

The documentation and process conversion measures necessary to comply with this revision shall be completed by 3 August 1996.

INCH-POUND

MIL-PRF-19500/603B
3 May 1996
SUPERSEDING
MIL-S-19500/603A
21 Januar 1994

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED
(TOTAL DOSE ONLY) TRANSISTORS, N-CHANNEL,
SILICON TYPES 2N7268, 2N7269, 2N7270, 2N7394, 2N7268U, 2N7269U, 2N7270U, AND 2N7394U
JANTXVM, D, R, F, G, AND H; AND JANSM, D, R, 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 detail requirements for an N-Channel, enhancement-mode, MOSFET, Radiation Hardened (total dose only), power transistor intended for use in high density power switching applications. Two levels of product assurance are provided for each device type specified in MIL-PRF-19500, with Avalanche Energy Maximum rating (E_{AS}) and Maximum Avalanche Current (I_{AS}).

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

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

Type	P _T 1/	P _T	V _{DS}	V _{DG}	V _{GS}	I _{D1} 2/	I _{D2}	I _S	I _{DM}	T _{op} and T _{STG}	V _{ISO} 70,000 ft. altitude
		T _A = +25° C				3/	T _C = +100° C	2/	4/		
	<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>	<u>V dc</u>
2N7394	150	4	60	60	±20	35.0	30.0	35.0	200	-55	N/A
2N7268	150	4	100	100	±20	34.0	21.0	34.0	136	to	N/A
2N7269	150	4	200	200	±20	26.0	16.0	26.0	104		N/A
2N7270	150	4	500	500	±20	11.0	7.0	11.0	44	+150	500

1/ Derate linearly 1.2 W/° C for T_C > +25° C;

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

2/

3/ I_{D1} may be limited by pin diameter.

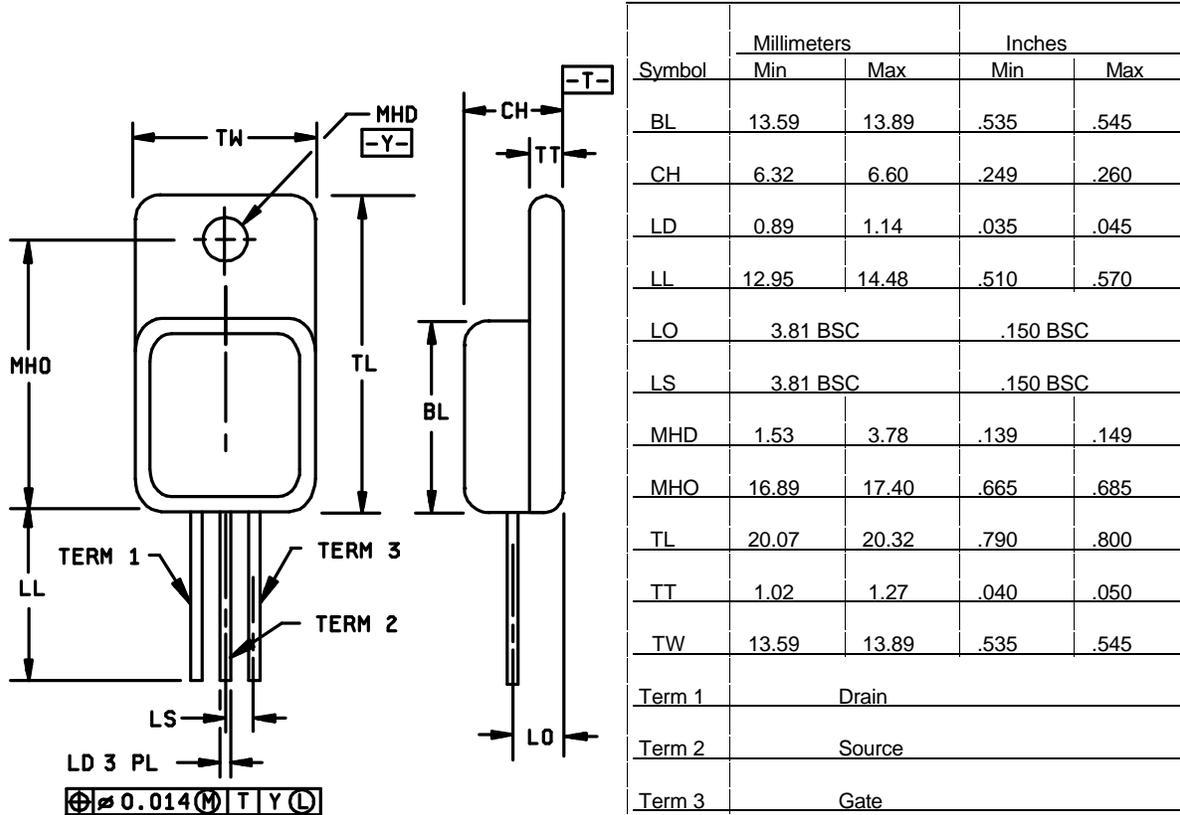
4/ I_{DM} = 4 × I_{D1}; I_{D1} as calculated by footnote 2/.

5/ Electrical characteristics, ratings, and conditions for "U" suffix devices (surface mount) are identical to the corresponding non-"U" suffix device unless otherwise noted.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Electronics Supply Center, ATTN: DESC-ELDT, 1507 Wilmington Pike, Dayton, OH 45444-5765, 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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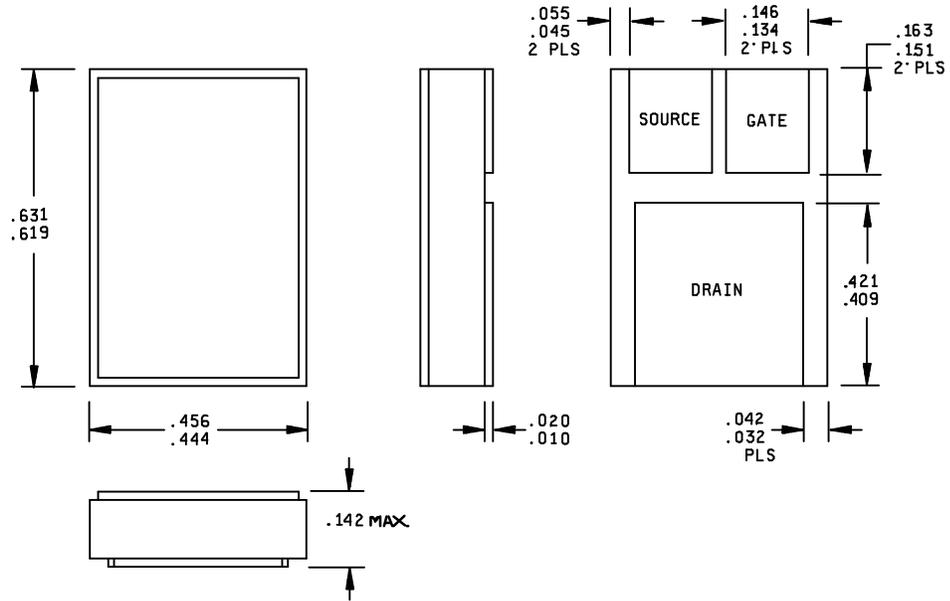
FSC 5961



NOTES:

1. Dimensions are in millimeters.
2. Inches equivalents are given for general information only.
3. Refer to applicable symbol list.
4. Dimensioning and tolerating are in accordance with ANSI Y14.5M.
5. All terminals are isolated from case.
6. In accordance with ANSI Y14.5M, diameters are equivalent to $\varnothing x$ symbology.

FIGURE 1. Physical dimensions for TO-254AA.



Inches	mm	Inches	mm
.010	.25	.146	3.70
.020	.51	.151	3.84
.032	.81	.163	4.14
.042	1.07	.409	10.39
.045	1.14	.421	10.69
.055	1.40	.444	11.28
.130	3.30	.456	11.58
.134	3.41	.619	15.73
.142	3.60	.631	16.02

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only

FIGURE 2. Dimensions and configuration of surface mount package outline.

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

Type	Min $V_{(BR)DSS}$ $V_{GS} = 0$ $I_D = 1.0$ mA dc	$V_{GS(TH)1}$ $V_{DS} \geq V_{GS}$ $I_D = 1.0$ mA dc	Max I_{DSS1} $V_{GS} = 0$ $V_{DS} = 80\%$ of rated V_{DS}	Max $r_{DS(ON)}$ ^{1/} $V_{GS} = 12\text{ V dc}$		$R_{\theta JC}$ max	EAS	I_{AS}	
				$T_J = +25^\circ\text{C}$ at I_{D2}	$T_J = +150^\circ\text{C}$ at I_{D2}				
	<u>V dc</u>	<u>V dc</u>		<u>$\mu\text{A dc}$</u>	<u>ohm</u>	<u>ohm</u>	<u>$^\circ\text{C/W}$</u>	<u>mJ</u>	<u>A</u>
		Min	Max						
2N7394	60	2.0	4.0	25	0.027	0.030	0.83	500	35.0
2N7268	100	2.0	4.0	25	0.065	0.132	0.83	500	34.0
2N7269	200	2.0	4.0	25	0.100	0.230	0.83	500	26.0
2N7270	500	2.0	4.0	50	0.450	1.260	0.83	500	11.0

^{1/} Pulsed (see 4.5.1).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 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 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 Associated detail specification. The individual item requirements shall be in accordance with MIL-PRF-19500, and as specified herein.

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

E_{AS} - Single pulse avalanche energy capability

I_{AS} - Rated avalanche current, nonrepetitive

$V_{(ISO)}$ - Source pin to case isolation voltage

3.3 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-PRF-19500, and on figure 1 and 2 herein. Methods used for electrical isolation of the terminal feedthroughs shall employ materials that contain a minimum of 90 percent AL_2O_3 (ceramic). Examples of such construction techniques are metallized ceramic eyelets or ceramic walled packages.

3.3.1 Lead material and finish. Lead material shall be copper-tungsten or Alloy 52; a copper core or plated core is permitted. Lead finish shall be solderable in accordance with MIL-PRF-19500 and herein. Where a choice of lead material or finish is desired, it shall be specified in the contract or purchase order (see 6.3).

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

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

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, $R \leq 100$ k, whenever bias voltage is to be 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 products list before contract award (see 4.2 and 6.2).

4. QUALITY ASSURANCE PROVISIONS

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, 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 inspection. Group E inspection shall be conducted in accordance with MIL-PRF-19500, and table III herein.

4.3 Screening (JANTXV, and JANS levels only). Screening shall be in accordance with MIL-PRF-19500 (table IV), 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> <u>2/</u>	Method 3470 (see 4.5.4)	Method 3470 (see 4.5.4)
<u>1/</u>	Method 3161 (see 4.5.3)	Method 3161 (see 4.5.3)
<u>1/</u> <u>2/</u>	Gate stress test (see 4.5.5)	Gate stress test (see 4.5.5)
9 <u>1/</u>	Subgroup 2 of table I herein I _{GSS} , I _{DSS1}	Subgroup 2 of table I herein
10	MIL-STD-750, method 1042 test condition B	MIL-STD750, method 1042 test condition B
11	I _{GSSF1} , I _{GSSR1} , I _{DSS1} , r _{DS(on)} , V _{GS(TH)} Subgroup 2 of table I herein Δ I _{GSSF1} = ±20 nA dc or ±100% of initial value, whichever is greater Δ I _{GSSR1} = ±20 nA dc or ±100% of initial value, whichever is greater Δ I _{DSS1} = ±10 μA dc or ±100% 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, condition A
13	Subgroups 2 and 3 of table I herein Δ I _{GSSF1} = ±20 nA dc or ±100% of initial value, whichever is greater Δ I _{GSSR1} = ±20 nA dc or ±100% of initial value, whichever is greater Δ I _{DSS1} = ±10 μA dc or ±100% of initial value, whichever is greater Δ r _{DS(on)} 1 = ±20% of initial value Δ V _{GS(th)} 1 = ±20% of initial value	Subgroups 2 and 3 of table I herein Δ I _{GSSF1} = ±20nA dc or 100% of initial value, whichever is greater Δ I _{GSSR1} = ±20nA dc or 100% of initial value, whichever is greater Δ I _{DSS1} = ±10μA dc or 100% of initial value, whichever is greater Δ r _{DS(on)} 1 = ±20% of initial value Δ V _{GS(th)} 1 = ±20% of initial value

1/ Shall be performed anytime before screen 10.

2/ This is a stress test designed to ensure a rugged product.

4.4 Quality conformance inspection. Quality 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 figure 4 of MIL-PRF-19500.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with 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. Electrical measurements (end-points) and delta requirements 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>
3	1051	Test condition G, 100 cycles.
3	2077	SEM qualification may be performed anytime prior to lot formation.
3	2037	Test condition A, all internal bond wires for each device shall be pulled separately.
4	1042	The heating cycle shall be 30 seconds minimum.
5	1042	Read and record $V_{(BR)DSS}$ (pre and post) at $I_D = 1$ mA. Read and record I_{DSS} (pre and post) in accordance with table I, group A, subgroup 2. No more than 15% of the sample shall be permitted to have a $\Delta V_{(BR)DSS}$ shift of more than 10% and ΔI_{DSS} greater than 25 μ A.
5	2037	Bond strength (Al-Au die interconnects only); test condition A.
6	3161	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>
2	1051	Test condition G.
3	1042	The heating cycle shall be 30 seconds minimum.
4	2075	See 3.3.2
4	2037	Test condition A. All internal bond wires for each device shall be pulled separately.
5 and 6	----	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 of table I, group A, subgroup 2 herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
2	1056	Test condition B.
2	2036	Test condition A; weight = 10 pounds; t = 15 s.(Not required for surface mount devices).
5	1001	Test condition C. For device type 2N7270: $V_{DS} = 500 \text{ V}$; $I_{(ISO)} < 0.25 \text{ mA}$.
6	1042	The heating cycle shall be 30 seconds minimum.

4.4.4 Group D Inspection. Group D inspection shall be conducted in accordance with MIL-PRF-19500 and table II herein. Level F and G represent 300 k and 600 k rad (Si) respectively.

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 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 $R_{\theta JC(max)} = 0.83^\circ \text{ C/W}$. The following parameter measurements shall apply:

- Measuring current (I_M) ----- 10 mA.
- Drain heating current (I_H) ----- 4 A.
- Heating time (t_H) ----- Steady-state (see MIL-STD-750, method 3161 for definition).
- Drain-source heating voltage (V_H) ----- 25 V.
- Measurement time delay (t_{MD}) ----- 30 to 60 μs .
- Sample window time (t_{SW}) ----- 10 μs 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 3, 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 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.

- Measuring current (I_M) ----- 10 mA.
- Drain heating current (I_H) ----- 4 A minimum.
- Heating time (t_H) ----- 100 ms.
- Drain-source heating voltage (V_H) ----- 25 V.
- Measurement time delay (t_{MD}) ----- 30 to 60 μs .
- Sample window time (t_{SW}) ----- 10 μs maximum.

TABLE I. Group A inspection.

Inspection <u>1/3/</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	$Z_{\theta JC}$		0.60	$^{\circ}C/W$
Breakdown voltage, drain to source	3407	$V_{GS} = 0 V$; $I_D = 1 mA$ dc Bias condition C	$V_{(BR)DSS}$			
2N7394				60		V dc
2N7268				100		V dc
2N7269				200		V dc
2N7270				500		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	$V_{GS} = +20$ and $-20 V$ dc Bias condition C, $V_{DS} = 0$	I_{GSS1}		± 100	nA dc
Drain current	3413	$V_{GS} = 0 V$ dc Bias condition C $V_{DS} = 80\%$ of rated V_{DS}	I_{DSS1}			
2N7394					25	μA dc
2N7268					25	μA dc
2N7269					25	μA dc
2N7270					50	μA dc
Static drain to source "ON"-state resistance	3421	$V_{GS} = 12 V$ dc, condition A Pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(on)1}$			
2N7394					0.027	ohm
2N7268					0.065	ohm
2N7269					0.100	ohm
2N7270					0.450	ohm
Static drain to source "ON"-state resistance	3421	$V_{GS} = 12 V$ dc, condition A Pulsed (see 4.5.1), $I_D = I_{D1}$	$r_{DS(on)2}$			
2N7394					0.030	ohm
2N7268					0.070	ohm
2N7269					0.110	ohm
2N7270					0.500	ohm

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/ 3/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u> - continued						
Forward voltage	4011	Pulsed (see 4.5.1), $I_D = I_{D1}$ $V_{GS} = 0$ V dc	V_{SD}			
2N7394					1.4	V
2N7268					1.4	V
2N7269					1.4	V
2N7270					1.6	V
<u>Subgroup 3</u>						
High temperature operation		$T_C = T_J = +125^\circ$ 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 dc Bias condition C $V_{DS} = 100\%$ of rated V_{DS}	I_{DSS2}		1.0	mA dc
		$V_{DS} = 80\%$ of rated V_{DS}	I_{DSS3}		0.25	mA dc
Static drain to source "ON"-state resistance	3421	$V_{GS} = 12$ V dc Pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(on)3}$			
2N7394					0.060	ohm
2N7268					0.132	ohm
2N7269					0.200	ohm
2N7270					1.000	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		$T_C = T_J = -55^\circ$ 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}			
2N7394				8.0		S
2N7268				8.0		S
2N7269				8.0		S
2N7270				4.0		S

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection <u>1/ 3/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4</u> - Continued.						
Switching time test	3472	$I_D = I_{D1}$, $V_{GS} = 12$ V dc $R_G = 2.35\Omega$, $V_{DD} = 50\%$ of rated V_{DS}				
Turn-on delay time			$t_{d(on)}$			
2N7394				35	ns	
2N7268				45	ns	
2N7269				33	ns	
2N7270				45	ns	
Rise time			t_r			
2N7394				140	ns	
2N7268				190	ns	
2N7269				140	ns	
2N7270				190	ns	
Turn-off delay time			$t_{d(off)}$			
2N7394				140	ns	
2N7268				170	ns	
2N7269				140	ns	
2N7270				190	ns	
Fall time			t_f			
2N7394				140	ns	
2N7268				130	ns	
2N7269				140	ns	
2N7270				130	ns	
<u>Subgroup 5</u>						
Safe operating area test (high voltage)	3474	See figure 4, 5, 6, and 7 $t_p = 10$ ms minimum $V_{DS} = 80\%$ of max 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				

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection <u>1/</u> <u>3/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 7</u> - Continued.						
On-state gate charge			$Q_{g(on)}$			
2N7394					200	nC
2N7268					160	nC
2N7269					170	nC
2N7270					150	nC
Gate to source charge			Q_{gs}			
2N7394					75	nC
2N7268					35	nC
2N7269					30	nC
2N7270					30	nC
Gate to drain charge			Q_{gd}			
2N7394					75	nC
2N7268					65	nC
2N7269					60	nC
2N7270					75	nC
Reverse recovery time	3473	$di/dt \leq 100 \text{ A}/\mu\text{s}$ $V_{DD} \leq 30 \text{ V}, I_D = I_{D1}$	t_{rr}			
2N7394					280	ns
2N7268					570	ns
2N7269					820	ns
2N7270					1100	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

JANTXV - group B, subgroups 2 and 3;
group C, subgroup 6;
group E, subgroup 1

3/ Electrical characteristics and conditions for "U" suffix devices (surface mount) are identical to the corresponding non-"U" suffix device unless otherwise noted.

TABLE II. Group D inspection.

Inspection 1/ 2/ 6/	MIL-STD-750		Symbol	Preirradiation limits				Postirradiation limits				Unit
	Method	Conditions		M. D. and R		3/ 5/ F. G. and H		M. D. and R		3/ 5/ F. G. and H		
				Min	Max	Min	Max	Min	Max	Min	Max	
<u>Subgroup 1</u>												
Not applicable												
<u>Subgroup 2</u>												
TC = +25° C												
Steady-state total dose irradiation (VGS bias) 4/	1019	VGS = 12 V VDS = 0										
Steady-state total dose irradiation (VDS bias) 4/	1019	VGS = 0 VDS = 80% of rated VDS (pre-irradiation)										
End-point electricals												
Breakdown voltage, drain to source	3407	VGS = 0; ID = 1 mA bias cond. C	V(BR)DSS									
2N7394				60		60		60		60		V dc
2N7268				100		100		100		100		V dc
2N7269				200		200		200		200		V dc
2N7270				500		500		500		500		V dc
Gate to source voltage (threshold)	3403	VDS ≥ VGS ID = 1 mA	VGS(th)									
2N7394				2	4	2	4	2	4	1.25	4.50	V dc
2N7268				2	4	2	4	2	4	1.25	4.50	V dc
2N7269				2	4	2	4	2	4	1.25	4.50	V dc
2N7270				2	4	2	4	2	4	1.25	4.50	V dc
Gate current	3411	VGS = 20 V VDS = 0 Bias cond. C	IGSSF1		100		100		100		100	nA dc
Gate current	3411	VGS = -20 V VDS = 0 Bias cond. C	IGSSR1		-100		-100		-100		-100	nA dc

See footnotes at end of table.

TABLE II. Group D inspection - Continued.

Inspection 1/ 2/ 6/	MIL-STD-750		Symbol	Preirradiation limits				Postirradiation limits				Unit
	Method	Conditions		3/ 5/		3/ 5/		3/ 5/		3/ 5/		
				M. D. and R	F. G. and H	M. D. and R	F. G. and H	M. D. and R	F. G. and H			
Min	Max	Min	Max	Min	Max	Min	Max	Min	Max			
<u>Subgroup 2</u> - Continued.												
Drain current	3413	V _{GS} = 0 Bias cond. C V _{DS} = 80% of rated V _{DS} (pre- irradiation)	I _{DSS}									
2N7394					25	25	25	25	50	μAdc		
2N7268					25	25	25	25	50	μAdc		
2N7269					25	25	25	25	50	μAdc		
2N7270					50	50	50	50	100	μAdc		
Static drain to source on-state resistance	3421	V _{GS} = 12 V Cond. A pulsed see 4.5.1 I _D = I _{D2}	r _{DS(on)1}									
2N7394					.027	0.027	.027	.027	0.040	Ω		
2N7268					.065	0.065	.065	.065	0.090	Ω		
2N7269					.100	0.100	.100	.100	0.155	Ω		
2N7270					.450	0.450	.450	.450	0.600	Ω		
Forward voltage source drain diode	4011	V _{GS} = 0 V I _D = I _{D1}	V _{SD}									
2N7394					1.4	1.4	1.4	1.4	1.4	V		
2N7268					1.4	1.4	1.4	1.4	1.4	V		
2N7269					1.4	1.4	1.4	1.4	1.4	V		
2N7270					1.6	1.6	1.6	1.6	1.6	V		

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 both 100 k and 300 k rads (Si). The G designation represents devices which pass 100 k, 300 k, and 600 k rad (Si) end-points.

4/ Separate samples shall be pulled for each bias.

5/ H must meet end-points for 300 k, 600 k, and 1000 k RAD (Si).

6/ Group D qualification may be performed with the sample die mounted in the T0-254AA, surface mount, or the T0-204AE 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	-55° C to +150° C, 500 cycles	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table I, group A, subgroup 2	
<u>Subgroup 2 1/</u>			12 devices c = 0
Steady-state reverse bias	1042	Condition A: 1,000 hours	
Electrical measurements		See table I, group A, subgroup 2	
Steady-state gate bias	1042	Condition B: 1,000 hours	
Electrical measurements		See table I, group A, subgroup 2	
<u>Subgroup 3</u>			
Not applicable			
<u>Subgroup 4</u>			
Thermal resistance	3161	$R_{\theta JC} = 0.83 \text{ } ^\circ\text{C/W}$ maximum. See 4.5.2	12 devices c = 0

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

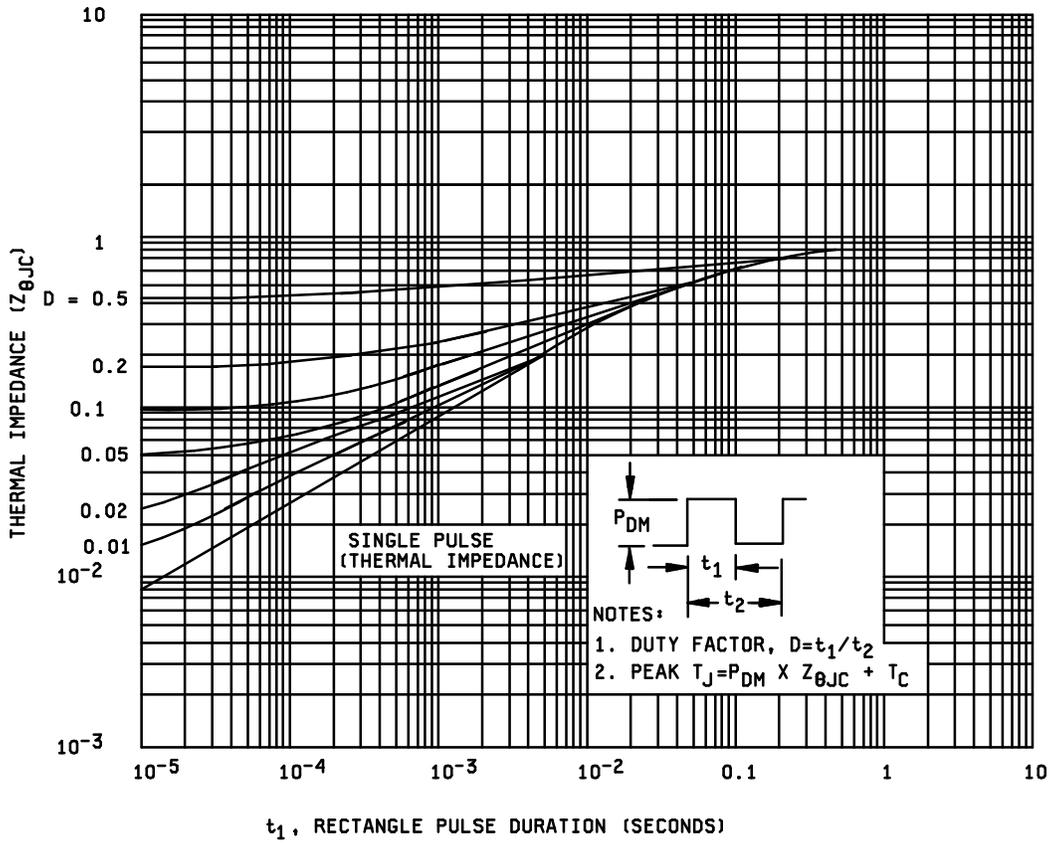


FIGURE 3. Thermal impedance curves.

2N7394, 2N7394U

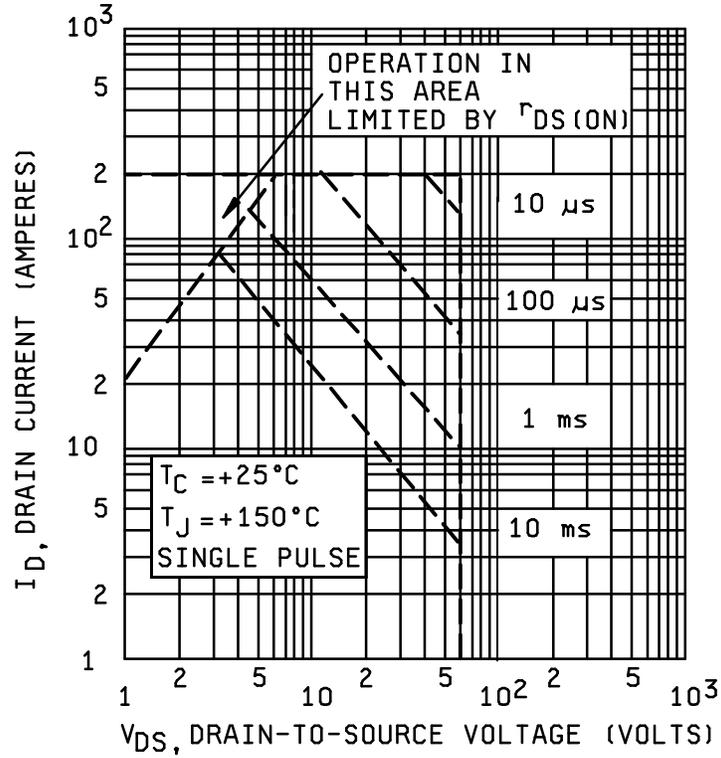


FIGURE 4. Safe operating area graph.

2N7268, 2N7268U

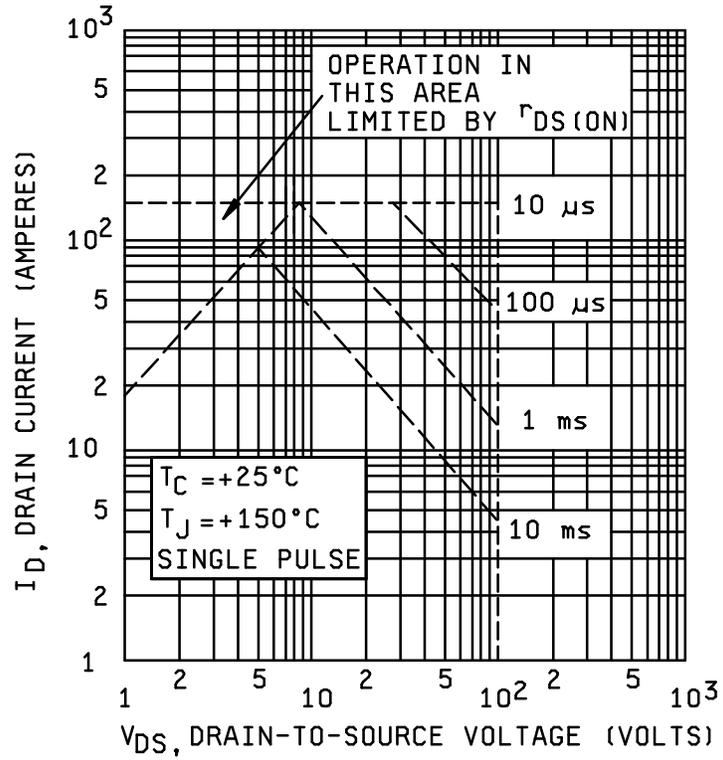


FIGURE 5. Safe operating area graph.

2N7269, 2N7269U

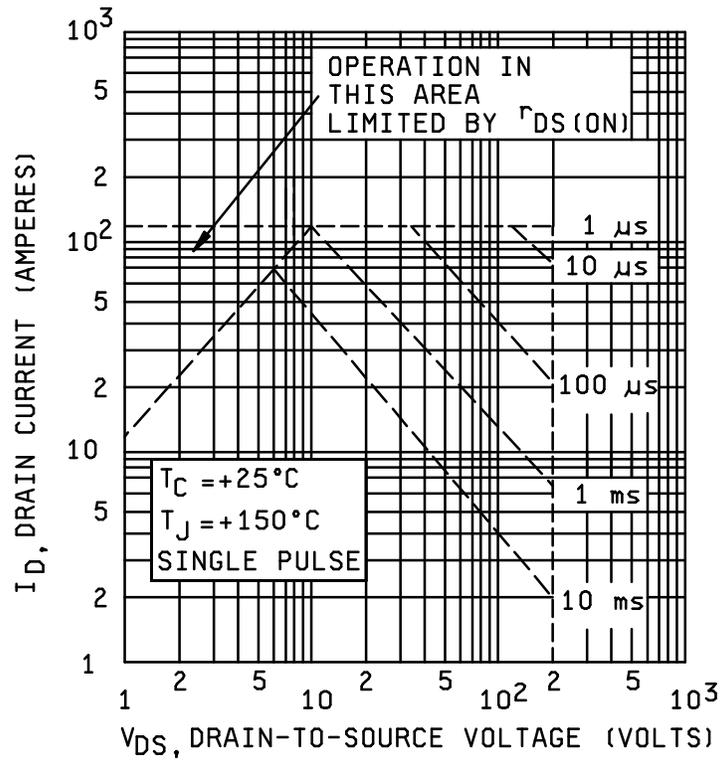


FIGURE 6. Safe operating area graph.

2N7270, 2N7270U

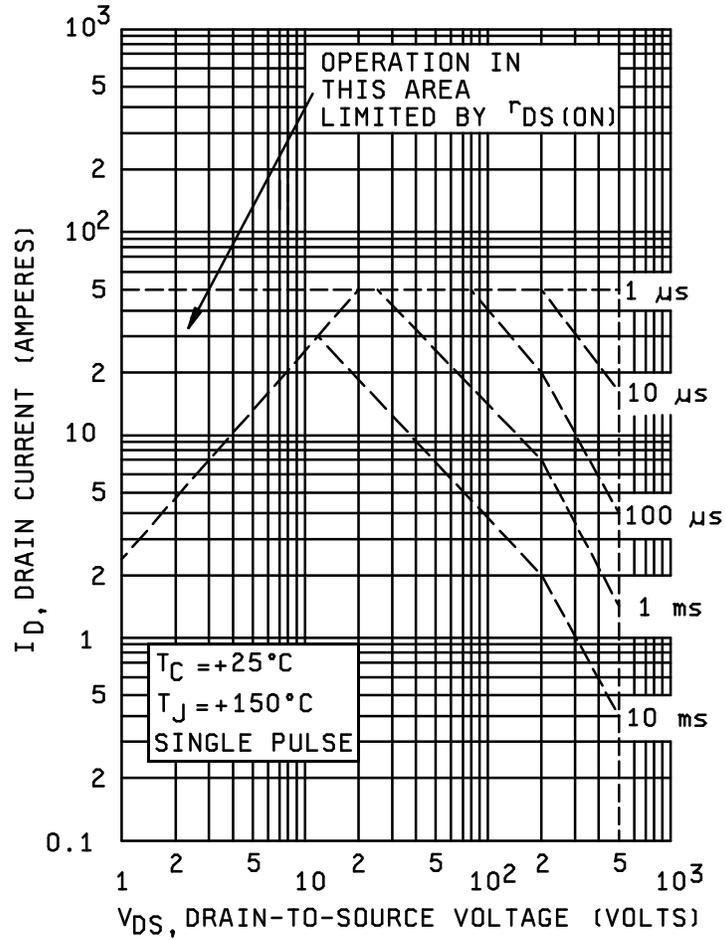


FIGURE 7. Safe operating area graph.

4.5.4 Single pulse avalanche energy E_{AS} .

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

4.5.5 Gate stress test.

- a. $V_{GS} = 24$ V minimum.
- b. $t = 250$ μs 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.

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

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 must specify the following:

- a. Issue of DODISS to be cited in the solicitation.
- b. Lead material and finish as specified (see 3.3.1).
- c. Type designator and quality level.

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-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 Electronics Supply Center, DESC-ELS, Dayton, OH 45444.

6.5 Substitution information. Devices covered by this specification are substitutable for the manufacturer's and user's Part or Identifying Number (PIN). This information in no way implies that manufacturer's PIN's are suitable for the military PIN.

Preferred types	Commercial types 1/
2N7394	IRHM7054
	IRHM8054
2N7268	IRHM7150
	IRHM8150
2N7269	IRHM7250
	IRHM8250
2N7270	IRHM7450
	IRHM8450
2N7394U	IRHN7054
	IRHN8054
2N7268U	IRHN7150
	IRHN8150
2N7269U	IRHN7250
	IRHN8250
2N7270U	IRHN7450
	IRHN8450

1/ IRH_7_ : 3K, 10K, and 100K Rad (Si).

IRH_3_ : 300K Rad (Si).

IRH_4_ : 600K Rad (Si).

IRH_8_ : 1000K Rad (Si).

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

6.7 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

CONCLUDING MATERIAL

Custodians:

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

Preparing activity:

DLA - ES

(Project 5961-1836)

Review activities:

Navy - TD
Air Force - 19, 70, 80

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.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/603B	2. DOCUMENT DATE (YYMMDD) 96/05/03
3. DOCUMENT TITLE SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED (TOTAL DOSE ONLY) TRANSISTORS, N-CHANNEL, SILICON TYPES 2N7268, 2N7269, 2N7270, 2N7394, 2N7268U, 2N7269U, 2N7270U, AND 2N7394U JANTXVM, D, R, F, G, AND H; AND JANSM, D, R, 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		
6. SUBMITTER		
a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)
8. PREPARING ACTIVITY		
a. NAME Alan Barone	b. TELEPHONE (Include Area Code) (1) Commercial 513-296-6048 (2) AUTOVON 986-6048	
c. ADDRESS (Include Zip Code) Defense Electronics Supply Center ATTN: DESC-ELDT Dayton, OH 45444-5765	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 AUTOVON 289-2340	