

The documentation and process conversion measures necessary to comply with this revision shall be completed by 30 June 2003.

INCH-POUND

MIL-PRF-19500/411K
 30 December 2002
 SUPERSEDING
 MIL-PRF-19500/411J
 9 October 2001

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, DIODE, SILICON, POWER RECTIFIER, FAST RECOVERY
 1N5415 THROUGH 1N5420, 1N5415US THROUGH 1N5420US,
 JAN, JANTX, JANTXV, JANS, JANJ, JANTXVM, JANTXVD, JANTXVR,
 JANTXVH, JANSM, JANSJ, JANSR, AND JANSK

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 rectifier diodes. Five levels of product assurance are provided for each device type as specified in MIL-PRF-19500. Provision for radiation hardness assurance (RHA) to four radiation test levels is provided for JANTXV and JANS product assurance levels. RHA level designators "M", "D", "R", and "H" are appended to the device prefix to identify devices which have passed RHA requirements.

1.2 Physical dimensions. See figure 1 (similar to D0-41) and figure 2 (surface mount).

1.3 Maximum ratings.

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	* Col. 8	Col. 9	Col. 10
Types	V_R	V_{RWM}	I_O (1) $T_A = 55^\circ\text{C}$ (2)	I_O (1) $T_A = 100^\circ\text{C}$ (3)	I_{FSM} $I_O = 2 \text{ A dc}$ $T_A = 100^\circ\text{C}$ $t_p = 8.3 \text{ ms}$	t_{rr}	T_{STG} T_J	$R_{\theta JL}$ at $L = .375$ in. (9.53 mm)	$R_{\theta JEC}$ at $L = 0$ for US versions
	V dc	V (pk)	A dc	A dc	A (pk)	ns	$^\circ\text{C}$	$^\circ\text{C/W}$	$^\circ\text{C/W}$
1N5415, 1N5415US	50	50	3	2	80	150	-65 to +175	20	10
1N5416, 1N5416US	100	100	3	2	80	150	-65 to +175	20	10
1N5417, 1N5417US	200	200	3	2	80	150	-65 to +175	20	10
1N5418, 1N5418US	400	400	3	2	80	150	-65 to +175	20	10
1N5419, 1N5419US	500	500	3	2	80	250	-65 to +175	20	10
1N5420, 1N5420US	600	600	3	2	80	400	-65 to +175	20	10

(1) I_O rating is independent of heat sinking, special mounting or forced air across the body or leads of the device.

(2) Derate linearly at 22 mA/ $^\circ\text{C}$ for $55^\circ\text{C} \leq T_A \leq 100^\circ\text{C}$.

(3) Derate linearly at 27 mA/ $^\circ\text{C}$ for $100^\circ\text{C} \leq T_A \leq 175^\circ\text{C}$.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. 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.

AMSC N/A
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FSC 5961

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

DEPARTMENT OF DEFENSE

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, 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.

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).

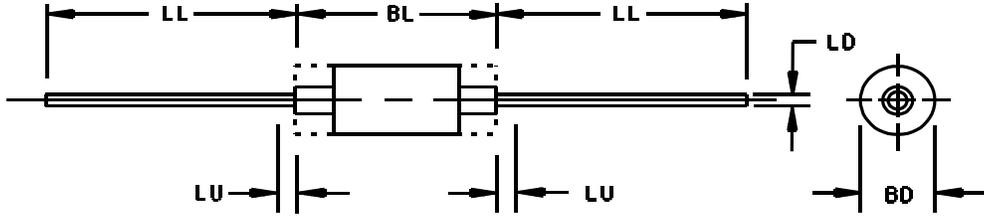
3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500 and as follows:

* EC..... End cap.

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 (DO-41) and figure 2 (surface mount) herein.

* 3.4.1 Lead finish. Unless otherwise specified, lead or end cap finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. When solder alloy is used for finish the maximum lead temperature is limited to 175°C maximum. Where a choice of finish is desired, it shall be specified in the acquisition document (see 6.2).

3.4.2 Encapsulant material. In addition to those categories of hermetically sealed package requirements specified in MIL-PRF-19500, fused-metal-oxide to metal shall also be acceptable.

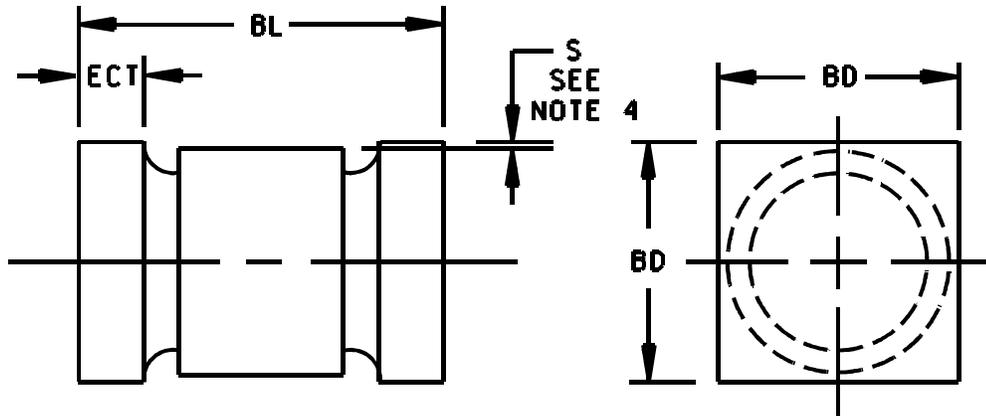


Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
BD	.110	.180	2.79	4.57	3
LD	.037	.042	0.94	1.07	4
BL	.130	.260	3.30	6.60	4
LL	.90	1.30	22.9	33.0	
LU		.050		1.27	5

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Dimension BD shall be measured at the largest diameter.
4. The BL dimension shall include all uncontrolled areas of the device leads.
5. Dimension LU shall include the sections of the lead over which the diameter is uncontrolled. This uncontrolled area is defined as the zone between the edge of the diode body and extending .050 inch (1.27 mm) onto the leads.

FIGURE 1. Physical dimensions (similar to D0-41).



Symbol	Dimension			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.200	.225	5.080	5.72
ECT	.019	.028	0.48	0.71
S	.003		0.08	
BD	.137	.148	3.48	3.76

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Dimensions are pre-solder dip.
4. Minimum clearance of glass body to mounting surface on all orientations.

FIGURE 2. Physical dimensions of surface mount family.

3.4.3 Diode construction. These devices shall be constructed utilizing non-cavity double plug construction with high temperature metallurgical bonding between both sides of the silicon die and terminal pins. Metallurgical bond shall be in accordance with the requirements of category I in MIL-PRF-19500.

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

3.5.1 Marking of US version. For US version only, all marking may be omitted from the device except for the cathode marking. All marking which is omitted from the body of the device shall appear on the label of the initial container.

3.5.2 Polarity. The polarity shall be indicated with a contrasting color band to denote the cathode end. Alternately for surface mount (US) devices, a minimum of three evenly spaced contrasting color dots around the periphery of the cathode end may be used. No color coding will be permitted.

3.5.3 Radiation hardness assurance (RHA). Radiation hardness assurance requirements, part number designators, and test levels shall be as defined in MIL-PRF-19500.

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

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

3.7.1 Post irradiation performance characteristics. The electrical performance characteristics of the RHA devices are as specified in 4.4.4 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 and as specified herein.

4.2.1 Qualification for radiation hardness assurance. Qualification inspection for radiation hardness assured JANS and JANTXV devices shall consist of group D examinations and tests specified in table II herein.

* 4.2.2 Group E qualification. Group E qualification shall be performed herein for qualification or requalification only. In case qualification was awarded to a prior revision of the associated specification that did not request the performance of table III tests, the tests specified in table III herein shall be performed on the first inspection lot to this revision to maintain qualification.

4.2.3 JANJ devices. For JANJ level, 3.3.1 through 3.3.1.3 of MIL-PRF-19500 shall apply, except as modified herein. Supplier imposed requirements as well as alternate screens, procedures, and/or controls shall be documented in the QM plan and must be submitted to the qualifying activity for approval. When alternate screens, procedures, and/or controls are used, in lieu of the JANJ screens herein, equivalency shall be proven and documented in the QM plan. Radiation characterization may be submitted in the QM plan at the option of the manufacturer, however, paragraph 3.3.1.1 of MIL-PRF-19500 is not required. Die lot control and rework shall be in accordance with 3.13 and D 3.13.2.1 of MIL-PRF-19500 for JANS level. Lot formation and conformance inspection requirements for JANJ shall be those used for JANTXV devices as a minimum.

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4.2.4 JANJ qualification. For JANJ qualification, 4.4.2.1 herein shall be performed as required by the qualifying activity.

4.3 Screening (JANS, JANJ, JANTXV and JANTX levels only). Screening shall be in accordance with table IV of MIL-PRF-19500 and as specified herein. Specified electrical measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screening (see table IV of MIL-PRF-19500)	JANS Level	JANJ Level	JANTXV and JANTX Level
1a	Required	Not required	Not required
1b	Required	Required	Required (JANTXV only)
2	Not required	Not required	Not required
3a (1) 3c	Required Thermal impedance (see 4.3.2)	Required Thermal impedance (see 4.3.2)	Required Thermal impedance (see 4.3.2)
4	Not applicable	Not applicable	Not applicable
5	Not applicable	Not applicable	Not applicable
6	Not applicable	Not applicable	Not applicable
7a	Not applicable	Not applicable	Not applicable
7b	Required	Required	Required
8	Required	Not required	Not required
* 9	Required I_{R1} and V_{F1}	Required I_{R1} and V_{F1}	Not required
10	Method 1038 of MIL-STD-750, condition A	Method 1038 of MIL-STD-750, condition A	Method 1038 of MIL-STD-750, condition A
11	Required I_{R1} and V_{F1} ; $\Delta I_{R1} \leq 100$ percent of initial reading or 250 nA dc, whichever is greater; $\Delta V_{F1} \leq \pm 0.1$ V dc.	Required I_{R1} and V_{F2}	Required I_{R1} and V_{F2}
12	Required See 4.3.1	Required $t = 240$ hrs. See 4.3.1	Required See 4.3.1
(2) 13	Subgroups 2 and 3 of table I herein; $\Delta I_{R1} \leq 100$ percent of initial value or 250 nA dc, whichever is greater; $\Delta V_{F1} \leq \pm 0.1$ V dc. Scope display evaluation (see 4.5.1)	Subgroups 2 and 3 of table I herein; $\Delta I_{R1} \leq 100$ percent of initial value or 250 nA dc, whichever is greater; $\Delta V_{F2} \leq \pm 0.1$ V dc. Scope display evaluation (see 4.5.1)	Subgroup 2 of table I herein; $\Delta I_{R1} \leq 100$ percent of initial value or 250 nA dc, whichever is greater; $\Delta V_{F2} \leq \pm 0.1$ V dc. Scope display evaluation (see 4.5.1)
14a	Not applicable	Not applicable	Not applicable
14b	Optional	Optional	Optional
15	Required	Not required	Not required
16	Required	Required	Not required
17	Not required	Required subgroup 2 of table I herein verify polarity	Not required

- (1) Thermal impedance shall be performed any time after sealing provided temperature cycling is performed in accordance with MIL-PRF-19500, screen 3 prior to this thermal test.
- (2) $Z_{\theta JX}$ is not required in screen 13, if already previously performed.

* 4.3.1 Power burn-in conditions. Power burn-in conditions are as follows (see 4.5.2, 4.5.2.1) adjust I_O to achieve the required T_J :

- Burn-in set up. Place a single device in your burn-in/life test rack. Adjust power (or current) until the part reaches $T_J = 135^\circ\text{C}$ minimum. This is the minimum power/current which must be applied to each device. Use method 3100 to measure T_J . Additional heat generated by self-heating is allowed but shall not cause any device to exceed the maximum temperature rating.

4.3.2 Thermal impedance $Z_{\theta JX}$ measurements for screening. 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 the group A, subgroup 2 herein.

- a. I_H5 A minimum.
- b. t_H 10 ms.
- c. I_M 1 mA to 10 mA.
- d. t_{MD} 100 μs maximum.

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 method 3101 of MIL-STD-750 (read and record data $Z_{\theta JX}$). $Z_{\theta JX}$ shall be supplied on one lot (500 pieces minimum and a thermal response curve shall be submitted.) Twenty-two of these samples shall be serialized and provided to the qualifying activity for correlation prior to shipment of parts. Measurements 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. The following test conditions shall be used for $Z_{\theta JX}$: $Z_{\theta JX} = 1.5^\circ\text{C/W}$ max.

- a. I_H5 A minimum.
- b. t_H 10 ms.
- c. I_M 1 mA to 10 mA.
- d. t_{MD} 100 μs maximum.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the tests and conditions specified for subgroup testing in table VIa (JANS) and table VIb (JAN, JANJ JANTX, and JANTXV) of MIL-PRF-19500. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein; except, $Z_{\theta JX}$ need not to be performed. See table IV for delta limits when applicable.

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* 4.4.2.1 Group B inspection, table VIa (JANS) of MIL-PRF-19500. For B5, if a failure occurs, resubmission shall be at the test conditions of the original sample.

	<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
*	B3	1056	0°C to +100°C, 10 cycles.
*	B3	1051	-55°C to +175°C, 20 cycles.
*	B3	4066	$I_{FSM} = \text{rated } I_{FSM}$ (see col. 6 of 1.3); 10 surges of 8.3 ms each at 1 minute intervals, superimposed on $I_O = 0$, $V_{RWM} = 0$.
	B4	1037	$I_O = I_O$ rated minimum (see col. 5 of 1.3) $V_R = \text{rated } V_{RWM}$ (see col. 3 of 1.3 and 4.5.4); 2,000 cycles.
*	B5	1027	$I_O = I_O$ rated minimum (see col. 5 of 1.3); apply $V_R = \text{rated } V_{RWM}$ (see col. 3 of 1.3 and 4.5.4) adjust I_O to achieve T_J minimum; $f = 50\text{-}60$ Hz; $n = 45$ $c = 0$.
*			Option 1: $T_A = +30^\circ\text{C}$ max. ; $T_J = 225^\circ\text{C}$ minimum; $t = 216$ hours.
*		or	Option 2: $T_A = +30^\circ\text{C}$ max. ; $T_J = 200^\circ\text{C}$ minimum; $t = 1,000$ hours, (see 4.5.2.1).
	B6	3101 or 4081	$R_{\theta JL}$ and $R_{\theta JEC}$ (maximum) (see 4.5.5).
	B7		Peak reverse power, see 4.5.3 and figure 3. $P_{RM} \geq 1,000$ W. Test shall be performed on each subplot; sampling plan $n = 10$, $c = 0$, electrical end-points, see table I, subgroup 2 herein.

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

	<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
*	B2	1056	0°C to +100°C, 10 cycles.
*	B2	1051	-55°C to +175°C, 20 cycles.
*	B3	1027	$I_O = 3$ A minimum; and adjust I_O to achieve the required T_J ; apply $V_R = \text{rated } V_{RWM}$ (see col. 3 of 1.3), $f = 50\text{-}60$ Hz (see 4.5.2 and 4.5.2.1).
	B5	3101 or 4081	$R_{\theta JL}$ (maximum) $\leq 20^\circ\text{C}/\text{W}$; $L = .375$ inch (9.53 mm). For surface mount devices (US versions), $R_{\theta JEC} \leq 10^\circ\text{C}/\text{W}$ (see 4.5.4 herein).

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 table I, subgroup 2 herein; except, $Z_{\theta JX}$ need not be performed. See table IV for delta limits when applicable.

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

	<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
*	C2	1056	0°C to +100°C, 10 cycles.
*	C2	1051	-55°C to +175°C, 20 cycles.
	C2	2036	Tension: Test condition A; weight = 20 pounds; t = 30 seconds. Lead fatigue: Test condition E; weight 2 pounds. NOTE: Both tension and lead fatigue are not applicable for US devices.
*	C6	1026	$I_O = 3$ A minimum; and adjust I_O to achieve the required T_J ; apply $V_R =$ rated V_{RWM} (see col. 3 of 1.3), $f = 50$ -60 Hz (see 4.5.2.1).

4.4.4 Group D inspection. Radiation hardness assured JANS and JANTXV devices shall include the group D tests specified in table II herein. These tests shall be performed as required in accordance with MIL-PRF-19500 and method 1019 of MIL-STD-750 for total ionizing dose or method 1017 for neutron fluence as applicable.

* 4.4.5 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table IX of MIL-PRF-19500 and as specified herein. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 herein; except, $Z_{\theta JX}$ need not be performed. See table IV for delta limits when applicable.

4.5 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

* 4.5.1 Scope display evaluation. Scope display evaluation shall be stable in accordance with method 4023 of MIL-STD-750. Scope display may be performed on ATE (automatic test equipment) for screening only, with the approval of the qualifying activity. Scope display in group A shall be performed on a scope. The reverse current (I_{BR}) over the knee shall be 500 μ A peak.

4.5.2 Burn-in and life tests. These tests shall be conducted with a half-sine waveform 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 be neither greater than 180 degrees, nor less than 150 degrees.

* 4.5.2.1 Delta T_J rise. I_O is adjusted such that the junction rise above ambient shall be $\Delta T_J = 100^\circ\text{C}$ min. for each diode and the junction temperature of each diode is maintained at $T_J = 135^\circ\text{C}$ min for burn-in and $T_J = 150^\circ\text{C}$ min for life testing. The ΔT_J rise is intended to be achieved by device current and not by external or self-heating. $(T_J - T_A) \geq 100^\circ\text{C}$. Deliberate heat sinking or forced air-cooling is prohibited unless otherwise approved by the qualifying activity. Ambient temperature shall be controlled to prevent T_J from exceeding rated T_J . The use of a current limiting or ballast resistor is permitted provided that each DUT still sees the full P_f (minimum) and that the minimum applied voltage, where applicable, is maintained through out the burn-in period.

4.5.3 Peak reverse power test. This test shall be measured in the circuit of figure 3, or equivalent. A 20 microsecond half-sine waveform of current shall be used and peak reverse power shall be determined by the product of peak reverse voltage and peak reverse current.

* 4.5.4 Thermal resistance. Thermal resistance measurement shall be performed in accordance with method 3101 or 4081 of MIL-STD-750. Read and record data in accordance with group E herein and shall be included in the qualification report. Forced moving air or draft shall not be permitted across the devices during test. The maximum limit for $R_{\theta JL}$ under this test condition shall be $R_{\theta JL(max)} = 20^{\circ}\text{C/W}$ for $L = .375$; $R_{\theta JEC(max)} = 10^{\circ}\text{C/W}$ for $L = 0$ (US version). The following conditions shall apply:

- a. I_H 3 A.
- b. t_H Thermal equilibrium.
- c. I_M 1 mA to 10 mA.
- d. t_{MD} 70 μs maximum.

LS = Lead spacing = .375 inch (9.52 mm) as defined on figure 4:

TABLE I. Group A inspection.

Inspection 1/ 	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Thermal impedance	3101	See 4.4.1	Z _{θJX}		1.5	°C/W
Forward voltage	4011	I _F = 1.5 A dc	V _{F1}	0.5	1.2	V dc
Forward voltage	4011	I _F = 9 A dc (pulsed); t _p = 300 μs; 2 percent maximum duty cycle	V _{F2}	0.6	1.5	V (pk)
Reverse current	4016	DC method V _R = rated (see col. 2 of 1.3).	I _{R1}		1.0	μA dc
Breakdown voltage	4021	I _R = 50 μA dc	V(BR)1			
1N5415, 1N5415US				55		V dc
1N5416, 1N5416US				110		V dc
1N5417, 1N5417US				220		V dc
1N5418, 1N5418US				440		V dc
1N5419, 1N5419US				550		V dc
1N5420, 1N5420US				660		V dc
<u>Subgroup 3</u>						
High temperature operation:		T _A = +100°C				
Reverse current	4016	DC method; V _R = rated (see col. 2 of 1.3).	I _{R2}		20	μA dc
Low temperature operation:		T _A = -55°C				
Forward voltage	4011	I _F = 0.5 A dc	V _{F3}	0.5	1.4	V dc
Breakdown voltage	4021	I _R = 50 μA dc	V(BR)2			
1N5415, 1N5415US				50		V dc
1N5416, 1N5416US				100		V dc
1N5417, 1N5417US				200		V dc
1N5418, 1N5418US				400		V dc
1N5419, 1N5419US				500		V dc
1N5420, 1N5420US				600		V dc

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection <u>1</u> /	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
<u>Subgroup 4</u>						
Reverse recovery time	4031	Condition B1	t_{rr}			
1N5415, 1N5415US					150	ns
1N5416, 1N5416US					150	ns
1N5417, 1N5417US					150	ns
1N5418, 1N5418US					150	ns
1N5419, 1N5419US					250	ns
1N5420, 1N5420US					400	ns
Capacitance	4001	$V_R = 4 \text{ V dc};$ $100 \text{ Khz} \leq f \leq 1 \text{ Mhz}$	C			
1N5415, 1N5415US					550	pF
1N5416, 1N5416US					430	pF
1N5417, 1N5417US					250	pF
1N5418, 1N5418US					165	pF
1N5419, 1N5419US					140	pF
1N5420, 1N5420US					120	pF
Scope display	4023	See 4.5.1 $n = 116, c = 0$				
<u>Subgroup 5</u>						
Not applicable						
* <u>Subgroup 6</u>						
Forward surge	4066	$I_{FSM} = \text{rated (see col. 6 of 1.3);}$ 10 surges of 8.3 ms each at 1 minute intervals, superimposed on $I_O = 0, V_{RSM} = 0$				
*						
Electrical measurement		See table I, subgroup 2.				
<u>Subgroup 7</u>						
Not applicable						

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

TABLE II. Group D inspection and end-point limits for radiation hardness assured JANS and JANTXV devices only.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
<u>Subgroup 1</u>						
Neutron irradiation	1017					
Electrical measurements		$I_F = 9 \text{ A dc, pulsed}$				
Forward voltage	4011	$t_p = 300 \mu\text{s};$ 2 percent maximum duty cycle	V_F			
M, D, R, H						
1N5415, 1N5415US				0.6	1.6	V (pk)
1N5416, 1N5416US				0.6	1.6	V (pk)
1N5417, 1N5417US				0.6	1.7	V (pk)
1N5418, 1N5418US				0.6	1.7	V (pk)
1N5419, 1N5419US				0.6	1.8	V (pk)
1N5420, 1N5420US				0.6	1.8	V (pk)
Reverse current, M, D, R, H	4016	DC method:	I_R			
1N5415, 1N5415US		$V_R = 50 \text{ V dc}$			1.0	$\mu\text{A dc}$
1N5416, 1N5416US		$V_R = 100 \text{ V dc}$			1.0	$\mu\text{A dc}$
1N5417, 1N5417US		$V_R = 200 \text{ V dc}$			1.0	$\mu\text{A dc}$
1N5418, 1N5418US		$V_R = 400 \text{ V dc}$			1.0	$\mu\text{A dc}$
1N5419, 1N5419US		$V_R = 500 \text{ V dc}$			1.0	$\mu\text{A dc}$
1N5420, 1N5420US		$V_R = 600 \text{ V dc}$			1.0	$\mu\text{A dc}$
<u>Subgroup 2</u>						
Total dose irradiation	1019					
Electrical measurements		$I_F = 9 \text{ A dc pulsed}$	V_F			

See footnote at end of table.

TABLE II. Group D inspection and end-point limits for radiation hardness assured JANS and JANTXV devices only. - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
<u>Subgroup 2</u> - Continued						
Forward voltage M, D, R, H 1N5415, 1N5415US 1N5416, 1N5416US 1N5417, 1N5417US 1N5418, 1N5418US 1N5419, 1N5419US 1N5420, 1N5420US	4011	$t_p = 300 \mu s$; 2 percent maximum duty cycle		0.6 0.6 0.6 0.6 0.6 0.6	1.6 1.6 1.7 1.7 1.8 1.8	V (pk) V (pk) V (pk) V (pk) V (pk) V (pk)
Reverse current M, D, R, H 1N5415, 1N5415US 1N5416, 1N5416US 1N5417, 1N5417US 1N5418, 1N5418US 1N5419, 1N5419US 1N5420, 1N5420US	4016	DC method: $V_R = 50 \text{ V dc}$ $V_R = 100 \text{ V dc}$ $V_R = 200 \text{ V dc}$ $V_R = 400 \text{ V dc}$ $V_R = 500 \text{ V dc}$ $V_R = 600 \text{ V dc}$	I_R		1.0 1.0 1.0 1.0 1.0 1.0	$\mu A \text{ dc}$ $\mu A \text{ dc}$

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

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TABLE III. Group E inspection (all quality levels) for qualification only.

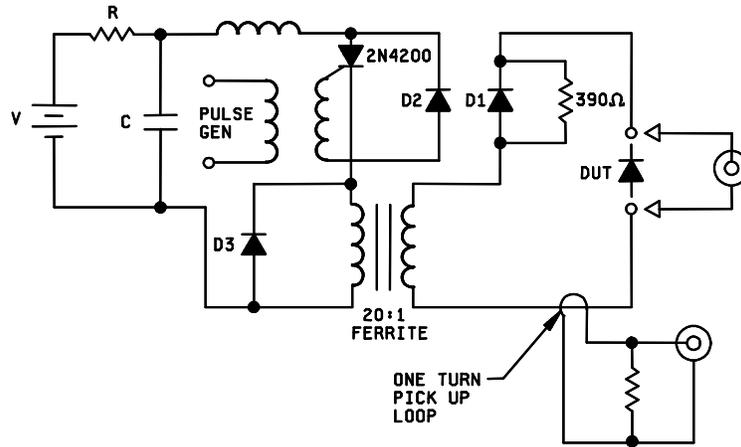
Inspection	MIL-STD-750		Sampling plan
	Method	Conditions	
* <u>Subgroup 1</u>			45 devices c = 0
Thermal shock	1056	500 cycles, condition C, -65°C to +175°C.	
Temperature cycling	1051	500 cycles, condition C, -65°C to +175°C.	
Electrical measurements		See table I, subgroup 2 herein.	
<u>Subgroup 2</u>			22 devices c = 0
Steady-state dc blocking life	1038	1,000 hours, condition A $V_R = V_{RWM}$ (see col. 3 of 1.3).	
Electrical measurements		See table I, subgroup 2 herein except for thermal impedance.	
<u>Subgroup 3</u>			
Not applicable			
<u>Subgroup 4</u>			22 devices c = 0
Thermal resistance	3101 or 4081	$R_{\theta JL} = 20^\circ\text{C/W}$ $R_{\theta JEC} = 10^\circ\text{C/W}$ (See 4.5.4 and figure 5).	
<u>Subgroup 5</u>			22 devices c = 0
Barometric pressure, reduced (altitude operation)	1001	Pressure 8.0 mm	
<u>Subgroup 6</u>			22 devices c = 0
Forward surge	4066	Condition A, $I_{FSM} = 80 \text{ A(pk)}$; 10 surges of 8.3 ms each at 1 minute intervals, superimposed on $I_O = 2 \text{ A dc}$; $V_{RWM} = \text{rated } V_{RWM}$ (see col. 3 of 1.3). $T_A = +100^\circ\text{C}$.	
Electrical measurement		See table I, subgroup 2 herein.	
* <u>Subgroup 7</u> ^{1/}			
Peak reverse power		See 4.5.3 and figure 3 herein. Peak reverse power (P_{RM}) shall be characterized by the supplier and this data shall be available to the government. Test shall be performed on each subplot.	
Electrical measurements		During the P_{RM} test, the voltage (V_{BR}) shall be monitored to verify it has not collapsed. Any collapse in V_{BR} during or after the P_{RM} test or rise in leakage current (I_R) after the test that exceeds I_{R1} in Group A shall be considered a failure to that level of applied P_{RM} . Progressively higher levels of P_{RM} shall be applied until failure occurs on all devices within the chosen sample size to characterize each subplot.	

^{1/} The sample size for this step stress requirement shall be determined by the supplier. A statistically significant sample size is required.

TABLE IV. Delta requirements. 1/ 2/ 3/ 4/

Step	Inspection	MIL-STD-750		Symbol	Limit
		Method	Conditions		
1	Reverse current	4016	DC method $V_R = \text{rated}$ (see col. 2 of 1.3)	ΔI_R <u>1/</u>	100 percent of initial value or 250 nA dc, whichever is greater.

- 1/ Devices which exceed the group A limits for this test shall not be accepted.
- 2/ The electrical measurements for table VIa (JANS) of MIL-PRF-19500 are as follows:
- a. Subgroup 4, see table IV herein, step 1.
 - b. Subgroup 5, see table IV herein, step 1.
- 3/ The electrical measurements for table VIb (JAN, JANJ, JANTX, and JANTXV) of MIL-PRF-19500 are as follows:
- a. Subgroup 3, see table IV herein, step 1.
 - b. Subgroup 6, see table IV herein, step 1.
- 4/ The electrical measurements for table VII (all quality levels) of MIL-PRF-19500 are as follows: Subgroup 6, see table IV herein, step 1.



NOTES:

- L = 13T H22 on 1 inch (25.4 mm) diameter form (air core).
- C ~ 1 to 10 μ fd to give 20 μ s pulse width.
- V - Adjustable to 200 volts for power desired in DUT.
- D1 - 3 kV; 600 Ma (1N3647 or equivalent).
- D2, D3 - 600 V; 3A (1N5552 or equivalent).
- * Values not stated are determined at the time of test.

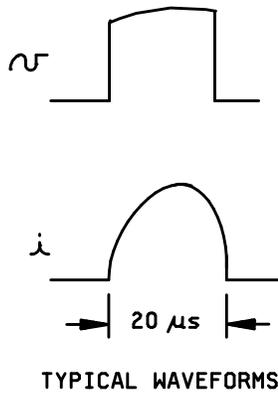


FIGURE 3. Peak reverse power measurement circuit and waveform.

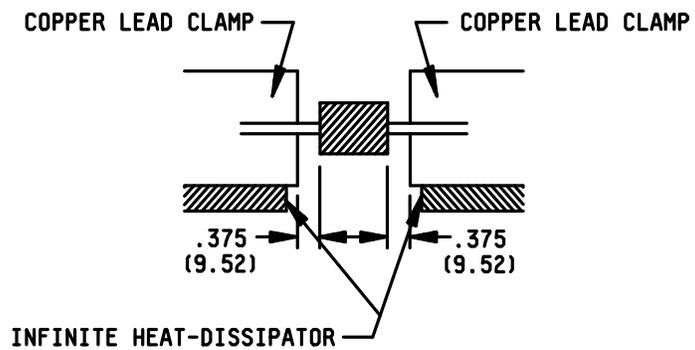
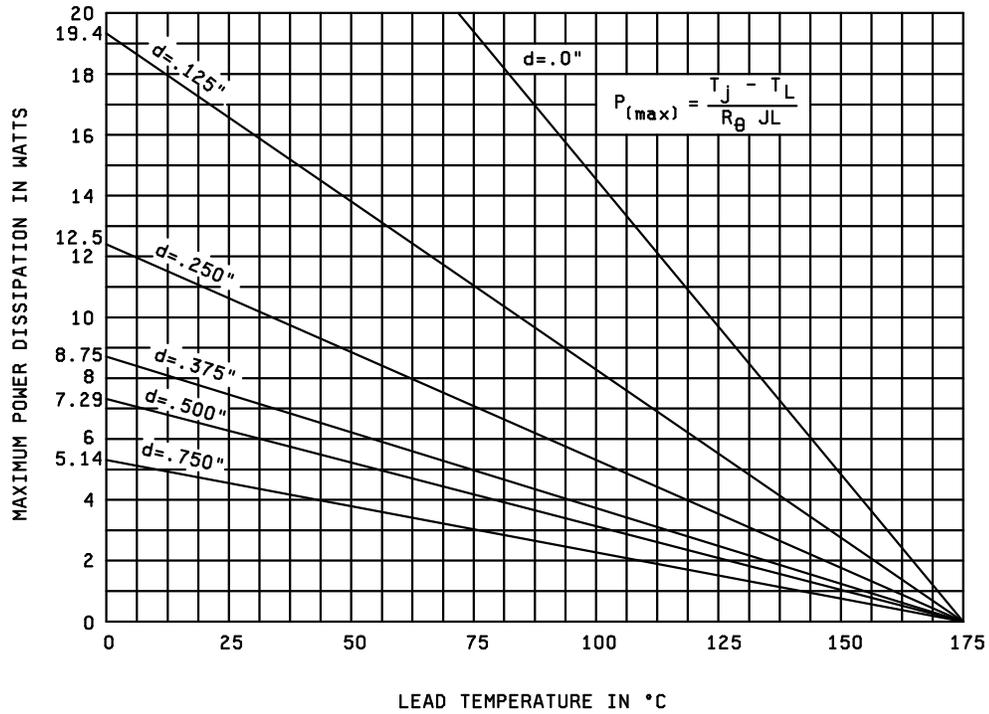


FIGURE 4. Mounting arrangement.



Maximum lead temperature in °C (T_L) at point "L" from body (for maximum operating junction temperature with equal two-lead conditions).

d	R _{θJL}
Inches (mm)	°C/W
.000 (0.00)	4
.125 (3.18)	9
.250 (6.35)	14
.375 (9.53)	20
.500 (12.70)	24
.750 (19.05)	34

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.

FIGURE 5. Maximum power in watts vs lead temperature.

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 personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. 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 must specify the following:

- a. Title, number, and date of this specification.
- b. Issue of DoDISS to be cited in the solicitation and if required, the specific issue of individual documents referenced (see 2.2.1).
- c. The lead finish as specified (see 3.4.1).
- d. Type designation and quality assurance level.
- e. Packaging requirements (see 5.1).

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.

6.4 Changes from previous issue. The margins of this revision 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 5961-2605)

Review activities:

Army - AR, AV, MI, SM
Navy - AS, MC
Air Force - 19, 71, 99

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/411K	2. DOCUMENT DATE 30 December 2002
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3. DOCUMENT TITLE
SEMICONDUCTOR DEVICE, DIODE, SILICON, POWER RECTIFIER, FAST RECOVERY 1N5415 THROUGH 1N5420, 1N5415US THROUGH 1N5420US, JAN, JANTX, JANTXV, JANS, JANJ, JANTXVM, JANTXVD, JANTXVR, JANTXVH, JANSM, JANSJ, JANSR, AND JANSK

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 614-692-0510	DSN 850-0510	FAX 614-692-6939
			EMAIL alan.barone@dscclia.mil
c. ADDRESS Defense Supply Center, Columbus ATTN: DSCC-VAC, P.O. Box 3990 Columbus, OH 43216-5000	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		