

# FQP6N40C / FQPF6N40C

## N-Channel QFET MOSFET

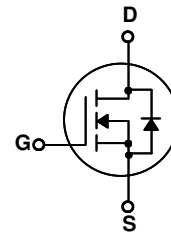
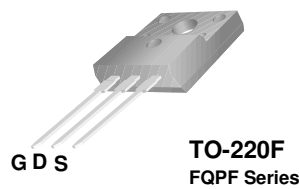
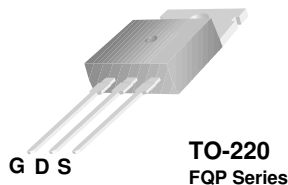
400 V, 6.0 A, 1.0  $\Omega$

### Description

This N-Channel enhancement mode power MOSFET is produced using Fairchild Semiconductor®'s proprietary planar stripe and DMOS technology. This advanced MOSFET technology has been especially tailored to reduce on-state resistance, and to provide superior switching performance and high avalanche energy strength. These devices are suitable for switched mode power supplies, active power factor correction (PFC), and electronic lamp ballasts.

### Features

- 6.0 A, 400 V,  $R_{DS(on)} = 1.0 \Omega$  (Max) @  $V_{GS} = 10 V$ ,  $I_D = 3.0 A$
- Low Gate Charge (Typ. 16 nC)
- Low Crss (Typ. 15 pF)
- 100% Avalanche Tested



### Absolute Maximum Ratings $T_C = 25^\circ C$ unless otherwise noted

Symbol	Parameter	FQP6N40C	FQPF6N40C	Unit
$V_{DSS}$	Drain-Source Voltage	400		V
$I_D$	Drain Current - Continuous ( $T_C = 25^\circ C$ ) - Continuous ( $T_C = 100^\circ C$ )	6	6 *	A
		3.6	3.6 *	A
$I_{DM}$	Drain Current - Pulsed (Note 1)	24	24 *	A
$V_{GSS}$	Gate-Source Voltage	$\pm 30$		V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	270		mJ
$I_{AR}$	Avalanche Current (Note 1)	6		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	7.3		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 $25^\circ C$	73	38	W
		0.58	0.3	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	FQP6N40C	FQPF6N40C	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	1.71	3.31	$^\circ C/W$
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink Typ.	0.5	--	$^\circ C/W$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	62.5	$^\circ C/W$

## Electrical Characteristics

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	400	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$	--	0.54	--	V/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}$	--	--	1	$\mu\text{A}$
		$V_{DS} = 320\text{ V}, T_C = 125^\circ\text{C}$	--	--	10	$\mu\text{A}$
$I_{GSSF}$	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

## On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	2.0	--	4.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 3\text{ A}$	--	0.83	1	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 40\text{ V}, I_D = 3\text{ A}$ (Note 4)	--	4.7	--	S

## Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	480	625	pF
$C_{oss}$	Output Capacitance		--	80	105	pF
$C_{rss}$	Reverse Transfer Capacitance		--	15	20	pF

## Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 200\text{ V}, I_D = 6\text{ A},$ $R_G = 25\ \Omega$	--	13	35	ns
$t_r$	Turn-On Rise Time		--	65	140	ns
$t_{d(off)}$	Turn-Off Delay Time		--	21	55	ns
$t_f$	Turn-Off Fall Time		(Note 4, 5)	--	38	85
$Q_g$	Total Gate Charge	$V_{DS} = 320\text{ V}, I_D = 6\text{ A},$ $V_{GS} = 10\text{ V}$	--	16	20	nC
$Q_{gs}$	Gate-Source Charge		--	2.3	--	nC
$Q_{gd}$	Gate-Drain Charge		(Note 4, 5)	--	8.2	--

## Drain-Source Diode Characteristics and Maximum Ratings

$I_S$	Maximum Continuous Drain-Source Diode Forward Current	--	--	6	A	
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current	--	--	24	A	
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 6\text{ A}$	--	--	1.4	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = 6\text{ A},$	--	230	--	ns
$Q_{rr}$	Reverse Recovery Charge	$di_F / dt = 100\text{ A}/\mu\text{s}$ (Note 4)	--	1.7	--	$\mu\text{C}$

### Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 13.7\text{ mH}, I_{AS} = 6\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 6\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , 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

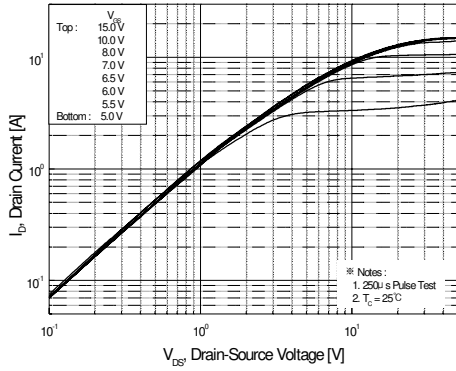


Figure 1. On-Region Characteristics

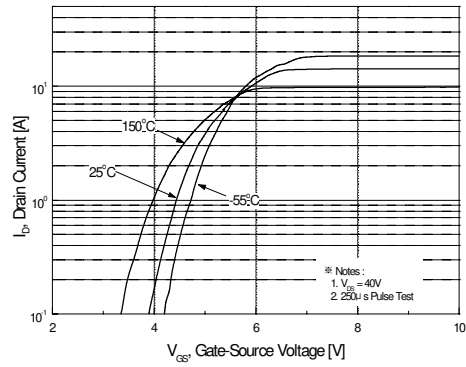


Figure 2. Transfer Characteristics

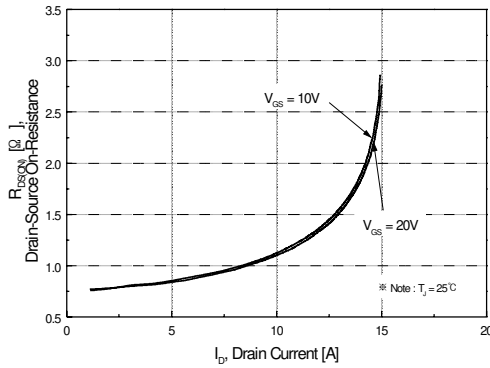


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

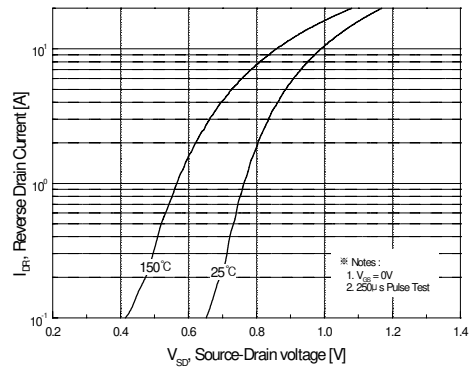


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

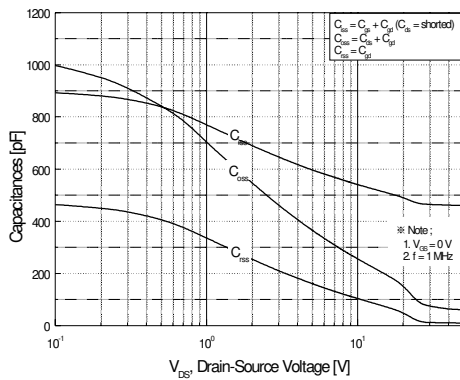


Figure 5. Capacitance Characteristics

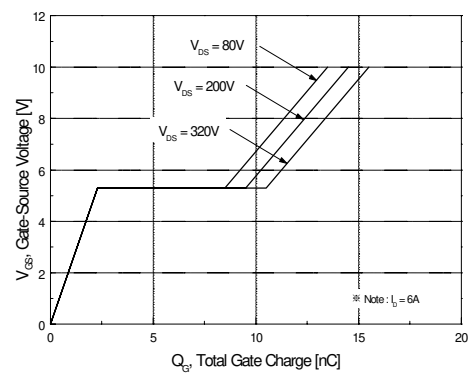
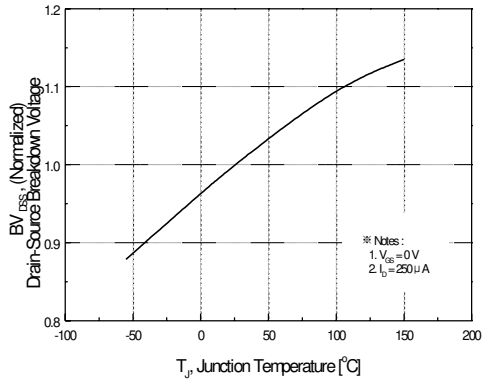
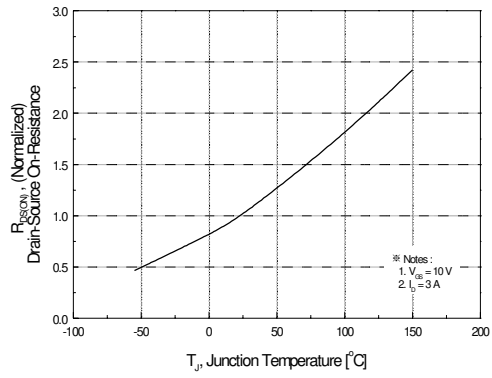


Figure 6. Gate Charge Characteristics

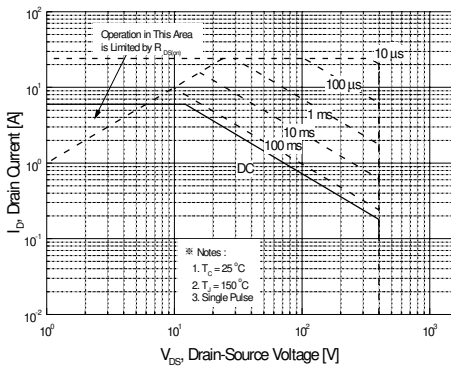
**Typical Characteristics** (Continued)



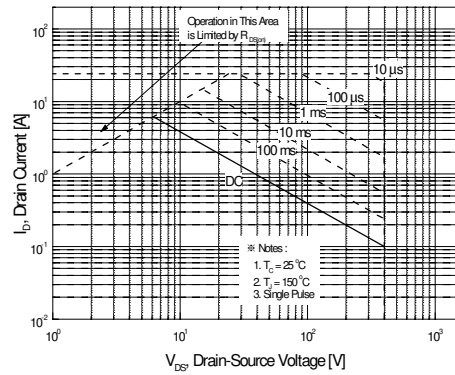
**Figure 7. Breakdown Voltage Variation vs Temperature**



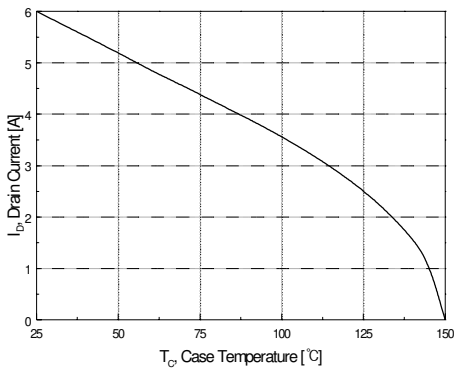
**Figure 8. On-Resistance Variation vs Temperature**



**Figure 9-1. Maximum Safe Operating Area for FQP6N40C**



**Figure 9-2. Maximum Safe Operating Area for FQPF6N40C**



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

Typical Characteristics (Continued)

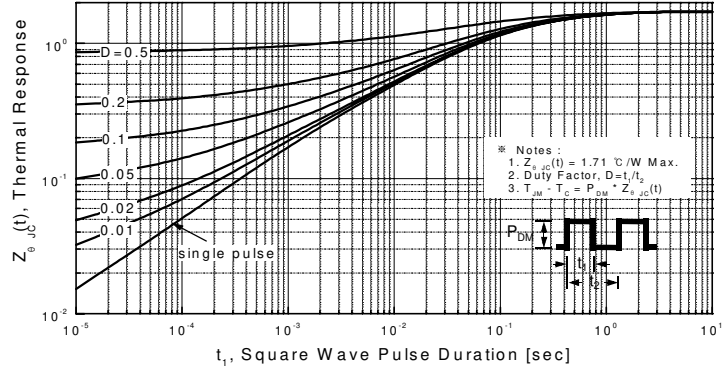


Figure 11-1. Transient Thermal Response Curve for FQP6N40C

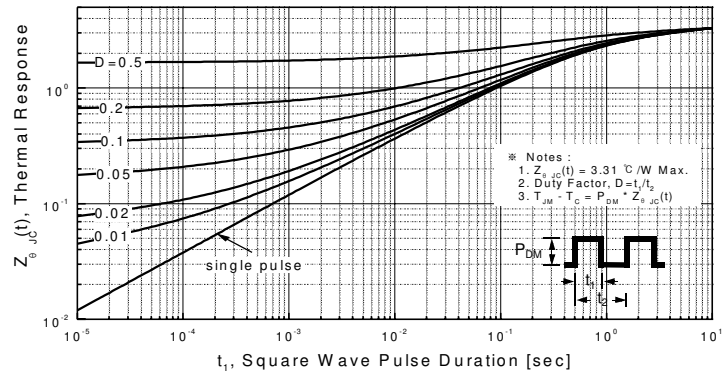
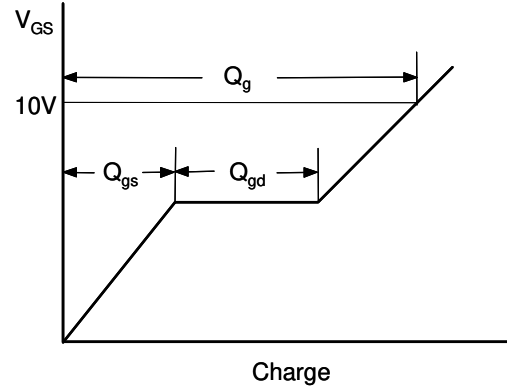
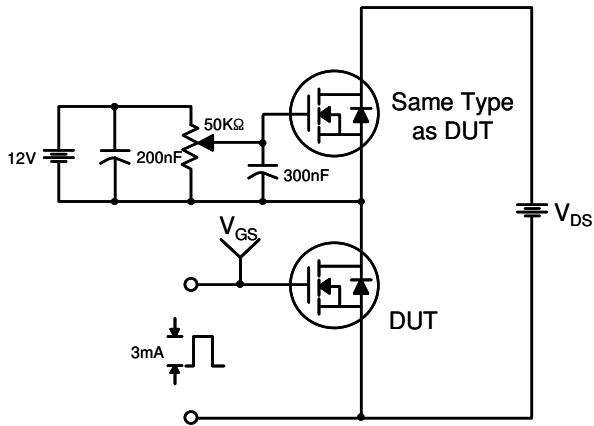
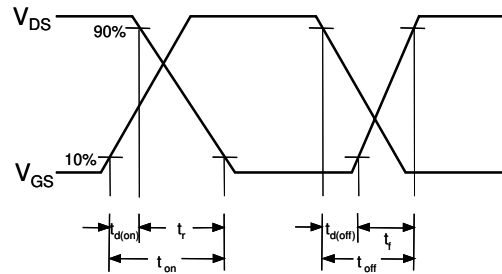
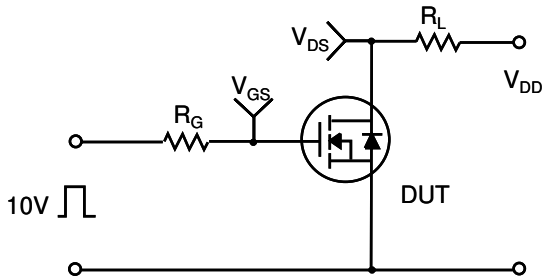


Figure 11-2. Transient Thermal Response Curve for FQPF6N40C

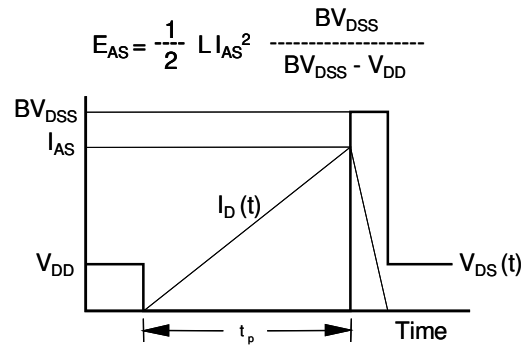
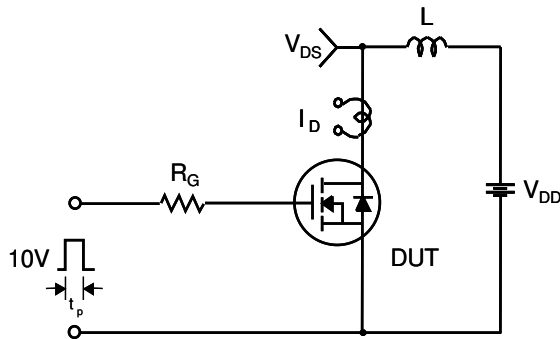
**Gate Charge Test Circuit & Waveform**



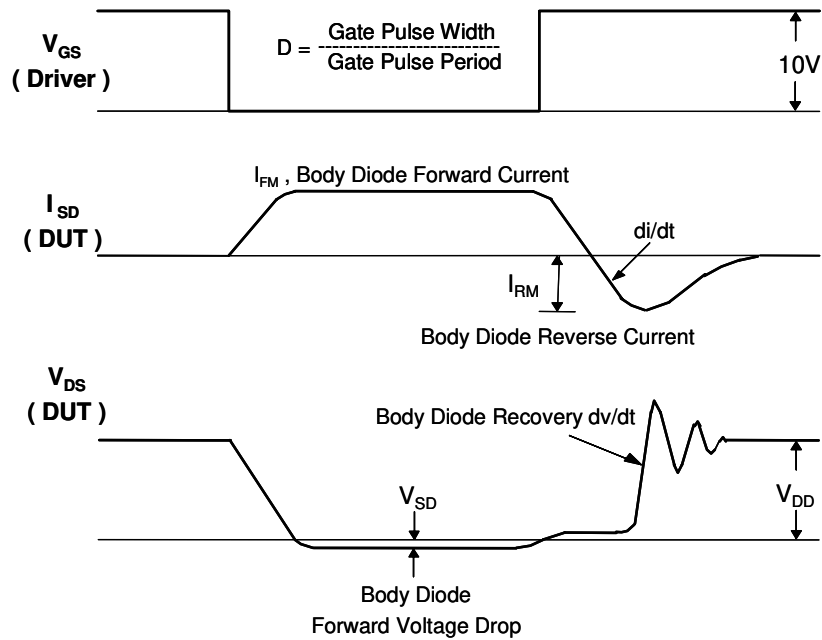
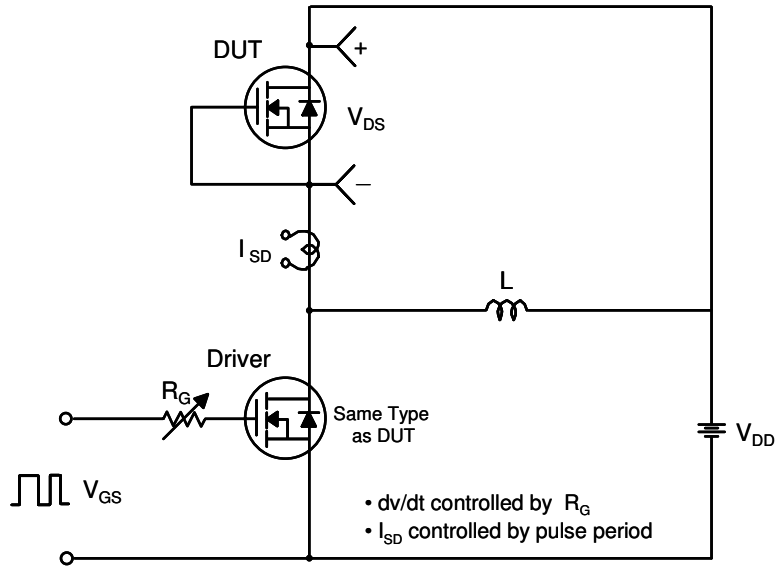
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

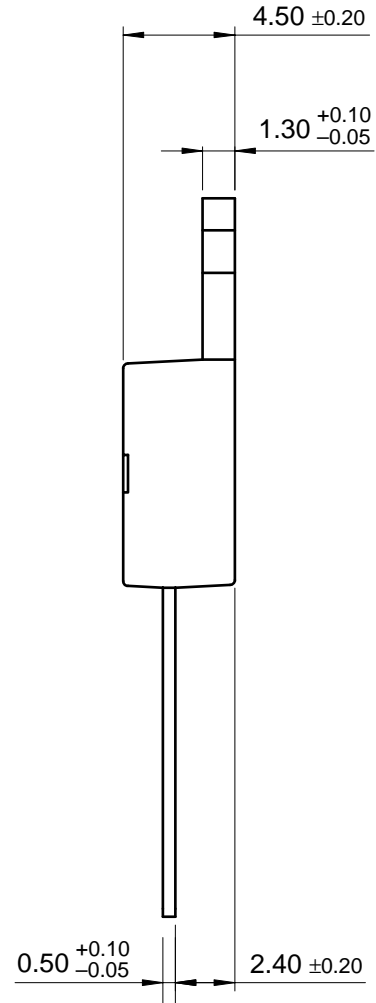
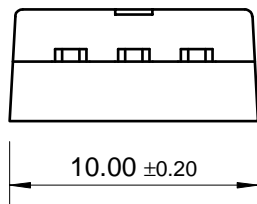
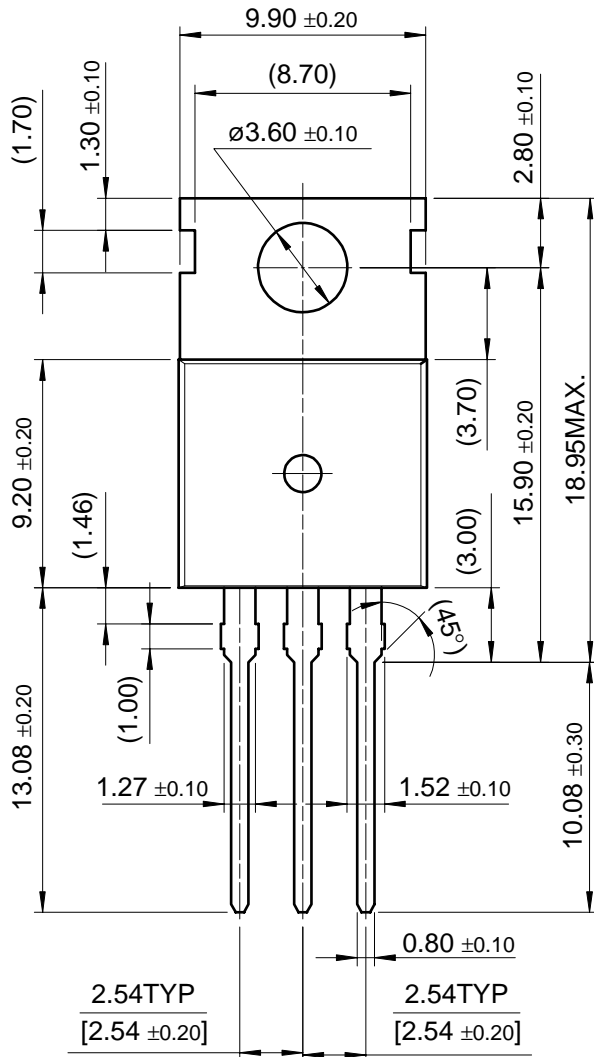


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Package Dimensions

TO-220



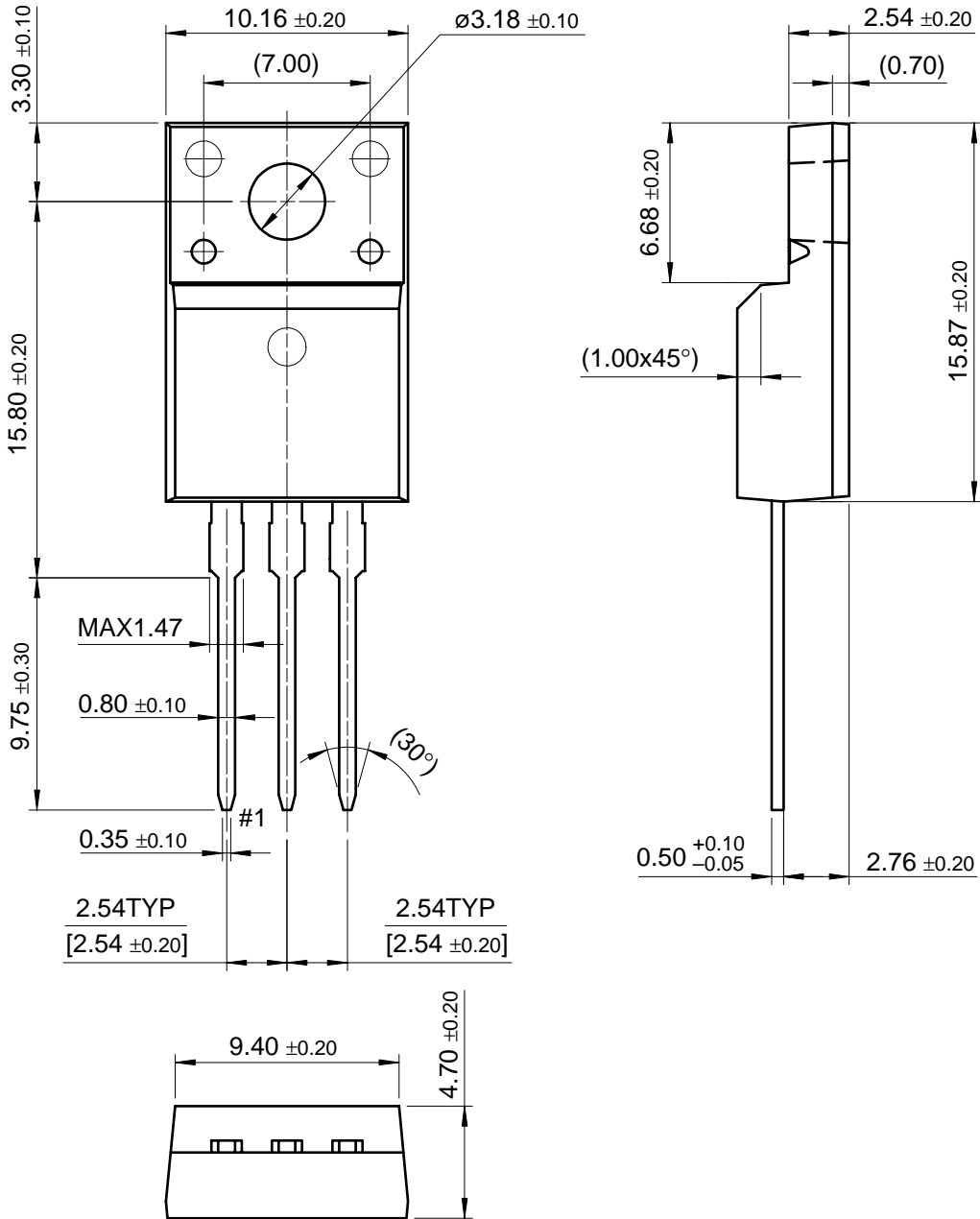
Dimensions in Millimeters

FQP6N40C / FQPF6N40C N-Channel MOSFET



Package Dimensions (Continued)

TO-220F



FQP6N40C / FQPF6N40C N-Channel MOSFET

Dimensions in Millimeters



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