The documentation and process conversion measures necessary to comply with this revision shall be completed by 18 July 2005.

INCH-POUND

MIL-PRF-19500/543H
18 April 2005
SUPERSEDING
MIL-PRF-19500/543G
19 May 2003

* PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, FIELD EFFECT TRANSISTORS, N-CHANNEL, SILICON
REPETITIVE AVALANCHE, TYPES 2N6764, 2N6764T1, 2N6766, 2N6766T1, 2N6768, 2N6768T1, 2N6770, AND 2N6770T1
JAN, JANTX, JANTXV, JANS, JANHC, AND JANKC

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

* The requirements for acquiring the product described herein shall consist of this specification sheet and MIL-PRF-19500.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for N-channel, enhancement-mode, MOSFET, power transistors. Four levels of product assurance are provided for each encapsulated device type as specified in MIL-PRF-19500 and two levels of product assurance for each unencapsulated die, with avalanche energy ratings ($E_{AS}$ and $E_{AR}$) and maximum avalanche current ($I_{AR}$).

1.2 Physical dimensions. See figure 1 (TO-204AE for types 2N6764 and 2N6766; TO-204AA for types 2N6768 and 2N6770 (formerly TO-3)), see figure 2 (TO-254AA for types 2N6764T1, 2N6766T1; 2N6768T1, and 2N6770T1), and figure 3 for JANHC and JANKC (die) dimensions.

* 1.3 Maximum ratings. ($T_A$ = +25°C, unless otherwise specified).

| Type | $P_T$ (1) $T_C$ = +25°C | $P_T$ $T_A$ = +25°C | $R_{\theta JC}$ | $V_{DS}$ | $V_{DG}$ | $V_{GS}$ | $I_{D1}$ (2) (3) $T_C$ = +25°C | $I_S$ | $I_{D2}$ (2) (3) $T_C$ = +100°C |
|---|---|---|---|---|---|---|---|---|---|
| | W | W | °C/W | V dc | V dc | V dc | A dc | A dc | A dc |
| 2N6764, 2N6764T1 | 150 | 4 | 0.83 | 100 | 100 | ± 20 | 38.0 | 38.0 | 24.0 |
| 2N6766, 2N6766T1 | 150 | 4 | 0.83 | 200 | 200 | ± 20 | 30.0 | 30.0 | 19.0 |
| 2N6768, 2N6768T1 | 150 | 4 | 0.83 | 400 | 400 | ± 20 | 14.0 | 14.0 | 9.0 |
| 2N6770, 2N6770T1 | 150 | 4 | 0.83 | 500 | 500 | ± 20 | 12.0 | 12.0 | 7.75 |

| Type | $I_{DM}$ (4) | $E_{AS}$ | $E_{AR}$ | $I_{AR}$ (5) | $V_{ISO}$ 70,000 ft. attitude | $T_{STG}$ and $T_J$ | Max $r_{DS(on)}$; (5) $V_{GS}$ = 10 V dc, $I_D$ = $I_{D2}$ | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | $T_J$ = +25°C | $T_J$ = +150°C |
| | A pk | A | mJ | mJ | | °C | Ω | Ω |
| 2N6764, 2N6764T1 | 152 | 150 | 15 | 38.0 | | -55 | 0.055 | 0.105 |
| 2N6766, 2N6766T1 | 120 | 500 | 15 | 30.0 | | to | 0.085 | 0.170 |
| 2N6768, 2N6768T1 | 56 | 700 | 15 | 14.0 | 400 | +150 | 0.300 | 0.750 |
| 2N6770, 2N6770T1 | 48 | 750 | 15 | 12.0 | 500 | | 0.400 | 1.000 |

See notes on next page.

* Comments, suggestions, or questions on this document should be addressed to Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to Semiconductor@dscc.dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://assist.daps.dla.mil .

* 1.3 Maximum ratings - Continued.

(1) Derate linearly 1.2 W/°C for $T_C$ > +25°C.
(2) The following formula derives the maximum theoretical $I_D$ limit. $I_D$ is also limited by package and internal wires:

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

(3) See figure 4, maximum drain current graphs.
(4) $I_{DM}$ = 4 x $I_{D1}$ as calculated in note 2.
(5) Pulsed (see 4.5.1).

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

| Type | Min $V_{(BR)DSS}$ $V_{GS}$ = 0 $I_D$ = 1.0mA dc | $V_{GS(TH)1}$ $V_{DS} \geq V_{GS}$ $I_D$ = 0.25 mA dc | | Max $I_{DSS1}$ $V_{GS}$ = 0 $V_{DS}$ = 80 percent of rated $V_{DS}$ |
|---|---|---|---|---|
| | | V dc | | |
| | V dc | Min | Max | µA dc |
| 2N6764, 2N6764T1 | 100 | 2.0 | 4.0 | 25 |
| 2N6766, 2N6766T1 | 200 | 2.0 | 4.0 | 25 |
| 2N6768, 2N6768T1 | 400 | 2.0 | 4.0 | 25 |
| 2N6770, 2N6770T1 | 500 | 2.0 | 4.0 | 25 |

(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 http://assist.daps.dla.mil/quicksearch/ or http://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. 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.

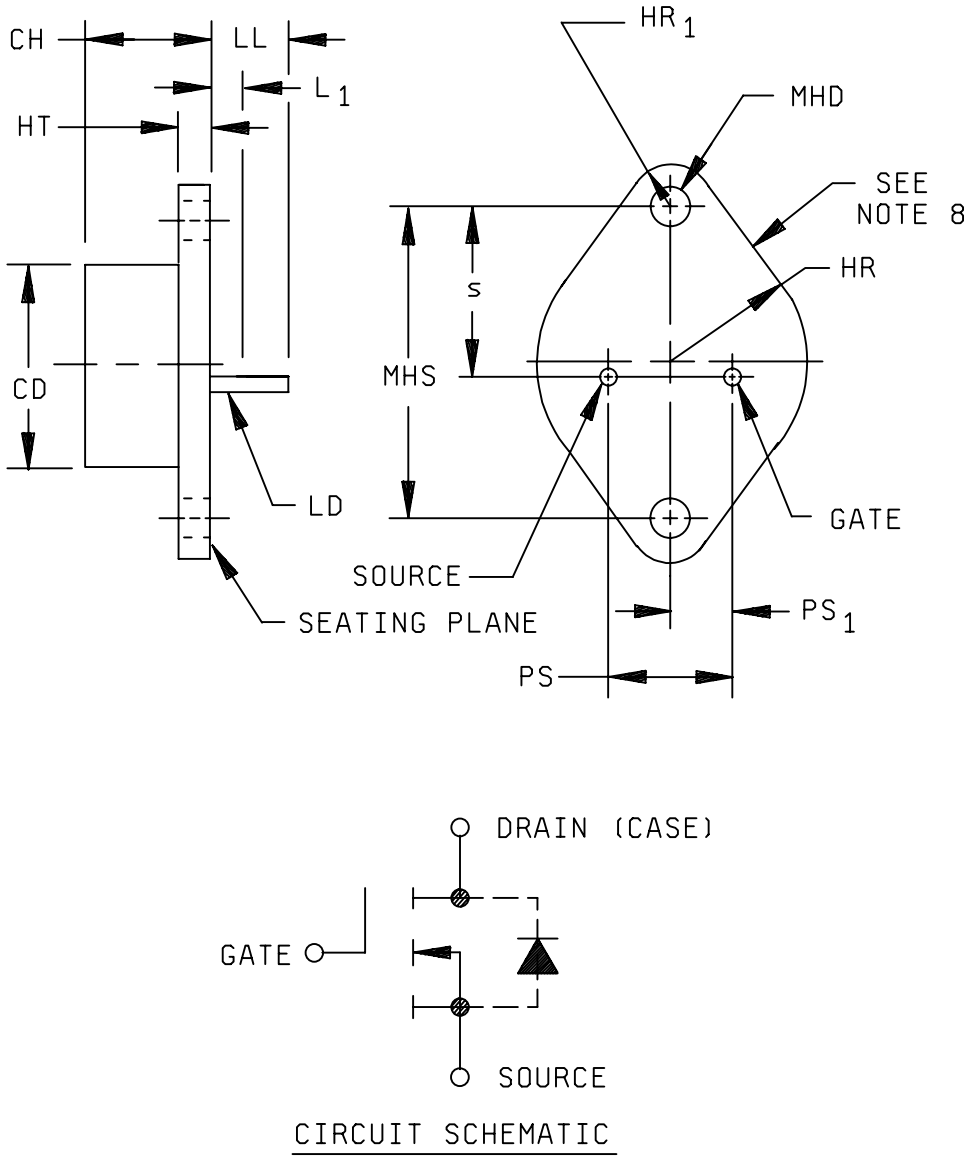


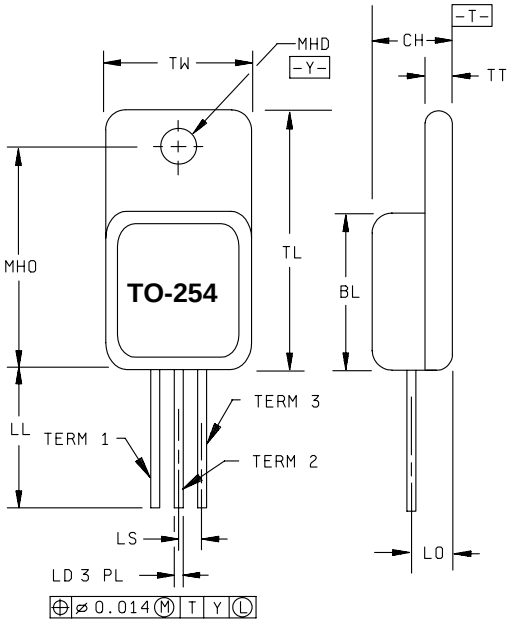

FIGURE 1. Physical dimensions of transistor types 2N6764 and 2N6766, TO-204AE; for types 2N6768 and 2N6770, TO-204AA.

| Dimensions | | | | | |
|---|---|---|---|---|---|
| Ltr | Inches | | Millimeter | | Notes |
| | Min | Max | Min | Max | |
| CD | | .875 | | 22.23 | |
| CH | .250 | .360 | 6.35 | 9.15 | |
| HR | .495 | .525 | 12.57 | 13.3 | |
| $HR_1$ | .131 | .188 | 3.33 | 4.78 | |
| HT | .060 | .135 | 1.52 | 3.43 | |
| LD | .057 | .063 | 1.45 | 1.60 | 5 |
| | .038 | .043 | 0.97 | 1.10 | 6 |
| LL | .312 | .500 | 7.92 | 12.70 | |
| $L_1$ | | .050 | | 1.27 | 3 |
| MHD | .151 | .161 | 3.84 | 4.09 | 7 |
| MHS | 1.177 | 1.197 | 29.90 | 30.40 | |
| PS | .420 | .440 | 10.67 | 11.18 | |
| $PS_1$ | .205 | .225 | 5.21 | 5.72 | |
| s | .655 | .675 | 16.64 | 17.15 | |

NOTES:

1. Dimensions are in inches.
* 2. Millimeters are given for general information only.
3. These dimensions shall be measured at points .050 inch (1.27 mm) and .055 inch (1.40 mm) below the seating plane. When gauge is not used, measurement will be made at the seating plane.
4. The seating plane of the header shall be flat within .001 inch (0.03 mm) concave to .004 inch (0.10 mm) convex inside a .930 inch (23.62 mm) diameter circle on the center of the header and flat within .001 inch (0.03 mm) concave to .006 inch (0.15 mm) convex overall.
5. These dimensions pertain to the 2N6764 and 2N6766 types.
6. These dimensions pertain to the 2N6768 and 2N6770 types.
7. Mounting holes shall be deburred on the seating plane side.
8. Drain is electrically connected to the case.
9. In accordance with ASME Y14.5M, diameters are equivalent to $\phi$x symbology.

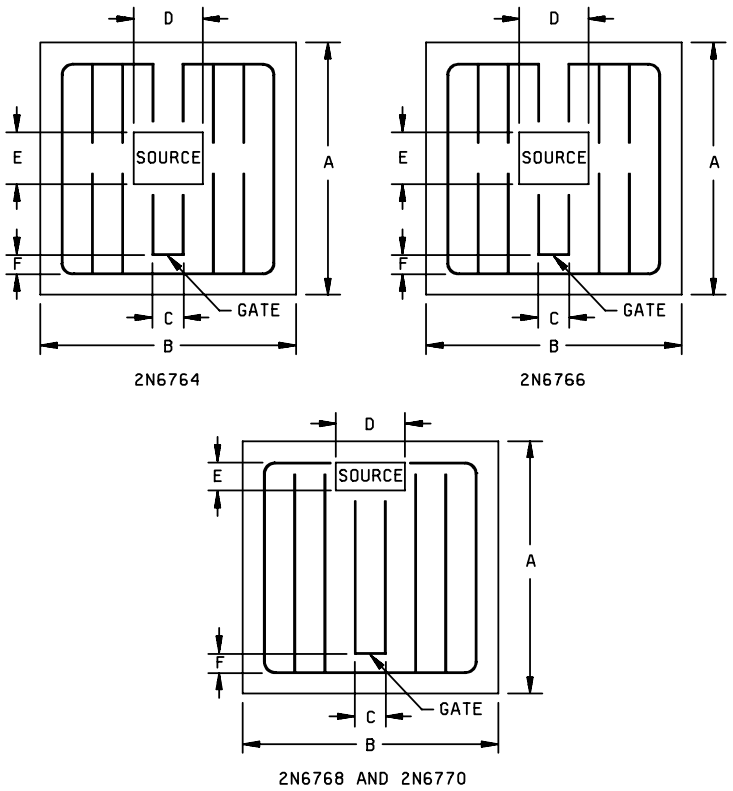
FIGURE 1. Physical dimensions of transistor types 2N6764 and 2N6766 TO-204AE; for types 2N6768 and 2N6770, TO-204AA - Continued.




| Ltr | Dimensions | | | | Notes |
|---|---|---|---|---|---|
| | Inches | | Millimeters | | |
| | Min | Max | Min | Max | |
| BL | .535 | .545 | 13.59 | 13.84 | |
| CH | .249 | .260 | 6.32 | 6.60 | |
| LD | .035 | .045 | 0.89 | 1.14 | |
| LL | .665 | .685 | 16.89 | 17.40 | 3, 4 |
| LO | .150 BSC | | 3.81 BSC | | |
| LS | .150 BSC | | 3.81 BSC | | |
| MHD | .139 | .149 | 3.53 | 3.78 | |
| MHO | .665 | .685 | 16.89 | 17.40 | |
| TL | .790 | .800 | 20.07 | 20.32 | |
| TT | .040 | .050 | 1.02 | 1.27 | |
| TW | .535 | .545 | 13.59 | 13.84 | |
| Term 1 | Drain | | | | |
| Term 2 | Source | | | | |
| Term 3 | Gate | | | | |

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Protrusion thickness of ceramic eyelets included in dimension LL.
4. All terminals are isolated from case.
5. In accordance with ASME Y14.5M, diameters are equivalent to $\phi$x symbology.

* FIGURE 2. Physical dimensions for 2N6764T1, 2N6766T1, 2N6770T1, and 2N6770T1 (TO-254AA).




| Ltr | Dimensions 2N6764 and 2N6766 | | | | Dimensions 2N6768 and 2N6770 | | | |
|---|---|---|---|---|---|---|---|---|
| | Inches | | Millimeters | | Inches | | Millimeters | |
| | Min | Max | Min | Max | Min | Max | Min | Max |
| A | .252 | .262 | 6.40 | 6.65 | .252 | .262 | 6.40 | 6.65 |
| B | .252 | .262 | 6.40 | 6.65 | .252 | .262 | 6.40 | 6.65 |
| C | .027 | .037 | 0.69 | 0.94 | .025 | .035 | 0.64 | 0.89 |
| D | .012 | .022 | 0.30 | 0.56 | .043 | .053 | 1.09 | 1.35 |
| E | .057 | .067 | 1.45 | 1.70 | .032 | .042 | 0.81 | 1.07 |
| F | .013 | .023 | 0.33 | 0.58 | .015 | .025 | 0.38 | 0.64 |

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Unless otherwise specified, tolerance is ± .005 inch (0.13 mm).
4. The physical characteristics of the die thickness are .0187 inch (0.474 mm). The back metals are chromium, nickel and silver. The top metal is aluminum and the back contact is the drain.

* FIGURE 3. JANHC and JANKC A-version die dimensions.

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. Interface and physical dimensions shall be as specified in MIL-PRF-19500, and on figures 1, 2, and 3.

3.4.1 Lead finish. 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 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 protection.

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

a. Devices shall be handled on benches with conductive and grounded surface.

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 shall 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.

* 3.8 Electrical test requirements. The electrical test requirements shall be as 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 table I).

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

4.2.1 JANHC and JANKC devices. Qualification for JANHC and JANKC devices shall be as specified in MIL-PRF-19500.

* 4.2.2 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 II tests, the tests specified in table II herein that were not performed in the prior revision shall be performed on the first inspection lot of this revision to maintain qualification.

* 4.3 Screening (JANS, JANTXV and JANTX 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 shall not be acceptable.

| Screen (see MIL-PRF-19500, table IV) (1) (2) | Measurements | |
|---|---|---|
| | JANS level | JANTX and JANTXV |
| (3) | Gate stress test (see 4.3.2) | Gate stress test (see 4.3.2). |
| (3) (4) | Method 3470 of MIL-STD-750, (see 4.3.3) | Method 3470 of MIL-STD-750, (see 4.3.3) |
| (3) 3c | Method 3161 of MIL-STD-750, (see 4.3.4) | Method 3161 of MIL-STD-750, (see 4.3.4) |
| 7 | Optional. | Optional. |
| 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 | $I_{GSSF1}$, $I_{GSSR1}$, $I_{DSS1}$, $r_{DS(on)1}$. $V_{GS(th)1}$ of subgroup 2 of table I herein. $\Delta I_{GSSF1}$ = +20 nA dc or ±100 percent of initial value, whichever is greater. $\Delta I_{GSSR1}$ = -20 nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{DSS1}$ = ± 25 μA dc or ± 100 percent of initial value, whichever is greater | $I_{GSSF1}$, $I_{GSSR1}$, $I_{DSS1}$, $r_{DS(on)1}$. $V_{GS(th)1}$ of 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, t = 160 hours |
| 13 | Subgroups 2 and 3 of table I. $\Delta I_{GSSF1}$ = +20 nA dc or ±100 percent of initial value, whichever is greater. $\Delta I_{GSSR1}$ = -20 nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{DSS1}$ = ± 25 μA dc or ± 100 percent of initial value whichever is greater. $\Delta r_{DS(on)1}$ = ± 20 percent of initial value $\Delta V_{GS(th)1}$ = ± 20 percent of initial value. | Subgroup 2 of table I herein. $\Delta I_{GSSF1}$ = +20 nA dc or ±100 percent of initial value, whichever is greater. $\Delta I_{GSSR1}$ = -20 nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{DSS1}$ = ± 25 μA dc or ± 100 percent of initial value whichever is greater. $\Delta r_{DS(on)1}$ = ± 20 percent of initial value. $\Delta V_{GS(th)1}$ = ± 20 percent of initial value. |
| 14 | Required. | Required. |

(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) Thermal impedance shall be performed anytime after temperature cycling, screen 3a and does not need to be repeated in screening requirements.
(4) This test method in no way implies a repetitive avalanche energy rating.

4.3.1 Screening (JANHC and JANKC). Screening shall be in accordance with appendix E, table IV of MIL-PRF 19500. As a minimum, die shall be 100 percent probed in accordance with table I, subgroup 2 except test current shall not exceed 20 A.

4.3.2 Gate stress test. Apply $V_{GS}$ = 30 V minimum for t = 250 µs minimum.

4.3.3 Single pulsed unclamped inductive switching.

a. Peak current .....$I_{D1}$.

b. Peak gate voltage, $V_{GS}$ .....10 V.

c. Gate to source resistor, $R_{GS}$ .....$25 \leq R_g \leq 200$ ohms.

d. Initial case temperature .....+25°C, +10°C, -5°C.

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

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

g. Supply voltage ($V_{DD}$) .....50 V, (25 V for devices with minimum $V_{(BR)DSS}$ of 100 V).

4.3.4 Thermal response ($\Delta V_{SD}$ measurements). The delta $V_{SD}$ measurements shall be performed with method 3161 of MIL-STD-750. The delta $V_{SD}$ conditions ($I_H$ and $V_H$) and maximum limit shall be derived by each vendor from the thermal response curves (see figure 5). The read and record delta $V_{SD}$ measurements and conditions for each device in the qualification lot shall be submitted in the qualification report. The chosen delta $V_{SD}$ shall be considered final after the manufacturer has had the opportunity to test five consecutive lots. The following parameter measurements shall apply:

a. $I_M$ measuring current ..... 10 mA.

b. $I_H$ drain heating current ..... 4 A minimum.

c. $t_H$ heating time ..... 100 ms.

d. $V_H$ drain-source heating voltage ..... 25 V minimum.

e. $t_{MD}$ measurement time delay ..... 30 to 60 µs.

f. $t_{SW}$ sample window time..... 10 µs (max).

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 figure 4 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 (JAN, JANTX, and JANTXV) of MIL-PRF-19500 and as follows. End-point electrical measurements 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 | Conditions |
|---|---|---|
| B3 | 1051 | Test condition G. |
| B4 | 1042 | Test condition D; the heating cycle shall be 1 minute minimum for 2,000 cycles. |
| B5 | 1042 | Test condition A; $V_{DS}$ = rated $V_{DS}$ (see 1.3), $T_A$ = +175° C, t = 120 hours minimum, read and record $V_{BR(DSS)}$ (pre and post) at $I_D$ = 1 mA, read and record $I_{DSS}$ (pre and post), (see table I). |
| B5 | 1042 | Test condition B; $V_{GS}$ = rated $V_{GS}$ (see 1.3), $T_A$ = +175° C, t = 24 hours minimum. |
| B6 | 3161 | See 4.5.2. |

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

| Subgroup | Method | Conditions |
|---|---|---|
| B2 | 1051 | Test condition G. |
| B3 | 1042 | Test condition D, 2,000 cycles. The heating cycle shall be 1 minute minimum. |
| B5, B6 | | 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. End-point electrical measurements shall be in accordance with table I, subgroup 2 herein.

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

| Subgroup | Method | Conditions |
|---|---|---|
| C2 | 2036 | Test condition A; weight = 10 lbs, t = 15 seconds. |
| C5 | 3161 | See 4.5.2. |
| C6 | 1042 | Test condition D; 6,000 cycles minimum. The heating cycle shall be 1 minute minimum. |

4.4.4 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 II 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. $R_{\theta JC}$ max = 0.83° C /W.

a. $I_M$ measuring current ..... 10 mA.

b. $I_H$ drain heating current ..... 4 A minimum.

c. $t_H$ heating time ..... Steady-state (see method 3161 of MIL-STD-750 for definition).

d. $V_H$ drain-source heating voltage ..... 25 V minimum.

e. $t_{MD}$ measurement time delay ..... 30 to 60 μs.

f. $t_{SW}$ sample window time..... 10 μs (max).

* TABLE I. Group A inspection.

| | Inspection 1/ 2/ | MIL-STD-750 | | Symbol | Limits | | Unit |
|---|---|---|---|---|---|---|---|
| | | Method | Conditions | | Min | Max | |
| | Subgroup 1 | | | | | | |
| | Visual and mechanical inspection | 2071 | | | | | |
| | Subgroup 2 | | | | | | |
| * | Thermal impedance 3/ | 3161 | See 4.3.4 | $\Delta V_{SD}$ | | | |
| | Breakdown voltage drain to source | 3407 | $V_{GS}$ = 0; $I_D$ = 1 mA dc, bias condition C | $V_{(BR)DSS}$ | | | V dc |
| | 2N6764 | | | | 100 | | |
| | 2N6766 | | | | 200 | | |
| | 2N6768 | | | | 400 | | |
| | 2N6770 | | | | 500 | | |
| | Gate to source voltage (threshold) | 3404 | $V_{DS} \geq V_{GS}$; $I_D$ = 0.25 mA dc | $V_{GS(th)1}$ | 2.0 | 4.0 | V dc |
| * | Gate current | 3411 | $V_{GS}$ = +20 V dc, bias condition C, $V_{DS}$ = 0 | $I_{GSSF1}$ | | +100 | nA dc |
| * | Gate current | 3411 | $V_{GS}$ = -20 V dc, bias condition C, $V_{DS}$ = 0 | $I_{GSSR1}$ | | -100 | nA dc |
| | Drain current | 3413 | $V_{GS}$ = 0; $V_{DS}$ = 80 percent of rated $V_{DS}$, bias condition C | $I_{DSS1}$ | | 25 | µA dc |
| | Static drain to source on-state resistance | 3421 | $V_{GS}$ = 10 V dc, pulsed (see 4.5.1), condition A $I_D$ = rated $I_{D2}$ (see 1.3) $T_C$ = +25° C. | $r_{DS}(on)1$ | | | |
| | 2N6764 | | | | | 0.055 | Ω |
| | 2N6766 | | | | | 0.085 | Ω |
| | 2N6768 | | | | | 0.3 | Ω |
| | 2N6770 | | | | | 0.4 | Ω |
| | Static drain to source on-state resistance | 3421 | $V_{GS}$ = 10 V dc, pulsed (see 4.5.1), condition A $I_D$ = rated $I_{D1}$ (see 1.3) | $r_{DS}(on)2$ | | | |
| | 2N6764 | | | | | 0.065 | Ω |
| | 2N6766 | | | | | 0.09 | Ω |
| | 2N6768 | | | | | 0.4 | Ω |
| | 2N6770 | | | | | 0.5 | Ω |
| | Forward voltage (source-drain diode) | 4011 | Pulsed (see 4.5.1) $V_{GS}$ = 0 V, $I_D$ = $I_{D1}$ | $V_{SD}$ | | | |
| | 2N6764 | | | | | 1.9 | V dc |
| | 2N6766 | | | | | 1.9 | V dc |
| | 2N6768 | | | | | 1.7 | V dc |
| | 2N6770 | | | | | 1.7 | V dc |

See footnote at end of table.

* TABLE I. Group A inspection - Continued.

| Inspection 1/ 2/ | MIL-STD-750 | | Symbol | Limits | | Unit |
|---|---|---|---|---|---|---|
| | Method | Conditions | | Min | Max | |
| Subgroup 3 | | | | | | |
| High temperature operation: | | $T_C$ = +125° C | | | | |
| Gate current | 3411 | Bias condition C; $V_{GS}$ = +20 and -20 V dc, $V_{DS}$ = 0 V dc | $I_{GSS2}$ | | 200 | nA dc |
| Drain current | 3413 | Bias condition C; $V_{GS}$ = 0 V dc | | | | |
| | | $V_{DS}$ = 100 percent of rated $V_{DS}$ | $I_{DSS2}$ | | 1.0 | mA dc |
| | | $V_{DS}$ = 80 percent of rated $V_{DS}$ | $I_{DSS3}$ | | 0.25 | mA dc |
| Static drain to source on-state resistance | 3421 | $V_{GS}$ = 10 V dc pulsed (see 4.5.1), $I_D$ = rated $I_{D2}$ (see 1.3) | $r_{DS}(on)3$ | | | |
| 2N6764 | | | | | 0.094 | Ω |
| 2N6766 | | | | | 0.153 | Ω |
| 2N6768 | | | | | 0.66 | Ω |
| 2N6770 | | | | | 0.88 | Ω |
| Gate to source voltage (threshold) | 3404 | $V_{DS} \geq V_{GS}$; $I_D$ = 0.25 mA dc | $V_{GS}(th)2$ | 1.0 | | V dc |
| Low temperature operation: | | $T_C$ = -55° C | | | | |
| Gate to source voltage (threshold) | 3404 | $V_{DS} \geq V_{GS}$; $I_D$ = 0.25 mA dc | $V_{GS}(th)3$ | | 5.0 | V dc |
| Subgroup 4 | | | | | | |
| Switching time test | 3472 | $I_D$ = rated $I_{D1}$ (see 1.3)<br>$V_{GS}$ = 10 V dc<br>Gate drive impedance = 2.35 Ω<br>$V_{DD}$ = 0.5 $V_{BR(DSS)}$ | | | | |
| Turn-on delay time | | | $t_{d(on)}$ | | 35 | ns |
| Rise time | | | $t_r$ | | 190 | ns |
| Turn-off delay time | | | $t_{d(off)}$ | | 170 | ns |
| Fall time | | | $t_f$ | | 130 | ns |
| Subgroup 5 | | | | | | |
| Safe operating area test | 3474 | See figure 6, $V_{DS}$ = 80 percent of rated $V_{BR(DSS)}$, $t_p$ = 10 ms, $V_{DS}$ = 200 V max. | | | | |
| * Electrical measurements | | Table I, subgroup 2 herein. | | | | |

See footnote at end of table.

* TABLE I. Group A inspection - Continued.

| Inspection 1/ 2/ | MIL-STD-750 | | Symbol | Limits | | Unit |
|---|---|---|---|---|---|---|
| | Method | Conditions | | Min | Max | |
| Subgroup 6 | | | | | | |
| Not applicable | | | | | | |
| Subgroup 7 | | | | | | |
| Gate charge | 3471 | Bias condition B | $Q_g(on)$ | | | |
| On-state gate charge | | | | | | |
| 2N6764 | | | | | 125 | nC |
| 2N6766 | | | | | 115 | nC |
| 2N6768 | | | | | 110 | nC |
| 2N6770 | | | | | 120 | nC |
| Gate to source charge | | | $Q_{gs}$ | | | |
| 2N6764 | | | | | 22 | nC |
| 2N6766 | | | | | 22 | nC |
| 2N6768 | | | | | 18 | nC |
| 2N6770 | | | | | 19 | nC |
| Gate to drain charge | | | $Q_{gd}$ | | | |
| 2N6764 | | | | | 65 | nC |
| 2N6766 | | | | | 60 | nC |
| 2N6768 | | | | | 65 | nC |
| 2N6770 | | | | | 70 | nC |
| Reverse recovery time | 3473 | di/dt = 100 A/µs<br>$V_{DD} \leq 30$ V dc, $I_D = I_{D1}$ | $t_{rr}$ | | | |
| 2N6764 | | | | | 500 | ns |
| 2N6766 | | | | | 950 | ns |
| 2N6768 | | | | | 1,200 | ns |
| 2N6770 | | | | | 1,600 | ns |

1/ For sampling plan, see MIL-PRF-19500.
2/ Unless otherwise specified, electrical characteristics for the T1 suffix devices are identical to the non T1 suffix devices.
3/ This test required for the following end-point measurements only:
Group B, subgroups 2 and 3 (JAN, JANTX, JANTXV).
Group B, subgroups 3 and 4 (JANS).
Group C, subgroups 2 and 6.
Group E, subgroup 1.

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

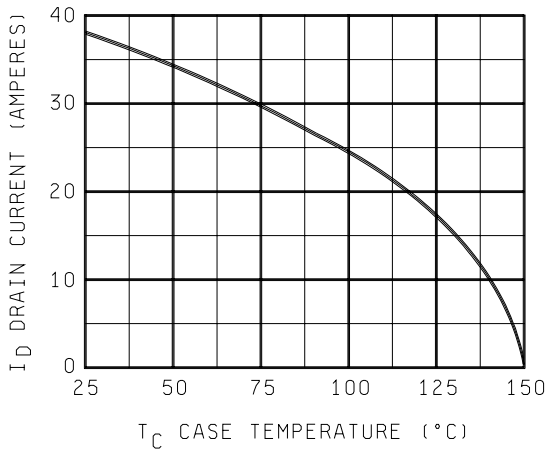
| | Inspection 1/ | MIL-STD-750 | | Qualification and large lot quality conformance inspection |
|---|---|---|---|---|
| | | Method | Conditions | |
| | Subgroup 1 | | | 45 devices, c = 0 |
| | Temperature cycling | 1051 | Test condition G, 500 cycles | |
| | Hermetic seal<br>Fine leak<br>Gross leak | 1071 | | |
| * | Electrical measurements | | See table I, subgroup 2 | |
| | Subgroup 2 1/ | | | 45 devices, c = 0 |
| | Steady-state reverse bias | 1042 | Condition A; 1,000 hours | |
| * | Electrical measurements | | See table I, subgroup 2 | |
| | Steady-state gate bias | 1042 | Condition B, 1,000 hours | |
| * | Electrical measurements | | See table I, subgroup 2 | |
| | Subgroup 4 | | | sample size N/A |
| * | Thermal impedance curves | | Each supplier shall submit their qual-lot average and design maximum thermal impedance curves to the qualifying activity. In addition, the optimal test conditions and thermal impedance limit shall be provided to the qualifying activity in the qualification report. | |
| | Subgroup 5 | | | 15 devices, c = 0 |
| | Barometric pressure (reduced)<br>400 V and 500 V devices only | 1001 | Test condition C;<br>$I_{(ISO)}$ = .25 mA (max),<br>$V_{(ISO)} = V_{DS}$ | |
| | Subgroup 6 | | | 3 devices |
| * | ESD | 1020 | Not required for devices classified as ESD class 1. | |
| | Subgroup 8 | | | 5 devices, c = 0 |
| | Repetitive avalanche energy | 3469 | $I_{AR} = I_D$; $V_{GS}$ = 10 V; 2.5 ≤ $R_{GS}$ ≤ 200 ohms;<br>$T_J$ = +150°C +10, -0 °C;<br>inductance = $\left[\frac{2E_{AR}}{(I_{D1})^2}\right]\left[\frac{V_{BR}-V_{DD}}{V_{BR}}\right]$ $mH\,\min$<br>number of pulses to be applied = 3.6 X $10^8$; ($V_{DD}$) = 50 V; time in avalanche = 2 μs minimum, 20 μs maximum; f = 1 KHz | |

See footnote at end of table.

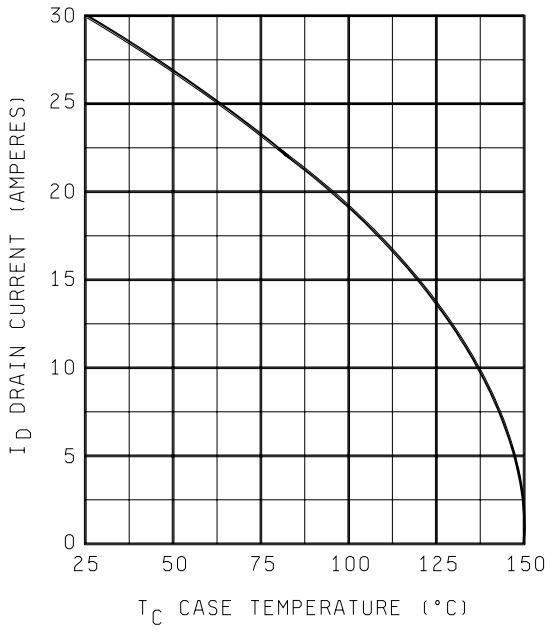
* TABLE II. Group E inspection (all quality levels) for qualification re-qualification only - Continued.

| Inspection 1/ | MIL-STD-750 | | Qualification and large lot quality conformance inspection |
|---|---|---|---|
| | Method | Conditions | |
| Subgroup 9<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 | 3476 | | 22 devices, c = 0 |

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

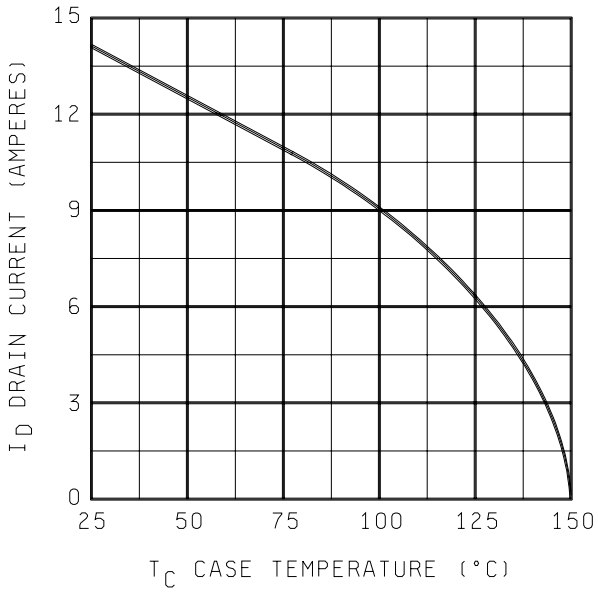



2N6764, 2N6764T1

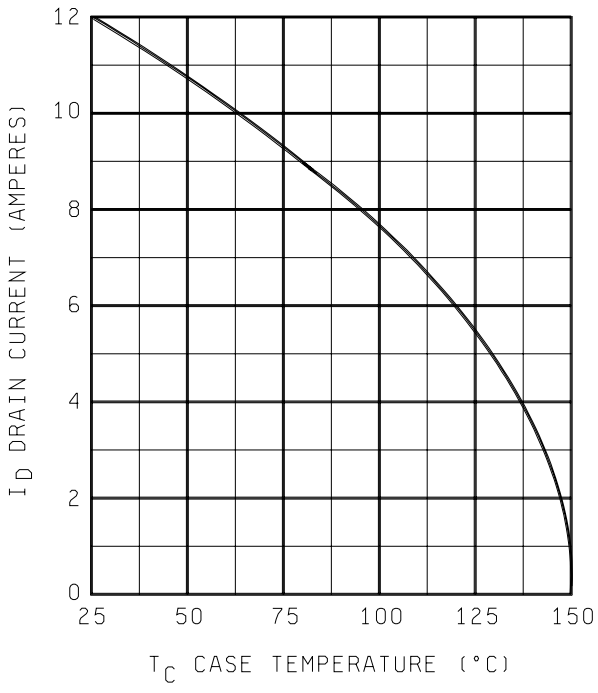



2N6766, 2N6766T1

FIGURE 4. Maximum drain current vs case temperature.




2N6768, 2N6768T1




2N6770, 2N6770T1

FIGURE 4. Maximum drain current vs case temperature - Continued.

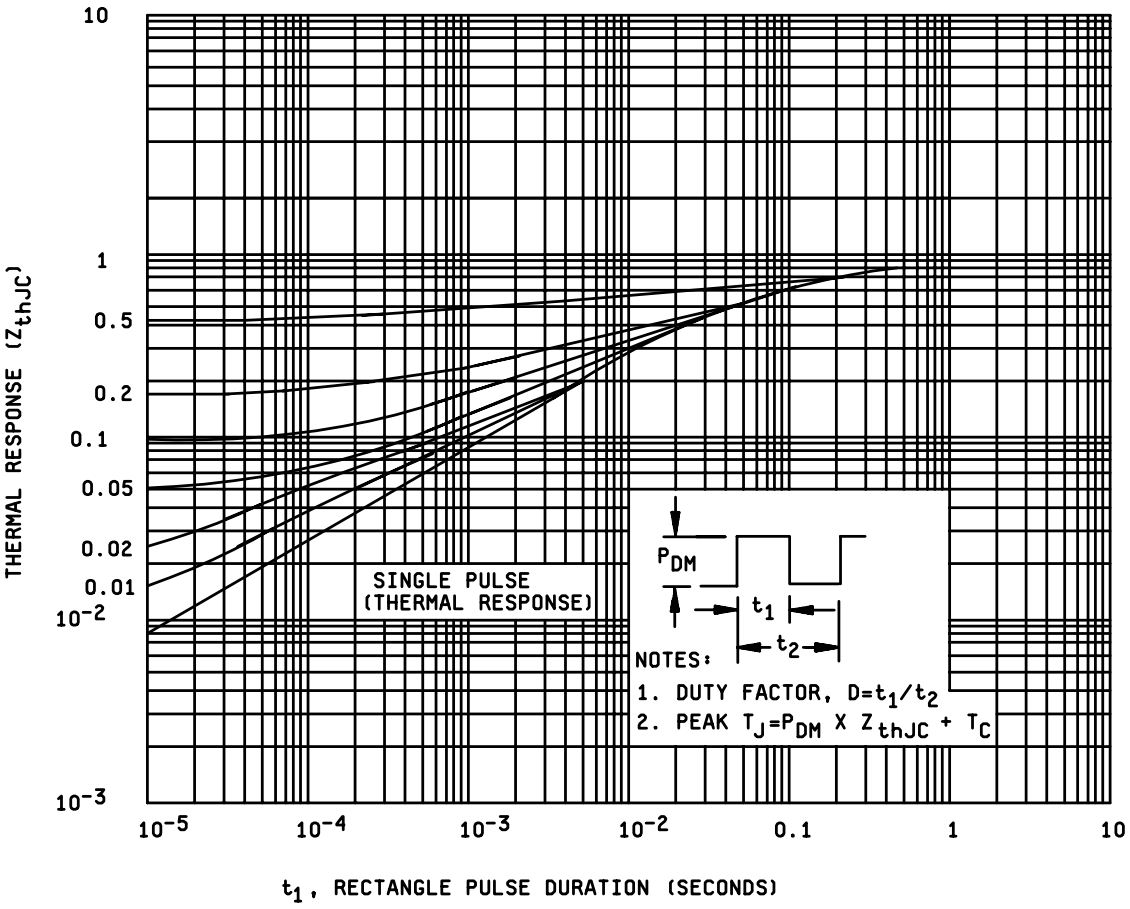
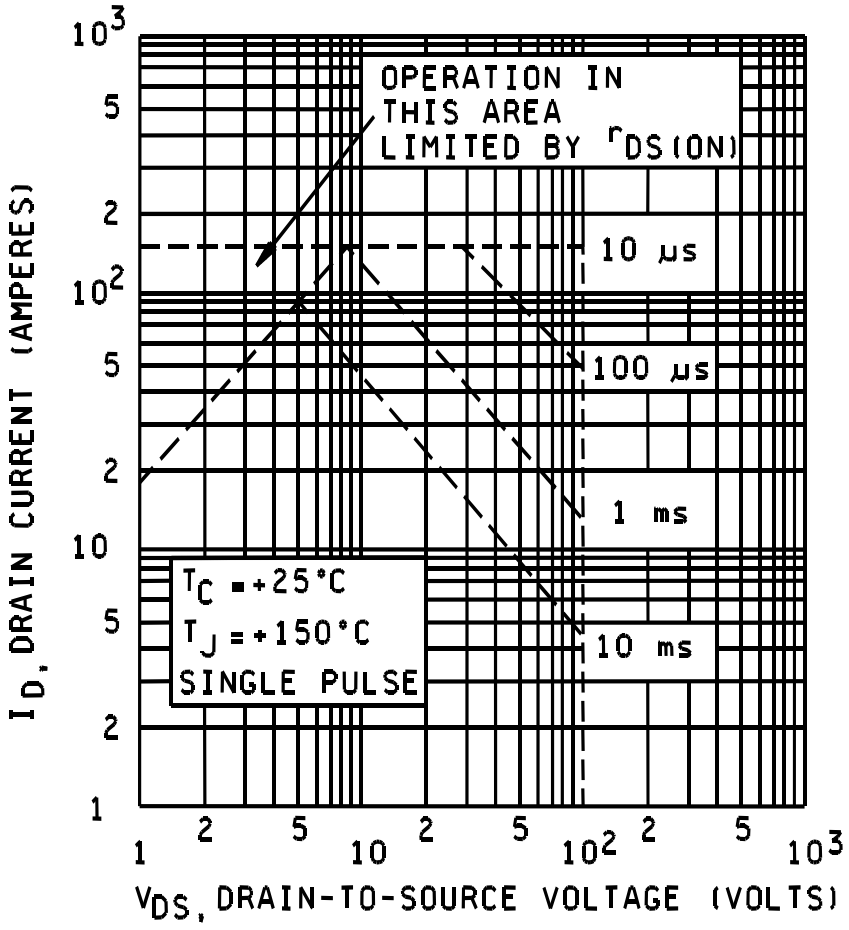
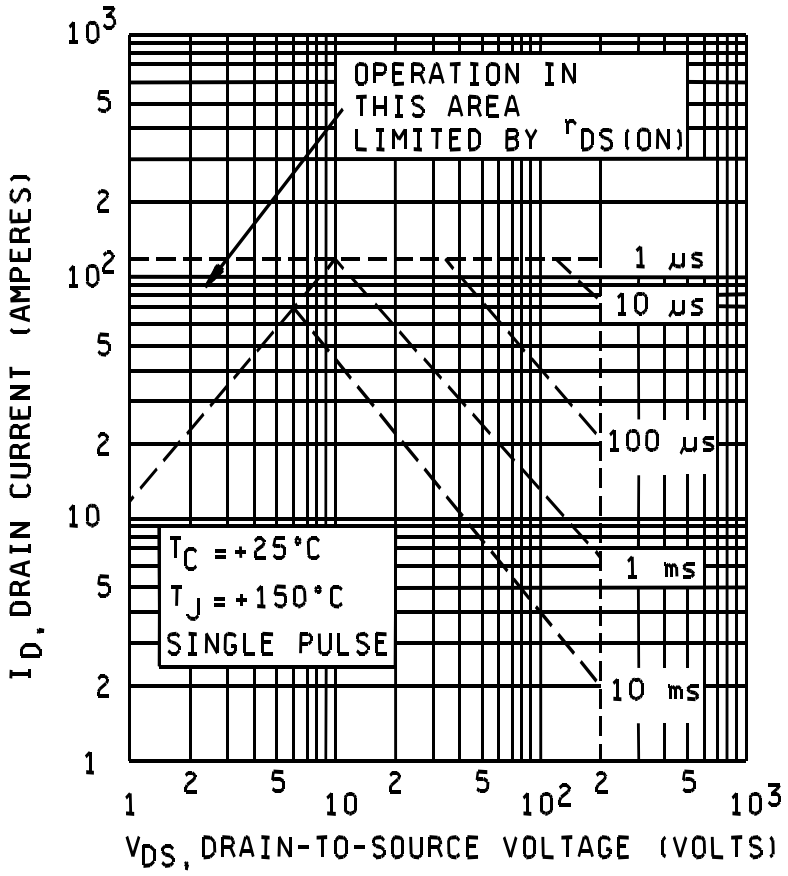



FIGURE 5. Thermal response curves.



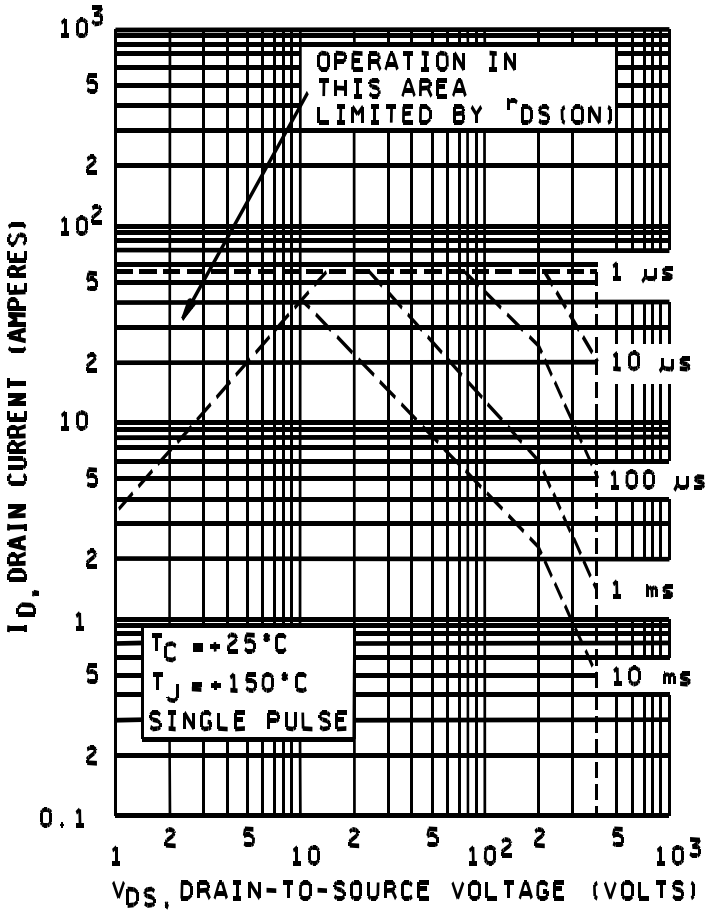

2N6764, 2N6764T1

* FIGURE 6. Safe operating area graph.



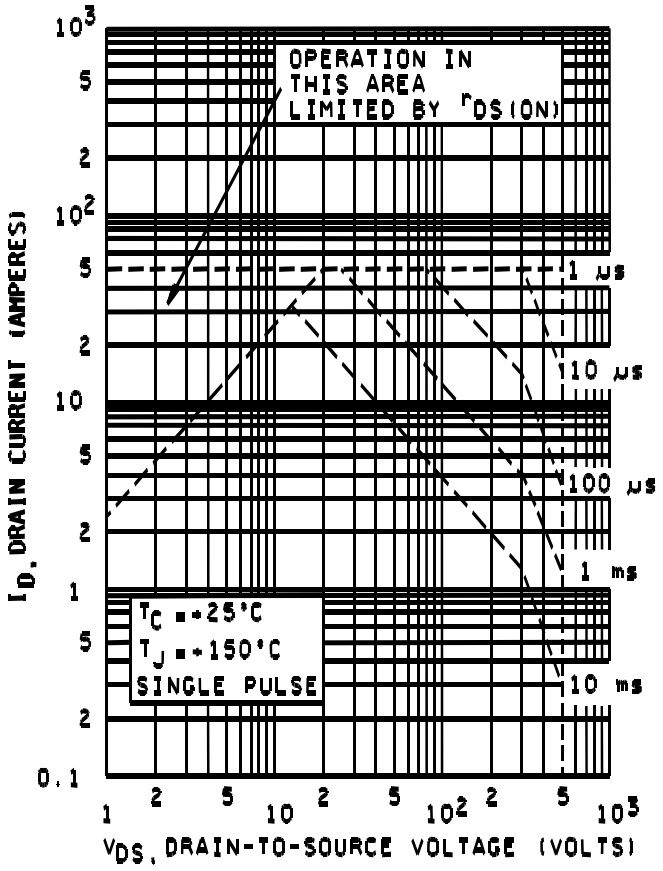

2N6766, 2N6766T1

* FIGURE 6. Safe operating area graph - Continued.




2N6768, 2N6788T1

* FIGURE 6. Safe operating area graph - Continued.




2N6770, 2N6770T1

* FIGURE 6. Safe operating area graph - Continued.

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.)

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

* 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 Defense Supply Center, Columbus, ATTN: DSCC/VQE, P.O. Box 3990, Columbus, OH 43218-3990 or e-mail vqe.chief@dla.mil.

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

| PIN | Manufacturer's CAGE code | Manufacturer's and user's PIN |
|---|---|---|
| 2N6764 | 59993 | IRF150, IRF151, IRF152, IRF153 |
| 2N6766 | 59993 | IRF250, IRF251, IRF252, IRF253 |
| 2N6768 | 59993 | IRF350, IRF351, IRF352, IRF353 |
| 2N6770 | 59993 | IRF450, IRF451, IRF452, IRF453 |

6.5 Suppliers of JANC die. The qualified JANC suppliers with the applicable letter version (example JANHCA2N6764) will be identified on the QML.

| JANC ordering information | |
|---|---|
| PIN | Manufacturer |
| | 59993 |
| 2N6764 | JANHCA2N6764<br>JANTXHCA2N6764<br>JANTXVHCA2N6764<br>JANSHCA2N6764 |
| 2N6766 | JANHCA2N6766<br>JANTXHCA2N6766<br>JANTXVHCA2N6766<br>JANSHCA2N6766 |
| 2N6768 | JANHCA2N6768<br>JANTXHCA2N6768<br>JANTXVHCA2N6768<br>JANSHCA2N6768 |
| 2N6770 | JANHCA2N6770<br>JANTXHCA2N6770<br>JANTXVHCA2N6770<br>JANSHCA2N6770 |

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

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