

Silicon N-Channel Power MOSFET

Description

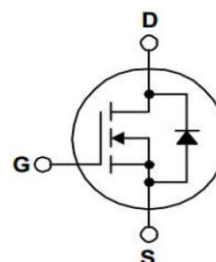
MD9N90, the silicon N-channel Enhanced MOSFETs, is obtained by advanced MOSFET technology which reduce the conduction loss, improve switching performance and enhance the avalanche energy. The transistor is suitable device for SMPS, high speed switching and general purpose applications.

General Features

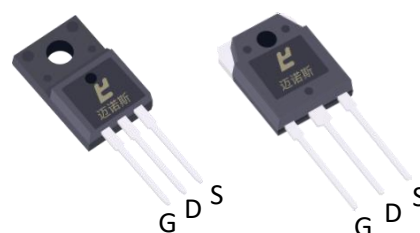
- ① $V_{DS}=900V$, $R_{ds(on)} < 1.15\Omega$ @ $V_{GS}=10V$, $I_D=9A$ (Typ: 0.97Ω)
- ② Fast Switching
- ③ Low C_{rss}
- ④ 100% avalanche tested
- ⑤ Improved dv/dt capability
- ⑥ ROHS product

Application

- ① High frequency switching mode power supply



Schematic diagram



TO-220F

TO-3P

Package Marking And Ordering Information:

Ordering Codes	Package	Product Code	Packing
MPF9N90	TO-220F	MPF9N90	Tube
MD9N90	TO-3P	MD9N90	Tube

ABSOLUTE RATINGS (at $T_C = 25^\circ C$, unless otherwise specified)

Symbol	Parameter	Value	Units
V_{DSS}	Drain-to-Source Voltage	900	V
I_D	Continuous Drain Current	9	A
	Continuous Drain Current $T_C = 100^\circ C$	5.6	A
I_{DM}	Pulsed Drain Current(Note1)	36	A
V_{GS}	Gate-to-Source Voltage	± 30	V
E_{AS}	Single Pulse Avalanche Energy(Note2)	1000	mJ
dv/dt	Peak Diode Recovery dv/dt (Note3)	4.0	V/ns
P_D	Power Dissipation TO-3P	230	W
	Derating Factor above $25^\circ C$	1.8	W/ $^\circ C$
P_D	Power Dissipation TO-220F	50	W
	Derating Factor above $25^\circ C$	0.4	W/ $^\circ C$

T_J, T_{stg}	Operating Junction and Storage Temperature Range	150, -55 to 150	$^{\circ}\text{C}$
T_L	Maximum Temperature for Soldering	300	$^{\circ}\text{C}$

Thermal characteristics (No FullPAK) TO-3P

Symbol	Parameter	Value	Units
$R_{\theta JC}$	Junction-to-Case	0.54	$^{\circ}\text{C}/\text{W}$
$R_{\theta JA}$	Junction-to-Ambient	62.5	$^{\circ}\text{C}/\text{W}$

Thermal characteristics (No FullPAK) TO-220F

Symbol	Parameter	Value	Units
$R_{\theta JC}$	Junction-to-Case	2.5	$^{\circ}\text{C}/\text{W}$
$R_{\theta JA}$	Junction-to-Ambient	62.5	$^{\circ}\text{C}/\text{W}$

Electrical Characteristics(at $T_C = 25^{\circ}\text{C}$, unless otherwise specified)

OFF Characteristics						
Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
V_{DS}	Drain to Source Breakdown Voltage	$V_{GS}=0\text{V}, I_D=250\mu\text{A}$	900	--	--	V
$\Delta BV_{DS}/\Delta T_J$	BV_{DS} Temperature Coefficient	$I_D=250\mu\text{A}$, Reference 25°C	--	1	--	$\text{V}/^{\circ}\text{C}$
I_{DSS}	Drain to Source Leakage Current	$V_{DS}=900\text{V}, V_{GS}=0\text{V}$, $T_J=25^{\circ}\text{C}$	--	--	1	μA
		$V_{DS}=720\text{V}, V_{GS}=0\text{V}$, $T_J=125^{\circ}\text{C}$	--	--	100	μA
$I_{GSS(F)}$	Gate to Source Forward Leakage	$V_{GS}=+30\text{V}$	--	--	100	nA
$I_{GSS(R)}$	Gate to Source Reverse Leakage	$V_{GS}=-30\text{V}$	--	--	100	nA

ON Characteristics						
Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
$R_{DS(ON)}$	Drain-to-Source On- Resistance	$V_{GS}=10\text{V}$, $I_D=4.5\text{A}$ (Note4)	--	0.97	1.15	Ω
$V_{GS(TH)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$, $I_D=250\mu\text{A}$ (Note4)	3.0	--	5.0	V

Dynamic Characteristics

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
R_g	Gate resistance	$f = 1.0\text{MHz}$	--	0.9	--	Ω
C_{iss}	Input Capacitance	$V_{GS} = 0V,$ $V_{DS} = 25V$ $f = 1.0\text{MHz}$	--	2510	--	PF
C_{oss}	Output Capacitance		--	195	--	
C_{rss}	Reverse Transfer Capacitance		--	10	--	

Switching Characteristics

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
$t_{d(ON)}$	Turn-on Delay Time	$I_D = 9A,$ $V_{DD} = 450V$ $V_{GS} = 10V$ $R_G = 20\Omega$	--	55	--	ns
t_r	Rise Time		--	103	--	
$t_{d(OFF)}$	Turn-Off Delay Time		--	110	--	
t_f	Fall Time		--	73	--	
Q_g	Total Gate Charge	$I_D = 9A$ $V_{DD} = 720V$ $V_{GS} = 10V$	--	52	--	nC
Q_{gs}	Gate to Source Charge		--	13	--	
Q_{gd}	Gate to Drain ("Miller") Charge		--	15	--	

Source-Drain Diode Characteristics

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
I_S	Continuous Source Current (Body Diode)	$T_C = 25^\circ\text{C}$	--	--	9	A
I_{SM}	Maximum Pulsed Current (Body Diode)		--	--	36	A
V_{SD}	Diode Forward Voltage	$I_S = 9A, V_{GS} = 0V$	--	--	1.2	V
T_{rr}	Reverse Recovery Time	$I_S = 9A,$ $T_J = 25^\circ\text{C}$ $dI_F/dt = 100A/\mu s,$ $V_{GS} = 0V$	--	610	--	ns
Q_{rr}	Reverse Recovery Charge		--	5500	--	nC

Note1: Pulse width limited by maximum junction temperature

Note2: $L = 20\text{mH}$, $V_{DS} = 50V$, Start $T_J = 25^\circ\text{C}$

Note3: $I_{SD} \leq 9A, dI/dt \leq 100A/\mu s, V_{DD} \leq B_{VDS}$, Start $T_J = 25^\circ\text{C}$

Note4: Pulse width $t_p \leq 300\mu s, \delta \leq 2\%$

Characteristics Curves

Figure 1a Safe Operating Area (No FullPAK)

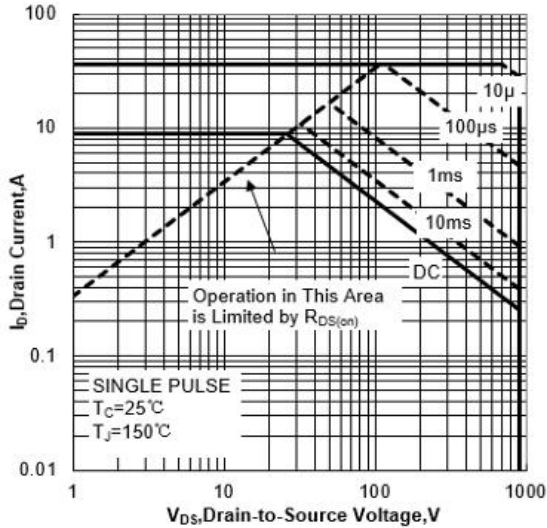


Figure 1b Safe Operating Area (FullPAK)

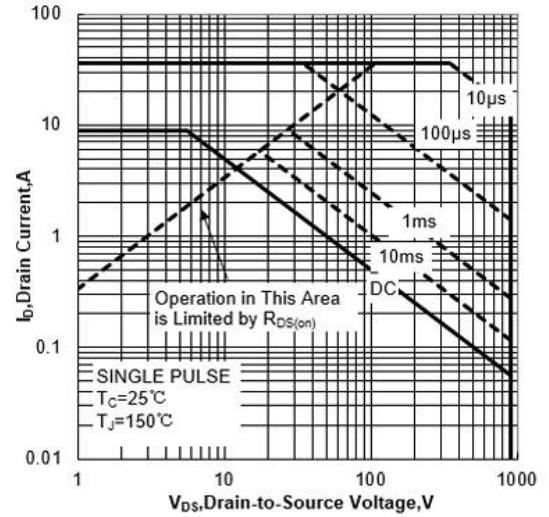


Figure 2a Power Dissipation (No FullPAK)

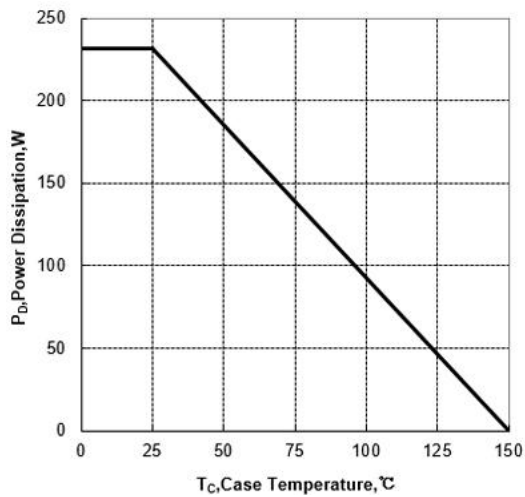


Figure 2b Power Dissipation (FullPAK)

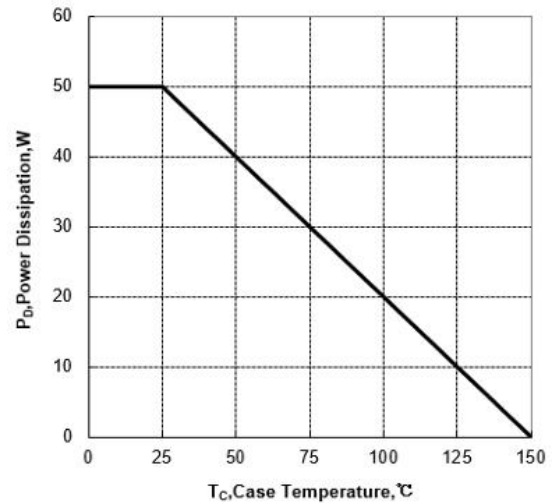


Figure 3a Max Thermal Impedance (No FullPAK)

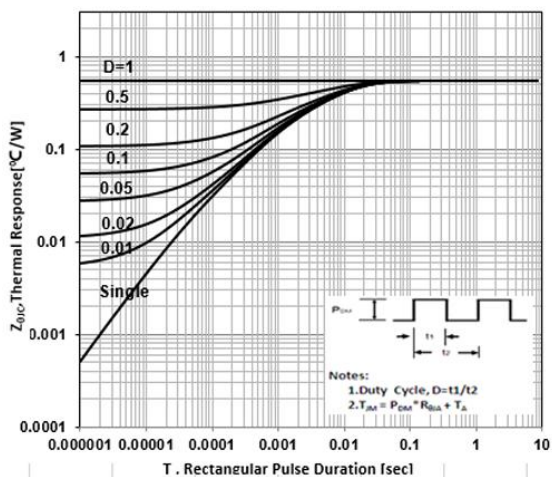


Figure 3b Max Thermal Impedance (FullPAK)

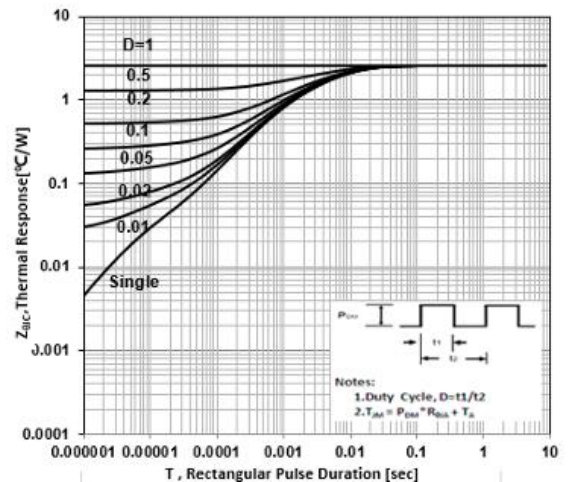


Figure 4 Typical Output Characteristics

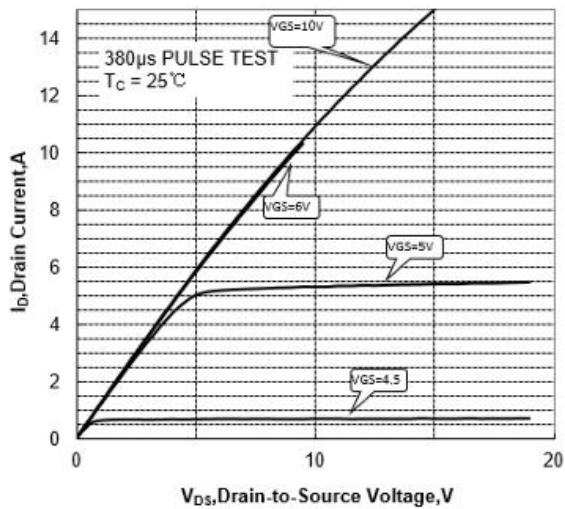


Figure 5 Typical Transfer Characteristics

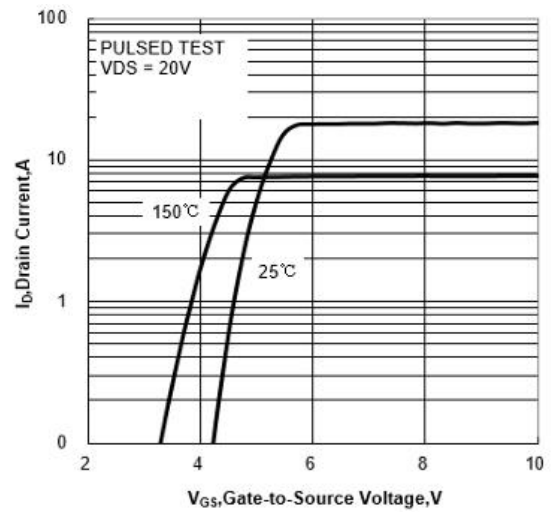


Figure 6 Typical Drain to Source ON Resistance vs Drain Current

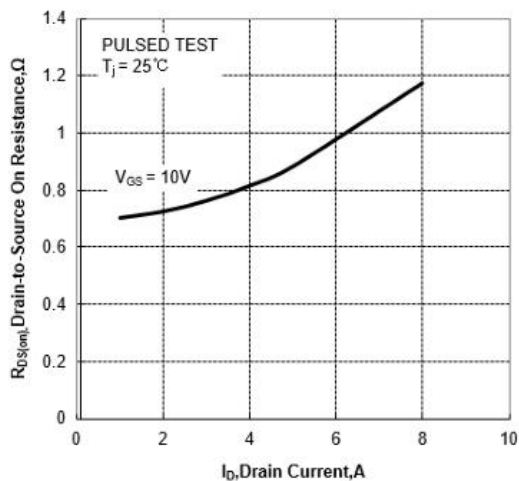


Figure 7 Typical Drain to Source on Resistance vs Junction Temperature

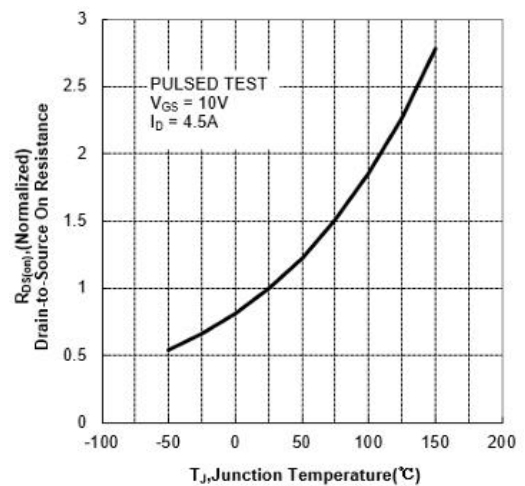


Figure 8 Typical Threshold Voltage vs Junction Temperature

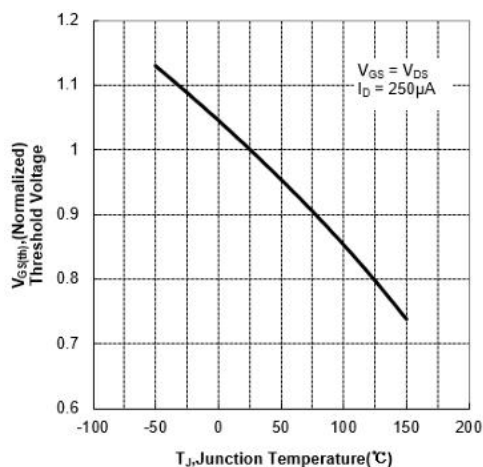


Figure 9 Typical Breakdown Voltage vs Junction Temperature

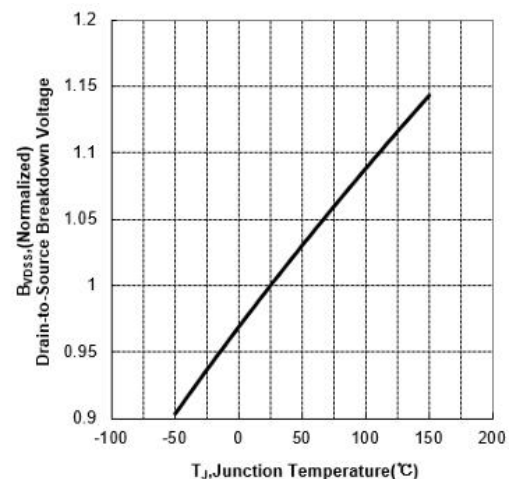


Figure 10 Typical Theshold Voltage vs Junction Temperature

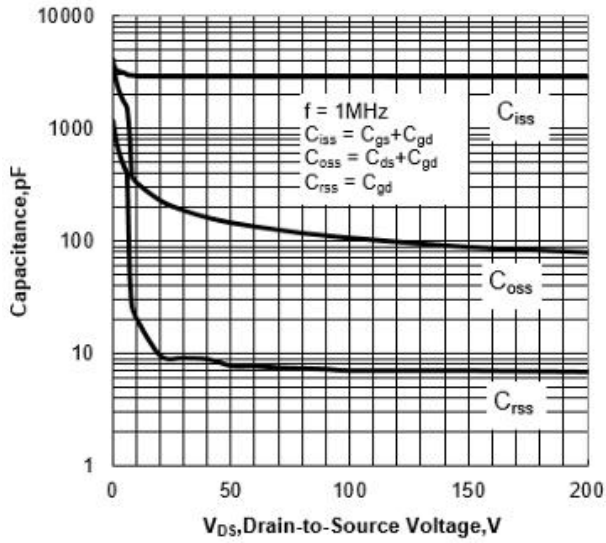
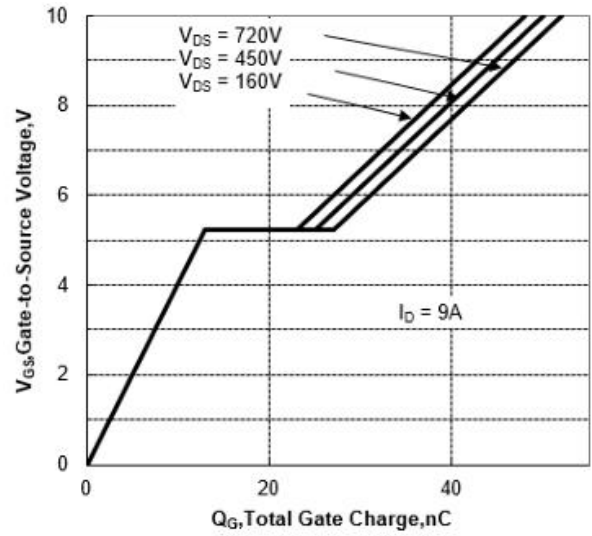


Figure 11 Typical Breakdown Voltage vs Junction Temperature



Test Circuit and Waveform

Figure 12 Gate Charge Test Circuit

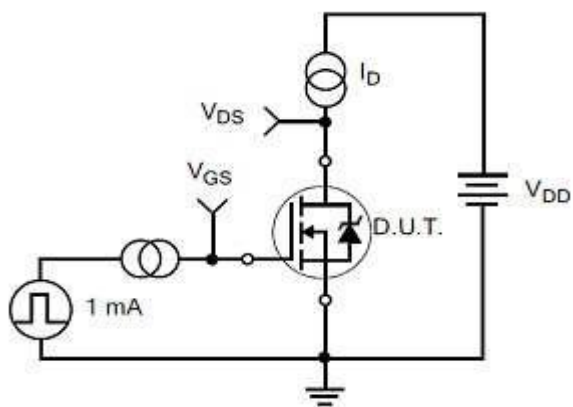


Figure 13 Gate Charge Waveforms

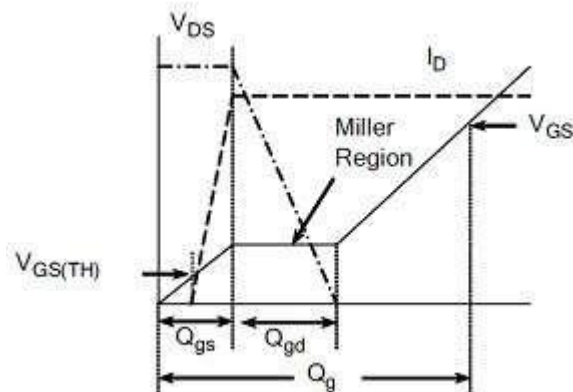


Figure 14 Resistive Switching Test Circuit

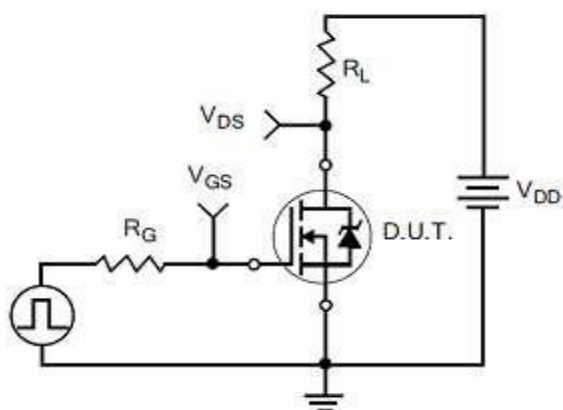


Figure 15 Resistive Switching Waveforms

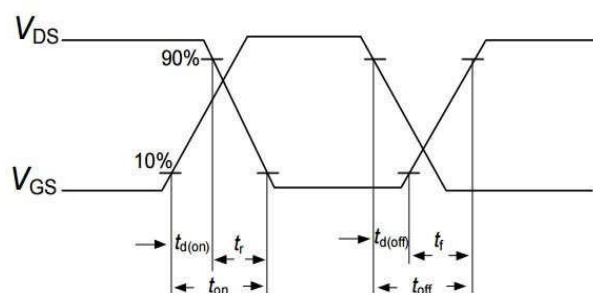


Figure 16 Diode Reverse Recovery Test Circuit

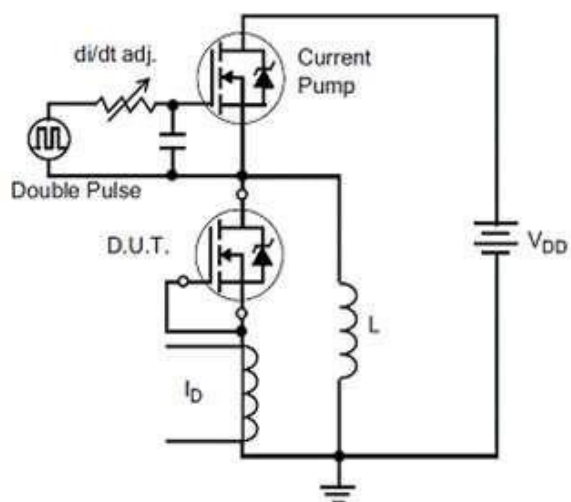


Figure 17 Diode Reverse Recovery Waveform

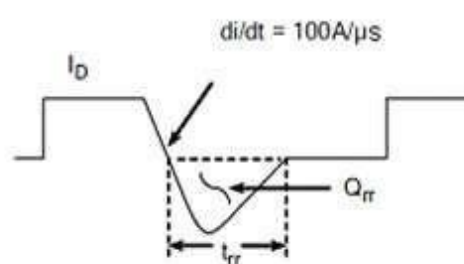


Figure 18 Unclamped Inductive Switching Test

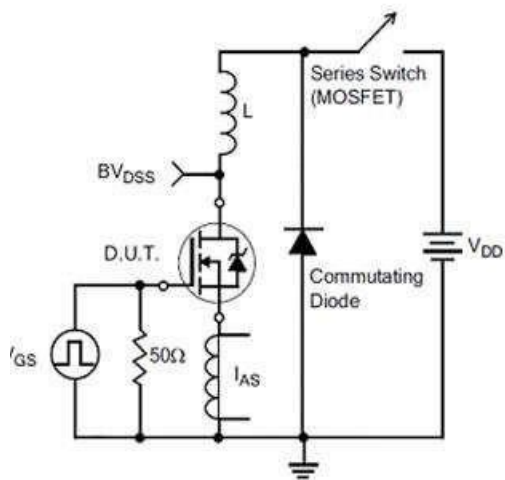
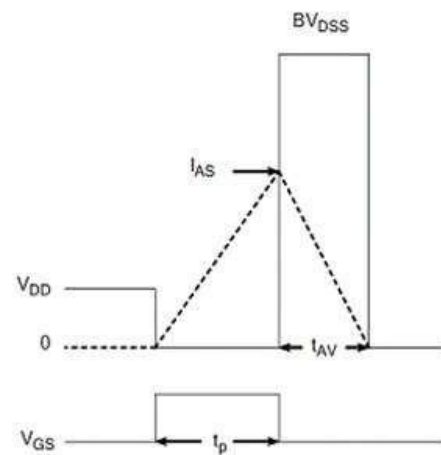
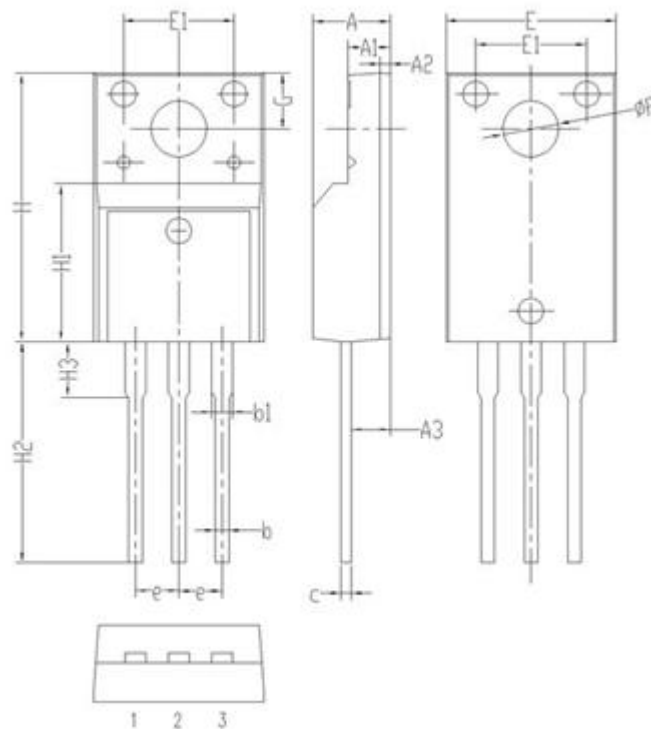


Figure 19 Unclamped Inductive Switching



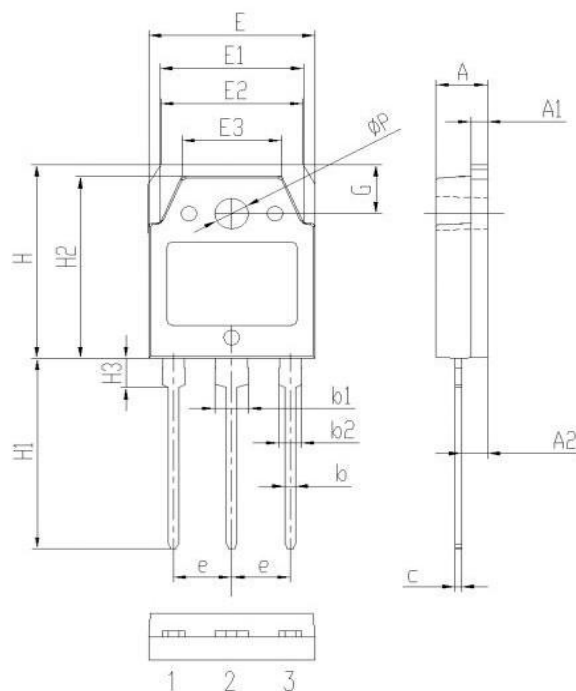
Package Information



Symbol	Values(mm)	
	MIN	MAX
A	4.35	4.75
A1	2.30	2.70
A2	0.40	0.80
A3	2.10	2.50
b	0.60	1.00
b1	1.00	1.40
c	0.30	0.70
e	2.30	2.70
E	9.80	10.2
E1	6.30	6.70
H	15.6	16.0
H1	8.80	9.20
H2	12.9	13.5
H3	3.10	3.50
G	3.10	3.50
ϕp	3.10	3.50

TO-220F Package

Package Information



Symbol	Values(mm)	
	MIN	MAX
A	4.60	5.00
A1	1.30	1.70
A2	2.20	2.60
b	0.80	1.20
b1	2.90	3.30
b2	1.90	2.30
c	0.40	0.80
e	5.25	5.65
E	15.3	15.7
E1	13.2	13.6
E2	13.1	13.5
E3	9.10	9.50
H	19.7	20.1
H1	19.1	20.1
H2	18.3	18.7
H3	2.80	3.20
G	4.80	5.20
ϕp	3.00	3.40

TO-3P Package

NOTE:

1. Exceeding the maximum ratings of the device in performance may cause damage to the device, even the permanent failure, which may affect the dependability of the machine. Please do not exceed the absolute maximum ratings of the device when circuit designing.
2. When installing the heat sink, please pay attention to the torsional moment and the smoothness of the heat sink.
3. MOSFETs is the device which is sensitive to the static electricity, it is necessary to protect the device from being damaged by the static electricity when using it.
4. Shenzhen Minos reserves the right to make changes in this specification sheet and is subject to change without prior notice.

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