The documentation and process conversion measures necessary to comply with this revision shall be completed by 23 August 2011.

INCH-POUND

MIL-PRF-19500/508D
23 May 2011
SUPERSEDING
MIL-PRF-19500/508C
19 June 2009

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.

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, 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. Unless otherwise specified, T_A = +25°C.

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. Unless otherwise specified, T_A = +25°C.

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

(1) Pulsed, (see 4.5.1).

* Comments, suggestions, or questions on this document should be addressed to DLA Land and Maritime, ATTN: VAC, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to Semiconductor@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.daps.dla.mil/.

1.4 Primary electrical characteristics - Continued.

	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).

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.

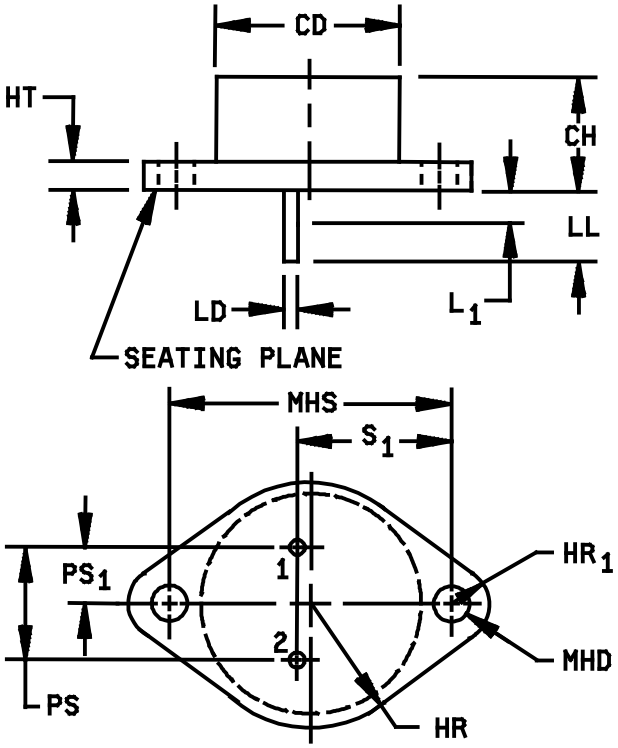
* (Copies of these documents are available online at https://assist.daps.dla.mil/quicksearch/ or https://assist.daps.dla.mil/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. Unless otherwise noted herein or in the contract, 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).



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

Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD		.875		22.23	
CH	.250	.360	6.35	9.14	
HR	.495	.525	12.57	13.33	4
HR_1	.131	.188	3.33	4.78	4
HT	.060	.135	1.52	3.43	
LD	.038	.043	0.97	1.09	4, 6
LL	.312	.500	7.92	12.7	
L_1		.050		1.27	6
MHD	.151	1.65	3.83	41.91	4
MHS	1.177	1.197	29.90	30.40	
PS	.420	.440	10.67	11.18	3
PS_1	.205	.225	5.21	5.72	3
S_1	.655	.675	16.64	17.15	
Notes	1, 2, 5, 7		1, 2, 5, 7		

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. These dimensions should be measured at points .050 inch (1.27 mm) +.005 inch (0.13 mm) -.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 .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.
6. Lead diameter shall not exceed twice LD within L_1.
7. Lead designation, shall be as follows:
8. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

Lead number	Bipolar transistor
1	Emitter
2	Base
Case	Collector

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

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.

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

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

4.VERIFICATION

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

a. Qualification inspection (see 4.2).

b. Screening (see 4.3).

c. Conformance inspection (see 4.4).

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

4.3 Screening (JANTX and JANTXV levels only). Screening shall be in accordance with table E-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 E-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 E-V of MIL-PRF-19500 and table I herein. Electrical measurements (end-points) 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 E-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.

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 E-VII of MIL-PRF-19500 and as follows. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

	Subgroup	Method	Condition
*	C2	2036	Condition A, weight = 10lbs, time = 15 seconds.
	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.

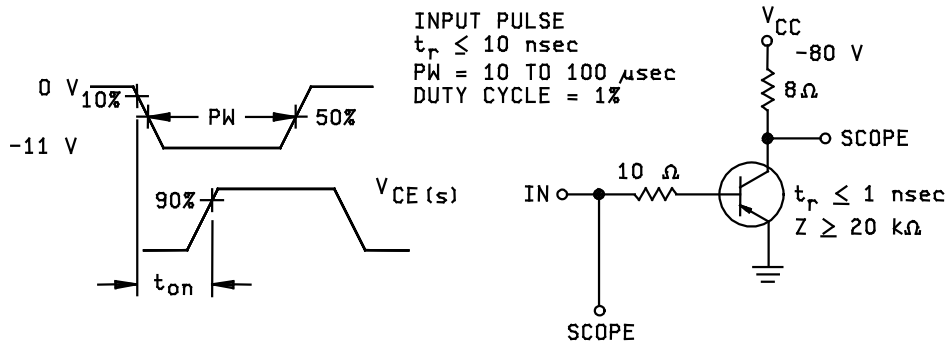
Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 2 - Continued						
Forward-current transfer ratio	3076	V_{CE} = 2 V dc, I_C = 10 A dc, pulsed (see 4.5.1)	h_{FE2}	30	120	
Forward-current transfer ratio	3076	V_{CE} = 2 V dc, I_C = 25 A dc pulsed (see 4.5.1)	h_{FE3}	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.

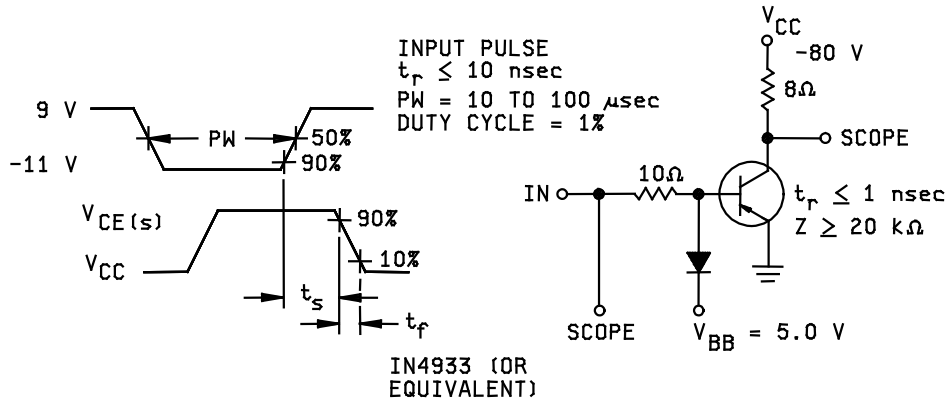
TABLE I. Group A inspection - Continued.

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



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



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

FIGURE 2. Switching time test circuits.

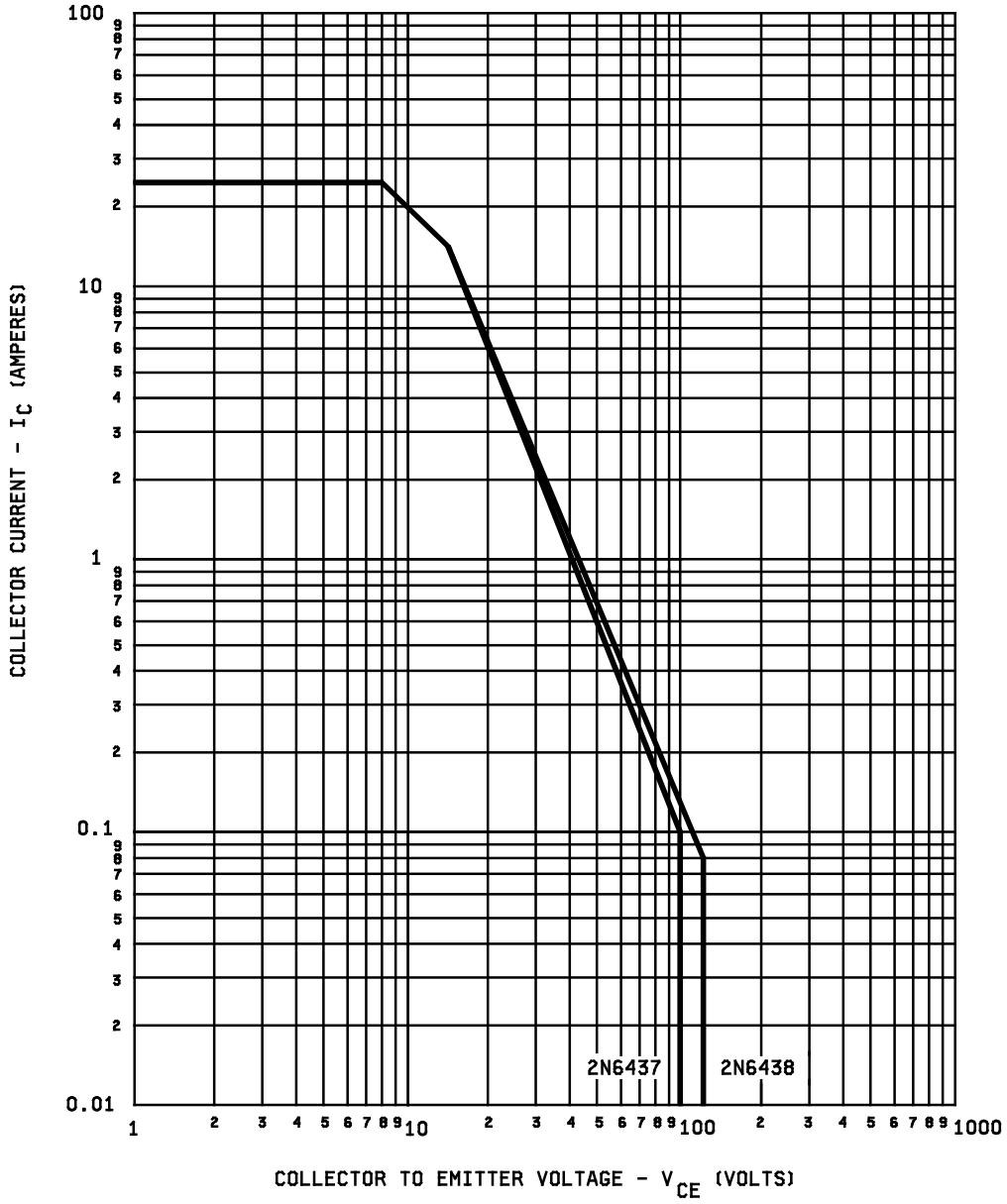


FIGURE 3. Maximum safe operating area (continuous dc).

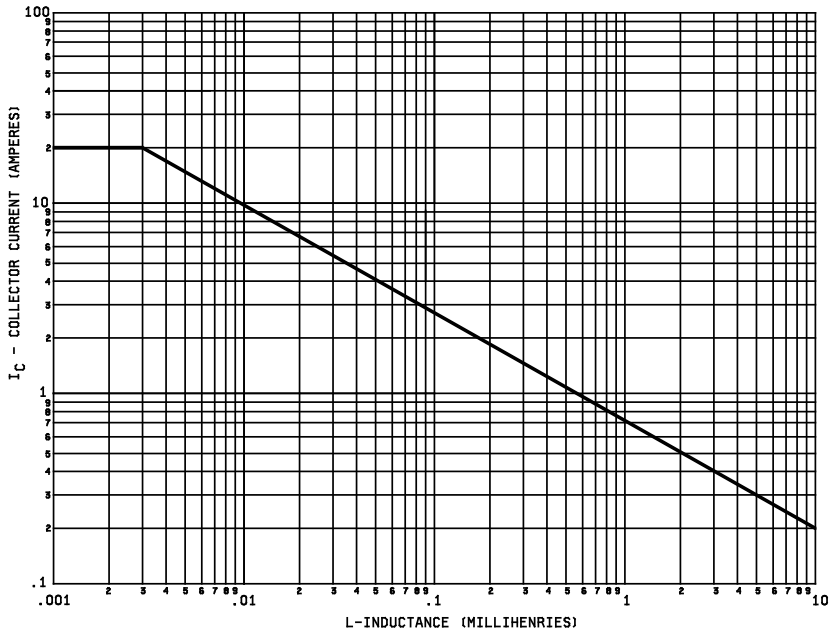
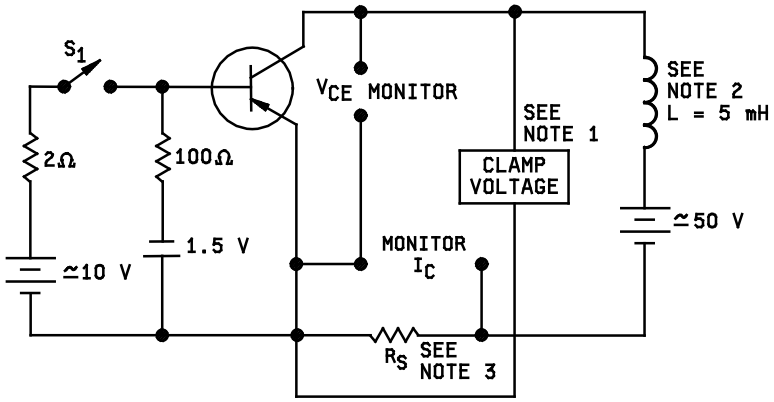


FIGURE 4 Safe operating area for switching between saturation and cutoff (unclamped inductive load).



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 shall be as specified in the contract or order (see 6.2). When 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. The notes specified in MIL-PRF-19500 are applicable to this specification.)

6.1 Intended use. Semiconductors conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

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 3.3.1).

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 DLA Land and Maritime, ATTN: VQE, P.O. Box 3990, Columbus, OH 43218-3990 or e-mail vqe.chief@dla.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.daps.dla.mil .

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 - 85
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2010-113)

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

* 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 https://assist.daps.dla.mil/ .