

The documentation and process conversion measures necessary to comply with this revision shall be completed by 31 January 2004.

INCH-POUND

MIL-PRF-19500/655C
 31 October 2003
 SUPERSEDING
 MIL-PRF-19500/655B
 9 January 2001

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED
 (TOTAL DOSE ONLY) TRANSISTOR, P-CHANNEL
 SILICON TYPES 2N7424U, 2N7425U AND 2N7426U
 JANTXVR AND F AND JANSR AND F

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 a P-Channel, enhancement-mode, MOSFET, radiation hardened (total dose only), power transistor. Two levels of product assurance are provided for each device type as 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, (surface mount).

* 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} (2) (3) T _C =+25° C	I _{D2} (2) 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>
2N7424U	300	2.5	-60	-60	±20	-48	-30	-48	-192	-55
2N7425U	300	2.5	-100	-100	±20	-38	-24	-38	-152	to
2N7426U	300	2.5	-200	-200	±20	-29	-18	-29	-108	+150

(1) Derate linearly by 2.4 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.

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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 -2.0 -4.0	<u>μA dc</u>	<u>Ω</u>	<u>Ω</u>	<u>°C/W</u>	<u>mJ</u>
2N7424U	-60		-25	0.045	0.100	0.42	500
2N7425U	-100			0.068	0.150		
2N7426U	-200			0.154	0.360		

(1) Pulsed (see 4.5.1).

2. APPLICABLE DOCUMENTS

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

2.2 Government documents.

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

SPECIFICATION

DEPARTMENT OF DEFENSE

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

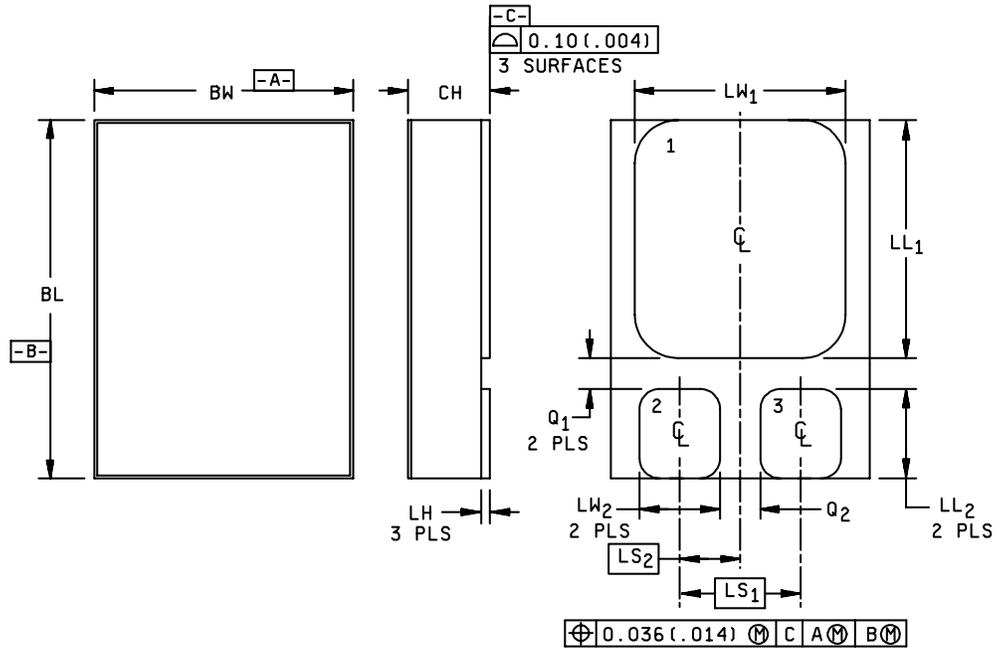
STANDARD

DEPARTMENT OF DEFENSE

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

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

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



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	4.11
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 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 1. Dimensions and configuration.

3. REQUIREMENTS

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

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

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

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

* 3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in MIL-PRF-19500, and on figure 1 (SMD2) herein.

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).

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

3.5.1 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.

- 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.

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

3.7 Electrical test requirements. The electrical test requirements shall be the subgroups as specified in group A, table I herein.

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

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 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.

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* 4.3 Screening (JANS 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	JANTXV
(3)	Gate stress test (see 4.3.1)	Gate stress test (see 4.3.1)
(3)	Method 3470 of MIL-STD-750, (see 4.3.2), E _{AS} test	Method 3470 of MIL-STD-750, (see 4.3.2), E _{AS} test
(3) 3c	Method 3161 of MIL-STD-750, (see 4.3.3), thermal impedance	Method 3161 of MIL-STD-750, (see 4.3.3), thermal impedance
9	Subgroup 2 of table I herein I _{DSS1} , I _{GSSF1} , I _{GSSR1} , as a 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 percent of initial value, whichever is greater. ΔI _{GSSR1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI _{DSS1} = ±10 μA 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 ΔI _{GSSF1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI _{GSSR1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI _{DSS1} = ±10 μA dc or ±100 percent of initial value, whichever is greater. Δr _{DS(ON)1} = ±20 percent of initial value. ΔV _{GS(TH)1} = ±20 percent of initial value.	Subgroups 2 and 3 of table I herein ΔI _{GSSF1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI _{GSSR1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI _{DSS1} = ±10 μA dc or ±100 percent of initial value, whichever is greater. Δr _{DS(ON)1} = ±20 percent of initial value. ΔV _{GS(TH)1} = ±20 percent of initial value.

- (1) At the end of the test program, I_{GSSF1}, I_{GSSR1}, and I_{DSS1} are measured.
- (2) An out-of-family program to characterize I_{GSSF1}, I_{GSSR1}, I_{DSS1} and V_{GS(th)1} shall be invoked.
- (3) Shall be performed anytime before screen 9.

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* 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 $V_{DD} = -25$ V dc, except $V_{DD} = -50$ V dc for 2N7426U.
- e. Initial case temperature $T_C = +25^\circ$ C, -5° C, $+10^\circ$ 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 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 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 and 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) 10 A.
- c. Heating time (t_H) 30 ms.
- d. Drain-source heating voltage (V_H) 20 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. 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.

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* 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.

* 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>
C5	3161	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.

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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 II herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

4.5 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

4.5.2 Thermal resistance. Thermal resistance measurements shall be performed in accordance with method 3161 of MIL-STD-750. The maximum limit of $R_{\theta JC} = 0.42 \text{ }^\circ\text{C/W}$. The following parameters shall apply:

- a. Measuring current (I_M) 10 mA.
- b. Drain heating current (I_H) 10 A.
- c. Heating time (t_H) Steady-state (see method 3161, MIL-STD-750).
- d. Drain-source heating voltage (V_H) 20 V.
- e. Measurement time delay (t_{MD}) 30 to 60 μs .
- f. Sample window time (t_{SW}) 10 μs 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 Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. 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.

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* TABLE I. Group A inspection.

Inspection 1/	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 2/	3161	See 4.3.3	$Z_{\theta JC}$.32	°C/W
Breakdown voltage drain to source	3407	$V_{GS} = 0V$, $I_D = -1 \text{ mA dc}$, bias condition C	$V_{(BR)DSS}$			
2N7424U				-60		V dc
2N7425U				-100		V dc
2N7426U				-200		V dc
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$, $I_D = -1 \text{ mA dc}$	$V_{GS(TH)1}$	-2.0	-4.0	V dc
Gate current	3411	$V_{GS} = \pm 20V \text{ dc}$, bias condition C, $V_{DS} = 0V$	I_{GSS1}		± 100	nA dc
Drain current	3413	$V_{GS} = 0V \text{ dc}$, bias condition C, $V_{DS} = 80 \text{ percent of rated } V_{DS}$,	I_{DSS1}		-25	$\mu A \text{ dc}$
Static drain to source "ON" state resistance	3421	$V_{GS} = -12V \text{ dc}$, condition A, Pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(ON)1}$			
2N7424U					0.045	Ω
2N7425U					0.068	Ω
2N7426U					0.154	Ω
Static drain to source "ON" state resistance	3421	$V_{GS} = -12V \text{ dc}$, condition A, Pulsed (see 4.5.1), $I_D = I_{D1}$	$r_{DS(ON)2}$			
2N7424U					0.048	Ω
2N7425U					0.071	Ω
2N7426U					0.159	Ω
Forward voltage	4011	$V_{GS} = 0V \text{ dc}$, condition A, pulsed (see 4.5.1), $I_D = I_{D1}$	V_{SD}			
2N7424U					-3.0	V dc
2N7425U					-3.3	V dc
2N7426U					-3.0	V dc

See footnotes at end of table.

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* TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
<u>Subgroup 3</u>						
High temperature operation						
Gate current	3411	$V_{GS} = \pm 20V$ dc, bias condition C, $V_{DS} = 0V$	I_{GSS2}		± 200	nA dc
Drain current	3413	$V_{GS} = 0V$ dc, bias condition C, $V_{DS} = 80$ percent of rated V_{DS}	I_{DSS2}		-0.25	mA dc
Static drain to source "ON"-state resistance 2N7424U 2N7425U 2N7426U	3421	$V_{GS} = -12V$ dc, condition A, Pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(ON)3}$		0.085 0.135 0.35	Ω Ω Ω
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$, $I_D = -1$ mA dc	$V_{GS(TH)2}$	-1.0		V dc
Low temperature operation						
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS(TH)3}$, $I_D = -1$ mA dc	$V_{GS(TH)3}$		-5.0	V dc
<u>Subgroup 4</u>						
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 2N7424U 2N7425U 2N7426U			$t_{D(on)}$		35 35 37	ns ns ns
Rise time 2N7424U 2N7425U 2N7426U			t_r		150 170 141	ns ns ns
Turn-off delay time 2N7424U 2N7425U 2N7426U			$t_{D(off)}$		200 190 148	ns ns ns
Fall time 2N7424U 2N7425U 2N7426U			t_f		200 190 220	ns ns 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	Condition		Min	Max		
<u>Subgroup 4</u> - continued Forward Transconductance 2N7424U 2N7425U 2N7426U	3475	$I_D = \text{rated } I_{D2}, V_{DD} = 15 \text{ V}$ (see 4.5.1)	g _{FS}				
				18		S	
				15		S	
				14		S	
<u>Subgroup 5</u> Safe operating area test (high voltage)	3474	See figures 4, 5 and 6 $t_p = 10 \text{ ms min. } V_{DS} = 80$ 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					
On-state gate charge				Q _{G(ON)}			
2N7424U						300	nC
2N7425U						290	nC
2N7426U					300	nC	
Gate to source charge				Q _{GS}			
2N7424U						70	nC
2N7425U						72	nC
2N7426U					65	nC	
Gate to drain charge				Q _{GD}			
2N7424U						91	nC
2N7425U						90	nC
2N7426U		58	nC				
Reverse recovery time	3473	$di/dt = -100 \text{ A}/\mu\text{s}, V_{DD} \leq -50 \text{ V}$ $I_D = I_{D1}$	t _{rr}				
2N7424U					270	ns	
2N7425U					300	ns	
2N7426U					738	ns	

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

2/ This test required for the following endpoint measurements only (not intended for screen 9, 11, or 13):

Group B Subgroups 2 and 3 (JANTXV)

Group B Subgroups 3 and 4 (JANS)

Group C, subgroup 6

Group E, subgroup 1

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TABLE II. Group D inspection.

Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Pre-irradiation limits		Post-irradiation limits				Unit
	Method	Conditions		R and F		R		F 4/		
				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) 5/	1019	$V_{GS} = -12 \text{ V};$ $V_{DS} = 0 \text{ V}$								
Steady-state total dose irradiation (VDS Bias) 5/	1019	$V_{GS} = 0 \text{ V};$ $V_{DS} = 80 \text{ percent}$ of rated V_{DS} (preirradiation)								
End-point electricals										
Breakdown voltage, drain to source	3407	$V_{GS} = 0 \text{ V};$ $I_D = -1 \text{ mA};$ bias condition C	$V_{(BR)DSS}$							
2N7424U				-60		-60		-60		V dc
2N7425U				-100		-100		-100		V dc
2N7426U				-200		-200		-200		V dc
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$ $I_D = -1 \text{ mA}$	$V_{GS(th)1}$							
2N7424U				-2.0	-4.0	-2.0	-4.0	-2.0	-5.0	V dc
2N7425U				-2.0	-4.0	-2.0	-4.0	-2.0	-5.0	V dc
2N7426U				-2.0	-4.0	-2.0	-4.0	-2.0	-5.0	V dc
Gate current	3411	$V_{GS} = -20 \text{ V}$ $V_{DS} = 0 \text{ V}$ bias condition C	I_{GSSF1}		-100		-100		-100	nA dc
Gate current	3411	$V_{GS} = +20 \text{ V}$ $V_{DS} = 0 \text{ V}$ bias condition C	I_{GSSR1}		100		100		100	nA dc
Drain current	3413	$V_{GS} = 0 \text{ V}$ $V_{DS} = 80 \text{ percent}$ of rated VDS (preirradiation) bias condition C	I_{DSS}		-25		-25		-25	μA dc

See footnotes at end of table.

TABLE II. Group D inspection - Continued.

Inspection <u>1/</u> <u>2/</u> <u>3/</u>	MIL-STD-750		Symbol	Pre-irradiation limits		Post-irradiation limits				Unit
	Method	Conditions		R and F		R		F <u>4/</u>		
				Min	Max	Min	Max	Min	Max	
<u>Subgroup 2 continued</u>		$T_C = + 25^\circ\text{C}$								
Static drain to source on-state voltage	3405	$V_{GS} = -12\text{ V}$ $I_D = I_{D2}$ condition A Pulsed (see 4.5.1)	$V_{DS(on)}$							
2N7424U					-1.35		-1.35		-1.35	V dc
2N7425U					-1.632		-1.632		-1.632	V dc
2N7426U					-2.772		-2.772		-2.88	V dc
Forward voltage source drain diode	4011	$V_{GS} = 0\text{ V}$ $I_D = I_{D1}$ bias condition C	V_{SD}							
2N7424U					-3.0		-3.0		-3.0	V dc
2N7425U					-3.3		-3.3		-3.3	V dc
2N7426U					-3.0		-3.0		-3.0	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/ The F designation represents devices which pass endpoints at both 100K and 300K rads (Si).

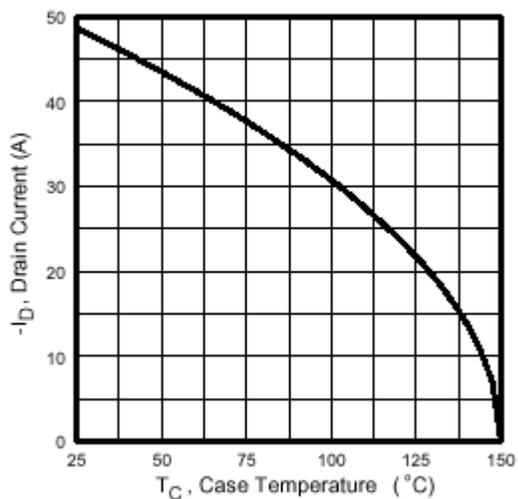
5/ Separate samples shall be pulled for each bias.

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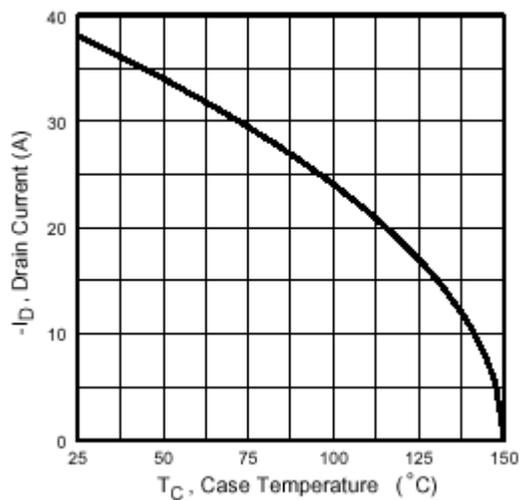
* TABLE III. Group E inspection (all quality levels) for qualification or re-qualification only.

Inspection	MIL-STD-750		Qualification inspection
	Method	Conditions	
<u>Subgroup 1</u>			12 devices c = 0
Temperature cycle	1051	Condition G, 500 cycles	
Hermetic seal	1071		
Fine leak Gross leak			
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 3</u>			3 devices, c = 0
DPA	2102		
<u>Subgroup 4</u>			sample size N/A
Thermal impedance curves		Each supplier shall submit their (typical) design thermal impedance curves. In addition, test conditions and $Z_{\theta JX}$ limit shall be provided to the qualifying activity in the qualification report	
<u>Subgroup 5</u>			
Not applicable			
<u>Subgroup 6</u>			3 devices
ESD	1020		
<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

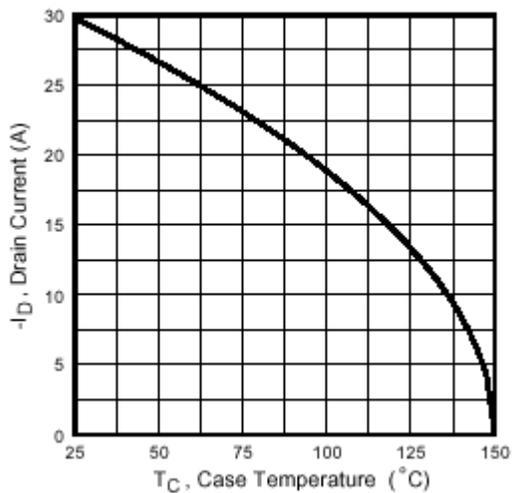
1/ A separate sample for each test may be pulled.



2N7424U

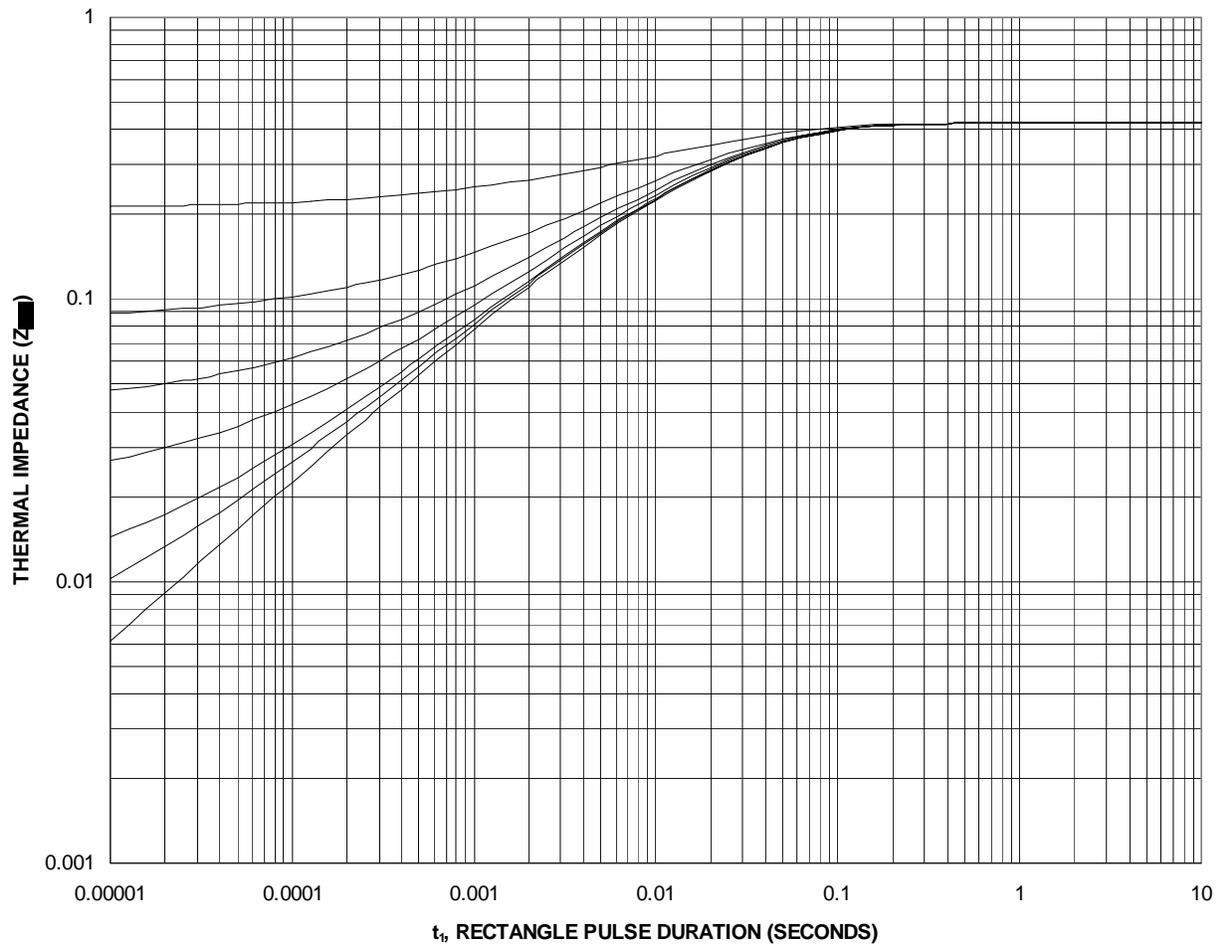


2N7425U



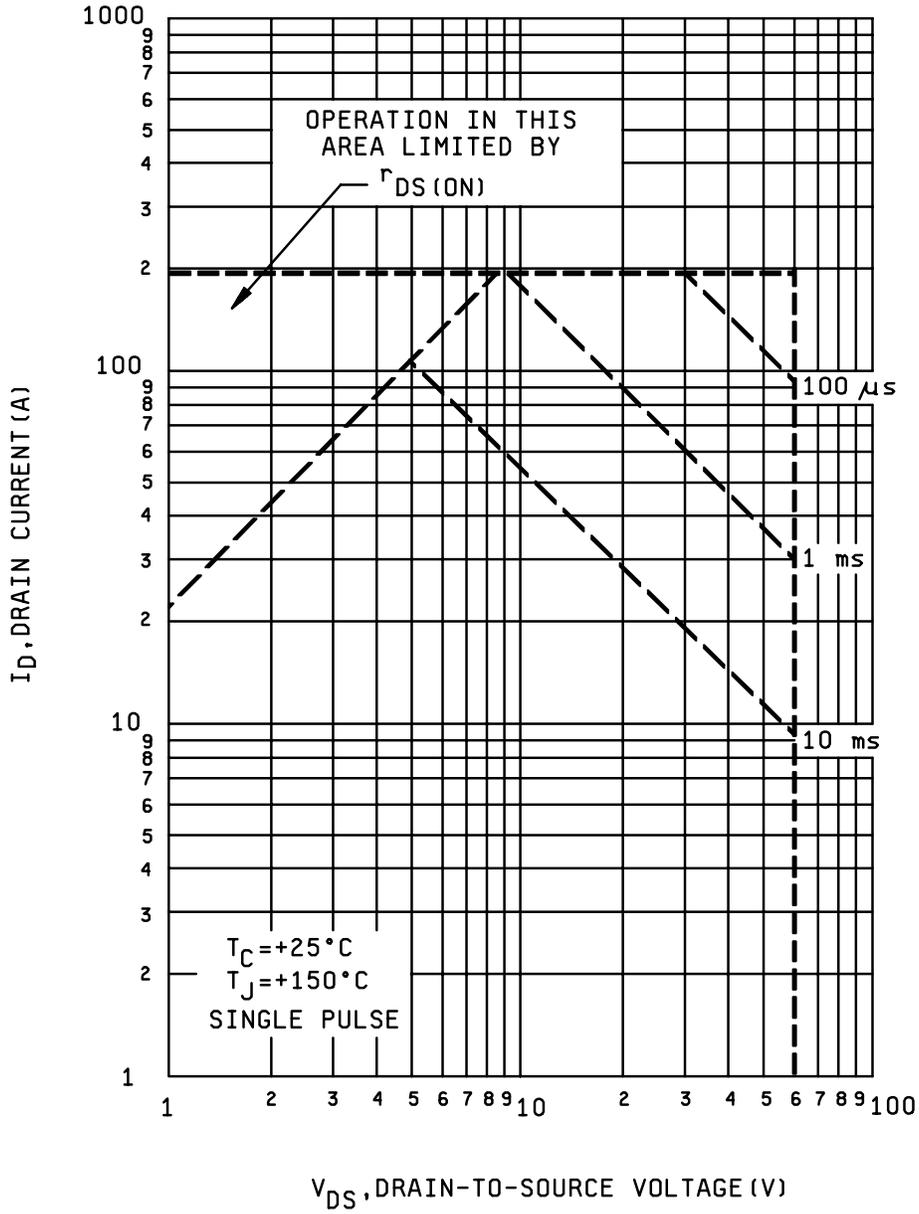
2N7426U

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



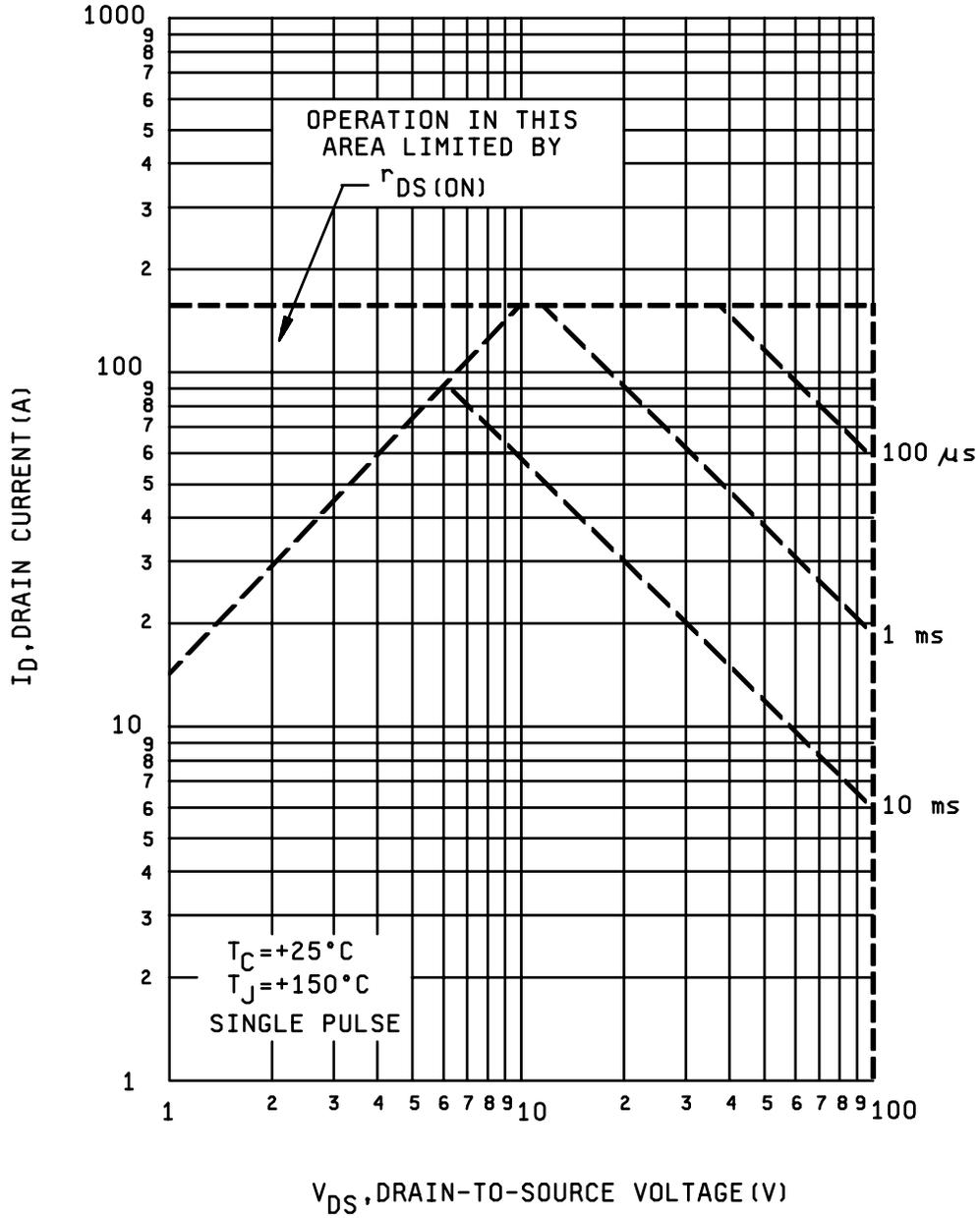
* FIGURE 3. Thermal response curve.

2N7424U



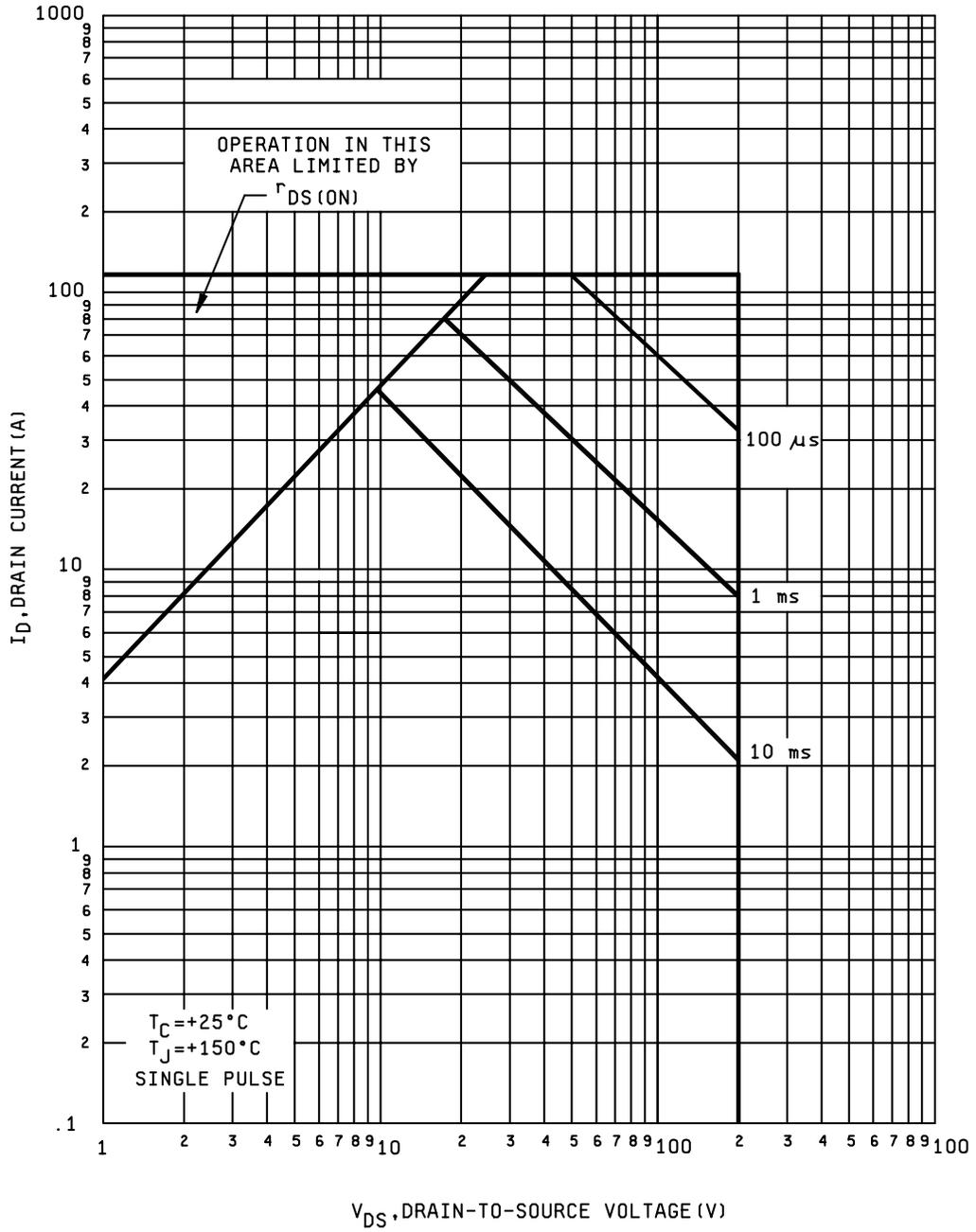
* FIGURE 4. Safe operating area graph.

2N7425U



* FIGURE 5. Safe operating area graph.

2N7426U



* FIGURE 6. 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. Packaging requirements (see 5.1).
- d. Lead finish (see 3.4.1).

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) 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
IRHNA9064	2N7424U
IRHNA9160	2N7425U
IRHNA9260	2N7426U

* 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
 Air Force - 11
 DLA - CC

Preparing activity:
 DLA - CC
 (Project 5961-2830)

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/655C	2. DOCUMENT DATE 31 October 2003
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3. DOCUMENT TITLE
SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED (TOTAL DOSE ONLY) TRANSISTOR, P-CHANNEL SILICON TYPES 2N7424U, 2N7425U AND 2N7426U JANTXVR AND F AND JANSR AND F

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