

The documentation and process conversion measures necessary to comply with this revision shall be completed by 2 February 1999

INCH-POUND

MIL-PRF-19500/573A
 2 November 1998
 SUPERSEDING
 MIL-S-19500/573
 12 January 1988

PERFORMANCE SPECIFICATION SHEET
 SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, SWITCHING
 TYPES 2N4209, 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 high-speed logic switching transistors. Four levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 herein (similar to TO-18).

1.3 Maximum ratings.

PT 1/ T _A = +25°C	PT 2/ T _C = +25°C	V _{CBO}	V _{CEO}	V _{EBO}	I _C	T _{OP} and T _{STG}	R _{θJC} 1/ 2/
<u>mW</u>	<u>mW</u>	<u>V dc</u>	<u>V dc</u>	<u>V dc</u>	<u>mA dc</u>	<u>°C</u>	<u>°C/W</u>
360	700	15	15	4.5	50	-65 to +200	250

1/ Derate linearly 2.05 mW/°C above T_A > 25°C.

2/ Derate linearly 4.0 mW/°C above T_C > 25°C.

1.4 Primary electrical characteristics.

Limits	h _{FE2} 2/ V _{CE} = 0.3 V dc I _C = 10 mA dc	h _{FE3} 2/ V _{CE} = 1.0 V dc I _C = 10 mA dc	h _{fe} f = 100 MHz V _{CE} = 10 V dc I _C = 10 mA dc
MIN	50	55	8.5
MAX	120	125	-----

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Supply Center Columbus, ATTN: DSCC-VAT, 3990 East Broad Street, 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 - Continued.

Limits	V _{BE(SAT)} 2 I _C = 10 mA dc I _B = 1.0 mA dc 2/	V _{CE(SAT)} 2 I _C = 10 mA dc I _B = 1.0 mA dc 2/	C _{obo} V _{CB} = 5 V dc I _E = 0 100 kHz ≤ f ≤ 1 MHz	t _{on} I _C = 10 mA dc I _B = 1.0 mA dc See figure 2	t _{off} I _C = 10 mA dc I _B = 1.0 mA dc See figure 2
	<u>V dc</u>	<u>V dc</u>	<u>pF</u>	<u>ns</u>	<u>ns</u>
Min	0.70				
Max	0.95	0.18	3.0	15	20

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

MILITARY

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

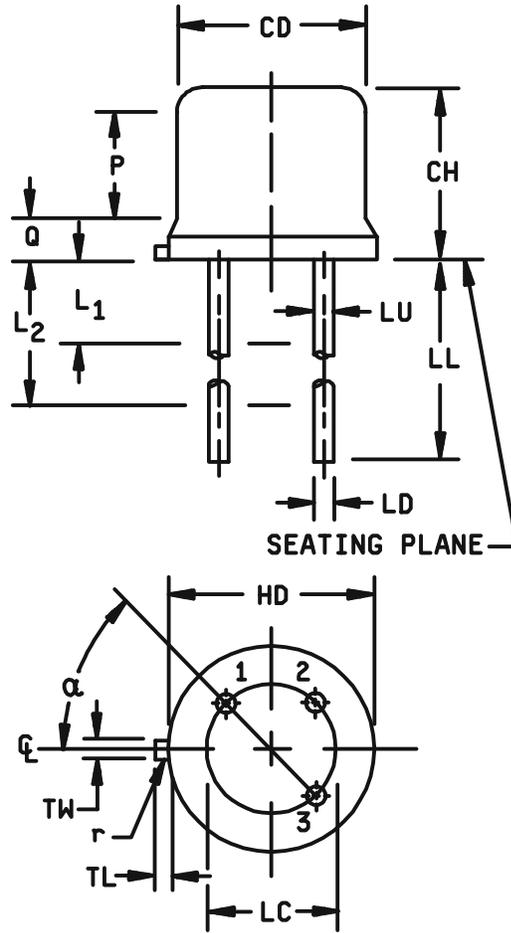
2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated specifications or specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 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).

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

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.178	.195	4.52	4.95	
CH	.170	.210	4.32	5.34	
H	.007	.041	0.23	1.04	
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	---	.030	---	0.76	5
r	---	.010	---	0.25	10
TL	.028	.048	0.71	1.22	3, 4
TW	.036	.046	0.91	1.17	3
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 Nx symbology.
12. Lead 1 is the Emitter; lead 2 is the Base; lead 3 is the collector.

FIGURE 1. Physical dimensions (similar to TO-18).

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

3.4 Interface requirements and physical dimensions. The interface requirements and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 (TO-18) herein.

3.4.1 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).

3.5 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.

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 (Appendix E, 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 appendix E, table IV of MIL-PRF-19500)	Measurement	
	JANS level	JANTX and JANTXV levels
9	hFE3, ICES1	Not applicable
11	ICES1; hFE3; Δ ICES1 = 100 percent of initial value or 5 nA dc, whichever is greater, Δ hFE3 = \pm 15 percent change from initial value	ICES1 and hFE3
12	See 4.3.1	See 4.3.1
13	Subgroups 2 and 3 of table I herein; Δ ICES1 = 100 percent of initial value or 5 nA dc, whichever is greater; Δ hFE3 = \pm 15 percent change from initial value.	Subgroup 2 of table I herein; Δ ICES1 = 100 percent of initial value or 5 nA dc, whichever is greater; Δ hFE3 = \pm 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} = 12 V dc; P_T = 360 mW.

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 appendix E, table VIa (JANS) and table VIb (JANTX and JANTXV) of MIL-PRF-19500. Electrical measurements (end points) and delta requirements shall be in accordance with the applicable steps of table II herein.

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

Subgroup	Method	Conditions
B4	1037	V_{CB} = 10 V dc; P_T = 360 mW at T_A = room ambient as defined in the general requirements of MIL-STD-750. $t_{on} = t_{off}$ = 1 minute minimum for 2,000 cycles. No heat sink or forced-air cooling on devices shall be permitted.
B5	1027	V_{CB} = 10 V dc; for 96 hours, T_A = +125°C for 96 hours, P_T = 360 mW at T_A = +100°C or adjusted as required according to the chosen T_A to give an average T_J = +275°C.
B6	3131	See 4.5.3.

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

Subgroup	Method	Conditions
B3	1027	V_{CB} = 12 V dc; P_T = 360 mW at T_A = room ambient as defined in the general requirements of MIL-STD-750. No heat sink or forced-air cooling on the devices shall be permitted.
B5	3131	See 4.5.3.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table VII of MIL-PRF-19500. Electrical measurements (end points) and delta requirements shall be in accordance with the applicable steps of table II herein.

4.4.3.1 Group C inspection, appendix E, table VII of MIL-PRF-19500.

Subgroup	Method	Conditions
C2	2036	Test condition E.
C6	1026	V_{CB} = 12 V dc, P_T = 360 mW at T_A = room ambient as defined in the general requirements of MIL-STD-750. No heat sink or forced-air cooling on device shall be permitted.

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. Use MIL-STD-750, method 3240, except the output capacitor shall be omitted.

4.5.3 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 application shall be 2.5 mA dc.
- b. Collector to emitter voltage magnitude shall be 10 V dc.
- c. 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.
- d. Mounting arrangement shall be with heat sink to case.
- e. Maximum $R_{\theta JC}$ limit shall be 250°C/W .

TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limit		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; $V_{CB} = 15$ V dc	I_{CBO1}		10	μ A dc
Emitter to base cutoff current	3061	Bias condition D; $V_{EB} = 4.5$ V dc	I_{EBO}		10	μ A dc
Breakdown voltage collector - emitter	3011	Bias condition D; $I_C = 3$ mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	15		V dc
Breakdown voltage collector - emitter	3041	Bias condition C; $I_C = 100$ mA dc	$V_{(BR)CES}$	15		V dc
Emitter to base cutoff current	3061	Bias condition D; $V_{EB} = 3.5$ V dc	I_{EBO2}		10	nA dc
Collector - emitter cutoff current	3041	$V_{CE} = 10$ V dc	I_{CES1}		10	nA dc
Forward-current transfer ratio	3076	$V_{CE} = 0.5$ V dc; $I_C = 1.0$ mA dc	h_{FE1}	35		
Forward-current transfer ratio	3076	$V_{CE} = 0.3$ V dc; $I_C = 10$ mA dc	h_{FE2}	50	120	
Forward-current transfer ratio	3076	$V_{CE} = 1.0$ V dc; $I_C = 10$ mA dc	h_{FE3}	55	125	
Forward-current transfer ratio	3076	$V_{CE} = 1.0$ V dc; $I_C = 50$ mA dc	h_{FE4}	40		
Collector - emitter voltage saturated	3071	$I_C = 1.0$ mA dc; $I_B = 0.1$ mA dc	$V_{CE(SAT)1}$		0.15	V dc
Collector - emitter voltage saturated	3071	$I_C = 10$ mA dc; $I_B = 1.0$ mA dc	$V_{CE(SAT)2}$		0.18	V dc
Collector - emitter voltage saturated	3071	$I_C = 50$ mA dc; $I_B = 5.0$ mA dc, pulsed (see 4.5.1)	$V_{CE(SAT)3}$		0.6	V dc
Base - emitter voltage saturated	3066	$I_C = 1.0$ mA dc; $I_B = 0.1$ mA dc	$V_{BE(SAT)1}$		0.8	V 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						
Base - emitter voltage saturated	3066	$I_C = 10 \text{ mA dc}; I_B = 1.0 \text{ mA dc}$	$V_{BE(SAT)2}$	0.70	0.95	V dc
Base - emitter voltage saturated	3066	$I_C = 50 \text{ mA dc}; I_B = 5.0 \text{ mA dc};$ pulsed (see 4.5.1)	$V_{BE(SAT)3}$		1.5	V dc
<u>Subgroup 3</u>						
High-temperature operation:		$T_A = +125^\circ\text{C}$				
Collector - emitter cutoff current	3041	Bias condition D; $V_{CE} = 10 \text{ V dc}$	I_{CES2}		5.0	$\mu\text{A dc}$
Low-temperature operation:		$T_A = -55^\circ\text{C}$				
Forward-current transfer ratio	3076	$V_{CE} = 1.0 \text{ V dc}; I_C = 10 \text{ mA dc}$	h_{FE5}	25		
<u>Subgroup 4</u>						
Open circuit output capacitance	3236	$V_{CB} = 5.0 \text{ V dc}; I_E = 0$ $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	C_{obo}		3.0	pF
Input capacitance (output open-circuited)	3240	$V_{CB} = 5.0 \text{ V dc}; I_E = 0$ $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	C_{ibo}		3.5	pF
Magnitude of common emitter small-signal short-circuit forward-current transfer ratio	3306	$V_{CE} = 10 \text{ V dc}; I_C = 10 \text{ mA dc};$ $f = 100 \text{ MHz}$	$ h_{fe} $	8.5		
Turn-on delay time		See figure 2	t_d		10	ns
Rise time		See figure 2	t_r		15	ns
Storage time		See figure 2	t_{s1}		20	ns
Storage time		See figure 2	t_{s2}		20	ns
Turn-on time		See figure 2	t_{on}		15	ns
Turn-off time		See figure 2	t_{off}		20	ns
<u>Subgroup 5</u>						
Not applicable						

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

TABLE II. Groups B and C electrical measurements. 1/ 2/ 3/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Collector - emitter cutoff current	3041	Bias condition D; $V_{CB} = 10 \text{ V dc}$	I_{CES1}		10	nA dc
2.	Collector - emitter cutoff current	3041	Bias condition D; $V_{CB} = 10 \text{ V dc}$	I_{CES2}		20	nA dc
3.	Collector - emitter voltage (saturated)	3071	$I_C = 10 \text{ mA dc};$ $I_B = 1.0 \text{ mA dc}$	$V_{CE(Sat)2}$		0.18	V dc
4.	Base - emitter voltage (saturated)	3066	$I_C = 10 \text{ mA dc};$ $I_B = 1.0 \text{ mA dc}$	$V_{BE(Sat)2}$	0.70	0.95	V dc
5.	Forward-current transfer ratio	3076	$V_{CE} = 1.0 \text{ V dc};$ $I_C = 10 \text{ mA dc}$	h_{FE3}	50	125	
6.	Forward-current transfer ratio	3076	$V_{CE} = 1.0 \text{ V dc};$ $I_C = 10 \text{ mA dc}$	Δh_{FE3}	± 25 percent change from initial value.		
7.	Collector - emitter cutoff current	3041		ΔI_{CES1}	100 percent of initial value or 5 nA dc, whichever is greater.		
8.	Base - emitter voltage (saturated)	3066	$I_C = 10 \text{ mA dc};$ $I_B = 1.0 \text{ mA dc}$	$\Delta V_{BE(Sat)2}$	± 50 mV dc change from initial value.		

1/ The electrical measurements for appendix E, table VIa (JANS) of MIL-PRF-19500 are as follows:

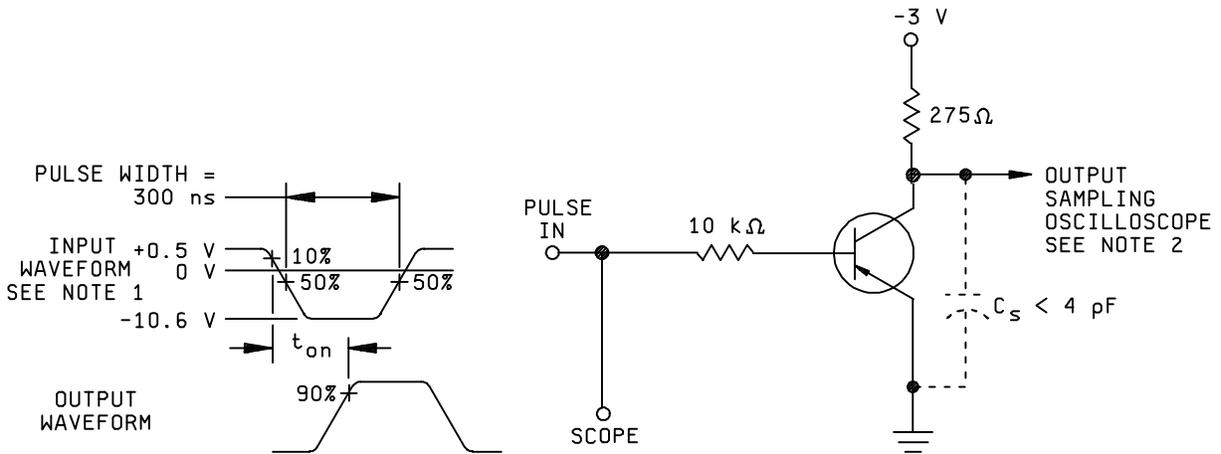
- a. Subgroup 3, see table II herein, steps 1, 3, 4 and 5.
- b. Subgroup 4, see table II herein, steps 2, 3, 4, 5, 6, 7 and 8.
- c. Subgroup 5, see table II herein, steps 2, 3, 4, 5, 6 and 7.

2/ The electrical measurements for appendix E, table VIb (JANTX and JANTXV) of MIL-PRF-19500 are as follows:

- a. Subgroup 2, see table II herein, steps 1, 4 and 5.
- b. Subgroups 3 and 6, see table II herein, steps 2, 5 and 6.

3/ The electrical measurements for appendix E, table VII of MIL-PRF-19500 are as follows:

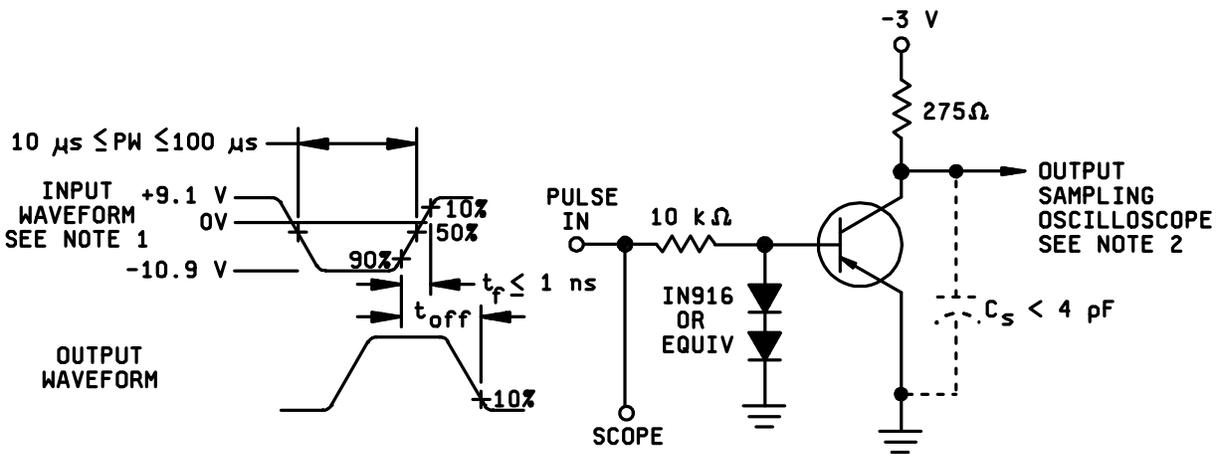
- a. Subgroups 2 and 3, table II herein, steps 1, 3, and 4.
- b. Subgroup 6, see table II herein, steps 1, 3, 4, 5, and 6 (for JANS) and 2, 3, and 5 (for JAN, JANTX, and JANTXV).



NOTES:

1. The rise time (t_r) of the applied pulse shall be $\leq 1.0 \text{ ns}$, duty cycle ≤ 2 percent, and the generator source Z shall be 50Ω .
2. Sampling oscilloscope: $Z_{IN} \geq 100 \text{ k}\Omega$; rise time(t_r) $\leq .1 \text{ ns}$.

FIGURE 2. Delay and rise time test circuit.



NOTES:

1. The rise time (t_r) of the applied pulse shall be $\leq 1.0 \text{ ns}$, duty cycle ≤ 2 percent, and the generator source Z shall be 50Ω .
2. Sampling oscilloscope: $Z_{IN} \geq 100 \text{ k}\Omega$; rise time (t_r) $\leq .1 \text{ ns}$.

FIGURE 3. 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.

5.2 Marking. Unless otherwise specified (see 6.2), marking shall be in accordance with MIL-PRF-19500.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Notes. 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 Products List QPL 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 purchase 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, 3990 East Broad Street, 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 extent of the changes.

Custodians:
Army - CR
Navy - EC
Air Force - 17
NASA - NA

Preparing activity:
DLA - CC
(Project 5961-2033)

Review activities:
Army - AR, AV, MI, SM
Navy - AS, CG, MC
Air Force - 13, 19, 85, 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-19500/573A

2. DOCUMENT DATE (YYMMDD)
981102

3. DOCUMENT TITLE

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, SWITCHING, TYPE 2N4209, 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
(YYMMDD)

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-VAT, 3990 East Broad
Street, Columbus, OH 43216-5000

IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:
Defense Quality and Standardization Office
5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466
Telephone (703) 756-2340 DSN 289-2340