

N-Channel Super-junction MOSFET Gen I

MOSFET

Metal Oixde Semiconductor Field Effect Transistor

650V Super-junction Gen I

650V Super-junction Gen I Power Transistor

HRM65R128Fx Data Sheet

Rev. 2020 V2.0



650V Super-junction Power MOSFET Gen I

Description

650V Super-junction MOSFET Gen I

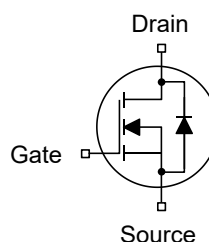
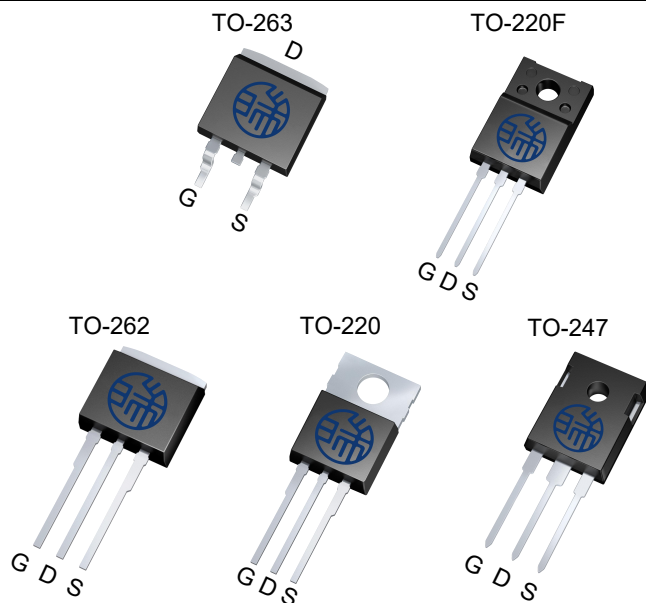
Super-junction MOSFET Gen I is designed by HR-Micro Semiconductor Company, according to the SJ principle. This device provides an excellent Gate charge and $R_{DS(on)}$, which leads to extremely low communication and conduction losses. So it is very suitable for AC/DC power conversion, Laptop adapter,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

Features

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

Applications

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Suitable for hard and soft switching (PFC and high performance LLC)
- Telecom and Solar inverter



Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	700	V
$R_{DS(on),max}$	0.128	Ω
$Q_{g,typ}$	57.0	nC
I_D	30	A
$I_{D,pulse}$	90	A
$E_{OSS} @ 400V$	6.60	μJ
Body Diode di_f/dt	900	A/ μs

Device Marking and Package Information

Device	Package	Marking
HRM65R128FB	TO-263	65R128FB
HRM65R128FF	TO-220F	65R128FF
HRM65R128FL	TO-262	65R128FL
HRM65R128FP	TO-220	65R128FP
HRM65R128FW	TO-247	65R128FW

Absolute Maximum Ratings T _C = 25°C, unless otherwise noted				
Parameter		Symbol	Value	Unit
Drain-Source voltage(V _{GS} =0V)		V _{DS}	650	V
Continuous Drain Current ¹⁾	T _C = 25°C	I _D	30	A
	T _C = 100°C		18	
Pulsed Drain Current ²⁾		I _{D,pulse}	90	A
Gate-Source Voltage		V _{GS}	±30V	V
Single Pulse Avalanche Energy		E _{AS}	636	mJ
Repetitive Avalanche Energy		E _{AR}	0.96	mJ
Avalanche Current		I _{AR}	5.2	A
MOSFET dv/dt Ruggedness, V _{DS} = 0...480V		dv/dt	50	V/ns
Power Dissipation For TO-263、TO-262、TO-220、TO-247		P _D	219	W
Power Dissipation For TO-220F			34	
Continuous Diode Forward Current		I _S	26	A
Diode Pulsed Current ²⁾		I _{S,pulse}	90	
Reverse Diode dv/dt ³⁾		dv/dt	50	V/ns
Maximum Diode Commutation Speed		di _f /dt	900	A/μs
Operating Junction and Storage Temperature Range		T _J , T _{stg}	-55~+150	°C

Thermal Resistance For TO-263、TO-262、TO-220、TO-247			
Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	R_{thJC}	0.57	$^{\circ}\text{C/W}$
Thermal Resistance, Junction-to-Ambient	R_{thJA}	62	

Thermal Resistance For TO-220F			
Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	R_{thJC}	3.65	$^{\circ}\text{C/W}$
Thermal Resistance, Junction-to-Ambient	R_{thJA}	80	

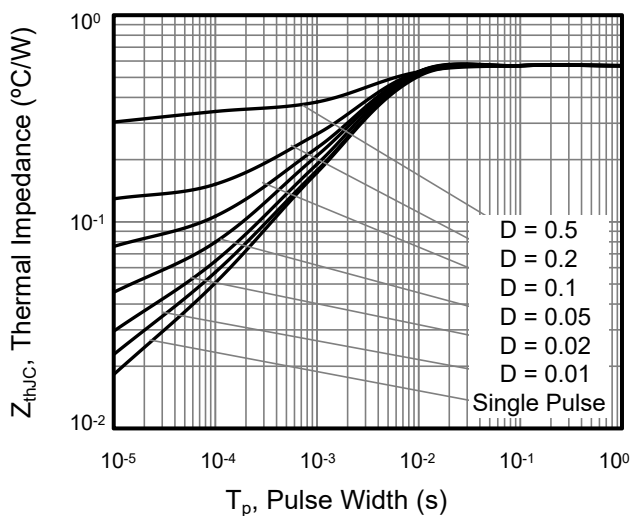
Notes

- 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 .

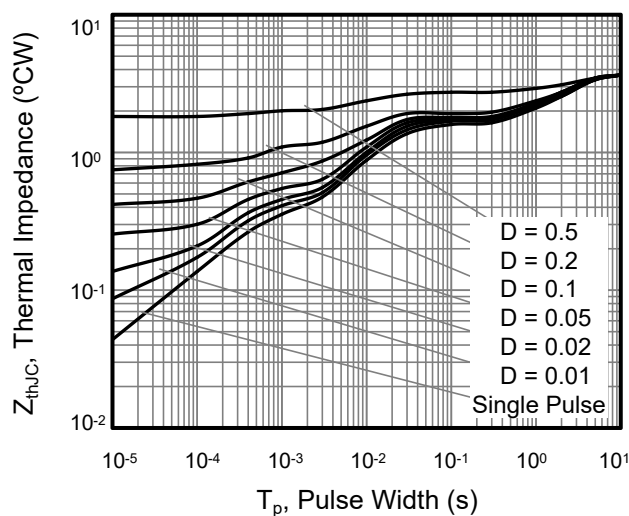
Electrical Characteristics T _J = 25°C, unless otherwise noted						
Parameter	Symbol	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
Static Characteristics						
Drain-Source Breakdown Voltage	V _{(BR)DSS}	V _{GS} = 0V, I _D = 250μA	650	--	--	V
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 650V V _{GS} = 0V, T _J = 25°C	--	--	3	μA
		V _{DS} = 650V, V _{GS} = 0V, T _J = 150°C	--	--	3000	
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	3.0	4.0	5.0	V
Drain-Source On-State-Resistance	R _{DS(on)}	V _{GS} = 10V, I _D = 15A	--	0.110	0.128	Ω
Gate Resistance	R _G	f = 1.0MHz open drain	--	4	--	Ω
Dynamic Characteristics						
Input Capacitance	C _{iss}	V _{GS} = 0V, V _{DS} = 100V f = 1.0MHz	--	2538	--	pF
Output Capacitance	C _{oss}		--	92	--	
Reverse Transfer Capacitance	C _{rss}		--	2.52	--	
Total Gate Charge	Q _g	V _{DD} = 520V , I _D = 30A V _{GS} = 10V	--	57.0	--	nC
Gate-Source Charge	Q _{gs}		--	17.1	--	
Gate-Drain Charge	Q _{gd}		--	22.7	--	
Gate Plateau Voltage	V _{Plateau}		--	6.5	--	V
Turn-on Delay Time	t _{d(on)}	V _{DD} = 400V,I _D = 30A R _G = 15Ω,V _{GS} = 10V	--	15	--	ns
Turn-on Rise Time	t _r		--	10	--	
Turn-off Delay Time	t _{d(off)}		--	60	--	
Turn-off Fall Time	t _f		--	10	--	
Drain-Source Body Diode Characteristics						
Body Diode Forward Voltage	V _{SD}	T _J = 25°C, I _{SD} = 15A, V _{GS} = 0V	--	1.0	1.5	V
Reverse Recovery Time	t _{rr}	V _R = 400V I _F = 15A, di _F /dt = 100A/μs	--	170	--	ns
Reverse Recovery Charge	Q _{rr}		--	1.1	--	μC
Peak Reverse Recovery Current	I _{rrm}		--	13	--	A

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

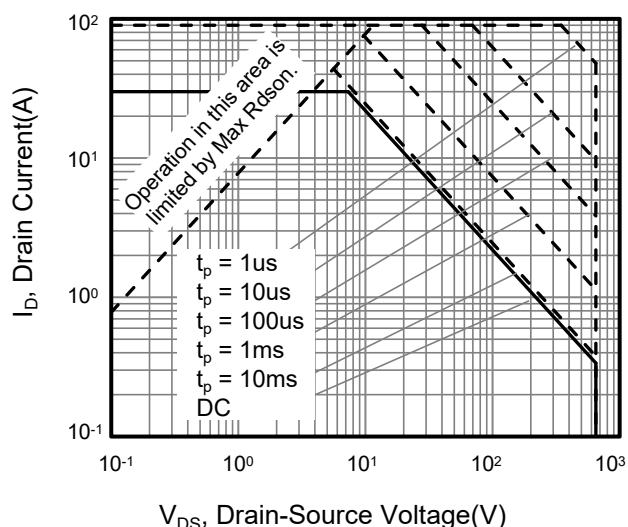
**Figure 1. Transient Thermal Impedance
For TO-263/262/220/247**



**Figure 2. Transient Thermal Impedance
For TO-220F**



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



**Figure 4. Safe Operation Area
For TO-220F**

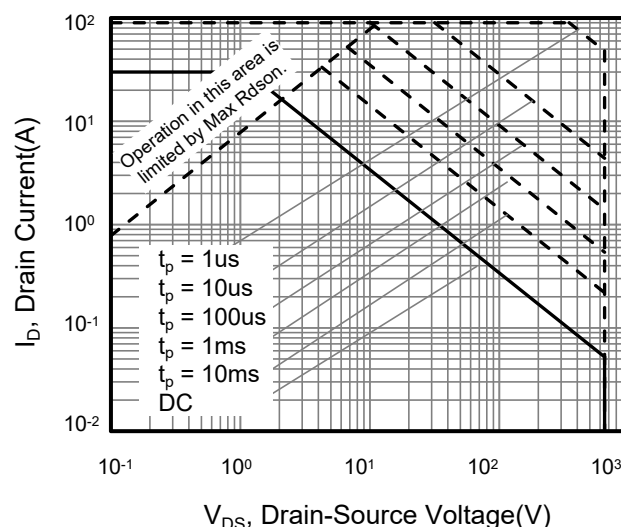


Figure 5. Output Characteristics

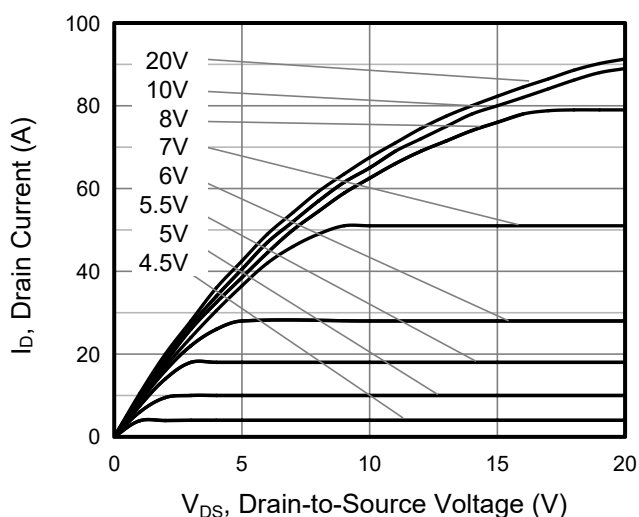
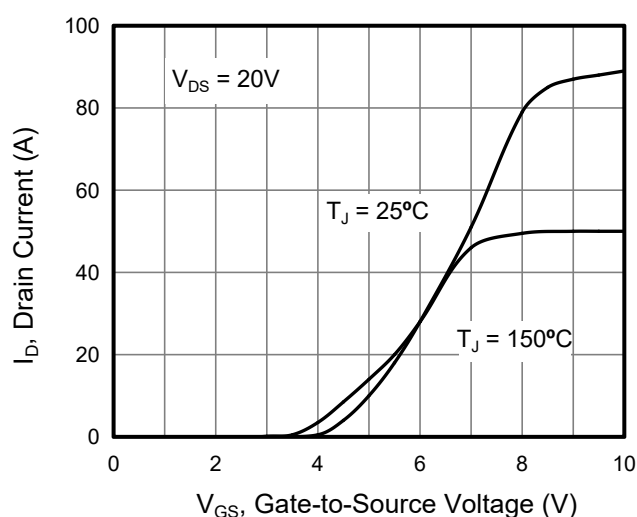


Figure 6. Transfer Characteristics



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

Figure 7. On-Resistance vs. Drain Current

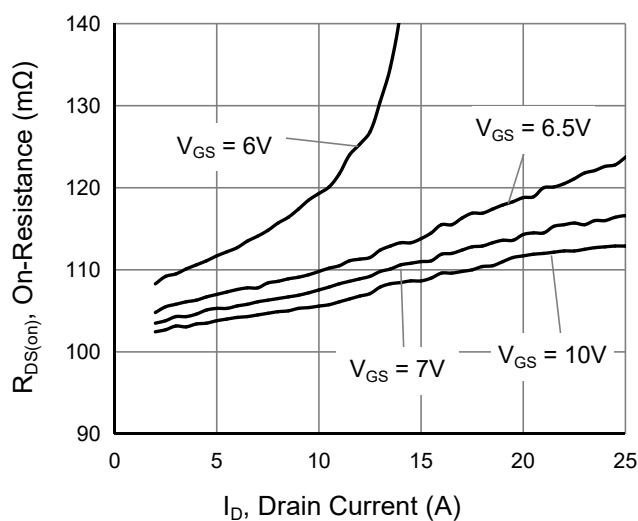


Figure 9. Gate Charge

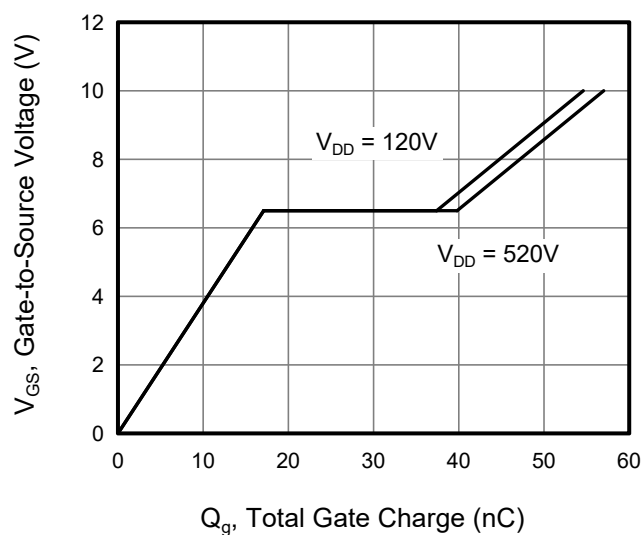


Figure 11. Typ. Coss Stored Energy

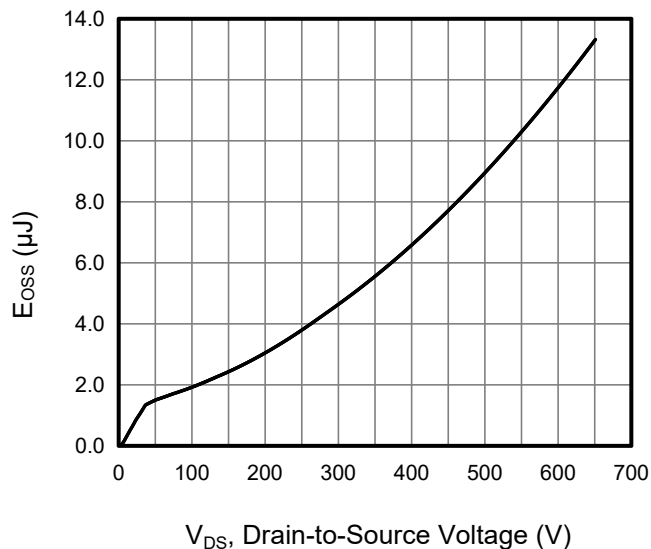


Figure 8. Capacitance

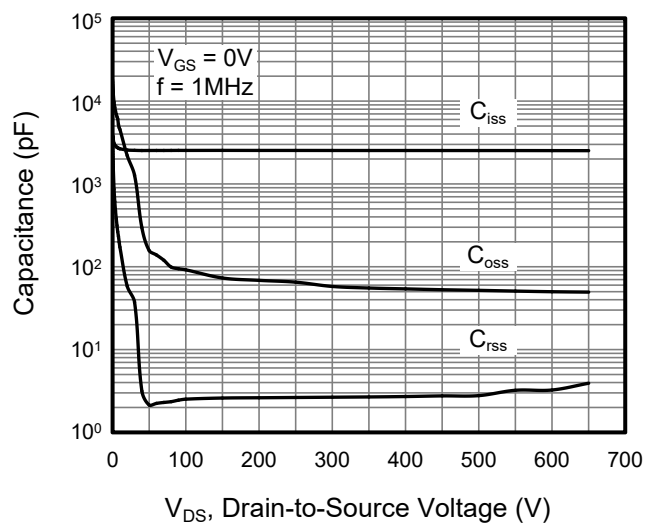


Figure 10. Body Diode Forward Voltage

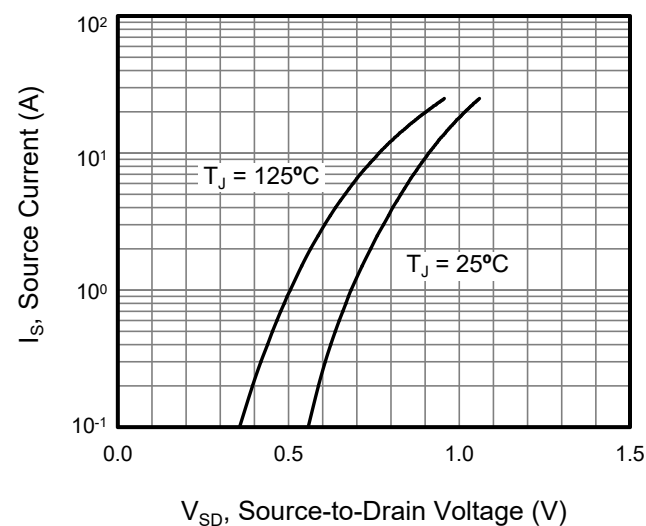
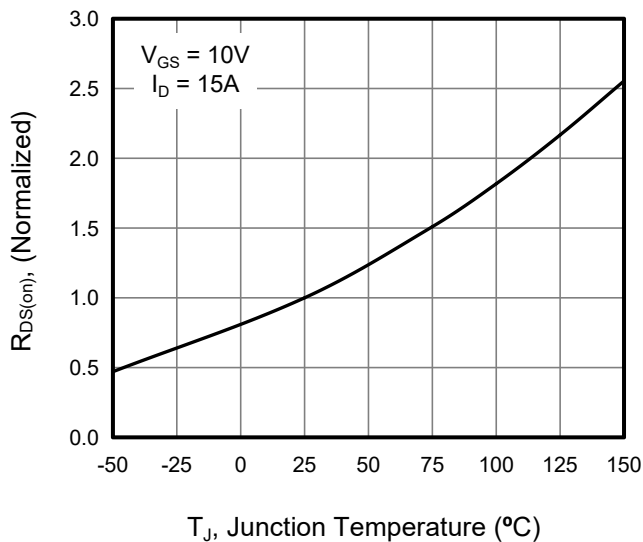


Figure 12. On-Resistance vs. Temperature



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

Figure 13. Breakdown Voltage vs. Junction Temperature

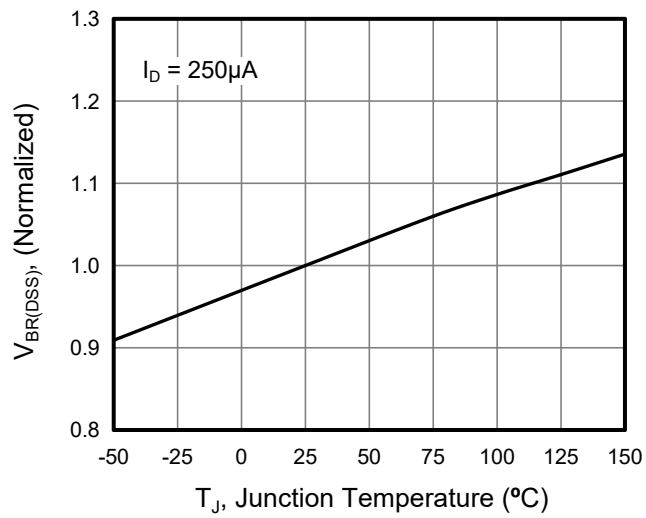


Figure A: Gate Charge Test Circuit and Waveform

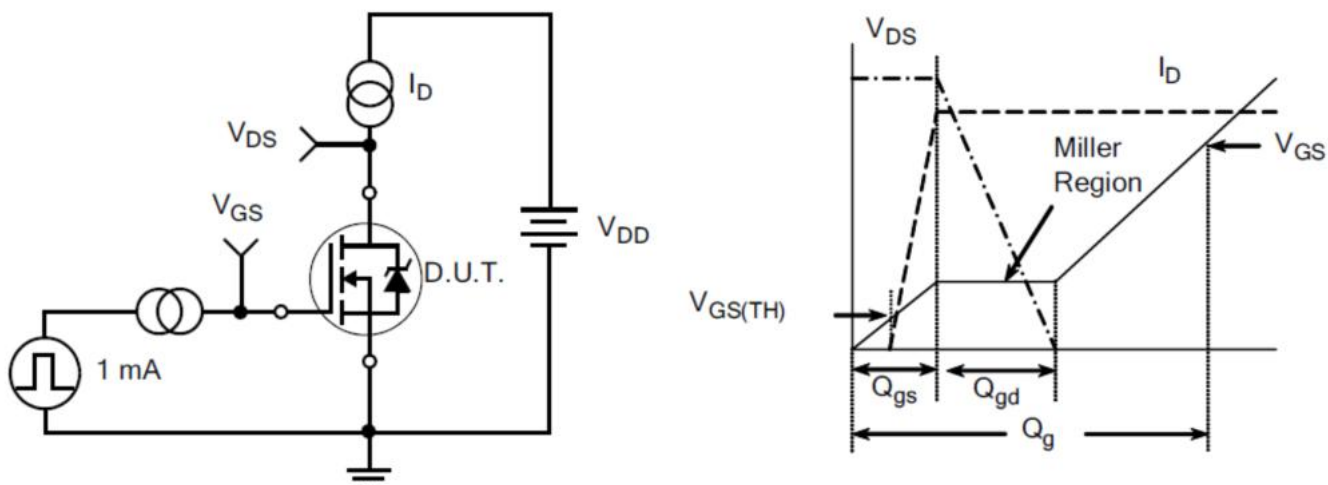


Figure B: Resistive Switching Test Circuit and Waveform

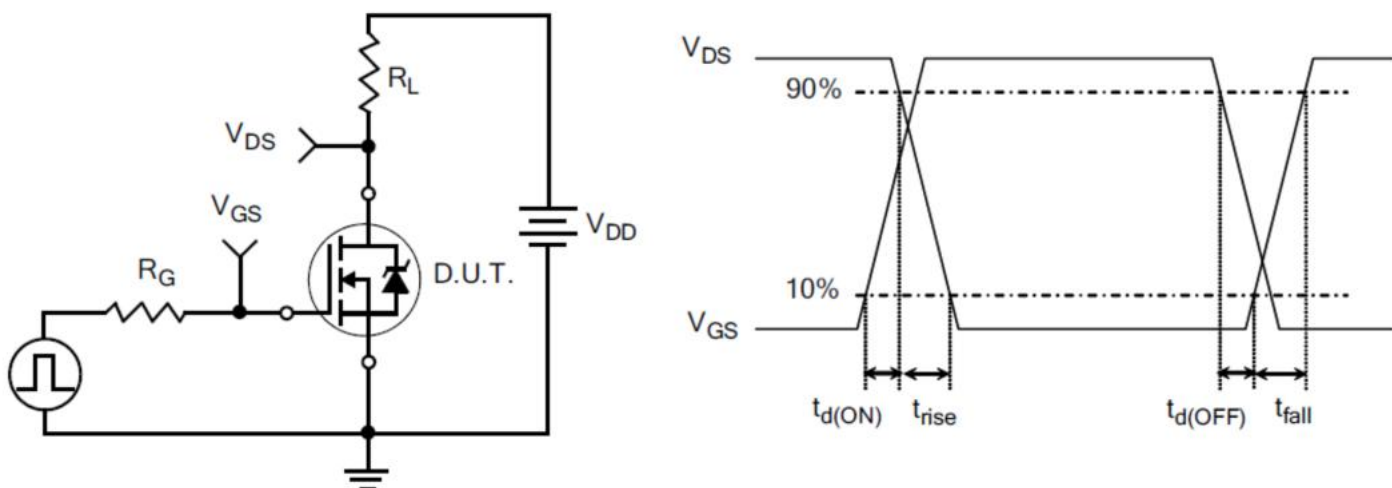
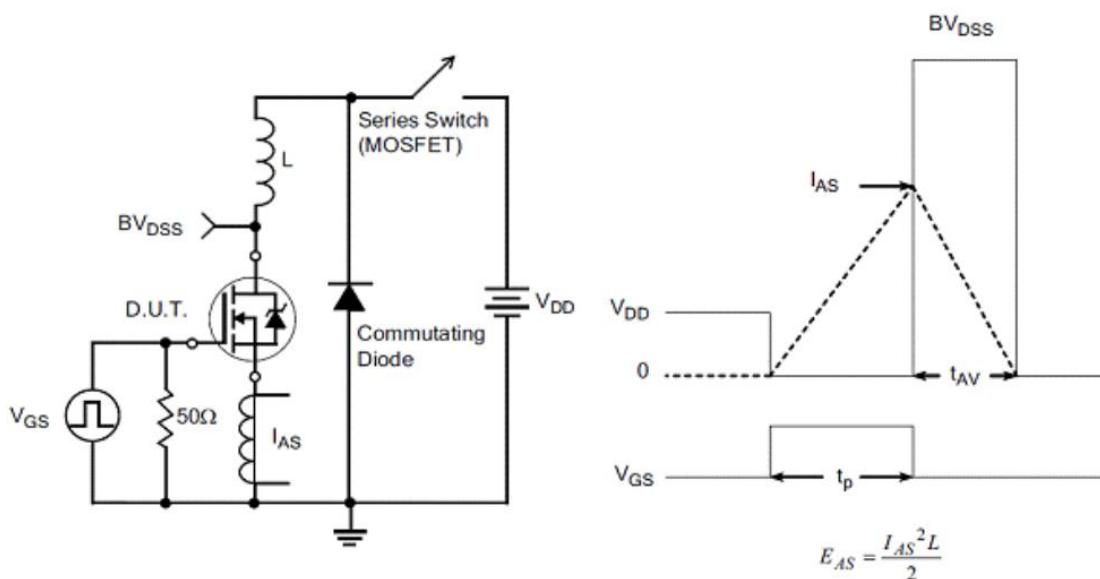
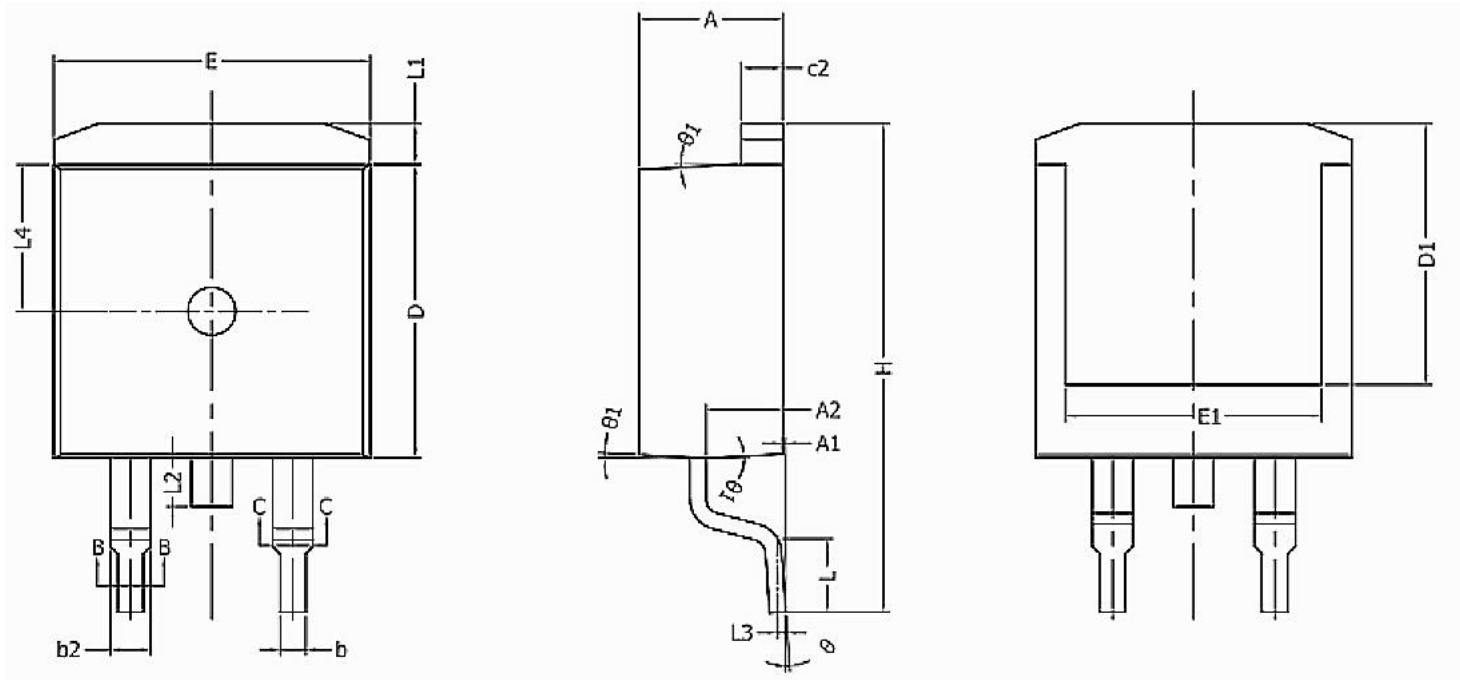


Figure C: Unclamped Inductive Switching Test Circuit and Waveform



TO-263



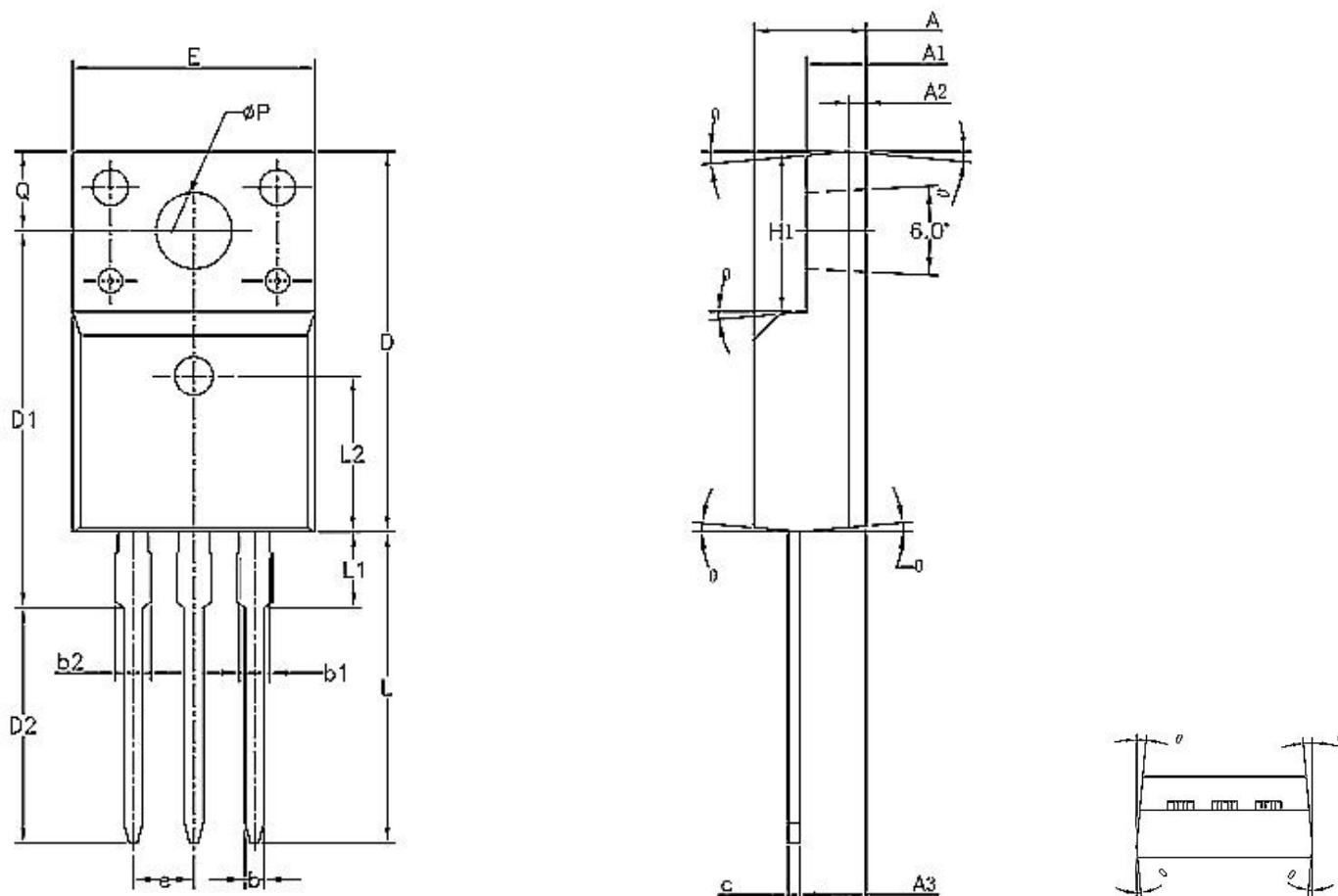
Unit:mm			
Symbol	Min.	Nom	Max.
A	4.40	4.50	4.60
A1	0	0.10	0.25
A2	2.20	2.40	2.60
b	0.76	---	0.89
b1	0.75	0.80	0.85
b2	1.23	---	1.37
b3	1.22	1.27	1.32
c	0.47	---	0.60
c1	0.46	0.51	0.56
c2	1.25	1.30	1.35
D	9.10	9.20	9.30

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/Carlton Box	Units/Carlton Box
TO-263	800	1	800	10	8000

TO-220F



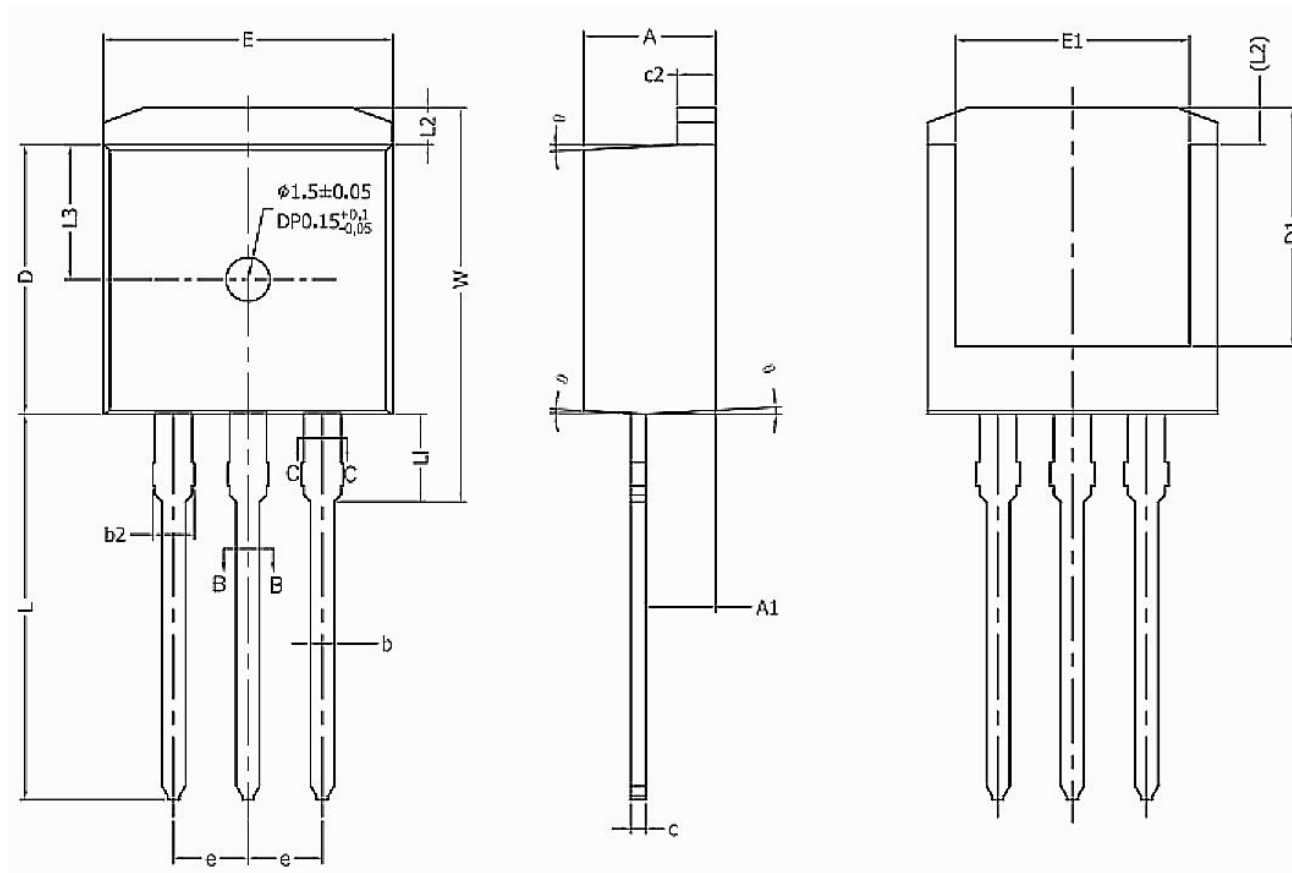
Unit:mm			
Symbol	Min.	Nom	Max.
A	4.50	4.70	4.83
A1	2.34	2.54	2.74
A2	0.70 REF		
A3	2.56	2.76	2.93
b	0.70	---	0.90
b1	1.18	---	1.38
b2	---	---	1.47
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.55	15.75	15.95

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/Carlton Box	Units/Carlton Box
TO-220F	50	40	2000	4	8000

TO-262



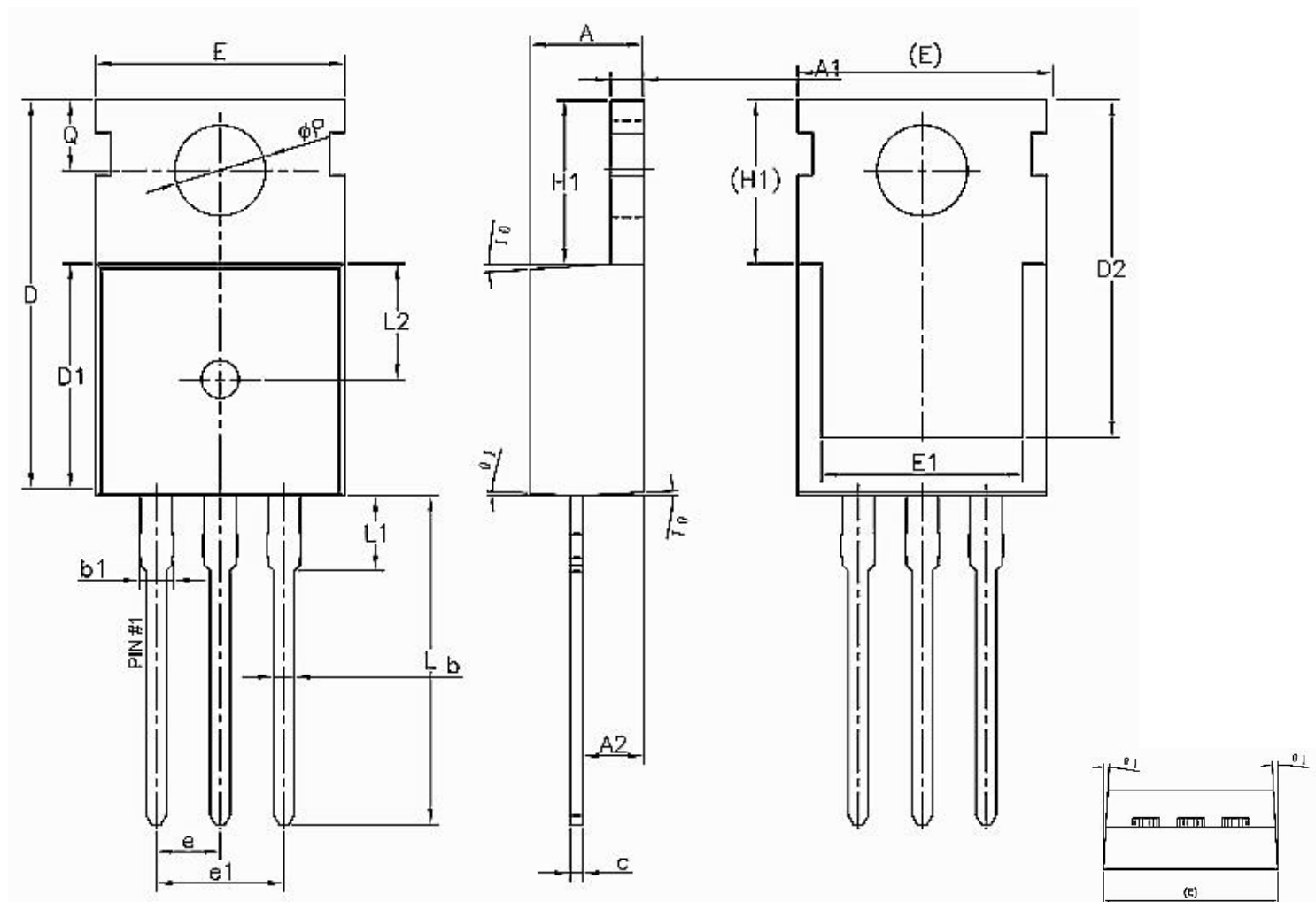
Unit:mm			
Symbol	Min.	Nom	Max.
A	4.40	4.50	4.60
A1	2.20	2.40	2.60
b	0.76	---	0.89
b1	0.75	0.80	0.85
b2	1.23	---	1.37
b3	1.22	1.27	1.32
c	0.47	---	0.60
c1	0.46	0.51	0.56
c2	1.25	1.30	1.35
D	9.10	9.20	9.30

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



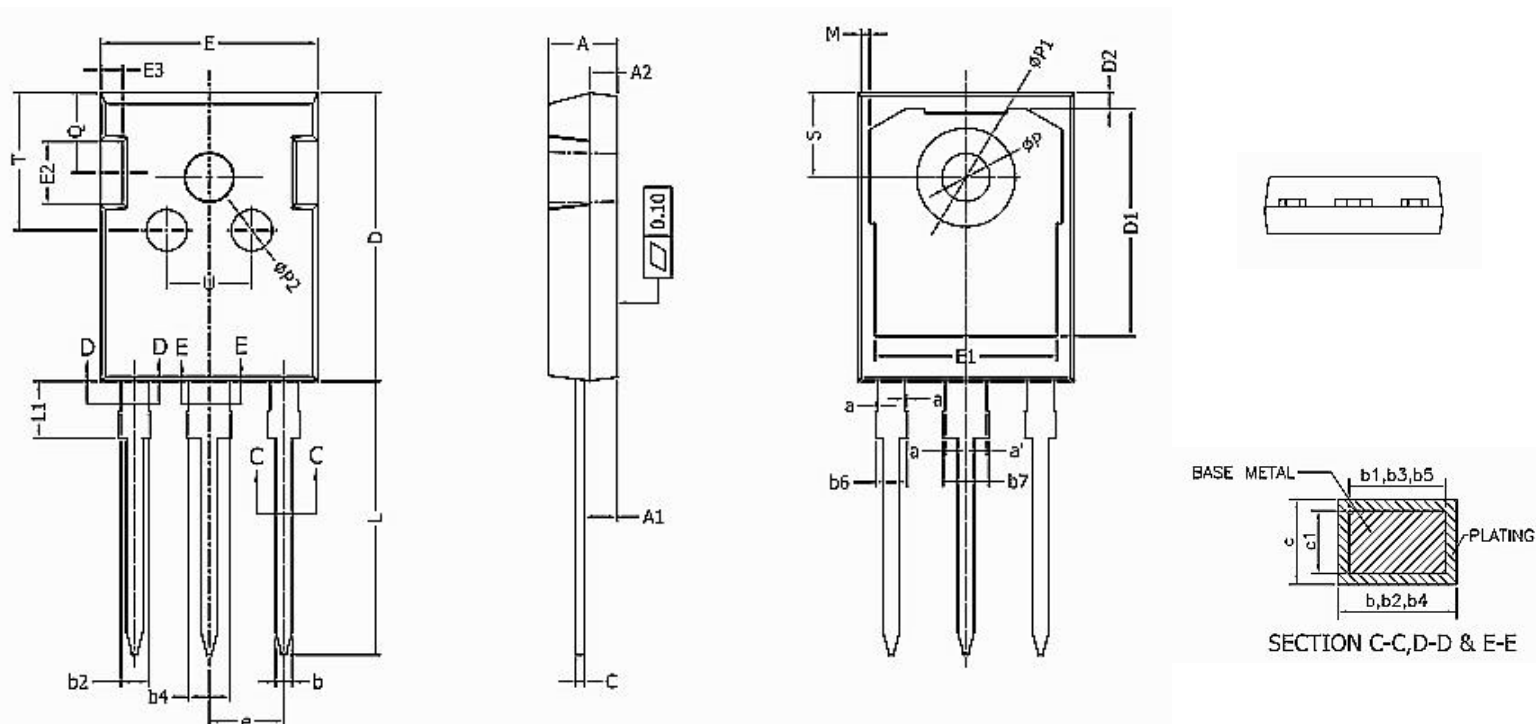
Unit:mm			
Symbol	Min.	Nom	Max.
A	4.40	4.50	4.60
A1	1.27	1.30	1.33
A2	2.30	2.40	2.50
b	0.70	---	0.90
b2	1.27	---	1.40
c	0.45	0.50	0.60
D	15.30	15.70	16.10
D1	9.10	9.20	9.30
D2	13.10	---	13.70
E	9.70	9.90	10.20

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/Carlton Box	Units/Carlton Box
TO-220	50	40	2000	4	8000

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/Carlton Box	Units/Carlton Box
TO-247	30	20	600	5	3000

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