

**FEATURES**

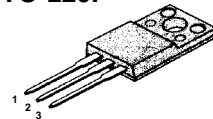
- Avalanche Rugged Technology
- Rugged Gate Oxide Technology
- Lower Input Capacitance
- Improved Gate Charge
- 175°C Operating Temperature
- Extended Safe Operating Area
- Lower Leakage Current : 10 μA (Max.) @  $V_{DS} = -60V$
- Low  $R_{DS(ON)}$  : 0.362 Ω (Typ.)

$$BV_{DSS} = -60 V$$

$$R_{DS(on)} = 0.5 \Omega$$

$$I_D = -5.3 A$$

**TO-220F**



1.Gate 2. Drain 3. Source

**Absolute Maximum Ratings**

Symbol	Characteristic	Value	Units
$V_{DSS}$	Drain-to-Source Voltage	-60	V
$I_D$	Continuous Drain Current ( $T_C=25^\circ C$ )	-5.3	A
	Continuous Drain Current ( $T_C=100^\circ C$ )	-3.8	
$I_{DM}$	Drain Current-Pulsed ①	-21	A
$V_{GS}$	Gate-to-Source Voltage ②	±30	V
$E_{AS}$	Single Pulsed Avalanche Energy	120	mJ
$I_{AR}$	Avalanche Current ①	-5.3	A
$E_{AR}$	Repetitive Avalanche Energy ①	2.4	mJ
dv/dt	Peak Diode Recovery dv/dt ③	-5.5	V/ns
$P_D$	Total Power Dissipation ( $T_C=25^\circ C$ )	24	W
	Linear Derating Factor	0.16	
$T_J, T_{STG}$	Operating Junction and Storage Temperature Range	- 55 to +175	°C
$T_L$	Maximum Lead Temp. for Soldering Purposes, 1/8" from case for 5-seconds	300	

**Thermal Resistance**

Symbol	Characteristic	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	--	6.25	°C/W
$R_{\theta JA}$	Junction-to-Ambient	--	62.5	

### Electrical Characteristics (T<sub>C</sub>=25°C unless otherwise specified)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Condition
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	-60	--	--	V	V <sub>GS</sub> =0V, I <sub>D</sub> =-250μA
ΔBV/ΔT <sub>J</sub>	Breakdown Voltage Temp. Coeff.	--	-0.05	--	V/°C	I <sub>D</sub> =-250μA <b>See Fig 7</b>
V <sub>GS(th)</sub>	Gate Threshold Voltage	-2.0	--	-4.0	V	V <sub>DS</sub> =-5V, I <sub>D</sub> =-250μA
I <sub>GSS</sub>	Gate-Source Leakage , Forward	--	--	-100	nA	V <sub>GS</sub> =-20V
	Gate-Source Leakage , Reverse	--	--	100		V <sub>GS</sub> =20V
I <sub>DSS</sub>	Drain-to-Source Leakage Current	--	--	-10	μA	V <sub>DS</sub> =-60V
		--	--	-100		V <sub>DS</sub> =-48V, T <sub>C</sub> =150°C
R <sub>DS(on)</sub>	Static Drain-Source On-State Resistance	--	--	0.5	Ω	V <sub>GS</sub> =-10V, I <sub>D</sub> =-2.7A ④
g <sub>fs</sub>	Forward Transconductance	--	2.2	--	S	V <sub>DS</sub> =-30V, I <sub>D</sub> =-2.7A ④
C <sub>iss</sub>	Input Capacitance	--	270	350	pF	V <sub>GS</sub> =0V, V <sub>DS</sub> =-25V, f=1MHz <b>See Fig 5</b>
C <sub>oss</sub>	Output Capacitance	--	90	135		
C <sub>rss</sub>	Reverse Transfer Capacitance	--	25	35		
t <sub>d(on)</sub>	Turn-On Delay Time	--	10	30	ns	V <sub>DD</sub> =-30V, I <sub>D</sub> =-6.7A, R <sub>G</sub> =24Ω <b>See Fig 13</b> ④⑤
t <sub>r</sub>	Rise Time	--	19	50		
t <sub>d(off)</sub>	Turn-Off Delay Time	--	21	50		
t <sub>f</sub>	Fall Time	--	16	40		
Q <sub>g</sub>	Total Gate Charge	--	9	11	nC	V <sub>DS</sub> =-48V, V <sub>GS</sub> =-10V, I <sub>D</sub> =-6.7A <b>See Fig 6 &amp; Fig 12</b> ④⑤
Q <sub>gs</sub>	Gate-Source Charge	--	1.8	--		
Q <sub>gd</sub>	Gate-Drain("Miller") Charge	--	4.2	--		

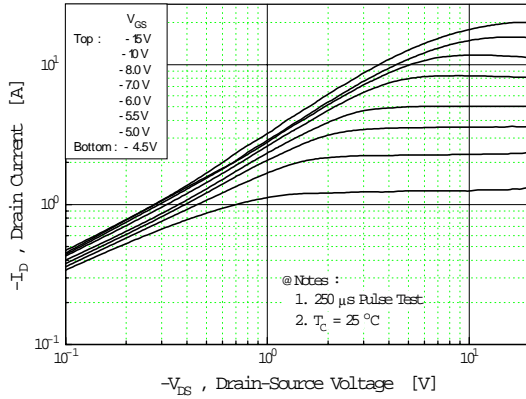
### Source-Drain Diode Ratings and Characteristics

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Condition
I <sub>S</sub>	Continuous Source Current	--	--	-5.3	A	Integral reverse pn-diode in the MOSFET
I <sub>SM</sub>	Pulsed-Source Current ①	--	--	-21		
V <sub>SD</sub>	Diode Forward Voltage ④	--	--	-3.8	V	T <sub>J</sub> =25°C, I <sub>S</sub> =-5.3A, V <sub>GS</sub> =0V
t <sub>rr</sub>	Reverse Recovery Time	--	75	--	ns	T <sub>J</sub> =25°C, I <sub>F</sub> =-6.7A
Q <sub>rr</sub>	Reverse Recovery Charge	--	0.17	--	μC	di <sub>F</sub> /dt=100A/μs ④

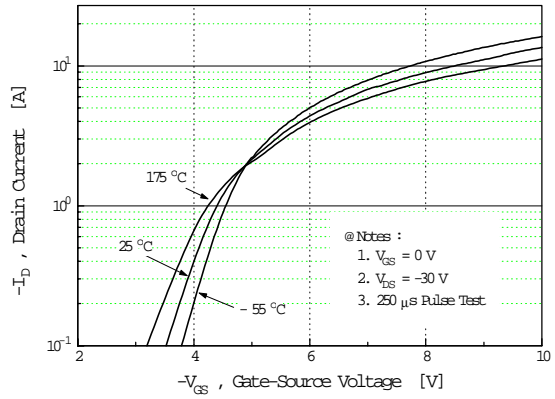
#### Notes ;

- ① Repetitive Rating : Pulse Width Limited by Maximum Junction Temperature
- ② L=5.0mH, I<sub>AS</sub>=-5.3A, V<sub>DD</sub>=-25V, R<sub>G</sub>=27Ω\*, Starting T<sub>J</sub>=25°C
- ③ I<sub>SD</sub> ≤ -6.7A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub>=25°C
- ④ Pulse Test : Pulse Width = 250μs, Duty Cycle ≤ 2%
- ⑤ Essentially Independent of Operating Temperature

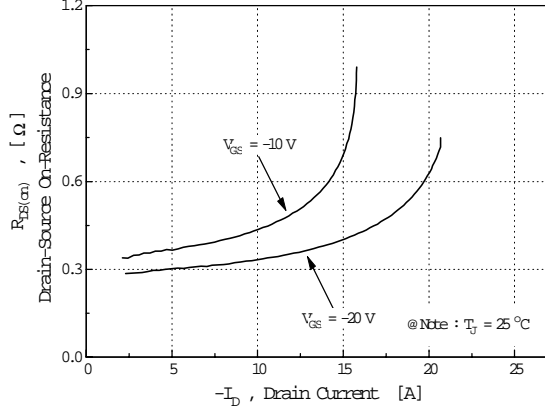
**Fig 1. Output Characteristics**



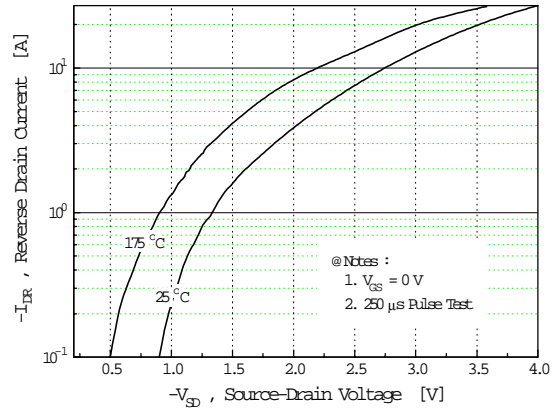
**Fig 2. Transfer Characteristics**



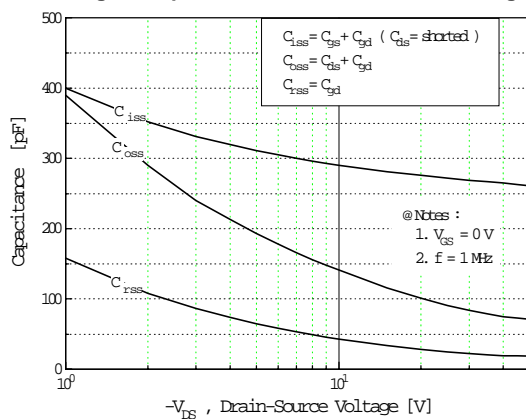
**Fig 3. On-Resistance vs. Drain Current**



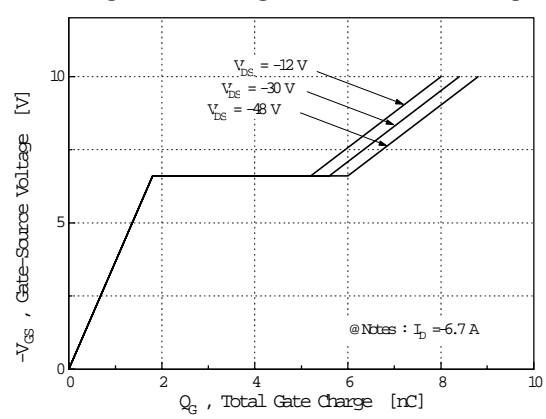
**Fig 4. Source-Drain Diode Forward Voltage**



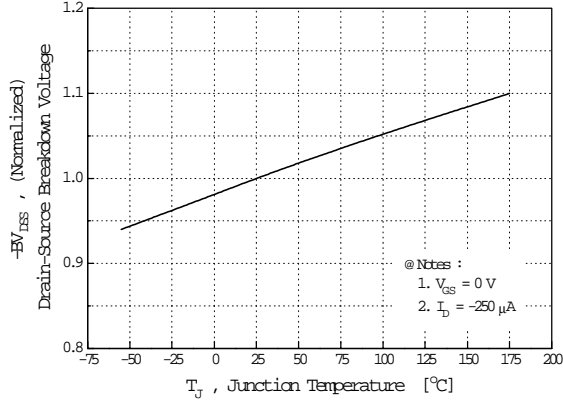
**Fig 5. Capacitance vs. Drain-Source Voltage**



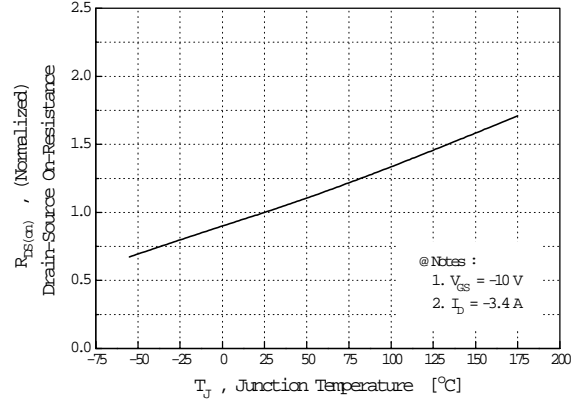
**Fig 6. Gate Charge vs. Gate-Source Voltage**



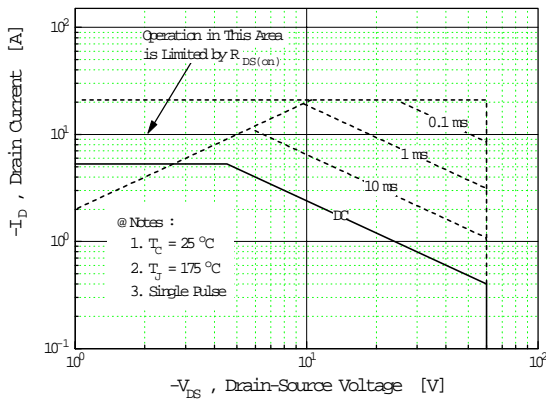
**Fig 7. Breakdown Voltage vs. Temperature**



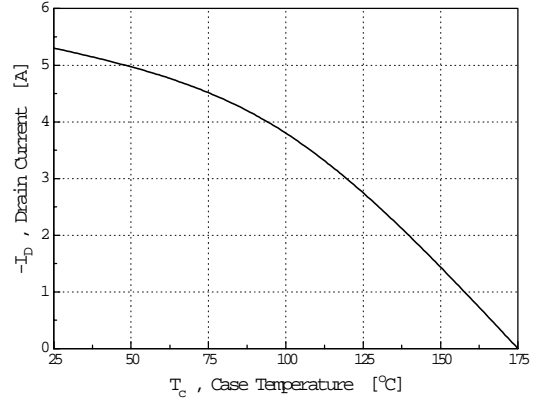
**Fig 8. On-Resistance vs. Temperature**



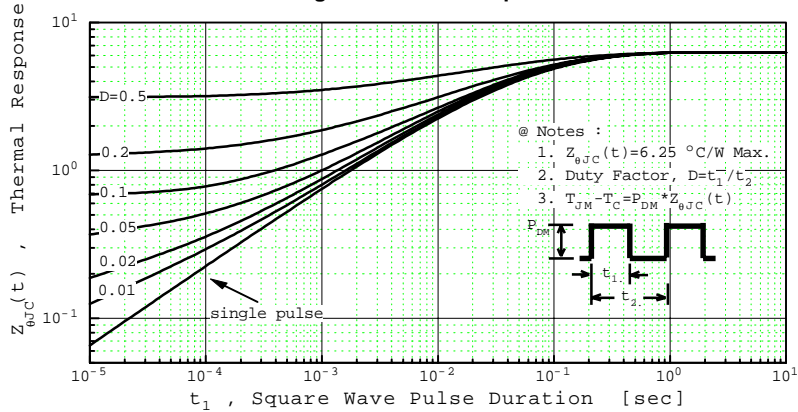
**Fig 9. Max. Safe Operating Area**



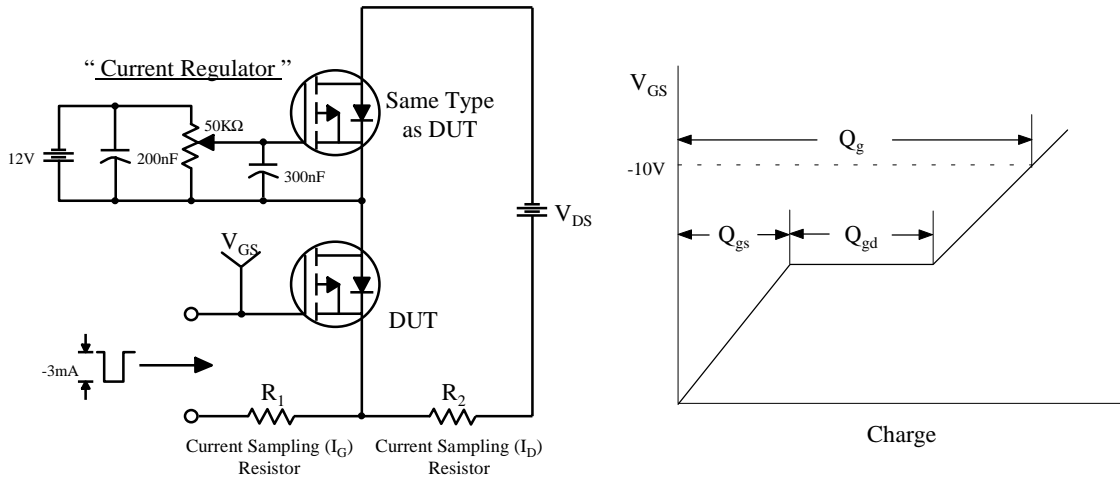
**Fig 10. Max. Drain Current vs. Case Temperature**



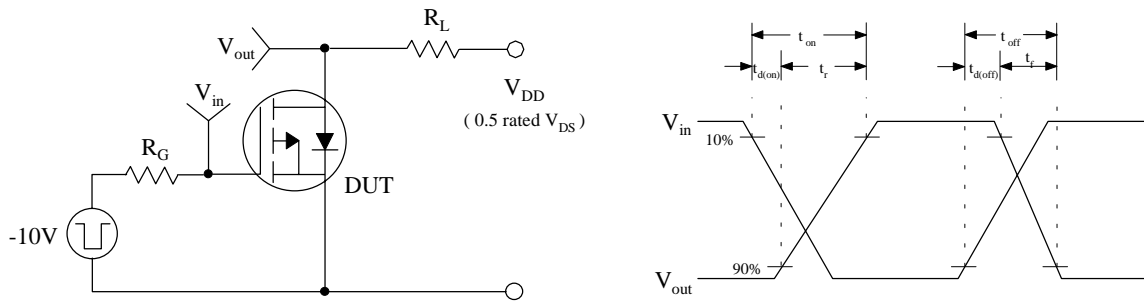
**Fig 11. Thermal Response**



**Fig 12. Gate Charge Test Circuit & Waveform**



**Fig 13. Resistive Switching Test Circuit & Waveforms**



**Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms**

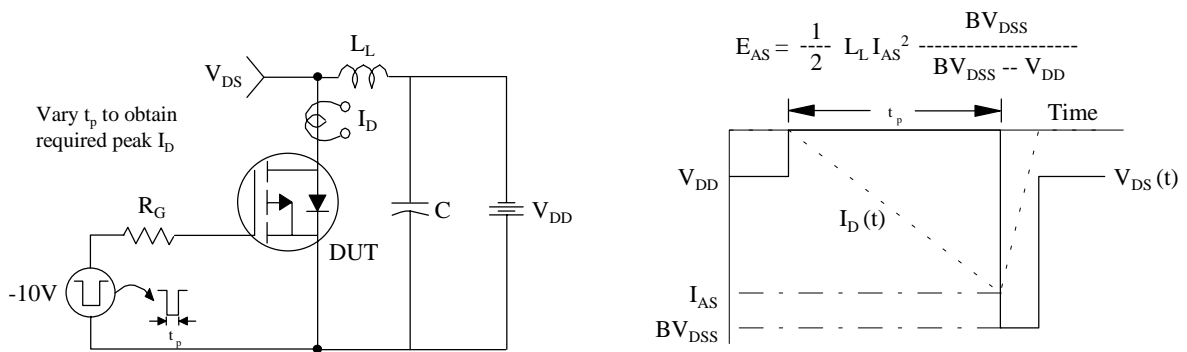
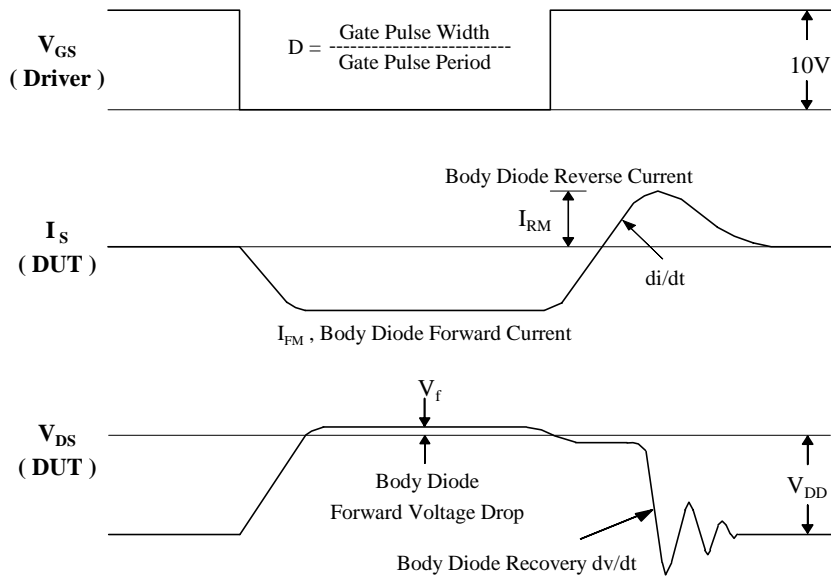
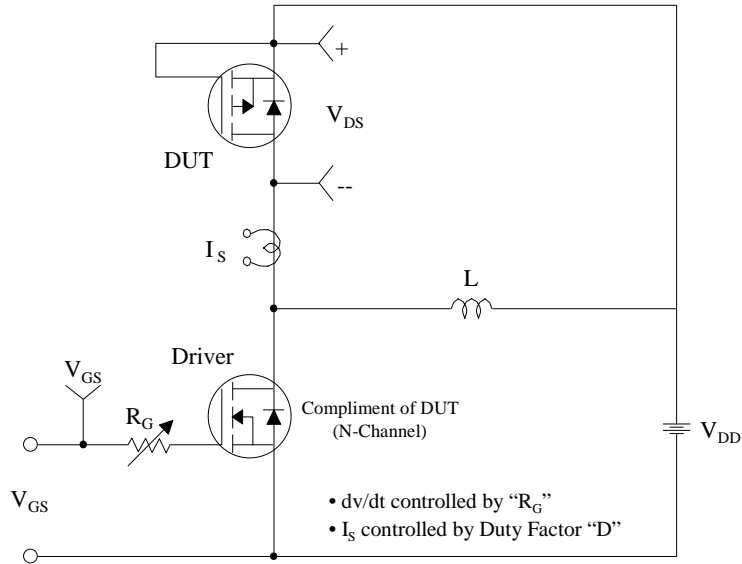


Fig 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



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