

The documentation process conversion measures necessary to comply with this revision shall be completed by 12 September 1998

INCH-POUND

MIL-PRF-19500/628A
12 June 1998
SUPERSEDING
MIL-S-19500/628
18 November 1994

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DIODE, SILICON, POWER RECTIFIER,
ULTRAFAST, TYPES 1N6690 THROUGH 1N6693,
1N6690US THROUGH 1N6693US, JAN, JANTX, JANTXV, AND JANS

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

1. SCOPE

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

1.2 Physical dimensions. See figures 1 and 2.

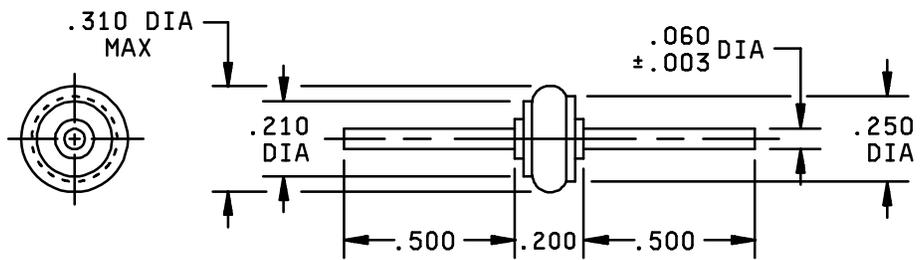
1.3 Maximum ratings.

| Types | V _{RWM} | I _O 1/ T _A = +25°C | t _{rr} | I _{FSM} t _p = 8.3 ms, T _A = +25°C | R _{θJL} at L = 0.335 | R _{θJE} 2/ | T _{STG} and T _J |
|-----------------|------------------|---|-----------------|---|----------------------------------|------------------------|-------------------------------------|
| | V _{dc} | A _{dc} | ns | A (pk) | °C/W | °C/W | °C |
| 1N6690,1N6690US | 600 | 20 | 75 | 375 | 4 | 3.5 | -65 to +175 |
| 1N6691,1N6691US | 800 | 20 | 75 | 375 | 4 | 3.5 | -65 to +175 |
| 1N6692,1N6692US | 1,000 | 20 | 75 | 375 | 4 | 3.5 | -65 to +175 |
| 1N6693,1N6693US | 1,200 | 20 | 75 | 375 | 4 | 3.5 | -65 to +175 |

1/ Derate linearly at 267 mA/°C from +100°C to +175°C.

2/ -US suffix devices only.

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



TOLERANCES: .XX ±.03
.XXX ±.010
(UNLESS OTHERWISE SPECIFIED)

FIGURE 1. Dimensions and configuration for 1N6690 through 1N6693.

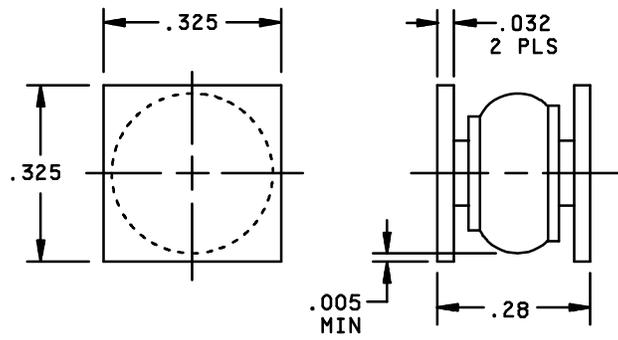


FIGURE 2. Physical dimensions for surface mount devices (1N6690US through 1N6693US).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

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

STANDARD

MILITARY

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated specifications or specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. Devices furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2 Associated specification. The individual item requirements shall be in accordance with MIL-PRF-19500 and as specified herein.

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

3.4 Interface requirements and physical dimensions. The interface requirements and physical dimensions shall be as specified in MIL-PRF-19500 and on figures 1 and 2 herein.

3.4.1 Diode construction. These devices shall be constructed utilizing non-cavity double plug construction with metallurgical bonding between both sides of the silicon die and terminal pins (see MIL-PRF-19500). Metallurgical bond shall be in accordance with the requirements of category 1 in MIL-PRF-19500. -US version devices shall be structurally identical to the non-surface mount devices except for lead terminations.

3.4.2 Lead material and finish. Lead finish shall be solderable as defined in 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).

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

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

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

4. QUALITY ASSURANCE PROVISIONS

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.

4.3 Screening (JANS, JANTX and JANTXV levels only). Screening shall be in accordance with MIL-PRF-19500 (Appendix E, table IV), 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 IV of MIL-PRF-19500) | Measurement | |
|--|--|--|
| | JANS level | JANTX and JANTXV levels |
| 3c <u>1/</u> | Thermal impedance (see 4.3.2) | Thermal impedance (see 4.3.2) |
| 9 | Not applicable | Not applicable |
| 10 | Not applicable | Not applicable |
| 11 | V_{F1} and I_{R1} | V_{F1} and I_{R1} |
| 12 | MIL-STD-750, method 1038; test condition A; $t = 240$ hours $V_R = 80$ percent of rated V_R ; $T_A = +125^\circ\text{C}$ | MIL-STD-750, method 1038; test condition A; $t = 48$ hours $V_R = 80$ percent of rated V_R ; $T_A = +125^\circ\text{C}$ |
| 13 | Subgroup 2 of table I herein; V_{F1} and I_{R1} ; $\Delta V_{F1} = \pm 100$ mV (pk); $\Delta I_{R1} = \pm 5 \mu\text{A}$ dc or 100 percent from the initial value, whichever is greater. | Subgroup 2 of table I herein; V_{F1} and I_{R1} ; $\Delta V_{F1} = \pm 100$ mV (pk); $\Delta I_{R1} = \pm 5 \mu\text{A}$ dc or 100 percent from the initial value, whichever is greater. |

1/ Thermal impedance shall be performed any time after screen 3.

4.3.1 Burn-in conditions. Burn-in conditions are as follows: $T_A = +125^\circ\text{C}$; $V_R = 0.8$ to 0.85 rated V_R dc (see 1.3)

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with appendix E, table V of MIL-PRF-19500 and tables I and III herein. The following test conditions shall be used for $Z_{\theta JX}$, group A inspection:

- a. I_M measure current 10 mA
- b. I_H forward heating current 5 - 50 A
- c. t_M heating time 50 ms
- d. t_{MS} measurement delay time 100 μ s minimum

The maximum limit for $Z_{\theta JX}$ under these test conditions are $Z_{\theta JX}(\max) = 3.8^\circ\text{C/W}$. For -US devices, $Z_{\theta JX}(\max) = 3.3^\circ\text{C/W}$.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table VIa (JANS) and table VIb (JANTX and JANTXV) of MIL-PRF-19500. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table I, group A, subgroup 2 and 4.4.5 herein.

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

| <u>Subgroup</u> | <u>Method</u> | <u>Condition</u> |
|-----------------|---------------|--|
| 3 | 4066 | I_{FSM} = rated (see 1.3); 10 surges of 8.3 ms each at 1 minute intervals. Condition B, $T_A = +25^\circ\text{C}$. |
| 4 | 1037 | T_A = room ambient as defined in the general requirements of MIL-STD-750 (see 4.5). I_F or $I_O = 2$ A minimum for 2,000 cycles. |
| 5 | 1027 | $I_O = 2$ A minimum, adjust T_A or I_O to achieve an average $T_J \geq +250^\circ\text{C}$. |

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

| <u>Subgroup</u> | <u>Method</u> | <u>Condition</u> |
|-----------------|---------------|--|
| 3 | 4066 | I_{FSM} = rated (see 1.3); 10 surges of 8.3 ms each at 1 minute intervals. Condition B, $T_A = +25^\circ\text{C}$. |
| 4 | 1037 | T_A = room ambient as defined in the general requirements of MIL-STD-750 (see 4.5). I_F or $I_O = 2$ A minimum for 2,000 cycles. |
| 5 | 3101 | 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 VII of MIL-PRF-19500. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table I, group A, subgroup 2 and 4.4.5 herein.

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

| <u>Subgroup</u> | <u>Method</u> | <u>Condition</u> |
|-----------------|---------------|--|
| 2 | 2036 | Test condition A, weight = 10 pounds, t = 15 seconds. |
| 3 | | Not applicable. |
| 6 | 1037 | T_A = room ambient as defined in the general requirements of MIL-STD-750 (see 4.5). I_F or $I_O = 2$ A minimum for 6,000 cycles. |

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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 IX of MIL-PRF-19500. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps and footnotes of table I, group A, subgroup 2 herein and 4.4.5.

4.4.4.1 Group E inspection, appendix E, table IX of MIL-PRF-19500.

| <u>Subgroup</u> | <u>Method</u> | <u>Condition</u> | <u>Sampling plan</u> |
|-----------------|---------------|---|----------------------|
| 1 | 1051 | 500 cycles. | 22 devices, c = 0 |
| 2 | 1038 | Condition A, t = 1,000 hours $V_R = 80$ percent V_{rated} | 22 devices, c = 0 |
| 3 | | Not applicable | |
| 4 | 3101 | $T_A = +25^\circ\text{C}$; $R_{\theta JL}$ (or $R_{\theta JE}$) = rated $R_{\theta JL}$ (or $R_{\theta JE}$) (see 1.3). | 5 devices, c = 0 |
| 5 | 1016 | $V_R =$ rated V_R (see 1.3); pressure = 33 mmHg; t = 1 minute (minimum), $R_{ISO} = 2.0 \times 10^6 \Omega$ maximum | 5 devices, c = 0 |

4.4.5 Group B, C, and E electrical measurements (delta requirements).

| <u>Test</u> | <u>Method</u> | <u>Condition</u> | <u>Symbol</u> | <u>Maximum</u> | <u>Unit</u> |
|--------------|---------------|--|-----------------|--|------------------|
| V_F | 4011 | $I_F = 5$ A (pk); pulsed (see 4.5.1) | V_{F1} | 0.78 | V dc |
| ΔV_F | 4011 | | ΔV_{F1} | ± 100 | mV dc |
| I_R | 4016 | DC method, $V_R =$ rated V_R (see 1.3); pulsed (see 4.5.1) | I_{R1} | 50 | μA dc |
| ΔI_R | 4016 | | ΔI_{R1} | ± 5 or 100 percent, whichever is greater. | μA dc |

TABLE I. Group A inspection.

| Inspection <u>1/</u> | MIL-STD-750 | | Symbol | Limits | | Unit |
|-----------------------------------|-------------|--|----------------------------------|------------------------------|--------------------|----------------------|
| | Method | Conditions | | Min | Max | |
| <u>Subgroup 1</u> | | | | | | |
| Visual and mechanical examination | 2071 | | | | | |
| <u>Subgroup 2</u> | | | | | | |
| Thermal impedance | 3101 | See 4.4.1 1N6690 through 1N6693 1N6690US through 1N6693US | $Z_{\theta JX}$ | | 3.8 3.3 | °C/W |
| Breakdown voltage | 4022 | $I_R = 100 \mu\text{A}$ dc pulsed (see 4.5.1) 1N6690, 1N6690US 1N6691, 1N6691US 1N6692, 1N6692US 1N6693, 1N6693US | V_{BR} | 600 800 1,000 1,200 | | V dc |
| Forward voltage | 4011 | $I_F = 5 \text{ A}$ (pk); pulsed (see 4.5.1) $I_F = 20 \text{ A}$ (pk); pulsed (see 4.5.1) $I_F = 70 \text{ A}$ (pk); pulsed (see 4.5.1) | V_{F1} V_{F2} V_{F3} | | 1.25 1.9 2.4 | V dc V dc V dc |
| Reverse current leakage | 4016 | DC method; $V_R = \text{rated } V_R$ (see 1.3); pulsed (see 4.5.1) | I_{R1} | | 10 | μA dc |
| <u>Subgroup 3</u> | | | | | | |
| High temperature operation: | | $T_C = +100^\circ\text{C}$ | | | | |
| Reverse current leakage | 4016 | DC method; $V_R = \text{rated } V_R$ (see 1.3); pulsed (see 4.5.1) | I_{R2} | | 250 | mA dc |
| Low temperature operation: | | $T_A = -65^\circ\text{C}$ | | | | |
| Forward voltage | 4011 | $I_F = 5 \text{ A}$ (pk); pulsed (see 4.5.1) | V_{F4} | | 1.5 | V dc |
| <u>Subgroup 4</u> | | | | | | |
| Scope display evaluation | <u>2/</u> | | | | | |
| Reverse recovery time | 4031 | Condition B; $I_F = .5 \text{ A}$, $I_R = 1 \text{ A}$ $I_{RR} = .25 \text{ A}$ | t_{rr} | | 75 | ns |
| Junction capacitance | 4001 | $V_R = 10 \text{ V}$ dc, $f = 1 \text{ MHz}$ $V_{SIG} = 50 \text{ mV}$ (p-p) (max) | C_J | | 250 | |
| <u>Subgroups 5, 6, and 7</u> | | | | | | |
| Not applicable | | | | | | |

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

2/ The reverse breakdown characteristics shall be viewed on an oscilloscope with display calibration factors of 20 to 50 μA /division and 20 to 200V/division. Reverse current over the knee shall be at least 100 μA . Each device may exhibit a slightly rounded characteristic and any discontinuity or dynamic instability of the trace shall be cause for rejection.

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

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in 4.3.2.1 of MIL-STD-750.

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

4.5.2.1 Thermal impedance ($Z_{\theta JX}$ measurements) for initial qualification or requalification. The $Z_{\theta JX}$ measurements shall be performed in accordance with MIL-STD-750, method 3101 (read and record date $Z_{\theta JX}$). $Z_{\theta JX}$ 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.

5. PACKAGING

5.1 Packaging. Packaging shall prevent mechanical damage of the devices during shipping and handling and shall not be detrimental to the device. When actual packaging of material 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 Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

5.2 Marking. Unless otherwise specified (see 6.2), marking shall be in accordance with MIL-PRF-19500.

6. NOTES

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

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

6.2 Acquisition requirements. See MIL- PRF-19500.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL 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 purchase 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, 3990 East Broad Street, Columbus, OH 43216-5000.

6.4 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodians:

Army - CR
Navy - EC
Air Force - 17
NASA - NA

Preparing activity:

DLA - CC

(Project 5961-1899-09)

Review activities:

Army - AR, MI, SM
Navy - AS
Air Force - 19, 85, 99

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

| | | |
|--|--|--|
| I RECOMMEND A CHANGE: | 1. DOCUMENT NUMBER MIL-PRF-19500/628A | 2. DOCUMENT DATE (YYMMDD) 980612 |
| 3. DOCUMENT TITLE SEMICONDUCTOR DEVICE, DIODE, SILICON, POWER RECTIFIER, ULTRAFast, TYPES 1N6690 THROUGH 1N6693, 1N6690US THROUGH 1N6693US, JAN, JANTX, JANTXV, AND JANS | | |
| 4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.) | | |
| 5. REASON FOR RECOMMENDATION | | |
| 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 (YYMMDD) |
| 8. PREPARING ACTIVITY | | |
| a. Point of contact: Alan Barone | b. TELEPHONE Commercial DSN FAX EMAIL 614-692-0510 850-0510 614-692-6939 alan_barone@dsccl.dla.mil | |
| c. ADDRESS: Defense Supply Center Columbus, ATTN: DSCC-VAT, 3990 East Broad Street, Columbus, OH 43216-5000 | IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 DSN 289-2340 | |