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August 2014

FCD5N60 / FCU5N60

N-Channel SuperFET® MOSFET

600 V, 4.6 A, 950 mΩ

Features

- 650 V @ T_J = 150°C
- Typ. $R_{DS(on)}$ = 810 mΩ
- Ultra Low Gate Charge (Typ. Q_g = 16 nC)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)}$ = 32 pF)
- 100% Avalanche Tested
- RoHS Compliant

Application

- LCD/LED TV and Monitor
- Lighting
- Solar Inverter
- AC-DC Power Supply

Description

SuperFET® MOSFET is Fairchild Semiconductor's first genera-tion of high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This technology is tailored to minimize conduction loss, provide superior switch-ing performance, dv/dt rate and higher avalanche energy. Con-sequently, SuperFET MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications.
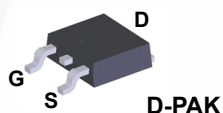
D-PAK
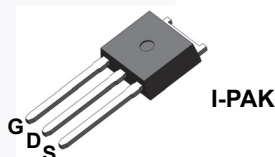
I-PAK
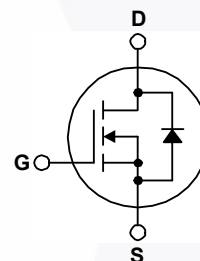
MOSFET Maximum Ratings T_C = 25°C unless otherwise noted.

Symbol	Parameter			FCD5N60TM FCD5N60TM_WS FCU5N60TU	Unit
V_{DSS}	Drain to Source Voltage			600	V
I_D	Drain Current	- Continuous (T_C = 25°C)		4.6	A
		- Continuous (T_C = 100°C)		2.9	
I_{DM}	Drain Current	- Pulsed	(Note 1)	13.8	A
V_{GSS}	Gate to Source Voltage			±30	V
E_{AS}	Single Pulsed Avalanche Energy		(Note 2)	159	mJ
I_{AR}	Avalanche Current		(Note 1)	4.6	A
E_{AR}	Repetitive Avalanche Energy		(Note 1)	5.4	mJ
dv/dt	Peak Diode Recovery dv/dt		(Note 3)	4.5	V/ns
P_D	Power Dissipation	(T_C = 25°C)		54	W
		- Derate Above 25°C		0.43	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

Thermal Characteristics

Symbol	Parameter	FCD5N60TM FCD5N60TM_WS FCU5N60TU	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	2.3	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	83	

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Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FCD5N60TM	FCD5N60	D-PAK	Tape and Reel	330 mm	16 mm	2500 units
FCD5N60TM_WS	FCD5N60	D-PAK	Tape and Reel	330 mm	16 mm	2500 units
FCU5N60TU	FCU5N60	IPAK	Tube	N/A	N/A	75 units

Electrical Characteristics T_C = 25°C unless otherwise noted.

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
BV_{DSS}	Drain to Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 µA, T_C = 25°C	600	-	-	V
		V_{GS} = 0 V, I_D = 250 µA, T_C = 150°C	-	650	-	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250 µA, Referenced to 25°C	-	0.6	-	V/°C
BV_{DS}	Drain to Source Avalanche Breakdown Voltage	V_{GS} = 0 V, I_D = 4.6 A	-	700	-	V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 600 V, V_{GS} = 0 V	-	-	1	µA
		V_{DS} = 480 V, T_C = 125°C	-	-	10	
I_{GSS}	Gate to Body Leakage Current	V_{GS} = ±30 V, V_{DS} = 0 V	-	-	±100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 250 µA	3.0	-	5.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	V_{GS} = 10 V, I_D = 2.3 A	-	0.81	0.95	Ω
g_{FS}	Forward Transconductance	V_{DS} = 40 V, I_D = 2.3 A	-	3.8	-	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1 MHz	-	470	600	pF
C_{oss}	Output Capacitance		-	250	320	pF
C_{rss}	Reverse Transfer Capacitance		-	22	-	pF
C_{oss}	Output Capacitance	V_{DS} = 480 V, V_{GS} = 0 V, f = 1 MHz	-	12	-	pF
$C_{oss(eff.)}$	Effective Output Capacitance	V_{DS} = 0 V to 400 V, V_{GS} = 0 V	-	32	-	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 300 V, I_D = 4.6 A, V_{GS} = 10 V, R_G = 25 Ω	-	12	30	ns
t_r	Turn-On Rise Time		-	40	90	ns
$t_{d(off)}$	Turn-Off Delay Time		-	47	95	ns
t_f	Turn-Off Fall Time	(Note 4)	-	22	55	ns
$Q_{g(tot)}$	Total Gate Charge at 10V	V_{DS} = 480 V, I_D = 4.6 A, V_{GS} = 10 V	-	16	-	nC
Q_{gs}	Gate to Source Gate Charge		-	2.8	-	nC
Q_{gd}	Gate to Drain "Miller" Charge	(Note 4)	-	7	-	nC
Drain-Source Diode Characteristics						
I_S	Maximum Continuous Drain to Source Diode Forward Current		-	-	4.6	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	13.8	A
V_{SD}	Drain to Source Diode Forward Voltage	V_{GS} = 0 V, I_{SD} = 4.6 A	-	-	1.4	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_{SD} = 4.6 A, dI_F/dt = 100 A/µs	-	295	-	ns
Q_{rr}	Reverse Recovery Charge		-	2.7	-	µC

Notes:

1. Repetitive rating: pulse-width limited by maximum junction temperature.

2. I_{AS} = 2.3 A, V_{DD} = 50 V, R_G = 25 Ω, starting T_J = 25°C.

3. I_{SD} ≤ 4.6 A, di/dt ≤ 200 A/µs, V_{DD} ≤ BV_{DSS}, starting T_J = 25°C.

4. Essentially independent of operating temperature typical characteristics.

Typical Performance Characteristics
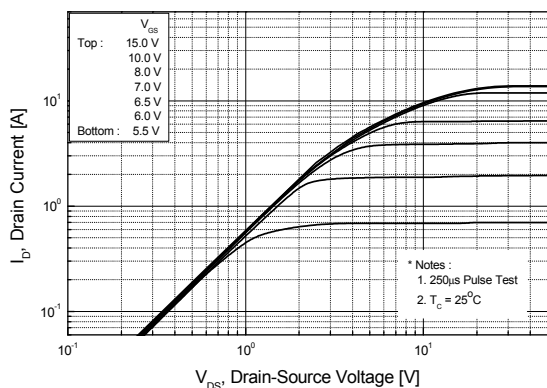
Figure 1. On-Region Characteristics

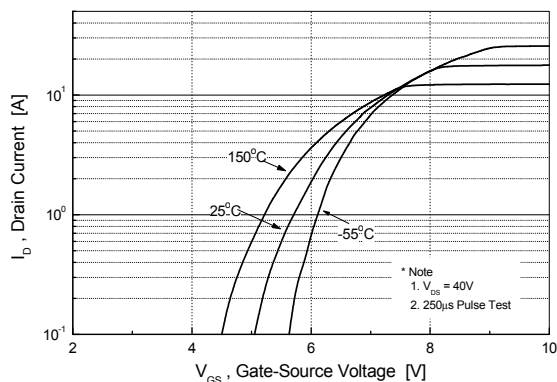### Figure 2. Transfer Characteristics

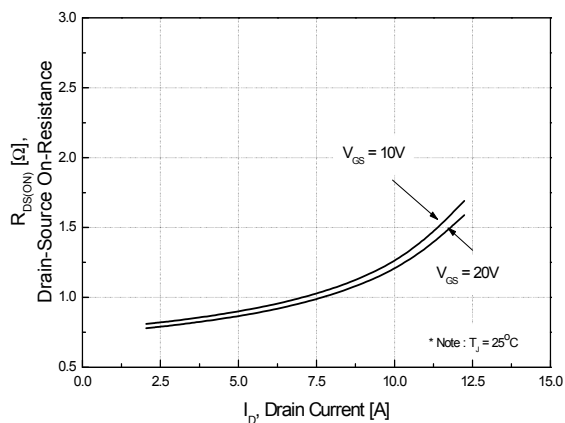### Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

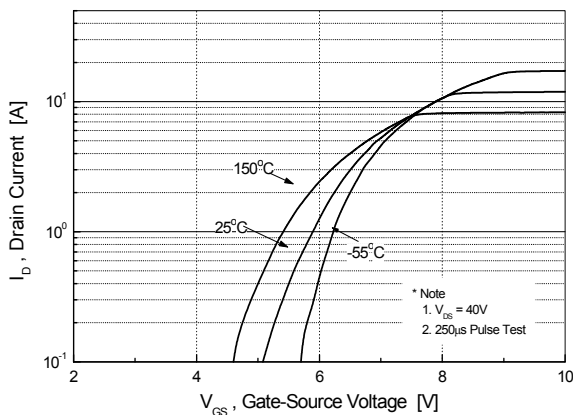### Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperatue
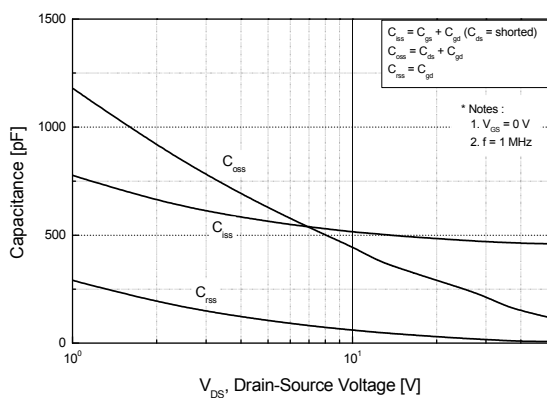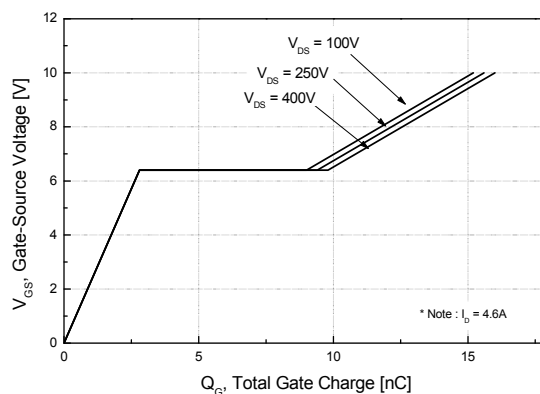

Figure 5. Capacitance Characteristics

Figure 6. Gate Charge Characteristics

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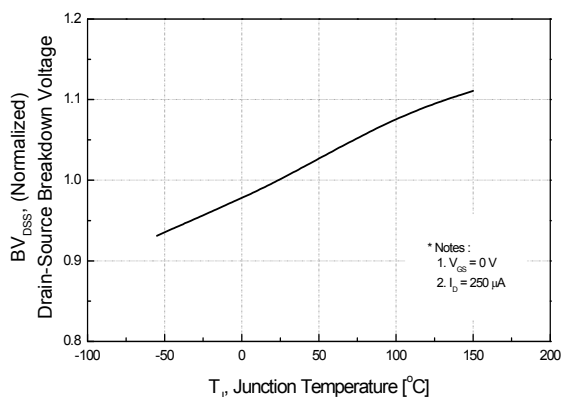
Figure 7. Breakdown Voltage Variation vs. Temperature

BV_{DSS}, (Normalized) Drain-Source Breakdown Voltage

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

T_J, Junction Temperature [°C]

* Notes :
1. V_{GS} = 10 V
2. I_D = 2.3 A
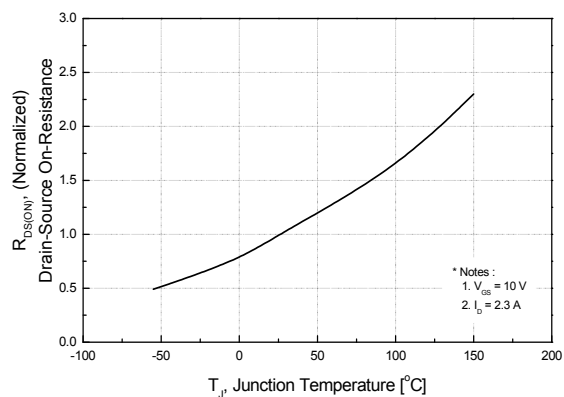
Figure 9. Maximum Safe Operating Area

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

10 us
100 us
1 ms
10 ms
100 ms
DC

I_D, Drain Current [A]

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

* Notes :
1. T_C = 25 °C
2. T_J = 150 °C
3. Single Pulse
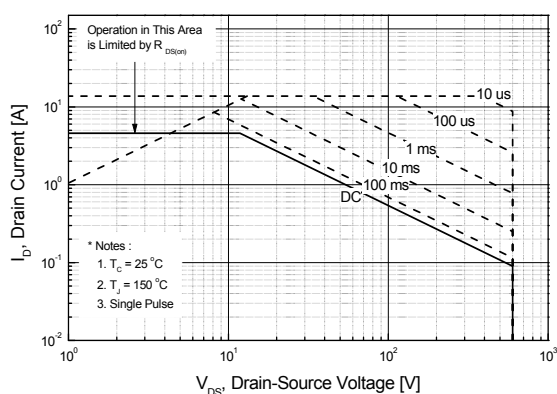
Figure 10. Maximum Drain Current vs. Case Temperature

I_D, Drain Current [A]

T_C, Case Temperature [°C]
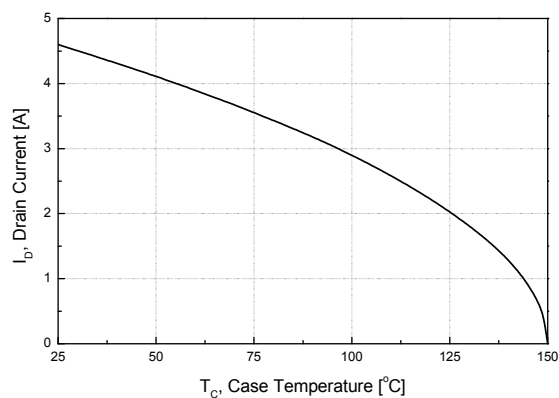
Figure 11. Transient Thermal Response Curve

D = 0.5
0.2
0.1
0.05
0.02
0.01
single pulse

$Z_{\theta JC}(t)$, Thermal Response [°C/W]

t_1, Square Wave Pulse Duration [sec]

* Notes :
1. $Z_{\theta JC}(t)$ = 2.3 °C/W Max.
2. Duty Factor, D = t_1/t_2
3. $T_{JM} - T_C = P_{DM} * Z_{\theta JC}(t)$

P_{DM}
t_1
t_2
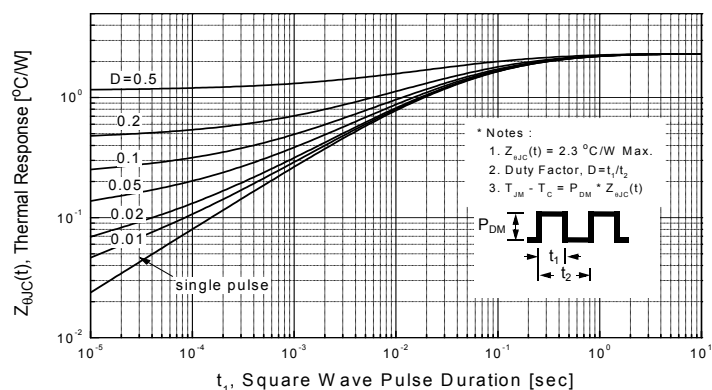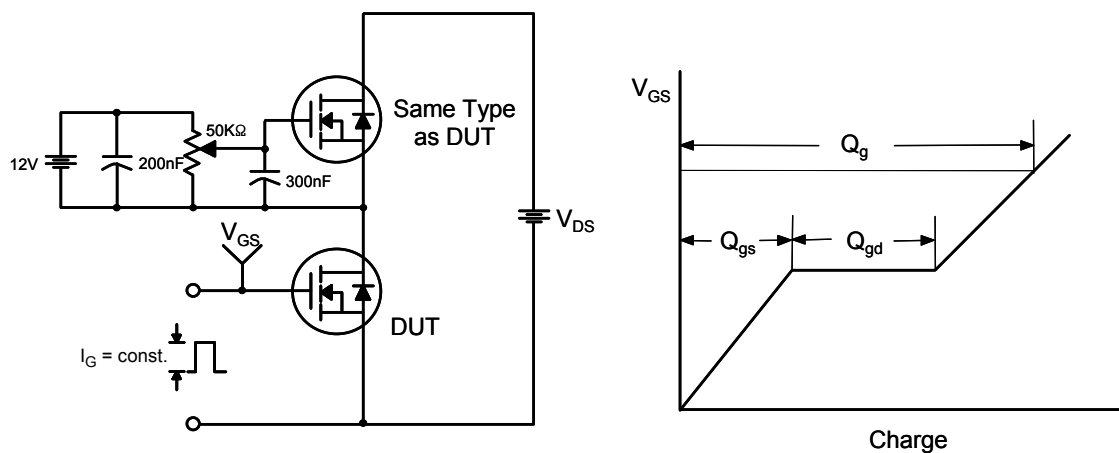
Figure 12. Gate Charge Test Circuit & Waveform
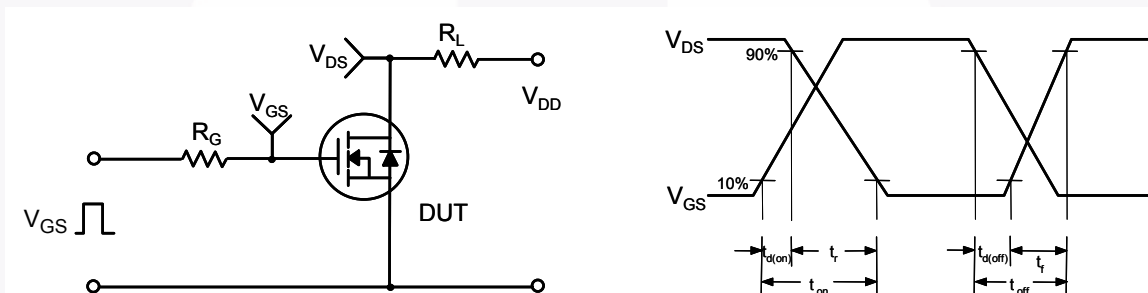
Figure 13. Resistive Switching Test Circuit & Waveforms

$$E_{AS} = \frac{1}{2} \, L \, I_{AS}^2 \; \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$
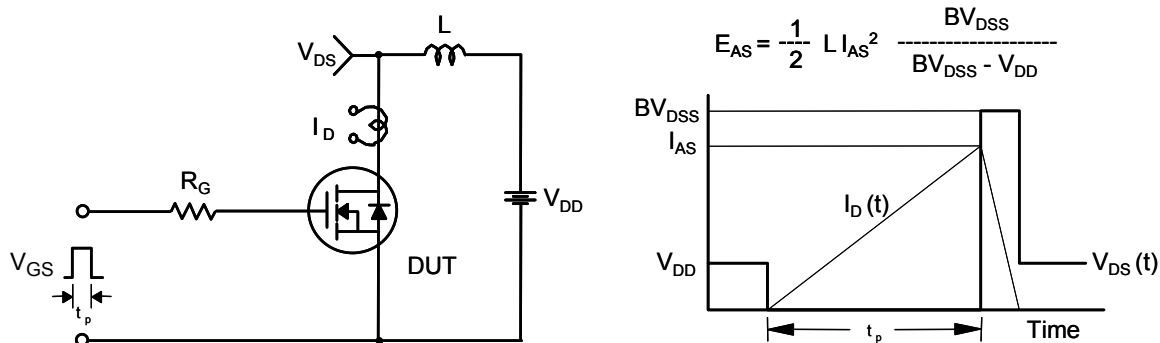
Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

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
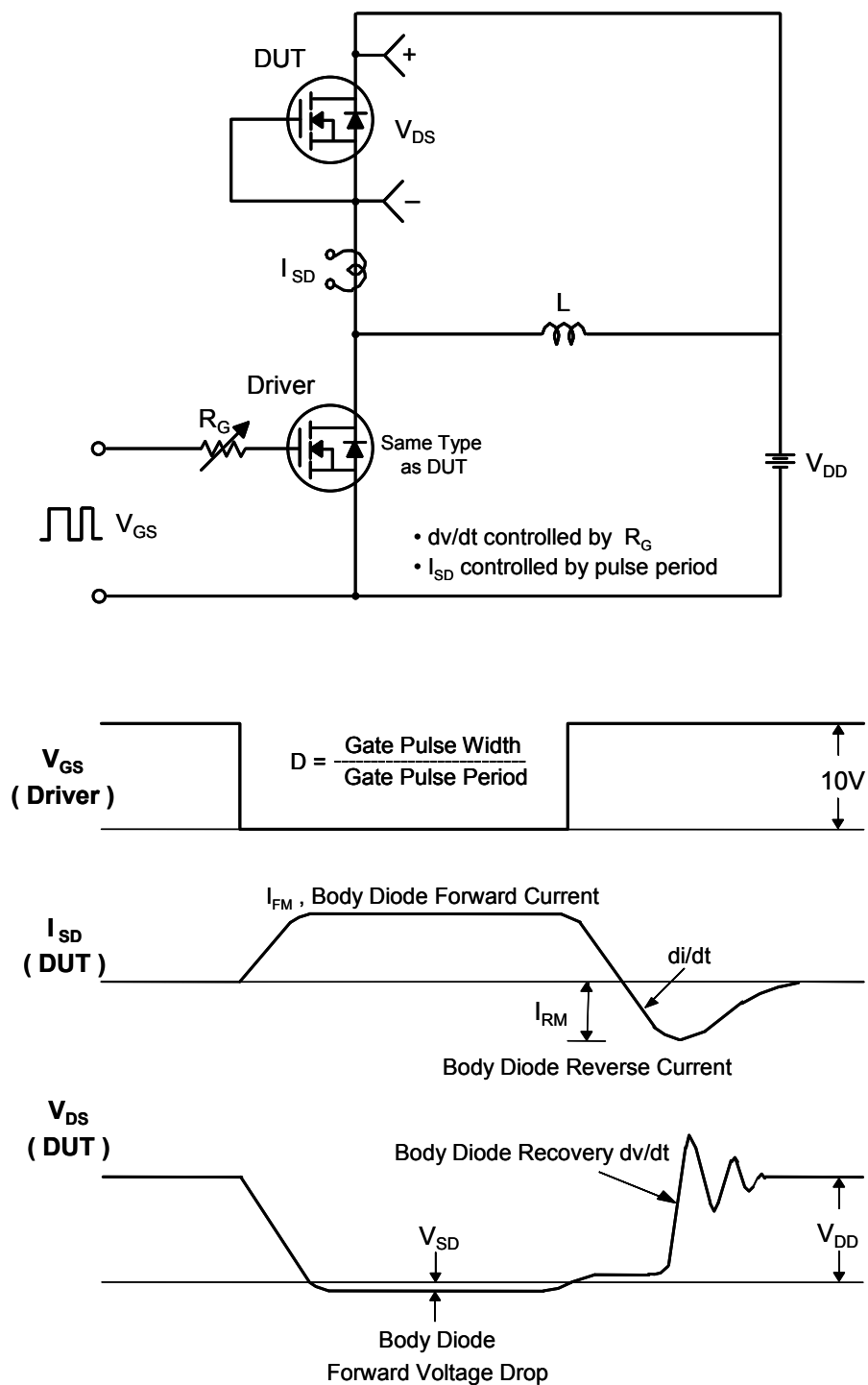
Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms

PUBLICATION ORDERING INFORMATION

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