

600V(D-S) N-Channel Enhancement Mode Power MOS FET

General Features

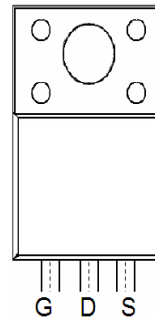
- $V_{DS} = 600V, I_D = 4A$
 $R_{DS(ON)} < 2.4 \Omega @ V_{GS} = 10V$
- High density cell design for ultra low $R_{DS(on)}$
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high E_{AS}
- Excellent package for good heat dissipation
- Special process technology for high ESD capability



Lead Free

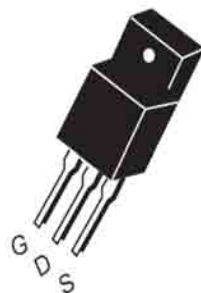
Application

- Power switching application
- Hard switched and high frequency circuits
- Uninterruptible power supply

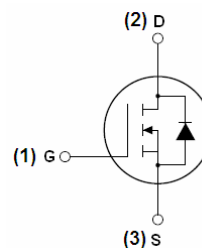


Marking and pin assignment

PIN Configuration



TO-220F top view



Schematic diagram

Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
MSN6004F	MSN6004F	TO-220F-3L	-	-	-

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

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	V_{DS}	600	V
Gate-Source Voltage	V_{GS}	± 30	V
Drain Current-Continuous	I_D	4	A
Drain Current-Continuous($T_C = 100^\circ C$)	$I_D(100^\circ C)$	3.2	A
Pulsed Drain Current	I_{DM}	16	A
Maximum Power Dissipation	P_D	30	W
Derating factor		1.47	W/ $^\circ C$
Single pulse avalanche energy ^(Note 5)	E_{AS}	240	mJ
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55 To 155	$^\circ C$

Thermal Characteristic

Thermal Resistance, Junction-to-Case ^(Note 2)	$R_{\theta JC}$	2.6	°C/W
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Electrical Characteristics ($T_C=25^{\circ}\text{C}$ unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	BV _{DSS}	V _{GS} =0V I _D =250μA	600	-	-	V
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} =600V, V _{GS} =0V	-	-	1	μA
Gate-Body Leakage Current	I _{GSS}	V _{GS} =±30V, V _{DS} =0V	-	-	±100	nA
On Characteristics ^(Note 3)						
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =V _{GS} , I _D =250μA	2	-	4	V
Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} =10V, I _D =2.0A	-	-	2.4	Ω
Forward Transconductance	g _{FS}	V _{DS} =40V, I _D =2A	-	4.7	-	S
Dynamic Characteristics ^(Note4)						
Input Capacitance	C _{ISS}	V _{DS} =25V, V _{GS} =0V, F=1.0MHz	-	490	-	PF
Output Capacitance	C _{OSS}		-	95	-	PF
Reverse Transfer Capacitance	C _{RSS}		-	9	-	PF
Switching Characteristics ^(Note 4)						
Turn-on Delay Time	t _{d(on)}	V _{DD} =300V, I _D =4A, R _L =25Ω V _{GS} =10V, R _G =2.5Ω	-	16	-	nS
Turn-on Rise Time	t _r		-	49	-	nS
Turn-Off Delay Time	t _{d(off)}		-	46	-	nS
Turn-Off Fall Time	t _f		-	37	-	nS
Total Gate Charge	Q _g	V _{DS} =480V, I _D =4A, V _{GS} =10V	-	13.3		nC
Gate-Source Charge	Q _{gs}		-	3.6		nC
Gate-Drain Charge	Q _{gd}		-	4.9		nC
Drain-Source Diode Characteristics						
Diode Forward Voltage ^(Note 3)	V _{SD}	V _{GS} =0V, I _S =4.0A	-		1.4	V
Diode Forward Current ^(Note 2)	I _S		-	-	4.0	A
Reverse Recovery Time	t _{rr}	T _J = 25°C, I _F = 4.0A di/dt = 100A/μs ^(Note3)	-	330		nS
Reverse Recovery Charge	Q _r		-	2.67		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_{AS} condition: $j=25^{\circ}\text{C}, V_{DD}=50V, V_G=10V, L=0.5mH, R_g=25\Omega$

Typical Electrical and Thermal Characteristics (Curves)

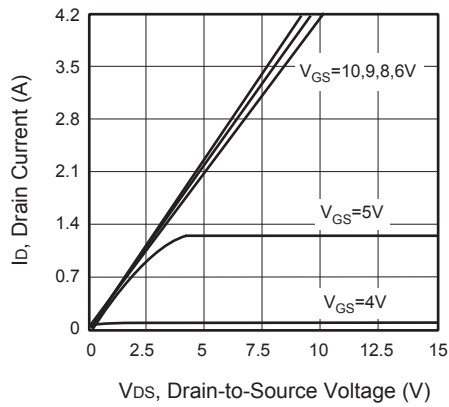


Figure 1. Output Characteristics

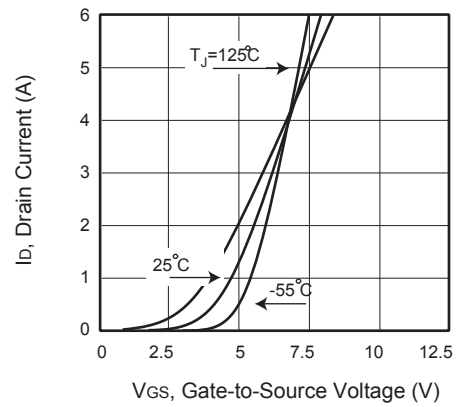


Figure 2. Transfer Characteristics

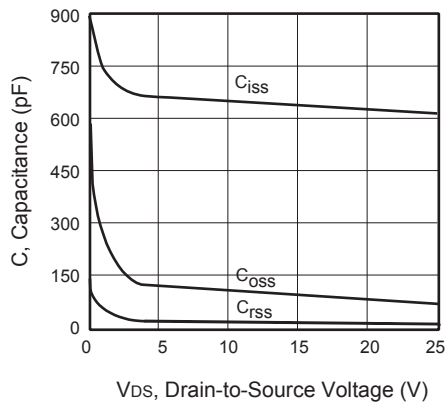


Figure 3. Capacitance

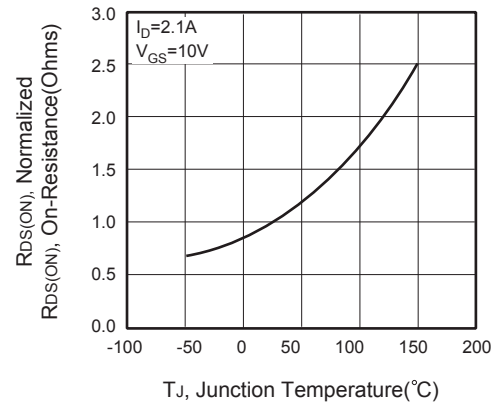


Figure 4. On-Resistance Variation with Temperature

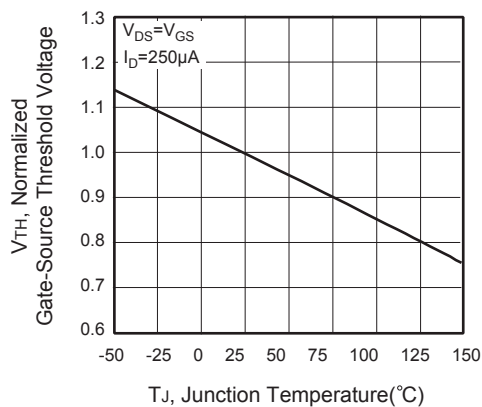


Figure 5. Gate Threshold Variation with Temperature

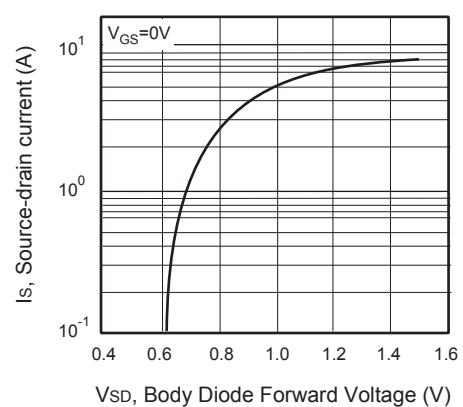


Figure 6. Body Diode Forward Voltage Variation with Source Current

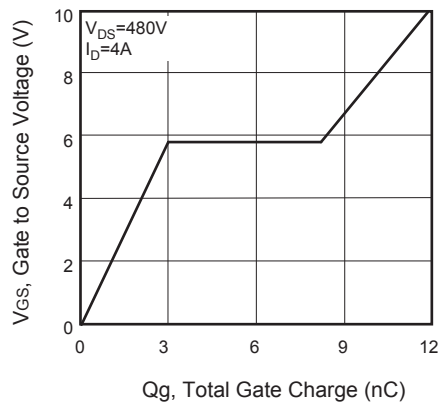


Figure 7. Gate Charge

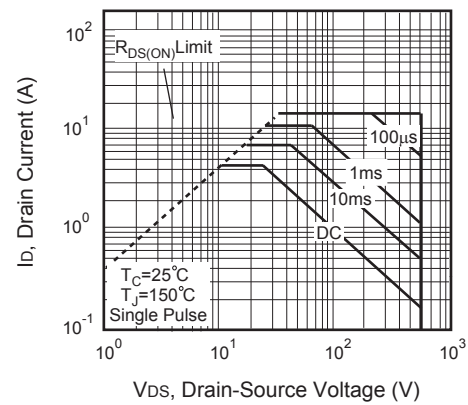


Figure 8. Maximum Safe Operating Area

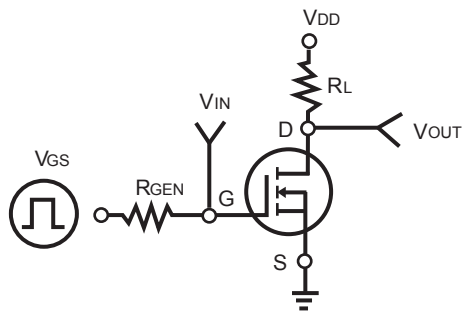


Figure 9. Switching Test Circuit

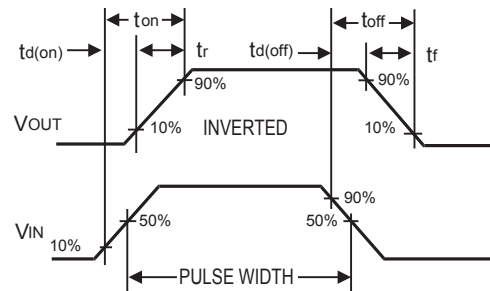


Figure 10. Switching Waveforms

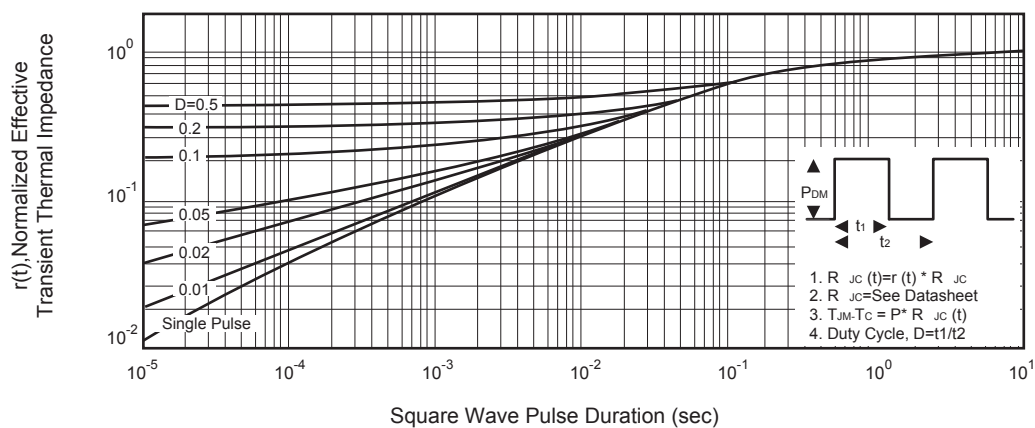
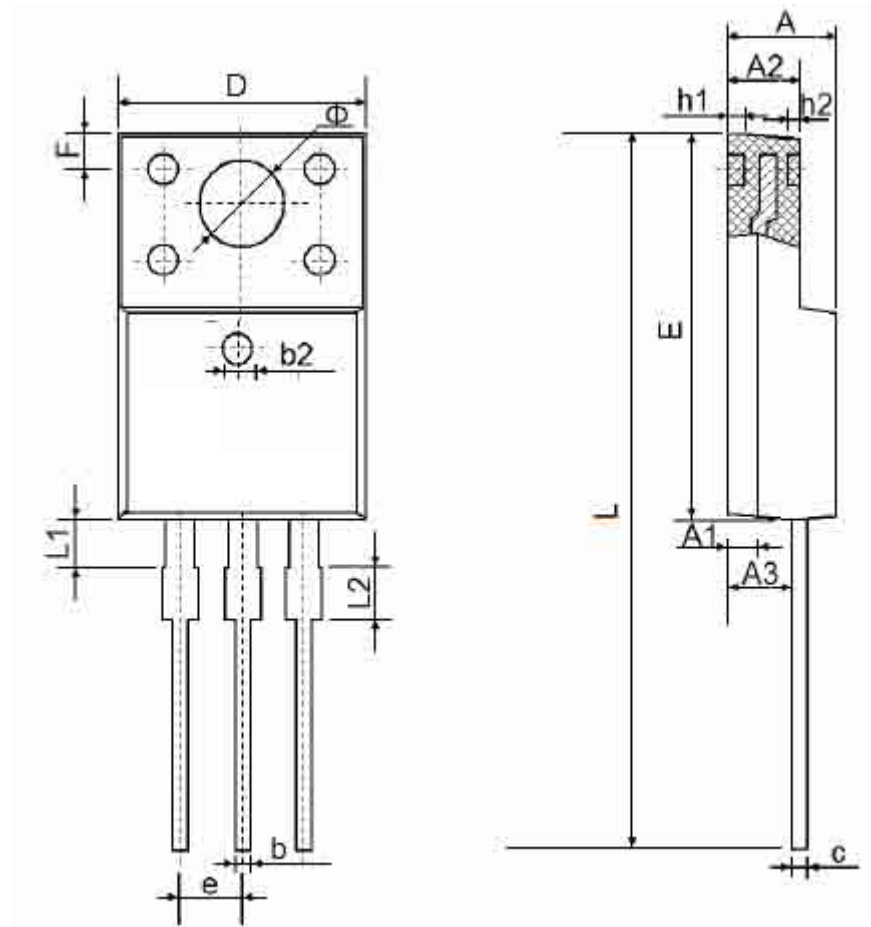


Figure 11. Normalized Thermal Transient Impedance Curve

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	
Φ	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