



## 650V Super-Junction Power MOSFET

### DESCRIPTION

#### 650V super-junction Power MOSFET

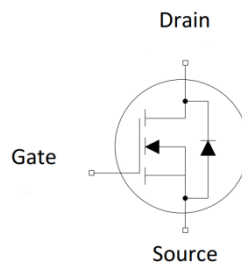
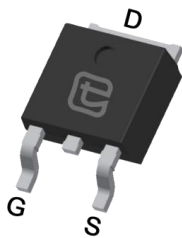
Super-junction power MOSFET is a revolutionary technology for high voltage power MOSFETs, designed according to the SJ principle. The SJ MOSFET is a price-performance optimized product enabling to target cost sensitive applications in Consumer and Lighting markets, designed by Wuxi Unigroup Microelectronics Company.

### FEATURES

- Very low FOM  $R_{DS(on)} \times Q_g$
- 100% avalanche tested
- RoHS compliant

### APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)



### Device Marking and Package Information

Device	Package	Marking
TPD65R520D	TO-252	65R520D

### Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	650	V
$R_{DS(on),max}$	0.52	$\Omega$
$I_D$	7	A
$Q_{g,typ}$	12.5	nC
$I_{DM}$	21	A



<b>Absolute Maximum Ratings</b> $T_C = 25^\circ\text{C}$ , unless otherwise noted			
Parameter	Symbol	Value	Unit
Drain-Source Voltage ( $V_{GS} = 0\text{V}$ )	$V_{DSS}$	650	V
Continuous Drain Current	$I_D$	$T_C = 25^\circ\text{C}$	7
		$T_C = 100^\circ\text{C}$	4
Pulsed Drain Current (note1)	$I_{DM}$	21	A
Gate-Source Voltage	$V_{GSS}$	$\pm 30$	V
Single Pulse Avalanche Energy (note2)	$E_{AS}$	45	mJ
Avalanche Current	$I_{AS}$	3	A
Power Dissipation	$P_D$	62.5	W
Continuous Body Diode Current	$I_S$	7	A
Pulsed Diode Forward Current (note1)	$I_{SM}$	21	
MOSFET dv/dt ruggedness, $V_{DS} = 0 \dots 650\text{V}$	dv/dt	50	V/ns
Reverse diode dv/dt, $V_{DS} = 0 \dots 650\text{V}$ , $I_{SD} \leq I_D$	dv/dt	5	A/us
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55~+150	$^\circ\text{C}$

<b>Thermal Resistance</b>			
Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{thJC}$	2	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	$R_{thJA}$	62	



Specifications $T_J = 25^{\circ}\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	650	--	--	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 650V, V_{GS} = 0V, T_J = 25^{\circ}\text{C}$	--	--	1	$\mu A$
		$V_{DS} = 650V, V_{GS} = 0V, T_J = 150^{\circ}\text{C}$	--	--	100	
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 30V$	--	--	$\pm 100$	nA
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	2.5	--	4.0	V
Drain-Source On-Resistance	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 3A$	--	0.44	0.52	$\Omega$
Forward Transconductance (Note3)	$g_{fs}$	$V_{DS} = 20V, I_D = 3A$	--	3.6	--	S
<b>Dynamic</b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0V,$ $V_{DS} = 100V,$ $f = 1.0\text{MHz}$	--	564	--	$\mu F$
Output Capacitance	$C_{oss}$		--	22	--	
Reverse Transfer Capacitance	$C_{rss}$		--	0.5	--	
Total Gate Charge	$Q_g$	$V_{DD} = 520V, I_D = 7A,$ $V_{GS} = 10V$	--	12.5	--	nC
Gate-Source Charge	$Q_{gs}$		--	5	--	
Gate-Drain Charge	$Q_{gd}$		--	3.2	--	
Turn-on Delay Time	$t_{d(on)}$	$V_{DD} = 400V, I_D = 7A,$ $R_G = 25\Omega$	--	52	--	ns
Turn-on Rise Time	$t_r$		--	62	--	
Turn-off Delay Time	$t_{d(off)}$		--	84	--	
Turn-off Fall Time	$t_f$		--	50	--	
<b>Drain-Source Body Diode Characteristics</b>						
Body Diode Voltage	$V_{SD}$	$T_J = 25^{\circ}\text{C}, I_{SD} = 7A, V_{GS} = 0V$	--	0.9	1.2	V
Reverse Recovery Time	$t_{rr}$	$V_R = 400V, I_S = 3A,$ $di_F/dt = 100A/\mu s$	--	200	--	ns
Reverse Recovery Charge	$Q_{rr}$		--	1.6	--	$\mu C$
Peak Reverse Recovery Current	$I_{rrm}$		--	3.2	--	A

**Notes**

1. Repetitive Rating: Pulse Width limited by maximum junction temperature
2.  $V_{DD} = 50V, R_G = 25\Omega, \text{Starting } T_J = 25^{\circ}\text{C}$
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 1\%$



Typical Characteristics  $T_J = 25^\circ\text{C}$ , unless otherwise noted

Figure 1. Output Characteristics

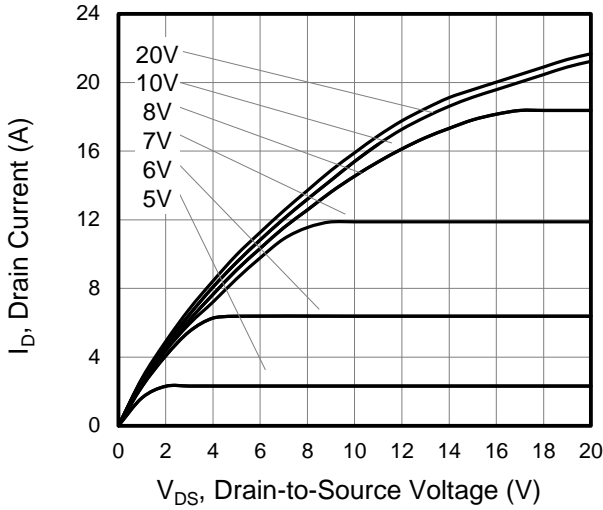


Figure 2. Transfer Characteristics

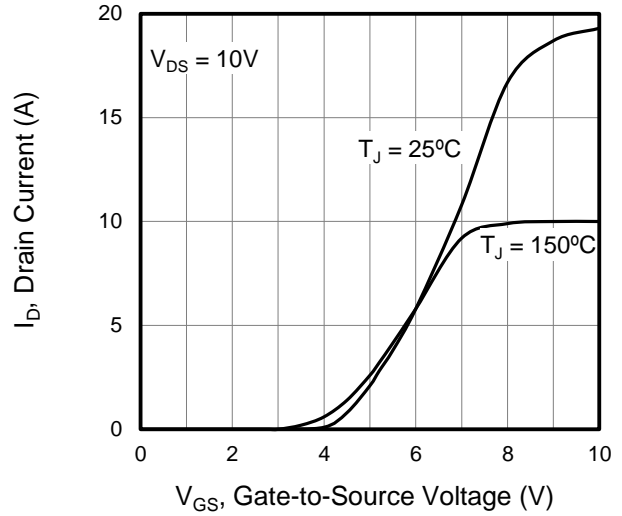


Figure 3. Body Diode Forward Voltage

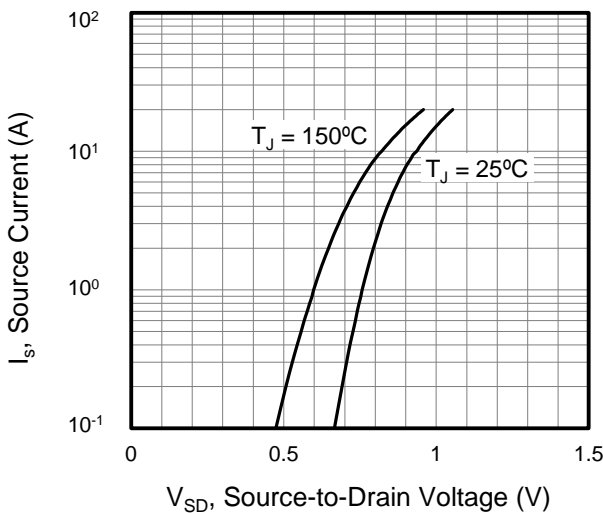


Figure 4. Capacitance

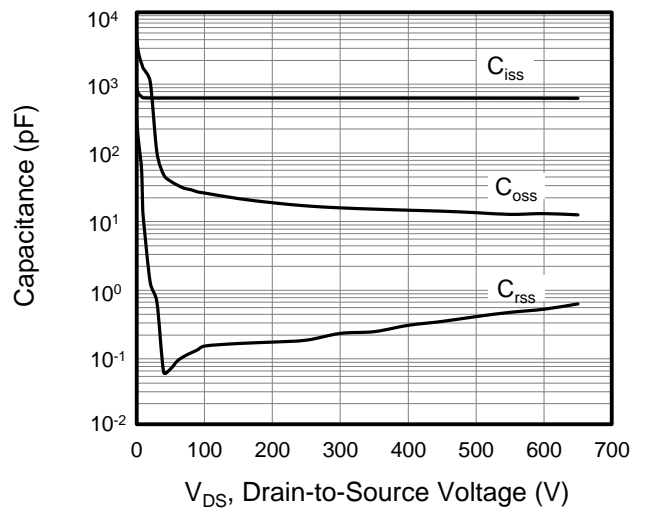


Figure 5. Gate Charge

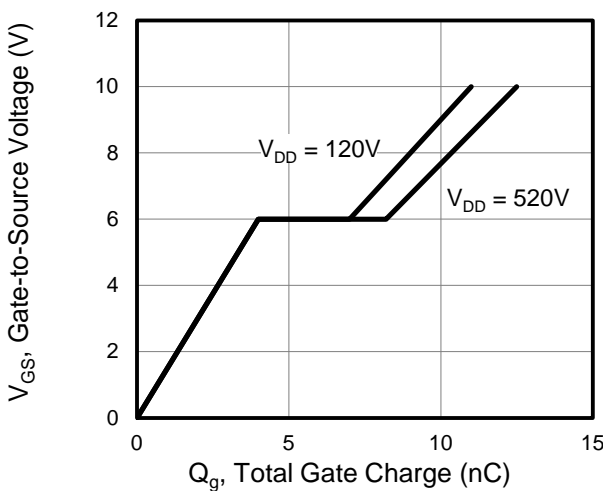


Figure 6. On-Resistance vs. Junction Temperature

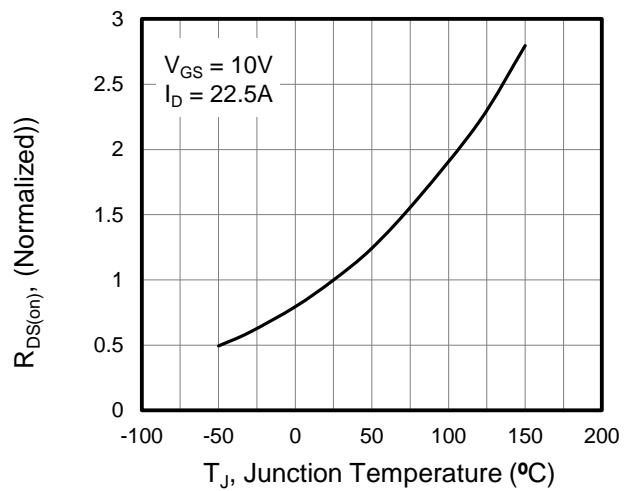




Figure 7. Breakdown voltage vs. Junction Temperature

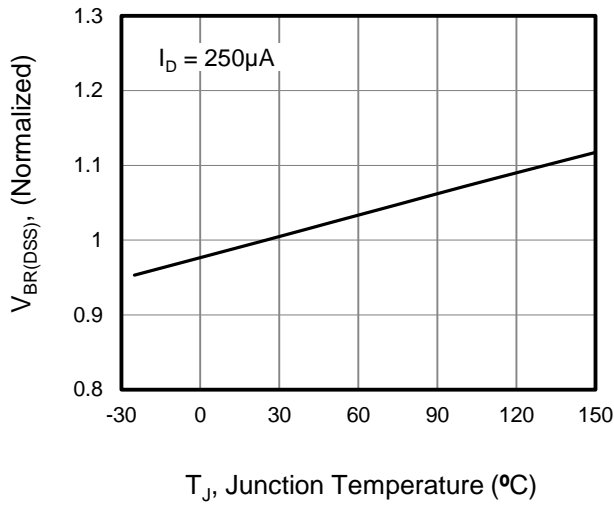


Figure 8. Threshold Voltage vs. Junction Temperature

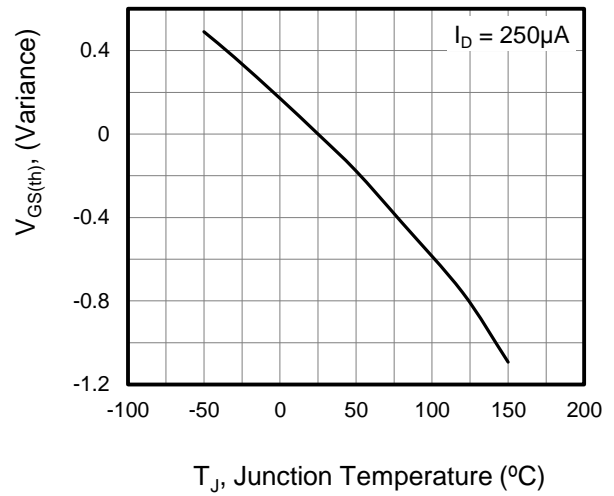


Figure 9. Transient Thermal Impedance for TO-252

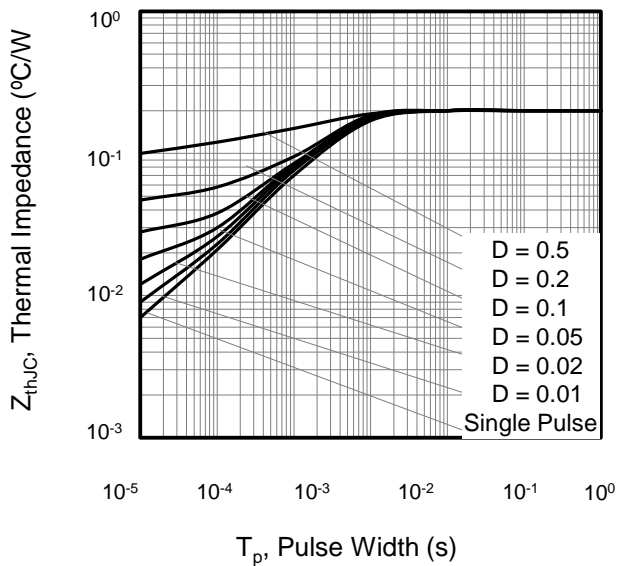


Figure 10. Safe operation area for TO-252

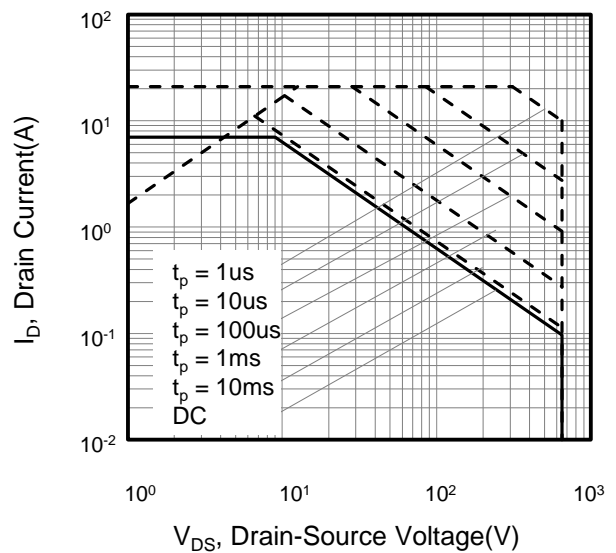




Figure A: Gate Charge Test Circuit and Waveform

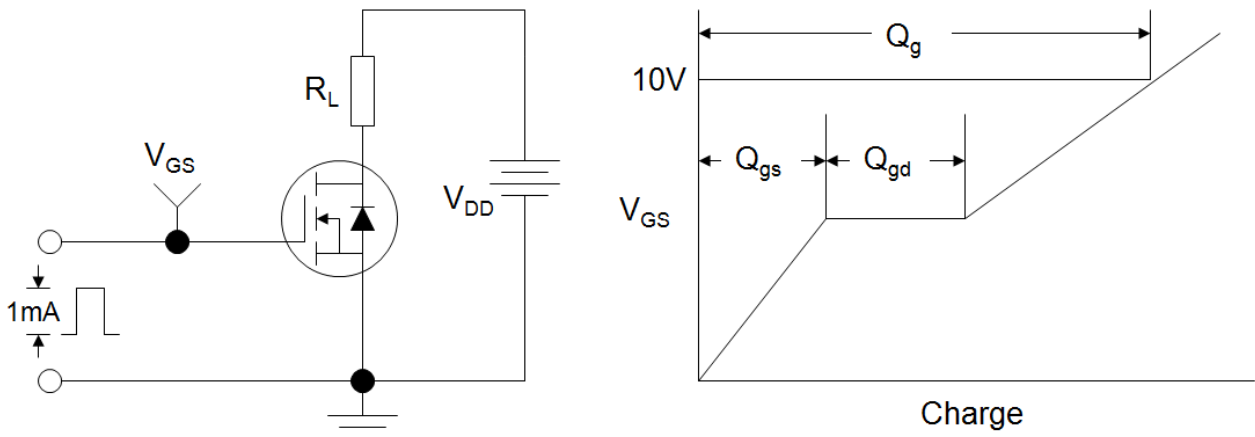


Figure B: Resistive Switching Test Circuit and Waveform

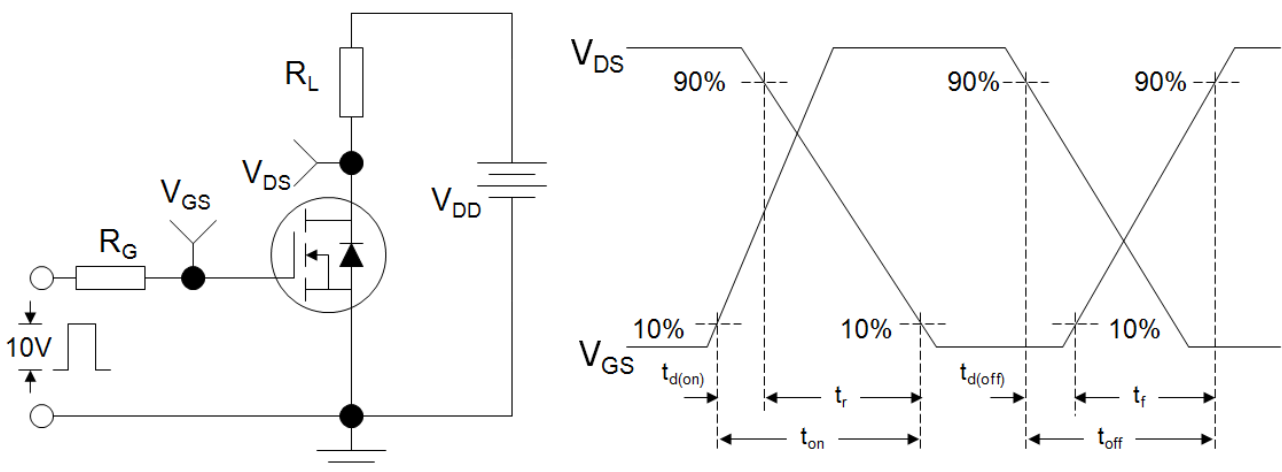
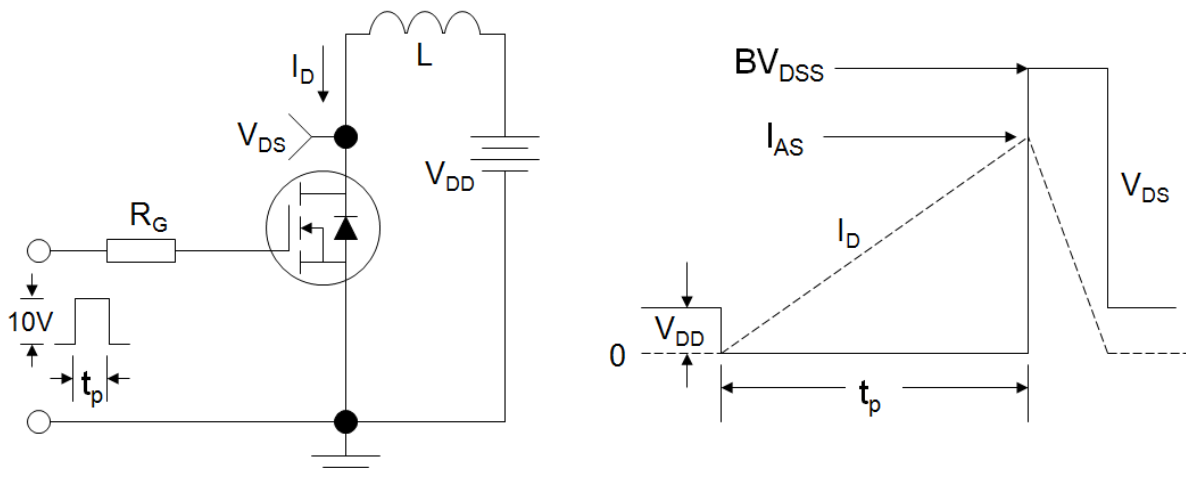
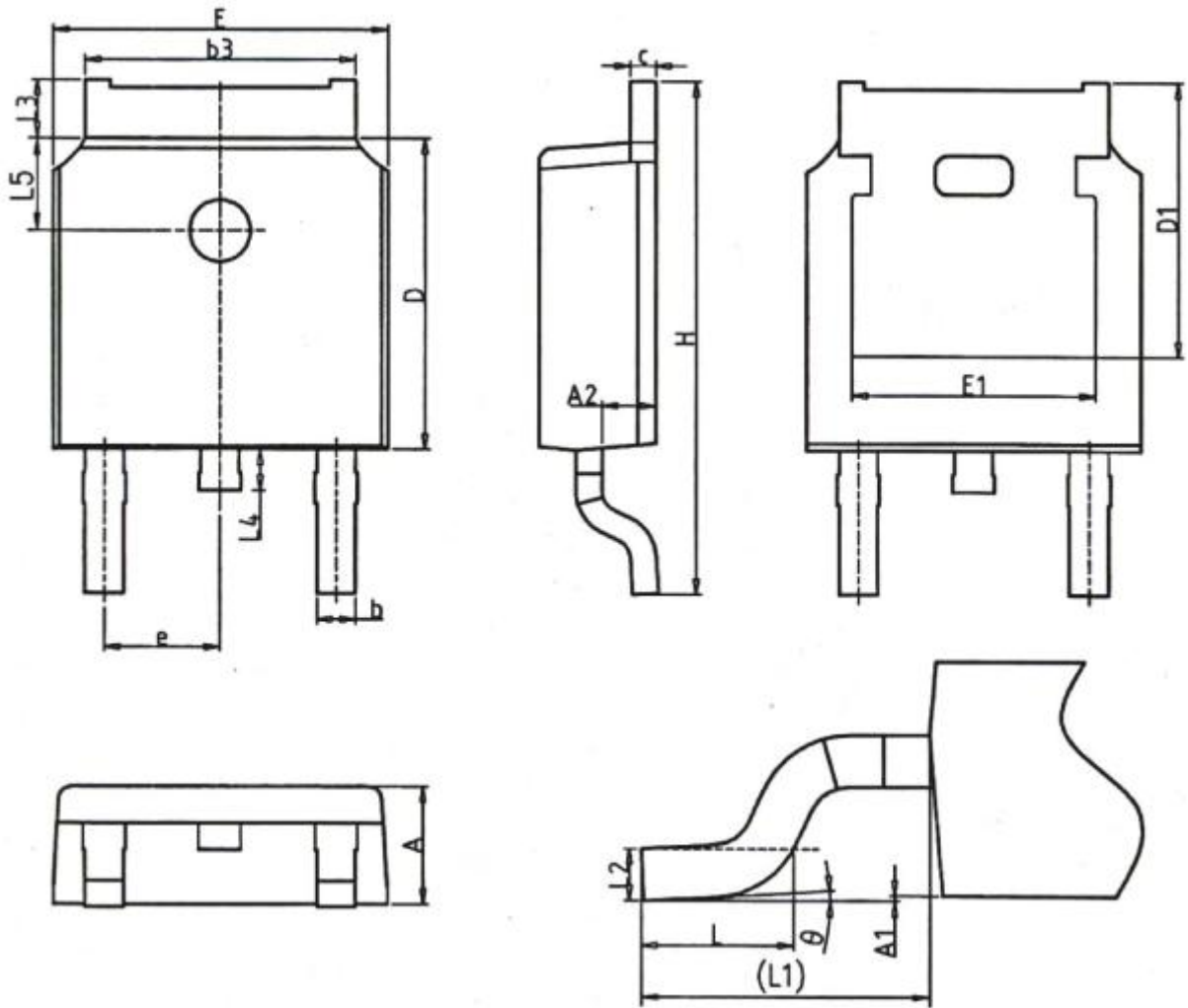


Figure C: Unclamped Inductive Switching Test Circuit and Waveform





### TO-252



Unit:mm			
Symbol	Min.	Nom	Max.
A	2.20	2.30	2.40
A1	0.00	-	0.20
A2	0.97	1.07	1.17
b	0.68	0.78	0.90
b3	5.20	5.33	5.50
c	0.43	0.53	0.63
D	5.98	6.10	6.22
D1	5.30 REF		
E	6.40	6.60	6.80
E1	4.63	-	-

Unit:mm			
Symbol	Min.	Nom	Max.
e	2.286 BSC		
H	9.40	10.10	10.50
L	1.38	1.50	1.75
L1	2.90 REF		
L2	0.51 BSC		
L3	0.88	-	1.28
L4	-	-	1.00
L5	1.65	1.80	1.95
theta	0°	-	8°



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