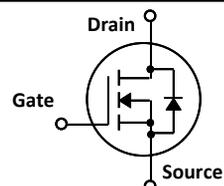


**FEATURES**

- Originative New Design
- 100% EAS Test
- Rugged Gate Oxide Technology
- Extremely Low Intrinsic Capacitances
- Remarkable Switching Characteristics
- Unequalled Gate Charge : 50 nC (Typ.)
- Extended Safe Operating Area
- Lower  $R_{DS(ON)}$  : 1.15Ω (Typ.) @ $V_{GS}=10V$

**PFP9N90E / PFF9N90E**  
**900V N-Channel MOSFET**

$BV_{DSS} = 900\text{ V}$   
 $R_{DS(on)} = 1.15\ \Omega$   
 $I_D = 8.5\text{ A}$


**APPLICATION**

- High current, High speed switching
- Suitable for power supplies, adaptors and PFC
- SMPS (Switched Mode Power Supplies)

**TO-220**


1.Gate 2. Drain 3. Source

**TO-220F**


1.Gate 2. Drain 3. Source

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

Symbol	Parameter	PFP9N90E	PFF9N90E	Units
$V_{DSS}$	Drain-Source Voltage	900		V
$I_D$	Drain Current – Continuous ( $T_C = 25^\circ\text{C}$ )	8.5	8.5*	A
	Drain Current – Continuous ( $T_C = 100^\circ\text{C}$ )	5.4	5.4*	A
$I_{DM}$	Drain Current – Pulsed (Note 1)	34.0	34.0*	A
$V_{GS}$	Gate-Source Voltage	$\pm 30$		V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	850		mJ
$I_{AR}$	Avalanche Current (Note 1)	9.0		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	22.3		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5		V/ns
$P_D$	Power Dissipation ( $T_C = 25^\circ\text{C}$ )	223	68	W
	- Derate above $25^\circ\text{C}$	1.8	0.5	W/ $^\circ\text{C}$
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150		$^\circ\text{C}$
$T_L$	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300		$^\circ\text{C}$

\* Drain current limited by maximum junction temperature.

**Thermal Resistance Characteristics**

Symbol	Parameter	PFP9N90E	PFF9N90E	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.56	1.85	$^\circ\text{C}/\text{W}$
$R_{\theta JS}$	Thermal Resistance, Junction-to-Sink	0.5	--	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	62.5	

**Electrical Characteristics**  $T_C=25^\circ\text{C}$  unless otherwise specified

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>On Characteristics</b>						
$V_{GS}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250 \mu\text{A}$	2.5	--	4.5	V
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS} = 10 \text{ V}, I_D = 4.5 \text{ A}$	--	1.15	1.4	$\Omega$

<b>Off Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0 \text{ V}, I_D = 250 \mu\text{A}$	900	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250 \mu\text{A}$ , Referenced to $25^\circ\text{C}$	--	0.5	--	$\text{V}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 900 \text{ V}, V_{GS} = 0 \text{ V}$	--	--	10	$\mu\text{A}$
		$V_{DS} = 720 \text{ V}, T_C = 125^\circ\text{C}$	--	--	100	$\mu\text{A}$
$I_{GSSF}$	Gate-Body Leakage Current, Forward	$V_{GS} = 30 \text{ V}, V_{DS} = 0 \text{ V}$	--	--	100	nA
$I_{GSSR}$	Gate-Body Leakage Current, Reverse	$V_{GS} = -30 \text{ V}, V_{DS} = 0 \text{ V}$	--	--	-100	nA

<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V}, f = 1.0 \text{ MHz}$	--	2655	3450	pF
$C_{oss}$	Output Capacitance		--	160	210	pF
$C_{rss}$	Reverse Transfer Capacitance		--	35	45	pF

<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Time	$V_{DS} = 450 \text{ V}, I_D = 9.0 \text{ A}, R_G = 25 \Omega$  (Note 4,5)	--	36	72	ns
$t_r$	Turn-On Rise Time		--	21	42	ns
$t_{d(off)}$	Turn-Off Delay Time		--	104	208	ns
$t_f$	Turn-Off Fall Time		--	31	62	ns
$Q_g$	Total Gate Charge	$V_{DS} = 720 \text{ V}, I_D = 9.0 \text{ A}, V_{GS} = 10 \text{ V}$  (Note 4,5)	--	50	75	nC
$Q_{gs}$	Gate-Source Charge		--	15	--	nC
$Q_{gd}$	Gate-Drain Charge		--	12	--	nC

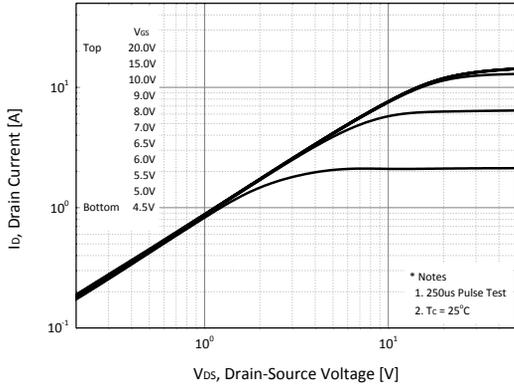
<b>Source-Drain Diode Maximum Ratings and Characteristics</b>						
$I_S$	Continuous Source-Drain Diode Forward Current	--	--	8.5	A	
$I_{SM}$	Pulsed Source-Drain Diode Forward Current	--	--	34.0		
$V_{SD}$	Source-Drain Diode Forward Voltage	$I_S = 8.5 \text{ A}, V_{GS} = 0 \text{ V}$	--	--	1.4	V
$t_{rr}$	Reverse Recovery Time	$I_S = 9.0 \text{ A}, V_{GS} = 0 \text{ V}$	--	540	--	ns
$Q_{rr}$	Reverse Recovery Charge	$di_f/dt = 100 \text{ A}/\mu\text{s}$ (Note 4)	--	7.0	--	$\mu\text{C}$

**Notes ;**

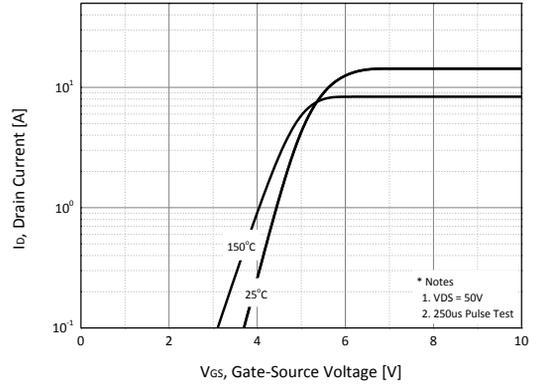
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L=21\text{mH}, I_{AS}=9.0\text{A}, V_{OD}=50\text{V}, R_G=25\Omega$ , Starting  $T_J=25^\circ\text{C}$
3.  $I_{SD}\leq 9.0\text{A}, di/dt\leq 200\text{A}/\mu\text{s}, V_{DD}\leq BV_{DSS}$ , Starting  $T_J=25^\circ\text{C}$
4. Pulse Test : Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2\%$
5. Essentially Independent of Operating Temperature

# Typical Characteristics

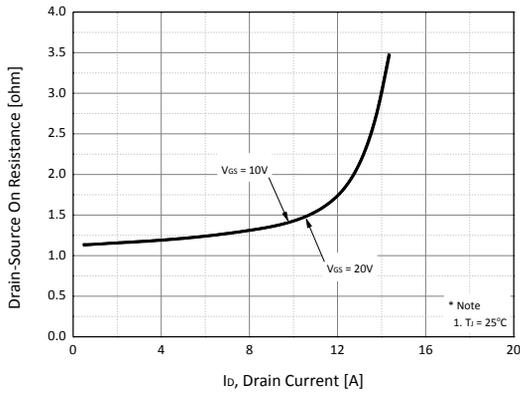
**Fig.1 On Region Characteristics**



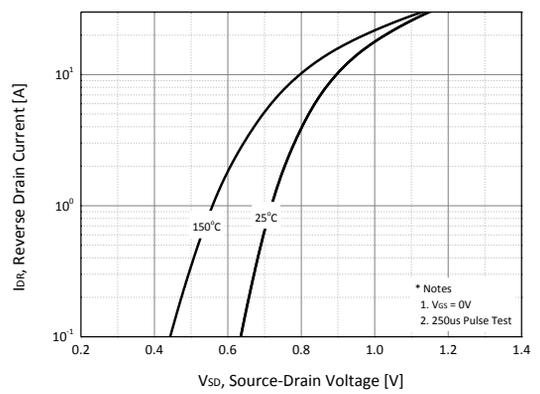
**Fig.2 Transfer Characteristics**



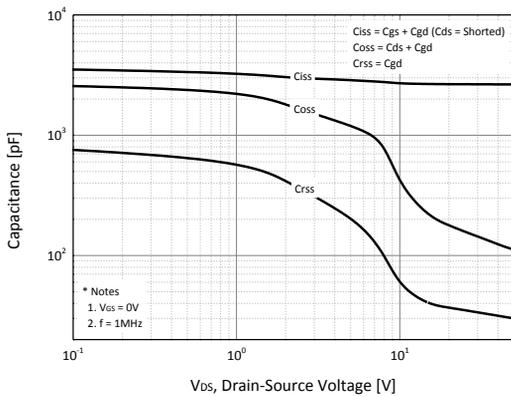
**Fig.3 Static Drain-Source On Resistance**



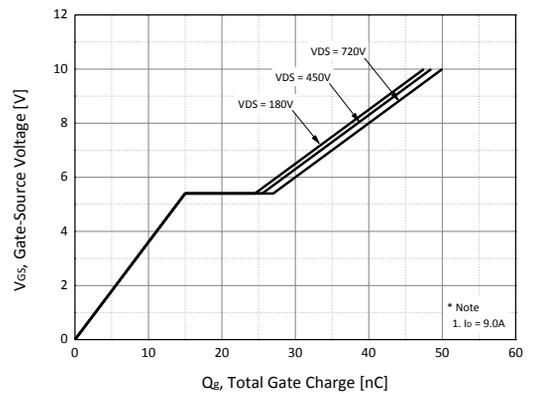
**Fig.4 Body Diode Forward Voltage**



**Fig.5 Capacitance Characteristics**

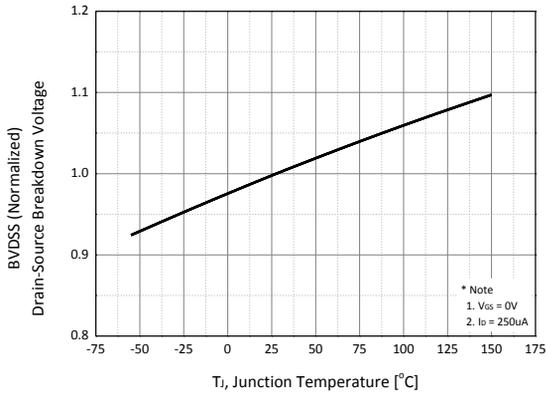


**Fig.6 Gate Charge Characteristics**

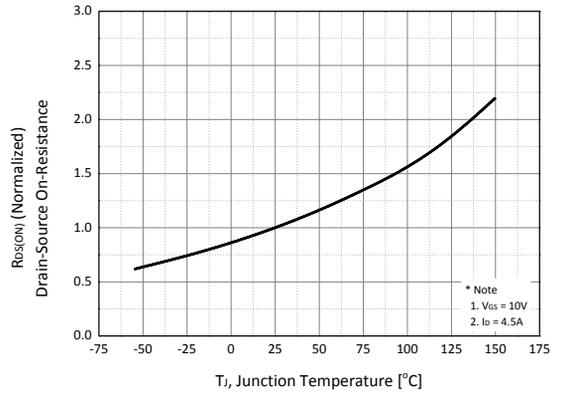


# Typical Characteristics

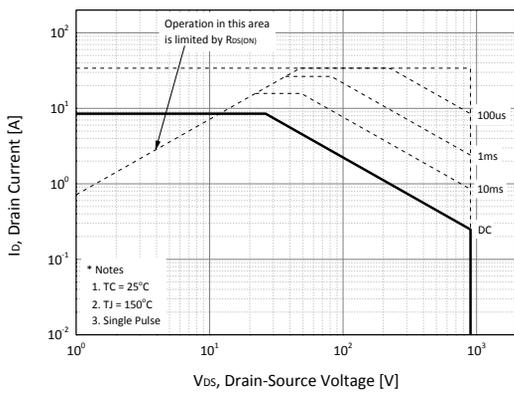
**Fig.7 BV<sub>DSS</sub> Variation vs. Temperature**



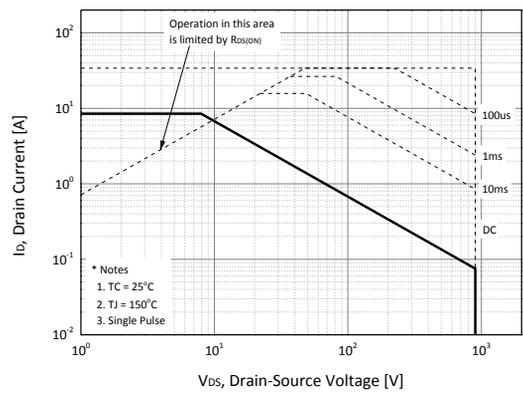
**Fig.8 On-Resistance Variation vs. Temperature**



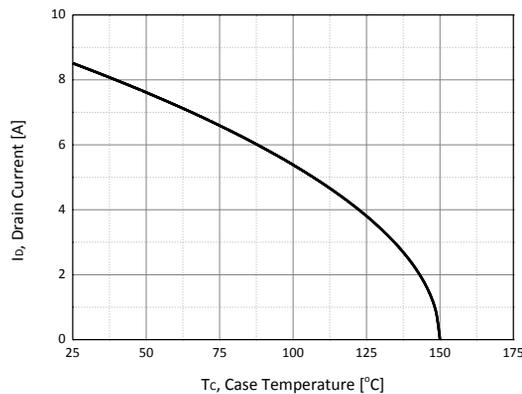
**Fig.9-1 Safe Operation Area for TO-220**



**Fig.9-2 Safe Operation Area for TO-220F**

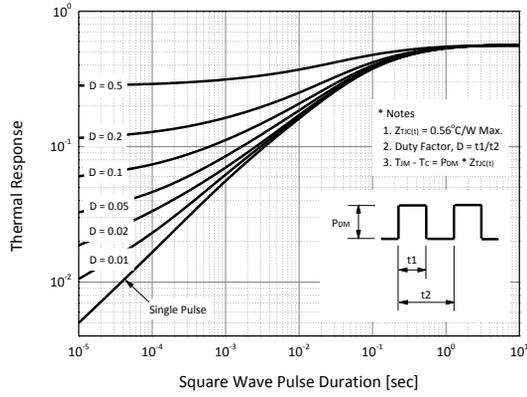


**Fig.10 Maximum I<sub>D</sub> vs. Case Temperature**

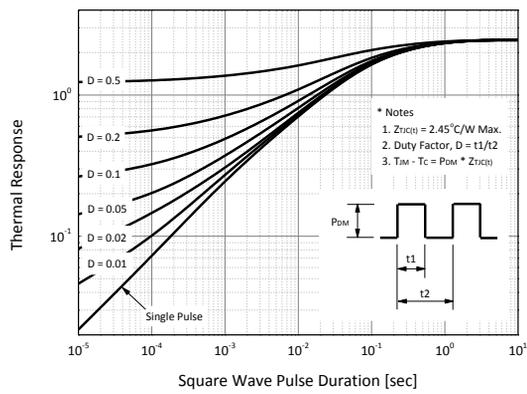


# Typical Characteristics

**Fig.11-1 Transient Thermal Response Curve**



**Fig.11-2 Transient Thermal Response Curve**



### Characteristics Test Circuit & Waveform

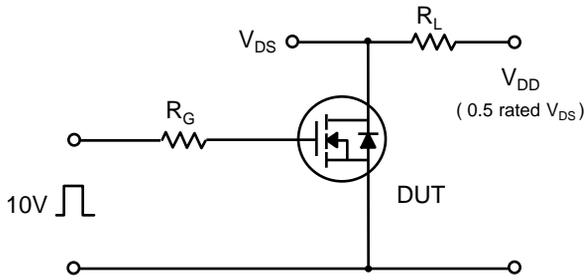


Fig 14. Resistive Switching Test Circuit & Waveforms

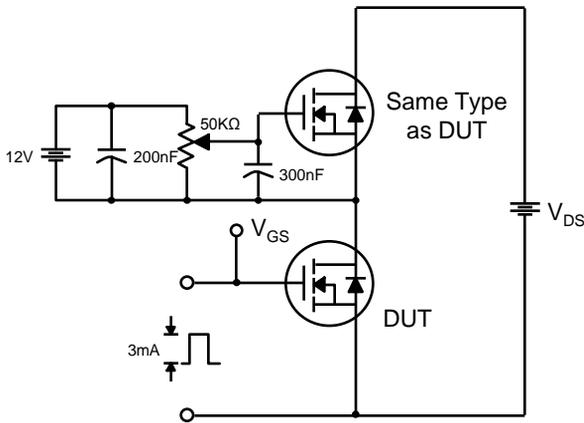


Fig 15. Gate Charge Test Circuit & Waveform

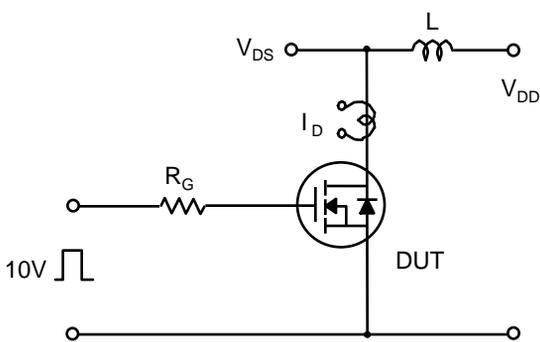
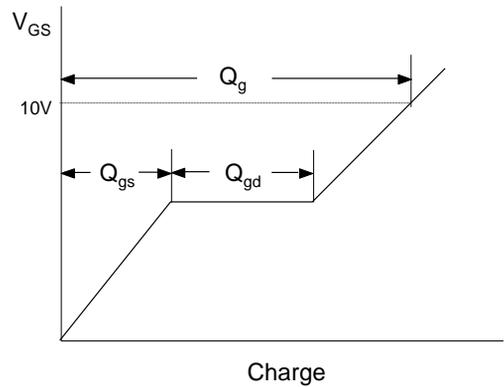
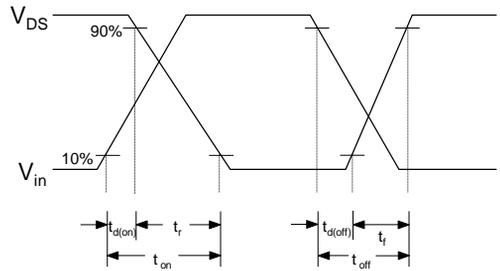
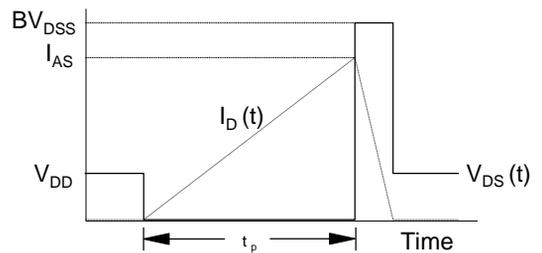


Fig 16. Unclamped Inductive Switching Test Circuit & Waveforms



$$E_{AS} = \frac{1}{2} L_L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$



Characteristics Test Circuit & Waveform (continued)

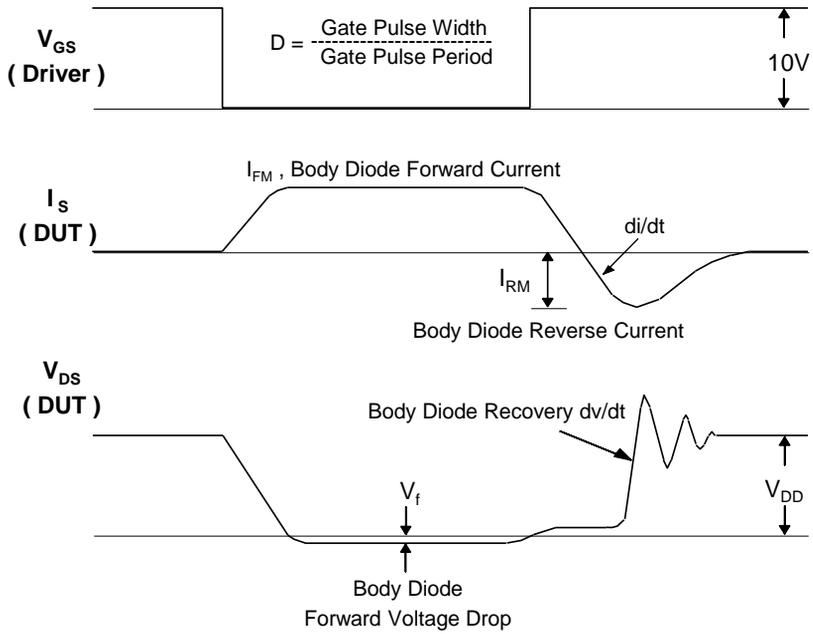
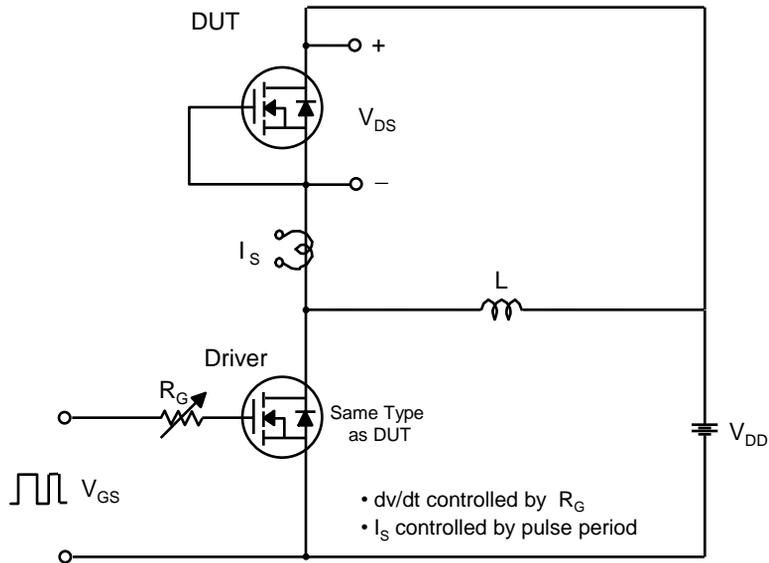


Fig 17. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

# Package Dimension

Z

## TO-220

PFP9N90E / PFF9N90E

