The documentation and process conversion measures necessary to comply with this revision shall be completed by 3 September 2013.

INCH-POUND

MIL-PRF-19500/514D
3 June 2013
SUPERSEDING
MIL-PRF-19500/514C
20 November 2006

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, POWER,
TYPES 2N6274 AND 2N6277, 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 NPN silicon, power transistors. Three levels of product assurance are provided for each encapsulated device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (TO-3).

1.3 Maximum ratings. Unless otherwise specified, T_C = +25°C.

Types	P_T T_C = +25°C (1)	P_T T_C = +100°C (1)	$R_{\theta JC}$	V_{CBO}	V_{CEO}	V_{EBO}	I_B	I_C	T_J and T_{STG}
	W	W	°C/W	V dc	V dc	V dc	A dc	A dc	°C
2N6274	250	143	0.7	120	100	6	20	50	-65 to +200
2N6277	250	143	0.7	180	150	6	20	50	-65 to +200

(1) Derate linearly 1.43 W/°C Between T_C = +25°C and T_C = +200°C.

* 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.dla.mil/.

1.4 Primary electrical characteristics. at T_C = +25°C unless otherwise specified.

Types	h_{FE3} (1)		h_{FE2} (1)		$V_{BE(sat)}$ (1)		$V_{CE(sat)}$ (1)		Switching		C_{obo}		$\lvert h_{fe} \rvert$	
	V_{CE} = 4 V dc I_C = 50 A dc		V_{CE} = 4 V dc I_C = 20 A dc		I_C = 20 A dc I_B = 2 A dc		I_C = 20 A dc I_B = 2 A dc		µs		V_{CB} = 10 V dc I_E = 0 F = 1 MHz		V_{CE} = 10 V dc I_C = 1 mA dc f = 10 MHz	
					V dc		V dc		t_{on}	t_{off}	pF			
	Min	Max	Min	Max	Min	Max	Min	Max	Max	Max	Min	Max	Min	Max
2N6274	10		30	120		1.8		1.0	0.5	1.05		600	3	12
2N6277	10		30	120		1.8		1.0	0.5	1.05		600	3	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

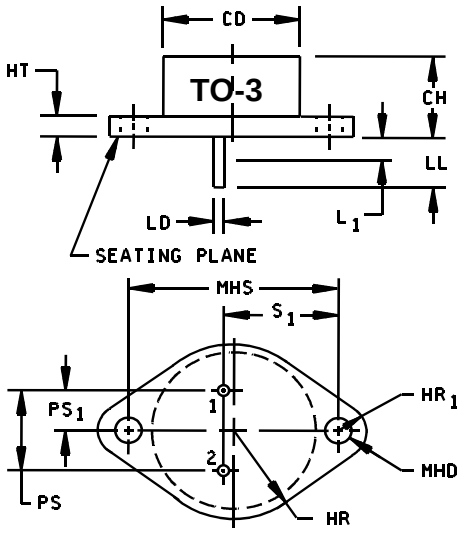
MIL-PRF-19500 - Semiconductor Devices, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

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

* (Copies of these documents are available online at http://quicksearch.dla.mil/ or https://assist.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.



Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD		.875		22.22	3
CH	.250	.328	6.35	8.33	
HR	.495	.525	12.57	13.34	
HR_1	.131	.188	3.33	4.78	6
HT	.060	.135	1.52	3.43	
LD	.057	.063	1.45	1.60	5, 9
LL	.312	.500	7.92	12.70	4, 5, 9
L_1		.050		1.27	5, 9
MHD	.151	.161	3.84	4.09	7
MHS	1.177	1.197	29.90	30.40	
PS	.420	.440	10.67	11.18	
PS_1	.205	.225	5.21	5.72	5
S_1	.655	.675	16.64	17.15	

NOTES:
1. Dimensions are in inches.
2. Millimeters 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 inch (1.27 mm) to .055 inch (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 L_1 and LL. Lead diameter shall not exceed twice LD within L_1.
10. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.
11. 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.

FIGURE 1. Physical dimensions (TO-3).

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 (TO-3) herein.

3.4.1 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 acquisition document (see 6.2).

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

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

3.7 Electrical test requirements. The electrical test requirements shall be as 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 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 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 III tests, the tests specified in table III herein that were not performed in the prior revision shall be performed on the first inspection lot of this revision to maintain qualification.

4.3 Screening. Screening shall be in accordance with MIL-PRF-19500 (table E-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 E-IV of MIL-PRF-19500)	Measurements JANTX and JANTXV levels
(1) 3c	Thermal impedance (see 4.3.2).
9	Not applicable
11	I_{CEX1} and h_{FE2}
12	See 4.3.1
13	Subgroup 2 of table I herein; ΔI_{CEX1} = 100 percent of initial value or 1 μA dc, whichever is greater. Δh_{FE2} = ± 25 percent of initial value.

(1) Shall be performed anytime after temperature cycling, screen 3a; and does not need to be repeated in screening requirements.

4.3.1 Power burn-in conditions. Power burn-in conditions are T_J = +187.5°C, ±12.5°C; $V_{CB} \geq$ 20 V dc.

4.3.2 Thermal impedance. The thermal impedance measurements shall be performed in accordance with method 3131 of MIL-STD-750 using the guidelines in that method for determining I_M, I_H, t_H, t_{SW}, (and V_H where appropriate). Measurement delay time (t_{MD}) = 70 μs max. See table III, group E, subgroup 4 herein.

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. Electrical measurements (end-points) shall be in accordance with applicable inspections of 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. End-point electrical measurements shall be in accordance with table I, subgroup 2 herein. Delta measurements shall be in accordance with table II herein.

Subgroup	Method	Condition
B3	1027	$V_{CE} \geq$ 20 V dc; T_J = 187.5°C, ± 12.5°C.
	or	
B3	1037	$V_{CB} \geq$ 20 V dc; ΔT_J =between cycles ≥ +100°C; $t_{on} = t_{off} \geq$ 1 minute.

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. End-point electrical measurements shall be in accordance with table I, subgroup 2 herein. Delta measurements shall be in accordance with table II herein.

Subgroup	Method	Condition
C2	2036	Test condition A; weight = 10 pounds; time = 15 s.
C5	3131	See 4.3.2, $R_{\theta JC}$ shall be 0.7 °C/W.
C6	1026	V_{CE} ≥ 20 V dc; T_J = 187.5°C, ± 12.5°C.

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-IX of MIL-PRF-19500 and as specified 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.

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.

TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical examination	2071					
Subgroup 2						
Thermal impedance 2/	3131	See 4.3.2	$Z_{\theta JX}$			°C/W
Collector to emitter breakdown voltage	3011	Bias condition D; I_C = 50 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$			
2N6274				100		V dc
2N6277				150		V dc
Collector to emitter cutoff current	3041	Bias condition D	I_{CEO}		50	µA dc
2N6274		V_{CE} = 50 V dc				
2N6277		V_{CE} = 75 V dc				
Collector to emitter cutoff current	3041	Bias condition A; V_{BE} = -1.5 V dc	I_{CEX1}		10	µA dc
2N6274		V_{CE} = 120 V dc				
2N6277		V_{CE} = 180 V dc				
Emitter-base cutoff current	3061	Bias condition D; V_{EB} = 6 V dc	I_{EBO}		100	µA dc
Collector to base cutoff current	3036	Bias condition D,	I_{CBO}		10	µA dc
2N6274		V_{CB} = 120 V dc				
2N6277		V_{CB} = 180 V dc				
Base emitter saturated voltage	3066	Test condition A; I_C = 20 A dc; pulsed (see 4.5.1) I_B = 2.0 A dc	$V_{BE(sat)}$		1.8	V dc
Forward-current transfer ratio	3076	V_{CE} = 4 V dc; I_C = 1 A dc; pulsed (see 4.5.1)	h_{FE1}	50		
Forward-current transfer ratio	3076	V_{CE} = 4 V dc; I_C = 20 A dc; pulsed (see 4.5.1)	h_{FE2}	30	120	
Forward-current transfer ratio	3076	V_{CE} = 4 V dc; I_C = 50 A dc; pulsed (see 4.5.1)	h_{FE3}	10		
Collector to emitter saturated voltage	3071	I_C = 20 A dc; pulsed (see 4.5.1) I_B = 2.0 A dc	$V_{CE(sat)1}$		1.0	V dc
Collector to emitter saturated voltage	3071	I_C = 50 A dc; I_B = 10 A dc; pulsed (see 4.5.1)	$V_{CE(sat)2}$		3.0	V dc

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
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
2N6274 2N6277		V_{CE} = 120 V dc V_{CE} = 180 V dc				
Low-temperature operation :		T_A = -55°C				
Forward-current transfer ratio	3076	V_{CE} = 4.0 V dc; I_C = 20 A dc; pulsed (see 4.5.1)	h_{FE4}	10		
Subgroup 4						
Pulse response:	3251	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 = 20 A dc; I_B = 2.0 A dc	t_{on}		0.5	µs
Turn-off time		V_{CC} = 80 V dc; I_C = 20 A dc; I_{B1} = I_{B2} = 2.0 A dc	t_{off}		1.05	µs
Magnitude of common emitter small-signal short-circuit forward- current transfer ratio	3306	V_{CE} = 10 V dc; I_C = 1 mA dc; f = 10 MHz	$\|h_{fe}\|$	3	12	
Open capacitance (open circuit)	3236	V_{CB} = 10 V dc; I_E = 0; f = 1.0 MHz	C_{obo}		600	pF
Subgroup 5						
Safe operating area (dc operation)	3051	T_C = +25°C; t = 1 s; 1 cycle; (See figure 3)				
Test 1		V_{CE} = 5 V dc; I_C = 50 A dc				
Test 2		V_{CE} = 86 V dc; I_C = 165 mA dc				
Test 3 2N6274		V_{CE} = 8 V dc; I_C = 29 A dc				
Test 4 2N6277		V_{CE} = 120 V dc; I_C = 110 mA dc				

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 5 - Continued						
Safe operating area (switching)	3053	Load condition C, (unclamped inductive load) (see figure 4) T_C = + 25°C; duty cycle ≤ 10 percent; R_s = 0.1 ohms; $t_r = t_f \leq 500$ ns				
Test 1		t_p approximately 5 ms (vary to obtain I_C); R_{BB1} = 2 ohms; V_{BB1} =12 V dc; $R_{BB2} = \infty$; V_{BB2} = 0 V; I_C = 40 A dc; V_{CC} = 50 V dc; L = 100 μH; (4 each Miller type 7827 in parallel, 40 A), 0.04 ohm, or equivalent				
Test 2		t_p approximately 5 ms (vary to obtain I_C;) R_{BB1} = 120ohms; V_{BB1} =12 V dc; $R_{BB2} = \infty$; V_{BB2} = 0 V; V_{CC} = 50 V dc; I_C = 850 mA dc; L = 100 μH; (= 80 + 20 mH 2 each Traid Transformer C-48u, in series), 0.713 ohm, or equivalent				
Safe operating area (switching)	3053	Clamped inductive load T_A = + 25°C; duty cycle ≤ 5 percent; t_p approximately 1.5 ms (vary to obtain I_C) V_{CC} =50 V dc; I_C = 50 A dc; V_{BB1} =12 V dc; V_{BB2} = 1.5 V; R_{BB1} = 2 ohms; R_{BB2} = 100 ohms; $R_s \leq 0.1$ ohms; L = 370 μH (Miller 7827 or equivalent) (see figure 5)				
2N6274		Clamp voltage = 100 V dc				
2N6277		Clamp voltage = 150 V dc				
Electrical measurements		See table I, subgroup 2 herein				
Subgroups 6 and 7						
Not applicable						

1/ For sampling plan, see MIL-PRF-19500.
2/ This test required for the following end-point measurements only:
Group B, subgroups 2 and 3 (JAN, JANTX, and JANTXV).
Group C, subgroups 2 and 6.
Group E, subgroup 1.

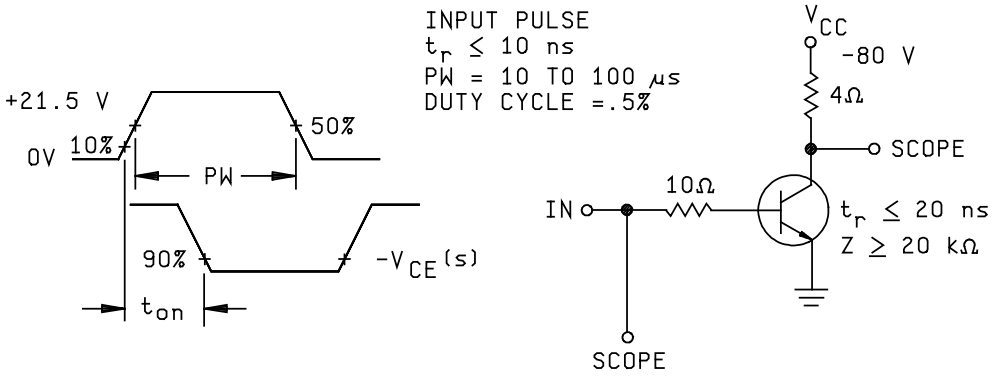
TABLE II. Groups B and C delta measurements. 1/ 2/ 3/

Steps	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Collector to emitter voltage (saturated)	3071	I_C = 20 A dc; I_B = 2 A dc, pulsed (see 4.5.1)	$\Delta V_{CE(sat)1}$		± 50 mV change from previously measured value.	

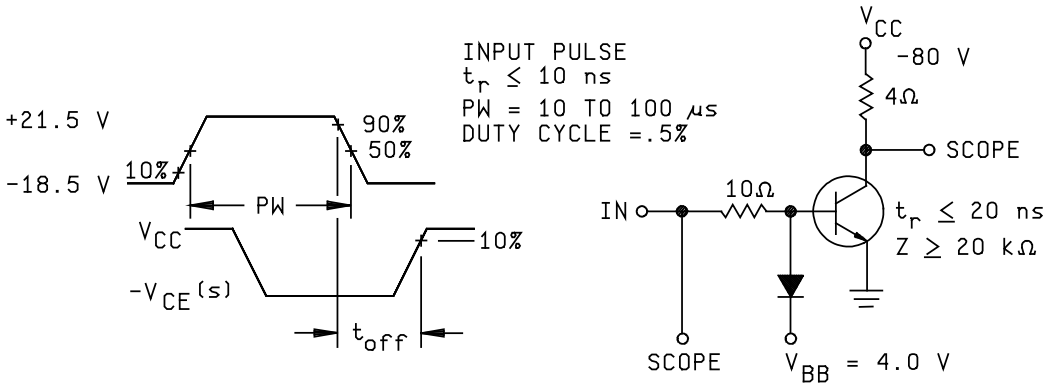
1/ The delta measurements for table E-VIB (JANTX and JANTXV) of MIL-PRF-19500 are subgroup 6, see table II herein, step 1.
2/ The delta measurements for table E-VII of MIL-PRF-19500 are subgroup 6, see table II herein, step 1.
3/ The delta measurements for table E-XI of MIL-PRF-19500 are subgroups 1 and 2, see table II herein, step 1.

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

Inspection	MIL-STD-750		Sample plan
	Method	Conditions	
Subgroup 1			45 devices c = 0
Temperature cycling	1051	500 cycles minimum	
Hermetic seal Fine leak Gross leak	1071		
Electrical measurements		See table I, subgroup 2 and table II herein.	
Subgroup 2			45 devices c = 0
Blocking life	1048	Test temperature = +125°C; V_{CB} = 80 percent of rated; T = 1,000 hours.	
Electrical measurements		See table I, subgroup 2 and table II herein.	
Subgroup 4			Sample size N/A
Thermal impedance curves		See MIL-PRF-19500.	
Subgroup 8			45 devices c = 0
Reverse stability	1033	Condition B.	



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



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

FIGURE 2. Switching time test circuits.

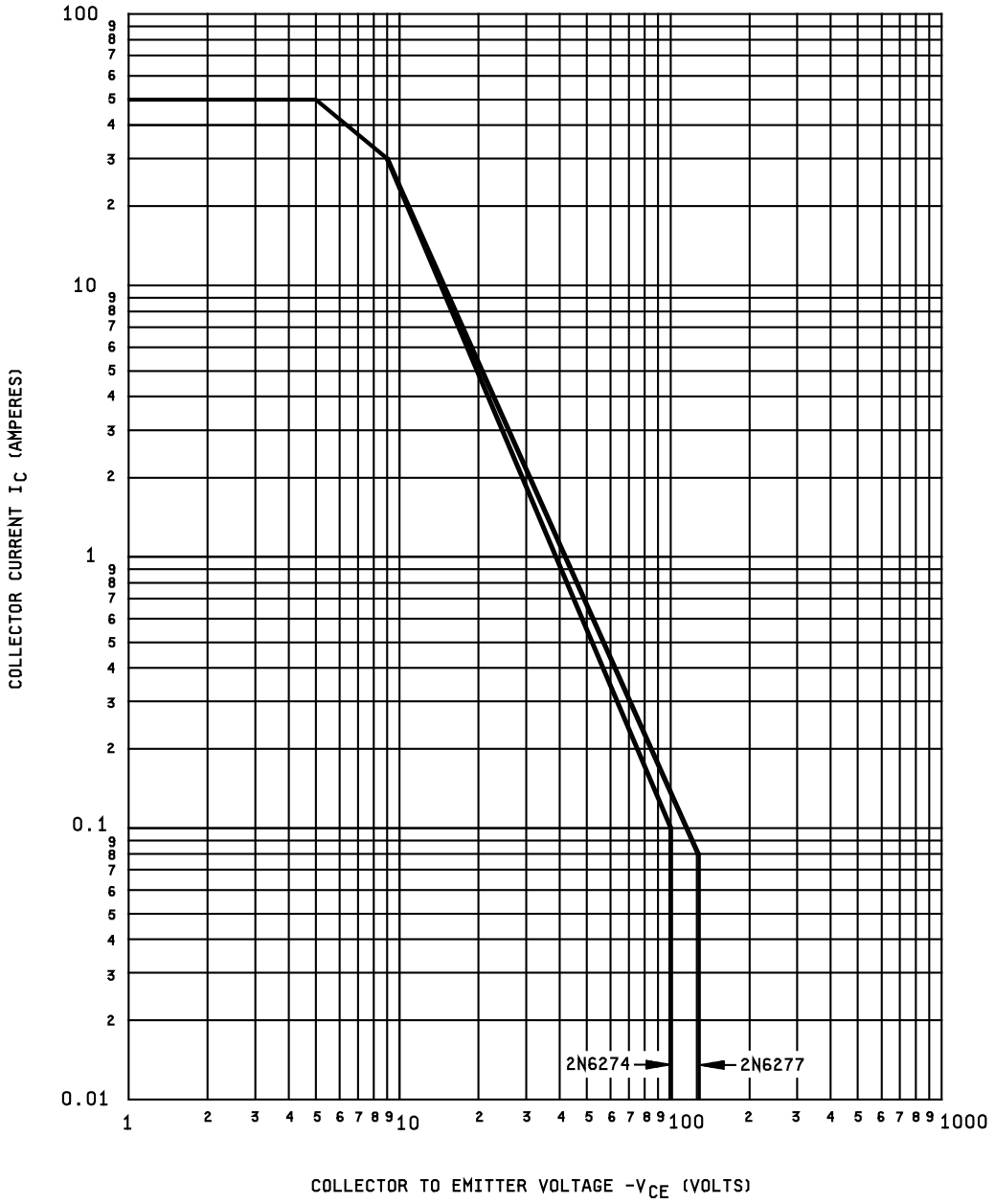


FIGURE 3. Maximum safe operating graph (continuous dc).

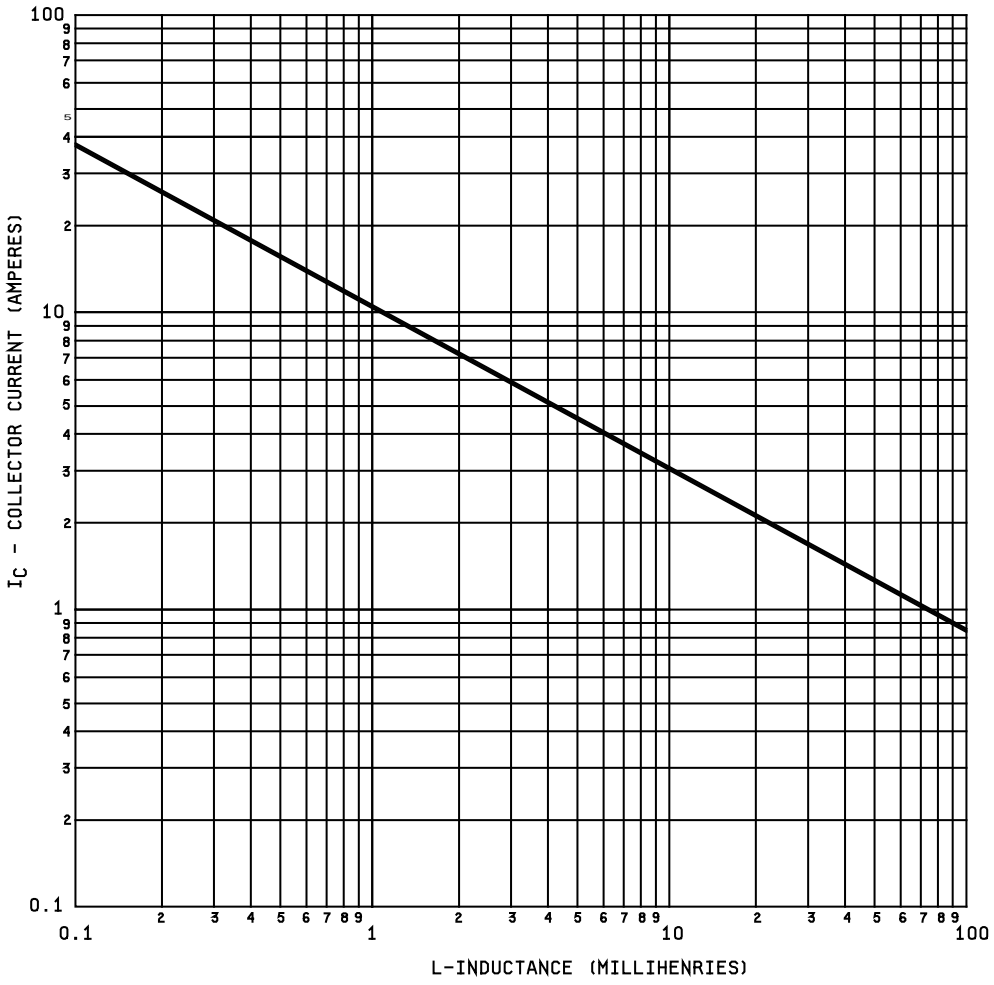
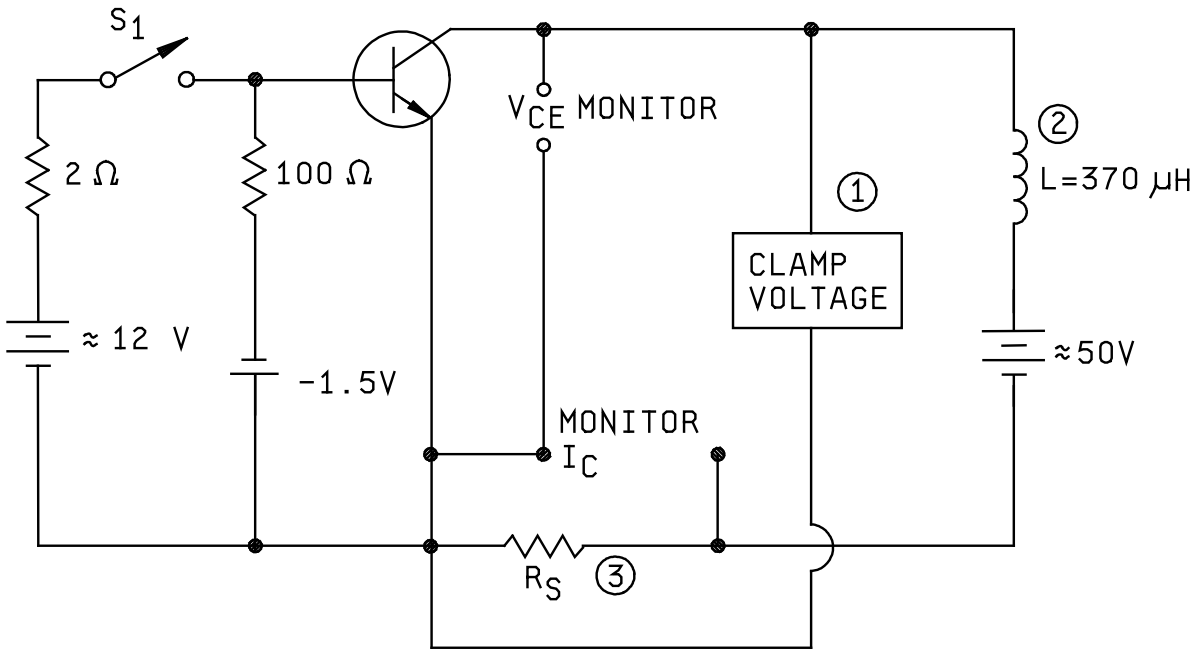


FIGURE 4. Safe operating area for switching between saturation and cutoff (unclamped inductive load).



NOTES:
1. Either a clamping circuit or clamping diode may be used.
2. The coil used shall provide a minimum inductance of 370 μH at 50 A with a maximum dc resistance of .15 Ω. For reference only: Miller type 7827; or equivalent.
3. $R_S \leq .1$ ohm, 12 W, 1 percent tolerance maximum, (noninductive).

Procedure:
1. With switch S1 closed, set the specified test conditions.
2. Open S1. Device fails if clamp voltage 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 3.4.1).

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 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.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 - 85
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2012-114)

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