40V N-Channel Power MOSFET

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

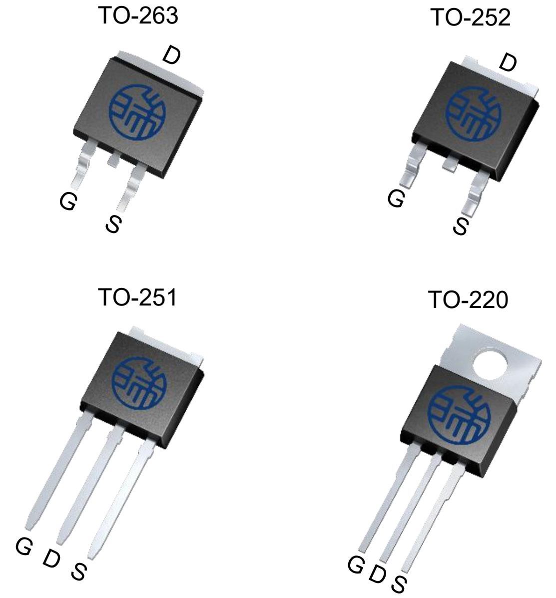
HRTK40N05x Data Sheet

Rev. 2020 V2.0

40V N-Channel Power MOSFET

Description

N-Channel Power MOSFET designed by HR-Micro Semiconductor Company, according to the advanced Trench Technology. This devices 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, load switch and industrial power applications.

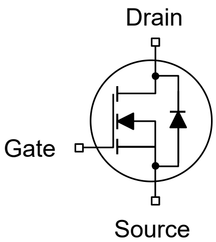


Features

- Low FOM $R_{DS(on)} \times Q_{gd}$
- 100% avalanche tested
- Easy to use/drive
- RoHS compliant

Applications

- AC/DC Converter
- Battery Protection Charge/Discharge
- Load Switch
- Synchronous Rectification



RoHS

Key Performance Parameters

Parameter	Value	Unit
$V_{DS@\ Tc=25℃}$	40	V
$R_{DS(on),max@10V}$	4.2	mΩ
$R_{DS(on),max@4.5V}$	5	mΩ
$Q_{g,typ}$	137	nC
$I_{D@Tc=25℃}$	120	A
$I_{D,pulse}$	330	A
E_{AS} 1)	480	mJ

Device Marking and Package Information

Device	Package	Marking
HRTK40N05B	TO-263	40N05B
HRTK40N05D	TO-252	40N05D
HRTK40N05U	TO-251	40N05U
HRTK40N05P	TO-220	40N05P

Absolute Maximum Ratings T_A = 25ºC, unless otherwise noted				
Parameter		**Symbol**	**Values**	**Unit**
Drain-Source Voltage(V_{GS}=0V)		V_{DS}	40	V
Continuous Drain Current[2]	T_C = 25ºC	I_D	120	A
	T_C = 100ºC		76	
Pulsed Drain Current[3]		$I_{D,pulse}$	330	A
Gate-Source Voltage		V_{GSS}	±20	V
Single Pulse Avalanche Energy[1]		E_{AS}	480	mJ
Power Dissipation		P_D	113	W
Operating Junction and Storage Temperature Range		T_J, T_{stg}	-55~+150	ºC

Thermal Resistance			
Parameter	**Symbol**	**Max.**	**Unit**
Thermal Resistance, Junction-to-Case	R_{thJC}	1.1	ºC/W
Thermal Resistance, Junction-to-Ambient	R_{thJA}	62	ºC/W

Notes

1) L=0.5mH, V_{DD}=20V, Start T_J=25℃.

2) Limited by maximum junction temperature.

3) Repetitive Rating: Pulse width limited by maximum junction temperature and package.

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	40	--	--	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 40V V_{GS} = 0V, T_J = 25ºC	--	--	1	μA
		V_{DS} =40V V_{GS} = 0V, T_J = 125ºC	--	--	100	
Gate-Source Leakage Current	I_{GSS}	V_{GS} = ±20V	--	--	±100	nA
Gate-Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250μA	0.8	1.4	2.0	V
Drain-Source On-State-Resistance	$R_{DS(on)}$	V_{GS} = 10V, I_D = 20A	--	3.2	4.2	mΩ
		V_{GS} = 4.5V, I_D = 20A	--	4	5	mΩ
Gate Resistance	R_G	f = 1.0MHz open drain	--	3	--	Ω
Dynamic Characteristics						
Input Capacitance	C_{iss}	V_{GS} = 0V, V_{DS} = 20V f = 1.0MHz	--	6922	--	pF
Output Capacitance	C_{oss}		--	572	--	
Reverse Transfer Capacitance	C_{rss}		--	499	--	
Total Gate Charge	Q_g	V_{DS} = 20V, I_D = 20A V_{GS} = 10V	--	137	--	nC
Gate-Source Charge	Q_{gs}		--	18	--	
Gate-Drain Charge	Q_{gd}		--	26	--	
Turn-on Delay Time	$t_{d(on)}$	V_{DS} = 20V, V_{GS} =10V R_G = 3Ω, I_D = 20A	--	20	--	ns
Turn-on Rise Time	t_r		--	25	--	
Turn-off Delay Time	$t_{d(off)}$		--	34	--	
Turn-off Fall Time	t_f		--	14	--	
Drain-Source Body Diode Characteristics						
Body Diode Forward Voltage	V_{SD}	T_J = 25ºC, I_{SD} = 20A V_{GS} = 0V	--	--	1.2	V
Continuous Diode Forward Current	I_S		--	--	120	A
Reverse Recovery Time	t_{rr}	I_F = 20A, di_F/dt = 100A/μs	--	28	--	ns
Reverse Recovery Charge	Q_{rr}		--	22	--	nC

Typical Characteristics T_J = 25ºC, unless otherwise noted

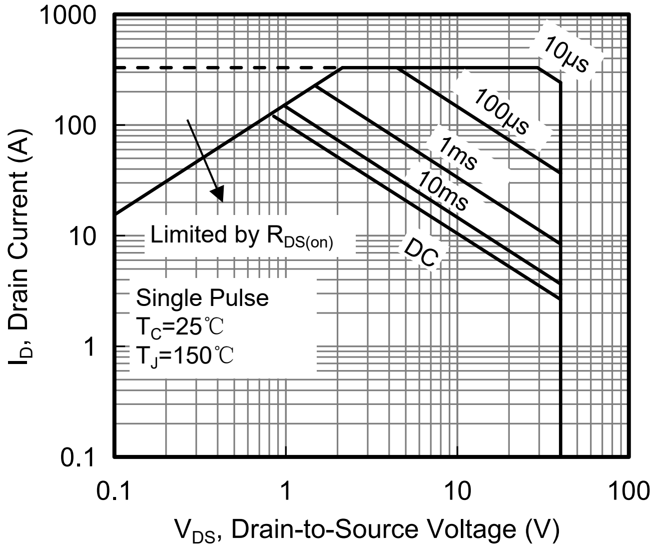


Figure 1. Maximum Safe Operating Area

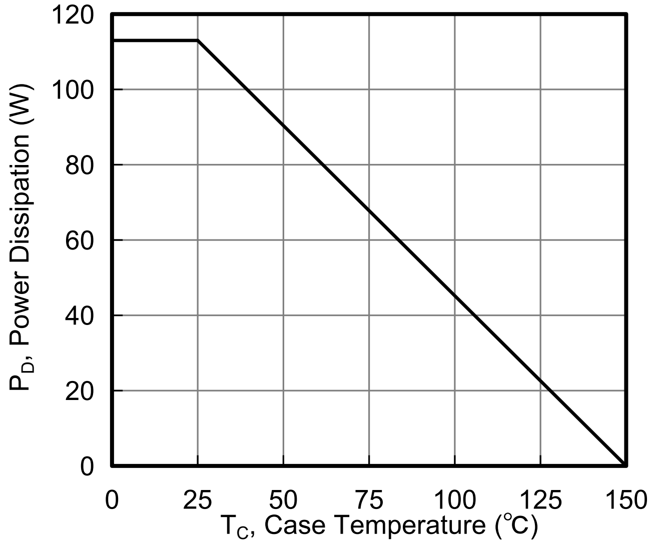


Figure 2. Maximum Power Dissipation vs Case Temperature

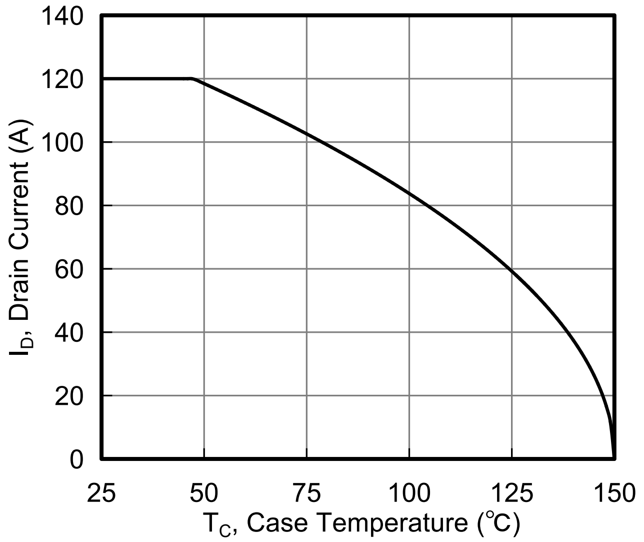


Figure 3. Maximum Continuous Drain Current vs Case Temperature

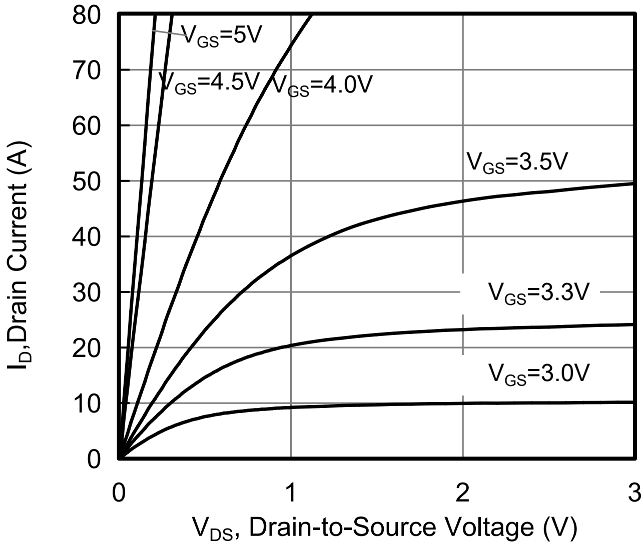


Figure 4. Typical output Characteristics

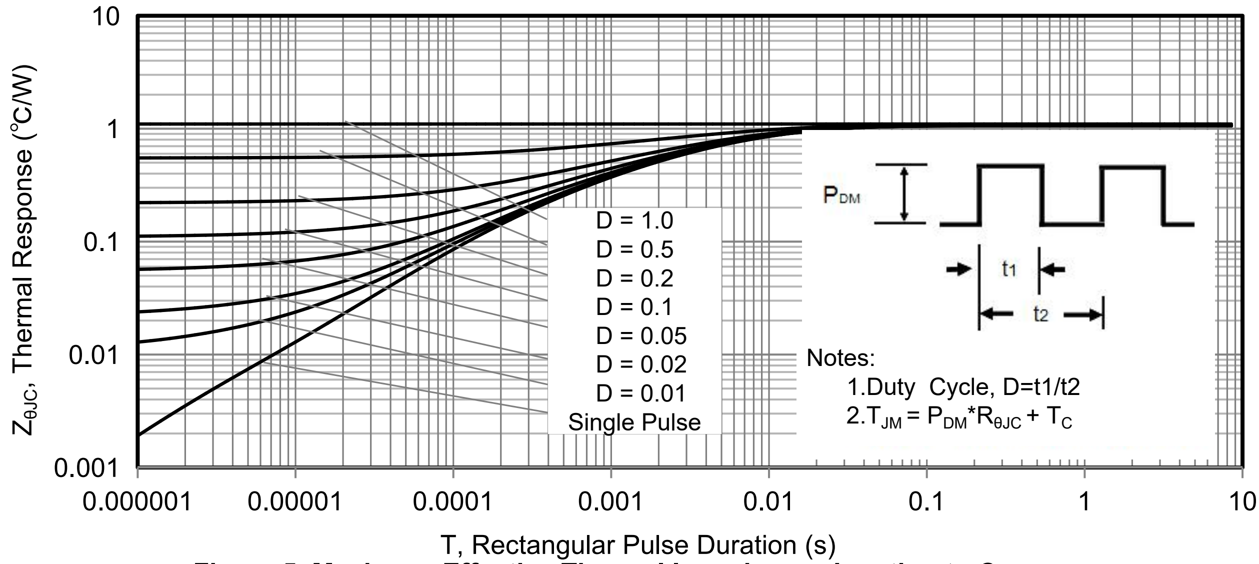


Figure 5. Maximum Effective Thermal Impedance, Junction to Case

Typical Characteristics T_J = 25ºC, unless otherwise noted

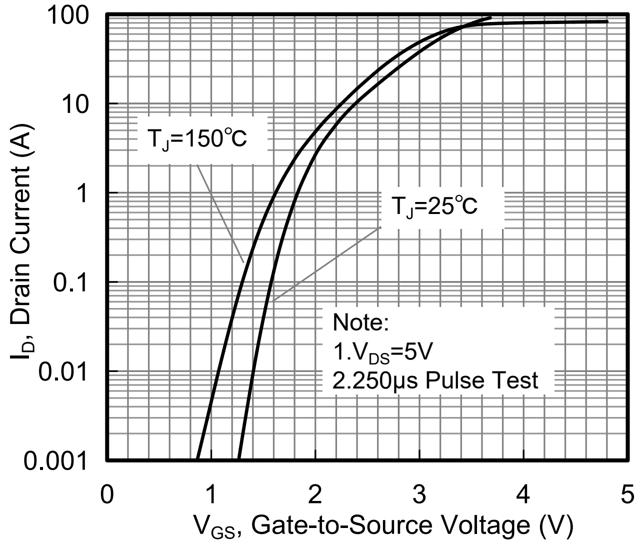


Figure 6. Typical Transfer Characteristics

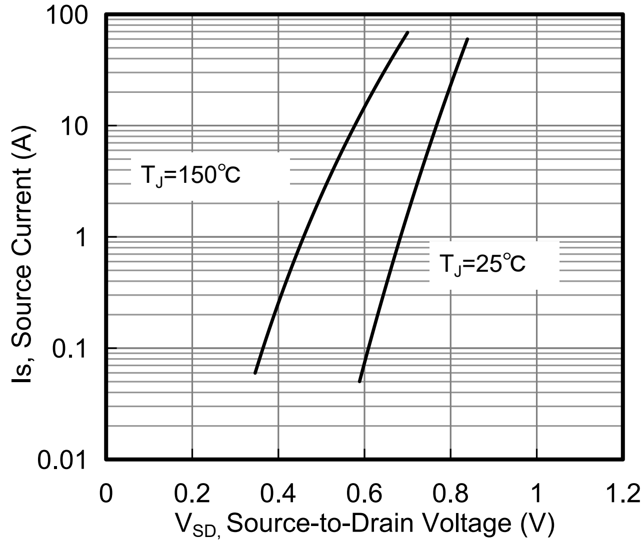


Figure 7. Typical Body Diode Transfer Characteristics

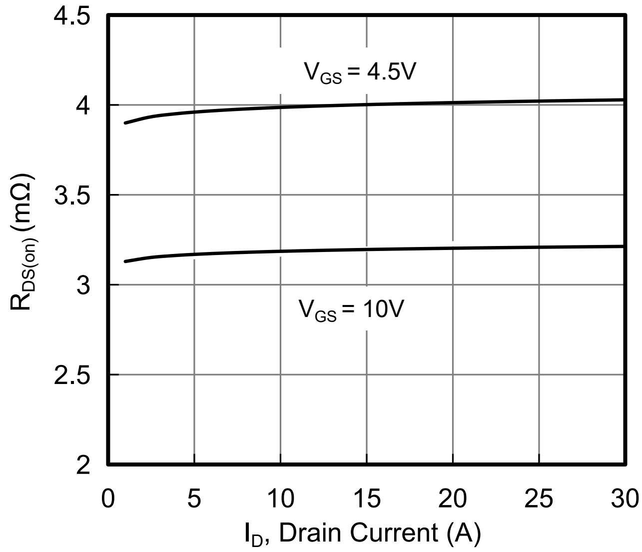


Figure 8. Drain-to-Source On Resistance vs Drain Current

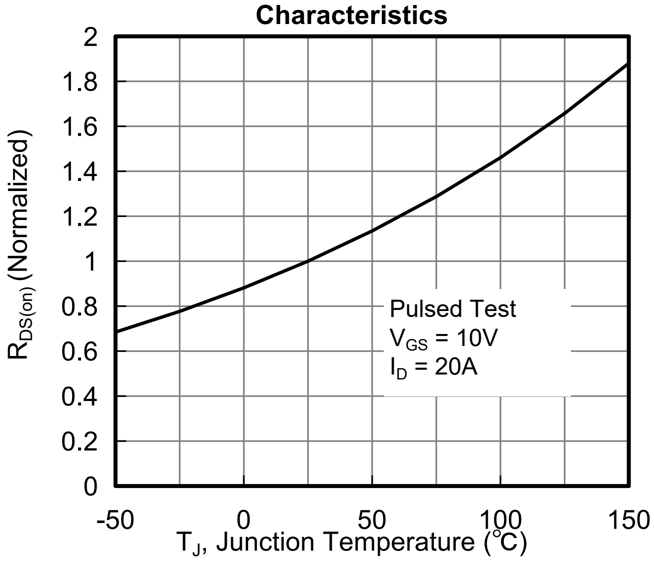


Figure 9. Normalized On Resistance vs Junction Temperature

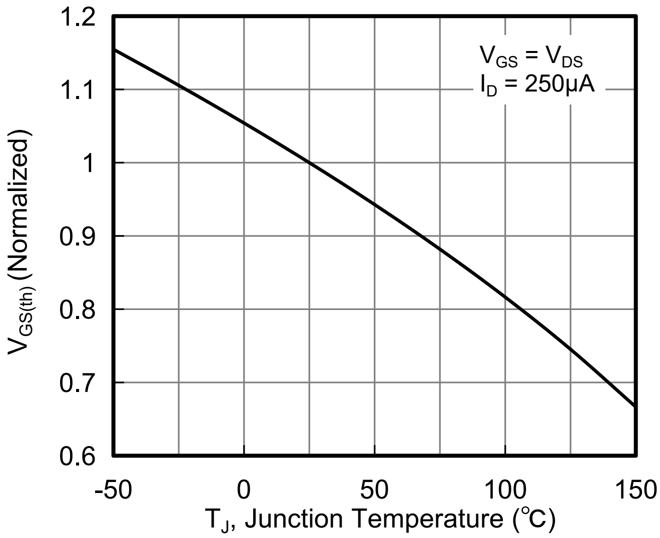


Figure 10. Normalized Threshold Voltage vs Junction Temperature

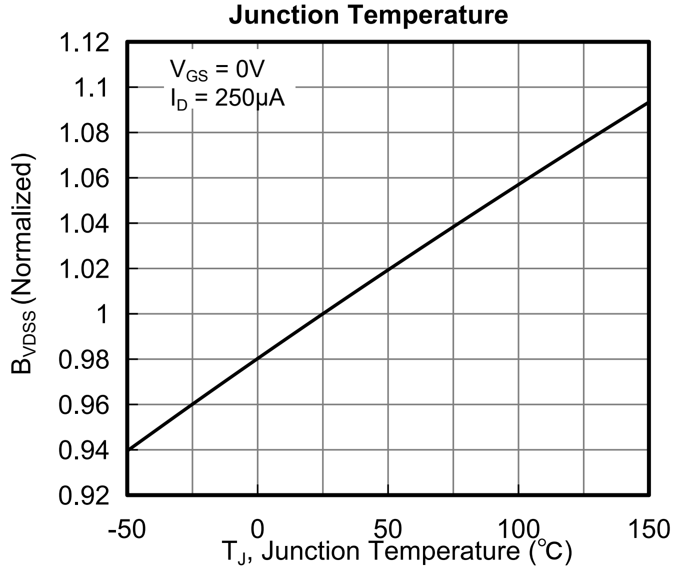


Figure 11. Normalized Breakdown Voltage vs Junction Temperature

Typical Characteristics T_J = 25ºC, unless otherwise noted

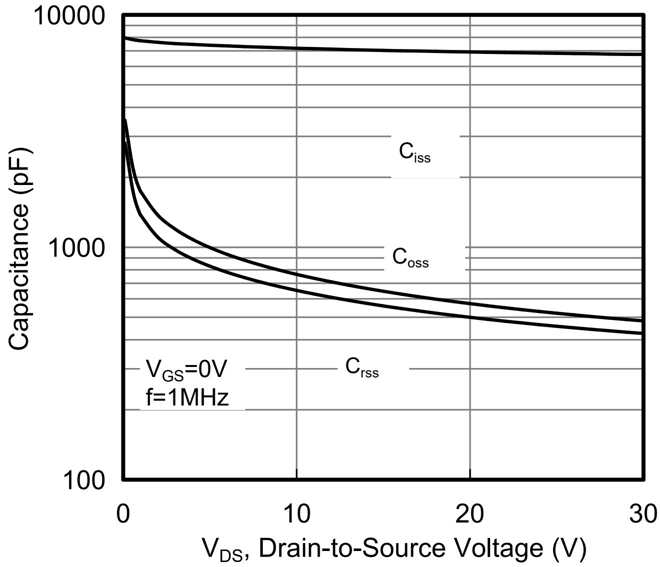


Figure 12. Capacitance Characteristics

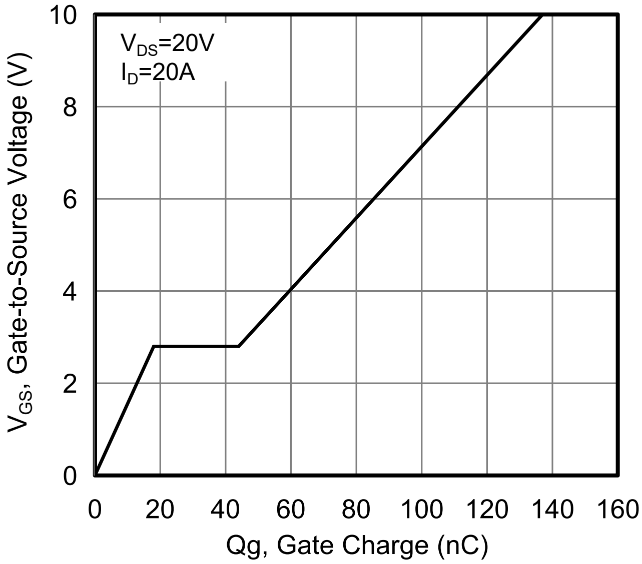


Figure 13. Typical Gate Charge vs Gate to Source Voltage

Figure A：Gate Charge Test Circuit and Waveform

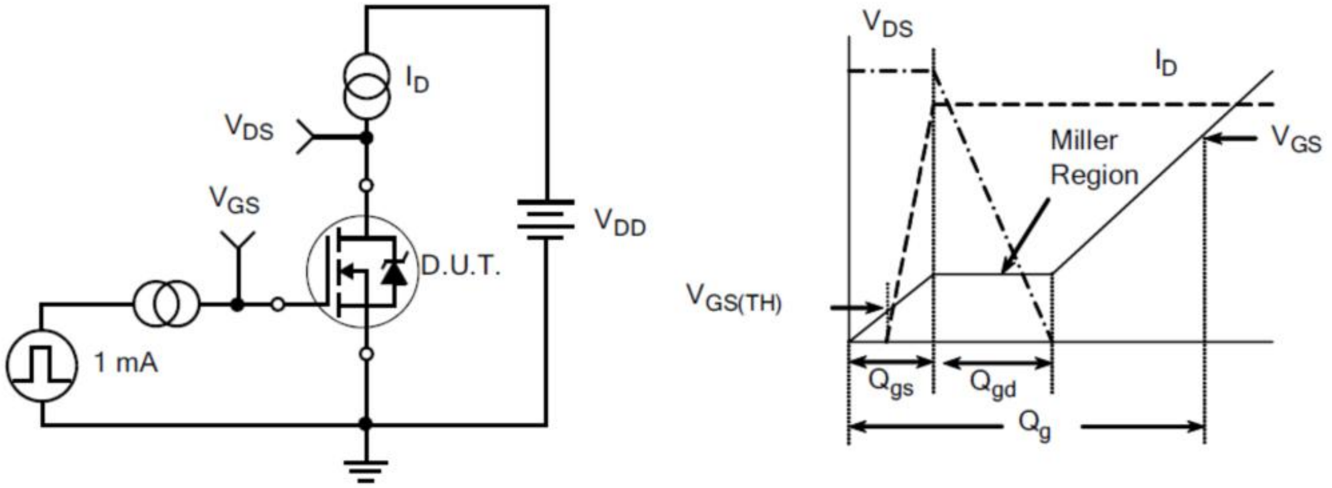


Figure B：Resistive Switching Test Circuit and Waveform

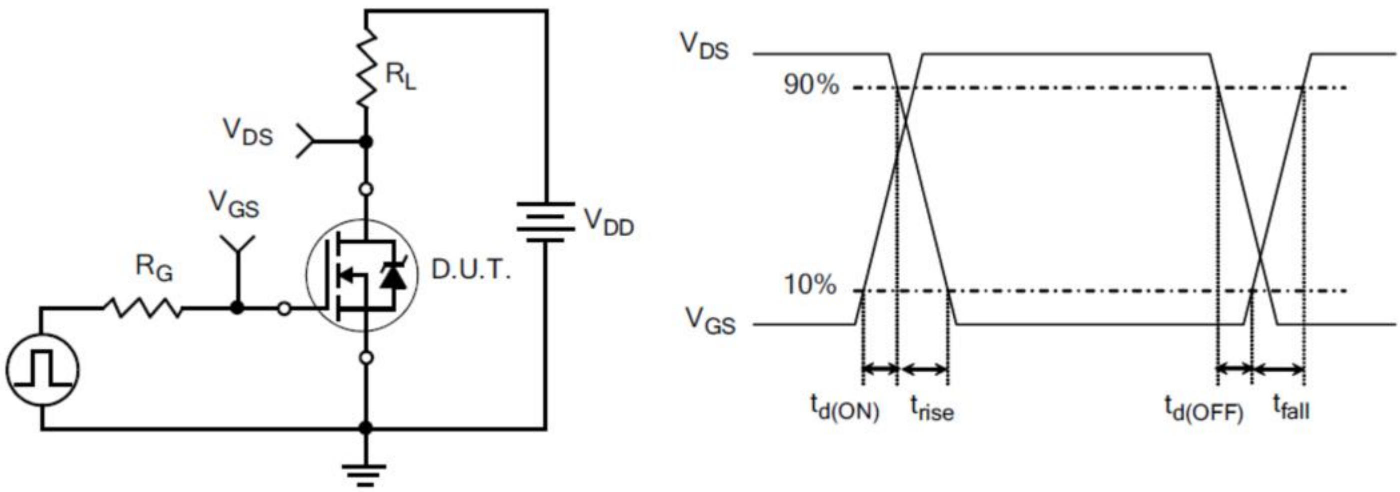
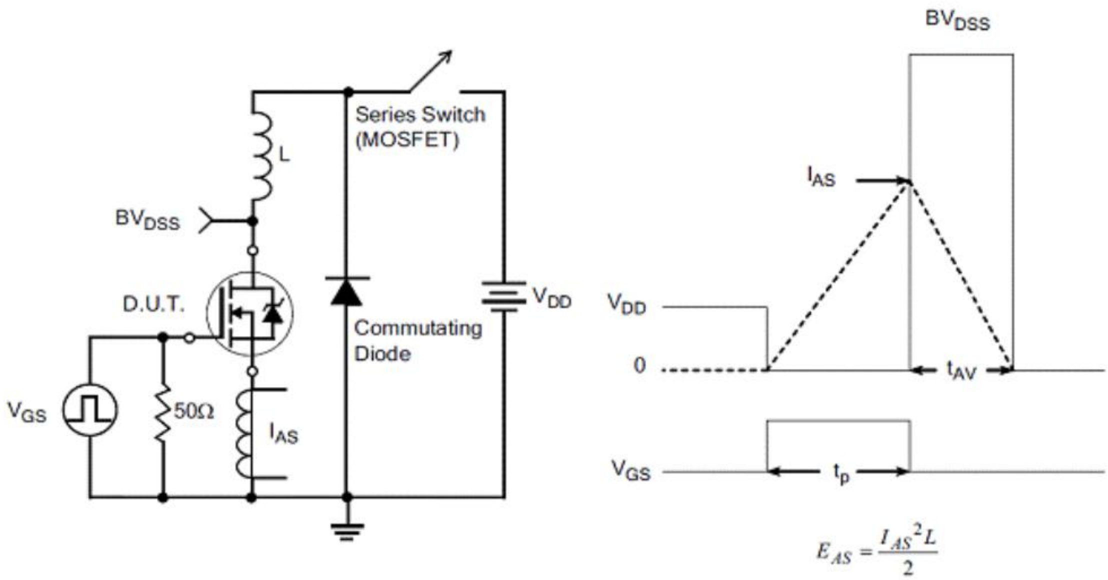
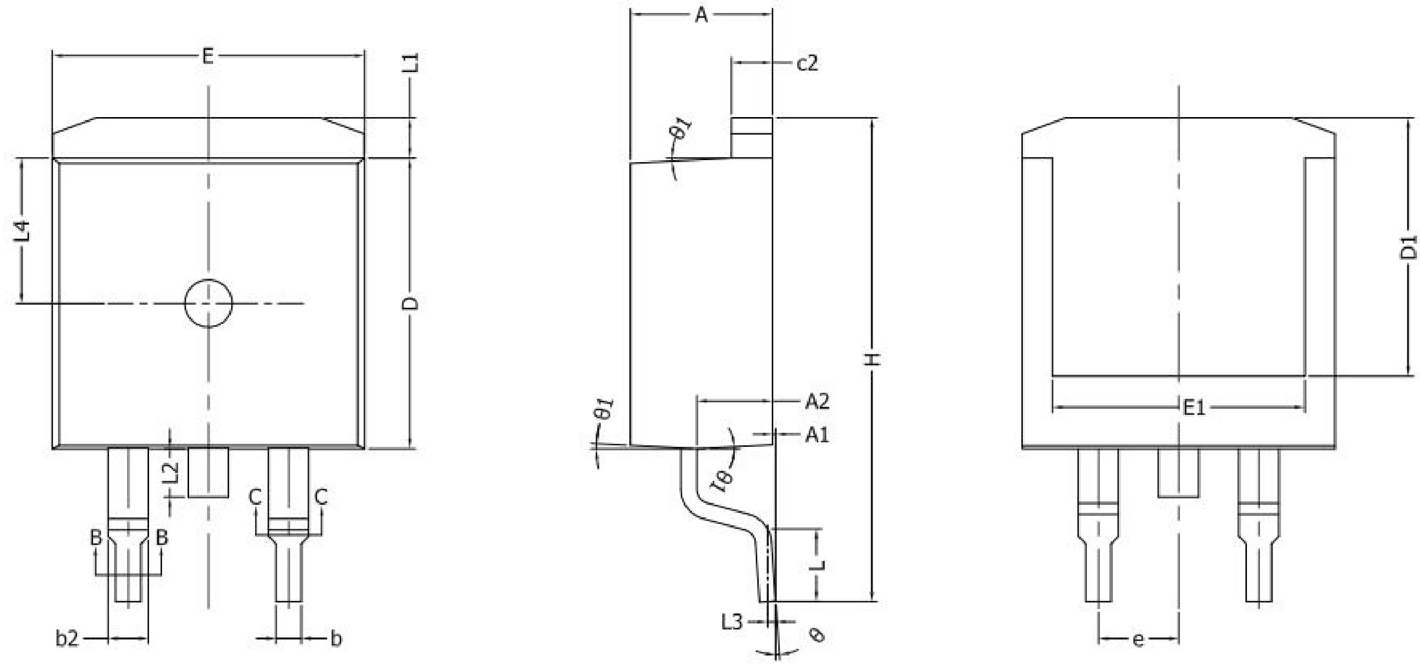
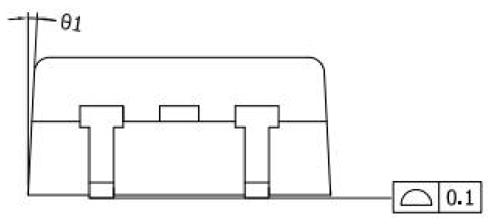


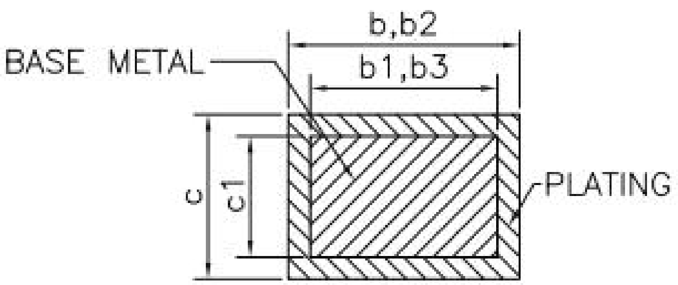
Figure C：Unclamped Inductive Switching Test Circuit and Waveform



Outlines TO-263 Package



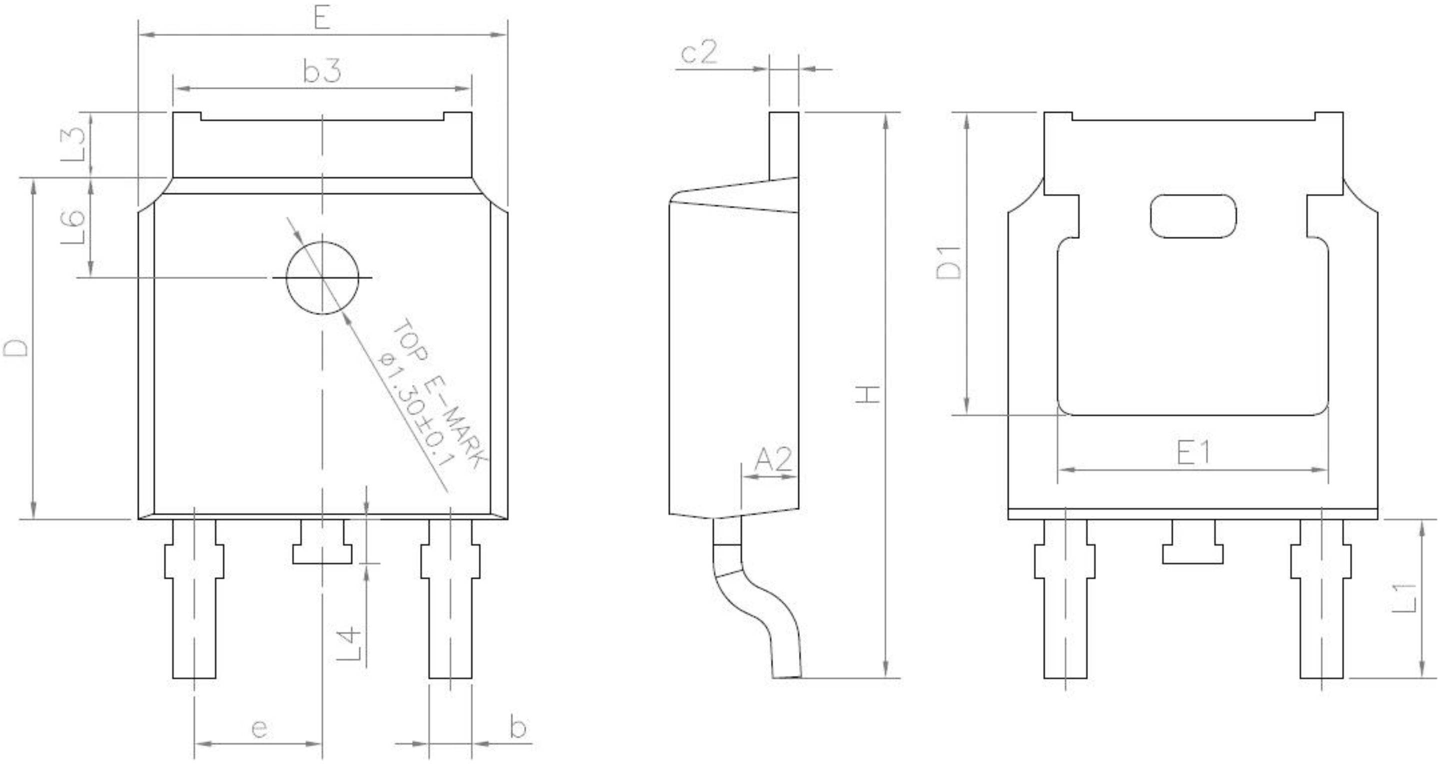


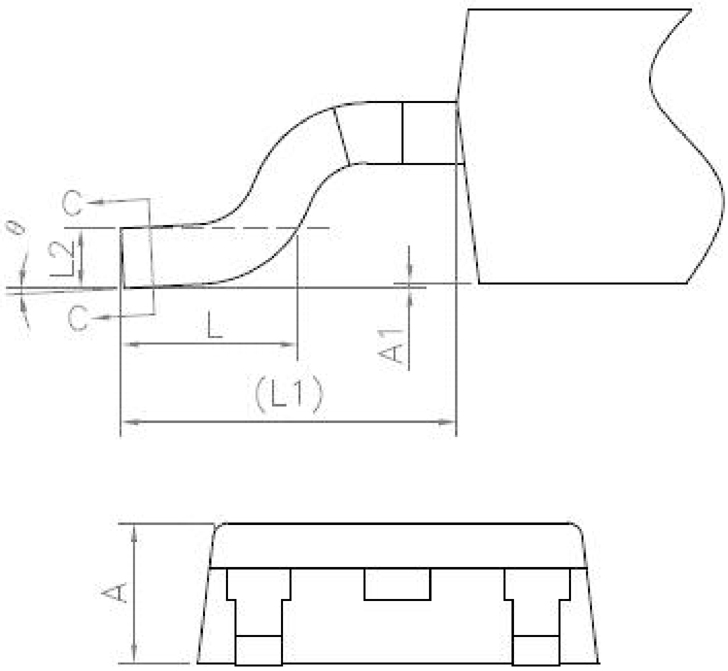


SECTION B-B&C-C

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°

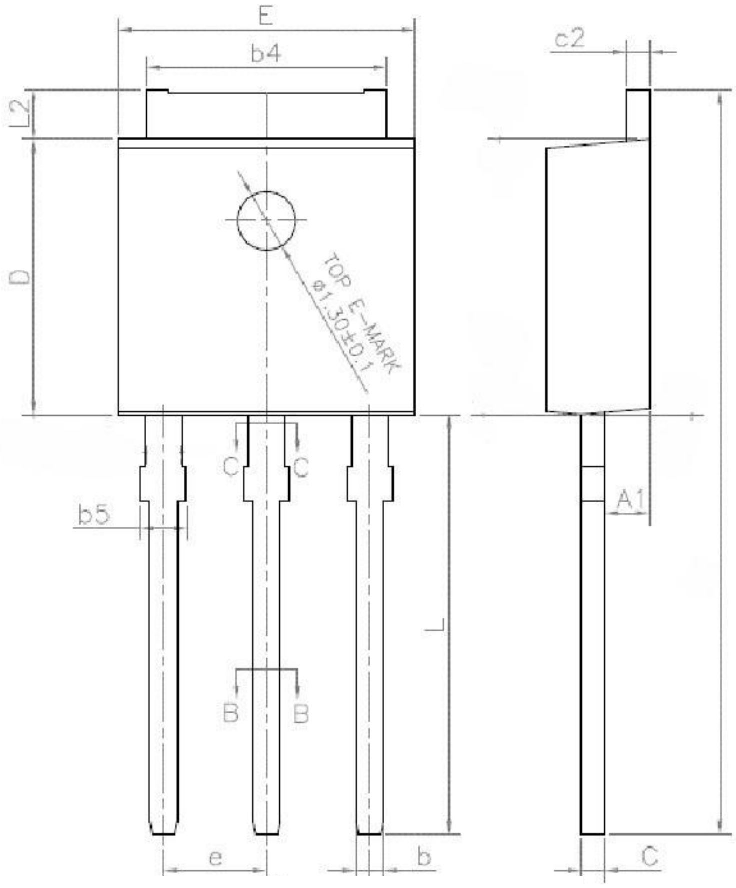
Outlines TO-252 Package

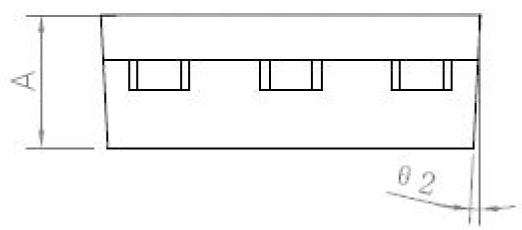


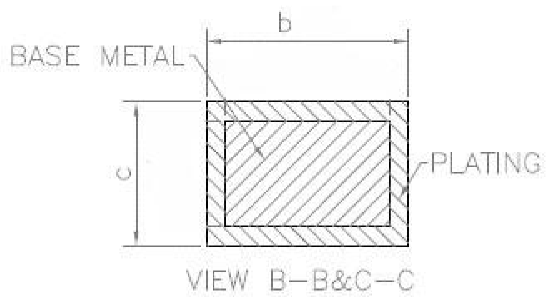


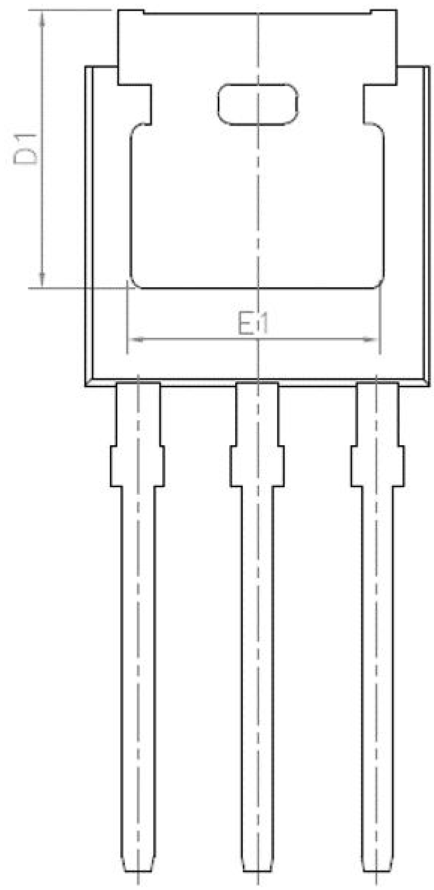
SYMBOL	MIN	NOM	MAX
A	2.2	2.3	2.4
A1	0	--	0.2
A2	0.9	1.035	1.17
b	0.645	--	0.9
b3	5.13	5.326	5.46
c	0.43	--	0.61
c2	0.41	--	0.61
D	5.98	6.1	6.22
D1	5.244	--	--
E	6.4	6.6	6.73
E1	4.63	--	--
e	2.186	2.286	2.386
H	9.4	10.04	10.5
L	1.38	1.5	1.75
L1	2.6	2.872	3
L2	0.5	0.509	0.52
L3	0.88	--	1.28
L4	0.5	--	1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

Outlines TO-251 Package



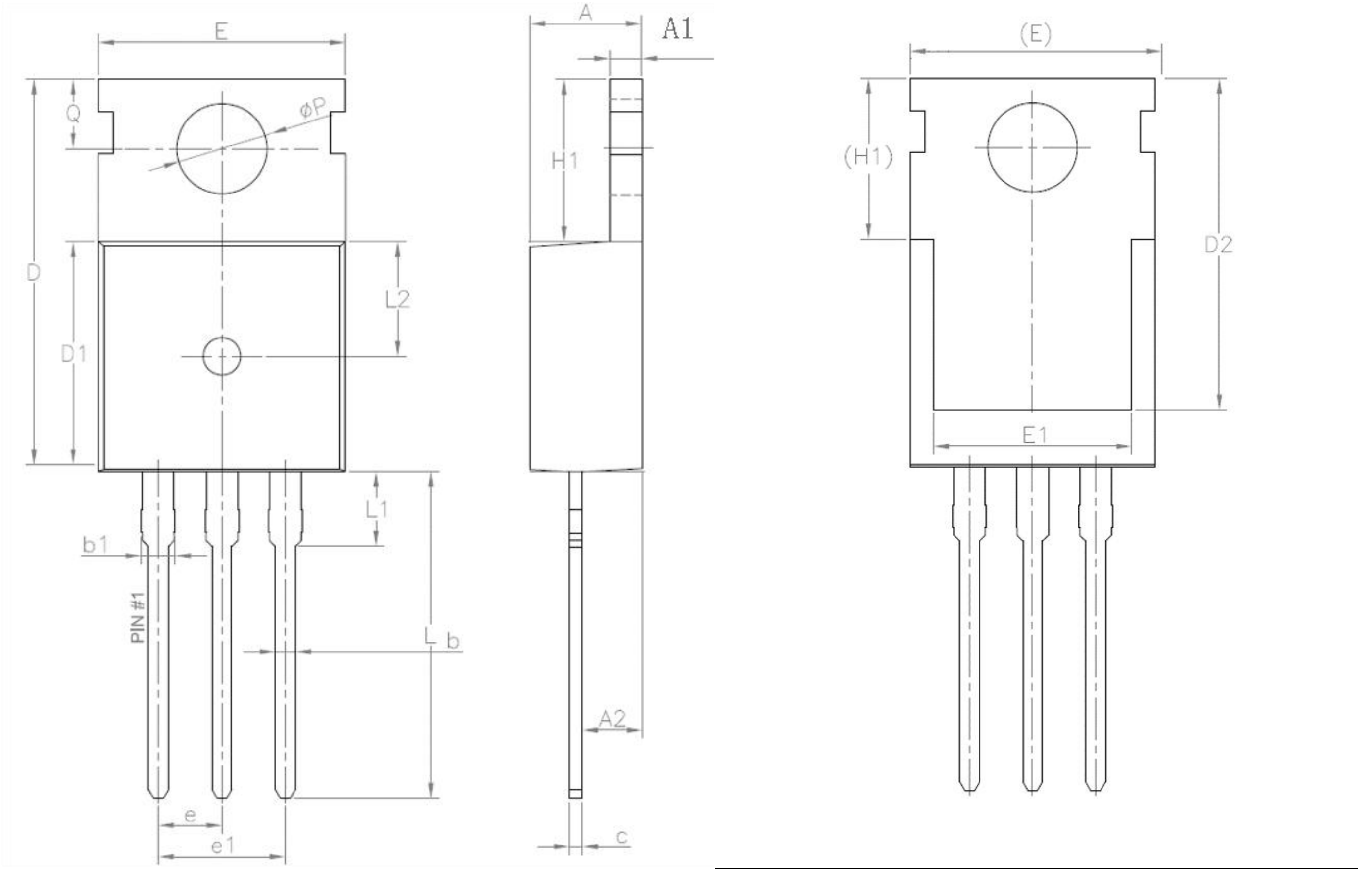


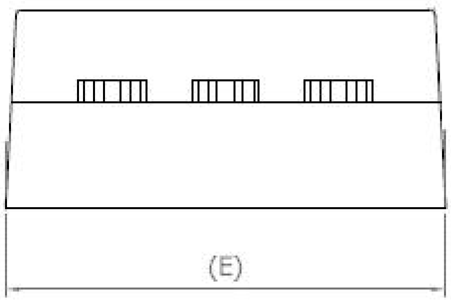




SYMBOL	MIN	NOM	MAX
A	2.20	2.30	2.38
A1	0.90	1.04	1.17
b	0.56	--	0.90
b4	5.20	5.33	5.46
b5	--	--	1.05
c	0.43	--	0.61
c2	0.43	--	0.61
D	5.98	6.10	6.22
D1	5.2	--	--
E	6.40	6.60	6.73
E1	4.60	--	--
e	2.24	2.29	2.34
e1	4.47	4.57	4.67
H	16.18	16.50	16.82
L	9	9.35	9.65
L2	0.88	1.05	1.28

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

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