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

HRD65T540x Data Sheet

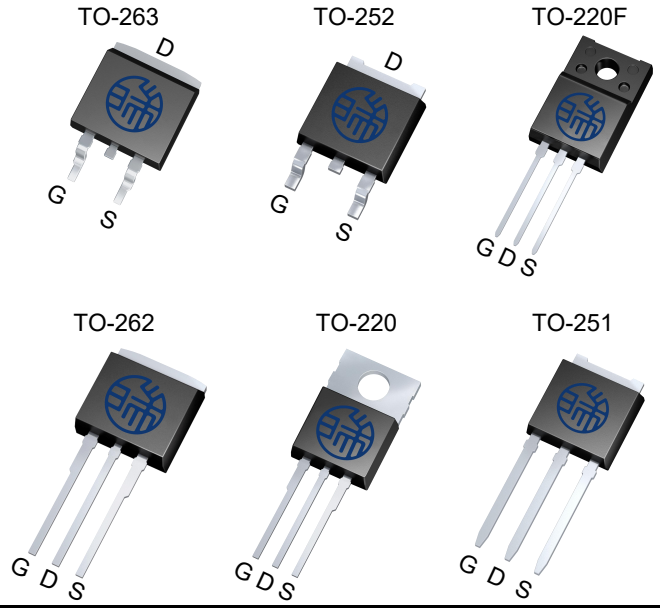
Rev. 2020 V1.0

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.

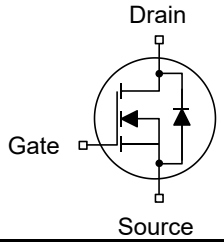


Features

- 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
$R_{DS(on),max}$	0.54	Ω
$Q_{g,typ}$	14.2	nC
I_D	7	A
$I_{D,pulse}$	21	A
E_{OSS} @ 400V	1.48	μJ
Body Diode di_F/dt	500	A/μs

Device Marking and Package Information

Device	Package	Marking
HRD65T540B	TO-263	D65T540B
HRD65T540D	TO-252	D65T540D
HRD65T540F	TO-220F	D65T540F
HRD65T540L	TO-262	D65T540L
HRD65T540P	TO-220	D65T540P
HRD65T540U	TO-251	D65T540U

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	7	A
	T_C = 100ºC		4.2	
Pulsed Drain Current[2]		$I_{D,pulse}$	21	A
Gate-Source Voltage		V_{GS}	±30	V
Single Pulse Avalanche Energy		E_{AS}	156	mJ
Repetitive Avalanche Energy		E_{AR}	0.3	mJ
Avalanche Current		I_{AR}	1.7	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	50	W
Power Dissipation For TO-220F			25	
Continuous Diode Forward Current		I_S	6.0	A
Diode Pulsed Current[2]		$I_{S,pulse}$	21	
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}	2.5	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}	5	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 = 3.5A	--	0.475	0.54	Ω
Gate Resistance	R_G	f = 1.0MHz open drain	--	3.9	--	Ω
Dynamic Characteristics						
Input Capacitance	C_{iss}	V_{GS} = 0V, V_{DS} = 100V f = 1.0MHz	--	439	--	pF
Output Capacitance	C_{oss}		--	20	--	
Reverse Transfer Capacitance	C_{rss}		--	0.7	--	
Total Gate Charge	Q_g	V_{DD} = 520V, I_D = 7A V_{GS} = 10V	--	14.2	--	nC
Gate-Source Charge	Q_{gs}		--	4.6	--	
Gate-Drain Charge	Q_{gd}		--	5.0	--	
Gate Plateau Voltage	$V_{Plateau}$		--	5.7	--	V
Turn-on Delay Time	$t_{d(on)}$	V_{DD} = 400V, I_D = 7A R_G = 15Ω, V_{GS} = 10V	--	8	--	ns
Turn-on Rise Time	t_r		--	6	--	
Turn-off Delay Time	$t_{d(off)}$		--	59	--	
Turn-off Fall Time	t_f		--	10	--	
Drain-Source Body Diode Characteristics						
Body Diode Forward Voltage	V_{SD}	T_J = 25ºC, I_{SD} = 3.5A V_{GS} = 0V	--	0.9	1.2	V
Reverse Recovery Time	t_{rr}	V_R = 400V I_F = 3.5A, di_F/dt = 100A/μs	--	185	--	ns
Reverse Recovery Charge	Q_{rr}		--	0.85	--	μC
Peak Reverse Recovery Current	I_{rrm}		--	9	--	A

Typical Characteristics T_J = 25ºC, unless otherwise noted

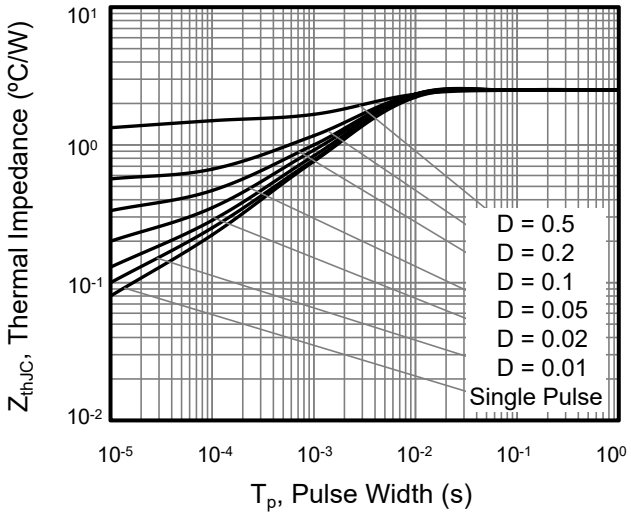


Figure 1. Transient Thermal Impedance For TO-263/TO-252/TO-262/TO-220/TO-251

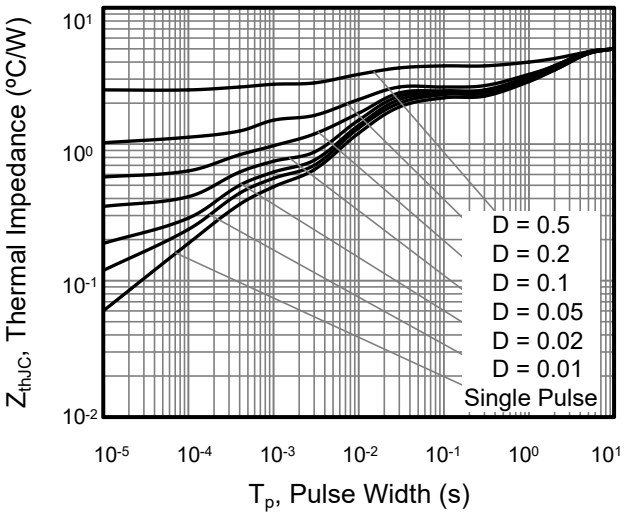


Figure 2. Transient Thermal Impedance For TO-220F

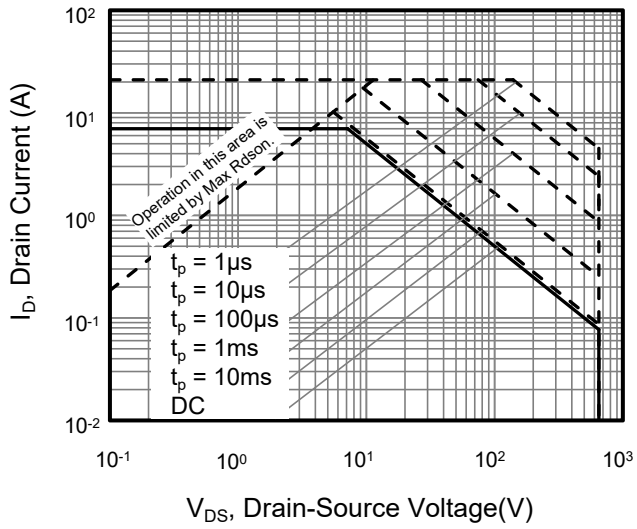


Figure 3. Safe Operation Area For TO-263/TO-252/TO-262/TO-220/TO-251

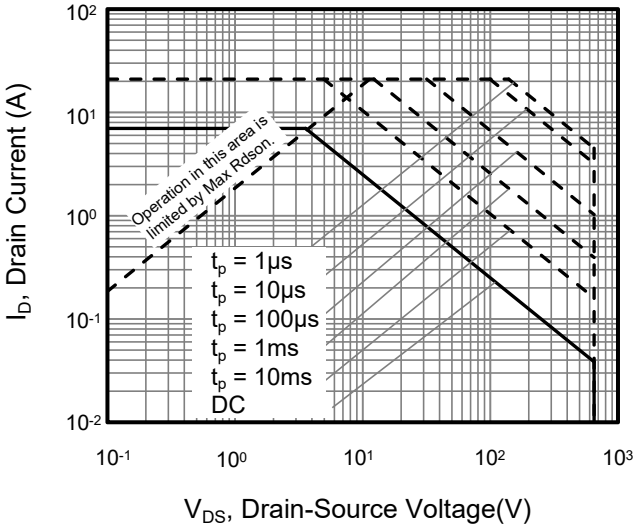


Figure 4. Safe Operation Area For TO-220F

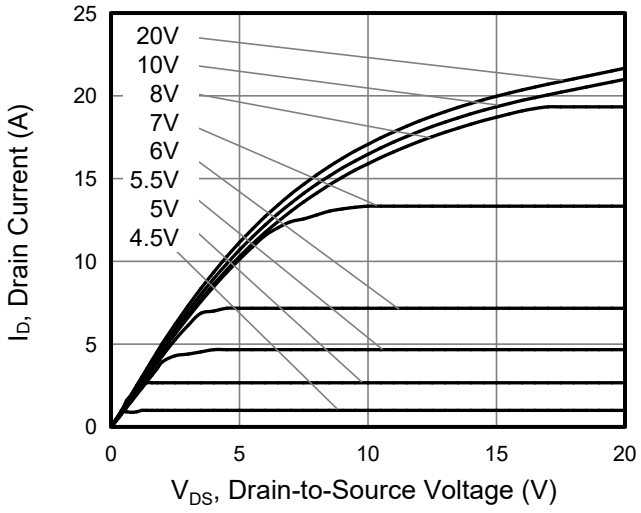


Figure 5. Output Characteristics

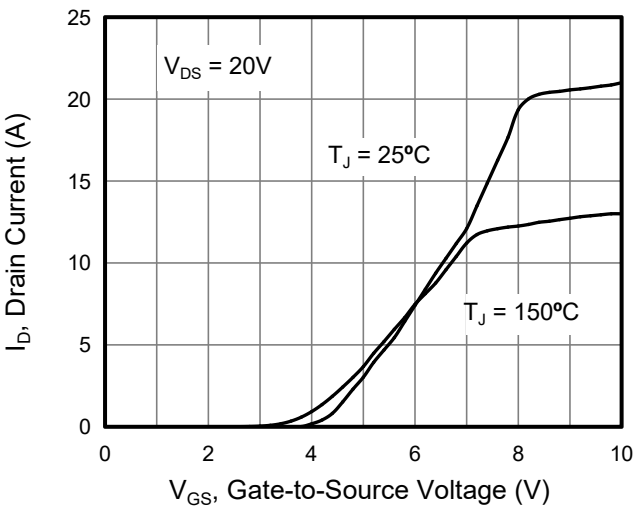


Figure 6. Transfer Characteristics

Typical Characteristics T_J = 25ºC, unless otherwise noted

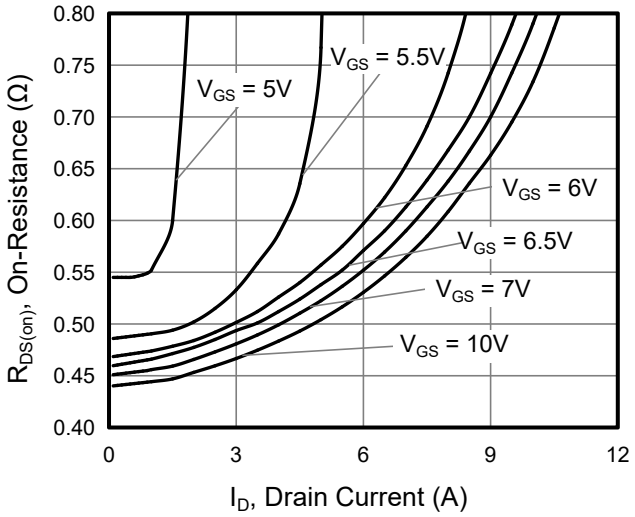


Figure 7. On-Resistance vs Drain Current

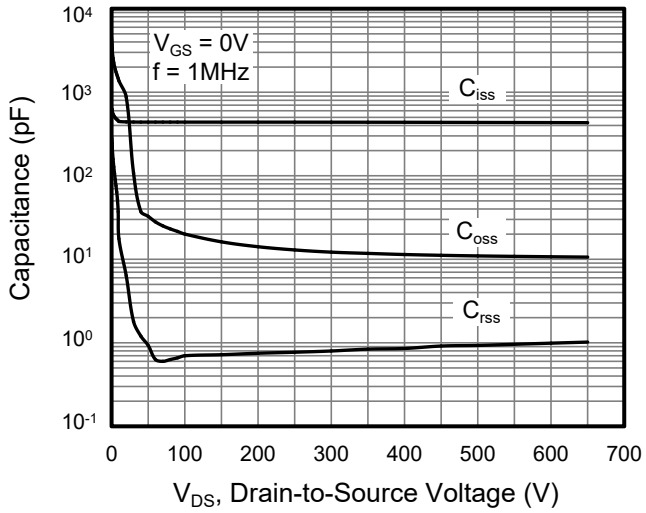


Figure 8. Capacitance

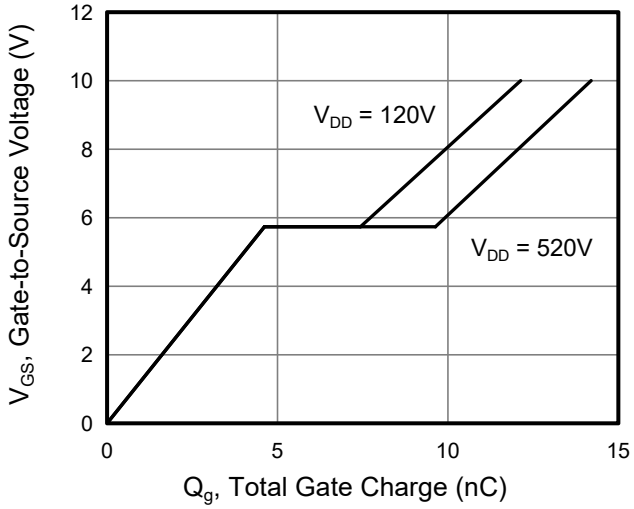


Figure 9. Gate Charge

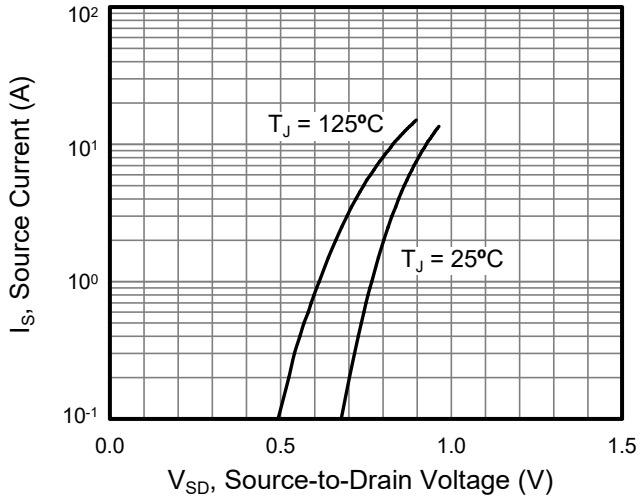


Figure 10. Body Diode Forward Voltage

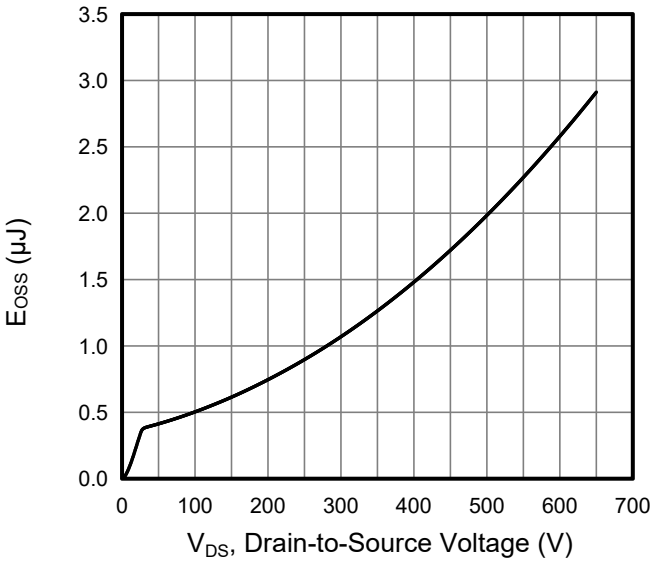


Figure 11. Typ. Coss Stored Energy

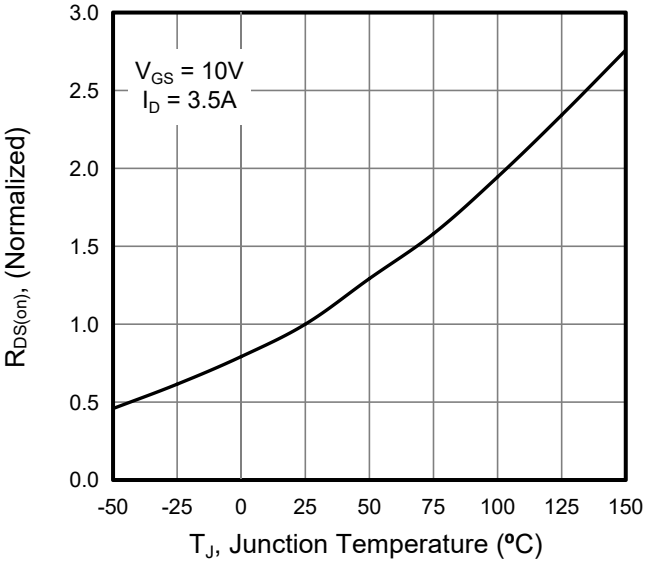


Figure 12. On-Resistance vs Temperature

Typical Characteristics T_J = 25ºC, unless otherwise noted

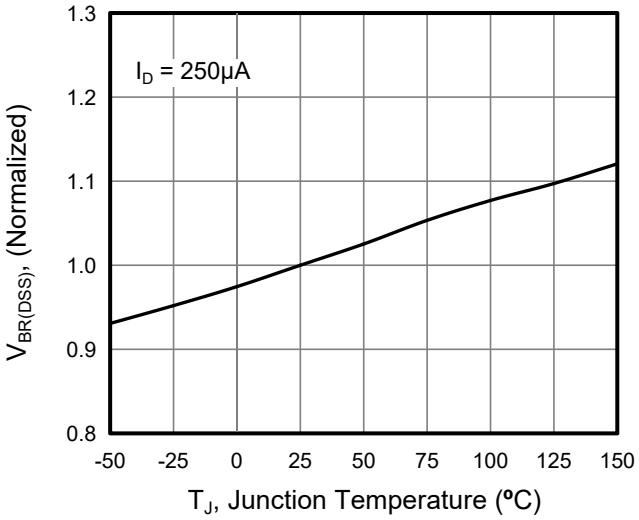


Figure 13. Breakdown Voltage vs Junction Temperature

Figure A：Gate Charge Test Circuit and Waveform

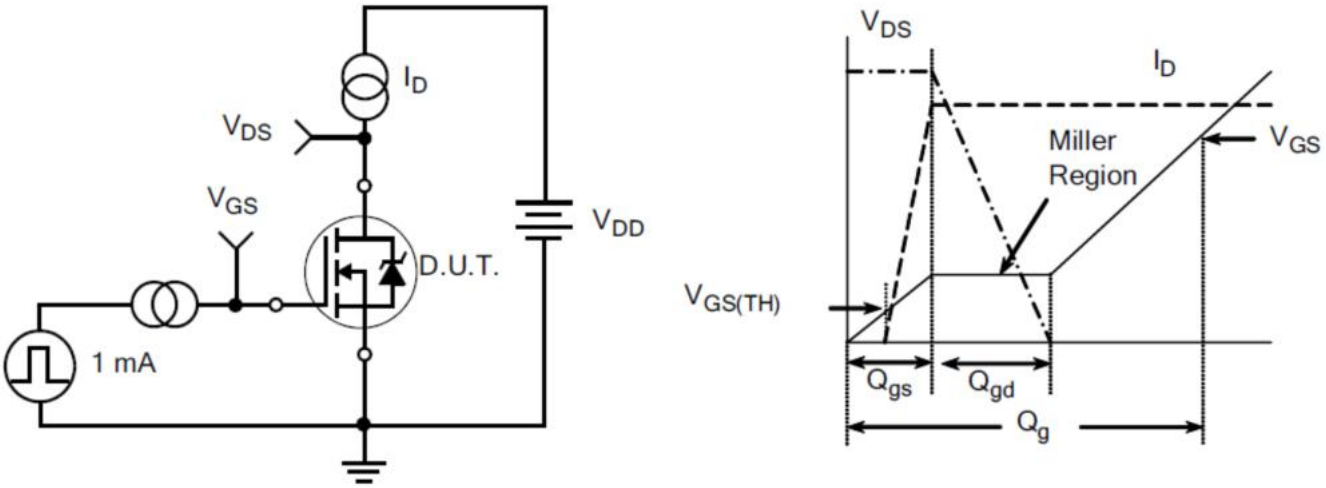


Figure B：Resistive Switching Test Circuit and Waveform

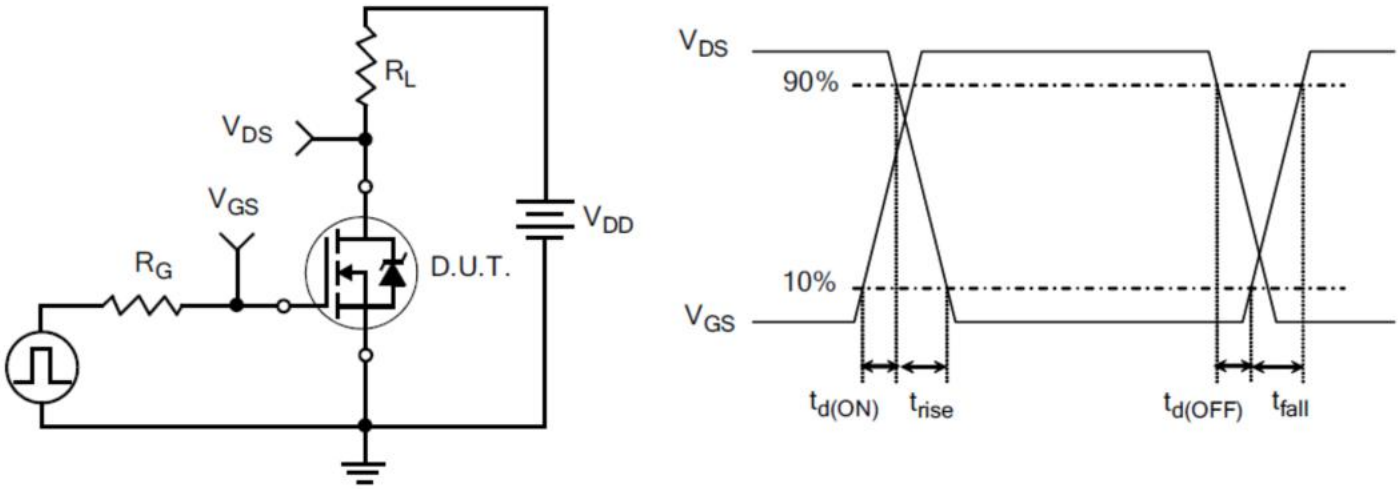
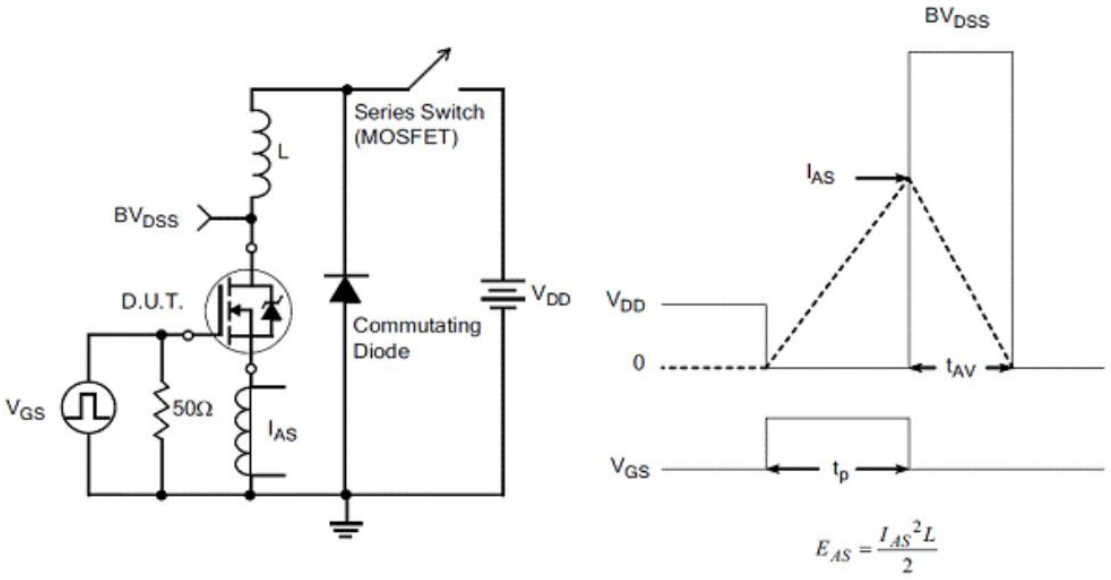
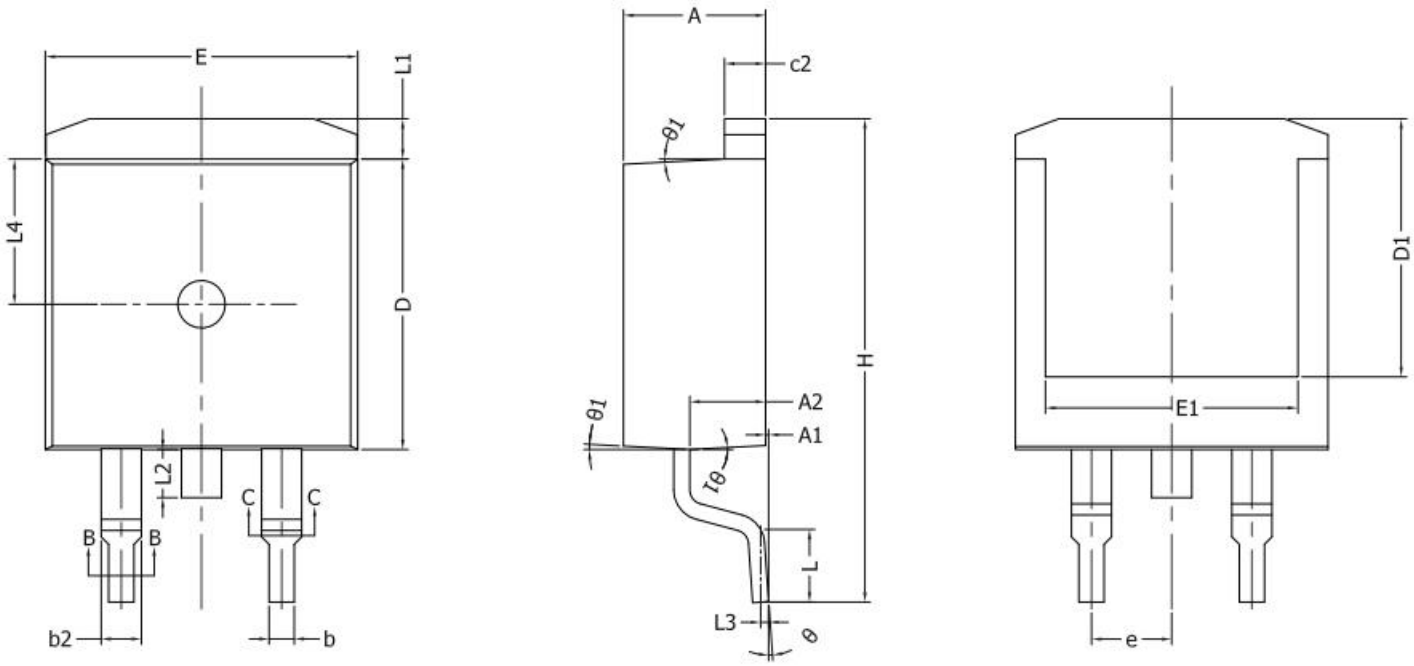
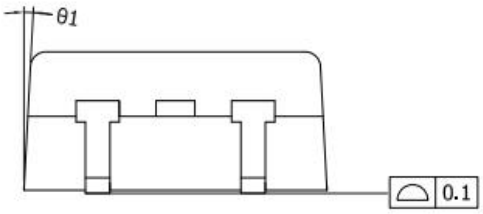


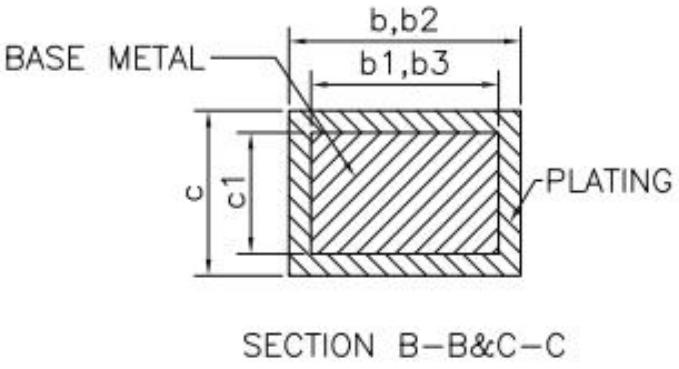
Figure C：Unclamped Inductive Switching Test Circuit and Waveform



Outlines TO-263 Package



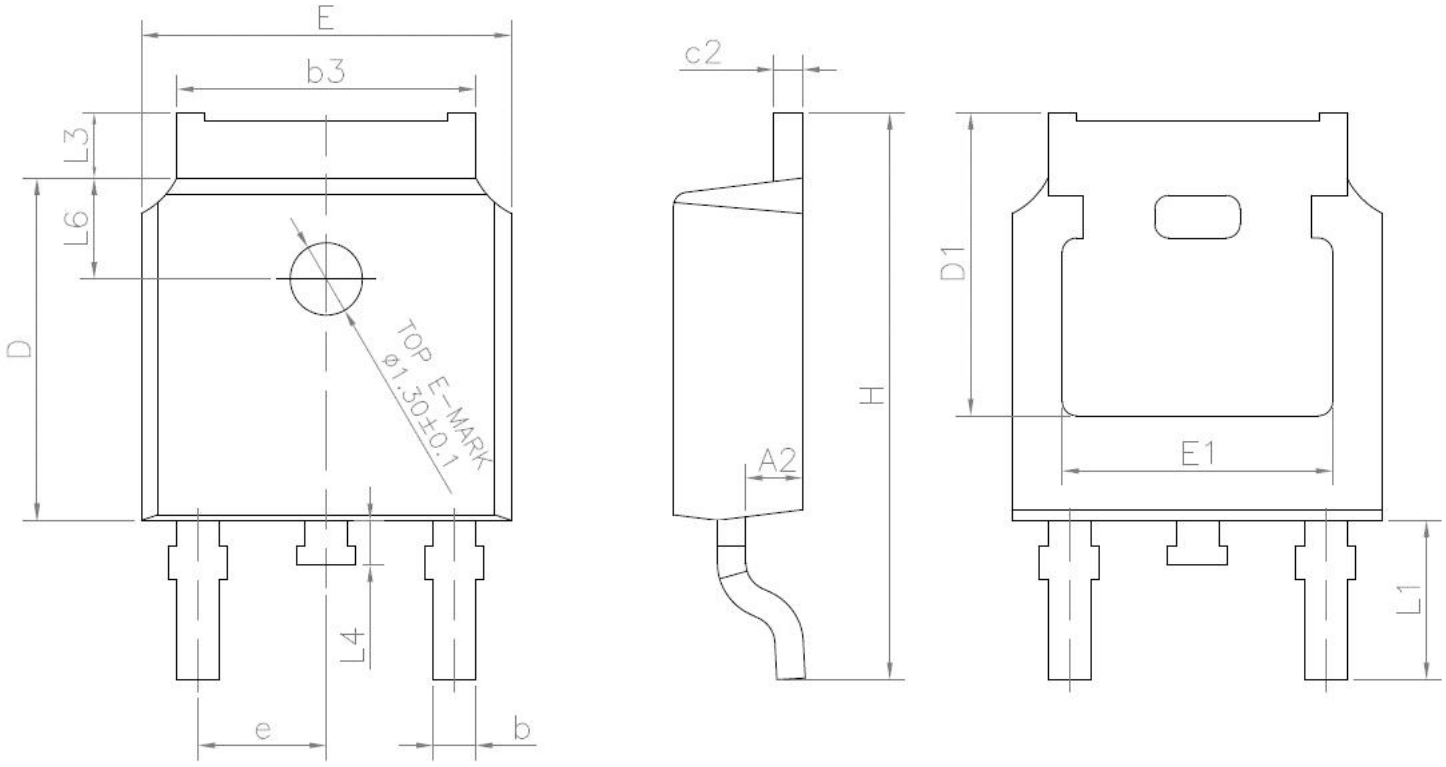


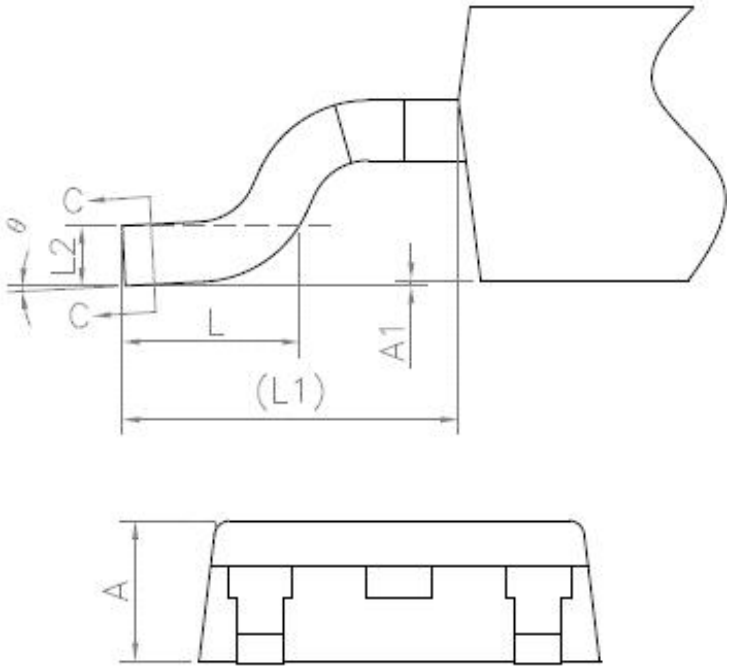


SECTION B–B&C–C

SYMBOL	MIN	NOM	MAX
A	4.4	4.5	4.6
A1	0	0.1	0.25
A2	2.2	2.4	2.6
b	0.76	--	0.89
b1	0.75	0.8	0.85
b2	1.23	--	1.37
b3	1.22	1.27	1.32
c	0.47	--	0.6
c1	0.46	0.51	0.56
c2	1.25	1.3	1.35
D	9.1	9.2	9.3
D1	8	--	--
E	9.8	9.9	10
E1	7.8	--	--
e	2.54 BSC		
H	14.9	15.3	15.7
L	2	2.3	2.6
L1	1.17	1.27	1.4
L2	--	--	1.75
L3	0.25 BSC		
L4	4.60 REF		
Θ	0°	--	8°
Θ1	1°	3°	5°

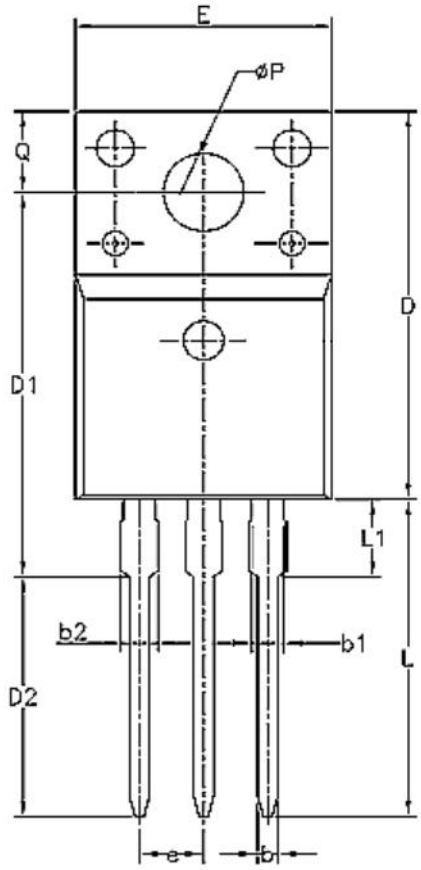
Outlines TO-252 Package

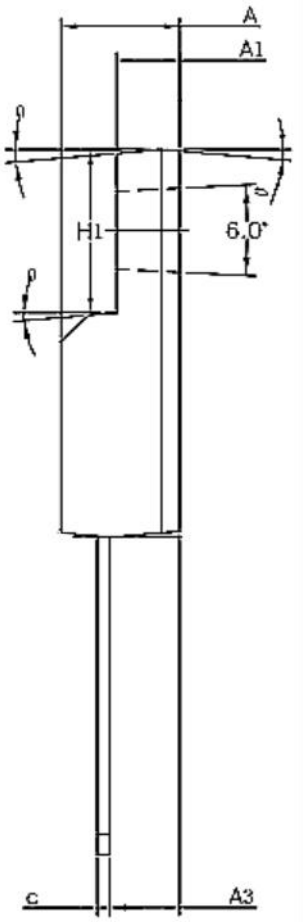


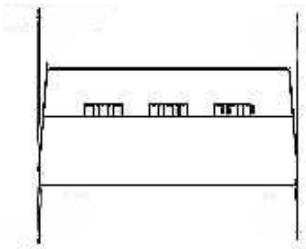


SYMBOL	MIN	NOM	MAX
A	2.2	2.3	2.4
A1	0	--	0.2
A2	0.9	1.035	1.17
b	0.645	--	0.9
b3	5.13	5.326	5.46
c	0.43	--	0.61
c2	0.41	--	0.61
D	5.98	6.1	6.22
D1	5.244	--	--
E	6.4	6.6	6.73
E1	4.63	--	--
e	2.186	2.286	2.386
H	9.4	10.04	10.5
L	1.38	1.5	1.75
L1	2.6	2.872	3
L2	0.5	0.509	0.52
L3	0.88	--	1.28
L4	0.5	--	1
L6	1.5	1.7	1.95
θ	0°	--	10°

Outlines TO-220F Package

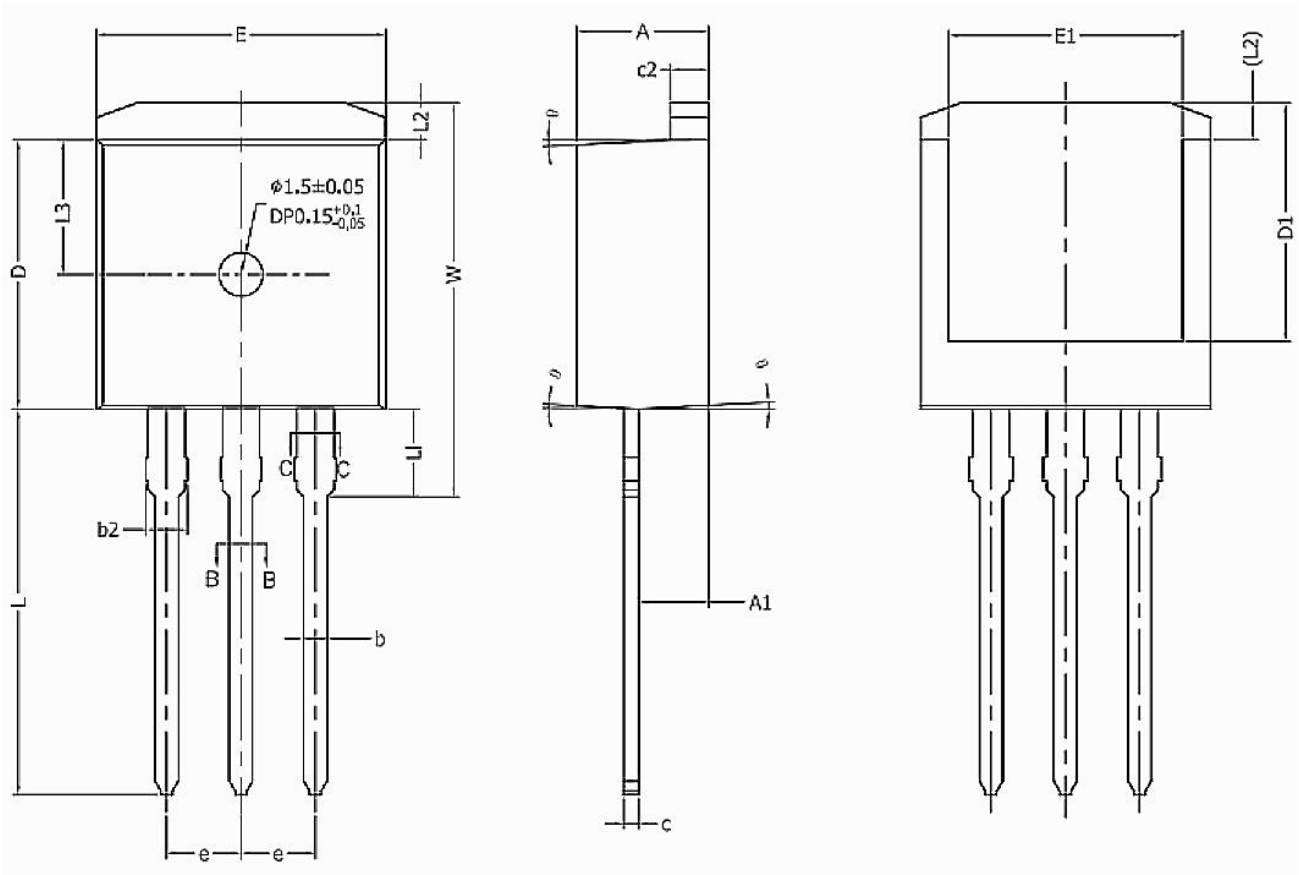






SYMBOL	MIN	NOM	MAX
A	4.5	4.7	4.9
A1	2.34	2.54	2.74
A3	2.56	2.76	2.96
b	0.7	---	0.95
b1	1.18	---	1.43
b2	---	---	1.55
c	0.4	0.5	0.65
D	15.57	15.87	16.17
D1	15.35	15.675	15.95
D2	9.6	9.875	10.15
E	9.96	10.16	10.36
e	2.54 BSC		
H1	6.48	6.68	6.88
L	12.68	12.98	13.28
L1	---	---	3.5

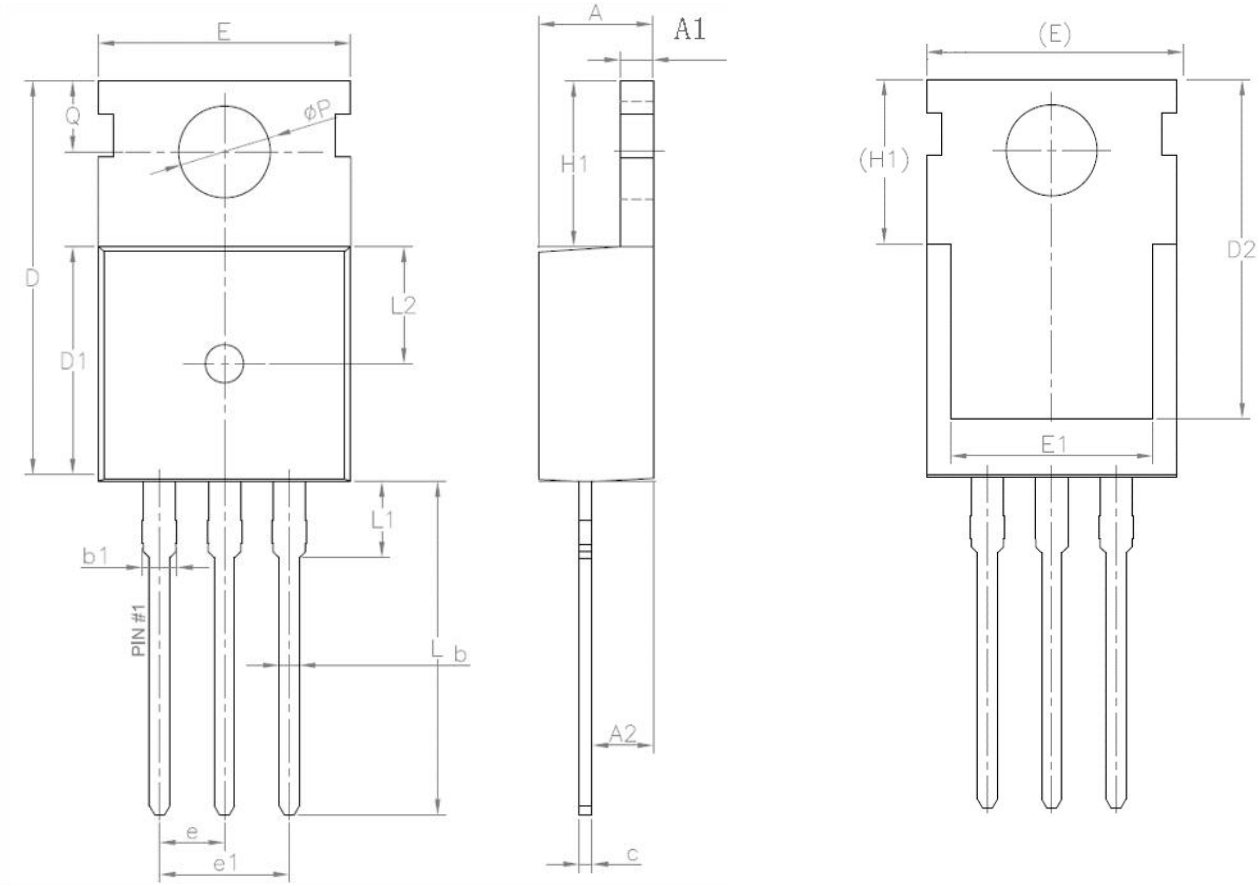
Outlines TO-262 Package

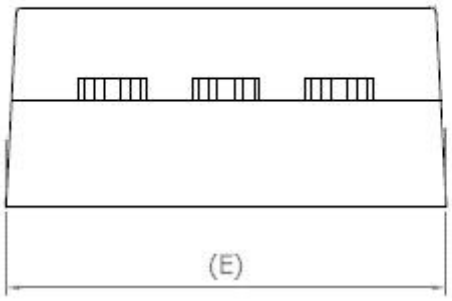


SYMBOL	MIN	NOM	MAX
A	4.40	4.50	4.60
A1	2.20	2.40	2.60
b	0.76	---	0.89
b1	0.75	0.80	0.85
b2	1.23	---	1.37
b3	1.22	1.27	1.32
c	0.47	---	0.60
c1	0.46	0.51	0.56
c2	1.25	1.30	1.35
D	9.10	9.20	9.30

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°

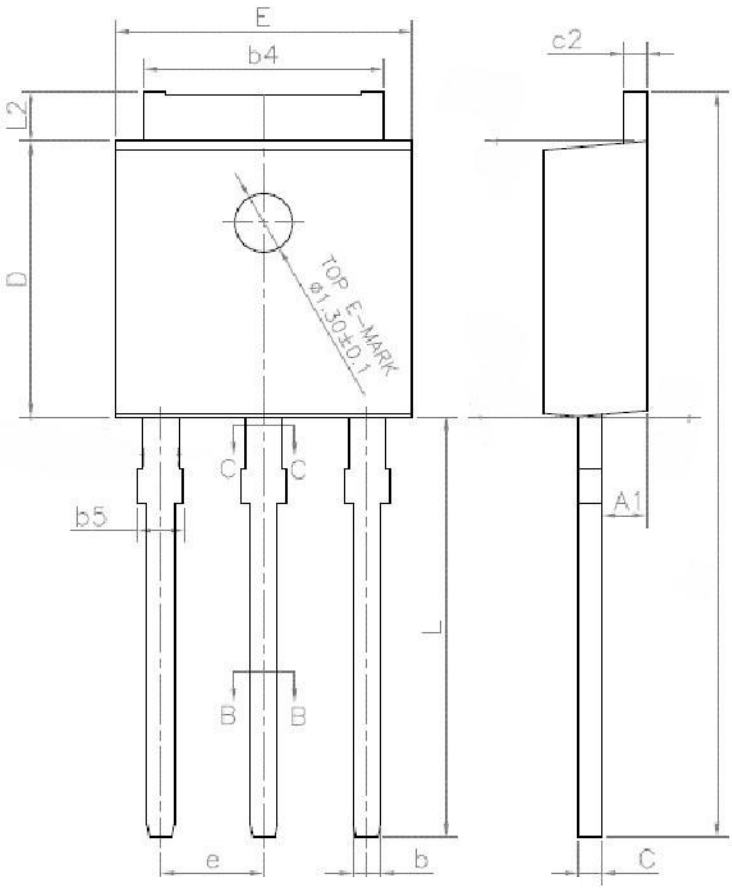
Outlines TO-220 Package

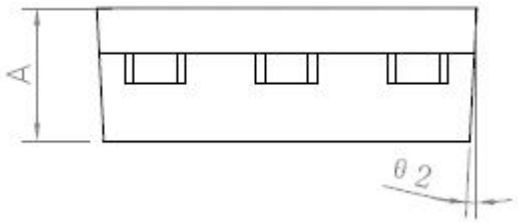


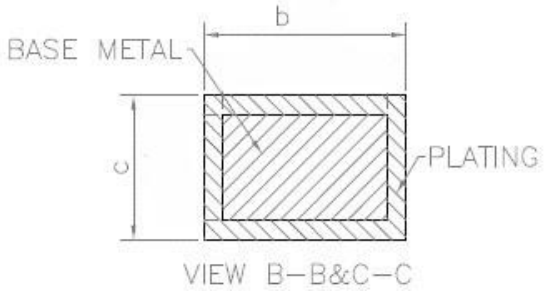


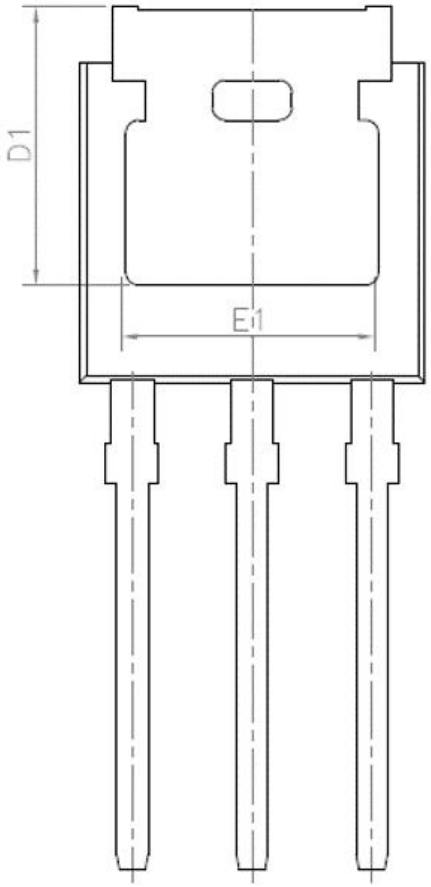
SYMBOL	MIN	NOM	MAX
A	4.37	4.535	4.7
A1	1.25	1.3	1.4
A2	2.2	2.4	2.6
b	0.7	---	0.95
b1	1.17	---	1.47
c	0.45	0.5	0.6
D	15.1	15.65	16.1
D1	8.8	9.15	9.4
D2	11.8	---	---
E	9.7	9.95	10.3
E1	7	---	---
e	2.54 BSC		
e1	5.08 BSC		
H1	6.25	6.5	6.85
L	12.75	13.29	13.8
L1	---	---	3.5
ΦP	3.4	3.67	3.8
Q	2.6	---	3

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

HRM has made reasonable commercial efforts to ensure that the information given in this datasheet is correct. However, it must clearly be understood that such information is for guidance only and does not constitute any representation or form part of any offer or contract.

For documents and material available from this datasheet, HRM does not warrant or assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, product, technology or process disclosed hereunder.

HRM reserves the rights to at its own discretion to make any changes or improvements to this datasheet. Unless said datasheet is incorporated into the formal contract, any customer should not rely on the information as any specification or product parameters duly committed by HRM. Customers are hereby advised to verify that the information contained herein is current and complete before the entering of any contract or acknowledgement of any purchase order. Accordingly, all products specified hereunder shall be sold subject to HRM's terms and conditions supplied at the time of order acknowledgement. Except where agreed upon by contractual agreement, testing of all parameters of each product is not necessarily performed.

HRM does not warrant or convey any license either expressed or implied under its patent rights, nor the rights of others. Reproduction of information contained herein shall be only permissible if such reproduction is without any modification or alteration. Reproduction of this information with any alteration is an unfair and deceptive business practice. HRM is not responsible or liable for such altered documentation.

Resale of HRM's products with statements different from or beyond the parameters stated by HRM for that product or service voids all express or implied warrantees for the associated HRM's product or service and is unfair and deceptive business practice. HRM is not responsible or liable for any such statements.

HRM's products are not authorized for use as critical components in life support devices or systems without the express written approval of HRM. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.