March 2016

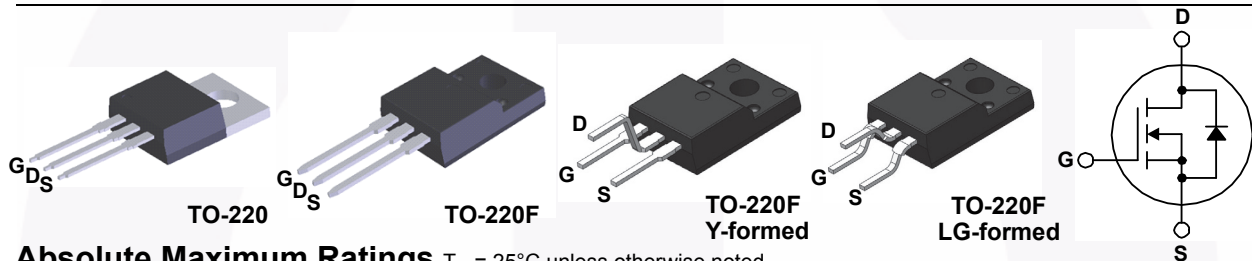# FDP51N25 / FDPF51N25

N-Channel UniFET^{TM} MOSFET
250 V, 51 A, 60 mΩ

Features

- $R_{DS(on)}$ = 48 mΩ(Typ.) @ V_{GS} = 10 V, I_D = 25.5 A
- Low Gate Charge (Typ. 55 nC)
- Low C_{rss} (Typ. 63 pF)

Applications

- PDP TV
- Lighting
- Uninterruptible Power Supply
- AC-DC Power Supply

Description

UniFET^{TM} MOSFET is Fairchild Semiconductor's high voltage MOSFET family based on planar stripe and DMOS technology. This MOSFET is tailored to reduce on-state resistance, and to provide better switching performance and higher avalanche energy strength. This device family is suitable for switching power converter applications such as power factor correction (PFC), flat panel display (FPD) TV power, ATX and electronic lamp ballasts.

TO-220   TO-220F   TO-220F Y-formed   TO-220F LG-formed

Absolute Maximum Ratings T_C = 25°C unless otherwise noted.

Symbol	Parameter		FDP51N25	FDPF51N25 FDPF51N25YDTU FDPF51N25RDTU	Unit
V_{DSS}	Drain-Source Voltage		250		V
I_D	Drain Current	- Continuous (T_C = 25°C)	51	51*	A
		- Continuous (T_C = 100°C)	30	30*	A
I_{DM}	Drain Current	- Pulsed (Note 1)	204	204*	A
V_{GSS}	Gate-Source voltage		±30		V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)		1111		mJ
I_{AR}	Avalanche Current (Note 1)		51		A
E_{AR}	Repetitive Avalanche Energy (Note 1)		32		mJ
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=0.3sec; T_C = 25°C)		N/A	2500	V
dv/dt	Peak Diode Recovery dv/dt (Note 3)		4.5		V/ns
P_D	Power Dissipation	(T_C = 25°C)	320	38	W
		- Derate Above 25°C	3.7	0.3	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to +150		°C
T_L	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds		300		°C

*Drain current limited by maximum junction temperature.

Thermal Characteristics

Symbol	Parameter	FDP51N25	FDPF51N25 FDPF51N25YDTU FDPF51N25RDTU	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	0.39	3.3	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	62.5	62.5	°C/W

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FDP51N25	FDP51N25	TO-220	Tube	N/A	N/A	50 units
FDPF51N25	FDPF51N25	TO-220F	Tube	N/A	N/A	50 units
FDPF51N25YDTU	FDPF51N25	TO-220F (Y-formed)	Tube	N/A	N/A	50 units
FDPF51N25RDTU	FDPF51N25	TO-220F (LG-formed)	Tube	N/A	N/A	50 units

Electrical Characteristics T_C = 25°C unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 µA, T_J = 25 °C	250	--	--	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250 µA, Referenced to 25°C	--	0.25	--	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 250 V, V_{GS} = 0 V V_{DS} = 200 V, T_C = 125°C	-- --	-- --	1 10	µA 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} = 0V	--	--	-100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 µA	3.0	--	5.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	V_{GS} = 10 V, I_D = 25.5 A	--	0.048	0.060	Ω
g_{FS}	Forward Transconductance	V_{DS} = 40 V, I_D = 25.5 A	--	43	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1 MHz	--	2620	3410	pF
C_{oss}	Output Capacitance		--	530	690	pF
C_{rss}	Reverse Transfer Capacitance		--	63	90	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 125 V, I_D = 51 A, V_{GS} = 10 V, R_G = 25 Ω	--	62	135	ns
t_r	Turn-On Rise Time		--	465	940	ns
$t_{d(off)}$	Turn-Off Delay Time		--	98	205	ns
t_f	Turn-Off Fall Time	(Note 4)	--	130	270	ns
Q_g	Total Gate Charge	V_{DS} = 200 V, I_D = 51 A, V_{GS} = 10 V	--	55	70	nC
Q_{gs}	Gate-Source Charge		--	16	--	nC
Q_{gd}	Gate-Drain Charge	(Note 4)	--	27	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	51	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	204	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 51 A	--	--	1.4	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = 51 A, dI_F/dt =100 A/µs	--	178	--	ns
Q_{rr}	Reverse Recovery Charge		--	4.0	--	µC

Notes:

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. L = 0.68 mH, I_{AS} = 51 A, V_{DD} = 50 V, R_G = 25 Ω starting T_J = 25°C.
3. $I_{SD} \leq$ 51 A, di/dt $\leq$ 200 A/µs, $V_{DD} \leq BV_{DSS}$, starting T_J = 25°C.
4. Essentially independent of operating temperature typical characteristics.

Typical Performance Characteristics
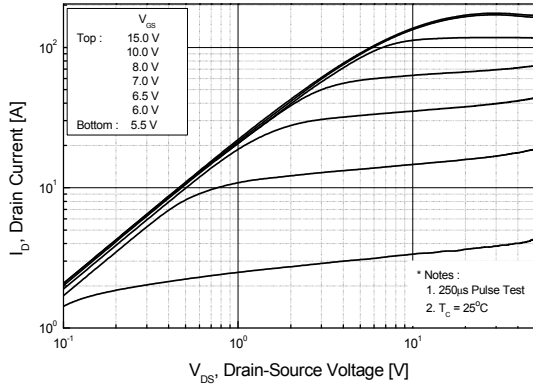
Figure 1. On-Region Characteristics

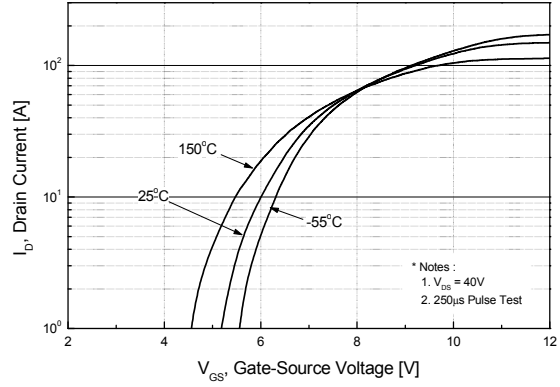### Figure 2. Transfer Characteristics

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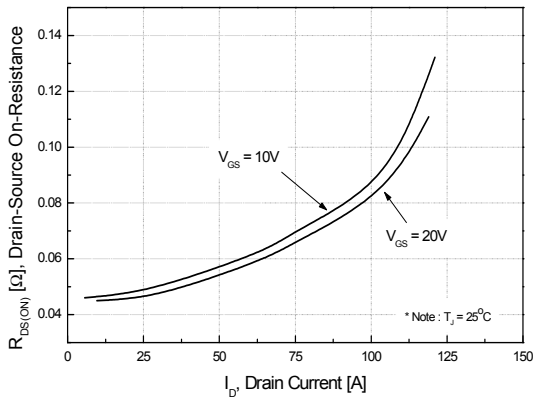

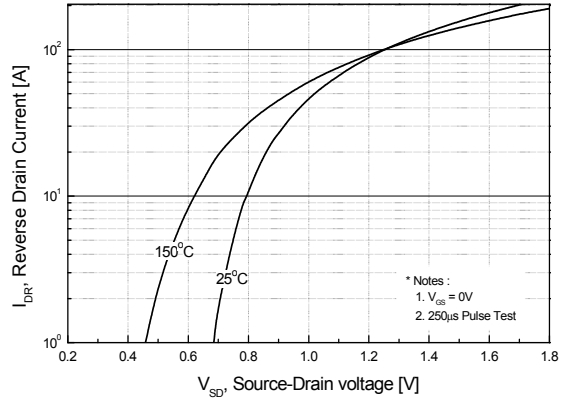### Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperatue
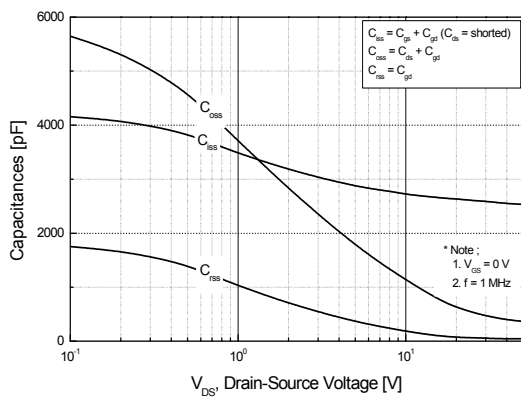

Figure 5. Capacitance Characteristics

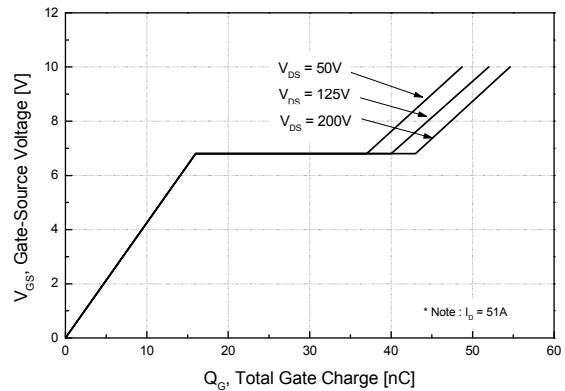### Figure 6. Gate Charge Characteristics

Typical Performance Characteristics (Continued)
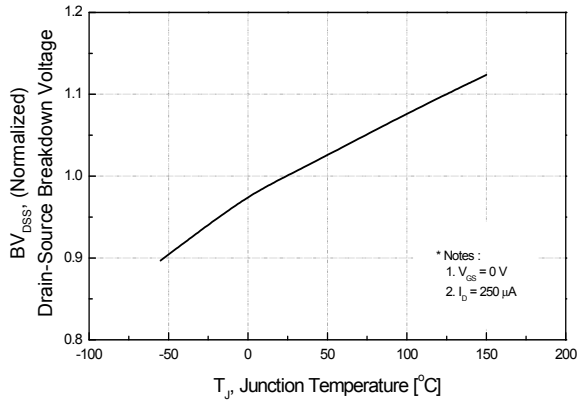
Figure 7. Breakdown Voltage Variation vs. Temperature

BV$_{DSS}$, (Normalized) Drain-Source Breakdown Voltage vs. T$_J$, Junction Temperature [°C]

* Notes :
1. V$_{GS}$ = 0 V
2. I$_D$ = 250 μA

Figure 8. On-Resistance Variation vs. Temperature

R$_{DS(ON)}$, (Normalized) Drain-Source On-Resistance vs. T$_J$, Junction Temperature [°C]

* Notes :
1. V$_{GS}$ = 10 V
2. I$_D$ = 25.5 A
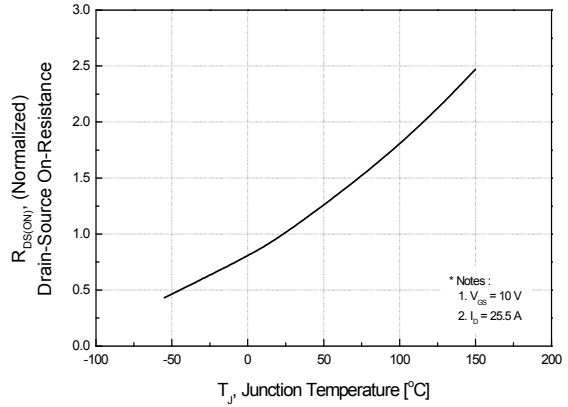
Figure 9-1. Maximum Safe Operating Area for FDP51N25

I$_D$, Drain Current [A] vs. V$_{DS}$, Drain-Source Voltage [V]

10 μs
100 μs
1 ms
10 ms
100 ms
DC

Operation in This Area is Limited by R$_{DS(on)}$

* Notes :
1. T$_C$ = 25 °C
2. T$_J$ = 150 °C
3. Single Pulse
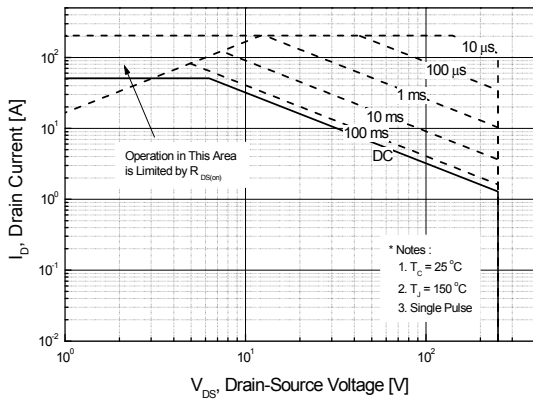
Figure 9-2. Maximum Safe Operating Area for FDPF51N25 / FDPF51N25YDTU

I$_D$, Drain Current [A] vs. V$_{DS}$, Drain-Source Voltage [V]

10 μs
100 μs
1 ms
10 ms
100 ms
DC

Operation in This Area is Limited by R$_{DS(on)}$

* Notes :
1. T$_C$ = 25 °C
2. T$_J$ = 150 °C
3. Single Pulse
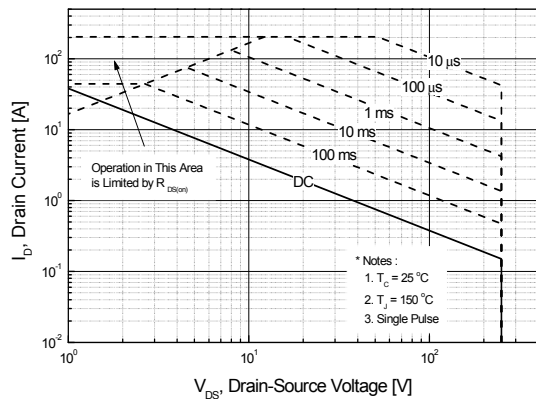
Figure 10. Maximum Drain Current vs. Case Temperature

I$_D$, Drain Current [A] vs. T$_C$, Case Temperature [°C]
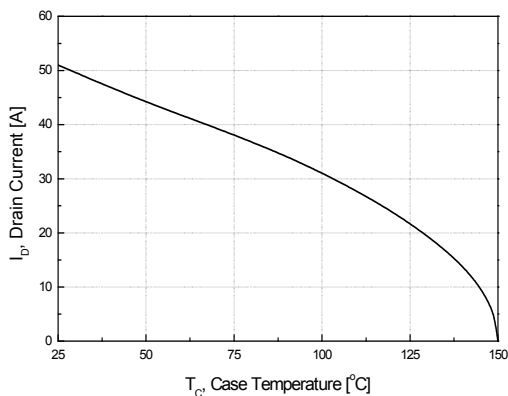
Typical Performance Characteristics (Continued)

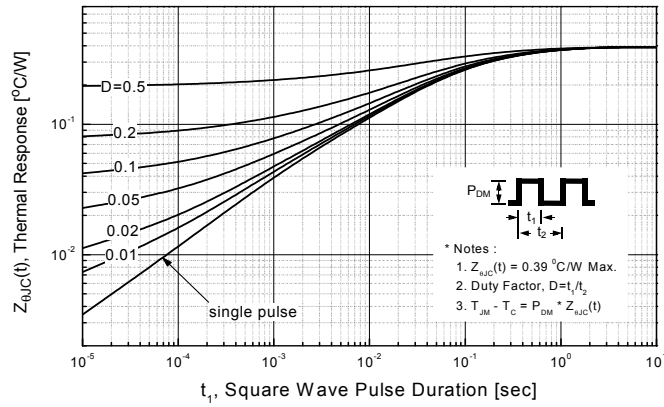### Figure 11-1. Transient Thermal Response Curve for FDP51N25
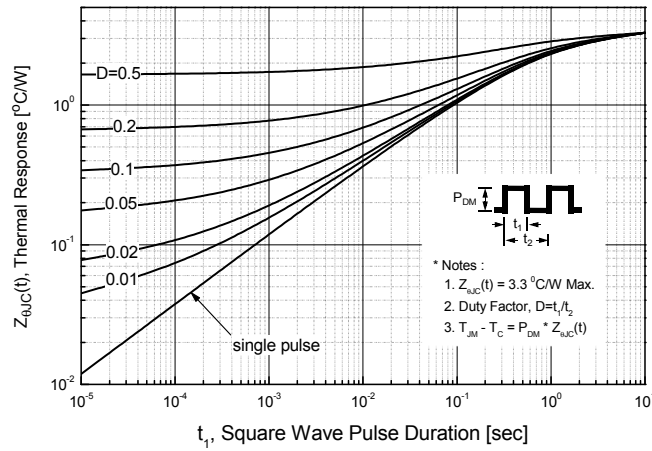

Figure 11-2. Transient Thermal Response Curve for FDPF51N25 / FDPF51N25YDTU
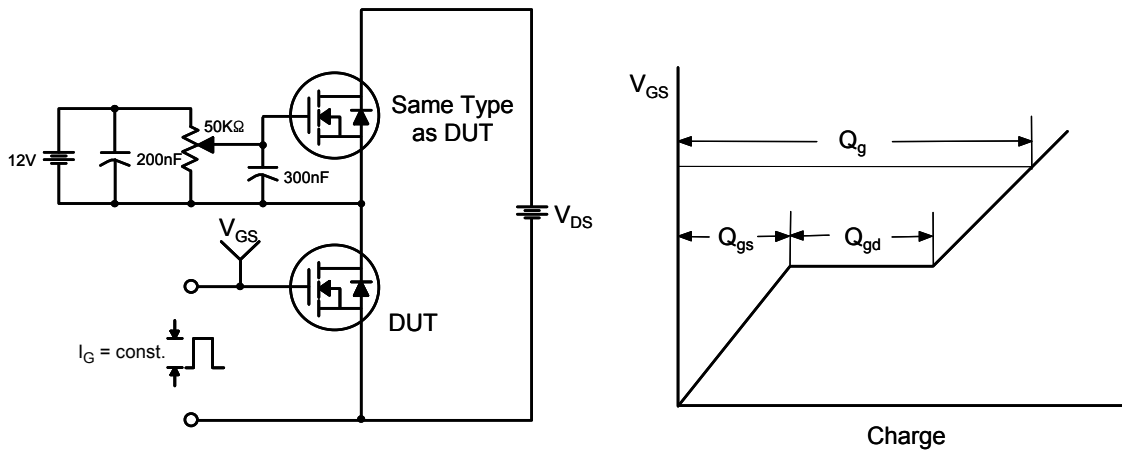
Figure 12. Gate Charge Test Circuit & Waveform
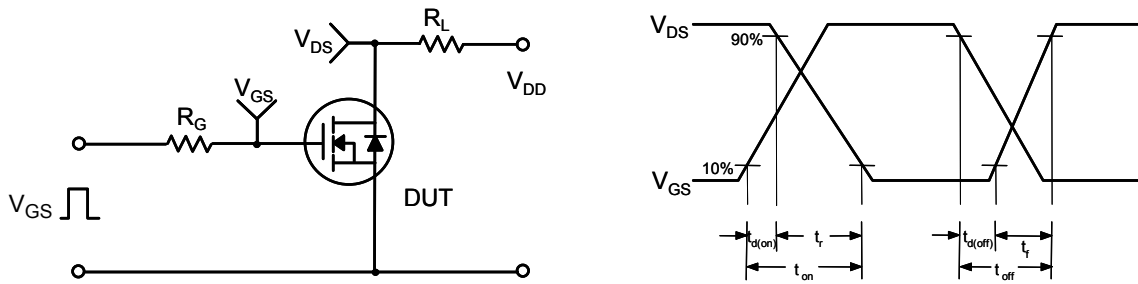
Figure 13. Resistive Switching Test Circuit & Waveforms

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

Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

$$D = \frac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$$
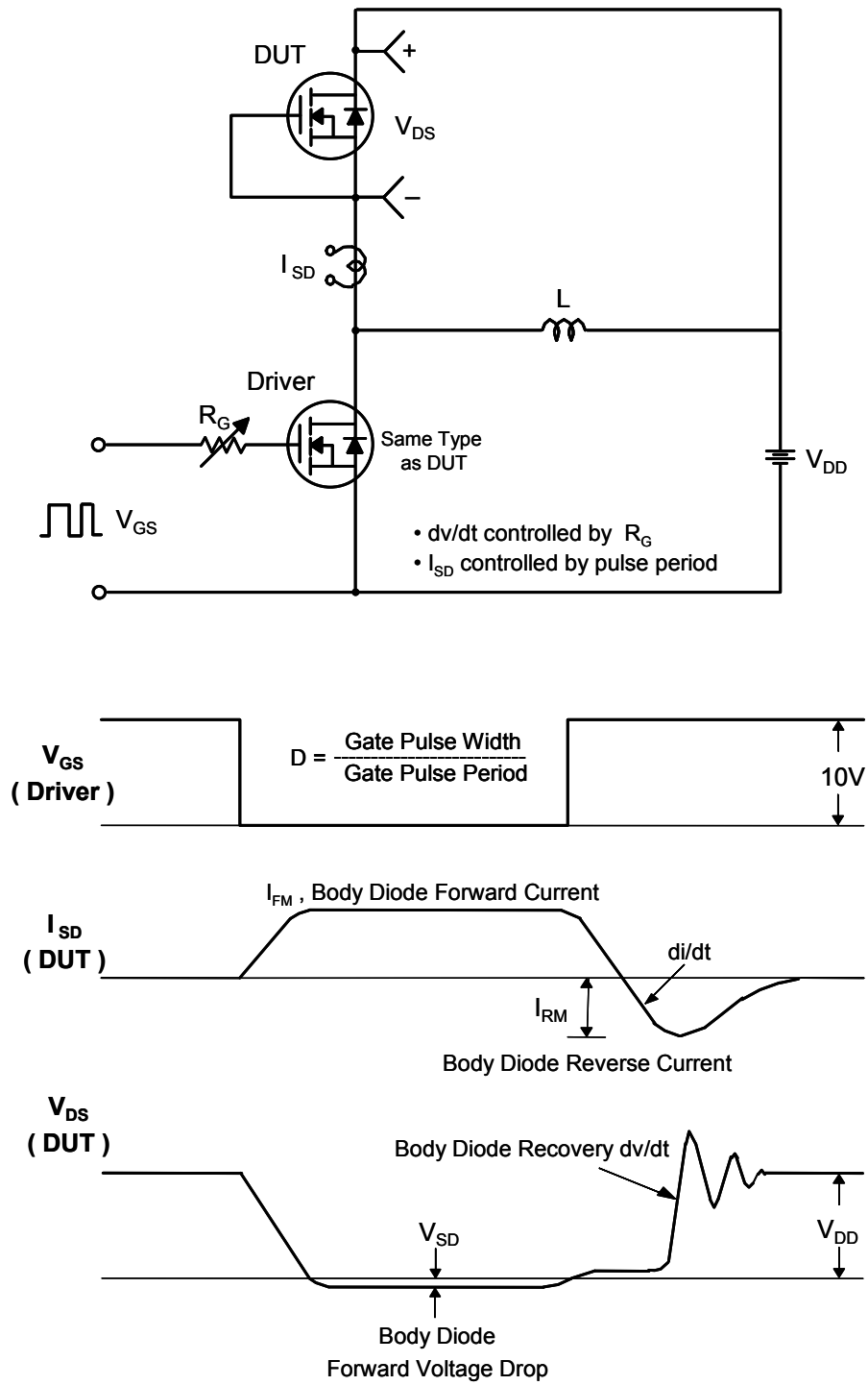
Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms
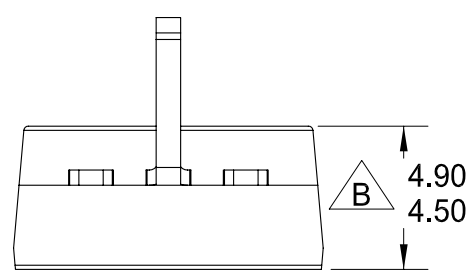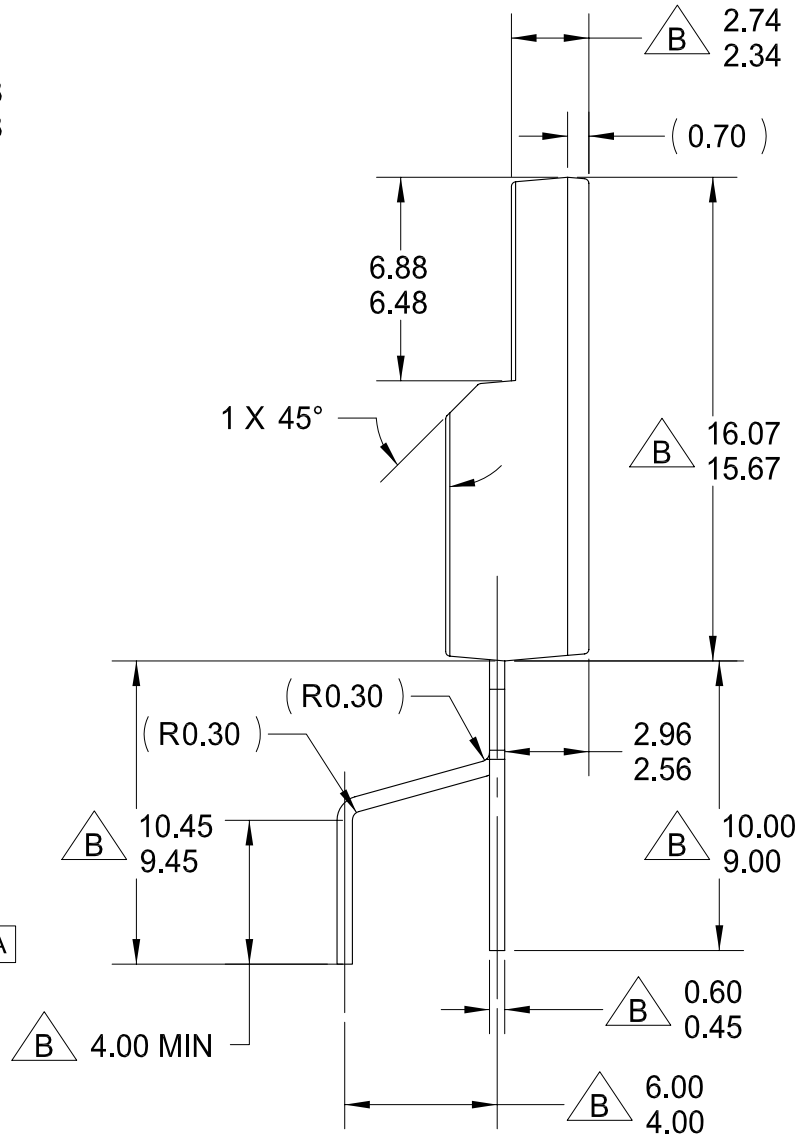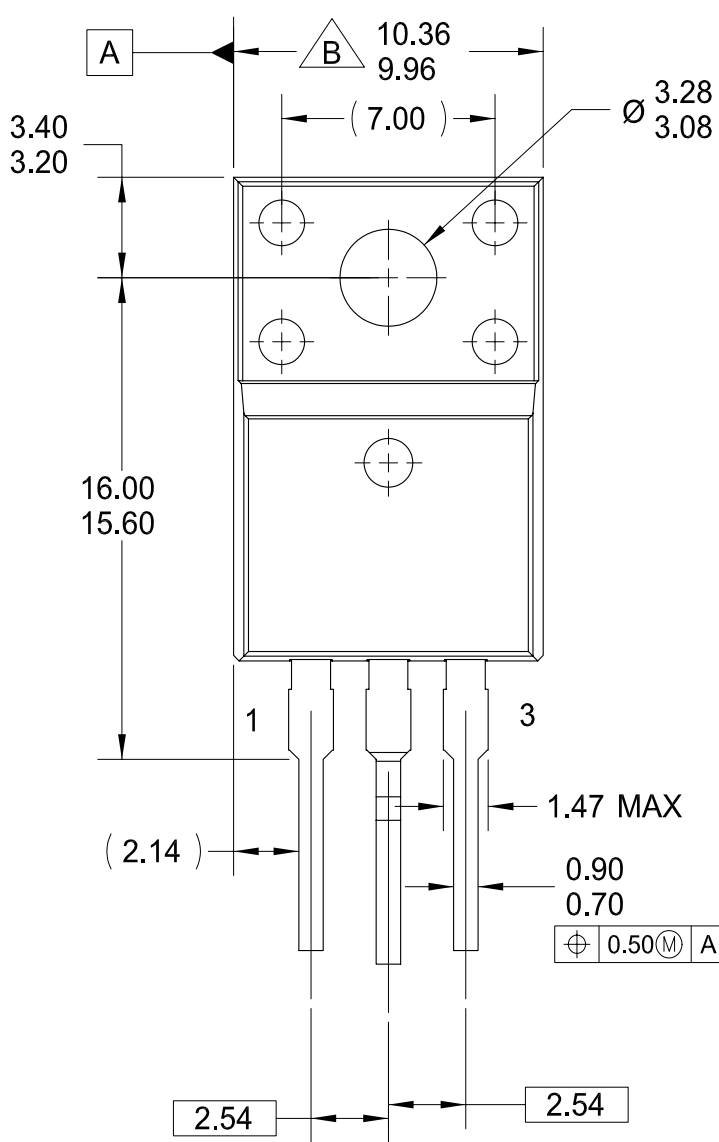
F

H

F

H

A

B 10.36
9.96

(7.00)

Ø 3.28
3.08

3.40
3.20

16.00
15.60

1   3

1.47 MAX

(2.14)

0.90
0.70

⊕ 0.50 Ⓜ A

2.54   2.54

B 4.90
4.50

B 2.74
2.34

(0.70)

6.88
6.48

1 X 45°

B 16.07
15.67

(R0.30)

(R0.30)

2.96
2.56

B 10.45
9.45

B 10.00
9.00

B 4.00 MIN

B 0.60
0.45

B 6.00
4.00

NOTES:

A. EXCEPT WHERE NOTED CONFORMS TO
   EIAJ SC91A.
B. DOES NOT COMPLY EIAJ STD. VALUE.
C. ALL DIMENSIONS ARE IN MILLIMETERS.
D. DIMENSIONS ARE EXCLUSIVE OF BURRS,
   MOLD FLASH AND TIE BAR PROTRUSIONS.
E. DIMENSION AND TOLERANCE AS PER ASME
   Y14.5-1994.
F. DRAWING FILE NAME: TO220Q03REV1

SUPPLIER "A" PACKAGE
SHAPE

SUPPLIER "B" PACKAGE
SHAPE

Ø4.00
3.50

10.67
9.65 E

3.40
2.50

IF PRESENT, SEE NOTE "D"

16.51
15.42

9.40
8.13 E

16.30
13.90 E

[2.46]

C

1 2 3

4.10
2.70

2.13

14.04
12.70

2.06

FRONT VIEWS

1.62
1.42 H

2.67
2.40

1.62
1.10

1.00
0.55

4.70
4.00

"A1"
SEE NOTE "F"

8.65
7.59

5°
3°

5°
3°

OPTIONAL
CHAMFER

6.69
6.06

14.30
11.50 E

NOTE "I"

BOTTOM VIEW

NOTES:
A) REFERENCE JEDEC, TO-220, VARIATION AB
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS COMMON TO ALL PACKAGE
   SUPPLIERS EXCEPT WHERE NOTED [ ].
D) LOCATION OF MOLDED FEATURE MAY VARY
   (LOWER LEFT CORNER, LOWER CENTER
   AND CENTER OF THE PACKAGE)
E) DOES NOT COMPLY JEDEC STANDARD VALUE.
F) "A1" DIMENSIONS AS BELOW:
   SINGLE GAUGE = 0.51 - 0.61
   DUAL GAUGE   = 1.10 - 1.45
G) DRAWING FILE NAME: TO220B03REV9
H) PRESENCE IS SUPPLIER DEPENDENT
I) SUPPLIER DEPENDENT MOLD LOCKING HOLES
   IN HEATSINK.

3 2 1

0.60
0.36

2.85
2.10

BACK VIEW

SIDE VIEW

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NOTES:

A. EXCEPT WHERE NOTED CONFORMS TO
   EIAJ SC91A.
B. DOES NOT COMPLY EIAJ STD. VALUE.
C. ALL DIMENSIONS ARE IN MILLIMETERS.
D. DIMENSIONS ARE EXCLUSIVE OF BURRS,
   MOLD FLASH AND TIE BAR PROTRUSIONS.
E. DIMENSION AND TOLERANCE AS PER ASME
   Y14.5-1994.
F. OPTION 1 - WITH SUPPORT PIN HOLE.
   OPTION 2 - NO SUPPORT PIN HOLE.
G. DRAWING FILE NAME: TO220M03REV4

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Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
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No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

Rev. I77

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