July 2005

QFET®

FQP10N60C / FQPF10N60C
600V N-Channel MOSFET

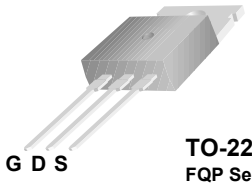
Features

- 9.5A, 600V, $R_{DS(on)}$ = 0.73Ω @V_{GS} = 10 V
- Low gate charge (typical 44 nC)
- Low Crss (typical 18 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability

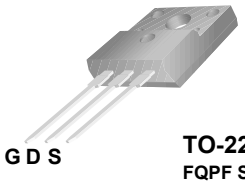
Description

These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DMOS technology.

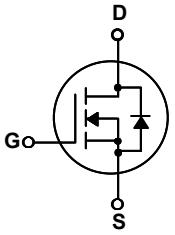
This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switched mode power supplies, active power factor correction, electronic lamp ballasts based on half bridge topology.



TO-220
FQP Series



TO-220F
FQPF Series



Absolute Maximum Ratings

Symbol	Parameter		FQP10N60C	FQPF10N60C	Units
V_{DSS}	Drain-Source Voltage		600		V
I_D	Drain Current - Continuous (T_C = 25°C)		9.5	9.5 *	A
	- Continuous (T_C = 100°C)		5.7	5.7 *	A
I_{DM}	Drain Current - Pulsed	(Note 1)	38	38 *	A
V_{GSS}	Gate-Source Voltage		± 30		V
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)	700		mJ
I_{AR}	Avalanche Current	(Note 1)	9.5		A
E_{AR}	Repetitive Avalanche Energy	(Note 1)	15.6		mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	4.5		V/ns
P_D	Power Dissipation (T_C = 25°C)		156	50	W
	- Derate above 25°C		1.25	0.4	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to +150		°C
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds		300		°C

* Drain current limited by maximum junction temperature.

Thermal Characteristics

Symbol	Parameter	FQP10N60C	FQPF10N60C	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.8	2.5	°C/W
$R_{\theta CS}$	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
FQP10N60C	FQP10N60C	TO-220	--	--	50
FQPF10N60C	FQPF10N60C	TO-220F	--	--	50

Electrical Characteristics T_C = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 μA	600	--	--	V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	I_D = 250 μA, Referenced to 25°C	--	0.7	--	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 600 V, V_{GS} = 0 V	--	--	1	μA
		V_{DS} = 480 V, T_C = 125°C	--	--	10	μA
I_{GSSF}	Gate-Body Leakage Current, Forward	V_{GS} = 30 V, V_{DS} = 0 V	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	V_{GS} = -30 V, V_{DS} = 0 V	--	--	-100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 μA	2.0	--	4.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	V_{GS} = 10 V, I_D = 4.75 A	--	0.6	0.73	W
g_{FS}	Forward Transconductance	V_{DS} = 40 V, I_D = 4.75 A (Note 4)	--	8.0	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz	--	1570	2040	pF
C_{oss}	Output Capacitance		--	166	215	pF
C_{rss}	Reverse Transfer Capacitance		--	18	24	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 300 V, I_D = 9.5A, R_G = 25 Ω	--	23	55	ns
t_r	Turn-On Rise Time		--	69	150	ns
$t_{d(off)}$	Turn-Off Delay Time		--	144	300	ns
t_f	Turn-Off Fall Time	(Note 4, 5)	--	77	165	ns
Q_g	Total Gate Charge	V_{DS} = 480 V, I_D = 9.5A, V_{GS} = 10 V	--	44	57	nC
Q_{gs}	Gate-Source Charge		--	6.7	--	nC
Q_{gd}	Gate-Drain Charge	(Note 4, 5)	--	18.5	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	9.5	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	38	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 9.5 A	--	--	1.4	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = 9.5 A, dI_F / dt = 100 A/μs (Note 4)	--	420	--	ns
Q_{rr}	Reverse Recovery Charge		--	4.2	--	μC

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 14.2mH, I_{AS} = 9.5 A, V_{DD} = 50V, R_G = 25 Ω, Starting T_J = 25°C
3. I_{SD} ≤ 9.5A, di/dt ≤ 200A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 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

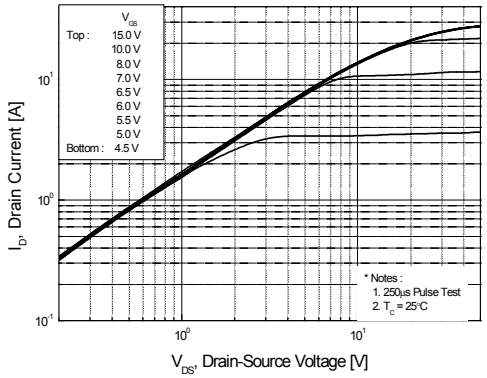


Figure 2. Transfer Characteristics

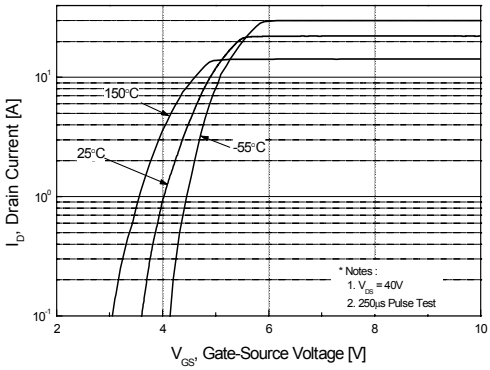


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

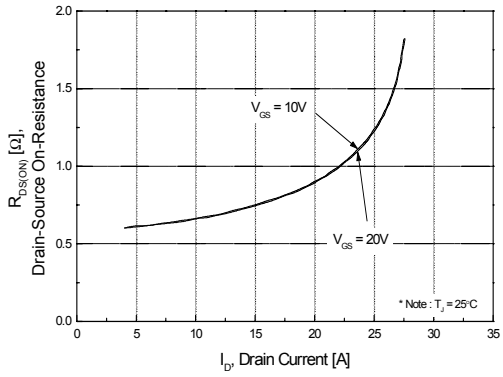


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperatue

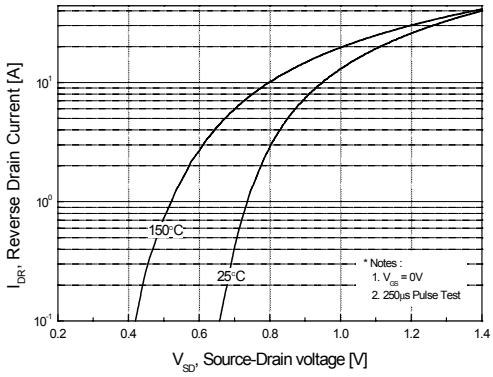


Figure 5. Capacitance Characteristics

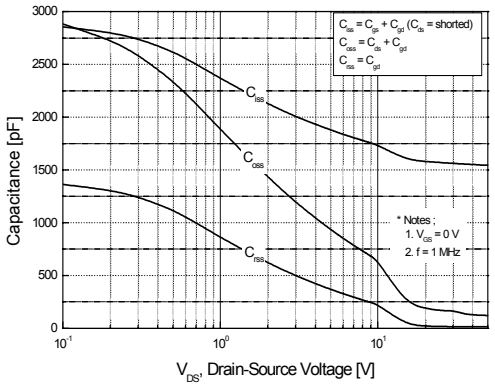
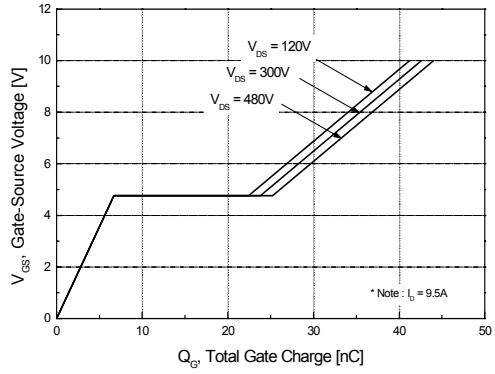


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

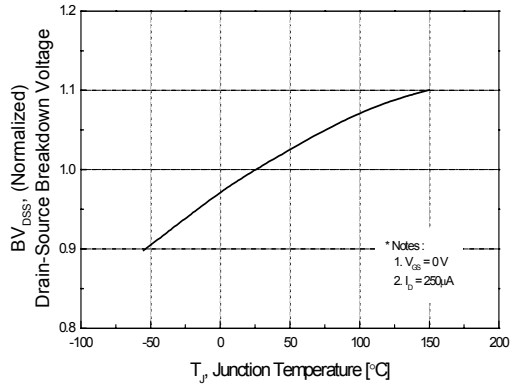


Figure 8. On-Resistance Variation vs. Temperature

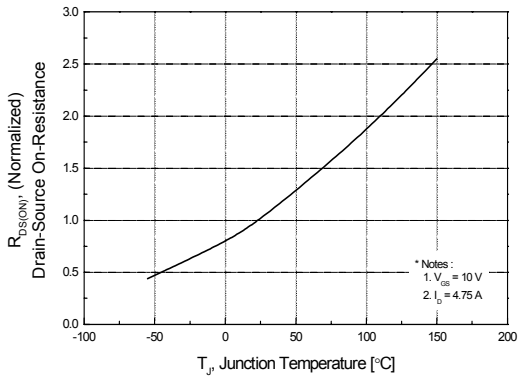


Figure 9-1. Maximum Safe Operating Area for FQP10N60C

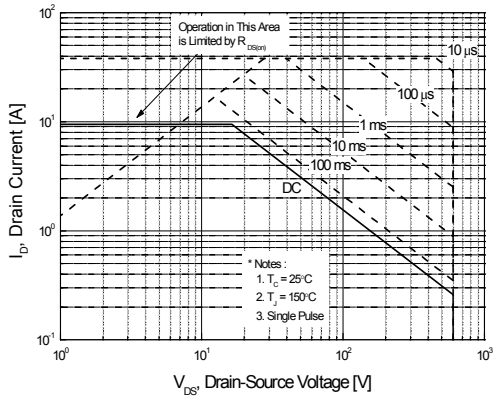


Figure 9-2. Maximum Safe Operating Area for FQPF10N60C

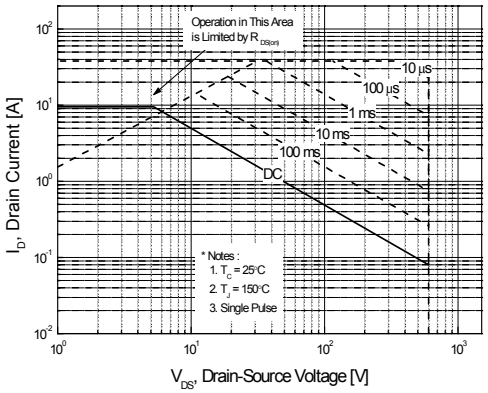
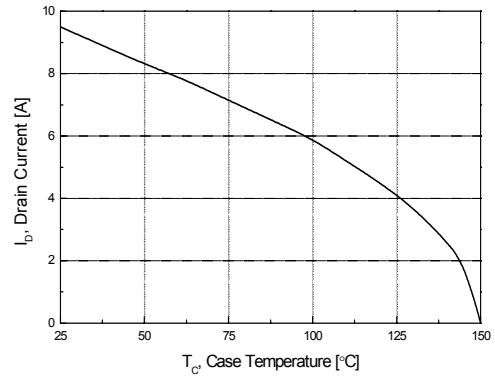


Figure 10. Maximum Drain Current vs. Case Temperature



Typical Performance Characteristics (Continued)

Figure 11-1. Transient Thermal Response Curve for FQP10N60C

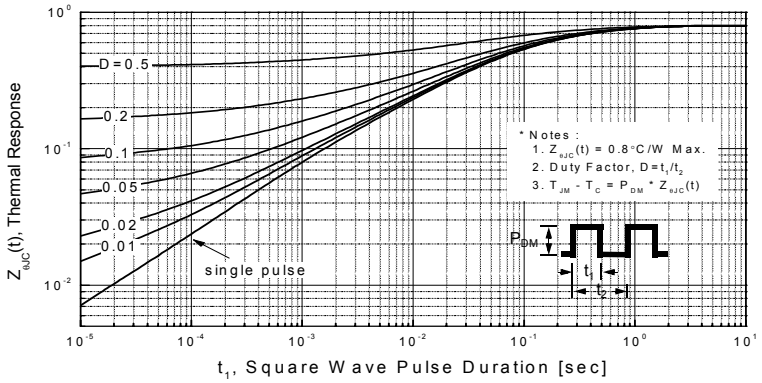
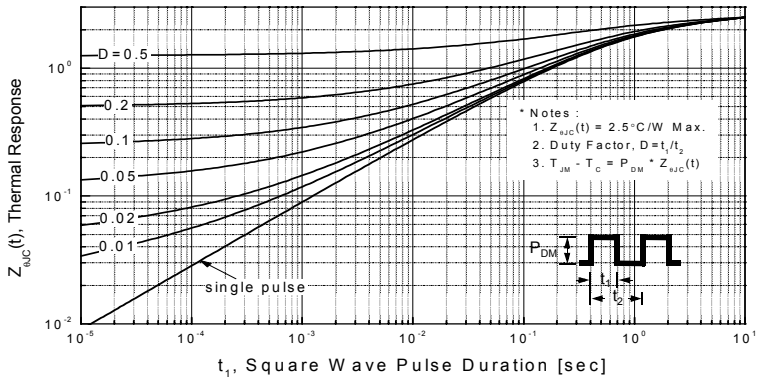
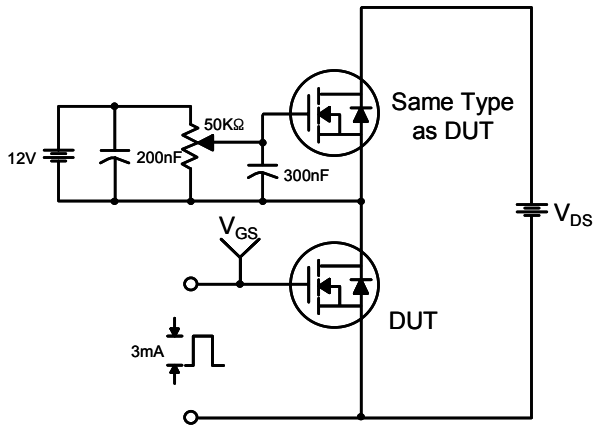
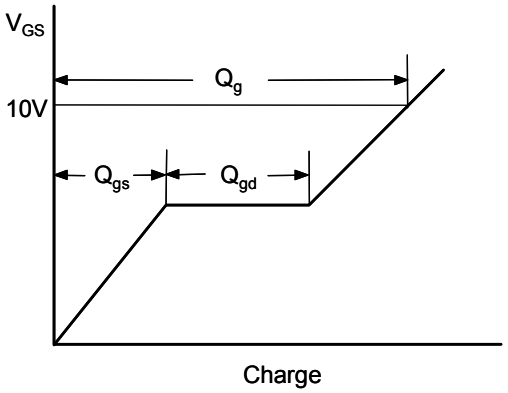


Figure 11-2. Transient Thermal Response Curve for FQPF10N60C

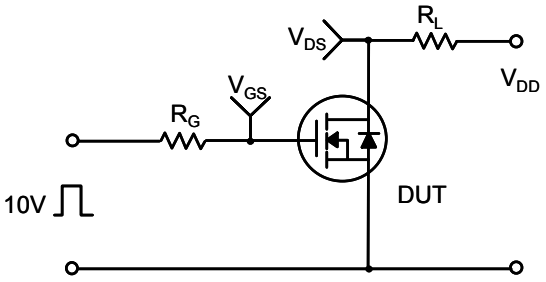


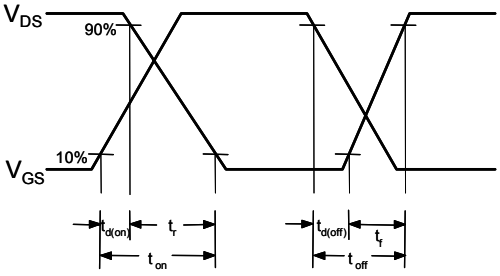
Gate Charge Test Circuit & Waveform



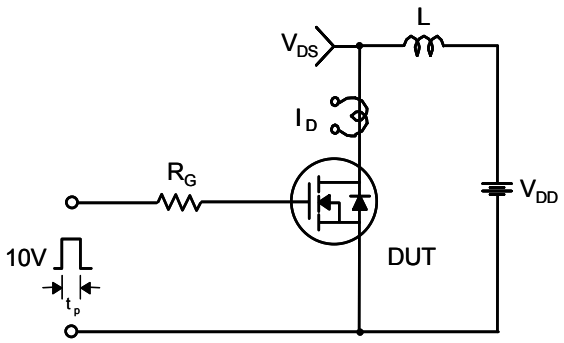


Resistive Switching Test Circuit & Waveforms

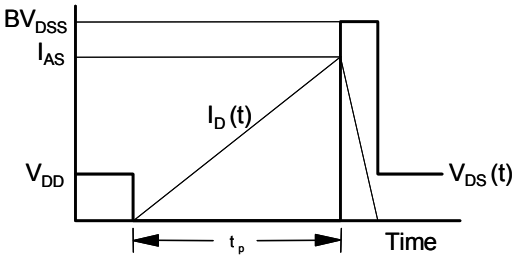




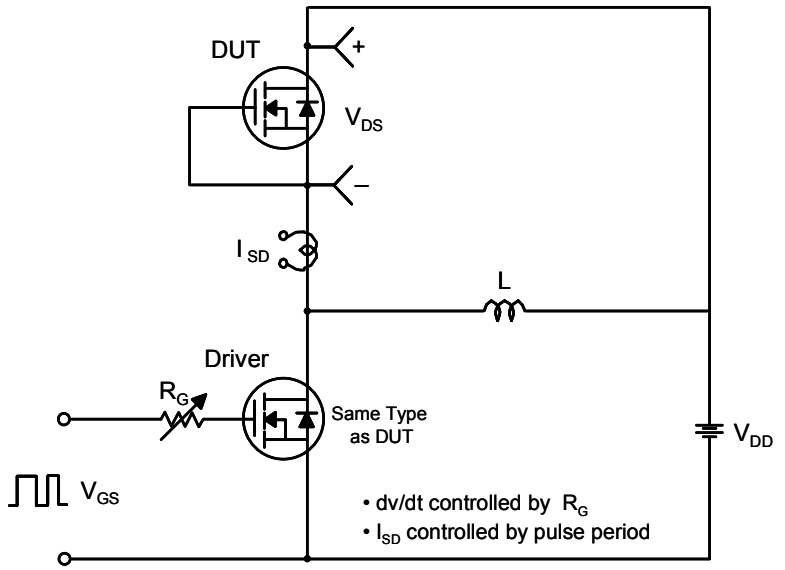
Unclamped Inductive Switching Test Circuit & Waveforms

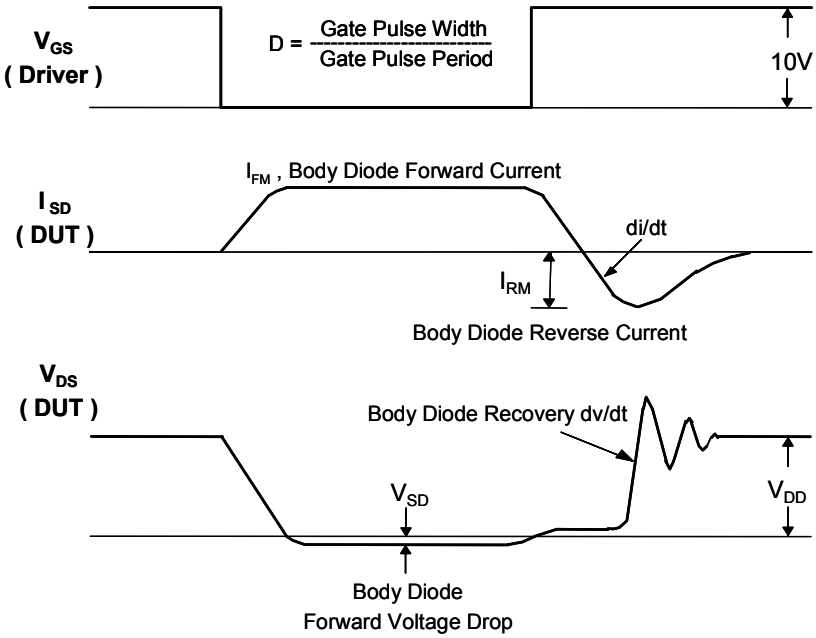


$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$



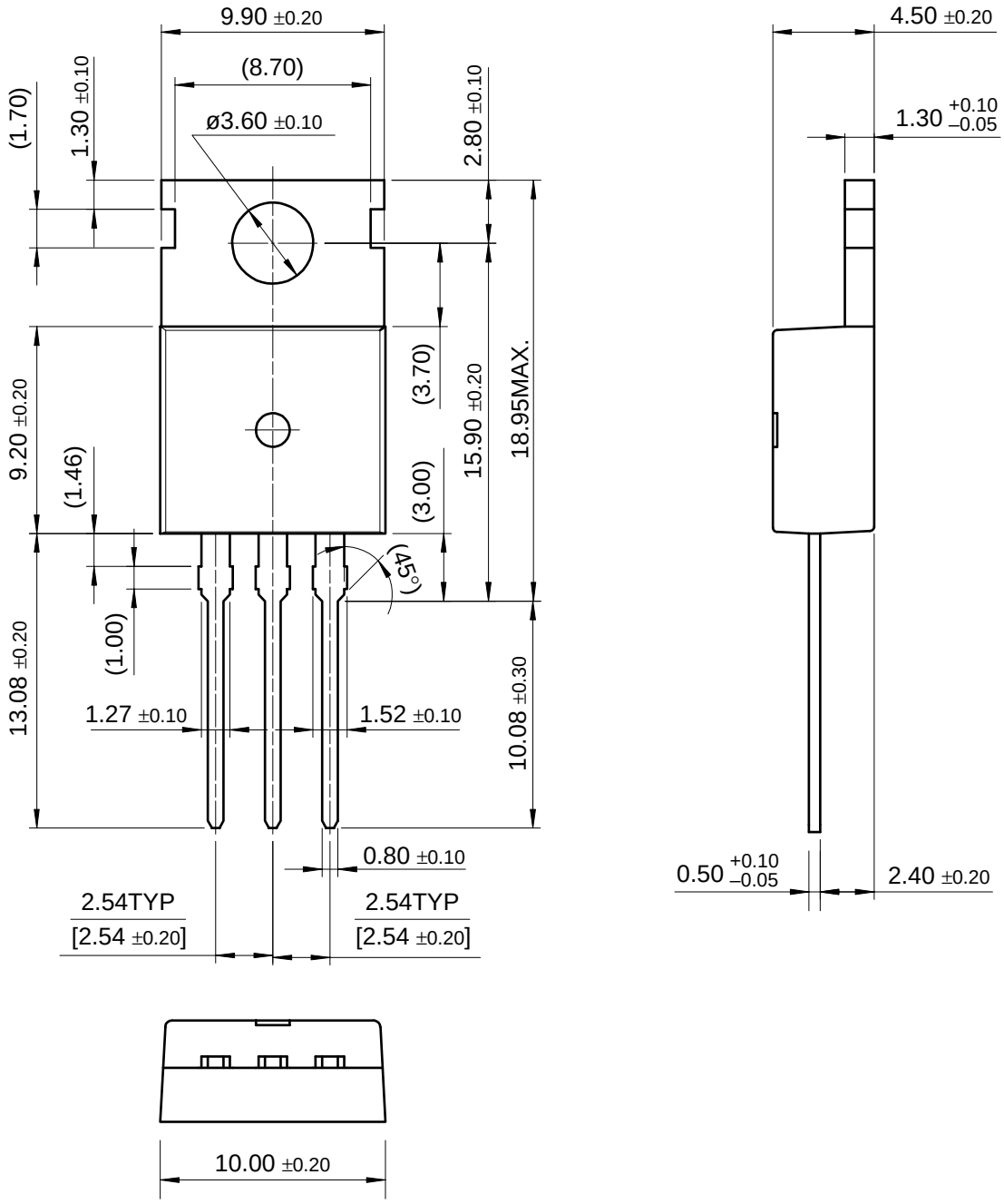
Peak Diode Recovery dv/dt Test Circuit & Waveforms





Mechanical Dimensions

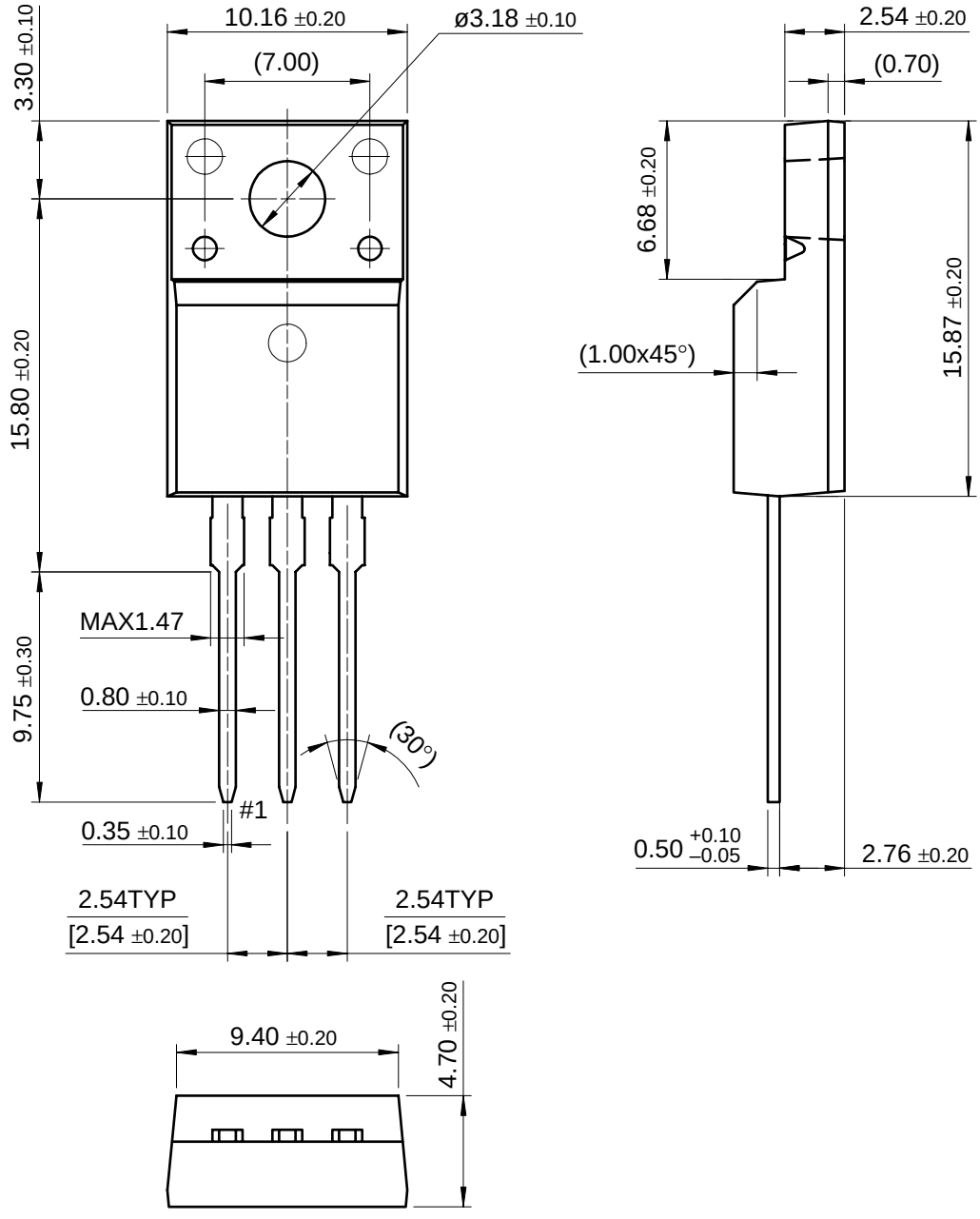
TO-220



Dimensions in Millimeters

Mechanical Dimensions (Continued)

TO-220F



Dimensions in Millimeters

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