

The documentation and process conversion measures necessary to comply with this document shall be completed by 30 April 2014.

INCH-POUND

MIL-PRF-19500/439H
 30 January 2014
 SUPERSEDING
 MIL-PRF-19500/439G
 17 February 2012

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, HIGH-POWER,
 TYPES 2N5038 AND 2N5039, JAN, JANTX, JANTXV, JANS, JANHC, AND JANKC

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](#).

1.1 Scope. This specification covers the performance requirements for NPN silicon, high-power transistors for use in high-speed power-switching applications. Four levels of product assurance are provided for each encapsulated device type as specified in [MIL-PRF-19500](#), and two levels of product assurance are provided for each unencapsulated device type.

1.2 Physical dimensions. See [figure 1](#) (TO-3) and [figure 2](#) (JANHC and JANKC).

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

	P_T (1) at $T_C = +25^\circ\text{C}$	V_{CBO}	V_{CEO}	V_{EBO}	I_B	I_C	T_J and T_{STG}
	<u>W</u>	<u>V dc</u>	<u>V dc</u>	<u>V dc</u>	<u>V dc</u>	<u>A dc</u>	<u>°C</u>
2N5038	140	150	90	7.0	5	20	-65 to +200
2N5039	140	125	75	7.0	5	20	-65 to +200

(1) Derate linearly 800 mW/°C for $T_A > +25^\circ\text{C}$, see [figure 3](#).

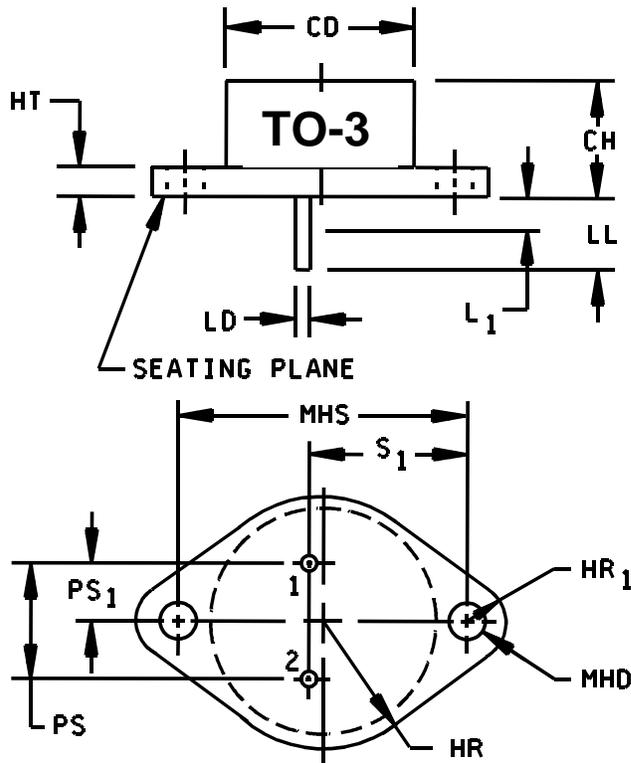
1.4 Primary electrical characteristics at $T_A = +25^\circ\text{C}$.

Limit	h_{FE3} (1) $V_{CE} = 5.0\text{ V dc}$ $I_C = 12\text{ A dc}$ (2N5038) $I_C = 10\text{ A dc}$ (2N5039)	$ h_{fe} $ $V_{CE} = 10\text{ Vdc}$ $I_C = 2.0\text{ A dc}$ $f = 5\text{ MHz}$	$V_{CE(sat)1}$ (1) $I_C = 12\text{ A dc}$ $I_B = 1.2\text{ A dc}$ (2N5038) $I_C = 10\text{ A dc}$ $I_B = 1.0\text{ A dc}$ (2N5039)	C_{obo} $V_{CB} = 10\text{ V dc}$ $I_E = 0$ $100\text{ kHz} \leq f \leq 1\text{ MHz}$	Pulse Response		$R_{\theta JC}$ (2)
					t_{on}	t_{off}	
Min	15	12	<u>V dc</u>	<u>pF</u>	<u>µs</u>	<u>µs</u>	<u>°C/W</u>
Max		48	1.0	500	0.5	2.0	1.25

(1) Pulsed (see [4.5.1](#)).

(2) See [figure 4](#) for thermal impedance curve.

* 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>.

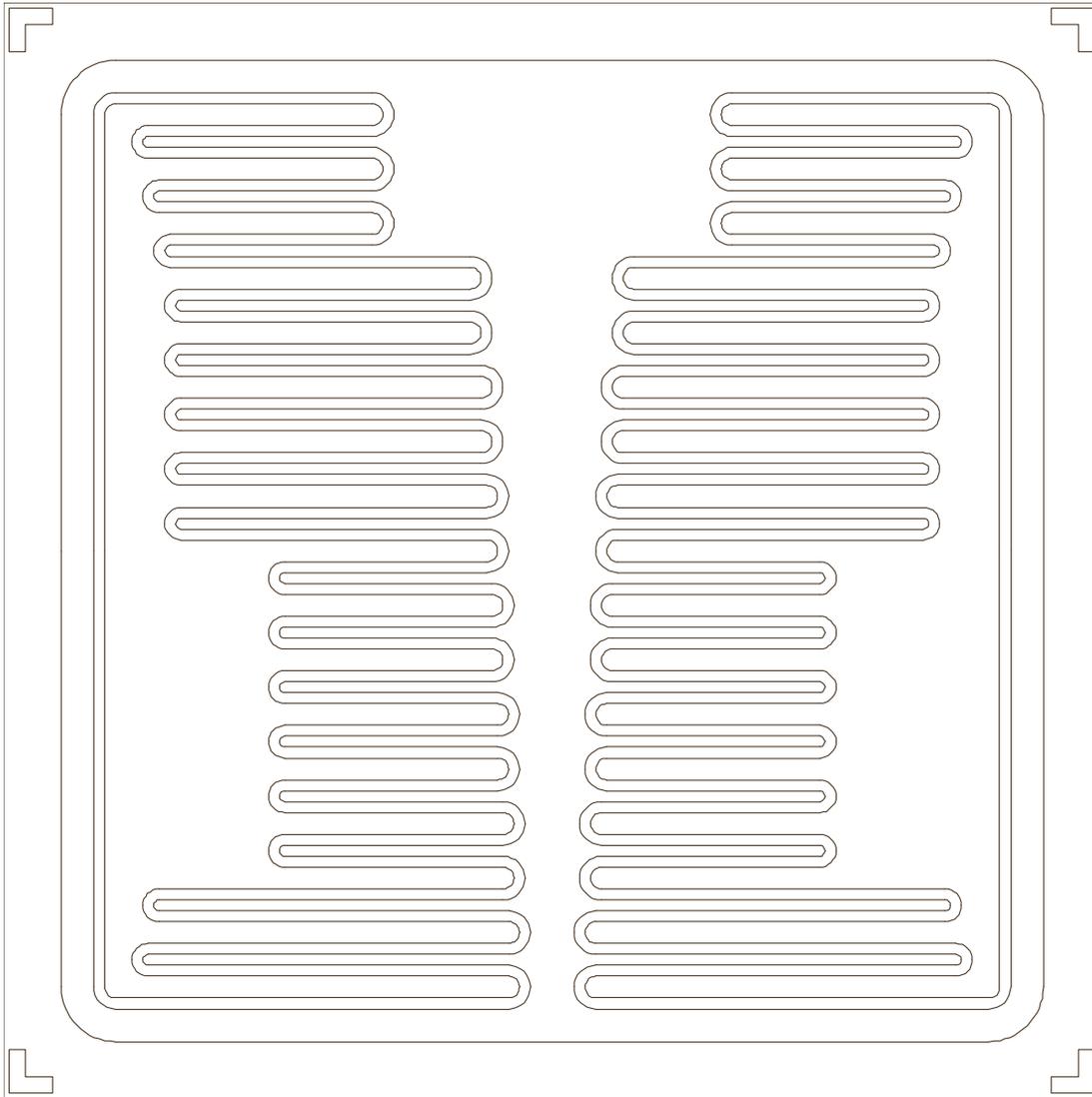


Symbol	Dimension				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD		.875		22.22	
CH	.270	.380	6.86	9.65	
HR	.495	.525	12.57	13.33	4
HR ₁	.131	.188	3.33	4.78	4
HT	.060	.135	1.52	3.43	
LD	.038	.053	0.97	1.35	4, 6
LL	.312	.500	7.92	12.70	
L ₁		.050		1.27	6
MHD	.151	.165	3.84	4.19	4
MHS	1.177	1.197	29.90	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. Dimensions are in inches.
2. Millimeters are given for general information only.
3. These dimensions should be measured at points .050 - .055 inch (1.27 mm - 1.40 mm) below seating plane. When gauge is not used, measurement will be made at seating plane.
4. Two places.
5. The seating plane of the header shall be flat within .001 inch (0.03 mm) 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 L₁.
7. Terminal 1 is emitter; terminal 2 is base; case is collector.

FIGURE 1. Physical dimensions, (TO-3).



NOTES:

1. Chip size: .200 X .200 inch (5.08 mm) \pm .003 inch (0.08 mm).
2. Chip thickness: .015 inch (0.38 mm).
3. Top metal: Aluminum 30,000 Å min, 33,000 Å nominal.
4. Back metal: AlTiNiAu for solder mount 5,000Å/2,000Å/7,000Å/5,000 Ang
or
Al/Ti/Ni/Ag 15,000/5,000/10,000/10,000.
5. Backside: Collector.
6. Bonding pad:
B = .027 inch (0.69 mm) X .053 inch (1.35mm) \pm .002 inch (0.05 mm).
E = .023 inch (0.58 mm) X .059 inch (1.50 mm) \pm .002 inch (0.05 mm).

FIGURE 2. JANHC and JANKC (A-version die dimensions).

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.

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) and [figure 2](#) (die).

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](#) herein.

3.7 Electrical test requirements. The electrical test requirements shall be the subgroups 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).

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 require 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.

4.2.2 JANHC and JANKC qualification. JANHC and JANKC qualification inspection shall be in accordance with MIL-PRF-19500.

4.3 Screening (JANS, JANTXV and JANTX levels). Screening shall be in accordance with table E-IV of MIL-PRF19500 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	
	JANS	JANTX and JANTXV levels
3c (1)	Thermal impedance (see 4.3.3)	Thermal impedance (see 4.3.3)
9	I_{CEX1} , h_{FE2} , and h_{FE3}	I_{CEX1}
11	I_{CEX1} , h_{FE2} , and h_{FE3} ; ΔI_{CEX1} = 100 percent of initial value or 1 μ A dc, whichever is greater; Δh_{FE3} = ± 20 percent of the initial value.	I_{CEX1} , h_{FE2} , and h_{FE3} ; ΔI_{CEX1} = 100 percent of initial value or 1 μ A dc, whichever is greater.
12	See 4.3.1	See 4.3.1
13 (2)	Subgroup 2 and 3 of table I herein; ΔI_{CEX1} = 100 percent of initial value or 1 μ A dc, whichever is greater; Δh_{FE3} = ± 20 percent of initial value.	Subgroup 2 of table I herein; ΔI_{CEX1} = 100 percent of initial value or 1 μ A dc, whichever is greater; Δh_{FE3} = ± 20 percent of initial value.

- (1) Shall be performed anytime after temperature cycling, screen 3a. JANTX and JANTXV levels do not need to be repeated in screening requirements.

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4.3.1 Power burn-in conditions. Power burn-in conditions are as follows: $T_J = +187.5^\circ\text{C} \pm 12.5^\circ\text{C}$; $V_{CB} = 60\text{ V dc} \pm 5\text{ V dc}$; $T_A \leq +100^\circ\text{C}$.

4.3.2 Screening (JANHC and JANKC). Screening of JANHC and JANKC die shall be in accordance with [MIL-PRF-19500](#).

4.3.3 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 [figure 4](#) and [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.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-Via (JANS) and table E-VIB (JANTX, and JANTXV) of [MIL-PRF-19500](#) and as follows. Electrical measurements (end-points) shall be in accordance with [table I](#), subgroup 2 herein. Delta requirement shall be in accordance with [4.5.3](#) herein.

* 4.4.2.1 Group B inspection, table E-VIA (JANS) of [MIL-PRF-19500](#).

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
* B3	2037	Test condition D.
* B4	1037	$V_{CB} = 10\text{ V dc}$; ΔT_J between cycles $\geq +100^\circ\text{C}$; $T_{on} = T_{off} \geq 1\text{ minute}$.
B5	1027	$V_{CE} \geq 20\text{ V dc}$; $P_T = 80\text{ W}$ at $T_C = +100^\circ\text{C}$ or adjusted as required by the chosen T_C to give an average lot $T_J = +225^\circ\text{C}$.
B6	3131	See 4.5.2 .
B7	3053	Load condition C; (unclamped inductive load) (see figure 5); $T_C = +25^\circ\text{C}$; duty cycle ≤ 10 percent; $R_S = 0.1\Omega$; $t_r = t_p \leq 500\text{ns}$, for qualification and large lot QCI, sample size = 22, c = 0; for small lot QCI, sample size = 6, c = 0.
*		TEST 1: $t_p = 5\text{ ms}$ (vary to obtain I_C); $R_{BB1} = 2\Omega$; $V_{BB1} = 10\text{ V dc}$ minimum; $R_{BB2} = 20\Omega$; $V_{BB2} = 4\text{ V dc}$; $V_{CC} = 10\text{ V dc}$; $I_C = 20\text{ A}$; $L = 70\ \mu\text{H}$, 0.1Ω .
*		TEST 2: $t_p = 5\text{ ms}$ (vary to obtain I_C); $R_{BB1} = 40\Omega$; $V_{BB1} = 10\text{ V dc}$ minimum; $R_{BB2} = 20\Omega$; $V_{BB2} = 4\text{ V dc}$; $V_{CC} = 10\text{ V dc}$; $I_C = 4.5\text{ A}$; $L = 500\ \mu\text{H}$, 0.1Ω .

* 4.4.2.2 Group B inspection, table E-VIB (JAN, JANTX, and JANTXV). Electrical end-points shall be in accordance with [table I](#), subgroup 2, and [4.5.3](#) herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
* B3	2037	Test condition D
B3	1037	2,000 cycles; $V_{CB} = 10$ V dc; ΔT_J between cycles $\geq +100^\circ\text{C}$; $t_{on} = t_{off} \geq 1$ minute
B5	3131	See 4.5.2 , $R_{\theta JC}$ shall be 1.25°C/W .
B7	3053	Load condition C; (unclamped inductive load) (see figure 5); $T_C = +25^\circ\text{C}$; duty cycle ≤ 10 percent; $R_S = 0.1\Omega$; $t_r = t_p \leq 500$ ns, for qualification and large lot QCI, sample size = 22, c = 0; for small lot QCI, sample size = 6, c = 0.
*		TEST 1: $t_p = 5$ ms (vary to obtain I_C); $R_{BB1} = 2\Omega$; $V_{BB1} = 10$ V dc minimum; $R_{BB2} = 20\Omega$; $V_{BB2} = 4$ V dc; $V_{CC} = 10$ V dc; $I_C = 20$ A; $L = 70$ μH , 0.1Ω .
*		TEST 2: $t_p = 5$ ms (vary to obtain I_C); $R_{BB1} = 40\Omega$; $V_{BB1} = 10$ V dc minimum; $R_{BB2} = 20\Omega$; $V_{BB2} = 4$ V dc; $V_{CC} = 10$ V dc; $I_C = 4.5$ A; $L = 500$ μH , 0.1Ω .

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) and delta requirements shall be in accordance with [table I](#), subgroup 2. Delta requirements shall be in accordance with [4.5.3](#) herein.

4.4.3.1 Group C inspection, table E-VII of [MIL-PRF-19500](#).

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	1056	Test condition B.
C2	2036	Test condition A, weight = 10 lbs., t = 15 s.
C6	1037	6,000 cycles; $V_{CB} = 10$ V dc; ΔT_J between cycles $\geq +100^\circ\text{C}$; $t_{on} = t_{off} \geq 1$ minute.

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the tests and conditions specified for subgroup testing in table E-IX of [MIL-PRF-19500](#), and [table II](#) herein. Electrical measurements (end-points) and delta measurements shall be in accordance with [table I](#), subgroup 2 herein and [4.5.3](#) 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.

4.5.2 Thermal resistance. The thermal resistance 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 [figure 4](#) and [table II](#), group E, subgroup 4 herein.

4.5.3 Delta requirements. Delta requirements shall be as specified below:

Step	Inspection (1) (2) (3) (4)	MIL-STD-750		Symbol	Limit		Unit
		Method	Conditions		Min	Max	
1	Collector to emitter voltage (saturated) 2N5038 2N5039	3071	$I_C = 12$ A dc, $I_B = 1.2$ A dc $I_C = 10$ A dc, $I_B = 1.0$ A dc	$\Delta V_{CE(sat)1}$	50 mV dc change from initial value.		
2	Collector to emitter cutoff current 2N5038 2N5039	3041	Bias condition A; $V_{BE} = -1.5$ V dc $V_{CE} = 100$ V dc $V_{CE} = 85$ V dc	ΔI_{CEX1}	100 percent of initial value or 1 μ A dc, whichever is greater.		
3	Forward-current transfer ratio 2N5038 2N5039	3076	$V_{CE} = 5.0$ V dc; $I_C = 12$ A dc $I_C = 10$ A dc	Δh_{FE3}	± 25 percent change from initial value.		

- (1) Devices which exceeded the [table I](#) limits, herein, for this test shall not be acceptable.
- (2) The electrical measurements for table E-VIA (JANS) of [MIL-PRF-19500](#) are as follows:
 - a. Subgroup 4, see step 1 above.
 - b. Subgroup 5, see steps 1, 2, and 3 above.
- (3) The electrical measurements for table E-VIB, (JAN, JANTX and JANTXV) of [MIL-PRF-19500](#) are as follows: Subgroups 3 and 6, see steps 1, 2 and 3 above.
- (4) The electrical measurements for table E-VII of [MIL-PRF-19500](#) are as follows: Subgroup 6, see steps 1, 2, and 3 (JANS) above and step 3 (JAN, JANTX, and JANTXV) above.

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* TABLE I. Group A inspection.

Inspection 1/ Method	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical examination	2071					
<u>Subgroup 2</u>						
Thermal impedance 2/	3131	See 4.3.3	Z _{ΘJX}			°C/W
Breakdown voltage, collector to emitter	3011	Bias condition D, I _C = 200 mA dc, pulsed (see 4.5.1)	V _{(BR)CEO}	90 75		V dc V dc
Collector-emitter cutoff current	3041	Bias condition D	I _{CEO}		1 1	μA dc μA dc
Emitter to base cutoff current	3061	Bias condition D, V _{EB} = 5.0 V dc	I _{EBO}		100	μA dc
Collector-emitter cutoff current	3041	Bias condition A, V _{BE} = -1.5 V dc	I _{CEX1}		5 5	μA dc μA dc
Collector to base cutoff current	3036	Bias condition D	I _{CBO}		1 1	μA dc μA dc
Breakdown voltage, emitter to base	3026	Bias condition D, I _E = 25 mA dc	V _{(BR)EBO}	7.0		V dc
Base to emitter voltage (nonsaturated)	3066	Test condition B, V _{CE} = 5 V dc; pulsed (see 4.5.1)	V _{BE}		1.8 1.8	V dc V dc
Base to emitter voltage (saturated)	3066	Test condition A, I _C = 20 A dc; I _B = 5 A dc	V _{BE(sat)}		3.3	V dc
Collector to emitter voltage (saturated)	3071	Pulsed (see 4.5.1)	V _{CE(sat)1}		1.0 1.0	V dc V dc

See footnote at end of table.

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* TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u> - Continued						
Collector to emitter voltage (saturated)	3071	$I_C = 20 \text{ A dc}$, $I_B = 5.0 \text{ A dc}$; pulsed (see 4.5.1)	$V_{CE(sat)2}$		2.5	V dc
Forward-current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}$; $I_C = 0.5 \text{ A dc}$; pulsed (see 4.5.1)	h_{FE1}			
2N5038 2N5039				50 30		
Forward current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}$; $I_C = 2.0 \text{ A dc}$; pulsed (see 4.5.1)	h_{FE2}			
2N5038 2N5039				50 30	200 150	
Forward current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}$; pulsed (see 4.5.1)	h_{FE3}			
2N5038 2N5039		$I_C = 12 \text{ A dc}$ $I_C = 10 \text{ A dc}$		15 15		
<u>Subgroup 3</u>						
High temperature operation:		$T_A = +150^\circ\text{C}$				
Collector to emitter cutoff current	3041	Bias condition A, $V_{BE} = -1.5 \text{ V dc}$	I_{CEX2}			
2N5038 2N5039		$V_{CE} = 100 \text{ V dc}$ $V_{CE} = 85 \text{ V dc}$			100 100	$\mu\text{A dc}$ $\mu\text{A dc}$
Low temperature operation:		$T_A = -55^\circ\text{C}$				
Forward-current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}$; pulsed (see 4.5.1),	h_{FE4}			
2N5038 2N5039		$I_C = 12 \text{ A dc}$ $I_C = 10 \text{ A dc}$		10 10		
<u>Subgroup 4</u>						
Magnitude small-signal short-circuit forward-current transfer ratio	3306	$V_{CE} = 10 \text{ V dc}$; $I_C = 2 \text{ A dc}$; $f = 5 \text{ MHz}$	$ h_{FE} $	12	48	
Open circuit output capacitance	3236	$V_{CB} = 10 \text{ V dc}$; $I_E = 0 \text{ A dc}$; $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	C_{obo}		500	pF

See footnote at end of table.

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* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4</u> - Continued						
Pulse response transfer ratio	3251	Test condition A except test circuit and pulse requirements in accordance with figure 6 herein.	t_{on}			
Turn on time				$V_{CC} = 30$ V dc		
2N5038		$I_C = 12$ A dc, $I_{B1} = 1.2$ A dc			0.5	μ S
2N5039		$I_C = 10$ A dc, $I_{B1} = 1.0$ A dc			0.5	μ S
Turn off time		$V_{CC} = 30$ V dc	t_{off}			
2N5038		$I_C = 12$ A dc, $I_{B1} = -I_{B2} = 1.2$ A dc			2.0	μ S
2N5039		$I_C = 10$ A dc, $I_{B1} = -I_{B2} = 1$ A dc			2.0	μ S
<u>Subgroup 5</u>						
Safe operating area (dc operation)	3051	$T_C = +25^\circ\text{C}$, $t = 1$ s, 1 cycle, see figure 7				
Test 1			$I_C = 5$ A dc, $V_{CE} = 28$ V dc			
Test 2			$I_C = 0.9$ A dc, $V_{CE} = 45$ V dc			
Test 3			$I_C = 20$ A dc, $V_{CE} = 7.0$ V dc			
Test 4 (2N5038 only)			$I_C = 0.23$ A dc, $V_{CE} = 90$ V dc			
Test 5 (2N5039 only)			$I_C = 0.32$ A dc, $V_{CE} = 75$ V dc			
* Safe operating area (clamped switching)	3053	Condition B, $T_C = +25^\circ\text{C}$, $I_C = 20$ A dc; (see figures 8 and 9)				
2N5038 2N5039			Clamp voltage = 90 V dc Clamp voltage = 75 V dc (Device fails if clamp voltage is not reached)			
Electrical measurements		See 4.5.3 , steps 1 and 3				
<u>Subgroup 6 and 7</u>						
Not applicable						

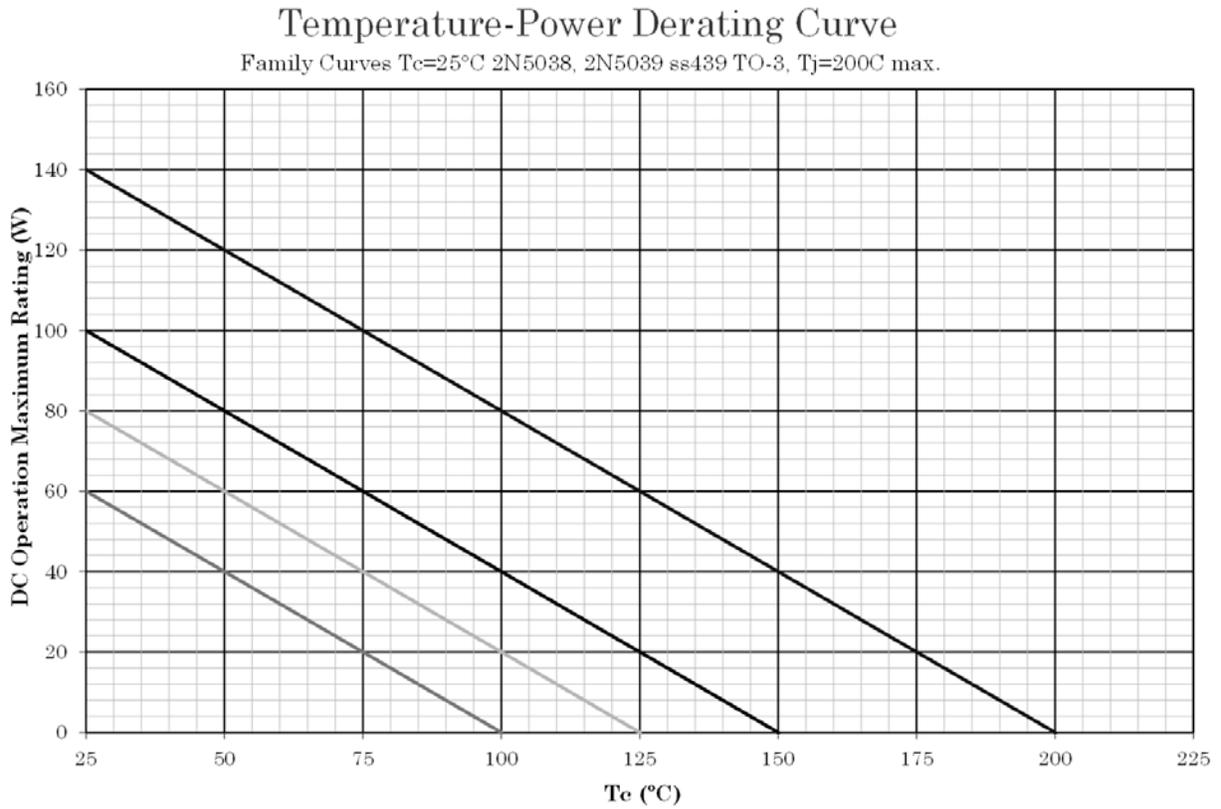
1/ For sampling plan, see MIL-PRF-19500.

2/ This test required for the following end-point measurements only:
Group B, subgroups 3, 4, and 5 (JANS).
Group B, subgroups 2 and 3 (JAN, JANTX, and JANTXV).
Group C, subgroup 2 and 6.
Group E, subgroup 1.

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

Inspection	MIL-STD-750		Qualification conformance inspection
	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 and 4.5.3 herein. See steps 1, 2 and 3	
<u>Subgroup 2</u>			45 devices c = 0
High temperature reverse bias	1039	Condition A; 1,000 hours	
Electrical measurements		Table I , subgroup 2 and 4.5.3 herein. See step 2.	
<u>Subgroup 3</u>			
Not applicable			
<u>Subgroup 4</u>			
Thermal impedance curves		See MIL-PRF-19500 .	
<u>Subgroup 5</u>			
Not applicable			
<u>Subgroup 8</u>			45 devices c = 0
Reverse stability	1033	Condition B	

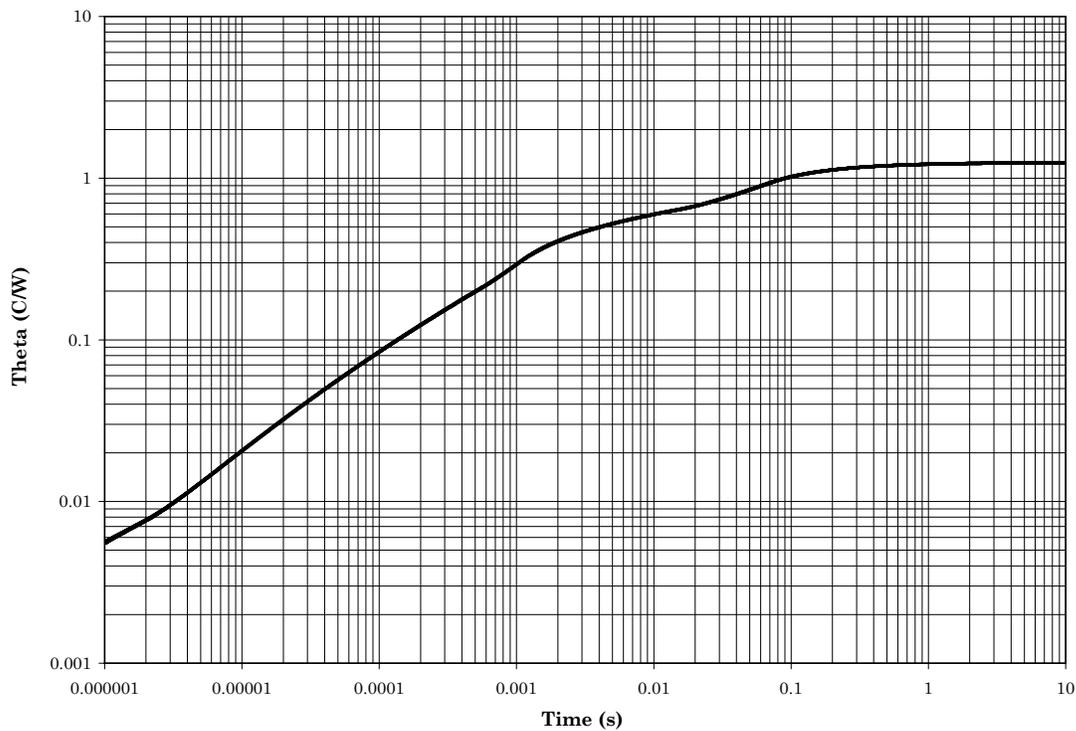


NOTES:

1. This is the true inverse of the worst case thermal resistance value. All devices are capable of operating at $\leq T_J$ specified on this curve. Any parallel line to this curve will intersect the appropriate power for the desired maximum T_J allowed.
2. Derate design curve constrained by the maximum junction temperature ($T_J \leq +200^\circ\text{C}$) and power/current rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq +150^\circ\text{C}$, where the maximum temperature of electrical test is performed.
4. Derate design curves chosen at $T_J \leq, +125^\circ\text{C}$, and $+110^\circ\text{C}$ to show power/current rating where most users want to limit T_J in their application.

FIGURE 3. Temperature-power derating graph.

**2N5038, 2N5039 $T_L = 25^\circ\text{C}$
Maximum Thermal Impedance Plots**



$R_{\theta JX} = 1.25^\circ\text{C/W}$
 $Z_{\theta JX} = 0.6^\circ\text{C/W}$ at 10ms
 $Z_{\theta JX} = 0.75^\circ\text{C/W}$ at 30ms

FIGURE 4. Thermal impedance.

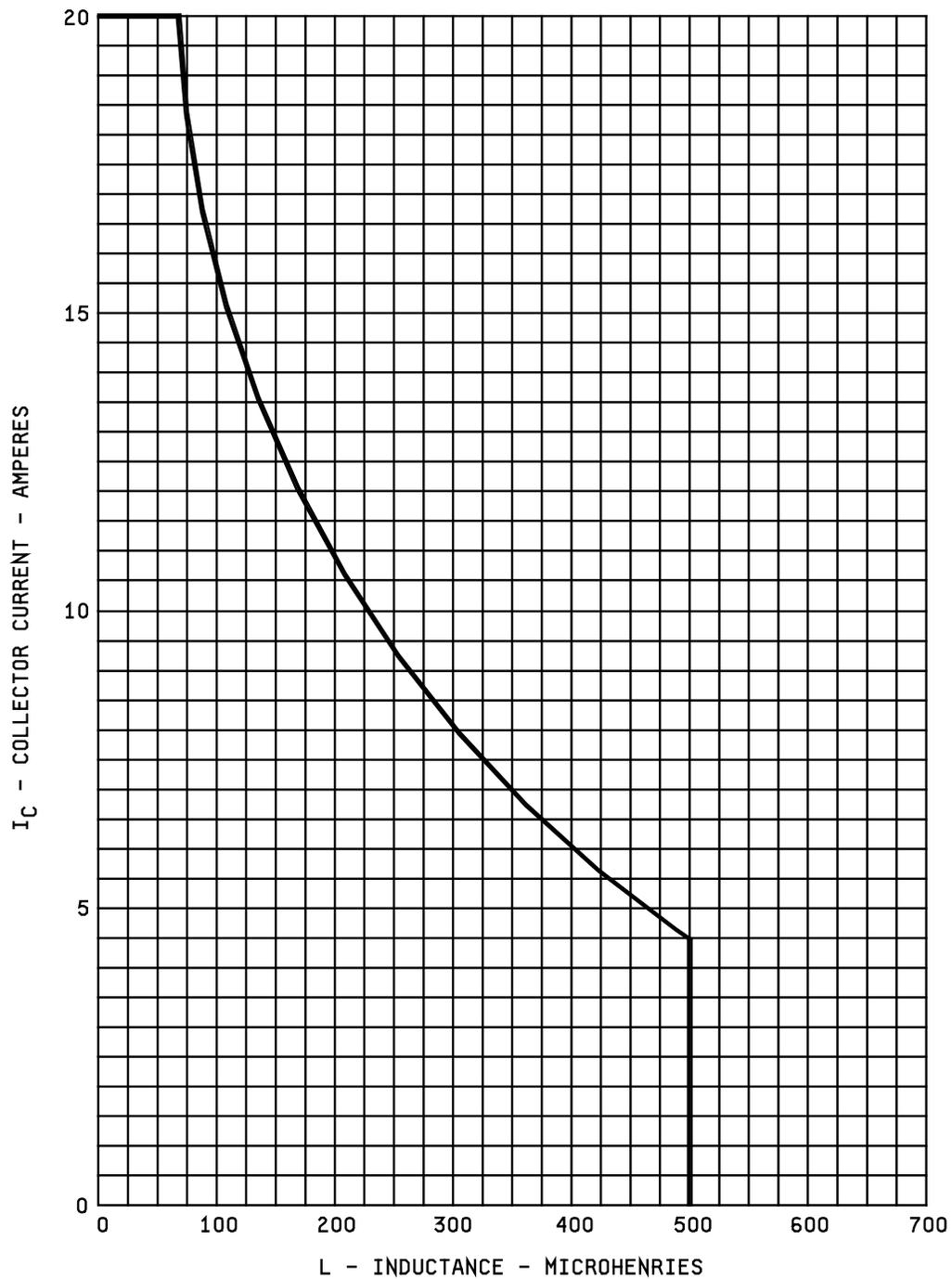


FIGURE 5. Safe operating area for switching between saturation and cutoff - unclamped inductive load.

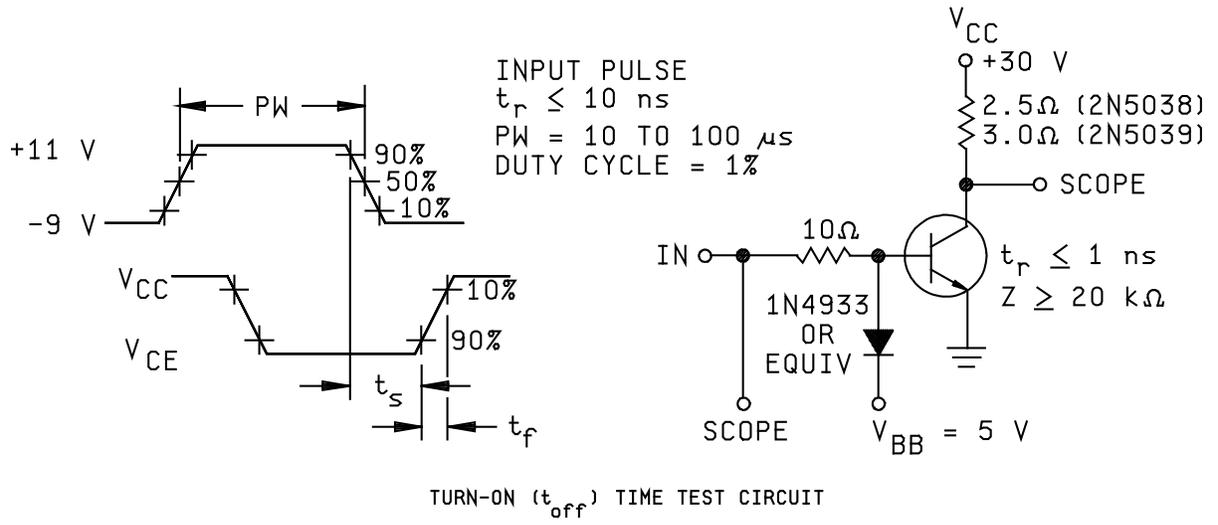
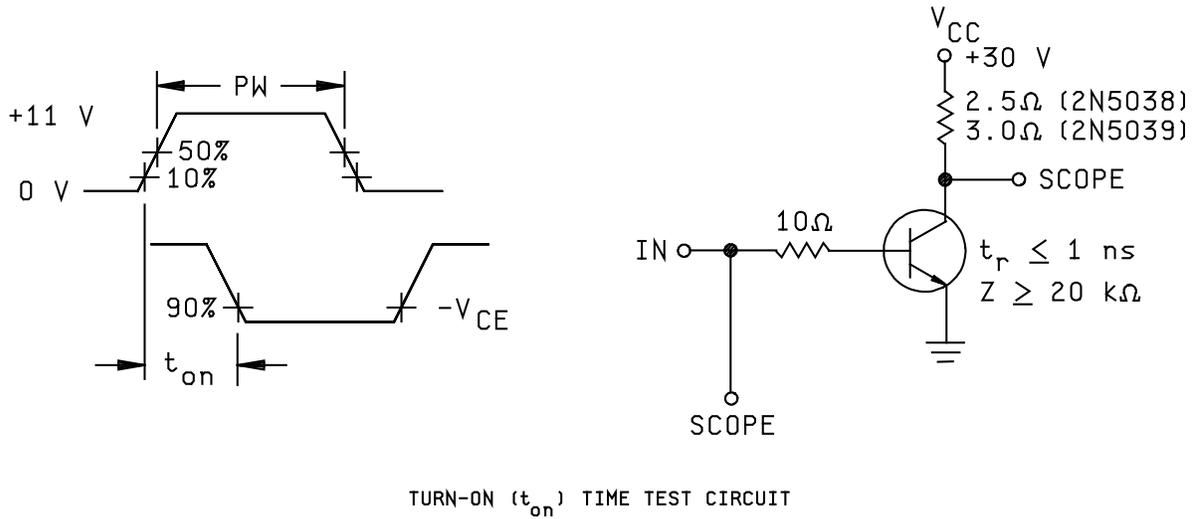


FIGURE 6. Switching time test circuits.

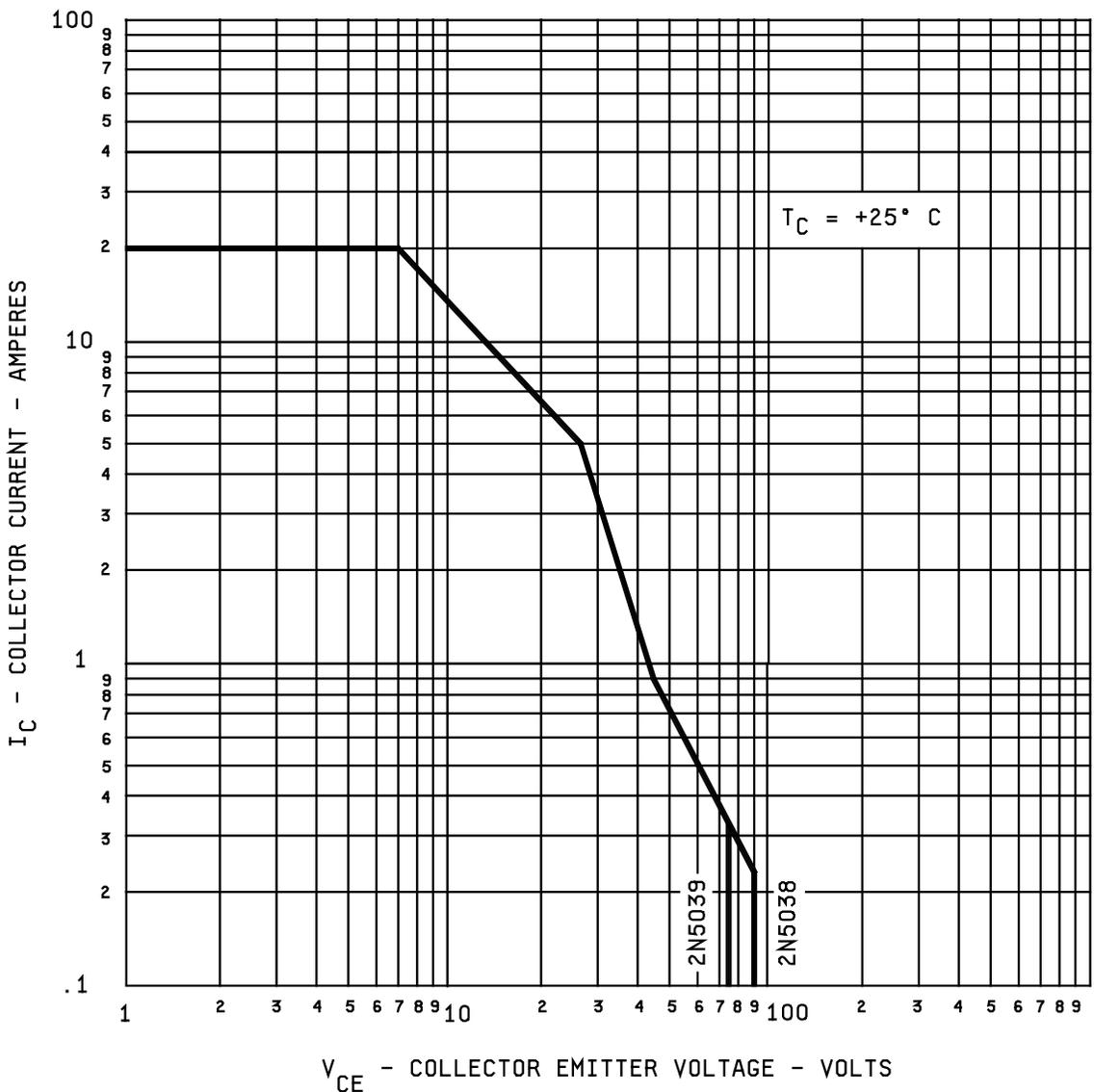


FIGURE 7. Maximum safe operating area graph (continuous dc).

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 Suppliers of JANHC and JANKC die. The qualified JANHC and JANKC suppliers with the applicable letter version (example JANHCA2N5038) will be identified on the QML.

Die ordering information	
PIN	Manufacturer
	43611
2N5038 2N5039	JANHCA2N5038 JANHCA2N5039
2N5038 2N5039	JANKCA2N5038 JANKCA2N5039

6.5 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 5961-2014-039)

Review activities:

Army - MI, SM
Navy - AS, MC
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.dla.mil>.