

# MSF9N90

## 900V N-Channel MOSFET

### Description

The MSF9N90 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-220F package is universally preferred for all commercial-industrial applications

### Features

- RDS(on) (Max 1.4 Ω)@VGS=10V
- Gate Charge (Typical 47nC)
- Improved dv/dt Capability, High Ruggedness
- 100% Avalanche Tested
- Maximum Junction Temperature Range (150°C)
- RoHS compliant package

### Application

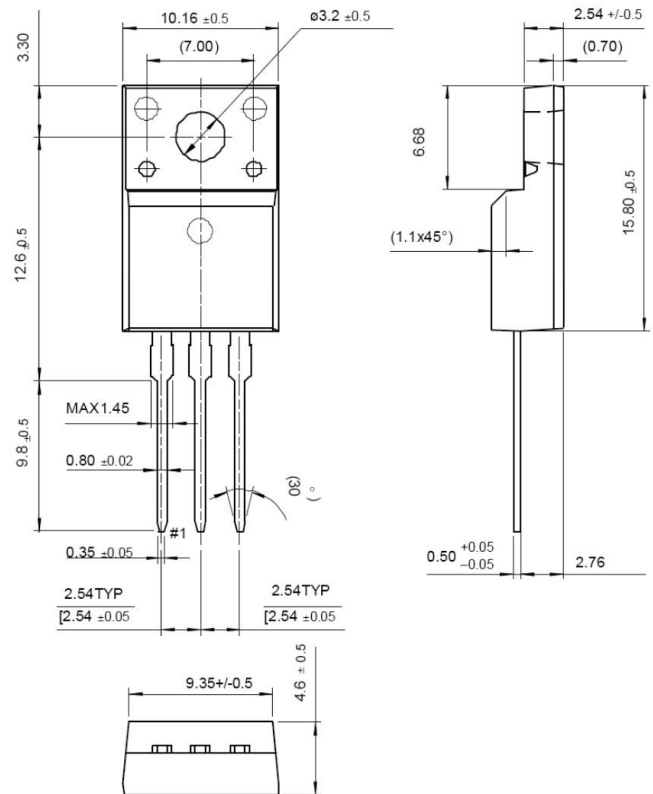
- Adapter
- Switching Mode Power Supply

### Packing & Order Information

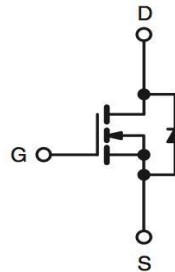
50/Tube ; 1,000/Box



**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	900	V
V <sub>GS</sub>	Gate-Source Voltage	±30	V
I <sub>D</sub>	Drain Current -Continuous (TC=25°C)	9	A
	Drain Current -Continuous (TC=100°C)	6	A
I <sub>DM</sub>	Drain Current Pulsed	36	A
E <sub>AS</sub>	Single Pulsed Avalanche Energy	900	mJ
E <sub>AR</sub>	Repetitive Avalanche Energy	28	mJ
dV/dt	Peak Diode Recovery dV/dt	4.0	V/ns
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range	-55 to +150	°C

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

Symbol	Parameter	Value	Unit
P <sub>D</sub>	Power Dissipation (TC = 25 °C)	280	W
	Power Dissipation (TC = 100 °C)	2.22	W/°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	3.5	°C/W
R <sub>θJA</sub>	Junction-to-Ambient	62.5	

#### 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	3.0	--	5.0	V
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 4.5 A	--	1.1	1.4	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	900	--	--	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250μA, Referenced to 25°C	--	1.05	--	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 900 V, V <sub>GS</sub> = 0 V V <sub>DS</sub> = 720 V, V <sub>C</sub> = 125°C	--	--	10 100	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

#### Dynamic Characteristics

Symbol	Parameter	Test Conditions	Min	Typ.	Max.	Units
C <sub>ISS</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, F = 1.0MHz	--	2200	--	pF
C <sub>OSS</sub>	Output Capacitance		--	180	--	pF
C <sub>RSS</sub>	Reverse Transfer Capacitance		--	15	--	pF

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Dynamic Characteristics						
Symbol	Parameter	Test Conditions	Min	Typ.	Max.	Units
$t_{d(on)}$	Turn-On Time	$V_{DS} = 450\text{ V}, I_D = 9\text{ A},$ $R_G = 25\ \Omega$	--	60	--	ns
$t_r$	Turn-On Time		--	130	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	110	--	ns
$t_f$	Turn-Off Fall Time		--	80	--	ns
$Q_g$	Total Gate Charge	$V_{DS} = 720\text{ V}, I_D = 10\text{ A},$ $V_{GS} = 9\text{ V}$	--	47	--	nC
$Q_{gs}$	Gate-Source Charge		--	15	--	nC
$Q_{gd}$	Gate-Drain Charge		--	20	--	nC

Source-Drain Diode Maximum Ratings and Characteristics						
Symbol	Parameter	Test Conditions	Min	Typ.	Max.	Units
$I_S$	Continuous Source-Drain Diode Forward Current		--	--	9	A
$I_{SM}$	Pulsed Source-Drain Diode Forward Current		--	--	35	
$V_{SD}$	Source-Drain Diode Forward Voltage	$I_S = 9\text{ A}, V_{GS} = 0\text{ V}$	--	--	1.4	V
$t_{rr}$	Reverse Recovery Time	$I_S = 9\text{ A}, V_{GS} = 0\text{ V}$ $diF/dt = 100\text{ A}/\mu\text{s}$	--	550	--	ns
$Q_{rr}$	Reverse Recovery Charge		--	6.5	--	$\mu\text{C}$

#### Notes;

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $L=21\text{mH}, I_{AS}=9.0\text{A}, V_{DD}=50\text{V}, R_G=25\Omega,$  Starting  $T_J=25^\circ\text{C}$
3.  $I_{SD} \leq 9.0\text{A}, di/dt \leq 200\text{A}/\mu\text{s}, V_{DD} \leq BV_{DSS},$  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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#### ■ Characteristics Curve

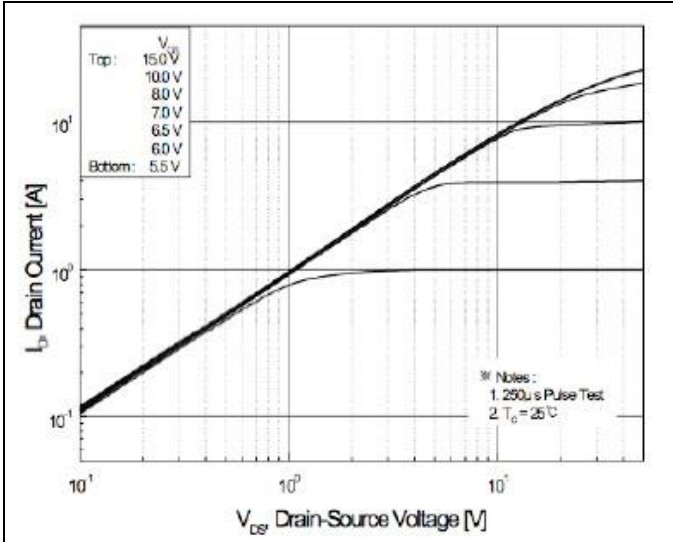


FIG.1-ON REGION CHARACTERISTICS

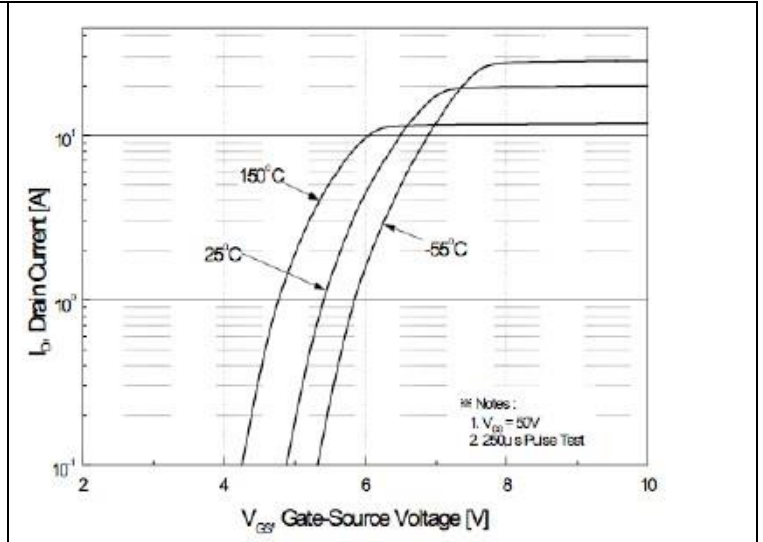


FIG.2-TRANSFER CHARACTERISTICS

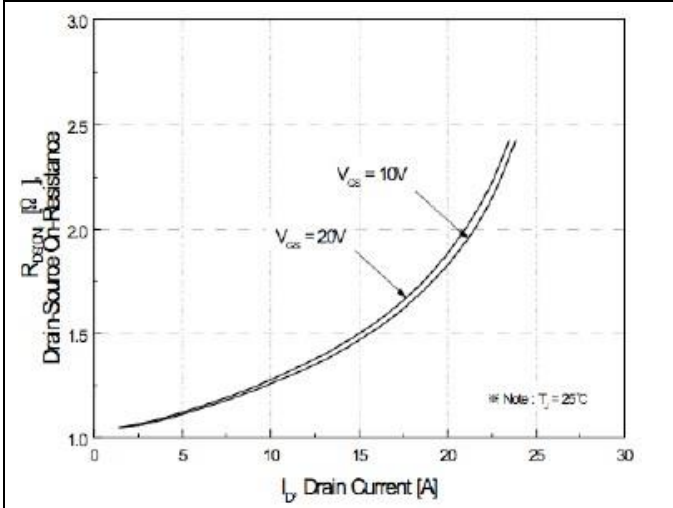


FIG.3-ON RESISTANCE VARIATION VS DRAIN CURRENT AND GATE VOLTAGE

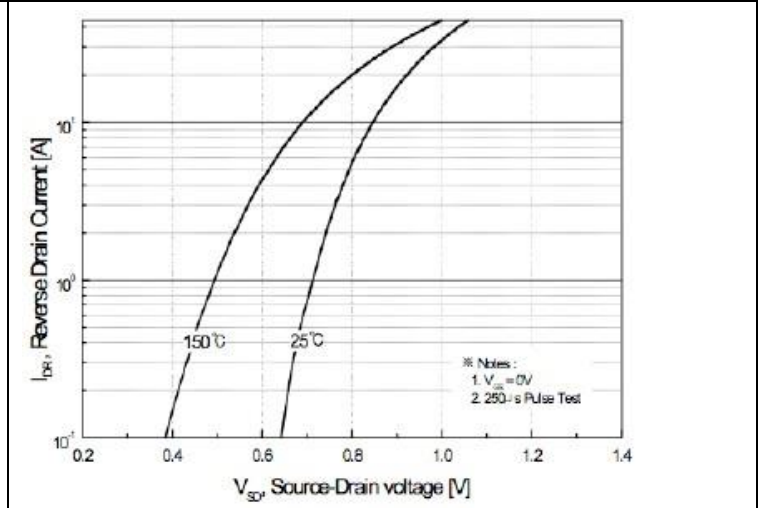


FIG.4-BODY DIODE FORWARD VOLTAGE VARIATION WITH SOURCE CURRENT AND TEMPERATURE

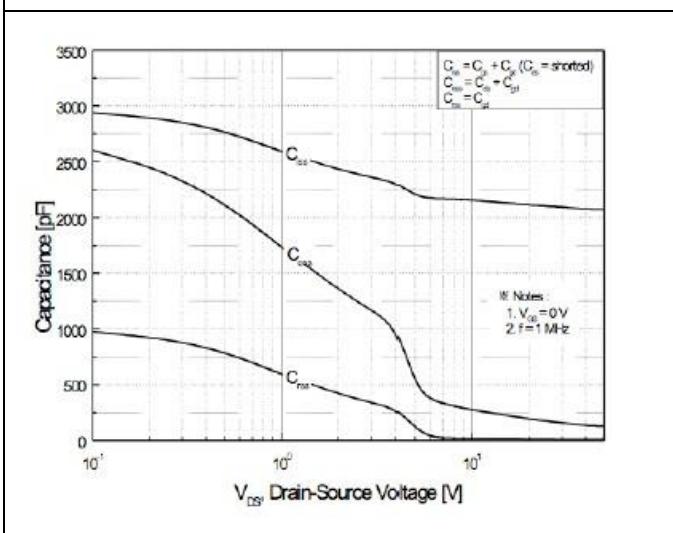


FIG.5-CAPACITANCE CHARACTERISTICS

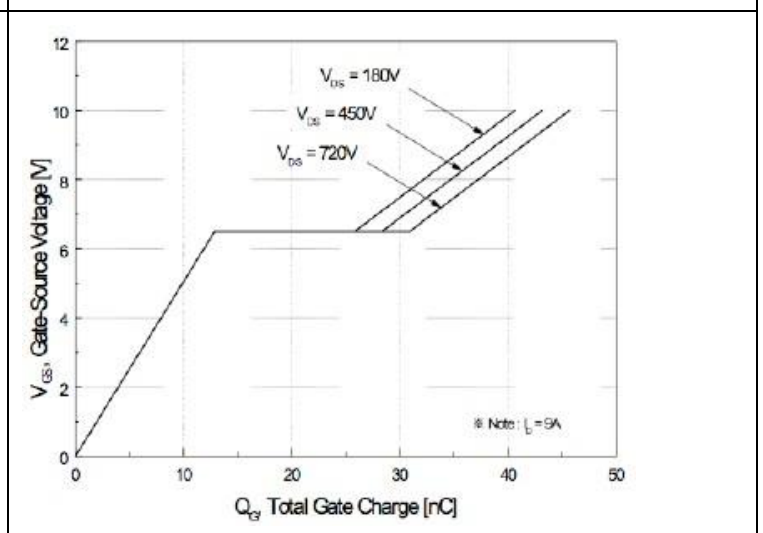
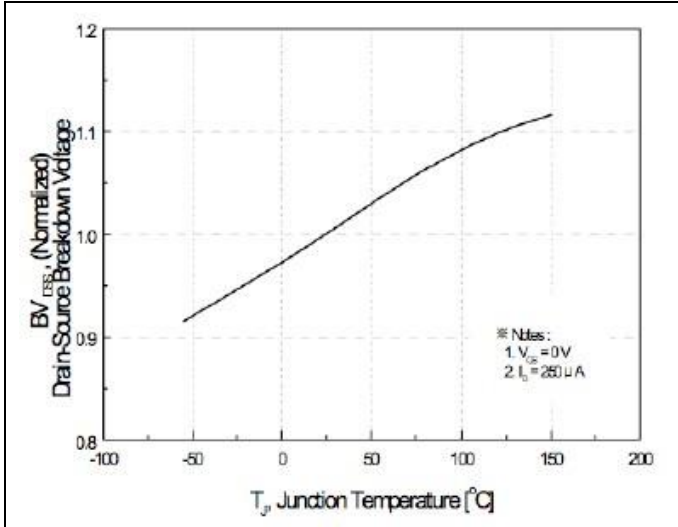


FIG.6-GATE CHARGE CHARACTERISTICS

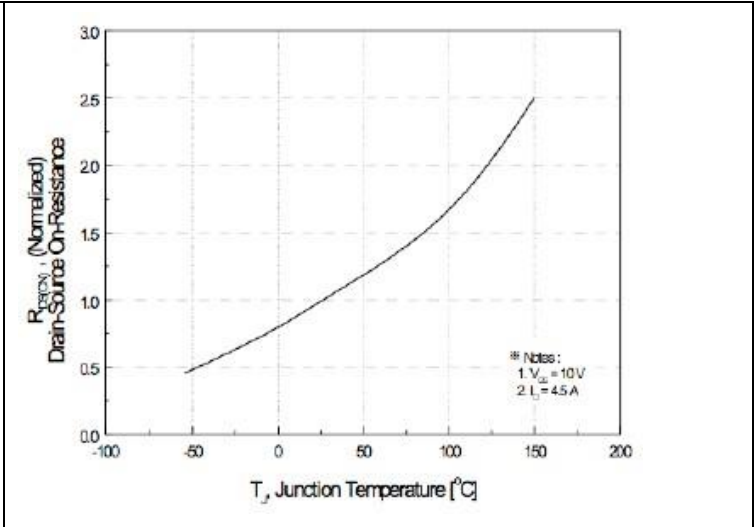
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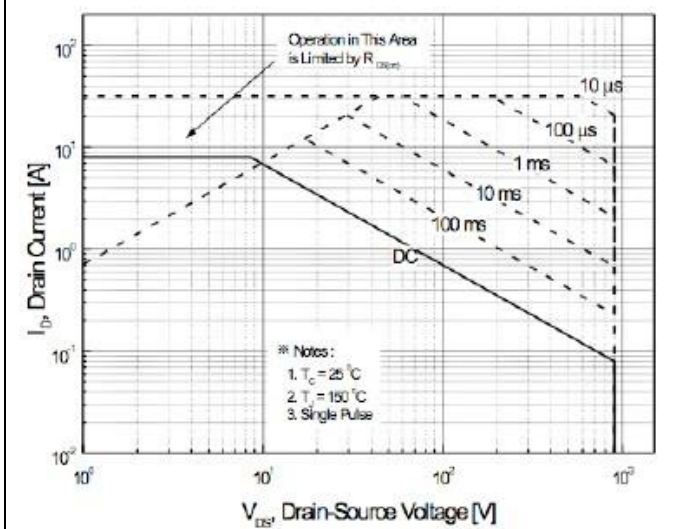
#### ■ Characteristics Curve



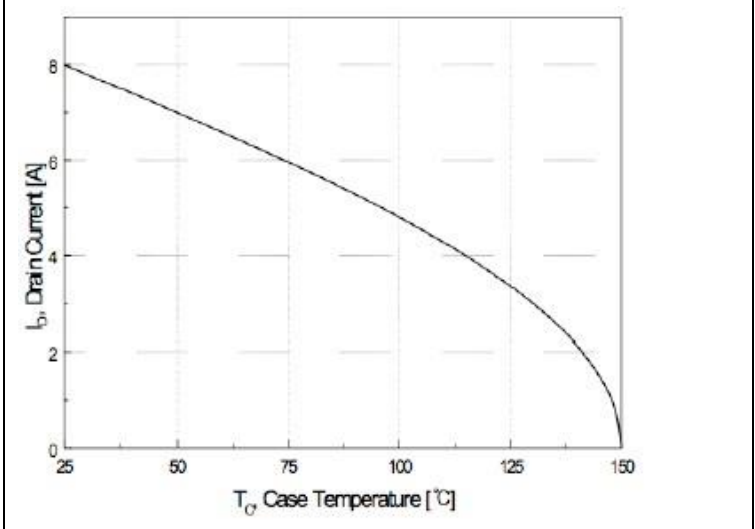
**FIG.7-BREAKDOWN VOLTAGE VARIATION VS TEMPERATURE**



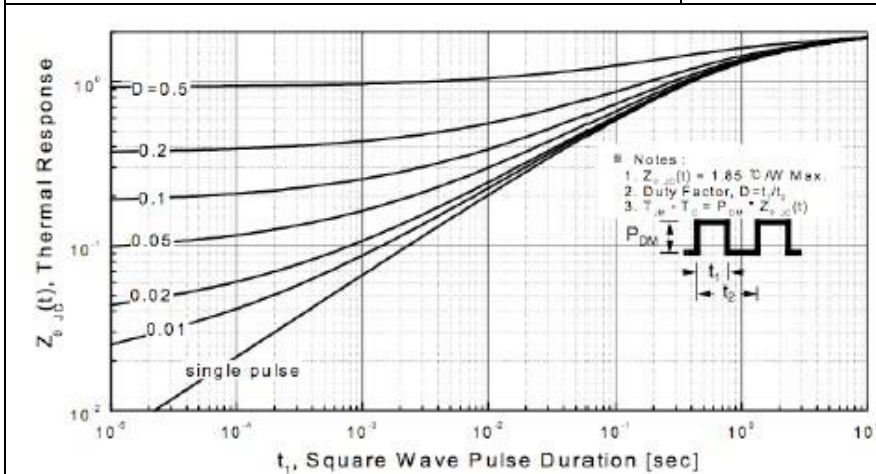
**FIG.8-ON-RESISTANCE VARIATION VS TEMPERATURE**



**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

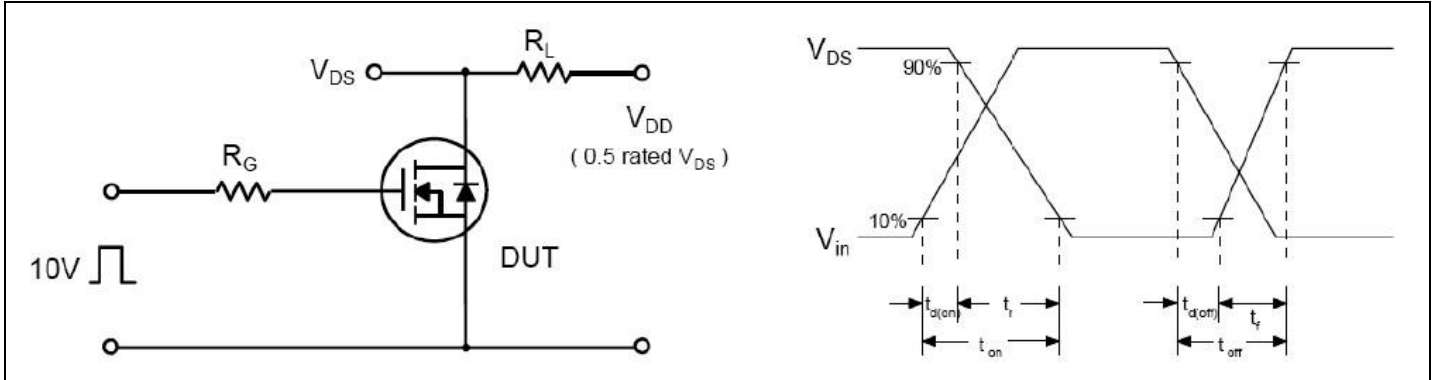


Fig 12. Resistive Switching Test Circuit & Waveforms

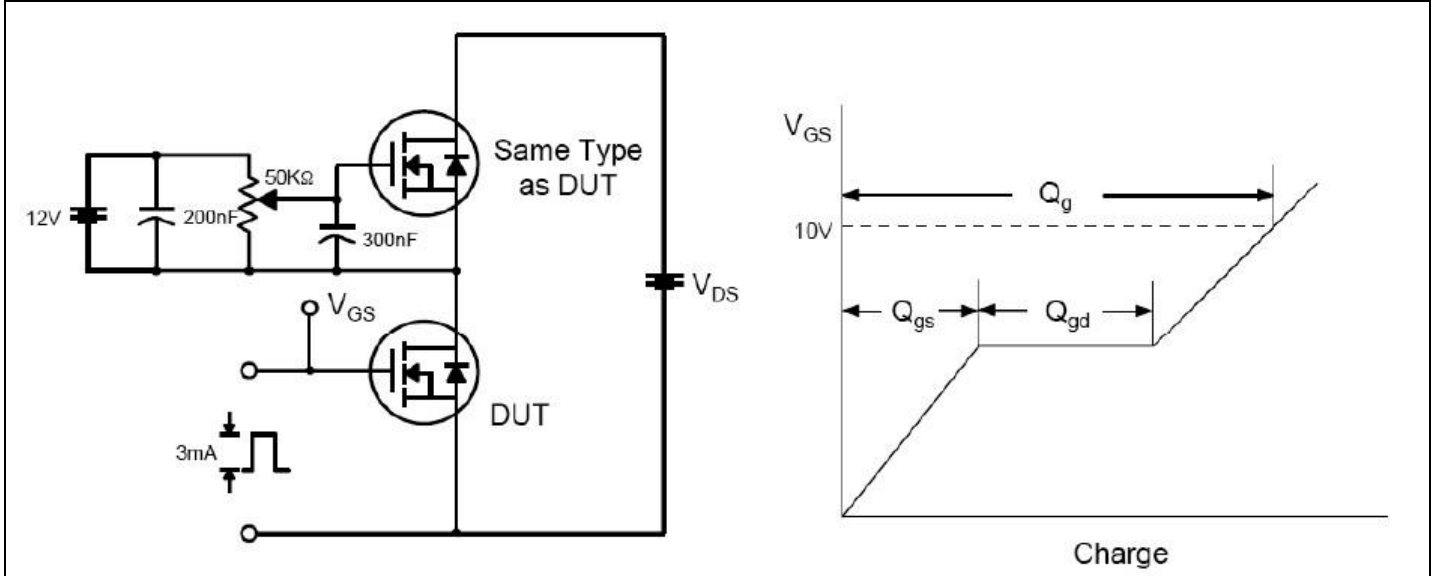


Fig 13. Gate Charge Test Circuit & Waveform

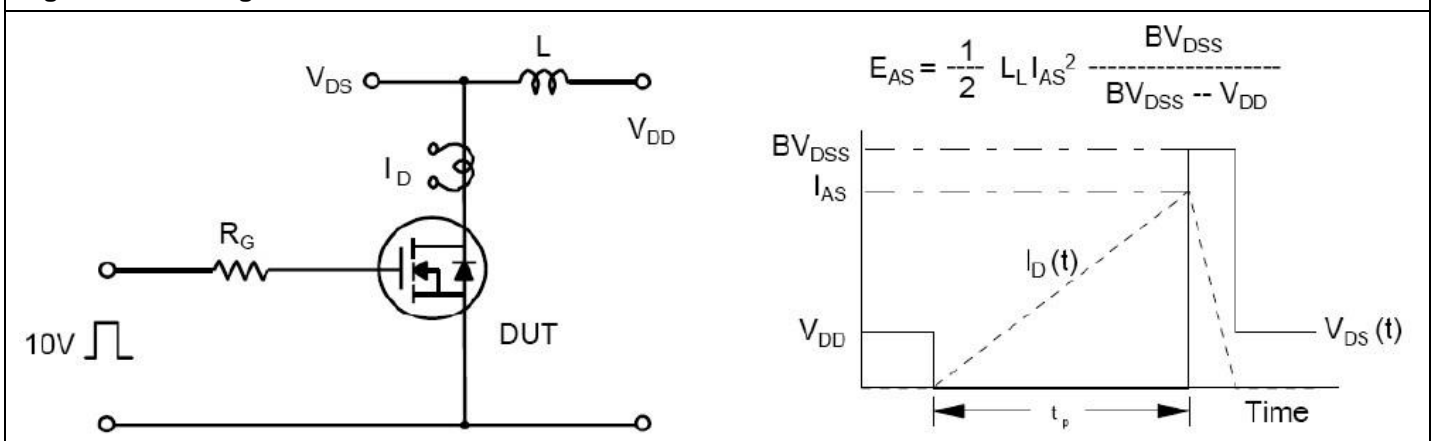


Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms

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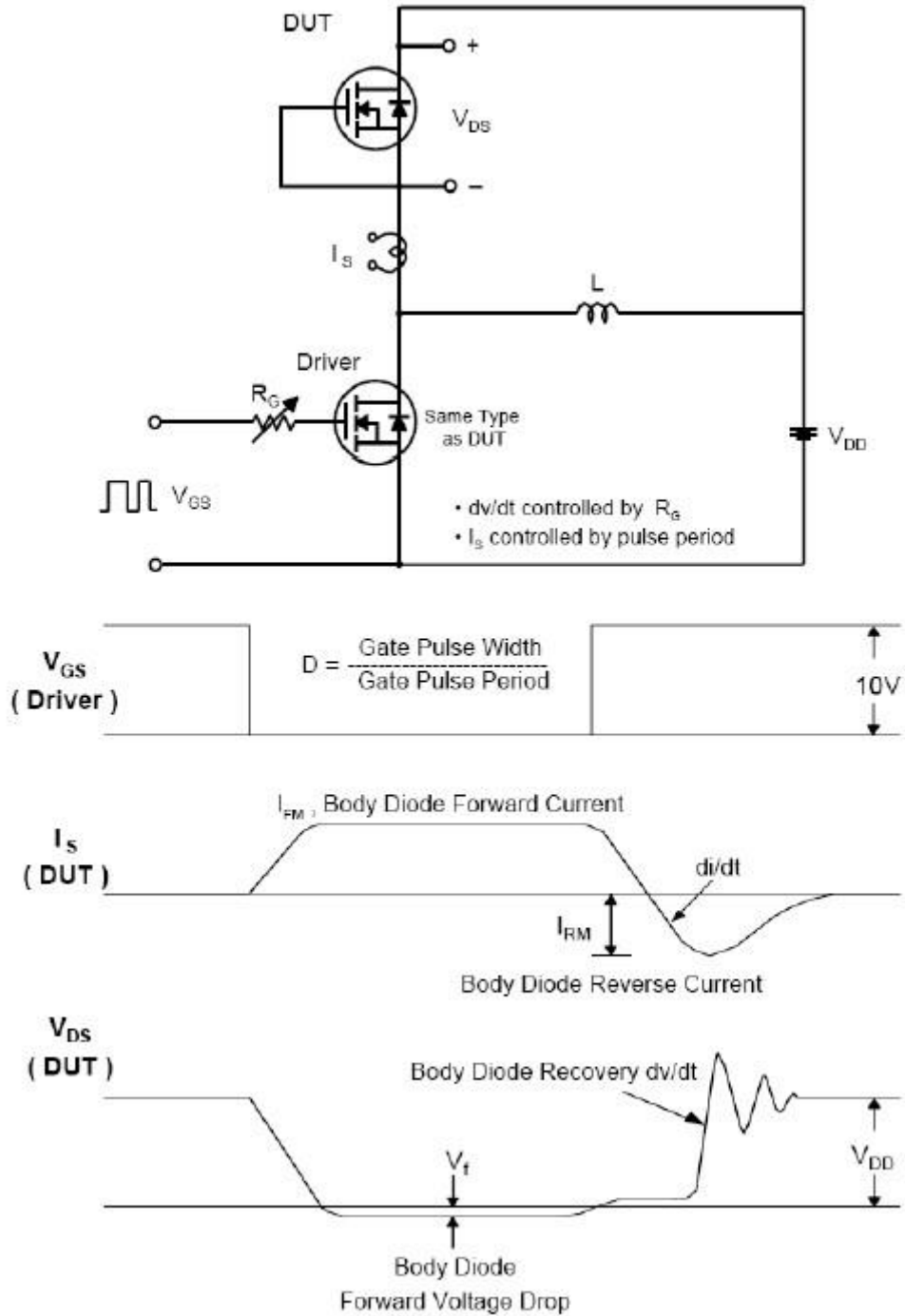


Fig 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

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