

The documentation and process conversion measures necessary to comply with this revision shall be completed by 27 January 2003.

INCH-POUND

MIL-PRF-19500/684A
 27 October 2003
 SUPERSEDING
 MIL-PRF-19500/684
 6 October 2001

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, FIELD EFFECT, SILICON, N-CHANNEL,
 RADIATION HARDENED (TOTAL DOSE AND SINGLE EVENT EFFECTS)
 TYPES 2N7472U2, 2N7473U2 AND 2N7474U2
 JANTXVR AND JANSR

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 effects (SEE) 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. T_A = +25°C, unless otherwise specified.

Type	P _T (1) T _C = +25°C	P _T T _A = +25°C	V _{DS}	V _{DG}	V _{GS}	I _{D1} T _C =+25°C (2) (3)	I _{D2} T _C = +100°C	I _S	I _{DM} (4)	T _J and T _{STG}
	<u>W</u>	<u>W</u>	<u>V dc</u>	<u>V dc</u>	<u>V dc</u>	<u>A dc</u>	<u>A dc</u>	<u>A dc</u>	<u>A (pk)</u>	<u>°C</u>
2N7472U2	250	2.5	130	130	±20	75	45	75	300	-55
2N7473U2			200	200		53.5	34	53.5	214	to
2N7474U2			250	250		44.5	28	44.5	178	+150

(1) Derate linearly by 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:

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

(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 = 1.0mA dc	V _{GS(TH)1} V _{DS} ≥ V _{GS} I _D = 1.0 mA dc	Max I _{DSS1} V _{GS} = 0 V _{DS} = 80% of rated V _{DS}	Max r _{DS(on)} (1) V _{GS} = 12V, I _D = I _{D2}		R _{θJC} Max	E _{AS}
				T _J = +25°C	T _J = +150°C		
	<u>V dc</u>	<u>V dc</u> Min Max 2.5 4.5	<u>μA dc</u>	<u>Ω</u>	<u>Ω</u>	<u>°C/W</u>	<u>mJ</u>
2N7472U2	130		10	0.0135	0.026	0.50	280
2N7473U2	200			0.038	0.080		380
2N7474U2	250			0.060	0.126		222

(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.

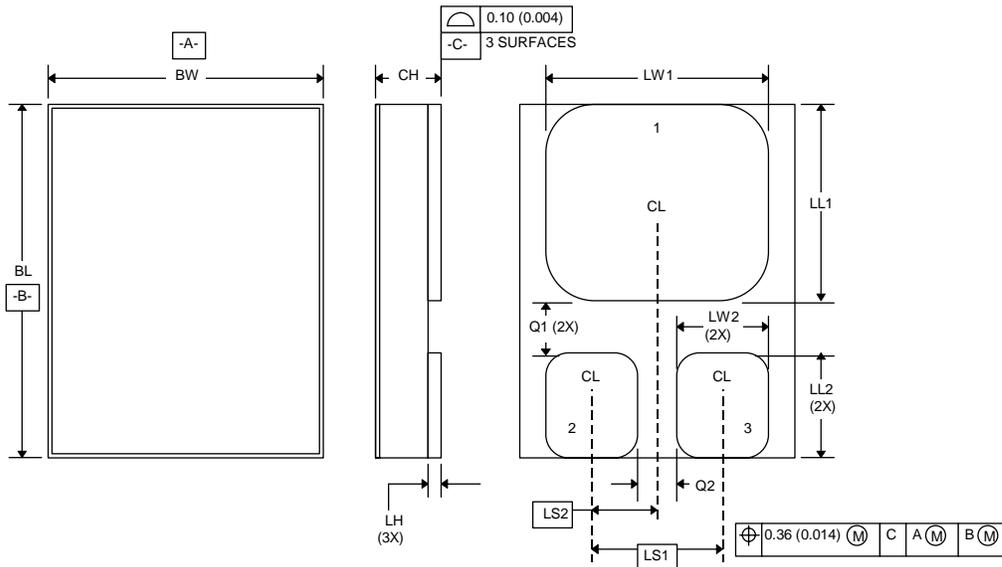
STANDARD

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.)

MIL-PRF-19500/684A



Symbol	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
LH	.010	.020	0.26	0.50
LW1	.435	.445	11.05	11.30
LW2	.135	.145	3.43	3.68
LL1	.470	.480	11.94	12.19
LL2	.152	.162	3.86	4.12
LS1	.240 BSC		6.10 BSC	
LS2	.120 BSC		3.05 BSC	
Q1	.035		0.89	
Q2	.050		1.27	
TERM 1	Drain			
TERM 2	Gate			
TERM 3	Source			

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 (TO-276AC).

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.

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 electrical isolation of the terminals shall employ materials that contain a minimum of 90 percent Al₂O₃ (ceramic).

3.4.1 Lead finish. Unless otherwise specified, 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).

3.5 Marking. Marking shall be in accordance with MIL-PRF-19500. At the option of the manufacturer, marking may be omitted from the body, but shall be retained on the initial container.

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, $R \leq$ or 100 k Ω , whenever bias voltage is applied drain to source.

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

3.8 Electrical test requirements. The electrical test requirements shall be the subgroups as specified in group A, table I 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 4.4).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein. Alternate flow is allowed for qualification inspection in accordance with figure 4 of MIL-PRF-19500.

* 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 associated specification 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 table III). End-point measurements shall be in accordance with table II.

* 4.3 Screening (JANS, JANTX, and JANTXV). 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) (1) (2)	Measurement	
	JANS	JANTX and JANTXV
(3)	Gate stress test (see 4.3.1 4.5.5)	Gate stress test (see 4.3.1 4.5.5)
(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 _{DSS1} , I _{GSSF1} , I _{GSSR1} as minimum	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)} , V _{GS(TH)} Subgroup 2 of table I herein. ΔI _{GSSF1} = ±20 nA dc or ±100% of initial value, whichever is greater. ΔI _{GSSR1} = ±20 nA dc or ±100% of initial value, whichever is greater. ΔI _{DSS1} = ±10 μA dc or ±100% of initial value, whichever is greater.	I _{GSSF1} , I _{GSSR1} , I _{DSS1} , r _{DS(ON)} , V _{GS(TH)} Subgroup 2 of table I herein.
12	Method 1042 of MIL-STD-750, test condition A	Method 1042 of MIL-STD-750, test condition A
13	Subgroups 2 and 3 of table I herein ΔI _{GSSF1} = ±20 nA dc or ±100% of initial value, whichever is greater. ΔI _{GSSR1} = ±20 nA dc or ±100% of initial value, whichever is greater. ΔI _{DSS1} = ±10 μA dc or ±100% of initial value, whichever is greater. Δr _{DS(ON)1} = ±20% of initial value. ΔV _{GS(TH)1} = ±20% of initial value.	Subgroup 2 of table I herein ΔI _{GSSF1} = ±20 nA dc or ±100% of initial value, whichever is greater. ΔI _{GSSR1} = ±20 nA dc or ±100% of initial value, whichever is greater. ΔI _{DSS1} = ±10 μA dc or ±100% of initial value, whichever is greater. Δr _{DS(ON)1} = ±20% of initial value. ΔV _{GS(TH)1} = ±20% 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 $t = 250$ μ s minimum.

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

- a. Peak current, $I_{AS} = I_{D1}$.
- b. Inductance, $L = (2 * E_{AS} / (I_{D1})^2) * ((V_{BR} - V_{DD}) / V_{BR})$ mH minimum.
- c. Gate to source resistor, R_{GS} : $25 \Omega \leq R_{GS} \leq 200 \Omega$.
- d. Supply voltage, $V_{DD} = \text{Rated VDS}$.
- e. Initial case temperature, $T_C = +25^\circ \text{C}, -5^\circ \text{C}, +10^\circ \text{C}$.
- f. Gate voltage, $V_{GS} = 12$ V dc.
- g. Number of pulses to be applied: 1 pulse minimum.

* 4.3.3 Thermal Response ($Z_{\theta JC}$ measurement). The $Z_{\theta JC}$ measurement (or equivalent ΔV_{SD} measurement) shall be performed in accordance with method 3161 of MIL-STD-750. The maximum limit (not to exceed figure 3, 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 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 process monitor.

- a. Measuring current (I_M)..... 10 mA.
- b. Drain heating current (I_H) 13.88 A.
- c. Heating time (t_H)..... 20 ms.
- d. Drain-source heating voltage (V_H) ... 12 V.
- e. Measurement time delay (t_{MD}) 30 - 60 μ s.
- f. Sample window time (t_{SW})..... 10 μ s 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 figure 4 of MIL-PRF-19500.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with table V of MIL-PRF-19500 and table I herein.

* 4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIa (JANS) and table VIb (JANTXV) of MIL-PRF-19500, and as follows. Electrical measurements (end-points) shall be in accordance with table I, 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>
B3	1051	Test condition G, 100 cycles.
B3	2077	SEM.
B4	1042	Intermittent operation life, condition D, 2,000 cycles. No heat sink or forced-air cooling on the device shall be permitted during the on cycle. $t_{on} = 30$ seconds minimum.
B5	1042	Accelerated steady-state gate bias, condition B, $V_{GS} = \text{rated}$; $T_A = +175^\circ\text{C}$, $t = 24$ hours minimum; or $T_A = +150^\circ\text{C}$, $t = 48$ hours minimum.
B5	1042	Accelerated steady-state reverse bias, condition A, $V_{DS} = \text{rated}$; $T_A = +175^\circ\text{C}$, $t = 120$ hours minimum; or $T_A = +150^\circ\text{C}$, $t = 240$ hours minimum.
B5	2037	Bond strength, test condition A.
B6	3161	Thermal resistance, see 4.5.2.

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

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B2	1051	Test condition G, 25 cycles.
B3	1042	Intermittent operation life, condition D, 2,000 cycles. No heat sink or forced-air cooling on the device shall be permitted during the on cycle. $t_{on} = 30$ seconds minimum.
B3	2037	Test condition A. All internal bond wires for each device shall be pulled separately.
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 table VII of MIL-PRF-19500 and as follows. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Terminal strength is not applicable.
C5	3161	Thermal resistance, see 4.5.2.
C6	1042	Intermittent operation life, condition D, 2,000 cycles. No heat sink or forced-air cooling on the device shall be permitted during the on cycle. $t_{on} = 30$ seconds minimum.

4.4.4 Group D inspection. Group D inspection shall be conducted in accordance with 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 $R_{\theta JC} = 0.50$ °C/W. The following parameters shall apply:

- a. Measuring current (I_M)..... 10 mA.
- b. Drain heating current (I_H)..... 13.88 A.
- c. Heating time (t_H)..... Steady-state (see MIL-STD-750, method 3161).
- d. Drain-source heating voltage (V_H)..... 12 V.
- e. Measurement time delay (t_{MD})..... 30 to 60 μ s.
- f. Sample window time (t_{SW})..... 10 μ s maximum.

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 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.

MIL-PRF-19500/684A

* TABLE I. Group A inspection.

Inspection1/ 	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Thermal impedance θ_{JC}	3161	See 4.3.3	$Z_{\theta JC}$	0.38		$^{\circ}C/W$
Breakdown voltage drain to source 2N7472U2 2N7473U2 2N7474U2	3407	$V_{GS} = 0V$, $I_D = 1$ mA dc, bias condition C	$V_{(BR)DSS}$	130 200 250		V dc V dc V dc
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$, $I_D = 1$ mA dc	$V_{GS(TH)1}$	2.5	4.5	V dc
Gate current	3411	$V_{GS} = \pm 20V$ dc, bias condition C, $V_{DS} = 0V$	I_{GSS1}		± 100	nA dc
Drain current	3413	$V_{GS} = 0V$ dc, bias condition C, $V_{DS} = 80\%$ of rated V_{DS} ,	I_{DSS1}		10	μA dc
Static drain to source "ON" state resistance 2N7472U2 2N7473U2 2N7474U2	3421	$V_{GS} = 12V$ dc, condition A, pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(ON)1}$		0.0135 0.038 0.060	Ω Ω Ω
Forward voltage 2N7472U2 2N7473U2 2N7474U2	4011	$V_{GS} = 0V$ dc, condition A, pulsed (see 4.5.1), $I_D = I_{D1}$	V_{SD}		1.2 1.2 1.2	V dc V dc V dc
<u>Subgroup 3</u>						
High temperature operation Gate current	3411	$T_C = T_J = +125^{\circ}C$ $V_{GS} = \pm 20V$ dc, bias condition C, $V_{DS} = 0V$	I_{GSS2}		± 200	nA dc
Drain current	3413	$V_{GS} = 0V$ dc, bias condition C, $V_{DS} = 80\%$ of rated V_{DS}	I_{DSS2}		25	μA dc

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
<u>Subgroup 3</u> - continued						
Static drain to source "ON"-state resistance 2N7472U2 2N7473U2 2N7474U2	3421	$V_{GS} = 12V$ dc, condition A, pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(ON)3}$		0.028 0.080 0.126	Ω Ω Ω
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$, $I_D = 1$ mA dc	$V_{GS(TH)2}$	1.5		V dc
Low temperature operation		$T_C = T_J = -55^\circ C$				
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS(TH)3}$, $I_D = 1$ mA dc	$V_{GS(TH)3}$		5.5	V dc
<u>Subgroup 4</u>						
Forward transconductance 2N7472U2 2N7473U2 2N7474U2	3475	$I_D = I_{D2}$, $V_{DD} = 15$ V dc, (see 4.5.1)	g_{FS}		39 35 27	S S S
Switching time test	3472	$I_D = I_{D2}$, $V_{GS} = 12$ V dc $R_G = 2.35 \Omega$, $V_{DD} = 50$ percent of rated V_{DS}				
Turn-on delay time 2N7472U2 2N7473U2 2N7474U2			$t_{D(on)}$		35 35 35	ns ns ns
Rise time 2N7472U2 2N7473U2 2N7474U2			t_r		125 125 125	ns ns ns
Turn-off delay time 2N7472U2 2N7473U2 2N7474U2			$t_{D(off)}$		80 80 80	ns ns ns
Fall time 2N7472U2 2N7473U2 2N7474U2			t_f		50 50 65	ns ns ns

See footnotes at end of table.

* TABLE I. Group A inspection - continued

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit			
	Method	Condition		Min	Max				
<u>Subgroup 5</u> Safe operating area test (high voltage)	3474	See figures 4, 5 and 6 $t_p = 10$ ms min. $V_{DS} = 80$ percent of max. rated V_{DS}							
Electrical measurements							See table I, subgroup 2		
<u>Subgroup 6</u> Not applicable									
<u>Subgroup 7</u> Gate charge	3471	Condition B $I_D = I_{D2}$							
On-state gate charge 2N7472U2							$Q_{G(ON)}$	160	nC
2N7473U2								155	nC
2N7474U2								165	nC
Gate to source charge 2N7472U2							Q_{GS}	55	nC
2N7473U2								45	nC
2N7474U2								45	nC
Gate to drain charge 2N7472U2							Q_{GD}	75	nC
2N7473U2								75	nC
2N7474U2								75	nC
Reverse recovery time	3473	$di/dt = -100$ A/ μ s, $V_{DD} \leq 50$ V $I_D = I_{D2}$							
2N7472U2							t_{rr}	300	ns
2N7473U2								450	ns
2N7474U2								560	ns

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

2/ This test is required for the following end-point measurement only (not intended for screen 9, 11, or 13): JANS, table VIa of MIL-PRF-19500, group B, subgroups 3 and 4; JANTXV, table VIb of MIL-PRF-19500, group B, subgroups 2 and 3; and table VII of MIL-PRF-19500, group C, subgroup 6, and table IX of MIL-PRF-19500, group E, subgroup 1.

* TABLE II. Group D inspection.

Inspection <u>1/ 2/ 3/</u>	MIL-STD-750		Symbol	Pre-irradiation limits		Post-irradiation limits		Unit
	Method	Conditions		R		R		
				Min	Max	Min	Max	
<u>Subgroup 1</u> Not applicable								
<u>Subgroup 2</u> Steady-state total dose irradiation (VGS bias) <u>4/</u>	1019	$T_C = + 25^\circ\text{C}$ $V_{GS} = 12\text{ V};$ $V_{DS} = 0\text{ V}$						
Steady-state total dose irradiation (VDS bias) <u>4/</u>	1019	$V_{GS} = 0\text{ V};$ $V_{DS} = 80\% \text{ of rated } V_{DS}$ (preirradiation)						
End-point electricals Breakdown voltage, drain to source 2N7472U2 2N7473U2 2N7474U2	3407	$V_{GS} = 0\text{ V}; I_D = 1\text{ mA};$ bias condition C	$V_{(BR)DSS}$	130 200 250		130 200 250		V dc V dc V dc
Gate to source voltage (threshold) 2N7472U2 2N7473U2 2N7474U2	3403	$V_{DS} \geq V_{GS}$ $I_D = 1\text{ mA}$	$V_{GS(th)1}$	2.5 2.5 2.5	4.5 4.5 4.5	2.0 2.0 2.0	4.5 4.5 4.5	V dc V dc V dc
Gate current	3411	$V_{GS} = +20\text{ V}, V_{DS} = 0\text{ V},$ bias condition C	I_{GSSF1}		100		100	nA dc
Gate current	3411	$V_{GS} = -20\text{ V}, V_{DS} = 0\text{ V},$ bias condition C	I_{GSSR1}		-100		-100	nA dc
Drain current	3413	$V_{GS} = 0\text{ V}$ $V_{DS} = 80\% \text{ of rated } V_{DS}$ (preirradiation) bias condition C	I_{DSS}		10		10	$\mu\text{A dc}$
Static drain to source on-state voltage 2N7472U2 2N7473U2 2N7474U2	3405	$V_{GS} = 12\text{ V};$ condition A, pulsed (see 4.5.1) $I_D = 45\text{ A}$ $I_D = 35\text{ A}$ $I_D = 26\text{ A}$	$V_{DS(on)}$		0.630 1.365 1.586		0.630 1.365 1.586	V dc V dc V dc
Forward voltage source drain diode	4011	$V_{GS} = 0\text{ V}; I_D = 45\text{ A}$ bias condition C	V_{SD}		1.2		1.2	V dc

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

2/ Group D qualification may be performed 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.

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

Inspection	MIL-STD-750		Qualification inspection
	Method	Conditions	
<u>Subgroup 1</u>			
Temperature cycling	1051	Condition G, 500 cycles	12 devices c = 0
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table I, subgroup 2	
<u>Subgroup 2 1/</u>			
Steady-state gate bias	1042	Condition B, 1,000 hours	12 devices c = 0
Electrical measurements		See table I, subgroup 2	
Steady-state reverse bias	1042	Condition A, 1,000 hours	
Electrical measurements		See table I, subgroup 2	
<u>Subgroup 3</u>			
DPA	2102		3 devices, c = 0
<u>Subgroup 4</u>			
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	sample size N/A
<u>Subgroup 5</u>			
Not applicable			
<u>Subgroup 6</u>			
ESD	1020		3 devices
<u>Subgroup 7</u>			
Commutating diode for safe operating area test procedure for measuring dv/dt during reverse recovery of power MOSFET transistors or insulated gate bipolar transistors	3476		22 devices c = 0

See footnotes at end of table.

* 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	
<u>Subgroup 8</u>			3 devices
Single Event Effects (SEE) <u>2/ 3/ 4/</u>	1080	See figure 7	
Electrical measurements <u>5/</u>		IGSS1 and IDSS1 per table I, subgroup 2	
SEE irradiation		Fluence = $3E5 \pm 20\%$ ions/cm ² Flux = $2E3$ to $2E4$ ions/cm ² /sec, temperature = 25 ± 5 °C	
2N7472U2		LET = 37 MeV-cm ² /mg, Range = 39 microns, Energy = 305 MeV	
2N7473U2		Insitu bias conditions: VDS = 130V & VGS = -20V	
2N7474U2		Insitu bias conditions: VDS = 200V & VGS = -20V	
		Insitu bias conditions: VDS = 250V & VGS = -20V	
2N7472U2		LET = 60 MeV-cm ² /mg, Range = 32 microns, Energy = 340 MeV	
		Insitu bias conditions: VDS = 130V & VGS = -10V	
		VDS = 100V & VGS = -15V	
		VDS = 50V & VGS = -20V	
2N7473U2		Insitu bias conditions: VDS = 200V & VGS = -10V	
		VDS = 185V & VGS = -15V	
		VDS = 120V & VGS = -20V	
2N7474U2		Insitu bias conditions: VDS = 250V & VGS = -15V	
		VDS = 240V & VGS = -20V	
2N7472U2		LET = 82 MeV-cm ² /mg, Range = 28 microns, Energy = 350 MeV	
		Insitu bias conditions: VDS = 130V & VGS = 0V	
		VDS = 120V & VGS = -5V	
		VDS = 30V & VGS = -10V	
2N7473U2		Insitu bias conditions: VDS = 200V & VGS = -5V	
		VDS = 150V & VGS = -10V	
		VDS = 50V & VGS = -15V	
		VDS = 25V & VGS = -20V	
2N7474U2		Insitu bias conditions: VDS = 250V & VGS = -5V	
		VDS = 225V & VGS = -10V	
		VDS = 175V & VGS = -15V	
		VDS = 50V & VGS = -20V	
Electrical measurements <u>5/</u>		IGSS1 and IDSS1 in accordance with table I, subgroup 2	

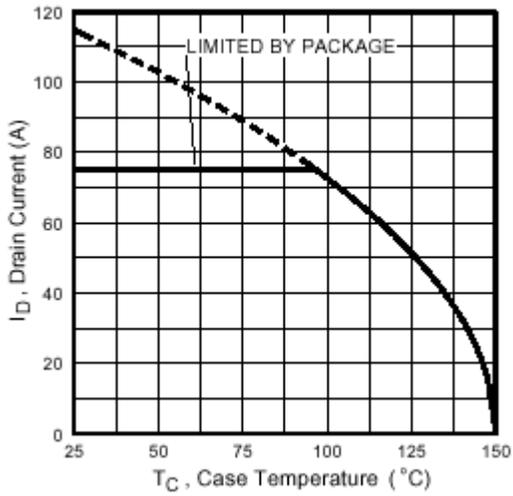
1/ A separate sample for each test shall be pulled.

2/ Group E qualification of SEE effect testing may be performed prior to lot formation. Qualification may be extended to other performance specifications utilizing the same structurally identical die design.

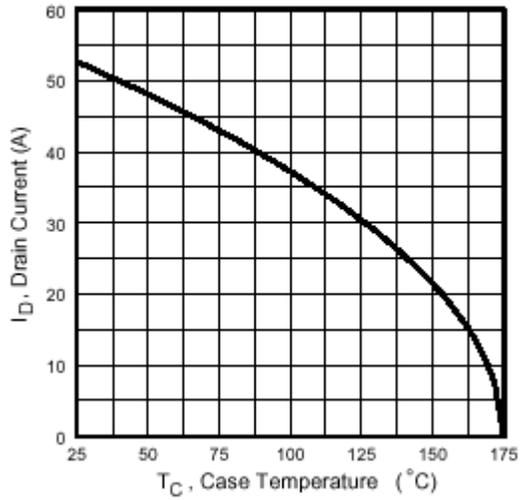
3/ Device qualification to a higher level LET is sufficient to qualify all lower level LET's.

4/ The sampling plan applies to each bias condition.

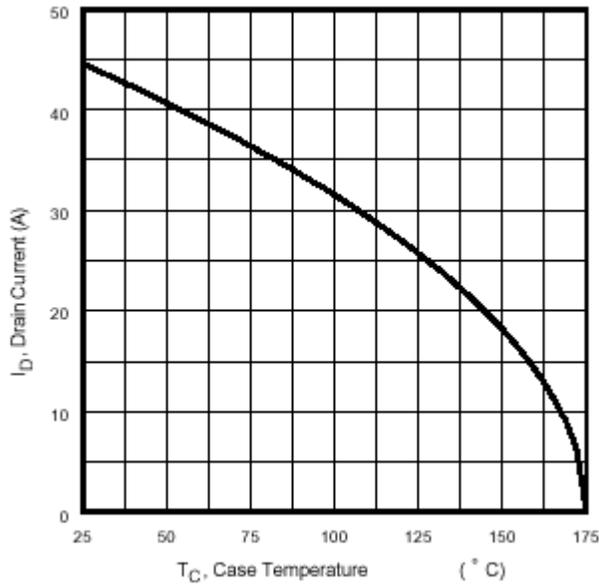
5/ Examine IGSS1 and IDSS1 before and following SEE irradiation to determine acceptability for each bias condition. Other test conditions in accordance with table I, subgroup 2, may be performed at the manufacturer's option.



2N7472U2

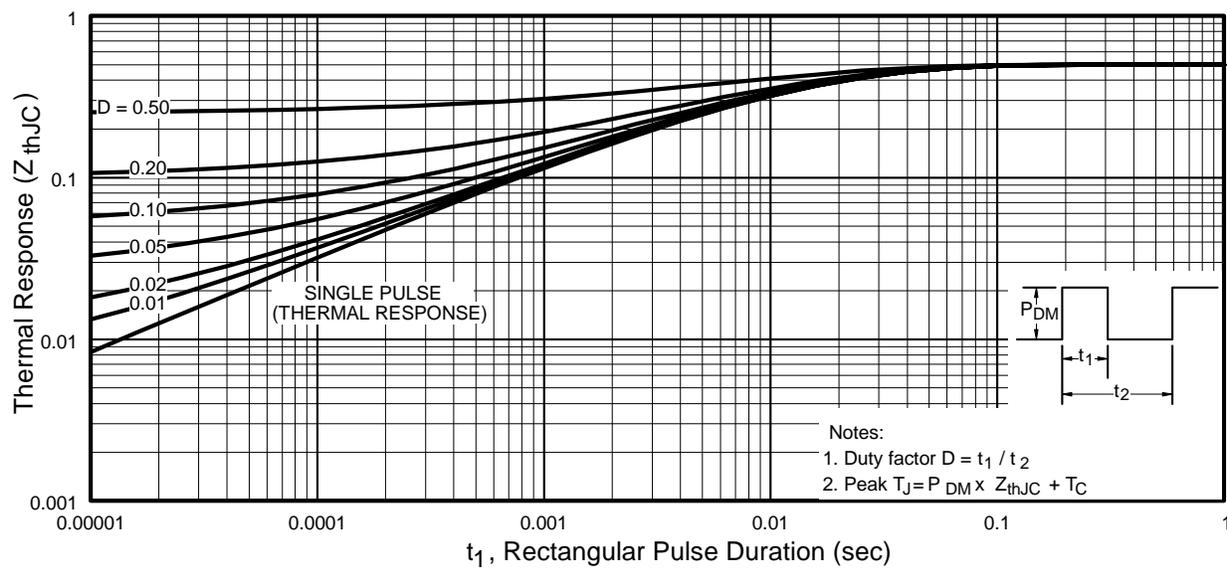


2N7473U2

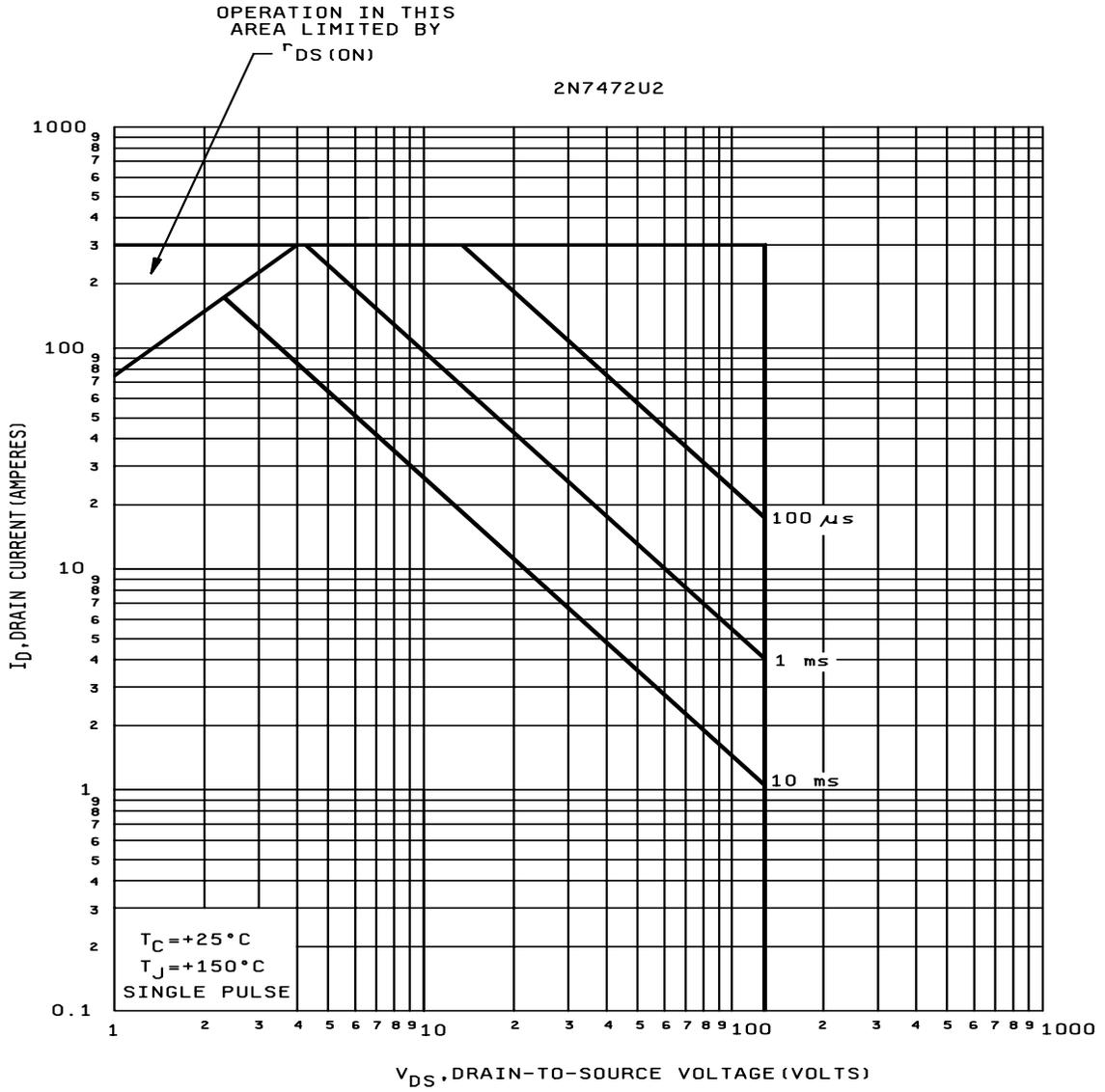


2N7474U2

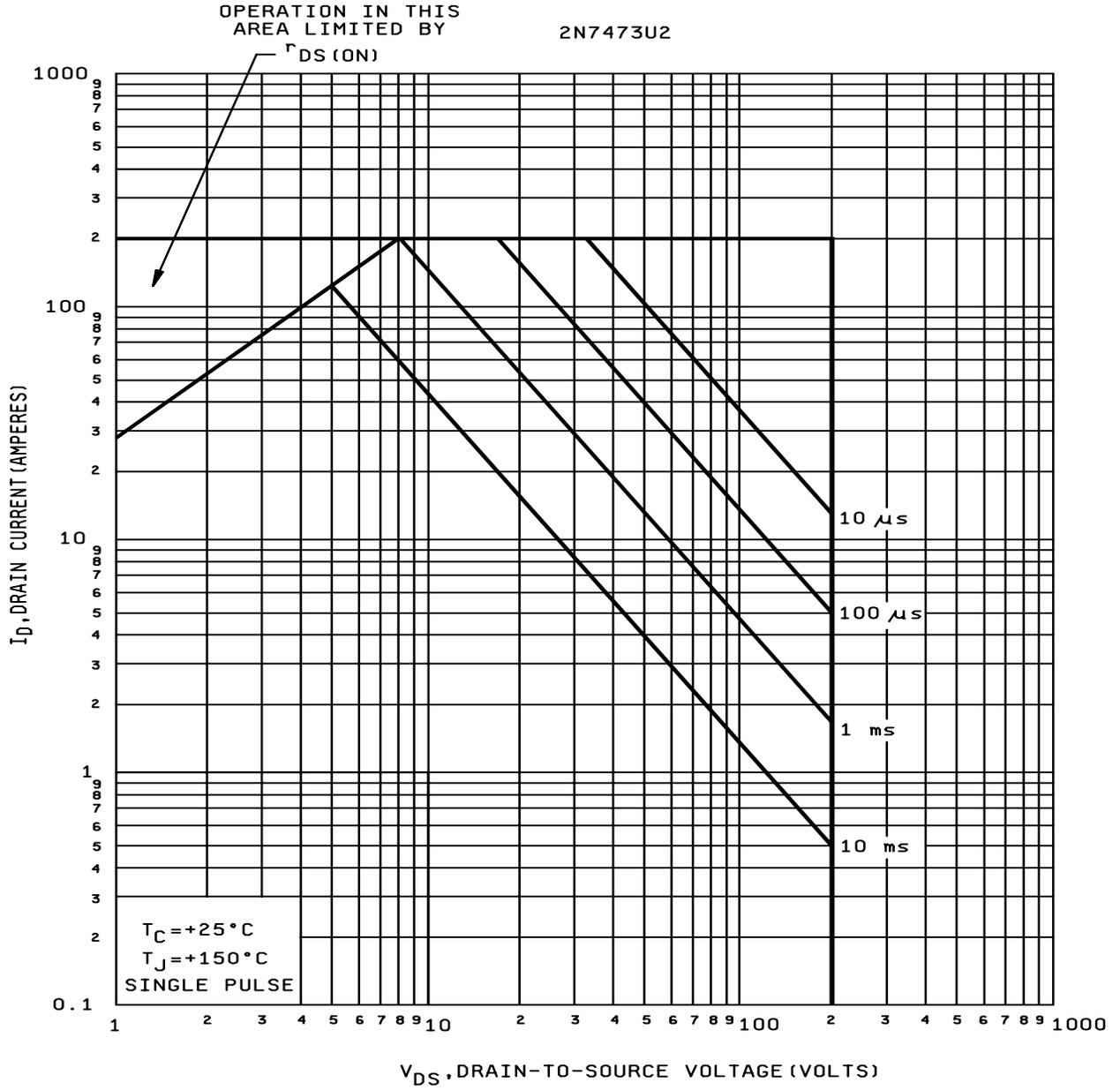
* FIGURE 2. Maximum drain current vs case temperature graphs.



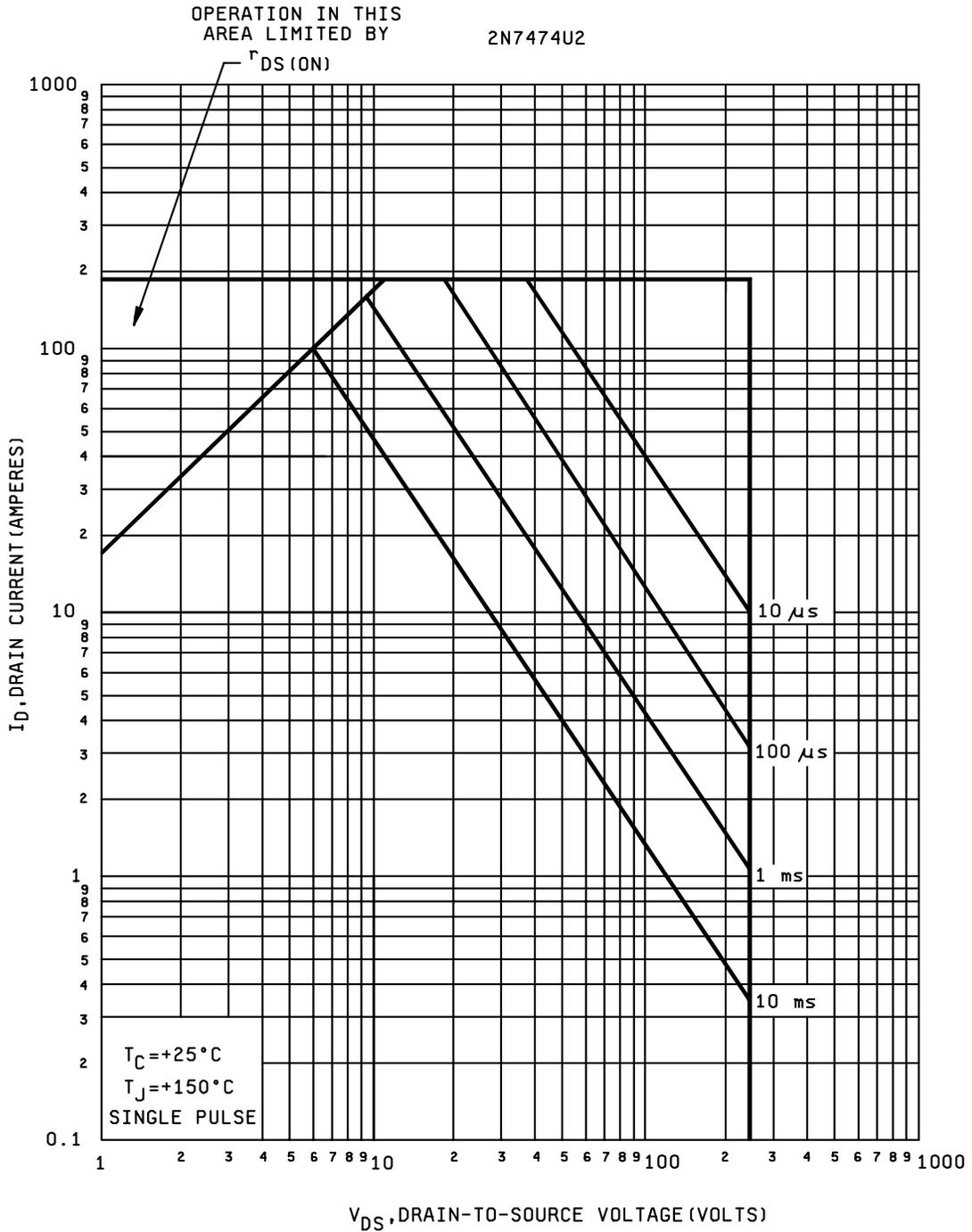
* FIGURE 3. Thermal response curve.



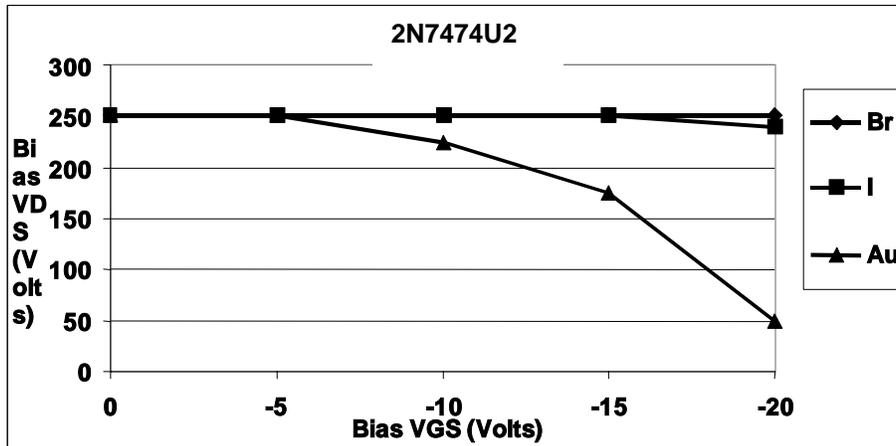
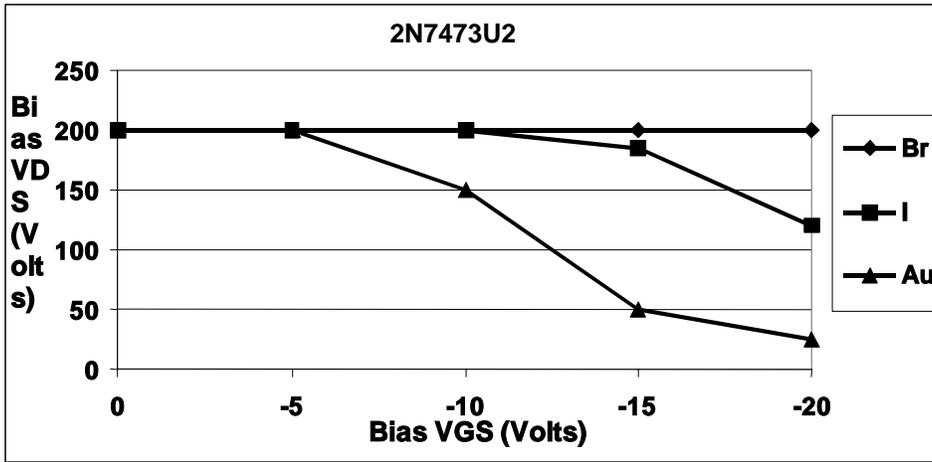
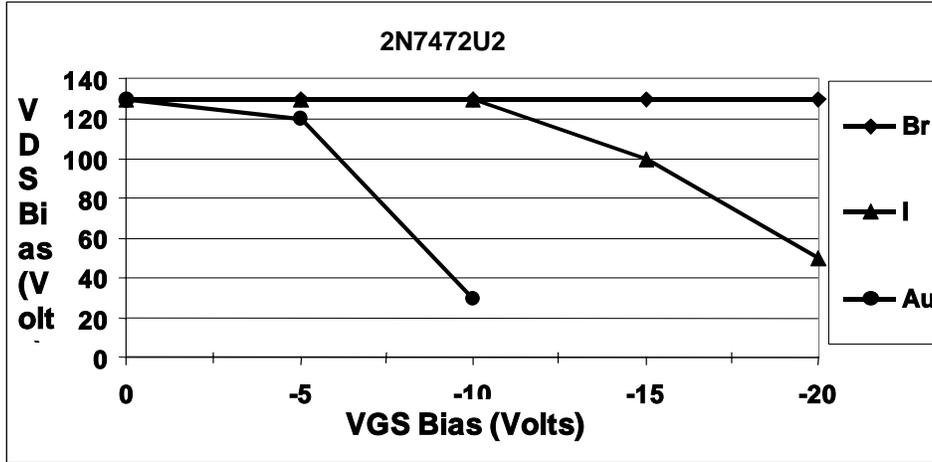
* FIGURE 4. Safe operating area graph.



* FIGURE 5. Safe operating area graph.



* FIGURE 6. Safe operating area graph.



* FIGURE 7. SEE safe operating 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. Lead finish (see 3.4.1).
- d. Type designation and product assurance level.
- e. Packaging requirements (see 5.1).

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 43216-5000.

6.4 Cross-reference list. The following table shows the generic P/N and its associated military P/N (without JAN and RHA prefix).

Generic P/N	Military P/N
IRHNA57163SE	2N7472U2
IRHNA57260SE	2N7473U2
IRHNA57264SE	2N7474U2

* 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 5961-2836)

