



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 and pioneered. The Multi-EPI SJ MOSFET provide an extremely fast and robust body diode. Also provide an extremely low switching, communication and conduction losses device with highest robustness make especially resonant switching applications more reliable, more efficient, lighter and cooler, 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

TO-220F



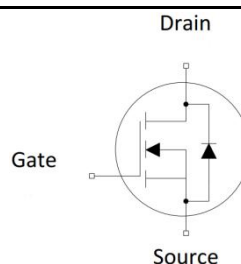
TO-263



TO-220



TO-247



Device Marking and Package Information

Device	Package	Marking
TPA65R190MFD	TO-220F	65R190MFD
TPB65R190MFD	TO-263	65R190MFD
TPP65R190MFD	TO-220	65R190MFD
TPW65R190MFD	TO-247	65R190MFD

Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	700	V
$R_{DS(on),max}$	0.19	Ω
$Q_{g,typ}$	42	nC
I_D	20	A
$I_{D,pulse}$	60	A
$E_{OSS} @ 400V$	4.98	μJ
Body Diode di_f/dt	500	A/ μs
t_{rr}	112	ns
Q_{rr}	0.54	μC
I_{rrm}	9.6	A



Absolute Maximum Ratings T _C = 25°C, unless otherwise noted				
Parameter		Symbol	Value	Unit
Continuous Drain Current	T _C = 25°C	I _D	20	A
	T _C = 100°C		12	
Pulsed Drain Current (note1)		I _{D,pulse}	60	A
Gate-Source Voltage		V _{GSS}	±30	V
Single Pulse Avalanche Energy (note2)		E _{AS}	484	mJ
Repetitive Avalanche Energy (note2)		E _{AR}	0.7	mJ
Avalanche Current		I _{AR}	3.5	A
MOSFET dv/dt Ruggedness, V _{DS} = 0...480V		dv/dt	50	V/ns
Power Dissipation For TO-220F		P _D	34	W
Power Dissipation For TO-263,TO-220,TO-247			151	
Continuous Diode Forward Current		I _S	20	A
Diode Pulsed Current (note1)		I _{S,pulse}	60	
Reverse Diode dv/dt (note3)		dv/dt	50	V/ns
Maximum Diode Commutation Speed (note3)		di _f /dt	900	A/μs
Operating Junction and Storage Temperature Range		T _J , T _{stg}	-55~+150	°C

Thermal Resistance For TO-220F			
Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	R_{thJC}	3.7	$^{\circ}\text{C/W}$
Thermal Resistance, Junction-to-Ambient	R_{thJA}	80	

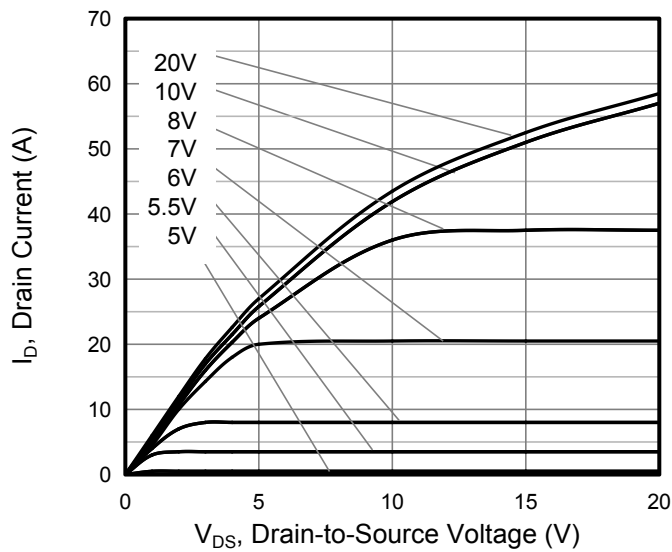
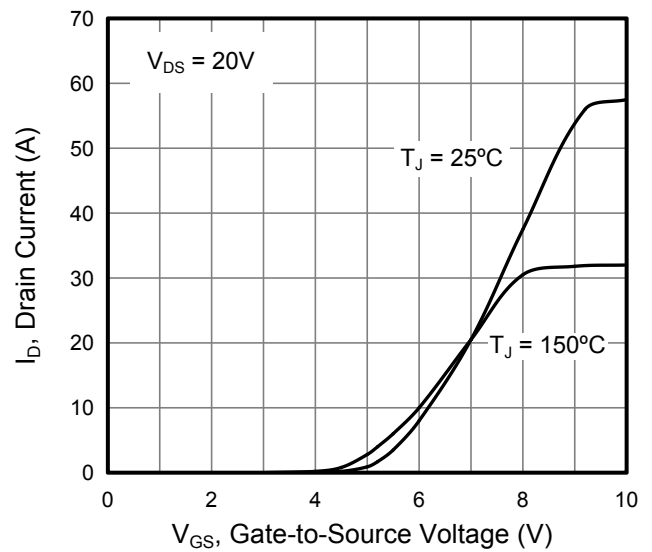
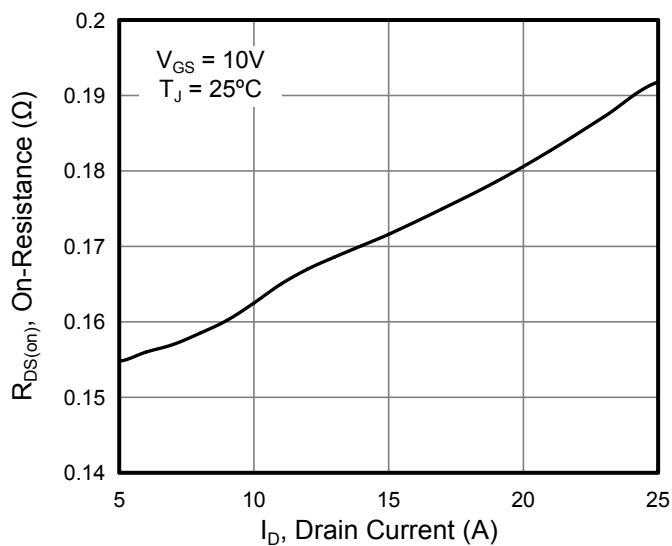
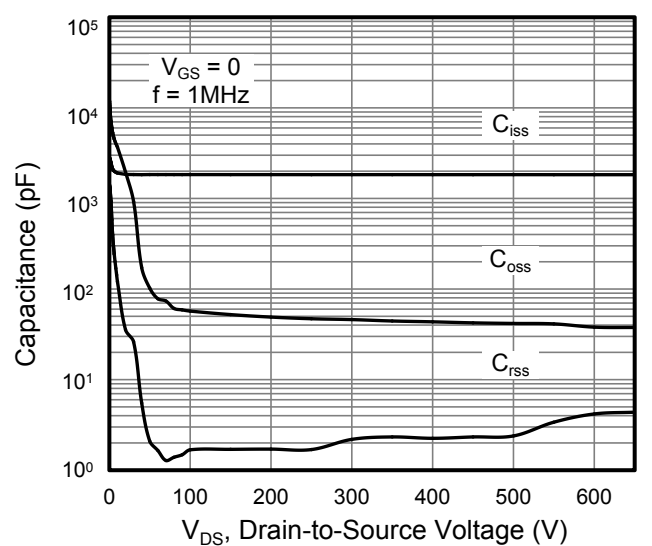
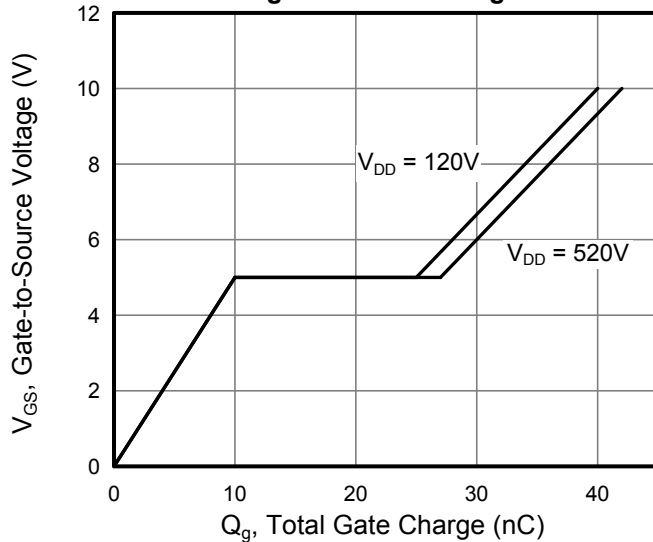
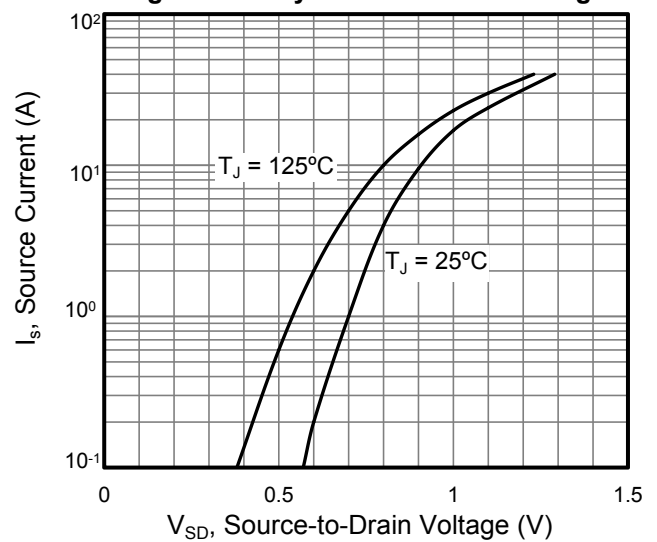
Thermal Resistance For TO-263,TO-220, TO-247			
Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	R_{thJC}	0.83	$^{\circ}\text{C/W}$
Thermal Resistance, Junction-to-Ambient	R_{thJA}	62	



Electrical Characteristics T _J = 25°C, unless otherwise noted						
Parameter	Symbol	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
Static Characteristics						
Drain-Source Breakdown Voltage	V _{(BR)DSS}	V _{GS} = 0V, I _D = 250μA	650	--	--	V
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 650V, V _{GS} = 0V, T _J = 25°C	--	--	5	μA
		V _{DS} = 650V, V _{GS} = 0V, T _J = 150°C	--	--	2500	
Gate-Source Leakage Current	I _{GSS}	V _{GS} = ±30V	--	--	±100	nA
Gate-Source Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250μA	3	--	5	V
Drain-Source On-State-Resistance	R _{DS(on)}	V _{GS} = 10V, I _D = 10A	--	0.17	0.19	Ω
Gate Resistance	R _G	f = 1.0MHz open drain	--	12	--	Ω
Dynamic Characteristics						
Input Capacitance	C _{iss}	V _{GS} = 0V, V _{DS} = 100V, f = 1.0MHz	--	1834	--	pF
Output Capacitance	C _{oss}		--	57	--	
Reverse Transfer Capacitance	C _{rss}		--	1.7	--	
Total Gate Charge	Q _g	V _{DD} = 520V, I _D = 20A, V _{GS} = 10V	--	42	--	nC
Gate-Source Charge	Q _{gs}		--	10	--	
Gate-Drain Charge	Q _{gd}		--	17	--	
Turn-on Delay Time	t _{d(on)}	V _{DD} = 400V, I _D = 20A, R _G = 25Ω	--	34	--	ns
Turn-on Rise Time	t _r		--	72	--	
Turn-off Delay Time	t _{d(off)}		--	114	--	
Turn-off Fall Time	t _f		--	41	--	
Drain-Source Body Diode Characteristics						
Body Diode Forward Voltage	V _{SD}	T _J = 25°C, I _{SD} = 10A, V _{GS} = 0V	--	1.0	1.5	V
Reverse Recovery Time	t _{rr}	V _R = 400V, I _F = I _S , di _F /dt = 100A/μs	--	112	--	ns
Reverse Recovery Charge	Q _{rr}		--	0.54	--	μC
Peak Reverse Recovery Current	I _{rrm}		--	9.6	--	A

Notes

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $I_{AS} = 3.5A, V_{DD} = 50V, R_G = 25\Omega$, 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. Temperature

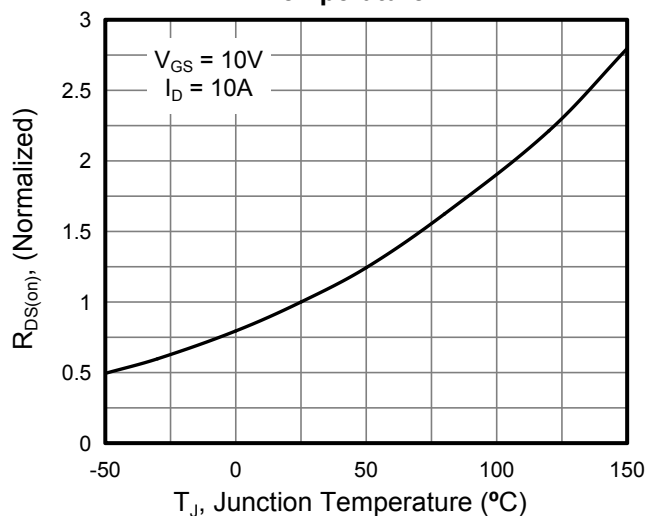


Figure 8. Breakdown voltage vs. Junction Temperature

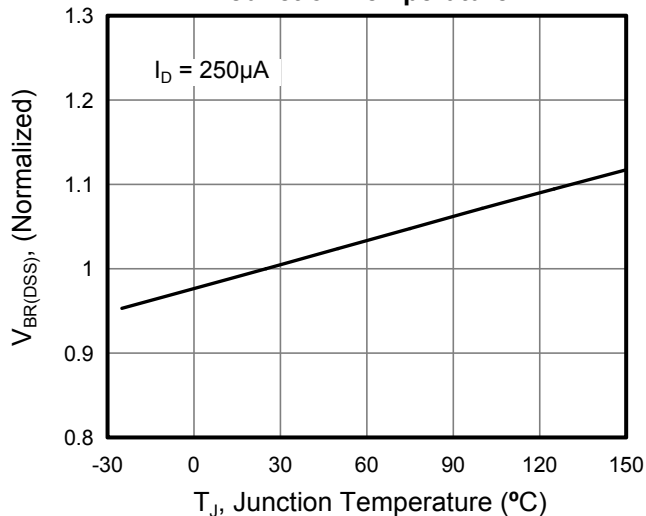


Figure9 . Transient Thermal Impedance For TO-220F

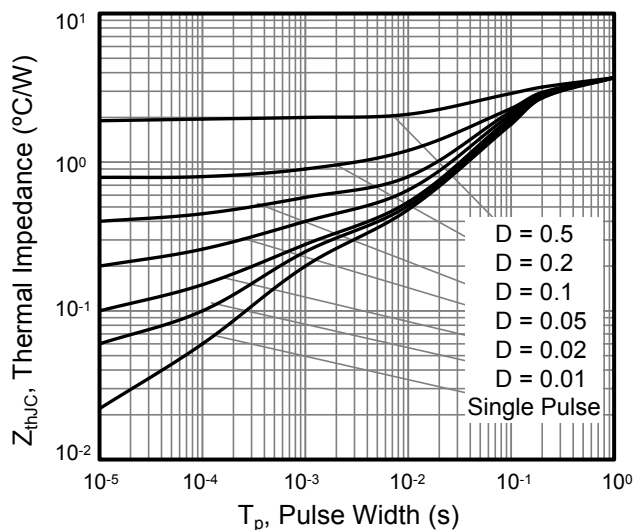


Figure10 . Transient Thermal Impedance For TO-263/TO-220/TO-247

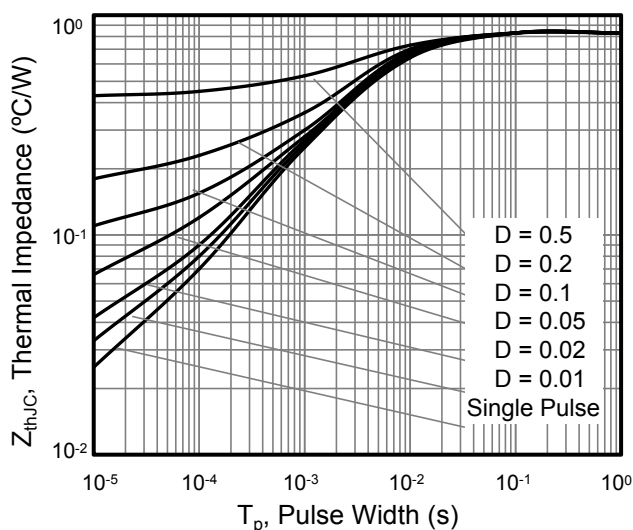


Figure 11. Safe Operation Area For TO-220F

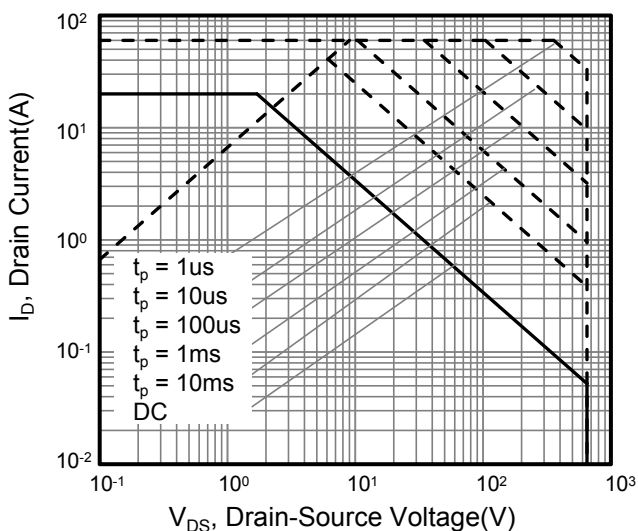
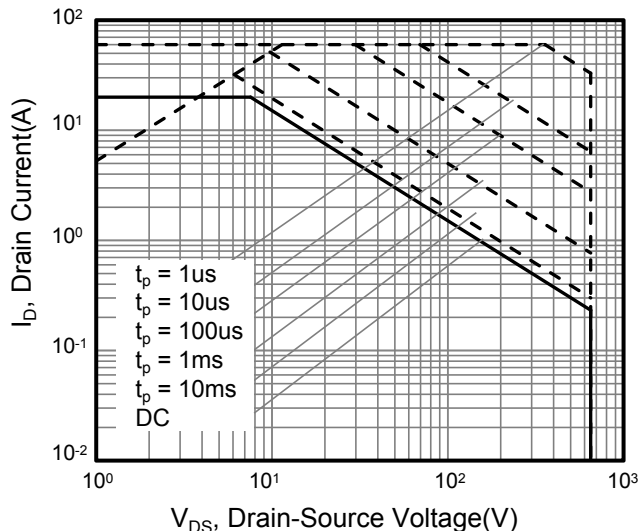


Figure 12. Safe Operation Area For TO-247/TO-263





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

Figure 13. Typ. Coss Stored Energy

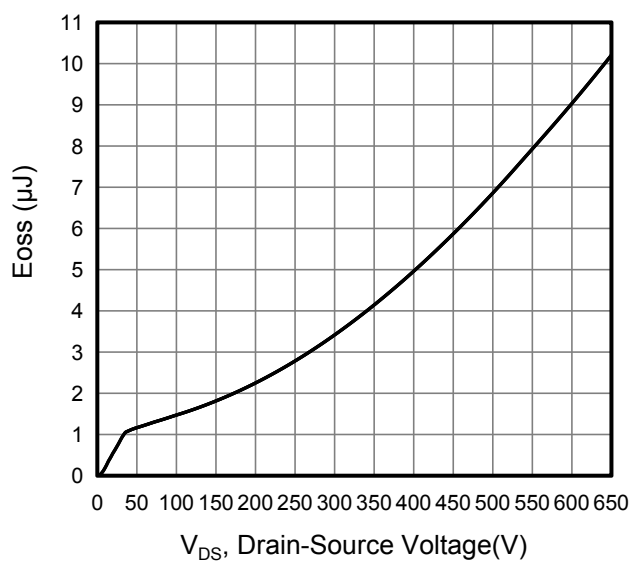




Figure A: Gate Charge Test Circuit and Waveform

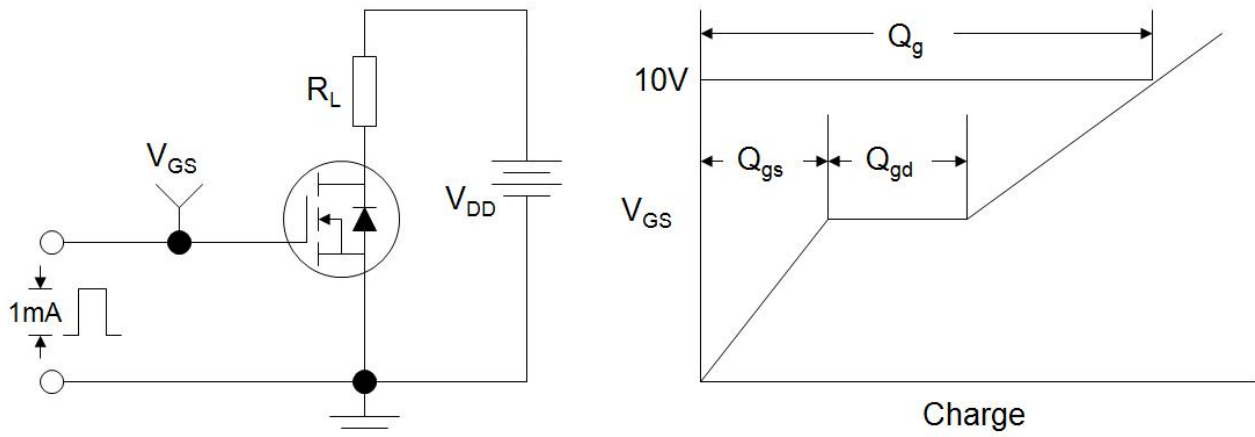


Figure B: Resistive Switching Test Circuit and Waveform

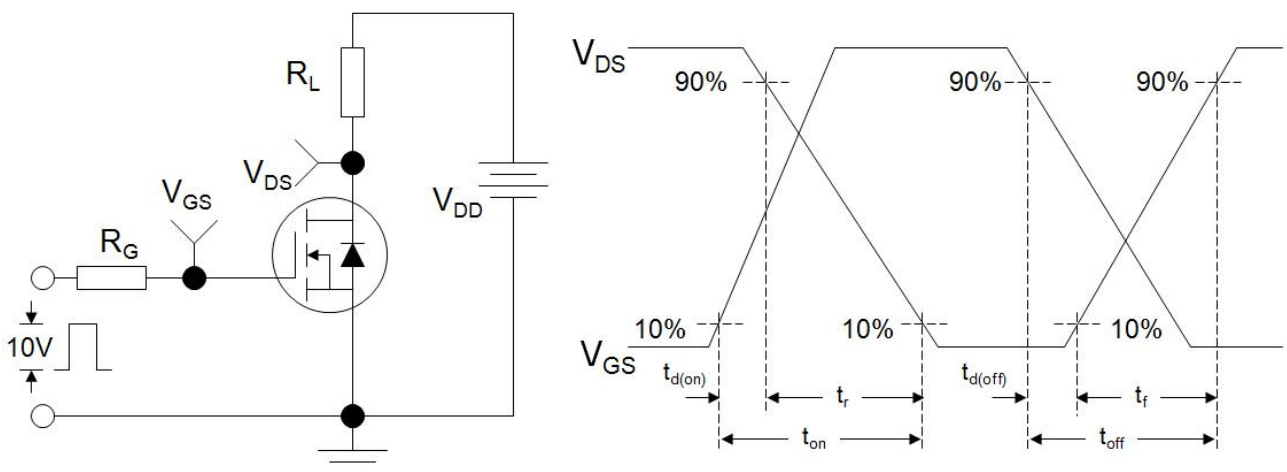
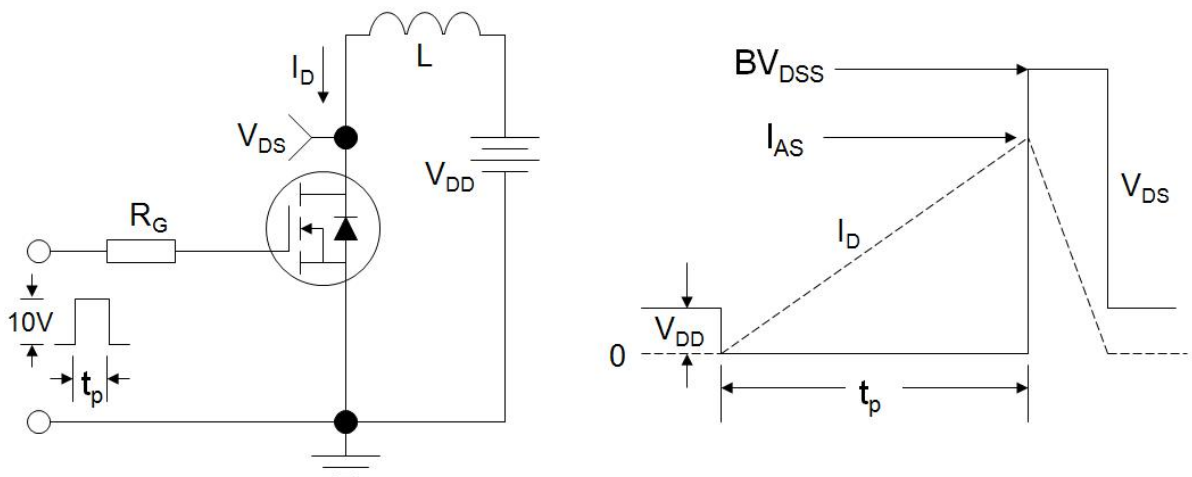
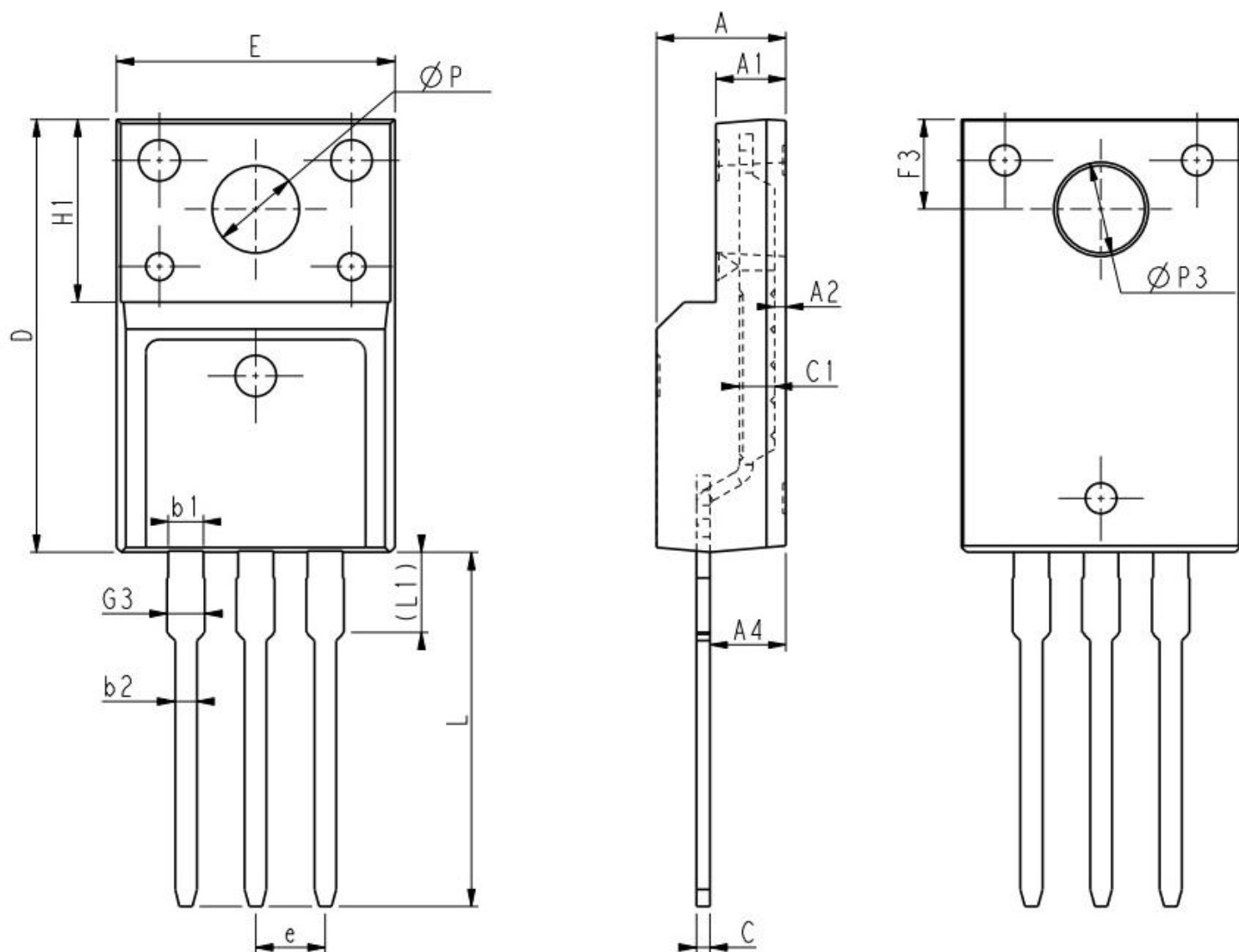


Figure C: Unclamped Inductive Switching Test Circuit and Waveform





TO-220F

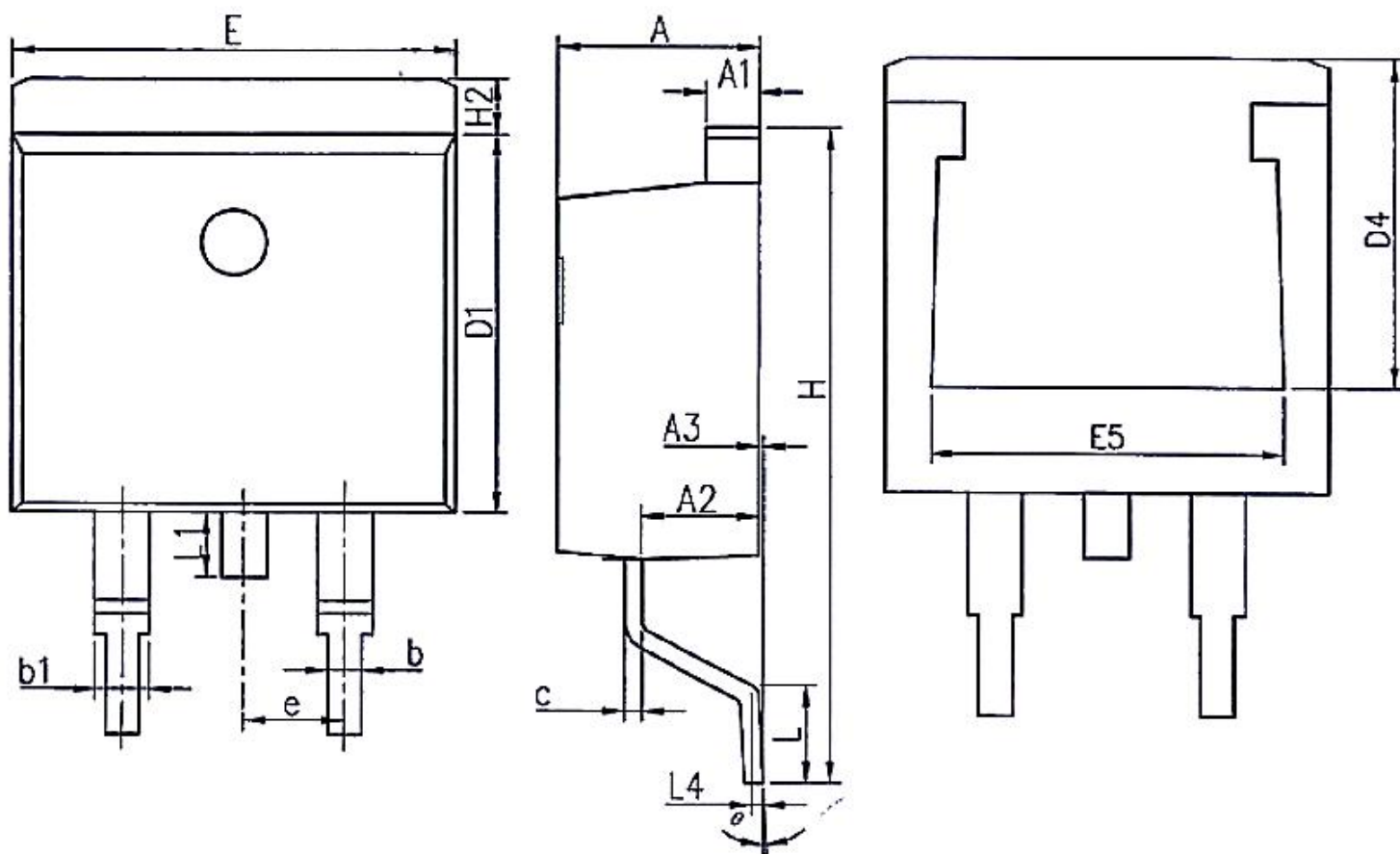


Unit:mm			
Symbol	Min.	Nom	Max.
E	9.96	10.16	10.36
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A2	0.30	0.45	0.60
A4	2.56	2.76	2.96
c	0.40	0.50	0.65
c1	1.20	1.30	1.35
D	15.57	15.87	16.17
H1	6.70REF		

Unit:mm			
Symbol	Min.	Nom	Max.
e	2.54BSC		
L	12.68	12.98	13.28
L1	2.93	3.03	3.13
ΦP	3.03	3.18	3.38
ΦP3	3.15	3.45	3.65
F3	3.15	3.30	3.45
G3	1.25	1.35	1.55
b1	1.18	1.28	1.43
b2	0.70	0.80	0.95



TO-263



Unit:mm				Unit:mm			
Symbol	Min.	Nom	Max.	Symbol	Min.	Nom	Max.
A	4.37	4.57	4.77	E	9.86	10.16	10.36
A1	1.22	1.27	1.42	E5	7.06	-	-
A2	2.49	2.69	2.89	e	2.54BSC		
A3	0.00	0.13	0.25	H	14.70	15.10	15.50
b	0.70	0.81	0.96	H2	1.07	1.27	1.47
b1	1.17	1.27	1.47	L	2.00	2.30	2.60
c	0.30	0.38	0.53	L1	1.40	1.55	1.70
D1	8.50	8.70	8.90	L4	0.25BSC		
D4	6.60	-	-	θ	0°	5°	9°



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Technical drawing of a 3-pin industrial plug, showing three views: front, side, and top.

Front View (Left): Shows the main body with dimensions D (total height), $D1$ (height to the top of the mounting tabs), E (width), ϕP (diameter of the top mounting hole), a (height of the mounting tabs), and L (length of the pins). The pins have a diameter of b and a length of L . The distance between the centers of the pins is $e1$, and the distance from the center of the middle pin to the side edge is e . The distance between the centers of the two outer pins is $b2$.

Side View (Middle): Shows the profile of the plug with dimensions A (total width), $A1$ (width of the top mounting tabs), H (height of the top mounting tabs), and $A2$ (width of the main body).

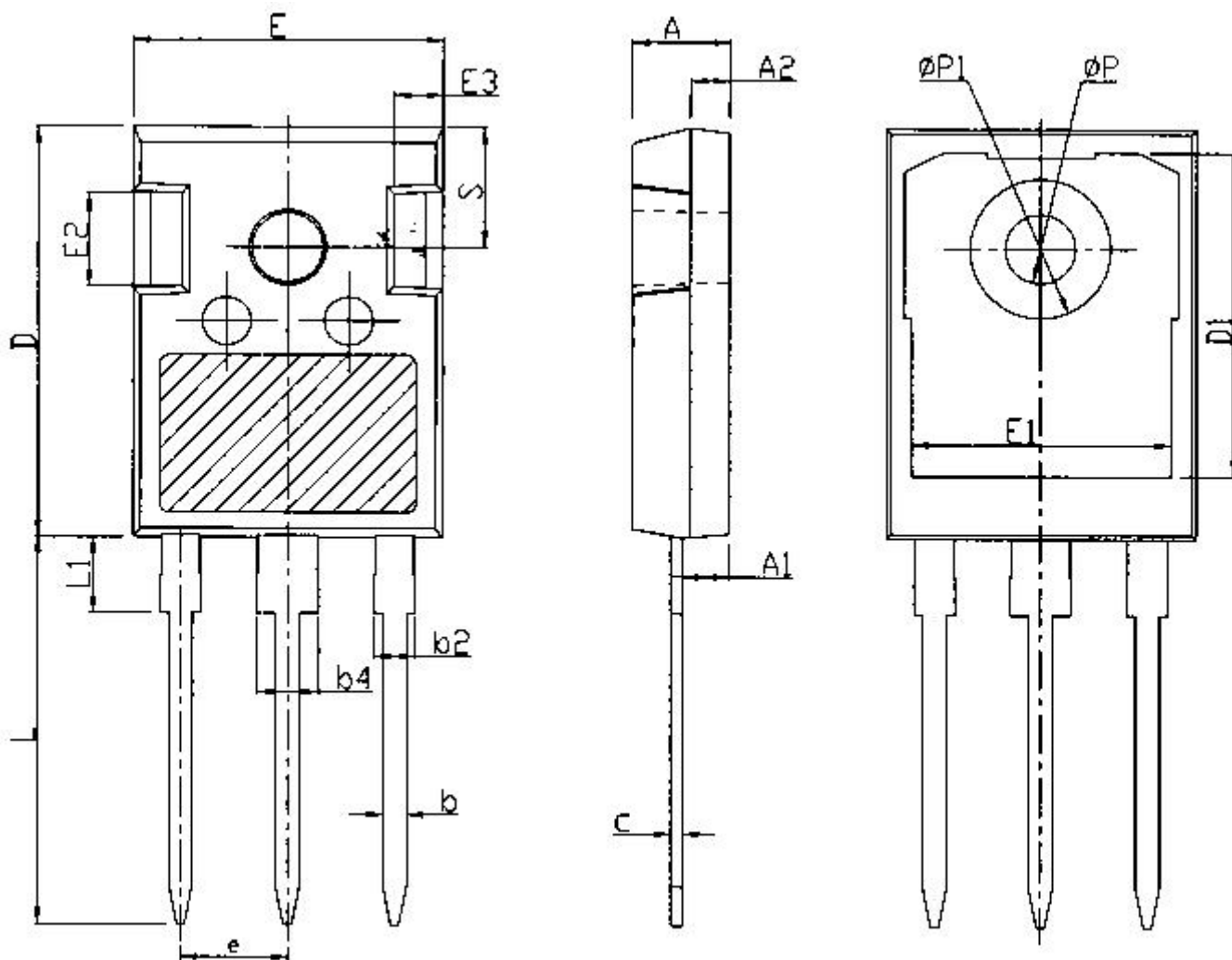
Top View (Right): Shows the top of the plug with dimensions $D2$ (height of the mounting tabs), $E3$ (width of the mounting tabs), and C (width of the main body).

Unit:mm			
Symbol	Min.	Nom	Max.
A	4.37	4.57	4.77
A1	1.25	1.30	1.40
A2	2.20	2.40	2.60
b	0.70	0.80	0.95
b2	1.17	1.27	1.47
c	0.45	0.50	0.60
D	15.10	15.60	16.10
D1	8.80	9.10	9.40
D2	5.50	-	-

Unit:mm			
Symbol	Min.	Nom	Max.
E	9.70	10.00	10.30
E3	7.00	-	-
e	2.54 BSC		
e1	5.08 BSC		
H1	6.25	6.50	6.85
L	12.75	13.50	13.80
L1	-	3.10	3.40
ΦP	3.40	3.60	3.80
Q	2.60	2.80	3.00



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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