MIL-S-19500/276A
AMENDMENT 3
18 February 1981
SUPERSEDING
AMENDMENT 2
5 January 1977

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, THYRISTORS (CONTROLLED RECTIFIERS), SILICON
TYPES (BOTH TX AND NON-TX)
2N2323, 2N2324, 2N2326, 2N2328, 2N2329,
2N2323A, 2N2324A, 2N2326A, AND 2N2328A

This amendment forms a part of Military Specification MIL-S-19500/276A, dated 29 January 1968, and is approved for use by all Departments and Agencies of the Department of Defense.

PAGE 1

* Title, delete and substitute:

"SEMICONDUCTOR DEVICE, THYRISTORS (CONROLLED RECTIFIERS) SILICON TYPES 2N2323, 2N2324, 2N2326, 2N2328, 2N2329, 2N2323S, 2N2324S, 2N2326S, 2N2328S, 2N2329S, 2N2223A, 2N2324A, 2N2326A, 2N2328A, 2N2323AS, 2N2324AS, 2N2326AS, 2N2328AS, NON-TX, TX, AND TXV."

* 1.1, delete and substitute:

"1.1 Scope. This specification covers the detail requirements for PNPN, silicon, reverse-blocking-triode thyristors. The prefix 'TX' is used on devices submitted to and passing the special process-conditioning, testing, and screening specified in 4.6. The prefix 'TXV' is used on devices submitted to and passing the internal visual inspection specified in 4.7. The suffix 'S' is used on devices that have 0.5 inch minimum to 0.75 inch maximum load length."

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* 1.3.2, add the following new type numbers:

Following "2N2323" add "2N2323S"; following "2N2323A" add "2N2323AS"; following "2N2324" add "2N2324S"; following "2N2324A" add "2N2324AS; following "2N2326" add "2N2326S"; following "2N2326A" add "2N2326AS; following "2N2328" add "2N2328S"; following "2N2328A" add "2N2328AS; following "2N2329" add "2N2329S". Make these same changes on pages 4, 5, 6, 7, 8, 9, 10, and 12.

PAGE 3

Add the following new paragraphs:

"3.4.2 Lead finish. Lead materials shall be Kovar or Alloy 52. Lead finish shall be gold- or tin-plated. Where a choice of lead finish is desired, it shall be specified in the contract or order (see 6.5).

3.4.3 Internal visual (PRECAP) inspection and process-conditioning, testing, and screening of 'TXV' types. The 'TXV' device type shall, in addition to all performance requirements, be internally visually inspected and process-conditioned, tested, and screened in accordance with 4.7.

3.5.2 'TXV' marking. Devices in accordance with the 'TXV' requirements shall be marked with 'TXV' immediately following the JAN prefix."

* 3.5.3 'S' marking. The 'S' suffix shall be used on devices meeting the 0.5 inch minimum to 0.75 inch maximum lead length requirement."

4.2.4, delete and substitute:

"4.2.4 Qualification testing. The non-TX types shall be used for qualification testing. Upon request to the qualifying activity, qualification will be extended to include the 'TX' and 'TXV' types of the device."

PAGE 5

TABLE I, Group A inspection, Subgroup 3, Exponential rate of voltage rise, Details column: Delete value of capacitance "C = 1 µfd" and substitute "C = 0.1 to 1 µF."

PAGE 6

TABLE I, Group A inspection, Subgroup 3, Gate trigger voltage test: Delete "R_L = 1000 ohms" and substitute "2N2323 thru 2N2326 and 2N2323A thru 2N2326A, R_L = 1,000 ohms; 2N2328, 2N2328A, and 2N2329, R_L = 4,000 ohms."

PAGE 13

Add the following new paragraph.

"4.7 Internal visual (PRECAP) inspection and process-conditioning, testing, and screening of 'TXV' types. The internal visual inspection shall be performed in accordance with test method 2072 of MIL-STD-750 prior to encapsulation on a 100 percent basis and process-conditioning, testing, and screening shall be as specified in 4.6. The manufacturer shall permit the authorized government representative to witness concurrent with time of manufacturer's performance of these tests, the process-conditioning, testing, and screening of the devices. Those conditioning and screening tests normally performed by a manufacturer as standard production tests, need not be repeated when these are predesignated and acceptable to the Government as being equal to or more severe than the test specified herein."

Add the following new paragraph:

"6.5 Ordering data. Procurement documents should specify the following:

(a) Lead finish (see 3.4.2).
(b) Inspection data (see 4.3)."

PAGE 14

* FIGURE 1: Delete and substitute new figure 1 as printed on page 3 of this amendment.

PAGE 15

* FIGURE 2, title, delete and substitute:

"FIGURE 2. Gage for lead and tab location."

NOTE: The margins of this amendment are marked with an asterisk to indicate where changes from the previous amendment were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous amendment.

Custodians:
Army - ER
Navy - EC
Air Force - 17

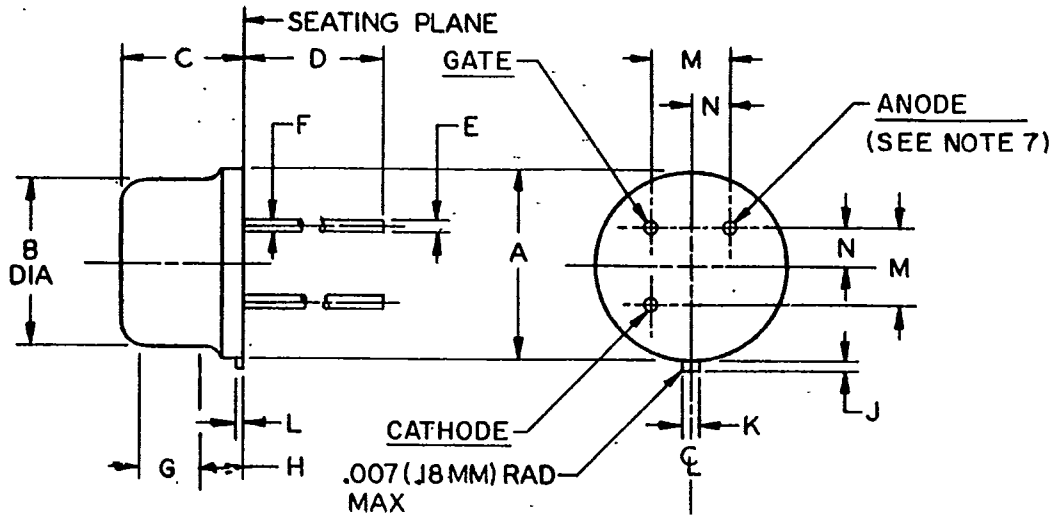
Review activities:
Army - MI
Navy - SH, EC
Air Force - 11, 19, 85, 99
DLA - ES

User activities:
Army - AV, SM
Navy - AS, CG, MC, OS

Preparing activity:
Navy - EC

Agent:
DLA - ES

(Project 5961-0785)



Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
A	.335	.370	8.51	9.40	
B	.305	.335	7.75	8.51	
C	.240	.260	6.10	6.60	
D	See notes 9, 10, and 11				
E	.016	.021	.41	.53	2,9
F	.016	.019	.41	.48	3,9
G	.100	---	2.54	---	4
H	---	---	---	---	5
J	.029	.045	.74	1.14	8
K	.028	.034	.71	.86	
L	.009	.125	.23	3.18	
M	.1414 Nom		3.592 Nom		6
N	.0707 Nom		1.796 Nom		6

NOTES:
1. Metric equivalents are given for general information only and are based upon 1.00 inch = 25.4 mm.
2. Measured in the zone beyond .250 (6.35 mm) from the seating plane.
3. Measured in the zone .050 (1.27 mm) and .250 (6.35 mm) from the seating plane.
4. Variations on dimension B in this zone shall not exceed .010 (.25 mm).
5. Outline in this zone is not controlled.
6. When measured in a gaging plane .054 +.001, -.000 (1.37 +.03, -.00 mm) below the seating plane of the transistor, maximum diameter leads shall be within .007 (.18 mm) of their true location relative to a maximum width tab. Smaller diameter leads shall fall within the outline of the maximum diameter lead tolerance. Figure 2 preferred measured method.
7. The anode shall be internally connected to the case.
8. Measured from the maximum diameter of the actual device.
9. All 3 leads.
10. For transistor types 2N2323S, 2N2324S, 2N2326S, 2N2328S, 2N2329S, 2N2323AS, 2N2324AS, 2N2326AS, 2N2328AS, D is .500 (12.70 mm) minimum, and .750 (19.05 mm) maximum.
11. For transistor types 2N2323, 2N2324, 2N2326, 2N2328, 2N2329, 2N2323A, 2N2324A, 2N2326A, 2N2328A, D is 1.500 (38.10 mm) minimum, and 1.750 (44.45 mm) maximum.

FIGURE 1. Physical dimensions.

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MIL-S-19500/276A
29 January 1968
SUPERSEDING
MIL-S-19500/276 (Navy)
28 October 1963
(See 6.4)

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, THYRISTORS (CONTROLLED RECTIFIERS), SILICON TYPES (BOTH TX AND NON-TX) 2N2323, 2N2324, 2N2326, 2N2328, 2N2329, 2N2323A, 2N2324A, 2N2326A, AND 2N2328A

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

1. SCOPE

1.1 Scope. This specification covers the detail requirements for PNPN silicon power, reverse-blocking-triode, thyristors, and is in accordance with MIL-S-19500 except as otherwise specified herein. The prefix "TX" is used on devices submitted to and passing the special process-conditioning, testing, and screening as specified in 4.6 through 4.6.6.3.

1.2 Physical dimensions. See figure 1 (TO-5)

1.3 Characteristics common to all types.

	V_{FM}	I_{HOX}	V_{GT} 1/ I_{GT} 1/ T_A = -65° C to +125° C 2N2323 thru 2N2329		V_{GT} 2/ I_{GT} 2/ T_A = -65° C to +125° C 2N2323A thru 2N2328A	
	v	mAdc	Vdc	μAdc	Vdc	μAdc
Min	---	---	0.1	---	0.1	---
Max	2.2	2.0	1.0	350	0.9	75

1/ Gate connected to cathode through 1000-ohm resistor.
2/ Gate connected to cathode through 2000-ohm resistor.

1.4 Ratings. (See 6.2.)

1.4.1 Ratings common to all types.

	I_O 1/	i_{FM} (surge) 2/ 1 cycle	v_{KGM}	T_{op}	T_{stg}	Barometric pressure
	A	a	v(pk)	°C	°C	mm Hg
Min	---	---	---	-65	-65	15
Max	0.22	15	6	+125	+150	---

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

1.3.2 Individual ratings.

Type	V_{RM}	V_{FBXM}	V_{RM} (non-rep)
	v(pk)	v(pk)	v(pk)
2N2323	50	50 1/	75
2N2323A	50	50 2/	75
2N2324	100	100 1/	150
2N2324A	100	100 2/	150
2N2326	200	200 1/	300
2N2326A	200	200 2/	300
2N2328	300	300 1/	400
2N2328A	300	300 2/	400
2N2329	400	400 1/	500

1/ Gate connected to cathode through 1000-ohm resistor.
2/ Gate connected to cathode through 2000-ohm resistor.

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on the date of invitation for bids or request for proposal form a part of the specification to the extent specified herein:

SPECIFICATION

MILITARY

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

STANDARDS

MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.

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

(Copies of specifications, standards, drawings and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General. Requirements for the thyristors shall be in accordance with MIL-S-19500, and as specified herein.

3.2 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-S-19500 and as follows:

i_{FBX} - - - D.C. forward blocking current with specified conditions applied to the gate.

I_{HOX} - - - D. C. holding current with gate connected to cathode with specified conditions.

i_{RBX} - - - D.C. reverse blocking current with specified conditions applied to the gate.

R_{GK} - - - External resistance between gate and cathode terminals.

V_{AA} - - - Anode power supply voltage (d. c.).

V_{FBX} - - - Forward blocking voltage, gate connected to the specified reference terminal.

V_{GG} - - - Gate power supply voltage (d. c.).

3.3 Marking. The following marking specified in MIL-S-19500 may be omitted at the option of the manufacturer.

(a) Country of origin.
(b) Manufacturer's identification.
(c) Polarity.

3.3.1 Additional marking. Devices in accordance with the requirements for the "TX" types (see 4.6) shall be marked with a "TX" preceding the applicable type designation.

3.4 Design, construction, and physical dimensions. Thyristors shall be of the design, construction, and physical dimensions shown on figure 1.

3.4.1 Terminal lead length. Terminal lead lengths shorter than those specified on figure 1 may be furnished when stipulated in the contract or order where the devices covered herein are required directly for particular equipment circuit installation or for automatic assembly technique programs. Where shorter lead lengths are required and provided, it shall not be construed as adversely affecting the Qualified-product status of the device or applicable JAN marking.

3.5 Performance characteristics. The performance characteristics of thyristors shall be as specified in tables I, II, and III.

3.5.1 Process - conditioning, testing and screening of "TX" types. Process - conditioning, testing and screening for the "TX" types shall be as specified in 4.6.

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500 and as specified herein, except that the lot accumulation period requirements shall be six months.

4.2 Qualification inspection. Qualification inspection shall consist of the examinations and tests specified in tables I, II, and III.

4.2.1 Subgroups 1 and 4 of group B inspection and subgroup 6 of group C inspection shall be performed on a full-sample size for the lowest and highest voltage types of both A and non-A types (if both are to be qualified) to qualify those voltage types and all intermediate voltage types.

4.2.2 Subgroup 2 of group B inspection shall be performed on the full-sample for each type being qualified. Subgroup 3 of group C shall be performed on a full-sample for the highest voltage type to qualify it and all lower-voltage types.

4.2.3 Subgroup 3 of group B inspection and subgroups 1, 2, 4, and 5 of group C inspection may be performed in accordance with MIL-S-19500 or may be performed on a full sample of any type to qualify all types.

4.2.4 Qualification testing. The non-TX types shall be used for qualification testing. At the manufacturers request to the qualifying activity, qualification will be extended to include the "TX" type of the device.

4.3 Qualityconformance inspection. Quality conformance inspection shall consist of the examinations and tests specified in groups A, B, and C.

4.3.1 Group A inspection. Group A inspection shall consist of examinations and tests specified in table I.

4.3.2 Group B inspection. Group B inspection shall consist of the examinations and tests specified in table II.

4.3.3 Group C inspection. Group C inspection shall consist of the examinations and tests specified in table III. Group C inspection shall be conducted on the first lot every six months. Successful completion of the group C inspection shall permit acceptance of lots for the period specified on the basis of completion of groups A and B inspection. If a group C failure occurs, inspection of the failed subgroup shall revert to a per-lot basis until three consecutive lots have passed.

4.3.4 Inspection procedure.

4.3.4.1 Subgroups 1 and 2 of group B inspection shall be performed on a full-sample size of each type in the lot.

4.3.4.2 Subgroup 3 of group B inspection and subgroups 1, 2, 4 and 5 of group C inspection may be performed in accordance with MIL-S-19500 or may be performed on a full sample of any type within the lot to accept all types in the lot.

4.3.4.3 Subgroup 4 of group B inspection and subgroups 3 and 6 of group C inspection shall be performed on a full-sample size of the highest-voltage type represented in the lot to accept all types in the lot. When a lot contains both "A" and non-"A" types, the samples for these subgroups shall be drawn from the highest-voltage "A" types and the highest-voltage non-"A" types in proportion to the numbers of these types in the lot. Subsequent acceptance of voltage types which are higher than those previously subjected to subgroups 3 and 6 of group C (within the current specified period) requires retesting of subgroups 3 and 6 of group C for a lot including the higher-voltage type. Provisions of MIL-S-19500 early-acceptance procedures do not apply to this specification.

4.4 Disposition of sample units. Sample units which have been subjected to and have passed subgroups 1, 2, and 4 of group B inspection and subgroups 1, 2, 3, and 6 of group C inspection may be delivered on the contract or order provided that, after the inspection is completed, these sample units are subjected to and pass group A inspection. Tests on subgroup 3 of group B and subgroups 4 and 5 of group C are destructive.

4.5 Methods of test. Methods of test shall be as specified in tables I, II and III, the referenced methods of MIL-STD-750 and the figures herein. Section 4 of MIL-STD-750 is applicable.

4.5.1 Time-limit for end points. End point tests for qualification and quality conformance inspection shall be completed within 96 hours after completion of the last test in the subgroup.

TABLE I. Group A inspection

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
Subgroup 1			10	10				
Visual and mechanical inspection	2071							
Subgroup 2			5	2				
Reverse blocking current	4211	DC method, bias cond. B			I_{RBX}			
2N2323 thru 2N2329 2N2323A thru 2N2328A		R_2 = 1000 ohms R_2 = 2000 ohms						
2N2323, 2N2323A		V_R = 50 Vdc				---	10	μAdc
2N2324, 2N2324A		V_R = 100 Vdc				---	10	μAdc
2N2326, 2N2326A		V_R = 200 Vdc				---	10	μAdc
2N2328, 2N2328A		V_R = 300 Vdc				---	10	μAdc
2N2329		V_R = 400 Vdc				---	10	μAdc

TABLE I. Group A inspection - Continued

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
Subgroup 2 - Continued								
Forward blocking current	4206	DC method, bias cond. B			I_{FBX}			
2N2323 thru 2N2329		R_2 = 1000 ohms						
2N2323A thru 2N2328A		R_2 = 2000 ohms						
2N2323, 2N2323A		V_{FBX} = 50 Vdc				---	10	μAdc
2N2324, 2N2324A		V_{FBX} = 100 Vdc				---	10	μAdc
2N2326, 2N2326A		V_{FBX} = 200 Vdc				---	10	μAdc
2N2328, 2N2328A		V_{FBX} = 300 Vdc				---	10	μAdc
2N2329		V_{FBX} = 400 Vdc				---	10	μAdc
Subgroup 3			5	3				
Reverse blocking current	4211	DC method, bias cond. B; T_A = 125° C			I_{RBX}			
2N2323 thru 2N2329		R_2 = 1000 ohms						
2N2323A thru 2N2328A		R_2 = 2000 ohms						
2N2323, 2N2323A		V_R = 50 Vdc				---	100	μAdc
2N2324, 2N2324A		V_R = 100 Vdc				---	100	μAdc
2N2326, 2N2326A		V_R = 200 Vdc				---	100	μAdc
2N2328, 2N2328A		V_R = 300 Vdc				---	100	μAdc
2N2329		V_R = 400 Vdc				---	100	μAdc
Forward blocking current	4206	DC method, bias cond. B; T_A = 125° C			I_{FBX}			
2N2323 thru 2N2329		R_2 = 1000 ohms						
2N2323A thru 2N2328A		R_2 = 2000 ohms						
2N2323, 2N2323A		V_{FBX} = 50 Vdc				---	100	μAdc
2N2324, 2N2324A		V_{FBX} = 100 Vdc				---	100	μAdc
2N2326, 2N2326A		V_{FBX} = 200 Vdc				---	100	μAdc
2N2328, 2N2328A		V_{FBX} = 300 Vdc				---	100	μAdc
2N2329		V_{FBX} = 400 Vdc				---	100	μAdc
Exponential rate of voltage rise	4231	Bias cond. B; T_A = 125° C; repetition rate = 60 pps; 50 Ω ≤ R_L ≤ 400 Ω; C = 1 μfd; test duration = 15 sec			V_{FBX}			
2N2323 thru 2N2329		dv/dt = 1.8 v/μsec; R_3 = 1000 ohms						
2N2323A thru 2N2328A		dv/dt = 0.7 v/μsec; R_3 = 2000 ohms						
2N2323, 2N2323A		V_{AA} = 50 Vdc				47	---	Vdc
2N2324, 2N2324A		V_{AA} = 100 Vdc				95	---	Vdc
2N2326, 2N2326A		V_{AA} = 200 Vdc				190	---	Vdc
2N2328, 2N2328A		V_{AA} = 300 Vdc				285	---	Vdc
2N2329		V_{AA} = 400 Vdc				380	---	Vdc

TABLE I. Group A inspection - Continued

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
Subgroup 3 - Continued								
Gate trigger voltage	4221	T_A = 125° C; R_L = 1000 ohms			V_{GT}			
2N2323 thru 2N2329		R_e = 1000 ohms						
2N2323A thru 2N2328A		R_e = 2000 ohms						
2N2323, 2N2323A		$V_2 = V_{FBX}$ = 50 Vdc				0.1	---	Vdc
2N2324, 2N2324A		$V_2 = V_{FBX}$ = 100 Vdc				0.1	---	Vdc
2N2326, 2N2326A		$V_2 = V_{FBX}$ = 200 Vdc				0.1	---	Vdc
2N2328, 2N2328A		$V_2 = V_{FBX}$ = 300 Vdc				0.1	---	Vdc
2N2329		$V_2 = V_{FBX}$ = 400 Vdc				0.1	---	Vdc
Subgroup 4			5	3				
Gate trigger voltage and current	4221	$V_2 = V_{FBX}$ = 6 Vdc; R_L = 100 ohms						
2N2323 thru 2N2329		R_e = 1000 ohms			V_{GT} I_{GT}	0.35 ---	0.80 200	Vdc μAdc
2N2323A thru 2N2328A		R_e = 2000 ohms			V_{GT} I_{GT}	0.35 ---	0.60 20	Vdc μAdc
Forward "on" voltage	4226	i_{FM} = 4 a(pk) (pulse); pulse width = 8.5 msec, max; duty cycle = 2% max			v_{FM}	---	2.2	v(pk)
Holding current	4201	Bias cond. B; V_{AA} = 24 Vdc max; I_{F1} = 100 mAdc; I_{F2} = 10 mAdc; gate trigger source voltage = 6 Vdc; trigger pulse width = 25 μsec min; R_2 = 330 ohms			I_{HOX}			
2N2323 thru 2N2329		R_3 = 1000 ohms				---	2.0	mAdc
2N2323A thru 2N2328A		R_3 = 2000 ohms				---	2.0	mAdc

TABLE II. Group B inspection

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
Subgroup 1			10	10				
Reverse gate current	4219	V_{KG} = 6 Vdc			I_{KG}	---	200	μAdc
Surge current	4066 (See fig 4)	T_A = 122° C; i_{FM} (surge) = 15 a, 10 surges at 1 per minute; I_o = 0 at rated v_{RM}; f = 60 Hz			---	---	---	---

TABLE II. Group B inspection - Continued

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
Subgroup 1 - Continued								
Non-repetitive peak reverse voltage	(See fig 5)	10 pulses			---	---	---	---
2N2323, 2N2323A		V_{RM} = 75 v (pk)						
2N2324, 2N2324A		V_{RM} = 150 v (pk)						
2N2326, 2N2326A		V_{RM} = 300 v (pk)						
2N2328, 2N2328A		V_{RM} = 400 v (pk)						
2N2329		V_{RM} = 500 v (pk)						
End points: (See 4.5.1)								
Reverse blocking current	4211	DC method, bias cond. B.			I_{RBX}			
2N2323 thru 2N2329		R_2 = 1000 ohms						
2N2323A thru 2N2328A		R_2 = 2000 ohms						
2N2323, 2N2323A		V_R = 50 Vdc				---	10	μAdc
2N2324, 2N2324A		V_R = 100 Vdc				---	10	μAdc
2N2326, 2N2326A		V_R = 200 Vdc				---	10	μAdc
2N2328, 2N2328A		V_R = 300 Vdc				---	10	μAdc
2N2329		V_R = 400 Vdc				---	10	μAdc
Forward blocking current.	4206	DC method, bias cond. B			I_{FBX}			
2N2323 thru 2N2329		R_2 = 1000 ohms						
2N2323 thru 2328A		R_2 = 2000 ohms						
2N2323, 2N2323A		V_{FBX} = 50 Vdc				---	10	μAdc
2N2324, 2N2324A		V_{FBX} = 100 Vdc				---	10	μAdc
2N2326, 2N2326A		V_{FBX} = 200 Vdc				---	10	μAdc
2N2328, 2N2328A		V_{FBX} = 300 Vdc				---	10	μAdc
2N2329		V_{FBX} = 400 Vdc				---	10	μAdc
Gate trigger voltage and current	4221	$V_2 = V_{FBX}$ = 6 Vdc; R_L = 100 ohms						
2N2323 thru 2N2329		R_e = 1000 ohms			V_{GT}	0.35	0.80	Vdc
					I_{GT}	---	200	μAdc
2N2323A thru 2N2328A		R_e = 2000 ohms			V_{GT}	0.35	0.60	Vdc
					I_{GT}	---	20	μAdc
Forward "on" voltage	4226	i_{FM} = 4 a(pk) (pulse); pulse width = 8.5 msec max; duty cycle = 2% max			v_{FM}	---	2.2	v(pk)

TABLE II. Group B inspection - Continued

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
Subgroup 2			10	10				
Low temperature tests:		T_A = -65° C						
Reverse blocking current	4211	DC method, bias cond. B			I_{RBX}			
2N2323 thru 2N2329		R_2 = 1000 ohms						
2N2323A thru 2N2328A		R_2 = 2000 ohms						
2N2323, 2N2323A		V_R = 50 Vdc				---	5.0	μAdc
2N2324, 2N2324A		V_R = 100 Vdc				---	5.0	μAdc
2N2326, 2N2326A		V_R = 200 Vdc				---	5.0	μAdc
2N2328, 2N2328A		V_R = 300 Vdc				---	5.0	μAdc
2N2329		V_R = 400 Vdc				---	5.0	μAdc
Forward blocking current	4206	DC method, bias cond. B; T_A = -65° C			I_{FBX}			
2N2323 thru 2N2329		R_2 = 1000 ohms						
2N2323A thru 2N2328A		R_2 = 2000 ohms						
2N2323, 2N2323A		V_{FBX} = 50 Vdc				---	5.0	μAdc
2N2324, 2N2324A		V_{FBX} = 100 Vdc				---	5.0	μAdc
2N2326, 2N2326A		V_{FBX} = 200 Vdc				---	5.0	μAdc
2N2328, 2N2328A		V_{FBX} = 300 Vdc				---	5.0	μAdc
2N2329		V_{FBX} = 400 Vdc				---	5.0	μAdc
Gate trigger voltage and current	4221	T_A = -65° C; V_2 = V_{FBX} = 6 Vdc; R_L = 100 ohms						
2N2323 thru 2N2329		R_e = 1000 ohms			V_{GT}	---	1.0	Vdc
					I_{GT}	---	350	μAdc
2N2323A thru 2N2328A		R_e = 2000 ohms			V_{GT}	---	0.8	Vdc
					I_{GT}	---	75	μAdc
Subgroup 3			10	10				
Solderability	2026				---	---	---	---
Thermal shock (temperature cycling)	1051	Test cond. F			---	---	---	---
Thermal shock (glass strain)	1056	Test cond. A			---	---	---	---
Moisture resistance	1021				---	---	---	---
End points: (Same as subgroup 1)								

TABLE II. Group B inspection - Continued

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
Subgroup 4			10	5				
Forward blocking voltage	(See fig 6)	T_A = 122° C ±3° C; t = 170 ±24 hours			---	---	---	---
2N2323 thru 2N2329		R_{GK} = 1000 ohms						
2N2323A thru 2N2328A		R_{GK} = 2000 ohms						
2N2323, 2N2323A		V_{FBX} = 50 Vdc						
2N2324, 2N2324A		V_{FBX} = 100 Vdc						
2N2326, 2N2326A		V_{FBX} = 200 Vdc						
2N2328, 2N2328A		V_{FBX} = 300 Vdc						
2N2329		V_{FBX} = 400 Vdc						
End points: (See 4.5.1)								
Reverse blocking current	4211	DC method, bias cond. B			I_{RBX}			
2N2323 thru 2N2329		R_2 = 1000 ohms						
2N2323A thru 2N2328A		R_2 = 2000 ohms						
2N2323, 2N2323A		V_R = 50 Vdc				---	12	µAdc
2N2324, 2N2324A		V_R = 100 Vdc				---	12	µAdc
2N2326, 2N2326A		V_R = 200 Vdc				---	12	µAdc
2N2328, 2N2328A		V_R = 300 Vdc				---	12	µAdc
2N2329		V_R = 400 Vdc				---	12	µAdc
Forward blocking current	4206	DC method, bias cond. B			I_{FBX}			
2N2323 thru 2N2329		R_2 = 1000 ohms						
2N2323A thru 2N2328A		R_2 = 2000 ohms						
2N2323, 2N2323A		V_{FBX} = 50 Vdc				---	12	µAdc
2N2324, 2N2324A		V_{FBX} = 100 Vdc				---	12	µAdc
2N2326, 2N2326A		V_{FBX} = 200 Vdc				---	12	µAdc
2N2328, 2N2328A		V_{FBX} = 300 Vdc				---	12	µAdc
2N2329		V_{FBX} = 400 Vdc				---	12	µAdc
Gate trigger voltage and current	4221	$V_{FBX} = V_2$ = 6 Vdc; R_L = 100 ohms						
2N2323 thru 2N2329		R_e = 1000 ohms			V_{GT}	0.25	0.80	Vdc
					I_{GT}	---	220	µAdc
2N2323A thru 2N2328A		R_e = 2000 ohms			V_{GT}	0.25	0.60	Vdc
					I_{GT}	---	25	µAdc
Forward "on" voltage	4226	i_{FM} = 4 a (pk) (pulse); pulse width = 8.5 msec max; duty cycle = 2% max			v_{FM}	---	2.2	v(pk)

TABLE III. Group C inspection

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
Subgroup 1			20	20				
Physical dimensions	2066	(See figure 1.)			---	---	---	---
Subgroup 2			10	10				
Shock	2016	Nonoperating; 1500 G, 0.5 msec, 5 blows each in orientations: X_1, Y_2 and Z_1			---	---	---	---
Vibration variable frequency	2056	Nonoperating			---	---	---	---
Constant acceleration	2006	20,000 G; in orientations X_1, Y_1, and Y_2			---	---	---	---
End points: (Same as group B, subgroup 1)								
Subgroup 3			15	15				
Barometric pressure, reduced	1001	t = 60 seconds; pressure = 15 mm Hg			---	---	---	---
		Voltage applied during test						
2N2323, 2N2323A 2N2324, 2N2324A 2N2326, 2N2326A 2N2328, 2N2328A 2N2329		V_R = 50 Vdc V_R = 100 Vdc V_R = 200 Vdc V_R = 300 Vdc V_R = 400 Vdc						
Subgroup 4			15	15				
Salt atmosphere (corrosion)	1041				---	---	---	---
Subgroup 5			15	15				
Terminal strength (lead fatigue)	2036	Test cond. E						
End points: (Same as group B, subgroup 1)								
Subgroup 6			λ=20	λ=10				
Intermittent operation life	(See fig 7)	50 min "on" 10 min "off" T_A = 75° C ±5° C; I_o = 220 mAdc			---	---	---	---
2N2323 thru 2N2329 2N2323A thru 2N2328A		R_{GK} = 1000 ohms R_{GK} = 2000 ohms						
End points: (Same as group B, subgroup 4)								

4.6 Process-conditioning, testing, and screening for "TX" Types. The procedure for process-conditioning, testing, and screening for "TX" types shall be in accordance with 4.6.1 through 4.6.6.3 and figure 8. Process-conditioning shall be conducted on 100 percent of the lot, prior to submission of the lot to the tests specified in tables I, II, and III. (At the option of the manufacturer, the non-TX type may be subjected to process-conditioning and testing.)

4.6.1 Quality assurance (lot verification). Quality assurance shall keep lot records for three years minimum, monitor for compliance to the prescribed procedures, and observe that satisfactory manufacturing conditions and records on lots are maintained for these devices. The records shall be available for review by the customer at all times. The quality-assurance monitoring shall include, but not be limited to: process-conditioning, testing, and screening. (The conditioning and screening tests performed as standard production tests need not be repeated when these are predesignated and acceptable to the Government as being equal to or more severe than specified herein.)

4.6.2 High-temperature storage. All devices shall be stored for at least 48 hours at a minimum temperature (T_A) of 150° C.

4.6.3 Thermal shock (temperature cycling). All devices shall be subjected to thermal shock (temperature cycling) in accordance with MIL-STD-750, method 1051, test condition F, except that ten (10) cycles shall be continuously performed and the time at the temperature extremes shall be fifteen (15) minutes minimum.

4.6.4 Acceleration. All devices shall be subjected to an acceleration test in accordance with MIL-STD-750, method 2006, with the following exceptions: The test shall be performed one time in the Y_1 orientation only, at a peak level of 20,000 G minimum. The one-minute hold-time requirement shall not apply.

4.6.5 Hermetic seal (fine-leak) test. All devices shall be fine-leak tested in accordance with MIL-STD-202, method 112, test condition C, procedure IIIa or IIIb (using the applicable conditions of 4.6.5.1 or 4.6.5.2).

4.6.5.1 Conditions for procedure IIIa. The devices shall be placed in a sealed chamber and pressurized to 50 psig minimum with helium gas for a minimum of 4 hours. The devices shall then be removed from the chamber and within 30 minutes be subjected to a helium leak-detection test. Devices shall be rejected that exhibit a leak-rate of 1×10^{-8} atm cc of helium per second when measured at a differential pressure of one atmosphere. All devices exhibiting this leakage rate or greater shall be removed from the lot.

4.6.5.2 Conditions for procedure IIIb. The devices shall be placed in an activation tank which shall be pressurized with Krypton 85 tracer gas in a nitrogen solution for sufficient time to detect a leak rate of 1×10^{-8} atmospheric cubic centimeters per second (atm cc/sec). Within four hours after pressurization in the Krypton 85 tracer gas, the leak rate of the devices shall be determined on an attribute basis using the general equation shown below. Any device exhibiting a leak rate equal to or greater than 1×10^{-8} atm cc/sec shall be removed from the lot. The general equation for use with radioactive-gas leak test equipment is:

$$Q = \frac{R}{SKT(P_e^2 - P_i^2)}$$

where:

- Q = leak rate in atm cc/sec.
- R = net counting rate of tested part above background in cts/min.
- S = specific activity of the test gas mixture in μCi/atm cc.
- K = counting efficiency of the system for the given part in cts/min μCi.
- P_e = pressure of test gas in activation tank during pressurization in atm abs.
- P_i = pressure inside part under test in atm abs.
- T = duration of pressurization in test gas mixture in seconds.

4.6.5.3 Hermetic seal (gross-leak) test. All devices shall be tested for gross-leaks by immersing in noncorrosive ethylene glycol at approximately 100° C for a minimum of 15 seconds and observed for bubbles. All devices that bubble shall be removed from the lot.

4.6.6 Preburn-in tests. The parameters of table IV shall be measured and the data recorded for all devices in the lot. All devices shall be handled or identified such that the delta end points can be determined after the burn-in test. All devices which fail to meet the requirements shall l removed from the lot and the quantity removed shall be noted on the lot record.

TABLE IV. Burn-in test measurements

Examination or test	MIL-STD-750		Symbol	Limits		
	Method	Details		Min	Max	Un
Reverse blocking current	4211	DC method, bias cond. B	I_{RBX}			
2N2323 thru 2N2329		R_2 = 1000 ohms				
2N2323A thru 2N2328A		R_2 = 2000 ohms				
2N2323, 2N2323A		V_R = 50 Vdc		---	10	µA
2N2324, 2N2324A		V_R = 100 Vdc		---	10	µA
2N2326, 2N2326A		V_R = 200 Vdc		---	10	µA
2N2328, 2N2328A		V_R = 300 Vdc		---	10	µA
2N2329		V_R = 400 Vdc		---	10	µA
Forward blocking current	4206	DC method, bias cond. B	I_{FBX}			
2N2323 thru 2N2329		R_2 = 1000 ohms				
2N2323A thru 2N2328A		R_2 = 2000 ohms				
2N2323, 2N2323A		V_{FBX} = 50 Vdc		---	10	µA
2N2324, 2N2324A		V_{FBX} = 100 Vdc		---	10	µA
2N2326, 2N2326A		V_{FBX} = 200 Vdc		---	10	µA
2N2328, 2N2328A		V_{FBX} = 300 Vdc		---	10	µA
2N2329		V_{FBX} = 400 Vdc		---	10	µA
Gate trigger voltage and current	4221	$V_{FBX} = V_2$ = 6 Vdc R_L = 100 ohms				
2N2323 thru 2N2329		R_e = 1000 ohms	V_{GT} I_{GT}	0.35 ---	0.80 200	Vdc µA
2N2323A thru 2N2328A		R_e = 2000 ohms	V_{GT} I_{GT}	0.35 ---	0.60 20	Vdc µA

4.6.6.1 Burn-in test. All devices shall be operated for 72 hours minimum under the following conditions:

T_A = 125° C

2N2323, 2N2323A - V_{FBX} = 50 Vdc
2N2324, 2N2324A - V_{FBX} = 100 Vdc
2N2326, 2N2326A - V_{FBX} = 200 Vdc
2N2328, 2N2328A - V_{FBX} = 300 Vdc
2N2329 - V_{FBX} = 400 Vdc

2N2323 thru 2N2329 - R_{GK} = 1000 ohms
2N2323A thru 2N2328A - R_{GK} = 2000 ohms

All devices which turn "on" during the burn-in test shall be removed from the lot and the quantity removed shall be noted on the lot record.

4.6.6.2 Postburn-in tests. All parameters of table IV shall be tested after burn-in and the data recorded for all devices in the lot. I_{RBX} and I_{FBX} shall not have changed during the burn-in test from the initial value by more than the specified amount as follows:

$$\Delta I_{RBX} = +4.0\ \mu Adc$$

$$\Delta I_{FBX} = +4.0\ \mu Adc$$

4.6.6.3 Burn-in test failures (screening). All devices that exceed the delta (Δ) limits of 4.6.6.2 or the limts of table IV after burn-in shall be removed from the inspection lot and the quantity removed shall be noted on the lot record. If the quantity removed after burn-in should exceed 10 percent of the total inspection lot on burn-in test, the entire lot shall be unacceptable as "TX" types.

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery. Preparation for delivery shall be in accordance with MIL-S-19500.

6. NOTES

6.1 The notes specified in MIL-S-19500 are applicable to this specification.

6.2 Rating application. The following values may be used as application guidelines:

V_{GKM} = 6 V, max.
i_{GKM} = 0.1 a, max.
P_{GM} = 0.1 watt, max.
$P_{G(av)}$ = 0.01 watt, max.

6.3 Substitution criteria. The devices covered herein are interchangeable with the corresponding devices covered by the superseded document.

6.4 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Custodians:
Army - EL
Navy - EC
Air Force - 11

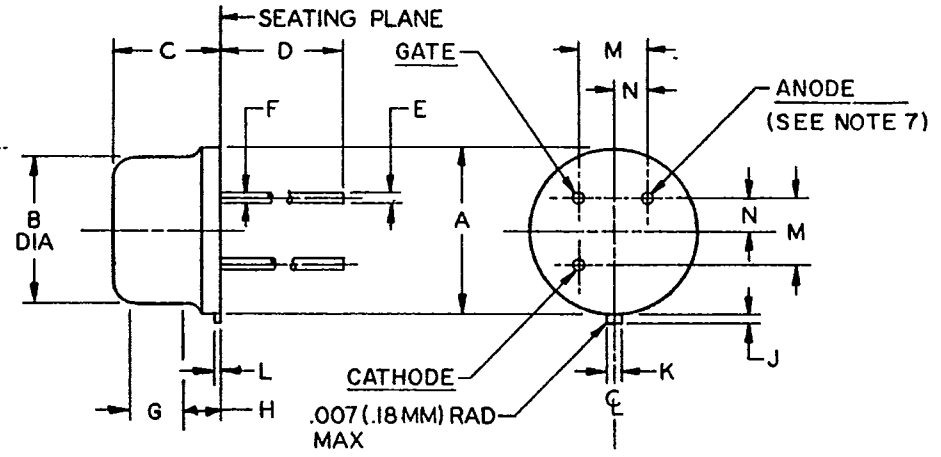
Review activities:
Army - EL, MI
Navy - SH, EC
Air Force - 11, 17, 85

User activities:
Army - SM
Navy - MC, CG, AS, OS
Air Force - 19

Preparing activity:
Navy - EC

(Project 5961-0050-16)

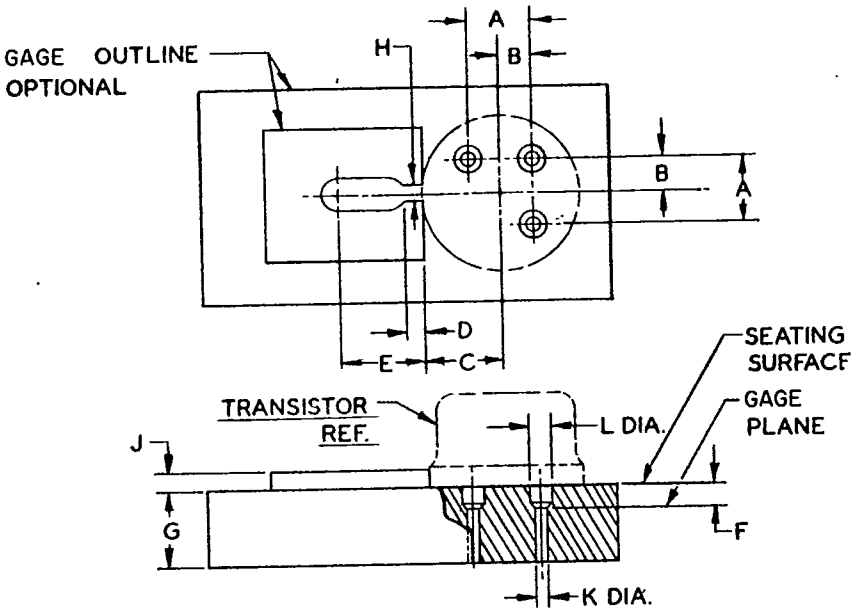
Code "C"



Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
A	.335	.370	8.51	9.40	
B	.305	.335	7.75	8.51	
C	.240	.260	6.10	6.60	
D	1.500	1.750	38.10	44.45	9
E	.016	.021	.41	.53	2,9
F	.016	.019	.41	.48	3,9
G	.100		2.54		4
H					5
J	.029	.045	.74	1.14	8
K	.028	.034	.71	.86	
L	.009	.125	.23	3.18	
M	.1414 Nom		3.59 Nom		6
N	.0707 Nom		1.80 Nom		6

NOTES:
1. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.
2. Measured in the zone beyond .250 (6.35 mm) from the seating plane.
3. Measured in the zone .050 (1.27 mm) and .250 (6.35 mm) from the seating plane.
4. Variations on dimension B in this zone shall not exceed .010 (.25 mm).
5. Outline in this zone is not controlled.
6. When measured in a gaging plane .054 +.001, −.000 (1.37 +.03, −.00 mm) below the seating plane of the transistor, maximum diameter leads shall be within .007 (.18 mm) of their true location relative to a maximum width tab. Smaller diameter leads shall fall within the outline of the maximum diameter lead tolerance. Figure 2 preferred measured method.
7. The anode shall be internally connected to the case.
8. Measured from the maximum diameter of the actual device.
9. All 3 leads.

FIGURE 1. Physical dimensions of thyristors types (both TX and non-TX) 2N2323 through 2N2329, 2N2323A through 2N2328A.



Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	.1409	.1419	3.58	3.60
B	.0702	.0712	1.78	1.81
C	.182	.199	4.62	5.05
D	.009	.011	.23	.28
E	.125 Nom		3.18 Nom	
F	.054	.055	1.37	1.40
G	.372	.378	9.45	9.60
H	.0350	.0355	.89	.90
J	.150 Nom		3.81 Nom	
K	.0325	.0335	.83	.85
L	.0595	.0605	1.51	1.54

NOTES:
1. The following gaging procedure shall be used: The use of a pin straightener prior to insertion in the gage is permissible. The device being measured shall be inserted until its seating plane is .125±.010 (3.18±.25 mm) from the seating surface of the gage. A spacer may be used to obtain the .125 (3.18 mm) distance from the gage seat prior to force application. A force of 8 oz ±.5 oz. shall then be applied parallel and symmetrical to the device's cylindrical axis. When examined visually after the force application (the force need not be removed) the seating plane of the device shall be seated against the gage.
2. The location of the tab locator, within the limits of dimension C, will be determined by the tab and flange dimension of the device being checked.
3. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.

FIGURE 2. Gage for lead and tab location for thyristors, types (both TX and non-TX) 2N2323 through 2N2329, 2N2323A through 2N2328A.

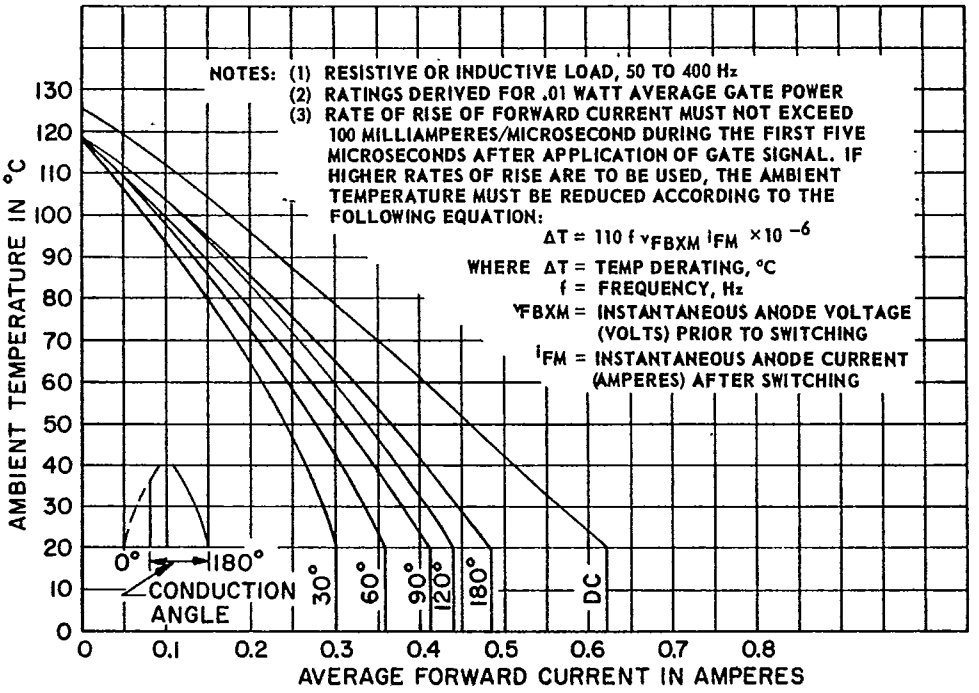


FIGURE 3A. Operating conditions (average forward current vs ambient temperature).

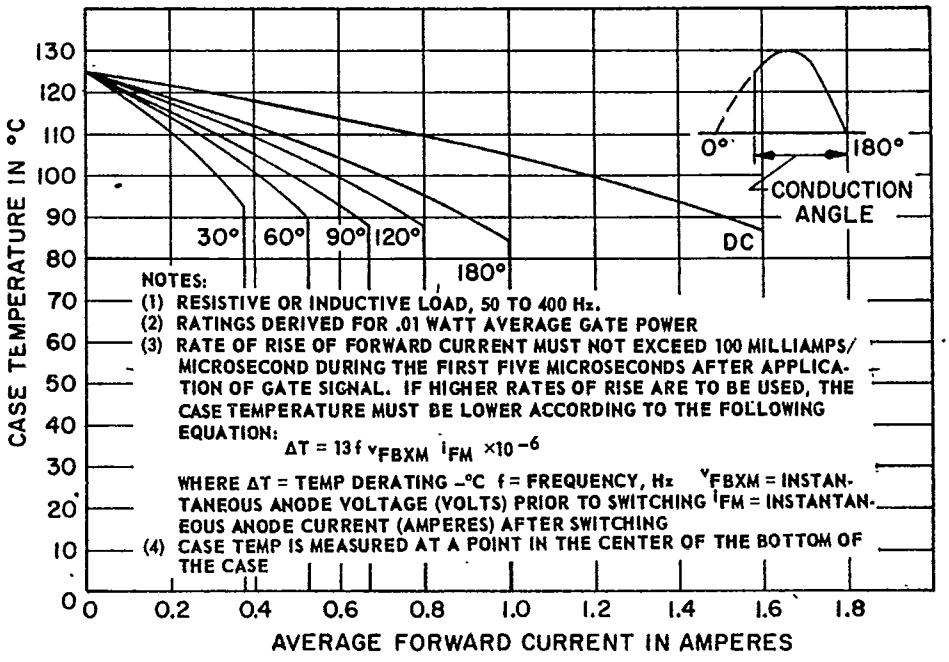
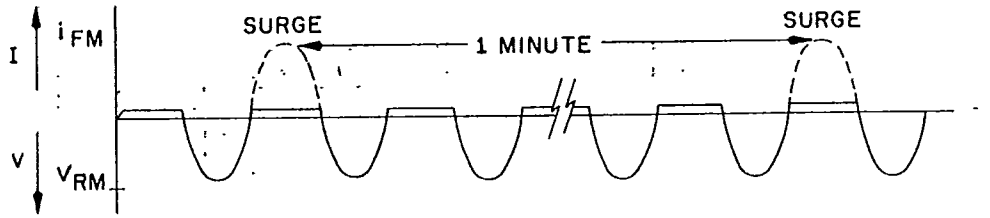
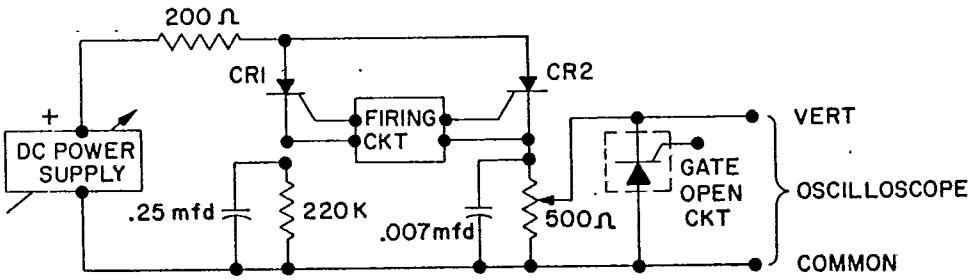


FIGURE 3B. Operating conditions (average forward current vs case temperature).



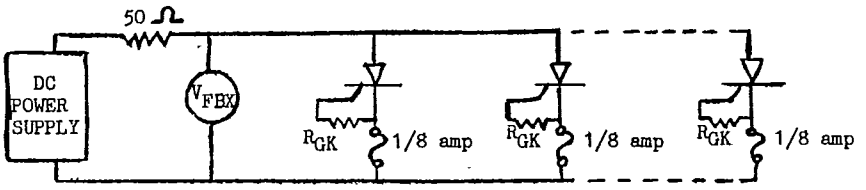
Procedure: The above waveform shall be applied to the devices under test. During this test the gate shall be connected to the anode through a suitable firing resistor and series diode or fired by an equivalent method. The device shall be operating at the specified maximum reverse voltage and specified 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 amps.

FIGURE 4. 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.

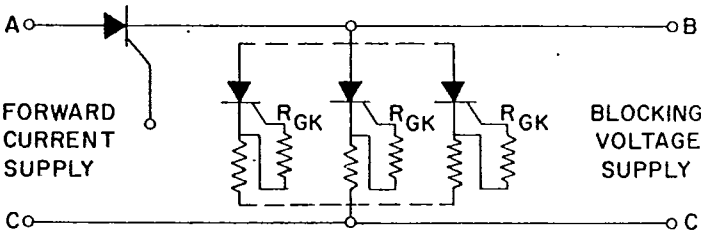
FIGURE 5. Non-repetitive peak reverse voltage test.

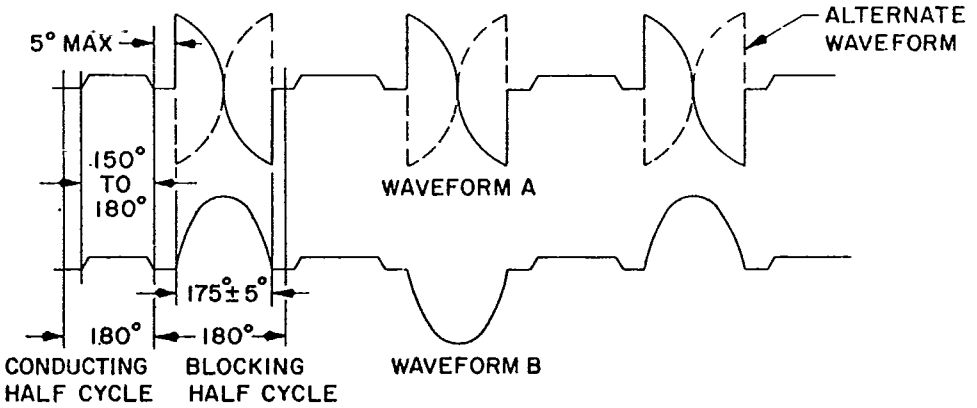


Procedure: Adjust the power supply to the specified value for the device under test.

NOTE: Rate of rise of voltage must be limited to values specified in Group A inspection.

FIGURE 6. Blocking-voltage test.





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 220mAdc average forward current to each device under test. The gate supply shall be in phase with the forward current supply. The gate 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:

a. Power sources are to be 60 Hz sinusoidal waveform sources.
b. The conduction angle of I_0 shall be 150° to 180°.
c. The rated forward or reverse blocking voltage shall be started during the non-conducting half cycle no later than 5° after conduction has ceased. For waveform A, the RC time constant of the blocking voltage shall be 200±100 microseconds.
d. The duration of the blocking voltages shall be 175±5°.
e. The duration of life test shall be 1000 (+72–24) hours.
f. Ambient test temperature shall be 75±5°C.

FIGURE 7. Test circuit and waveforms for intermittent operation life test.

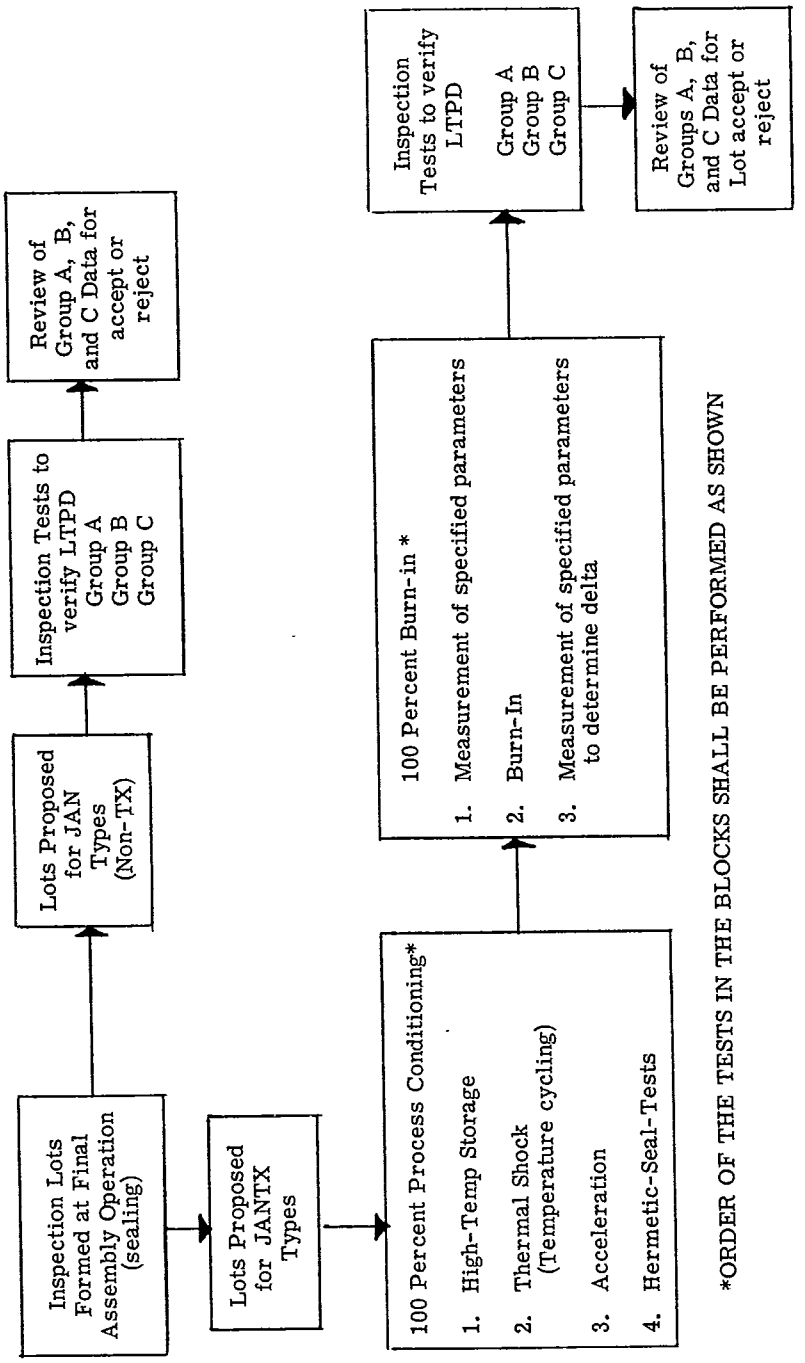


FIGURE 8. Order of procedure diagram for JAN (Non-TX) and JANTX types.