

The documentation and process conversion measures necessary to comply with this revision shall be completed by 27 October 2014

INCH-POUND

MIL-PRF-19500/704F  
12 September 2014  
SUPERSEDING  
MIL-PRF-19500/704E  
25 January 2013

## PERFORMANCE SPECIFICATION SHEET

\* SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED  
TRANSISTOR, N-CHANNEL, SILICON, TYPES 2N7485U3, 2N7486U3, 2N7487U3, AND 2N7555U3  
JANTXVR AND JANSR

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 N-channel, enhancement-mode, MOSFET, radiation hardened, power transistor. Two levels of product assurance are provided for each device type as specified in [MIL-PRF-19500](#), with avalanche energy maximum rating ( $E_{AS}$ ) and maximum avalanche current ( $I_{AS}$ ). See [6.5](#) for JANHC and JANKC die versions.

1.2 Physical dimensions. See [figure 1](#), (surface mount, TO-276AA, SMD-0.5).

1.3 Maximum ratings.  $T_A = +25^\circ\text{C}$ , unless otherwise specified.

Type	$P_T$ (1) $T_c = +25^\circ\text{C}$	$P_T$ $T_A = +25^\circ\text{C}$	$R_{\theta_{JC}}$ (2)	$V_{DS}$	$V_{DG}$	$V_{GS}$	$I_{D1}$ (3) (4) $T_c = +25^\circ\text{C}$	$I_{D2}$ $T_c = +100^\circ\text{C}$	$I_s$	$I_{DM}$ (5)	$T_J$ and $T_{STG}$	$V_{ISO}$ 70,000 ft. altitude
2N7485U3	W	W	°C/W	V dc	V dc	V dc	A dc	A dc	A dc	A (pk)	°C	V dc
2N7486U3	75	2.5	1.67	130	130	±20	20	12.5	20	80	-55	N/A
2N7487U3	75	2.5	1.67	200	200	±20	12	7.8	12	48	to	N/A
2N7555U3	75	2.5	1.67	250	250	±20	10	6.4	10	40	+150	250
											+150	250

(1) Derate linearly by 0.6 W/°C for  $T_c > +25^\circ\text{C}$ .  
 (2) See [figure 2](#), thermal impedance curves.  
 (3) The following formula derives the maximum theoretical  $I_D$  limit.  $I_D$  is limited by package and internal construction.

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

(4) See [figure 3](#), maximum drain current graph.  
 (5)  $I_{DM} = 4 \times I_{D1}$  as calculated in note (3).

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](mailto: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/>.

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

Type	Min $V_{(\text{BR})\text{DSS}}$ $V_{\text{GS}} = 0$ $I_D = 1.0\text{mA dc}$	$V_{\text{GS}(\text{TH})1}$ $V_{\text{DS}} \geq V_{\text{GS}}$ $I_D = 1.0\text{ mA dc}$	Max $I_{\text{DSS}1}$ $V_{\text{GS}} = 0$ $V_{\text{DS}} = 80\%$ of rated $V_{\text{DS}}$	Max $r_{\text{DS}(\text{on})}$ (1) $V_{\text{GS}} = 12\text{V}$ , $I_D = I_{D2}$		$E_{\text{AS}}$
				$T_J = +25^\circ\text{C}$	$T_J = +150^\circ\text{C}$	
2N7485U3	<u>V</u> <u>dc</u>	<u>V</u> <u>dc</u> Min Max	<u>μA</u> <u>dc</u>	<u>Ω</u>	<u>Ω</u>	<u>mJ</u>
2N7486U3	130	2.5 4.5	10	0.080	0.184	65
2N7487U3	200	2.5 4.5	10	0.220	0.486	60
2N7555U3	250	2.5 4.5	10	0.400	0.780	58
	250	2.5 4.5	10	0.400	0.780	58

(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 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

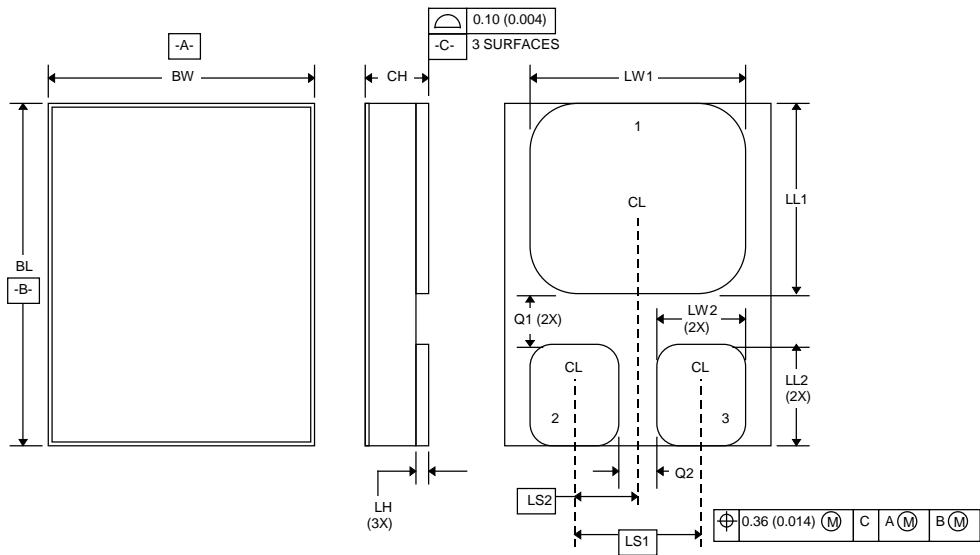
MIL-PRF-19500 - Semiconductor Devices, General Specification for.

## DEPARTMENT OF DEFENSE STANDARDS

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

- \* (Copies of these documents are available online at <http://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.



Symbol	Dimensions			
	Inches		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.
4. In accordance with ASME Y14.5M, diameters are equivalent to  $\phi x$  symbology.

FIGURE 1. Dimensions and configuration (TO-276AA, SMD-0.5).

### 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](#).

3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in [MIL-PRF-19500](#), and on [figure 1](#) (TO-276AA, SMD-0.5) herein.

3.4.1 Lead finish. 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 Multiple chip construction. Multiple chip construction is not permitted to meet the requirements of this specification.

3.5 Electrostatic discharge (ESD) protection. The devices covered by this specification require electrostatic discharge protection (see [3.5.1](#)).

3.5.1 Handling. Metal oxide semiconductor (MOS) devices must be handled with certain precautions to avoid damage due to the accumulation of static charge. However, the following handling practices are recommended (see [3.5](#)).

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

3.6 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in [1.3](#), [1.4](#), and [table I](#).

3.7 Electrical test requirements. The electrical test requirements shall be as specified in [table I](#).

3.8 Marking. Marking shall be in accordance with [MIL-PRF-19500](#).

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 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.

\* 4.2.1.1 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). 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 (see table E-IV of <a href="#">MIL-PRF-19500</a> ) (1) (2)	Measurement	
	JANS	JANTXV
(3)	Gate stress test (see <a href="#">4.3.1</a> )	Gate stress test (see <a href="#">4.3.1</a> )
(3)	Method 3470 of <a href="#">MIL-STD-750</a> , $E_{AS}$ (see <a href="#">4.3.2</a> )	Method 3470 of <a href="#">MIL-STD-750</a> , $E_{AS}$ (see <a href="#">4.3.2</a> )
(3) 3c	Method 3161 of <a href="#">MIL-STD-750</a> , thermal impedance, (see <a href="#">4.3.3</a> )	Method 3161 of <a href="#">MIL-STD-750</a> , thermal impedance, (see <a href="#">4.3.3</a> )
9	Subgroup 2 of <a href="#">table I</a> herein $I_{GSSF1}$ , $I_{GSSR1}$ , $I_{DSS1}$ as a minimum	Not applicable
10	Method 1042 of <a href="#">MIL-STD-750</a> , test condition B	Method 1042 of <a href="#">MIL-STD-750</a> , test condition B
11	$I_{GSSF1}$ , $I_{GSSR1}$ , $I_{DSS1}$ , $r_{DS(ON)1}$ , $V_{GS(TH)1}$ Subgroup 2 of <a href="#">table I</a> herein. $\Delta I_{GSSF1} = \pm 20$ nA dc or $\pm 100$ percent of initial value, whichever is greater. $\Delta I_{GSSR1} = \pm 20$ nA dc or $\pm 100$ percent of initial value, whichever is greater. $\Delta I_{DSS1} = \pm 10$ $\mu$ A dc or $\pm 100$ percent of initial value, whichever is greater.	$I_{GSSF1}$ , $I_{GSSR1}$ , $I_{DSS1}$ , $r_{DS(ON)1}$ , $V_{GS(TH)1}$ Subgroup 2 of <a href="#">table I</a> herein.
12	Method 1042 of <a href="#">MIL-STD-750</a> , test condition A	Method 1042 of <a href="#">MIL-STD-750</a> , test condition A
13	Subgroups 2 and 3 of <a href="#">table I</a> herein $\Delta I_{GSSF1} = \pm 20$ nA dc or $\pm 100$ percent of initial value, whichever is greater. $\Delta I_{GSSR1} = \pm 20$ nA dc or $\pm 100$ percent of initial value, whichever is greater. $\Delta I_{DSS1} = \pm 10$ $\mu$ A dc or $\pm 100$ percent of initial value, whichever is greater. $\Delta r_{DS(ON)1} = \pm 20$ percent of initial value. $\Delta V_{GS(TH)1} = \pm 20$ percent of initial value.	Subgroup 2 of <a href="#">table I</a> herein $\Delta I_{GSSF1} = \pm 20$ nA dc or $\pm 100$ percent of initial value, whichever is greater. $\Delta I_{GSSR1} = \pm 20$ nA dc or $\pm 100$ percent of initial value, whichever is greater. $\Delta I_{DSS1} = \pm 10$ $\mu$ A dc or $\pm 100$ percent of initial value, whichever is greater. $\Delta r_{DS(ON)1} = \pm 20$ percent of initial value. $\Delta V_{GS(TH)1} = \pm 20$ percent of initial value.
17	For U3 packages: Method 1081 of <a href="#">MIL-STD-750</a> (see <a href="#">4.3.4</a> ), Endpoints: Subgroup 2 of <a href="#">table I</a> herein.	For U3 packages: Method 1081 of <a href="#">MIL-STD-750</a> (see <a href="#">4.3.4</a> ), Endpoints: Subgroup 2 of <a href="#">table I</a> 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) Shall be performed anytime after temperature cycling, screen 3a. JANTX and JANTXV levels do not need to be repeated in screening requirements.

4.3.1 Gate stress test. Apply  $V_{GS} = 24$  V minimum for  $t = 250$   $\mu$ s minimum.

4.3.2 Single pulse avalanche energy (E<sub>AS</sub>).

- a. Peak current .....  $I_{AS} = I_{D1}$ .
- b. Inductance: .....  $\left[ \frac{2E_{AS}}{(I_{D1})^2} \right] \left[ \frac{V_{BR} - V_{DD}}{V_{BR}} \right]$  mH minimum.
- c. Gate to source resistor ( $R_{GS}$ ) .....  $25 \leq R_{GS} \leq 200$   $\Omega$ .
- d. Supply voltage ( $V_{DD}$ ) .....  $V_{DD} = 25$  V dc, except  $V_{DD} = 50$  V dc for 2N7487U3 and 2N7555U3.
- e. Peak gate voltage ( $V_{GS}$ ) ..... 12 V.
- f. Initial case temperature .....  $T_C = +25^\circ\text{C} +10^\circ\text{C}, -5^\circ\text{C}$ .
- g. Number of pulses to be applied ..... 1 pulse minimum.

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  $I_M$ ,  $I_H$ ,  $t_H$ ,  $t_{SW}$ , (and  $V_H$  where appropriate). Measurement delay time ( $t_{MD}$ ) = 70  $\mu$ s max. See [table III](#), group E, subgroup 4 herein.

\* 4.3.4 Dielectric withstanding voltage.

- a. Magnitude of test voltage ..... 600 V dc.
- b. Duration of application of test voltage ..... 15 seconds (min).
- c. Points of application of test voltage ..... All terminals to case.
- 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 table E-V of [MIL-PRF-19500](#) and [table I](#) herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-VIA (JANS) and table E-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 E-VIA (JANS) of [MIL-PRF-19500](#).

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B3	1051	Test condition G, 100 cycles.
B3	2077	Scanning electron microscope (SEM).
B4	1042	Intermittent operation life, condition D, $t_{on} = 30$ seconds minimum.
B5	1042	Accelerated steady-state gate bias, condition B, $V_{GS} = \text{rated}$ ; $T_A = +175^\circ\text{C}$ , $t = 24$ hours minimum; or $T_A = +150^\circ\text{C}$ , $t = 48$ hours minimum.
B5	1042	Accelerated steady-state reverse bias, condition A, $V_{DS} = \text{rated}$ ; $T_A = +175^\circ\text{C}$ , $t = 120$ hours minimum; or $T_A = +150^\circ\text{C}$ , $t = 240$ hours minimum.
B5	2037	Bond strength, test condition D.

- \* 4.4.2.2 Group B inspection, table E-VIB (JANTXV) of [MIL-PRF-19500](#).

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B2	1051	Test condition G, 25 cycles.
B3	1042	Intermittent operation life, condition D, $t_{on} = 30$ seconds minimum.
B5 and 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 E-VII of [MIL-PRF-19500](#) and as follows. Electrical measurements (end-points) shall be in accordance with [table I](#), subgroup 2 herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Terminal strength is not applicable.
C5	3161	See <a href="#">4.3.3</a> .
C6	1042	Intermittent operation life, condition D, $t_{on} = 30$ 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 [MIL-PRF-19500](#), and [table III](#) 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 the appropriate tables and as follows.

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

TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Thermal impedance 2/	3161	See 4.3.3	$Z_{\theta JC}$			°C/W
Breakdown voltage drain to source 2N7485U3 2N7486U3 2N7487U3 2N7555U3	3407	Bias condition C, $V_{GS} = 0$ V, $I_D = 1$ mA dc	$V_{(BR)DSS}$	130 200 250 250		V dc V dc V dc V dc
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$ , $I_D = 1$ mA dc	$V_{GS(TH)1}$	2.5	4.5	V dc
Gate current	3411	$V_{GS} = +20$ V dc, bias condition C, $V_{DS} = 0$ V	$I_{GSSF1}$		+100	nA dc
Gate current	3411	$V_{GS} = -20$ V dc, bias condition C, $V_{DS} = 0$ V	$I_{GSSR1}$		-100	nA dc
Drain current	3413	$V_{GS} = 0$ V dc, bias condition C, $V_{DS} = 80$ percent of rated $V_{DS}$ ,	$I_{DSS1}$		10	μA dc
Static drain to source on-state resistance 2N7485U3 2N7486U3 2N7487U3 2N7555U3	3421	$V_{GS} = 12$ V dc, condition A, pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(ON)1}$		0.080 0.220 0.400 0.400	Ω Ω Ω Ω
Forward voltage	4011	$V_{GS} = 0$ V dc, condition A, pulsed (see 4.5.1), $I_D = I_{D1}$	$V_{SD}$		1.2	V dc

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
<u>Subgroup 3</u>						
High temperature operation		$T_C = T_J = +125^\circ\text{C}$				
Gate current	3411	$V_{GS} = \pm 20 \text{ V dc}$ , bias condition C, $V_{DS} = 0 \text{ V}$	$I_{GSS2}$		$\pm 200$	nA dc
Drain current	3413	$V_{GS} = 0 \text{ V dc}$ , bias condition C, $V_{DS} = 80 \text{ percent of rated } V_{DS}$	$I_{DSS2}$		25	$\mu\text{A dc}$
Static drain to source on-state resistance 2N7485U3 2N7486U3 2N7487U3 2N7555U3	3421	$V_{GS} = 12 \text{ V dc}$ , condition A, pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(ON)3}$		0.160 0.462 0.750 0.750	$\Omega$
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$ , $I_D = 1 \text{ mA dc}$	$V_{GS(TH)2}$	1.5		V dc
Low temperature operation		$T_C = T_J = -55^\circ\text{C}$				
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS(TH)3}$ , $I_D = 1 \text{ mA dc}$	$V_{GS(TH)3}$		5.5	V dc
<u>Subgroup 4</u>						
Forward transconductance 2N7485U3 2N7486U3 2N7487U3 2N7555U3	3475	$I_D = I_{D2}$ , $V_{DD} = 15 \text{ V dc}$ (see 4.5.1)	$g_{FS}$	8 6 6 3		S
Switching time test	3472	$I_D = I_{D1}$ , $V_{GS} = 12 \text{ V dc}$ , $R_G = 7.5 \Omega$ , $V_{DD} = 50 \text{ percent of rated } V_{DS}$				
Turn-on delay time 2N7485U3 2N7486U3 2N7487U3 2N7555U3			$t_{D(on)}$		20 25 25 25	ns
Rise time			$t_r$		100	ns
Turn-off delay time			$t_{D(off)}$		35	ns
Fall time			$t_f$		40 30 30 30	ns
2N7485U3 2N7486U3 2N7487U3 2N7555U3						ns

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
<u>Subgroup 5</u>						
Safe operating area test	3474	See <a href="#">figure 4</a> $t_p = 10$ ms min. $V_{DS} = 80$ percent of max. rated $V_{DS}$				
Electrical measurements		See <a href="#">table I</a> , subgroup 2				
<u>Subgroup 6</u>						
Not applicable						
<u>Subgroup 7</u>						
Gate charge	3471	Condition B, $I_D = I_{D1}$ , $V_{GS} = 12$ V dc $V_{DD} = 50$ percent of rated $V_{DS}$	$Q_{G(ON)}$	48	nC	
On-state gate charge 2N7485U3				35	nC	
2N7486U3				28	nC	
2N7487U3				32	nC	
2N7555U3						
Gate to source charge 2N7485U3			$Q_{GS}$	16	nC	
2N7486U3				9	nC	
2N7487U3				7.4	nC	
2N7555U3				11	nC	
Gate to drain charge 2N7485U3			$Q_{GD}$	18	nC	
2N7486U3				15	nC	
2N7487U3				12	nC	
2N7555U3				16	nC	
Reverse recovery time	3473	$di/dt = -100$ A/ $\mu$ s, $V_{DD} \leq 50$ V $I_D = I_{D1}$	$t_{rr}$			
2N7485U3				250	ns	
2N7486U3				300	ns	
2N7487U3				300	ns	
2N7555U3				300	ns	

1/ For sampling plan, see [MIL-PRF-19500](#).2/ This test is required for the following end-point measurement only (not intended for [4.3](#), screen 9 or 11):  
JANS table E-VIA of [MIL-PRF-19500](#), group B, subgroups 3 and 4; JANTXV, table E-VIB of [MIL-PRF-19500](#), group B, subgroups 2 and 3; and table E-VII of [MIL-PRF-19500](#), group C, subgroups 2 and 6, and table E-IX of [MIL-PRF-19500](#), group E, subgroup 1.

TABLE II. Group D inspection.

Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Pre-irradiation limits		Post-irradiation limits		Unit		
	Method	Conditions		R		R				
				Min	Max	Min	Max			
<u>Subgroup 1</u>										
Not applicable										
<u>Subgroup 2</u>										
Steady-state total dose irradiation ( $V_{GS}$ bias) 4/	1019	$T_c = +25^\circ\text{C}$ $V_{GS} = 12 \text{ V};$ $V_{DS} = 0$								
Steady-state total dose irradiation ( $V_{DS}$ bias) 4/	1019	$V_{GS} = 0; V_{DS} = 80 \text{ percent of}$ rated $V_{DS}$ (preirradiation)								
End-point electricals:										
Breakdown voltage, drain to source 2N7485U3	3407	Bias condition C, $V_{GS} = 0; I_D = 1$ mA	$V_{(BR)DSS}$	130		130		V dc		
2N7486U3				200		200		V dc		
2N7487U3				250		250		V dc		
2N7555U3				250		250		V dc		
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$ $I_D = 1 \text{ mA}$	$V_{GS(\text{th})1}$	2.5	4.5	2.0	4.5	V dc		
Gate current	3411	Bias condition C, $V_{GS} = +20 \text{ V};$ $V_{DS} = 0$	$I_{GSSF1}$		100		100	nA dc		
Gate current	3411	Bias condition C, $V_{GS} = -20 \text{ V};$ $V_{DS} = 0$	$I_{GSSR1}$		-100		-100	nA dc		
Drain current	3413	Bias condition C, $V_{GS} = 0$ $V_{DS} = 80 \text{ percent of rated } V_{DS}$ (preirradiation)	$I_{DSS}$		10		10	$\mu\text{A dc}$		
Static drain to source on- state voltage 2N7485U3	3405	$V_{GS} = 12 \text{ V}; I_D = I_{D2}$ condition A, pulsed (see 4.5.1)	$V_{DS(\text{on})}$			1.025	1.025	V dc		
2N7486U3					1.732		1.732	V dc		
2N7487U3					2.586		2.586	V dc		
2N7555U3					2.586		2.586	V dc		
Forward voltage source drain diode	4011	Bias condition C, $V_{GS} = 0; I_D = I_{D1}$	$V_{SD}$		1.2		1.2	V dc		

- 1/ For sampling plan see [MIL-PRF-19500](#).
- 2/ Group D qualification may be performed prior to lot formation. Wafers qualified to these group D QCI requirements may be used for any other specification sheets 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/ Separate samples shall be pulled for each bias.

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

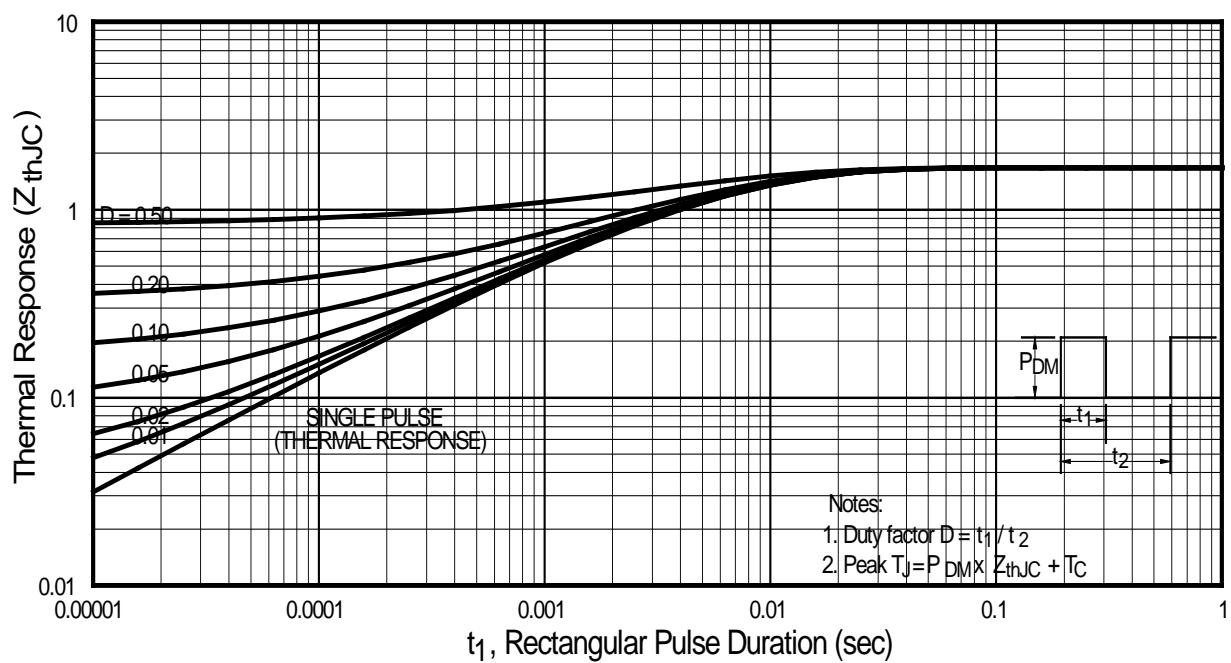
Inspection	MIL-STD-750		Qualification and large lot quality conformance inspection
	Method	Conditions	
<u>Subgroup 1</u>			
Temperature cycling	1051	-55°C to +150°C, 500 cycles	45 devices c = 0
Hermetic seal	1071	As applicable	
Fine leak			
Gross leak			
Electrical measurements		See <a href="#">table I</a> , subgroup 2 herein.	
<u>Subgroup 2 1/</u>			45 devices c = 0
Steady-state gate bias	1042	Condition B, 1,000 hours.	
Electrical measurements		See <a href="#">table I</a> , subgroup 2 herein.	
Steady-state reverse bias	1042	Condition A, 1,000 hours.	
Electrical measurements		See <a href="#">table I</a> , subgroup 2 herein.	
<u>Subgroup 4</u>			Sample size N/A
Thermal impedance curves		See <a href="#">MIL-PRF-19500</a> .	
<u>Subgroup 5</u>			15 devices c = 0
Barometric pressure 2N7487U3 and 2N7555U3	1001	Test condition C.	
<u>Subgroup 10</u>			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	

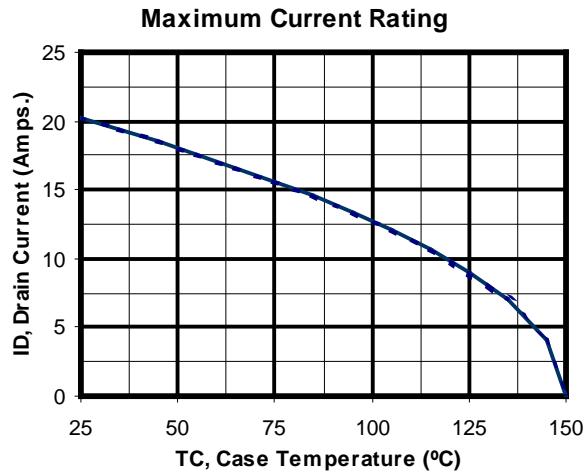
See footnotes at end of table.

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

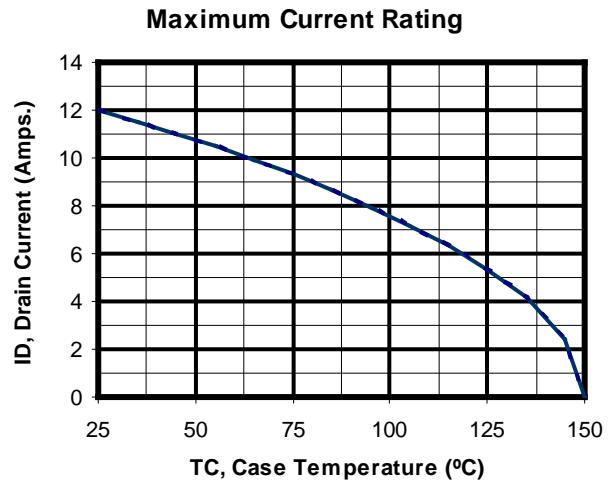
Inspection	MIL-STD-750		Qualification and large lot quality conformance inspection
	Method	Conditions	
<u>Subgroup 11</u> SEE <u>2/ 3/</u>	1080	See MIL-STD-750 method 1080 and 6.2.	3 devices

- 1/ A separate sample for each test shall be pulled.
- 2/ Group E qualification of SEE 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.

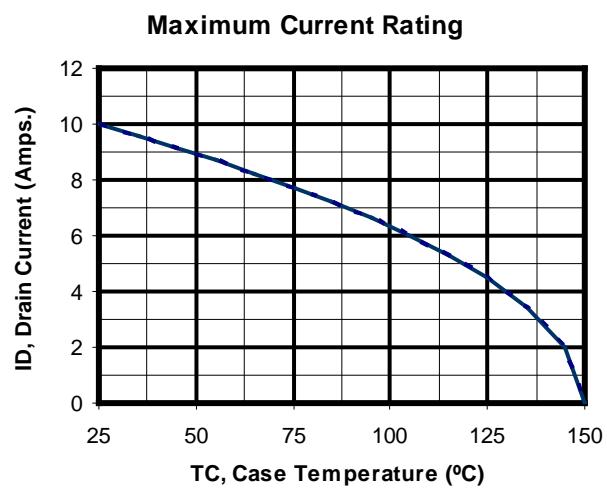
FIGURE 2. Thermal response curve.



2N7485U3



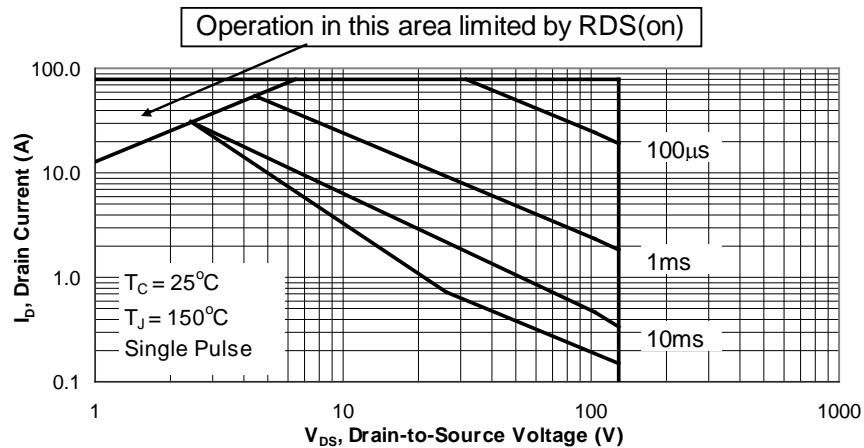
2N7486U3



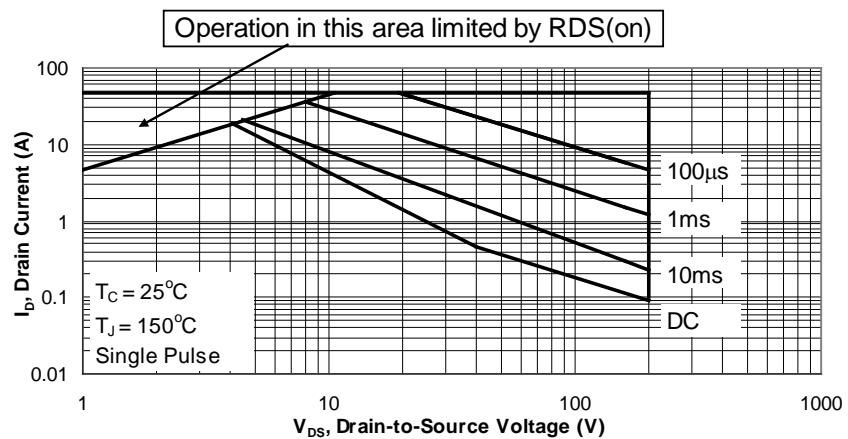
2N7487U3 and 2N7555U3

FIGURE 3. Maximum drain current versus case temperature graphs.

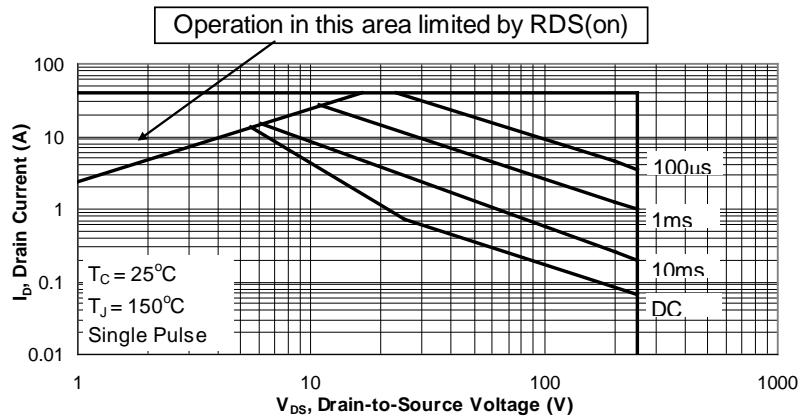
2N7485U3



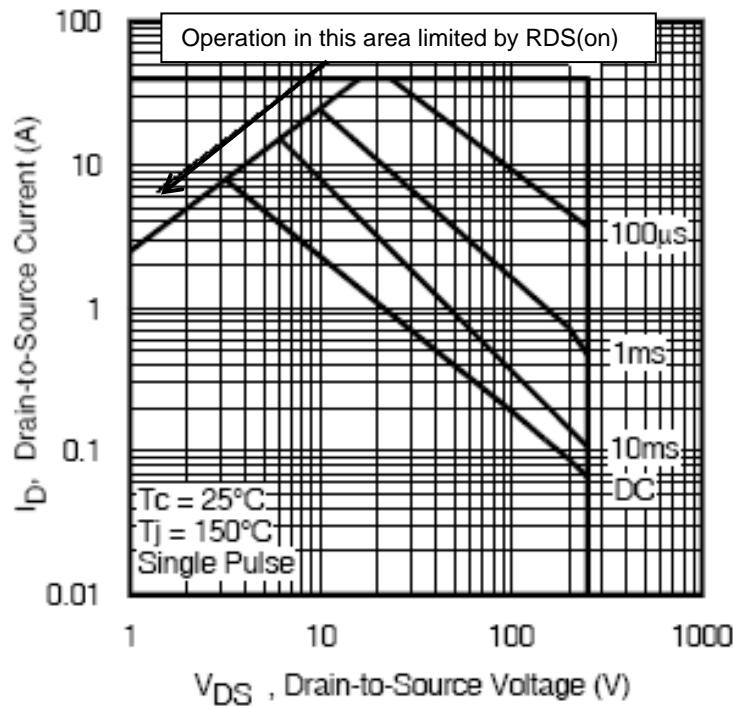
2N7486U3

FIGURE 4. Safe operating area graph.

## 2N7487U3



## 2N7555U3

FIGURE 4. Safe operating area graph - 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 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 Part or Identifying Number (PIN), see title and section 1.
  - 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 specific SEE characterization conditions are desired (see [6.6](#) 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](mailto:vqe.chief@dla.mil). An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.dla.mil>.

6.4 Substitution information. Devices covered by this specification are substitutable for the manufacturer's and user's Part or Identifying Number (PIN) (without JAN and RHA prefix). This information in no way implies that manufacturer's PINs are substitutable for the military PIN.

Preferred types military PIN	Commercial PIN
2N7485U3	IRHNJ57133SE
2N7486U3	IRHNJ57230SE
2N7487U3 (obsolete)	IRHNJ57234SE
2N7555U3 (2N7487U3 replacement)	IRHNJ57234SE

6.5 JANC die versions. The JANHC and JANKC die versions of these devices are covered under specification sheet [MIL-PRF-19500/741](#).

- \* 6.6 Application data.
- \* 6.6.1 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 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	
69210 (Applicable to devices with a date code of 2 February 1998 and older)	SEE 1/	1080	See MIL-STD-750 method 1080. See figure 5.	3 devices
	Electrical measurements		$I_{GSSF1}$ , $I_{GSSR1}$ , and $I_{DSS1}$ in accordance with table I, subgroup 2	
	SEE Irradiation:		Fluence = $3E5 \pm 20$ percent ions/cm <sup>2</sup> Flux = $2E3$ to $2E4$ ions/cm <sup>2</sup> /sec, temperature = $25 \pm 5^\circ\text{C}$	
	2N7485U3		Surface LET = $38 \text{ MeV-cm}^2/\text{mg} \pm 5\%$ , range = $38 \mu\text{m} \pm 7.5\%$ , energy = $300 \text{ MeV} \pm 7.5\%$	
	2N7486U3		In situ bias conditions: $V_{DS} = 130 \text{ V}$ and $V_{GS} = -20 \text{ V}$ (typical 3.75 MeV/Nucleon at Texas A&M Cyclotron)	
	2N7487U3 and 2N7555U3		In situ bias conditions: $V_{DS} = 200 \text{ V}$ and $V_{GS} = -20 \text{ V}$ (nominal 3.86 MeV/Nucleon at Brookhaven National Lab Accelerator)	
	2N785U3		In situ bias conditions: $V_{DS} = 250 \text{ V}$ and $V_{GS} = -20 \text{ V}$ nominal 3.86 MeV/Nucleon at Brookhaven National Lab Accelerator)	
	2N7486U3		Surface LET = $61 \text{ MeV-cm}^2/\text{mg} \pm 5$ percent, Range = $31 \mu\text{m} \pm 10\%$ , energy = $330 \text{ MeV} \pm 7.5\%$ , Energy = $305 \text{ MeV} \pm 7.5\%$	
	2N7487U3 and 2N7555U3		In situ bias conditions: $V_{DS} = 130 \text{ V}$ and $V_{GS} = -10 \text{ V}$ $V_{DS} = 100 \text{ V}$ and $V_{GS} = -15 \text{ V}$ $V_{DS} = 50 \text{ V}$ and $V_{GS} = -20 \text{ V}$ (typical 2.70 MeV/Nucleon at Texas A&M Cyclotron)	
			In situ bias conditions: $V_{DS} = 200 \text{ V}$ and $V_{GS} = -10 \text{ V}$ $V_{DS} = 185 \text{ V}$ and $V_{GS} = -15 \text{ V}$ $V_{DS} = 120 \text{ V}$ and $V_{GS} = -20 \text{ V}$ (nominal 2.92 MeV/Nucleon at Brookhaven National Lab Accelerometer)	
			In-situ bias conditions: $V_{DS} = 250 \text{ V}$ and $V_{GS} = -15 \text{ V}$ $V_{DS} = 240 \text{ V}$ and $V_{GS} = -20 \text{ V}$ (nominal 2.92 MeV/nucleon at Brookhaven National Lab Accelerator)	

See footnotes at end of table.

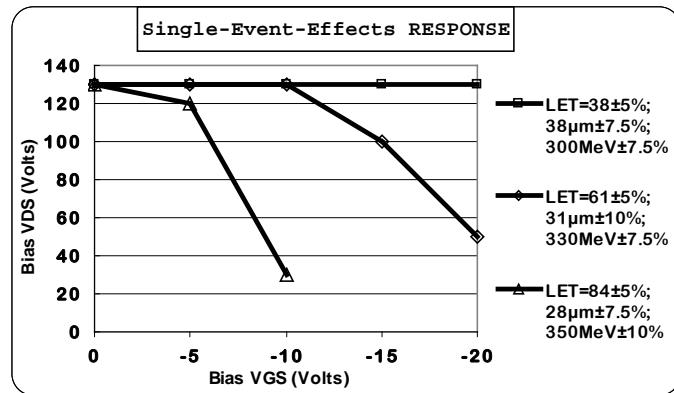
TABLE IV. Manufacturers characterization conditions – Continued.

Manufacturers CAGE	Inspection	MIL-STD-750		Sample plan	
		Method	Conditions		
	2N7485U3		<p>Surface LET = 84 MeV-cm<sup>2</sup>/mg <math>\pm 5\%</math>, range = 28 <math>\mu</math>m <math>\pm 7.5\%</math>, energy = 350 MeV <math>\pm 10\%</math></p> <p>In-situ bias conditions: <math>V_{DS} = 130</math> V and <math>V_{GS} = 0</math> V  <math>V_{DS} = 120</math> V and <math>V_{GS} = -5</math> V  <math>V_{DS} = 30</math> V and <math>V_{GS} = -10</math> V  (typical 1.89 MeV/nucleon at Texas A &amp; M Cyclotron)</p>		
	2N7486U3		<p>In-situ bias conditions: <math>V_{DS} = 200</math> V and <math>V_{GS} = -5</math> V  <math>V_{DS} = 150</math> V and <math>V_{GS} = -10</math> V  <math>V_{DS} = 50</math> V and <math>V_{GS} = -15</math> V  <math>V_{DS} = 25</math> V and <math>V_{GS} = -20</math> V  (nominal 1.98 MeV/nucleon at Brookhaven National Lab Accelerator)</p>		
	2N7487U3 and 2N7555U3		<p>In-situ bias conditions: <math>V_{DS} = 250</math> V and <math>V_{GS} = -5</math> V  <math>V_{DS} = 225</math> V and <math>V_{GS} = -10</math> V  <math>V_{DS} = 175</math> V and <math>V_{GS} = -15</math> V  <math>V_{DS} = 50</math> V and <math>V_{GS} = -20</math> V  (nominal 1.98 MeV/nucleon at Brookhaven National Lab Accelerator)</p>		
	Electrical measurements		$I_{GSSF1}$ , $I_{GSSR1}$ , and $I_{DSS1}$ in accordance with <a href="#">table I</a> , subgroup 2		

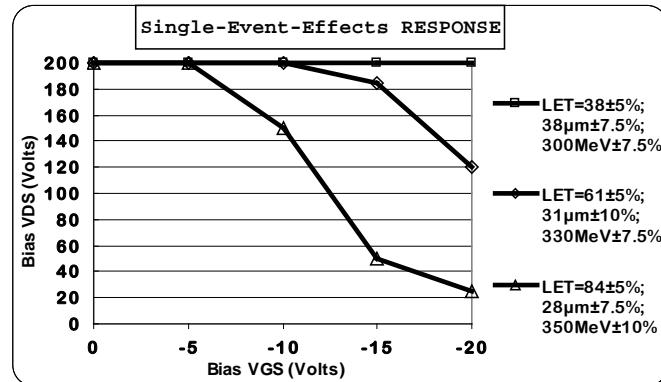
Upon qualification, all manufacturers will provide the verification test conditions to be added to this table.

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.

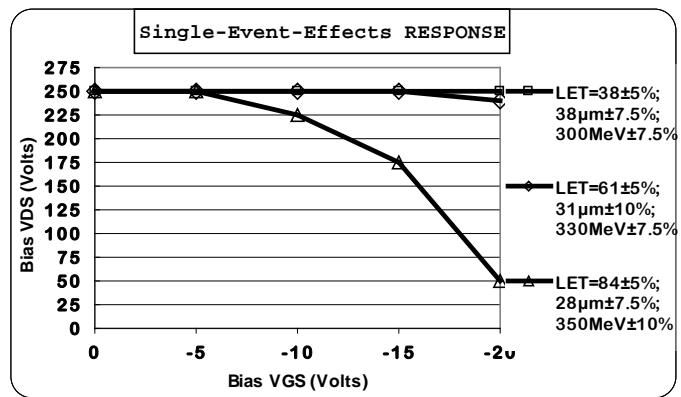
## 2N7485U3



## 2N7486U3



## 2N7487U3 and 2N7555U3

FIGURE 5. Typical SEE safe operating area graph.

- \* 6.7 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 previous issue.

Custodians:

Army - CR  
Navy - EC  
Air Force - 85  
NASA - NA  
DLA - CC

Preparing activity:

DLA - CC

(Project 5961-2014-123)

Review activity:

Air Force - 99

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/>.