

# FQP12N60C / FQPF12N60C

## 600V N-Channel MOSFET

### Features

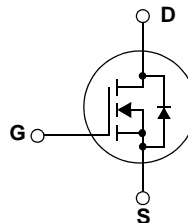
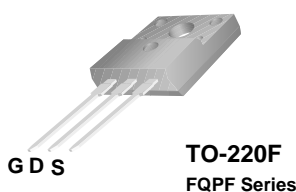
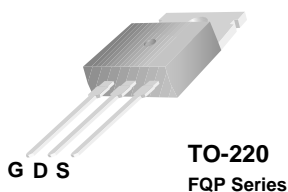
- 12A, 600V,  $R_{DS(on)} = 0.65\Omega @ V_{GS} = 10V$
- Low gate charge ( typical 48 nC)
- Low Crss ( typical 21pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- RoHS compliant



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



### Absolute Maximum Ratings

Symbol	Parameter	FQP12N60C	FQPF12N60C	Unit
$V_{DSS}$	Drain-Source Voltage	600		V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	12	12*
		- Continuous ( $T_C = 100^\circ\text{C}$ )	7.4	7.4*
$I_{DM}$	Drain Current - Pulsed (Note 1)	48	48*	A
$V_{GSS}$	Gate-Source voltage	$\pm 30$		V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	870		mJ
$I_{AR}$	Avalanche Current (Note 1)	12		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	22.5		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5		V/ns
$P_D$	Power Dissipation ( $T_C = 25^\circ\text{C}$ ) - Derate above $25^\circ\text{C}$	225	51	W W/°C
		1.78	0.41	
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150		°C
$T_L$	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300		°C

\*Drain current limited by maximum junction temperature

### Thermal Characteristics

Symbol	Parameter	FQP12N60C	FQPF12N60C	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.56	2.43	°C/W
$R_{\theta JS}$	Thermal Resistance, Case-to-Sink Typ.	0.5	--	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	62.5	°C/W

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FQP12N60C	FQP12N60C	TO-220	-	-	50
FQPF12N60C	FQPF12N60C	TO-220F	-	-	50

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

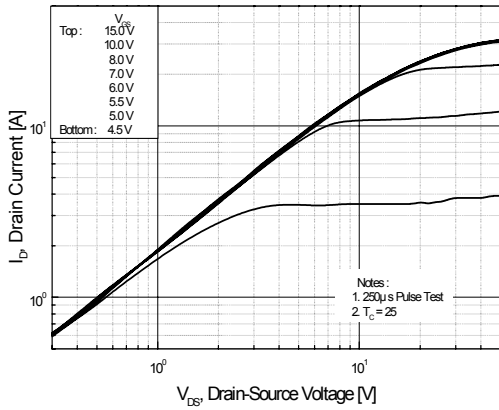
Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>Off Characteristics</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA, T <sub>J</sub> = 25°C	600	--	--	V
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250μA, Referenced to 25°C	--	0.5	--	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 600V, V <sub>GS</sub> = 0V V <sub>DS</sub> = 480V, T <sub>C</sub> = 125°C	--	--	1 10	μA μA
I <sub>GSSF</sub>	Gate-Body Leakage Current, Forward	V <sub>GS</sub> = 30V, V <sub>DS</sub> = 0V	--	--	100	nA
I <sub>GSSR</sub>	Gate-Body Leakage Current, Reverse	V <sub>GS</sub> = -30V, V <sub>DS</sub> = 0V	--	--	-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> = 250μA	2.0	--	4.0	V
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10V, I <sub>D</sub> = 6A	--	0.53	0.65	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 40V, I <sub>D</sub> = 6A (Note 4)	--	13	--	S
<b>Dynamic Characteristics</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, f = 1.0MHz	--	1760	2290	pF
C <sub>oss</sub>	Output Capacitance		--	182	235	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		--	21	28	pF
<b>Switching Characteristics</b>						
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 300V, I <sub>D</sub> = 12A R <sub>G</sub> = 25Ω  (Note 4, 5)	--	30	70	ns
t <sub>r</sub>	Turn-On Rise Time		--	85	180	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	140	280	ns
t <sub>f</sub>	Turn-Off Fall Time		--	90	190	ns
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 400V, I <sub>D</sub> = 12A V <sub>GS</sub> = 10V  (Note 4, 5)	--	48	63	nC
Q <sub>gs</sub>	Gate-Source Charge		--	8.5	--	nC
Q <sub>gd</sub>	Gate-Drain Charge		--	21	--	nC
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current		--	--	12	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current		--	--	48	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0V, I <sub>S</sub> = 12A	--	--	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0V, I <sub>S</sub> = 12A di <sub>F</sub> /dt = 100A/μs  (Note 4)	--	420	--	ns
Q <sub>rr</sub>	Reverse Recovery Charge		--	4.9	--	μC

### Notes:

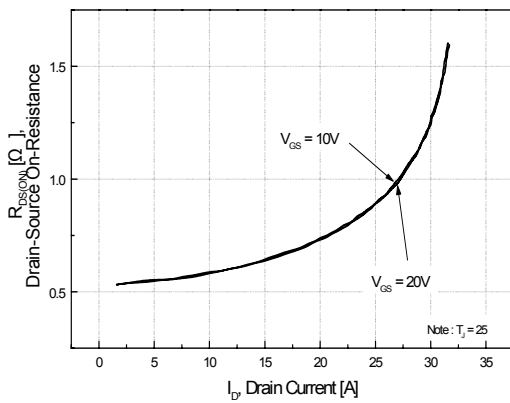
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. L = 11mH, I<sub>AS</sub> = 12A, V<sub>DD</sub> = 50V, R<sub>G</sub> = 25Ω, Starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 12A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C
4. Pulse Test: Pulse width ≤ 300μs, Duty Cycle ≤ 2%
5. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

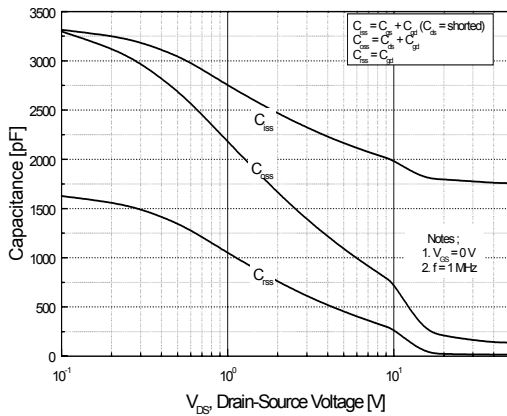
**Figure 1. On-Region Characteristics**



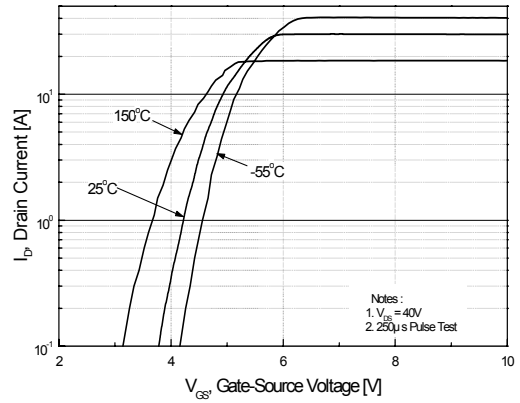
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



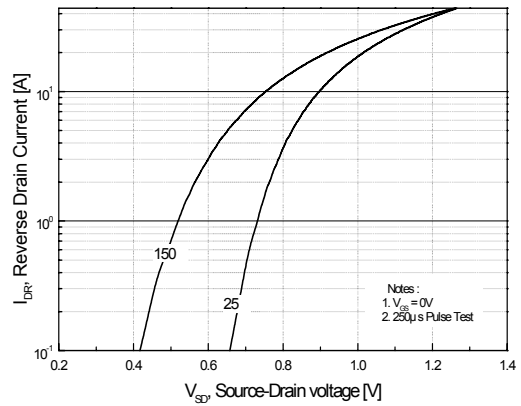
**Figure 5. Capacitance Characteristics**



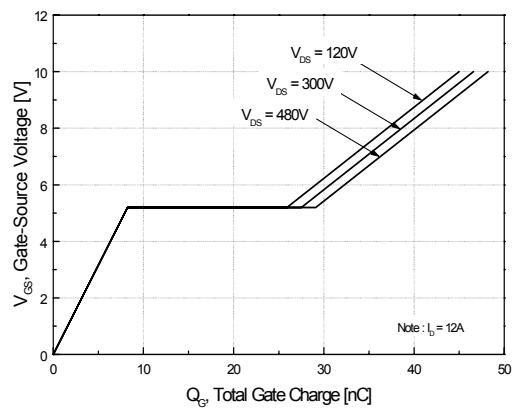
**Figure 2. Transfer Characteristics**



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

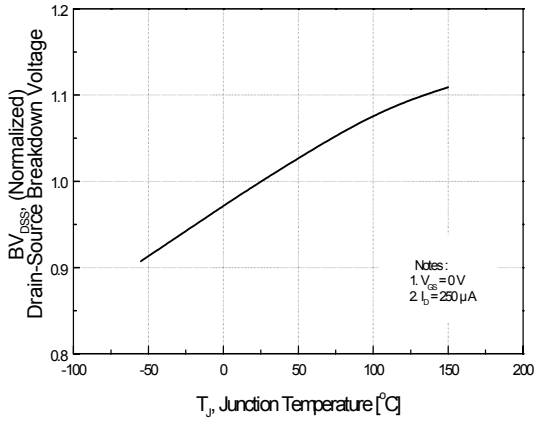


**Figure 6. Gate Charge Characteristics**

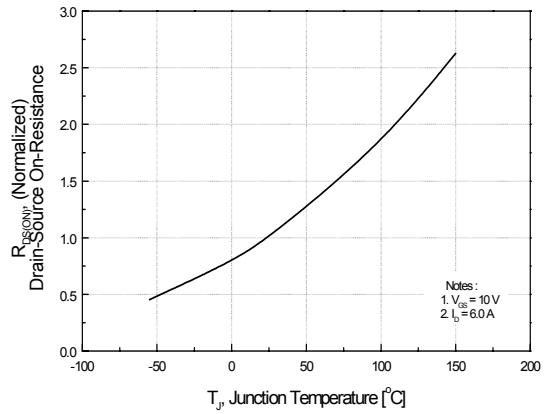


**Typical Performance Characteristics** (Continued)

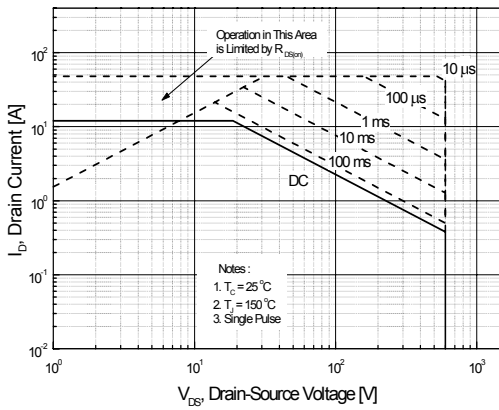
**Figure 7. Breakdown Voltage Variation vs. Temperature**



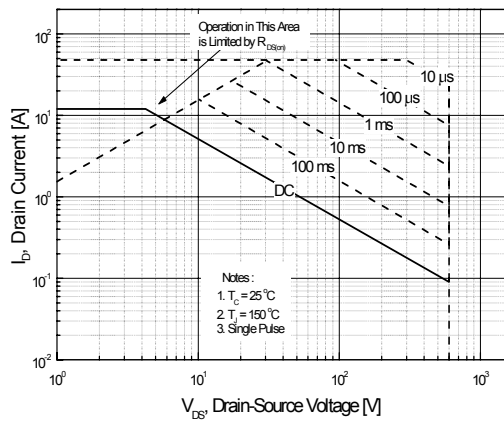
**Figure 8. On-Resistance Variation vs. Temperature**



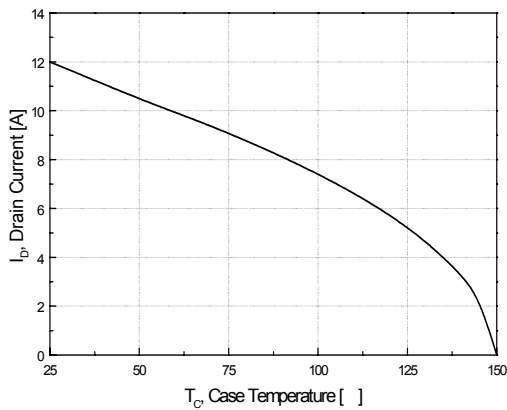
**Figure 9-1. Maximum Safe Operating Area for FQP12N60C**



**Figure 9-2. Maximum Safe Operating Area for FQPF12N60C**



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



Typical Performance Characteristics (Continued)

Figure 11-1. Transient Thermal Response Curve for FQP12N60C

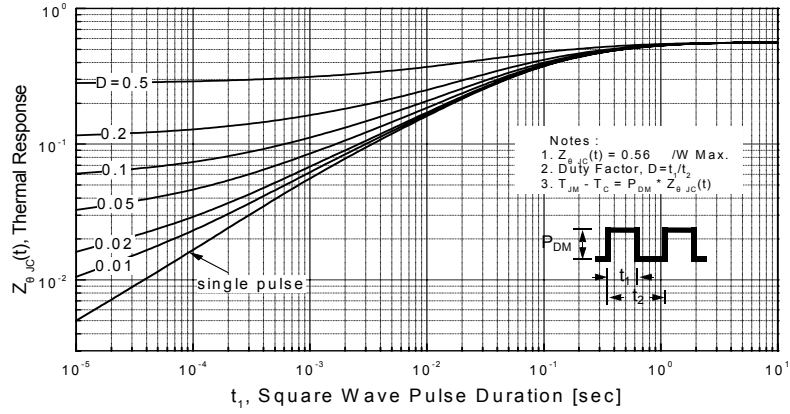
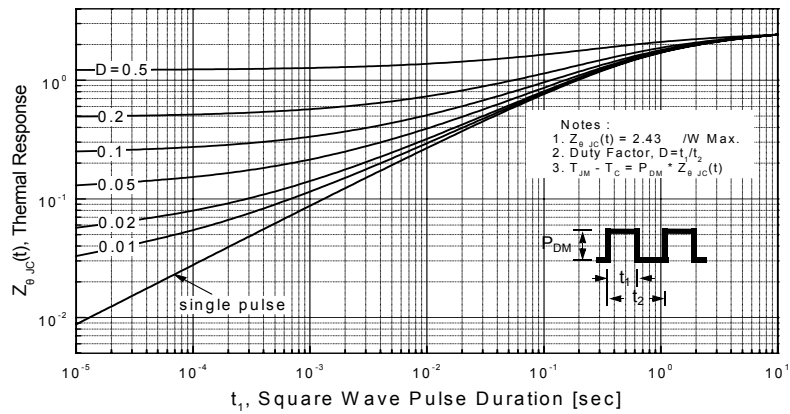


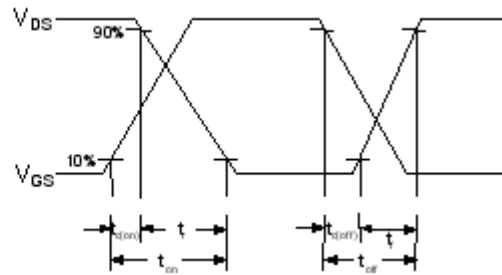
Figure 11-2. Transient Thermal Response Curve for FQPF12N60C



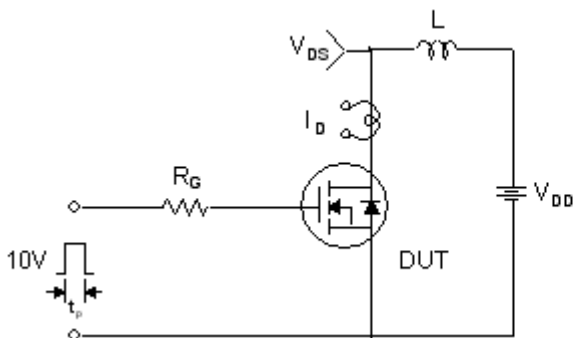
**Gate Charge Test Circuit & Waveform**



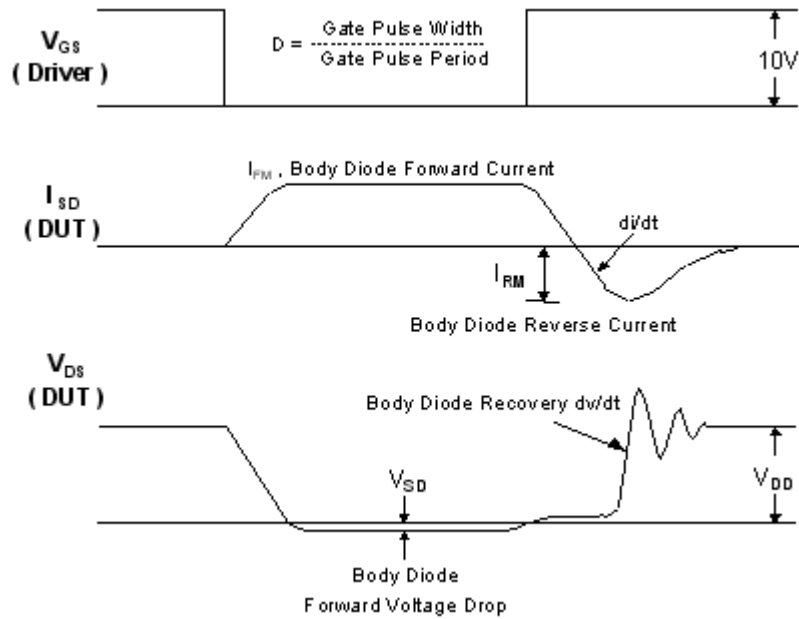
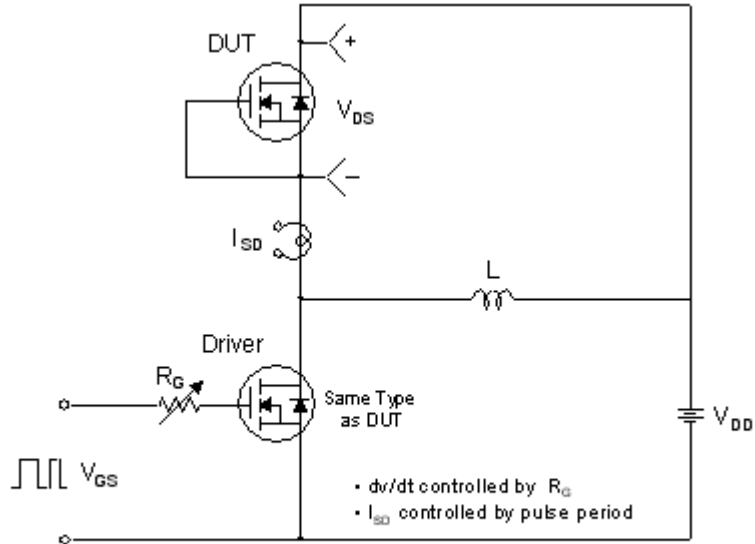
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

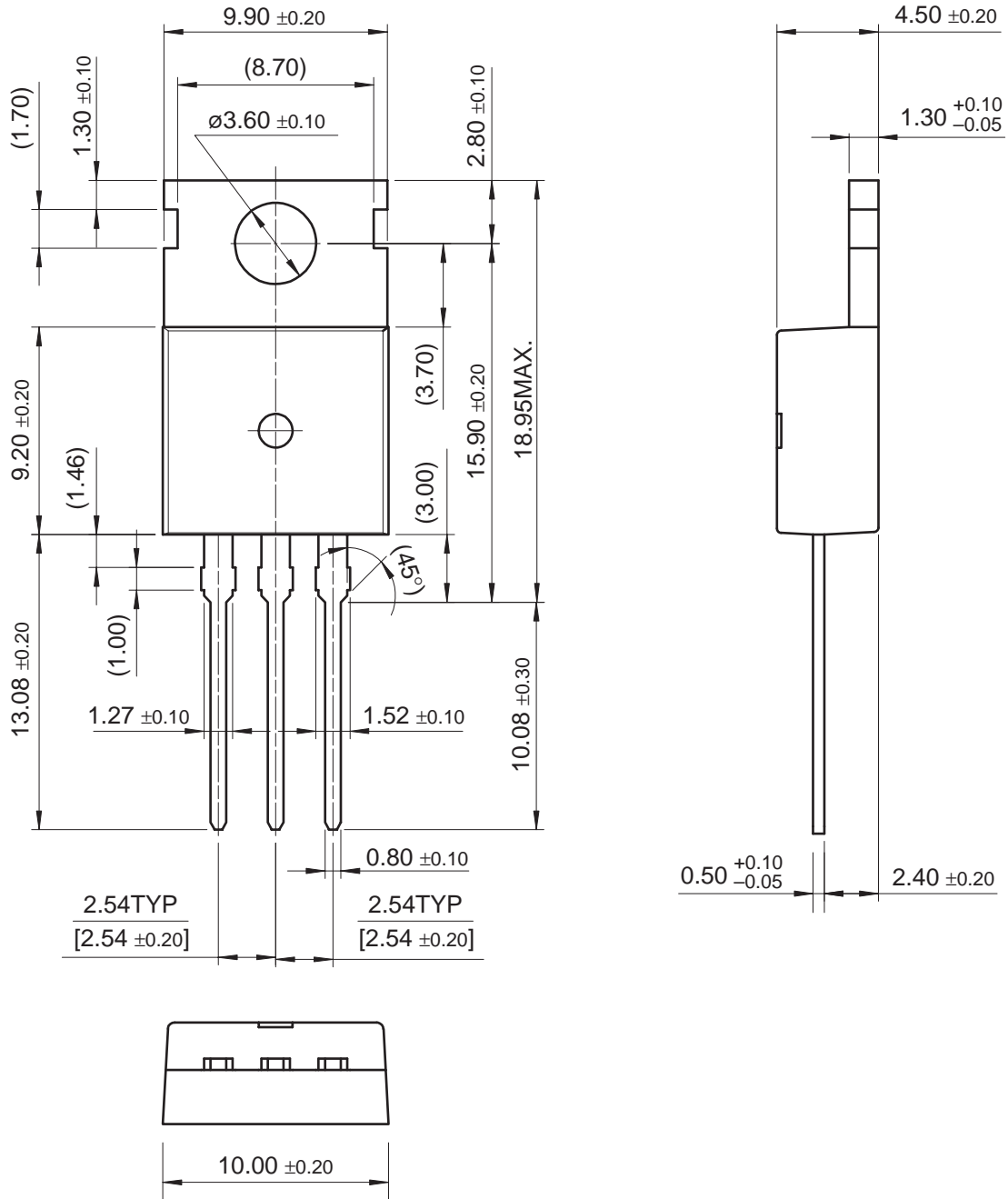


### Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

TO-220

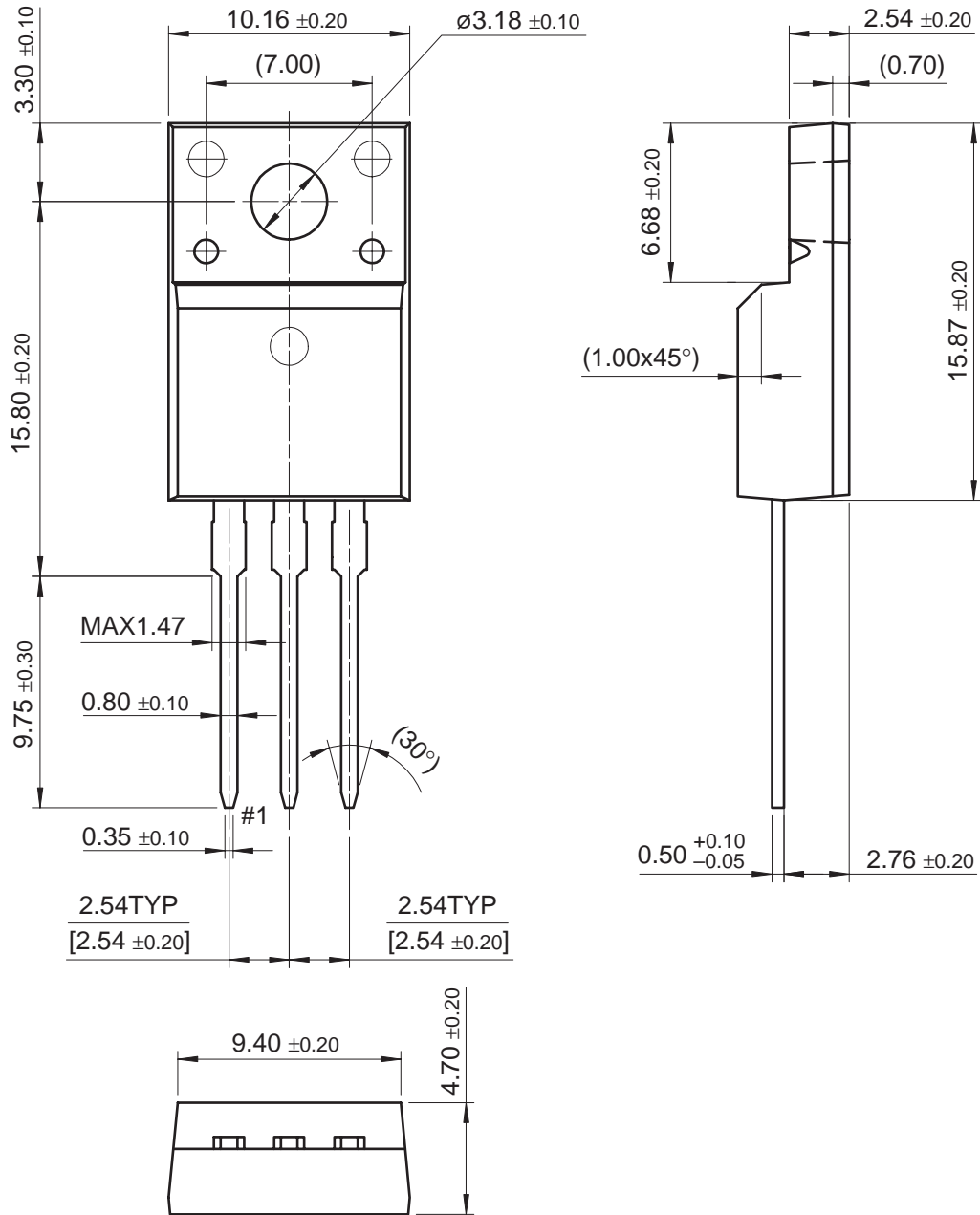


Dimensions in Millimeters



Mechanical Dimensions (Continued)

TO-220F




Dimensions in Millimeters



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Rev. I31