

# FQP11N40C/FQPF11N40C 400V N-Channel MOSFET

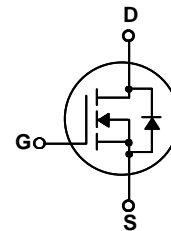
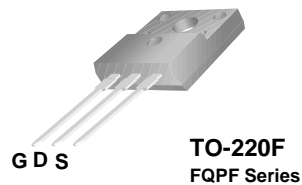
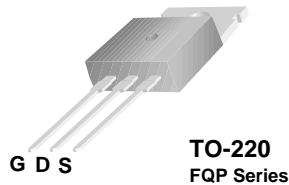
## Features

- 10.5 A, 400V,  $R_{DS(on)} = 0.5 \Omega @ V_{GS} = 10 V$
- Low gate charge ( typical 28 nC)
- Low Crss ( typical 85pF)
- 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	FQP11N40C	FQPF11N40C	Units
$V_{DSS}$	Drain-Source Voltage	400		V
$I_D$	Drain Current - Continuous ( $T_C = 25^\circ C$ ) - Continuous ( $T_C = 100^\circ C$ )	10.5	10.5 *	A
		6.6	6.6 *	A
$I_{DM}$	Drain Current - Pulsed (Note 1)	42	42 *	A
$V_{GSS}$	Gate-Source Voltage	$\pm 30$		V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	360		mJ
$I_{AR}$	Avalanche Current (Note 1)	11		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	13.5		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5		V/ns
$P_D$	Power Dissipation ( $T_C = 25^\circ C$ ) - Derate above $25^\circ C$	135	44	W
		1.07	0.35	W/ $^\circ C$
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150		$^\circ C$
$T_L$	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300		$^\circ C$

\* Drain current limited by maximum junction temperature

## Thermal Characteristics

Symbol	Parameter	FQP11N40C	FQPF11N40C	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.93	2.86	$^\circ C/W$
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink Typ.	0.5	--	$^\circ C/W$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	62.5	$^\circ C/W$

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FQP11N40C	FQP11N40C	TO-220	--	--	50
FQPF11N40C	FQPF11N40C	TO-220F	--	--	50

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

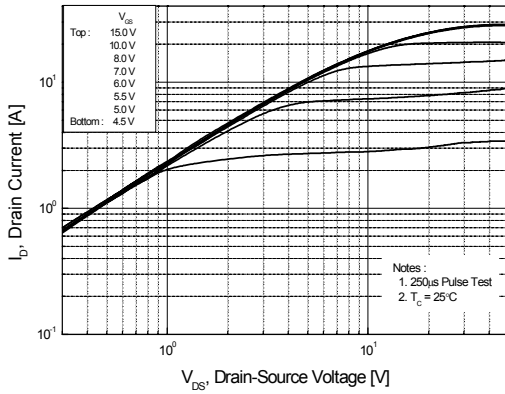
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
<b>Off Characteristics</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	400	--	--	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C	--	0.54	--	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V	--	--	1	μA
		V <sub>DS</sub> = 320 V, T <sub>C</sub> = 125°C	--	--	10	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> = 5.25 A	--	0.43	0.53	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 40 V, I <sub>D</sub> = 5.25 A (Note 4)	--	7.1	--	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	--	840	1090	pF
C <sub>oss</sub>	Output Capacitance		--	250	325	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		--	85	110	pF
<b>Switching Characteristics</b>						
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 200 V, I <sub>D</sub> = 10.5 A, R <sub>G</sub> = 25 Ω  (Note 4, 5)	--	14	40	ns
t <sub>r</sub>	Turn-On Rise Time		--	89	190	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	81	170	ns
t <sub>f</sub>	Turn-Off Fall Time		--	81	170	ns
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 320 V, I <sub>D</sub> = 10.5 A, V <sub>GS</sub> = 10 V  (Note 4, 5)	--	28	35	nC
Q <sub>gs</sub>	Gate-Source Charge		--	4	--	nC
Q <sub>gd</sub>	Gate-Drain Charge		--	15	--	nC
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current		--	--	10.5	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current		--	--	42	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 10.5 A	--	--	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 10.5 A,	--	290	--	ns
Q <sub>rr</sub>	Reverse Recovery Charge	dI <sub>F</sub> / dt = 100 A/μs (Note 4)	--	2.4	--	μC

### Notes:

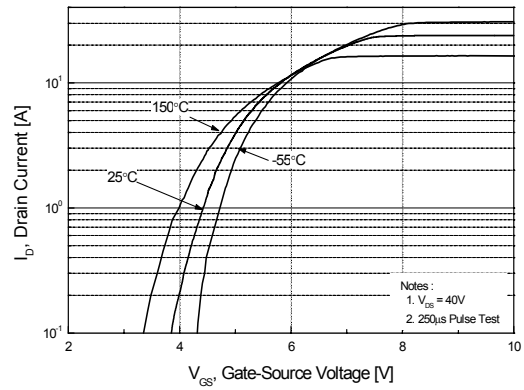
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 5.7 mH, I<sub>AS</sub> = 10.5A, V<sub>DD</sub> = 50V, R<sub>G</sub> = 25 Ω, Starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 10.5A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C
4. Pulse Test : Pulse width ≤ 300μs, Duty cycle ≤ 2%
5. Essentially independent of operating temperature

## Typical Performance Characteristics

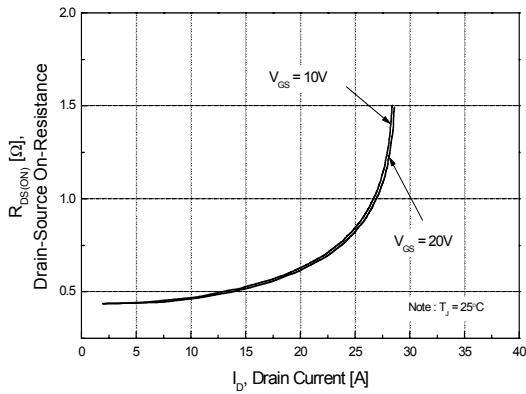
**Figure 1. On-Region Characteristics**



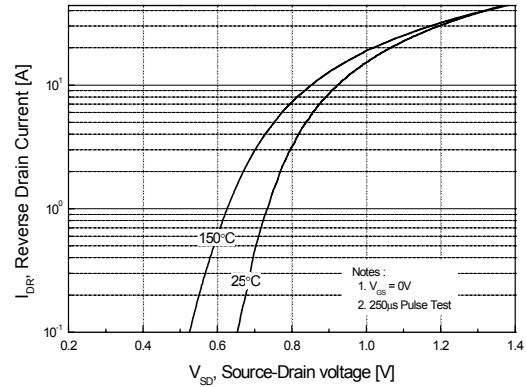
**Figure 2. Transfer Characteristics**



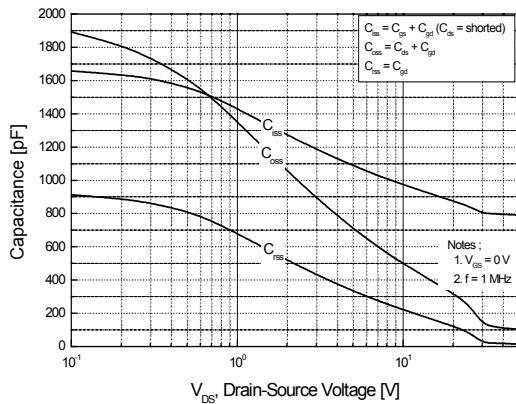
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



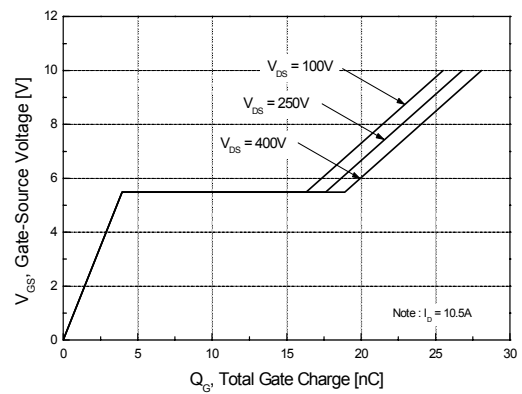
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

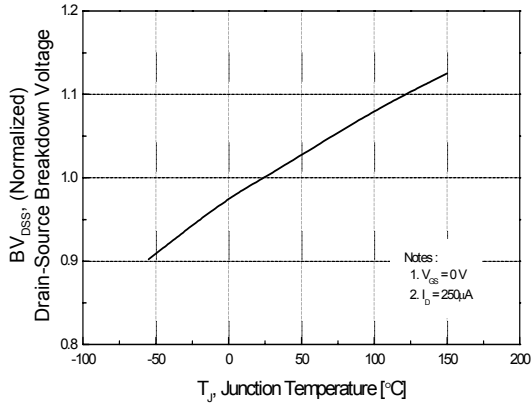


**Figure 6. Gate Charge Characteristics**

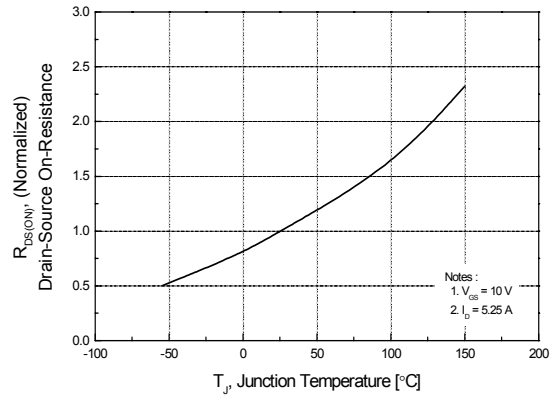


**Typical Performance Characteristics** (Continued)

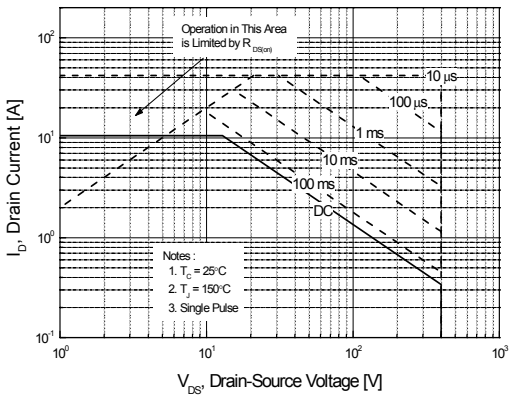
**Figure 7. Breakdown Voltage Variation vs. Temperature**



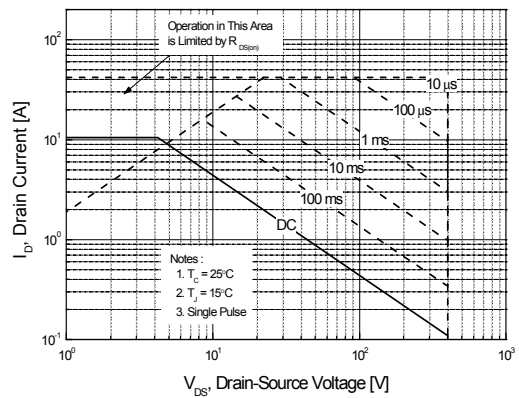
**Figure 8. On-Resistance Variation vs. Temperature**



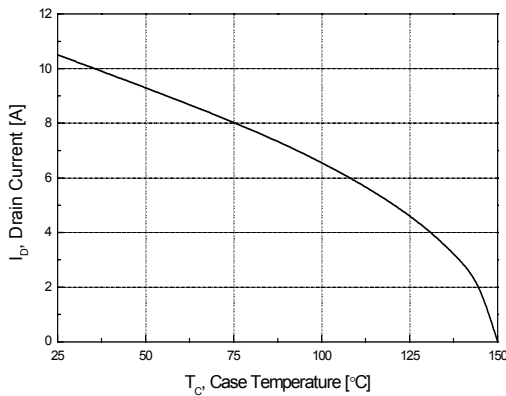
**Figure 9-1. Maximum Safe Operating Area of FQP3N50C**



**Figure 9-2. Maximum Safe Operating Area of FQPF3N50C**



**Figure 10. Maximum Drain Current**



Typical Performance Characteristics (Continued)

Figure 11-1. ransient Thermal Response Curve of FQP3N50C

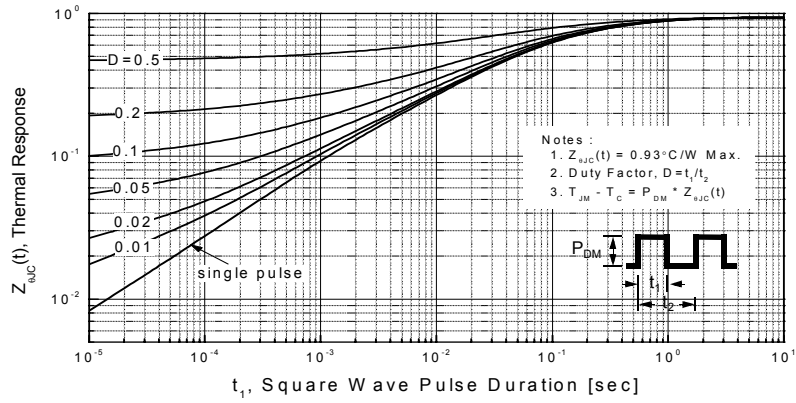
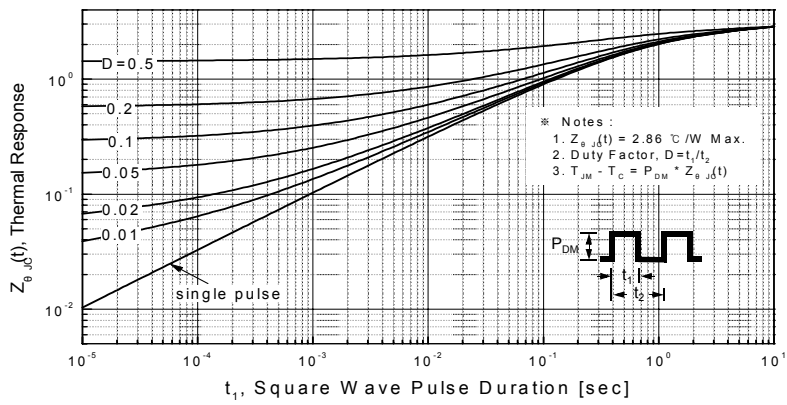
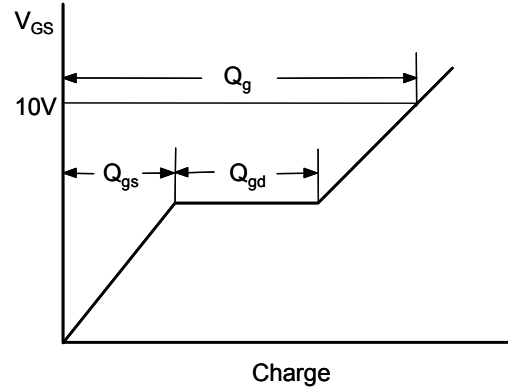
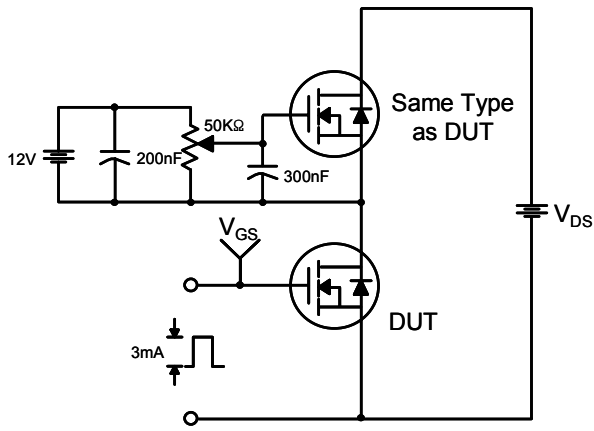


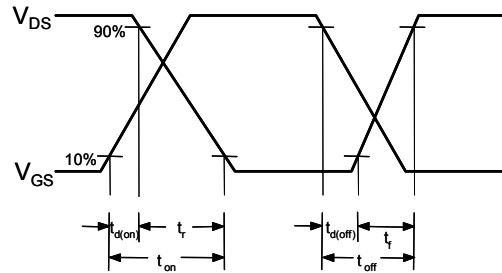
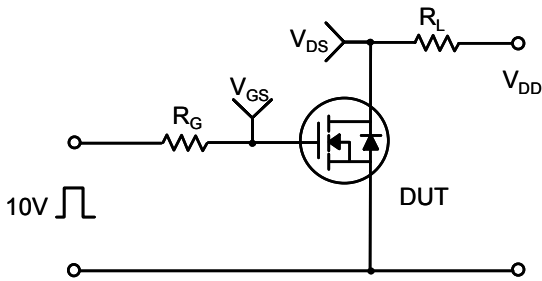
Figure 11-2. ransient Thermal Response Curve of FQPF3N50C



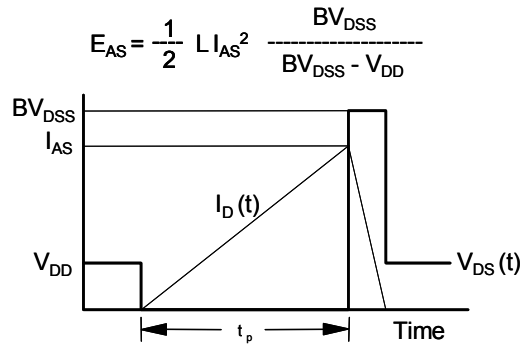
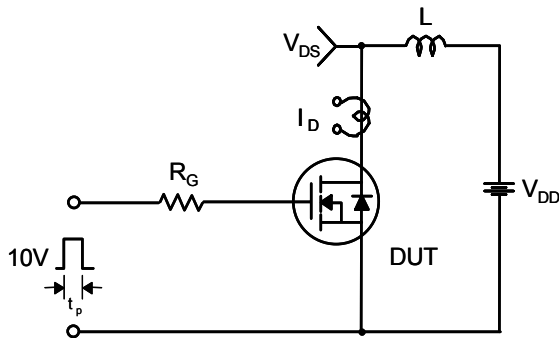
**Gate Charge Test Circuit & Waveform**



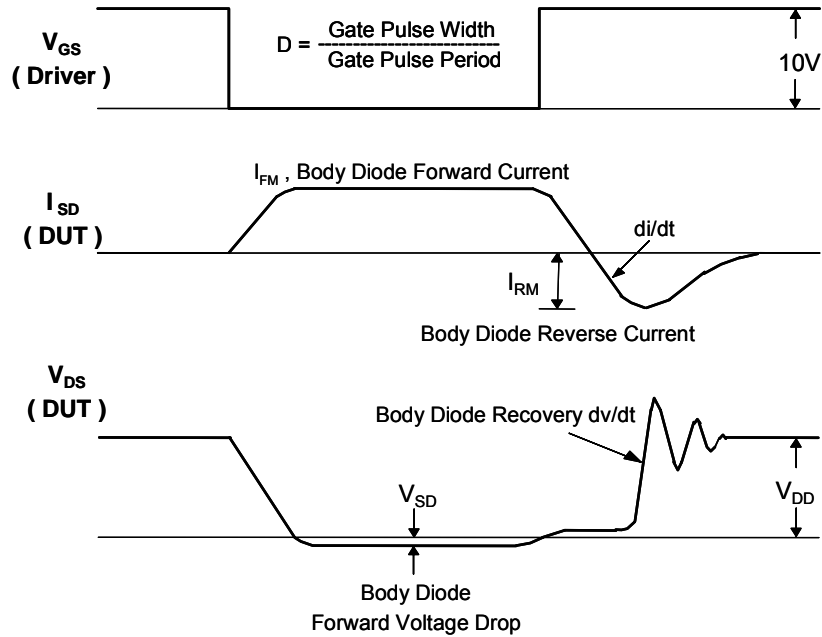
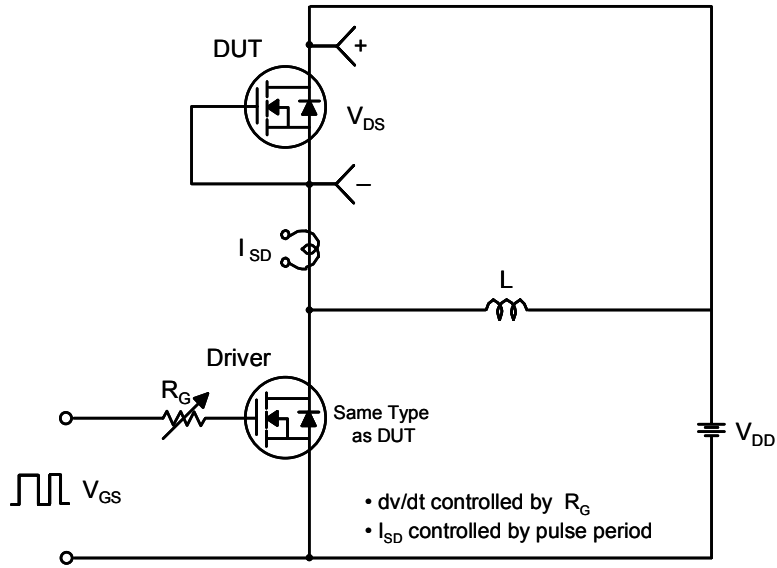
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

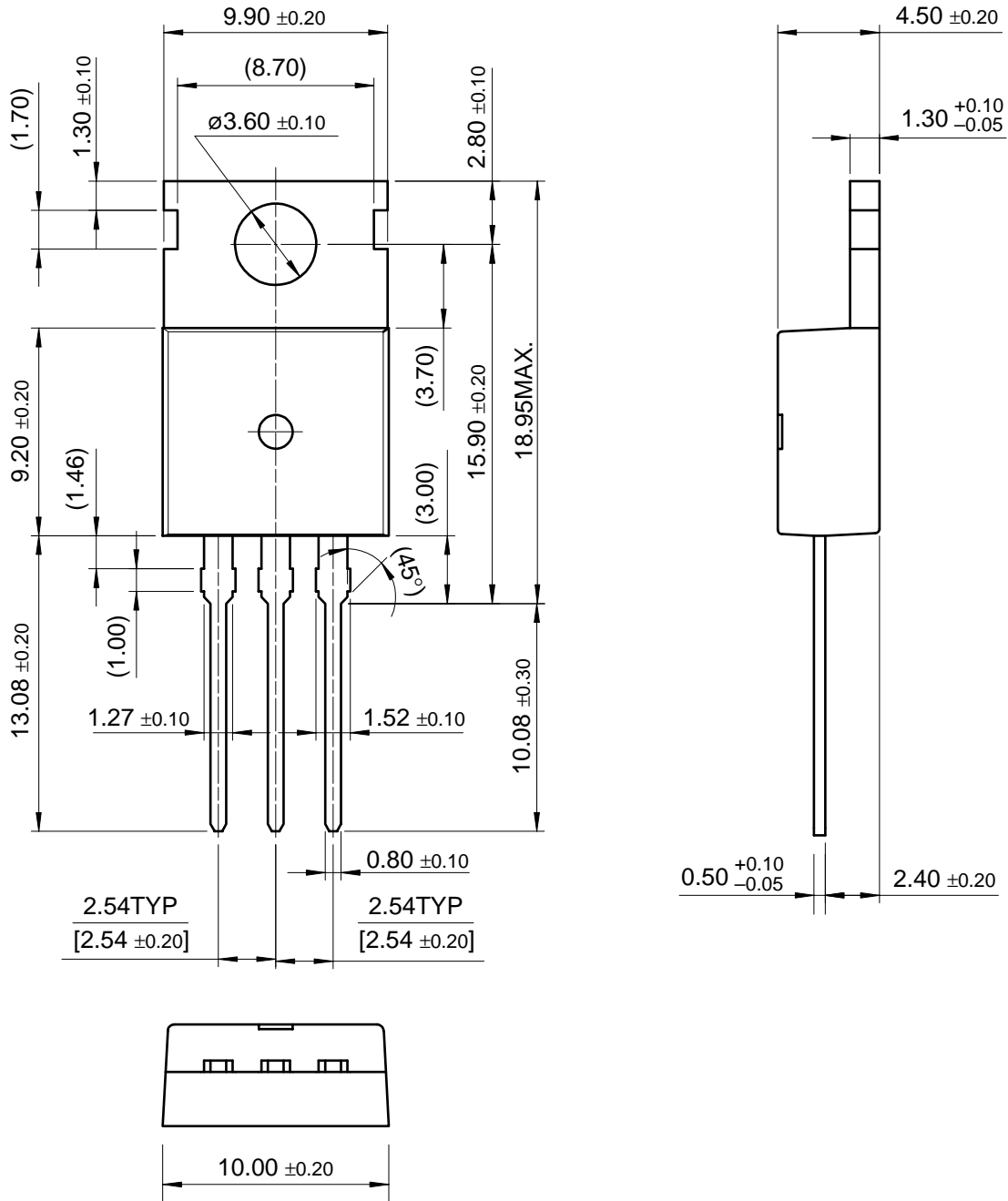


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

TO-220

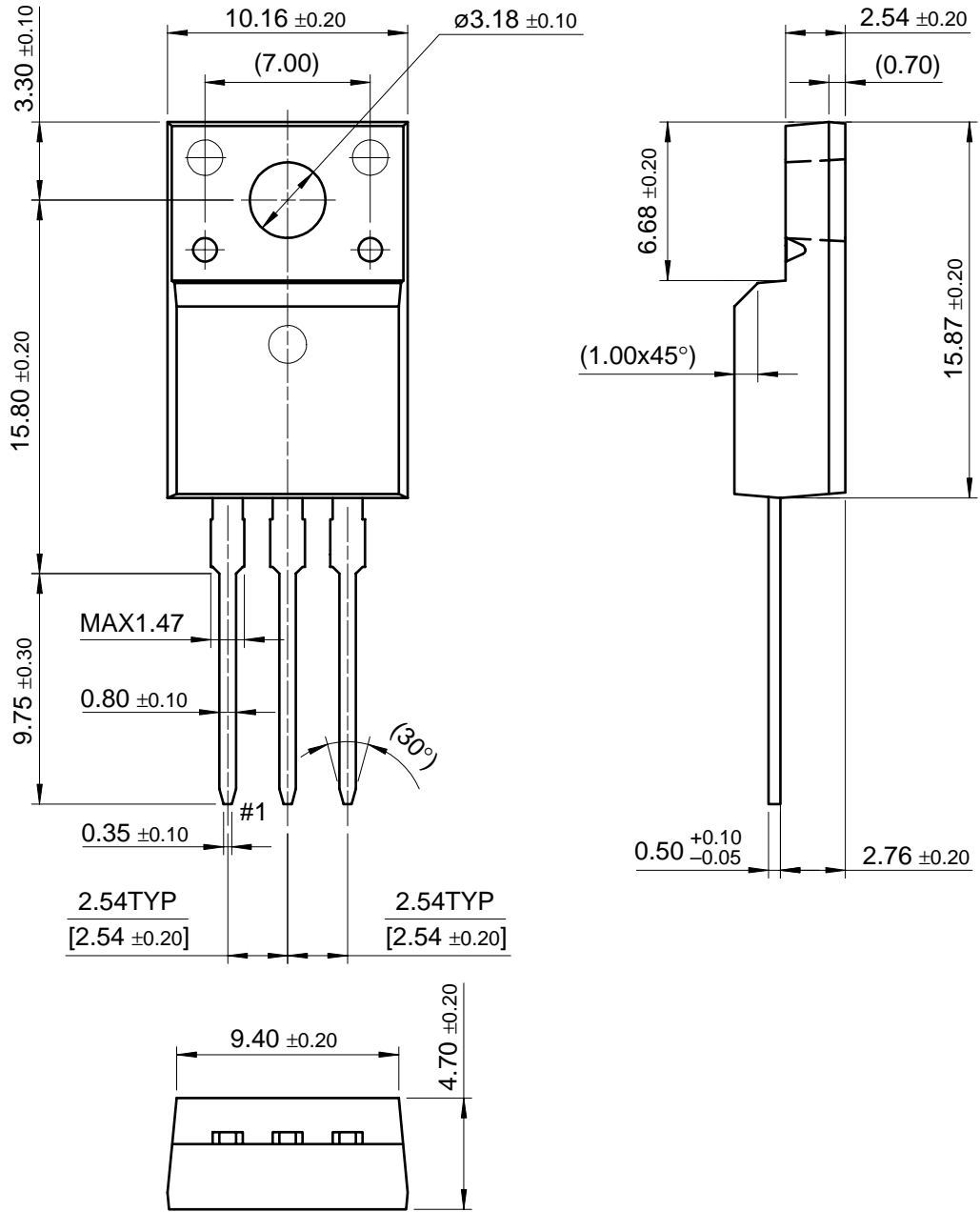


Dimensions in Millimeters



Mechanical Dimensions (Continued)

TO-220F



Dimensions in Millimeters

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FACT™	ImpliedDisconnect™	OCX™	RapidConfigure™	TruTranslation™
FACT Quiet Series™		OCXPro™	RapidConnect™	UHC™
Across the board. Around the world.™		OPTOLOGIC <sup>®</sup>	μSerDes™	UltraFET <sup>®</sup>
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