The documentation and process conversion measures necessary to comply with this document shall be completed by 5 October 2010.

INCH-POUND

MIL-PRF-19500/350L
5 July 2010
SUPERSEDING
MIL-PRF-19500/350K
5 June 2007

PERFORMANCE SPECIFICATION SHEET

* SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, LOW POWER
TYPES 2N3867, 2N3867S, 2N3867U4, 2N3868, 2N3868S, AND 2N3868U4,
JAN, JANTX, JANTXV, JANS, JANSM, JANSD, JANSP, JANSL, JANSR, JANSF, JANSG, JANSH, JANHCB, JANKCB, JANKCBM, JANKCBD, JANKCBP, JANKCBL, JANKCBR, JANKCBF, JANKCBG, AND JANKCBH

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 PNP, silicon, switching transistor. 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 each unencapsulated device type. Provisions for radiation hardness assurance (RHA) to eight radiation levels is provided for JANTXV, JANS, JANHC, and JANKC product assurance levels. RHA level designators “M”, “D”, “P“, “L”, “R”, “F”, “G”, and “H” are appended to the device prefix to identify devices, which have passed RHA requirements.

* 1.2 Physical dimensions. See figure 1 (TO- 5, TO-39), figure 2 (U4) , and figure 3 for JANHC and JANKC (B version die) dimensions.

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

Types	P_T (1) T_A = +25°C	P_T (1) T_{PCB} = +25°C	P_T (2) T_C = +25°C	$R_{\theta JA}$	$R_{\theta JPCB}$	$R_{\theta JC}$	V_{CBO}	V_{CEO}	V_{EBO}	I_C	T_J and T_{STG}
	W	W	W	°C/W	°C/W	°C/W	V dc Min	V dc Min	V dc	A dc	°C
2N3867, S	1.0		10	175		17.5	40	40	4.0	3.0	-65 to +200
2N3868, S	1.0		10	175		17.5	60	60	4.0	3.0	-65 to +200
2N3867U4		1.0	35		175	5	40	40	4.0	3.0	-65 to +200
2N3868U4		1.0	35		175	5	60	60	4.0	3.0	-65 to +200

(1) For derating, see figure 4, 5, 6 and 7.
(2) For thermal curves, see figures 8, 9, 10 and 11.

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

1.4 Primary electrical characteristics.

	h_{FE}				C_{obo} $I_E = 0$	|hfe| I_C = 100 mA dc	I_C = 1.5 A dc		$V_{CE(sat)}2$ I_C = 1.5 A dc
	I_C = 1.5 A dc V_{CE} = 2 V dc		I_C = 3.0 A dc V_{CE} = 5 V dc		V_{CB} = 10 V dc 100 kHz ≤ f ≤ 1 MHz	V_{CE} = 5 V dc f = 20 MHz	I_B = 150 mA dc		I_B = 150 mA dc
							t_{on}	t_{off}	
	2N3867 2N3867S 2N3867U4	2N3868 2N3868S 2N3868U4	2N3867 2N3867S 2N3867U4	2N3868 2N3968S 2N3968U4	pF		ns max	ns max	V dc
Min	40	30	20	20		3			
Max	200	150			120	12	100	600	0.75

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 SPECIFICATION

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

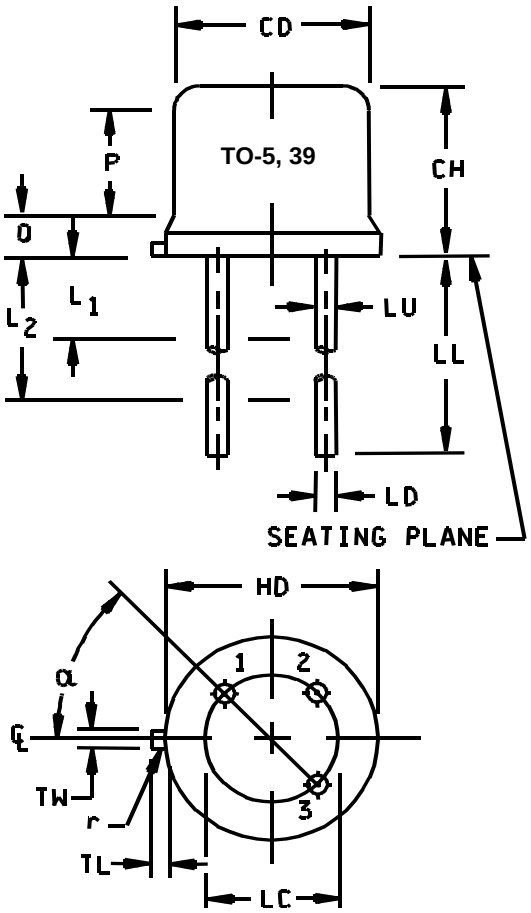
DEPARTMENT OF DEFENSE STANDARD

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.

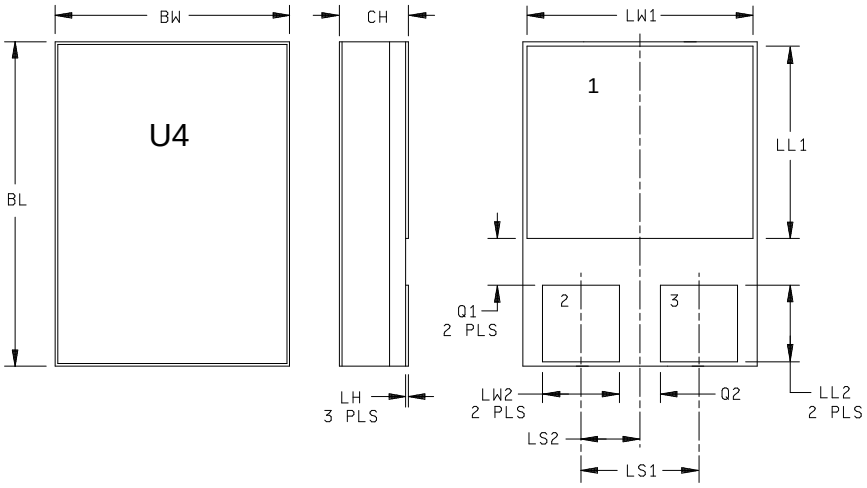
Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.335	7.75	8.51	5, 6
CH	.240	.260	6.10	6.60	
HD	.335	.370	8.51	9.40	4, 5
LC	.200 TP		5.08 TP		7
LD	.016	.019	0.41	0.48	8,9
LL	See note 8, 14				
LU	.016	.019	0.41	0.48	8,9
L_1		.050		1.27	8,9
L_2	.250		6.35		8,9
P	.100		2.54		7
Q		.030		0.76	5
TL	.029	.045	0.74	1.14	3,4
TW	.028	.034	0.71	0.86	3
r		.010		0.25	10
α	45° TP		45° TP		7
1, 2, 10, 12, 13, 14					



NOTES:

1. Dimensions 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. CD shall not vary more than .010 inch (0.25 mm) in zone P. This zone is controlled for automatic handling.
7. 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 gauging procedure.
8. Dimension LU applies between L_1 and L_2. Dimension LD applies between L_2 and LL minimum. Diameter is uncontrolled in and beyond LL minimum.
9. All three leads.
10. The collector shall be internally connected to the case.
11. Dimension r (radius) applies to both inside corners of tab.
12. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.
13. Lead 1 = emitter, lead 2 = base, lead 3 = collector.
14. For non-S-suffix devices (TO-5), dimension LL = 1.5 inches (38.10 mm) min. and 1.75 inches (44.45 mm) max. For S-suffix types (TO-39), dimension LL = .5 inch (12.70 mm) min. and .750 inch (19.05 mm) max.

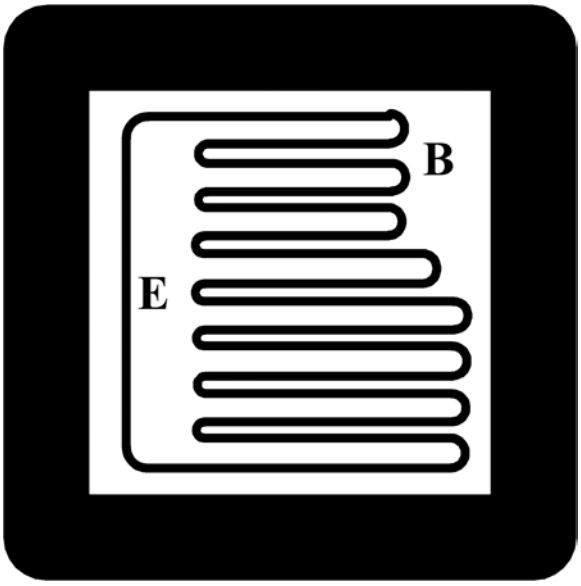
FIGURE 1. Physical dimensions (similar to TO-5, TO-39).



Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.215	.225	5.46	5.72
BW	.145	.155	3.68	3.94
CH	.049	.075	1.24	1.91
LH		.020		0.51
LW1	.135	.145	3.43	3.68
LW2	.047	.057	1.19	1.45
LL1	.085	.125	2.16	3.17
LL2	.045	.075	1.14	1.9
LS1	.070	.095	1.78	2.41
LS2	.035	.048	0.89	1.21
Q1	.03	.070	0.76	1.78
Q2	.02	.035	0.51	0.89
TERM 1	Collector			
TERM 2	Base			
TERM 3	Emitter			

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

* FIGURE 2. Physical dimensions and configuration (SMD.22, U4).



B version

1. Chip size: .075 x .075 inch ±.002 inch (1.905 x 1.905 mm ±0.051 mm).
2. Chip thickness: .010 inch ±.0015 inch nominal (0.254 mm ±0.0381 mm).
3. Top metal: Aluminum 30,000 Å minimum, 33,000 Å nominal.
4. Back metal: Gold 3,500Å minimum, 5,000Å nominal.
5. Backside: Collector.
6. Bonding pad: B = .023 x .008 inch (0.5842 x 0.2032 mm), E = .049 x .008 inch (1.2446 x 0.2032 mm).

* FIGURE 3. JANHCB and JANKCB die dimensions.

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 before contract award (see 4.2 and 6.3).

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

* 3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and on figures 1, 2, and 3.

3.4.1 Lead finish. Lead finish shall be solderable as defined in 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).

* 3.4.2 Construction. These devices shall be constructed in a manner and using materials which enable the devices to meet the applicable requirements of MIL-PRF-19500 and this document.

* 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 herein.

* 3.7 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table I and II herein.

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

* 3.9 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

* 4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.2).

b. Screening (see 4.3).

* c. Conformance inspection (see 4.4 and tables I, II, 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, JANTXV, and JANTX levels only). Screening shall be in accordance with table E-IV of MIL-PRF-19500 and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table E-IV of MIL-PRF-19500)	Measurement	
	JANS level	JANTX and JANTXV levels
(1) 3c	Thermal impedance, method 3131 of MIL-STD-750 (see 4.3.3)	Thermal impedance, method 3131 of MIL-STD-750 (see 4.3.3)
9	I_{CEX1} and h_{FE2}	Not applicable
10	24 hours minimum	24 hours minimum
11	I_{CEX1}; h_{FE2}; ΔI_{CEX1} = 100 percent of initial value or 200 nA dc, whichever is greater; Δh_{FE2} = ±15 percent of initial value	I_{CEX1}; h_{FE2}
12	See 4.3.2	See 4.3.2
13	Subgroup 2 and 3 of table I herein; ΔI_{CEX1} = 100 percent of initial value or 200 nA dc, whichever is greater; Δh_{FE2} = ±15 percent of initial value	Subgroup 2 of table I herein; ΔI_{CEX1} = 100 percent of initial value or 200 nA dc, whichever is greater; Δh_{FE2} = ±15 percent of initial value

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

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

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

* 4.3.3 Thermal impedance. The thermal impedance measurements shall be performed in accordance with method 3131 of MIL-STD-750 using the guidelines in that method for determining I_M, I_H, t_H, t_{MD} (and V_C and V_H where appropriate). Measurement delay time (t_{MD}) = 70 μs 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 subgroup 1 and 2 of table I herein, inspection only (table E-VIb, group B, subgroup 1 is not required to be performed since solderability and resistance to solvents testing is performed in table I herein).

* 4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500, and table I herein. Electrical measurements (end-points) shall be in accordance with the applicable inspections of table I, subgroup 2 herein.

* 4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in E-VIa (JANS) and 4.4.2.1 herein. Electrical measurements (end-points) and delta requirements shall be in accordance with table I, subgroup 2 and table IV herein. See 4.4.2.2 for JAN, JANTX, and JANTXV group B testing. Electrical measurements (end-points) and delta requirements JAN, JANTX, and JANTXV shall be after each step in 4.4.2.2 and shall be in accordance with table I, subgroup 2 and table IV herein.

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

Subgroup	Method	Condition
B4	1037	V_{CB} = 10 V dc; 2,000 cycles adjust device current, or power, to achieve a minimum ΔT_J of +100°C.
B5	1027	(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: For 96 hours minimum sample size in accordance with table VIa of MIL-PRF-19500, adjust T_A or P_D to achieve T_J = +275°C minimum. Option 2: For 216 hours minimum, sample size = 45, c = 0; adjust T_A or P_D to achieve T_J = +225°C minimum.
* B6	3131	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.

Step	Method	Condition
1	1026	Steady-state life: 1,000 hours minimum, V_{CB} = 10 V dc, power shall be applied to achieve T_J = +150°C minimum using a minimum of P_D = 75 percent of maximum rated P_T as defined in 1.3. n = 45 devices, c = 0. The sample size may be increased and the test time decreased as long as the devices are stressed for a total of 45,000 device hours minimum, and the actual time of test is at least 340 hours.
2	1048	Blocking life, T_A = +150°C, V_{CB} = 80 percent of rated voltage, 48 hours minimum. n = 45 devices, c = 0.
3	1032	High-temperature life (non-operating), t = 340 hours, T_A = +200°C. n = 22, c = 0.

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

a. For JAN, JANTX, and JANTXV samples shall be selected randomly from a minimum of three wafers (or from each wafer in the lot) from each wafer lot. For JANS, samples shall be selected from each inspection lot. See MIL-PRF-19500.

b. Shall be chosen from an inspection lot that has been submitted to and passed table I, subgroup 2, conformance inspection. When the final lead finish is solder or any plating prone to oxidation at high temperature, the samples for life test (subgroups B4 and B5 for JANS, and group B for JAN, JANTX, and JANTXV) may be pulled prior to the application of final lead finish.

* 4.4.3 Group C inspection, Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-VII of MIL-PRF-19500, and in 4.4.3.1 (JANS) and 4.4.3.2 (JAN, JANTX, and JANTXV) herein for group C testing. Electrical measurements (end-points) and delta requirements shall be in accordance with table I, subgroup 2 and table IV herein.

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

Subgroup	Method	Condition
C2	2036	Test condition E, not applicable for U4 devices.
C5	3131	$R_{\theta JA}$ and $R_{\theta JC}$ only, as applicable (see 1.3 and 4.3.3) and in accordance with thermal impedance curves.
C6	1026	1,000 hours at V_{CB} = 10 V dc; power shall be applied to achieve T_J = +150°C minimum and a minimum of P_D = 75 percent of maximum rated P_T as defined in 1.3 n = 45, c = 0. The sample size may be increased and the test time decreased as long as the devices are stressed for a total of 45,000 device hours minimum, and the actual time of test is at least 340 hours.

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

Subgroup	Method	Condition
C2	2036	Test condition E, not applicable for U4 devices..
C5	3131	$R_{\theta JA}$ and $R_{\theta JC}$ only, as applicable (see 1.3 and 4.3.3) and in accordance with thermal impedance curves.
C6		Not applicable.

4.4.3.3 Group C sample selection. Samples for subgroups in group C shall be chosen at random from any lot containing the intended package type and lead finish procured to the same specification which is submitted to and passes group A tests 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 JANKC 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 appendix E, table E-IX of MIL-PRF-19500 and as specified in table III herein. Electrical measurements (end-points) and delta measurements shall be in accordance with the applicable steps of table I, subgroup 2; and table IV 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.

* TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1 2/						
Visual and mechanical examination 3/	2071	n = 45 devices, c = 0				
Solderability 3/ 4/	2026	n = 15 leads, c = 0				
Resistance to solvent 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 5/	1071	n = 22 devices, c = 0				
Fine leak Gross leak						
Electrical measurements 4/		Table I, subgroup 2				
Bond strength 3/ 4/	2037	Precondition T_A = +250°C at t = 24 hrs or T_A = +300°C at t = 2 hrs, n = 11 wires, c = 0.				
Decap internal visual (design verification) 4/	2075	n = 4 devices, c = 0.				
Subgroup 2						
Thermal impedance	3131	See 4.3.3	$Z_{\theta JX}$			°C/W
Collector to base cutoff current	3036		I_{CBO1}			
2N3867, 2N3867S, 2N3867U4		V_{CB} = 40 V dc			100	μA dc
2N3868, 2N3868S, 2N3868U4		V_{CB} = 60 V dc			100	μA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 4 V dc	I_{EBO1}		100	μA dc
Breakdown voltage, collector to emitter	3011	Bias condition D; I_C = 20 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$			
2N3867, 2N3867S, 2N3867U4				40		V dc
2N3868, 2N3868S, 2N3868U4				60		V dc

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 2 – Continued						
Collector to emitter cutoff current	3041	Bias condition A; V_{EB} = 2.0 V dc	I_{CEX1}		1.0	µA dc
2N3867, 2N3867S, 2N3867U4 2N3868, 2N3868S, 2N3868U4		V_{CE} = 40 V dc, V_{CE} = 60 V dc				
Forward-current transfer ratio	3076	V_{CE} = 1.0 V dc, I_C = 500 mA dc, pulsed (see 4.5.1)	h_{FE1}			
2N3867, 2N3867S, 2N3867U4 2N3868, 2N3868S, 2N3868U4				50 35		
Forward-current transfer ratio	3076	V_{CE} = 2.0 V dc, I_C = 1.5 A dc, pulsed (see 4.5.1)	h_{FE2}			
2N3867, 2N3867S, 2N3867U4 2N3868, 2N3868S, 2N3868U4				40 30	200 150	
Forward-current transfer ratio	3076	V_{CE} = 3.0 V dc, I_C = 2.5 A dc, pulsed (see 4.5.1)	h_{FE3}			
2N3867, 2N3867S, 2N3867U4 2N3868, 2N3868S, 2N3868U4				25 20		
Forward-current transfer ratio	3076	V_{CE} = 5.0 V dc, I_C = 3.0 A dc, pulsed (see 4.5.1)	h_{FE4}	20		
Collector to emitter voltage (saturated)	3071	I_C = 500 mA dc; I_B = 50 mA dc, pulsed (see 4.5.1)	$V_{CE(sat)1}$		0.5	V dc
Collector to emitter voltage (saturated)	3071	I_C = 1.5 A dc; I_B = 150 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)2}$		0.75	V dc
Collector to emitter voltage (saturated)	3071	I_C = 2.5 A dc; I_B = 250 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)3}$		1.5	V dc
Base emitter voltage (saturated)	3066	Test condition A; I_C = 500 mA dc; I_B = 50 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)1}$		1.0	V dc
Base emitter voltage (saturated)	3066	Test condition A; I_C = 1.5 A dc; I_B = 150 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)2}$			
2N3867, 2N3867S, 2N3868, 2N3868S				0.9	1.4	V dc
2N3867U4, 2N3868U4				0.85	1.4	V dc

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 2 - continued.						
Base emitter voltage (saturated)	3066	Test condition A; I_C = 2.5 A dc; I_B = 250 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)3}$		2.0	V dc
Subgroup 3						
High temperature operation:		T_A = +150°C				
Collector to emitter cutoff current	3041	Bias condition A, V_{EB} = 2.0 V dc	I_{CEX2}		50	µA dc
2N3867, 2N3867S, 2N3867U4		V_{CE} = 40 V dc				
2N3868, 2N3868S, 2N3868U4		V_{CE} = 60 V dc				
Low temperature operation:		T_A = -55°C				
Forward-current transfer ratio	3076	V_{CE} = 1.0 V dc, I_C = 500 mA dc, pulsed (see 4.5.1)	h_{FE5}			
2N3867, 2N3867S, 2N3867U4				25		
2N3868, 2N3868S, 2N3868U4				17		
Subgroup 4						
Magnitude of common-emitter small-signal short-circuit forward-current transfer ratio	3306	V_{CE} = 5 V dc, I_C = 100 mA dc, f = 20 MHz	$\|h_{fe}\|$	3	12	
Open circuit output capacitance	3236	V_{CB} = 10 V dc, I_E = 0, 100 kHz ≤ f ≤ 1 MHz	C_{obo}		120	pF
Input capacitance (output open-circuited)	3240	V_{EB} = 3.0 V dc, I_C = 0, 100 kHz ≤ f ≤ 1 MHz	C_{ibo}		800	pF
Subgroup 5						
Pulse response	3251	Test condition A				
Delay time		V_{CC} = -30 V dc, V_{EB} = 0 , I_C = 1.5 A dc, I_{B1} = 150 mA dc, See figure 12	t_d		35	ns

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 5 - Continued						
Pulse response	3251	Test condition A				
Rise time		V_{CC} = -30 V dc, V_{EB} = 0 V dc, I_C = 1.5 A dc, I_{B1} = 150 mA dc, See figure 12	t_r		65	ns
Storage time		V_{CC} = -30 V dc, V_{EB} = 0 V dc, I_C = 1.5 A dc, I_{B1} = I_{B2} = 150 mA dc, See figure 13	t_s		500	ns
Fall time		V_{CC} = -30 V dc, V_{EB} = 0 V dc, I_C = 1.5 A dc, I_{B1} = I_{B2} = 150 mA dc, See figure 13	t_f		100	ns
SOA (continuous dc)	3051	T_C = +25°C, 1 cycle, t = 1.0 s, (see figure 14)				
Test 1		V_{CE} = 3.33 V dc, I_C = 3 A dc				
Test 2						
2N3867, 2N3867S, 2N3867U4		V_{CE} = 40 V dc, I_C = 160 mA dc				
2N3868, 2N3868S, 2N3868U4		V_{CE} = 60 V dc, I_C = 80 mA dc				
Electrical measurements		See table IV, steps 1 and 2.				

1/ For sampling plan see MIL-PRF-19500.
2/ For resubmission of failed subgroup 1, 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.

* TABLE II. Group D inspection.

Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1 4/						
Neutron Irradiation	1017	Neutron exposure Vces = 0 V				
Collector to base cutoff current	3036		I_{CBO1}			
2N3867, 2N3867S, 2N3867U4		V_{CB} = 40 V dc			200	μA dc
2N3868, 2N3868S, 2N3868U4		V_{CB} = 60 V dc			200	μA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 4 V dc	I_{EBO1}		200	μA dc
Breakdown voltage, collector to emitter	3011	Bias condition D; I_C = 20 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$			
2N3867, 2N3867S, 2N3867U4				40		V dc
2N3868, 2N3868S, 2N3868U4				60		V dc
Collector to emitter cutoff current	3041	Bias condition A; V_{EB} = 2.0 V dc	I_{CEX1}		2.0	μA dc
2N3867, 2N3867S, 2N3867U4		V_{CE} = 40 V dc,				
2N3868, 2N3868S, 2N3868U4		V_{CE} = 60 V dc				
Forward-current transfer ratio	3076	V_{CE} = 1.0 V dc, I_C = 500 mA dc, pulsed (see 4.5.1)	[h_{FE1}] 5/			
2N3867, 2N3867S, 2N3867U4				[25]		
2N3868, 2N3868S, 2N3868U4				[17.5]		
Forward-current transfer ratio	3076	V_{CE} = 2.0 V dc, I_C = 1.5 A dc, pulsed (see 4.5.1)	[h_{FE2}] 5/			
2N3867, 2N3867S, 2N3867U4				[20]	200	
2N3868, 2N3868S, 2N3868U4				[15]	150	
Forward-current transfer ratio	3076	V_{CE} = 3.0 V dc, I_C = 2.5 A dc, pulsed (see 4.5.1)	[h_{FE3}] 5/			
2N3867, 2N3867S, 2N3867U4				[12.5]		
2N3868, 2N3868S, 2N3868U4				[10]		
Forward-current transfer ratio	3076	V_{CE} = 5.0 V dc, I_C = 3.0 A dc, pulsed (see 4.5.1)	[h_{FE4}] 5/	[10]		

See footnotes at end of table.

* TABLE II Group D inspection - Continued.

Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1 – Continued 4/						
Collector to emitter voltage (saturated)	3071	I_C = 500 mA dc; I_B = 50 mA dc, pulsed (see 4.5.1)	$V_{CE(sat)1}$		0.575	V dc
Collector to emitter voltage (saturated)	3071	I_C = 1.5 A dc; I_B = 150 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)2}$		0.86	V dc
Collector to emitter voltage (saturated)	3071	I_C = 2.5 A dc; I_B = 250 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)3}$		1.73	V dc
Base emitter voltage (saturated)	3066	Test condition A; I_C = 500 mA dc; I_B = 50 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)1}$		1.15	V dc
Base emitter voltage (saturated)	3066	Test condition A; I_C = 1.5 A dc; I_B = 150 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)2}$			
2N3867, 2N3867S, 2N3868, 2N3868S				0.9	1.61	V dc
2N3867U4, 2N3868U4				0.85	1.61	V dc
Base emitter voltage (saturated)	3066	Test condition A; I_C = 2.5 A dc; I_B = 250 mA dc;pulsed (see 4.5.1)	$V_{BE(sat)3}$		2.3	V dc
Subgroup 2						
Total dose irradiation	1019	Gamma exposure				
2N3867 2N3868		Vces = 32V Vces = 48V				
Collector to base cutoff current	3036		I_{CBO1}			
2N3867, 2N3867S, 2N3867U4 2N3868, 2N3868S, 2N3868U4		V_{CB} = 40 V dc V_{CB} = 60 V dc			200 200	µA dc µA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 4 V dc	I_{EBO1}		200	µA dc
Breakdown voltage, collector to emitter	3011	Bias condition D; I_C = 20 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$			
2N3867, 2N3867S, 2N3867U4 2N3868, 2N3868S, 2N3868U4				40 60		V dc V dc

See footnotes at end of table.

* TABLE II Group D inspection - Continued.

Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 2 – Continued						
Collector to emitter cutoff current	3041	Bias condition A; V_{EB} = 2.0 V dc	I_{CEX1}		2.0	μA dc
2N3867, 2N3867S, 2N3867U4 2N3868, 2N3868S, 2N3868U4		V_{CE} = 40 V dc, V_{CE} = 60 V dc				
Forward-current transfer ratio	3076	V_{CE} = 1.0 V dc, I_C = 500 mA dc, pulsed (see 4.5.1)	[h_{FE1}] 5/			
2N3867, 2N3867S, 2N3867U4 2N3868, 2N3868S, 2N3868U4				[25] [17.5]		
Forward-current transfer ratio	3076	V_{CE} = 2.0 V dc, I_C = 1.5 A dc, pulsed (see 4.5.1)	[h_{FE2}] 5/			
2N3867, 2N3867S, 2N3867U4 2N3868, 2N3868S, 2N3868U4				[20] [15]	200 150	
Forward-current transfer ratio	3076	V_{CE} = 3.0 V dc, I_C = 2.5 A dc, pulsed (see 4.5.1)	[h_{FE3}] 5/			
2N3867, 2N3867S, 2N3867U4 2N3868, 2N3868S, 2N3868U4				[12.5] [10]		
Forward-current transfer ratio	3076	V_{CE} = 5.0 V dc, I_C = 3.0 A dc, pulsed (see 4.5.1)	[h_{FE4}] 5/	[10]		
Collector to emitter voltage (saturated)	3071	I_C = 500 mA dc; I_B = 50 mA dc, pulsed (see 4.5.1)	$V_{CE(sat)1}$		0.575	V dc
Collector to emitter voltage (saturated)	3071	I_C = 1.5 A dc; I_B = 150 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)2}$		0.86	V dc
Collector to emitter voltage (saturated)	3071	I_C = 2.5 A dc; I_B = 250 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)3}$		1.73	V dc
Base emitter voltage (saturated)	3066	Test condition A; I_C = 500 mA dc; I_B = 50 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)1}$		1.15	V dc
Base emitter voltage (saturated)	3066	Test condition A; I_C = 1.5 A dc; I_B = 150 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)2}$			
2N3867, 2N3867S, 2N3868, 2N3868S				0.9	1.61	V dc
2N3867U4, 2N3868U4				0.85	1.61	V dc
Base emitter voltage (saturated)	3066	Test condition A; I_C = 2.5 A dc; I_B = 250 mA dc;pulsed (see 4.5.1)	$V_{BE(sat)3}$		2.3	V dc

See footnotes at end of table.

* TABLE II Group D inspection - Continued.

1/ Tests to be performed on all devices receiving radiation exposure.
2/ For sampling plan, see MIL-PRF-19500.
3/ Electrical characteristics apply to all device types 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}. 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.

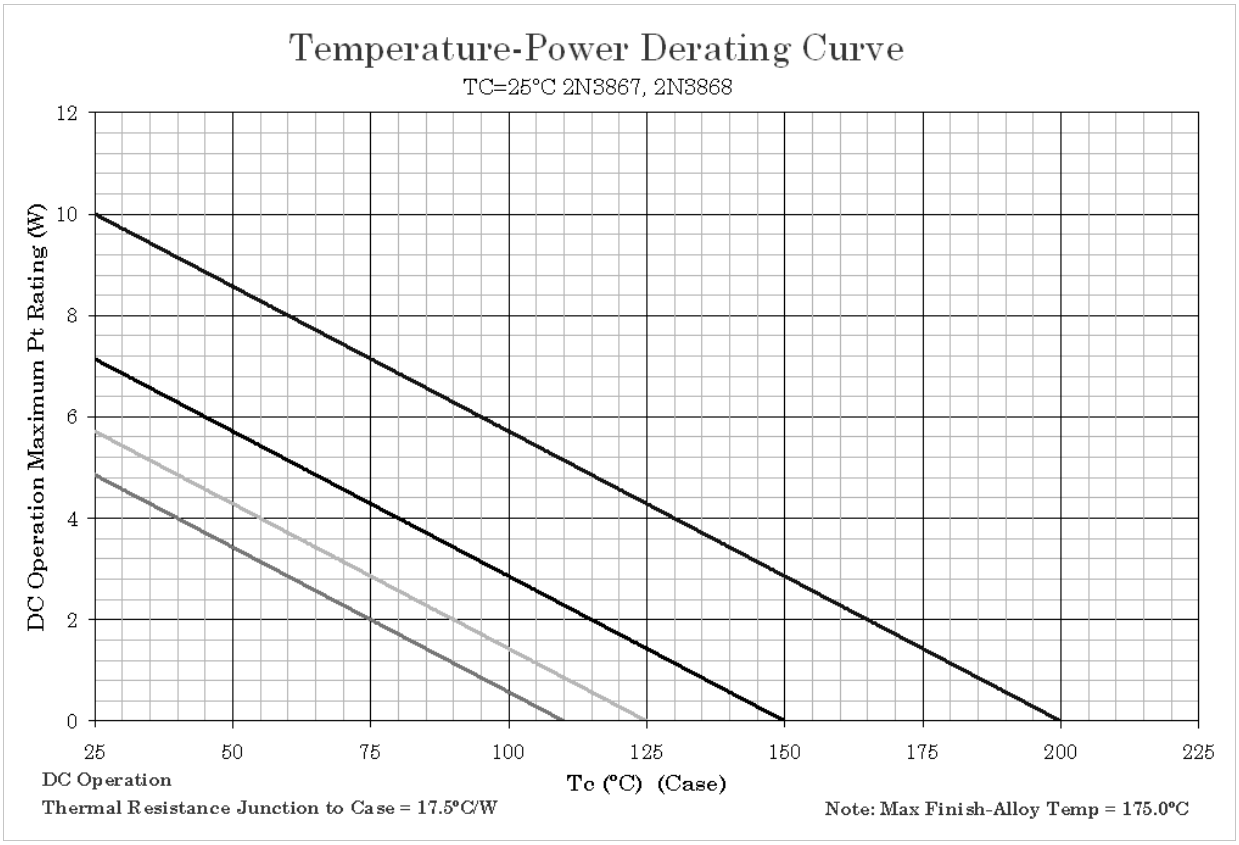
* TABLE III. Group E inspection (all quality levels) - for qualification and re-qualification only.

Inspection	MIL-STD-750		Qualification
	Method	Conditions	
Subgroup 1			45 devices c = 0
Temperature cycling (air to air)	1051	Test condition C, 500 cycles	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table I, subgroup 2 and table III herein.	
Subgroup 2			45 devices c = 0
Intermittent life	1037	V_{CB} = 10 V dc, 6,000 cycles, adjust device current, or power, to achieve a minimum ΔT_J of +100°C. Forced air cooling allowed on cooling cycle only.	
Electrical measurements		See table I, subgroup 2 and table III herein.	
Subgroup 4			
Thermal impedance curves		See MIL-PRF-19500. table E-IX, group E, subgroup 4.	Sample size N/A
Subgroups 5			
Not applicable			
Subgroup 6			3 devices c = 0
ESD	1020		
Subgroup 8			45 devices c = 0
Reverse stability	1033	Condition B.	

* TABLE IV. Delta requirements.

Step	Inspection	MIL-STD-750		Symbol	Limit	Unit
		Method	Conditions			
1	Collector-base cutoff current	3041	Bias condition A, V_{EB} = 2.0 V dc	ΔI_{CEX1} 1/	100 percent of initial value or 200 nA dc, whichever is greater.	
	2N3867, 2N3867S, 2N3867U4		V_{CE} = 40 V dc			
	2N3868, 2N3868S, 2N3868U4		V_{CE} = 60 V dc			
2	Forward current transfer ratio	3076	V_{CE} = 2 V dc; I_C = 1.5 A dc; pulsed see 4.5.1	Δh_{FE2} 1/	15 percent change from initial reading.	

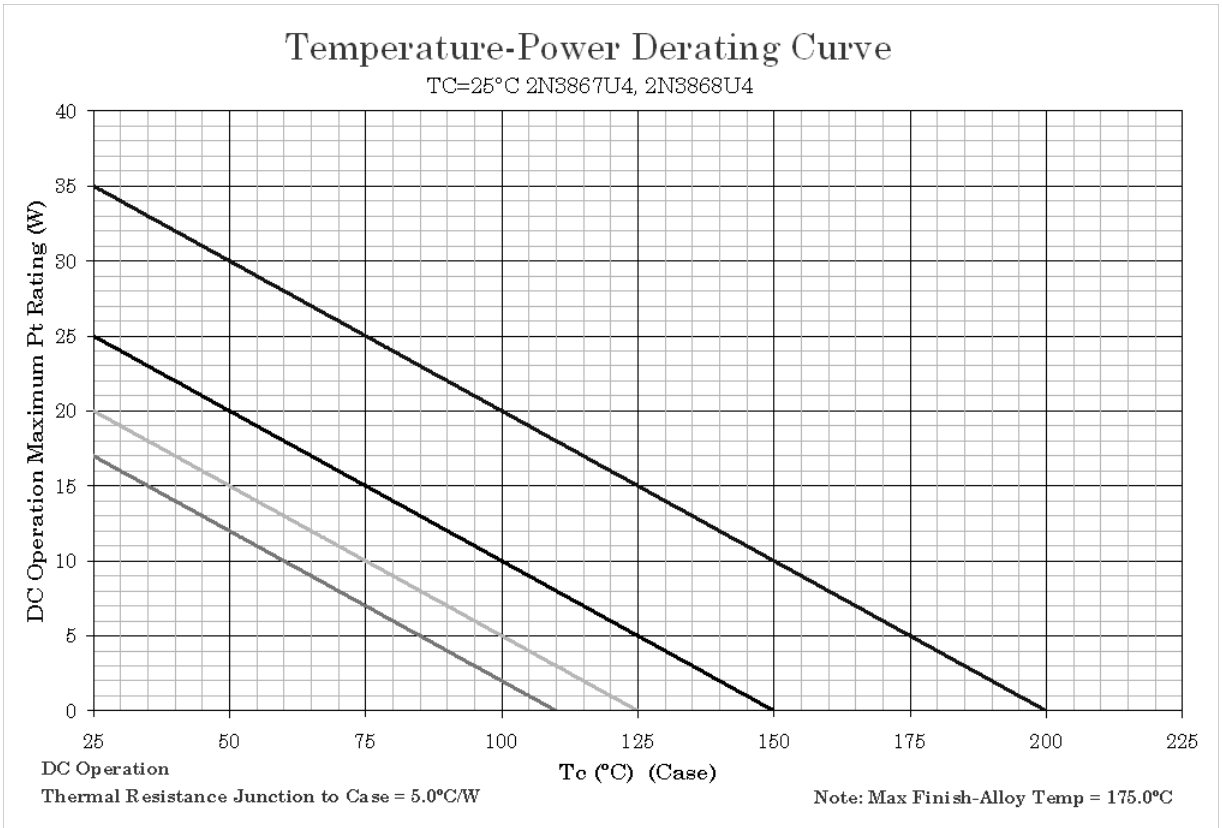
1/ Devices which exceed the table I limits for this test shall not be accepted.



NOTES:

1. 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 $T_J \leq 150°C$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq 125°C$, and 110°C to show power rating where most users want to limit T_J in their application.

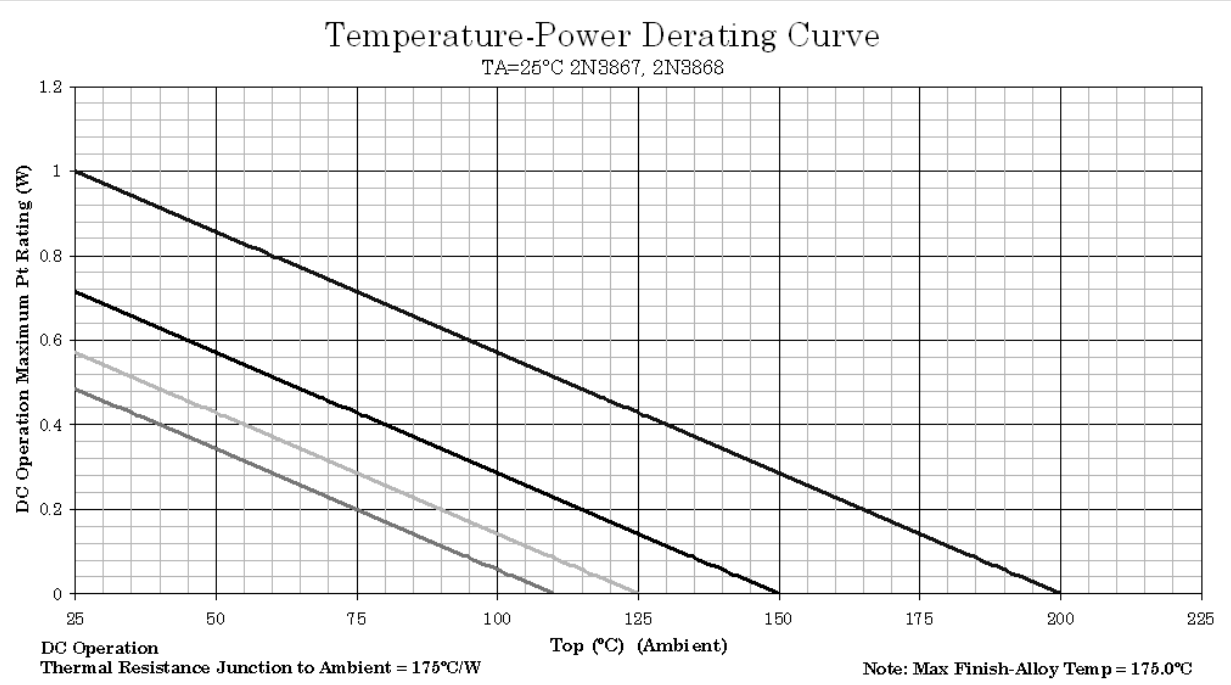
* FIGURE 4. Derating for 2N3867, 2N3868 (TO-5, TO-39).



NOTES:

1. 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 $T_J \leq 150°C$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq 125°C$, and 110°C to show power rating where most users want to limit T_J in their application.

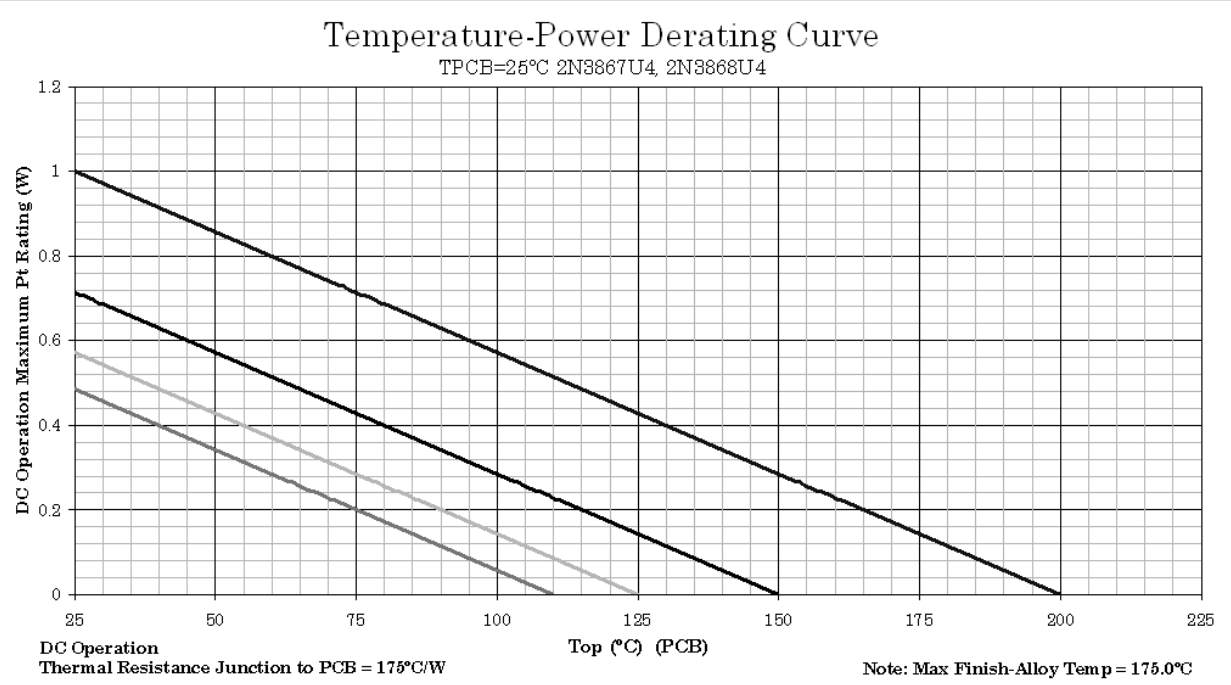
* FIGURE 5. Derating for 2N3867U4, 2N3868U4.



NOTES:

1. 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 $T_J \leq 150°C$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq 125°C$, and 110°C to show power rating where most users want to limit T_J in their application.

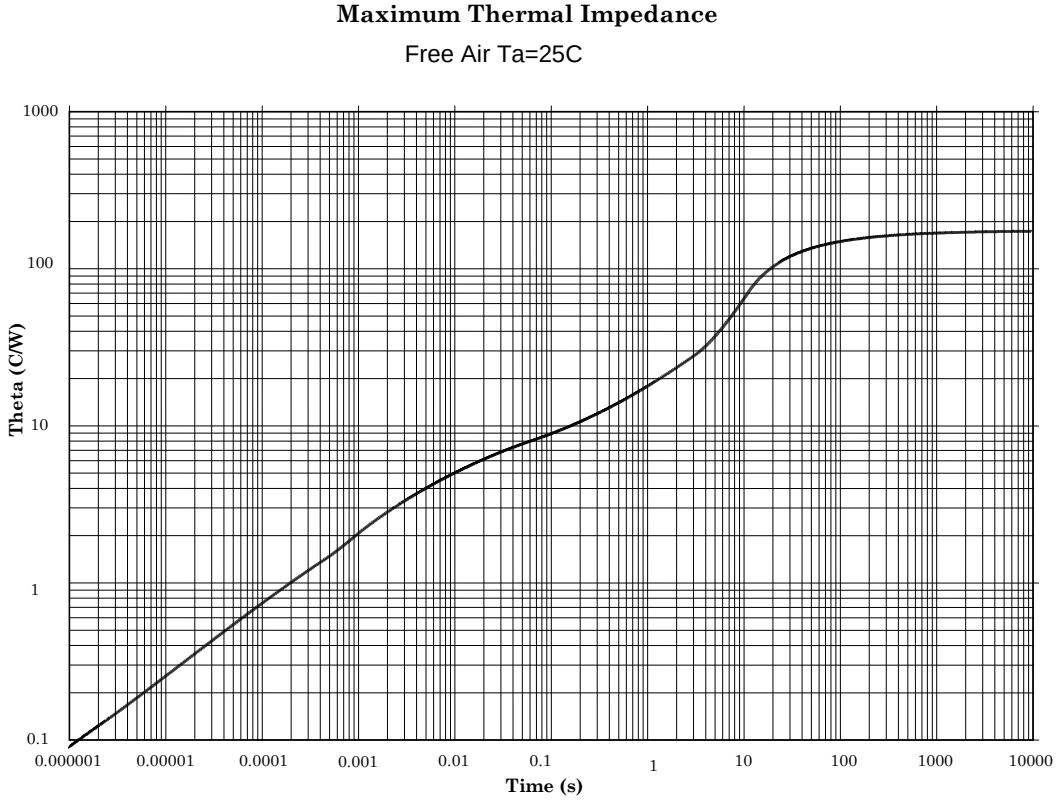
* FIGURE 6. Derating for 2N3867, 2N3868.



NOTES:

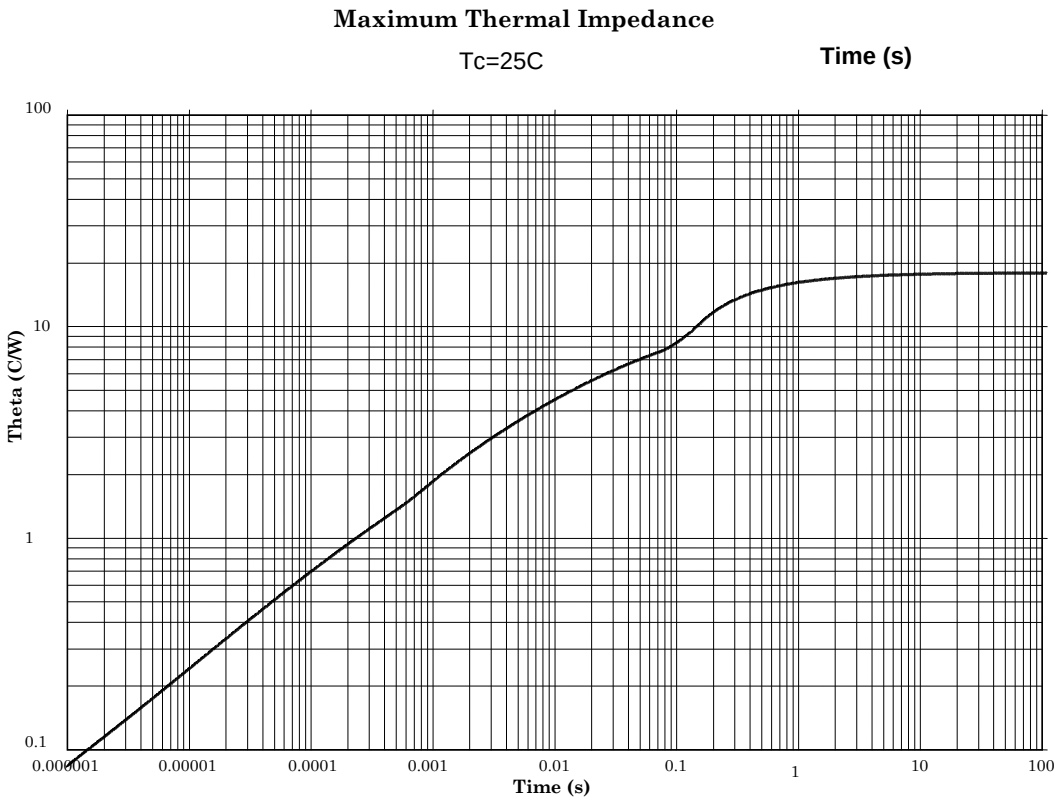
1. All devices are capable of operating at $\leq T_J$ specified on this curve. Any parallel line to this curve will intersect the appropriate power for the desired maximum T_J allowed.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See 1.3 herein.)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

* FIGURE 7. Derating for 2N3867U4, 2N3868U4.



$R_{\theta JA}$ = 175 °C/W

* FIGURE 8. Thermal impedance for 2N3867 and 2N3868 (TO-5 and TO-39).

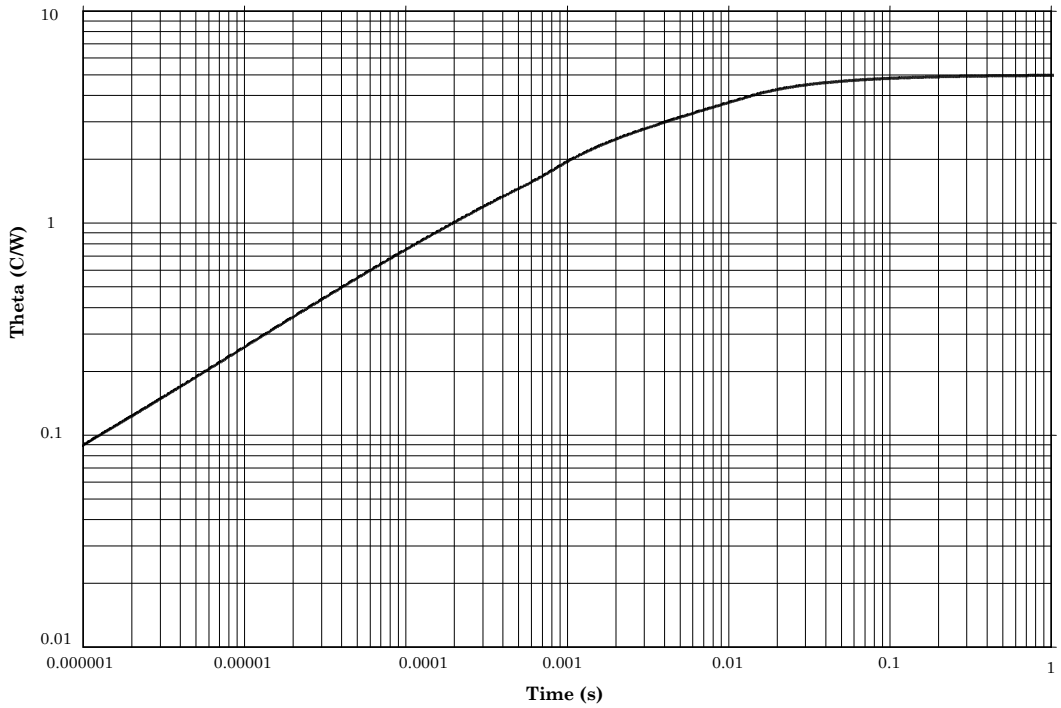


$R_{\theta JC}$ = 17.5 °C/W

* FIGURE 9. Thermal impedance for 2N3867 and 2N3868 (TO-5 and TO-39).

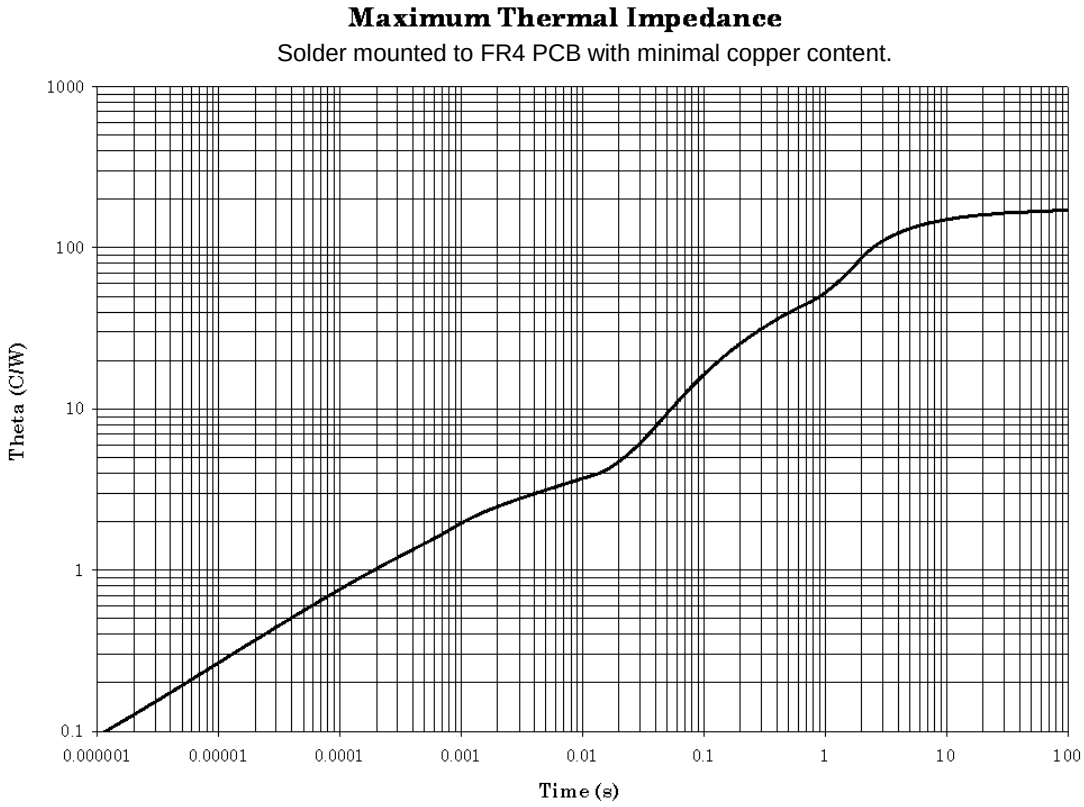
Maximum Thermal Impedance

Solder mounted to copper heatsink at Tc=25C



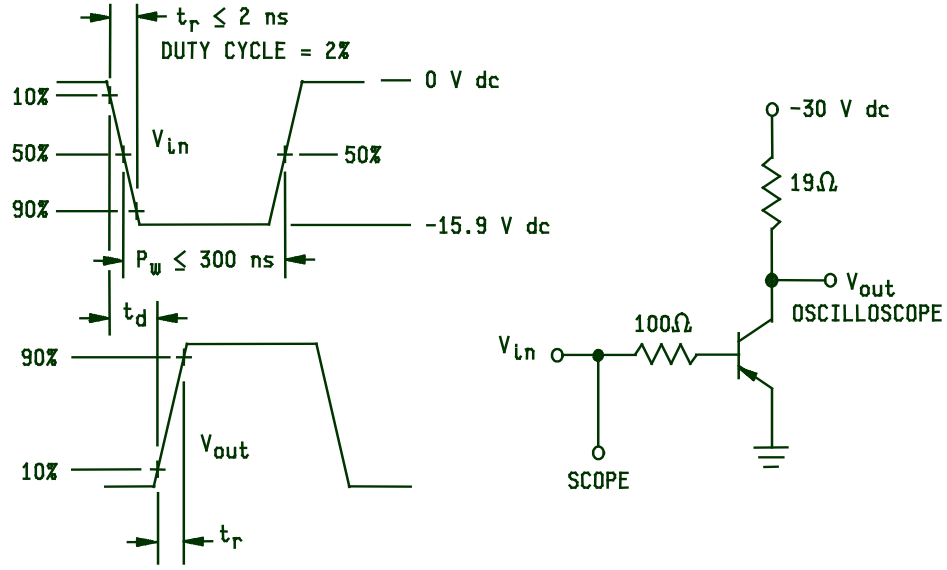
$R_{\theta JC}$ = 5 °C/W

* FIGURE 10. Thermal impedance for 2N3867U4, 2N3868U4.

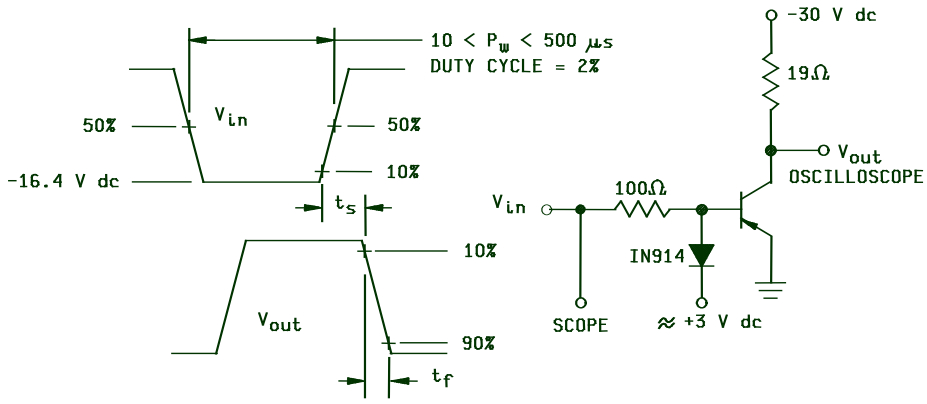


$R_{\theta JPCB}$ = 175 °C/W

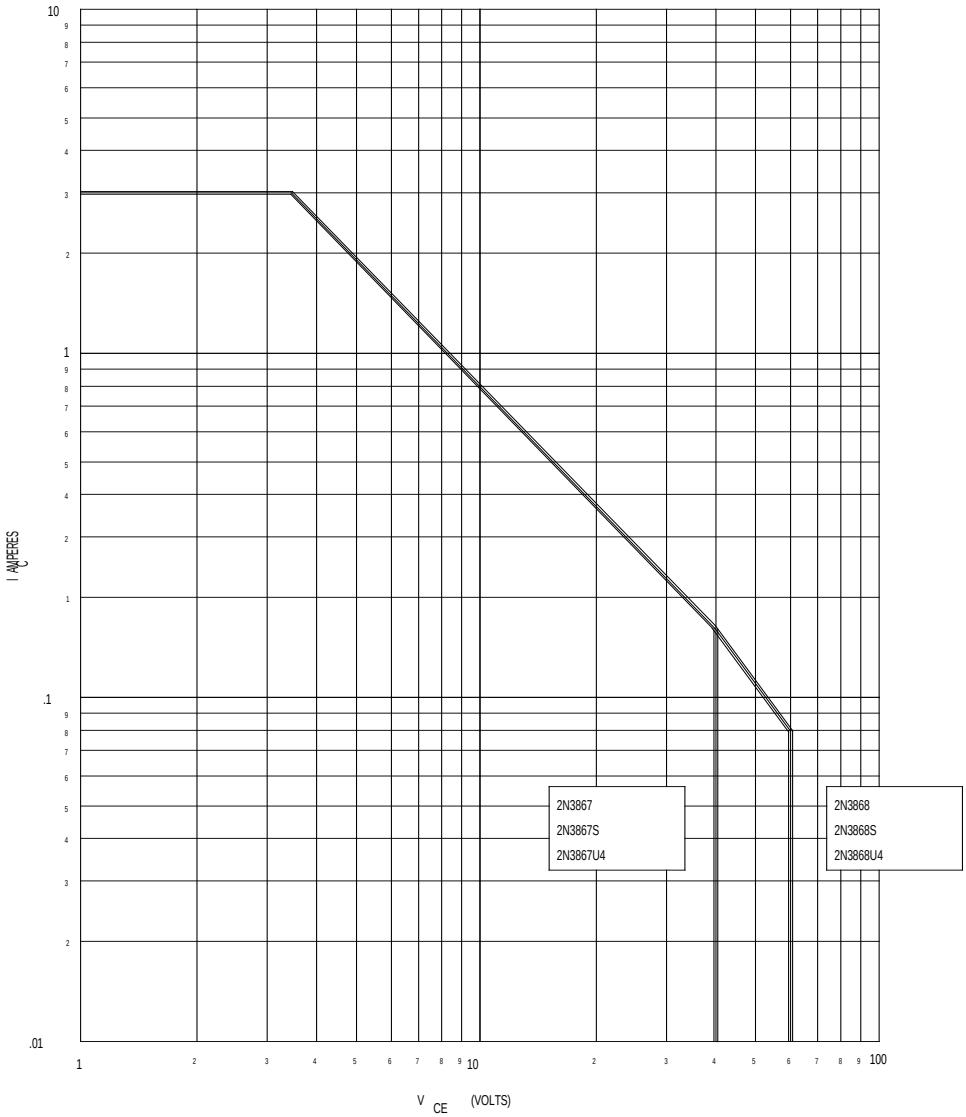
* FIGURE 11. Thermal impedance for 2N3867U4, 2N3868U4.



* FIGURE 12. Equivalent circuit for measuring delay and rise times.



* FIGURE 13. Equivalent circuit for measuring storage and fall times.



* FIGURE 14. Maximum SOA graph (continuous dc).

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory. The notes specified in MIL-PRF-19500 are applicable to this specification.)

6.1 Intended use. Semiconductors conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Packaging requirements (see 5.1).

c. Lead finish (see 3.4.1).

d. Product assurance level and type designator.

* e. For acquisition of RHA designated devices, table II, subgroup 1 testing of group D is optional. If subgroup 1 testing is desired, it should 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 Defense Supply Center, Columbus, ATTN: DSCC/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, JANHCB2N3867) will be identified on the QML.

JANHC and JANKC ordering information	
PIN	Manufacturers
	43611
2N3867	JANHCB2N3867, JANKCB2N3867
2N3868	JANHCB2N3868, JANKCB2N3868

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
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2009-039)

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