

The documentation and process conversion measures necessary to comply with this revision shall be completed by 23 October 2001.

INCH-POUND

MIL-PRF-19500/512E
 23 July 2001
 SUPERSEDING
 MIL-PRF-19500/512D
 14 July 2000

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, SWITCHING
 TYPES 2N4029, 2N4033, 2N4033UA, 2N4033UB, JAN, JANTX, JANTXV, JANS AND
 JANKC2N4033 AND JANHC2N4033

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 PNP silicon transistors designed for use in high speed switching and driver applications. Four levels of product assurance are provided for each encapsulated device type and two levels of product assurance for each unencapsulated specified as in MIL-PRF-19500.

1.2 Physical dimensions. See figures 1 (TO-18), figure 2 (TO-39), figure 3 and figure 4 (surface mount)) and figure 5 (JANKC and JANHC) herein.

1.3 Maximum ratings.

P_T (1) $T_A = +25^\circ\text{C}$	P_T (2) $T_A = +25^\circ\text{C}$	P_T (3) $T_A = +25^\circ\text{C}$	P_T (1) $T_A = +25^\circ\text{C}$	V_{CBO}	V_{CEO}	V_{EBO}	I_c	T_{OP} and T_{STG}
2N4029	2N4033	2N4033UA	2N4033UB					
<u>W</u>	<u>W</u>	<u>W</u>	<u>W</u>	<u>V dc</u>	<u>V dc</u>	<u>V dc</u>	<u>A dc</u>	<u>°C</u>
0.5	0.8	0.65	0.5	80	80	5.0	1.0	-65 to +200

$R_{\theta JA}$	$R_{\theta JA}$	$R_{\theta JA}$
2N4029 2N4033UB	2N4033	2N4033UA
<u>°C/W</u>	<u>°C/W</u>	<u>°C/W</u>
325	175	210

- (1) Derate linearly 3.08 mW/°C above $T_A = +37.5^\circ\text{C}$.
- (2) Derate linearly 5.7 mW/°C above $T_A = +60^\circ\text{C}$.
- (3) Derate linearly 4.76 mW/°C above $T_A = +63.5^\circ\text{C}$.

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, Post Office 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.

AMSC N/A

FSC 5961

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

MIL-PRF-19500/512E

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

Limits	h_{FE1} $V_{CE} = 5.0 \text{ V dc}$ $I_C = 100 \mu\text{A dc}$	h_{FE2} $V_{CE} = 5.0 \text{ V dc}$ $I_C = 100 \text{ mA dc}$	h_{FE3} $V_{CE} = 5.0 \text{ V dc}$ $I_C = 500 \text{ mA dc}$	h_{FE4} $V_{CE} = 5.0 \text{ V dc}$ $I_C = 1.0 \text{ A dc}$	$ h_{fe} $ $f = 100 \text{ MHz}$ $V_{CE} = 10 \text{ V dc}$ $I_C = 50 \text{ mA dc}$
Min	50	100	70	25	1.5
Max		300			6.0

Limits	$V_{CE(SAT)2}$ $I_C = 500 \text{ mA dc}$ $I_B = 50 \text{ mA dc}$	C_{obo} $V_{CB} = 10 \text{ V dc}$ $I_E = 0$ $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	t_d	t_r	t_s	t_f
Min	<u>V dc</u>	<u>pF</u>	<u>ns</u>	<u>ns</u>	<u>ns</u>	<u>ns</u>
Max	0.5	20	15	25	175	35

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.

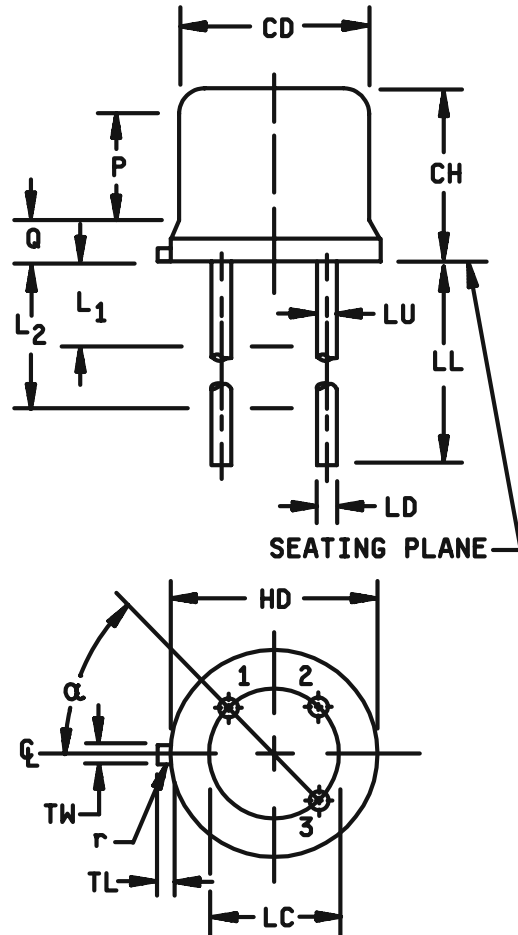
STANDARD

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.)

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.178	.195	4.52	4.95	
CH	.170	.210	4.32	5.34	
HD	.209	.230	5.31	5.84	
LC	.100 TP		2.54 TP		6
LD	.016	.021	0.41	0.53	7, 8
LL	.500	.750	12.70	19.05	7, 8, 12
LU	.016	.019	0.41	0.48	7, 8
L ₁		.050		1.27	7, 8
L ₂	.250		6.35		7, 8
Q		.040		1.02	5
TL	.028	.048	0.71	1.22	3, 4
TW	.036	.046	0.91	1.17	3
r		.010		0.18	10
P	.100		2.54		
α	45°TP		45°TP		6



NOTES:

1. Dimension are in inches.
2. Metric equivalents are given for general information only.
3. Beyond r (radius) maximum, TW shall be held for a minimum length of .011 (0.28 mm).
4. Dimension TL measured from maximum HD.
5. Body contour optional within zone defined by HD, CD, and Q.
6. Leads at gauge plane .054 +.001 -.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods.
7. Dimension LU applies between L₁ and L₂. Dimension LD applies between L₂ and minimum. Diameter is uncontrolled in L₁ and beyond LL minimum.
8. All three leads.
9. The collector shall be internally connected to the case.
10. Dimension r (radius) applies to both inside corners of tab.
11. In accordance with ANSI Y14.5M, diameters are equivalent to øx symbology.
12. For "L" suffix devices, dimension LL is 1.50 (38.10 mm) minimum, 1.75 (19.05 mm) maximum.

FIGURE 1. Physical dimensions (type 2N4029) (TO - 18).

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.335	7.75	8.51	
CH	.240	.260	6.10	6.60	
HD	.335	.370	8.51	9.40	
LC	.200 TP		5.08 TP		6
LD	.016	.021	0.41	0.53	7, 8
LL	.500	.750	12.70	19.05	7, 8, 12
LU	.016	.019	0.41	0.48	7, 8
L ₁		.050		1.27	7, 8
L ₂	.250		6.35		7, 8
Q		.050		1.27	5
TL	.029	.045	0.74	1.14	3, 4
TW	.028	.034	0.71	0.86	3
r		.010		0.18	10
P	.100		2.54		
α	45°TP		45°TP		6

NOTES:

1. Dimension are in inches.
2. Metric equivalents are given for general information only.
3. Beyond r (radius) maximum, TW shall be held for a minimum length of .011 (0.28 mm).
4. Dimension TL measured from maximum HD.
5. Body contour optional within zone defined by HD, CD, and Q.
6. Leads at gauge plane .054 +.001 -.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods.
7. Dimension LU applies between L₁ and L₂. Dimension LD applies between L₂ and minimum. Diameter is uncontrolled in L₁ and beyond LL minimum.
8. All three leads.
9. The collector shall be internally connected to the case.
10. Dimension r (radius) applies to both inside corners of tab.
11. In accordance with ANSI Y14.5M, diameters are equivalent to θx symbology.
12. For "L" suffix devices, dimension LL is 1.50 (38.10 mm) minimum, 1.75 (19.05 mm) maximum.

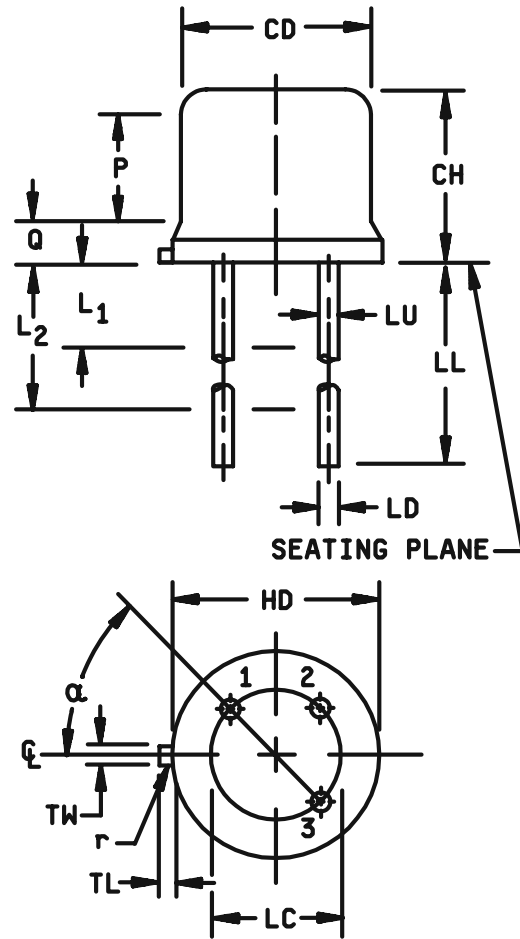
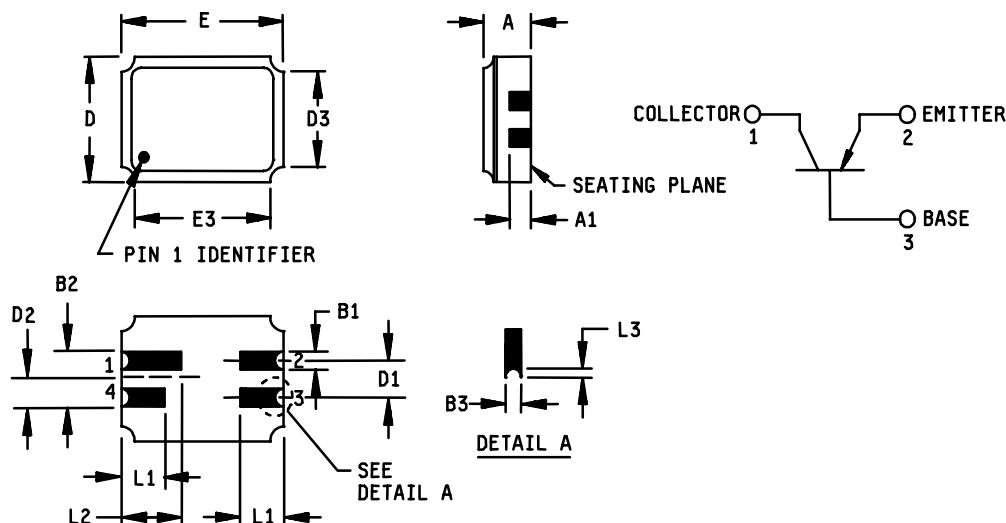


FIGURE 2. Physical dimensions (type 2N4033) (TO - 39).

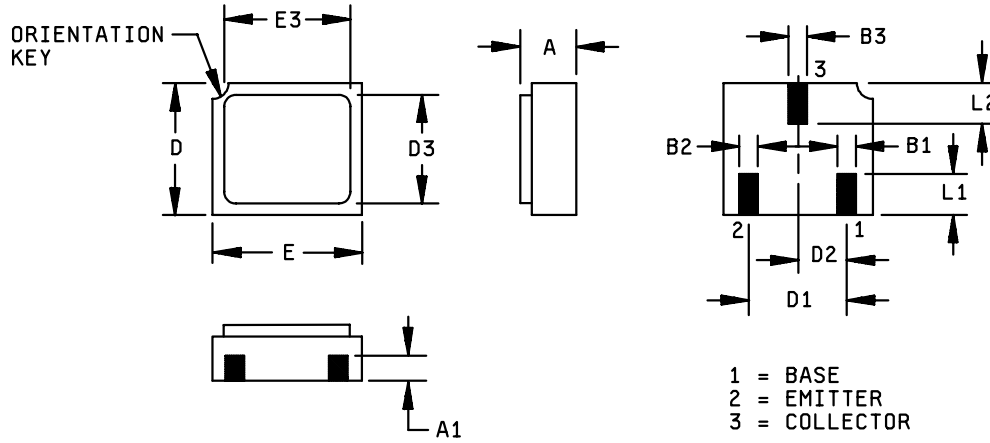


Ltr	Dimensions				Notes	Ltr	Dimensions				Notes
	Inches		Millimeters				Inches		Millimeter		
	Min	Max	Min	Max			Min	Max	Min	Max	
A	.061	.075	1.55	1.90	3	D ₂	.0375 BSC		0.952 BSC		
A ₁	.029	.041	0.74	1.04		D ₃		.155		3.93	
B ₁	.022	.028	0.56	0.71		E	.215	.225	5.46	5.71	
B ₂	.075 REF		1.91 REF			E ₃		.225		5.71	
B ₃	.006	.022	0.15	0.56	5	L ₁	.032	.048	0.81	1.22	
D	.145	.155	3.68	3.93		L ₂	.072	.088	1.83	2.23	
D ₁	.045	.055	1.14	1.39		L ₃	.003	.007	0.08	0.18	5

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Dimension "A" controls the overall package thickness. When a window lid is used, dimension "A" must increase by a minimum of .010 inch (0.254 mm) and a maximum of .040 inch (1.020 mm).
4. The corner shape (square, notch, radius, etc.) may vary at the manufacturer's option, from that shown on the drawing.
5. Dimensions "B3" minimum and "L3" minimum and the appropriately castellation length define an unobstructed three-dimensional space traversing all of the ceramic layers in which a castellation was designed. (Castellations are required on bottom two layers, optional on top ceramic layer.) Dimension "B3" maximum and "L3" maximum define the maximum width and depth of the castellation at any point on its surface. Measurement of these dimensions may be made prior to solder dipping.

FIGURE 3. Physical dimensions, surface mount (UA version).

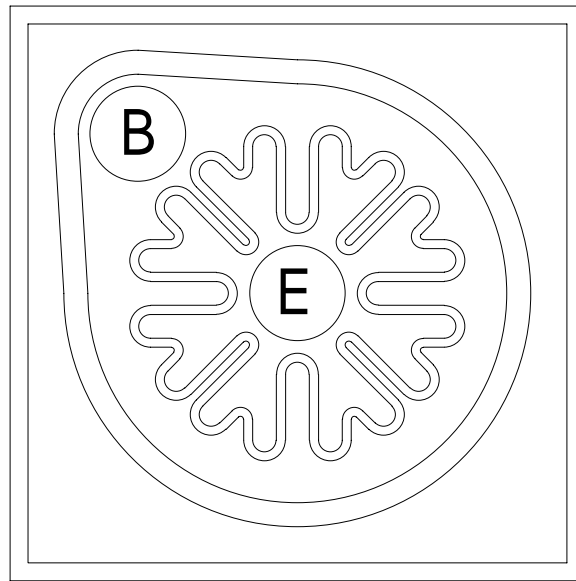


Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min.	Max.	Min.	Max.	
A	.046	.056	0.97	1.42	
A1	.017	.035	0.43	0.89	
B1	.016	.024	0.41	0.61	3
D	.085	.108	2.41	2.74	
D1	.071	.079	1.81	2.01	
D2	.035	.039	0.89	0.99	
D3					
E	.115	.128	2.82	3.25	
E3					
L1	.022	.038	0.56	0.96	4

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Dimensions B2 and B3 are identical to B1
4. Dimension L2 is identical to L1.

FIGURE 4. Physical dimensions, surface mount UB version.



Die size: .030 x .030 inch (0.762 x 0.762 mm).
Die thickness: .008 ±.0016 inch (0.2032 ±0.04064 mm).
Base pad: .005 inch diameter (0.127 mm).
Emitter pad: .005 inch diameter (0.127 mm).
Back metal: Gold, 6500 ± 1950 Ang.
Top metal: Aluminum, 22500 ±2500 Ang.
Back side: Collector.
Glassivation: SiO₂, 7500 ± 1500 Ang.

FIGURE 5. JANHC and JANKC (A-version) die dimensions.

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.

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 figures 1, 2, 3, 4, and 5 herein.

3.4.1 Lead finish. Lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750 and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

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

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

3.7 Electrical test requirements. The electrical test requirements shall be the subgroups specified in 4.4.2 and 4.4.3 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 as specified herein.

4.3 Screening (JANS, JANTX and JANTXV 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 table IV of MIL-PRF-19500)	Measurement	
	JANS level	JANTX and JANTXV levels
(1) 3c	Required (see 4.3.2)	Required (see 4.3.2)
9	h_{FE2} , I_{CBO2}	Not applicable
11	I_{CBO2} ; h_{FE2} ; ΔI_{CBO2} = 100 percent of initial value or 2 nA dc, whichever is greater; Δh_{FE2} = 15 percent change from initial value.	I_{CBO2} and h_{FE2}
12	See 4.3.1	See 4.3.1
13	Subgroups 2 and 3 of table I herein; ΔI_{CBO2} = 100 percent of initial value or 2 nA dc, whichever is greater; Δh_{FE2} = 15 percent change from initial value.	Subgroup 2 of table I herein; ΔI_{CBO2} = 100 percent of initial value or 2 nA dc, whichever is greater; Δh_{FE2} = 15 percent change from initial value.

(1) Thermal impedance may be performed any time after sealing provided temperature cycling is performed in accordance with MIL-PRF-19500, screen 3 prior to this thermal test.

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows: T_A = Room ambient as defined in 4.5 of MIL-STD-750; V_{CB} = 10-20 V dc; power shall be applied to achieve T_J = 135°C minimum and a minimum power dissipation = 75 percent of maximum rated P_T (see 1.3). NOTE: No heat sink or forced air cooling on the devices shall be permitted.

4.3.2 Thermal impedance ($Z_{\theta JX}$ measurements). The $Z_{\theta JX}$ measurements shall be performed in accordance with method 3131 of MIL-STD-750.

- a. I_M measurement current 5 mA.
- b. I_H forward heating current 200 mA (min).
- c. t_H heating time 25 - 30 ms.
- d. t_{md} measurement delay time 60 μ s max.
- e. V_{CE} collector-emitter voltage 10 V dc minimum(same as V_H).
- f. V_H collector-emitter heating voltage ... 10 V (minimum).
- g. t_{SW} sample window time 10 μ s (maximum).

The maximum limit for $Z_{\theta JX}$ under these test conditions are $Z_{\theta JX}$ (max) = 60°C/W. (UA and UB); 67°C/W (2N4029 and 2N4033).

4.3.3 Screening (JANHC and JANKC). Screening of JANHC and JANKC die shall be in accordance with MIL-PRF-19500, "Discrete Semiconductor Die/Chip Lot Acceptance". Burn-in duration for the 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 appendix E, table V of MIL-PRF-19500 and table I 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 table VIa (JANS) of MIL-PRF-19500 and 4.4.2.1 herein. Electrical measurements (end-points) and delta requirements shall be in accordance with group A, subgroup 2 and 4.5.2 herein: delta requirements only apply to subgroups B4, and B5. See 4.4.2.2 for JAN, JANTX, and JANTXV group B testing. Electrical measurements (end-points) and delta requirements for JAN, JANTX, and JANTXV shall be after each step in 4.4.2.2 and shall be in accordance with group A, subgroup 2 and 4.5.2 herein.

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

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B4	1037	$V_{CB} = 10$ V dc.
B5	1027	$V_{CB} = 10 - 20$ V dc; $P_D \geq 75$ percent of maximum rated P_T (see 1.3). Option 1: 96 hours min, sample size in accordance with table VIa of MIL-PRF-19500, adjust T_A to achieve $T_J = +275^\circ\text{C}$ minimum. Option 2: 216 hours., sample size = 45, c = 0; adjust T_A to achieve $T_J = +225^\circ\text{C}$ minimum.

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	1039	Steady-state life: Test condition B, 340 hours, $V_{CB} = 10 - 20$ V dc, power shall be applied to the device to achieve $T_J = +150^\circ\text{C}$ minimum, and a minimum of $P_D = 75$ percent of maximum rated P_T as defined in 1.3 herein. $n = 45$, $c = 0$.
2	1039	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, $n = 22$, $c = 0$.

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

- 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. For JANS, samples shall be selected from each inspection lot. See MIL-PRF-19500.
- Must be chosen from an inspection lot that has been submitted to and passed group A, 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 (subgroups B4 and B5 for JANS, and 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 tests and conditions specified for subgroup testing in table VII of MIL-PRF-19500, and in 4.4.3.1 (JANS) and 4.4.3.2 (JAN, JANTX, and JANTXV) herein for group C testing. Electrical measurements (end-points) and delta requirements shall be in accordance with group A, subgroup 2 and 4.5.2 herein; delta requirements only apply to subgroup C6.

4.4.3.1 Group C inspection, table VII (JANS) of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition E; (method 2036 not applicable for UA and UB devices).
C6	1026	1,000 hours at $V_{CB} = 10$ V dc; power shall be applied to achieve $T_J = +150^\circ\text{C}$ minimum and a minimum of $P_D = 75$ percent of maximum rated P_T as defined in 1.3.

4.4.3.2 Group C inspection, table VII (JAN, JANTX, and JANTXV) of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition E; not applicable for UA and UB devices.
C6		Not applicable.

4.4.3.3 Group C sample selection. Samples for subgroups in group C shall be chosen at random from any inspection lot containing the intended package type and lead finish procured to the same specification which is submitted to and passes group A tests 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.

4.5 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 Delta requirements. Delta requirements shall be as follows: 3/ 4/ 5/ 6/

Step	Inspection <u>1/ 2/</u>	MIL-STD-750		Symbol	Limit	Unit
		Method	Conditions			
1.	Collector-base cutoff current	3036	Bias condition D, $V_{CB} = 60 \text{ V dc}$	$\Delta I_{CB02} (1)$	100 percent of initial value or 5 nA dc, whichever is greater.	
2.	Forward current transfer ratio	3076	$V_{CE} = 5 \text{ V dc};$ $I_C = 100 \text{ mA dc};$ pulsed see 4.5.1	$\Delta h_{FE2} (1)$	± 25 percent change from initial reading.	

1/ See MIL-PRF-19500 for sampling plan.

2/ Devices which exceed the group A limits for this test shall not be acceptable.

3/ The delta measurements for table VIa (JANS) of MIL-PRF-19500 are as follows:

- a. Subgroup 3, see table II herein, step 2.
- b. Subgroups 4 and 5, see table II herein, step 2.

4/ The delta measurements for table VIb (JANTX and JANTXV) of MIL-PRF-19500 are as follows:

- a. Subgroup 2, see table II herein, step 1.
- b. Subgroups 3 and 6, see table II herein, step 1.

5/ The delta measurements for table VII of MIL-PRF-19500 are as follows:

- a. Subgroup 6, see table II herein, step 1.

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 inspection <u>3/</u>	2071	n = 45 devices, c = 0				
Solderability <u>3/ 4/</u>	2026	n = 15 leads, c = 0				
Resistance to solvents <u>3/ 4/ 5/</u>	1022	n = 15 devices, c = 0				
Temp cycling <u>3/ 4/</u>	1051	Test condition C, 25 cycles. n = 22 devices, c = 0				
Hermetic seal <u>4/</u> Fine leak Gross leak	1071	n = 22 devices, c = 0				
Electrical measurements <u>4/</u>		Group A, subgroup 2				
Bond strength <u>3/ 4/</u>	2037	Precondition $T_A = + 250^\circ\text{C}$ at t = 24 hours or $T_A = + 300^\circ\text{C}$ at t = 2 hours n = 11 wires, c = 0				
<u>Subgroup 2</u>						
Collector to base cutoff current	3036	Bias condition D; $V_{CB} = 80\text{ V dc}$ pulsed (see 4.5.1)	I_{CBO1}		10	$\mu\text{A dc}$
Emitter to base cutoff current	3061	Bias condition D; $V_{BE} = 5\text{ V dc}$	I_{EBO1}		10	$\mu\text{A dc}$
Collector - base cutoff current	3036	Bias condition D; $V_{CB} = 60\text{ V dc}$	I_{CBO2}		10	nA dc
Collector - emitter cutoff current	3041	Bias condition A; $V_{BE} = 2.0\text{ V dc}$; $V_{CE} = 60\text{ V dc}$	I_{CEX1}		25	nA dc
Base emitter cutoff current	3061	Bias condition D; $V_{BE} = 3.0\text{ V dc}$	I_{EBO2}		25	nA dc
Forward-current transfer ratio	3061	$V_{CE} = 5.0\text{ V dc}$; $I_C = 100\ \mu\text{A dc}$	h_{FE1}	50		

See footnotes at end of table.

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						
Forward-current transfer ratio	3076	$V_{CE} = 5.0 \text{ V dc}; I_C = 100 \text{ mA dc}$	h_{FE2}	100	300	
Forward-current transfer ratio	3076	$V_{CE} = 5.0 \text{ V dc}; I_C = 500 \text{ mA dc}$ pulsed (see 4.5.1)	h_{FE3}	70		
Forward-current transfer ratio	3076	$V_{CE} = 5.0 \text{ V dc}; I_C = 1.0 \text{ A dc};$ pulsed (see 4.5.1)	h_{FE4}	25		
Collector – emitter saturated voltage	3071	$I_C = 150 \text{ mA dc}; I_B = 15 \text{ mA dc}$ pulsed (see 4.5.1)	$V_{CE(SAT)1}$		0.15	V dc
Collector – emitter saturated voltage	3071	$I_C = 500 \text{ mA dc}; I_B = 50 \text{ mA dc};$ pulsed (see 4.5.1)	$V_{CE(SAT)2}$		0.50	V dc
Collector – emitter saturated voltage	3071	$I_C = 1.0 \text{ A dc}; I_B = 100 \text{ mA dc};$ pulsed (see 4.5.1)	$V_{CE(SAT)3}$		1.0	V dc
Base – emitter Saturated voltage	3066	Test condition A; $I_C = 150 \text{ mA}$ dc; $I_B = 15 \text{ mA dc}$ pulsed (see 4.5.1)	$V_{BE(SAT)1}$		0.9	V dc
Base - emitter Saturated voltage	3066	Test condition A; $I_C = 500 \text{ mA}$ dc; $I_B = 50 \text{ mA dc};$ pulsed (see 4.5.1)	$V_{BE(SAT)2}$		1.2	V dc
<u>Subgroup 3</u>						
High-temperature operation:		$T_A = +150^\circ\text{C}$				
Collector -base cutoff current	3036	Bias condition D; $V_{CB} = 60 \text{ V dc}$	I_{CBO3}		25	$\mu\text{A dc}$
Low-temperature operation:		$T_A = -55^\circ\text{C}$				
Forward-current transfer ratio	3076	$V_{CE} = 5.0 \text{ V dc}; I_C = 500 \text{ mA dc}$ pulsed (see 4.5.1)	h_{FE5}	30		

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4</u>						
Magnitude of common emitter small-signal short-circuit forward-current transfer ratio	3306	$V_{CE} = 10 \text{ V dc}; I_C = 50 \text{ mA dc}; f = 100 \text{ MHz}$	$ h_{fe} $	1.5	6.0	
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}		20	pF
Input capacitance (output open-circuited)	3240	$V_{EB} = 0.5 \text{ V dc}; I_C = 0;$ $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	C_{ibo}		80	pF
Pulse response						
On-time	3251	Test condition A; $I_C = 500 \text{ mA dc};$ $I_{B1} = 50 \text{ mA dc};$ (see figure 6)	t_d		15	ns
Rise time	3251	Test condition A; $I_C = 500 \text{ mA dc};$ $I_{B1} = 50 \text{ mA dc};$ (see figure 6)	t_r		25	ns
Storage time	3251	Test condition A; $I_C = 500 \text{ mA dc};$ $I_{B1} = 50 \text{ mA dc};$ (see figure 7)	t_s		175	ns
Fall time	3251	Test condition A; $I_C = 500 \text{ mA dc};$ $I_{B1} = 50 \text{ mA dc};$ (see figure 7)	t_f		35	Ns
<u>Subgroups 5, 6, and 7</u>						
Not applicable						

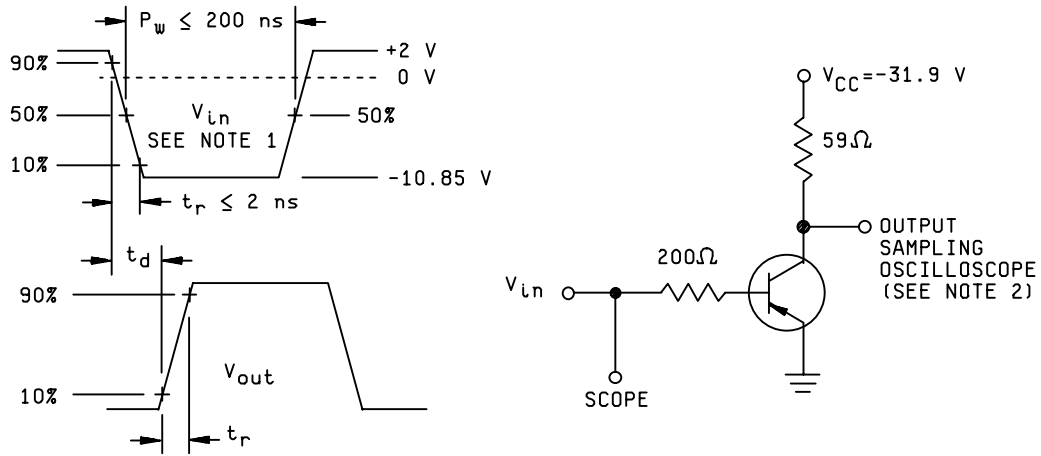
1/ For sampling plan see MIL-PRF-19500.

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 JANS devices.

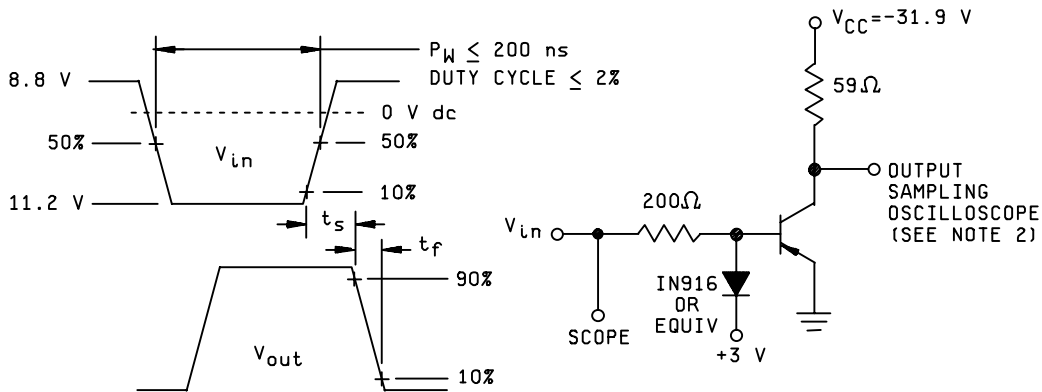
5/ Not required for laser marked devices.



NOTES:

1. The rise time (t_r) of the applied pulse shall be ≤ 2.0 ns, duty cycle ≤ 2 percent, and the generator source Z shall be 50Ω .
2. Sampling oscilloscope: $Z_{IN} \geq 100 \text{ k}\Omega$; $C_{in} \leq 12 \text{ pF}$, rise time(t_r) ≤ 5 ns.

FIGURE 6. Delay and rise time, test circuit.



NOTES:

1. The rise time (t_r) of the applied pulse shall be ≤ 20 ns, duty cycle ≤ 2 percent, and the generator source impedance shall be 50Ω .
2. Sampling oscilloscope: $Z_{IN} \geq 100 \text{ k}\Omega$; $C_{in} \leq 12 \text{ pF}$, rise time(t_r) ≤ 5 ns.

FIGURE 7. Storage and fall time, test circuit.

5. PACKAGING

5.1 Packaging. Packaging shall prevent mechanical damage of the devices during shipping and handling and shall not be detrimental to the device. 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 Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' 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 (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).

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) 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 Suppliers of JANHC and JANKC die. The qualified JANHC and JANKC suppliers with the applicable letter version (example JANHCA2N4033) will be identified on the QPL.

Die ordering information	
PIN	Manufacturer
	34156
2N4033	JANHCA2N4033 JANKCA2N4033

6.5 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:

Army - CR
Navy - NW
Air Force - 11
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2386)

Review activities:

Army - AV
Air Force - 19, 71, 99

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/512E	2. DOCUMENT DATE 010723
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3. DOCUMENT TITLE
SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, SWITCHING TYPES 2N4029, 2N4033, 2N4033UA, 2N4033UB, JAN, JANTX, JANTXV, AND JANS AND JANKC2N4033 AND JANHC2N4033

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)	7. DATE SUBMITTED	
	COMMERCIAL DSN FAX EMAIL		

8. PREPARING ACTIVITY

a. Point of Contact Alan Barone	b. TELEPHONE Commercial DSN FAX EMAIL 614-692-0510 850-0510 614-692-6939 alan.barone@dscclia.mil
c. ADDRESS Defense Supply Center Columbus, ATTN: DSCC-VAC P.O. Box 3990 Columbus, OH 43216-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman, Suite 2533, Fort Belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-6888