

The documentation and process conversion measures necessary to comply with this revision shall be completed by 8 December 2004.

INCH-POUND

MIL-PRF-19500/629C
8 September 2004
SUPERSEDING
MIL-PRF-19500/629B
5 December 1999

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, HERMETIC, DIODE, SILICON, RECTIFIER,
SCHOTTKY BARRIER, TYPES 1N6702 AND 1N6702US,
JAN, JANTX, JANTXV, JANS, JANHC, AND JANKC

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

* The requirements for acquiring the product described herein shall consist of
this specification sheet and MIL-PRF-19500.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for silicon, Schottky barrier rectifier diodes. Four levels of product assurance are provided for each encapsulated device type as specified in MIL-PRF-19500, and two levels of product assurance for each unencapsulated die (element evaluation).

1.2 Physical dimensions. See figures 1 (similar to DO-41), 2 (D-5C), and 3 (JANHC and JANKC die) dimensions.

* 1.3 Maximum ratings.

Types	V_{RWM} (1)	I_{O1} (2) (3)	I_{FSM}	T_{STG}	T_J (4)
	<u>V (pk)</u>	<u>A dc</u>	<u>A (pk)</u>	<u>°C</u>	<u>°C</u>
1N6702 1N6702US	40	5.0	150	-65 to +150	-65 to +125

- (1) Derate linearly at 1.2 V/ °C above T_L or $T_{EC} = +90$ °C where T_L is at $L = .375$ inch (9.52 mm).
(2) Derate linearly at 71 mA/ °C above T_L or $T_{EC} = +55$ °C where T_L is at $L = .375$ inch (9.52 mm).
(3) For derating, see figures 4 and 5.
(4) The maximum T_J depends on the voltage applied. See figures 4 and 5.

1.4 Primary electrical characteristics. Unless otherwise specified, primary electrical characteristics at $T_A = +25$ °C.

Types	Max V_{FM1} $I_{FM} = 3.0$ A	Max V_{FM2} $I_{FM} = 5.0$ A	Max V_{FM3} $I_{FM} = 15.7$ A	Max I_{RM} $V_{RM} = 40$ V dc pulsed method (see 4.5.1)		Max $R_{\theta JL}$ or $R_{\theta JEC}$.375 inch (9.52 mm) lead length or end cap	Max $Z_{\theta JX}$
				$T_J = +25$ °C I_{RM1}	$T_J = +100$ °C I_{RM2}		
	<u>(pk)</u>	<u>V (pk)</u>	<u>V (pk)</u>	<u>mA</u>	<u>MA</u>	<u>°C/W</u>	<u>°C/W</u>
1N6702 1N6702US	0.44 0.44	0.47 0.47	0.60 0.60	0.20 0.20	25.0 25.0	20 10	2.5 2.5

* Comments, suggestions, or questions on this document should be addressed to Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to semiconductor@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <http://www.dodssp.daps.mil>.

2. APPLICABLE DOCUMENTS

* 2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 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, 4, or 5 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 cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

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

DEPARTMENT OF DEFENSE STANDARDS

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

* (Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch> or <http://www.dodssp.daps.mil> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, 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

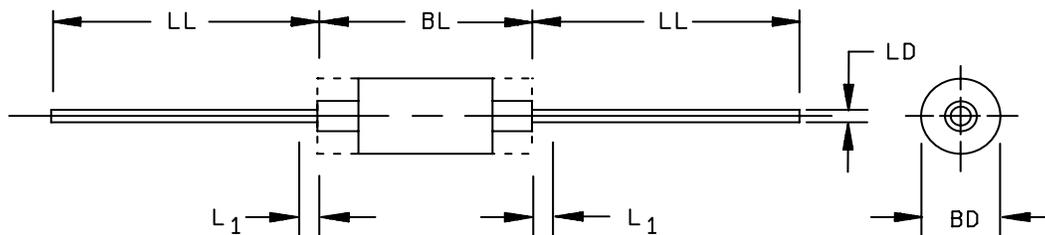
* 3.1 General. The individual item requirements shall be as specified in MIL-PRF-19500 and as modified herein.

* 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 before contract award (see 4.2 and 6.3).

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

3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in MIL-PRF-19500 and on figures 1 (similar to DO-41), 2 (D-5C), and 3 (JANHC and JANKC die).

3.4.1 Lead finish. Lead finish shall be solderable as defined in MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

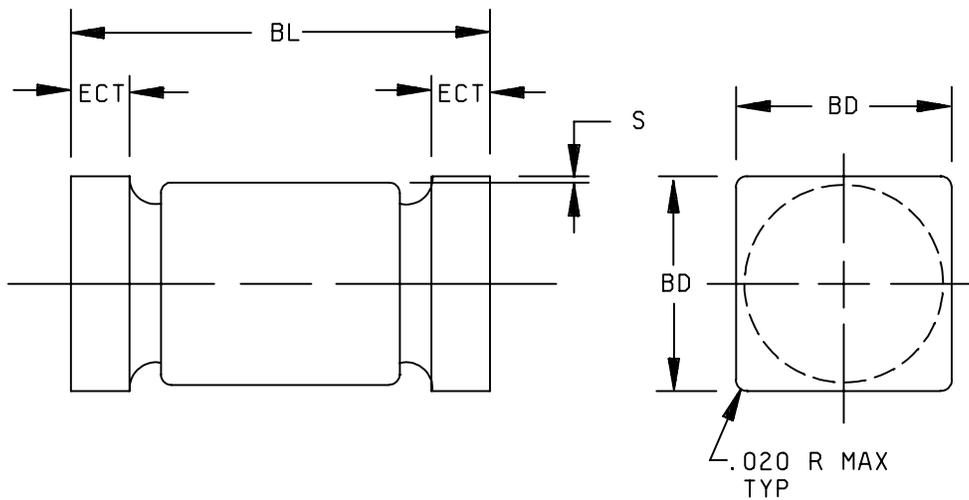


Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
LD	.047	.054	1.19	1.37	
BD	.145	.185	3.68	4.70	3
BL	.150	.300	3.81	7.62	
LL	1.000	1.300	25.40	33.02	
L ₁		.050		1.27	4

NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Symbol BD shall be measured at the largest diameter.
4. Lead diameter is not controlled in this zone to allow for flash, lead finish build-up, and mirror irregularities other than heat slugs.

FIGURE 1. Physical dimensions (similar to DO-41).

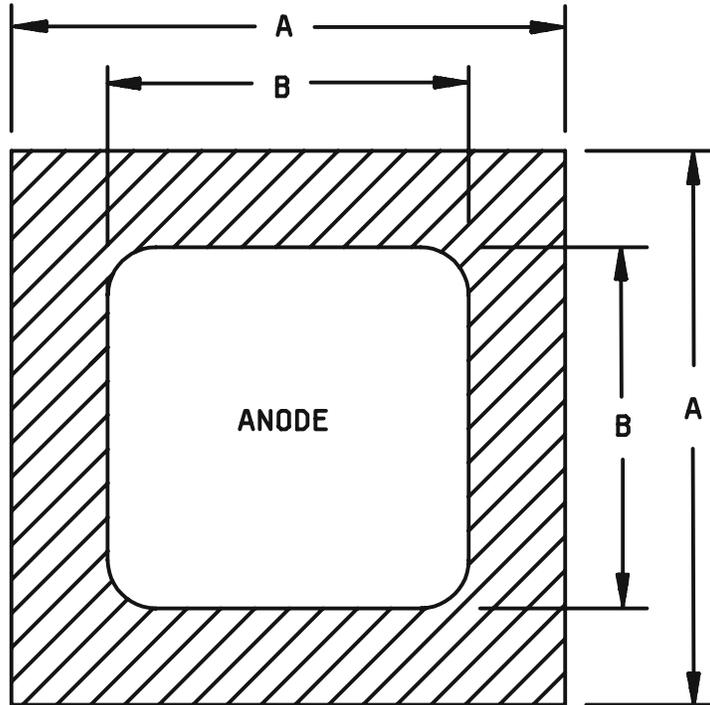


Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.205	.245	5.20	6.22
BD	.183	.202	4.65	5.13
ECT	.019	.028	0.48	0.71
S	.003		0.08	

NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. In accordance with ASME Y14.5M, diameters are equivalent to $\varnothing X$ symbology.

FIGURE 2. Physical dimensions of surface mount family, (D-5C).



Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	.088	.090	2.24	2.29
B	.078	.080	1.98	2.03

Design data

Metallization:
 Top: (Anode)..... Al
 Back: (Cathode)..... Au

AL thickness..... 25,000 Å minimum.
 Gold thickness 4,000 Å minimum.
 Chip thickness..... 10 mils (0.254 mm) ± 2 mils (0.051mm).

FIGURE 3. JANHC and JANKC (A-version) die dimensions.

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3.4.2 Diode construction. These devices shall be constructed in a manner and using materials which enable the diodes to meet the applicable requirements of MIL-PRF-19500 and this document.

3.4.2.1 Surface mount (US). The surface mount (US) version shall be considered structurally identical to the non surface mount (US) version except for lead attach.

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

* 3.6 Electrical test requirements. The electrical test requirements shall be as specified in table I and II.

* 3.7 Marking. Devices shall be marked as specified in MIL-PRF-19500.

* 3.7.1 Marking for surface mount US devices. Surface mount (US) suffix parts are to be marked with the polarity identification. Initial container package marking will be in accordance with MIL-PRF-19500.

* 3.8 Polarity. The polarity of all types shall be indicated with a contrasting color band to denote the cathode end. Alternatively, for US suffix devices, a minimum of three contrasting color dots spaced around the periphery on the cathode end may be used.

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

4. VERIFICATION

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

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

* 4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500, and as specified herein.

4.2.1 Group E inspection. Group E inspection shall be conducted in accordance with MIL-PRF-19500 and herein.

4.2.2 Construction verification. Cross sectional photos from three devices shall be submitted in the qualification report.

4.2.3 JANHC and JANKC die devices. Qualification for these devices shall be in accordance with MIL-PRF-19500. This testing may be performed in a TO-5 package in lieu of the axial leaded package.

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*4.3 Screening (JANTX, JANTXV, and JANS levels only). Screening shall be in accordance with 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	JANTXV and JANTX level
1a 1b	Required Required	Not required Required (JANTXV only)
2	Not required	Not required
3a 3b (1) 3c	Required Not applicable Required (see 4.3.3)	Temperature cycling Not applicable Thermal impedance (see 4.3.3)
4, 5, 6 and 7a	Not applicable	Not applicable
7b	Optional	Optional
8	Required	Not required
9	I_{R1} and V_{FM2}	Not applicable
(2) 10	Required, $T_A = 90^\circ\text{C}$; $V_{RWM} = 40 \text{ V(pk)}$; $I_O = 0$, half sine wave, $f = 60 \text{ Hz}$	$T_A = 90^\circ\text{C}$; $V_{RWM} = 40 \text{ V(pk)}$; $I_O = 0$, half sine wave, $f = 60 \text{ Hz}$
11	Required, $\Delta I_{R1} \leq 100$ percent of initial reading or $.05 \text{ mA}$ whichever is greater. $\Delta V_{FM2} \leq \pm 50 \text{ mV dc}$.	I_{R1} and V_{FM2}
12	Required, see 4.3.2	See 4.3.2, $t = 48 \text{ hours}$
13	Required, subgroup 2 of table I herein; $\Delta I_{R1} \leq 100$ percent of initial reading or 0.05 mA whichever is greater; $V_{FM2} \leq \pm 50 \text{ mV dc}$.	Subgroup 2 of table I herein; $\Delta I_{R1} \leq 100$ percent of initial reading or $.05 \text{ mA}$ whichever is greater; $V_{FM2} \leq \pm 50 \text{ mV dc}$.
14a 14b	Not applicable Required (3)	Not applicable Required (3)
15 and 16	Required	Not required

(1) Thermal impedance shall be performed any time after sealing provided temperature cycling is performed in accordance with appendix E, table IV of MIL-PRF-19500, screen 3 prior to this thermal test.

(2) Junction temperature (T_J) is not to exceed 100°C at V_{RWM} . T_J is affected by the device mounting thermal resistance when parasitic power is generated by the temperature dependent leakage current. Until this leakage becomes significant near thermal runaway, T_J remains approximately equal to T_A or T_L for $I_O = 0$.

(3) For clear glass diodes, gross leak seal test may be performed anytime after temperature cycling.

* 4.3.1 Screening (JANHC or JANKC). Screening of die shall be in accordance with MIL-PRF-19500. As a minimum, die shall be 100 percent probed in accordance with table I, subgroup 2, except for thermal impedance.

* 4.3.1.1 JAN testing. JAN level product will have temperature cycling and thermal impedance testing performed in accordance with MIL-PRF-19500, JANTX level screening level requirements.

* 4.3.2 Burn-in conditions. Burn-in conditions are as follows: $I_F = 5 \text{ A dc min}$. $T_A = \text{room ambient}$ as defined in the general requirements of 4.5 of MIL-STD-750. Mounting and test conditions in accordance with method 1038 of MIL-STD-750, test condition B.

* 4.3.3 Thermal impedance ($Z_{\theta JX}$ measurements). The $Z_{\theta JX}$ measurements shall be performed in accordance with method 3101 of MIL-STD-750. The maximum screen limit shall be developed by the supplier using statistical methods and it shall not to exceed the table I, subgroup 2 herein.

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

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with table V of MIL-PRF-19500, and table I herein. The following test conditions shall be used for Z_{BJX}, group A inspection:

- a. I_M measurement current1 mA to 10 mA.
- b. I_H forward heating current.....10 A to 20 A.
- c. t_H heating time10 ms.
- d. t_{MD} measurement delay time.....100 μs maximum.

* 4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in tables VIa (JANS) and VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500 and as follows. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table I, subgroup 2 herein.

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

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B3	1056	-55°C to 100°C, 25 cycles, n = 22, c = 0.
	1051	-55°C to 150°C, 100 cycles, n = 22, c = 0.
B3	4066	I _{FSM} = 150 A (pk), condition A 2, I _O = 5 A dc; T _A = room ambient as defined in the general requirements of 4.5 of MIL-STD-750; five surges of 8.3 ms each at 1 minute intervals.
B4	1036	I _F = 5.0 A dc; T _A = room ambient as defined in the general requirements of 4.5 of MIL-STD-750; t _{on} = t _{off} ; 3 minutes minimum for 2,000 cycles.
B5	1027	I _F = 5 A dc minimum, adjust I _F or T _A to achieve T _J = + 125°C minimum.

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

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B2	1056	-55°C to 100°C, 10 cycles, n = 22, c = 0.
	1051	-55°C to 150°C, 25 cycles, n = 22, c = 0.
B2	4066	I _{FSM} = 150 A (pk), condition A 2, I _O = 5 A dc; T _A = room ambient as defined in the general requirements of 4.5 of MIL-STD-750; five surges of 8.3 ms each at 1 minute intervals.
B3	1027	I _F = 5 A dc minimum, adjust I _F or T _A to achieve T _J = + 125°C minimum.
B4	2075	

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

* 4.4.3.1 Group C inspection table VII of MIL-PRF-19500.

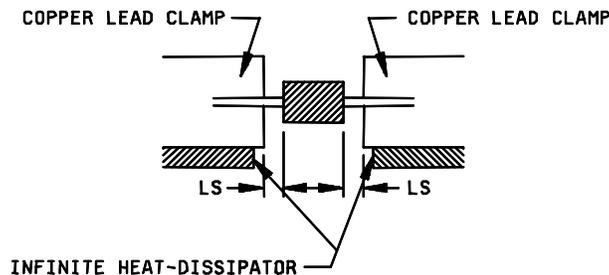
<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Tension: Test condition A; weight = 20 pounds; t = 15 s. Lead fatigue: Test condition E; weight 1 pounds. NOTE: Both tension and lead fatigue are not applicable for US suffix devices.
C5	3101	See 4.4.5 herein.
C6	1026	$T_A = 90^\circ\text{C}$; $V_{RWM} = 40 \text{ V(pk)}$; $I_O = 0$, half sine wave, $f = 60 \text{ Hz}$. T_A adjusted to achieve $T_J = +110^\circ\text{C}$ minimum.

* 4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with MIL-PRF-19500 and the conditions for subgroup testing herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

* 4.4.5 Thermal resistance. Thermal resistance measurement shall be in accordance with method 3101 or 4081 of MIL-STD-750. Forced moving air or draft shall not be permitted across the device during test. The maximum limit for $R_{\theta JL}$ under these test conditions shall be $R_{\theta JL} (\text{max}) = 20^\circ\text{C/W}$, $R_{\theta JEC} (\text{max}) = 10^\circ\text{C/W}$. The following conditions shall apply when using method 3101:

- a. I_M 1 mA to 10 mA.
- b. I_H 3.0 A.
- c. t_H 20 seconds minimum.
- d. t_{MD} 100 μs maximum.

LS = lead spacing = .375 inch (9.53 mm) for non-surface mount devices and 0 inch for surface mount devices as follows:



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 MIL-STD-750.

4.5.2 Steady-state operation life. This test shall be conducted with a half-sine wave of the specified peak voltage impressed across the diode in the reverse direction followed by a half-sine waveform of the specified average rectified current. The forward conduction angle of the rectified current shall not be greater than 180 degrees nor less than 150 degrees.

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TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical examination	2071					
<u>Subgroup 2</u>						
Thermal impedance	3101	See 4.3.3	$Z_{\theta JX}$			°C/W
Forward voltage	4011	$I_{FM} = 3.0$ A (pk) pulse method (see 4.5.1)	V_{FM1}	0.44		V
	4011	$I_{FM} = 5.0$ A (pk) pulse method (see 4.5.1)	V_{FM2}	0.47		V
	4011	$I_{FM} = 15.7$ A (pk) pulse method (see 4.5.1)	V_{FM3}	0.60		V
Reverse current leakage	4016	$V_{RM} = 40$ V (pk) pulse method (see 4.5.1)	I_{RM1}	0.20		mA
<u>Subgroup 3</u>						
High temperature operation:		$T_A = +100^\circ\text{C}$				
Reverse current leakage	4016	$V_{RM} = 40$ V (pk) pulse method (see 4.5.1)	I_{RM2}	25.0		mA
Forward voltage	4011	$I_F = 5.0$ A (pk) pulse method (see 4.5.1)	V_{FM4}	0.47		V
Low temperature operation:		$T_A = -55^\circ\text{C}$				
Reverse current leakage	4016	$V_{RM} = 40$ V (pk) pulse method (see 4.5.1)	I_{RM3}	1.00		mA
Forward voltage	4011	$I_F = 5.0$ A (pk) pulse method (see 4.5.1)	V_{FM5}	0.62		V
<u>Subgroups 4, 5, 6, and 7</u>						
Not applicable						

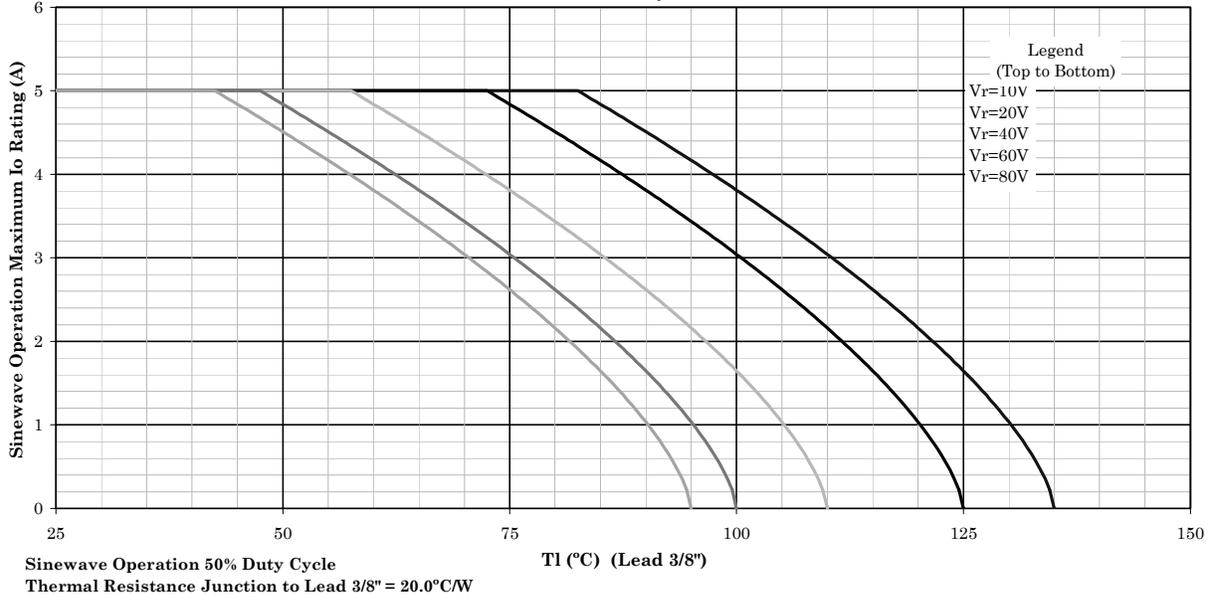
1/ For sampling plan, see MIL-PRF-19500.

* TABLE II. Group E inspection (all quality levels) for qualification and re-qualification.

Inspection	MIL-STD-750		Qualification Inspection
	Method	Conditions	
<u>Subgroup 1</u>			22 devices, c = 0
Temp cycling	1056	500 cycles -55°C to 100°C	
Thermal shock	1051	500 cycles -55°C to 100°C	
Hermetic seal	1071	Test condition E	
<u>Subgroup 2</u>			22 devices, c = 0
Steady-state operating life	1026	$T_A = 90^\circ\text{C}$; $V_{RWM} = 40 \text{ V(pk)}$; $I_O = 0$, half sine wave, $f = 60 \text{ Hz}$. T_A adjusted to achieve $T_J = +110^\circ\text{C}$ minimum.	
<u>Subgroup 4</u>			22 devices, c = 0
Thermal impedance, thermal resistance curves		Each supplier shall submit their (typical) maximum design thermal impedance curves to the qualifying activity. In addition, the optimal test conditions and $Z_{\theta JX}$ limit shall be provided to the qualifying activity in the qualification report.	sample size N/A
<u>Subgroup 5</u>			
Not applicable			
<u>Subgroup 6</u>			3 devices, c = 0
ESD	1020		
<u>Subgroup 8</u>			45 devices, c = 0
Resistance to glass cracking	1057	Test to destruction, or 25 cycles max, whichever comes first.	

Temperature-Current Derating Curve

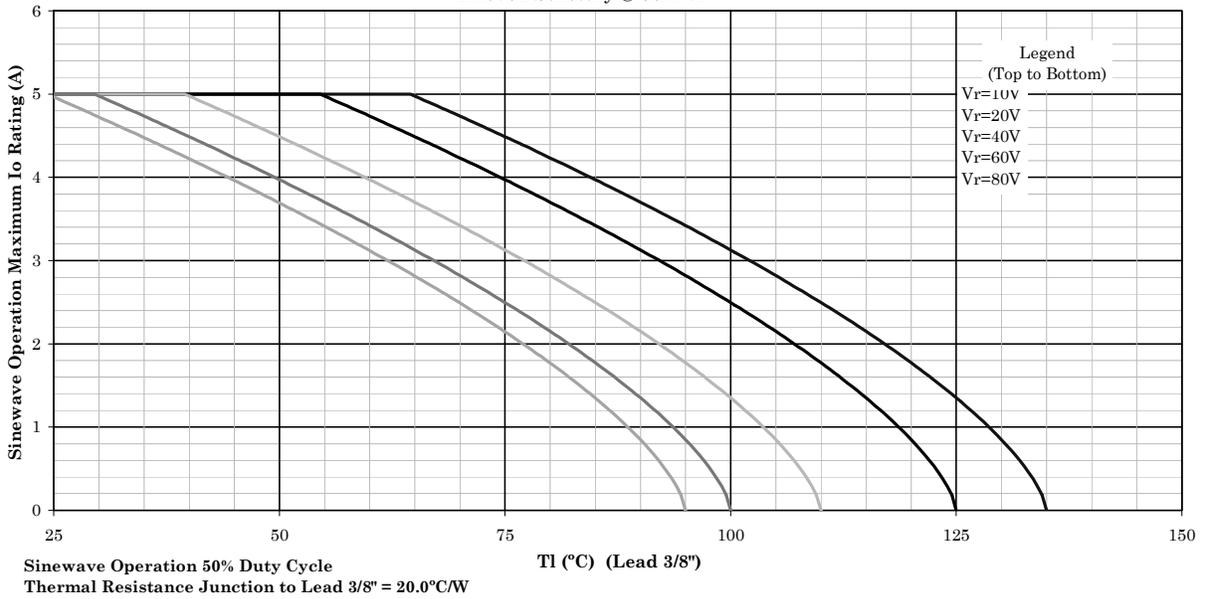
1N6702 Schottky



* FIGURE 4. Temperature current derating for 1N6702.

Temperature-Current Derating Curve

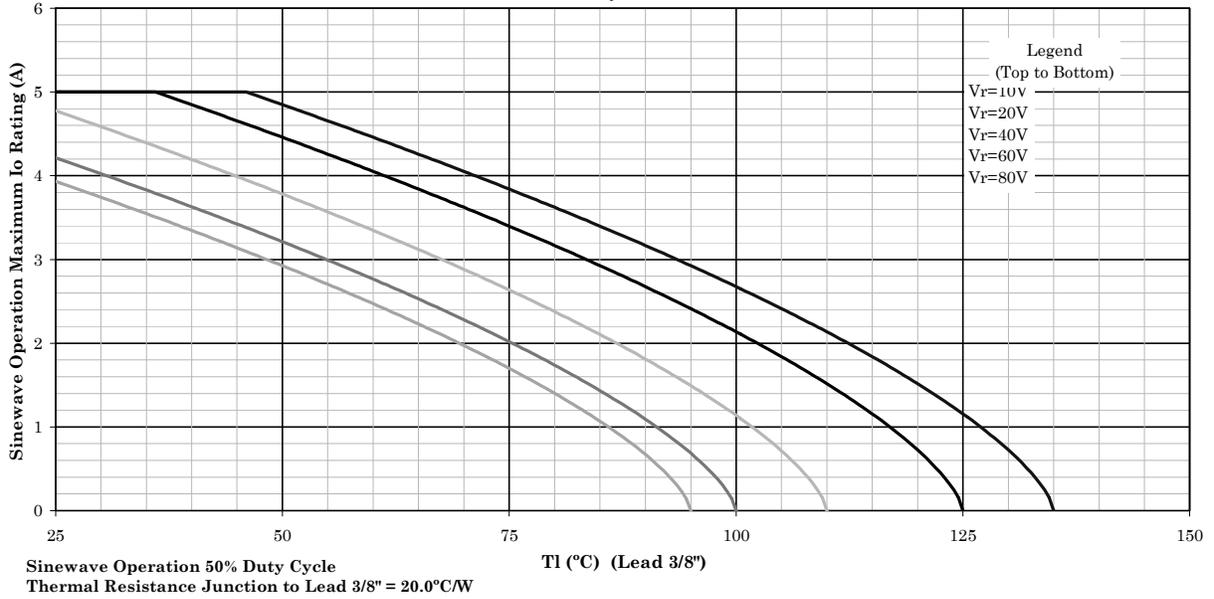
1N6702 Schottky @ 50% Vr



* FIGURE 4a. Temperature current derating at 50 percent Vr for 1N6702.

Temperature-Current Derating Curve

1N6702 Schottky @ 25% Vr



* FIGURE 4b. Temperature current derating at 25 percent Vr for 1N6702.

Temperature-Current Derating Curve

1N6702US Schottky



* FIGURE 5. Temperature current derating for 1N6702US.

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 or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Service's system commands. 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 should specify the following:

- a. Title, number, and date of this specification.
- b. Packaging requirements (see 5.1)..
- c. Lead finish (see 3.4.1).
- d. Product assurance level and type designator.
- e. For die acquisition, the JANHC or JANKC letter version shall be specified (see figure 3).

* 6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers List (QML 19500) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or 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 43218-3990 or e-mail vqe.chief@dla.mil .

* 6.4 Suppliers of die. The qualified die suppliers with the applicable letter version (e.g., JANHCA1N6702) will be identified on the QML.

JANC ordering information	
PIN	Manufacturer
	43611
1N6702	JANHCA1N6702
1N6702	JANKCA1N6702

* 6.5 Changes from previous issue. The margins of this specification are marked with asterisks 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.

Custodians:

Army - CR
Navy - EC
Air Force - 11
NASA – NA
DLA - CC

Preparing activity:

DLA - CC

(Project 5961- 2723)

Review activities:

Army - AR, MI, SM
Navy - AS, MC
Air Force - 19

* NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <http://www.dodssp.daps.mil/>.