

The documentation and process conversion measures necessary to comply with this revision shall be completed by 15 March 1994

INCH-POUND

MIL-S-19500/545A(USAF)
 15 January 1994
 SUPERSEDING
 MIL-S-19500/545(USAF)
 6 August 1980

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, POWER
 TYPES 2N5151, 2N5153, 2N5151L, 2N5153L, 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 detail requirements for PNP, silicon, power transistors for use in high-speed power-switching applications. Three levels of product assurance are provided for each device type as specified in MIL-S-19500. Two levels of product assurance are provided for die.

1.2 Physical dimensions. See figure 1 (TO-205) and figures 3 and 4 (JANHC and JANKC).

1.3 Maximum ratings.

PT 1/ TA = 25°C	PT 2/ TC = 25°C	VCBO	VCEO	VEBO	IC	IC 3/	Reverse pulse 4/ energy	Safe operating area	Tstg and TJ
W	W	V dc	V dc	V dc	A dc	A dc	mJ	See	°C
1	11.8	100	80	5.5	2	10	15	figure 7	-65 to +200

- 1/ Derate linearly 5.7 mW/°C for TA > 25°C.
- 2/ Derate linearly 66.7 mW/°C for TC > 25°C.
- 3/ This value applies for PW ≤ 8.3 ms, duty cycle ≤ 1 percent.
- 4/ This rating is based on the capability of the transistors to operate safely in the unclamped inductive load energy test circuit of figure 6.

1.4 Primary electrical characteristics at TC = 25°C.

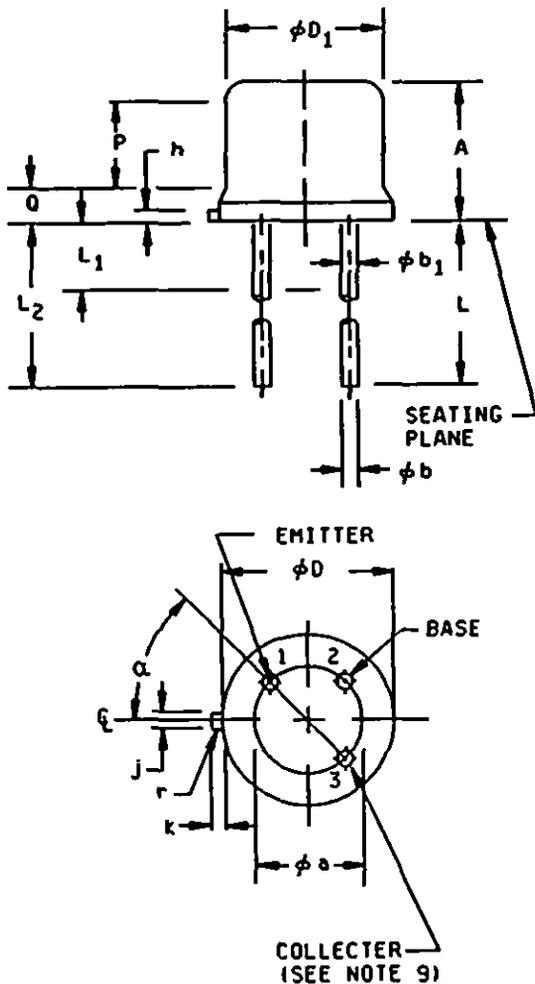
Limits	hFE2 1/ VCE = 5 V IC = 2.5 A		hfe VCE = 5 V IC = 500 mA dc f = 10 MHz		VBE(sat)2 1/ IC = 5 A dc IB = 500 mA dc	VCE(sat)2 1/ IC = 5 A dc IB = 500 mA dc	Cobo VCB = 10 V dc IE = 0 f = 1 Mhz	RθJA	RθJC
	2N5151 2N5151L	2N5153 2N5153L	2N5151 2N5151L	2N5153 2N5153L					
Min	30	70	6	7	V dc	V dc	pF	°C/W	°C/W
Max	90	200			2.2	1.5	250	175	15

1/ Pulsed (see 4.5.1).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Electronics Supply Center, ATTN: DESC-ECT, 1507 Wilmington Pike, Dayton, OH 45444-5270, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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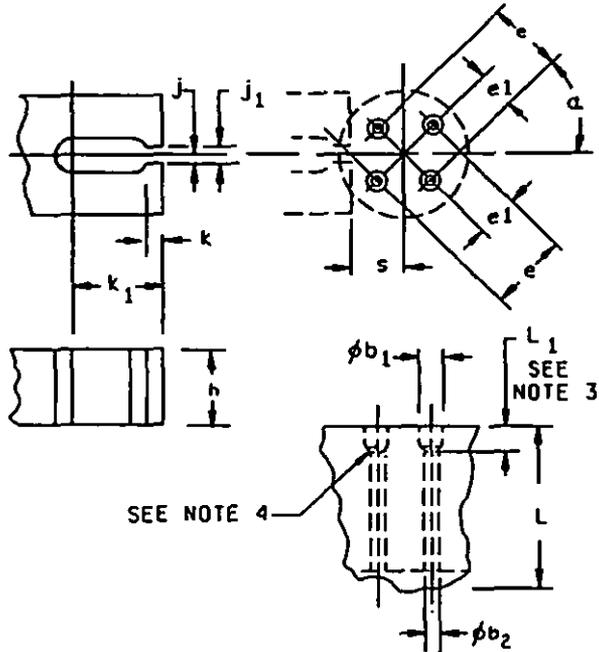


Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
A	.240	.260	6.10	6.60	
ϕa	.200 TP		5.08 TP		6
ϕb	.016	.021	.41	.53	7, 8
ϕb_1	.016	.019	.41	.48	
ϕD	.335	.370	8.51	9.40	
ϕD_1	.305	.335	7.75	8.51	
h	.009	.041	.23	1.04	
j	.028	.034	.71	.86	2
k	.029	.045	.74	1.14	3
L	See notes 7, 8, 11, and 12				
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		.25	10
α	45° TP		45° TP		6

NOTES:

1. Metric equivalents are given for general information only.
2. Beyond r (radius) maximum, j shall be held for a minimum length of .011 (.28 mm).
3. k measured from maximum ϕD .
4. Outline in this zone is not controlled.
5. ϕD_1 shall not vary more than .010 (.25 mm) in zone P . This zone is controlled for automatic handling.
6. Leads at gauge plane $.054 + .001 - .000$ (1.37 + .03 - .00 mm) below seating plane shall be within .007 (.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods or by the gauge and gauging procedure shown on figure 3.
7. ϕb_1 applied between L_1 and L_2 . ϕb applies between L_2 and L minimum. Diameter is uncontrolled in L_1 and beyond L minimum.
8. All three leads.
9. The collector shall be electrically and mechanically connected to the case.
10. r (radius) applies to both inside corners of tab.
11. For transistor types 2N5151 and 2N5153, L is .5 (12.70 mm) minimum, and .75 (19.05 mm) maximum.
12. For transistor types 2N5151L and 2N5153L, L is 1.5 (38.10 mm) minimum and 1.75 (44.45 mm) maximum.

FIGURE 1. Physical dimensions (T0-205).

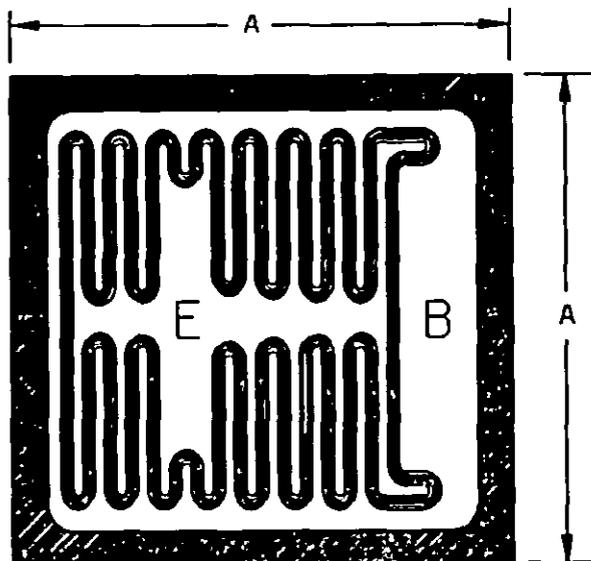


Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
ϕb_1	.0595	.0605	1.511	1.537	
ϕb_2	.0325	.0335	0.826	0.851	
e	.1995	.2005	5.067	5.093	
e1	.0995	.1005	2.527	2.553	
h	.150 Nominal		3.81 Nominal		
j	.0175	.0180	0.444	0.457	
j1	.0350	.0355	0.889	0.902	
k	.009	.011	0.23	0.28	
k1	.125 Nominal		3.18 Nominal		
L	.372	.378	9.45	9.60	
L1	.054	.055	1.37	1.40	
s	.182	.199	4.62	5.05	1
α	44.90°	45.10°	44.90°	45.10°	

NOTES:

1. The location of the tab locator within the limits indicated will be determined by the tab and flange dimensions of the device being checked.
2. Gauging procedure. The device being measured shall be inserted until its' seating plane is $.125 \pm .010$ (3.18 ± 0.25 mm) from the seating surface of the gauge. A force of $8 \pm .5$ ounce shall then be applied parallel and symmetrical to the devices' 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. The use of a pin straightener prior to insertion in the gauge is permissible.
3. Gauging plane.
4. Drill angle.

FIGURE 2. Gauge for lead and tab location.

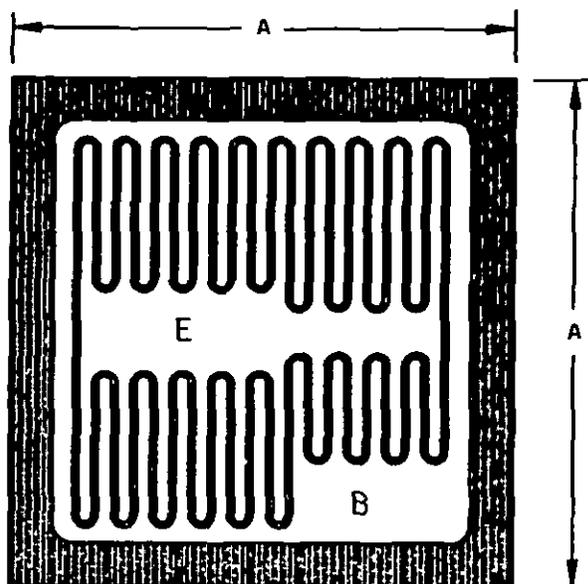


Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
A	.117	.127	2.97	3.23	

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: .008 (0.20 mm) to .012 (0.30 mm), tolerance is ± 0.005 (0.13 mm).
 - Top metal: Aluminum, 40,000 Å minimum, 50,000 Å nominal.
 - Back metal: Gold 2,500 Å minimum, 3,000 Å nominal.
 - Back side: Collector.
 - Bonding pad:
 - B = .015 (0.38 mm) x .0072 (1.83).
 - E = .015 (0.38 mm) x .0060 (1.52).

FIGURE 3. JANHCA and JANKCA die dimensions.



Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
A	.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: .0078 (0.198 mm) nominal, tolerance is ± 0.005 (0.13 mm).
 - Top metal: Aluminum, 25,000 Å minimum, 33,000 Å nominal.
 - Back metal: Gold 1,500 Å minimum, 2,500 Å nominal.
 - Back side: Collector.
 - Bonding pad: .012 (0.305 mm) min. x .030 (.761) min.

FIGURE 4. JANHCB and JANKCB die dimensions.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 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

MILITARY

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

STANDARD

MILITARY

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

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

2.2 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.

3. REQUIREMENTS

3.1 Associated detail specification. The individual item requirements shall be in accordance with MIL-S-19500, and as specified herein.

3.2 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein shall be as specified in MIL-S-19500.

3.3 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-S-19500 and figures 1 (TO-205), 3, and 4 (JANHC and JANKC) herein.

3.3.1 Lead finish. Lead finish shall be solderable in accordance with MIL-S-19500.

3.3.2 Current density. Current density of internal conductors shall be as specified in 3.6.5 of MIL-S-19500.

3.4 Marking. Marking shall be in accordance with MIL-S-19500.

3.5 Electrostatic discharge protection. The devices covered by this specification require electrostatic discharge protection (see 6.4). ESD device failures in groups B and C are not counted as failures against the lot when verified.

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein.

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

4.2.1 Group E inspection. Group E inspection shall be conducted in accordance with MIL-S-19500 and 4.4.4 herein.

4.2.2 JANHC and JANKC die. Qualification shall be in accordance with appendix H of MIL-S-19500.

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4.3 Screening (JANTX, JANTXV, and JANS Levels only). Screening shall be in accordance with MIL-S-19500 (table II), 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 II of MIL-S-19500)	Measurement	
	JANS levels	JANTX and JANTXV levels
1/	Thermal response (see 4.3.3)	Thermal response (see 4.3.3)
9	ICES1 and hFE2	Not applicable
11	ICES1 and hFE2; Δ ICES1 = 100 percent of initial value or 100 nA dc, whichever is greater. Δ hFE2 = \pm 20 percent.	ICES1 and hFE2
12	See 4.3.1	See 4.3.1
13	Subgroup 2 of table I herein: Δ ICES1 = +100 percent of initial value or 100 nA, whichever is greater. Δ hFE2 = \pm 20 percent.	Subgroup 2 of table I herein: Δ ICES1 = +100 percent of initial value or 100 nA, whichever is greater. Δ hFE2 = \pm 20 percent.

1/ This test shall be performed anytime before screen 9.

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

4.3.2 Power burn-in conditions. Power burn-in conditions are as follows: T_A = Room ambient as defined in 4.5 of MIL-STD-750.

$$V_{CE} = 40 \text{ V} \pm 1 \text{ V} \quad P_t = 1.0 \text{ W (min)}$$

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

4.3.3 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_H 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).

4.4 Quality conformance inspection. Quality conformance inspection shall be in accordance with MIL-S-19500.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-S-19500 and table I herein. Endpoint electrical measurements shall be in accordance with the applicable steps of table II herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with conditions specified for the subgroup testing in table IVa (JANS) and table IVb (JAN, JANTX, and JANTXV) of MIL-S-19500, and as follows. Electrical measurements (end points) and delta requirements shall be in accordance with the applicable steps of table II herein.

4.4.2.1 Group B inspection, table IVa (JANS) of MIL-S-19500.

Subgroup	Method	Condition
B4	1037	$P_T = 1.0$ W minimum, $V_{CB} = 40$ V dc ± 1 V, $T_A = 25^\circ\text{C} \pm 3^\circ\text{C}$, $t_{on} = t_{off} = 3$ minutes minimum for 2,000 cycles. No heat sink or forced air on the device shall be permitted.
B5	1027	$V_{CB} = 20$ V dc, $T_J = 275^\circ\text{C} \pm 5^\circ\text{C}$ for 96 hours. Adjust as required by the chosen T_A to give an average lot $T_J = 275^\circ\text{C}$. Marking legibility requirements shall not apply.
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 IVb (JANTX and JANTXV) of MIL-S-19500.

Subgroup	Method	Condition
B3	1037	2,000 cycles; $V_{CB} \geq 10$ V dc; ΔT_J between cycles $\geq 100^\circ\text{C}$; $t_{on} = t_{off} = 3$ minutes.
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 IV of MIL-S-19500 and as follows. Electrical measurements (endpoints) and delta requirements shall be in accordance with the applicable steps of table II herein.

Subgroup	Method	Condition
C2	2036	Test condition E.
C6	1026	$T_A = 25^\circ\text{C}$, 1,000 hours, $V_{CB} = 40$ V dc ± 1 V dc, $P_T = 1$ W (minimum).

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4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-S-19500. Electrical measurements (end points) and delta requirements shall be in accordance with the applicable steps and footnotes of table II herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>	<u>Sampling plan</u>
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 (See 4.5.2)	22 devices, c = 0
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:

- a. Collector current magnitude during power application shall be 500 mA dc.
- b. Collector to emitter voltage magnitude shall be 10 V dc.
- c. Reference temperature measuring point shall be the case.
- d. 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.
- e. Mounting arrangement shall be with heat sink to case.
- f. Maximum limit of $R_{\theta JC}$ shall be 15.0°C/W .

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TABLE I. Group A inspection.

Inspection 1/ Method	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
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 _{CE} S1	--	1.0	uA dc
Collector to emitter cutoff current	3041	Bias condition C, V _{CE} = 100 V dc V _{BE} = 0	I _{CE} S2	--	1.0	mA dc
Collector to emitter cutoff current	3041	Bias condition D, V _{CE} = 40 V dc I _B = 0	I _{CE} O	--	50	uA dc
Emitter to base cutoff current	3061	Bias condition D, V _{EB} = 4 V dc I _C = 0	I _{EB} O1	--	1.0	uA dc
Emitter to base cutoff current	3061	Bias condition D, V _{EB} = 5.5 V dc I _C = 0	I _{EB} O2	--	1.0	mA dc
Forward current transfer ratio	3076	V _{CE} = 5 V dc I _C = 50 mA dc (see 4.5.1)	h _{FE} 1			
2N5151				20	--	--
2N5153				50	--	--
Forward - current transfer ratio	3076	V _{CE} = 5 V dc I _C = 2.5 A dc Pulsed (see 4.5.1)	h _{FE} 2			
2N5151				30	90	--
2N5153				70	200	--
Forward - current transfer ratio	3076	V _{CE} = 5 V dc I _C = 5 A dc Pulsed (see 4.5.1)	h _{FE} 3			
2N5151				20	--	--
2N5153				40	--	--

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u> - Continued						
Base-emitter voltage (non-saturated)	3066	Test condition B, VCE = 5 V dc IC = 2.5 A dc Pulsed (see 4.5.1)	VBE	--	1.45	V dc
Base-emitter saturation voltage	3066	Test condition A, IC = 2.5 A dc IB = 250 mA dc Pulsed (see 4.5.1)	VBE(sat)1	--	1.45	V dc
Base-emitter saturation voltage	3066	Test condition A, IC = 5 A dc IB = 500 mA dc Pulsed (see 4.5.1)	VBE(sat)2	--	2.2	V dc
Collector-emitter saturation voltage	3071	IC = 2.5 A dc IB = 250 mA dc Pulsed (see 4.5.1)	VCE(sat)1	--	0.75	V dc
Collector-emitter saturation voltage	3071	IC = 5 A dc IB = 500 mA dc Pulsed (see 4.5.1)	VCE(sat)2	--	1.5	V dc
<u>Subgroup 3</u>						
High temperature operation:		TC = 150°C				
Collector to emitter cutoff current	3041	Bias condition A VCE = 60 V dc VBE = +2 V dc	ICEX	--	500	uA dc
Low temperature operation		TC = -55°C				
Forward - current transfer ratio	3076	VCE = 5 V dc IC = 2.5 A dc Pulsed (see 4.5.1)	hFE4			
2N5151				15	--	--
2N5153				25	--	--
<u>Subgroup 4</u>						
Common-emitter, small- signal, short-circuit, forward-current transfer ratio	3206	VCE = 5 V dc IC = 100 mA dc f = 1 KHz	hfe			
2N5151				20	--	--
2N5153				50	--	--

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 4 - Continued</u>						
Magnitude of common-emitter, small-signal short-circuit, forward-current, transfer ratio	3306	V _{CE} = 5 V dc I _C = 500 mA dc f = 10 MHz	h _{fe}			
2N5151				6	--	--
2N5153				7	--	--
Open-circuit output capacitance	3236	V _{CB} = 10 V dc I _E = 0 f = 1 MHz	C _{obo}	--	250	pf
Switching time		I _C = 5 A dc I _{B1} = 500 mA dc	t _{on}	--	0.5	us
		I _{B2} = -500 mA dc	t _s	--	1.4	us
		V _{BE(off)} = 3.7 V dc	t _f	--	0.5	us
		R _L = 6 Ω (see figure 5)	t _{off}	--	1.5	us
<u>Subgroup 5</u>						
Safe operating area (D.C.)	3055	Pre-pulse condition for each test: V _{CE} = 0 I _C = 0 T _C = 25°C Pulse condition for each test t _p = 1 sec. 1 cycle T _C = 25°C (see figure 7)				
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				

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 5</u> - Continued						
Safe operating area (unclamped inductive)		$T_c = 25^\circ\text{C}$ $R_{BB1} = 10 \Omega$ $R_{BB2} = 100 \Omega$ $L = 0.3 \text{ mH}$ $R_L = 0.1 \Omega$ $V_{CC} = 10 \text{ V dc}$ $V_{BB1} = 10 \text{ V dc}$ $V_{BB2} = 4 \text{ V dc}$ $I_{CM} = 10 \text{ A dc}$ (see figure 6)				
End point electrical measurements		See table IV Steps 1, 2, and 3				
<u>Subgroups 6 and 7</u>						
Not applicable						

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

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

Steps	Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Collector to emitter cutoff current	3041	V _{CE} = 60 V dc cond. C, V _{BE} = 0	I _{CES1}		1.0	μA dc
2.	Forward - current transfer ratio 2N5151 2N5153	3076	V _{CE} = 5 V dc I _C = 2.5 A dc Pulsed (see 4.5.1)	h _{FE2}			
					30	90	--
					70	200	--
3.	Breakdown voltage collector to emitter	3011	Bias condition A, I _C = 100 mA dc I _B = 0 Pulsed (see 4.5.1)	V(BR)CEO	80	--	Vdc
4.	Collector to emitter cutoff current	3041	V _{CE} = 60 V dc	I _{CES1} 2/	100% of initial value or 100 nA whichever is greater		
5.	Forward - current transfer ratio	3076	I _C = 5 V dc V _{CE} = 5 V dc Pulsed (see 4.5.1)	Δh _{FE2} 2/	± 20% change from initial reading		
6.	Base to 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)}		1.45	V dc
7.	Thermal response 7/	3131	See 4.3.3	ΔV _{BE}			

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

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

3/ The electrical measurements for table IVa (JANS) of MIL-S-19500 are as follows:

- a. Subgroup 3, see table II herein, steps 1, 2, and 6.
- b. Subgroup 4, see table II herein, steps 3, 4, 5, 6, and 7.
- c. Subgroup 5, see table II herein, steps 3, 4, 5, 6, and 7.

4/ The electrical measurements for table IVb (JANTX and JANTXV) of MIL-S-19500 are as follows:

- a. Subgroup 2, see table II herein, steps 1, 2, and 3.
- b. Subgroup 3, see table II herein, steps 4, 5, and 7.
- c. Subgroup 6, see table II herein, steps 4, and 5.

TABLE II. Groups A, B, and C electrical measurements - Continued. 3/ 4/ 5/ 6/

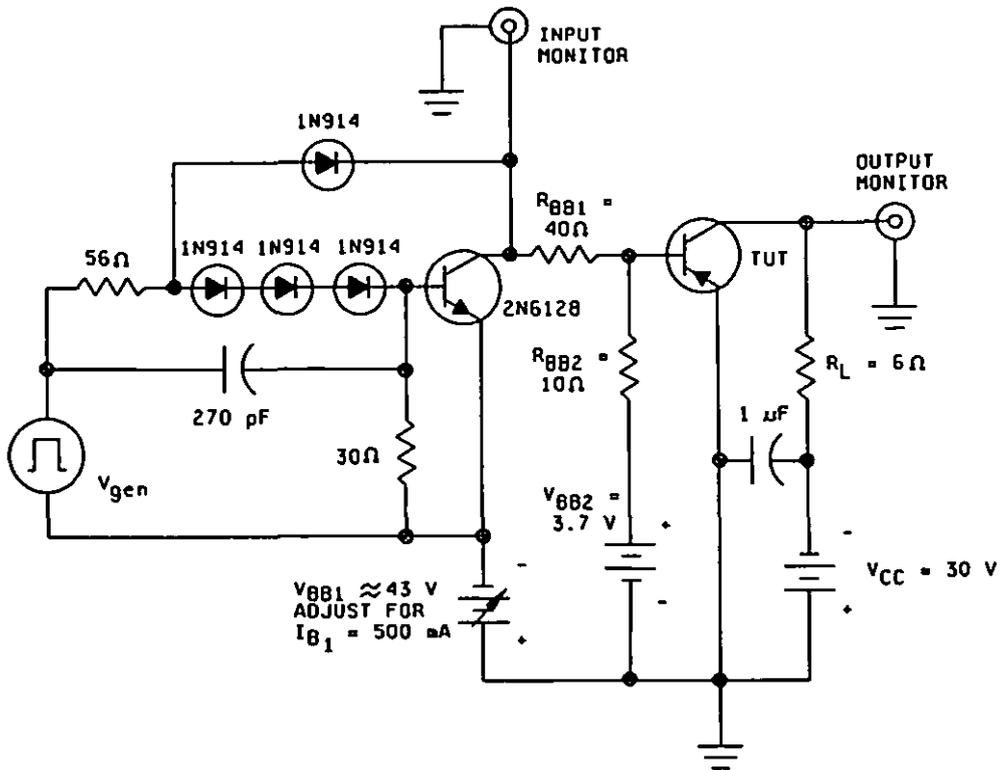
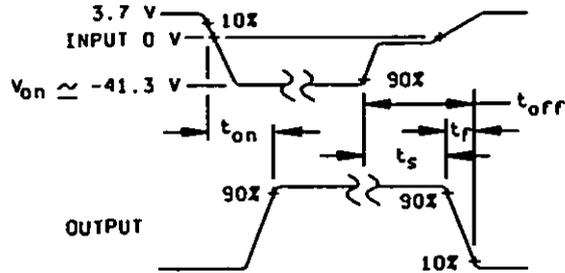
5/ The electrical measurements for table V of MIL-S-19500 are as follows:

- a. Subgroup 2, see table II herein, steps 1, 2, and 3.
- b. Subgroup 3, see table II herein, steps 1, 2, and 3.
- c. Subgroup 5, see table II herein, steps 3, 4, 5, and 7.

6/ The electrical measurements for table VII of MIL-S-19500 are as follows:

- a. Subgroup 1, see table II herein, steps 3, 4, 5, and 6.
- b. Subgroup 2, see table II herein, steps 3, 4, 5, and 6.

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.



NOTES:

1. V_{gen} is -30 pulse (from 0 V) into a 50 ohm termination.
2. The V_{gen} waveform is supplied by a generator with the following characteristics: $t_r \leq 15$ ns, $t_f = 15$ ns, $Z_{OUT} = 50$ ohm, duty cycle ≤ 2 percent.
3. Waveforms are monitored on an oscilloscope with the following characteristics: $t_r \leq 15$ ns, $R_{IN} \geq 10$ M Ω , $C_{IN} \leq 11.5$ pF.
4. Resistors shall be noninductive types.
5. The dc power supplies may require additional bypassing in order to minimize ringing.
6. An equivalent circuit may be used.

FIGURE 5. Switching time test circuit.

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

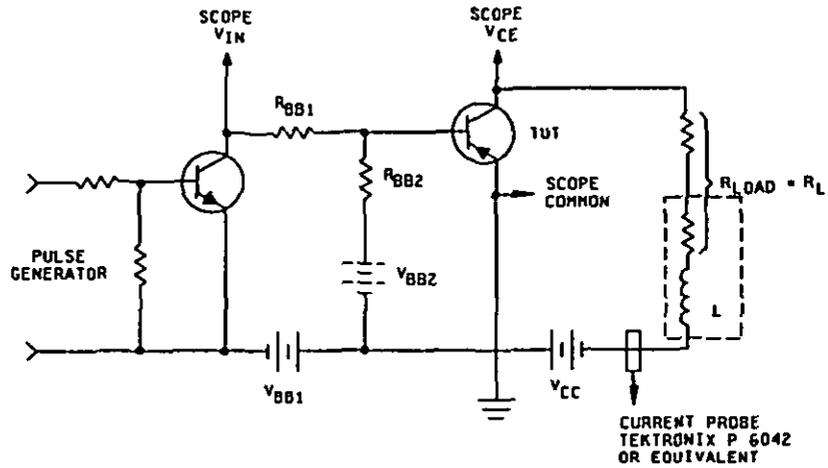


FIGURE 6. Unclamped inductive load energy test circuit.

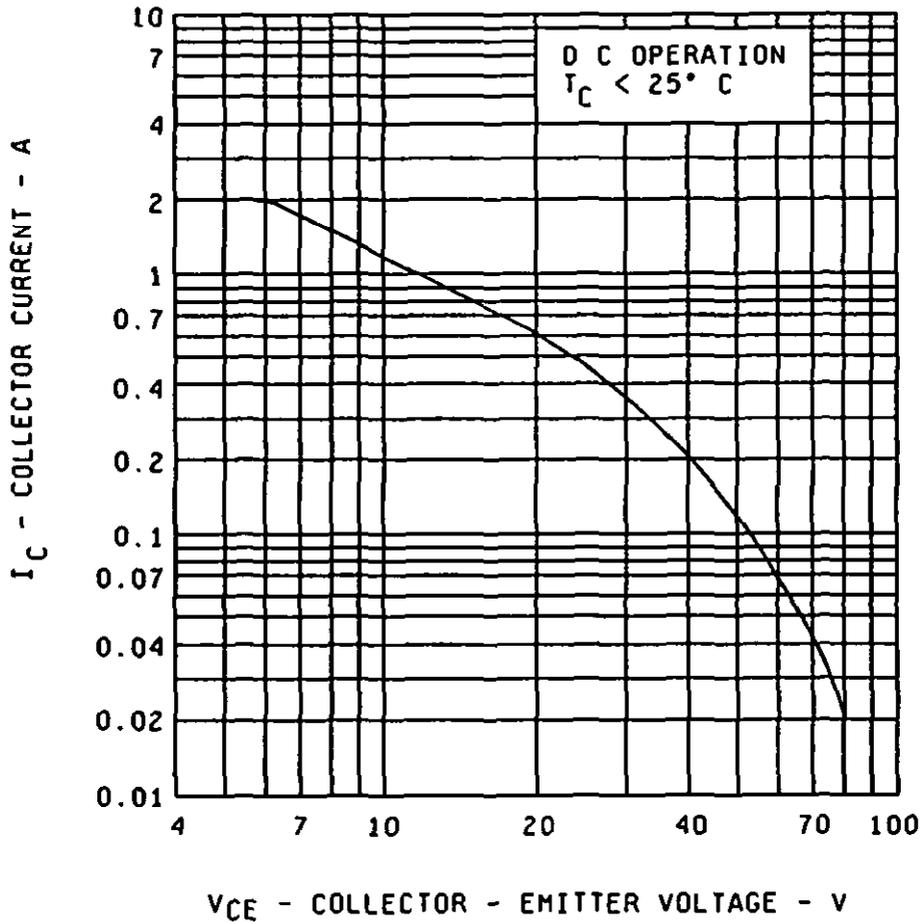


FIGURE 7. Maximum safe operating area.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-S-19500.

6. NOTES

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

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

6.2 Complimentary use. The devices specified herein are designed for complimentary use with the 2N5152 and 2N5154.

6.3 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of the specification.
- b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1).
- c. Lead finish (see 3.3.1).
- d. Product assurance level and type designator.
- e. For die acquisition, the JANHC and/or JANKC letter version shall be as specified (see figures 3 and 4).

6.4 Handling. Devices must be handled with certain precautions to avoid damage due to the accumulation of static charge. The following handling practices are recommended (see 3.5).

- a. Devices should be handled on benches with conductive and grounded surface.
- b. Ground test equipment, tools, and personnel handling devices.
- c. Do not handle the devices by the leads.
- d. Store devices in conductive foam or carriers.
- e. Avoid use of plastic, rubber, or silk.

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

JANHC and JANKC ordering information		
PIN	Manufacturer	
	3317B	34156
2N5151	JANHCA2N5151	JANHCB2N5151
2N5153	JANHCA2N5153	JANHCB2N5153
2N5151	JANKCA2N5151	JANKCB2N5151
2N5153	JANKCA2N5153	JANKCB2N5153

6.6 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.

MIL-S-19500/545A(USAF)

CONCLUDING MATERIAL

Custodians:
Air Force - 17
NASA - NA

Review activities:
DLA - ES

Preparing activity:
Air force - 17

Agent:
DLA - ES

(Project 5961-F050)

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.
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I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
MIL-S-19500/545A(USAF)

2. DOCUMENT DATE (YYMMDD)
94/01/15

3. DOCUMENT TITLE SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, POWER TYPES 2N5151, 2N5153, 2N5151L, 2N5153L, JANTX, JANTXV, JANHC, JANKC, 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)

7. DATE SUBMITTED
(YYMMDD)

- (1) Commercial
- (2) AUTOVON
(If applicable)

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