N-Channel Super-junction MOSFET Gen Ⅲ

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

650V Super-junction Gen Ⅲ

650V Super-junction Gen Ⅲ Power Transistor

HRD65T230x Data Sheet

Rev. 2020 V1.0

650V Super-junction Power MOSFET Gen Ⅲ

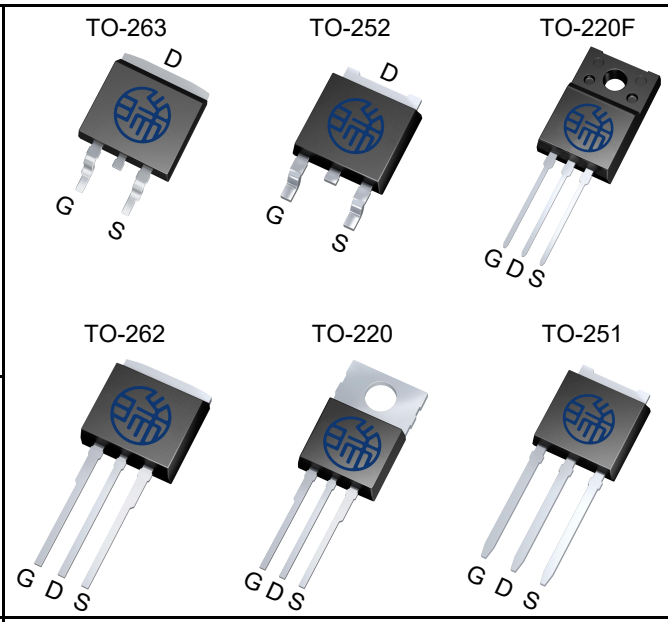
Description

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 $R_{DS(on)}$,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.

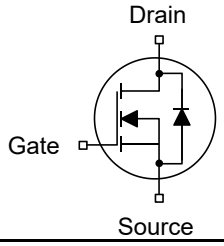
Features

- 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
$R_{DS(on),max}$	0.23	Ω
$Q_{g,typ}$	26.1	nC
I_D	15	A
$I_{D,pulse}$	45	A
E_{OSS} @ 400V	3.36	μJ
Body Diode di_F/dt	500	A/μs

Device Marking and Package Information

Device	Package	Marking
HRD65T230B	TO-263	D65T230B
HRD65T230D	TO-252	D65T230D
HRD65T230F	TO-220F	D65T230F
HRD65T230L	TO-262	D65T230L
HRD65T230P	TO-220	D65T230P
HRD65T230U	TO-251	D65T230U

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	15	A
	T_C = 100ºC		9	
Pulsed Drain Current[2]		$I_{D,pulse}$	45	A
Gate-Source Voltage		V_{GS}	±30	V
Single Pulse Avalanche Energy		E_{AS}	304	mJ
Repetitive Avalanche Energy		E_{AR}	1.6	mJ
Avalanche Current		I_{AR}	3	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		P_D	83	W
Power Dissipation For TO-220F			28	
Continuous Diode Forward Current		I_S	12.8	A
Diode Pulsed Current[2]		$I_{S,pulse}$	45	
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			
Parameter	**Symbol**	**Value**	**Unit**
Thermal Resistance, Junction-to-Case	R_{thJC}	1.5	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}	4.4	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	3.0	3.5	4.0	V
Drain-Source On-State-Resistance	$R_{DS(on)}$	V_{GS} = 10V, I_D = 7.5A	--	0.205	0.23	Ω
Gate Resistance	R_G	f = 1.0MHz open drain	--	3.0	--	Ω
Dynamic Characteristics						
Input Capacitance	C_{iss}	V_{GS} = 0V, V_{DS} = 100V f = 1.0MHz	--	1010	--	pF
Output Capacitance	C_{oss}		--	46.9	--	
Reverse Transfer Capacitance	C_{rss}		--	2.1	--	
Total Gate Charge	Q_g	V_{DD} = 520V, I_D = 15A V_{GS} = 10V	--	26.1	--	nC
Gate-Source Charge	Q_{gs}		--	8.7	--	
Gate-Drain Charge	Q_{gd}		--	10.1	--	
Gate Plateau Voltage	$V_{Plateau}$		--	6.59	--	V
Turn-on Delay Time	$t_{d(on)}$	V_{DD} = 400V, I_D = 15A R_G = 15Ω, V_{GS} = 10V	--	14	--	ns
Turn-on Rise Time	t_r		--	8	--	
Turn-off Delay Time	$t_{d(off)}$		--	55	--	
Turn-off Fall Time	t_f		--	7	--	
Drain-Source Body Diode Characteristics						
Body Diode Forward Voltage	V_{SD}	T_J = 25ºC, I_{SD} = 7.5A, V_{GS} = 0V	--	0.9	1.2	V
Reverse Recovery Time	t_{rr}	V_R = 400V I_F = 7.5A, di_F/dt = 100A/μs	--	240	--	ns
Reverse Recovery Charge	Q_{rr}		--	2	--	μC
Peak Reverse Recovery Current	I_{rrm}		--	17	--	A

Typical Characteristics T_J = 25ºC, unless otherwise noted

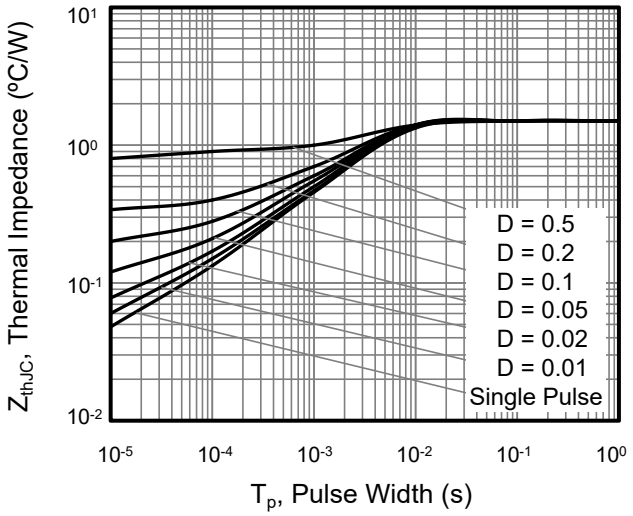


Figure 1. Transient Thermal Impedance For TO-263/TO-252/TO-262/TO-220/TO-251

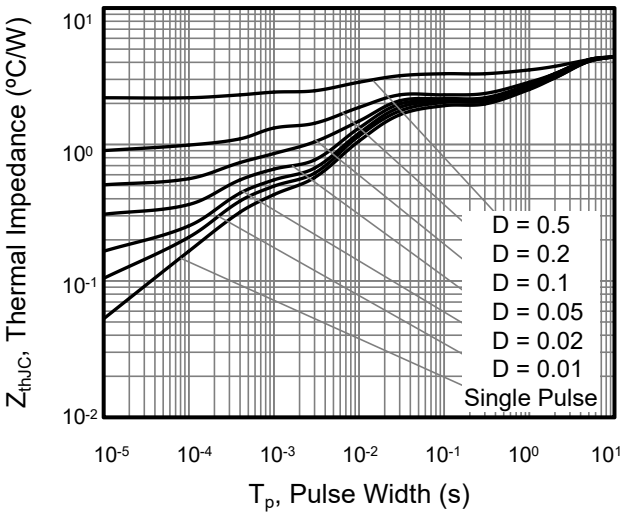


Figure 2. Transient Thermal Impedance For TO-220F

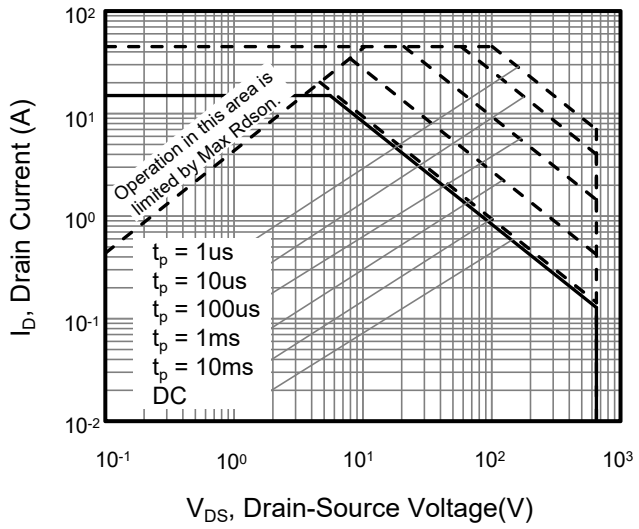


Figure 3. Safe Operation Area For TO-263/TO-252/TO-262/TO-220/TO-251

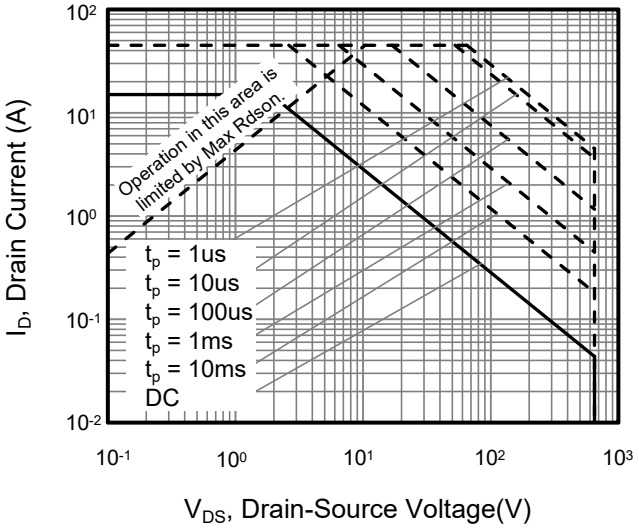


Figure 4. Safe Operation Area For TO-220F

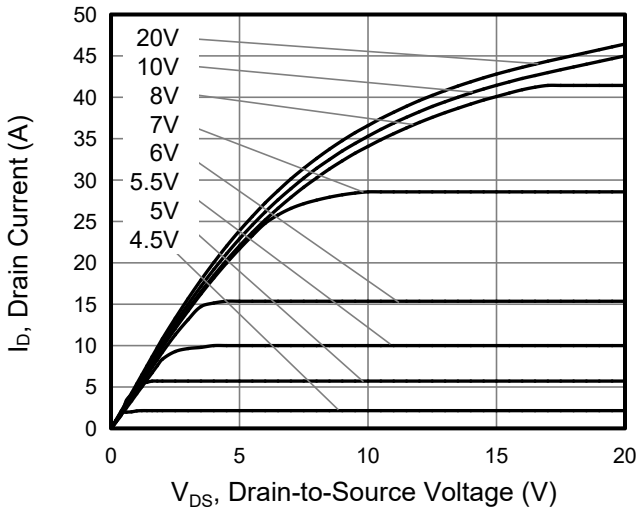


Figure 5. Output Characteristics

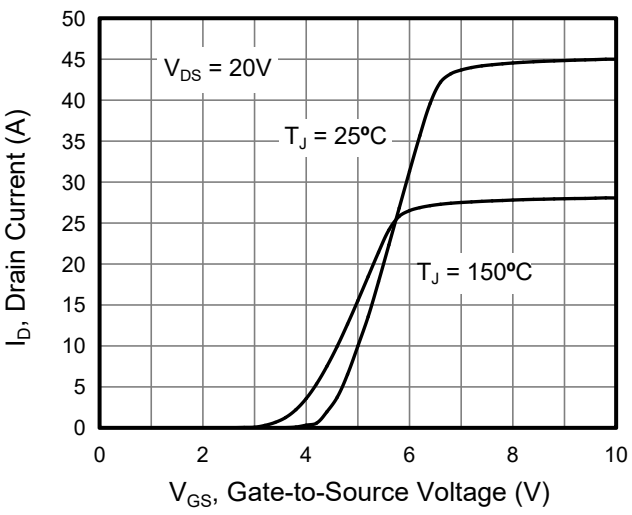


Figure 6. Transfer Characteristics

Typical Characteristics T_J = 25ºC, unless otherwise noted

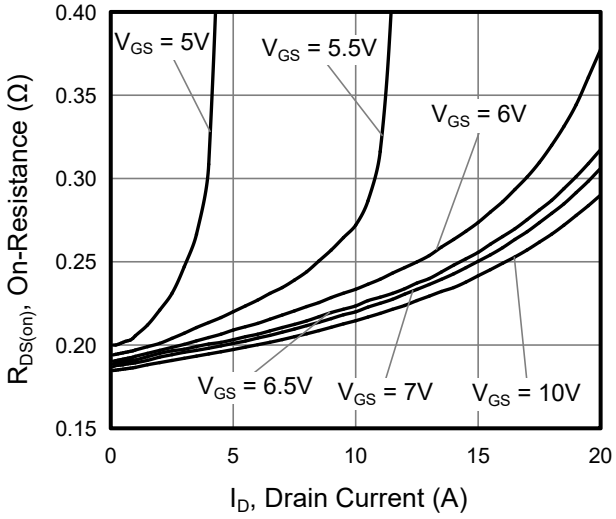


Figure 7. On-Resistance vs Drain Current

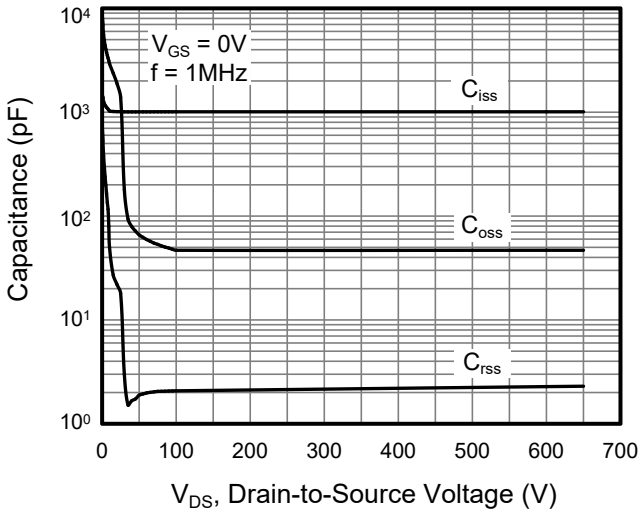


Figure 8. Capacitance

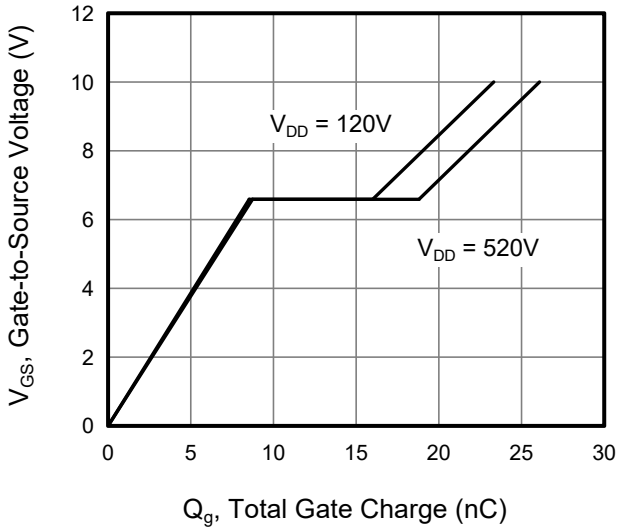


Figure 9. Gate Charge

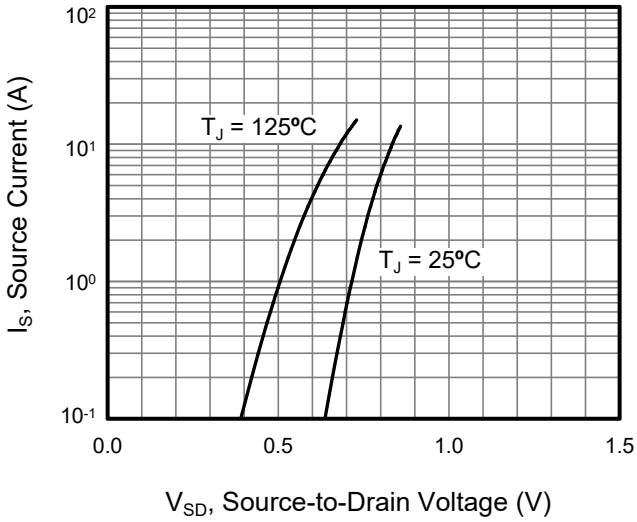


Figure 10. Body Diode Forward Voltage

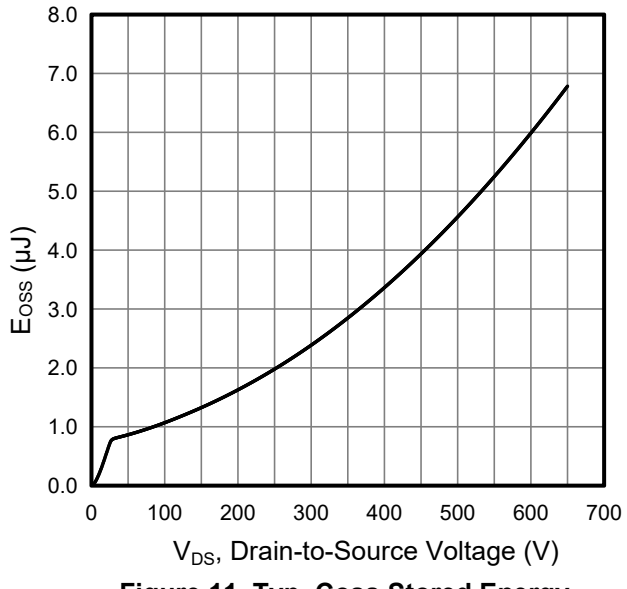


Figure 11. Typ. Coss Stored Energy

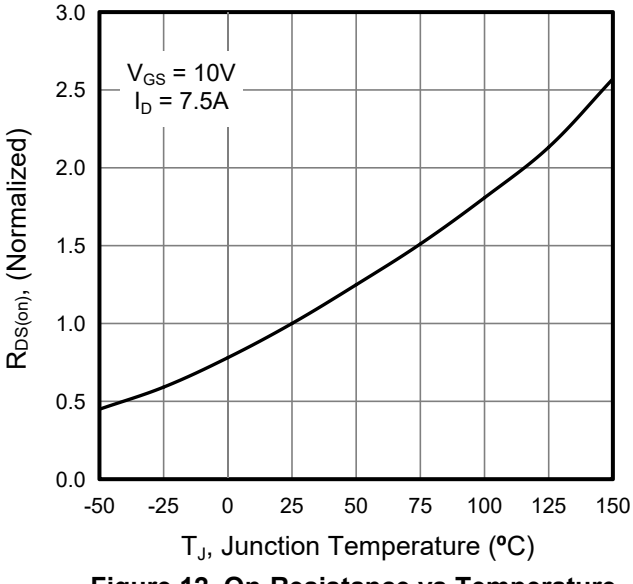


Figure 12. On-Resistance vs Temperature

Typical Characteristics T_J = 25ºC, unless otherwise noted

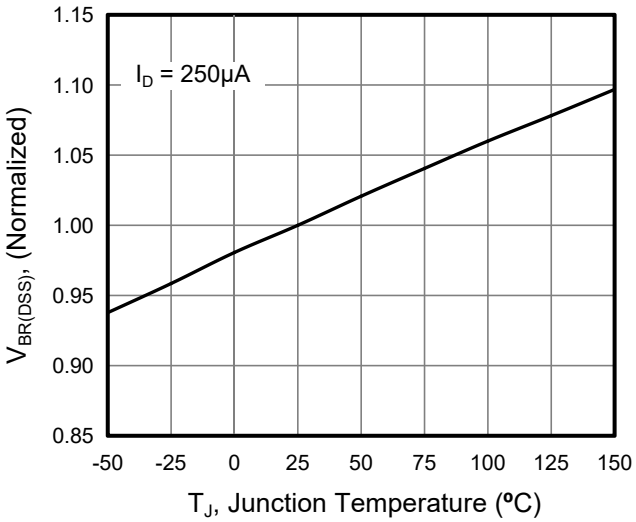


Figure 13. Breakdown Voltage vs Junction Temperature

Figure A：Gate Charge Test Circuit and Waveform

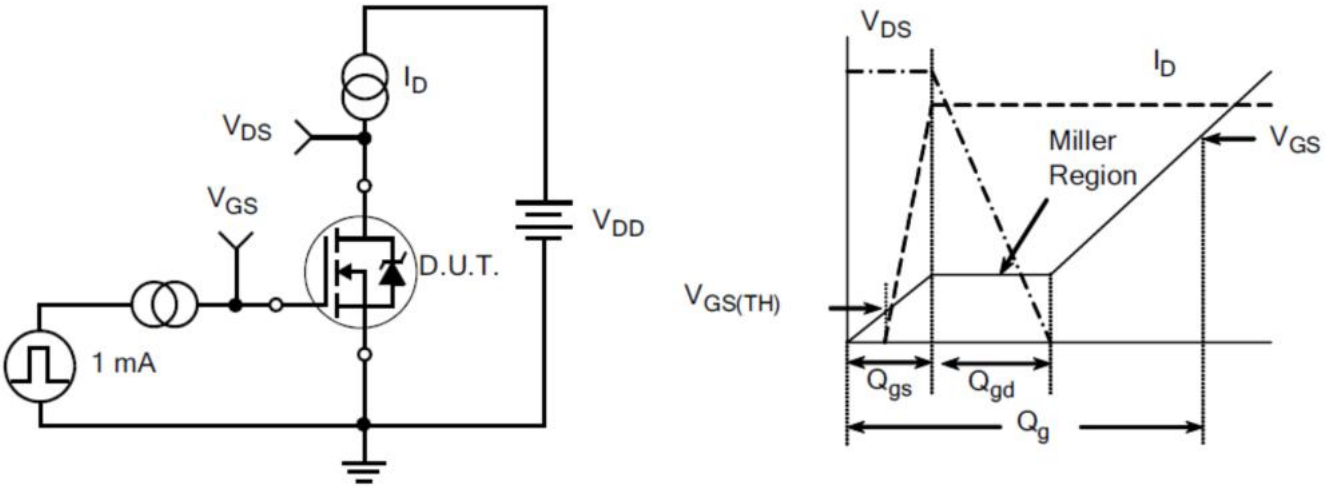


Figure B：Resistive Switching Test Circuit and Waveform

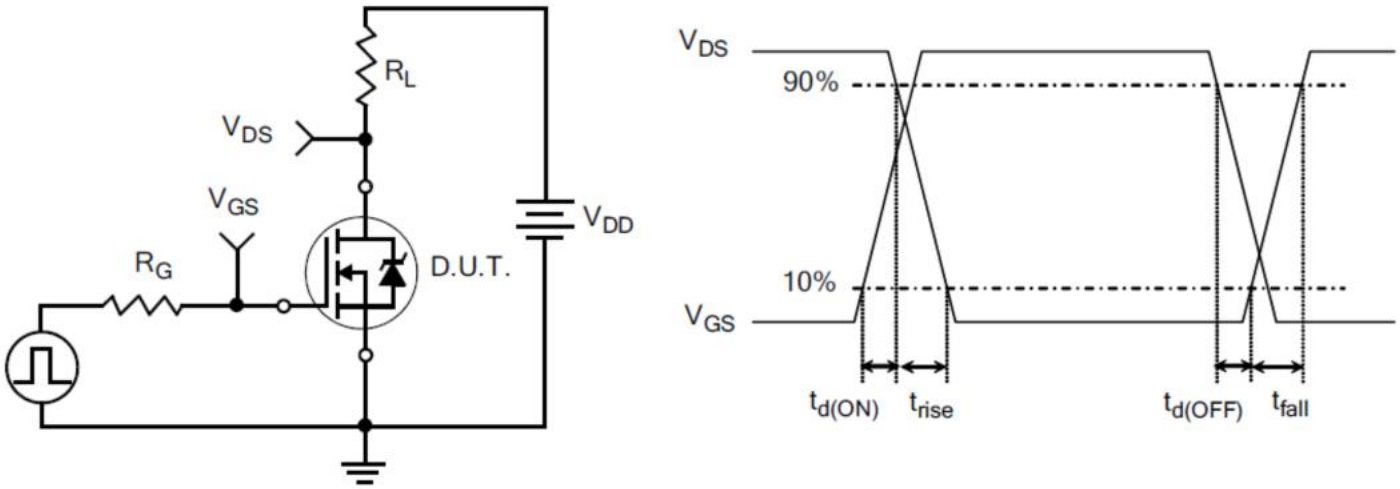
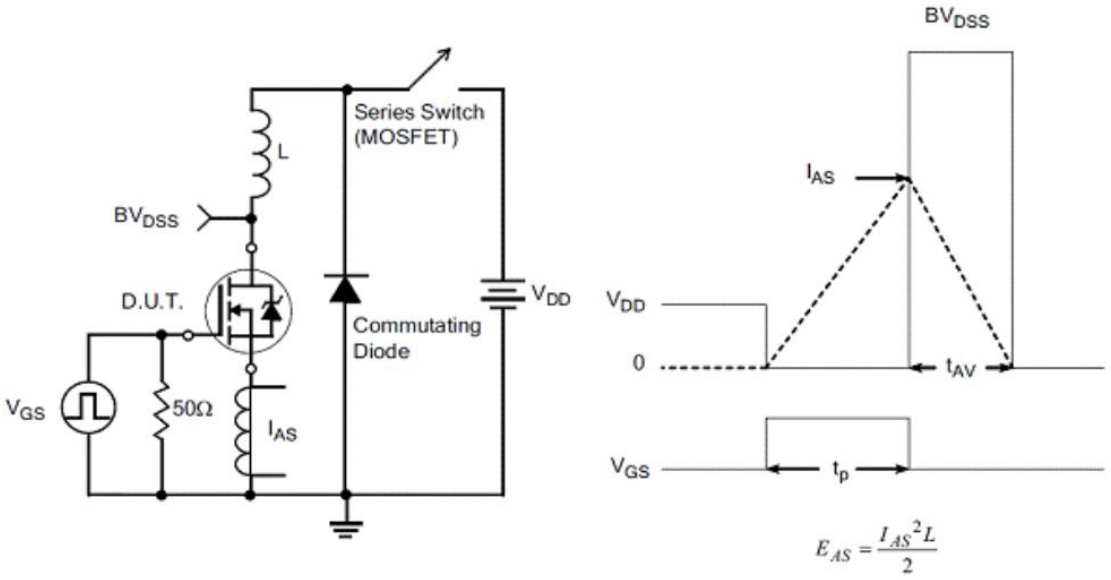
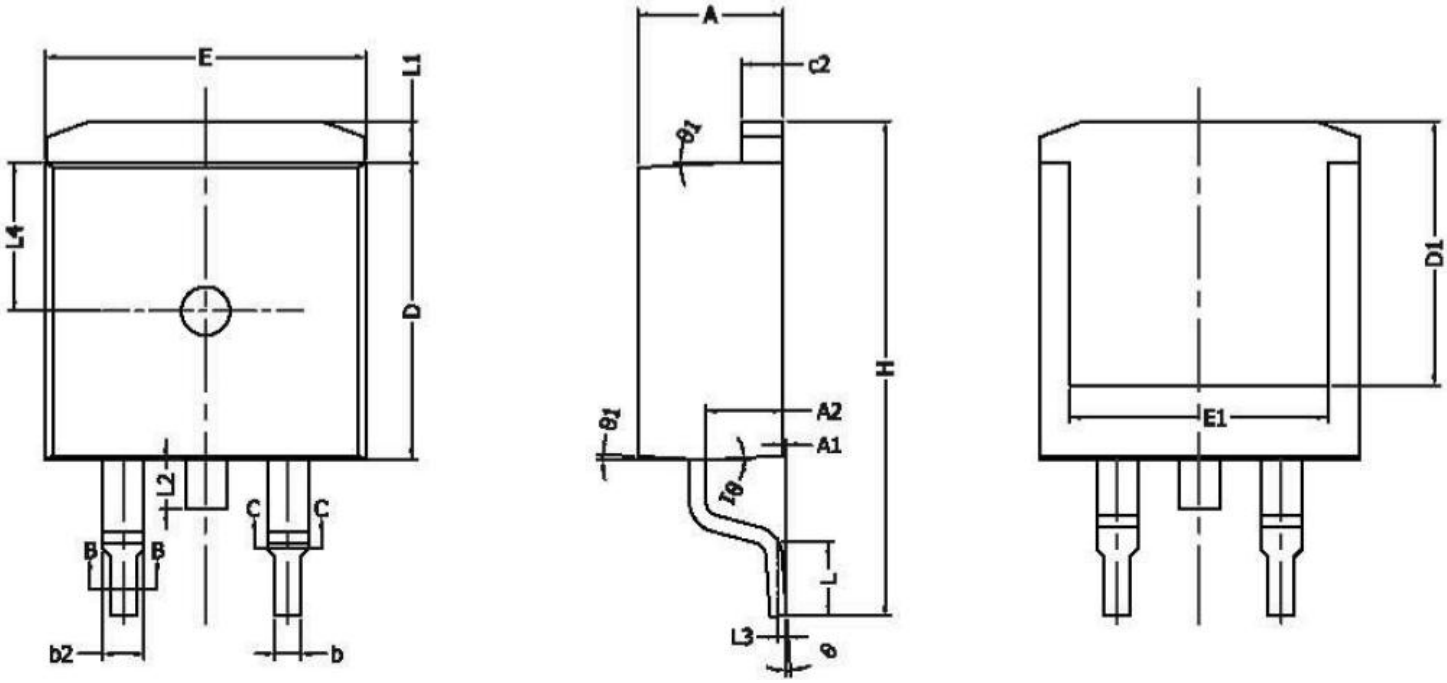
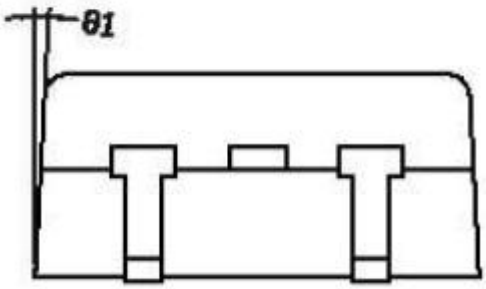


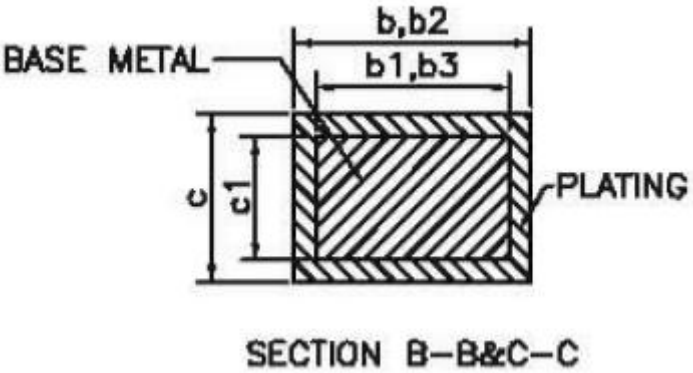
Figure C：Unclamped Inductive Switching Test Circuit and Waveform



Outlines TO-263 Package



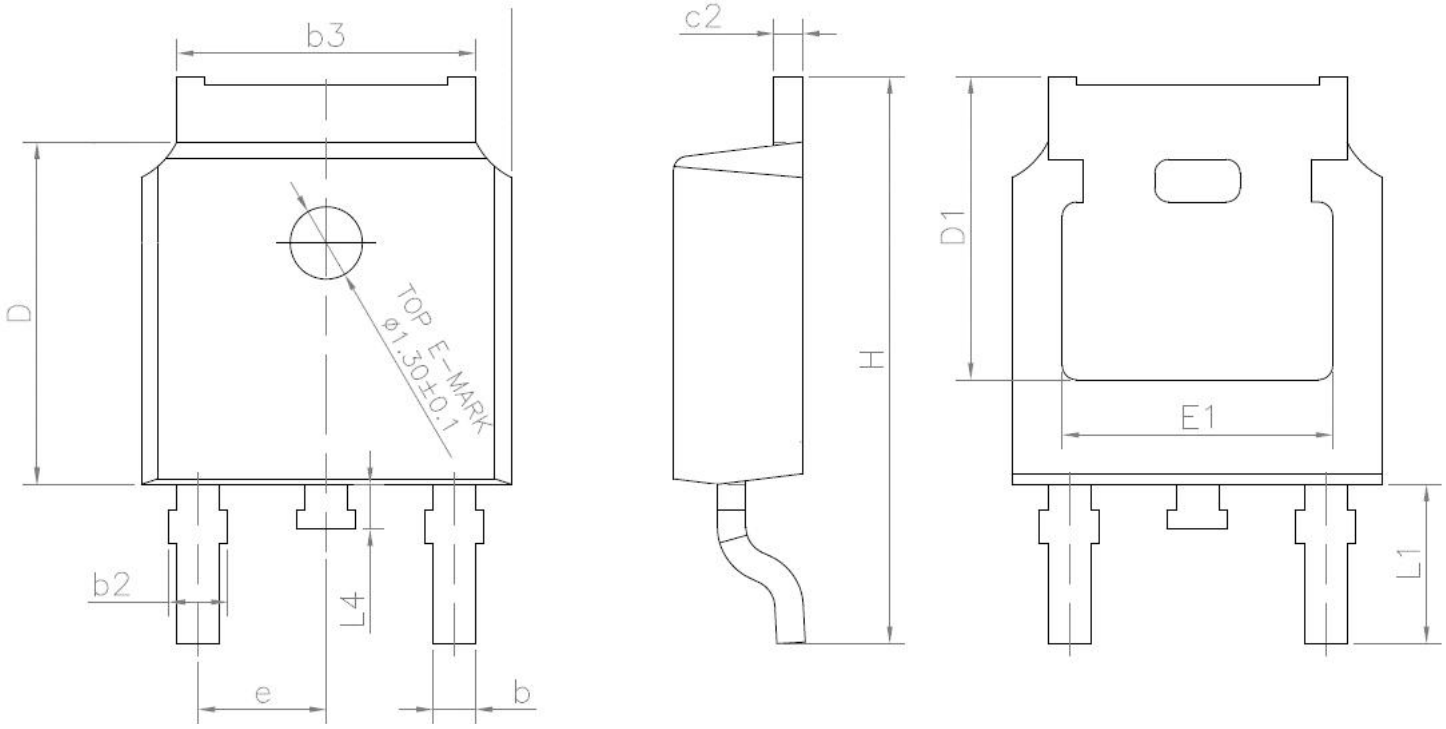


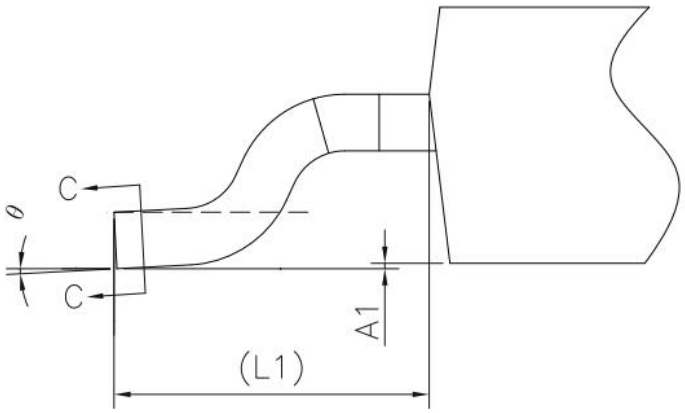


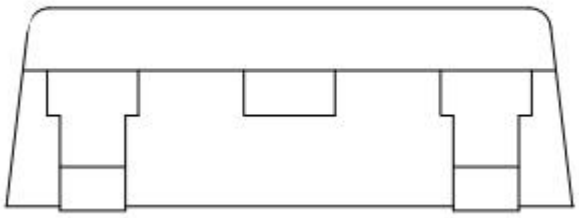
SECTION B–B&C–C

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
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°

Outlines TO-252 Package

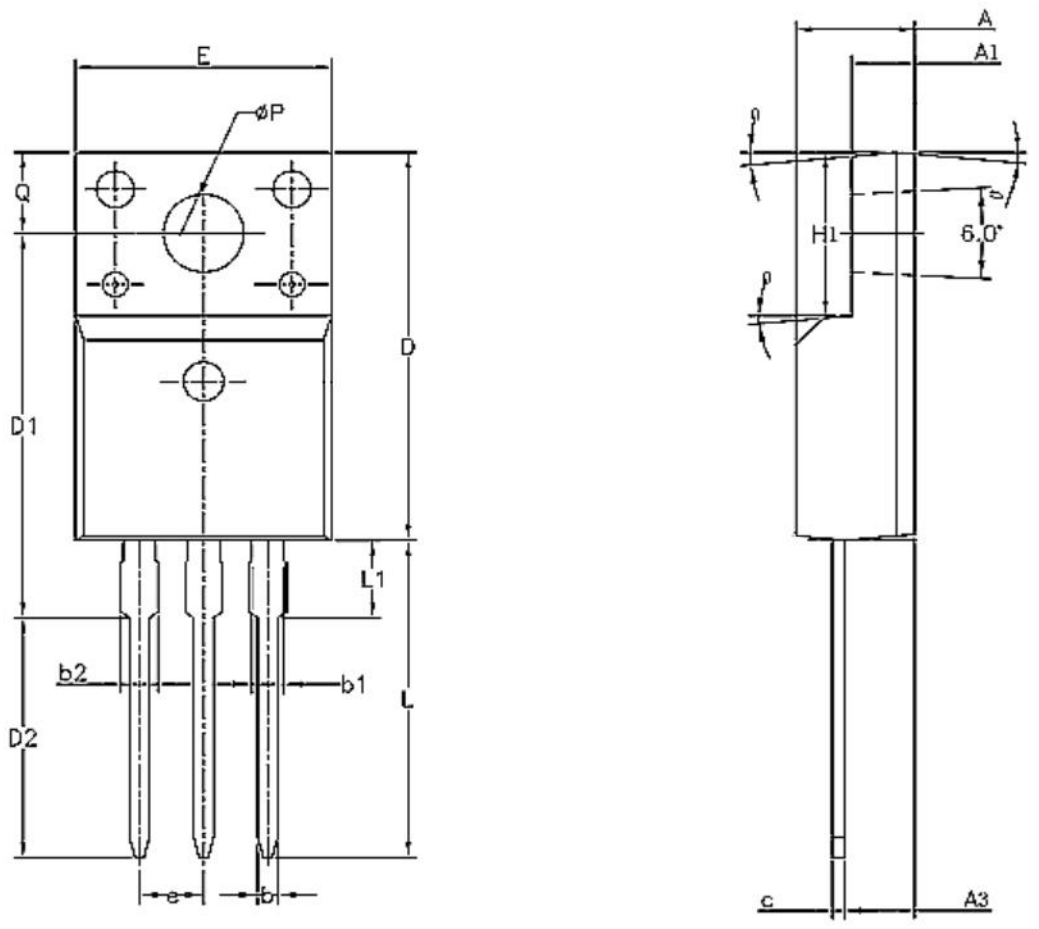


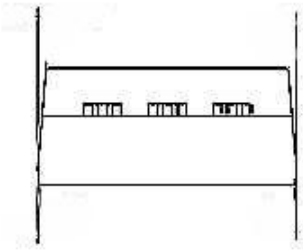




SYMBOL	MIN	NOM	MAX
A1	0	--	0.2
b	0.645	--	0.9
b3	5.13	5.326	5.46
c2	0.41	--	0.61
D	5.98	6.1	6.22
D1	5.244	--	--
E1	4.63	--	--
e	2.186	2.286	2.386
H	9.4	10.04	10.5
L1	2.6	2.872	3
L4	0.5	--	1
θ	0°	--	10°

Outlines TO-220F Package

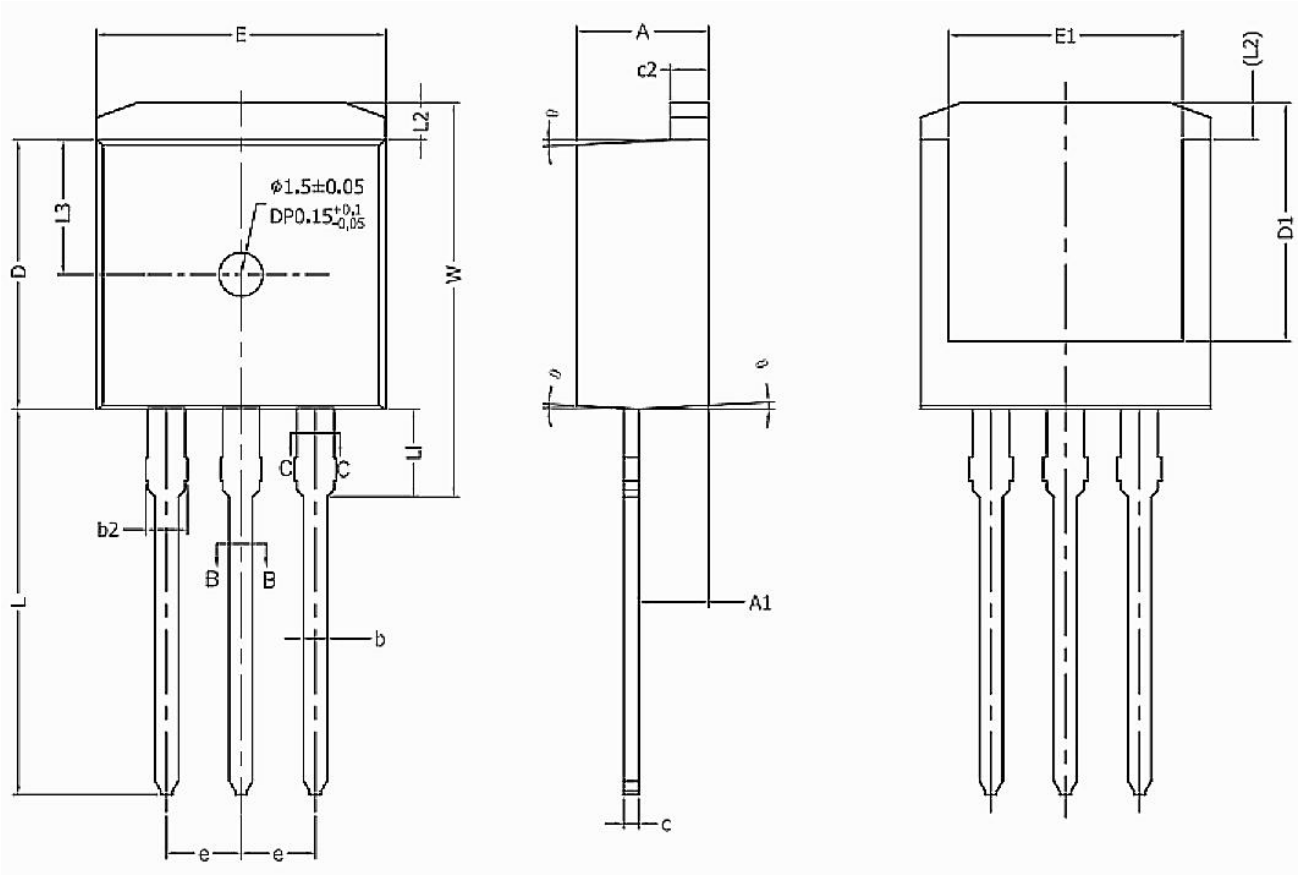




SYMBOL	MIN	NOM	MAX
A	4.5	4.7	4.9
A1	2.34	2.54	2.74
A3	2.56	2.76	2.96
b	0.7	---	0.95
b1	1.18	---	1.43
b2	---	---	1.55
c	0.4	0.5	0.65
D	15.57	15.87	16.17

SYMBOL	MIN	NOM	MAX
D1	15.35	15.675	15.95
D2	9.6	9.875	10.15
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	---	---	3.5

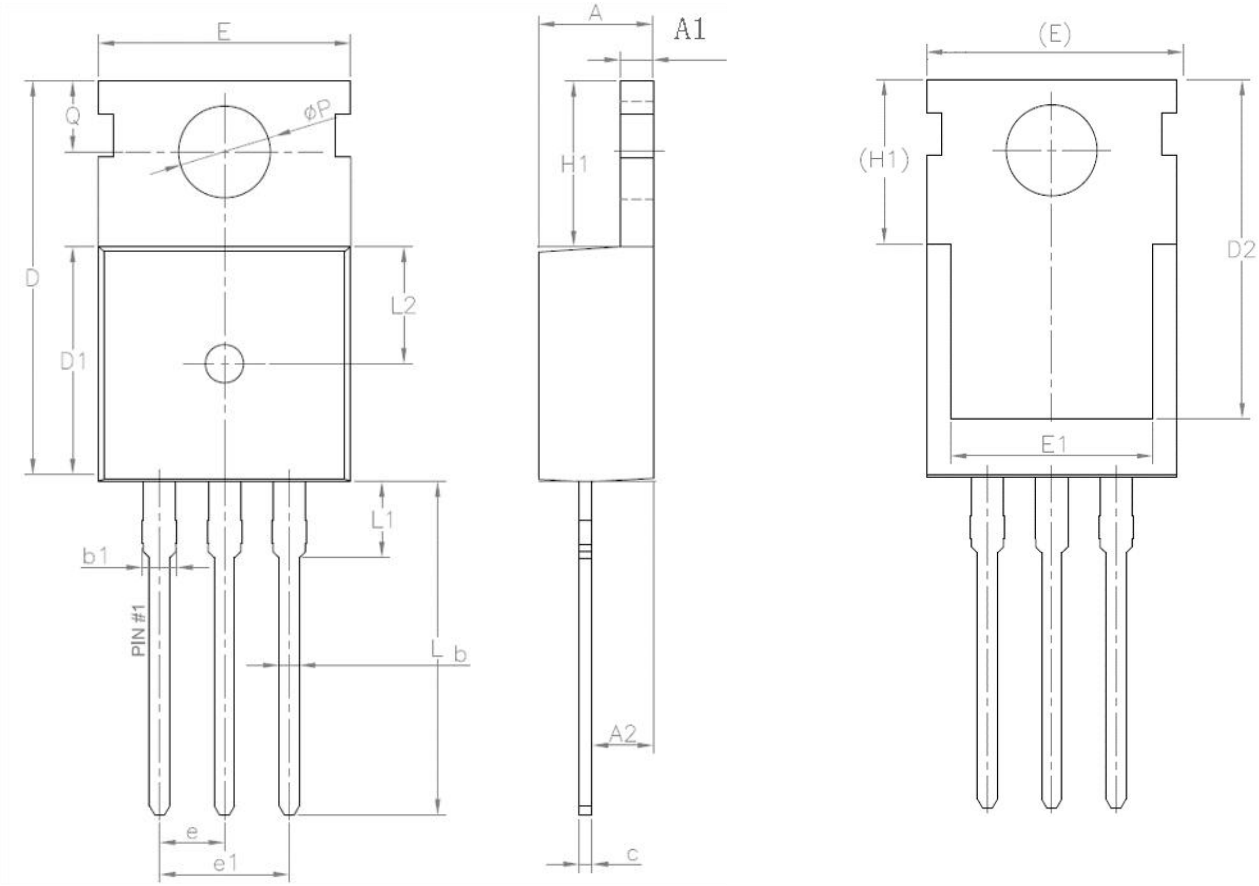
Outlines TO-262 Package

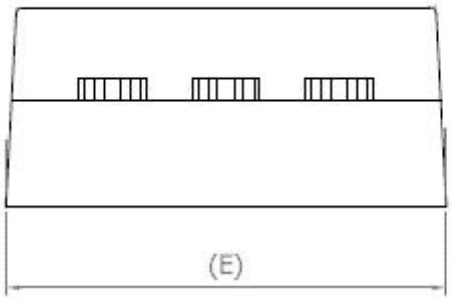


Unit:mm			
Symbol	Min.	Nom	Max.
A	4.40	4.50	4.60
A1	2.20	2.40	2.60
b	0.76	---	0.89
b1	0.75	0.80	0.85
b2	1.23	---	1.37
b3	1.22	1.27	1.32
c	0.47	---	0.60
c1	0.46	0.51	0.56
c2	1.25	1.30	1.35
D	9.10	9.20	9.30

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°

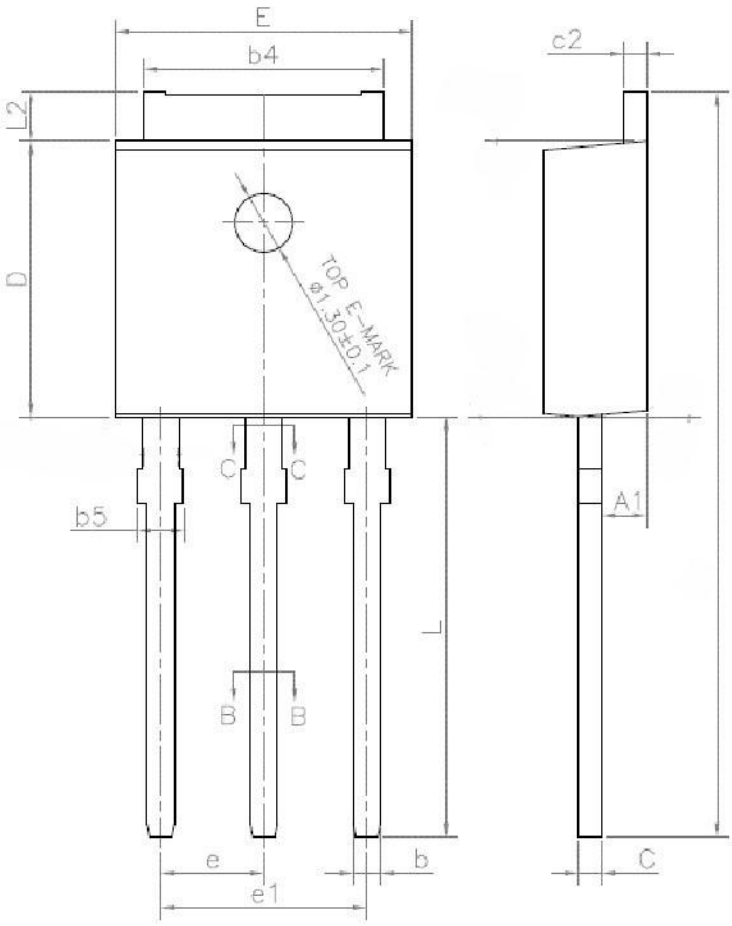
Outlines TO-220 Package

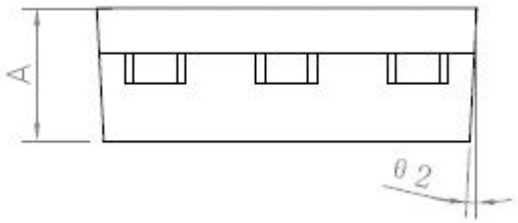


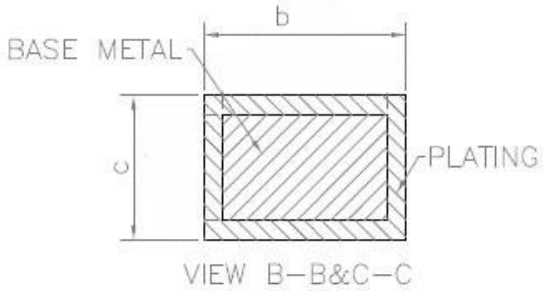


SYMBOL	MIN	NOM	MAX
A	4.37	4.535	4.7
A1	1.25	1.3	1.4
A2	2.2	2.4	2.6
b	0.7	---	0.95
b1	1.17	---	1.47
c	0.45	0.5	0.6
D	15.1	15.65	16.1
D1	8.8	9.15	9.4
D2	11.8	---	---
E	9.7	9.95	10.3
E1	7	---	---
e	2.54 BSC		
e1	5.08 BSC		
H1	6.25	6.5	6.85
L	12.75	13.29	13.8
L1	---	---	3.5
ΦP	3.4	3.67	3.8
Q	2.6	---	3

Outlines TO-251 Package







SYMBOL	MIN	NOM	MAX
A	2.20	2.30	2.38
A1	0.90	1.04	1.17
b	0.56	--	0.90
b4	5.20	5.33	5.46
b5	--	--	1.05
c	0.43	--	0.61
c2	0.43	--	0.61
D	5.98	6.10	6.22
D1	5.2	--	--
E	6.40	6.60	6.73
E1	4.60	--	--
e	2.24	2.29	2.34
e1	4.47	4.57	4.67
H	16.18	16.50	16.82
L	9	9.35	9.65
L2	0.88	1.05	1.28

Disclaimer

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