

MIL-PRF-19500/182H

1.4 Primary electrical characteristics.

Limits	h_{FE1} (1)	h_{FE2} (1)	h_{FE3} (1)	$ h_{fe} $	$V_{CE(SAT)}$ (1)
	$V_{ce} = 10$ V dc $I_C = 0.1$ mA dc	$V_{ce} = 10$ V dc $I_C = 10$ mA dc	$V_{ce} = 10$ V dc $I_C = 150$ mA dc	$f = 20$ MHz $V_{ce} = 10$ V dc $I_C = 50$ mA dc	$I_C = 50$ mA dc $I_B = 5.0$ mA dc
Min	20	35	40	3.0	<u>V dc</u>
Max			120	10	1.2

(1) Pulsed (see 4.5.1).

2. APPLICABLE DOCUMENTS

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

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

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

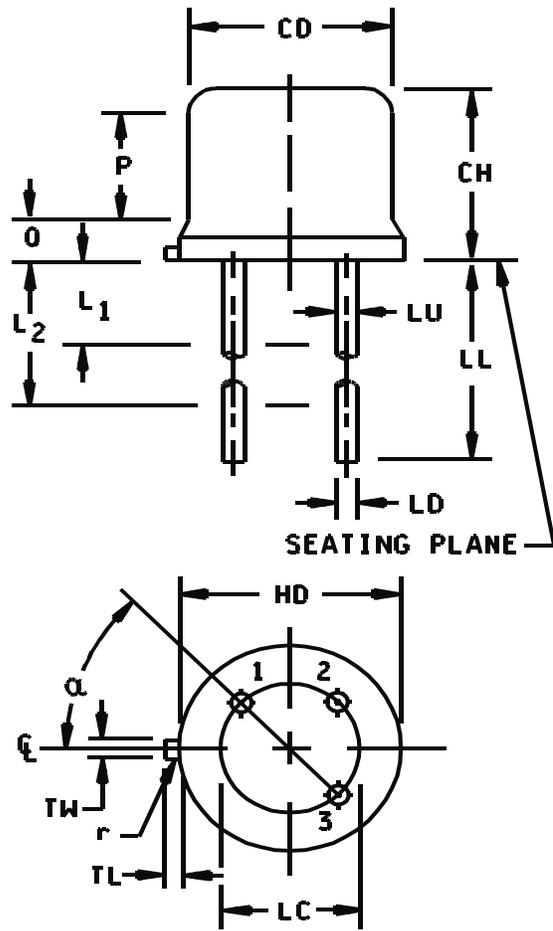
DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Copies of these documents are available online at <https://assist.daps.dla.mil/quicksearch> or <https://assist.daps.dla.mil> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

Ltr	Dimensions				Notes
	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		5
LD		.021		0.53	3, 8
LL	.500		12.70		8, 9
LU	.016	.019	0.41	0.48	3, 8, 9
L ₁		.050		1.27	9
L ₂	.250		6.35		9
P	.100		2.54		
Q		.030		0.76	4
TL	.028	.048	0.71	1.22	7
TW	.036	.046	0.91	1.17	
r		.010		0.25	
α	45° TP		45° TP		

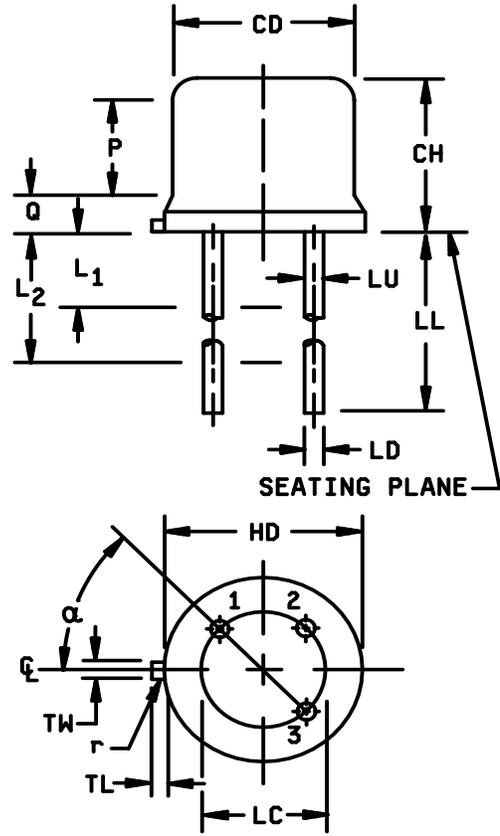


NOTES:

1. Dimensions are in inches.
2. Millimeters equivalents are given for general information only.
3. Measured in the zone beyond .250 inch (6.35 mm) from the seating plane.
4. Details of outline in this zone are optional.
5. When measured in a gauging plane .054 +.001 -.000 inch (1.37 +0.03 -0.00 mm) below the seating plane of the transistor, maximum diameter leads shall be within .007 inch (0.18 mm) of their true location relative to a maximum width tab. Smaller diameter leads shall fall within the outline of the maximum diameter lead tolerance.
6. The collector shall be internally connected to the case.
7. Measured from the maximum diameter of the actual device.
8. All three leads.
9. Symbol LU applies between L₁ and L₂. Dimension LD applies between L₂ and LL minimum. Lead diameter shall not exceed .042 inch (1.07 mm) within L₁ and beyond LL minimum.
10. Lead 1 = emitter, lead 2 = base, lead 3 = collector.
11. In accordance with ASME Y14.5M, diameters are equivalent to ϕ x symbology.

FIGURE 1. Physical dimensions for device type 2N720A (TO-18).

Dimensions					
Symbol	Inches		Millimeters		Notes
	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	See notes				7, 8, 11,12
LU	.016	.019	0.41	0.48	7, 8
L ₁		.050		1.27	7, 8
L ₂	.250		6.35		7, 8
P	.100		2.54		5
Q		.050		1.27	4
r		.010		0.25	10
TL	.029	.045	0.74	1.14	3
TW	.028	.034	0.71	0.86	2
α	45° TP		45° TP		6

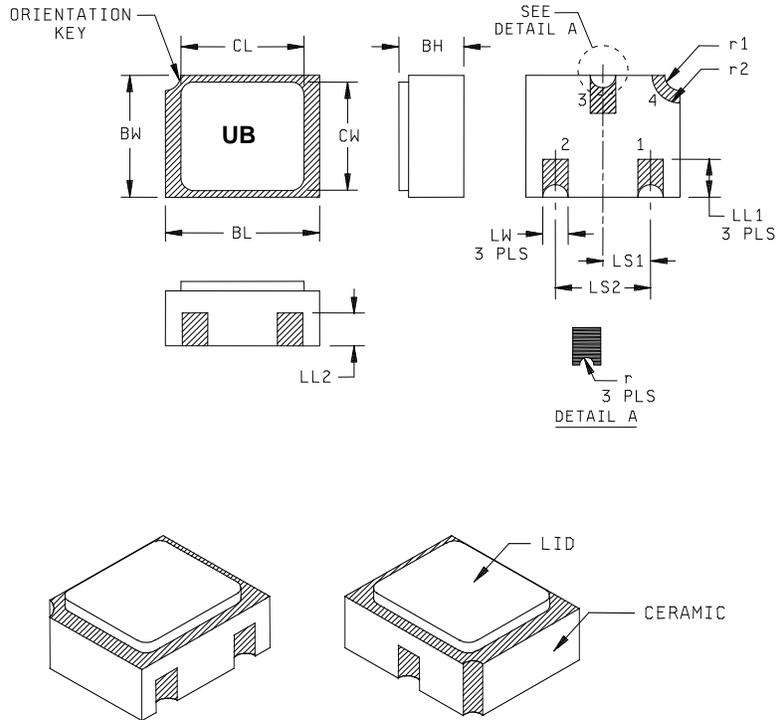


NOTES:

1. Dimension are in inches.
2. Millimeters are given for general information only.
3. Beyond r (radius) maximum, TH shall be held for a minimum length of .011 (0.28 mm).
4. Dimension TL measured from maximum HD.
5. Body contour optional within zone defined by HD, CD, and Q.
6. Leads at gauge plane .054 +.001 -.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC.
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. For 2N1893, dimension LL shall be 1.5 inches (38.1mm) minimum and 1.75 inches (44.4 mm) maximum.
12. For 2N1893S, dimension LL shall be .5 inch (12.7mm) minimum and .75 inch (19.0 mm) maximum.
13. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.
14. Lead 1 = emitter, lead 2 = base, lead 3 = collector.

FIGURE 2. Physical dimensions for device types 2N1893 and 2N1893S (similar to TO-5).

MIL-PRF-19500/182H

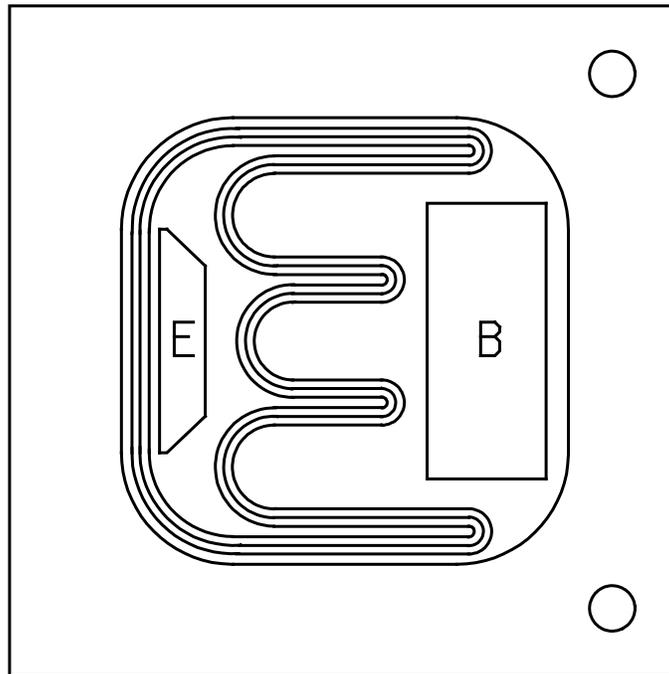


Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
BH	.046	.056	1.17	1.42	
BL	.115	.128	2.92	3.25	
BW	.085	.108	2.16	2.74	
CL		.128		3.25	
CW		.108		2.74	
LL1	.022	.038	0.56	0.96	
LL2	.017	.035	0.43	0.89	
LS1	.036	.040	0.91	1.02	
LS2	.071	.079	1.80	2.01	
LW	.016	.024	0.41	0.61	
r		.008		.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 ϕx symbology.

FIGURE 3. Physical dimensions, surface mount (2N720AUB).



Die size:	.030 x .030 inch (0.76 mm x 0.76 mm).
Die thickness:	.008 ±.0016 inch (0.20 mm ±0.041 mm).
Base pad	.004 x .010 inch (0.10 mm x 0.254 mm).
Emitter pad:	.0023 x .007 inch (0.058 mm x 0.18 mm).
Back metal:	Gold, 6.5 kÅ ±1.95 kÅ.
Top metal:	Aluminum, 12 kÅ. Minimum; 14.5 kÅ. nominal.
Back side:	Collector.
Glassivation:	SiO ₂ , 7.5 kÅ ±1.5 kÅ.

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. In accordance with ASME Y14.5M, diameters are equivalent to ϕ x symbology.

FIGURE 4. JANHCA2N720A and JANKCA2N720A 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 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.
UB	Surface mount case outlines (see figure 3).

3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in MIL-PRF-19500, and on figures 1, 2, 3, and 4.

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).

* 3.4.2 Marking. Devices shall be marked in accordance with MIL-PRF-19500. The prefixes JAN, JANTX, JANTXV, and JANS can be abbreviated as J, JX, JV, and JS respectively. 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).

* 3.5 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 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 and II).

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 (list applicable JANS, JANTX, and JANTXV levels). 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) 3a	Thermal impedance (see 4.3.2).	Thermal impedance (see 4.3.2).
7	Optional	Optional
9	I_{CBO2} , h_{FE3}	Not applicable
11	I_{CBO2} , h_{FE3} ΔI_{CBO2} = 100 percent of initial value or 5 nA dc, whichever is greater; Δh_{FE3} = 15 percent of initial value.	I_{CBO2} , h_{FE3}
12	See 4.3.1 .	See 4.3.1 .
13	ΔI_{CBO2} = 100 percent of initial value or 5 nA dc, whichever is greater; Δh_{FE3} = 15 percent of initial value, subgroup 2 and 3 of table I herein.	ΔI_{CBO2} = 100 percent of initial value or 5 nA dc, whichever is greater; Δh_{FE3} = 15 percent of initial value, subgroup 2 of table I herein.
14	Required	Required

(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 $T_J = +135^\circ\text{C}$ 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.

4.3.2 Thermal impedance. The thermal impedance measurements shall be performed in accordance with method 3131 of MIL-STD-750 using the guidelines in that method for determining I_M , I_H , t_H , t_{SW} (V_C and V_H where appropriate). Measurement delay time (t_{MD}) = 70 μs max. See group E, subgroup 4 herein.

4.3.3 Screening (JANHC and JANKC). Screening of JANHC and JANKC die shall be in accordance with MIL-PRF-19500, "Discrete Semiconductor Die/Chip Lot Acceptance". As a minimum, die shall be 100-percent probed to ensure compliance with group A, subgroup 2. Burn-in duration for the JANKC level follows JANS requirements; the JANHC follows JANTX requirements.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500 and [table I](#) herein.

4.4.2 Group B inspection. See [4.4.2.1](#) for JAN, JANTX, and JANTXV group B testing. Electrical measurements (end-points) shall be in accordance with [table I](#), subgroup 2 herein.

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

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
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B4	1037	$V_{CB} = 10$ V dc, adjust device current, or power, to achieve a minimum ΔT_J of $+100^\circ\text{C}$.
B5	1027	$V_{CB} = 10$ V dc; $P_D \geq 100$ 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 shall be analyzed to the extent possible to identify root cause and corrective action.

<u>Step</u>	<u>Method</u>	<u>Condition</u>
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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 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, $T_A = 150^\circ\text{C}$, $V_{CB} = 80$ percent of rated voltage, 48 hours minimum. $n = 45$ devices, $c = 0$.
3	1032	High-temperature life (non-operating), $t = 340$ hours $T_A = +200^\circ\text{C}$. $n = 22$, $c = 0$.

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.
- 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 (group B for JAN, JANTX, and JANTXV) may be pulled prior to the application of final lead finish.

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

* 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 to the 2N720AUB).
C5	3131	$R_{\theta JA}$ and $R_{\theta JC}$ only, as applicable (see 1.3 and 4.3.2).
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 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 (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 to the 2N720AUB).
C5	3131	$R_{\theta JA}$ and $R_{\theta JC}$ only, as applicable (see 1.3 and 4.3.2).
C6	1026	Not applicable.

4.4.3.3 Group C sample selection. Samples selected from group C inspection 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 group 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. Alternate package options may also be substituted for the testing provided there is no adverse effect to the fluence profile.

* 4.4.5 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-IX of MIL-PRF-19500 and as specified in table 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 appropriate tables and as follows.

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

MIL-PRF-19500/182H

* TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1 2/</u>						
Solderability	2026	n = 15 leads, c = 0				
Resistance to solvents <u>3/</u>	1022	n = 15 devices, c = 0				
Temp cycling	1051	Test condition C, 25 cycles. n = 22 devices, c = 0				
Hermetic seal <u>4/</u> Fine leak Gross leak	1071	n = 22 devices, c = 0				
Electrical measurements		Table I , subgroup 2				
Bond strength	2037	Precondition T _A = +250°C at t = 24 hours or T _A = +300°C at t = 2 hours, n = 11 wires, c = 0				
Decap internal visual (design verification)	2075	n = 4 devices, 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} = 120 V dc pulsed (see 4.5.1).	I _{CBO1}		100	μA dc
Emitter to base cutoff current	3061	Bias condition D, V _{EB} = 7 V dc pulsed (see 4.5.1).	I _{EBO1}		100	μA dc
Breakdown voltage, collector-emitter	3011	Bias condition D; I _C = 30 mA dc; pulsed (see 4.5.1)	V _{(BR)CEO}	80		V dc
Breakdown voltage collector-emitter	3011	Bias condition D, I _C = 10 mA dc, pulsed (see 4.5.1), R _{BE} = 10 Ω	V _{(BR)CER}	100		V dc
Collector to base cutoff current	3036	Bias condition D, V _{CB} = 90 V dc	I _{CBO2}		10	nA dc
Emitter-base cutoff current	3061	Bias condition D, V _{EB} = 5 V dc	I _{EBO2}		10	nA dc
Collector-emitter saturated voltage	3071	I _C = 150 mA dc, I _B = 15 mA dc, pulsed (see 4.5.1)	V _{CE(sat)1}		5.0	V dc

See footnotes at end of table.

MIL-PRF-19500/182H

* TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u> - Continued						
Collector-emitter saturated voltage	3071	$I_C = 50 \text{ mA dc}$, $I_B = 5 \text{ mA dc}$, pulsed (see 4.5.1)	$V_{CE(sat)2}$		1.2	V dc
Base-emitter saturated voltage	3066	Test condition A, $I_C = 150 \text{ mA dc}$, $I_B = 15 \text{ mA dc}$, pulsed (see 4.5.1)	$V_{BE(sat)1}$		1.3	V dc
Base-emitter saturated voltage	3066	Test condition A, $I_C = 50 \text{ mA dc}$, $I_B = 5 \text{ mA dc}$, pulsed (see 4.5.1)	$V_{BE(sat)2}$		1.2	V dc
Forward-current transfer ratio	3076	$V_{CE} = 10 \text{ V dc}$, $I_C = 0.1 \text{ mA dc}$, pulsed (see 4.5.1)	h_{FE1}	20		
Forward-current transfer ratio	3076	$V_{CE} = 10 \text{ V dc}$, $I_C = 10 \text{ mA dc}$, pulsed (see 4.5.1)	h_{FE2}	35		
Forward-current transfer ratio	3076	$V_{CE} = 10 \text{ V dc}$, $I_C = 150 \text{ mA dc}$, pulsed (see 4.5.1)	h_{FE3}	40	120	
<u>Subgroup 3</u>						
High temperature operation:		$T_A = +150^\circ\text{C}$				
Collector to base cutoff current	3036	Bias condition D, $V_{CB} = 90 \text{ V dc}$	I_{CBO3}		15	$\mu\text{A dc}$
Low temperature operation		$T_A = -55^\circ\text{C}$				
Forward-current transfer ratio	3076	$V_{CE} = 10 \text{ V dc}$, $I_C = 10 \text{ mA dc}$, pulsed (see 4.5.1)	h_{FE4}	20		
<u>Subgroup 4</u>						
Small signal short circuit forward current transfer ratio	3206	$V_{CE} = 5 \text{ V dc}$, $f = 1 \text{ kHz}$, $I_C = 1 \text{ mA dc}$:	h_{fe}	35	100	
		$V_{CE} = 10 \text{ V dc}$, $f = 1 \text{ kHz}$, $I_C = 5 \text{ mA dc}$	h_{fe}	45	150	
Magnitude of common emitter small-signal short-circuit forward-current transfer ratio	3306	$V_{CE} = 10 \text{ V dc}$, $f = 20 \text{ MHz}$, $I_C = 50 \text{ mA dc}$	$ h_{fe} $	3	10	
Small signal short circuit input impedance	3201	$V_{CB} = 10 \text{ V dc}$, $I_C = 5 \text{ mA dc}$	h_{ib}	4	8	ohms

See footnotes at end of table.

MIL-PRF-19500/182H

* TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4</u> - Continued						
Small signal short circuit output admittance	3216	$V_{CB} = 10 \text{ V dc}, I_C = 5 \text{ mA dc}$	h_{ob}	0	0.5	$\mu \text{ ohms}$
Small signal open circuit reverse voltage transfer ratio	3211	$V_{CB} = 10 \text{ V dc}, I_C = 5 \text{ mA dc}$	h_{rb}		1.5×10^{-4}	
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}	2	15	pF
Pulse response	3251	Test condition A, except test circuit and pulse requirements. See figure 9 herein.	$t_{on} + t_{off}$		30	ns
<u>Subgroups 5, 6, and 7</u>						
Not applicable						

1/ For sampling plan see MIL-PRF-19500.

2/ For resubmission of failed test in 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/ Not required for laser marked devices.

4/ This hermetic seal test is an end-point to temp-cycling in addition to electrical measurements.

MIL-PRF-19500/182H

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

Inspection <u>1/ 2/ 3/</u>	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; $V_{CB} = 120$ V dc; pulsed (see 4.5.1)	I_{CBO1}		200	μ A dc
Emitter to base cutoff current	3061	Bias condition D; $V_{EB} = 7.0$ V dc; pulsed (see 4.5.1)	I_{EBO1}		200	μ A dc
Breakdown voltage, collector - emitter	3011	Bias condition D; $I_C = 30$ mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	80		V dc
Breakdown voltage, collector - emitter	3011	Bias condition D; $I_C = 10$ mA dc; pulsed (see 4.5.1), $R_{BE} = 10 \Omega$	$V_{(BR)CER}$	100		V dc
Collector to base cutoff current	3036	Bias condition D, $V_{CB} = 90$ V dc	I_{CBO2}		20	η A dc
Emitter - base cutoff current	3061	Bias condition D; $V_{EB} = 5$ V dc	I_{EBO2}		20	η A dc
Collector – emitter saturated voltage	3071	$I_C = 150$ mA dc; $I_B = 15$ mA dc; pulsed (see 4.5.1)	$V_{CE(sat)1}$		5.75	V dc
Collector – emitter saturated voltage	3071	$I_C = 50$ mA dc; $I_B = 5$ mA dc; pulsed (see 4.5.1)	$V_{CE(sat)2}$		1.38	V dc
Base - emitter saturated voltage	3066	Test condition A; $I_C = 150$ mA dc; $I_B = 15$ mA dc, pulsed (see 4.5.1)	$V_{BE(sat)1}$		1.50	V dc
Base - emitter saturated voltage	3066	Test condition A; $I_C = 50$ mA dc; $I_B = 5$ mA dc, pulsed (see 4.5.1)	$V_{BE(sat)2}$		1.38	V dc
Forward-current transfer ratio	3076	$V_{CE} = 10$ V dc, $I_C = 0.1$ mA dc, pulsed (see 4.5.1)	$[h_{FE1}] \underline{5/}$	[10]		
Forward-current transfer ratio	3076	$V_{CE} = 10$ V dc, $I_C = 10$ mA dc, pulsed (see 4.5.1)	$[h_{FE2}] \underline{5/}$	[17.5]		
Forward-current transfer ratio	3076	$V_{CE} = 10$ V dc, $I_C = 150$ mA dc, pulsed (see 4.5.1)	$[h_{FE3}] \underline{5/}$	[20]	120	

See footnotes at end of table.

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

Inspection <u>1/ 2/ 3/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u>						
Steady-state total dose irradiation	1019	Gamma exposure $V_{CES} = 64$ V				
Collector to base cutoff current	3036	Bias condition D; $V_{CB} = 120$ V dc; pulsed (see 4.5.1)	I_{CBO1}		200	μ A dc
Emitter to base cutoff current	3061	Bias condition D; $V_{EB} = 7.0$ V dc; pulsed (see 4.5.1)	I_{EBO1}		200	μ A dc
Breakdown voltage, collector - emitter	3011	Bias condition D; $I_C = 30$ mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	80		V dc
Breakdown voltage, collector - emitter	3011	Bias condition D; $I_C = 10$ mA dc; pulsed (see 4.5.1), $R_{BE} = 10 \Omega$	$V_{(BR)CER}$	100		V dc
Collector to base cutoff current	3036	Bias condition D, $V_{CB} = 90$ V dc	I_{CBO2}		20	η A dc
Emitter - base cutoff current	3061	Bias condition D; $V_{EB} = 5$ V dc	I_{EBO2}		20	η A dc
Collector - emitter saturated voltage	3071	$I_C = 150$ mA dc; $I_B = 15$ mA dc; pulsed (see 4.5.1)	$V_{CE(sat)1}$		5.75	V dc
Collector - emitter saturated voltage	3071	$I_C = 50$ mA dc; $I_B = 5$ mA dc; pulsed (see 4.5.1)	$V_{CE(sat)2}$		1.38	V dc
Base - emitter saturated voltage	3066	Test condition A; $I_C = 150$ mA dc; $I_B = 15$ mA dc, pulsed (see 4.5.1)	$V_{BE(sat)1}$		1.50	V dc
Base - emitter saturated voltage	3066	Test condition A; $I_C = 50$ mA dc; $I_B = 5$ mA dc, pulsed (see 4.5.1)	$V_{BE(sat)2}$		1.38	V dc
Forward-current transfer ratio	3076	$V_{CE} = 10$ V dc, $I_C = 0.1$ mA dc, pulsed (see 4.5.1)	$[h_{FE1}]$ <u>5/</u>	[10]		
Forward-current transfer ratio	3076	$V_{CE} = 10$ V dc, $I_C = 10$ mA dc, pulsed (see 4.5.1)	$[h_{FE2}]$ <u>5/</u>	[17.5]		
Forward-current transfer ratio	3076	$V_{CE} = 10$ V dc, $I_C = 150$ mA dc, pulsed (see 4.5.1)	$[h_{FE3}]$ <u>5/</u>	[20]	120	

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.

MIL-PRF-19500/182H

* 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>			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 herein.	
<u>Subgroup 2</u>			45 devices c = 0
Intermittent life	1037	Intermittent operation life: $V_{CB} = 10$ V dc, 6,000 cycles. Adjust device current, or power, to achieve a minimum ΔT_J of +100°C.	
Electrical measurements		See table I , subgroup 2 herein.	
<u>Subgroup 4</u>			
* Thermal resistance	3131	$R_{\theta JSP(IS)}$ can be calculated but shall be measured once in the same package with a similar die size to confirm calculations (may apply to multiple specification sheets).	15 devices, c = 0
Thermal impedance curves.		See table E-IX of MIL-PRF-19500, group E, subgroup 4.	Sample size N/A
<u>Subgroup 5</u>			
Not applicable			
<u>Subgroup 8</u>			
Reverse stability	1033	Condition B.	45 devices c = 0

Maximum Thermal Impedance

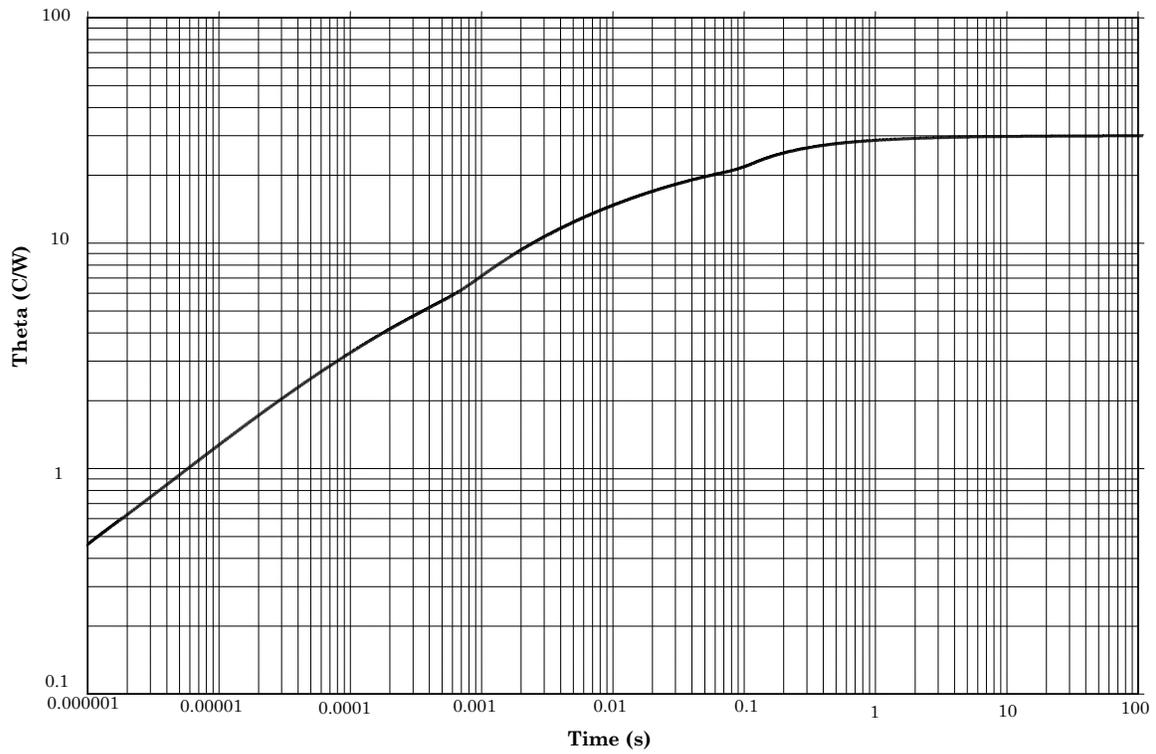


FIGURE 5. Thermal impedance graph ($R_{\theta JC}$) for 2N1893 and 2N1893S (TO-5).

Maximum Thermal Impedance

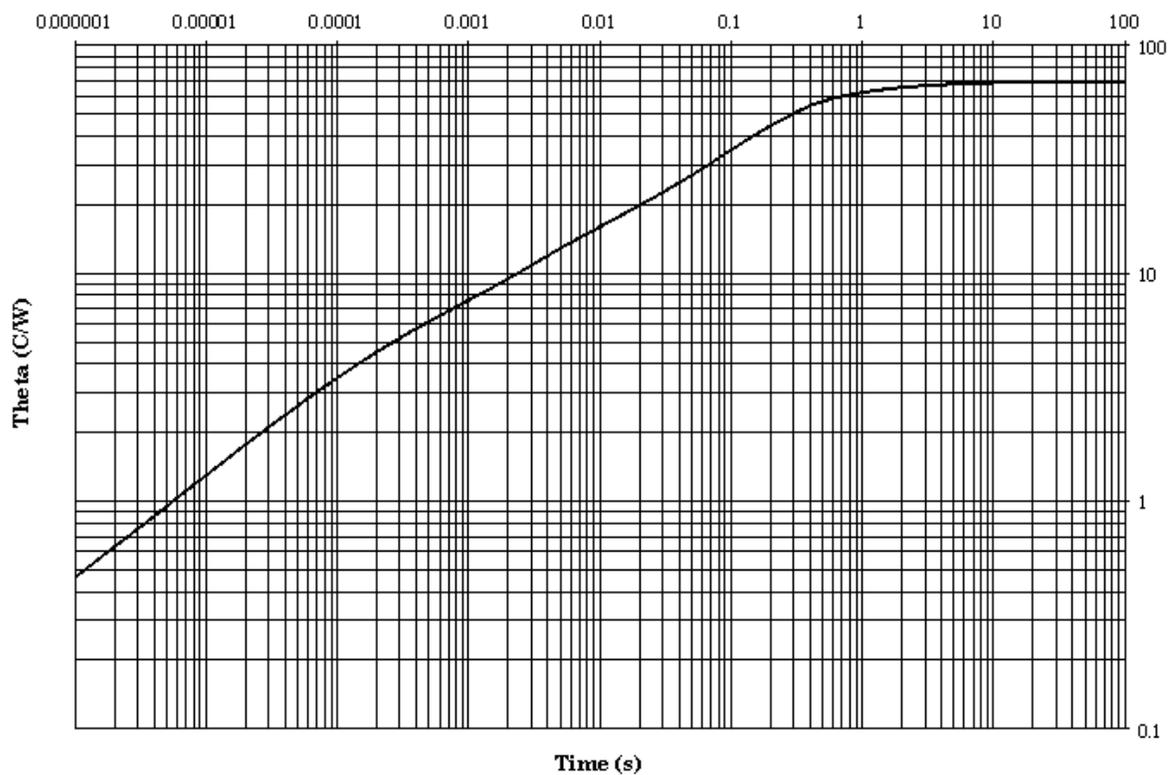


FIGURE 6. Thermal impedance graph ($R_{\theta JC}$) for 2N1893 and 2N1893S (TO-18).

Maximum Thermal Impedance

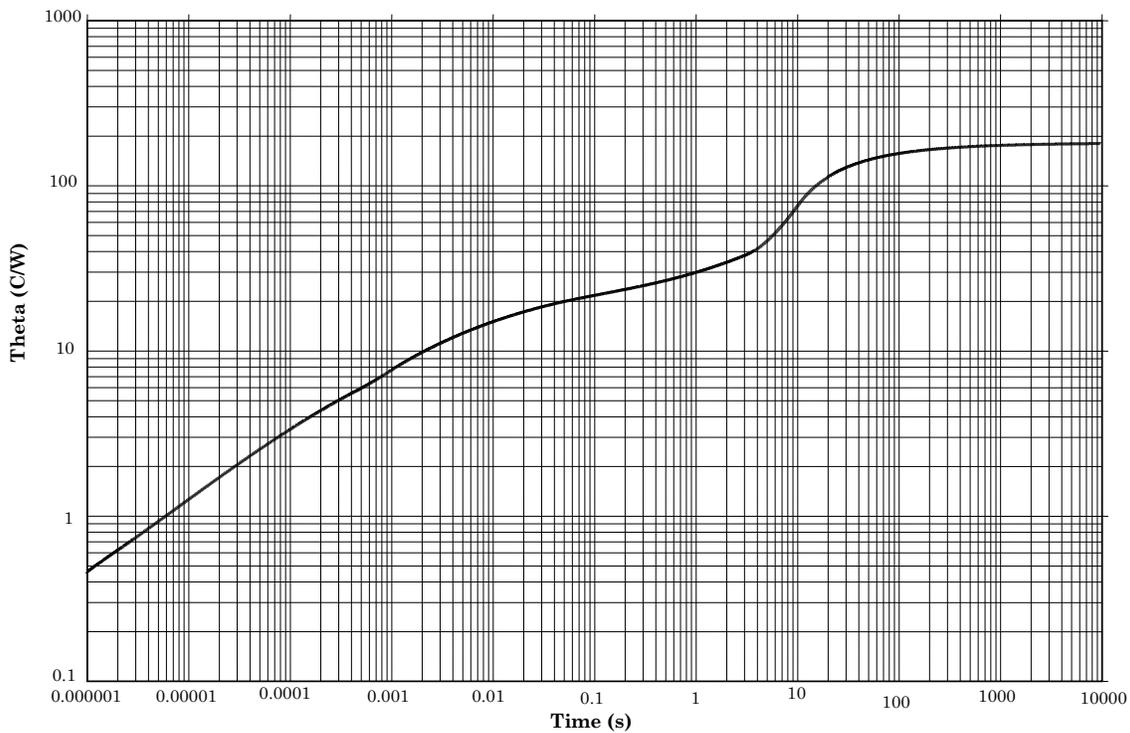


FIGURE 7. Thermal impedance graph ($R_{\theta JA}$) for 2N1893 and 2N1893S (TO-5).

Maximum Thermal Impedance

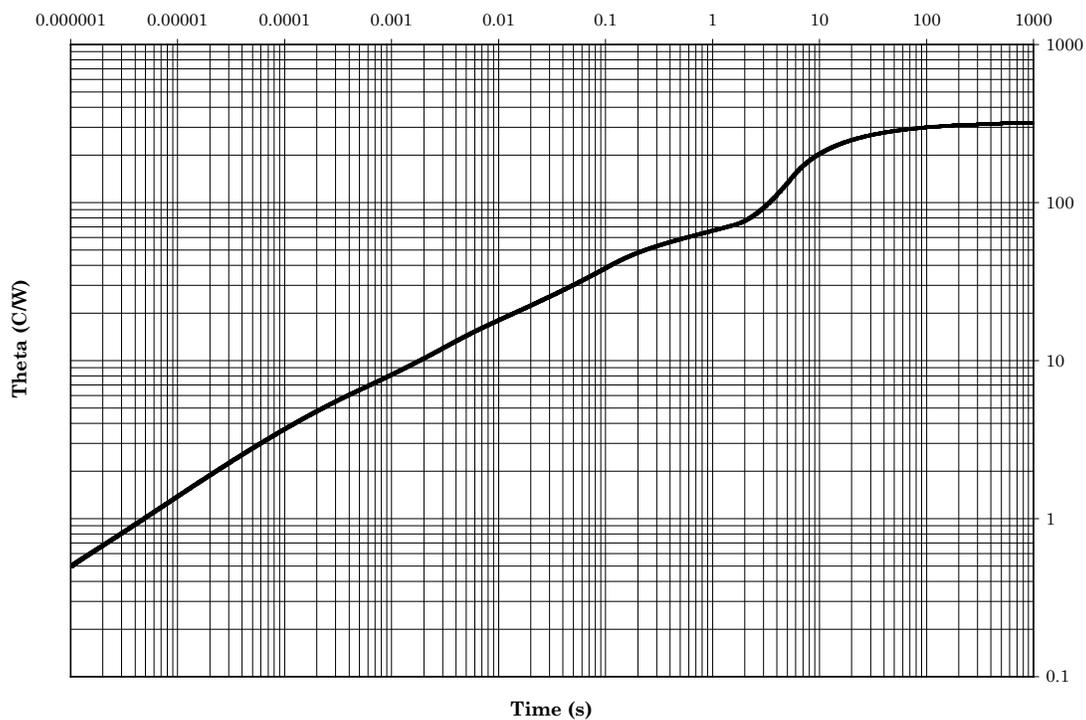
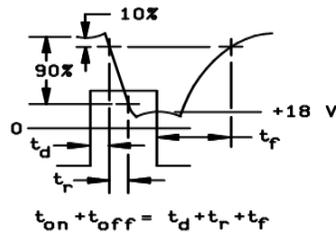
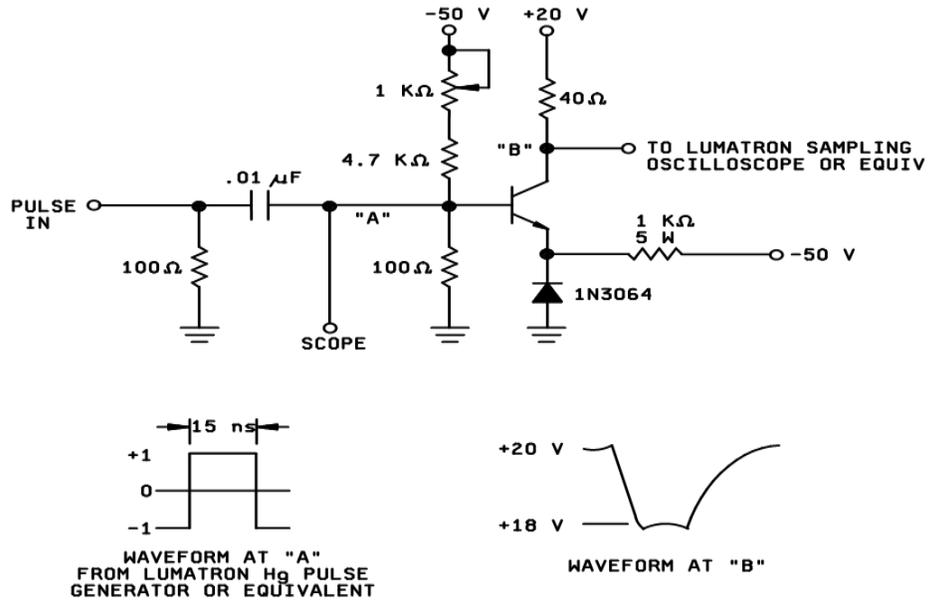


FIGURE 8. Thermal impedance graph ($R_{\theta JA}$) for 2N1893 and 2N1893S (TO-18).



NOTES:

1. The rise time (T_r) of the applied pulse shall be $2.0 \leq$ nanoseconds, duty cycle ≤ 2 percent, and the generator source impedance shall be 50 ohms.
2. Sampling oscilloscope: $Z_{in} 100$ K ohms, $C_{in} \leq 12$ pF, rise time ≤ 5 nsec.

FIGURE 9. Pulse response (turn-on plus turn-off) measurement circuit and waveforms.

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 JANHCA2N720A) will be identified on the QML

Die ordering information	
PIN	Manufacturer
2N720A	JANHCA2N720A JANKCA2N720A

MIL-PRF-19500/182H

* 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 5961-2010-080)

Review activities:
Army - AR, MI, SM
Navy - AS, MC
Air Force - 19, 71, 99

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