

# MSU4N40

## 400V N-Channel MOSFET

### Description

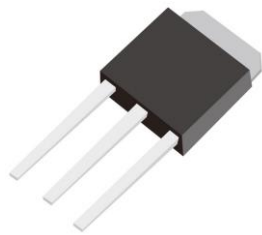
The MSU4N40 is a N-channel enhancement-mode MOSFET, providing the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost effectiveness. The TO-251 package is universally preferred for all commercial-industrial applications

### Features

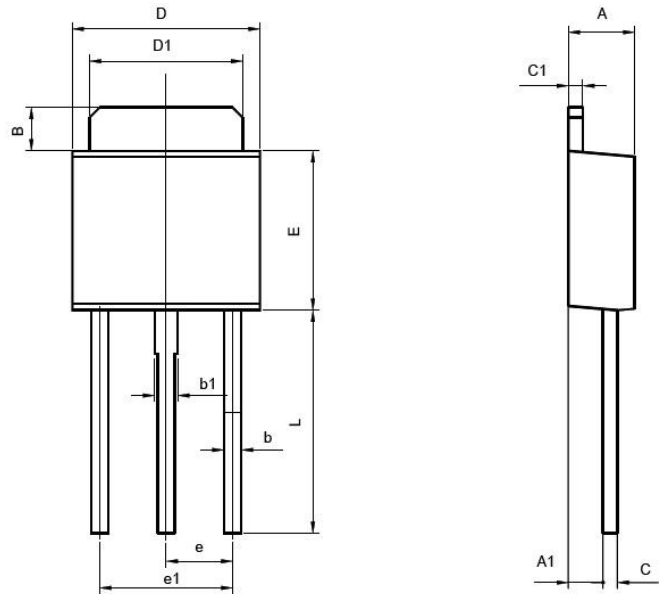
- Originative New Design
- 100% EAS Test
- Rugged Gate Oxide Technology
- Extremely Low Intrinsic Capacitances
- Remarkable Switching Characteristics
- Unequalled Gate Charge : 25 nC (Typ.)
- Extended Safe Operating Area
- Lower RDS(ON) : 0.78  $\Omega$  (Typ.) @VGS=10V
- RoHS compliant package

### Packing & Order Information

80/Tube ; 4,000/Box

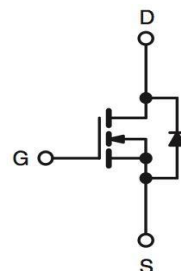


**RoHS  
COMPLIANT**



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	min	max	min	max
A	2.15	2.45	0.85	0.96
A1	1.00	1.40	0.39	0.55
B	1.25	1.75	0.49	0.69
b	0.45	0.75	0.18	0.3
b1	0.65	0.95	0.26	0.37
C	0.38	0.64	0.15	0.25
C1	0.38	0.64	0.15	0.25
D	6.30	6.70	2.48	2.64
D1	5.10	5.50	2.01	2.17
E	5.30	5.70	2.09	2.24
e	2.3 (typ.)		0.91 (typ.)	
e1	4.4	4.8	1.73	1.89
L	7.4	8.0	2.91	3.15

Graphic symbol



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#### MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

##### Absolute Maximum Ratings (Tc=25°C unless otherwise noted)

Symbol	Parameter	Value	Unit
V <sub>DSS</sub>	Drain-Source Voltage	400	V
V <sub>GS</sub>	Gate-Source Voltage	±30	V
I <sub>D</sub>	Drain Current -Continuous (TC=25°C)	4.5	A
	Drain Current -Continuous (TC=100°C)	3.0	A
I <sub>DM</sub>	Drain Current Pulsed	22	A
E <sub>AS</sub>	Single Pulsed Avalanche Energy	270	mJ
E <sub>AR</sub>	Repetitive Avalanche Energy	7.3	mJ
dV/dt	Peak Diode Recovery dV/dt	4.5	V/ns
P <sub>D</sub>	Power Dissipation (TC = 25 °C)	25	W
	- Derate above 25°C	0.38	W/°C
T <sub>J</sub> ,T <sub>STG</sub>	Operating and Storage Temperature Range	-55 to +150	°C
T <sub>L</sub>	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300	°C

- Drain current limited by maximum junction temperature

##### Thermal Resistance Characteristics

Symbol	Parameter	Max.	Units
R <sub>θJC</sub>	Junction-to-Case	1.72	°C/W
R <sub>θJA</sub>	Junction-to-Ambient	83.3	

##### On Characteristics

Symbol	Test Conditions	Min	Typ.	Max.	Units
V <sub>GS</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA	2.0	--	4.0	V
*R <sub>DS(ON)</sub>	V <sub>GS</sub> = 10 V , I <sub>D</sub> = 1 A	--	0.78	0.9	Ω

##### Static Characteristics

Symbol	Test Conditions	Min	Typ.	Max.	Units
BV <sub>DSS</sub>	V <sub>GS</sub> = 0 V , I <sub>D</sub> =250μA	400	--	--	V
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	I <sub>D</sub> = 250μA, Referenced to 25°C	--	0.54	--	V/°C
I <sub>DSS</sub>	V <sub>DS</sub> = 400 V , V <sub>GS</sub> = 0 V	--	--	1	μA
	V <sub>DS</sub> = 320 V , T <sub>C</sub> = 125°C	--	--	10	
I <sub>GSSF</sub>	V <sub>GS</sub> = 30 V , V <sub>DS</sub> = 0 V	--	--	100	nA
I <sub>GSSR</sub>	V <sub>GS</sub> = -30 V , V <sub>DS</sub> = 0 V	--	--	-100	nA

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Dynamic Characteristics					
Symbol	Test Conditions	Min	Typ.	Max.	Units
$t_{d(on)}$	$V_{DS} = 200\text{ V}, I_D = 4.5\text{ A},$ $R_G = 25\ \Omega$	--	15	35	ns
$t_r$		--	65	140	ns
$t_{d(off)}$		--	23	55	ns
$t_f$		--	40	85	ns
$Q_g$	$V_{DS} = 320\text{ V}, I_D = 4.5\text{ A},$ $V_{GS} = 10\text{ V}$	--	16	20	nC
$Q_{gs}$		--	2.3	--	nC
$Q_{gd}$		--	8.5	--	nC
$C_{ISS}$	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $F = 1.0\text{ MHz}$	--	480	625	pF
$C_{OSS}$		--	80	105	pF
$C_{RSS}$		--	15	20	pF

Source-Drain Diode Maximum Ratings and Characteristics						
Symbol	Parameter	Test Conditions	Min	Typ.	Max.	Units
$I_S$			--	--	4.5	A
$I_{SM}$			--	--	18	
$V_{SD}$	$I_S = 4.5\text{ A}, V_{GS} = 0\text{ V}$		--	--	1.4	V
$t_{rr}$	$I_S = 4.5\text{ A}, V_{GS} = 0\text{ V}$		--	230	--	ns
$Q_{rr}$	$diF/dt = 100\text{ A}/\mu\text{s}$		--	1.7	--	$\mu\text{C}$

Notes ;

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $I_{AS}=4.5\text{ A}, V_{DD}=50\text{ V}, R_G=25\ \Omega, \text{ Starting } T_J=25^\circ\text{C}$
3.  $I_{SD}\leq 4.5\text{ A}, di/dt\leq 300\text{ A}/\mu\text{ s}, V_{DD}\leq BV_{DSS}, \text{ Starting } T_J=25^\circ\text{C}$
4. Pulse Test: Pulse Width  $\leq 300\ \mu\text{ s}, \text{ Duty Cycle } \leq 2\%$
5. Essentially Independent of Operating Temperature

## MS U4N40

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#### Characteristics Curve

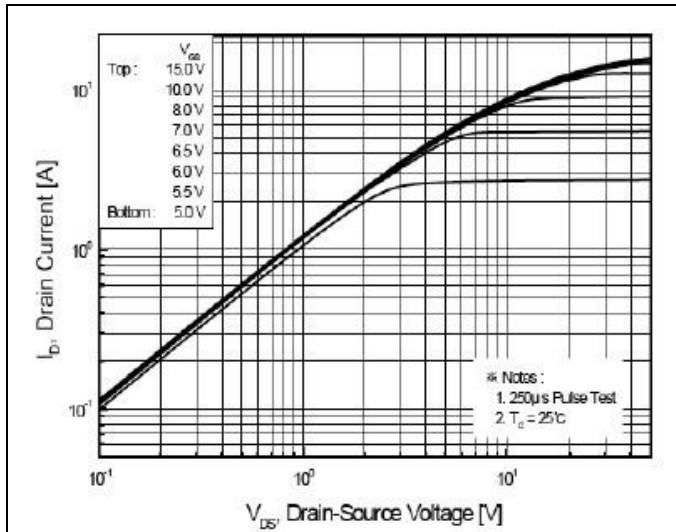


FIG.1-ON REGION CHARACTERISTICS

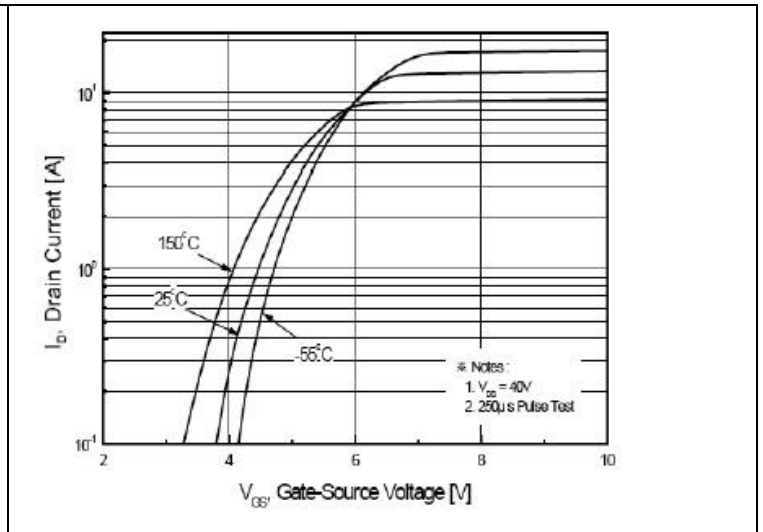


FIG.2-TRANSFER CHARACTERISTICS

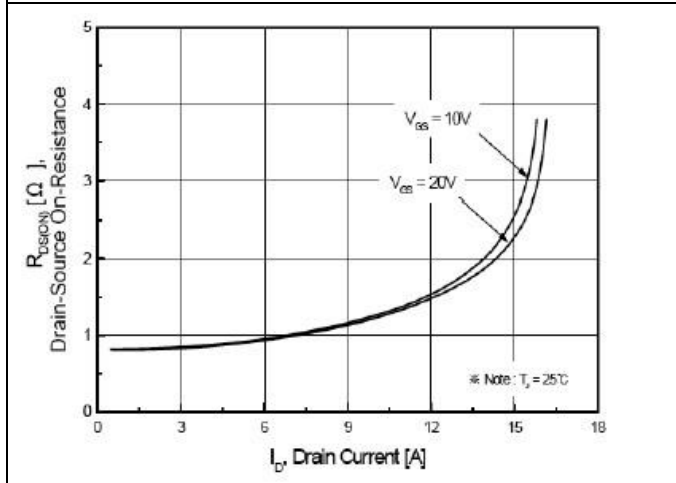


FIG.3-ON RESISTANCE VARIATION VS DRAIN CURRENT AND GATE VOLTAGE

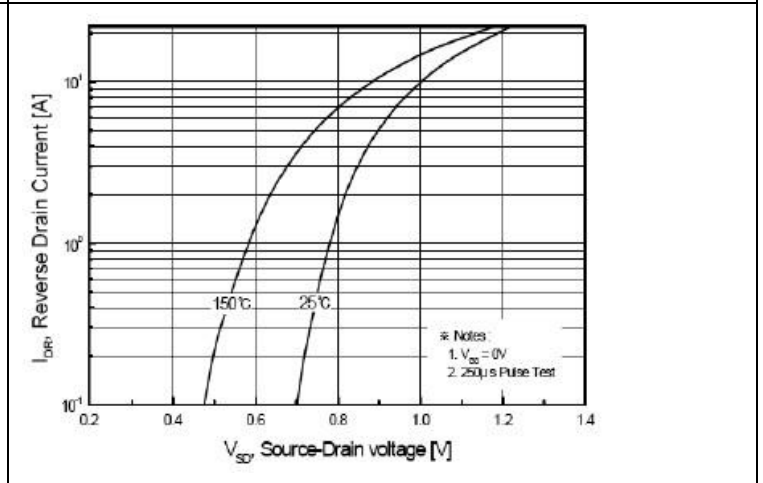


FIG.4-BODY DIODE FORWARD VOLTAGE VARIATION WITH SOURCE CURRENT AND TEMPERATURE

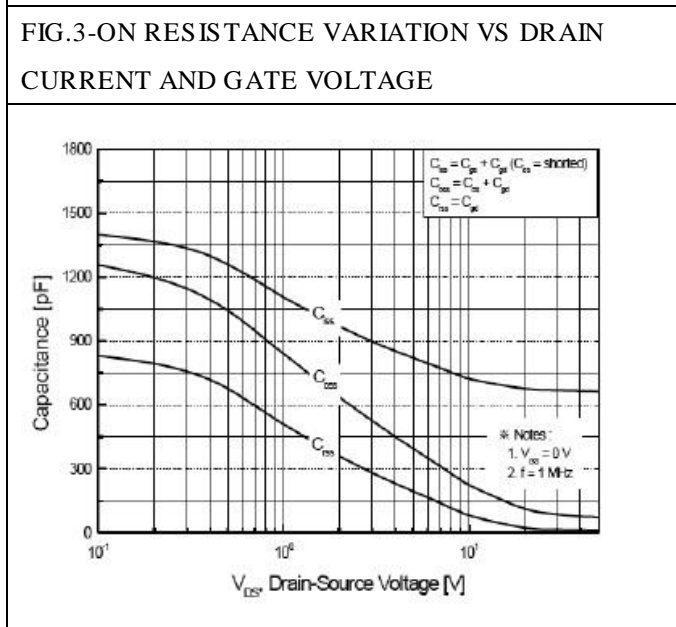


FIG.5-CAPACITANCE CHARACTERISTICS

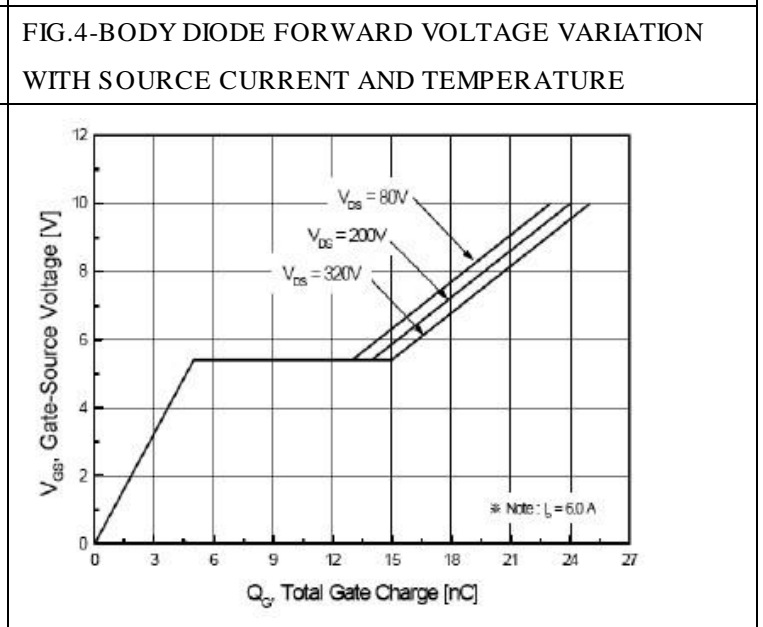


FIG.6-GATE CHARGE CHARACTERISTICS

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#### Characteristics Curve

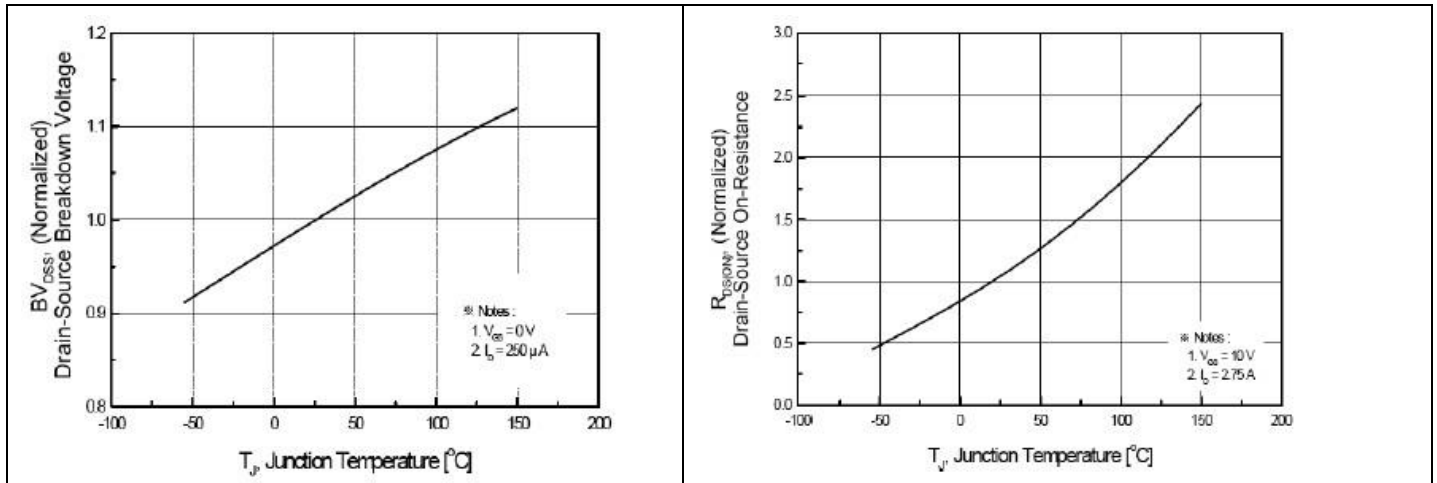


FIG. 7-BREAKDOWN VOLTAGE VARIATION VS TEMPERATURE

FIG. 8-ON-RESISTANCE VARIATION VS TEMPERATURE

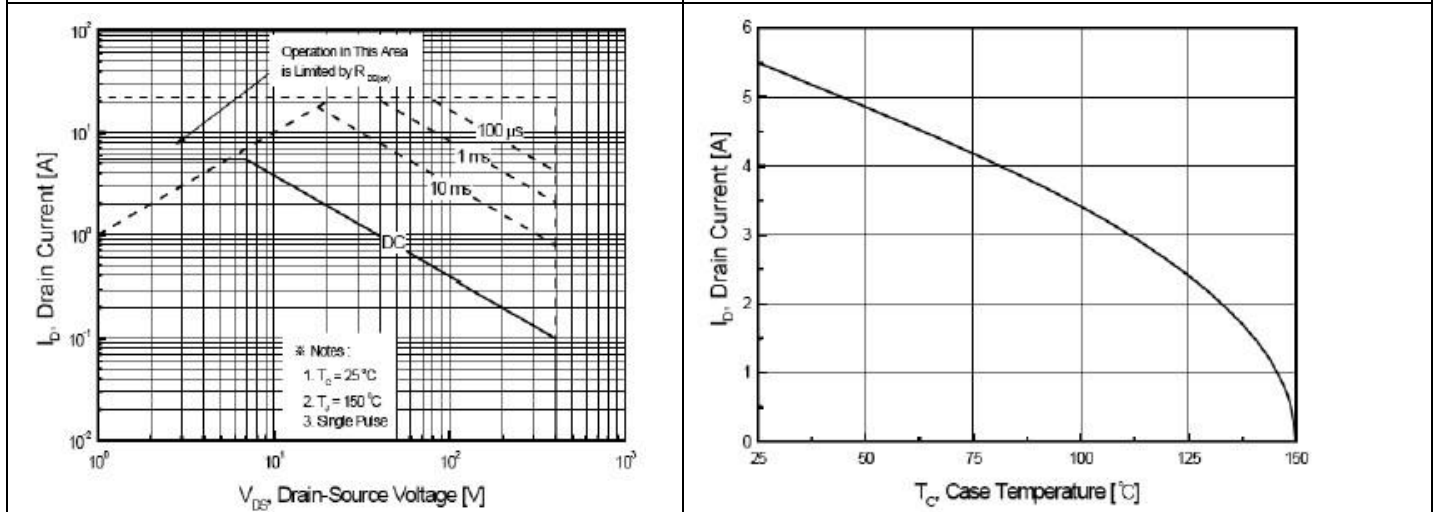


FIG. 9-MAXIMUM SAFE OPERATING AREA

FIG. 10-MAXIMUM DRAIN CURRENT VS CASE TEMPERATURE

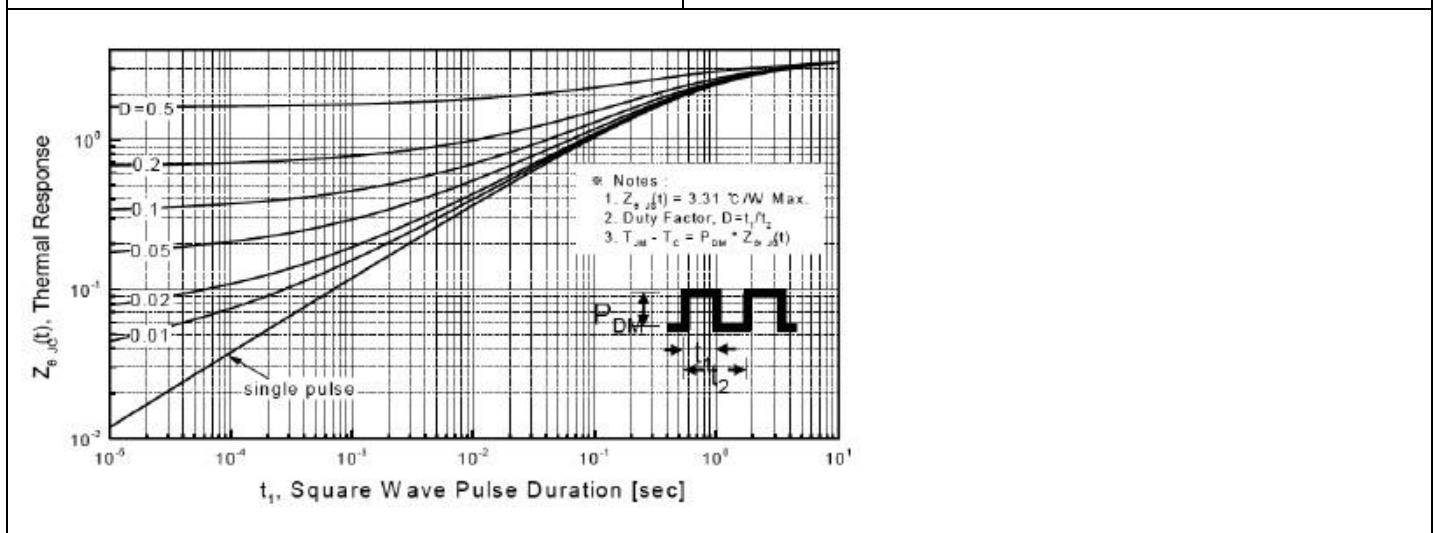


FIG. 11-TRANSIENT THERMAL RESPONSE CURVE

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#### ■ Characteristics Test Circuit & Waveform

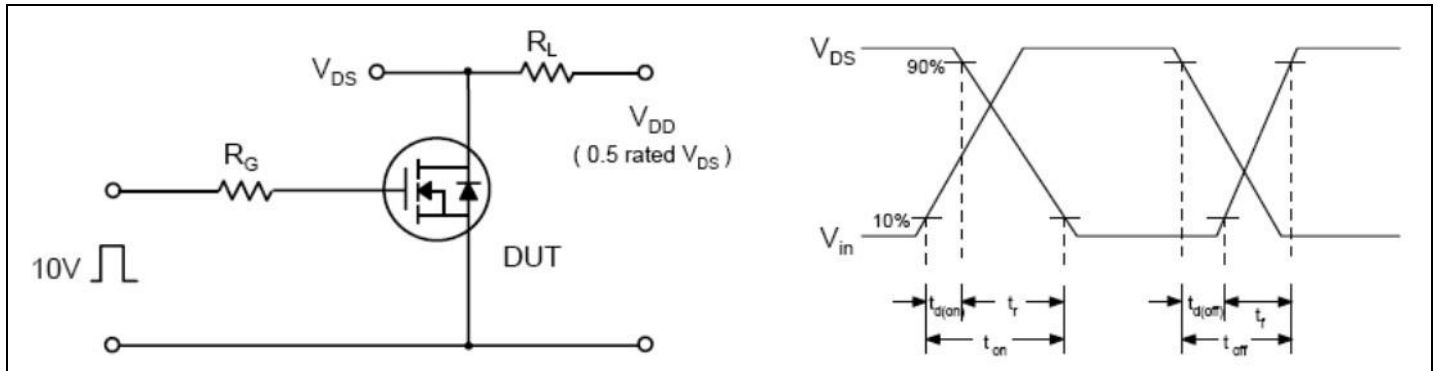


FIG.12-RESISTIVE SWITCHING TEST CIRCUIT & WAVEFORMS

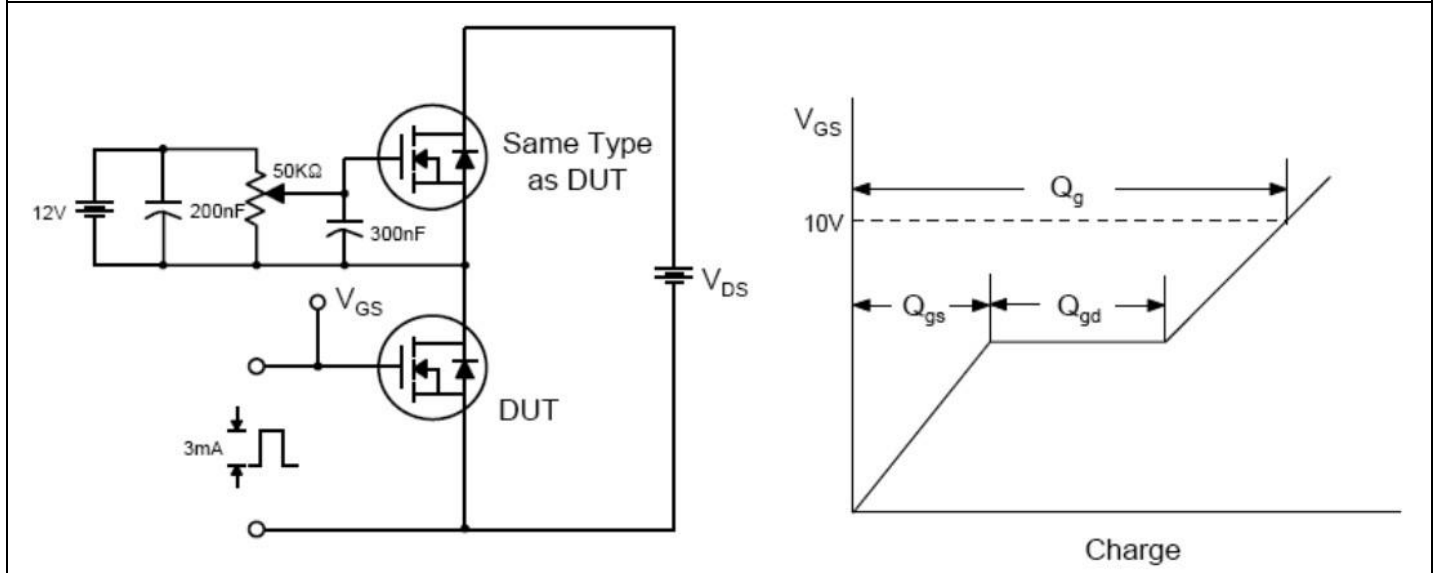


FIG.13-GATE CHARGE TEST CIRCUIT & WAVEFORM

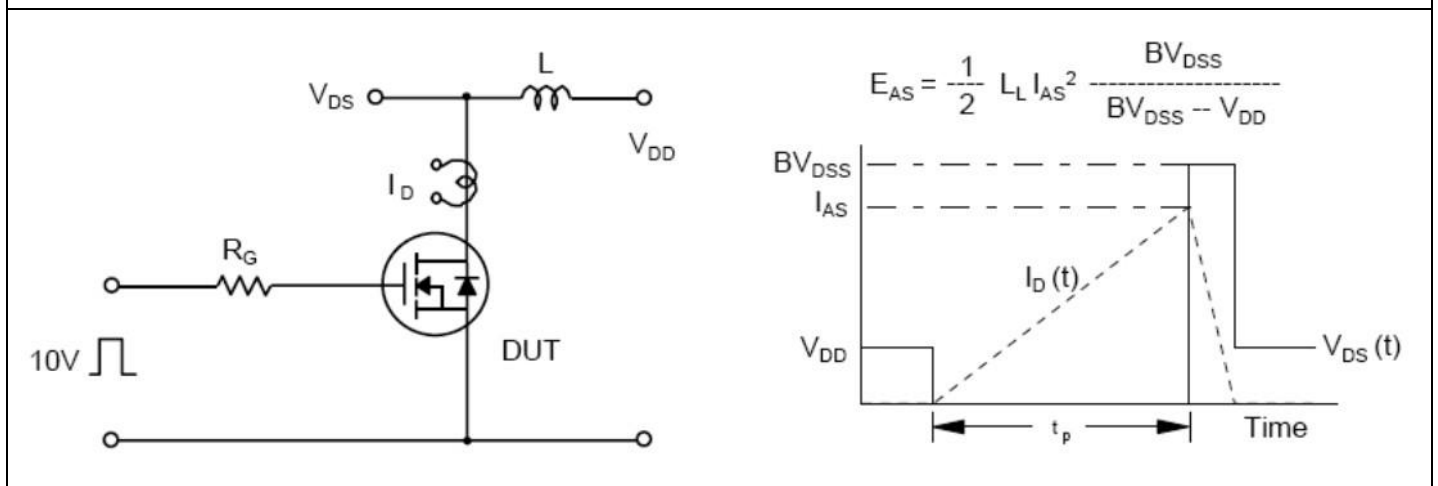


FIG.14-UNCLAMPED LINDUCTIVE SWITCHING TEST CIRCUIT & WAVEFORMS



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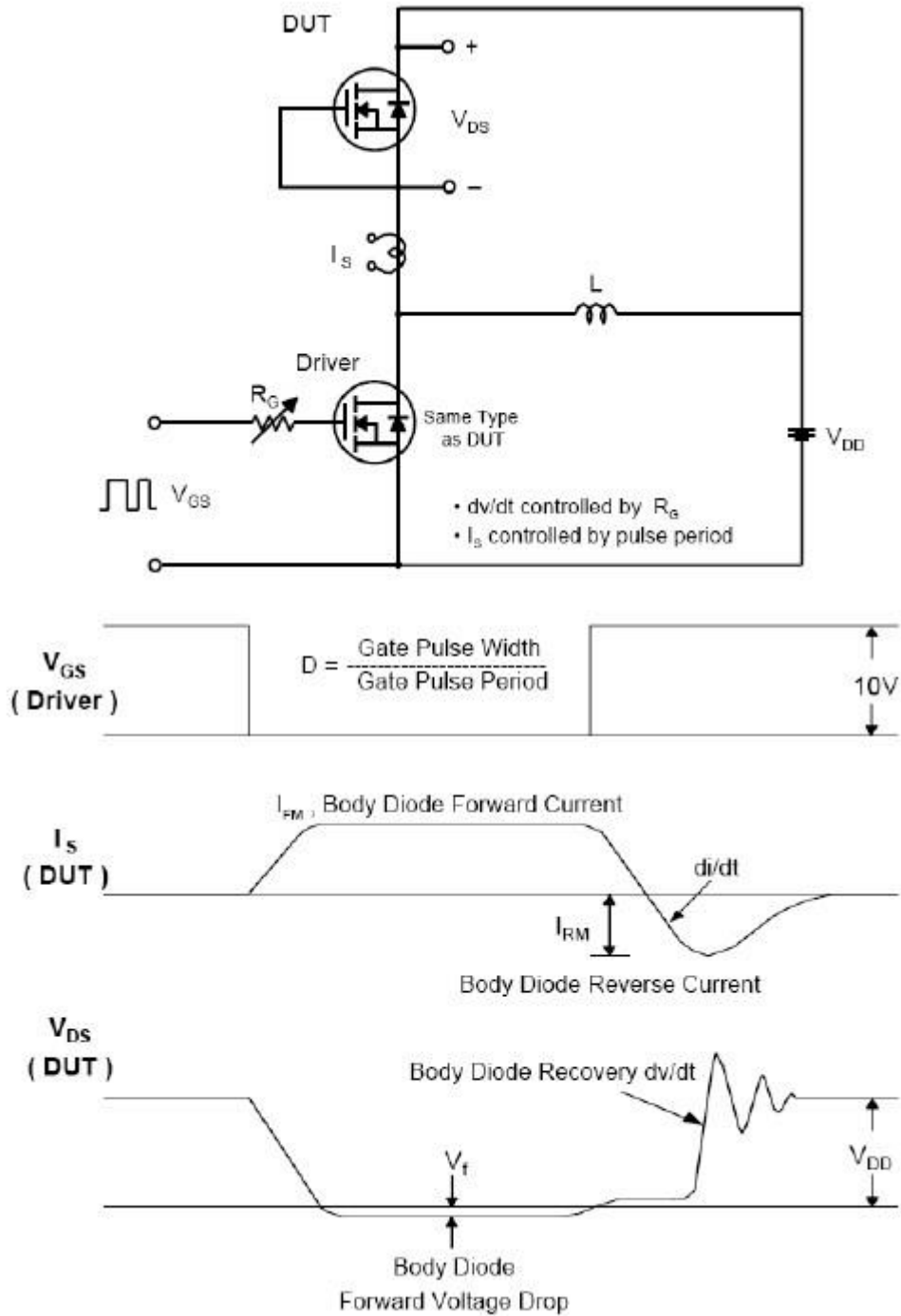


Fig 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

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#### Disclaimer

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