

The documentation and process conversion measures necessary to comply with this revision shall be completed by 19 November 2003.

INCH-POUND

MIL-PRF-19500/601E  
 19 August 2003  
 SUPERSEDING  
 MIL-PRF-19500/601D  
 17 July 2001

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED (TOTAL DOSE ONLY)  
 TRANSISTORS, N-CHANNEL, SILICON, TYPES 2N7261 AND 2N7262 AND U SUFFIXES,  
 JANTXVR, F, G, AND H AND JANSR, F, G, AND H

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for an N-channel, enhancement-mode, MOSFET, radiation hardened (total dose only), power transistor. Two levels of product assurance are provided for each device type as specified in MIL-PRF-19500, with avalanche energy maximum rating (E<sub>AS</sub>) and maximum avalanche current (I<sub>AS</sub>).

1.2 Physical dimensions. See figure 1 (TO-205AF) and figure 2 (LCC).

\* 1.3 Maximum ratings. Unless otherwise specified, T<sub>A</sub> = +25°C.

Type (1)	P <sub>T</sub> (2) T <sub>C</sub> = +25°C	P <sub>T</sub> T <sub>A</sub> = +25°C (free air)	V <sub>DS</sub>	V <sub>DG</sub>	V <sub>GS</sub>	I <sub>D1</sub> (3) (4) T <sub>C</sub> = +25°C	I <sub>D2</sub> T <sub>C</sub> = +100°C	I <sub>S</sub> (3)	I <sub>DM</sub> (5)	T <sub>op</sub> and T <sub>STG</sub>
	W	W	V dc	V dc	V dc	A dc	A dc	A dc	A(pk)	°C
2N7261	25	0.8	100	100	±20	8.0	5.0	8.0	32	-55 to
2N7262	25	0.8	200	200	±20	5.5	3.5	5.5	22	+150

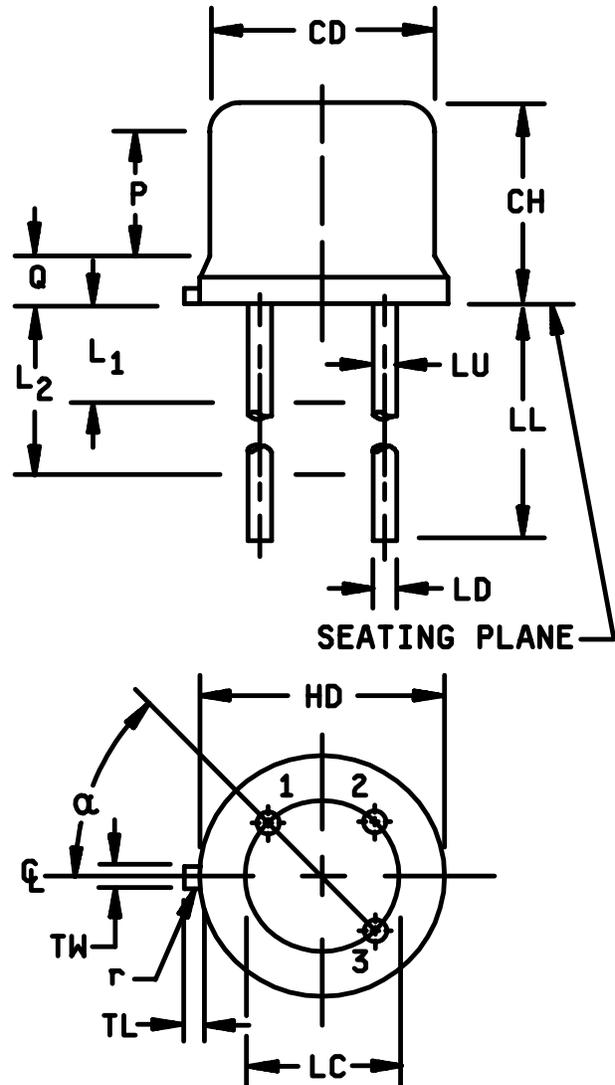
- (1) Unless otherwise specified, electrical characteristics, ratings and conditions for "U" suffix devices (surface mount LCC) are identical to the corresponding non "U" suffix devices.
- (2) Derate linearly 0.2 W/°C for T<sub>C</sub> > +25°C;
- (3) The following formula derives the maximum theoretical I<sub>D</sub> limit. I<sub>D</sub> 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<sub>DM</sub> = 4 X I<sub>D1</sub> as calculated in footnote (3).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
CD	.315	.355	8.01	9.01
CH	.160	.180	4.07	4.57
HD	.340	.370	8.64	9.39
LC	.200 BSC		5.08 BSC	
LD	.016	.021	0.41	0.53
LL	.500	.750	12.70	19.05
LU	.016	.019	0.41	0.48
L <sub>1</sub>		.050		1.27
L <sub>2</sub>	.250		6.35	
P	.070		1.78	
Q		.050		1.27
TL	.029	.045	0.74	1.14
TW	.028	.034	0.72	0.86
$\alpha$	45° BSC			
Term 1	Source			
Term 2	Gate			
Term 3	Drain			

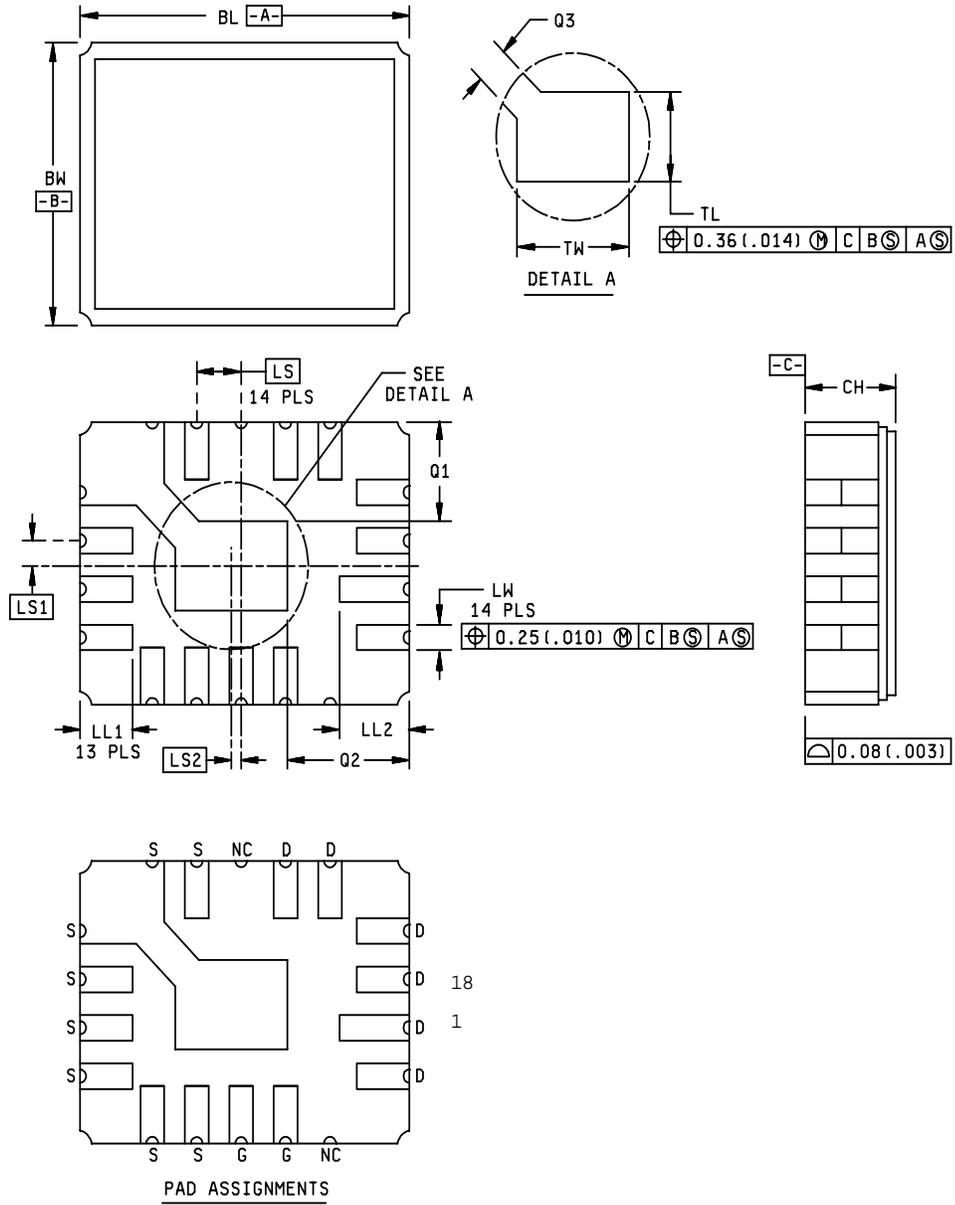


NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. The US Government preferred system of measurement is the metric SI system. However, this item was originally designed using inch-pound units of measurement. In the event of a conflict between the metric and inch-pound units, the inch-pound units shall take precedence.
4. Lead number 1 is the source, lead number 2 is the gate, lead 3 is the drain and is electrically connected to the case, lead number 4 is omitted from this outline.
5. Dimensions and tolerancing shall be in accordance with ASME Y14.5M.

\* FIGURE 1. Physical dimensions for TO-205AF (2N7261 and 2N7262).

MIL-PRF-19500/601E



\* FIGURE 2. Physical dimensions for LCC (2N7261U and 2N7262U).

MIL-PRF-19500/601E

Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.345	.360	8.77	9.14
BW	.280	.295	7.12	7.49
CH	.095	.115	2.42	2.92
LL <sub>1</sub>	.040	.055	1.02	1.39
LL <sub>2</sub>	.055	.065	1.40	1.65
LS	.059 BSC		1.27 BSC	
LS <sub>1</sub>	.025 BSC		0.635 BSC	
LS <sub>2</sub>	.008 BSC		0.203 BSC	
LW	.020	.030	0.51	0.76
Q <sub>1</sub>	.105 REF		2.67 REF	
Q <sub>2</sub>	.120 REF		3.05 REF	
Q <sub>3</sub>	.045	.055	1.15	1.39
TL	.070	.080	1.78	2.03
TW	.120	.130	3.05	3.30

NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Dimensions and tolerancing shall be in accordance with ASME Y14.5M.

\* FIGURE 2. Physical dimensions for LCC (2N7261U and 2N7262U) - Continued.

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

Type (1)	Min $V_{(BR)DSS}$ $V_{GS} = 0$ $I_D = 1.0$ mA dc	$V_{GS(TH)}$ $V_{DS} \geq V_{GS}$ $I_D = 1.0$ mA dc		Max $I_{DSS1}$ $V_{GS} = 0$ $V_{DS} = 80$ percent of rated $V_{DS}$	Max $r_{DS(ON)}$ (2) $V_{GS} = 12$ V dc		$R_{\theta JC}$ max	$E_{AS}$ at $I_{D1}$	$I_{AS}$
					$T_J = +25^\circ\text{C}$ at $I_{D2}$	$T_J = +150^\circ\text{C}$ at $I_{D2}$			
	<u>V dc</u>	<u>V dc</u>		<u><math>\mu\text{A dc}</math></u>	<u>ohm</u>	<u>ohm</u>	<u><math>^\circ\text{C/W}</math></u>	<u>mJ</u>	<u>A</u>
		Min	Max						
2N7261	100	2.0	4.0	25	0.180	0.390	5.0	130	8.0
2N7262	200	2.0	4.0	25	0.350	0.840	5.0	240	5.5

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

(2) Pulsed (see 4.5.1).

## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements 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 listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

## SPECIFICATION

## DEPARTMENT OF DEFENSE

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

## STANDARD

## DEPARTMENT OF DEFENSE

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. 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.

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and on figures 1 (TO-205AF) and 2 (LCC) herein.

3.4.1 Lead material and finish. Lead material shall be Kovar or Alloy 52 for the TO-205AF; a copper core or plated core is permitted. Lead finish shall be solderable as defined in MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead material or finish is desired, it shall be specified in the acquisition document (see 6.2).

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

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

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

3.6.1 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,  $R \leq 100 \text{ k}$ , whenever bias voltage is to be applied drain to source.

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

3.8 Electrical test requirements. The electrical test requirements shall be the subgroups specified in 4.4.2 and 4.4.3 herein.

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

#### 4. VERIFICATION

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

- a. Qualification inspection (see 4.2).
- b. Screening (see 4.3).
- c. Conformance inspection (see 4.4 and tables I, II and III herein).

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 associated specification that did not request the performance of table III tests, the tests specified in table III herein shall be performed by the first inspection lot of this revision to maintain qualification.

MIL-PRF-19500/601E

\* 4.3 Screening (JANS and JANTXV levels only). Screening shall be in accordance with appendix E, 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	$I_{GSS}$ , $I_{DSS1}$ , subgroup 2 of table I herein	Not applicable
10	Method 1042 of MIL-STD-750, test condition B of MIL-STD-750	Method 1042 of MIL-STD-750, test condition B of MIL-STD-750
11	$I_{GSSF1}$ , $I_{GSSR1}$ , $I_{DSS1}$ , $r_{DS(on)}$ , $V_{GS(TH)}$ Subgroup 2 of table I herein; $\Delta I_{GSSF1} = \pm 20$ nA dc or $\pm 100$ percent of initial value, whichever is greater. $\Delta I_{GSSR1} = \pm 20$ nA dc or $\pm 100$ percent of initial value, whichever is greater. $\Delta I_{DSS1} = \pm 10$ $\mu$ A dc or $\pm 100$ percent of initial value, whichever is greater.	$I_{GSSF1}$ , $I_{GSSR1}$ , $I_{DSS1}$ , $r_{DS(on)}$ , $V_{GS(TH)}$ 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 $\pm 100$ percent of initial value, whichever is greater. $\Delta I_{GSSR1} = \pm 20$ nA dc or $\pm 100$ percent of initial value, whichever is greater. $\Delta I_{DSS1} = \pm 10$ $\mu$ A dc or $\pm 100$ percent of initial value, whichever is greater. $\Delta r_{DS(on)1} = \pm 20$ percent of initial value $\Delta V_{GS(TH)1} = \pm 20$ percent of initial value	Subgroups 2 and 3 of table I herein $\Delta I_{GSSF1} = \pm 20$ nA dc or $\pm 100$ percent of initial value, whichever is greater. $\Delta I_{GSSR1} = \pm 20$ nA dc or $\pm 100$ percent of initial value, whichever is greater. $\Delta I_{DSS1} = \pm 10$ $\mu$ A dc or $\pm 100$ percent of initial value, whichever is greater. $\Delta r_{DS(on)1} = \pm 20$ percent of initial value $\Delta V_{GS(TH)1} = \pm 20$ percent of initial value

(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 before screen 9.

\* 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 ( $I_{AS}$ ) .....  $I_{AS(max)}$ .
- b. Peak gate voltage ( $V_{GS}$ ) ..... 10 V.
- c. Gate to source resistor ( $R_{GS}$ ) .....  $25\Omega \leq R_{GS} \leq 200\Omega$ .
- d. Initial case temperature ( $T_C$ ) .....  $+25^\circ\text{C} +10^\circ\text{C}, -5^\circ\text{C}$ .
- e. Inductance (L) .....  $\left[ \frac{2E_{AS}}{(I_{DI})^2} \right] \left[ \frac{(V_{BR} - V_{DD})}{V_{BR}} \right] \text{ mH minimum}$ .
- f. Number of pulses to be applied ..... 1 pulse minimum.
- g. Supply voltage ( $V_{DD}$ ) ..... 25 V for 2N7261, 2N7261U, 50 V for 2N7262, 2N7262U.

\* 4.3.3 Thermal impedance ( $Z_{\theta JC}$  measurements). The  $Z_{\theta JC}$  measurements shall be performed in accordance with method 3161 of MIL-STD-750. The maximum limit (not to exceed figure 4, thermal impedance curves and the table I, subgroup 2 limits) for  $Z_{\theta JC}$  in screening (appendix E, table IV of MIL-PRF-19500) shall be derived by each vendor by means of statistical process control. When the process has exhibited control and capability, the capability data shall be used to establish the fixed screening limit. In addition to screening, once a fixed limit has been established, monitor all future sealing lots using a random five piece sample from each lot to be plotted on the applicable X bar R chart. If a lot exhibits an out of control condition, the entire lot shall be removed from the line and held for engineering evaluation and disposition. This procedure may be used in lieu of an in-line procedure.

- a. Measuring current ( $I_M$ ) ..... 10 mA.
- b. Drain heating current ( $I_H$ ) ..... 1 A minimum (1.3 A minimum for LCC).
- c. Heating time ( $t_H$ ) ..... 10 ms.
- d. Drain-source heating voltage ( $V_H$ ) ..... 25 V (15 V for LCC).
- e. Measurement time delay ( $t_{MD}$ ) ..... 30  $\mu$ s to 60  $\mu$ s.
- f. Sample window time ( $t_{SW}$ ) ..... 10  $\mu$ s maximum.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500 and as specified herein. Alternate flow is allowed for quality conformance inspection in accordance with MIL-PRF-19500.

\* 4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with table V of MIL-PRF-19500. End-point electrical measurements 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 appendix E, table VIa (JANS) and table VIb (JANTXV) of MIL-PRF-19500 and herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

MIL-PRF-19500/601E

4.4.2.1 Group B inspection, appendix E, table 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 herein.
B3	2077	Scanning electron microscope (SEM) qualification may be performed anytime prior to lot formation.
B3	2037	Test condition A, all internal wired for each device shall be pulled separately.
B4	1042	Condition D, 2,000 cycles. No heat sink nor forced-air cooling on the device shall be permitted during the on cycle. The heating cycle shall be 30 seconds minimum.
B5	1042	Test condition A, $V_{DS} = \text{rated}$ $T_A = +175^{\circ}\text{C}$ , $t = 120$ hours.
B5	1042	Condition B, $V_{GS} = \text{rated}$ ; $T_A = 175^{\circ}\text{C}$ ; $t = 24$ hours.
B5	2037	Bond strength; test condition A.
B6	3161	See 4.5.2 herein.

4.4.2.2 Group B inspection, appendix E, table VIb (JANTXV) of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B2	1051	Test condition G, 25 cycles.
B3	1042	Test condition D, 2,000 cycles; The heating cycle shall be 30 seconds minimum.
B4	2075	See 3.4.2 herein.
B5 and B6		Not applicable.

\* 4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table VII of MIL-PRF-19500 and as follows. Electrical measurements (end-points) shall be in accordance with the applicable of table I, subgroup 2 herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	1056	Test condition B.
C2	2036	Test condition E; weight = 8 ounces, 3 arcs of 90 degrees (applicable to TO-205AF only).
C2	1021	Omit initial conditioning.
C5	3161	See 4.5.2
C6	1042	Test condition D, 6,000 cycles. The heating cycle shall be 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. 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.

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

- a. Measuring current ( $I_M$ ) ..... 10 mA.
- b. Drain heating current ( $I_H$ ) ..... 1 A (1.3 A minimum for LCC).
- c. Heating time ( $t_H$ ) ..... Steady-state (see method 3161 of MIL-STD-750 for definition).
- d. Drain-source heating voltage ( $V_H$ ) ..... 25 V (15 V for LCC).
- e. Measurement time delay ( $t_{MD}$ ) ..... 30  $\mu$ s to 60  $\mu$ s.
- f. Sample window time ( $t_{SW}$ ) ..... 10  $\mu$ s maximum.

MIL-PRF-19500/601E

\* TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		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	$Z_{\theta JC}$		1.40	°C/W
Breakdown voltage, drain to source	3407	$V_{GS} = 0$ V dc, $I_D = 1$ mA dc, bias condition C	$V_{(BR)DSS}$			
2N7261, 2N7261U 2N7262, 2N7262U				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	$V_{GS} = +20$ V dc and $-20$ V dc, bias condition C, $V_{DS} = 0$	$I_{GSS(TH)1}$		$\pm 100$	nA dc
Drain current	3413	$V_{GS} = 0$ V dc, bias condition C, $V_{DS} = 80$ percent of rated $V_{DS}$	$I_{DSS1}$		25	$\mu$ A dc
Static drain to source on-state resistance	3421	$V_{GS} = 12$ V dc, condition A, pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(on)1}$			
2N7261, 2N7261U 2N7262, 2N7262U					0.180 0.350	ohm ohm
Static drain to source on-state resistance	3421	$V_{GS} = 12$ V dc, condition A, pulsed (see 4.5.1), $I_D = I_{D1}$	$r_{DS(on)2}$			
2N7261, 2N7261U 2N7262, 2N7262U					0.185 0.364	ohm ohm
Forward voltage	4011	Pulsed (see 4.5.1), $I_D = I_{D1}$ , $V_{GS} = 0$ V dc	$V_{SD}$			
2N7261, 2N7261U 2N7262, 2N7262U					1.5 1.4	V V

See footnote at end of table.

MIL-PRF-19500/601E

\* TABLE I. Group A inspection - Continued.

Inspection 1/  <u>Subgroup 3</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
High-temperature operation:		$T_C = T_J = +125^\circ\text{C}$				
Gate current	3411	$V_{GS} = +20\text{ V dc and } -20\text{ V dc, bias condition C, } V_{DS} = 0$	$I_{GSS2}$		$\pm 200$	nA dc
Drain current	3413	$V_{GS} = 0\text{ V dc, bias condition C, } V_{DS} = 100\text{ percent of rated } V_{DS}$	$I_{DSS2}$		1.0	mA dc
		$V_{DS} = 80\text{ percent of rated } V_{DS}$	$I_{DSS3}$		0.25	mA dc
Static drain to source on-state resistance	3421	$V_{GS} = 12\text{ V dc, pulsed (see 4.5.1), } I_D = I_{D2}$	$r_{DS(on)3}$		0.350 0.6	ohm ohm
2N7261, 2N7261U 2N7262, 2N7262U						
Gate to source voltage (thresholds)	3403	$V_{DS} \geq V_{GS}, I_D = 1\text{ mA dc}$	$V_{GS(TH)2}$	1.0		V dc
Low-temperature operation:		$T_C = T_J = -55^\circ\text{C}$				
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	3475	$I_D = \text{rated } I_{D2}, V_{DD} = 15\text{ V, pulsed (see 4.5.1)}$	$g_{FS}$			
2N7261, 2N7261U 2N7262, 2N7262U				2.5 2.5		S S
Switching time test	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			$t_{d(on)}$			
2N7261, 2N7261U 2N7262, 2N7262U					25 25	ns ns

See footnote at end of table.

\* TABLE I. Group A inspection - Continued.

Inspection <u>1</u> /	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4</u> - Continued.						
Rise time			$t_r$			
2N7261, 2N7261U					32	ns
2N7262, 2N7262U					40	ns
Turn-off delay time			$t_{d(off)}$			
2N7261, 2N7261U					40	ns
2N7262, 2N7262U					60	ns
Fall time			$t_f$			
2N7261, 2N7261U					40	ns
2N7262, 2N7262U					45	ns
<u>Subgroup 5</u>						
Safe operating area test (high voltage)	3474	See figure 5 and 6; $t_p = 10$ ms minimum, $V_{DS} = 80$ percent of maximum rated $V_{DS}$ , ( $V_{DS} \leq 200$ )				
Electrical measurements		See table I, subgroup 2 herein.				
<u>Subgroup 6</u>						
Not applicable						
<u>Subgroup 7</u>						
Gate charge	3471	Condition B				
On-state gate charge			$Q_{G(on)}$			
2N7261, 2N7261U					50	nC
2N7262, 2N7262U					50	nC
Gate to source charge			$Q_{GS}$			
2N7261, 2N7261U					10	nC
2N7262, 2N7262U					10	nC

See footnote at end of table.

MIL-PRF-19500/601E

\* TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 7</u> - Continued.						
Gate to drain charge 2N7261, 2N7261U 2N7262, 2N7262U			$Q_{GD}$		20 25	nC nC
Reverse recovery time 2N7261, 2N7261U 2N7262, 2N7262U	3473	$d_i/d_t \leq 100 \text{ A}/\mu\text{s}$ , $V_{DD} \leq 30 \text{ V}$ , $I_D = I_{D1}$	$t_{rr}$		270 400	ns ns

1/ For sampling plan, see MIL-PRF-19500.

2/ This test is required for the following end-point measurements only (not intended for screen 13).  
JANS - group B, subgroups 3 and 4. JANTXV - group B, subgroups 2 and 3; group C, subgroup 6;  
group E, subgroup 1.

\* TABLE II. Group D inspection.

Inspection 1/ 2/ 3/ 4/	MIL-STD-750		Symbol	Pre-irradiation limits				Post-irradiation limits				Unit
	Method	Conditions		R		5/ F, G, and H		R		5/ F, G, and H		
				Min	Max	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 ( $V_{GS}$ bias) 6/	1019	$V_{GS} = 12\text{ V},$ $V_{DS} = 0$										
Steady-state total dose irradiation ( $V_{DS}$ bias) 6/	1019	$V_{GS} = 0,$ $V_{DS} = 80$ percent of rated $V_{DS}$ (preirradiation)										
End-point electrical												
Breakdown voltage, drain to source	3407	$V_{GS} = 0,$ $I_D = 1\text{ mA},$ bias condition C	$V_{BRDSS}$									
2N7261 2N7262				100 200		100 200		100 200		100 200		V dc V dc
Gate to source Voltage (threshold)	3403	$V_{DS} \geq V_{GS}$ $I_D = 1\text{ mA}$	$V_{GSth}$									
2N7261 2N7262				2 2	4 4	2 2	4 4	2 2	4 4	1.25 1.25	4.50 4.50	V dc V dc
Gate current	3411	$V_{GS} = 20\text{ V},$ $V_{DS} = 0,$ bias condition C	$I_{GSSF1}$		100		100		100		100	nA dc
Gate current	3411	$V_{GS} = -20\text{ V},$ $V_{DS} = 0,$ bias condition C	$I_{GSSR1}$		-100		-100		-100		-100	nA dc

See footnotes at end of table.

\* 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		5/ F, G, and H		R		5/ F, G, and H		
				Min	Max	Min	Max	Min	Max	Min	Max	
<u>Subgroup 2</u> - Continued.												
Drain current	3413	$V_{GS} = 0$ Bias condition C $V_{DS} = 80$ percent of rated $V_{DS}$ (preirradiation)	$I_{DSS}$									
2N7261 2N7262				25 25		25 25		25 25		50 50		$\mu A$ dc $\mu A$ dc
Static drain to source on- state voltage	3405	$V_{GS} = 12$ V Condition A pulsed (see 4.5.1) $I_D = I_{D2}$	$V_{DSon1}$									
2N7261 2N7262				0.9 1.225		0.9 1.225		0.9 1.225		1.2 1.68		V dc V dc
Forward voltage Source drain diode	4011	$V_{GS} = 0$ V $I_D = I_{D1}$	$V_{SD}$									
2N7261 2N7262				1.5 1.4		1.5 1.4		1.5 1.4		1.5 1.4		V dc V dc

1/ For sampling plan, see MIL-PRF-19500.

2/ Group D qualification may be performed anytime prior to lot formation. Wafers qualified to these group D QCI requirements may be used for any other detail specification utilizing the same die design.

3/ At the manufacturers option, group D samples need not be subjected to the screening tests, and may be assembled in it's qualified package or in any qualified package that the manufacturer has data to correlate the performance to the designated package.

4/ Unless otherwise specified, electrical characteristics, ratings and conditions for "U" suffix devices (surface mount LCC) are identical to the corresponding non "U" suffix devices.

5/ The F designation represent devices which pass end-points at both 100K and 300K rad (Si). The G designation represents devices which pass 100K, 300K, and 600K rad (Si) end-points. The H designation represents devices which pass 100k, 300k, 600k and 1000k rad (Si).

6/ Separate samples shall be pulled for each bias.

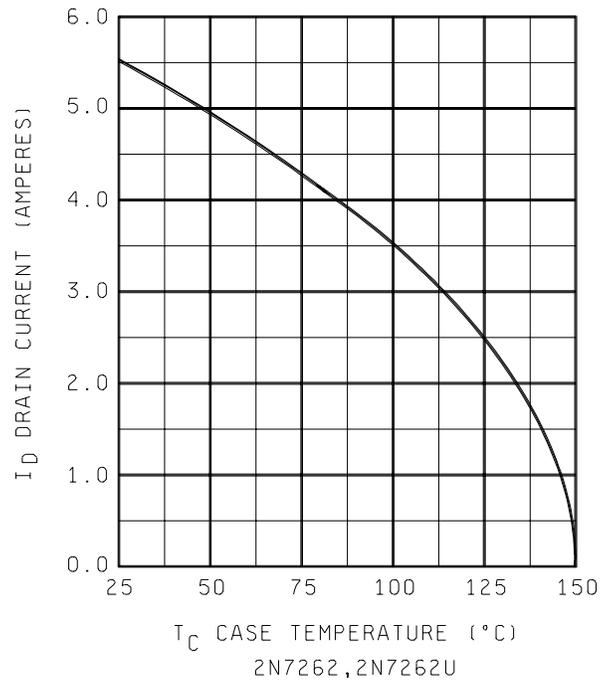
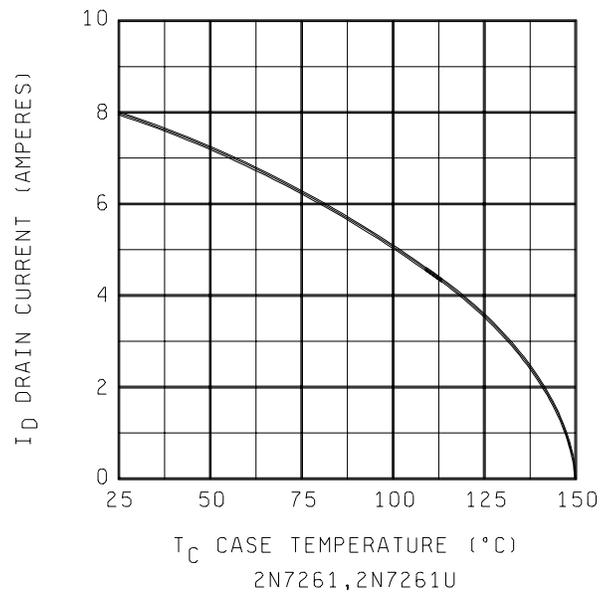
MIL-PRF-19500/601E

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

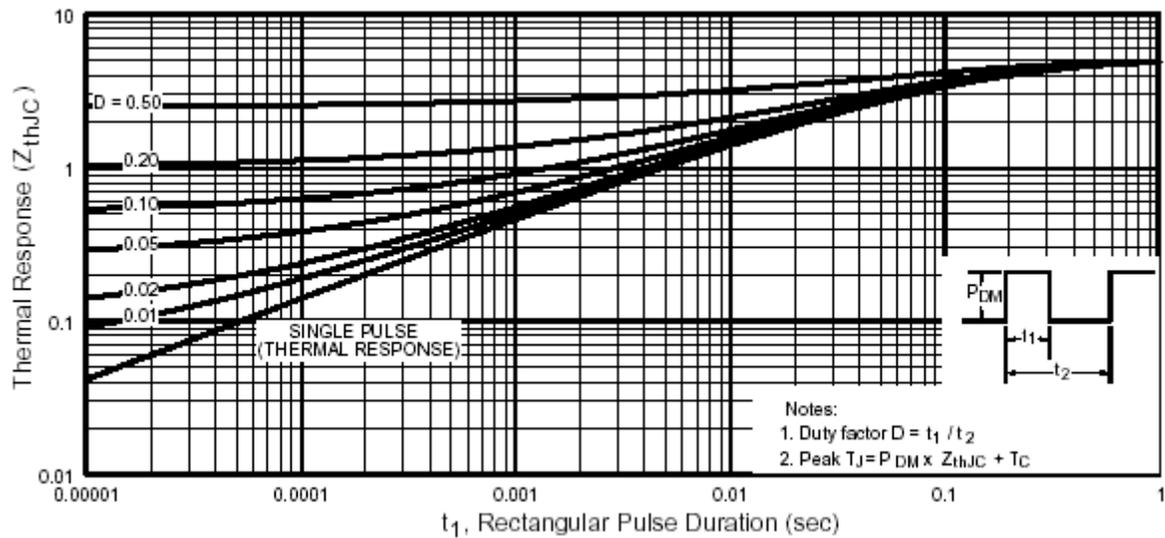
Inspection	MIL-STD-750		Qualification and large lot quality conformance inspection
	Method	Conditions	
<u>Subgroup 1</u>			12 devices c = 0
Temperature cycling	1051	Test condition G, 500 cycles	
Hermetic seal	1071		
Fine leak			
Gross leak			
Electrical measurements		See table I, subgroup 2	
<u>Subgroup 2 1/</u>			12 devices c = 0
Steady-state gate bias	1042	Condition B, 1,000 hours	
Electrical measurements		See table I, subgroup 2	
Steady-state reverse bias	1042	Condition A, 1,000 hours	
Electrical measurements		See table I, subgroup 2	
<u>Subgroup 3</u>			3 devices, c = 0
Destructive physical analysis	2102		
<u>Subgroup 4</u>			sample size N/A
Thermal resistance, thermal impedance curves		Each supplier shall submit their (typical) design thermal impedance curves. In addition, test conditions and $Z_{\theta JX}$ limit shall be provided to the qualifying activity in the qualification report	
<u>Subgroup 5</u>			
Not applicable			
<u>Subgroup 6</u>			3 devices
ESD	1020		
<u>Subgroup 7</u>			
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		22 devices c = 0
Solder heat	2031	one cycle	45 devices c = 0

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

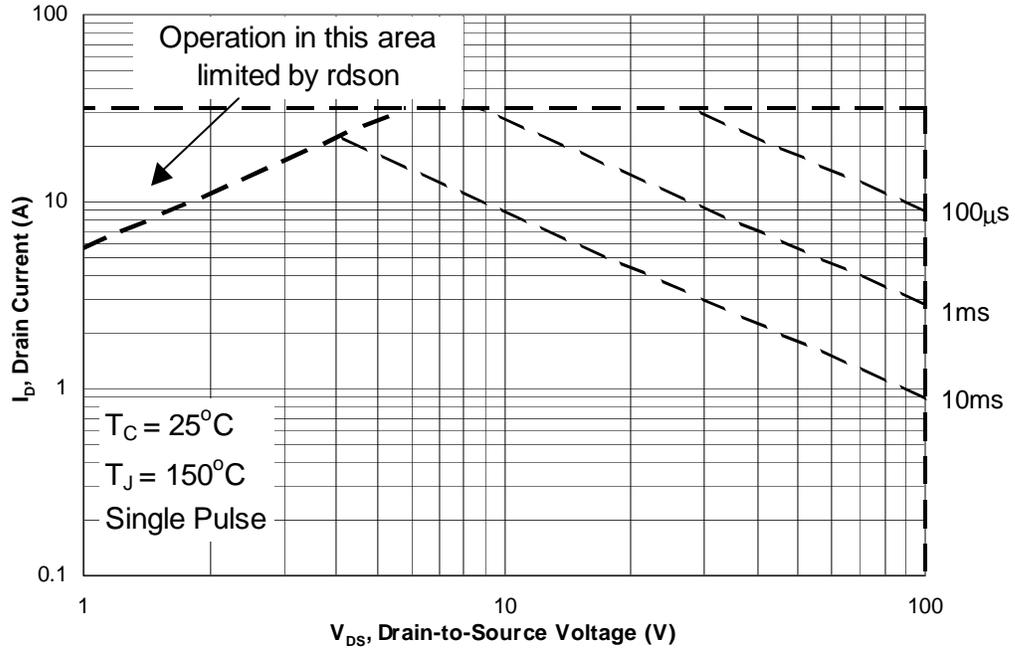
MIL-PRF-19500/601E



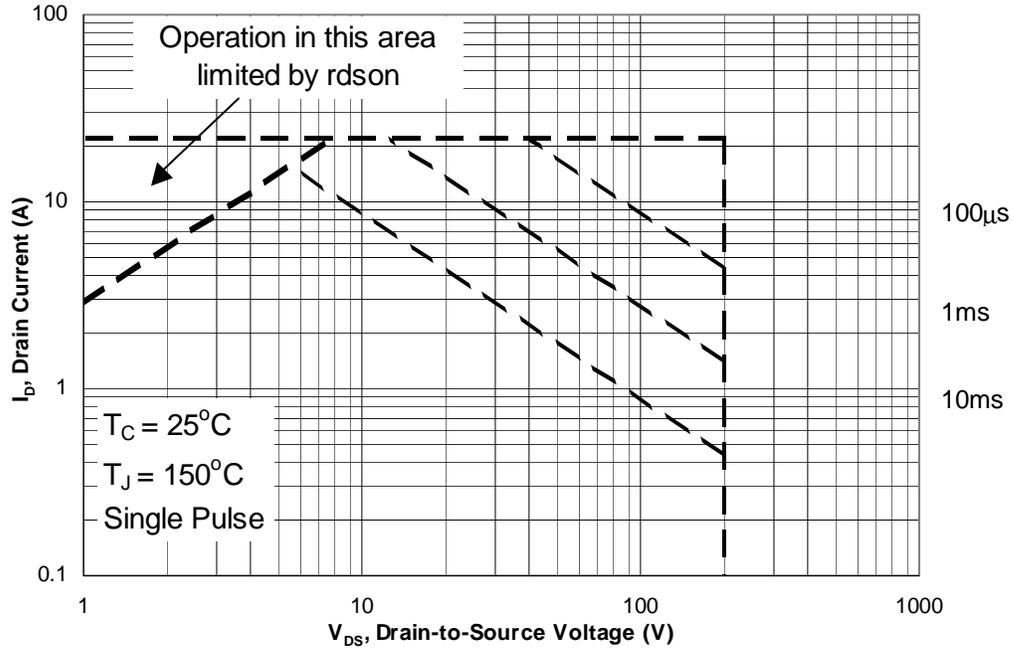
\* FIGURE 3. Maximum drain current vs case temperature graphs.



\* FIGURE 4. Thermal impedance curves (all devices).



\* FIGURE 5. Safe operating area graph 2N7261 and 2N7261U.



\* FIGURE 6. Safe operating area graph 2N7262 and 2N7262U.

## 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 personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. 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 must specify the following:

- a. Title, number, and date of this specification.
- b. Issue of DoDISS to be cited in the solicitation and if required, the specific issue of individual documents referenced (see 2.2.1).
- c. Packaging requirements (see 5.1).
- d. Lead finish (see 3.4.1).
- e. Type designation and quality assurance level.

\* 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) 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 Defense Supply Center, Columbus, ATTN: DSCC/VQE, P.O. Box 3990, Columbus, OH 43216-5000.

6.4 Substitution information. 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.

Preferred types	Commercial types	
	TO-205AF	LCC
2N7261, U	IRHFX130 (1)	IRHEX130 (1)
2N7262, U	IRHFX230 (1)	IRHEX230 (1)

- (1) Replace "X" with number indicating qualified Radiation Hardness as follows:  
 7 = 100K Rad Si  
 3 = 300K Rad Si  
 4 = 600K Rad Si  
 8 = 1000K Rad Si

\* 6.5 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 last previous issue.

Custodians:  
 Army - CR  
 Navy - EC  
 Air Force - 11  
 NASA - NA  
 DLA - CC

Preparing activity:  
 DLA - CC  
 (Project 5961-2769)

Review activities:  
 Army - MI  
 Air Force - 19, 70

**STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL**

**INSTRUCTIONS**

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

<b>I RECOMMEND A CHANGE:</b>	1. DOCUMENT NUMBER MIL-PRF-19500/601E	2. DOCUMENT DATE 19 August 2003
------------------------------	--	------------------------------------

3. **DOCUMENT TITLE**  
SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED (TOTAL DOSE ONLY) TRANSISTORS, N-CHANNEL, SILICON, TYPES 2N7261 AND 2N7262 AND U SUFFIXES, JANTXVR, F, G, AND H AND JANSR, F, G, AND H

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)	b. ORGANIZATION		
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code)	7. DATE SUBMITTED	
	COMMERCIAL DSN FAX EMAIL		

8. PREPARING ACTIVITY

a. Point of Contact Alan Barone	b. TELEPHONE			
	Commercial	DSN	FAX	EMAIL
	614-692-0510	850-0510	614-692-6939	<a href="mailto:alan.barone@dla.mil">alan.barone@dla.mil</a>
c. ADDRESS Defense Supply Center Columbus ATTN: DSCC-VAC P.O. Box 3990 Columbus, OH 43216-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman, Suite 2533 Fort Belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-6888			