



600V Super-junction Power MOSFET

DESCRIPTION

600V Super-junction Power MOSFET

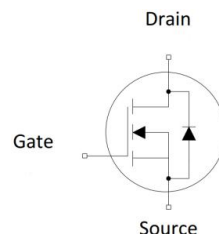
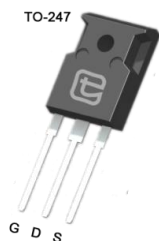
Super-junction power MOSFET is a revolutionary technology for high voltage power MOSFETs, designed according to the SJ principle and pioneered. The Multi-EPI SJ MOSFET provide an extremely fast and robust body diode. Also provide an extremely low switching, conduction and conduction losses device with highest robustness make especially resonant switching applications more reliable, more efficient, lighter and cooler, also fits the industrial grade applications, like AC-DC SMPS requirements for PFC, AC/DC power conversion, designed by Wuxi Unigroup Microelectronics Company.

FEATURES

- Ultra-fast body diode
- Very low FOM $R_{DS(on)} \times Q_g$
- Easy to use/drive
- 100% avalanche tested
- RoHS compliant

APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)
- LLC Half-bridge
- Charger



Device Marking and Package Information

Device	Package	Marking
TPW60R040MFD	TO-247	60R040MFD

Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	600	V
$R_{DS(on),max}$	0.04	Ω
I_D	72	A
$Q_{g,typ}$	169	nC
I_{DM}	216	A
t_{rr}	225	ns
Q_{rr}	1.4	μ C
I_{rrm}	12.5	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}	600	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	72	A
Pulsed Diode Forward Current (note1)	I_{SM}	216	
Reverse diode dv/dt (note3)	dv/dt	50	V/ns
Maximum diode commutation speed (note3)	di_f/dt	900	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	$^\circ\text{C}/\text{W}$
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	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	600	--	--	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 600V, V_{GS} = 0V, T_J = 25^\circ\text{C}$	--	--	10	μA
Gate-Source Leakage	I_{GSS}	$V_{GS} = \pm 30V$	--	--	± 100	nA
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	3	--	5	V
Drain-Source On-Resistance	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 36A$	--	0.035	0.04	Ω
Gate resistance	R_G	$f = 1.0\text{MHz}$ open drain	--	0.3	--	Ω
Dynamic						
Input Capacitance	C_{ISS}	$V_{GS} = 0V,$ $V_{DS} = 100V,$ $f = 1.0\text{MHz}$	--	8043	--	pF
Output Capacitance	C_{OSS}		--	283	--	
Reverse Transfer Capacitance	C_{RSS}		--	3.6	--	
Total Gate Charge	Q_g	$V_{DD} = 520V, I_D = 50A,$ $V_{GS} = 10V$	--	169	--	nC
Gate-Source Charge	Q_{gs}		--	50	--	
Gate-Drain Charge	Q_{gd}		--	65	--	
Turn-on Delay Time	$t_{d(on)}$	$V_{DD} = 400V, I_D = 50A,$ $R_G = 25\Omega$	--	91	--	ns
Turn-on Rise Time	t_r		--	90	--	
Turn-off Delay Time	$t_{d(off)}$		--	583	--	
Turn-off Fall Time	t_f		--	133	--	
Drain-Source Body Diode Characteristics						
Body Diode Voltage	V_{SD}	$T_J = 25^\circ\text{C}, I_{SD} = 36A, V_{GS} = 0V$	--	1.0	1.5	V
Reverse Recovery Time	t_{rr}	$V_R = 400V, I_F = 50A,$ $di_F/dt = 100A/\mu s$	--	225	--	ns
Reverse Recovery Charge	Q_{rr}		--	1.4	--	μC
Peak Reverse Recovery Current	I_{rrm}		--	12.5	--	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

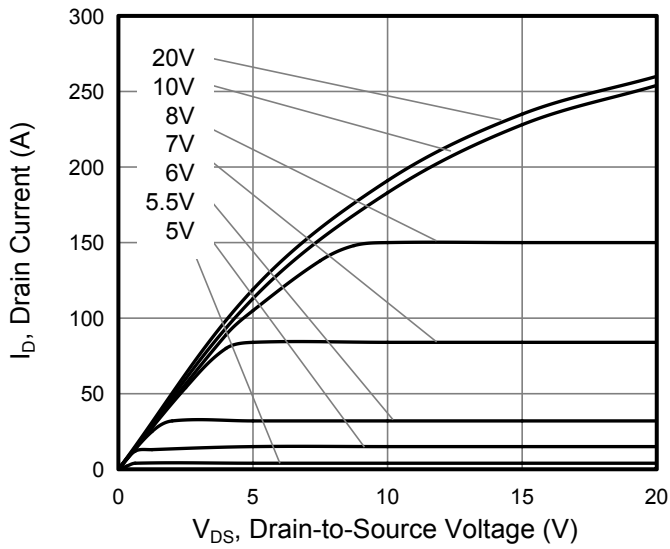


Figure 2. Transfer Characteristics

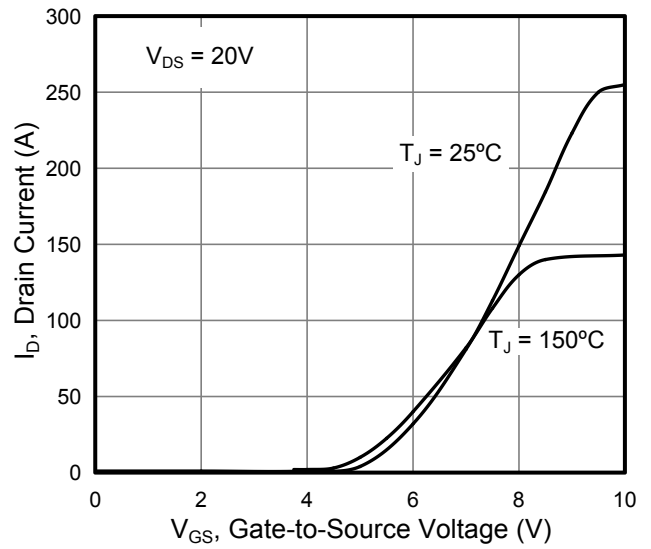


Figure 3. On-Resistance vs. Drain Current

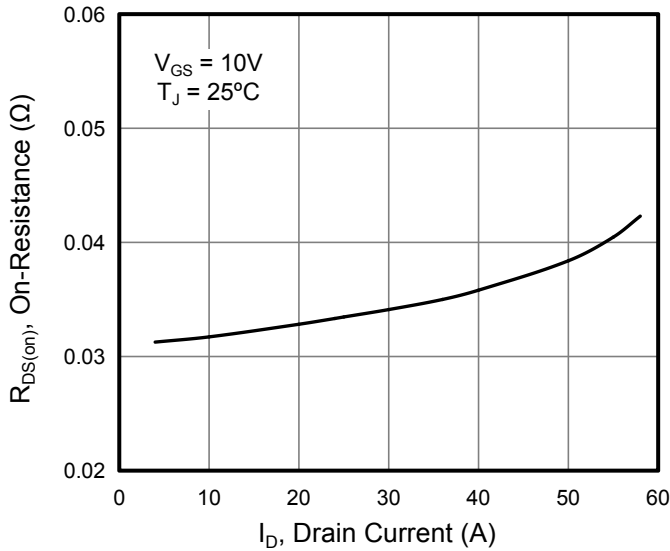


Figure 4. Capacitance

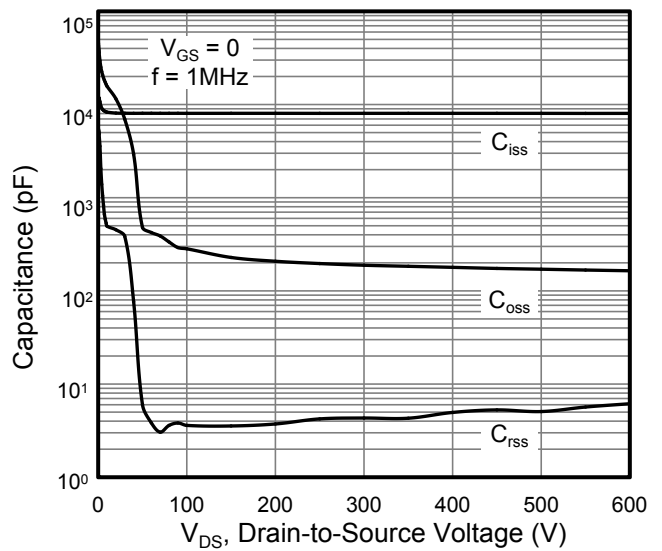


Figure 5. Gate Charge

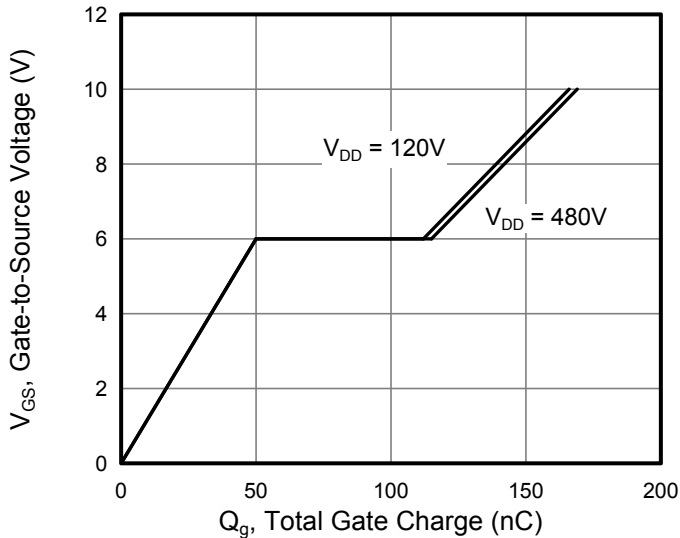
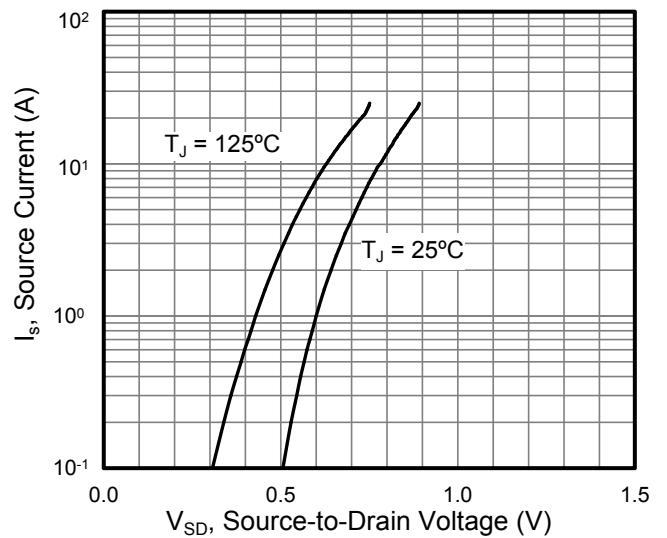


Figure 6. Body Diode Forward Voltage





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

Figure 7. On-Resistance vs. Junction Temperature

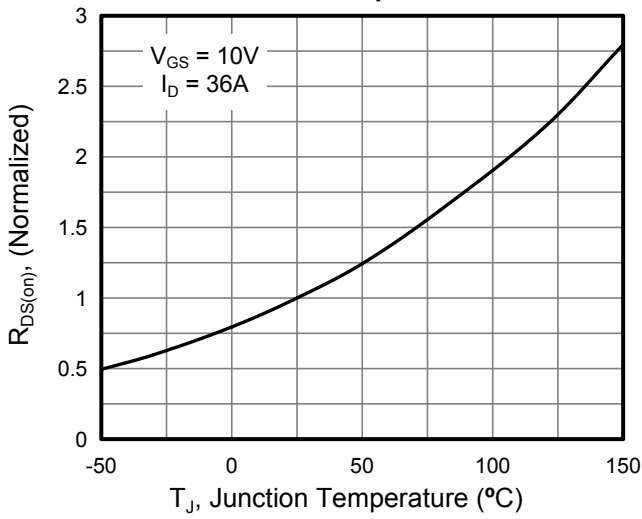


Figure 8. Breakdown voltage vs. Junction Temperature

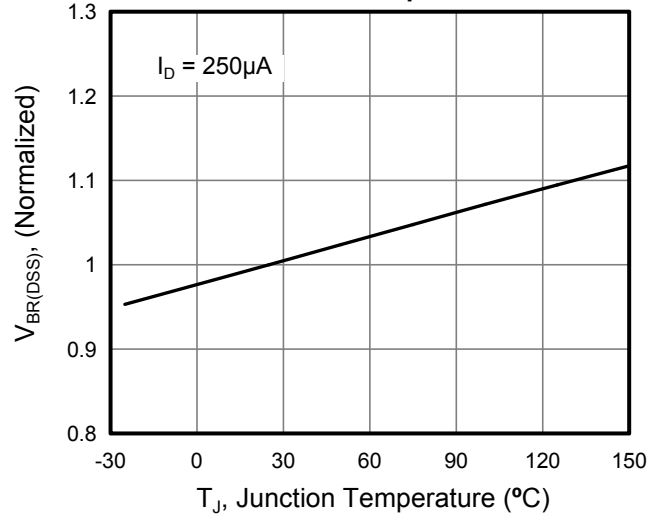


Figure9 . Transient Thermal Impedance for TO-247

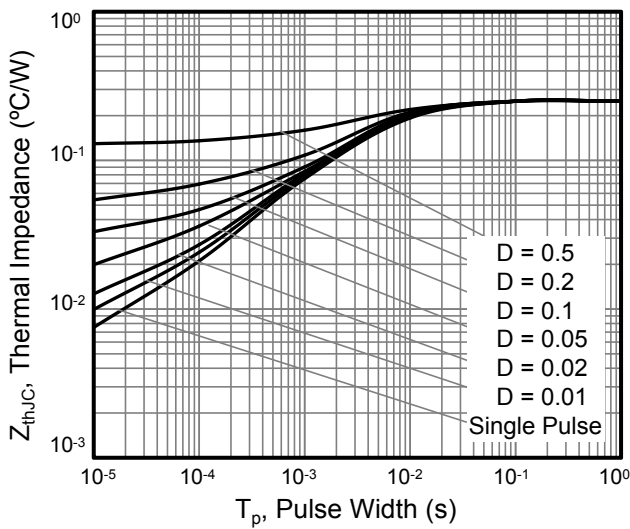


Figure 10. Safe operation area for TO-247

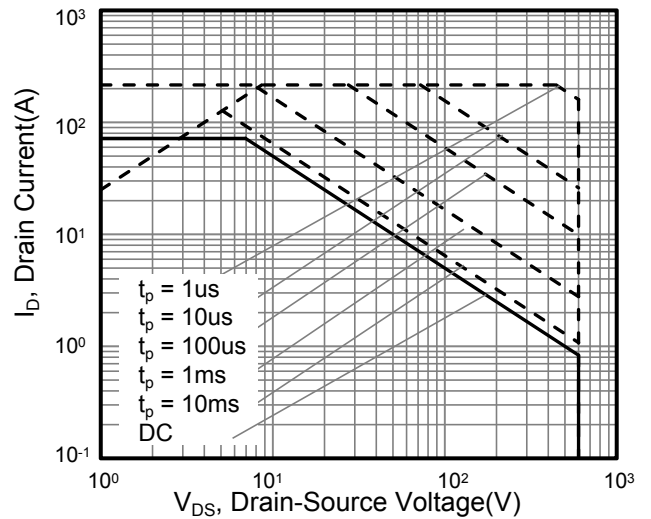




Figure A: Gate Charge Test Circuit and Waveform

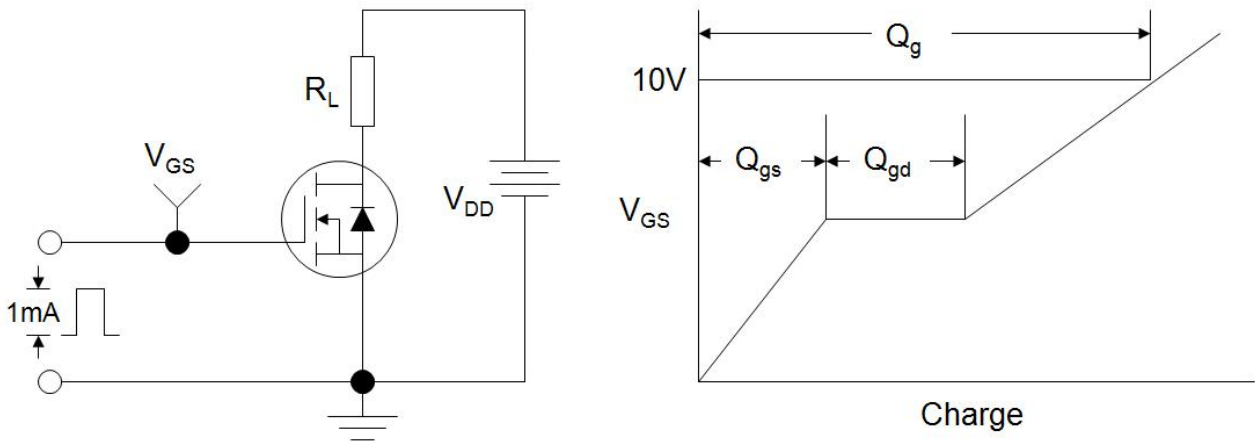


Figure B: Resistive Switching Test Circuit and Waveform

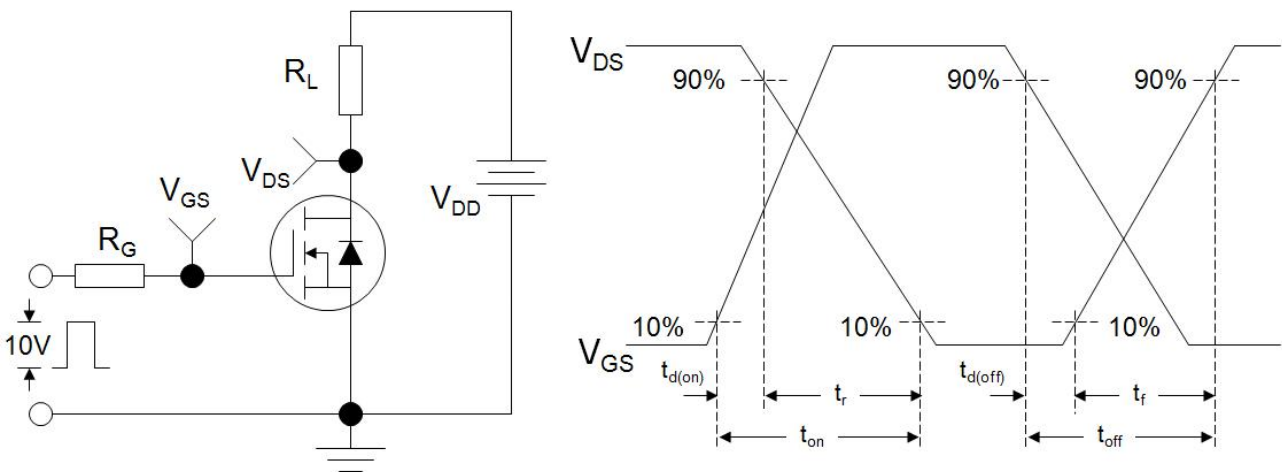
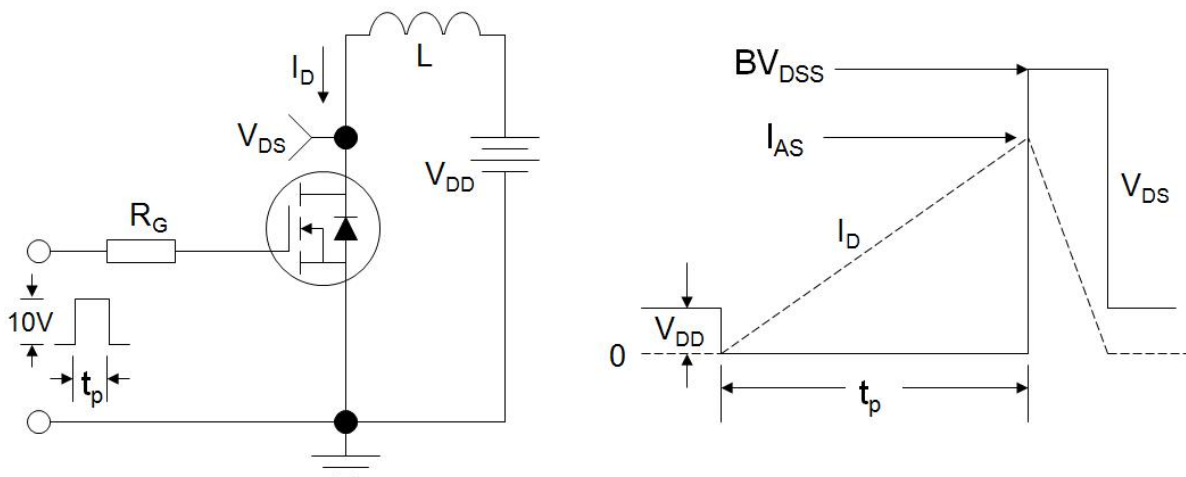
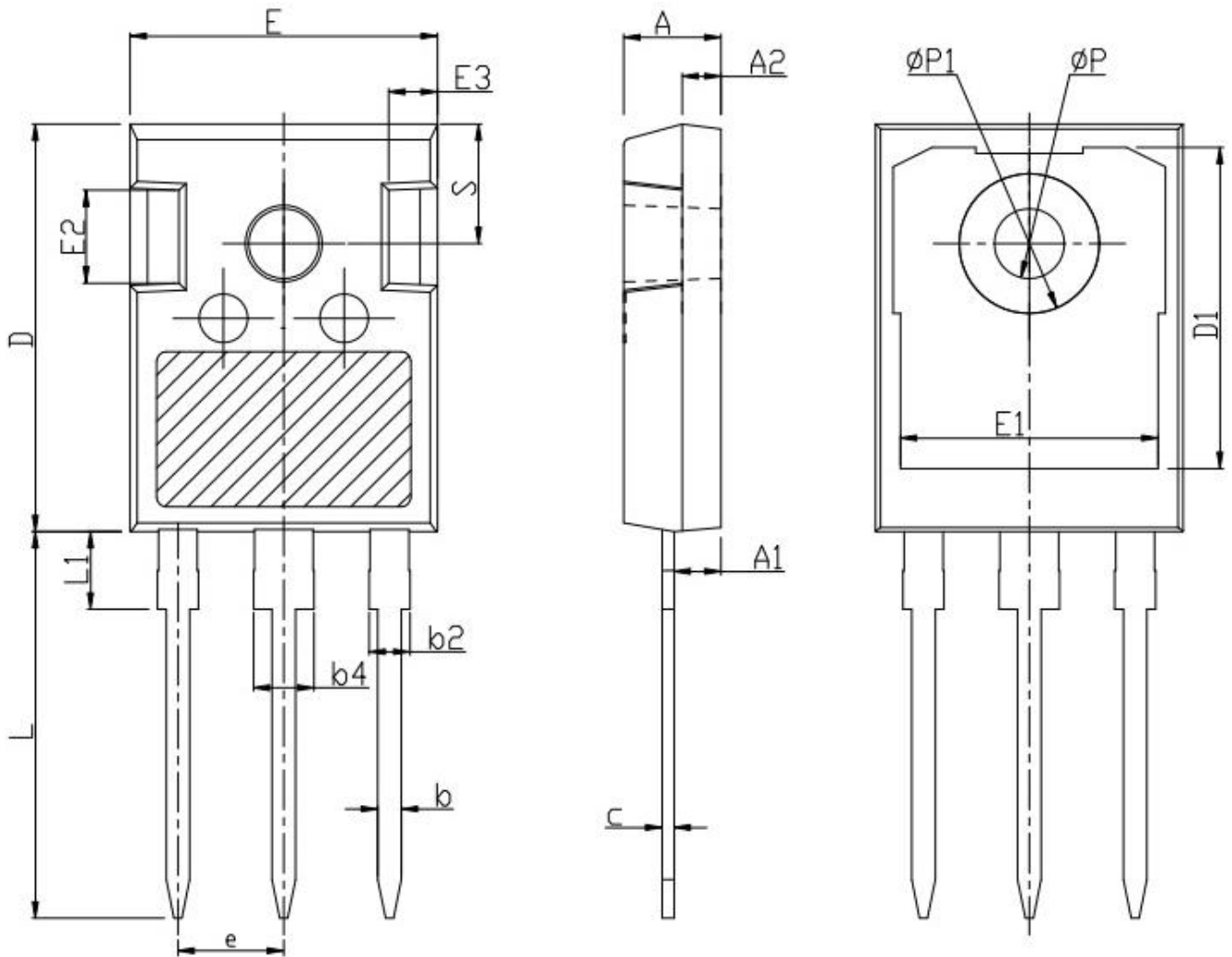


Figure C: Unclamped Inductive Switching Test Circuit and Waveform





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
phi P	3.40	3.60	3.80
phi P1	-	-	7.30
S	6.15BSC		



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