



## 650V Super-Junction Power MOSFET

### DESCRIPTION

#### 650V super-junction Power MOSFET

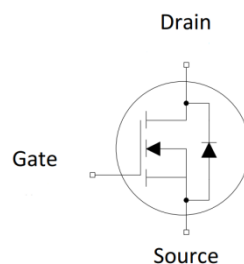
Super-junction power MOSFET is a revolutionary technology for high voltage power MOSFETs, designed according to the SJ principle. The SJ MOSFET is a price-performance optimized product enabling to target cost sensitive applications in Consumer and Lighting markets, designed by Wuxi Unigroup Microelectronics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

### FEATURES

- Ultra-fast body diode
- 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
TPW65R044MFD	TO-247	65R044MFD

### Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	650	V
$R_{DS(on),max}$	0.044	$\Omega$
$I_D$	72	A
$Q_{g,typ}$	165	nC
$I_{DM}$	216	A
$t_{rr}$	242	ns
$Q_{rr}$	1.5	$\mu$ C
$I_{rrm}$	12	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	$I_D$	$T_C = 25^\circ\text{C}$	72
		$T_C = 100^\circ\text{C}$	43.2
Pulsed Drain Current (note1)	$I_{DM}$	216	A
Gate-Source Voltage	$V_{GSS}$	$\pm 30$	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	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	$^\circ\text{C}$

<b>Thermal Resistance</b>			
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.	
<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	$I_{DSS}$	$V_{DS} = 650V, V_{GS} = 0V, T_J = 25^\circ\text{C}$	--	--	10	$\mu A$
		$V_{DS} = 650V, V_{GS} = 0V, T_J = 150^\circ\text{C}$	--	--	10000	
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 30V$	--	--	$\pm 100$	nA
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	3	--	5	V
Drain-Source On-Resistance	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 36A$	--	0.039	0.044	$\Omega$
Gate resistance	$R_G$	$f = 1.0\text{MHz}$ open drain	--	0.3	--	$\Omega$
<b>Dynamic</b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0V,$ $V_{DS} = 100V,$ $f = 1.0\text{MHz}$	--	7837	--	$\mu F$
Output Capacitance	$C_{oss}$		--	221	--	
Reverse Transfer Capacitance	$C_{rss}$		--	13.2	--	
Total Gate Charge	$Q_g$	$V_{DD} = 520V, I_D = 50A,$ $V_{GS} = 10V$	--	165	--	nC
Gate-Source Charge	$Q_{gs}$		--	50	--	
Gate-Drain Charge	$Q_{gd}$		--	70	--	
Turn-on Delay Time	$t_{d(on)}$	$V_{DD} = 400V, I_D = 50A,$ $R_G = 25\Omega$	--	103	--	ns
Turn-on Rise Time	$t_r$		--	83	--	
Turn-off Delay Time	$t_{d(off)}$		--	543	--	
Turn-off Fall Time	$t_f$		--	93	--	
<b>Drain-Source Body Diode Characteristics</b>						
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	$t_{rr}$	$V_R = 400V, I_F = 36A,$ $di_F/dt = 100A/\mu s$	--	242	--	ns
Reverse Recovery Charge	$Q_{rr}$		--	1.45	--	$\mu C$
Peak Reverse Recovery Current	$I_{rrm}$		--	12	--	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

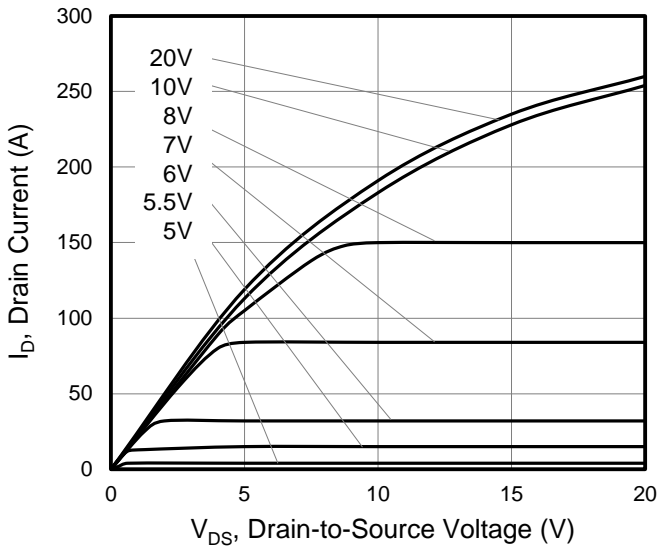


Figure 2. Transfer Characteristics

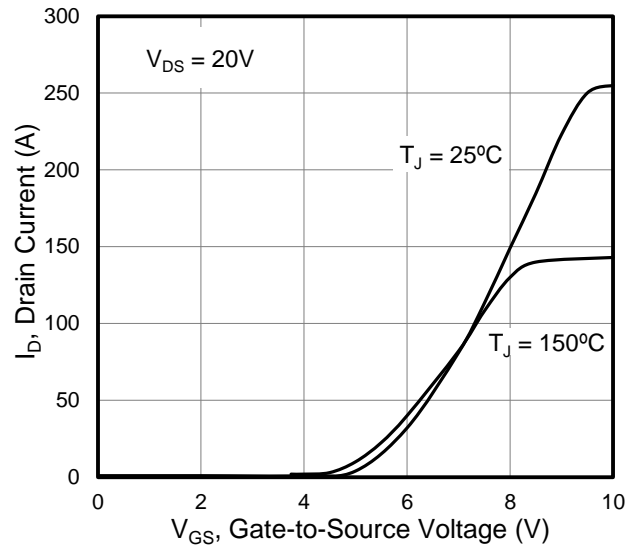


Figure 3. On-Resistance vs. Drain Current

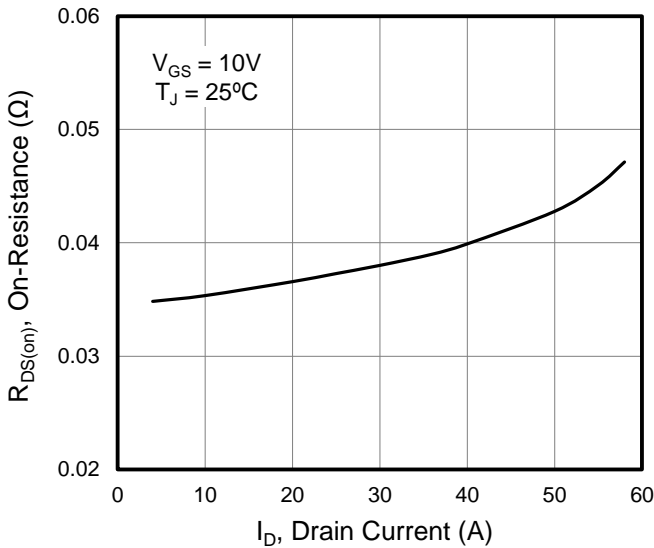


Figure 4. Capacitance

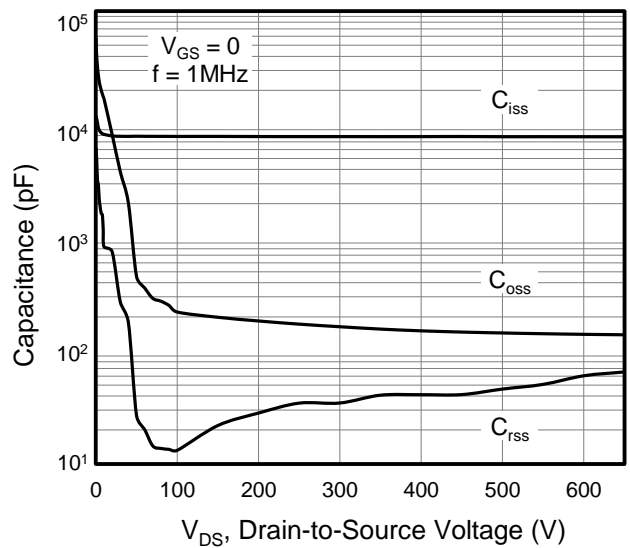


Figure 5. Gate Charge

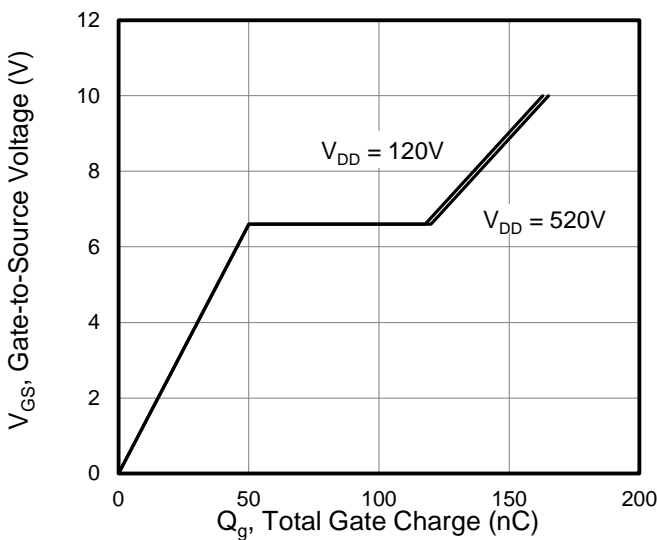
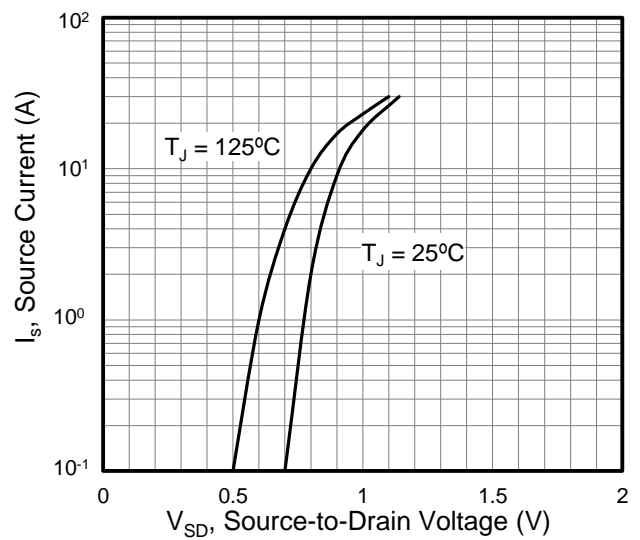


Figure 6. Body Diode Forward Voltage





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

Figure 7. On-Resistance vs. Junction Temperature

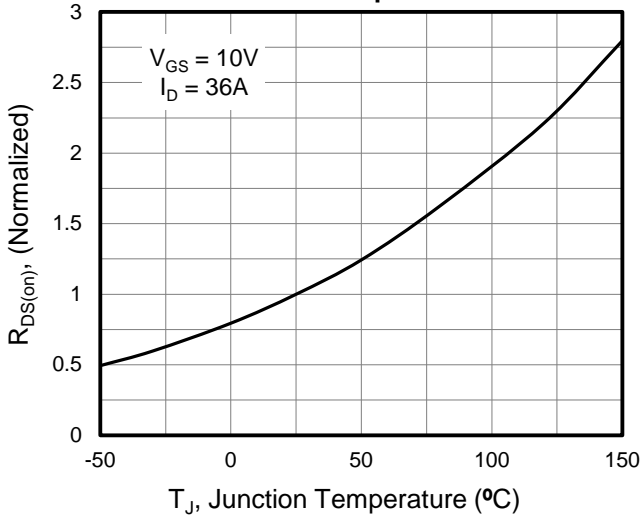


Figure 8. Breakdown voltage vs. Junction Temperature

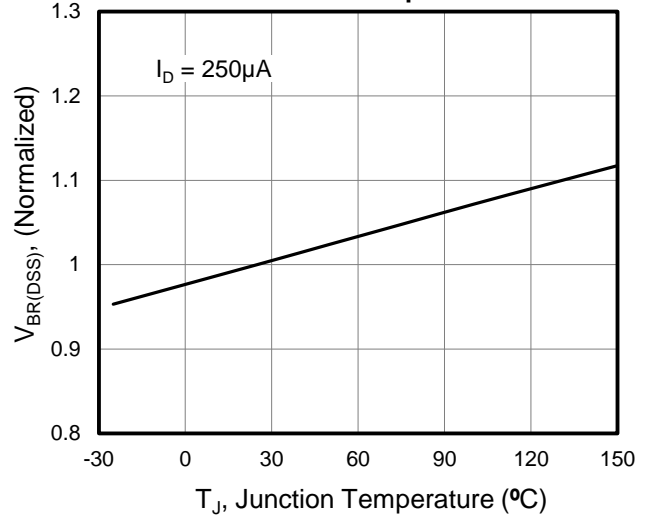


Figure9 . Transient Thermal Impedance for TO-247

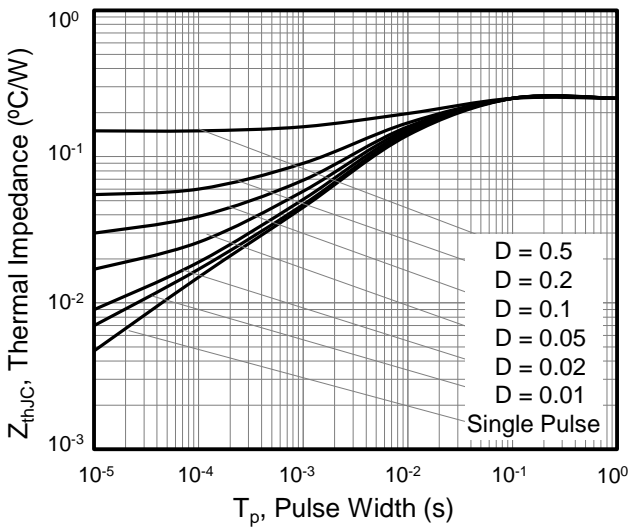


Figure 10. Safe operation area for TO-247

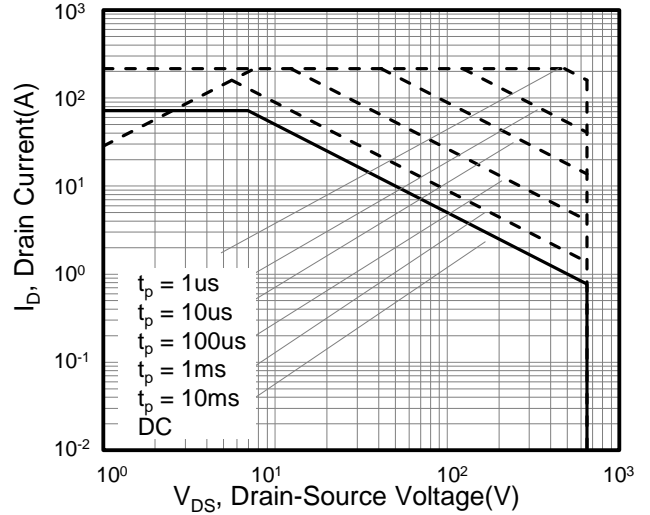




Figure A: Gate Charge Test Circuit and Waveform

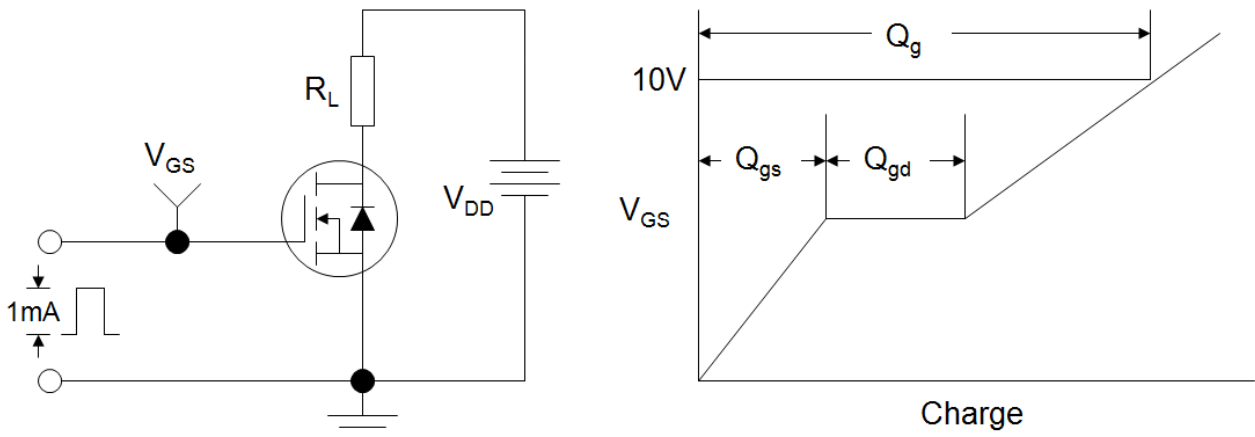


Figure B: Resistive Switching Test Circuit and Waveform

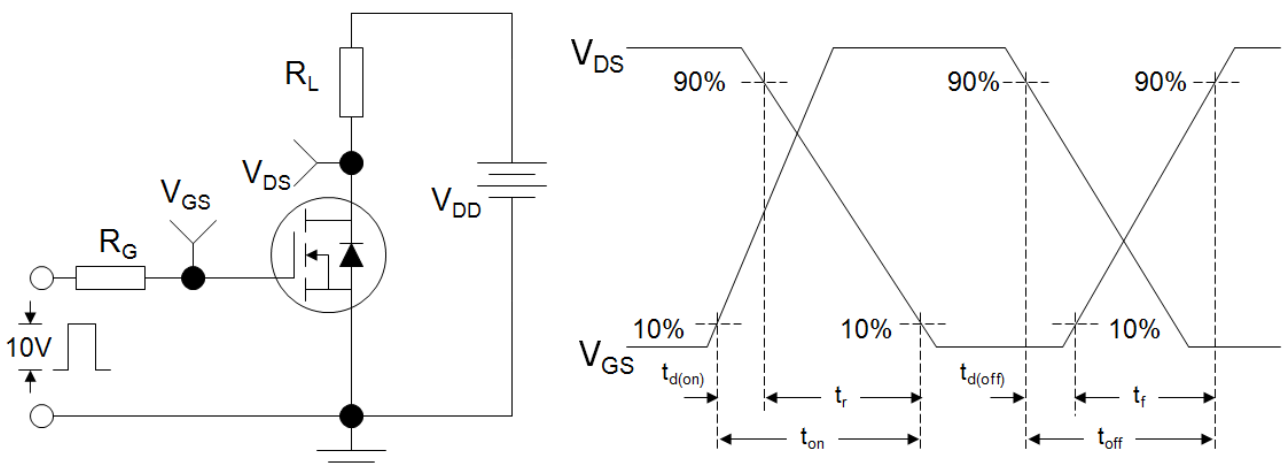
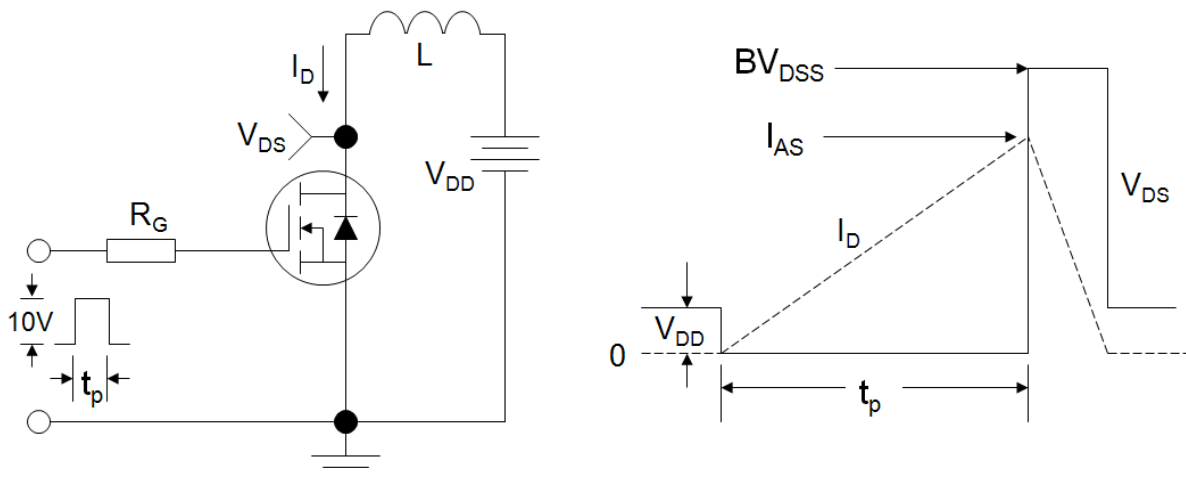
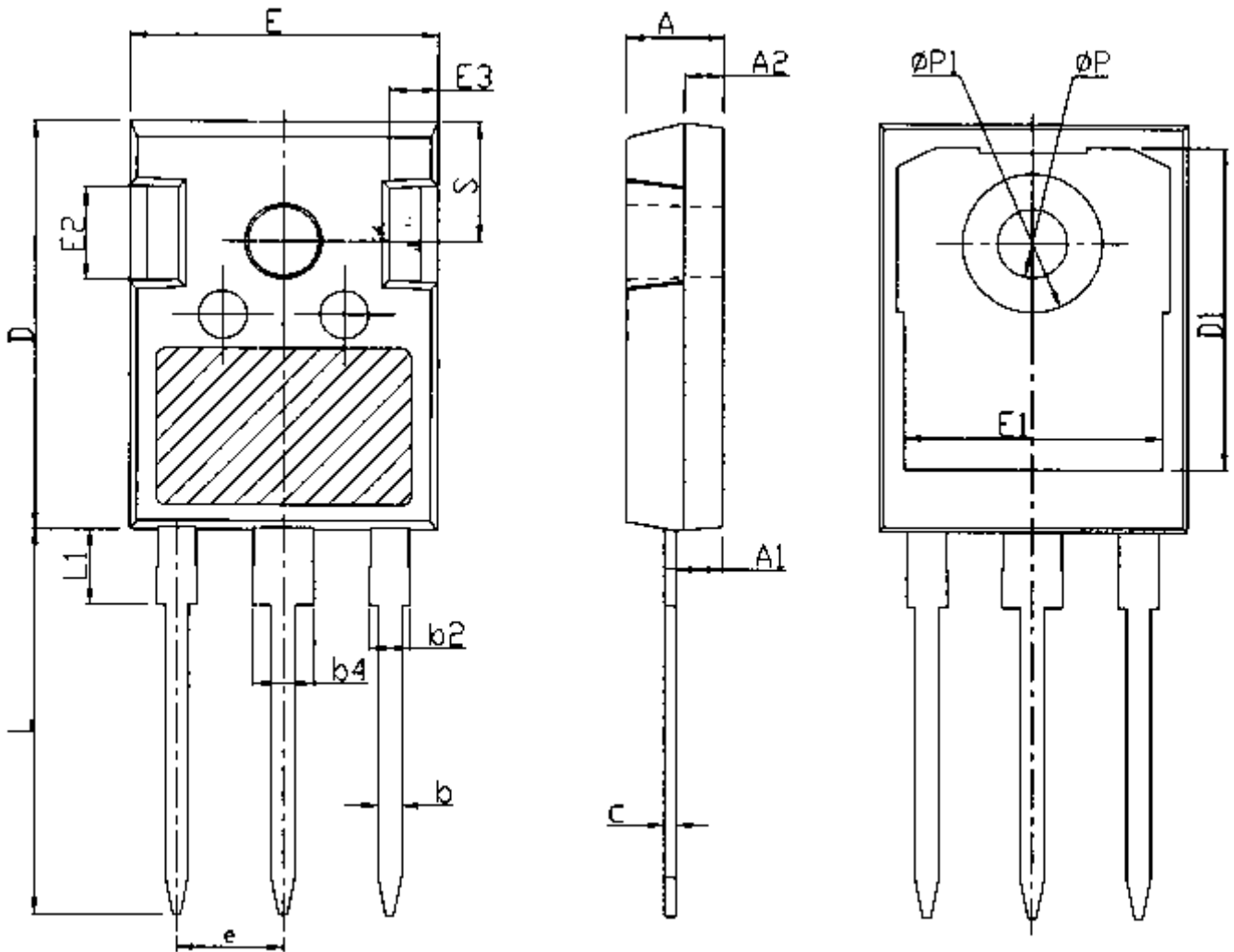


Figure C: Unclamped Inductive Switching Test Circuit and Waveform





### 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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