

The documentation and process conversion measures necessary to comply with this revision shall be completed by 4 February 2004.
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INCH-POUND

MIL-PRF-19500/276F
4 November 2003
SUPERSEDING
MIL-PRF-19500/276E
10 April 2003

PERFORMANCE SPECIFICATION

* SEMICONDUCTOR DEVICE, THYRISTORS (CONTROLLED RECTIFIERS), SILICON, TYPES 2N2323, 2N2324, 2N2326, 2N2328, 2N2329, AND S AND U4 VERSIONS, 2N2323A, 2N2324A, 2N2326A, 2N2328A, 2N2329A, AND AS AND AU4 VERSIONS, 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, reverse-blocking-triode thyristors. 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-39, 5) and 2 (U4).

* 1.3 Maximum ratings.

Type	V _{RM}	V _{RM} (Non-rep)	V _{FBXM}	I _o (1)	I _{FSM} (2)	V _{GKM}	T _J and T _{STG}	Barometric pressure
	<u>V (pk)</u>	<u>V (pk)</u>	<u>V (pk)</u>	<u>A dc</u>	<u>a</u>	<u>V (pk)</u>	<u>°C</u> -65 to +150	<u>mmHg</u>
2N2323, S, U4	50	75	50 (3)	.22	15	6		
2N2323A, AS, AU4	50	75	50 (4)	.22	15	6		
2N2324, S, U4	100	150	100 (3)	.22	15	6		
2N2324A, AS, AU4	100	150	100 (4)	.22	15	6		
2N2326, S, U4	200	300	200 (3)	.22	15	6		
2N2326A, AS, AU4	200	300	200 (4)	.22	15	6		
2N2328, S, U4	300	400	300 (3)	.22	15	6		15
2N2328A, AS, AU4	300	400	300 (4)	.22	15	6		15
2N2329, S, U4	400	500	400 (3)	.22	15	6		15
2N2329A, AS, AU4	400	500	400 (4)	.22	15	6		15

- (1) This average forward current is for an ambient temperature of 80°C and 180 electrical degrees of conduction. For other operating conditions see figure 3.
- (2) Surge current is non-recurrent. The rate of rise of peak surge current shall not exceed 40 A during the first 5 μs after switching from the "off" (blocking) to the "on" (conducting) state. This is measured from the point where the thyristor voltage has decayed to 90 percent of its initial blocking value.
- (3) Gate connected to cathode through 1,000 ohm resistor.
- (4) Gate connected to cathode through 2,000 ohm resistor.

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. $T_C = +25^\circ\text{C}$, unless otherwise specified.

	V_{FM}	I_{HOX}	$V_{GT} (1)$	$I_{GT} (1)$	$V_{GT} (2)$	$I_{GT} (2)$
	$I_{FM} = 4 \text{ (pk)}$ $t_p = 8.5 \text{ ms max}$	(1) (2)	2N2323, S, U4 2N2324, S, U4 2N2326, S, U4 2N2328, S, U4 2N2329, S, U4		2N2323A, AS, AU4 2N2324A, AS, AU4 2N2326A, AS, AU4 2N2328A, AS, AU4 2N2329A, AS, AU4	
	V	mA dc	$V \text{ dc}$	$\mu\text{A dc}$	$V \text{ dc}$	$\mu\text{A dc}$
Min			0.1		0.1	
Max	2.2	2.0	1.0	350	0.8	75

- (1) Gate connected to cathode through 1,000 ohm resistor (for non-A types).
- (2) Gate connected to cathode through 2,000 ohm resistor (for A types).

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

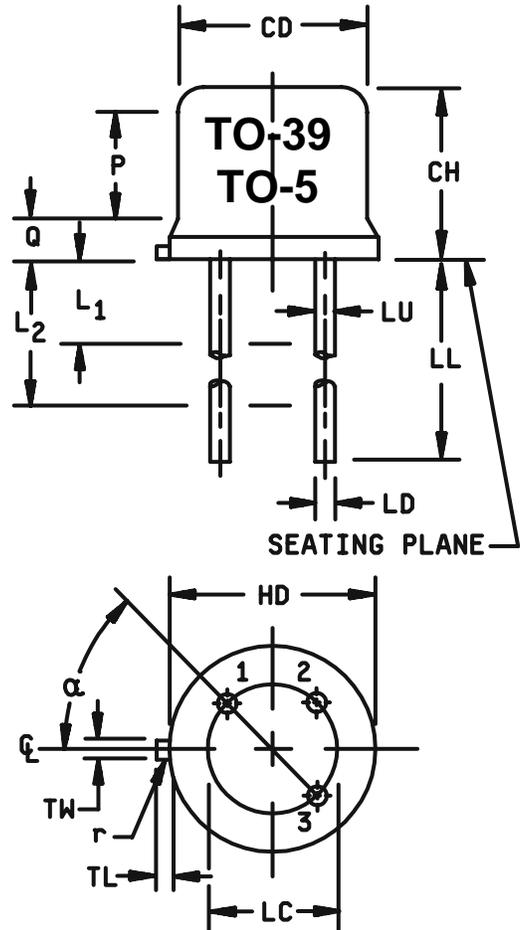
DEPARTMENT OF DEFENSE

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.

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					8, 12, 13
LU	.016	.019	0.041	0.048	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	4, 10
TW	.028	.034	0.71	0.86	3, 10
r		.010		0.25	10
α	45° TP		45° TP		6
P	.100		2.54		

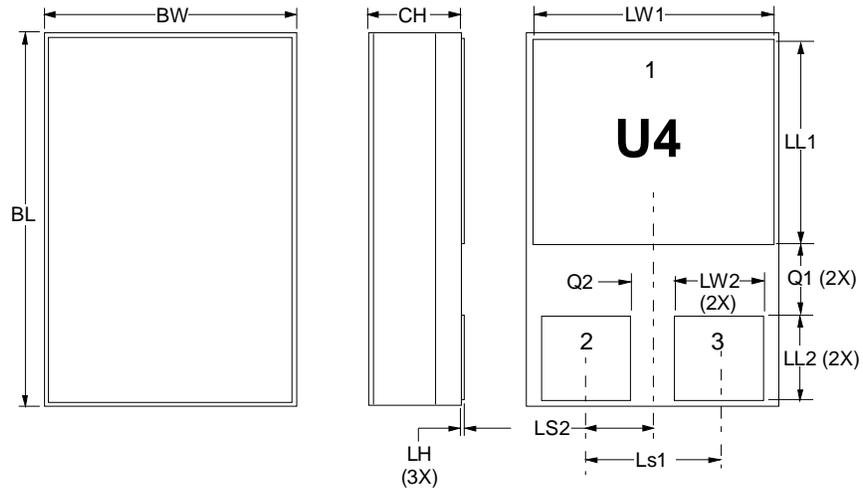


NOTES:

1. Dimension are in inches.
2. Millimeters 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. Lead 1 = cathode, lead 2 = gate, lead 3 = anode. The anode shall be internally connected to the case.
10. Dimension r (radius) applies to both inside corners of tab.
11. In accordance with ASME Y14.5M, diameters are equivalent to Φx symbology.
12. For "S" suffix devices (TO-39), dimension LL is .500 (12.70 mm) minimum, .750 (19.05 mm) maximum.
13. For "non-S" suffix devices (TO-5), dimension LL is 1.500 (38.10 mm) minimum, 1.750 (44.45 mm) maximum.

FIGURE 1. Physical dimensions (TO-39, 5).

MIL-PRF-19500/276F



Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.215	.225	5.46	5.72
BW	.145	.155	3.68	3.94
CH	.050	.070	1.27	1.77
LH		.020		0.50
LW1	.135	.145	3.43	3.68
LW2	.047	.057	1.19	1.45
LL1	.085	.125	2.16	3.17
LL2	.045	.075	1.14	1.91
LS1	.065	.095	1.65	2.41
LS2	.033	.048	.825	1.21
Q1	.045	.070	1.14	1.78
Q2	.025	.048	.635	1.22
TERM 1	cathode			
TERM 2	gate			
TERM 3	anode			

NOTES:

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

* FIGURE 2. Physical dimensions and configuration (U4).

3. REQUIREMENTS

3.1 General. The individual requirements shall be as specified in MIL-PRF-19500 and as modified herein.

3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.3).

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

I_{FBX}	DC forward blocking current with specified conditions applied to the gate.
I_{HOX}	DC holding current with specified conditions applied to the gate.
I_{RBX}	DC reverse blocking current with specified conditions applied to the gate.
R_{GK}	External resistance between gate and cathode terminals.
V_{AA}	Anode supply voltage (dc).
V_{FBX}	Forward blocking voltage, gate connected to the specified reference terminal.
V_{GG}	Gate supply voltage.

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 and figure 2 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 specification (see 6.2).

3.4.2 Lead material. Where a choice of lead material is desired, it shall be specified in the acquisition document (see 6.2).

3.4.3 Construction. These devices shall be constructed in a manner and using materials which enable the thyristors to meet the applicable requirements of MIL-PRF-19500 and this specification.

3.5 Marking. Devices shall be marked as specified in 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.

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.

MIL-PRF-19500/276F

4.3 Screening (JANS, JANTX and JANTXV levels). Screening shall be in accordance with appendix E, 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
2	Optional	Optional
3a 3b 3c	Required Not applicable Not applicable	Required Not applicable Not applicable
4	Required	Optional
5	Required	Not applicable
7a and 7b	Optional	Optional
8	Required	Not required
9	Not applicable	Not applicable
10	Not applicable	Not applicable
11	I_{RBX1} , I_{FBX1} , V_{GT1} , I_{GT1}	I_{RBX1} , I_{FBX1} , V_{GT1} , I_{GT1}
12	See 4.3.2	See 4.3.1
(1) 13	Subgroups 2 and 3 of table I herein: $\Delta I_{RBX1} = \pm 4.0 \mu A$ dc; $\Delta I_{FBX1} = +4.0 \mu A$ dc.	Subgroup 2 of table I herein: $\Delta I_{RBX1} = \pm 4.0 \mu A$ dc; $\Delta I_{FBX1} = +4.0 \mu A$ dc.
14a and 14b	Required	Required
15	Required	Not required
16	Required	Not required

(1) Devices which exceed the table I limits for this test shall be rejected.

4.3.1 High temperature blocking. Blocking voltage conditions are as follows: Forward blocking voltage. See figure 4, $T_A = 122^\circ\text{C} \pm 3^\circ\text{C}$. $t = 96$ hours min.

- a. $V_{\text{FBX}} = 50$ V dc for 2N2323, U4, S, A, AU4, AS.
- b. $V_{\text{FBX}} = 100$ V dc for 2N2324, U4, S, A, AU4, AS.
- c. $V_{\text{FBX}} = 200$ V dc for 2N2326, U4, S, A, AU4, AS.
- d. $V_{\text{FBX}} = 300$ V dc for 2N2328, U4, S, A, AU4, AS.
- e. $V_{\text{FBX}} = 400$ V dc for 2N2329, U4, S, A, AU4, AS.

* 4.3.2 High temperature blocking. Blocking voltage for JANS are as follows: Forward blocking voltage. See figure 4, $T_A = 122^\circ\text{C} \pm 3^\circ\text{C}$. $t = 240$ hours min.

- a. $V_{\text{FBX}} = 50$ V dc for 2N2323, U4, S, A, AU4, AS.
- b. $V_{\text{FBX}} = 100$ V dc for 2N2324, U4, S, A, AU4, AS.
- c. $V_{\text{FBX}} = 200$ V dc for 2N2326, U4, S, A, AU4, AS.
- d. $V_{\text{FBX}} = 300$ V dc for 2N2328, U4, S, A, AU4, AS.
- e. $V_{\text{FBX}} = 400$ V dc for 2N2329, U4, S, A, AU4, AS.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500 and as specified herein. If alternate screening is being performed in accordance with MIL-PRF-19500, a sample of screened devices shall be submitted to and pass the requirements of table I, subgroups 1 and 2 inspection only (table VIb, group B, subgroup 1 is not required to be performed again if group B has already been satisfied in accordance with 4.4.2).

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 (JANTX and JANTXV) of MIL-PRF-19500, appendix E, and as follows. Electrical measurements (end-points) 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.

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
B4	1037	$T_A = 75^\circ\text{C} \pm 5^\circ\text{C}$, $I_O = 220$ mA dc, see figure 3. No heatsink or forced air on the device shall be permitted. $R_{\text{GK}} = 1$ k ohm for 2N2323, S, U4, 2N2324, S, U4, 2N2326, S, U4, 2N2328, S, U4, 2N2329, S, U4. $R_{\text{GK}} = 2$ k ohm for 2N2323A, AS, AU4, 2N2324A, AS, AU4, 2N2326A, AS, AU4, 2N2328A, AS, AU4, 2N2329A, AS, AU4.
B5	1027	$T_A = 175^\circ\text{C}$ 96 hours or adjust to give an average lot $T_J = 225^\circ\text{C}$; $I_O = 220$ mA dc, see figure 3.
B6	3181	$R_{\theta\text{JA}} = 175^\circ$ C/W max.

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

<u>Step</u>	<u>Method</u>	<u>Conditions</u>
1.	1037	<p>$T_A = 75^\circ\text{C} \pm 5^\circ\text{C}$, $I_O = 220$ mA dc, see figure 3. No heatsink or forced air on the device shall be permitted.</p> <p>$R_{GK} = 1$ k ohm for 2N2323, S, U4, 2N2324, S, U4, 2N2326, S, U4, 2N2328, S, U4, 2N2329, S, U4. $R_{GK} = 2$ k ohm for 2N2323A, AS, AU4, 2N2324A, AS, AU4, 2N2326A, AS, AU4, 2N2328A, AS, AU4, 2N2329A, AS, AU4.</p>
2.	1037	The intermittent operation life test of step 1 shall be extended to 6000 cycles. Group B, step 2 shall not be required more than once for any single wafer lot. 45 devices, c = 0.
3.	3181	$R_{\theta JA} = 175^\circ$ C/W max., (for qualification only). 22 devices, c = 0.

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

- a. 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.
- b. Must be chosen from an inspection lot that has been submitted to and passed table I, 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 of MIL-PRF-19500 for JANS, and group B for JAN, JANTX, and JANTXV) may be pulled prior to the application of final lead finish.
- c. 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.

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) 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.

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
C2	2036	Condition E.
C6	1037	Not applicable.

4.5 Methods 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.

MIL-PRF-19500/276F

* 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 examination <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>		Table I, subgroup 2				
Bond strength <u>3/ 4/</u>	2037	Precondition T _A = +250°C at t = 24 hrs or T _A = +300°C at t = 2 hrs n = 11 wires, c = 0				
<u>Subgroup 2</u>						
Reverse blocking current 2N2323A, AS, AU4 2N2324A, AS, AU4 2N2326A, AS, AU4 2N2328A, AS, AU4 2N2329A, AS, AU4 2N2323, S, U4 2N2324, S, U4 2N2326, S, U4 2N2328, S, U4 2N2329, S, U4 2N2323, U4, S, A, AU4, AS 2N2324, U4, S, A, AU4, AS 2N2326, U4, S, A, AU4, AS 2N2328, U4, S, A, AU4, AS 2N2329, U4, S, A, AU4, AS	4211	DC method, condition B R ₂ = 2 k ohm R ₂ = 1 k ohm V _R = 50 V dc V _R = 100 V dc V _R = 200 V dc V _R = 300 V dc V _R = 400 V dc	I _{RBX1}		10	μA dc
Forward blocking current 2N2323A, AS, AU4 2N2324A, AS, AU4 2N2326A, AS, AU4 2N2328A, AS, AU4 2N2329A, AS, AU4	4206	DC method, condition B R ₂ = 2 k ohm	I _{FBX1}		10	μA dc

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u> - Continued.						
Forward blocking current 2N2323, S, U4 2N2324, S, U4 2N2326, S, U4 2N2328, S, U4 2N2329, S, U4 2N2323, U4, S, A, AU4, AS 2N2324, U4, S, A, AU4, AS 2N2326, U4, S, A, AU4, AS 2N2328, U4, S, A, AU4, AS 2N2329, U4, S, A, AU4, AS	4026	DC method, condition B, $R_2 = 1 \text{ k ohm}$ $V_R = 50 \text{ V dc}$ $V_R = 100 \text{ V dc}$ $V_R = 200 \text{ V dc}$ $V_R = 300 \text{ V dc}$ $V_R = 400 \text{ V dc}$	I_{FBX1}		10	$\mu\text{A dc}$
Reverse gate current	4219	$V_{KG} = 6 \text{ V dc}$	I_{KG}		200	$\mu\text{A dc}$
Gate trigger voltage and current 2N2323, S, U4 2N2324, S, U4 2N2326, S, U4 2N2328, S, U4 2N2329, S, U4 2N2323A, AS, AU4 2N2324A, AS, AU4 2N2326A, AS, AU4 2N2328A, AS, AU4 2N2329A, AS, AU4	4221	$V_2 = V_{FBX} = 6 \text{ V dc};$ $R_L = 100 \text{ ohms}$ $R_e = 1 \text{ k ohm}$ $R_e = 2 \text{ k ohm}$	V_{GT1} I_{GT1} V_{GT1} I_{GT1}	0.35	0.80 200 0.60 20	V dc $\mu\text{A dc}$ V dc $\mu\text{A dc}$
<u>Subgroup 3</u>						
High temperature operation:		$T_A = +125^\circ\text{C}$				
Reverse blocking current 2N2323A, AS, AU4 2N2324A, AS, AU4 2N2326A, AS, AU4 2N2328A, AS, AU4 2N2329A, AS, AU4 2N2323, S, U4 2N2324, S, U4 2N2326, S, U4 2N2328, S, U4 2N2329, S, U4 2N2323, U4, S, A, AU4, AS 2N2324, U4, S, A, AU4, AS 2N2326, U4, S, A, AU4, AS 2N2328, U4, S, A, AU4, AS 2N2329, U4, S, A, AU4, AS	4211	DC method, condition B $R_2 = 2 \text{ k ohm}$ $R_2 = 1 \text{ k ohm}$ $V_R = 50 \text{ V dc}$ $V_R = 100 \text{ V dc}$ $V_R = 200 \text{ V dc}$ $V_R = 300 \text{ V dc}$ $V_R = 400 \text{ V dc}$	I_{RBX2}		100	$\mu\text{A dc}$

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 3</u> - Continued.						
Forward blocking current	4206	DC method, condition B	I _{FBX2}		100	μA dc
2N2323, S, U4 2N2324, S, U4 2N2326, S, U4 2N2328, S, U4 2N2329, S, U4		R ₂ = 1 kΩ				
2N2323A, AS, AU4 2N2324A, AS, AU4 2N2326A, AS, AU4 2N2328A, AS, AU4 2N2329A, AS, AU4		R ₂ = 2 kΩ				
2N2323, U4, S, A, AU4, AS 2N2324, U4, S, A, AU4, AS 2N2326, U4, S, A, AU4, AS 2N2328, U4, S, A, AU4, AS 2N2329, U4, S, A, AU4, AS		V _{FBX} = 50 V dc V _{FBX} = 100 V dc V _{FBX} = 200 V dc V _{FBX} = 300 V dc V _{FBX} = 400 V dc				
Gate trigger voltage	4221		V _{GT3}	0.1		V dc
2N2323, S, U4 2N2324, S, U4 2N2326, S, U4 2N2328, S, U4 2N2329, S, U4		R _L = 1,000 ohm; R _e = 1 kΩ				
2N2323A, AS, AU4 2N2324A, AS, AU4 2N2326A, AS, AU4 2N2328A, AS, AU4 2N2329A, AS, AU4		R _L = 100 ohm; R _e = 2 kΩ				
2N2323, U4, S, A, AU4, AS 2N2324, U4, S, A, AU4, AS 2N2326, U4, S, A, AU4, AS 2N2328, U4, S, A, AU4, AS 2N2329, U4, S, A, AU4, AS		V ₂ = V _{FBX} = 6 V dc				
Low temperature operation:	4211	T _A = -65°C	I _{RBX3}			
Reverse blocking current		DC method, condition B			5	μA dc
2N2323A, AS, AU4 2N2324A, AS, AU4 2N2326A, AS, AU4 2N2328A, AS, AU4 2N2329A, AS, AU4		R ₂ = 2 k ohm				

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 3</u> - Continued.						
Low temperature operation:		$T_A = -65^\circ\text{C}$				
Reverse blocking current	4211	DC method, condition B $R_2 = 1 \text{ k ohm}$	I_{RBX3}		5	$\mu\text{A dc}$
2N2323, S, U4 2N2324, S, U4 2N2326, S, U4 2N2328, S, U4 2N2329, S, U4						
2N2323, U4, S, A, AU4, AS 2N2324, U4, S, A, AU4, AS 2N2326, U4, S, A, AU4, AS 2N2328, U4, S, A, AU4, AS 2N2329, U4, S, A, AU4, AS		$V_R = 50 \text{ V dc}$ $V_R = 100 \text{ V dc}$ $V_R = 200 \text{ V dc}$ $V_R = 300 \text{ V dc}$ $V_R = 400 \text{ V dc}$				
Forward blocking current	4206	DC method, condition B $R_2 = 1 \text{ k ohm.}$	I_{FBX3}		5	$\mu\text{A dc}$
2N2323, S, U4 2N2324, S, U4 2N2326, S, U4 2N2328, S, U4 2N2329, S, U4						
2N2323A, AS, AU4 2N2324A, AS, AU4 2N2326A, AS, AU4 2N2328A, AS, AU4 2N2329A, AS, AU4		$R_2 = 2 \text{ k ohm.}$				
2N2323, U4, S, A, AU4, AS 2N2324, U4, S, A, AU4, AS 2N2326, U4, S, A, AU4, AS 2N2328, U4, S, A, AU4, AS 2N2329, U4, S, A, AU4, AS		$V_{FBX} = 50 \text{ V dc}$ $V_{FBX} = 100 \text{ V dc}$ $V_{FBX} = 200 \text{ V dc}$ $V_{FBX} = 300 \text{ V dc}$ $V_{FBX} = 400 \text{ V dc}$				
Gate trigger voltage and current	4221	$V_2 = V_{FBX} = 6 \text{ V dc};$ $R_L = 100 \text{ ohms}$				
2N2323, S, U4 2N2324, S, U4 2N2326, S, U4 2N2328, S, U4 2N2329, S, U4		$R_e = 1 \text{ k ohm}$	V_{GT2} I_{GT2}		1.0 350	V dc $\mu\text{A dc}$
2N2323A, AS, AU4 2N2324A, AS, AU4 2N2326A, AS, AU4 2N2328A, AS, AU4 2N2329A, AS, AU4		$R_e = 2 \text{ k ohm}$	V_{GT2} I_{GT2}		0.8 75	V dc $\mu\text{A dc}$

See footnotes at end of table.

MIL-PRF-19500/276F

* TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4</u>						
Exponential rate of voltage rise	4231	$T_A = 125^\circ\text{C}$, condition B, $50 \text{ ohms} \leq R_L \leq 400 \text{ ohms}$, $C = 0.1 \text{ to } 1.0 \mu\text{F}$, repetition rate = 60 pps, test duration = 15 seconds $dv/dt = 1.8 \text{ V}/\mu\text{s}$, $R_3 = 1 \text{ k ohm}$ $dv/dt = 0.7 \text{ V}/\mu\text{s}$, $R_3 = 2 \text{ k ohm}$	V_{FBX}			
2N2323, S, U4 2N2324, S, U4 2N2326, S, U4 2N2328, S, U4 2N2329, S, U4 2N2323A, AS, AU4 2N2324A, AS, AU4 2N2326A, AS, AU4 2N2328A, AS, AU4 2N2329A, AS, AU4						
2N2323, U4, S, A, AU4, AS 2N2324, U4, S, A, AU4, AS 2N2326, U4, S, A, AU4, AS 2N2328, U4, S, A, AU4, AS 2N2329, U4, S, A, AU4, AS		$V_{AA} = 50 \text{ V dc}$ $V_{AA} = 100 \text{ V dc}$ $V_{AA} = 200 \text{ V dc}$ $V_{AA} = 300 \text{ V dc}$ $V_{AA} = 400 \text{ V dc}$		47 95 190 285 380		V dc V dc V dc V dc V dc
Forward "on" voltage	4226	$I_{FM} = 4 \text{ A(pk)}$ (pulse), pulse width = 8.5 ms, max; duty cycle = 2 percent max	V_{FM}		2.2	V (pk)
Holding current	4201	Condition B, $V_{AA} = 24 \text{ V dc}$ max, $I_{F1} = 100 \text{ mA dc}$, $I_{F2} = 10 \text{ mA dc}$, gate trigger source voltage = 6 V dc, trigger pulse width = 25 μs minimum, $R_2 = 330 \text{ ohms}$ $R_3 = 1 \text{ k ohm}$ $R_3 = 2 \text{ k ohm}$	I_{HOX}		2.0	mA dc
2N2323, S, U4 2N2324, S, U4 2N2326, S, U4 2N2328, S, U4 2N2329, S, U4 2N2323A, AS, AU4 2N2324A, AS, AU4 2N2326A, AS, AU4 2N2328A, AS, AU4 2N2329A, AS, AU4						
<u>Subgroup 5</u>						
Not applicable						

See footnotes at end of table.

MIL-PRF-19500/276F

* TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 6</u>						
Surge current	4066	See figure 5; $T_A = 122^\circ\text{C}$, $I_{FM} = 15\text{ A}$; 10 surges, 1 per minute, $I_O = 0$ at rated V_{RWM} , $f = 60\text{ Hz}$				
Electrical end-point measurements		See table II, steps 1, 2, 3, and 4				
<u>Subgroup 7</u>						
Nonrepetitive peak voltage		See figure 6, 10 pulses.				
2N2323, U4, S, A, AU4, AS		$V_{RM} = 75\text{ V dc}$				
2N2324, U4, S, A, AU4, AS		$V_{RM} = 150\text{ V dc}$				
2N2326, U4, S, A, AU4, AS		$V_{RM} = 300\text{ V dc}$				
2N2328, U4, S, A, AU4, AS		$V_{RM} = 400\text{ V dc}$				
2N2329, U4, S, A, AU4, AS		$V_{RM} = 500\text{ V dc}$				
Electrical end-point measurements		See table II, steps 1, 2, 3, and 4.				

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

2/ For resubmission of failed table I, subgroup 1, double the sample size of the failed test or sequence of tests. A failure in table I, 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.

MIL-PRF-19500/276F

* TABLE II. Groups A, B, and C electrical (end-point) measurements. 1/ 2/ 3/ 4/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Reverse blocking current 2N2323, S, U4 2N2324, S, U4 2N2326, S, U4 2N2328, S, U4 2N2329, S, U4 2N2323A, AS, AU4 2N2324A, AS, AU4 2N2326A, AS, AU4 2N2328A, AS, AU4 2N2329A, AS, AU4 2N2323, U4, S, A, AU4, AS 2N2324, U4, S, A, AU4, AS 2N2326, U4, S, A, AU4, AS 2N2328, U4, S, A, AU4, AS 2N2329, U4, S, A, AU4, AS	4211	DC method, condition C $R_2 = 1 \text{ k ohm}$ $R_2 = 2 \text{ k ohm}$ $V_R = 50 \text{ V dc}$ $V_R = 100 \text{ V dc}$ $V_R = 200 \text{ V dc}$ $V_R = 300 \text{ V dc}$ $V_R = 400 \text{ V dc}$	I_{RBX1}		10	$\mu\text{A dc}$
2.	Forward blocking current 2N2323, S, U4 2N2324, S, U4 2N2326, S, U4 2N2328, S, U4 2N2329, S, U4 2N2323A, AS, AU4 2N2324A, AS, AU4 2N2326A, AS, AU4 2N2328A, AS, AU4 2N2329A, AS, AU4 2N2323, U4, S, A, AU4, AS 2N2324, U4, S, A, AU4, AS 2N2326, U4, S, A, AU4, AS 2N2328, U4, S, A, AU4, AS 2N2329, U4, S, A, AU4, AS	4206	DC method, condition C $R_2 = 1 \text{ k ohm}$ $R_2 = 2 \text{ k ohm}$ $V_{FBX} = 50 \text{ V dc}$ $V_{FBX} = 100 \text{ V dc}$ $V_{FBX} = 200 \text{ V dc}$ $V_{FBX} = 300 \text{ V dc}$ $V_{FBX} = 400 \text{ V dc}$	I_{FBX1}		10	$\mu\text{A dc}$
3.	Forward "on" voltage	4226	$I_{FM} = 4\text{A(pk)}$ (pulse), pulse width = 8.5 ms, max; duty cycle = 2 percent max	V_{FM}		2.2	V (pk)

See footnotes on next page.

MIL-PRF-19500/276F

* TABLE II. Groups A, B, and C electrical (end-point) measurements - Continued. 1/ 2/ 3/ 4/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
4.	Gate trigger voltage	4221	$V_2 = V_{FBX} = 6 \text{ V dc};$ $R_L = 100 \text{ ohms}$	V _{GT1} I _{GT1}	0.35	0.8 200	V dc μA dc
	2N2323, S, U4 2N2324, S, U4 2N2326, S, U4 2N2328, S, U4 2N2329, S, U4 2N2323A, AS, AU4 2N2324A, AS, AU4 2N2326A, AS, AU4 2N2328A, AS, AU4 2N2329A, AS, AU4		$R_e = 1 \text{ k ohm}$				
			$R_e = 2 \text{ k ohm}$				

1/ The electrical measurements for table V of MIL-PRF-19500, appendix E, are as follows: Subgroups 6 and 7, see table II herein, steps 1, 2, 3, and 4.

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

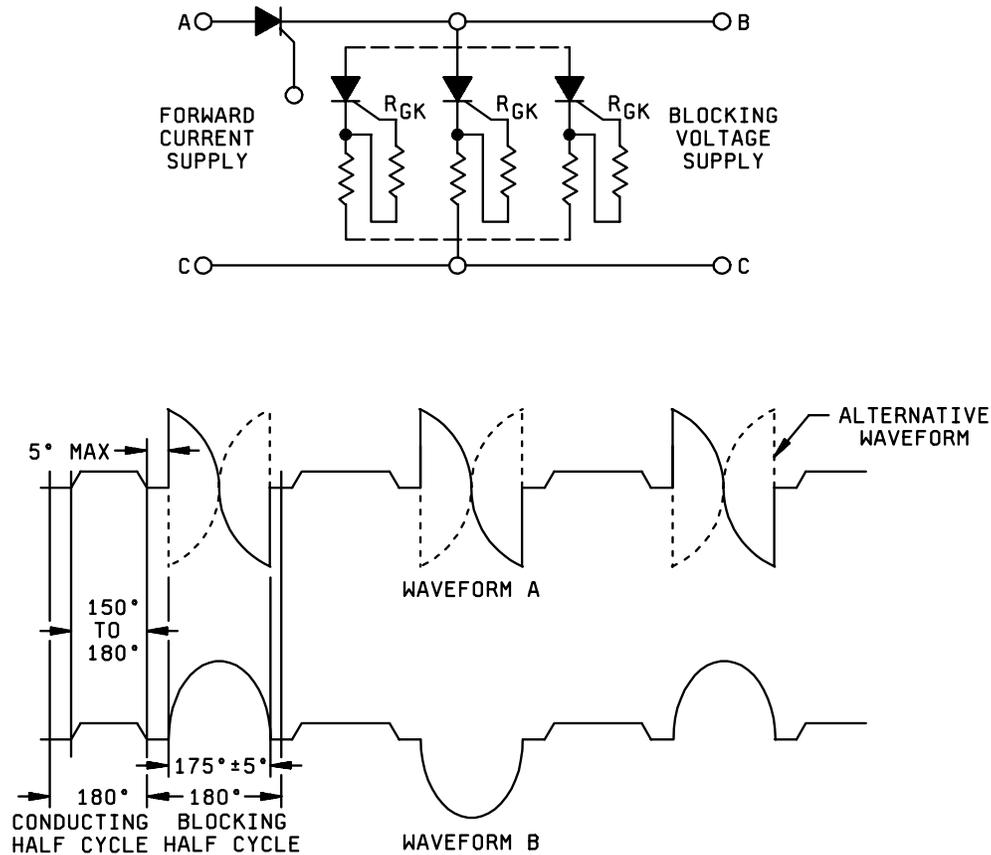
- a. Subgroup 3, see table II herein, steps 1, 2, 3, and 4.
- b. Subgroup 4, see table II herein, steps 1, 2, 3, and 4.
- c. Subgroup 5, see table II herein, steps 1, 2, 3, and 4.

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

- a. Step 1, see table II herein, steps 1, 2, 3, and 4.
- b. Step 2, see table II herein, steps 1, 2, 3, and 4.
- c. Step 3, see table II herein, steps 1, 2, 3, and 4.

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

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

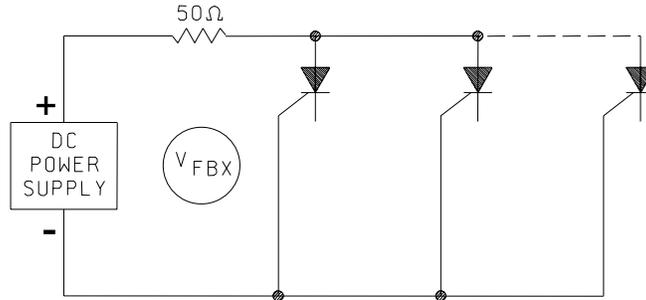


Test circuit details: The test circuit used must provide one of the waveforms shown. When a large number of devices are to be tested, they may be connected in parallel or series combinations with suitable provisions (resistive, reactive, etc, methods) for proper division of forward current or blocking voltages. Suitable protective elements should be used to isolate defective devices without interrupting the test and to protect the remaining devices on test. The forward current supply shall consist of a low-voltage transformer with a means of adjusting the secondary voltage. It shall supply 22 mA dc average forward current to each device under test. The gate supply shall be in phase with the forward current supply. The average power input shall not be allowed to exceed .01 watt per device.

Operating conditions: The devices shall be subjected to the following operational conditions:

- Power sources are to be 60 Hz sinusoidal waveform sources.
- The conduction angle of I_O shall be 150 degrees to 180 degrees.
- The rated forward or reverse blocking voltage shall be started during the nonconducting half cycle no later than 5 degrees after conduction has ceased. For waveform A, the IRC time constant of the blocking voltage shall be 200 ± 100 microseconds.
- For accelerated steady-state operation, blocking voltage shall be equal to or greater than 30 V.
- The duration of the blocking voltages shall be 175 ± 5 degrees.
- The duration of life test shall be 1,000 (+72, -24) hours.
- Ambient test temperature shall be $75 \pm 5^\circ\text{C}$.

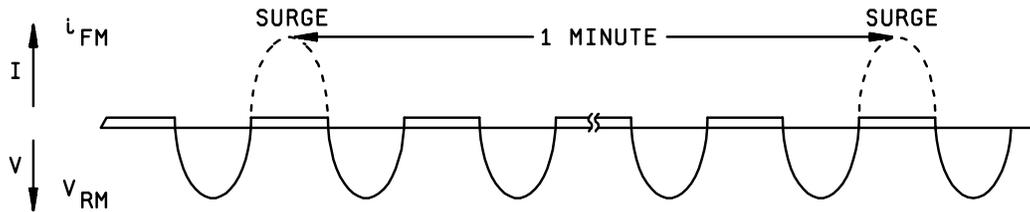
FIGURE 3. Test circuit and waveforms for intermittent operation life test.



Procedure: Adjust the power supply to the specified value for the device under test.

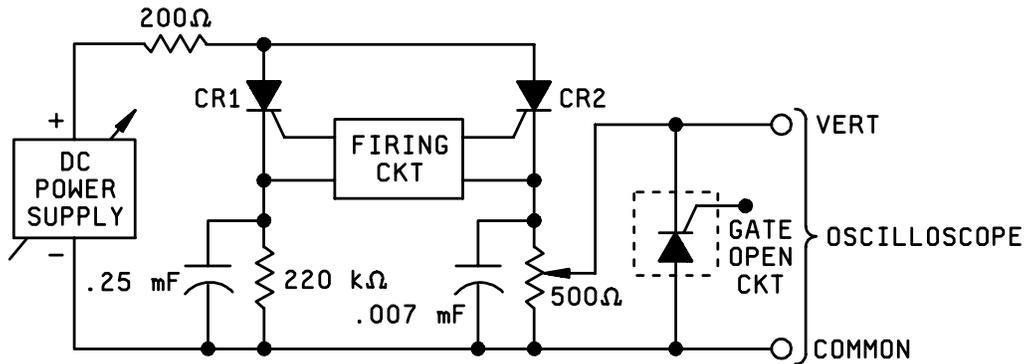
NOTE: Rate of rise of voltage must be limited to values specified in table I.

FIGURE 4. Blocking-voltage test.



Procedure: The above waveform shall be applied to the devices under test. During this test, the gate shall be connected to the anode through a suitable firing resistor and series diode or fired by an equivalent method. The device shall be operated at the specified maximum reverse voltage and specified temperature in a single phase circuit with a 60 Hz supply and a resistive load. The total peak device current during the surge shall be 15 amperes.

FIGURE 5. Surge current waveform.



Procedure: Adjust potentiometer to achieve the specified voltage across the device under test. Timing sequence of firing circuit is: Apply trigger pulse to CR2 once every 15 seconds, apply trigger pulse to CR1, 5.0 ± 1.0 milliseconds after firing CR2. The specified number of pulses shall be applied. Alternate circuits shall apply rectangular pulses of 5.0 ± 1.0 milliseconds with a maximum rise and fall time of 50 microseconds.

FIGURE 6. Nonrepetitive peak reverse voltage test.

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 or material as specified (see 3.4.1 and 3.4.2).
- d. Type designation and product 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 Manufacturer's List 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. The margins of this specification are marked with an asterisk to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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Army - CR
Navy - EC
Air Force - 11
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Preparing activity:
DLA - CC

(Project 5961-2827)

Review activities:
Army - MI, SM
Navy - AS, MC, OS
Air Force - 19, 99

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE
	MIL-PRF-19500/276F	4 November 2003

3. **DOCUMENT TITLE** SEMICONDUCTOR DEVICE, THYRISTORS (CONTROLLED RECTIFIERS), SILICON, TYPES 2N2323, 2N2324, 2N2326, 2N2328, 2N2329, AND S AND U4 VERSIONS, 2N2323A, 2N2324A, 2N2326A, 2N2328A, 2N2329A, AND AS AND AU4 VERSIONS, 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)	7. DATE SUBMITTED
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8. PREPARING ACTIVITY

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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