

# PFP60R360 / PFF60R360

## N-Channel Super Junction MOSFET

### FEATURES

- New technology for high voltage device
- Low  $R_{DS(on)}$  low conduction losses
- Small package
- Ultra low gate charge cause lower driving requirement
- 100% avalanche tested
- RoHS

<b><math>BV_{DSS} = 600\text{ V}</math></b> <b><math>R_{DS(on)} = 0.30\ \Omega</math></b> <b><math>I_D = 11.0\text{ A}</math></b>	
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### APPLICATION

- Power Factor Correction(PFC)
- Switched mode power supply (SMPS)
- Uninterruptible Power Supply (UPS)

<b>TO-220</b> 	<b>TO-220F</b> 
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### Absolute Maximum Ratings $T_c=25^\circ\text{C}$ unless otherwise specified

Symbol	Parameter	PFP60R360	PFF60R360	Units
$V_{DS}$	Drain-Source Voltage ( $V_{GS}=0\text{V}$ )	600		V
$I_D$	Drain Current – Continuous ( $T_c = 25^\circ\text{C}$ )	11.0	11.0*	A
	Drain Current – Continuous ( $T_c = 100^\circ\text{C}$ )	7.0	7.0*	A
$I_{DM(pulse)}$	Drain Current – Pulsed * Note 1	33	33*	A
$V_{GS}$	Gate-Source Voltage ( $V_{DS}=0\text{V}$ )	$\pm 30$		V
$E_{AS}$	Single Pulsed Avalanche Energy * Note 2	280		mJ
$I_{AR}$	Avalanche Current * Note 1	5.5		A
$E_{AR}$	Repetitive Avalanche Energy * Note 1	0.5		mJ
dv/dt	Drain Source Voltage Slope, $V_{DS} \leq 480\text{V}$	50		V/ns
	Reverse Diode dv/dt, $V_{DS} \leq 480\text{V}$	15		V/ns
$P_D$	Maximum Power Dissipation ( $T_c = 25^\circ\text{C}$ )	121	32.7	W
	Derate above $25^\circ\text{C}$	0.97	0.26	W/ $^\circ\text{C}$
$T_I, T_{STG}$	Operating and Storage Temperature Range	-55 to +150		$^\circ\text{C}$

\* Limited by maximum junction temperature

### Thermal Resistance Characteristics

Symbol	Parameter	PFP60R360	PFF60R360	Units
$R_{\theta JC}$	Junction-to-Case (Maximum)	1.03	3.82	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Junction-to-Ambient (Maximum)	62	80	

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>On Characteristics</b>						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	2.5	3.0	3.5	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 7.0\text{ A}$	--	300	360	m.ohm
<b>Off Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	600	--	--	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$	--	--	1	$\mu\text{A}$
		$V_{DS} = 600\text{ V}, T_C = 125\text{ }^\circ\text{C}$	--	--	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>						
$g_{FS}$	Forward Transconductance	$V_{DS} = 20\text{ V}, I_D = 7.0\text{ A}$	--	8	--	S
$R_G$	Intrinsic Gate Resistance	$f = 1.0\text{ MHz}$ , open drain	--	2	--	ohm
$C_{iss}$	Input Capacitance	$V_{DS} = 50\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	1030	--	pF
$C_{oss}$	Output Capacitance		--	87	--	pF
$C_{riss}$	Reverse Transfer Capacitance		--	4.5	--	pF
$Q_g$	Total Gate Charge	$V_{DS} = 480\text{ V}, I_D = 11.0\text{ A},$ $V_{GS} = 10\text{ V}$	--	23	40	nC
$Q_{gs}$	Gate-Source Charge		--	5.7	--	nC
$Q_{gd}$	Gate-Drain Charge		--	8	--	nC
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Time	$V_{DS} = 380\text{ V}, I_D = 5.5\text{ A},$ $R_G = 6.8\text{ }\Omega, V_{GS} = 10\text{ V}$	--	9	--	ns
$t_r$	Turn-On Rise Time		--	4	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	40	65	ns
$t_f$	Turn-Off Fall Time		--	4.5	8	ns
<b>Source-Drain Diode Maximum Ratings and Characteristics</b>						
$I_S$	Continuous Source-Drain Diode Forward Current		--	--	11.0	A
$I_{SM}$	Pulsed Source-Drain Diode Forward Current		--	--	33.0	
$V_{SD}$	Source-Drain Diode Forward Voltage	$I_S = 11.0\text{ A}, V_{GS} = 0\text{ V}$	--	0.9	1.2	V
$t_{rr}$	Reverse Recovery Time	$I_S = 11.0\text{ A}$	--	245	--	ns
$Q_{rr}$	Reverse Recovery Charge	$di/dt = 100\text{ A}/\mu\text{s}$	--	2.4	--	$\mu\text{C}$

**Notes ;**

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $V_{DD}=50\text{ V}, R_G=25\Omega$ , Starting  $T_J=25^\circ\text{C}$

# Typical Characteristics

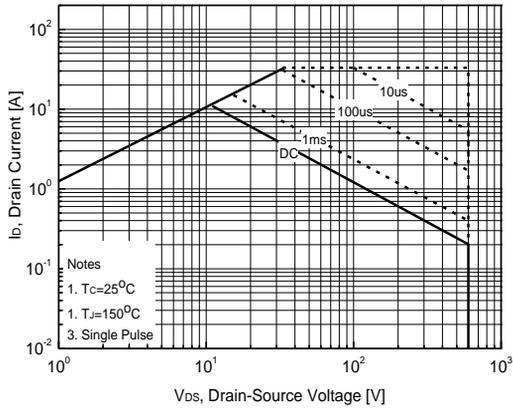


Figure 1. Safe Operating Area(TO-220)

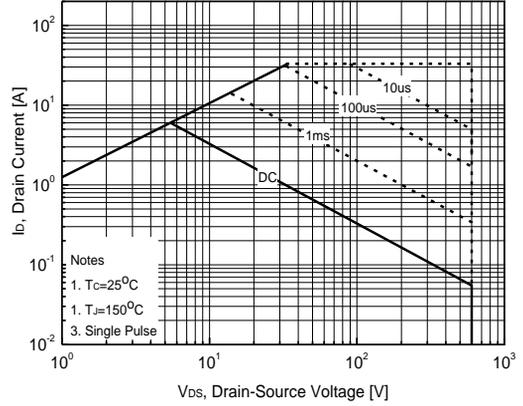


Figure 2. Safe Operating Area(TO-220F)

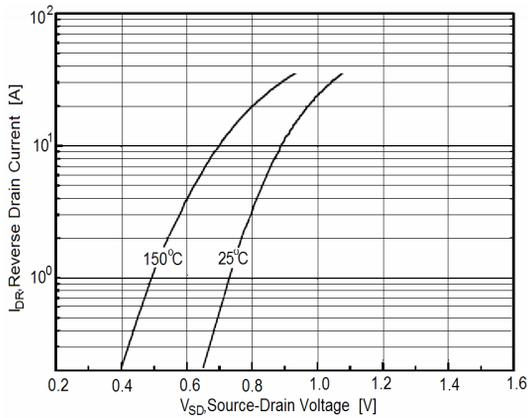


Figure 3. Source-Drain Diode Forward Voltage

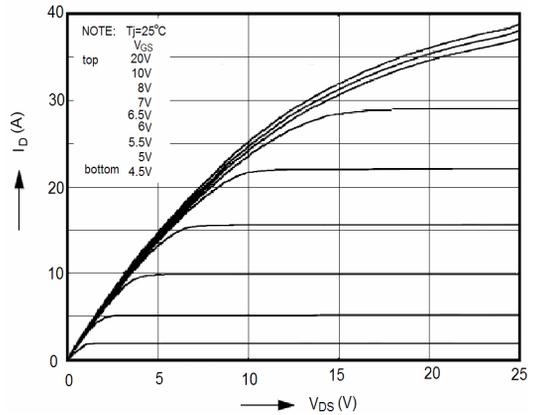


Figure 4. Output Characteristics

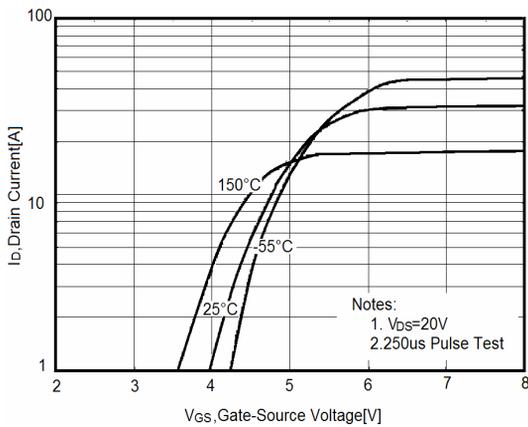


Figure 5. Transfer Characteristics

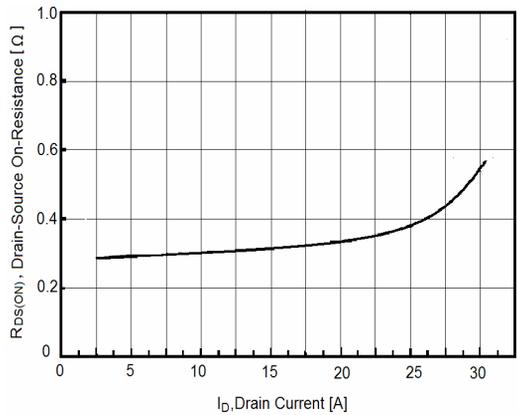


Figure 6. Static Drain-Source On Resistance

Typical Characteristics (continued)

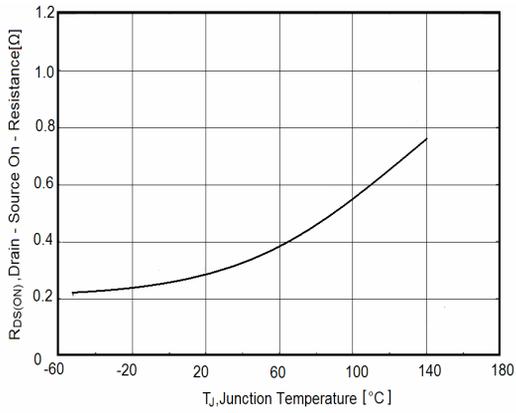


Figure 7. Rds(on) vs. Junction Temperature

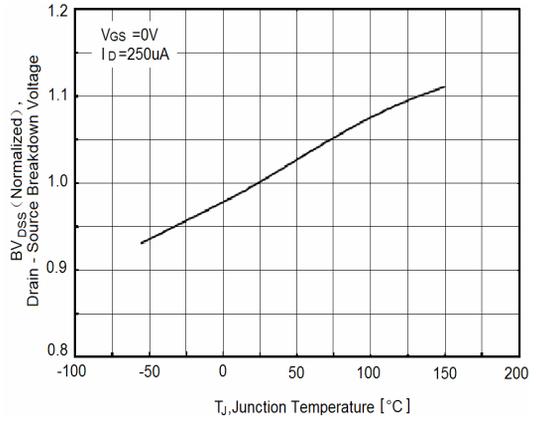


Figure 8. BVdss vs. Junction Temperature

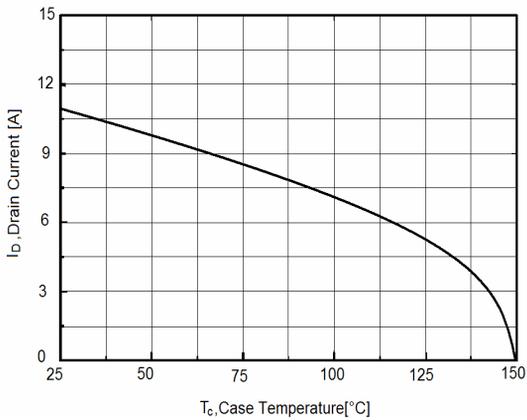


Figure 9. Maximum ID vs. Junction Temperature

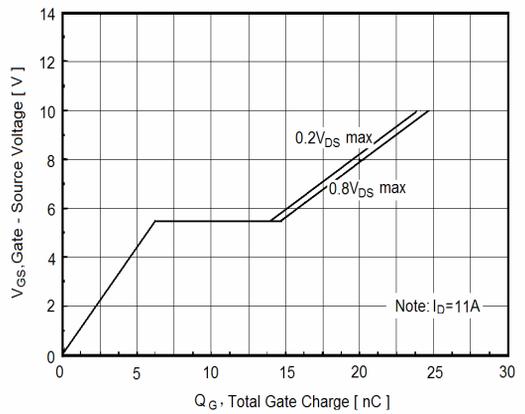


Figure 10. Gate Charge Waveforms

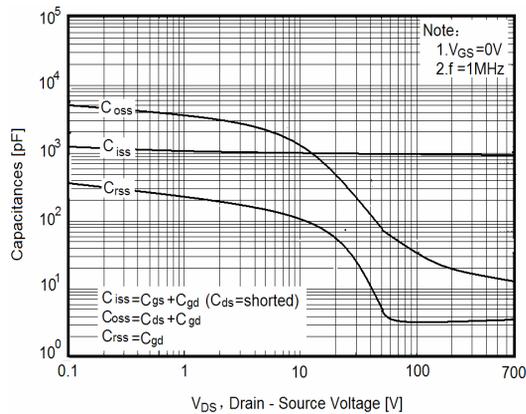


Figure 11. Capacitance

Typical Characteristics (continued)

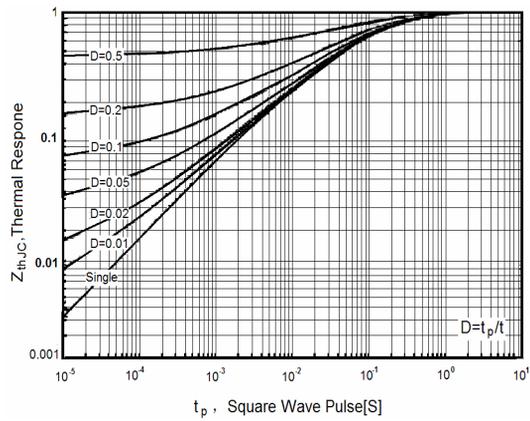


Figure 12. Transient Thermal Response Curve (TO-220)

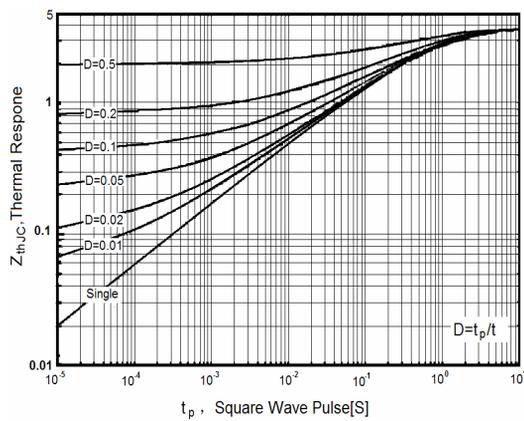
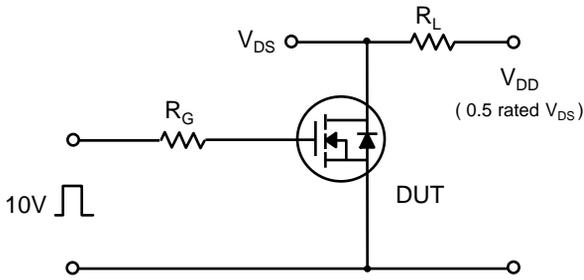
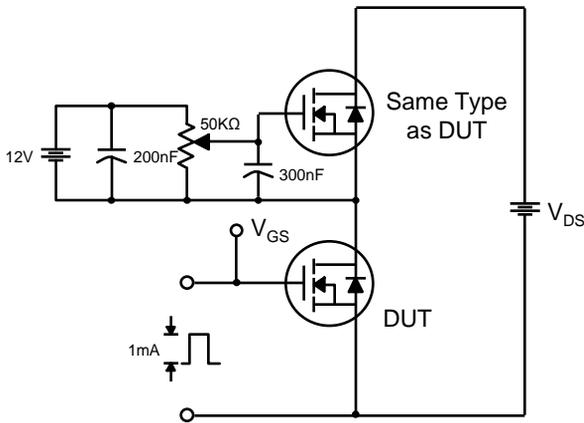


Figure 13. Transient Thermal Response Curve (TO-220F)

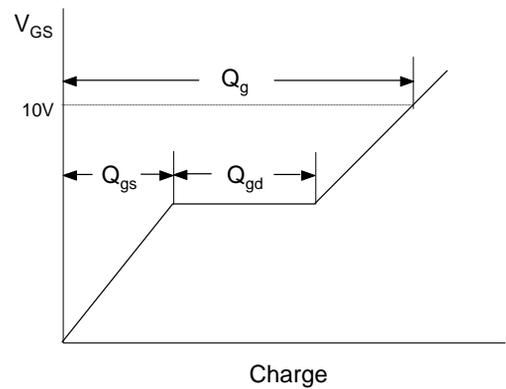
**Characteristics Test Circuit & Waveform**



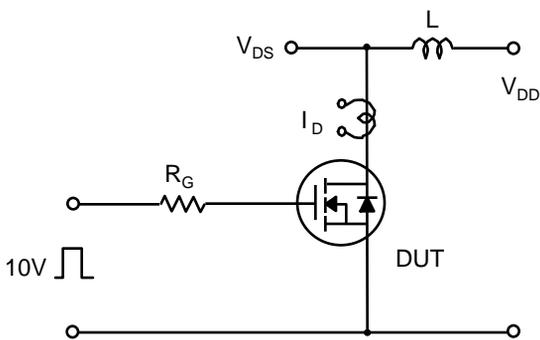
**Switching Time Test Circuit & Waveforms**



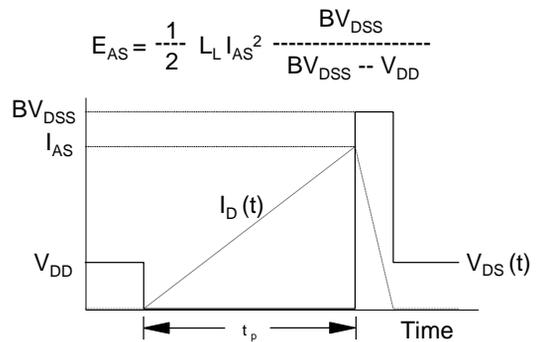
**Gate Charge Test Circuit & Waveform**



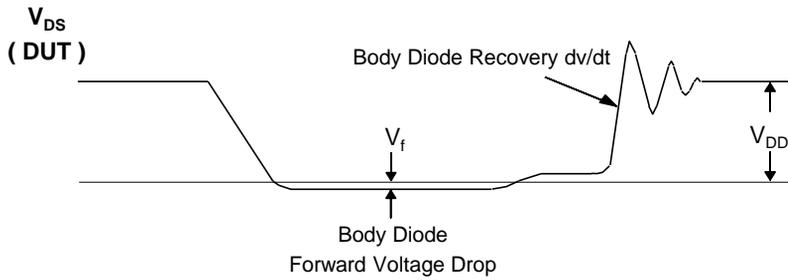
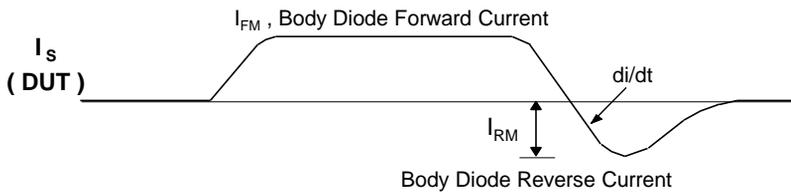
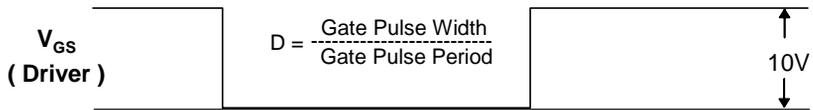
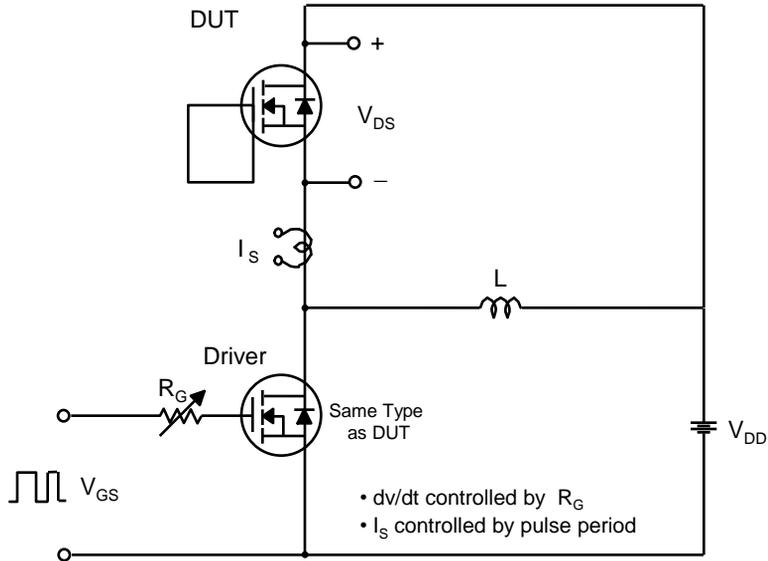
**Charge**



**Unclamped Inductive Switching Test Circuit & Waveforms**



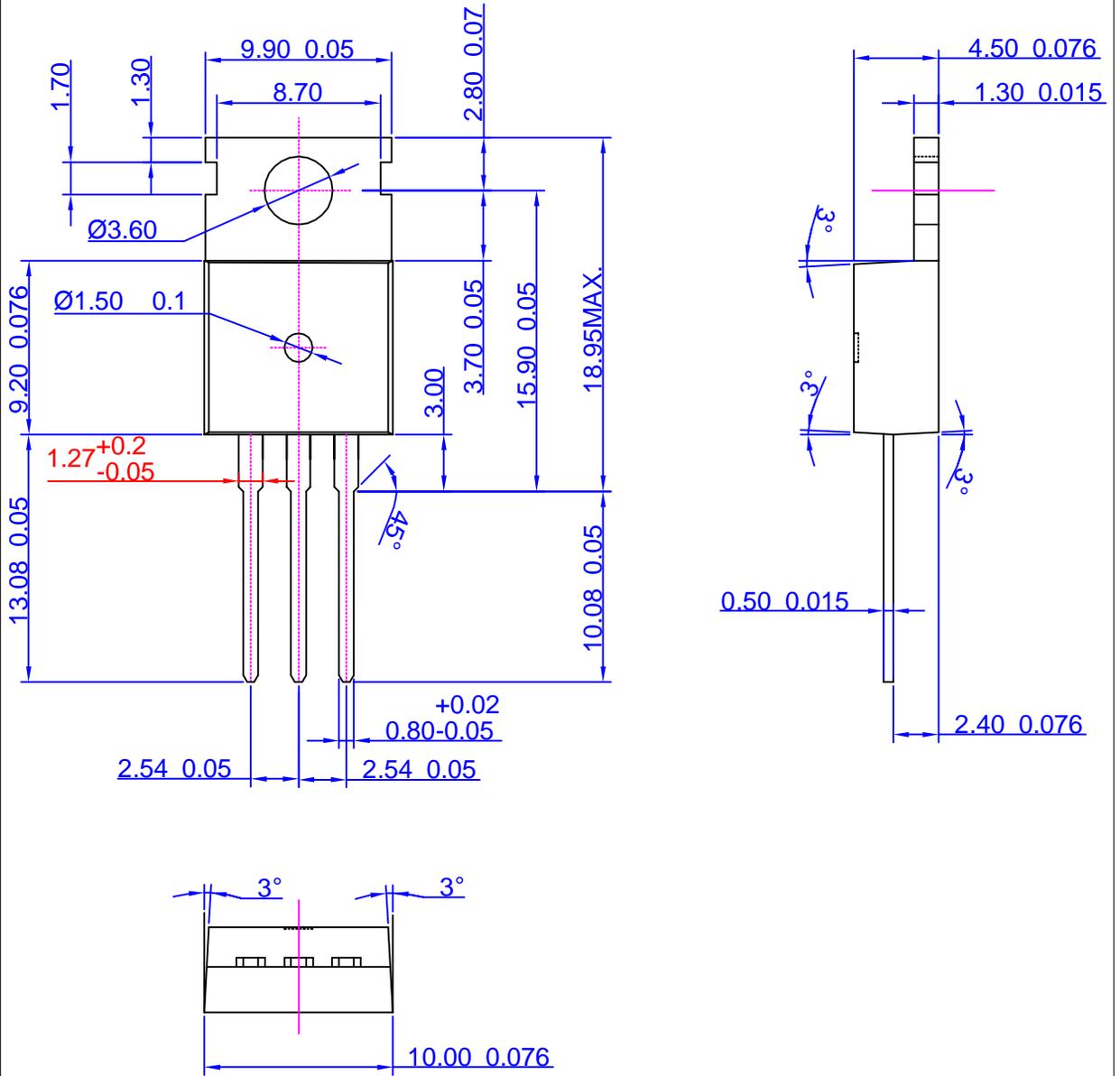
Characteristics Test Circuit & Waveform (continued)



Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

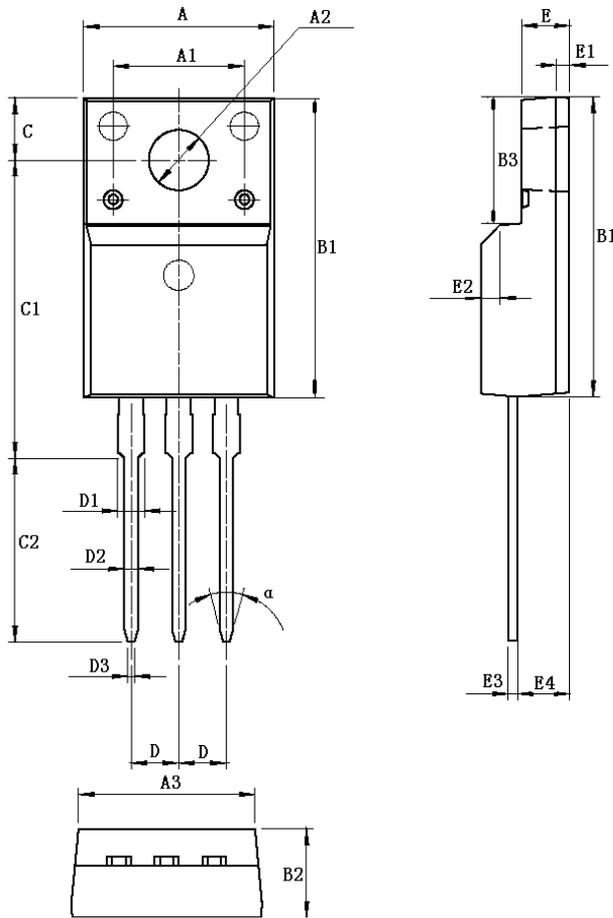
Package Dimension

TO-220 Type 1



Package Dimension

TO-220F Type 1



unit : mm

Symbol	Dimensions	
	Min	Max
A	9.96	10.36
A1	7.00	
A2(Φ)	3.08	3.28
A3	9.26	9.66
B1	15.67	16.07
B2	4.50	4.90
B3	6.48	6.88
C	3.20	3.40
C1	15.60	16.00
C2	9.55	9.95
D	2.54	
D1	--	1.47
D2	0.70	0.90
D3	0.25	0.45
E	2.34	2.74
E1	0.70	
E2	1.0 * 45°	
E3	0.45	0.60
E4	2.56	2.96
α	30°	