FAIRCHILD
SEMICONDUCTOR®

May 2012

UniFET™

FDP10N60ZU / FDPF10N60ZUT

N-Channel MOSFET, FRFET

### 600V, 9A, 0.8Ω

Features

- $R_{DS(on)} = 0.65\Omega$ (Typ.)@ $V_{GS} = 10V$, $I_D = 4.5A$

- Low gate charge (Typ. 31nC)

- Low C_{rss} (Typ. 15pF)

- 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 advance 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 switching mode power supplies and active power factor correction.

TO-220
FDP Series

G D S

TO-220F
FDPF Series

G D S
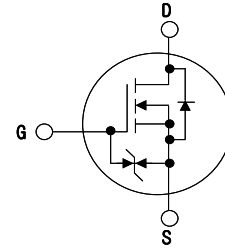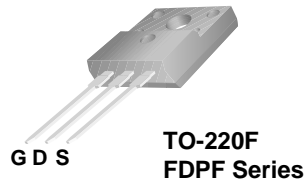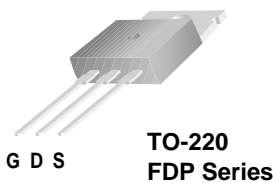
MOSFET Maximum Ratings $T_C = 25^oC$ unless otherwise noted*

Symbol	Parameter			FDP10N60ZU	FDPF10N60ZUT	Units
V_{DSS}	Drain to Source Voltage			600		V
V_{GSS}	Gate to Source Voltage			±30		V
I_D	Drain Current	-Continuous ($T_C = 25^oC$)		9	9*	A
		-Continuous ($T_C = 100^oC$)		5.4	5.4*	
I_{DM}	Drain Current	- Pulsed	(Note 1)	36	36*	A
E_{AS}	Single Pulsed Avalanche Energy		(Note 2)	100		mJ
I_{AR}	Avalanche Current		(Note 1)	9		A
E_{AR}	Repetitive Avalanche Energy		(Note 1)	18		mJ
dv/dt	Peak Diode Recovery dv/dt		(Note 3)	20		V/ns
P_D	Power Dissipation	($T_C = 25^oC$)		180	42	W
		- Derate above 25^oC		1.45	0.3	W/^oC
T_J, T_{STG}	Operating and Storage Temperature Range			-55 to +150		^oC
T_L	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds			300		^oC

*Drain current limited by maximum junction temperature

Thermal Characteristics

Symbol	Parameter	FDP10N60ZU	FDPF10N60ZUT	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	0.7	3.0	^oC/W
$R_{\theta CS}$	Thermal Resistance, Junction to Ambient	0.5	-	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	62.5	62.5	

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDP10N60ZU	FDP10N60ZU	TO-220	-	-	50
FDPF10N60ZUT	FDPF10N60ZUT	TO-220F	-	-	50

Electrical Characteristics $T_C = 25^oC$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units

Off Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
BV_{DSS}	Drain to Source Breakdown Voltage	$I_D = 250\mu A$, $V_{GS} = 0V$, $T_J = 25^oC$	600	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu A$, Referenced to 25^oC	-	0.8	-	$V/^oC$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 600V$, $V_{GS} = 0V$	-	-	25	μA
		$V_{DS} = 480V$, $T_C = 125^oC$	-	-	250	
I_{GSS}	Gate to Body Leakage Current	$V_{GS} = \pm30V$, $V_{DS} = 0V$	-	-	±10	μA

On Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 250\mu A$	3.0	-	5.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10V$, $I_D = 4.5A$	-	0.65	0.8	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 40V$, $I_D = 4.5A$	-	12.5	-	S

Dynamic Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
C_{iss}	Input Capacitance	$V_{DS} = 25V$, $V_{GS} = 0V$ f = 1MHz	-	1490	1980	pF
C_{oss}	Output Capacitance		-	230	240	pF
C_{rss}	Reverse Transfer Capacitance		-	15	25	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 480V$, $I_D = 10A$ $V_{GS} = 10V$ (Note 4)	-	31	40	nC
Q_{gs}	Gate to Source Gate Charge		-	8	-	nC
Q_{gd}	Gate to Drain "Miller" Charge		-	12	-	nC

Switching Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 300V$, $I_D = 10A$ $R_G = 25\Omega$, $V_{GS} = 10V$ (Note 4)	-	25	60	ns
t_r	Turn-On Rise Time		-	40	90	ns
$t_{d(off)}$	Turn-Off Delay Time		-	95	200	ns
t_f	Turn-Off Fall Time		-	60	130	ns

Drain-Source Diode Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
I_S	Maximum Continuous Drain to Source Diode Forward Current		-	-	9	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	36	A
V_{SD}	Drain to Source Diode Forward Voltage	$V_{GS} = 0V$, $I_{SD} = 10A$	-	-	1.6	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0V$, $I_{SD} = 10A$ $dI_F/dt = 100A/\mu s$	-	45	-	ns
Q_{rr}	Reverse Recovery Charge		-	52	-	nC

Notes:
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $L = 2mH$, $I_{AS} = 10A$, $V_{DD} = 50V$, $R_G = 25\Omega$, Starting $T_J = 25°C$
3. $I_{SD} \le 10A$, $di/dt \le 200A/\mu s$, $V_{DD} \le BV_{DSS}$, Starting $T_J = 25°C$
4. Essentially Independent of Operating Temperature Typical Characteristics

Typical Performance Characteristics

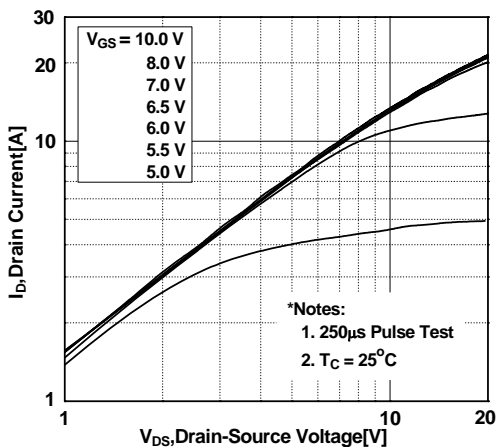### Figure 1. On-Region Characteristics

V_{GS} = 10.0 V
8.0 V
7.0 V
6.5 V
6.0 V
5.5 V
5.0 V

*Notes:
1. 250μs Pulse Test
2. T_C = 25°C

I_D, Drain Current[A] vs V_{DS}, Drain-Source Voltage[V]

Figure 2. Transfer Characteristics

25°C
150°C

* Notes :
1. V_{DS} = 20V
2. 250μs Pulse Test

I_D, Drain Current[A] vs V_{GS}, Gate-Source Voltage[V]
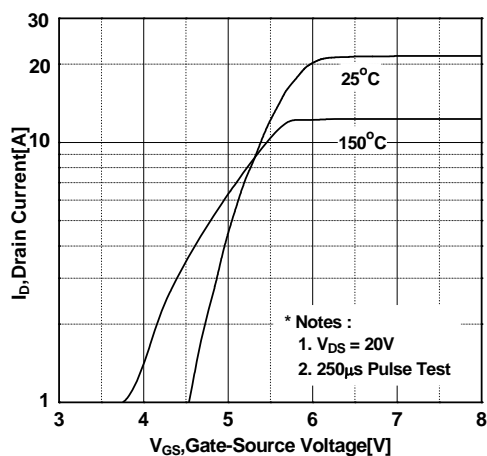
Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

V_{GS} = 10V
V_{GS} = 20V

* Note : T_J = 25°C

$R_{DS(on)}$ [Ω], Drain-Source On-Resistance vs I_D, Drain Current [A]
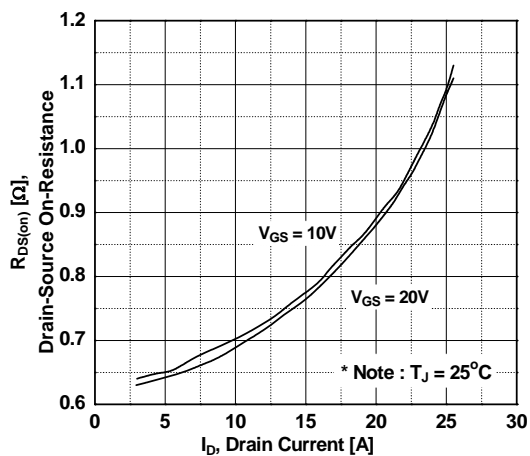
Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

150°C
25°C

Notes:
1. V_{GS} = 0V
2. 250μs Pulse Test

I_S, Reverse Drain Current [A] vs V_{SD}, Body Diode Forward Voltage [V]
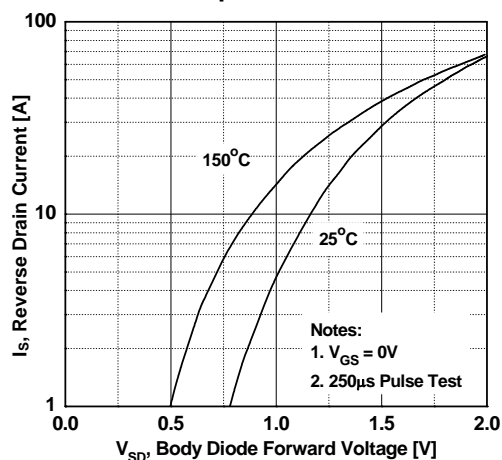
Figure 5. Capacitance Characteristics

C_{oss}
C_{iss}
C_{rss}

$C_{iss} = C_{gs} + C_{gd}$ (C_{ds} = shorted)
$C_{oss} = C_{ds} + C_{gd}$
$C_{rss} = C_{gd}$

* Note:
1. V_{GS} = 0V
2. f = 1MHz

Capacitances [pF] vs V_{DS}, Drain-Source Voltage [V]
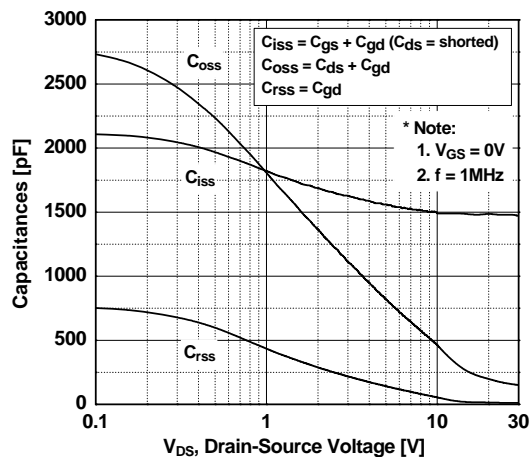
Figure 6. Gate Charge Characteristics

V_{DS} = 150V
V_{DS} = 380V
V_{DS} = 400V

* Note : I_D = 10A

V_{GS}, Gate-Source Voltage [V] vs Q_g, Total Gate Charge [nC]
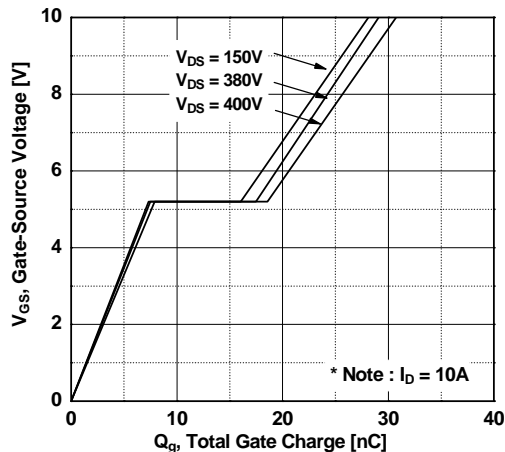
Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperaure

* Notes :
1. V_{GS} = 0V
2. I_D = 250µA
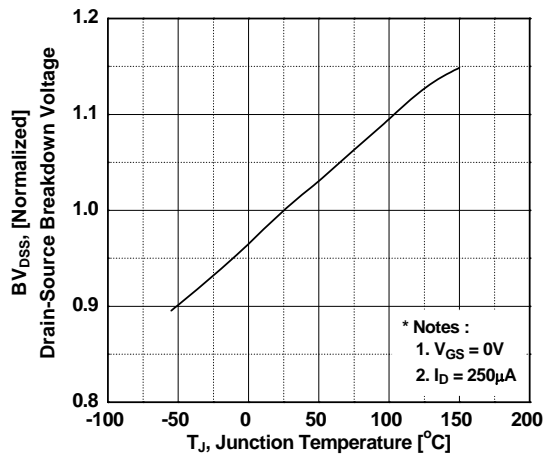
Figure 8. Maximum Safe Operating Area - FDPF10N60ZUT

Operation in This Area is Limited by $R_{DS(on)}$
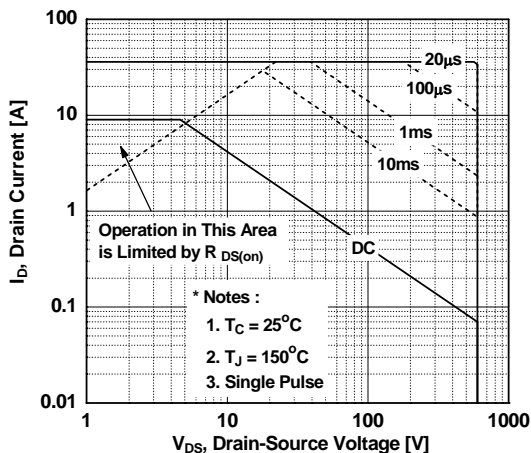
* Notes :
1. T_C = 25°C
2. T_J = 150°C
3. Single Pulse

Figure 9. Maximum Drain Current vs. Case Temperature
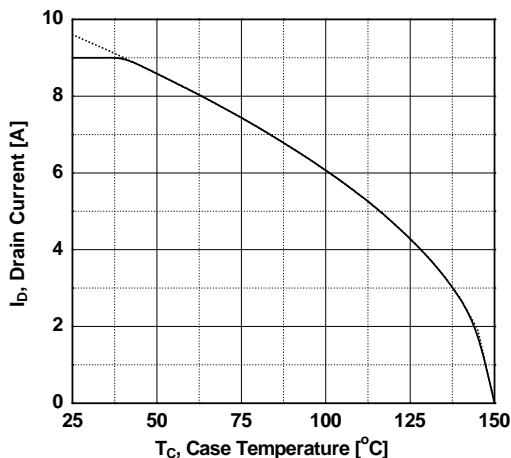
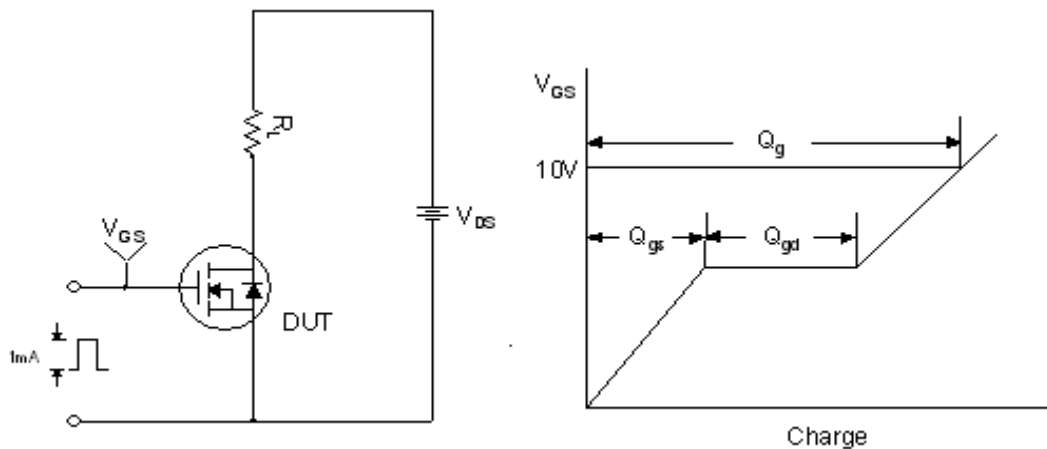**Figure 10. Transient Thermal Response Curve - FDPF10N60ZUT**

* Notes :
1. $Z_{\theta JC}(t)$ = 3.0°C/W Max.
2. Duty Factor, D=t_1/t_2
3. $T_{JM} - T_C = P_{DM} * Z_{\theta JC}(t)$
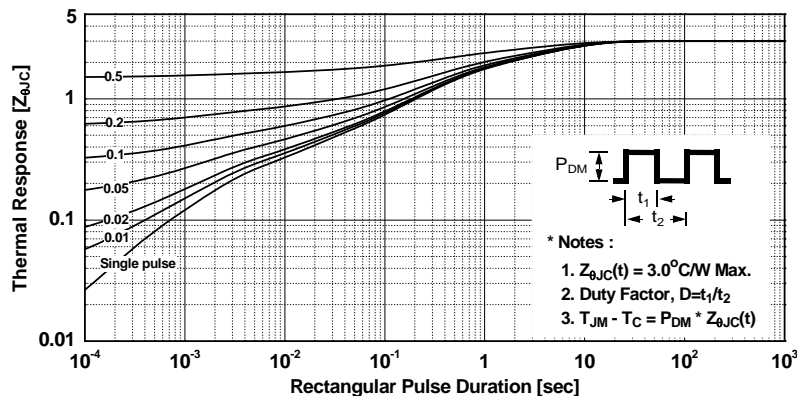
Gate Charge Test Circuit & Waveform

Resistive Switching Test Circuit & Waveforms
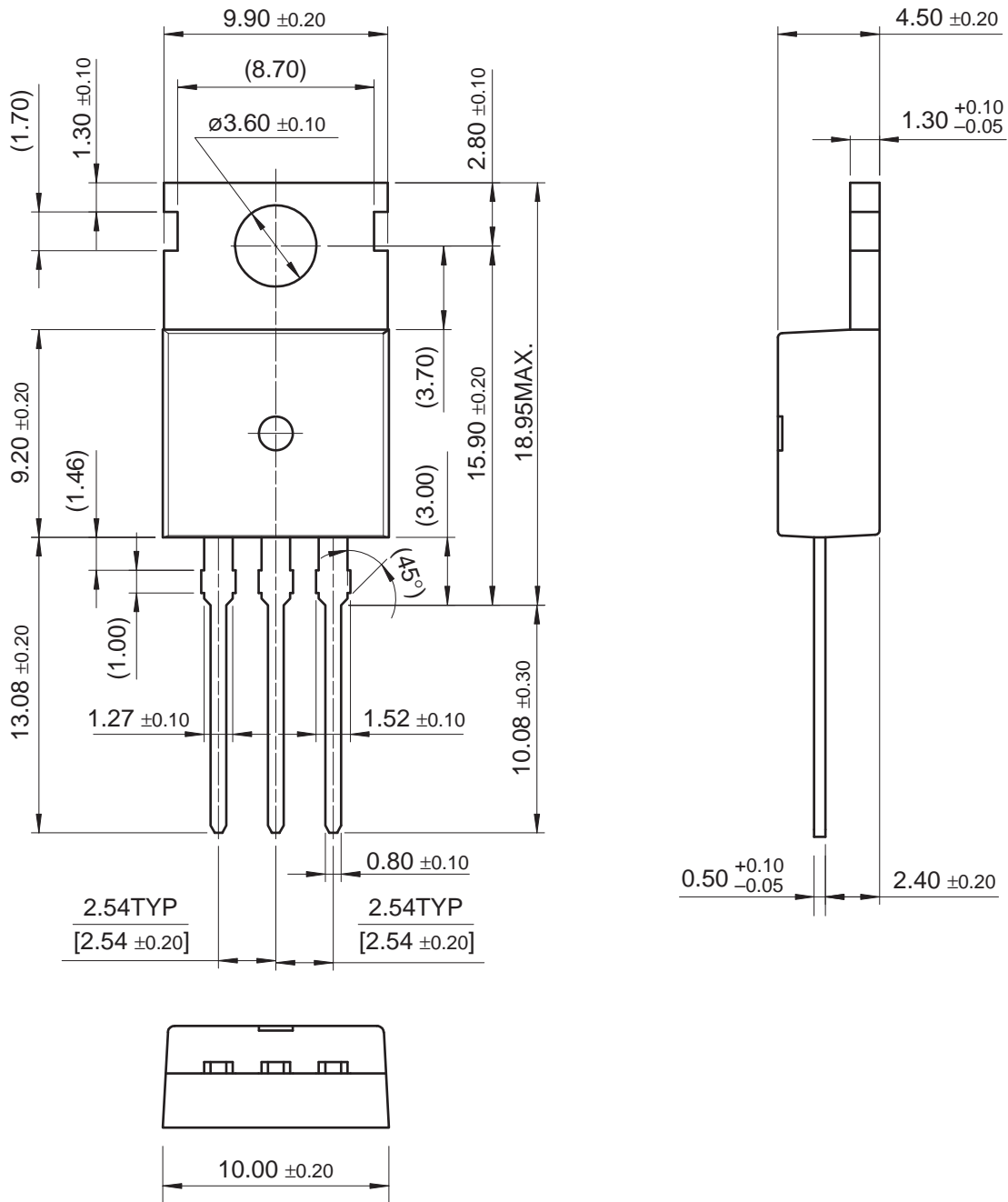
Unclamped Inductive Switching Test Circuit & Waveforms

$$E_{AS} = \frac{1}{2}\ L I_{AS}^2$$

Peak Diode Recovery dv/dt Test Circuit & Waveforms

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)

$$D = \frac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$$

10V

I_{SD}
(DUT)

I_{FM} , Body Diode Forward Current

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
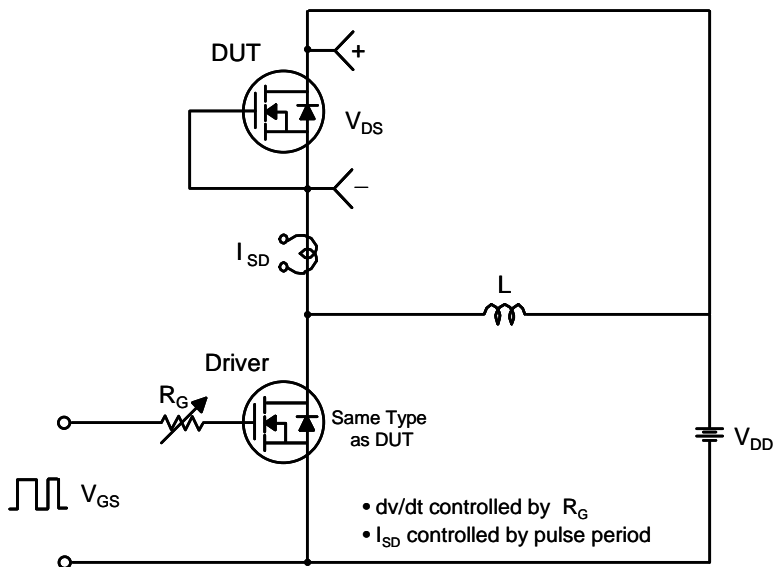
Mechanical Dimensions

TO-220

Package Dimensions

TO-220F Potted

Potting

A' (Potting)

Ø3.18±0.10
10.16±0.20
(7.00)
3.30±0.10
15.80±0.20
MAX1.47
0.70±0.10
#1
0.35±0.10
2.54TYP
[2.54±0.20]
2.54TYP
[2.54±0.20]
9.75±0.20
30°
(5.40)
2.54±0.20
(0.70)
6.70±0.20
(1.00×45°)
15.90±0.20
0.50 +0.10 -0.05
2.76±0.20
9.40±0.20
4.70±0.20
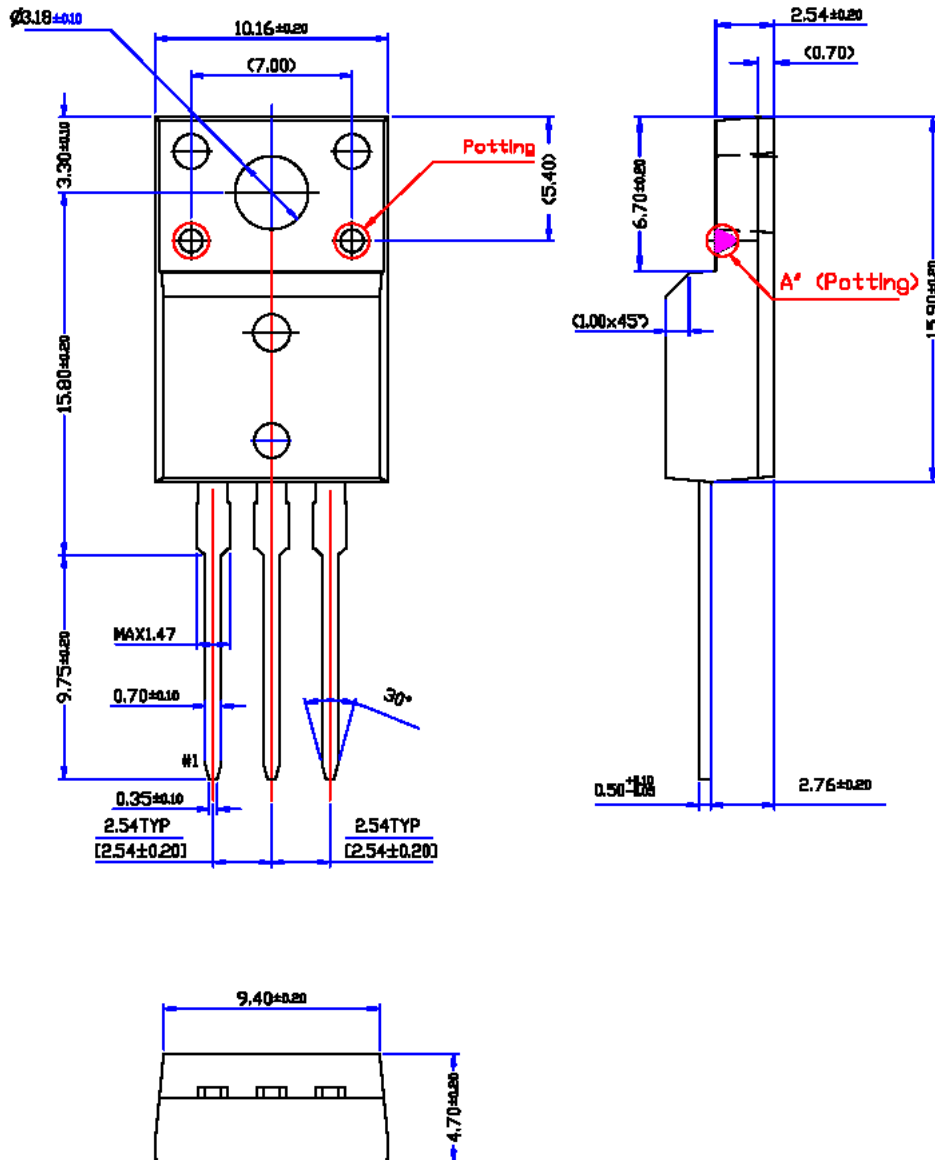
* Front/Back Side Isolation Voltage : AC 2500V

Dimensions in Millimeters

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