The documentation and process conversion measures necessary to comply with this revision shall be completed by 29 November 2023.

INCH-POUND

MIL-PRF-19500/615H
w/AMENDMENT 4
25 September 2023
SUPERSEDING
MIL-PRF-19500/615H
w/AMENDMENT 3
26 August 2021

PERFORMANCE SPECIFICATION SHEET

TRANSISTOR, FIELD EFFECT RADIATION HARDENED ENCAPSULATED (THROUGH-HOLE AND SURFACE MOUNT PACKAGE) P-CHANNEL, SILICON, TYPES 2N7382 AND 2N7383, JANTXV M, D, R, AND F AND JANS M, D, 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 (total dose and single event effects (SEE)), enhancement mode, MOSFET, power transistor intended for use in high density power switching applications. Two levels of product assurance (JANTXV and JANS) are provided for each device type, with avalanche energy ratings (E_{AS}) and maximum avalanche current (I_{AS}). Provisions for radiation hardness assurance (RHA) to four radiation levels ("M", "D", "R" and "F") are provided for JANTXV and JANS product assurance levels. See 6.7 for JANHC and JANKC die versions.

1.2 Package outlines. The device package outlines are as follows: TO-257AA in accordance with figure 1, and TO-276AA (SMD.5, U3) in accordance with figure 2 for all encapsulated device types.

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

Type	P_T (1)	P_T T_A = +25°C (free air)	$R_{\theta JC}$ (2)	Min $V_{(BR)DSS}$ V_{GS} = 0 V I_D =-1.0 mA dc	I_{D1} (3) (4)	I_{D2} (3) (4) T_C = +100°C	T_J and T_{STG}
	W	W	°C/W	V dc	A dc	A dc	°C
2N7382, U3	75	2	1.67	-100	-11.0	-7.0	-55 to +150
2N7383	75	2	1.67	-200	-6.5	-4.1	-55 to +150

Type	I_S	I_{DM} (5)	E_{AS}	I_{AS}	V_{GS}
	A dc	A (pk)	mJ	A dc	V dc
2N7382	-11.0	-44	150	-11.0	±20
2N7383	-6.5	-26	165	-6.5	±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

1.3 Maximum ratings - Continued.
Electrical characteristics for the "U3" suffix devices are identical to the non-suffix devices unless otherwise noted.

(1) Derated linearly by 0.6 W/°C for T_C > +25°C.
(2) See figure 3, thermal impedance curves.
(3) The following formula derives the maximum theoretical I_D limit. I_D is limited by package and internal construction.

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

(4) See figure 4, maximum drain current graph.
(5) I_{DM} = 4 x I_{D1} as calculated in note 3.

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

Type	$V_{GS(th)1}$ $V_{DS} \geq V_{GS}$ I_D = -1.0 mA		Max I_{DSS} 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		µA dc	ohms	
	Min	Max			
2N7382	2.0	4.0	-25	0.30	0.615
2N7383	2.0	4.0	-25	0.80	1.76
2N7382U3	2.0	4.0	-25	0.29	0.595

(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 6.5 for PIN construction example and 6.6 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: "M", "D", "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: "7382" and "7383".

1.5.3.3 Suffix symbols. The following suffix symbols are incorporated in the PIN for this specification sheet:

	A blank suffix indicates a TO-257AA package (see figure 1).
U3	Indicates a TO-276AA 3 pad surface mount package (SMD-0.5) (see figure 2).

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

1.6 Radiation features:

Maximum total ionizing dose (TID) available (Dose rate = 50-300 rad(Si)/s)):

For device type 2N7382, 2N7383: ..... 300 krads(Si) 1/

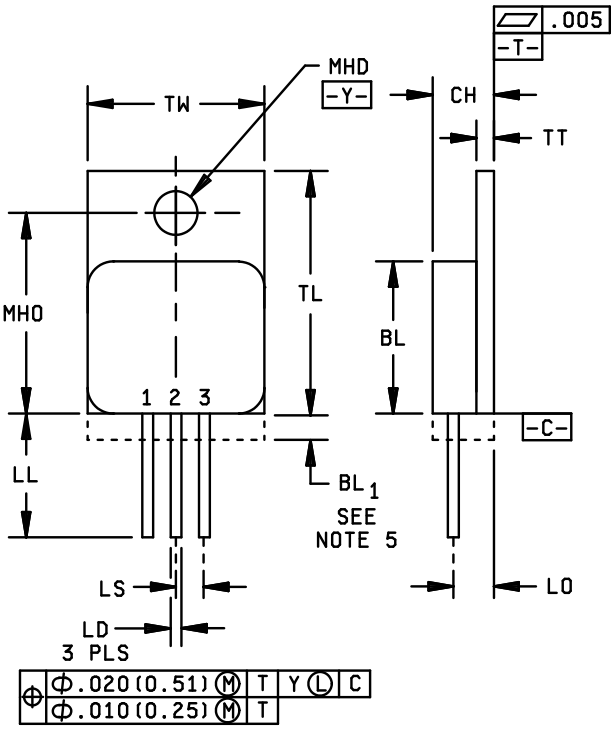
Heavy Ion Single Event Effect (SEE) SEB and SEGR test:

For device type 2N7382:
No SEB and SEGR were observed at surface LET (see table IV) ..... ≤ 63.4 MeV·cm^2/mg 2/
(In-situ Bias V_{DS} = -50 V and V_{GS} = 0 V)

For device type 2N7383:
No SEB and SEGR were observed at surface LET (see table IV) ..... ≤ 37 MeV·cm^2/mg 2/
(V_{DS} = -200 V and V_{GS} = +5 V)
(V_{DS} = -125 V and V_{GS} = +10 V)
(V_{DS} = -75 V and V_{GS} = +15 V)

1/ Manufacturer supplying device types 2N7382 and 2N7383 has performed characterization testing in accordance with MIL-STD-750, method 1019, condition A (dose rate = 50 - 300 rad(Si)/s). The radiation end point limits are guaranteed only for the conditions as specified in MIL-STD-750, method 1019, condition A to a maximum total ionizing dose level of 300 krads(Si).

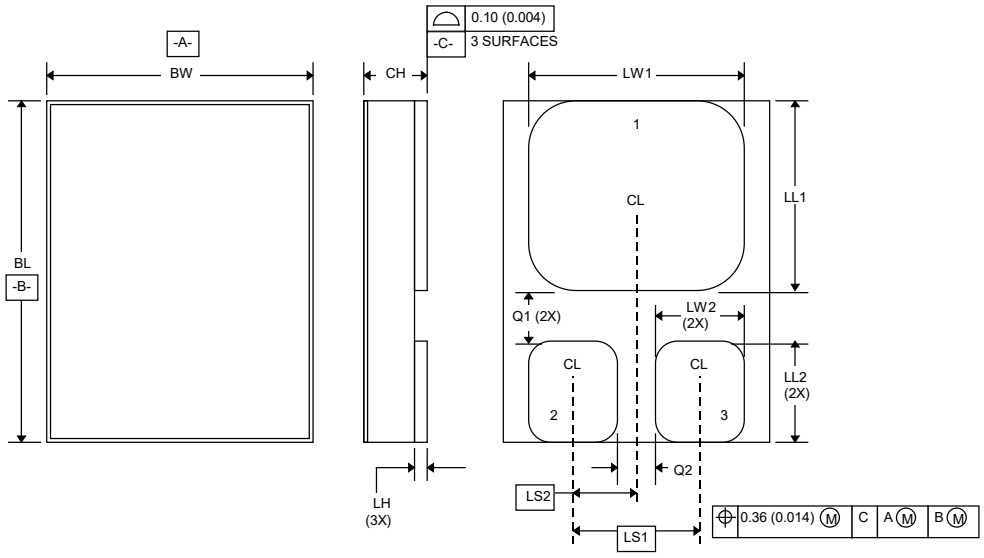
2/ Manufacturer also performed heavy ion SEB and SEGR test at Brookhaven National Lab Accelerator for the MOSFET technology devices in accordance with TM1080 of MIL-STD-750. Limits are characterized at initial qualification and after any design or process changes which may affect the SEE (SEB/SEGR) characteristics. For more information on SEE (SEB/SEGR) test results, customers are requested to contact the manufacturer.



Ltr	Dimensions			
	Inches	Inches	mm	mm
	Min	Max	Min	Max
BL	.410	.430	10.41	10.92
BL1		.028		0.71
CH	.190	.200	4.83	5.08
LD	.025	.035	0.64	0.89
LL	.500	.650	12.70	16.51
LO	.120 BSC		3.05 BSC	
LS	.100 BSC		2.54 BSC	
MHD	.140	.150	3.56	3.81
MHO	.527	.537	13.39	13.64
TL	.645	.665	16.38	16.89
TT	.035	.045	0.89	1.14
TW	.410	.420	10.41	10.67
Term 1	Drain			
Term 2	Source			
Term 3	Gate			

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. All terminals are isolated from case.
4. In accordance with ASME Y14.5, diameters are equivalent to ϕx symbology.
5. This area is for the lead feed-thru eyelets (configuration is optional, but will not extend beyond this zone.

FIGURE 1. Dimensions and configuration (TO-257AA).



Symbol	Dimensions			
	Inches	Inches	Millimeters	Millimeters
	Min	Max	Min	Max
BL	.395	.405	10.03	10.29
BW	.291	.301	7.39	7.65
CH		.124		3.15
LH	.010	.020	0.25	0.51
LW1	.281	.291	7.14	7.39
LW2	.090	.100	2.29	2.54
LL1	.220	.230	5.59	5.84
LL2	.115	.125	2.92	3.18
LS1	.150 BSC		3.81 BSC	
LS2	.075 BSC		1.91 BSC	
Q1	.030		0.762	
Q2	.030		0.762	
TERM 1	Drain			
TERM 2	Gate			
TERM 3	Source			

NOTES:
1. Dimension are in inches.
2. Millimeters are given for information only.
3. The lid shall be electrically isolated from the drain, gate and source.

FIGURE 2. Dimensions and configuration (TO-276AA, SMD-0.5, U3).

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.
MIL-STD-883 - Test Methods Standard Microcircuits.

(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 manufacturer's list (QML) before contract award (see 4.2 and 6.3).

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.
nC ..... nano Coulomb.
PIND ..... Particle impact noise detector.

3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in MIL-PRF-19500, figure 1 (TO-257AA), and figure 2 (U3), herein. Methods used for electrical isolation of the terminal feedthroughs shall employ materials that contain a minimum of 90 percent AL_2O_3 (ceramic). Examples of such construction techniques are metallized ceramic eyelets or ceramic walled packages.

3.4.1 Lead material and finish. Lead material shall be Kovar, Alloy 52, and a copper core is permitted. 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 requirement (see 6.2).

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

3.4.3 Silicone Die coating. The use of a silicone die coat requires a successful completion of MIL-STD-883, method 5011 on each silicone lot for its intended applications, and as part of the full MIL-PRF-19500 qualification process.

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

3.6 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, $R \leq 100\ k\Omega$, 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 herein.

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

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

4. VERIFICATION

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

a. Qualification inspection (see 4.2).

b. Screening (see 4.3).

c. Conformance inspection (see 4.4 and table I and II).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

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 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.

4.2.2 Single event effects (SEE). SEE (SEB/SEGR) shall be performed in accordance with TM1080 of MIL-STD-750 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 III. SEE characterization data shall be made available upon request of the qualifying or acquiring activity.

4.3 Screening (JANS and JANTXV levels). 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)
5	Method 2052 of MIL-STD-750, PIND (see MIL-PRF-19500 and 4.3.4)	Not applicable
9	Subgroup 2 of table I herein.	Subgroup 2 of table I herein.
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.
17	For TO-257AA packages: Method 1081 of MIL-STD-750 (see 4.3.5), Endpoints: Subgroup 2 of table I herein.	For TO-257AA packages: Method 1081 of MIL-STD-750 (see 4.3.5), Endpoints: Subgroup 2 of table I herein.

(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}, $V_{GS(th)1}$, and $r_{DS(ON)1}$ shall be invoked.
(3) Screening shall be performed anytime after temperature cycling, screen 3a; JANTXV level does not need to be repeated in screening requirements.

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

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 ≤ R_{GS} ≤ 200 Ω.

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

e. Inductance ..... $(2E_{AS}/(I_{AS})^2)((V_{BR} - V_{DD})/V_{BR})$ 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_{MD}, t_{SW}, (and V_H where appropriate). See table III, group E, subgroup 4 herein.

4.3.4 PIND. Not applicable in screening when devices are processed using alternative method and flow requirements approved by the qualifying activity, that includes incorporating the use of certified clean processing and silicone die coat. Instead, the PIND test performance shall be performed in group B3 and group C3, on a lot sample basis. PIND failures detected in group B or C will represent lot jeopardy and shall be evaluated for root cause and lot integrity.

4.3.5 Dielectric withstanding voltage.

a. Magnitude of test voltage……800 V dc.

b. Duration of application of test voltage……..15 seconds (min).

c. Points of application of test voltage……..All leads to case (bunch connection).

d. Method of connection……..Mechanical.

e. Kilovolt-ampere rating of high voltage source…….1,200 V/1.0 mA (min).

f. Maximum leakage current……...1.0 mA.

g. Voltage ramp up time.....500 V/second.

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 level JANS, table E-VIA of MIL-PRF-19500.

Subgroup	Method	Condition
B3	1051	Condition G.
B3	2052	PIND, required if not performed in screening. (22 devices, c = 0 for large lots, 12 devices, c = 0 for small lots).
B4	1042	The heating cycle shall be 1 minute minimum.
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	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).

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

Subgroup	Method	Condition
B2	1051	Test condition G.
B3	1042	The heating cycle shall be 1 minute minimum.
B3	2037	Test condition D.

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 A, weight = 10 lbs. (4.54 Kg), t = 10 seconds.
C3	2052	PIND, required if not performed in screening. (JANS only, 22 devices, c = 0 for large lots, 12 devices, c = 0 for small lots).
C5	3161	See 4.3.3, $R_{\theta JC(max)}$ = 1.67°C/W.
C6	1042	The heating cycle shall be 1 minute 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		Symbol	Limits	Limits	Unit
	Method	Condition		Min	Max	
Subgroup 1						
Visual and mechanical inspection	2071					
Subgroup 2						
Thermal impedance 2/	3161	See 4.3.3	$Z_{\theta JC}$			°C/W
Breakdown voltage, drain to source	3407	Bias condition C, V_{GS} = 0V, I_D = -1 mA dc	$V_{(BR)DSS}$			
2N7382, U3				-100		V dc
2N7383				-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)	$r_{DS(on)1}$			
2N7382					0.30	Ω
2N7382U3					0.29	Ω
2N7383					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)	$r_{DS(on)2}$			
2N7382					0.35	Ω
2N7382U3					0.34	Ω
2N7383					0.92	Ω
Forward voltage	4011	V_{GS} = 0 V dc, condition A, I_D = rated I_{D1}	V_{SD}			V
2N7382, U3					-3.0	V
2N7383					-5.0	V

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits	Limits	Unit
	Method	Condition		Min	Max	
Subgroup 3						
High temperature operation:		$T_C = T_J = +125°C$				
Gate current	3411	Bias condition C, $V_{GS} = \pm 20$ 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	Condition A, $V_{GS} = -12$ V dc, pulsed (see 4.5.1), I_D = rated I_{D2}	$r_{DS(on)3}$			
2N7382					0.54	Ω
2N7382U3					0.58	Ω
2N7383					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		50	ns
Turn-off delay time			$t_{d(off)}$			
2N7382, U3					70	ns
2N7383					75	ns
Fall time			t_f			
2N7382, U3					70	ns
2N7383					65	ns
Forward transconductance	3475	$I_D = I_{D2}$; $V_{DD} = -15$ V dc, pulsed (see 4.5.1)	g_{fs}			
2N7382, U3				2.5		S
2N7383				2.0		S

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits	Limits	Unit
	Method	Condition		Min	Max	
Subgroup 5						
Safe operating area test (high voltage)	3474	See figure 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			$Q_{g(on)}$			
2N7382, U3					45	nC
2N7383					45	nC
Gate to source charge			Q_{gs}			
2N7382, U3					10	nC
2N7383					10	nC
Gate to drain charge			Q_{gd}			
2N7382, U3					25	nC
2N7383					25	nC
Reverse recovery time	3473	Condition A, $di/dt \leq -100$ A/µs, $V_{DD} \leq -50$ V, $I_D = I_{D1}$, (see 1.3)	t_{rr}			
2N7382, U3					250	ns
2N7383					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, subgroup 2 and 6.
Group E, subgroup 1.

TABLE II. Group D inspection.

Inspection 1/ 2/	MIL-STD-750 Method	MIL-STD-750 Conditions	Symbol	Pre-irradiation limits M, D, R, and F Min	Pre-irradiation limits M, D, R, and F Max	Post-irradiation limits M, D, and R Min	Post-irradiation limits M, D, and R Max	Post-irradiation limits F 4/ Min	Post-irradiation limits F 4/ Max	Units
Subgroup 1										
Not applicable										
Subgroup 2		T_C = +25°C								
Steady-state total dose irradiation (V_{GS} bias) 3/	1019	Condition A V_{GS} = -12 V; V_{DS} = 0 V								
Steady-state total dose irradiation (V_{DS} bias) 3/	1019	Condition A V_{GS} = 0 V; V_{DS} = 80 percent of rated V_{DS} (pre-irradiation)								
End-point electricals		See table I, subgroup 2								
Breakdown voltage, drain to source	3407	V_{GS} = 0 V; I_D = -1 mA; bias condition C	$V_{(BR)DSS}$							
2N7382, U3				-100		-100		-100		V dc
2N7383				-200		-200		-200		V dc
Gate to source voltage (threshold) 3/	3403	$V_{DS} \geq V_{GS}$; I_D = -1 mA	$V_{GS(th)}$							
2N7382, U3				-2.0	-4.0	-2.0	-4.0	-2.0	-5.0	V dc
2N7383				-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		MIL-STD-750	Symbol	Pre-irradiation limits		Post-irradiation limits		Post-irradiation limits		Units
1/ 2/	Method	Conditions		M, D, R, and F		M, D, and R		F 4/		
				Min	Max	Min	Max	Min	Max	
Subgroup 2 - Continued										
Static drain to source on-state resistance	3421	V_{GS} = -12 V, condition A pulsed (see 4.5.1) $I_D = I_{D2}$	r_{DSon1}							
2N7382					0.30		0.30		0.30	Ω
2N7382U3					0.29		0.29		0.29	Ω
2N7383					0.80		0.80		0.80	Ω
Forward voltage source drain diode	4011	V_{GS} = 0 V, condition A $I_D = I_{D1}$	V_{SD}							
2N7382, U3					-3.0		-3.0		-3.0	V
2N7383					-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/ Separate samples shall be pulled for each bias.
4/ The "F" designation represents devices which pass end-points at M, D, R, and F designated total-ionizing dose (TID).

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

Inspection	MIL-STD-750		Sampling plan
	Method	Conditions	
Subgroup 1			45 devices c = 0
Temperature cycling	1051	Test condition G; 500 cycles.	
Hermetic seal Fine leak Gross leak	1071		
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.	
Subgroup 11			3 devices
SEE 2/ 3/	1080	See method 1080 of MIL-STD-750 and 6.2 herein.	

1/ A separate sample for each test shall be pulled.
2/ Group E qualification of SEE effect testing may be performed prior to lot formation. Qualification may be extended to other specification sheets utilizing the same structurally identical die design.
3/ Device qualification to a higher level Linear energy transfer (LET) is sufficient to qualify all lower level LETs.

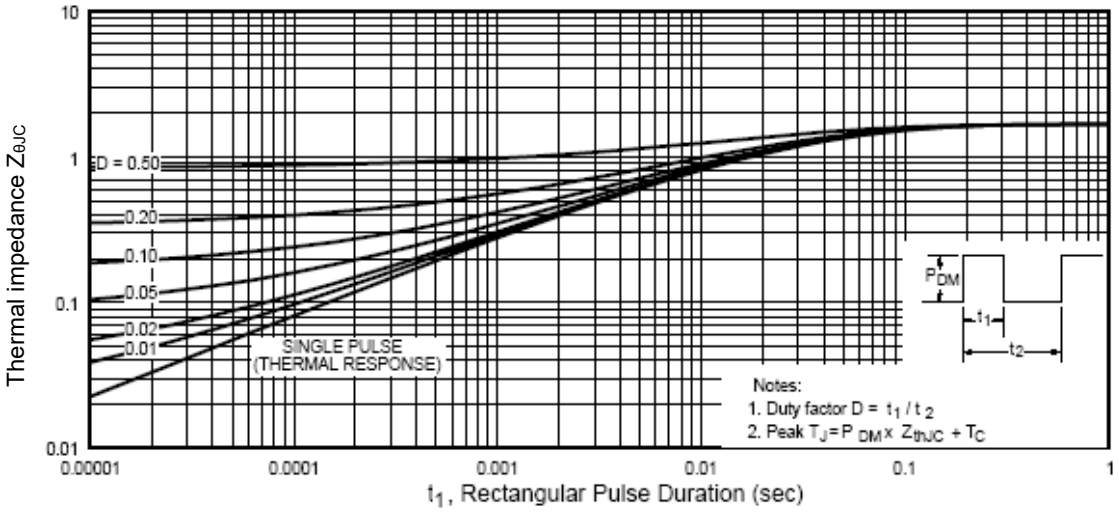
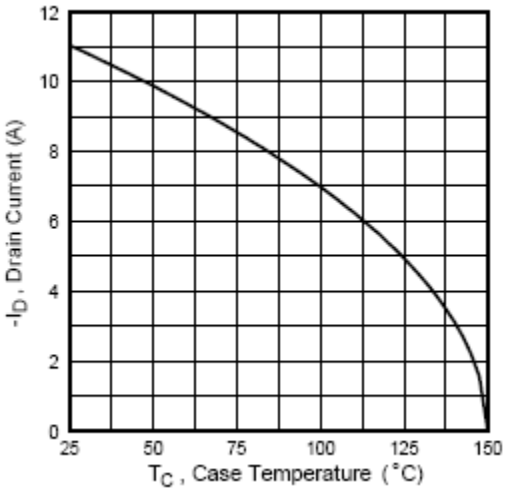


FIGURE 3. Thermal impedance curves.

2N7382, 2N7382U3



2N7383

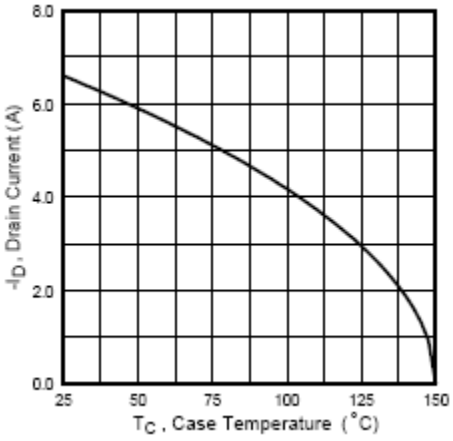


FIGURE 4. Maximum drain current versus case temperature graphs.

2N7382, 2N7382U3

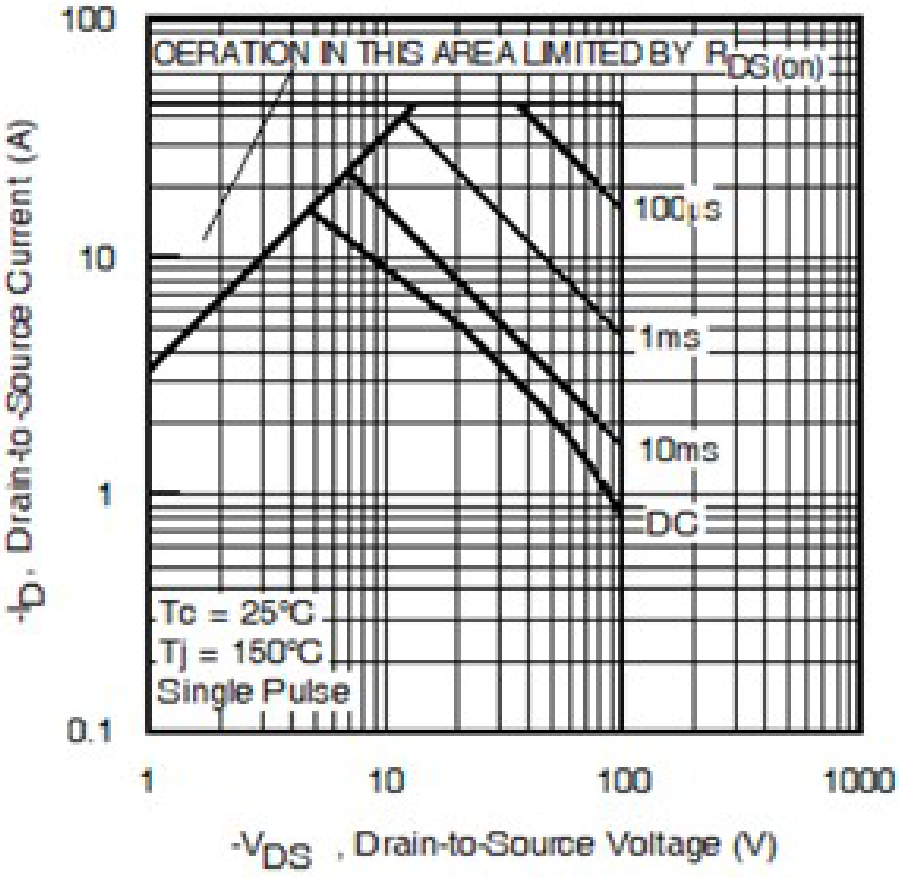


FIGURE 5. Safe operating area graphs.

2N7383

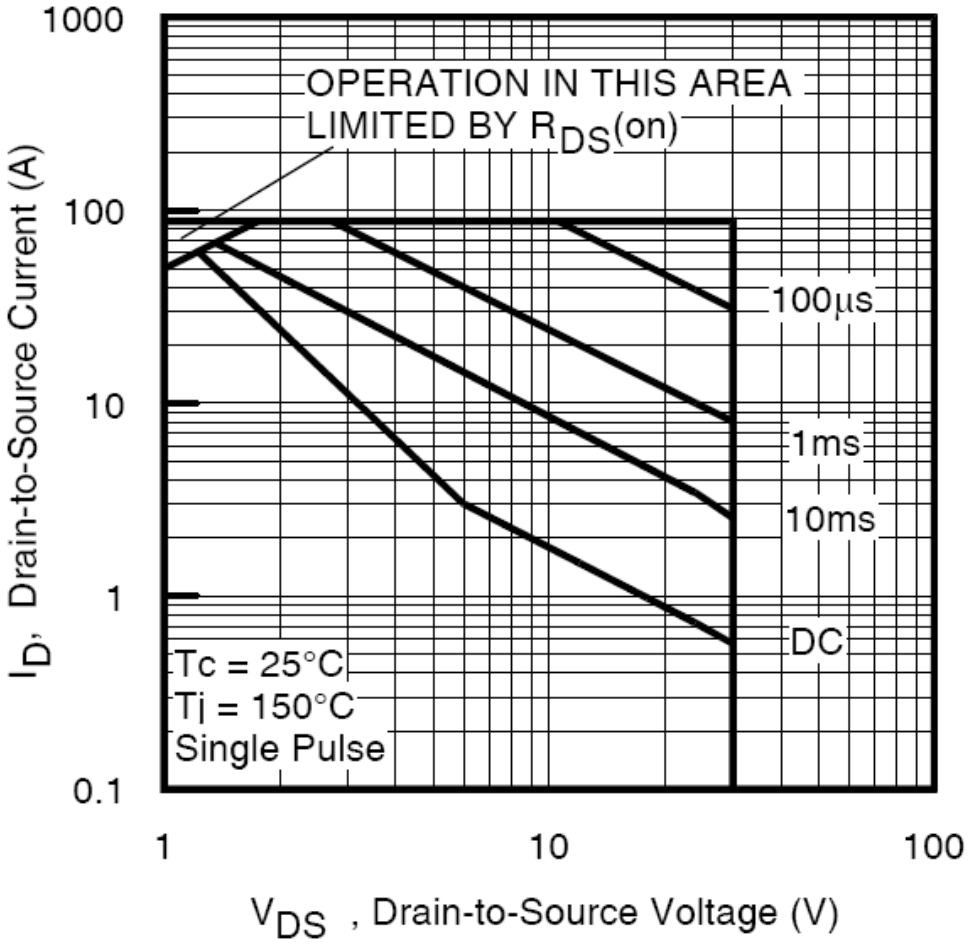


FIGURE 6. Safe operating area graphs.

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 material and finish (see 3.4.1).

d. The complete PIN, see 1.5 and 6.6.

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.

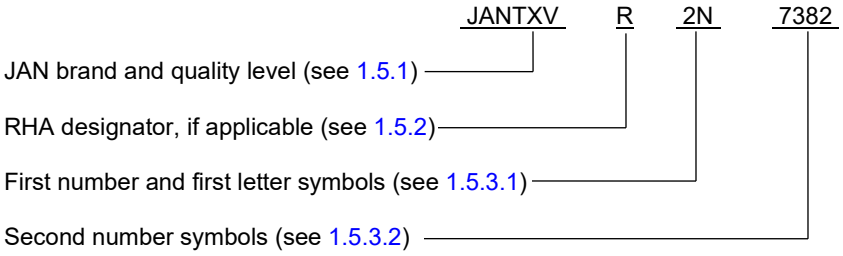
f. If SEE testing data is desired, it should be specified in the contract or order (see 4.2.2).

g. If specific SEE characterization conditions are desired (see section 6.8 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 Supersession data. This specification supersedes DESC drawing 89009, dated 19 December 1989.

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



6.6 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)
JANTXV2N7382	JANTXV#2N7382	JANS2N7382	JANS#2N7382
JANTXV2N7383	JANTXV#2N7383	JANS2N7383	JANS#2N7383
JANTXV2N7382U3	JANTXV#2N7382U3	JANS2N7382U3	JANS#2N7382U3

(1) The number sign (#) represents one of four RHA designators available on this specification sheet ("M", "D", "R", or "F").

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

6.8 Application data.

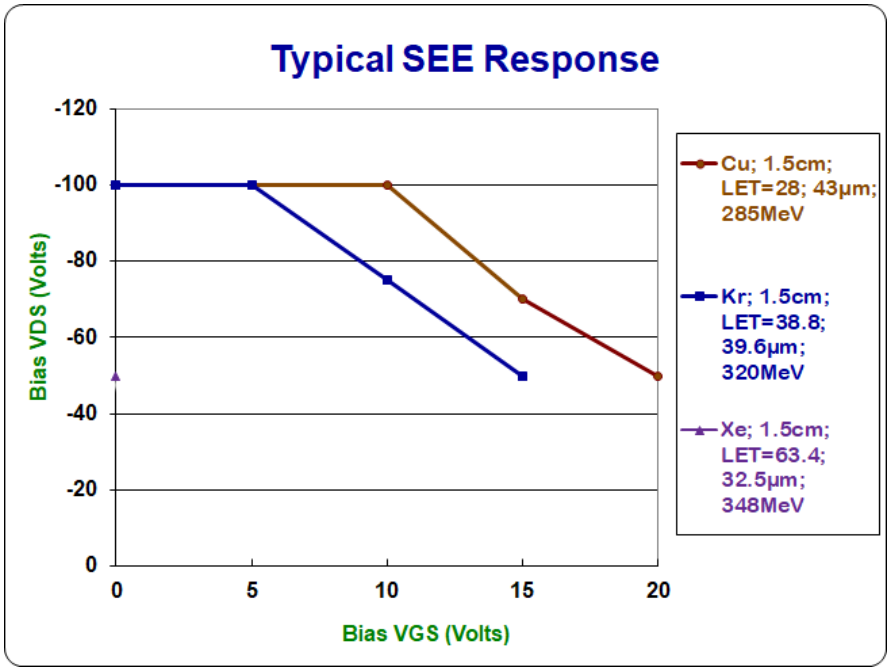
6.8.1 Manufacturer specific irradiation data. Each manufacturer qualified to this slash sheet has characterized its devices to the requirements of MIL-STD-750 method 1080 and as specified herein. Since each manufacturer's characterization conditions can be different and can vary by the version of method 1080 qualified to, the MIL-STD-750 method 1080 revision version date and conditions used by each manufacturer for characterization have been listed here (see table IV) for information only. SEE (SEB and SEGR) 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.

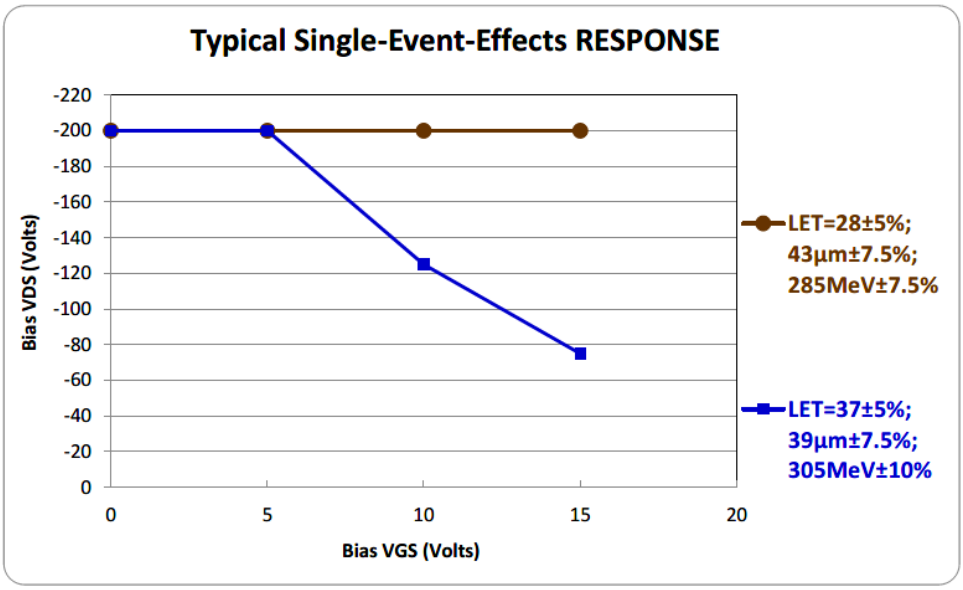
Manufacture's Cage	Inspection	MIL-STD-750		Sample plan
		Method	Conditions	
69210 (Applicable to devices with a date code of June 1998 and older)	SEE 1/	1080	See MIL-STD-750E method 1080.0 dated 20 November 2006. See figure 7	3 devices
	Electrical measurements		I_{GSSF1}, I_{GSSR1}, and I_{DSS1} in accordance with table I, subgroup 2	
	SEE irradiation:		Fluence = 3E5 ±20 percent ions/cm^2 Flux = 2E3 to 2E4 ions/cm^2/sec, temperature = +25°C ±5°C	
			Surface LET = 28 MeV-cm^2/mg ±5%, range = 42.8 µm ±7.5%, Cu ion beam energy = 283.3 MeV ±7.5%	
*	2N7382		In-situ bias conditions: V_{DS} = -100 V and V_{GS} = +10 V V_{DS} = -70 V and V_{GS} = +15 V V_{DS} = -50 V and V_{GS} = +20 V (typical 4.53 MeV/nucleon at Brookhaven National Lab Accelerator)	
	2N7383		In-situ bias conditions: V_{DS} = -200 V and V_{GS} = +15 V (nominal 4.53 MeV/nucleon at Brookhaven National Lab Accelerator)	
			Surface LET = 37 MeV-cm^2/mg ±5%, range = 39 µm ±5%, Br ion beam energy = 305 MeV ±5%	
*	2N7382		In situ bias conditions: V_{DS} = -100 V and V_{GS} = +5 V V_{DS} = -75 V and V_{GS} = +10 V V_{DS} = -50 V and V_{GS} = +15 V (typical 3.77 MeV/nucleon at Brookhaven National Lab Accelerator)	
			Surface LET = 37 MeV-cm^2/mg, range = 39 µm, Kr ion beam energy = 345 MeV	
*	2N7383		In situ bias conditions: V_{DS} = -200 V and V_{GS} = +5 V V_{DS} = -125 V and V_{GS} = +10 V V_{DS} = -75 V and V_{GS} = +15 V (nominal 3.63 MeV/nucleon at Brookhaven National Lab Accelerator)	
			Surface LET = 63.4 MeV-cm^2/mg ±5%, range = 32.8 µm ±7.5%, Xe ion beam energy = 345 MeV ±7.5%	
*	2N7382		In situ bias conditions: V_{DS} = -50 V and V_{GS} = 0 V	
			(typical 2.72 MeV/nucleon at Brookhaven National Lab Accelerator)	
	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.

2N7382



2N7383



* FIGURE 7. Cage 69210 typical SEE response graphs.

6.9 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 or by facsimile (614) 693-1642 or DSN 850-6939.

6.10 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.

Custodians:
Army - CR
Navy - SH
Air Force - 85
NASA - NA
DLA - CC

Review activities:
Army - SM
Navy - AS, MC
Air Force - 19, 71

Preparing activity:
DLA - CC

(Project 5961-2023-083)

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/.