December 2014

SemiHow
Know-How for Semiconductor

BV_{DSS} = 75 V

$R_{DS(on)\ typ}$ = 7.2 mΩ

I_D = 70 A

HRP90N75K
75V N-Channel Trench MOSFET
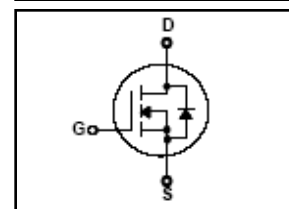
TO-220

1.Gate 2. Drain 3. Source

FEATURES

❑ Originative New Design
❑ Superior Avalanche Rugged Technology
❑ Excellent Switching Characteristics
❑ Unrivalled Gate Charge : 95 nC (Typ.)
❑ Extended Safe Operating Area
❑ Lower $R_{DS(ON)}$: 7.2 mΩ (Typ.) @V_{GS}=10V
❑ 100% Avalanche Tested

Absolute Maximum Ratings T_C=25℃ unless otherwise specified

Symbol	Parameter	Value	Units
V_{DSS}	Drain-Source Voltage	75	V
I_D	Drain Current – Continuous (T_C = 25℃)	70	A
	Drain Current – Continuous (T_C = 100℃)	50	A
I_{DM}	Drain Current – Pulsed (Note 1)	245	A
V_{GS}	Gate-Source Voltage	±25	V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	300	mJ
E_{AR}	Repetitive Avalanche Energy (Note 1)	9.4	mJ
P_D	Power Dissipation (T_C = 25℃)	94	W
	- Derate above 25℃	0.63	W/℃
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +175	℃
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300	℃

Thermal Resistance Characteristics

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	--	1.6	℃/W
$R_{\theta CS}$	Case-to-Sink	0.5	--	℃/W
$R_{\theta JA}$	Junction-to-Ambient	--	62.5	℃/W

Electrical Characteristics T_J=25 °C unless otherwise specified

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
On Characteristics						
V_{GS}	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 250\ \mu A$	2.2	--	3.8	V
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS} = 10$ V, $I_D = 40$ A	--	7.2	9.0	mΩ
g_{FS}	Forward Transconductance	$V_{DS} = 20$, $I_D = 40$ A	--	90	--	S
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0$ V, $I_D = 250\ \mu A$	75	--	--	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 60$ V, $V_{GS} = 0$ V	--	--	1	μA
		$V_{DS} = 60$ V, $T_J = 125$℃	--	--	100	μA
I_{GSS}	Gate-Body Leakage Current	$V_{GS} = \pm20$ V, $V_{DS} = 0$ V	--	--	±100	nA
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS} = 25$ V, $V_{GS} = 0$ V, f = 1.0 MHz	--	4700	--	pF
C_{oss}	Output Capacitance		--	370	--	pF
C_{rss}	Reverse Transfer Capacitance		--	270	--	pF
R_g	Gate Resistance	$V_{GS} = 0$ V, $V_{DS} = 0$ V, f = 1MHz	--	1.7	--	Ω
Switching Characteristics						
$t_{d(on)}$	Turn-On Time	$V_{DS} = 38$ V, $I_D = 30$ A, $R_G = 6\ \Omega$	--	60	--	ns
t_r	Turn-On Rise Time		--	60	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	170	--	ns
t_f	Turn-Off Fall Time		--	50	--	ns
Q_g	Total Gate Charge	$V_{DS} = 60$ V, $I_D = 30$ A, $V_{GS} = 10$ V	--	95	--	nC
Q_{gs}	Gate-Source Charge		--	20	--	nC
Q_{gd}	Gate-Drain Charge		--	30	--	nC
Source-Drain Diode Maximum Ratings and Characteristics						
I_S	Continuous Source-Drain Diode Forward Current		--	--	70	A
I_{SM}	Pulsed Source-Drain Diode Forward Current		--	--	245	
V_{SD}	Source-Drain Diode Forward Voltage	$I_S = 30$ A, $V_{GS} = 0$ V	--	--	1.3	V
trr	Reverse Recovery Time	$I_S = 30$ A, $V_{GS} = 0$ V, $di_F/dt = 100$ A/μs	--	40	--	ns
Qrr	Reverse Recovery Charge		--	55	--	nC

Notes :
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L=1mH, I_{AS}=20A, V_{DD}=25V, R_G=25Ω, Starting T_J=25°C

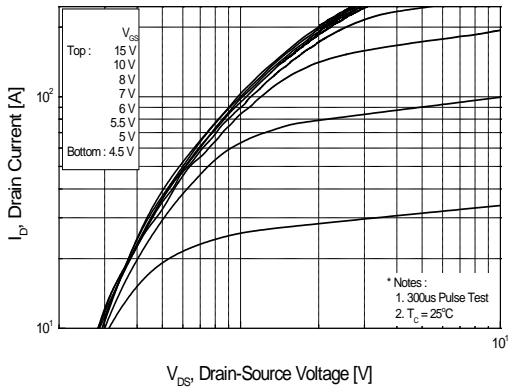# Typical Characteristics

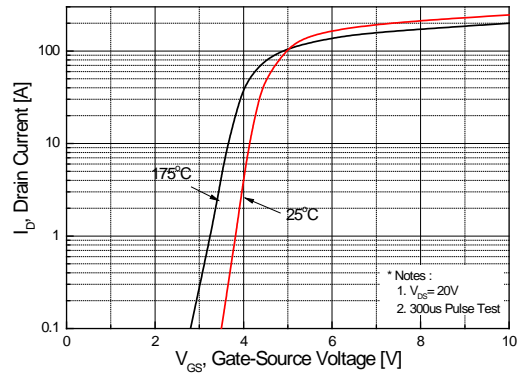**Figure 1. On Region Characteristics**
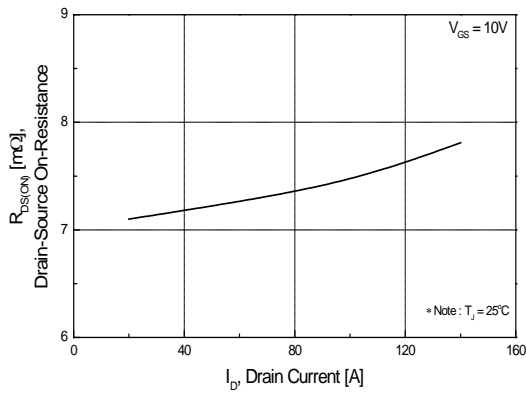
Figure 2. Transfer Characteristics

Figure 3. On Resistance Variation vs Drain Current and Gate Voltage
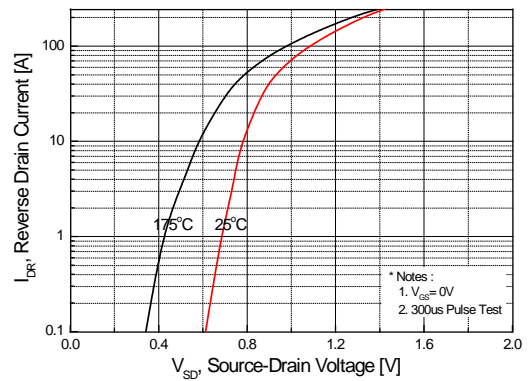
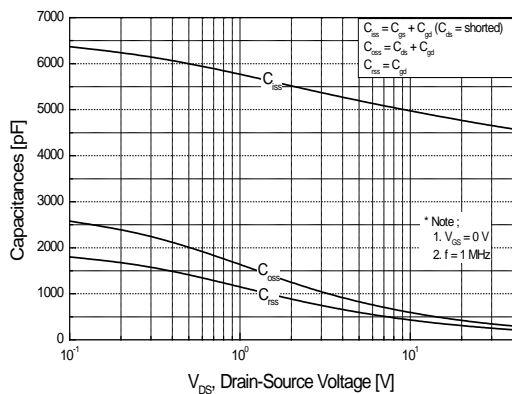**Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature**
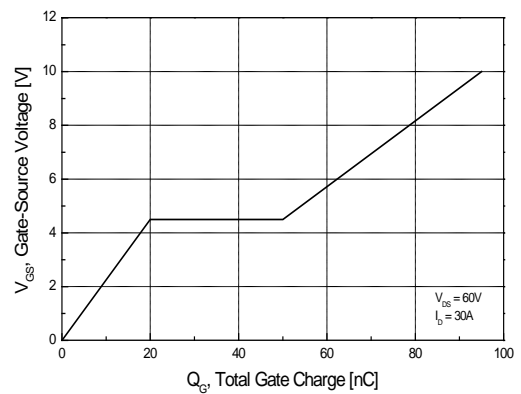
Figure 5. Capacitance Characteristics

Figure 6. Gate Charge Characteristics
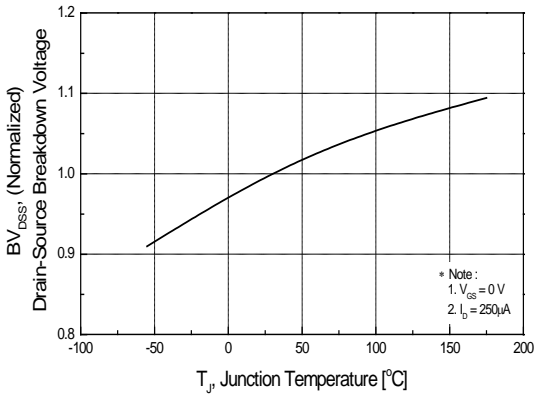
Typical Characteristics   (continued)

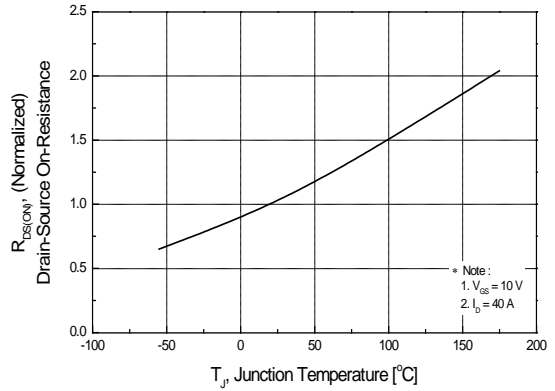Figure 7. Breakdown Voltage Variation
vs Temperature

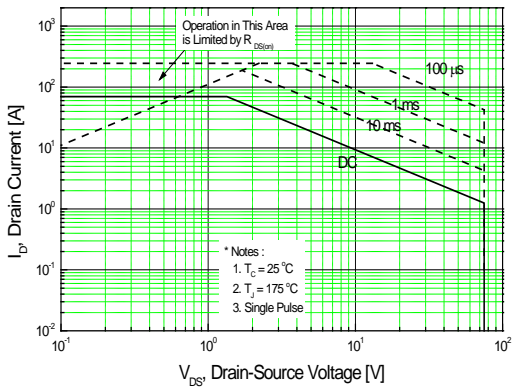Figure 8. On-Resistance Variation
vs Temperature

Figure 9. Maximum Safe Operating Area
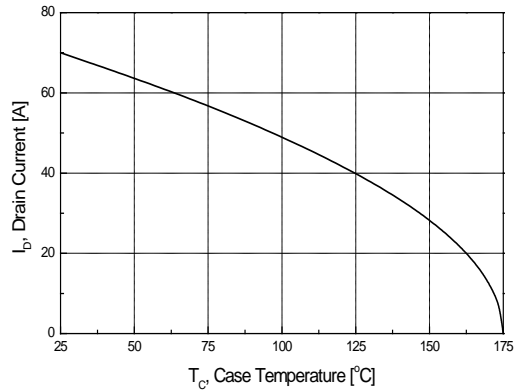

Figure 10. Maximum Drain Current
vs Case Temperature
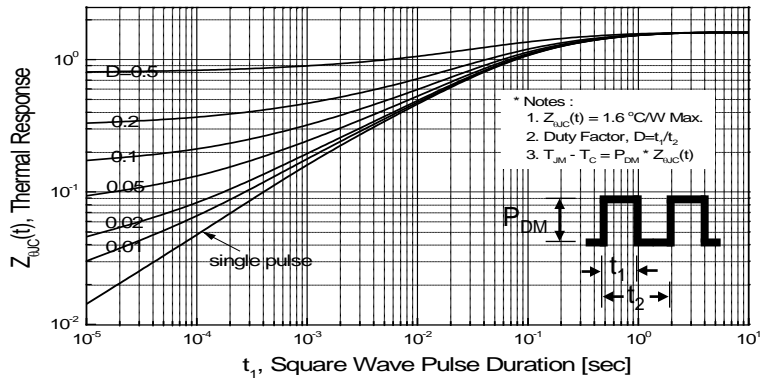

Figure 11. Transient Thermal Response Curve
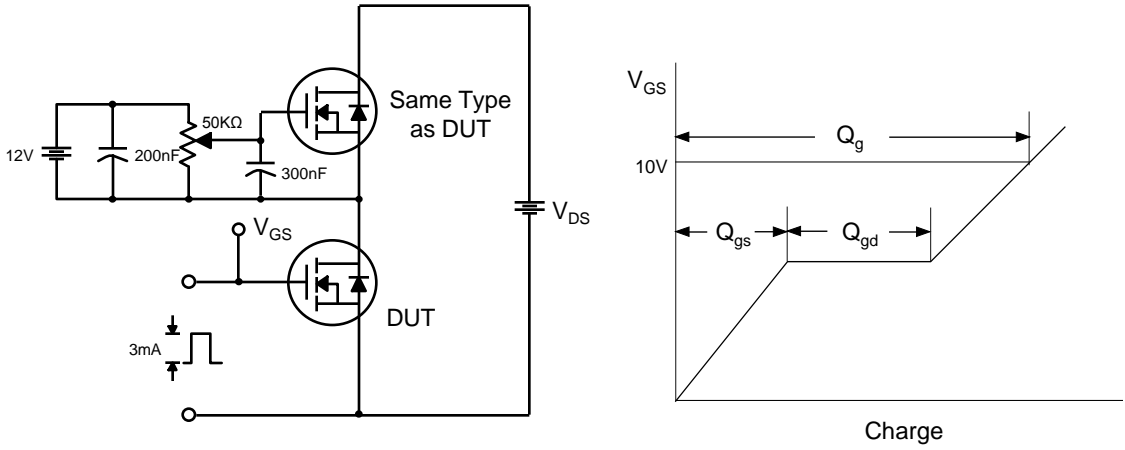
Fig 12. Gate Charge Test Circuit & Waveform

12V | 200nF | 50KΩ | 300nF | Same Type as DUT | V_{DS}

V_{GS}

DUT

3mA

V_{GS}

10V

Q_g

Q_{gs} | Q_{gd}

Charge

Fig 13. Resistive Switching Test Circuit & Waveforms

V_{DS} — R_L — V_{DD} (0.5 rated V_{DS})

R_G

10V

DUT

V_{DS} 90%

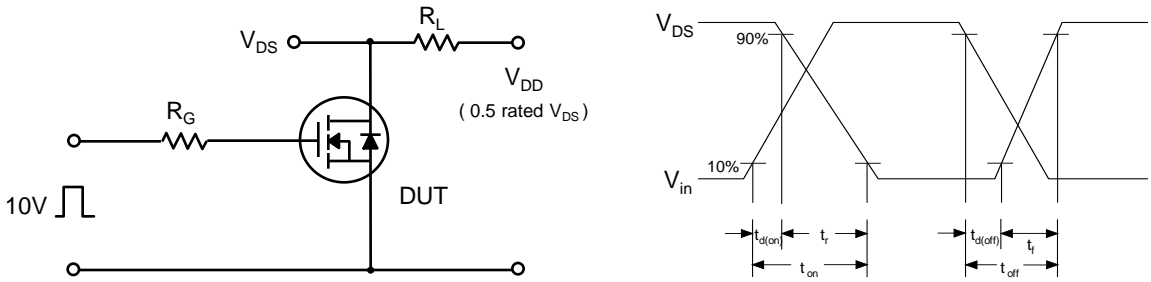V_{in} 10%

$t_{d(on)}$ | t_r | $t_{d(off)}$ | t_f

t_{on} | t_{off}

Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms

V_{DS} — L — V_{DD}

I_D

R_G

10V

DUT

$$E_{AS} = \frac{1}{2} L_L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$

BV_{DSS} | I_{AS}

$I_D (t)$

V_{DD}

$V_{DS} (t)$

t_p | Time
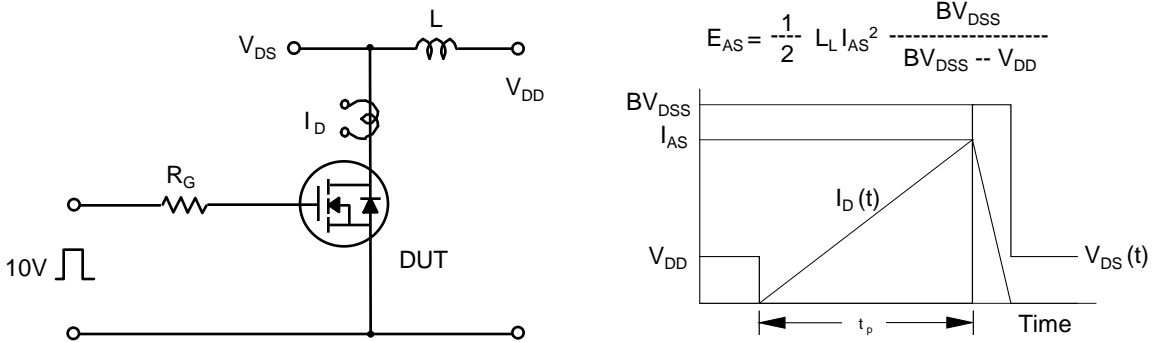
Fig 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms
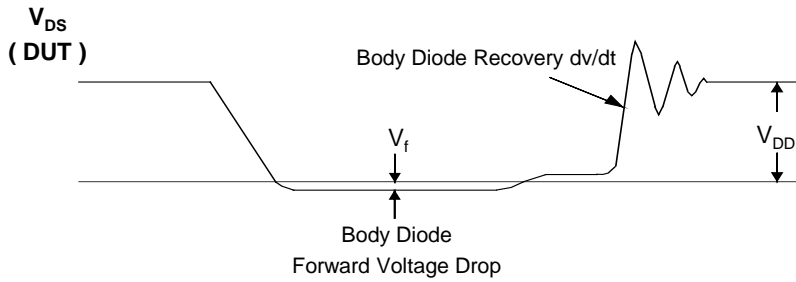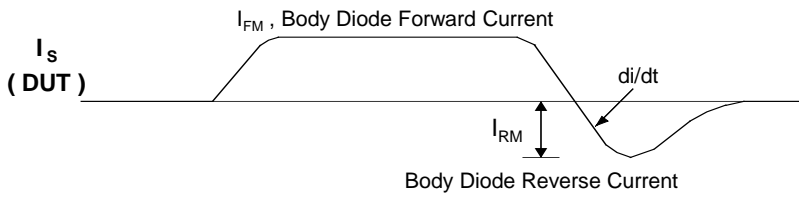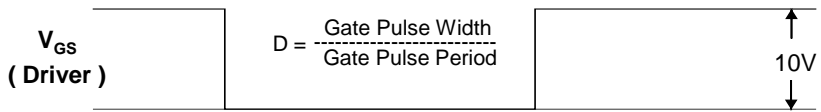

DUT

V_{DS}

I_S

L

Driver

R_G

Same Type as DUT

V_{GS}

V_{DD}

• dv/dt controlled by R_G
• I_S controlled by pulse period

V_{GS} (Driver)

$D = \dfrac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$

10V

I_S (DUT)

I_{FM} , Body Diode Forward Current

di/dt

I_{RM}

Body Diode Reverse Current

V_{DS} (DUT)

Body Diode Recovery dv/dt

V_f

V_{DD}

Body Diode
Forward Voltage Drop
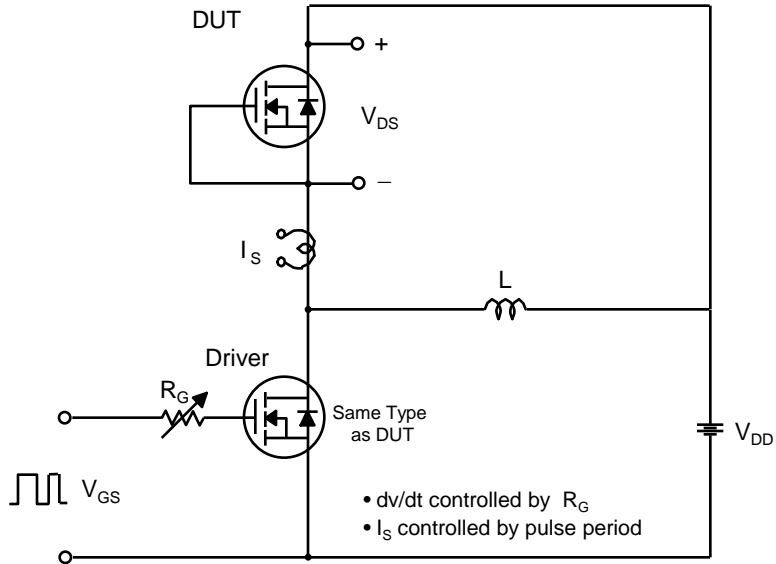
Package Dimension

TO-220

9.90±0.20

φ3.60±0.20

4.50±0.20

1.30±0.20

15.70±0.20

2.80±0.20

6.50±0.20

9.19±0.20

13.08±0.20

1.27±0.20

1.52±0.20

3.02±0.20

2.40±0.20

0.80±0.20

2.54typ

2.54typ

0.50±0.20

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