

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED TRANSISTOR, N-CHANNEL, SILICON,
 TYPES 2N7380 AND 2N7381
 JANTXV M, D, R, F, G, AND H
 JANS M, D, R, 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 detail requirements for an N-channel, radiation hardened, enhancement mode, MOSFET, power transistor intended for use in high density power switching applications. 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}).

1.2 Physical dimensions. See figure 1 (T0-257AA).

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

| Type | Min $V_{(BR)DSS}$ $V_{GS} = 0\text{ V}$ $I_D = 1.0\text{ mA dc}$ | P_T 1/ $T_C = +25^\circ\text{C}$ | P_T 1/ $T_A = +25^\circ\text{C}$ (free air) | V_{GS} | I_{D1} 2/ $T_C = +25^\circ\text{C}$ | I_{D2} 2/ $T_C = +100^\circ\text{C}$ | T_J and T_{STG} |
|--------|--|---------------------------------------|---|-------------|--|---|---------------------|
| | <u>V dc</u> | <u>W</u> | <u>W</u> | <u>V dc</u> | <u>A dc</u> | <u>A dc</u> | <u>°C</u> |
| 2N7380 | 100 | 75 | 2 | ± 20 | 14.4 | 9.1 | -55 to +150 |
| 2N7381 | 200 | 75 | 2 | ± 20 | 9.4 | 6.0 | -55 to +150 |

| Type | I_s | I_{DM} 3/ | Max $r_{DS(on)}$ 1/ $V_{GS} = 12\text{ V dc}$ $I_D = I_{D2}$ | | $R_{\theta JC}$ max | E_{AS} | I_{AS} |
|--------|-------------|--------------|--|----------------------------|------------------------|-----------|-------------|
| | | | $T_J = +25^\circ\text{C}$ | $T_J = +150^\circ\text{C}$ | | | |
| | <u>A dc</u> | <u>A(pk)</u> | <u>ohms</u> | <u>ohms</u> | <u>°C/W</u> | <u>mJ</u> | <u>A dc</u> |
| 2N7380 | 14.4 | 57 | 0.18 | 0.33 | 1.67 | 150 | 14.4 |
| 2N7381 | 9.4 | 37 | 0.40 | 0.84 | 1.67 | 150 | 9.4 |

1/ Derated linearly by $0.6\text{ W}/^\circ\text{C}$ for $T_C > +25^\circ\text{C}$; $P_T = T - T_C$
 $J_{max} T_C$

$$2/ I_D = \sqrt{\frac{T_{Jmax} - T_C}{(R_{\theta JC}) \times (R_{DS(on)} \text{ at } T_{Jmax})}} R_{\theta JC}$$

3/ $I_{DM} = 4 \times I_{D1}$; I_{D1} as calculated by footnote 2/.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Electronics Supply Center, ATTN: DESC-ELDT, 1507 Wilmington Pk. Dayton, OH 45444-5675, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 5961

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1.4 Primary electrical characteristics. Unless otherwise specified, $T_c = +25^\circ\text{C}$.

| | | | | |
|--------|---------------------------|---------------------------|--|---------------------------------------|
| Type | Min $V_{(BR)DSS}$ | $V_{GS(th)1}$ | $I_{DSS} \text{ max}$ | Max $r_{DS(on)1}$ ^{1/} |
| | $V_{GS} = 0 \text{ V}$ | $V_{DS} \geq V_{GS}$ | $V_{GS} = 0 \text{ V}$ | $V_{GS} = 12 \text{ V}; I_D = I_{D2}$ |
| | $I_D = 1.0 \text{ mA dc}$ | $I_D = 1.0 \text{ mA dc}$ | $V_{DS} = 80 \text{ percent}$ of rated V_{DS} | $T_J = +25^\circ\text{C}$ |
| | <u>V dc</u> | <u>V dc</u> | <u>μA dc</u> | <u>ohms</u> |
| | | <u>Min</u> <u>Max</u> | | |
| 2N7380 | 100 | 2.0 4.0 | 25 | 0.18 |
| 2N7381 | 200 | 2.0 4.0 | 25 | 0.40 |

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

SPECIFICATION

DEPARTMENT OF DEFENSE

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

STANDARD

MILITARY

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

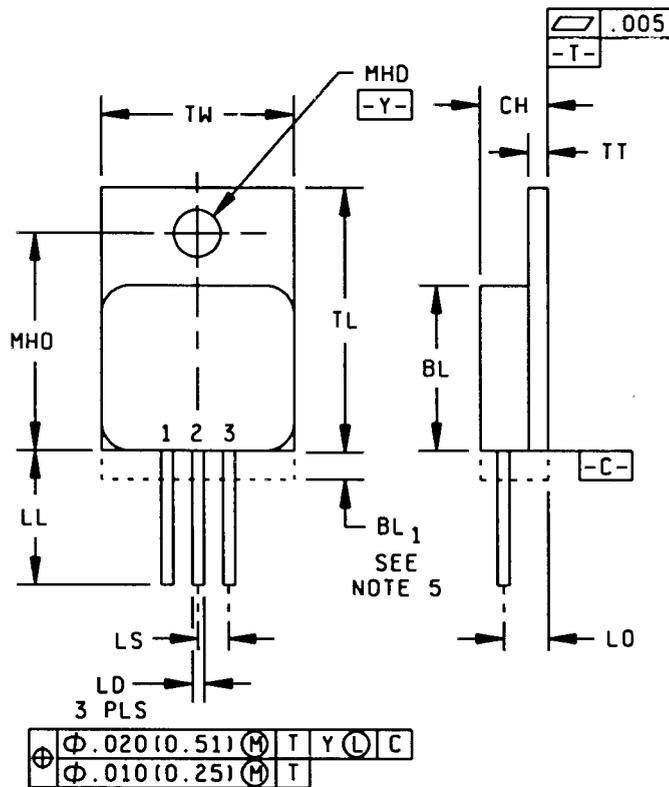
(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

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

3. REQUIREMENTS

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

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



| Ltr | Dimensions | | | |
|-----------------|-------------|-------|----------|------|
| | Millimeters | | Inches | |
| | Min | Max | Min | Max |
| BL | 10.41 | 10.67 | .410 | .420 |
| BL ₁ | | 0.84 | | .033 |
| CH | 4.83 | 5.08 | .190 | .200 |
| LD | 0.64 | 0.89 | .025 | .035 |
| LL | 15.24 | 16.51 | .600 | .650 |
| LO | 3.05 BSC | | .120 BSC | |
| LS | 2.54 BSC | | .100 BSC | |
| MHD | 3.56 | 3.81 | .140 | .150 |
| MHO | 13.39 | 13.64 | .527 | .537 |
| TL | 16.38 | 16.89 | .645 | .665 |
| TT | 0.89 | 1.14 | .035 | .045 |
| TW | 10.41 | 10.67 | .410 | .420 |
| Term 1 | Drain | | | |
| Term 2 | Source | | | |
| Term 3 | Gate | | | |

NOTES:

1. Dimensions are in millimeters.
2. Equivalents are given for general information only.
3. All terminals are isolated from case.
4. The preferred measurements used herein are the metric units. However, this transistor was designed using inch-pound units of measurement. In case of conflicts between the metric and inch-pound units, the inch-pound units shall be the rule.
5. This area is for the lead feed-thru eyelets (configuration is optional, but will not extend beyond this zone).

FIGURE 1. Dimensions and configuration (T0-257AA).

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3.3 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-PRF-19500, and on figure 1 herein. Methods used for electrical isolation of the terminal feedthroughs shall employ materials that contain a minimum of 90 percent AL_2O_3 (ceramic). Examples of such construction techniques are metallized ceramic eyelets or ceramic walled packages. The preferred measurements used herein are the metric units. However, this transistor was designed using inch-pound units of measurement. In case of conflicts between the metric and inch-pound units, the inch-pound units shall be the rule.

3.3.1 Lead finish. Lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish or formation is desired, it shall be specified in the acquisition document (see 6.2). When lead formation is performed, as a minimum, the vendor shall perform 100 percent hermetic seal in accordance with screen 14 of MIL-PRF-19500 and 100 percent group A2 electrical measurements.

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

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

3.5 Electrostatic discharge protection. The devices covered by this specification require electrostatic 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. $R \leq 100$ k, whenever bias voltage is to be applied drain to source.

3.6 Qualification. Devices furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.2).

4. QUALITY ASSURANCE PROVISIONS

4.1 Classification of Inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Screening (see 4.3)
- c. Conformance inspection (see 4.4).

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

4.2.1 Group E inspection. Group E inspection shall be in accordance with table III herein.

4.3 Screening (JANS and JANTXV levels only). Screening shall be in accordance with 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 table IV of MIL-PRF-19500) | Measurement | |
|--|--|---|
| | JANS levels | JANTXV levels |
| 1/ | Thermal response (see 4.5.3) | Thermal response (see 4.5.3) |
| 1/ 2/ | Method 3470 (see 4.5.5) | Method 3470 (see 4.5.5) |
| 1/ 2/ | Gate stress test (see 4.5.4) | Gate stress test (see 4.5.4) |
| 9 1/ | I_{GSS1} , I_{DSS1} , subgroup 2 of table I herein | Subgroup 2 of table I herein |
| 10 | Method 1042, test condition B | Method 1042, test condition B |
| 11 | I_{GSS1} , I_{DSS1} , $r_{DS(on)1}$, $V_{GS(th)1}$ Subgroup 2 of table I herein. $\Delta I_{GSS1} = \pm 20$ 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_{GSS1} , I_{DSS1} , $r_{DS(on)1}$, $V_{GS(th)1}$ Subgroup 2 of table I herein. |
| 12 | Method 1042, test condition A. t = 240 hours | Method 1042, test condition A |
| 13 | Subgroup 2 and 3 of table I herein. $\Delta I_{GSS1} = \pm 20$ 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. $\Delta I_{GSS1} = \pm 20$ 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/ Shall be performed anytime before screen 10.

2/ This is a stress test designed to ensure a rugged product.

4.4 Quality conformance inspection. Quality 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) and delta requirements shall be in accordance with the applicable steps of table I, subgroup 2 herein.

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

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

| <u>Subgroup</u> | <u>Method</u> | <u>Condition</u> |
|-----------------|---------------|---|
| 3 | 1051 | Condition G |
| 4 | 1042 | The heating cycle shall be 1 minute minimum, 2,000 cycles. No heat sink nor forced air cooling on the device shall be permitted. |
| 5 | 1042 | Condition A; $V_{DS} = 80$ percent of rated; read and record $V_{BR(DSS)}$ (pre and post) at $I_D = 1$ mA; read and record I_{DSS} (pre and post), in accordance with table I, group A, subgroup 2. |
| 5 | 1042 | Condition B; $V_{GS} = 80$ percent of rated $T_A = +175^\circ\text{C}$, $t = 24$. |
| 6 | 3161 | See 4.5.3. |

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

| <u>Subgroup</u> | <u>Method</u> | <u>Condition</u> |
|-----------------|---------------|--|
| 2 | 1051 | Condition G |
| 3 | 1042 | The heating cycle shall be 1 minute minimum. |

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

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

| <u>Subgroup</u> | <u>Method</u> | <u>Condition</u> |
|-----------------|---------------|--|
| 2 | 2036 | Test condition A, weight = 10 lbs, $t = 10$ seconds. |
| 6 | 1042 | The heating cycle shall be 1 minute minimum. |

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.

4.5.2 Thermal resistance. Thermal resistance measurements shall be performed in accordance with method 3161 of MIL-STD-750. The maximum limit of $R_{\theta JC(max)}$ shall be $1.67^{\circ}C/W$. The following parameter measurements shall apply:

- a. Measuring current (I_M): 10 mA.
- b. Drain heating current (I_H): 1.5 A minimum.
- c. Heating time (t_H): Steady state (see MIL-STD-750, method 3161 for definition).
- d. Drain-source heating voltage (V_H): 20 V minimum.
- e. Measurement time delay (t_{MD}): 30 μs to 60 μs maximum.
- f. Sample window time (t_{SW}): 10 μs maximum.

4.5.3 Thermal impedance ($Z_{\theta JC}$ measurements). The $Z_{\theta JC}$ measurements shall be performed in accordance with MIL-STD-750, method 3161. The maximum limit (not to exceed figure 2, thermal impedance curves and the group A, subgroup 2 limits) for $Z_{\theta JC}$ in screening (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, 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 process monitor.

- a. Measuring current (I_M): 10 mA.
- b. Drain heating current (I_H): 1.5 A minimum.
- c. Heating time (t_H): 100 ms.
- d. Drain-source heating voltage (V_H): 20 V minimum.
- e. Measurement time delay (t_{MD}): 30 μs to 60 μs maximum.
- f. Sample window time (t_{SW}): 10 μs maximum.

4.5.4 Gate stress test.

- a. $V_{GS} = \pm 24$ V minimum.
- b. $t = 250$ μs minimum.

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

- a. Peak current (I_{AS}): I_{D1} .
- b. Peak gate voltage (V_{GS}): 10 V.
- c. Gate to source resistor (R_{GS}): $25 \leq R_{GS} \leq 200 \Omega$.
- d. Initial case temperature: $+25^{\circ}C$, $+10^{\circ}C$, $-5^{\circ}C$.
- e. Inductance: $(2 E_{AS}/(I_{D1})^2)((V_{BR} - V_{DD})/V_{BR})$ mH minimum.
- f. Number of pulses to be applied: 1 pulse minimum.
- g. Supply voltage $V_{DD} = 50$ V, or 25 V for 100 V devices.

TABLE I. Group A inspection.

| Inspection 1/ | MIL-STD-750 | | Symbol | Limits | | Unit |
|--|-------------|---|-----------------|------------|--------------|----------------------|
| | Method | Conditions | | Min | Max | |
| <u>Subgroup 1</u> | | | | | | |
| Visual and mechanical inspection | 2071 | | | | | |
| <u>Subgroup 2</u> | | | | | | |
| Thermal impedance 2/ | 3161 | See 4.5.3 | $Z_{\theta JC}$ | | 1.67 | $^{\circ}C/W$ |
| Breakdown voltage, drain to source | 3407 | $V_{GS} = 0$ V dc, $I_D = 1.0$ mA, bias condition C | $V_{(BR)DSS}$ | | | |
| 2N7380 2N7381 | | | | 100 200 | | V dc V dc |
| Gate to source voltage (threshold) | 3403 | $V_{DS} \geq V_{GS}$, $I_D = 1.0$ mA | $V_{GS(th)1}$ | 2.0 | 4.0 | V dc |
| Gate current | 3411 | $V_{GS} = \pm 20$ V dc, $V_{DS} = 0$ V dc, bias condition C | I_{GSS1} | | ± 100 | nA dc |
| Drain current | 3413 | $V_{GS} = 0$ V dc, $V_{DS} = 80$ percent of rated V_{DS} , bias condition C | I_{DSS1} | | 25 | μA dc |
| Static drain to source on-state resistance | 3421 | $V_{GS} = 12$ V dc, condition A, pulsed (see 4.5.1), $I_D =$ rated I_{D2} (see 1.3) | $r_{DS(on)1}$ | | | |
| 2N7380 2N7381 | | | | | 0.18 0.40 | Ω Ω |
| Static drain to source on-state resistance | 3421 | $V_{GS} = 12$ V dc, condition A, pulsed (see 4.5.1), $I_D =$ rated I_{D1} (see 1.3) | $r_{DS(on)2}$ | | | |
| 2N7380 2N7381 | | | | | 0.20 0.49 | Ω Ω |
| Forward voltage (source drain diode) | 4011 | $V_{GS} = 0$ V dc, $I_D =$ rated I_{D1} pulsed (see 4.5.1) | V_{SD} | | | |
| 2N7380 2N7381 | | | | | 1.8 1.4 | V V |

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

| Inspection 1/ | MIL-STD-750 | | Symbol | Limits | | Unit |
|------------------------------------|-------------|--|---------------|--------|-----------|----------|
| | Method | Conditions | | Min | Max | |
| <u>Subgroup 3</u> | | | | | | |
| High temperature operation: | | $T_A = +125^\circ\text{C}$ | | | | |
| Gate current | 3411 | Bias condition C, $V_{GS} = \pm 20\text{ V dc}$, $V_{DS} = 0\text{ V dc}$ | I_{GSS2} | | ± 200 | nA dc |
| Drain current | 3413 | Bias condition C, $V_{GS} = 0\text{ V dc}$, $V_{DS} = 80\text{ percent of rated } V_{DS}$ | I_{DSS3} | | 0.25 | mA dc |
| Static drain to source on-state | 3421 | $V_{GS} = 12\text{ V dc}$, pulsed (see 4.5.1), $I_D = \text{rated } I_{D2}$ | $r_{DS(on)3}$ | | | |
| 2N7380 | | | | | 0.35 | Ω |
| 2N7381 | | | | | 0.75 | Ω |
| Gate to source voltage (threshold) | 3403 | $V_{DS} \geq V_{GS}$, $I_D = 1.0\text{ mA dc}$ | $V_{GS(th)2}$ | 1.0 | | V dc |
| Low temperature operation: | | $T_A = -55^\circ\text{C}$ | | | | |
| Gate to source voltage (threshold) | 3403 | $V_{DS} \geq V_{GS}$, $I_D = 1.0\text{ mA dc}$ | $V_{GS(th)3}$ | | 5.0 | V dc |
| <u>Subgroup 4</u> | | | | | | |
| Switching time test | 3472 | $I_D = \text{rated } I_{D1}$, $V_{GS} = 12\text{ V dc}$, gate drive impedance = 7.5Ω , $V_{DD} = 50\text{ percent of } V_{BR(DSS)}$ | | | | |
| Turn-on delay time | | | $t_{d(on)}$ | | | |
| 2N7380 | | | | | 35 | ns |
| 2N7381 | | | | | 35 | ns |
| Rise time | | | t_r | | | |
| 2N7380 | | | | | 75 | ns |
| 2N7381 | | | | | 75 | ns |
| Turn-off delay time | | | $t_{d(off)}$ | | | |
| 2N7380 | | | | | 70 | ns |
| 2N7381 | | | | | 70 | ns |
| Fall time | | | t_f | | | |
| 2N7380 | | | | | 60 | ns |
| 2N7381 | | | | | 60 | ns |

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 | Conditions | | Min | Max | | | | |
| <u>Subgroup 4</u> - continued | | | | | | | | | |
| Forward transconductance | 3475 | $I_D = I_{D2}$, $V_{DD} = 15$ V dc see 4.5.1 | g _{fs} | | | | | | |
| 2N7380 | | | | 2.5 | | S | | | |
| 2N7381 | | | | 2.5 | | S | | | |
| <u>Subgroup 5</u> | | | | | | | | | |
| Safe operating area test (high voltage) | 3474 | See figure 3,4 $t_p = 10$ ms, $V_{DS} = 80$ percent of rated $V_{BR(DSS)}$, $V_{DS} = 200$ V maximum | | | | | | | |
| Electrical measurements | | | | | | | See table I, group A, subgroup 2 | | |
| <u>Subgroup 6</u> | | | | | | | | | |
| Not applicable | | | | | | | | | |
| <u>Subgroup 7</u> | | | | | | | | | |
| Gate charge | 3471 | Condition B | | | | | | | |
| On-state gate charge | | | | | | | Q _{g(on)} | | |
| 2N7380 | | | | | | | | 50 | nC |
| 2N7381 | | | | | | | | 50 | nC |
| Gate to source charge | | | | | | | Q _{gs} | | |
| 2N7380 | | | | | | | | 10.0 | nC |
| 2N7381 | | | | | | | | 10.0 | nC |
| Gate to drain charge | Q _{gd} | | | | | | | | |
| 2N7380 | | 20 | nC | | | | | | |
| 2N7381 | | 25 | nC | | | | | | |
| Reverse recovery time | 3473 | $d/d_1 \leq 100$ A/ μ s, $V_{DD} \leq 50$ V, $I_D = I_{D1}$ | t _{rr} | | | | | | |
| 2N7380 | | | | | | | 370 | ns | |
| 2N7381 | 460 | ns | | | | | | | |

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

2/ This test is required for the following endpoint measurements only:
JANS - group B, subgroup 3 and 4; JANTX and JANTXV - group B, subgroup 2 and 3; group C, subgroup 6;
group E, subgroup 1.

TABLE II. Group D inspection.

| Inspection 1/ 2/ 3/ | MIL-STD-750 | | Symbol | Pre-irradiation limits | | | | Post-irradiation limits | | | | Unit |
|---|-------------|--|--------------------|------------------------|------|----------------|------|-------------------------|------|----------------|------|-------|
| | Method | Conditions | | M, D, and R | | F, G, and H 4/ | | M, D, and R | | F, G, and H 4/ | | |
| | | | | Min | Max | Min | Max | Min | Max | Min | Max | |
| Subgroup 2 | | | | | | | | | | | | |
| 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 electrical | | | | | | | | | | | | |
| Breakdown voltage, drain to source | 3407 | V _{GS} = 0 V, I _D = 1 mA bias condition C | V _{BRDSS} | | | | | | | | | |
| 2N7380 | | | | 100 | | 100 | | 100 | | 100 | | V dc |
| 2N7381 | | | | 200 | | 200 | | 200 | | 200 | | V dc |
| Gate to source voltage 4/ (threshold) | 3403 | V _{DS} ≥ V _{GS} I _D = 1 mA | V _{GStH} | | | | | | | | | |
| 2N7380 | | | | 2.0 | 4.0 | 2.0 | 4.0 | 2.0 | 4.0 | 1.25 | 4.5 | V dc |
| 2N7381 | | | | 2.0 | 4.0 | 2.0 | 4.0 | 2.0 | 4.0 | 1.25 | 4.5 | V dc |
| Gate current | 3411 | V _{GS} = 20 V V _{DS} = 0 V, bias condition C | I _{GSSF1} | | 100 | | 100 | | 100 | | 100 | nA dc |
| Gate current | 3411 | V _{GS} = -20 V V _{DS} = 0 V, bias condition C | I _{GSSR1} | | -100 | | -100 | | -100 | | -100 | nA dc |

See footnotes at end of table.

TABLE II. Group D inspection - Continued.

| Inspection 1/ 2/ 3/ | MIL-STD-750 | | Symbol | Pre-irradiation limits | | | | Post-irradiation limits | | | | Unit |
|---|-------------|---|-------------|------------------------|--------------|----------------|--------------|-------------------------|--------------|----------------|--------------|--------------------------------------|
| | Method | Conditions | | M, D, and R | | F, G, and H 4/ | | M, D, and R | | F, G, and H 4/ | | |
| | | | | Min | Max | Min | Max | Min | Max | Min | Max | |
| Subgroup 2 - Continued | | | | | | | | | | | | |
| Drain current 2N7380 2N7381 | 3413 | $V_{GS} = 0\text{ V}$ Bias condition C $V_{DS} = 80$ percent of rated V_{DS} (pre- irradiation) | I_{DSS} | | 25 25 | | 25 25 | | 25 25 | | 50 50 | $\mu\text{A dc}$ $\mu\text{A dc}$ |
| Static drain to source on-state resistance 2N7380 2N7381 | 3421 | $V_{GS} = 12\text{ V}$, Condition A pulsed, see 4.5.1. $I_D = I_{D2}$ | r_{DSON1} | | 0.18 0.40 | | 0.18 0.40 | | 0.18 0.40 | | 0.24 0.53 | ohm ohm |
| Forward voltage source drain diode 2N7380 2N7381 | 4011 | $V_{GS} = 0\text{ V}$, $I_D =$ I_{D1} , bias condition C | V_{SD} | | 1.8 1.4 | | 1.8 1.4 | | 1.8 1.4 | | 1.8 1.4 | V V |

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

2/ Separate samples shall be pulled for each bias.

3/ 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 detail specification utilizing the same die design.

4/ The F designation represents devices which pass endpoints at both 100K and 300K rads (Si). The G designation represents devices which pass 100K, 300K and 600K rad (Si) endpoints.

5/ H must meet end points for 300K and 1,000K rad (Si).

TABLE III. Group E inspection (all quality levels) for qualification only.

| Inspection | MIL-STD-750 | | Qualification inspection |
|---------------------------------|-------------|----------------------------------|--------------------------|
| | Method | Conditions | |
| <u>Subgroup 1</u> | | | 12 devices, c = 0 |
| Temperature cycling | 1051 | Test condition G, 500 cycles | |
| Hermetic seal | 1071 | | |
| Fine leak Gross leak | | | |
| Electrical measurements | | See table I, group A, subgroup 2 | |
| <u>Subgroup 2</u> ^{1/} | | | 12 devices, c = 0 |
| Steady-state reverse bias | 1042 | Condition A, 1,000 hours | |
| Electrical measurements | | See table I, group A, subgroup 2 | |
| Steady-state gate bias | 1042 | Condition B, 1,000 hours | |
| Electrical measurements | | See table I, group A, subgroup 2 | |
| <u>Subgroup 3</u> | | | |
| Not applicable | | | |
| <u>Subgroup 4</u> | | | 12 devices, c = 0 |
| Thermal resistance | 3161 | See 4.5.2 | |
| <u>Subgroup 5</u> | | | |
| Not applicable | | | |

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

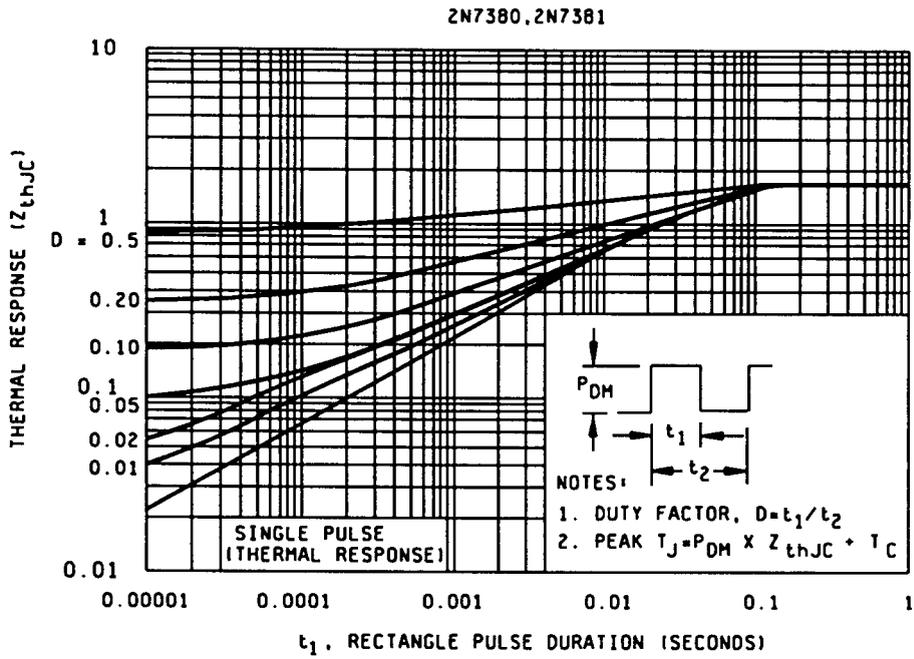


FIGURE 2. Thermal response curves.

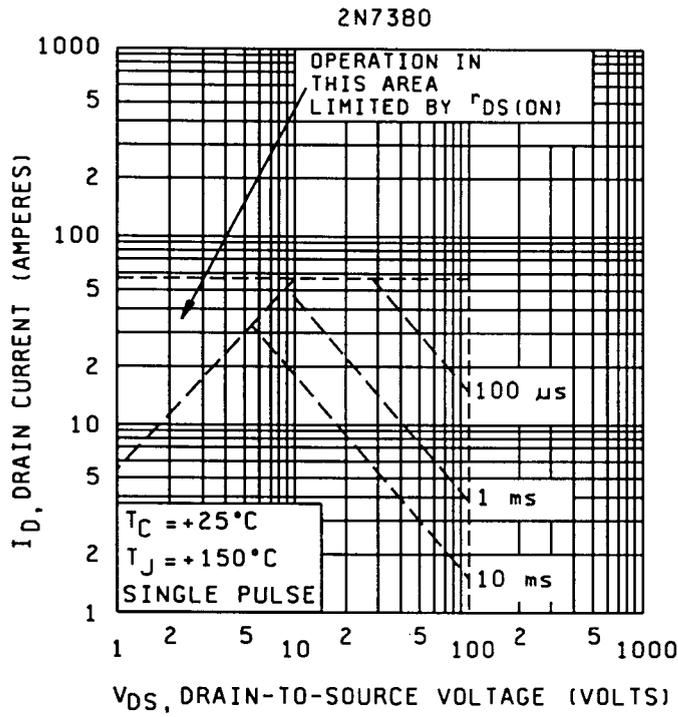


FIGURE 3. Safe operating area graphs.

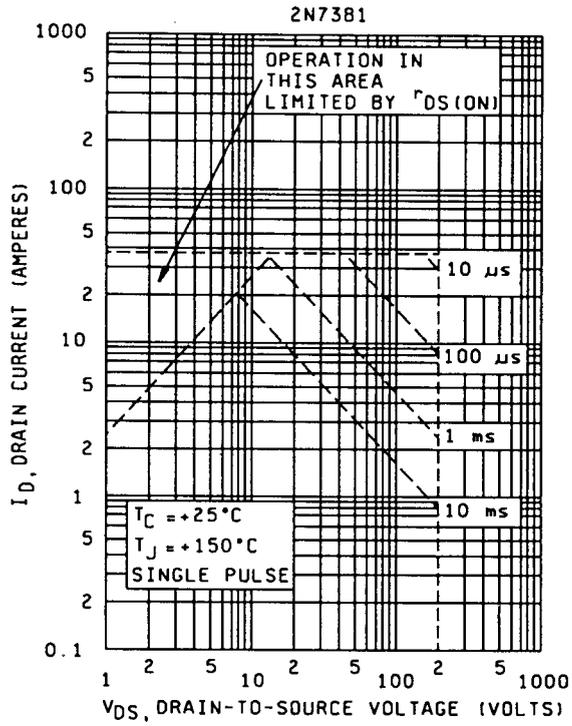


FIGURE 4. Safe operating area graphs.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

5.2 Marking. Unless otherwise specified (see 6.2), marking shall be in accordance with MIL-STD-129.

6 NOTES

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

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

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Issue of DODISS to be cited in the solicitation.
- b. Lead formation and finish as specified (see 3.3.1).
- c. 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 Products List QPL-19500 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Electronics Supply Center, DESC-ELS, Dayton, OH 45444.

6.4 Supersession data. This specification supersedes DESC drawing 89009, dated 19 December 1989.

CONCLUDING MATERIAL

Custodians:

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

Preparing activity:
DLA - ES

Review activities:

Army - AR, MI, SM
Navy - AS, CG, MC, OS
Air Force - 13, 19, 85, 99

(Project 5961-1793)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

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

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

| | | |
|------------------------------|---|-------------------------------------|
| I RECOMMEND A CHANGE: | 1. DOCUMENT NUMBER MIL-PRF-19500/614A | 2. DOCUMENT DATE 96/05/03 |
|------------------------------|---|-------------------------------------|

3. DOCUMENT TITLE SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED TRANSISTOR, N-CHANNEL, SILICON, TYPES 2N7380 AND 2N7381 JANTXV M, D, R, F, G, AND H JANS M, D, R, 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 (Last, First, Middle initial) | b. ORGANIZATION | |
| c. ADDRESS (Include Zip Code) | d. TELEPHONE (Include Area Code) Commercial DSN FAX EMAIL | 7. DATE SUBMITTED |

| | | | |
|---|--|----------|--------------------------------------|
| 8. PREPARING ACTIVITY | | | |
| a. Point of Contact Alan Barone | b. TELEPHONE Commercial | DSN | FAX EMAIL |
| | 614-692-0510 | 850-0510 | 614-692-6939 alan_barone@dscclia.mil |
| c. ADDRESS Defense Supply Center Columbus ATTN: DSCC-VAT Columbus, OH 43216-5000 | IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 DSN 289-2340 | | |