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Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

FAIRCHILD
SEMICONDUCTOR®

FDD1600N10ALZD

BoostPak (N-Channel PowerTrench® MOSFET + Diode)
100 V, 6.8 A, 160 mΩ

Features

- $R_{DS(on)}$ = 124 mΩ (Typ.) @ V_{GS} = 10 V, I_D = 3.4 A

- $R_{DS(on)}$ = 175 mΩ (Typ.) @ V_{GS} = 5.0 V, I_D = 2.1 A

- Low Gate Charge (Typ. 2.78 nC)

- Low C_{rss} (Typ. 2.04 pF)

- Fast Switching

- 100% Avalanche Tested

- Improved dv/dt Capability

- RoHS Compliant

Description

This N-Channel MOSFET is produced using Fairchild Semiconductor's PowerTrench® process that has been tailored to minimize the on-state resistance while maintaining superior switching performance.
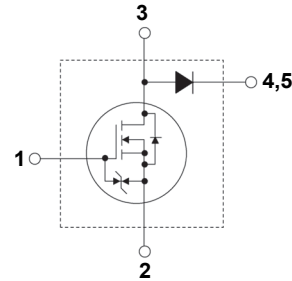
The NP diode is hyperfast rectifier with low forward voltage drop and excellent switching performance.

Applications

- LED Monitor Backlight

- LED TV Backlight

- LED Lighting

- Consumer Appliances,
  DC-DC converter (Step up & Step down)
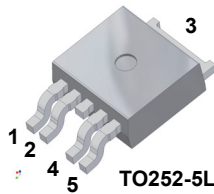
1. Gate
2. Source
3. Drain / Anode
4. Cathode
5. Cathode

TO252-5L

3

▷ 4,5

1

2

Maximum Ratings T_C = 25°C unless otherwise noted.

Symbol	Parameter		FDD1600N10ALZD	Unit
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)	6.8	A
		- Continuous (T_C = 100°C)	4.3	
I_{DM}	Drain Current	- Pulsed (Note 1)	13.6	A
E_{AS}	Single Pulsed Avalanche Energy (Note 2)		5.08	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)		6.0	V/ns
P_D	Power Dissipation	(T_C = 25°C)	14.9	W
		- Derate Above 25°C	0.12	W/°C
I_F	Diode Continuous Forward Current (T_C = 124°C)		4	A
I_{FM}	Diode Maximum Forward Current		40	A
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

Thermal Characteristics

Symbol	Parameter	FDD1600N10ALZD	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case for MOSFET, Max.	8.4	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction to Case for Diode, Max.	3.3	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	87	

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FDD1600N10ALZD	1600N10ALZD	TO-252 5L	Tape and Reel	13"	16 mm	2500 units

Electrical Characteristics of the MOSFET T_C = 25°C unless otherwise noted.

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
BV_{DSS}	Drain to Source Breakdown Voltage	I_D = 250 µA, V_{GS} = 0 V	100	-	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	I_D = 250 µA, Referenced to 25°C	-	0.1	-	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 80 V, V_{GS} = 0 V	-	-	1	µA
		V_{DS} = 80 V, V_{GS} = 0 V, T_C = 125°C	-	-	500	
I_{GSS}	Gate to Source Leakage Current	V_{GS} = ±20 V, V_{DS} = 0 V	-	-	±10	µA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 250 µA	1.4	2.1	2.8	V
$R_{DS(on)}$	Static Drain to Source On Resistance	V_{GS} = 10 V, I_D = 3.4 A	-	124	160	mΩ
		V_{GS} = 5 V, I_D = 2.1 A	-	175	375	
g_{FS}	Forward Transconductance	V_{DS} = 10 V, I_D = 6.8 A	-	19.6	-	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 50 V, V_{GS} = 0 V, f = 1 MHz	-	169	225	pF
C_{oss}	Output Capacitance		-	43	55	pF
C_{rss}	Reverse Transfer Capacitance		-	2.04	-	pF
$C_{oss(er)}$	Energy Related Output Capacitance	V_{DS} = 50 V, V_{GS} = 0 V		85	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	V_{GS} = 10 V	V_{DD} = 50 V, I_D = 6.8 A	-	2.78	3.61	nC
$Q_{g(tot)}$	Total Gate Charge at 5V	V_{GS} = 5 V			1.5	1.95	nC
Q_{gs}	Gate to Source Gate Charge			-	0.72	-	nC
Q_{gd}	Gate to Drain "Miller" Charge			-	0.56	-	nC
$V_{plateau}$	Gate Plateau Volatge		(Note 4)	-	4.02	-	V
Q_{sync}	Total Gate Charge Sync.	V_{DS} = 0 V, I_D = 3.4 A		-	2.5	-	nC
Q_{oss}	Output Charge	V_{DS} = 50 V, V_{GS} = 0 V		-	5.2	-	nC
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 50 V, I_D = 6.8 A, V_{GS} = 10 V, R_G = 4.7 Ω	-	7	24	ns
t_r	Turn-On Rise Time		-	2	14	ns
$t_{d(off)}$	Turn-Off Delay Time		-	13	36	ns
t_f	Turn-Off Fall Time	(Note 4)	-	2	14	ns
ESR	Equivalent Series Resistance (G-S)	f = 1 MHz	-	2.1	-	Ω
Drain-Source Diode Characteristics						
I_S	Maximum Continuous Drain to Source Diode Forward Current		-	-	6.8	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	13.6	A
V_{SD}	Drain to Source Diode Forward Voltage	V_{GS} = 0 V, I_{SD} = 6.8 A	-	-	1.3	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_{SD} = 6.8 A, V_{DS} = 50 V, dI_F/dt = 100 A/µs	-	37	-	ns
Q_{rr}	Reverse Recovery Charge		-	42	-	nC

Notes:

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. L = 1 mH, I_{AS} = 3.18 A, R_G = 25 Ω, starting T_J = 25°C.
3. I_{SD} ≤ 6.8 A, di/dt ≤ 200 A/µs, V_{DD} ≤ BV_{DSS}, starting T_J = 25°C.
4. Essentially independent of operating temperature typical characteristics.

Electrical Characteristics of the Diode T_C = 25°C unless otherwise noted.

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
V_R	DC Blocking Voltage	I_R = 1 mA		150	-	-	V
V_{FM}	Maximum Instantaneous Forward Voltage	I_F = 4 A	T_C = 25°C	-	-	2.5	V
			T_C = 125°C	-	1.01	-	
I_{RM}	Maximum Instantaneous Reverse Current @ rated V_R		T_C = 25°C	-	-	50	uA
			T_C = 125°C	-	-	1000	
t_{rr}	Diode Reverse Recovery Time	I_F = 4 A, dI/dt = 200 A/µs	T_C = 25°C	-	12.7	26	ns
			T_C = 125°C	-	17.1	-	
I_{rr}	Diode Peak Reverse Recovery Current		T_C = 25°C	-	2.6	6	A
			T_C = 125°C	-	3.8	-	
Q_{rr}	Diode Reverse Recovery Charge		T_C = 25°C	-	18.3	-	nC
			T_C = 125°C	-	35.7	-	
W_{AVL}	Avalanche Energy (L = 40 mH)			10	-	-	mJ

Typical Performance Characteristics - MOSFET

Figure 1. On-Region Characteristics

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

V_{GS} = 15.0V
10.0V
8.0V
6.0V
5.0V
4.5V
4.0V
3.5V

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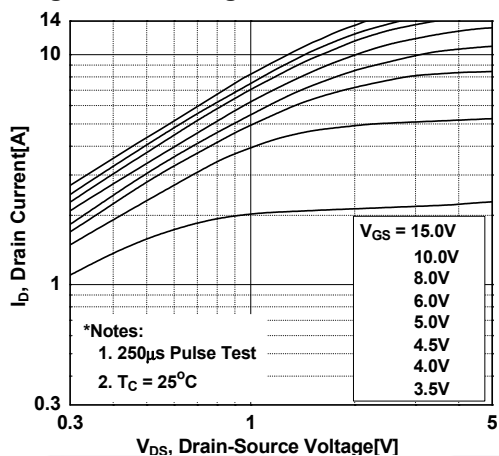
Figure 2. Transfer Characteristics

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

*Notes:
1. V_{DS} = 10V
2. 250µs Pulse Test

150°C
25°C
-55°C
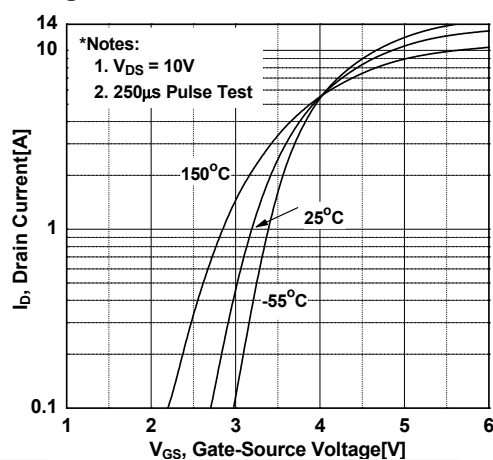
Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

$R_{DS(ON)}$ [mΩ], Drain-Source On-Resistance vs I_D, Drain Current [A]

V_{GS} = 5V
V_{GS} = 10V

*Note: T_C = 25°C
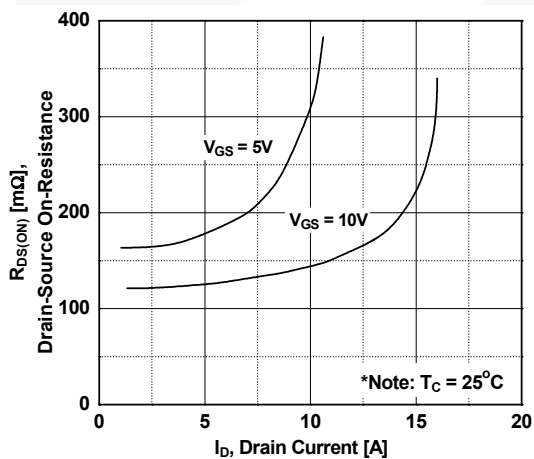
Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

I_S, Reverse Drain Current [A] vs V_{SD}, Body Diode Forward Voltage [V]

150°C
25°C

*Notes:
1. V_{GS} = 0V
2. 250µs Pulse Test
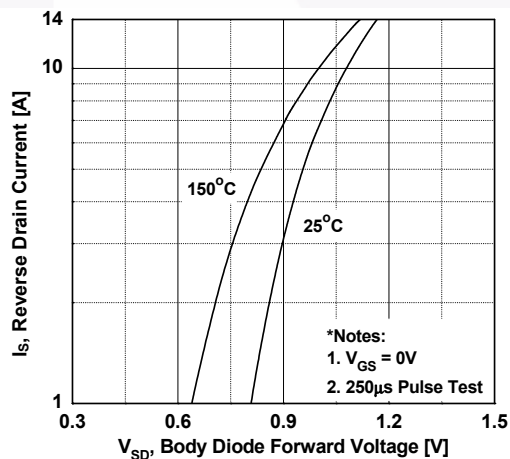
Figure 5. Capacitance Characteristics

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

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

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

C_{iss} = C_{gs} + C_{gd} (C_{ds} = shorted)
C_{oss} = C_{ds} + C_{gd}
C_{rss} = C_{gd}
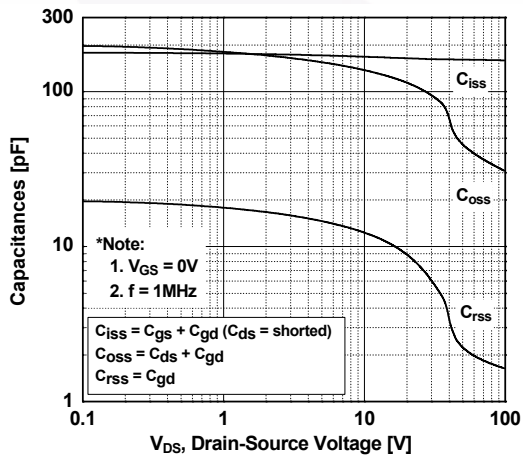
Figure 6. Gate Charge Characteristics

V_{GS}, Gate-Source Voltage [V] vs Q_g, Total Gate Charge [nC]

V_{DS} = 20V
V_{DS} = 50V
V_{DS} = 80V

*Note: I_D = 3.4A
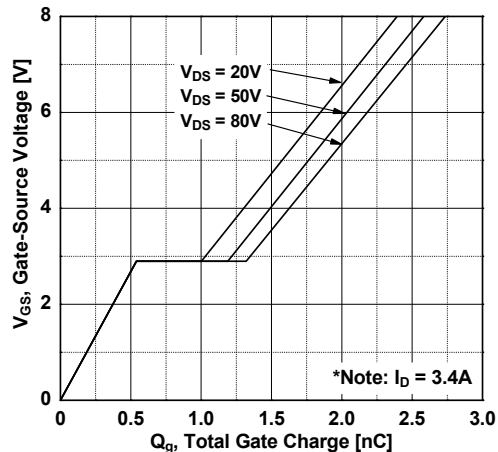
Typical Performance Characteristics - MOSFET (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

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

*Notes:
1. V$_{GS}$ = 0V
2. I$_D$ = 250µA
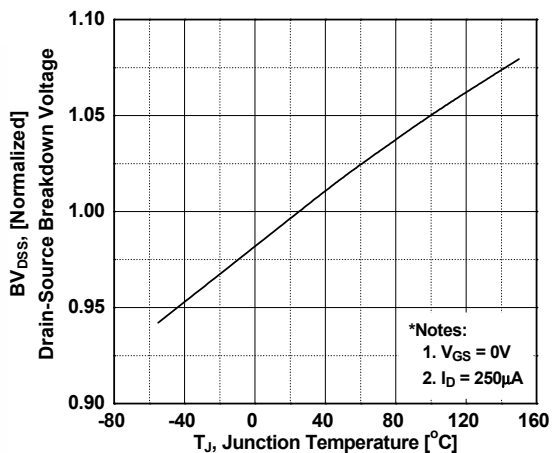
Figure 8. On-Resistance Variation vs. Temperature

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

*Notes:
1. V$_{GS}$ = 10V
2. I$_D$ = 3.4A
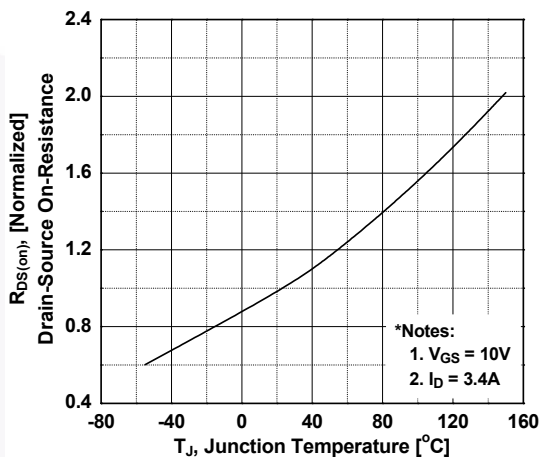
Figure 9. Maximum Safe Operating Area

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

100us
1ms
10ms
100ms
DC

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

SINGLE PULSE
T$_C$ = 25°C
T$_J$ = 150°C
R$_{θJC}$ = 8.4°C/W
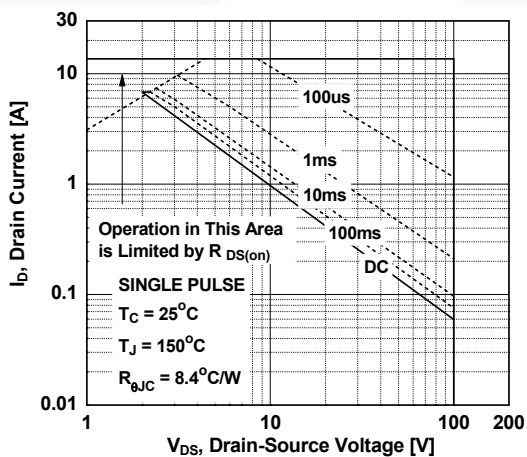
Figure 10. Maximum Drain Current vs. Case Temperature

I$_D$, Drain Current [A] vs. T$_C$, Case Temperature [°C]

V$_{GS}$ = 10V
V$_{GS}$ = 5V
R$_{θJC}$ = 8.4°C/W
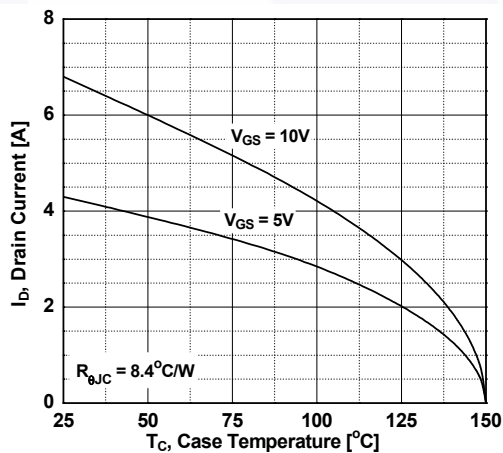
Figure 11. Eoss vs. Drain to Source Voltage

E$_{OSS}$ [µJ] vs. V$_{DS}$, Drain to Source Voltage [V]
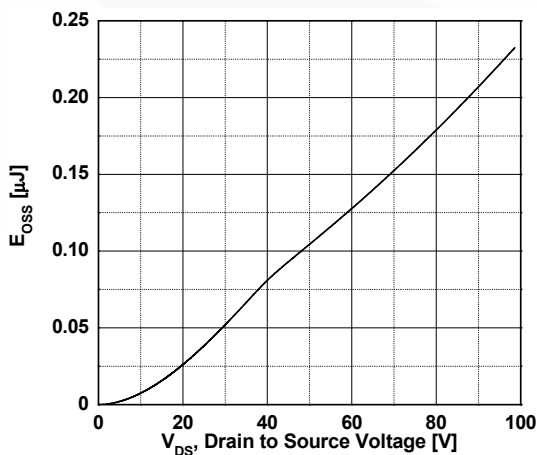
Figure 12. Unclamped Inductive Switching Capability

I$_{AS}$, AVALANCHE CURRENT (A) vs. t$_{AV}$, TIME IN AVALANCHE (ms)

T$_J$ = 25 °C
T$_J$ = 125 °C
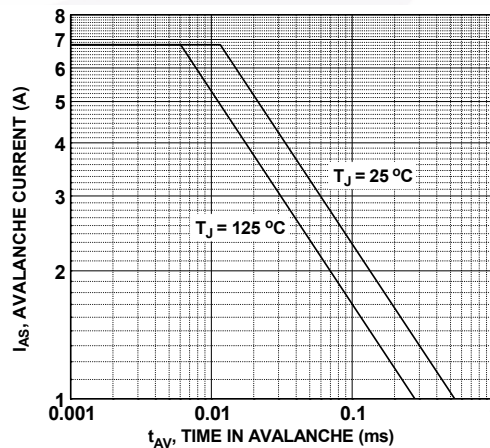
Typical Performance Characteristics - Diode (Continued)

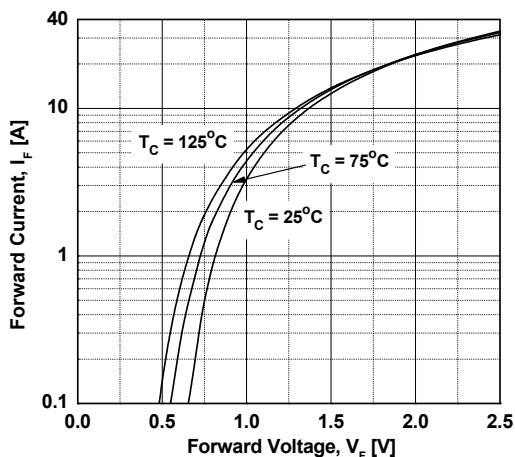### Figure 13. Forward Voltage Drop vs. Forward Current
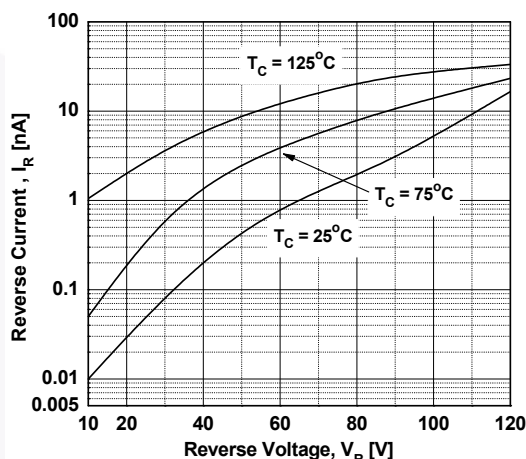

Figure 14. Reverse Current vs. Reverse Voltage

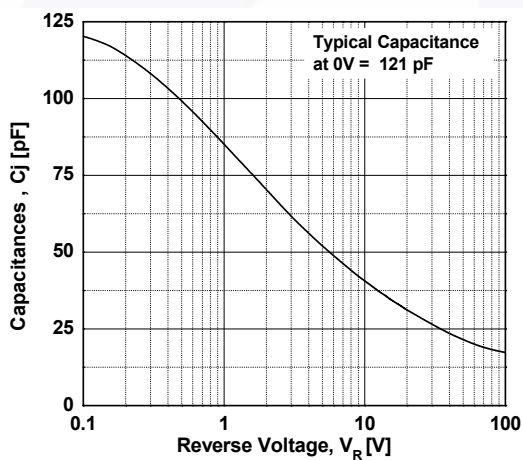### Figure 15. Junction Capacitance

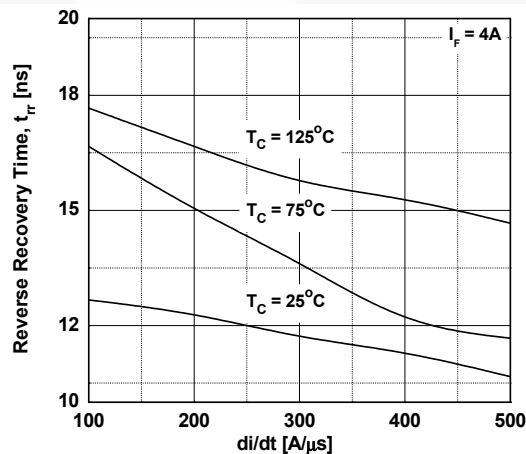### Figure 16. Reverse Recovery Time vs. di/dt

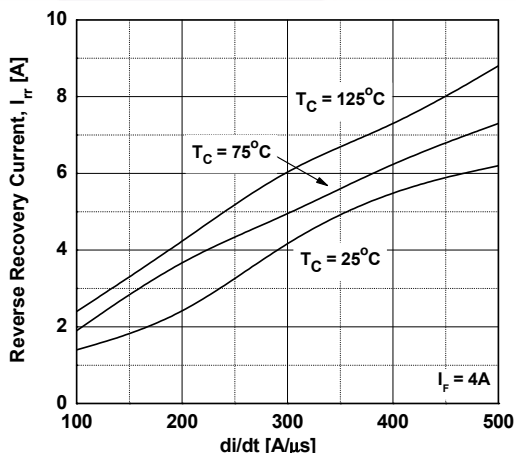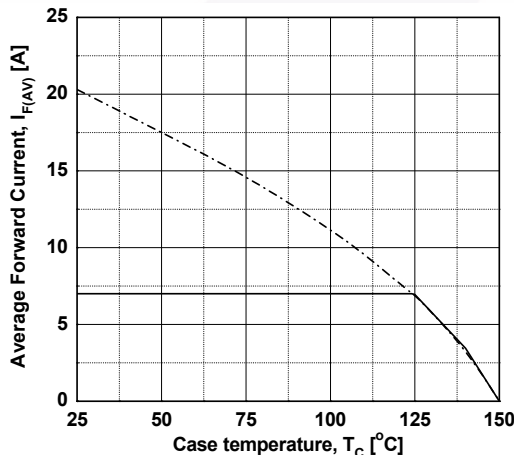### Figure 17. Reverse Recovery Current vs. di/dt

Figure 18. Forward Current Derating Curve

Typical Performance Characteristics (Continued)
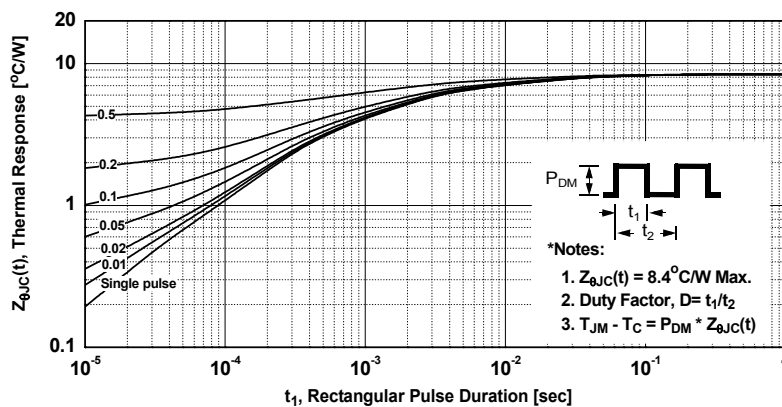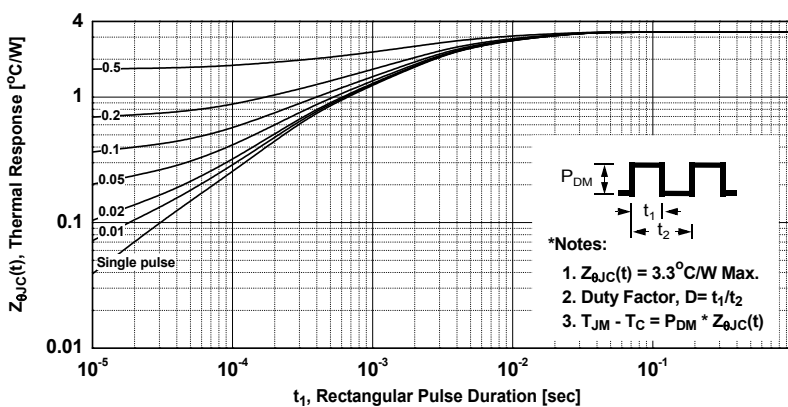
Figure 19. Transient Thermal Response Curve of MOSFET

*Notes:
1. $Z_{\theta JC}(t)$ = 8.4°C/W Max.
2. Duty Factor, D= t_1/t_2
3. $T_{JM} - T_C = P_{DM} * Z_{\theta JC}(t)$

Figure 20. Transient Thermal Response Curve of Diode

*Notes:
1. $Z_{\theta JC}(t)$ = 3.3°C/W Max.
2. Duty Factor, D= t_1/t_2
3. $T_{JM} - T_C = P_{DM} * Z_{\theta JC}(t)$
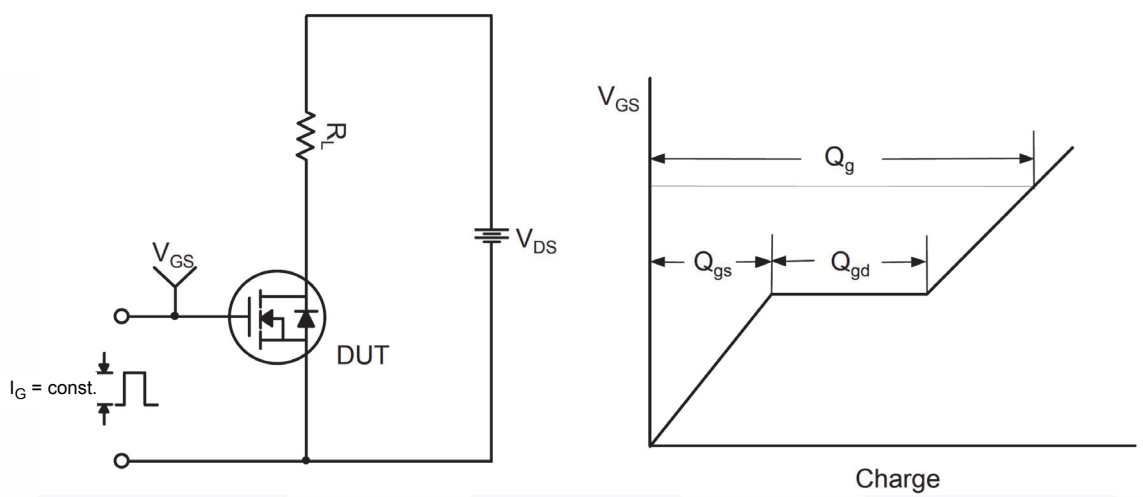
Figure 21. Gate Charge Test Circuit & Waveform
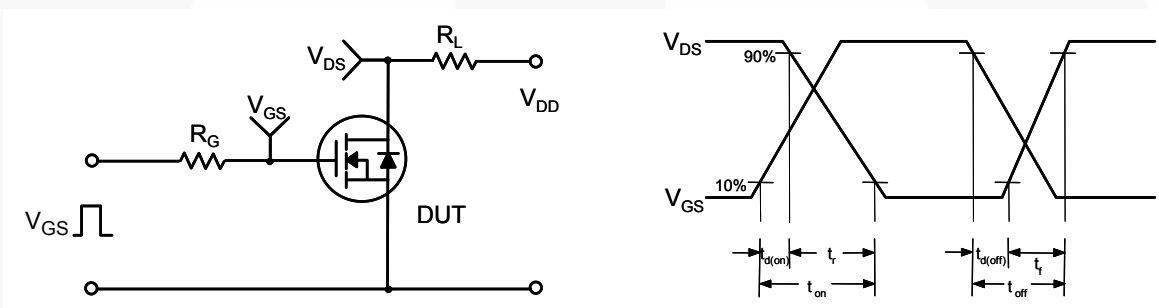
Figure 22. Resistive Switching Test Circuit & Waveforms

$$E_{AS} = \frac{1}{2} L I_{AS}^2$$
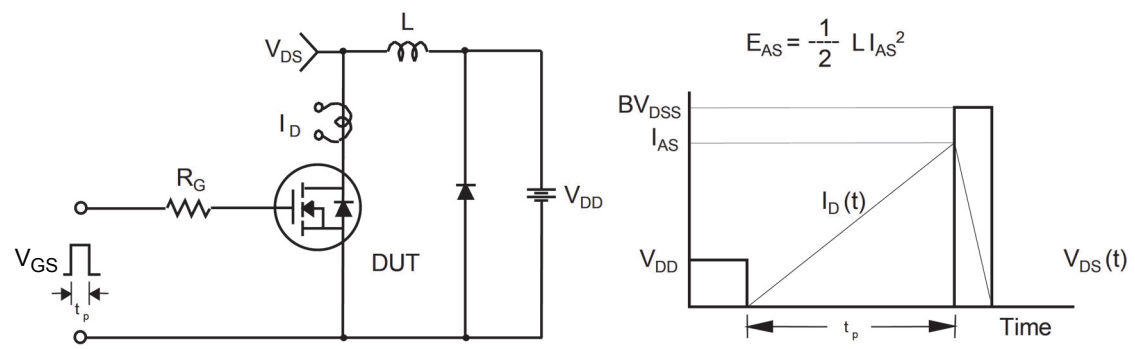
Figure 23. Unclamped Inductive Switching Test Circuit & Waveforms

$$D = \frac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$$
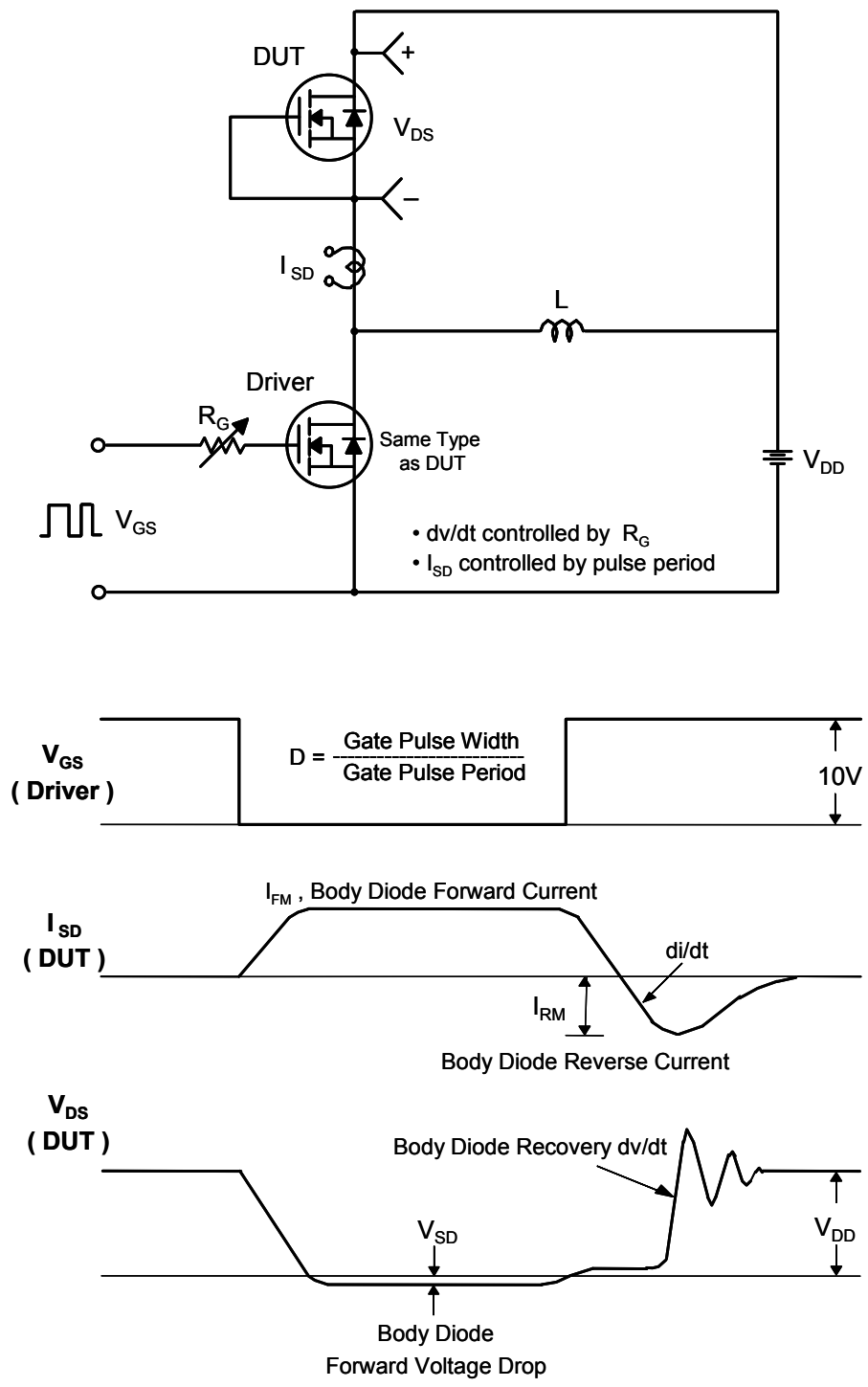
Figure 24. Peak Diode Recovery dv/dt Test Circuit & Waveforms
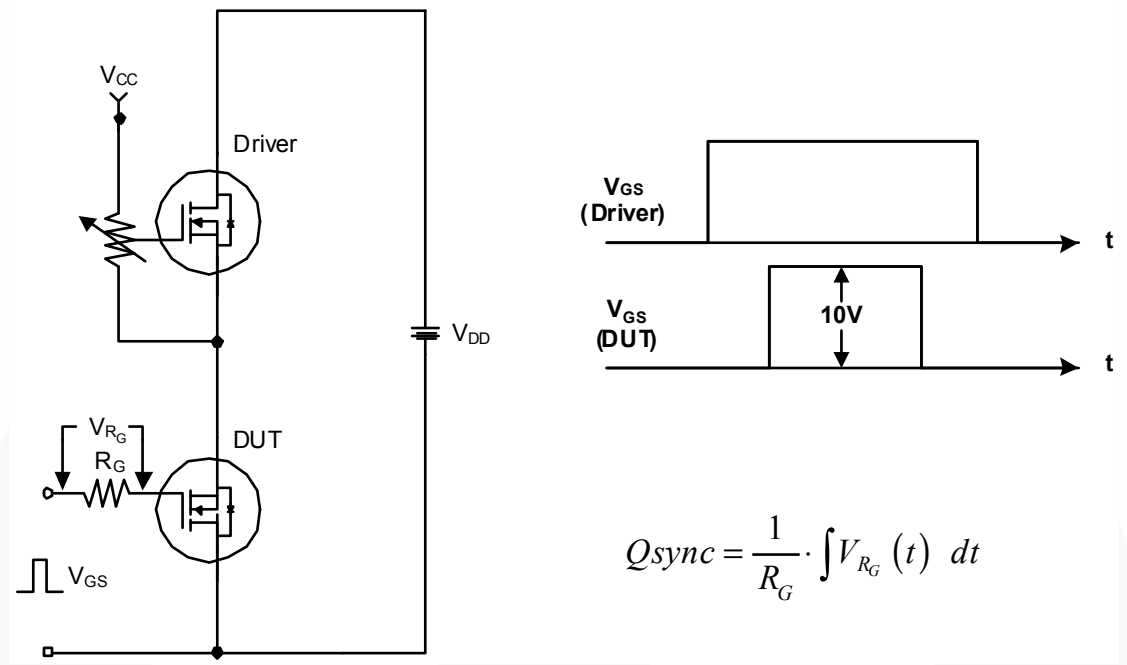
$$Qsync = \frac{1}{R_G} \cdot \int V_{R_G}(t) \ dt$$

Figure 25. Total Gate Charge Qsync. Test Circuit & Waveforms

Mechanical Dimensions
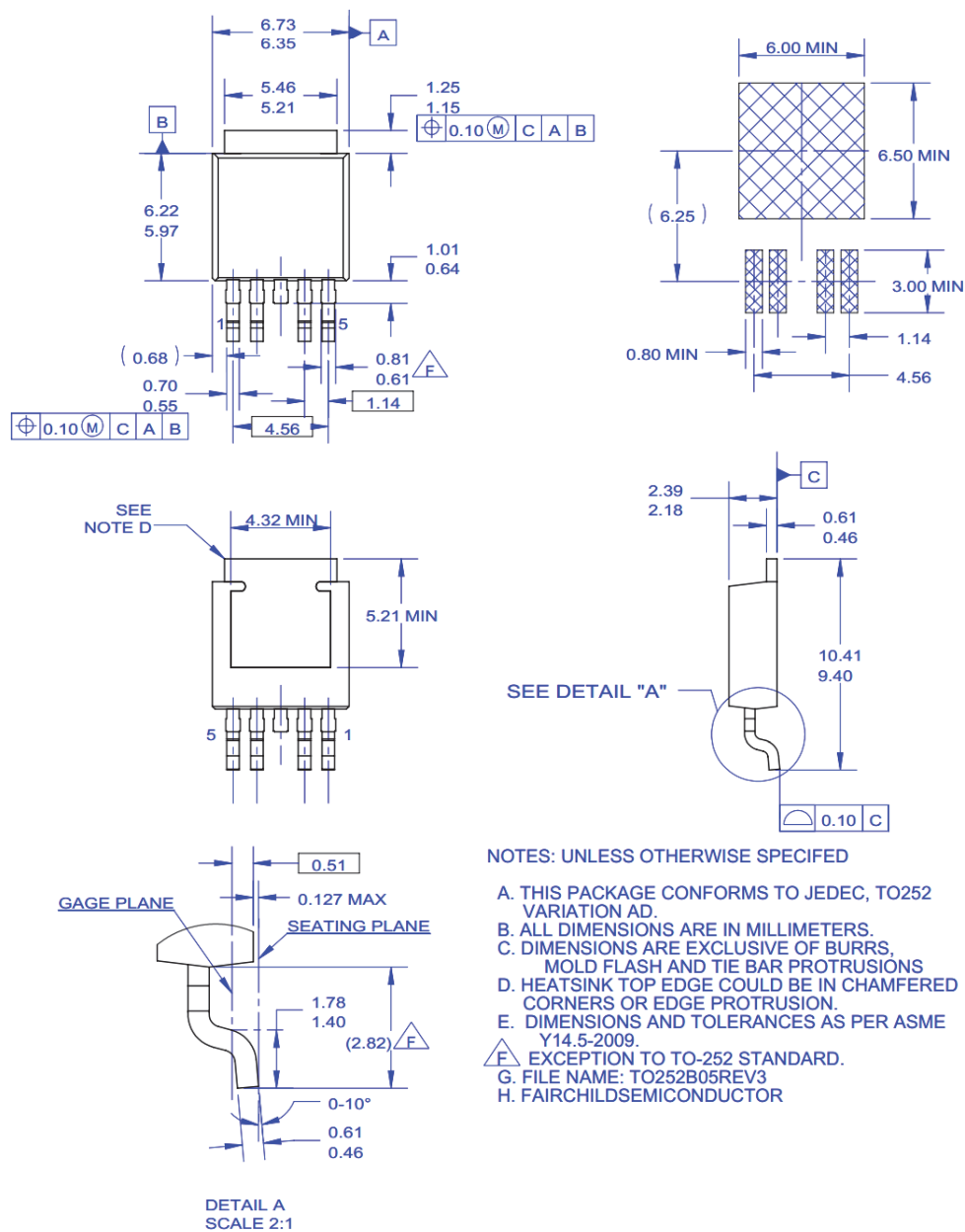
Figure 26. TO252 (D-PAK), Molded, 5-Lead, Option AD

NOTES: UNLESS OTHERWISE SPECIFED

A. THIS PACKAGE CONFORMS TO JEDEC, TO252 VARIATION AD.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS
D. HEATSINK TOP EDGE COULD BE IN CHAMFERED CORNERS OR EDGE PROTRUSION.
E. DIMENSIONS AND TOLERANCES AS PER ASME Y14.5-2009.
F. EXCEPTION TO TO-252 STANDARD.
G. FILE NAME: TO252B05REV3
H. FAIRCHILDSEMICONDUCTOR

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http://www.fairchildsemi.com/package/packageDetails.html?id=PN_TT252-005

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2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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PRODUCT STATUS DEFINITIONS
Definition of Terms

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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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