

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED
(TOTAL DOSE ONLY) TRANSISTORS, N-CHANNEL, SILICON
TYPES 2N7431U, 2N7432U and 2N7433U
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.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for an N-channel, enhancement-mode, MOSFET, radiation hardened (total dose only), power transistor. 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, SMD-2 (Surface mount).

1.3 Maximum ratings. Unless otherwise specified, T_C = +25°C.

Type	P _T 1/	P _T T _A = +25°C 1/	V _{DS}	V _{DG}	V _{GS}	I _{D1} 2/	I _{D2} T _C = +100°C 2/	I _S 2/	I _{DM} 3/	T _{op} and T _{STG}	V _{ISO} 70,000 ft altitude
	W	W	V dc	V dc	V dc	A dc	A dc	A dc	A(pk)	°C	V dc
2N7431U	300	2.5	60	60	±20	75.0	56.0	75.0	356	-55	NA
2N7432U	300	2.5	100	100	±20	51.0	32.5	51.0	204	to	NA
2N7433U	300	2.5	200	200	±20	43.0	27.0	43.0	172	+150	N/A

1/ Derate linearly at 2.0 W/°C for T_C > +25°C;

$$2/ I_D = \sqrt{\frac{T_J \text{ max} - T_C}{(R_{\theta JC}) \times (r_{Dson} \text{ at } T_J \text{ max})}}$$

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

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

Type	Min V(BR)DSS V _{GS} = 0 I _D = 1.0 mA dc	V _{GS} (TH) ₁ V _{DS} ≥ 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		R _{θJC} max	E _{AS} at I _{D1}	I _{AS}	
				T _J = +25°C at I _{D2}	T _J = +150°C at I _{D2}				
	V dc	V dc		μA dc	ohm	ohm	°C/W	mJ	A
		Min	Max						
2N7431U	60	2.0	4.0	25	0.015	0.036	0.42	500	75.0
2N7432U	100	2.0	4.0	25	0.040	0.100	0.42	500	51.0
2N7433U	200	2.0	4.0	25	0.070	0.175	0.42	500	43.0

1/ Pulsed (see 4.5.1).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Supply Center Columbus, ATTN: DSCC-VAT, 3990 East Broad Street, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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

MILITARY

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

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

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

3. REQUIREMENTS

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

3.2 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

3.3 Interface requirements and physical dimensions. The interface requirements and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 (SMD-2) herein. Methods used for electrical isolation of the terminals shall employ materials that contain a minimum of 90 percent Al_2O_3 (ceramic).

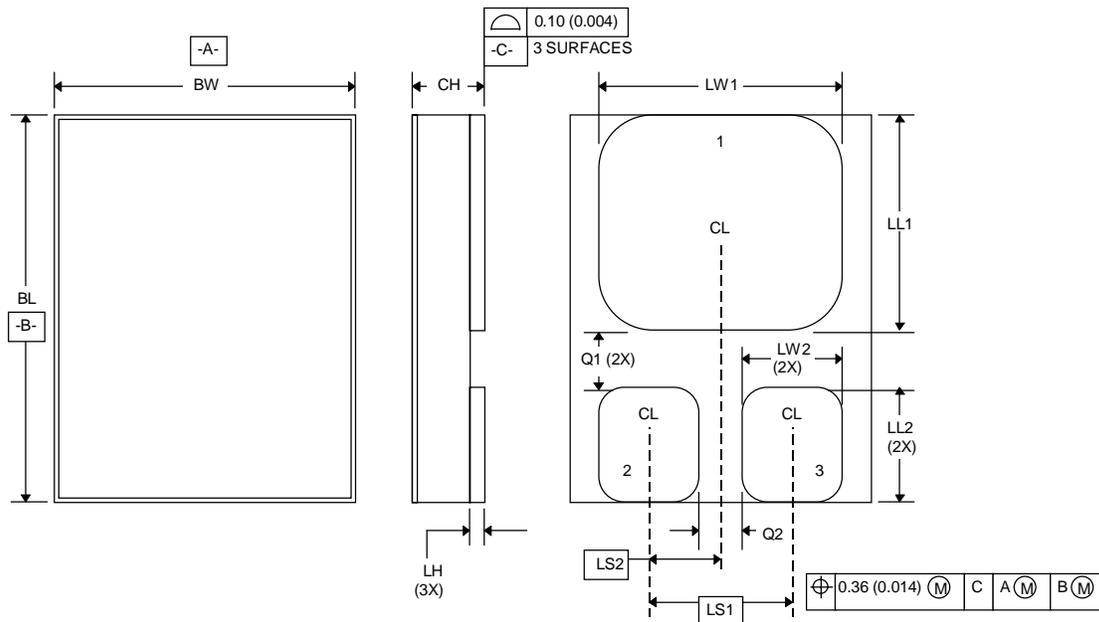
3.3.1 Terminal material and finish. Terminal material shall be copper-tungsten. Terminal finish shall be solderable as defined in MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of terminal finish is desired, it shall be specified in the acquisition document (see 6.2).

3.3.2 Internal construction. Multiple chip construction is not permitted to meet the requirements of this specification.

3.4 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.

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

3.6 Electrical test requirements. The electrical test requirements shall be the subgroups specified in paragraphs 4.4.2 and 4.4.3.



Symbol	Dimensions			
	Millimeters		Inches	
	Min	Max	Min	Max
BL	17.38	17.67	0.684	0.696
BW	13.19	13.48	0.519	0.531
CH	---	3.60	---	0.142
LH	0.26	0.50	0.010	0.020
LW1	11.03	11.32	0.434	0.446
LW2	3.41	3.70	0.134	0.146
LL1	11.92	12.21	0.469	0.481
LL2	3.84	4.14	0.151	0.163
LS1	6.10 BSC		0.240 BSC	
LS2	3.05 BSC		0.120 BSC	
Q1	0.89	---	0.035	---
Q2	1.27	---	0.050	---
TERM 1	Drain			
TERM 2	Gate			
TERM 3	Source			

Notes:

1. Controlling dimension: Inch
2. Metric equivalents are given for information only.
3. The lid shall be electrically isolated from the Drain, Gate and Source.
4. In accordance with ANSI Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 1. Physical dimensions for SMD-2 (Surface mount package)

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

3.7.1 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 3.5).

- 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, $R \leq 100 \text{ k}$, whenever bias voltage is to be applied drain to source.

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

4. 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.

4.2.1 Group E inspection. Group E inspection shall be conducted in accordance with MIL-PRF-19500 and table III herein. End-point electrical measurements shall be in accordance with applicable tests of table I, group A, subgroup 2 herein.

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

Screen (see table IV of MIL-PRF-19500)	Measurement	
	JANS level	JANTXV levels
<u>1/</u>	Method 3470 (see 4.5.4) E_{AS}	Method 3470 (see 4.5.4) E_{AS}
<u>1/</u>	Method 3161, thermal impedance (see 4.5.3)	Method 3161, thermal impedance (see 4.5.3)
<u>1/</u>	Gate stress test (see 4.5.5)	Gate stress test (see 4.5.5)
9 <u>2/</u>	Subgroup 2 of table I herein. I_{GSS} , I_{DSS1}	Not applicable
10	MIL-STD-750, method 1042, test condition B	MIL-STD-750, method 1042, 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	MIL-STD-750, method 1042, test condition A	MIL-STD-750, method 1042, 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

1/ Shall be performed anytime before screen 10.

2/ Shall be performed after E_{AS} test, thermal impedance test, and gate stress test.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein. Alternate flow is allowed for quality conformance inspection in accordance with 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. End-point electrical measurements shall be in accordance with table I, group A, 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 table VIa (JANS) and table VIb (JANTX and JANTXV) of MIL-PRF-19500, and herein. End-point electrical measurements shall be in accordance with table I, group A, subgroup 2 herein.

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

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B3	1051	Test condition G, 100 cycles.
B3	2075	See 3.3.2.
B3	2077	SEM qualification may be performed anytime prior to lot formation.
B4	1042	Intermittent operation life, condition D, 2000 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.
B5	1042	Accelerated steady-state reverse bias, condition A, $V_{DS} = \text{rated}$, $T_A = +175^\circ\text{C}$, $t = 120$ hours minimum.
B5	2037	Bond strength (Al-Au die interconnects only); test condition A.
B6	3161	Thermal resistance, see 4.5.2.

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

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B2	1051	Test condition G, 25 cycles.
B3	1042	Intermittent operation life, condition D, 2000 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.
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 the applicable tests of table I, group A, subgroup 2 herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Not applicable.
C6	1042	Intermittent operation life, condition D, 6000 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.

4.5 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 $R_{\theta JC(max)} = 0.42^{\circ}C/W$. The following parameter measurements shall apply:

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

4.5.3 Thermal impedance ($Z_{\theta JC}$ measurements). The $Z_{\theta JC}$ measurements shall be performed in accordance with MIL-STD-750, method 3161. The maximum limit (not to exceed figure 2, thermal impedance curves and the group A, subgroup 2 limits) for $Z_{\theta JC}$ in screening (table VI of MIL-PRF-19500) shall be derived by each vendor by means of statistical process control. When the process has exhibited control and capability, the capability data shall be used to establish the fixed screening limit. In addition to screening, once a fixed limit has been established, monitor all future sealing lots using a random five piece sample from each lot to be plotted on the applicable X, R chart. If a lot exhibits an out of control condition, the entire lot shall be removed from the line and held for Engineering evaluation and disposition. This procedure may be used in lieu of an in line monitor.

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

4.5.4 Single pulse avalanche energy E_{AS} .

- a. Peak current (I_{AS}) $I_{AS} = I_{D1}$.
- 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) $+25^{\circ}C +10^{\circ}C, -5^{\circ}C$.
- e. Inductance (L) $\frac{\left[\frac{2E_{AS}}{(I_{D1})^2} \right] \left[(V_{BR} - V_{DD}) \right]}{V_{BR}}$ mH minimum.
- f. Number of pulses to be applied 1 pulse minimum.
- g. Supply voltage (V_{DD}) 25 V (50 V for 2N7433).

4.5.5 Gate stress test.

- a. $V_{GS} = 30$ V minimum.
- b. $t = 250$ μ s minimum.

TABLE I. Group A inspection.

Inspection <u>1</u> /	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 <u>2</u> /	3161	See 4.5.3	$Z_{\theta JC}$		0.32	$^{\circ}C/W$
Breakdown voltage, drain to source	3407	$V_{GS} = 0 V$; $I_D = 1 \text{ mA dc}$ Bias condition C	$V_{(BR)DSS}$			
2N7431U				60		V dc
2N7432U				100		V dc
2N7433U				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	$V_{GS} = +20 \text{ and } -20 \text{ V dc}$ $V_{DS} = 80 \text{ percent of rated } V_{DS}$	I_{GSS1}		± 100	nA dc
Drain current	3413	$V_{GS} = 0 \text{ V dc}$, Bias condition C $V_{DS} = 80 \text{ percent of rated } V_{DS}$	I_{DSS1}		25	$\mu\text{A dc}$
Static drain to source "ON"-state resistance	3421	$V_{GS} = 12 \text{ V dc}$, condition A pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(on)1}$			
2N7431U					0.015	ohm
2N7432U					0.040	ohm
2N7433U					0.070	ohm
Static drain to source "ON"-state resistance	3421	$V_{GS} = 12 \text{ V dc}$, condition A pulsed (see 4.5.1), $I_D = I_{D1}$	$r_{DS(on)2}$			
2N7431U					0.018	ohm
2N7432U					0.045	ohm
2N7433U					0.077	ohm
Forward voltage	4011	Pulsed (see 4.5.1), $I_D = I_{D1}$ $V_{GS} = 0 \text{ V dc}$	V_{SD}			
2N7431U					1.5	V dc
2N7432U					1.8	V dc
2N7433U					1.8	V dc

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 3</u>						
High temperature operation:		$T_C = T_J = +125^\circ\text{C}$				
Gate current	3411	$V_{GS} = +20$ and -20 V dc Bias condition C, $V_{DS} = 0$	I_{GSS2}		± 200	nA dc
Drain current	3413	$V_{GS} = 0$ V; bias condition C $V_{DS} = 80$ percent of rated V_{DS}	I_{DSS2}		0.25	mA dc
Static drain to source "ON"-state resistance	3421	$V_{GS} = 12$ V dc pulsed (see 4.51), $I_D = I_{D2}$	$r_{DS(on)3}$			
2N7431U					0.030	ohm
2N7432U					0.085	ohm
2N7433U					0.140	ohm
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:		$T_C = T_J = +55^\circ\text{C}$				
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$, $I_D = 1$ 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}			
2N7431U				18.0		S
2N7432U				16.0		S
2N7433U				9.0		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			$t_{d(on)}$			
2N7431U					27	ns
2N7432U					35	ns
2N7433U					50	ns
Rise time			t_r			
2N7431U					120	ns
2N7432U					150	ns
2N7433U					200	ns
Turn-off delay time			$t_{d(off)}$			
2N7431U					120	ns
2N7432U					150	ns
2N7433U					200	ns

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 4</u> - Continued						
Fall time 2N7431U 2N7432U 2N7433U			t_f		100 130 130	ns ns ns
<u>Subgroup 5</u>	3474					
Safe operating area test (high voltage)		See figures 3, 4 and 5 $t_p = 10$ ms minimum $V_{DS} = 80$ percent of maximum rated V_{DS} , ($V_{DS} \leq 200$)				
Electrical measurements		See table I, group A, subgroup 2				
<u>Subgroup 6</u>						
Not applicable						
<u>Subgroup 7</u>						
Gate charge	3471	Condition B				
On-state gate charge 2N7431U 2N7432U 2N7433U			$Q_{g(on)}$		270 310 290	nC nC nC
Gate to source charge 2N7431U 2N7432U 2N7433U			Q_{gs}		60 53 42	nC nC nC
Gate to drain charge 2N7431U 2N7432U 2N7433U			Q_{gd}		110 110 120	nC nC nC
Reverse recovery time 2N7431U 2N7432U 2N7433U	3473	$di/dt \leq 100$ A/ μ s, $V_{DD} \leq 50$ V, $I_D = I_{D1}$	t_{rr}		360 520 820	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 screen 13):

JANS - group B, subgroups 3 and 4
JANTX and JANTXV - group B, subgroups 2 and 3;

group C, subgroup 6;
group E, subgroup 1

TABLE II. Group D inspection.

Inspection <u>1/3/4/</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 1</u>												
Not applicable												
<u>Subgroup 2</u>		$T_C = +25^\circ\text{C}$										
Steady-state total dose irradiation (V_{GS} bias) <u>4/</u>	1019	$V_{GS} = 12\text{V}$ $V_{DS} = 0$										
Steady-state total dose irradiation (V_{DS} bias) <u>4/</u>	1019	$V_{DS} = 80\%$ of rated V_{DS} (pre- irradiation) $V_{GS} = 0$										
Pre & Post electricals												
Breakdown voltage, drain to source	3407	$V_{GS} = 0$ $I_D = 1\text{ mA}$ Bias Cond. C	V_{BRDSS}									
2N7431U				60		60		60		60		V dc
2N7432U				100		100		100		100		V dc
2N7433U				200		200		200		200		V dc
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$	V_{GSth1}									
2N7431U				2.0	4.0	2.0	4.0	2.0	4.0	1.25	4.5	V dc
2N7432U				2.0	4.0	2.0	4.0	2.0	4.0	1.25	4.5	V dc
2N7433U				2.0	4.0	2.0	4.0	2.0	4.0	1.25	4.5	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
Drain current	3413	$V_{GS} = 0$ Bias Cond. C $V_{DS} = 80\%$ of rated V_{DS} (pre- irradiation)	I_{DSS1}		25		25		25		50	μA dc

See footnotes at end of table

TABLE II. Group D inspection - Continued.

Inspection <u>1/3/4/</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	
Static drain to source on-state voltage 2N7431U 2N7432U 2N7433U	3405	V _{GS} = 12 V Cond. A pulsed (see 4.5.1) I _D = I _{D2}	V _{DSon1}		0.840 1.300 1.890		0.840 1.300 1.890		0.840 1.300 1.890		1.400 1.852 2.970	V dc V dc Vdc
Forward voltage source to drain diode 2N7431U 2N7432U 2N7433U	4011	V _{GS} = 0 I _D = I _{D1}	V _{SD}		1.5 1.8 1.8		1.5 1.8 1.8		1.5 1.8 1.8		1.5 1.8 1.8	V dc V dc V dc

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

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 detail specification utilizing the same die design.

3/ The F designation represent devices which pass end-points at 100k and 300k Rads (Si). The G designation represents devices which pass 100k, 300k and 600k Rads (Si) end-points. H must meet end-points for 100k, 300k, 600k and 1000k Rads (Si).

4/ Separate samples shall be pulled for each bias.

5/ At the manufacturer's option, group D samples need not be subjected to the screening tests, and may be assembled in it's qualified package or in any qualified package that the manufacturer has data to correlate the performance to the designated package.

TABLE III. Group E inspection (all quality levels) for 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, 500 cycles	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table I, group A, subgroup 2.	
<u>Subgroup 2</u> ^{1/}			12 devices c = 0
Steady-state gate bias	1042	Condition B, 1,000 hours.	
Electrical measurements		See table I, group A, subgroup 2.	
Steady-state reverse bias	1042	Condition A, 1,000 hours.	
Electrical measurements		See table I, group A, subgroup 2.	
<u>Subgroup 3</u>			
Not applicable			
<u>Subgroup 4</u>			12 devices c = 0
Thermal resistance	3161	$R_{\theta JC} = 0.42^{\circ}\text{C/W}$ maximum. See 4.5.2.	

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

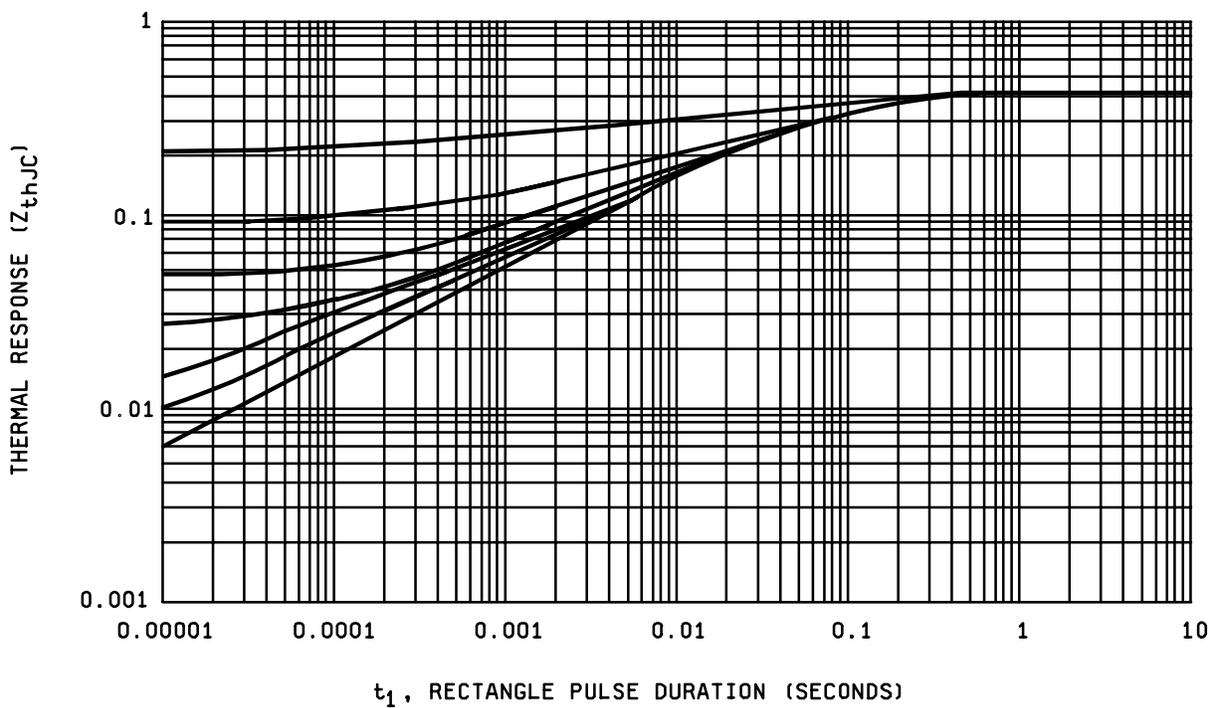


FIGURE 2. Thermal response curve.

2N7431U

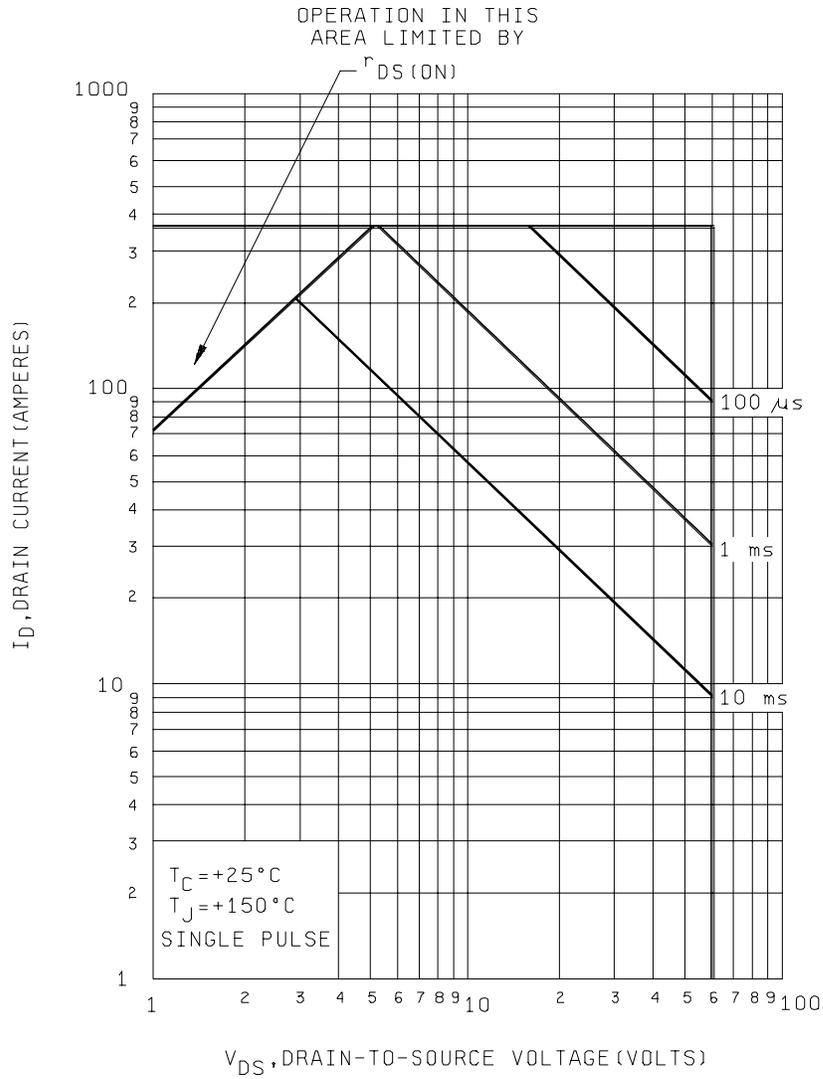


FIGURE 3. Safe operating area graph for 2N7431U.

2N7432U

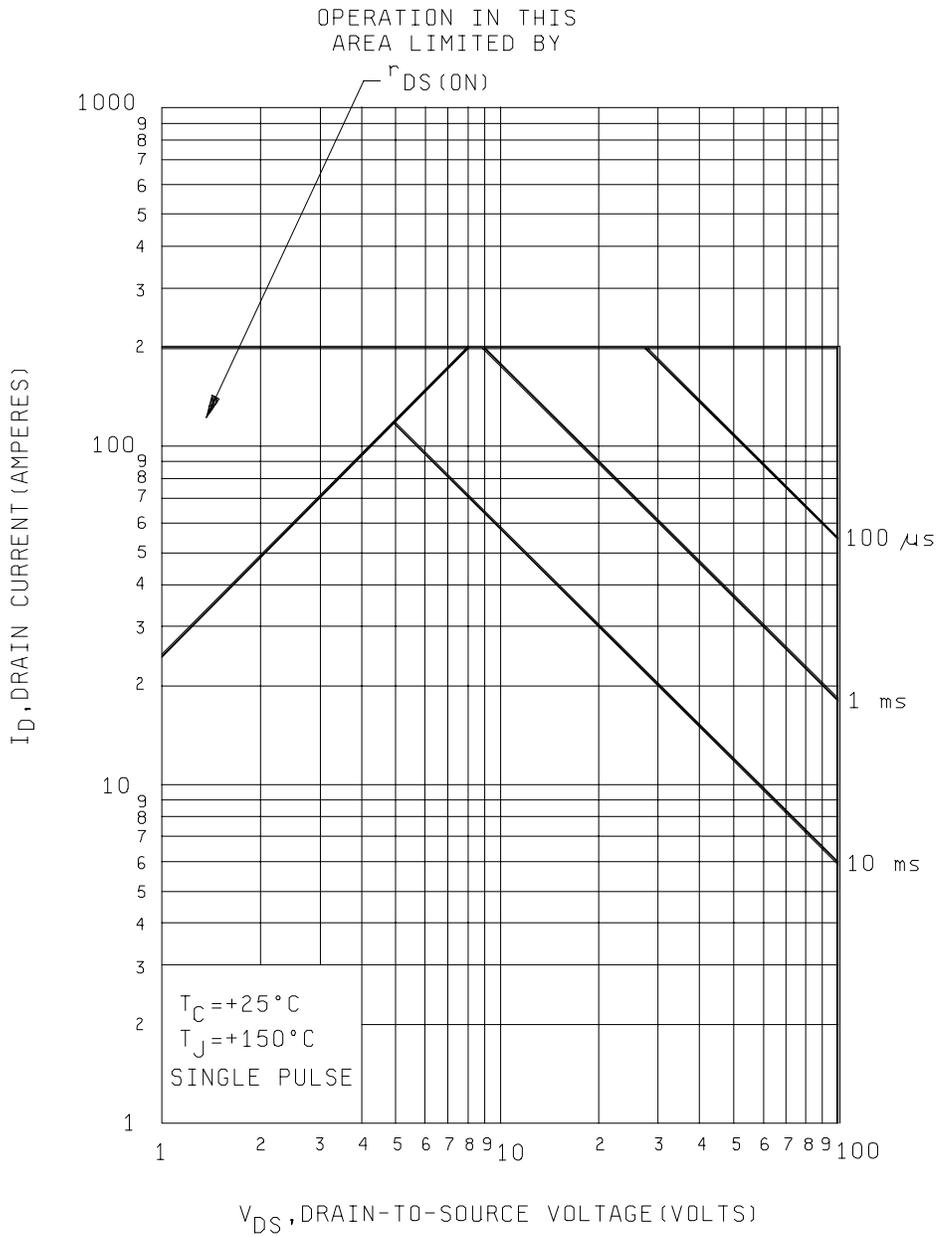


FIGURE 4. Safe operating area graph for 2N7432U.

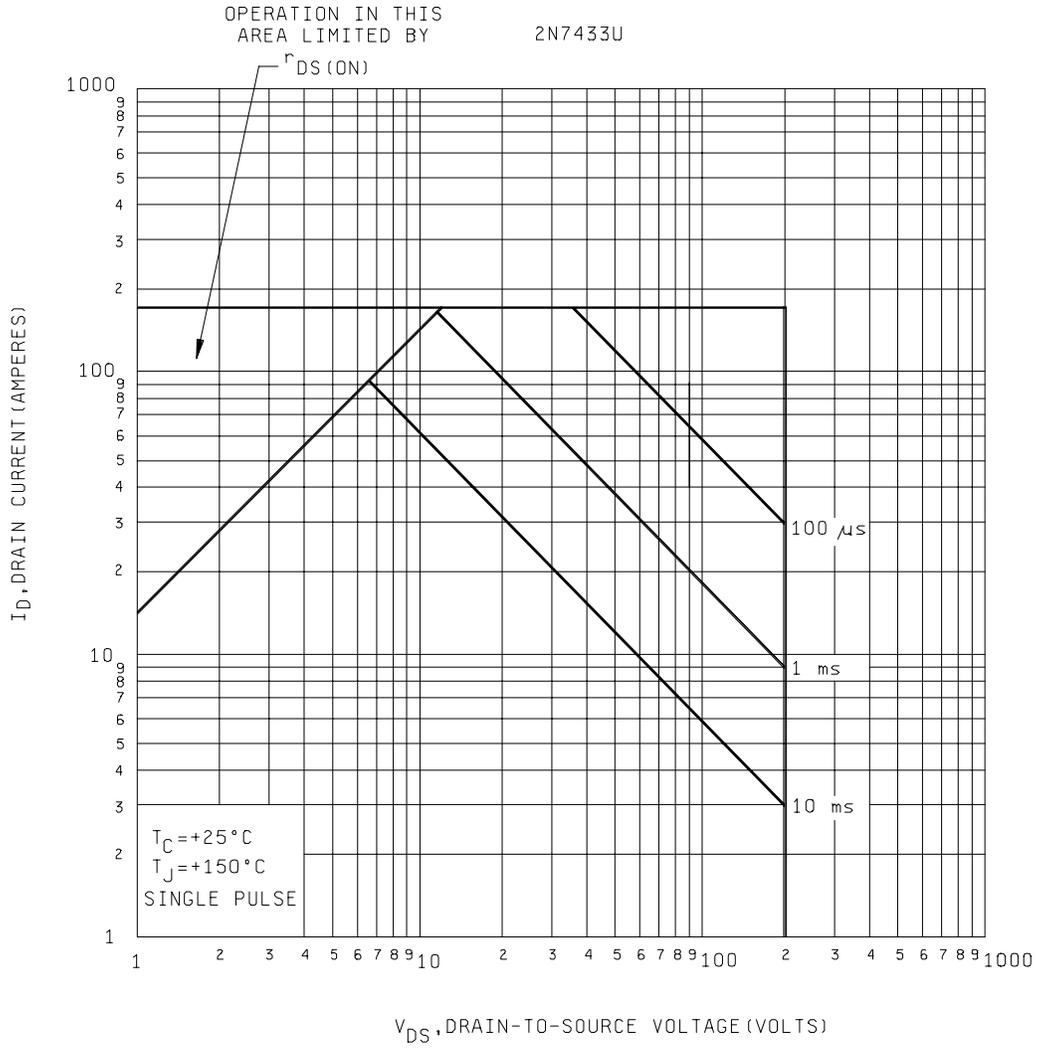


FIGURE 5. Safe operating area graph for 2N7433U.

5. PACKAGING

5.1 Packaging. Packaging shall prevent mechanical damage of the devices during shipping and handling and shall not be detrimental to the device. When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

5.2 Marking. Unless otherwise specified (see 6.2), marking shall be in accordance with MIL-STD-129 and MIL-PRF-19500.

6. NOTES

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

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

6.2 Acquisition requirements. See MIL- PRF-19500.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No.19500 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center Columbus, ATTN: DSCC-VQE, 3990 East Broad Street, Columbus, OH 43216-5000.

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 Military PIN	Commercial PIN
	SMD2
2N7431U 2N7432U 2N7433U	IRHNA_064 IRHNA_160 IRHNA_260

- 1/ IRHNA7: 100k RAD (Si)
- IRHNA3: 300k RAD (Si)
- IRHNA4: 600k RAD (Si)
- IRHNA8: 1000k RAD (Si)

6.5 Ordering data. Acquisition documents may specify the material and finish (see 3.3.1).

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

Preparing activity:
DLA - CC

(Project 5961-2017)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL		
INSTRUCTIONS		
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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/664	2. DOCUMENT DATE 12 June 1998
3. DOCUMENT TITLE SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED (TOTAL DOSE ONLY) TRANSISTOR, N-CHANNEL, SILICON TYPES 2N7431U, 2N7432U, AND 2N7433U, JANTXVR , F, G AND H; AND JANSR, F, G AND H		
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)		
5. REASON FOR RECOMMENDATION		
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c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) Commercial DSN FAX EMAIL	7. DATE SUBMITTED
8. PREPARING ACTIVITY		
a. Point of Contact Alan Barone	b. TELEPHONE Commercial DSN FAX EMAIL 614-692-0510 850-0510 614-692-6939 alan_barone@dsccl.dla.mil	
c. ADDRESS Defense Supply Center Columbus ATTN: DSCC-VAT Columbus, OH 43216-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 DSN 289-2340	