



September 2007

QFET®

FQP12N60C / FQPF12N60C 600V N-Channel MOSFET

Features

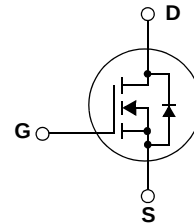
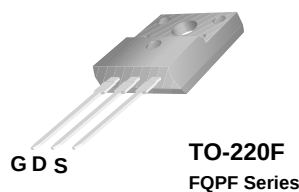
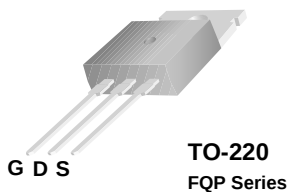
- 12A, 600V, $R_{DS(on)} = 0.65\Omega$ @ $V_{GS} = 10V$
- Low gate charge (typical 48 nC)
- Low C_{rss} (typical 21pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- RoHS compliant



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 ($T_C = 25^\circ\text{C}$) - Continuous ($T_C = 100^\circ\text{C}$)	12	12*	A
		7.4	7.4*	A
I_{DM}	Drain Current - Pulsed (Note 1)	48	48*	A
V_{GSS}	Gate-Source voltage	± 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°C	225	51	W
		1.78	0.41	W/ $^\circ\text{C}$
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150		$^\circ\text{C}$
T_L	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300		$^\circ\text{C}$

*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	$^\circ\text{C/W}$
$R_{\theta JS}$	Thermal Resistance, Case-to-Sink Typ.	0.5	--	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	62.5	$^\circ\text{C/W}$



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_C = 25°C unless otherwise noted

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

Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. L = 11mH, I_{AS} = 12A, V_{DD} = 50V, R_G = 25Ω, Starting T_J = 25°C
3. I_{SD} ≤ 12A, 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 Characteristics



Typical Performance Characteristics

Figure 1. On-Region Characteristics

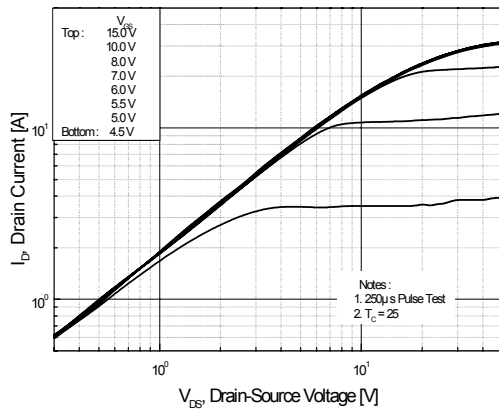


Figure 2. Transfer Characteristics

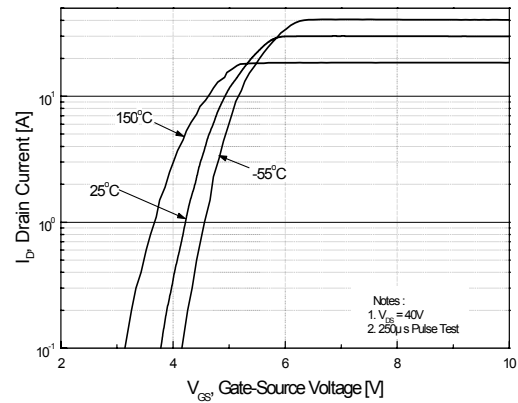


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

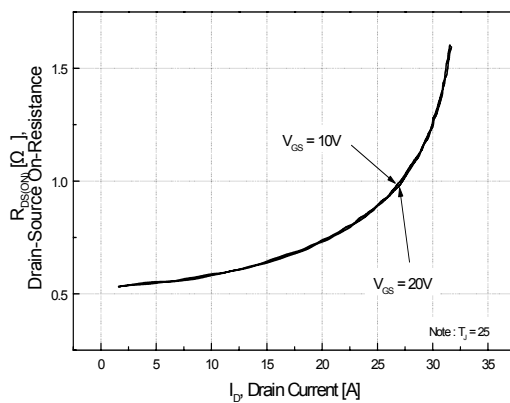


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

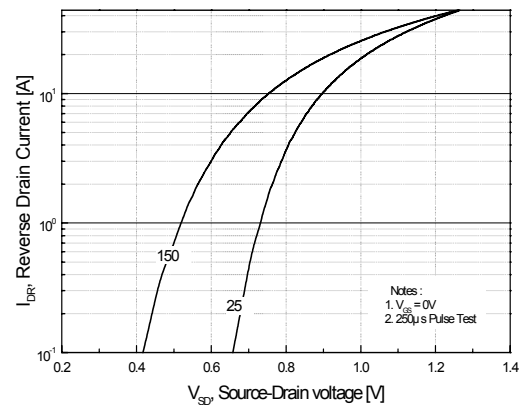


Figure 5. Capacitance Characteristics

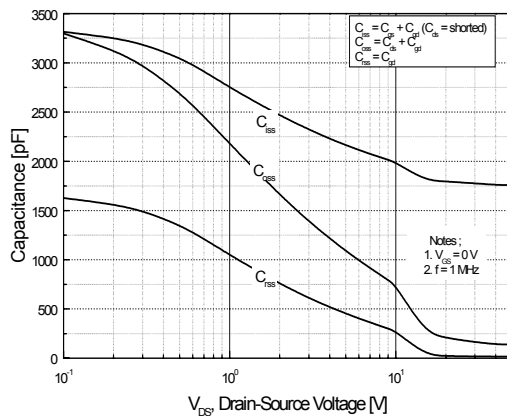
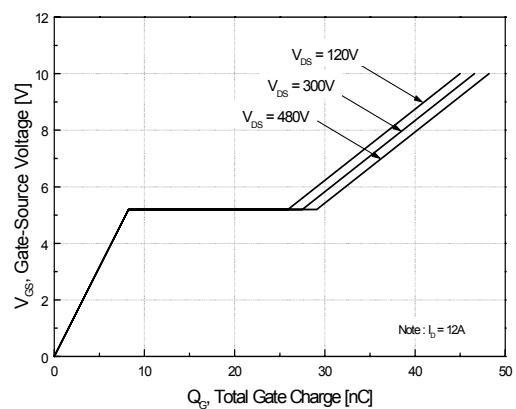


Figure 6. Gate Charge Characteristics





Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

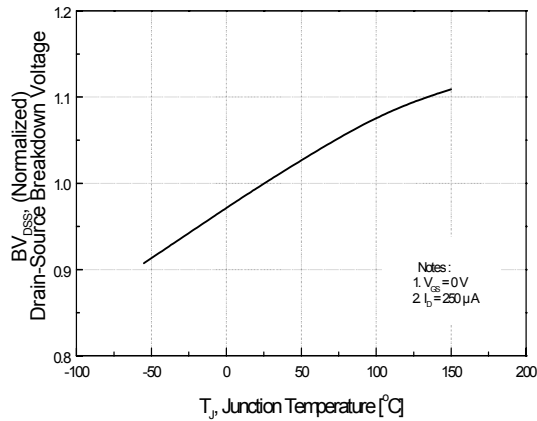


Figure 8. On-Resistance Variation vs. Temperature

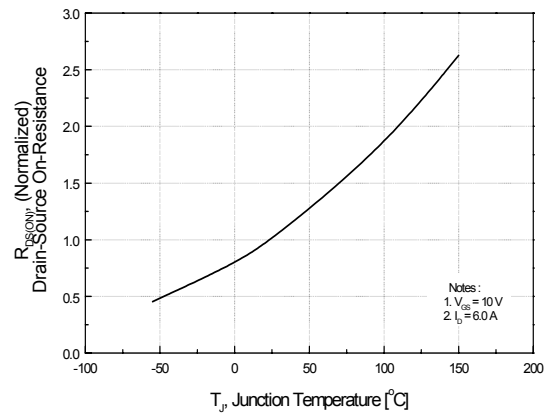


Figure 9-1. Maximum Safe Operating Area for FQP12N60C

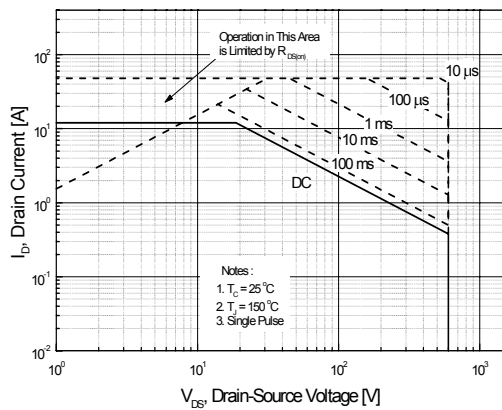


Figure 9-2. Maximum Safe Operating Area for FQPF12N60C

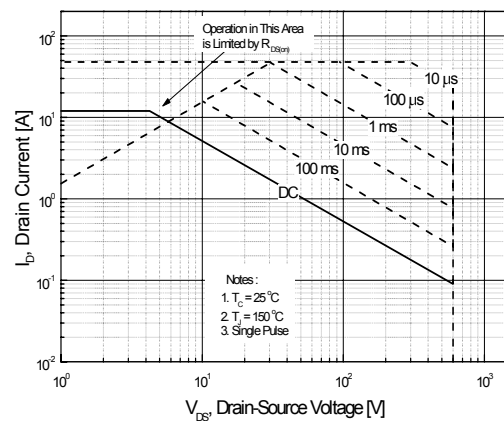
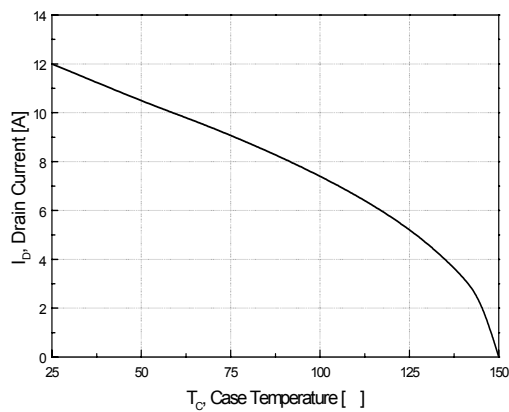


Figure 10. Maximum Drain Current vs. Case Temperature





Typical Performance Characteristics (Continued)

Figure 11-1. Transient Thermal Response Curve for FQP12N60C

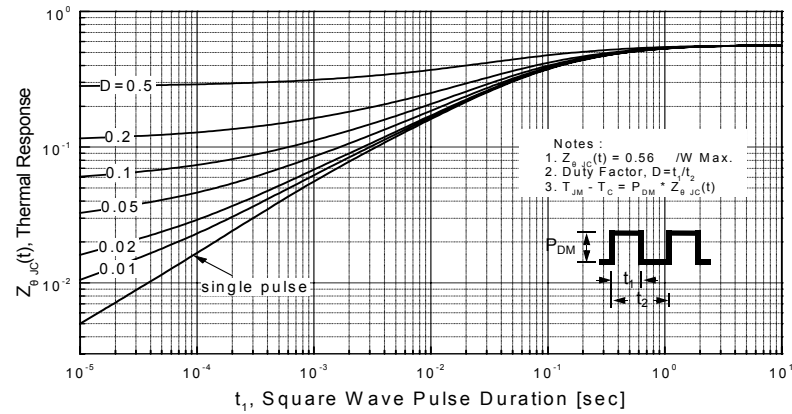
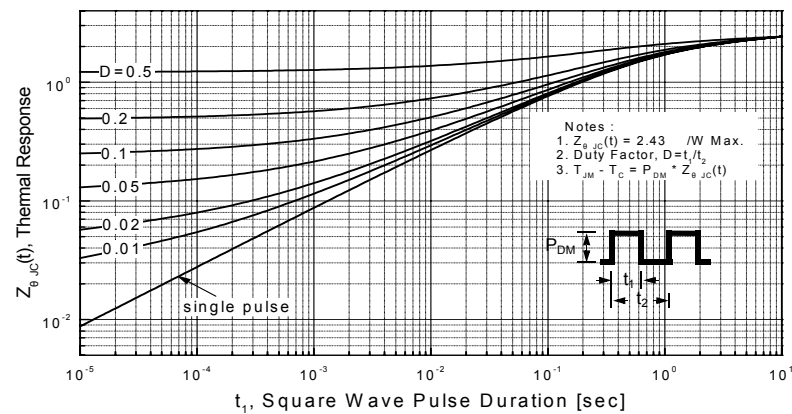
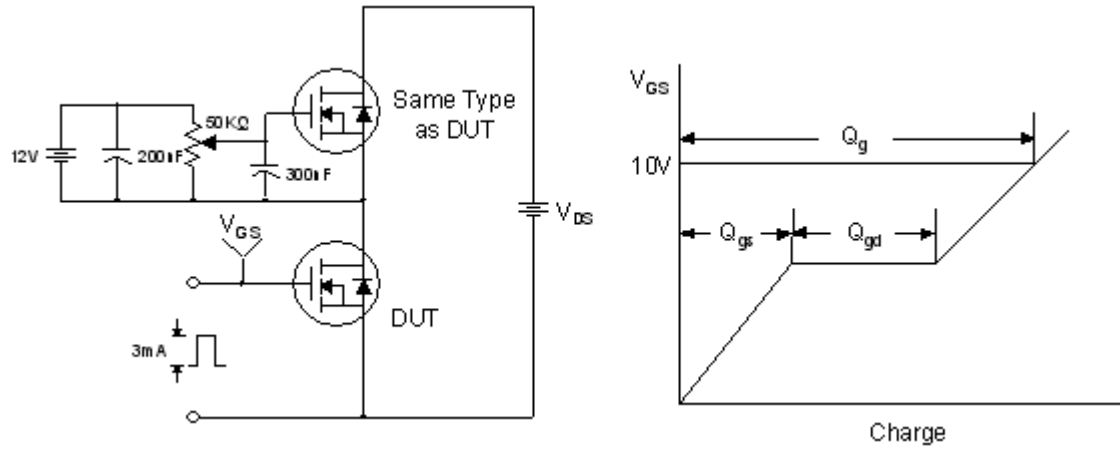


Figure 11-2. Transient Thermal Response Curve for FQPF12N60C

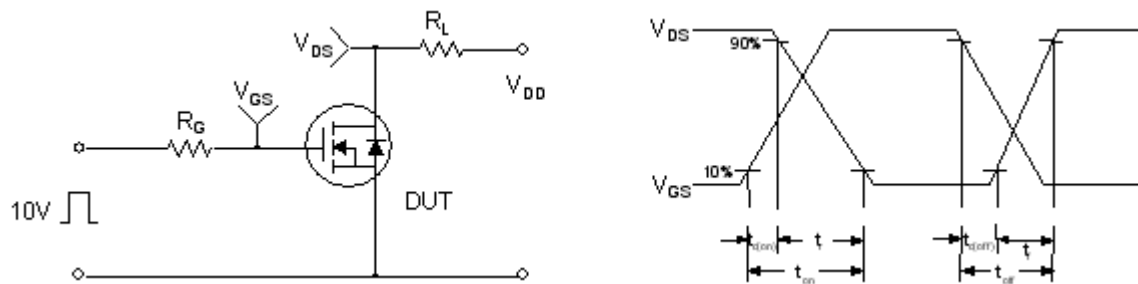




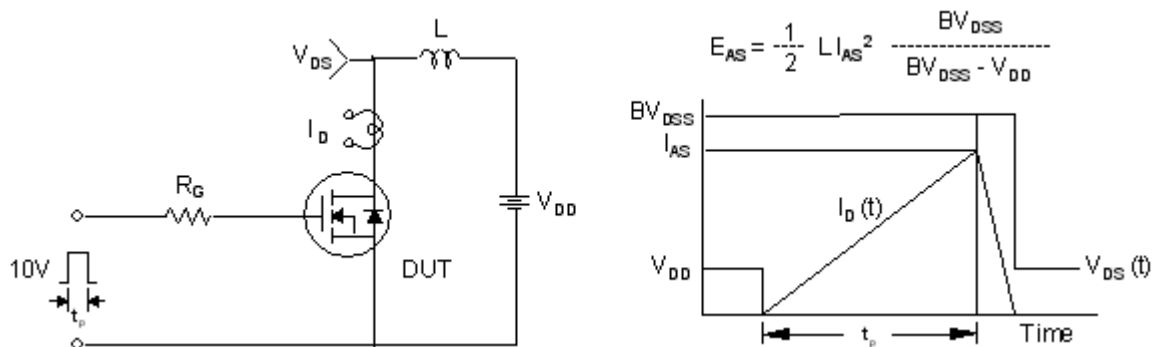
Gate Charge Test Circuit & Waveform



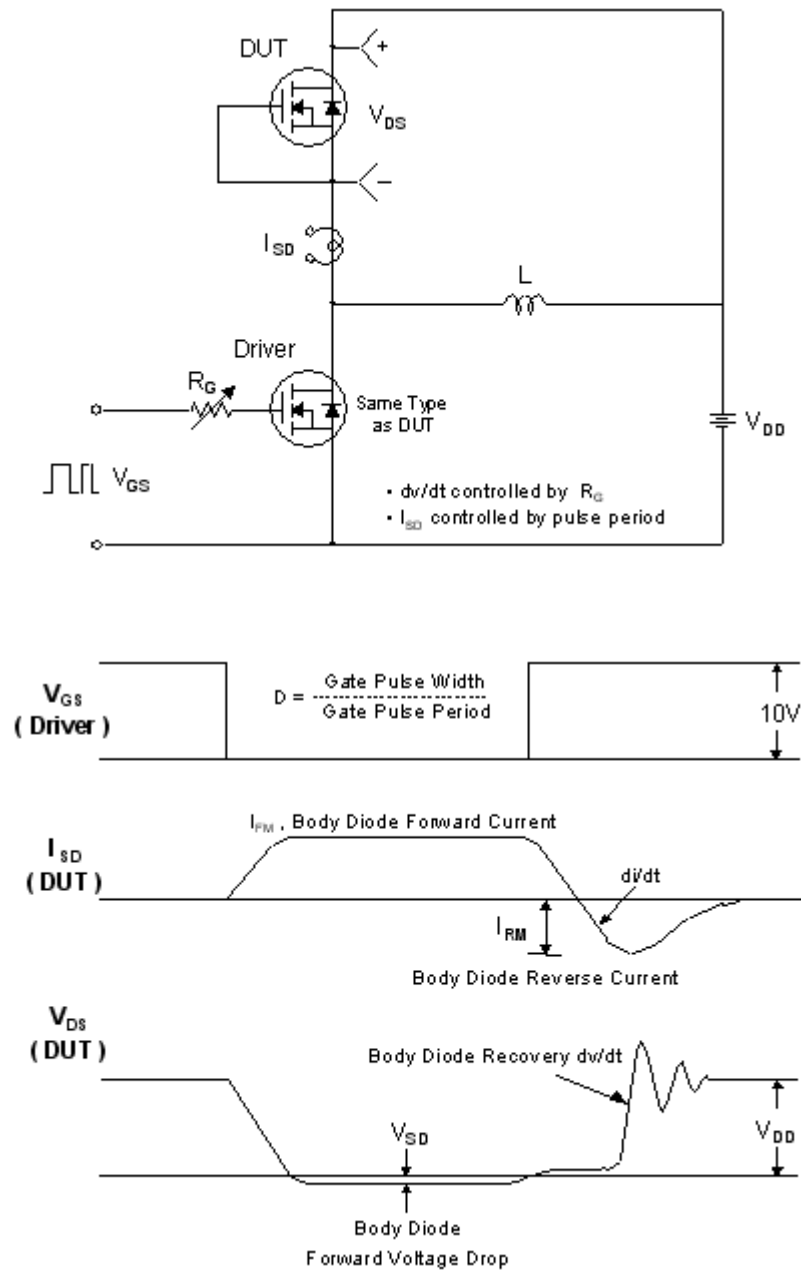
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms



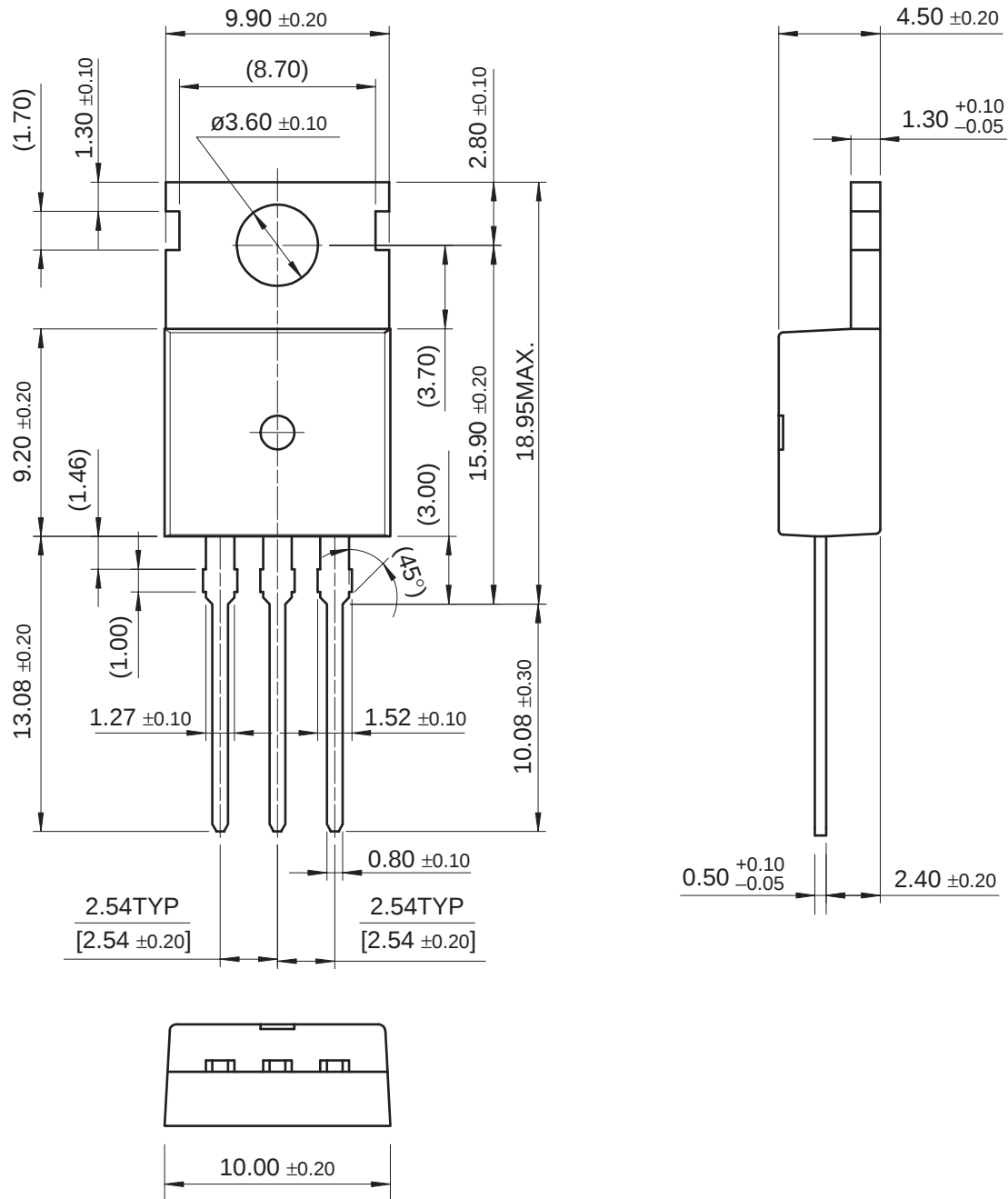
Peak Diode Recovery dv/dt Test Circuit & Waveforms





Mechanical Dimensions

TO-220

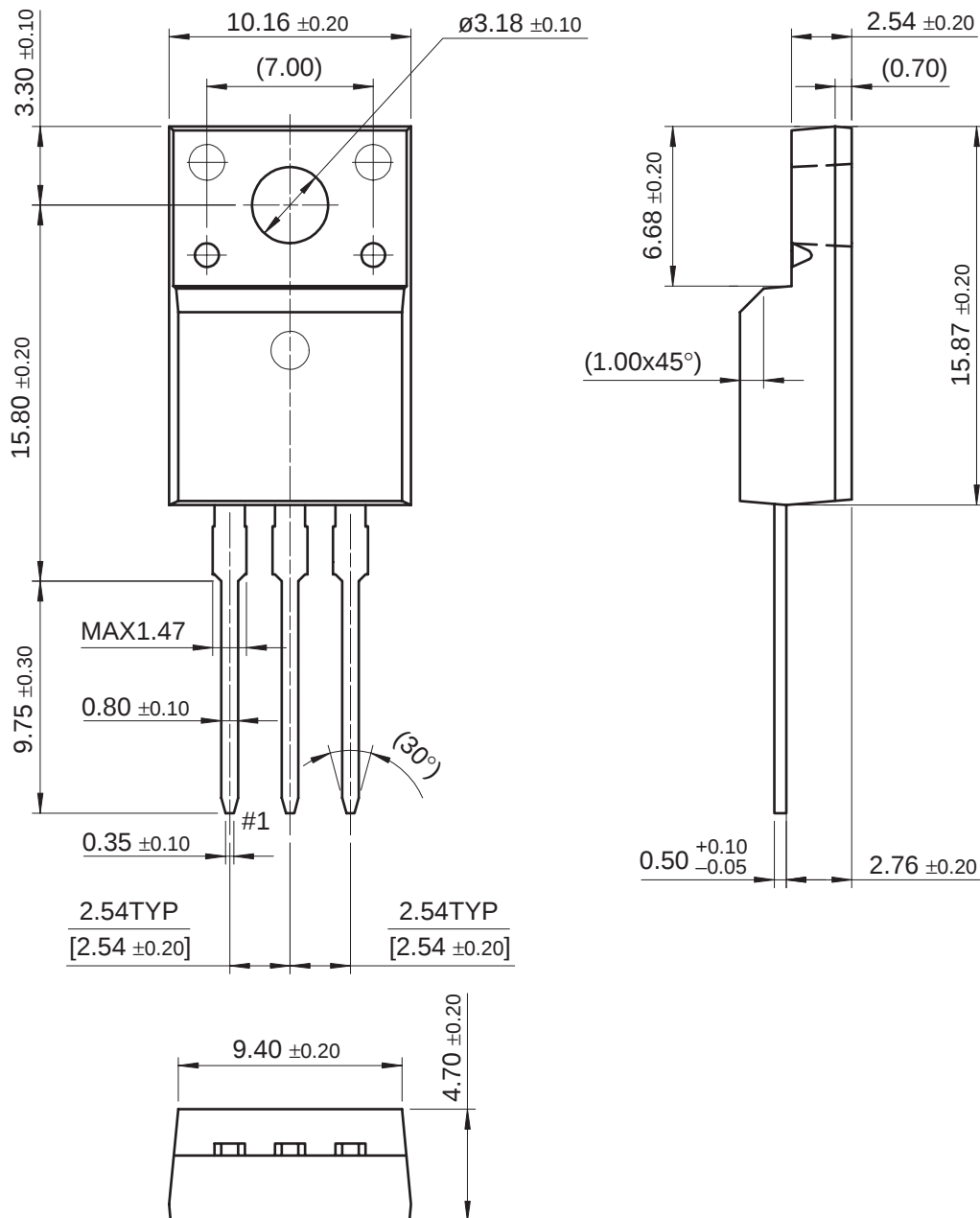


Dimensions in Millimeters



Mechanical Dimensions (Continued)

TO-220F



Dimensions in Millimeters



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