

## FQPF4N60

### 600V N-Channel MOSFET

#### General Description

These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switch mode power supply.

#### Features

- 2.6A, 600V,  $R_{DS(on)} = 2.2\Omega$  @  $V_{GS} = 10$  V
- Low gate charge ( typical 15 nC)
- Low  $C_{RSS}$  ( typical 8.0 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



#### Absolute Maximum Ratings

$T_C = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	FQPF4N60	Units
$V_{DSS}$	Drain-Source Voltage	600	V
$I_D$	Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ )	2.6	A
	- Continuous ( $T_C = 100^\circ\text{C}$ )	1.64	A
$I_{DM}$	Drain Current - Pulsed	(Note 1)	A
$V_{GSS}$	Gate-Source Voltage	$\pm 30$	V
$E_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	mJ
$I_{AR}$	Avalanche Current	(Note 1)	A
$E_{AR}$	Repetitive Avalanche Energy	(Note 1)	mJ
$dv/dt$	Peak Diode Recovery $dv/dt$	(Note 3)	V/ns
$P_D$	Power Dissipation ( $T_C = 25^\circ\text{C}$ )	36	W
	- Derate above $25^\circ\text{C}$	0.29	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	$^\circ\text{C}$

#### Thermal Characteristics

Symbol	Parameter	Typ	Max	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	--	3.47	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	62.5	$^\circ\text{C}/\text{W}$

## Electrical Characteristics

$T_C = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>Off Characteristics</b>						
$\text{BV}_{\text{DSS}}$	Drain-Source Breakdown Voltage	$V_{\text{GS}} = 0 \text{ V}$ , $I_D = 250 \mu\text{A}$	600	--	--	V
$\Delta \text{BV}_{\text{DSS}} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250 \mu\text{A}$ , Referenced to $25^\circ\text{C}$	--	0.6	--	$\text{V}/^\circ\text{C}$
$I_{\text{DSS}}$	Zero Gate Voltage Drain Current	$V_{\text{DS}} = 600 \text{ V}$ , $V_{\text{GS}} = 0 \text{ V}$	--	--	10	$\mu\text{A}$
		$V_{\text{DS}} = 480 \text{ V}$ , $T_C = 125^\circ\text{C}$	--	--	100	$\mu\text{A}$
$I_{\text{GSSF}}$	Gate-Body Leakage Current, Forward	$V_{\text{GS}} = 30 \text{ V}$ , $V_{\text{DS}} = 0 \text{ V}$	--	--	100	nA
$I_{\text{GSSR}}$	Gate-Body Leakage Current, Reverse	$V_{\text{GS}} = -30 \text{ V}$ , $V_{\text{DS}} = 0 \text{ V}$	--	--	-100	nA
<b>On Characteristics</b>						
$V_{\text{GS(th)}}$	Gate Threshold Voltage	$V_{\text{DS}} = V_{\text{GS}}$ , $I_D = 250 \mu\text{A}$	3.0	--	5.0	V
$R_{\text{DS(on)}}$	Static Drain-Source On-Resistance	$V_{\text{GS}} = 10 \text{ V}$ , $I_D = 1.3 \text{ A}$	--	1.77	2.2	$\Omega$
$g_{\text{FS}}$	Forward Transconductance	$V_{\text{DS}} = 50 \text{ V}$ , $I_D = 1.3 \text{ A}$ (Note 4)	--	3.1	--	S
<b>Dynamic Characteristics</b>						
$C_{\text{iss}}$	Input Capacitance	$V_{\text{DS}} = 25 \text{ V}$ , $V_{\text{GS}} = 0 \text{ V}$ , $f = 1.0 \text{ MHz}$	--	520	670	pF
$C_{\text{oss}}$	Output Capacitance		--	70	90	pF
$C_{\text{rss}}$	Reverse Transfer Capacitance		--	8	11	pF
<b>Switching Characteristics</b>						
$t_{\text{d(on)}}$	Turn-On Delay Time	$V_{\text{DD}} = 300 \text{ V}$ , $I_D = 4.4 \text{ A}$ , $R_G = 25 \Omega$	--	13	35	ns
$t_r$	Turn-On Rise Time		--	45	100	ns
$t_{\text{d(off)}}$	Turn-Off Delay Time		--	25	60	ns
$t_f$	Turn-Off Fall Time		--	35	80	ns
$Q_g$	Total Gate Charge	$V_{\text{DS}} = 480 \text{ V}$ , $I_D = 4.4 \text{ A}$ , $V_{\text{GS}} = 10 \text{ V}$	--	15	20	nC
$Q_{\text{gs}}$	Gate-Source Charge		--	3.4	--	nC
$Q_{\text{gd}}$	Gate-Drain Charge		--	7.1	--	$\mu\text{C}$
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
$I_S$	Maximum Continuous Drain-Source Diode Forward Current	--	--	2.6	A	
$I_{\text{SM}}$	Maximum Pulsed Drain-Source Diode Forward Current	--	--	10.4	A	
$V_{\text{SD}}$	Drain-Source Diode Forward Voltage	$V_{\text{GS}} = 0 \text{ V}$ , $I_S = 2.6 \text{ A}$	--	--	1.4	V
$t_{\text{rr}}$	Reverse Recovery Time	$V_{\text{GS}} = 0 \text{ V}$ , $I_S = 4.4 \text{ A}$ , $dI_F / dt = 100 \text{ A}/\mu\text{s}$	--	250	--	ns
$Q_{\text{rr}}$	Reverse Recovery Charge		--	1.5	--	$\mu\text{C}$

**Notes:**

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 71\text{mH}$ ,  $I_{AS} = 2.6\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25 \Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 4.4\text{A}$ ,  $dI/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq \text{BV}_{\text{DSS}}$ , 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

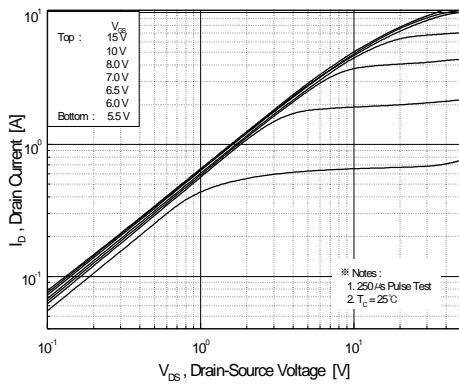


Figure 1. On-Region Characteristics

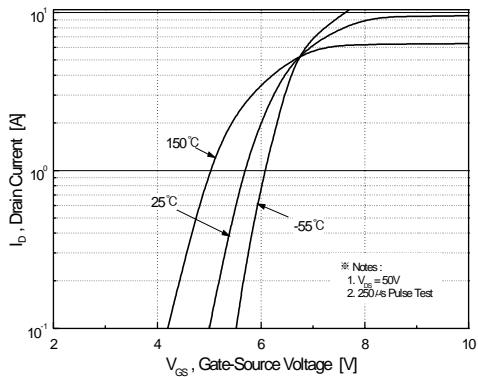


Figure 2. Transfer Characteristics

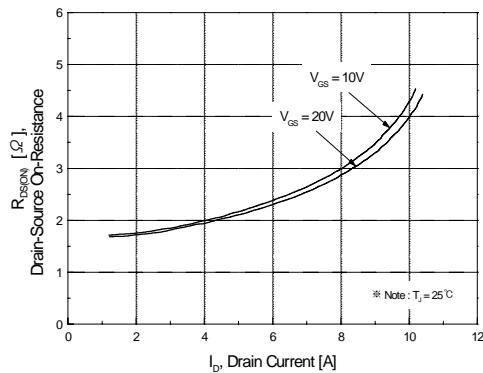


Figure 3. On-Resistance Variation vs.  
Drain Current and Gate Voltage

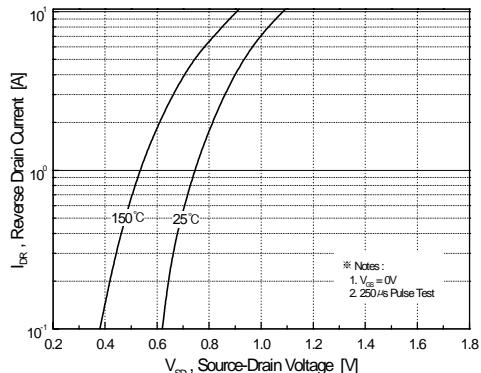


Figure 4. Body Diode Forward Voltage  
Variation vs. Source Current  
and Temperature

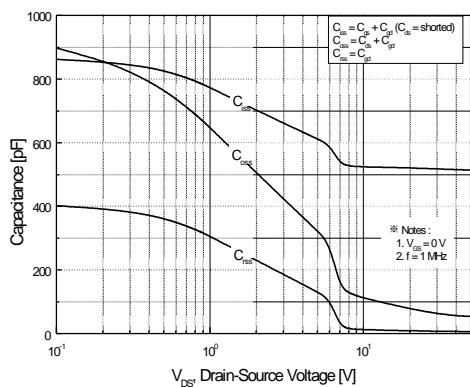


Figure 5. Capacitance Characteristics

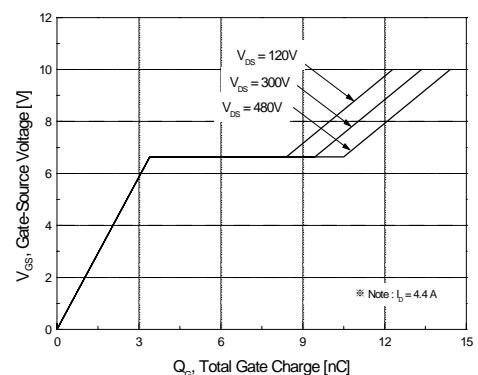
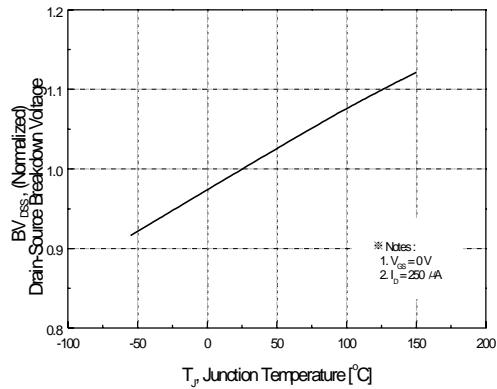
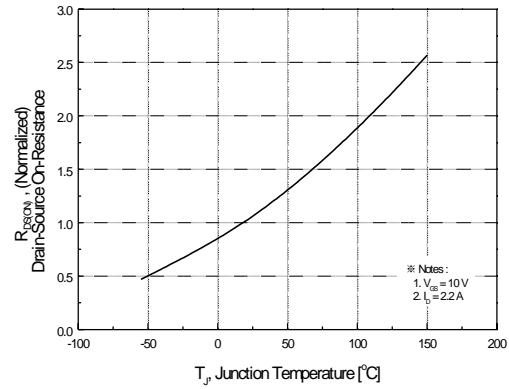


Figure 6. Gate Charge Characteristics

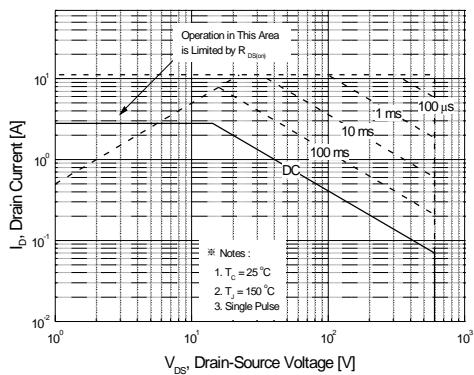
## Typical Characteristics (Continued)



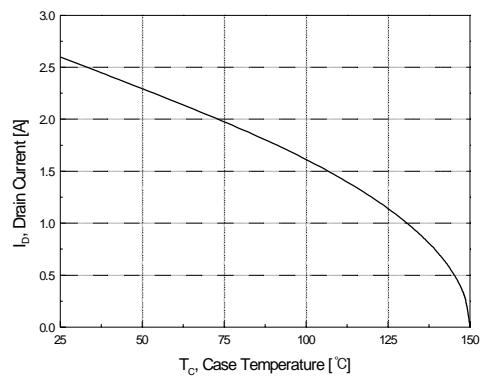
**Figure 7. Breakdown Voltage Variation vs. Temperature**



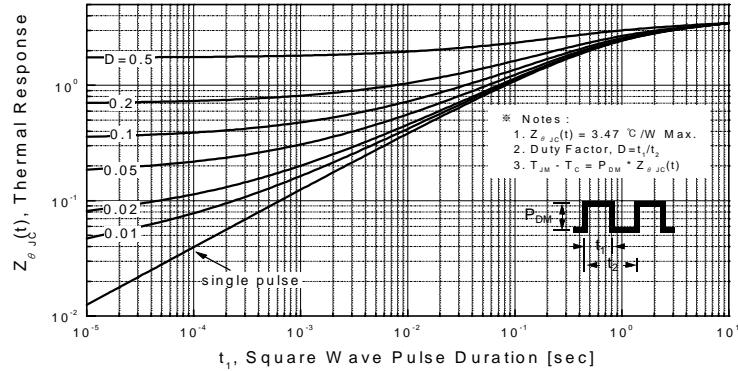
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**

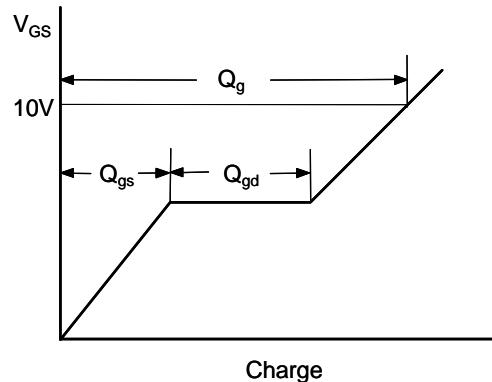
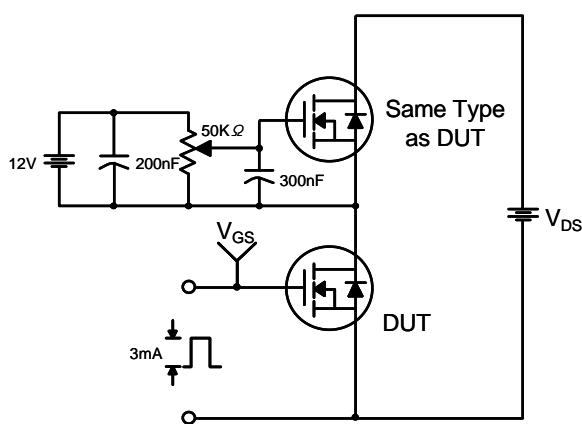


**Figure 10. Maximum Drain Current vs. Case Temperature**

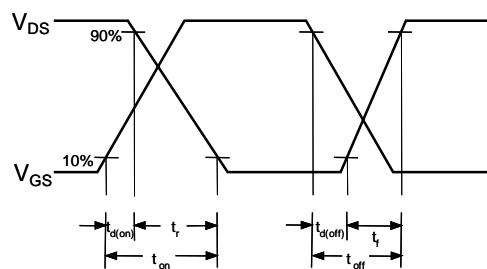
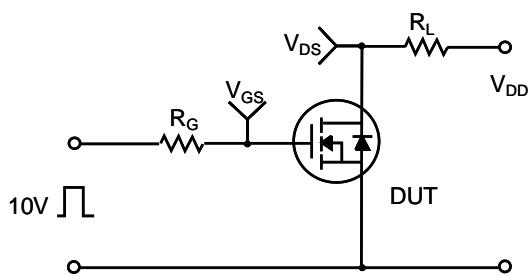


**Figure 11. Transient Thermal Response Curve**

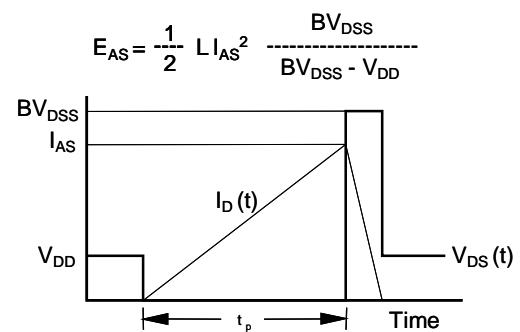
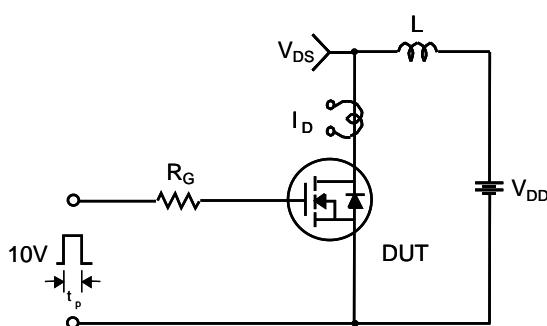
## Gate Charge Test Circuit &amp; Waveform



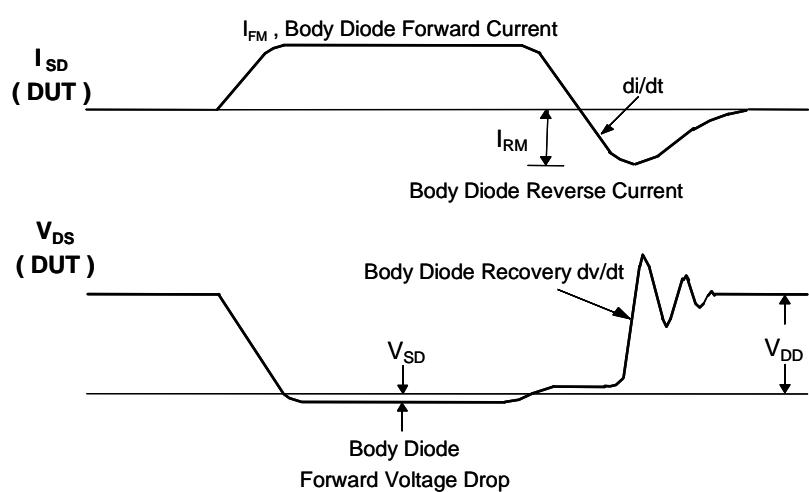
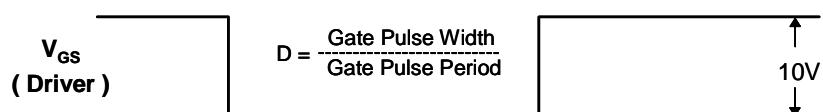
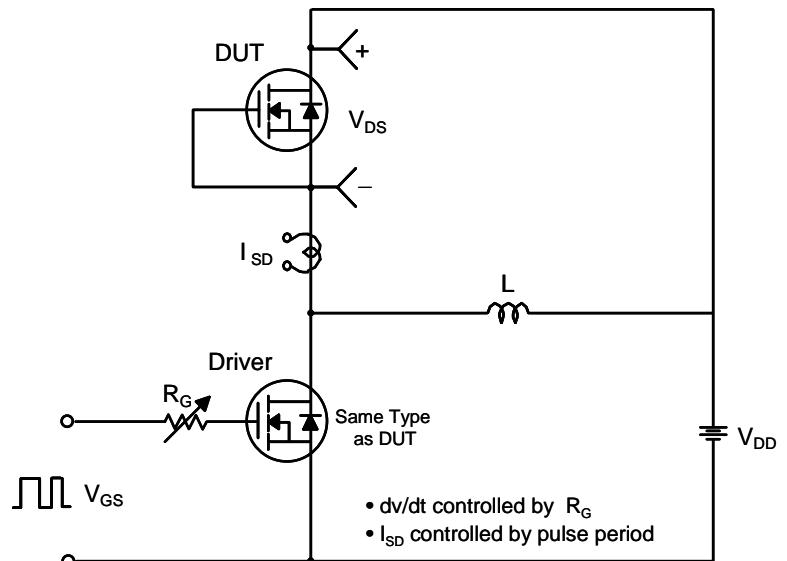
## Resistive Switching Test Circuit &amp; Waveforms



## Unclamped Inductive Switching Test Circuit &amp; Waveforms

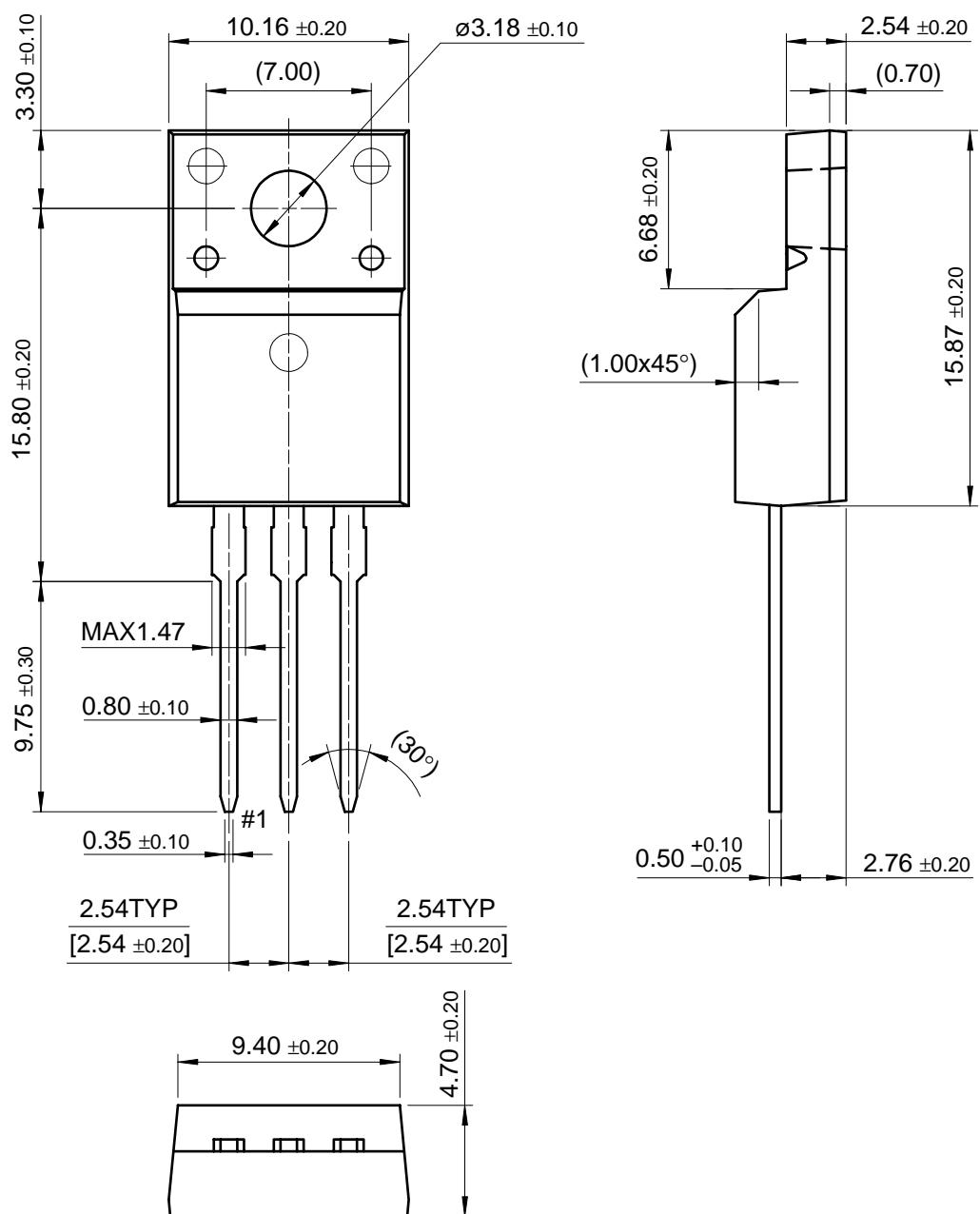


## Peak Diode Recovery dv/dt Test Circuit &amp; Waveforms



## Package Dimensions

## TO-220F



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