

The documentation and process conversion measures necessary to comply with this revision shall be completed by 20 March 2020.

INCH-POUND

MIL-PRF-19500/662F  
w/AMENDMENT 2  
20 December 2019  
SUPERSEDING  
MIL-PRF-19500/662F  
w/AMENDMENT 1  
9 May 2014

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, TRANSISTOR, FIELD EFFECT RADIATION HARDENED  
P-CHANNEL, SILICON, TYPES 2N7422, 2N7422U, 2N7423, AND 2N7423U,  
JANTXVR AND F AND JANSR 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, enhancement-mode, MOSFET, radiation hardened, power transistor. Two levels of product assurance are provided for each encapsulated device type (JANTXV and JANS) as specified in [MIL-PRF-19500](#), with avalanche energy maximum rating ( $E_{AS}$ ) and maximum avalanche current ( $I_{AS}$ ). See 6.7 for JANHC and JANKC die versions.

1.2 Package outlines. The device packages for this specification sheet are the TO-254AA in accordance with [figure 1](#), and the surface mount TO-276AB in accordance with [figure 2](#) for all packaged device types.

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

Type (1)	$P_T$ (2) $T_C = +25^\circ\text{C}$	$P_T$ $T_A = +25^\circ\text{C}$	$R_{\theta JC}$ (3)	$V_{DS}$	$V_{DG}$	$V_{GS}$	$I_{D1}$ (4) (5) $T_C = +25^\circ\text{C}$	$I_{D2}$ (4) (5) $T_C = +100^\circ\text{C}$	$I_S$	$I_{DM}$ (6)	$T_J$ and $T_{STG}$
	<u>W</u>	<u>W</u>	<u><math>^\circ\text{C/W}</math></u>	<u>V dc</u>	<u>V dc</u>	<u>V dc</u>	<u>A dc</u>	<u>A dc</u>	<u>A dc</u>	<u>A (pk)</u>	<u><math>^\circ\text{C}</math></u>
2N7422	150	4.0	0.83	-100	-100	$\pm 20$	-22.0	-14.0	-22.0	-88	-55 to +150
2N7423	150	4.0	0.83	-200	-200	$\pm 20$	-14.0	-9.0	-14.0	-56	

- (1) Unless otherwise noted, electrical characteristics, ratings, and conditions for "U" suffix devices (surface mount) are identical to the corresponding non-"U" suffix devices.
- (2) Derate linearly by 1.2 W/ $^\circ\text{C}$  for  $T_C > +25^\circ\text{C}$ .
- (3) See [figure 3](#), thermal impedance curves.
- (4) The following formula derives the maximum theoretical  $I_D$  limit.  $I_D$  is limited by package and internal construction.

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

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

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>.



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

Type (1)	Min $V_{(BR)DSS}$ $V_{GS} = 0$ $I_D = -1.0 \text{ mA}$ dc	$V_{GS(TH)1}$ $V_{DS} \geq V_{GS}$ $I_D = -1.0 \text{ mA}$ dc		Max $I_{DSS1}$ $V_{GS} = 0$ $V_{DS} = 80$ percent of rated $V_{DS}$	Max $r_{DS(on)}$ (2)		$E_{AS}$ at $I_{D1}$	$I_{AS}$
					$V_{GS} = -12\text{V}$ $I_D = I_{D2}$			
					$T_J = 25^\circ\text{C}$	$T_J = 150^\circ\text{C}$		
					$\underline{\Omega}$	$\underline{\Omega}$	$\underline{\text{mJ}}$	$\underline{\text{A}}$
	<u>V dc</u>	<u>V dc</u>		<u><math>\mu\text{A dc}</math></u>	<u><math>\Omega</math></u>	<u><math>\Omega</math></u>	<u>mJ</u>	<u>A</u>
		Min Max						
2N7422	-100	-2.0 -4.0		-25	0.080	0.200	500	-22
2N7423	-200	-2.0 -4.0		-25	0.315	0.708	500	-14

(1) Unless otherwise noted, electrical characteristics, ratings, and conditions for "U" suffix devices (surface mount) are identical to the corresponding non-"U" suffix devices.

(2) Pulsed (see 4.5.1).

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

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

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

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

\* 1.5.3.1 First number and first letter symbols. The transistors of this specification sheet are identified by 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: "7422" and "7423".

\* 1.5.4 Suffix symbols. The suffix letter U indicates an unleaded surface mount package (see figure 2)

\* 1.5.5 Lead finish. The lead finishes applicable to this specification sheet are listed on QML 19500.

## 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.

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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.

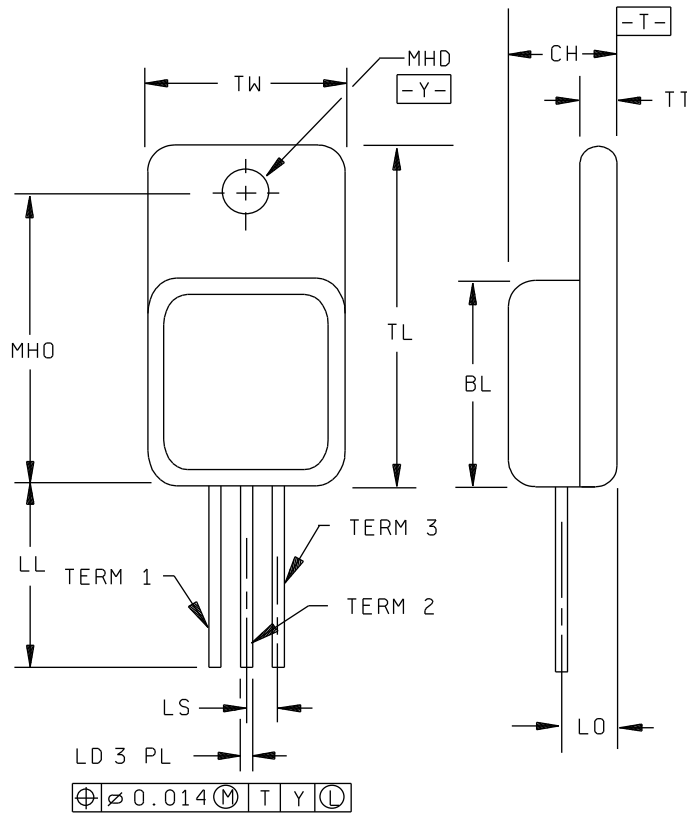
DEPARTMENT OF DEFENSE STANDARDS

[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.

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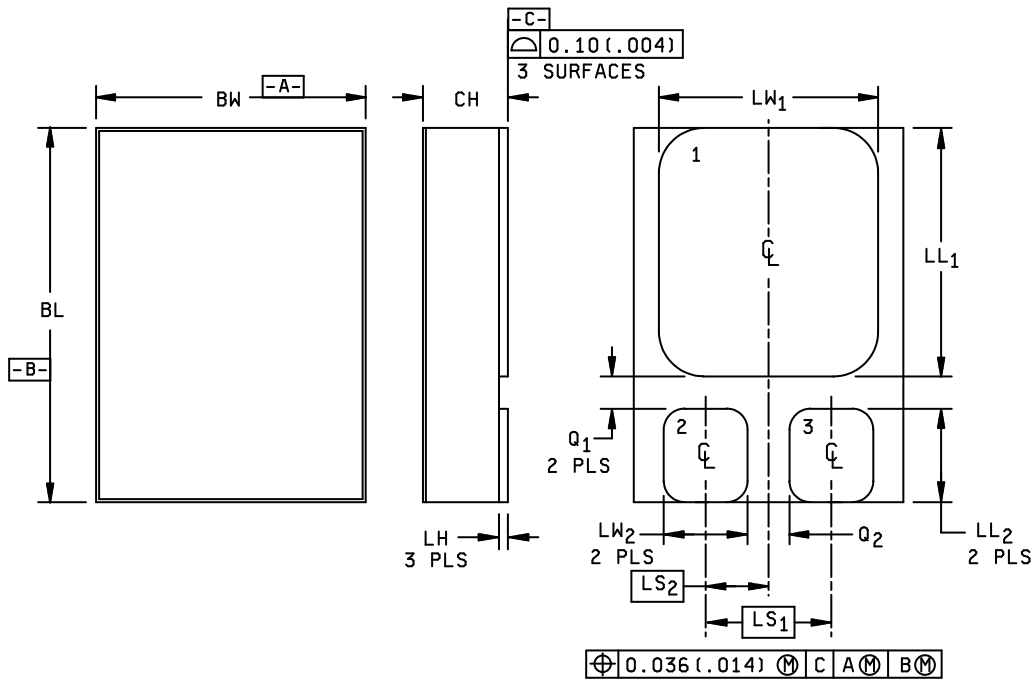
Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.535	.545	13.59	13.84
CH	.249	.260	6.32	6.60
LD	.035	.045	0.89	1.14
LL	.510	.570	12.95	14.48
LO	.150 BSC		3.81 BSC	
LS	.150 BSC		3.81 BSC	
MHD	.139	.149	3.53	3.78
MHO	.665	.685	16.89	17.40
TL	.790	.800	20.07	20.32
TT	.040	.050	1.02	1.27
TW	.535	.545	13.59	13.84
Term 1	Drain			
Term 2	Source			
Term 3	Gate			

NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. In accordance with ASME Y14.5M, diameters are equivalent to  $\phi x$  symbology.
4. All terminals are isolated from case.

FIGURE 1. Physical dimensions for TO-254AA.

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Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.620	.630	15.75	16.00
BW	.445	.455	11.30	11.56
CH		.141		3.58
LH	.010	.020	0.25	0.51
LL <sub>1</sub>	.410	.420	10.41	10.67
LL <sub>2</sub>	.152	.162	3.86	4.11
LS <sub>1</sub>	.210 BSC		5.33 BSC	
LS <sub>2</sub>	.105 BSC		2.67 BSC	
LW <sub>1</sub>	.370	.380	9.40	9.65
LW <sub>2</sub>	.135	.145	3.43	3.68
Q <sub>1</sub>	.030		0.76	
Q <sub>2</sub>	.035		0.89	
Term 1	Drain			
Term 2	Gate			
Term 3	Source			

NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general 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 2. Dimensions and configuration of surface mount package outline, TO-276AB.

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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<sub>AS</sub> ..... Rated avalanche current, nonrepetitive  
nC ..... nano Coulomb.

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in [MIL-PRF-19500](#) and on [figures 1](#) and [2](#) herein. Methods used for electrical isolation of the terminals shall employ materials that contain a minimum of 90 percent Al<sub>2</sub>O<sub>3</sub> (ceramic). Examples of such construction techniques are metallized ceramic eyelets, or ceramic walled packages.

3.4.1 Lead material and finish. Unless otherwise specified, the lead finish shall be solderable as defined in [MIL-PRF-19500](#), [MIL-STD-750](#), and herein. Where a choice of terminal finish is desired, it shall be specified in the acquisition document (see [6.2](#)).

3.4.2 Internal construction: Multiple chip construction shall not be permitted 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](#). At the option of the manufacturer, marking of the country of origin may be omitted from the body of the transistor but shall be retained on the initial container.

\* 3.6 Electrostatic discharge 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 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,  $R \leq$  or 100 k $\Omega$ , whenever bias voltage is 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.

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

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

#### 4. VERIFICATION

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

- a. Qualification inspection (see 4.2).
- b. Screening (see [4.3](#)).
- c. Conformance inspection (see [4.4](#) and [tables I and II](#)).

4.2 Qualification inspection. Qualification inspection shall be in accordance with [MIL-PRF-19500](#).

4.2.1 Group E qualification. Group E 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.

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4.3 Screening (JANS and JANTXV levels only). Screening shall be in accordance with table E-IV of MIL-PRF-19500, and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table E-IV of MIL-PRF-19500) (1) (2)	Measurement	
	JANS	JANTXV
(3)	Gate stress test (see 4.3.1)	Gate stress test (see 4.3.1)
(3)	Method 3470 of MIL-STD-750, E <sub>AS</sub> test (see 4.3.2)	Method 3470 of MIL-STD-750, E <sub>AS</sub> test (see 4.3.2)
(3) 3c	Method 3161 of MIL-STD-750, thermal impedance (see 4.3.3)	Method 3161 of MIL-STD-750, thermal impedance (see 4.3.3)
5	Method 2052 of MIL-STD-750, PIND (see MIL-PRF-19500 and 4.3.4)	Not applicable
9	I <sub>GSSF1</sub> , I <sub>GSSR1</sub> , I <sub>DSS1</sub> , subgroup 2 of table I herein	Not applicable
10	Method 1042 of MIL-STD-750, test condition B	Method 1042 of MIL-STD-750, test condition B
11	I <sub>GSSF1</sub> , I <sub>GSSR1</sub> , I <sub>DSS1</sub> , r <sub>DS(ON)1</sub> , V <sub>GS(TH)1</sub> , Subgroup 2 of table I herein. ΔI <sub>GSSF1</sub> = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI <sub>GSSR1</sub> = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI <sub>DSS1</sub> = ±10 μA dc or ±100 percent of initial value, whichever is greater.	I <sub>GSSF1</sub> , I <sub>GSSR1</sub> , I <sub>DSS1</sub> , r <sub>DS(ON)1</sub> , V <sub>GS(TH)1</sub> , 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 <sub>GSSF1</sub> = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI <sub>GSSR1</sub> = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI <sub>DSS1</sub> = ±10 μA dc or ±100 percent of initial value, whichever is greater. Δr <sub>DS(ON)1</sub> = ±20 percent of initial value. ΔV <sub>GS(TH)1</sub> = ±20 percent of initial value.	Subgroups 2 of table I herein. ΔI <sub>GSSF1</sub> = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI <sub>GSSR1</sub> = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI <sub>DSS1</sub> = ±10 μA dc or ±100 percent of initial value, whichever is greater. Δr <sub>DS(ON)1</sub> = ±20 percent of initial value. ΔV <sub>GS(TH)1</sub> = ±20 percent of initial value.
17	For TO-254AA packages: Method 1081 of MIL-STD-750 (see 4.3.5), Endpoints: Subgroup 2 of table I herein.	For TO-254AA 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<sub>GSSF1</sub>, I<sub>GSSR1</sub>, and I<sub>DSS1</sub> are measured.
- (2) An out-of-family program to characterize I<sub>GSSF1</sub>, I<sub>GSSR1</sub>, I<sub>DSS1</sub> and V<sub>GS(TH)1</sub> shall be invoked.
- (3) Shall be performed anytime after temperature cycling, screen 3a; JANTXV level does not need to be repeated in screening requirements.



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4.3.1 Gate stress test. Apply  $V_{GS} = -30$  V minimum for  $t = 250$   $\mu$ s minimum.

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

- a. Peak current,  $I_{AS} = I_{D1}$
- b. Inductance,  $L = (2 \cdot E_{AS} / (I_{D1})^2) \cdot ((V_{BR} - V_{DD}) / V_{BR})$  mH minimum.
- c. Gate to source resistor,  $R_{GS}: 25 \leq R_{GS} \leq 200 \Omega$ .
- d. Supply voltage,  $V_{DD} = -25$  V dc, except  $V_{DD} = -50$  V dc for 2N7423.
- e. Initial case temperature,  $T_C = +25^\circ$  C,  $-5^\circ$  C,  $+10^\circ$  C.
- f. Gate voltage,  $V_{GS} = -12$  V dc.
- 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  $I_M$ ,  $I_H$ ,  $t_H$ ,  $t_{MD}$ ,  $t_{sw}$ , (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 be evaluated for root cause and lot integrity.

\* 4.3.5 Dielectric withstanding voltage.

- a. Magnitude of test voltage.....900 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 table E-V of [MIL-PRF-19500](#) and [table I](#) herein. Electrical measurements (end-points) shall be in accordance with [table I](#), subgroup 2 herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table 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.

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4.4.1 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	2075	See 3.4.2.
B3	2077	SEM qualification may be performed anytime prior to lot formation.
* 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	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 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. No heat sink or forced-air cooling on the device shall be permitted during the on cycle; $t_{on} = 30$ seconds minimum.

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	Test condition A; weight = 10 pounds; $t = 15$ seconds (applicable to TO-254AA only).
C3	2052	PIND, required if not performed in screening. (22 devices, c = 0 for large lots, 12 devices, c = 0 for small lots).
C5	3161	See 4.3.3, $R_{\theta JC} = 0.83$ °C/W.
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 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. 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.

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TABLE I. Group A inspection

Inspection <u>1/</u>	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 <u>2/</u>	3161	See 4.3.3	$Z_{\theta JC}$			°C/W
Breakdown voltage drain to source 2N7422, 2N7422U 2N7423, 2N7423U	3407	Bias condition C, $V_{GS} = 0$ V, $I_D = -1$ mA dc,	$V_{(BR)DSS}$	-100 -200		V dc V dc
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$ , $I_D = -1$ mA dc	$V_{GS(TH)1}$	-2.0	-4.0	V dc
Gate current	3411	Bias condition C, $V_{GS} = -20$ V dc, $V_{DS} = 0$ V	$I_{GSSF1}$		-100	nA dc
Gate current	3411	Bias condition C, $V_{GS} = 20$ V dc, $V_{DS} = 0$ V	$I_{GSSR1}$		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 2N7422, 2N7422U 2N7423, 2N7423U	3421	$V_{GS} = -12$ V dc, condition A, pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(ON)1}$		0.080 0.315	Ω Ω
Static drain to source on-state resistance 2N7422, 2N7422U 2N7423, 2N7423U	3421	$V_{GS} = -12$ V dc, condition A, pulsed (see 4.5.1), $I_D = I_{D1}$	$r_{DS(ON)2}$		0.085 0.330	Ω Ω
Forward voltage 2N7422, 2N7422U 2N7423, 2N7423U	4011	$V_{GS} = 0$ V dc, condition A, pulsed (see 4.5.1), $I_D = I_{D1}$	$V_{SD}$		-3.0 -3.6	V dc V dc

See footnotes at end of table.

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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:						
High temperature operation:		$T_C = T_J = +125^\circ\text{C}$				
Gate current	3411	Bias condition C, $V_{GS} = -20\text{ V dc}$ , $V_{DS} = 0\text{ V}$	$I_{GSSF2}$		-200	nA dc
Gate current	3411	Bias condition C, $V_{GS} = 20\text{ V dc}$ , $V_{DS} = 0\text{ V}$	$I_{GSSR2}$		200	nA dc
Drain current	3413	Bias condition C, $V_{GS} = 0\text{ V dc}$ , $V_{DS} = 80\text{ percent of rated } V_{DS}$	$I_{DSS2}$		-0.25	mA dc
Static drain to source on-state resistance 2N7422, 2N7422U 2N7423, 2N7423U	3421	$V_{GS} = -12\text{ V dc}$ , condition A, pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(ON)3}$		0.170 0.669	$\Omega$ $\Omega$
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$ , $I_D = -1\text{ mA dc}$	$V_{GS(TH)2}$	-1.0		V dc
Low temperature operation:						
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$ , $I_D = -1\text{ mA dc}$	$V_{GS(TH)3}$		-5.0	V dc
<u>Subgroup 4</u>						
Forward transconductance 2N7422, 2N7422U 2N7423, 2N7423U	3475	$I_D = I_{D2}$ , $V_{DD} > -15\text{ V dc}$ , see 4.5.1	$g_{fs}$	11.0 4.0		S S
Switching time tests	3472	$I_D = I_{D1}$ , $V_{GS} = -12\text{ V dc}$ , $R_G = 2.35\ \Omega$ , $V_{DD} = 50\text{ percent of rated } V_{DS}$				
Turn-on delay time 2N7422, 2N7422U 2N7423, 2N7423U			$t_{D(on)}$		40 60	ns ns
Rise time 2N7422, 2N7422U 2N7423, 2N7423U			$t_r$		170 240	ns ns

See footnotes at end of table.

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TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
<u>Subgroup 4- Continued</u>						
Turn-off delay time 2N7422, 2N7422U 2N7423, 2N7423U			$t_{D(off)}$		190 225	ns ns
Fall time 2N7422, 2N7422U 2N7423, 2N7423U			$t_f$		190 220	ns ns
<u>Subgroup 5</u>						
Safe operating area test (high voltage)	3474	See <a href="#">figures 5 and 6</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				
On-state gate charge 2N7422, 2N7422U 2N7423, 2N7423U			$Q_{G(ON)}$		200 200	nC nC
Gate to source charge 2N7422, 2N7422U 2N7423, 2N7423U			$Q_{GS}$		35 45	nC nC
Gate to drain charge 2N7422, 2N7422U 2N7423, 2N7423U			$Q_{GD}$		48 85	nC nC
Reverse recovery time  2N7422, 2N7422U 2N7423, 2N7423U	3473	Condition A. $di/dt = -100$ A/ $\mu$ s, $V_{DD} \leq -50$ V $I_D = I_{D1}$	$t_{rr}$		300 775	ns 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 2 and 3 (JANTXV).  
Group B, subgroups 3 and 4 (JANS).  
Group C, subgroup 2 and 6.9 M  
Group E, subgroup 1.

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TABLE II. Group D inspection.

Inspection 1/ 2/ 3/ 4/	MIL-STD-750		Symbol	Pre-irradiation limits		Post-irradiation limits				Unit
	Method	Conditions		R and F		R		F 5/		
				Min	Max	Min	Max	Min	Max	
<u>Subgroup 1</u>										
Not applicable										
<u>Subgroup 2</u>		$T_C = +25^\circ\text{C}$								
Steady-state total dose irradiation (V <sub>GS</sub> bias) 6/	1019	V <sub>GS</sub> = -12 V; V <sub>DS</sub> = 0 V								
Steady-state total dose irradiation (V <sub>DS</sub> bias) 6/	1019	V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 80 percent of rated V <sub>DS</sub> (pre-irradiation)								
End-point electricals:										
Breakdown voltage, drain to source	3407	V <sub>GS</sub> = 0 V; I <sub>D</sub> = -1 mA; bias condition C	V <sub>(BR)DSS</sub>							
2N7422				-100		-100		-100		V dc
2N7423				-200		-200		-200		V dc
Gate to source voltage (threshold)	3403	V <sub>DS</sub> ≥ V <sub>GS</sub> ; I <sub>D</sub> = -1 mA	V <sub>GS(th)1</sub>							
2N7422				-2.0	-4.0	-2.0	-4.0	-2.0	-5.0	V dc
2N7423				-2.0	-4.0	-2.0	-4.0	-2.0	-5.0	V dc
Gate current	3411	Bias condition C; V <sub>GS</sub> = -20 V; V <sub>DS</sub> = 0 V	I <sub>GSSF1</sub>		-100		-100		-100	nA dc
Gate current	3411	Bias condition C; V <sub>GS</sub> = +20 V; V <sub>DS</sub> = 0 V	I <sub>GSSR1</sub>		100		100		100	nA dc
Drain current	3413	Bias condition C; V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 80 percent of rated V <sub>DS</sub> (pre-irradiation)	I <sub>DSS</sub>		-25		-25		-25	μA dc

See footnotes at end of table.

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TABLE II. Group D inspection - Continued.

Inspection 1/ 2/ 3/ 4/	MIL-STD-750		Symbol	Pre-irradiation limits		Post-irradiation limits				Unit
	Method	Conditions		R and F		R		F 5/		
				Min	Max	Min	Max	Min	Max	
<u>Subgroup 2</u> - Continued		$T_C = + 25^\circ\text{C}$								
Static drain to source on-state voltage	3405	Condition A; $V_{GS} = -12\text{ V}$ ; $I_D = I_{D2}$ ; pulsed (see 4.5.1)	$V_{DS(on)}$							
2N7422					-1.12		-1.12		-1.12	V dc
2N7423					-2.835		-2.835		-2.835	V dc
Forward voltage source drain diode	4011	Bias condition C; $V_{GS} = 0\text{ V}$ ; $I_D = I_{D1}$	$V_{SD}$							
2N7422					-3.0		-3.0		-3.0	V dc
2N7423					-3.6		-3.6		-3.6	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 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/ Unless otherwise noted, electrical characteristics, ratings, and conditions for "U" suffix devices (surface mount) are identical to the corresponding non-"U" suffix devices.

5/ The "F" designation represents devices which pass end-points at both R and F designated Total-Ionizing-Dose (TID).

6/ Separate samples shall be pulled for each bias.

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

Inspection	MIL-STD-750		Sample plan
	Method	Conditions	
<u>Subgroup 1</u>			45 devices c = 0
Temperature cycle	1051	Condition G, 500 cycles	
Hermetic seal	1071		
Fine leak			
Gross leak			
Electrical measurements		See <a href="#">table I</a> , subgroup 2	
<u>Subgroup 2</u> <sup>1/</sup>			45 devices c = 0
Steady-state gate bias	1042	Condition B, 1,000 hours	
Electrical measurements		See <a href="#">table I</a> , subgroup 2	
Steady-state reverse bias	1042	Condition A, 1,000 hours	
Electrical measurements		See <a href="#">table I</a> , subgroup 2	
<u>Subgroup 4</u>			Sample size N/A
Thermal impedance curves		See <a href="#">MIL-PRF-19500</a> .	
<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	
<u>Subgroup 11</u>			3 devices
SEE <sup>2/</sup> <sup>3/</sup>	1080	See <a href="#">MIL-STD-750</a> method 1080 and <a href="#">6.2</a> .	

<sup>1/</sup> A separate sample for each test shall be pulled.

<sup>2/</sup> 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.

<sup>3/</sup> Device qualification to a higher level LET is sufficient to qualify all lower level LETs.



2N7422, 2N7422U, 2N7423, and 2N7423U

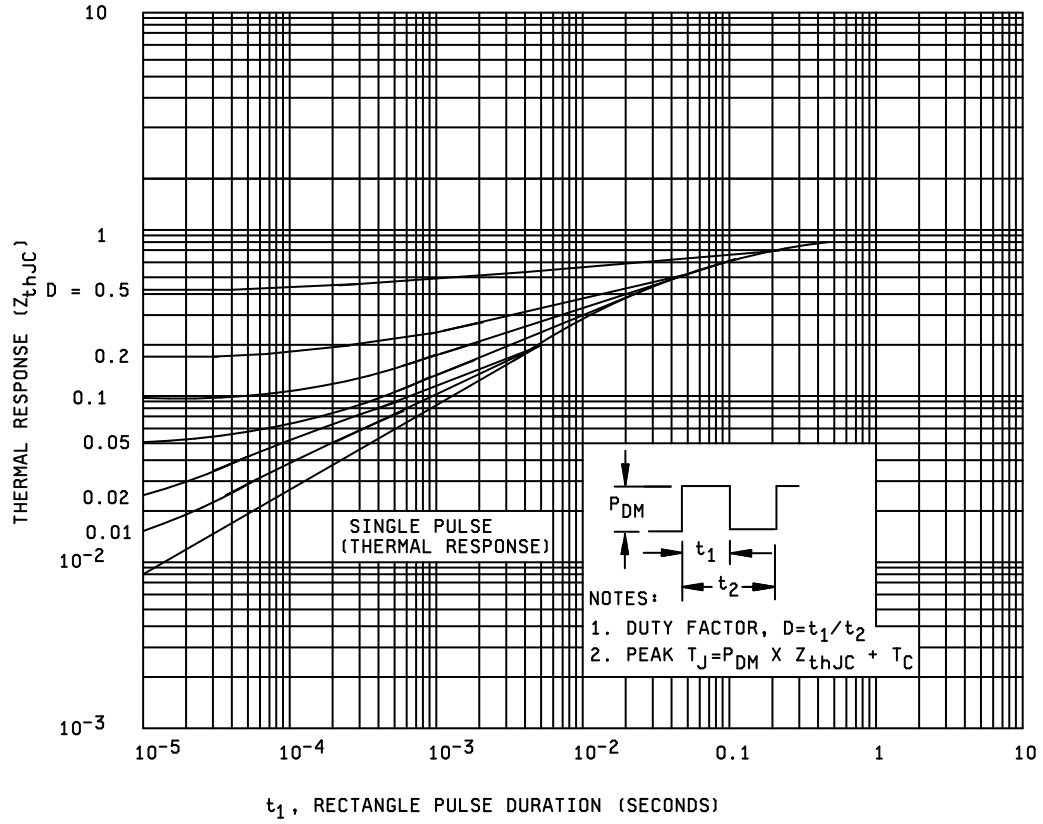
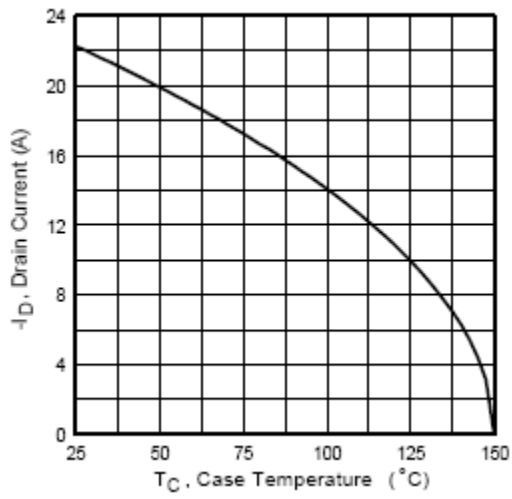
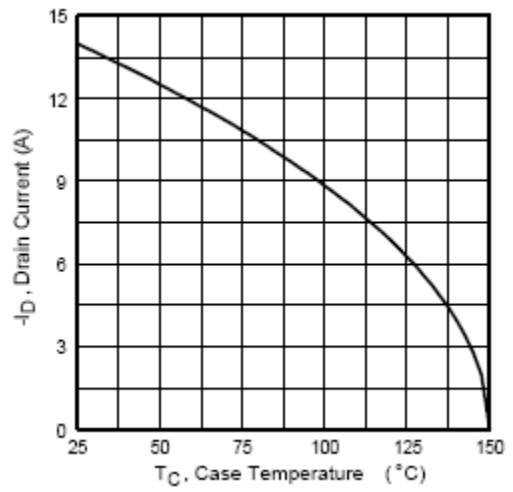


FIGURE 3. Thermal impedance curve.



2N7422, 2N7422U



2N7423, 2N7423U

FIGURE 4. Maximum drain current versus case temperature graphs.

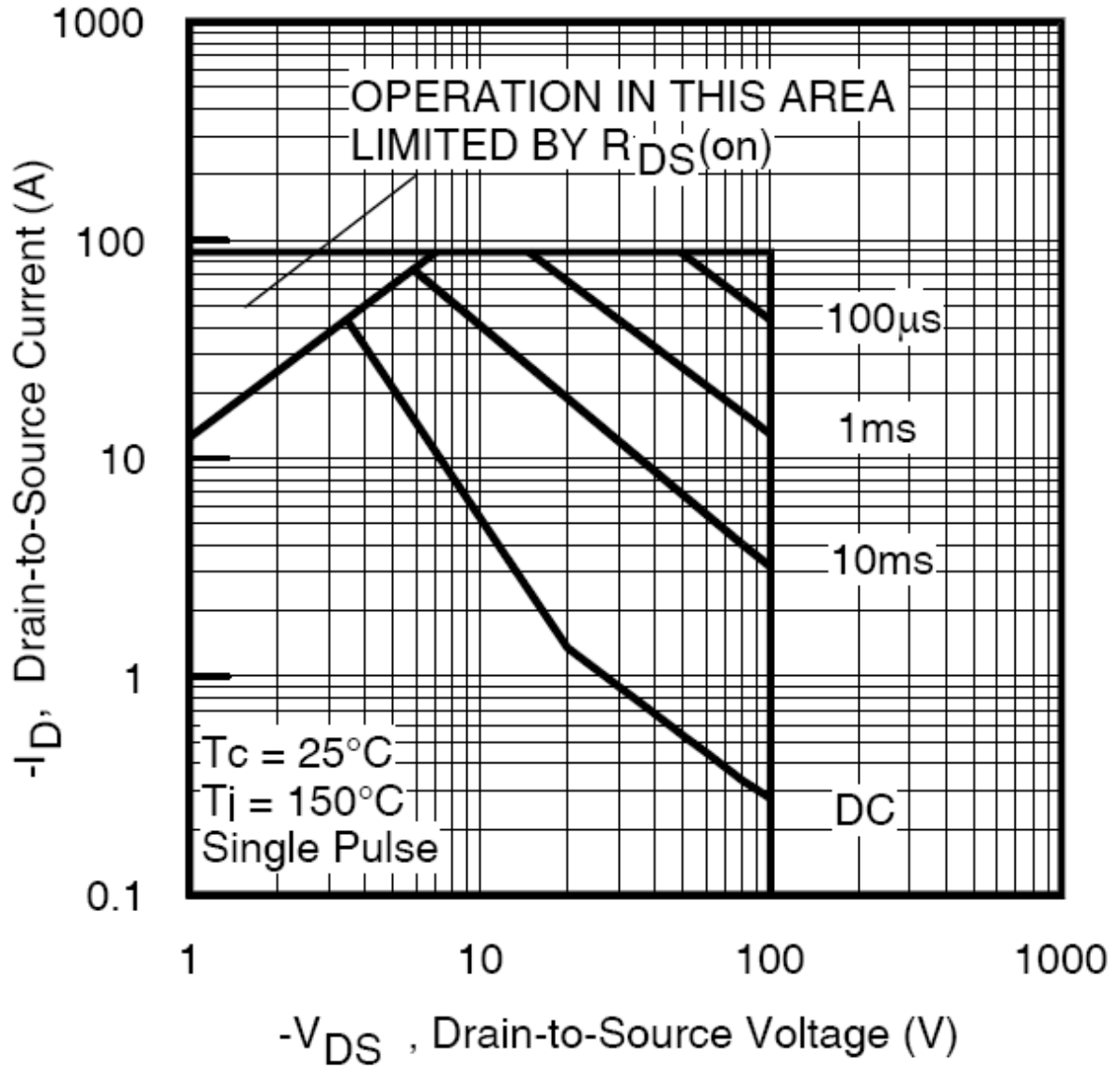


FIGURE 5. Safe operating area graph (2N7422, 2N7422U).

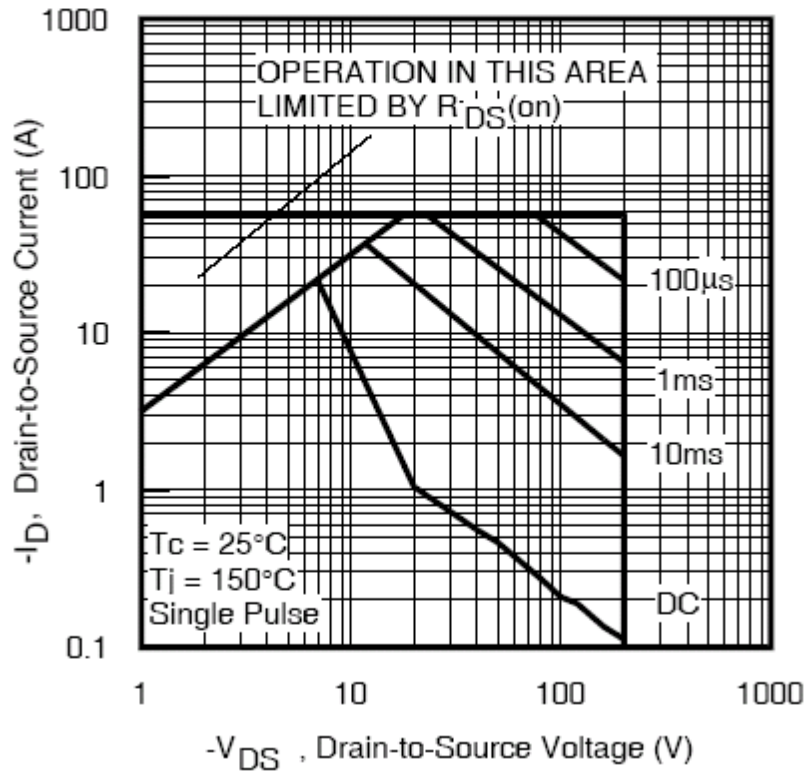


FIGURE 6. Safe operating area graph (2N7423, 2N7423U).

## 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.

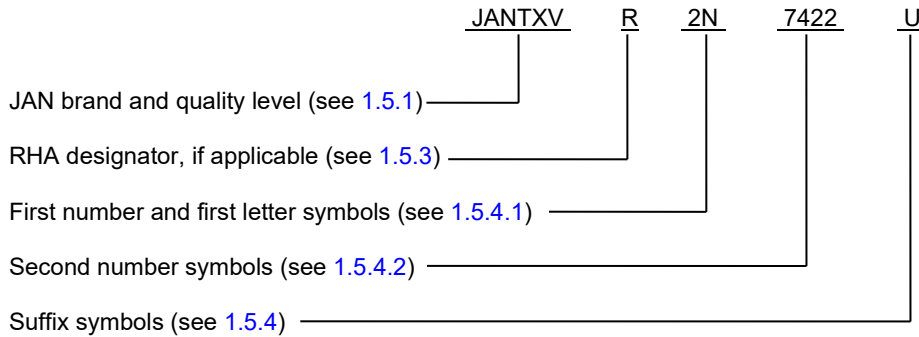
6.2 Acquisition requirements. Acquisition documents should specify the following:

- 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 section 6.6 and [table IV](#)), manufacturer's cage code should be specified in the contract or order.
- g. If SEE testing data is desired, it 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>.

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



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

PINs for devices of the "TXV" quality level	PINs for devices of the "TXV" quality level with RHA (1)	PINs for devices of the "S" quality level	PINs for devices of the "S" quality level with RHA (1)
JANTXV2N7422	JANTXV#2N7422	JANS2N7422	JANS#2N7422
JANTXV2N7423	JANTXV#2N7423	JANS2N7423	JANS#2N7423

(1) The number sign (#) represents one of two RHA designators available (R or F).

6.6 Cross-reference list. The following table shows the generic P/N and its associated military P/N (without JAN and RHA prefix).

Commercial types (1)		
Preferred types	TO-254AA	"U"
2N7422	IRHM9_150	IRHN9_150
2N7423	IRHM9_250	IRHN9_250

(1) IRH9\_: 100 K Rad (Si)  
IRH9<sub>3</sub>: 300 K Rad (Si)

6.7 JANC die versions. The JANHC and JANKC die versions of these devices are covered under specification sheet [MIL-PRF-19500/657](#).

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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 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	
No manufacturers are currently qualified to the SEE requirements	SEE 1/ Electrical measurements	1080	See MIL-STD-750E method 1080  I <sub>GSSF1</sub> , I <sub>GSSR1</sub> , and I <sub>DSS1</sub> in accordance with table I, subgroup 2	3 devices
	Electrical measurements		I <sub>GSSF1</sub> , I <sub>GSSR1</sub> , and I <sub>DSS1</sub> in accordance with table I, subgroup 2	
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">                     Upon qualification, all manufacturers will provide the verification test conditions to be added to this table.                 </div>				

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

\* 6.9 Amendment notations. The margins of this specification are marked with asterisks to indicate modifications generated by this amendment. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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

Preparing activity:  
DLA - CC  
  
(Project 5961-2019-126)

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>.