December 2014

SemiHow
Know-How for Semiconductor

BV_{DSS} = 75 V

$R_{DS(on)\ typ}$ = 7.2mΩ

I_D = 70 A

HRS90N75K
75V N-Channel Trench MOSFET

TO-220F

1 2 3

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
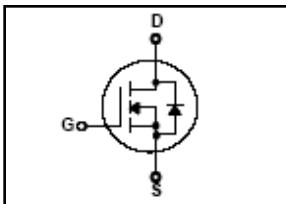
Absolute Maximum Ratings T_C=25℃ unless otherwise specified

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)		3.5	mJ
P_D	Power Dissipation (T_C = 25℃)		35	W
	- Derate above 25℃		0.23	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	℃

* Drain current limited by maximum junction temperature

Thermal Resistance Characteristics

Symbol	Parameter	Typ.	Max.	Units
$R_{θJC}$	Junction-to-Case	--	4.3	℃/W
$R_{θJA}$	Junction-to-Ambient	--	62.5	

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	$V_{GS} = \pm 20$ 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, $R_G = 6$ Ω	--	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
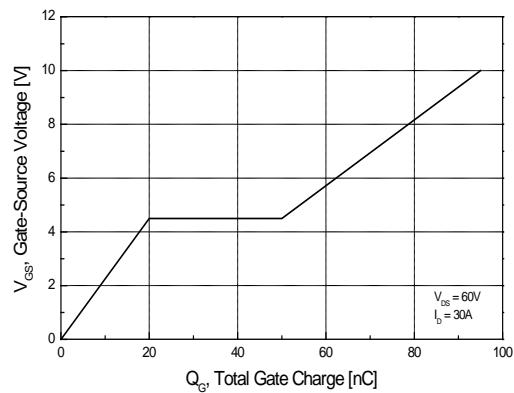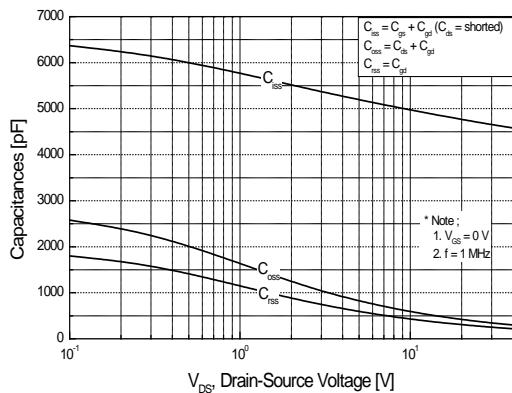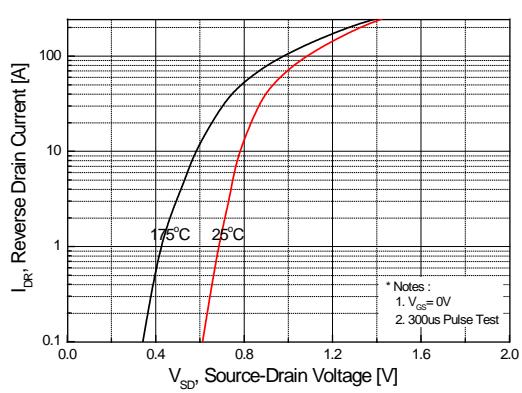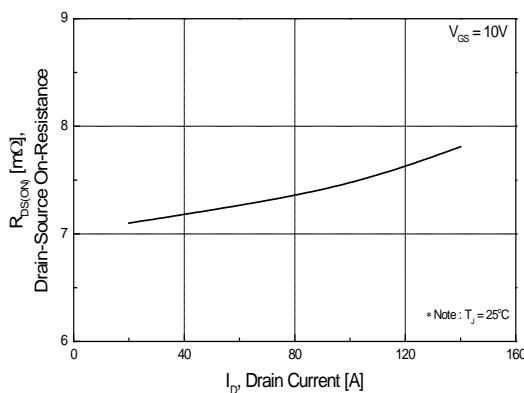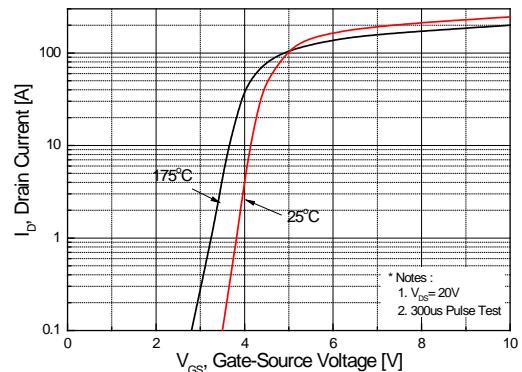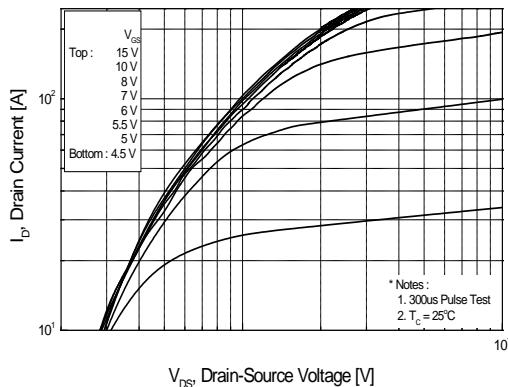
# Typical Characteristics (continued)
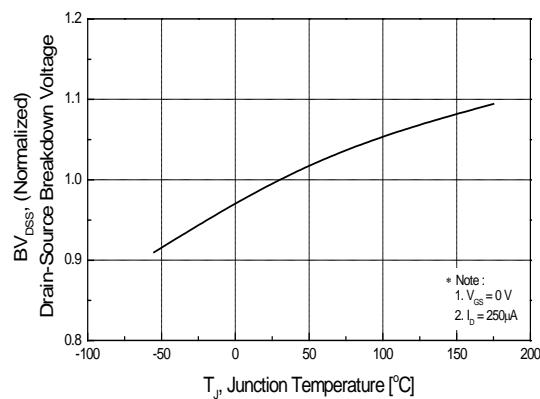
Figure 7. Breakdown Voltage Variation
vs Temperature
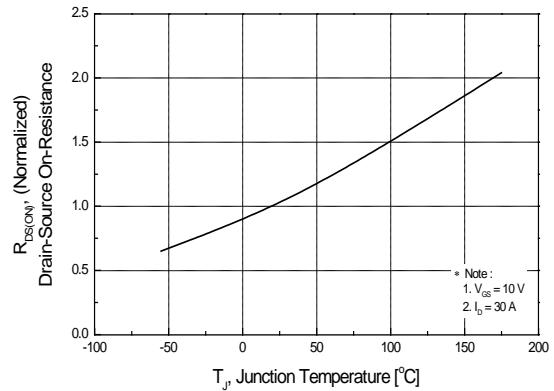
Figure 8. On-Resistance Variation
vs Temperature
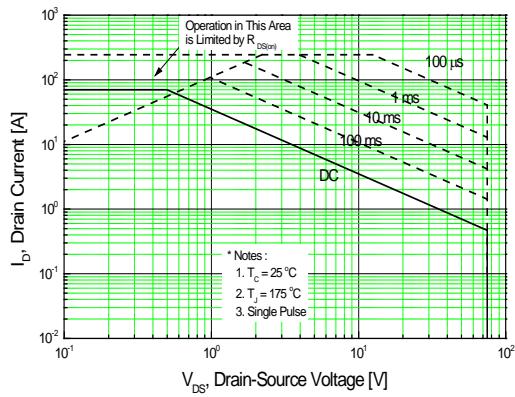
Figure 9. Maximum Safe Operating Area
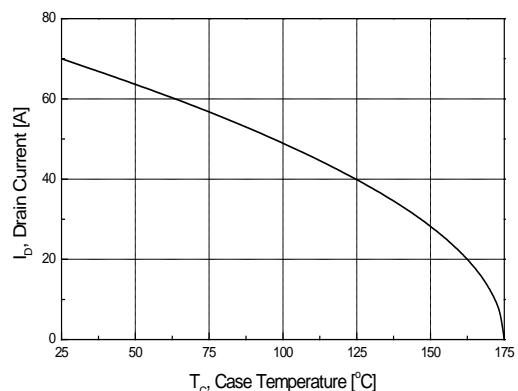

Figure 10. Maximum Drain Current
vs Case Temperature
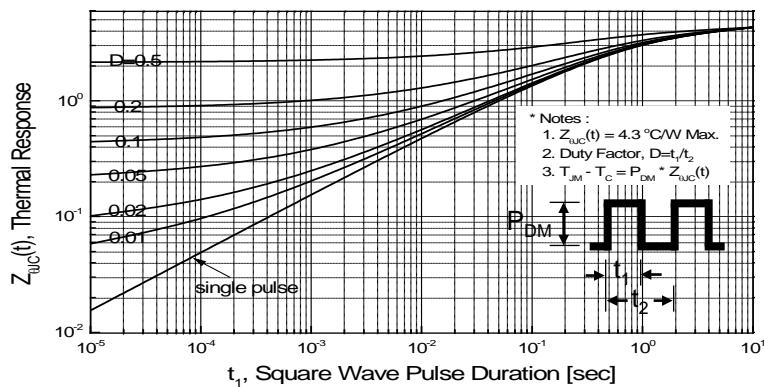

Figure 11. Transient Thermal Response Curve

Fig 12. Gate Charge Test Circuit & Waveform

12V
200nF
50KΩ
300nF
Same Type as DUT
V_{DS}
V_{GS}
3mA
DUT

V_{GS}
10V
Q_g
Q_{gs}
Q_{gd}
Charge
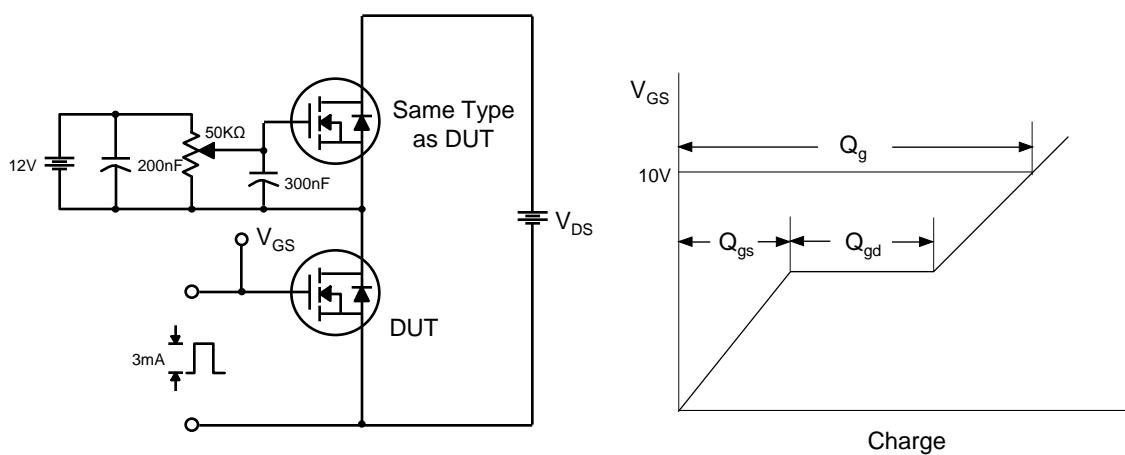
Fig 13. Resistive Switching Test Circuit & Waveforms

R_L
V_{DS}
R_G
V_{DD}
(0.5 rated V_{DS})
10V
DUT

V_{DS}
90%
V_{in}
10%
$t_{d(on)}$ t_r $t_{d(off)}$ t_f
t_{on} t_{off}
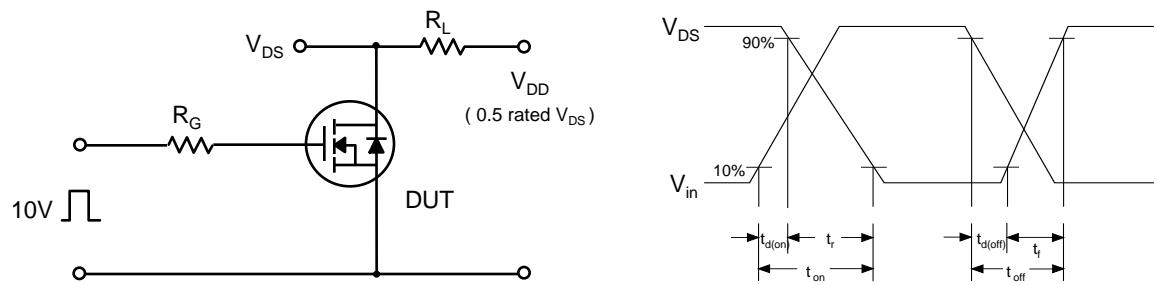
**Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms**

L
V_{DS}
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

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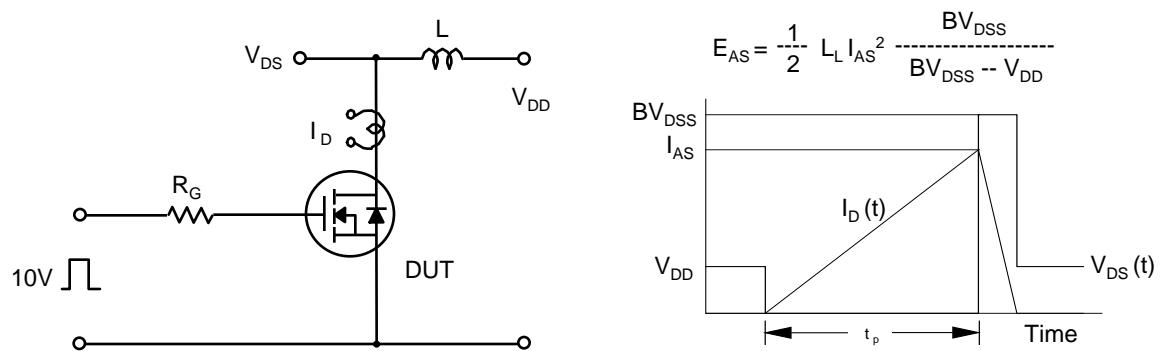
Fig 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms

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)

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

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
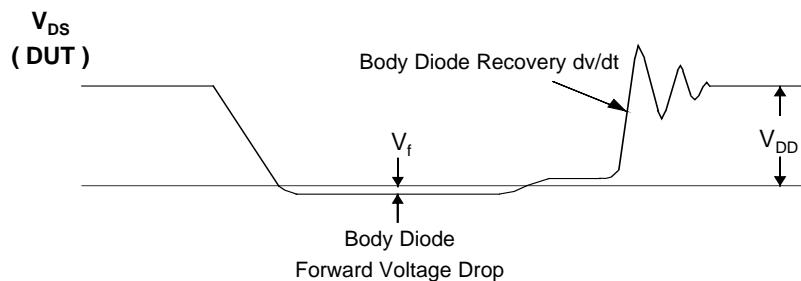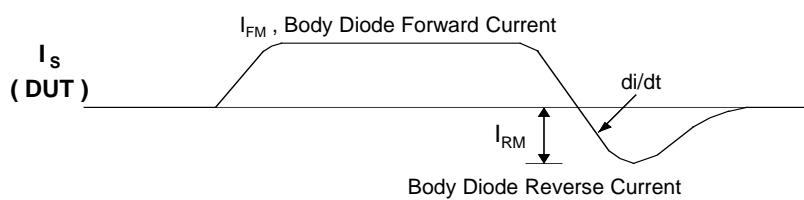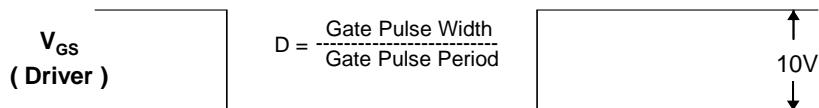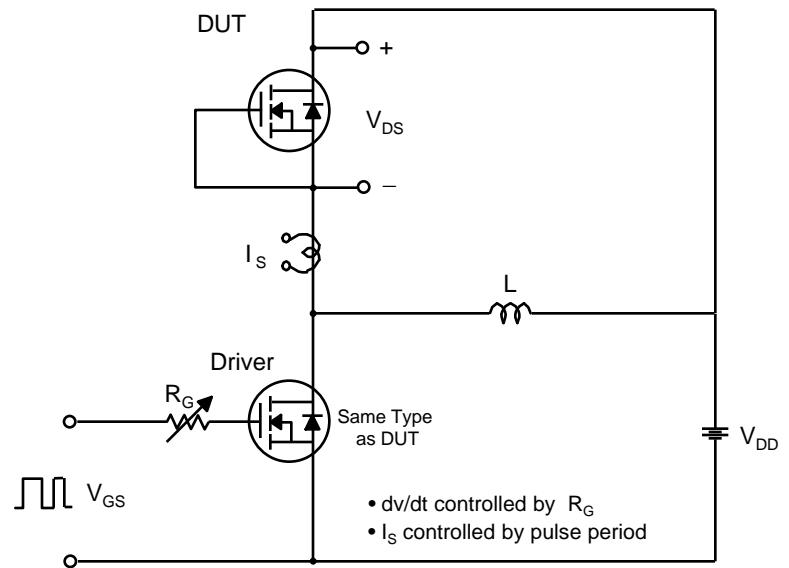
Package Dimension

TO-220F

10.16±0.20

φ3.18±0.20

6.68±0.20

15.87±0.20

3.30±0.20

12.42±0.20

1.47max

9.75±0.20

0.80±0.20

2.54typ

2.54typ

4.70±0.20

2.54±0.20

0.70±0.20

2.76±0.20

0.50±0.20