The documentation and process conversion measures necessary to comply with this revision shall be completed by 21 September 2013.

INCH-POUND

MIL-PRF-19500/647E
21 June 2013
SUPERSEDING
MIL-PRF-19500/647D
5 November 2007

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DIODE, SILICON, POWER RECTIFIER,
ULTRAFAST, TYPES 1N6778 AND 1N6779,
JAN, JANTX, JANTXV, AND JANS

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 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 Maximurn ratings.

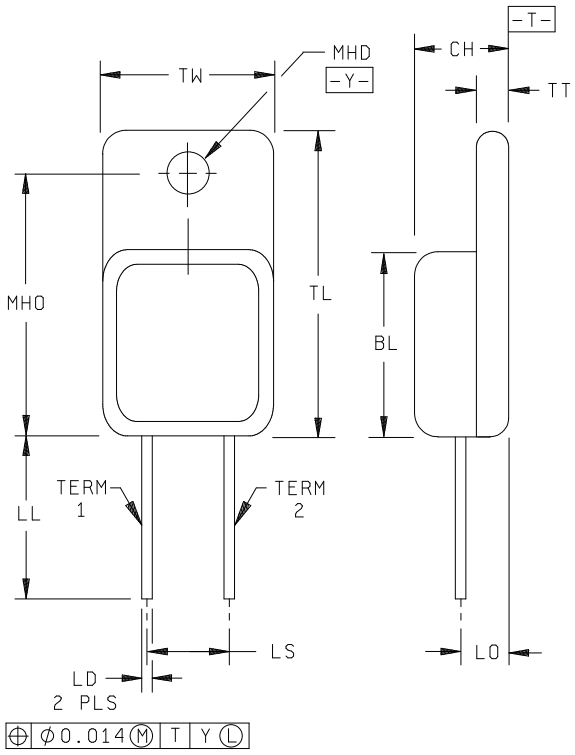
Types	V_{RWM} (1) I_D = 10 µA dc	I_F (1) (2) T_C =+100°C	I_{FSM} (1) t_p= 8.3 ms	$R_{\theta JC}$ (1)	$R_{\theta JA}$ (1)	T_{STG} and T_J
	Vdc	A dc	A (pk)	°C/W	°C/W	°C
1N6778 1N6779	400 600	15	140	1.8	40	-65 to +150

(1) Each individual diode.
(2) Derate at 300 mA/°C above T_C = +100°C.

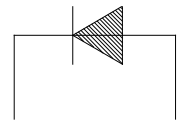
1.4 Primary electrical characteristics. Unless otherwise specified, primary electrical characteristics are at +25°C, and for each diode.

Types	V_{F1} I_F = 8 A dc	V_{F2} I_F =15 A dc	I_{R1} (see 1.3) V_R = 0.8 V_{RWM}	I_{R2} V_R = 0.8 V_{RWM} (see 1.3) T_C = +100°C	t_{rr}	C_J V_R = 5 V f = 1 MHz
	V dc	V dc	µA dc	µA dc	ns	pF
1N6778 1N6779	1.40	1.60	10	1,000	60	300

* Comments, suggestions, or questions on this document should be addressed to DLA Land and Maritime, ATTN: 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 https://assist.dla.mil/ .



SCHEMATIC



Configuration

Terminal	Description
1	Cathode
2	Anode

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

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	3.56	3.81
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. Millimeters are given for general information only.
3. All terminals are isolated from case.
4. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

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

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 of 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://quicksearch.dla.mil or https://assist.dla.mil/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

* 2.3 Order of precedence. Unless otherwise noted herein or in the contract, 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 (QML) 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 figure 1.

3.4.1 Lead finish. Lead finish shall be solderable in accordance with 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).

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

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.

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

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 and as specified herein.

4.2.1 Group E qualification. Group E inspection shall be performed for qualification or re-qualification only. In case qualification was awarded to a prior revision of the specification sheet that did not request the performance of table II tests, the tests specified in table II herein that were not performed in the prior revision shall be performed on the first inspection lot of this revision to maintain qualification.

4.3 Screening (JANTX, JANTXV, and JANS levels). Screening shall be in accordance with appendix E, table E-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 appendix E, table E-IV of MIL-PRF-19500)	Measurement	
	JANS level	JANTX and JANTXV levels
(1) 3c	Thermal impedance (see 4.3.2)	Thermal impedance (see 4.3.2)
9 and 10	Not applicable	Not applicable
11	I_{R1} and V_{F1}	I_{R1} and V_{F1}
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_{F1} and I_{R1}; $\Delta I_{R1} \leq$ 100 percent of initial value or ±2.5 μA, whichever is greater; $\Delta V_{F1} \leq$ ±100 mV.	Subgroup 2 of table I herein; V_{F1} and I_{R1}; $\Delta I_{R1} \leq$ 100 percent of initial value or ±2.5 μA whichever is greater; $\Delta V_{F1} \leq$ ±100 mV.

(1) Thermal impedance shall be performed any time after temperature cycling, screen 3a; JANTXV level does not need to be repeated in screening requirements.

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows: Method 1038 of MIL-STD-750, test condition A. T_C = +125°C; V_R = 0.8 of rated V_{RWM} (see 1.3).

4.3.2 Thermal impedance The thermal impedance measurements shall be performed in accordance with method 3101 or 4081 of MIL-STD-750, using the guidelines in that method for determining I_M, I_H, t_H, t_{SW}, (V_C and V_H where appropriate). Measurement delay time (t_{MD}) = 35 μs max. See table II, subgroup 4 herein.

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 III herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table E-VIA (JANS) and table E-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 III herein.

4.4.2.1 Group B inspection, appendix E, table E-VIA (JANS) of MIL-PRF-19500.

Subgroup	Method	Condition
B4	1037	I_F or I_O = 1.25 A to 10 A; ΔT_J = +85°C minimum, for 2,000 cycles minimum.

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

Subgroup	Method	Condition
B3	1037	I_F or I_O = 1.25 A to 10 A; ΔT_J = +85°C minimum, for 2,000 cycles minimum.
B5		Not applicable

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table E-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 III herein.

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

Subgroup	Method	Condition
C2	2036	Test condition A, 5 pounds, t = 15 seconds ±3 seconds.
C5	4081	$R_{\theta JC}$ (maximum) = 1.8 °C/W.
C6	1037	I_F or I_O = 1.25 A to 10 A; ΔT_J = +85°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 appendix E, table E-IX of MIL-PRF-19500 and table II herein. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps and footnotes of table III 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/ 2/

Inspection	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical examination	2071					
Subgroup 2						
Thermal impedance	3101	See 4.3.2	$Z_{\theta JX}$			°C/W
Breakdown voltage 1N6778 1N6779	4022	I_R = 10 µA dc, pulsed 3/	V_{BR}	 400 600		V dc
Forward voltage	4011	I_F = 8 A dc, pulsed 3/ I_F = 15 A dc, pulsed 3/	V_{F1} V_{F2}		1.40 1.60	V dc V dc
Reverse leakage current	4016	DC method; pulsed 3/ V_R = 0.8 of V_{RWM} (see 1.3)	I_{R1}		10	µA dc
Subgroup 3						
High temperature operation:		T_C = +100°C				
Reverse leakage Current	4016	DC method; pulsed 3/ V_R = 0.8 of V_{RWM} (see 1.3)	I_{R2}		1.0	mA dc
Low temperature operation:		T_A = -55°C				
Forward voltage	4011	I_F = 15 A dc, pulsed 3/	V_{F3}		1.80	V dc
Subgroup 4						
Scope display evaluation 4/	4023					
Reverse recovery time measurements	4031	Condition B1	t_{rr}		60	ns

See footnotes at end of table.

TABLE I. Group A inspection – Continued. 1/ 2/

Inspection	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroups 5 and 6						
Not applicable						
Subgroup 7						
Junction capacitance	4001	V_R = 5 V dc; f = 1.0 MHz	C_J		300	pF

1/ For sampling plan, see MIL-PRF-19500.
2/ Each individual diode.
3/ Pulse test: Pulse width = 300 μs, duty cycle ≤ 2 percent.
4/ The reverse breakdown characteristics shall be viewed on an oscilloscope with display calibration factors of 50 to 100 μA/division and 50 to 100 V/division. Reverse current over the knee shall be at least 500 μA. Each device may exhibit a slightly rounded characteristic and any discontinuity or dynamic instability of the trace shall be cause for rejection.

TABLE II. Group E inspection (all quality levels) for qualification and requalification only.

Inspection	MIL-STD-750		Sampling plan
	Method	Conditions	
Subgroup 1			22 devices c = 0
Temperature cycling	1051	500 cycles	
Hermetic seal	1071		
Fine leak			
Gross leak			
Electrical measurements		See table III herein, steps 1, 2, 3, 4, 5, and 6.	
Subgroup 2			22 devices c = 0
Steady-state reverse bias	1038	Test condition A t = 1,000 hours, T_C = +125°C V_R = 0.8 of rated V_{RWM} (see 1.3)	
Electrical measurements		See table III herein, steps 1, 2, and 6.	
Subgroup 4			
Thermal impedance curves		See MIL-PRF-19500.	
Subgroup 5			
Barometric pressure, reduced (altitude operation)	1001	Pressure 8.0 mm	15 devices c = 0

TABLE III. Groups A, B, C, and E electrical and delta measurements. 1/ 2/ 3/ 4/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1	Forward voltage	4011	I_F = 15 A dc pulsed	V_{F2}		1.60	V dc
2	Reverse leakage current	4016	V_R = 0.8 of percent V_{RWM} (see 1.3) DC method, pulsed	I_{R1}		10	µA dc
3	Forward voltage	4011	I_F = 15 A dc pulsed	ΔV_{F2}		±100 mV dc from initial reading	
4	Reverse leakage current	4016	V_R = 0.8 of percent V_{RWM} (see 1.3) DC method, pulsed	ΔI_{R1}		100 percent of initial value or ±2.5 µA dc whichever is greater.	
5	Thermal impedance	3101	See 4.3.2	$Z_{\theta JX}$		1.6	°C/W
6 5/	Reverse recovery time	4031	See table I, subgroup 4 herein.	t_{rr}		60	ns

1/ The electrical measurements for table E-VIa (JANS) of MIL-PRF-19500 are as follows:
   a. Subgroup 3, see table III herein, steps 1 and 2.
   b. Subgroup 4, see table III herein, steps 1, 2, 3, 4, 5, and 6.
   c. Subgroup 5, see table III herein, steps 1, 2, 3, 4, and 6.

2/ The electrical measurements for table E-VIb (JANTX and JANTXV) of MIL-PRF-19500 are as follows:
   a. Subgroup 2, see table III herein, steps 1, 2, 5, and 6.
   b. Subgroup 3, see table III herein, steps 1, 2, 3, 4, 5, and 6.
   c. Subgroup 6, see table III herein, steps 1 and 2.

3/ The electrical measurements for table E-VII of MIL-PRF-19500 are as follows:
   a. Subgroup 2, see table III herein, steps 1, 2, and 5 for all levels.
   b. Subgroup 3, see table III herein, steps 1 and 2.
   c. Subgroup 6, see table III herein, steps 1, 2, 3, 4, 5, and 6 for all levels.

4/ The electrical measurements for table E-IX of MIL-PRF-19500 are as follows:
   a. Subgroup 1, see table III herein, steps 1, 2, 3, 4, 5, and 6.
   b. Subgroup 2, see table III herein, steps 1 and 2.

5/ Step 6 applies to irradiated devices only.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When 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. The notes specified in MIL-PRF-19500 are applicable to this specification.)

6.1 Intended use. Semiconductors conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

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.

* 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 DLA Land and Maritime, ATTN: VQE, P.O. Box 3990, Columbus, OH 43218-3990 or e-mail vqe.chief@dla.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.dla.mil.

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

Preferred types	Commercial types
JAN1N6778, JANTX1N6778, JANTXV1N6778,JANS1N6778 JAN1N6779, JANTX1N6779, JANTXV1N6779,JANS1N6779	1N6778 1N6779

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 - 85
NASA - NA
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2013-060)

* 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 https://assist.dla.mil.

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