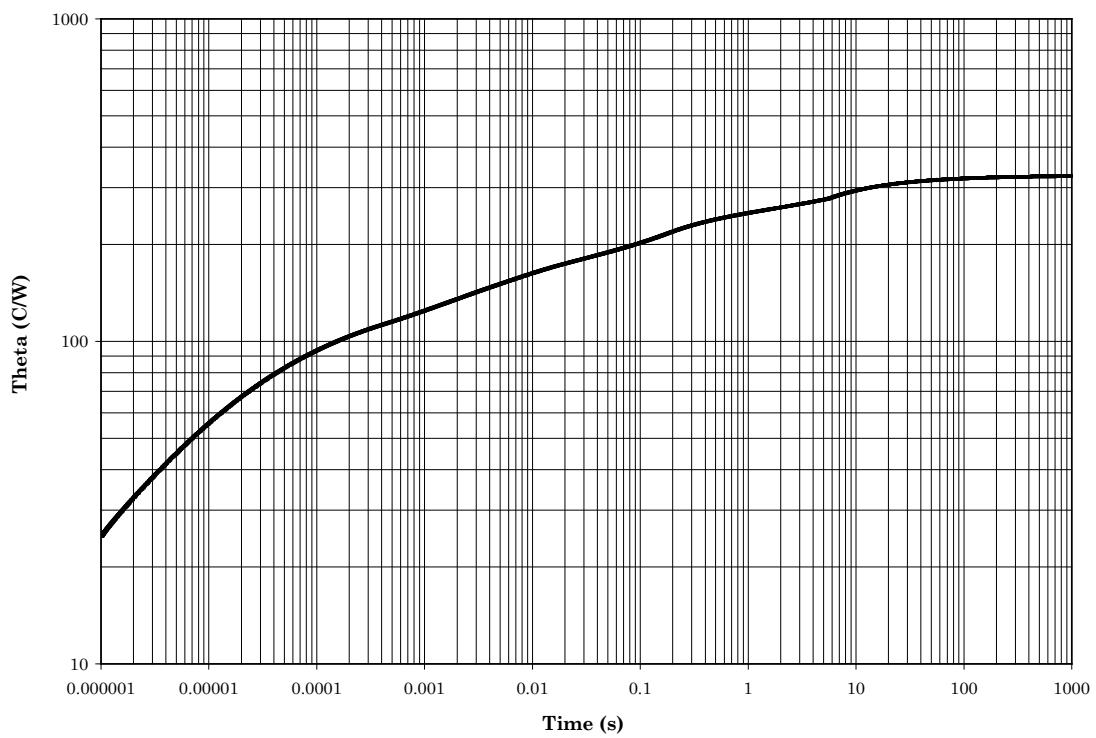


FIGURE 10. Thermal impedance graph ( $R_{\theta,JA}$ ) for 2N930UB (UB).

**Maximum Thermal Impedance**

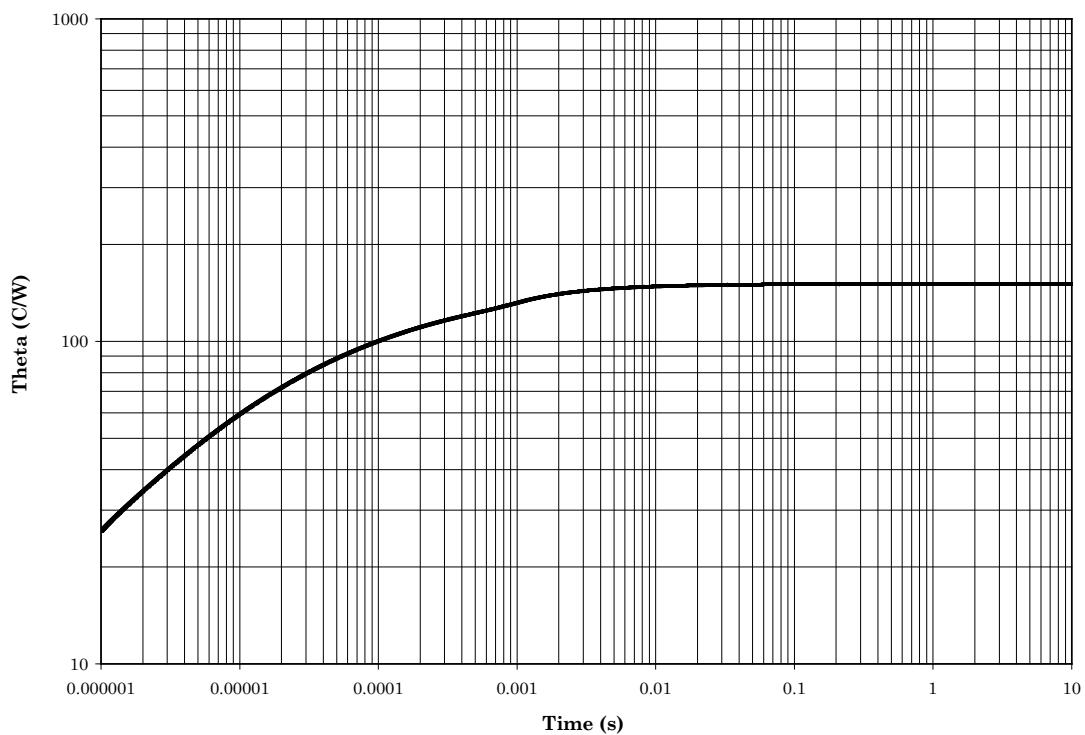


FIGURE 11. Thermal impedance graph ( $R_{\theta JC}$ ) for 2N930 (TO-18 package case base mounted).

**Maximum Thermal Impedance**

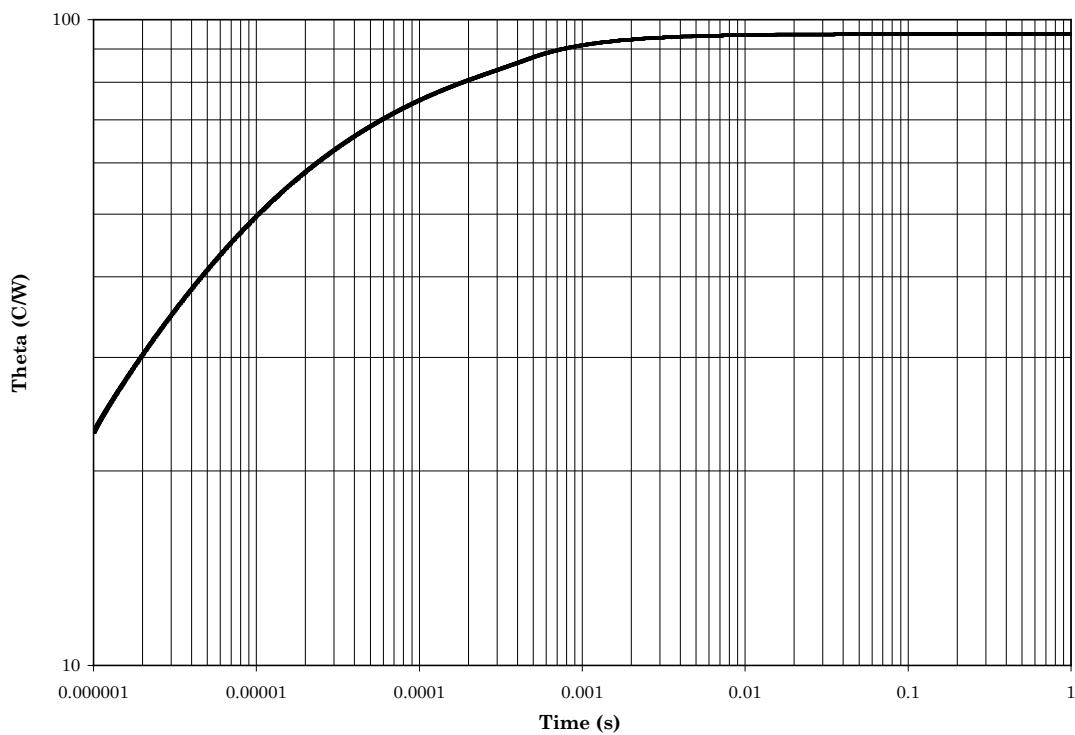


FIGURE 12. Thermal impedance graph ( $R_{\theta JSP(IS)}$ ) for 2N930UB (UB).

## 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](mailto: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 die. The qualified JANHC and JANKC suppliers with the applicable letter version (example JANHCA2N930) will be identified on the QML.

JANC ordering information		
PIN	Manufacturer	
	43611	34156
2N930	JANHCA2N930 JANKCC2N930	JANHCB2N930 JANKCB2N930

\* 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 5961-2010-081)

Review activities:

Army - AR, AV, MI, SM  
Navy - AS  
Air Force - 71, 99

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