The documentation and process conversion measures necessary to comply with this revision shall be completed by 27 February 2004.

INCH-POUND

MIL-PRF-19500/610E
1 December 2003
SUPERSEDING
MIL-PRF-19500/610D
7 September 2000

* PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, HERMETIC, DIODE, SILICON, SCHOTTKY BARRIER,
TYPES 1N6677-1 AND 1N6677UR-1,
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 diodes. Four levels of product assurance are provided for each encapsulated device types as specified in MIL-PRF-19500, and two levels of product assurance for each unencapsulated device type die.

1.2 Physical dimensions. See figure 1 (DO-35), figure 2 (DO-213AA), and figure 3 (JANHC and JANKC die) dimensions.

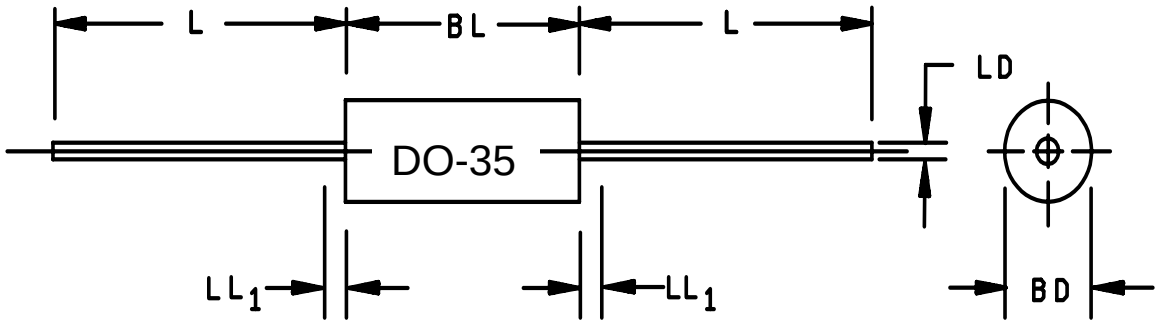
* 1.2.1 Mounting arrangement. See figure 4.

* 1.3 Maximum ratings.

Types	V_{RWM}	I_{O1} (1)	I_{FSM}	T_{STG}	T_J
	V (pk)	mA dc	A (pk)	°C	°C
1N6677-1, 1N6677UR-1	40	200	5	-65 to +150	-65 to +125

(1) For derating, see figures 5 and 6.

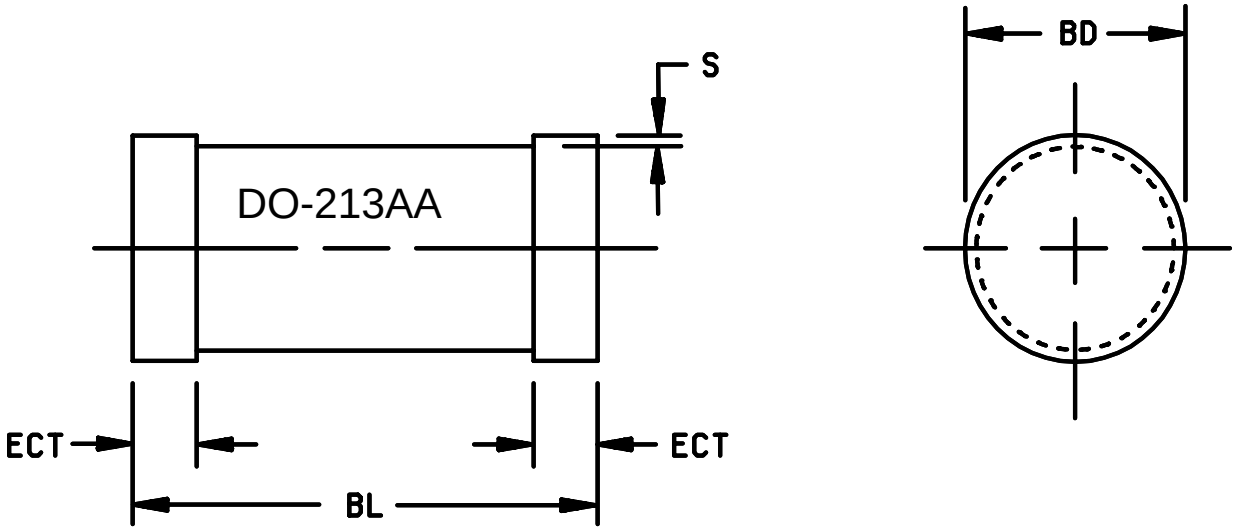
Comments, suggestions, or questions on this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43216-5000, or emailed to alan.barone@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil.



Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
LD	.018	.022	0.46	0.56	
BD	.055	.090	1.40	2.29	3
BL	.120	.200	3.05	5.08	3
L	1.000	1.500	25.40	38.10	
LL_1		.050		1.27	4

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Package contour optional within BD and length L. Heat slugs, if any, shall be included within this cylinder but shall not be subject to minimum limit of BD.
4. Within this zone lead, diameter may vary to allow for lead finishes and irregularities other than heat slugs.
5. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

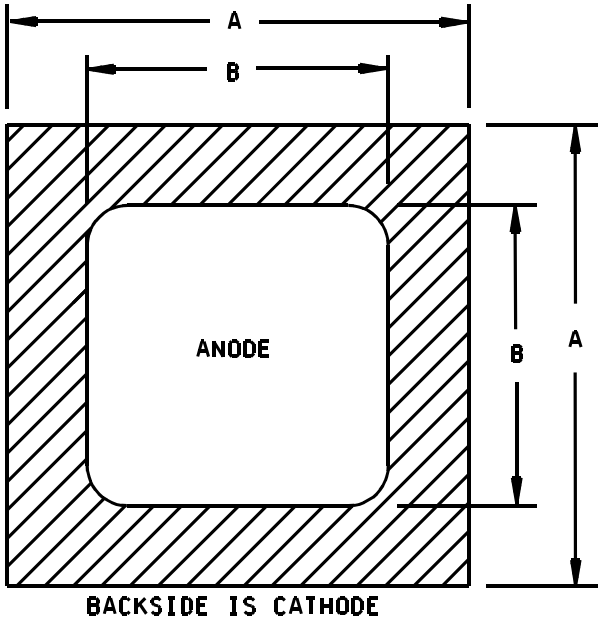
FIGURE 1. Physical dimensions of 1N6677-1 (DO-35).



Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BD	.063	.067	1.60	1.70
ECT	.016	.022	0.41	0.56
BL	.130	.146	3.30	3.71
S	.001 min		0.03 min	

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

FIGURE 2. Physical dimensions of surface mount family, 1N6677UR-1 (DO-213AA).



A version

Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	.021	.025	0.53	0.64
B	.013	.017	0.33	0.43

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) $\pm$ 2 mils (0.051 mm)

FIGURE 3. JANC (A-version) die dimensions.

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

Types	Max V_{FM1} I_{FM} = 20 mA	Max V_{FM2} I_{FM} = 200 mA	Max V_{FM3} I_{FM} = 630 mA	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 $Z_{\theta JX}$	Max C_T V_R = 0 V dc
				T_J = +25°C I_{RM1}	T_J = +100°C I_{RM2}			
	V (pk)	V (pk)	V (pk)	µA	mA	°C/W	°C/W	pF
1N6677-1	0.37	0.50	0.70	5.0	0.60	250	20	50
1N6677UR-1	0.37	0.50	0.70	5.0	0.60	100	20	50

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 SPECIFICATION

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

DEPARTMENT OF DEFENSE STANDARD

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

* (Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or www.dodssp.dap.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, 2, and 3 herein.

* 3.4.1 Lead material and finish. Lead material shall be copper clad steel with a minimum of 50 percent copper by weight. Lead finish shall be in accordance with MIL-PRF-19500 and MIL-STD-750. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

3.4.2 Diode construction. All devices shall be metallurgically bonded, double plug construction in accordance with the requirements of category I or II (see MIL-PRF-19500).

3.4.2.1 Surface mount. The UR version shall be considered structurally identical to the non-UR version except for lead attach.

3.5 Marking. Marking shall be in accordance with MIL-PRF-19500.

* 3.5.1 Marking for UR devices. UR-suffix devices only, all marking (except for 3.6) may be omitted from the body, but shall be retained on the initial container.

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

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

3.8 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table I.

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 table II herein and MIL-PRF-19500.

4.2.1 JANHC and JANKC devices. Qualification for JANC devices shall be in accordance with appendix G of MIL-PRF-19500. This testing may be performed on a TO-5 package in lieu of the axial leaded package.

* 4.3 Screening (JAN, 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
1a 1b	Required Required
2	Not required
3a 3b (1) 3c	Required Not applicable Required (see 4.3.3)
4, 5, 6, and 7a	Not applicable
7b	Required
8	Required
9	Required I_{R1} and V_{F2}
(2) 10	Required T_A = +110°C; V_{RWM} = 40 V(pk); I_O = 0, half sine wave, f = 60 Hz
11	Required $\Delta I_{R1} \leq$ 100 percent of initial reading or 2 μA whichever is greater. $\Delta V_{FM2} \leq \pm$ 50 mV dc.
12	Required See 4.3.2
13	Required Subgroup 2 of table I herein; $\Delta I_{R1} \leq$ 100 percent of initial reading or 2 μA whichever is greater; $V_{FM2} \leq \pm$ 50 mV dc.
14a 14b	Not applicable Optional (3)
15	Required
16	Required

See notes at end of table.

4.3 Screening (JAN, JANTX, JANTXV, and JANS levels only) - Continued.

Screen (see table IV of MIL-PRF-19500)	Measurement	
	JANTX and JANTXV level	JAN level
1a 1b	Not required Required (JANTXV only)	Not required Not required
2	Not required	Not required
3a 3b (1) 3c	Required Not applicable Required (see 4.3.3)	Required in accordance with MIL-PRF-19500, JANTX level Not applicable Required (see 4.3.3)
4, 5, 6, and 7a	Not applicable	Not applicable
7b	Required	Not required
8	Not required	Not required
9	Not applicable	Not applicable
(2) 10	Required T_A = +110°C; V_{RWM} = 40 V(pk); I_O = 0, half sine wave, f = 60 Hz	Not applicable
11	Required I_{R1} and V_{FM2}	Not applicable
12	Required See 4.3.2, t = 48 hours	Not applicable
13	Required Subgroup 2 of table I herein; $\Delta I_{R1} \leq$ 100 percent of initial reading or 2 μA whichever is greater; $V_{FM2} \leq \pm$ 50 mV dc.	Not applicable
14a 14b	Not applicable Optional (3)	Not applicable Not required
15 and 16	Not required	Not required

(1) Thermal impedance shall be performed any time after sealing provided temperature cycling is performed in accordance with table IV of MIL-PRF-19500, screen 3 prior to this thermal test.
(2) Junction temperature (T_J) is not to exceed 115°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_J for I_O = 0.
(3) In accordance with MIL-PRF-19500.

* 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 1, subgroup 2.

4.3.2 Burn-in conditions. Burn-in conditions are as follows: I_F = 200 mA dc. Mounting and test conditions in accordance with method 1038 of MIL-STD-750, test condition B.

4.3.2.1 Mounting. Devices may be mounted using any convenient method including the temporary attachment of leads on UR suffix devices, provided that the parts are burned-in at $T_J \geq +110^\circ C$.

* 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 exceed table 1, subgroup 2 herein.

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 table V of MIL-PRF-19500 and table I herein. The following test conditions shall be used for $Z_{\theta JX}$, table 1 inspection:

a. I_M measurement current .....1 mA to 10 mA.

b. I_H forward heating current.....0.5 A to 1.0 A.

c. t_H heating time .....10 ms.

d. t_{MD} measurement delay time.....70 μs maximum.

* 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 (JAN, JANTX, and JANTXV) of MIL-PRF-19500. Electrical measurements (end-points) shall be in accordance with the applicable inspections of table I, subgroup 2 herein.

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

Subgroup	Method	Condition
B3	1056 1051	-55°C to 100°C, 25 cycles, n = 22, c = 0. -55°C to 150°C, 100 cycles, n = 22, c = 0.
B3	4066	I_{FSM} = 5 A(pk), condition A 2, I_O = 200 mA; T_A = room ambient as defined in the general requirements of MIL-STD-750 (see 4.5); 5 surges of 8.3 ms each at 1 minute intervals.
B4	1036	I_O = 200 mA; T_A = room ambient as defined in the general requirements of MIL-STD-750 (see 4.5); f = 50 - 60 Hz; V_{RWM} = 40 V(pk); $t_{on} = t_{off}$ = 3 minutes minimum for 2,000 cycles.
B5	1027	I_F = 200 mA 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, JANTXV of MIL-PRF-19500).

Subgroup	Method	Condition
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} = 5 A(pk), condition A 2, I_O = 200 mA; T_A = room ambient as defined in the general requirements of MIL-STD-750 (see 4.5); 5 surges of 8.3 ms each at 1 minute intervals.
B3	1027	I_F = 200 mA dc minimum, adjust I_F or T_A to achieve T_J = + 125°C minimum.
B4	2075	As specified.

* 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.

Subgroup	Method	Condition
C2	2036	Tension: Test condition A; weight = 8 pounds; t = 15 s. Lead fatigue: Test condition E; weight 1 pound. NOTE: Both tension and lead fatigue are not applicable for UR devices.
C5	3101	See 4.4.5 herein.
C6	1027	I_F = 200 mA dc minimum, adjust I_F or T_A to achieve T_J = + 125°C minimum.

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

* 4.4.5 Thermal resistance. Thermal resistance measurement shall be performed in accordance with method 3101 or 4081 of MIL-STD-750. Forced moving air or draft shall not be permitted across the devices during test. The maximum limit for $R_{\theta JL}$ under these test conditions shall be $R_{\theta JL(max)}$ = 250°C/W and $R_{\theta JEC(max)}$ = 100°C/W. The following conditions shall apply:

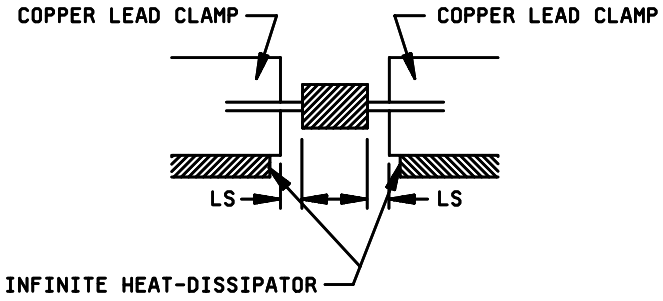
a. I_M = 1 mA to 10 mA.

b. I_H = 200 mA.

c. t_H = 20 seconds minimum.

d. t_{MD} = 70 μs maximum.

LS = Lead spacing = .375 inch (9.53 mm) for non-surface mount devices and 0 inch for surface mount devices is as defined on figure 4:



* FIGURE 4. Mounting arrangement.

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 4.3.2.1 of 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.

* TABLE I. Group A inspection.

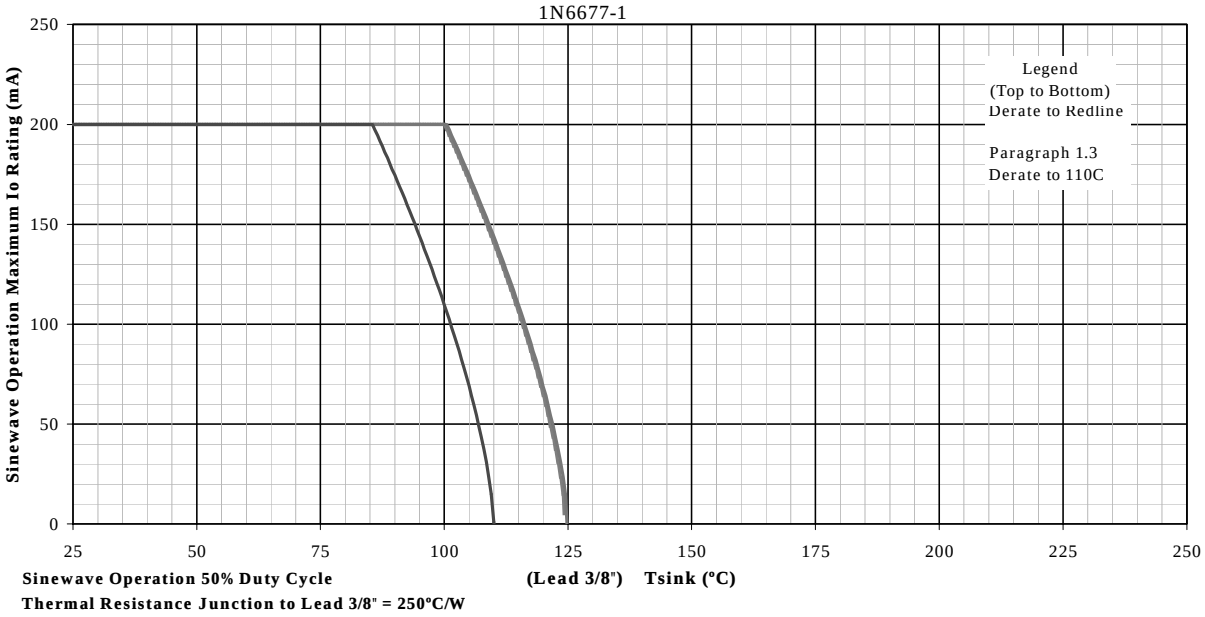
Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical examination	2071					
Subgroup 2						
Thermal impedance	3101	See 4.3.3	$Z_{\theta JX}$		20	°C/W
Forward voltage	4011	I_{FM} = 20 mA (pk), pulse method (see 4.5.1)	V_{FM1}		0.37	V
	4011	I_{FM} = 200 mA (pk), pulse method (see 4.5.1)	V_{FM2}		0.50	V
	4011	I_{FM} = 630 mA (pk), pulse method (see 4.5.1)	V_{FM3}		0.70	V
Reverse current leakage	4016	V_{RM} = 40 V (pk), pulse method (see 4.5.1)	I_{RM1}		5.0	µA
Subgroup 3						
High temperature operation:		T_A = +100°C				
Reverse current leakage	4016	V_{RM} = 40 V (pk), pulse method (see 4.5.1)	I_{RM2}		0.60	mA
Forward voltage	4011	I_F = 200 mA (pk), pulse method (see 4.5.1)	V_{FM4}		0.47	V
Low temperature operation:		T_A = -55°C				
Reverse current leakage	4016	V_{RM} = 40 V (pk), pulse method (see 4.5.1)	I_{RM3}		20	µA
Forward voltage	4011	I_F = 200 mA (pk), pulse method (see 4.5.1)	V_{FM5}		0.60	V
Subgroup 4						
Capacitance	4001	V_R = 0 V dc, .01 ≤ f ≤ 1 MHz, V_{SIG} = 15 mV p-p	C_T		50	pF

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		Sampling plan
	Method	Conditions	
Subgroup 1			22 devices c = 0
Thermal shock	1056	500 cycles -55°C to 100°C	
Temperature cycling	1051	500 cycles -55°C to 150°C	
Hermetic seal	1071	Test condition E	
Electrical measurement		See table I, subgroup 2	
Subgroup 2			22 devices c = 0
Steady-state reverse bias	1038	Test condition A; 1,000 hours, see 4.4.3.1, subgroup C6 herein.	
Electrical measurement		See table I, subgroup 2	
Subgroup 3			3 devices, c = 0
Destructive physical analysis	2101	Cross section, and scribe and break	
Subgroup 4			
Thermal impedance curves		Each supplier shall submit their (typical) design thermal impedance curves. In addition, test conditions and $Z_{\theta JX}$ limit shall be provided to the qualifying activity in the qualification report.	
Subgroup 5			
Not applicable			
Subgroup 6			3 devices, c =0
ESD	1020		
Subgroup 7			45 devices
Resistance to glass cracking	1057	Test to destruction or 25 cycles max, whichever comes first.	
Subgroup 8			45 devices, c = 0
Soldering heat	2031	1 cycle	
Electrical measurement		See table I, subgroup 2.	

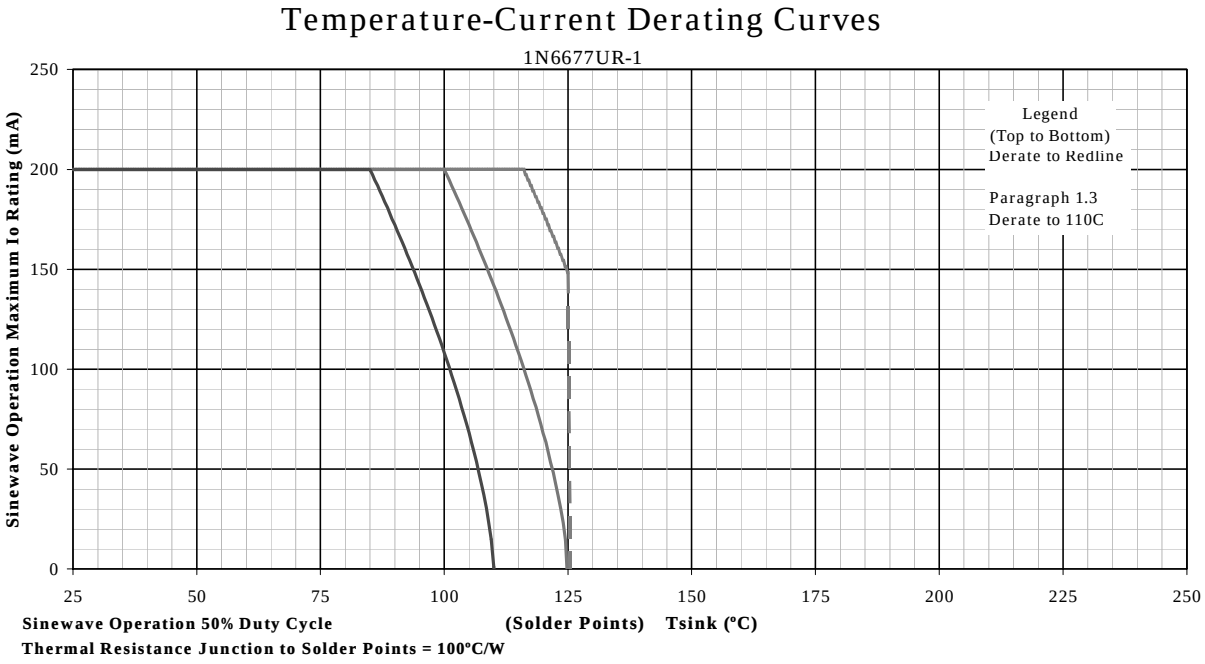
Temperature-Current Derating Curves



NOTES:

1. Maximum theoretical derate design curve. This is the true inverse of the worst case thermal resistance value. All devices are capable of operating at $\leq T_J$ specified on this curve. Any parallel line to this curve will intersect the appropriate power for the desired maximum T_J allowed.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq 110^{\circ}C$ to show power rating where most users want to limit T_J in their application.

* FIGURE 5. Temperature power derating for 1N6677-1 (DO-35).



NOTES:

1. Maximum theoretical derate design curve. This is the true inverse of the worst case thermal resistance value. All devices are capable of operating at $\leq T_J$ specified on this curve. Any parallel line to this curve will intersect the appropriate power for the desired maximum T_J allowed.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq 110^{\circ}C$ to show power rating where most users want to limit T_J in their application.

* FIGURE 6. Temperature power derating for 1N6677UR-1 (DO-213AA).

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

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

6.2 Acquisition requirements. The acquisition requirements are as specified in MIL-PRF-19500.

* 6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturer's List (QML No. 19500) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or 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 or e-mail vqe.chief@dla.mil .

6.4 Suppliers of die. The qualified die suppliers with the applicable letter version (e.g., JANHCA1N6677) will be identified on the QML.

JANC ordering information	
PIN	Manufacturer
	43611
1N6677-1	JANHCA1N6677-1 JANKCA1N6677-1

6.5 Ordering data. Acquisition documents may specify the material and finish.

* 6.6 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

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

Preparing activity:
DLA - CC

(Project 5961-2721)

* 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 www.dodssp.daps.mil.