

MSF650N420

N-Channel 650-V (D-S) MOSFET

Description

The device is using advanced Super-Junction technology. This advanced technology has been especially tailored to minimize conduction loss, provide superior switching performance and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for AC/DC power conversion in switching mode operation for higher efficiency.

Features

- 11A, 650V, $R_{DS(ON)typ} = 0.33\Omega @ V_{GS} = 10V$
- Low Gate Charge (typical 23nC)
- High Ruggedness
- Fast Switching
- 100% Avalanche Tested
- Improved dv/dt Capability
-

Typical Applications

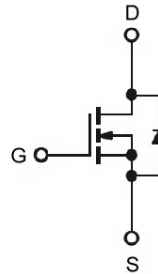
- Switching Mode Power Supply
- Adapter / Charger
- Server Power

Package type : TO-220F

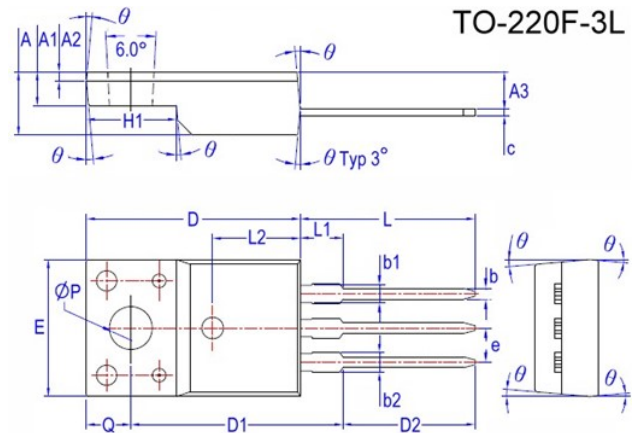


RoHS Compliant

Graphic Symbol



Package Dimension



REF.	Millimeter			REF.	Millimeter		
	Min.	Nom.	Max.		Min.	Nom.	Max.
A	4.50	4.70	4.90	D1	15.35	-	15.95
A1	2.34	2.54	2.74	D2	9.60	9.80	10.15
A2	0.70REF.			E	9.96	10.16	10.36
A3	2.56	2.76	2.96	e	2.54BSC		
b	0.70	-	0.90	H1	6.48	6.68	6.88
b1	1.18	-	1.43	L	12.68	12.98	13.28
b2	-	-	1.55	L1	-	-	3.50
c	0.40	0.50	0.65	ΦP	3.06	3.18	3.28
D	15.57	15.87	16.17	Q	3.15	-	3.45

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MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

Symbol	Parameter	Value	Units
V_{DS}	Drain-Source Voltage	650	V
V_{GS}	Gate-Source Voltage	± 30	V
I_D	Continuous Drain Current ¹ ($T_C = 25^\circ\text{C}$)	11	A
	Continuous Drain Current ¹ ($T_C = 100^\circ\text{C}$)	7	A
I_{DM}	Pulsed Drain Current ^{1,2}	44	A
I_{AS}	Single Pulse Avalanche Current, $L = 79\text{mH}^3$	2.4	A
E_{AS}	Single Pulse Avalanche Energy, $L = 79\text{mH}^3$	227	mJ
dv/dt	Peak Diode Recovery dv/dt	15	V/ns
P_D	Power Dissipation ⁴ ($T_C = 25^\circ\text{C}$)	35	W
	Derating Factor Above 25°C	0.28	W/ $^\circ\text{C}$
T_J/T_{STG}	Operating Junction and Storage Temperature	-55 to +150	$^\circ\text{C}$

Thermal Resistance Ratings

Symbol	Parameter	Maximum	Units
$R_{\theta JA}$	Maximum Junction-to-Ambient ¹	62.5	$^\circ\text{C/W}$
$R_{\theta JC}$	Maximum Junction-to-Case ¹	3.57	$^\circ\text{C/W}$

Electrical Characteristics ($T_J = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 250\mu\text{A}$	2.0	-	4.0	V
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{V}$, $I_D = 250\mu\text{A}$	650	-	-	V
$BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$, referenced to 25°C	-	0.6	-	V/ $^\circ\text{C}$
I_{GSS}	Gate-Source Leakage Current	$V_{DS} = 0\text{V}$, $V_{GS} = \pm 30\text{V}$	-	-	± 100	nA
I_{DSS}	Drain-Source Leakage Current	$V_{DS} = 650\text{V}$, $V_{GS} = 0\text{V}$, $T_C = 25^\circ\text{C}$	-	-	1	μA
		$V_{DS} = 520\text{V}$, $V_{GS} = 0\text{V}$, $T_C = 125^\circ\text{C}$	-	-	10	μA
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{V}$, $I_D = 3.5\text{A}$	-	0.33	0.4	Ω
R_g	Gate Resistance	$V_{GS} = V_{DS} = 0\text{V}$, $f = 1.0\text{MHz}$	-	5.2	-	Ω

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Dynamic						
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Q_g	Total Gate Charge ²	$V_{DS} = 520V$	--	23	--	nC
Q_{gs}	Gate-Source Charge	$I_D = 11A$	--	5.3	--	
Q_{gd}	Gate-Drain Charge	$V_{GS} = 10V$	--	11	--	
$t_{d(on)}$	Turn-On Delay Time ²	$V_{DS} = 325V$	--	12	--	ns
t_r	Rise Time	$I_D = 11A$	--	35	--	
$t_{d(off)}$	Turn-Off Delay Time	$V_{GS} = 10V$	--	64	--	
t_f	Fall Time	$R_G = 24\Omega$	--	31	--	
C_{iss}	Input Capacitance	$V_{DS} = 100V$	--	632	--	pF
C_{oss}	Output Capacitance	$V_{GS} = 0V$	--	37	--	
C_{rss}	Reverse Transfer Capacitance	$f = 1.0MHz$	--	2.3	--	

Source-Drain Diode						
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
I_S	Continuous Source Current ^{1,5}	$V_G = V_D = 0V$, Force Current	-	-	11	A
I_{SM}	Pulsed Source Current ^{2,5}		-	-	44	
V_{SD}	Diode Forward Voltage ²	$I_S = 11A$, $V_{GS} = 0V$, $T_J = 25^\circ C$	-	-	1.4	V
t_{rr}	Reverse Recovery Time ²	$I_S = 11A$, $V_{GS} = 0V$, $dI_F / dt = 100A/\mu s$		361		ns
Q_{rr}	Reverse Recovery Charge ²				3.9	

Notes

1. The data tested by surface mounted on a 1 inch² FR-4 board with 2OZ copper.
2. The data tested by pulsed, pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$.
3. The EAS data shows maximum rating. The test condition is $V_{DD} = 100V$, $L = 79mH$, $I_{AS} = 2.4A$.
4. The power dissipation is limited by $150^\circ C$ junction temperature.
5. The data is theoretically the same as I_D and I_{DM} , in real applications, should be limited by total power dissipation.

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- Typical Electrical Characteristics

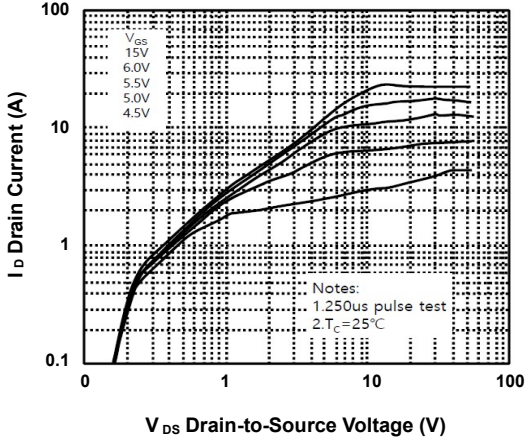


FIG.1-Typical Output Characteristics

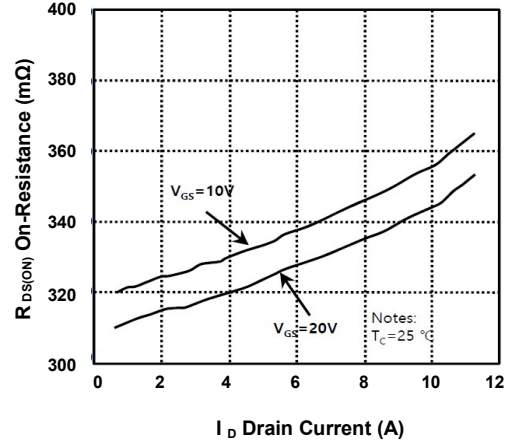


FIG.2-On-Resistance vs. Drain Current and V_{GS}

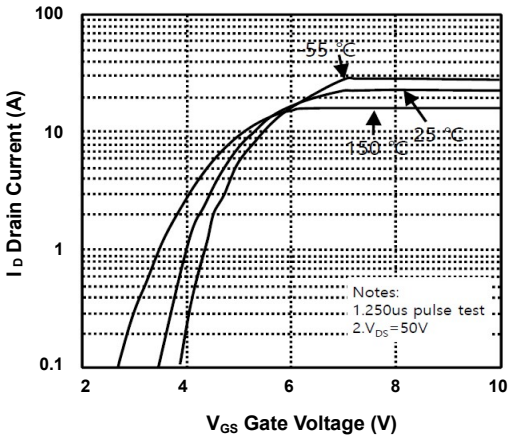


FIG.3-Transfer Characteristics

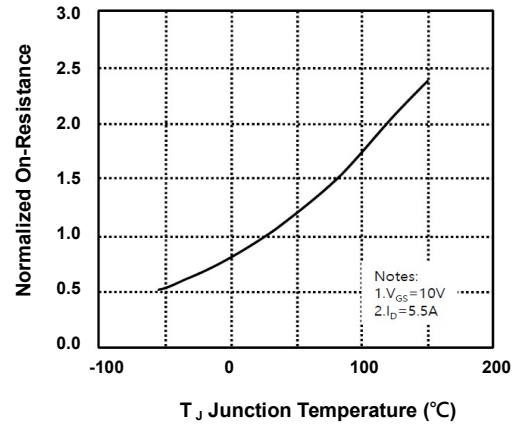


FIG.4-Normalized $R_{DS(ON)}$ vs. T_J

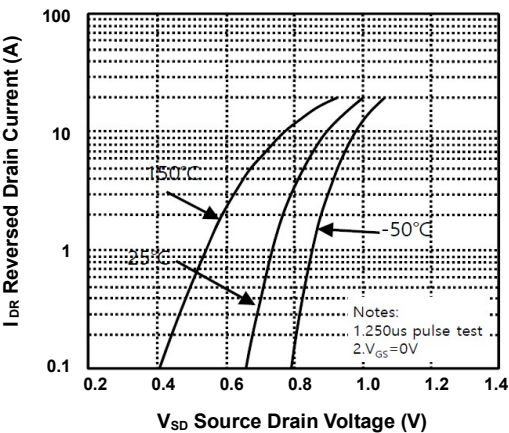


FIG.5-Body Diode Forward Voltage Variation

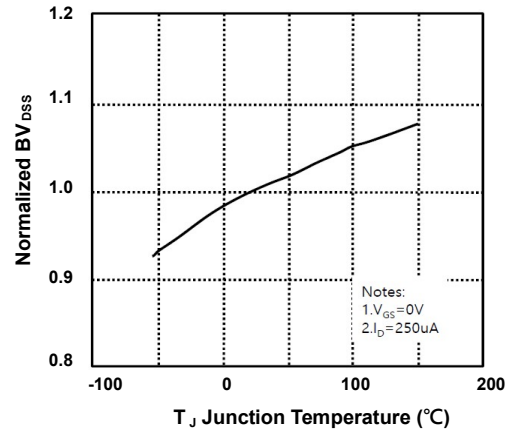


FIG.6-Breakdown Voltage Variation vs Temperature

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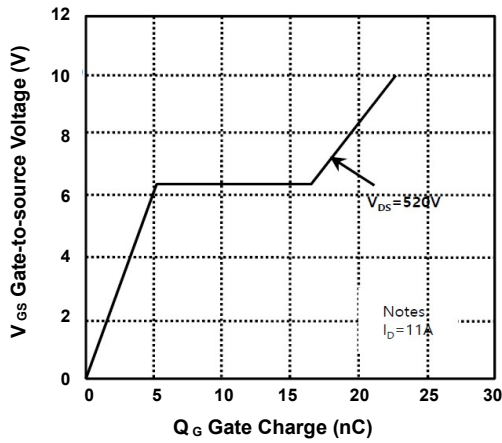


FIG.7-Gate Charge Characteristics

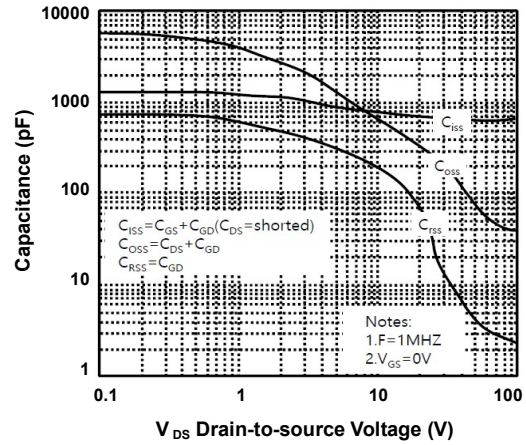


FIG.8-Capacitance Characteristics

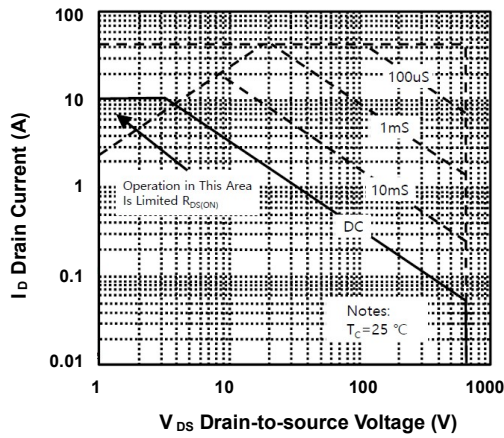


FIG.9-Safe Operating Area

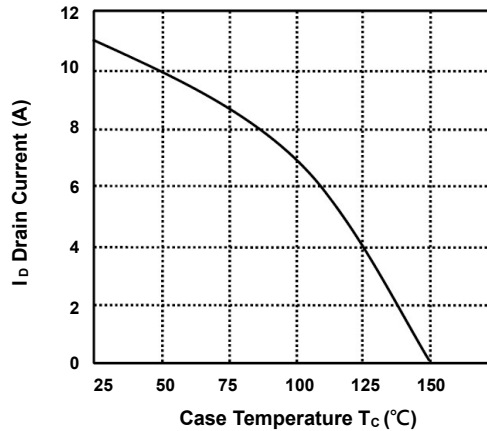


FIG.10-Maximum Drain Current vs Case Temperature

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