

PFP9N90E / PFF9N90E

900V N-Channel MOSFET

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.) @ $V_{GS}=10V$

APPLICATION

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

$BV_{DSS} = 900\text{ V}$ $R_{DS(on)} = 1.15\ \Omega$ $I_D = 8.5\text{ A}$	
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	± 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°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	$^\circ\text{C/W}$
$R_{\theta JS}$	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
On Characteristics						
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	Ω

Off Characteristics						
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°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	μA
		$V_{DS} = 720 \text{ V}, T_C = 125^\circ\text{C}$	--	--	100	μA
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

Dynamic Characteristics						
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

Switching Characteristics						
$t_{d(on)}$	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

Source-Drain Diode Maximum Ratings and Characteristics						
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	--	μC

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

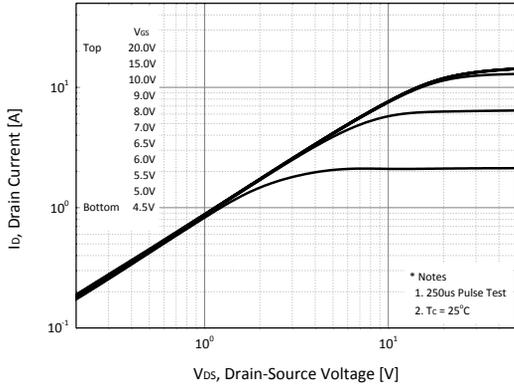


Fig.2 Transfer Characteristics

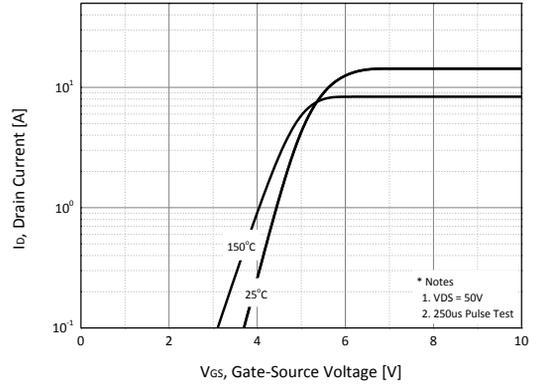


Fig.3 Static Drain-Source On Resistance

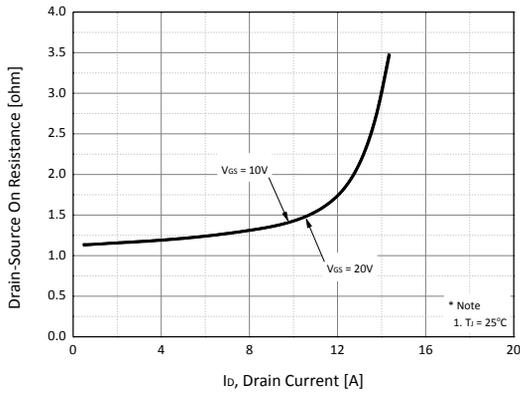


Fig.4 Body Diode Forward Voltage

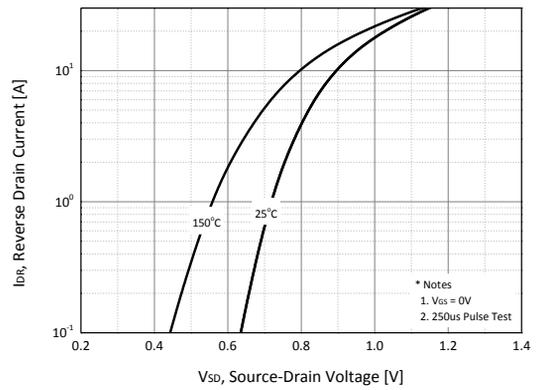


Fig.5 Capacitance Characteristics

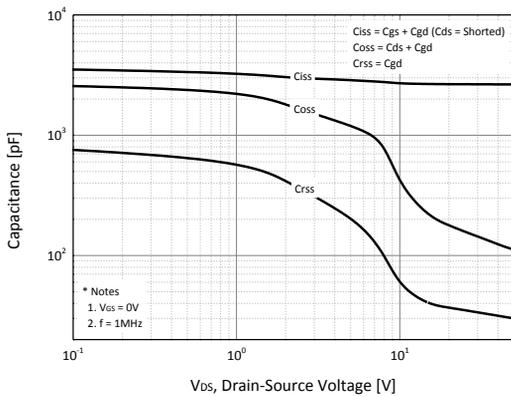
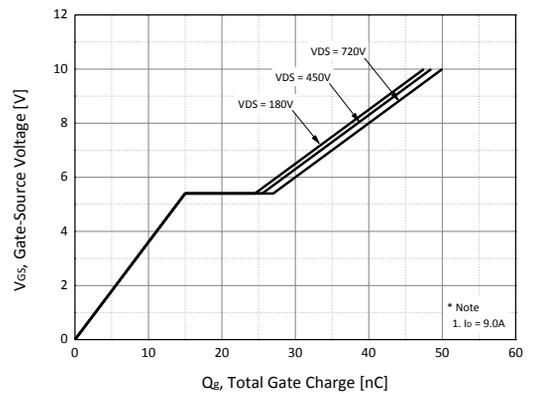


Fig.6 Gate Charge Characteristics



Typical Characteristics

Fig.7 BV_{DSS} Variation vs. Temperature

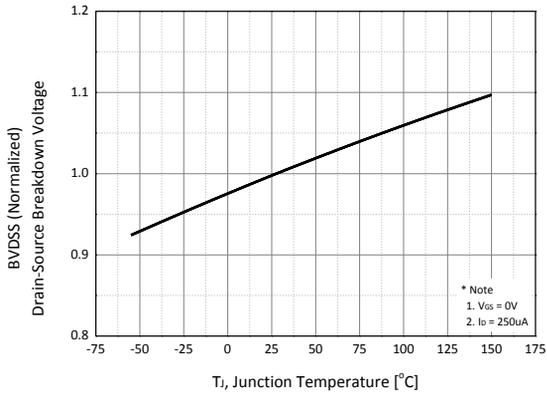


Fig.8 On-Resistance Variation vs. Temperature

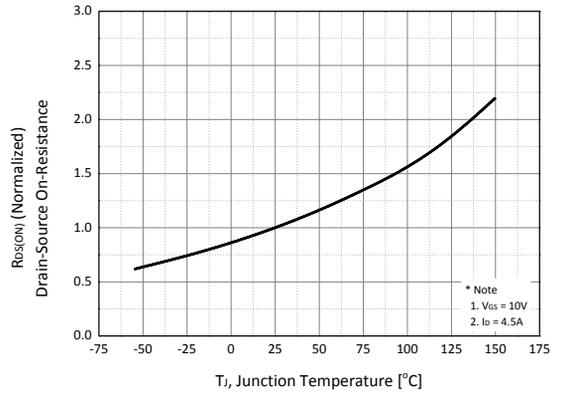


Fig.9-1 Safe Operation Area for TO-220

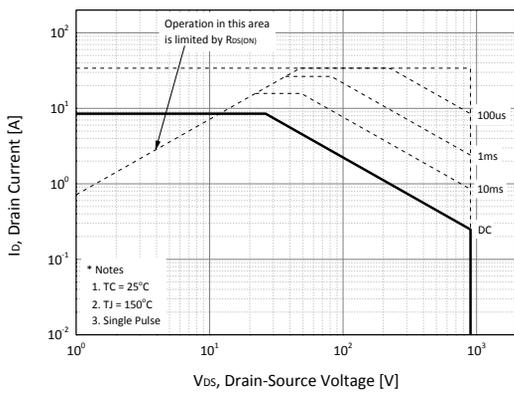


Fig.9-2 Safe Operation Area for TO-220F

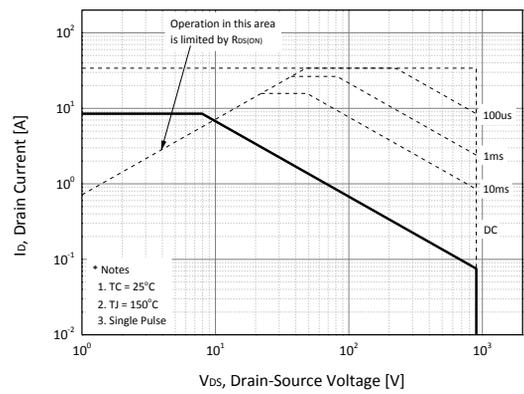
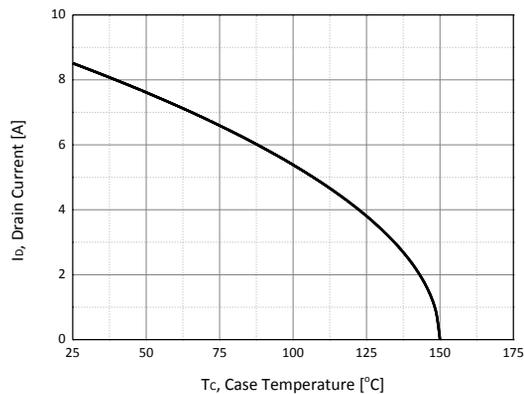


Fig.10 Maximum I_D vs. Case Temperature



Typical Characteristics

Fig.11-1 Transient Thermal Response Curve

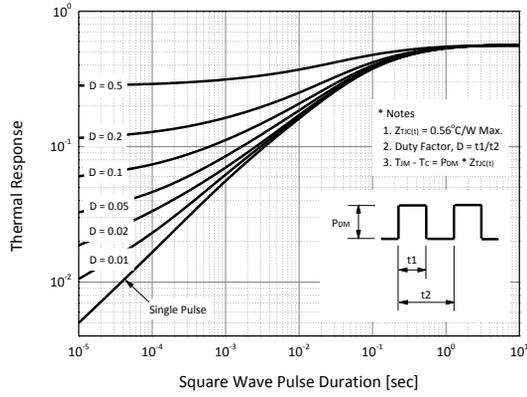
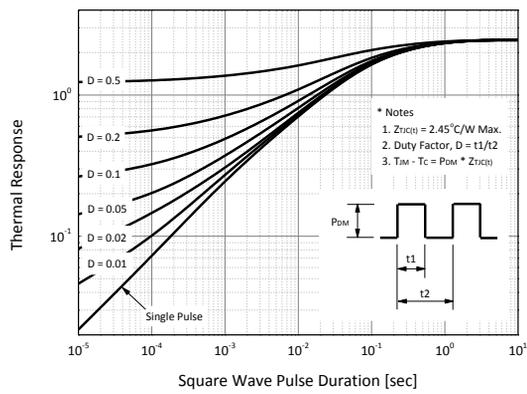


Fig.11-2 Transient Thermal Response Curve



Characteristics Test Circuit & Waveform

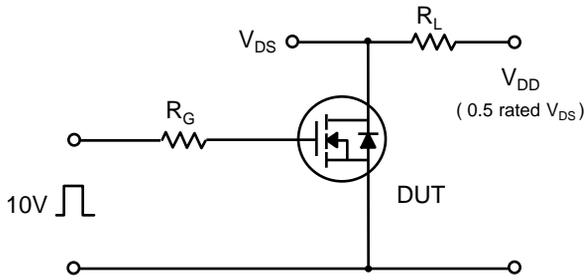


Fig 14. Resistive Switching Test Circuit & Waveforms

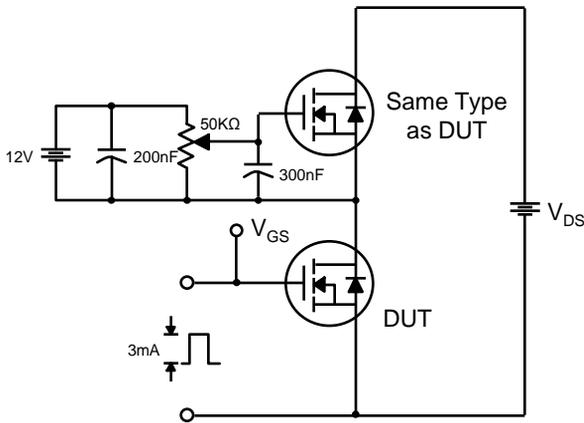


Fig 15. Gate Charge Test Circuit & Waveform

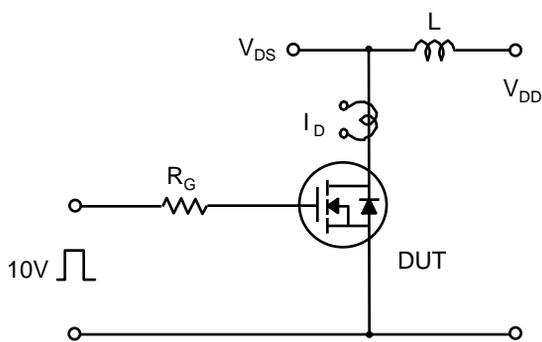
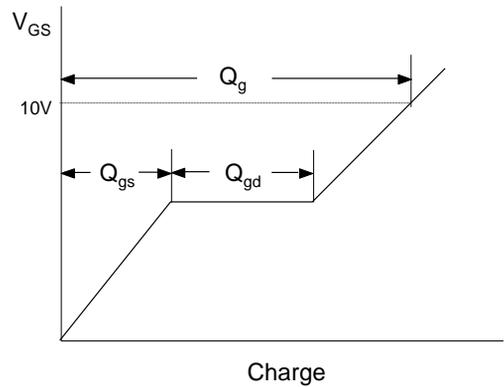
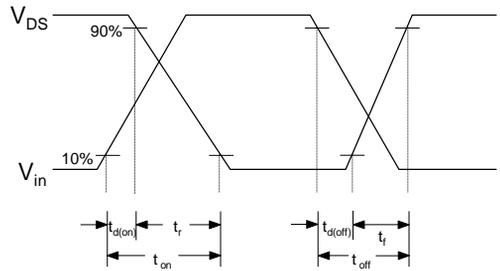
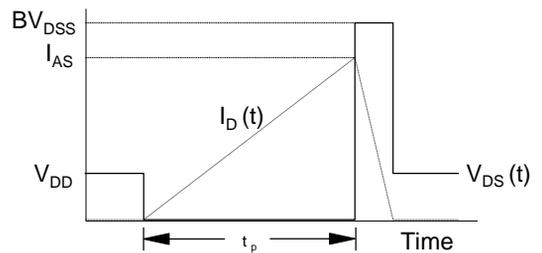


Fig 16. Unclamped Inductive Switching Test Circuit & Waveforms



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



Characteristics Test Circuit & Waveform (continued)

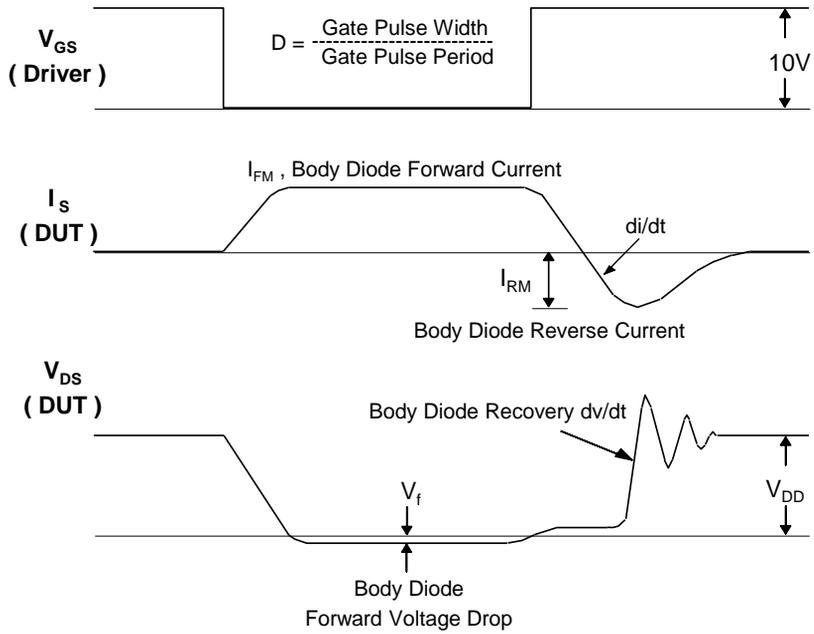
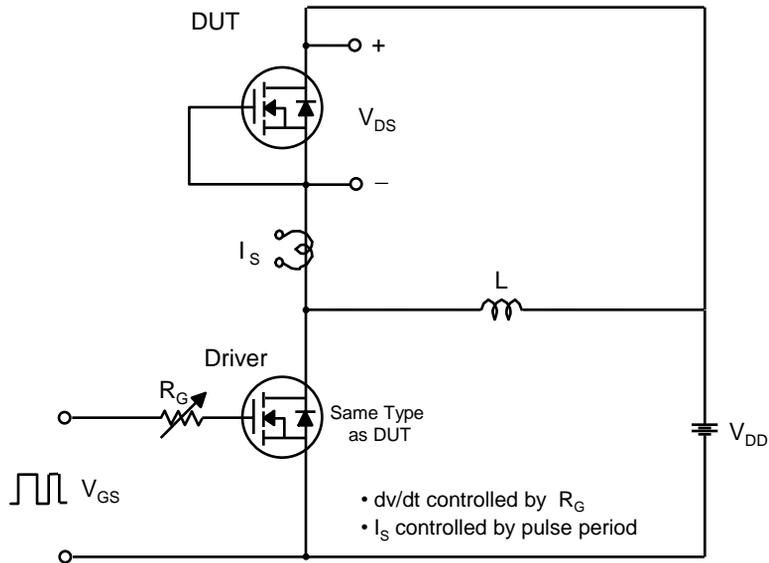


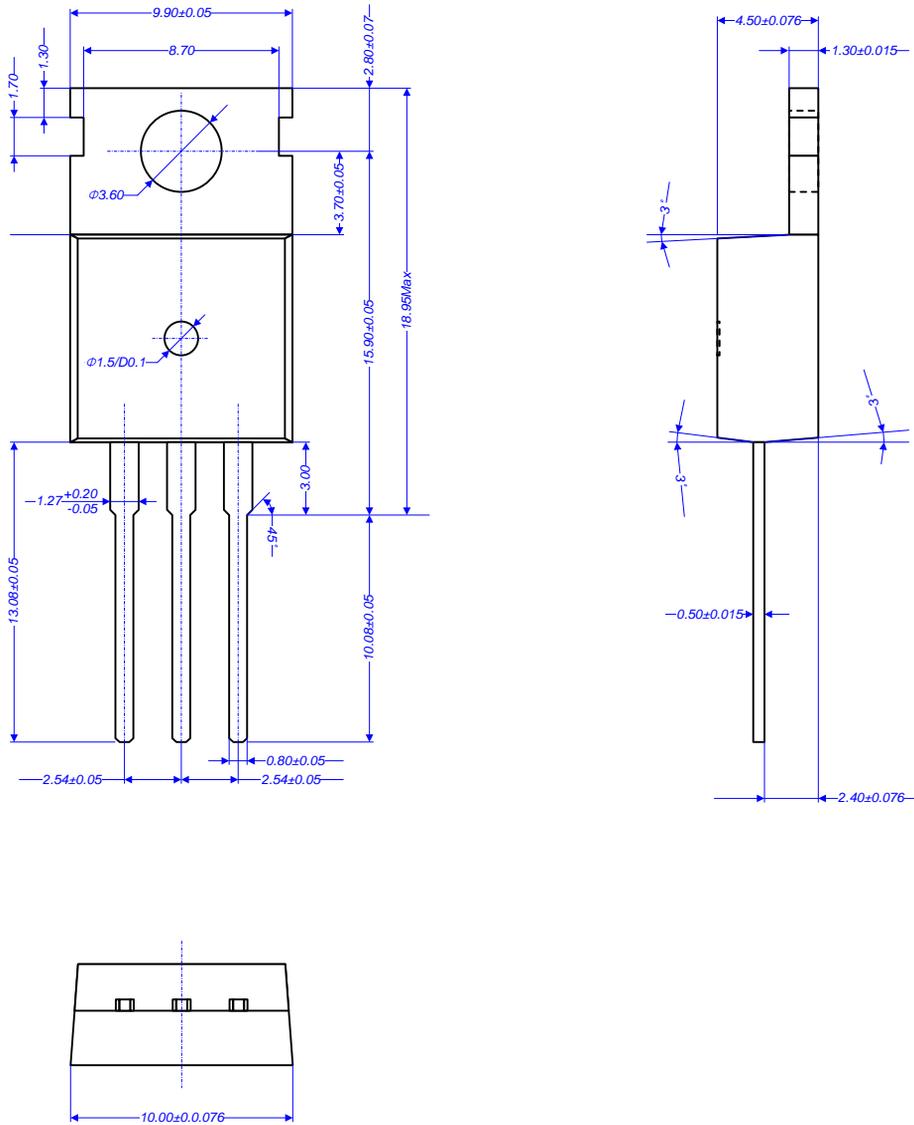
Fig 17. Peak Diode Recovery dv/dt Test Circuit & Waveforms

Package Dimension

Z

TO-220

PFP9N90E / PFF9N90E



Package Dimension

TO-220F

