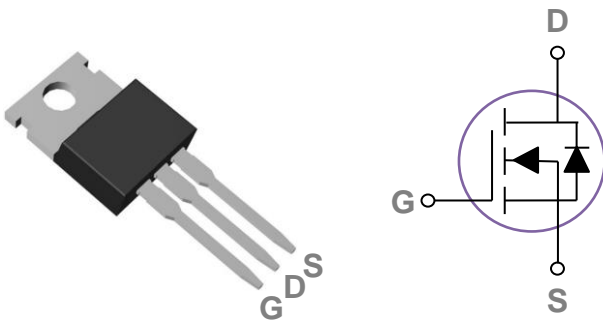


### General Description

These N-Channel enhancement mode power field effect transistors are using super junction MOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency fast switching applications.

### TO220 Pin Configuration



BVDSS	RDSON	ID
650V	190mΩ	20A

### Features

- 650V,20A,  $R_{DS(ON)} = 190m\Omega @ V_{GS} = 10V$
- Improved  $dv/dt$  capability
- Fast switching
- 100% EAS Guaranteed
- Green Device Available

### Applications

- PFC Power Supply Stages
- Motor Control
- DC-DC Converters
- Adapter

### Absolute Maximum Ratings $T_c=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Rating	Units
$V_{DS}$	Drain-Source Voltage	650	V
$V_{GS}$	Gate-Source Voltage	$\pm 30$	V
$I_D$	Drain Current – Continuous ( $T_c=25^\circ\text{C}$ )	20	A
	Drain Current – Continuous ( $T_c=100^\circ\text{C}$ )	12.5	A
$I_{DM}$	Drain Current – Pulsed <sup>1</sup>	80	A
EAS	Single Pulse Avalanche Energy	420	mJ
$P_D$	Power Dissipation ( $T_c=25^\circ\text{C}$ )	160	W
	Power Dissipation – Derate above $25^\circ\text{C}$	1.28	W/ $^\circ\text{C}$
$T_{STG}$	Storage Temperature Range	-55 to 150	$^\circ\text{C}$
$T_J$	Operating Junction Temperature Range	-55 to 150	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit
$R_{\theta JA}$	Thermal Resistance Junction to ambient	---	62	$^\circ\text{C}/\text{W}$
$R_{\theta JC}$	Thermal Resistance Junction to Case	---	0.78	$^\circ\text{C}/\text{W}$

**Electrical Characteristics (T<sub>J</sub>=25 °C, unless otherwise noted)**
**Off Characteristics**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> =0V, I <sub>D</sub> =1mA	650	---	---	V
I <sub>DSS</sub>	Drain-Source Leakage Current	V <sub>DS</sub> =650V, V <sub>GS</sub> =0V, T <sub>J</sub> =25°C	---	---	1	μA
		V <sub>DS</sub> =520V, V <sub>GS</sub> =0V, T <sub>J</sub> =125°C	---	---	10	μA
I <sub>GSS</sub>	Gate-Source Leakage Current	V <sub>GS</sub> =±30V, V <sub>DS</sub> =0V	---	---	±100	nA

**On Characteristics**

R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> =10V, I <sub>D</sub> =10A	---	160	190	mΩ
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =250μA	2	3	4	V

**Dynamic and switching Characteristics**

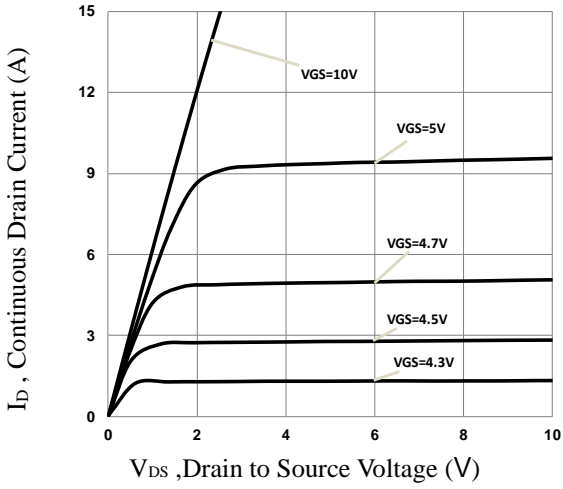
Q <sub>g</sub>	Total Gate Charge <sup>2,3</sup>	V <sub>DS</sub> =480V, V <sub>GS</sub> =10V, I <sub>D</sub> =10A	---	47	70	nC
Q <sub>gs</sub>	Gate-Source Charge <sup>2,3</sup>		---	5	8	
Q <sub>gd</sub>	Gate-Drain Charge <sup>2,3</sup>		---	14	21	
T <sub>d(on)</sub>	Turn-On Delay Time <sup>2,3</sup>	V <sub>DS</sub> =480V, V <sub>GS</sub> =10V, R <sub>G</sub> =25Ω I <sub>D</sub> =10A	---	32	48	ns
T <sub>r</sub>	Rise Time <sup>2,3</sup>		---	73	110	
T <sub>d(off)</sub>	Turn-Off Delay Time <sup>2,3</sup>		---	146	220	
T <sub>f</sub>	Fall Time <sup>2,3</sup>		---	47	70	
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> =100V, V <sub>GS</sub> =0V, F=1MHz	---	1400	2100	pF
C <sub>oss</sub>	Output Capacitance		---	55	85	
C <sub>rss</sub>	Reverse Transfer Capacitance		---	1.3	4.6	
R <sub>g</sub>	Total Gate Charge <sup>2,3</sup>	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, F=1MHz	---	8	---	Ω

**Drain-Source Diode Characteristics and Maximum Ratings**

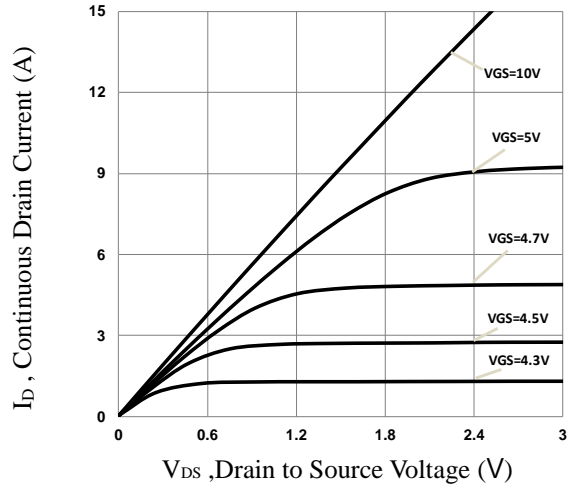
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I <sub>S</sub>	Continuous Source Current	V <sub>G</sub> =V <sub>D</sub> =0V, Force Current	---	---	20	A
I <sub>SM</sub>	Pulsed Source Current		---	---	40	A
V <sub>SD</sub>	Diode Forward Voltage	V <sub>GS</sub> =0V, I <sub>S</sub> =10A, T <sub>J</sub> =25°C	---	---	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>R</sub> =400V, I <sub>S</sub> =10A	---	310	---	ns
Q <sub>rr</sub>	Reverse Recovery Charge	di/dt=100A/μs, T <sub>J</sub> =25°C	---	4.4	---	μC

Note :

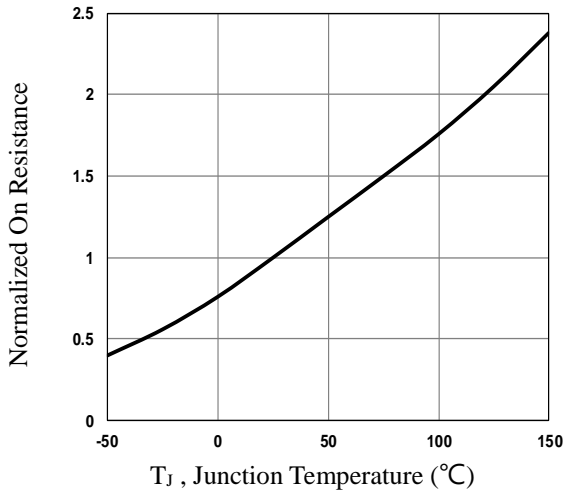
1. Repetitive Rating : Pulsed width limited by maximum junction temperature.
2. The data tested by pulsed , pulse width ≤ 300us , duty cycle ≤ 2%.
3. Essentially independent of operating temperature.



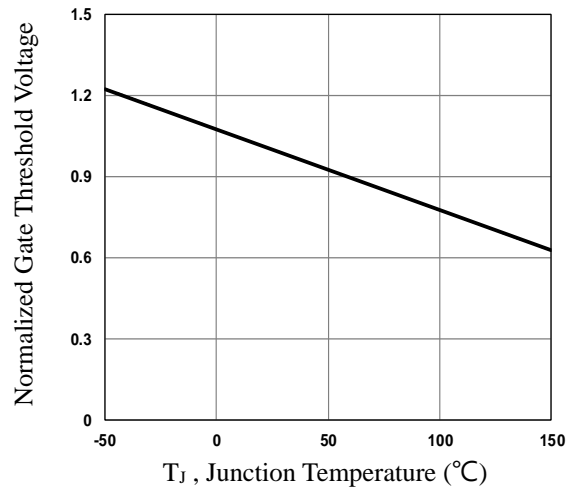
**Fig.1 Typical Output Characteristics**



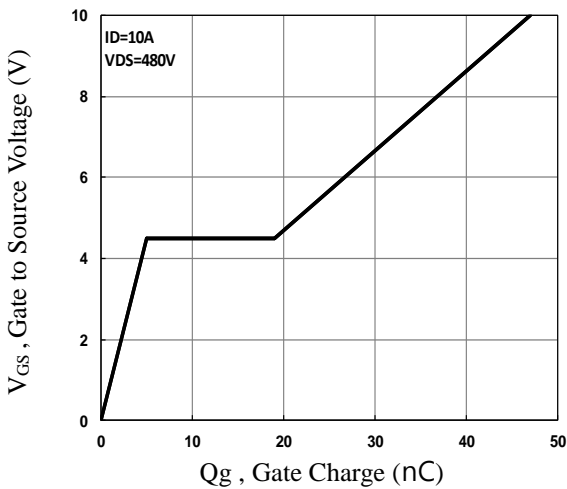
**Fig.2 Typical Output Characteristics**



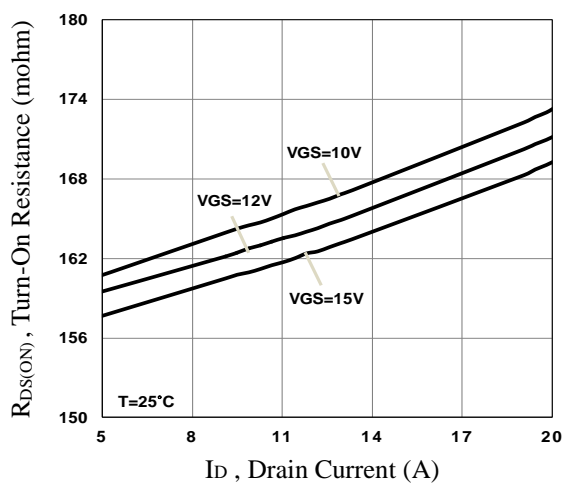
**Fig.3 Normalized  $R_{DS(on)}$  vs.  $T_J$**



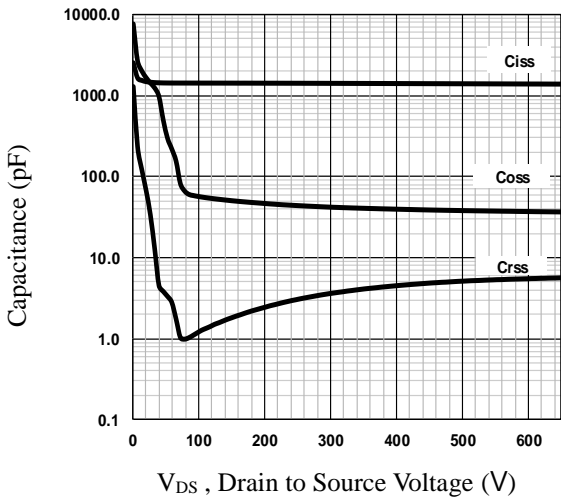
**Fig.4 Normalized  $V_{th}$  vs.  $T_J$**



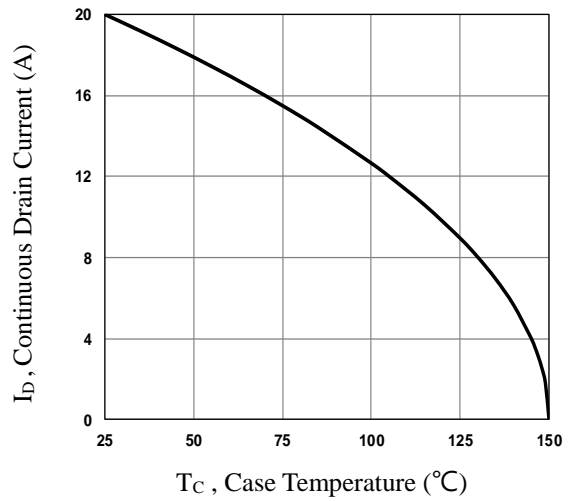
**Fig.5 Gate Charge Characteristics**



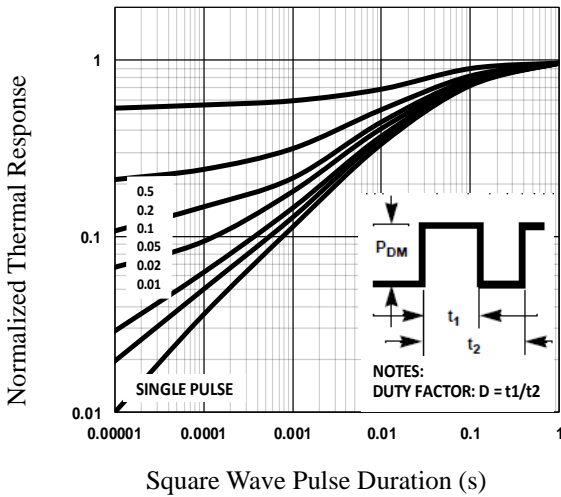
**Fig.6 Turn-On Resistance vs.  $I_D$**



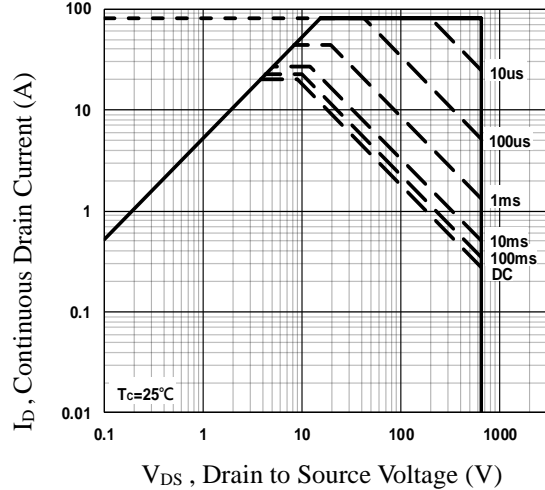
**Fig.7 Capacitance Characteristics**



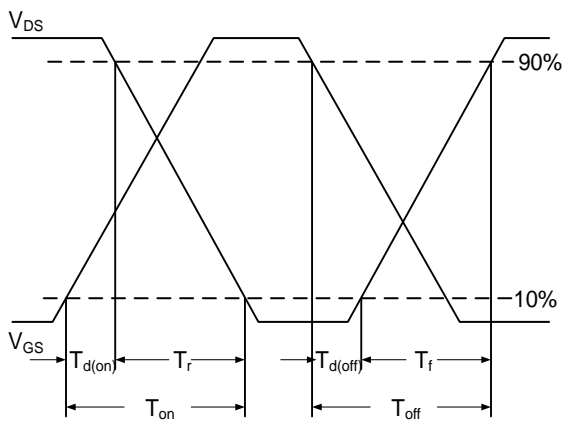
**Fig.8 Continuous Drain Current vs. T<sub>c</sub>**



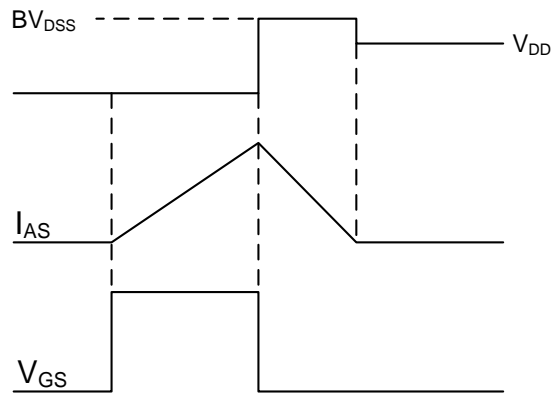
**Fig.9 Normalized Transient Impedance**



**Fig.10 Maximum Safe Operation Area**

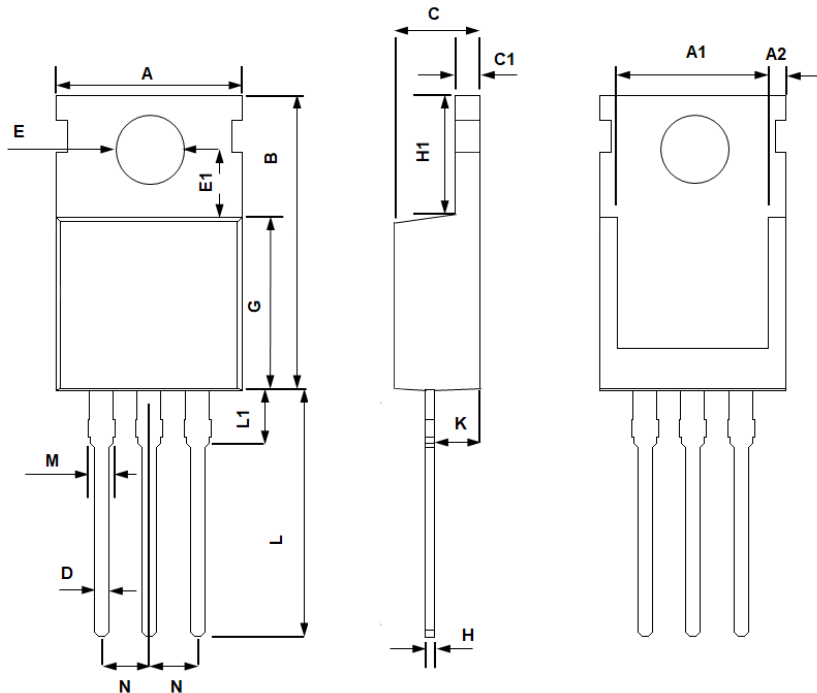


**Fig.11 Switching Time Waveform**



**Fig.12 EAS Waveform**

## TO220 PACKAGE INFORMATION



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MAX	MIN	MAX	MIN
A	10.400	9.700	0.409	0.382
A1	8.900	7.400	0.350	0.291
A2	1.400	0.800	0.055	0.031
B	16.500	14.500	0.650	0.571
C	4.750	4.200	0.187	0.165
C1	1.500	1.100	0.059	0.043
D	1.000	0.600	0.039	0.024
E	4.000	3.300	0.157	0.130
E1	3.800	3.400	0.150	0.134
G	9.400	8.400	0.370	0.331
H	0.600	0.200	0.024	0.008
H1	6.850	6.200	0.270	0.244
K	2.850	2.100	0.112	0.083
L	14.000	12.500	0.551	0.492
L1	4.000	2.700	0.157	0.106
M	1.750	1.100	0.069	0.043
N	2.640	2.440	0.104	0.096