The documentation and process conversion measures necessary to comply with this revision shall be completed by 1 November 1999.

INCH-POUND

MIL-PRF-19500/508B
1 August 1999
SUPERSEDING
MIL-S-19500/508A
30 November 1993

PERFORMANCE SPECIFICATION SHEET
SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, POWER
TYPES 2N6437 AND 2N6438, 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 PNP, 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 figure 1 (TO – 204 similar to TO – 3).

1.3 Maximum ratings.

Type	P_T 1/		V_{CBO}	V_{CEO}	V_{EBO}	I_C	I_B	T_{OP} and T_{STG}	$R_{\theta JC}$
	T_C = +25°C	T_C = +100°C							
	W	W	V dc	V dc	V dc	A dc	A dc	°C	°C/W
2N6437	200	112	120	100	6	25	10	-65 to +200	0.875 max
2N6438	200	112	140	120	6	25	10	-65 to +200	0.875 max

1/ Between T_C = +25°C and T_C = +200°C, linear derating factor (average) = 1.14 W/°C.

1.4 Primary electrical characteristics.

Limits	h_{FE1} 1/	h_{FE2} 1/	$V_{CE(sat)2}$	$V_{CE(sat)1}$	$V_{BE(sat)1}$	Switching	
	V_{CE} = 2 V dc I_C = 25 A dc	V_{CE} = 2 V dc I_C = 10 A dc	I_C = 25 A dc I_B = 2.5 A dc	I_C = 10 A dc I_B = 1.0 A dc	I_C = 10 A dc I_B = 1.0 A dc	t_{on}	t_{off}
			V dc	V dc	V dc	µs	µs
Min	12	30					
Max		120	1.8	1.0	1.8	0.5	1.25

	C_{obo} V_{CB} = 10 V dc I_E = 0 .1 MHz ≤ f ≤ 1 MHz	$\lvert h_{fe} \rvert$ V_{CE} = 10 V dc I_C = 1 A dc f = 10 MHz
	pF	
Min		4
Max	700	12

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 Supply Center Columbus, ATTN: DSCC-VAC, 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

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.

2.1.1 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

DEPARTMENT OF DEFENSE

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

STANDARD

MILITARY

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.)

2.2 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 (TO – 204 similar to TO – 3).

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

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 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.

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

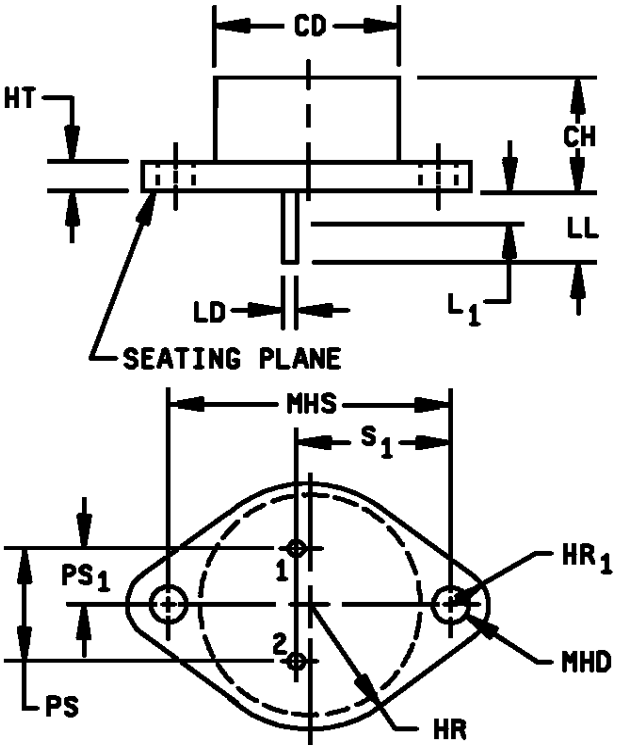


FIGURE 1. Physical dimensions. (Similar to TO-3)

Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD		0.875		22.23	
CH	0.250	0.360	6.35	9.14	
HR	0.495	0.525	12.57	13.33	4
HR_1	0.131	0.188	3.33	4.78	4
HT	0.060	0.135	1.52	3.43	
LD	0.038	0.043	0.97	1.09	4, 6
LL	0.312	0.500	7.92	12.7	
L_1		0.050		1.27	6
MHD	0.151	1.65	3.83	41.91	4
MHS	1.177	1.197	29.90	30.40	
PS	0.420	0.440	10.67	11.18	3
PS_1	0.205	0.225	5.21	5.72	3
S_1	0.655	0.675	16.64	17.15	
Notes	1, 2, 5, 7		1, 2, 5, 7		

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. These dimensions should be measured at points 0.050 inch (1.27 mm) + 0.005 inch (0.13 mm) - 0.000 inch (0.00 mm) below seating plane. Measurement will be made at the seating plane.
4. Two places.
5. The seating plane of the header shall be flat within 0.001 inch (0.03 mm) concave to 0.004 inch (0.10 mm) convex inside a 0.930 inch (23.62 mm) diameter circle on the center of the header and flat within 0.001 inch (0.03 mm) concave to 0.006 inch (0.15 mm) convex overall.
6. Lead diameter shall not exceed twice LD within L_1.
7. Lead designation, shall be as follows:

Lead number	Bipolar transistor
1	Emitter
2	Base
Case	Collector

FIGURE 1. Physical dimensions (TO – 204 similar to TO – 3).- Continued.

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.

4.3 Screening (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)	Measurements
	JANTX and JANTXV levels
11	I_{CEX1} and h_{FE1}
12	See 4.3.1
13	Subgroup 2 of table I herein; ΔI_{CEX1} = 100 percent of initial value or 2 µA dc, whichever is greater. Δh_{FE1} = ± 25 percent of initial value.

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

T_J = 187.5°C ± 12.5°C; $V_{CB} \geq$ 20 V dc; $T_A \leq$ 35°C.

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

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 table V of MIL-PRF-19500 and table I herein. Electrical measurements (end-points) and delta requirements shall be in accordance with 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 VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500 and herein. 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
B3	1037	For solder die attach: $V_{CB} \geq$ 20 V dc; 2,000 cycles; $T_A \leq$ 35°C.
B3	1027	For eutectic die attach: $T_A \leq$ 35°C, $V_{CB} \geq$ 20 V dc adjust P_T to achieve T_J = 175°C minimum.
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.

Subgroup	Method	Condition
C6	1037	For solder die attach: $V_{CB} \geq 20$ V dc; 6,000 cycles; $T_A \leq 35°C$.
C6	1027	For eutectic die attach: $T_A \leq 35°C$, $V_{CB} \geq 20$ V dc adjust P_T to achieve $T_J = 175°C$ minimum.

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

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

4.5.2 Thermal resistance Thermal resistance measurements shall be conducted in accordance with method 3131 of MIL-STD-750. The following details shall apply: $R_{\theta JC} = 0.875°C/W$.

a. I_M ..... 20 mA.

b. V_{CE}..... 10 V dc.

c. I_H collector heating current ..... 4.0 A min.

d. V_H collector-emitter heating voltage ..... 10 V dc.

e. t_h heating time..... 1 s (min).

f. t_{md} measurement delay time ..... 50 - 80 µs.

g. t_{sw} sample window time..... 10 µs maximum.

TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical examination	2071					
Subgroup 2						
Collector to emitter breakdown voltage	3011	Bias condition D, I_C = 50 mA dc, pulsed (see 4.5.1)	$V_{(BR)CEO}$			
2N6437				100		V dc
2N6348				120		V dc
Collector to emitter cutoff current	3041	Bias condition D,	I_{CEO}		50	µA dc
2N6437		V_{CE} = 50 V dc				
2N6438		V_{CE} = 60 V dc				
Emitter to base cutoff current	3061	Bias condition D, V_{EB} = 6 V dc	I_{EBO}		100	µA dc
Collector to emitter cutoff current	3041	Bias condition A, V_{BE} = 1.5 V dc,	I_{CEX1}		5.0	µA dc
2N6437		V_{CE} = 100 V dc				
2N6438		V_{CE} = 120 V dc				
Collector to base cutoff current	3036	Bias condition D,	I_{CBO}		10	µA dc
2N6437		V_{CB} = 120 V dc				
2N6438		V_{CB} = 140 V dc				
Base emitter voltage (saturated)	3066	Test condition A, I_C = 10 A dc, I_B = 1.0 A dc, pulsed (see 4.5.1)	$V_{BE(sat)}$		1.8	V dc
Collector to emitter saturated voltage	3071	I_C = 10 A dc, I_B = 1.0 A dc, pulsed (see 4.5.1)	$V_{CE(sat)1}$		1.0	V dc
Collector to emitter saturated voltage	3071	I_C = 25 A dc, I_B = 2.5 A dc, pulsed (see 4.5.1)	$V_{CE(sat)2}$		1.8	V dc
Forward-current transfer ratio	3076	V_{CE} = 2 V dc, I_C = .5 A dc, pulsed (see 4.5.1)	h_{FE1}	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	
Subgroup 2 - Continued						
Forward-current transfer ratio	3076	V_{CE} = 2 V dc, I_C = 10 A dc, pulsed (see 4.5.1)	h_{FE2}	30	120	
Forward-current transfer ratio	3076	V_{CE} = 2 V dc, I_C = 25 A dc pulsed (see 4.5.1)	h_{FE3}	12		
Subgroup 3						
High temperature operation:		T_A = +150°C				
Collector to emitter cutoff current	3041	Bias condition A, V_{BE} = 1.5 V dc	I_{CEX2}		1.0	mA dc
2N6437		V_{CE} = 100 V dc				
2N6438		V_{CE} = 120 V dc				
Low temperature operation:		T_A = -55°C				
Forward-current transfer ratio	3076	V_{CE} = 2 V dc, I_C = 10 A dc, pulsed (see 4.5.1)	h_{FE4}	10		
Subgroup 4						
Pulse response		Test condition A except test circuit and pulse requirements in accordance with figure 2 herein.				
Turn-on time		V_{CC} = 80 V dc, I_C = 10 A dc, I_{B1} = 1.0 A dc	t_{on}		0.5	µs
Turn-off time		V_{CC} = 80 V dc, I_C = 10 A dc, I_{B1} = I_{B2} = 1.0 A dc	t_{off}		1.25	µs
Storage time		V_{CC} = 80 V dc, I_C = 10 A dc, I_{B1} = I_{B2} = 1.0 A dc	t_s		1.0	µs
Magnitude of common-emitter small-signal short-circuit forward current transfer ratio	3306	V_{CE} = 10 V dc, I_C = 1 A dc, f = 10 MHz	$\lvert h_{fe} \rvert$	4.0	12	
Output capacitance (open circuit)	3236	V_{CB} = 10 V dc, I_E = 0, 0.1 MHz ≤ f ≤ 1 MHz	C_{obo}		700	pF

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 5						
Safe operating area continuous (dc operation)	3051	T_C = 25°C, t = 1s, 1 cycle, (see figure 3)				
Test 1 (Both device types)		V_{CE} = 8 V dc, I_C = 25 A dc				
Test 2 (Both device types)		V_{CE} = 14 V dc, I_C = 14 A dc				
Test 3						
2N6437		V_{CE} = 100 V dc, I_C = 100 mA dc				
2N6438		V_{CE} = 120 V dc, I_C = 83 mA dc				
Safe operating area (switching)	3053	Load condition C, (unclamped inductive load), (see figure 4) T_A = 25°C, R_s = 0.1Ω, $t_r + t_f \leq$ 500 ns, duty cycle ≤ 10 percent				
Test 1		t_p = 10 µs, (vary to obtain I_C), R_{BB1} = 10 Ω, V_{BB1} = 20 V dc, R_{BB2} = ∞, V_{BB2} = 0, I_C = 20 A dc, $V_{CC} \geq$ 5.0 V dc, L = 3 µH				
Test 2		t_p = 200 µs, (vary to obtain I_C), R_{BB1} = 100 Ω, V_{BB1} = 10 V dc, R_{BB2} = ∞, V_{BB2} = 0, I_C = 200 mA dc, $V_{CC} \geq$ 10 V dc, L = 10 mH				
Safe operating area (switching)		Clamped inductive load T_A = +25°C, duty cycle ≤ 5 percent, t_p = 1.5 ms (vary to obtain I_C), V_{CC} = 50 V dc, I_C = 25 A dc, (see figure 5)				
2N6437		Clamp voltage = 100 V dc				
2N6438		Clamp voltage = 120 V dc				
Electrical measurements		See table I, subgroup 2 herein.				
Subgroups 6 and 7						
Not applicable						

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

TABLE II. Groups B and C delta electrical measurements. 1/ 2/

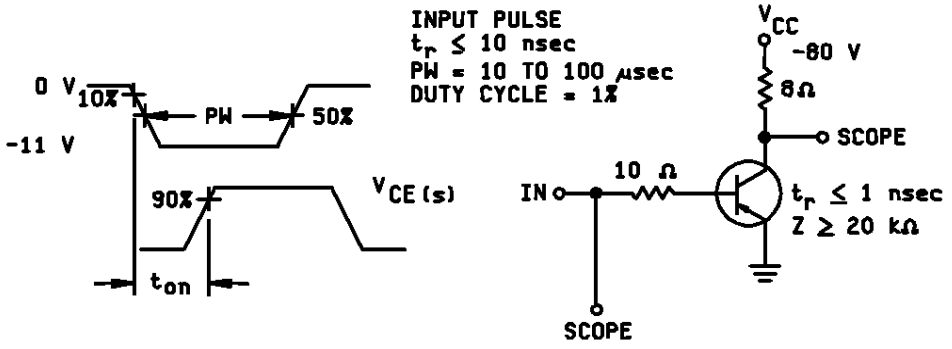
Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Forward-current transfer ratio	3076	V_{CE} = 2 V dc, I_C = 10 A dc, pulsed (see 4.5.1)	Δh_{FE2}	±25%		

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

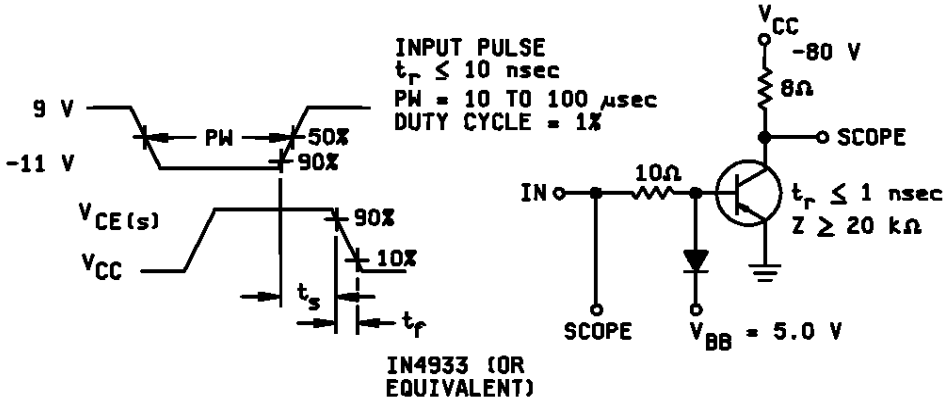
a. Subgroups 3 and 6, see table II herein, step 1..

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

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



TURN-ON (t_{on}) TIME TEST CIRCUIT



TURN-OFF (t_{off}) TIME TEST CIRCUIT

FIGURE 2. Switching time test circuits.

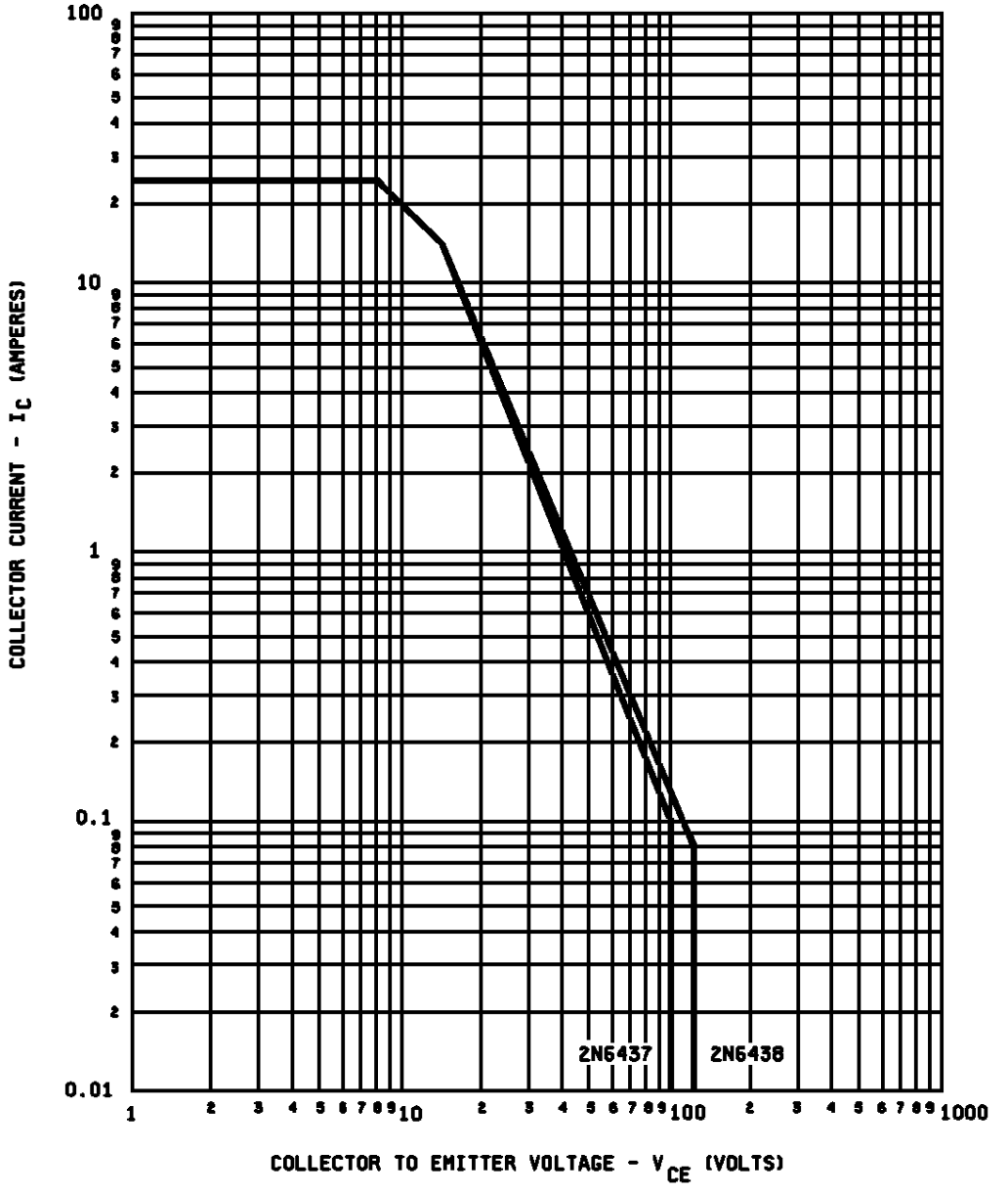


FIGURE 3. Maximum safe operating area (continuous dc).

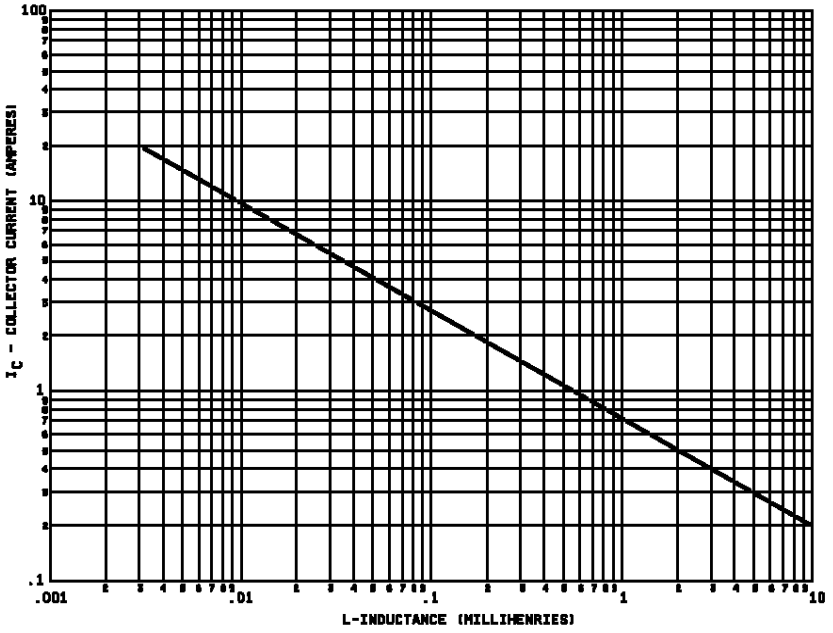
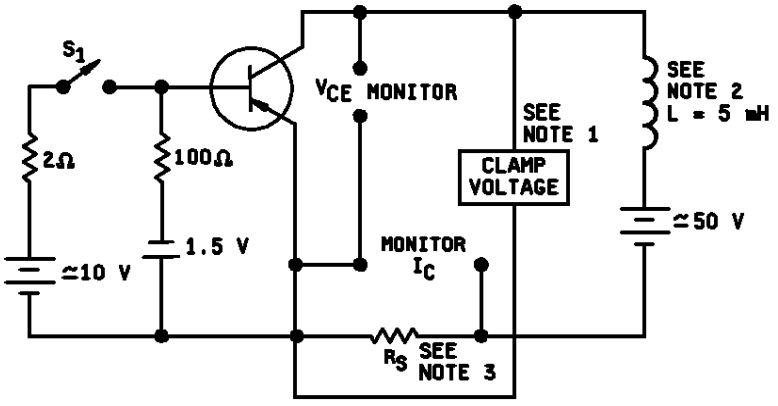


FIGURE 4 Safe operating area for switching between saturation and cutoff (unclamped inductive load).



NOTES:

1. Either a clamping circuit or clamping diode may be used.
2. The coil used shall provide a minimum inductance of 5 mH at 25A with a maximum dc resistance of 0.1 ohm. For reference only: 4 Triad C-48U; (20 mH windings in parallel) or equivalent.
3. $R_S \leq .1$ ohm, 12 W, 1 percent tolerance maximum, (noninductive).

Procedure:

1. With switch S_1 closed, set the specified test conditions.
2. Open S_1. Device fails if clamp voltage is not reached and maintained until the current returns to zero.
3. Perform specified endpoint tests.

FIGURE 5. Clamped inductive sweep test circuit.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements should 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 Notes. 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 2.1.1).

b. The lead finish as specified (see 3.3.1).

c. Type designation and quality assurance level.

d. Packaging requirements (see 5.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturer's List QML-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 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:
Army – CR
Navy - EC
Air Force – 11
DLA – CC

Review activities:
Army - AR, MI
Navy - AS, CG, MC, SH
Air Force - 19, 99

Preparing activity:
DLA - CC

(Project 5961-2069)

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-19500/508B	2. DOCUMENT DATE 990801

3. **DOCUMENT TITLE**
SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, POWER TYPES 2N6437 AND 2N6438, 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 614-692-0510 DSN 850-0510 FAX 614-692-6939 EMAIL alan_barone@dscc.dla.mil
c. ADDRESS Defense Supply Center Columbus, ATTN: DSCC-VAC, 3990 East Broad Street, Columbus, OH 43216-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman, Suite 2533, Fort Belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-6888