The documentation and process conversion measures necessary to comply with this revision shall be completed by 4 December 2003.

INCH-POUND

MIL-PRF-19500/605B
4 September 2003
SUPERSEDING
MIL-PRF-19500/605A
17 December 1997

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED (TOTAL DOSE ONLY)
TRANSISTORS, N-CHANNEL, SILICON TYPES 2N7292, 2N7294, 2N7296, AND 2N7298
JANTXVM, D, R, H AND JANSM, D AND R

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

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

1.2 Physical dimensions. See figure 1 (similar to TO-254).

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

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 (2)	I_{DM} (4)	T_J and T_{STG}	V_{ISO} 70,000 feet altitude
	W	W	V dc	V dc	A dc	A dc	A dc	A dc	A(pk)	°C	V dc
2N7292	125	2.5	100	100	±20	25	20	25	75	-55 to +150	N/A
2N7294	125	2.5	200	200	±20	23	15	23	69	-55 to +150	N/A
2N7296	125	2.5	250	250	±20	17	11	17	51	-55 to +150	250
2N7298	125	2.5	500	500	±20	9	6	9	27	-55 to +150	500

(1) Derate linearly 1.0 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 graph.
(4) I_{DM} = 4 x I_D as calculated by 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, P.O. 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 = .250 mA dc		Max I_{DSS1} V_{GS} = 0 V_{DS} = 80 percent of rated V_{DS}	Max $r_{DS(on)}$ V_{GS} = 10 V dc (1)		$R_{\theta JC}$ max	$I_{AS} = I_{DM}$	E_{AS} at I_{AS}
		V dc			T_J = +25°C at I_{D2}	T_J = +125°C at I_{D2}			
	V dc	Min	Max	µA dc	Ω	Ω	°C/W	A(pk)	mJ
2N7292	100	2	4	25	0.070	0.140	1.00	75	281
2N7294	200	2	4	25	0.115	0.253	1.00	69	238
2N7296	250	2	4	25	0.185	0.444	1.00	51	130
2N7298	500	2	4	25	0.615	1.60	1.00	27	36

(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.

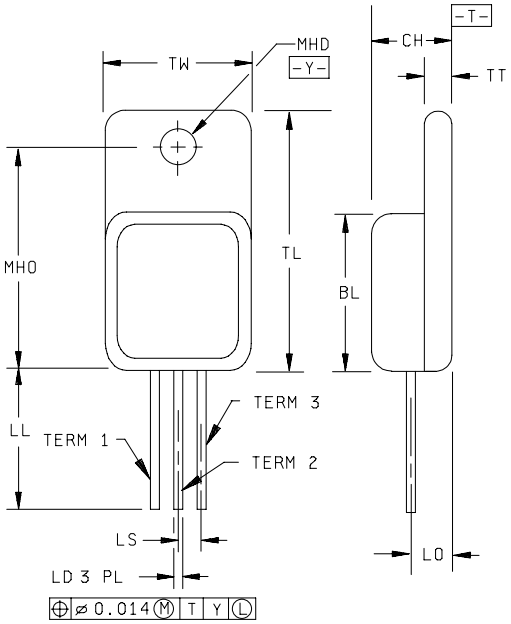
STANDARD

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.



Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
BL	.530	.550	13.46	13.97	
CH	.249	.260	6.32	6.60	
LD	.035	.045	0.89	1.14	
LL	.520	.560	13.21	14.22	
LO	.150 BSC		3.81 BSC		
LS	.150 TYP		3.81 TYP		
MHD	.139	.149	3.53	3.78	
MHO	.665	.685	16.89	17.40	
TL	.790	.800	20.07	20.32	3, 4
TT	.040	.050	1.02	1.27	3, 4
TW	.535	.545	13.59	13.84	
Term 1	Drain				
Term 2	Source				
Term 3	Gate				

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. All terminals are isolated from case.
4. The preferred measurements used herein are the metric units. However, 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. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.
6. Die to base is BeO isolated, terminals to case ceramic (AL_2O_3) isolated.

* FIGURE 1. Physical dimensions for TO-254AA (2N7292, 2N7294, 2N7296, and 2N7298).

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 6.4).

* 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, non-repetitive.

* 3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500, and figure 1 (T0-254AA) herein.

* 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 lead finish is desired, it shall be specified in the acquisition documents (see 6.2).

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

* 3.5 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.

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

* 3.6.1 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 3.6).

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, $R \leq 100\ k\Omega$, whenever bias voltage is to be applied drain to source.

* 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 the subgroups specified in 4.4.2 and 4.4.3.

* 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, and as specified herein. Alternate flow is allowed for qualification inspection in accordance with 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 associated specification 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 levels). 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 level	JANTXV level
(3)	Gate stress test (see 4.3.1)	Gate stress test (see 4.3.1)
(3)	E_{AS} test, method 3470 of MIL-STD-750. (see 4.3.2)	E_{AS} test, method 3470 of MIL-STD-750. (see 4.3.2)
(3) 3c	V_{SD} test, method 3161 of MIL-STD-750 (see 4.3.3)	V_{SD} test, method 3161 of MIL-STD-750 (see 4.3.3)
(4)	Subgroup 2 of table I herein	Subgroup 2 of table I herein
9	I_{GSSF1}, I_{GSSR1}, I_{DSS1}	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}, $R_{DS(on)1}$, $V_{GS(th)}$ 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} = ±25 μA dc or ± 100 percent of initial value, whichever is greater.	I_{GSSF1}, I_{GSSR1}, I_{DSS1}, $r_{DS(on)1}$, $V_{GS(th)1}$ 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 or T_A = +175°C and t = 48 hours min (5)
13	Subgroup 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} = ±25 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.	Subgroup 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} = ±25 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 any time before screen 9.
(4) Shall be performed after V_{SD} test, E_{AS} test, and gate stress test.
(5) Use of this accelerated screening option requires a 1,000-hour life test in accordance with applicable group E, subgroup 2 life test, and end-points specified herein to be provided to the qualifying activity for review and acceptance.

* 4.3.1 Gate stress test. Apply V_{GS} = 30 V minimum for t = 250 µs minimum.

* 4.3.2 Single pulse avalanche energy (E_{AS}).

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

b. L = .1 mH

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

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

* 4.3.3 Thermal response (ΔV_{SD} measurement). The delta V_{SD} measurement shall be performed in accordance with method 3161 of MIL-STD-750. The delta V_{SD} conditions (I_H and V_H) and maximum limit shall be derived by each vendor from the thermal response curves (see figure 3) 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) ..... 4 A minimum.

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

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.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein. Alternate flow is allowed for quality conformance inspection in accordance with 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 table I, 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 (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	Condition G, 100 cycles.
B4	1042	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	Condition A; V_{DS} = 100 percent of rated; T_A = +175°C, t = 120 hours, or T_A = +150°C, t = 120 hours minimum. 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, subgroup 2.
B5	1042	Condition B; V_{GS} = 100 percent of rated; T_A = +175°C; t = 24 hours minimum.
B5	2037	Bond strength, test condition A.
B6	3161	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	The heating cycle shall be 30 seconds minute minimum.
B5		Not applicable
B6		Not applicable

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

Subgroup	Method	Condition
C2	2036	Terminal strength, test condition A, weight = 10 lbs., t = 15 sec.
C5	3161	See 4.5.2.
C6	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 appendix E, 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 appendix E, table IX of MIL-PRF-19500 and as specified 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 appropriate tables and as follows.

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

4.5.2 Thermal resistance. Thermal resistance measurements shall be performed in accordance with method 3161 of MIL-STD-750. The maximum limit of $R_{\theta JC(max)}$ = 1.00°C/W. The following parameter measurements shall apply:

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

b. Drain heating current (I_H) ..... 4 A.

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

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		Unit
	Method	Condition		Min	Max	
Subgroup 1						
Visual and mechanical inspection	2071					
Subgroup 2						
Thermal Impedance 2/	3161	See 4.3.3	$Z_{\theta JX}$			
Breakdown voltage, drain to source	3407	Bias condition C, V_{GS} = 0V, I_D = 1 mA dc	$V_{(BR)DSS}$			
2N7292				100		V dc
2N7294				200		V dc
2N7296				250		V dc
2N7298				500		V dc
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$, I_D = 1 mA	$V_{GS(th)1}$	2.0	4.0	V dc
Gate current	3411	Bias condition C, V_{GS} = +20 V dc, V_{DS} = 0 V dc	I_{GSSF1}		+100	nA dc
Gate current	3411	Bias condition C, V_{GS} = -20 V dc, V_{DS} = 0 V dc	I_{GSSR1}		-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} = 10 V dc, condition A, pulsed (see 4.5.1), I_D = rated I_{D2}	$r_{DS(on)1}$			
2N7292					0.070	Ω
2N7294					0.115	Ω
2N7296					0.185	Ω
2N7298					0.615	Ω
Static drain to source on-state resistance	3421	V_{GS} = 10 V dc, condition A, pulsed (see 4.5.1), I_D = rated I_{D1}	$r_{DS(on)2}$			
2N7292					0.074	Ω
2N7294					0.121	Ω
2N7296					0.194	Ω
2N7298					0.646	Ω
Forward voltage	4011	V_{GS} = 0 V dc, I_D = rated I_{D1}, pulsed (see 4.5.1)	V_{SD}		1.8	V

See footnote at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
Subgroup 3						
High temperature operation:		$T_C = T_J = +125°C$				
Gate current	3411	Bias condition C, V_{GS} = +20 and -20 V dc, V_{DS} = 0 V dc,	I_{GSS2}		±200	nA dc
Drain current	3413	Bias condition C, V_{GS} = 0 V dc, V_{DS} = 100 percent of rated V_{DS}	I_{DSS2}		1.0	mA dc
Drain current	3413	Bias condition C, V_{GS} = 0 V dc, V_{DS} = 80 percent of rated V_{DS}	I_{DSS3}		0.25	mA dc
Static drain to source on-state resistance	3421	V_{GS} = 10 V dc, pulsed (see 4.5.1), I_D = rated I_{D2}	$r_{DS(on)3}$			
2N7292					0.140	Ω
2N7294					0.253	Ω
2N7296					0.444	Ω
2N7298					1.60	Ω
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$, I_D = 1 mA	$V_{GS(th)2}$	1.0		V dc
Low temperature operation:		$T_C = T_J = -55°C$				
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$, I_D = 0.25 mA	$V_{GS(th)3}$		5.0	V dc

See footnote at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
Subgroup 4						
Switching time test	3472	$I_D = I_{D1}$, V_{GS} = 10 V dc, R_G = 25 Ω, V_{DD} = 50 percent of V_{DS}				
Turn-on delay time			$t_{d(on)}$			
2N7292					134	ns
2N7294					156	ns
2N7296					114	ns
2N7298					148	ns
Rise time			t_r			
2N7292					628	ns
2N7294					510	ns
2N7296					162	ns
2N7298					196	ns
Turn-off delay time			$t_{d(off)}$			
2N7292					642	ns
2N7294					574	ns
2N7296					990	ns
2N7298					800	ns
Fall time			t_f			
2N7292					490	ns
2N7294					280	ns
2N7296					256	ns
2N7298					180	ns
Subgroup 5						
Safe operating area test	3474	See figure 4, t_p = 10 ms, V_{DS} = 80 percent of max rated V_{DS}, ($V_{DS} \leq$ 200 V)				
Electrical measurements		See table I, subgroup 2 herein				
Subgroup 6						
Not applicable						

See footnote at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
Subgroup 7						
Gate charge	3471	Condition B				
On-state gate charge			$Q_{g(on)}$			
2N7292					314	nC
2N7294					298	nC
2N7296					264	nC
2N7298					264	nC
Gate to source charge			Q_{gs}			
2N7292					46	nC
2N7294					66	nC
2N7296					48	nC
2N7298					56	nC
Gate to drain charge			Q_{gd}			
2N7292					164	nC
2N7294					144	nC
2N7296					124	nC
2N7298					126	nC
Reverse recovery time	3473	$d_i/d_t \leq 100$ A/µs, $V_{DD} \leq 30$ V, $I_D = I_{D1}$, (see 1.3)	t_{rr}			
2N7292					1400	ns
2N7294					1700	ns
2N7296					2000	ns
2N7298					2300	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	Preirradiation limits		Postirradiation limits		Unit
	Method	Conditions		R		R		
				Min	Max	Min	Max	
Subgroup 1								
Not applicable								
Subgroup 2		T_C = +25°C						
Steady-state total dose irradiation	1019	2/, 3/						
End-point electricals		See table I, subgroup 2 herein.						
Breakdown voltage, drain to source	3407	Bias condition C V_{GS} = 0, I_D = 1 mA	$V_{(BR)DSS}$					
2N7292				100		100		V dc
2N7294				200		200		V dc
2N7296				250		250		V dc
2N7298				500		500		V dc
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$	V_{GSth1}	2.0	4.0	2.0	4.0	V dc
Gate current	3411	Bias condition C V_{GS} = 20 V V_{DS} = 0	I_{GSSF1}		100		100	nA dc
Gate current	3411	Bias condition C V_{GS} = -20 V V_{DS} = 0	I_{GSSR1}		-100		-100	nA dc
Drain current	3413	Bias condition C V_{GS} = 0 V_{DS} = 80 percent of rated V_{DS} (pre-irradiation)	I_{DSS1}		25		25	µA dc
Static drain to source on-state resistance	3421	V_{GS} = 10 V, condition A pulsed (see 4.5.1) I_D= I_{D2}	R_{DSon1}					
2N7292				0.070		0.070		Ω
2N7294				0.115		0.115		Ω
2N7296				0.185		0.185		Ω
2N7298				0.615		0.615		Ω

See footnotes at end of table.

* TABLE II. Group D inspection - Continued.

Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Preirradiation limits		Postirradiation limits		Unit
	Method	Conditions		R		R		
				Min	Max	Min	Max	
Drain to source on state voltage	3405	V_{GS} = 10 V condition A pulsed (see 4.5.1) $I_D = I_{D1}$	V_{DSon}					
2N7292					1.84		1.84	V dc
2N7294					2.78		2.78	V dc
2N7296					3.30		3.30	V dc
2N7298					5.81		5.81	V dc

1/ For sampling plan see MIL-PRF-19500.
2/ Inspection requires all subgroup 2 (group D) measurements after exposure to both of the following insitu bias conditions:

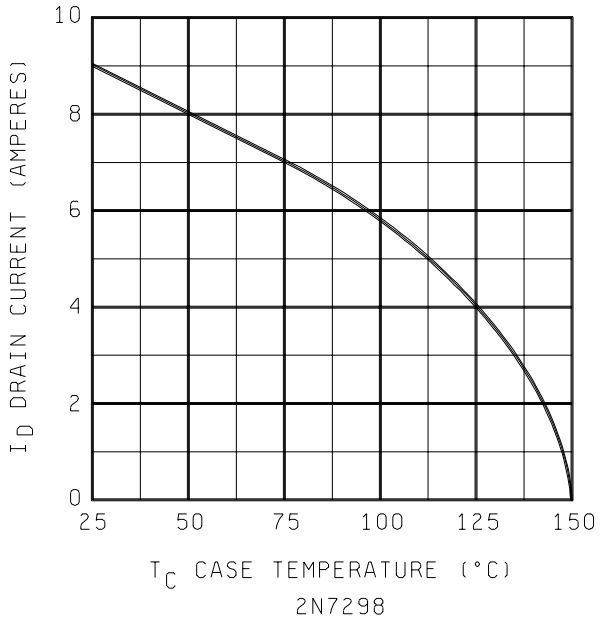
V_{GS} = 10 V; V_{DS} = 0
V_{GS} = 0 V; V_{DS} = 80 percent of rated V_{DS}

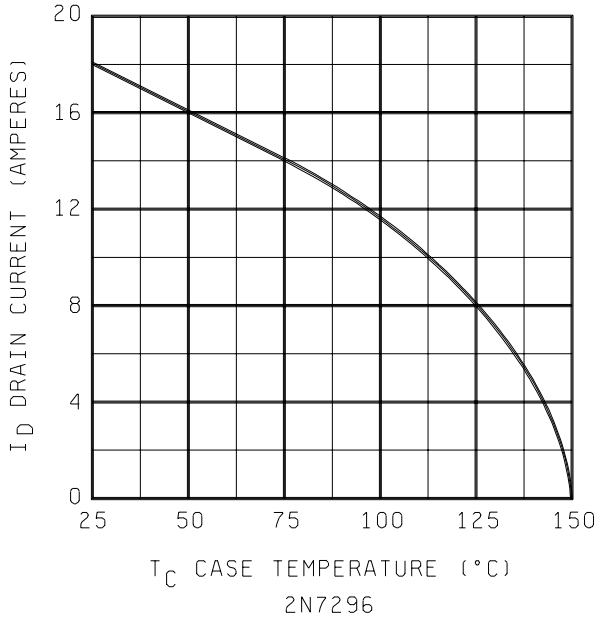
3/ Each bias condition requires a separate total dose sample.

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

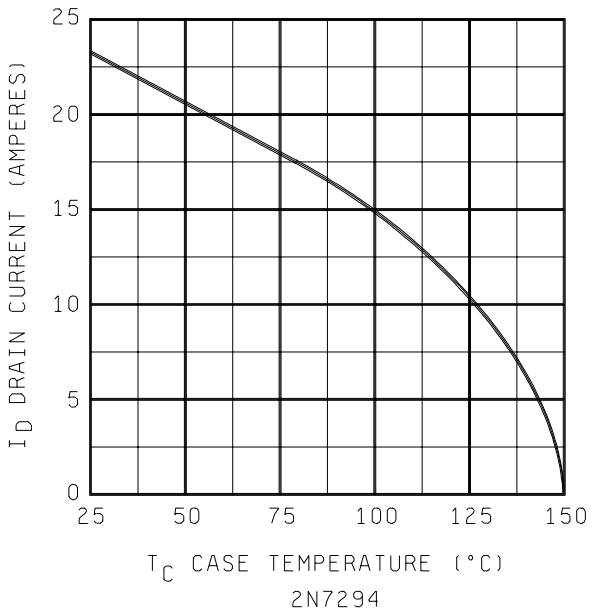
Inspection	MIL-STD-750		Sampling plan
	Method	Conditions	
Subgroup 1			12 devices c = 0
Temperature cycling	1051	-55 to 150°C, 500 cycles.	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table I, subgroup 2 herein.	
Subgroup 2 1/			12 devices c = 0
Steady-state reverse bias	1042	Condition A, 1,000 hours.	
Electrical measurements		See table I, subgroup 2 herein.	
Steady-state gate bias	1042	Condition B, 1,000 hours.	
Electrical measurements		See table I, subgroup 2 herein.	
Subgroup 3			3 devices c = 0
DPA	2102		
Subgroup 4			sample size N/A
Thermal resistance, 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 2/			5 devices c = 0
Barometric pressure test 2N7296 2N7298	1001	Condition C, $V_{(ISO)} = V_{DS}$ V_{DS} = 250 V dc V_{DS} = 500 V dc	
Subgroup 6			3 devices
ESD	1020		
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		
Soldering heat	2031	1 cycle	

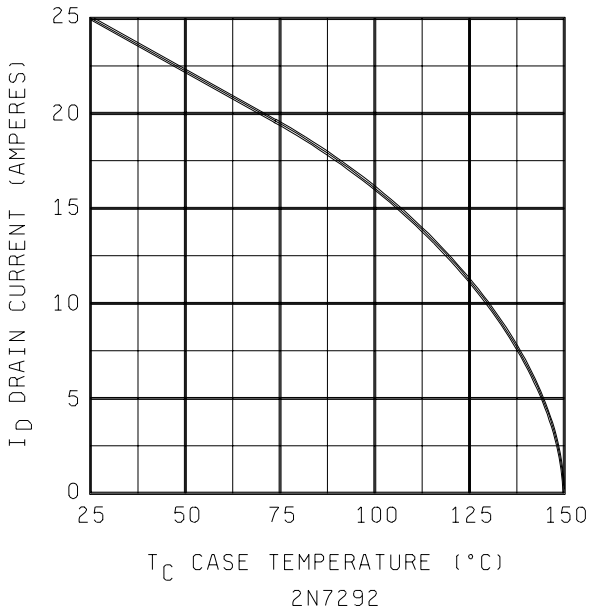
1/ A separate sample for each test shall be pulled.
2/ Not required for 2N7292, 2N7294.



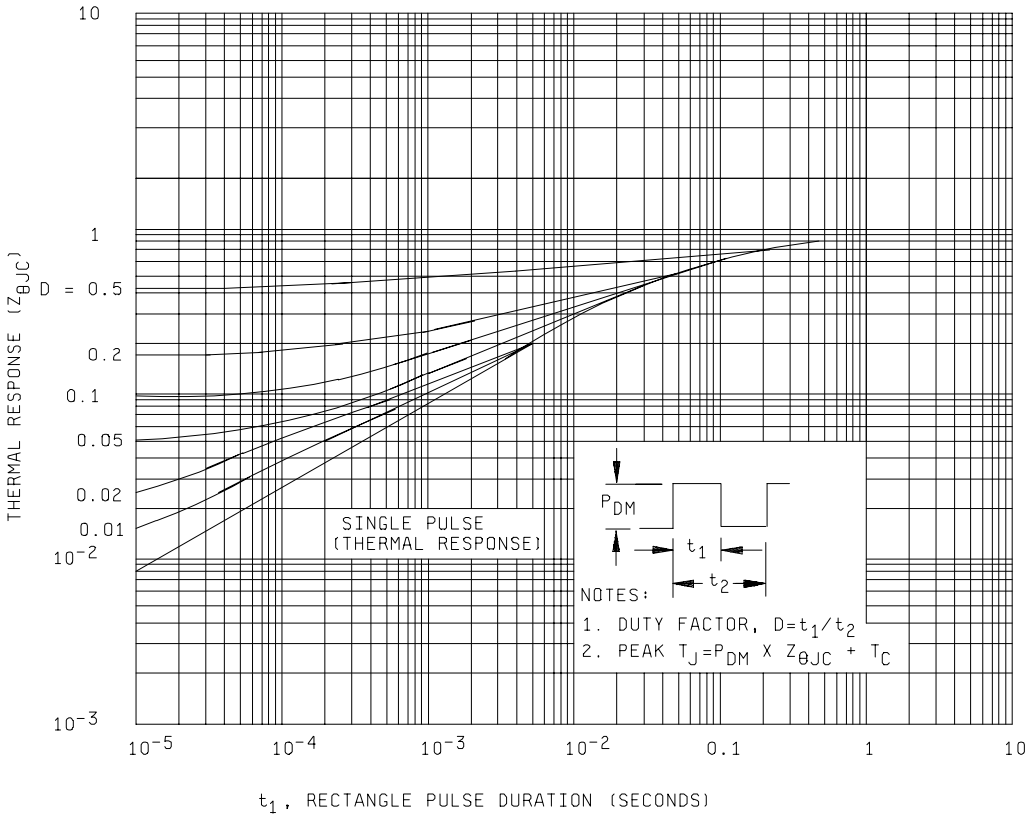


* FIGURE 2. Maximum drain current vs case temperature graphs.

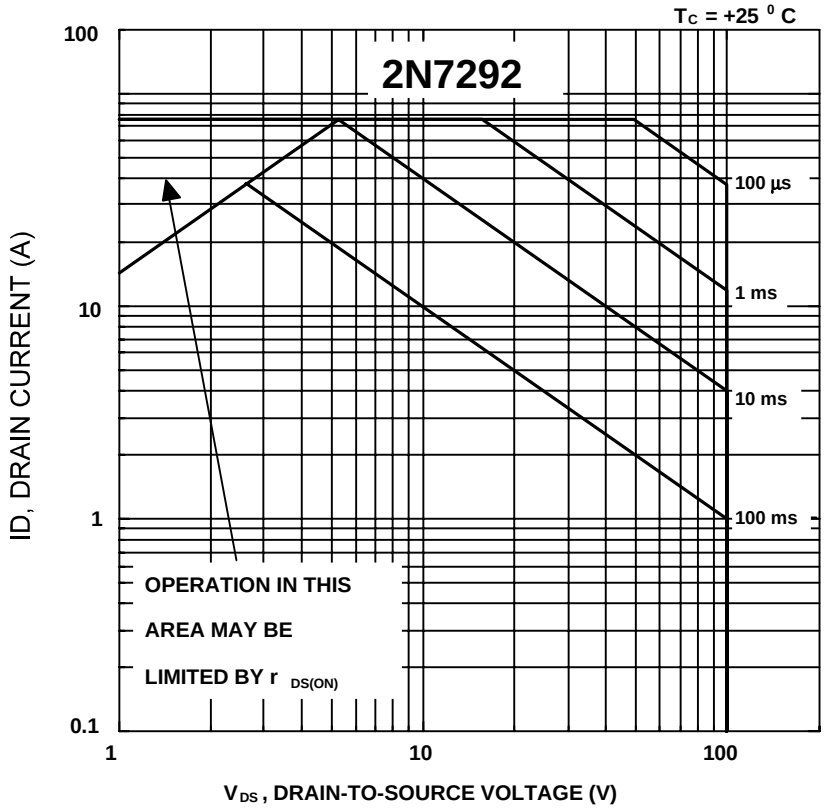




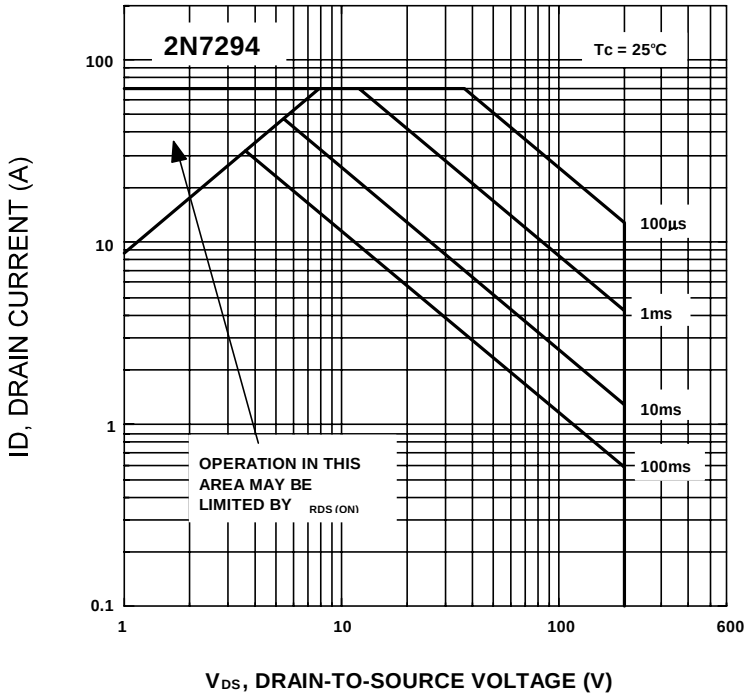
* FIGURE 2. Maximum drain current vs case temperature graphs. - Continued.



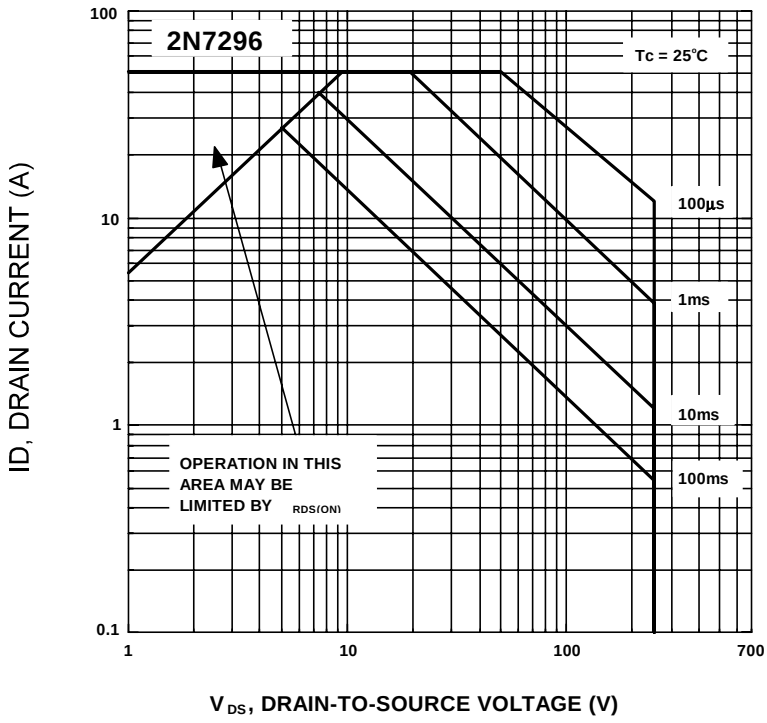
* FIGURE 3. Thermal response curves.



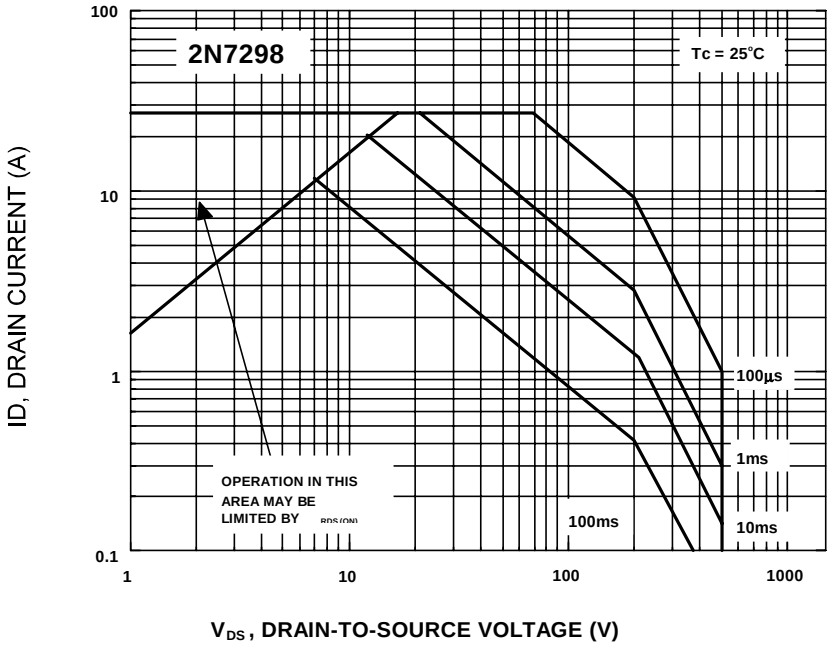
* FIGURE 4. Safe operating area graphs.



* FIGURE 4. Safe operating area graphs - Continued.



* FIGURE 4. Safe operating area graphs - Continued.



* FIGURE 4. Safe operating area graphs - Continued.

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 may be specified (see 3.4.1).

d. Type designation and product assurance level.

e. Packaging requirements (see 5.1).

6.3 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
2N7292	FRF150 (1)
2N7294	FRF250 (1)
2N7296	FRF254 (1)
2N7298	FRF450 (1)

(1) FRFxxxM, FRFxxxD FRFxxxR, 3 k, 10 k, 100 k RAD(Si)

* 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 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.

* 6.5 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 activities:
Navy - TD
Air Force - 70, 99

Preparing activity:
DLA - CC

(Project 5961-2736)

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-19500/605B	2. DOCUMENT DATE 4 September 2003

3. **DOCUMENT TITLE**
SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED (TOTAL DOSE ONLY) TRANSISTORS, N-CHANNEL, SILICON TYPES 2N7292, 2N7294, 2N7296, AND 2N7298 JANTXVM, D, R, H AND JANSM, D AND R

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			