MOSFET – N-Channel, UNIFET™

250 V, 51 A, 60 mΩ

FDP51N25, FDPF51N25

V_{DSS}	$R_{DS(on)}$ MAX	I_D MAX
250 V	60 mΩ @ 10 V	51 A

Description

UniFET MOSFET is **onsemi**'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.

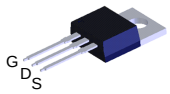
Features

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

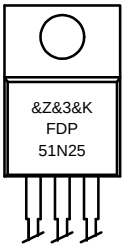
Applications

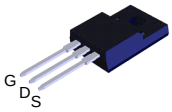
- PDP TV
- Lighting
- Uninterruptible Power Supply
- AC−DC Power Supply

MARKING DIAGRAM

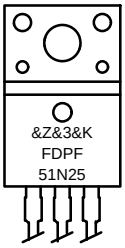


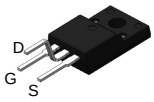
TO−220−3LD
CASE 340AT



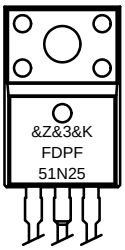


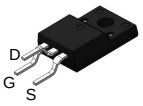
TO−220 Fullpack,
3−Lead /
TO−220F−3SG
CASE 221AT



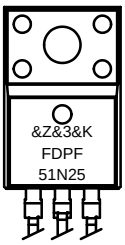


TO−220−3LD LF
(Y−formed)
CASE 340BJ



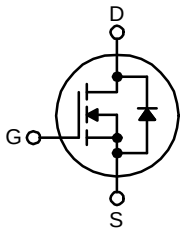


TO−220−3LD LF
(LG−formed)
CASE 340BL



&Z	= Assembly Plant Code
&3	= 3−Digit Date Code
&K	= 2−Digits Lot Run Code
FDP51N25, FDPF51N25	= Specific Device Code

N−CHANNEL MOSFET



ORDERING INFORMATION

See detailed ordering and shipping information on page 9 of this data sheet.

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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) − Continuous (T_C = 100°C)	51 30	51* 30*	A 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 = 0.3 s; 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) − Derate Above 25°C	320 3.7	38 0.3	W 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

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
*Drain current limited by maximum junction temperature.
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} ≤ 51 A, di/dt ≤ 200 A/μs, V_{DD} ≤ BV_{DSS}, starting T_J = 25°C.

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

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 (Note 4)	−	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		−	130	270	ns
Q_g	Total Gate Charge	V_{DS} = 200 V, I_D = 51 A, V_{GS} = 10 V (Note 4)	−	55	70	nC
Q_{gs}	Gate−Source Charge		−	16	−	nC
Q_{gd}	Gate−Drain Charge		−	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

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. Essentially independent of operating temperature typical characteristics.

TYPICAL PERFORMANCE CHARACTERISTICS

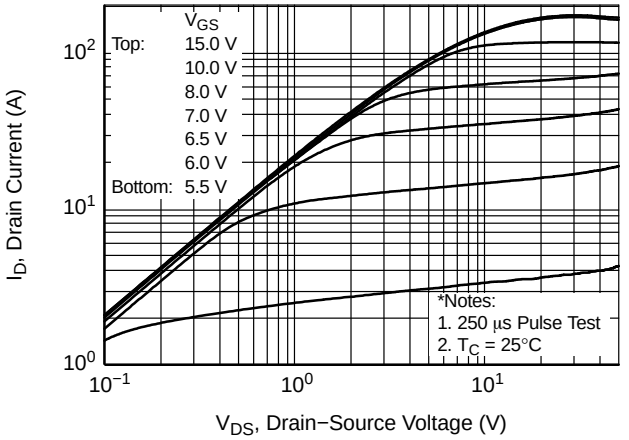


Figure 1. On−Region Characteristics

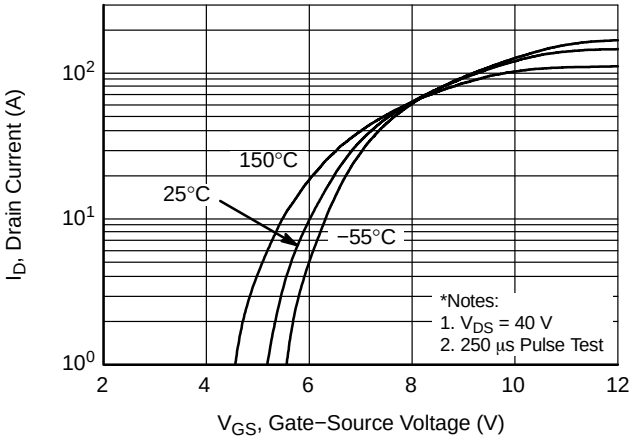


Figure 2. Transfer Characteristics

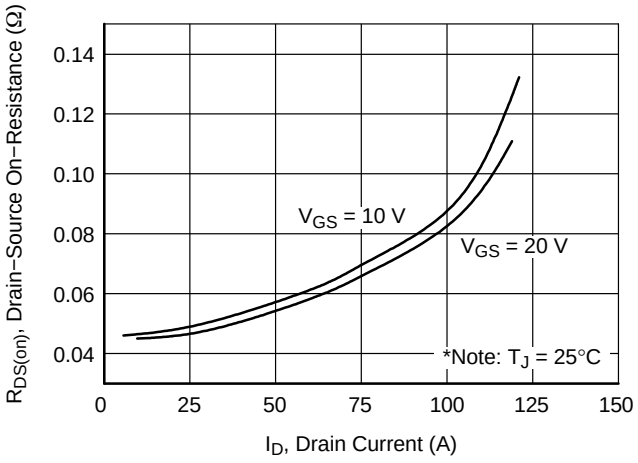


Figure 3. On−Resistance Variation vs. Drain Current and Gate Voltage

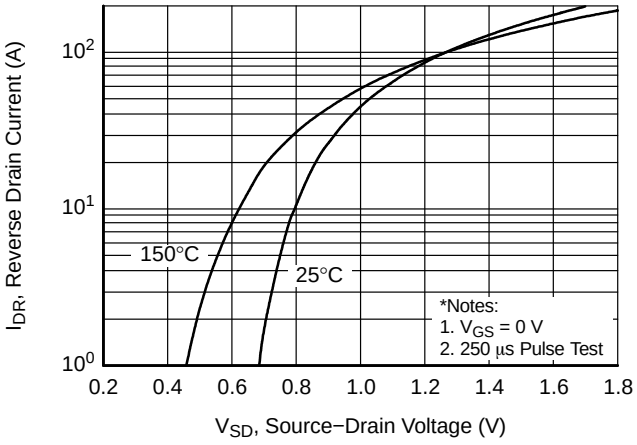


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

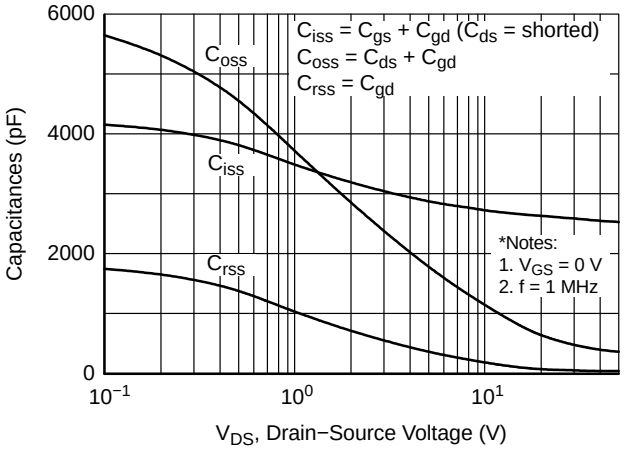


Figure 5. Capacitance Characteristics

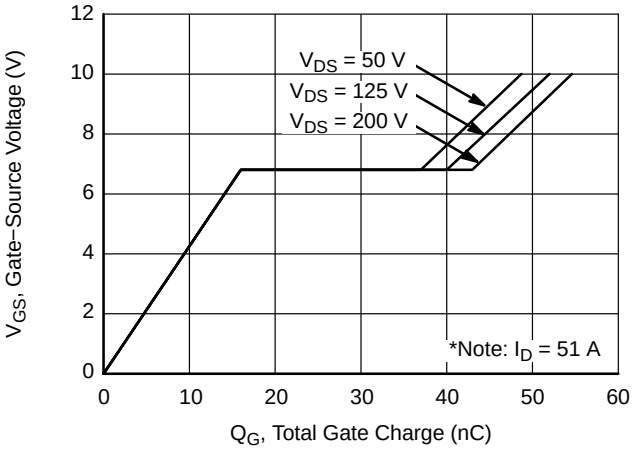


Figure 6. Gate Charge Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

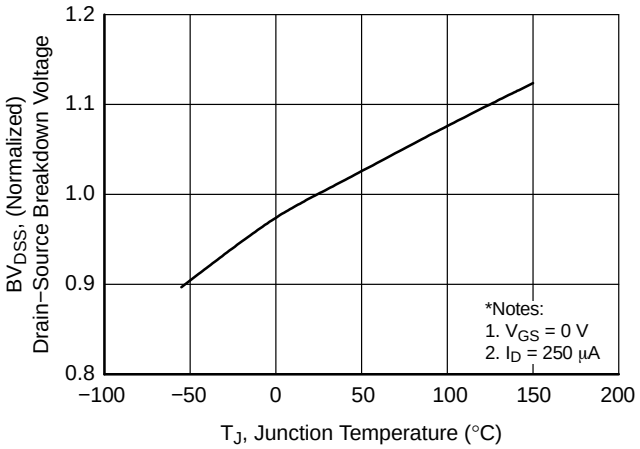


Figure 7. Breakdown Voltage Variation vs. Temperature

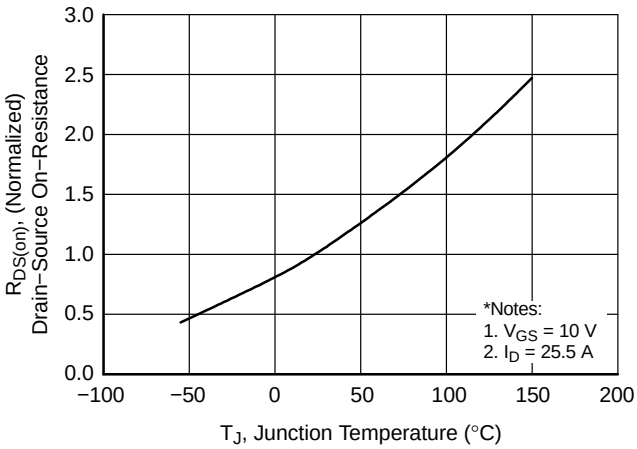


Figure 8. On−Resistance Variation vs. Temperature

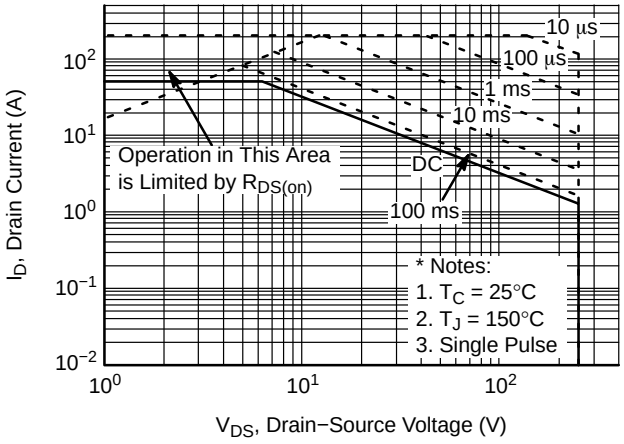


Figure 9−1. Maximum Safe Operating Area for FDP51N25

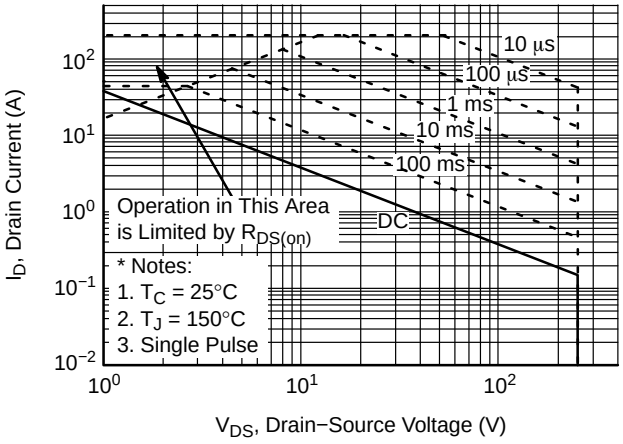


Figure 9−2. Maximum Safe Operating Area for FDPF51N25 / FDPF51N25YDTU

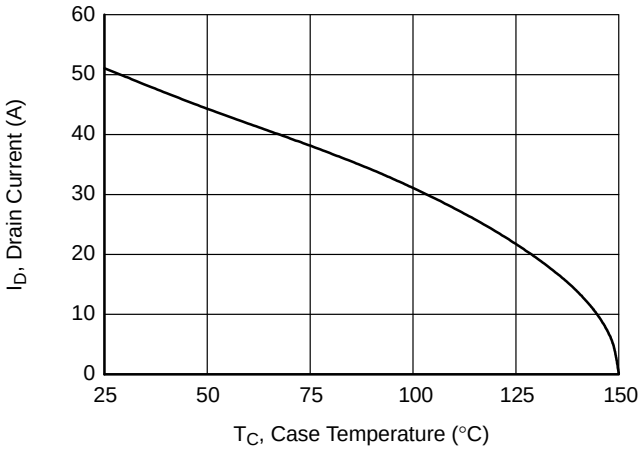


Figure 10. Maximum Drain Current vs. Case Temperature

TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

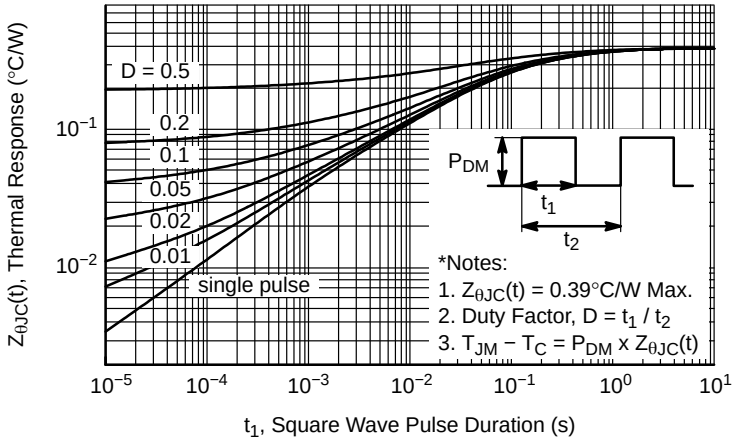


Figure 11−1. Transient Thermal Response Curve for FDP51N25

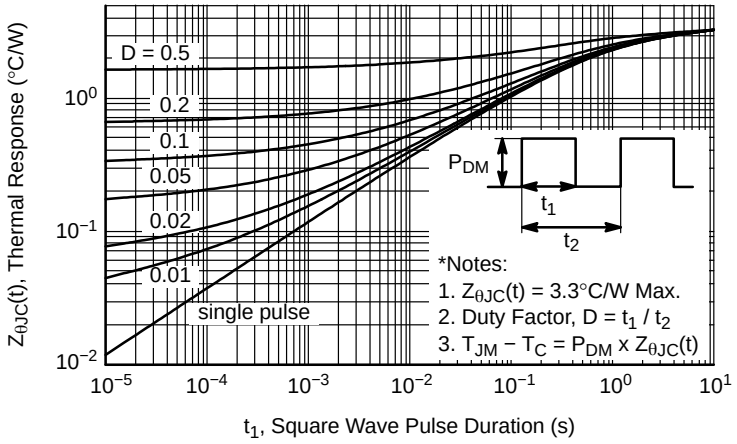


Figure 11−2. Transient Thermal Response Curve for FDPF51N25 / FDPF51N25YDTU

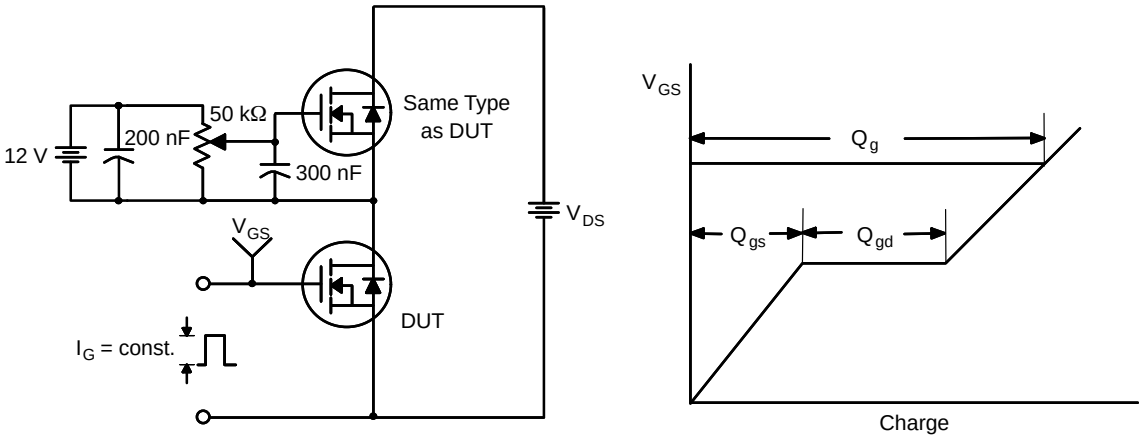


Figure 11. Gate Charge Test Circuit & Waveform

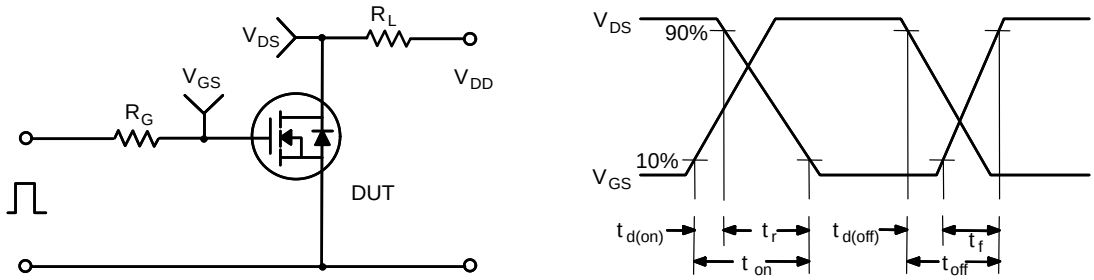


Figure 12. Resistive Switching Test Circuit & Waveforms

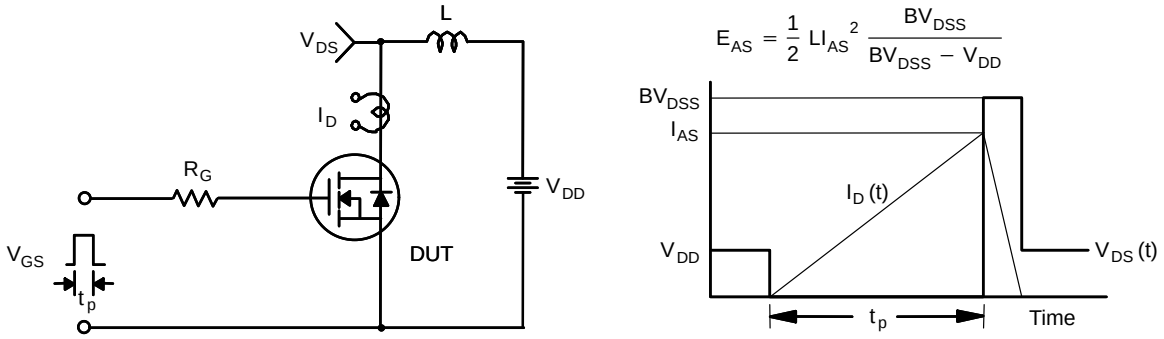
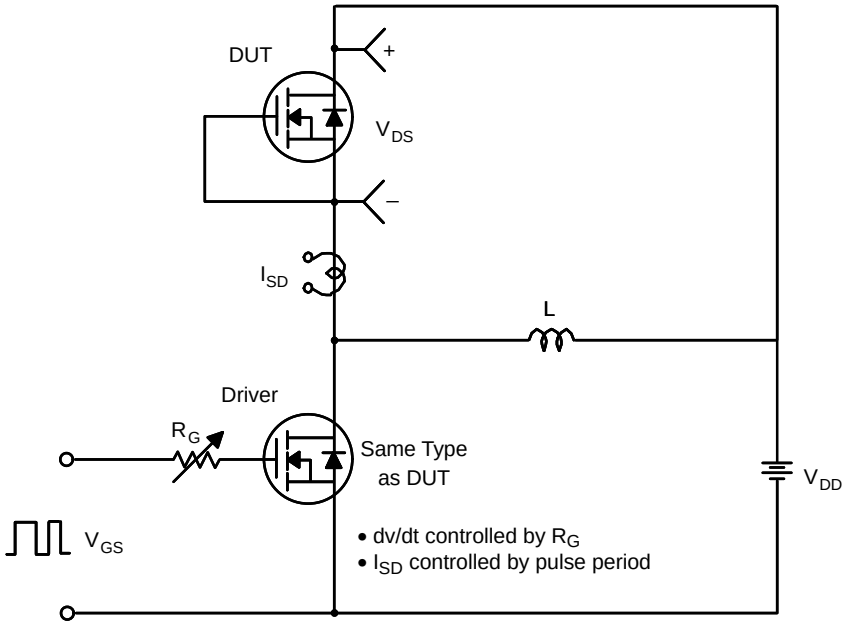
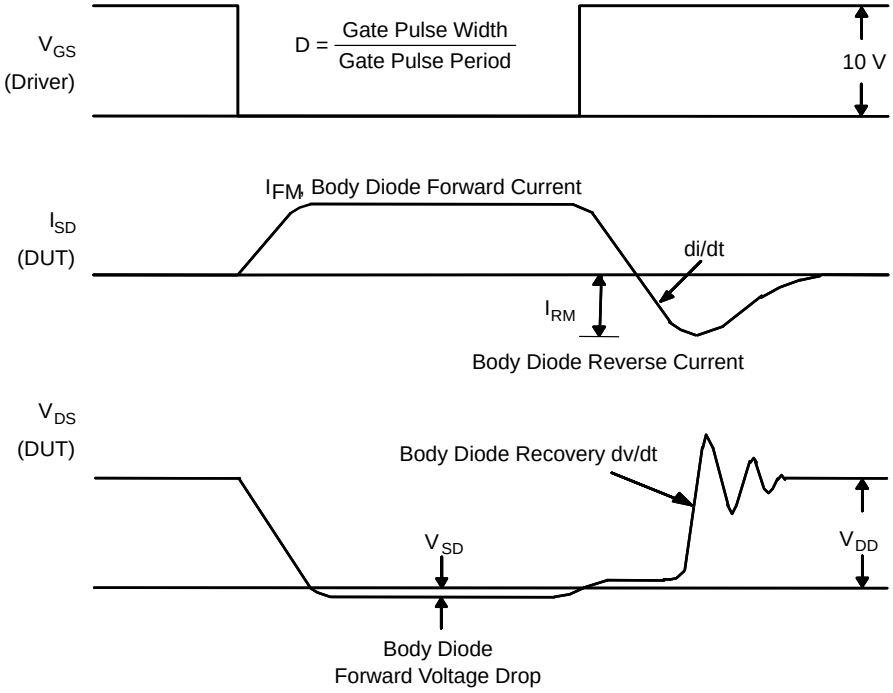


Figure 13. Unclamped Inductive Switching Test Circuit & Waveforms


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 = Gate Pulse Width / Gate Pulse Period
10 V
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

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Mark	Package	Shipping
FDP51N25	FDP51N25	TO−220−3LD CASE 340AT	50 Units / Tube
FDPF51N25	FDPF51N25	TO−220 Fullpack, 3−Lead / TO−220F−3SG CASE 221AT	50 Units / Tube
FDPF51N25YDTU	FDPF51N25	TO−220−3LD LF (Y−formed) CASE 340BJ	50 Units / Tube
FDPF51N25RDTU	FDPF51N25	TO−220−3LD LF (LG−formed) CASE 340BL	50 Units / Tube

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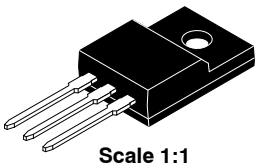
TO−220 Fullpack, 3−Lead / TO−220F−3SG
CASE 221AT
ISSUE B

DATE 19 JAN 2021



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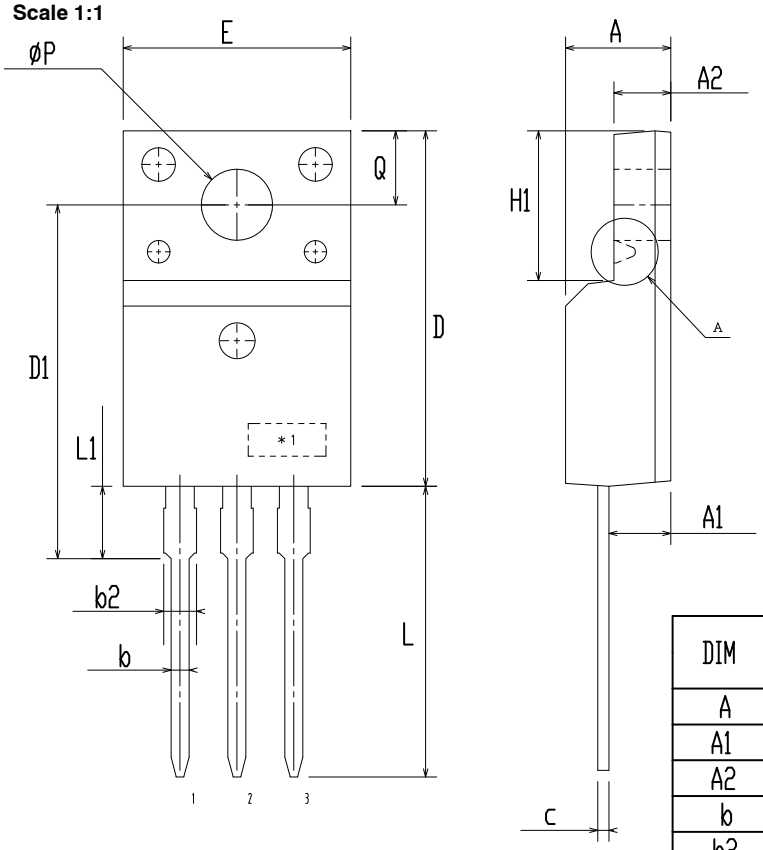

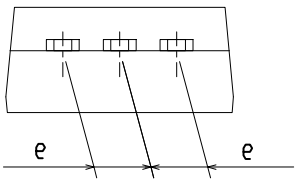

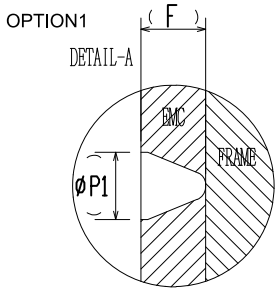

DIM	MILLIMITERS		
	MIN	NOM	MAX
A	4.50	4.70	4.90
A1	2.56	2.76	2.96
A2	2.34	2.54	2.74
b	0.70	0.80	0.90
b2	~	~	1.47
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.60	15.80	16.00
E	9.96	10.16	10.36
e	2.34	2.54	2.74
F	~	0.84	~
H1	6.48	6.68	6.88
L	12.78	12.98	13.18
L1	3.03	3.23	3.43
ø P	2.98	3.18	3.38
ø P1	~	1.00	~
Q	3.20	3.30	3.40

NOTES:
A. DIMENSION AND TOLERANCE AS ASME Y14.5-2009
B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUCSIONS.
C. OPTION 1 - WITH SUPPORT PIN HOLE
OPTION 2 - NO SUPPORT PIN HOLE

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DESCRIPTION:	**TO−220 FULLPACK, 3−LEAD / TO−220F−3SG**	**PAGE 1 OF 1**

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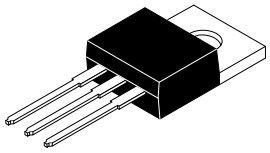
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®

TO−220−3LD
CASE 340AT
ISSUE A

DATE 03 OCT 2017



Scale 1:1

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 PRESENCE IS SUPPLIER DEPENDENT
H) SUPPLIER DEPENDENT MOLD LOCKING HOLES IN HEATSINK.

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DESCRIPTION:	**TO−220−3LD**	**PAGE 1 OF 1**

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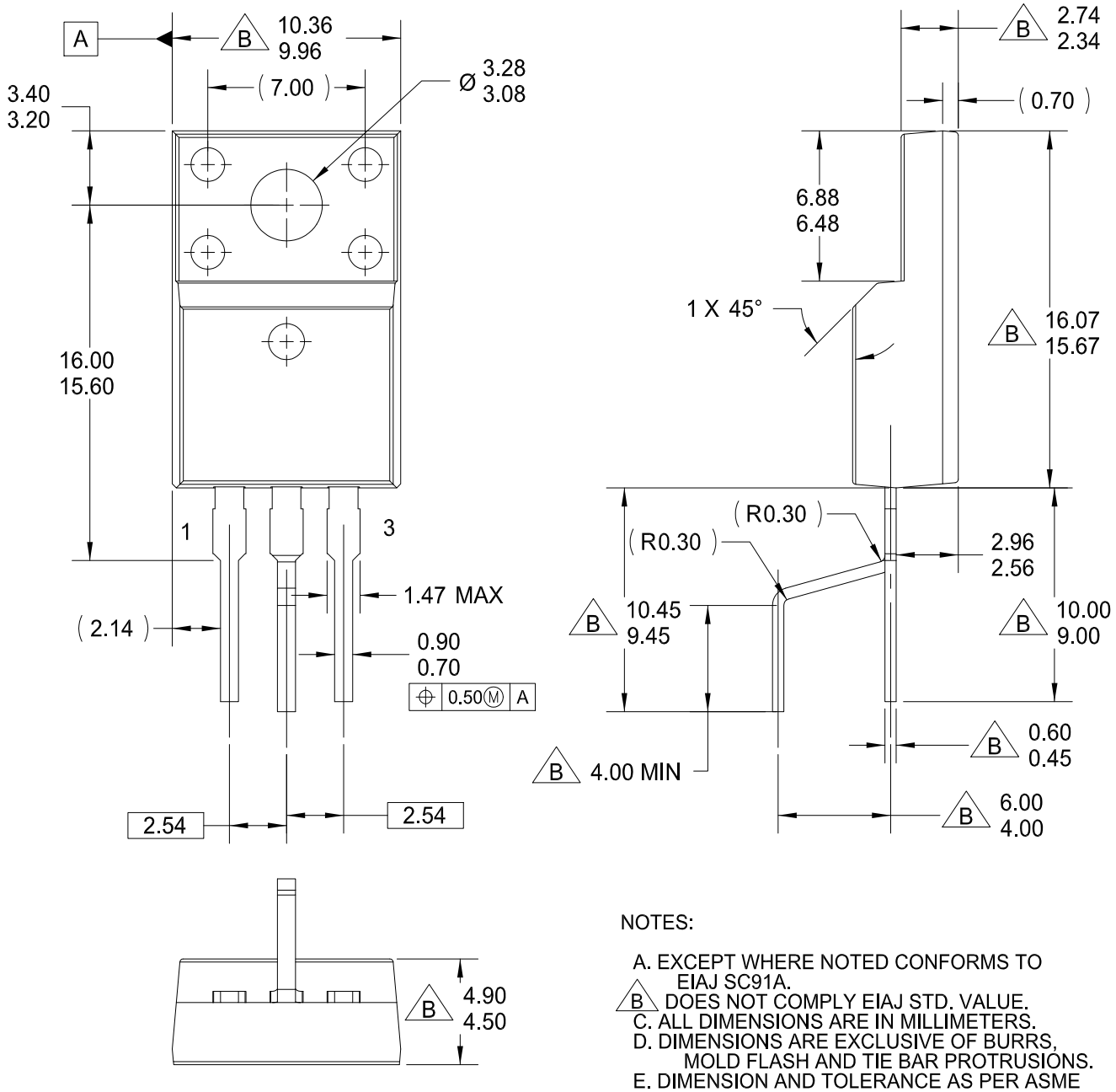
TO−220−3LD LF
CASE 340BJ
ISSUE O

DATE 31 AUG 2016



NOTES:

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C. ALL DIMENSIONS ARE IN MILLIMETERS.
D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
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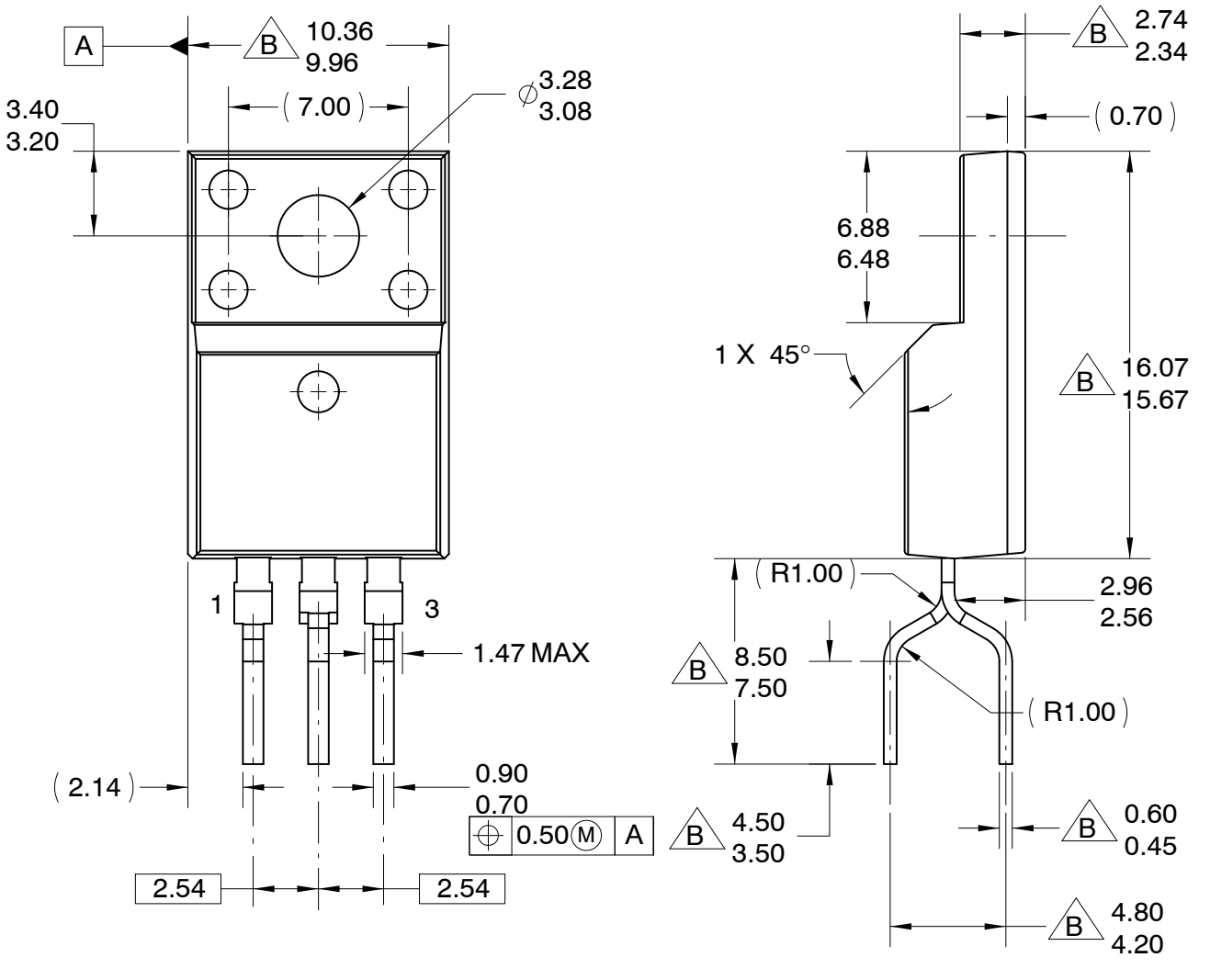

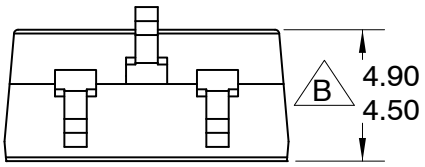

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