The documentation and process conversion measures necessary to comply with this revision shall be completed by 14 January 2014.

INCH-POUND

MIL-PRF-19500/429M
14 October 2013
SUPERSEDING
MIL-PRF-19500/429L
7 August 2008

PERFORMANCE SPECIFICATION SHEET

# SEMICONDUCTOR DEVICE, DIODE, SILICON, POWER RECTIFIER, FAST RECOVERY, TYPES 1N5615, 1N5617, 1N5619, 1N5621, 1N5623, 1N5615US, 1N5617US, 1N5619US, 1N5621US, 1N5623US, 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, fast recovery power rectifier diodes that are hermetic glass encapsulated. Four levels of product assurance are provided for each encapsulated device as specified in MIL-PRF-19500. Two levels of product assurance are provided each unencapsulated device type.

1.2 Physical dimensions. See figure 1 (axial lead), figure 2 surface mount (D-5A), figures 3, and 4 (JANHC and JANKC).

1.3 Maximum ratings. Unless otherwise specified $T_C$ = +25°C.

| Col. 1 | Col. 2 | Col. 3 | | Col. 4 | Col. 5 | Col. 6 | Col. 7 | Col. 8 | Col. 9 | Col. 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Types (1) | $V_{RWM}$ | $I_O$ (2) (3) | | $t_{rr}$ | $T_{STG}$ $T_J$ | $I_{FSM}$ $T_A$ = +100°C $I_O$ = 750 mA dc $V_{RWM}$ = rated $t_P$ = 8.3 ms | Barometric pressure (reduced) (4) | $R_{\theta JL}$ L = .375 inch (9.53 mm) (5) | $R_{\theta JEC}$ (6) | $R_{\theta JX}$ |
| | | $T_A$ = +55°C | $T_A$ = +100°C | | | | | | | |
| | V(pk) | A dc | mA dc | ns | °C | A(pk) | mmHg | °C/W | °C/W | °C/W |
| 1N5615 | 200 | 1 | 750 | 150 | -65 | 25 | N/A | 38 | 13 | 115 |
| 1N5617 | 400 | 1 | 750 | 150 | | 25 | 8 | 38 | 13 | 115 |
| 1N5619 | 600 | 1 | 750 | 250 | to | 25 | 8 | 38 | 13 | 115 |
| 1N5621 | 800 | 1 | 750 | 300 | | 25 | 33 | 38 | 13 | 115 |
| 1N5623 | 1,000 | 1 | 750 | 500 | +175 | 25 | 33 | 38 | 13 | 115 |

See notes on next page.

* 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/.

1.3 Maximum ratings - Continued.

(1) Electrical characteristics for US suffix are identical to the corresponding non-suffix device.
(2) Derate linearly from 1.0 A at $T_A$ = +55°C to 0.75 A at +100°C. Derate linearly from 0.75 A to 0 A between +100°C and +175°C. See figure 5 for derating curves.
(3) For the 1 amp rating at 55°C ambient or 0.75 amp rating at 100°C ambient, these $I_O$ ratings are for thermal mounting methods (PC boards or other) where thermal resistance from mounting point to ambient is still sufficiently controlled where $T_{J(MAX)}$ in 1.3 is not exceeded. This equates to $R_{\theta JX} \leq 115^{o}C/W$ as shown. Also see application notes in 6.5.1.
(4) Barometric pressure: 1N5617 and 1N5619 is 8 mm Hg (100,000 feet); 1N5621 and 1N5623 is 33 mm Hg (70,000 feet).
(5) See figure 6.
(6) See figure 7.

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.

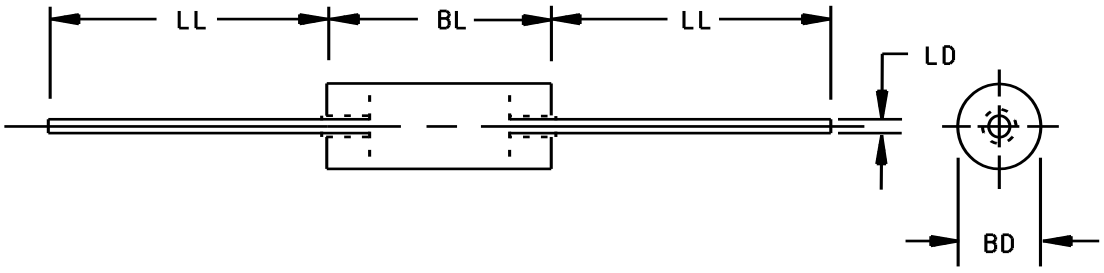
3. REQUIREMENTS

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 and as follows:

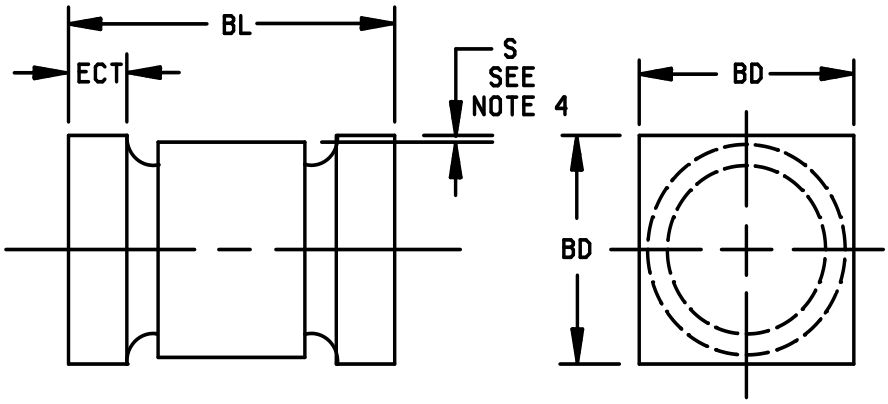
EC End-cap.
US Short-body unleaded or surface mounted diodes (square end-caps).




| Ltr | Dimensions | | | | Notes |
|---|---|---|---|---|---|
| | Inches | | Millimeters | | |
| | Min | Max | Min | Max | |
| BD | .065 | .110 | 1.65 | 2.79 | 3 |
| LD | .026 | .033 | .66 | .84 | |
| BL | .130 | .225 | 3.30 | 5.71 | 4 |
| LL | 1.00 | 1.30 | 25.40 | 33.02 | |

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Dimension BD shall be measured at the largest diameter.
4. Dimension BL shall include the entire body including slugs and 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 onto the leads .050 inch (1.27 mm)
5. In accordance with ASME Y14.5M, diameters are equivalent to $\phi$x symbology.

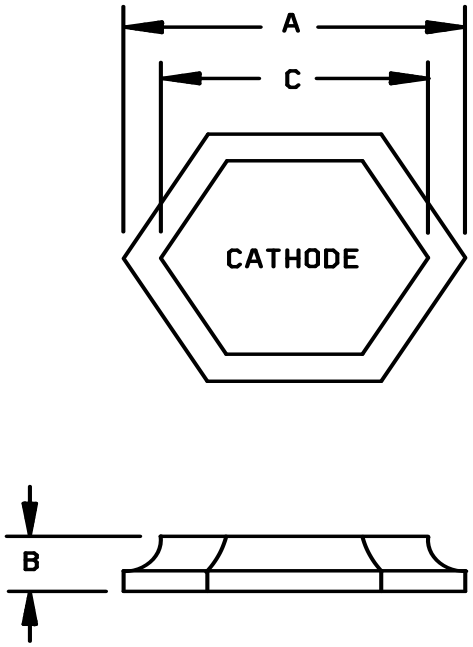
FIGURE 1. Physical dimensions (for non-US suffix devices only) (axial lead).




| Ltr | Dimensions | | | |
|---|---|---|---|---|
| | Inches | | Millimeters | |
| | Min | Max | Min | Max |
| BL | .168 | .200 | 4.27 | 5.08 |
| ECT | .019 | .028 | 0.48 | 0.71 |
| S | .003 | | 0.08 | |
| BD | .091 | .103 | 2.31 | 2.62 |

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Dimensions are pre-solder dip.
4. Minimum clearance of glass body to mounting surface on all orientations.
5. In accordance with ASME Y14.5M, diameters are equivalent to $\phi$x symbology.

FIGURE 2. Physical dimensions for types 1N5615US, 1N5617US, 1N5619US, 1N5621US, and 1N5623US, (surface mount devices) (D-5A).

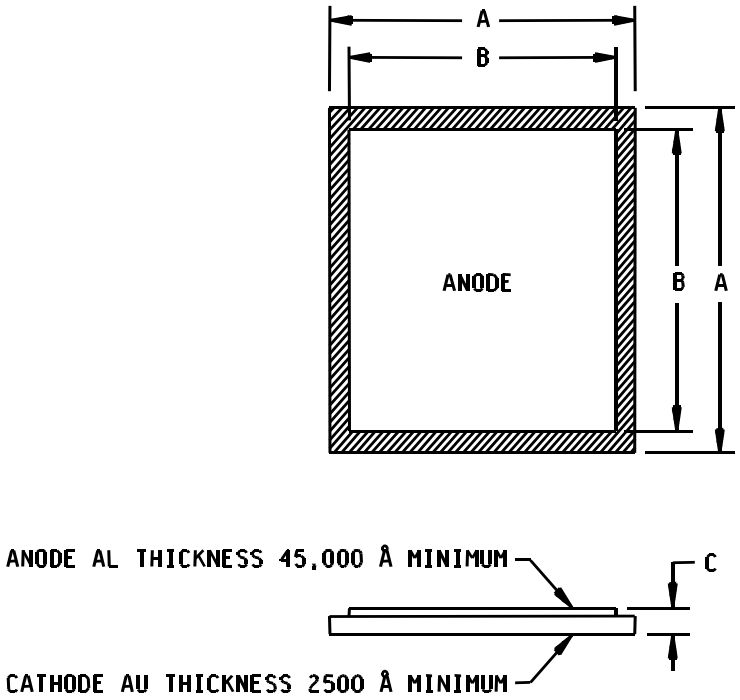



A - version

| Ltr | Dimensions | | | |
|---|---|---|---|---|
| | Inches | | Millimeters | |
| | Min | Max | Min | Max |
| A | .047 | .053 | 1.19 | 1.35 |
| B | .007 | .011 | 0.18 | 0.28 |
| C | .033 | .037 | 0.84 | 0.94 |

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. The physical characteristics of the die are:
   Top metal: Gold 10,000 Å minimum.
   Back metal: Gold 4,000 Å minimum.
4. In accordance with ASME Y14.5M, diameters are equivalent to $\phi$x symbology.

FIGURE 3. Physical dimensions, JANHCA and JANKCA die.




| Ltr | Dimensions | | | |
|---|---|---|---|---|
| | Inches | | Millimeters | |
| | Min | Max | Min | Max |
| A | .039 | .043 | 1.00 | 1.09 |
| B | .021 | .025 | 0.53 | 0.64 |
| C | .008 | .012 | 0.20 | 0.31 |

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. The physical characteristics of the die are:
   Top metal: Aluminum (anode) 45,000 Å minimum.
   Back metal: Gold (cathode) 2,500 Å minimum.
4. In accordance with ASME Y14.5M, diameters are equivalent to $\phi$x symbology.

FIGURE 4. Physical dimensions, JANHCB and JANKCB die.

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 (axial lead), figure 2 surface mount (D-5A), figures 3, and 4 (JANHC and JANKC).

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).

3.5 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 bonds shall be in accordance with the requirements of category I, appendix A, MIL-PRF-19500. No point contacts are allowed. Silver button dumet design is prohibited. US version devices shall be structurally identical to the non-surface mount devices except for lead terminations.

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

3.6.1 Marking of US version. For US version only, all marking except polarity indicator (see 3.6.2) may be omitted from the body, but shall be retained on the initial container.

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

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

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

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

4. VERIFICATION

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

a. Qualification inspection (see 4.2).

b. Screening (see 4.3).

c. Conformance inspection (see 4.4).

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

4.2.1 Group E qualification. Group E inspection shall be performed for qualification or requalification 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 to this revision to maintain qualification.

4.2.2 JANHC and JANKC die. Qualification shall be in accordance with appendix G of MIL-PRF-19500 and as specified herein.

* 4.3 Screening (JANS, JANTX, and JANTXV 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 | JANTXV and JANTX level |
| 1a<br>1b | Required<br>Required | Not required<br>Required (JANTXV only) |
| 2 | Not required | Not required |
| 3a<br>(1) 3c | Required<br>Thermal impedance (see 4.3.1) | Required<br>Thermal impedance (see 4.3.1) |
| 4 | Not applicable | Not applicable |
| 5 | Not applicable | Not applicable |
| 6 | Not applicable | Not applicable |
| 8 | Required | Not required |
| 9 | Required $I_{R1}$ and $V_F$ | Not required |
| 10 | Method 1038 of MIL-STD-750, condition A | Method 1038 of MIL-STD-750, condition A |
| * (2) 11 | $I_{R1}$ and $V_F$, $\Delta I_{R1} \leq 100$ percent of initial reading or ±100 nA dc, whichever is greater. $\Delta V_F \leq \pm 0.1$ V dc | $I_{R1}$ and $V_F$ |
| 12 | Required, see 4.3.2 | Required, see 4.3.2 |
| * (2) (3) 13 | Subgroups 2 and 3 of table I herein:<br>$\Delta I_{R1} \leq 100$ percent of initial reading or ±100 nA dc, whichever is greater.<br>$\Delta V_F \leq \pm 0.1$ V dc. Scope display evaluation (see 4.5.4) | Subgroup 2 of table I herein:<br>$\Delta I_{R1} \leq 100$ percent of initial reading or ±100 nA dc, whichever is greater.<br>$\Delta V_F \leq \pm 0.1$ V dc. Scope display evaluation (see 4.5.4) |
| 15 | Required | Not required |
| 16 | Required | 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) For JANTX and JANTXV devices, $\Delta V_{F2}$ may be omitted if thermal impedance is performed, unless irradiation is used to reduce the carrier lifetime.

(3) $Z_{\theta JX}$ is not required in screen 13, if already previously performed.

4.3.1 Thermal impedance. The thermal impedance measurements shall be performed in accordance with method 3101 of MIL-STD 750 as applicable, using the guidelines in that method for determining $I_M$, $I_H$, $t_H$, and K factor where appropriate). Measurement delay time ($t_{MD}$) = 70 µs max. The thermal impedance limit used in screen 3c and table I, subgroup 2 shall be set statistically by the supplier.

4.3.2 Free air power burn-in conditions. Power burn-in conditions are as follows (see 4.5.3 and 4.5.3.1): $I_{O(min)}$ = rated $I_O$ (see 1.3 herein); $T_A$ = 55°C maximum. Test conditions in accordance with method 1038 of MIL-STD-750, condition B. Use method 3100 of MIL-STD-750 to measure $T_J$. Adjust $I_O$ or $T_A$ to achieve the required $T_J$. $T_J$ = 135°C minimum. With approval of the qualifying activity and preparing activity, alternate burn-in criteria (hours, bias conditions, $T_J$, mounting conditions) may be used for JANTX and JANTXV quality levels. A justification demonstrating equivalence is required. In addition, the manufacturing site's burn-in data and performance history will be essential criteria for burn-in modification approval.

4.3.3 Screening (JANHC and JANKC). Screening of die shall be in accordance with appendix G of MIL-PRF-19500. As a minimum, die shall be 100-percent probed to ensure compliance with table I, subgroup 2. Burn-in duration for the JANKC level follows JANS requirements; the JANHC follows JANTX requirements.

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 $Z_{\theta JX}$ end-point shall be derived by the supplier and approved by the qualifying activity. This $Z_{\theta JX}$ end-point shall be documented in the qualification report.

* 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, appendix E, and as follows. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta measurements shall be as specified in table III herein.

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

| Subgroup | Method | Condition |
|---|---|---|
| B3 | 1056 | 0°C to +100°C, 25 cycles. |
| B3 | 1051 | -55°C to +175°C, 100 cycles. |
| B3 | 4066 | $I_{FSM}$ = rated $I_{FSM}$ (see col. 6 of 1.3); ten surges of 8.3 ms each at 1 minute intervals, superimposed on $I_O$ = 750 mA, $V_{RWM}$ = rated $V_{RWM}$ (see col. 3 of 1.3) $T_A$ = 100°C. |
| B4 | 1037 | $I_O$ = 1 A minimum (see col. 3 of 1.3); $V_R$ = rated $V_{RWM}$ (see col. 2 of 1.3, 4.5.3 and 4.5.3.1); 2,000 cycles. |
| B5 | 1027 | $I_O$ = 1 A minimum (see column 3 of 1.3), apply $V_R$ = rated $V_{RWM}$ (see column 2 of 1.3), adjust $I_O$ to achieve $T_J$ = +175°C minimum. t = 1,000 hours, n = 45, c = 0. Temporary leads may be added for surface mount devices. For irradiated devices, include $t_{rr}$ as an end-point measurement. |
| B8 | 4065 | Peak reverse power, see table II, subgroup 8 herein. $P_{RM} \geq 318$ W for square wave in accordance with method 4065 of MIL-STD-750, ($P_{RM} \geq 500$ W for half-sine wave). Test shall be performed on each sublot; sampling plan n = 10, c = 0, end-points, see 4.4.2. |

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

| | Subgroup | Method | Condition |
|---|---|---|---|
| * | B3 | 1027 | $I_O$ = 1 A minimum adjust $I_O$ or $T_A$ to achieve the required $T_J$ of +150°C minimum. Apply $V_R$ = rated $V_{RWM}$ (see col. 2 of 1.3), f = 50-60 Hz (see 4.5.3 and 4.5.3.1). $T_A$ = 55°C (max). For irradiated devices, include $t_{rr}$ as an end-point measurement. |
| | 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. End-point electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta limits shall be in accordance with table III herein.

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

| | Subgroup | Method | Condition |
|---|---|---|---|
| | C2 | 1056 | 0°C to +100°C, 10 cycles. |
| | C2 | 1051 | -55°C to +175°C, 25 cycles. |
| | C2 | 2036 | US devices – Tension: Test condition A; weight = 12 pounds; t = 15 seconds. Suitable fixtures may be used to pull the end-caps in a manner which does not aid construction. Reference to axial lead may be interpreted as end-cap with fixtures used for mounting (see figure 8 herein). (Lead fatigue is not applicable to US diodes). |
| | C2 | 2036 | Tension: Test condition A; weight = 12 pounds; t = 30 seconds. Lead fatigue: Test condition E; weight 1 pound. NOTE: Lead fatigue is not applicable for US devices. |
| * | C5 | 4081 | $R_{\theta JL}$ (maximum) ≤ 38°C/W; L = .375 inch (9.53 mm), (see 4.3.1). For surface mount devices (US version), $R_{\theta JEC}$ ≤ 7°C/W. |
| | C6 | 1026 | $I_O$ = 1 A, minimum; adjust $I_O$ to achieve $T_J$ = +150°C minimum. Apply $V_R$ = rated $V_{RWM}$ (see col. 2 of 1.3), f = 50-60 Hz (see 4.5.3 and 4.5.3.1). For irradiated devices, include $t_{rr}$ as an end-point measurement. |

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 as specified herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein; except, $Z_{\theta JX}$ need not be performed. See table III for delta limits when applicable.

4.5 Methods of inspection. Methods of inspection shall be 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.

4.5.2 Inspection conditions. Unless otherwise specified, all inspections shall be conducted at an ambient temperature $T_A$ of +25°C ±3°C.

4.5.3 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.

4.5.3.1 Free air burn-in and life tests. The use of a current limiting or ballast resistor is permitted provided that each DUT still sees the full $P_t$ (minimum) and that the minimum applied voltage, where applicable, is maintained through out the burn-in period. Suppliers must report the (heat sinking), thermal resistance of their mounting conditions in all life test and burn-in boards to the qualifying activity.

4.5.4 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 table I, subgroup 4 shall be performed on a scope. Reverse current ($I_{BR}$) over the knee shall be 500 μA peak.

* TABLE I. Group A inspection.

| Inspection 1/ | MIL-STD-750 | | Symbol | Limits | | Unit |
|---|---|---|---|---|---|---|
| | Method | Conditions | | Min | Max | |
| Subgroup 1<br>Visual and mechanical inspection | 2071 | | | | | |
| Subgroup 2 | | | | | | |
| Thermal impedance 2/ | 3101 | See 4.3.1 | $Z_{\theta JX}$ | | | °C/W |
| Forward voltage | 4011 | $I_F$ = 3 A dc (pulsed), (see 4.5.1) $t_p$ = 300 µs; 2 percent maximum duty cycle | $V_F$ | 0.8 | 1.6 | $V_{pk}$ |
| Reverse current leakage | 4016 | DC method | $I_{R1}$ | | | |
| 1N5615, US | | $V_R$ = 200 V | | | 0.5 | µA |
| 1N5617, US | | $V_R$ = 400 V | | | 0.5 | µA |
| 1N5619, US | | $V_R$ = 600 V | | | 0.5 | µA |
| 1N5621, US | | $V_R$ = 800 V | | | 0.5 | µA |
| 1N5623, US | | $V_R$ = 1,000 V | | | 0.5 | µA |
| Breakdown voltage | 4021 | $I_R$ = 50 µA | $V_{BR}$ | | | |
| 1N5615, US | | | | 220 | | V |
| 1N5617, US | | | | 440 | | V |
| 1N5619, US | | | | 660 | | V |
| 1N5621, US | | | | 880 | | V |
| 1N5623, US | | | | 1100 | | V |
| Subgroup 3 | | | | | | |
| High temperature operation: | | $T_A$ = +125°C | | | | |
| Reverse current leakage | 4016 | DC method | $I_{R2}$ | | | |
| 1N5615, US | | $V_R$ = 200 V | | | 55 | µA |
| 1N5617, US | | $V_R$ = 400 V | | | 55 | µA |
| 1N5619, US | | $V_R$ = 600 V | | | 55 | µA |
| 1N5621, US | | $V_R$ = 800 V | | | 55 | µA |
| 1N5623, US | | $V_R$ = 1,000 V | | | 55 | µA |

See footnote at end of table.

* TABLE I. Group A inspection - Continued.

| Inspection 1/ | MIL-STD-750 | | Symbol | Limits | | Unit |
|---|---|---|---|---|---|---|
| | Method | Conditions | | Min | Max | |
| Subgroup 4 | | | | | | |
| Reverse recovery time | 4031 | Condition B1 | $t_{rr}$ | | | |
| 1N5615, US | | | | | 150 | ns |
| 1N5617, US | | | | | 150 | ns |
| 1N5619, US | | | | | 250 | ns |
| 1N5621, US | | | | | 300 | ns |
| 1N5623, US | | | | | 500 | ns |
| Capacitance | 4001 | $V_R$ = 12 V dc, 0.1 < f < 1.0 MHz | C | | | |
| 1N5615, US | | | | | 45 | pF |
| 1N5617, US | | | | | 35 | pF |
| 1N5619, US | | | | | 25 | pF |
| 1N5621, US | | | | | 20 | pF |
| 1N5623, US | | | | | 15 | pF |
| Scope display evaluation | 4023 | See 4.5.4; n = 116, c = 0 | | | | |
| Subgroup 5 | | | | | | |
| Not applicable | | | | | | |
| Subgroup 6 | | | | | | |
| Forward surge | 4066 | $I_{FSM}$ = 25 A (pk); ten surges of 8.3 ms each at 1 minute intervals, $I_O$ = 750 mA dc; $V_R$ = rated $V_{RWM}$ (see col. 2 of 1.3); $T_A$ = +100°C; ($T_{EC}$ = +100°C for surface mount devices (US version)). | | | | |
| Electrical measurement | | See table I, subgroup 2 except thermal impedance. | | | | |
| Subgroup 7 | | | | | | |
| Not applicable | | | | | | |

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

* 2/ This test required for the following end-point measurements only:
Group B, subgroups 3, 4, and 5 (JANS).
Group B, subgroups 2 and 3 (JAN, JANTX, and JANTXV).
Group C, subgroup 2 and 6.
Group E, subgroup 1.

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

| Inspection | MIL-STD-750 | | Sampling plan |
|---|---|---|---|
| | Method | Conditions | |
| Subgroup 1 | | | 45 devices<br>c = 0 |
| Thermal shock | 1056 | 20 cycles, condition D except low temperature shall be achieved using liquid nitrogen (-195°C). Perform a visual for cracked glass. | |
| Temperature cycling | 1051 | 500 cycles, -65°C to +175°C. | |
| Hermetic seal | 1071 | | |
| Gross leak | | | |
| Electrical measurements | | See table I, subgroup 2, and table III, steps 1, 2. | |
| * Subgroup 2 | | | 22 devices<br>c = 0 |
| Steady state dc blocking life | 1048 | 1,000 hours; $V_R$ = 80 – 85 percent of rated $V_{RWM}$ (see col. 2 of 1.3). | |
| Electrical measurements | | See table I, subgroup 2 herein except for thermal impedance and table III, step 1. For irradiated devices, include $t_{rr}$ as an end-point measurement. | |
| Subgroup 4 1/ | | | |
| Thermal impedance curves | | See MIL-PRF-19500. | |
| Subgroup 5 | | | 22 devices<br>c = 0 |
| Barometric pressure, reduced (altitude operation) | 1001 | Pressure 1N5617, 1N5619 = 8 mm Hg (100,000 ft); 1N5621, 1N5623 = 33 mm Hg (70,000 ft); $V_R = V_{RWM}$ (see col. 2 of 1.3); t = 1 minute (minimum). | |

See footnote at end of table.

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

| Inspection | MIL-STD-750 | | Sampling plan |
|---|---|---|---|
| | Method | Conditions | |
| Subgroup 8 1/ | | | 45 devices c = 0 |
| Peak reverse power | 4065 | 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 sublot. | |
| 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 table I herein, 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 sublot. | |
| Subgroup 9 1/ | | | 45 devices c = 0 |
| Resistance to glass cracking | 1057 | Step stress to destruction by increasing cycles or up to a maximum of 25 cycles. | |
| Subgroup 10 | | | 22 devices c = 0 |
| Forward surge | 4066 | Condition A, $I_{FSM}$ = rated (see col. 6 of 1.3); ten surges of 8.3 ms each at 1 minute intervals superimposed on $I_O$ = 750 mA; $V_R = V_{RWM}$ = (see col. 2 of 1.3); $T_A$ = +100°C. | |
| Electrical measurement | | See table I, subgroup 2. | |

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

* TABLE III. Groups B, C, and E delta measurements. 1/ 2/ 3/ 4/ 5/

| Step | Inspection | MIL-STD-750 | | Symbol | Limits | | Unit |
|---|---|---|---|---|---|---|---|
| | | Method | Conditions | | Min | Max | |
| 1. | Reverse current leaking change<br>1N5615, US<br>1N5617, US<br>1N5619, US<br>1N5621, US<br>1N5623, US | 4016 | DC method<br><br>$V_R$ = 200 V<br>$V_R$ = 400 V<br>$V_R$ = 600 V<br>$V_R$ = 800 V<br>$V_R$ = 1,000 V | $\Delta I_{R1}$ | | For JAN, JANTX, and JANTXV, ≤ 250 nA dc or 100 percent, whichever is greater; for JANS, ≤ 100 nA dc or 100 percent, whichever is greater. | |
| 2. | Forward voltage change | 4011 | $I_F$ = 3 A dc; pulsed (see 4.5.1) $t_p$ = 300 µs; 2 percent maximum duty cycle. | $\Delta V_{F1}$ | | ±50 mV dc maximum change from previous measured value. | |

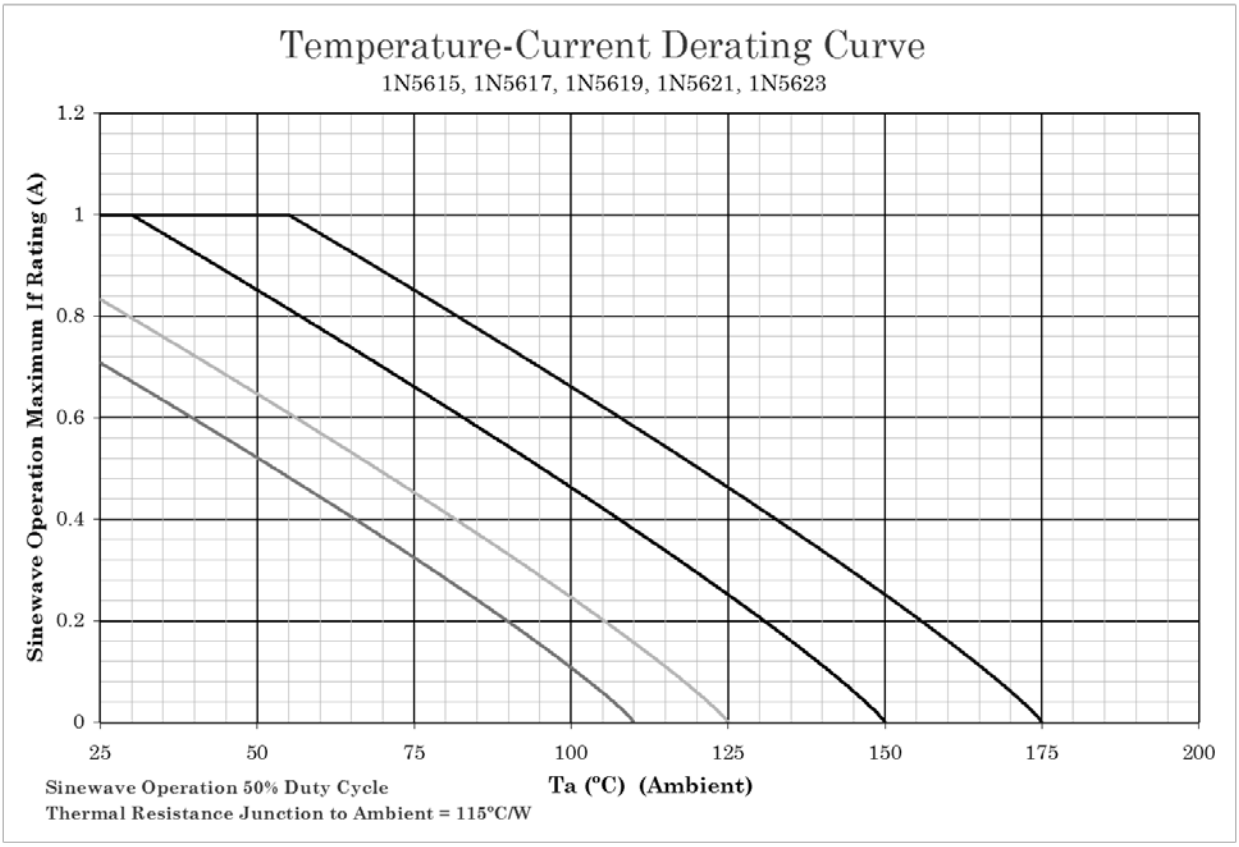
1/ Devices which exceed the table I, subgroup 2 (group A) limits for this test shall not be accepted.

* 2/ The delta measurements for group B inspections in 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, step 2.
- c. Subgroup 5, see table III herein, steps 1 and 2.

* 3/ The delta measurements for group B inspections in table E-VIB (JAN, JANTX, and JANTXV) of MIL-PRF-19500 are as follows:
- a. Subgroup 3, see table III herein, steps 1 and 2.
- b. Subgroup 6, see table III herein, step 1.

* 4/ The delta measurements for group C inspections in table E-VII of MIL-PRF-19500 are as follows:
- a. Subgroup 2, see table III herein, step 1 (JANS).
- b. Subgroup 6, see table III herein, steps 1 and 2 (JANS), step 1 (JAN, JANTX, and JANTXV).

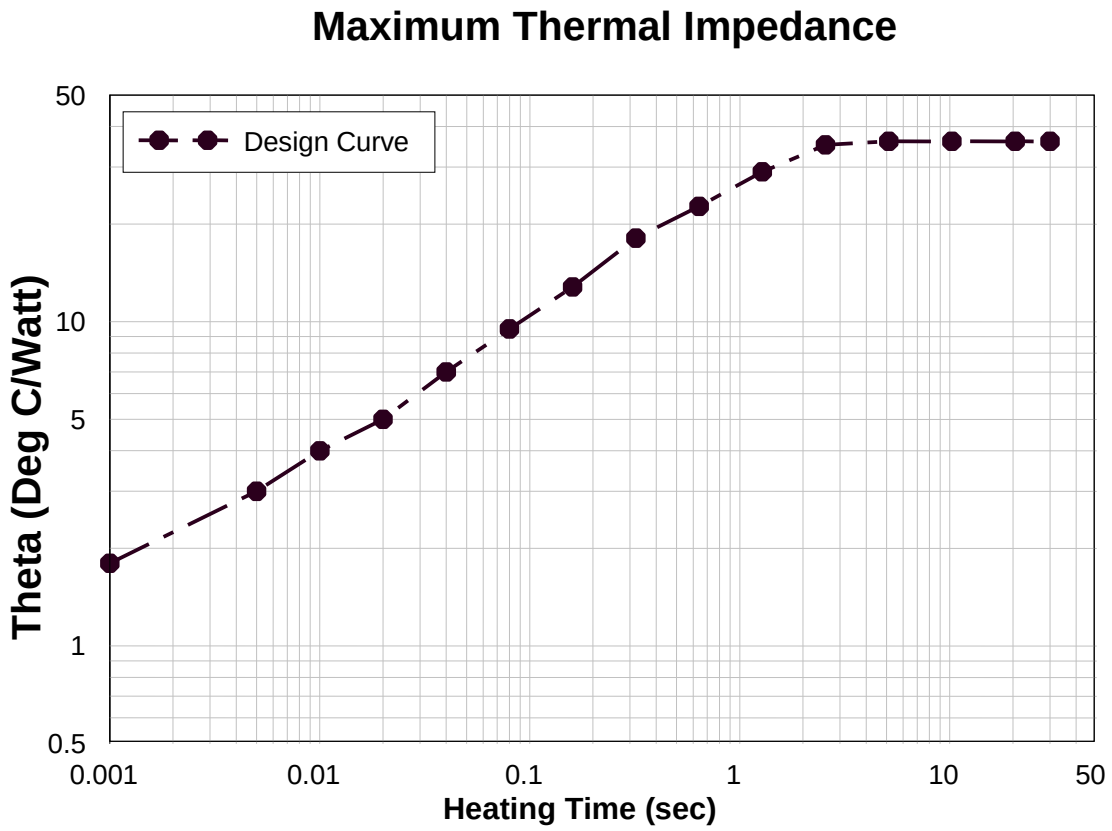
* 5/ The delta measurements for group E inspections in table E-IX of MIL-PRF-19500 are: Subgroups 1 and 2, see table III herein, steps 1 and 2.




NOTES:

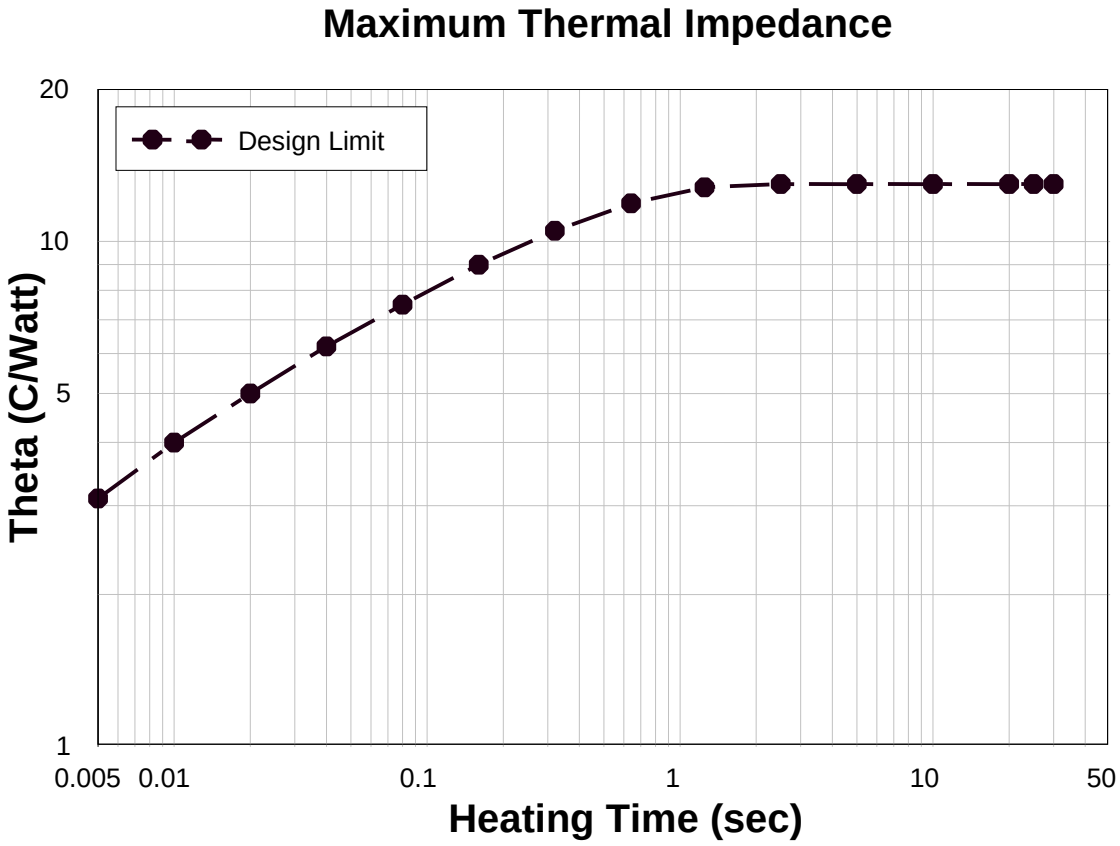
1. All devices are capable of operating at ≤ $T_J$ specified on this curve. Any parallel line to this curve will intersect the appropriate power for the desired maximum $T_J$ allowed. Also see applications data in section 6.5 for mounting.
2. Derate design curve constrained by the maximum junction temperature ($T_J$ ≤ +175°C) and current rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J$ ≤ +125°C, where the maximum temperature of electrical test is performed.
4. Derate design curves chosen at $T_J$ ≤, +150°C, +125°C, and +110°C to show current rating where most users want to limit $T_J$ in their application.

FIGURE 5. Temperature-current derating curve.




$Z_{\theta JX}$ = 4°C/W at 10 ms.

FIGURE 6. Thermal impedance curve, $R_{\theta JL}$ = 38°C/W for 1N5615, 1N517, 1N5619, 1N5621, and 1N5623.




$Z_{\theta JX}$ = 4°C/W at 10 ms.

FIGURE 7. Thermal impedance curve $R_{\theta JEC}$ = 13°C/W for 1N5615US, 1N517US, 1N5619US, 1N5621US, and 1N5623US.

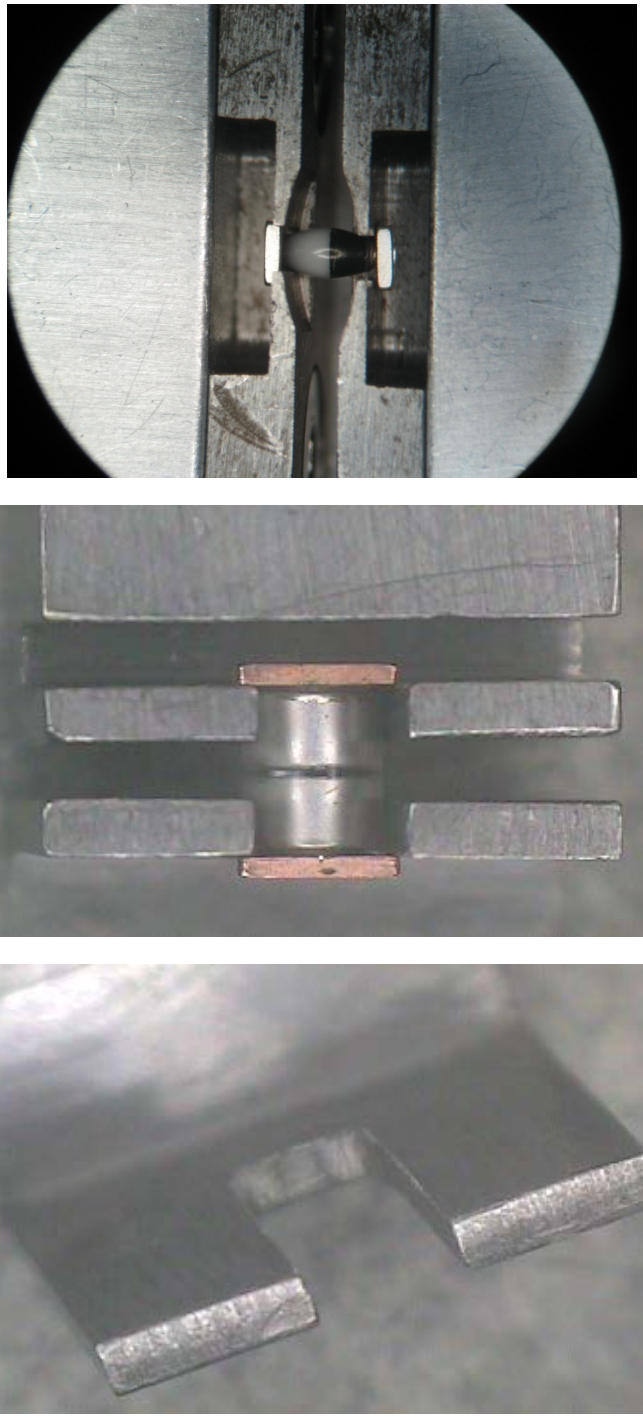


FIGURE 8. US terminal strength mounting.

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 Suppliers of die. The qualified die suppliers with the applicable letter version (e.g., JANHCA1N5615) will be identified on the Qualified Manufacturers List (QML).

| JANHC and JANKC ordering information | | |
|---|---|---|
| PIN | Manufacturer | |
| | 14552 | 33178 |
| 1N5615 | JANHCA1N5615<br>JANKCA1N5615 | JANHCB1N5615<br>JANKCB1N5615 |
| 1N5617 | JANHCA1N5617<br>JANKCA1N5617 | JANHCB1N5617<br>JANKCB1N5617 |
| 1N5619 | JANHCA1N5619<br>JANKCA1N5619 | JANHCB1N5619<br>JANKCB1N5619 |
| 1N5621 | JANHCA1N5621<br>JANKCA1N5621 | JANHCB1N5621<br>JANKCB1N5621 |
| 1N5623 | JANHCA1N5623<br>JANKCA1N5623 | JANHCB1N5623<br>JANKCB1N5623 |

6.5 Applications data.

6.5.1 Half-sine-wave application with 1N5615-1N5623. For a PCB mounting example with FR4 material where the full 1 amp $I_O$ rating (half-sine-wave) is used at a $T_J$ of +175ºC and ambient temperature of +55ºC, the following steps guide the user in what the PCB pad size will need to be with 1 ounce, 2 ounce, and 3 ounce Copper for a 1N5615 to 1N5623. For axial-leaded, the lead length for mounting will be .187 inch (4.76 mm) or less from body to entry point on PCB surface.

a. Use the $I_O$ versus Po curve in figure 9 to look up 1 Amp (X-axis) and follow up to the $T_J$ = 175ºC curve (lower) for 1.04 watts.

b. Calculate maximum thermal resistance needed (175ºC – 55ºC) /1.04 W = 115 ºC/W.

c. Look up thermal resistance of 115ºC/W on Y-axis using a thermal resistance versus pad area plot on one of the three curves in figure 10 for different weights of copper cladding and then intersect curve horizontally to get answer. These curves assume still air, horizontal position.

* d. In this example, the answer is: 1 ounce PCB = .042 in X 0.42 in (1.067 mm X 1.067 mm), 2 ounce PCB = .025 in X .025 in (0.635 mm X 0.635 mm), 3 ounce PCB = .014 in X .014 in (0.356 mm X 0.356 mm) for each pad.

e. Add a conservative guard-band to the pad size (larger) to keep $T_J$ below 175ºC.

6.5.2 Square-wave application with 1N5615-1N5623. For a PCB mounting example with FR4 material to support a 0.5 amp $I_O$ square wave switching at a 0.50 duty factor (50 percent duty cycle) at $T_J$ = +125ºC and ambient temperature of +55ºC, the following steps guide the user in what the PCB pad size will need to be with 1 ounce, 2 ounce, and 3 ounce copper.

a. Find size of copper pads on standard FR4 PCB to support operation at 0.5 amp $I_O$ square wave switching at a 0.50 duty factor (50 percent duty cycle) at $T_J$ = +125ºC with $T_A$ = +55ºC.

b. Calculate peak $I_F$ = 0.5A/0.50 duty factor = 1 amp.

c. Use the $V_F$ versus $I_F$ curve in figure 11 to look up $I_F$ = 1 A (Y-axis) and follow across to the $T_J$ = 125ºC curve (middle) for $V_F$ = 0.96 V.

d. Calculate power = $I_F$ * $V_F$ * duty factor = 1 x 0.96 x 0.50 = 0.48 W.

e. Calculate maximum thermal resistance needed (125ºC – 55ºC) / 0.48 W = 146ºC/W.

f. Look up thermal resistance of 146ºC/W on the Y-axis using a thermal resistance versus pad area plot on one of the three curves in figure 10 for different weights of copper cladding and then intersect curve horizontally to get answer. Curves assume still air, horizontal position.

* g. Answer: 1 ounce PCB = .02 in X .02 in (0.508 mm X 0.508 mm), 2 ounce PCB = .012 in X .012 in (0.305 mm X 0.305 mm ), 3 ounce PCB = .008 in X .008 in (0.202 mm X 0.202 mm) for each pad.

h. A conservative pad guard-band is optional since $T_J$ is only 125ºC. NOTE: Multilayer PCB's, forced air cooling, etc. will improve performance. Closed confinement of the PCB will do the opposite. Please use sound thermal management.

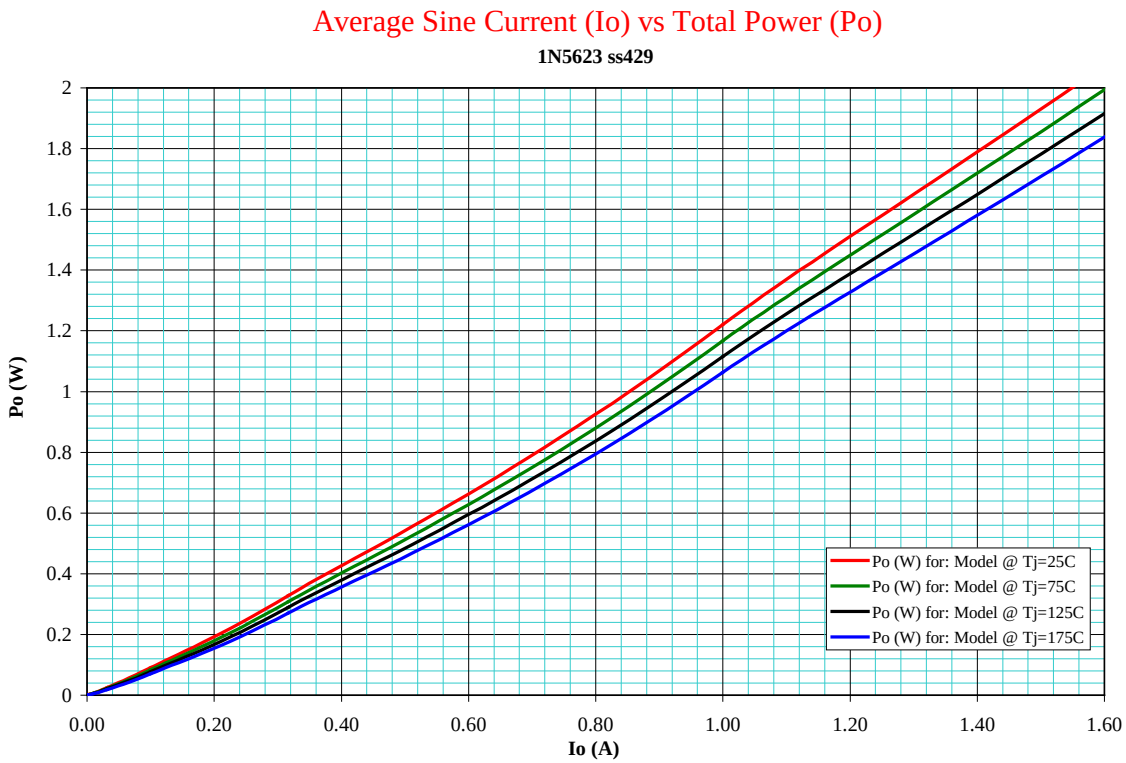



FIGURE 9. Rectifier power versus $I_O$ (average forward current) for 1N5615-1N5623.

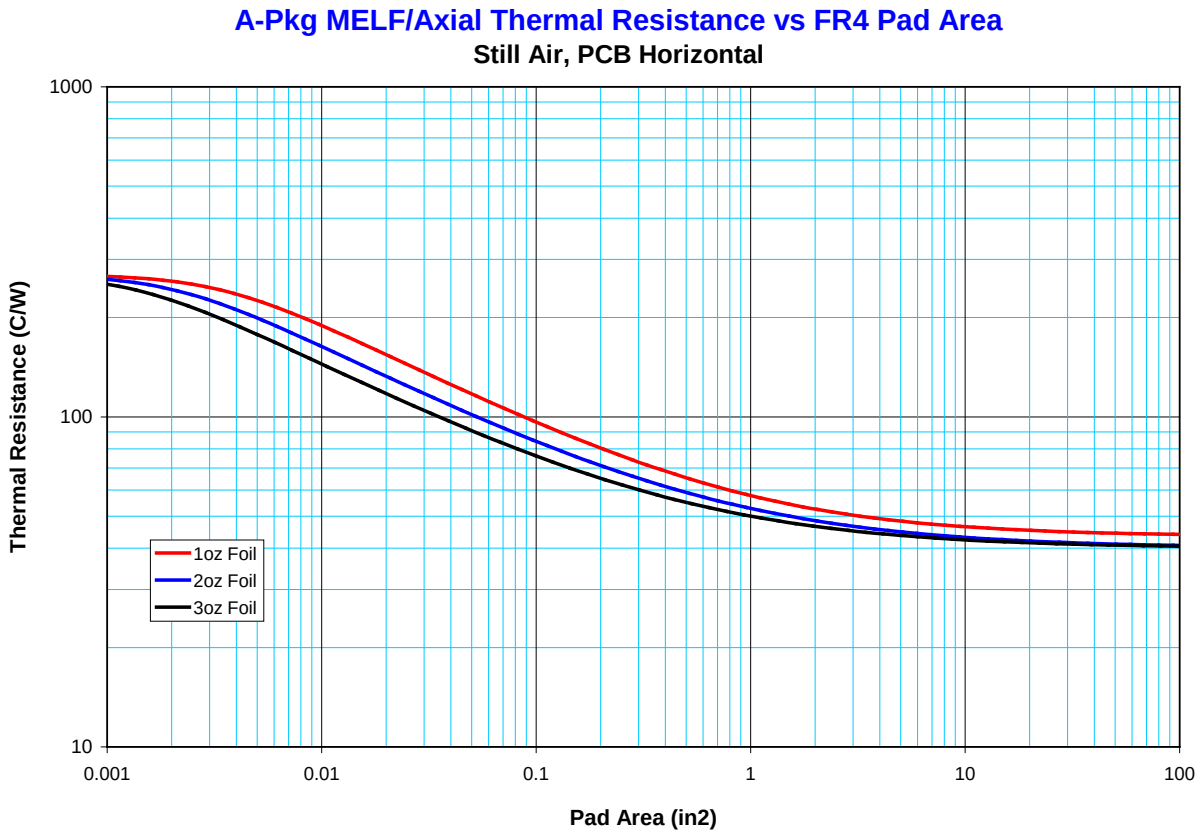



FIGURE 10. Thermal resistance versus pad area (for each pad) with 1, 2, and 3 ounce copper for 1N5615-1N5623.

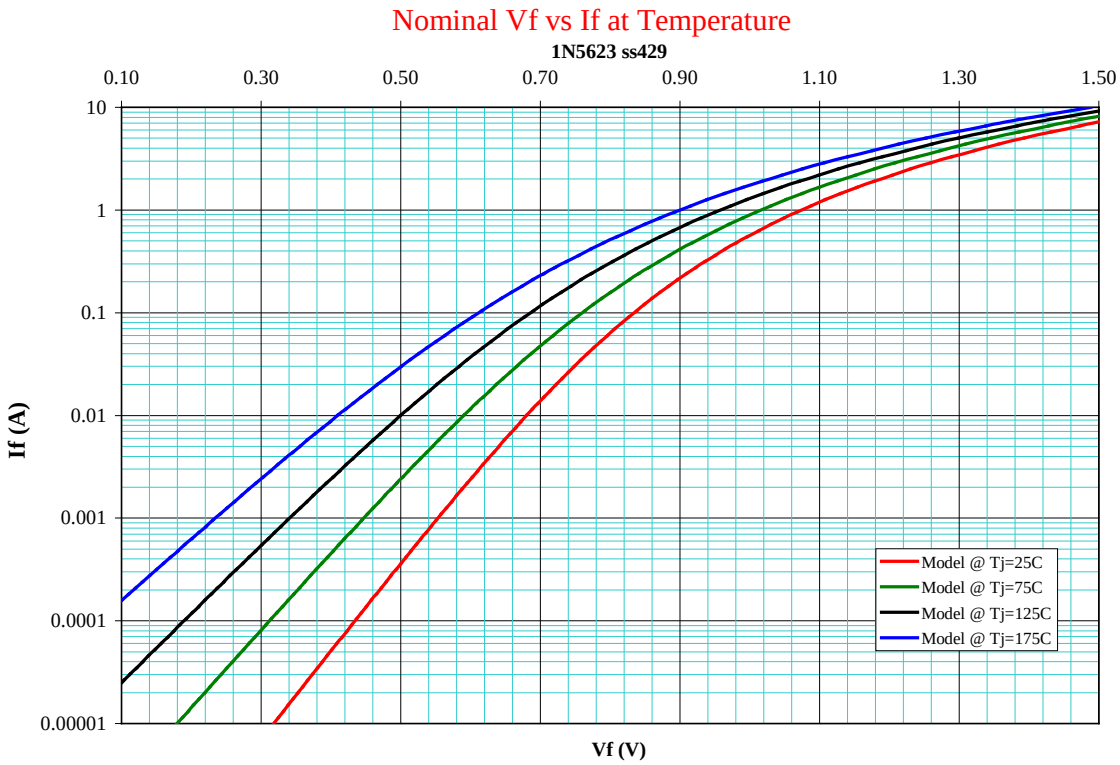



FIGURE 11. Forward voltage versus forward current for 1N5615-1N5623.

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.

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