BPSEMI

9N90

BV$_{DSS}$	900V
R$_{DS(ON)}$	1.2Ω
I$_D$	9A

N-Channel MOSFET

Features
* Very Low Intrinsic Capacitances
* Excellent Switching Characteristics
* Superior Avalanche Rugged Technology
* Robust Gate Oxide Technology
* Lower R$_{DS(ON)}$

Package Dimensions

TO-220

Marking :

Date Code

REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	4.40	4.80	c1	1.25	1.45
b	0.76	1.00	b1	1.17	1.47
c	0.36	0.50	L	13.25	14.25
D	8.60	9.00	e	2.54 REF.	
E	9.80	10.4	L1	2.60	2.89
L4	14.7	15.3	Ø	3.71	3.96
L5	6.20	6.60	A1	2.60	2.80

Absolute Maximum Ratings T$_C$=25℃ unless otherwise specified

Symbol	Parameter		Value	Units
V$_{DSS}$	Drain-Source Voltage		900	V
I$_D$	Drain Current – Continuous (T$_C$ = 25℃)		9	A
	Drain Current – Continuous (T$_C$ = 100℃)		3.5	A
I$_{DM}$	Drain Current – Pulsed	(Note 1)	40	A
V$_{GS}$	Gate-Source Voltage		3-5	V
E$_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	710	mJ
I$_{AR}$	Avalanche Current	(Note 1)	10	A
E$_{AR}$	Repetitive Avalanche Energy	(Note 1)	15.8	mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	4.5	V/ns
P$_D$	Power Dissipation (T$_C$ = 25℃)		157	W
	– Derate above 25℃		1.14	W/℃
T$_J$, T$_{STG}$	Operating and Storage Temperature Range		-55 to +150	℃
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	--	0.85	℃ /W
R$_{θCS}$	Case-to-Sink	0.5	--	
R$_{θJA}$	Junction-to-Ambient	--	63.5	

Electrical Characteristics T_C=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	--	4	V
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS} = 10$ V, $I_D = 5$ A	--	1.2	--	Ω
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0$ V, $I_D = 250\ \mu A$	900	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu A$, Referenced to 25℃	--	0.7	--	V/℃
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 600$ V, $V_{GS} = 0$ V	--	--	1	μA
		$V_{DS} = 480$ V, $T_C = 125$℃	--	--	10	μA
I_{GSSF}	Gate-Body Leakage Current, Forward	$V_{GS} = 30$ V, $V_{DS} = 0$ V	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS} = -30$ 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	--	1550	2020	pF
C_{oss}	Output Capacitance		--	164	212	pF
C_{rss}	Reverse Transfer Capacitance		--	17	24	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Time	$V_{DS} = 300$ V, $I_D = 10$ A, $R_G = 25$ Ω	--	17	45	ns
t_r	Turn-On Rise Time		--	65	145	ns
$t_{d(off)}$	Turn-Off Delay Time		--	141	270	ns
t_f	Turn-Off Fall Time	(Note 4,5)	--	75	160	ns
Q_g	Total Gate Charge	$V_{DS} = 480$ V, $I_D = 10$ A, $V_{GS} = 10$ V	--	43	55	nC
Q_{gs}	Gate-Source Charge		--	6.4	--	nC
Q_{gd}	Gate-Drain Charge	(Note 4,5)	--	18	--	nC
Source-Drain Diode Maximum Ratings and Characteristics						
I_S	Continuous Source-Drain Diode Forward Current		--	--	10	A
I_{SM}	Maximum Pulsed Source-Drain Diode Forward Current		--	--	40	
V_{SD}	Source-Drain Diode Forward Voltage	$I_S = 10A$, $V_{GS} = 0$ V	--	--	1.4	V
trr	Reverse Recovery Time	$I_S = 10A$, $V_{GS} = 0$ V	--	425	--	ns
Qrr	Reverse Recovery Charge	$di_F/dt = 100$ A/μs (Note 4)	--	4.4	--	μC

Notes ;

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L=14.2mH, V_{DD}=50V, R_G=25Ω, Starting T_J=25°C
3. I_{SD}≤10A, di/dt ≤200A/μs, V_{DD}≤BV_{DSS} , Starting T_J=25 °C
4. Pulse Test : Pulse Width ≤ 300μs, Duty Cycle ≤ 2%
5. Essentially Independent of Operating Temperature
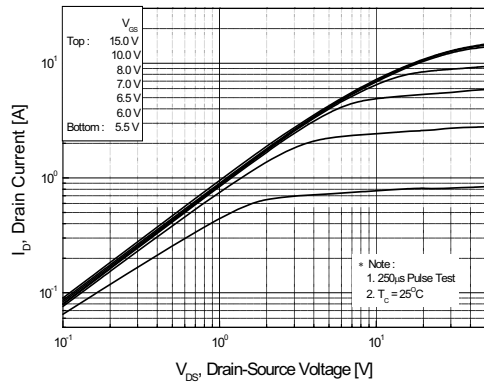
Typical Characteristics

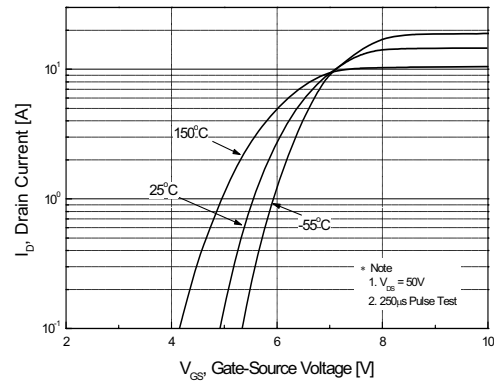**Figure 1. On Region Characteristics**

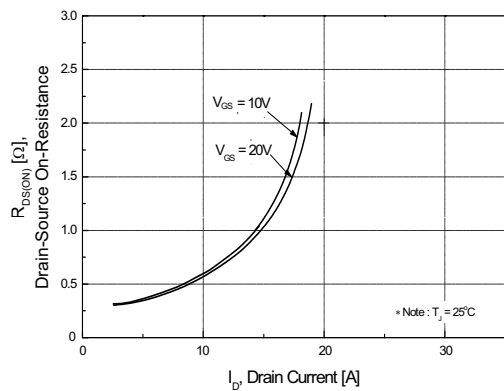**Figure 2. Transfer Characteristics**

Figure 3. On Resistance Variation vs Drain Current and Gate Voltage
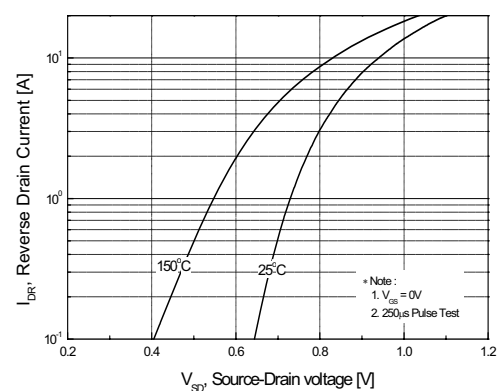

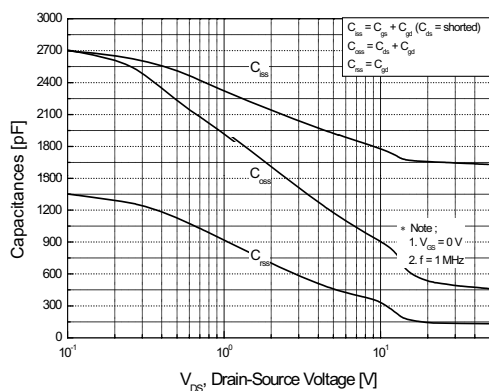**Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature**
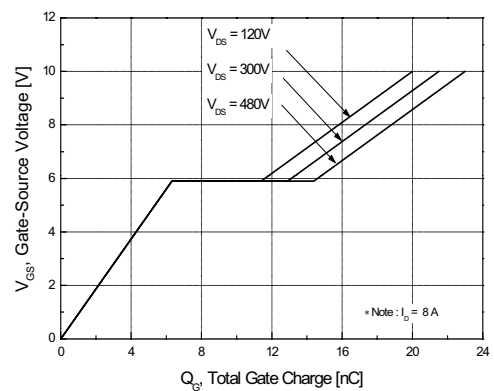

Figure 5. Capacitance Characteristics

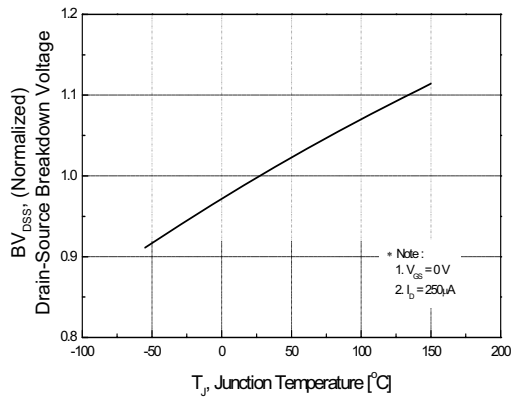**Figure 6. Gate Charge Characteristics**

Typical Characteristics (continued)

Figure 7. Breakdown Voltage Variation
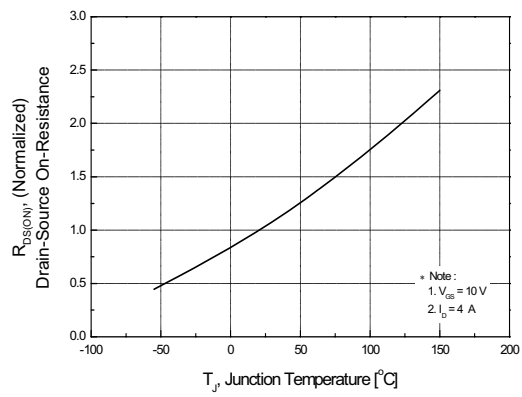vs Temperature

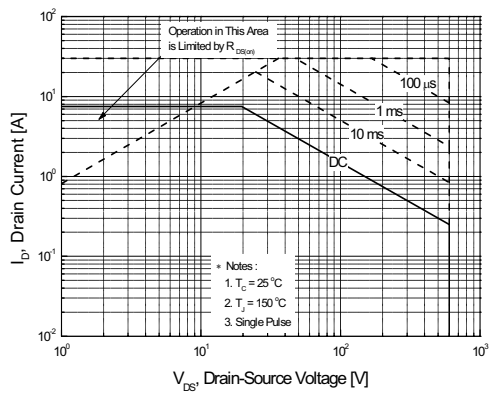Figure 8. On-Resistance Variation
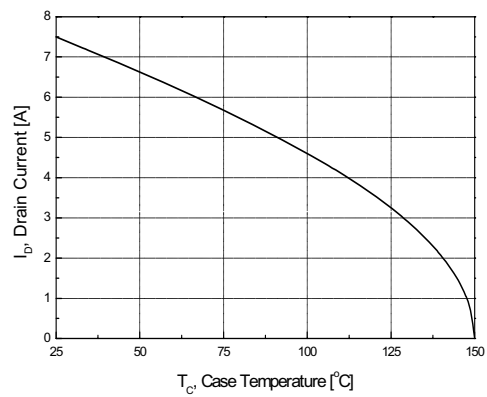vs Temperature

Figure 9. Maximum Safe Operating Area
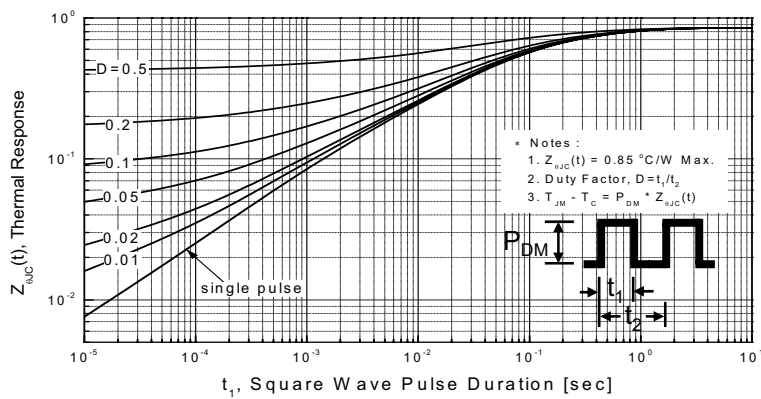

Figure 10. Maximum Drain Current
vs Case Temperature

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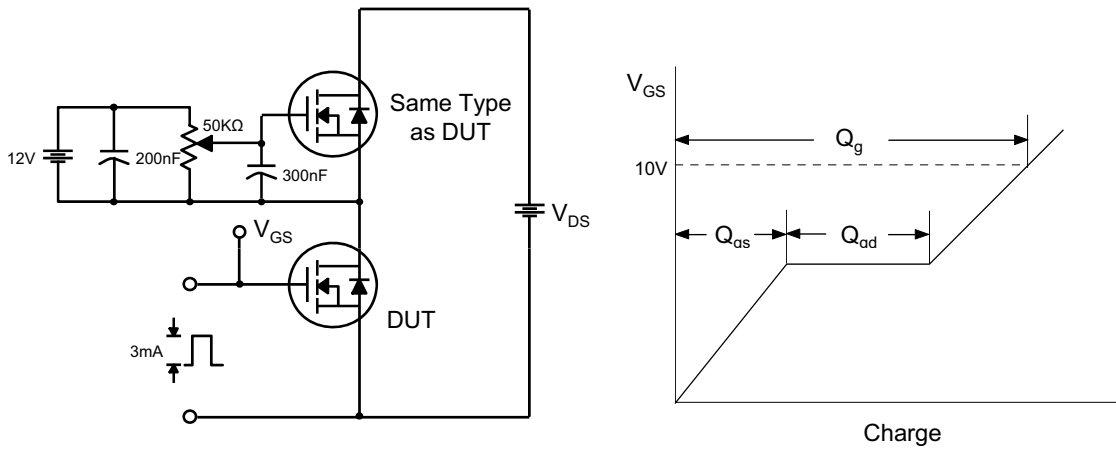
Fig 12. Gate Charge Test Circuit & Waveform

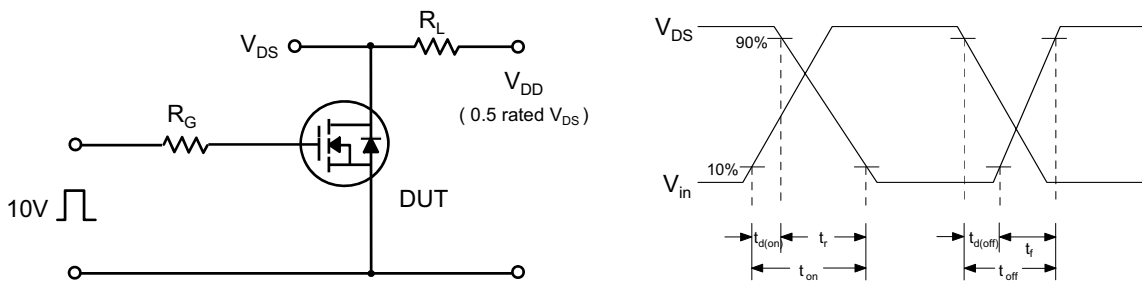**Fig 13. Resistive Switching Test Circuit & Waveforms**

Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms

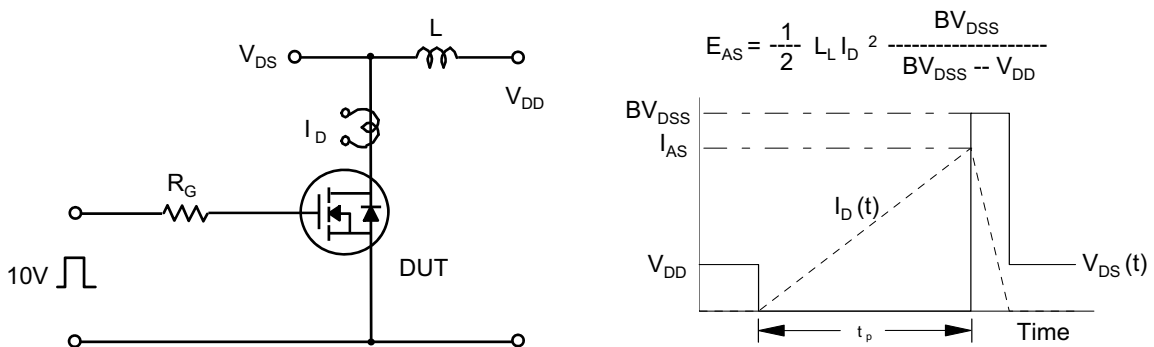$$E_{AS} = \frac{1}{2} L_L I_D{}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$

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