The documentation and process conversion measures necessary to comply with this revision shall be completed by 12Jun93

INCH-POUND
MIL-S-19500/543D
30 June 1992
SUPERSEDING
MIL-S-19500/543C
8 September 1987

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, FIELD EFFECT TRANSISTORS, N-CHANNEL, SILICON TYPES 2N6764, 2N6766, 2N6768, 2N6770, JANTX, JANTXV, JANS, and JANC

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 detail requirements for N-channel, enhancement-mode, MOSFET, power transistor intended for use in high density power switching applications. Four levels of product assurance are provided for each device type as specified in MIL-S-19500. See 6.4 for JAN level. See 6.5 for JANC 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 figure 2 and figure 3 herein for JANC (die) dimensions.

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

Type	P_T 1/ T_C = +25°C	P_T T_A = +25°C (free air)	V_{DS}	V_{DG}	V_{GS}	I_{D1} 2/ T_C = +25°C	I_{D2} 2/ T_C = +100°C	I_S
	W	W	V dc	V dc	V dc	A dc	A dc	A dc
2N6764	150	4	100	100	±20	38.0	24.0	38.0
2N6766	150	4	200	200	±20	30.0	19.0	30.0
2N6768	150	4	400	400	±20	14.0	9.0	14.0
2N6770	150	4	500	500	±20	12.0	7.75	12.0

I_{DM} 3/	T_J and T_{STG}	V_{ISO} 70,000 ft altitude	Max $r_{DS(on)}$ 1/ V_{GS} = 10 V dc, I_D = I_{D2}		$R_{\theta JC}$ max
			T_J = +25°C	T_J = +150°C	
A (pk)	°C		ohm	ohm	°C/W
152	-55 to +150	---	0.055	0.105	0.83
120	-55 to +150	---	0.085	0.170	0.83
56	-55 to +150	400	0.300	0.750	0.83
48	-55 to +150	500	0.400	1.000	0.83

See footnotes on next page.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: NASA/Parts Project Office (NPPO), NASA Goddard Space Center, Code 310.A, Greenbelt, MD 20771 by using the Standardization Document Improvement Proposal (DD form 1426) appearing at the end of this document or by letter

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1/ *Derate linearly, 1.2 W/°C for T_C > +25 °C.* $P_T = \frac{T_J \max - T_C}{R_{\theta JC}}$

2/ $I_{D1} = \sqrt{\frac{T_J \max - T_C}{(R_{\theta JC}) \times (R_{DS(on)} \text{ at } T_J \max)}}$

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

1.4 Primary electrical characteristics at T_C = +25°C, unless otherwise specified.

Type	Min $V_{(BR)DSS}$ V_{GS} = 0 V I_D = 1 mA dc	$V_{GS(th)1}$ $V_{DS} \geq V_{GS}$ I_D = 0.25 mA		Max I_{DSS1} V_{GS} = 0 V	Max $r_{DS(on)1}$ 1/ V_{GS} = 10 V dc $I_D = I_{D2}$
				V_{DS} = 80% of rated V_{DS}	T_J = +25°C
	V dc	V dc Min	Max	µA dc	ohms
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 Government documents.

2.1.1 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

MILITARY

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

STANDARD

MILITARY

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

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 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.

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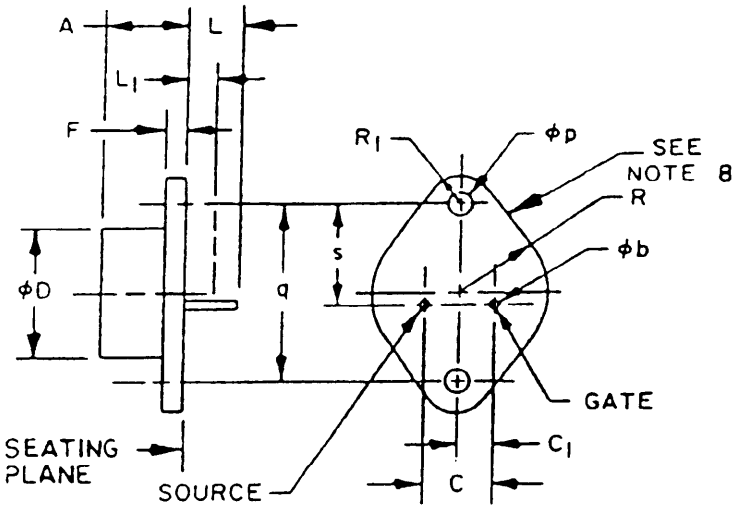
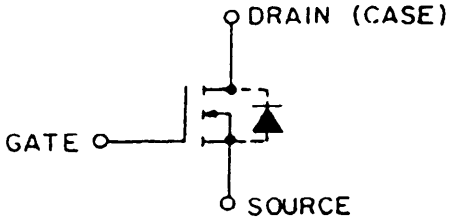


Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
A	.250	.360	6.35	9.15	
ϕb	.057	.063	1.45	1.60	5
ϕb	.038	.043	0.97	1.10	6
ϕD		.875		22.23	
C	.420	.440	10.67	11.18	7
C_1	.205	.225	5.21	5.72	7
F	.060	.135	1.52	3.43	
L	.312	.500	7.92	12.70	
L_1		.050		1.27	
ϕp	.161	.165	4.09	4.19	
q	1.177	1.197	29.90	30.40	
R	.495	.525	12.57	13.34	
R_1	.131	.188	3.33	4.78	
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 should be measured at points .050 (1.27 mm) and .055 (1.40 mm) below 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 (0.03 mm) concave to .004 (0.10 mm) convex inside a .930 (23.62 mm) diameter circle on the center of the header and flat within .001 (0.03 mm) concave to .006 (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.

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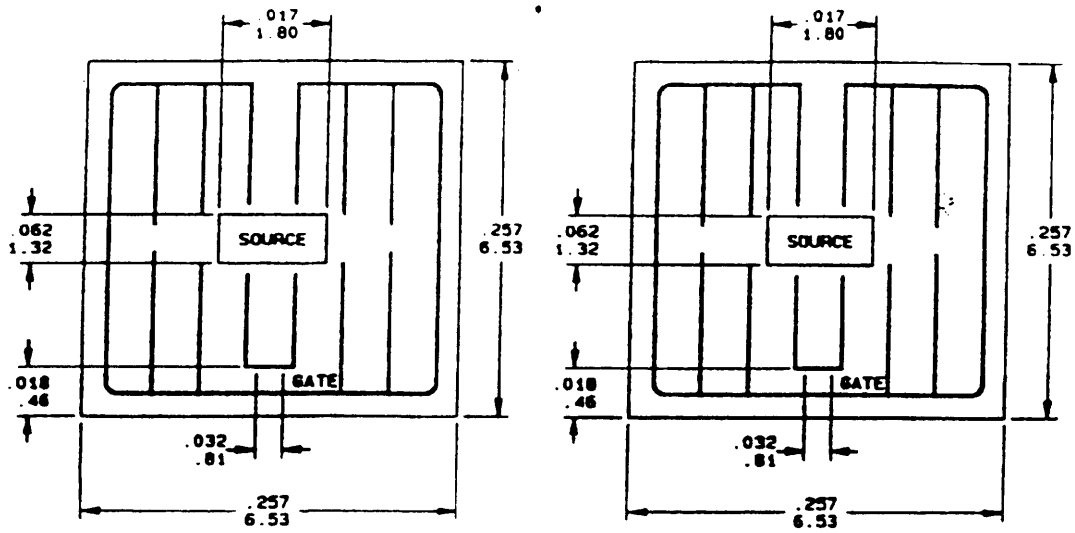
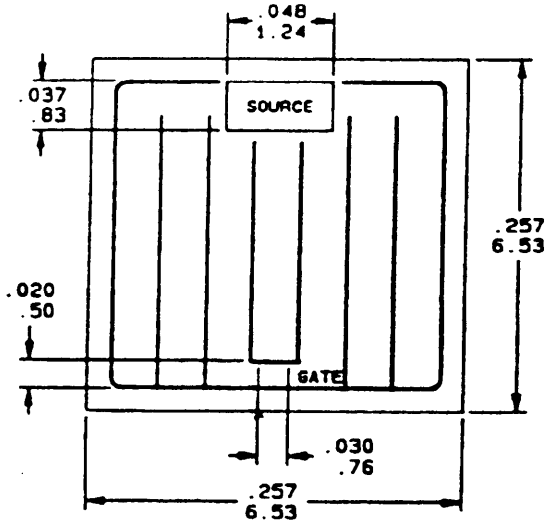


2N6764

2N6766



2N6768, 2N6770

Inches	mm	Inches	mm
.018	0.46	.46	11.7
.020	0.51	.50	12.7
.030	0.76	.76	19.3
.032	0.81	.81	20.6
.037	0.94	.83	21.1
.048	1.22	1.24	31.5
.062	1.58	1.32	33.5
.071	1.80	1.80	45.7
.257	6.53	6.53	165.9

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Unless otherwise specified, tolerance is ±.005 (0.13 mm).
4. The physical characteristics of the die thickness are .0187 (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. JANC A-version die dimensions.

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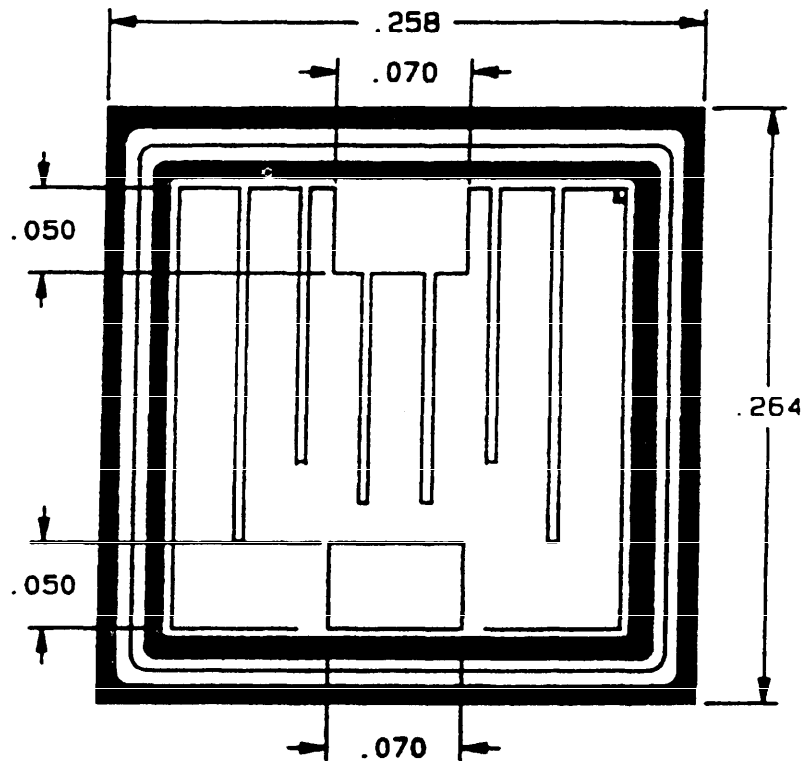

Inches	mm
.050	1.27
.070	1.78
.258	6.57
.264	6.72

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Unless otherwise specified, tolerance is ±.005 (0.13 mm).
4. The physical characteristics of the die thickness is .014 (0.36 mm). The back metals are nickel, aluminum, and titanium. The top metal is aluminum and the back contract is the drain.

FIGURE 3. JANC B-versions die dimensions for 2N6764, 2N6766, 2N6768, and 2N6770.

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3. REQUIREMENTS

3.1 Detail specification. The individual item requirements shall be in accordance with MIL-S-19500, and as specified herein.

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

3.3 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-S-19500, and 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 plated core is permitted. Lead finish shall be solderable in accordance with MIL-STD-750, MIL-S-19500 and herein. Where a choice of lead material or finish is desired, it shall be specified in the contract or purchase order (see 6.2).

3.3.2 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-S-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 electrostatic charge. The following handling practices shall be followed.

a. Devices shall 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 shall be exercised, during test and troubleshooting, to apply not more than maximum rated voltage to any lead.

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

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein.

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-S-19500, and as specified herein. Alternate flow is allowed for qualification inspection in accordance with figure 2 of MIL-S-19500.

4.2.1 Group E inspection. Group E inspection shall be conducted in accordance with MIL-S-19500, and table IV herein.

4.3 Screening (JANS, JANTXV, and JANTX levels only). Screening shall be in accordance with MIL-S-19500 (table II), 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.

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4.3.1 Screening (JANC). Screening shall be in accordance with MIL-S-19500 (appendix H). As a minimum die shall be 100 percent probed in accordance with group A, subgroup 2 except test current shall not exceed 20 A.

Screen (see table II of MIL-S-19500)	Measurement	
	JANS level	JANTX and JANTXV levels
1/	Gate stress test (see 4.5.5).	Gate stress test (see 4.5.5).
1/ 2/	Method 3470 (see 4.5.4). Optional	Method 3470 (see 4.5.4). Optional
1/	Method 3161 (see 4.5.3).	Method 3161 (see 4.5.3).
9	I_{GSS1}, I_{DSS1}	
10	Method 1042, test condition B.	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 ΔI_{GSS1} = ±20 nA dc or ±100% of initial value whichever is greater ΔI_{DSS1} = ±25 µA dc or ±100% 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	Method 1042, test condition A, t = 240 hrs.	Method 1042, test condition A, or t = 48 hrs. min. at T_A = 175°C min.
13	Subgroups 2 and 3 of table I herein ΔI_{GSS1} = ±20 nA dc or ±100% of initial value whichever is greater ΔI_{DSS1} = ±25 µA dc or ±100% of initial value whichever is greater $\Delta r_{DS(on)1}$ = ±20% of initial value $\Delta V_{GS(th)1}$ = ±20% of initial value.	Subgroup 2 of table I herein ΔI_{GSS1} = ±20 nA dc or 100% of initial value whichever is greater ΔI_{DSS1} = ±25 µA dc or ±100% of initial value whichever is greater $\Delta r_{DS(on)1}$ = ±20% of initial value $\Delta V_{GS(th)1}$ = ±20% of initial value.

1/ Shall be performed anytime before screen 10.
2/ This test method in no way implies a repetitive avalanche energy rating. This test need not be performed in group A when performed as a screen.

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

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4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-S-19500, and table I herein. (End-point electrical measurements shall be in accordance with the applicable steps of table V herein.)

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IVa (JANS) and table IVb (JANTX and JANTXV) of MIL-S-19500, and table IIa and IIb herein. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table V herein.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table V of MIL-S-19500, and table III herein. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table V 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. $R_{\theta JC}$ max = 0.83°C/W.

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

4.5.3 Thermal response (ΔV_{SD} measurement). The delta V_{SD} measurements shall be performed in accordance with method 3161 of MIL-STD-750. The delta V_{SD} conditions (I_H and V_H) and maximum limit shall be derived by each vendor from the thermal response curves (see figure 4). The read and record delta V_{SD} measurements and conditions for each device in the qualification lot shall be submitted read and record 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 (min)
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 µs
f. t_{SW} sample window time - - - - - - - 10 µs (max)

4.5.4 Single pulse unclamped inductive switching.

a. Peak current, I_D - - - - - - - - - - rated I_D
b. Peak gate voltage, V_{GS} - - - - - - - 10 V
c. Gate to source resistor - - - - - - 25 $\leq R_{GS} \leq$ 200Ω
d. Initial case temperature - - - - - - +25°C +10, -5°C
e. Inductance - - - - - - - - - - - - - 100 µH min
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 µs minimum.

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TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical inspection	2071					
Subgroup 2						
Breakdown voltage, drain to source	3407	V_{GS} = 0 V dc, I_D = 1 mA dc Condition C.	$V_{(BR)DSS}$			V dc
2N6764				100	---	
2N6766				200	---	
2N6768				400	---	
2N6770				500	---	
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
Gate current	3411	V_{GS} = +20 V dc 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% of rated V_{DS}, Bias condition C.	I_{DSS1}	---	25	µA 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°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	

See footnote at end of table.

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TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Forward voltage (source drain diode)	4011	Pulsed (see 4.5.1) V_{GS} = 0 V dc, $I_D = I_{D1}$.	V_{SD}			V
2N6764					1.9	
2N6766					1.9	
2N6768					1.7	
2N6770					1.7	
Subgroup 3						
High temperature operation		T_C = +125°C				
Gate current	3411	Bias condition C V_{GS} = +20 V dc 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% of rated V_{DS}	I_{DSS2}	---	1.0	mA dc
		V_{DS} = 80% 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 = rated I_{D2}.	$r_{DS(on)3}$			Ω
2N6764				---	0.094	
2N6766				---	0.153	
2N6768				---	0.66	
2N6770				---	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°C				
Gate to source voltage (threshold)	3404	$V_{DS} \geq V_{GS}$ I_D = 0.25 mA dc	$V_{GS(th)3}$	---	5.0	V dc
Subgroup 4						
Switching time test	3472	I_D = rated I_{D1} V_{GS} = 10 V dc Gate drive Impedance = 2.35Ω V_{DD} = 0.5 $V_{BR(DSS)}$.				

See footnote at end of table.

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TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Turn-on delay time			$t_{d(on)}$	---	35	ns
2N6764						
2N6766						
2N6768						
2N6770						
Rise time			t_r		190	ns
2N6764				---		
2N6766				---		
2N6768				---		
2N6770				---		
Turn-off delay time			$t_{d(off)}$		170	ns
2N6764				---		
2N6766				---		
2N6768				---		
2N6770				---		
Fall time			t_f		130	ns
2N6764				---		
2N6766				---		
2N6768				---		
2N6770				---		
Subgroup 5						
Single pulse unclamped inductive switching	3470	See 4.5.4, 116 devices c = 0				
Electrical measurements		See table V, steps 1, 2, 3, 4, 5, and 6.				
Safe operating area test	3474	See figure 5, V_{DS} = 80% of rated $V_{BR(DSS)}$ t_p = 10 ms, V_{DS} = 200 V max.				
Electrical measurements		See table V, steps 1, 2, 3, 4, 5, 6, and 7.				
Subgroup 6						
Not applicable						

See footnote at end of table.

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TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 7						
Gate charge	3471	Condition B				
On-state gate charge			$Q_{g(on)}$			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	di/dt = 100 A/µs $V_{DD} \leq 30$ V dc $I_D = I_{D1}$.	t_{rr}			ns
2N6764				---	500	
2N6766				---	950	
2N6768				---	1200	
2N6770				---	1600	

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

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TABLE IIa. Group B inspection for JANS device.

Inspection 1/	MIL-STD-750	
	Method	Conditions
Subgroup 1		
Physical dimensions	2066	See figure 1.
Subgroup 2 2/		
Solderability	2026	
Resistance to solvents	1022	
Subgroup 3		
Temperature cycling	1051	Test condition G
Hermetic seal	1071	
Fine leak		
Gross leak		
Electrical measurements		See table V, steps 1, 2, 3, 4, 5, 6, and 7.
Decap internal visual (design verification)	2075	See 3.3.2
SEM	2077	
Die shear	2017	

See footnotes at end of table.

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TABLE IIa. Group B inspection for JANS device - Continued.

Inspection 1/	MIL-STD-750	
	Method	Conditions
Subgroup 4		
Intermittent operation life	1042	Condition D: The heating cycle shall be 1 minute minimum, 2,000 cycles min. No heat sink nor forced air cooling on the device shall be permitted, during the on cycle.
Electrical measurements		See table V, steps 1, 2, 3, 4, 5, 6, 7, and 8.
Bond strength	2037	Test condition A
Subgroup 5 2/		
Accelerated steady-state reverse bias	1042	Condition A, V_{DS} = rated T_A = +175°C, t = 120 hours min Read and record $V_{BR(DSS)}$ (pre and post) at I_D = 1 mA Read and record I_{DSS} (pre and post), see table V.
Electrical measurements		See table V, steps 1, 2, 3, 4, 5, 6, and 7. No more than 15% of the sample shall be permitted to have a $\Delta V_{BR(DSS)}$ shift of more than 10% and ΔI_{DSS} greater than 50 µA.
Accelerated steady-state gate stress		Condition B, V_{GS} = rated T_A = +175 °C min, t = 24 hours min.
Electrical measurements		See table V, steps 1, 2, 3, 4, 5, 6, and 7.
Subgroup 6		
Thermal impedance	3161	See 4.5.2

1/ For sampling plan, see MIL-S-19500.
2/ A separate sample may be pulled for each test.

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TABLE IIb. Group B inspection for JANTX and JANTXV.

Inspection 1/	MIL-STD-750	
	Method	Conditions
Subgroup 1 2/		
Solderability	2026	
Resistance to solvents	1022	
Subgroup 2		
Temperature cycling	1051	Test condition G
Hermetic seal	1071	
Fine leak Gross leak		
Electrical measurements		See table V, steps 1, 2, 3, 4, 5, 6, and 7.
Subgroup 3		
Intermittent operation	1042	Test condition D, 2,000 cycles. The heating cycle shall be 1 minute minimum.
Electrical measurements		See table V, steps 1, 2, 3, 4, 5, 6, 7, and 8.
Bond strength (wire or clip bonded)	2037	Test condition A. All internal bond wires for each device shall be pulled separately.
Subgroup 4		
Decap internal visual (design verification)	2075	See 3.3.2
Subgroup 5		
Not applicable		
Subgroup 6		
Not applicable		

1/ For sampling plan, see MIL-S-19500.
2/ A separate sample may be pulled for each test.

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TABLE III. Group C inspection (all quality levels).

Inspection 1/	MIL-STD-750	
	Method	Conditions
Subgroup 1		
Physical dimensions	2066	See figure 1.
Subgroup 2		
Thermal shock (glass strain)	1056	Condition A
Terminal strength	2036	Test condition A: Weight = 10 lbs, t = 15 seconds
Hermetic seal	1071	
Fine leak		
Gross leak		
Moisture resistance	1021	
Electrical measurements		See table V, steps 1, 2, 3, 4, 5, 6, and 7.
Subgroup 3		
Shock	2016	
Vibration, variable frequency	2056	
Constant acceleration	2006	
Electrical measurements		See table V, steps 1, 2, 3, 4, 5, 6, and 7.
Subgroup 4		
Salt atmosphere	1041	
Subgroup 5		
Not applicable		
Subgroup 6		
Intermittent operation	1042	Test condition D: 6,000 cycles min. The heating cycle shall be 1 minute minimum.
Hermetic seal	1071	
Fine leak		
Gross leak		
Electrical measurements		See table V, steps 1, 2, 3, 4, 5, 6, 7, and 8.

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

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

Inspection	MIL-STD-750		Qualification and large lot quality conformance inspection
	Method	Conditions	
Subgroup 1			45 devices c = 1
Temperature cycling	1051	Test condition G, 500 cycles.	
Hermetic seal	1071		
a. Fine leak b. Gross leak			
Electrical measurements		See table V, steps 1, 2, 3, 4, 5, 6, and 7.	
Subgroup 2 1/			45 devices c = 1
Steady-state reverse bias	1042	Condition A: 1,000 hours	
Electrical measurements		See table V, steps 1, 2, 3, 4, 5, 6, and 7.	
Steady-state gate bias	1042	Condition B: 1,000 hours	
Electrical measurements		See table V, steps 1, 2, 3, 4, 5, 6, and 7.	
Subgroup 3			3 devices, c = 0
Destructive physical analysis (DPA)	2102		
Subgroup 4			5 devices c = 0
Thermal resistance	3161	$R_{\theta JC}$ = 0.83°C/W max. See 4.5.2	
Subgroup 5			5 devices c = 0
Barometric pressure (reduced) 400 and 500 V only	1001	Test condition C, $V_{ISO} = V_{DS}$ $I_{(ISO)}$ = .25 mA (max).	

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

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TABLE V. Groups A, B, C, and E electrical end-point measurements.

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Breakdown voltage drain to source	3407	V_{GS} = 0, I_D = 1 mA dc Bias condition C	$V_{(BR)DSS}$			V dc
	2N6764				100	---	
	2N6766				200	---	
	2N6768				400	---	
	2N6770				500	---	
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} = ±20 V dc Bias condition C	I_{GSS1}	---	±100	nA dc
4.	Drain current	3413	V_{GS} = 0, V_{DS} = 80% of rated V_{DS}, bias condition C	I_{DSS1}	---	25	µA dc
5.	Static drain to source on-state resistance	3421	V_{GS} = 10 V dc Condition A Pulsed (see 4.5.1) $I_D = I_{D2}$.	$r_{DS(on)1}$			Ω
	2N6764				---	0.055	
	2N6766				---	0.085	
	2N6768				---	0.3	
	2N6770				---	0.4	
6.	Static drain to source on-state resistance	3421	V_{GS} = 10 V dc Condition A Pulsed (see 4.5.1) $I_D = I_{D1}$.	$r_{DS(on)2}$			Ω
	2N6764				---	.065	
	2N6766				---	.090	
	2N6768				---	.400	
	2N6770				---	.500	
7.	Forward voltage (source-drain diode)	4011	Pulsed (see 4.5.1) V_{GS} = 0 V dc, $I_D = I_{D1}$	V_{SD}			V
	2N6764					1.9	
	2N6766					1.9	
	2N6768					1.7	
	2N6770					1.7	
8.	Thermal response	3161	See 4.5.3	ΔV_{SD}			

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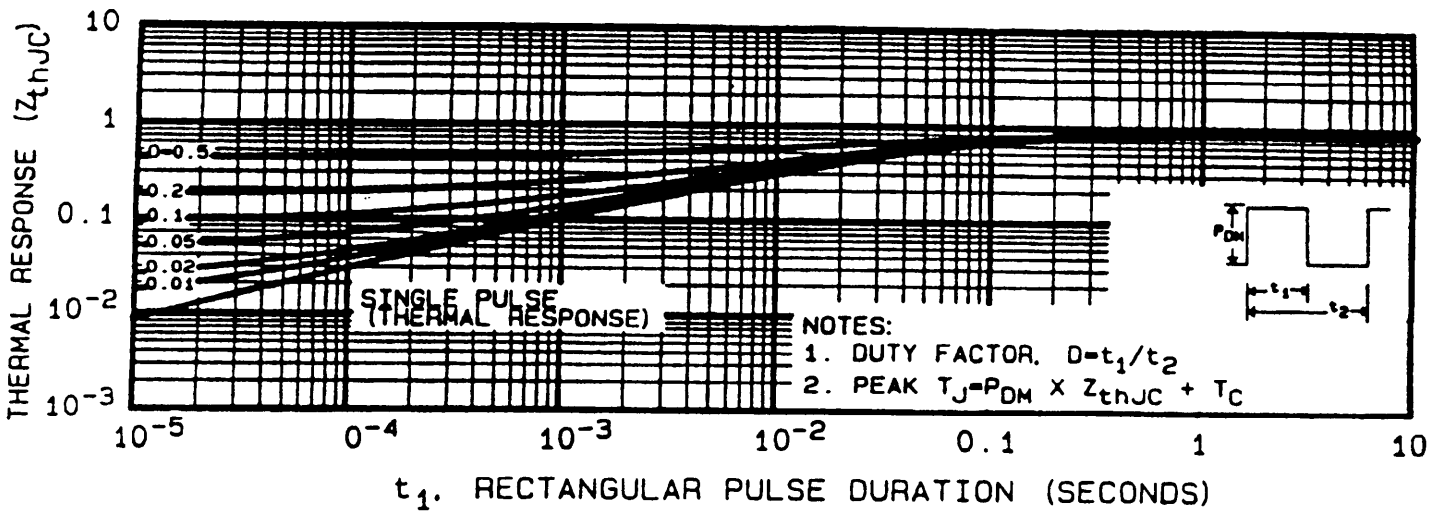

FIGURE 4 . Thermal response curves.

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2N6764

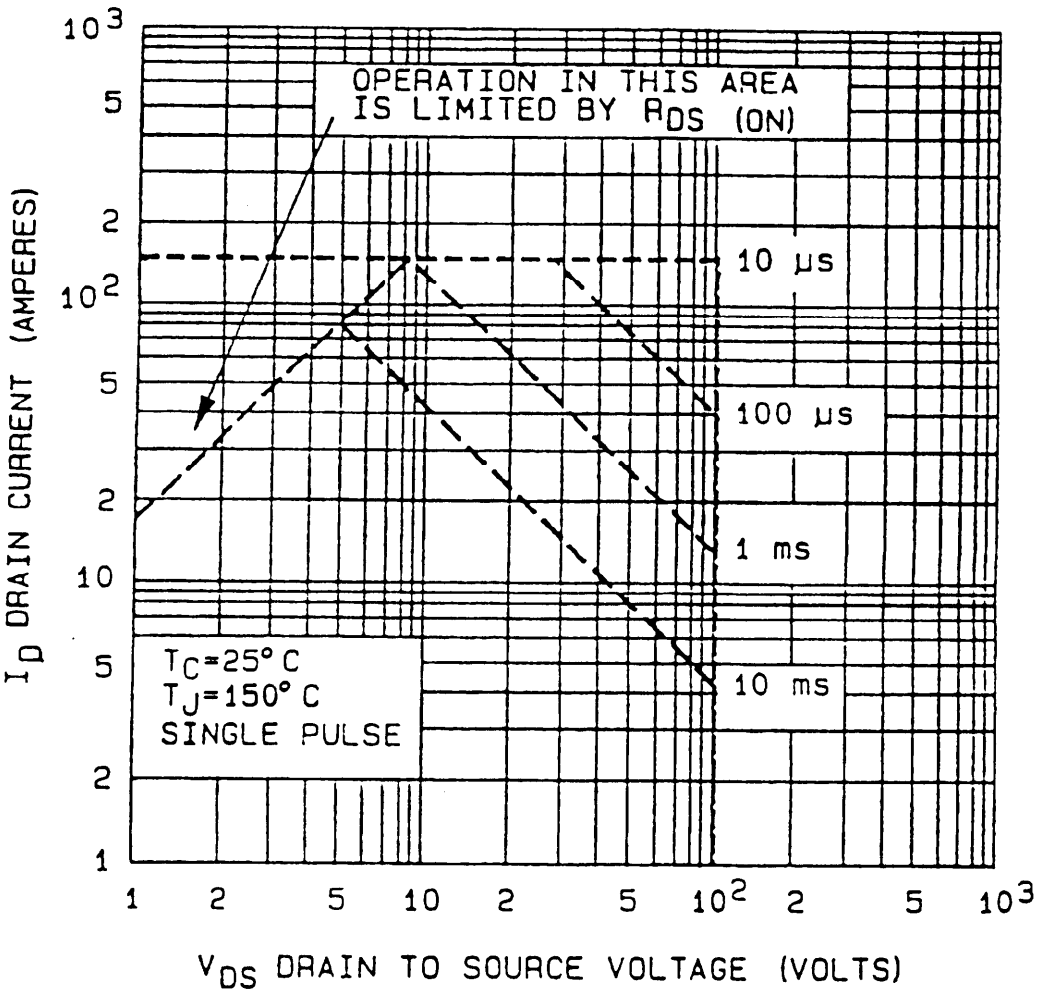

FIGURE 5. Safe operating area graphs.

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2N6766

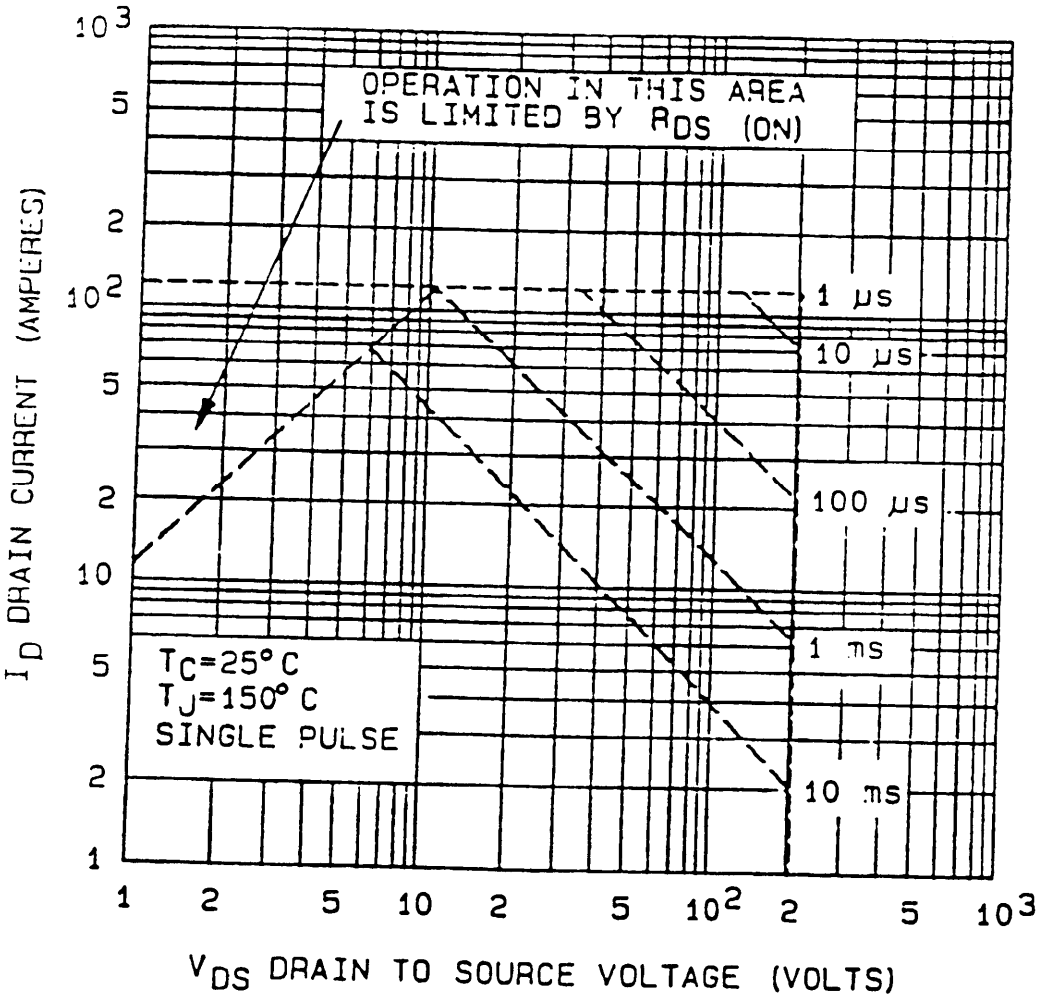

FIGURE 5. Safe operating area graphs - Continued.

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2N6768

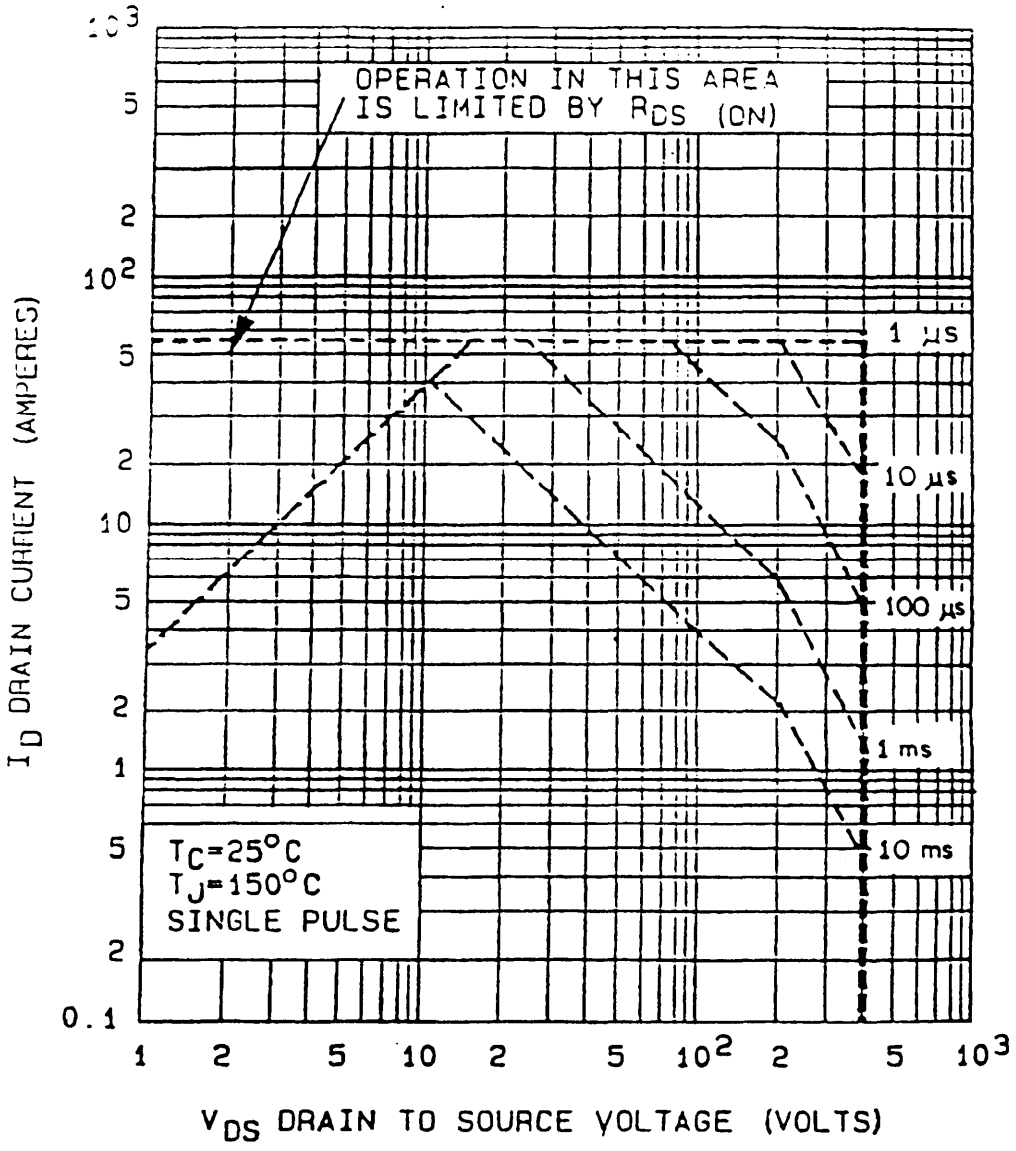

FIGURE 5. Safe operating area graphs - Continued.

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2N6770

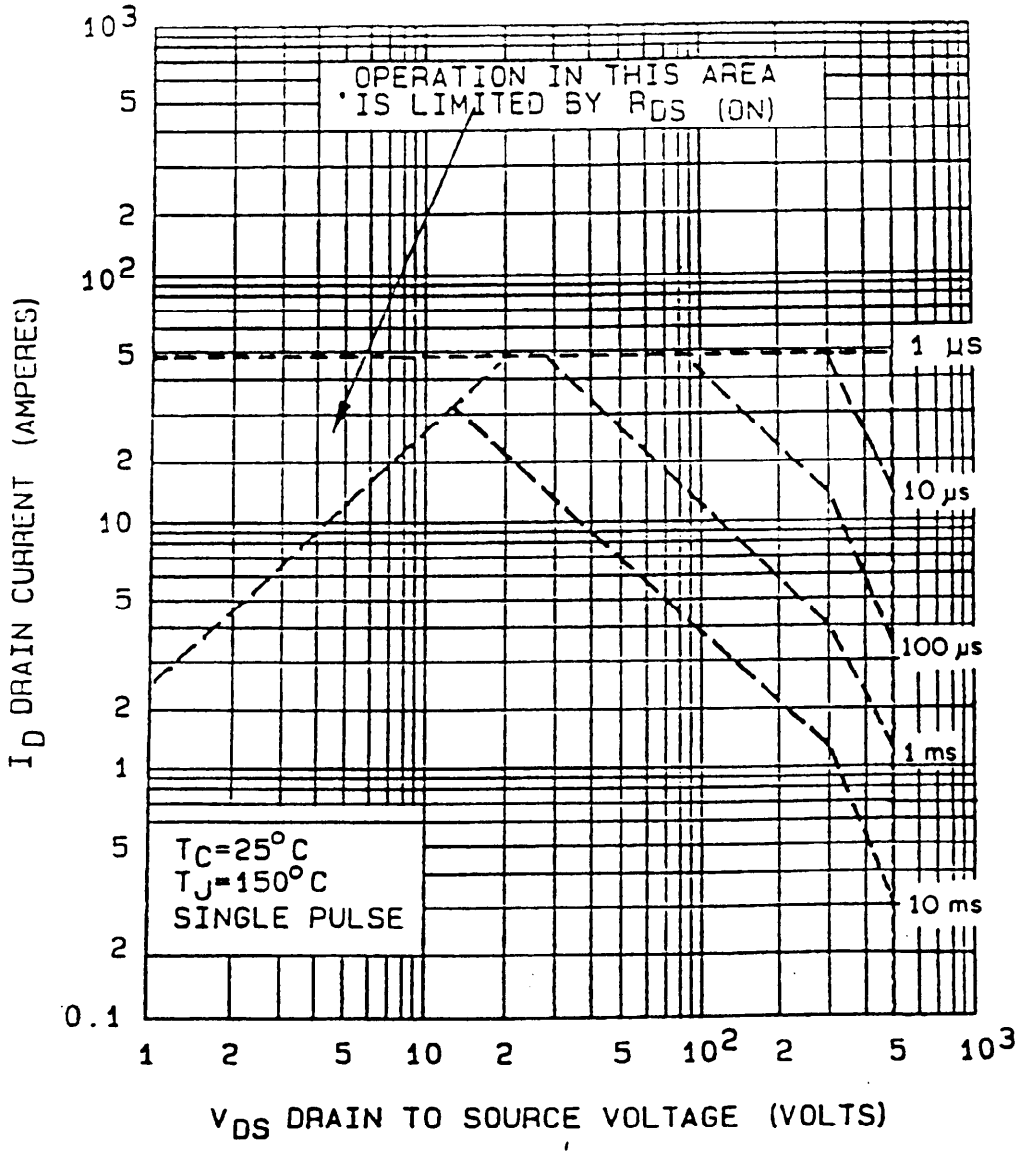

FIGURE 5. Safe operating area graphs - Continued.

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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-S-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of the specification.

b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1).

c. Lead material and finish as specified (see 3.3.1).

d. For die acquisition, the JANC letter version should be specified (see figures 2 and 3).

e. Type designator and product assurance level.

6.3 Substitution information. Devices covered by this specification are substitutable for the manufacturer's and user's part number. This information in no way implies that manufacturer's part numbers 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

6.4 Replacement data. JANTX devices shall be a direct replacement for JAN devices (example: JANTX2N6764 for JAN2N6764). Manufacturers can no longer manufacture device types from this specification with a JAN assurance level.

6.5 Suppliers of JANC die. The qualified JANC die suppliers with the applicable letter version (example JANCA6764) will be identified on the QPL.

JANC Ordering Information		
	manufacture	
PIN	59993	18722
2N6764	A6764	B6764
2N6766	A6766	B6766
2N6768	A6768	B6768
2N6770	A6770	B6770

6.6 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

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CONCLUDING MATERIAL

Custodians:
Army - ER
Navy - EC
Air Force - 17
NASA - NA

Review activities:
Navy - TD
Air Force - 70, 80
DLA - ES
NASA - LRC, MSF

User activity:
Air Force - 19

Preparing activity:
NASA - NA

Agent:
DLA - ES

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-S-19500/543D	2. DOCUMENT DATE (YYMMDD)

3. DOCUMENT TITLE Semiconductor Device, Field Effect Transistory N-Channel, Silicon Types 2N6764, 2N6766, 2N6768, 2N6770

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) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON
c. ADDRESS (Include Zip Code)	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340

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