The documentation and process conversion measures necessary to comply with this revision shall be completed by 24 April 2024.

INCH-POUND

MIL-PRF-19500/630G
w/AMENDMENT 1
25 January 2024
SUPERSEDING
MIL-PRF-19500/630G
9 October 2018

PERFORMANCE SPECIFICATION SHEET

TRANSISTOR , FIELD EFFECT, RADIATION HARDENED P-CHANNEL, SILICON, TYPES 2N7389 AND 2N7390, JANTXV, R, AND F AND JANS, R, AND F

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

The requirements for acquiring the product described herein shall consist of this specification sheet and MIL-PRF-19500.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for a P-channel, radiation hardened, enhancement mode, MOSFET, power transistor. Two levels of product assurance (JANTXV and JANS) are provided for each device type as specified in MIL-PRF-19500, with avalanche energy ratings (E_{AS}) and maximum avalanche current (I_{AS}). Provisions for radiation hardness assurance (RHA) to two radiation levels (“R” and “F”) are provided for JANTXV and JANS product assurance levels. See 6.6 for JANHC and JANKC die versions.

1.2 Package outlines. The device package outline is as follows: Similar to TO-205AF in accordance with figure 1 and LCC in accordance with figure 2 for all encapsulated device types.

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

Type (1)	P_T (2)	P_T T_A = +25°C (free air)	$R_{\theta JC}$ (3)	Min $V_{(BR)DSS}$ V_{GS} = 0 V I_D = -1 mA dc	I_{D1} (4) (5) T_C = +25°C	I_{D2} (4) (5) T_C = +100°C	T_J and T_{STG}
	W	W	°C/W	V dc	A dc	A dc	°C
2N7389, 2N7389U, 2N7389U5	25	0.8	5	-100	-6.5	-4.1	-55 to +150
2N7390, 2N7390U, 2N7390U5	25	0.8	5	-200	-4.0	-2.4	-55 to +150

Type (1)	I_S	I_{DM} (6)	E_{AS}	I_{AS}	V_{GS}
	A dc	A (pk)	mJ	A dc	V dc
2N7389, 2N7389U, 2N7389U5	-6.5	-26	165	-6.5	±20
2N7390, 2N7390U, 2N7390U5	-4.0	-16	171	-4.0	±20

See notes on next page.

Comments, suggestions, or questions on this document should be addressed to DLA Land and Maritime, ATTN: VAC, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to Semiconductor@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil/.

AMSC N/A

FSC 5961

* DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited.

1.3 Maximum ratings. Continued.

(1) Electrical characteristics, ratings, and conditions for "U" and "U5" suffix devices are identical to the corresponding non "U" and "U5" suffix devices, unless otherwise specified.
(2) Derate linearly 0.2 W/°C for $T_C > +25°C$.
(3) See figure 3, thermal impedance curves.
(4) The following formula derives the maximum theoretical I_D limit. I_D is limited by package and internal construction.

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

(5) See figure 4, maximum drain current graph.
(6) $I_{DM} = 4 \times I_{D1}$ as calculated in note 4.

1.4 Primary electrical characteristics. Unless otherwise specified, $T_C = +25°C$.

Type	Min $V_{(BR)DSS}$ $V_{GS} = 0$ V $I_D = -1$ mA dc	$V_{GS(th)1}$ $V_{DS} \geq V_{GS}$ $I_D = -1$ mA		Max I_{DSS1} $V_{GS} = 0$ V $V_{DS} = 80$ percent of rated V_{DS}	Max $r_{DS(on)1}$ (1) $V_{GS} = -12$ V dc $I_D = I_{D2}$	
					$T_J = +25°C$	$T_J = +150°C$
	V dc	V dc Min	V dc Max	µA dc	ohms	ohms
2N7389, 2N7389U, 2N7389U5	-100	-2.0	-4.0	-25	0.30	0.60
2N7390, 2N7390U, 2N7390U5	-200	-2.0	-4.0	-25	0.80	1.68

(1) Pulsed, (see 4.5.1).

1.5 Part or Identifying Number (PIN). The PIN is in accordance with MIL-PRF-19500, and as specified herein. See 6.4 for PIN construction example and 6.5 for a list of available PINs.

1.5.1 JAN certification mark and quality level for encapsulated devices. The quality level designators for encapsulated devices that are applicable for this specification sheet from the lowest to the highest level are as follows: "JANTXV" and "JANS".

1.5.2 Radiation hardness assurance (RHA) designator. The RHA levels that are applicable for this specification sheet from lowest to highest are as follows: "R" and "F".

1.5.3 Device type. The designation system for the device types of transistors covered by this specification sheet are as follows.

1.5.3.1 First number and first letter symbols. The transistors of this specification sheet use the first number and letter symbols "2N".

1.5.3.2 Second number symbols. The second number symbols for the transistors covered by this specification sheet are as follows: "7389" and "7390".

* 1.5.3.3 Suffix letters. No suffix letters are used on devices that are packaged in the TO-205AF package of figure 1. The suffix letters "U" or "U5" are used on devices that are packaged in the LCC package of figure 2.

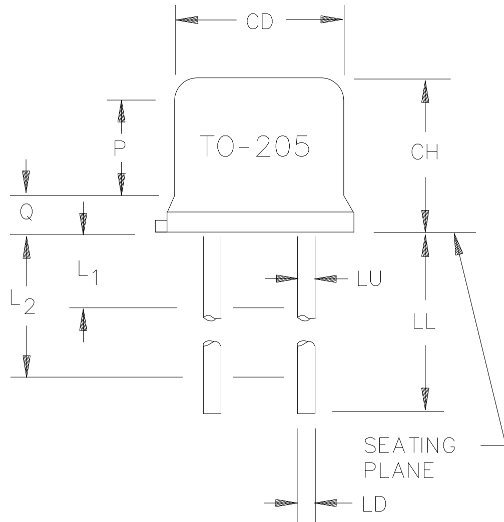
1.5.4 Lead finish. The lead finishes applicable to this specification sheet are listed on QPDSIS-19500.

* 1.6 Radiation features. The following radiation features are applicable for RHA devices supplied to this specification sheet.

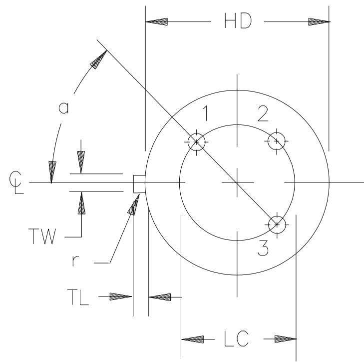
* 1.6.1 Maximum total ionizing dose (TID). The maximum TID that RHA devices were tested to in accordance with condition A (dose rate = 50 to 300 rad(Si)/s) of method 1019 of MIL-STD-750 are as follows:

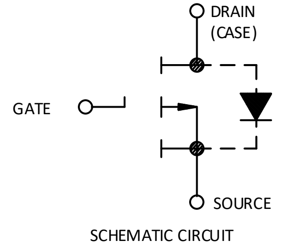
For device type 2N7389, 2N7389U, 2N7390, 2N7390U: .... 300 krads(Si) 1/

* 1/ The manufacturers supplying these device types have performed characterization testing in accordance with condition A (dose rate = 50 to 300 rad(Si)/s) of method 1019 of MIL-STD-750. The radiation end point limits are guaranteed only to a maximum TID level of 300 krads(Si).



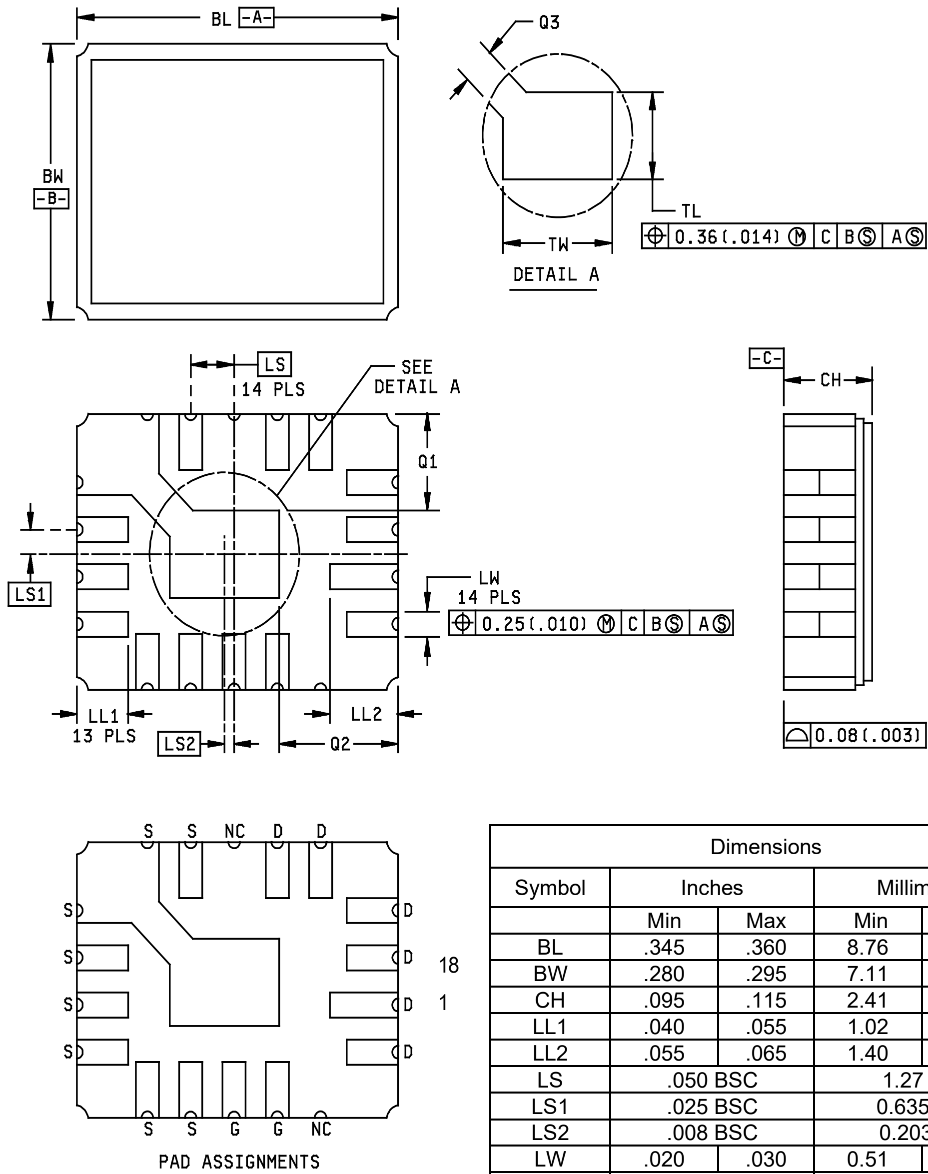
Ltr	Dimensions				
	Inches		Millimeters		Notes
	Min	Max	Min	Max	
CD	.315	.355	8.01	9.01	
CH	.160	.180	4.06	4.57	
HD	.340	.370	8.64	9.39	
LC	.200 TP		5.08 TP		6
LD	.016	.019	0.41	0.48	7, 8
LL	.500	.750	12.7	19.05	7, 8
LU	.016	.019	0.41	0.48	7, 8
L_1		.050		1.27	7, 8
L_2	.250		6.35		7, 8
P	.100		2.54		5
Q		.050		1.27	4
r		.010		0.25	9
TL	.029	.045	0.74	1.14	3
TW	.028	.034	0.71	0.86	2
α	45° TP		45° TP		6





NOTES:
1. Dimensions are in inches. Millimeters are given for general information only.
2. Beyond radius (r) maximum, TW shall be held for a minimum length of .011 (0.28 mm).
3. Dimension TL measured from maximum HD.
4. Outline in this zone is not controlled.
5. Dimension CD shall not vary more than .010 (0.25 mm) in zone P. This zone is controlled for automatic handling.
6. Leads at gauge plane .054 +.001, -.000 (1.37 +0.03, -0.00 mm) below seating plane shall be within .007 (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC.
7. LU applies between L_1 and L_2. LD applies between L_2 and LL minimum. Diameter is uncontrolled in L_1 and beyond LL minimum.
8. All three leads.
9. Radius (r) applies to both inside corners of tab.
10. Lead 1 is the Source, lead 2 is the Gate, and lead 3 is the Drain and is electrically connected to the case.

FIGURE 1. Physical dimensions for TO-205AF (2N7389, 2N7390).



Dimensions				
Symbol	Inches		Millimeters	
	Min	Max	Min	Max
BL	.345	.360	8.76	9.14
BW	.280	.295	7.11	7.49
CH	.095	.115	2.41	2.92
LL1	.040	.055	1.02	1.40
LL2	.055	.065	1.40	1.65
LS	.050 BSC		1.27 BSC	
LS1	.025 BSC		0.635 BSC	
LS2	.008 BSC		0.203 BSC	
LW	.020	.030	0.51	0.76
Q1	.105 REF		2.67 REF	
Q2	.120 REF		3.05 REF	
Q3	.045	.055	1.14	1.40
TL	.070	.080	1.78	2.03
TW	.120	.130	3.05	3.30

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.

FIGURE 2. Physical dimensions for LCC (2N7389U, 2N7389U5, 2N7390U, 2N7390U5).

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 of 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 cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-750 - Test Methods for Semiconductor Devices.

* (Copies of these documents are available online at https://quicksearch.dla.mil/).

2.3 Order of precedence. Unless otherwise noted herein or in the contract, 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.

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 manufacturers list before contract award (see 4.2 and 6.3).

3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as defined in MIL-PRF-19500 and as follows:

I_{AS}........Rated avalanche current, nonrepetitive
nC ....nano coulomb.

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500, and on figures 1 and 2 herein.

3.4.1 Lead material and finish. Lead material shall be Kovar. 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).

3.4.2 Internal construction. Multiple chip construction shall not be permitted.

3.5 Electrostatic discharge sensitive (ESDS). The devices covered by this specification sheet have been classified as ESDS. The devices shall be handled in accordance with the ESD program established to comply with the requirements of MIL-PRF-19500 to avoid damage due to the accumulation of static charge. The following handling practices shall be followed:

a. Devices shall 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 shall be exercised, during test and troubleshooting, to apply not more than maximum rated voltage to any lead.

h. Gate must be terminated to source. $R \leq 100$ kΩ, whenever bias voltage is to be applied drain to source.

3.6 Marking. Marking shall be in accordance with MIL-PRF-19500. At the option of the manufacturer, marking of country of origin may be omitted from the body of the transistor, but shall be retained on the initial container.

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

3.8 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table I.

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

4. VERIFICATION

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

a. Qualification inspection (see 4.2).

b. Screening (see 4.3).

c. Conformance inspection (see 4.4, and tables I and II).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500.

4.2.1 Group E qualification. Group E qualification shall be performed for qualification or re-qualification only. In case qualification was awarded to a prior revision of the specification sheet that did not request the performance of table III tests, the tests specified in table III herein that were not performed in the prior revision shall be performed on the first inspection lot of this revision to maintain qualification.

4.2.1.1 Single event effects (SEE). SEE shall be performed at initial qualification and after process or design changes which may affect radiation hardness (see table III and table IV). Upon qualification, manufacturers shall provide the verification test conditions from section 5 of method 1080 of MIL-STD-750 that were used to qualify the device for inclusion into section 6 of the slash sheet. End-point measurements shall be in accordance with table II. SEE characterization data shall be made available upon request of the qualifying or acquiring activity.

4.3 Screening (JANS and JANTXV levels only). Screening shall be in accordance with table E-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 (1) (2)	Measurements for JANS level	Measurements for JANTXV levels
(3)	Gate stress test (see 4.3.1)	Gate stress test (see 4.3.1)
(3)	Method 3470 of MIL-STD-750 (see 4.3.2), optional	Method 3470 of MIL-STD-750 (see 4.3.2), optional
(3) 3c	Method 3161 of MIL-STD-750 (see 4.3.3)	Method 3161 of MIL-STD-750 (see 4.3.3)
9	Subgroup 2 of table I herein.	Not applicable
10	Method 1042 of MIL-STD-750, test condition B	Method 1042 of MIL-STD-750, test condition B
11	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.	Subgroup 2 of table I herein
12	Method 1042 of MIL-STD-750, test condition A, t = 240 hours	Method 1042 of MIL-STD-750, test condition A
13	Subgroups 2 and 3 of table I herein; ΔI_{GSSF1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI_{GSSR1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI_{DSS1} = ±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 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 anytime after temperature cycling, screen 3a. JANTXV levels do not need to be repeated in screening requirements.

4.3.1 Gate stress test. Apply V_{GS} = -24 V minimum for t = 250 µs minimum.

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

a. Peak current (I_{AS})............................I_{D1}.

b. Peak gate voltage (V_{GS}):..................-12 V.

c. Gate to source resistor (R_{GS})...........25 Ω ≤ R_{GS} ≤ 200 Ω.

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

e. Inductance ....(2 $E_{AS}/(I_{AS})^2$)((V_{BR} - V_{DD})/V_{BR}) mH minimum.

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

g. Supply voltage ....V_{DD} = -50 V, or -25 V for 100 V devices.

4.3.3 Thermal impedance. The thermal impedance measurements shall be performed in accordance with method 3161 of MIL-STD-750 using the guidelines in that method for determining I_M, I_H, t_H, t_{SW}, t_{MD} (and V_H where appropriate). See table III, group E, subgroup 4 herein.

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 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 E-VIA (JANS) and table E-VIB (JANTXV) of MIL-PRF-19500, and as follows.

* 4.4.2.1 Quality levels JANS, table E-VIA of MIL-PRF-19500.

Subgroup	Method	Condition
B3	1051	Condition G, 100 cycles.
B4	1042	The heating cycle shall be 30 seconds minimum.
B5	1042	Condition B, V_{GS} = 100 percent of rated, T_A = +175°C, t = 24 hours, or T_A = +150°C, t = 48 hours (manufacturers option).
B5	1042	Condition A, V_{DS} = 100 percent of rated, T_A = +175°C, t = 120 hours, or T_A = +150°C, t = 240 hours (manufacturers option).
B5	2037	Bond strength; test condition D.

4.4.2.2 Quality level JANTXV, table E-VIB of MIL-PRF-19500.

Subgroup	Method	Condition
B2	1051	Test condition G, 25 cycles.
B3	1042	The heating cycle shall be 30 seconds minimum.
B4	2075	See 3.4.2.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-VII of MIL-PRF-19500, and as follows.

Subgroup	Method	Condition
C2	2036	Test condition E (applicable to TO-205AF only).
C5	3161	See 4.3.3, $R_{\theta JC(max)}$ = 5°C/W
C6	1042	The heating cycle shall be 30 seconds minimum.

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

4.4.5 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-IX of MIL-PRF-19500 and as specified in table III 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 measurements shall be as specified in section 4 of MIL-STD-750.

TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750 Method	MIL-STD-750 Condition	Symbol	Limits Min	Limits Max	Unit
Subgroup 1						
Visual and mechanical inspection	2071					
Subgroup 2						
Thermal impedance 2/	3161	See 4.3.3	$Z_{\theta JC}$			°C/W
Breakdown voltage, drain to source	3407	Bias condition C, V_{GS} = 0 V, I_D = -1 mA dc	$V_{(BR)DSS}$			
2N7389, 2N7389U, 2N7389U5				-100		V dc
2N7390, 2N7390U, 2N7390U5				-200		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} = -12 V dc, condition A, pulsed (see 4.5.1), I_D = rated I_{D2} (see 1.3)	$r_{DS(on)1}$			
2N7389, 2N7389U, 2N7389U5					0.30	Ω
2N7390, 2N7390U, 2N7390U5					0.80	Ω
Static drain to source on-state resistance	3421	V_{GS} = -12 V dc, condition A, pulsed (see 4.5.1), I_D = rated I_{D1}, (see 1.3)	$r_{DS(on)2}$			
2N7389, 2N7389U, 2N7389U5					0.35	Ω
2N7390, 2N7390U, 2N7390U5					0.92	Ω
Forward voltage	4011	V_{GS} = 0 V dc, I_D = rated I_{D1}, condition A,	V_{SD}			
2N7389, 2N7389U, 2N7389U5					-3.0	V
2N7390, 2N7390U, 2N7390U5					-5.0	V

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750 Method	MIL-STD-750 Condition	Symbol	Limits Min	Limits Max	Unit
Subgroup 3						
High temperature operation:		$T_C = T_J = +125°C$				
Gate current	3411	Bias condition C, $V_{GS} = \pm 20$ 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} = 80 percent of rated V_{DS}	I_{DSS2}		-0.25	mA dc
Static drain to source on-state resistance	3421	$V_{GS} = -12$ V dc, condition A, pulsed (see 4.5.1), I_D = rated I_{D2}	$r_{DS(on)3}$			
2N7389, 2N7389U, 2N7389U5					0.54	Ω
2N7390, 2N7390U, 2N7390U5					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	$V_{DS} \geq V_{GS}$, $I_D = -1$ mA	$V_{GS(th)3}$		-5.0	V dc
Subgroup 4						
Switching time test	3472	I_D = rated I_{D1}, $V_{GS} = -12$ V dc, Gate drive impedance = 7.5 Ω, V_{DD} = 50 percent of $V_{(BR)DSS}$				
Turn-on delay time			$t_{d(on)}$		30	ns
Rise time			t_r			
2N7389, 2N7389U, 2N7389U5					50	ns
2N7390, 2N7390U, 2N7390U5					30	ns
Turn-off delay time			$t_{d(off)}$			
2N7389, 2N7389U, 2N7389U5					70	ns
2N7390, 2N7390U, 2N7390U5					75	ns
Fall time			t_f			
2N7389, 2N7389U, 2N7389U5					70	ns
2N7390, 2N7390U, 2N7390U5					65	ns

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750 Method	MIL-STD-750 Condition	Symbol	Limits Min	Limits Max	Unit
Subgroup 4 - Continued						
Forward transconductance	3475	$I_D = I_{D2}$, V_{DD} = -15 V dc, pulsed (see 4.5.1)	g_{fs}			
2N7389, 2N7389U, 2N7389U5				2.5		S
2N7390, 2N7390U, 2N7390U5				2.5		S
Subgroup 5						
Safe operating area test (high voltage)	3474	See figures 5 and 6, t_p = 10 ms, V_{DS} = 80 percent of rated $V_{(BR)DSS}$				
Electrical measurements		See table I, subgroup 2				
Subgroup 6						
Not applicable						
Subgroup 7						
Gate charge	3471	Condition B				
On-state gate charge			$Q_{g(on)}$			
2N7389, 2N7389U, 2N7389U5					45	nC
2N7390, 2N7390U, 2N7390U5					45	nC
Gate to source charge			Q_{gs}			
2N7389, 2N7389U, 2N7389U5					10	nC
2N7390, 2N7390U, 2N7390U5					10	nC
Gate to drain charge			Q_{gd}			
2N7389, 2N7389U, 2N7389U5					25	nC
2N7390, 2N7390U, 2N7390U5					25	nC
Reverse recovery time	3473	$d_i/d_t \leq$ -100 A/µs, $V_{DD} \leq$ -50 V, $I_D = I_{D1}$, (see 1.3), condition A	t_{rr}			
2N7389, 2N7389U, 2N7389U5					250	ns
2N7390, 2N7390U, 2N7390U5					400	ns

1/ For sampling plan, see MIL-PRF-19500.
2/ For end-point measurements, this test is required for the following subgroups:
Group B, subgroups 3 and 4 (JANS).
Group B, subgroups 2 and 3 (JANTXV).
Group C, subgroups 2 and 6.
Group E, subgroup 1.

TABLE II. Group D inspection.

Inspection 1/ 2/ 3/	MIL-STD-750 Method	MIL-STD-750 Conditions	Symbol	Pre-irradiation limits R and F Min	Pre-irradiation limits R and F Max	Post-irradiation limits R Min	Post-irradiation limits R Max	Post-irradiation limits 4/ F Min	Post-irradiation limits 4/ F Max	Units
Subgroup 1										
Not applicable										
Subgroup 2		T_C = +25°C								
Steady-state total dose irradiation (V_{GS} bias) 5/	1019	V_{GS} = -12 V, V_{DS} = 0 V								
Steady-state total dose irradiation (V_{DS} bias) 5/	1019	V_{GS} = 0 V, V_{DS} = 80 percent of rated V_{DS} (pre-irradiation)								
End-point electricals:										
Breakdown voltage, drain to source	3407	V_{GS} = 0 V, I_D = -1 mA, bias condition C	$V_{(BR)DSS}$							
2N7389, 2N7389U, 2N7389U5				-100		-100		-100		V dc
2N7390, 2N7390U, 2N7390U5				-200		-200		-200		V dc
Gate to source voltage (threshold) 5/	3403	$V_{DS} \geq V_{GS}$, I_D = -1 mA	$V_{GS(th)}$							
2N7389, 2N7389U, 2N7389U5				-2.0	-4.0	-2.0	-4.0	-2.0	-5.0	V dc
2N7390, 2N7390U, 2N7390U5				-2.0	-4.0	-2.0	-4.0	-2.0	-5.0	V dc
Gate current	3411	Bias condition C V_{GS} = -20 V, V_{DS} = 0 V,	I_{GSSF1}		-100		-100		-100	nA dc
Gate current	3411	Bias condition C V_{GS} = +20 V, V_{DS} = 0 V,	I_{GSSR1}		100		100		100	nA dc
Drain current	3413	Bias condition C V_{GS} = 0 V, V_{DS} = 80 percent of rated V_{DS} (pre-irradiation)	I_{DSS}		-25		-25		-25	µA dc

See footnotes at end of table.

TABLE II. Group D inspection - Continued.

Inspection 1/ 2/	MIL-STD-750 Method	MIL-STD-750 Conditions	Symbol	Pre-irradiation limits R and F Min	Pre-irradiation limits R and F Max	Post-irradiation limits R Min	Post-irradiation limits R Max	Post-irradiation limits 4/ F Min	Post-irradiation limits 4/ F Max	Units
Subgroup 2 - Continued										
Static drain to source on-state voltage	3405	V_{GS} = -12 V, condition A pulsed (see 4.5.1) $I_D = I_{D2}$	V_{DSon1}							
2N7389, 2N7389U, 2N7389U5					1.23		1.23		1.23	V dc
2N7390, 2N7390U, 2N7390U5					1.92		1.92		1.92	V dc
Forward voltage source drain diode	4011	V_{GS} = 0 V, condition A $I_D = I_{D1}$	V_{SD}							
2N7389, 2N7389U, 2N7389U5					-3.0		-3.0		-3.0	V
2N7390, 2N7390U, 2N7390U5					-5.0		-5.0		-5.0	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 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 end-points at both R and F designated total-ionizing-dose (TID) levels.
5/ Separate samples shall be pulled for each bias.

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

Inspection	MIL-STD-750		Sample plan
	Method	Conditions	
Subgroup 1			45 devices c = 0
Temperature cycle	1051	Condition G, 500 cycles	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table I, subgroup 2	
Subgroup 2 1/			45 devices c = 0
Steady-state reverse bias	1042	Condition A, 1,000 hours	
Electrical measurements		See table I, subgroup 2	
Steady-state gate bias	1042	Condition B, 1,000 hours	
Electrical measurements		See table I, subgroup 2	
Subgroup 4			Sample size N/A
Thermal impedance curves		See MIL-PRF-19500.	
Subgroup 10			22 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	Test conditions shall be derived by the manufacturer	

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

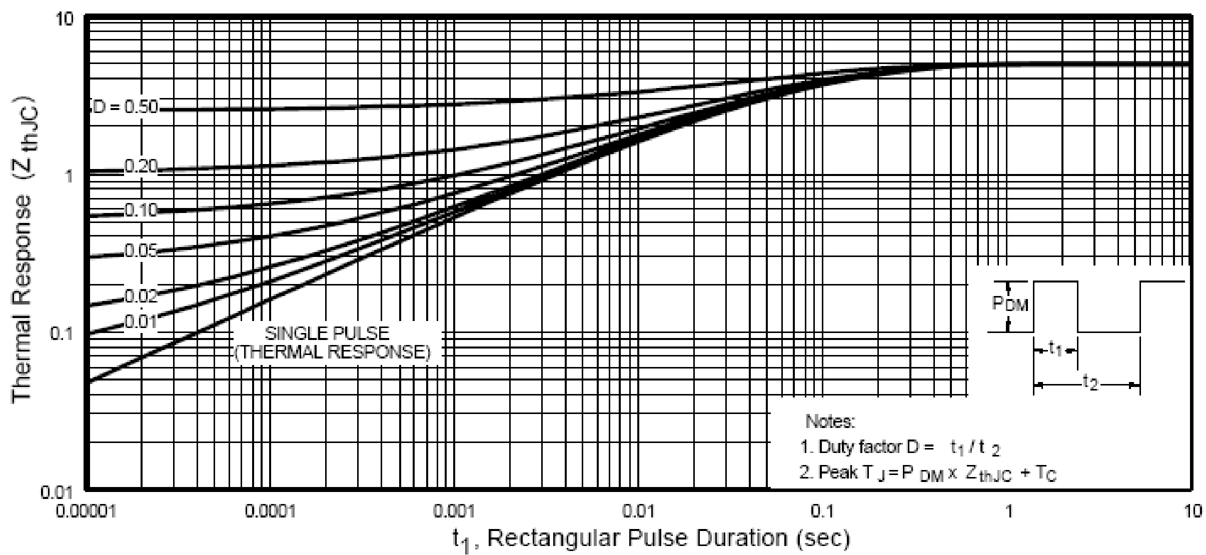
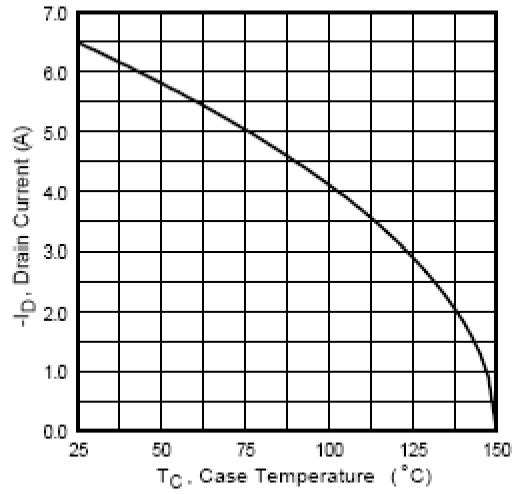
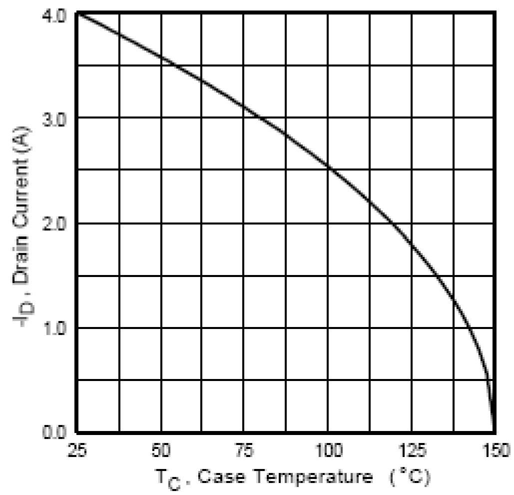


FIGURE 3. Thermal impedance curves.



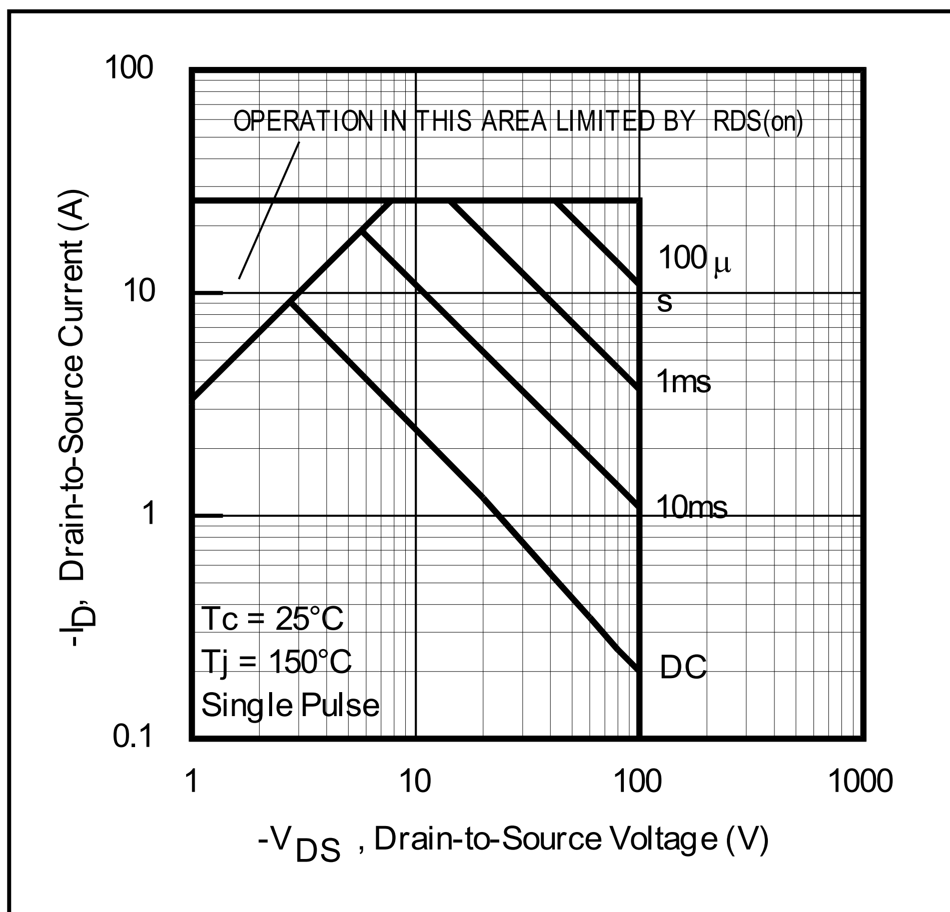
2N7389, 2N7389U, 2N7389U5



2N7390, 2N7390U, 2N7390U5

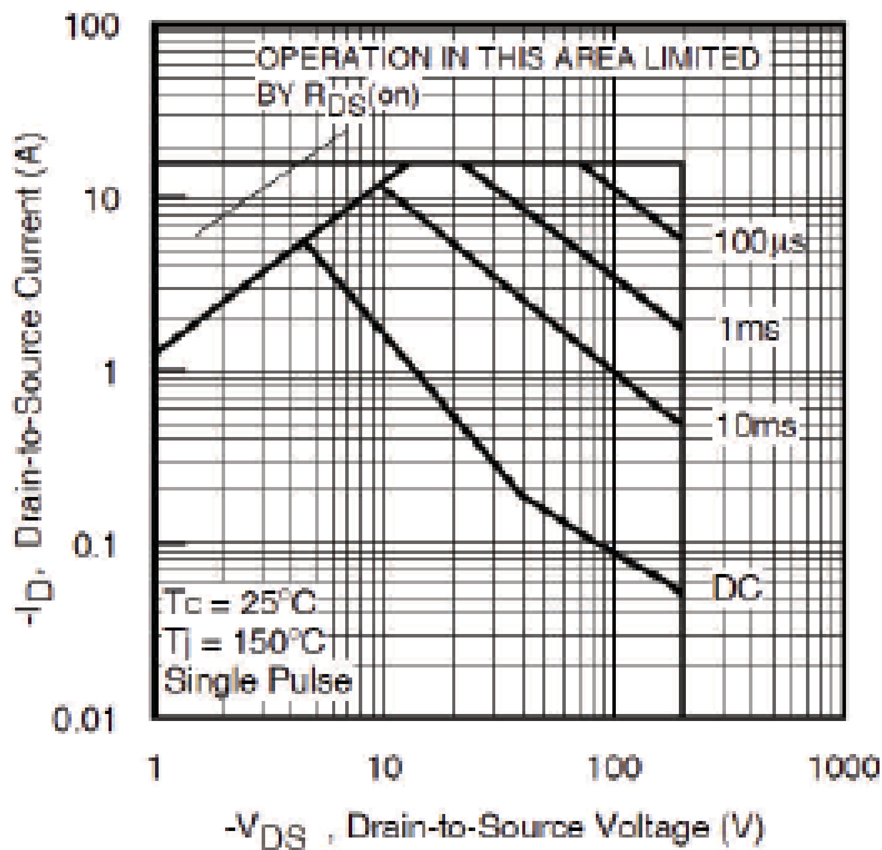
FIGURE 4. Maximum drain current versus case temperature graphs.

2N7389, 2N7389U, 2N7389U5



* FIGURE 5. Safe operating area graphs.

2N7390, 2N7390U, 2N7390U5



* FIGURE 6. Safe operating area graphs.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Service's system commands. 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. The notes specified in MIL-PRF-19500 are applicable to this specification.)

6.1 Intended use. Semiconductors conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

6.2 Acquisition requirements. Acquisition documents should specify the following:

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

b. Packaging requirements (see 5.1).

c. Lead finish (see 3.4.1).

d. The complete PIN, see 1.5 and 6.5.

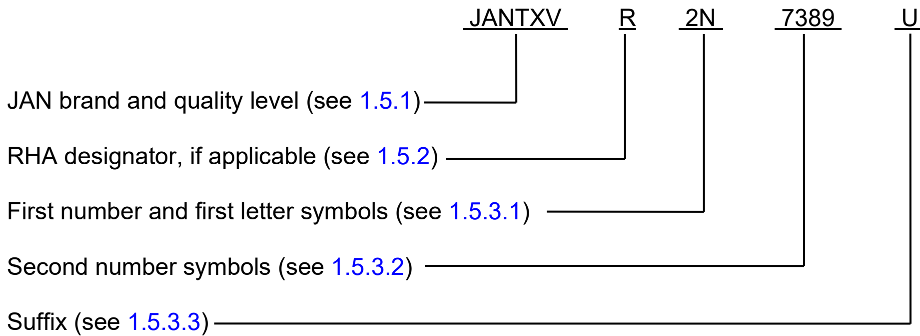
e. For acquisition of RHA designated devices, table II, subgroup 1 testing of group D herein is optional. If subgroup 1 is desired, it should be specified in the contract or order.

f. If SEE testing data is desired, it should be specified in the contract or order.

g. If specific SEE characterization conditions are desired (see section 6.7 and table IV), manufacturer's cage code should be specified in the contract or order.

* 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 orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from DLA Land and Maritime, ATTN: VQE, P.O. Box 3990, Columbus, OH 43218-3990 or e-mail vqe.chief@dla.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://qpldocs.dla.mil.

6.4 PIN construction example. The PINs for encapsulated devices are construction using the following form.



6.5 List of PINs. The following is a list of possible PINs available on this specification sheet.

PINs for devices of the "TXV" quality level	PINs for devices of the "TXV" quality level with RHA (1)	PINs for devices of the "S" quality level	PINs for devices of the "S" quality level with RHA (1)
JANTXV2N7389	JANTXV#2N7389	JANS2N7389	JANS#2N7389
JANTXV2N7389U	JANTXV#2N7389U	JANS2N7389U	JANS#2N7389U
JANTXV2N7389U5	JANTXV#2N7389U5	JANS2N7389U5	JANS#2N7389U5
JANTXV2N7390	JANTXV#2N7390	JANS2N7390	JANS#2N7390
JANTXV2N7390U	JANTXV#2N7390U	JANS2N7390U	JANS#2N7390U
JANTXV2N7390U5	JANTXV#2N7390U5	JANS2N7390U5	JANS#2N7390U5

(1) The number sign (#) represents one of two RHA designators available on this specification sheet (“R” or "F"). The PIN is also available without a RHA designator.

6.6 JANC die versions. The JANHC and JANKC die versions of these devices are covered under specification sheet MIL-PRF-19500/657.

6.7 Application data.

6.7.1 Manufacturer specific irradiation data. Each manufacturer qualified to this slash sheet has characterized its devices to the requirements method 1080 of MIL-STD-750 and as specified herein. Since each manufacturer’s characterization conditions can be different, the MIL-STD-750 method 1080 conditions used by each manufacturer for characterization have been listed here (see table IV) for information only. SEE conditions and figures listed in section 6 are current as of the date of this specification sheet, please contact the manufacturer for the most recent conditions.

TABLE IV. Manufacturers characterization conditions.

Manufactures cage	Inspection	MIL-STD-750		Sample plan
		Method	Conditions	
	SEE 1/	1080	See MIL-STD-750E method 1080.0 dated 20 November 2006.	
	Electrical measurements		I_{GSSF1}, I_{GSSR1}, and I_{DSS1} in accordance with table I, subgroup 2	3 devices
	SEE irradiation:			
	Electrical measurements		I_{GSSF1}, I_{GSSR1}, and I_{DSS1} in accordance with table I, subgroup 2	
			Upon qualification, all manufacturers should provide the verification test conditions to be added to this table.	

1/ I_{GSSF1}, I_{GSSR1}, and I_{DSS1} was examined before and following SEE irradiation to determine acceptability for each bias condition. Other test conditions in accordance with table I, subgroup 2, may be performed at the manufacturer's option.

* 6.8 Request for new types and configurations. Requests for new device types or configurations for inclusions in this specification sheet should be submitted to: DLA Land and Maritime, ATTN: VAC, Post Office Box 3990, Columbus, OH 43218-3990 or by electronic mail at Semiconductor@dla.mil.

* 6.9 Amendment notations. The margins of this specification are marked with asterisks to indicate modifications generated by this amendment. 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 - 85
NASA - NA
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2024-005)

Review activities:
Army - SM
Navy - AS, MC
Air Force - 19

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.dla.mil/.