

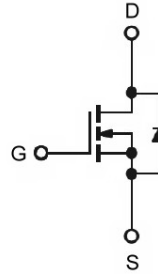
# MSD650N420

## 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.

### Graphic Symbol



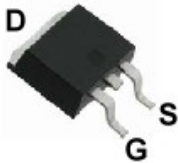
### Features

- 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
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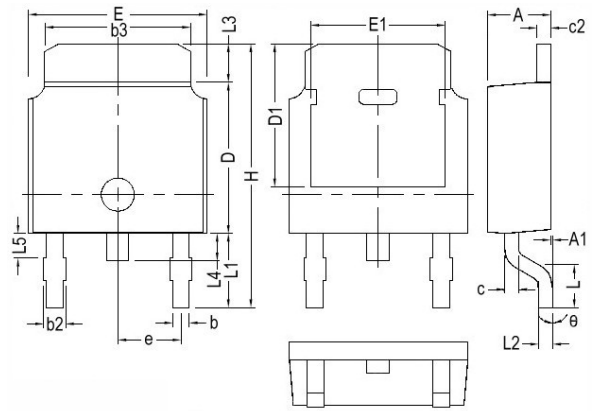
### Typical Applications

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

Package type : TO-252



### Package Dimension



REF.	Millimeter			REF.	Millimeter		
	Min.	Nom.	Max.		Min.	Nom.	Max.
A	2.20	2.30	2.38	E1	4.40	-	-
A1	0	-	0.127	e	2.286 BSC		
b	0.64	0.76	0.88	H	9.40	10.00	10.40
b2	0.77	0.84	1.14	L	1.40	1.52	1.77
b3	5.21	5.34	5.46	L1	2.743 Ref.		
c	0.45	0.50	0.60	L2	0.508 BSC		
c2	0.45	0.50	0.58	L3	0.89	-	1.27
D	6.00	6.10	6.223	L4	0.64	-	1.01
D1	5.21	-	-	L5	-	-	-
E	6.40	6.60	6.731	θ	0°	-	10°

RoHS Compliant

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

#### MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

##### Absolute Maximum Ratings

Symbol	Parameter	Value	Units
$V_{DS}$	Drain-Source Voltage	650	V
$V_{GS}$	Gate-Source Voltage	$\pm 30$	V
$I_D$	Continuous Drain Current <sup>1</sup> ( $T_C = 25^\circ\text{C}$ )	11	A
	Continuous Drain Current <sup>1</sup> ( $T_C = 100^\circ\text{C}$ )	7	A
$I_{DM}$	Pulsed Drain Current <sup>1,2</sup>	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 <sup>4</sup> ( $T_C = 25^\circ\text{C}$ )	87	W
	Derating Factor Above $25^\circ\text{C}$	0.7	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 <sup>1</sup>	62.5	$^\circ\text{C}/\text{W}$
$R_{\theta JC}$	Maximum Junction-to-Case <sup>1</sup>	1.44	$^\circ\text{C}/\text{W}$

##### 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 $25^\circ\text{C}$	-	0.6	-	V/ $^\circ\text{C}$
$I_{GSS}$	Gate-Source Leakage Current	$V_{DS} = 0\text{V}$ , $V_{GS} = \pm 30\text{V}$	-	-	$\pm 100$	nA
$I_{DSS}$	Drain-Source Leakage Current	$V_{DS} = 650\text{V}$ , $V_{GS} = 0\text{V}$ , $T_C = 25^\circ\text{C}$	-	-	1	$\mu\text{A}$
		$V_{DS} = 520\text{V}$ , $V_{GS} = 0\text{V}$ , $T_C = 125^\circ\text{C}$	-	-	10	$\mu\text{A}$
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{V}$ , $I_D = 3.5\text{A}$	-	0.33	0.4	$\Omega$
$R_g$	Gate Resistance	$V_{GS} = V_{DS} = 0\text{V}$ , $f = 1.0\text{MHz}$	-	5.2	-	$\Omega$

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Dynamic						
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Q <sub>g</sub>	Total Gate Charge <sup>2</sup>	V <sub>DS</sub> = 520V	--	23	--	nC
Q <sub>gs</sub>	Gate-Source Charge	I <sub>D</sub> = 11A	--	5.3	--	
Q <sub>gd</sub>	Gate-Drain Charge	V <sub>GS</sub> = 10V	--	11	--	
t <sub>d(on)</sub>	Turn-On Delay Time <sup>2</sup>	V <sub>DS</sub> = 325V	--	12	--	ns
t <sub>r</sub>	Rise Time	I <sub>D</sub> = 11A	--	35	--	
t <sub>d(off)</sub>	Turn-Off Delay Time	V <sub>GS</sub> = 10V	--	64	--	
t <sub>f</sub>	Fall Time	R <sub>G</sub> = 24Ω	--	31	--	
C <sub>ISS</sub>	Input Capacitance	V <sub>DS</sub> = 100V	--	632	--	pF
C <sub>OSS</sub>	Output Capacitance	V <sub>GS</sub> = 0V	--	37	--	
C <sub>RSS</sub>	Reverse Transfer Capacitance	f = 1.0MHz	--	2.3	--	

Source-Drain Diode						
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
I <sub>S</sub>	Continuous Source Current <sup>1,5</sup>	V <sub>G</sub> = V <sub>D</sub> = 0V, Force Current	-	-	11	A
I <sub>SM</sub>	Pulsed Source Current <sup>2,5</sup>		-	-	44	
V <sub>SD</sub>	Diode Forward Voltage <sup>2</sup>	I <sub>S</sub> = 11A, V <sub>GS</sub> = 0V, T <sub>J</sub> = 25°C	-	-	1.4	V
t <sub>rr</sub>	Reverse Recovery Time <sup>2</sup>	I <sub>S</sub> = 11A, V <sub>GS</sub> = 0V, dI <sub>F</sub> / dt = 100A/μs		361		ns
Q <sub>rr</sub>	Reverse Recovery Charge <sup>2</sup>				3.9	

#### Notes

1. The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 2OZ copper.
2. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%.
3. The EAS data shows maximum rating. The test condition is V<sub>DD</sub> = 100V, L = 79mH, I<sub>AS</sub> = 2.4A.
4. The power dissipation is limited by 150°C junction temperature.
5. The data is theoretically the same as I<sub>D</sub> and I<sub>DM</sub>, in real applications, should be limited by total power dissipation.

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

- Typical Electrical Characteristics

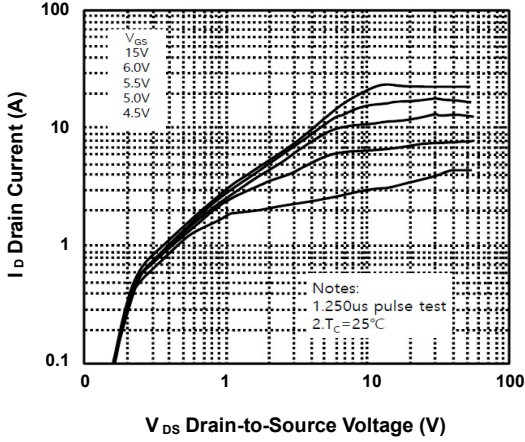


FIG.1-Typical Output Characteristics

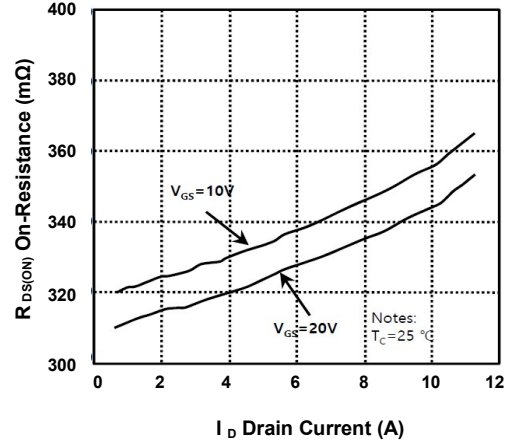


FIG.2-On-Resistance vs. Drain Current and  $V_{GS}$

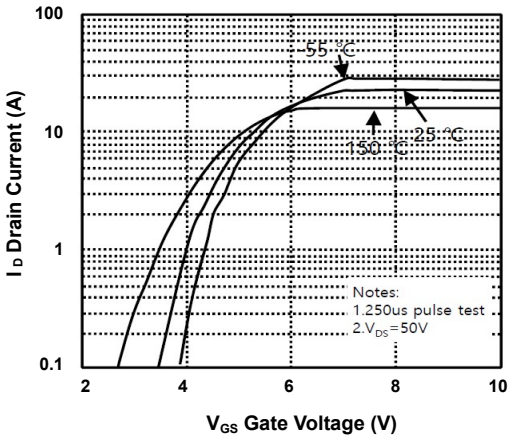


FIG.3-Transfer Characteristics

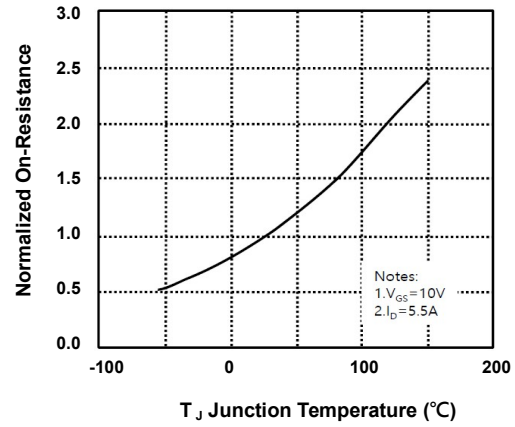


FIG.4-Normalized  $R_{DS(ON)}$  vs.  $T_J$

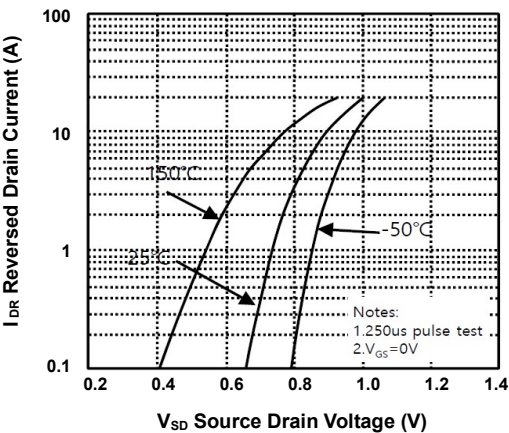


FIG.5-Body Diode Forward Voltage Variation

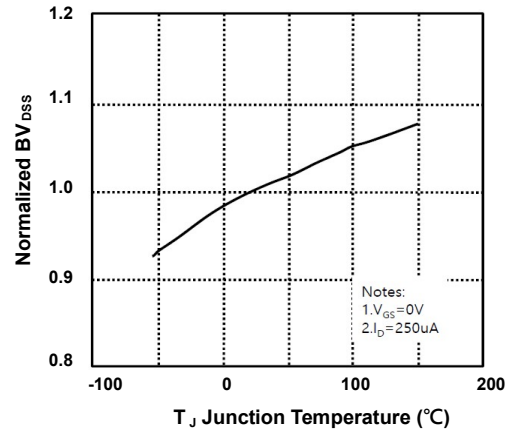


FIG.6-Breakdown Voltage Variation vs Temperature

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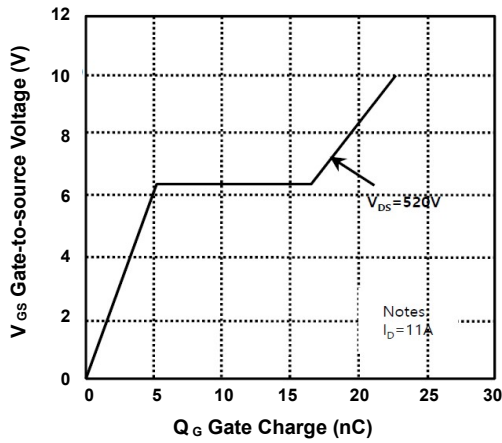


FIG.7-Gate Charge Characteristics

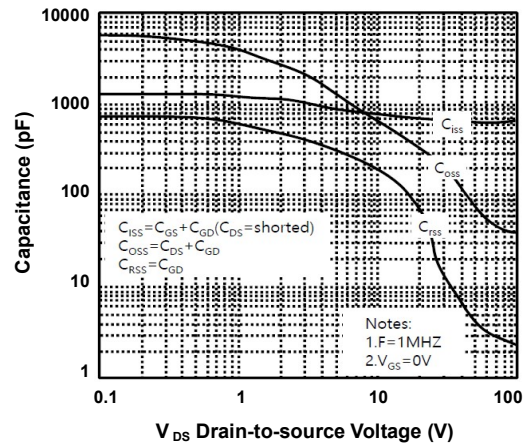


FIG.8-Capacitance Characteristics

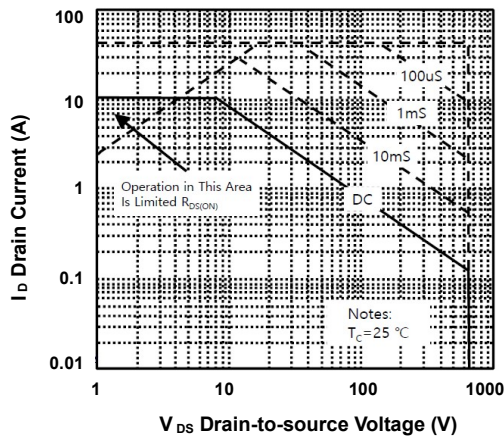


FIG.9-Safe Operating Area

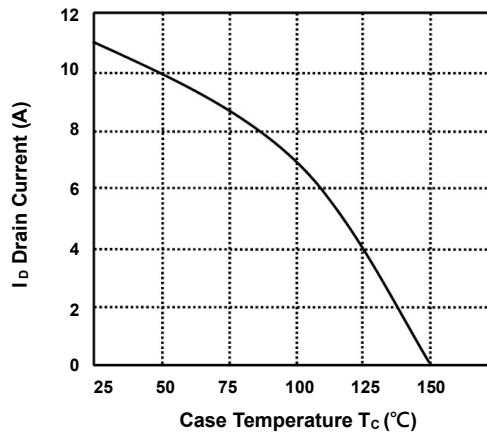


FIG.10-Maximum Drain Current vs Case Temperature

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