

**700V(D-S) N-Channel Enhancement Mode Power MOS FET**

**General Features**

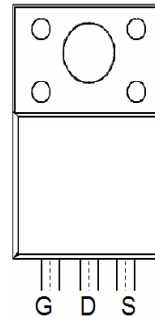
- $V_{DS} = 700V, I_D = 4A$   
 $R_{DS(ON)} < 2.3 \Omega @ V_{GS} = 10V$
- High density cell design for ultra low  $R_{ds(on)}$
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high  $E_{AS}$
- Excellent package for good heat dissipation
- Special process technology for high ESD capability



**Lead Free**

**Application**

- Power switching application
- Hard switched and high frequency circuits
- Electronic ballast and transformer

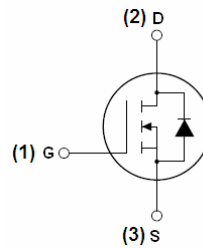


**Marking and pin assignment**

**PIN Configuration**



**TO-220F top view**



**Schematic diagram**

**Package Marking and Ordering Information**

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
MSN7004F	MSN7004F	TO-220F	-	-	-

**Absolute Maximum Ratings ( $T_C = 25^\circ C$  unless otherwise noted)**

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	700	V
Gate-Source Voltage	$V_{GS}$	$\pm 30$	V
Drain Current-Continuous	$I_D$	4	A
Drain Current-Continuous( $T_C = 100^\circ C$ )	$I_D(100^\circ C)$	2.4	A
Pulsed Drain Current	$I_{DM}$	16	A
Maximum Power Dissipation	$P_D$	36	W
Derating factor		0.20	W/ $^\circ C$
Single pulse avalanche energy <sup>(Note 5)</sup>	$E_{AS}$	260	mJ
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 150	$^\circ C$

**Thermal Characteristic**

Thermal Resistance, Junction-to-Case <sup>(Note 2)</sup>	$R_{\theta JC}$	3.47	°C/W
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**Electrical Characteristics (T<sub>C</sub>=25°C unless otherwise noted)**

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	700	-	-	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=700V, V_{GS}=0V$	-	-	1	μA
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 30V, V_{DS}=0V$	-	-	±100	nA
<b>On Characteristics</b> <sup>(Note 3)</sup>						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2	-	4	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=2.0A$	-	-	2.3	Ω
Forward Transconductance	$g_{FS}$	$V_{DS}=40V, I_D=2.0A$	-	4.0	-	S
<b>Dynamic Characteristics</b> <sup>(Note 4)</sup>						
Input Capacitance	$C_{iss}$	$V_{DS}=25V, V_{GS}=0V,$ $F=1.0MHz$	-	730	-	PF
Output Capacitance	$C_{oss}$		-	25	-	PF
Reverse Transfer Capacitance	$C_{rss}$		-	16	-	PF
<b>Switching Characteristics</b> <sup>(Note 4)</sup>						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=350V, I_D=4A, R_L=25\Omega$ $V_{GS}=10V, R_G=2.5\Omega$	-	10	-	nS
Turn-on Rise Time	$t_r$		-	26	-	nS
Turn-Off Delay Time	$t_{d(off)}$		-	25	-	nS
Turn-Off Fall Time	$t_f$		-	27	-	nS
Total Gate Charge	$Q_g$	$V_{DS}=560V, I_D=4A,$ $V_{GS}=10V$	-	17.5	-	nC
Gate-Source Charge	$Q_{gs}$		-	4.8	-	nC
Gate-Drain Charge	$Q_{gd}$		-	5.4	-	nC
<b>Drain-Source Diode Characteristics</b>						
Diode Forward Voltage <sup>(Note 3)</sup>	$V_{SD}$	$V_{GS}=0V, I_S=4.0A$	-	-	1.4	V
Diode Forward Current <sup>(Note 2)</sup>	$I_S$		-	-	4.0	A
Reverse Recovery Time	$t_{rr}$	$T_J = 25^\circ C, I_F = 4.0A$ $di/dt = 100A/\mu s$ <sup>(Note 3)</sup>	-	250	-	nS
Reverse Recovery Charge	$Q_{rr}$		-	1.5	-	μC
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

**Notes:**

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. E<sub>AS</sub> condition:  $j=25^\circ C, V_{DD}=50V, V_G=10V, L=0.5mH, R_g=25\Omega$

**Typical Electrical and Thermal Characteristics (Curves)**

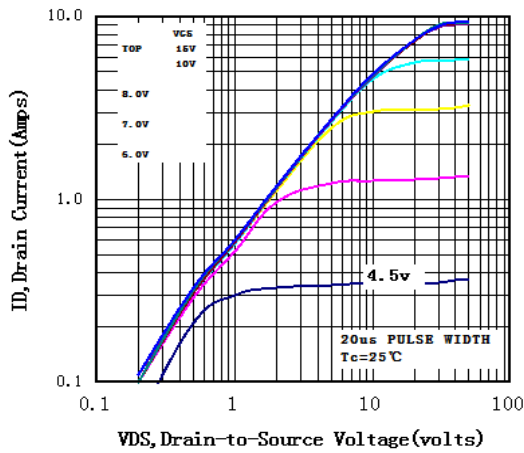


Fig1 Typical Output Characteristics, Tc=25°C

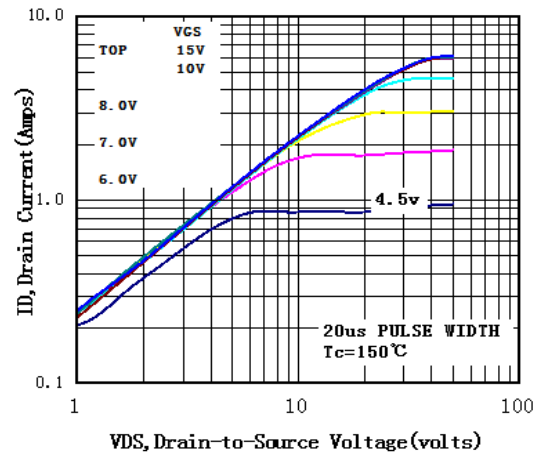


Fig2 Typical Output Characteristics, Tc=150°C

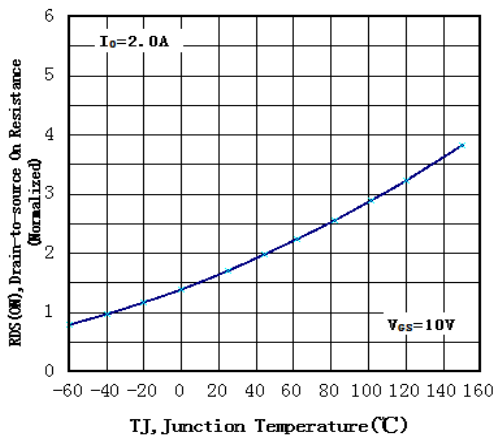


Fig3 Normalized Resistance Vs. Temperature

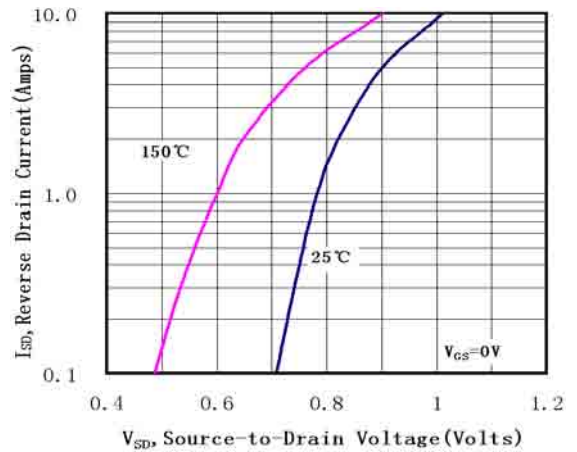


Fig4 Typical Source-Drain Diode Forward Voltage

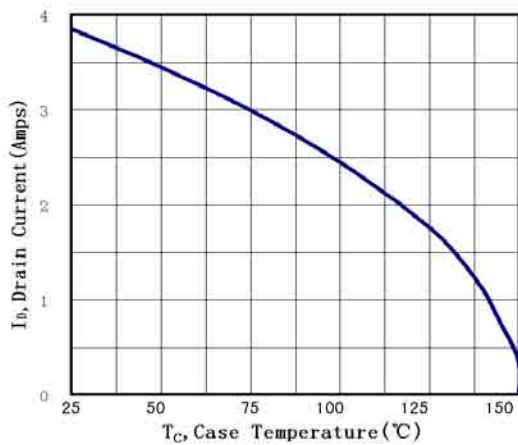


Fig5 Maximum Drain Current Vs. Case Temperature

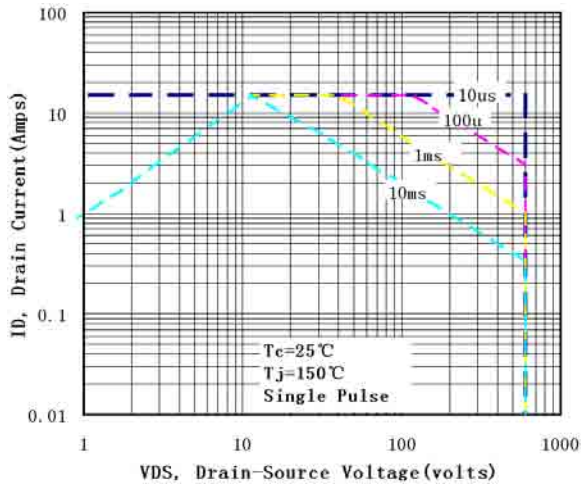


Fig6-1 Maximum Safe Operating Area

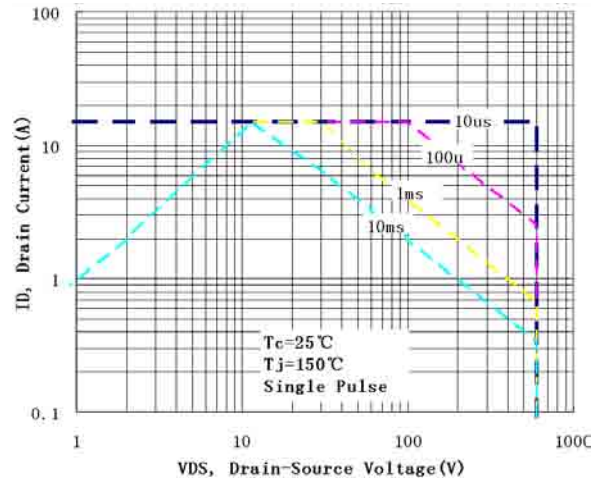
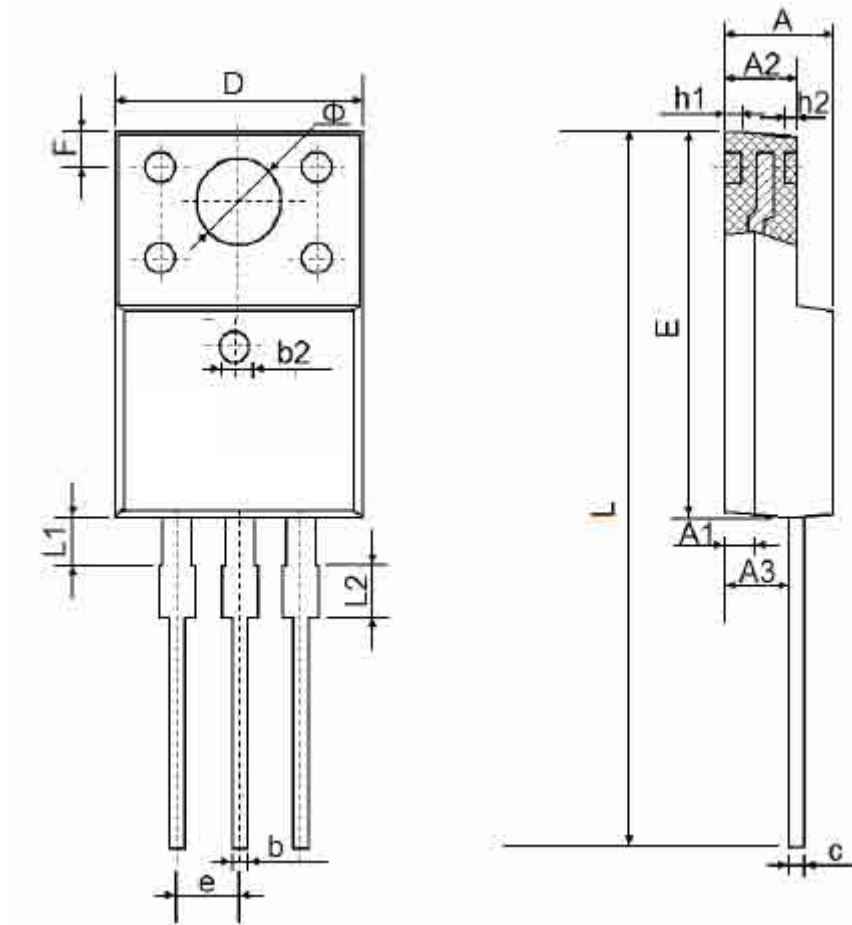


Fig6-2 Maximum Safe Operating Area

**TO-220F-3L Package Information**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.300	4.700	0.169	0.185
A1	1.300REF		0.051REF	
A2	2.800	3.200	0.110	0.126
A3	2.500	2.900	0.098	0.114
b	0.500	0.750	0.020	0.030
b1	1.100	1.350	0.043	0.053
b2	1.500	1.750	0.059	0.069
c	0.500	0.750	0.020	0.030
D	9.960	10.360	0.392	0.408
E	14.800	15.200	0.583	0.598
e	2.540TYP.		0.100TYP	
F	2.700REF		0.106REF	
$\Phi$	3.500REF		0.138REF	
h1	0.800REF		0.031REF	
h2	0.500REF		0.020REF	
L	28.000	28.400	1.102	1.118
L1	1.700	1.900	0.067	0.075
L2	1.900	2.100	0.075	0.083