

The documentation and process conversion measures necessary to comply with this revision shall be completed by 27 July 1998.

INCH-POUND

MIL-PRF-19500/498C
27 March 1998
SUPERSEDING
MIL-S-19500/498B
5 October 1993

PERFORMANCE SPECIFICATION SHEET
SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, POWER
TYPE 2N6306, 2N6308, JAN, JANTX AND JANTXV

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, power transistors. Three levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See 3.3. (Similar to TO-3)

1.3 Maximum ratings.

	P_T $T_C = +25^\circ\text{C}$ 1/	P_T $T_C = +100^\circ\text{C}$ 1/	V_{CBO}	V_{CEO}	V_{EBO}	I_B	I_C	T_J and T_{STG}
	<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>°C</u>
2N6306	125	62.5	500	250	8.0	4.0	8.0	-65 to +200
2N6308	125	62.5	700	350	8.0	4.0	8.0	-65 to +200

1/ Between $T_C = +25^\circ\text{C}$ and $T_C = +175^\circ\text{C}$, linear derating factor (average) = .833 W/°C.

1.4 Primary electrical characteristics.

	h_{FE2}		h_{FE3}		$V_{BE(sat)}$ 1/		$V_{CE(sat)}$ 1			
	$V_{CE} = 5\text{ V dc}$ $I_C = 3\text{ A dc}$		$V_{CE} = 5\text{ V dc}$ $I_C = 8\text{ A dc}$		$I_C = 8\text{ A dc}$ $I_B = 2/$		$I_C = 8\text{ A dc}$ $I_B = 2/$		$I_C = 3\text{ A dc}$ $I_B = 0.6\text{ A dc}$	
	Min	Max	Min	Max	Min	Max	Min <u>V dc</u>	Max <u>V dc</u>	Min <u>V dc</u>	Max <u>V dc</u>
2N6306	15	75	4			2.3		5		0.8
2N6308	12	60	3			2.5		5		1.5

	$ h_{fe} $	C_{obo}	Switching	
	$V_{CE} = 10\text{ V dc}$ $I_C = 0.3\text{ A dc}$ $f = 1\text{ MHz}$	$V_{CB} = 10\text{ V dc}$ $I_E = 0$ $100 \leq f \leq 1\text{ MHz}$	t_{on}	t_{off}
	<u>pF</u>	<u>pF</u>	<u>μs</u>	<u>μs</u>
Min	5			
Max	30	250	0.6	3.0

1/ Pulsed (see 4.5.1).

2/ 2N6306 (I_B) = 2.0 A dc; 2N6308 (I_B) = 2.67 A dc.

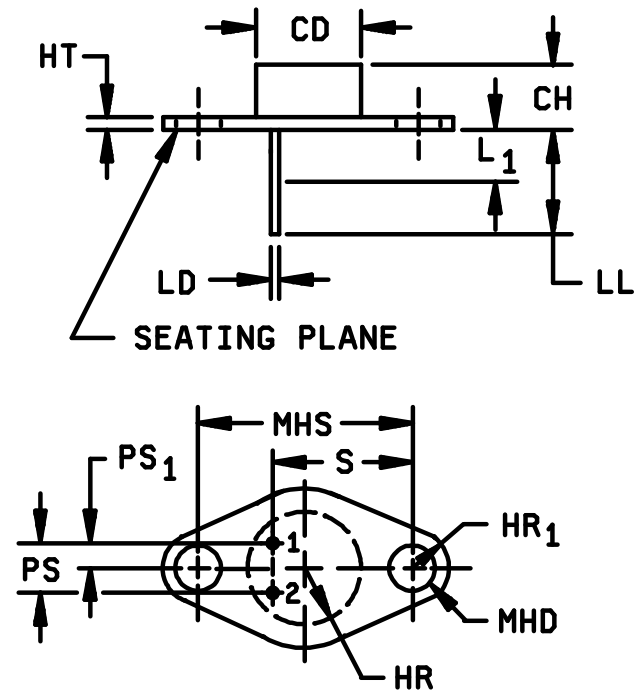
Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Supply Center Columbus, ATTN: DSCC-VAT, 3990 East Broad St., Columbus, OH 43216-5000, by using the addressed Standardization Document 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.

Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD		.875		22.22	3
CH	.250	.450	.635	11.43	
HR	.495	.525	12.57	13.34	
HR1	.131	.188	3.33	4.78	
HT	.060	.135	1.52	3.43	
L1		.050		1.27	5, 9
LD	.038	.043	0.97	1.09	5, 9
LL	.312	.500	7.92	12.70	5
MHD	.151	.165	3.84	4.19	7
MHS	1.177	1.197	29.90	30.40	
PS	.420	.440	10.67	11.18	4
PS1	.205	.225	5.21	5.72	4, 5
S	.655	.675	16.64	17.14	4



Notes:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Body contour is optional within zone defined by CD
4. These dimensions shall be measured at points .050 (1.27 mm) to .055 (1.40 mm) below seating plane. When gauge is not used, measurement shall be made at seating plane.
5. Both terminals.
6. At both ends.
7. Two holes.
8. Terminal 1 is the emitter, terminal 2 is base. The collector shall be electrically connected to the case.
9. LD applies between L1 and LL. Diameter is uncontrolled in L1.
10. In accordance with ANSI Y14.5M, diameters are equivalent to ϕ x symbology.

FIGURE 1. Physical dimensions (similar to T0-3).

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

STANDARD

MILITARY

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

(Copies of the specification and standard required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

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

3. REQUIREMENTS

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

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

3.3 Interface requirements and physical dimensions. The Interface requirements and physical dimensions shall be as specified in MIL-PRF-19500, and figure 1 (similar to T0-3) herein.

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

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

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

3.6 Electrical test requirements. The electrical test requirements shall be the subgroups specified in paragraphs 4.4.2 and 4.4.3.

3.7 Qualification. Devices furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.2).

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.

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

Screen (see table IV of MIL-PRF-19500)	Measurements
	JANTX, JANTXV levels
1/	Thermal response (see 4.3.2)
11	I_{CEX1} and h_{FE3}
12	See 4.3.1
13	Subgroup 2 of table I herein; $\Delta I_{CEX1} \leq 100\%$ of initial value or 500 nA dc, whichever is greater. $\Delta h_{FE3} \leq 25\%$ of initial value.

1/ This test shall be performed any time before screen 10.

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows:

T_A = room ambient as defined in the general requirements of 4.5 of MIL-STD-750; $V_{CB} \geq 10$ V dc; $T_J = +162.5^\circ\text{C} \leq 12.5^\circ\text{C}$. No heat sink or forced air cooling on the devices shall be permitted.

4.3.2 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 Operation 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 submitted to the qualifying activity. The following parameter measurements shall apply:

- I_M measurement ----- 10 mA.
- V_{CE} measurement voltage ----- 20 V (same as V_H).
- I_H collector heating current ----- 4 A (minimum).
- V_H collector-emitter heating voltage ----- 20 V (minimum).
- t_H heating time ----- 100 ms.
- t_{MD} measurement delay time ----- 50 μs to 80 μs .
- t_{SW} sample window time ----- 10 μs (maximum).

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

- I_M measurement ----- 10 mA.
- V_{CE} measurement voltage ----- 15 V.
- I_H collector heating current ----- 8 A.
- V_H collector-emitter heating voltage ----- 15 V.
- t_H heating time ----- Stead-state (see MIL-STD-750, method 2131 for definition).
- t_{MD} measurement delay time ----- 20 μs (maximum).
- t_{SW} sample window time ----- 10 μs (maximum).

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 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 table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 herein.

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

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
3	1037	$V_{CB} \geq 10$ V dc; ΔT_J between cycles $\geq +100^\circ\text{C}$; $t_{on} = t_{off} \geq 1$ minute f 2000 cycles.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table V of MIL-PRF-19500. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
6	1037	$V_{CB} \geq 10$ V dc; ΔT_J between cycles $\geq +100^\circ\text{C}$; $t_{on} = t_{off}$ 1 minute for 6000 cycles. No heat sink or forced-air cooling on device shall be permitted.

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.

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.

5.2 Marking. Unless otherwise specified (see 6.2), marking shall be in accordance with MIL-STD-129.

6. NOTES

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

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

6.2 Acquisition requirements. Acquisition documents should specify the following:

- Issue of DODISS to be cited in the solicitation and, if required, the specific issue of individual documents referenced (see 2.2.1).
- Lead finish (see 3.3.1).
- Type designation and product assurance level.
- Packaging requirements (see 5.1).

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

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL-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.

TABLE I. Group A inspection.

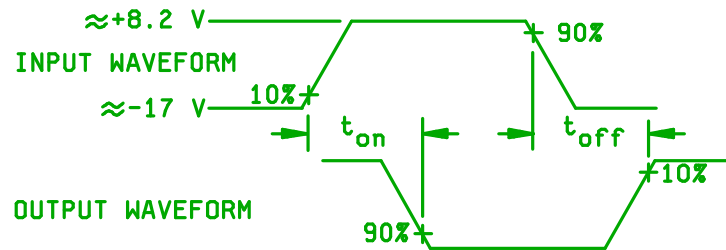
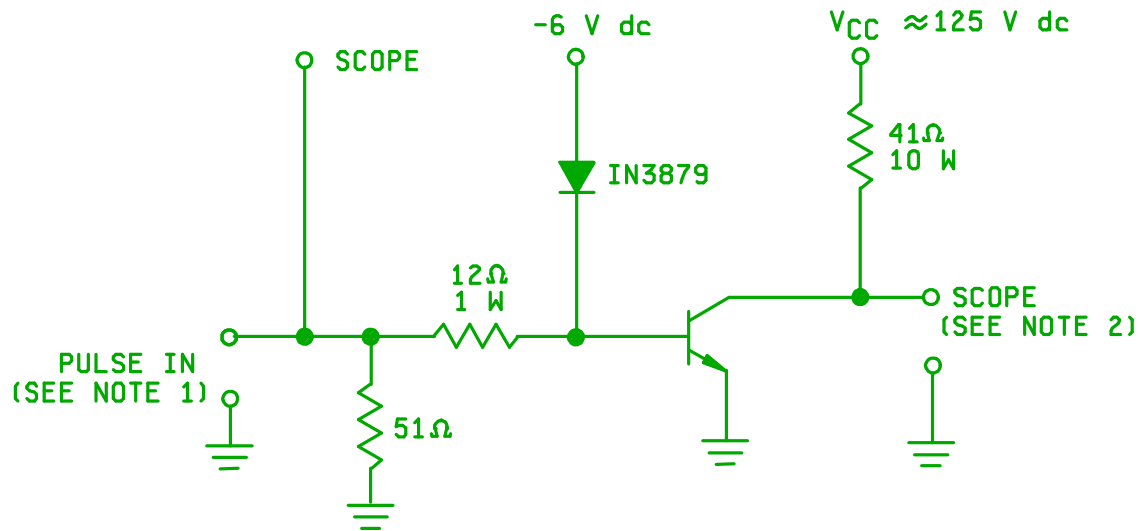
Inspection 1/ <u>Subgroup 1</u>	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u>	2071					
Visual and mechanical examination						
Collector to base breakdown voltage	3011	Bias condition D; $I_C = 100$ mA dc; Pulsed (see 4.5.1)	$V_{(BR)CEO}$			
2N6306				250		V dc
2N6308				350		V dc
Collector to emitter cutoff current	3041	Bias condition D;	I_{CEO}		50	μ A dc
2N6306		$V_{CE} = 250$ V dc				
2N6308		$V_{CE} = 350$ V dc				
Emitter-base cutoff current	3061	Bias condition D $V_{EB} = 8$ V dc	I_{EBO}		5.0	μ A dc
Collector to emitter cutoff current	3041	Bias condition A; $V_{BE} = 1.5$ V dc	I_{CEX1}			
2N6306		$V_{CE} = 500$ V dc			5.0	μ A dc
2N6308		$V_{CE} = 700$ V dc			5.0	μ A dc
Base emitter voltage	3066	Test condition A; $I_C = 8.0$ A dc; Pulsed (see 4.5.1)	$V_{BE(sat)}$			
2N6306		$I_B = 2.0$ A dc			2.3	V dc
2N6308		$I_B = 2.67$ A dc			2.5	V dc
Base emitter voltage	3066	Test condition B; $I_C = 3.0$ A dc; $V_{CE} = 5.0$ V dc; Pulsed (see 4.5.1)	$V_{BE(on)2}$			
2N6306					1.3	V dc
2N6308					1.5	V dc
Collector to emitter saturated voltage	3071	$I_C = 8.0$ A dc; Pulsed (see 4.5.1)	$V_{CE(sat)1}$		5.0	V dc
2N6306		$I_B = 2.0$ A dc				
2N6308		$I_B = 2.67$ A dc				
Collector to emitter saturated voltage	3071	$I_C = 3.0$ A dc; $I_B = 0.6$ A dc; Pulsed (see 4.5.1)	$V_{CE(sat)2}$			
2N6306					0.8	V dc
2N6308					1.5	V dc
Forward-current transfer ratio	3076	$V_{CE} = 5$ V dc; $I_C = 3.0$ A dc; Pulsed (see 4.5.1)	h_{FE1}			
2N6306				15	75	
2N6308				12	60	
Forward-current transfer ratio	3076	$V_{CE} = 5$ V dc; $I_C = 8.0$ A dc; Pulsed (see 4.5.1)	h_{FE2}			
2N6306				4		
2N6308				3		

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/ <u>Subgroup 2</u> - Continued.	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Forward-current transfer ratio 2N6306 2N6308	3076	$V_{CE} = 5 \text{ V dc}$; $I_C = 0.5 \text{ A dc}$; Pulsed (see 4.5.1)	h_{FE3}	15 12		
<u>Subgroup 3</u> High-temperature operation		$T_A = +150^\circ\text{C}$				
Collector to emitter cutoff current 2N6306 2N6308	3041	Bias condition A; $V_{BE} = 1.5 \text{ V dc}$ $V_{CE} = 450 \text{ V dc}$ $V_{CE} = 650 \text{ V dc}$ $T_A = -55^\circ\text{C}$	I_{CEX2}		500	$\mu\text{A dc}$
Low-temperature operation						
Forward-current transfer ratio 2N6306 2N6308	3076	$V_{CE} = 5.0 \text{ V dc}$; $I_C = 3.0 \text{ A dc}$; Pulsed (see 4.5.1)	h_{FE4}	6 5		
<u>Subgroup 4</u>						
Pulse response: transfer ratio	3251	Test condition A except test circuit and pulse requirements in accordance with figure 1.				
Turn-on time		$V_{CC} = 125 \text{ V dc}$; $I_C = 3.0 \text{ A dc}$; $I_B = 0.6 \text{ A dc}$	t_{on}		0.6	μs
Turn-off time		$V_{CC} = 125 \text{ V dc}$; $I_C = 3.0 \text{ A dc}$; $I_{B1} = 0.6 \text{ A dc}$ $I_{B2} = 1.5 \text{ A dc}$	t_{off}		3.0	μs
Magnitude of common emitter small-signal short-circuit forward- current transfer ratio	3306	$V_{CE} = 10 \text{ V dc}$; $I_C = 0.3 \text{ A dc}$; $f = 1 \text{ MHz}$	$ h_{fe} $	5	30	
Open capacitance(open circuit)	3236	$V_{CB} = 10 \text{ V dc}$; $I_E = 0$; $100 \text{ kHz} \leq f \leq 1.0 \text{ MHz}$	C_{obo}		250	pF
Small-signal short- circuit forward- current transfer ratio	3206	$V_{CE} = 4.0 \text{ V dc}$; $I_C = 0.5 \text{ A dc}$; $f = 1.0$ kHz	h_{fe}	5		
<u>Subgroup 5</u>						
Safe operating area(dc operation)	3051	$T_C = +25^\circ\text{C}$ $t = 1 \text{ s}$; 1 cycle; (See figures 2 and 3)				
<u>Test 1</u> (Both device types)		$V_{CE} = 15.6 \text{ V dc}$; $I_C = 8 \text{ A dc}$				
<u>Test 2</u> (Both device types)		$V_{CE} = 37 \text{ V dc}$; $I_C = 3.4 \text{ A dc}$				
<u>Test 3</u> 2N6306 2N6308		$V_{CE} = 200 \text{ V dc}$; $I_C = 65 \text{ mA dc}$ $V_{CE} = 300 \text{ V dc}$; $I_C = 25 \text{ mA dc}$				
Electrical measurements		table I, group A, subgroup 2 herein				
<u>Subgroups 6 and 7</u> Not applicable						

For sampling plan see MIL-PRF 19500.



NOTES:

1. The rise time (t_r) and fall time (t_f) of the applied pulse shall be each ≤ 2 ns; duty cycle ≤ 1 percent; generator source impedance shall be 50Ω ; pulse width = $30\ \mu\text{s}$.
2. Output sampling oscilloscope: $Z_{IN} \geq 20\ \text{k}\Omega$; $C_{IN} \leq 50\ \text{pF}$; rise time ≤ 0.2 ns.

FIGURE 2. Pulse response test circuit.

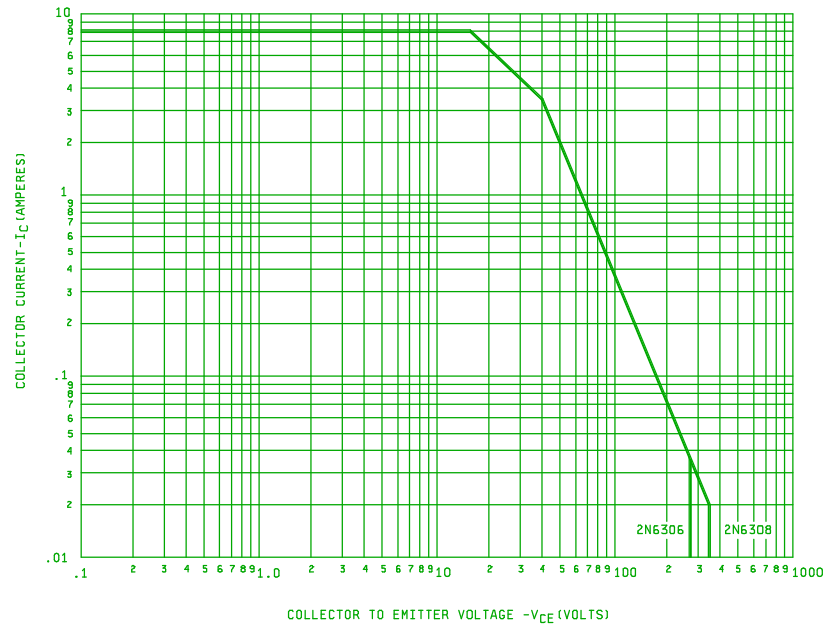


FIGURE 3. Maximum safe operating area graph (continuous dc).

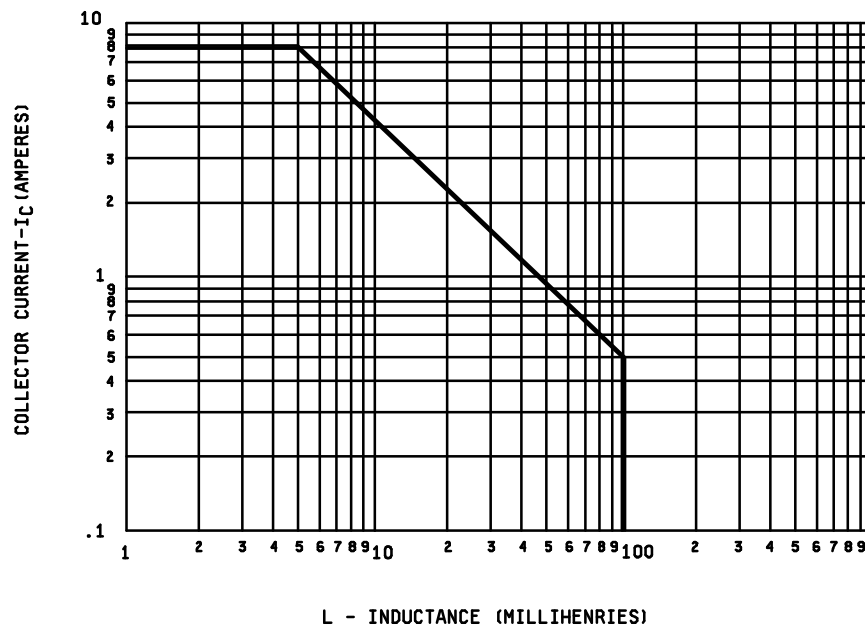


FIGURE 4. Safe operating area for switching between saturation and cutoff (unclamped inductive load).

MIL-PRF-19500/498C

CONCLUDING MATERIAL

Custodians:
Air Force - 17

Review activities:
Air Force - 13, 19, 85, 99

Preparing activity:
DLA-CC
(Project 5961-1782)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL		
<p style="text-align: center;"><u>INSTRUCTIONS</u></p> <p>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.</p> <p>2. The submitter of this form must complete blocks 4, 5, 6, and 7.</p> <p>3. The preparing activity must provide a reply within 30 days from receipt of the form.</p> <p>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.</p>		
I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/498C	2. DOCUMENT DATE 27 March 1998
3. DOCUMENT TITLE SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, POWER TYPE 2N6306, 2N6308, JAN, JANTX AND JANTXV		
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		
a. Point of Contact Alan Barone	b. TELEPHONE Commercial DSN FAX EMAIL 614-692-0510 850-0510 614-692-6939 alan_barone@dscclia.mil	
c. ADDRESS Defense Supply Center Columbus ATTN: DSCC-VAT Columbus, OH 43216-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 DSN 289-2340	