The documentation and process conversion measures necessary to comply with this revision shall be completed by 29 October 2015.

INCH-POUND

MIL-PRF-19500/692B
29 July 2015
SUPERSEDING
MIL-PRF-19500/692A
10 September 2004

PERFORMANCE SPECIFICATION SHEET

TRANSISTOR, FIELD EFFECT, N-CHANNEL, SILICON,
TYPES 2N7515, 2N7516, AND 2N7517,
JANTXV AND JANS

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 (total dose and single event effects (SEE) characterization), power transistor. Two levels of product assurance are provided for each device type as specified in MIL-PRF-19500. Provisions for radiation hardness assurance (RHA) to five radiation levels ("M", "D", "P", "L", "R") are provided for JANTXV and JANS product assurance levels.

* 1.2 Package outlines. The device package outlines are as follows: TO-205AF in accordance with figure 1 for all encapsulated device types.

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

Type	P_T (1) T_C = +25°C	$R_{\theta JC}$ Max	V_{DS}	V_{DG}	V_{GS}	I_{D1} (2) (3) T_C =+25°C	I_{D2} (2) (3) T_C = +100°C	I_S	I_{DM}	T_J and T_{STG}	V_{ISO} 70,000 ft. altitude
	W	°C/W	V dc	V dc	V dc	A dc	A dc	A dc	A (pk)	°C	V dc
2N7515	25	5.0	100	100	±30	12	8	12	48	-55	N/A
2N7516	25	5.0	200	200	±30	8	5	8	29	to	N/A
2N7517	25	5.0	250	250	±30	7	4	7	28	+150	250

(1) Derate linearly 0.20 W/°C for T_C > +25°C.
(2) The following formula derives the maximum theoretical I_D limit. I_D is limited by package and internal wires and may be limited by pin diameter:

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

(3) See figure 2, maximum drain current graph.

* 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.

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

Type	Min $V_{(BR)DSS}$ V_{GS} = 0 I_D = 1.0 mA dc	$V_{GS(TH)1}$ V_{DS} = V_{GS} I_D = 1.0 mA dc	Max I_{DSS1} V_{GS} = 0 V_{GS} = 80 percent of rated V_{DS}	Max $r_{DS(on)}$ (1) V_{GS} = 12V		I_{AS}
				T_J = +25°C at I_{D2}	T_J = +125°C at I_{D2}	
	V dc	V dc Min	Max	μA dc	Ω	Ω	A (pk)
2N7515	100	2.0	4.5	25	0.080	0.129	48
2N7516	200				0.180	0.324	29
2N7517	250				0.255	0.510	28

(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: “JAN”, “JANTX”, “JANTXV” and "JANS".

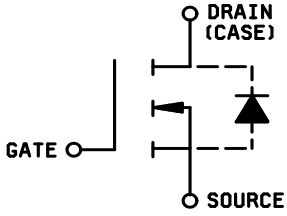
* 1.5.2 Radiation hardness assurance (RHA) designator. The RHA levels that are applicable for this specification sheet from lowest to highest are as follows: "M", "D", "P", "L", "R”.

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

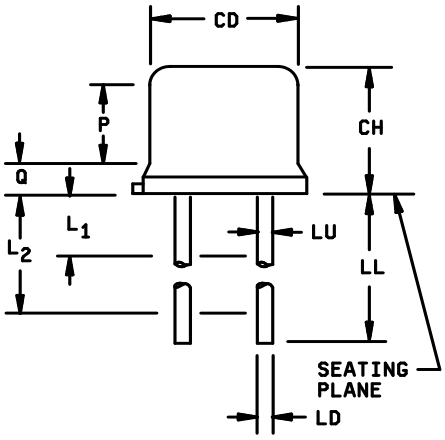
* 1.5.3.1 First number and first letter symbols. The transistors of this specification sheet use the first number and letter symbols "2N".

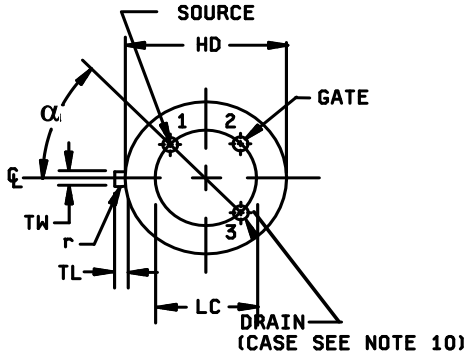
* 1.5.3.2 Second number symbols. The second number symbols for the transistors covered by this specification sheet are as follows: "7515", "7516", and "7517".

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



SCHEMATIC CIRCUIT





Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.355	7.75	9.02	
CH	.160	.180	4.07	4.57	
HD	.335	.370	8.51	9.40	
LC	.200 TP		5.08 TP		6
LD	.016	.021	.041	0.53	7, 8
LL	.500	.750	12.7	19.05	7, 8
LU	.016	.019	0.41	0.48	
L_1		.050		1.27	7, 8
L_2	.250		6.35		7, 8
P	.070		1.78		5
Q		.050		1.27	7
TL	.029	.045	0.74	1.14	3
TW	.028	.034	0.71	0.86	2
r		.010		0.25	9
α	45°TP		45°TP		6

NOTES:
1. Dimensions are inches. Millimeters are given for general information only.
2. Beyond radius (r) maximum, TW shall be held for a minimum length of .011 inch (0.028 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 inch (0.25 mm) in zone P. This zone is controlled for automatic handling.
6. Leads at gauge plane .054 +.001, -.000 inch (1.37 +0.03, -0.00 mm) below seating plane shall be within .007 inch (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 min.
8. All three leads.
9. Radius (r) applies to both inside corners of tab.
10. Drain is electrically connected to the case.
11. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 1. Physical dimensions for TO-205AF.

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.

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, 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 figure 1 (TO-205AF).

3.4.1 Lead finish. Unless otherwise specified, 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).

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

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

a. Devices should be handled on benches with conductive handling devices.

b. Ground test equipment, tools, and personnel handling devices.

c. Do not handle devices by the leads.

d. Store devices in conductive foam or carriers.

e. Avoid use of plastic, rubber, or silk in MOS areas.

f. Maintain relative humidity above 50 percent if practical.

g. Care should be exercised during test and troubleshooting to apply not more than maximum rated voltage to any lead.

h. Gate must be terminated to source, $R \leq 100\ k\Omega$, whenever bias voltage is to be 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 herein.

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 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.

* 4.2.1.1 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 IV of MIL-PRF-19500, and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table IV of MIL-PRF-19500) (1) (2)	Measurement	
	JANS level	JANTXV 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)	Method 3470 of MIL-STD-750, (see 4.3.2)
(3) 3c	Method 3161 of MIL-STD-750, (see 4.3.3)	Method 3161 of MIL-STD-750, (see 4.3.3)
9	I_{GSSF1}, I_{GSSR1}, I_{DSS1}, subgroup 2 of table I herein	I_{GSSF1}, I_{GSSR1}, I_{DSS1}, 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	I_{GSSF1}, I_{GSSR1}, I_{DSS1}, $r_{DS(on)}$, $V_{GS(TH)1}$ 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} = ± 10 µA dc or ± 100 percent of initial value, whichever is greater.	I_{GSSF1}, I_{GSSR1}, I_{DSS1}, $r_{DS(on)}$, $V_{GS(TH)1}$ Subgroup 2 of table I herein
12	Method 1042 of MIL-STD-750, test condition A	Method 1042 of MIL-STD-750, test condition A
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} = ± 10 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} = ± 10 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 level does not need to be repeated in screening requirements.

4.3.1 Gate stress test. Apply V_{GS} = +45 V minimum for t = 250 µs minimum.

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

a. Peak current (I_{AS}) .....$I_{AS(max)}$.

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

c. Gate to source resistor (R_{GS}) .....$25\Omega \leq R_{GS} \leq 200\Omega$.

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

e. Inductance (L) .....L = 0.1 mH.

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

g. Supply voltage (V_{DD}) .....50 V to 150 V dc.

4.3.3 Thermal impedance (V_{SD} measurement). The delta V_{SD} measurement shall be performed in accordance with method 3161 of MIL-STD-750. The delta V_{SD} conditions (I_H and V_H) and maximum limit shall be derived by each vendor from the thermal response curves (see figure 3) and shall be specified in the certificate of conformance prior to qualification. The following parameter measurements shall apply:

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

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

c. Heating time (t_H) .....10 ms.

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

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

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

* 4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with table V of MIL-PRF-19500 and table I herein.

* 4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIA (JANS) and table VIB (JANTXV) of MIL-PRF-19500, and herein.

* 4.4.2.1 Group B inspection, table VIA (JANS) of MIL-PRF-19500.

Subgroup	Method	Condition
B3	1051	Test condition F or G, 100 cycles.
* B4	1042	Intermittent operation life, condition D. No heat sink or forced-air cooling on the device shall be permitted during the on cycle. T_{on} = 30 seconds minimum.
B5	1042	Accelerated steady-state reverse bias, condition A.
B5	1042	Accelerated steady-state gate bias, condition B.
* B5	2037	Bond strength, test condition D.
B6	3161	Thermal resistance, see 4.5.2.

* 4.4.2.2 Group B inspection, table VIB (JANTXV) of MIL-PRF-19500.

Subgroup	Method	Condition
* B3	1042	Intermittent operation life, condition D. No heat sink or forced-air cooling on the device shall be permitted during the on cycle. T_{on} = 30 seconds minimum.
B5	3161	Thermal resistance, see 4.5.2.

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

Subgroup	Method	Condition
C2	2036	Terminal strength, test condition E, weight = 8 ounces., 3 arcs.
C5	3161	Thermal resistance, see 4.5.2.
* C6	1042	Intermittent operation life, condition D. No heat sink or forced-air cooling on the device shall be permitted during the on cycle. T_{on} = 30 seconds minimum.

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

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

4.5.2 Thermal resistance. Thermal resistance measurements shall be performed in accordance with method 3161 of MIL-STD-750. The maximum limit of $R_{\theta JC}$ = 5.0°C/W. The following parameters shall apply:

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

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

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

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

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

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

* TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical inspection	2071					
Subgroup 2						
Thermal impedance 2/	3161	See 4.3.3.	ΔV_{SD}		230	mV
Breakdown voltage, drain to source	3407	V_{GS} = 0, I_D = 1 mA dc, bias condition C	$V_{(BR)DSS}$			
2N7515				100		V dc
2N7516				200		V dc
2N7517				250		V dc
Gate to source voltage (threshold)	3403	$V_{DS} = V_{GS}$, I_D = 1 mA dc	$V_{GS(TH)1}$	2.0	4.5	V dc
Gate current	3411	V_{GS} = ±30 V dc, bias condition C, V_{DS} = 0	I_{GSS1}		±100	nA dc
Drain current	3413	V_{GS} = 0, bias condition C, 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), $I_D = I_{D2}$	$r_{DS(on)}1$			
2N7515					0.080	Ω
2N7516					0.180	Ω
2N7517					0.255	Ω
Static drain to source on-state voltage	3405	V_{GS} = 12 V dc, condition A, $I_D = I_{D1}$, pulsed (see 4.5.1)	$V_{DS(ON)}$			
2N7515					0.972	V dc
2N7516					1.48	V dc
2N7517					1.82	V dc
* Forward voltage	4011	Condition A, V_{GS} = 0, pulsed (see 4.5.1), $I_D = I_{D1}$	V_{SD}		1.5	V dc

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 3						
High-temperature operation:		$T_C = T_J = +125°C$				
Gate current	3411	$V_{GS} = \pm 30$ V dc, bias condition C, $V_{DS} = 0$	I_{GSS2}		± 200	nA dc
Drain current	3413	$V_{GS} = 0$, bias condition C, V_{DS} = 80 percent of rated V_{DS}	I_{DSS2}		0.250	mA dc
Static drain to source on-state resistance	3421	V_{GS} = 12 V dc, condition A, pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(on)2}$			
2N7515					0.129	Ω
2N7516					0.324	Ω
2N7517					0.510	Ω
Gate to source voltage (threshold)	3403	$V_{DS} = V_{GS}$, I_D = 1 mA dc	$V_{GS(TH)2}$	1.0		V dc
Low-temperature operation:		$T_C = T_J = -55°C$				
Gate to source voltage (threshold)	3403	$V_{DS} = V_{GS}$, I_D = 1 mA dc	$V_{GS(TH)3}$		5.5	V dc
Subgroup 4						
Switching time test	3472	$I_D = I_{D1}$, V_{GS} = 12 V dc, $R_G = 7.5\Omega$, V_{DD} = 50 percent of rated V_{DS}				
Turn-on delay time			$t_{D(on)}$		20	ns
Rise time			t_R			
2N7515					50	ns
2N7516					40	ns
2N7517					40	ns
Turn-off delay time			$t_{D(off)}$		35	ns
Fall time			t_f			
2N7515					30	ns
2N7516					15	ns
2N7517					15	ns

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 5						
Safe operating area test (high voltage)	3474	See figure 4; t_p = 10 ms, V_{DS} = 80 percent of max. rated V_{DS} ($V_{DS} \leq 200$ V)				
Electrical measurements		See table I, subgroup 2 herein.				
Subgroup 6						
Not applicable						
Subgroup 7						
Gate charge	3471	Condition A or B				
On-state gate charge			$Q_{G(ON)}$			
2N7515					35	nC
2N7516					28	nC
2N7517					28	nC
Gate to source charge			Q_{GS}			
2N7515					13	nC
2N7516					12	nC
2N7517					12	nC
Gate to drain charge			Q_{GD}			
2N7515					12	nC
2N7516					10	nC
2N7517					10	nC
Reverse recovery time	3473	di/dt = 100 A/µs, $V_{DD} \leq 50$ V, I_D = I_{D1}	t_{rr}			
2N7515					160	ns
2N7516					210	ns
2N7517					360	ns

1/ For sampling plan, see MIL-PRF-19500.
2/ This test is required for the following end-point measurements only (not intended for 4.3, screen 9, 11, or 13): 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.

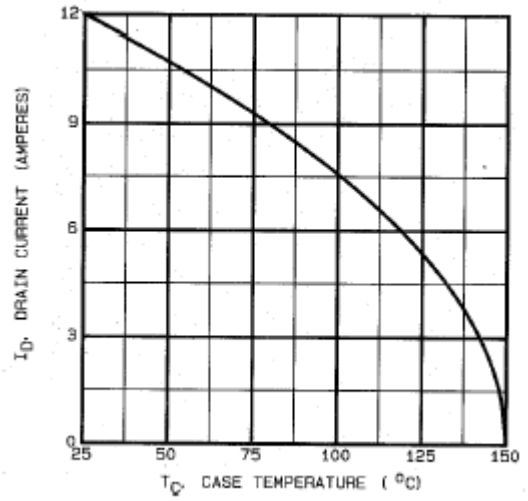
Inspection 1/ 2/ 3/ 4/ 5/	MIL-STD-750 Method	MIL-STD-750 Conditions	Symbol	Preirradiation limits Min	Preirradiation limits Max	Postirradiation limits Min	Postirradiation limits Max	Unit
Subgroup 1								
Not applicable								
Subgroup 2		T_C = +25°C						
Steady-state total dose irradiation (V_{GS} bias)	1019	V_{GS} = 12V V_{DS} = 0						
Steady-state total dose irradiation (V_{DS} bias)	1019	V_{GS} = 0, V_{DS} = 80 percent of rated V_{DS} (pre-irradiation)						
Breakdown voltage, drain to source	3407	V_{GS} = 0, I_D = 1 mA bias cond. C	$V_{(BR)DSS}$					
2N7515				100		100		V dc
2N7516				200		200		V dc
2N7517				250		250		V dc
Gate to source voltage (threshold)	3403	V_{DS} = V_{GS}, I_D = 1 mA dc	$V_{GS(TH)1}$	2.0	4.5	2.0	4.5	V dc
Gate current	3411	V_{GS} = ±30 V V_{DS} = 0, bias cond. C	I_{GSS1}		±100		±100	nA dc
Drain current	3413	V_{GS} = 0, bias cond. C V_{DS} = 80 percent of rated V_{DS} (pre-irradiation)	I_{DSS1}		25		25	µA dc
Static drain to source on-state resistance	3421	V_{GS} = 12 V, bias cond. A, pulsed (see 4.5.1) I_D = I_{D2}	$r_{DS(ON)1}$					
2N7515					0.080		0.080	Ω
2N7516					0.180		0.180	Ω
2N7517					0.255		0.255	Ω
Static drain to source on-state voltage	3405	V_{GS} = 12 V, bias cond. A, pulsed (see 4.5.1) I_D = I_{D1}	$V_{DS(ON)}$					
2N7515					0.972		0.972	Ω
2N7516					1.48		1.48	Ω
2N7517					1.82		1.82	Ω

1/ For sampling plan, see MIL-PRF-19500.
2/ Electrical specifications are for "D" and "R" rad levels.
3/ Group D qualification may be performed 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.
4/ Separate samples shall be pulled for each bias.
5/ 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.

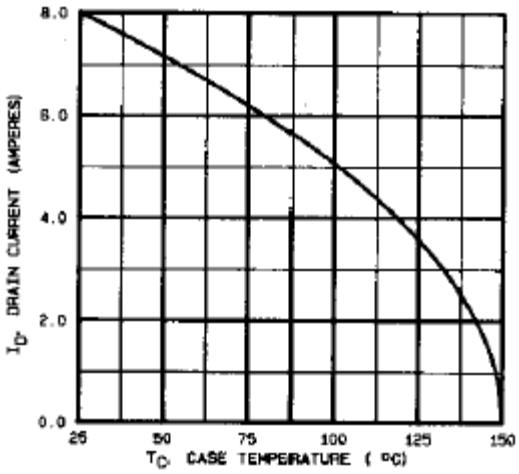
* TABLE III. Group E inspection (all quality levels) for qualification or re-qualification only. 1/

	Inspection	MIL-STD-750		Qualification and large lot quality conformance inspection
		Method	Conditions	
*	Subgroup 1			45 devices c = 0
	Temperature cycling (air to air)	1051	Test condition F or G, 500 cycles	
*	Hermetic seal Fine leak Gross leak	1071		
	Electrical measurements		See table I, subgroup 2	
	Subgroup 2 2/			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		See MIL-PRF-19500.	
	Subgroup 5			15 devices c = 0
	Barometric pressure test 2N7517	1001	Test condition C V_{DS} = 250 V; $I_{(ISO)}$ < 0.25 mA	
	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.	

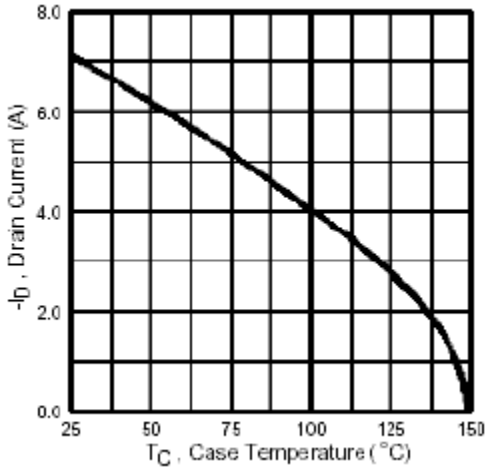
1/ Group E qualification of SEE testing may be performed prior to lot formation. Wafers qualified to these group E QCI requirements may be used for any other specification utilizing the same die design.
2/ A separate sample for each test shall be pulled.
3/ This sampling plan applies to each bias condition specified.



2N7515



2N7516



2N7517

FIGURE 2. Maximum drain current vs case temperature graphs.

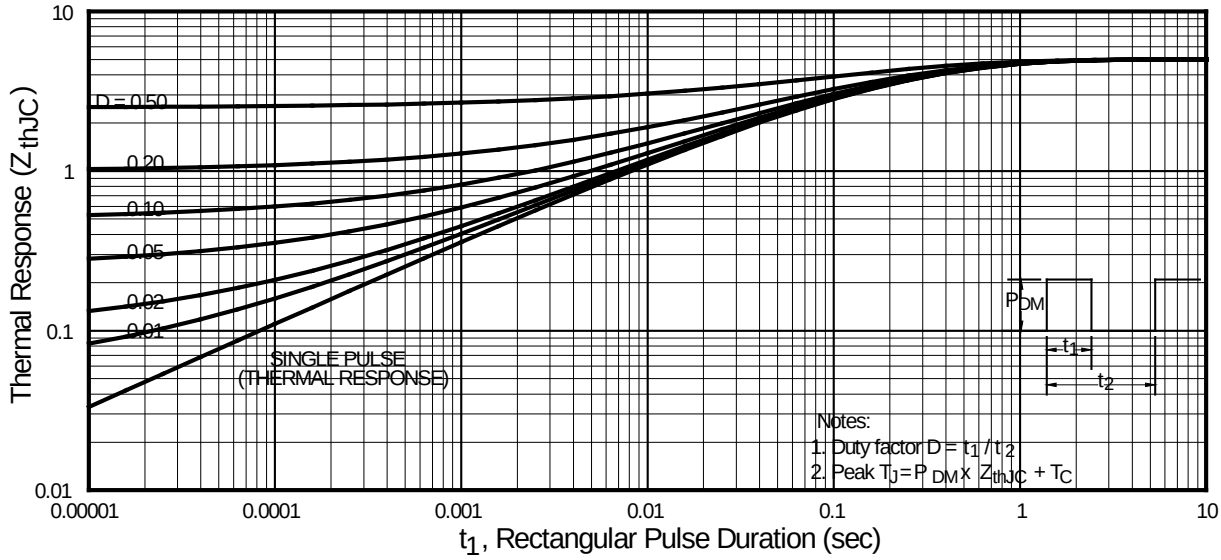


FIGURE 3. Thermal impedance curves.

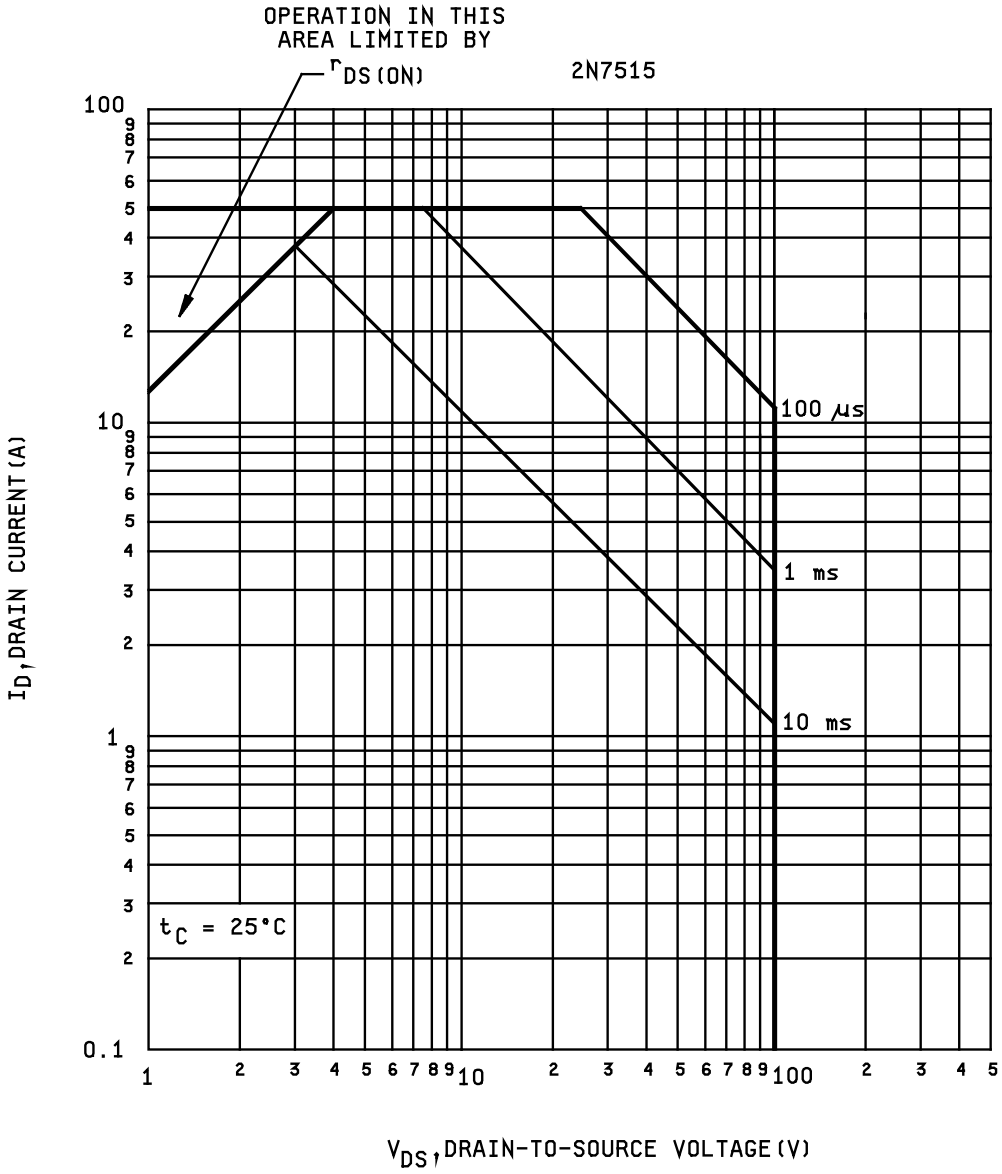


FIGURE 4. Safe operating area graphs.

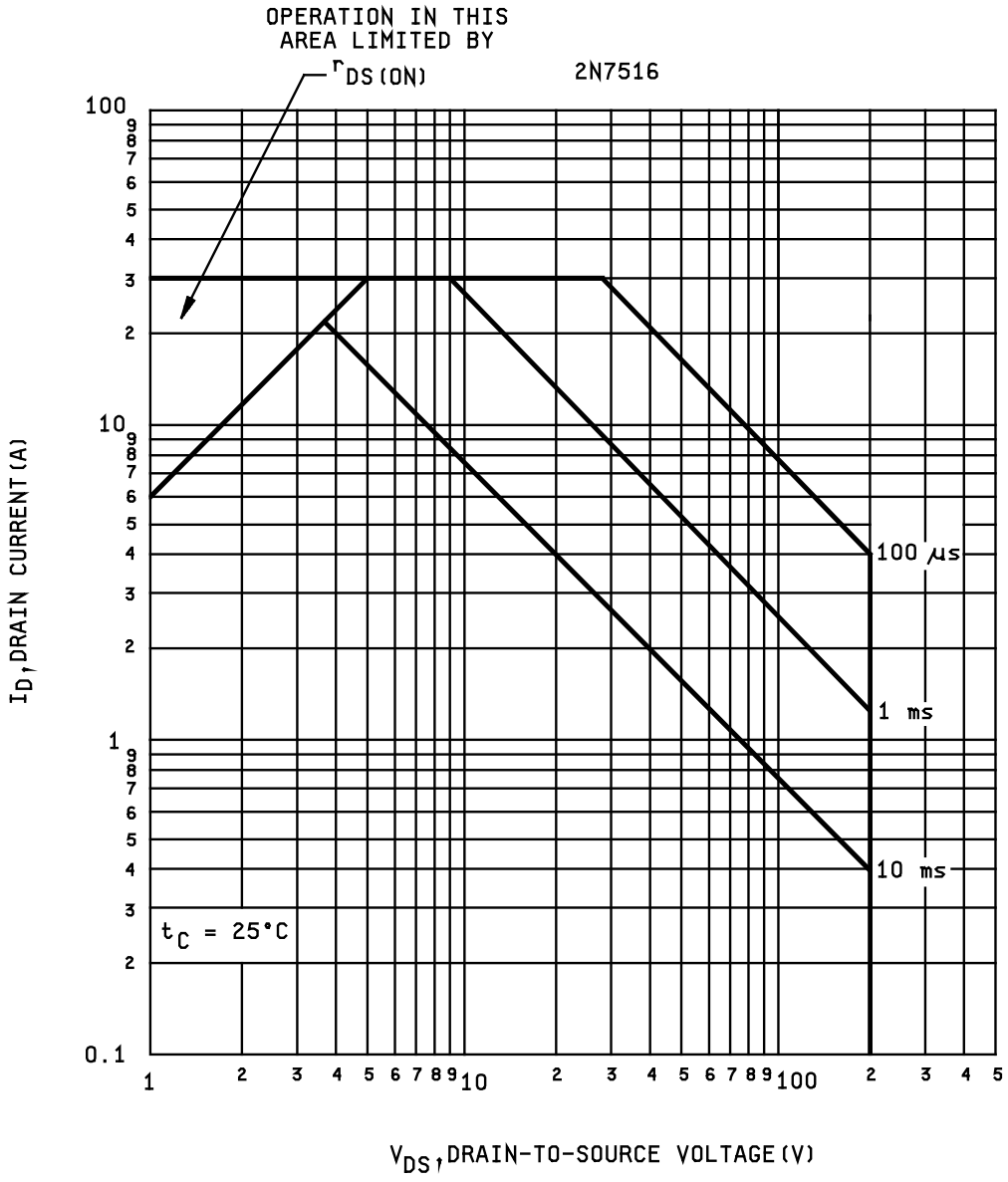


FIGURE 4. Safe operating area graphs - Continued.

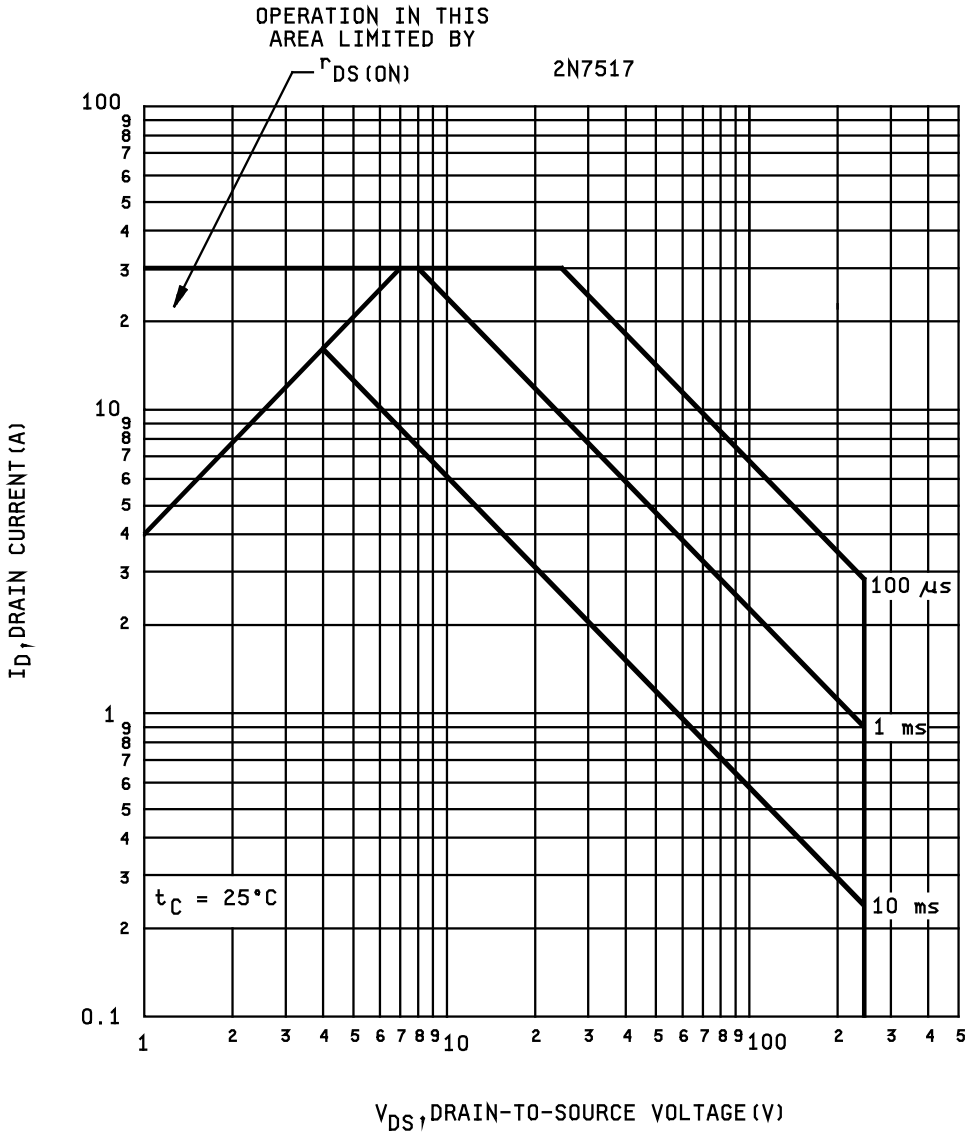


FIGURE 4. Safe operating area graphs - Continued.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD 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.)

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

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).

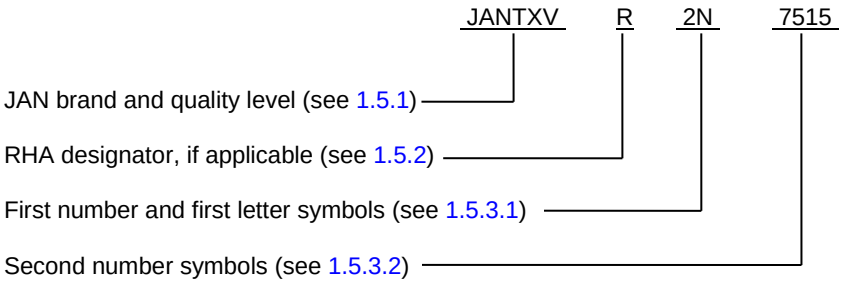
* d. The complete Part or Identifying Number (PIN), see 1.5 and 6.5.

* 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://assist.dla.mil.

* 6.4 Cross-reference list. The following table shows the generic P/N and its associated military P/N (without JAN and RHA prefix). Devices covered by this specification are substitutable for the manufacturer's and user's Part or Identifying Number (PIN). This information in no way implies that manufacturer's PIN's are suitable for the military PIN.

Generic P/N	Military P/N
FSGL130 FSGL230 FSGL234	2N7515 2N7516 2N7517

* 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)
JANTXV2N7515	JANTXV#2N7515	JANS2N7515	JANS#2N7515
JANTXV2N7516	JANTXV#2N7516	JANS2N7516	JANS#2N7516
JANTXV2N7517	JANTXV#2N7517	JANS2N7517	JANS#2N7517

(1) The number sign (#) represent one of the RHA designators available ("M", "D", "P", "L", "R".).

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 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.

Manufacturers CAGE	Inspection	MIL-STD-750		Sample plan
		Method	Conditions	
69210 (Applicable to devices with a date code of September 2009 and older)	SEE 1/	1080	See MIL-STD-750E method 1080.0 dated 20 November 2006. 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 ±20 percent ions/cm^2 Flux = 5E3 to 2E4 ions/cm^2/sec Beam energy = 260 to 360 MeV Temperature = 25°C ±5 °C;	
	2N7515		LET = 36 to 40 MeV-cm^2/mg, ion range = 35 to 40 microns in-situ bias conditions: V_{DS} = 100V & V_{GS} = -10V LET = 56 to 60 MeV-cm^2/mg, ion range = 30 to 35 microns in-situ bias conditions: V_{DS} = 100V & V_{GS} = -5V V_{DS} = 50V & V_{GS} = -8V LET = 80 to 84 MeV-cm^2/mg, ion range = 25 to 30 microns in-situ bias conditions: V_{DS} = 80V & V_{GS} = 0V V_{DS} = 50V & V_{GS} = -5V	
	2N7516		LET = 36 to 40 MeV-cm^2/mg, ion range = 35 to 40 microns in-situ bias conditions: V_{DS} = 200V & V_{GS} = -20V LET = 56 to 60 MeV-cm^2/mg, ion range = 30 to 35 microns in-situ bias conditions: V_{DS} = 200V & V_{GS} = -10V LET = 80 to 84 MeV-cm^2/mg, ion range = 25 to 30 microns in-situ bias conditions: V_{DS} = 160V & V_{GS} = -5V V_{DS} = 120V & V_{GS} = -10V	
	2N7517		LET = 36 to 40 MeV-cm^2/mg, ion range = 35 to 40 microns in-situ bias conditions: V_{DS} = 250V & V_{GS} = -20V LET = 56 to 60 MeV-cm^2/mg, ion range = 30 to 35 microns in-situ bias conditions: V_{DS} = 250V & V_{GS} = -10V LET = 80 to 84 MeV-cm^2/mg, ion range = 25 to 30 microns in-situ bias conditions: V_{DS} = 200V & V_{GS} = -5V V_{DS} = 150V & V_{GS} = -10V	
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 conditions. Other test conditions in accordance with table I, subgroup 2, may be performed at the manufacturer's option.

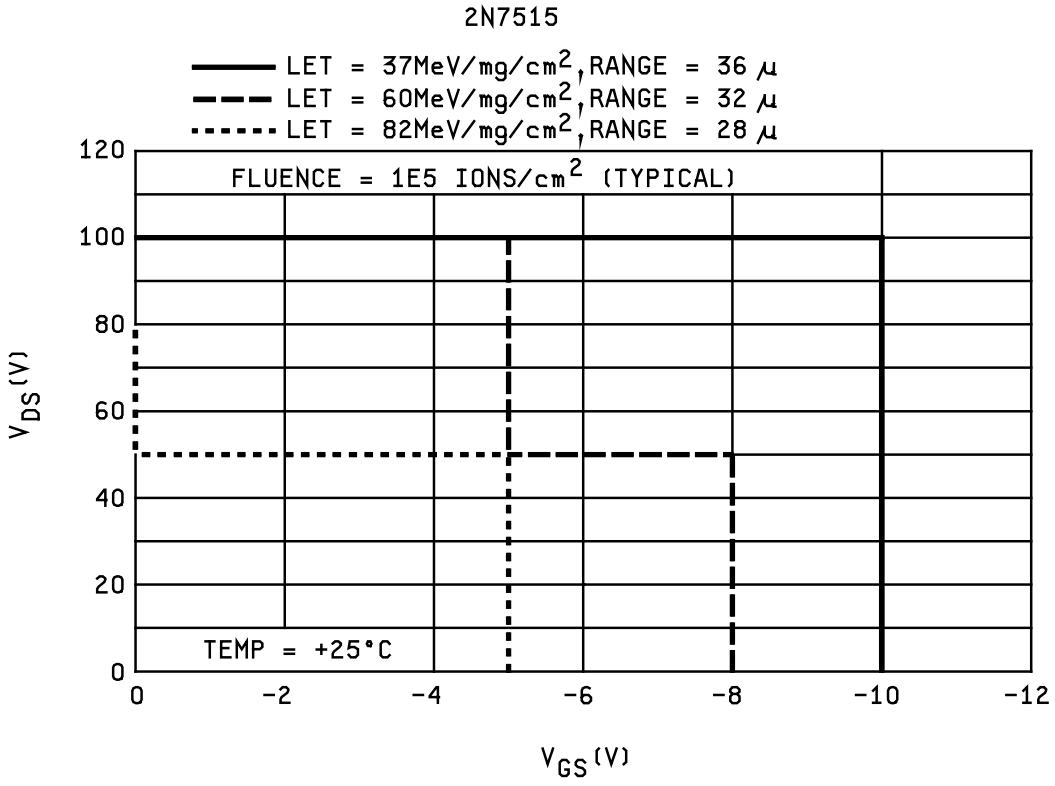


FIGURE 5. SEE safe operating area graphs.

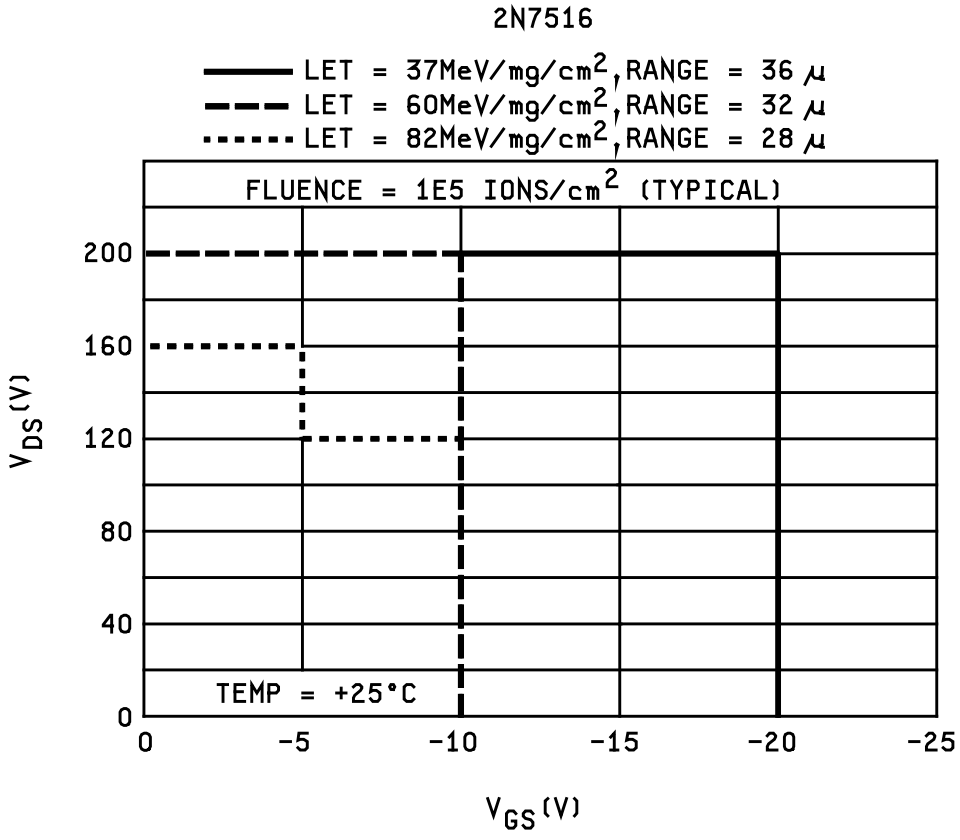


FIGURE 5. SEE safe operating area graphs - Continued.

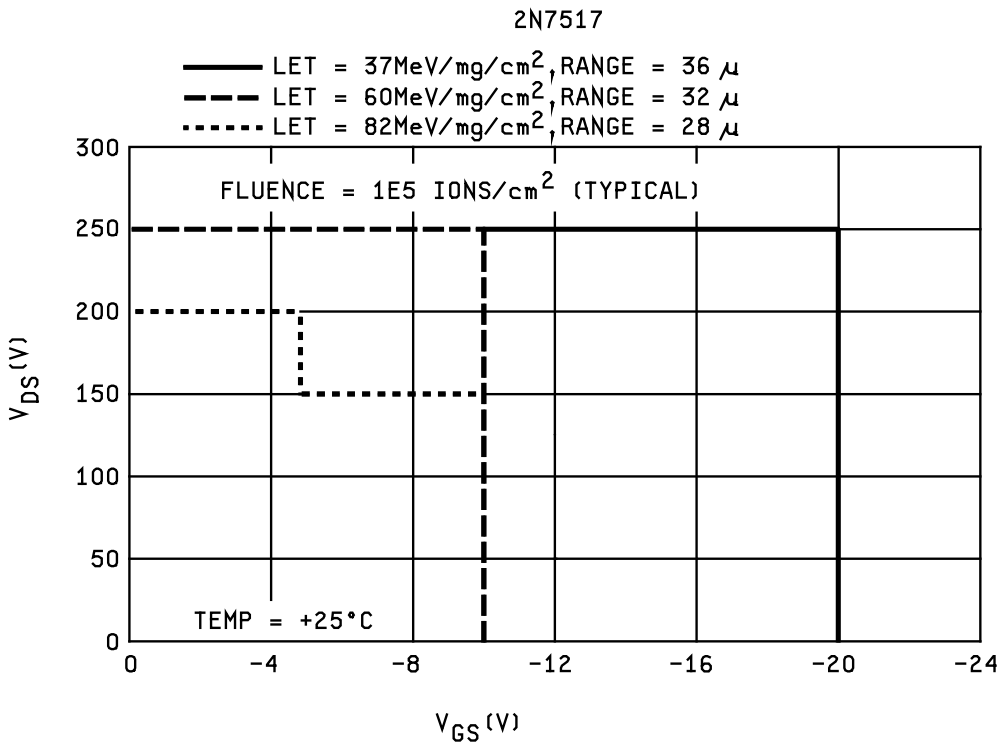


FIGURE 5. SEE safe operating area graphs - Continued.

6.8 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 5961-2015-073)

* 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/.