

The documentation and process conversion measures necessary to comply with this revision shall be completed by 27 July 2000.

INCH-POUND

MIL-PRF-19500/198C
 27 April 2000
 SUPERSEDING
 MIL-PRF-19500/198B
 16 July 1999

PERFORMANCE SPECIFICATION
 SEMICONDUCTOR DEVICE, THYRISTORS
 TYPES 2N1870A, 2N1871A, 2N1872A AND 2N1874A
 JAN

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 silicon thyristors. One level of product assurance is provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (similar to TO-39).

1.3 Maximum ratings. 1/

I_o $T_A = +100^\circ\text{C}$	i_f (surge)	V_G V_{CG}	I_G	i_G	Operating and storage temperature	Operating altitude
<u>mA dc</u>	<u>a</u>	<u>V dc</u>	<u>mA dc</u>	<u>ma</u>	<u>°C</u>	<u>mm Hg</u>
220	15	5	25	250	-65 to +150	15

(1) For additional information on ratings see figures 2 and 3.

Type	V_{RM} (1)	V_{FBXM} (1)
	v(pk)	v(pk)
2N1870A	30	30
2N1871A	60	60
2N1872A	100	100
2N1874A	200	200

(1) Blocking voltage ratings apply with gate connected through a resistor, $R_2 = 1 \text{ k}\Omega$ or less, to cathode as shown on figure 4.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: (ex. Defense Supply Center, Columbus, ATTN: DSCC/VAC, Post Office Box 3990, Columbus, OH 43216-5000), by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

1.4 Primary electrical characteristics.

Limits	V_f $i_f = 2A$	I_H	V_{GT} $V_{AC} = 5 V$ $R_e = 1 k\Omega$	I_{GT} $V_{AC} = 5 V$ $R_e > 1 k\Omega$
	<u>V</u>	<u>mA dc</u>	<u>V dc</u>	<u>μA dc</u>
Min	---	0.3	0.4	---
Max	2.5	5.0	0.8	200

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.

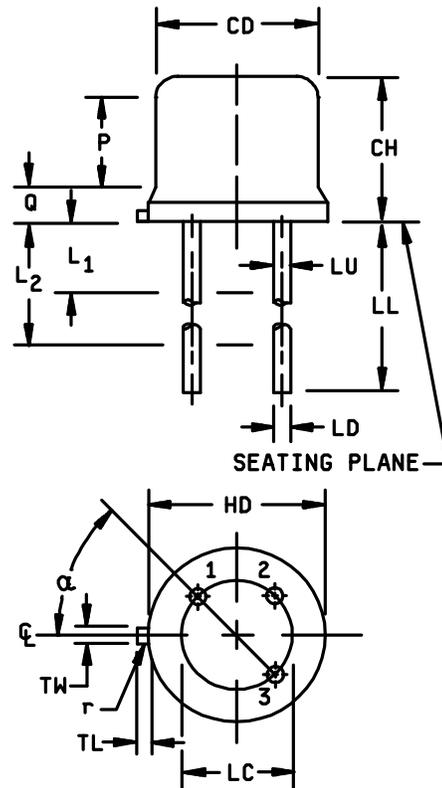
(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

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

3. REQUIREMENTS

3.1 General. The requirements for acquiring the product described herein shall consist of this document and MIL-PRF-19500.

Symbol	Dimensions 1, 4, 5, 6, 7, 8, 9, 10				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.290	.335	7.37	8.51	
CH	.200	.260	5.08	6.60	
HD	.290	.370	7.37	9.40	
LC	.190	.210	4.83	5.33	
LD	.016	.021	0.41	0.53	2, 3
LL	1.50	---	38.1	---	
LU	.016	.019	0.41	0.48	2, 3
Q	see note 12				11
P	.100	---	2.54	---	1
TL	.028	.048	0.71	1.22	12
TW	.036	.046	0.91	1.17	12
r	---	.010	---	0.25	12, 13
α	45° TP		45° TP		



NOTES:

1. This zone is controlled for automatic handling. The variation in actual diameter within this zone shall not exceed 0.010 (.25 mm).
2. The specified lead diameter applies in the zone between 0.050 and 0.250 from the base seat. Between 0.250 and 1.5 a maximum of 0.021 diameter is held. Outside of these zones the lead diameter is not controlled.
3. All terminals are electrically insulated from the case.
4. Leads may be soldered to within 1/16 inch of base. Heat sinking not required if temperature-time exposure is less than 230°C for 10 seconds.
5. This device is for socketed single-sided circuit-board, wire-in, and similar applications. Where used in double sided or eyeletted circuit-board or similar applications where solder bridging may occur, a dielectric washer or other standoff device may be necessary.
6. Dimension are in inches.
7. Metric equivalents are given for general information only.
8. Body contour optional within zone defined by P and Q.
9. In accordance with ANSI Y14.5M, diameters are equivalent to ϕx symbology.
10. Lead 1 = cathode, lead 2 = gate, lead 3 = anode.
11. Details of outline in this zone are optional.
12. Tab is optional.
13. Dimension r (radius) applies to both inside corners of tab.

FIGURE 1. Physical dimensions of semiconductor types 2N1870A, 2N1871A, 2N1872A and 2N1874A.

3.2 Qualification. Devices furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.4).

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

I_{FBX} ... DC forward blocking current with resistor R_2 across gate and cathode.
 I_{RBX} ... DC reverse blocking current with resistor R_2 across gate and cathode.
 i_G ... Peak gate current.
 V_{AA} ... Anode power supply voltage (dc).
 V_{FBX} .. Forward anode voltage.
 V_{CG} ... Reverse gate voltage.
 V_G Rated reverse gate voltage.

3.4 Interface requirements and physical dimensions. The Interface requirements and physical dimensions shall be as specified in MIL-PRF-19500, and figure 1 herein.

3.4.1 Lead finish. Lead finish shall be solderable in accordance with MIL-STD-750 and MIL-PRF-19500.

3.5 Marking. Marking shall be in accordance with MIL-PRF-19500. At the option of the manufacturer, marking of the country of origin may be omitted from the body of the transistor, but shall be retained on the initial container.

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

3.7 Electrical test requirements. The electrical test requirements shall be group A as specified herein.

3.8 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of Inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Screening (see 4.3)
- c. Conformance inspection (see 4.4).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500.

4.3 Screening. Screening is not required for JAN level, see MIL-PRF-19500.

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 MIL-PRF-19500 and table I herein.

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4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIb (JAN) of MIL-PRF-19500 and paragraph 4.4.2.1 herein. Electrical measurements (end-points) shall be in accordance with the applicable inspections of table I, group A, subgroup 2 herein. Subgroups 3 and 6 shall be performed on a sample from the subplot containing the highest voltage rated devices in the lot.

4.4.2.1 Group B inspection, table VIb (JAN) of MIL-PRF-19500.

Subgroup	Method	Condition
B3	1037	Operational life, see 4.5, test circuit figure 6, $T_A = +100^\circ\text{C}$.
B6	1031	$T_A = +150^\circ\text{C}$

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-PRF-19500, and as follows. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 herein.

Subgroup	Method	Condition
C2	2036	Lead fatigue.
C6	1031	$T_A = +150^\circ\text{C}$

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.

4.6 Holding current. The holding current is measured by decreasing the anode current to the point where the device under test switches from the on-state to the off-state. The gate current shall be $-150\ \mu\text{A}$ and the anode supply voltage shall be 5 volts. The test circuit shown on figure 5, or its equivalent, may be used. Resistor R_4 is increased, thereby decreasing device anode current, until the device switches to the off-state. The current measured by M_1 immediately prior to switching is the holding current. Switch S_1 is used to trigger the device to the on-state prior to making a holding current measurement.

4.7 Operational life test. The operational life test shall be performed in the test circuit shown on figure 6, or its equivalent. Transformer T_1 is adjusted such that the peak value of secondary voltage from T_3 equals the rated forward blocking voltage of the device under test. Transformer T_2 is adjusted such that meter M_a reads 220 mA average rectified current. Transformer T_5 is selected to provide a maximum secondary peak voltage of 5 volts as read on meter M_3 . The device under test shall be in an oven at an ambient temperature of $+100^\circ \pm 5^\circ\text{C}$.

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TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical examination	2071					
<u>Subgroup 2</u>						
Forward blocking current 2N1870A 2N1871A 2N1872A 2N1874A	4206	DC method, bias condition B; R ₂ = 1,000 ohms, .25 watt V _{FBX} = 30 V _{FBX} = 60 V _{FBX} = 100 V _{FBX} = 200	I _{FBX}		10	μA dc
Reverse blocking current 2N1870A 2N1871A 2N1872A 2N1874A	4211	DC method, bias condition B; R ₂ = 1,000 ohms, .25 watt V _{FBX} = 30 V _{FBX} = 60 V _{FBX} = 100 V _{FBX} = 200	I _{RBX}		10	μA dc
Gate trigger current	4221	V ₂ = V _{FBX} = 5 V dc R _e = 1,000 Ω R _L = 100Ω	I _{GT}	---	200	μA dc
Gate trigger voltage	4221	V ₂ = V _{FBX} = 5 V dc R _e = 1,000 Ω R _L = 100Ω	V _{GT}	0.4	0.8	V dc
Forward "on" voltage	4226	I _{FM} = 2 a(pk) (pulse); pulse width = 8.5 ms; maximum; duty cycle = 2 percent maximum	V _f	---	2.5	V dc
Exponential rate of voltage rise 2N1870A 2N1871A 2N1872A 2N1874A	4231	Bias condition B; Repetition rate = 60 pps; 50Ω ≤ R _L ≤ 400 Ω; C = .001 μF min; test duration = 15 sec; R ₃ = 1,000Ω dv/dt = 100 V/μs; V _{AA} = 30 V dc dv/dt = 60 V/μs; V _{AA} = 60 V dc dv/dt = 40 V/μs; V _{AA} = 100 V dc dv/dt = 30 V/μs; V _{AA} = 200 V dc	V _{FBX}	---	---	---
				25		
				55		
				95		
				190		

See footnote at end of table.

TABLE I. Group A inspection - Continued.

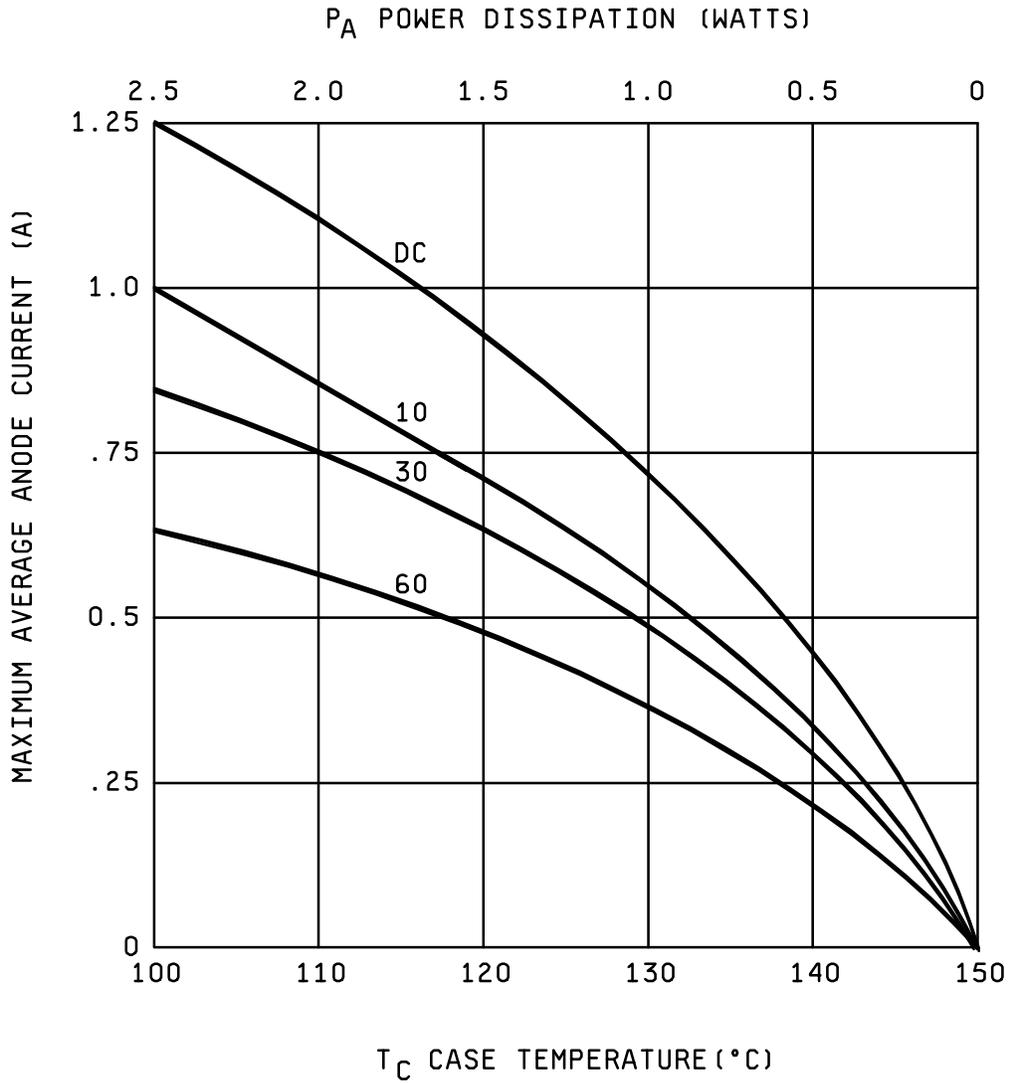
Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u> - Continued						
Reverse gate current	4219	$V_{CG} = 5 \text{ V dc}$, anode open	I_{KG}	---	10	$\mu\text{A dc}$
Holding current	4201	$I_G = -150 \mu\text{A dc}$, $V_{AA} = 5 \text{ V dc}$	I_H	0.3	5	mA dc
<u>Subgroup 3</u>						
High temperature operation:	4206	$T_A = +125^\circ\text{C}$				
Forward blocking current 2N1870A 2N1871A 2N1872A 2N1874A	4206	$R_2 = 1,000 \text{ ohms}$ $V_{FBX} = 30$ $V_{FBX} = 60$ $V_{FBX} = 100$ $V_{FBX} = 200$	I_{FBX}	---	100	$\mu\text{A dc}$
Reverse blocking current 2N1870A 2N1871A 2N1872A 2N1874A	4211	$R_2 = 1,000 \text{ ohms}$ $V_{FBX} = 30$ $V_{FBX} = 60$ $V_{FBX} = 100$ $V_{FBX} = 200$	I_{RBX}	---	100	$\mu\text{A dc}$
Gate trigger voltage	4221	$V_2 = V_{FBX} = 5 \text{ V}$, $R_e = 1,000 \Omega$ $R_L = 100\Omega$	V_{GT}	0.2	---	V dc
Holding current	4201	$I_G = -150 \mu\text{A dc}$, $V_{AA} = 5 \text{ V dc}$	I_H	0.2	---	mA dc
Low temperature operation:		$T_A = -65^\circ\text{C}$				
Gate trigger voltage	4221	$V_2 = V_{FBX} = 5 \text{ V}$ $R_e = 1,000 \Omega$ $R_L = 100\Omega$	V_{GT}	---	1.0	V dc
Gate trigger current	4221	$V_2 = V_{FBX} = 5 \text{ V}$, $R_e = 1,000 \Omega$ $R_L = 100\Omega$	I_{GT}	---	500	$\mu\text{A dc}$
Holding current	4201	$I_G = -150 \mu\text{A dc}$, $V_{AA} = 5 \text{ V dc}$	I_H	---	15	mA dc

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroups 4 and 5</u>						
Not applicable						
<u>Subgroup 6</u>						
Surge current	4066	$I_{TSM} = 15 \text{ A(pk)}$ (.5 sine wave); 10 surges per 1 minute; $I_o = 16 \text{ A}$ at rated V_{RRM} ; $T_C = +65^\circ\text{C}$; $f = 60 \text{ Hz}$; surge duration = 7 ms, minimum				
Electrical measurements		See table I, group A, subgroup 2				

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



NOTE:

1. Ratings apply for 50 to 400 Hz frequency.

FIGURE 2. Anode current rating as a function of operating case temperature.

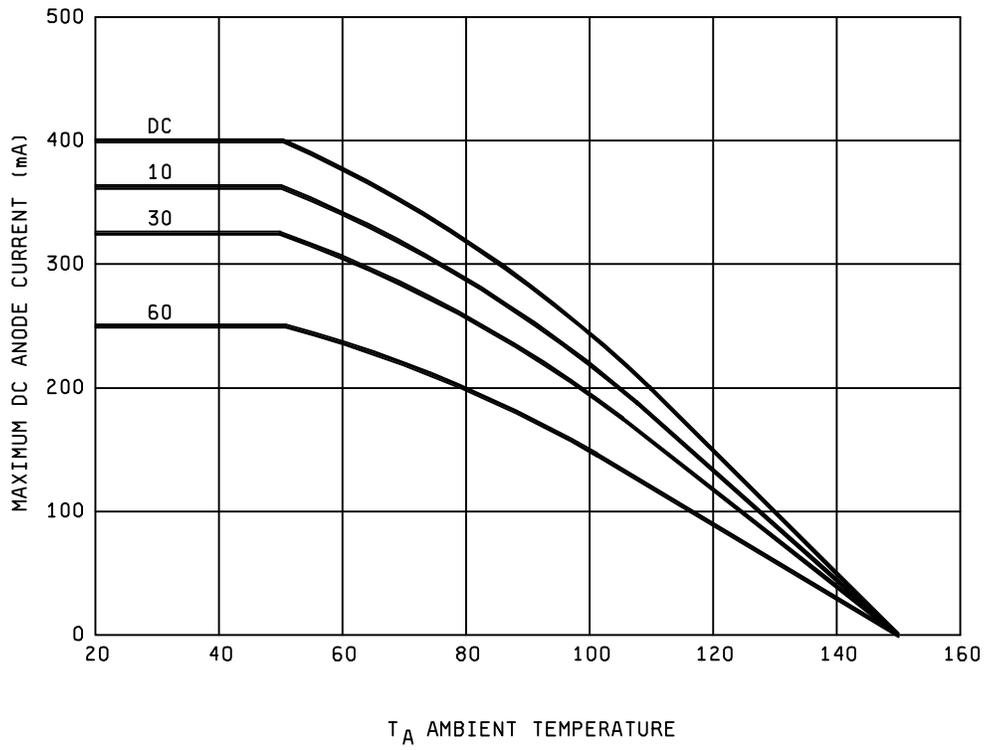


FIGURE 3. Anode current rating as a function of operating ambient temperature.

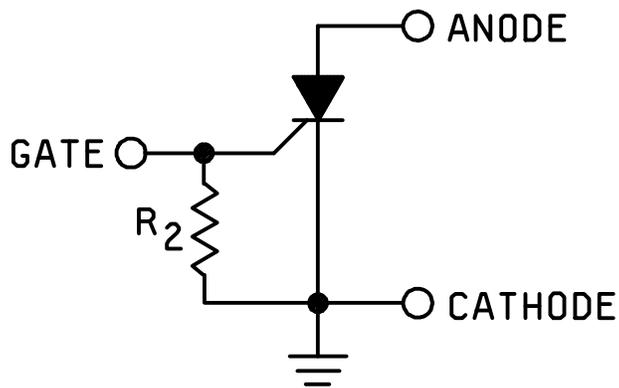
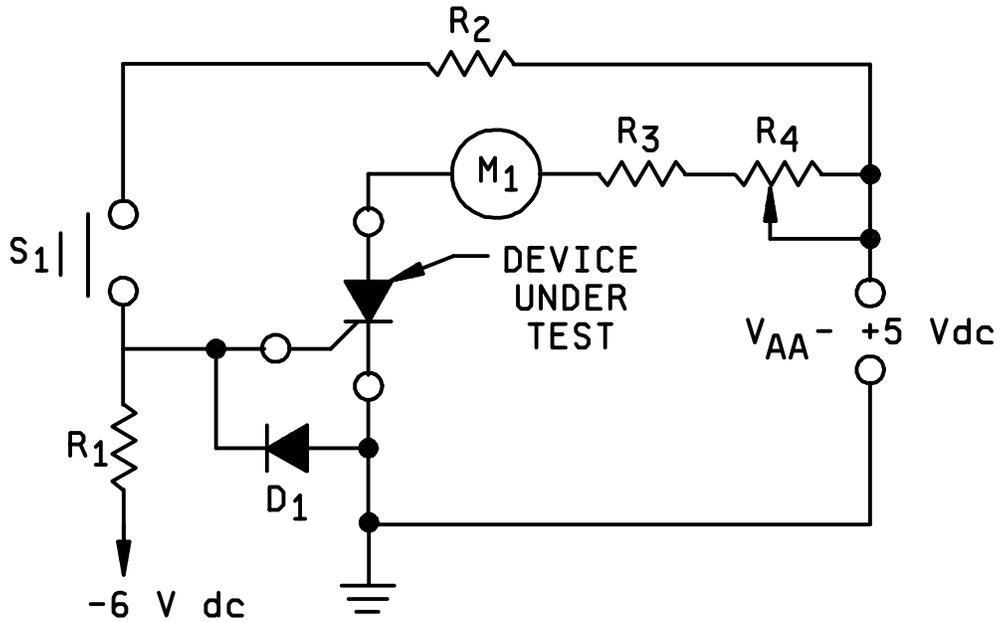
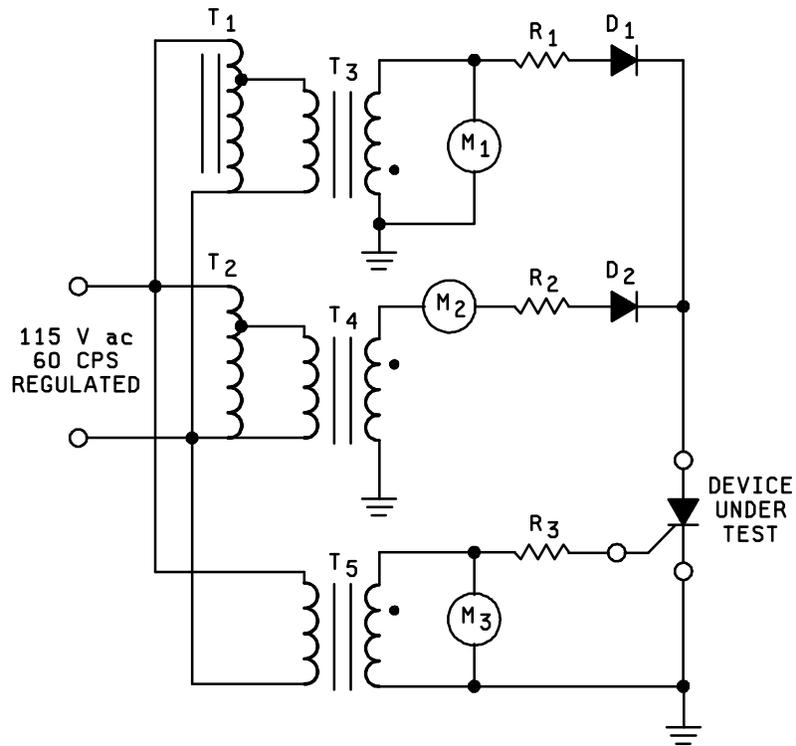


Figure 4. Condition for blocking voltage rating.



- | | |
|--|------------------------------------|
| M ₁ DC milliammeter | R ₁ 40 kΩ, 1/4 watt |
| S ₁ Trigger on switch, momentary type,
normally open | R ₂ 4700 Ω, 1/4 watt |
| D ₁ 1N457 diode | R ₃ 270 Ω, 1/4 watt |
| | R ₄ 25 kΩ potentiometer |

FIGURE 5. Test circuit for holding current.



- | | | | |
|--------|--|----|--|
| T1 | 115 VAC adjustable transformer | R1 | 20 k Ω , 1/2 watt |
| T2 | 115 VAC adjustable transformer | R2 | 20 Ω , 20 watt |
| T3 | Step up transformer 115 VAC to 140 VAC | R3 | 1000 Ω , 1/4 watt |
| T4 | Step down transformer 115 VAC to 3.0 VAC | M1 | Peak reading voltmeter or RMS equivalent (0 - 250 volts) |
| D1, D2 | 1N540 | M2 | DC millimeter 0 - 300 mA |
| | | M3 | Peak reading voltmeter or RMS equivalent (0 - 10 volts) |

FIGURE 6. Circuit for operational life 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 material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

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

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Issue of DODISS to be cited in the solicitation and, if required, the specific issue of individual documents referenced (see 2.2.1).
- b. Lead finish (see 3.3.1).
- c. Type designation and product assurance level.
- d. Packaging requirements (see 5.1).

6.3 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.

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers' List (QML) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: DSCC-VQE, P.O. Box 3990, Columbus, Ohio, 43216-5000..

CONCLUDING MATERIAL

Custodians:
Army - CR
Navy - EC
Air Force - 11
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2223)

Review activities:
Army - MI
Navy - AS, CG, MC
Air Force - 19

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-19500/198C	2. DOCUMENT DATE 27 April 2000
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3. DOCUMENT TITLE
SEMICONDUCTOR DEVICE, THYRISTORS TYPES 2N1870A, 2N1871A, 2N1872A AND 2N1874A

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) COMMERCIAL DSN FAX EMAIL	7. DATE SUBMITTED

8. PREPARING ACTIVITY

a. Point of Contact Alan Barone	b. TELEPHONE Commercial DSN FAX EMAIL 614-692-0510 850-0510 614-692-6939 alan_barone@dsccl.dla.mil		
c. ADDRESS Defense Supply Center Columbus, ATTN: DSCC-VAC, 3990 East Broad Street, Columbus, OH 43213-1199	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman, Suite 2533, Fort Belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-6888		