The documentation and process conversion measures necessary to comply with this revision shall be completed by 27 January 2004.

INCH-POUND

MIL-PRF-19500/660A
27 October 2003
SUPERSEDING
MIL-PRF-19500/660
27 May 1998

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED (TOTAL DOSE ONLY) TRANSISTOR, P-CHANNEL SILICON, TYPES 2N7424, 2N7425, AND 2N7426, JANTXVR, JANTXVF, JANSR, AND JANSF

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, TO-254AA.

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

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}
	W	W	V dc	V dc	V dc	A dc	A dc	A dc	A (pk)	°C
2N7424	250	3.0	-60	-60	±20	-35	-30	-35	-192	-55 to +150
2N7425			-100	-100		-35	-24	-35	-152	
2N7426			-200	-200		-27	-17	-27	-108	

(1) Derate linearly 2.0 W/°C for T_C > +25°C.
(2) The following formula derives the maximum theoretical I_D limit. I_D is limited by package and internal wires and may be limited by pin diameter:

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

(3) See figure 2, maximum drain current graphs.
(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.

AMSC N/A FSC 5961

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

Type	Min $V_{(BR)DSS}$ V_{GS} = 0 I_D = -1.0 mA dc	$V_{GS(TH)1}$ $V_{DS} \geq V_{GS}$ 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} = -12V $I_D = I_{D2}$		$R_{\theta JC}$ Max	E_{AS}
					T_J = +25°C	T_J = +150°C		
	V dc	V dc Min	V dc Max	µA dc	Ω	Ω	°C/W	mJ
2N7424	-60	-2.0	-4.0	-25	0.050	0.105	0.50	500
2N7425	-100	-2.0	-4.0	-25	0.073	0.155	0.50	500
2N7426	-200	-2.0	-4.0	-25	0.160	0.340	0.50	500

(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

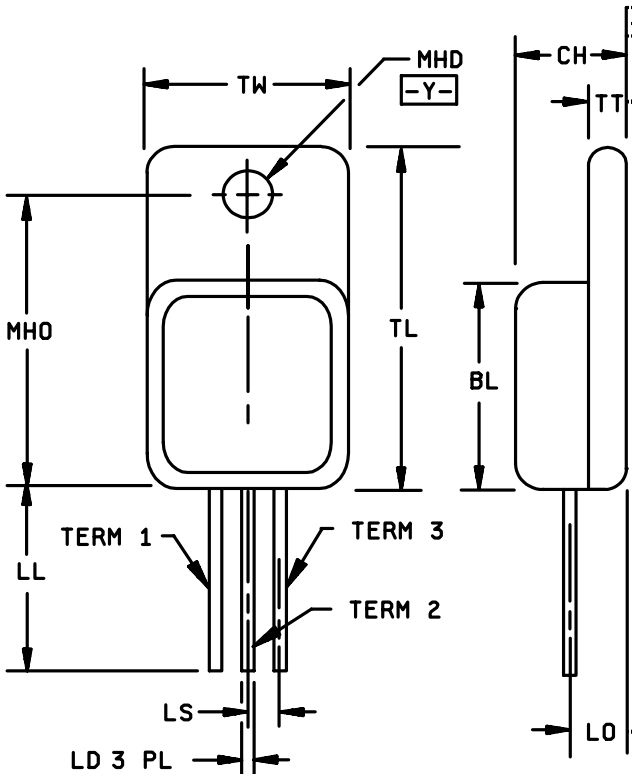
DEPARTMENT OF DEFENSE

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	.535	.545	13.59	13.89
CH	.249	.260	6.32	6.60
LD	.035	.045	0.89	1.14
LL	.510	.570	12.95	14.48
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.

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 figure 1 (TO-254AA) herein. Methods used for electrical isolation of the terminals shall employ materials that contain a minimum of 90 percent Al_2O_3 (ceramic).

* 3.4.1 Lead material and finish. Lead material shall be Kovar or Alloy 52; a copper core or plated core is permitted. Lead 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).

3.5 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 (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, $R \leq$ or 100 kΩ, whenever bias voltage is applied drain to source.

* 3.6 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.

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

* 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, II, and III).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500. 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 specification sheet that did not request the performance of table III tests, the tests specified in table III herein shall be performed by the first inspection lot of this revision to maintain qualification.

* 4.3 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, E_{AS} test (see 4.3.2)	Method 3470 of MIL-STD-750, E_{AS} test (see 4.3.2)
(3) 3c	Method 3161 of MIL-STD-750, thermal impedance (see 4.3.3)	Method 3161 of MIL-STD-750, thermal impedance (see 4.3.3)
9	Subgroup 2 of table I herein I_{DSS1} , I_{GSSF1}, and 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. $\Delta r_{DS(ON)1}$ = ±20 percent of initial value. $\Delta V_{GS(TH)1}$ = ±20 percent of initial value.	Subgroups 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. $\Delta r_{DS(ON)1}$ = ±20 percent of initial value. $\Delta V_{GS(TH)1}$ = ±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.

* 4.3.1 Gate stress test. Apply V_{GS} = -24 V minimum for t = 250 µs 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}: $25 \leq R_{GS} \leq 200\ \Omega$.

d. Supply voltage ..... V_{DD} = -25 V dc, except V_{DD} = -50 V dc for 2N7426.

e. Initial case temperature ..... T_C = +25°C, -5°C, +10°C.

f. Gate voltage ..... V_{GS} = -12 V dc.

g. Number of pulses to be applied ..... 1 pulse minimum.

* 4.3.3 Thermal impedance ($Z_{\theta JC}$ 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 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) ..... 100 ms.

d. Drain-source heating voltage (V_H) ..... 20 V.

e. Measurement time delay (t_{MD}) ..... 30 - 60 µs.

f. Sample window time (t_{SW}) ..... 10 µs 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.

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

Subgroup	Method	Condition
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} = rated; T_A = +175°C, t = 24 hours minimum; or T_A = +150°C, t = 48 hours minimum.
B5	1042	Accelerated steady-state reverse bias, condition A, V_{DS} = rated; T_A = +175°C, t = 120 hours minimum; or T_A = +150°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.

Subgroup	Method	Condition
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.

Subgroup	Method	Condition
C2	2036	Test condition A; weight = 10 pounds; t = 15 seconds
C5	3161	See 4.5.2
C6	1042	Intermittent operation life, condition D, 6,000 cycles. No heat sink or forced-air cooling on the device shall be permitted during the on cycle. t_{on} = 30 seconds minimum.

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

* 4.4.5 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IX of MIL-PRF-19500 and as specified in table III herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

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

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

4.5.2 Thermal resistance. Thermal resistance measurements shall be performed in accordance with method 3161 of MIL-STD-750. The maximum limit of $R_{\theta JC}$ = 0.50°C/W. The following parameters shall apply:

a. Measuring current(I_M) ..... 10 mA.

b. Drain heating current (I_H) ..... 10 A.

c. Heating time (t_H) ..... Steady-state (see MIL-STD-750, method 3161).

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.

* TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
Subgroup 1						
Visual and mechanical inspection	2071					
Subgroup 2						
Thermal impedance 2/	3161	See 4.3.3	$Z_{\theta JC}$	.39		°C/W
Breakdown voltage drain to source	3407	Bias condition C, V_{GS} = 0 V, I_D = -1 mA dc,	$V_{(BR)DSS}$			
2N7424				-60		V dc
2N7425				-100		V dc
2N7426				-200		V dc
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$, I_D = -1 mA dc	$V_{GS(TH)1}$	-2.0	-4.0	V dc
Gate current	3411	Bias condition C, V_{GS} = ±20V dc, V_{DS} = 0 V	I_{GSS1}		±100	nA dc
Drain current	3413	Bias condition C, V_{GS} = 0 V dc, V_{DS} = 80 percent of rated V_{DS},	I_{DSS1}		-25	µA dc
Static drain to source on-state resistance	3421	V_{GS} = -12 V dc, condition A, pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(ON)1}$			
2N7424					0.050	Ω
2N7425					0.073	Ω
2N7426					0.160	Ω
Static drain to source on-state resistance	3421	V_{GS} = -12 V dc, condition A, pulsed (see 4.5.1), $I_D = I_{D1}$	$r_{DS(ON)2}$			
2N7424					0.053	Ω
2N7425					0.075	Ω
2N7426					0.170	Ω
Forward voltage	4011	V_{GS} = 0 V dc, condition A, pulsed (see 4.5.1), $I_D = I_{D1}$	V_{SD}			
2N7424					-3.0	V dc
2N7425					-3.3	V dc
2N7426					-3.3	V dc
Subgroup 3						
High temperature operation:		$T_C = T_J$ = +125°C				
Gate current	3411	Bias condition C, V_{GS} = ±20 V dc, V_{DS} = 0 V	I_{GSS2}		±200	nA dc

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
Subgroup 3 - Continued		$T_C = T_J = +125°C$				
Drain current	3413	Bias condition C, V_{GS} = 0 V dc, 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, condition A, pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(ON)3}$			
2N7424					0.090	Ω
2N7425					0.140	Ω
2N7426					0.315	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:		$T_C = T_J = -55°C$				
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
Subgroup 4						
Switching time test	3472	$I_D = I_{D1}$, V_{GS} = -12 V dc, R_G = 2.35 Ω, V_{DD} = 50 percent of rated V_{DS}				
Turn-on delay time			$t_{D(on)}$			
2N7424					35	ns
2N7425					35	ns
2N7426					37	ns
Rise time			t_r			
2N7424					150	ns
2N7425					170	ns
2N7426					83	ns
Turn-off delay time			$t_{D(off)}$			
2N7424					200	ns
2N7425					190	ns
2N7426					140	ns
Fall time			t_f			
2N7424					200	ns
2N7425					190	ns
2N7426					172	ns
Forward transconductance	3475	I_D = rated I_{D2}, V_{DD} = 15 V, see 4.5.1	g_{FS}			
2N7424				18		s
2N7425				15		s
2N7426				13		s

See footnotes at end of table.

* TABLE I. Group A inspection - continued

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
Subgroup 5						
Safe operating area test (high voltage)	3474	See figures 4, 5, and 6 t_p = 10 ms min. V_{DS} = 80 percent of maximum rated V_{DS}				
Electrical measurements		See table I, subgroup 2				
Subgroup 6						
Not applicable						
Subgroup 7						
Gate charge	3471	Condition B				
On-state gate charge			$Q_{G(ON)}$			
2N7424					260	nC
2N7425					290	nC
2N7426					300	nC
Gate to source charge			Q_{GS}			
2N7424					66	nC
2N7425					72	nC
2N7426					60	nC
Gate to drain charge			Q_{GD}			
2N7424					91	nC
2N7425					77	nC
2N7426					70	nC
Reverse recovery time	3473	di/dt = -100 A/µs, $V_{DD} \leq$ -50 V $I_D = I_{D1}$	t_{rr}			
2N7424					270	ns
2N7425					300	ns
2N7426					600	ns

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

TABLE II. Group D inspection.

Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Pre-irradiation limits		Post-irradiation limits				Unit
				R and F		R		F 4/		
	Method	Conditions		Min	Max	Min	Max	Min	Max	
Subgroup 1										
Not applicable										
Subgroup 2		T_C = + 25°C								
Steady-state total dose irradiation (V_{GS} bias) 5/	1019	V_{GS} = -12 V; V_{DS} = 0 V								
Steady-state total dose irradiation (V_{DS} bias) 5/	1019	V_{GS} = 0 V; V_{DS} = 80 percent of rated V_{DS} (pre-irradiation)								
End-point electricals										
Breakdown voltage, drain to source	3407	Bias condition C; V_{GS} = 0 V; I_D = -1 mA	$V_{(BR)DSS}$							
2N7424				-60		-60		-60		V dc
2N7425				-100		-100		-100		V dc
2N7426				-200		-200		-200		V dc
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$; I_D = -1 mA	$V_{GS(th)1}$							
2N7424				-2.0	-4.0	-2.0	-4.0	-2.0	-5.0	V dc
2N7425				-2.0	-4.0	-2.0	-4.0	-2.0	-5.0	V dc
2N7426				-2.0	-4.0	-2.0	-4.0	-2.0	-5.0	V dc
Gate current	3411	V_{GS} = -20 V; V_{DS} = 0 V; bias condition C	I_{GSSF1}		-100		-100		-100	nA dc
Gate current	3411	V_{GS} = +20 V; V_{DS} = 0 V; bias condition C	I_{GSSR1}		100		100		100	nA dc
Drain current	3413	V_{GS} = 0 V; V_{DS} = 80 percent of rated V_{DS} (pre-irradiation); bias condition C	I_{DSS}		-25		-25		-25	µA dc

See footnotes at end of table.

TABLE II. Group D inspection - Continued.

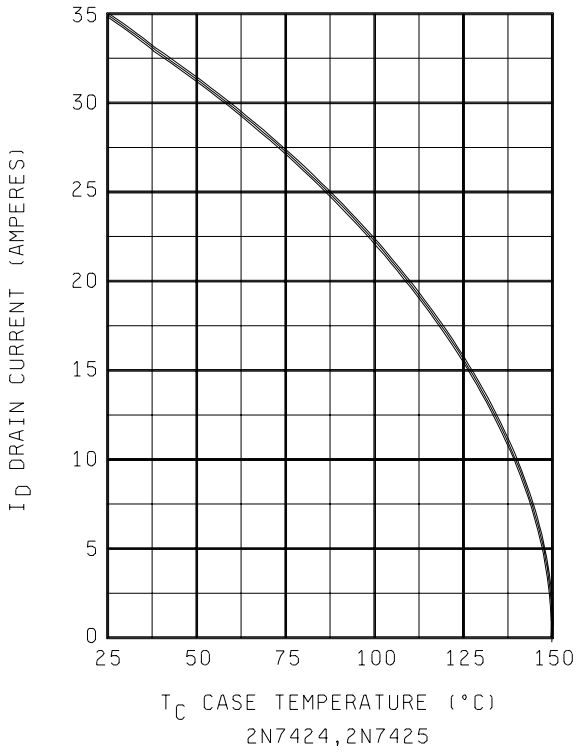
Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Pre-irradiation limits		Post-irradiation limits				Unit
				R and F		R		F 4/		
	Method	Conditions		Min	Max	Min	Max	Min	Max	
Subgroup 2 - Continued		T_C = + 25°C								
Static drain to source on-state voltage	3405	Pulsed (see 4.5.1); V_{GS} = -12 V; $I_D = I_{D2}$; bias condition A	$V_{DS(on)}$							
2N7424					-1.50		-1.50		-1.50	V dc
2N7425					-1.752		-1.752		-1.752	V dc
2N7426					-2.72		-2.72		-2.72	V dc
Forward voltage source drain diode	4011	Bias condition C; V_{GS} = 0 V; $I_D = I_{D1}$	V_{SD}							
2N7424					-3.0		-3.0		-3.0	V dc
2N7425					-3.3		-3.3		-3.3	V dc
2N7426					-3.3		-3.3		-3.3	V dc

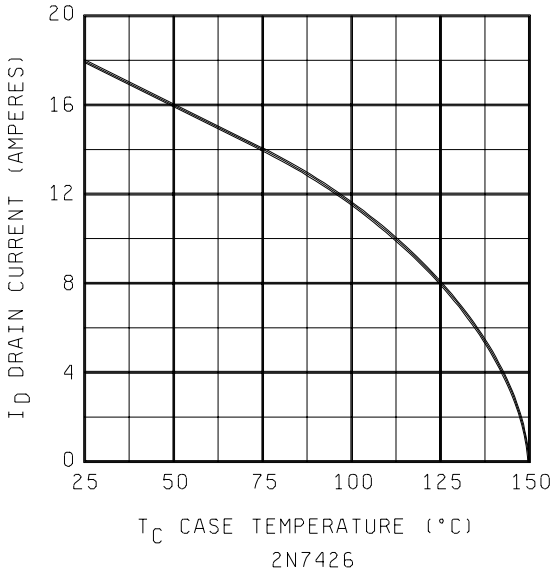
1/ For sampling plan see MIL-PRF-19500
2/ Group D qualification may be performed prior to lot formation. Wafers qualified to these group D QCI requirements may be used for any other specification utilizing the same die design.
3/ At the manufacturer's option, group D samples need not be subjected to the screening tests, and may be assembled in it's 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 end-points at both 100K and 300K rads (Si).
5/ Separate samples shall be pulled for each bias.

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

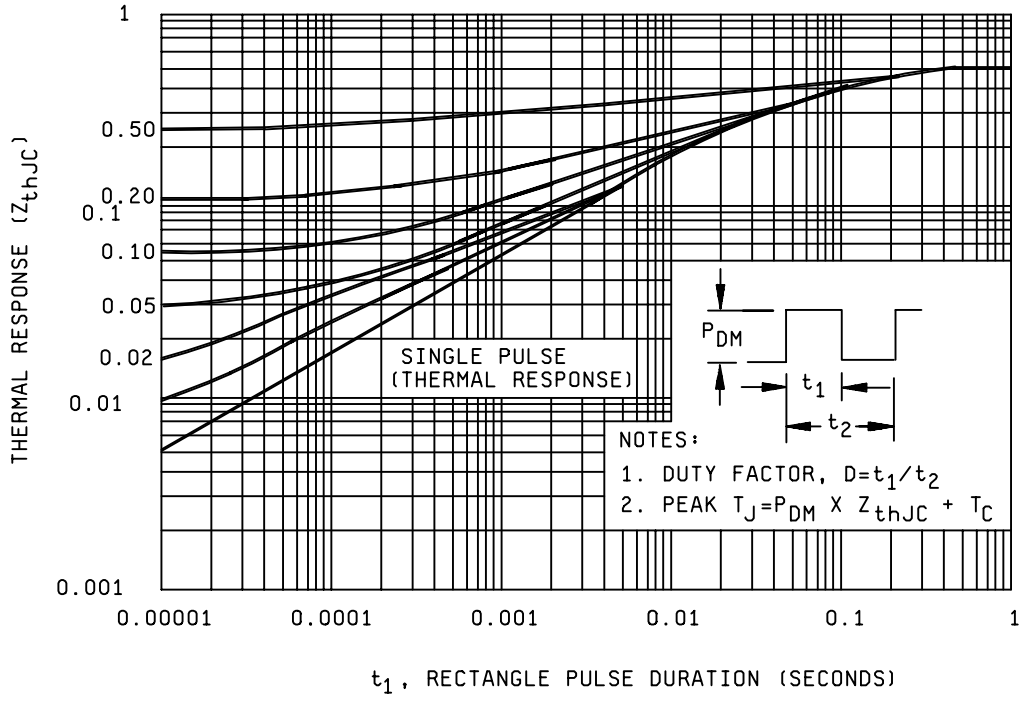
Inspection	MIL-STD-750		Qualification and large lot quality conformance inspection
	Method	Conditions	
Subgroup 1			12 devices c = 0
Temperature cycling	1051	Test condition G.	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table I, subgroup 2.	
Subgroup 2 1/			12 devices c = 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.	
Subgroup 3			3 devices c = 0
DPA	2102		
Subgroup 4			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.	
Subgroup 5			
Not applicable			
Subgroup 6			3 devices
ESD	1020		
Electrical measurements		See table I, subgroup 2.	
Subgroup 7			45 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.

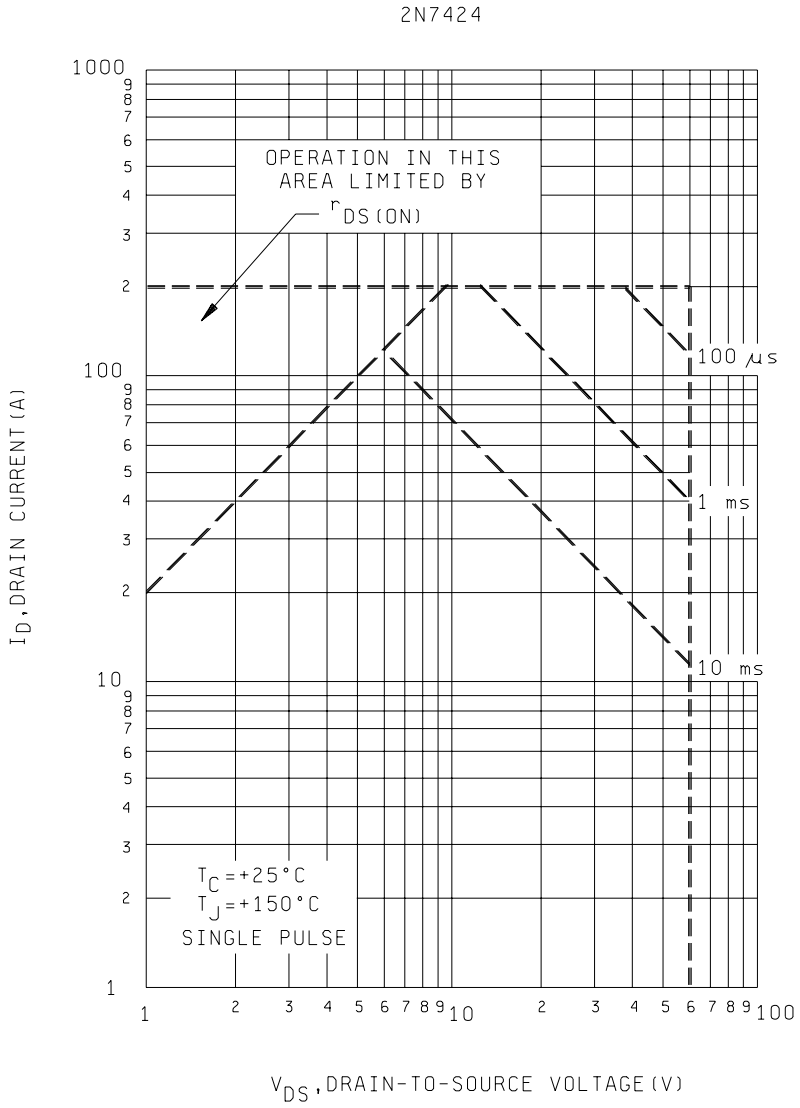




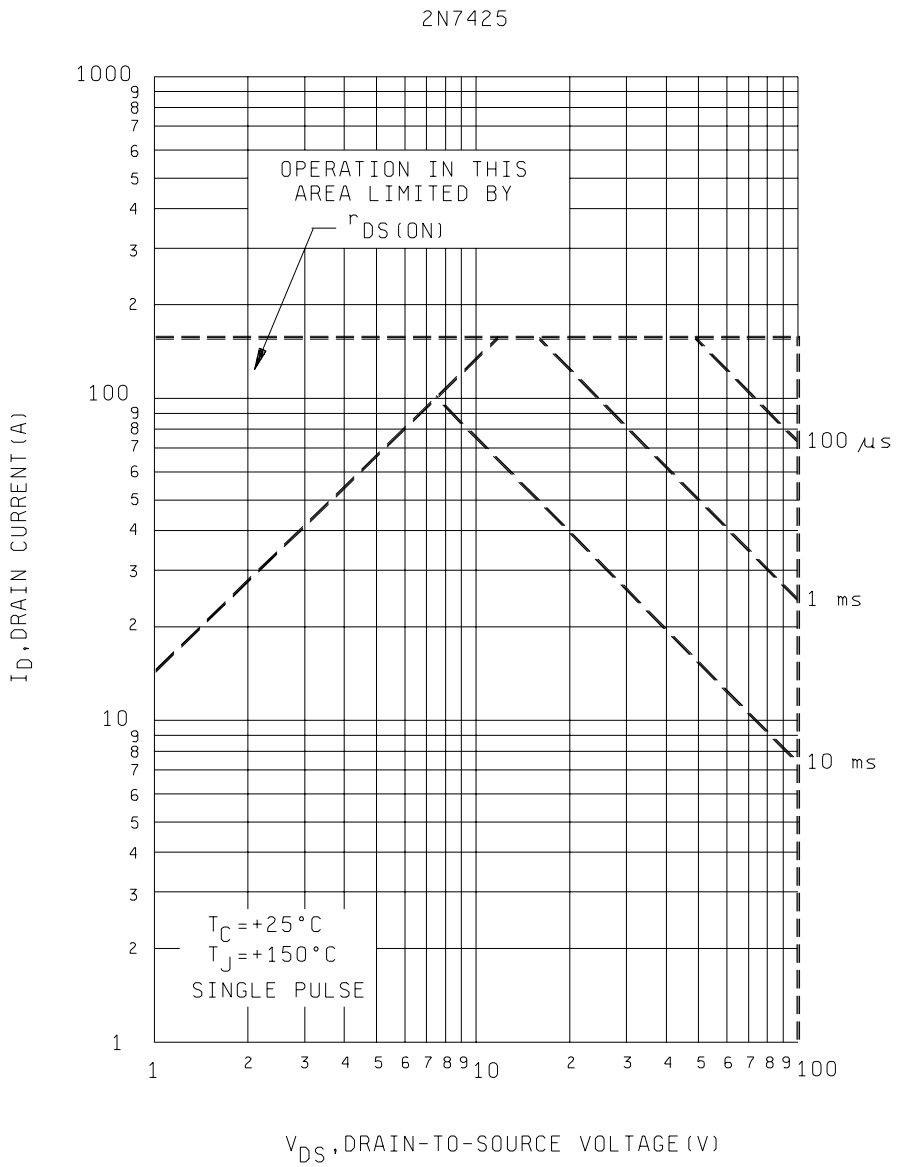
* FIGURE 2. Maximum drain current vs case temperature graphs.



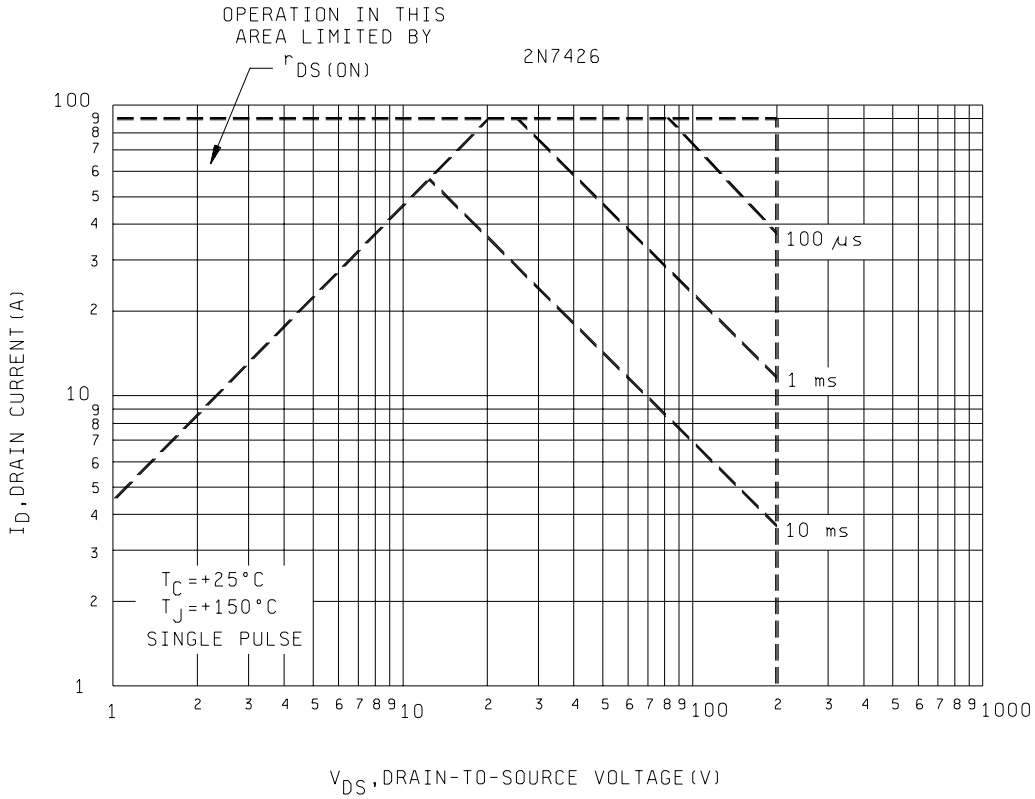
* FIGURE 3. Thermal response curve.



* FIGURE 4. Safe operating area graph (2N7424).



* FIGURE 5. Safe operating area graph (2N7425).



* FIGURE 6. Safe operating area graph (2N7426).

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.

6. NOTES

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

* 6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

* 6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.

b. Issue of DODISS to be cited in the solicitation and, if required, the specific issue of individual documents referenced (see 2.2.1).

c. Lead finish (see 3.4.1).

d. Type designation and product assurance level.

e. Packaging requirements (see 5.1).

* 6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers' List (QML) 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
IRHM9064	2N7424
IRHM9160	2N7425
IRHM9260	2N7426

* 6.5 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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

Review activity:
Air Force - 99

Preparing activity:
DLA - CC

(Project 5961- 2787)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7.

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/660A	2. DOCUMENT DATE 27 October 2003

3. **DOCUMENT TITLE** SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED (TOTAL DOSE ONLY) TRANSISTOR, P-CHANNEL SILICON, TYPES 2N7424, 2N7425, AND 2N7426, JANTXVR, JANTXVF, JANSR, AND JANSF

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) COMMERCIAL DSN FAX EMAIL	7. DATE SUBMITTED

8. PREPARING ACTIVITY

a. Point of Contact Alan Barone	b. TELEPHONE Commercial 614-692-0510	DSN 850-0510	FAX 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			