

MOSFET – Power, N-Channel, SUPERFET® III, Easy Drive

650 V, 65 A, 40 mΩ

FCH040N65S3

Description

SUPERFET III MOSFET is onsemi'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, provides superior switching performance, and withstand extreme dv/dt rate.

Consequently, SUPERFET III MOSFET Easy drive series helps manage EMI issues and allows for easier design implementation.

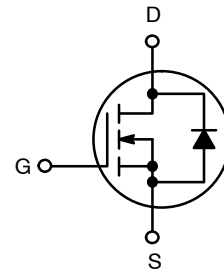
Features

- 700 V @ $T_J = 150^\circ\text{C}$
- Typ. $R_{DS(on)} = 35.4\text{ m}\Omega$
- Ultra Low Gate Charge (Typ. $Q_g = 136\text{ nC}$)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)} = 1154\text{ pF}$)
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

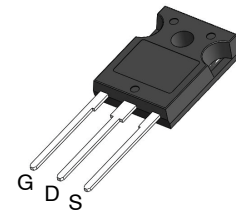
Applications

- Telecom / Server Power Supplies
- Industrial Power Supplies
- UPS / Solar

V_{DSS}	$R_{DS(on)}\text{ MAX}$	$I_D\text{ MAX}$
650 V	40 mΩ @ 10 V	65 A



POWER MOSFET



**TO-247 LONG LEADS
CASE 340CH**

MARKING DIAGRAM



\$Y	= Logo
&Z	= Assembly Plant Code
&3	= Data Code (Year & Week)
&K	= Lot
FCH040N65S3	= Specific Device Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

FCH040N65S3

ABSOLUTE MAXIMUM RATINGS ($T_C = 25^\circ\text{C}$, Unless otherwise noted)

Symbol	Parameter	FCH040N65S3–F155	Unit
V_{DSS}	Drain to Source Voltage	650	V
V_{GSS}	Gate to Source Voltage	– DC	V
		– AC ($f > 1\text{ Hz}$)	
I_D	Drain Current	– Continuous ($T_C = 25^\circ\text{C}$)	A
		– Continuous ($T_C = 100^\circ\text{C}$)	
I_{DM}	Drain Current	– Pulsed (Note 1)	A
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	358	mJ
I_{AS}	Avalanche Current (Note 2)	8.1	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	4.17	mJ
dv/dt	MOSFET dv/dt	100	V/ns
	Peak Diode Recovery dv/dt (Note 3)	20	
P_D	Power Dissipation	($T_C = 25^\circ\text{C}$)	W
		– Derate Above 25°C	W/ $^\circ\text{C}$
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	$^\circ\text{C}$

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.

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

2. $I_{AS} = 8.1\text{ A}$, $R_G = 25\ \Omega$, starting $T_J = 25^\circ\text{C}$.

3. $I_{SD} \leq 32.5\text{ A}$, $di/dt \leq 200\text{ A}/\mu\text{s}$, $V_{DD} \leq 400\text{ V}$, starting $T_J = 25^\circ\text{C}$.

THERMAL CHARACTERISTICS

Symbol	Parameter	FCH040N65S3–F155	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.3	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
FCH040N65S3–F155	FCH040N65S3	TO–247 G03	Tube	N/A	N/A	30 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	–	0.64	–	V/ $^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 650\text{ V}$, $V_{GS} = 0\text{ V}$	–	–	1	μA
		$V_{DS} = 520\text{ V}$, $T_C = 125^\circ\text{C}$	–	4.5	–	
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	$V_{GS} = V_{DS}$, $I_D = 1.7\text{ mA}$	2.5	–	4.5	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{ V}$, $I_D = 32.5\text{ A}$	–	35.4	40	m Ω
g_{FS}	Forward Transconductance	$V_{DS} = 20\text{ V}$, $I_D = 32.5\text{ A}$	–	46	–	S

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ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted) (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
DYNAMIC CHARACTERISTICS						
C_{iss}	Input Capacitance	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	–	4740	–	pF
C_{oss}	Output Capacitance		–	120	–	pF
$C_{oss(eff.)}$	Effective Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$	–	1154	–	pF
$C_{oss(er.)}$	Energy Related Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$	–	171	–	pF
$Q_{g(tot)}$	Total Gate Charge at 10 V	$V_{DS} = 400\text{ V}, I_D = 32.5\text{ A}, V_{GS} = 10\text{ V}$ (Note 4)	–	136	–	nC
Q_{gs}	Gate to Source Gate Charge		–	33	–	nC
Q_{gd}	Gate to Drain “Miller” Charge		–	59	–	nC
ESR	Equivalent Series Resistance	$f = 1\text{ MHz}$	–	0.7	–	Ω

SWITCHING CHARACTERISTICS

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 400\text{ V}, I_D = 32.5\text{ A},$ $V_{GS} = 10\text{ V}, R_g = 3.3\text{ }\Omega$ (Note 4)	–	35	–	ns
t_r	Turn-On Rise Time		–	51	–	ns
$t_{d(off)}$	Turn-Off Delay Time		–	95	–	ns
t_f	Turn-Off Fall Time		–	30	–	ns

SOURCE-DRAIN DIODE CHARACTERISTICS

I _S	Maximum Continuous Drain to Source Diode Forward Current		–	–	65	A
I _{SM}	Maximum Pulsed Drain to Source Diode Forward Current		–	–	162.5	A
V _{SD}	Drain to Source Diode Forward Voltage	V _{GS} = 0 V, I _{SD} = 32.5 A	–	–	1.2	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0 V, I _{SD} = 32.5 A, dI _F /dt = 100 A/μs	–	534	–	ns
Q _{rr}	Reverse Recovery Charge		–	13.6	–	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

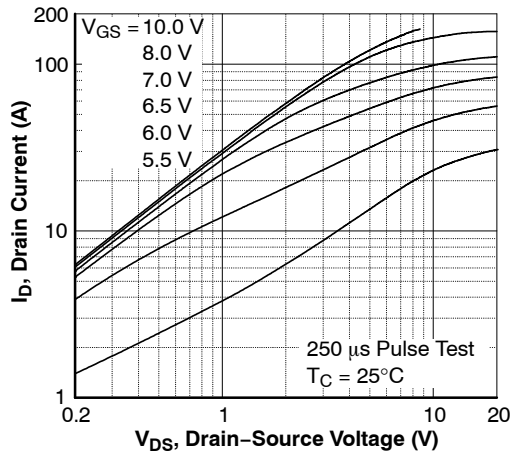


Figure 1. On-Region Characteristics

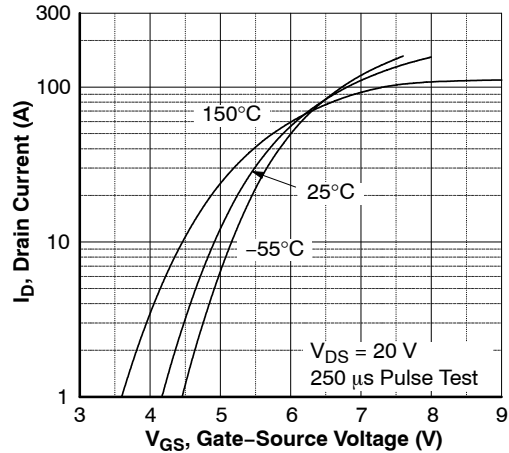


Figure 2. Transfer Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

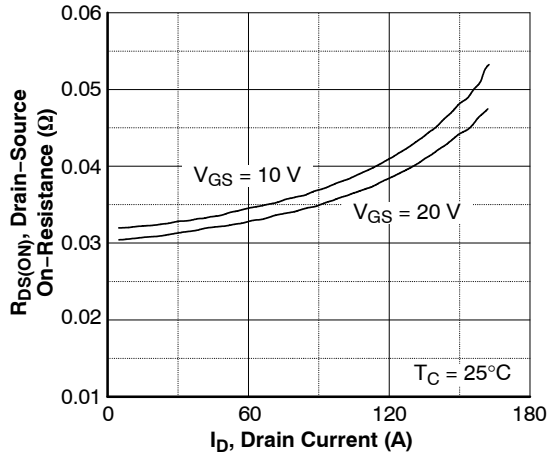


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

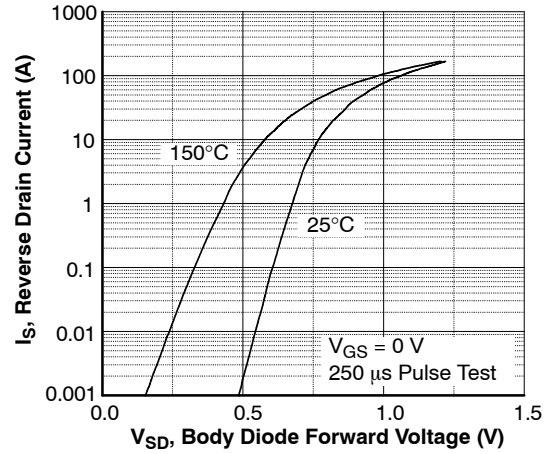


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

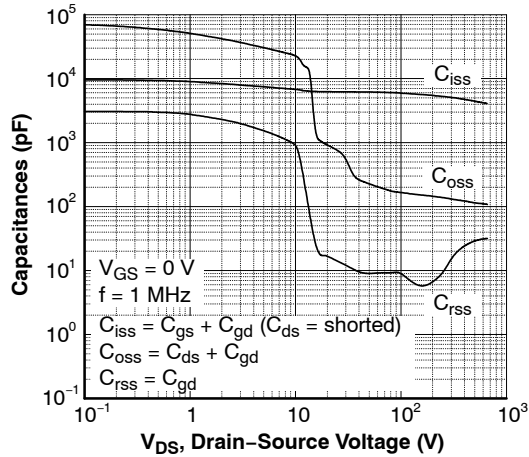


Figure 5. Capacitance Characteristics

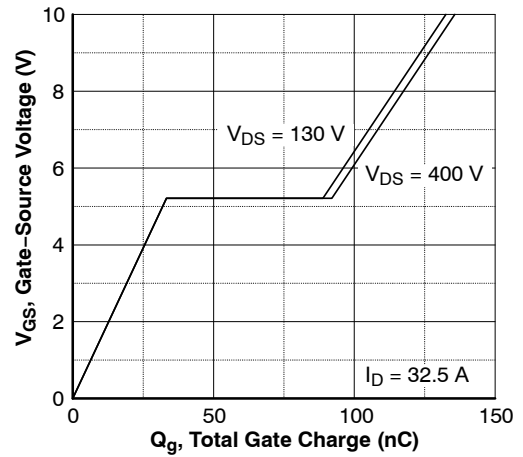


Figure 6. Gate Charge Characteristics

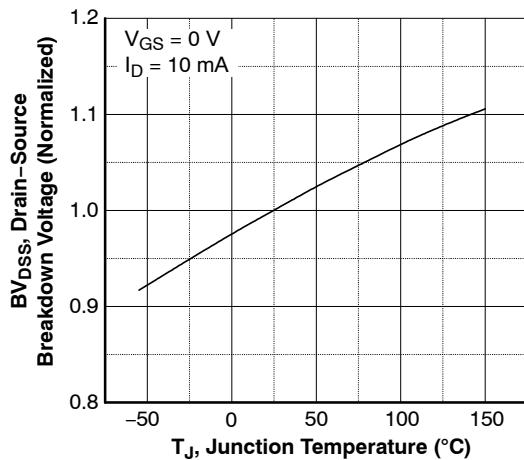


Figure 7. Breakdown Voltage Variation vs. Temperature

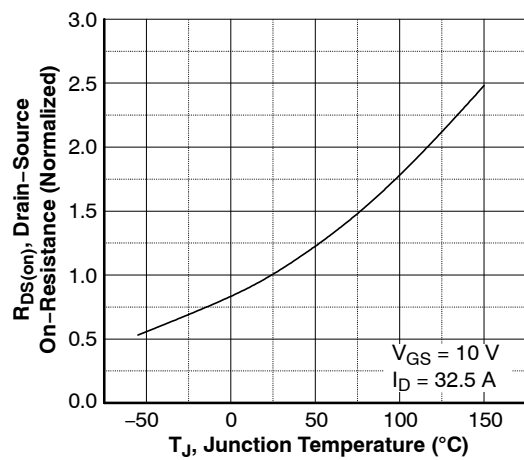


Figure 8. On-Resistance Variation vs. Temperature

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

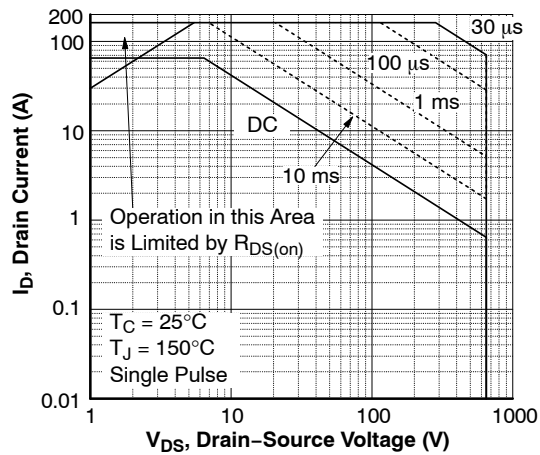


Figure 9. Maximum Safe Operating Area

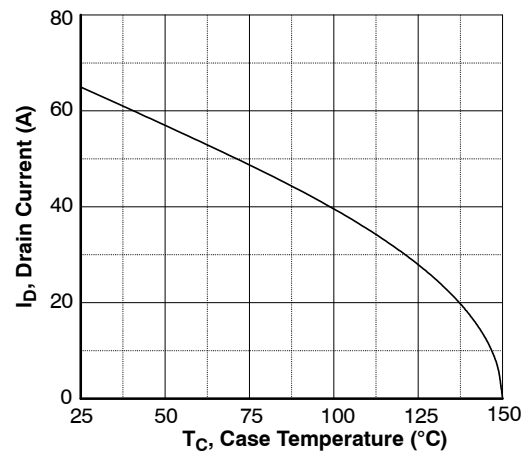


Figure 10. Maximum Drain Current vs. Case Temperature

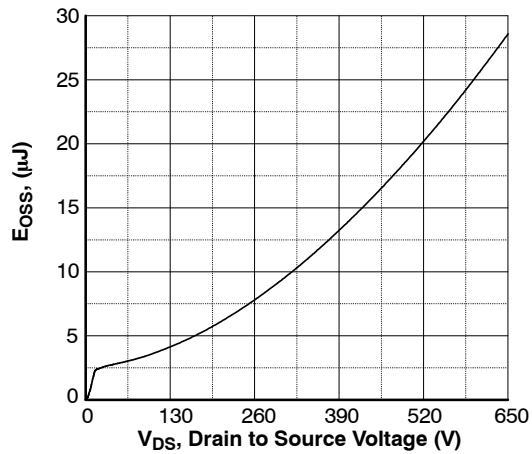
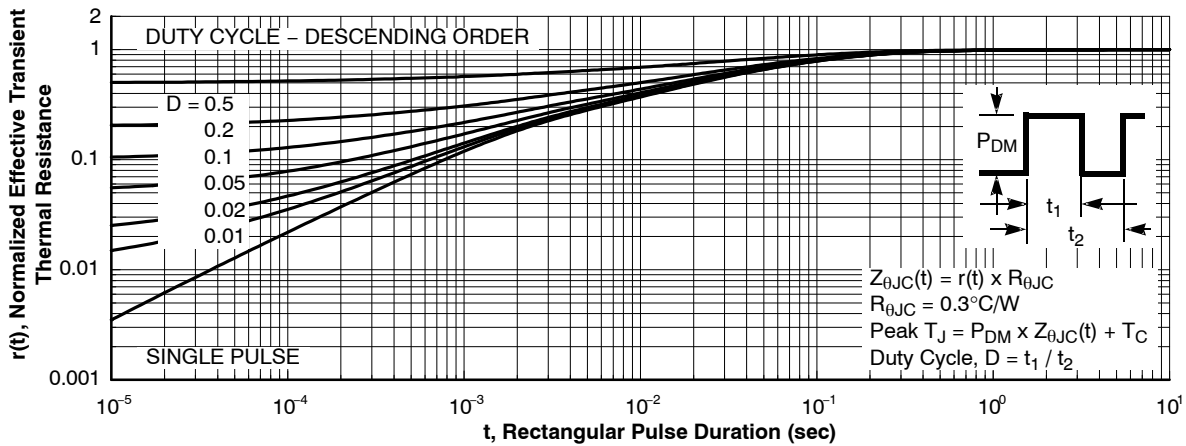
Figure 11. E_{OSS} vs. Drain to Source Voltage

Figure 12. Transient Thermal Response Curve

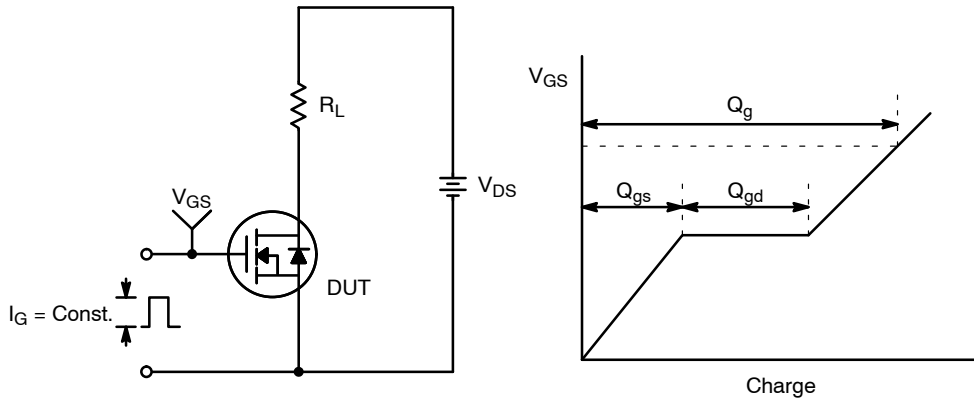


Figure 13. Gate Charge Test Circuit & Waveform

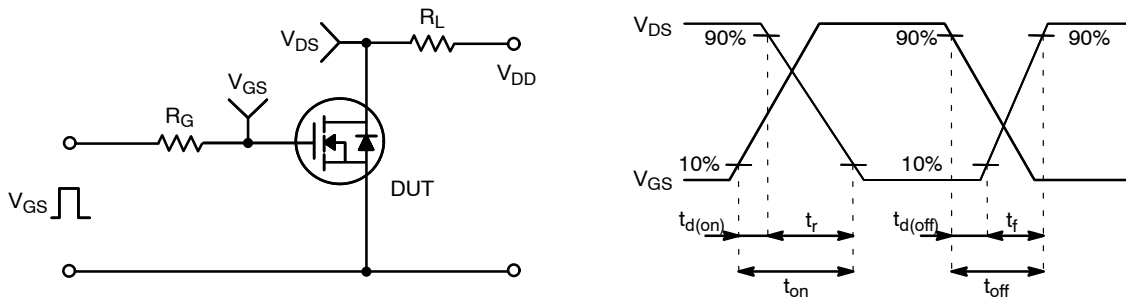


Figure 14. Resistive Switching Test Circuit & Waveforms

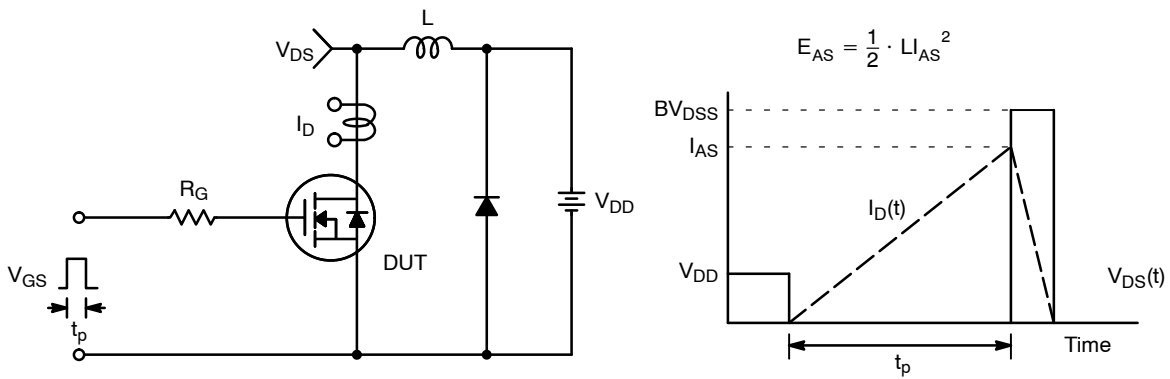


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

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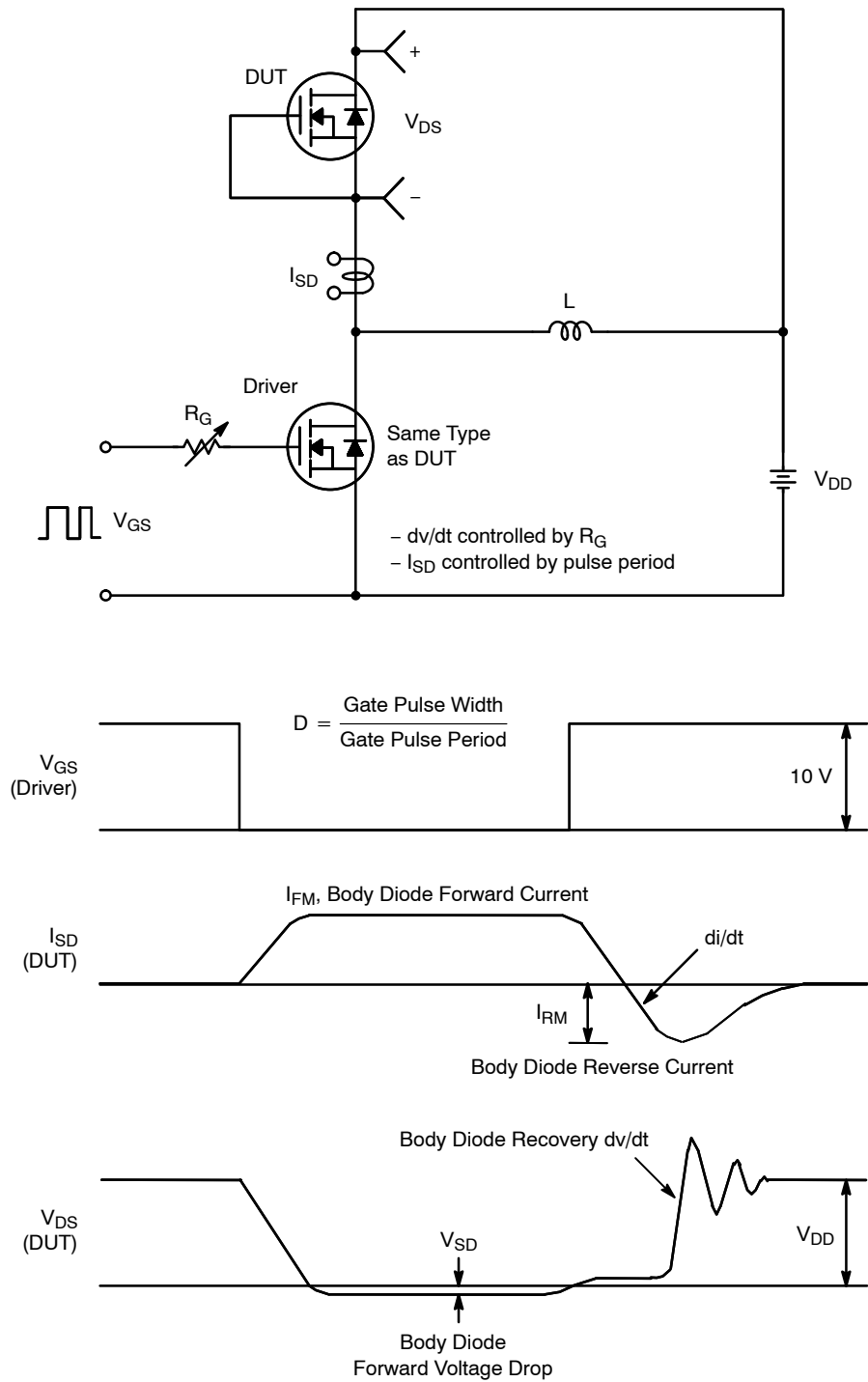


Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms

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