

The documentation and process conversion measures necessary to comply with this revision shall be completed by 21 July 2000.

INCH-POUND

MIL-PRF-19500/655A  
 21 April 2000  
 SUPERSEDING  
 MIL-PRF-19500/655  
 14 November 1997

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.  $T_A = +25^\circ\text{C}$ , unless otherwise specified.

Type	$P_T$ (1) $T_C = +25^\circ\text{C}$	$P_T$ (1) $T_A = +25^\circ\text{C}$	$V_{DS}$	$V_{DG}$	$V_{GS}$	$I_{D1}$ (2) $T_C = +25^\circ\text{C}$	$I_{D2}$ (2) $T_C = +100^\circ\text{C}$	$I_S$	$I_{DM}$ (3)	$T_J$ and $T_{STG}$	$V_{ISO}$ 70,000 ft. altitude
	<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> -55 to +150	<u>V dc</u>
2N7424U	300	2.5	-60	-60	$\pm 20$	-48	-30	-48	-192		N/A
2N7425U			-100	-100		-38	-24	-38	-152		
2N7426U			-200	-200		-23	-15	-23	-92		

(1) Derate linearly  $2.4 \text{ W}/^\circ\text{C}$  for  $T_C > +25^\circ\text{C}$ ;  $P_T = (T_{jmax} - T_C)/R_{\theta JC}$

(2)  $I_D = ((T_{jmax} - T_C)/((R_{\theta JC}) \times (r_{DS(on)} \text{ at } T_{jmax})))^{1/2}$

(3)  $I_{DM} = 4 \times I_{D1}$ ;  $I_{D1}$  as calculated by footnote (2).

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-VAC, 3990 East Broad St., Columbus, OH 43216-5000, by using the addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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FSC 5961

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

Type	Min $V_{(BR)DSS}$ $V_{GS} = 0$ $I_D = -1.0\text{mA}$ dc	$V_{GS(TH)1}$ $V_{DS} \geq V_{GS}$ $I_D = -1.0\text{ mA dc}$	Max $I_{DSS1}$ $V_{GS} = 0$ $V_{DS} = 80\%$ of rated $V_{DS}$	Max $r_{DS(on)}$ (1) $V_{GS} = -12\text{V}$ , $I_D = I_{D2}$		$R_{\theta JC}$ Max	$E_{AS}$
				$T_J = +25^\circ\text{C}$	$T_J = +150^\circ\text{C}$		
	<u>V dc</u>	<u>V dc</u> Min    Max	<u><math>\mu\text{A dc}</math></u>	<u><math>\Omega</math></u>	<u><math>\Omega</math></u>	<u><math>^\circ\text{C/W}</math></u>	<u>mJ</u>
2N7424U	-60	-2.0    -4.0	-25	0.045	0.100	0.42	500
2N7425U	-100			0.068	0.150		
2N7426U	-200			0.230	0.530		

(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.

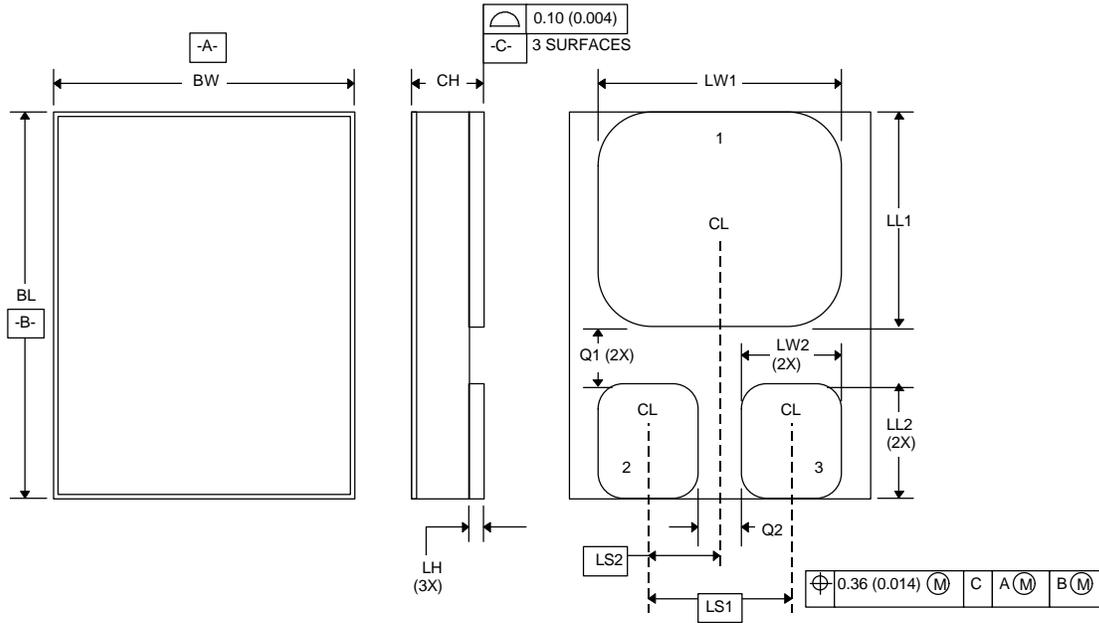
STANDARD

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 Defense Automated Printing Service, Building 4D (NPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

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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  $\phi x$  symbology.

FIGURE 1. Dimensions and configuration .

### 3. REQUIREMENTS

3.1 General. The requirements for acquiring the product described herein shall consist of this document and MIL-PRF-19500.

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

3.3 Interface requirements and physical dimensions. The Interface requirements and physical dimensions shall be as specified in MIL-PRF-19500, and figure 1 (SMD2) herein. Methods used for electrical isolation of the terminals shall employ materials that contain a minimum of 90 percent Al<sub>2</sub>O<sub>3</sub> (ceramic).

3.3.1 Lead finish. Unless otherwise specified, lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

3.4 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 Electrostatic discharge protection. The devices covered by this specification require electrostatic discharge protection (see 6.2).

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 k $\Omega$ , whenever bias voltage is applied drain to source.

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

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

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

3.9 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

### 4. VERIFICATION

4.1 Classification of Inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Screening (see 4.3).
- c. Conformance inspection (see 4.4).

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

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

Screen (see table IV of MIL-PRF-19500)	Measurement	
	JANS	JANTX and JANTXV
(1)	Method 3470, E <sub>AS</sub> test (see 4.5.4)	Method 3470, E <sub>AS</sub> test (see 4.5.4)
(1)	Method 3161, thermal impedance (see 4.5.3)	Method 3161, thermal impedance (see 4.5.3)
(1)	Gate stress test (see 4.5.5)	Gate stress test (see 4.5.5)
9 (2)	Subgroup 2 of table I herein I <sub>DSS1</sub> , I <sub>GSS</sub> as a minimum	Not applicable
10	MIL-STD-750, method 1042 test condition B	MIL-STD-750, method 1042 test condition B
11	I <sub>GSSF1</sub> , I <sub>GSSR1</sub> , I <sub>DSS1</sub> , r <sub>DS(ON)</sub> , V <sub>GS(TH)</sub> Subgroup 2 of table I herein.  $\Delta I_{GSSF1} = \pm 20 \text{ nA dc or } \pm 100\% \text{ of initial value, whichever is greater.}$ $\Delta I_{GSSR1} = \pm 20 \text{ nA dc or } \pm 100\% \text{ of initial value, whichever is greater.}$ $\Delta I_{DSS1} = \pm 10 \text{ } \mu\text{A dc or } \pm 100\% \text{ of initial value, whichever is greater.}$	I <sub>GSSF1</sub> , I <sub>GSSR1</sub> , I <sub>DSS1</sub> , r <sub>DS(ON)</sub> , V <sub>GS(TH)</sub> 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 $\Delta I_{GSSF1} = \pm 20 \text{ nA dc or } \pm 100\% \text{ of initial value, whichever is greater.}$ $\Delta I_{GSSR1} = \pm 20 \text{ nA dc or } \pm 100\% \text{ of initial value, whichever is greater.}$ $\Delta I_{DSS1} = \pm 10 \text{ } \mu\text{A dc or } \pm 100\% \text{ of initial value, whichever is greater.}$ $\Delta r_{DS(ON)1} = \pm 20\% \text{ of initial value.}$ $\Delta V_{GS(TH)1} = \pm 20\% \text{ of initial value.}$	Subgroups 2 and 3 of table I herein $\Delta I_{GSSF1} = \pm 20 \text{ nA dc or } \pm 100\% \text{ of initial value, whichever is greater.}$ $\Delta I_{GSSR1} = \pm 20 \text{ nA dc or } \pm 100\% \text{ of initial value, whichever is greater.}$ $\Delta I_{DSS1} = \pm 10 \text{ } \mu\text{A dc or } \pm 100\% \text{ of initial value, whichever is greater.}$ $\Delta r_{DS(ON)1} = \pm 20\% \text{ of initial value.}$ $\Delta V_{GS(TH)1} = \pm 20\% \text{ of initial value.}$

- (1) Shall be performed anytime before screen 10.
- (2) Shall be performed after E<sub>AS</sub> test, thermal impedance test, and gate stress test.

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 (JANTX and JANTXV) of MIL-PRF-19500, and as follows. Electrical measurements (end points) 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.

Subgroup	Method	Condition
3	1051	Test condition G, 100 cycles
3	2077	SEM
4	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.
5	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.
5	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.
5	2037	Bond strength (Al-Au die interconnects only), Test condition A
6	3161	Thermal resistance, see 4.5.2.

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

Subgroup	Method	Condition
2	1051	Test condition G, 25 cycles.
3	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.
5 and 6	----	Not applicable.

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, group A, subgroup 2 herein.

Subgroup	Method	Condition
2	2036	Terminal strength is not applicable.
6	1042	Intermittent operation life, condition D, 2,000 cycles. No heat sink or forced-air cooling on the device shall be permitted during the on cycle. $t_{on} = 30$ seconds minimum.

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

4.5 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.

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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 4.5.3	$Z_{\theta JC}$	.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, $V_{DS} = 0V$	$I_{GSS1}$		$\pm 100$	nA dc
Drain current	3413	$V_{GS} = 0V \text{ dc}$ , Bias condition C, $V_{DS} = 80 \% \text{ of rated } V_{DS}$ ,	$I_{DSS1}$		-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	$\Omega$
2N7425U					0.068	$\Omega$
2N7426U					0.230	$\Omega$
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	$\Omega$
2N7425U					0.071	$\Omega$
2N7426U					0.240	$\Omega$
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					-3.3	V dc

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 3</u>						
High temperature operation		$T_C = T_J = +125^\circ\text{C}$				
Gate current	3411	$V_{GS} = \pm 20\text{V dc}$ , Bias condition C, $V_{DS} = 0\text{V}$	$I_{GSS2}$		$\pm 200$	nA dc
Drain current	3413	$V_{GS} = 0\text{V dc}$ , Bias condition C, $V_{DS} = 80\%$ of rated $V_{DS}$	$I_{DSS2}$		-0.25	mA dc
Static drain to source "ON"-state resistance	3421	$V_{GS} = -12\text{V dc}$ , condition A, Pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(ON)3}$			
2N7424U					0.085	$\Omega$
2N7425U					0.135	$\Omega$
2N7426U					0.46	$\Omega$
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$ , $I_D = -1\text{ mA dc}$	$V_{GS(TH)2}$	-1.0		V dc
Low temperature operation		$T_C = T_J = -55^\circ\text{C}$				
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS(TH)3}$ , $I_D = -1\text{ mA dc}$	$V_{GS(TH)3}$		-5.0	V dc
<u>Subgroup 4</u>						
Switching time test	3472	$I_D = I_{D1}$ , $V_{GS} = -12\text{ V dc}$ $R_G = 2.35\ \Omega$ , $V_{DD} = 50\%$ of rated $V_{DS}$				
Turn-on delay time			$t_{D(on)}$			
2N7424U					35	ns
2N7425U					35	ns
2N7426U					70	ns
Rise Time			$t_r$			
2N7424U					150	ns
2N7425U					170	ns
2N7426U					240	ns
Turn-off delay time			$t_{D(off)}$			
2N7424U					200	ns
2N7425U					190	ns
2N7426U					220	ns
Fall time			$t_f$			
2N7424U					200	ns
2N7425U					190	ns
2N7426U					220	ns

See footnotes at end of table.

TABLE I. Group A inspection - continued

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
<u>Subgroup 5</u> Safe operating area test (high voltage)	3474	See figures 3, 4 and 5 $t_p = 10$ ms min. $V_{DS} = 80\%$ of max. rated $V_{DS}$				
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 2N7424U			$Q_{G(ON)}$		300	nC
2N7425U					290	nC
2N7426U					300	nC
Gate to source charge 2N7424U			$Q_{GS}$		70	nC
2N7425U					72	nC
2N7426U					75	nC
Gate to drain charge 2N7424U			$Q_{GD}$		91	nC
2N7425U					90	nC
2N7426U					90	nC
Reverse recovery time	3473	$di/dt = -100$ A/ $\mu$ s, $V_{DD} \leq -50$ V $I_D = I_{D1}$				
2N7424U			$t_{rr}$		270	ns
2N7425U					300	ns
2N7426U					775	ns

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

2/ This test required for the following endpoint measurements only:

Group B Subgroups 2 and 3 (JANTX/JANTXV)  
Group B Subgroups 3 and 4 (JANS)

Group C, subgroup 6  
Group E, subgroup 1

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	$V_{GS} = 0\text{ V};$ $V_{DS} = 80\% \text{ of}$ 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	$V_{DS} \quad V_{GS}$ $I_D = -1\text{ mA}$	$V_{GS(th)1}$							
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	$V_{GS} = 0\text{ V}$ $V_{DS} = 80\% \text{ of}$ rated VDS (preirradiation) Bias condition C	$I_{DSS}$		-25		-25		-25	$\mu\text{A}$ dc

See footnotes at end of table.

TABLE II Group D inspection - continued

Inspection <u>1/ 2/ 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</u> <u>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				-3.45		-3.45		-3.45		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				-3.3		-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 detail 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 only

Inspection	MIL-STD-750		Qualification inspection
	Method	Conditions	
<u>Subgroup 1</u>			12 devices c = 0
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> <sup>1/</sup>			12 devices c = 0
Steady-state gate bias	1042	Test condition B; 1,000 hours	
Electrical measurements		See table I, group A, subgroup 2	
Steady state reverse bias	1042	Test 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	
<u>Subgroup 5</u>			
Not applicable			

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

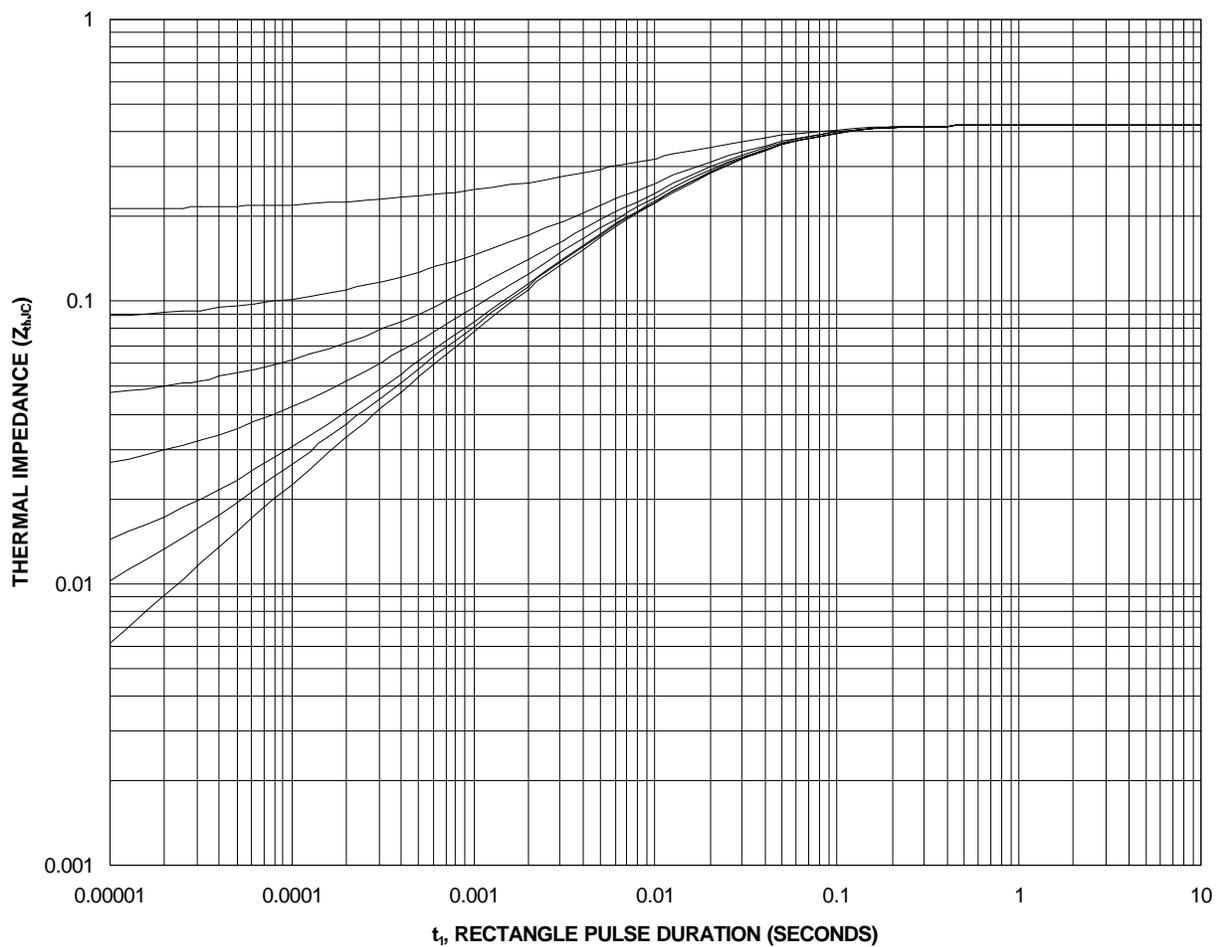


FIGURE 2. Thermal response curve

2N7424U

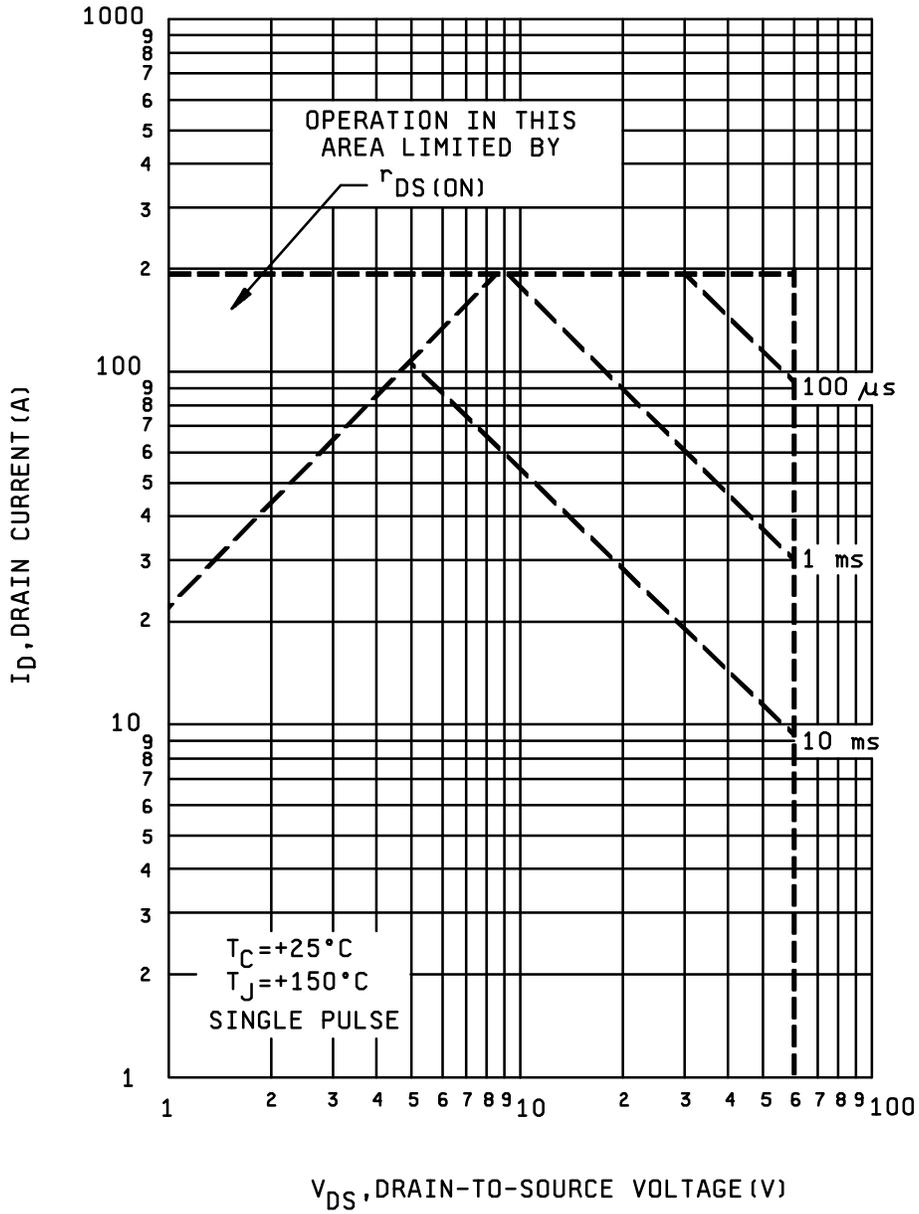


FIGURE 3. Safe operating area graph

2N7425U

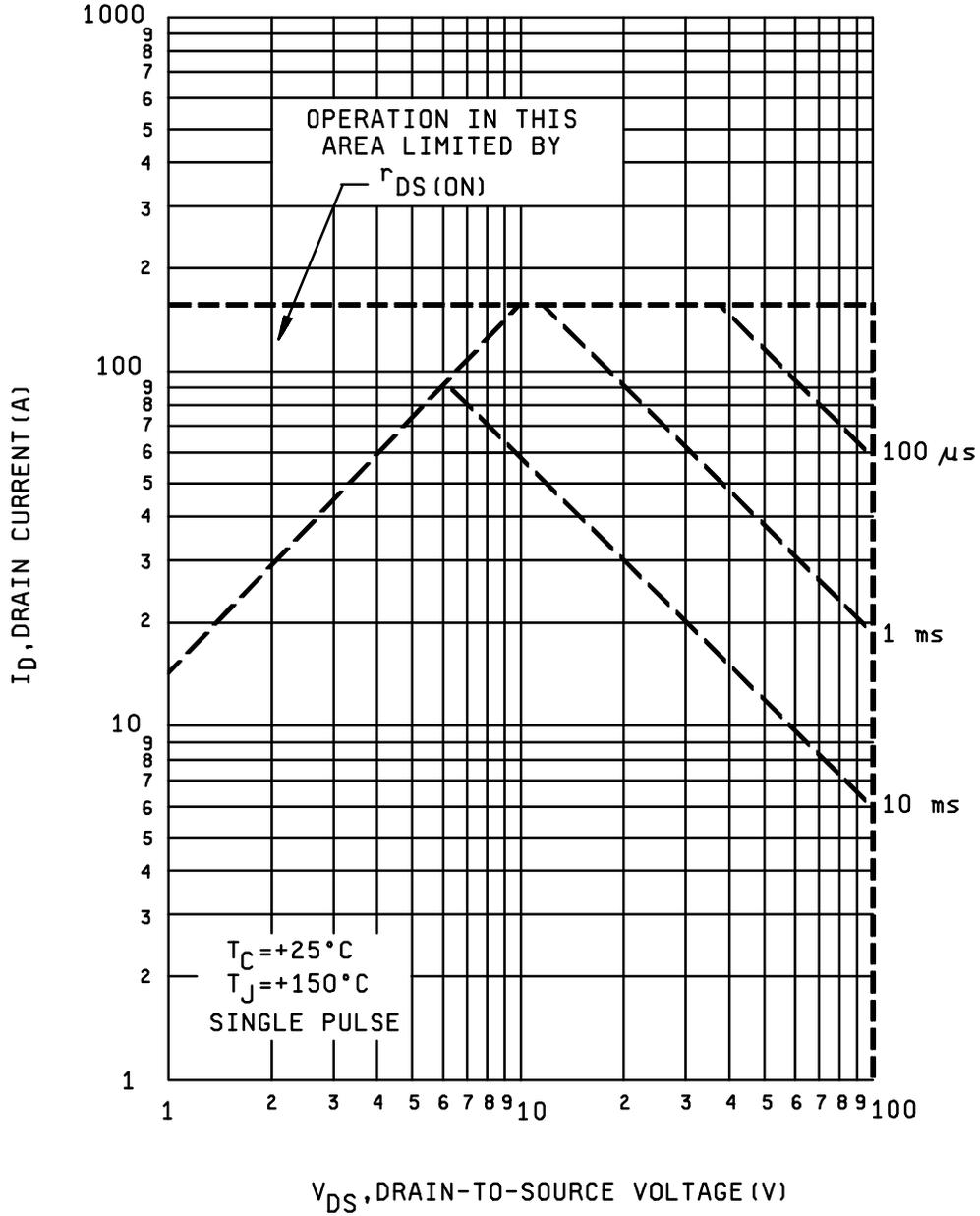


FIGURE 4. Safe operating area graph

2N7426U

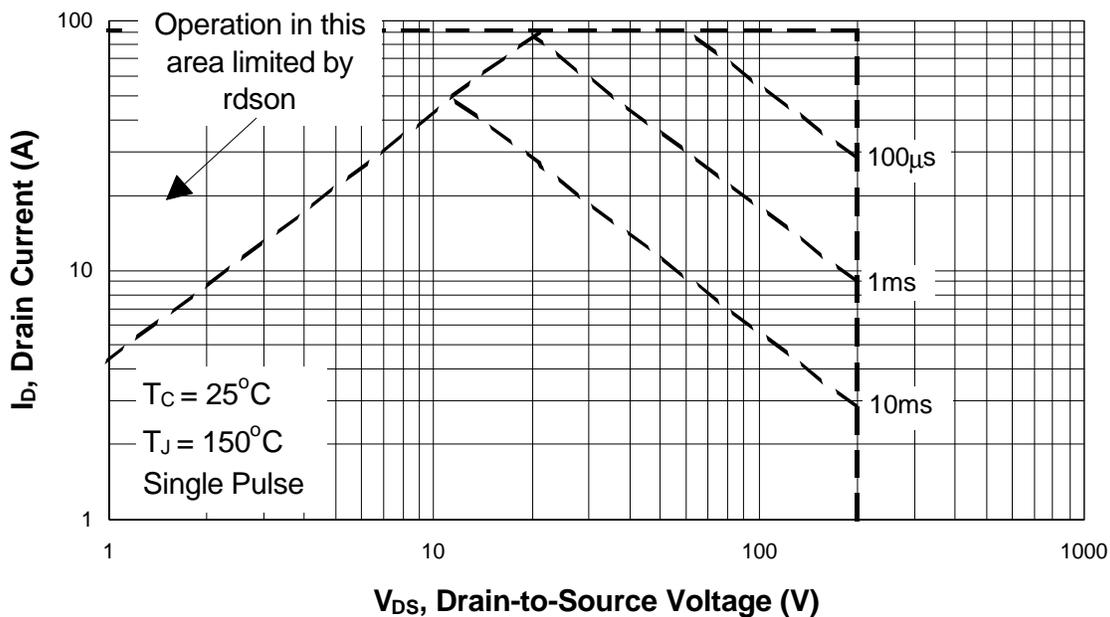


FIGURE 5. Safe operating area graph

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 MIL-STD-750, method 3161)
- d. Drain-source heating voltage ( $V_H$ )..... 20 V
- e. Measurement time delay ( $t_{MD}$ )..... 30 to 60  $\mu\text{s}$
- f. Sample window time ( $t_{SW}$ )..... 10  $\mu\text{s}$  maximum

4.5.3 Thermal Response ( $Z_{\theta JC}$  measurement). The  $Z_{\theta JC}$  measurement (or equivalent  $\Delta V_{SD}$  measurement) shall be performed in accordance with method 3161 of MIL-STD-750. 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 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 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  $\mu\text{s}$
- f. Sample window time ( $t_{SW}$ )..... 10  $\mu\text{s}$  maximum

4.5.4 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,  $V_{DD} = -25 \text{ V dc}$ , except  $V_{DD} = -50 \text{ V dc}$  for 2N7426U
- e. Initial case temperature,  $T_C = +25^{\circ}\text{C}$ ,  $-5^{\circ}\text{C}$ ,  $+10^{\circ}\text{C}$
- f. Gate voltage,  $V_{GS} = -12 \text{ V dc}$
- g. Number of pulses to be applied: 1 pulse minimum

4.5.5 Gate stress test.

- a.  $V_{GS} = -24 \text{ V}$ , minimum
- b.  $t = 250 \mu\text{s}$ , minimum

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 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.

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. Acquisition documents should specify the following:

- a. Issue of DODISS to be cited in the solicitation and, if required, the specific issue of individual documents referenced (see 2.2.1).
- b. Terminal finish (see 3.3.1).
- c. Type designation and product assurance level.
- d. Packaging requirements (see 5.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers List QML-19500 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center Columbus, DSCC-VQE, Columbus, OH 43216.

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

MIL-PRF-19500/655A

CONCLUDING MATERIAL

Custodians:  
Army - CR  
Air Force - 11

Review activity:  
Air Force - 10, 80, 99

Preparing activity:  
DLA - CC  
(Project 5961-2044)

## 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.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

<b>I RECOMMEND A CHANGE:</b>	1. DOCUMENT NUMBER MIL-PRF-19500/655A	2. DOCUMENT DATE 21 April 2000
<b>3. DOCUMENT TITLE</b> 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		
<b>6. SUBMITTER</b>		
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
<b>8. PREPARING ACTIVITY</b>		
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-VAC, 3990 East Broad Street, Columbus, OH 43213-1199	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	