

The documentation and process conversion measures necessary to comply with this revision shall be completed by 21 October 2000.

INCH-POUND

MIL-PRF-19500/545C(USAF)
 21 July 2000
 SUPERSEDING
 MIL-PRF-19500/545B(USAF)
 30 July 1999

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, POWER
 TYPES 2N5151, 2N5153, 2N5151L, 2N5153L, 2N5151U3, AND 2N5153U3
 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 PNP, silicon, power transistors for use in high-speed power-switching applications. Four levels of product assurance are provided for each encapsulated device type as specified in MIL-PRF-19500. Two levels of product assurance are provided for each unencapsulated device type.

1.2. Physical dimensions. See figure 1 (similar to T0-205), figures 2, 3, and 4 (JANHC and JANKC), and figure 5 (U3).

1.3. Maximum ratings.

Types	P_T $T_A = +25^\circ\text{C}$	P_T $T_C = +25^\circ\text{C}$	V_{CBO}	V_{CEO}	V_{EBO}	I_C	I_C (4), (5)	Reverse pulse (6) energy	Safe operating area	T_{stg} and T_J
	<u>W</u>	<u>W</u>	<u>V dc</u>	<u>V dc</u>	<u>V dc</u>	<u>A dc</u>	<u>A dc</u>	<u>mj</u>		<u>°C</u>
2N5151, L 2N5153, L	1 (1) 1 (1)	11.8 (2) 11.8 (2)	100 100	80 80	5.5 5.5	2 2	10 10	15 15	See figure 8	-65 to +200
2N5151U3 2N5153U3	1.2 (3) 1.2 (3)	1.4 1.4	100 100	80 80	5.5 5.5	2 2	10 10	15 15	See figure 8	-65 to +200

- (1) Derate linearly 5.7 mW/°C for $T_A > +25^\circ\text{C}$.
- (2) Derate linearly 66.7 mW/°C for $T_C > +25^\circ\text{C}$.
- (3) Derate linearly 6.67 mW/°C for $T_A > +25^\circ\text{C}$.
- (4) Derate linearly 80 mW/°C for $T_C > +25^\circ\text{C}$.
- (5) This value applies for $P_w \leq 8.3$ ms, duty cycle ≤ 1 percent.
- (6) This rating is based on the capability of the transistors to operate safely in the unclamped inductive load energy test circuit of figure 7.

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-VAC, 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.

AMSC N/A

FSC 5961

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

1.4. Primary electrical characteristics at $T_C = +25^\circ\text{C}$.

Limits	h_{FE2} (1) $V_{CE} = 5\text{ V}$ $I_C = 2.5\text{ A dc}$		$ h_{fe} $ $V_{CE} = 5\text{ V}$ $I_C = 500\text{ mA dc}$ $f = 10\text{ MHz}$		$V_{CE(sat)2}$ (1) $I_C = 5\text{ A dc}$ $I_B = 500\text{ mA dc}$	$V_{CE(sat)2}$ (1) $I_C = 5\text{ A dc}$ $I_B = 500\text{ mA dc}$	C_{obo} $V_{CB} = 10\text{ V dc}$ $I_E = 0$ $f = 1\text{ MHz}$	$R_{\theta JA}$	$R_{\theta JC}$
	2N5151 (2)	2N5153 (2)	2N5151 (2)	2N5153 (2)					
Min	30	70	6	7	<u>V dc</u>	<u>V dc</u>	<u>pF</u>	<u>°C/W</u>	<u>°C/W</u>
Max (TO-205)	90	200			2.2	1.5	250	175	15
Max (U3)	90	200			2.2	1.5	250	150	12.5

(1) Pulsed (see 4.5.1)

(2) The limits specified apply to all package outlines unless otherwise stated.

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 section 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

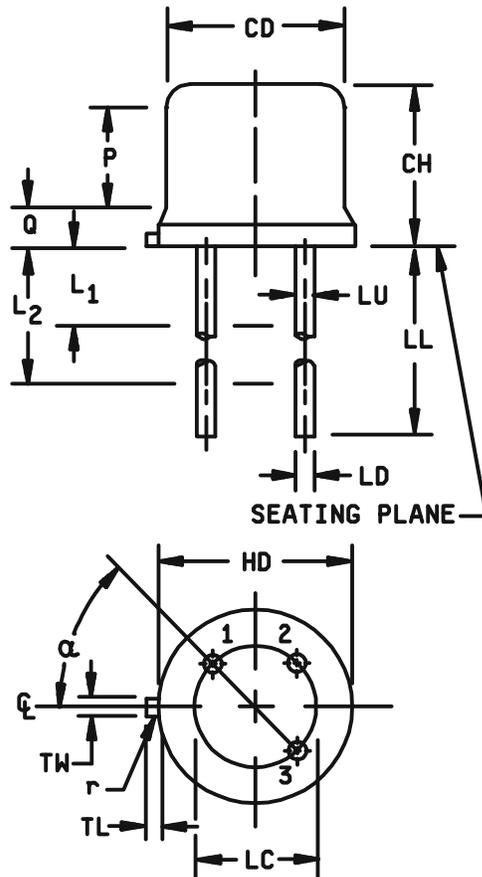
DEPARTMENT OF DEFENSE

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Defense Automated Printing Service, 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 specification and the references cited herein, the text of this specification takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	0.305	0.335	7.75	8.51	6
CH	0.240	0.260	6.10	6.60	
HD	0.335	0.370	8.51	9.40	
LC	0.200 TP		5.08 TP		7
LD	0.016	0.021	0.41	0.53	8, 9
LL	See notes 8, 9, 12, 13				
LU	0.016	0.019	0.041	0.48	8, 9
L ₁	---	0.050	---	1.27	8, 9
L ₂	0.250	---	6.35	---	8, 9
Q	---	0.050	---	1.27	6
TL	0.029	0.045	0.74	1.14	4, 5
TW	0.028	0.034	0.71	0.86	3
r	---	0.010	---	0.25	11
α	45° TP		45° TP		7
P	0.100		2.54		
Notes	1, 2, 10, 12, 15				

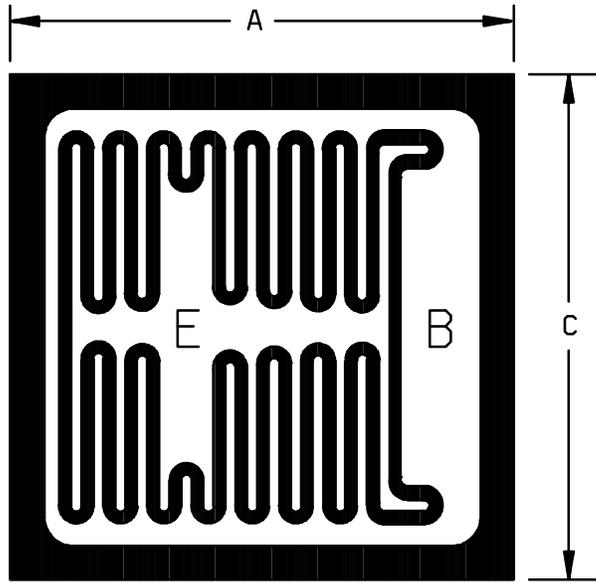


NOTES:

1. Dimension are in inches.
2. Metric equivalents are given for general information only.
3. Beyond r (radius) maximum, TW shall be held for a minimum length of 0.011 (.28 mm).
4. TL measured from maximum HD.
5. Outline in this zone is not controlled.
6. CD shall not vary more than 0.010 (0.25 mm) in zone P. This zone is controlled for automatic handling.
7. Leads at gauge plane $0.054 + 0.001 - 0.000$ (1.37 + 0.03 - 0.00 mm) below seating plane shall be within 0.007 (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC
8. LU applied between L₁ and L₂. LD applies between L₂ and LL minimum. Diameter is uncontrolled in L₁ and beyond LL minimum.
9. All three leads.
10. The collector shall be electrically and mechanically connected to the case.
11. r (radius) applies to both inside corners of tab.
12. In accordance with ANSI Y14.5M, diameters are equivalent to \varnothing x symbology.
13. For transistor types 2N5151 and 2N5153, LL is 0.5 (12.70 mm) minimum, and 0.75 (19.05 mm) maximum.
14. For transistor types 2N5151L and 2N5153L, LL is 1.5 (38.10 mm) minimum and 1.75 (44.45 mm) maximum.
15. Lead designation, depending on device type, shall be as follows:

Lead number	TO-205
1	Emitter
2	Base
3	Collector

FIGURE 1. Physical dimensions (TO-205)

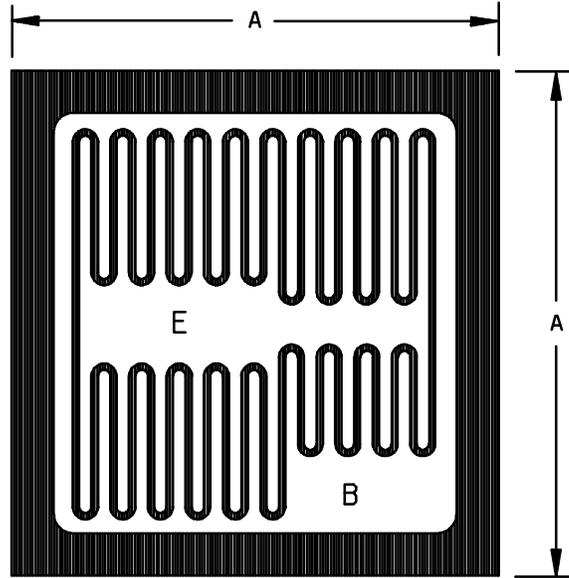


Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
A	0.117	0.127	02.97	3.23	

NOTES:

1. Dimensions are in inches.
2. Metric equivalents (millimeters) are in parenthesis.
3. Metric equivalents are given for general information only.
4. Unless otherwise specified, tolerance is ± 0.005 (0.13 mm).
5. The physical characteristics of the die are;
 - Thickness: 0.008 (0.20 mm) to .012 (0.30 mm), tolerance is ± 0.005 (0.13 mm).
 - Top metal: Aluminum, 40,000 Å minimum, 50
 - Back metal: Gold 2,500 Å minimum, 3,000 Å nominal.
 - Back side: Collector.
 - Bonding pad:
 - B = 0.015 (0.38 mm) x 0.0072 (1.83 mm).
 - E = 0.015 (0.38 mm) x 0.0060 (1.52 mm).

FIGURE 2. JANHCA and JANKCA die dimensions.

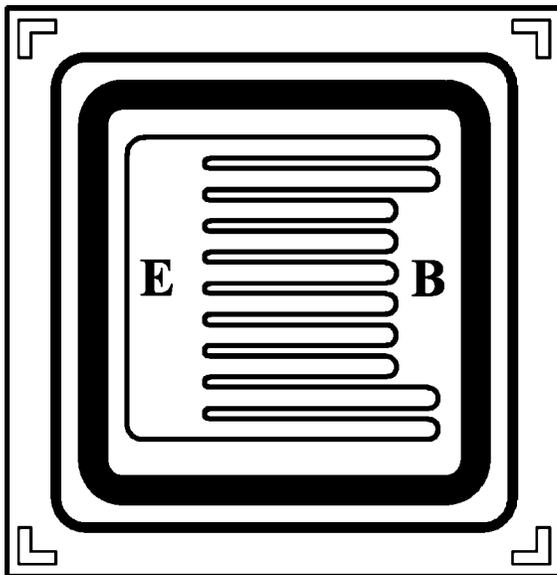


Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
A	0.1		2.54		

NOTES:

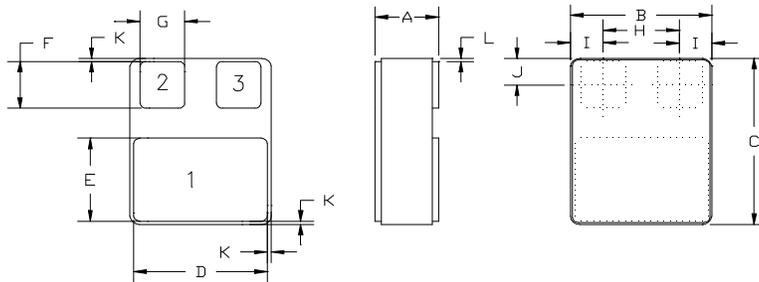
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Unless otherwise specified, tolerance is ± 0.005 (0.13 mm).
4. The physical characteristics of the die are;
 - Thickness: 0.0078 (0.198 mm) nominal, tolerance is ± 0.005 (0.13 mm).
 - Top metal: Aluminum, 25,000 Å minimum, 33
 - Back metal: Gold 1,500 Å minimum, 2,500 Å nominal.
 - Back side: Collector.
 - Bonding pad: 0.012 (0.305 mm) min. x 0.030 (0.761 mm) min.

FIGURE 3. JANHCB and JANKCB die dimensions.



1. Chip size..... 0.128 x 0.128 inches ±0.002 inches
2. Chip thickness.....0.010 ± 0.0015 inches nominal
3. Top metal.....Aluminum 30,000 minimum, 33,000Å nominal
4. Back metal.....A. Al/Ti/Ni/Ag15k /2kÅ/7kÅ/7kÅ min. 18kÅ/3kÅ/10kÅ/10kÅ nom.
B. Gold 2,500Å minimum, 3,000Å nominal
5. Backside.....Collector
6. Bonding pad.....B = 0.052 x 0.012 inches, E = 0.084 x 0.012 inches

FIGURE 4. JANHC and JANKC C-version die dimensions.



Symbol	Dimensions			
	Millimeters		Inches	
	Min	Max	Min	Max
A	2.82	3.10	0.111	0.122
B	7.39	7.65	0.291	0.301
C	10.03	10.29	0.395	0.405
D	7.14	7.39	0.281	0.291
E	5.59	5.84	0.220	0.230
F	2.92	3.18	0.115	0.125
G	2.29	2.54	0.09	0.100
H	3.68	3.94	0.145	0.155
I	1.85 TYP.	-	0.073 TYP.	-
J	2.11 TYP.	-	0.083 TYP.	-
K	0.13 TYP.	-	0.005 TYP.	-
L	0.38 TYP.	-	0.015 TYP.	-

NOTES:

1. Dimensions are in millimeters.
2. Inch-pound equivalents are given for general information only.

SCHEMATIC

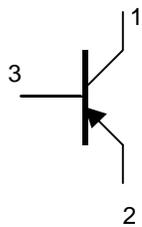


FIGURE 5. Physical dimensions and configuration for SMD.5

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 manufacturers (QML) 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 requirements and physical dimensions. The Interface requirements and physical dimensions shall be as specified in MIL-PRF-19500 and figure 1 (TO-205), figures 2, 3, and 4 for JANHC and JANKC, figure 5 for U3 herein.

3.4.1. Current density. Current density of internal conductors shall be as specified in MIL-PRF-19500.

3.4.2. 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).

3.5. Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4, and table I herein.

3.6. Electrical test requirements. The electrical test requirements shall be the subgroups specified in table I herein.

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

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 herein.

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

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4.3. Screening (JANS, JANTX, and JANTXV 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 levels	JANTX and JANTXV levels
1a 1b	Not Required Required	Not Required Required for JANTXV only
2	Optional	Optional
3a 3b 3c	Required Not applicable Thermal response (see 4.5.3)	Required Not applicable Thermal response (see 4.5.3)
4	Required	Optional
5	Required	Not applicable
6	Required	Not applicable
7a and 7b	Required	Required
8	Required	Not required
9	I_{CES1} and h_{FE2}	Not applicable
10	48 hours minimum	48 hours minimum
11	I_{CES1} and h_{FE2} ; ΔI_{CES1} = 100 percent of initial value or 100 nA dc, whichever is greater. Δh_{FE2} = ± 20 percent.	I_{CES1} and h_{FE2}
12	See 4.3.2	See 4.3.2
13	Subgroup 2 of table I herein; ΔI_{CES1} = 100 percent of initial value or 100 nA dc, whichever is greater. Δh_{FE2} = ± 20 percent.	Subgroup 2 of table I herein; ΔI_{CES1} = 100 percent of initial value or 100 nA dc, whichever is greater. Δh_{FE2} = ± 20 percent.
14a and 14b	Optional	Optional
15	Required	Not required
16	Required	Not required

4.3.1. Screening (JANHC and JANKC). Screening of JANHC and JANKC die shall be in accordance with MIL-PRF-19500. As a minimum, die shall be 100-percent probed to insure compliance with group A, subgroup 2.

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4.3.2. Power burn-in conditions. Power burn-in conditions are as follows: $V_{CB} = 10 - 30 \text{ Vdc}$ $T_A = \text{Room ambient}$ as defined in the general requirements of MIL-STD-750, paragraph 4.5. Power shall be applied to the device to achieve a Junction temperature, $T_J = 135^\circ\text{C}$ minimum and a minimum $P_D = 75\%$ of P_T maximum rated as defined in paragraph 1.3.

4.4. Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500.

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 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 table VIa of MIL-PRF-19500 (JANS) and 4.4.2.1 herein. Electrical measurements (end-points) shall be in accordance with group A, subgroup 2 herein. Delta measurements shall be in accordance with table II herein. See 4.4.2.2 herein and table VIb of MIL-PRF-19500 for JAN, JANTX, and JANTXV group B testing. Electrical measurements (end-points) requirements shall be in accordance with group A, subgroup 2 herein. Delta measurements shall be in accordance with table II herein.

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

Subgroup	Method	Conditions
B4	1037	$V_{CB} = 40 \text{ V dc} \pm 1 \text{ V}$.
B5	1027	$V_{CB} = 10 \text{ V dc}$; $T_A = +125^\circ\text{C} \pm 25^\circ\text{C}$ for 96 hours with P_T adjusted according to the chosen T_A to give $T_J = +275^\circ\text{C}$ minimum. Optionally the test may be performed for a minimum of 216 hours with P_T adjusted to achieve a $T_J = +225^\circ\text{C}$ minimum;
sample		size = 45, c = 0. In this case the ambient temperature shall be adjusted such that a minimum 75% of maximum rated P_T (see 1.3) is applied to the device under test. (Note: If a failure occurs, resubmission shall be at the test conditions of the original sample.)
B5	2037	Test condition A (Al - Au die interconnects only).
B6	3131	Forward voltage drop, emitter to base diode only (see 4.5.2).

4.4.2.2. Group B inspection, table VIb (JAN, JANTX and, JANTXV) of MIL-PRF-19500.

Subgroup	Method	Conditions
B3	1027	For eutectic die attach: $V_{CB} = 10$ percent of V_{CBO} (min) (see 1.3); $T_A \leq +35^\circ\text{C}$ (max); adjust P_T to achieve $T_J = +150^\circ\text{C}$ (min).
B3	1037	For solder die attach: $V_{CB} = 10$ percent of V_{CBO} (min) (see 1.3) 2,000 cycles.
B5	3131	See 4.5.2

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 as follows. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta measurements shall be in accordance with table II herein. Delta measurements shall be in accordance with table II herein.

Subgroup	Method	Conditions
C2	2036	Test condition E.
C6	1026	1,000 hours, $V_{CB} \geq 10$ V dc, $T_J = +150^\circ\text{C}$ minimum; $T_A \leq +35^\circ\text{C}$.

4.4.4. Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IX of MIL-PRF-19500. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta measurements shall be in accordance with table II herein.

Subgroup	Method	Condition	Sampling plan
E1	1051	500 cycles	45 devices, $c = 0$
E2	1039	Condition A: 500 hours	45 devices, $c = 0$
E3		Not applicable	
E4	3131	$R_{\theta JC} = 15^\circ\text{C/W}$ maximum (TO-205) 22 devices, $c = 0$ (See 4.5.2) $R_{\theta JC} = 12.5^\circ\text{C/W}$ maximum (U3) 22 devices, $c = 0$ (See 4.5.2) (See 4.5.2)	
E5		Not applicable	

4.5. Methods of examination and test. Methods of examination and test shall be as specified in the 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.

4.5.2. Thermal resistance. Thermal resistance measurements shall be conducted in accordance with method 3131 of MIL-STD-750. The following details shall apply:

- Collector current magnitude during power application shall be 500 mA dc.
- Collector to emitter voltage magnitude shall be 10 V dc.
- Reference temperature measuring point shall be the case.
- Reference temperature measuring point shall be within the range $+25^\circ\text{C} \leq T_R \leq +35^\circ\text{C}$. The chosen reference temperature shall be recorded before the test is started.
- Mounting arrangement shall be with heat sink to case.
- Maximum limit of $R_{\theta JC}$ shall be 15.0°C/W for (TO-205) and 12.5°C/W for (U3).

4.5.3. Thermal response (ΔV_{BE} measurements). The ΔV_{BE} measurements shall be performed in accordance with MIL-STD-750, method 3131. The ΔV_{BE} conditions (I_H and V_H) and maximum limit shall be derived by each vendor. The chosen ΔV_{BE} measurement and conditions for each device in the qualification lot shall be submitted in the qualification report and a thermal response curve shall be plotted. The chosen ΔV_{BE} shall be considered final after the manufacturer has had the opportunity to test five consecutive lots. One-hundred percent safe operating area (SOA) testing may be performed in lieu of thermal response testing herein provided that the appropriate conditions of temperature, time, current, and voltage to achieve die attach integrity are approved by the qualifying activity. The following parameter measurements shall apply:

- a. I_M measurement..... 10 mA.
- b. V_{CE} measurement voltage 16 V (same as V_H).
- c. I_H collector heating current..... 1 A minimum.
- d. V_H collector-emitter heating voltage 16 V minimum.
- e. t_H heating time 10 ms.
- f. t_{MD} measurement delay time 50 μ s.
- g. t_{SW} sample window time..... 10 μ s maximum.

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TABLE I. Group A inspection.

Inspection 1/ <u>Subgroup 1</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Breakdown voltage, collector to emitter	3011	Bias condition D, $I_C = 100$ mA dc; $I_B = 0$, pulsed (see 4.5.1)	$V_{(BR)CEO}$	80		V dc
Collector to emitter cutoff current	3041	Bias condition C, $V_{CE} = 60$ V dc; $V_{BE} = 0$	I_{CES1}		1.0	μ A dc
Collector to emitter cutoff current	3041	Bias condition C, $V_{CE} = 100$ V dc; $V_{BE} = 0$	I_{CES2}		1.0	mA dc
Collector to emitter cutoff current	3041	Bias condition D, $V_{CE} = 40$ V dc; $I_B = 0$	I_{CEO}		50	μ A dc
Emitter to base cutoff current	3061	Bias condition D, $V_{EB} = 4$ V dc; $I_C = 0$	I_{EBO1}		1.0	μ A dc
Emitter to base cutoff current	3061	Bias condition D, $V_{EB} = 5.5$ V dc; $I_C = 0$	I_{EBO2}		1.0	mA dc
Forward current transfer ratio 2N5151 2/ 2N5153	3076	$V_{CE} = 5$ V dc; $I_C = 50$ mA dc pulsed (see 4.5.1)	h_{FE1}	20 50		
Forward current transfer ratio 2N5151 2/ 2N5153	3076	$V_{CE} = 5$ V dc; $I_C = 2.5$ A dc pulsed (see 4.5.1)	h_{FE2}	30 70	90 200	
Forward current transfer ratio 2N5151 2/ 2N5153	3076	$V_{CE} = 5$ V dc; $I_C = 5$ A dc pulsed (see 4.5.1)	h_{FE3}	20 40		
Base-emitter voltage (non-saturated)	3066	Test condition B, $V_{CE} = 5$ V dc; $I_C = 2.5$ A dc, pulsed (see 4.5.1)	V_{BE}		1.45	V dc
Base-emitter saturation voltage	3066	Test condition A, $I_C = 2.5$ A dc; $I_B = 250$ mA dc, pulsed (see 4.5.1)	$V_{BE(sat)1}$		1.45	V dc
Base-emitter saturation voltage	3066	Test condition A, $I_C = 5$ A dc; $I_B = 500$ mA dc; pulsed (see 4.5.1)	$V_{BE(sat)2}$		2.2	V dc

See footnote at end of table.

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TABLE I. Group A inspection - Continued.

Inspection 1/ 	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u> - Continued						
Collector-emitter saturation voltage	3071	$I_C = 2.5 \text{ A dc}; I_B = 250 \text{ mA dc, pulsed}$ (see 4.5.1)	$V_{CE(sat)1}$		0.75	V dc
Collector-emitter saturation voltage	3071	$I_C = 5 \text{ A dc}; I_B = 500 \text{ mA dc, pulsed}$ (see 4.5.1)	$V_{CE(sat)2}$		1.5	V dc
<u>Subgroup 3</u>						
High temperature operation:		$T_C = +150^\circ\text{C}$				
Collector to emitter cutoff current	3041	Bias condition A, $V_{CE} = 60 \text{ V dc};$ $V_{BE} = +2 \text{ V dc}$	I_{CEX}		500	$\mu\text{A dc}$
Low temperature operation		$T_C = -55^\circ\text{C}$				
Forward - current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}; I_C = 2.5 \text{ A dc; pulsed}$ (see 4.5.1)	h_{FE4}			
2N5151 <u>2/</u> 2N5153					15 25	
<u>Subgroup 4</u>						
Common-emitter, small- signal, short-circuit, forward-current transfer ratio	3206	$V_{CE} = 5 \text{ V dc}; I_C = 100 \text{ mA dc};$ $f = 1 \text{ KHz}$	h_{fe}			
2N5151 <u>2/</u> 2N5153					20 50	
Magnitude of common- emitter, small-signal short-circuit, forward-current, transfer ratio	3306	$V_{CE} = 5 \text{ V dc}; I_C = 500 \text{ mA dc},$ $f = 10 \text{ MHz}$	$ h_{fe} $			
2N5151 <u>2/</u> 2N5153					6 7	
Open-circuit output capacitance	3236	$V_{CB} = 10 \text{ V dc}; I_E = 0, f = 1 \text{ MHz}$	C_{obo}		250	pf
Switching time		$I_C = 5 \text{ A dc}; I_{B1} = 500 \text{ mA dc}$	t_{on}		0.5	μs
		$I_{B2} = -500 \text{ mA dc}$	t_s		1.4	μs
		$V_{BE(off)} = 3.7 \text{ V dc}$	t_f		0.5	μs
		$R_L = 6 \Omega, \text{ (see figure 4)}$	t_{off}		1.5	μs

See footnote at end of table.

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TABLE I, Group A inspection - Continued.

Inspection <u>1</u> /	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 5</u>	3051	Pre-pulse condition for each test: $V_{CE} = 0$; $I_C = 0$; $T_C = +25^\circ\text{C}$				
Safe operating area (D.C.)		Pulse condition for each test: $t_p = 1$ sec. 1 cycle. $T_C = +25^\circ\text{C}$, (see figure 6)				
Test # 1		$V_{CE} = 5.8$ V dc; $I_C = 2$ A dc				
Test # 2		$V_{CE} = 32$ V dc; $I_C = 340$ mA dc				
Test # 3		$V_{CE} = 80$ V dc; $I_C = 20$ mA dc				
Safe operating area (unclamped inductive)		$T_C = +25^\circ\text{C}$; $R_{BB1} = 10 \Omega$; $R_{BB2} = 100 \Omega$; $L = 0.3$ mH; $R_L = 0.1 \Omega$; $V_{CC} = 10$ V dc; $V_{BB1} = 10$ V dc; $V_{BB2} = 4$ V dc; $I_{CM} = 10$ A dc (see figure 5)				
End point electrical measurements		See table I, Subgroup 2				
<u>Subgroups 6 and 7</u>						
Not applicable						

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

2/ The units specified apply to all package outlines unless otherwise stated.

TABLE II. Groups B, C and E delta electrical measurements. 3/ 4/ 5/ 6/

Steps	Inspection <u>1/</u> , <u>2/</u>	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Forward - current transfer ratio	3076	$I_C = 2.5$ V dc; $V_{CE} = 5$ V dc, Pulsed (see 4.5.1)	Δh_{FE2}	± 20 percent change from initial reading.		
2.	Thermal response <u>7/</u>	3131	See 4.5.3	ΔV_{BE}			

1/ See MIL-PRF-19500 for sampling plan.

2/ Devices which exceed the group A limits for this test shall not be acceptable.

3/ The delta measurements for table VIa (JANS) of MIL-PRF-19500 are as follows:

- a. Subgroup 3, see table II herein, step 2.
- b. Subgroups 4 and 5, see table II herein, step 2.

4/ The delta measurements for table VIb (JANTX and JANTXV) of MIL-PRF-19500 are as follows:

- a. Subgroup 2, see table II herein, step 1.
- b. Subgroups 3 and 6, see table II herein, step 1.

5/ The delta measurements for table VII of MIL-PRF-19500 are as follows:

- a. Subgroup 6, see table II herein, step 1.

6/ The delta measurements for table IX of MIL-PRF-19500 are as follows:

- a. Subgroup 1, see table II herein, step 1.
- b. Subgroup 2, see table II herein, step 1.

7/ Safe operating area (SOA) testing may be performed in lieu of thermal response testing herein provided that appropriate conditions of temperature, time, current, and voltage to achieve die attach integrity are submitted to the qualifying activity.

$R_{BB1} = 10 \Omega$
 $R_{BB2} = 100 \Omega$
 $L = 0.3 \text{ mH}$
 $R_L = 0.1 \Omega$
 $V_{CC} = 10 \text{ V dc}$
 $I_C = 10 \text{ nA}$
 $V_{BB1} = 10 \text{ V dc}$
 $V_{BB2} = 4 \text{ V dc}$

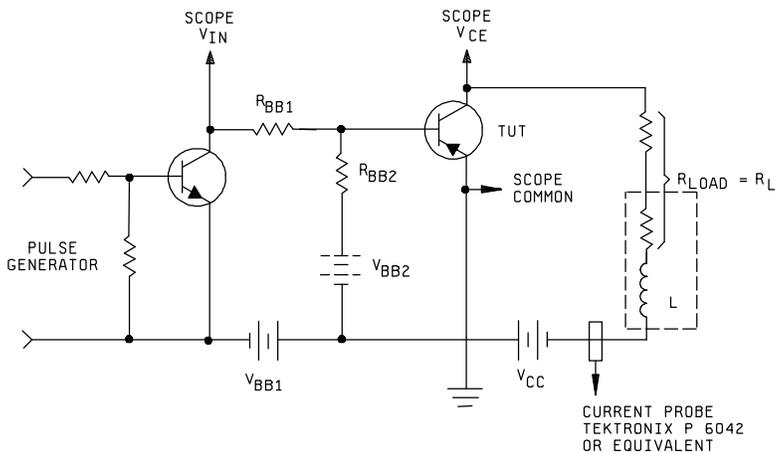


FIGURE 7. Unclamped inductive load energy test circuit.

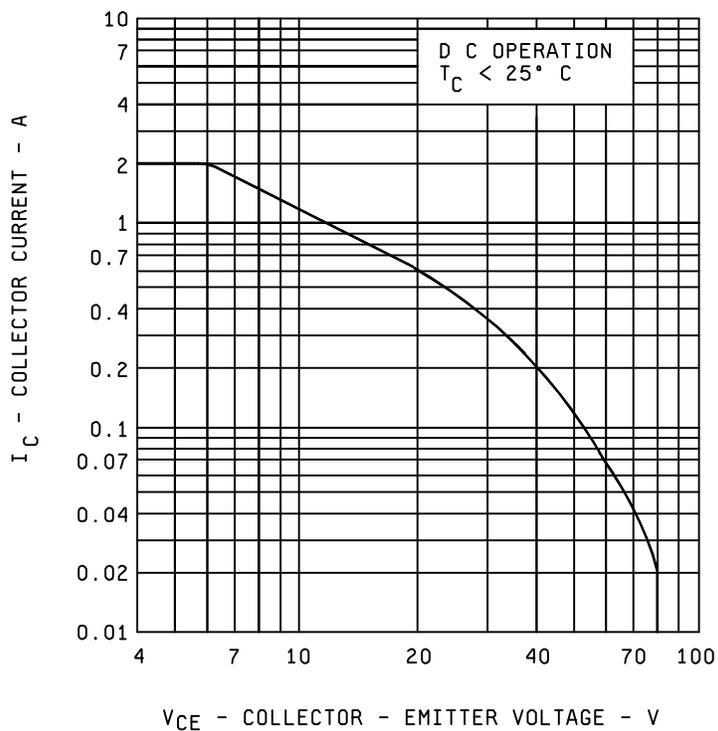


FIGURE 8. Maximum safe operating area.

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 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.

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 must specify the following:

- a. Issue of DODISS to be cited in the solicitation (see 2.2.1).
- b. The lead finish as specified (see 3.4.2).
- c. Type designation and quality assurance level.
- c. Packaging requirements (see 5.1).
- e. For die acquisition, the JANHC or JANKC letter version shall be specified (see figures 2, 3, and 4).

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 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 purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center Columbus, DSCC-VQE, Columbus, OH 43216.

6.4. Suppliers of JANHC and JANKC die. The qualified JANHC and JANKC suppliers with the applicable letter version (example JANHCA2N5151) will be identified on the QML.

JANHC and JANKC ordering information			
PIN	Manufacturer		
	33178	34156	43611
2N5151 2N5153	JANHCA2N5151 JANHCA2N5153	JANHCB2N5151 JANHCB2N5153	JANHCC2N5151 JANHCC2N5153
2N5151 2N5153	JANKCA2N5151 JANKCA2N5153	JANKCB2N5151 JANKCB2N5153	JANHCC2N5151 JANHCC2N5153

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

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CONCLUDING MATERIAL

Custodians:
Air Force - 11
NASA - NA
DLA - CC

Preparing activity:
DLA - CC
(Project 5961-2263)

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.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:**1. DOCUMENT NUMBER**

MIL-PRF-19500/545C

2. DOCUMENT DATE (YYMMDD)

000721

3. DOCUMENT TITLE

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, POWER, TYPES 2N5151, 2N5153, 2N5151L, 2N5153L, 2N5151U3, 2N5153U3 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 (YYMMDD)

8. PREPARING ACTIVITY

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c. ADDRESS : Defense Supply Center
Columbus, ATTN: DSCC-VAC, 3990
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43216-5000

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