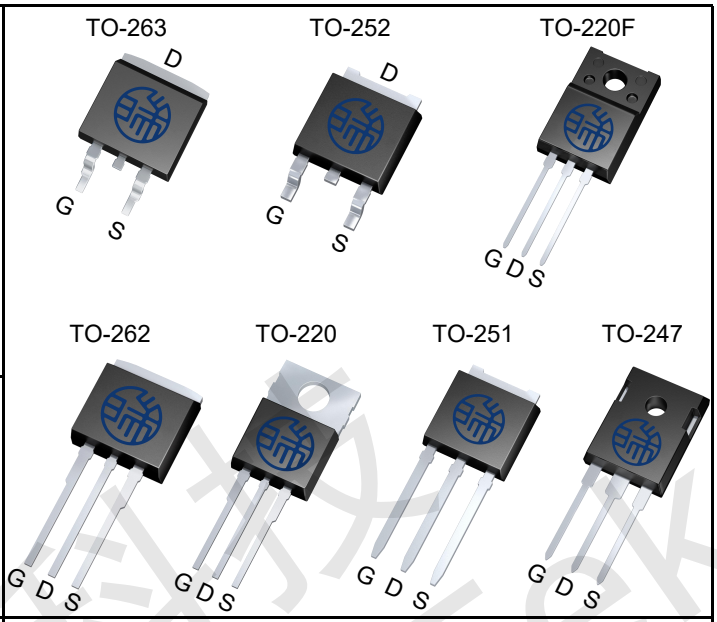
650V Super-junction Power MOSFET Gen Ⅲ

Description

650V Super-junction MOSFET Gen Ⅲ

Super-junction MOSFET Gen Ⅲ is designed by HR-Micro Semiconductor Company,according to the SJ principle.This device provide an excellent Gate charge and Rds(on),which leads to extremely communication and conduction losses .So it is very suitable for AC/DC power conversion, Laptop adapter, Lighting, and industrial power applications.

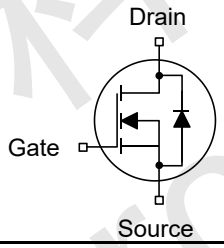


Features

- 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



RoHS

Key Performance Parameters

Parameter	Value	Unit
V_{DS} @ $T_{j,max}$	700	V
$R_{DS(on),max}$	0.16	Ω
$Q_{g,typ}$	32.9	nC
I_D	21	A
$I_{D,pulse}$	63	A
E_{OSS} @ 400V	4.14	μJ
Body Diode di_F/dt	500	A/μs

Device Marking and Package Information

Device	Package	Marking
HRD65T160B	TO-263	D65T160B
HRD65T160D	TO-252	D65T160D
HRD65T160F	TO-220F	D65T160F
HRD65T160L	TO-262	D65T160L
HRD65T160P	TO-220	D65T160P
HRD65T160U	TO-251	D65T160U
HRD65T160W	TO-247	D65T160W

Absolute Maximum Ratings T_C = 25ºC, unless otherwise noted				
Parameter		**Symbol**	**Value**	**Unit**
Drain-Source voltage(V_{GS}=0V)		V_{DS}	650	V
Continuous Drain Current[1]	T_C = 25ºC	I_D	21	A
	T_C = 100ºC		12.6	
Pulsed Drain Current[2]		$I_{D,pulse}$	63	A
Gate-Source Voltage		V_{GS}	±30	V
Single Pulse Avalanche Energy		E_{AS}	497	mJ
Repetitive Avalanche Energy		E_{AR}	0.75	mJ
Avalanche Current		I_{AR}	4.1	A
MOSFET dv/dt Ruggedness, V_{DS} = 0...480V		dv/dt	50	V/ns
Power Dissipation For TO-263、TO-252、TO-262、TO-220、TO-251、TO-247		P_D	176	W
Power Dissipation For TO-220F			34	
Continuous Diode Forward Current		I_S	17.9	A
Diode Pulsed Current[2]		$I_{S,pulse}$	63	
Reverse Diode dv/dt[3]		dv/dt	15	V/ns
Maximum Diode Commutation Speed		di_f/dt	500	A/μs
Operating Junction and Storage Temperature Range		T_J, T_{stg}	-55~+150	ºC

Thermal Resistance For TO-263、TO-252、TO-262、TO-220、TO-251、TO-247			
Parameter	**Symbol**	**Value**	**Unit**
Thermal Resistance, Junction-to-Case	R_{thJC}	0.71	ºC/W
Thermal Resistance, Junction-to-Ambient	R_{thJA}	62	

Thermal Resistance For TO-220F			
Parameter	**Symbol**	**Value**	**Unit**
Thermal Resistance, Junction-to-Case	R_{thJC}	3.67	ºC/W
Thermal Resistance, Junction-to-Ambient	R_{thJA}	80	

Notes

1) Limited by maximum junction temperature.

2) Repetitive Rating: Pulse width limited by maximum junction temperature.

3) Identical low side and high side switch with identical R_G.

Electrical Characteristics T_J = 25ºC, 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 = 25ºC	--	--	1	μA
		V_{DS} = 650V, V_{GS} = 0V, T_J = 150ºC	--	--	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	3	3.5	4	V
Drain-Source On-State-Resistance	$R_{DS(on)}$	V_{GS} = 10V, I_D = 10.5A	--	0.13	0.16	Ω
Gate Resistance	R_G	f = 1.0MHz open drain	--	2.7	--	Ω
Dynamic Characteristics						
Input Capacitance	C_{iss}	V_{GS} = 0V, V_{DS} = 100V f = 1.0MHz	--	1517	--	pF
Output Capacitance	C_{oss}		--	51.4	--	
Reverse Transfer Capacitance	C_{rss}		--	2.3	--	
Total Gate Charge	Q_g	V_{DD} = 520V , I_D = 21A V_{GS} = 10V	--	32.9	--	nC
Gate-Source Charge	Q_{gs}		--	9.9	--	
Gate-Drain Charge	Q_{gd}		--	9.8	--	
Gate Plateau Voltage	$V_{Plateau}$		--	5.67	--	V
Turn-on Delay Time	$t_{d(on)}$	V_{DD} = 400V,I_D = 21A R_G = 15Ω,V_{GS} = 10V	--	13	--	ns
Turn-on Rise Time	t_r		--	13	--	
Turn-off Delay Time	$t_{d(off)}$		--	96	--	
Turn-off Fall Time	t_f		--	8	--	
Drain-Source Body Diode Characteristics						
Body Diode Forward Voltage	V_{SD}	T_J = 25ºC, I_{SD} = 10.5A, V_{GS} = 0V	--	0.9	1.2	V
Reverse Recovery Time	t_{rr}	V_R = 400V I_F = 10.5A, di_F/dt = 100A/μs	--	300	--	ns
Reverse Recovery Charge	Q_{rr}		--	3.3	--	μC
Peak Reverse Recovery Current	I_{rrm}		--	22	--	A

Typical Characteristics T_J = 25ºC, unless otherwise noted

Figure 1. Transient Thermal Impedance For TO-263/TO-252/TO-262/TO-220/TO-251/TO247

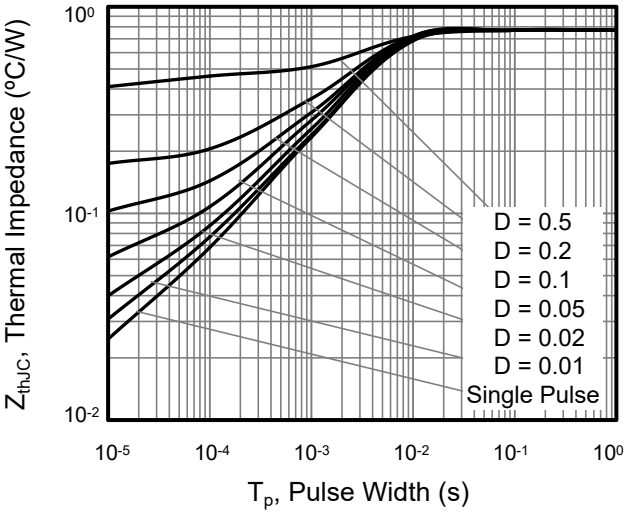


Figure 2. Transient Thermal Impedance For TO-220F

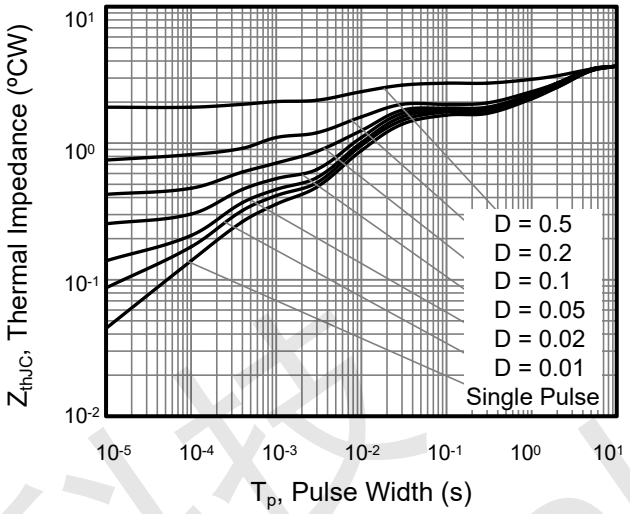


Figure 3. Safe Operation Area For TO-263/TO-252/TO-262/TO-220/TO-251/TO-247

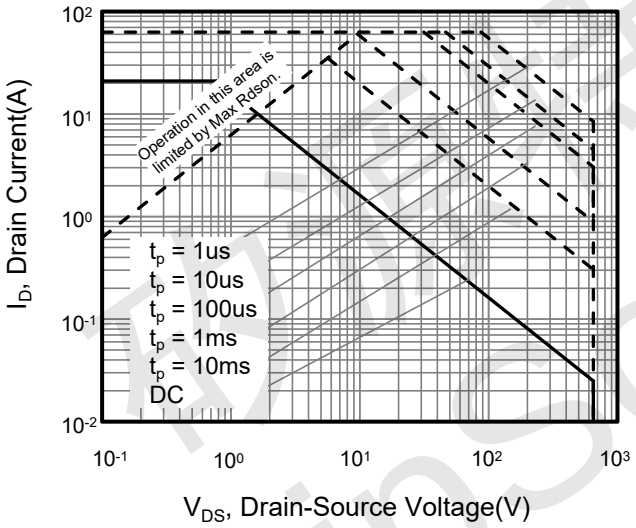


Figure 4. Safe Operation Area For TO-220F

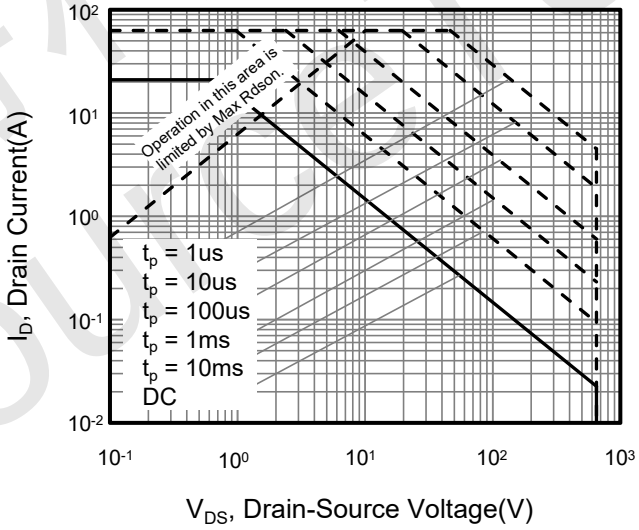


Figure 5. Output Characteristics

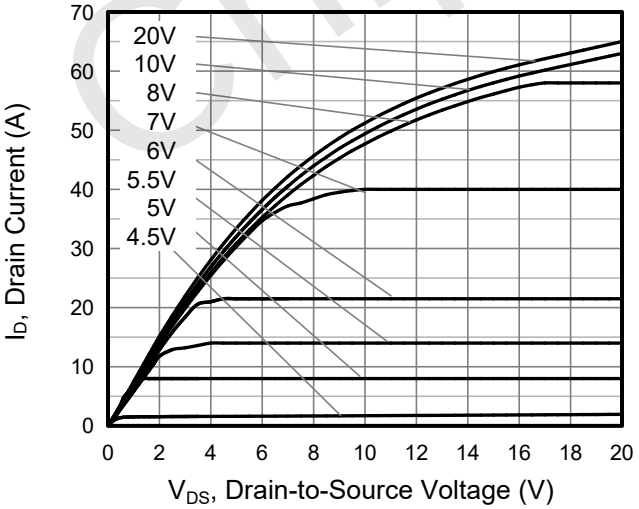
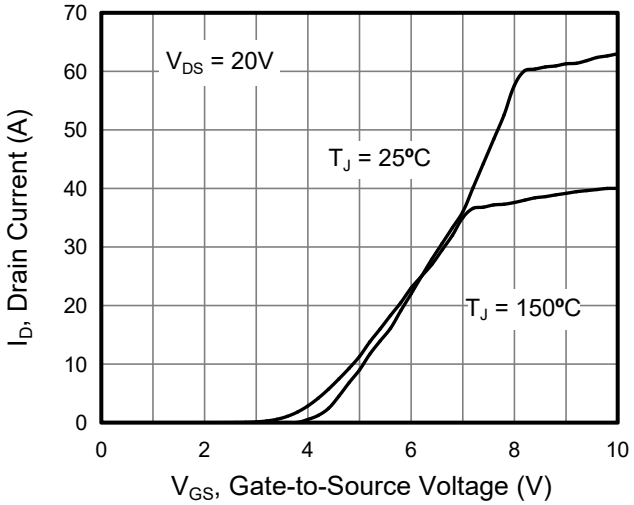


Figure 6. Transfer Characteristics



Typical Characteristics T_J = 25ºC, unless otherwise noted

Figure 7. On-Resistance vs. Drain Current

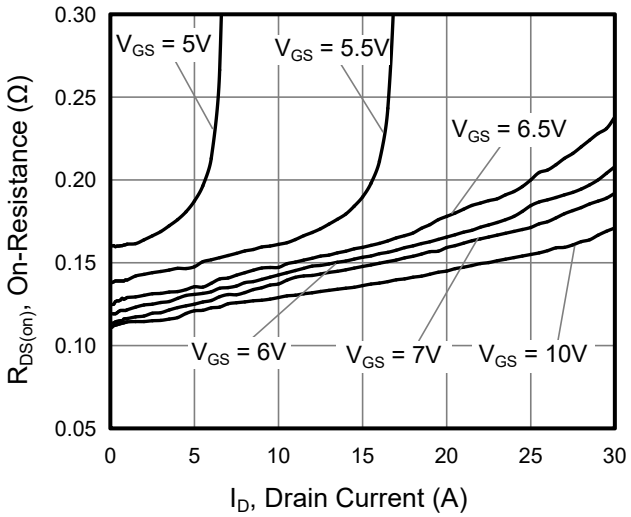


Figure 8. Capacitance

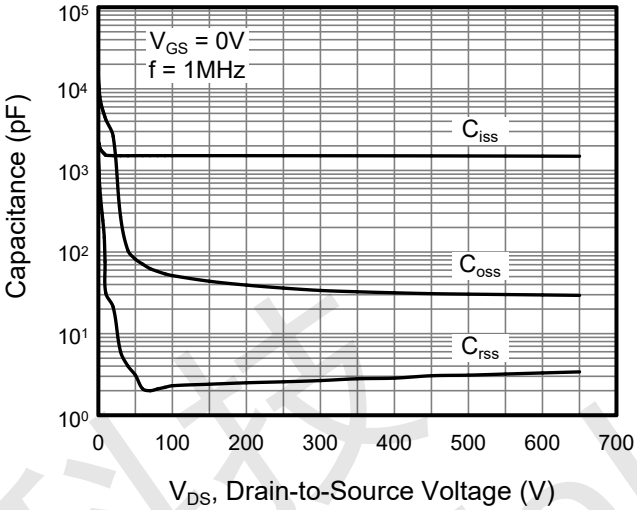


Figure 9. Gate Charge

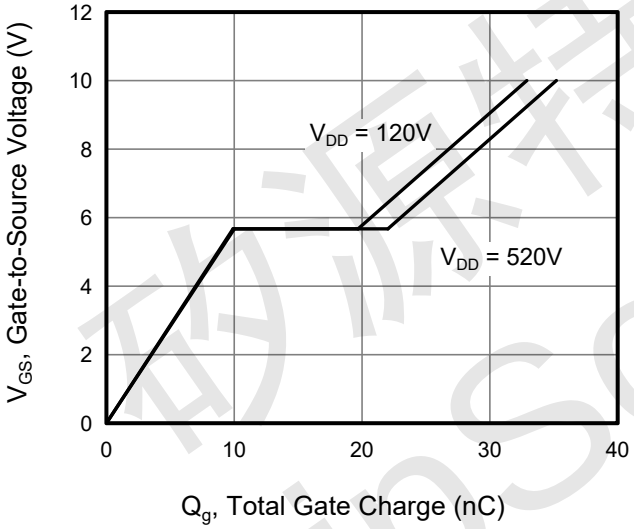


Figure 10. Body Diode Forward Voltage

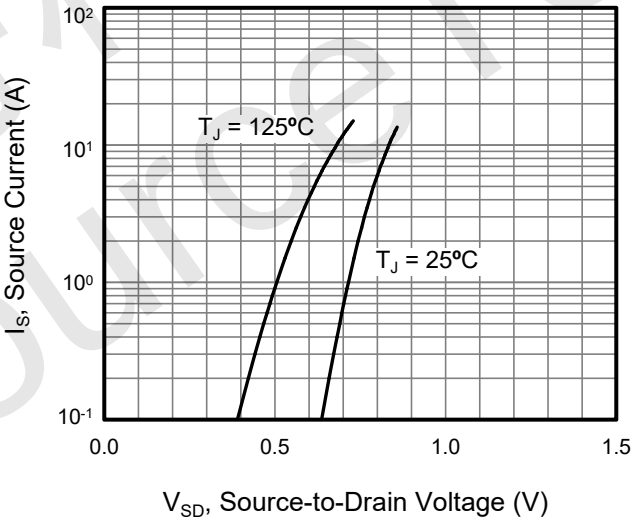


Figure 11. Typ. Coss Stored Energy

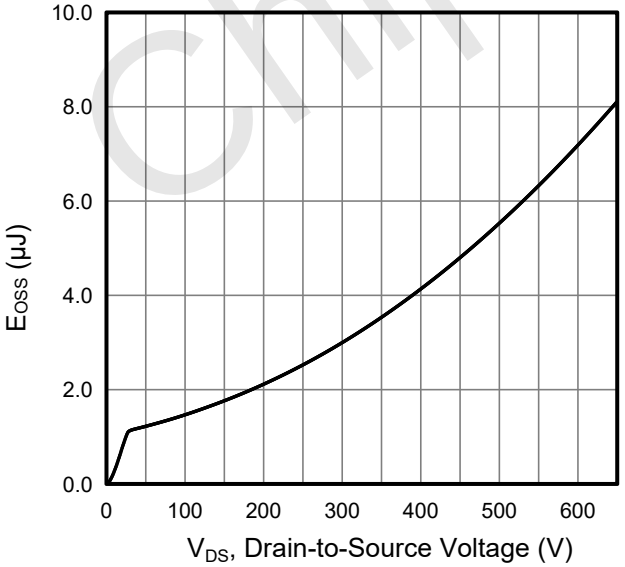
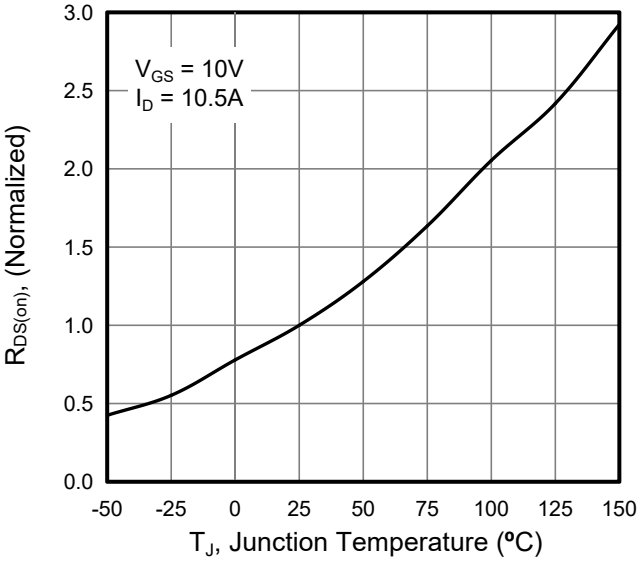


Figure 12. On-Resistance vs. Temperature



Typical Characteristics T_J = 25ºC, unless otherwise noted

Figure 13. Breakdown Voltage vs. Junction Temperature

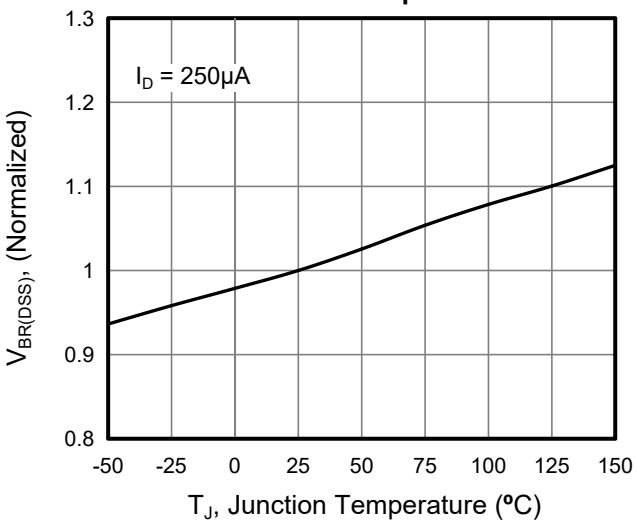


Figure A：Gate Charge Test Circuit and Waveform

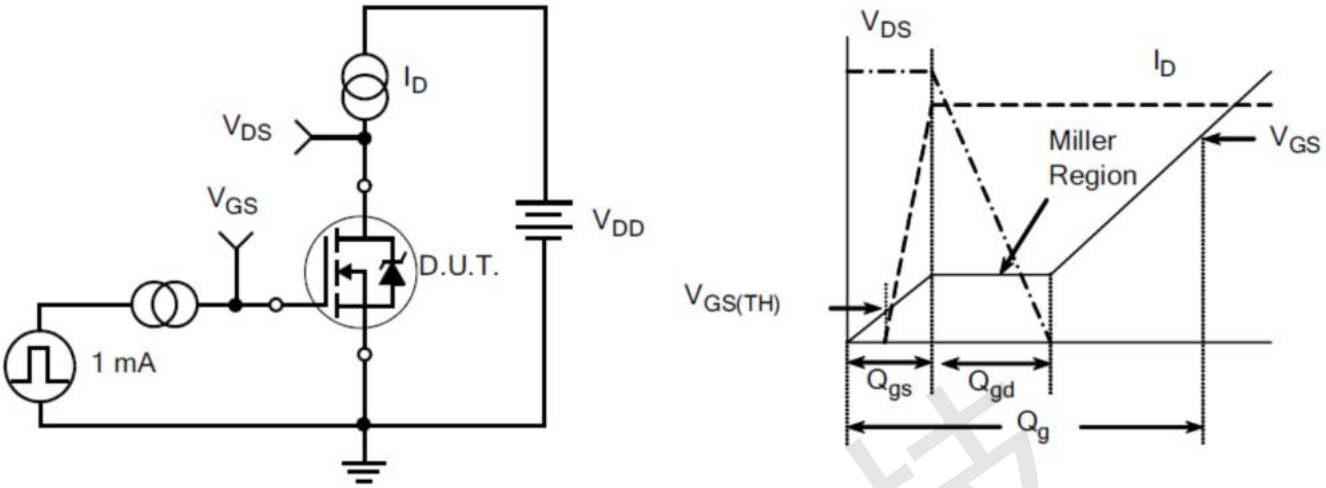


Figure B：Resistive Switching Test Circuit and Waveform

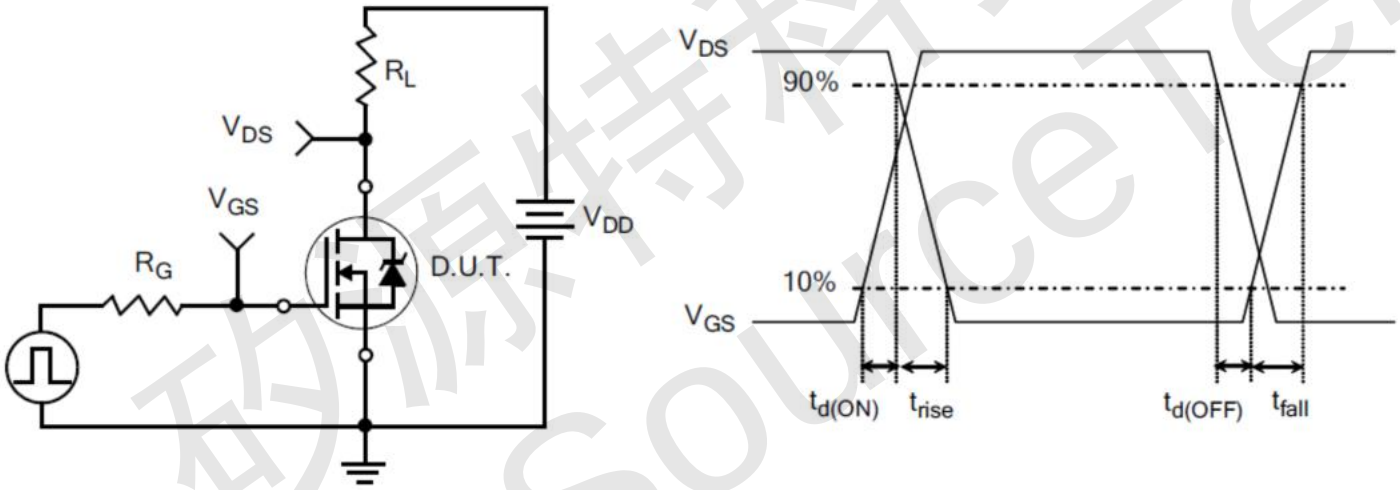
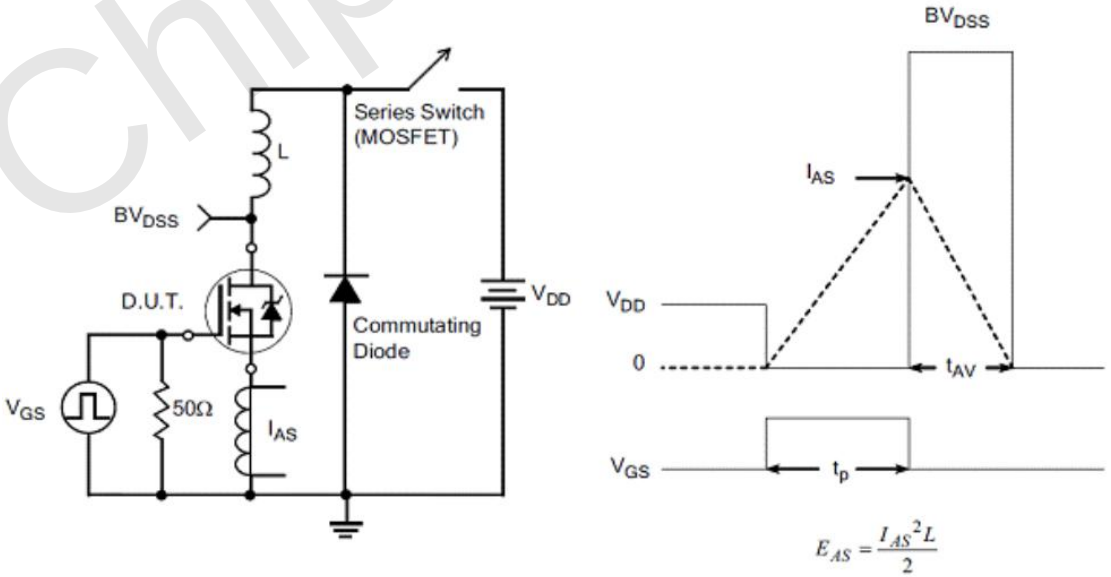
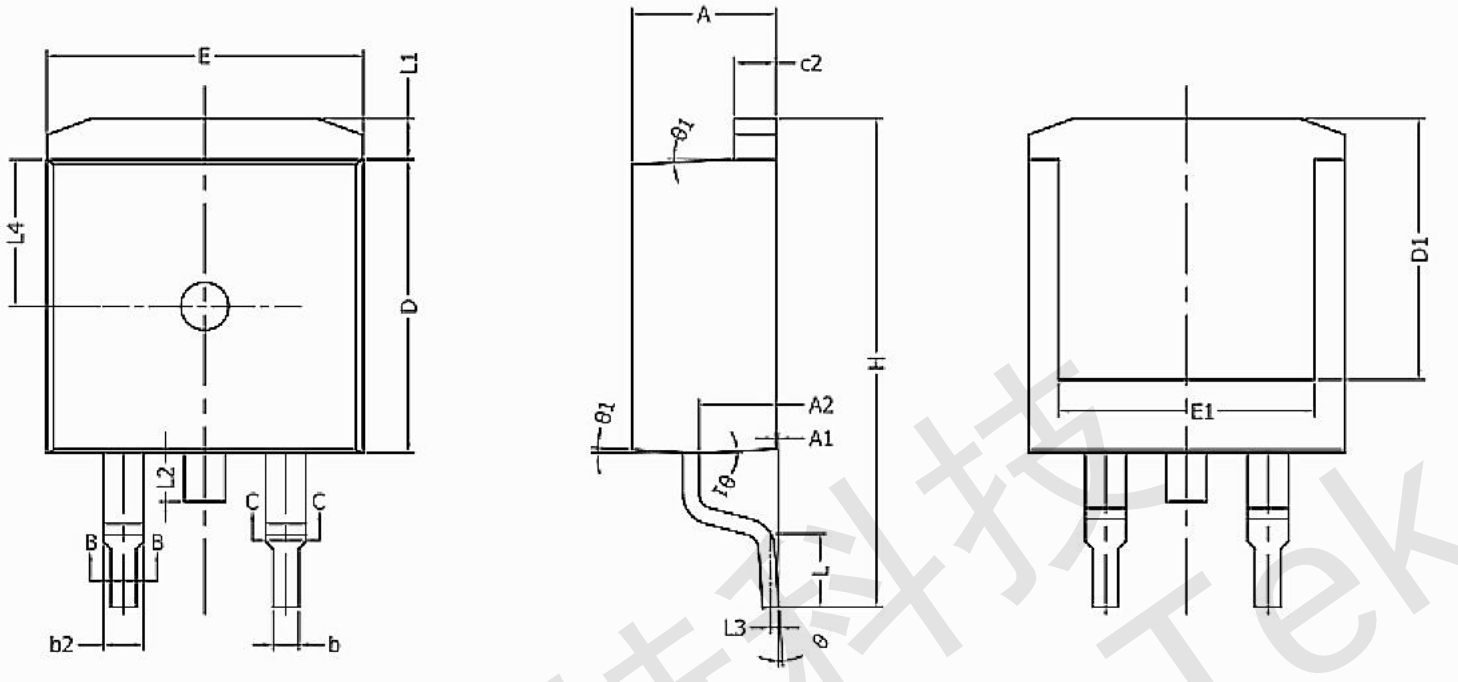


Figure C：Unclamped Inductive Switching Test Circuit and Waveform



$$E_{AS} = \frac{I_{AS}^2 L}{2}$$

TO-263

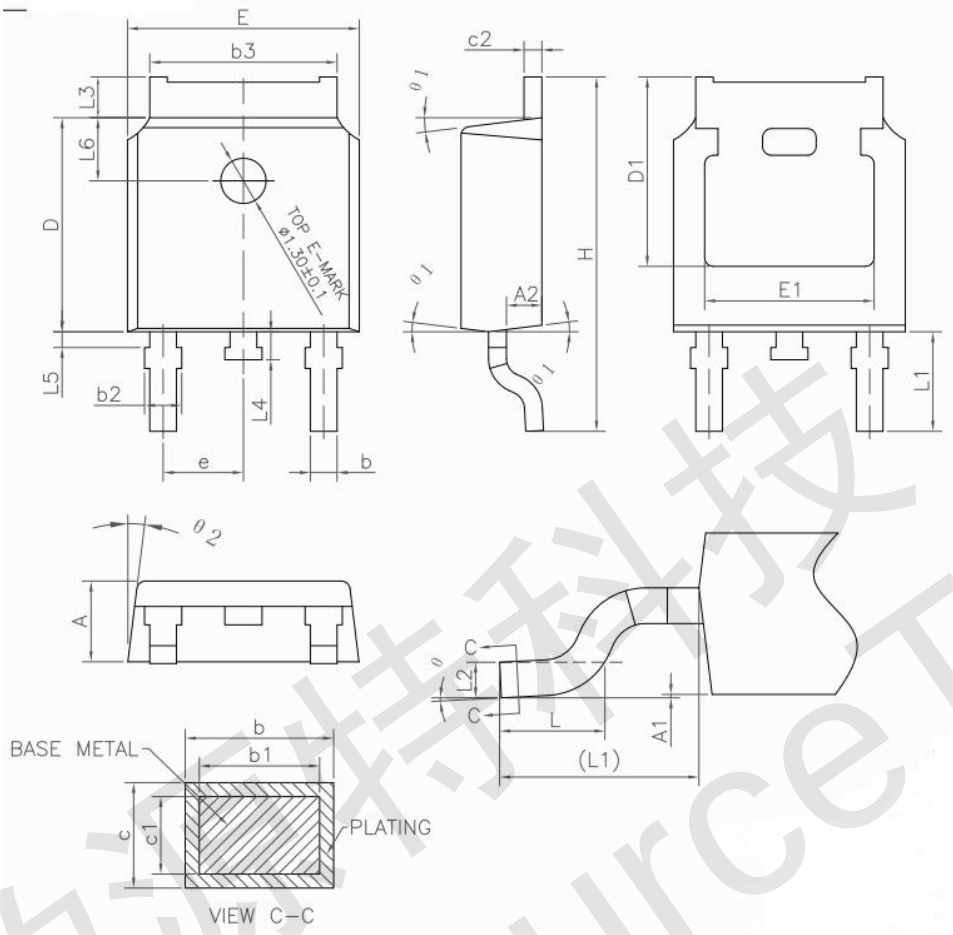


Unit:mm			
Symbol	**Min.**	**Nom**	**Max.**
A	4.40	4.50	4.60
A1	0	0.10	0.25
A2	2.20	2.40	2.60
b	0.76	---	0.89
b1	0.75	0.80	0.85
b2	1.23	---	1.37
b3	1.22	1.27	1.32
c	0.47	---	0.60
c1	0.46	0.51	0.56
c2	1.25	1.30	1.35
D	9.10	9.20	9.30

Unit:mm			
Symbol	**Min.**	**Nom**	**Max.**
D1	8.00	---	---
E	9.80	9.90	10.00
E1	7.80	---	---
e	2.54 BSC		
H	14.90	15.30	15.70
L	2.00	2.30	2.60
L1	1.17	1.27	1.40
L2	---	---	1.75
L3	0.25 BSC		
L4	4.60 REF		
θ	0°	---	8°
θ1	1°	3°	5°

Ordering information For TO-263					
Package	**Units/Tape**	**Tapes/ Inner Box**	**Units/Inner Box**	**Inner Box/Carton Box**	**Units/Carton Box**
TO-263	800	1	800	10	8000

TO-252



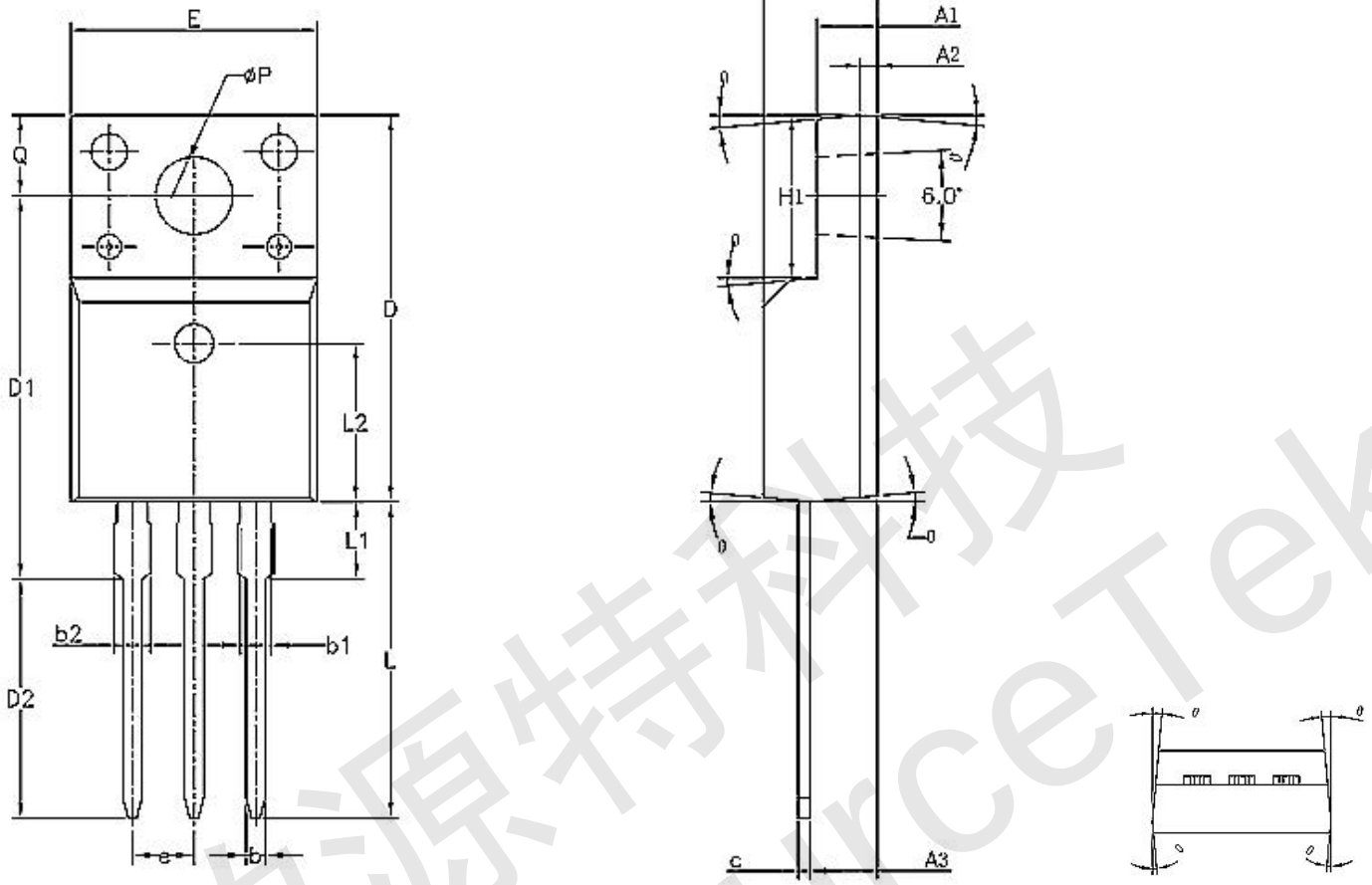
Unit:mm			
Symbol	**Min.**	**Nom**	**Max.**
A	2.20	2.30	2.38
A1	0.00	-	0.20
A2	0.90	1.01	1.10
b	0.72	--	0.85
b1	0.71	0.76	0.81
b2	0.72	--	0.90
b3	5.13	5.33	5.46
c	0.47	--	0.60
c1	0.46	0.51	0.56
c2	0.47	--	0.60
D	6.00	6.10	6.20
D1	5.25	--	--
E	6.50	6.60	6.70

Unit:mm			
Symbol	**Min.**	**Nom**	**Max.**
E1	4.70	--	--
e	2.186	2.286	2.386
H	9.80	10.10	10.40
L	1.40	1.50	1.70
L1	2.90 REF		
L2	0.508 BSC		
L3	0.90	--	1.25
L4	0.60	0.80	1.00
L5	0.15	--	0.75
L6	1.80 REF		
θ	0°	-	8°
θ1	5°	7°	9°
θ2	5°	7°	9°

Ordering information For TO-252

Package	Units/Tape	Tapes/ Inner Box	Units/Inner Box	Inner Box/Carton Box	Units/Carton Box
TO-252	2500	2	5000	5	25000

TO-220F



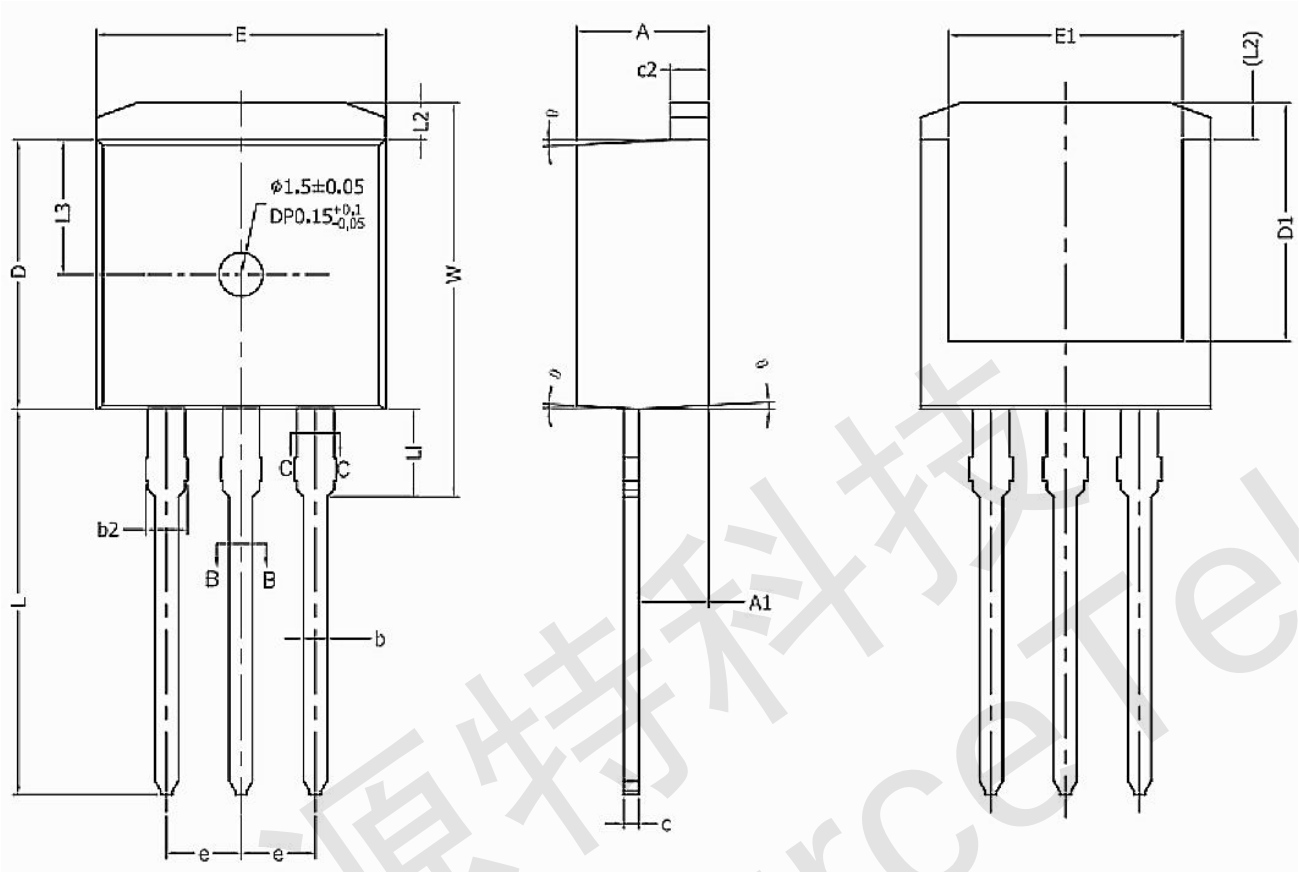
Unit:mm			
Symbol	Min.	Nom	Max.
A	4.50	4.70	4.83
A1	2.34	2.54	2.74
A2	0.70 REF		
A3	2.56	2.76	2.93
b	0.70	---	0.90
b1	1.18	---	1.38
b2	---	---	1.47
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.55	15.75	15.95

Unit:mm			
Symbol	Min.	Nom	Max.
D2	9.60	9.80	10.0
E	9.96	10.16	10.36
e	2.54 BSC		
H1	6.48	6.68	6.88
L	12.68	12.98	13.28
L1	---	---	3.50
L2	6.50 REF		
ΦP	3.08	3.18	3.28
Q	3.20	---	3.40
θ1	1°	3°	5°

Ordering information For TO-220F

Package	Units/Tube	Tubes/ Inner Box	Units/Inner Box	Inner Box/Carton Box	Units/Carton Box
TO-220F	50	40	2000	4	8000

TO-262

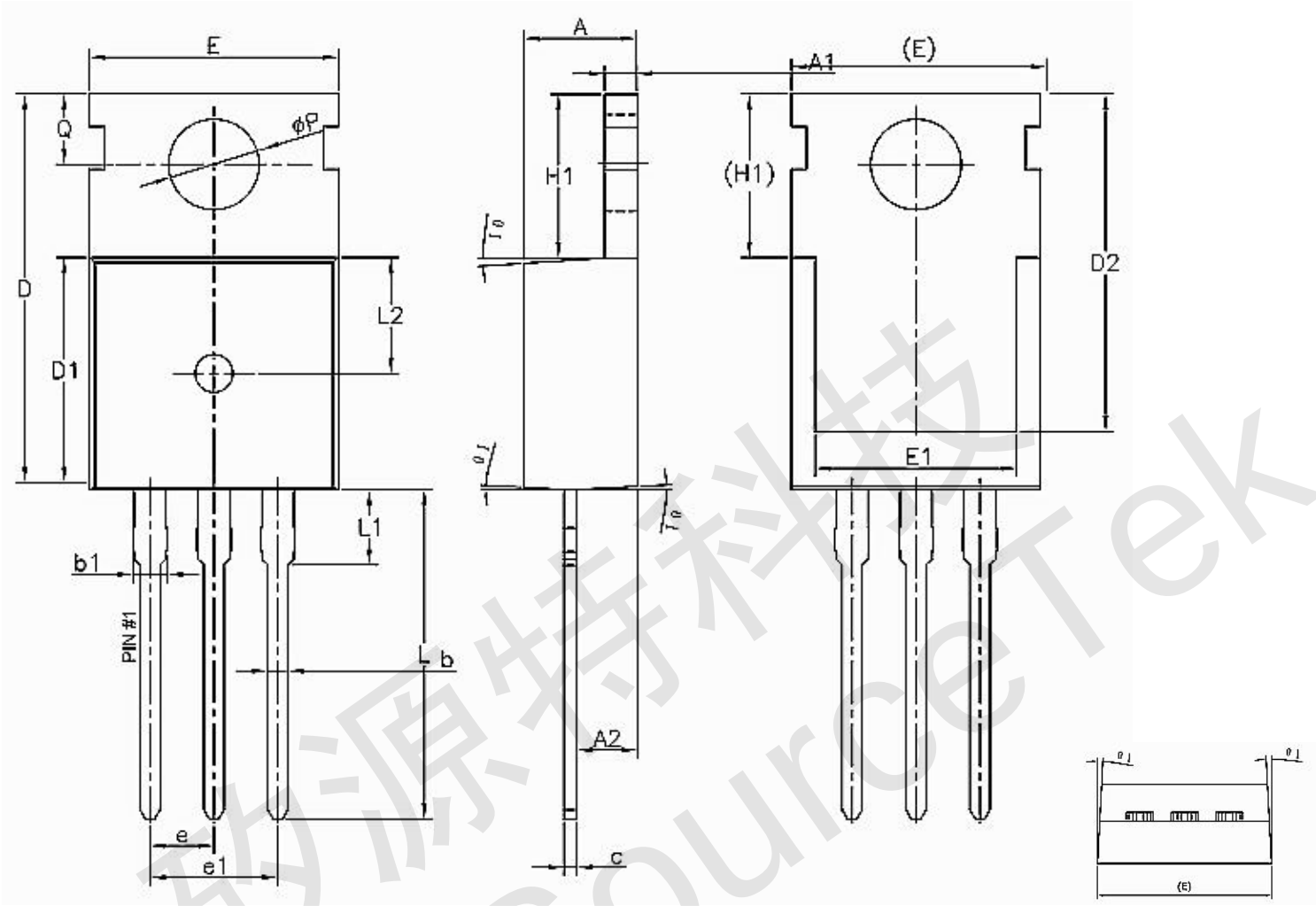


Unit:mm			
Symbol	Min.	Nom	Max.
A	4.40	4.50	4.60
A1	2.20	2.40	2.60
b	0.76	---	0.89
b1	0.75	0.80	0.85
b2	1.23	---	1.37
b3	1.22	1.27	1.32
c	0.47	---	0.60
c1	0.46	0.51	0.56
c2	1.25	1.30	1.35
D	9.10	9.20	9.30

Unit:mm			
Symbol	Min.	Nom	Max.
D1	8.00	---	---
E	9.80	9.90	10.00
E1	7.80	---	---
e	2.54 BSC		
L	12.90	13.20	13.50
L1	2.80	3.00	3.20
L2	1.17	1.27	1.40
L3	4.60 REF		
W	13.25	---	14.00
θ	1°	3°	5°

Ordering information For TO-262					
Package	Units/Tube	Tubes/ Inner Box	Units/Inner Box	Inner Box/Carton Box	Units/Carton Box
TO-262	50	40	2000	4	8000

TO-220



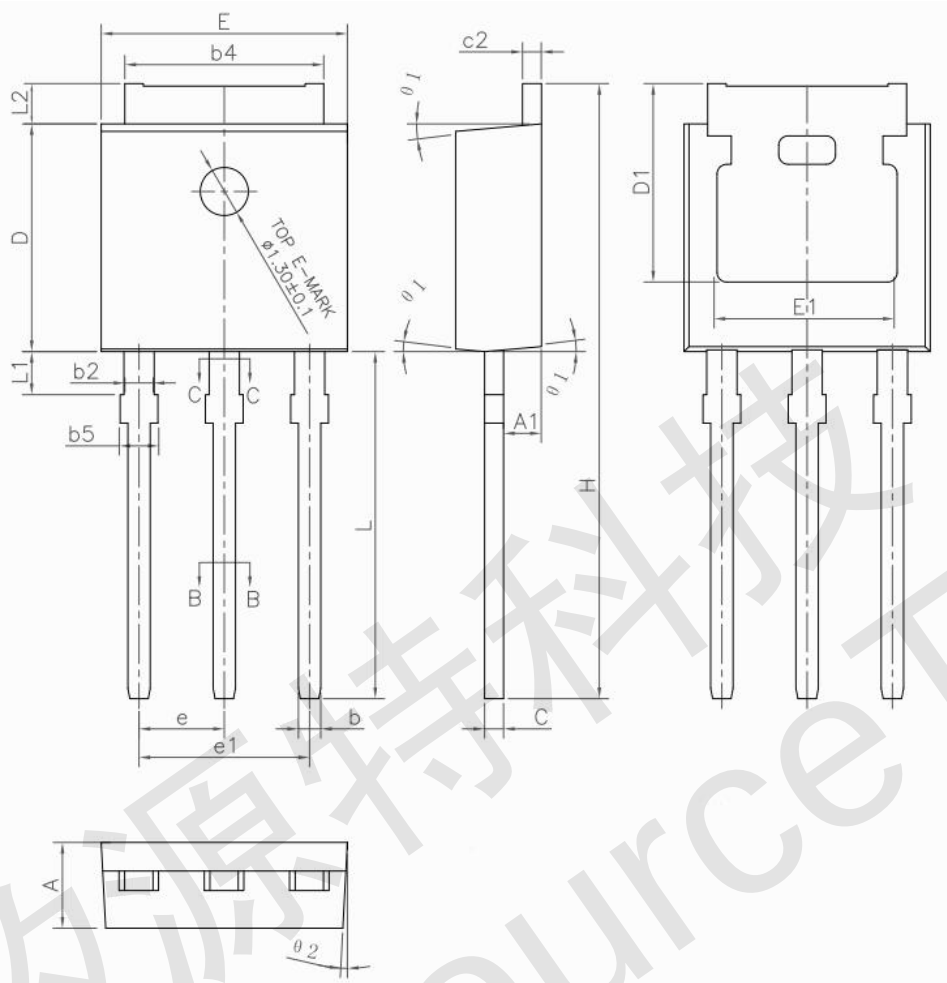
Unit:mm			
Symbol	Min.	Nom	Max.
A	4.40	4.50	4.60
A1	1.27	1.30	1.33
A2	2.30	2.40	2.50
b	0.70	---	0.90
b2	1.27	---	1.40
c	0.45	0.50	0.60
D	15.30	15.70	16.10
D1	9.10	9.20	9.30
D2	13.10	---	13.70
E	9.70	9.90	10.20

Unit:mm			
Symbol	Min.	Nom	Max.
E1	7.80	8.00	8.20
e	2.54 BSC		
e1	5.08 BSC		
H1	6.30	6.50	6.70
L	12.78	13.08	13.38
L1	---	---	3.50
L2	4.60 REF		
ΦP	3.55	3.60	3.65
Q	2.73	---	2.87
θ1	1°	3°	5°

Ordering information For TO-220

Package	Units/Tube	Tubes/ Inner Box	Units/Inner Box	Inner Box/Carton Box	Units/Carton Box
TO-220	50	40	2000	4	8000

TO-251



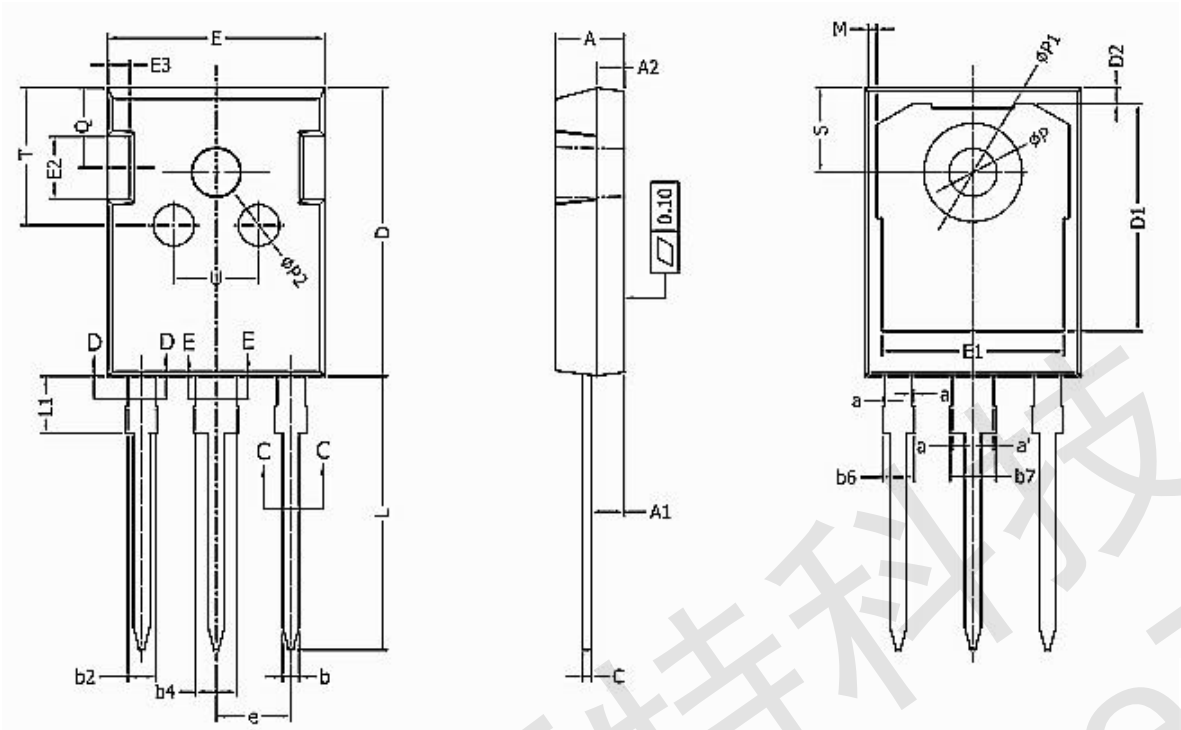
Unit:mm			
Symbol	Min.	Nom	Max.
A	2.20	2.30	2.35
A1	0.90	1.01	1.10
b	0.56	--	0.69
b1	0.55	0.60	0.65
b2	0.77	--	0.90
b3	0.76	0.81	0.86
b4	5.23	5.33	5.43
b5	--	--	1.05
c	0.46	--	0.59
c1	0.45	0.51	0.55
c2	0.46	--	0.59
D	6.00	6.10	6.20

Unit:mm			
Symbol	Min.	Nom.	Max.
D1	5.20	--	--
E	6.50	6.60	6.70
E1	4.60	4.83	5.00
e	2.24	2.29	2.34
e1	4.47	4.57	4.67
H	16.18	16.48	16.78
L	9.00	9.30	9.60
L1	0.95	1.16	1.35
L2	0.90	1.08	1.25
θ1	3°	5°	7°
θ2	1°	3°	5°

Ordering information For TO-251

Package	Units/Tube	Tubes/ Inner Box	Units/Inner Box	Inner Box/Carton Box	Units/Carton Box
TO-251	75	120	9000	4	36000

TO-247



Unit:mm			
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

Unit:mm			
Symbol	Min.	Nom.	Max.
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

Ordering information For TO-247					
Package	Units/Tube	Tubes/ Inner Box	Units/Inner Box	Inner Box/Carton Box	Units/Carton Box
TO-247	30	20	600	5	3000

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