



650V Super-Junction Power MOSFET

DESCRIPTION

650V super-junction Power MOSFET

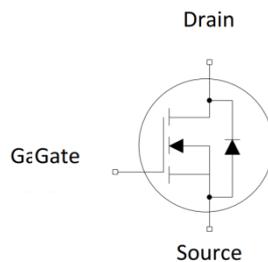
Super-junction power MOSFET is a revolutionary technology for high voltage power MOSFETs, designed according to the SJ principle. The SJ MOSFET is a price-performance optimized product enabling to target cost sensitive applications in Consumer and Lighting markets, designed by Wuxi Unigroup Microelectronics 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
TPW65R040M	TO-247	65R040M

Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	650	V
$R_{DS(on),max}$	0.04	Ω
I_D	72	A
$Q_{g,typ}$	160	nC
I_{DM}	216	A



Absolute Maximum Ratings $T_C = 25^\circ\text{C}$, unless otherwise noted			
Parameter	Symbol	Value	Unit
Drain-Source Voltage ($V_{GS} = 0\text{V}$)	V_{DSS}	650	V
Continuous Drain Current	I_D	$T_C = 25^\circ\text{C}$	72
		$T_C = 100^\circ\text{C}$	43.2
Pulsed Drain Current (note1)	I_{DM}	216	A
Gate-Source Voltage	V_{GSS}	± 30	V
Single Pulse Avalanche Energy (note2)	E_{AS}	2185	mJ
Repetitive Avalanche Energy (note2)	E_{AR}	3.31	mJ
Avalanche Current	I_{AR}	13.7	A
MOSFET dv/dt ruggedness, $V_{DS} = 0 \dots 480\text{V}$	dv/dt	50	V/ns
Power Dissipation	P_D	500	W
Continuous Body Diode Current	I_S	61	A
Pulsed Diode Forward Current (note1)	I_{SM}	216	
Reverse diode dv/dt (note3)	dv/dt	15	V/ns
Maximum diode commutation speed (note3)	di_f/dt	500	A/us
Operating Junction and Storage Temperature Range	T_J, T_{stg}	-55~+150	$^\circ\text{C}$

Thermal Resistance			
Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	R_{thJC}	0.25	$^\circ\text{C/W}$
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.	
Static						
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	μA
		$V_{DS} = 650V, V_{GS} = 0V, T_J = 150^{\circ}\text{C}$	--	--	100	
Gate-Source Leakage	I_{GSS}	$V_{GS} = \pm 30V$	--	--	± 100	nA
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	2.5	--	4.5	V
Drain-Source On-Resistance	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 25A$	--	0.035	0.04	Ω
Gate resistance	R_G	$f = 1.0\text{MHz}$ open drain	--	0.3	--	Ω
Dynamic						
Input Capacitance	C_{iss}	$V_{GS} = 0V,$ $V_{DS} = 100V,$ $f = 1.0\text{MHz}$	--	7565	--	μF
Output Capacitance	C_{oss}		--	268	--	
Reverse Transfer Capacitance	C_{rss}		--	3.3	--	
Total Gate Charge	Q_g	$V_{DD} = 520V, I_D = 50A,$ $V_{GS} = 10V$	--	160	--	nC
Gate-Source Charge	Q_{gs}		--	38	--	
Gate-Drain Charge	Q_{gd}		--	60	--	
Turn-on Delay Time	$t_{d(on)}$	$V_{DD} = 400V, I_D = 50A,$ $R_G = 25\Omega$	--	45	--	ns
Turn-on Rise Time	t_r		--	161	--	
Turn-off Delay Time	$t_{d(off)}$		--	287	--	
Turn-off Fall Time	t_f		--	87	--	
Drain-Source Body Diode Characteristics						
Body Diode Voltage	V_{SD}	$T_J = 25^{\circ}\text{C}, I_{SD} = 72A, V_{GS} = 0V$	--	0.9	1.2	V
Reverse Recovery Time	t_{rr}	$V_R = 400V, I_F = 30A,$ $di_F/dt = 100A/\mu s$	--	540	--	ns
Reverse Recovery Charge	Q_{rr}		--	13.5	--	μC
Peak Reverse Recovery Current	I_{rrm}		--	50.4	--	A

Notes

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $I_{AS} = 13.7A, V_{DD} = 50V, R_G = 25\Omega$, Starting $T_J = 25^{\circ}\text{C}$
3. Identical low side and high side switch with identical R_G



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

Figure 1. Output Characteristics

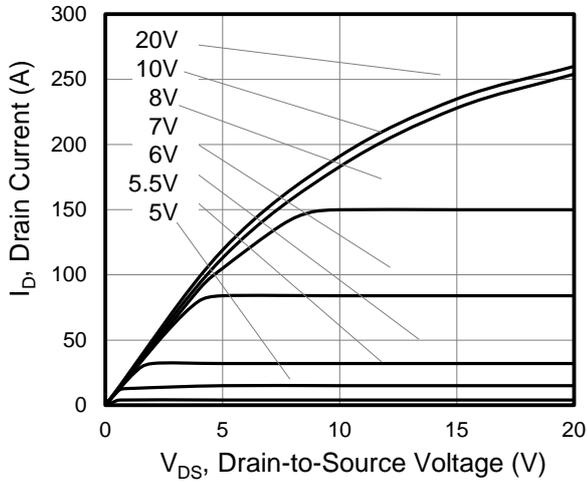


Figure 2. Transfer Characteristics

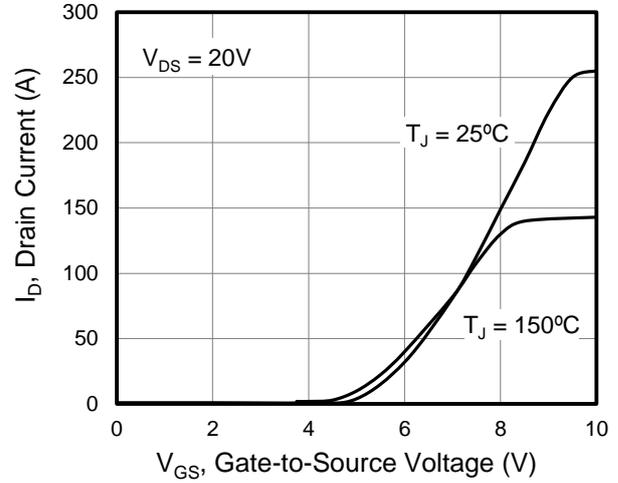


Figure 3. On-Resistance vs. Drain Current

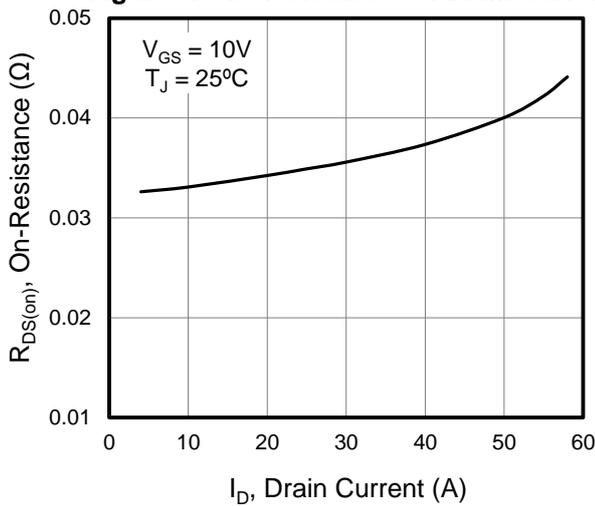


Figure 4. Capacitance

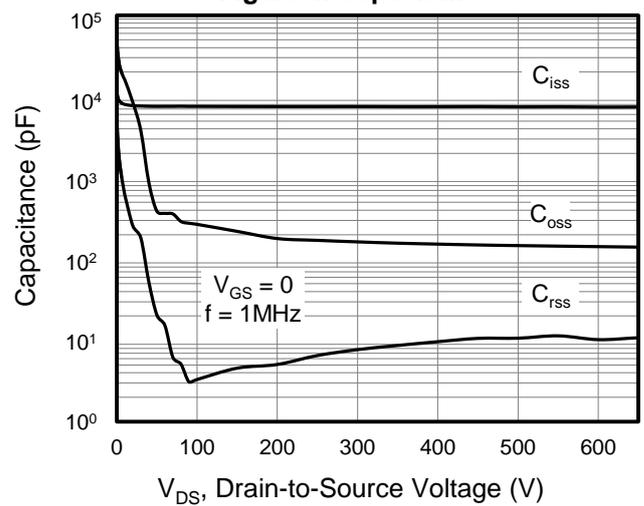


Figure 5. Gate Charge

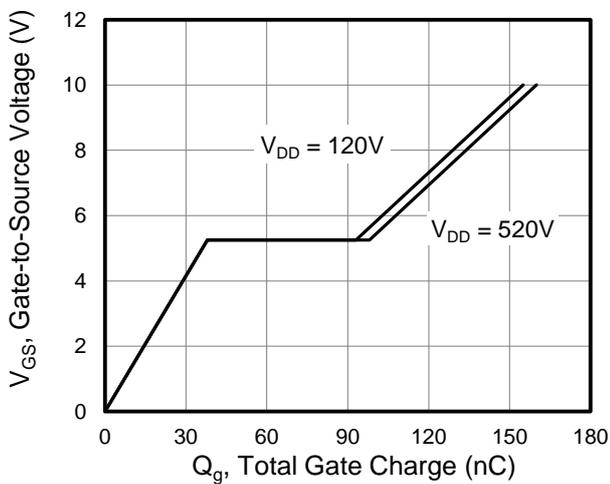
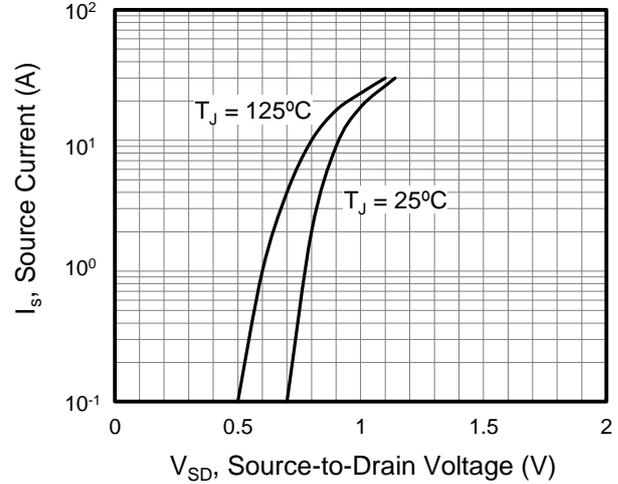


Figure 6. Body Diode Forward Voltage





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

Figure 7. On-Resistance vs. Junction Temperature

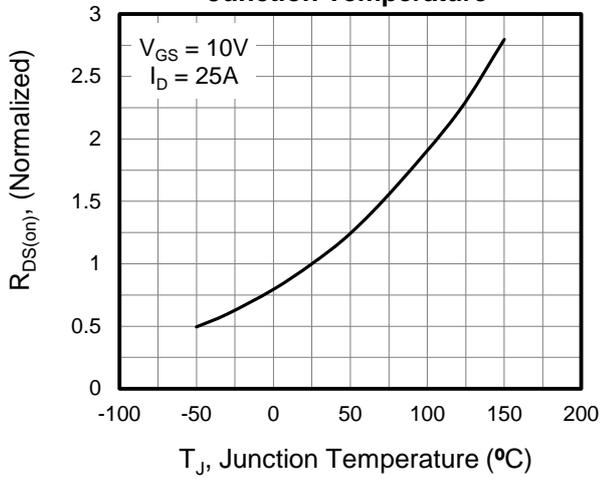


Figure 8. Breakdown voltage vs. Junction Temperature

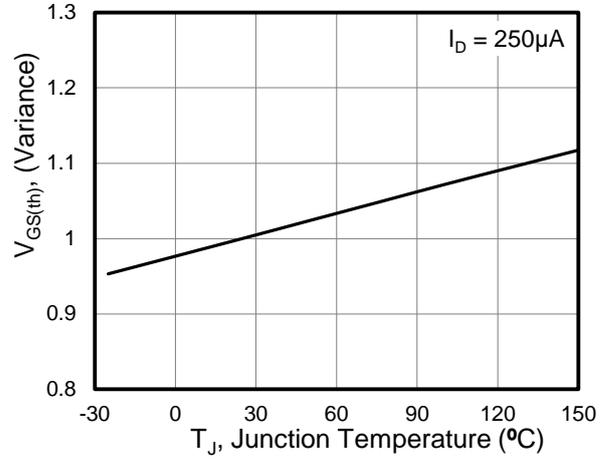


Figure 9. Transient Thermal Impedance TO-247

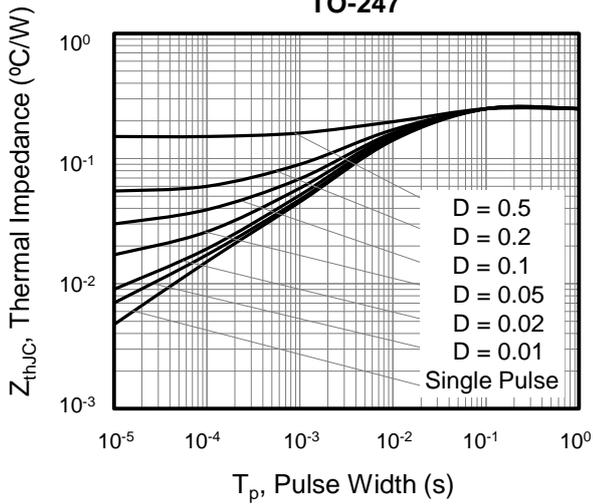


Figure 10. Safe operation area for TO-247

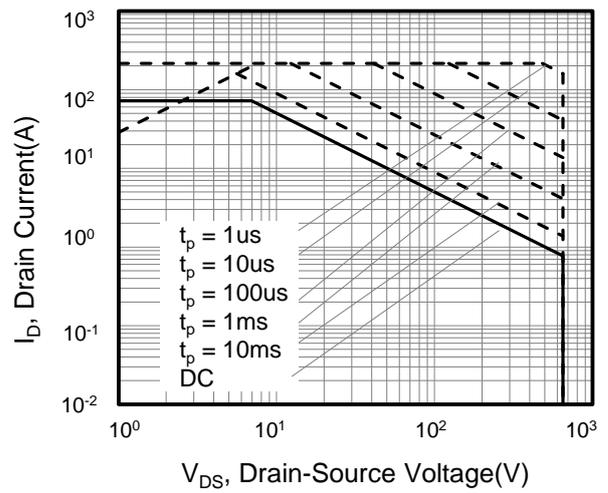




Figure A: Gate Charge Test Circuit and Waveform

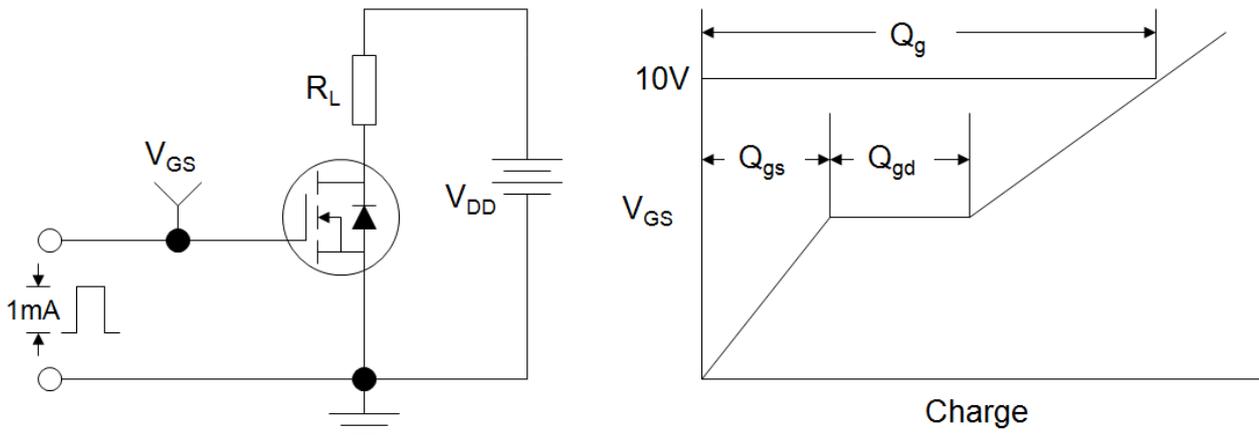


Figure B: Resistive Switching Test Circuit and Waveform

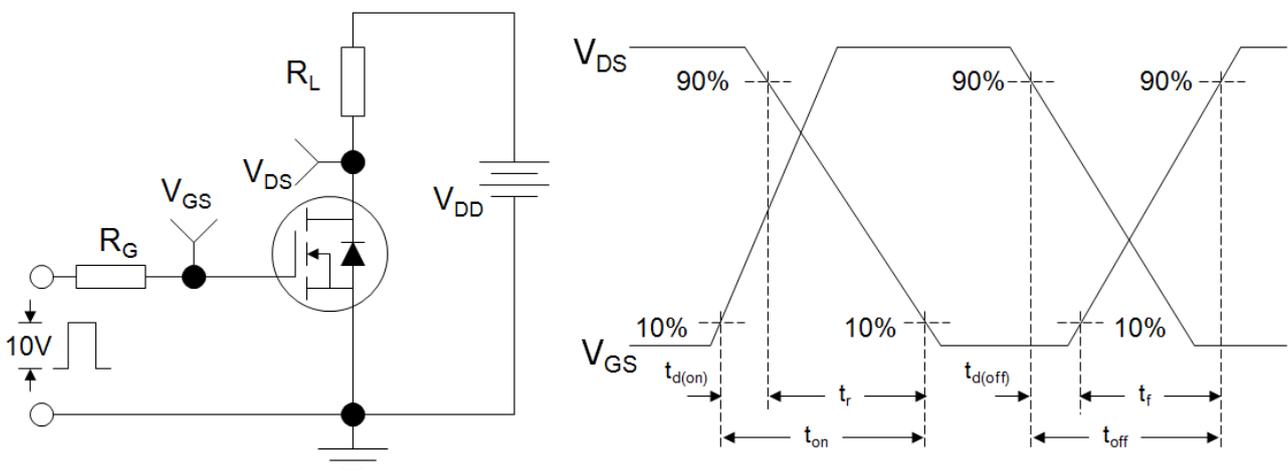
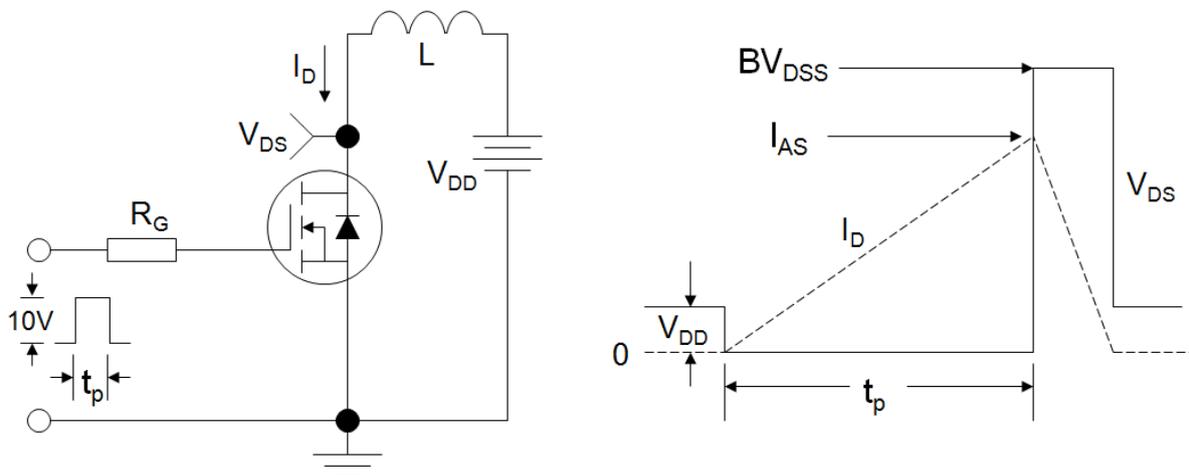
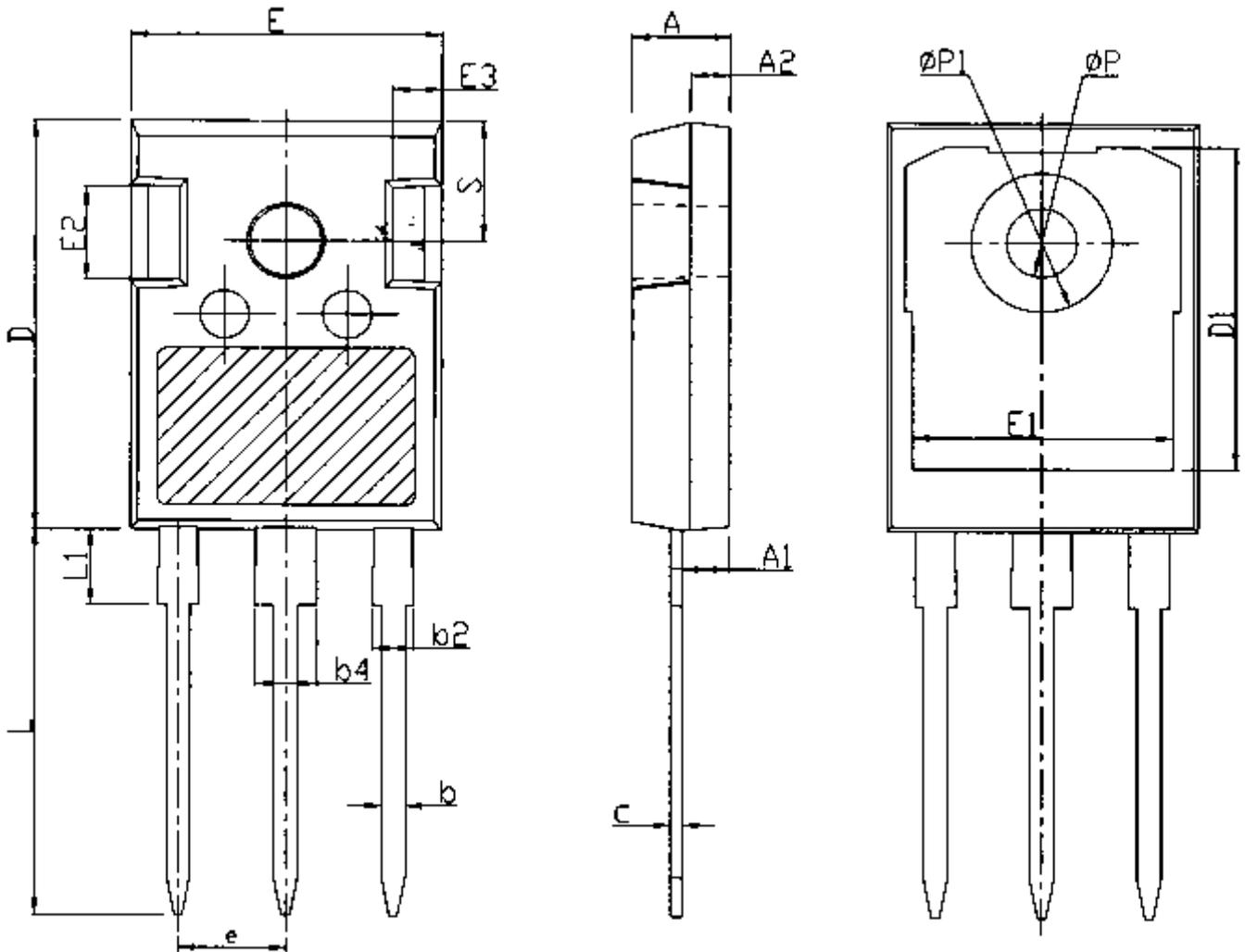


Figure C: Unclamped Inductive Switching Test Circuit and Waveform





TO-247



Unit:mm			
Symbol	Min.	Nom	Max.
A	4.80	5.00	5.20
A1	2.21	2.41	2.61
A2	1.85	2.00	2.15
b	1.11	1.21	1.36
b2	1.91	2.01	2.21
b4	2.91	3.01	3.21
c	0.51	0.61	0.75
D	20.70	21.00	21.30
D1	16.25	16.55	16.85

Unit:mm			
Symbol	Min.	Nom.	Max.
E	15.50	15.80	16.10
E1	13.00	13.30	13.60
E2	4.80	5.00	5.20
E3	2.30	2.50	2.70
e	5.44BSC		
L	19.62	19.92	20.22
L1	-	-	4.30
ϕP	3.40	3.60	3.80
$\phi P1$	-	-	7.30
S	6.15BSC		



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