

NTCW040N65S3HF

Power MOSFET, N-Channel, SUPERFET[®] III, FRFET[®], 650 V, 65 A, 40 mΩ



ON Semiconductor[®]

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Description

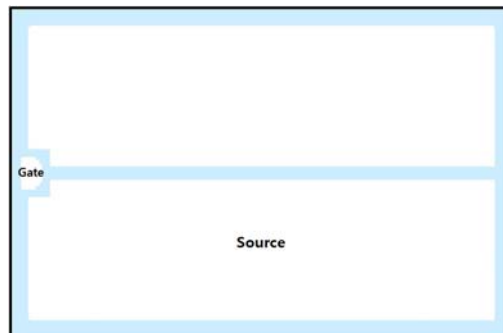
SUPERFET III MOSFET is ON Semiconductor's brand-new high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This advanced technology is tailored to minimize conduction loss, provide superior switching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

Consequently, SUPERFET III MOSFET is very suitable for the various power system for miniaturization and higher efficiency.

SUPERFET III FRFET MOSFET's optimized reverse recovery performance of body diode can remove additional component and improve system reliability.

Features

- 700 V @ T_J = 150°C
- Typ. R_{DS(on)} = 32 mΩ
- Ultra Low Gate Charge (Typ. Q_g = 159 nC)
- Low Effective Output Capacitance (Typ. C_{oss(eff.)} = 1367 pF)
- 100% Avalanche Tested
- Unsawn Wafer



Die Information

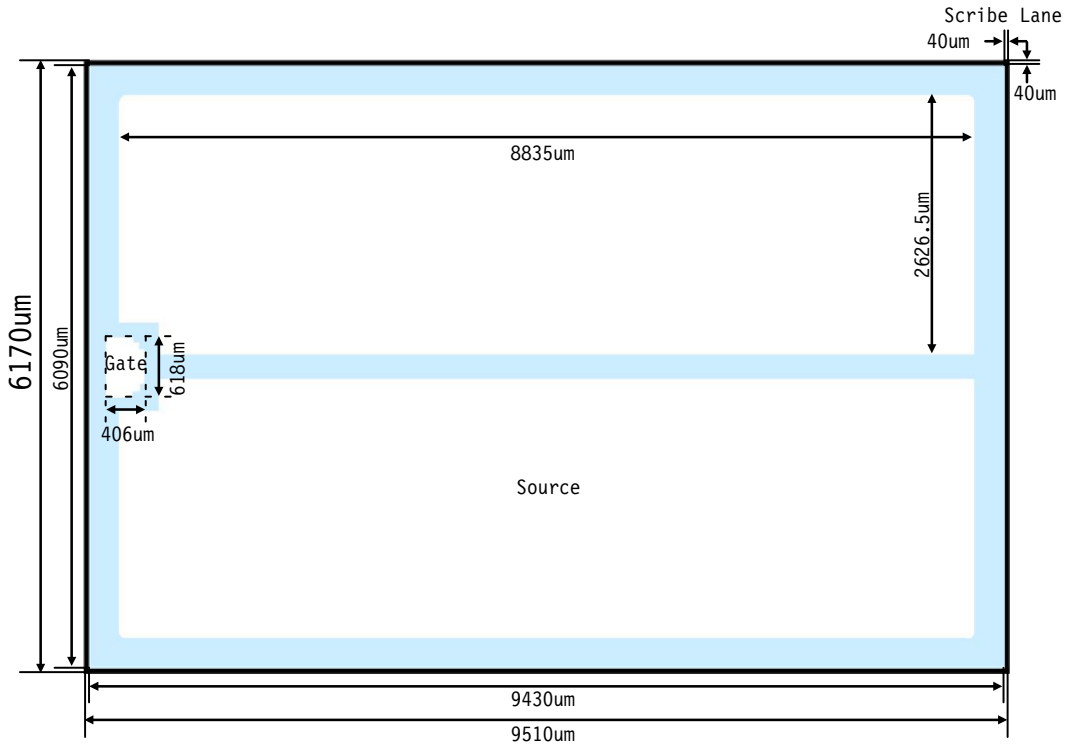
- Wafer Diameter 8 inch
- Die Size 9,510 μm x 6,170 μm
- Metallization
 - Top AlSiCu 5 μm
 - Back Ti/V/Ni/Ag 0.65 μm
- Die Thickness Typ. 300 μm
- Bonding Pad Size
 - Gate 406 μm x 618 μm
- Recommended Wire Bonding
 - Gate 5mil x 1
 - Source 15mil x 3

ELECTRICAL CHARACTERISTICS (T_J = 25°C) (Note 1)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V _{GS(th)}	Gate Threshold Voltage	V _{GS} = V _{DS} , I _D = 6.5 mA	3.0		5.0	V
V _{SD}	Source to Drain Diode Forward Voltage	V _{GS} = 0 V, I _{SD} = 32.5 A			1.3	V
I _{GSS}	Gate to Body Leakage Current	V _{GS} = ±30 V, V _{DS} = 0 V			±100	nA
R _{DS(on)}	Static Drain to Source On Resistance	V _{GS} = 10 V, I _D = 32.5 A		32	40	mΩ
BV _{DSS}	Drain to Source Breakdown Voltage	V _{GS} = 0 V, I _D = 1 mA	650			V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 650 V, V _{GS} = 0 V			10	μA

1. Tested 100% on wafer.

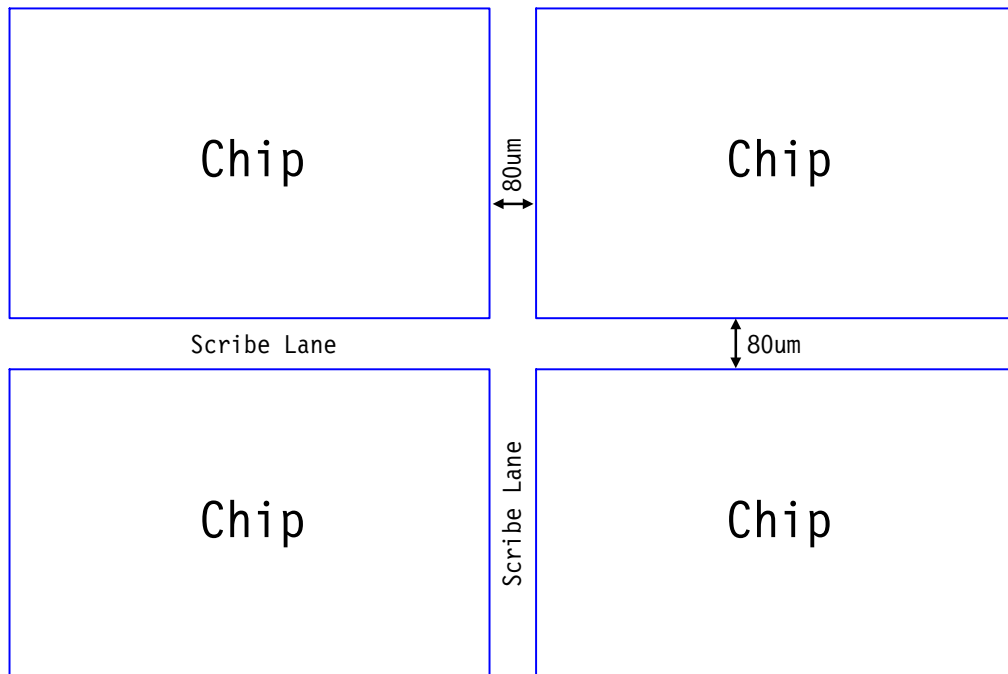
Die Layout



2. Passivation Information

- Passivation Material: Silicon Nitride (SiN)
- Passivation Type: Local Passivation
- Passivation Thickness 15KÅ
- : Passivation Area

Wafer Sawing Information



NTHL040N65S3HF

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C, Unless otherwise noted)

Symbol	Parameter	Value	Unit
V _{DSS}	Drain to Source Voltage	650	V
V _{GSS}	Gate to Source Voltage	- DC	±30
		- AC (f > 1 Hz)	±30
I _D	Drain Current	- Continuous (T _C = 25°C)	65
		- Continuous (T _C = 100°C)	45
I _{DM}	Drain Current	- Pulsed (Note 2)	162.5
E _{AS}	Single Pulsed Avalanche Energy (Note 3)	1009	mJ
I _{AS}	Avalanche Current (Note 3)	9	A
E _{AR}	Repetitive Avalanche Energy (Note 2)	4.46	mJ
dv/dt	MOSFET dv/dt	100	V/ns
	Peak Diode Recovery dv/dt (Note 4)	50	
P _D	Power Dissipation	(T _C = 25°C)	446
		- Derate Above 25°C	3.57
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.

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

3. I_{AS} = 9 A, R_G = 25 Ω, starting T_J = 25°C.

4. I_{SD} ≤ 32.5 A, di/dt ≤ 200 A/μs, V_{DD} ≤ 400 V, starting T_J = 25°C.

THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
R _{θJC}	Thermal Resistance, Junction to Case, Max.	0.28	°C/W
R _{θJA}	Thermal Resistance, Junction to Ambient, Max.	40	

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
NTHL040N65S3HF	NTHL040N65S3HF	TO-247	Tube	N/A	N/A	30 Units

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ELECTRICAL CHARACTERISTICS (T_C = 25°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 V, I _D = 1 mA, T _J = 25°C	650			V
		V _{GS} = 0 V, I _D = 1 mA, T _J = 150°C	700			V
ΔBV _{DSS} /ΔT _J	Breakdown Voltage Temperature Coefficient	I _D = 15 mA, Referenced to 25°C		0.63		V/°C
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 650 V, V _{GS} = 0 V			10	μA
		V _{DS} = 520 V, T _C = 125°C		213		
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 = 6.5 mA	3.0		5.0	V
R _{DS(on)}	Static Drain to Source On Resistance	V _{GS} = 10 V, I _D = 32.5 A		32	40	mΩ
g _{FS}	Forward Transconductance	V _{DS} = 20 V, I _D = 32.5 A		48		S

DYNAMIC CHARACTERISTICS

C _{iss}	Input Capacitance	V _{DS} = 400 V, V _{GS} = 0 V, f = 1 MHz		5945		pF
C _{oss}	Output Capacitance			135		pF
C _{oss(eff.)}	Effective Output Capacitance	V _{DS} = 0 V to 400 V, V _{GS} = 0 V		1367		pF
C _{oss(er.)}	Energy Related Output Capacitance	V _{DS} = 0 V to 400 V, V _{GS} = 0 V		245		pF
Q _{g(tot)}	Total Gate Charge at 10V	V _{DS} = 400 V, I _D = 32.5 A, V _{GS} = 10 V (Note 5)		159		nC
Q _{gs}	Gate to Source Gate Charge			46		nC
Q _{gd}	Gate to Drain "Miller" Charge			64		nC
ESR	Equivalent Series Resistance	f = 1 MHz		1.2		Ω

SWITCHING CHARACTERISTICS

t _{d(on)}	Turn-On Delay Time	V _{DD} = 400 V, I _D = 32.5 A, V _{GS} = 10 V, R _g = 2.2 Ω (Note 5)		40		ns
t _r	Turn-On Rise Time			32		ns
t _{d(off)}	Turn-Off Delay Time			102		ns
t _f	Turn-Off Fall Time			26		ns

SOURCE-DRAIN DIODE CHARACTERISTICS

I _S	Maximum Continuous Source to Drain Diode Forward Current			65		A
I _{SM}	Maximum Pulsed Source to Drain Diode Forward Current			162.5		A
V _{SD}	Source to Drain Diode Forward Voltage	V _{GS} = 0 V, I _{SD} = 32.5 A			1.3	V
t _{rr}	Reverse Recovery Time	V _{DS} = 400 V, I _{SD} = 32.5 A, dI _F /dt = 100 A/μs		160		ns
Q _{rr}	Reverse Recovery Charge			874		nC

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.

5. Essentially independent of operating temperature typical characteristics.

TYPICAL PERFORMANCE CHARACTERISTICS

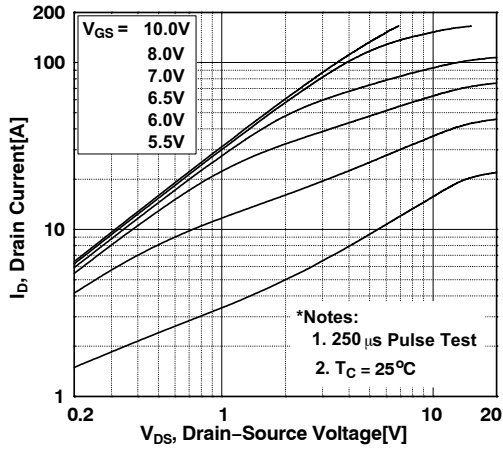


Figure 1. On-Region Characteristics

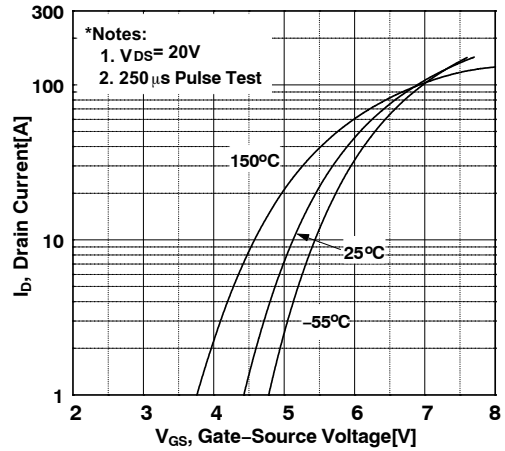


Figure 2. Transfer Characteristics

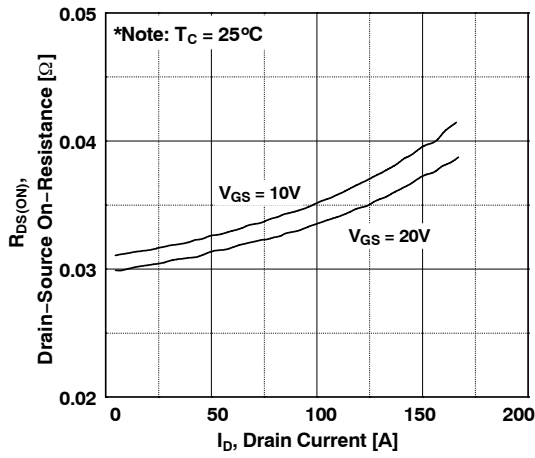


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

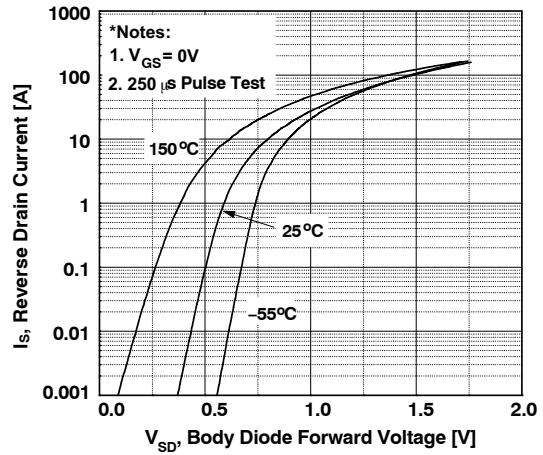


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

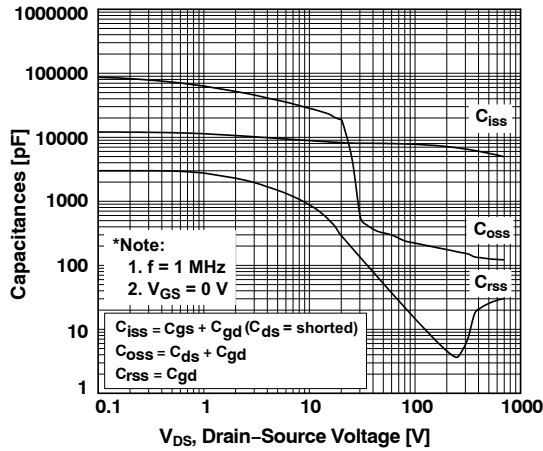


Figure 5. Capacitance Characteristics

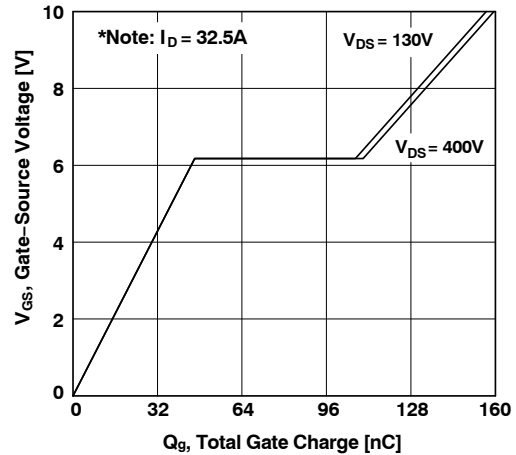


Figure 6. Gate Charge Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

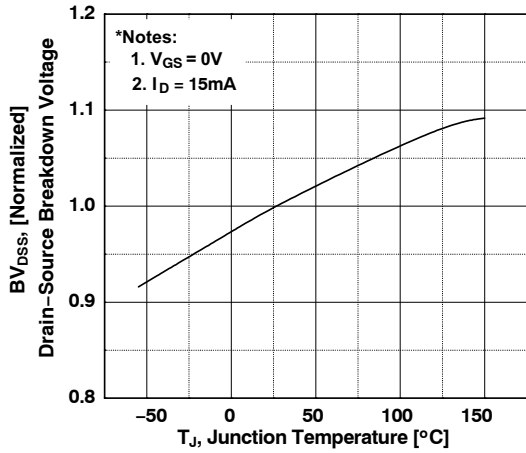


Figure 7. Breakdown Voltage Variation vs. Temperature

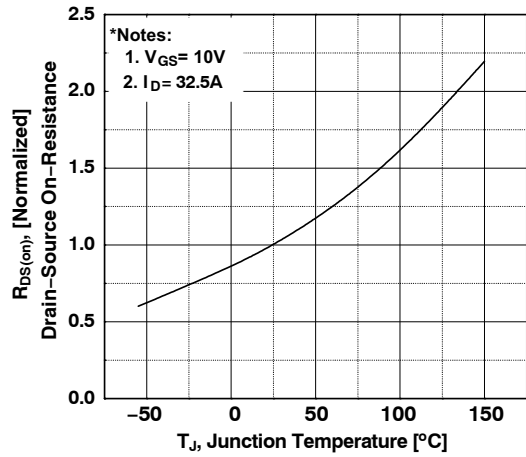


Figure 8. On-Resistance Variation vs. Temperature

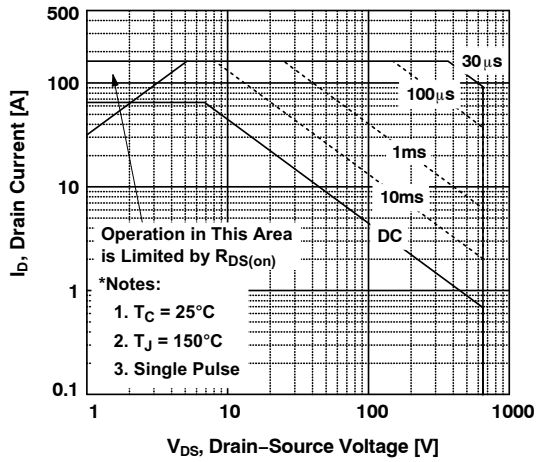


Figure 9. Maximum Safe Operating Area

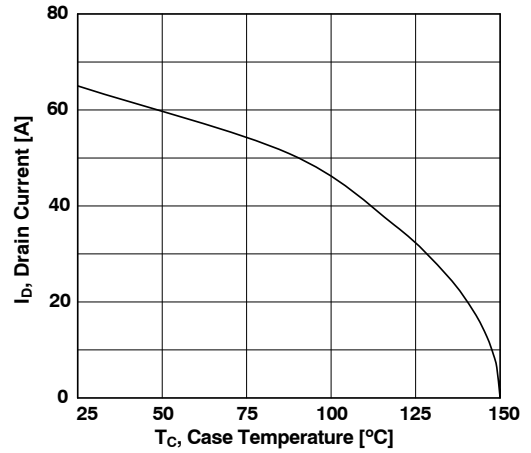


Figure 10. Maximum Drain Current vs. Case Temperature

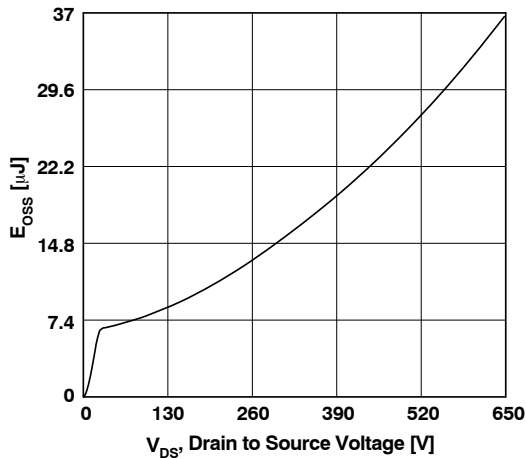


Figure 11. Eoss vs. Drain to Source Voltage

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TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

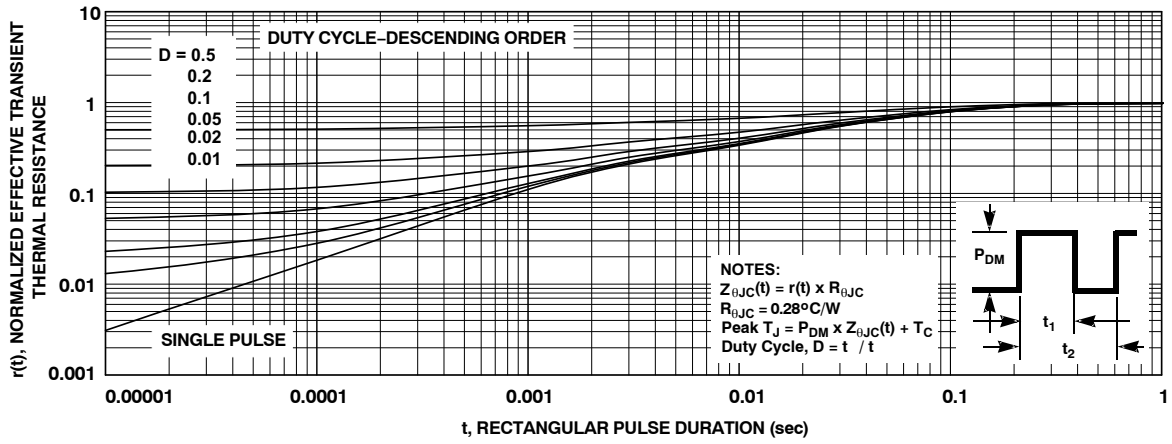


Figure 12. Transient Thermal Response Curve

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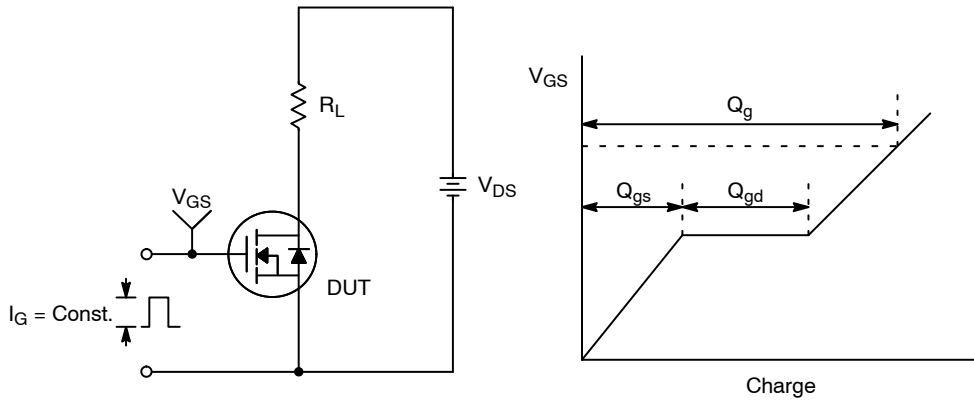


Figure 13. Gate Charge Test Circuit & Waveform

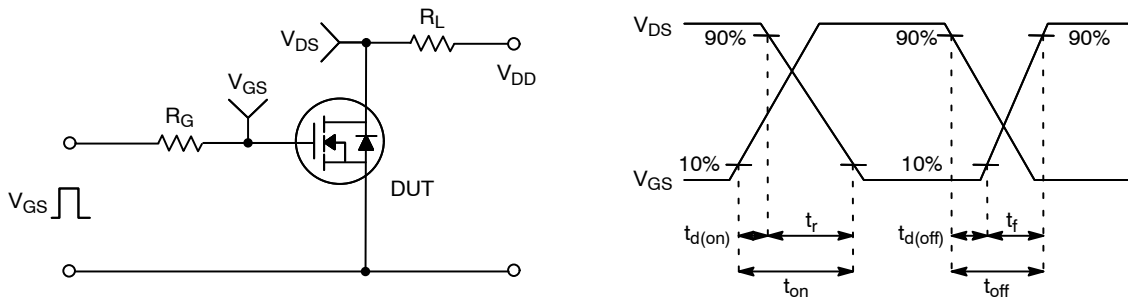


Figure 14. Resistive Switching Test Circuit & Waveforms

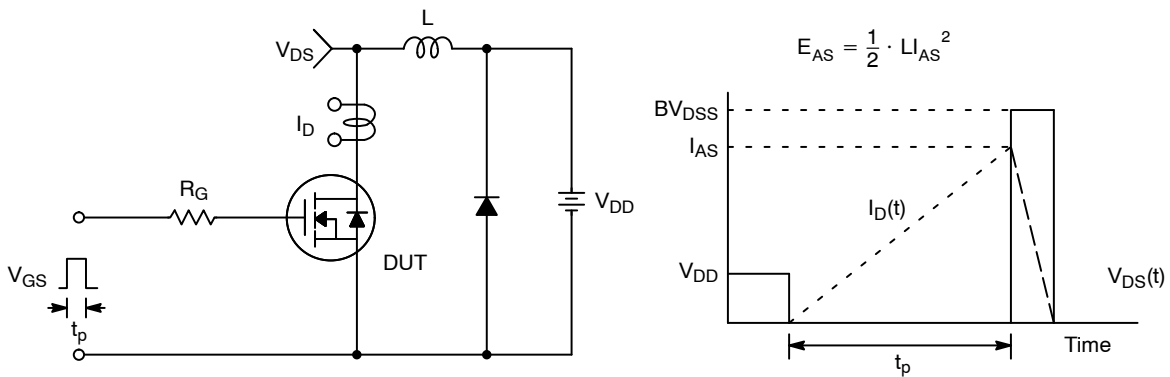


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

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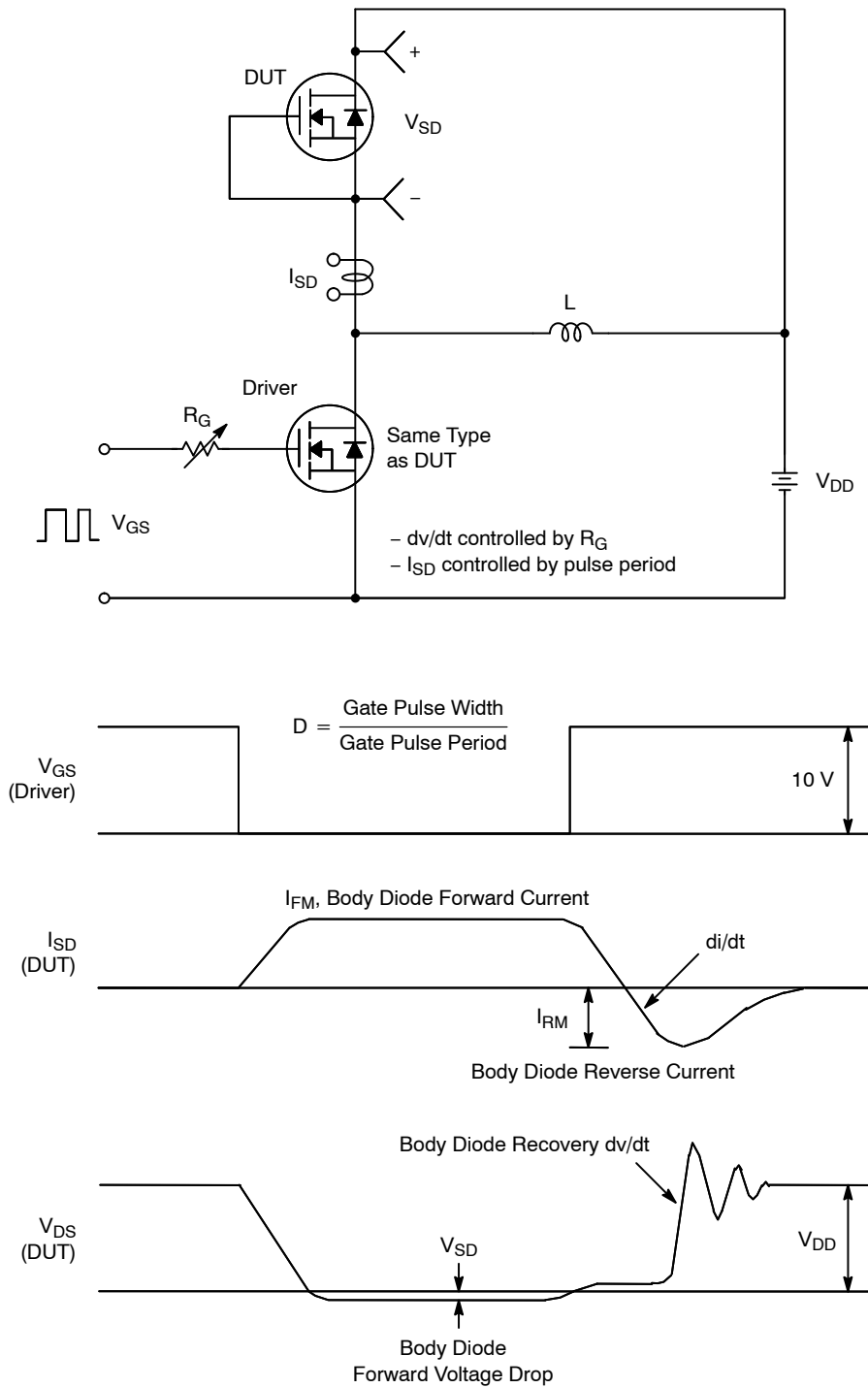



Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms

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