

The documentation and process conversion measures necessary to comply with this revision shall be completed by 2 February 2013.

INCH-POUND

MIL-PRF-19500/526H
 2 November 2012
 SUPERSEDING
 MIL-PRF-19500/526G
 25 January 2008

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, POWER,
 TYPE 2N3879, 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 device type as specified in [MIL-PRF-19500](#).

1.2 Physical dimensions. See [figure 1](#) (TO-66).

1.3 Maximum ratings. ($T_A = +25^\circ\text{C}$, unless otherwise specified).

P_T (1) $T_C = +25^\circ\text{C}$	$R_{\theta JC}$	V_{CBO}	V_{CEO}	V_{EBO}	I_B	I_C	T_J and T_{STG}
<u>W</u>	<u>$^\circ\text{C/W}$</u>	<u>V dc</u>	<u>V dc</u>	<u>V dc</u>	<u>A dc</u>	<u>A dc</u>	<u>$^\circ\text{C}$</u>
35	5	120	75	7	5	7	-65 to +200

(1) Derate linearly 200 mW/ $^\circ\text{C}$ for $T_C > +25^\circ\text{C}$.

* 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.

	h_{FE1} (1)	h_{FE2} (1)	$V_{BE(SAT)1}$	$V_{CE(SAT)1}$	C_{obo}	$ h_{fe} $	Switching (see table 1 and figure 2 herein)	
	$V_{CE} = 5.0 \text{ V dc}$ $I_C = 0.5 \text{ A dc}$	$V_{CE} = 5.0 \text{ V dc}$ $I_C = 4.0 \text{ A dc}$	$I_C = 4.0 \text{ A dc}$ $I_B = 0.4 \text{ A dc}$	$I_C = 4.0 \text{ A dc}$ $I_B = 0.4 \text{ A dc}$	$V_{CB} = 10 \text{ V dc}$ $I_E = 0$ $0.1 \text{ MHz} \leq f \leq 1 \text{ MHz}$	$V_{CE} = 10 \text{ V dc}$ $I_C = 500 \text{ mA dc}$ $f = 10 \text{ MHz}$	t_{on}	t_{off}
			<u>V dc</u>	<u>V dc</u>	<u>pF</u>		<u>μs</u>	<u>μs</u>
Min	40	20				4		
Max		80	2.0	1.2	175	20	0.44	1.2

(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.

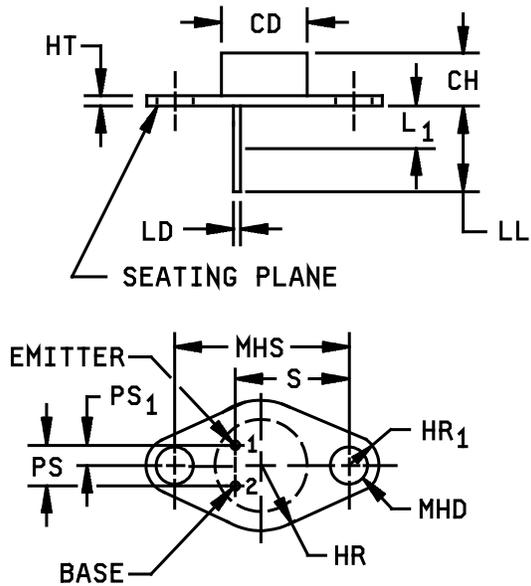
DEPARTMENT OF DEFENSE STANDARDS

[MIL-STD-750](#) - Test Methods for Semiconductor Devices.

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

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.470	.500	11.94	12.70	3,10
CH	.250	.340	6.35	8.64	
HR		.350		8.89	
HT	.050	.075	1.27	1.91	
HR ₁	.115	.145	2.92	3.68	8
LD	.028	.034	0.71	0.86	3,7,10
LL	.360	.500	9.14	12.70	3,9
L ₁		.050		1.27	9
MHD	.142	.152	3.61	3.86	7,10
MHS	.958	.962	24.33	24.43	
PS	.190	.210	4.83	5.33	4
PS ₁	.093	.107	2.36	2.72	4
S	.570	.590	14.48	14.99	



NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Body contour is optional within zone defined by CD and PS₁.
4. These dimensions should be measured at points .050 inch (1.27 mm) .055 inch (1.40 mm) below seating plane. When gauge is not used measurement will be made at the seating plane.
5. Both terminals.
6. At both ends.
7. Two holes.
8. The collector is electrically connected to the case.
9. LD applies between L₁ and LL. Lead diameter shall not exceed twice LD within L₁.
10. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 1. Physical dimensions (TO-66).

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](#).

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, the electrical performance characteristics are as specified in [1.3](#), [1.4](#), and [table I](#) herein.

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 [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 II](#) tests, the tests specified in [table II](#) 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 (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	h_{FE2} ; I_{CEX1} ; ΔI_{CEX1} = 100 percent of initial value or 2 μ A 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 μ A 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. Power burn-in conditions are as follows: $T_J = +187.5^\circ\text{C}, \pm 12.5^\circ\text{C}$; $V_{CB} = 10 - 30$ V dc; T_A = room ambient as defined in the general requirements of 4.5 of MIL-STD-750. With approval of the qualifying activity and preparing activity, alternate burn-in criteria (hours, bias conditions, T_J , and mounting conditions) shall be used. A justification demonstrating equivalence is required. In addition, the manufacturing site's burn-in data and performance history will be essential criteria for burn-in modification approval.

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 μ s max. See table II, 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. End-point electrical measurements 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 tests and conditions specified for subgroup testing in 4.4.2 for JAN, JANTX, and JANTXV group B testing. Separate samples may be used for each step. In the event of a group B failure, the manufacturer may pull a new sample at double size from either the failed assembly lot or from another assembly lot from the same wafer lot. If the new assembly lot option is exercised, the failed assembly lot shall be scrapped. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

<u>Step</u>	<u>Method</u>	<u>Condition</u>
1	1026	Steady-state life: Test condition B, 1,000 hours minimum, $V_{CB} = 10$ V dc, power shall be applied to the device to achieve $T_J = +150^\circ\text{C}$ minimum; $n = 45$, $c = 0$.
2	1048	Blocking life, $T_A = +150^\circ\text{C}$, $V_{CB} = 80$ percent of rated voltage, 48 hours minimum. $n = 45$, $c = 0$.
3	1032	High-temperature life (non-operating), $T_A = +200^\circ\text{C}$, $t = 340$ hours, $n = 22$, $c = 0$.

4.4.2.1 Group B sample selection. Samples selected from group B inspection shall meet all of the following requirements:

- a. For JAN, JANTX, and JANTXV samples shall be selected randomly from a minimum of three wafers (or from each wafer in the lot) from each wafer lot. See MIL-PRF-19500.
- b. Shall be chosen from an inspection lot that has been submitted to and passed table I, subgroup 2, conformance inspection. When the final lead finish is solder, or any plating prone to oxidation at high temperature, the samples for life test (group B for JAN, JANTX, and JANTXV) may be pulled prior to the application of final lead finish.

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. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition A; weight = 10 pounds; $t = 15$ s.
C5	3131	See 4.3.2, $R_{\theta JC} = 5^\circ\text{C/W}$.
C6		Not applicable.

4.4.3.1 Group C sample selection. Samples for subgroups in group C shall be chosen at random from any lot containing the intended package type and lead finish procured to the same specification which is submitted to and passes [table I](#) tests herein for conformance inspection. When the final lead finish is solder, or any plating prone to oxidation at high temperature, the samples for C6 life test may be pulled prior to the application of final lead finish. Testing of a subgroup using a single device type enclosed in the intended package type shall be considered as complying with the requirements for that subgroup.

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 in [table II](#) herein. Electrical measurements (end-points) shall be in accordance with [table I](#), subgroup 2 herein.

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

4.5.1 Pulse measurements. Conditions for pulse measurements shall be as specified in section 4 of [MIL-STD-750](#).

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* TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1 2/</u>						
* Visual and mechanical <u>3/</u> examination	2071					
* Solderability <u>3/</u>	2026					
* Resistance to <u>3/ 4/</u> solvent	1022					
* Temp cycling <u>3/</u>	1051	Test condition C, 25 cycles				
* Hermetic seal Fine leak Gross leak	1071					
Electrical measurements		Table I, subgroup 2				
Bond strength <u>3/</u>	2037	Pre-condition $T_A = +250^\circ\text{C}$ at $t = 24$ hours or $T_A = +300^\circ\text{C}$ at $t = 2$ hours, $n = 11$ wires, $c = 0$				
Decap internal visual	2075	$n = 4, c = 0$				
<u>Subgroup 2</u>						
Thermal impedance <u>5/</u>	3131	See 4.3.2	$Z_{\theta JX}$			$^\circ\text{C/W}$
* Breakdown voltage, collector to emitter	3011	Bias condition D; $I_C = 200$ mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	75		V dc
Collector to emitter cutoff current	3041	Bias condition D; $V_{CE} = 50$ V dc	I_{CEO}		5	mA dc
Collector to emitter cutoff current	3041	Bias condition A; $V_{CE} = 100$ V dc; $V_{BE} = 1.5$ V dc	I_{CEX1}		10	μA dc
Emitter to base cutoff current	3061	Bias condition D; $V_{EB} = 7$ V dc	I_{EBO}		10	mA dc
Collector to base cutoff current	3036	Bias condition D; $V_{CB} = 120$ V dc	I_{CBO}		10	μA dc
Base emitter voltage (nonsaturated)	3066	Test condition B; $I_C = 4.0$ A dc; $V_{CE} = 2.0$ V dc; pulsed (see 4.5.1)	V_{BE}		1.8	V dc
Base emitter voltage (saturated)	3066	Test condition A; $I_C = 4.0$ A dc; $I_B = 0.4$ A dc; pulsed (see 4.5.1)	$V_{BE(SAT)}$		2.0	V dc
Collector to emitter saturated voltage	3071	$I_C = 4.0$ A dc; $I_B = 0.4$ A dc; pulsed (see 4.5.1)	$V_{CE(SAT)}$		1.2	V dc

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/			Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u> continued						
Forward-current transfer ratio	3076	$V_{CE} = 5.0 \text{ V dc}; I_C = 0.5 \text{ A dc};$ pulsed (see 4.5.1)	h_{FE1}	40		
Forward-current transfer ratio	3076	$V_{CE} = 5.0 \text{ V dc}; I_C = 4.0 \text{ A dc};$ pulsed (see 4.5.1)	h_{FE2}	20	80	
Forward-current transfer ratio	3076	$V_{CE} = 2.0 \text{ V dc}; I_C = 4.0 \text{ A dc};$ pulsed (see 4.5.1)	h_{FE3}	12	100	
<u>Subgroup 3</u>						
High temperature operation:		$T_A = +150^\circ\text{C}$				
Collector to emitter cutoff current	3041	Bias condition A; $V_{CE} = 100 \text{ V dc};$ $V_{BE} = 1.5 \text{ V dc}$	I_{CEX2}		750	$\mu\text{A dc}$
Low temperature operation:		$T_A = -55^\circ\text{C}$				
Forward-current transfer ratio	3076	$V_{CE} = 5.0 \text{ V dc}; I_C = 0.5 \text{ A dc};$ pulsed (see 4.5.1)	h_{FE4}	10		
<u>Subgroup 4</u>						
Pulse response	3251	Test condition A except test circuit and pulse requirements in accordance with figure 2 herein.				
Turn-on time		$V_{CC} = 30 \text{ V dc}; I_C = 4.0 \text{ A dc};$ $I_B = 0.4 \text{ A dc}$	$t_{(on)}$		0.44	μs
Turn-off time		$V_{CC} = 30 \text{ V dc}; I_C = 4.0 \text{ A dc};$ $I_B = -I_B = 0.4 \text{ A dc}$	$t_{(off)}$		1.2	μs
Magnitude of common emitter small-signal short-circuit forward-current transfer ratio	3306	$V_{CE} = 10 \text{ V dc}; I_C = 500 \text{ mA dc};$ $f = 10 \text{ MHz}$	$ h_{fe} $	4	20	
Open circuit output capacitance	3236	$V_{CB} = 10 \text{ V dc}; I_E = 0;$ $0.1 \text{ MHz} \leq f \leq 1.0 \text{ MHz}$	C_{obo}		175	pF

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/			Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 5</u>						
Safe operating area (continuous dc)	3051	$T_C = +25^\circ\text{C}$; $t = 1 \text{ s}$, 1 cycle; (see figure 3)				
Test 1		$V_{CE} = 5 \text{ V dc}$; $I_C = 7 \text{ A dc}$				
Test 2		$V_{CE} = 28 \text{ V dc}$; $I_C = 1.25 \text{ A dc}$				
Test 3		$V_{CE} = 40 \text{ V dc}$; $I_C = 500 \text{ mA dc}$				
Test 4		$V_{CE} = 75 \text{ V dc}$; $I_C = 100 \text{ mA dc}$				
* End-point electrical measurements		Table I, subgroup 2				
Safe operating area (switching)	3053	Load condition C, (unclamped inductive load) (see figure 4) $T_C = +25^\circ\text{C}$; duty cycle ≤ 5 percent; $R_S = 0.1 \text{ ohm}$; $t_r = t_f \leq 2 \mu\text{s}$				
Test 1		$t_p \approx 50 \mu\text{s}$ (vary to obtain I_C); $R_{BB1} = 5.0 \text{ ohms}$; $V_{BB1} = 10 \text{ V dc}$; $R_{BB2} = 50 \text{ ohms}$; $V_{BB2} = 4 \text{ V dc}$; $I_C = 4 \text{ A dc}$; $L = 125 \mu\text{H}$; $V_{CC} = 10 \text{ V dc}$; R of inductor = 0.1 ohm				
Test 2		$t_p \approx 25 \mu\text{s}$ (vary to obtain I_C); $R_{BB1} = 5.0 \text{ ohms}$; $V_{BB1} = 10 \text{ V dc}$; $R_{BB2} = 50 \text{ ohms}$; $V_{BB2} = 1.5 \text{ V dc}$; $I_C = 1 \text{ A dc}$; $L = 250 \mu\text{H}$; $V_{CC} = 10 \text{ V dc}$; R of inductor = 0.1 ohm				
* End-point electrical measurements		Table I, subgroup 2				
Safe operating area (switching)	3053	Load condition B; $T_A = +25^\circ\text{C}$; $I_C = 7 \text{ A dc}$; $V_{CC} = 45 \text{ V dc}$; clamped voltage = 75 V dc, duty cycle ≤ 5 percent; $R_{BB1} = 5.0 \text{ ohms}$; $V_{BB1} = 10 \text{ V dc}$; $R_{BB2} = 50 \text{ ohms}$; $V_{BB2} = -4 \text{ V dc}$; $L = 250 \mu\text{H}$; R of inductor = 0.1 ohm; $R_L = \text{as required to limit } I_C$				

See footnotes at end of table.

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* TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>			Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroups 6 and 7</u>						
Not applicable						

1/ For sampling plan, see [MIL-PRF-19500](#).

2/ For resubmission of failed subgroup 1, double the sample size of the failed test or sequence of tests.

3/ Separate samples may be used.

4/ Not required for laser marked devices.

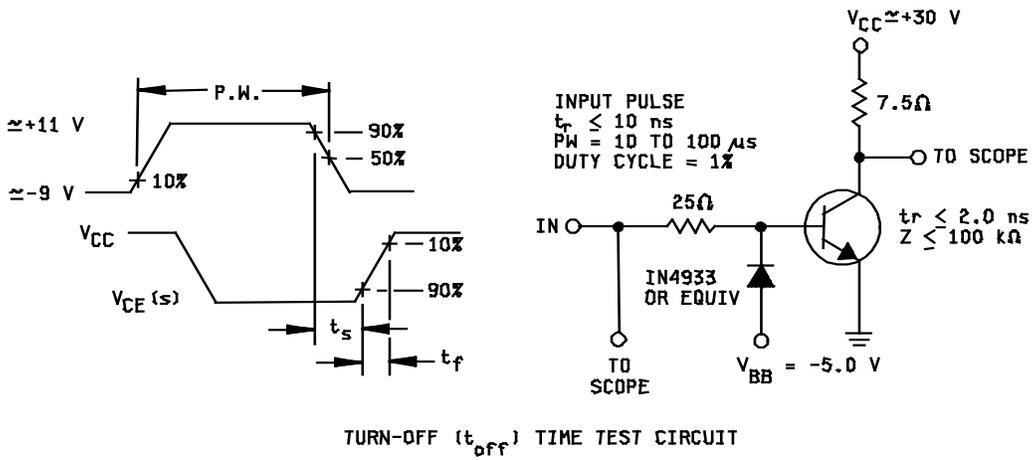
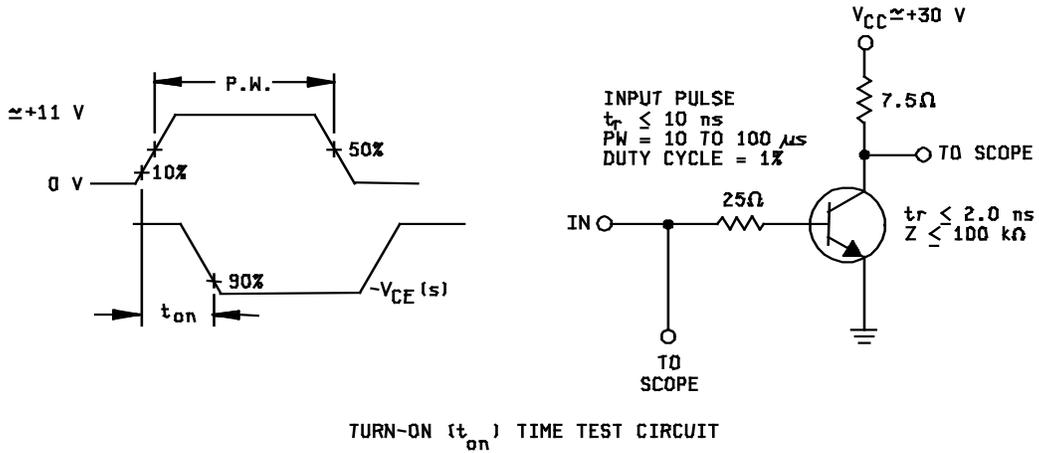
5/ This test required for the following end-point measurements only:

- * Group B, steps 2 and 3.
- Group C, subgroup 2.
- Group E, subgroup 1.

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

Inspection			Sample plan
	Method	Conditions	
<u>Subgroup 1</u>			45 devices c = 0
Temperature cycling	1051	500 cycles	
Hermetic seal	1071		
Fine leak			
Gross leak			
Electrical measurements		Table I, subgroup 2	
<u>Subgroup 2</u>			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	
<u>Subgroup 4</u>			Sample size N/A
Thermal impedance curves		See MIL-PRF-19500.	
<u>Subgroup 8</u>			45 devices c = 0
Reverse stability	1033	Condition B	



$$t_s + t_f = t_{off}$$

FIGURE 2. Switching time test circuits.

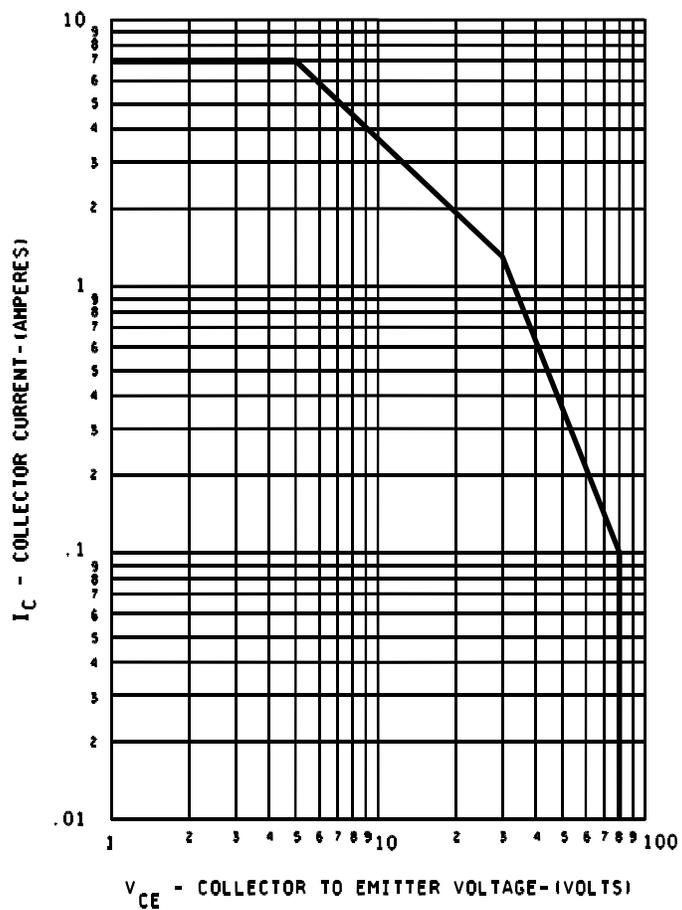


FIGURE 3. Maximum safe operating graph (continuous dc).

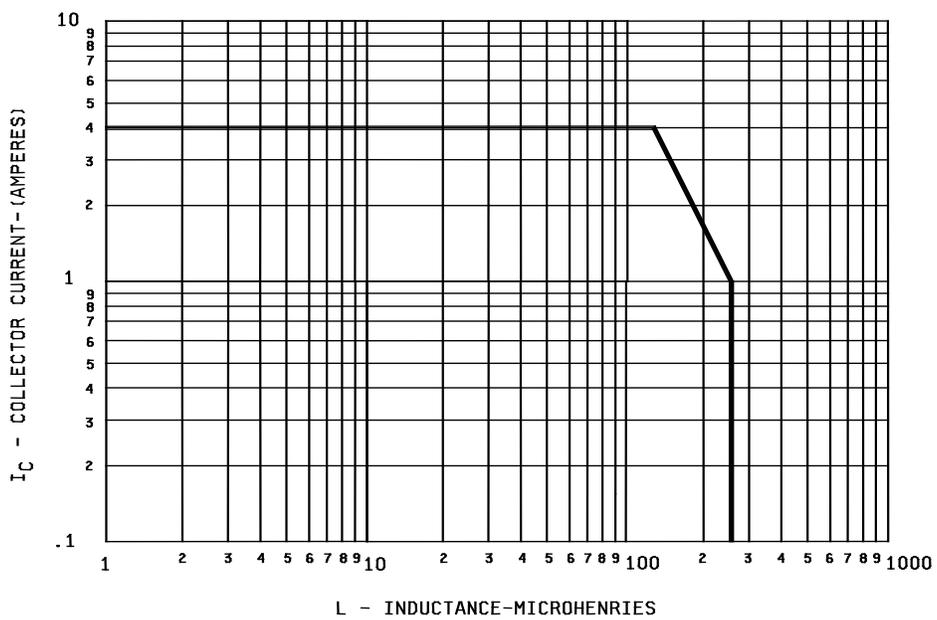


FIGURE 4. Safe operating area for switching between saturation and cutoff (unclamped load).

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 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:
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 Navy - EC
 Air Force - 85
 NASA - NA
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Preparing activity:
 DLA - CC
 (Project 5961-2012-052)

Review activity:
 Army - AV
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