

The documentation and process conversion measures necessary to comply with this revision shall be completed by 5 November 1997

INCH-POUND

MIL-PRF-19500/543E

5 August 1997
SUPERSEDING
MIL-S-19500/543D
30 June 1992

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, FIELD EFFECT TRANSISTORS, N-CHANNEL, SILICON
TYPES 2N6764, 2N6766, 2N6768, 2N6770,
JAN, JANTX, JANTXV, JANS, JANHC, AND JANKC

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 N-channel, enhancement-mode, MOSFET, power transistor intended for use in power switching applications. Four levels of product assurance are provided for each encapsulated device type as specified in MIL-PRF-19500, and two levels of product assurance for each unencapsulated device type die. See 6.5 for JANHC and JANKC ordering information.

1.2 Physical dimensions. See figure 1. (TO-204AE for types 2N6764 and 2N6766; TO-204AA for types 2N6768 and 2N6770 (formerly TO-3)), see figures 2 and 3 for JANHC and JANKC (die) dimensions.

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

Type	P_T 1/ $T_C = +25^\circ\text{C}$	P_T $T_C = +25^\circ\text{C}$	V_{DS}	V_{DG}	V_{GS}	I_{D1} 2/ $T_C = +25^\circ\text{C}$	I_{D2} 2/ $T_C = +100^\circ\text{C}$	I_S
	<u>W</u>	<u>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>
2N6764	15	4	100	100	± 20	38.0	24.0	38.0
2N6766	15	4	200	200	± 20	30.0	19.0	30.0
2N6768	15	4	400	400	± 20	14.0	9.0	14.0
2N6770	15	4	500	500	± 20	12.0	7.75	12.0

Type	I_{DM} 3/ <u>A pk</u>	V_{ISO} 70,000 ft. altitude	T_J and T_{STG} <u>$^\circ\text{C}$</u>	Max $r_{DS(on)}$ 1/ $V_{GS} = 10 \text{ V dc}$ $I_D = I_{D2}$		$R_{\theta JC}$ max <u>$^\circ\text{C/W}$</u>
				$T_J = +25^\circ\text{C}$ <u>Ω</u>	$T_J = +150^\circ\text{C}$ <u>Ω</u>	
2N6764	152		-55	0.055	0.105	0.83
2N6766	120		to	0.085	0.170	0.83
2N6768	56	400	+150	0.300	0.750	0.83
2N6770	48	500		0.400	1.000	0.83

See footnotes at end of table.

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

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FSC 5961

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

1/ Derate linearly, 1.2 W/°C for $T_C > +25^\circ\text{C}$. $P_T = \frac{T_{J \text{ max}} - T_C}{R_{\theta JC}}$

2/ $I_D = \frac{\sqrt{T_{J \text{ max}} - T_C}}{R_{\theta IC} + R_{DS(on)}}$ at $T_{J \text{ max}}$

3/ $I_{DM} = 4 \times I_{D1}$ as calculated in footnote 2.

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

Type	Min V(BR)DSS V _{GS} = 0 V I _D = 1 mA dc	V _{GS(th)1} V _{DS} V _{GS} I _D = 0.25 mA		Max I _{DSS1} V _{GS} = 0 V	Max r _{DS(on)} 1/ V _{GS} = 10 V dc I _D = I _{D2}
				V _{DS} = 80 percent of rated V _{DS}	T _J = +25°C
	V dc	V dc		mA dc	Ω
		Min	Max		
2N6764	100	2.0	4.0	25	0.055
2N6766	200	2.0	4.0	25	0.085
2N6768	400	2.0	4.0	25	0.3
2N6770	500	2.0	4.0	25	0.4

1/ Pulsed (see 4.5.1)

2. APPLICABLE DOCUMENTS

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

MILITARY

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, 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 (except for related associated specifications or specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

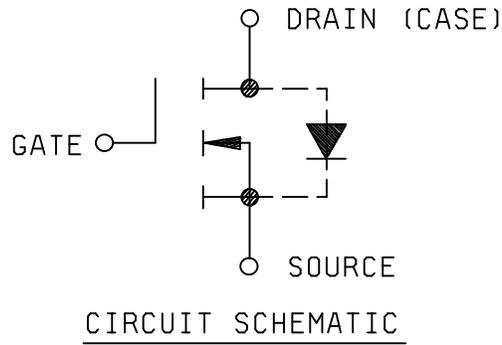
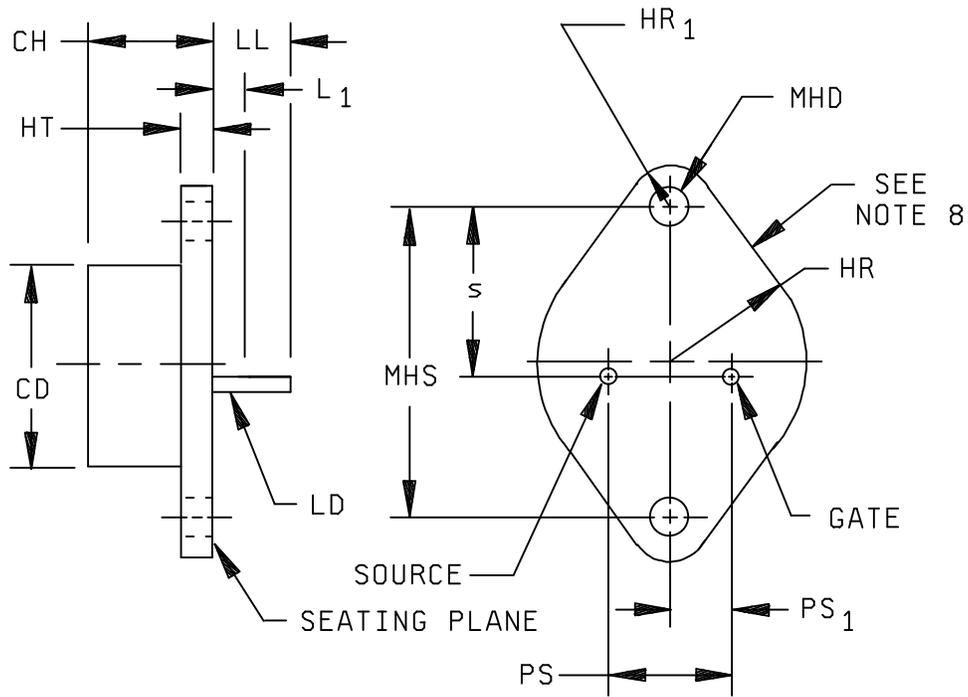


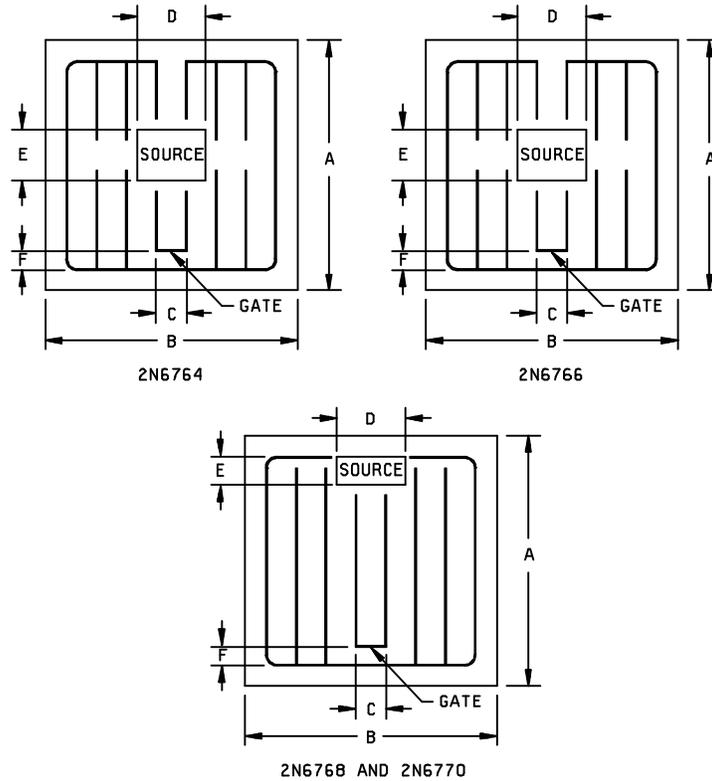
FIGURE 1. Physical dimensions of transistor type TO-204AE, 2N6764, and 2N6766; for types TO-204AA, 2N6768, and 2N6770.

Dimensions					
Ltr	Inches		Millimeter		Notes
	Min	Max	Min	Max	
CD		.875		22.23	
CH	.250	.360	6.35	9.15	
HR	.495	.525	12.57	13.3	
HR ₁	.131	.188	3.33	4.78	
HT	.060	.135	1.52	3.43	
LD	.057	.063	1.45	1.60	5
	.038	.043	0.97	1.10	6
LL	.312	.500	7.92	12.70	
L ₁		.050		1.27	3
MHD	.151	.161	3.84	4.09	7
MHS	1.177	1.197	29.90	30.40	
PS	.420	.440	10.67	11.18	
PS ₁	.205	.225	5.21	5.72	7
s	.655	.675	16.64	17.15	

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. These dimensions shall be measured at points .050 inch (1.27 mm) and .055 inch (1.40 mm) below the seating plane. When gauge is not used, measurement will be made at the seating plane.
4. The seating plane of the header shall be flat within .001 inch (0.03 mm) concave to .004 inch (0.10 mm) convex inside a .930 inch (23.62 mm) diameter circle on the center of the header and flat within .001 inch (0.03 mm) concave to .006 inch (0.15 mm) convex overall.
5. These dimensions pertain to the 2N6764 and 2N6766 types.
6. These dimensions pertain to the 2N6768 and 2N6770 types.
7. Mounting holes shall be deburred on the seating plane side.
8. Drain is electrically connected to the case.

FIGURE 1. Physical dimensions of transistor type TO-204AE, 2N6764, and 2N6766; for types TO-204AA, 2N6768, and 2N6770 - Continued.

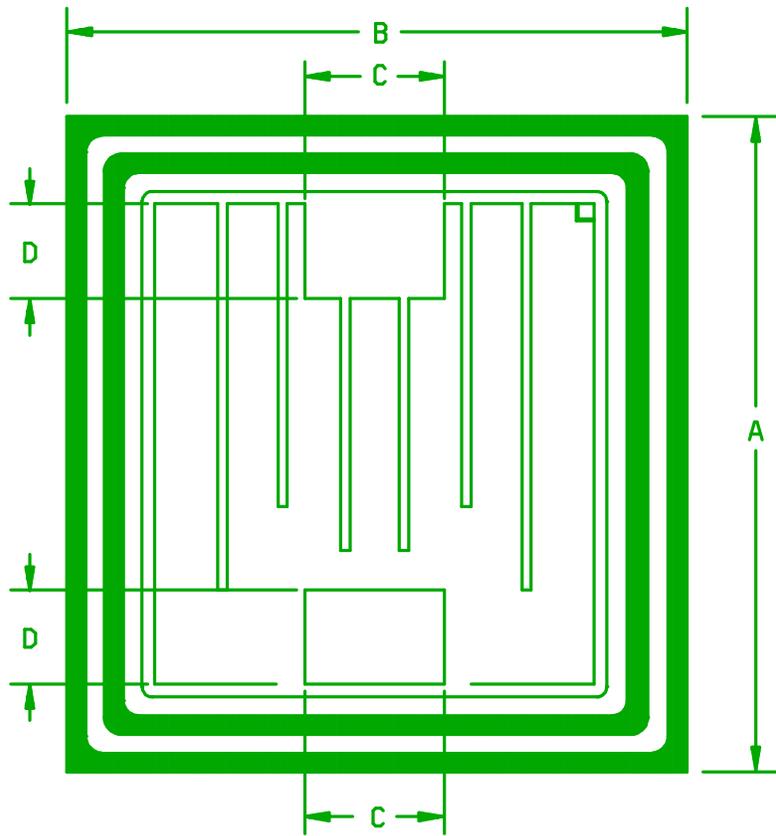


Ltr	Dimensions 2N6764				Dimensions 2N6766				Dimensions 2N6768 and 2N6770			
	Inches		Millimeters		Inches		Millimeters		Inches		Millimeters	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
A	.252	.262	6.40	6.65	.252	.262	6.40	6.65	.252	.262	6.40	6.65
B	.252	.262	6.40	6.65	.252	.262	6.40	6.65	.252	.262	6.40	6.65
C	.027	.037	0.69	0.94	.027	.037	0.69	0.94	.025	.035	0.64	0.89
D	.012	.022	0.30	0.56	.012	.022	0.30	0.56	.043	.053	1.09	1.35
E	.057	.067	1.45	1.70	.057	.067	1.45	1.70	.032	.042	0.81	1.07
F	.013	.023	0.33	0.58	.013	.023	0.33	0.58	.015	.025	0.38	0.64

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Unless otherwise specified, tolerance is ± 0.005 inch (0.13 mm).
4. The physical characteristics of the die thickness are .0187 inch (0.474 mm). The back metals are chromium, nickel, and silver. The top metal is aluminum and the back contact is the drain.

FIGURE 2. JANHC and JANKC A-version die dimensions.



Dimensions				
	Inches		Millimeters	
	Min	Max	Min	Max
A	.259	.269	6.58	6.83
B	.253	.263	6.43	6.68
C	.065	.075	1.65	1.91
D	.045	.055	1.14	1.40

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Unless otherwise specified, tolerance is ± 0.005 inch (0.13 mm).
4. The physical characteristics of the die thickness are 0.014 inch (0.36 mm). The back metals are nickel, aluminum, and titanium. The top metal is aluminum and the back contact is the drain.

FIGURE 3. JANHC and JANKC B-version die dimensions.

3. REQUIREMENTS

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

3.2 Associated detail specification. The individual item performance requirements shall be in accordance with MIL-PRF-19500, and as specified herein.

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

3.3 Interface requirements and physical dimensions. The interface requirements and physical dimensions for the purpose of interchangeability shall be as specified on figures 1, 2, and 3 herein.

3.3.1 Lead material and finish. Lead material shall be Kovar or Alloy 52; a copper core or a plated core is permitted. Unless otherwise specified, lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein.

3.3.2 Construction. These devices shall be constructed in a manner and using materials which enable the diodes to meet the applicable requirements of MIL-PRF-19500 and this document.

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

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

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

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

- a. Devices shall be handled on benches with conductive and grounded surface.
- 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 shall be exercised during test and troubleshooting to apply not more than maximum rated voltage to any lead.
- h. Gate shall be terminated to source, $R \leq 100 \text{ k}$, whenever bias voltage is to be applied drain to source.

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

3.7 Electrical test requirements. The electrical test requirements shall be subgroups specified in 4.4.2 and 4.4.3.

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).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500.

4.2.1 JANHC and JANKC devices. Qualification for JANHC and JANKC devices shall be as specified in MIL-PRF-19500, appendix G.

4.3 Screening (JANTX level only). Screening shall be in accordance with MIL-PRF-19500 (Appendix E, table IV), 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 MIL-PRF-19500, appendix E, table IV)	Measurements	
	JANS level	JANTX and JANTXV
1/	Gate stress test (see 4.5.5)	Gate stress test (see 4.5.5).
1/ 2/	MIL-STD-750, method 3470 (see 4.5.4) optional	MIL-STD-750, method 3470 (see 4.5.4) optional
1/ 3/	MIL-STD-750, method 3161 (see 4.5.3)	MIL-STD-750, method 3161 (see 4.5.3).
9	I_{GSS1} , I_{DSS1}	
10	MIL-STD-750, method 1042, test condition B	MIL-STD-750, method 1042, test condition B
11	I_{GSS1} , I_{DSS1} , $r_{DS(on)1}$, $V_{GS(th)1}$ of subgroup 2 of table I herein. $\Delta I_{GSS1} = \pm 20$ nA dc or ± 100 percent of initial value, whichever is greater. $\Delta I_{DSS1} = \pm 25$ μ A dc or ± 100 percent of initial value, whichever is greater	I_{GSS1} , I_{DSS1} , $r_{DS(on)1}$, $V_{GS(th)1}$ of subgroup 2 of table I herein
12	MIL-STD-750, method 1042, test condition A, t = 240 hours	MIL-STD-750, method 1042, test condition A, t = 48 hours minimum at $T_A = +175^\circ\text{C}$ minimum.
13	Subgroups 2 and 3 of table I. $\Delta I_{GSS1} = \pm 20$ nA dc or ± 100 percent of initial value whichever is greater. $\Delta I_{DSS1} = \pm 25$ μ A 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. $\Delta I_{GSS1} = \pm 20$ nA dc or ± 100 percent of initial value whichever is greater. $\Delta I_{DSS1} = \pm 25$ μ A 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/ Shall be performed anytime before screen 10.
- 2/ This test method in no way implies a repetitive avalanche energy rating.
- 3/ This test need not be performed in group A when performed as a screen.

4.3.1 Screening (JANHC and JANKC). Screening shall be in accordance with MIL-PRF 19500 (appendix E, table IV). As a minimum die shall be 100 percent probed in accordance with group A, subgroup 2 except test current shall not exceed 20 A.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein. Alternate flow is allowed for conformance inspection in accordance with figure 2 of MIL-PRF-19500.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500, appendix E, table V herein. End-point electrical and Delta measurements shall be in accordance with the applicable tests of table III 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 (JANTX, JANTXV, and JANS) of MIL-PRF-19500, and as follows. End-point electrical and delta measurements shall be in accordance with the applicable steps of table III herein.

4.4.2.1 Group B inspection, appendix E, table VIa (JANS) of MIL-PRF-19500.

Subgroup	Method	Conditions
B3	1051	Test condition G.
B4	1042	Test condition D; The heating cycle shall be 1 minimum for 2,000 cycles. No forced air cooling on the device shall be permitted.
B5	1042	Test condition A; $V_{DS} = \text{rated } V_{DS}$ (see 1.3), $T_A = +175^\circ\text{C}$, $t = 120$ hours minimum, read and record $V_{BR(DSS)}$ (pre and post) at $I_D = 1$ mA, read and record I_{DSS} (pre and post), (see table III).
B5	1042	Test condition B; $V_{GS} = \text{rated } V_{GS}$ (see 1.3), $T_A = +175^\circ\text{C}$, $t = 24$ hours minimum.
B6	3161	See 4.5.2.

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

Subgroup	Method	Conditions
B2	1051	Test condition G.
B3	1042	Test condition D, 2,000 cycles. The heating cycle shall be 1 minute minimum.
B5, 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. End-point electrical and delta measurements shall be in accordance with the applicable steps of table III herein.

4.4.3.1 Group C inspection, appendix E, table VII of MIL-PRF-19500.

Subgroup	Method	Conditions
C2	2036	Test condition A; weight = 10 lbs, $t = 15$ seconds.
C6	1042	Test condition D; 6,000 cycles minimum. The heating cycle shall be 1 minute minimum.

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. $R_{\theta JC \text{max}} = 0.83^\circ\text{C/W}$.

- I_M measuring current 10 mA.
- I_H drain heating current 4 A.
- t_H heating time Steady-state (see MIL-STD-750, method 3161 for definition).
- V_H drain-source heating voltage 25 V.
- t_{MD} measurement time delay 30 to 60 μs .
- t_{SW} sample window time 10 μs (max).

4.5.3 Thermal response (ΔV_{SD} measurements). The delta V_{SD} measurements shall be performed with method 3161 of MIL-STD-750. The delta V_{SD} conditions (I_H and V_H) and maximum limit shall be derived by each vendor from the thermal response curves (see figure 4). The read and record delta V_{SD} measurements and conditions for each device in the qualification lot shall be submitted in the qualification report. The chosen delta V_{SD} shall be considered final after the manufacturer has had the opportunity to test five consecutive lots. The following parameter measurements shall apply:

- a. I_M measuring current 10 mA.
- b. I_H drain heating current 4 A.
- c. t_H heating time 100 ms.
- d. V_H drain-source heating voltage 25 V.
- e. t_{MD} measurement time delay 30 to 60 μ s.
- f. t_{SW} sample window time 10 μ s (max).

4.5.4 Unclamped inductive switching.

- a. Peak current, I_D rated I_D .
- b. Peak gate voltage, V_{GS} 10 V.
- c. Gate to source resistor, R_{GS} $25 \leq R_{GS} \leq 200 \Omega$.
- d. Initial case temperature $+25^\circ\text{C} +10^\circ\text{C}, -5^\circ\text{C}$.
- e. Inductance 100 μ H \pm 10 percent.
- f. Number of pulses to be applied 1 pulse minimum.
- g. Supply voltage V_{DD} 50 V.

4.5.5 Gate stress test.

- a. $V_{GS} = 30$ V minimum.
- b. $t = 250$ μ s minimum.

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>						
Breakdown voltage drain to source	3407	$V_{GS} = 0$ V dc; $I_D = 1$ mA dc, Bias condition C	$V_{(BR)DSS}$			V dc
2N6764				100		
2N6766				200		
2N6768				400		
2N6770				500		
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$; $I_D = 0.25$ mA dc	$V_{GS(th)1}$	2.0	4.0	V dc
Gate current	3411	$V_{GS} = +20$ and -20 V dc; bias condition C, $V_{DS} = 0$	I_{GSS1}		± 100	nA dc
Drain current	3413	$V_{GS} = 0$ V dc; $V_{DS} = 80$ percent of rated V_{DS} , bias condition C	I_{DSS1}		25	μ A dc
Static drain to source on-state resistance	3421	$V_{GS} = 10$ V dc, pulsed (see 4.5.1), condition A $I_D =$ rated I_{D2} (see 1.3) $T_C = +25^\circ\text{C}$.	$r_{DS(on)1}$			Ω
2N6764					0.055	
2N6766					0.085	
2N6768					0.3	
2N6770					0.4	
Static drain to source on-state resistance	3421	$V_{GS} = 10$ V dc, pulsed (see 4.5.1), condition A $I_D =$ rated I_{D1} (see 1.3)	$r_{DS(on)2}$			Ω
2N6764					0.065	
2N6766					0.09	
2N6768					0.40	
2N6770					0.50	
Forward voltage (source-drain diode)	4011	Pulsed (see 4.5.1) $V_{GS} = 0$ V, $I_D = I_{D1}$	V_{SD}			V dc
2N6764					1.9	
2N6766					1.9	
2N6768					1.7	
2N6770					1.7	

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 3</u>						
High temperature operation:		$T_C = +125^\circ\text{C}$				
Gate current	3411	Bias condition C; $V_{GS} = +20$ and -20 V dc $V_{DS} = 0$ V dc	I_{GSS2}		± 200	nA dc
Drain current	3413	Bias condition C; $V_{GS} = 0$ V dc				
		$V_{DS} = 100$ percent of rated V_{DS}	I_{DSS2}		1.0	mA dc
		$V_{DS} = 80$ percent of rated V_{DS}	I_{DSS3}		0.25	mA dc
Static drain to source on-state resistance	3421	$V_{GS} = 10$ V dc pulsed (see 4.5.1) $I_D = \text{rated } I_{D2}$ (see 1.3)	$r_{DS(on)3}$			Ω
2N6764 2N6766 2N6768 2N6770					0.094 0.153 0.66 0.88	
Gate to source voltage (threshold)	3404	$V_{DS} \geq V_{GS}$; $I_D = 0.25$ mA dc	$V_{GS(th)2}$	1.0		V dc
Low temperature operation:		$T_C = -55^\circ\text{C}$				
Gate to source voltage (threshold)		$V_{DS} \geq V_{GS}$; $I_D = 0.25$ mA dc	$V_{GS(th)3}$		5.0	V dc
<u>Subgroup 4</u>						
Switching time test	3472	$I_D = \text{rated } I_{D1}$ (see 1.3) $V_{GS} = 10$ V dc Gate drive impedance = 2.35Ω $V_{DD} = 0.5 V_{BR(DSS)}$				
Turn-on delay time			$t_{d(on)}$		35	ns
Rise time			t_r		190	ns
Turn-off delay time			$t_{d(off)}$		170	ns
Fall time			t_f		130	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 5</u>						
Single pulse unclamped inductive switching	3470	See 4.5.4, 116 devices $c = 0$				
Electrical measurements		See table III, steps, 1, 2, 3, 4, 5 and 6				
Safe operating area test	3474	See figure 5, $V_{DS} = 80$ percent of rated $V_{BR}(DSS)$ $t_p = 10$ ms, $V_{DS} = 200$ V max.				
Electrical measurements		See table III, steps, 1, 2, 3, 4, 5 6 and 7.				
<u>Subgroup 6</u>						
Not applicable						
<u>Subgroup 7</u>						
Gate charge	3471					
On-state gate charge		Bias condition B	$Q_{g(on)}$			nC
2N6764				50	125	
2N6766				55	115	
2N6768				52	110	
2N6770				55	120	
Gate to source charge			Q_{gs}			nC
2N6764				8	22	
2N6766				8	22	
2N6768				5	18	
2N6770				5	19	
Gate to drain charge			Q_{gd}			nC
2N6764				25	65	
2N6766				30	60	
2N6768				25	65	
2N6770				27	70	
Reverse recovery time	3473		t_{rr}			nC
2N6764		$di/dt = 100$ A/ μ s			500	
2N6766		$V_{DD} \leq 30$ V dc, $I_D = I_{D1}$			950	
2N6768					1,200	
2N6770					1,600	

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

TABLE II. Group E inspection (all quality levels) for qualification only.

Inspection ^{1/}	MIL-STD-750		Qualification and large lot quality conformance inspection
	Method	Conditions	
<u>Subgroup 1</u>			45 devices, c = 0
Temperature cycling	1051	Test condition G, 500 cycles	
Hermetic seal	1071		
Fine leak			
Gross leak			
Electrical measurements		See table III, steps, 1, 2, 3, 4, 5, 6 and 7.	
<u>Subgroup 2</u> ^{1/}			45 devices, c = 0
Steady-state reverse bias	1042	Condition A; 1,000 hours	
Electrical measurements		See table III, steps, 1, 2, 3, 4, 5, 6 and 7.	
Steady-state gate bias	1042	Condition B, 1,000 hours	
Electrical measurements		See table III, steps, 1, 2, 3, 4, 5, 6 and 7.	
<u>Subgroup 3</u>			
Not applicable			
<u>Subgroup 4</u>			5 devices, c = 0
Thermal resistance	3161	$R_{\theta JC} = 0.83^{\circ}\text{C/W}$ max. (see 4.5.2)	
<u>Subgroup 5</u>			5 devices, c = 0
Barometric pressure (reduced) 400 V and 500 V only	1001	Test condition C; $I_{(ISO)} = .25 \text{ mA (max)}$, $V_{(ISO)} = V_{DS}$	

^{1/} A separate sample for each test may be pulled.

TABLE III. Groups A, B, C and E electrical measurements. 1/ 2/ 3/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Breakdown voltage drain to source 2N6764 2N6766 2N6768 2N6770	3407	$V_{GS} = 0$, $I_D = 1$ mA dc Bias condition C;	$V_{(BR)DSS}$	100 200 400 500		V dc
2.	Gate to source voltage (threshold)	3404	$V_{DS} \geq V_{GS}$ $I_D = 0.25$ mA dc	$V_{GS(th)1}$	2.0	4.0	V dc
3.	Gate current	3411	$V_{GS} = \pm 2.0$ Bias condition C;	I_{GSS1}		± 100	nA dc
4.	Saturation voltage and resistance	3413	$V_{GS} = 0$ $V_{DS} = 80\%$ of rated V_D , Bias condition C;	I_{DSS1}		25	μ A dc
5.	Static drain to source on-state resistance 2N6764 2N6766 2N6768 2N6770	3421	$V_{GS} = 10$ V dc condition A, pulsed (see 4.5.1). $I_D = I_{D2}$	$r_{DS(on)1}$		0.055 0.085 0.3 0.4	ohms
6.	Static drain to source on-state resistance 2N6764 2N6766 2N6768 2N6770	3421	$V_{GS} = 10$ V dc condition A, pulsed (see 4.5.1). $I_D = I_{D2}$	$r_{DS(on)2}$		0.065 0.090 0.400 0.500	ohms
7.	Forward voltage (source-drain diode) 2N6764 2N6766 2N6768 2N6770	4011	$V_{GS} = 0$ V dc; $I_D = I_{D1}$ pulsed (see 4.5.1)	V_{SD}		1.9 1.9 1.7 1.7	V
8.	Thermal response 4/	3131	See 4.3.3	ΔV_{SD}			

1/ The electrical measurements for appendix E, table VIa (JANS) of MIL-PRF-19500 are as follows:

- Subgroup 3, table III, steps 1, 2, 3, 4, 5, 6 and 7.
- Subgroup 4, table III, steps 1, 2, 3, 4, 5, 6, 7, and 8.
- Subgroup 5, table III, condition A, steps 1, 2, 3, 4, 5, 6 and 7. No more than 15 percent of the sample shall be permitted to have a $\Delta V_{BR(DSS)}$ shift of more than 10 percent and ΔI_{DSS} greater than 50 μ A. Subgroup 5, table III, condition B, steps 1, 2, 3, 4, 5, 6 and 7

TABLE II. Groups A, B, and C electrical measurements - Continued. 1/ 2/ 3/

2/ The electrical measurements for appendix E, table VIb (JANTX and JANTXV) of MIL-PRF-19500 are as follows:

- a. Subgroup 2, table III, steps 1, 2, 3, 4, 5, 6 and 7.
- b. Subgroup 3, table III, steps 1, 2, 3, 4, 5, 6, 7 and 8.

3/ The electrical measurements for appendix E, table VII of MIL-PRF-19500 are as follows:

- a. Subgroup 2, table III, steps 1, 2, 3, 4, 5, 6 and 7.
- b. Subgroup 3, table III, steps 1, 2, 3, 4, 5, 6 and 7.
- c. Subgroup 6, table III, steps 1, 2, 3, 4, 5, 6, 7 and 8.

2N7364

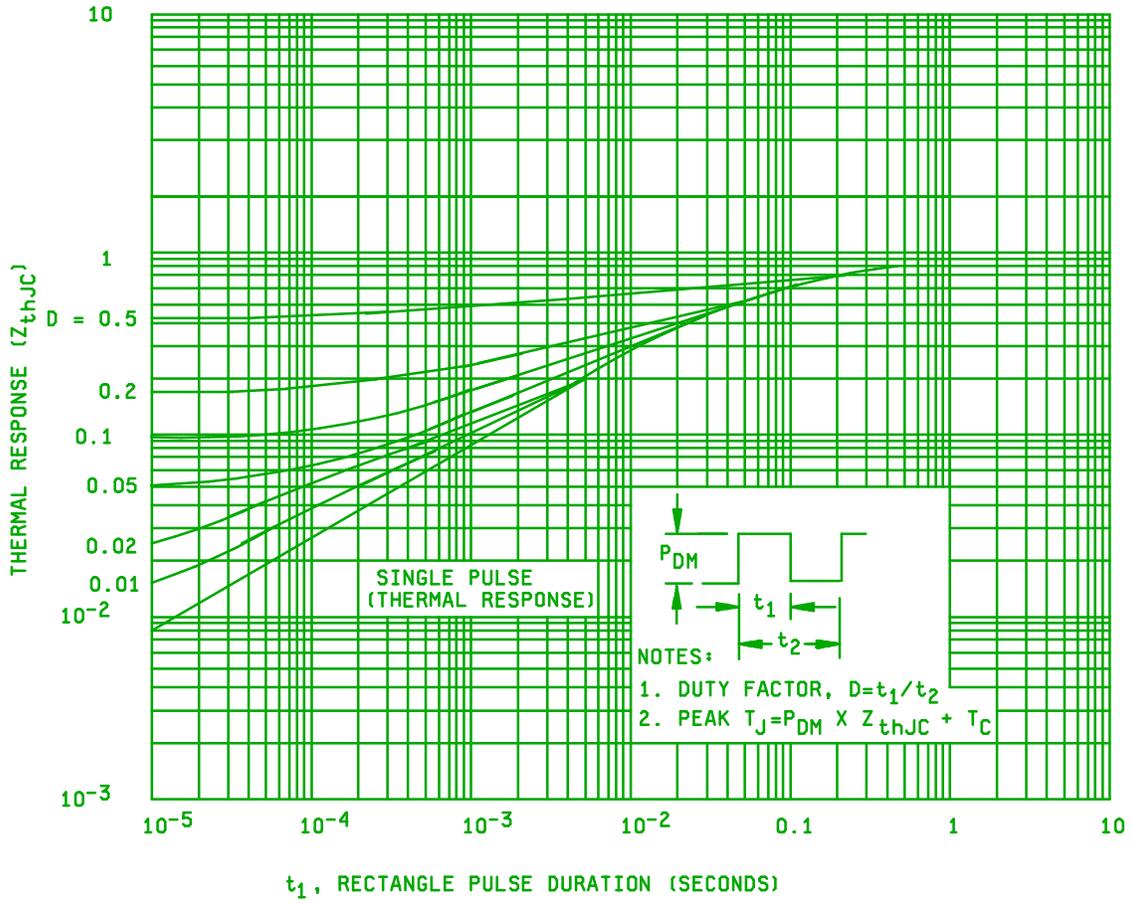
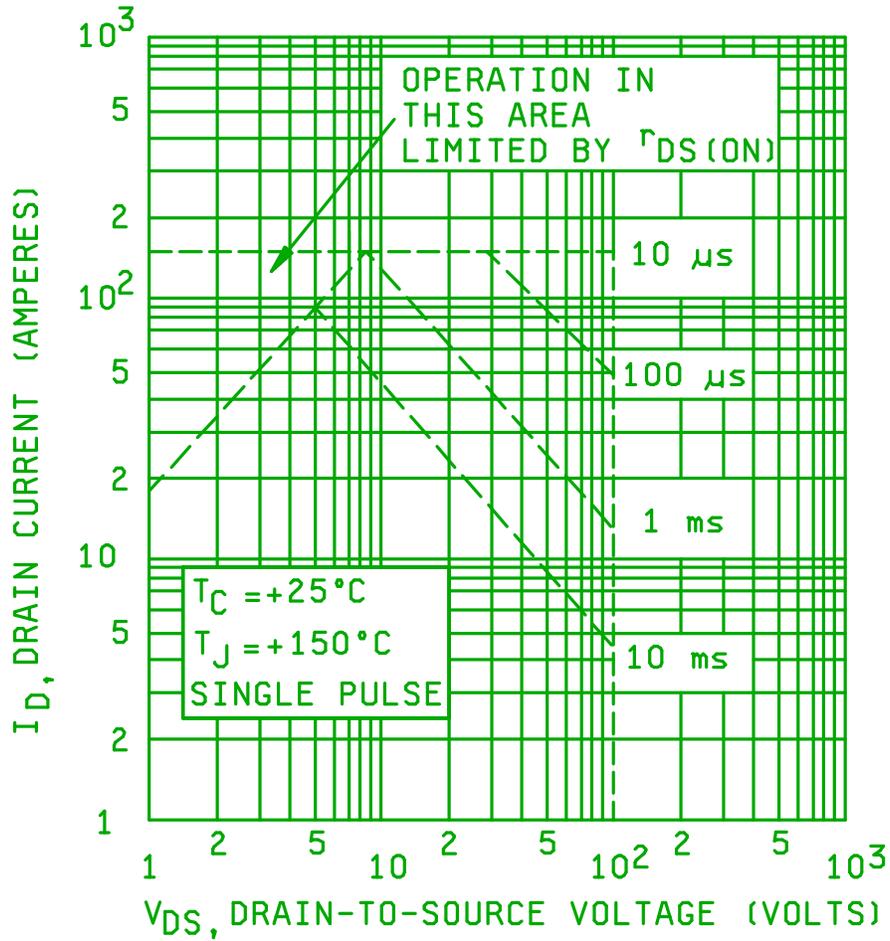
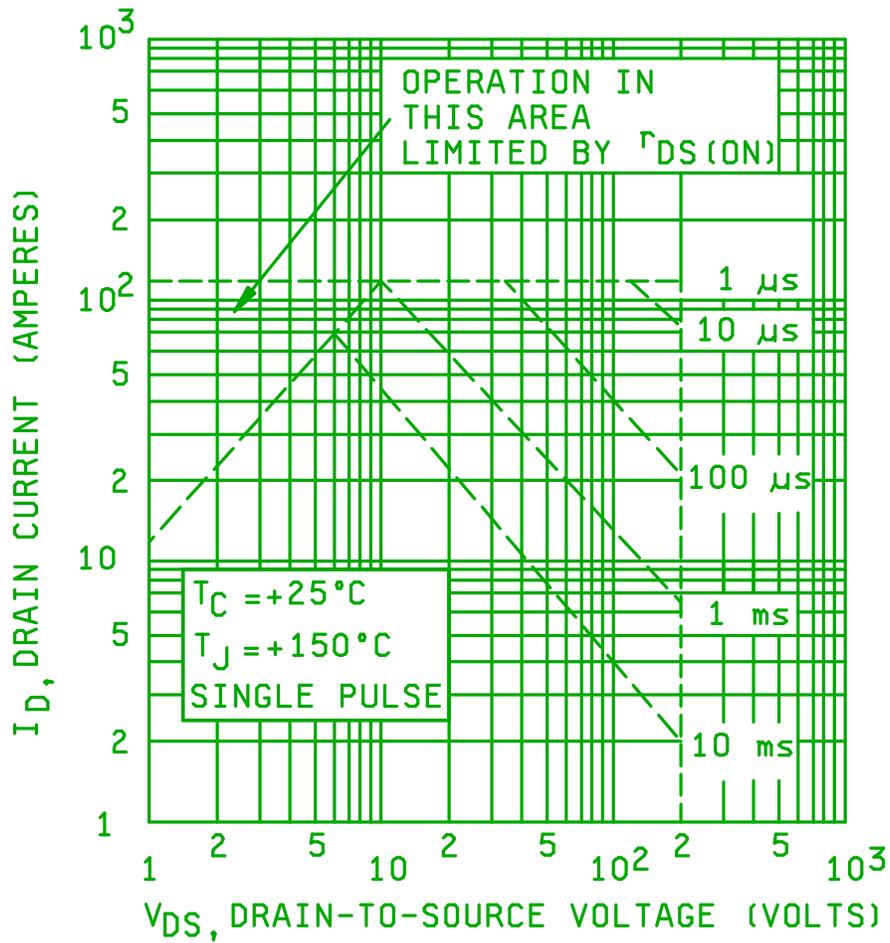


FIGURE 4. Thermal response curves.



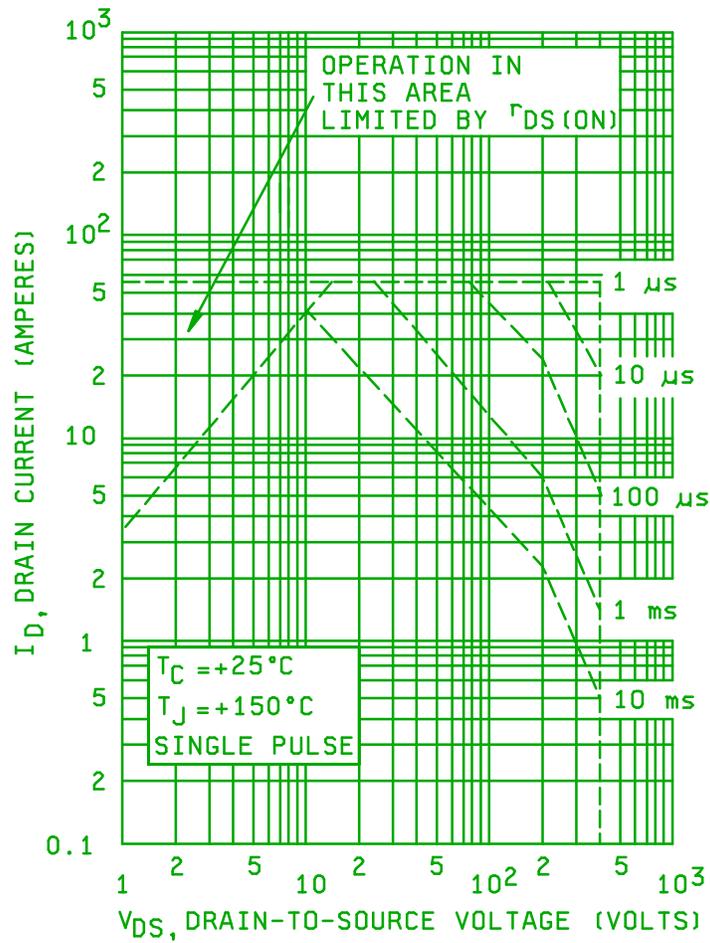
2N6764

FIGURE 5. Safe operating area graph.



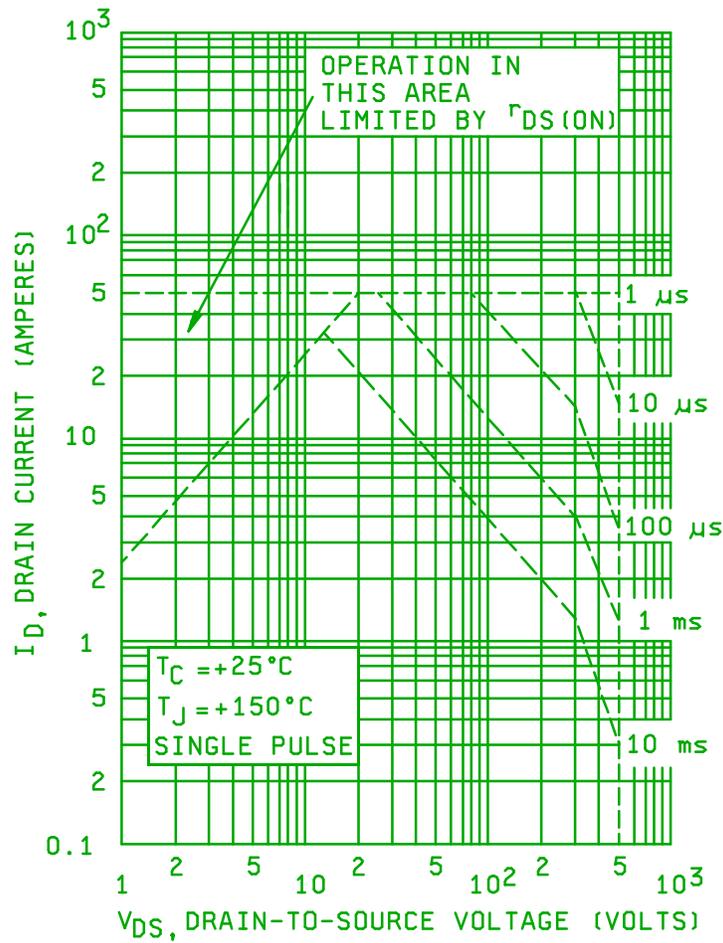
2N6766

FIGURE 5. Safe operating area graph - Continued.



2N6768

FIGURE 5. Safe operating area graph - Continued.



2N6770

FIGURE 5. Safe operating area graph - Continued.

5. PACKAGING

5.1 Packaging. Packaging shall prevent mechanical damage of the devices during shipping and handling and shall not be detrimental to the device. When actual packaging of material 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 Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

5.2 Marking. Unless otherwise specified (see 6.2), marking shall be in accordance with MIL-STD-129.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

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

6.2 Acquisition requirements. See MIL-PRF-19500.

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 Products List QPL No.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 purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from: Commander, Defense Supply Center Columbus, ATTN: DSCC-VQE, 3990 East Broad Street, Columbus, OH 43216-5000.

6.4 Substitution information. Devices covered by this specification are substitutable for the manufacturer's and user's PIN. This information in no way implies that manufacturer's PINs are suitable as a substitute for the military Part or Identifying Number (PIN).

PIN	Manufacturer's CAGE code	Manufacturer's and user's PIN
2N6764	17856, 04713, 59993, 18722	IRF150, IRF151, IRF152, IRF153
2N6766	17856, 04713, 59993, 18722	IRF250, IRF251, IRF252, IRF253
2N6768	17856, 04713, 59993, 18722	IRF350, IRF351, IRF352, IRF353
2N6770	17856, 04713, 59993, 18722	IRF450, IRF451, IRF452, IRF453

6.5 Replacement data. JANTX devices shall be a direct one way replacement for JAN devices (example: JANTX2N6764 for JAN2N6764).

6.6 Suppliers of JANC die. The qualified JANC suppliers with the applicable letter version (example JANHCAM2N6764) will be identified on the QPL.

JANC ordering information		
PIN	Manufacturer	
	59993	18722
2N6764	JANHCAM2N6764 JANTXHCAM2N6764 JANTXVHCAM2N6764 JANSHCAM2N6764	JANHCBM2N6764 JANTXHCBM2N764 JANTXVHCBM2N6764 JANSHCBM2N6764
2N6766	JANHCAM2N6766 JANTXHCAM2N6766 JANTXVHCAM2N6766 JANSHCA2N6766	JANHCBM2N6766 JANTXHCBM2N766 JANTXVHCBM2N6766 JANSHCBM2N6766
2N6768	JANHCAM2N6768 JANTXHCAM2N6768 JANTXVHCAM2N6768 JANSHCA2N6768	JANHCBM2N6768 JANTXHCBM2N768 JANTXVHCBM2N6768 JANSHCBM2N6768
2N6770	JANHCAM2N6770 JANTXHCAM2N6770 JANTXVHCAM2N6770 JANSHCA2N6770	JANHCBM2N6770 JANTXHCBM2N770 JANTXVHCBM2N6770 JANSHCBM2N6770

6.7 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodians:
Army - CR
Navy -EC
Air Force - 17

Preparing activity:
DLA - CC
(Project 5961-1617)

Review activities:
NAVY - TD
Air Force - 19, 70, 80, 85, 99

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I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
MIL-S-19500/543E

2. DOCUMENT DATE (YYMMDD)
970805

3. DOCUMENT TITLE

SEMICONDUCTOR DEVICE, FIELD EFFECT TRANSISTORS, N-CHANNEL, SILICON, TYPES 2N6764, 2N6766, AND 2N6770, JAN, JANTX, JANTXV, JANS, JANHC, AND JANKC

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
(YYMMDD)

(1) Commercial

(2) AUTOVON
(If applicable)

8. PREPARING ACTIVITY

a. NAME Alan Barone

b. TELEPHONE (Include Area Code)

(1) Commercial (2) AUTOVON
(614)692-0510 850-0510

c. ADDRESS (Include Zip Code)
Defense Supply Center Columbus, ATTN:
DSCC-VAT, 3990 East Broad Street,
Columbus, OH 43216-5000

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