

The documentation process conversion measures necessary to comply with this revision shall be completed by 25 September 1997

INCH POUND

MIL-PRF-19500/169J
 25 June 1997
 SUPERSEDING
 MIL-S-19500/169H
 10 June 1994

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, DIODE, SILICON, SWITCHING,
 TYPES 1N3070, 1N3070-1, 1N3070UR-1, 1N4938, 1N4938-1, 1N4938UR-1
 JAN, JANTX, JANTXV, JANS, AND JANC

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, switching diodes. Four levels of product assurance are provided for each device type and one product assurance level for die, as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figures 1, 2, 3 and 4 (similar to DO-7 and DO-35).

1.3 Maximum ratings ($T_A = +25^\circ\text{C}$, unless otherwise specified).

| | | | | | | | | |
|---------------|---------------|--------------|-----------------------------------|-------------------------------------|-------------|-------------|-----------------|-----------------------|
| $V_{(BR)}$ | V_{RWM} | I_O 1/ | I_{FSM1} $t_p = 1 \text{ s}$ | I_{FSM2} $t_p = 1 \mu\text{s}$ | T_{OP} | T_{STG} | $Z_{\theta JX}$ | $R_{\theta JL}$ 2/ |
| <u>V (pk)</u> | <u>V (pk)</u> | <u>mA dc</u> | <u>mA dc</u> | <u>A dc</u> | <u>°C</u> | <u>°C</u> | <u>°C/W</u> | <u>°C/W</u> |
| 200 | 175 | 100 | 500 | 2.0 | -65 to +175 | -65 to +175 | 70 | 250 |

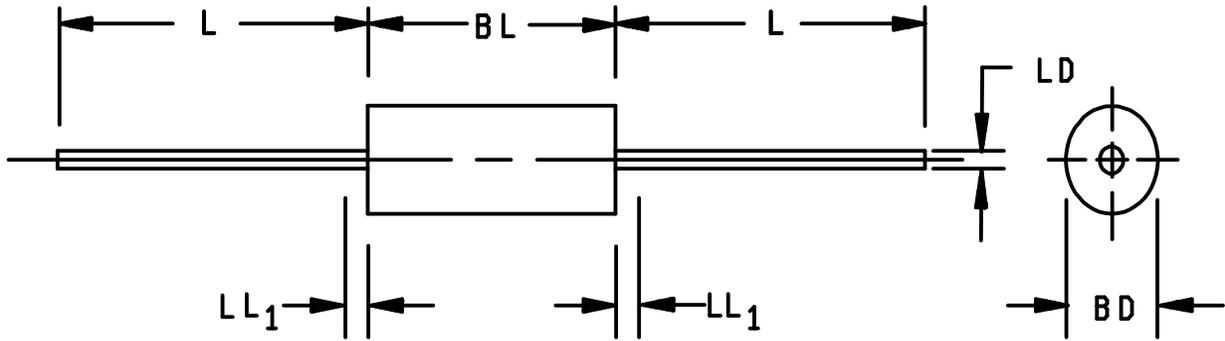
1/ Derate at 0.667 mA/°C above $T_A = +25^\circ\text{C}$.

2/ For UR suffix devices, $R_{\theta JEC(max)} = 50^\circ\text{C/W}$.

1.4 Primary electrical characteristics. Primary electrical characteristics at $T_A = +25^\circ\text{C}$, unless otherwise specified.

| | | |
|------------------------------------|-----------------------------------|-----------|
| V_{F1} $I_F = 100 \text{ mA}$ | I_{R1} $V_R = 175 \text{ V}$ | t_{rr} |
| <u>V dc</u> | <u>μA dc</u> | <u>ns</u> |
| 1.0 | 0.1 | 50 |

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.

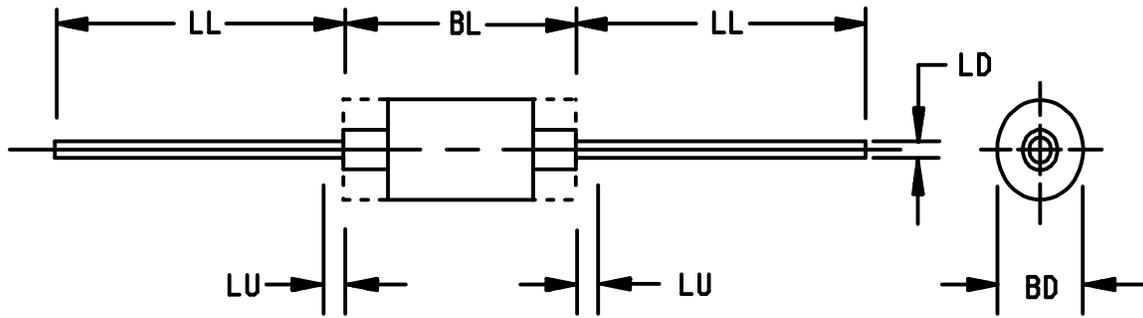


| Type | Symbol | Dimensions | | | | Notes |
|--------------------|--------|-------------|-------|--------|-------|-------|
| | | Millimeters | | Inches | | |
| | | Min | Max | Min | Max | |
| 1N3070 1N3070-1 | BL | 4.95 | 7.62 | .195 | .300 | |
| | BD | 1.98 | 2.72 | .078 | .107 | |
| | LL | 25.40 | 38.10 | 1.000 | 1.500 | |
| | LD | 0.46 | 0.56 | .018 | .022 | 2,3 |

NOTES:

1. Metric equivalents are given for general information only.
2. Both leads shall be within the specified limit.
3. The specified lead diameter applied in the zone between .050 inch (1.27 mm) and 1.000 inches (25.40 mm) from the diode body. Outside of this zone the lead diameter is not controlled.
4. Within LL₁, lead diameter may vary to allow for flash, lead finish build-up, and minor irregularities other than heat slugs.

FIGURE 1. Physical dimensions of 1N3070, 1N3070-1.

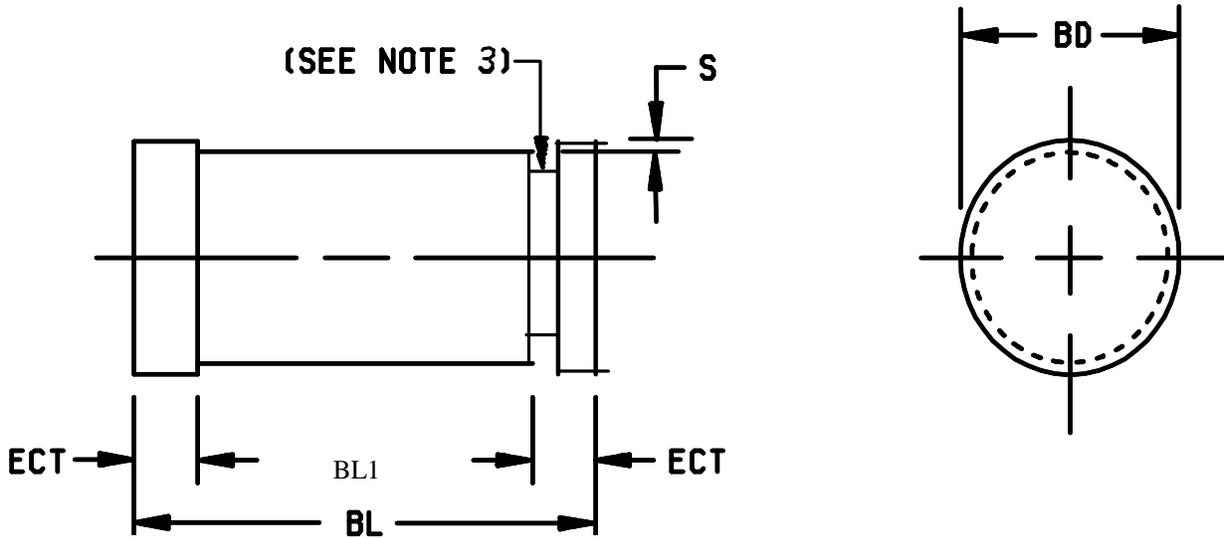


| Type | Symbol | Dimensions | | | | Notes |
|--------------------|--------|-------------|------|--------|------|-------|
| | | Millimeters | | Inches | | |
| | | Min | Max | Min | Max | |
| 1N4938 1N4938-1 | BL | 3.56 | 4.57 | .140 | .180 | |
| | BD | 1.42 | 1.88 | .056 | .074 | |
| | LL | 25.40 | | 1.000 | | |
| | LD | 0.48 | 0.53 | .019 | .021 | 2,3 |
| | G | 1.91 | | .075 | | |

NOTES:

1. Metric equivalents are given for general information only.
2. Both leads shall be within the specified limit.
3. The specified lead diameter applied in the zone between .050 inch (1.27 mm) and 1.000 inches (25.40 mm) from the diode body. Outside of this zone the lead diameter is not controlled.
4. Within LU₁, lead diameter may vary to allow for flash, lead finish build-up, and minor irregularities other than heat slugs.

FIGURE 2. Physical dimensions of 1N4938, and 1N4938-1.

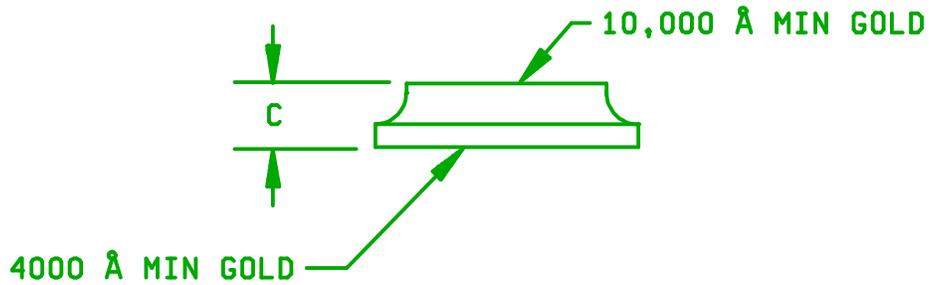
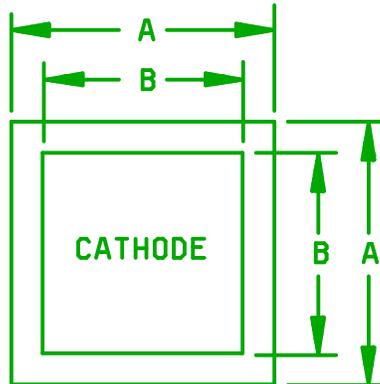


| Symbol | Dimensions | | | |
|-----------------|------------|------|-------------|------|
| | Inches | | Millimeters | |
| | Min | Max | Min | Max |
| BD | .063 | .070 | 1.60 | 1.78 |
| ECT | .016 | .028 | 0.41 | 0.71 |
| BL | .130 | .146 | 3.30 | 3.71 |
| BL ₁ | .100 ref | | 2.54 ref | |
| S | .001 min | | 0.03 min | |

NOTES:

1. Dimensions are in inches.
2. Metric equivalent are given for general information only.
3. Minimum clearance of glass body to mounting surface on all orientations.

FIGURE 3. Physical dimensions and configuration for 1N3070UR-1 and 1N4938UR-1 (DO-213AA).



| Symbol | Dimension | | | |
|--------|-----------|------|-------------|------|
| | Inches | | Millimeters | |
| | Min | Max | Min | Max |
| A | .019 | .025 | 0.48 | 0.64 |
| B | .008 | .012 | 0.20 | 0.30 |
| C | .007 | .011 | 0.18 | 0.28 |

DESIGN DATA

Metallization:

Top: (Cathode) Au
 Back (Anode)..... Au

Au thickness:

Top: 10,000Å minimum
 Back: 4,000Å minimum
 Chip thickness 9 mils "2 mils

NOTES:

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

FIGURE 4. JANC (A-version) die dimensions for 1N4938.

2. APPLICABLE DOCUMENTS

2.1 Government 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).

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

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

3.3 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified on figures 1, 2, 3 and 4.

3.3.1 Lead finish. Lead finish shall be solderable as defined in MIL-PRF-19500, MIL-STD-750, and herein.

3.3.2 Dash-one construction. These devices shall be category I, II, or III metallurgically bonded in accordance with MIL-PRF-19500. JANS devices shall utilize only category I metallurgical bonds and voidless, thermally matched, double plug construction.

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

3.4.1 Marking for UR devices. For UR version devices only, all marking except polarity may be omitted from the body, but shall be retained on the initial container.

3.5 Polarity. Alternatively, the polarity of all types shall be indicated with a contrasting color band to denote the cathode end. For UR suffix devices a minimum of three contrasting color dots spaced around the cathode end of the device may be used in lieu of contrasting color band.

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.

4.2.1 JANC devices. Qualification for JANC devices shall be in accordance with appendix G of 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 |
| 3A | Temperature cycling in accordance with MIL-PRF-19500. | Temperature cycling in accordance with MIL-PRF-19500. |
| 3C ^{1/} | Thermal impedance (see 4.3.3) | Thermal impedance (see 4.3.3) |
| 9 | I_{R1} and V_{F1} | Not applicable |
| 11 | I_{R1} and V_{F1} ; $\Delta I_{R1} \leq \pm 100$ percent of initial reading or 50 nA dc, whichever is greater. $\Delta V_{F1} \leq \pm 25$ mV dc change from initial reading. | I_{R1} and V_{F1} |
| 12 | See 4.3.1 | See 4.3.1, t = 48 hours |
| 13 ^{2/} | Subgroups 2 and 3 of table I herein; $\Delta I_{R1} \leq \pm 100$ percent of initial reading or 50 nA dc, whichever is greater. $\Delta V_{F1} \leq \pm 25$ mV dc change from initial reading. | Subgroup 2 of table I herein; $\Delta I_{R1} \leq \pm 100$ percent of initial reading or 50 nA dc, whichever is greater. $\Delta V_{F1} \leq \pm 25$ mV dc change from initial reading. |

^{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/} Thermal impedance ($Z_{\theta JX}$) is not required in screen 13, if previously preformed during screening.

4.3.1 Screening (JANC). Screening of JANC die shall be in accordance with MIL-PRF-19500, appendix G.

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

$I_O = 100$ mA dc; $V_{RWM} = 175$ V (pk); $f = 50 - 60$ Hz; $T_A =$ room ambient as defined in the general requirements in (see 4.5) of MIL-STD-750.

or

$I_f = 160$ mA dc; $T_A =$ room ambient as defined in the general requirements in (see 4.5) of MIL-STD-750.

4.3.3 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). 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. Maximum limit for $Z_{\theta JX}$ in both screening and group A, subgroup 2 = 50°C/W.

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 table I herein. Electrical measurements (end-points) shall be in accordance with the steps and footnotes of table I, group A, subgroup 2 herein. Thermal impedance conditions are as follows:

- a. I_H 300 mA to 500 mA.
- b. t_H 10 ms.
- c. I_M 1 mA to 10 mA.
- d. t_{MD} 100 μ s maximum.

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 steps and footnotes of table I, group A, subgroup 2 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> |
|-----------------|---------------|--|
| B4 | 1037 | $I_O = 100$ mA dc; $V_R = 175$ V (pk); $f = 60$ Hz; $t_{on} = t_{off} = 3$ minutes minimum for 2,000 cycles. |
| B5 | 1027 | $T_A = +125^\circ\text{C}$,..... $T_A = +125^\circ\text{C}$, $I_O = 100$ mA dc or $I_f = 160$ mA dc $f = 60$ Hz, $V_R = 175$ V(pk) |
| B6 | 3101 | $R_{\theta JL} = 250^\circ\text{C/W}$ maximum. |

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

| <u>Subgroup</u> | <u>Method</u> | <u>Condition</u> |
|-----------------|---------------|--|
| B2 | 4066 | Not applicable. |
| B3 | 1027 | $I_O = 100$ mA dc; $V_R = 175$ V (pk); $f = 60$ Hz, $T_A =$ room ambient as defined in the general requirements in (see 4.5) of MIL-STD-750. |
| B5 | 3101 | $R_{\theta JL} = 250^\circ\text{C/W}$ maximum (see 4.5.1). |

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 and footnotes of table I, group A, subgroup 2 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> |
|-----------------|---------------|---|
| C2 | 2036 | Lead tension: Test condition A; weight = 4 lb; t = 15 s ± 3 s. Lead fatigue: Test condition E. Not applicable for UR suffix devices. |
| C6 | 1026 | I _O = 100 mA dc; V _R = 175 V (pk); f = 60 Hz, T _A = room ambient as defined in the general requirements in (see 4.5) of MIL-STD-750. |

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

4.5.1 Thermal resistance. Thermal resistance measurement shall be performed in accordance with MIL-STD-750, method 3101 or 4081. Forced moving air or draft shall not be permitted across the device during test. The maximum limit for R_{θJL} under these condition shall be R_{θJL(max)} = 250°C/W.

- a. I_H..... 75 mA to 300 mA.
- b. t_H..... Thermal equilibrium.
- c. I_M..... 1 mA to 10 mA.
- d. t_{MD}..... 100 μs (maximum).

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

LS = 0 for UR suffix devices and R_{θJEC(max)} = 50°C/W.

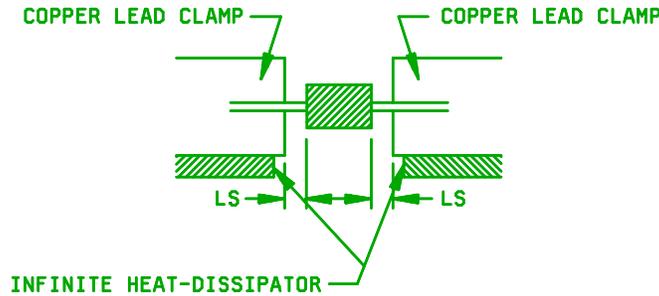


FIGURE 5. Mounting arrangement.

MIL-PRF-19500/169H

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 <u>2/</u> | 3101 | See 4.3.3 | $Z_{\theta JX}$ | | 70 | °C/W |
| Forward voltage | 4011 | $I_F = 100 \text{ mA dc}$ | V_{F1} | | 1.0 | V dc |
| Reverse current | 4016 | $V_R = 175 \text{ V dc}$ | I_{R1} | | 0.1 | μA dc |
| Breakdown voltage | 4021 | $I_R = 100 \text{ μA dc}$ | $V_{(BR)}$ | 200 | | V dc |
| <u>Subgroup 3</u> | | | | | | |
| High temperature operation | | $T_A = +150^\circ\text{C}$ | | | | |
| Reverse current | 4016 | $V_R = 175 \text{ V dc}$ | I_{R2} | | 100 | μA dc |
| Low temperature operation | | $T_A = -55^\circ\text{C}$ | | | | |
| Forward voltage | 4011 | $I_F = 100 \text{ mA dc}$ | V_{F2} | | 1.2 | V dc |
| <u>Subgroup 4</u> | | | | | | |
| Reverse recovery time | 4031 | Test condition B; $I_F = 30 \text{ mA dc}$; $I_R = 30 \text{ mA dc}$; $I_{REC} = 3.0 \text{ mA}$ | t_{rr} | | 50 | ns |
| Capacitance | 4001 | $V_R = 0 \text{ V dc}$; $f = 1.0 \text{ MHz}$; $V_{sig} = 50 \text{ mV (p-p) maximum}$ | C | | 5.0 | pF |
| <u>Subgroup 5</u> | | | | | | |
| Not applicable | | | | | | |
| <u>Subgroup 6</u> | | | | | | |
| Surge current | 4066 | $I_F = 0 \text{ mA dc}$; 10 surges at 1 per minute; $t_p = 1 \text{ μs}$; $I_{FSM} = 2.0 \text{ A (pk)}$ | | | | |
| Electrical measurements | | Group A, subgroup 2 | | | | |
| <u>Subgroup 7</u> | | | | | | |
| Not applicable | | | | | | |

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

2/ Not applicable to JANC.

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-STD-129.

6. NOTES

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

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

6.2 Acquisition requirements. 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 Suppliers of JANC die. The qualified JANC suppliers with the applicable letter version (example, JANCA4938) will be identified on the QPL. The Part or Identifying Number (PIN) is listed below:

| JANC ordering information | | |
|---------------------------|--------------|--|
| PIN | Manufacturer | |
| | 14552 | |
| 1N4938 | A4938 | |

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

CONCLUDING MATERIAL

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

Preparing activity:
 DLA - CC
 (Project 5961-1902-12)

Review activities:
 Army - MI, SM
 Navy - AS
 Air Force - 19, 85, 99

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.
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I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
MIL-PRF-19500/169J

2. DOCUMENT DATE (YYMMDD)
970625

3. DOCUMENT TITLE

SEMICONDUCTOR DEVICE, DIODE, SILICON, SWITCHING, TYPES 1N3070, 1N3070-1, 1N3070UR-1, 1N4938, 1N4938-1, 1N4938UR-1, JAN, JANTX, JANTXV, JANS, JANC

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)

7. DATE SUBMITTED (YYMMDD)

- (1) Commercial
- (2) AUTOVON (If applicable)

8. PREPARING ACTIVITY

a. NAME Alan Barone

b. TELEPHONE (Include Area Code)
(1) Commercial (2) AUTOVON
(614) 692-0510 850-0510

c. ADDRESS (Include Zip Code)
Defense Supply Center Columbus, ATTN:
DSCC-VAT, 3990 East Broad Street, Columbus,
OH 43216-5000

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