



## Description

The 2N60L can be used in various power switching circuit for system miniaturization and higher efficiency. The package form is TO-252-2L, which accords with the RoHS standard.

## General Features

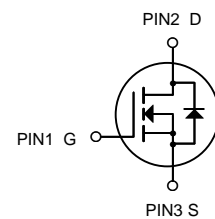
$V_{DS} = 650V, I_D = 2A$   
 $R_{DS(ON)} < 5 \Omega @ V_{GS} = 10V$

## Application

- Power switch circuit of adaptor and charger.



TO252-2L



N-Channel MOSFET

## Package Marking and Ordering Information

Product ID	Pack	Marking	Qty(PCS)
2N60L	TO252-2L	2N65 XXX YYYY	2500

## Absolute Maximum Ratings@ $T_J=25^\circ C$ (unless otherwise specified)

Symbol	Parameter	Rating	Units
$V_{DS}$	Drain-Source Voltage	650	V
$V_{GS}$	Gate-Source Voltage	$\pm 30$	V
$I_D @ T_C = 25^\circ C$	Drain Current, $V_{GS} @ 4.5V$	2	A
$I_D @ T_C = 100^\circ C$	Drain Current, $V_{GS} @ 4.5V$	1.3	A
IDM	Pulsed Drain Current <sup>1</sup>	8	A
$P_D @ T_C = 25^\circ C$	Total Power Dissipation	35	W
$E_{AS}$	Single Pulse Avalanche Energy <sup>4</sup>	50	mJ
TSTG	Storage Temperature Range	-45 to 125	$^\circ C$
$T_J$	Operating Junction Temperature Range	-45 to 125	$^\circ C$



**Electrical Characteristics** (Tc= 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> =250μA	650	--	--	V
Δ BV <sub>DSS</sub> / Δ T <sub>J</sub>	Bvdss Temperature Coefficient	I <sub>D</sub> =250uA, Reference 25°C	--	0.7	--	V/°C
I <sub>DSS</sub>	Drain to Source Leakage Current	V <sub>DS</sub> =650V, V <sub>GS</sub> = 0V, T <sub>a</sub> = 25°C	--	--	1	μA
		V <sub>DS</sub> =520V, V <sub>GS</sub> = 0V, T <sub>a</sub> = 125°C	--	--	100	μA
I <sub>GSS(F)</sub>	Gate to Source Forward Leakage	V <sub>GS</sub> =+30V	--	--	100	nA
I <sub>GSS(R)</sub>	Gate to Source Reverse Leakage	V <sub>GS</sub> =-30V	--	--	-100	nA

<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> =1A	--	4.2	5	Ω
V <sub>GS(TH)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA	2.0	--	4.0	V
Pulse width tp ≤ 300μs, δ ≤ 2%						

<b>Dynamic Characteristics</b>						
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
g <sub>fs</sub>	Forward Transconductance	V <sub>DS</sub> =15V, I <sub>D</sub> =1A	--	1.8	--	S
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> = 0V V <sub>DS</sub> = 25V f = 1.0MHz	--	335	--	pF
C <sub>oss</sub>	Output Capacitance		--	33	--	
C <sub>rss</sub>	Reverse Transfer Capacitance		--	3	--	

<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> =2A V <sub>DD</sub> = 325V R <sub>G</sub> =10Ω	--	11	--	ns
t <sub>r</sub>	Rise Time		--	13	--	
t <sub>d(OFF)</sub>	Turn-Off Delay Time		--	29	--	
t <sub>f</sub>	Fall Time		--	12	--	
Q <sub>g</sub>	Total Gate Charge	I <sub>D</sub> =2A V <sub>DD</sub> =520V V <sub>GS</sub> = 10V	--	9.5	--	nC
Q <sub>gs</sub>	Gate to Source Charge		--	1.5	--	
Q <sub>gd</sub>	Gate to Drain ("Miller") Charge		--	4.9	--	



Source-Drain Diode Characteristics						
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
$I_S$	Continuous Source Current (Body Diode)		--	--	2	A
$I_{SM}$	Maximum Pulsed Current (Body Diode)		--	--	8	A
$V_{SD}$	Diode Forward Voltage	$I_S=2.0A, V_{GS}=0V$	--	--	1.5	V
$t_{rr}$	Reverse Recovery Time	$I_S=2.0A, T_J = 25^\circ C$ $dI_F/dt=100A/us,$ $V_{GS}=0V$	--	187	--	ns
$Q_{rr}$	Reverse Recovery Charge		--	610	--	nC
$I_{RRM}$	Reverse Recovery Current		--	6.6	--	A
Pulse width $t_p \leq 300\mu s, \delta \leq 2\%$						

Symbol	Parameter	Max.	Units
$R_{\theta JC}$	Junction-to-Case	3.57	$^\circ C/W$
$R_{\theta JA}$	Junction-to-Ambient	100	$^\circ C/W$

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

<sup>a2</sup>:  $L=10mH, I_D=3.1A, Start T_J=25^\circ C$

<sup>a3</sup>:  $I_{SD}=2A, di/dt \leq 100A/us, V_{DD} \leq BV_{DS}, Start T_J=25^\circ C$



### Characteristics Curve:

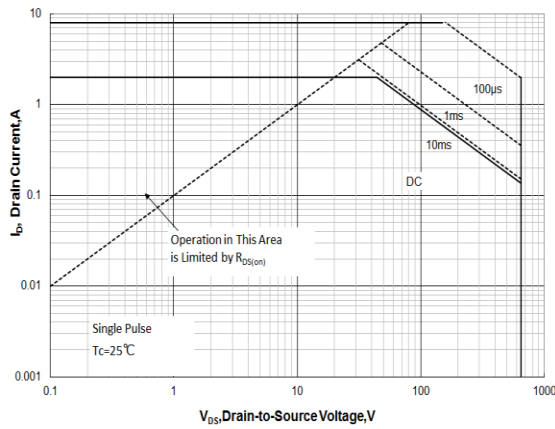


Figure 1 Maximum Forward Bias Safe Operating Area

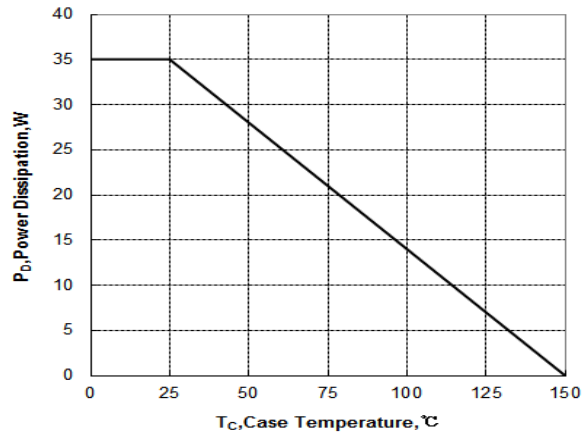


Figure 2 Maximum Power dissipation vs Case Temperature

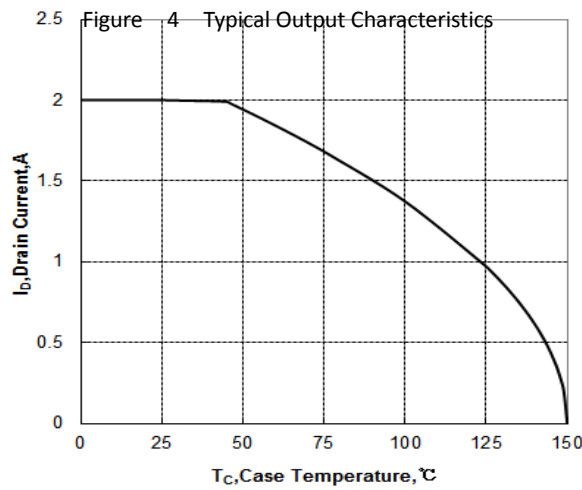


Figure 3 Maximum Continuous Drain Current vs Case Temperature

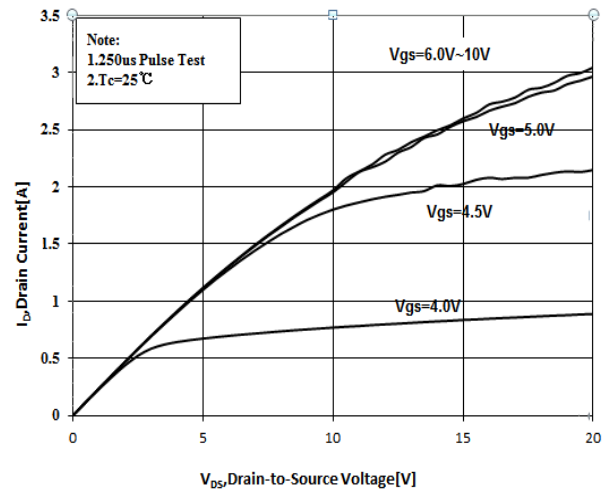


Figure 4 Typical Output Characteristics

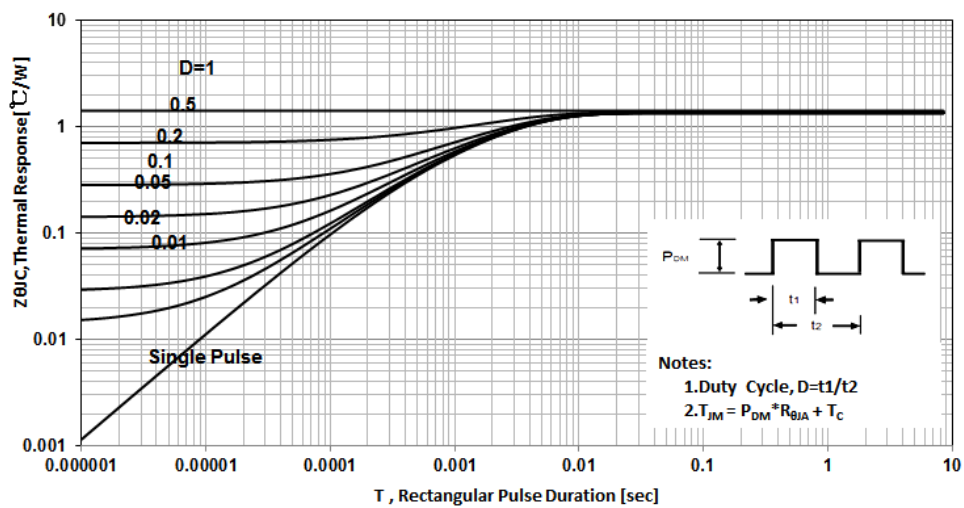


Figure 5 Maximum Effective Thermal Impedance , Junction to Case

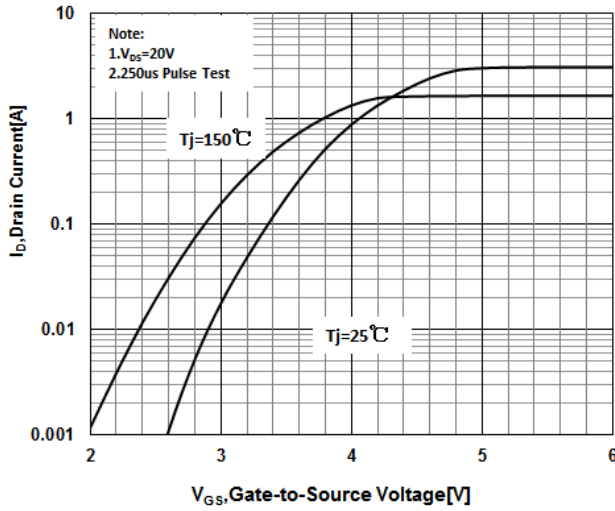


Figure 6 Typical Transfer Characteristics

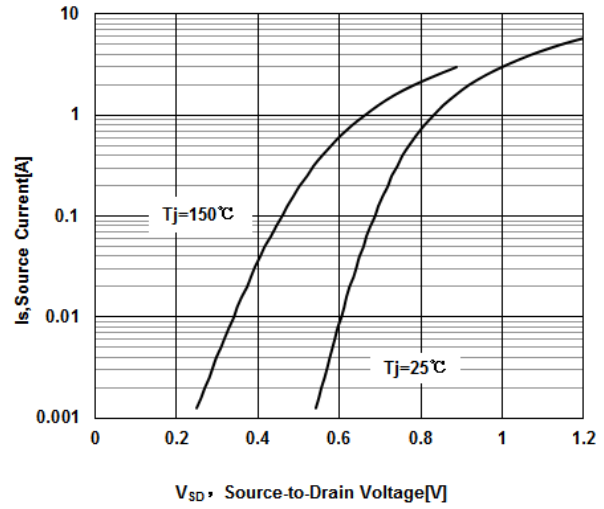


Figure 7 Typical Body Diode Transfer Characteristics

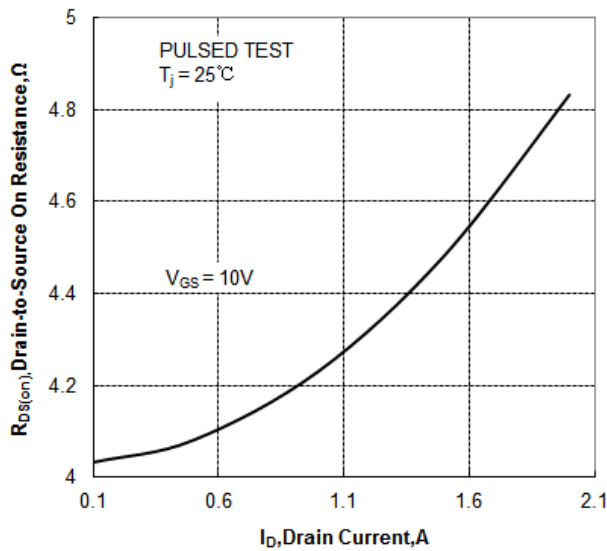


Figure 8 Typical Drain to Source ON Resistance vs Drain Current

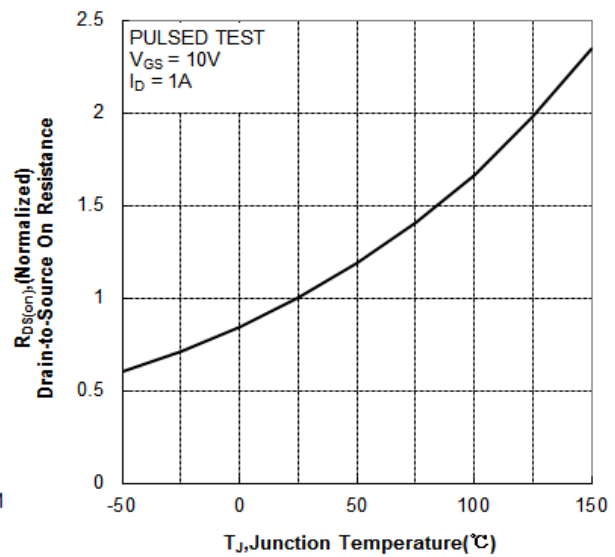


Figure 9 Typical Drian to Source on Resistance vs Junction Temperature

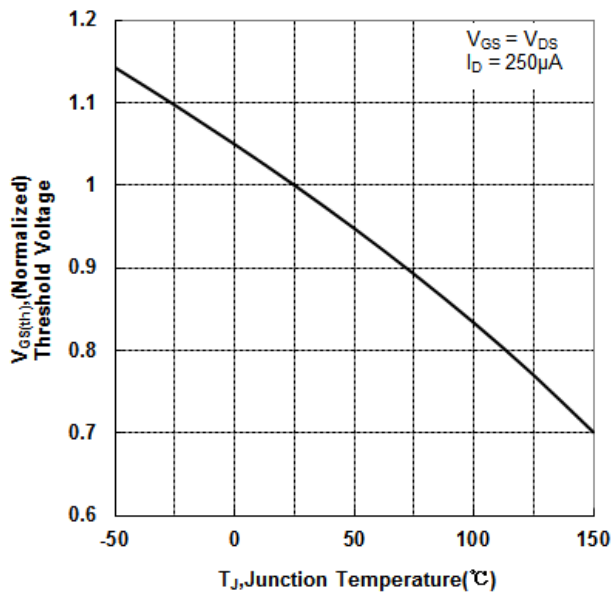


Figure 10 Typical Theshold Voltage vs Junction Temperature

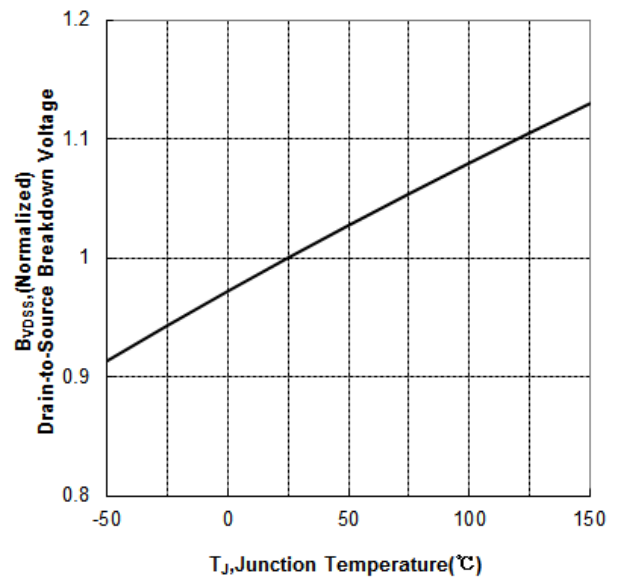


Figure 11 Typical Breakdown Voltage vs Junction Temperature

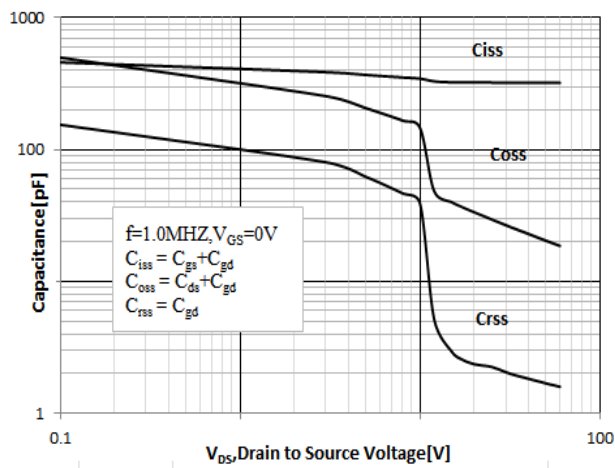


Figure 12 Typical Capacitance vs Drain to Source Voltage

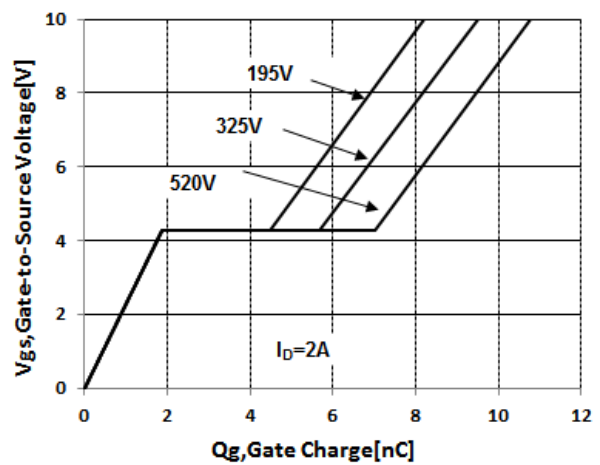


Figure 13 Typical Gate Charge vs Gate to Source Voltage



### Test Circuit and Waveform

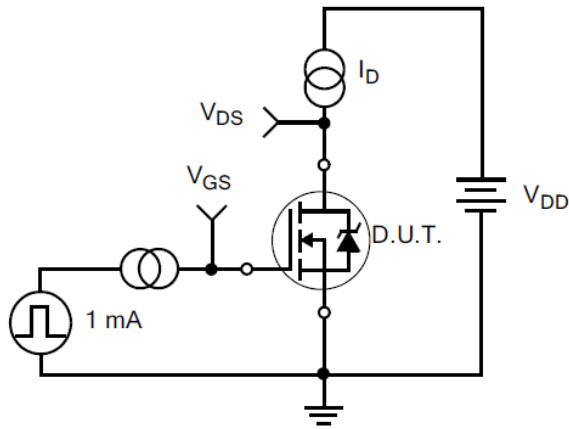


Figure 14. Gate Charge Test Circuit

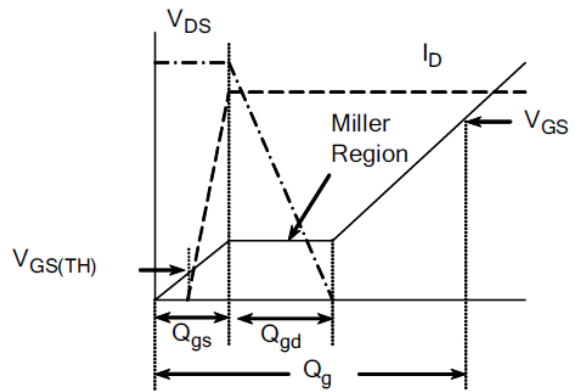


Figure 15. Gate Charge Waveforms

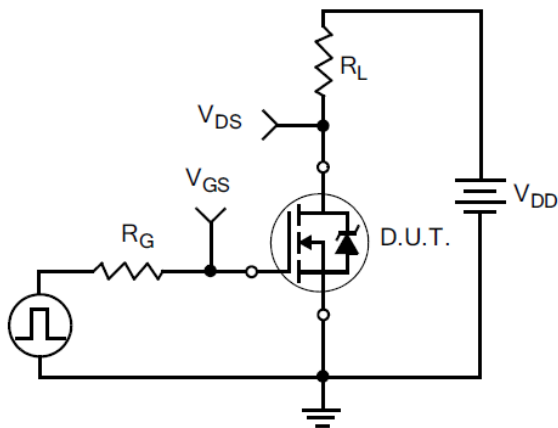


Figure 16. Resistive Switching Test Circuit

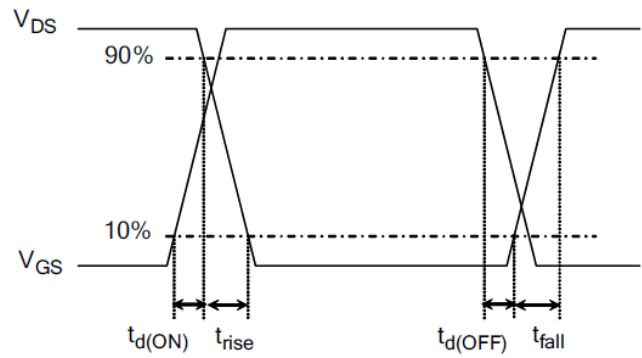


Figure 17. Resistive Switching Waveforms

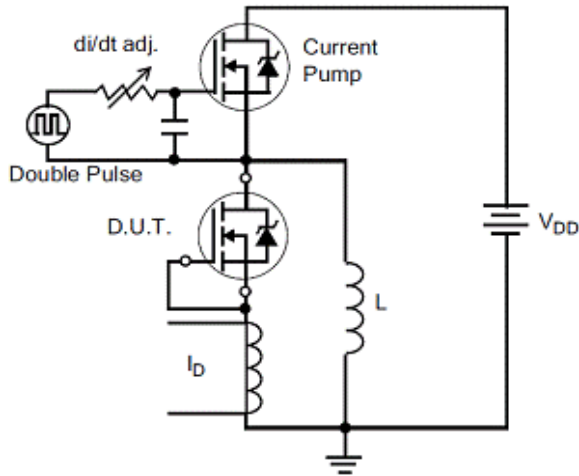


Figure 18. Diode Reverse Recovery Test Circuit

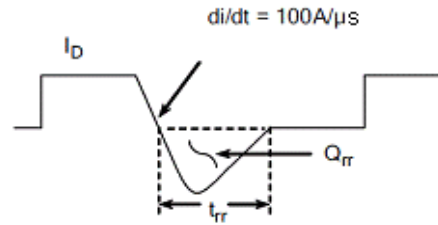


Figure 19. Diode Reverse Recovery Waveform

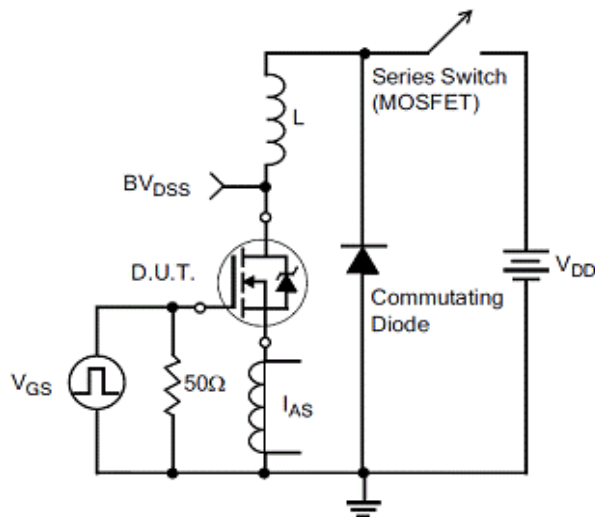


Figure20.Unclamped Inductive Switching Test Circuit

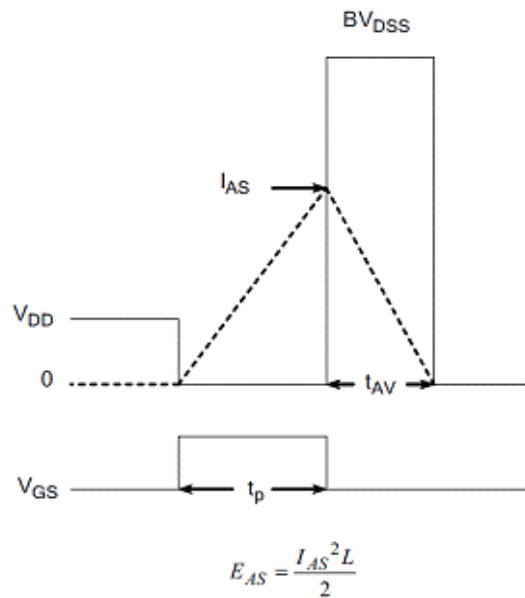
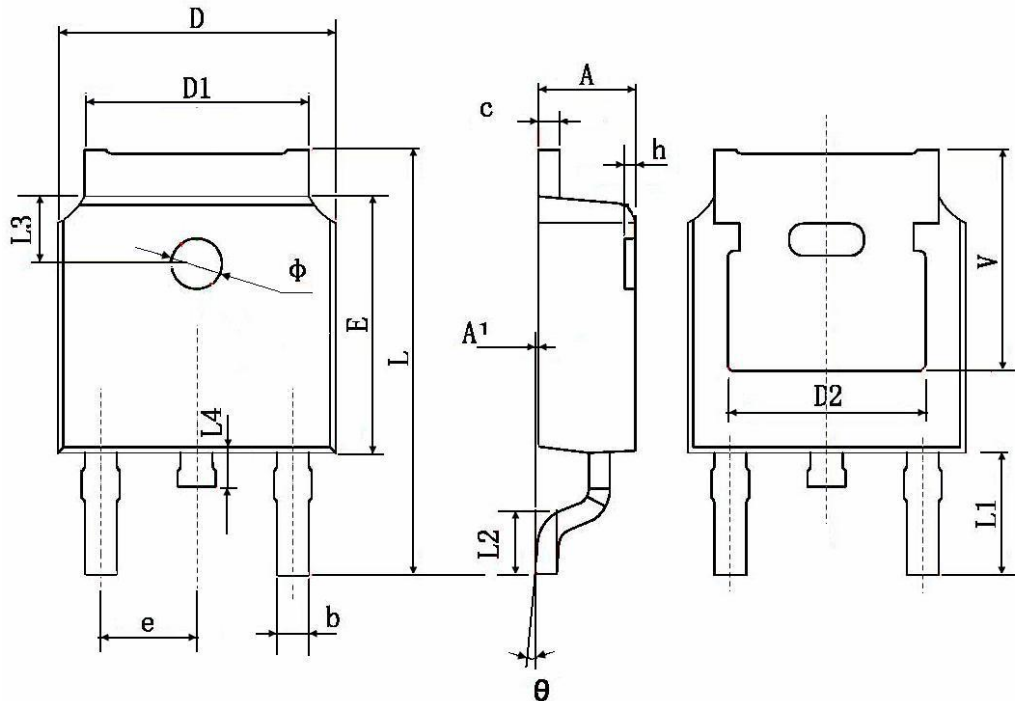


Figure21.Unclamped Inductive Switching Waveform





### TO252-2L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.200	2.400	0.087	0.094
A1	0.000	0.127	0.000	0.005
b	0.660	0.860	0.026	0.034
c	0.460	0.580	0.018	0.023
D	6.500	6.700	0.256	0.264
D1	5.100	5.460	0.201	0.215
D2	0.483 TYP.		0.190 TYP.	
E	6.000	6.200	0.236	0.244
e	2.186	2.386	0.086	0.094
L	9.800	10.400	0.386	0.409
L1	2.900 TYP.		0.114 TYP.	
L2	1.400	1.700	0.055	0.067
L3	1.600 TYP.		0.063 TYP.	
L4	0.600	1.000	0.024	0.039
φ	1.100	1.300	0.043	0.051
θ	0°	8°	0°	8°
h	0.000	0.300	0.000	0.012
V	5.350 TYP.		0.211 TYP.	



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