

PERFORMANCE SPECIFICATION SHEET

TRANSISTOR, FIELD EFFECT, N-CHANNEL, SILICON, SURFACE MOUNT,
RADIATION HARDENED, TYPES 2N7663, QUALITY LEVELS 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, logic level MOSFET, radiation hardened (total dose and single event effects (SEE)), power transistor. Two levels of product assurance (JANTXV and JANS) are provided for each encapsulated device. Provisions for radiation hardness assurance (RHA) to two radiation levels ("R" and "F") are provided for JANTXV and JANS product assurance level.

1.2 Physical dimensions.

1.2.1 Package outlines. The device package outline is a surface mount (U2A) in accordance with [figure 1](#) for all encapsulated 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 $T_A = +25^\circ\text{C}$	$R_{\theta JC}$ (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} (6)	T_J and T_{STG}
	<u>W</u>	<u>W</u>	<u>$^\circ\text{C}/\text{W}$</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>$^\circ\text{C}$</u>
2N7663U2A	125	2.50	1.00	20	20	± 12	75	75	75	300	-55 to +150

(1) Derate linearly by 1.00 W/ $^\circ\text{C}$ (U2A) 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 wires and may be limited by pin diameter:

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

(4) See [figure 3](#), maximum drain current graph.

(5) $I_{DM} = 4 \times I_{D1}$; I_{D1} as calculated by footnote (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. 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. Unless otherwise specified at $T_C = +25^\circ\text{C}$.

Types (1)	Min $V_{(BR)DSS}$ $V_{GS} = 0$ $I_D = 250\mu\text{A dc}$	$V_{GS(TH)1}$ $V_{DS} \geq V_{GS}$ $I_D = 1.8 \text{ mA dc}$	Max I_{DSS1} $V_{GS} = 0$ $V_{DS} = 80\%$ of rated V_{DS}	Max $r_{DS(on)}$ (1) $V_{GS} = 4.5\text{V},$ $I_D = I_{D2}$	Max $r_{DS(on)}$ (1) $V_{GS} = 4.5\text{V},$ $I_D = I_{D2}$	EAS
				$T_J = +25^\circ\text{C}$	$T_J = +150^\circ\text{C}$	
	<u>V dc</u>	<u>V dc</u> <u>Min</u> <u>Max</u>	<u>$\mu\text{A dc}$</u>	<u>Ω</u>	<u>Ω</u>	<u>mJ</u>
2N7663U2A	20	1.0 2.3	1.0	0.0025	0.0046	535

(1) Pulsed (see 4.5.1).

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

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

1.5.2 Radiation hardness assurance (RHA) designator. The RHA levels that are applicable for this specification sheet for product assurance levels JANTXV and JANS from lowest to highest are as follows: "R", and "F". See 1.6 for RHA details.

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: "7663".

1.5.4 Suffix letters. The following suffix letters are incorporated in the PIN for this specification sheet:

U2A	Indicates a metal lidded 3 pad surface mount package (see figure 1)
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1.5.5 Lead finish. The lead finishes applicable to this specification sheet are listed on QPDSIS-19500.

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

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

For device types 2N7663U2A: 100 krad(Si) 1/

1.6.2 Heavy ion irradiation SEE. SEE testing includes Single-Event Burnout (SEB) and Single-Event Gate Rupture (SEGR) tests at the specified linear energy transfer (LET) units. See [6.7](#) for the specific RHA SEE characterization testing details. The following characterization conditions were used for the testing to the requirements herein:

For device type 2N7663U2A:

No SEB or SEGR were observed at surface LET (see [table IV](#)) $\leq 92 \text{ MeV} \cdot \text{cm}^2/\text{mg}$ 2/
(In-situ Bias $V_{DS} = 12 \text{ V}$ and $V_{GS} = -1 \text{ V}$)

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- 1/ The manufacturers supplying these device types have performed characterization testing in accordance with condition A (dose rate = 50 to 300 rad(Si)/s) of method 1019 of [MIL-STD-750](#). The radiation end point limits are guaranteed only to a maximum TID level of 100 krad(Si).
- 2/ The manufacturers have performed SEE tests at Texas A&M University (TAMU) Radiation Effects Facility in accordance with method 1080 of [MIL-STD-750](#). For more information on SEE testing and results, customers should contact the qualified manufacturer.

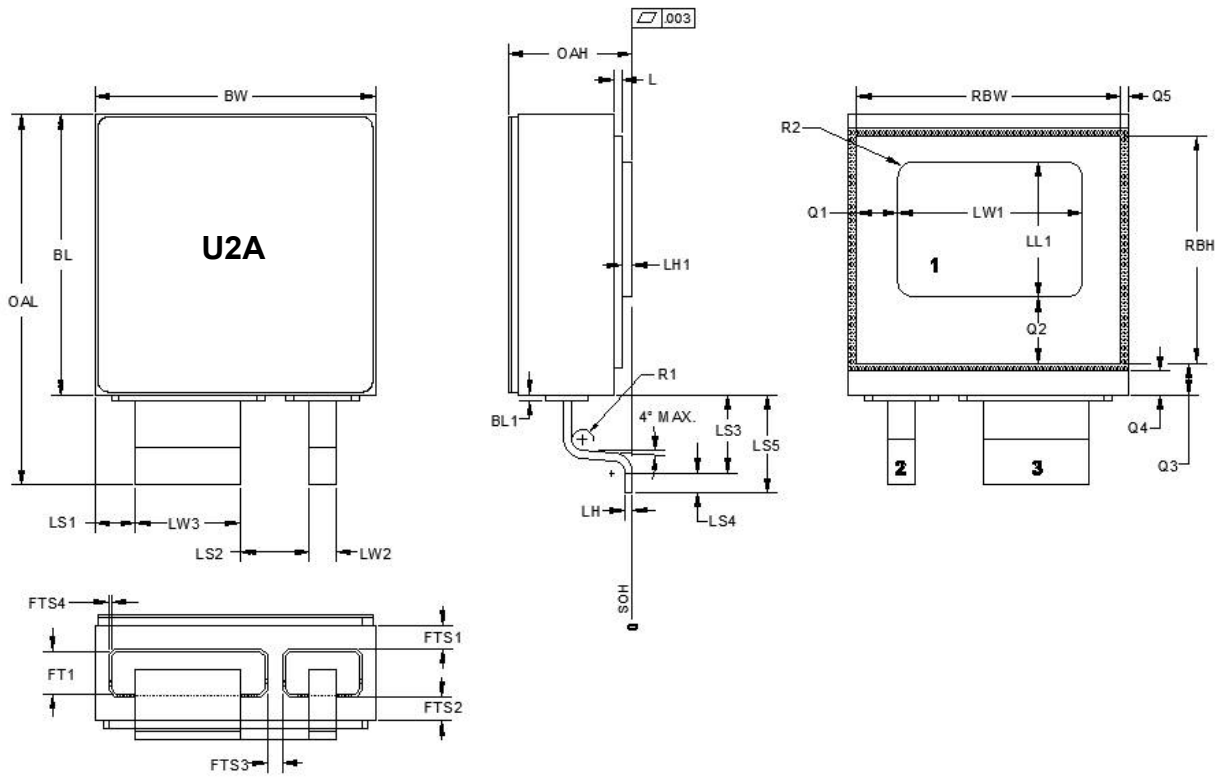


FIGURE 1. Physical dimensions, U2A surface mount (2N7663U2A).

Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.524	.536	13.31	13.61
BL1	.005	.015	0.13	0.38
BW	.524	.536	13.31	13.61
FT1	.075	.085	1.91	2.16
FTS1	.036		0.91	
FTS2	.036		0.91	
FTS3	.030		0.76	
FTS4	.005 TYP		0.127 TYP	
L	.013	.017	0.33	0.43
LH	.013	.017	0.33	0.43
LH1	.02	.024	0.51	0.58
LL1	.25	.26	6.35	6.60
LS1	.07	.08	1.78	2.03
LS2	.125	.135	3.18	3.43
LS3	.125	.145	3.18	3.68
LS4	.040	.050	1.02	1.27
LS5	.170	.190	4.32	4.83
LW1	.345	.355	8.76	9.02
LW2	.045	.055	1.14	1.4
LW3	.195	.205	4.95	5.21
OAH	.26 TYP		6.60 TYP	
OAL		.71		18.03
Q1	.073	.083	1.85	2.11
Q2	.12	.13	3.05	3.3
Q3	.055	.065	1.4	1.65
Q4	.04		1.02	
Q5	.010	.020	.25	.51
RBH	.425	.435	10.8	11.05
RBW	.495	.505	12.57	12.83
R1	.02		0.51	
R2	.025	.035	0.635	0.889
TERM 1	Drain			
TERM 2	Gate			
TERM 3	Source			

NOTES:

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

FIGURE 1. Physical dimensions, U2A surface mount – continued

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

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

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-750 – Test Methods For Semiconductor Devices.

MIL-STD-883 – Test Method Standard for Microcircuits.

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

2.3 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General. The individual item requirements shall be as specified in MIL-PRF-19500 and as modified herein.

3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.3).

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

3.4 Interface requirements and physical dimensions. The interface requirements and physical dimensions shall be as specified in MIL-PRF-19500 and on figures 1 (U2A surface mount) herein. Methods used for the electrical isolation of the terminals shall employ materials that contain a minimum of 90 percent Al₂O₃ (ceramic).

3.4.1 Lead finish. Terminal material for the U2A package shall be copper tungsten (base / drain) or copper (leads). 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 shall not be permitted in order to meet the requirements of this specification.

3.4.3 Pin-out. The pin-out of the device shall be as shown on figure 1.

3.4.4 Silicone die coating. The use of a silicone die coat requires a successful completion of method 5011 of MIL-STD-883, on each lot of silicone die coating for its intended applications.

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

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

- a. Devices 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.

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

3.8 RHA. RHA requirements and test levels shall be as defined in [MIL-PRF-19500](#) and herein. RHA characterization data shall be made available upon request of the acquiring or qualifying activity.

3.8.1 SEE. After being tested for SEE as specified in [4.5.2](#) at the identified test location (see [6.7](#)) using the exposure, beam and bias conditions listed in [table IV](#), the device testing conditions shall be listed in [table IV](#).

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.

4.2.2 SEE. SEE (SEB/SEGR) shall be performed at initial qualification and thereafter whenever a process or a major die design change which may affect radiation hardness is introduced. Upon qualification, manufacturers shall provide the SEE 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 herein. 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

4.2.3 Silicone die coating. When silicone die coating is used, method 5011 of [MIL-STD-883](#) shall be performed on that coating in the full [MIL-PRF-19500](#) qualification process.

4.3 Screening of encapsulated devices. Screening of packaged devices shall be in accordance with table E-IV of [MIL-PRF-19500](#), and as specified herein. The following measurements shall be made in accordance with [table I](#) herein. Devices that exceed the limits of [table I](#) herein shall not be acceptable.

Screen (1) (2)	Measurements for JANS	Measurements for JANTXV
(3)	Gate stress test (see 4.3.1)	Gate stress test (see 4.3.1)
(3)	Method 3470 of MIL-STD-750 , E _{AS} (see 4.3.2)	Method 3470 of MIL-STD-750 , E _{AS} (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 4.3.5)	Not applicable
9	Subgroup 2 of table I herein	Not applicable
10	Method 1042 of MIL-STD-750 , test condition B	Method 1042 of MIL-STD-750 , test condition B
11	Subgroup 2 of table I herein. $\Delta I_{GSSF1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{GSSR1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{DSS1} = \pm 500$ nA dc or ± 100 percent of initial value, whichever is greater.	Subgroup 2 of table I herein.
12	Method 1042 of MIL-STD-750 , test condition A	Method 1042 of MIL-STD-750 , test condition A
13	Subgroups 2 and 3 of table I herein $\Delta I_{GSSF1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{GSSR1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{DSS1} = \pm 500$ nA dc or ± 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 table I herein $\Delta I_{GSSF1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{GSSR1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{DSS1} = \pm 500$ nA dc or ± 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.

- (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 does not need to be repeated in screening requirements.

4.3.1 Gate stress test. Apply $V_{GS} = 14$ V minimum for $t = 20$ μ s minimum.

4.3.2 Single pulse avalanche energy (E_{AS}). The test for single pulse avalanche energy shall be performed in accordance with method 3470 of [MIL-STD-750](#). The following details shall apply:

- a. Peak current (I_{AS})..... $I_{AS} = I_{D1}$.
- b. Inductance (L)..... $L = \left[\frac{2E_{AS}}{(I_{D1})^2} \right] \left[\frac{V_{BR} - V_{DD}}{V_{BR}} \right]$ 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, up to rated V_{DS} .
- e. Peak gate voltage (V_{GS})..... 12 V, up to maximum rated V_{GS} .
- f. Initial case temperature (T_C) $T_C = +25^\circ\text{C}$ $+10^\circ\text{C}$, -5°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} , t_{MD} (and V_H where appropriate). See [table III](#), group E, subgroup 4 herein.

4.3.4 Dielectric withstanding voltage.

- a. Magnitude of test voltage.....1,200V 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

4.3.5 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.

4.4 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 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.

4.4.2.1 Quality level JANS (table E-VIA 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).
B3	2052	PIND, required if not performed in screening. Sampling plan 22 devices, c = 0 for large lots, 12 devices, c = 0 for small lots.
B4	1042	Intermittent operation life, condition D, t_{on} shall be 30 seconds minimum.
B5	1042	Accelerated steady-state gate bias, condition B, V_{GS} = rated V_{GS} ; T_A = +175 °C, t = 24 hours minimum; or T_A = +150 °C, t = 48 hours minimum.
B5	1042	Accelerated steady-state reverse bias, condition A, V_{DS} = rated V_{DS} ; T_A = +175 °C, t = 120 hours minimum; or T_A = +150 °C, t = 240 hours minimum.
B5	2037	Test condition D.

4.4.2.2 Quality level JANTXV (table E-VIB 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} shall be 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.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Terminal strength is not applicable.
C3	2052	PIND, required if not performed in screening. Sampling plan 22 devices, c = 0 for large lots, 12 devices, c = 0 for small lots.
C5	3161	See 4.3.3, $R_{\theta JC}$ = 0.50 °C/W.
C6	1042	Intermittent operation life, condition D, t_{on} shall be 30 seconds minimum.

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

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

4.5 Methods of inspection. Methods of inspection shall be as specified in 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 SEE. The heavy ion SEE (SEB/SEGR) characterization testing shall be performed in accordance with method 1080 of [MIL-STD-750](#). Electrical measurements (end-points) shall be in accordance with [table III](#) herein.

TABLE I. Group A inspection.

Inspection 1/ , 2/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical examination	2071					
<u>Subgroup 2</u>						
Thermal impedance 2/	3161	See 4.3.3	$Z_{\theta JC}$			°C/W
Breakdown voltage drain to source	3407	Bias condition C, $V_{GS} = 0$ V dc, $I_D = 0.25$ mA dc	$V_{(BR)DSS}$	20		V dc
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$, $I_D = 1.8$ mA dc	$V_{GS(TH)1}$	1.0	2.3	V dc
Gate current	3411	Bias condition C, $V_{GS} = +12$ V dc, $V_{DS} = 0$ V	I_{GSSF1}		+100	nA dc
Gate current	3411	Bias condition C, $V_{GS} = -12$ 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}		1.0	μA dc
Static drain to source on-state resistance	3421	Condition A, $V_{GS} = 4.5$ V dc, pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(ON)1}$		0.0025	Ω
Forward voltage	4011	Condition A, $V_{GS} = 0$ V dc, $I_D = I_{D1}$	V_{SD}		1.0	V dc

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/ , 2/	MIL-STD-750		Symbol	Limits	Limits	Unit
	Method	Condition		Min	Max	
<u>Subgroup 3</u>						
High temperature operation		T _C = T _J = +125°C				
Gate current	3411	Bias condition C, V _{GS} = ±12 V dc, V _{DS} = 0 V	I _{GSS2}		±200	nA dc
Drain current	3413	Bias condition C, V _{GS} = 0 V dc, V _{DS} = 80 percent of rated V _{DS}	I _{DSS2}		50	µA dc
Static drain to source on-state resistance	3421	Condition A, V _{GS} = 4.5 V dc, pulsed (see 4.5.1), I _D = I _{D2}	r _{DS(ON)3}		0.0037	Ω
Gate to source voltage (threshold)	3403	V _{DS} ≥ V _{GS} , I _D = 1.8 mA dc	V _{GS(TH)2}	0.7		V dc
Low temperature operation		T _C = T _J = -55°C				
Gate to source voltage (threshold)	3403	V _{DS} ≥ V _{GS(TH)3} , I _D = 1.8 mA dc	V _{GS(TH)3}		2.5	V dc
<u>Subgroup 4</u>						
Forward transconductance	3475	I _D = I _{D2} , V _{DD} = 10 V dc (see 4.5.1)	g _{FS}	75		S
Switching time test	3472	I _D = rated I _{D1} , V _{GS} = 4.5 V dc, R _G = 2.3 Ω, V _{DD} = 50 percent of rated V _{DS}				
Turn-on delay time			t _{d(on)}		90	ns
Rise-time			t _r		130	ns
Turn-off delay time			t _{d(off)}		110	ns
Fall time			t _f		55	ns

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection <u>1/</u> , <u>2/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
<u>Subgroup 5</u>						
Safe operating area	3474	See figure 4 ; $t_p = 10$ ms min. $V_{DS} = 80$ percent of max. rated V_{DS}				
Electrical measurements		See table I , subgroup 2				
<u>Subgroup 6</u>						
Not applicable						
<u>Subgroup 7</u>						
Gate charge	3471	Condition B, $I_D = I_{D1}$, $V_{GS} = 4.5$ V dc $V_{DD} = 50$ percent of rated V_{DS}				
On-state gate charge			$Q_{G(ON)}$		145	nC
and turn-off gate charge			$Q_{G(OFF)}$		145	nC
Gate to source charge			Q_{GS1}		52	nC
(turn-on and turn-off)			Q_{GS2}		52	nC
Gate to drain charge			Q_{GD1}		45	nC
(turn-on and turn-off)			Q_{GD2}		45	nC
Reverse recovery time	3473	Condition A, $di/dt = -100$ A/ μ s, $V_{DD} \leq 20$ V, $I_D = I_{D1}$	t_{rr}		100	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.

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, F,	R, F	R, F	R, F	
				Min	Max	Min	Max	
Subgroup 1								
Not applicable								
Subgroup 2		T _C = + 25 °C						
Steady-state total dose irradiation (V _{GS} bias) 4/	1019	Condition A, V _{GS} = 12 V; V _{DS} = 0						
Steady-state total dose irradiation (V _{DS} bias) 4/	1019	Condition A, V _{GS} = 0; V _{DS} = 80 percent of rated V _{DS} (pre-irradiation)						
End-point electricals								
Breakdown voltage, drain to source	3407	Bias condition C, V _{GS} = 0; I _D = 0.25 mA	V _{(BR)DSS}	20		20		V dc
Gate to source voltage (threshold)	3403	V _{DS} ≥ V _{GS} , I _D = 1 mA	V _{GS(th)1}	1.0	2.3	1.0	2.3	V dc
Gate current	3411	Bias condition C, V _{GS} = +12 V; V _{DS} = 0	I _{GSSF1}		100		100	nA dc
Gate current	3411	Bias condition C, V _{GS} = -12 V; V _{DS} = 0	I _{GSSR1}		-100		-100	nA dc
Drain current	3413	Bias condition C, V _{GS} = 0, V _{DS} = 80 percent of rated V _{DS} (pre-irradiation)	I _{DSS}		1		1	µA dc
Static drain to source on-state voltage	3405	V _{GS} = 4.5 V; I _D = I _{D2} condition A, pulsed (see 4.5.1)	V _{DS(on)}		0.1875		0.1875	
Forward voltage source drain diode	4011	Bias condition A, V _{GS} = 0; I _D = I _{D1}	V _{SD}		1.0		1.0	V dc

- [1/](#) For sampling plan, see [MIL-PRF-19500](#). Characteristics also apply to U3 and U3C suffix versions.
- [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 selected for each bias. Devices supplied to this specification sheet have been characterized through RHA levels R and F of irradiation. Pre and Post irradiation values are identical unless otherwise specified in [table II](#). When performing post irradiation electrical measurements for any RHA level, $T_A = +25^{\circ}\text{C}$ (see [1.6](#) herein).
- [5/](#) Group D samples are built and tested in T0-3 packages. The equivalent pre-radiation and post radiation limit for $V_{DS(on)}$ in the T0-3 package is 0.225Vdc (at 75A) for the 2N7663U2A.

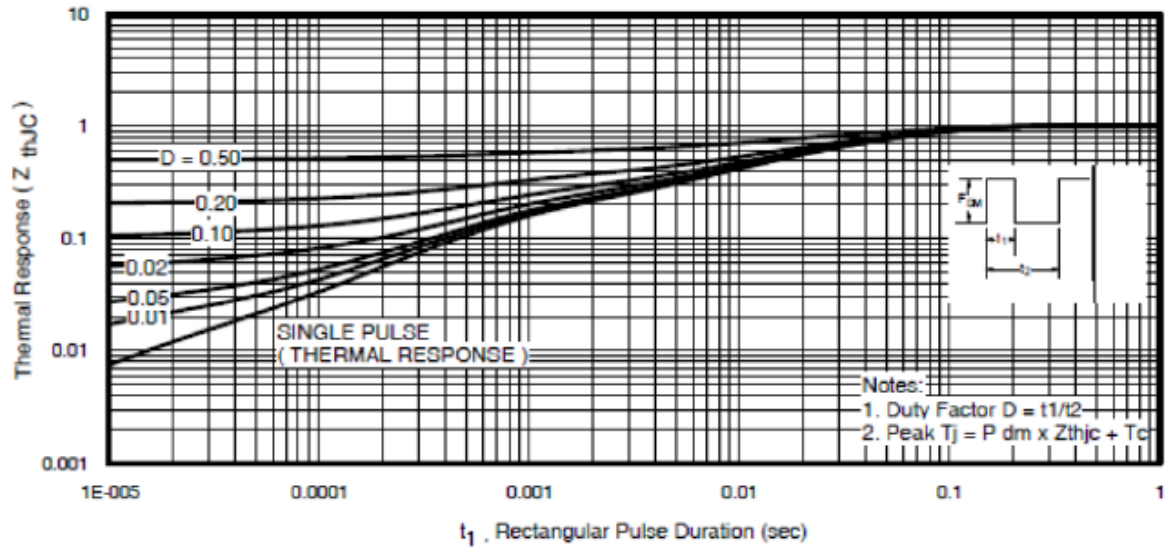
TABLE III. Group E inspection (all quality levels) for qualification or re-qualification only.

Inspection	MIL-STD-750		Sample plan
	Method	Conditions	
<u>Subgroup 1</u>			45 devices, c = 0
Temperature cycling	1051	Test condition G, 500 cycles.	
Hermetic seal	1071	Fine and gross leak, as applicable.	
Electrical measurements		See table I , subgroup 2 herein.	
<u>Subgroup 2</u> 1/			45 devices, c = 0
Steady-state gate bias	1042	Condition B, 1,000 hours.	
Electrical measurements		See table I , subgroup 2 herein.	
Steady-state reverse bias	1042	Condition A, 1,000 hours.	
Electrical measurements		See table I , subgroup 2 herein.	
<u>Subgroup 4</u>			Sample size, N/A
Thermal impedance curves		See MIL-PRF-19500 .	
<u>Subgroup 5</u>			
Not applicable			
<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	3476	Test conditions shall be derived by the manufacturer.	
<u>Subgroup 11</u>			3 devices
SEE 2/ 3/	1080	See 1.6 , 6.2 , 6.7 , and table IV .	

1/ A separate sample for each test shall be selected.

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.

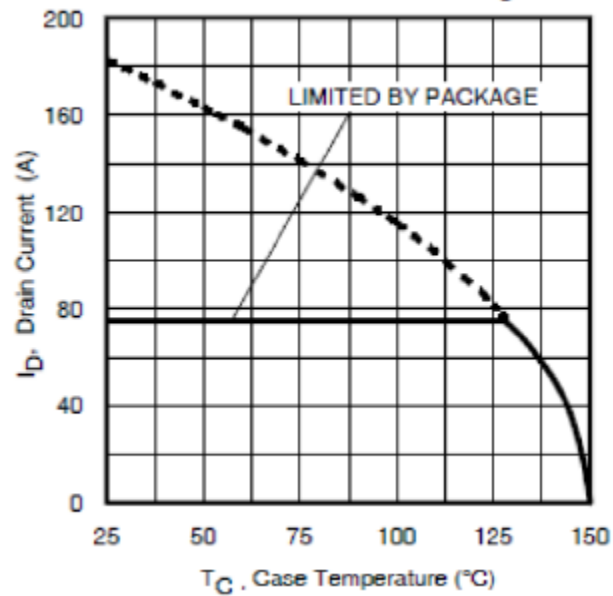
3/ Device qualification to a higher level LET is sufficient to qualify all lower level LETs.



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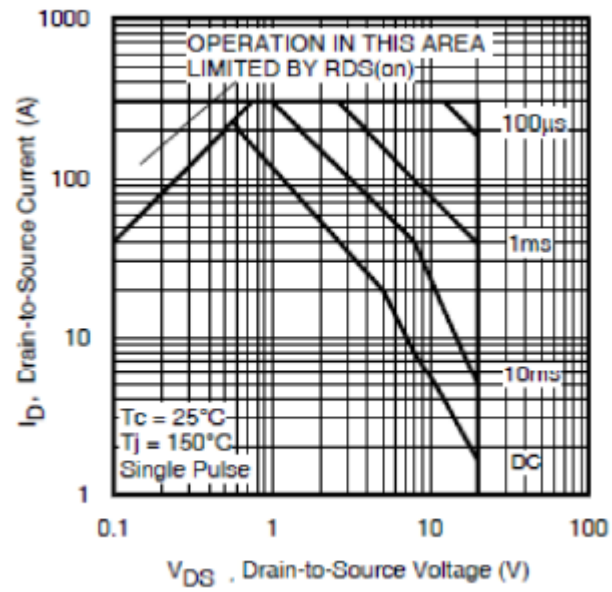
FIGURE 2. Thermal response curve.

Maximum Current Rating



2N7663U2A

FIGURE 3. Maximum drain current versus case temperature graphs.



2N7663U2A

FIGURE 4. Safe operating area graph.

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 material is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory. The notes specified in MIL-PRF-19500 are applicable to this specification.)

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

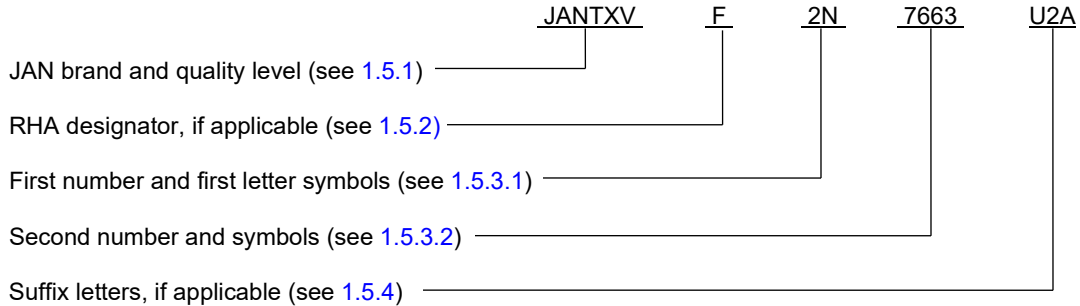
6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Packaging requirements (see 5.1).
- c. Lead finish (see 3.4.1).
- d. The complete PIN, see 1.5 and 6.4.
- 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 6.7 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. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://qpldocs.dla.mil>.

6.4 PIN construction examples.

6.4.1 Encapsulated devices. The PINs for encapsulated devices are constructed using the following form.



6.5 List of PINs.

6.5.1 List of PINs for encapsulated devices. The following is a list of possible PINs for encapsulated devices available on this specification sheet.

PINs for devices of the "TXV" quality level	PINs for devices of the "S" quality level
JANTXVF2N7663U2A	JANSF2N7663U2A
JANTXVR2N7663U2A	JANSR2N7663U2A

These PINs are also available without a RHA designator.

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

Preferred military types	Commercial PIN
2N7663U2A	IRHNS87Y50

6.7 Manufacturer specific SEE irradiation characterization conditions. The manufacturer's SEE irradiation characterization conditions listed in [table IV](#) is for information only. Each qualified manufacturer identified in [table IV](#) has characterized its devices to the requirements of method 1080 of [MIL-STD-750](#) using the testing conditions specified herein (see [1.6](#) and [table IV](#)). Since each manufacturer's characterization testing conditions can be different and may vary by the revision of method 1080 of [MIL-STD-750](#) that was used during qualification testing, the revision and conditions used by each manufacturer for characterization have been listed in [table IV](#) for information only.

The SEE (SEB and SEGR) conditions and figures listed herein are current of the date of this specification sheet. For irradiation testing results data, please contact the qualified manufacturer for the most recent conditions.

TABLE IV. SEE characterization conditions for method 1080 of [MIL-STD-750](#).

Manufacturers CAGE	Inspection	MIL-STD-750		Sample plan
		Method	Conditions	
69210	SEE 1/ Pre SEE Electrical measurements SEE irradiation 2N7663U2A	1080	See MIL-STD-750 method 1080.1 and figure 5 . I_{GSSF1} , I_{GSSR1} , and I_{DSS1} in accordance with table I , subgroup 2 Fluence = $3E5 \pm 20$ percent ions/cm ² Flux = $4E3$ to $4E4$ ions/cm ² /sec, temperature = $25 \pm 5^\circ\text{C}$ Surface LET = 40 MeV-cm ² /mg $\pm 5\%$, range = $40.1 \mu\text{m} \pm 5\%$ Kr ion beam energy = 312 MeV $\pm 5\%$ In-situ bias conditions: $V_{DS} = 16 \text{ V}$ and $V_{GS} = -4 \text{ V}$ $V_{DS} = 15 \text{ V}$ and $V_{GS} = -5 \text{ V}$ (Typical 4.97 MeV/Nucleon at Texas A & M Cyclotron) I_{GSSF1} , I_{GSSR1} , and I_{DSS1} in accordance with table I , subgroup 2	3 devices
	Post SEE Electrical measurements SEE 1/ Pre SEE Electrical measurements SEE irradiation 2N7663U2A	1080	See MIL-STD-750 method 1080.1 I_{GSSF1} , I_{GSSR1} , and I_{DSS1} in accordance with table I , subgroup 2 Fluence = $3E5 \pm 20$ percent ions/cm ² Flux = $4E3$ to $4E4$ ions/cm ² /sec, temperature = $25 \pm 5^\circ\text{C}$ Surface LET = 67.9 MeV-cm ² /mg $\pm 5\%$, range = $52.5 \mu\text{m} \pm 5\%$, Xe ion beam energy = 675 MeV $\pm 5\%$ In-situ bias conditions: $V_{DS} = 15 \text{ V}$ and $V_{GS} = -4 \text{ V}$; $V_{DS} = 12 \text{ V}$ and $V_{GS} = -5 \text{ V}$ (Typical 5.84 MeV/Nucleon at Texas A & M Cyclotron) I_{GSSF1} , I_{GSSR1} , and I_{DSS1} in accordance with table I , subgroup 2	3 devices
	Post SEE Electrical Measurements SEE 1/ Pre SEE Electrical measurements SEE irradiation 2N7663U2A	1080	See MIL-STD-750 method 1080.1 and figure 5 . I_{GSSF1} , I_{GSSR1} , and I_{DSS1} in accordance with table I , subgroup 2 Fluence = $3E5 \pm 20$ percent ions/cm ² Flux = $4E3$ to $4E4$ ions/cm ² /sec, temperature = $25 \pm 5^\circ\text{C}$ Surface LET = 93.2 MeV-cm ² /mg, range = $65.1 \mu\text{m}$, Au ion beam energy = 1105 MeV In-situ bias conditions: $V_{DS} = 15 \text{ V}$ and $V_{GS} = -2 \text{ V}$ $V_{DS} = 12 \text{ V}$ and $V_{GS} = -3 \text{ V}$ $V_{DS} = 12 \text{ V}$ and $V_{GS} = -4 \text{ V}$ $V_{DS} = 8 \text{ V}$ and $V_{GS} = -5 \text{ V}$ (Typical 7.7 MeV/Nucleon at Texas A & M Cyclotron) I_{GSSF1} , I_{GSSR1} , and I_{DSS1} in accordance with table I , subgroup 2	3 devices
	Post SEE Electrical measurements			
Upon qualification, all manufacturers will provide the verification test conditions to be added to this table.				

1/ Electrical measurements (I_{GSSF1} , I_{GSSR1} , and I_{DSS}) were taken before and following SEE irradiation to determine acceptability for each bias condition. Other test conditions in accordance with [table I](#), subgroup 2 may be taken at the manufacturer's option.

Single-Event-Effects RESPONSE

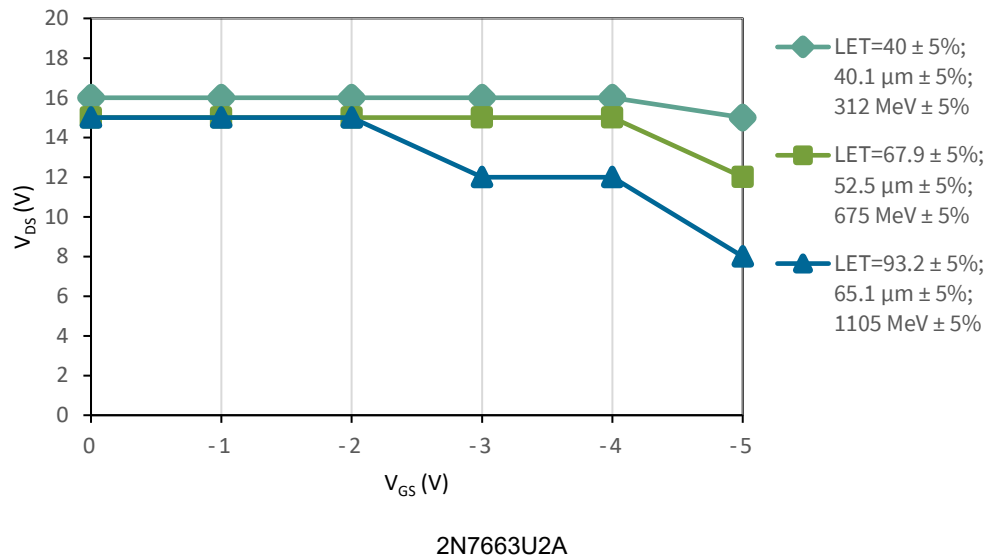


FIGURE 5. Typical SEE safe operating area graph (CAGE 69210).

6.8 Request for new types and configurations. Requests for new device types or configurations for inclusions in this specification sheet should be submitted to: DLA Land and Maritime, ATTN: VAC, Post Office Box 3990, Columbus, OH 43218-3990 or by electronic mail at Semiconductor@dla.mil or by facsimile (614) 692-6939 or DSN 850-6939.

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

Preparing activity:
 DLA – CC

(Project 5961-2024-102)

Review activities:
 Army – MI
 Air Force – 19

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