

## TO-220F Plastic-Encapsulate MOSFETS

N-Channel Power MOSFET

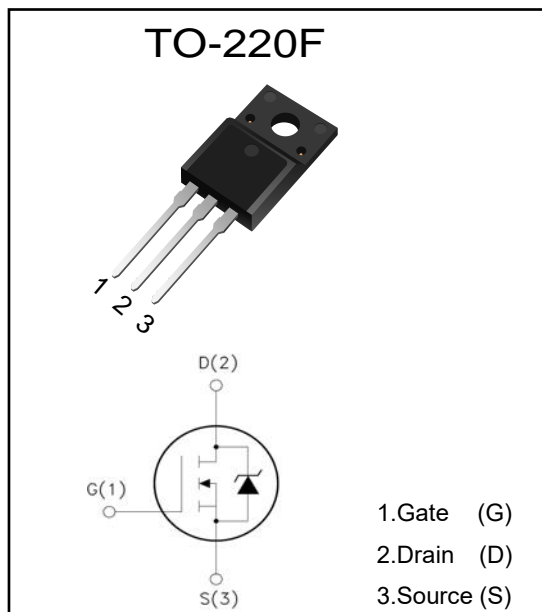
### FEATURE

- Low Intrinsic Capacitances.
- Excellent Switching Characteristics.
- Extended Safe Operating Area.
- Unrivalled Gate Charge :Qg=75 nC (Typ.).
- $BV_{DSS}=650V, I_D=20A$
- $R_{DS(on)} : 0.42\Omega$  (Max) @ $V_G=10V$
- 100% Avalanche Tested

### MARKING



PF20N65SE= Device code.  
Solid dot = Green molding compound device,  
if none, the normal device.  
XXXX = Code.



### Absolute Maximum Ratings (Ta=25°C unless otherwise noted)

Symbol	Parameter	Value	Unit
$V_{DSS}$	Drain-Source Voltage	650	V
$I_D$	Drain Current	$T_C=25^\circ C$	20
		$T_C=100^\circ C$	12.5
$V_{GSS}$	Gate-Source Voltage	$\pm 30$	V
$E_{AS}$	Single Pulse Avalanche Energy (note1)	580	mJ
$I_{AR}$	Avalanche Current (note2)	20	A
$P_D$	Power Dissipation ( $T_C=25^\circ C$ )	84	W
$T_j$	Junction Temperature(Max)	150	°C
$T_{stg}$	Storage Temperature	-55~+150	
TL	Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds	300	

### Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case	-	1.48	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	-	62.5	

**ELECTRICAL CHARACTERISTICS (T<sub>a</sub>=25°C unless otherwise specified)**

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

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
<b>Off Characteristics</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	I <sub>D</sub> =250μA, V <sub>GS</sub> =0	650	-	-	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> =250μA, Reference to 25°C	-	0.71	-	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> =650V, V <sub>GS</sub> =0V	-	-	10	μA
		V <sub>DS</sub> =520V, T <sub>c</sub> =125°C	-	-	100	
I <sub>GSSF</sub>	Gate-body leakage Current, Forward	V <sub>GS</sub> =+30V, V <sub>DS</sub> =0V	-	-	100	nA
I <sub>GSSR</sub>	Gate-body leakage Current, Reverse	V <sub>GS</sub> =-30V, V <sub>DS</sub> =0V	-	-	-100	
<b>On Characteristics</b>						
V <sub>GS(TH)</sub>	Gate Threshold Voltage	I <sub>D</sub> =250μA, V <sub>DS</sub> =V <sub>GS</sub>	2	-	4	V
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance	I <sub>D</sub> =10A, V <sub>GS</sub> =10V	-	0.35	0.42	Ω
<b>Dynamic Characteristics</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> =25V, V <sub>GS</sub> =0, f=1.0MHz	-	3420	-	pF
C <sub>oss</sub>	Output Capacitance		-	325	-	
C <sub>rss</sub>	Reverse Transfer Capacitance		-	25	-	
<b>Switching Characteristics</b>						
T <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> =325V, I <sub>D</sub> =20A R <sub>G</sub> =25Ω (Note 3,4)	-	62	135	ns
T <sub>r</sub>	Turn-On Rise Time		-	140	290	
T <sub>d(off)</sub>	Turn-Off Delay Time		-	230	470	
T <sub>f</sub>	Turn-Off Rise Time		-	65	140	
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> =520V, V <sub>GS</sub> =10V, I <sub>D</sub> =20A (Note 3,4)	-	75	98	nC
Q <sub>gs</sub>	Gate-Source Charge		-	13.5	18	
Q <sub>gd</sub>	Gate-Drain Charge		-	36	-	
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
I <sub>S</sub>	Max. Diode Forward Current	-	-	-	20	A
I <sub>SM</sub>	Max. Pulsed Forward Current	-	-	-	80	
V <sub>SD</sub>	Diode Forward Voltage	I <sub>D</sub> =20A	-	-	1.4	V
T <sub>rr</sub>	Reverse Recovery Time	I <sub>S</sub> =20A, V <sub>GS</sub> =0V diF/dt=100A/μs (Note3)	-	530	-	nS
Q <sub>rr</sub>	Reverse Recovery Charge		-	10.5	-	μC

- Notes : 1, L=3.45mH, I<sub>AS</sub>=20A, V<sub>DD</sub>=50V, R<sub>G</sub>=25Ω, Starting T<sub>J</sub> =25°C  
 2, Repetitive Rating : Pulse width limited by maximum junction temperature  
 3, Pulse Test : Pulse Width ≤ 300μs, Duty Cycle ≤ 2%  
 4, Essentially Independent of Operating Temperature

Figure 1. On-Region Characteristics

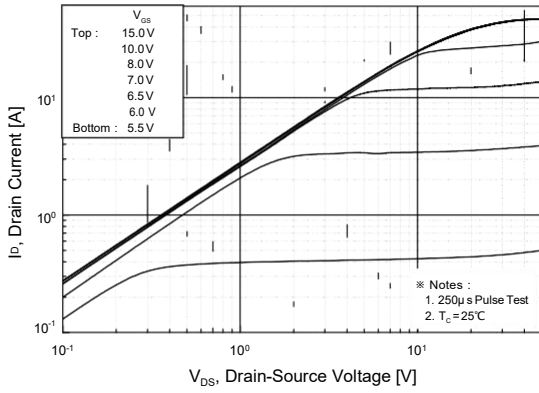


Figure 2. Transfer Characteristics

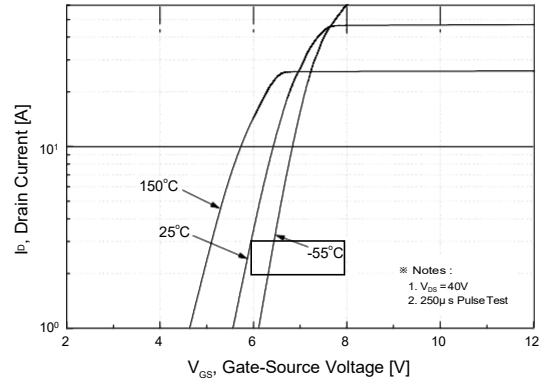


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

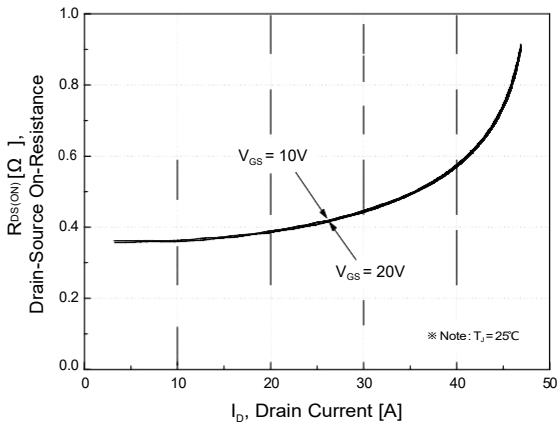


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

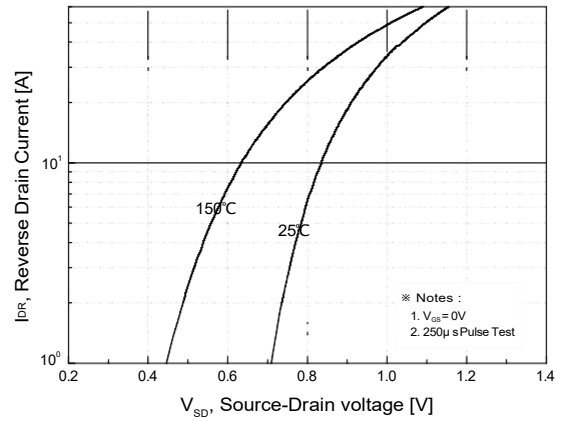


Figure 5. Capacitance Characteristics

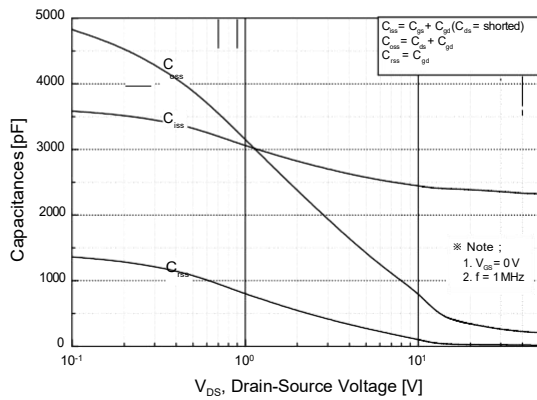


Figure 6. Gate Charge Characteristics

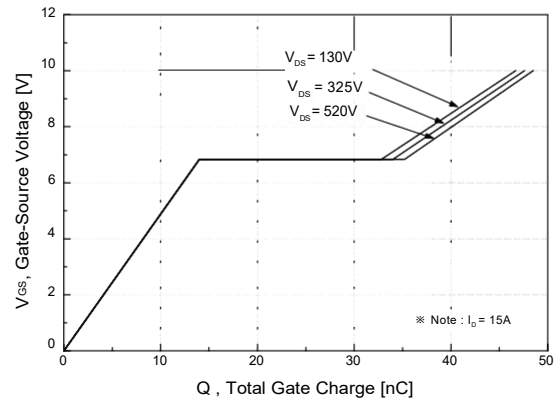


Figure 7. Breakdown Voltage Variation vs. Temperature

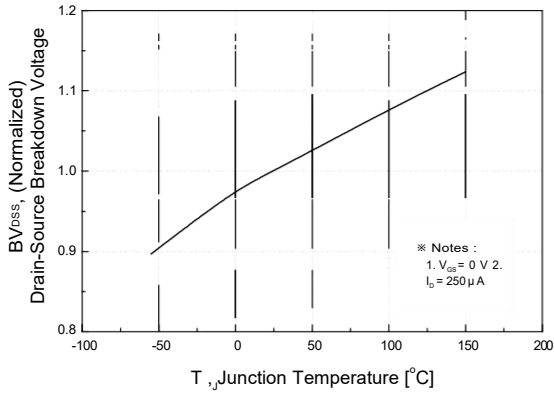


Figure 8. On-Resistance Variation vs. Temperature

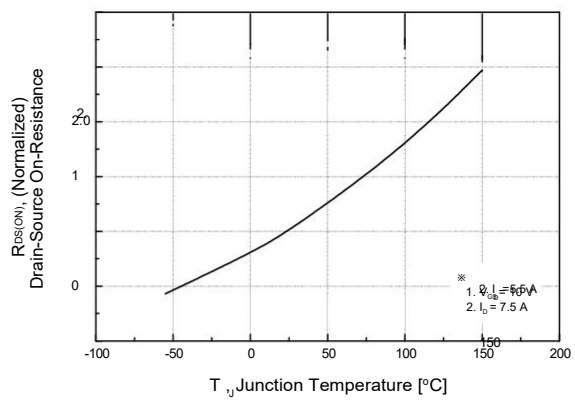


Figure 9 Safe Operating Area

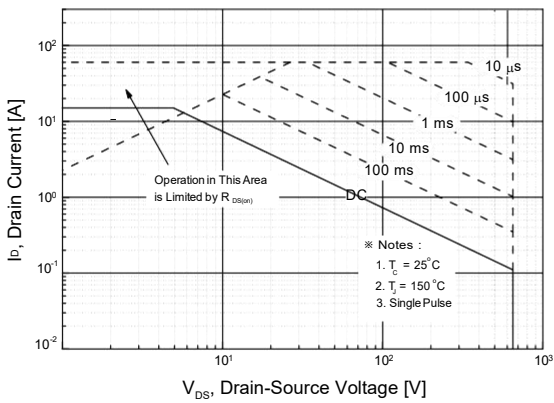


Figure 10. Maximum Drain Current vs. Case Temperature

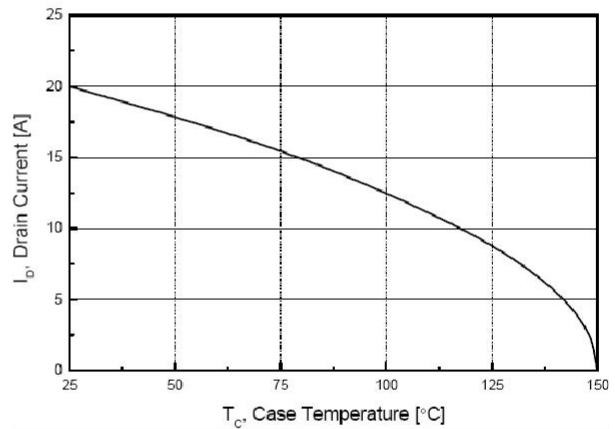
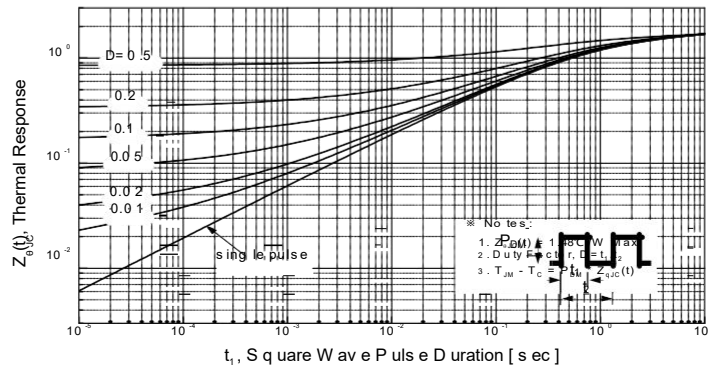
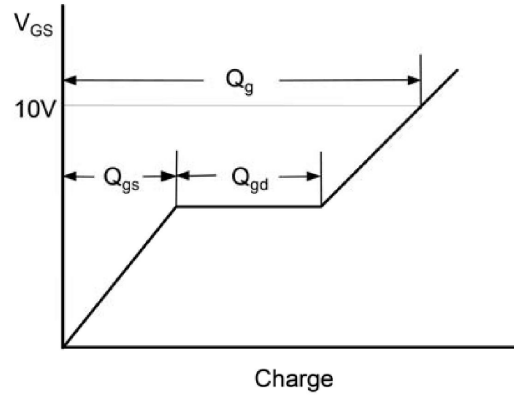
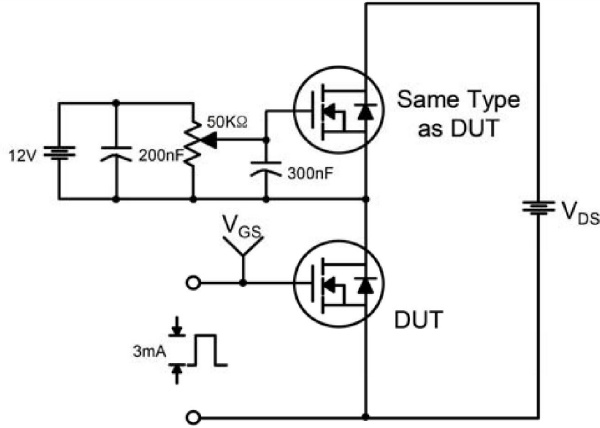


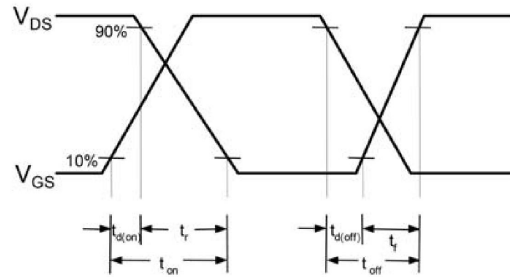
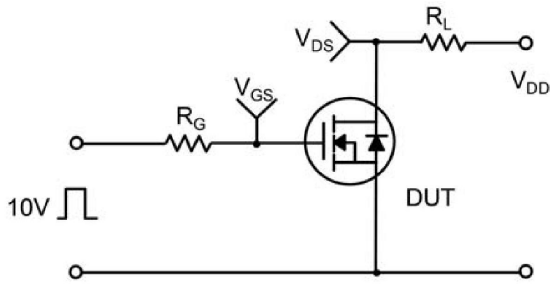
Figure 11 Transient Thermal Response Curve



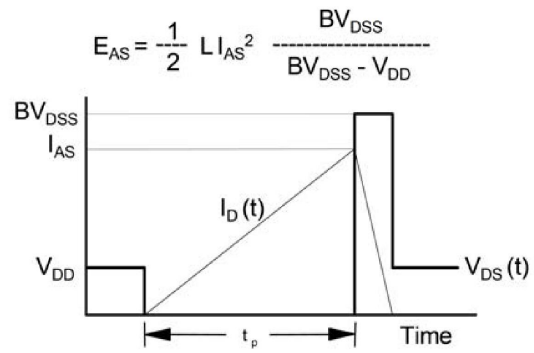
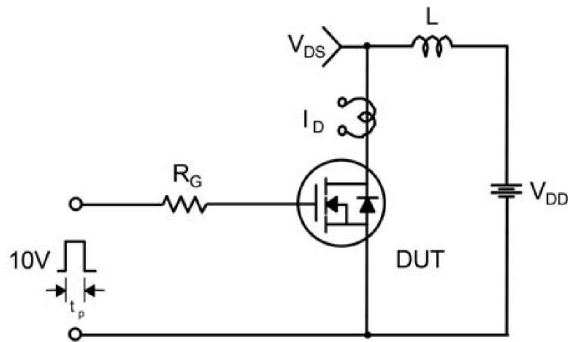
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms



Peak Diode Recovery dv/dt Test Circuit & Waveform

