

# FQP10N60CF / FQPF10N60CF

## 600V N-Channel MOSFET

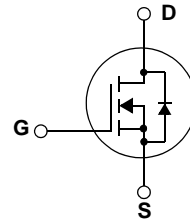
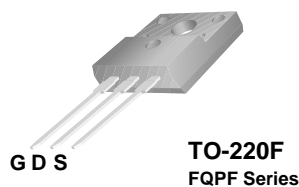
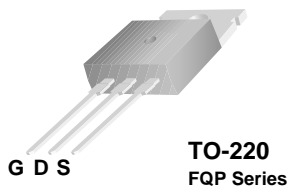
### Features

- 9A, 600V,  $R_{DS(on)} = 0.8\Omega @ V_{GS} = 10V$
- Low gate charge ( typical 44 nC)
- Low  $C_{rss}$  ( typical 18 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability

### 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 switched mode power supplies, active power factor correction, electronic lamp ballasts based on half bridge topology.



### Absolute Maximum Ratings

Symbol	Parameter	FQP10N60CF	FQPF10N60CF	Units
$V_{DSS}$	Drain-Source Voltage	600		V
$I_D$	Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ )	9.0	9.0 *	A
	- Continuous ( $T_C = 100^\circ\text{C}$ )	5.7	5.7 *	A
$I_{DM}$	Drain Current - Pulsed (Note 1)	36	36 *	A
$V_{GSS}$	Gate-Source Voltage	$\pm 30$		V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	583		mJ
$I_{AR}$	Avalanche Current (Note 1)	9.0		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	16.9		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5		V/ns
$P_D$	Power Dissipation ( $T_C = 25^\circ\text{C}$ )	169	50	W
	- Derate above $25^\circ\text{C}$	1.35	0.4	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 Characteristics

Symbol	Parameter	FQP10N60CF	FQPF10N60CF	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.74	2.5	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	62.5	$^\circ\text{C}/\text{W}$

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FQP10N60CF	FQP10N60CF	TO-220	--	--	50
FQPF10N60CF	FQPF10N60CF	TO-220F	--	--	50

## Electrical Characteristics T<sub>C</sub> = 25°C unless otherwise noted

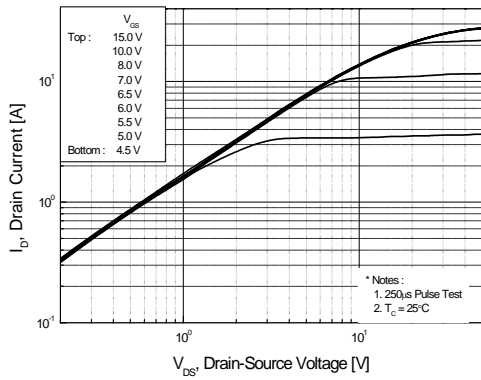
Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>Off Characteristics</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	600	--	--	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C	--	0.7	--	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 600 V, V <sub>GS</sub> = 0 V	--	--	10	μA
		V <sub>DS</sub> = 480 V, T <sub>C</sub> = 125°C	--	--	100	μA
I <sub>GSSF</sub>	Gate-Body Leakage Current, Forward	V <sub>GS</sub> = 30 V, V <sub>DS</sub> = 0 V	--	--	100	nA
I <sub>GSSR</sub>	Gate-Body Leakage Current, Reverse	V <sub>GS</sub> = -30 V, V <sub>DS</sub> = 0 V	--	--	-100	nA
<b>On Characteristics</b>						
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	2.0	--	4.0	V
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 4.5 A	--	0.61	0.8	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 40 V, I <sub>D</sub> = 4.5 A (Note 4)	--	8.0	--	S
<b>Dynamic Characteristics</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	--	1570	2040	pF
C <sub>oss</sub>	Output Capacitance		--	166	215	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		--	18	24	pF
<b>Switching Characteristics</b>						
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 300 V, I <sub>D</sub> = 9.0A, R <sub>G</sub> = 25 Ω	--	23	55	ns
t <sub>r</sub>	Turn-On Rise Time		--	69	150	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	144	300	ns
t <sub>f</sub>	Turn-Off Fall Time	(Note 4, 5)	--	77	165	ns
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 480 V, I <sub>D</sub> = 9.0A, V <sub>GS</sub> = 10 V	--	44	57	nC
Q <sub>gs</sub>	Gate-Source Charge		--	6.7	--	nC
Q <sub>gd</sub>	Gate-Drain Charge	(Note 4, 5)	--	18.5	--	nC
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current		--	--	9.0	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current		--	--	36	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 9.0 A	--	--	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 9.0A, dI <sub>F</sub> / dt = 100 A/μs	--	90	--	ns
Q <sub>rr</sub>	Reverse Recovery Charge	(Note 4)	--	0.3	--	μC

**Notes:**

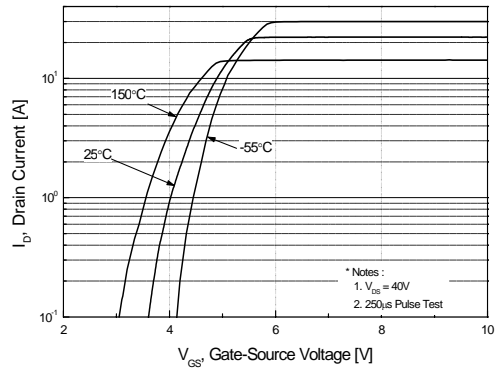
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 13.2mH, I<sub>AS</sub> = 9.0 A, V<sub>DD</sub> = 50V, R<sub>G</sub> = 25 Ω, Starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 9.0A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C
4. Pulse Test : Pulse width ≤ 300μs, Duty cycle ≤ 2%
5. Essentially independent of operating temperature

## Typical Performance Characteristics

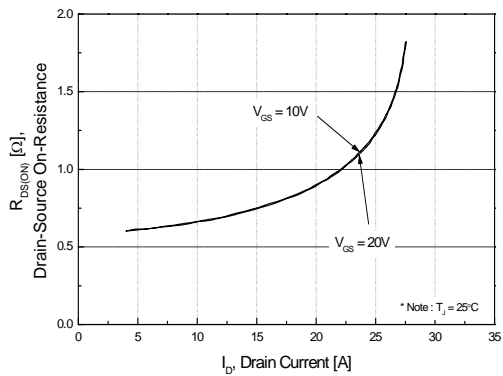
**Figure 1. On-Region Characteristics**



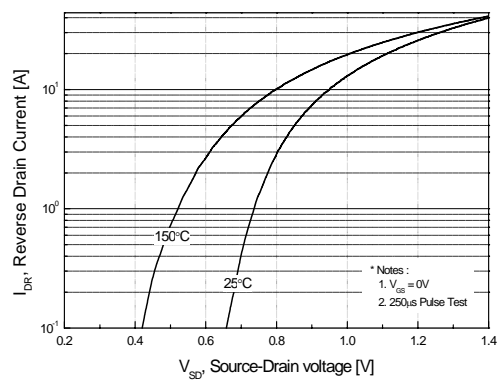
**Figure 2. Transfer Characteristics**



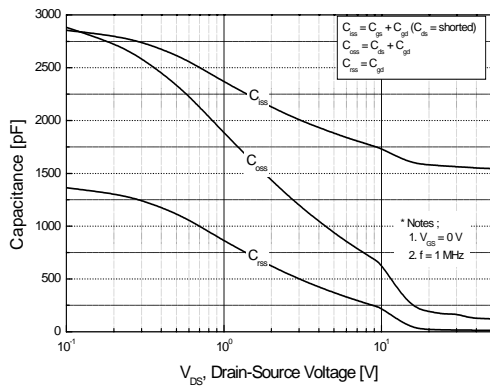
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



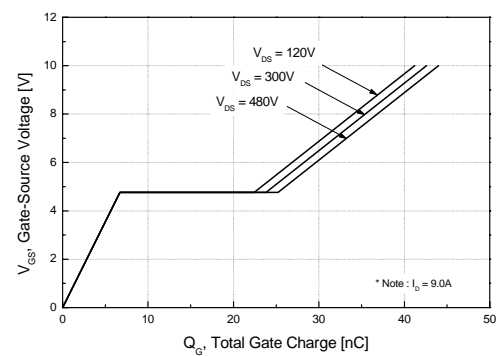
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

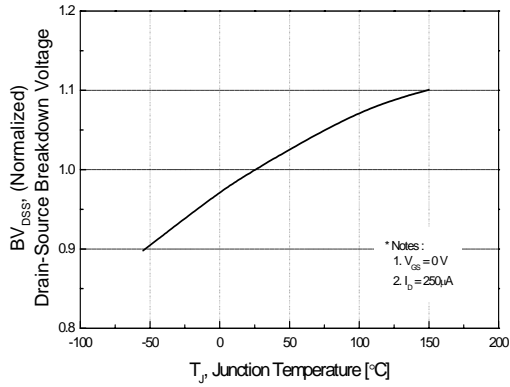


**Figure 6. Gate Charge Characteristics**

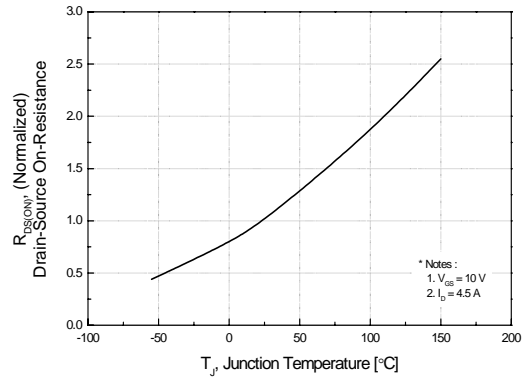


**Typical Performance Characteristics** (Continued)

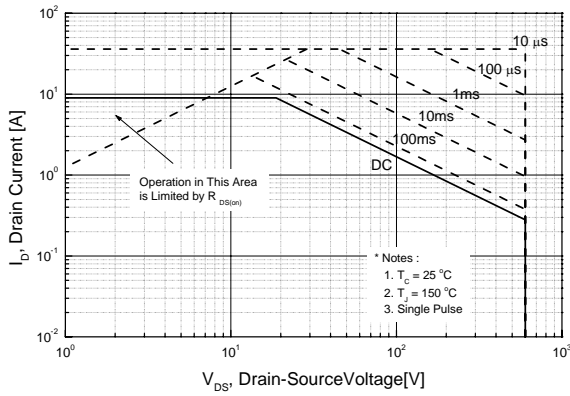
**Figure 7. Breakdown Voltage Variation vs. Temperature**



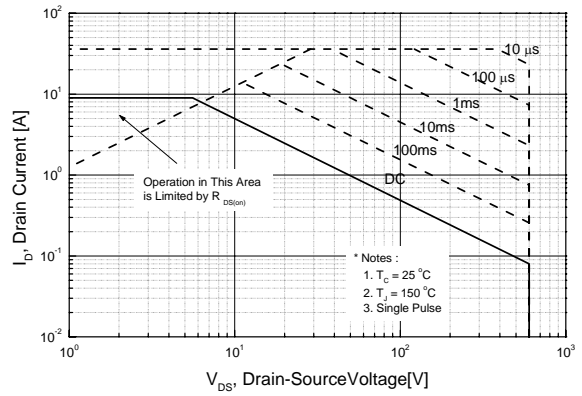
**Figure 8. On-Resistance Variation vs. Temperature**



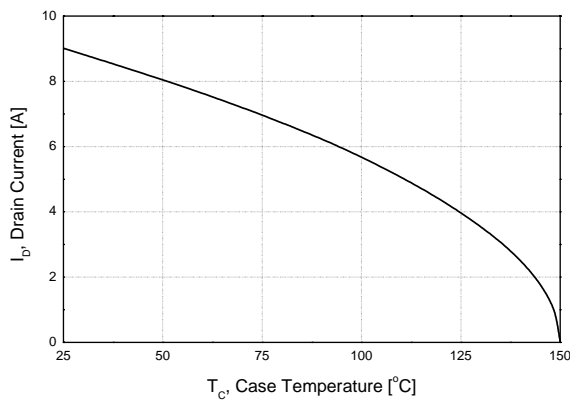
**Figure 9-1. Maximum Safe Operating Area for FQP10N60C**



**Figure 9-2. Maximum Safe Operating Area for FQPF10N60C**



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



Typical Performance Characteristics (Continued)

Figure 11-1. Transient Thermal Response Curve for FQP10N60CF

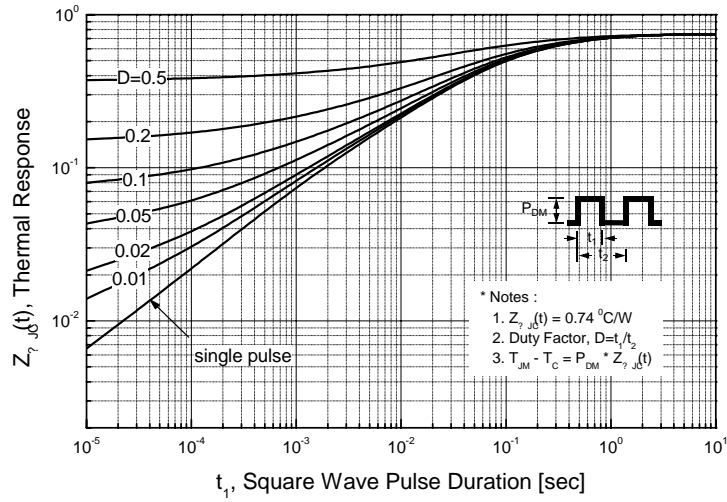
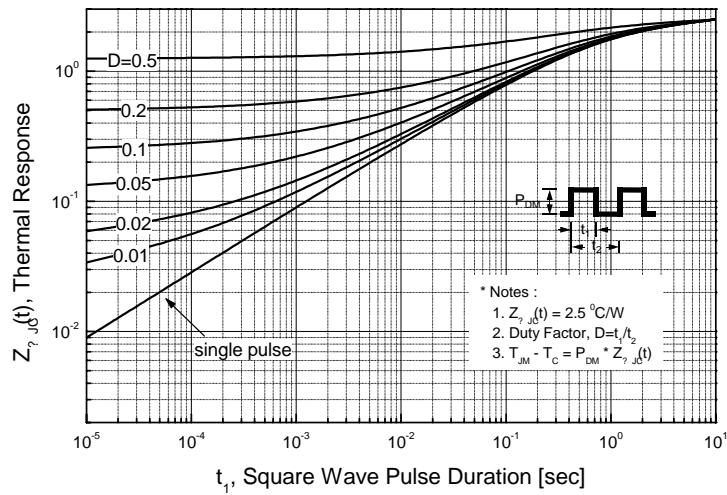


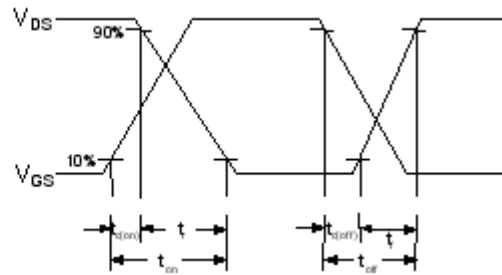
Figure 11-2. Transient Thermal Response Curve for FQPF10N60CF



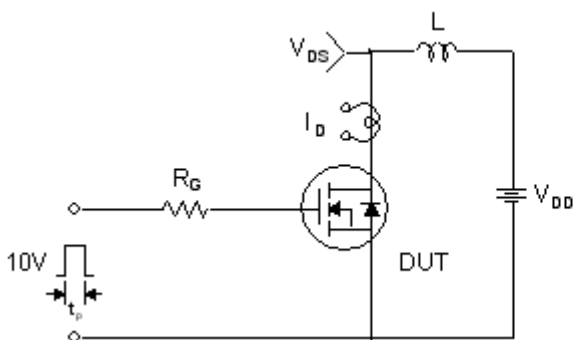
**Gate Charge Test Circuit & Waveform**



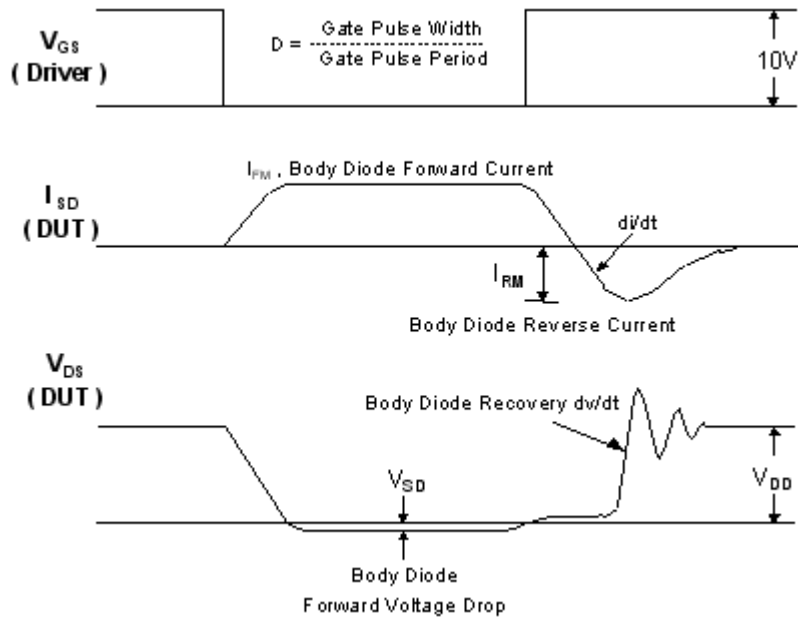
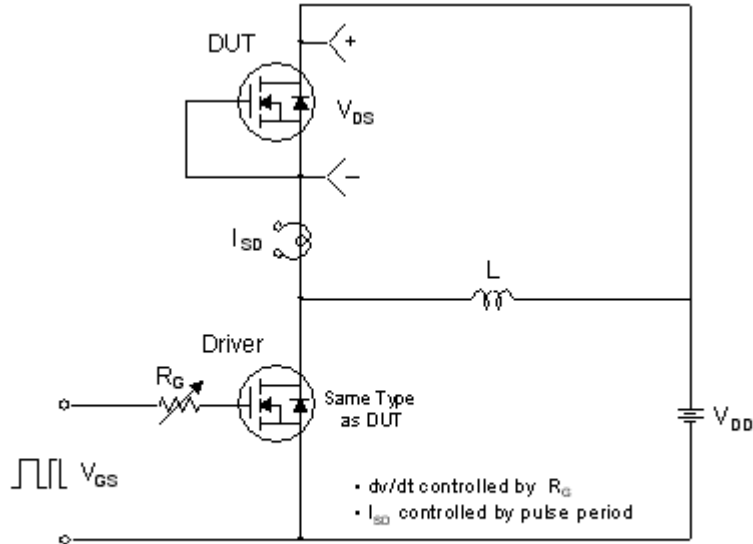
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

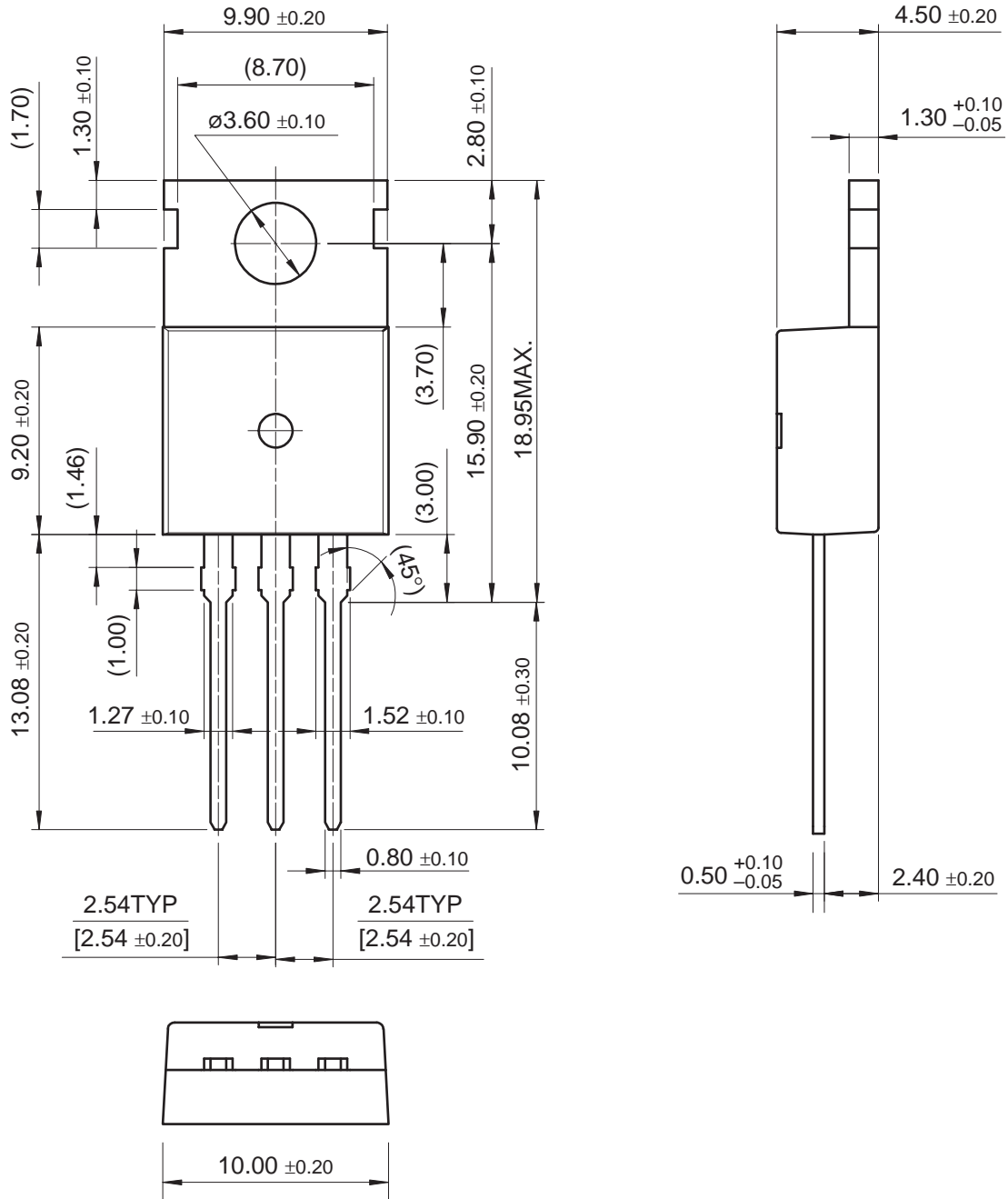


**Peak Diode Recovery dv/dt Test Circuit & Waveforms**



Mechanical Dimensions

TO-220

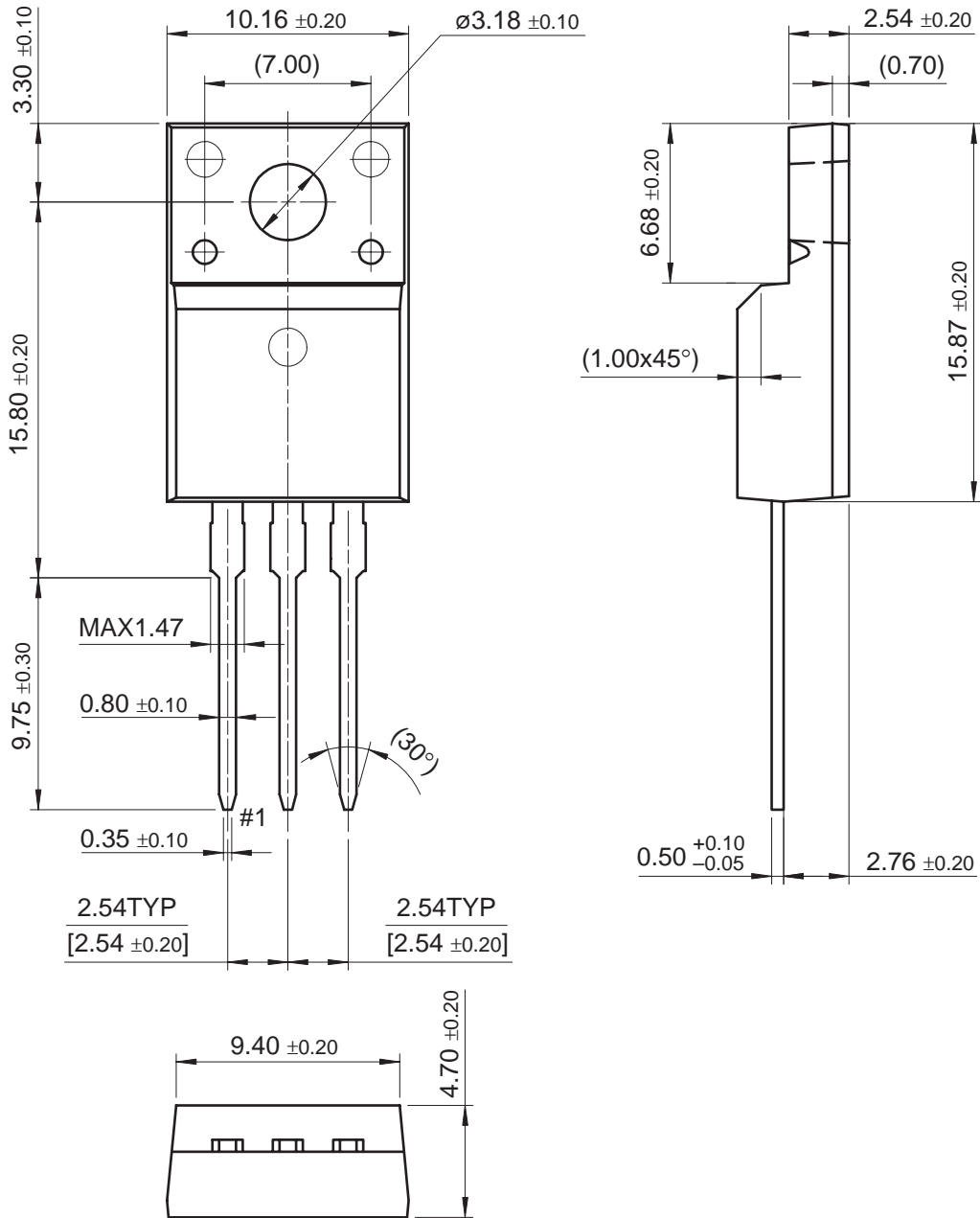


Dimensions in Millimeters



Mechanical Dimensions (Continued)

TO-220F



Dimensions in Millimeters

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