

The documentation and process conversion measures necessary to comply with this revision shall be completed by 20 March 1999

INCH-POUND

MIL-PRF-19500/394D
 20 December 1998
 SUPERSEDING
 MIL-S-19500/394C
 12 August 1997

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, POWER SWITCHING
 TYPES: 2N4150, 2N5237, 2N5238, 2N4150S, 2N5237S, AND 2N5238S
 JAN, JANTX, JANTXV, AND JANS

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for NPN, silicon, low-power, high voltage transistors. Four levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (TO- 5).

1.3 Maximum ratings.

Types	P_T <u>1/</u> $T_A = +25^\circ\text{C}$	P_T <u>2/</u> $T_C = +25^\circ\text{C}$	V_{CBO}	V_{CEO}	V_{EBO}	I_C	T_{STG} and T_{OP}	$R_{\theta JC}$ (max)	$R_{\theta JA}$ (min)
	<u>W</u>	<u>W</u>	<u>V dc</u>	<u>V dc</u>	<u>V dc</u>	<u>A dc</u>	<u>°C</u>	<u>°C/mW</u>	<u>°C/mW</u>
2N4150, S	1.0	5.0	100	70	10	10	-65 to +200	.020	.175
2N5237, S	1.0	5.0	150	120	10	10	-65 to +200	.020	.175
2N5238, S	1.0	5.0	200	170	10	10	-65 to +200	.020	.175

1/ Derate linearly 5.7 mW/°C for $T_A > +25^\circ\text{C}$.

2/ Derate linearly 50 mW/°C for $T_C > +25^\circ\text{C}$.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Supply Center Columbus, ATTN: DSCC-VAT, 3990 East Broad Street, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

1.4 Primary electrical characteristics.

	h_{FE2} ^{1/}	h_{FE3} ^{1/}	C_{obo}	h_{fe}	$V_{BE(sat)}$ ^{1/}	$V_{CE(sat)}$
Limits	$I_C = 5 \text{ A dc}$ $V_{CE} = 5 \text{ V dc}$	$I_C = 10 \text{ A dc}$ $V_{CE} = 5 \text{ V dc}$	$I_E = 0$ $V_{CB} = 10 \text{ V dc}$ $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	$I_C = 0.2 \text{ A dc}$ $V_{CE} = 10 \text{ V dc}$ $f = 10 \text{ MHz}$	$I_C = 5 \text{ A dc}$ $I_B = 0.5 \text{ A dc}$	$I_C = 5 \text{ A dc}$ $I_B = 0.5 \text{ A dc}$
Min	40	10	μF	1.5	V dc	V dc
Max	120		350	7.5	1.5	0.6

^{1/} Pulsed, (see 4.5.1).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 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 and 4 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 listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

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

STANDARD

MILITARY

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated specifications or specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. Devices furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2 Associated specification. The individual item requirements shall be in accordance with MIL-PRF-19500 and as specified herein.

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

3.4 Interface requirements and physical dimensions. The interface requirements and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 herein.

3.4.1 Lead material and 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 Diode construction. These devices shall be constructed in a manner and using materials which enable the diodes to meet the applicable requirements of MIL-PRF-19500 and this document.

3.5 Marking. Marking shall be in accordance with 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 4.4.2 and 4.4.3 herein.

4. VERIFICATION

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

- a. Qualification inspection (see 4.2).
- b. Screening (see 4.3).
- c. Conformance inspection (see 4.4).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500.

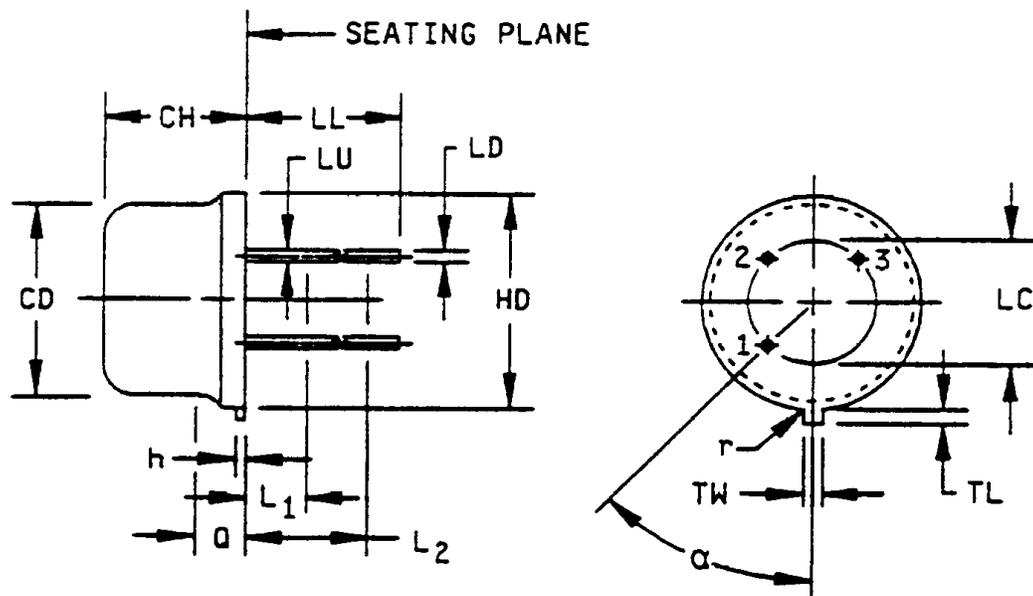


FIGURE 1. Physical dimensions .

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.335	7.75	8.51	
CH	.240	.260	6.10	6.60	
h	.009	.041	0.23	1.04	
HD	.335	.370	8.51	9.40	
LC	.200 TP		5.08 TP		6
LD	.016	.021	0.41	0.53	7
LL	See notes 14 and 15				
LU	.016	.019	0.41	0.48	7
L ₁	---	.050	---	1.27	7
L ₂	.250	---	6.35	---	7
Q	---	.050	---	1.27	4,13
r	---	.010	---	0.25	11,12
TL	.029	.045	0.74	1.14	3
TW	.028	.034	0.71	0.86	10
α	45° TP		45° TP		6

NOTES:

- Dimensions are in inches.
- Metric equivalents are given for general information only.
- Symbol TL is measured from HD maximum.
- Lead number 4 omitted on this variation.
- CD shall not vary more than .010 inch (0.25 mm) in zone P. This zone is controlled for automatic handling.
- Leads at gauge plane .054 inch (1.37 mm) + .001 (0.03 mm) - .000 inch (0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) relative to the tab. The device may be measured by direct methods or by the gauge and gauging procedure described on gauge drawing on figure 2.
- LD 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.
- Lead designation is as follows: 1 - emitter; 2 - base; 3 - collector.
- Lead number three is electrically connected to case.
- Beyond r maximum, TW shall be held for a minimum length of .011 inch (0.28 mm).
- r (radius) applies to both inside corners of tab.
- Tab shown omitted.
- Details of outline in this zone optional.
- For transistor types 2N4150S, 2N5237S, and 2N5238S, dimension LL = .500 inch (12.70 mm) minimum, and .750 inch (19.5 mm) maximum.
- For transistor types 2N4150, 2N5237, and 2N5238, dimension LL = 1.500 inch (38.10 mm) minimum, and 1.750 inches (44.45 mm) maximum

FIGURE 1. Physical dimensions - Continued.

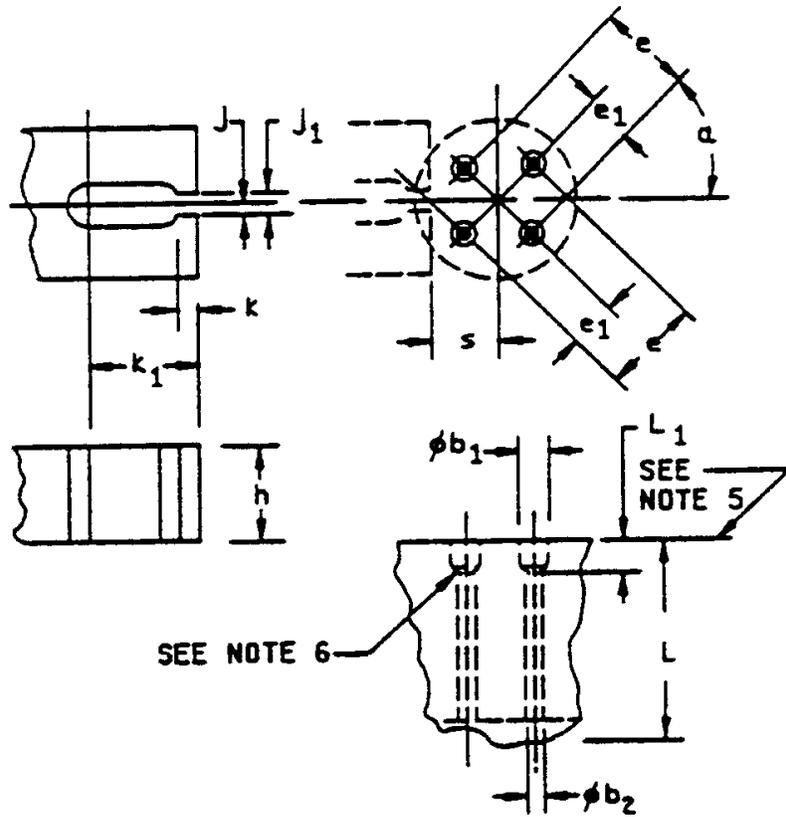


FIGURE 2. Gauge for lead and tab location.

Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
e	.1995	.2005	5.07	5.09
e1	.0995	.1005	2.53	2.55
fb1	.0595	.0605	1.511	1.537
fb2	.0325	.0335	0.824	0.851
h	.150 Nom		3.81 Nom	
j	.0175	.0180	0.44	0.46
j1	.0350	.0355	0.89	0.90
k	.009	.011	0.23	0.28
k1	.125 Nom		3.18 Nom	
L	.372	.378	9.45	9.60
L1	.054	.055	1.37	1.40
S	.182	.199	4.62	5.05
μ	44.90°	45.10°	44.90°	45.10°

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. The location of the tab locator, within the limits indicated, will be determined by the tab and flange dimensions of the device being checked.
4. The following gauging procedure shall be used:

The use of a pin straightener prior to insertion in the gauge is permitted. The device being measured shall be inserted until its seating plane is 0.125 ± 0.010 inch ($3.18 \text{ mm} \pm 0.25 \text{ mm}$) from the seating surface of the gauge. A spacer may be used to obtain the 0.125 inch (3.18 mm) distance from the gauge seat prior to force application. A force of 8 inch-ounce ± 0.50 inch-ounce shall then be applied parallel and symmetrical to the device's cylindrical axis. When examined visually after the force application (the force need not be removed) the seating plane of the device shall be seated against the gauge.

5. Gauging plane.
6. Drill angle.

FIGURE 2. Gauge for lead and tab location - Continued.

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

Screen (see table IV of MIL-PRF-19500)	Measurement	
	JANS level	JANTX and JANTXV levels
3c	Thermal impedance (see 4.3.3)	Thermal impedance (see 4.3.3)
7	Hermetic seal (optional)	<u>1/</u>
9	I_{CB02} and h_{FE1}	Not applicable
10	48 hours minimum	48 hours minimum
11	I_{CB02} ; h_{FE1} ; ΔI_{CB02} = 100 percent of initial value or 50 nA dc, whichever is greater; Δh_{FE1} = \pm 15 percent of initial value.	I_{CB02} and h_{FE1}
12	See 4.3.1 240 hours minimum	See 4.3.1 80 hours minimum
13	Subgroups 2 and 3 of table I herein; ΔI_{CB02} = 100 percent of initial value or 50 nA dc, whichever is greater; Δh_{FE1} = \pm 15 percent of initial value.	Subgroup 2 of table I herein; ΔI_{CB02} = 100 percent of initial value or 50 nA dc, whichever is greater; Δh_{FE1} = \pm 15 percent of initial value.

1/ Hermetic seal test shall be performed in either screen 7 or screen 14.

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows: T_A = Room ambient as defined in the general requirements of MIL-STD-750, paragraph 4.5:

V_{CB} = 10 V dc, P_T = 1.0 mW .

NOTE: No heat sink or forced air cooling on the devices shall be permitted.

4.3.3 Thermal impedance ($Z_{\theta JX}$ measurements). The $Z_{\theta JX}$ measurements shall be performed in accordance with MIL-STD-750, Method 3131.

- a. I_M measurement current ----- 10 mA.
- b. I_H forward heating current ----- 1 A.
- c. t_H heating time ----- 100 ms.
- d. t_{MD} measurement delay time ----- 30 – 60 μ s.
- e. V_{CE} collector-emitter voltage ----- 16 V dc minimum.

The maximum limit for $Z_{\theta JX}$ under these test conditions are $Z_{\theta JX}$ (max) = 12 °C/W.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500 and as specified herein. If alternate screening is being performed per MIL-PRF-19500, a sample of screened devices shall be submitted to and pass the requirements of group A1 and A2 inspection only (table VIb, group B, subgroup 1 is not required to be performed again if group B has already been satisfied in accordance with 4.4.2).

4.4.1 Group A inspection. Group A inspection shall be conducted with MIL-PRF-19500, and table I herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in VIa (JANS) of 4.4.2.1. Electrical measurements (end-points) and delta requirements shall be in accordance with group A, subgroup 2 and 4.5.3 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 group A, subgroup 2 and 4.5.3 herein.

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

Subgroup	Method	Condition
B4	1037	$V_{CB} = 10$ V dc; $P_T = 1.0$ W at : $T_A =$ Room ambient as defined in the general requirements of MIL-STD-750 see 4.5; $t_{ON} = t_{OFF} = 3$ minutes minimum for 2,000 cycles.
B5	1027	$V_{CB} = 10$ V dc; $P_T = 1.0$ W at $T_A = 100^\circ\text{C}$ (or $P_T = 1.43$ W at $T_A = +25^\circ\text{C}$) for 96 hours.
B6	3131	See 4.5.2.

4.4.2.2 Group B inspection. (JAN, JANTX, and JANTXV). 1/

Step	Method	Condition
1	1039	Steady-state life: Test condition B, 340 hours, $V_{CB} = 10$ -30 V dc, $T_J = 150^\circ\text{C}$ min. No heat sink or forced-air cooling on the devices shall be permitted. $n = 45$ devices, $c = 0$
2	1039	The steady state life test of step 1 shall be extended to 1,000 hours for each die design. Samples shall be selected from a wafer lot every twelve months of wafer production. Group B step 2 shall not be required more than once for any single wafer lot. $n = 45$, $c = 0$.
3	1032	High-temperature life (non-operating), $T_A = +200^\circ\text{C}$. $n = 22$, $c = 0$

1/ Separate samples may be used for each step. In the event of a group B failure, the manufacturer may pull a new sample at double size from either the failed assembly lot or from another assembly lot from the same wafer lot. If the new "assembly lot" option is exercised, the failed assembly lot shall be scrapped.

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

- a. For JAN, JANTX, and JANTXV samples shall be selected randomly from a minimum of three wafers (or from each wafer in the lot) from each wafer lot. For JANS, samples shall be selected from each inspection lot. See MIL-PRF-19500.
- b. Must be chosen from an inspection lot that has been submitted to and passed group A, subgroup 2, conformance inspection. When the final lead finish is solder or any plating prone to oxidation at high temperature, the samples for life test (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 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 4.5.3 herein.

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

Subgroup	Method	Condition
C2	2036	Test condition E.
C6	1026	$V_{CB} = 10 \text{ V dc}$; $T_J = 150^\circ\text{C}$. No heat sink or forced-air cooling on the devices shall be permitted.

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.
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. 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 E inspection. Group E inspection shall be performed for qualification or re-qualification only. The tests specified in table II herein must be performed to maintain qualification.

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 measurements shall be conducted in accordance with method 3131 of MIL-STD-750. The following conditions shall apply:

- a. I_M Collector current 10 mA.
- b. V_{CE} : Measurement current (same as V_H) 10 V dc.
- c. I_H : Collector heating current 0.375 A.
- d. V_H : Collector-emitter heating voltage 10 V dc.
- e. t_H Heating time 1.0 s.
- f. t_{MD} : Measurement delay time 30 to 60 μ s.
- g. t_{SW} : Sampling window time 10 μ s maximum.

4.5.3 Delta requirements. Delta requirements shall be as specified below:

Step	Inspection	MIL-STD-750		Symbol	Limit	Unit
		Method	Conditions			
1	Collector-base cutoff current	3036	Bias condition D, $V_{CB} = 50$ V dc	ΔI_{CB02} 1/	100 percent of initial value or 50 nA dc, whichever is greater.	
2	Forward current transfer ratio	3076	$V_{CE} = 5$ V dc; $I_C = 5$ A dc; pulsed see 4.5.2	Δh_{FE2} 1/	± 20 percent change from initial reading.	

1/ Devices which exceed the group A limits for this test shall not be accepted.

TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1 2/</u>						
Visual and mechanical <u>3/</u> examination	2071	n = 45 devices, c = 0				
Solderability <u>3/ 5/</u>	2026	n = 15 leads, c = 0				
Resistance to <u>3/ 4/ 5/</u> solvent	1022	n = 15 devices, c = 0				
Temperature cycling <u>3/ 5/</u>	1051	Test condition C, 25 cycles. n = 22 devices, c = 0				
Hermetic seal <u>5/</u>	1071	n = 22 devices, c = 0				
Fine leak Gross leak						
Electrical measurements <u>5/</u>		Group A, subgroup 2				
Bond strength <u>3/ 5/</u>	2037	Precondition T _A = +250°C at t = 24 hrs or T _A = +300°C at t = 2 hrs, n = 11 wires, c = 0				
<u>Subgroup 2</u>						
Collector to base cutoff current	3036		I _{CB01}		10	μA dc
2N4150, 2N4150S 2N5237, 2N5237S 2N5238, 2N5238S		V _{CB} = 100 V dc V _{CB} = 150 V dc V _{CB} = 200 V dc				
Breakdown voltage, collector to emitter	3011	Bias condition D, I _C = 0.1 A dc, pulsed (see 4.5.1)	V _{(BR)CEO}			V dc
2N4150, 2N4150S 2N5237, 2N5237S 2N5238, 2N5238S				70 120 170		

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u> – continued						
Emitter to base cutoff current	3061	$V_{BE} = 7 \text{ V dc}$; $I_E = 10 \text{ } \mu\text{A dc}$	I_{EBO1}		10	$\mu\text{A dc}$
Collector to emitter cutoff current	3041	Bias condition D	I_{CEO1}		10	$\mu\text{A dc}$
2N4150, 2N4150S 2N5237, 2N5237S 2N5238, 2N5238S		$V_{CE} = 60 \text{ V dc}$ $V_{CE} = 110 \text{ V dc}$ $V_{CE} = 160 \text{ V dc}$				
Collector to emitter cutoff current	3041	Bias condition A $V_{BE} = 0.5 \text{ V dc}$	I_{CEX}		10	$\mu\text{A dc}$
2N4150, 2N4150S 2N5237, 2N5237S 2N5238, 2N5238S		$V_{CE} = 100 \text{ V dc}$ $V_{CE} = 110 \text{ V dc}$ $V_{CE} = 160 \text{ V dc}$				
Emitter to base cutoff current	3061	Bias condition D, $V_{BE} = 5 \text{ V dc}$	I_{EBO2}		0.1	$\mu\text{A dc}$
Collector to base cutoff current	3036	Bias condition D, $V_{CB} = 80 \text{ V dc}$	I_{CBO}		0.1	$\mu\text{A dc}$
Forward-current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}$, $I_C = 1 \text{ A dc}$, pulsed (see 4.5.1)	h_{FE1}			
2N4150, 2N4150S 2N5237, 2N5237S 2N5238, 2N5238S				50 50 50	200 225 225	
Forward-current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}$, $I_C = 5 \text{ A dc}$, pulsed (see 4.5.1)	h_{FE2}	40	120	
Collector to emitter voltage (saturated)	3071	$I_C = 5 \text{ A dc}$, $I_B = 0.5 \text{ A dc}$ pulsed (see 4.5.1)	$V_{CE(sat)1}$		0.6	V dc
Collector to emitter voltage (saturated)	3071	$I_C = 10 \text{ A dc}$, $I_B = 1 \text{ A dc}$ pulsed (see 4.5.1)	$V_{CE(sat)2}$		2.5	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	
<u>Subgroup 2</u> – continued						
Base emitter voltage saturation	3066	Test condition A, $I_C = 5$ A dc, $I_B = 0.5$ A dc pulsed (see 4.5.1)	$V_{BE(sat)1}$		1.5	V dc
Base emitter voltage saturation	3066	Test condition A, $I_C = 10$ A dc, $I_B = 1$ A dc pulsed (see 4.5.1)	$V_{BE(sat)2}$		2.5	V dc
Forward-current transfer ratio	3076	$V_{CE} = 5$ V dc, $I_C = 10$ A dc pulsed (see 4.5.1)	h_{FE3}	10		
<u>Subgroup 3</u>						
High temperature operation:		$T_A = +150^\circ\text{C}$				
Collector to emitter cutoff current	3041	Bias condition A, $V_{BE} = -0.5$ V dc	I_{CEX2}		100	$\mu\text{A dc}$
		$V_{CE} = 80$ V dc				
		$V_{CE} = 150$ V dc				
		$V_{CE} = 200$ V dc				
Low temperature operation:		$T_A = -55^\circ\text{C}$				
Forward-current transfer ratio	3076	$V_{CE} = 5$ V dc, $I_C = 5$ A dc, pulsed (see 4.5.1)	h_{FE4}	20		
<u>Subgroup 4</u>						
Magnitude of common-emitter small-signal short-circuit forward-current transfer ratio	3306	$V_{CE} = 10$ V dc, $I_C = 0.2$ A dc, $f = 10$ MHz	$ h_{fe} $	1.5	7.5	
Small-signal short-circuit forward-current transfer ratio	3206	$V_{CE} = 5$ V dc, $I_C = 50$ mA dc, $f = 1$ kHz	h_{fe}			
				40	160	
				40	160	
				40	250	

See footnotes at end of table.

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						
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}		350	pF
Pulse response	3251	Test condition A				
Delay time		See figure 4	t_d		50	ns
Rise time		See figure 4	t_r		500	ns
Storage time		See figure 4	t_s		1.5	ns
Fall time		See figure 4	t_f		500	ns
<u>Subgroup 5</u>						
Safe operating area (continuous dc)	3051	$T_C = +25^\circ\text{C}, t = 1.0 \text{ s},$				
<u>Test 1</u>		$V_{CE} = 40 \text{ V dc}, I_C = 0.22 \text{ A dc}$				
<u>Test 2</u>		$V_{CE} = 70 \text{ V dc}, I_C = 90 \text{ mA dc}$				
<u>Test 3</u>						
2N5237, 2N5237S only		$V_{CE} = 120 \text{ V dc}, I_C = 15 \text{ mA dc}$				
2N5238, 2N5238S only		$V_{CE} = 170 \text{ V dc}, I_C = 3.5 \text{ mA dc}$				
Clamped inductive sweep	3053	$T_C = +100^\circ\text{C minimum}, I_B = 0.5 \text{ A dc}, I_C = 5 \text{ A dc},$ (see figure 5)				
Electrical measurements		See paragraph 4.5.3				
<u>Subgroup 7</u> <u>5/</u>						
Decap internal visual (design verification)	2075	$n = 1 \text{ device}, c = 0$				

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

2/ For resubmission of failed subgroup A1, double the sample size of the failed test or sequence of tests.

3/ Separate samples may be used.

4/ Not required for JANS.

5/ Not required for laser marked devices.

TABLE II. Group E inspection (all quality levels) - For qualification and requalification only

Inspection	MIL-STD-750		Qualification
	Method	Conditions	
<u>Subgroup 1</u>			12 devices c = 0
Temperature cycling (air to air)	1051	Test condition C, 500 cycles	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See group A, subgroup 2 and 4.5.3 herein.	
<u>Subgroup 2</u>			45 devices c = 0
Intermittent life	1037	Intermittent operation life: $V_{CB} = 10$ V dc , 6,000 cycles, $\Delta T_J \geq +100^\circ\text{C}$; forced air cooling allowed on cooling cycle only.	
Electrical measurements		See group A, subgroup 2 and 4.5.3 herein.	
<u>Subgroup 3, 4, and 5</u>			
Not applicable			

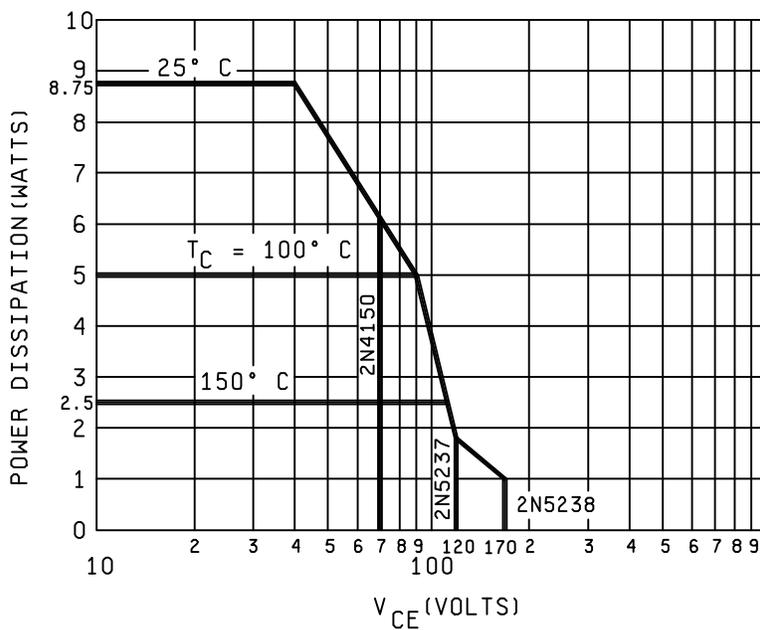


FIGURE 3. Maximum operating conditions - dc forward biased mode.

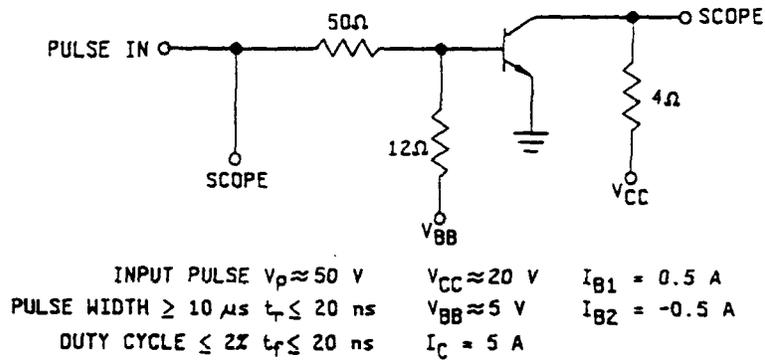
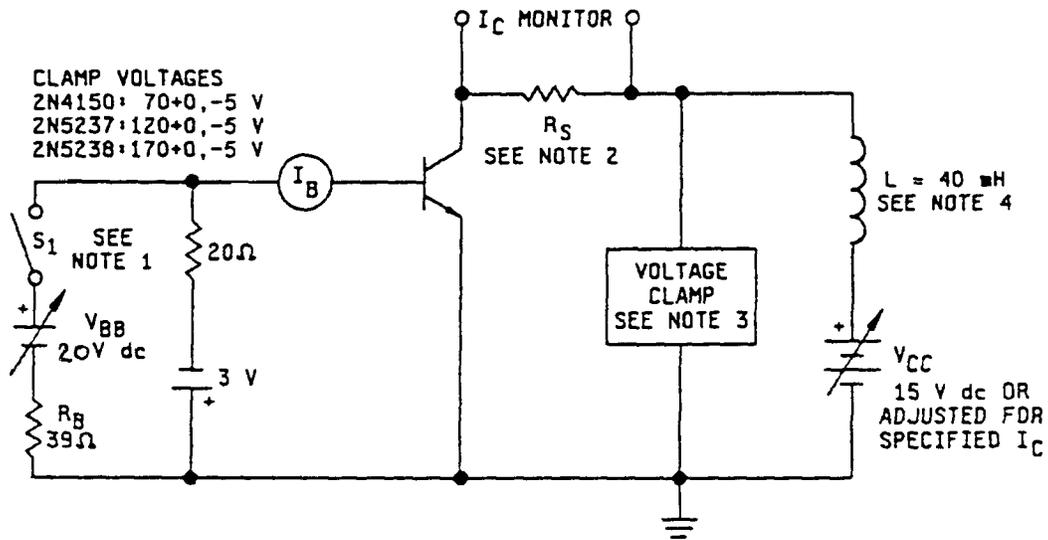


FIGURE 4. Speed of response test circuit.



NOTES:

1. An appropriate pulse generator may be substituted.
2. $R_S \leq 1.0 \Omega$ noninductive.
3. Clamp voltage: 2N4150: 70 V dc +0 V dc, -5 V dc; 2N5237: 120 V dc +0 V dc, -5 V dc; 2N5238: 170 V dc +0 V dc, -5 V dc
4. STANCOR C-2691 or equivalent; 2 in series.

FIGURE 5. Clamped inductive sweep test circuit.

5. PACKAGING

5.1 Packaging. Packaging shall prevent mechanical damage of the devices during shipping and handling and shall not be detrimental to the device. When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

5.2 Marking. Unless otherwise specified (see 6.2), marking shall be in accordance with MIL-PRF-19500.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Notes. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. See MIL- PRF-19500.

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 Products List QPL No.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 purchase 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, 3990 East Broad Street, Columbus, OH 43216-5000.

6.4 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:
Army - CR
Navy - EC
Air Force - 17

Preparing activity:
DLA - CC

(Project 5961 - 2063)

Review activities:
Army - MI, SM
Air Force - 13, 19, 85, 99

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

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3. The preparing activity must provide a reply within 30 days from receipt of the form.

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I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER

MIL-PRF-19500/394D

2. DOCUMENT DATE (YYMMDD)

3. DOCUMENT TITLE SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, POWER SWITCHING; TYPES 2N4150, 2N5237, 2N5238, 2N4150S, 2N5237S, AND 2N5238S; JAN, JANTX, JANTXV, AND JANS

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)

Commercial
DSN
FAX
EMAIL

7. DATE SUBMITTED
(YYMMDD)

8. PREPARING ACTIVITY

a. Point of contact: Alan Barone

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c. ADDRESS: Defense Supply Center
Columbus, ATTN: DSCC-VAT, 3990 East Broad
Street, Columbus, OH 43216-5000

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