QFET®

ON Semiconductor®

FQP3N50C/FQPF3N50C
500V N-Channel MOSFET

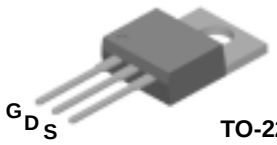
Features

- 3 A, 500 V, $R_{DS(on)}$ = 2.5 Ω @ V_{GS} = 10 V
- Low gate charge (typical 10 nC)
- Low Crss (typical 8.5 pF)
- Fast switching
- 100 % avalanche tested
- Improved dv/dt capability

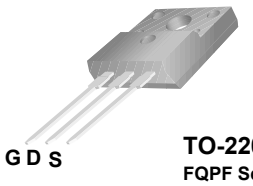
Description

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

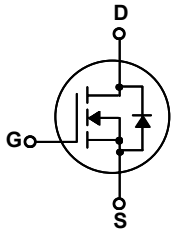
This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switched mode power supplies, active power factor correction,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



TO-220
FQP Series



TO-220F
FQPF Series



Absolute Maximum Ratings

Symbol	Parameter		FQP3N50C	FQPF3N50C	Units
V_{DSS}	Drain-Source Voltage		500		V
I_D	Drain Current	- Continuous (T_C = 25°C)	3	3 *	A
		- Continuous (T_C = 100°C)	1.8	1.8 *	A
I_{DM}	Drain Current	- Pulsed (Note 1)	12	12 *	A
V_{GSS}	Gate-Source Voltage		± 30		V
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)	200		mJ
I_{AR}	Avalanche Current	(Note 1)	3		A
E_{AR}	Repetitive Avalanche Energy	(Note 1)	6.2		mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	4.5		V/ns
P_D	Power Dissipation (T_C = 25°C)		62	25	W
	- Derate above 25°C		0.5	0.2	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	FQP3N50C	FQPF3N50C	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	2.0	4.9	°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

October-2017,Rev. 1

Publication Order Number:
FQP3N50C/D

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FQP3N50C	FQP3N50C	TO-220	--	--	50
FQPF3N50C	FQPF3N50C	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	500	--	--	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} = 500 V, V_{GS} = 0 V	--	--	1	μA
		V_{DS} = 400 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 = 1.5 A	--	2.1	2.5	Ω
g_{FS}	Forward Transconductance	V_{DS} = 40 V, I_D = 1.5 A (Note 4)	--	1.5	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz	--	280	365	pF
C_{oss}	Output Capacitance		--	50	65	pF
C_{rss}	Reverse Transfer Capacitance		--	8.5	11	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 250 V, I_D = 3 A, R_G = 25 Ω (Note 4, 5)	--	10	30	ns
t_r	Turn-On Rise Time		--	25	60	ns
$t_{d(off)}$	Turn-Off Delay Time		--	35	80	ns
t_f	Turn-Off Fall Time		--	25	60	ns
Q_g	Total Gate Charge	V_{DS} = 400 V, I_D = 3 A, V_{GS} = 10 V (Note 4, 5)	--	10	13	nC
Q_{gs}	Gate-Source Charge		--	1.5	--	nC
Q_{gd}	Gate-Drain Charge		--	5.5	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	3	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	12	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 3 A	--	--	1.4	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = 3 A, dI_F / dt = 100 A/μs (Note 4)	--	170	--	ns
Q_{rr}	Reverse Recovery Charge		--	0.7	--	μC

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 40mH, I_{AS} = 3A, V_{DD} = 50V, R_G = 25 Ω, Starting T_J = 25°C
3. I_{SD} ≤ 3A, 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

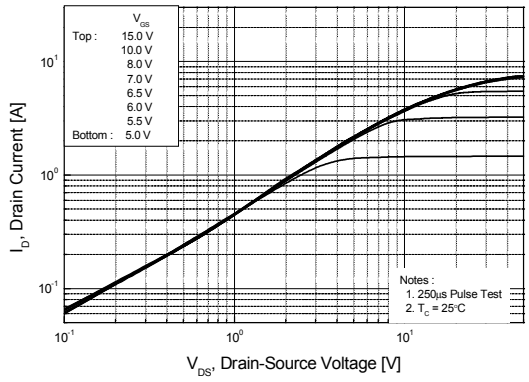


Figure 2. Transfer Characteristics

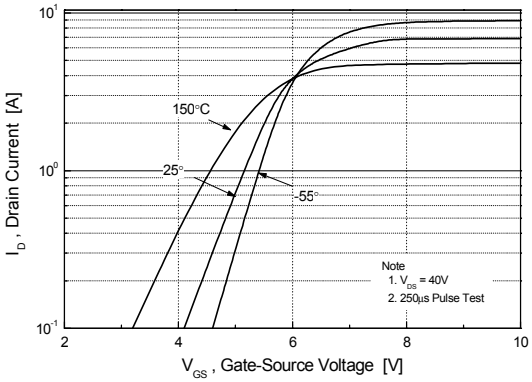


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

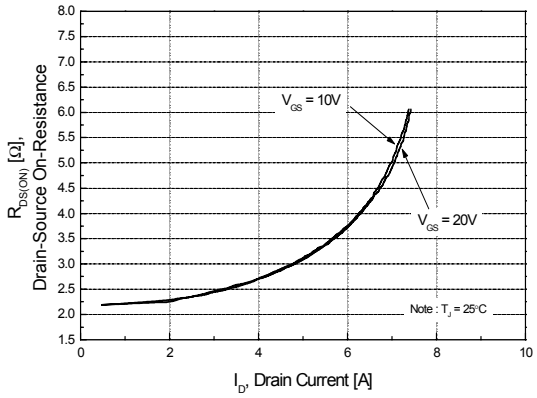


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperatue

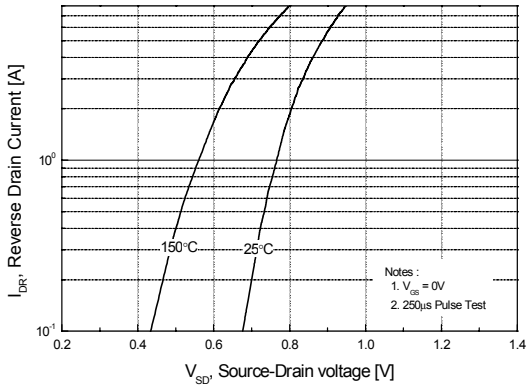


Figure 5. Capacitance Characteristics

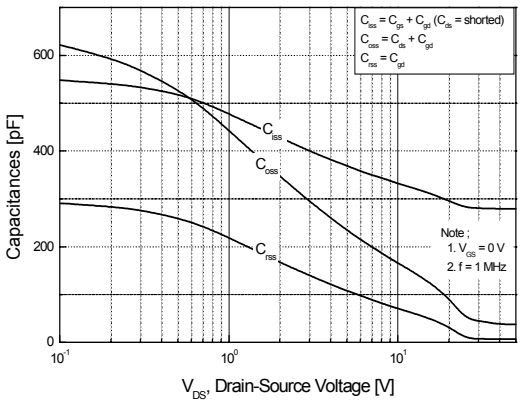
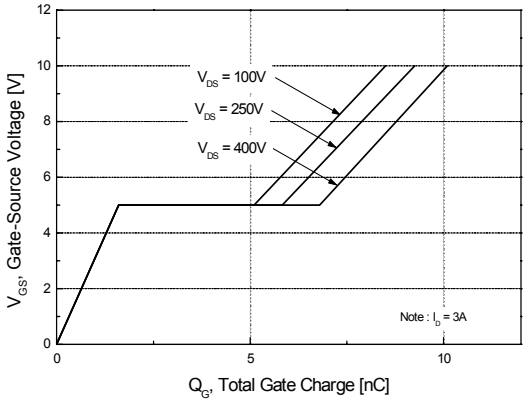


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

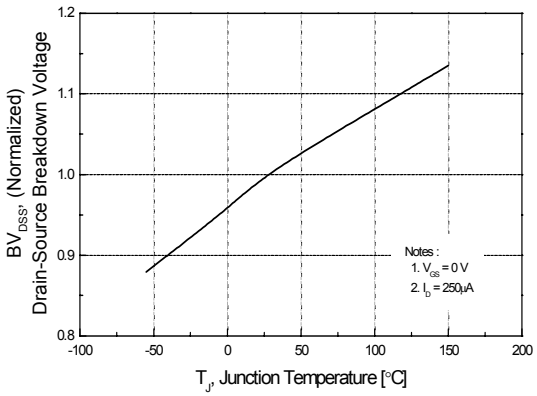


Figure 8. On-Resistance Variation vs. Temperature

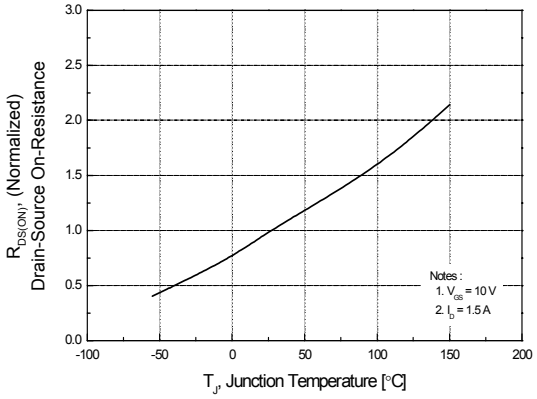


Figure 9-1. Maximum Safe Operating Area of FQP3N50C

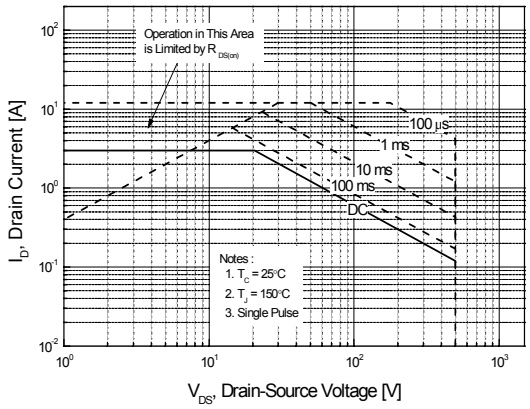


Figure 9-2. Maximum Safe Operating Area of FQPF3N50C

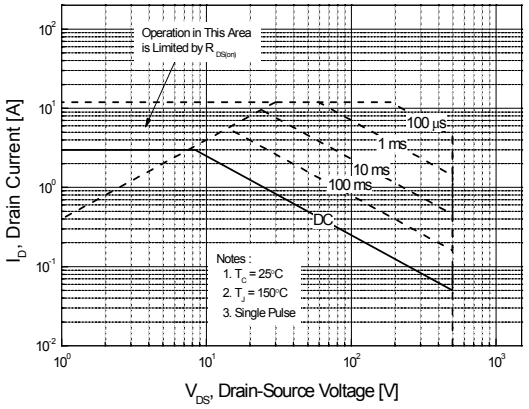
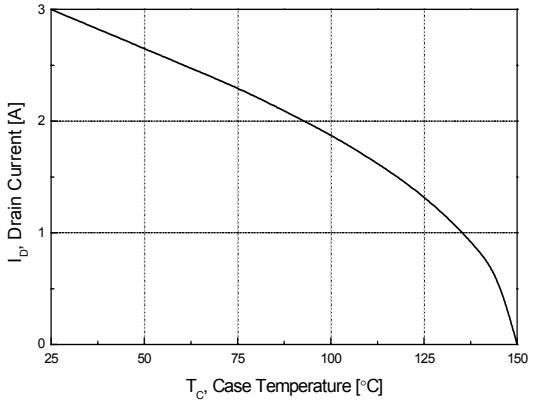


Figure10.MaximumDrainCurrent



Typical Performance Characteristics (Continued)

Figure 11-1. ransient Thermal Response Curve of FQP3N50C

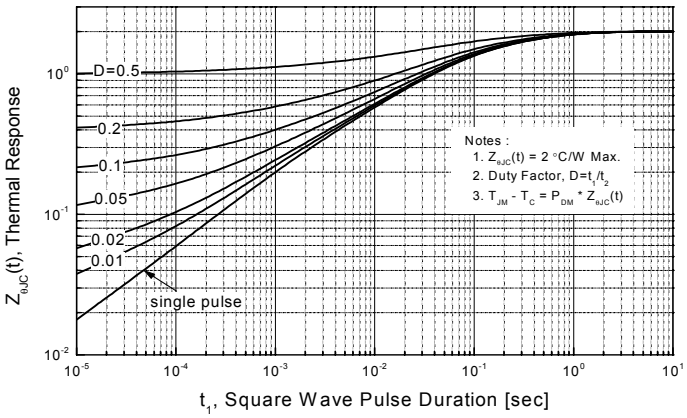
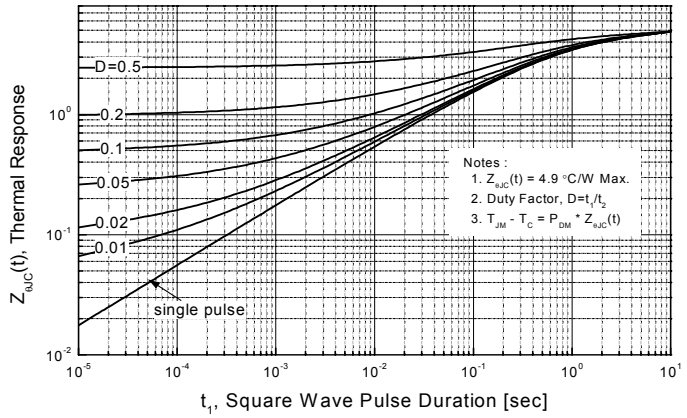
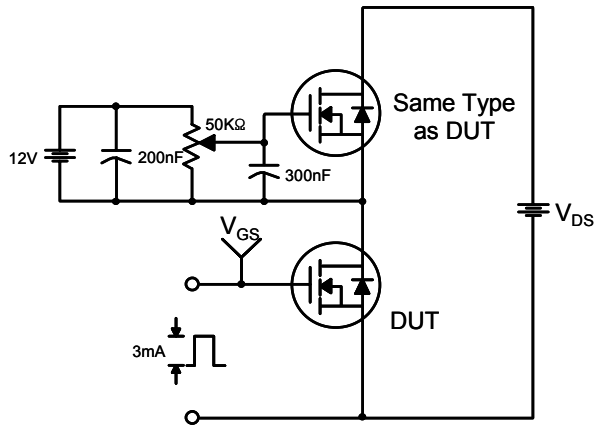
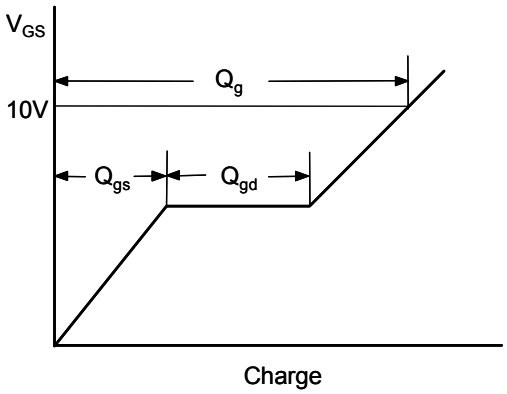


Figure 11-2. ransient Thermal Response Curve of FQPF3N50C

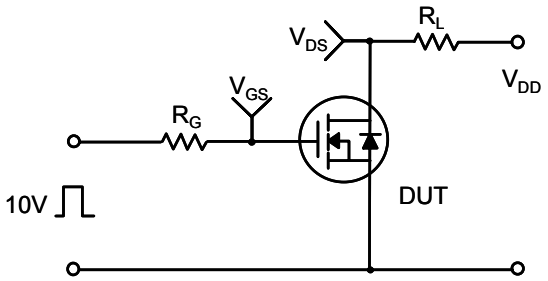


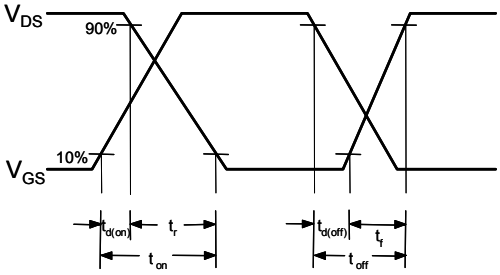
Gate Charge Test Circuit & Waveform



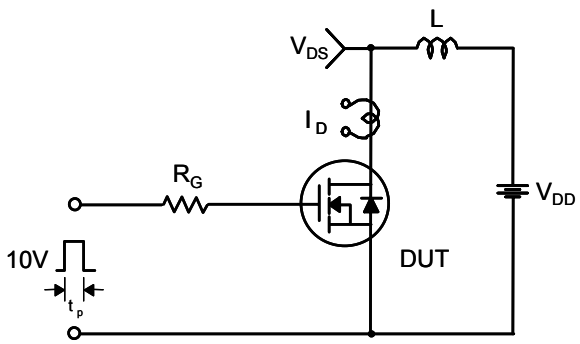


Resistive Switching Test Circuit & Waveforms

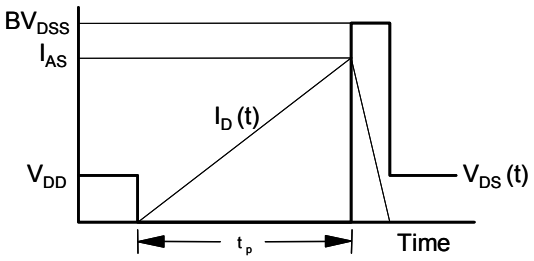




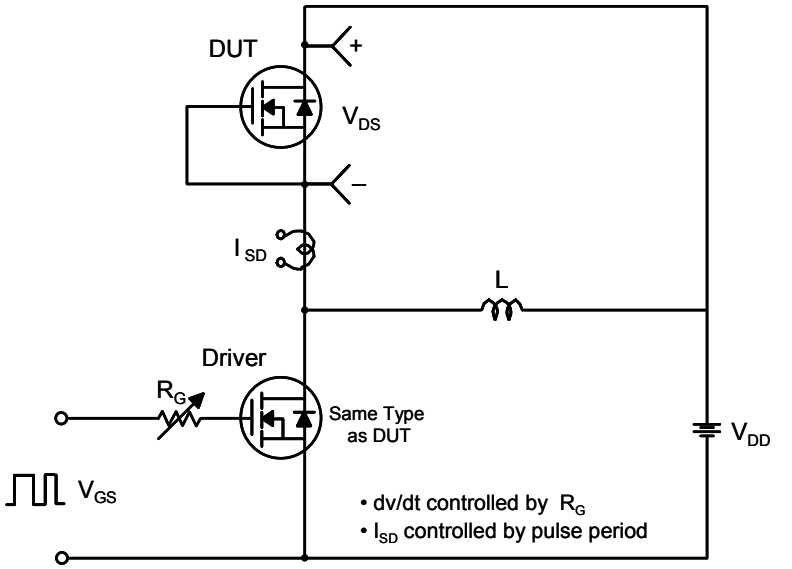
Unclamped Inductive Switching Test Circuit & Waveforms

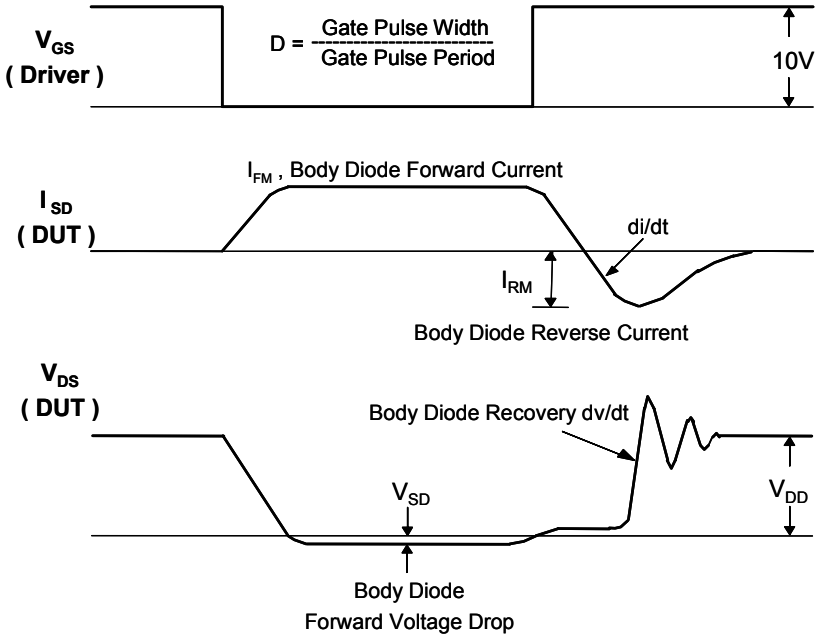


$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$



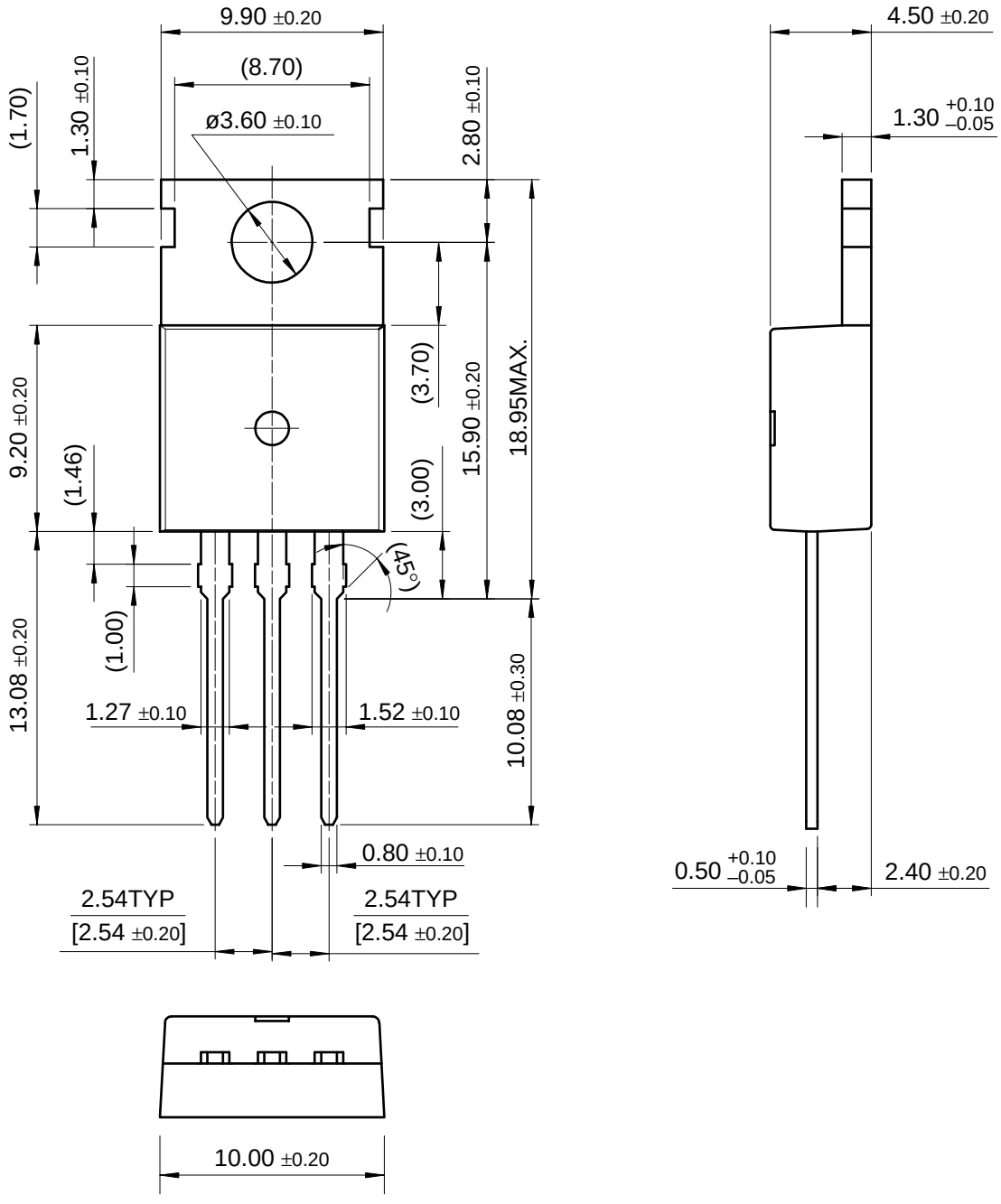
Peak Diode Recovery dv/dt Test Circuit & Waveforms





Mechanical Dimensions

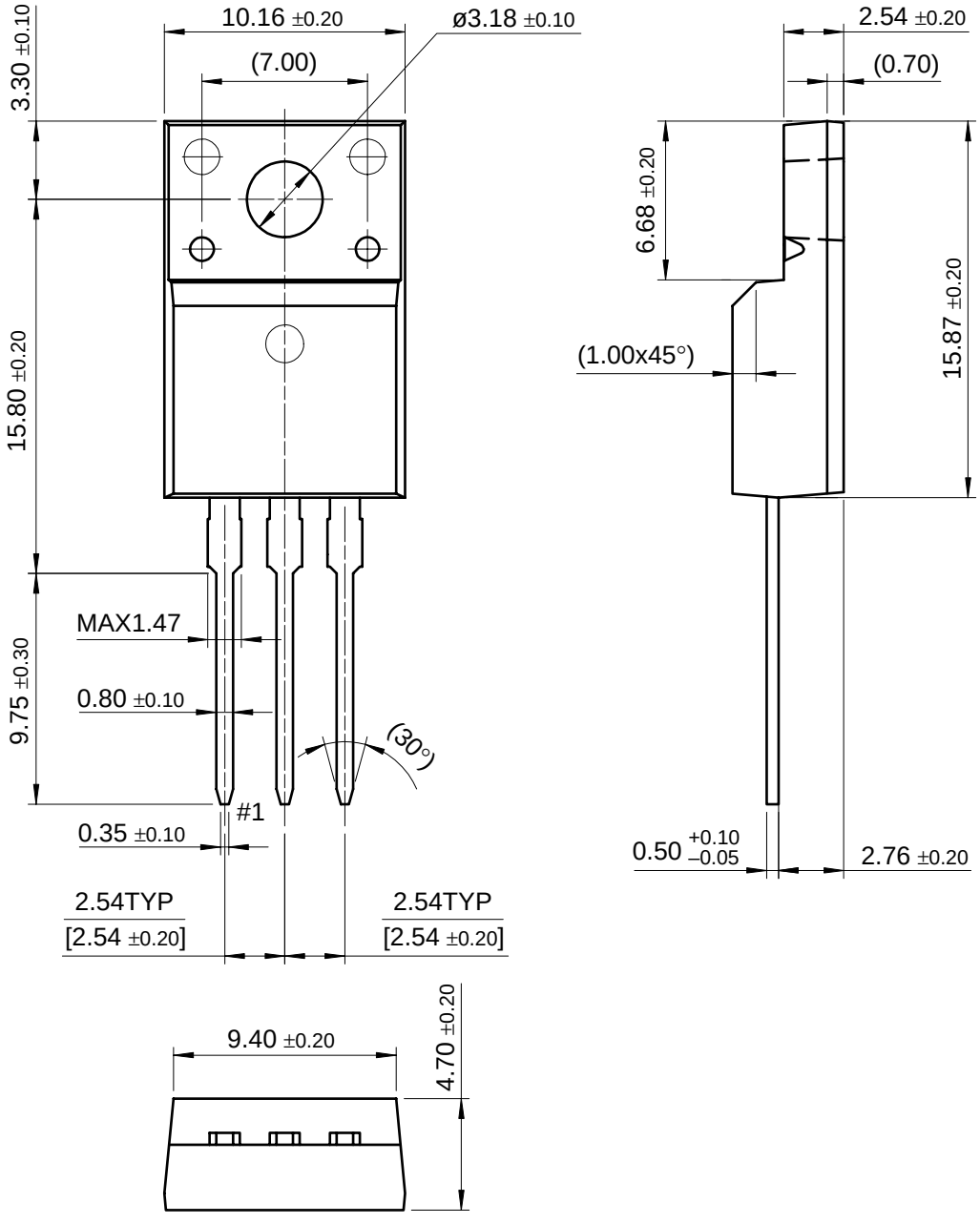
TO-220



Dimensions in Millimeters

Mechanical Dimensions (Continued)

TO-220F



Dimensions in Millimeters

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