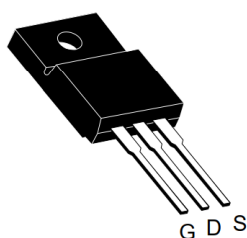


# N-Channel 650 V (D-S) Super Junction Power MOSFET

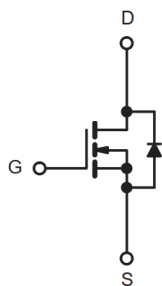
## PRODUCT SUMMARY

$V_{DS}$ (V)	$R_{DS(on)}$ (m $\Omega$ )(Max.)	$I_D$ (A)	$Q_g$ (Typ.)
650	190 at $V_{GS} = 10$ V	20	44 nC

TO-220 FULLPAK



Top View



N-Channel MOSFET

## FEATURES

- DT-SJ Power MOSFET
- 100 % R<sub>g</sub> and UIS tested
- Low  $R_{DS(on)}$  × FOM
- Extremely low switching loss
- Excellent stability and uniformity

## APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)



**RoHS**  
COMPLIANT

## ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage(Typ.)	$V_{DS}$	650	V
Gate-Source Voltage	$V_{GS}$	$\pm 30$	
Continuous Drain Current ( $T_J = 150$ °C) <sup>a</sup>	$I_D$	$T_C = 25$ °C 20	A
		$T_C = 100$ °C 13	
Pulsed Drain Current <sup>b</sup>	$I_{DM}$	60	
Single Avalanche Energy <sup>e</sup>	$E_{AS}$	390	mJ
Maximum Power Dissipation <sup>c</sup>	$P_D$	$T_C = 25$ °C 27	W
		$T_C = 100$ °C 10.8	
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55 to +150	°C

## THERMAL RESISTANCE RATINGS

PARAMETER	SYMBOL	LIMIT	UNIT
Junction-to-Ambient (PCB Mount) <sup>d</sup>	$R_{thJA}$	50.6	°C/W
Junction-to-Case (Drain)	$R_{thJC}$	4.6	

## Notes

- Calculated continuous current based on maximum allowable junction temperature.
- Repetitive rating; pulse width limited by max. junction temperature.
- $P_D$  is based on max. junction temperature, using junction-case thermal resistance.
- The value of  $R_{thJA}$  is measured with the device mounted on 1 in 2 FR-4 board with 2oz. Copper, in a still air environment with  $T_a = 25$  °C.
- $V_{DS} = 150$  V,  $V_{GS} = 10$  V,  $L = 10.8$  mH, starting  $T_J = 25$  °C.

SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Static						
Drain-Source Breakdown Voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	650	-	-	V
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	2.6	-	4	
Gate-Body Leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 30 V	-	-	± 100	nA
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0 V	-	-	10	μA
Drain-Source On-State Resistance <sup>a</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 10 A	-	140	190	mΩ
		V <sub>GS</sub> = 10 V, I <sub>D</sub> = 10 A, T <sub>J</sub> =150 °C	-	390	-	
Forward Transconductance <sup>a</sup>	g <sub>fs</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 4 A	-	9	-	S
Dynamic <sup>b</sup>						
Input Capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 100 V, f = 100 KHz	-	1670	-	pF
Output Capacitance	C <sub>oss</sub>		-	83	-	
Reverse Transfer Capacitance	C <sub>rss</sub>		-	0.8	-	
Total Gate Charge <sup>c</sup>	Q <sub>g</sub>	V <sub>DS</sub> = 520 V, V <sub>GS</sub> = 10 V, I <sub>D</sub> = 10 A	-	4	-	nC
Gate-Source Charge <sup>c</sup>	Q <sub>gs</sub>		-	9	-	
Gate-Drain Charge <sup>c</sup>	Q <sub>gd</sub>		-	18	-	
Gate Resistance	R <sub>g</sub>	f = 1 MHz	-	20	-	Ω
Turn-On Delay Time <sup>c</sup>	t <sub>d(on)</sub>	V <sub>DD</sub> = 520 V, I <sub>D</sub> = 20 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 25 Ω	-	50	-	ns
Rise Time <sup>c</sup>	t <sub>r</sub>		-	61	-	
Turn-Off Delay Time <sup>c</sup>	t <sub>d(off)</sub>		-	195	-	
Fall Time <sup>c</sup>	t <sub>f</sub>		-	55	-	
Drain-Source Body Diode Ratings and Characteristics <sup>b</sup> (T <sub>C</sub> = 25 °C)						
Continuous Source Current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	-	-	20	A
Pulsed Current (t = 100 μs)	I <sub>SM</sub>		-	-	60	A
Forward Voltage <sup>a</sup>	V <sub>SD</sub>	I <sub>S</sub> = 8 A, V <sub>GS</sub> = 0 V	-	-	1.2	V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>S</sub> = 20 A, di/dt = 100 A/μs	-	350	-	ns
Reverse Recovery Charge	Q <sub>rr</sub>		-	6.2	-	μC
Peak reverse recovery current	I <sub>rrm</sub>		-	-36	-	A

**Notes**

- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
 b. Guaranteed by design, not subject to production testing.  
 c. Independent of operating temperature.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**TYPICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)

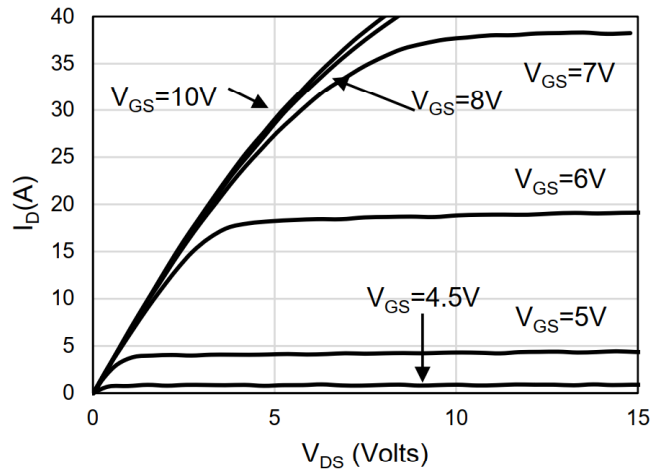


Figure 1: On-Region Characteristics

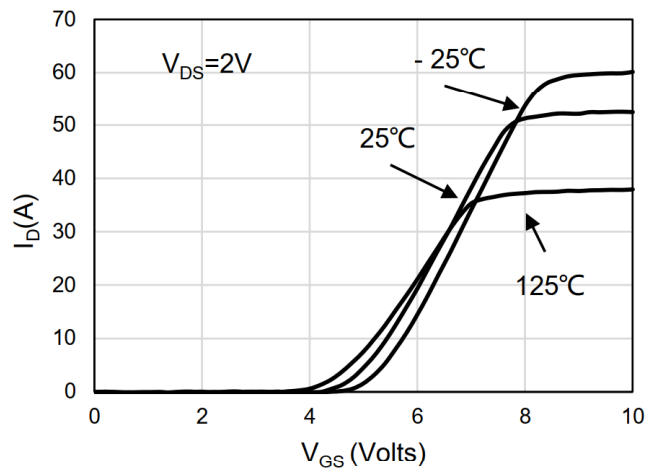


Figure 2: Transfer Characteristics

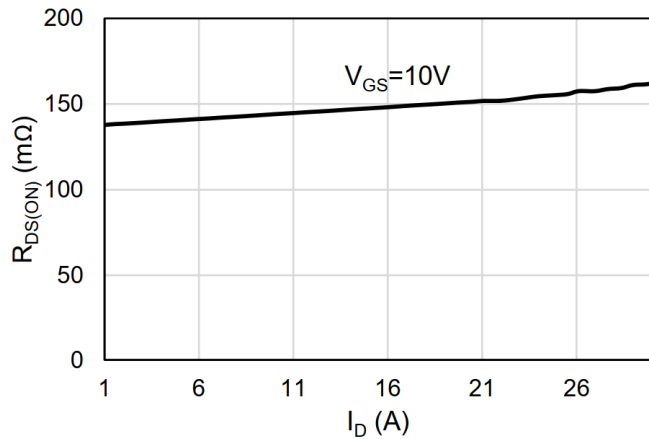


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

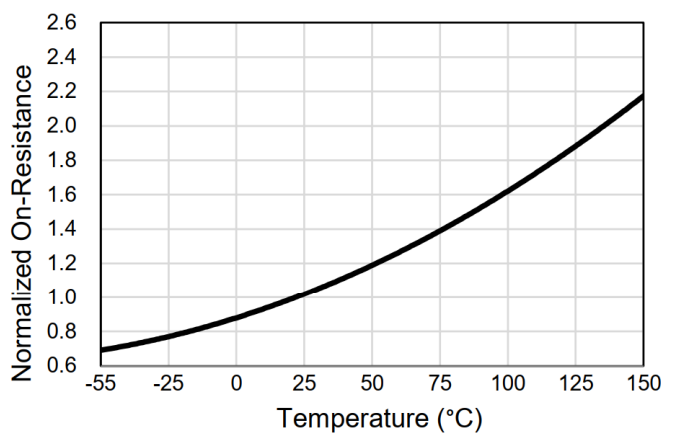


Figure 4: On-Resistance vs. Junction Temperature

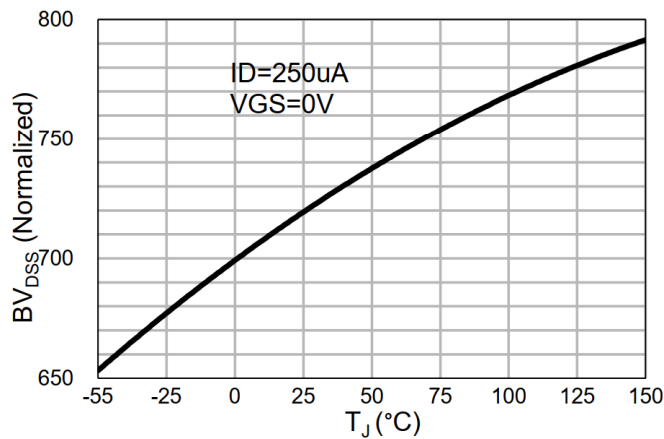


Figure 5: Break Down vs. Junction Temperature

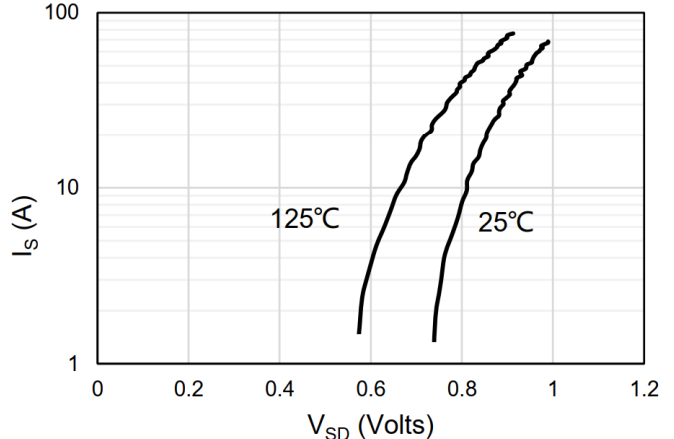


Figure 6: Body-Diode Characteristics

**TYPICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)

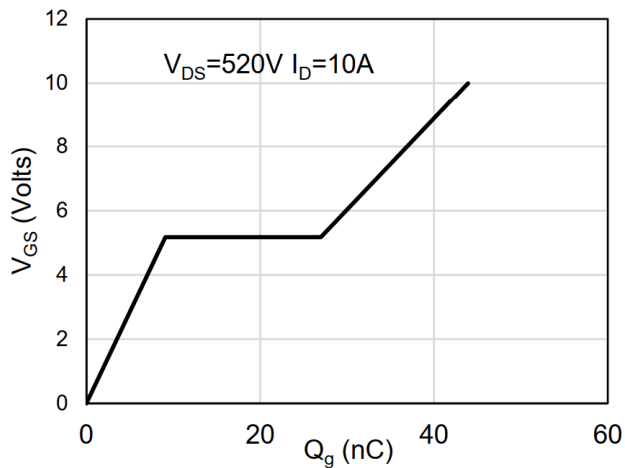


Figure 7: Gate-Charge Characteristics

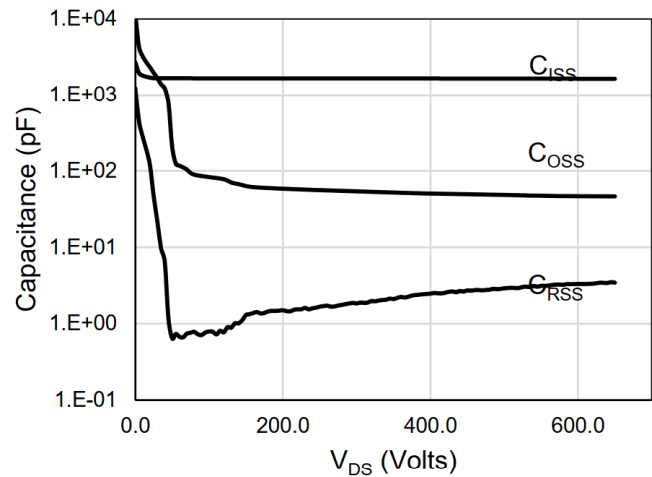


Figure 8: Capacitance Characteristics

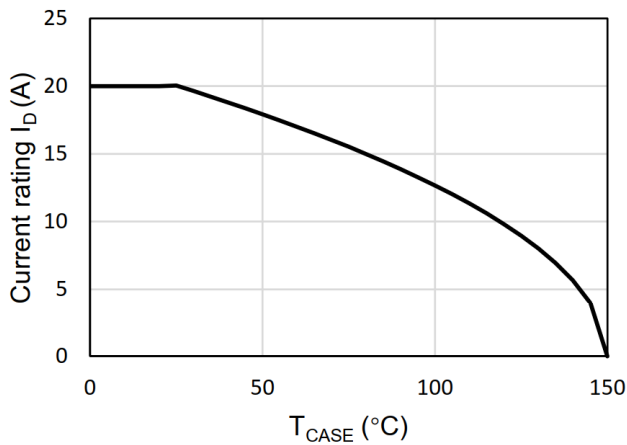


Figure 9: Current De-rating

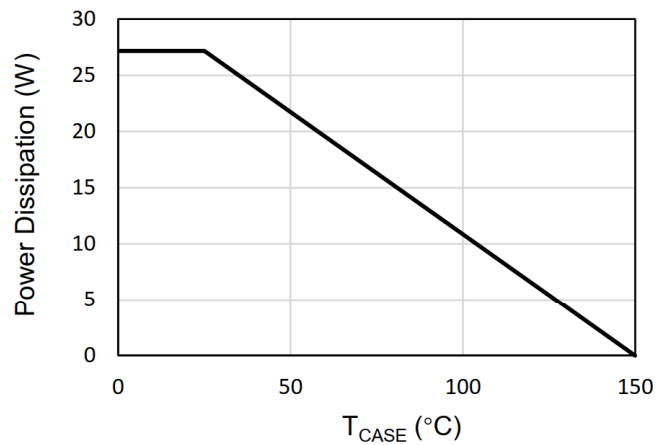


Figure 10: Power De-rating

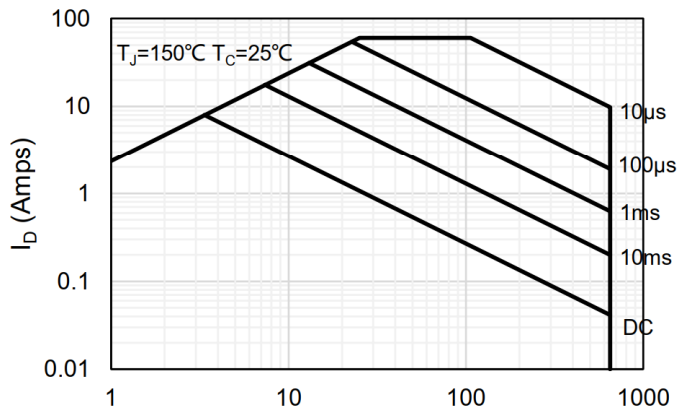


Figure 11: Maximum Forward Biased Safe Operating Area

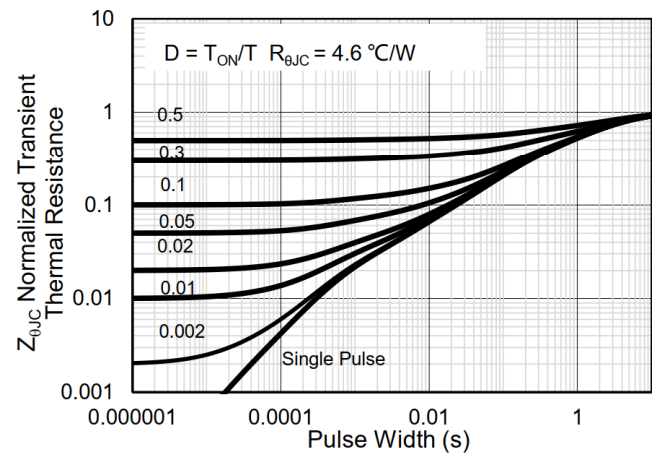
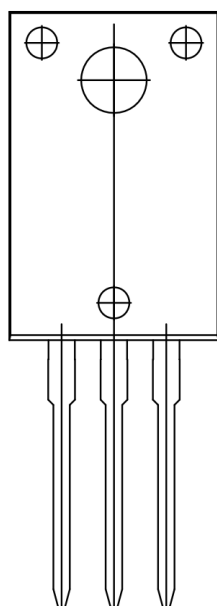
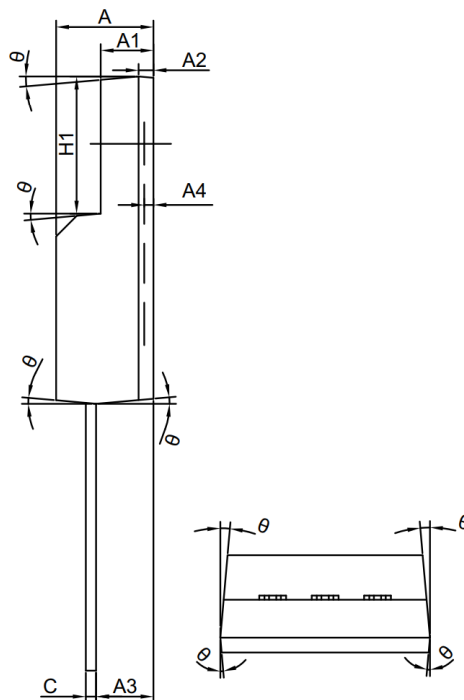
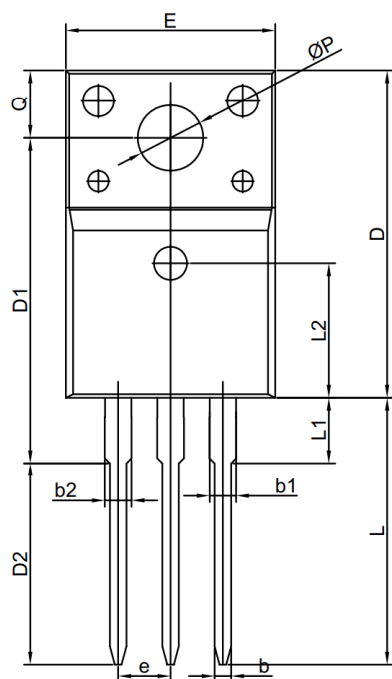


Figure 12: Normalized Maximum Transient Thermal Impedance

TO-220F-3L PACKAGE OUTLINE



COMMON DIMENSIONS  
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	4.30	4.72	5.10
A1	2.25	2.56	2.90
A2	0.72 REF		
A3	2.28	2.78	3.50
A4	0.45 MAX		
b	0.65	-	0.95
b1	1.00	-	1.55
b2	-	-	1.55
c	0.40	0.50	0.65
D	15.47	15.87	16.37
D1	15.35	15.75	16.25
E	9.76	10.16	10.76
e	2.54 BSC		
H1	6.28	6.68	7.08
L	12.48	12.98	13.50
L1	2.90	-	3.80
L2	2.54 BSC		
ØP	2.98	3.18	3.50
Q	3.00	-	3.60
θ	3°	5°	7°

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