

### General Description

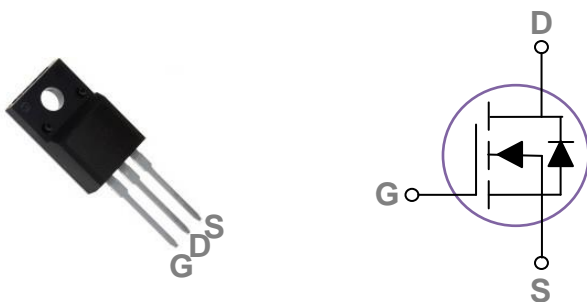
These N-Channel enhancement mode power field effect transistors are using trench DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These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

BVDSS	RDSON	ID
60V	12mΩ	35A

### Features

- 60V,35A,  $R_{DS(ON)} = 12m\Omega$  @VGS = 10V
- Improved dv/dt capability
- Fast switching
- 100% EAS Guaranteed
- Green Device Available

### TO220F Pin Configuration



### Applications

- Motor Drive
- Power Tools
- LED Lighting

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

Symbol	Parameter	Rating	Units
$V_{DS}$	Drain-Source Voltage	60	V
$V_{GS}$	Gate-Source Voltage	$\pm 20$	V
$I_D$	Drain Current – Continuous ( $T_C=25^\circ\text{C}$ )	35	A
	Drain Current – Continuous ( $T_C=100^\circ\text{C}$ )	22	A
$I_{DM}$	Drain Current – Pulsed <sup>1</sup>	140	A
EAS	Single Pulse Avalanche Energy <sup>2</sup>	61	mJ
IAS	Single Pulse Avalanche Current <sup>2</sup>	35	A
$P_D$	Power Dissipation ( $T_C=25^\circ\text{C}$ )	42	W
	Power Dissipation – Derate above $25^\circ\text{C}$	0.34	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	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance Junction to Case	---	3	$^\circ\text{C/W}$

**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> =250uA	60	---	---	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	BV <sub>DSS</sub> Temperature Coefficient	Reference to 25°C, I <sub>D</sub> =1mA	---	0.03	---	V/°C
I <sub>DSS</sub>	Drain-Source Leakage Current	V <sub>DS</sub> =60V, V <sub>GS</sub> =0V, T <sub>J</sub> =25°C	---	---	1	uA
		V <sub>DS</sub> =48V, V <sub>GS</sub> =0V, T <sub>J</sub> =125°C	---	---	10	uA
I <sub>GSS</sub>	Gate-Source Leakage Current	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V	---	---	±100	nA

**On Characteristics**

R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance <sup>3</sup>	V <sub>GS</sub> =10V, I <sub>D</sub> =10A	---	10	12	mΩ
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =8A	---	12	15	mΩ
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =250uA	1.2	1.6	2.5	V
ΔV <sub>GS(th)</sub>	V <sub>GS(th)</sub> Temperature Coefficient		---	-4	---	mV/°C
gfs	Forward Transconductance	V <sub>DS</sub> =10V, I <sub>D</sub> =6A	---	11.7	---	S

**Dynamic and switching Characteristics**

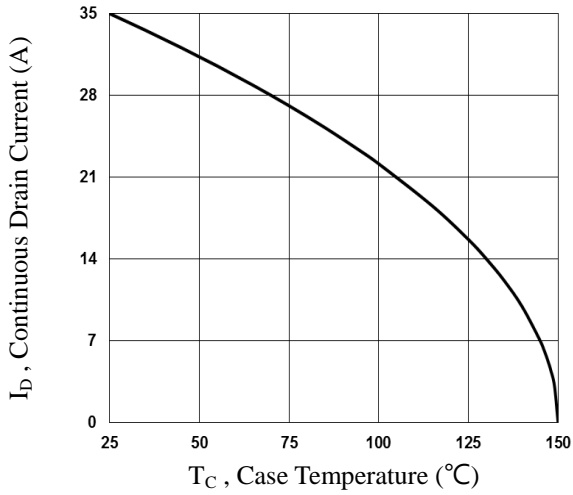
Q <sub>g</sub>	Total Gate Charge <sup>3,4</sup>	V <sub>DS</sub> =30V, V <sub>GS</sub> =10V, I <sub>D</sub> =10A	---	39.2	59	nC
Q <sub>gs</sub>	Gate-Source Charge <sup>3,4</sup>		---	5.9	9	
Q <sub>gd</sub>	Gate-Drain Charge <sup>3,4</sup>		---	8.8	14	
T <sub>d(on)</sub>	Turn-On Delay Time <sup>3,4</sup>	V <sub>DD</sub> =15V, V <sub>GS</sub> =10V, R <sub>G</sub> =6Ω I <sub>D</sub> =1A	---	9.6	18	ns
T <sub>r</sub>	Rise Time <sup>3,4</sup>		---	28.2	54	
T <sub>d(off)</sub>	Turn-Off Delay Time <sup>3,4</sup>		---	45.3	86	
T <sub>f</sub>	Fall Time <sup>3,4</sup>		---	10.9	21	
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> =25V, V <sub>GS</sub> =0V, F=1MHz	---	2100	3050	pF
C <sub>oss</sub>	Output Capacitance		---	165	240	
C <sub>rss</sub>	Reverse Transfer Capacitance		---	80	120	
R <sub>g</sub>	Gate resistance	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, F=1MHz	---	1.6	3.2	Ω

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

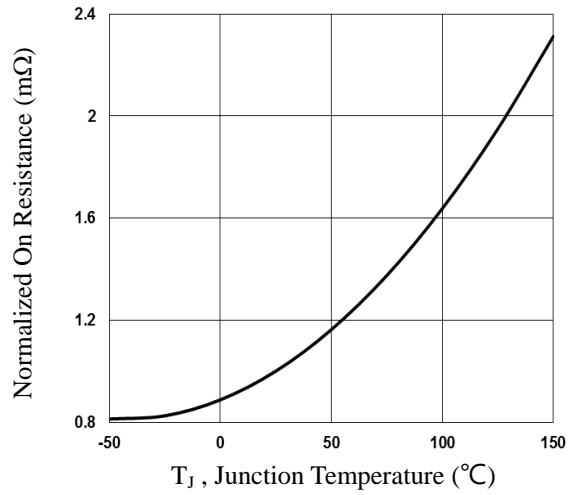
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I <sub>S</sub>	Continuous Source Current	V <sub>G</sub> =V <sub>D</sub> =0V, Force Current	---	---	35	A
I <sub>SM</sub>	Pulsed Source Current <sup>3</sup>		---	---	140	A
V <sub>SD</sub>	Diode Forward Voltage <sup>3</sup>	V <sub>GS</sub> =0V, I <sub>S</sub> =1A, T <sub>J</sub> =25°C	---	---	1	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> =0V, I <sub>S</sub> =1A, di/dt=100A/μs	---	---	---	ns
Q <sub>rr</sub>	Reverse Recovery Charge	T <sub>J</sub> =25°C	---	---	---	nC

Note :

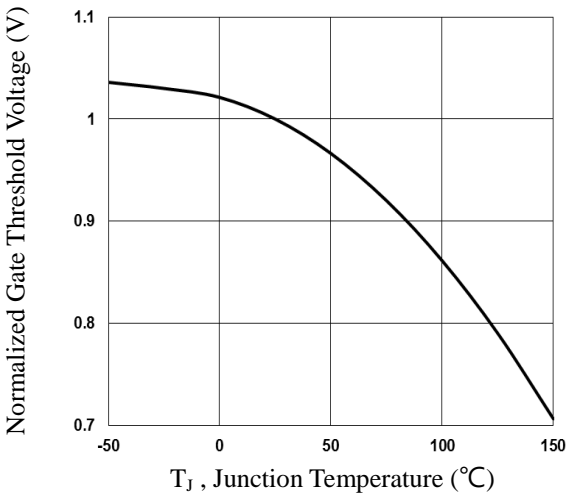
1. Repetitive Rating : Pulsed width limited by maximum junction temperature.
2. V<sub>DD</sub>=25V, V<sub>GS</sub>=10V, L=0.1mH, I<sub>AS</sub>=35A., R<sub>G</sub>=25Ω, Starting T<sub>J</sub>=25°C.
3. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%.
4. Essentially independent of operating temperature.



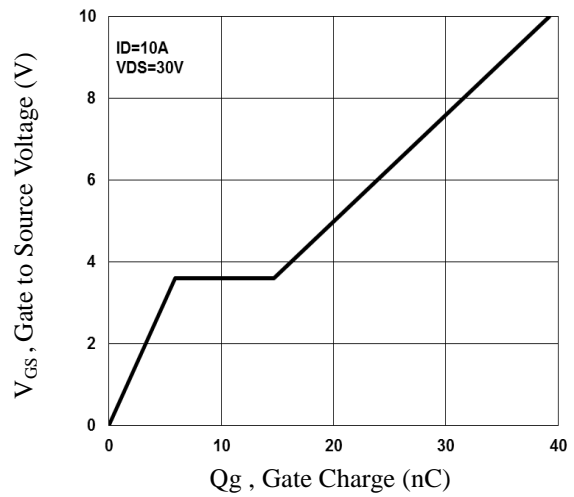
**Fig.1 Continuous Drain Current vs. T<sub>c</sub>**



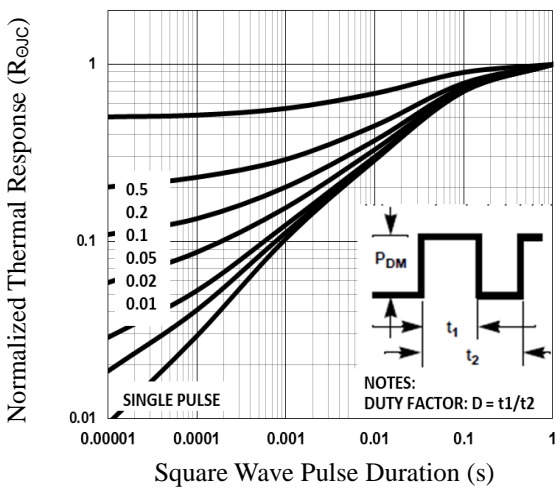
**Fig.2 Normalized R<sub>DSon</sub> vs. T<sub>j</sub>**



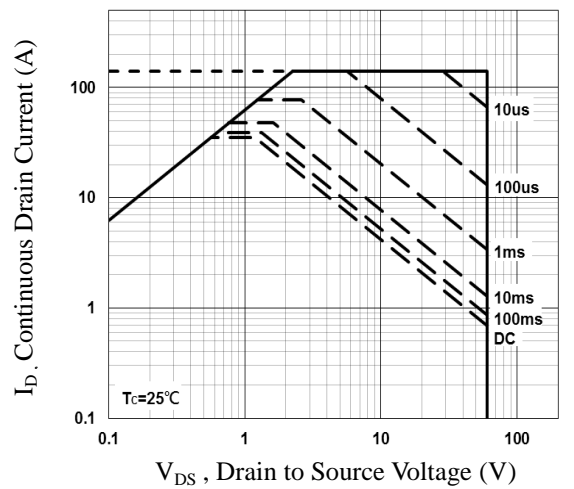
**Fig.3 Normalized V<sub>th</sub> vs. T<sub>j</sub>**



**Fig.4 Gate Charge Waveform**



**Fig.5 Normalized Transient Response**



**Fig.6 Maximum Safe Operation Area**

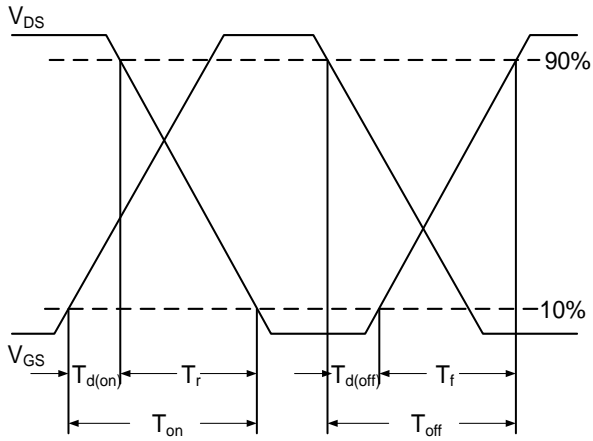


Fig.7 Switching Time Waveform

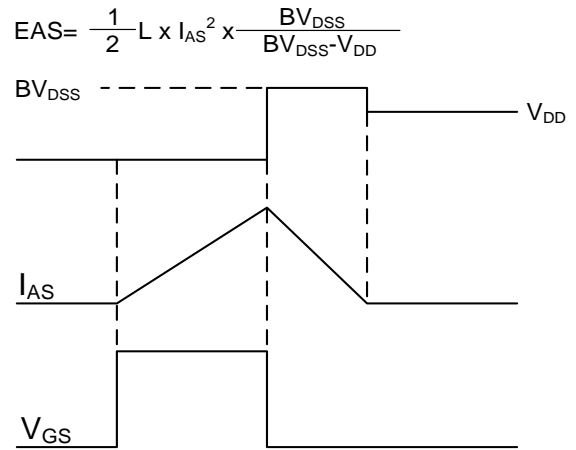
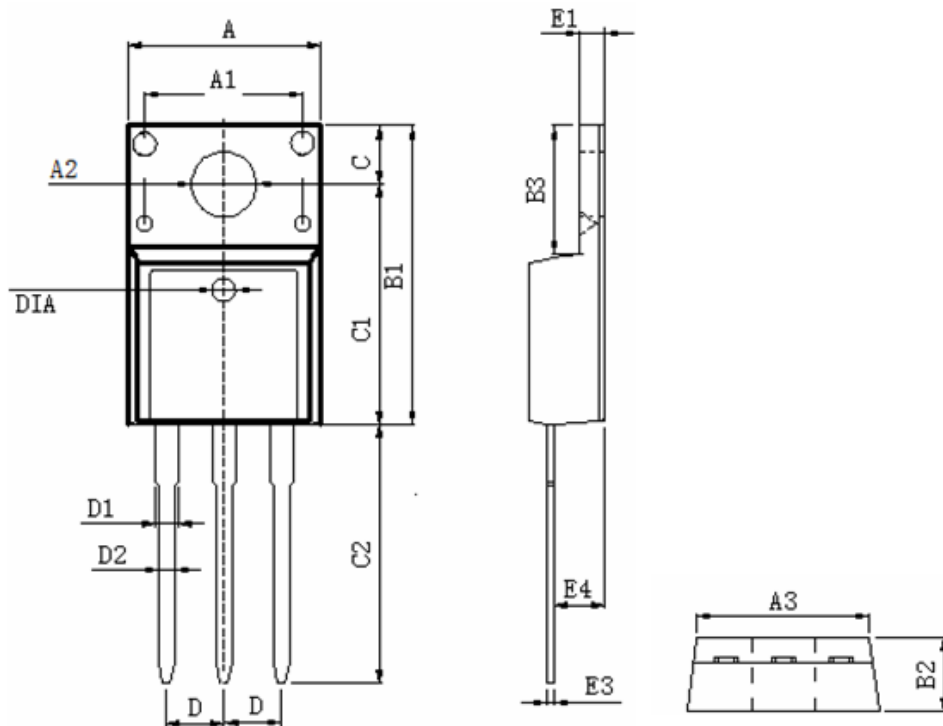


Fig.8 EAS Waveform

## TO220F PACKAGE INFORMATION



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MAX	MIN	MAX	MIN
A	10.460	9.860	0.412	0.388
A1	7.100	6.900	0.280	0.272
A2	3.500	3.100	0.138	0.122
A3	9.900	9.500	0.390	0.374
B1	16.170	15.570	0.637	0.613
B2	4.900	4.500	0.193	0.177
B3	6.880	6.480	0.271	0.255
C	3.500	3.100	0.138	0.122
C1	12.870	12.270	0.507	0.483
C2	13.380	12.580	0.527	0.495
D	2.590	2.490	0.102	0.098
D1	1.470	1.070	0.058	0.042
D2	0.900	0.700	0.035	0.028
E1	2.740	2.340	0.108	0.092
E3	0.600	0.400	0.024	0.016
E4	2.960	2.560	0.117	0.101
DIA	Φ1.5 TYP.	deep0.1 TYP.	Φ0.059 TYP.	deep0.004 TYP.