

The documentation and process conversion measures necessary to comply with this revision shall be completed by 27 April 2012.

INCH-POUND

MIL-PRF-19500/630F
27 January 2012
SUPERSEDING
MIL-PRF-19500/630E
19 December 2007

PERFORMANCE SPECIFICATION SHEET

* SEMICONDUCTOR DEVICE, FIELD EFFECT, RADIATION HARDENED TRANSISTOR, P-CHANNEL, SILICON, TYPES 2N7389, 2N7390, 2N7389U, 2N7389U5, AND 2N7390U, 2N7390U5, JANTXV, R, AND F AND JANS, R, AND F

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 a P-channel, radiation hardened, enhancement mode, MOSFET, power transistor. Two levels of product assurance are provided for each device type as specified in [MIL-PRF-19500](#), with avalanche energy ratings (E_{AS}) and maximum avalanche current (I_{AS}). See 6.4 for JANHC and JANKC die versions.

1.2 Physical dimensions. See [figure 1](#) (TO-205AF) and [figure 2](#) (LCC).

* 1.3 Maximum ratings. Unless otherwise specified, $T_C = +25^\circ\text{C}$.

| Type (1) | P_T (2) | P_T $T_A = +25^\circ\text{C}$ (free air) | $R_{\theta JC}$ (3) | Min $V_{(BR)DSS}$ $V_{GS} = 0\text{ V}$ $I_D = -1\text{ mA dc}$ | I_{D1} (4) (5) $T_C = +25^\circ\text{C}$ | I_{D2} (4) (5) $T_C = +100^\circ\text{C}$ | T_J and T_{STG} |
|------------------------------|-----------|--|--------------------------------------|---|---|--|---------------------|
| | <u>W</u> | <u>W</u> | <u>$^\circ\text{C/W}$</u> | <u>V dc</u> | <u>A dc</u> | <u>A dc</u> | <u>V dc</u> |
| 2N7389, 2N7389U, 2N7389U5 | 25 | 0.8 | 5 | -100 | -6.5 | -4.1 | -55 to +150 |
| 2N7390, 2N7390U, 2N7390U5 | 25 | 0.8 | 5 | -200 | -4.0 | -2.4 | -55 to +150 |

| Type (1) | I_S | I_{DM} (6) | E_{AS} | I_{AS} | V_{GS} |
|------------------------------|-------------|-----------------|-----------|-------------|-------------|
| | <u>A dc</u> | <u>A (pk)</u> | <u>mJ</u> | <u>A dc</u> | <u>V dc</u> |
| 2N7389, 2N7389U, 2N7389U5 | -6.5 | -26 | 165 | -6.5 | ± 20 |
| 2N7390, 2N7390U, 2N7390U5 | -4.0 | -16 | 171 | -4.0 | ± 20 |

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.daps.dla.mil/>.

- * (1) Electrical characteristics, ratings, and conditions for "U" and "U5" suffix devices are identical to the corresponding non "U" and "U5" suffix devices, unless otherwise specified.
- (2) Derate linearly 0.2 W/°C for T_C > +25°C.
- (3) See [figure 3](#), thermal impedance curves.
- (4) The following formula derives the maximum theoretical I_D limit. I_D is limited by package and internal construction.

$$I_D = \sqrt{\frac{T_{JM} - T_C}{(R_{\theta JC}) \times (R_{DS(on)} \text{ at } T_{JM})}}$$

- (5) See [figure 4](#), maximum drain current graph.
 - (6) I_{DM} = 4 x I_{D1} as calculated in note 4.
- * 1.4 Primary electrical characteristics. Unless otherwise specified, T_C = +25°C.

| Type | Min V _{(BR)DSS} V _{GS} = 0 V I _D = -1 mA dc | V _{GS(th)1} V _{DS} ≥ V _{GS} I _D = -1 mA | Max I _{DSS1} V _{GS} = 0 V V _{DS} = 80 percent of rated V _{DS} | Max r _{DS(on)1} (1) V _{GS} = -12 V dc I _D = I _{D2} | |
|---------------------------|--|---|---|--|-------------------------|
| | | | | T _J = +25°C | T _J = +150°C |
| | V dc | V dc | μA dc | ohms | ohms |
| 2N7389, 2N7389U, 2N7389U5 | -100 | Min -2.0 Max -4.0 | -25 | 0.30 | 0.60 |
| 2N7390, 2N7390U, 2N7390U5 | -200 | Min -2.0 Max -4.0 | -25 | 0.80 | 1.68 |

(1) Pulsed, (see [4.5.1](#)).

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

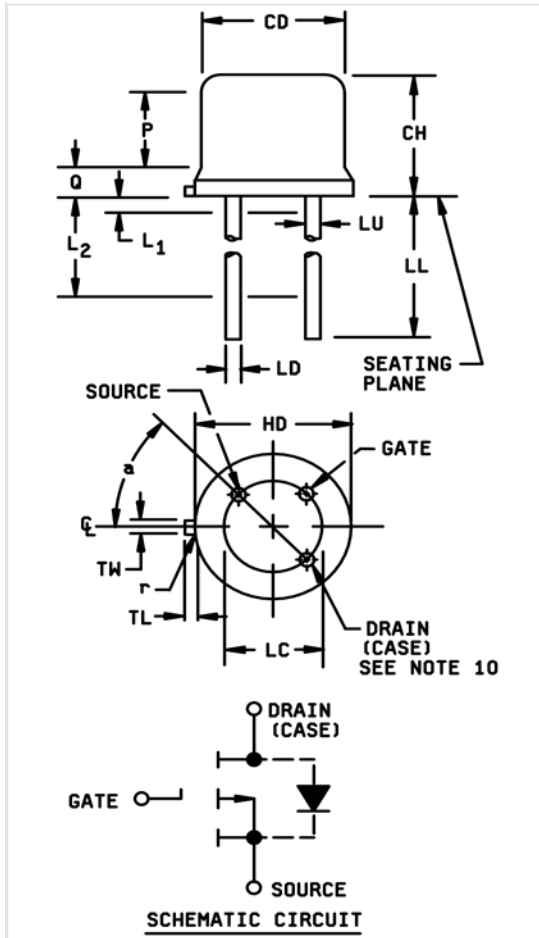
[MIL-PRF-19500](#) - Semiconductor Devices, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

[MIL-STD-750](#) - Test Methods for Semiconductor Devices.

* (Copies of these documents are available online at <https://assist.daps.dla.mil/quicksearch/> or <https://assist.daps.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.



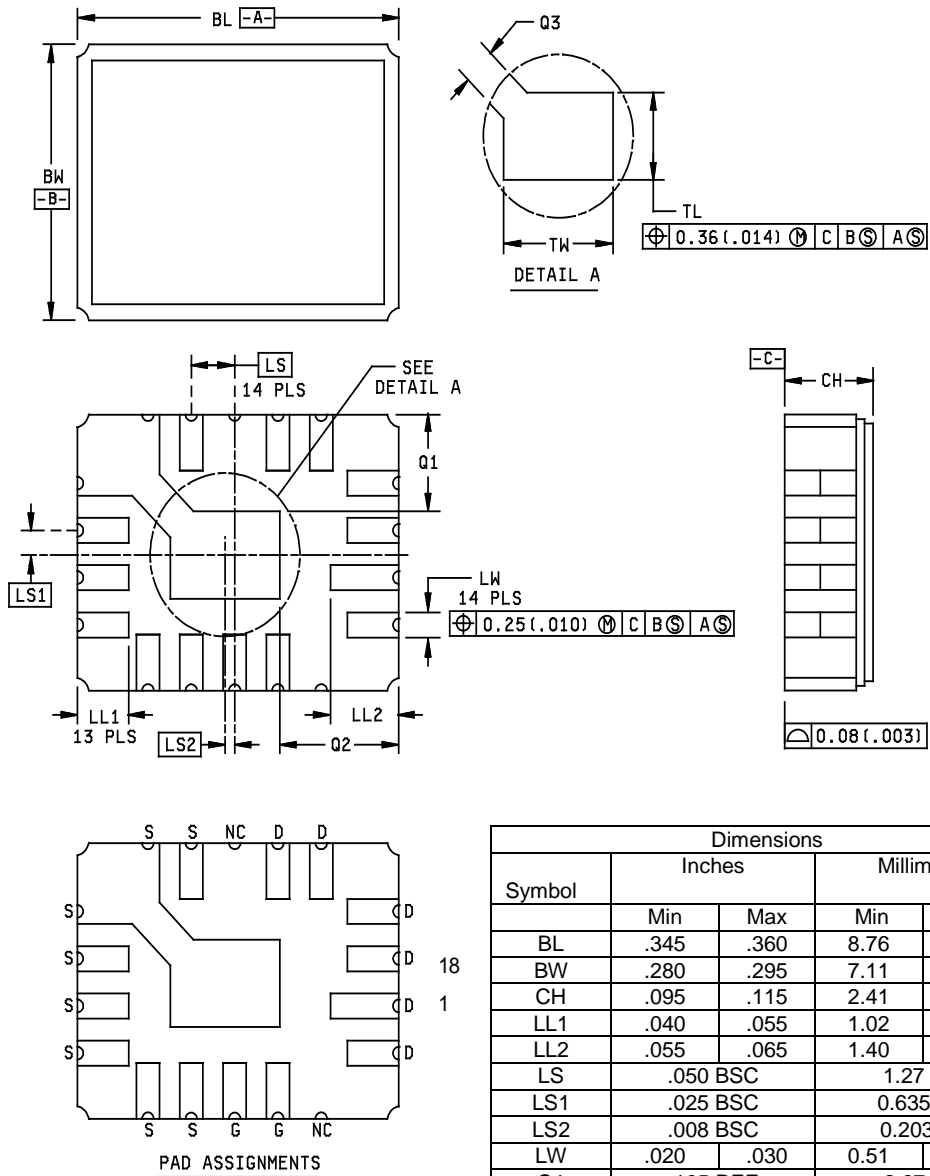
| Ltr | Dimensions | | | | Notes |
|----------------|------------|------|-------------|-------|-------|
| | Inches | | Millimeters | | |
| | Min | Max | Min | Max | |
| CD | .305 | .335 | 7.75 | 8.51 | |
| CH | .160 | .180 | 4.06 | 4.57 | |
| HD | .335 | .370 | 8.51 | 9.39 | |
| LC | .200 TP | | 5.08 TP | | 6 |
| LD | .016 | .021 | 0.41 | 0.53 | 7, 8 |
| LL | .500 | .750 | 12.7 | 19.05 | 7, 8 |
| LU | .016 | .019 | 0.41 | 0.48 | 7, 8 |
| L ₁ | | .050 | | 1.27 | 7, 8 |
| L ₂ | .250 | | 6.35 | | 7, 8 |
| P | .100 | | 2.54 | | 5 |
| Q | | .050 | | 1.27 | 4 |
| r | | .010 | | 0.25 | 9 |
| TL | .029 | .045 | 0.74 | 1.14 | 3 |
| TW | .028 | .034 | 0.71 | 0.86 | 2 |
| α | 45° TP | | 45° TP | | 6 |

NOTES:

1. Dimensions are in inches. Millimeters are given for general information only.
2. Beyond radius (r) maximum, TW shall be held for a minimum length of .011 (0.28 mm).
3. Dimension TL measured from maximum HD.
4. Outline in this zone is not controlled.
5. Dimension CD shall not vary more than .010 (0.25 mm) in zone P. This zone is controlled for automatic handling.
6. Leads at gauge plane .054 +.001, -.000 (1.37 +0.03, -0.00 mm) below seating plane shall be within .007 (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC.
7. LU applies between L₁ and L₂. LD applies between L₂ and LL minimum. Diameter is uncontrolled in L₁ and beyond LL minimum.
8. All three leads.
9. Radius (r) applies to both inside corners of tab.
10. Drain is electrically connected to the case.
11. In accordance with ASME Y14.5M, diameters are equivalent to ϕ x symbology.

FIGURE 1. Physical dimensions for TO-205AF (2N7389, 2N7390).

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| Symbol | Dimensions | | | |
|--------|------------|------|-------------|------|
| | Inches | | Millimeters | |
| | Min | Max | Min | Max |
| BL | .345 | .360 | 8.76 | 9.14 |
| BW | .280 | .295 | 7.11 | 7.49 |
| CH | .095 | .115 | 2.41 | 2.92 |
| LL1 | .040 | .055 | 1.02 | 1.40 |
| LL2 | .055 | .065 | 1.40 | 1.65 |
| LS | .050 BSC | | 1.27 BSC | |
| LS1 | .025 BSC | | 0.635 BSC | |
| LS2 | .008 BSC | | 0.203 BSC | |
| LW | .020 | .030 | 0.51 | 0.76 |
| Q1 | .105 REF | | 2.67 REF | |
| Q2 | .120 REF | | 3.05 REF | |
| Q3 | .045 | .055 | 1.14 | 1.40 |
| TL | .070 | .080 | 1.78 | 2.03 |
| TW | .120 | .130 | 3.05 | 3.30 |

NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. In accordance with ASME Y14.5M, diameters are equivalent to $\varnothing x$ symbology.

* FIGURE 2. Physical dimensions for LCC (2N7389U, 2N7389U5, 2N7390U, 2N7390U5).

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 manufacturers list before contract award (see [4.2](#) and [6.3](#)).

3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as defined in [MIL-PRF-19500](#) and as follows:

I_{AS}Rated avalanche current, nonrepetitive
nCnano coulomb.

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in [MIL-PRF-19500](#), and on [figures 1](#) and [2](#) herein.

3.4.1 Lead material and finish. Lead material shall be Kovar. Lead finish shall be solderable in accordance with [MIL-PRF-19500](#), [MIL-STD-750](#), and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see [6.2](#)).

3.4.2 Internal construction. Multiple chip construction shall not be permitted.

3.5 Electrostatic discharge protection. The devices covered by this specification require electrostatic discharge protection.

3.5.1 Handling. MOS devices must be handled with certain precautions to avoid damage due to the accumulation of static charge. The following handling procedures shall be followed:

- a. Devices shall be handled on benches with conductive handling devices.
- b. Ground test equipment, tools, and personnel handling devices.
- c. Do not handle devices by the leads.
- d. Store devices in conductive foam or carriers.
- e. Avoid use of plastic, rubber, or silk in MOS areas.
- f. Maintain relative humidity above 50 percent, if practical.
- g. Care shall be exercised, during test and troubleshooting, to apply not more than maximum rated voltage to any lead.
- h. Gate must be terminated to source. $R \leq 100 \text{ k}\Omega$, whenever bias voltage is to be applied drain to source.

3.6 Marking. Marking shall be in accordance with [MIL-PRF-19500](#). At the option of the manufacturer, marking of country of origin may be omitted from the body of the transistor, but shall be retained on the initial container.

3.7 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in [1.3](#), [1.4](#), and [table I](#).

3.8 Electrical test requirements. The electrical test requirements shall be the subgroups specified in [table I](#).

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, and tables I and II).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500.

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

* 4.3 Screening (JANS and JANTXV levels only). Screening shall be in accordance with 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 table E-IV of MIL-PRF-19500) (1) (2) | Measurement | |
|---|--|---|
| | JANS level | JANTXV levels |
| (3) | Gate stress test (see 4.3.1) | Gate stress test (see 4.3.1) |
| (3) | Method 3470 of MIL-STD-750 (see 4.3.2), optional | Method 3470 of MIL-STD-750 (see 4.3.2), optional |
| (3) 3c | Method 3161 of MIL-STD-750 (see 4.3.3) | Method 3161 of MIL-STD-750 (see 4.3.3) |
| 9 | I_{GSSF1} , I_{GSSR1} , I_{DSS1} | Not applicable |
| 10 | Method 1042 of MIL-STD-750, test condition B | Method 1042 of MIL-STD-750, test condition B |
| 11 | I_{GSSF1} , I_{GSSR1} , I_{DSS1} , $r_{DS(on)1}$, $V_{GS(th)1}$ subgroup 2 of table I herein: $\Delta I_{GSSF1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{GSSR1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{DSS1} = \pm 25$ μ A dc or ± 100 percent of initial value, whichever is greater. | I_{GSSF1} , I_{GSSR1} , I_{DSS1} , $r_{DS(on)1}$, $V_{GS(th)1}$ subgroup 2 of table I herein |
| 12 | Method 1042 of MIL-STD-750, test condition A, t = 240 hours | Method 1042 of MIL-STD-750, test condition A |
| 13 | Subgroups 2 and 3 of table I herein; $\Delta I_{GSSF1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{GSSR1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{DSS1} = \pm 25$ μ A dc or ± 100 percent of initial value, whichever is greater. $\Delta r_{DS(on)1} = \pm 20$ percent of initial value. $\Delta V_{GS(th)1} = \pm 20$ percent of initial value. | Subgroup 2 of table I herein; $\Delta I_{GSSF1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{GSSR1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{DSS1} = \pm 25$ μ A dc or ± 100 percent of initial value, whichever is greater. $\Delta r_{DS(on)1} = \pm 20$ percent of initial value. $\Delta V_{GS(th)1} = \pm 20$ percent of initial value. |

- (1) At the end of the test program, I_{GSSF1} , I_{GSSR1} , and I_{DSS1} are measured.
- (2) An out-of-family program to characterize I_{GSSF1} , I_{GSSR1} , I_{DSS1} and $V_{GS(th)1}$ shall be invoked.
- * (3) Shall be performed anytime after temperature cycling, screen 3a. JANTXV levels do not need to be repeated in screening requirements.

4.3.1 Gate stress test. Apply $V_{GS} = -24$ V minimum for $t = 250$ μ s minimum.

4.3.2 Single pulse avalanche energy (E_{AS}).

- a. Peak current (I_{AS})..... I_{D1} .
- b. Peak gate voltage (V_{GS}):.....-12 V.
- c. Gate to source resistor (R_{GS})..... $25 \Omega \leq R_{GS} \leq 200 \Omega$.
- d. Initial case temperature.....+25°C +10°C, -5°C.
- e. Inductance($2 E_{AS}/(I_{AS})^2$)($V_{BR} - V_{DD}$)/ V_{BR}) mH minimum.
- f. Number of pulses to be applied1 pulse minimum.
- g. Supply voltage $V_{DD} = -50$ V, or -25 V for 100 V devices.

4.3.3 Thermal impedance. The thermal impedance measurements shall be performed in accordance with method 3161 of [MIL-STD-750](#) using the guidelines in that method for determining I_M , I_H , t_H , t_{SW} , (and V_H where appropriate). Measurement delay time (t_{MD}) = 70 μ s max. See [table III](#), group E, subgroup 4 herein.

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 [MIL-PRF-19500](#), and [table I](#) herein. Electrical measurements (end-points) shall be in accordance with the inspections of [table I](#), subgroup 2 herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in [table E-VIA \(JANS\)](#) and [table E-VIB \(JANTXV\)](#) of [MIL-PRF-19500](#), and as follows. Electrical measurements (end-points) shall be in accordance with the applicable inspections of [table I](#), subgroup 2 herein.

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

| Subgroup | Method | Condition |
|----------|--------|---|
| B3 | 1051 | Condition G, 100 cycles. |
| B4 | 1042 | The heating cycle shall be 30 seconds minimum. |
| B5 | 1042 | Condition B, $V_{GS} = 100$ percent of rated, $T_A = +175^\circ\text{C}$, $t = 24$ hours, or $T_A = +150^\circ\text{C}$, $t = 48$ hours (manufacturers option). |
| B5 | 1042 | Condition A, $V_{DS} = 100$ percent of rated, $T_A = +175^\circ\text{C}$, $t = 120$ hours, or $T_A = +150^\circ\text{C}$, $t = 240$ hours (manufacturers option). |
| B5 | 2037 | Bond strength; test condition D. |

4.4.2.2 Group B inspection, table E-VIB (JANTXV) of MIL-PRF-19500.Subgroup Method Condition

| | | |
|----|------|--|
| B2 | 1051 | Test condition G, 25 cycles. |
| B3 | 1042 | The heating cycle shall be 30 seconds minimum. |
| B4 | 2075 | See 3.4.2. |

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-VII of MIL-PRF-19500, and as follows. Electrical measurements (end-points) shall be in accordance with the applicable inspections of [table I](#), subgroup 2 herein.

Subgroup Method Condition

| | | |
|----|------|---|
| C2 | 2036 | Test condition E (applicable to TO-205AF only). |
| C5 | 3161 | See 4.3.3, $R_{\theta JC(max)} = 5^{\circ}C/W$ |
| C6 | 1042 | The heating cycle shall be 30 seconds minimum. |

4.4.4 Group D Inspection. Group D inspection shall be conducted in accordance with table E-VIII of MIL-PRF-19500 and [table II](#) herein.

4.4.5 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-IX of MIL-PRF-19500 and as specified in [table III](#) herein. Electrical measurements (end-points) shall be in accordance with [table I](#), subgroup 2 herein.

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

4.5.1 Pulse measurements. Conditions for pulse measurements shall be as specified in section 4 of MIL-STD-750.

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* TABLE I. Group A inspection.

| Inspection <u>1/</u> | 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 <u>2/</u> | 3161 | See 4.3.3 | $Z_{\theta JC}$ | | | °C/W |
| Breakdown voltage, drain to source 2N7389, 2N7389U, 2N7389U5 2N7390, 2N7390U, 2N7390U5 | 3407 | Bias condition C, $V_{GS} = 0$ V, $I_D = -1$ mA dc | $V_{(BR)DSS}$ | -100 | | V dc |
| | | | | -200 | | V dc |
| Gate to source voltage (threshold) | 3403 | $V_{DS} \geq V_{GS}$, $I_D = -1$ mA | $V_{GS(th)1}$ | -2.0 | -4.0 | V dc |
| Gate current | 3411 | Bias condition C, $V_{GS} = +20$ V dc, $V_{DS} = 0$ V dc | I_{GSSF1} | | +100 | nA dc |
| Gate current | 3411 | Bias condition C, $V_{GS} = -20$ V dc, $V_{DS} = 0$ V dc | I_{GSSR1} | | -100 | nA dc |
| Drain current | 3413 | Bias condition C, $V_{GS} = 0$ V dc, $V_{DS} = 80$ percent of rated V_{DS} | I_{DSS1} | | -25 | μA dc |
| Static drain to source on-state resistance 2N7389, 2N7389U, 2N7389U5 2N7390, 2N7390U, 2N7390U5 | 3421 | $V_{GS} = -12$ V dc, condition A, pulsed (see 4.5.1), $I_D =$ rated I_{D2} (see 1.3) | $r_{DS(on)1}$ | | 0.30 | Ω |
| | | | | | 0.80 | Ω |
| Static drain to source on-state resistance 2N7389, 2N7389U, 2N7389U5 2N7390, 2N7390U, 2N7390U5 | 3421 | $V_{GS} = -12$ V dc, condition A, pulsed (see 4.5.1), $I_D =$ rated I_{D1} , (see 1.3) | $r_{DS(on)2}$ | | 0.35 | Ω |
| | | | | | 0.92 | Ω |
| Forward voltage 2N7389, 2N7389U, 2N7389U5 2N7390, 2N7390U, 2N7390U5 | 4011 | $V_{GS} = 0$ V dc, $I_D =$ rated I_{D1} , pulsed (see 4.5.1) | V_{SD} | | -3.0 | V |
| | | | | | -5.0 | V |

See footnotes at end of table.

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* TABLE I. Group A inspection - Continued.

| Inspection 1/ | MIL-STD-750 | | Symbol | Limits | | Unit |
|--|-------------|--|---------------|--------|-----------|----------|
| | Method | Condition | | Min | Max | |
| <u>Subgroup 3</u> | | | | | | |
| High temperature operation: | | | | | | |
| Gate current | 3411 | Bias condition C, $V_{GS} = \pm 20$ V dc, $V_{DS} = 0$ V dc, | I_{GSS2} | | ± 200 | nA dc |
| Drain current | 3413 | Bias condition C, $V_{GS} = 0$ V dc, $V_{DS} = 80$ percent of rated V_{DS} | I_{DSS2} | | -0.25 | mA dc |
| Static drain to source on-state resistance 2N7389, 2N7389U, 2N7389U5 2N7390, 2N7390U, 2N7390U5 | 3421 | $V_{GS} = -12$ V dc, pulsed (see 4.5.1), $I_D =$ rated I_{D2} | $r_{DS(on)3}$ | | 0.54 | Ω |
| | | | | | 1.60 | Ω |
| Gate to source voltage (threshold) | 3403 | $V_{DS} \geq V_{GS}$, $I_D = -1$ mA | $V_{GS(th)2}$ | -1.0 | | V dc |
| Low temperature operation: | | | | | | |
| Gate to source voltage (threshold) | 3403 | $V_{DS} \geq V_{GS}$, $I_D = -1$ mA | $V_{GS(th)3}$ | | -5.0 | V dc |
| <u>Subgroup 4</u> | | | | | | |
| Switching time test | | | | | | |
| Turn-on delay time | 3472 | $I_D =$ rated I_{D1} , $V_{GS} = -12$ V dc, Gate drive impedance = 7.5Ω , $V_{DD} = 50$ percent of $V_{(BR)DSS}$ | $t_{d(on)}$ | | 30 | ns |
| Rise time 2N7389, 2N7389U, 2N7389U5 2N7390, 2N7390U, 2N7390U5 | | | t_r | | 50 | ns |
| | | | | | 30 | ns |
| Turn-off delay time 2N7389, 2N7389U, 2N7389U5 2N7390, 2N7390U, 2N7390U5 | | | $t_{d(off)}$ | | 70 | ns |
| | | | | | 75 | ns |
| Fall time 2N7389, 2N7389U, 2N7389U5 2N7390, 2N7390U, 2N7390U5 | | | t_f | | 70 | ns |
| | | | | | 65 | ns |

See footnotes 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> - Continued | | | | | | |
| Forward transconductance 2N7389, 2N7389U, 2N7389U5 2N7390, 2N7390U, 2N7390U5 | 3475 | $I_D = I_{D2}$, $V_{DD} = -15$ V dc, pulsed (see 4.5.1) | g_{fs} | 2.5 2.5 | | S S |
| <u>Subgroup 5</u> | | | | | | |
| Safe operating area test (high voltage) | 3474 | See figures 5 and 6, $t_p = 10$ ms, $V_{DS} = 80$ percent of rated $V_{(BR)DSS}$ | | | | |
| Electrical measurements | | See table I, subgroup 2 | | | | |
| <u>Subgroup 6</u> | | | | | | |
| Not applicable | | | | | | |
| <u>Subgroup 7</u> | | | | | | |
| Gate charge | 3471 | Condition B | | | | |
| On-state gate charge 2N7389, 2N7389U, 2N7389U5 2N7390, 2N7390U, 2N7390U5 | | | $Q_{g(on)}$ | | 45 45 | nC nC |
| Gate to source charge 2N7389, 2N7389U, 2N7389U5 2N7390, 2N7390U, 2N7390U5 | | | Q_{gs} | | 10 10 | nC nC |
| Gate to drain charge 2N7389, 2N7389U, 2N7389U5 2N7390, 2N7390U, 2N7390U5 | | | Q_{gd} | | 25 25 | nC nC |
| Reverse recovery time 2N7389, 2N7389U, 2N7389U5 2N7390, 2N7390U, 2N7390U5 | 3473 | $d_i/d_t \leq -100$ A/ μ s, $V_{DD} \leq -50$ V, $I_D = I_{D1}$, (see 1.3) | t_{rr} | | 250 400 | ns ns |

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

2/ This test required for the following end-point measurements only:

- Group B, subgroups 3 and 4 (JANS).
- Group B, subgroups 2 and 3 (JANTXV).
- Group C, subgroups 2 and 6.
- Group E, subgroup 1.

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* TABLE II. Group D inspection.

| Inspection 1/ 2/ 3/ | MIL-STD-750 | | Symbol | Pre-irradiation limits | | Post-irradiation limits | | Post-irradiation limits 4/ | | Units |
|--|-------------|---|----------------------|------------------------|------|-------------------------|------|----------------------------|------|-------|
| | Method | Conditions | | R and F | | R | | F | | |
| | | | | Min | Max | Min | Max | Min | Max | |
| | | | | | | | | | | |
| <u>Subgroup 1</u> Not applicable | | | | | | | | | | |
| <u>Subgroup 2</u> Steady-state total dose irradiation (V _{GS} bias) 5/ | 1019 | T _C = +25°C V _{GS} = -12 V, V _{DS} = 0 V | | | | | | | | |
| Steady-state total dose irradiation (V _{DS} bias) 5/ | 1019 | V _{GS} = 0 V, V _{DS} = 80 percent of rated V _{DS} (pre-irradiation) | | | | | | | | |
| End-point electricals: Breakdown voltage, drain to source | 3407 | V _{GS} = 0 V, I _D = -1 mA, bias condition C | V _{(BR)DSS} | | | | | | | |
| 2N7389, 2N7389U, 2N7389U5 | | | | -100 | | -100 | | -100 | | V dc |
| 2N7390, 2N7390U, 2N7390U5 | | | | -200 | | -200 | | -200 | | V dc |
| Gate to source voltage (threshold) 5/ | 3403 | V _{DS} ≥ V _{GS} , I _D = -1 mA | V _{GS(th)} | | | | | | | |
| 2N7389, 2N7389U, 2N7389U5 | | | | -2.0 | -4.0 | -2.0 | -4.0 | -2.0 | -5.0 | V dc |
| 2N7390, 2N7390U, 2N7390U5 | | | | -2.0 | -4.0 | -2.0 | -4.0 | -2.0 | -5.0 | V dc |
| Gate current | 3411 | Bias condition C V _{GS} = -20 V, V _{DS} = 0 V, | I _{GSSF1} | | -100 | | -100 | | -100 | nA dc |
| Gate current | 3411 | Bias condition C V _{GS} = +20 V, V _{DS} = 0 V, | I _{GSSR1} | | 100 | | 100 | | 100 | nA dc |
| Drain current | 3413 | Bias condition C V _{GS} = 0 V, V _{DS} = 80 percent of rated V _{DS} (pre-irradiation) | I _{DSS} | | -25 | | -25 | | -25 | μA dc |

See footnotes at end of table.

* TABLE II. Group D inspection - Continued.

| Inspection 1/ 2/ | MIL-STD-750 | | Symbol | Pre-irradiation limits | | Post-irradiation limits | | Post-irradiation limits 4/ | | Units |
|--|-------------|--|--------------------|------------------------|------|-------------------------|------|----------------------------|-----|-------|
| | Method | Conditions | | R and F | | R | | F | | |
| | | | | Min | Max | Min | Max | Min | Max | |
| | | | | | | | | | | |
| <u>Subgroup 2</u> - Continued | | | | | | | | | | |
| Static drain to source on-state voltage | 3405 | V _{GS} = -12 V, condition A pulsed (see 4.5.1) I _D = I _{D2} | V _{DSon1} | | 1.23 | 1.23 | 1.23 | | | V dc |
| 2N7389, 2N7389U, 2N7389U5 2N7390, 2N7390U, 2N7390U5 | | | | 1.92 | 1.92 | 1.92 | 1.92 | | | V dc |
| Forward voltage source drain diode | 4011 | V _{GS} = 0 V, condition A I _D = I _{D1} | V _{SD} | | -3.0 | -3.0 | -3.0 | | | V |
| 2N7389, 2N7389U, 2N7389U5 2N7390, 2N7390U, 2N7390U5 | | | | -5.0 | -5.0 | -5.0 | -5.0 | | | V |

1/ For sampling plan see [MIL-PRF-19500](#).

2/ Group D qualification may be performed anytime prior to lot formation. Wafers qualified to these group D QCI requirements may be used for any other specification utilizing the same die design.

3/ At the manufacturer's option, group D samples need not be subjected to the screening tests, and may be assembled in its qualified package or in any qualified package that the manufacturer has data to correlate the performance to the designated package.

4/ The F designation represents devices which pass end-points at both R and F designated total-ionizing-dose (TID) levels.

5/ Separate samples shall be pulled for each bias.

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* TABLE III. Group E inspection (all quality levels) for qualification or re-qualification only.

| Inspection | MIL-STD-750 | | Sample plan |
|--|-------------|--|---------------------|
| | Method | Conditions | |
| <u>Subgroup 1</u> | | | |
| Temperature cycle | 1051 | Condition G, 500 cycles | 45 devices c = 0 |
| Hermetic seal | 1071 | | |
| Fine leak Gross leak | | | |
| Electrical measurements | | See table I , subgroup 2 | |
| <u>Subgroup 2 1/</u> | | | |
| Steady-state reverse bias | 1042 | Condition A, 1,000 hours | 45 devices c = 0 |
| Electrical measurements | | See table I , subgroup 2 | |
| Steady-state gate bias | 1042 | Condition B, 1,000 hours | |
| Electrical measurements | | See table I , subgroup 2 | |
| <u>Subgroup 4</u> | | | |
| Thermal impedance curves | | See MIL-PRF-19500 . | Sample size N/A |
| <u>Subgroup 10</u> | | | |
| Commutating diode for safe operating area test procedure for measuring dv/dt during reverse recovery of power MOSFET transistors or insulated gate bipolar transistors | 3476 | Test conditions shall be derived by the manufacturer | 22 devices c = 0 |

1/ A separate sample for each test may be pulled.

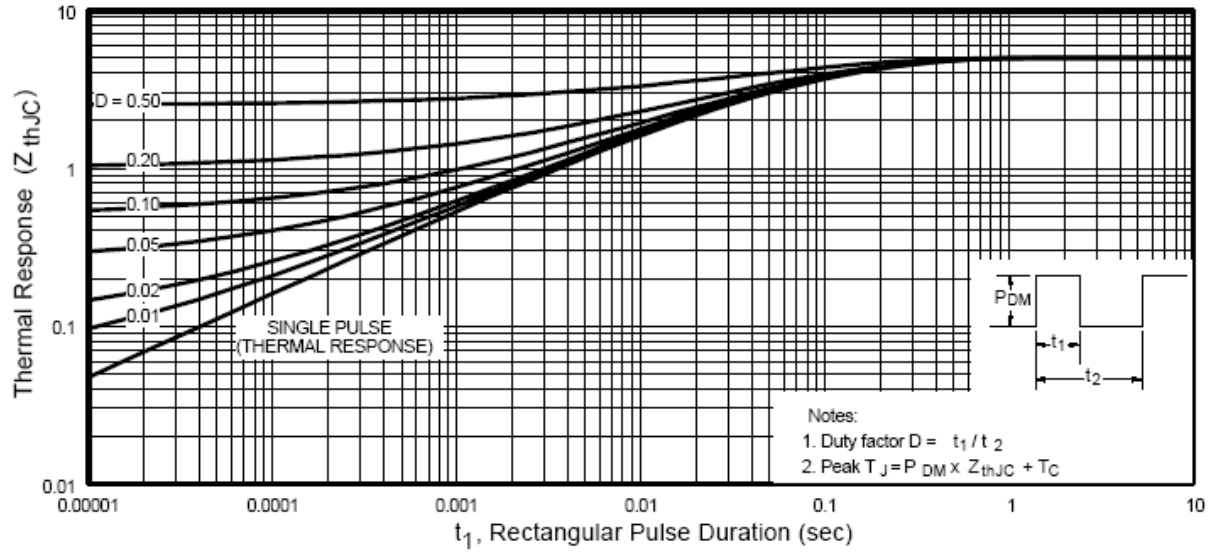
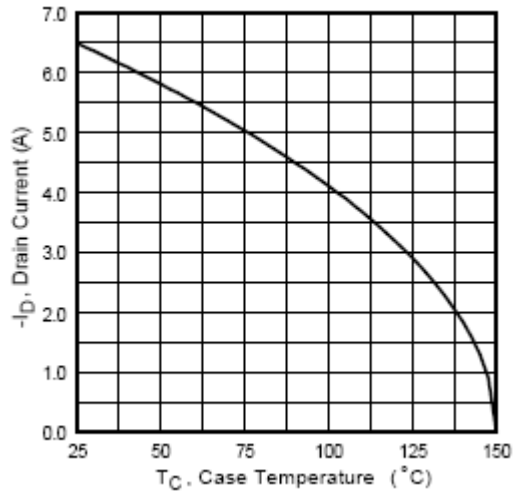
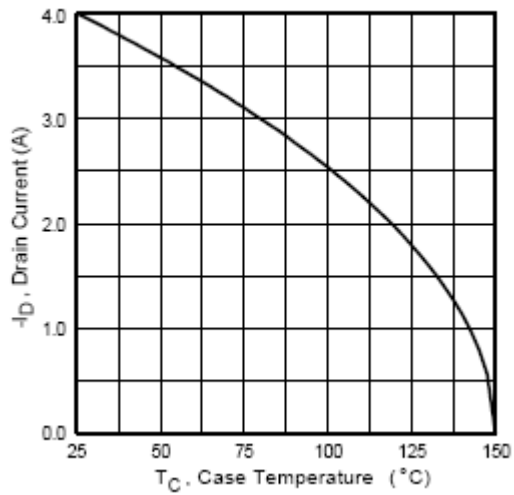


FIGURE 3. Thermal impedance curves.



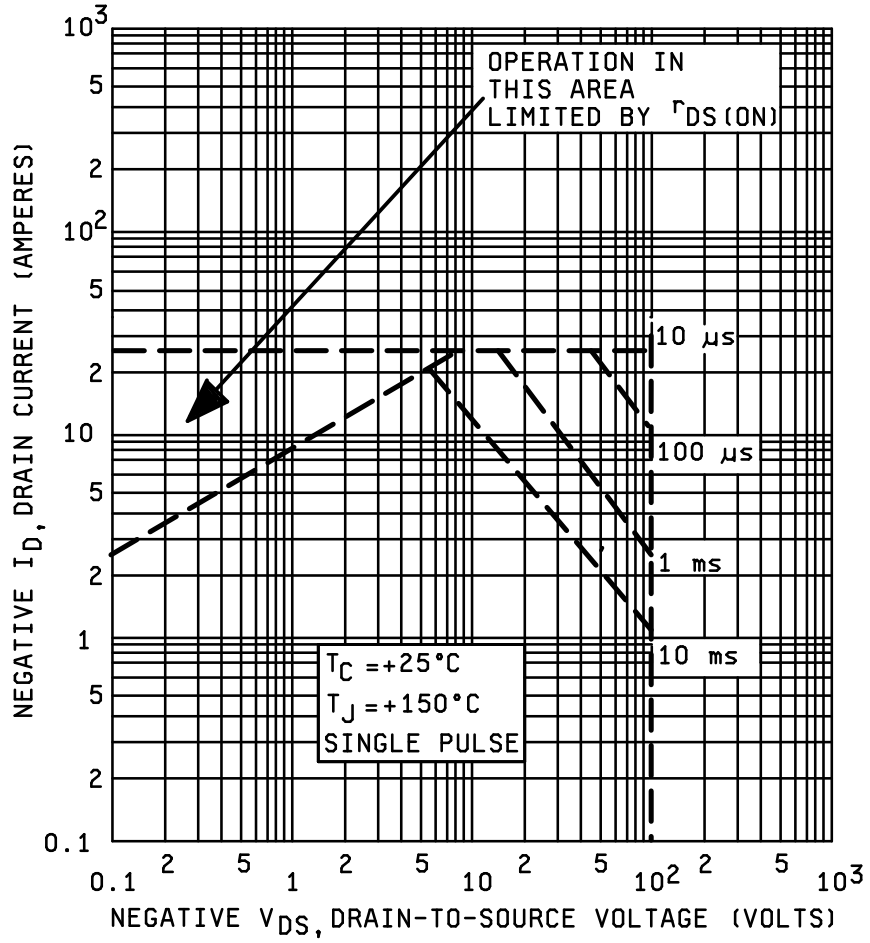
2N7389, 2N7389U, 2N7389U5



2N7390, 2N7390U, 2N7390U5

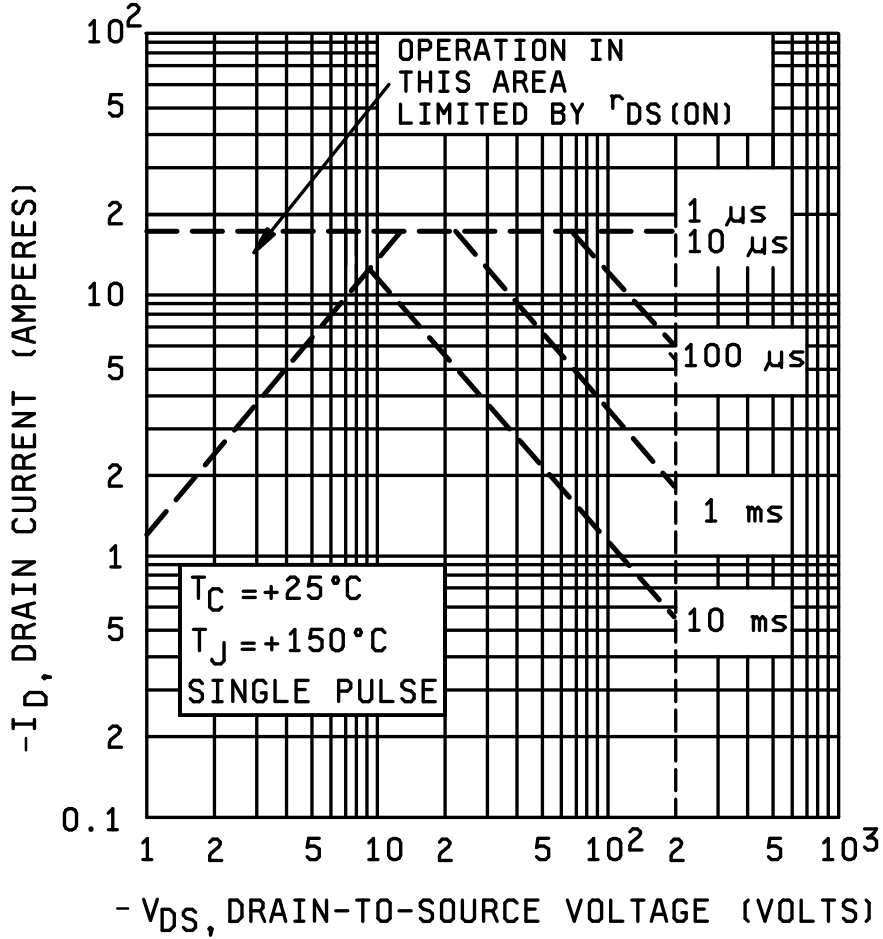
* FIGURE 4. Maximum drain current versus case temperature graphs.

2N7389, 2N7389U, 2N7389U5



* FIGURE 5. Safe operating area graphs.

2N7390, 2N7390U, 2N7390U5



* FIGURE 6. Safe operating area graphs.

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.daps.dla.mil>.

6.4 JANC die versions. The JANHC and JANKC die versions of these devices are covered under specification sheet [MIL-PRF-19500/657](#).

6.5 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:

Army - CR
Navy - EC
Air Force - 85
NASA - NA
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2011-094)

Review activities:

Army - SM
Navy - AS, MC
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