FAIRCHILD

SEMICONDUCTOR®

March 2008

FDPF3860T

N-Channel PowerTrench® MOSFET

100V, 20A, 38.2mΩ

Description

- $R_{DS(on)}$ = 38.2mΩ (MAX) @ V_{GS} = 10V, I_D = 5.9A

- Fast switching speed

- Low gate charge

- High performance trench technology for extremely low $R_{DS(on)}$

- High power and current handling capability

- RoHS compliant

100% LEAD-FREE IMPLEMENTATION

General Description

This N-Channel MOSFET is produced using Fairchild Semiconductor's advanced PowerTrench process that has been especially tailored to minimize the on-state resistance and yet maintain superior switching performance.

Application

- DC to AC converters / Synchronous Rectification

TO-220F

G D S

D

G

S
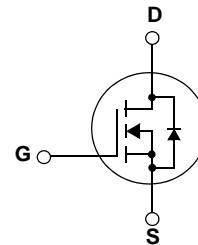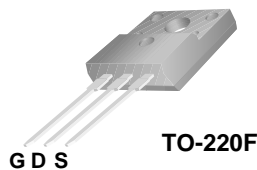
MOSFET Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Parameter			Ratings	Units
V_{DSS}	Drain to Source Voltage			100	V
V_{GSS}	Gate to Source Voltage			±20	V
I_D	Drain Current	- Continuous (T_C = 25°C)		20	A
		- Continuous (T_C = 100°C)		12.7	
I_{DM}	Drain Current	- Pulsed	(Note 1)	80	A
E_{AS}	Single Pulsed Avalanche Energy		(Note 2)	278	mJ
I_{AR}	Avalanche Current		(Note 1)	20	A
E_{AR}	Repetitive Avalanche Energy		(Note 1)	3.4	mJ
dv/dt	Peak Diode Recovery dv/dt		(Note 3)	15	V/ns
P_D	Power Dissipation	(T_C = 25°C)		33.8	W
		- Derate above 25°C		0.27	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range			-55 to +150	°C
T_L	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds			300	°C

Thermal Characteristics

Symbol	Parameter	Ratings	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	3.7	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	62.5	

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Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDPF3860T	FDPF3860T	TO-220F	-	-	50

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Off Characteristics						
BV_{DSS}	Drain to Source Breakdown Voltage	$I_D = 250\mu A$, $V_{GS} = 0V$, $T_J = 25^oC$	100	-	-	V
$\dfrac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu A$, Referenced to 25^oC	-	0.1	-	V/^oC
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 80V$, $V_{GS} = 0V$	-	-	1	μA
		$V_{DS} = 48V$, $T_C = 150^oC$	-	-	500	
I_{GSS}	Gate to Body Leakage Current	$V_{GS} = \pm20V$, $V_{DS} = 0V$	-	-	±100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 250\mu A$	2.5	-	4.5	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10V$, $I_D = 5.9A$	-	29.1	38.2	mΩ
g_{FS}	Forward Transconductance	$V_{DS} = 10V$, $I_D = 5.9A$ (Note 4)	-	21	-	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS} = 25V$, $V_{GS} = 0V$ f = 1MHz	-	1350	1800	pF
C_{oss}	Output Capacitance		-	145	190	pF
C_{rss}	Reverse Transfer Capacitance		-	60	90	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 50V$, $I_D = 5.9A$ $V_{GS} = 10V$, $R_{GEN} = 6\Omega$	-	15	40	ns
t_r	Turn-On Rise Time		-	17	45	ns
$t_{d(off)}$	Turn-Off Delay Time		-	24	60	ns
t_f	Turn-Off Fall Time	(Note 4, 5)	-	7	25	ns
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 80V$, $I_D = 5.9A$ $V_{GS} = 10V$	-	23	35	nC
Q_{gs}	Gate to Source Gate Charge		-	7	-	nC
Q_{gd}	Gate to Drain "Miller" Charge	(Note 4, 5)	-	8	-	nC
Drain-Source Diode Characteristics						
I_S	Maximum Continuous Drain to Source Diode Forward Current		-	-	20	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	80	A
V_{SD}	Drain to Source Diode Forward Voltage	$V_{GS} = 0V$, $I_{SD} = 5.9A$	-	-	1.3	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0V$, $I_{SD} = 5.9A$ $dI_F/dt = 100A/\mu s$	-	40	-	ns
Q_{rr}	Reverse Recovery Charge	(Note 4)	-	56	-	nC

Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature

2. L =16mH, $I_{AS} = 5.9A$, $V_{DD} = 50V$, $R_G = 25\Omega$, Starting $T_J = 25°C$

3. $I_{SD} \leq 5.9A$, di/dt $\leq 200A/\mu s$, $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25°C$

4. Pulse Test: Pulse width $\leq 300\mu s$, Duty Cycle $\leq 2\%$

5. Essentially Independent of Operating Temperature Typical Characteristics

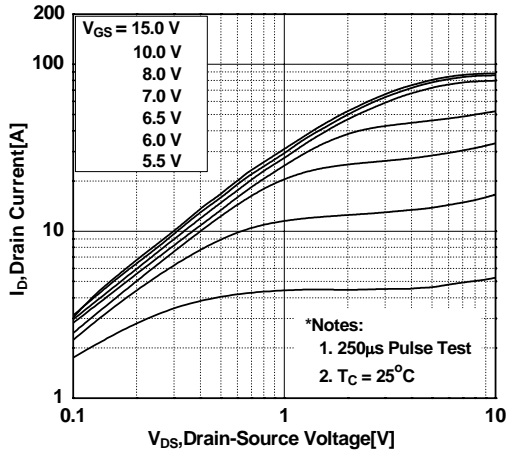# Typical Performance Characteristics

Figure 1. On-Region Characteristics

V_{GS} = 15.0 V
10.0 V
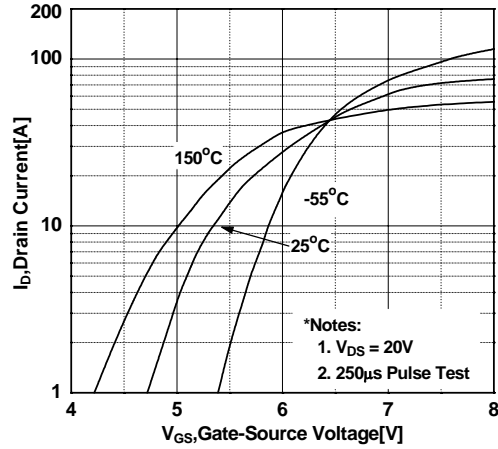8.0 V
7.0 V
6.5 V
6.0 V
5.5 V

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

I_D,Drain Current[A]

V_{DS},Drain-Source Voltage[V]

Figure 2. Transfer Characteristics

150°C
-55°C
25°C

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

I_D,Drain Current[A]

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

I_D, Drain Current [A]
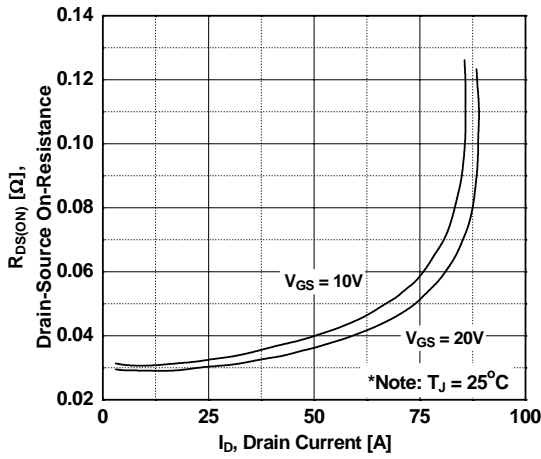
Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

150°C
25°C

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

I_S, Reverse Drain Current [A]

V_{SD}, Body Diode Forward Voltage [V]
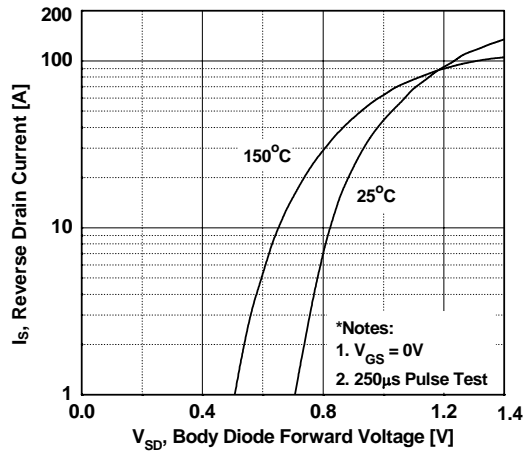
Figure 5. Capacitance Characteristics

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

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

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

Capacitances [pF]

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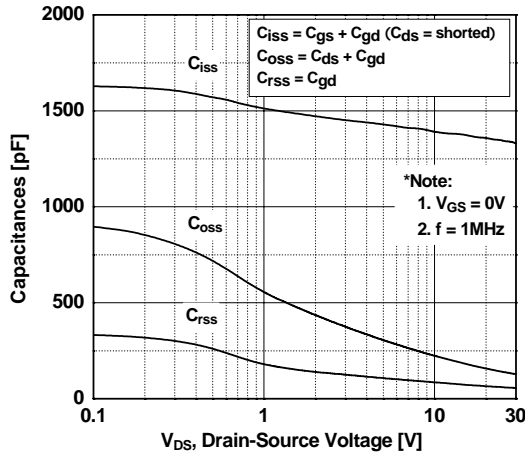
Figure 6. Gate Charge Characteristics

V_{DS} = 80V
V_{DS} = 50V
V_{DS} = 25V

*Note: I_D = 5.9A

V_{GS}, Gate-Source Voltage [V]

Q_g, Total Gate Charge [nC]
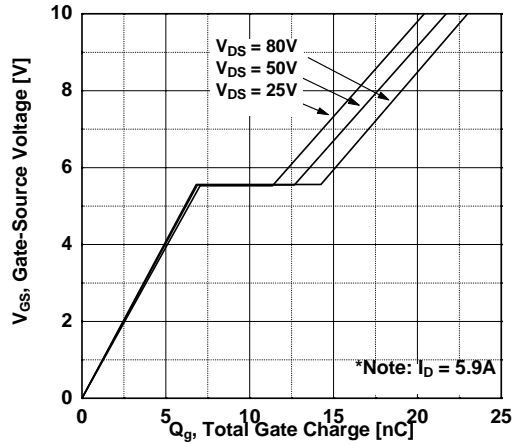
Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

*Notes:
1. V_{GS} = 0V
2. I_D = 250µA
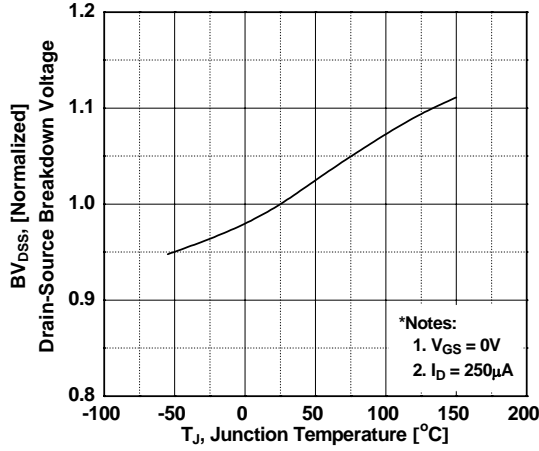
Figure 8. On-Resistance Variation vs. Temperature

*Notes:
1. V_{GS} = 10V
2. I_D = 5.9A
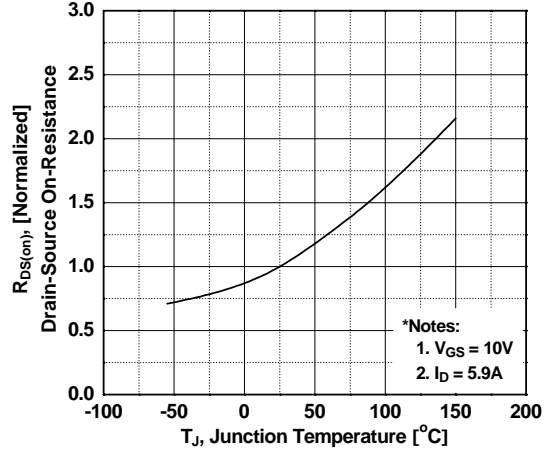
Figure 9. Maximum Safe Operating Area

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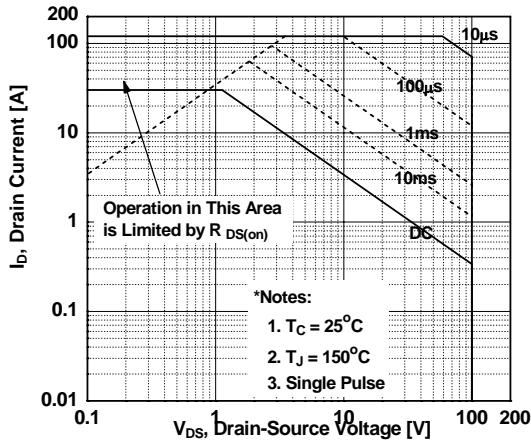
*Notes:
1. T_C = 25°C
2. T_J = 150°C
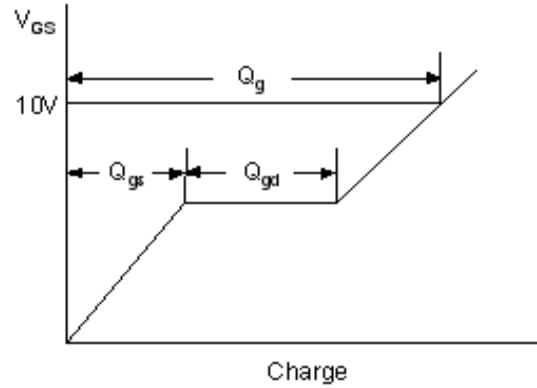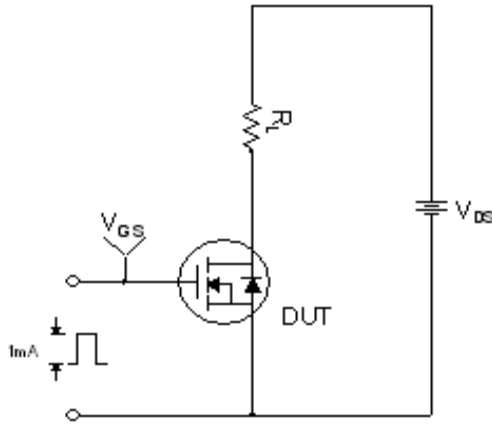3. Single Pulse

Figure 10. Maximum Drain Current vs. Case Temperature
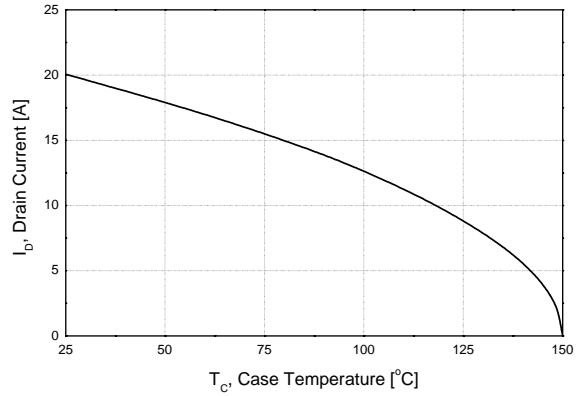
Figure 11. Transient Thermal Response Curve

*Notes:
1. $Z_{\theta JC}(t)$ = 3.7°C/W Max.
2. Duty Factor, D= t_1/t_2
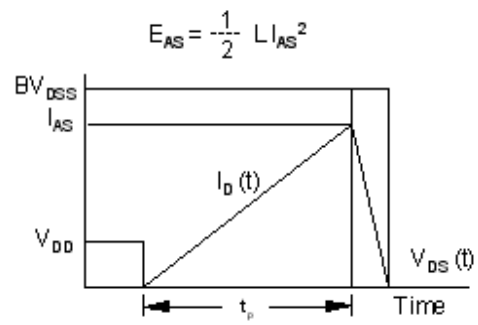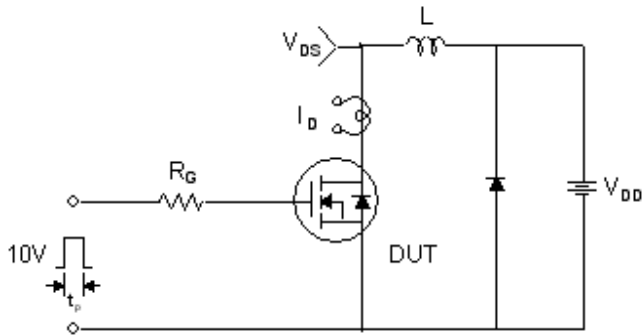3. $T_{JM} - T_C = P_{DM} * Z_{\theta JC}(t)$
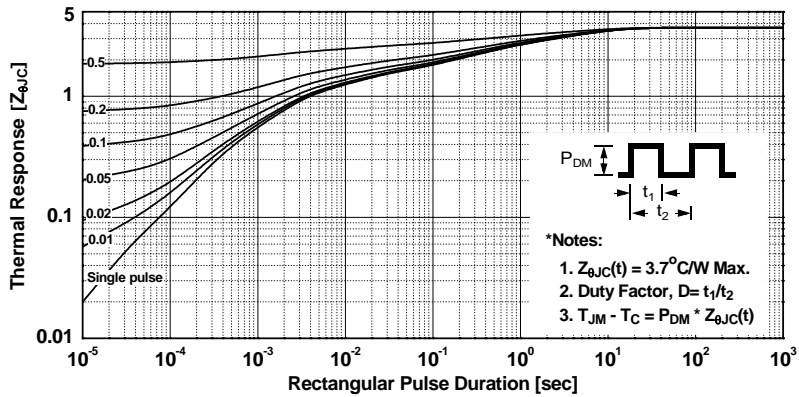
Gate Charge Test Circuit & Waveform

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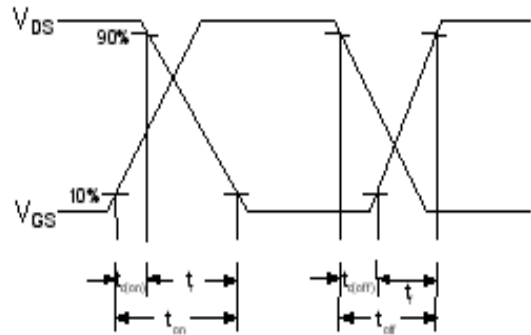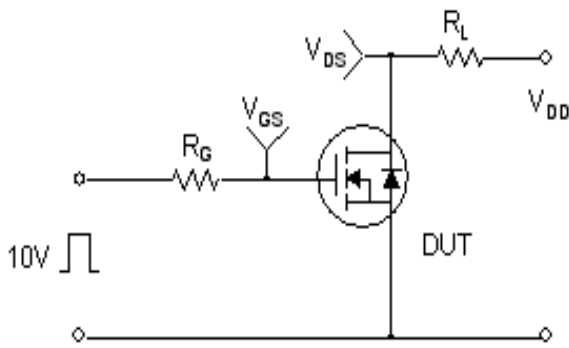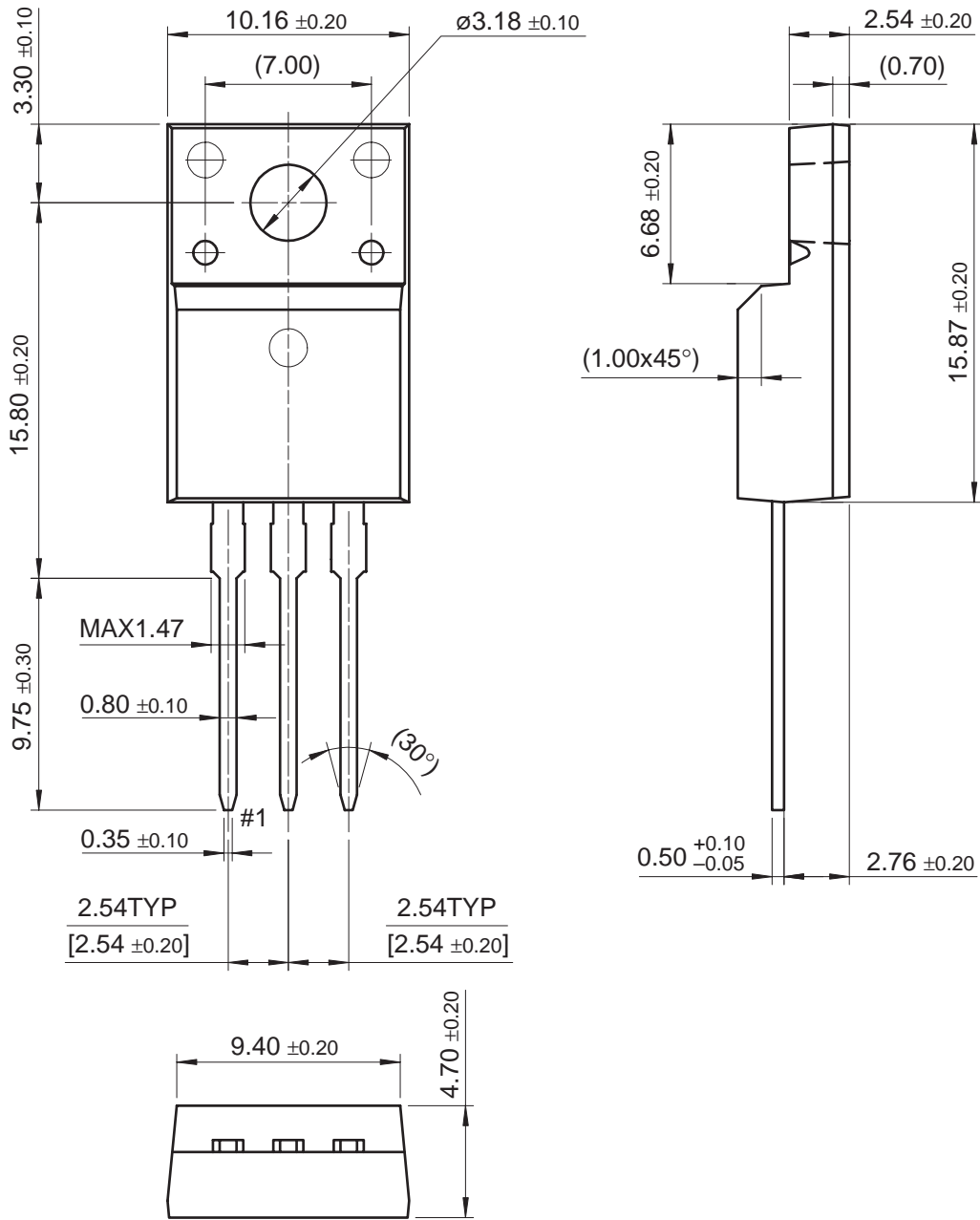
Unclamped Inductive Switching Test Circuit & Waveforms

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

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)

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

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
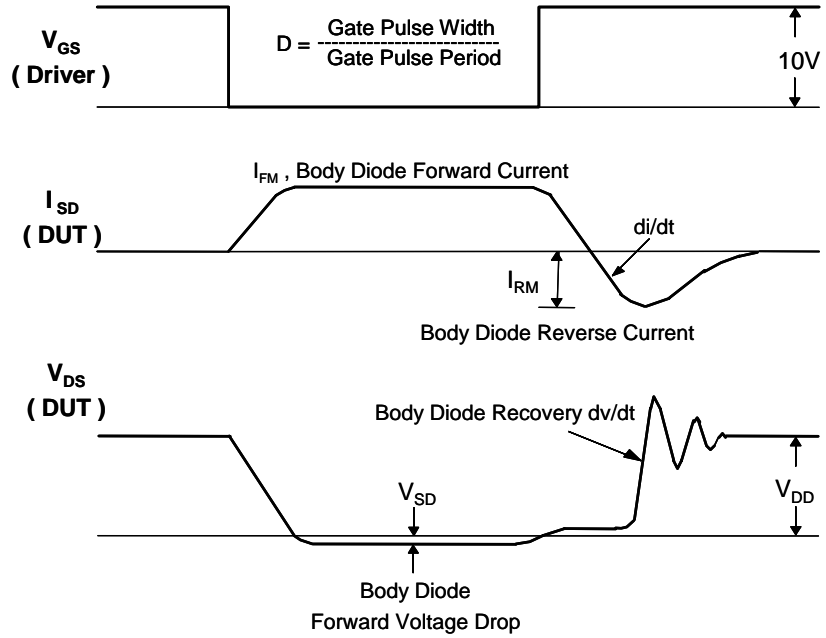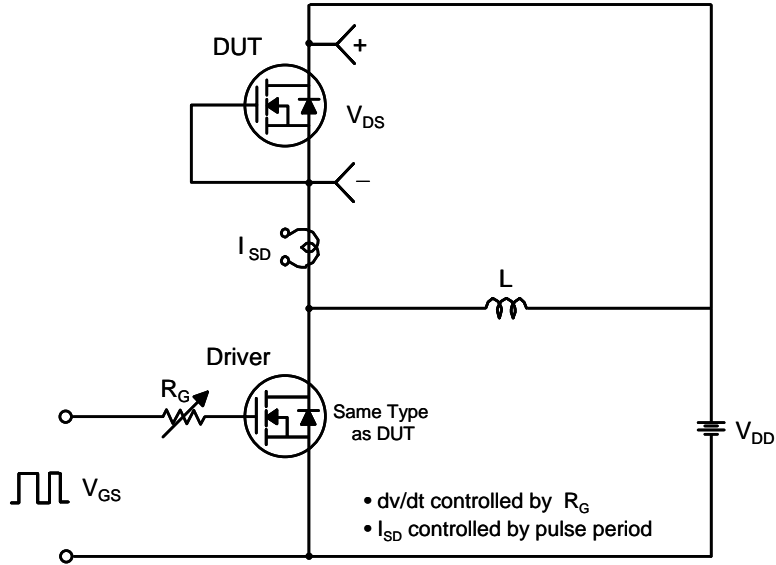
Package Dimensions

TO-220F

10.16 ±0.20

(7.00)

ø3.18 ±0.10

3.30 ±0.10

15.80 ±0.20

MAX1.47

0.80 ±0.10

9.75 ±0.30

(30°)

0.35 ±0.10   #1

2.54TYP
[2.54 ±0.20]

2.54TYP
[2.54 ±0.20]

2.54 ±0.20

(0.70)

6.68 ±0.20

(1.00x45°)

15.87 ±0.20

0.50 $^{+0.10}_{-0.05}$

2.76 ±0.20

9.40 ±0.20

4.70 ±0.20

Dimensions in Millimeters

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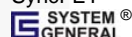## TRADEMARKS

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Datasheet Identification	Product Status	Definition
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