

450V N-Channel Planar MOSFET

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

450V N-Channel Planar MOSFET

450V N-Channel Planar MOSFET Power Transistor

HRH10N45BNx Data Sheet

Rev. 2023 V1.1



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Description

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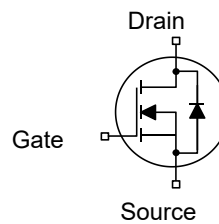
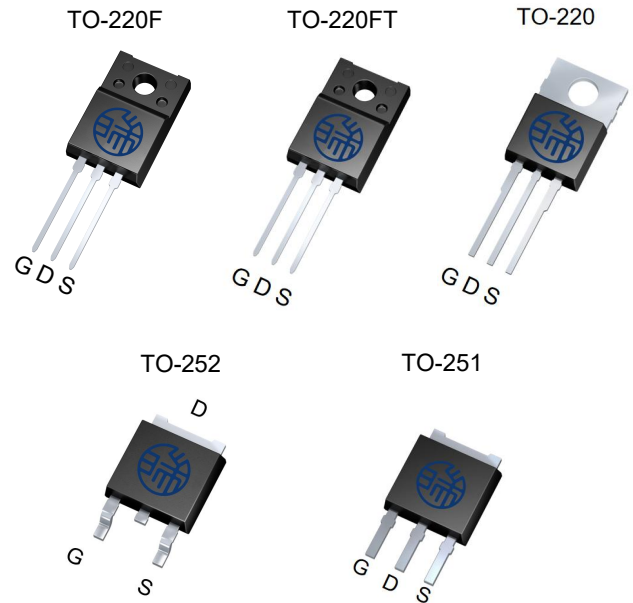
HRH10N45BNx is HRM high voltage MOSFET family based on advanced planar stripe DMOS technology. This advanced MOSFET family has optimized on-state resistance, and also provides superior switching performance and higher avalanche energy strength. This device family is suitable for high efficiency switch mode power supplies.

Features

- $R_{DS(on)}=0.5\Omega$ @ $V_{GS}=10V$, $I_D=5A$
- Ultra Low gate Charge (typical 25nC)
- Low C_{rss} (typical 3.35pF)
- Fast switching capability
- 100% avalanche tested
- Improved dv/dt capability

Applications

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC) (PFC)
- Charger



Key Performance Parameters

Parameter	Value	Unit
V_{DS}	450	V
$R_{DS(on),typ}$	0.5	Ω
$Q_{g,typ}$	25	nC
I_D	10	A
$I_{D,pulse}$	40	A

Device Marking and Package Information

Device	Package	Marking
HRH10N45BNF	TO-220F	H10N45BNF
HRH10N45BNFT	TO-220FT	H10N45BNFT
HRH10N45BNP	TO-220	H10N45BNP
HRH10N45BND	TO-252	H10N45BND
HRH10N45BNU	TO-251	H10N45BNU

Absolute Maximum Ratings T _C = 25°C, unless otherwise noted				
Parameter		Symbol	Value	Unit
Drain-Source Voltage(V _{GS} =0V)		V _{DS}	450	V
Continuous Drain Current ¹⁾	T _C = 25°C	I _D	10	A
	T _C = 100°C		6	
Pulsed Drain Current ²⁾		I _{D,pulse}	40	A
Gate-Source Voltage		V _{GS}	±30	V
Single Pulse Avalanche Energy ³⁾		E _{AS}	295	mJ
MOSFET dv/dt Ruggedness, V _{DS} = 0...480V		dv/dt	5	V/ns
Power Dissipation For TO-220F		P _D	59.81	W
Power Dissipation For TO-3P/247/220			77.64	
Continuous Diode Forward Current		I _S	10	A
Diode Pulsed Current ²⁾		I _{S,pulse}	40	
Operating Junction and Storage Temperature Range		T _J , T _{stg}	-55~+150	°C

Thermal Resistance For TO-220F			
Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	R_{thJC}	2.09	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	R_{thJA}	80	

Thermal Resistance For TO-3P/247/220			
Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	R_{thJC}	1.61	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	R_{thJA}	62	

Notes

- 1) Limited by maximum junction temperature.
- 2) Repetitive Rating: Pulse width limited by maximum junction temperature.
- 3) $L=10\text{mH}$, $I_D=7.7\text{A}$, Start $T_J=25^\circ\text{C}$

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	450	--	--	V
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 450V V _{GS} = 0V, T _J = 25°C	--	--	1	μA
		V _{DS} = 450V, V _{GS} = 0V, T _J = 150°C	--	--	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	2	--	4	V
Drain-Source On-State-Resistance	R _{DS(on)}	V _{GS} = 10V, I _D = 5A	--	0.5	0.62	Ω
Gate Resistance	R _G	f = 1.0MHz open drain	--	1.69	--	Ω
Dynamic Characteristics						
Input Capacitance	C _{iss}	V _{GS} = 0V, V _{DS} = 25V f = 1.0MHz	--	1167	--	pF
Output Capacitance	C _{oss}		--	108.5	--	
Reverse Transfer Capacitance	C _{rss}		--	3.35	--	
Total Gate Charge	Q _g	V _{DD} = 360V, I _D = 10A V _{GS} = 10V	--	25	--	nC
Gate-Source Charge	Q _{gs}		--	7.1	--	
Gate-Drain Charge	Q _{gd}		--	7.3	--	
Gate Plateau Voltage	V _{plateau}		--	4.9	--	V
Turn-on Delay Time	t _{d(on)}	V _{DD} = 225V, I _D = 10A R _G = 10Ω, V _{GS} = 10V	--	26	--	ns
Turn-on Rise Time	t _r		--	20	--	
Turn-off Delay Time	t _{d(off)}		--	52	--	
Turn-off Fall Time	t _f		--	21	--	
Drain-Source Body Diode Characteristics						
Body Diode Forward Voltage	V _{SD}	T _J = 25°C, I _{SD} = 10A V _{GS} = 0V	--	--	0.89	V
Reverse Recovery Time	t _{rr}	V _R = 400V I _F = 10A, di _F /dt = 100A/μs	--	412	--	ns
Reverse Recovery Charge	Q _{rr}		--	2.6	--	μC

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

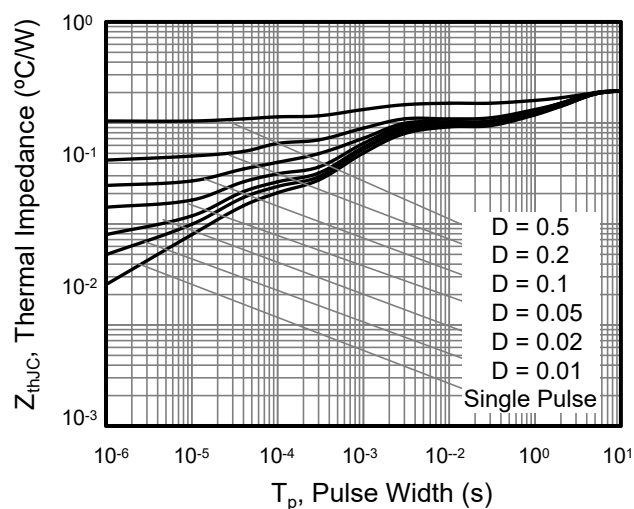


Figure 1. Transient Thermal Impedance For TO-220F

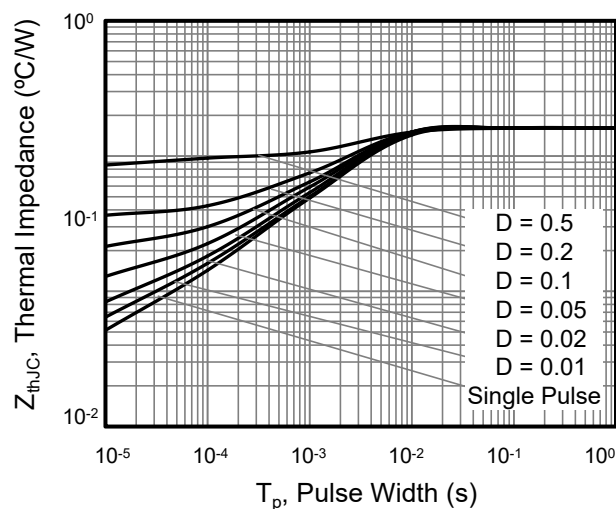


Figure 2. Transient Thermal Impedance For TO-3P/247/220

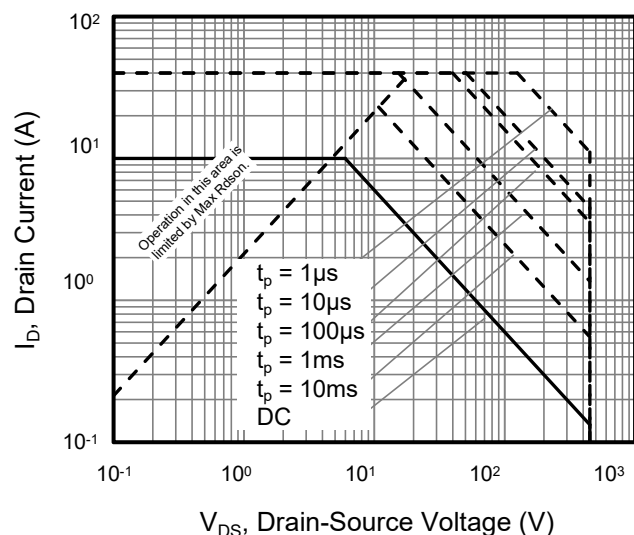


Figure 3. Safe Operation Area For TO-220F

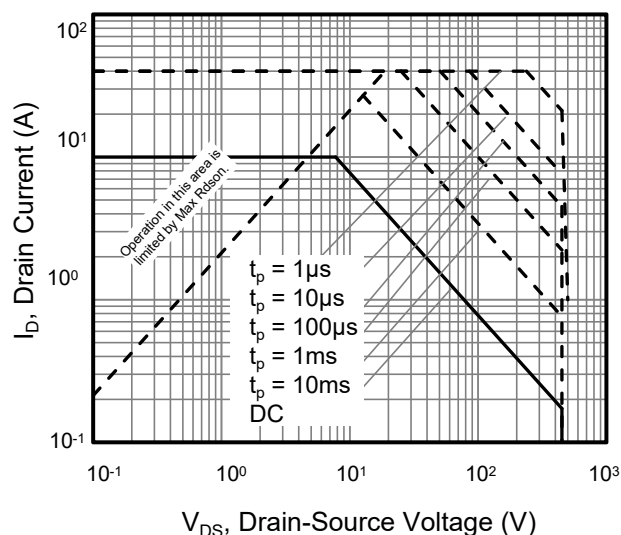


Figure 4. Safe Operation Area For TO-3P/247/220

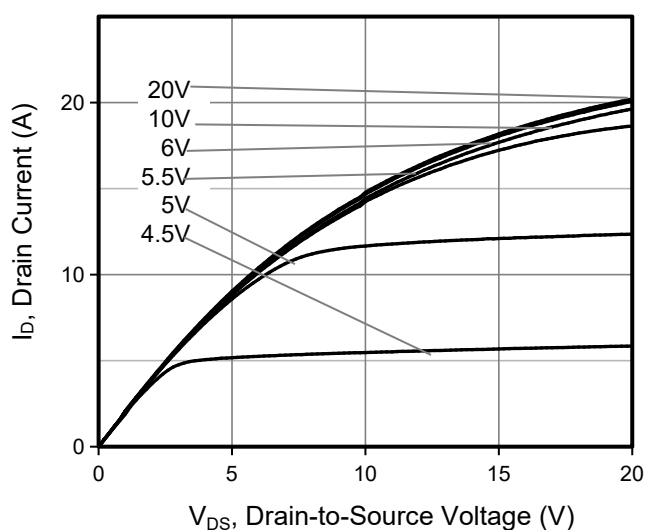


Figure 5. Output Characteristics

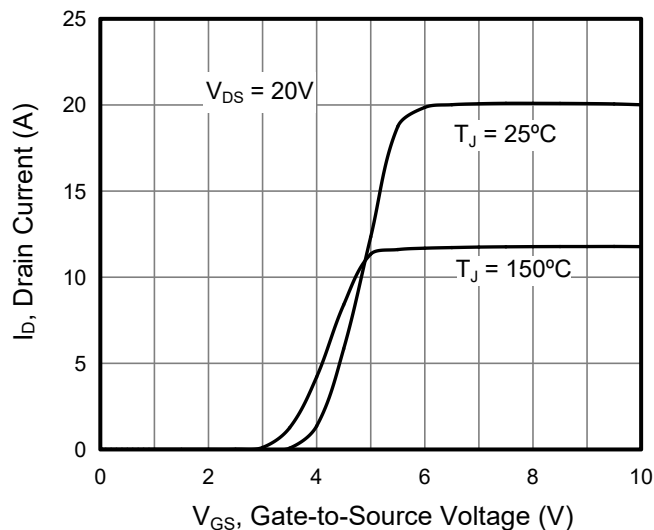


Figure 6. Transfer Characteristics

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

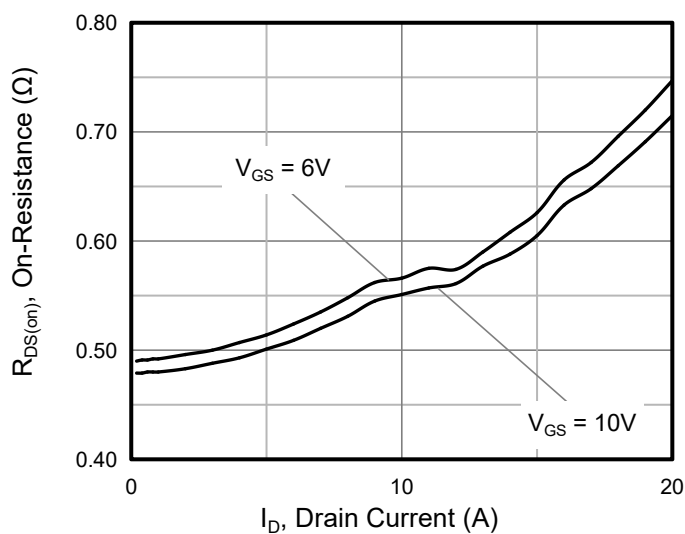


Figure 7. On-Resistance vs Drain Current

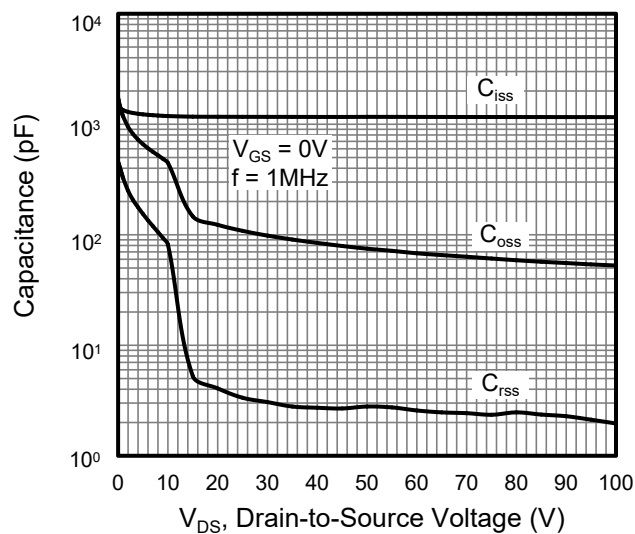


Figure 8. Capacitance

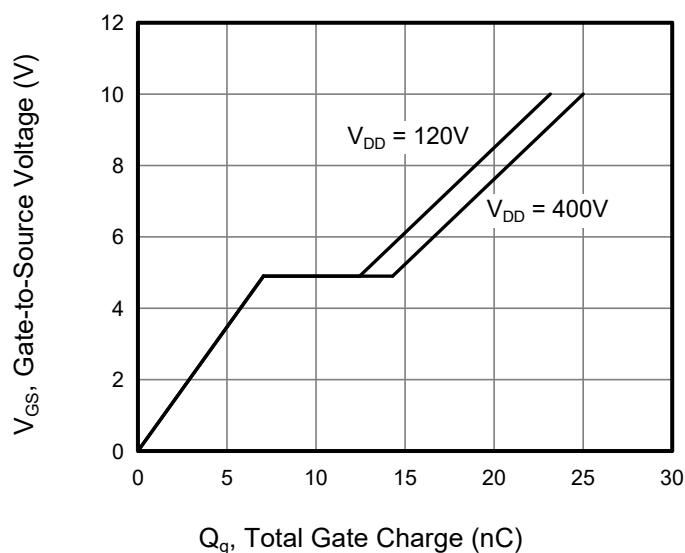


Figure 9. Gate Charge

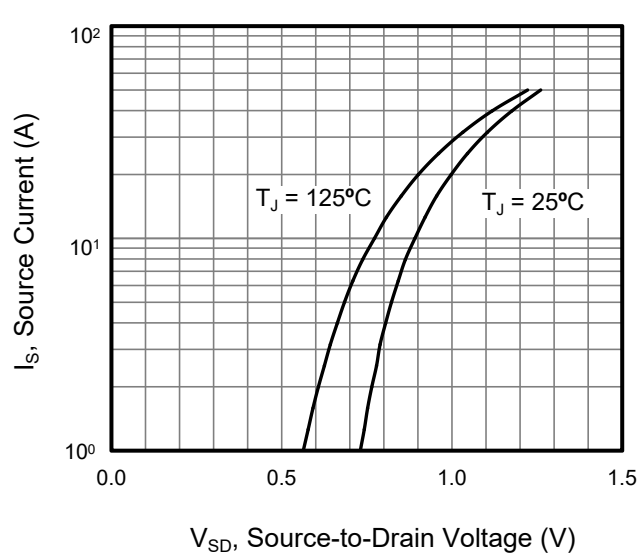


Figure 10. Body Diode Forward Voltage

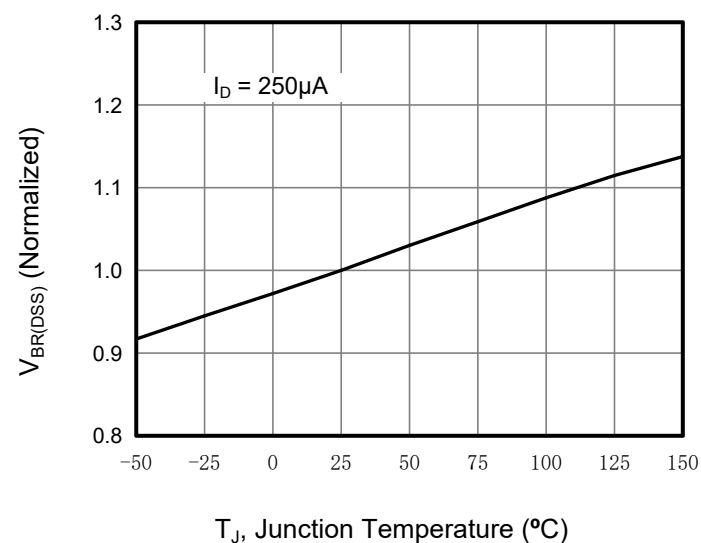


Figure 11. Breakdown Voltage vs Junction Temperature

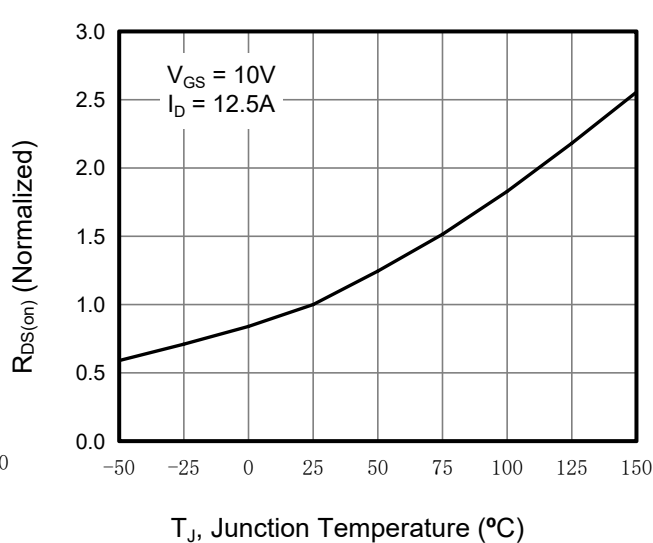


Figure 12. On-Resistance vs Temperature

Figure A: Gate Charge Test Circuit and Waveform

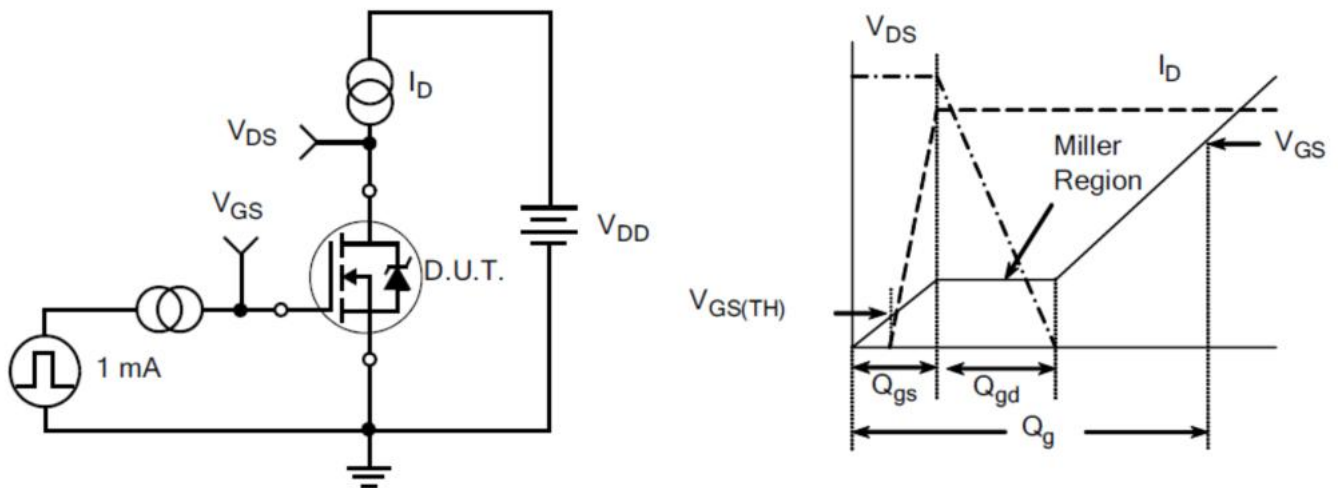


Figure B: Resistive Switching Test Circuit and Waveform

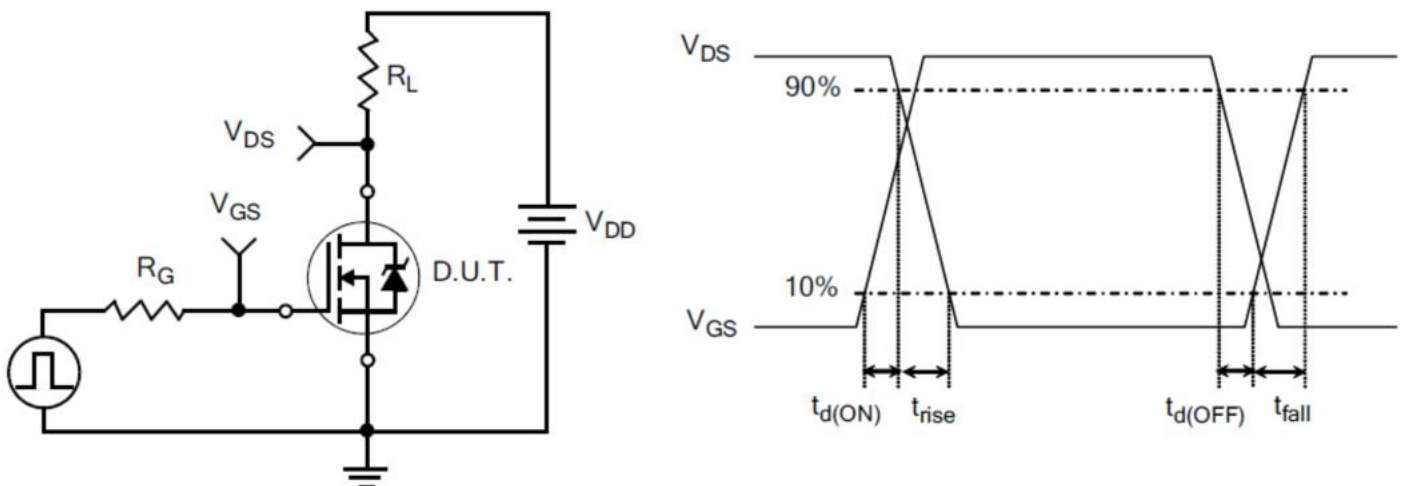
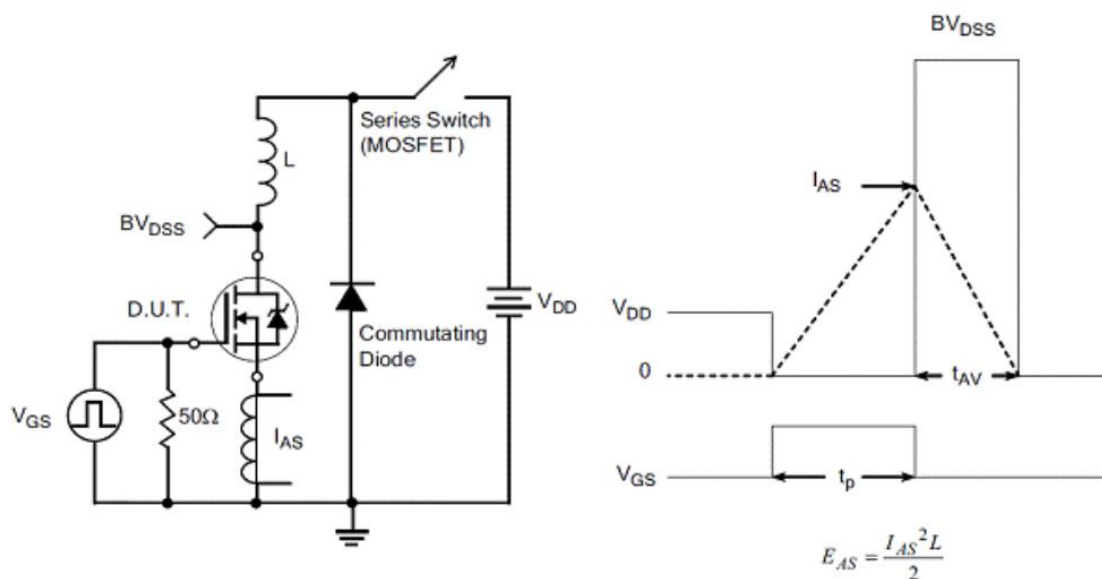
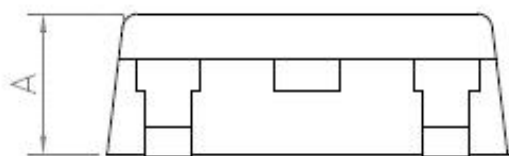
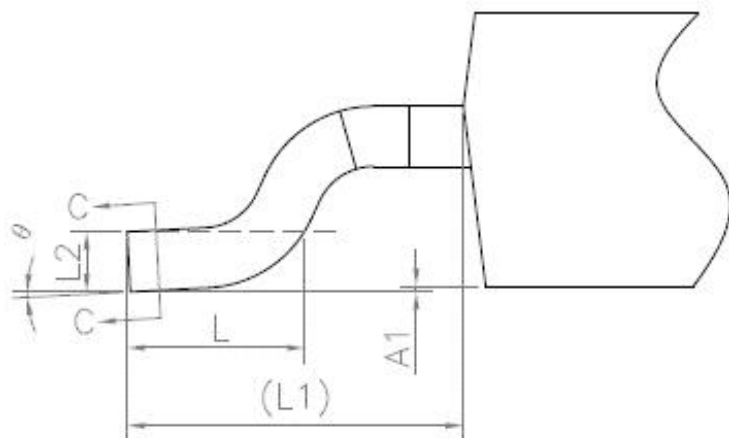
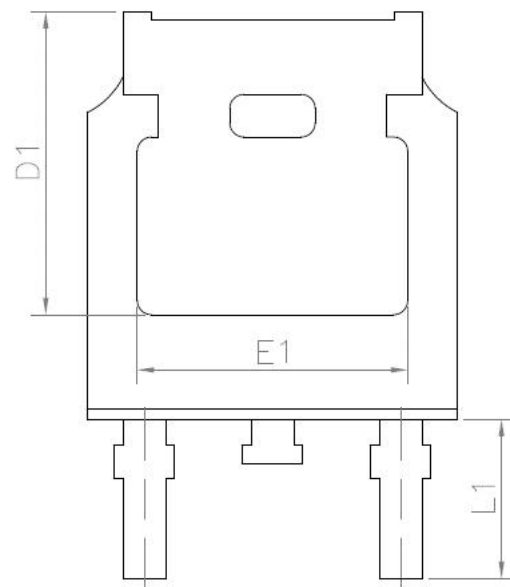
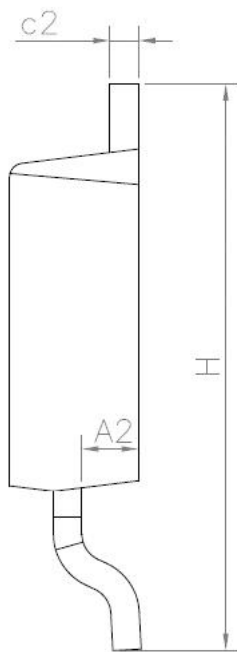
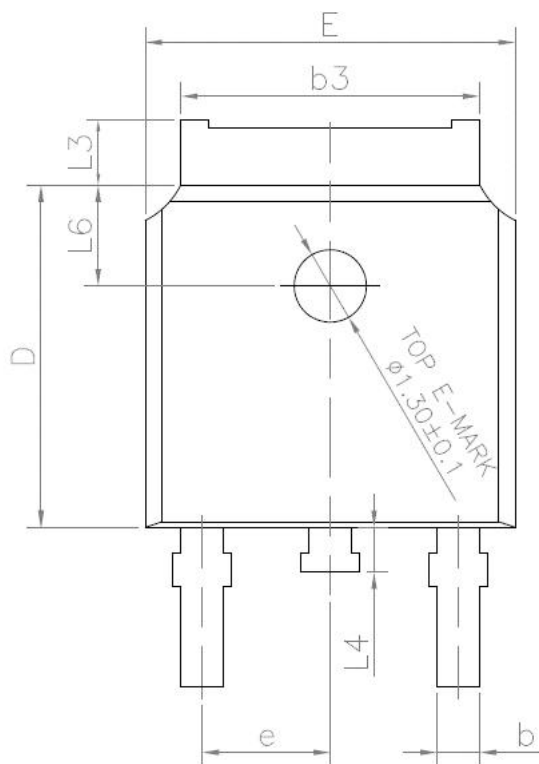


Figure C: Unclamped Inductive Switching Test Circuit and Waveform

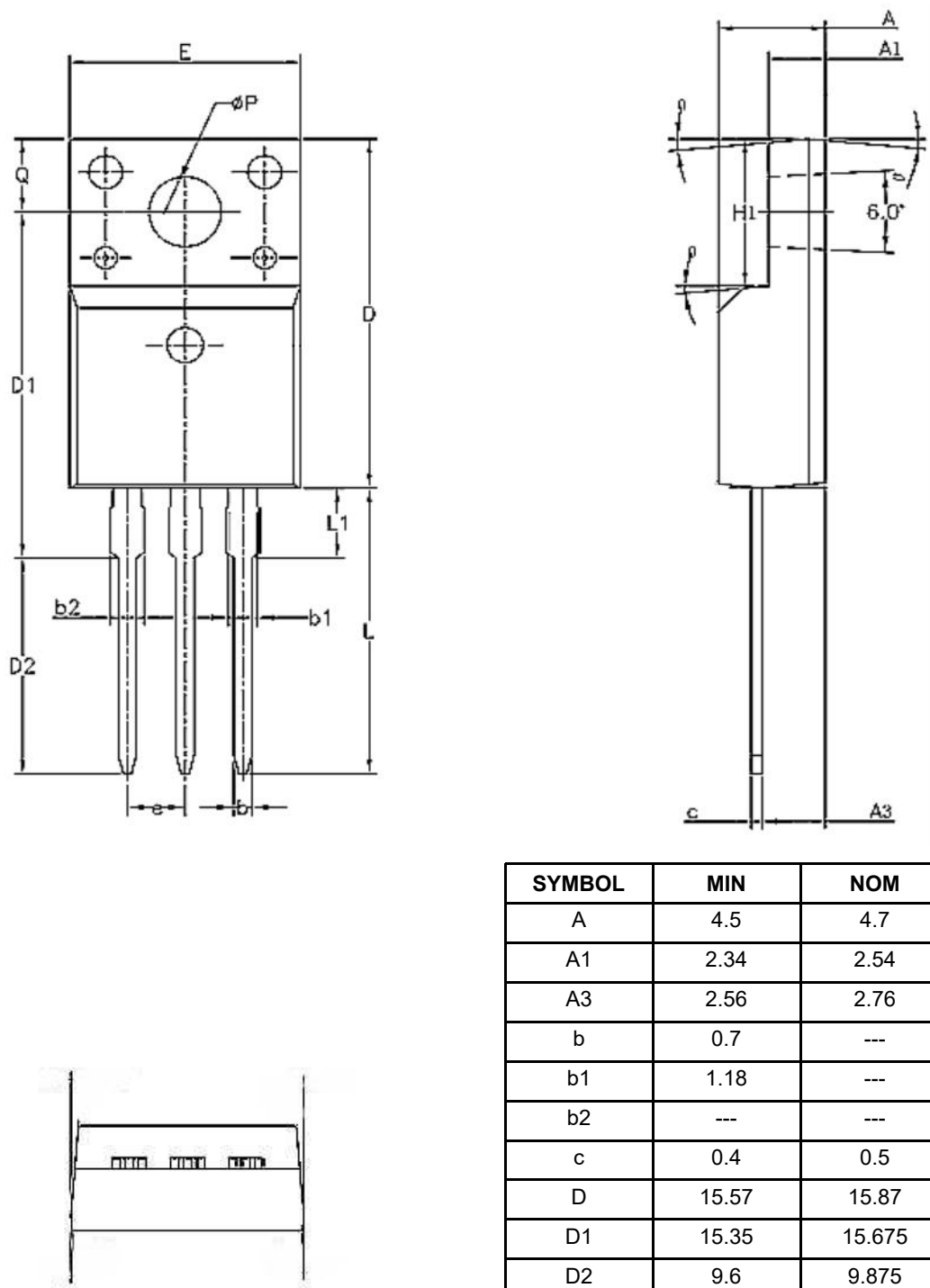


Outlines TO-252 Package



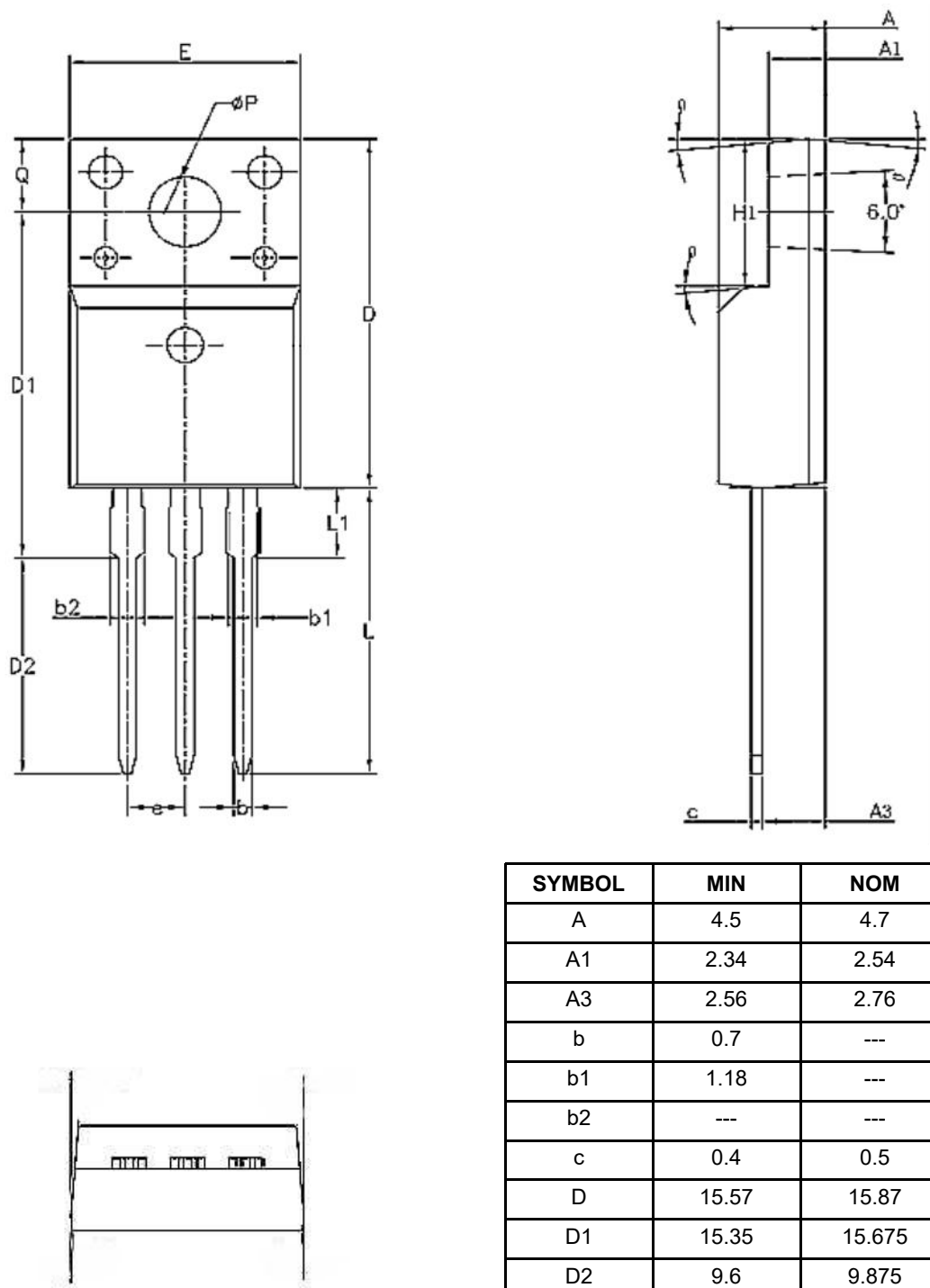
SYMBOL	MIN	NOM	MAX
A	2.2	2.3	2.4
A1	0	--	0.2
A2	0.9	1.035	1.17
b	0.645	--	0.9
b3	5.13	5.326	5.46
c	0.43	--	0.61
c2	0.41	--	0.61
D	5.98	6.1	6.22
D1	5.244	--	--
E	6.4	6.6	6.73
E1	4.63	--	--
e	2.186	2.286	2.386
H	9.4	10.04	10.5
L	1.38	1.5	1.75
L1	2.6	2.872	3
L2	0.5	0.509	0.52
L3	0.88	--	1.28
L4	0.5	--	1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

Outlines TO-220F Package



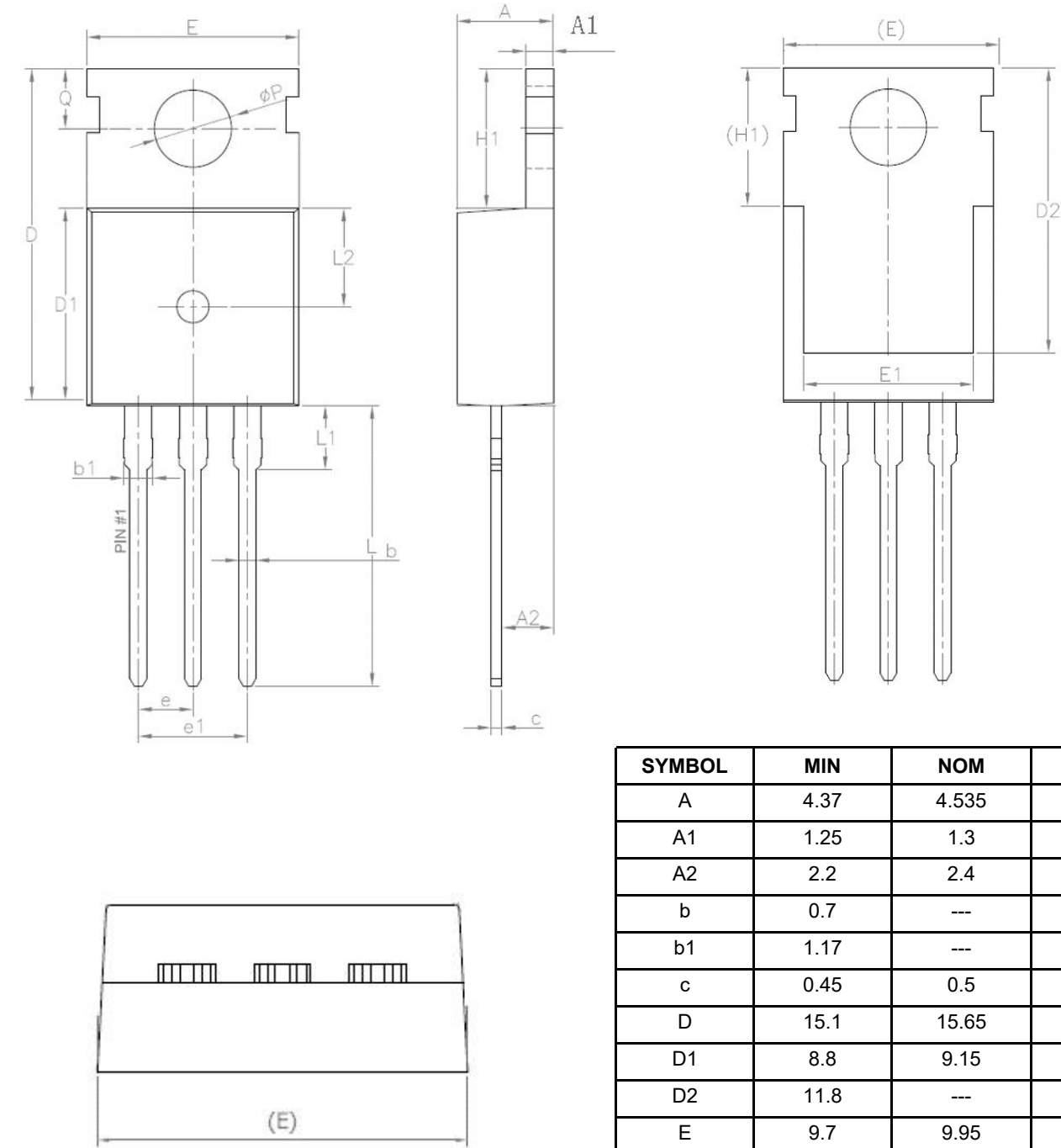
SYMBOL	MIN	NOM	MAX
A	4.5	4.7	4.9
A1	2.34	2.54	2.74
A3	2.56	2.76	2.96
b	0.7	---	0.95
b1	1.18	---	1.43
b2	---	---	1.55
c	0.4	0.5	0.65
D	15.57	15.87	16.17
D1	15.35	15.675	15.95
D2	9.6	9.875	10.15
E	9.96	10.16	10.36
e	2.54 BSC		
H1	6.48	6.68	6.88
L	12.68	12.98	13.28
L1	---	---	3.5

Outlines TO-220FT Package



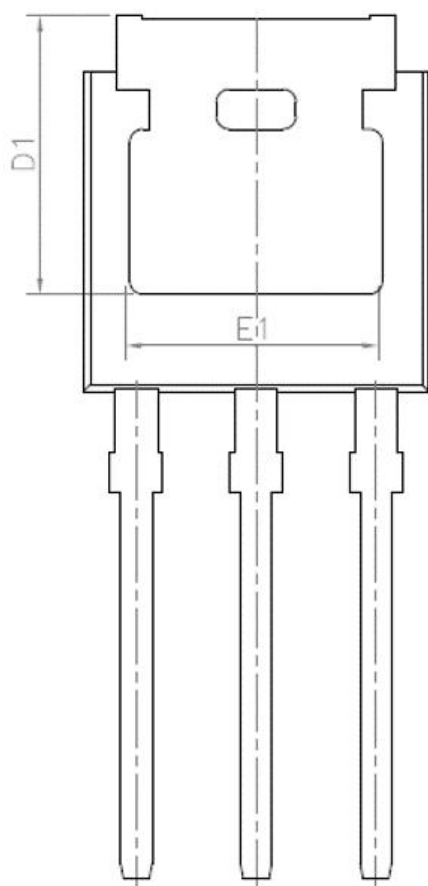
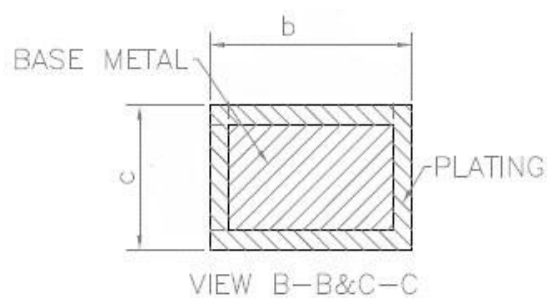
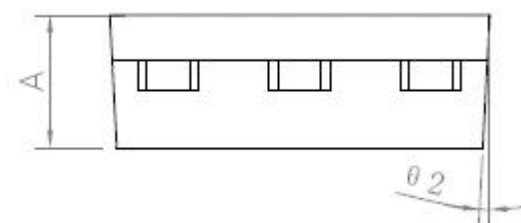
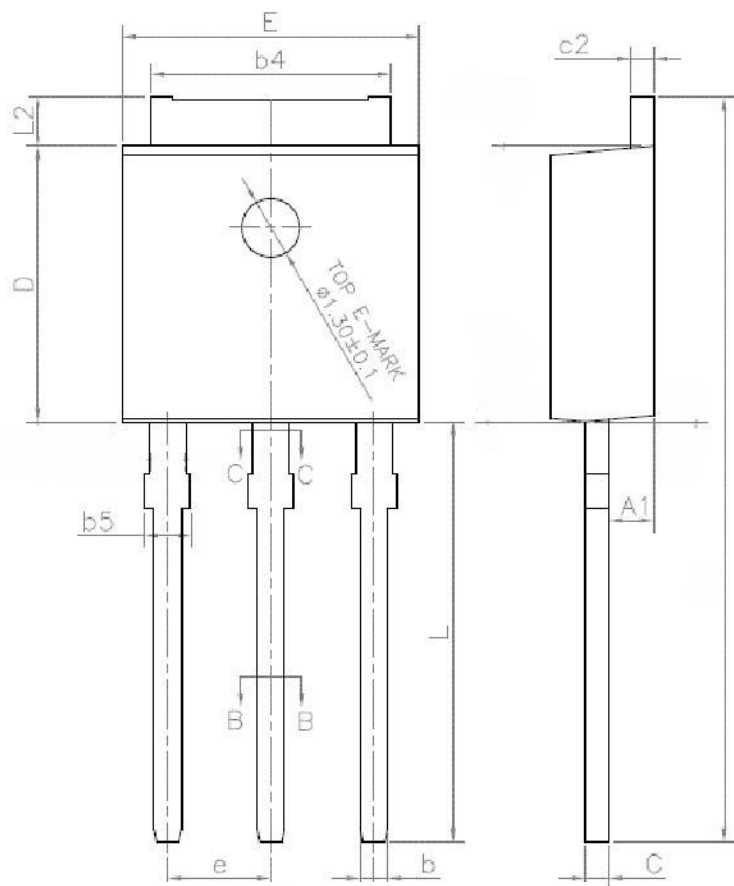
SYMBOL	MIN	NOM	MAX
A	4.5	4.7	4.9
A1	2.34	2.54	2.74
A3	2.56	2.76	2.96
b	0.7	---	0.95
b1	1.18	---	1.43
b2	---	---	1.55
c	0.4	0.5	0.65
D	15.57	15.87	16.17
D1	15.35	15.675	15.95
D2	9.6	9.875	10.15
E	9.96	10.16	10.36
e	2.54 BSC		
H1	6.48	6.68	6.88
L	12.68	12.98	13.28
L1	---	---	3.5

Outlines TO-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

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