



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 Multi-EPI SJ MOSFET 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

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

Applications

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

TO-220F



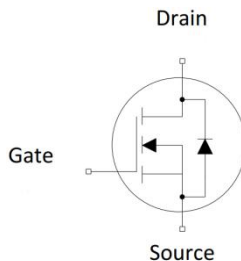
TO-263



TO-3PN



TO-247



Device Marking and Package Information

Device	Package	Marking
TPA65R090M	TO-220F	65R090M
TPB65R090M	TO-263	65R090M
TPV65R090M	TO-3PN	65R090M
TPW65R090M	TO-247	65R090M

Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	700	V
$R_{DS(on),max}$	0.09	Ω
$Q_{g,typ}$	75	nC
I_D	47	A
$I_{D,pulse}$	141	A
$E_{OSS} @ 400V$	9.53	μJ
Body Diode di_f/dt	500	A/ μs



Absolute Maximum Ratings T _C = 25°C, unless otherwise noted				
Parameter		Symbol	Value	Unit
Continuous Drain Current	T _C = 25°C	I _D	47	A
	T _C = 100°C		28.2	
Pulsed Drain Current (note1)		I _{D,pulse}	141	A
Gate-Source Voltage		V _{GSS}	±30	V
Single Pulse Avalanche Energy (note2)		E _{AS}	1160	mJ
Repetitive Avalanche Energy (note2)		E _{AR}	1.76	mJ
Avalanche Current		I _{AR}	8.7	A
MOSFET dv/dt Ruggedness, V _{DS} = 0...480V		dv/dt	50	V/ns
Power Dissipation For TO-220F		P _D	37	W
Power Dissipation For TO-263,TO-3PN,TO-247			391	
Continuous Diode Forward Current		I _S	40	A
Diode Pulsed Current (note1)		I _{S,pulse}	141	
Reverse Diode dv/dt (note3)		dv/dt	15	V/ns
Maximum Diode Commutation Speed (note3)		di _f /dt	300	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}	3.37	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	R_{thJA}	80	

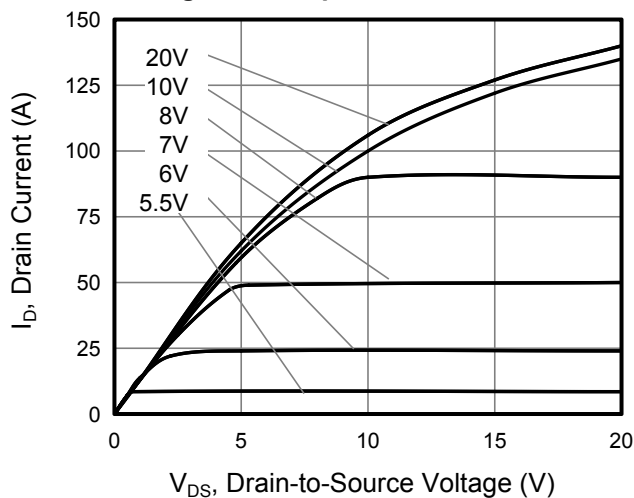
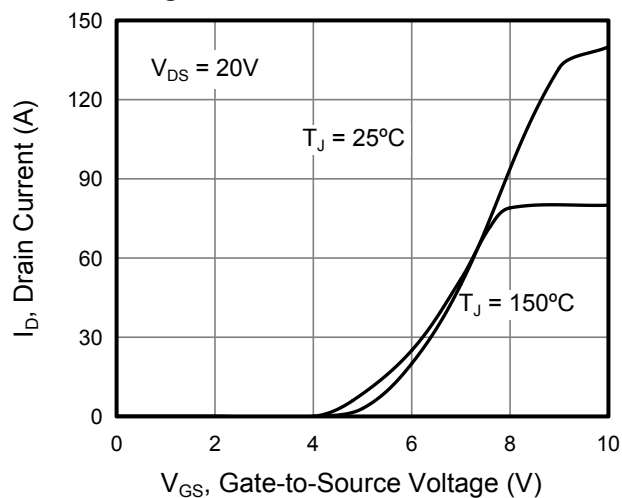
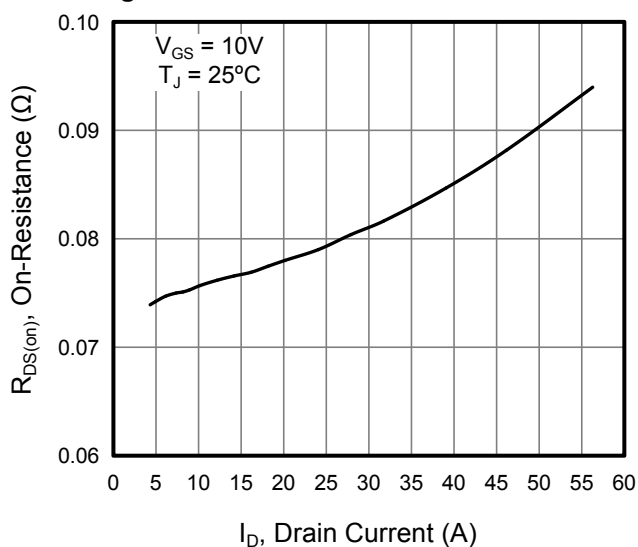
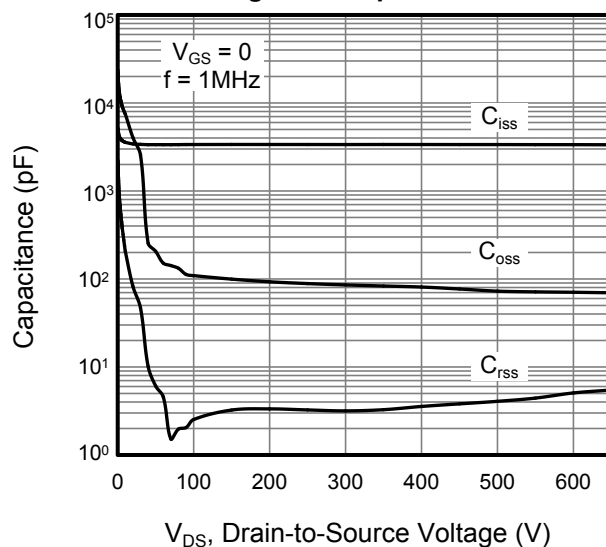
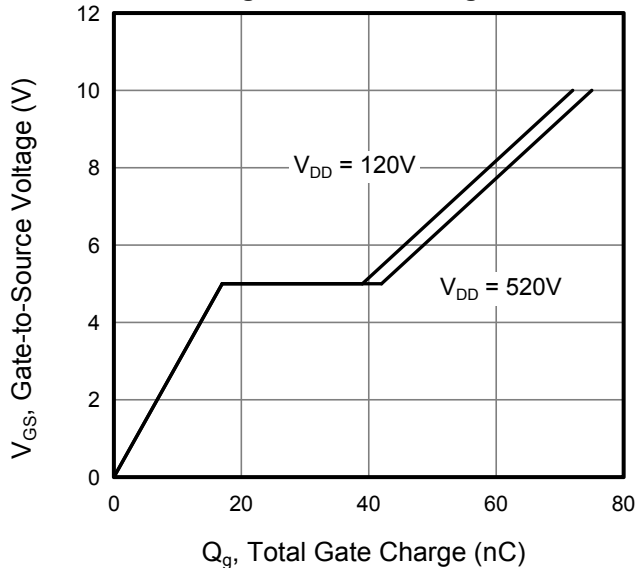
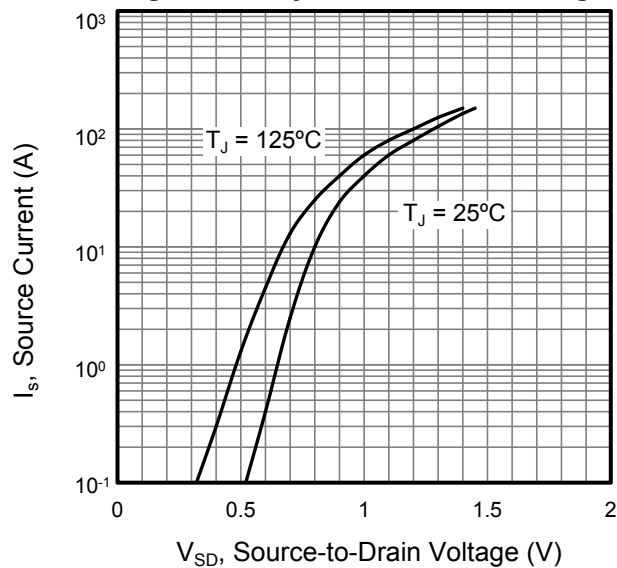
Thermal Resistance For TO-263, TO-3PN, TO-247			
Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	R_{thJC}	0.32	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	R_{thJA}	62	



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	--	--	1	μA
		V _{DS} = 650V, V _{GS} = 0V, T _J = 150°C	--	--	100	
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	2.5	--	4.5	V
Drain-Source On-State-Resistance	R _{DS(on)}	V _{GS} = 10V, I _D = 24A	--	0.079	0.09	Ω
Gate Resistance	R _G	f = 1.0MHz open drain	--	0.8	--	Ω
Dynamic Characteristics						
Input Capacitance	C _{iss}	V _{GS} = 0V, V _{DS} = 100V, f = 1.0MHz	--	3370	--	pF
Output Capacitance	C _{oss}		--	109	--	
Reverse Transfer Capacitance	C _{rss}		--	2.5	--	
Total Gate Charge	Q _g	V _{DD} = 520V, I _D = 47A, V _{GS} = 10V	--	75	--	nC
Gate-Source Charge	Q _{gs}		--	17	--	
Gate-Drain Charge	Q _{gd}		--	25	--	
Turn-on Delay Time	t _{d(on)}	V _{DD} = 400V, I _D = 47A, R _G = 25Ω	--	46	--	ns
Turn-on Rise Time	t _r		--	79	--	
Turn-off Delay Time	t _{d(off)}		--	185	--	
Turn-off Fall Time	t _f		--	64	--	
Drain-Source Body Diode Characteristics						
Body Diode Forward Voltage	V _{SD}	T _J = 25°C, I _{SD} = 24A, V _{GS} = 0V	--	0.9	1.2	V
Reverse Recovery Time	t _{rr}	V _R = 400V, I _F = 20A, di _F /dt = 100A/μs	--	400	--	ns
Reverse Recovery Charge	Q _{rr}		--	8	--	μC
Peak Reverse Recovery Current	I _{rrm}		--	39.8	--	A

Notes

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $I_{AS} = 9.3A, V_{DD} = 50V, R_G = 25\Omega$, 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

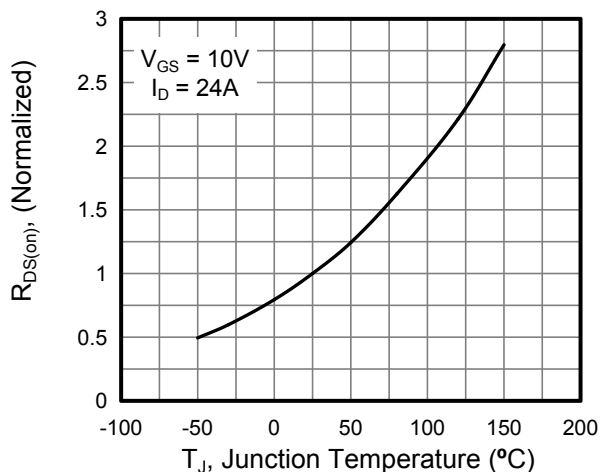


Figure 8. Breakdown voltage vs. Junction Temperature

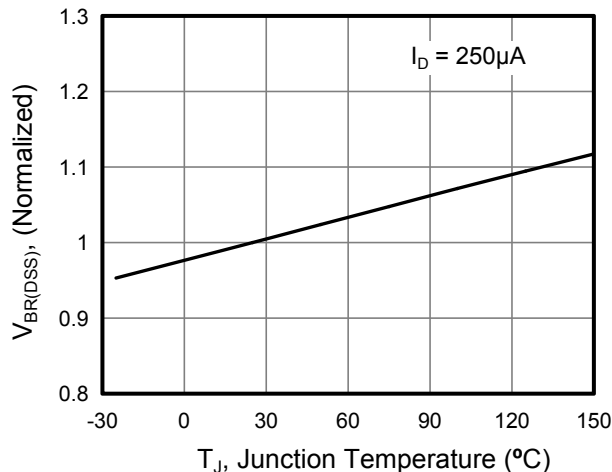


Figure 9. Transient Thermal Impedance For TO-263/TO-3PN/TO-247

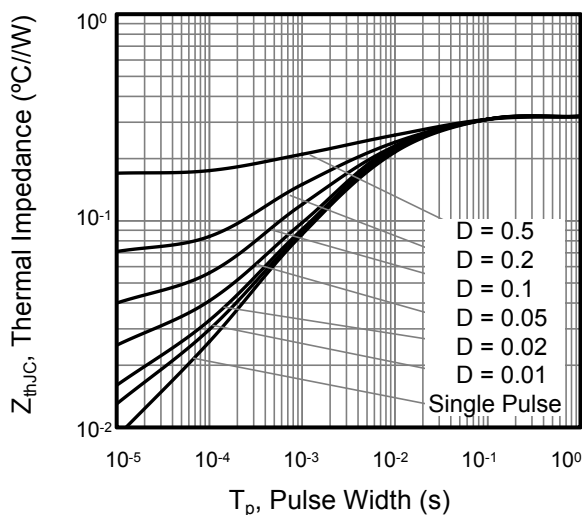


Figure 10. Transient Thermal Impedance For TO-220F

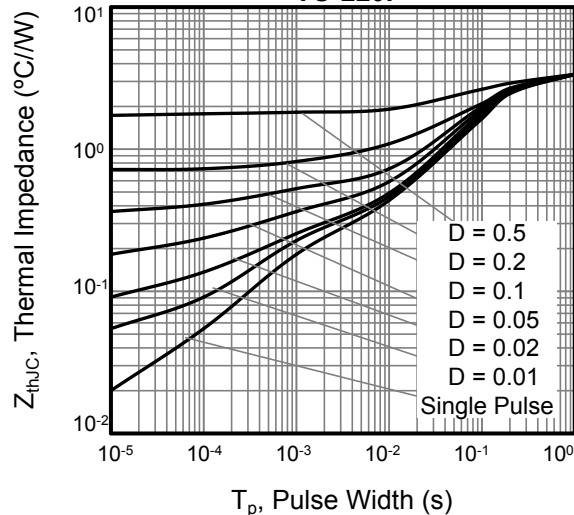


Figure 11. Safe Operation Area For TO-263/TO-3PN/TO-247

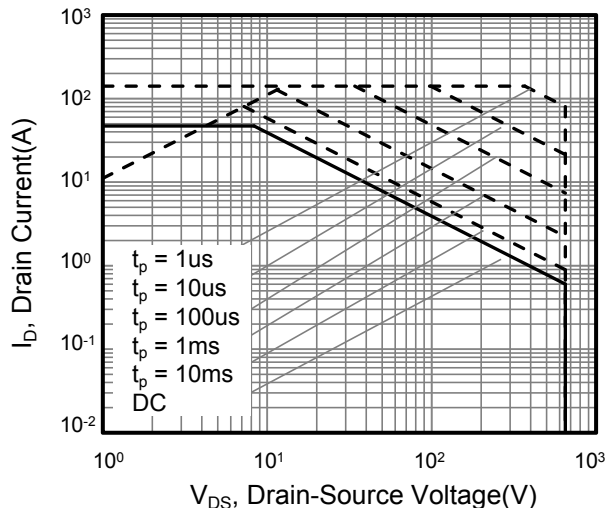
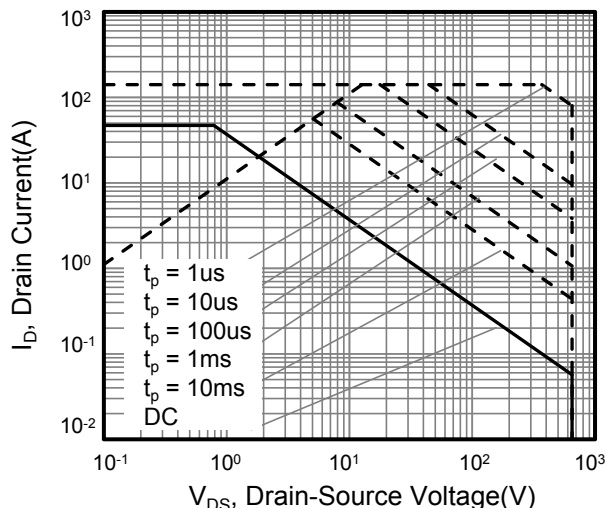


Figure 12. Safe operation area For TO-220F





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

Figure 13. Typ. Coss Stored Energy

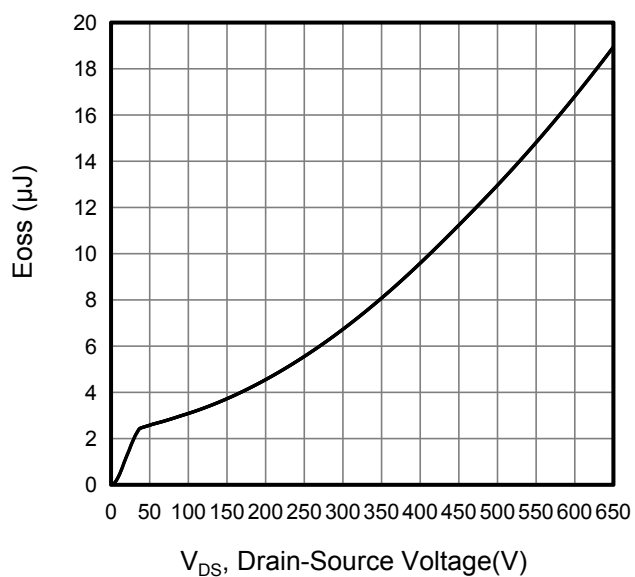




Figure A: Gate Charge Test Circuit and Waveform

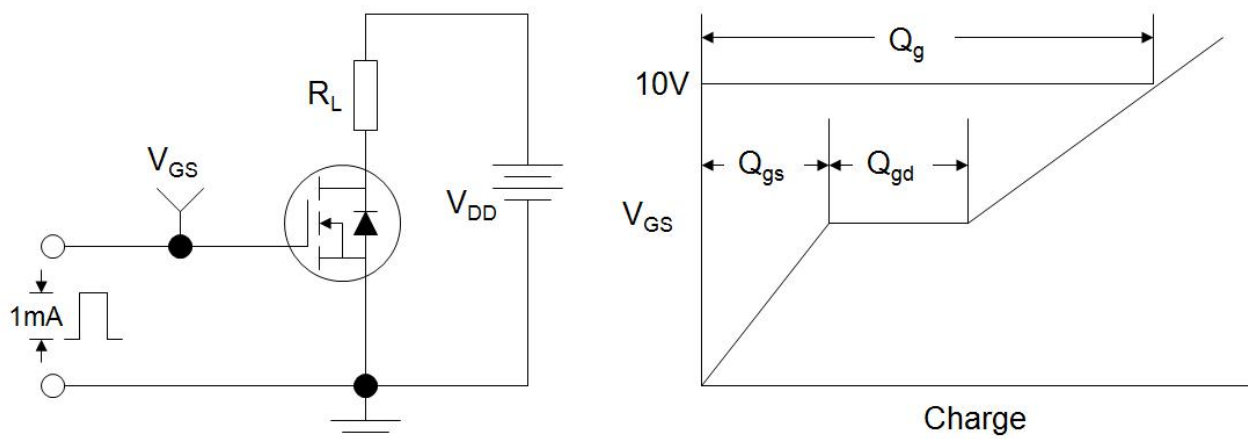


Figure B: Resistive Switching Test Circuit and Waveform

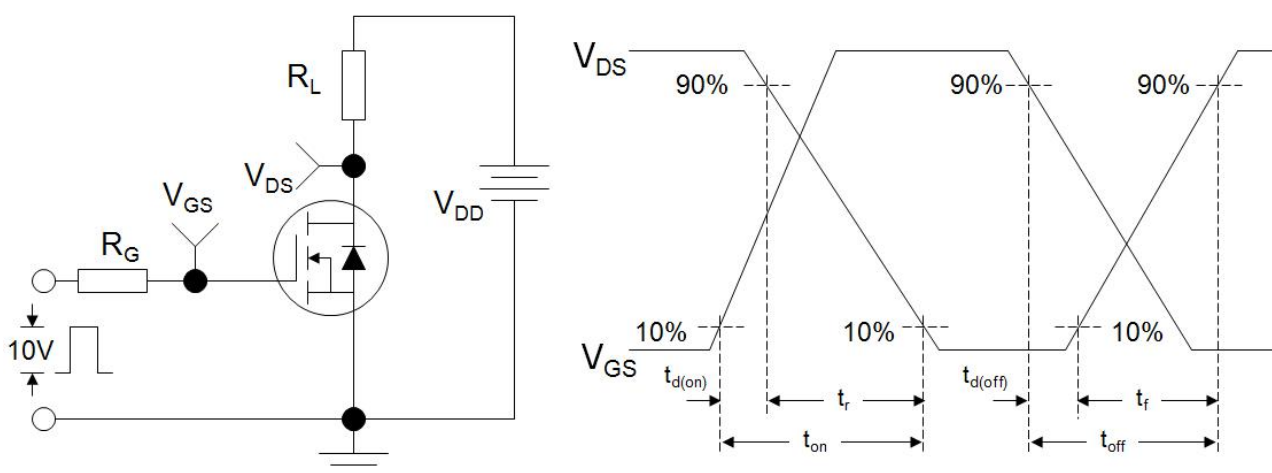
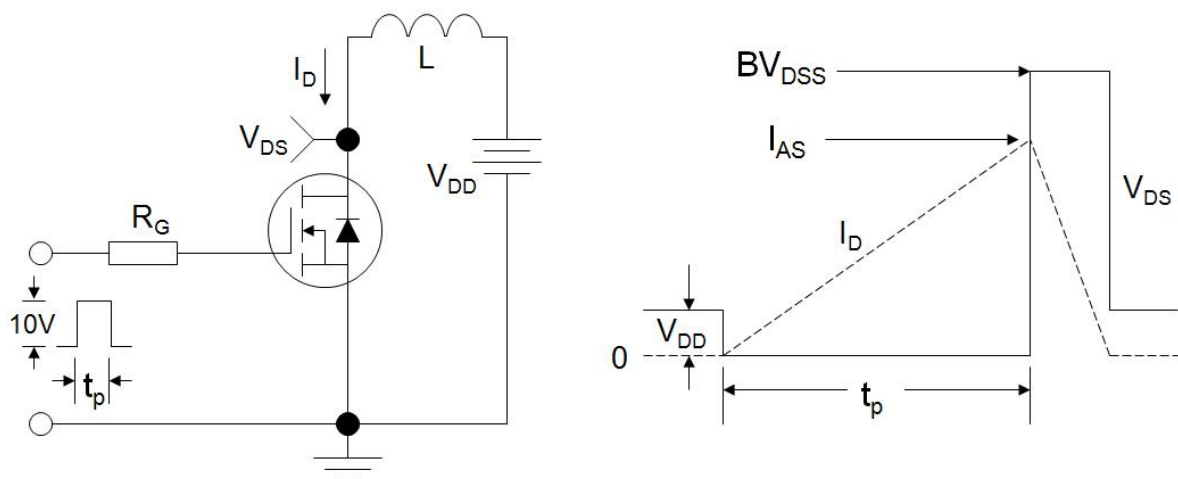
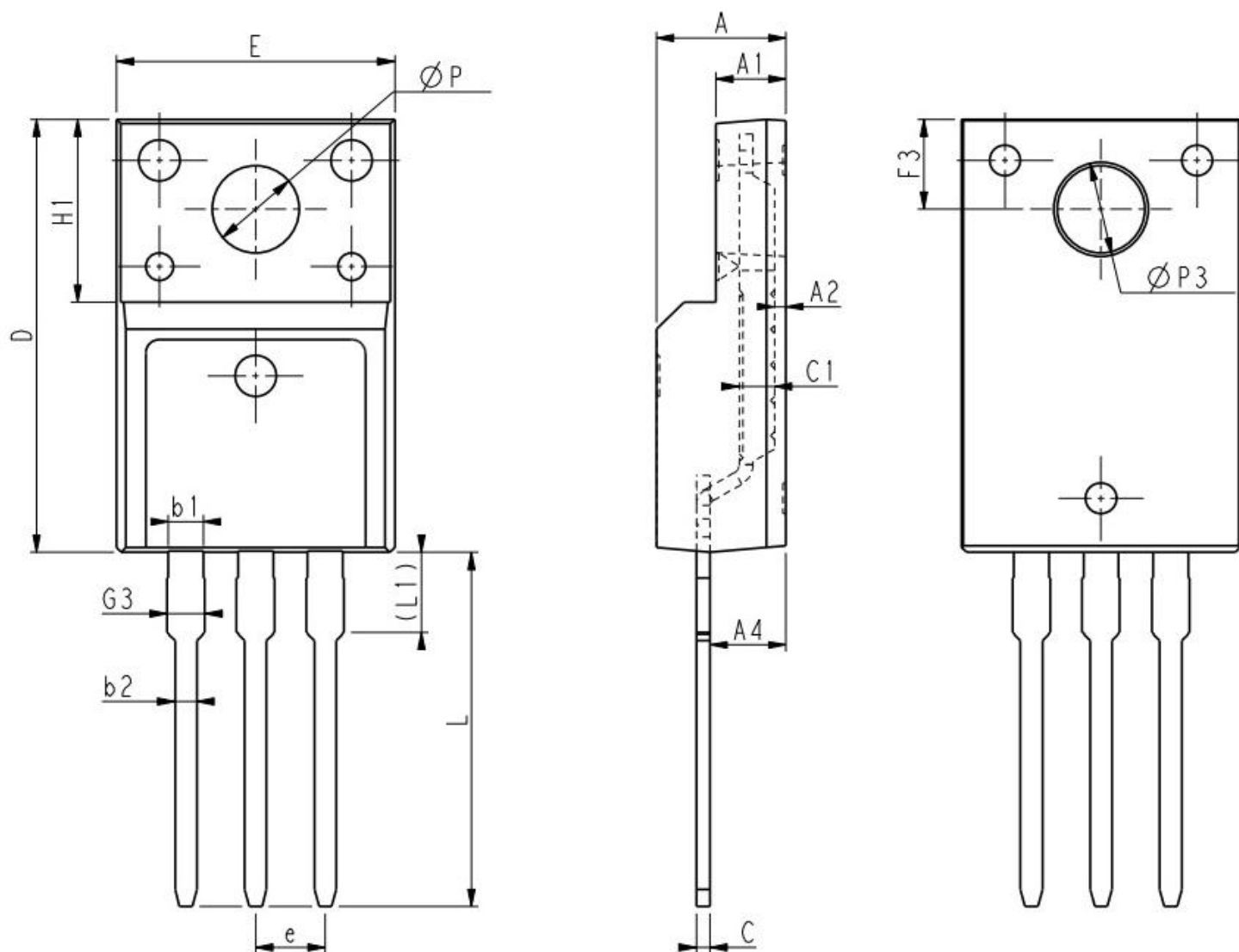


Figure C: Unclamped Inductive Switching Test Circuit and Waveform





TO-220F (华羿)

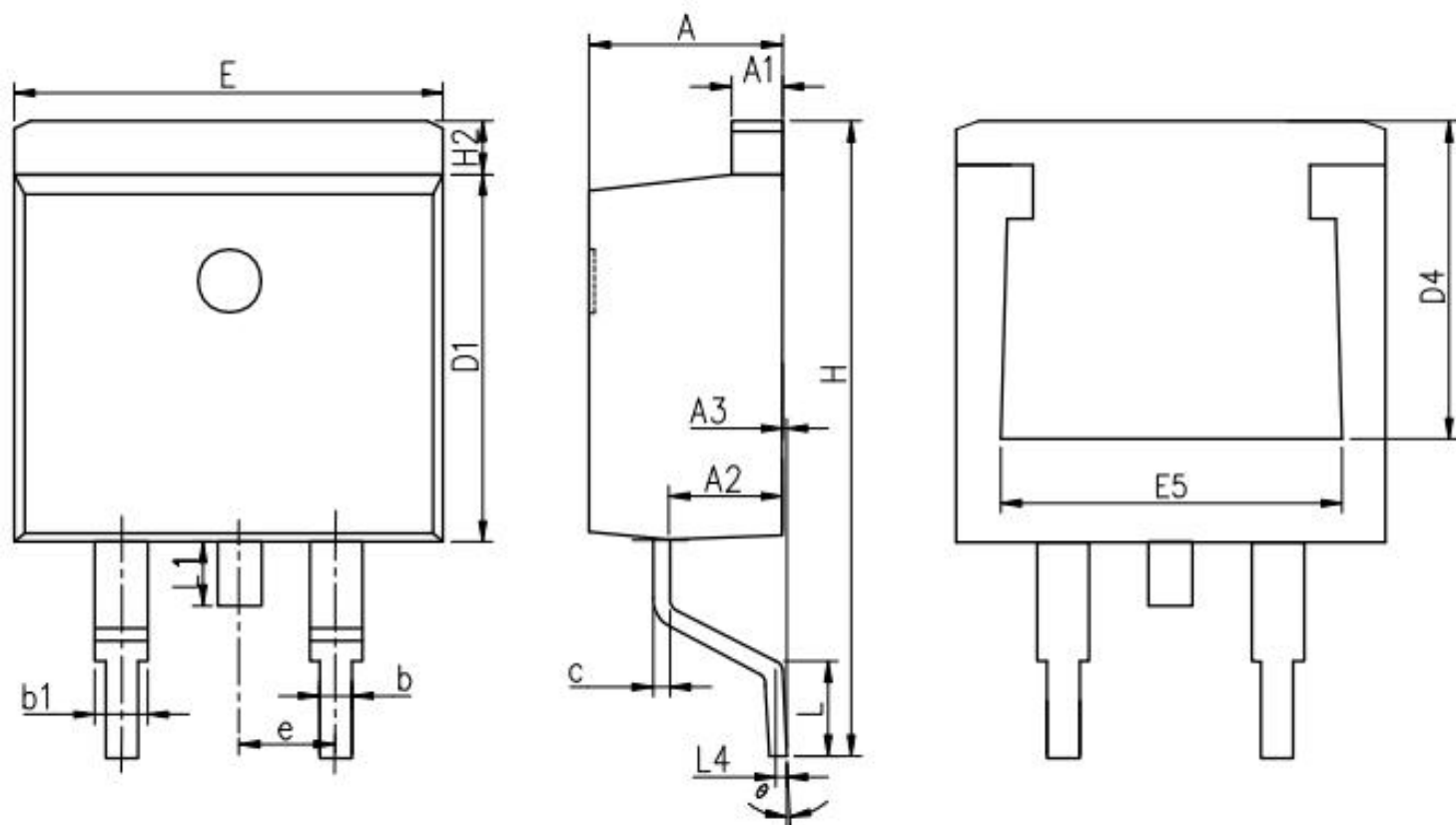


Unit:mm			
Symbol	Min.	Nom	Max.
E	9.96	10.16	10.36
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A2	0.30	0.45	0.60
A4	2.56	2.76	2.96
c	0.40	0.50	0.65
c1	1.20	1.30	1.35
D	15.57	15.87	16.17
H1	6.70REF		

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



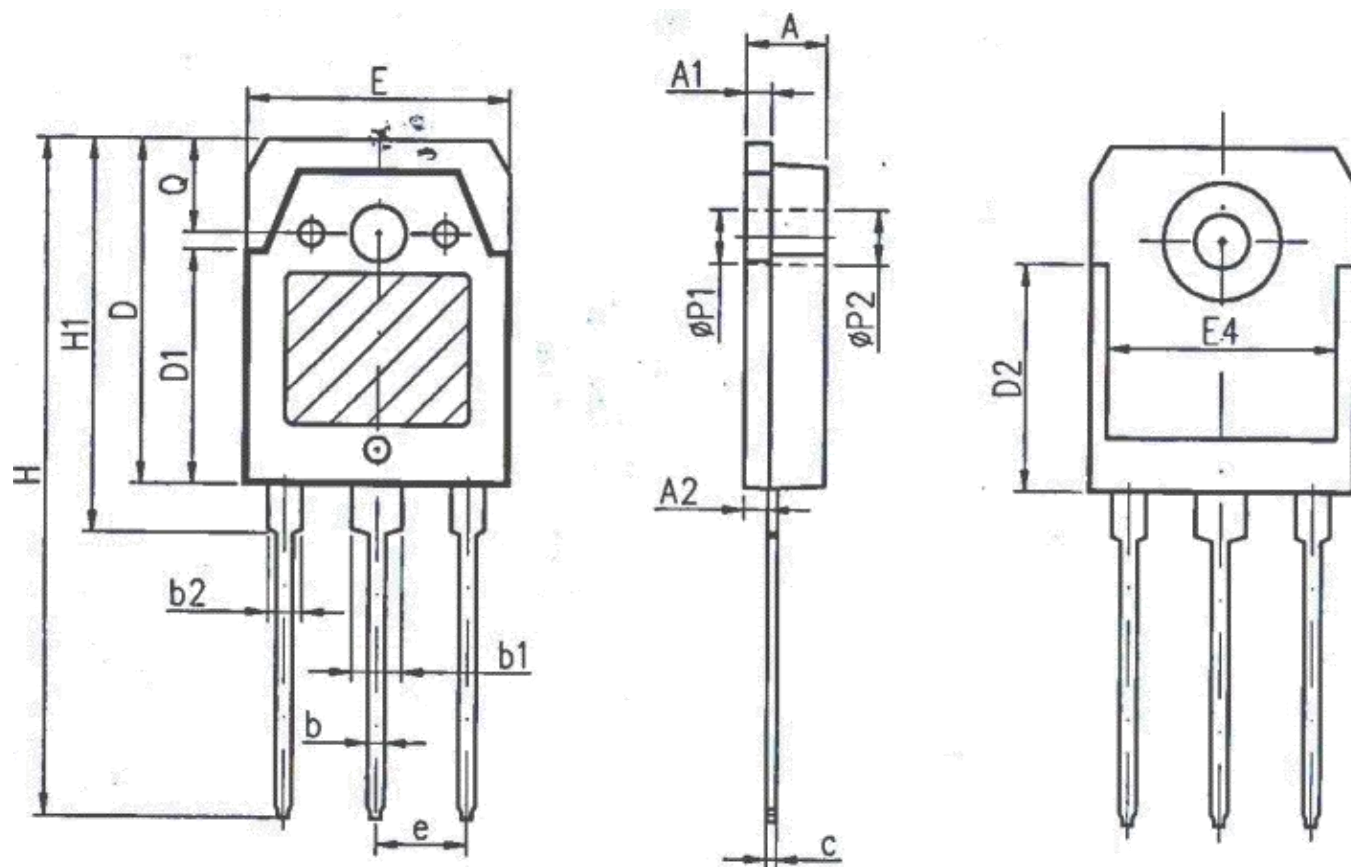
TO-263 (华羿)



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	-	-	theta	0°	5°	9°



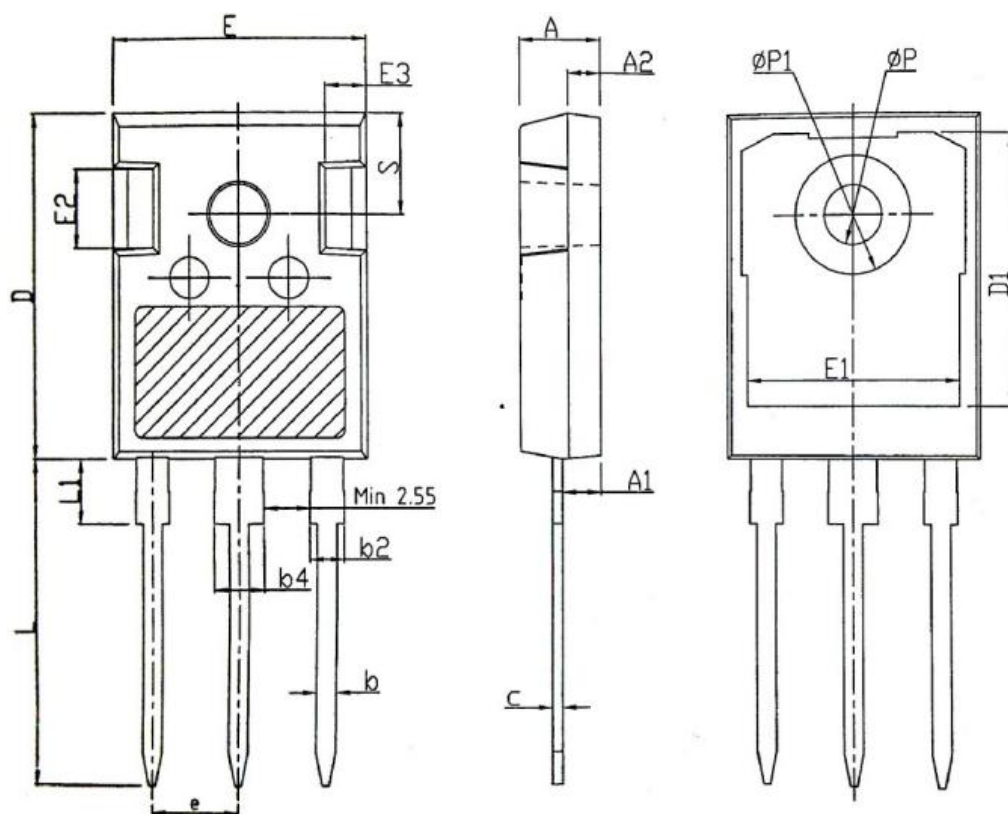
TO-3PN (华羿)



SYMBOL	mm		
	MIN	NOM	MAX
A	4.60	4.80	5.00
A1	1.40	1.50	1.65
A2	1.18	1.38	1.58
b	0.80	1.00	1.20
b1	2.80	3.00	3.20
b2	1.80	2.00	2.20
c	0.50	0.60	0.75
D	19.60	19.90	20.20
D1	13.55	13.90	14.25
D2	12.90 REF		
E	15.35	15.60	15.85
E4	12.60	-	-
e	5.45 TYP		
H	40.10	40.50	40.90
H1	23.15	23.40	23.65
$\Phi P1$	3.20 REF		
$\Phi P2$	3.50 REF		



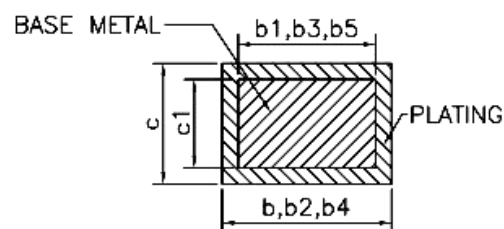
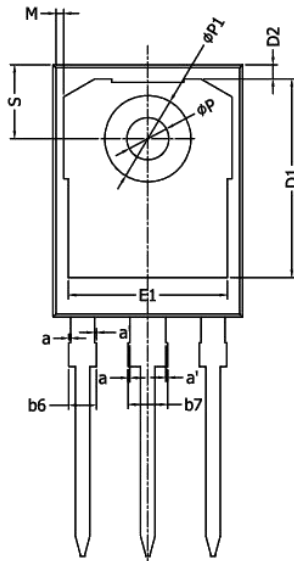
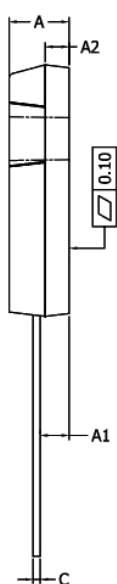
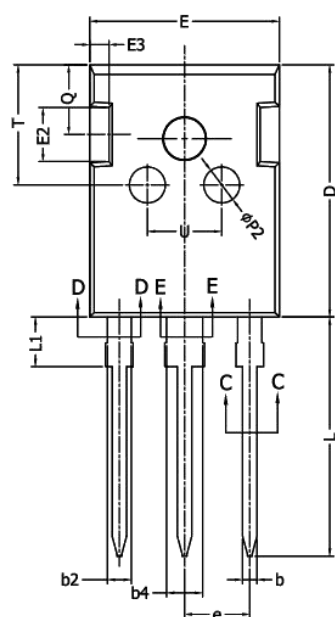
TO-247 (华羿)



SYMBOL	mm		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.59
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	20.80	21.00	21.30
D1	16.25	16.55	16.85
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	19.82	19.92	20.22
L1	-	-	4.30
ϕP	3.40	3.60	3.80
$\phi P1$	-	-	7.30
S	6.15BSC		



TO-247 (集佳)



SYMBOL	MIN	NOM	MAX
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
a	0	---	0.15
a'	0	---	0.15
b	1.16	---	1.26
b1	1.15	1.2	1.22
b2	1.96	---	2.06
b3	1.95	2.00	2.02
b4	2.96	---	3.06
b5	2.96	3.00	3.02
b6	---	---	2.25
b7	---	---	3.25
c	0.59	---	0.66
c1	0.58	0.60	0.62
D	20.90	21.00	21.10
D1	16.25	16.55	16.85
D2	1.05	1.17	1.35
E	15.70	15.80	15.90
E1	13.10	13.30	13.50
E2	4.40	4.50	4.60
E3	2.40	2.50	2.60
e	5.436 BSC		
L	19.80	19.92	20.10
L1	---	---	4.30
M	0.35	---	0.95
P	3.40	3.50	3.60
P1	7.00	---	7.40
P2	2.40	2.50	2.60
Q	5.60	---	6.00
S	6.05	6.15	6.25
T	9.80	---	10.20
U	6.00	---	6.40



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