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FCPF125N65S3

N-Channel SuperFET® III MOSFET

650 V, 24 A, 125 mΩ

Features

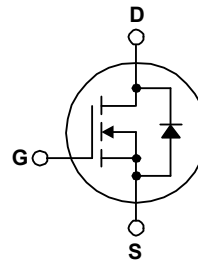
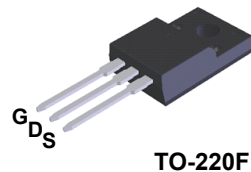
- 700 V @ $T_J = 150^\circ\text{C}$
- Typ. $R_{DS(on)} = 105\text{ m}\Omega$
- Ultra Low Gate Charge (Typ. $Q_g = 44\text{ nC}$)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)} = 405\text{ pF}$)
- 100% Avalanche Tested
- RoHS Compliant

Applications

- Computing / Display Power Supplies
- Telecom / Server Power Supplies
- Industrial Power Supplies

Description

SuperFET® III MOSFET is ON Semiconductor's brand-new high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This advanced technology is tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate. Consequently, SuperFET III MOSFET is very suitable for various power system for miniaturization and higher efficiency.



Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted.

Symbol	Parameter	FCPF125N65S3	Unit
V_{DSS}	Drain to Source Voltage	650	V
V_{GSS}	Gate to Source Voltage	- DC	± 30
		- AC ($f > 1\text{ Hz}$)	± 30
I_D	Drain Current	- Continuous ($T_C = 25^\circ\text{C}$)	24*
		- Continuous ($T_C = 100^\circ\text{C}$)	15*
I_{DM}	Drain Current	- Pulsed (Note 1)	60*
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	115	mJ
I_{AS}	Avalanche Current (Note 1)	3.7	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	0.38	mJ
dv/dt	MOSFET dv/dt	100	V/ns
	Peak Diode Recovery dv/dt (Note 3)	20	
P_D	Power Dissipation	($T_C = 25^\circ\text{C}$)	38
		- Derate Above 25°C	0.31
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$
T_L	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds	300	$^\circ\text{C}$

*Drain current limited by maximum junction temperature.

Thermal Characteristics

Symbol	Parameter	FCPF125N65S3	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	3.24	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FCPF125N65S3	FCPF125N65S3	TO-220F	Tube	N/A	N/A	50 units

Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted.

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
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Off Characteristics

BV_{DSS}	Drain to Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 25^\circ\text{C}$	650	-	-	V
		$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 150^\circ\text{C}$	700	-	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 1\text{ mA}$, Referenced to 25°C	-	0.65	-	$\text{V}/^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$	-	-	1	μA
		$V_{DS} = 520\text{ V}, T_C = 125^\circ\text{C}$	-	1.29	-	μA
I_{GSS}	Gate to Body Leakage Current	$V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$	-	-	± 100	nA

On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 2.4\text{ mA}$	2.5	-	4.5	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{ V}, I_D = 12\text{ A}$	-	105	125	$\text{m}\Omega$
g_{FS}	Forward Transconductance	$V_{DS} = 20\text{ V}, I_D = 12\text{ A}$	-	16	-	S

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$	-	1790	-	pF
C_{oss}	Output Capacitance		-	40	-	pF
$C_{oss(eff.)}$	Effective Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$	-	405	-	pF
$C_{oss(er.)}$	Energy Related Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$	-	60	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 400\text{ V}, I_D = 12\text{ A},$ $V_{GS} = 10\text{ V}$	-	44	-	nC
Q_{gs}	Gate to Source Gate Charge		-	12	-	nC
Q_{gd}	Gate to Drain "Miller" Charge		(Note 4)	-	19	-
ESR	Equivalent Series Resistance	$f = 1\text{ MHz}$	-	4	-	Ω

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 400\text{ V}, I_D = 12\text{ A},$ $V_{GS} = 10\text{ V}, R_g = 4.7\ \Omega$	-	22	-	ns
t_r	Turn-On Rise Time		-	25	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	60	-	ns
t_f	Turn-Off Fall Time		(Note 4)	-	15	-

Source-Drain Diode Characteristics

I_S	Maximum Continuous Source to Drain Diode Forward Current	-	-	24	A	
I_{SM}	Maximum Pulsed Source to Drain Diode Forward Current	-	-	60	A	
V_{SD}	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_{SD} = 12\text{ A}$	-	-	1.2	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_{SD} = 12\text{ A},$ $di_F/dt = 100\text{ A}/\mu\text{s}$	-	362	-	ns
Q_{rr}	Reverse Recovery Charge		-	6.36	-	μC

Notes:

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. $I_{AS} = 3.7\text{ A}, R_G = 25\ \Omega$, starting $T_J = 25^\circ\text{C}$.
3. $I_{SD} \leq 12\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq 400\text{ V}$, starting $T_J = 25^\circ\text{C}$.
4. Essentially independent of operating temperature typical characteristics.

Typical Performance Characteristics

Figure 1. On-Region Characteristics

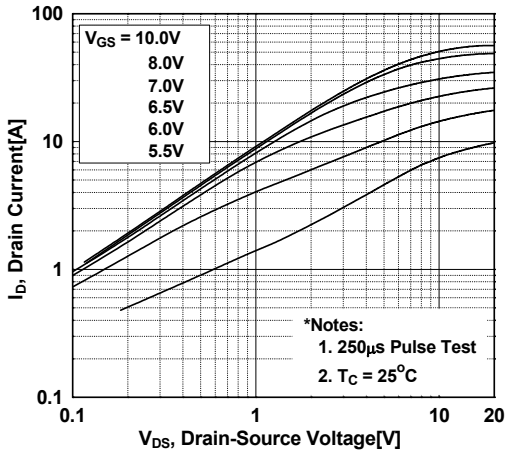


Figure 2. Transfer Characteristics

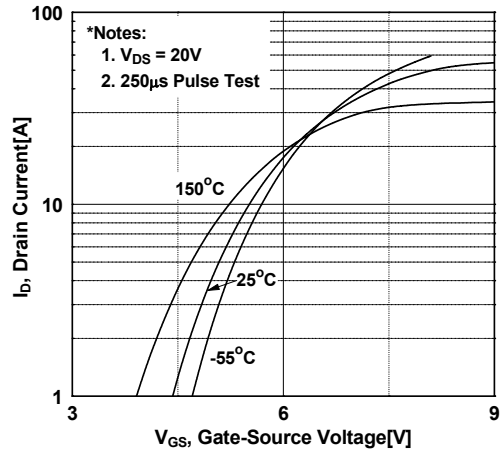


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

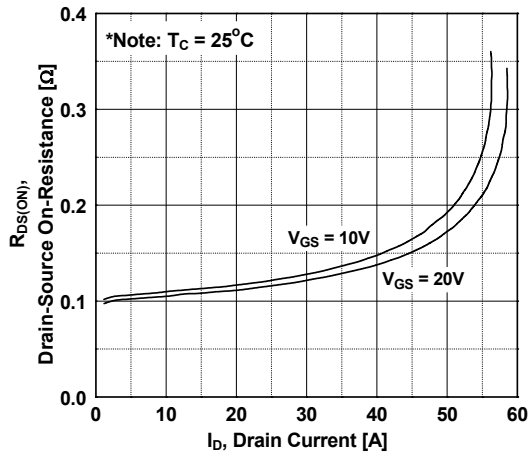


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

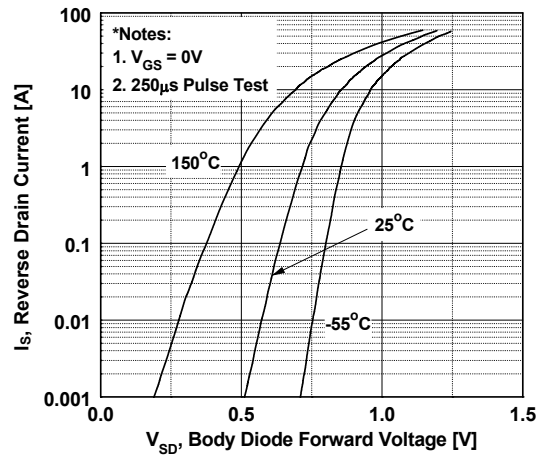


Figure 5. Capacitance Characteristics

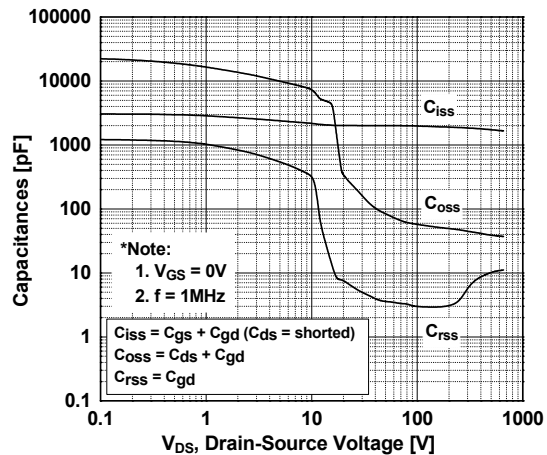
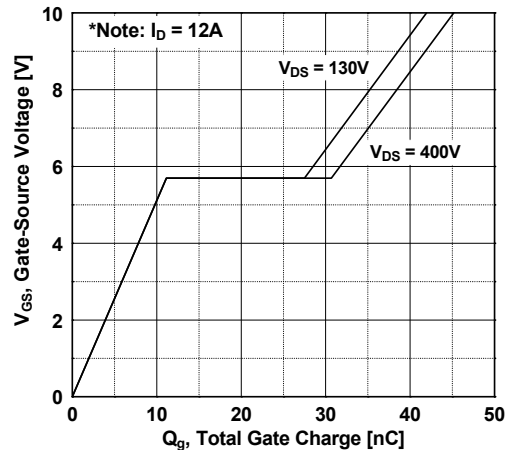


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

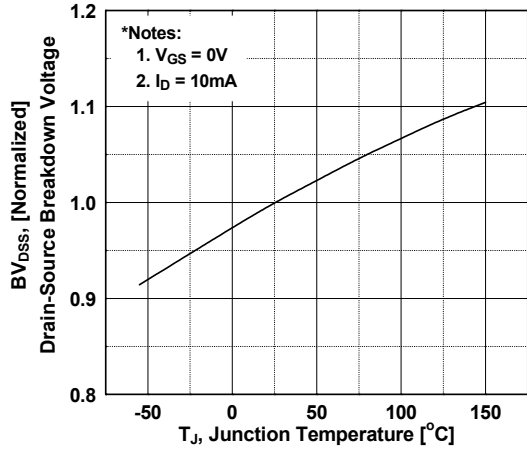


Figure 8. On-Resistance Variation vs. Temperature

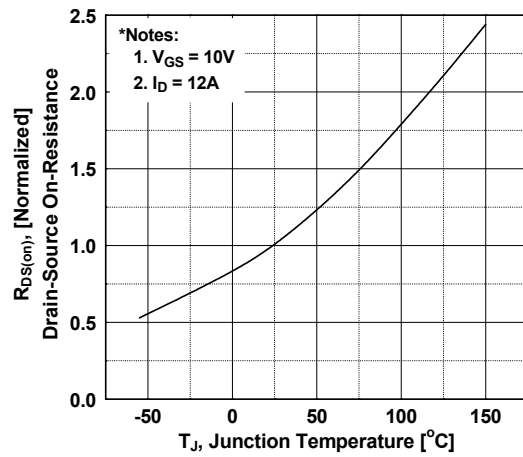


Figure 9. Maximum Safe Operating Area

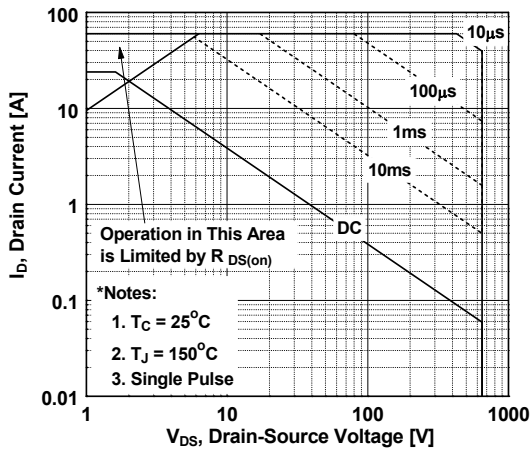


Figure 10. Maximum Drain Current vs. Case Temperature

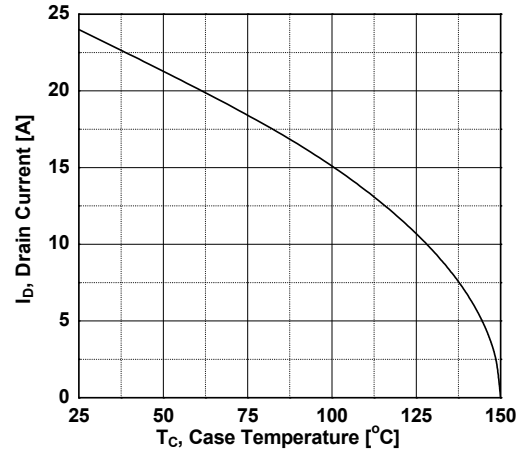
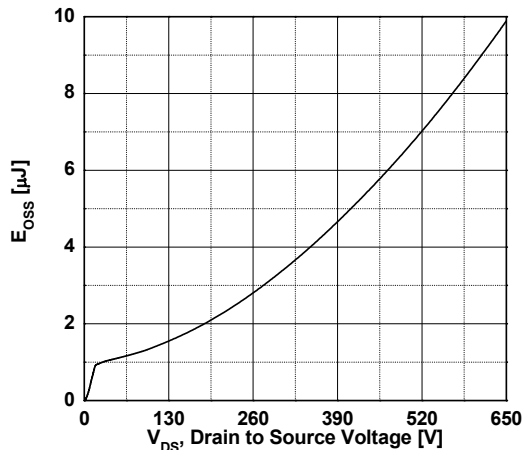
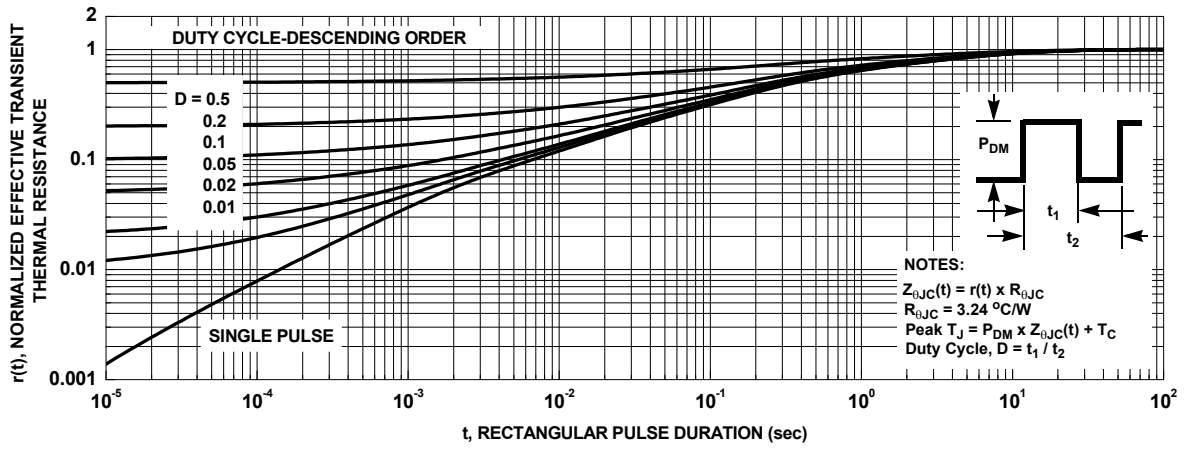


Figure 11. E_oss vs. Drain to Source Voltage



Typical Performance Characteristics (Continued)

Figure 12. Transient Thermal Response Curve



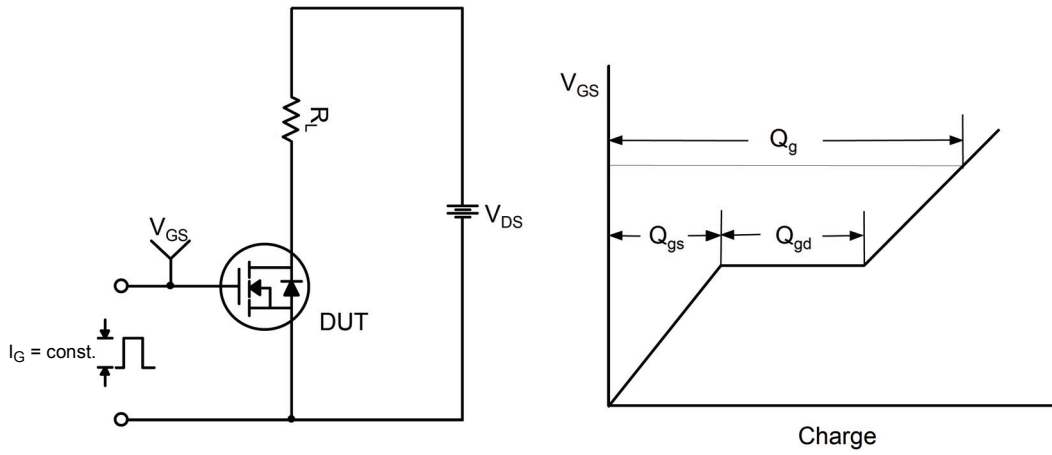


Figure 13. Gate Charge Test Circuit & Waveform

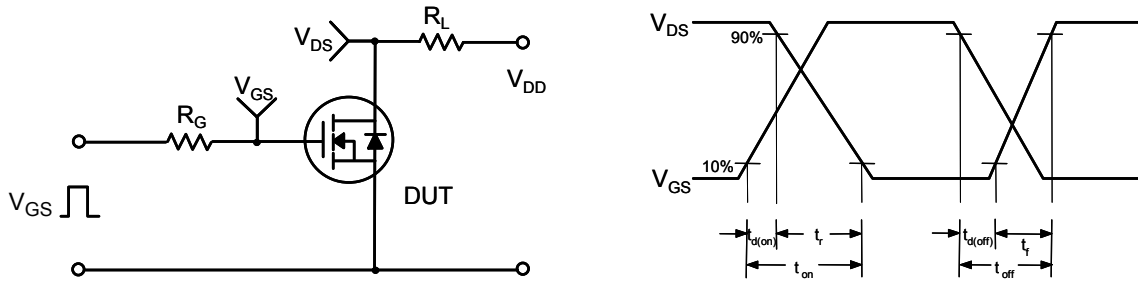


Figure 14. Resistive Switching Test Circuit & Waveforms

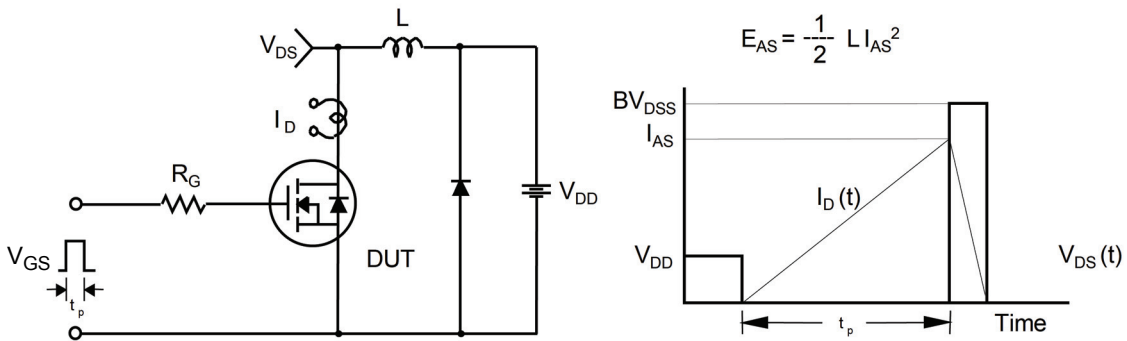


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

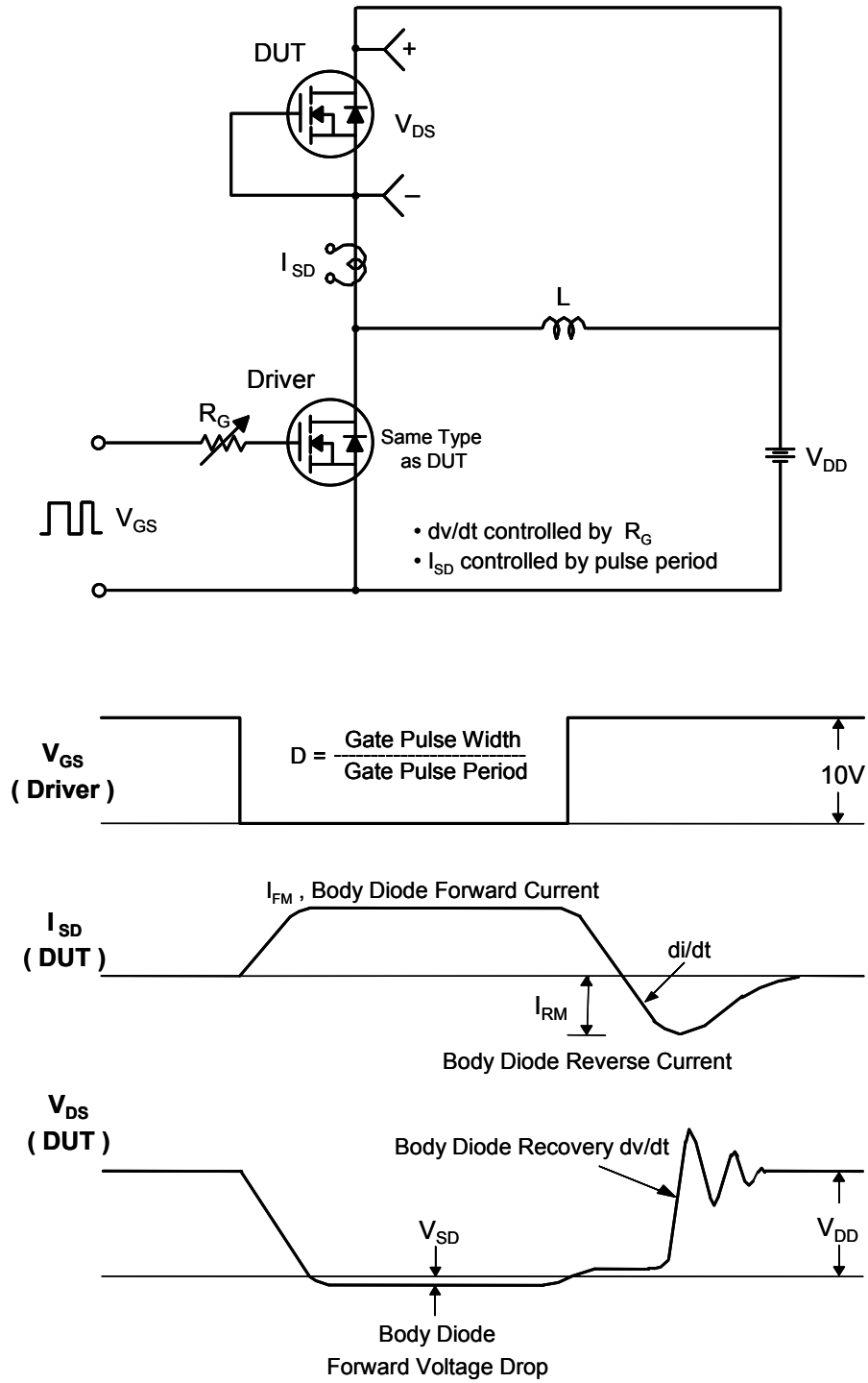


Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms

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