The documentation and process conversion measures necessary to comply with this revision shall be completed by 4 December 2008.

INCH POUND

MIL-PRF-19500/502E
4 September 2008
SUPERSEDING
MIL-PRF-19500/502D
12 March 2004

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DARLINGTON TRANSISTOR, NPN, SILICON, POWER,
TYPES 2N6058 AND 2N6059, 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, Darlington, 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 (similar to TO-3).

1.3 Maximum ratings at T_C = +25°C unless otherwise specified.

Type	P_T (1) T_C = +25°C	P_T T_C = +100°C	V_{CBO}	V_{CEO}	V_{EBO}	I_C	I_B	T_J and T_{STG}
	W	W	V dc	V dc	V dc	A dc	A dc	°C
2N6058	150	75	80	80	5	12	0.2	-55 to +175
2N6059	150	75	100	100	5	12	0.2	-55 to +175

(1) Derate linearly at 1.00 W/°C above T_C > +25°C.

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

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

Limit	h_{FE2} (1) V_{CE} = 3 V dc I_C = 6 A dc	h_{FE3} (1) V_{CE} = 3 V dc I_C = 12 A dc	h_{fe} V_{CE} = 3 V dc I_C = 5 A dc f = 1 kHz	$\|h_{fe}\|$ V_{CE} = 3 V dc I_C = 5 A dc f = 1 MHz	C_{obo} 100 kHz ≤ f ≤ 1 MHz V_{CB} = 10 V dc I_E = 0	$R_{\theta JC}$
					pF	°C/W
Min	1,000	150	1,000	10		
Max	18,000			250	300	1.0

Limit	$V_{BE(sat)}$ (1) I_C = 12 A dc I_B = 120 mA dc	$V_{CE(sat)1}$ (1) I_C = 12 A dc I_B = 120 mA dc	$V_{CE(sat)2}$ (1) I_C = 6 A dc I_B = 24 mA dc	Pulse response	
				t_{on}	t_{off}
	V dc	V dc	V dc	µs	µs
Min					
Max	4.0	3.0	2.0	2	10

(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://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.

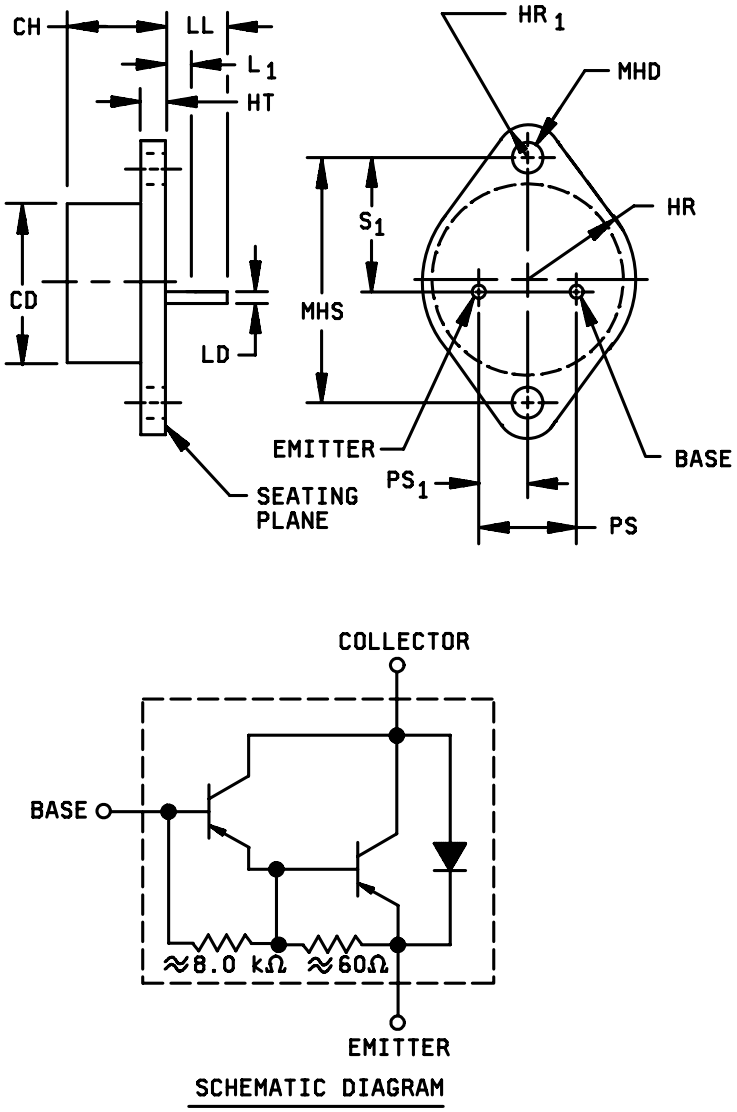


FIGURE 1. Physical dimensions and schematic circuit (similar to TO-3).

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD		.875		22.23	
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	.038	.043	0.97	1.09	5, 9
LL	.312	.500	7.92	12.7	5
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	4, 10
PS_1	.205	.225	5.21	5.72	4, 5, 10
S_1	.655	.675	16.64	17.15	4

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 the 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. The collector shall be electrically connected to the case.
9. LD applies between L_1 and LL. Diameter is uncontrolled in L_1.
10. 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.
11. In accordance with ASME Y14.5M, diameters are equivalent to ϕ symbology.

FIGURE 1. Physical dimensions and schematic circuit (similar to TO-3) - Continued.

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 (similar to TO-3).

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 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 as specified in table I.

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

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 tables I and II).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500.

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 shall be performed on the first inspection lot of this revision to maintain qualification.

* 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)	Measurement
	JANTX and JANTXV levels
(1) 3c	Thermal impedance, see 4.3.2.
9	I_{CEX1}.
11	I_{CEX1}, h_{FE2}; ΔI_{CEX1} = 100 percent of initial value or 2 μA dc, whichever is greater.
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_{FE2} = ±40 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 as follows: T_J = +162.5°C ± 12.5°C; $V_{CE} \geq$ 10 V dc, $T_A \leq$ +100°C. NOTE: No heat sink or forced air cooling on the devices shall be permitted.

* 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.

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.

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 as follows. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2. Delta requirements shall be in accordance with the applicable step of table II herein.

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

	Subgroup	Method	Condition
	B3	1037	$V_{CB} \geq$ 10 V dc; ΔT_J = between cycles ≥ +100°C. ton = toff = 3 minutes for 2,000 cycles. No heat sink or forced-air cooling on the devices shall be permitted.
*	B5	3131	Not applicable.

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. Delta requirements shall be in accordance with the applicable step of table II herein.

	Subgroup	Method	Condition
	C2	2036	Tension: test condition A; weight = 10 lbs; time = 15 s.
*	C5	3131	See 4.3.2, $R_{\theta JC}$ = 1°C/W (maximum).
	C6	1037	$V_{CB} \geq 10$ V dc; ΔT_J between cycles $\geq +100$ °C. $t_{on} = t_{off} = 3$ minutes 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 appendix E, table E-IX of MIL-PRF-19500 and as specified herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2. Delta requirements shall be in accordance with the applicable step of 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	Limits		Unit
		Method	Conditions		Min	Max	
	Subgroup 1						
	Visual and mechanical examination	2071					
	Subgroup 2						
*	Thermal impedance	3131	See 4.3.2	$Z_{\theta JC}$			°C/W
	Breakdown voltage, collector to emitter	3011	Bias condition D, I_C = 100 mA dc, pulsed (see 4.5.1)	$V_{(BR)CEO}$			
	2N6058				80		V dc
	2N6059				100		V dc
	Collector to emitter cutoff current	3041	Bias condition A; V_{BE} = 1.5 V dc	I_{CEX1}			
*	2N6058		V_{CE} = 80 V dc			10	μA dc
*	2N6059		V_{CE} = 100 V dc			10	μA dc
	Collector to emitter cutoff current	3041	Bias condition D;	I_{CEO}			
	2N6058		V_{CE} = 40 V dc			1.0	mA dc
	2N6059		V_{CE} = 50 V dc			1.0	mA dc
	Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 5 V dc	I_{EBO}		2.0	mA dc
	Base to emitter voltage (nonsaturated)	3066	Test condition B; V_{CE} = 3 V dc; I_C = 6 A dc	V_{BE}		2.8	V dc
	Base to emitter voltage (saturated)	3066	Test condition A; I_C = 12 A dc; I_B = 120 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)}$		4.0	V dc
	Collector to emitter voltage (saturated)	3071	I_C = 12 A dc; I_B = 120 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)1}$		3.0	V dc
	Collector to emitter voltage (saturated)	3071	I_C = 6 A dc; I_B = 24 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)2}$		2.0	V dc
	Forward-current transfer ratio	3076	V_{CE} = 3 V dc; I_C = 1 A dc; pulsed (see 4.5.1)	h_{FE1}	1,000		
	Forward-current transfer ratio	3076	V_{CE} = 3 V dc; I_C = 6 A dc; pulsed (see 4.5.1)	h_{FE2}	1,000	18,000	
	Forward-current transfer ratio	3076	V_{CE} = 3 V dc; I_C = 12 A dc; pulsed (see 4.5.1)	h_{FE3}	150		

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 3						
High temperature operation:		T_A = +150°C				
Collector to emitter cutoff current 2N6058 2N6059	3041	Bias condition A; V_{BE} = 1.5 V dc V_{CE} = 80 V dc V_{CE} = 100 V dc	I_{CEX2}		 5.0 5.0	 mA dc mA dc
Collector to emitter voltage (saturated)	3071	I_C = 6 A dc; I_B = 24 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)3}$		2.0	V dc
Low temperature operation:		T_A = -55°C				
Forward-current transfer ratio	3076	V_{CE} = 3 V dc; I_C = 6 A dc; pulsed (see 4.5.1)	h_{FE4}	300		
Subgroup 4						
Small-signal short-circuit forward-current transfer ratio	3206	V_{CE} = 3 V dc, I_C = 5 A dc f = 1 kHz	h_{fe}	1,000		
Magnitude of common-emitter small-signal short-circuit forward-current transfer ratio	3306	V_{CE} = 3 V dc; I_C = 5 A dc; f = 1.0 MHz	$\|h_{fe}\|$	10	250	
Open circuit output capacitance	3236	V_{CB} = 10 V dc; I_E = 0; 100 kHz ≤ f ≤ 1 MHz	C_{obo}		300	pF
Pulse response						
Turn-on time		(See figure 2); V_{CC} = 30 V dc; I_C = 5 A dc; I_B = 20 mA dc	t_{on}		2.0	µs
Turn-off time		(See figure 2); V_{CC} = 30 V dc; I_C = 5 A dc; I_{B1} = I_{B2} = 20 mA dc	t_{off}		10	µs

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)	3051	T_C = +25°C +10°C, -0°; $t \geq 1$ s; 1 cycle; (see figure 3)				
Test 1		V_{CE} = 12.5 V dc; I_C = 12 A dc				
Test 2		V_{CE} = 30 V dc; I_C = 5 A dc				
Test 3 2N6058 2N6059		 V_{CE} = 70 V dc; I_C = 200 mA dc V_{CE} = 90 V dc; I_C = 155 mA dc				
Safe operating area (switching)	3053	Load condition B; (clamped inductive load); T_A = +25°C; $t_r + t_f \leq 1.0$ µs; duty cycle ≤ 2 percent; t_p = 1 ms; (vary to obtain I_C); R_s = 0.10 Ω; R_{BB1} = 80 Ω; V_{BB1} = 16 V dc; R_{BB2} = 100 Ω; V_{BB2} = 1.5 V dc; I_C = 12 A dc; V_{CC} = 20 V dc; $R_L \leq 2$ Ω; L = 10 mH (Stancor C-2688 or equivalent); (see figure 4).				
2N6058 2N6059		Clamp voltage = 80 +0, -5 V dc Clamp voltage = 100 +0, -5 V dc				
		Device fails if clamp voltage not reached.				
End-point electrical measurements		See table I, subgroup 2				
Subgroups 6 and 7						
Not applicable						

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

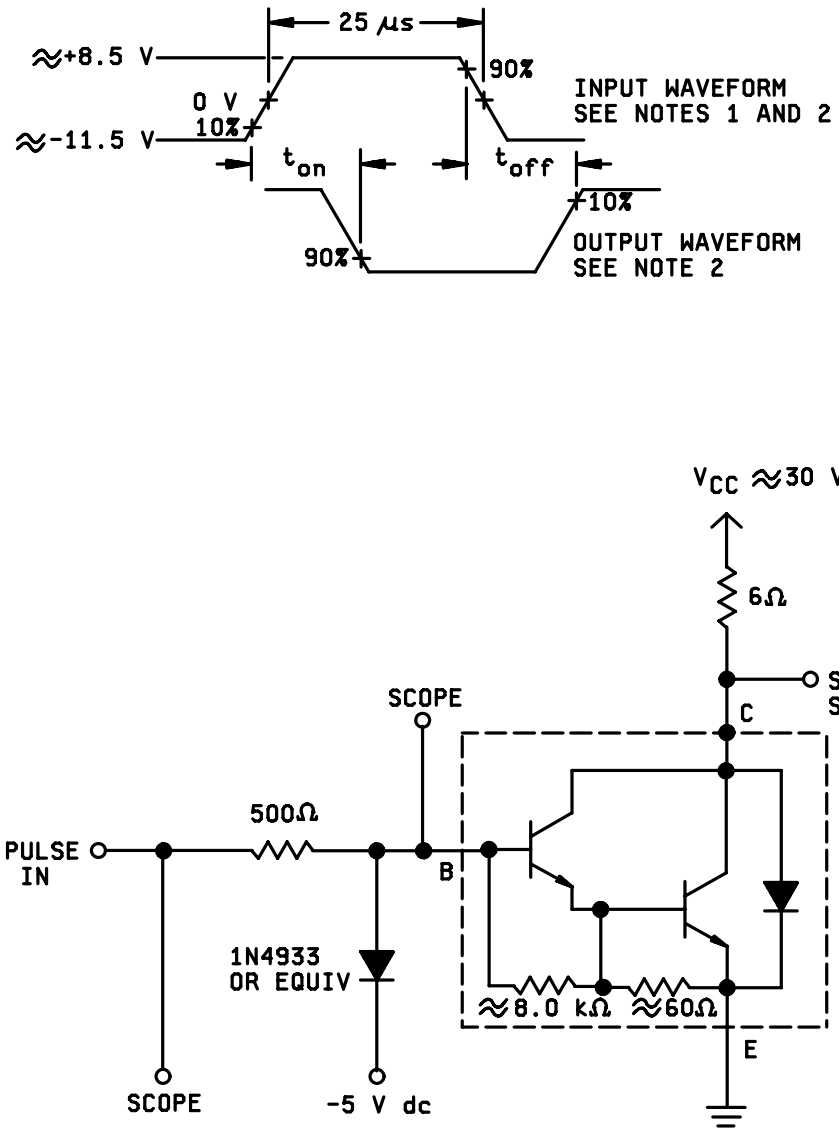
TABLE II. Group B, C, and E delta measurements. 1/ 2/ 3/

Step	Inspection	MIL-STD-750		Symbol	Limit
		Method	Conditions		
1.	Forward current transfer ratio	3076	V_{CE} = 3 V dc; I_C = 6 A dc; pulsed (see 4.5.1)	Δh_{FE2}	±40 percent change from initial reading.

1/ The delta measurements for table E-VIB (JAN, JANTX and JANTXV) are: Subgroups 3 and 6 of MIL-PRF-19500, see table II, step 1 herein.
2/ The delta measurement for table E-VII is: Subgroup 6 of MIL-PRF-19500, see table II, step 1 herein.
3/ The delta measurements for table E-IX of MIL-PRF-19500 are: Subgroups 1 and 2, see table II, step 1 herein.

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

Inspection	MIL-STD-750		Sample plan
	Method	Conditions	
Subgroup 1			45 devices c = 0
Temperature cycling	1051	Test condition C, 500 cycles.	
Hermetic seal Fine leak Gross leak	1071	 Test conditions G or H Test conditions C or D	
End-point electrical measurements		See table I, subgroup 2 and table II herein.	
Subgroup 2			45 devices c = 0
Intermittent life	1037	Intermittent operation life: $V_{CB} \geq 10$ V dc, 6,000 cycles.	
End-point 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.	



NOTES:

1. The input waveform is supplied by a pulse generator with the following characteristics: $t_r \leq 20$ ns, $t_f \leq 20$ ns, $Z_{out} = 50$ ohms, PW = 25 µs, duty cycle ≤ 2 percent.
2. Output wave forms are monitored on an oscilloscope with the following characteristics: $t_r \leq 2.0$ ns, $Z_{in} \geq 20$ kΩ, $C_{in} \leq 11.5$ pF.
3. Resistors shall be noninductive types.
4. The dc power supplies may require additional by-passing in order to minimize ringing.

FIGURE 2. Pulse response test circuit.

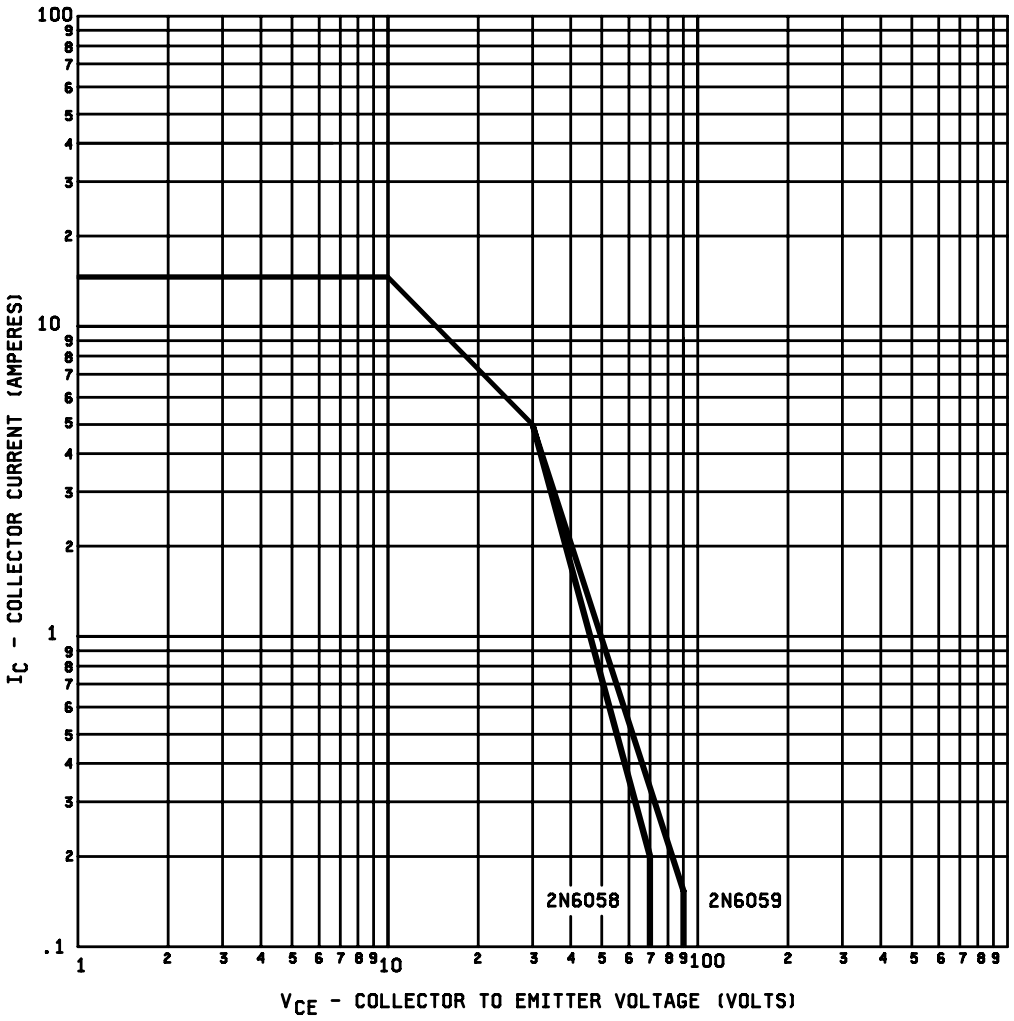


FIGURE 3. Maximum safe operating area graph (continuous dc).

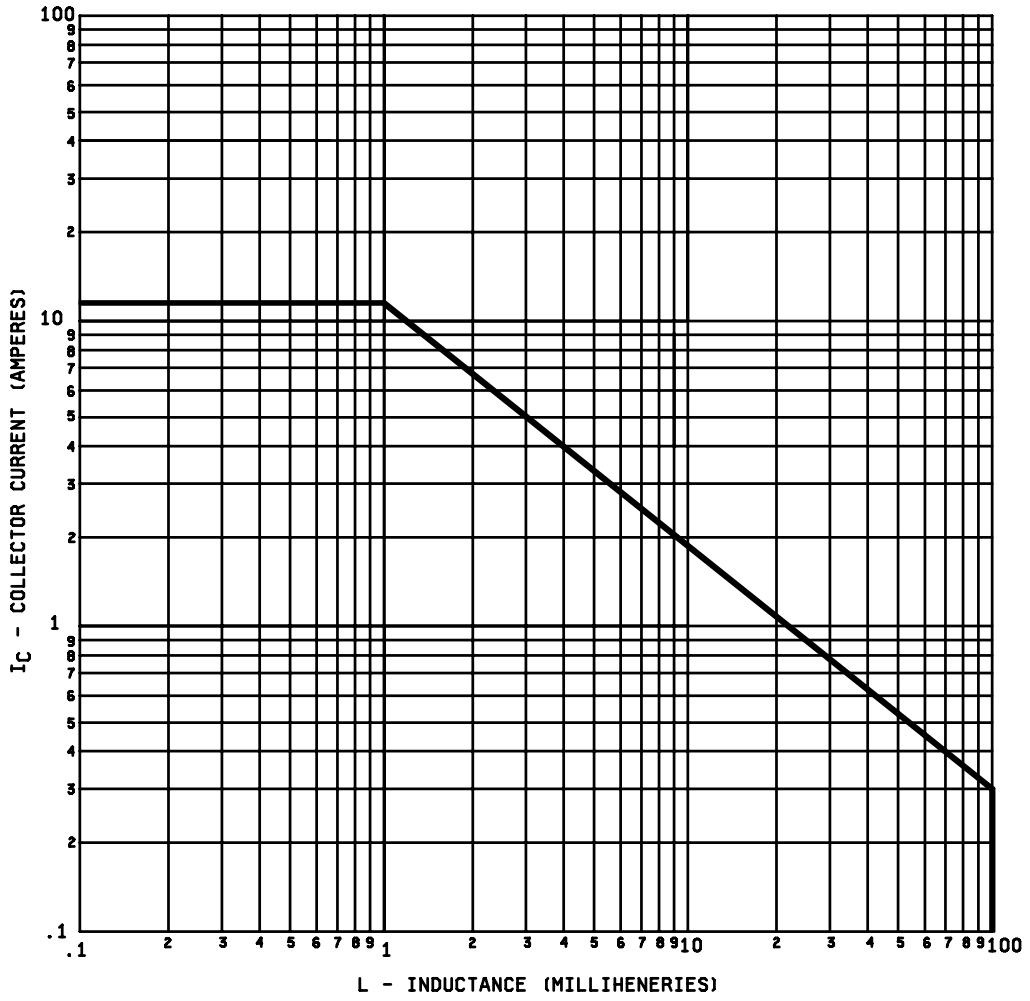


FIGURE 4. Safe operating area for switching between saturation and cutoff (unclamped inductive load).

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 Defense Supply Center, Columbus, ATTN: DSCC/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 http://assist.daps.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
NASA - NA
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2008-001)

Review activities:
Air Force - 19, 99

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