The documentation and process conversion measures necessary to comply with this revision shall be completed by 27 January 2004.

INCH-POUND

MIL-PRF-19500/683A
27 October 2003
SUPERSEDING
MIL-PRF-19500/683
9 March 2001

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, FIELD EFFECT, N-CHANNEL,
RADIATION HARDENED (TOTAL DOSE AND SINGLE EVENT EFFECTS)
TYPE 2N7467U2, JANTXVR, F, G, AND H AND JANSR, F, G, AND H

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 an N-channel, enhancement-mode power MOSFET transistor with radiation hardened total dose and single event (SEE) effects ratings, with avalanche energy maximum rating ($E_{AS}$) and maximum avalanche current ($I_{AS}$). Two levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1, surface mount, U2.

* 1.3 Maximum ratings. Unless otherwise specified, $T_A$ = +25°C.

| Type | $P_T$ (1) $T_C$ = +25°C | $P_T$ $T_A$ = +25°C (free air) | $V_{DS}$ | $V_{DG}$ | $V_{GS}$ | $I_{D1}$ $T_C$ = +25°C (2) (3) | $I_{D2}$ $T_C$ = +100°C | $I_S$ (2) | $I_{DM}$ (4) | $T_J$ and $T_{STG}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | W | W | V dc | V dc | V dc | A dc | A dc | A dc | A(pk) | °C |
| 2N7467U2 | 250 | 2.5 | 30 | 30 | ±20 | 75 | 45 | 75 | 300 | -55 to +150 |

(1) Derate linearly 2.0 W/°C for $T_C$ > +25°C.
(2) The following formula derives the maximum theoretical $I_D$ limit. $I_D$ is limited by package and internal wires and may be limited by pin diameter:

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

(3) See figure 2, maximum drain current graph.
(4) $I_{DM}$ = 4 X $I_{D1}$ as calculated in note (2).

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

1.4 Primary electrical characteristics at $T_C$ = +25°C.

| Type | Min $V_{(BR)DSS}$ $V_{GS}$ = 0 $I_D$ = 1.0 mA dc | $V_{GS(TH)}$ $V_{DS} \geq V_{GS}$ $I_D$ = 1.0 mA dc | | Max $I_{DSS1}$ $V_{GS}$ = 0 $V_{DS}$ = 80 percent of rated $V_{DS}$ | Max $r_{DS(ON)}$ (1) $V_{GS}$ = 12 V dc | | $R_{\theta JC}$ max | $E_{AS}$ at $I_{D1}$ | $I_{AS}$ |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | $T_J$ = 25°C at $I_{D2}$ | $T_J$ = 150°C at $I_{D2}$ | | | |
| | V dc | V dc | | µA dc | ohm | ohm | °C/W | mJ | A |
| | | Min | Max | | | | | | |
| 2N7467U2 | 30 | 2.0 | 4.0 | 10 | .0035 | .006 | .50 | 500 | 75 |

(1) Pulsed (see 4.5.1).

2. APPLICABLE DOCUMENTS

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

2.2 Government documents.

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

SPECIFICATION

DEPARTMENT OF DEFENSE

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

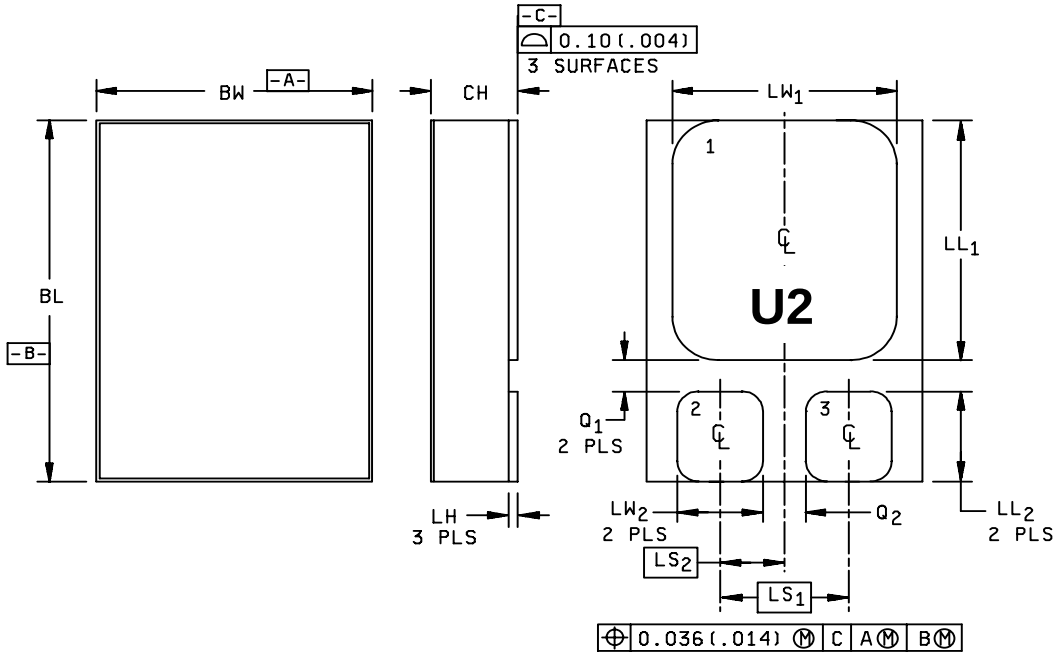
STANDARD

DEPARTMENT OF DEFENSE

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.




| LTR | Dimensions | | | |
|---|---|---|---|---|
| | Inches | | Millimeters | |
| | Min | Max | Min | Max |
| BL | .685 | .695 | 17.40 | 17.65 |
| BW | .520 | .530 | 13.21 | 13.46 |
| CH | | .142 | | 3.60 |
| LL1 | .470 | .480 | 11.94 | 12.19 |
| LL2 | .152 | .162 | 3.86 | 4.11 |
| LH | .010 | .020 | .254 | .508 |
| LS1 | .240 BSC | | 6.10 BSC | |
| LS2 | .120 BSC | | 3.05 BSC | |
| LW1 | .435 | .445 | 11.05 | 11.30 |
| LW2 | .135 | .145 | 3.43 | 3.68 |
| Q1 | .035 | | .89 | |
| Q2 | .050 | | 1.27 | |

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Dimensions and tolerancing shall be in accordance with ASME Y14.5M.
4. Terminal 1 – Drain, Terminal 2 – Gate, Terminal 3 – Source

* FIGURE 1. Physical dimensions for surface mount - U2.

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:

$I_{AS}$ .....Rated avalanche current, nonrepetitive
nC .....nano coulomb.

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and figure 1 (U2) herein. Methods used for the electrical isolation of the terminals shall employ materials that contain a minimum of 90 percent $Al_2O_3$ (ceramic).

3.4.1 Lead material and finish. Terminal material shall be copper tungsten. Terminal finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of terminal finish is desired, it shall be specified in the acquisition document (see 6.5).

3.4.2 Internal construction. Multiple chip construction is not permitted to meet the requirements of this specification.

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

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

3.6.1 Handling. MOS devices must be handled with certain precautions to avoid damage due to the accumulation of static charge. However, the following handling practices are recommended (see 3.6).

a. Devices should 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 should be exercised during test and troubleshooting to apply not more than maximum rated voltage to any lead.

h. Gate must be terminated to source, $R \leq 100\ k\Omega$, whenever bias voltage is to be applied drain to source.

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

3.8 Electrical test requirements. The electrical test requirements shall be the subgroups as specified in table I, group A 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 tables I, II and III and 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 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 shall be performed by the first inspection lot of this revision to maintain qualification.

4.2.1.1 SEE. Design capability shall be tested on the initial qualification and thereafter whenever a major die design or process change is introduced. See the design safe operation area graph shown herein. End-point measurements shall be in accordance with table III.

4.3 Screening (JANS, JANTXV levels only). Screening shall be in accordance with appendix E, table 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 IV of MIL-PRF-19500) (1) (2) | Measurement | |
|---|---|---|
| | JANS level | JANTXV level |
| (3) | Gate stress test (see 4.3.1) | Gate stress test (see 4.3.1) |
| (3) | Method 3470 of MIL-STD-750, $E_{AS}$ (see 4.3.2) | Method 3470 of MIL-STD-750, $E_{AS}$ (see 4.3.2) |
| (3) 3c | Method 3161 of MIL-STD-750, thermal impedance, (see 4.3.3) | Method 3161 of MIL-STD-750, thermal impedance, (see 4.3.3) |
| 9 | Subgroup 2 of table I herein; $I_{GSSF1}$, $I_{GSSR1}$, $I_{DSS1}$. | Not applicable. |
| 10 | Method 1042 of MIL-STD-750, test condition B | Method 1042 of MIL-STD-750, test condition B |
| 11 | Subgroup 2 of table I herein; $I_{GSSF1}$, $I_{GSSR1}$, $I_{DSS1}$, $r_{DS(on)1}$, $V_{GS(TH)1}$.<br><br>$\Delta I_{GSSF1}$ = ± 20 nA dc or ±100 percent of initial value, whichever is greater.<br>$\Delta I_{GSSR1}$ = ± 20 nA dc or ± 100 percent of initial value, whichever is greater.<br>$\Delta I_{DSS1}$ = ± 5 μA dc or ± 100 percent of initial value, whichever is greater. | Subgroup 2 of table I herein; $I_{GSSF1}$, $I_{GSSR1}$, $I_{DSS1}$, $r_{DS(on)1}$, $V_{GS(TH)1}$. |
| 12 | MIL-STD-750, method 1042, test condition A | MIL-STD-750, method 1042, test condition A |
| 13 | Subgroups 2 and 3 of table I herein<br><br>$\Delta I_{GSSF1}$ = ± 20 nA dc or ± 100 percent of initial value, whichever is greater.<br>$\Delta I_{GSSR1}$ = ± 20 nA dc or ± 100 percent of initial value, whichever is greater.<br>$\Delta I_{DSS1}$ = ± 5 μA dc or ± 100 percent of initial value, whichever is greater.<br><br>$\Delta r_{DS(on)1}$ =± 20 percent of initial value<br>$\Delta V_{GS(th)1}$ = ± 20 percent of initial value | Subgroup 2 of table I herein<br><br>$\Delta I_{GSSF1}$ = ± 20 nA dc or ± 100 percent of initial value, whichever is greater.<br>$\Delta I_{GSSR1}$ = ± 20 nA dc or ± 100 percent of initial value, whichever is greater.<br>$\Delta I_{DSS1}$ = ± 5 μA dc or ± 100 percent of initial value, whichever is greater.<br><br>$\Delta r_{DS(on)1}$ =± 20 percent of initial value<br>$\Delta V_{GS(th)1}$ = ± 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 before screen 9.

* 4.3.1 Gate stress test. Apply $V_{GS}$ = 24 V minimum for t = 250 μs minimum.

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

a. Peak current ($I_{AS}$): ..... $I_{AS(max)}$.

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 ($T_C$): ..... +25°C +10°C, -5°C.

e. Inductance (L): ..... $\left[\frac{2E_{AS}}{(I_{D1})^2}\right] \frac{[(V_{BR} - V_{DD})]}{V_{BR}}$ *mH minimum*.

f. Number of pulses to be applied: ..... 1 pulse minimum.

g. Supply voltage ($V_{DD}$): ..... 20 V.

* 4.3.3 Thermal impedance ($Z_{\theta JC}$ measurements). The $Z_{\theta JC}$ measurements shall be performed in accordance with method 3161 of MIL-STD-750. The maximum limit (not to exceed the thermal impedance curves (see figure 3 herein) shown and the table I, subgroup 2 limits) for $Z_{\theta JC}$ in screening (appendix E, table IV 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 bar 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. This procedure may be used in lieu of an in line procedure.

a. Measuring current ($I_M$): ..... 10 mA.

b. Drain heating current ($I_H$): ..... 16.67 A minimum.

c. Heating time ($t_H$): ..... 20 ms.

d. Drain-source heating voltage ($V_H$): ..... 10 V.

e. Measurement time delay ($t_{MD}$): ..... 30 μs to 60 μs.

f. Sample window time ($t_{SW}$): ..... 10 μs maximum.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500 and as specified herein. Alternate flow is allowed for conformance inspection in accordance with appendix E of 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. End-point electrical measurements shall be in accordance with 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 appendix E, table VIa (JANS) and table VIb (JANTXV) of MIL-PRF-19500, and as specified herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

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

| Subgroup | Method | Condition |
|---|---|---|
| B3 | 1051 | Test condition G, 100 cycles. |
| B3 | 2075 | See 3.4.2. |
| B3 | 2037 | Test condition A, all internal wires for each device shall be pulled separately. |
| B3 | 2077 | Scanning electron microscope (SEM) qualification may be performed anytime prior to lot formation. |
| B4 | 1042 | Test condition D, 2,000 cycles. Neither heat sink nor forced-air cooling on the device shall be permitted during the on cycle. The heating cycle shall be 60 seconds minimum. |
| B5 | 1042 | Test condition B, $V_{GS}$ = rated; $T_A$ = +175°C, t = 24 hours. |
| B5 | 1042 | Test condition A, $V_{DS}$ = rated; $T_A$ = +175°C; t = 120 hours. |
| B5 | 2037 | Bond strength; test condition A. |
| B6 | 3161 | Thermal resistance, see 4.5.2. |

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

| Subgroup | Method | Condition |
|---|---|---|
| B2 | 1051 | Test condition G, 25 cycles. (45 total, including 20 cycles performed in screening). |
| B3 | 1042 | Test condition D, 2,000 cycles. Neither heat sink nor forced-air cooling on the device shall be permitted during the on cycle. The heating cycle shall be 60 seconds minimum. |
| B3 | 2037 | Test condition A. All internal bond wires for each device shall be pulled separately. |
| B4 | 2075 | See 3.4.2. |
| B5 | 3161 | Thermal resistance, see 4.5.2. |

* 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 and as follows. Electrical measurements (end-points) and delta requirements shall be in accordance with table I, subgroup 2 herein.

| Subgroup | Method | Condition |
|---|---|---|
| C2 | 1056 | Test condition B. |
| C2 | 1021 | Omit initial conditioning. |
| C5 | 3161 | See 4.5.2 |
| C6 | 1042 | Test condition D, 6,000 cycles. Neither heat sink nor forced-air cooling on the device shall be permitted during the on cycle. The heating cycle shall be 60 seconds minimum. |
| C6 | 2037 | Test condition A. All internal bond wires for each device shall be pulled separately. (Wire bond pull test performed if devices continued from group B.) |
| C7 | 1018 | No pre-bake required. |

4.4.4 Group D Inspection. Group D inspection shall be conducted in accordance with appendix E, table 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 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 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 Thermal resistance. Thermal resistance measurements shall be performed in accordance with method 3161 of MIL-STD-750. The maximum limit of $R_{\theta JC(max)}$ = 0.50°C/W. The following parameter measurements shall apply:

a. Measuring current ($I_M$): ..... 10 mA.

b. Drain heating current ($I_H$): ..... 16.67 A.

c. Heating time ($t_H$): ..... Steady-state (see method 3161 of MIL-STD-750).

d. Drain-source heating voltage ($V_H$): .... 10 V.

e. Measurement time delay ($t_{MD}$): ..... 30 µs to 60 µs.

f. Sample window time ($t_{SW}$): ..... 10 µs maximum.

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 materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control 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.

* TABLE I. Group A inspection.

| Inspection 1/ | MIL-STD-750 | | Symbol | Limits | | Unit |
|---|---|---|---|---|---|---|
| | Method | Conditions | | Min | Max | |
| Subgroup 1 | | | | | | |
| Visual and mechanical inspection | 2071 | | | | | |
| Subgroup 2 | | | | | | |
| Thermal impedance 2/ | 3161 | See 4.3.3 | $Z_{\theta JC}$ | | 0.38 | °C/W |
| Breakdown voltage, drain to source | 3407 | $V_{GS}$ = 0 V dc, $I_D$ = 1 mA dc, bias condition C | $V_{(BR)DSS}$ | 30 | | V dc |
| Gate to source voltage (threshold) | 3403 | $V_{DS} \geq V_{GS}$, $I_D$ = 1 mA dc | $V_{GS(TH)1}$ | 2.0 | 4.0 | V dc |
| Gate current | 3411 | $V_{GS}$ = +20 V dc and -20 V dc, bias condition C, $V_{DS}$ = 0 | $I_{GSS(TH)1}$ | | ± 100 | nA dc |
| Drain current | 3413 | $V_{GS}$ = 0 V dc, bias condition C, $V_{DS}$ = 24 V dc | $I_{DSS1}$ | | 10 | µA dc |
| Static drain to source on-state resistance | 3421 | $V_{GS}$ = 12 V dc, condition A, pulsed (see 4.5.1), $I_D = I_{D2}$ | $r_{DS(on)1}$ | | .0035 | Ω |
| Forward voltage | 4011 | Pulsed (see 4.5.1), $I_D = I_{D1}$, $V_{GS}$ = 0 V dc | $V_{SD}$ | | 1.3 | V |
| Subgroup 3 | | | | | | |
| High-temperature operation: | | $T_C = T_J$ = +125°C | | | | |
| Gate current | 3411 | $V_{GS}$ = +20 V dc and -20 V dc, bias condition C, $V_{DS}$ = 0 | $I_{GSS2}$ | | ± 200 | nA dc |
| Drain current | 3413 | $V_{GS}$ = 0 V dc, bias condition C, $V_{DS}$ = 24 V dc | $I_{DSS2}$ | | 25 | µA dc |
| Static drain to source on-state resistance | 3421 | $V_{GS}$ = 12 V dc, pulsed (see 4.5.1), $I_D = I_{D2}$ | $r_{DS(on)3}$ | | .0055 | Ω |
| Gate to source voltage (thresholds) | 3403 | $V_{DS} \geq V_{GS}$, $I_D$ = 1 mA dc | $V_{GS(TH)2}$ | | | |
| Low-temperature operation: | | $T_C = T_J$ = -55°C | | | | |
| Gate to source voltage (threshold) | 3403 | $V_{DS} \geq V_{GS}$, $I_D$ = 1 mA dc | $V_{GS(TH)3}$ | | 5.0 | V dc |

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

| Inspection 1/ | MIL-STD-750 | | Symbol | Limits | | Unit |
|---|---|---|---|---|---|---|
| | Method | Conditions | | Min | Max | |
| Subgroup 4 | | | | | | |
| Forward transconductance | 3475 | $I_D$ = rated $I_{D2}$, $V_{DD}$ = 15 V (see 4.5.1) | $g_{FS}$ | 45 | | |
| Switching time test | 3472 | $I_D = I_{D2}$, $V_{GS}$= 12 V dc, $R_G = 2.35\Omega$, $V_{DD}$ = 15 V dc | | | | |
| Turn-on delay time | | | $t_{d(on)}$ | | 35 | ns |
| Rise time | | | $t_r$ | | 125 | ns |
| Turn-off delay time | | | $t_{d(off)}$ | | 80 | ns |
| Fall time | | | $t_f$ | | 50 | ns |
| Subgroup 5 | | | | | | |
| Safe operating area test (high voltage) | 3474 | See figure 4; $t_p$ = 10 ms $V_{DS}$ = 24 V | | | | |
| Electrical measurements | | See table I, subgroup 2 herein. | | | | |
| Subgroup 6 | | | | | | |
| Not applicable | | | | | | |
| Subgroup 7 | | | | | | |
| Gate charge | 3471 | Condition B, $I_D = I_{D2}$ | | | | |
| On-state gate charge | | | $Q_{G(on)}$ | | 200 | nC |
| Gate to source charge | | | $Q_{GS}$ | | 55 | nC |
| Gate to drain charge | | | $Q_{GD}$ | | 40 | nC |
| Reverse recovery time | 3473 | $d_i/d_t \leq 100$ A/µs, $V_{DD} \leq 25$ V, $I_D = I_{D2}$ | $t_{rr}$ | | 165 | ns |

1/ For sampling plan, see MIL-PRF-19500.
2/ This test is required for the following end-point measurements only (not intended for screen 9, 11, or 13):
Group B, subgroups 3 and 4 (JANS) or group B, subgroups 2 and 3 (JANTXV).
Group C, subgroup 6, and Group E, subgroups 1 and 2.

TABLE II. Group D inspection.

| Inspection 1/ 2/ 3/ | MIL-STD-750 | | Symbol | Preirradiation limits | | Postirradiation limits | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | Method | Conditions | | R, F, G AND H | | R, F AND G | | H | | |
| | | | | Min | Max | Min | Max | Min | Max | |
| Subgroup 1 | | | | | | | | | | |
| Not applicable | | | | | | | | | | |
| Subgroup 2 | | $T_C$ = +25°C | | | | | | | | |
| Steady-state total dose irradiation ($V_{GS}$ bias) 4/ | 1019 | $V_{GS}$ = 12V<br>$V_{DS}$ = 0 | | | | | | | | |
| Steady-state total dose irradiation ($V_{DS}$ bias) 4/ | 1019 | $V_{GS}$ = 0<br>$V_{DS}$ = 80 percent of rated $V_{DS}$ (pre-irradiation) | | | | | | | | |
| End-point electricals | | | | | | | | | | |
| Breakdown voltage, drain to source | 3407 | $V_{GS}$ = 0<br>$I_D$ = 1 mA<br>Bias condition C | $V_{(BR)DSS}$ | 30 | | 30 | | 30 | | V dc |
| Gate to source voltage (threshold) | 3403 | $V_{DS} \geq V_{GS}$ | $V_{GSth1}$ | 2.0 | 4.0 | 2.0 | 4.0 | 1.5 | 4.0 | V dc |
| Gate current | 3411 | $V_{GS}$ = 20 V<br>$V_{DS}$ = 0<br>Bias condition C | $I_{GSSF1}$ | | 100 | | 100 | | 100 | nA dc |
| Gate current | 3411 | $V_{GS}$ = -20 V<br>$V_{DS}$ = 0<br>Bias condition C | $I_{GSSR1}$ | | -100 | | -100 | | -100 | nA dc |
| Drain current | 3413 | $V_{GS}$ = 0<br>Bias condition C<br>$V_{DS}$ = 80 percent of rated $V_{DS}$ (pre-irradiation) | $I_{DSS1}$ | | 10 | | 10 | | 10 | µA dc |

See footnotes at end of table.

TABLE II. Group D inspection - Continued.

| Inspection 1/ 2/ 3/ | MIL-STD-750 | | Symbol | Preirradiation limits | | Postirradiation limits | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | Method | Conditions | | R, F, G AND H | | R, F AND G | | H | | |
| | | | | Min | Max | Min | Max | Min | Max | |
| Static drain to source on-state voltage 5/ | 3405 | $V_{GS}$ = 12 V Condition A pulsed (see 4.5.1) $I_D = I_{D2}$ | $V_{Dson1}$ | | .180 | | .180 | | .2025 | V dc |
| Static drain to source on-state voltage | 3405 | $V_{GS}$ = 12 V Condition A pulsed (see 4.5.1) $I_D = I_{D2}$ | $V_{Dson1}$ | | .1575 | | .1575 | | .180 | V dc |
| Forward voltage source to drain diode | 4011 | $V_{GS}$ = 0 $I_D = I_{D2}$ | $V_{SD}$ | | 1.3 | | 1.3 | | 1.3 | V dc |

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/ Separate samples shall be pulled for each bias.
5/ Limit using TO-204AE package. The higher package resistance necessitates the higher $V_{DSon1}$ limit when the manufacturer uses the alternate package as allowed in 4/ above.

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

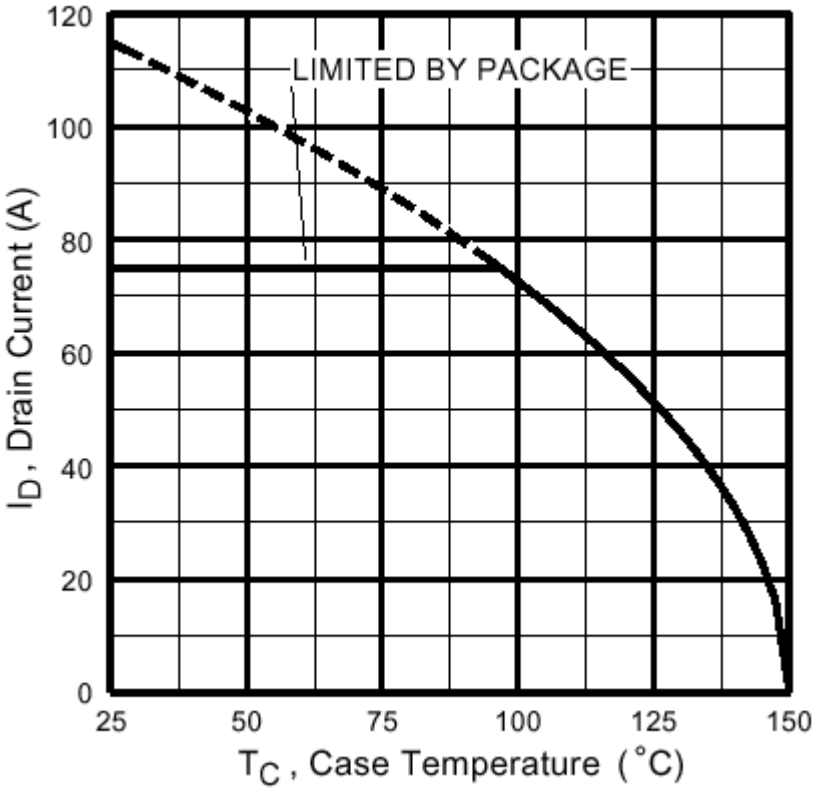
| Inspection | MIL-STD-750 | | Qualification and large lot quality conformance inspection |
|---|---|---|---|
| | Method | Conditions | |
| Subgroup 1 | | | 12 devices<br>c = 0 |
| Temperature cycling | 1051 | Test condition G, 500 cycles. | |
| Hermetic seal | 1071 | | |
| Fine leak<br>Gross leak | | | |
| Electrical measurements | | See table I, group A, subgroup 2. | |
| Subgroup 2 1/ | | | 12 devices<br>c = 0 |
| Steady-state reverse bias | 1042 | Condition B, 1,000 hours. | |
| Electrical measurements | | See table I, subgroup 2. | |
| Steady-state gate bias | 1042 | Condition A, 1,000 hours. | |
| Electrical measurements | | See table I, subgroup 2. | |
| Subgroup 3 | | | 3 devices<br>c = 0 |
| DPA | 2102 | | |
| Subgroup 4 | | | sample size<br>N/A |
| Thermal impedance curves | | Each supplier shall submit their (typical) design thermal impedance curves. In addition, test conditions and $Z_{\theta JX}$ limit shall be provided to the qualifying activity in the qualification report | |
| Subgroup 5 | | | |
| Not applicable | | | |
| Subgroup 6 | | | 3 devices |
| ESD | 1020 | | |

See footnotes at end of table.

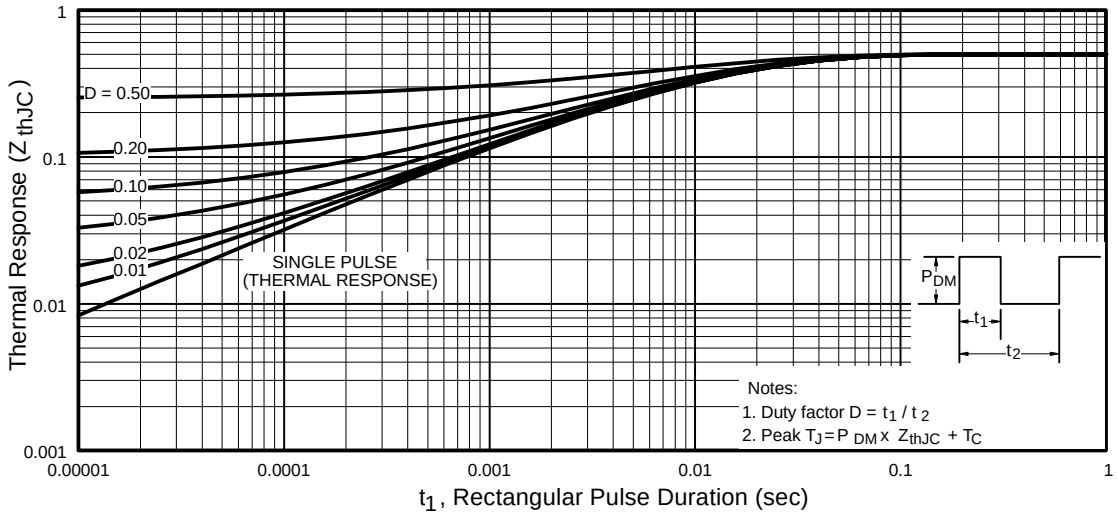
* TABLE III. Group E inspection (all quality levels) for qualification or re-qualification only - Continued.

| Inspection | MIL-STD-750 | | Qualification and large lot quality conformance inspection |
|---|---|---|---|
| | Method | Conditions | |
| Subgroup 7<br><br>Commutating diode for safe operating area test procedure for measuring dv/dt during reverse recovery of power MOSFET transistors or insulated gate bipolar transistors | | | 22 devices<br>c = 0 |
| Subgroup 8 | | | 3 devices |
| SEE 2/ 3/ 4/ | 1080 | See figure 5. | |
| Electrical measurements 5/ | | $I_{GSS1}$ and $I_{DSS1}$ in accordance with table I, subgroup 2 | |
| SEE irradiation | | Fluence = 3E5 ± 20 percent ions/cm$^2$<br>Flux = 2E3 to 2E4 ions/cm$^2$/sec<br>Temperature = 25 ± 5 °C<br>(ION – COPPER)<br>LET = 28 MeV-cm$^2$/mg<br>Range = 40 microns<br>Energy = 261 MeV<br>Insitu bias conditions: $V_{DS}$ = 30V & $V_{GS}$ = -10V<br>$V_{DS}$ = 25V & $V_{GS}$ = -15V<br>$V_{DS}$ = 15V & $V_{GS}$ = -20V<br><br>(ION – BROMINE)<br>LET = 37 MeV-cm$^2$/mg<br>Range = 37 microns<br>Energy = 285 MeV<br>Insitu bias conditions: $V_{DS}$ = 30V & $V_{GS}$ = -10V<br>$V_{DS}$ = 22.5V & $V_{GS}$ = -15V<br>$V_{DS}$ = 15V & $V_{GS}$ = -20V<br>(ION – IODINE)<br>LET = 60 MeV-cm$^2$/mg<br>Range = 33 microns<br>Energy = 344 MeV<br>Insitu bias conditions: $V_{DS}$ = 25V & $V_{GS}$ = -5V<br>$V_{DS}$ = 20V & $V_{GS}$ = -10V<br>$V_{DS}$ = 15V & $V_{GS}$ = -15V<br>$V_{DS}$ = 7.5V & $V_{GS}$ = -20V | |
| Electrical measurements 5/ | | $I_{GSS1}$ and $I_{DSS1}$ in accordance with table I, subgroup 2 | |

1/ A separate sample for each test shall be pulled.
2/ Group E qualification of SEE testing may be performed prior to lot formation. Qualification may be extended to other performance specifications utilizing the same structurally identical die design.
3/ Device qualification to a higher level LET is sufficient to qualify all lower level LET's.
4/ The sampling plan applies to each bias condition.
5/ Examine $I_{GSS1}$ and $I_{DSS1}$ before and following SEE irradiation to determine acceptability for each bias condition. Other test conditions in accordance with table I, subgroup 2 herein, may be performed at the manufacturer's option."

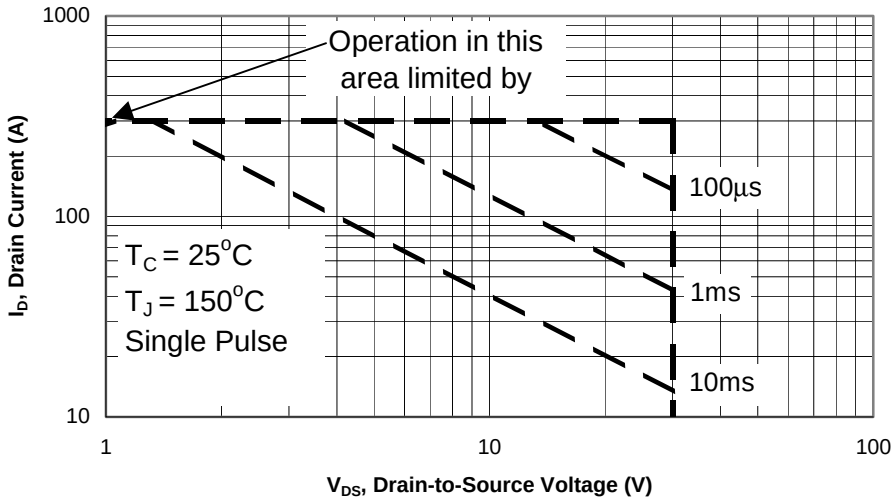



* FIGURE 2. Maximum drain current vs case temperature graph.

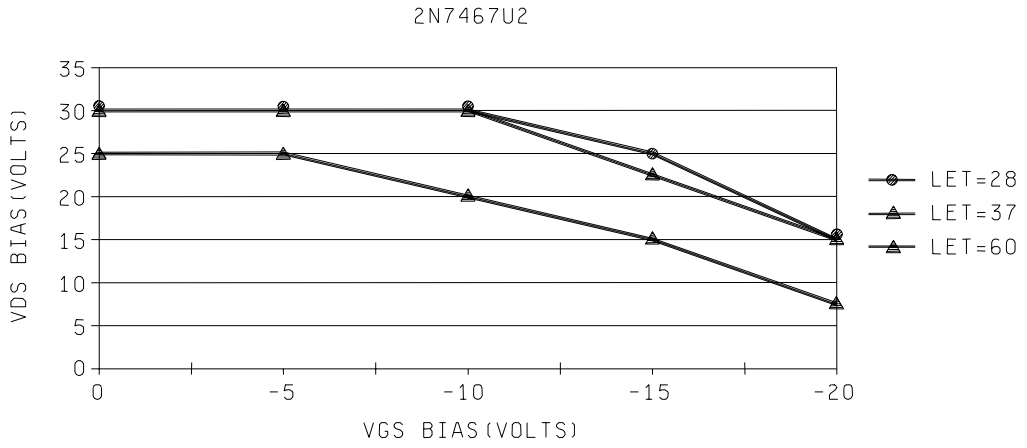



* FIGURE 3. Thermal impedance curves.

**2N7467U**




* FIGURE 4. Safe operating area graph.




* FIGURE 5. SEE safe operation area graph.

6. NOTES

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

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

* 6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.

b. Issue of DoDISS to be cited in the solicitation and if required, the specific issue of individual documents referenced (see 2.2.1).

c. Packaging requirements (see 5.1).

d. Lead material and finish (see 3.4.1).

e. Type designation and quality assurance level.

* 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) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: DSCC/VQE, P.O. Box 3990, Columbus, OH 43216-5000.

6.4 Substitution information. Devices covered by this specification are substitutable for the manufacturer's and user's Part or Identifying Number (PIN). This information in no way implies that manufacturer's PIN's are suitable for the military PIN.

| Preferred types | Commercial types |
|---|---|
| 2N7467U2 | IRHNA57Z60 |

* 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 - 11
NASA - NA
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2835)

# 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, and send to preparing activity.

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<br>MIL-PRF-19500/683A | 2. DOCUMENT DATE<br>27 October 2003 |
|---|---|---|

3. DOCUMENT TITLE SEMICONDUCTOR DEVICE, TRANSISTOR, FIELD EFFECT, N-CHANNEL, RADIATION HARDENED (TOTAL DOSE AND SINGLE EVENT EFFECTS) TYPE 2N7467U2, JANTXVR F, G, AND H AND JANSR, F, G, AND H

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 (PLEASE PRINT) | b. ORGANIZATION | |
|---|---|---|
| c. ADDRESS *(Include Zip Code)* | d. TELEPHONE (Include Area Code)<br>COMMERCIAL<br>DSN<br>FAX<br>EMAIL | 7. DATE SUBMITTED |

8. PREPARING ACTIVITY

| a. NAME<br>Alan Barone | b. TELEPHONE<br>Commercial DSN FAX EMAIL<br>614-692-0510 850-0510 614-692-6939 alan.barone@dla.mil |
|---|---|
| c. ADDRESS *(Include Zip Code)*<br>Defense Supply Center Columbus<br>ATTN: DSCC-VAC<br>P.O. Box 3990<br>Columbus, OH 43216-5000 | IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:<br>Defense Standardization Program Office (DLSC-LM)<br>8725 John J. Kingman Road, Suite 2533<br>Fort Belvoir, Virginia 22060-6221<br>Telephone (703)767-6888 DSN 427-6888 |