

The documentation and process conversion measures necessary to comply with this revision shall be completed by 7 September 2004.

INCH-POUND

MIL-PRF-19500/433F  
 7 June 2004  
 SUPERSEDING  
 MIL-PRF-19500/433E  
 1 July 1998

\* PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, HIGH-POWER,  
 TYPE 2N4399 AND 2N5745, JAN, JANTX, JANTXV, AND JANS

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

\* The requirements for acquiring the product described herein shall consist of this specification sheet and MIL-PRF-19500.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for PNP silicon, high-power 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 - 3).

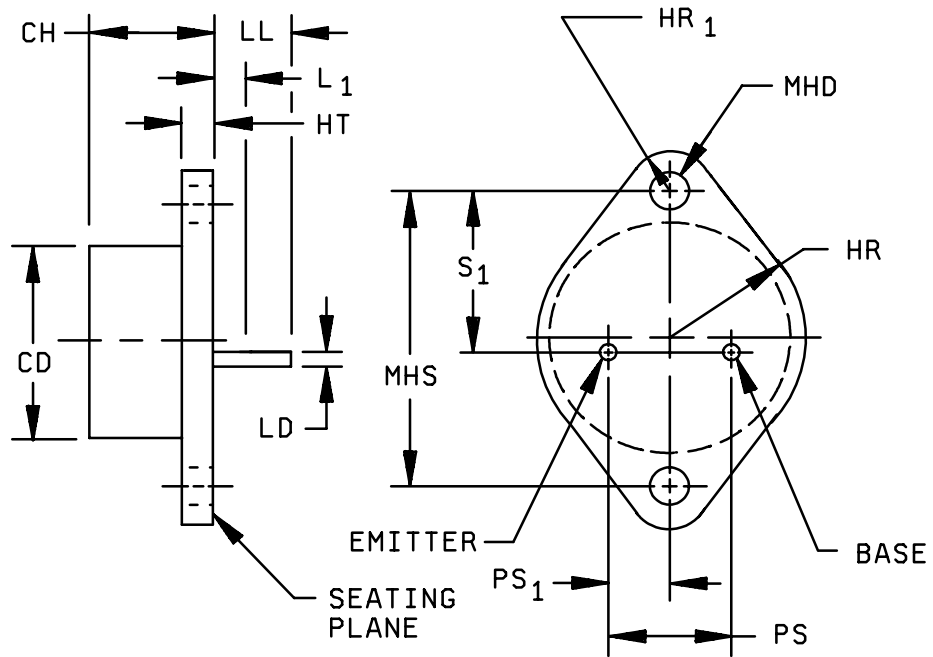
1.3 Maximum ratings.  $T_A = +25^{\circ}\text{C}$ , unless otherwise specified.

Type	$P_T$ (1) $T_A = +25^{\circ}\text{C}$	$P_T$ (2) $T_C = +100^{\circ}\text{C}$	$V_{CBO}$	$V_{CEO}$	$V_{EBO}$	$I_B$	$I_C$	$T_J$ and $T_{STG}$	$R_{\theta JC}$	$R_{\theta JA}$
	W	W	V <sub>dc</sub>	V <sub>dc</sub>	V <sub>dc</sub>	A <sub>dc</sub>	A <sub>dc</sub>	$^{\circ}\text{C}$	$^{\circ}\text{C/W}$	$^{\circ}\text{C/W}$
2N4399	5	115	60	60	5	7.5	30	-55 to +200	0.875	35
2N5745	5	115	80	80	5	7.5	20	-55 to +200	0.875	35

(1) Derate linearly 28.57 mW/ $^{\circ}\text{C}$  above  $T_A = +25^{\circ}\text{C}$ .

(2) Derate linearly 1.15 W/ $^{\circ}\text{C}$  above  $T_C = +100^{\circ}\text{C}$ .

\* Comments, suggestions, or questions on this document should be addressed to Defense Supply Center, Columbus, ATTN: DSCC-VAC, Post Office Box 3990, Columbus, OH 43218-3990, or emailed to [Semiconductor@dscclia.mil](mailto:Semiconductor@dscclia.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <http://www.dodssp.daps.mil>.



\* FIGURE 1. Physical dimensions (TO-3).

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Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD		.875		22.23	5
CH	.270	.380	6.86	9.65	
HT	.060	.135	1.52	3.43	
HR	.495	.525	12.57	13.34	
HR <sub>1</sub>	.131	.188	3.33	4.78	
LD	.038	.043	0.97	1.09	
LL	.312	.500	7.92	12.70	
L <sub>1</sub>		.050		1.27	
MHD	.151	.161	3.84	4.09	
MHS	1.177	1.197	29.90	30.40	
PS	.420	.440	10.67	11.18	2, 3
PS <sub>1</sub>	.205	.225	5.21	5.72	2, 3
S <sub>1</sub>	.655	.675	16.64	17.15	2

NOTES:

1. Dimensions are in inches. Millimeters are given for general information only.
2. These dimensions should be measured at points .050 inch (1.27 mm) to .055 inch (1.40 mm) below seating plane. When gauge is not used, measurement will be made at the seating plane.
3. The seating plane of the header shall be flat within .001 inch (0.03 mm) concave to .004 inch (0.10 mm) convex inside a .930 inch (23.62 mm) diameter circle on the center of the header and flat within .001 inch (0.03 mm) concave to .006 inch (0.15 mm) convex overall.
4. Collector shall be electrically connected to the case.
5. LD applies between L<sub>1</sub> and LL. Diameter is uncontrolled in L<sub>1</sub>.
6. In accordance with ASME Y14.5M, diameters are equivalent to  $\phi$ x symbology.

\* FIGURE 1. Physical dimensions (TO-3) - Continued.

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\* 1.4 Primary electrical characteristics at T<sub>C</sub> = +25°C.

Limit	h <sub>FE2</sub> (1)		h <sub>FE1</sub>	V <sub>CE(sat)1</sub> (1)		V <sub>BE(sat)1</sub> (1)		C <sub>obo</sub>	Switching	
	V <sub>CE</sub> = 2 V dc I <sub>C</sub> = 15 A dc	V <sub>CE</sub> = 2 V dc I <sub>C</sub> = 10 A dc	V <sub>CE</sub> = 10 V dc I <sub>C</sub> = 1 A dc f = 1 MHz	I <sub>C</sub> = 5 A dc I <sub>B</sub> = 0.5 A dc	I <sub>C</sub> = 15 A dc I <sub>B</sub> = 1.5 A dc	V <sub>CB</sub> = 10 V dc I <sub>E</sub> = 0 100 kHz ≤ f ≤ 1 MHz		t <sub>on</sub>	t <sub>off</sub>	
	<u>2N4399</u>	<u>2N5745</u>	V dc	<u>2N4399</u> V dc	<u>2N5745</u> V dc	<u>2N4399</u>	<u>2N5745</u>	pF	μs	μs
Min	15	15	4			1.8	2.0	1,000	1.2	2.5
Max	60	60	40	0.75	1.0					

(1) Pulsed (see 4.5.1).

2. APPLICABLE DOCUMENTS

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

2.2 Government documents.

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

\* DEPARTMENT OF DEFENSE SPECIFICATIONS

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

\* DEPARTMENT OF DEFENSE STANDARDS

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

\* (Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or <http://www.dodssp.daps.mil/> or 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, 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 General. The individual item requirements shall be as specified in MIL-PRF-19500 and as modified herein.

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

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

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

3.4.1 Lead finish. Unless otherwise specified, lead finish shall be solderable in accordance with MIL-STD-750, MIL-PRF-19500, and herein (see 6.2).

\* 3.5 Marking. Marking shall be in accordance with MIL-PRF-19500.

3.6 Electrical performance characteristics. Unless otherwise specified, 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 table I.

\* 3.8 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

### 4. VERIFICATION

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

a. Qualification inspection (see 4.2).

b. Screening (see 4.3).

\* c. Conformance inspection (see 4.4 and table I and II).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

\* 4.2.1 Group E qualification. Group E inspection shall be performed for qualification or re-qualification only. In case qualification was awarded to a prior revision of the specification sheet that did not request the performance of table II tests, the tests specified in table II herein that were not performed in the prior revision shall be performed on the first inspection lot of this revision to maintain qualification.

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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 level	JANTX and JANTXV levels
3c	Thermal impedance (see 4.3.2)	Thermal impedance (see 4.3.2)
7	Optional.	Optional.
9	$I_{CEX1}$ and $h_{FE2}$	$I_{CEX1}$
11	$I_{CEX1}$ and $h_{FE2}$ $\Delta I_{CEX1} \leq 100$ percent of initial value or 5 nA dc, whichever is greater. $\Delta h_{FE2} \leq \pm 15$ percent of initial value	$I_{CEX1}$ and $h_{FE2}$ ; $\Delta I_{CEX1} \leq 100$ percent of initial value or 100 nA dc, whichever is greater.
12	See 4.3.1	See 4.3.1
13	Subgroup 2 of table I herein; $\Delta I_{CEX1} \leq 100$ percent of initial value or 50 nA dc, whichever is greater; $\Delta h_{FE2} \leq \pm 15$ percent of initial value	Subgroup 2 of table I herein; $\Delta I_{CEX1} \leq 100$ percent of initial value or 100 nA dc, whichever is greater; $\Delta h_{FE2} \leq \pm 15$ percent of initial value;
14	Required.	Required.

\* 4.3.1 Power burn-in conditions. Power burn-in conditions are as follows:  $T_J = +187.5 \pm 12.5^\circ\text{C}$ ;  $V_{CE} = +30$  V dc,  $\pm 10$  V dc;  $T_A$  = room ambient as defined in the general requirements of MIL-STD-750.

\* 4.3.2 Thermal impedance ( $\Delta V_{BE}$  measurements). The  $\Delta V_{BE}$  measurements shall be performed in accordance with method 3131 of MIL-STD-750. The  $\Delta V_{BE}$  conditions ( $I_H$  and  $V_H$ ) and maximum limit shall be derived by each vendor. The chosen  $\Delta V_{BE}$  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  $\Delta V_{BE}$  shall be considered final after the manufacturer has had the opportunity to test five consecutive lots.

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

\* 4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with table V of 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 appendix E, table VIa (JANS) and table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500, and as follows. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

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

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
B4	1037	$V_{CE} = 20 \text{ V dc}$ ; $P_T = 5 \text{ W}$ at $T_A = \text{room ambient}$ as defined in the general requirements of 4.5 of MIL-STD-750; $t_{on} = t_{off} = 3 \text{ minutes}$ minimum for 2,000 cycles. No heat sink or forced-air cooling on devices shall be permitted.
B5	1027	$V_{CB} = 20 \text{ V dc}$ ; $T_A = +125^\circ\text{C} \pm 25^\circ\text{C}$ for 96 hours; $P_T = 5 \text{ W}$ at $T_A = +125^\circ\text{C}$ or adjusted as required by the chosen $T_A$ to give an average lot $T_J = +275^\circ\text{C}$ .

4.4.2.2 Group B inspection, appendix E, table VIb of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
B3	1037	$V_{CB} = 20 \text{ V dc}$ ; $\Delta T_J$ between cycles $\geq +100^\circ\text{C}$ . $t_{on} = t_{off} = 3 \text{ minutes}$ minimum for 2,000 cycles. No heat sink or forced-air cooling on the devices shall be permitted.

\* 4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table VII of MIL-PRF-19500, and as follows. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
* C2	2036	Test condition A.
* C5	3131	See 4.5.2.
C6	1037	$V_{CB} = 20 \text{ V dc}$ ; $\Delta T_J$ between cycles $\geq +100^\circ\text{C}$ , $t_{on} = t_{off} = 3 \text{ minutes}$ minimum for 6,000 cycles. No heat sink or forced-air cooling on device shall be permitted.

\* 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 and as specified in table II herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

4.5 Method of inspection. Methods of inspection shall be as specified in 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 test method 3131 of MIL-STD-750. The following details shall apply:

- a.  $I_M$  measurement ..... 10 mA dc.
- b.  $V_{CE}$  measurement voltage ..... 20 V dc.
- c.  $I_H$  collector heating current ..... 2.5 A (minimum).
- d.  $V_H$  collector emitter heating voltage ..... 20 V (minimum).
- \* e.  $t_H$  heating time ..... Steady-state (see method 3131 of MIL-STD-750).
- f.  $t_{MD}$  measurement delay time ..... 20  $\mu$ s.
- g.  $t_{SW}$  sample window time ..... 10  $\mu$ s maximum.



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\* TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits 2/		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Collector to base breakdown voltage 2N4399 2N5745	3011	Bias condition D; $I_C = 200 \text{ mA dc}$ ; pulsed (see. 4.5.1)	$V_{(BR)CEO}$	60 80		V dc V dc
Collector to emitter cutoff current 2N4399 2N5745	3041	Bias condition D  $V_{CE} = 60 \text{ V dc}$ $V_{CE} = 80 \text{ V dc}$	$I_{CEO}$		100 100	$\mu\text{A dc}$ $\mu\text{A dc}$
Emitter-base cutoff current	3061	Bias condition D; $V_{EB} = 5 \text{ V dc}$	$I_{EBO}$		5.0	$\mu\text{A dc}$
Collector to emitter cutoff current 2N4399 2N5745	3041	Bias condition A; $V_{BE} = 1.5 \text{ V dc}$  $V_{CE} = 60 \text{ V dc}$ $V_{CE} = 80 \text{ V dc}$	$I_{CEX1}$		5.0 5.0	$\mu\text{A dc}$ $\mu\text{A dc}$
Base emitter saturated voltage	3066	Test condition A; $I_C = 10 \text{ A dc}$ ; $I_B = 1.0 \text{ A dc}$ ; pulsed (see 4.5.1)	$V_{BE(sat)1}$		1.7	V dc
Base emitter saturated voltage 2N4399 2N5745	3066	Test condition A; ; $I_C = 15 \text{ A dc}$ ; $I_B = 1.5 \text{ A dc}$ ; pulsed (see 4.5.1)	$V_{BE(sat)2}$		1.8 2.0	V dc V dc
* Collector to emitter saturated voltage 2N4399 2N5745	3071	Pulsed (see 4.5.1); $I_C = 5.0 \text{ A dc}$ ; $I_B = 0.5 \text{ A dc}$	$V_{CE(sat)1}$		0.75 1.0	V dc V dc
* Collector to emitter saturated voltage	3071	$I_C = 10 \text{ A dc}$ ; $I_B = 1.0 \text{ A dc}$ ; pulsed (see 4.5.1)	$V_{CE(sat)2}$		0.55	V dc
Forward-current transfer ratio	3076	$V_{CE} = 2 \text{ V dc}$ ; $I_C = 1.0 \text{ A dc}$ ; pulsed (see 4.5.1)	$h_{FE1}$	40	425	

See footnote at end of table.

\* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits 2/		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u> - Continued						
Forward-current transfer ratio 2N4399 2N5745	3076	$V_{CE} = 2 \text{ V dc}$ ; pulsed (see 4.5.1) $I_C = 15 \text{ A dc}$ $I_C = 10 \text{ A dc}$	$h_{FE2}$	15 15	60 60	
Forward-current transfer ratio 2N4399 2N5745	3076	$V_{CE} = 5 \text{ V dc}$ ; pulsed (see 4.5.1) $I_C = 30 \text{ A dc}$ $I_C = 20 \text{ A dc}$	$h_{FE3}$	5 5		
<u>Subgroup 3</u>						
High-temperature operation:		$T_A = +150^\circ\text{C}$				
Collector to emitter cutoff current 2N4399 2N5745	3041	Bias condition A; ; $V_{BE} = 1.5 \text{ V dc}$ $V_{CE} = 60 \text{ V dc}$ $V_{CE} = 80 \text{ V dc}$	$I_{CEX2}$		10 10	mA dc mA dc
Low-temperature operation:		$T_A = -55^\circ\text{C}$				
Forward-current transfer ratio 2N4399 2N5745	3076	$V_{CE} = 2 \text{ V dc}$ ; pulsed (see 4.5.1) $I_C = 15 \text{ A dc}$ $I_C = 10 \text{ A dc}$	$h_{FE4}$	7 7		
<u>Subgroup 4</u>						
* Pulse response transfer ratio	3251	Test condition A, except test circuit and pulse requirement in accordance with figure 2				
Pulse on time		See figure 2	$t_{on}$		1.2	$\mu\text{s dc}$
Pulse off time		See figure 2	$t_{off}$		2.5	$\mu\text{s dc}$

See footnote at end of table.

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\* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits 2/		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4</u> - Continued						
Magnitude of common-emitter small-signal short-circuit forward-current transfer ratio	3306	$V_{CE} = 10 \text{ V dc}; I_C = 1.0 \text{ A dc}; f = 1 \text{ MHz}$	$ h_{fe} $	4	40	
Open circuit output capacitance	3236	$V_{CB} = 10 \text{ V dc}; I_E = 0; 100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	$C_{obo}$		1,000	pF
Small-signal short-circuit forward-current transfer ratio	3206	$V_{CE} = 10 \text{ V dc}; I_C = 1.0 \text{ A dc}; f = 1.0 \text{ kHz}$	$h_{fe}$	40	425	
<u>Subgroup 5</u>						
* Safe operating area (dc operation)	3051	$T_C = +25^\circ\text{C}; t = 1 \text{ s}; 1 \text{ cycle, (see figure 3)}$				
<u>Test 1</u> (Both device type) 2N4399 2N5745		$V_{CE} = 6.67 \text{ V dc}; I_C = 30 \text{ A dc}$ $V_{CE} = 10 \text{ V dc}; I_C = 20 \text{ A dc}$				
<u>Test 2</u> (Both device types)		$V_{CE} = 20 \text{ V dc}; I_C = 10 \text{ A dc}$				
<u>Test 3</u> (Both device types)		$V_{CE} = 40 \text{ V dc}; I_C = 3 \text{ A dc}$				
<u>Test 4</u> (Both device type)		$V_{CE} = 50 \text{ V dc}; I_C = 600 \text{ mA dc}$ $V_{CE} = 60 \text{ V dc}; I_C = 600 \text{ mA dc}$				
Electrical measurements		See subgroup 2, herein for $I_{CEX1}$ and $h_{FE2}$				
* Safe operating area (unclamped inductive load)	3053	Load condition C; (see figure 4); $T_C = +25^\circ\text{C}; \text{duty cycle} \leq 10 \text{ percent}; R_s = .01\Omega; t_r = t_f \leq 500 \text{ ns}.$				
<u>Test 1</u> (Both device types)		$t_p = 5 \text{ ms (vary to obtain } I_C); V_{BB2} = 0; R_{BB1} = 10\Omega; L = 2 \text{ mH}; V_{BB1} = 10 \text{ V dc}; R_{BB2} = \text{infinity}; I_C = 10 \text{ A dc}; V_{CC} = 15 \text{ V dc}.$				

See footnote at end of table.

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\* TABLE I. Group A inspection - Continued.

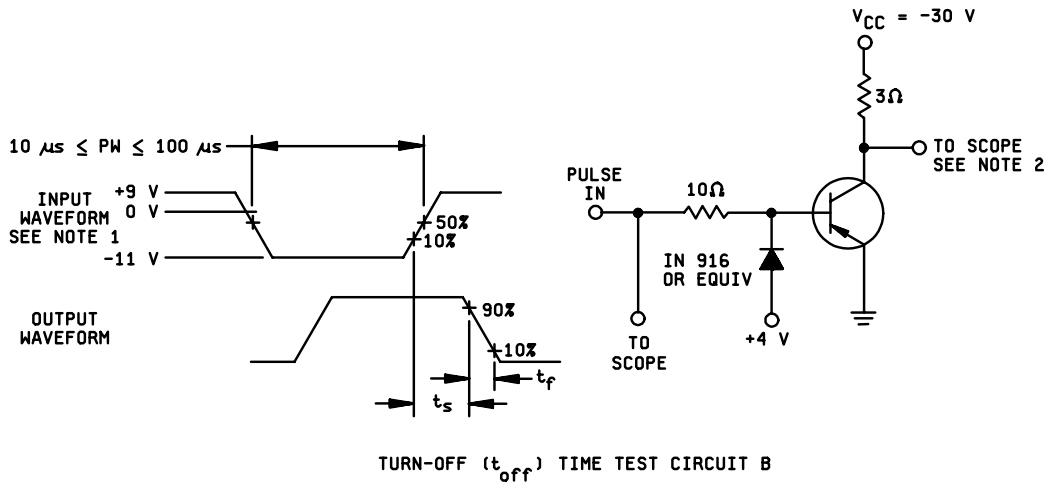
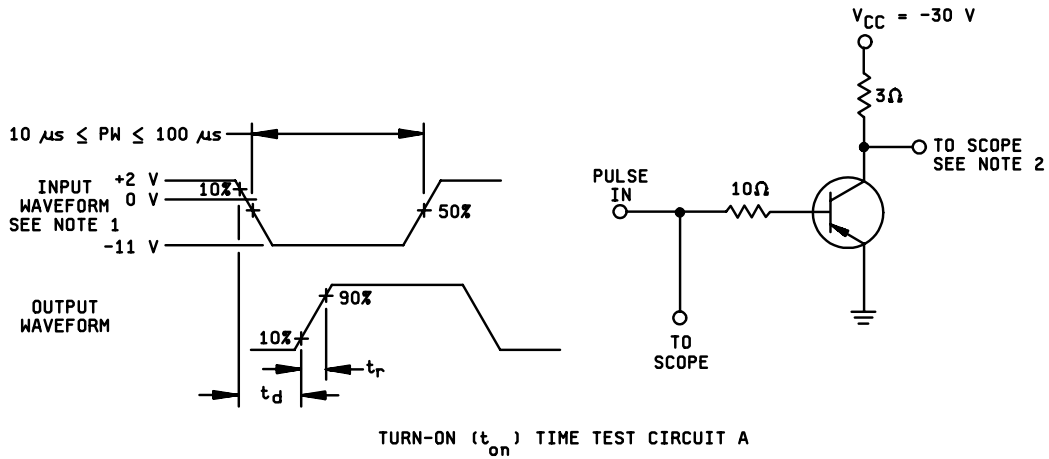
Inspection 1/	MIL-STD-750		Symbol	Limits 2/		Unit
	Method	Conditions		Min	Max	
<p><u>Subgroup 5</u> - continued</p> <p>* Safe operating area (unclamped inductive load) - continued</p> <p style="text-align: center;"><u>Test 2</u> (Both device types)</p> <p>* Safe operating area Clamped (switching destructive) 2N4399  2N5745</p> <p style="text-align: center;"><u>Subgroups 6 and 7</u></p> <p>Not applicable</p>	3053	<p>Load condition C; (see figure 4); <math>T_C = +25^\circ\text{C}</math>; duty cycle <math>\leq 10</math> percent; <math>R_s = .01\Omega</math>; <math>t_r = t_f \leq 500</math> ns.</p> <p><math>t_p = 5</math> ms (vary to obtain <math>I_C</math>); <math>V_{BB2} = 0</math>; <math>V_{BB1} = 10</math> V dc; <math>R_{BB1} = 100\Omega</math>; <math>L = 40</math> mH; <math>R_{BB2} = \text{infinity}</math>; <math>I_C = 1</math> A dc; <math>V_{CC} = 15</math> V dc.</p>				
	3053	<p><math>V_{CC} = 55</math> V dc; <math>T_A = +25^\circ\text{C}</math>; <math>L = 20</math> mH; (see figures 5 and 6)</p> <p>clamped voltage = 60 V dc; <math>I_C = 30</math> A dc</p> <p>clamped voltage = 80 V dc; <math>I_C = 20</math> A dc</p>				

1/ For sampling plan see MIL-PRF 19500.

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\* TABLE II. Group E inspection (all quality levels) - for qualification and re-qualification only.

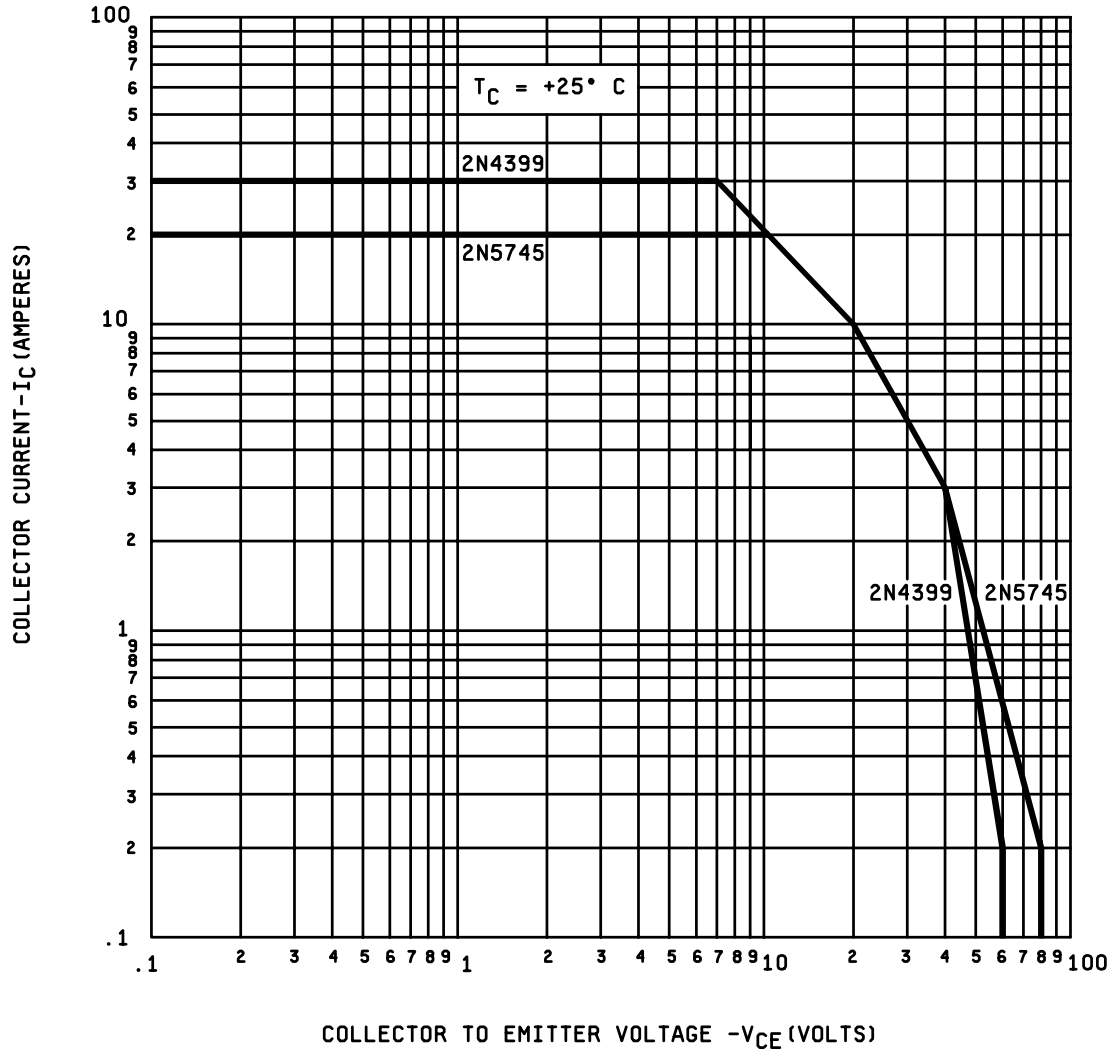
Inspection	MIL-STD-750		Qualification
	Method	Conditions	
<u>Subgroup 1</u>			45 devices c = 0
Temperature cycling	1051	500 cycles	
Hermetic seal Fine leak Gross leak	1071	Test conditions G or H Test conditions C or D	
Electrical measurements		See table I, subgroup 2.	
<u>Subgroup 2</u>			45 devices c = 0
High temperature reverse bias	1039	Condition A; 1,000 hrs	
Electrical measurements		See table I, subgroup 2.	
<u>Subgroup 3</u>			3 devices c = 0
DPA	2102		
<u>Subgroup 4</u>			Sample size N/A
Thermal impedance curves		Each supplier shall submit their qual-lot average and design maximum thermal impedance curves. In addition, the optimal test conditions and $Z_{\theta jx}$ limit shall be provided to the qualifying activity in the qualification report	
<u>Subgroups 5 and 6</u>			
Not applicable			
<u>Subgroup 8</u>			45 devices c = 0
Reverse stability	1033	Condition A for devices $\geq 400$ V, condition B for devices $< 400$ V.	



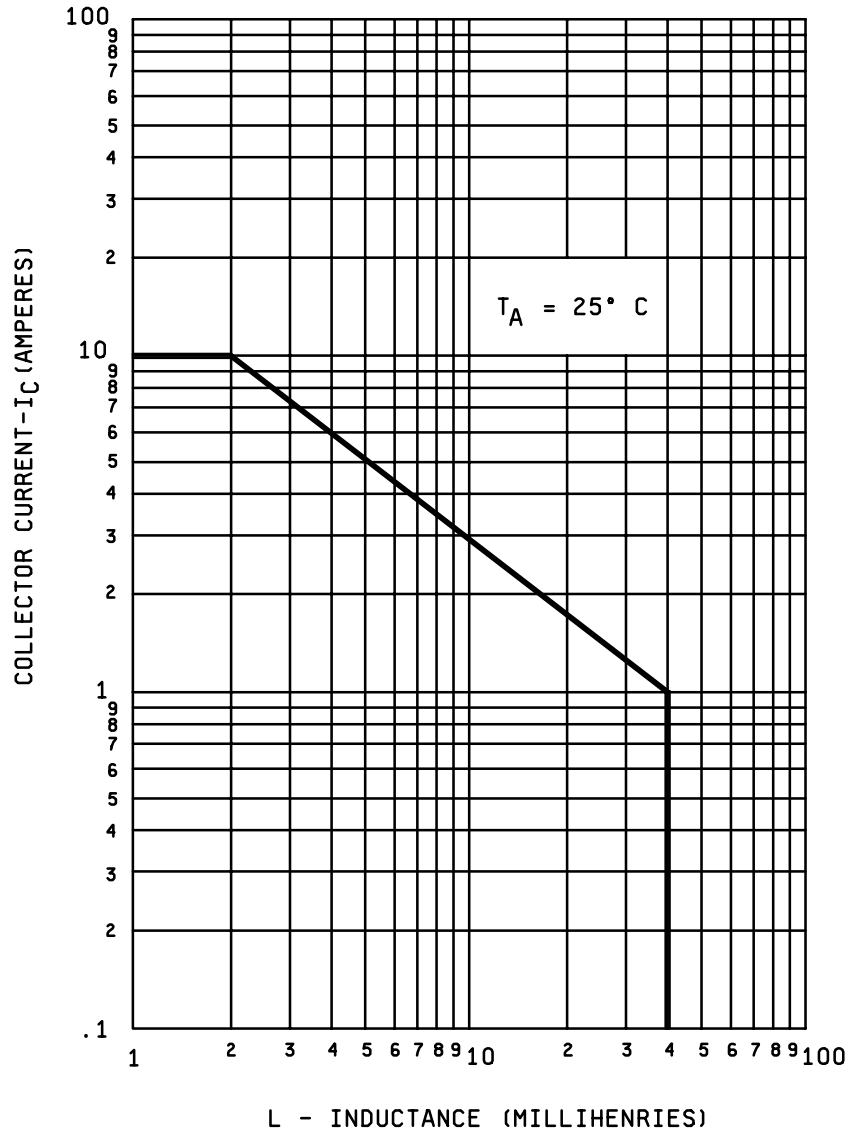
NOTES:

1. The input waveform is supplied by a pulse generator with the following characteristics:  
 $t_r \leq 20 \mu s$ ,  $t_f \leq 1 \mu s$ ,  $10 \mu s \leq PW \leq 100 \mu s$ ,  $Z_{OUT} = 50 \Omega$ , duty cycle  $\leq 2$  percent.
2. Output waveforms are monitored on an oscilloscope with the following characteristics:  
 $t_r \leq 2 \mu s$ ,  $Z_{IN} \geq 100 k\Omega$ ,  $C_{IN} \leq 12 pF$ .
3. Test circuit A for  $t_d$  and  $t_r$ ; test circuit B for  $t_s$  and  $t_f$ .

\* FIGURE 2. Pulse response test circuit.

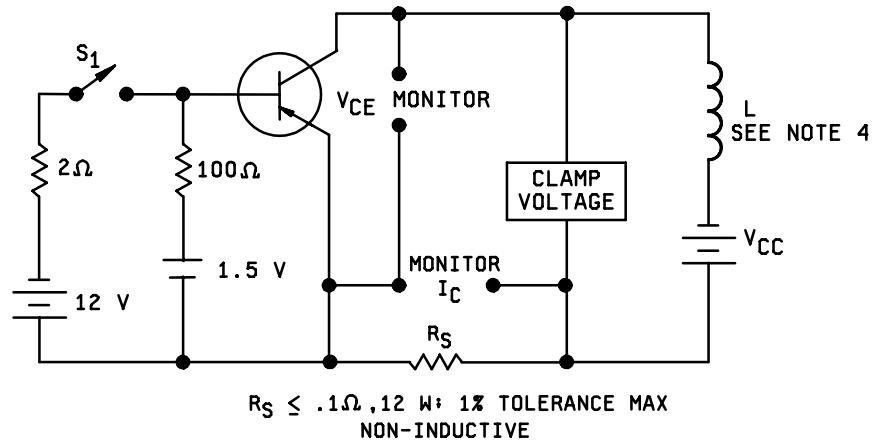


\* FIGURE 3. Maximum safe operating area graph (continuous dc).



\* FIGURE 4. Safe operating area for switching between saturation and cutoff (unclamped inductive load).

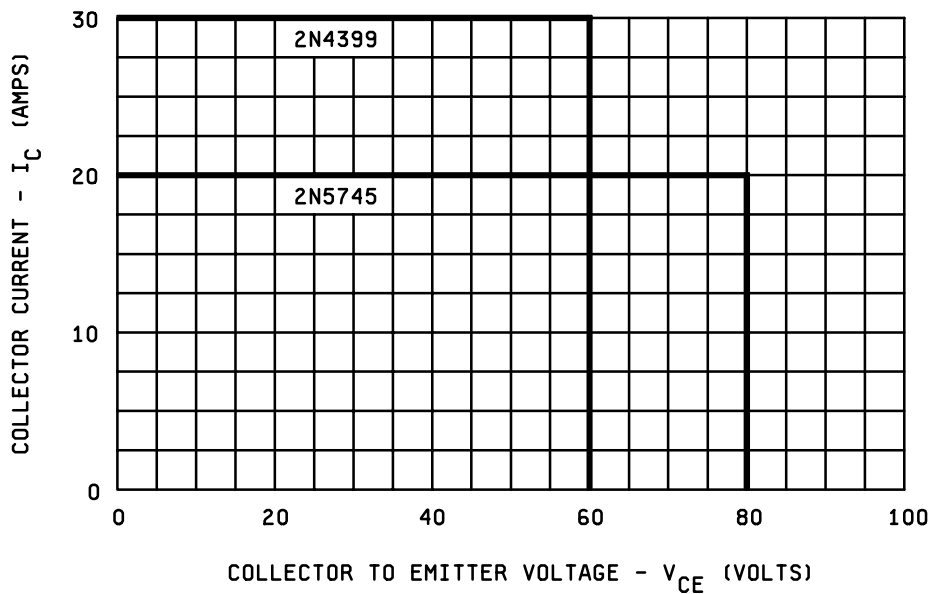




NOTES:

1. With switch S1 closed, set the specified test conditions.
2. Open S1. Device fails if clamp voltage not reached.
3. Perform specified end-points tests.
4. L = 2.0 mH (2 each 1 mH, 50 A, .001Ω, Sanford Miller CK-50, or equivalent).

\* FIGURE 5. Clamped inductive sweep test circuit.



\* FIGURE 6. Safe operating area for switching between saturation and cutoff (clamped inductive load).

## 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 or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

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

\* 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. Packaging requirements (see 5.1).
- c. Lead finish (see 3.4.1).
- d. Product assurance level and type designator.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers List (QML 19500) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: DSCC/VQE, P.O. Box 3990, Columbus, OH 43216-5000 or e-mail [vqe.chief@dla.mil](mailto:vqe.chief@dla.mil).

\* 6.4 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:

Army - CR  
Navy - EC  
Air Force - 11  
NASA - NA  
DLA - CC

Preparing activity:

DLA - CC

(Project 5961-2857)

Review activities:

Army - MI, SM  
Navy - AS, MC  
Air Force - 19

\* NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <http://www.dodssp.daps.mil/> .