The documentation and process conversion measures necessary to comply with this revision shall be completed by 5 October 2002.

INCH-POUND

MIL-PRF-19500/394G
5 July 2002
SUPERSEDING
MIL-PRF-19500/394F
23 April 2001

PERFORMANCE SPECIFICATION

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

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 encapsulated device type as specified in MIL-PRF-19500 and two levels of product assurance are provided for each unencapsulated device type.

1.2 Physical dimensions. See figure 1 (TO- 5) and figures 2 and 3 (JANHC and JANKC).

1.3 Maximum ratings.

Types	P_T (1) T_A = +25°C	P_T (2) T_C = +25°C	V_{CBO}	V_{CEO}	V_{EBO}	I_C	T_{STG} and T_J	$R_{\theta JC}$ (max)	$R_{\theta JA}$ (min)
	W	W	V dc	V dc	V dc	A dc	°C	°C/mW	°C/mW
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°C.
(2) Derate linearly 50 mW/°C for T_C > +100°C.

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

AMSC N/A
FSC 5961

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

1.4 Primary electrical characteristics.

Limits	h_{FE2} (1)	h_{FE3} (1)	C_{obo}	h_{fe}	$V_{BE(sat)}$ (1)	$V_{CE(sat)}$
	I_C = 5 A dc V_{CE} = 5 V dc	I_C = 10 A dc V_{CE} = 5 V dc	I_E = 0 V_{CB} = 10 V dc 100 kHz ≤ f ≤ 1 MHz	I_C = 0.2 A dc V_{CE} = 10 V dc f = 10 MHz	I_C = 5 A dc I_B = 0.5 A dc	I_C = 5 A dc I_B = 0.5 A dc
			pF		V dc	V dc
Min	40	10		1.5		
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

DEPARTMENT OF DEFENSE

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM–DODSSP), 700 Robbins Avenue, 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, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

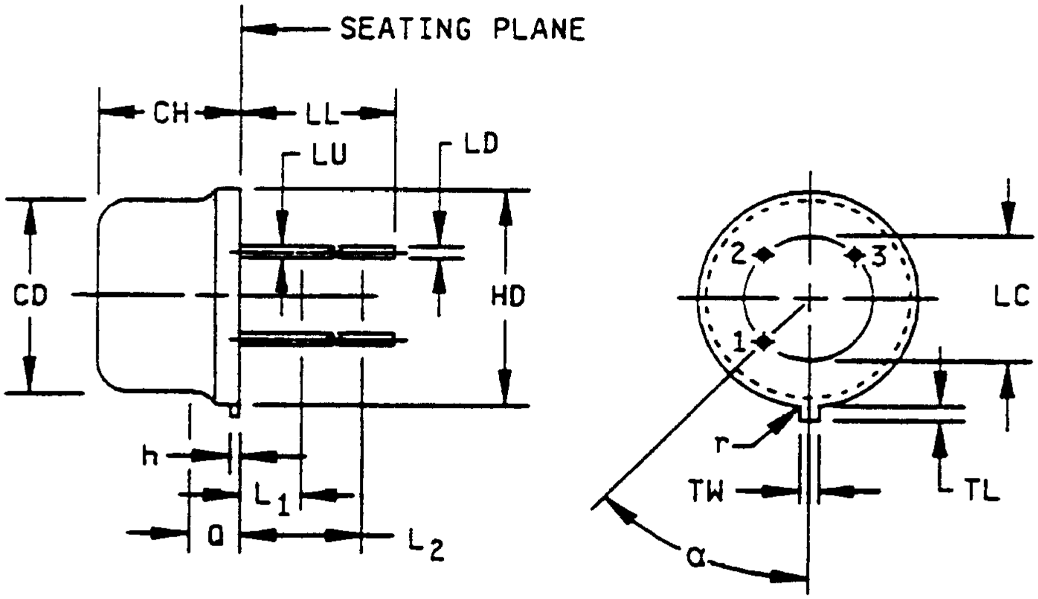


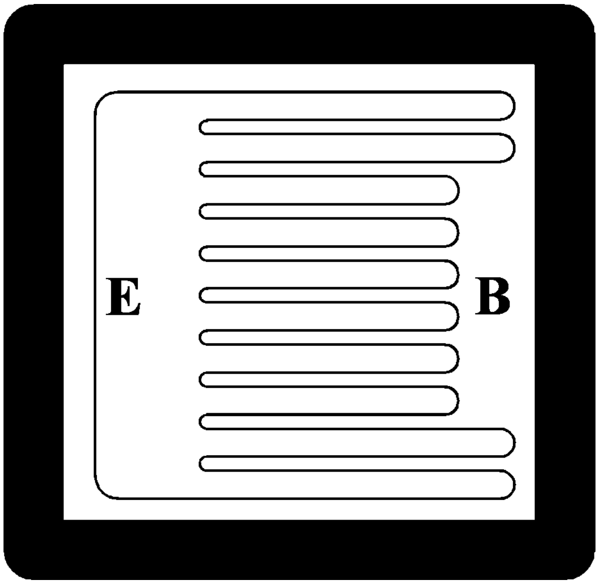
FIGURE 1. Physical dimensions .

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.335	7.75	8.51	5
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	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		4, 6, 8, 9

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Symbol TL is measured from HD maximum.
4. Lead number 4 omitted on this variation.
5. CD shall not vary more than .010 inch (0.25 mm) in zone P. This zone is controlled for automatic handling.
6. 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.
7. LD applies between L_1 and L_2. Dimension LD applies between L_2 and LL minimum. Lead diameter shall not exceed .042 inch (1.07 mm) within L_1 and beyond LL minimum.
8. Lead designation is as follows: 1 - emitter; 2 - base; 3 - collector.
9. Lead number three is electrically connected to case.
10. Beyond r maximum, TW shall be held for a minimum length of .011 inch (0.28 mm).
11. r (radius) applies to both inside corners of tab.
12. Tab shown omitted.
13. Details of outline in this zone optional.
14. For transistor types 2N4150S, 2N5237S, and 2N5238S, dimension LL = 0.500 inch (12.70 mm) minimum, and 0.750 inch mm) maximum.
15. For transistor types 2N4150, 2N5237, and 2N5238, dimension LL = 1.500 inch (38.10 mm) minimum, and 1.750 inches (44.45 mm) maximum.

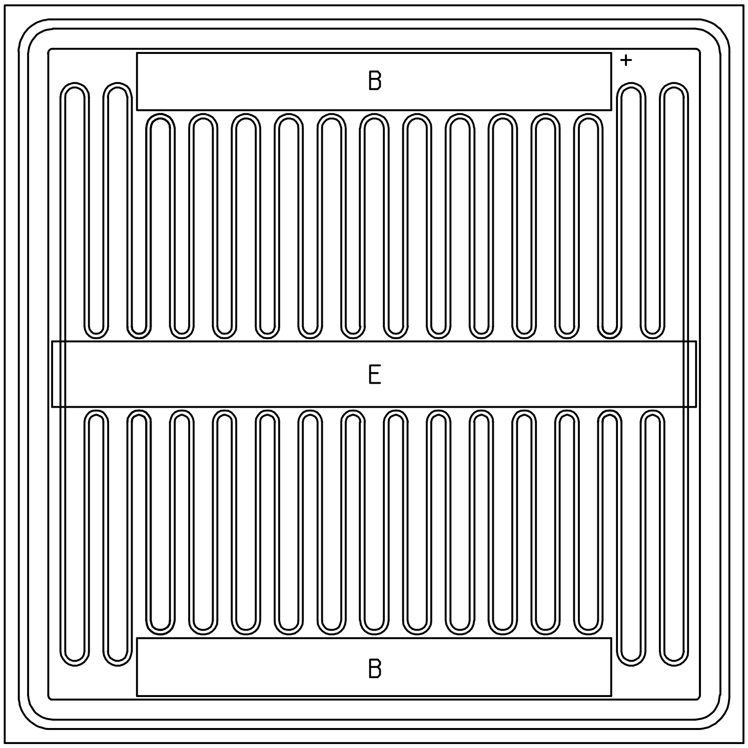
FIGURE 1. Physical dimensions - Continued.



NOTES:

1. Chip size: 120 x 120 mils ± 2 mils.
2. Chip thickness: 10 ±1.5mils nominal.
3. Top metal: Aluminum 30,000Å minimum, 33,000Å nominal.
4. Back metal:
    A. Al/Ti/Ni/Ag12kÅ/3kÅ/7kÅ/7kÅmin.15kÅ/5kÅ/10kÅ/10kÅ nominal.
    B. Gold 2,500Å minimum, 3,000Å nominal.
5. Backside: Collector.
6. Bonding pad: B = 52 x 12 mils, E = 84 x 12 mils.

FIGURE 2. JANHC and JANKC A-version die dimensions.



NOTES:

1.	Die size:	.155 x .155 inch (3.937 x 3.937 mm).
2.	Die thickness:	.008 ±.0016 inch (0.2032 ±0.04064 mm).
3.	Base pad:	.012 x .090 inch (0.3048 x 2.286 mm).
4.	Emitter pad:	.012 x .090 inch.
5.	Back metal:	Gold, 2400 ±720 Ang.
6.	Top metal:	Aluminum, 37500 ±7500 Ang.
7.	Back side:	Collector.
8.	Glassivation:	SiO_2, 7500 ± 1500 Ang.

FIGURE 3. JANHC and JANKC B-version die dimensions.

3. REQUIREMENTS

3.1 General. The requirements for acquiring the product described herein shall consist of this document and MIL-PRF-19500.

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

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

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500, on figure 1 (TO- 5) and on figures 2 and 3 (JANHC and JANKC) herein.

3.4.1 Lead finish. Lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

3.4.2 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 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.

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).

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 qualification shall be performed herein for qualification or requalification only. In case qualification was awarded to a prior revision of the associated specification that did not request the performance of table II tests, the tests specified in table II herein shall be performed by the first inspection lot to this revision to maintain qualification.

* 4.3 Screening (JANS, JANTXV, and JANTX levels only). Screening shall be in accordance with table 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 IV of MIL-PRF-19500)	Measurement	
	JANS level	JANTX and JANTXV levels
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).
7	Hermetic seal (optional) (1)	Hermetic seal (optional) (1)
9	I_{CBO2} and h_{FE1}	Not applicable
10	48 hours minimum	48 hours minimum
11	I_{CBO2} ; h_{FE1}; ΔI_{CB02} = 100 percent of initial value or 50 nA dc, whichever is greater; Δh_{FE1} = ± 15 percent of initial value.	I_{CBO2} and h_{FE1}
12	See 4.3.2 240 hours minimum	See 4.3.2 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} = ± 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} = ± 15 percent of initial value.

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

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 Vdc. 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.

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

a. I_M measurement current .... 10 mA.

b. I_H forward heating current.................... 1 A.

c. t_H heating time .... 10 - 30 ms.

d. t_{md} measurement delay time............... 30 - 60 µs.

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 in accordance with MIL-PRF-19500, a sample of screened devices shall be submitted to and pass the requirements of group A1 and A2 inspection only (table 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 tests and conditions specified for subgroup testing in table VIa (JANS) of MIL-PRF-19500 and 4.4.2.1 herein. Electrical measurements (end-points) and delta requirements shall be in accordance with table I, group A, subgroup 2 and 4.5.3 herein: delta requirements only apply to subgroups, B4, and B5. See 4.4.2.2 herein for JAN, JANTX, and JANTXV group B testing. Electrical measurements (end-points) and delta requirements for JAN, JANTX, and JANTXV shall be after each step in 4.4.2.2 and shall be in accordance with table I, group A, subgroup 2 and 4.5.3 herein.

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

Subgroup	Method	Condition
B4	1037	V_{CB} = 10 V dc.
B5	1027	(Note: If a failure occurs, resubmission shall be at the test conditions of the original sample). V_{CB} = 10 V dc; $P_D \geq$ 100 percent of maximum rated P_T (see 1.3). Option 1: 96 hours minimum, sample size in accordance with table VIa of MIL-PRF-19500, adjust T_A or P_D to achieve T_J = +275°C minimum. Option 2: 216 hours., sample size = 45, c = 0; adjust T_A or P_D to achieve T_J = +225°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 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.

Subgroup	Method	Condition
1	1039	Steady-state life: Test condition B, 340 hours min., V_{CB} = 10 - 30 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.
2	1039	The steady-state life test of step 1 shall be extended to 1,000 hrs 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 = 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. 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 tests and 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 table I, group A, subgroup 2 and 4.5.3 herein, delta measurements apply to subgroup C6.

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

Subgroup	Method	Condition
C2	2036	Test condition E.
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.

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.
*	C5	3131	See 4.5.2, $R_{\theta JC}$.
	C6		Not applicable.

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

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

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

4.5.2 Thermal resistance. Thermal resistance 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 µs.

g. t_{SW}: Sampling window time.. 10 µs 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} = 80 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 4.5.1 (see figure 4).	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 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 4/	1071	n = 22 devices, c = 0				
Fine leak Gross leak						
Electrical measurements 4/		Group A, 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 4/ visual (design verification)	2075	n = 4 device, c = 0				
Subgroup 2						
Collector to base cutoff current	3036		I_{CBO1}		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	
Subgroup 2 - Continued						
Emitter to base cutoff current	3061	V_{BE} = 7 V dc	I_{EBO1}		10	µA dc
Collector to emitter cutoff current	3041	Bias condition D	I_{CEO1}		10	µA dc
2N4150, 2N4150S 2N5237, 2N5237S 2N5238, 2N5238S		V_{CE} = 60 V dc V_{CE} = 110 V dc V_{CE} = 160 V dc				
Collector to emitter cutoff current	3041	Bias condition A V_{BE} = 0.5 V dc	I_{CEX}		10	µA dc
2N4150, 2N4150S 2N5237, 2N5237S 2N5238, 2N5238S		V_{CE} = 60 V dc V_{CE} = 110 V dc V_{CE} = 160 V dc				
Emitter to base cutoff current	3061	Bias condition D, V_{BE} = 5 V dc	I_{EBO2}		0.1	µA dc
Collector to base cutoff current	3036	Bias condition D, V_{CB} = 80 V dc	I_{CBO}		0.1	µA dc
Forward-current transfer ratio	3076	V_{CE} = 5 V dc, I_C = 1 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 V dc, I_C = 5 A dc, pulsed (see 4.5.1)	h_{FE2}	40	120	
Collector to emitter voltage (saturated)	3071	I_C = 5 A dc, I_B = 0.5 A dc, pulsed (see 4.5.1)	$V_{CE(sat)1}$		0.6	V dc
Collector to emitter voltage (saturated)	3071	I_C = 10 A dc, I_B = 1 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	
Subgroup 2 - 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		
Subgroup 3						
High temperature operation:		T_A = +150°C				
Collector to emitter cutoff current	3041	Bias condition A, V_{BE} = -0.5 V dc	I_{CEX2}		100	µA dc
2N4150, 2N4150S		V_{CE} = 60 V dc				
2N5237, 2N5237S		V_{CE} = 110 V dc				
2N5238, 2N5238S		V_{CE} = 160 V dc				
Low temperature operation:		T_A = -55°C				
Forward-current transfer ratio	3076	V_{CE} = 5 V dc, I_C = 5 A dc, pulsed (see 4.5.1)	h_{FE4}	20		
Subgroup 4						
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}			
2N4150, 2N4150S				40	160	
2N5237, 2N5237S				40	160	
2N5238, 2N5238S				40	250	

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 4 - Continued						
Open circuit output capacitance	3236	V_{CB} = 10 V dc, I_E = 0, 100 kHz ≤ f ≤ 1 MHz	C_{obo}		350	pF
Pulse response	3251	Test condition A				
Delay time		See figure 5	t_d		50	ns
Rise time		See figure 5	t_r		500	ns
Storage time		See figure 5	t_s		1.5	µs
Fall time		See figure 5	t_f		500	ns
Subgroup 5						
Safe operating area (continuous dc)	3051	T_C = +25°C, t = 1.0 s,				
Test 1		V_{CE} = 40 V dc, I_C = 0.22 A dc				
Test 2		V_{CE} = 70 V dc, I_C = 90 mA dc				
Test 3						
2N5237, 2N5237S only		V_{CE} = 120 V dc, I_C = 15 mA dc				
2N5238, 2N5238S only		V_{CE} = 170 V dc, I_C = 3.5 mA dc				
Clamped inductive sweep	3053	T_C = +100°C minimum, I_B = 0.5 A dc, I_C = 5 A dc, (see figure 6)				
Electrical Measurements		See 4.5.3 herein.				

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 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			
Fine leak Gross leak	1071		
Electrical measurements		See group A, subgroup 2 herein.	
Subgroup 2			45 devices c = 0
Intermittent life	1037	V_{CB} = 10 V dc, 6,000 cycles.	
Electrical measurements		See table I, group A, subgroup 2 herein.	
Subgroups 3, 4, 5, 6, and 7			
Not applicable			
Subgroup 8			45 devices c = 0
Reverse stability	1033	Condition A for devices ≥ 400 V Condition B for devices < 400 V	

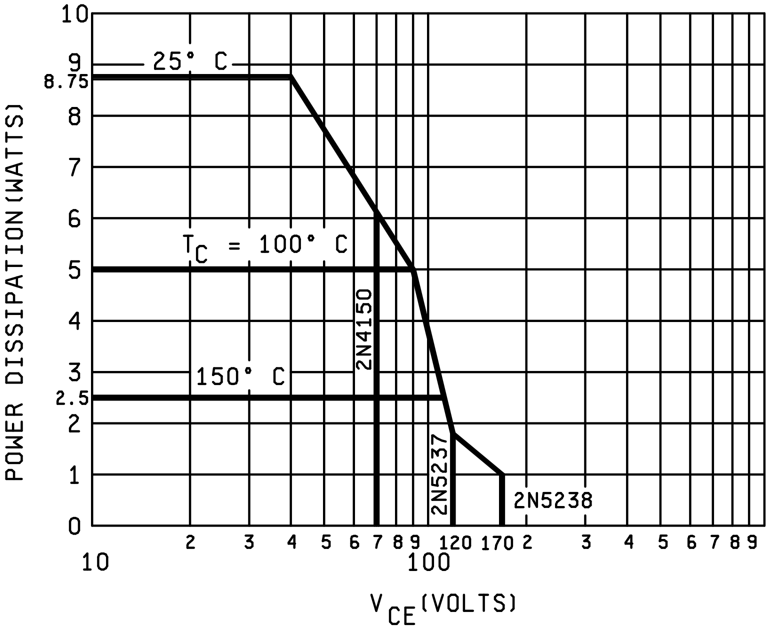


FIGURE 4. Maximum operating conditions - dc forward biased mode.

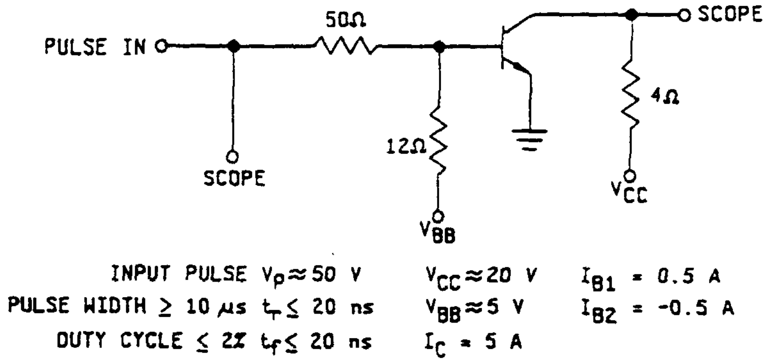
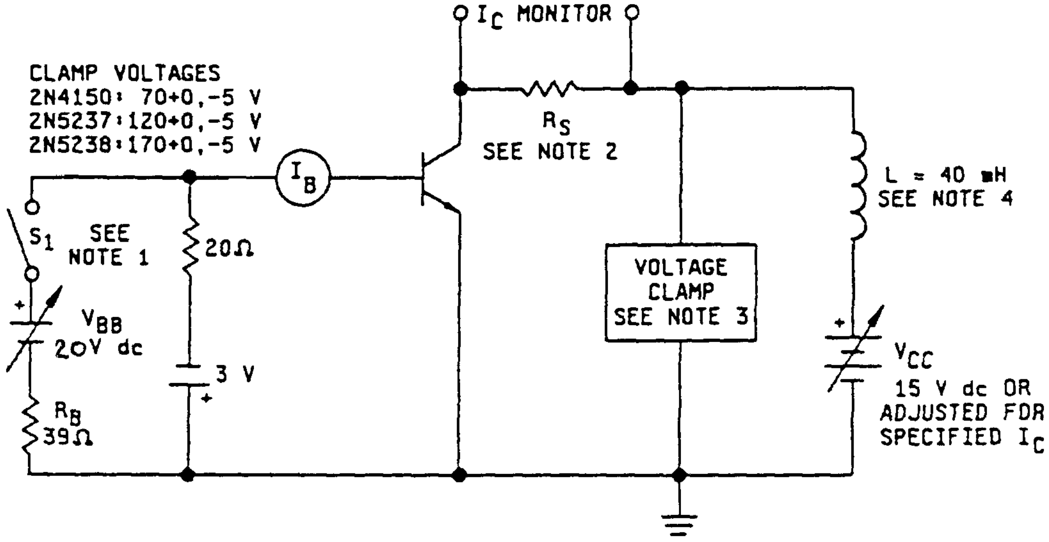


FIGURE 5. Speed of response test circuit.



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 6. Clamped inductive sweep test circuit.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel 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 Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. 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.)

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

6.2 Acquisition requirements. Acquisition documents should specify the following:

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

b. Issue of DoDISS to be cited in the solicitation and, if required, the specified issue of individual documents referenced (see 2.2.1).

c. Lead finish (see 3.4.1).

d. Type designation and quality assurance level.

e. Packaging requirements (see 5.1).

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 Manufacturer's List (QML) 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 43216-5000.

6.4 Suppliers of JANHC and JANKC die. The qualified die suppliers with the applicable letter version (example, JANHCA2N4150) will be identified on the QML.

JANC ordering information		
PIN	Manufacturers	
	43611	34156
2N4150	JANHCA2N4150 JANKCA2N4150	JANHCB2N4150 JANKCB2N4150

6.5 Changes from previous issue. The margins of this revision are marked with an asterisk 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 - 11
DLA – CC

Review activities:
Army - MI, SM
Air Force - 19, 71, 99

Preparing activity:
DLA - CC

(Project 5961 - 2559)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7.

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-19500/394G	2. DOCUMENT DATE 5 July 2002

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

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

8. PREPARING ACTIVITY

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IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:
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Fort Belvoir, VA 22060-6221
Telephone (703) 767-6888 DSN 427-6888