



## 600V Super-junction Power MOSFET

### Description

#### 600V Super-junction Power MOSFET

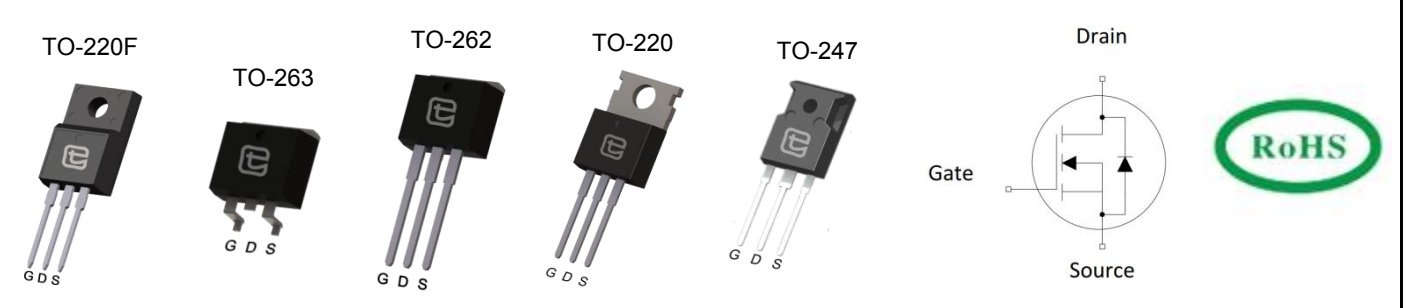
Super-junction power MOSFET is a revolutionary technology for high voltage power MOSFETs, designed according to the SJ principle. The Multi-EPI SJ MOSFET provide an extremely low switching, communication and conduction losses device with highest robustness make especially resonant switching applications 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



### Device Marking and Package Information

Device	Package	Marking
TPA60R240M	TO-220F	60R240M
TPB60R240M	TO-263	60R240M
TPC60R240M	TO-262	60R240M
TPP60R240M	TO-220	60R240M
TPW60R240M	TO-247	60R240M

### Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	650	V
$R_{DS(on),max}$	0.24	$\Omega$
$Q_{g,typ}$	27	nC
$I_D$	15	A
$I_{D,pulse}$	45	A
$E_{OSS} @ 400V$	3.77	$\mu J$
Body Diode $di_T/dt$	500	A/ $\mu s$



Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ , unless otherwise noted				
Parameter		Symbol	Value	Unit
Continuous Drain Current	$T_C = 25^\circ\text{C}$	$I_D$	15	A
	$T_C = 100^\circ\text{C}$		9	
Pulsed Drain Current	(note1)	$I_{D,pulse}$	45	A
Gate-Source Voltage		$V_{GSS}$	$\pm 30$	V
Single Pulse Avalanche Energy	(note2)	$E_{AS}$	284	mJ
Repetitive Avalanche Energy	(note2)	$E_{AR}$	0.44	mJ
Avalanche Current		$I_{AR}$	2.4	A
MOSFET dv/dt Ruggedness, $V_{DS} = 0 \dots 480\text{V}$		dv/dt	50	V/ns
Power Dissipation For TO-220F		$P_D$	32	W
Power Dissipation For TO-263, TO-262, TO-220, TO-247			104	
Continuous Diode Forward Current		$I_S$	12.8	A
Diode Pulsed Current	(note1)	$I_{S,pulse}$	45	
Reverse Diode dv/dt	(note3)	dv/dt	15	V/ns
Maximum Diode Commutation Speed	(note3)	$di_f/dt$	500	A/ $\mu\text{s}$
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	-55~+150	$^\circ\text{C}$

Thermal Resistance For TO-220F				
Parameter		Symbol	Value	Unit
Thermal Resistance, Junction-to-Case		$R_{thJC}$	3.9	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient		$R_{thJA}$	80	

Thermal Resistance For TO-263, TO-262, TO-220, TO-247				
Parameter		Symbol	Value	Unit
Thermal Resistance, Junction-to-Case		$R_{thJC}$	1.2	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient		$R_{thJA}$	62	



Electrical Characteristics $T_J = 25^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
<b>Static Characteristics</b>						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	600	--	--	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 600V, V_{GS} = 0V, T_J = 25^\circ\text{C}$	--	--	1	$\mu A$
		$V_{DS} = 600V, V_{GS} = 0V, T_J = 150^\circ\text{C}$	--	--	100	
Gate-Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 30V$	--	--	$\pm 100$	nA
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	2.5	--	4.5	V
Drain-Source On-State-Resistance	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 7.5A$	--	0.21	0.24	$\Omega$
Gate Resistance	$R_G$	$f = 1.0\text{MHz}$ open drain	--	12.5	--	$\Omega$
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0V,$ $V_{DS} = 100V$ $f = 1.0\text{MHz}$	--	1129	--	$\mu F$
Output Capacitance	$C_{oss}$		--	43	--	
Reverse Transfer Capacitance	$C_{rss}$		--	2.3	--	
Total Gate Charge	$Q_g$	$V_{DD} = 480V,$ $I_D = 15A,$ $V_{GS} = 10V$	--	27	--	nC
Gate-Source Charge	$Q_{gs}$		--	5.5	--	
Gate-Drain Charge	$Q_{gd}$		--	10.5	--	
Turn-on Delay Time	$t_{d(on)}$	$V_{DD} = 400V,$ $I_D = 15A,$ $R_G = 25\Omega$	--	23	--	ns
Turn-on Rise Time	$t_r$		--	65	--	
Turn-off Delay Time	$t_{d(off)}$		--	105	--	
Turn-off Fall Time	$t_f$		--	50	--	
<b>Drain-Source Body Diode Characteristics</b>						
Body Diode Forward Voltage	$V_{SD}$	$T_J = 25^\circ\text{C}, I_{SD} = 7.5A, V_{GS} = 0V$	--	0.9	1.2	V
Reverse Recovery Time	$t_{rr}$	$V_R = 400V,$ $I_F = I_S,$ $di_F/dt = 100A/\mu s()$	--	410	--	ns
Reverse Recovery Charge	$Q_{rr}$		--	4.1	--	$\mu C$
Peak Reverse Recovery Current	$I_{rrm}$		--	20	--	A

**Notes**

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $I_D = 2.4A, V_{DD} = 50V, R_G = 25\Omega,$  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

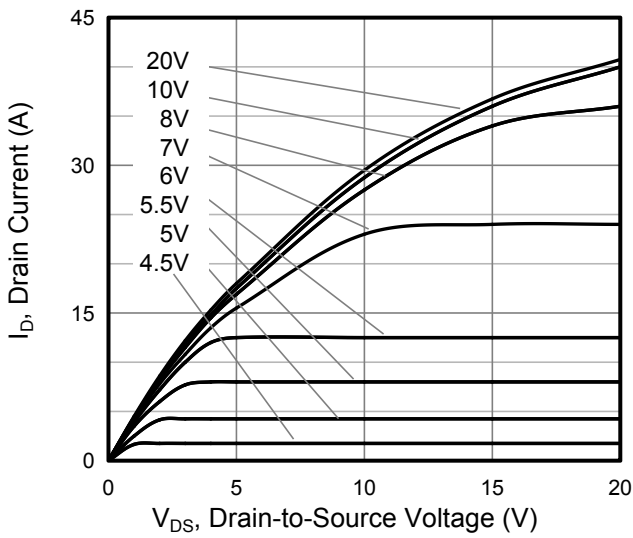


Figure 2. Transfer Characteristics

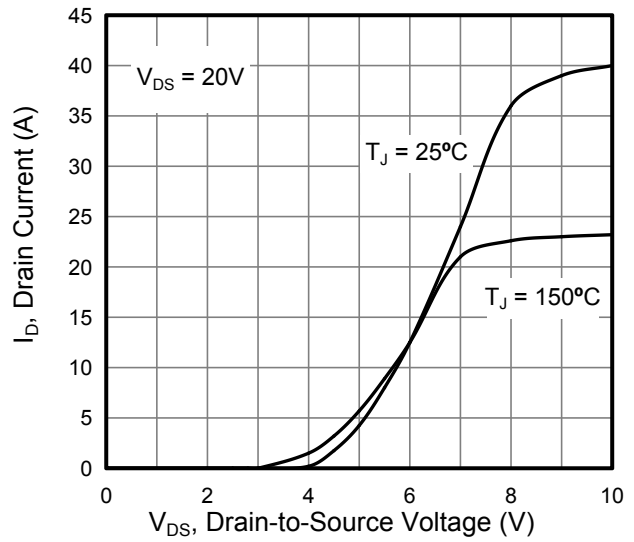


Figure 3. On-Resistance vs. Drain Current

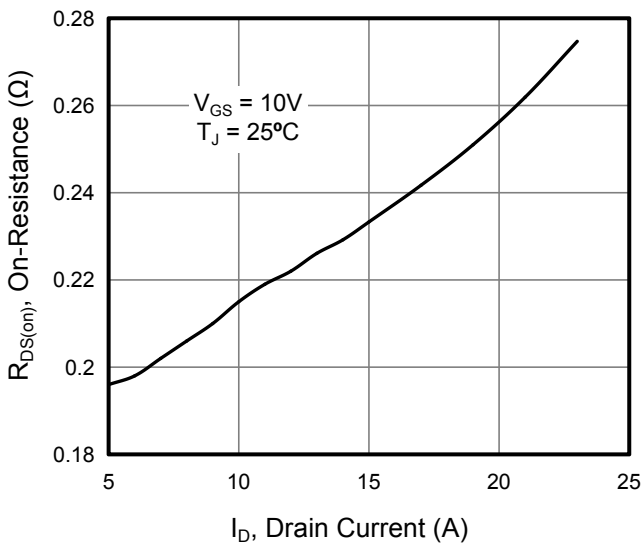


Figure 4. Capacitance

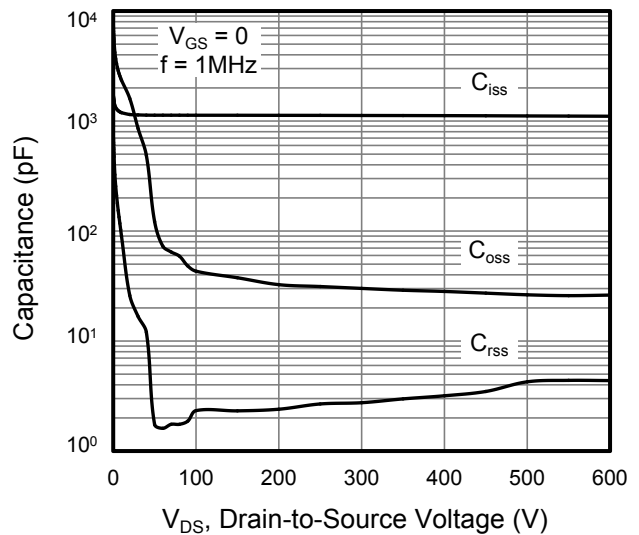


Figure 5. Gate Charge

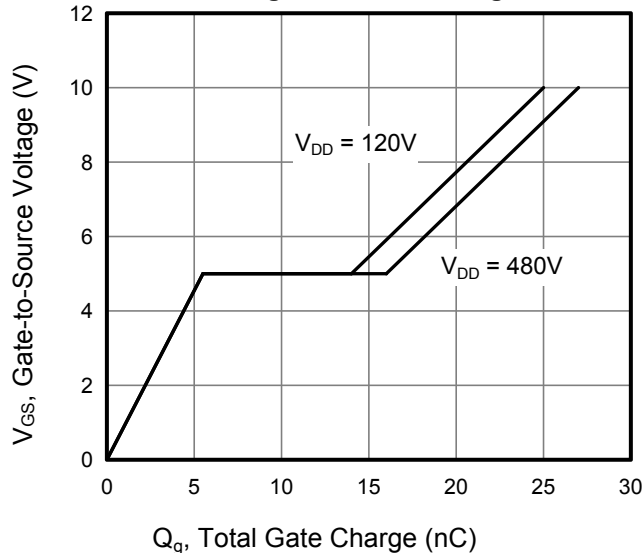
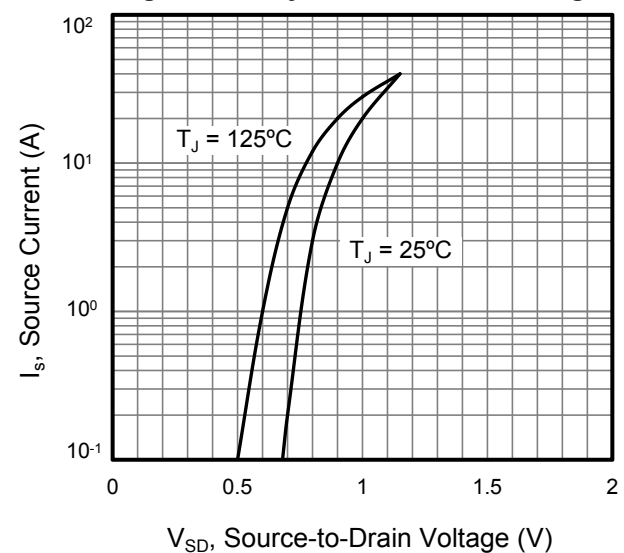


Figure 6. Body Diode Forward Voltage





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

Figure 7. On-Resistance vs. Temperature

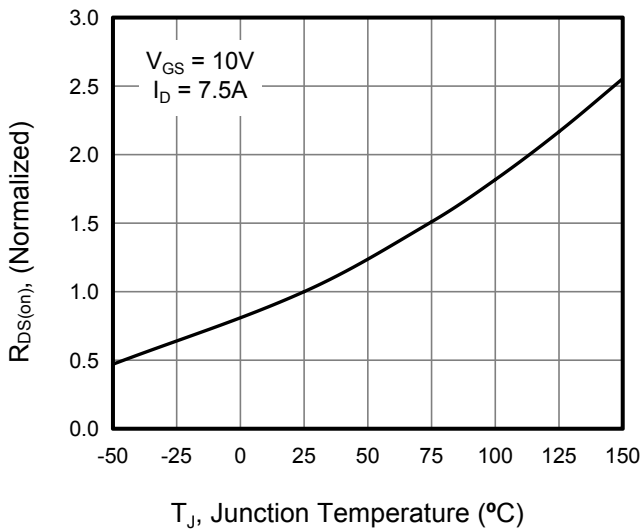


Figure 8. Breakdown voltage vs. Junction Temperature

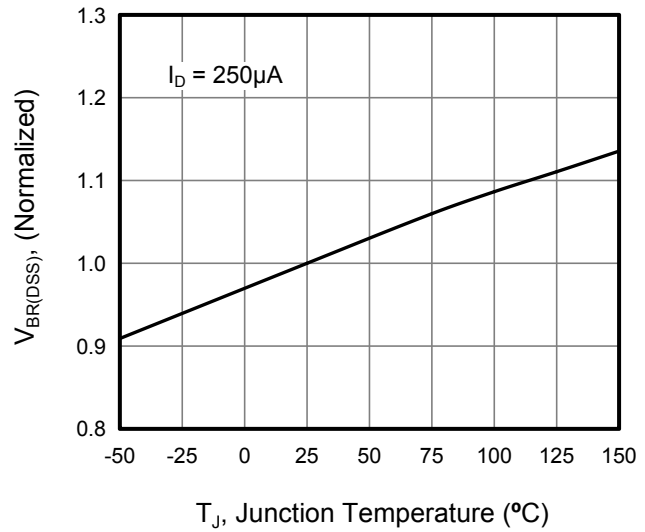


Figure 9. Transient Thermal Impedance For TO-263/TO-262/TO-220/TO-247

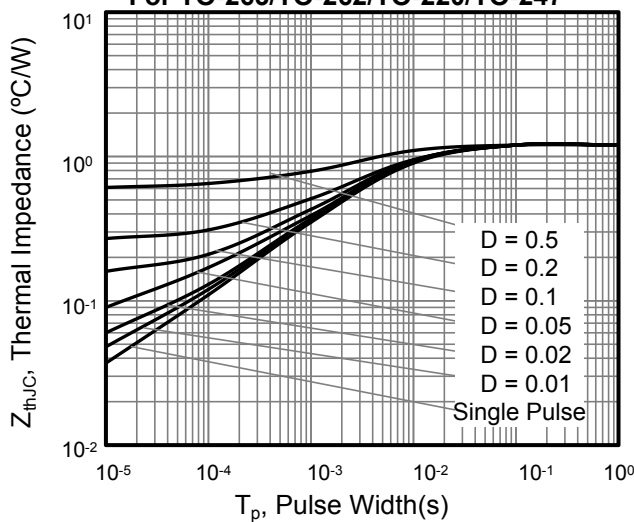


Figure 10. Transient Thermal Impedance For TO-220F

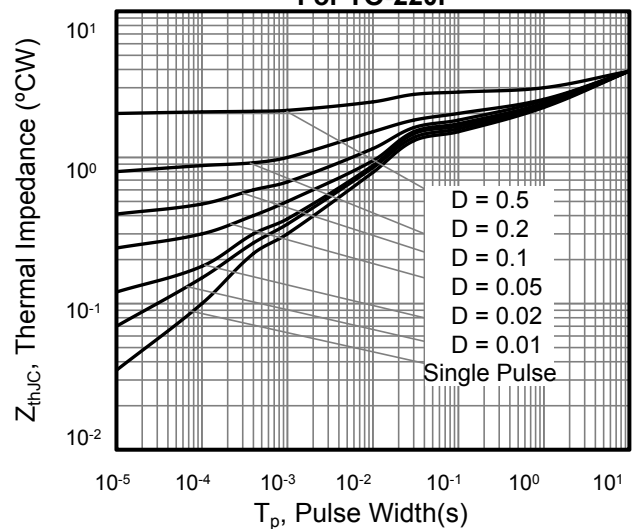


Figure 11. Safe Operation Area For TO-263/TO-262/TO-220/TO-247

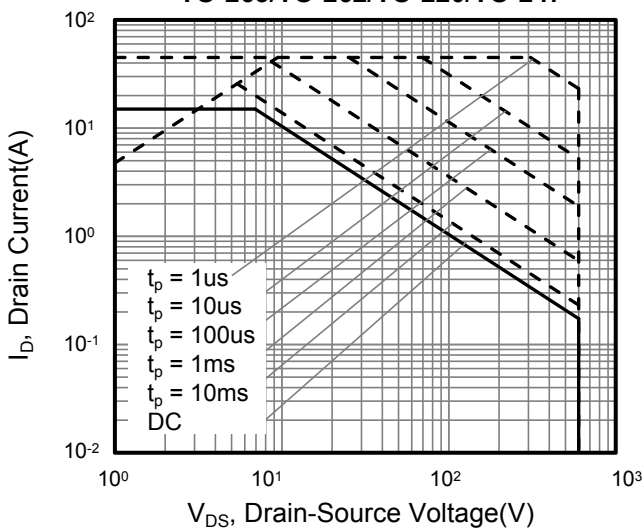
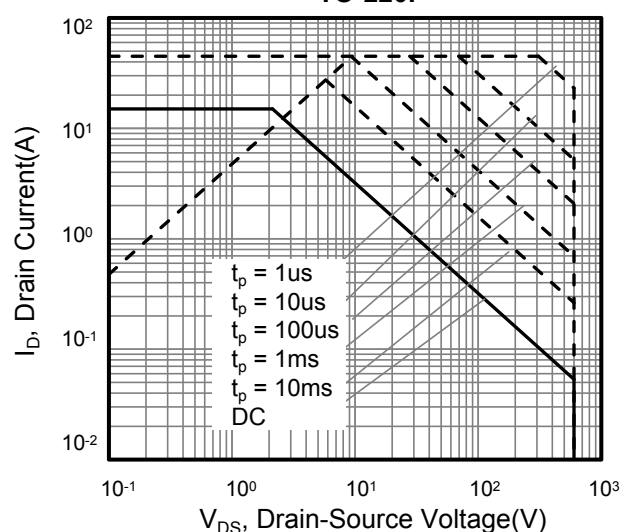


Figure 12. Safe Operation Area For TO-220F





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

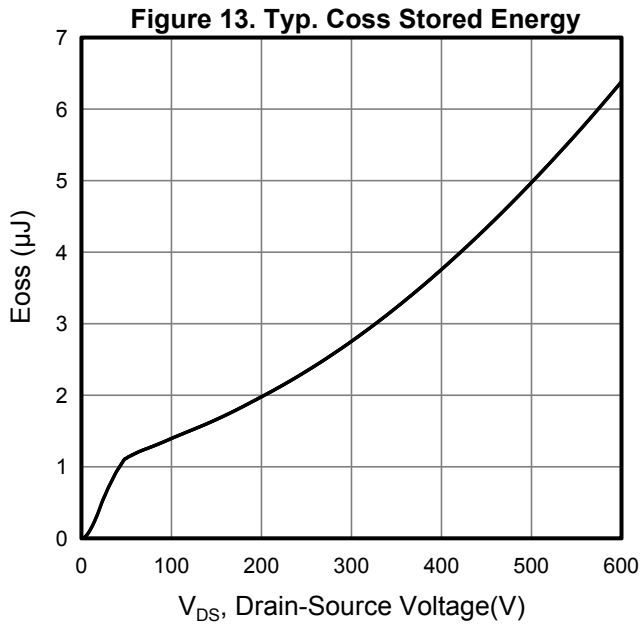




Figure A: Gate Charge Test Circuit and Waveform

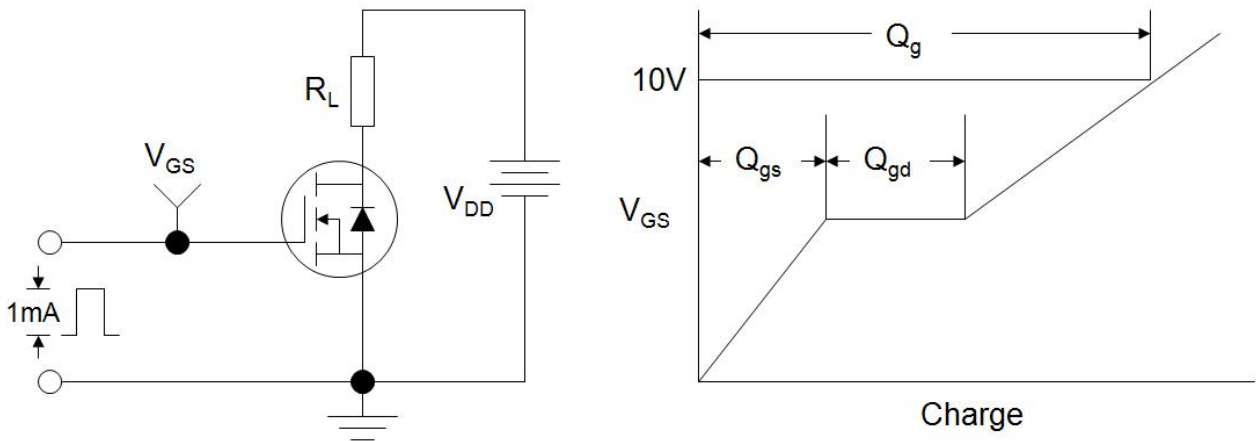


Figure B: Resistive Switching Test Circuit and Waveform

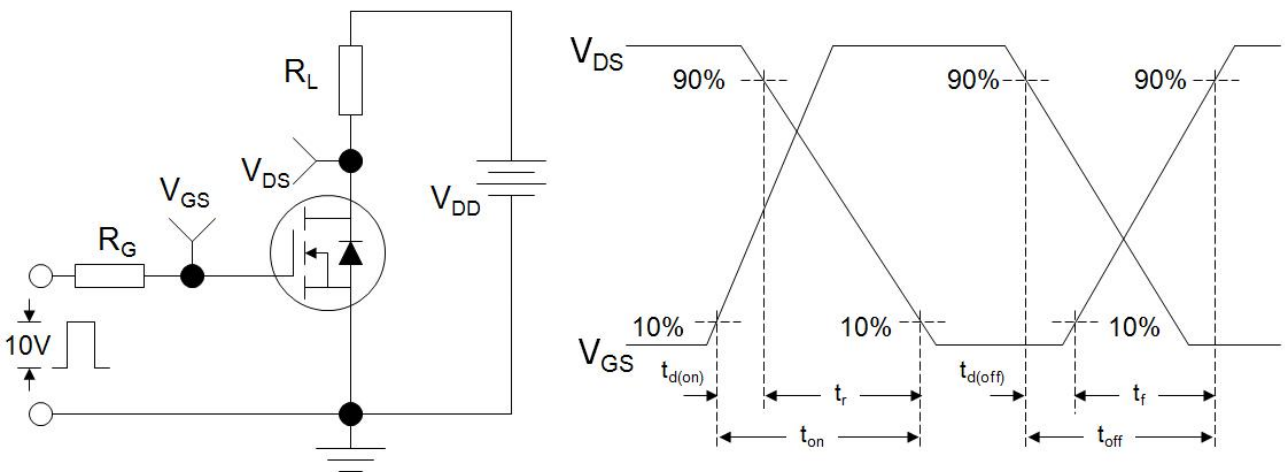
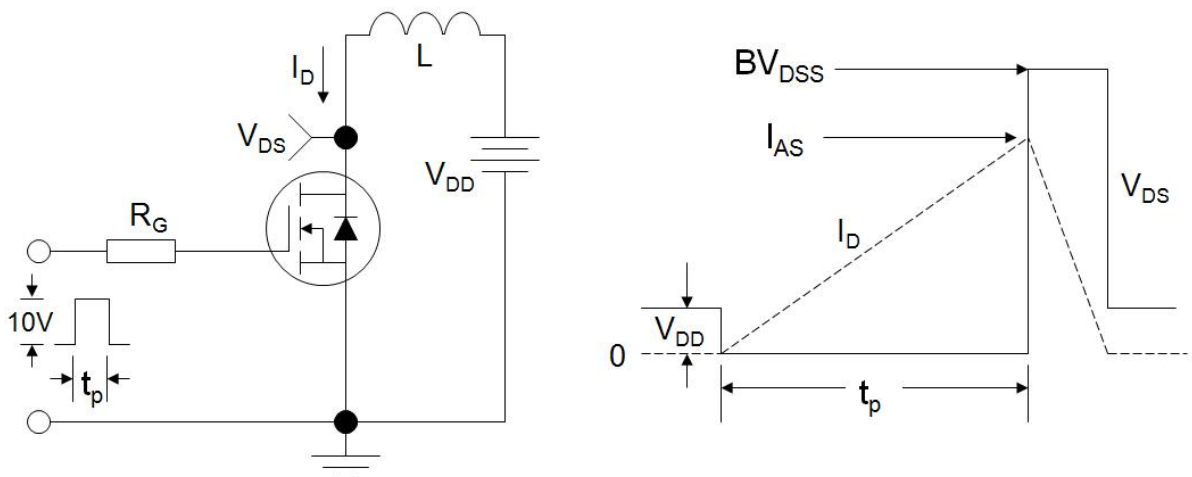
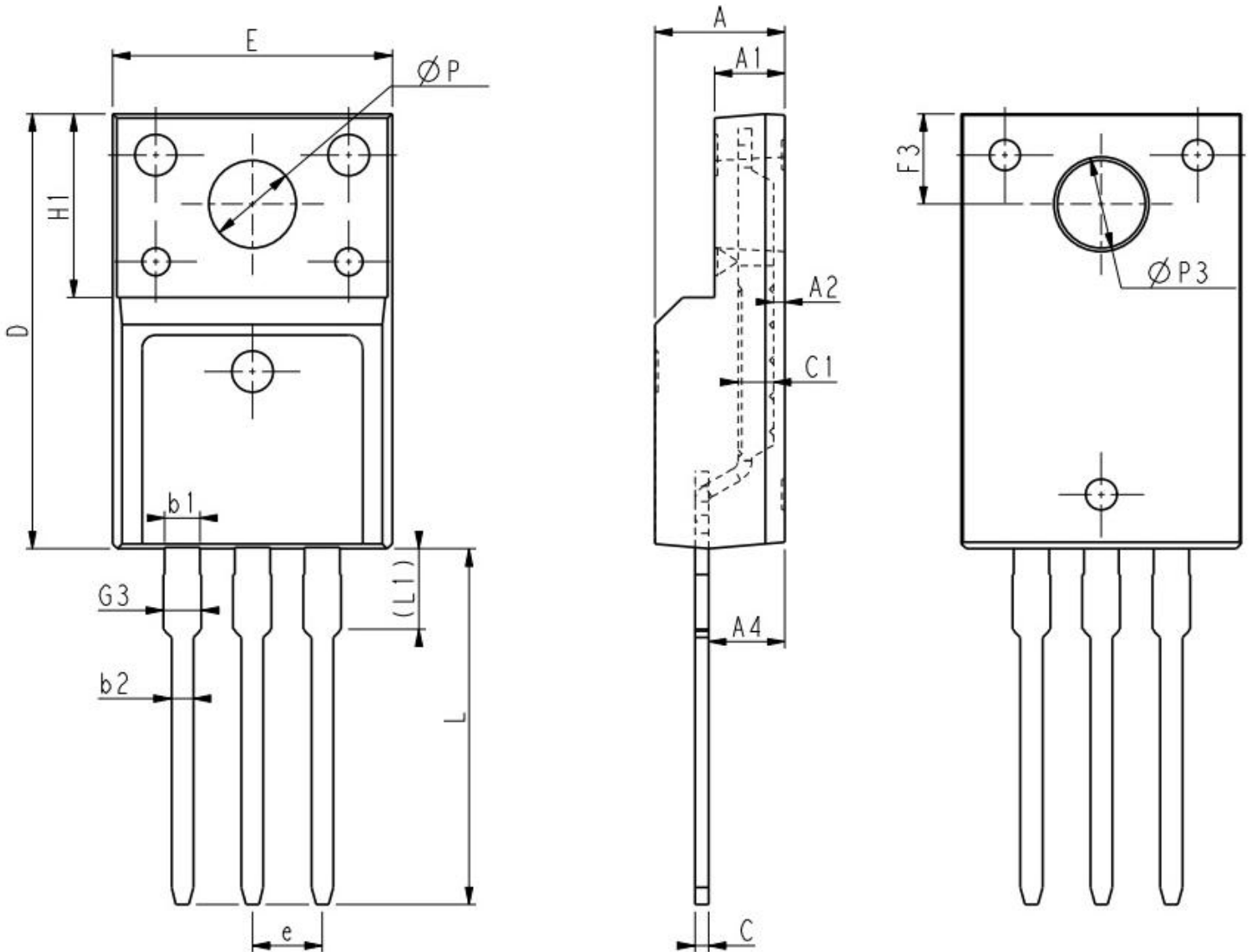


Figure C: Unclamped Inductive Switching Test Circuit and Waveform





TO-220F (华羿)



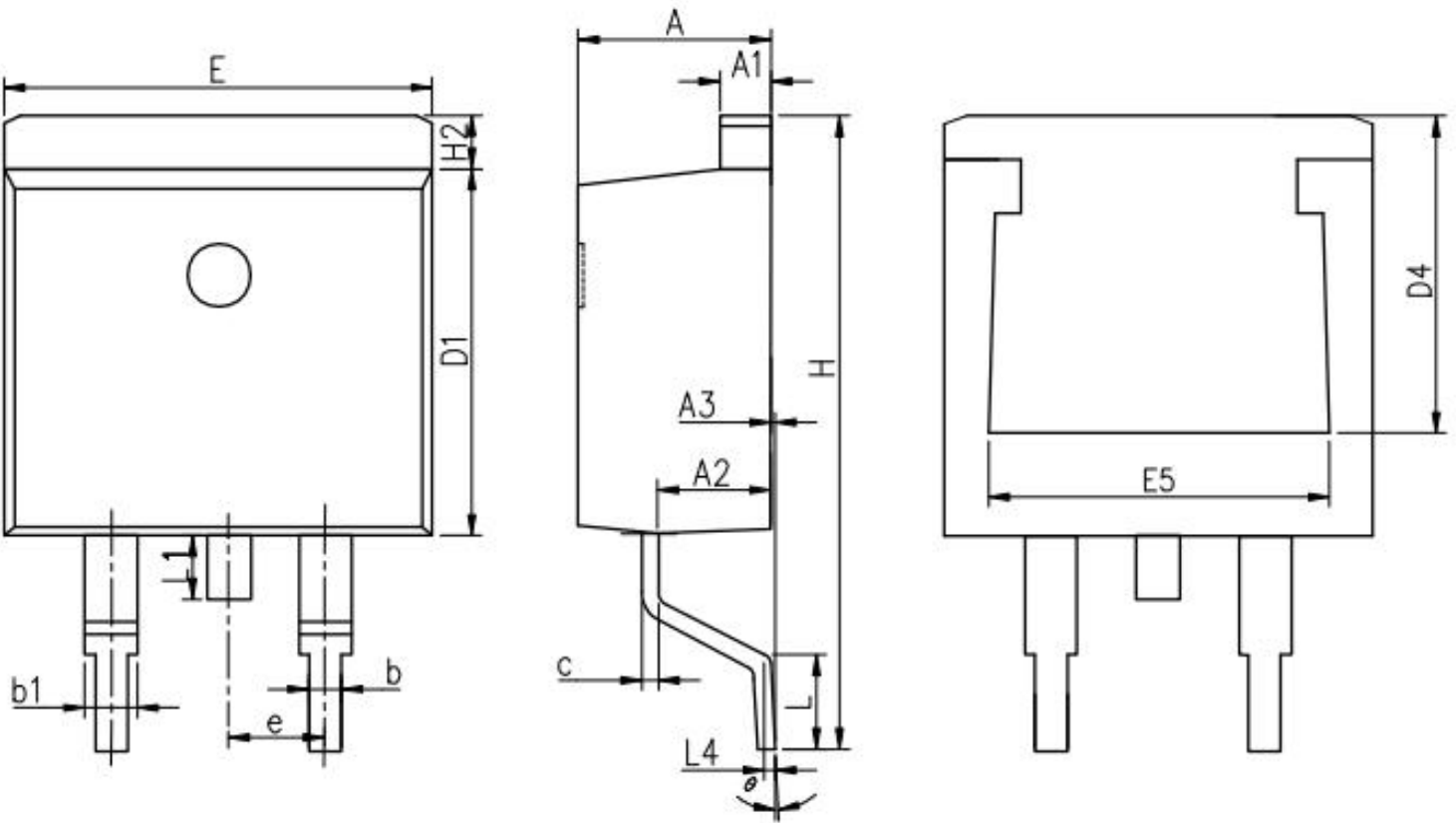
Unit:mm			
Symbol	Min.	Nom	Max.
E	9.96	10.16	10.36
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A2	0.30	0.45	0.60
A4	2.56	2.76	2.96
c	0.40	0.50	0.65
c1	1.20	1.30	1.35
D	15.57	15.87	16.17
H1	6.70REF		

Unit:mm			
Symbol	Min.	Nom	Max.
e	2.54BSC		
L	12.68	12.98	13.28
L1	2.93	3.03	3.13
$\Phi P$	3.03	3.18	3.38
$\Phi P3$	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)

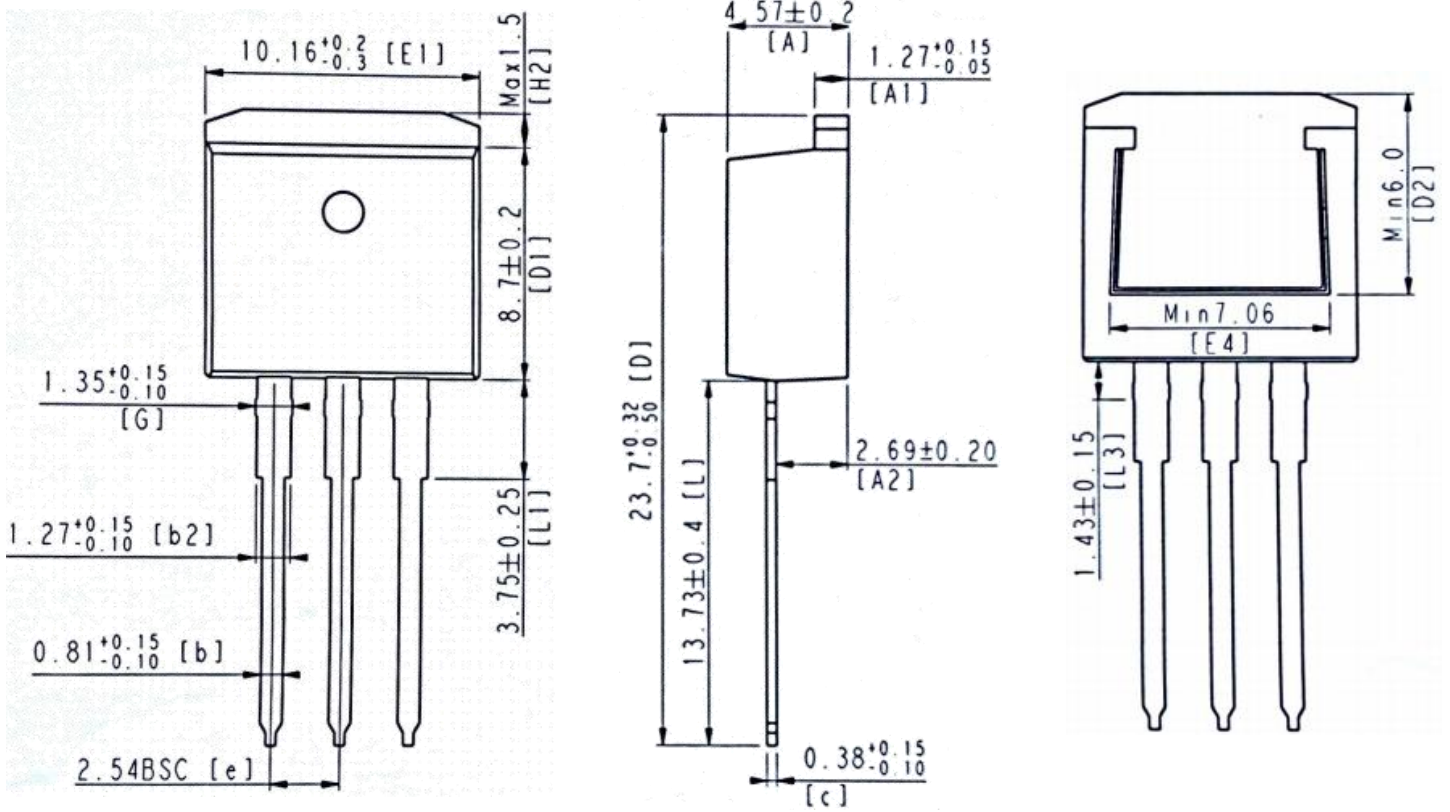


Unit:mm			
Symbol	Min.	Nom	Max.
A	4.37	4.57	4.77
A1	1.22	1.27	1.42
A2	2.49	2.69	2.89
A3	0.00	0.13	0.25
b	0.70	0.81	0.96
b1	1.17	1.27	1.47
c	0.30	0.38	0.53
D1	8.50	8.70	8.90
D4	6.60	-	-

Unit:mm			
Symbol	Min.	Nom	Max.
E	9.86	10.16	10.36
E5	7.06	-	-
e	2.54BSC		
H	14.70	15.10	15.50
H2	1.07	1.27	1.47
L	2.00	2.30	2.60
L1	1.40	1.55	1.70
L4	0.25BSC		
$\theta$	0°	5°	9°

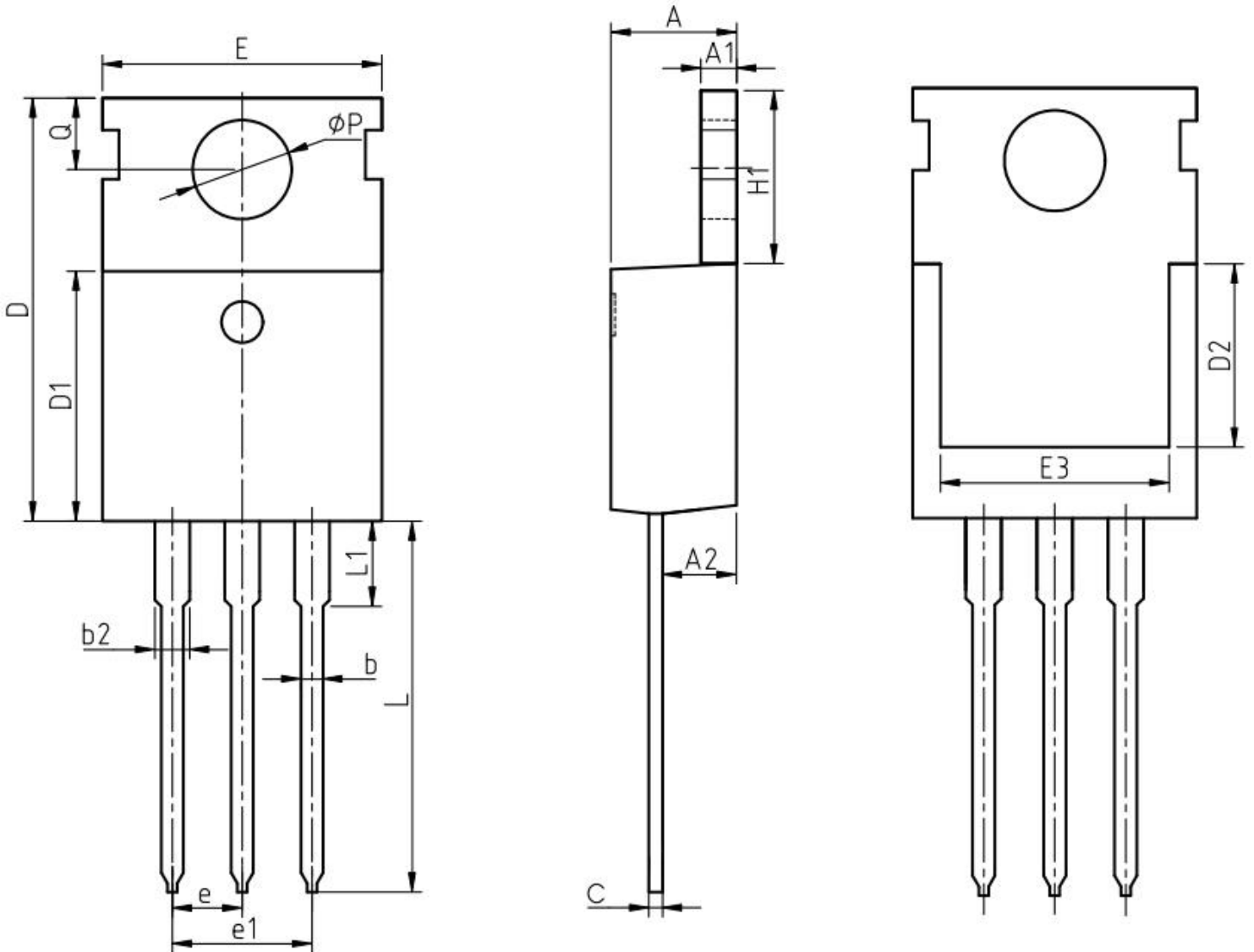


## TO-262 (华羿)





TO-220 (华羿)

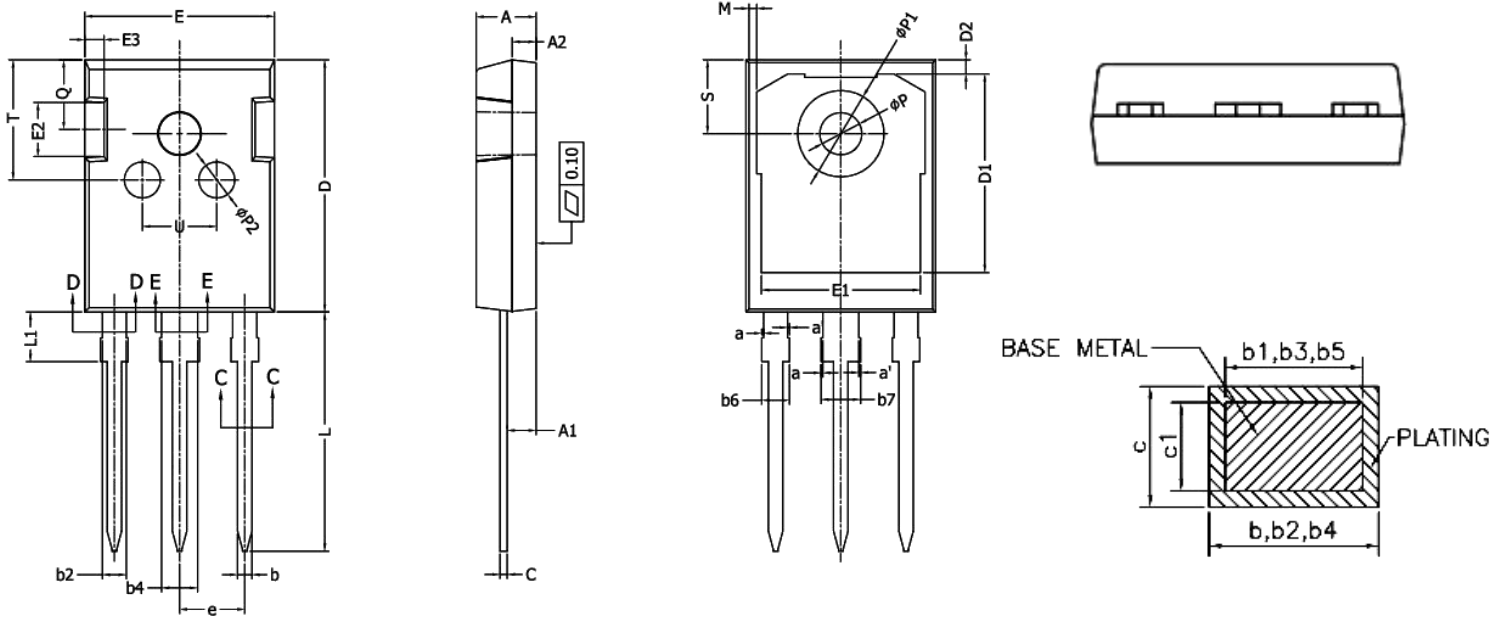


Unit:mm			
Symbol	Min.	Nom	Max.
A	4.37	4.57	4.70
A1	1.25	1.30	1.40
A2	2.20	2.40	2.60
b	0.70	0.80	0.95
b2	1.17	1.27	1.47
c	0.45	0.50	0.60
D	15.10	15.60	16.10
D1	8.80	9.10	9.40
D2	5.50	-	-

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 (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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