

The documentation and process conversion measures necessary to comply with this revision shall be completed by 6 June 2002.

INCH-POUND

MIL-PRF-19500/560E  
6 March 2002  
SUPERSEDING  
MIL-PRF-19500/560D  
3 January 2001

## PERFORMANCE SPECIFICATION

### SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, SWITCHING TYPE 2N5339 AND 2N5339U3 JAN, JANTX, JANTXV, JANS, JANHC AND JANKC

This specification is approved for use by all Departments and Agencies of the Department of Defense.

#### 1. SCOPE

1.1 Scope. This specification covers the performance requirements for NPN silicon switching transistors. 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 as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (TO-39), figures 2, 3, and 4 for JANHC and JANKC (die) and figure 5 for U3 devices (TO-276AA) dimensions.

#### 1.3 Maximum ratings.

Types	$P_T$ (1) $T_A = +25^\circ\text{C}$	$P_T$ (2) $T_C = +25^\circ\text{C}$	$V_{CBO}$	$V_{CEO}$	$V_{EBO}$	$I_C$	$I_B$	$T_{OP}$ and $T_{STG}$	$R_{\theta JC}$
	<u>W</u>	<u>W</u>	<u>V dc</u>	<u>V dc</u>	<u>V dc</u>	<u>A dc</u>	<u>A dc</u>	<u>°C</u>	<u>°C/W</u>
2N5339	1.0		100	100	6.0	5.0	1.0	-65 to +200	17.5
2N5339U3	1.0	100	100	100	6.0	5.0	1.0	-65 to +200	12.5

(1) Derate linearly at 5.71 mW/°C above  $T_A > +25^\circ\text{C}$ .

(2) Derate linearly from 80 mW/°C to 571 mW/°C.

#### 1.4 Primary electrical characteristics $T_A = +25^\circ\text{C}$ . (Unless otherwise indicated, applies to all devices.)

Limits	$h_{FE1}$ (1) $V_{CE} = 2.0 \text{ V dc}; I_C = 0.5 \text{ A dc}$	$h_{FE2}$ (1) $V_{CE} = 2.0 \text{ V dc}; I_C = 2.0 \text{ A dc}$	$h_{FE3}$ (1) $V_{CE} = 2.0 \text{ V dc}; I_C = 5.0 \text{ A dc}$
Min	60	60	40
Max		240	

(1) Pulsed (see 4.5.1).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

1.4 Primary electrical characteristics  $T_A = +25^\circ\text{C}$ . (Unless otherwise indicated, applies to all devices.) - Continued.

Limits	$ h_{FE} $  $f = 10 \text{ MHz}$ $V_{CE} = 10 \text{ V dc}$ $I_C = 0.5 \text{ A dc}$	$C_{obo}$  $V_{CE} = 10 \text{ V dc}$ $I_E = 0$ $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	Switching		$V_{CE(SAT)1}$  $I_C = 2.0 \text{ A dc}$ $I_B = 0.2 \text{ A dc}$ (1)	$V_{BE(SAT)1}$  $I_C = 2.0 \text{ A dc}$ $I_B = 0.2 \text{ A dc}$ (1)
			See figure 4 $t_{on}$	See figure 5 $t_{off}$		
		<u>pF</u>	<u><math>\mu\text{s}</math></u>	<u><math>\mu\text{s}</math></u>	<u>V dc</u>	<u>V dc</u>
Min	3.0					
Max	15.0	250	0.2	2.2	0.7	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 and 4 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 documents cited in sections 3 and 4 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 listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

## SPECIFICATION

## DEPARTMENT OF DEFENSE

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

## STANDARD

## DEPARTMENT OF DEFENSE

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. 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.

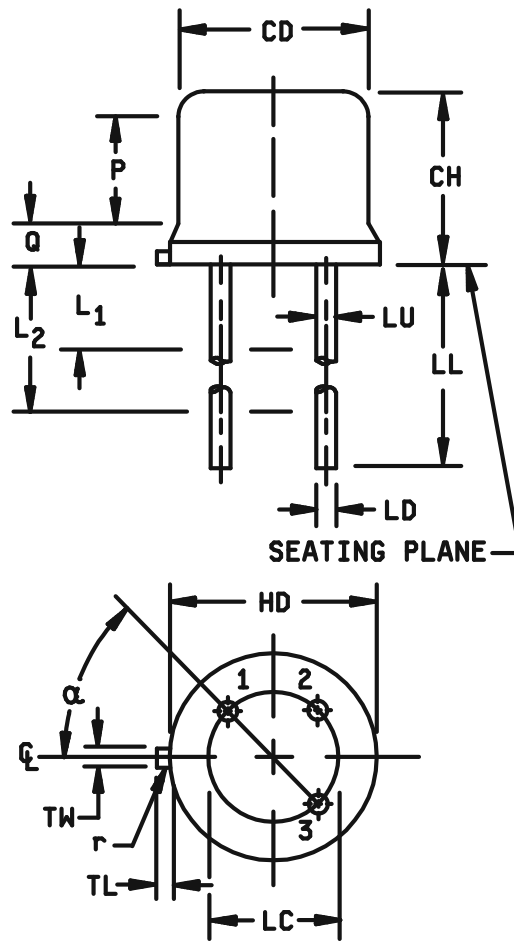


FIGURE 1. Physical dimensions (TO-39).

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	0.305	0.355	7.75	8.51	
CH	0.240	0.260	6.10	6.60	
HD	0.335	0.370	8.51	9.40	
LC	0.200 TP		5.08 TP		6
LD	0.016	0.021	0.41	0.53	7
LL	0.500	0.750	12.70	19.05	7
LU	0.016	0.019	0.41	0.48	7
L1		0.050		1.27	7
L2	0.250		6.35		7
TL	0.029	0.045	0.74	1.14	3
TW	0.028	0.034	0.71	0.86	10
P	0.100		2.54		5
Q		0.050		1.27	4
r		0.010		0.25	11
$\alpha$	45° TP		45° TP		6
Notes	1, 2, 8, 9		1, 2, 8, 9		

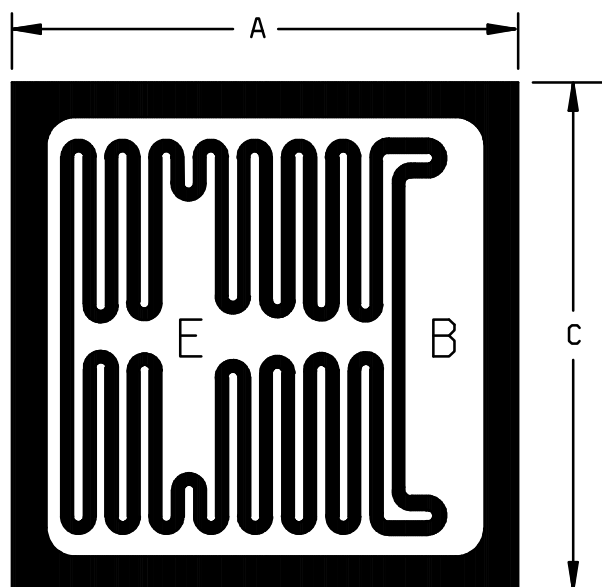
## NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Symbol TL is measured from HD maximum.
4. Details of outline in this zone are optional.
5. Symbol CD shall not vary more than 0.010 (0.25 mm) in zone P. This zone is controlled for automatic handling.
6. Leads at gauge plane 0.054 inch (1.37 mm) +0.001 inch (0.03 mm) -0.000 inch (0.00 mm) below seating plane shall be within 0.007 inch (0.18 mm) radius of true position (TP) relative to tab. Device may be measured by direct methods or by gauge.
7. Symbol LD applies between L1 and L2. Dimension LD applies between L2 and LL minimum.
8. Lead designation, depending on device type, shall be as follows:

Lead number	TO-39
1	Emitter
2	Base
3	Collector

9. Lead number three is electrically connected to case.
10. Beyond r maximum, TW shall be held for a minimum length of 0.011 inch (0.28 mm).
11. Symbol r applied to both inside corners of tab.

FIGURE 1. Physical dimensions (TO-39) - Continued.

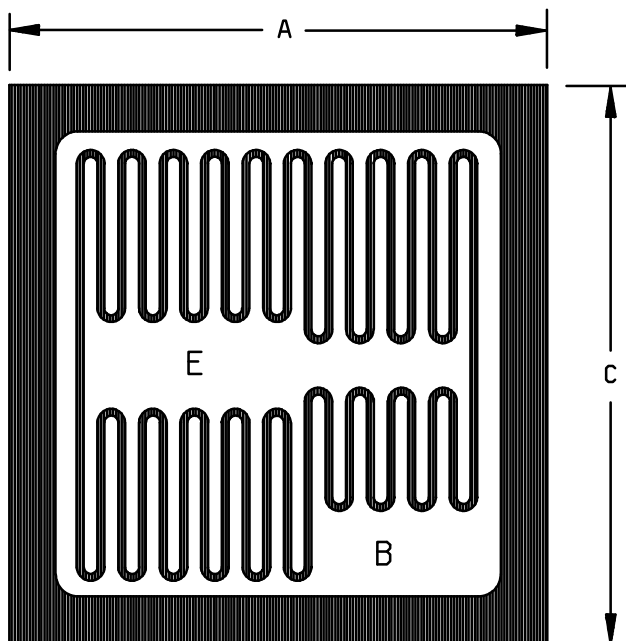


Letter	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	0.120	0.124	3.05	3.15
C	0.120	0.124	3.05	3.15

## NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. The physical characteristics of the die are:  
 Thickness: 0.008 inch (0.20 mm) to 0.012 inch (0.30 mm).  
 Top metal: Aluminum 40,000 Å minimum, 50,000 Å nominal.  
 Back metal: Gold 2,500 Å minimum, 3,000 Å nominal.  
 Back side: Collector.  
 Bonding pad: B = 0.015 inch (0.38 mm) x 0.072 inch (1.83 mm).  
 E = 0.015 inch (0.38 mm) x 0.060 inch (1.52 mm).
4. Unless otherwise specified, tolerance is  $\pm 0.005$  inch (0.13 mm).

FIGURE 2. Physical dimensions JANHCA and JANKCA.

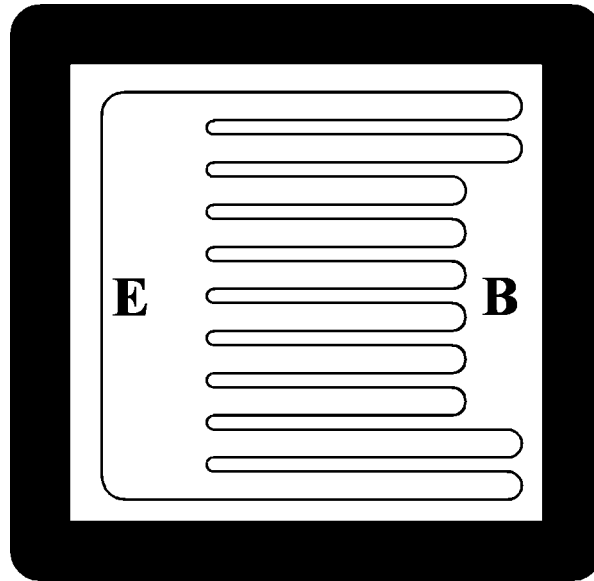


Letter	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	0.098	0.102	2.49	2.59
C	0.098	0.102	2.49	2.59

## NOTES:

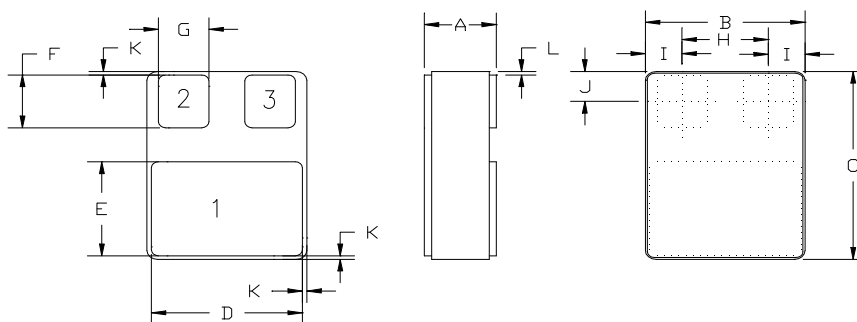
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. The physical characteristics of the die are:  
 Thickness: 0.006 inch (0.15 mm) to 0.010 inch (0.25 mm).  
 Top metal: Aluminum 25,000 Å minimum, 37,500 Å nominal.  
 Back metal: Gold 1,500 Å minimum, 6,500 Å nominal.  
 Back side: Collector.
4. Unless otherwise specified, tolerance is  $\pm 0.005$  inch (0.13 mm).

FIGURE 3. Physical dimensions JANHCB and JANKCB.



- |                   |  |
|-------------------|--|
| 1. Chip size      | 0.120 x 0.120 inches $\pm$ 2 inches  |
| 2. Chip thickness | 0.010 $\pm$ 0.0015 inches nominal  |
| 3. Top metal      | Aluminum 30,000Å minimum, 33,000Å nominal  |
| 4. Back metal     | A. Al/Ti/Ni/Ag 12kÅ/3kÅ/7kÅ/7kÅ minimum 15kÅ/5kÅ/10kÅ/10kÅ nominal.<br>B. Gold 2,500Å minimum, 3000Å nominal |
| 5. Backside       | Collector  |
| 6. Bonding pad    | B = 0.052 x 0.012 inches, E = 0.084 x 0.012 inches   |

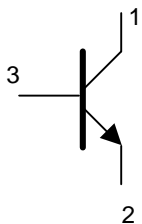
FIGURE 4. Physical dimensions JANHCC and JANKCC.

**BOTTOM VIEW**

Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	0.111	0.122	2.82	3.10
B	0.291	0.301	7.39	7.65
C	0.395	0.405	10.03	10.29
D	0.281	0.291	7.14	7.39
E	0.220	0.230	5.59	5.84
F	0.115	0.125	2.92	3.18
G	0.09	0.100	2.29	2.54
H	0.145	0.155	3.68	3.94
I	0.073 TYP.	-	1.85 TYP.	-
J	0.083 TYP.	-	2.11 TYP.	-
K	0.005 TYP.	-	0.13 TYP.	-
L	0.015 TYP.	-	0.38 TYP.	-

**NOTES:**

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.

**SCHEMATIC****FIGURE 5. Physical dimensions and configuration (U3) (SMD 5) (TO-276AA).**

### 3. REQUIREMENTS

3.1 General. The requirements for acquiring the product described herein shall consist of this document and MIL-PRF-19500.

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 manufacturer's list (QML) 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. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 (TO-39), figures 2, 3, and 4 (JANHC and JANKC) and figure 5 for U3 (TO-276AA) devices herein.

3.4.1 Lead finish. Unless otherwise specified, lead finish shall be solderable in accordance with in 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. Devices shall be marked in accordance with MIL-PRF-19500. At the option of the manufacturer, marking may be omitted from the body, but shall be retained on the initial container.

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, group A herein.

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 herein.

\* 4.2.1 JANHC and JANKC qualification. JANHC and JANKC qualification inspection shall be in accordance with MIL-PRF-19500.

4.3 Screening (JAN, JANTX, JANTXV and JANS levels only). Screening shall be in accordance with table 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 MIL-PRF-19500)	Measurements	
	JANS level	JANTX and JANTXV levels
* 3C	Thermal impedance method 3131 of MIL-STD-750.	Thermal impedance method 3131 of MIL-STD-750.
9	$I_{CBO1}$ and $h_{FE2}$	Not applicable
11	$I_{CBO1}$ ; $h_{FE2}$ , $\Delta I_{CBO1} = \pm 100$ percent of initial value or $1.0 \mu A$ dc, whichever is greater; $\Delta h_{FE2} = \pm 15$ percent	$I_{CBO1}$ and $h_{FE2}$
12	See 4.3.1	See 4.3.1
13	Subgroups 2 and 3 of table I herein; $\Delta I_{CBO1} = \pm 100$ percent of initial value or $1.0 \mu A$ dc, whichever is greater; $\Delta h_{FE2} = \pm 15$ percent	Subgroup 2 of table I herein; $\Delta I_{CBO1} = \pm 100$ percent of initial value or $1.0 \mu A$ dc, whichever is greater; $\Delta h_{FE2} = \pm 15$ percent.

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows:  $T_A$  = Room ambient as defined in the general requirements of 4.5 of MIL-STD-750. Power shall be applied to the device to achieve  $T_J$  = minimum  $175^\circ C$  and minimum power dissipation of  $P_D = 75$  percent  $P_T$  max as defined in 1.3.

\* 4.3.2 Screening for JANHC and JANKC. Screening for JANHC and JANKC die shall be in accordance with MIL-PRF-19500 Discrete Semiconductor Die/Chip Lot Acceptance. Burn-in duration for JANKC level follows JANS requirements; the JANHC follows JANTX requirements.

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 table V of MIL-PRF-19500 and table I herein. Electrical measurements (end-points) requirements shall be in accordance with group A, 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 VIa of MIL-PRF-19500 (JANS) and 4.4.2.1 herein. Electrical measurements (end-points) shall be in accordance with group A, subgroup 2 herein. See 4.4.2.2 herein and table VIb of MIL-PRF-19500 for JAN, JANTX, and JANTXV group B testing. Electrical measurements (end-points) requirements shall be in accordance with group A, subgroup 2 herein.

\* 4.4.2.1 Group B inspection, table VIa (JANS) of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
B4	1037	$V_{CB} \geq 10$ V dc.
B5	1027	(NOTE: If a failure occurs, resubmission shall be at the test conditions of the original sample.) $V_{CB} = 10$ V dc; $P_D \geq 100$ percent of rated $P_T$ (see 1.3).  Option 1: 96 hours minimum sample size in accordance with MIL-PRF-19500, table VIa, adjust $T_A$ or $P_D$ to achieve $T_J = +275^\circ\text{C}$ minimum.  Option 2: 216 hours minimum, sample size = 45, $c = 0$ ; adjust $T_A$ or $P_D$ to achieve $T_J = +225^\circ\text{C}$ minimum.
B5	2037	Test condition A.

4.4.2.2 Group B inspection, (JAN, JANTX, and JANTXV). 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.

<u>Step</u>	<u>Method</u>	<u>Condition</u>
* 1	1027	Steady-state life: Test condition B, 340 hours, $V_{CB} = 10 - 30$ V dc, power shall be applied to the device to achieve $T_J = +175^\circ\text{C}$ minimum, and minimum power dissipation of 75 percent of max rated $P_T$ (see 1.3 herein); $n = 45$ , $C = 0$ .
2	1027	The steady-state life test of step 1 shall be extended to 1,000 hours for each die design. Samples shall be selected from a wafer lot every twelve months of wafer production. Group B step 2 shall not be required more than once for any single wafer lot. $n = 45$ , $C = 0$ .
3	1032	High- temperature life (non-operating), $T_A = +200^\circ\text{C}$ , $t = 340$ hours, $n = 22$ , $C = 0$ .

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-PRF-19500, and herein. Electrical measurements (end-points) shall be in accordance with group A, subgroup 2 herein.

\* 4.4.3.1 Group C inspection, table VII of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition E.
C5	3131	See 4.5.3.
C6	1037	For solder die attach: $V_{CB} \geq 10$ V dc, $T_A$ = Room ambient as defined in the general requirements of MIL-STD-750. 6,000 cycles.
* C6	1027	For eutectic die attach: $V_{CB} \geq 10$ V dc, adjust $P_T$ to achieve $T_J = + 175^\circ\text{C}$ min.

\* 4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IX of MIL-PRF-19500, and herein. Electrical measurements (end-points) shall be in accordance with group A, subgroup 2 herein. Group E inspection shall be performed for qualification or re-qualification only. In case qualification was awarded to a prior revision of the spec sheet that did not request the performance of table II tests, the tests specified in table II herein must be performed to maintain qualification.

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 Input capacitance. This test shall be conducted in accordance with method 3240 of MIL-STD-750, except the output capacitor shall be omitted.

4.5.3 Thermal resistance (to be performed for qualification inspection only). The thermal resistance measurements shall be conducted in accordance with method 3131 of MIL-STD-750. The following details shall apply:

- Collector current magnitude during power application shall be 0.15 A dc.
- Collector to emitter voltage magnitude shall be 20 V dc.
- Reference temperature measuring point shall be the case.
- Reference point temperature shall be  $+ 25^\circ\text{C} \leq T_R \leq +35^\circ\text{C}$  and recorded before the test is started.
- Mounting arrangement shall be with heat sink to case.
- Maximum limit shall be  $R_{\theta JC} = 17.5^\circ\text{C/W}$  for TO-39 devices and  $R_{\theta JC} = 1.7.5^\circ\text{C/W}$  for U3 devices.

TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
* <u>Subgroup 1 2/</u>						
Visual and mechanical <u>3/</u> Examination	2071	n = 45 devices, c = 0				
Solderability <u>3/</u> , <u>4/</u>	2026	n = 15 leads, c = 0				
Resistance to solvents <u>3/</u> , <u>4/</u> , <u>5/</u>	1022	n = 15 devices, c = 0				
Temp Cycling <u>3/</u> , <u>4/</u>	1051	Test condition C, 25 cycles. n = 22 devices, c = 0				
Hermetic Seal <u>4/</u>	1071	n = 22 devices, c = 0				
Fine leak Gross leak						
Electrical measurements <u>4/</u>		Group A, subgroup 2				
Bond strength <u>3/</u> , <u>5/</u>	2037	Precondition T <sub>A</sub> = +250°C at t = 24 hrs or T <sub>A</sub> = +300°C at t = 2 hrs n = 11 wires, c = 0				
Decap internal visual (design verification)	2075	n = 4 device, c = 0				
<u>Subgroup 1</u>						
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Breakdown voltage, collector to emitter	3011	Bias condition D; I <sub>C</sub> = 50 mA dc; pulsed (see 4.5.1)	V <sub>(BR)CEO</sub>	100		V dc
Collector to emitter cutoff current	3041	Bias condition D; V <sub>CE</sub> = 100 V dc	I <sub>CEO</sub>		100	μA dc
Collector to emitter cutoff current	3041	Bias condition A; V <sub>BE</sub> = 1.5 V dc; V <sub>CE</sub> = 90 V dc	I <sub>CEX1</sub>		10	μA dc
Collector to base cutoff current	3036	Bias condition D; V <sub>CB</sub> = 100 V dc	I <sub>CBO</sub>		10	μA dc

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u> - continued						
Emitter to base, cutoff current	3061	Bias condition D; $V_{EB} = 6.0$ V dc	$I_{EBO}$		100	$\mu$ A dc
Forward - current transfer ratio	3076	$V_{CE} = 2.0$ V dc; $I_C = 0.5$ A dc, pulsed (see 4.5.1)	$h_{FE1}$	60		
Forward - current transfer ratio	3076	$V_{CE} = 2.0$ V dc; $I_C = 2.0$ A dc; pulsed (see 4.5.1)	$h_{FE2}$	60	240	
Forward - current transfer ratio	3076	$V_{CE} = 2.0$ V dc; $I_C = 5.0$ A dc; pulsed (see 4.5.1)	$h_{FE3}$	40		
Collector to emitter voltage (saturated)	3071	$I_C = 2.0$ A dc; $I_B = 0.2$ A dc; pulsed (see 4.5.1)	$V_{CE(SAT)1}$		0.7	V dc
Collector to emitter voltage (saturated)	3071	$I_C = 5.0$ A dc; $I_B = 0.5$ A dc; pulsed (see 4.5.1)	$V_{CE(SAT)2}$		1.2	V dc
Base to emitter voltage (saturated)	3066	Test condition A; $I_C = 2.0$ A dc; $I_B = 0.2$ A dc; pulsed (see 4.5.1)	$V_{BE(SAT)1}$		1.2	V dc
Base to emitter voltage (saturated)	3066	Test condition A; $I_C = 5.0$ A dc; $I_B = 0.5$ A dc; pulsed (see 4.5.1)	$V_{BE(SAT)2}$		1.8	V dc
<u>Subgroup 3</u>						
High - temperature operation		$T_A = +150^{\circ}\text{C}$				
Collector to emitter cutoff current	3041	Bias condition A; $V_{CE} = 90$ V dc; $V_{BE} = 1.5$ V dc;	$I_{CEX2}$		1.0	mA dc
Low-temperature operation		$T_A = -55^{\circ}\text{C}$				
Forward - current transfer ratio	3076	$V_{CE} = 2.0$ V dc; $I_C = 2.0$ A dc; Pulsed (see 4.5.1)	$h_{FE4}$	12		

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4</u>						
Small - signal short - circuit forward - current transfer ratio	3306	$V_{CE} = 10 \text{ V dc}; I_C = 0.5 \text{ A dc}; f = 10 \text{ MHz}$	$ h_{fe} $	3	15	
Open circuit output capacitance	3236	$V_{CB} = 10 \text{ V dc}; I_E = 0; 100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	$C_{obo}$		250	pF
Input capacitance (output open - circuited)	3240	$V_{BE} = 2.0 \text{ V dc}; I_C = 0; 100 \text{ kHz} \leq f \leq 1 \text{ MHz}$ (see 4.5.2)	$C_{ibo}$		1,000	pF
Pulse response						
Pulse delay time	3251	See figure 6	$t_d$		100	ns
Pulse rise time	3251	See figure 6	$t_r$		100	ns
Pulse storage time	3251	See figure 7	$t_s$		2	μs
Pulse fall time	3251	See figure 7	$t_f$		200	ns
<u>Subgroup 5</u>						
Safe operating area (continuous dc)	3051	$T_C = +25^{\circ}\text{C}; t \geq 0.5 \text{ s}; 1 \text{ cycle}$				
Test 1		$V_{CE} = 2.0 \text{ V dc}; I_C = 5.0 \text{ A dc}$				
Test 2		$V_{CE} = 5.0 \text{ V dc}; I_C = 2.0 \text{ A dc}$				
Test 3		$V_{CE} = 90 \text{ V dc}; I_C = 55 \text{ mA dc}$				
End-point electrical measurements		See table I, group A, subgroup 2				
<u>Subgroups 6 and 7</u>						
Not applicable						

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

2/ For resubmission of failed subgroup A1, double the sample size of the failed test or sequence of tests. A failure in group A, subgroup 1 shall not require retest of the entire subgroup. Only the failed test shall be rerun upon submission.

3/ Separate samples may be used.

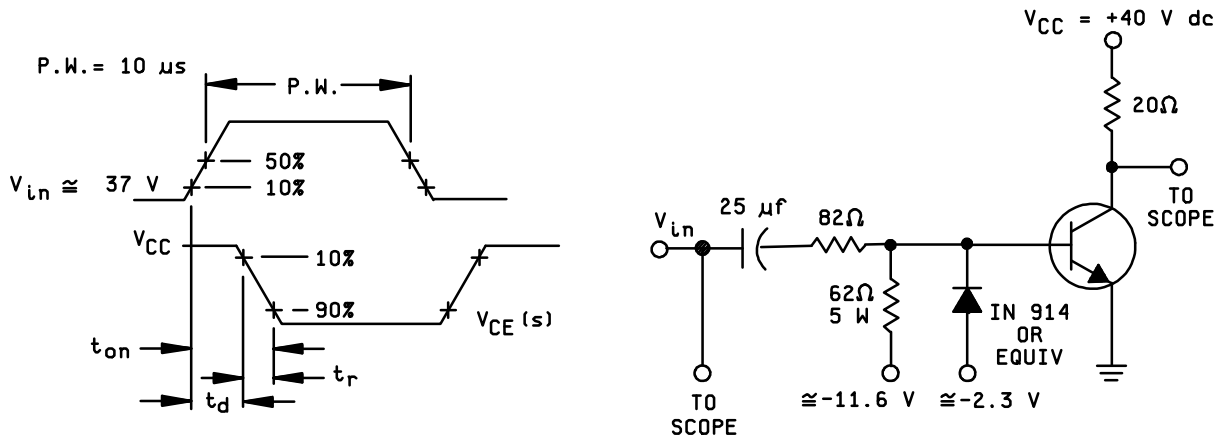
4/ Not required for laser marked devices.

5/ Not required for JANS devices.

## MIL-PRF-19500/560E

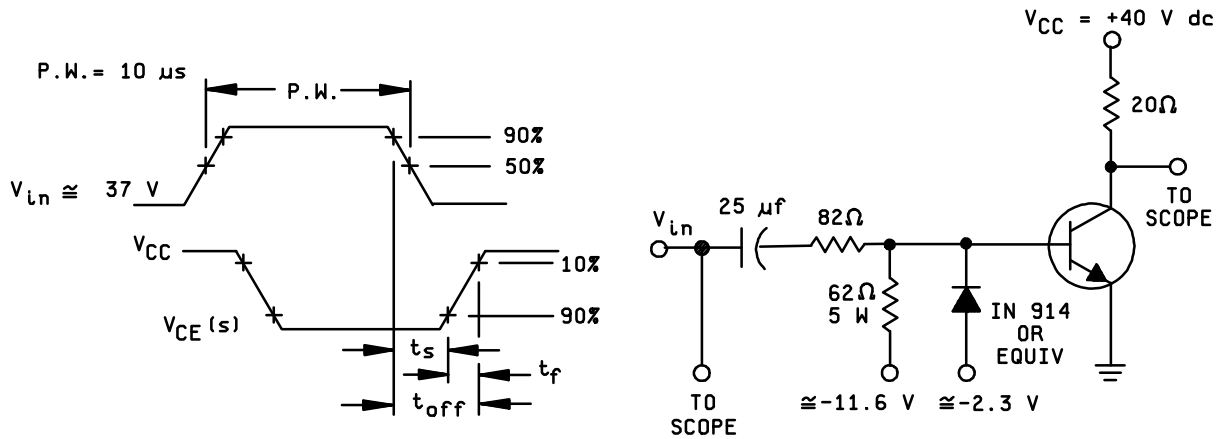
\* TABLE II. Group E inspection (all quality levels) – for qualification only.

Inspection	MIL-STD-750		Qualification
	Method	Conditions	
<u>Subgroup 1</u>			45 devices c = 0
Temperature cycling (air to air)	1051	Test condition C, 500 cycles	
Hermetic seal			
Fine leak	1071		
Gross leak			
Electrical measurements		See group A, subgroup 2 and table III herein.	
<u>Subgroup 2</u>			45 devices c = 0
Intermittent life	1037	V <sub>CB</sub> = 10 V dc, 6,000 cycles.	
Electrical measurements		See group A, subgroup 2 and table III herein.	
<u>Subgroups 3, 4, 5, 6 and 7</u>			
Not applicable			
<u>Subgroup 8</u>			45 devices c = 0
Reverse stability	1033	Condition A for devices $\geq 400$ V Condition B for devices $< 400$ V	



## NOTES:

1. The rise time ( $t_r$ ) of the applied pulse shall be  $\leq 20$  ns, duty cycle  $\leq 2$  percent, and the generator source impedance shall be  $50\Omega$ .
2. Sampling oscilloscope:  $Z_{in} \geq 1\text{ M}\Omega$ ,  $C_{in} \leq 20\text{ pF}$ , rise time  $\leq 20$  ns.
3.  $t_{on}$  conditions:  $I_C = 2\text{ A}$ ,  $I_{B1} = 200\text{ mA}$ .

FIGURE 6. Saturated turn-on switching waveform and time test circuit.

## NOTES:

1. The rise time ( $t_r$ ) of the applied pulse shall be  $\leq 20$  ns, duty cycle  $\leq 2$  percent, and the generator source impedance shall be  $50\Omega$ .
2. Sampling oscilloscope:  $Z_{in} \geq 1\text{ M}\Omega$ ,  $C_{in} \leq 20\text{ pF}$ , rise time  $\leq 20$  ns.
3.  $t_{on}$  conditions:  $C_1 = 2\text{ A}$ ,  $I_{B1} = I_{B2} = 200\text{ mA}$ .

FIGURE 7. Saturated turn-off switching time waveform and 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 actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. 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.)

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Issue of DODISS to be cited in the solicitation and if required, the specific issue of individual documents referenced (see 2.2.1).
- c. The lead finish as specified (see 3.4.1).
- d. Type designation and quality assurance level.
- e. Packaging requirements (see 5.1).
- f. For die acquisition, the JANHC or JANKC letter version shall be specified (see figures 2 and 3).

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 Manufacturer's List QML No.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 43216-5000.

6.4 Application guidance. The following PNP type transistor is complimentary to the NPN device listed herein.

<u>NPN</u>	<u>PNP</u>
2N5339	2N6193

6.5 Suppliers of JANHC and JANKC die. The qualified die suppliers with the applicable letter version (example, JANHCA2N6193) will be identified on the QML.

JANC ordering information			
PIN	Manufacturers		
	33178	34156	43611
2N5339	JANHCA2N5339 JANKCA2N5339	JANHCB2N5339 JANKCB2N5339	JANHCC2N5339 JANKCC2N5339

6.6 Changes from previous issue. The margins of this revision are marked with an asterisk to indicate where changes from the previous amendment 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 amendment.

Custodians:

Army - CR  
Air Force 11  
DLA - CC

Preparing activity:  
DLA - CC

(Project 5961-2531)

Review activities:

Air Force – 19, 71, 99

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**I RECOMMEND A CHANGE:**

1. DOCUMENT NUMBER  
MIL-PRF-19500/560E

2. DOCUMENT DATE  
6 March 2002

**3. DOCUMENT TITLE**

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, SWITCHING TYPE 2N5339 AND 2N5339U3 JAN, JANTX, JANTXV, JANS, JANHC AND JANKC

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

**6. SUBMITTER**

a. NAME (Last, First, Middle initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)  
COMMERCIAL  
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EMAIL

7. DATE SUBMITTED

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