

The documentation and process conversion measures necessary to comply with this revision shall be completed by 16 November 1998

INCH-POUND

MIL-PRF-19500/646A  
16 August 1998  
SUPERSEDING  
MIL-PRF-19500/646  
18 April 1997

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DIODE, SILICON,  
POWER RECTIFIER, ULTRAFAST,  
TYPES 1N6774 THROUGH 1N6777  
JAN, JANTX, JANTXV, AND JANS

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

1. SCOPE

1.1 Scope. This specification covers the performance requirements for silicon, ultrafast, power rectifier diodes. Four levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (2 pin, isolated - TO-257).

1.3 Maximum ratings.

Types	$V_{RWM}$ $I_D = 10 \mu A$ dc	$I_F$ <u>1/</u> $T_C =$ $+100^\circ C$	$I_{FSM}$ $t_p = 8.3ms$	$R_{\theta JC}$	$R_{\theta JA}$	$T_{STG}$ and $T_{OP}$
	<u>Vdc</u>	<u>Adc</u>	<u>A(pk)</u>	<u>°C/W</u>	<u>°C/W</u>	<u>°C</u>
1N6774	50					
1N6775	100	15	180		40	-65 to +150
1N6776	150			2.0		
1N6777	200					

1/ Derate at 300 mA/°C above  $T_C = +100^\circ C$ .

1.4 Primary electrical characteristics. Unless otherwise specified, primary electrical characteristics are at  $+25^\circ C$ .

Types	$V_{F1}$ $I_F = 8 A$ dc	$V_{F2}$ $I_F = 15 A$ dc	$I_{R1}$ $V_R = 0.8 V_{RWM}$ (See 1.3)	$I_{R2}$ <u>1/</u> $V_R = 0.8 V_{RWM}$ $T_C = +100^\circ C$	$t_{rr}$	$C_J$ $V_R = 5 V$ $f = 1 MHz$
ALL	<u>V dc</u> 1.00	<u>V dc</u> 1.15	<u>μA dc</u> 10	<u>μA dc</u> 500	<u>ns</u> 35	<u>pF</u> 300

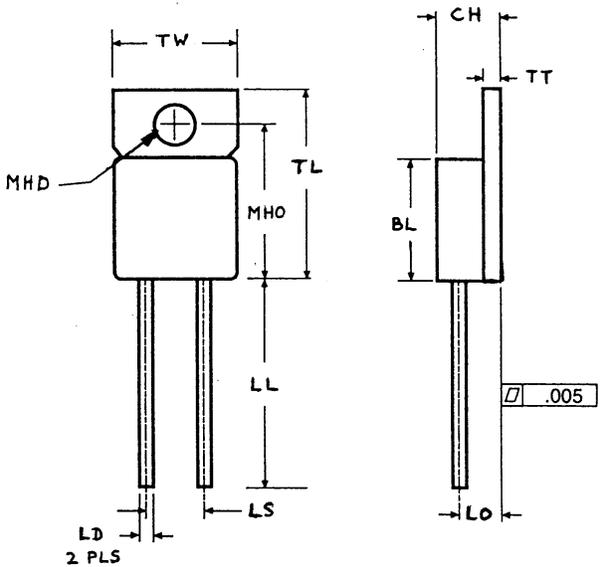
1/ see 1.3

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Supply Center, Columbus, ATTN: DSCC-VA, 3990 East Broad Street, Columbus, Ohio 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 5961

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Dimensions				
Symbol	Inches		Millimeters	
	Min	Max	Min	Max
BL	.410	.430	10.4	10.9
CH	.249	.260	6.32	6.60
LD	.035	.045	0.89	1.14
LL	.500	.750	12.70	19.05
LO	.150 typ		3.81 typ	
LS	.200 bsc		5.08 bsc	
MHD	.140	.150	3.55	3.80
MHO	.527	.537	13.4	13.6
TL	.645	.665	16.4	16.9
TT	.040	.050	1.02	1.27
TW	.410	.420	10.4	10.7

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only. See 3.3.
3. All terminals are isolated from case.

Configuration

Terminal	Description
1	Cathode
2	Anode

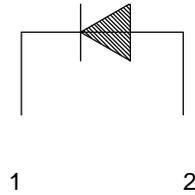


FIGURE 1. Physical dimensions and configuration (2 pin, isolated) (similar to TO-257).

## 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 federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 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 Associated specification. The individual item requirements shall be in accordance with MIL-PRF-19500 and as specified herein.

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

3.3 Interface requirements and physical dimensions. The interface requirements and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 (TO-257) herein. Methods used for electrical isolation of the terminal feedthroughs shall employ materials that contain a minimum of 90 percent  $Al_2O_3$ (ceramic). Examples of such construction techniques are metallized ceramic eyelets or ceramic walled packages. The preferred measurements used herein is the metric SI system. However, since this item was originally designed using inch-pound units of measurement, in the event of a conflict between the metric and inch-pound units, the inch-pound units shall take precedence.

3.3.1 Lead material and finish. Lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish or formation is desired, it shall be specified in the acquisition document (see 6.2). When lead formation is performed, as a minimum, the vendor shall perform 100 percent hermetic seal in accordance with screen 14 of table II of MIL-PRF-19500 and 100 percent DC testing in accordance with group A, subgroup 2 herein.

3.3.2 Polarity. Polarity and terminal configuration shall be in accordance with figure 1 herein.

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

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

3.6 Electrical test requirements. The electrical test requirements shall be the subgroups specified in 4.4.2 and 4.4.3 herein.

3.7 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 6.2).

#### 4. QUALITY ASSURANCE 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 table III herein.

4.3 Screening (JANTX, JANTXV, and JANS levels). 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	JANTX and JANTXV levels
3C <u>1/</u>	Thermal impedance (see 4.3.2)	Thermal impedance (see 4.3.2)
9 and 10	Not applicable	Not applicable
11	$I_{R1}$ and $V_{F2}$	$I_{R1}$ and $V_{F2}$
12	See 4.3.1, $t = 240$ hours	See 4.3.1, $t = 48$ hours
13	Subgroups 2 and 3 of table I herein; $V_{F2}$ and $\Delta I_{R1}$ ; $I_{R1} \leq 100$ percent of initial value or $\pm 2.5 \mu A$ , whichever is greater; $\Delta V_{F2} \leq \pm 100$ mV.	Subgroup 2 of table I herein; $V_{F2}$ and $I_{R1}$ ; $\Delta I_{R1} \leq 100$ percent of initial value or $\pm 2.5 \mu A$ , whichever is greater; $\Delta V_{F2} \leq \pm 100$ mV.

1/ Thermal impedance shall be performed any time before screen 13.

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows:

MIL-STD-750 method 1038, test condition A.  $T_C = +125^\circ C$ ;  $V_R = 0.8$  of rated  $V_{RWM}$  (see 1.3).

4.3.2 Thermal impedance ( $Z_{\theta JX}$ ) measurements for screening. The  $Z_{\theta JX}$  measurements shall be performed in accordance with MIL-STD-750, method 3101. The maximum limit (not to exceed the group A, subgroup 2 limit) and conditions for  $Z_{\theta JX}$  in screening (table IV of MIL-PRF-19500) shall be derived by each vendor by means of statistical process control. When the process has exhibited control and capability, the capability data shall be used to establish the fixed screening limit. In addition to screening, once a fixed limit has been established, monitor all future sealing lots using a random five piece sample from each lot to be plotted on the applicable X, R chart. If a lot exhibits an out of control condition, the entire lot shall be removed from the line and held for Engineering evaluation and disposition.

4.3.2.1 Thermal impedance ( $Z_{\theta JX}$ ) measurements for initial qualification or requalification. The  $Z_{\theta JX}$  measurements shall be performed in accordance with MIL-STD-750, method 3101 (read and record data  $Z_{\theta JX}$ ). Derived conditions limits and thermal response curve shall be supplied to the qualifying activity on the qualification lot prior to qualification approval. Measurement conditions shall be in accordance with 4.4.1.

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

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500 and table I herein. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table II herein. The following test conditions shall be used for  $Z_{\theta JX}$ , group A inspection:

- a.  $I_M$  measure current ----- 15 mA
- b.  $I_H$  forward heating current ----- 9.9 A
- c.  $t_H$  heating time ----- 200 ms
- d.  $t_{MD}$  measurement delay time ----- 35  $\mu$ s
- e.  $V_H$  heating voltage ----- 1 V

The maximum limit for  $Z_{\theta JX}$  under these conditions is  $Z_{\theta JX}(\max) = 1.8 \text{ }^\circ\text{C/W}$

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

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

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
4	1037	$I_F$ or $I_O = 1.25 \text{ A to } 10 \text{ A}$ ; $\Delta T_J = +85^\circ\text{C}$ , minimum for 2,000 cycles minimum.

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

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
3	1037	$I_F$ or $I_O = 1.25 \text{ A to } 10 \text{ A}$ ; $\Delta T_J = +85^\circ\text{C}$ , minimum for 2,000 cycles minimum.

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) and delta requirements shall be in accordance with the applicable steps of table II herein.

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

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
2	2036	Test condition A, 5 pounds, $t = 15 \text{ seconds } \pm 3 \text{ seconds}$ .
6	1037	$I_F$ or $I_O = 1.25 \text{ A to } 10 \text{ A}$ ; $\Delta T_J = 85^\circ\text{C}$ , minimum for 6,000 cycles minimum.

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table III herein. Electrical measurements (end points) and delta requirements shall be in accordance with the applicable steps and footnotes of table II herein.

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.

TABLE I. Group A inspection. 1/

Inspection	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 <u>2/</u>	3101	See 4.4.1	$Z_{\theta JX}$		1.8	°C/ W
Breakdown voltage 1N6774 1N6775 1N6776 1N6777	4022	$I_R = 10 \mu\text{A}$ dc, pulsed <u>3/</u>	$V_{BR}$	50 100 150 200		V dc
Forward voltage	4011	$I_F = 8 \text{ A}$ dc, pulsed <u>3/</u> $I_F = 15 \text{ A}$ dc, pulsed <u>3/</u>	$V_{F1}$ $V_{F2}$		1.00 1.15	V dc V dc
Reverse leakage current	4016	DC method; pulsed <u>3/</u> $V_R = 0.8$ of $V_{RWM}$ (see 1.3)	$I_{R1}$		10	$\mu\text{A}$ dc
<u>Subgroup 3</u>						
High temperature operation:		$T_C = +100^\circ\text{C}$				
Reverse leakage current	4016	DC method; pulsed <u>3/</u> $V_R = 0.8$ of $V_{RWM}$ (see 1.3)	$I_{R2}$		500	$\mu\text{A}$ dc
Low-temperature operation:		$T_A = -55^\circ\text{C}$				
Forward voltage	4011	$I_F = 15 \text{ A}$ dc, pulsed <u>3/</u>	$V_{F3}$		1.3	V dc
<u>Subgroup 4</u>						
Scope display evaluation <u>4/</u>	4023					
Reverse recovery time measurements	4031	Condition B; $I_F = 1.0 \text{ A}$ , $di/dt = 50 \text{ A}/\mu\text{s}$	$t_{rr}$		35	ns
<u>Subgroups 5 and 6</u>						
Not applicable						
<u>Subgroup 7</u>						
Junction capacitance	4001	$V_R = 5 \text{ V}$ dc; $f = 1.0 \text{ MHz}$	$C_J$		300	pF

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

2/ If 4.4.1 test conditions are performed in 100 percent screening, this test need not be performed in Group A.

3/ Pulse test: pulse width = 300  $\mu$ s, duty cycle  $\leq$  2 percent.

4/ The reverse breakdown characteristics shall be viewed on an oscilloscope with display calibration factors of 2 to 5  $\mu$ A/division and 20 to 50 V/division. Reverse current over the knee shall be at least 20  $\mu$ A. Each device may exhibit a slightly rounded characteristic and any discontinuity or dynamic instability of the trace shall be cause for rejection.

TABLE II. Groups A, B, C, and E electrical measurements. 1/ 2/ 3/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1	Forward voltage	4011	$I_F = 15$ A dc pulsed	$V_{F2}$		1.15	V dc
2	Reverse leakage current	4016	$V_R = 0.8$ of $V_{RWM}$ (see 1.3) DC method, pulsed	$I_{R1}$		10	$\mu$ A dc
3	Forward voltage	4011	$I_F = 15$ A dc pulsed	$\Delta V_{F2}$		$\pm 100$ mV dc from initial reading	
4	Reverse leakage current	4016	$V_R = 0.8$ of $V_{RWM}$ (see 1.3) DC method, pulsed	$\Delta I_{R1}$		100 percent of initial value or $\pm 2.5$ $\mu$ A dc whichever is greater.	
5	Thermal impedance	3101	See 4.4.1	$Z_{\theta JX}$		1.8	$^{\circ}$ C/W

1/ The electrical measurements for table VIa (JANS) of MIL-PRF-19500 are as follows:

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

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

- a. Subgroup 2, see table II herein, steps 1 and 2.
- a. Subgroup 3, see table II herein, steps 1, 2, and 5.
- a. Subgroup 6, see table II herein, steps 1 and 2.

3/ The electrical measurements for table VII of MIL-PRF-19500 are as follows:

- a. Subgroups 2 and 3, see table II herein, steps 1 and 2 for all levels.
- a. Subgroup 6, see table II herein, steps 1, 2, and 5 for all levels.

TABLE III. Group E inspection (all quality levels) for qualification only. <sup>1/</sup>

Inspection	MIL-STD-750		Sampling plan
	Method	Conditions	
<u>Subgroup 1</u>			22 devices c = 0
Thermal shock (temperature cycling)	1051	500 cycles	
Hermetic seal	1071		
Fine leak		Test condition H 5 x 10 <sup>-7</sup> atm cc/s	
Gross leak		Test condition C or K	
Electrical measurements		See table II herein, steps 1 and 2	
<u>Subgroup 2</u>			22 devices c = 0
Steady-state reverse bias	1038	Test condition A t = 1,000 hours, T <sub>C</sub> = +125°C V <sub>R</sub> = 0.8 of rated V <sub>RWM</sub> (see 1.3)	
Electrical measurements		See table II herein, steps 1 and 2	
<u>Subgroup 3</u>			3 devices c = 0
Destructive physical analysis	2101		
<u>Subgroup 4</u>			22 devices c = 0
Thermal resistance	3101	See 4.5.2; R <sub>θJC</sub> = 2.0 °C/W	
<u>Subgroup 5</u>			
Not applicable			

<sup>1/</sup> For initial design and process change verification only (one time testing).

4.5.2 Thermal resistance. Thermal resistance measurements shall be performed in accordance with method 3101 of MIL-STD-750. The maximum limits for R<sub>θJC</sub>(max) shall be 2.0°C/W for devices in the 2 pin case style. The following parameter measurements shall apply:

- a.  $I_M$  measure current ----- 15 mA
- b.  $I_H$  forward heating current ----- 9.9 A
- c.  $t_H$  heating time ----- Steady state (see MIL-STD-750, method 3101)
- d.  $t_{MD}$  measurement delay time ----- 35  $\mu$ s
- e.  $V_H$  heating voltage ----- 1 V

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging must be in accordance with MIL-PRF-19500.

5.2 Marking. Unless otherwise specified (see 6.2), marking shall be in accordance with MIL-STD-129.

6. NOTES

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

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

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Lead finish (see 3.3.1).
- b. Type designation and product assurance level.
- c. Packaging requirements (see 5.1).

6.3 Cross reference list. Parts covered by this specification may be used to replace the following commercial Part of Identifying Numbers (PIN):

Preferred types	Commercial types
JAN1N6774, JANTX1N6774, JANTXV1N6774, JANS1N6774	1N6774
JAN1N6775, JANTX1N6775, JANTXV1N6775, JANS1N6775	1N6775
JAN1N6776, JANTX1N6776, JANTXV1N6776, JANS1N6776	1N6776
JAN1N6777, JANTX1N6777, JANTXV1N6777, JANS1N6777	1N6777

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 Products List QPL-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 purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center Columbus, DSCC-VQE, Columbus, OH 43216.

6.5 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.

Custodians:  
Army - CR  
Navy - EC  
Air Force - 17  
NASA - NA  
DLA - CC

Preparing activity:  
DLA - CC  
  
(Project 5961-1996)

**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.

<b>I RECOMMEND A CHANGE:</b>	<b>1. DOCUMENT NUMBER</b> MIL-PRF-19500/646A	<b>2. DOCUMENT DATE</b> 16 August 1998
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**3. DOCUMENT TITLE**  
SEMICONDUCTOR DEVICE, DIODE, SILICON, POWER RECTIFIER, ULTRAFast, TYPES 1N6774 THROUGH 1N6777 JAN, JANTX, JANTXV, AND JANS

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

**5. REASON FOR RECOMMENDATION**

<b>6. SUBMITTER</b>		
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

<b>8. PREPARING ACTIVITY</b>			
a. Point of Contact Alan Barone	b. TELEPHONE Commercial 614-692-0510	DSN 850-0510	FAX 614-692-6939
			EMAIL alan_barone@dscclia.mil
c. ADDRESS Defense Supply Center Columbus ATTN: DSCC-VAT Columbus, OH 43216-5000	<b>IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:</b> Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 DSN 289-2340		