

# MSD4N40

## 400V N-Channel MOSFET

### Description

The MSD4N40 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-252 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 Ω (Typ.) @VGS=10V
- RoHS compliant package

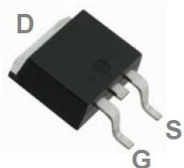
### Application

- Low power battery chargers
- Switch mode power supply (SMPS)
- DC-AC converters.

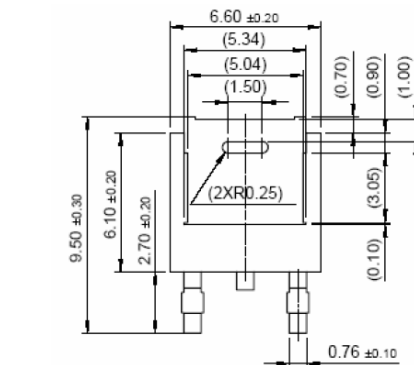
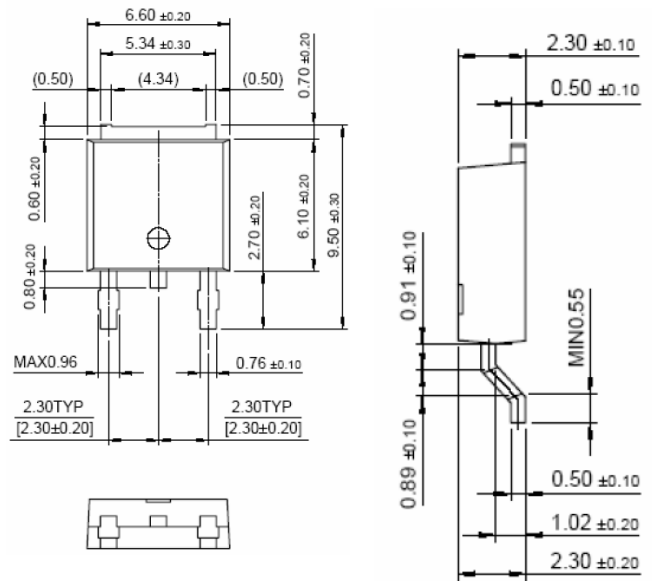
### Packing & Order Information

Part No./ T : 2,500/Reel

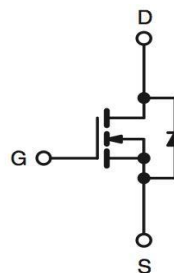
Part No./ R : 80/Tube , 4,000/Box



**RoHS**  
COMPLIANT



### Graphic symbol



## 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>	Continuous Drain Current (T <sub>C</sub> =25°C)	4.5	A
	Continuous Drain Current (T <sub>C</sub> =100°C)	3.0	A

## MSD4N40

### 400V N-Channel MOSFET

#### Absolute Maximum Ratings (T<sub>c</sub>=25°C unless otherwise noted)

Symbol	Parameter	Value	Unit
I <sub>DM</sub>	Pulsed Drain Current	22	A
EAS	Single Pulsed Avalanche Energy	270	mJ
EAR	Repetitive Avalanche Energy	7.3	mJ
dV/dt	Peak Diode Recovery dV/dt	4.5	V/ns
P <sub>D</sub>	Power Dissipation (T <sub>c</sub> =25°C)	2.5	W
	- Derate above 25°C	0.38	W
T <sub>J</sub> /T <sub>STG</sub>	Operating Junction and Storage Temperature	-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 (T<sub>c</sub>=25°C unless otherwise noted)

Symbol	Parameter	Typ.	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	Parameter	Test Conditions	Min	Typ.	Max.	Units
V <sub>GS</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA	2.0	--	4.0	V
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 2.25 A	--	0.78	0.9	Ω

#### Off Characteristics

Symbol	Parameter	Test Conditions	Min	Typ.	Max.	Units
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> =250μA	400	--	--	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250μA, Referenced to 25°C	--	0.54	--	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V V <sub>DS</sub> = 320 V, T <sub>C</sub> = 125°C	--	--	1 10	μA
I <sub>GSSF</sub>	Gate-Body Leakage Current, Forward	V <sub>GS</sub> = 30 V, V <sub>DS</sub> = 0 V	--	--	100	nA
I <sub>GSSR</sub>	Gate-Body Leakage Current, Reverse	V <sub>GS</sub> = -30 V, V <sub>DS</sub> = 0 V	--	--	-100	nA

## MSD4N40

### 400V N-Channel MOSFET

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

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

#### NOTE:

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.  $I_{SD} \leq 4.5\text{A}, di/dt \leq 300\text{A}/\mu\text{s}, V_{DD} \leq BVDSS, \text{Starting } T_J = 25^\circ\text{C}$
4. Pulse Test : Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2\%$
5. Essentially Independent of Operating Temperature

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### 400V N-Channel MOSFET

#### ■ Characteristics Curve

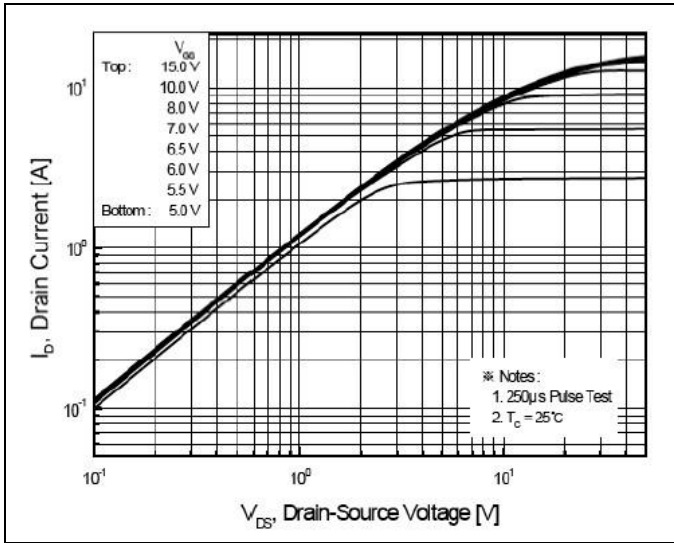


FIG.1-ON REGION CHARACTERISTICS

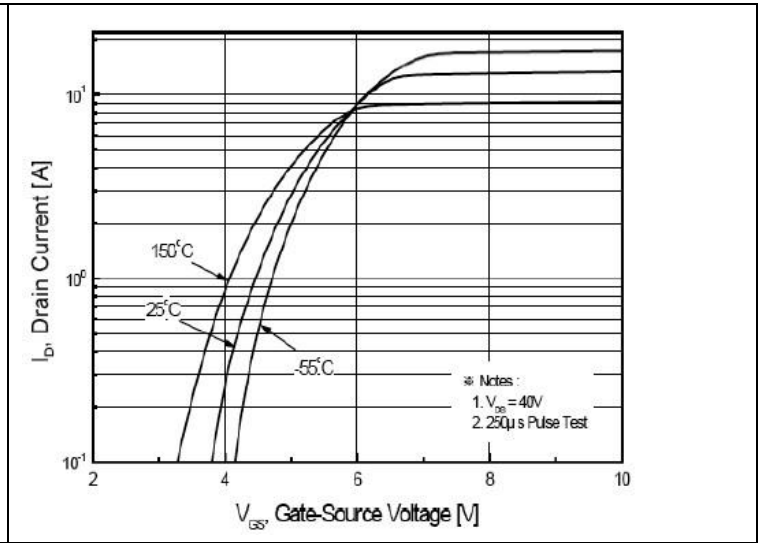


FIG.2-TRANSFER CHARACTERISTICS

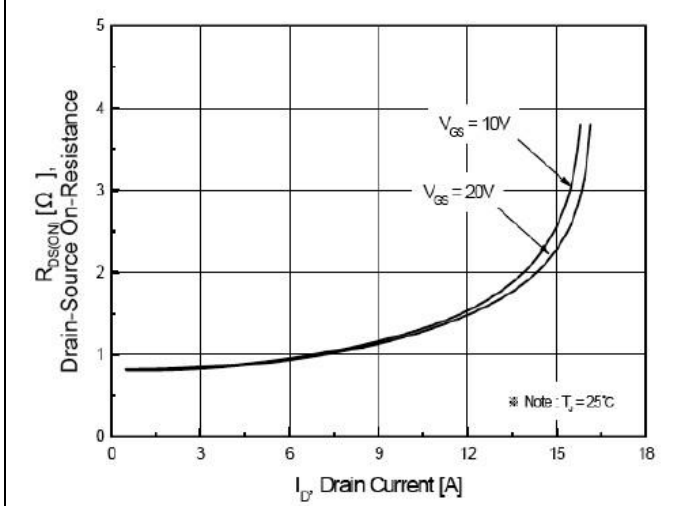


FIG.3-ON RESISTANCE VARIATION VS DRAIN CURRENT AND GATE VOLTAGE

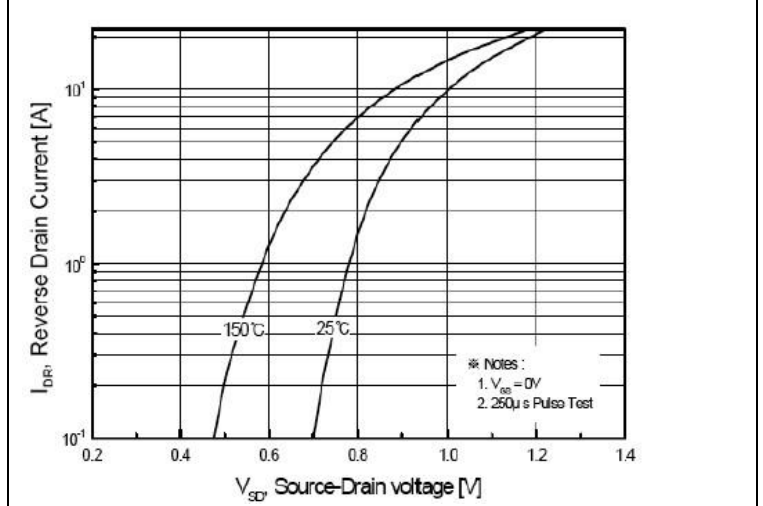


FIG.4-BODY DIODE FORWARD VOLTAGE VARIATION WITH SOURCE CURRENT AND TEMPERATURE

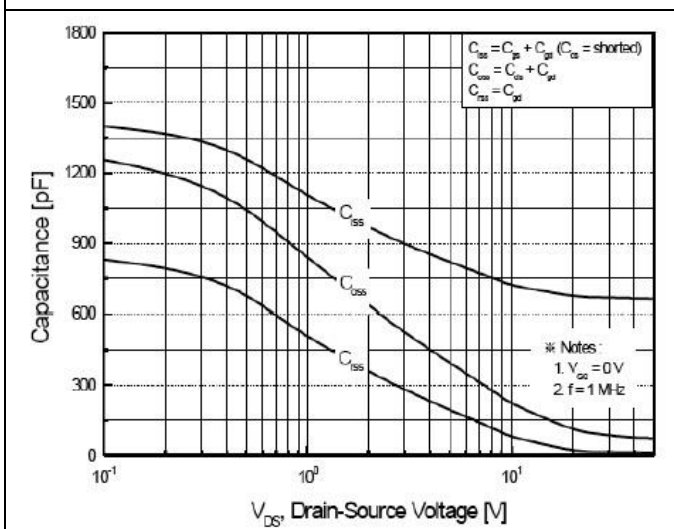


FIG.5-CAPACITANCE CHARACTERISTICS

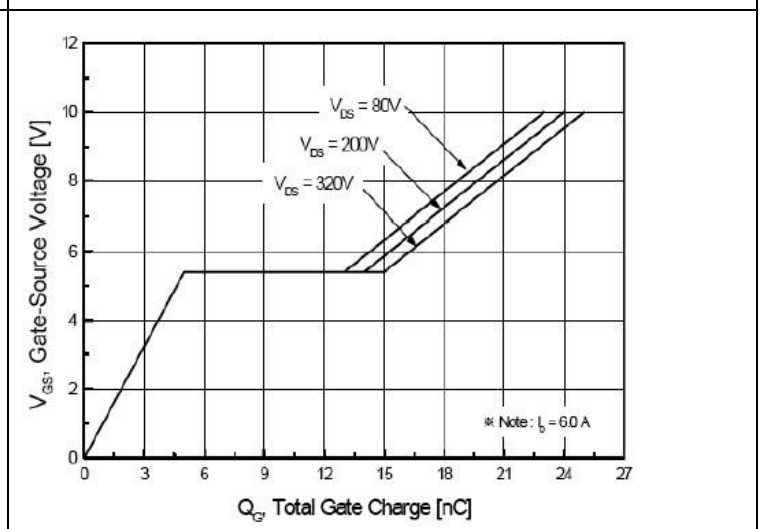
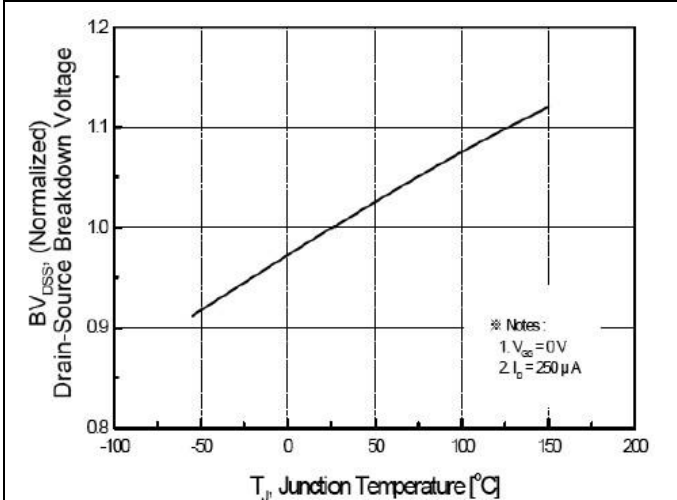


FIG.6-GATE CHARGE CHARACTERISTICS

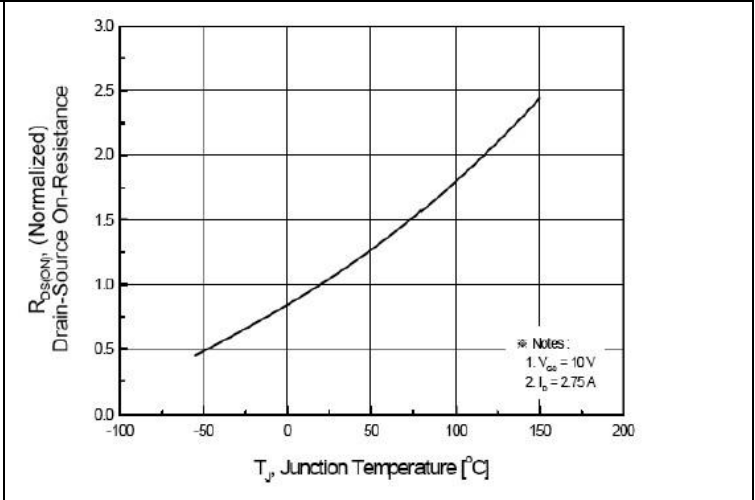
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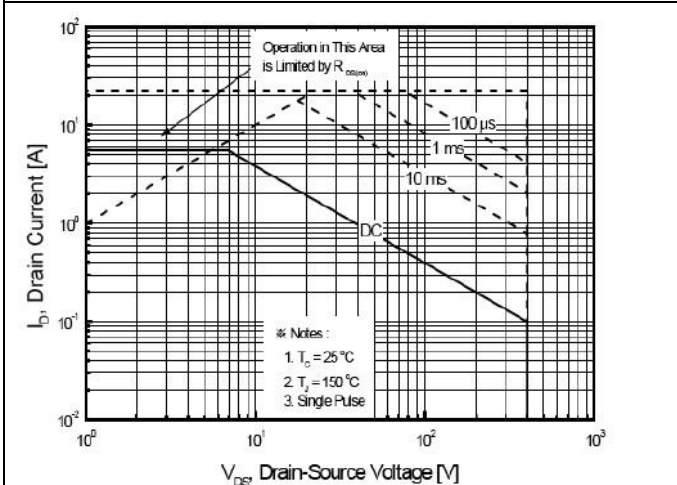
#### ■ Characteristics Curve



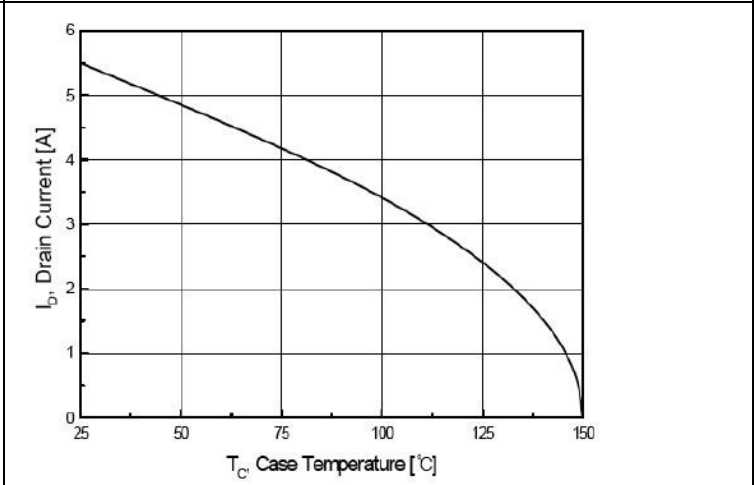
**FIG.7-BREAKDOWN VOLTAGE VARIATION VS TEMPERATURE**



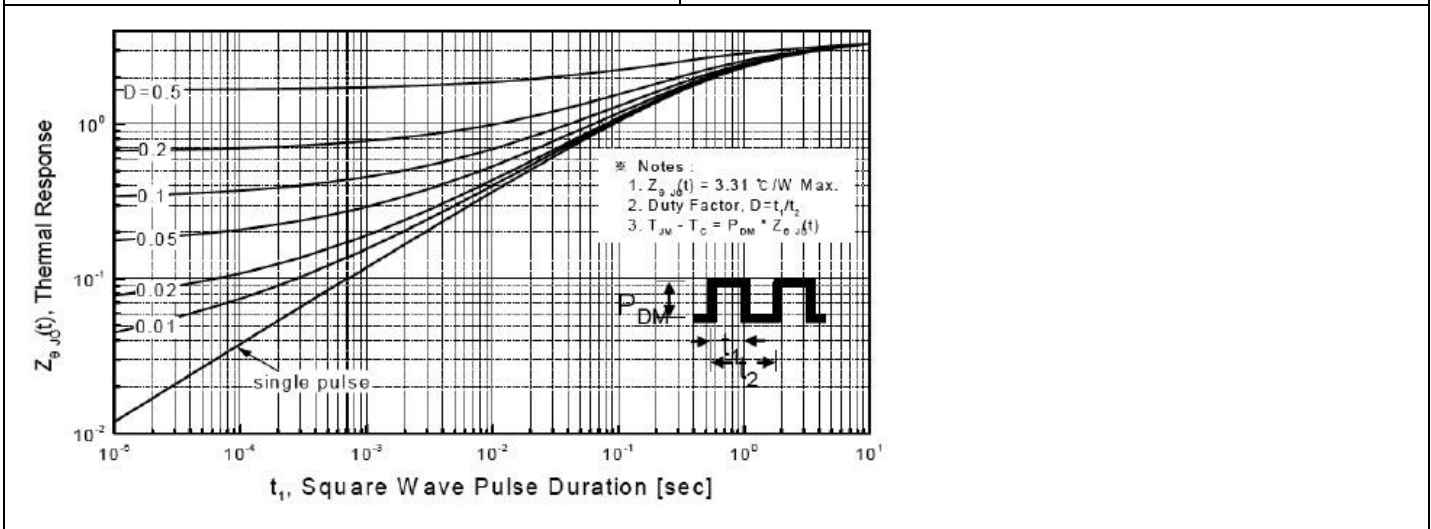
**FIG.8-ON-RESISTANCE VARIATION VS TEMPERATURE**



**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

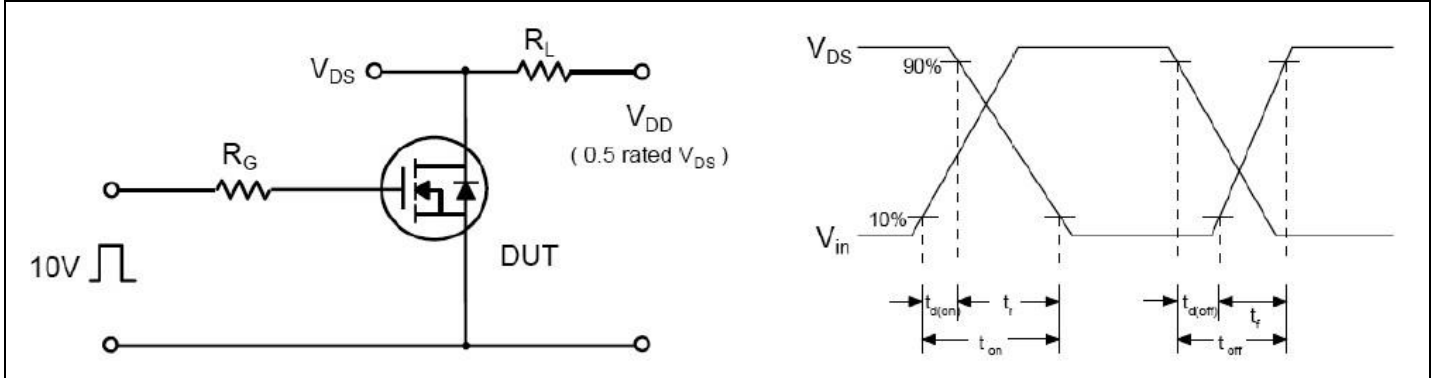


Fig 12. Resistive Switching Test Circuit & Waveforms

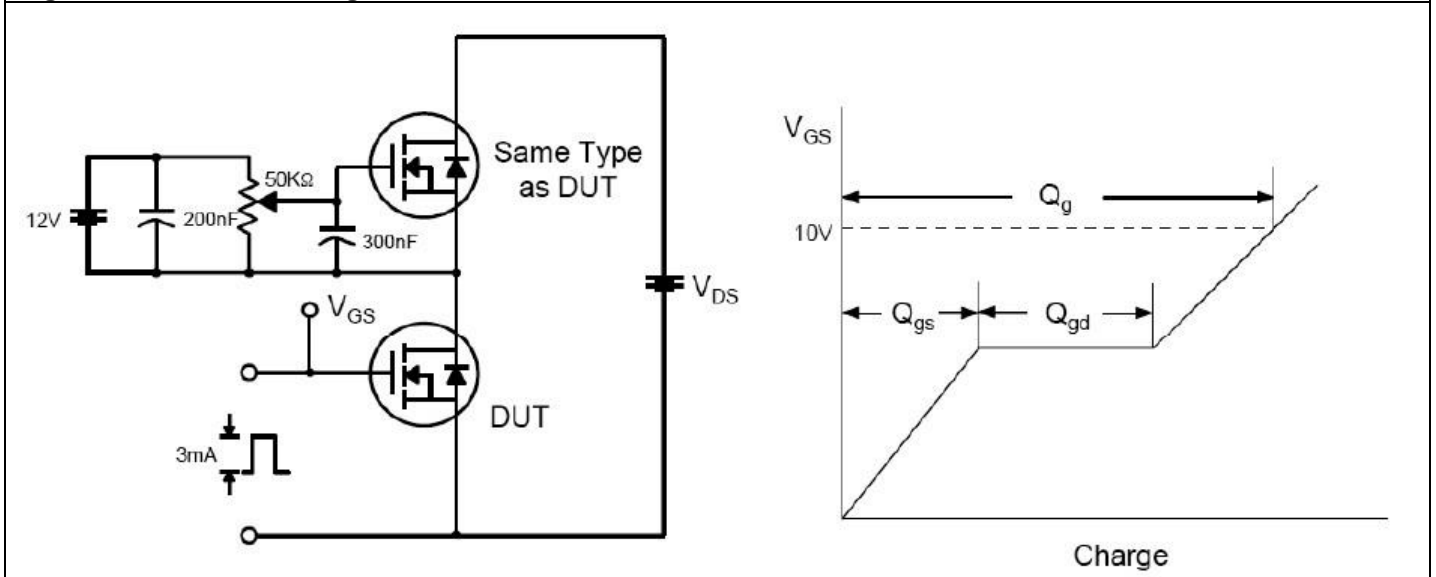


Fig 13. Gate Charge Test Circuit & Waveform

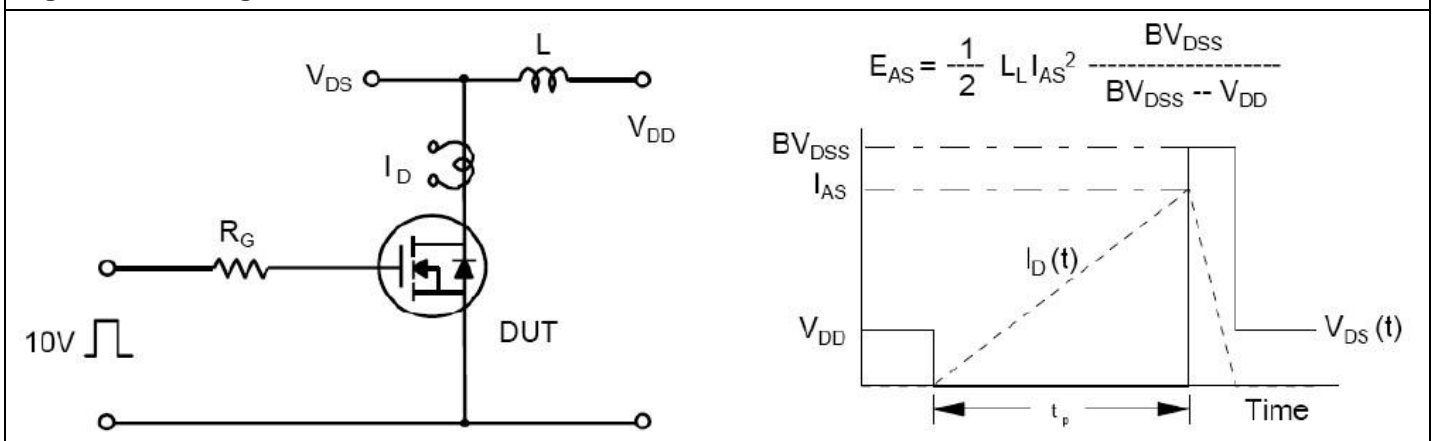


Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms

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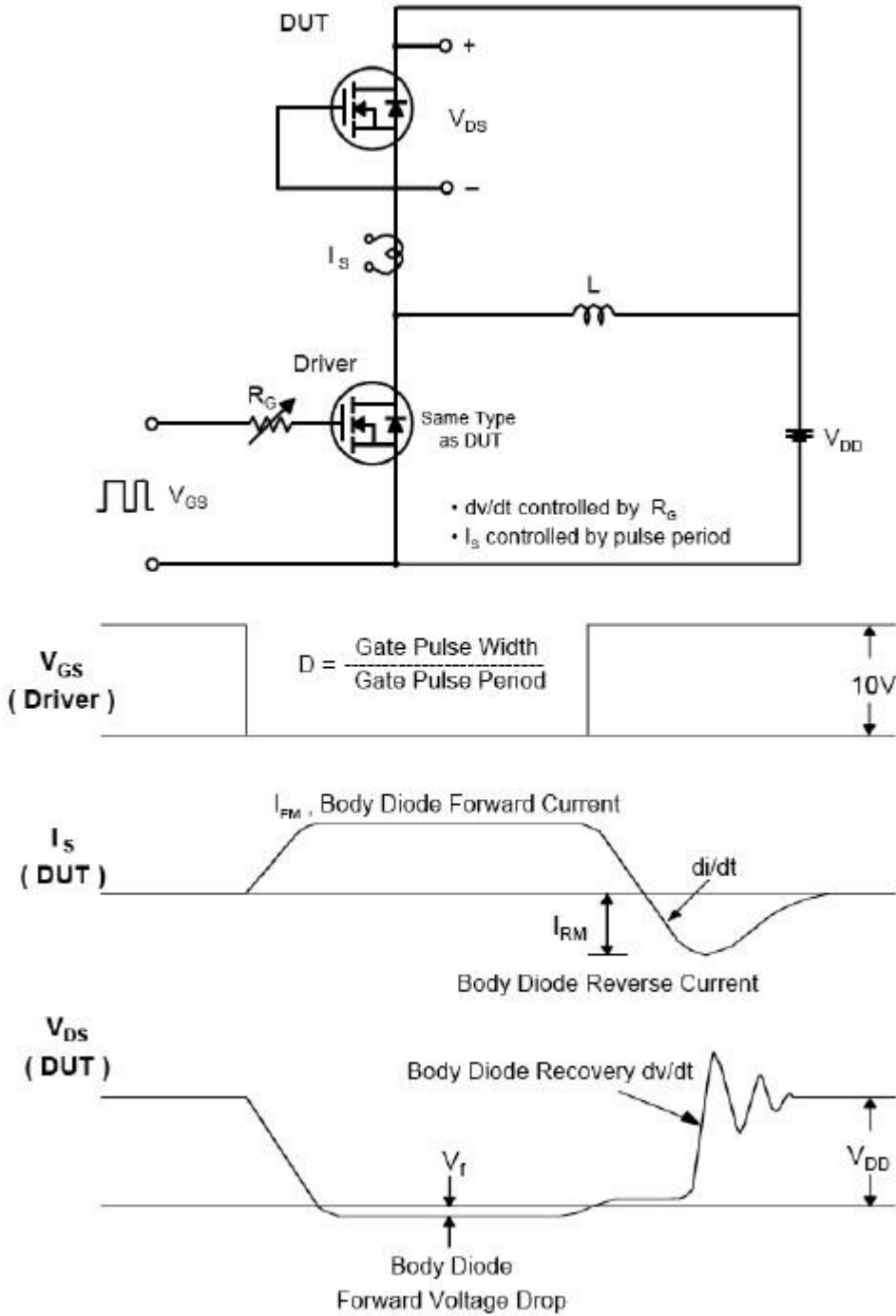


Fig 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

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