

The documentation and process conversion measures necessary to comply with this revision shall be completed by 14 October 2000.

INCH-POUND

MIL-PRF-19500/512D  
 14 July 2000  
 SUPERSEDING  
 MIL-PRF-19500/512C  
 31 January 1998

PERFORMANCE SPECIFICATION

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

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 device type as specified in MIL-PRF-19500.

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

1.3 Maximum ratings.

P <sub>T</sub> (1) T <sub>A</sub> = +25°C	P <sub>T</sub> (2) T <sub>A</sub> = +25°C	P <sub>T</sub> (3) T <sub>A</sub> = +25°C	P <sub>T</sub> (1) T <sub>A</sub> = +25°C	V <sub>CB0</sub>	V <sub>CEO</sub>	V <sub>EBO</sub>	I <sub>c</sub>	T <sub>OP</sub> and T <sub>STG</sub>
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 <sub>θJA</sub>	R <sub>θJA</sub>	R <sub>θJA</sub>
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<sub>A</sub> = +37.5°C.
- (2) Derate linearly 5.7 mW/°C above T<sub>A</sub> = +60°C.
- (3) Derate linearly 4.76 mW/°C above T<sub>A</sub> = +63.5°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-19500/512D

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.

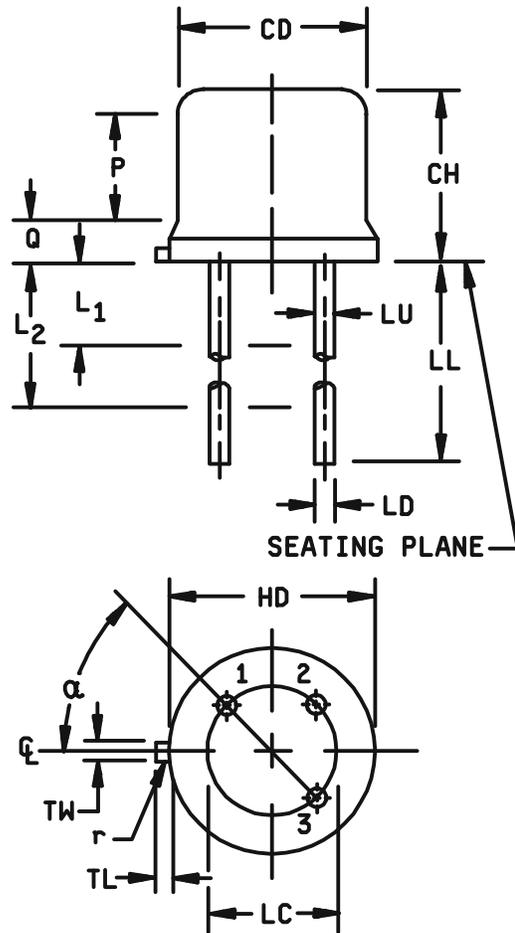
STANDARD

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 <sub>1</sub>	---	.050	---	1.27	7, 8
L <sub>2</sub>	.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
$\alpha$	45°TP		45°TP		6

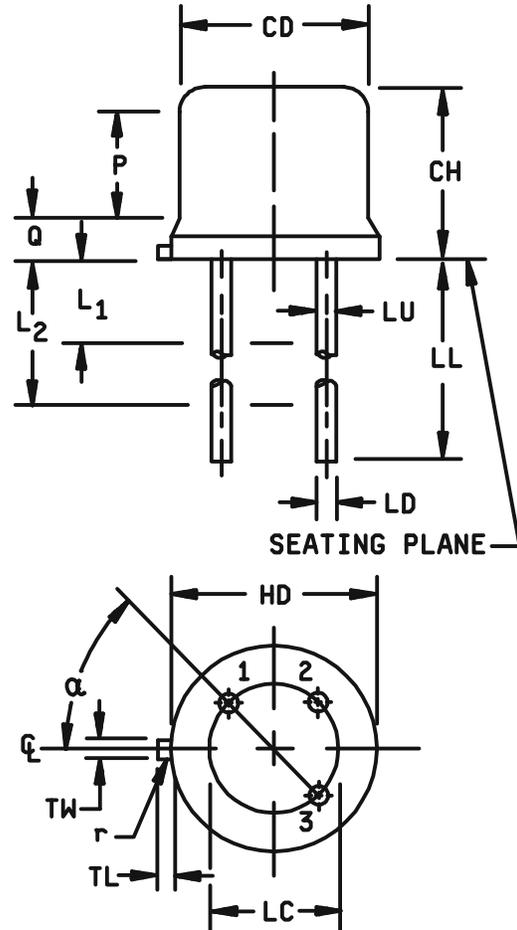


NOTES:

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 L<sub>1</sub> and L<sub>2</sub>. Dimension LD applies between L<sub>2</sub> and minimum. Diameter is uncontrolled in L<sub>1</sub> 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 Nx 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).

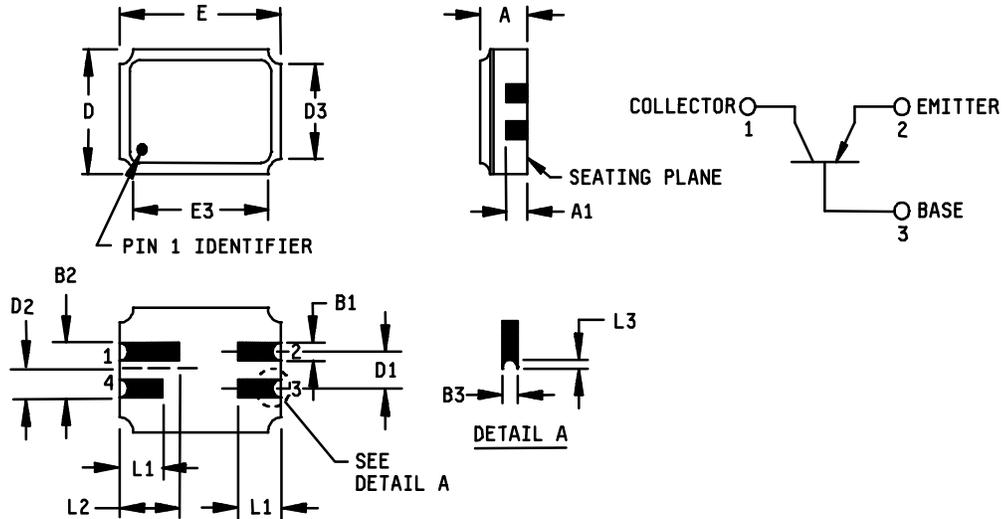
Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.335	7.75	8.51	
CH	.240	.260	6.10	6.60	
HD	.335	.370	8.51	9.40	
LC	.200 TP		5.08 TP		6
LD	.016	.021	0.41	0.53	7, 8
LL	.500	.750	12.70	19.05	7, 8, 12
LU	.016	.019	0.41	0.48	7, 8
L <sub>1</sub>	---	.050	--	1.27	7, 8
L <sub>2</sub>	.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
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 L<sub>1</sub> and L<sub>2</sub>. Dimension LD applies between L<sub>2</sub> and minimum. Diameter is uncontrolled in L<sub>1</sub> 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 Nx 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).

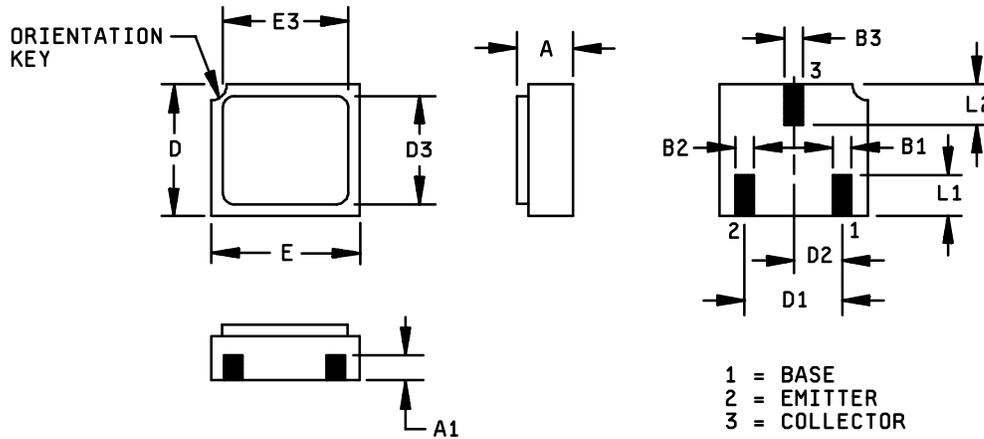


Ltr	Dimensions				Notes	Ltr	Dimensions				Notes
	Inches		Millimeters				Inches		Millimeter		
	Min	Max	Min	Max			Min	Max	Min	Max	
A	0.061	0.075	1.55	1.90	3	D <sub>2</sub>	0.0375 BSC		0.952 BSC		
A <sub>1</sub>	0.029	0.041	0.74	1.04		D <sub>3</sub>	---	0.155	---	3.93	
B <sub>1</sub>	0.022	0.028	0.56	0.71		E	0.215	0.225	5.46	5.71	
B <sub>2</sub>	0.075 REF		1.91 REF			E <sub>3</sub>	--	0.225	--	5.71	
B <sub>3</sub>	0.006	0.022	0.15	0.56	5	L <sub>1</sub>	0.032	0.048	0.81	1.22	
D	0.145	0.155	3.68	3.93		L <sub>2</sub>	0.072	0.088	1.83	2.23	
D <sub>1</sub>	0.045	0.055	1.14	1.39		L <sub>3</sub>	0.003	0.007	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 0.010 inch (0.254 mm) and a maximum of 0.040 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 2. 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 3. Physical dimensions, surface mount UB version.

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated specifications or specification sheets), 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 authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.3 Associated specification. The individual item performance requirements shall be in accordance with MIL-PRF-19500, and as specified herein.

3.4 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500.

3.5 Interface requirements and physical dimensions. The interface requirements and physical dimensions shall be as specified in MIL-PRF-19500 and on figures 1, 2, 3, and 4 herein.

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

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

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

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

3.9 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.

4.3 Screening (JANS, JANTX and JANTXV levels only). Screening shall be in accordance with MIL-PRF-19500 (table IV), 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
9	$h_{FE2}$ , $I_{CBO2}$	Not applicable
11	$I_{CBO2}$ ; $h_{FE2}$ ; $\Delta I_{CBO2}$ = 100 percent of initial value or 2 nA dc, whichever is greater; $\Delta h_{FE2}$ = 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; $\Delta I_{CBO2}$ = 100 percent of initial value or 2 nA dc, whichever is greater; $\Delta h_{FE2}$ = 15 percent change from initial value.	Subgroup 2 of table I herein; $\Delta I_{CBO2}$ = 100 percent of initial value or 2 nA dc, whichever is greater; $\Delta h_{FE2}$ = 15 percent change from initial value.

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;

$V_{CB}$  = 10-30 V dc; Power shall be applied to achieve  $T_J$  = 135°C minimum and a minimum power dissipation = 75 % of maximum rated  $P_T$  (see 1.3).

NOTE: No heat sink or forced air cooling on the devices shall be permitted.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with 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 conditions specified for subgroup testing in table VIa (JANS) and table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500. Electrical measurements (end points) shall be in accordance with table I, group A, subgroup 2 herein.

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

Subgroup	Method	Conditions
B4	1037	$V_{CB} = 40 \text{ V dc}$ ;
B5	1027	$V_{CB} = 40 \text{ V dc}$ ; $T_A = +125^\circ\text{C} \pm 25^\circ\text{C}$ for 96 hours adjusted as required according to the chosen $T_A$ to give $T_J = +275^\circ\text{C}$ , sample size = 45, $c = 0$ . Optionally, the test may be conducted for minimum 216 hours with $P_T$ adjusted to achieve $T_J = 225^\circ\text{C}$ minimum, sample size (for option) = 45, $c = 0$ . In this case, the ambient temperature shall be adjusted such that a minimum 75% of maximum rated $P_T$ (see 1.3) is applied to the device under test. (Note: If a failure occurs, resubmission shall be at the test conditions of the original sample.)
B5	2037	Test condition A (Au)die interconnects only).
B6	3131	See 4.5.2.

4.4.2.2 Group B inspection, table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500.

Subgroup	Method	Conditions
B3	1027	$V_{CB} = 40 \text{ V dc}$ ; $T_A = \text{room ambient}$ as defined in the general requirements of MIL-STD-750. Power shall be applied to achieve $T_J = 150^\circ\text{C}$ minimum and a minimum power dissipation $P_D = 75\%$ of $P_T$ maximum rated as defined in 1.3 herein.
B5	3131	See 4.5.2.

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

Subgroup	Method	Conditions
C2	2036	Test condition E.
C6	1027	$V_{CB} = 40 \text{ V dc}$ ; $T_A = \text{room ambient}$ as defined in the general requirements of MIL-STD-750. Power shall be applied to achieve $T_J = 150^\circ\text{C}$ minimum and a minimum power dissipation $P_D = 75\%$ of $P_T$ maximum rated as defined in 1.3 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. Thermal resistance measurements shall be conducted in accordance with test method 3131 of MIL-STD-750. The following details shall apply:

- a. Collector current magnitude during power applications shall be 0.15 A dc maximum.
- b. Collector to emitter voltage magnitude shall be 20 V dc.
- c. Reference temperature measuring point shall be the case.
- d. Reference point temperature shall be  $+25^{\circ}\text{C} \leq T_R \leq +35^{\circ}\text{C}$ . The chosen reference temperature shall be recorded before the test is started.
- e. Mounting arrangements shall be with heat sink to case.
- f. Maximum  $R_{\theta\text{JC}}$  limit shall be  $150^{\circ}\text{C}/\text{W}$  for 2N4029 and  $25.0^{\circ}\text{C}/\text{W}$  for 2N4033, UA, and UB.

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TABLE I. Group A inspection.

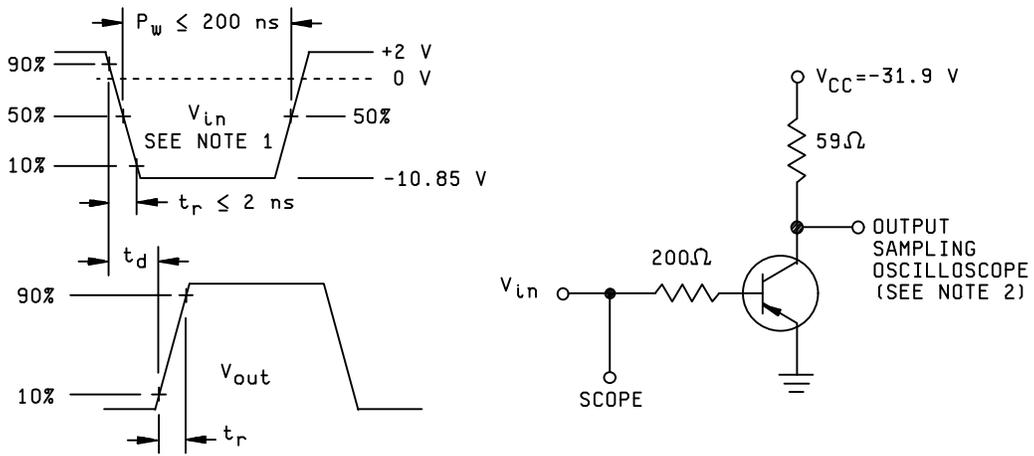
Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical examination	2071					
<u>Subgroup 2</u>						
Collector to base cutoff current	3036	Bias condition D; $V_{CB} = 80$ V dc pulsed (see 4.5.1)	$I_{CBO1}$		10	$\mu$ A dc
Emitter to base current cutoff	3061	Bias condition D; $V_{BE} = 5$ V dc	$I_{EBO1}$		10	$\mu$ A dc
Collector - base cutoff current	3036	Bias condition D; $V_{CB} = 60$ V dc	$I_{CBO2}$		10	nA dc
Collector - emitter cutoff current	3041	Bias condition A; $V_{BE} = 2.0$ V dc; $V_{CE} = 60$ V dc	$I_{CEX1}$		25	nA dc
Base emitter cutoff current	3061	Bias condition D; $V_{BE} = 3.0$ V dc	$I_{EBO2}$		25	nA dc
Forward-current transfer ratio	3061	$V_{CE} = 5.0$ V dc; $I_C = 100$ $\mu$ A dc	$h_{FE1}$	50		
Forward-current transfer ratio	3076	$V_{CE} = 5.0$ V dc; $I_C = 100$ mA dc	$h_{FE2}$	100	300	
Forward-current transfer ratio	3076	$V_{CE} = 5.0$ V dc; $I_C = 500$ mA dc pulsed (see 4.5.1)	$h_{FE3}$	70		
Forward-current transfer ratio	3076	$V_{CE} = 5.0$ V dc; $I_C = 1.0$ A dc; pulsed (see 4.5.1)	$h_{FE4}$	25		
Collector - emitter saturated voltage	3071	$I_C = 150$ mA dc; $I_B = 15$ mA dc pulsed (see 4.5.1)	$V_{CE(SAT)1}$		0.15	V dc
Collector - emitter saturated voltage	3071	$I_C = 500$ mA dc; $I_B = 50$ mA dc; pulsed (see 4.5.1)	$V_{CE(SAT)2}$		0.50	V dc
Collector - emitter saturated voltage	3071	$I_C = 1.0$ A dc; $I_B = 100$ mA dc; pulsed (see 4.5.1)	$V_{CE(SAT)3}$		1.0	V dc
Base - emitter saturated voltage	3066	Test condition A; $I_C = 150$ mA dc; $I_B = 15$ mA dc pulsed (see 4.5.1)	$V_{BE(SAT)1}$		0.9	V dc

See footnote 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						
Base - emitter saturated voltage	3066	Test condition A; $I_C = 500$ mA dc; $I_B = 50$ 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; $V_{CB} = 60$ V dc	$I_{CBO3}$		25	$\mu\text{A}$ dc
Low-temperature operation:		$T_A = -55^\circ\text{C}$				
Forward-current transfer ratio	3076	$V_{CE} = 5.0$ V dc; $I_C = 500$ mA dc pulsed (see 4.5.1)	$h_{FE5}$	30		
<u>Subgroup 4</u>						
Magnitude of common emitter small-signal short-circuit forward-current transfer ratio	3306	$V_{CE} = 10$ V dc; $I_C = 50$ mA dc; $f = 100$ MHz	$ h_{fe} $	1.5	6.0	
Open circuit output capacitance	3236	$V_{CB} = 10$ V dc; $I_E = 0$ $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	$C_{obo}$		20	pF
Input capacitance (output open-circuited)	3240	$V_{EB} = 0.5$ 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; $I_C = 500$ mA dc; $I_{B1} = 50$ mA dc; (see figure 4)	$t_d$		15	ns
Rise time	3251	Test condition A; $I_C = 500$ mA dc; $I_{B1} = 50$ mA dc; (see figure 4)	$t_r$		25	ns
Storage time	3251	Test condition A; $I_C = 500$ mA dc; $I_{B1} = 50$ mA dc; (see figure 5)	$t_s$			
Fall time	3251	Test condition A; $I_C = 500$ mA dc; $I_{B1} = 50$ mA dc; (see figure 5)				
<u>Subgroups 5, 6, and 7</u>						
Not applicable						

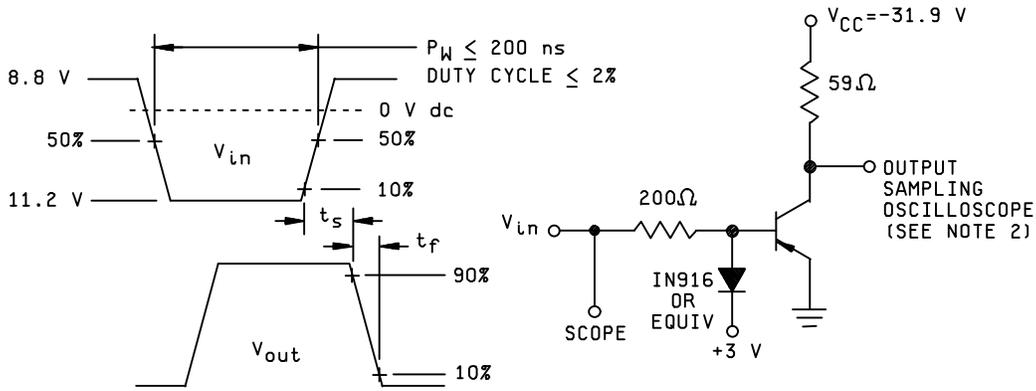
1/ For sampling plan, see MIL-PRF-19500.



NOTES:

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

FIGURE 4. Delay and rise 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:  $Z_{IN} \geq 100$  k $\Omega$ ;  $C_{in} \leq 12$  pF, rise time( $t_r$ )  $\leq 5$  ns.

FIGURE 5. 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 material 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. See MIL-PRF-19500.

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 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 - EC  
Air Force - 11  
DLA - CC

Preparing activity:  
DLA - CC  
  
(Project 5961-2276)

Review activities:  
Army - AV  
Air Force - 19, 80, 99

**STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL**

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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.

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<b>I RECOMMEND A CHANGE:</b>	1. DOCUMENT NUMBER	2. DOCUMENT DATE
	MIL-PRF-19500/512D	14 July 2000

**3. DOCUMENT TITLE**  
SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, SWITCHING TYPES 2N4029, 2N4033, 2N4033UA, 2N4033UB, JAN, JANTX, JANTXV, AND JANS

**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 DSN FAX EMAIL	7. DATE SUBMITTED

**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@dsccl.dla.mil
c. ADDRESS Defense Supply Center Columbus, ATTN: DSCC-VAC, 3990 East Broad Street, Columbus, OH 43213-1199	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