FQP12N60C/FQPF12N60C

600V N-Channel MOSFET

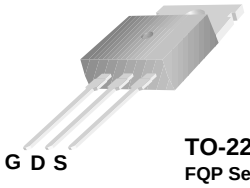
General Description

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

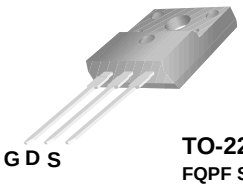
This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switch mode power supply.

Features

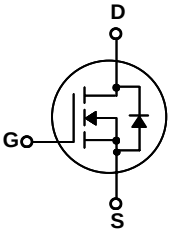
- 12A, 600V, $R_{DS(on)}$ = 0.65Ω @V_{GS} = 10 V
- Low gate charge (typical 48 nC)
- Low Crss (typical 21 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



TO-220
FQP Series



TO-220F
FQPF Series



Absolute Maximum Ratings

T_C = 25°C unless otherwise noted

Symbol	Parameter		FQP12N60C	FQPF12N60C	Units
V_{DSS}	Drain-Source Voltage		600		V
I_D	Drain Current - Continuous (T_C = 25°C)		12	12 *	A
	- Continuous (T_C = 100°C)		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°C)		225	51	W
	- Derate above 25°C		1.78	0.41	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	FQP12N60C	FQPF12N60C	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.56	2.43	°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

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
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250 μA, Referenced to 25°C	--	0.5	--	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 = 6 A	--	0.53	0.65	Ω
g_{FS}	Forward Transconductance	V_{DS} = 40 V, I_D = 6 A (Note 4)	--	13	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz	--	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} = 300 V, I_D = 12 A, R_G = 25 Ω (Note 4, 5)	--	30	70	ns
t_r	Turn-On Rise Time		--	85	180	ns
$t_{d(off)}$	Turn-Off Delay Time		--	155	120	ns
t_f	Turn-Off Fall Time		--	90	190	ns
Q_g	Total Gate Charge	V_{DS} = 400 V, I_D = 12 A, V_{GS} = 10 V (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} = 0 V, I_S = 12 A	--	--	1.4	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = 12 A, dI_F / dt = 100 A/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 = 25 Ω, 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

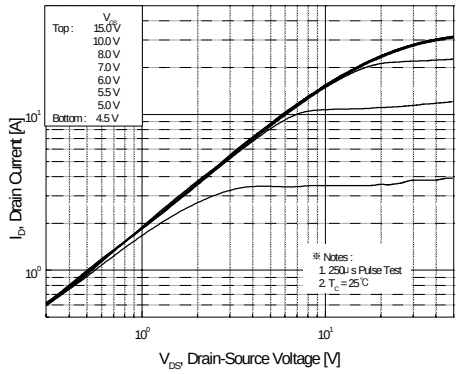


Figure 1. On-Region Characteristics

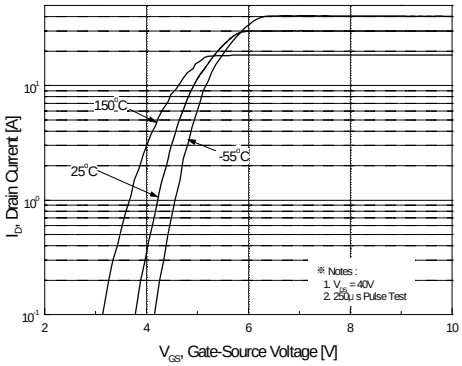


Figure 2. Transfer Characteristics

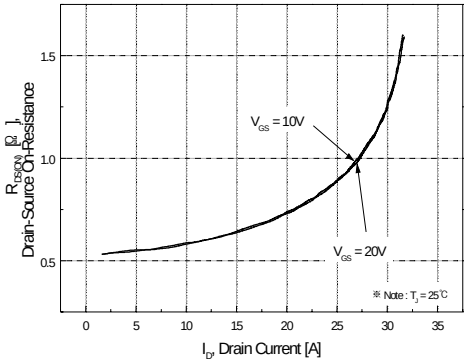


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

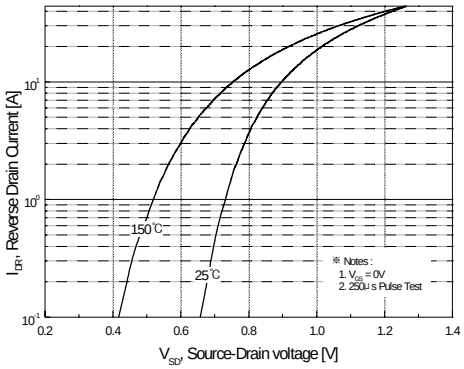


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

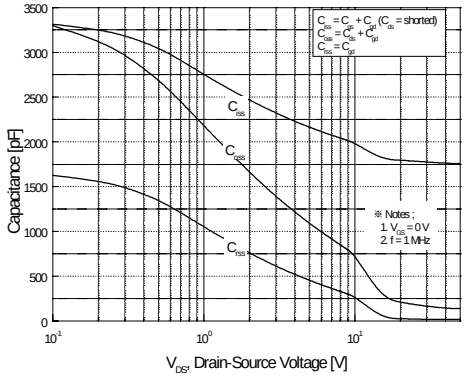


Figure 5. Capacitance Characteristics

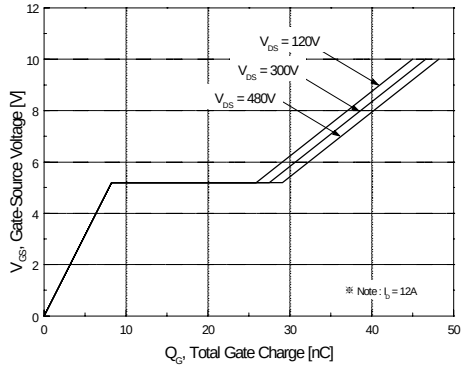


Figure 6. Gate Charge Characteristics

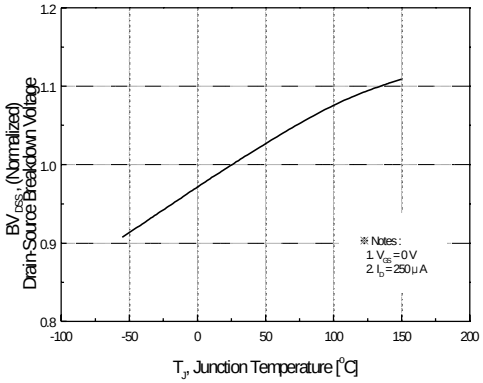


Figure 7. Breakdown Voltage Variation vs Temperature

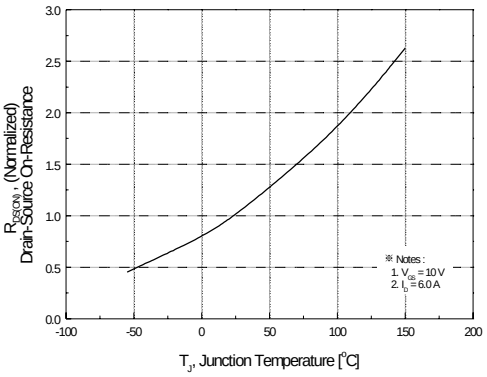


Figure 8. On-Resistance Variation vs Temperature

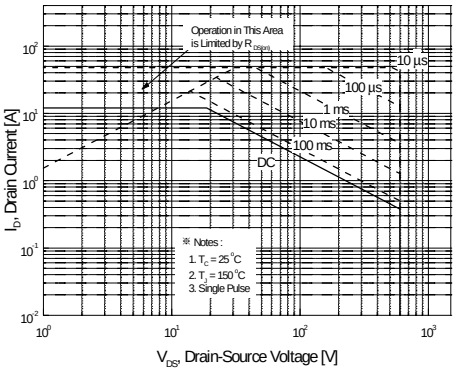


Figure 9-1. Maximum Safe Operating Area for FQP12N60C

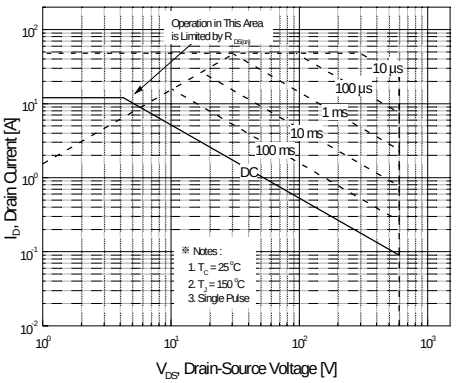


Figure 9-2. Maximum Safe Operating Area for FQPF12N60C

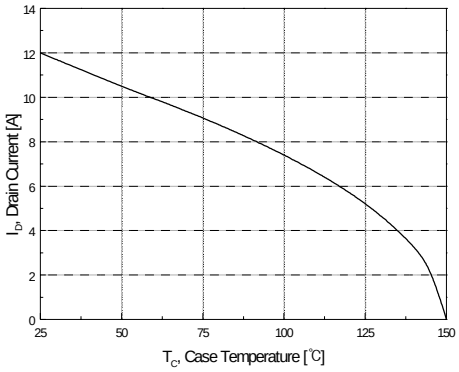


Figure 10. Maximum Drain Current vs Case Temperature

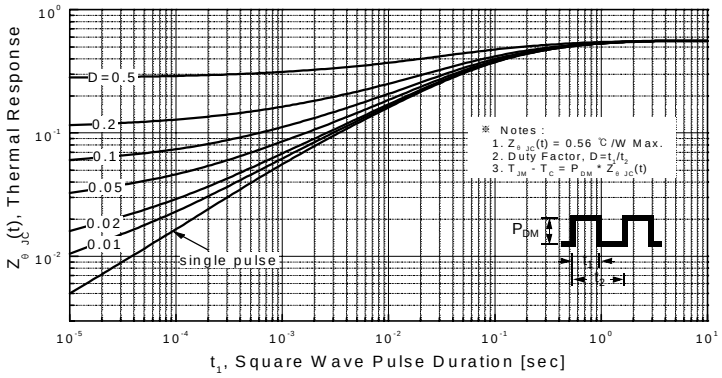


Figure 11-1. Transient Thermal Response Curve for FQP12N60C

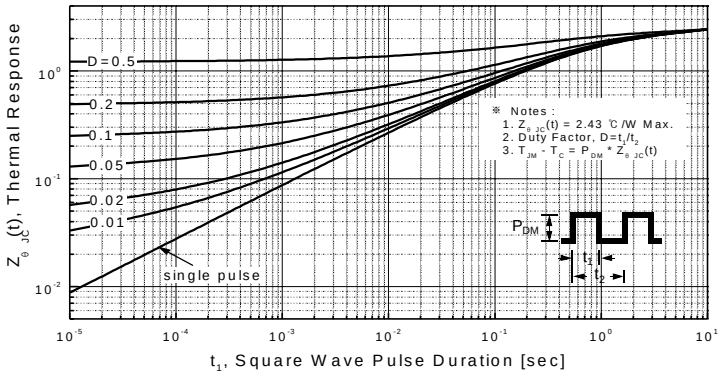
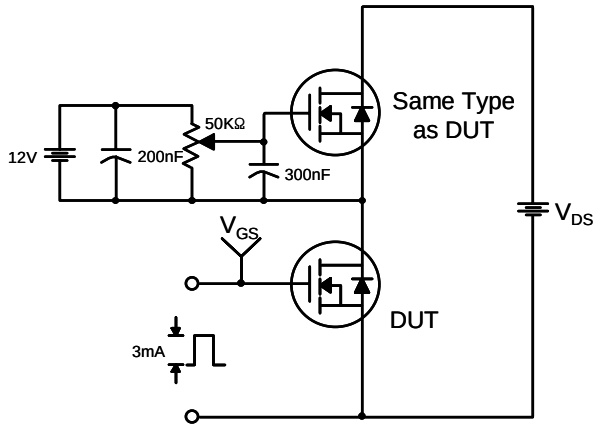
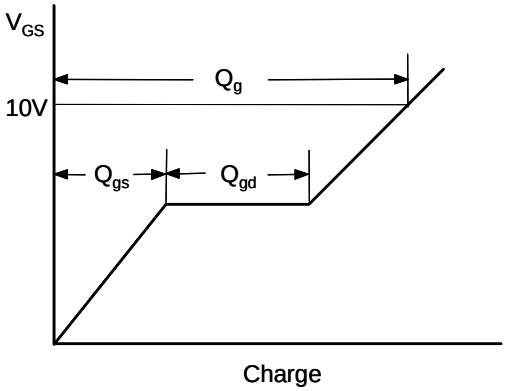
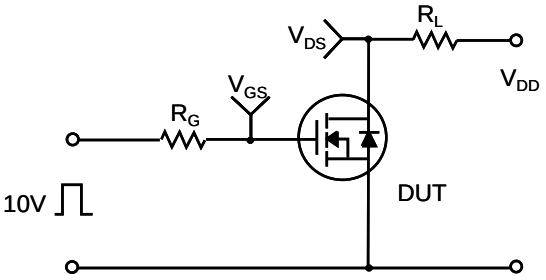


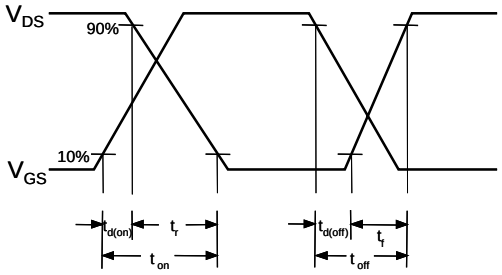
Figure 11-2. Transient Thermal Response Curve for FQPF12N60C



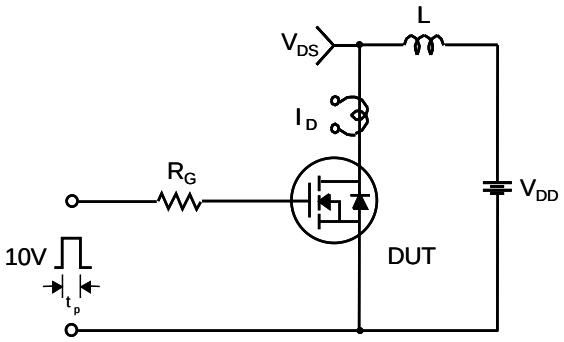


Resistive Switching Test Circuit & Waveforms

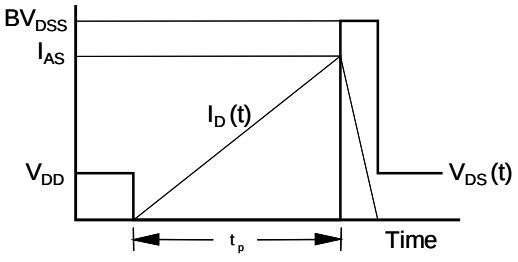


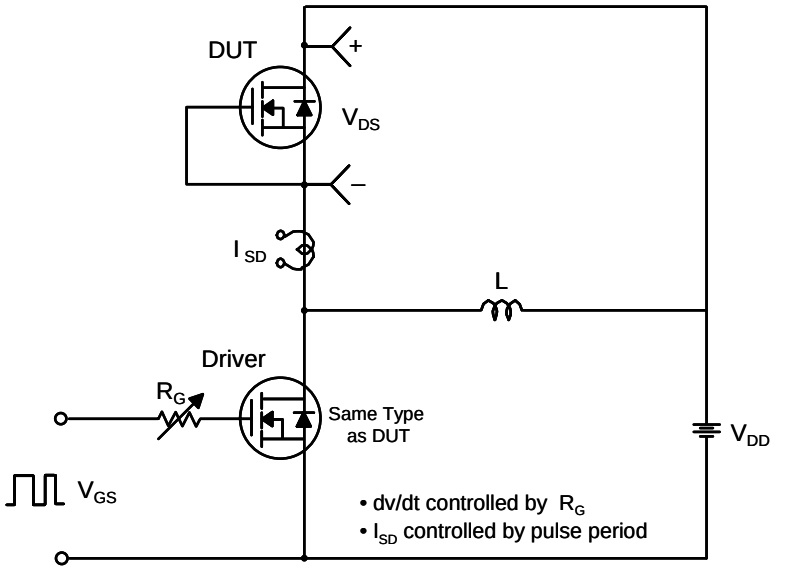


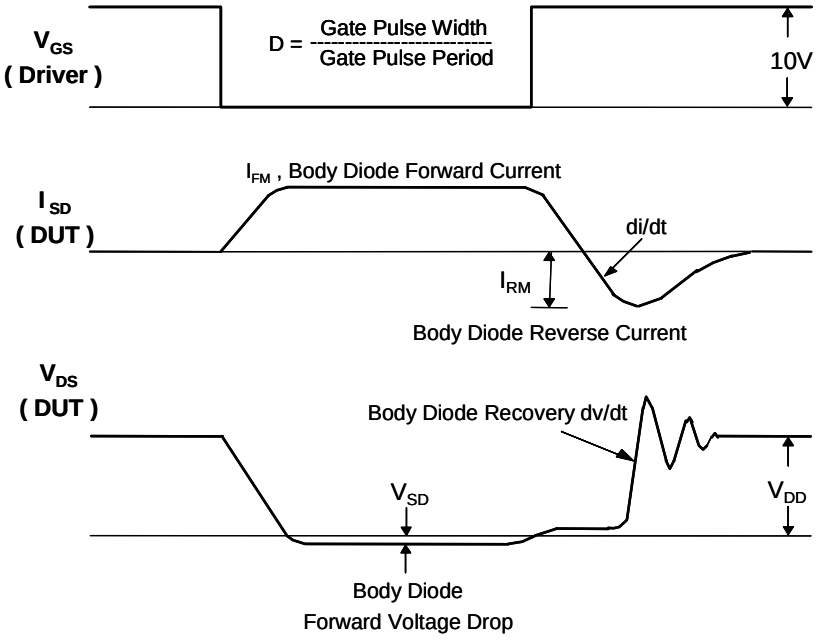
Unclamped Inductive Switching Test Circuit & Waveforms



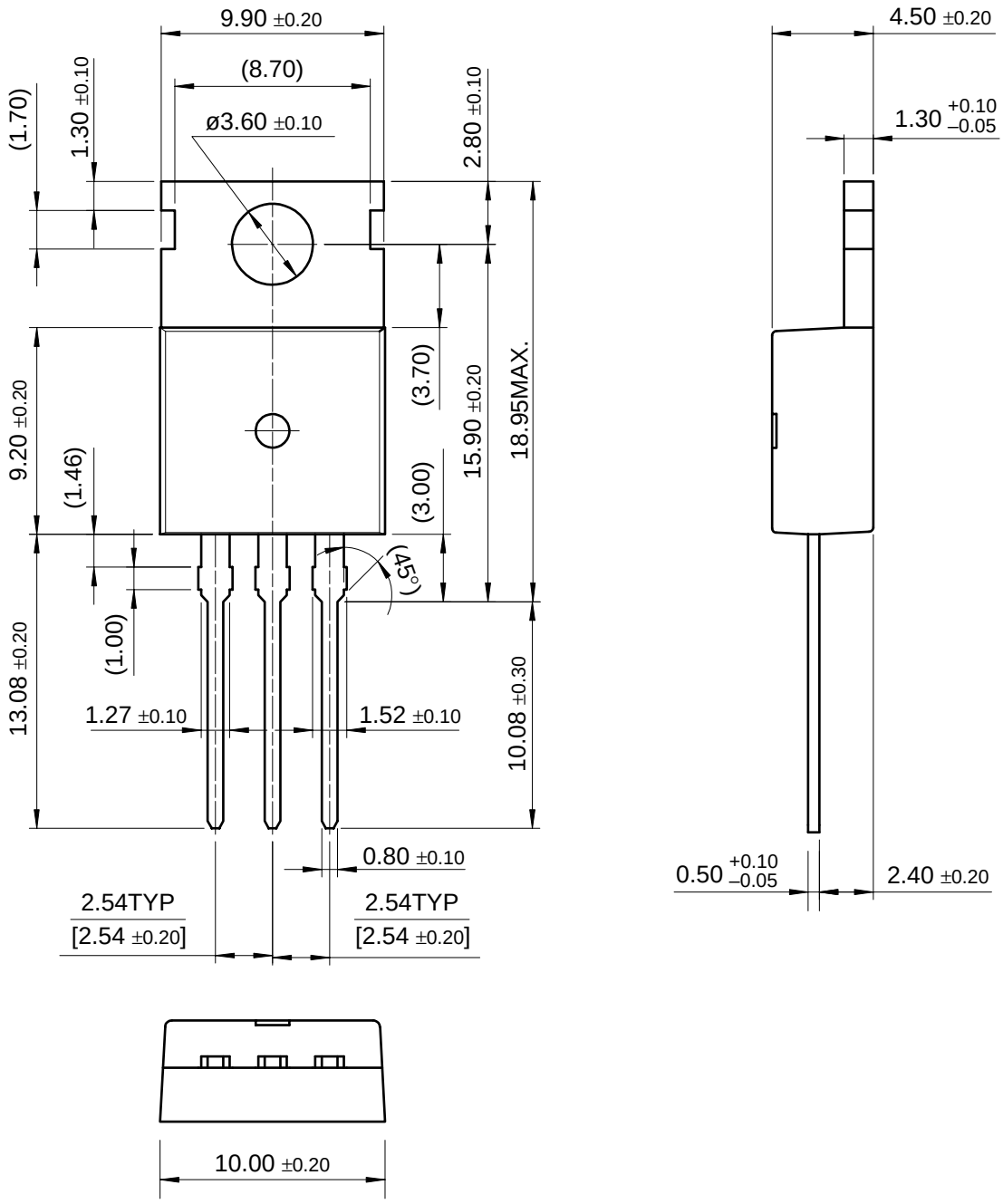
$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$



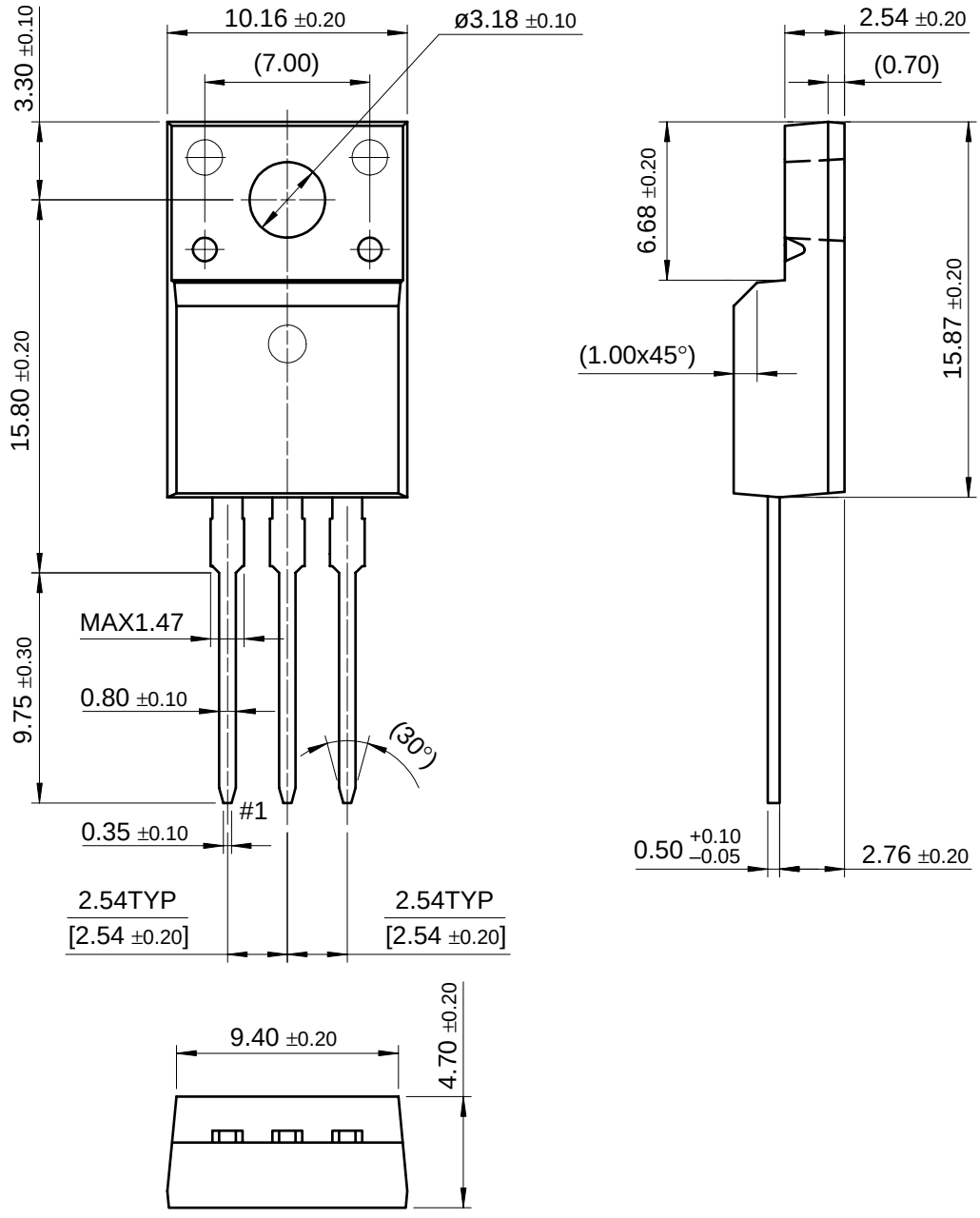

DUT
+
V_{DS}
–
I_{SD}
L
Driver
R_G
Same Type
as DUT
V_{DD}
V_{GS}
• dv/dt controlled by R_G
• I_{SD} controlled by pulse period


V_{GS}
(Driver)
D = Gate Pulse Width / Gate Pulse Period
10V
I_{FM} , Body Diode Forward Current
I_{SD}
(DUT)
di/dt
I_{RM}
Body Diode Reverse Current
V_{DS}
(DUT)
Body Diode Recovery dv/dt
V_{SD}
V_{DD}
Body Diode
Forward Voltage Drop

TO-220


9.90 ±0.20
(8.70)
ø3.60 ±0.10
(1.70)
1.30 ±0.10
2.80 ±0.10
(3.70)
15.90 ±0.20
18.95MAX.
9.20 ±0.20
(1.46)
(3.00)
45°
(1.00)
13.08 ±0.20
1.27 ±0.10
1.52 ±0.10
10.08 ±0.30
0.80 ±0.10
2.54TYP
[2.54 ±0.20]
2.54TYP
[2.54 ±0.20]
10.00 ±0.20
4.50 ±0.20
1.30 +0.10 −0.05
0.50 +0.10 −0.05
2.40 ±0.20

TO-220F


10.16 ±0.20
ø3.18 ±0.10
(7.00)
3.30 ±0.10
15.80 ±0.20
9.75 ±0.30
MAX1.47
0.80 ±0.10
(30°)
#1
0.35 ±0.10
2.54TYP
[2.54 ±0.20]
2.54TYP
[2.54 ±0.20]
2.54 ±0.20
(0.70)
6.68 ±0.20
15.87 ±0.20
(1.00x45°)
0.50 +0.10 −0.05
2.76 ±0.20
9.40 ±0.20
4.70 ±0.20