

The documentation and process conversion measures necessary to comply with this revision shall be completed by 10 February 2005.

INCH-POUND

MIL-PRF-19500/603F
 10 November 2004
 SUPERSEDING
 MIL-PRF-19500/603E
 29 May 2003

* PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED
 (TOTAL DOSE ONLY) TRANSISTORS, N-CHANNEL, SILICON,
 TYPES 2N7268, 2N7269, 2N7270, 2N7394, 2N7268U, 2N7269U, 2N7270U, AND 2N7394U,
 JANTXVR, F, G, AND H; AND JANSR, F, G, AND H

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

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

* 1.2 Physical dimensions. See figure 1 (TO-254AA) and figure 2 (surface mount, TO-276AC).

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

Type	P_T (1)	P_T $T_A = +25^\circ\text{C}$	$R_{\theta JA}$ max	$R_{\theta JC}$ max	V_{DS}	V_{DG}	V_{GS}	I_{D1} (2) (3)	I_{D2} (2) (3) $T_C = +100^\circ\text{C}$	I_S (2)
	<u>W</u>	<u>W</u>	<u>$^\circ\text{C/W}$</u>	<u>$^\circ\text{C/W}$</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>
2N7394, 2N7394U	150	4	35	0.83	60	60	± 20	35.0	30.0	35.0
2N7268, 2N7268U	150	4	35	0.83	100	100	± 20	34.0	21.0	34.0
2N7269, 2N7269U	150	4	35	0.83	200	200	± 20	26.0	16.0	26.0
2N7270, 2N7270U	150	4	35	0.83	500	500	± 20	11.0	7.0	11.0

Type	I_{DM}	T_J and T_{STG}	V_{ISO} 70,000 ft altitude
	<u>A(pk)</u>	<u>$^\circ\text{C}$</u>	<u>V dc</u>
2N7394, 2N7394U	140	-55 to +150	N/A
2N7268, 2N7268U	136		N/A
2N7269, 2N7269U	104		N/A
2N7270, 2N7270U	44		500

See notes 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@dsc.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. Unless otherwise specified, $T_C = +25^\circ\text{C}$ - Continued.

- (1) Derate linearly 1.2 W/°C for $T_C > +25^\circ\text{C}$.
- (2) The following formula derives the maximum theoretical I_D limit. I_D is limited by package design:

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

- (3) See figure 3 for maximum drain current graphs.

1.4 Primary electrical characteristics at $T_C = +25^\circ\text{C}$.

Type	Min $V_{(BR)DSS}$ $V_{GS} = 0$ $I_D = 1.0$ mA dc	$V_{GS(TH)1}$ $V_{DS} \geq V_{GS}$ $I_D = 1.0$ mA dc		Max I_{DSS1} $V_{GS} = 0$ $V_{DS} = 80$ percent of rated V_{DS}	Max $r_{DS(ON)}$ (1) $V_{GS} = 12$ V dc		E_{AS} at I_{D1}	I_{AS}
					$T_J = +25^\circ\text{C}$ at I_{D2}	$T_J = +150^\circ\text{C}$ at I_{D2}		
	<u>V dc</u>	Min <u>V dc</u>	Max <u>V dc</u>	<u>μA dc</u>	<u>ohm</u>	<u>ohm</u>	<u>mJ</u>	<u>A</u>
2N7394, 2N7394U	60	2.0	4.0	25	0.027	0.030	500	35.0
2N7268, 2N7268U	100	2.0	4.0	25	0.065	0.132	500	34.0
2N7269, 2N7269U	200	2.0	4.0	25	0.100	0.230	500	26.0
2N7270, 2N7270U	500	2.0	4.0	50	0.450	1.260	500	11.0

(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.

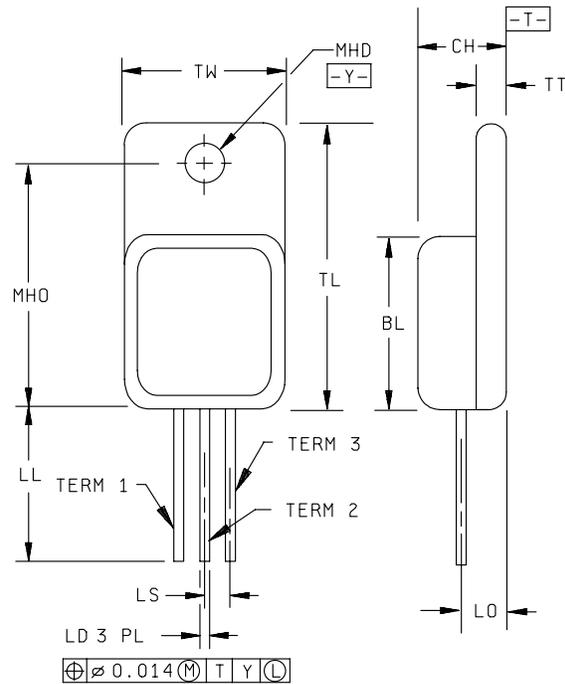
* DEPARTMENT OF DEFENSE STANDARDS

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.

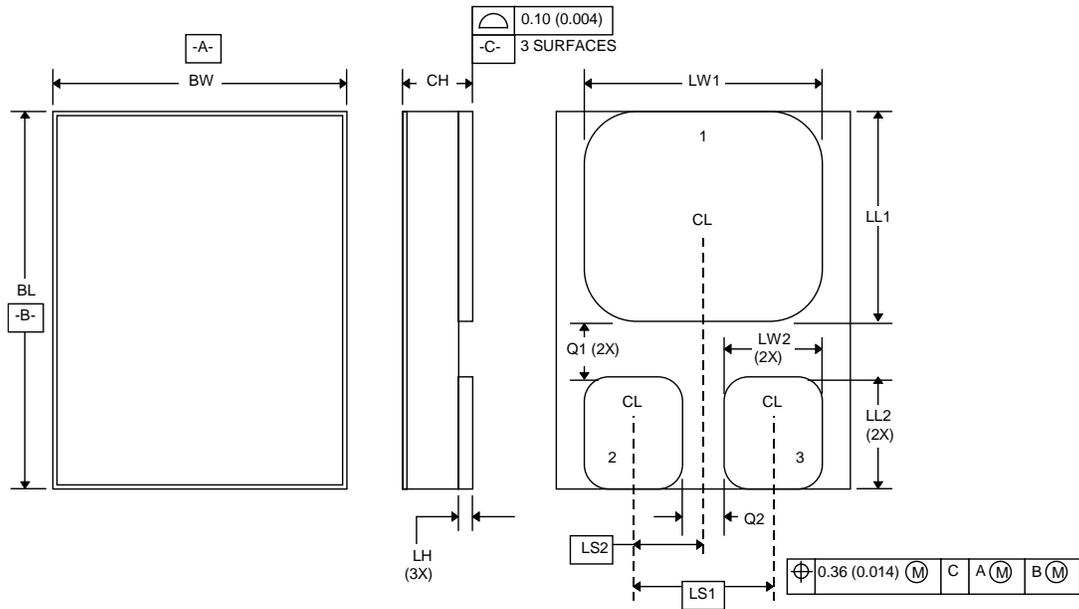
Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.535	.545	13.59	13.89
CH	.249	.260	6.32	6.60
LD	.035	.045	0.89	1.14
LL	.665	.685	16.89	17.40
LO	.150 BSC		3.81 BSC	
LS	.150 BSC		3.81 BSC	
MHD	.139	.149	1.53	3.78
MHO	.665	.685	16.89	17.40
TL	.790	.800	20.07	20.32
TT	.040	.050	1.02	1.27
TW	.535	.545	13.59	13.89
Term 1	Drain			
Term 2	Source			
Term 3	Gate			



NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Refer to applicable symbol list.
4. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.
5. All terminals are isolated from case.

* FIGURE 1. Physical dimensions for TO-254AA (2N7268, 2N7269, 2N7270, and 2N7394).



* FIGURE 2. Dimensions and configuration of surface mount package outline, TO-276AC (2N7268U, 2N7269U, 2N7270U, AND 2N7394U).

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Dimensions				
Symbol	SMD-1			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.620	.630	15.75	16.00
BW	.445	.455	11.30	11.56
CH		.142		3.60
LH	.010	.020	0.26	0.50
LL ₁	.410	.420	10.41	10.67
LL ₂	.152	.162	3.86	4.11
LS ₁	.210 BSC		5.33 BSC	
LS ₂	.105 BSC		2.67 BSC	
LW ₁	.370	.380	9.40	9.65
LW ₂	.135	.145	3.43	3.68
Q ₁	.030		0.76	
Q ₂	.035		0.89	
Term 1	Drain			
Term 2	Gate			
Term 3	Source			

NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. The lid shall be electrically isolated from the drain, gate and source.
4. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

* FIGURE 2. Dimensions and configuration of surface mount package outline, TO-276AC (2N7268U, 2N7269U, 2N7270U, AND 2N7394U) - Continued.

3. REQUIREMENTS

3.1 General. The individual item requirements shall be as specified in MIL-PRF-19500 and as modified herein.

3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.3).

* 3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500 and as follows.

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

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and on figures 1 and 2 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.

* 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.

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

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

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

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

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

* 3.8 Electrical test requirements. The electrical test requirements shall be 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 tables I and II).

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

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

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* 4.3 Screening (JANTXV and JANS levels only). Screening shall be in accordance with appendix E, table IV of MIL-PRF-19500 and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table IV of MIL-PRF-19500) (1) (2)	Measurement	
	JANS level	JANTXV levels
(3)	Gate stress test (see 4.3.1)	Gate stress test (see 4.3.1)
(3)	Single pulse avalanche energy test, method 3470 of MIL-STD-750 (see 4.3.2)	Single pulse avalanche energy test, method 3470 of MIL-STD-750 (see 4.3.2)
(3) 3c	Method 3161 of MIL-STD-750 (see 4.3.3)	Method 3161 of MIL-STD-750 (see 4.3.3)
7	Optional.	Optional.
9	Subgroup 2 of table II herein. I_{GSSF1} , I_{GSSR1} , I_{DSS1}	Subgroup 2 of table I herein
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 $\Delta I_{GSSF1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{GSSR1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{DSS1} = \pm 10$ μ A dc or ± 100 percent 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 $\Delta I_{GSSF1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{GSSR1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{DSS1} = \pm 10$ 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	Subgroups 2 and 3 of table I herein $\Delta I_{GSSF1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{GSSR1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{DSS1} = \pm 10$ 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
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) Shall be performed anytime before screen 9.

* 4.3.1 Gate stress test. Apply $V_{GS} = 30$ V minimum for $t = 250$ μ s minimum.

* 4.3.2 Single pulse avalanche energy E_{AS} .

- a. Peak current (I_{AS}) $I_{AS(max)}$.
- b. Peak gate voltage (V_{GS}) 12 V.
- c. Gate to source resistor (R_{GS}) $25\Omega \leq R_{GS} \leq 200\Omega$.
- d. Initial case temperature (T_C) $+25^\circ\text{C}$ $+10^\circ\text{C}$, -5°C .
- e. Inductance (L) $L = (2 \cdot E_{AS} / (I_{D1})^2) \cdot ((V_{BR} - V_{DD}) / V_{BR})$ mH minimum.
- f. Number of pulses to be applied 1 pulse minimum.
- g. Supply voltage (V_{DD}) 25 V for 2N7268, 2N7394, and 2N7268U; 50 V for 2N7269, 2N7269U, and 2N7270.

* 4.3.3 Thermal impedance ($Z_{\theta JC}$ measurements). The $Z_{\theta JC}$ measurements shall be performed in accordance with method 3161 of MIL-STD-750. The maximum limit (not to exceed figure 4, thermal impedance curves and the table I, 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 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 monitor.

- a. Measuring current (I_M) 10 mA.
- b. Drain heating current (I_H) 4 A minimum.
- c. Heating time (t_H) 100 ms (30 ms for "U" suffix devices).
- d. Drain-source heating voltage (V_H) 25 V (20 V for "U" suffix devices).
- e. Measurement time delay (t_{MD}) 30 to 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.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with appendix E, table V of MIL-PRF-19500 and table I herein. End-point electrical measurements shall be in accordance with table I, subgroup 2 herein.

* 4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table VIa (JANS) and table VIb (JANTXV) of MIL-PRF-19500, and herein. Electrical measurements (end-points) and delta requirements 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	2075	See 3.4.2.
B3	2077	SEM qualification may be performed anytime prior to lot formation.
B4	1042	The heating cycle shall be 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	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	The heating cycle shall be 30 seconds minimum.
* B3	2037	Test condition A. All internal bond wires for each device shall be pulled separately.
B4	2075	See 3.4.2.
B5 and 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 table VII of MIL-PRF-19500 and as follows. Electrical measurements (end-points) and delta requirements shall be in accordance with table I, subgroup 2 herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition A; weight = 10 pounds; t = 15 s (applicable to TO-254AA only).
C5	3161	See 4.5.2.
C6	1042	The heating cycle shall be 30 seconds minimum.

4.4.4 Group D Inspection. Group D inspection shall be conducted in accordance with appendix E, table VIII of MIL-PRF-19500 and table II herein.

4.4.5 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IX of MIL-PRF-19500 and as specified 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 MIL-STD-750.

4.5.2 Thermal resistance. Thermal resistance measurements shall be performed in accordance with method 3161 of MIL-STD-750. The maximum limit of $R_{\theta JC(max)} = 0.83^{\circ}C/W$. The following parameter measurements shall apply:

- a. Measuring current (I_M) 10 mA.
- b. Drain heating current (I_H) 4 A minimum.
- c. Heating time (t_H) Steady-state (see method 3161 of MIL-STD-750 for definition).
- d. Drain-source heating voltage (V_H) 25 V (20 V for "U" suffix devices).
- e. Measurement time delay (t_{MD}) 30 to 60 μ s.
- f. Sample window time (t_{SW}) 10 μ s maximum.

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* 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 4.3.3 TO-254 surface mount devices	Z _{θJC}		0.60 0.45	°C/W °C/W
Breakdown voltage, drain to source	3407	V _{GS} = 0; I _D = 1 mA dc bias condition C	V _{(BR)DSS}			
2N7394, 2N7394U 2N7268, 2N7268U 2N7269, 2N7269U 2N7270, 2N7270U				60 100 200 500		V dc V dc V dc V dc
Gate to source voltage threshold	3403	V _{DS} ≥ V _{GS} I _D = 1 mA dc	V _{GS(TH)1}	2.0	4.0	V dc
* Gate current	3411	V _{GS} = +20 V dc, 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, bias condition C V _{DS} = 80 percent of rated V _{DS}	I _{DSS1}			
2N7394, 2N7394U 2N7268, 2N7268U 2N7269, 2N7269U 2N7270, 2N7270U					25 25 25 50	μA dc μA dc μA dc μA dc
Static drain to source on-state resistance	3421	V _{GS} = 12 V dc, condition A pulsed (see 4.5.1), I _D = I _{D2}	r _{DS(on)1}			
2N7394, 2N7394U 2N7268, 2N7268U 2N7269, 2N7269U 2N7270, 2N7270U					0.027 0.065 0.100 0.450	ohm ohm ohm ohm
Static drain to source on-state resistance	3421	V _{GS} = 12 V dc, condition A pulsed (see 4.5.1), I _D = I _{D1}	r _{DS(on)2}			
2N7394, 2N7394U 2N7268, 2N7268U 2N7269, 2N7269U 2N7270, 2N7270U					0.030 0.070 0.110 0.500	ohm ohm ohm ohm
Forward voltage	4011	Pulsed (see 4.5.1), I _D = I _{D1} V _{GS} = 0 V dc	V _{SD}			
2N7394, 2N7394U 2N7268, 2N7268U 2N7269, 2N7269U 2N7270, 2N7270U					1.4 1.4 1.4 1.6	V V V V

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/ <u>Subgroup 3</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
High temperature operation:		$T_C = T_J = +125^\circ\text{C}$				
Gate current	3411	$V_{GS} = +20$ and -20 V dc bias condition C, $V_{DS} = 0$	I_{GSS2}		± 200	nA dc
Drain current	3413	$V_{GS} = 0$; bias condition C $V_{DS} = 100$ 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	$V_{GS} = 12$ V dc pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(on)3}$			
2N7394, 2N7394U 2N7268, 2N7268U 2N7269, 2N7269U 2N7270, 2N7270U					0.060 0.132 0.200 1.000	ohm ohm ohm ohm
Gate to source voltage (threshold)	3404	$V_{DS} \geq V_{GS}$, $I_D = 1$ mA dc	$V_{GS(TH)2}$	1.0		V dc
Low temperature operation:		$T_C = T_J = -55^\circ\text{C}$				
Gate to source voltage (threshold)	3404	$V_{DS} \geq V_{GS}$, $I_D = 1$ mA dc	$V_{GS(TH)3}$		5.0	V dc
<u>Subgroup 4</u>						
Forward transconductance	3475	$I_D = \text{rated } I_{D2}$, $V_{DD} = 15$ V (see 4.5.1)	g_{FS}			
2N7394, 2N7394U 2N7268, 2N7268U 2N7269, 2N7269U 2N7270, 2N7270U				12 8 8 4		S S S S
Switching time test	3472	$I_D = I_{D1}$, $V_{GS} = 12$ V dc $R_G = 2.35\Omega$, $V_{DD} = 50$ percent of rated V_{DS}				
Turn-on delay time			$t_{d(on)}$			
2N7394, 2N7394U 2N7268, 2N7268U 2N7269, 2N7269U 2N7270, 2N7270U					27 45 33 45	ns ns ns ns

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4</u> - Continued						
Rise time			t_r			
2N7394, 2N7394U					100	ns
2N7268, 2N7268U					190	ns
2N7269, 2N7269U					140	ns
2N7270, 2N7270U					190	ns
Turn-off delay time			$t_{d(off)}$			
2N7394, 2N7394U					75	ns
2N7268, 2N7268U					170	ns
2N7269, 2N7269U					140	ns
2N7270, 2N7270U					190	ns
Fall time			t_f			
2N7394, 2N7394U					75	ns
2N7268, 2N7268U					130	ns
2N7269, 2N7269U					140	ns
2N7270, 2N7270U					130	ns
<u>Subgroup 5</u>						
Safe operating area test (high voltage)	3474	See figures 5, 6, 7, and 8 $t_p = 10$ ms minimum $V_{DS} = 80$ percent of maximum rated V_{DS} , ($V_{DS} \leq 200$)				
Electrical measurements		See table I, subgroup 2				
<u>Subgroup 6</u>						
Not applicable						
<u>Subgroup 7</u>						
Gate charge	3471	Condition B				
On-state gate charge			$Q_{g(on)}$			
2N7394, 2N7394U					200	nC
2N7268, 2N7268U					160	nC
2N7269, 2N7269U					170	nC
2N7270, 2N7270U					150	nC

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 7</u> - Continued						
Gate to source charge 2N7394, 2N7394U 2N7268, 2N7268U 2N7269, 2N7269U 2N7270, 2N7270U			Q _{gs}		60 35 30 30	nC nC nC nC
Gate to drain charge 2N7394, 2N7394U 2N7268, 2N7268U 2N7269, 2N7269U 2N7270, 2N7270U			Q _{gd}		75 65 60 75	nC nC nC nC
Reverse recovery time 2N7394, 2N7394U 2N7268, 2N7268U 2N7269, 2N7269U 2N7270, 2N7270U	3473	di/dt ≤ 100 A/μs, V _{DD} ≤ 30 V, I _D = I _{D1}	t _{rr}		280 570 820 1,100	ns ns ns ns

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

^{2/} This test is required for the following end-point measurements only (not intended for 4.3, 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; table VII of MIL-PRF-19500, group C, subgroups 2 and 6; table

IX of

MIL-PRF-19500, group E, subgroup 1.

TABLE II. Group D inspection.

Inspection 1/ 2/	MIL-STD-750		Symbol	Preirradiation limits				Postirradiation limits				Unit
	Method	Conditions		R		3/ F, G, and H		R		3/ F, G, and H		
				Min	Max	Min	Max	Min	Max	Min	Max	
<u>Subgroup 1</u>												
Not applicable												
<u>Subgroup 2</u>		$T_C = +25^\circ\text{C}$										
Steady-state total dose irradiation (VGS bias) 4/	1019	$V_{GS} = 12\text{ V}$ $V_{DS} = 0$										
Steady-state total dose irradiation (VDS bias) 4/	1019	$V_{GS} = 0$ $V_{DS} = 80$ percent of rated V_{DS} (pre-irradiation)										
End-point electricals												
Breakdown voltage, drain to source	3407	$V_{GS} = 0;$ $I_D = 1\text{ mA}$ bias cond. C	V_{BRDSS}									
2N7394, 2N7394U				60		60		60		60		V dc
2N7268, 2N7268U				100		100		100		100		V dc
2N7269, 2N7269U				200		200		200		200		V dc
2N7270, 2N7270U				500		500		500		500		V dc
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$ $I_D = 1\text{ mA}$	V_{GSth}									
2N7394, 2N7394U				2	4	2	4	2	4	1.25	4.50	V dc
2N7268, 2N7268U				2	4	2	4	2	4	1.25	4.50	V dc
2N7269, 2N7269U				2	4	2	4	2	4	1.25	4.50	V dc
2N7270, 2N7270U				2	4	2	4	2	4	1.25	4.50	V dc
Gate current	3411	$V_{GS} = 20\text{ V}$ $V_{DS} = 0$ bias cond. C	I_{GSSF1}		100		100		100		100	nA dc
Gate current	3411	$V_{GS} = 20\text{ V}$ $V_{DS} = 0$ bias cond. C	I_{GSSR1}		-100		-100		-100		-100	nA dc

See footnotes at end of table.

TABLE II. Group D inspection - Continued.

Inspection <u>1/ 2/</u>	MIL-STD-750		Symbol	Preirradiation limits				Postirradiation limits				Unit
	Method	Conditions		R		<u>3/</u> F, G, and H		R		<u>3/</u> F, G, and H		
				Min	Max	Min	Max	Min	Max	Min	Max	
<u>Subgroup 2</u> - Continued	3413	Bias cond. C $V_{GS} = 0$ $V_{DS} = 80$ percent of rated V_{DS} (pre- irradiation)	I_{DSS}									
				2N7394, 2N7394U 2N7268, 2N7268U 2N7269, 2N7269U 2N7270, 2N7270U	25 25 25 50	25 25 25 50	25 25 25 50	50 50 50 100	μA dc μA dc μA dc μA dc			
Static drain to source on-state voltage	3405	Condition A $V_{GS} = 12$ V pulsed see 4.5.1 $I_D = I_{D2}$	V_{DSon1}									
				2N7394, 2N7394U 2N7268, 2N7268U 2N7269, 2N7269U 2N7270, 2N7270U	0.81 1.365 1.6 3.15	0.81 1.365 1.6 3.15	0.81 1.365 1.6 3.15	1.2 1.89 2.48 4.2	Vdc Vdc Vdc Vdc			
Forward voltage source drain diode	4011	$V_{GS} = 0$ $I_D = I_{D1}$	V_{SD}									
				2N7394, 2N7394U 2N7268, 2N7268U 2N7269, 2N7269U 2N7270, 2N7270U	1.4 1.4 1.4 1.6	1.4 1.4 1.4 1.6	1.4 1.4 1.4 1.6	1.4 1.4 1.4 1.6	Vdc Vdc Vdc Vdc			

- 1/ For sampling plan, see MIL-PRF-19500. 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.
- 2/ Group D qualification may be performed anytime prior to lot formation. Wafers qualified to these group D QCI requirements may be used for any other specification sheet utilizing the same die design.
- 3/ The F designation represent devices which pass end-points at both 100 k and 300 k rads (Si). The G designation represents devices which pass 100 k, 300 k, and 600 k rad (Si) end-points. H must meet end-points for 100 k, 300 k, 600 k and 1,000 k RAD (Si).
- 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 and large lot quality conformance inspection
	Method	Conditions	
<u>Subgroup 1</u>			12 devices c = 0
Thermal shock (temperature cycling)	1051	Test condition G.	
* Hermetic seal Fine leak Gross leak	1071	Test conditions G or H Test conditions C or D	
Electrical measurements		See table I, subgroup 2.	
<u>Subgroup 2 1/</u>			12 devices c = 0
Steady-state gate bias	1042	Condition B, 1,000 hours.	
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 4</u>			Sample size N/A
* Thermal impedance curves		Each supplier shall submit their qual-lot average and design maximum thermal impedance curves. In addition, the optimal test conditions and $Z_{\theta JX}$ limit shall be provided to the qualifying activity in the qualification report	
<u>Subgroup 5</u>			15 devices c = 0
Barometric pressure (2N7270, 2N7270U only)	1001	Test condition C. For device type 2N7270, 2N7270U: $V_{DS} = 500 \text{ V}$; $I_{(ISO)} < 0.25 \text{ mA}$.	
<u>Subgroup 6</u>			3 devices
* ESD	1020	Not required for devices classified as ESD class 1.	
<u>Subgroup 8</u>			22 devices c = 0
* 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		

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

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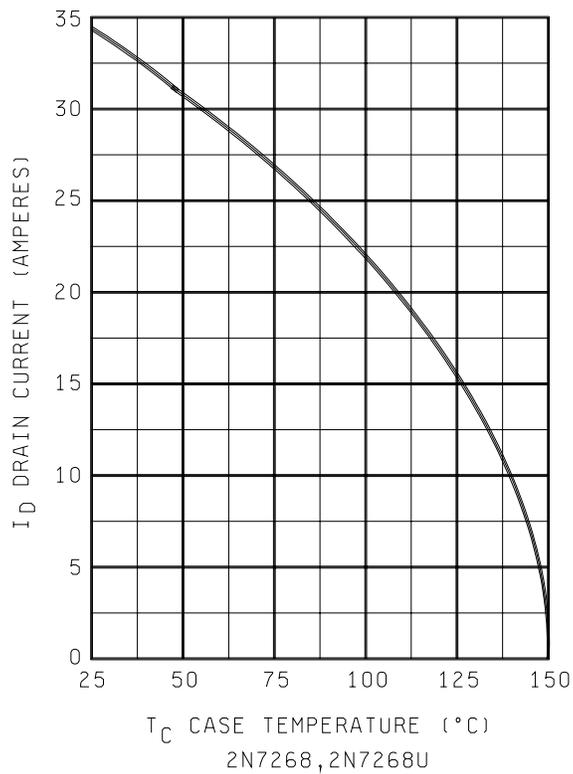
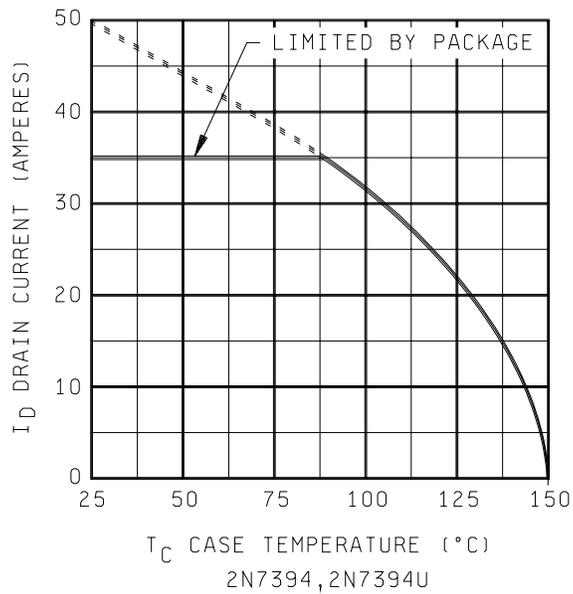


FIGURE 3. Maximum drain current vs case temperature.

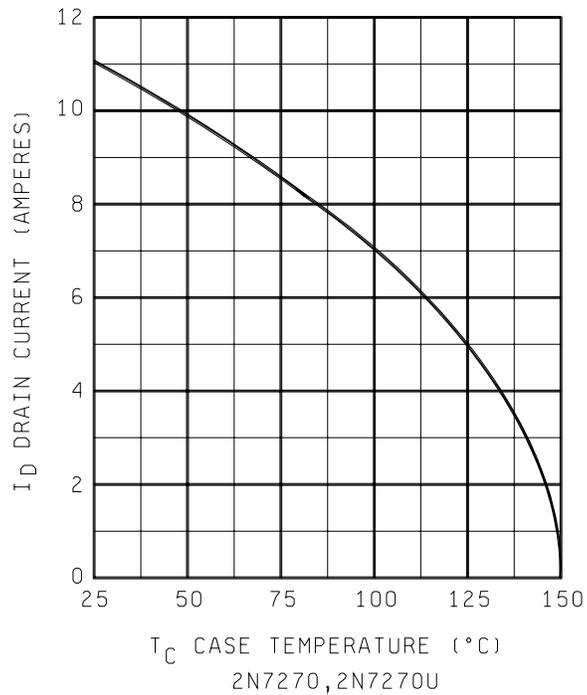
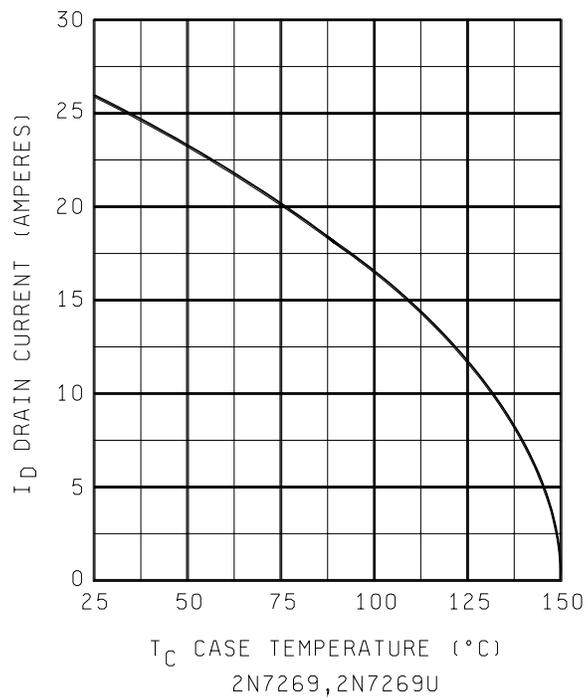


FIGURE 3. Maximum drain current vs case temperature - Continued.

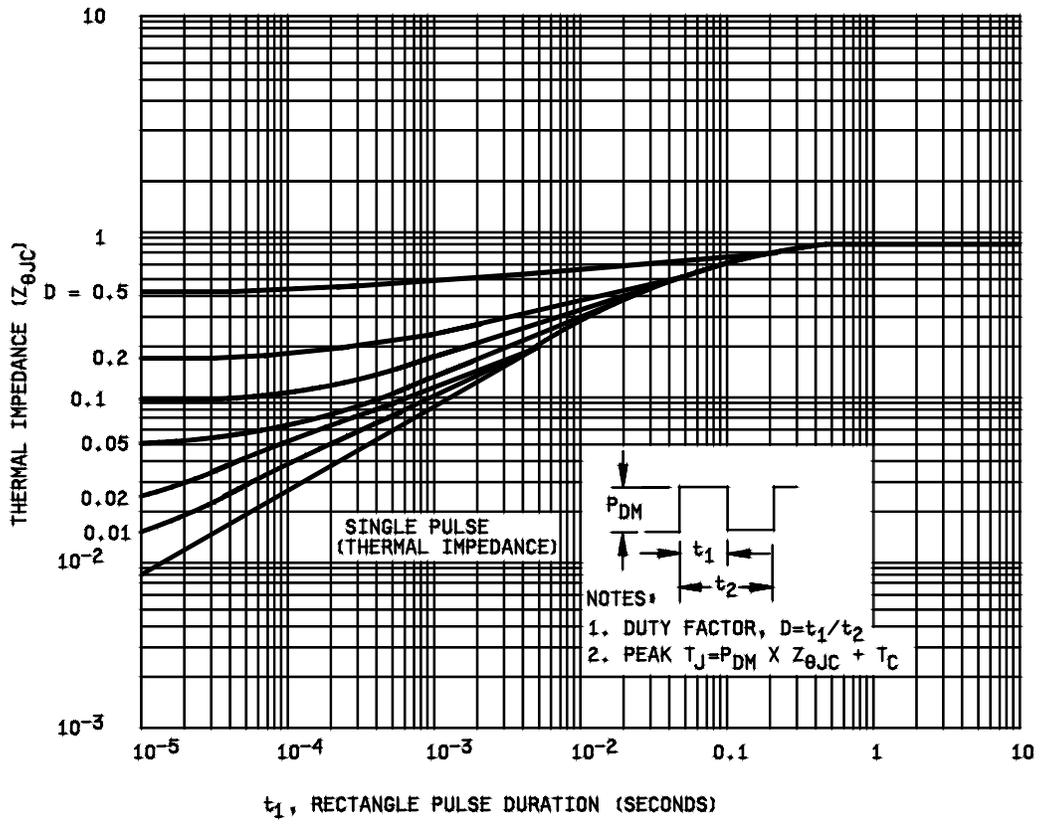


FIGURE 4. Thermal impedance curves.

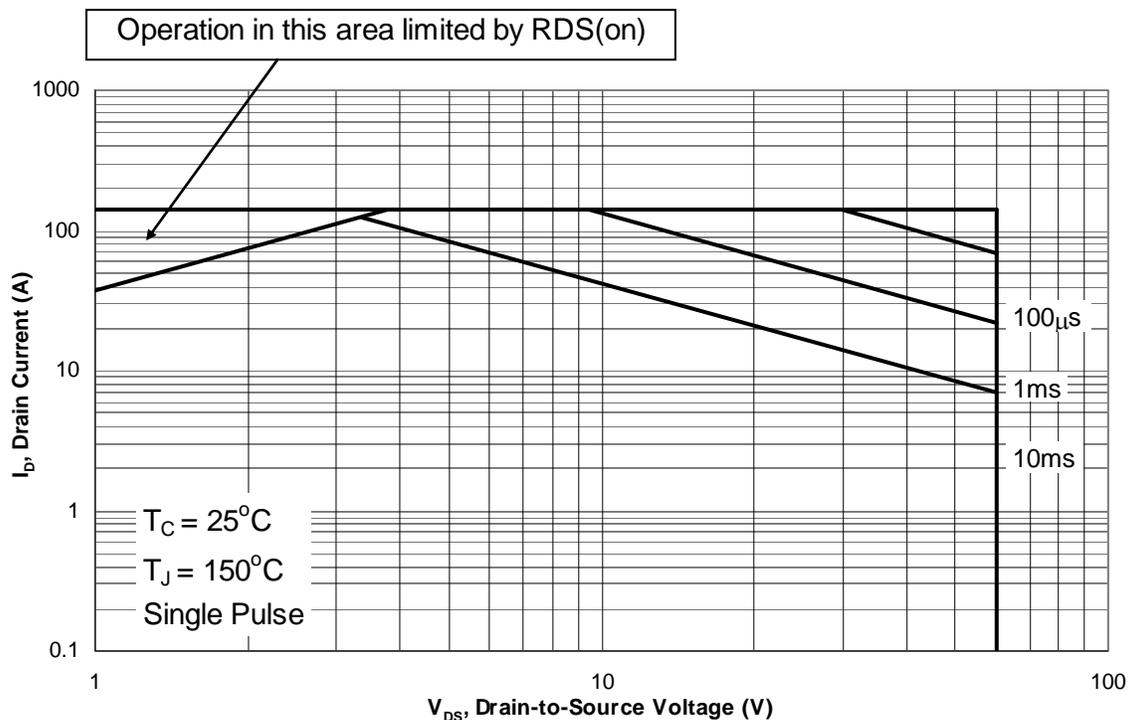


FIGURE 5. Safe operating area graph.

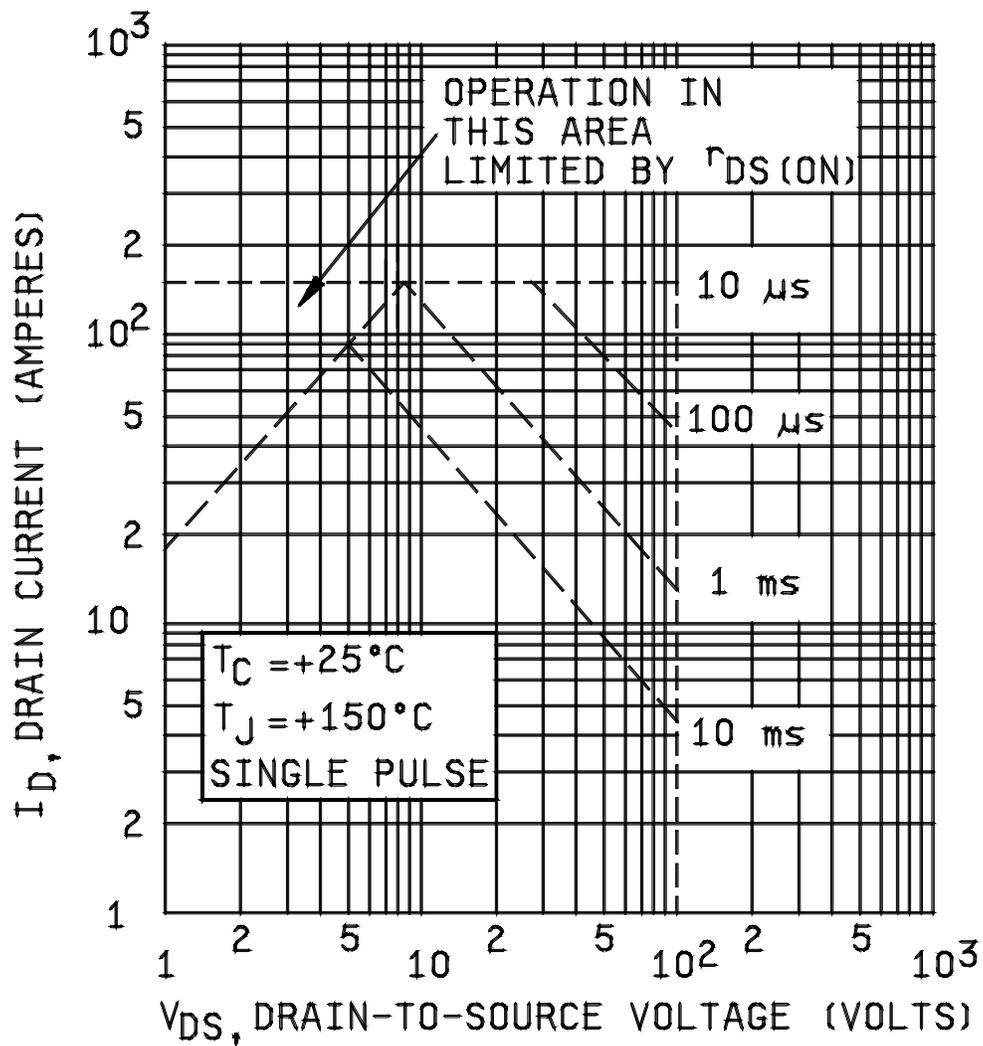


FIGURE 6. Safe operating area graph.

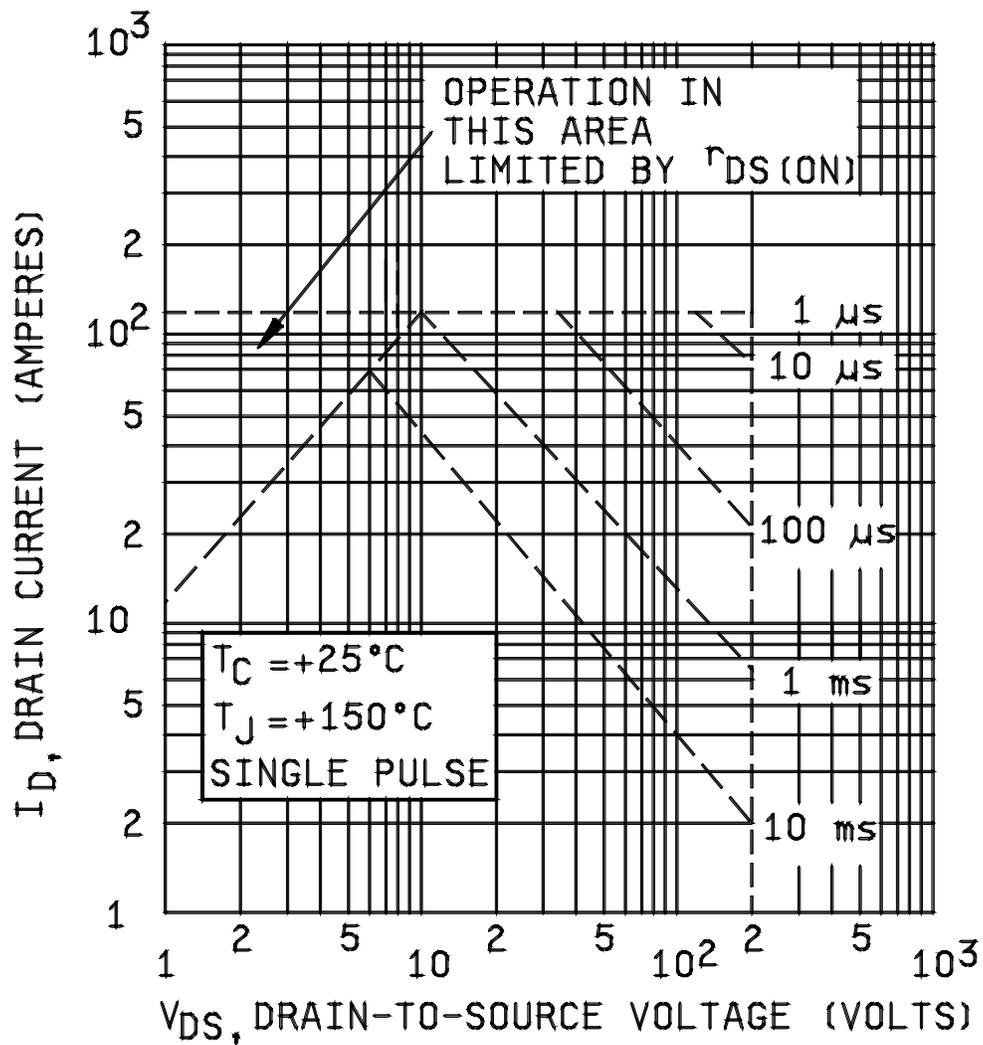


FIGURE 7. Safe operating area graph.

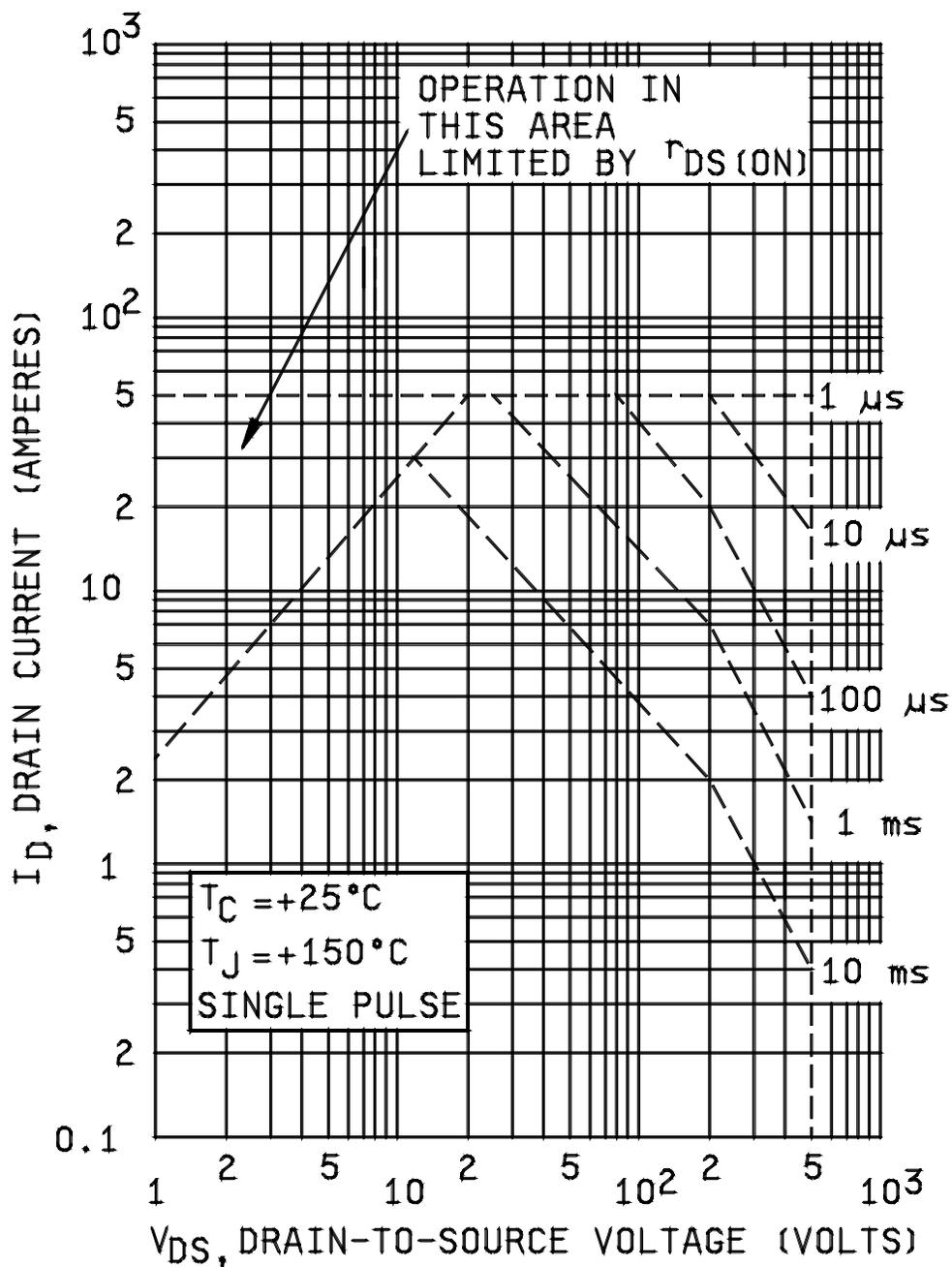


FIGURE 8. Safe operating area graph.

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 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 Part or Identifying Number (PIN). This information in no way implies that manufacturer's PIN's are suitable for the military PIN.

Preferred types	Commercial types (1)	
	TO254-AA	"U"
2N7394	IRHM7054	IRHN7054
2N7268	IRHM7150	IRHN7150
2N7269	IRHM7250	IRHN7250
2N7270	IRHM7450	IRHN7450

- (1) IRH 7: 100k RAD (Si)
 IRH 3: 300k RAD (Si)
 IRH 4: 600k RAD (Si)
 IRH 8: 1,000k RAD (Si)

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.

Custodians:

Army - CR
Navy - EC
Air Force - 11
NASA - NA
DLA - CC

Preparing activity:

DLA - CC

(Project 5961-2879)

Review activities:

Navy - TD
Air Force - 19, 70

* NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <http://assist.daps.dla.mil/> .