



CS9N90 ANHD

General Description:

CS9N90 ANHD, the silicon N-channel Enhanced VDMOSFETs, is obtained by the self-aligned planar Technology which reduce the conduction loss, improve switching performance and enhance the avalanche energy. The transistor can be used in various power switching circuit for system miniaturization and higher efficiency. The package form is TO-3P(N), which accords with the RoHS standard.

Features:

- Fast Switching
- ESD Improved Capability
- Low Gate Charge (Typical Data: 65nC)
- Low Reverse transfer capacitances(Typical: 13pF)
- 100% Single Pulse avalanche energy Test

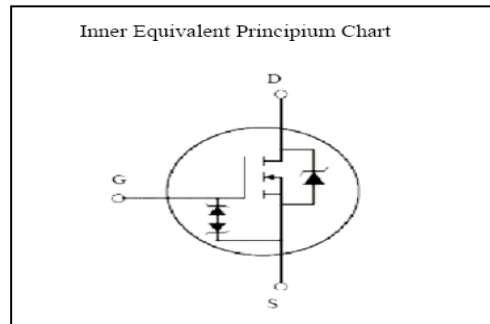
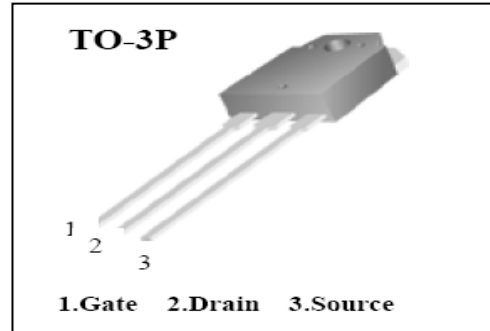
Applications:

Power switch circuit of PC POWER.

Absolute (Tc= 25°C unless otherwise specified):

Symbol	Parameter	Rating	Units
V <sub>DSS</sub>	Drain-to-Source Voltage	900	V
I <sub>D</sub>	Continuous Drain Current	9	A
	Continuous Drain Current T <sub>C</sub> = 100 °C	5.8	A
I <sub>DM</sub> <sup>a1</sup>	Pulsed Drain Current	36	A
V <sub>GS</sub>	Gate-to-Source Voltage	±30	V
E <sub>AS</sub> <sup>a3</sup>	Single Pulse Avalanche Energy	1000	mJ
dv/dt <sup>a2</sup>	Peak Diode Recovery dv/dt	5.0	V/ns
P <sub>D</sub>	Power Dissipation	150	W
	Derating Factor above 25 °C	1.2	W/°C
V <sub>ESD(G-S)</sub>	Gate source ESD (HBM-C= 100pF, R=1.5kΩ)	6000	V
T <sub>J</sub> , T <sub>stg</sub>	Operating Junction and Storage Temperature Range	150, -55 to 150	°C
T <sub>L</sub>	Maximum Temperature for Soldering	300	°C

V <sub>DSS</sub>	900	V
I <sub>D</sub>	9	A
P <sub>D</sub> (T <sub>C</sub> =25°C)	150	W
R <sub>DS(ON)Typ</sub>	0.95	Ω




**Electrical Characteristics** (T<sub>c</sub>= 25 °C unless otherwise specified):

<b>OFF Characteristics</b>						
Symbol	Parameter	Test Conditions	Rating			Unit s
			Min.	Typ.	Max.	
V <sub>DSS</sub>	Drain to Source Breakdown Voltage	V <sub>GS</sub> =0V, I <sub>D</sub> =250 μA	900	--	--	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Bvdss Temperature Coefficient	I <sub>D</sub> =250μA, Reference 25 °C	--	0.95	--	V/°C
I <sub>DSS</sub>	Drain to Source Leakage Current	V <sub>DS</sub> = 900V, V <sub>GS</sub> = 0V, T <sub>a</sub> = 25 °C	--	--	25	μA
		V <sub>DS</sub> = 720V, V <sub>GS</sub> = 0V, T <sub>a</sub> = 125 °C	--	--	250	μA
I <sub>GSS(F)</sub>	Gate to Source Forward Leakage	V <sub>GS</sub> = +20V	--	--	10	μA
I <sub>GSS(R)</sub>	Gate to Source Reverse Leakage	V <sub>GS</sub> = -20V	--	--	-10	μA

<b>ON Characteristics</b>						
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
R <sub>DS(ON)</sub>	Drain-to-Source On-Resistance	V <sub>GS</sub> =10V, I <sub>D</sub> =4.5A	--	0.95	1.3	Ω
V <sub>GS(TH)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	2.0		4.0	V
Pulse width tp ≤ 300 μs, δ ≤ 2%						

<b>Dynamic Characteristics</b>						
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
g <sub>fs</sub>	Forward Trans conductance	V <sub>DS</sub> =15V, I <sub>D</sub> = 4.5A		10	--	S
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> = 0V V <sub>DS</sub> = 25V f = 1.0MHz	--	3850		pF
C <sub>oss</sub>	Output Capacitance		--	185		
C <sub>rss</sub>	Reverse Transfer Capacitance		--	13		

<b>Resistive Switching Characteristics</b>						
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
t <sub>d(ON)</sub>	Turn-on Delay Time	I <sub>D</sub> = 4A V <sub>DD</sub> = 450V V <sub>GS</sub> = 10V R <sub>G</sub> = 4.7Ω	--	22	--	ns
t <sub>r</sub>	Rise Time		--	9.0	--	
t <sub>d(OFF)</sub>	Turn-Off Delay Time		--	62	--	
t <sub>f</sub>	Fall Time		--	23	--	
Q <sub>g</sub>	Total Gate Charge	I <sub>D</sub> = 9A V <sub>DD</sub> = 450V V <sub>GS</sub> = 10V	--	65		nC
Q <sub>gs</sub>	Gate to Source Charge		--	22		
Q <sub>gd</sub>	Gate to Drain ("Miller") Charge		--	18		



### Source-Drain Diode Characteristics

Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
$I_S$	Continuous Source Current (Body Diode)		--	--	9	A
$I_{SM}$	Maximum Pulsed Current (Body Diode)		--	--	36	A
$V_{SD}$	Diode Forward Voltage	$I_S=9.0A, V_{GS}=0V$	--	--	1.5	V
$t_{rr}$	Reverse Recovery Time	$I_S=9.0A, T_J = 25^\circ C$	--	1.2	--	us
$Q_{rr}$	Reverse Recovery Charge	$dI_F/dt=100A/us, V_{GS}=0V$	--	9.4	--	$\mu C$

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

Symbol	Parameter	Typ.	Units
$R_{\theta JC}$	Junction-to-Case	0.83	$^\circ C/W$
$R_{\theta JA}$	Junction-to-Ambient	40	$^\circ C/W$

### Gate-source Zener diode

Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
$V_{GSO}$	Gate-source breakdown voltage	$I_{GS} = \pm 1mA$ (Open Drain)	30			V

The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

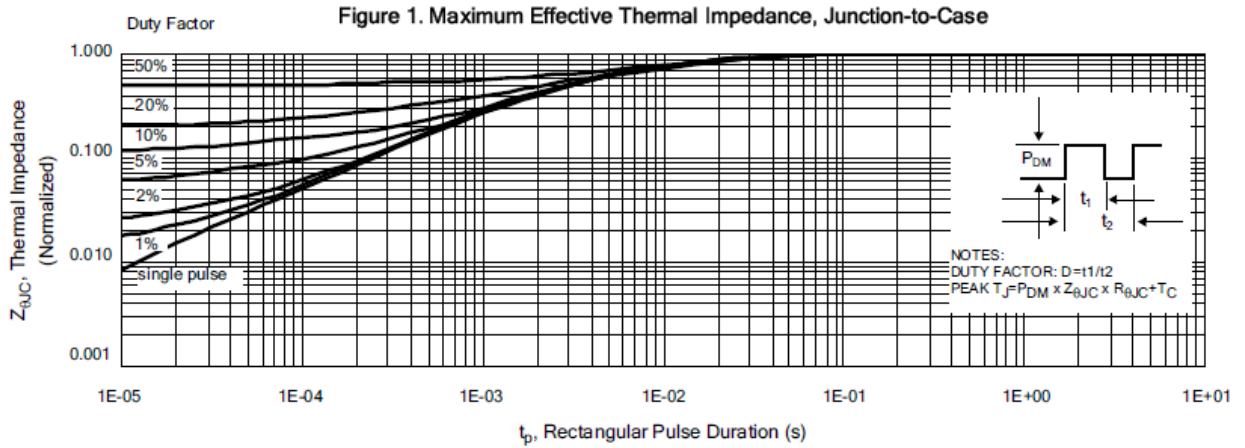
<sup>a1</sup>: Repetitive rating; pulse width limited by maximum junction temperature

<sup>a2</sup>:  $I_{SD} = 9A, di/dt \leq 100A/us, V_{DD} \leq BV_{DS}$ , Start  $T_J = 25^\circ C$

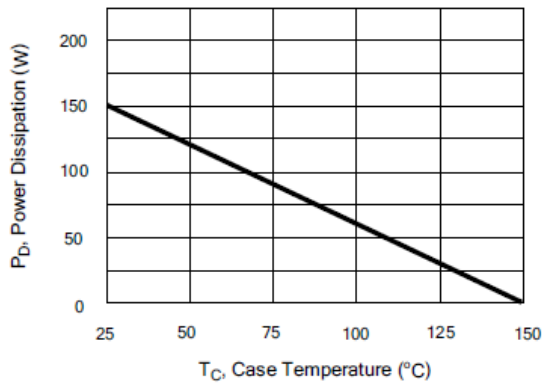
<sup>a3</sup>:  $L = 20mH, V_{dd} = 50V, T_J = 25^\circ C$



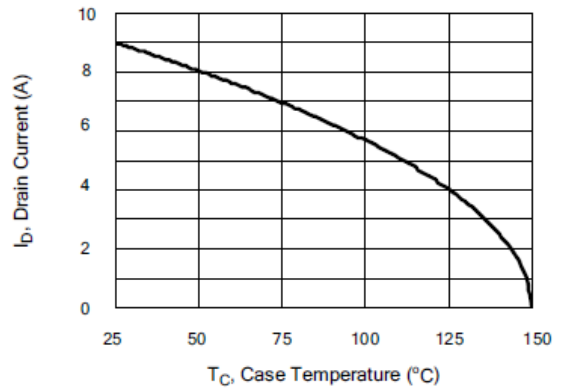
Characteristics Curve:



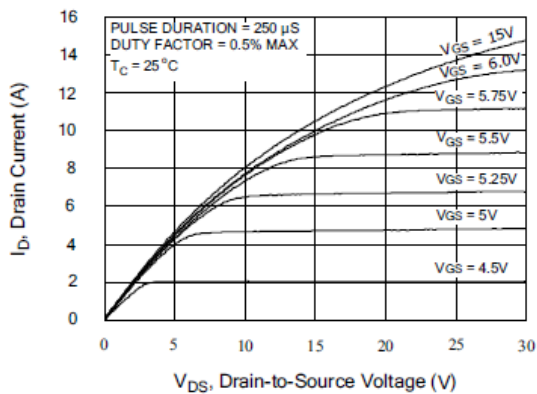
**Figure 2. Maximum Power Dissipation vs Case Temperature**



**Figure 3. Maximum Continuous Drain Current vs Case Temperature**



**Figure 4. Typical Output Characteristics**



**Figure 5. Typical Drain-to-Source ON Resistance vs Gate Voltage and Drain Current**

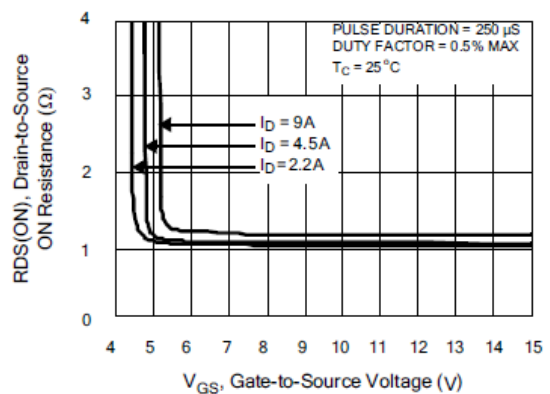




Figure 6. Maximum Peak Current Capability

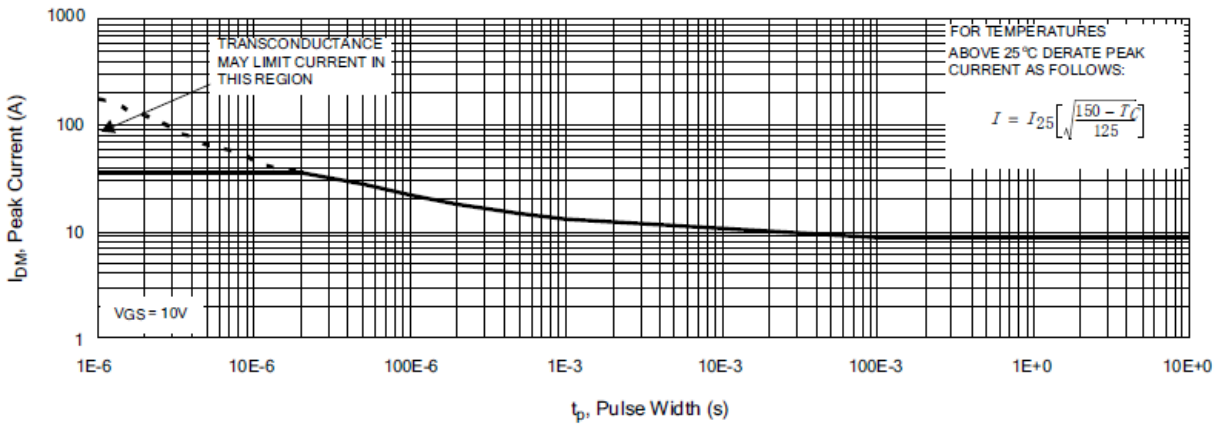


Figure 7. Typical Transfer Characteristics

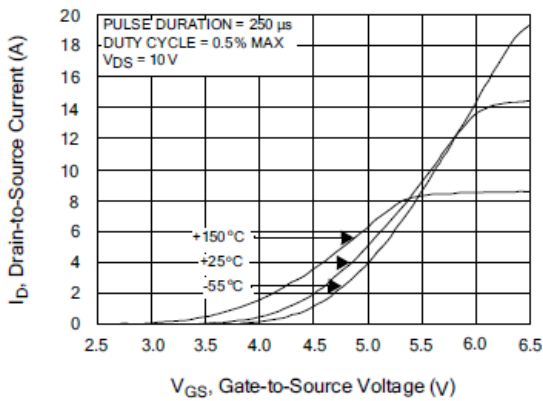


Figure 8. Unclamped Inductive Switching Capability

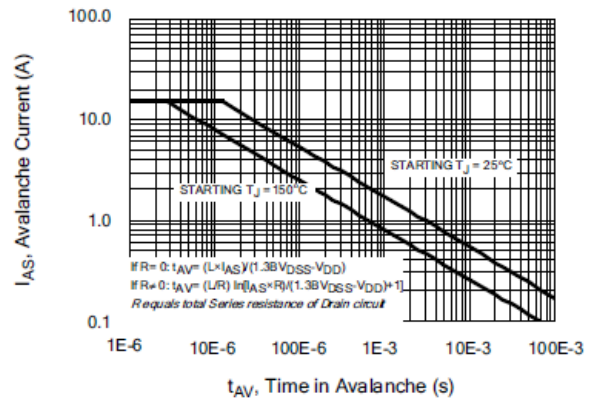


Figure 9. Typical Drain-to-Source ON Resistance vs Drain Current

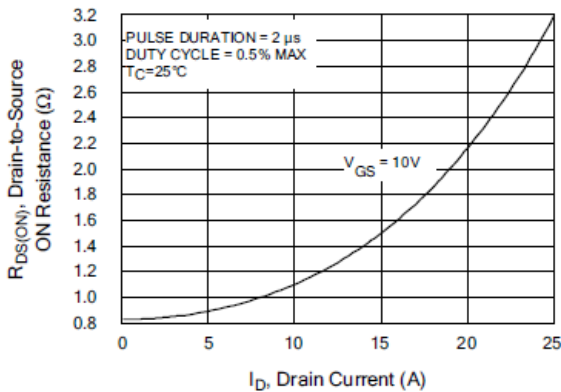


Figure 10. Typical Drain-to-Source ON Resistance vs Junction Temperature

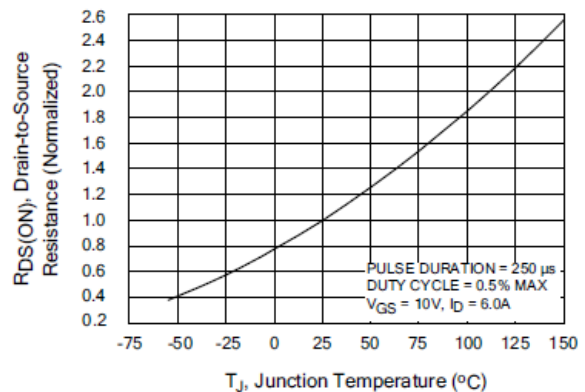




Figure 11. Typical Breakdown Voltage vs Junction Temperature

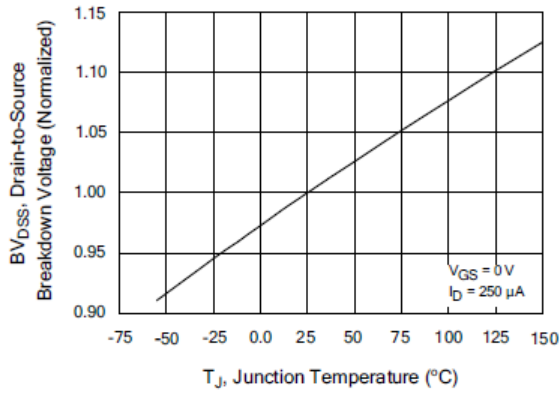


Figure 12. Typical Threshold Voltage vs Junction Temperature

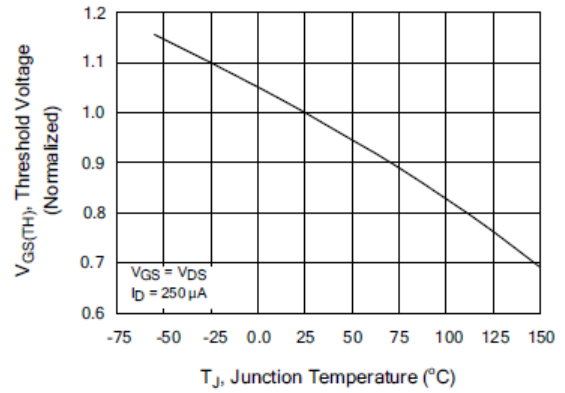


Figure 13. Maximum Forward Bias Safe Operating Area

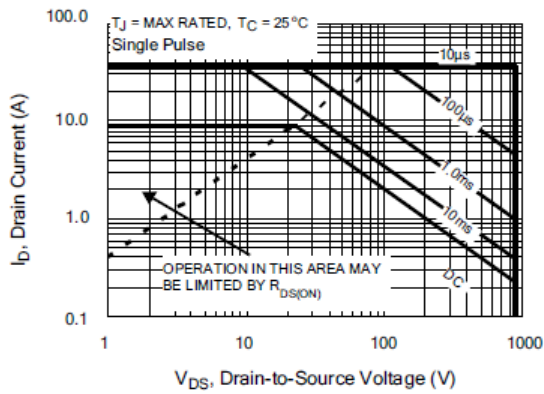


Figure 14. Typical Capacitance vs Drain-to-Source Voltage

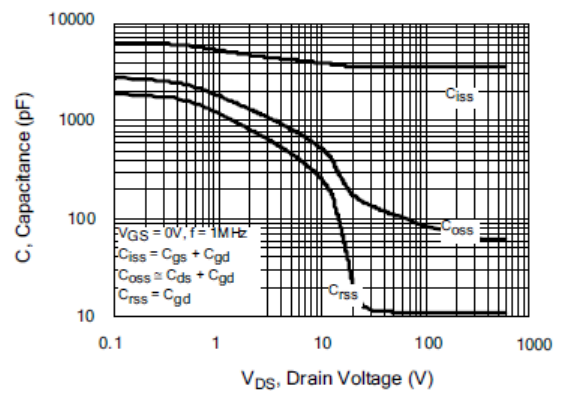


Figure 15. Typical Gate Charge vs Gate-to-Source Voltage

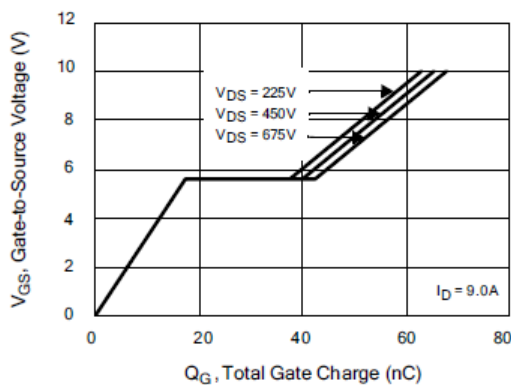
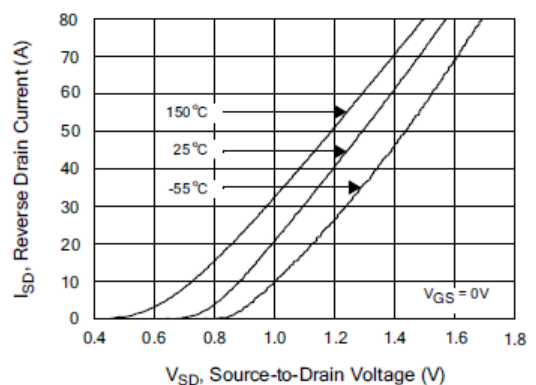


Figure 16. Typical Body Diode Transfer Characteristics



## Test Circuit and Waveform

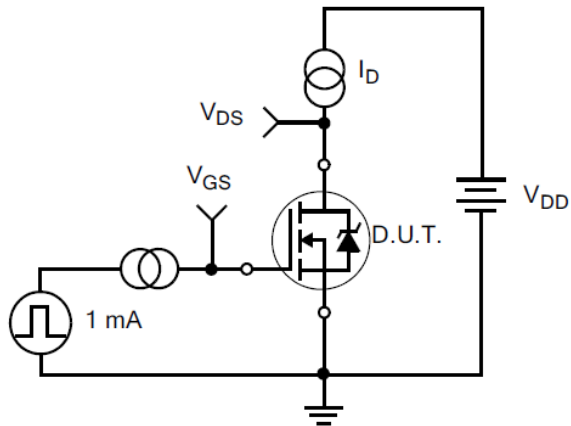


Figure 17. Gate Charge Test Circuit

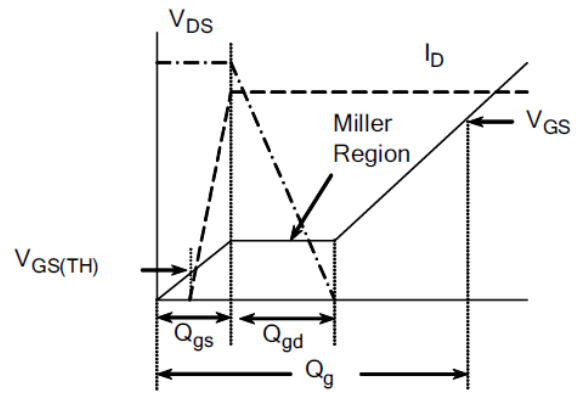


Figure 18. Gate Charge Waveform

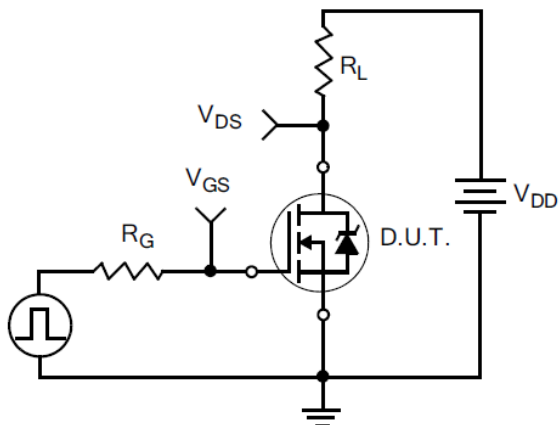


Figure 19. Resistive Switching Test Circuit

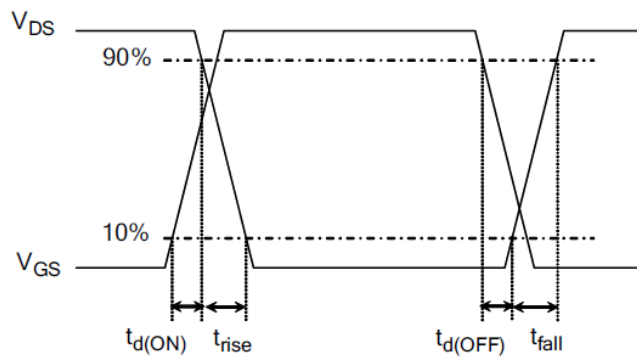


Figure 20. Resistive Switching Waveforms

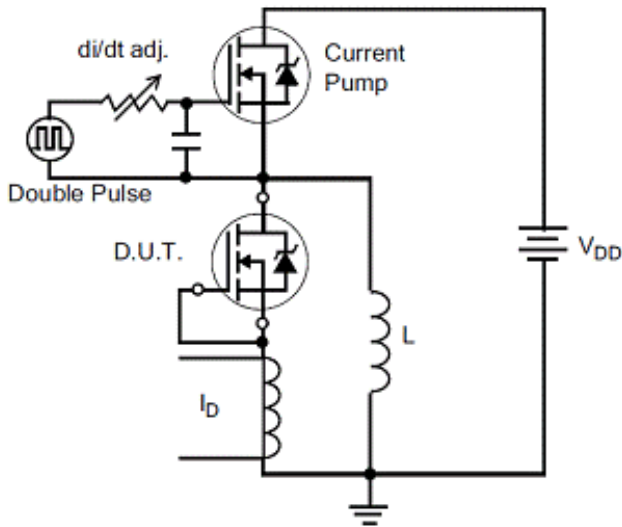


Figure 21. Diode Reverse Recovery Test Circuit

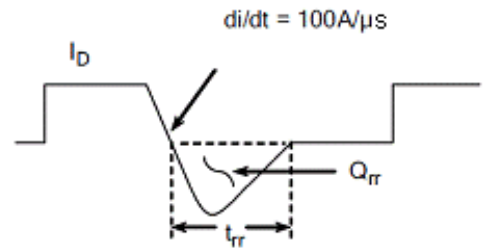


Figure 22. Diode Reverse Recovery Waveform

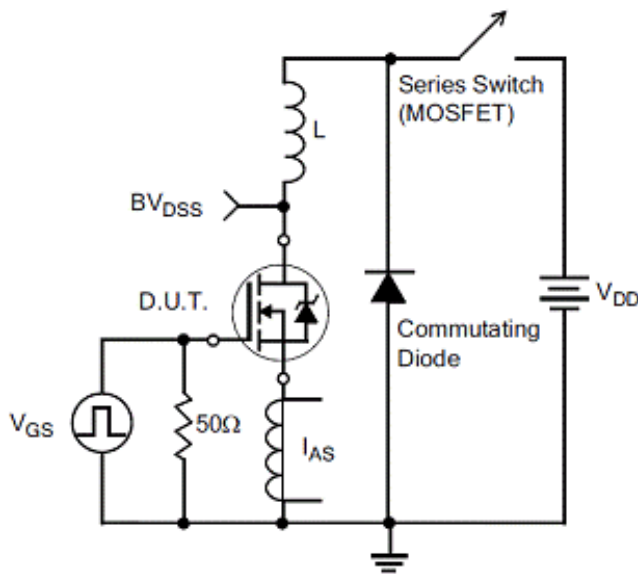


Figure 23. Unclamped Inductive Switching Test Circuit

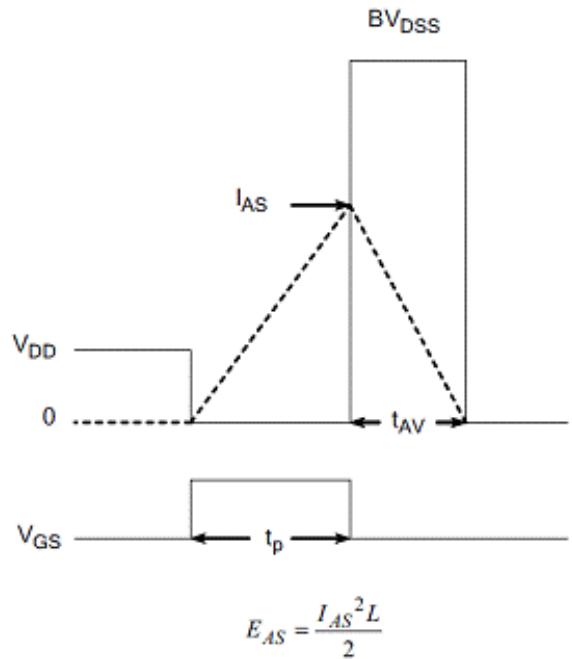
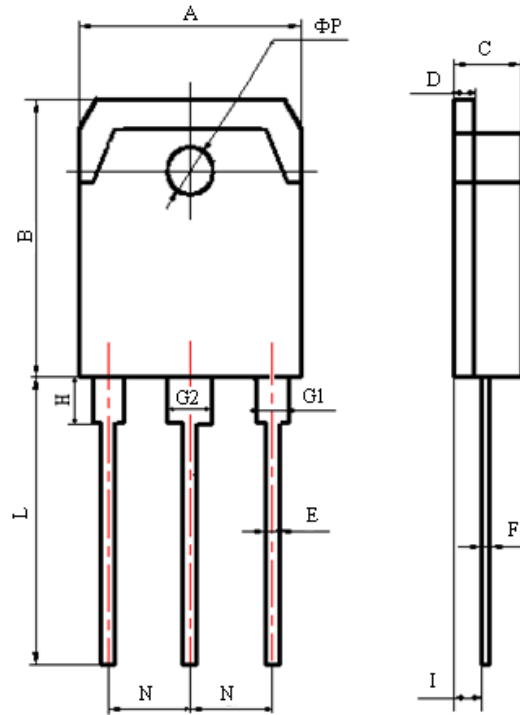


Figure 24. Unclamped Inductive Switching Waveforms



## Package Information



Items	Values(mm)	
	MIN	MAX
A	15.00	16.00
B	19.20	20.60
C	4.60	5.00
D	1.40	1.60
E	0.90	1.10
F	0.50	0.70
G1	2.00	2.20
G2	3.00	3.20
H	3.00	3.70
I	1.20	1.70
	2.70	2.90
L*	19.00	21.00
N	5.25	5.65
Φ P	3.10	3.30

\*: adjustable

TO-3P(N) Package



### The name and content of poisonous and harmful material in products

Part's Name	Hazardous Substance									
	Pb	Hg	Cd	Cr(VI)	PBB	PBDE	DIBP	DEHP	DBP	BBP
Limit	≤0.1%	≤0.1%	≤ 0.01%	≤0.1%	≤0.1%	≤0.1%	≤0.1%	≤0.1%	≤0.1%	≤0.1%
Lead Frame	○	○	○	○	○	○	○	○	○	○
Molding	○	○	○	○	○	○	○	○	○	○
Chip	○	○	○	○	○	○	○	○	○	○
Wire Bonding	○	○	○	○	○	○	○	○	○	○
Solder	×	○	○	○	○	○	○	○	○	○
Note	<p>○: Means the hazardous material is under the criterion of 2011/65/EU.</p> <p>×: Means the hazardous material exceeds the criterion of 2011/65/EU.</p> <p>The plumbum element of solder exist in products presently, but within the allowed range of Eurogroup's RoHS.</p>									

### Warnings

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. It is suggested to be used under 80 percent of the maximum ratings of the device.
2. When installing the heatsink, please pay attention to the torsional moment and the smoothness of the heatsink.
3. VDMOSFETs 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. This publication is made by Huajing Microelectronics and subject to regular change without notice.

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