INCH-POUND

MIL-PRF-19500/659
20 August 1998

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED (TOTAL DOSE AND SINGLE EVENT EFFECTS) TRANSISTOR, P-CHANNEL SILICON TYPE 2N7440, AND 2N7441 JANSD AND JANSR

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 and Single Event characterization - see figure 4), power transistor. One level of product assurance is provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1, (similar to TO-257).

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

Type	P_T 1/ T_C = +25°C	P_T 1/ T_A = +25°C	V_{DS}	V_{DG}	V_{GS}	I_{D1} 2/ T_C =+25°C	I_{D2} T_C = +100°C	I_S 2/	I_{DM}	T_J and T_{STG}	V_{ISO} 70,000 ft. altitude
	W	W	V dc	V dc	V dc	A dc	A dc	A dc	A (pk)	°C	V dc
2N7440	56	22	-100	-100	±20	10.0	6.0	10.0	30	-55 to +150	N/A
2N7441			-200	-200		7.0	4.0	7.0	21		N/A

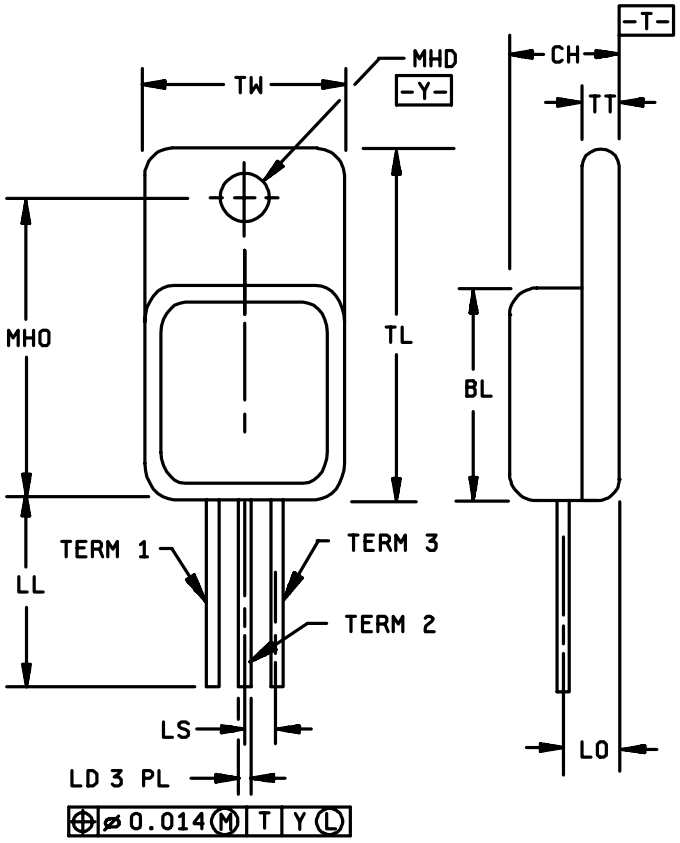
1/ Derate linearly 0.45 W/°C for T_C > +25°C; $P_T = (T_{jmax} - T_C)/R_{\theta JC}$
2/ $I_D = ((T_{jmax} - T_C)/((R_{\theta JC})X(r_{DS(on)} \text{ at } T_{jmax})))^{1/2}$

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

Type	Min $V_{(BR)DSS}$ V_{GS} = 0 I_D = 1.0 mA dc	$V_{GS(TH)1}$ $V_{DS} \geq V_{GS}$ I_D = 1.0 mA dc	Max I_{DSS1} V_{GS} = 0 V_{GS} = 80% of rated V_{DS}	Max $r_{DS(on)}$ 1/ V_{GS} = -12V		$R_{\theta JC}$ Max	$I_{AS} = I_{DM}$
				T_J = 25°C at I_{D2}	T_J = 125°C at I_{D2}		
	V dc	V dc Min Max	µA dc	Ω	Ω	°C/W	A (pk)
2N7440	-100	-2.0 -6.0	25	0.28	0.50	2.2	30
2N7441	-200			0.65	1.24		21

1/ Pulsed (see 4.5.1).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Supply Center Columbus, ATTN: DSCC-VAT, 3990 East Broad 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.



Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.405	.425	10.27	10.80
CH	.190	.200	4.83	5.08
LD	.025	.035	0.64	0.89
LL	.600	.650	15.24	16.51
LO	.120 BSC		3.05 BSC	
LS	.100 TYP		2.54 TYP	
MHD	.140	.150	3.56	3.81
MHO	.522	.542	13.29	13.77
TL	.645	.665	16.38	16.89
TT	.035	.045	0.89	1.14
TW	.410	.420	10.41	10.67
Term 1	Gate			
Term 2	Drain			
Term 3	Source			

NOTES:
1. Dimensions are in inches.
2. Equivalents are given for general information only.
3. All terminals are isolated from case.
4. The preferred measurements used herein are the inch units. This transistor was designed using inch-pound units of measurement. In case of conflicts between the metric and inch-pound units, the inch-pound units shall be the rule.
5. Die to base is BeO isolated, terminals to case ceramic (AL_2O_3) isolated.
6. In accordance with ANSI Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 1. Physical dimensions (similar to TO-257).

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 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.

3.3 Interface requirements and physical dimensions. The Interface requirements and physical dimensions shall be as specified in MIL-PRF-19500, and figure 1(TO-257AA) herein.

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

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

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

3.7.1 Handling. MOS devices must be handled with certain precautions to avoid damage due to the accumulation of static charge. However, the following handling practices are recommended (see 3.5).

a. Devices should be handled on benches with conductive handling devices.
b. Ground test equipment, tools and personnel handling devices.
c. Do not handle devices by the leads.
d. Store devices in conductive foam or carriers.
e. Avoid use of plastic, rubber or silk in MOS areas.
f. Maintain relative humidity above 50 percent if practical.
g. Care should be exercised during test and troubleshooting to apply not more than maximum rated voltage to any lead.
h. Gate must be terminated to source, $R \leq$ or 100 kΩ, whenever bias voltage is applied drain to source.

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

4. VERIFICATION

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

a. Qualification inspection (see 4.2).

b. Screening (see 4.3).

c. Conformance inspection (see 4.4).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500. 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 the conditions specified for subgroup testing in table IX of MIL-PRF-19500, and table III herein. End point electrical measurements shall be in accordance with the applicable steps of table IV herein.

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

Screen (See table IV of MIL-PRF-19500)	Measurement JANS
1/	E_{AS} test (see 4.5.4)
1/	Method 3161 (see 4.5.3)
1/	Gate stress test (see 4.5.5)
2/	Subgroup 2 of table I herein
9	I_{DSS1} , I_{GSS} as a minimum
10	MIL-STD-750, method 1042 test condition B
11	I_{GSSF1}, I_{GSSR1}, I_{DSS1}, $r_{DS(ON)}$, $V_{GS(TH)}$ Subgroup 2 of table I herein. ΔI_{GSSF1} = ±20 nA dc or ±100% of initial value, whichever is greater. ΔI_{GSSR1} = ±20 nA dc or ±100% of initial value, whichever is greater. ΔI_{DSS1} = ±25 µA dc or ±100% of initial value, whichever is greater.
12	MIL-STD-750, method 1042 test condition A
13	Subgroups 2 and 3 of table I herein ΔI_{GSSF1} = ±20 nA dc or ±100% of initial value, whichever is greater. ΔI_{GSSR1} = ±20 nA dc or ±100% of initial value, whichever is greater. ΔI_{DSS1} = ±25 µA dc or ± 100% of initial value, whichever is greater. $\Delta r_{DS(ON)1}$ = ±20% of initial value. $\Delta V_{GS(TH)1}$ = ±20% of initial value.

1/ Shall be performed anytime before screen 10.
2/ Shall be performed after E_{AS} test, method 3161, and gate stress test.

4.4 Conformance inspection. Conformance inspection shall be in accordance with 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) of MIL-PRF-19500, and as follows. End point electrical measurements shall be in accordance with the applicable steps of table IV 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 nor or forced-air cooling on the device shall be permitted during the on cycle. 0n = 30 seconds minimum.
5	1042	Accelerated steady-state reverse bias, condition A, V_{DS} = rated; T_A = +175°C; t = 120 hours, min.
5	1042	Accelerated steady-state gate bias, condition B, V_{GS} = rated; T_A = +175°C; t = 24 hours.
5	2037	Bond strength (Al-Au die interconnects only), Test condition A
6	3161	Thermal resistance, see 4.5.2.

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 steps of table IV herein.

Subgroup	Method	Condition
2	2036	Terminal strength, test condition A, weight = 10 lbs., 15 sec.
6	1042	Test condition D, 6,000 cycles; 1 cycle = 30 sec. min.

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.

4.4.4.1 Design parameters. Not tested on a per lot basis. Design shall be such that the devices shall be capable of meeting the requirements in figure 4.

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 $R_{\theta JC}$ = 2.2°C/W. The following parameters shall apply:

a. Measuring current(I_M)..... 10 mA
b. Drain heating current (I_H)..... 1 A
c. Heating time (t_H)..... Steady-state (see MIL-STD-750, method 3161)
d. Drain-source heating voltage (V_H)..... -25 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		Units
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical inspection	2071					
Subgroup 2						
Breakdown voltage drain to source	3407	V_{GS} = 0V, I_D = 1 mA dc, Bias condition C	$V_{(BR)DSS}$			
2N7440				-100		V dc
2N7441				-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	-6.0	V dc
Gate current	3411	V_{GS} = ±20V dc, Bias condition C, V_{DS} = 0V	I_{GSS1}		±100	nA dc
Drain current	3413	V_{GS} = 0V dc, Bias condition C, V_{DS} = 80 % of rated V_{DS},	I_{DSS1}		25	µA dc
Static drain to source "ON" state resistance	3421	V_{GS} = -12V dc, condition A, Pulsed (see 4.5.1), I_D = I_{D2}	$r_{DS(ON)1}$			
2N7440					0.28	Ω
2N7441					0.65	Ω
Static drain to source "ON" state voltage	3405	V_{GS} = -12V dc, condition A, Pulsed (see 4.5.1), I_D = I_{D1}	$V_{DS(ON)}$			
					-3.36	V dc
2N7440					-5.00	V dc
2N7441						
Forward voltage	4011	V_{GS} = 0V dc, condition A, pulsed (see 4.5.1), I_D = I_{D1}	V_{SD}		-1.8	V dc
Subgroup 3						
High temperature operation		T_C = T_J = +125°C				
Gate current	3411	V_{GS} = ±20V dc, Bias condition C, V_{DS} = 0V	I_{GSS2}		±200	nA dc
Drain current	3413	V_{GS} = 0V dc, Bias condition C, V_{DS} = 80% of rated V_{DS}	I_{DSS2}		0.25	mA dc

See footnotes at end of table.

TABLE I. Group A inspection - Continued

Inspection 1/	MIL-STD-750		Symbol	Limits		Units
	Method	Conditions		Min	Max	
Static drain to source "ON"-state resistance	3421	V_{GS} = -12V dc, condition A, Pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(ON)2}$			
2N7440					0.50	Ω
2N7441					1.24	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	$V_{GS(TH)3}$		-7.0	V dc
Subgroup 4						
Switching time test	3472	$I_D = I_{D1}$, V_{GS} = -12 V dc R_G = 7.5 Ω, V_{DD} = 50% of rated V_{DS}				
Turn-on delay time			$t_{D(on)}$			
2N7440					20	ns
2N7441					20	ns
Rise Time			t_r			
2N7440					55	ns
2N7441					35	ns
Turn-off delay time			$t_{D(off)}$			
2N7440					45	ns
2N7441					55	ns
Fall time			t_f			
2N7440					35	ns
2N7441					30	ns
Subgroup 5						
Safe operating area test (high voltage)	3474	See figure 3, t_p = 10 ms min. V_{DS} = 80% of max. rated V_{DS} ($V_{DS} \leq$ 200 V)				
Electrical measurements		See table IV, steps 1,2,3,4,5, 6, and 7				

See footnotes at end of table.

TABLE I. Group A inspection - Continued

Inspection 1/	MIL-STD-750		Symbol	Limits		Units
	Method	Conditions		Min	Max	
Subgroup 6						
Not applicable						
Subgroup 7						
Gate charge	3471	Condition B				
On-state gate charge			$Q_{G(ON)}$			
2N7440					40	nC
2N7441					40	nC
Gate to source charge			Q_{GS}			
2N7440					7.4	nC
2N7441					7.6	nC
Gate to drain charge			Q_{GD}			
2N7440					19	nC
2N7441					19	nC
Reverse recovery time	3473	di/dt = 100 A/µs, $V_{DD} \leq 30$ V, $I_D = I_{D1}$	t_{rr}			
2N7440					160	ns
2N7441					220	ns

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

Table II. Group D Inspection

Inspection 1/ 2/ 3/ 4/	MIL-STD-750		Symbol	Pre-irradiation limits		Post irradiation limits		Units
	Method	Conditions		Min.	Max.	Min.	Max.	
Subgroup 1								
Not Applicable								
Subgroup 2		T_C = +25°C						
Steady state total dose irradiation (V_{GS} bias)	1019	V_{GS} = -12V, V_{DS} = 0V						
Steady state total dose irradiation (V_{DS} bias)	1019	V_{GS} = 0V, V_{DS} = 80% of rated V_{DS}						
Breakdown voltage drain to source	3407	V_{GS} = 0V, I_D = 1 mA dc, Bias condition C	$V_{(BR)DSS}$					
2N7440				-100		-100		V dc
2N7441				-200		-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	-6.0	-2.0	-6.0	V dc
Gate current	3411	V_{GS} = ±20V dc, V_{DS} = 0V, Bias condition C	I_{GSS1}		±100		±100	nA dc
Drain current	3413	V_{GS} = 0V, V_{DS} = 80% of rated V_{DS}, Bias condition C	I_{DSS1}		25		25	µA dc
Static drain to source "ON"-state resistance	3421	V_{GS} = -12V dc, condition A, pulsed (see4.5.1), I_D = I_{D2}	$r_{DS(ON)1}$					
2N7440					0.28		0.28	Ω
2N7441					0.65		0.65	Ω
Static drain to source "ON"-state voltage	3405	V_{GS} = -12V dc, condition A, Pulsed (see 4.5.1), I_D = I_{D1}	$V_{DS(ON)}$					
2N7440					-3.36		-3.36	V dc
2N7441					-5.00		-5.00	V dc

1/ For sampling plan see MIL-PRF-19500.
2/ Electrical specifications are for 'D' and 'R' rad levels.
3/ 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.
4/ At the manufacturer's option, group D samples need not be subjected to all the screening tests, but shall be assembled in its qualified package or in any qualified package that the manufacturer has data to correlate the performance to the designated package.

TABLE III. Group E inspection (all quality levels) - For qualification only

Inspection 1/, 2/, 3/, 4/, 5/	MIL-STD-750		Qualification and large lot quality conformance inspection.
	Method	Conditions	
Subgroup 1			12 devices c = 0
Temperature cycling (air to air)	1051	Test condition G, 500 cycles	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table IV, steps 1,2,3,4,5,6, and 7	
Subgroup 2 1/			12 devices c = 0
Steady-state gate bias	1042	Test condition B; 1,000 hours	
Electrical measurements		See table IV, steps 1,2,3,4,5,6, and 7	
Steady state reverse bias	1042	Test condition A; 1,000 hours	
Electrical measurements		See table IV, steps 1,2,3,4,5,6, and 7	
Subgroup 3			
Not applicable			
Subgroup 4			22 devices c = 0
Thermal resistance	3161	$R_{\theta JC}$ = 2.2°C/W maximum. See 4.5.2	
Subgroup 5			
Barometric pressure test (not required for $V_{BR(DSS)} \leq$ 200V)	1001	Test condition C	15 devices c = 0

1/ See footnotes at end of table.

TABLE III. Group E inspection (all quality levels) - For qualification only - continued.

Inspection 1/, 2/, 3/, 4/, 5/	MIL-STD-750		Qualification and large lot conformance inspection.
	Method	Conditions	
Subgroup 6 3/			3 devices 5/ c = 0
Electrical measurements 3/		See table IV, steps 3 and 4	
SEE Effect Testing	1080	Fluence = 3e5 ±20% ions/cm^2 Flux = 5e3 to 2e4 ions/cm^{2}sec Beam energy = 260 to 300 MeV Temperature = 25°C ± 5°C	
2N7440		LET = 26 to 30 MeV-cm^2/mg Ion range = 40 to 45 microns Insitu bias conditions: V_{DS} = -100V and V_{GS} = 20V LET = 36 to 40 MeV-cm^2/mg Ion range = 35 to 40 microns Insitu bias conditions: V_{DS} = -100V and V_{GS} = 10V V_{DS} = -80V and V_{GS} = 15V V_{DS} = -50V and V_{GS} = 20V	
2N7441		LET = 26 to 30 MeV-cm^2/mg Ion range = 40 to 45 microns Insitu bias conditions: V_{DS} = -200V and V_{GS} = 20V LET = 36 to 40 MeV-cm^2/mg Ion range = 35 to 40 microns Insitu bias conditions: V_{DS} = -200V and V_{GS} = 5V V_{DS} = -160V and V_{GS} = 10V V_{DS} = -100V and V_{GS} = 15V V_{DS} = -40V and V_{GS} = 20V	
Electrical measurements 3/		See table IV, steps 3 and 4	

1/ A separate sample for each test may be pulled.
2/ Group E qualification of single event effect testing may be performed prior to lot formation. Wafers qualified to these group E QCI requirements may be used for any other performance specification utilizing the same die design.
3/ As a minimum, gate to source leakages and drain to source leakage are to be examined to verify the electrical performance of the DUT prior to and after test. At the manufacturer's option, the remaining static tests in table IV, with the exception of step 8, may be performed.
4/ Devices passing a given combination of drain and gate voltage for an LET of 36 to 40 MeV-cm^2/mg qualify the same conditions for an LET of 26 to 30 MeV-cm^2/mg.
5/ This sampling plan applies to each bias condition defined.

TABLE IV. Group A, B, C and E electrical measurements

Step	Inspection 1/, 2/	MIL-STD-750		Symbol	Limits		Units
		Method	Conditions		Min	Max	
1.	Breakdown voltage drain to source	3407	V_{GS} = 0V, I_D = 1 mA dc, Bias condition C	$V_{(BR)DSS}$			
	2N7440				-100		V dc
	2N7441				-200		V dc
2.	Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$, I_D = 1 mA dc	$V_{GS(TH)1}$	-2.0	-6.0	V dc
3.	Gate current	3411	V_{GS} = ±20V dc, Bias condition C, V_{DS} = 0V	I_{GSS1}		±100	nA dc
4.	Drain current	3413	V_{GS} = 0V dc, Bias condition C, V_{DS} = 80% of rated V_{DS}	I_{DSS1}		25	µA dc
5.	Static drain to source "ON"-state resistance	3421	V_{GS} = -12V dc, condition A, Pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(ON)1}$			
	2N7440					0.28	Ω
	2N7441					0.65	Ω
6.	Static drain to source "ON"-state voltage	3405	V_{GS} = -12V dc, condition A, Pulsed (see 4.5.1), $I_D = I_{D1}$	$V_{DS(ON)}$			
	2N7440					-3.36	V dc
	2N7441					-5.00	V dc
7.	Forward voltage	4011	V_{GS} = 0V dc, condition A, Pulsed (see 4.5.1), $I_D = I_{D1}$	V_{SD}		-1.8	V dc
8.	Thermal response	3161	See 4.5.3	ΔV_{SD}		85	mV

1/ The electrical measurements for table VIa (JANS) of MIL-PRF-19500 are as follows:

a. Subgroup 3, see table IV herein, steps 1, 2, 3, 4, 5, 6, and 7.
b. Subgroup 4, see table IV herein, steps 1, 2, 3, 4, 5, 6, 7, and 8.
c. Subgroup 5, see table IV herein, steps 1, 2, 3, 4, 5, 6, and 7.

2/ The electrical measurements for table VII of MIL-PRF-19500 are as follows:

a. Subgroup 2 and 3, see table IV herein, steps 1, 2, 3, 4, 5, 6, and 7.
b. Subgroup 6, see table IV herein, steps 1, 2, 3, 4, 5, 6, 7, and 8.

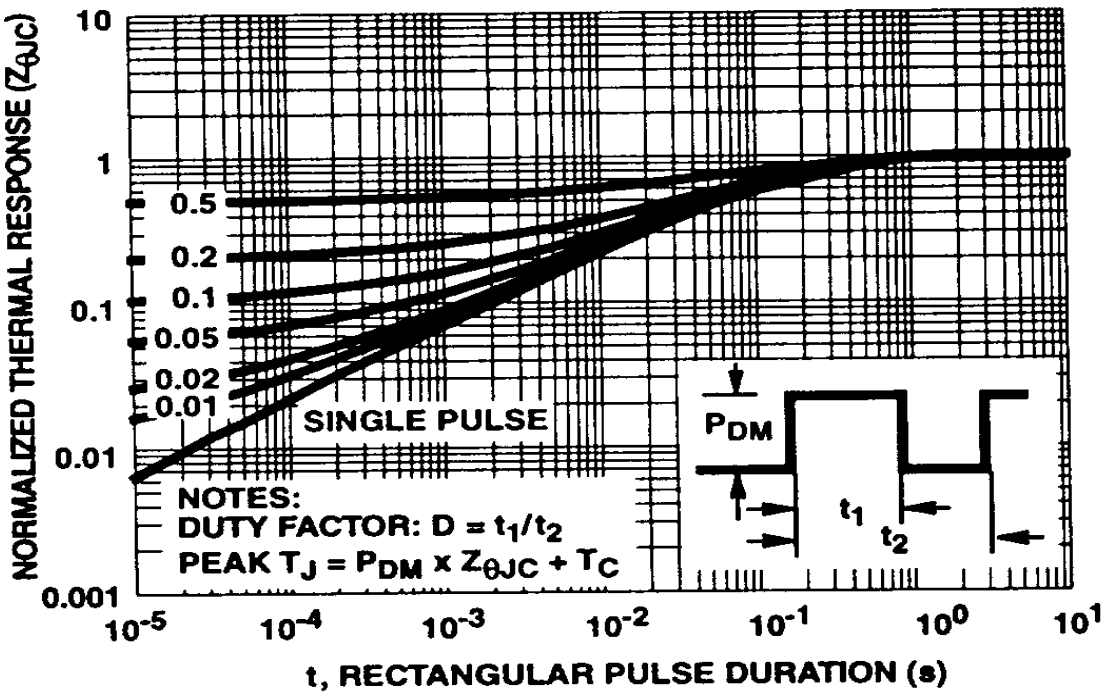
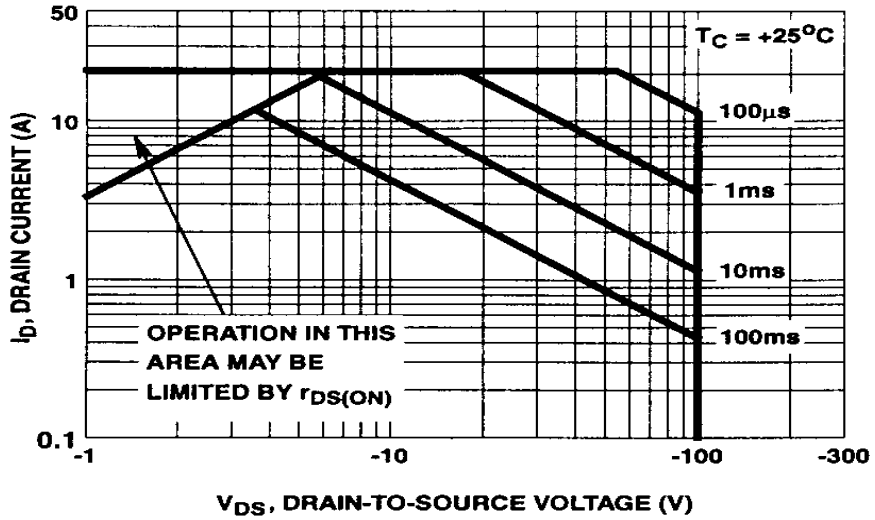


FIGURE 2. Thermal response curves

2N7440



2N7441

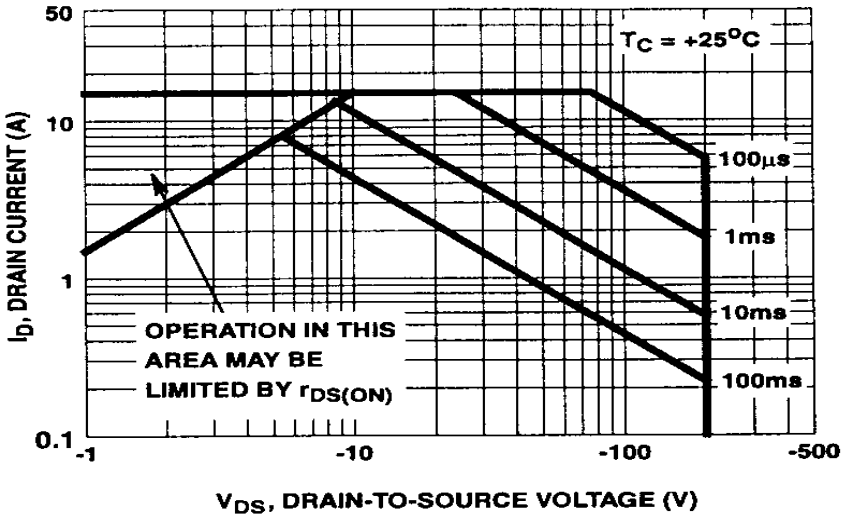
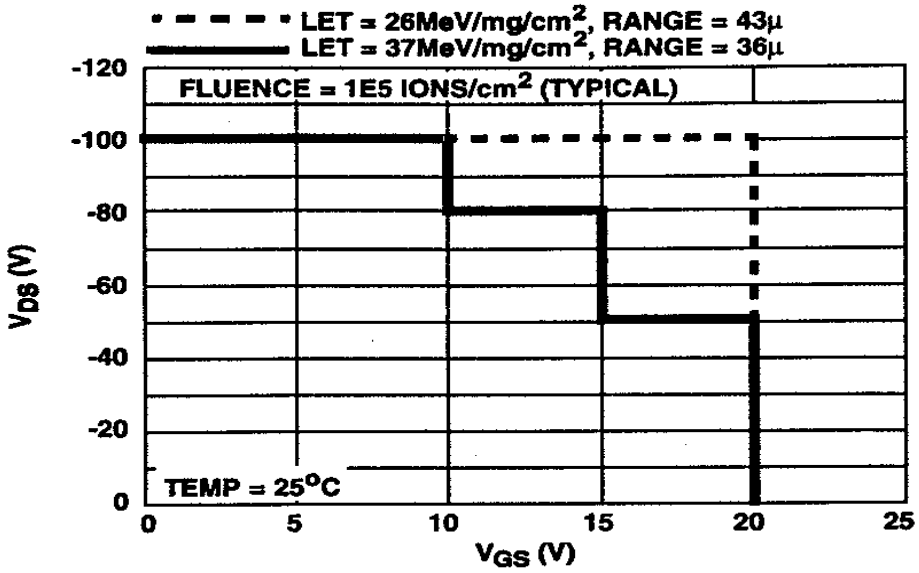


FIGURE 3. Safe operating area graphs

2N7440



2N7441

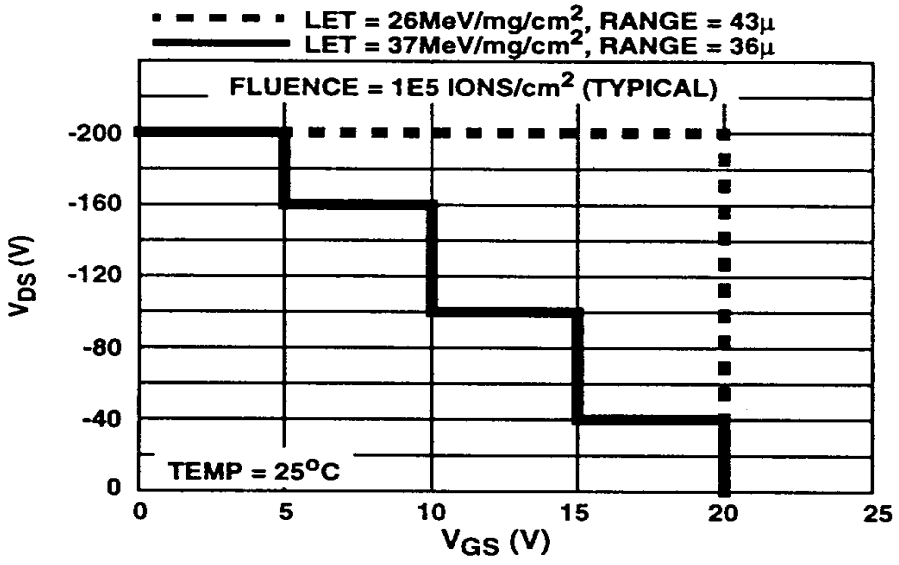


FIGURE 4. Single event effects safe operating area graphs

4.5.3 Thermal Response (ΔV_{SD} measurement). The ΔV_{SD} measurement shall be performed in accordance with method 3161 of MIL-STD-750. The ΔV_{SD} conditions (I_H and V_H) and maximum limit shall be derived by each vendor from the thermal response curves (see figure 2) and shall be specified in the certificate of conformance prior to qualification. The following parameter measurements shall apply:

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

b. Drain heating current (I_H)..... 1 A

c. Heating time (t_H)..... 100 ms

d. Drain-source heating voltage (V_H)..... -25 V

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

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

4.5.4 Single pulse avalanche energy (E_{AS}).

a. $I_{AS} = I_{DM}$

b. L = 0.1 mH

c. $E_{AS} = 1/2\ LI_{AS}^2$

d. V_{DD} = -50 V to -150 V dc

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

4.5.5 Gate stress test.

a. V_{GS} = -30 V

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 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. Lead finish (see 3.3.1).

c. Type designation and product assurance level.

d. Packaging requirements (see 5.1).

6.4 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 Supply Center Columbus, DSCC-VQE, Columbus, OH 43216.

6.5 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
SS913A0 SS923A0	2N7440 2N7441

CONCLUDING MATERIAL

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

Preparing activity:
DLA - CC

(Project 5961-2006)

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-19500/659	**2. DOCUMENT DATE** 20 August 1998

3. DOCUMENT TITLE SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED (TOTAL DOSE AND SINGLE EVENT EFFECTS) TRANSISTOR, P-CHANNEL SILICON TYPE 2N7440, AND 2N7441 JANSD AND JANSR

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 / DSN / FAX / EMAIL 614-692-0510 / 850-0510 / 614-692-6939 / alan_barone@dscc.dla.mil
c. ADDRESS Defense Supply Center Columbus ATTN: DSCC-VAT Columbus, OH 43216-5000	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 DSN 289-2340

DD Form 1426, OCT 89 Previous editions are obsolete