

# 60V N-Channel Power MOSFET

## MOSFET

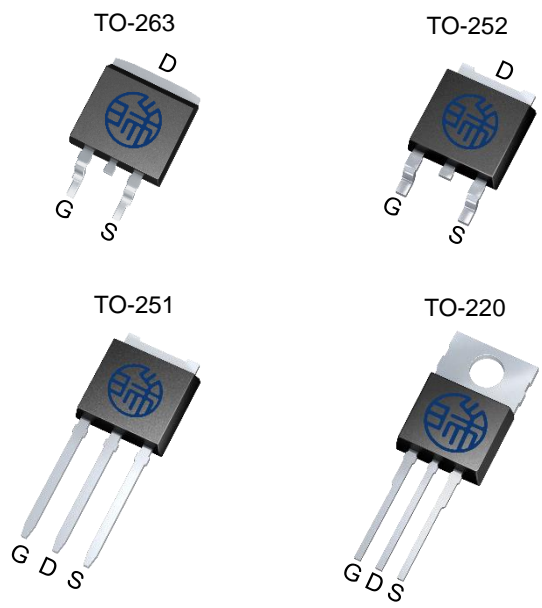
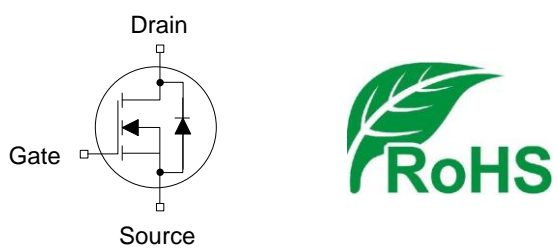
Metal Oxide Semiconductor Field Effect Transistor

## HRT60N08x Data Sheet

Rev. 2020 V1.0



## 60V N-Channel Power MOSFET

<p><b>Description</b></p> <p>N-Channel Power MOSFET designed by HR-Micro Semiconductor Company, according to the advanced Trench Technology. This devices provide an excellent gate charge and <math>R_{DS(on)}</math>, which leads to extremely communication and conduction losses. So it is very suitable for AC/DC power conversion, load switch and industrial power applications.</p>		
<p><b>Features</b></p> <ul style="list-style-type: none"> <li>● Low FOM <math>R_{DS(on)} \times Q_{gd}</math></li> <li>● 100% avalanche tested</li> <li>● Easy to use/drive</li> <li>● RoHS compliant</li> </ul>		
<p><b>Applications</b></p> <ul style="list-style-type: none"> <li>● DC/DC Converter</li> <li>● Battery Protection Charge/Discharge</li> <li>● Load Switch</li> <li>● Synchronous Rectification</li> </ul>		
<p><b>Key Performance Parameters</b></p>		
<p><b>Parameter</b></p>	<p><b>Value</b></p>	<p><b>Unit</b></p>
<p><math>V_{DS@T_c=25^\circ C}</math></p>	<p>60</p>	<p>V</p>
<p><math>R_{DS(on),max@10V}</math></p>	<p>8</p>	<p>m<math>\Omega</math></p>
<p><math>Q_{g,typ}</math></p>	<p>76</p>	<p>nC</p>
<p><math>I_{D@T_c=25^\circ C}</math></p>	<p>80</p>	<p>A</p>
<p><math>I_{D,pulse}</math></p>	<p>320</p>	<p>A</p>
<p><math>E_{AS}^{1)}</math></p>	<p>244</p>	<p>mJ</p>
<p><b>Device Marking and Package Information</b></p>		
<p><b>Device</b></p>	<p><b>Package</b></p>	<p><b>Marking</b></p>
<p>HRT60N08B</p>	<p>TO-263</p>	<p>60N08B</p>
<p>HRT60N08D</p>	<p>TO-252</p>	<p>60N08D</p>
<p>HRT60N08U</p>	<p>TO-251</p>	<p>60N08U</p>
<p>HRT60N08P</p>	<p>TO-220</p>	<p>60N08P</p>

Absolute Maximum Ratings $T_A = 25^\circ\text{C}$ , unless otherwise noted			
Parameter	Symbol	Values	Unit
Drain-Source Voltage( $V_{GS}=0V$ )	$V_{DS}$	60	V
Continuous Drain Current <sup>2)</sup>	$I_D$	$T_C = 25^\circ\text{C}$	80
		$T_C = 100^\circ\text{C}$	51
Pulsed Drain Current <sup>3)</sup>	$I_{D,pulse}$	320	A
Gate-Source Voltage	$V_{GSS}$	$\pm 20$	V
Single Pulse Avalanche Energy <sup>1)</sup>	$E_{AS}$	244	mJ
Power Dissipation	$P_D$	83	W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55~+150	$^\circ\text{C}$

Thermal Resistance			
Parameter	Symbol	Max.	Unit
Thermal Resistance, Junction-to-Case	$R_{thJC}$	1.5	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	$R_{thJA}$	62	$^\circ\text{C/W}$

**Notes**

1)  $L=0.5\text{mH}$ ,  $V_{DD}=30V$ , Start  $T_J=25^\circ\text{C}$ .

2) Limited by maximum junction temperature.

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

Electrical Characteristics $T_J = 25^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
<b>Static Characteristics</b>						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	60	--	--	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 60V$ $V_{GS} = 0V, T_J = 25^\circ\text{C}$	--	--	1	$\mu A$
		$V_{DS} = 60V$ $V_{GS} = 0V, T_J = 125^\circ\text{C}$	--	--	100	
Gate-Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 20V$	--	--	$\pm 100$	nA
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	2	2.8	4	V
Drain-Source On-State-Resistance	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 20A$	--	6.5	8	$m\Omega$
Gate Resistance	$R_G$	$f = 1.0\text{MHz}$ open drain	--	1.6	--	$\Omega$
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0V, V_{DS} = 30V$ $f = 1.0\text{MHz}$	--	4009	--	$\mu F$
Output Capacitance	$C_{oss}$		--	243	--	
Reverse Transfer Capacitance	$C_{rss}$		--	201	--	
Total Gate Charge	$Q_g$	$V_{DS} = 30V, I_D = 20A$ $V_{GS} = 10V$	--	76	--	nC
Gate-Source Charge	$Q_{gs}$		--	17	--	
Gate-Drain Charge	$Q_{gd}$		--	19	--	
Gate Plateau Voltage	$V_{plateau}$		--	4.3	--	V
Turn-on Delay Time	$t_{d(on)}$	$V_{DS} = 30V, V_{GS} = 10V$ $R_G = 3\Omega, I_D = 20A$	--	19	--	ns
Turn-on Rise Time	$t_r$		--	42	--	
Turn-off Delay Time	$t_{d(off)}$		--	48	--	
Turn-off Fall Time	$t_f$		--	29	--	
<b>Drain-Source Body Diode Characteristics</b>						
Body Diode Forward Voltage	$V_{SD}$	$T_J = 25^\circ\text{C}, I_{SD} = 20A$ $V_{GS} = 0V$	--	--	1.2	V
Continuous Diode Forward Current	$I_S$		--	--	80	A
Reverse Recovery Time	$t_{rr}$	$I_F = 20A, di_F/dt = 100A/\mu s$	--	28	--	ns
Reverse Recovery Charge	$Q_{rr}$		--	52	--	nC

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

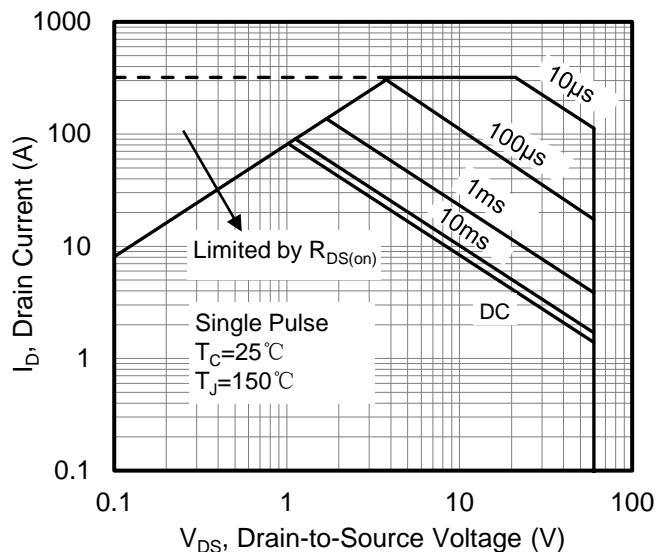


Figure 1. Maximum Safe Operating Area

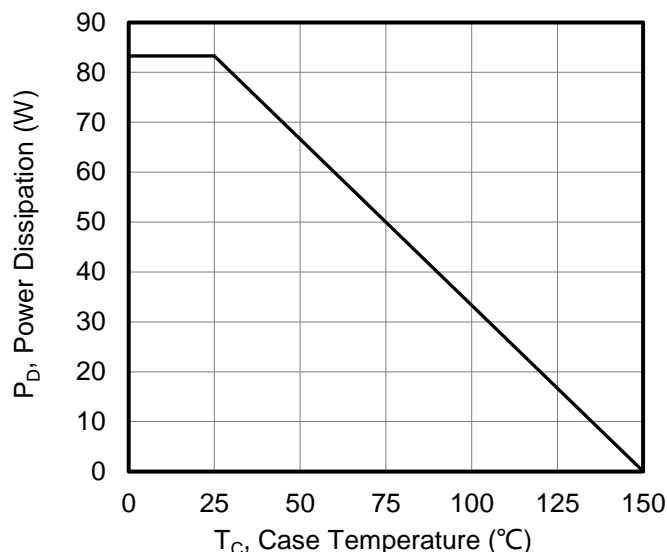


Figure 2. Maximum Power Dissipation vs Case Temperature

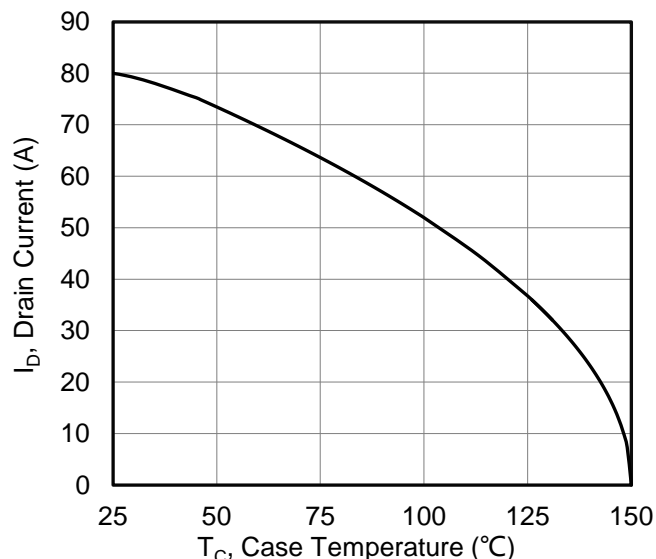


Figure 3. Maximum Continuous Drain Current vs Case Temperature

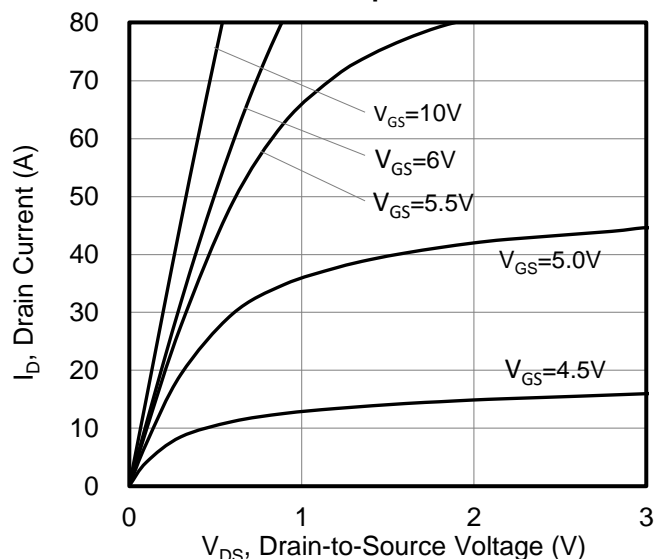


Figure 4. Typical output Characteristics

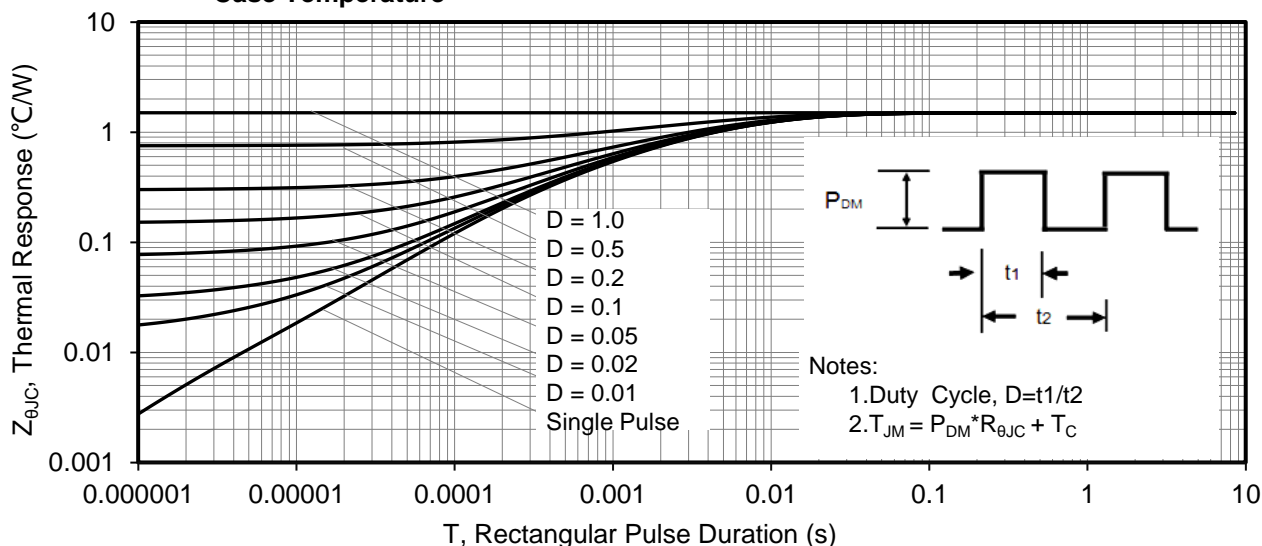
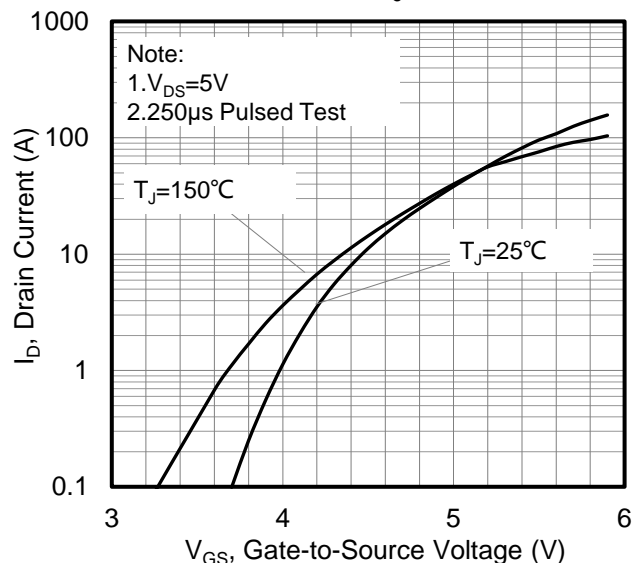
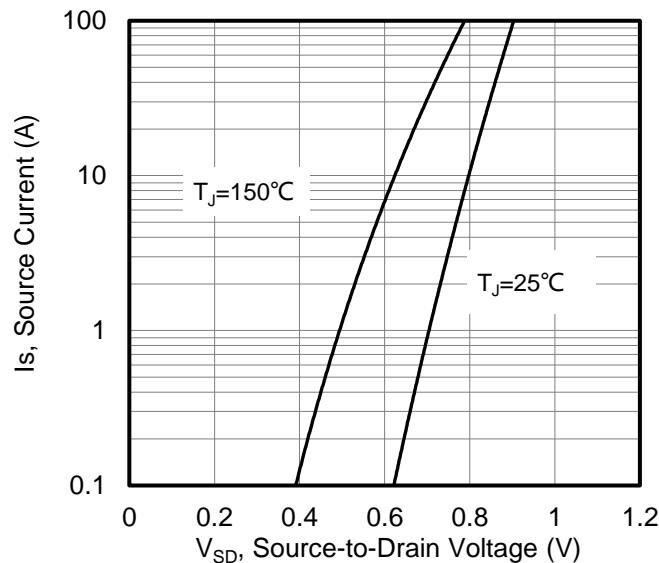


Figure 5. Maximum Effective Thermal Impedance, Junction to Case

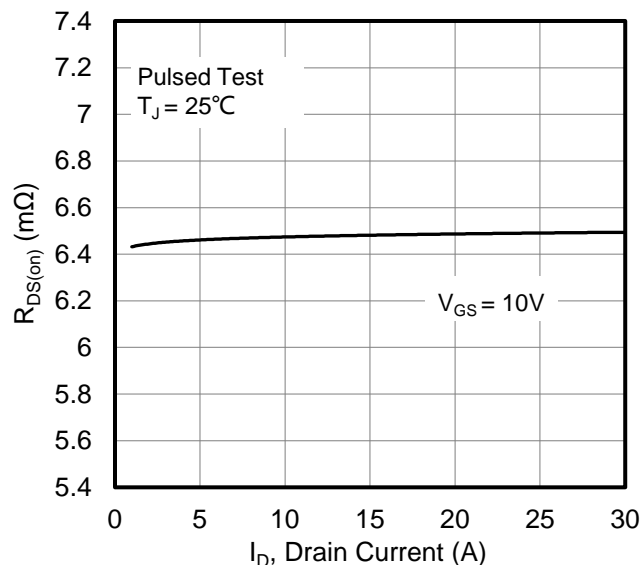
**Typical Characteristics**  $T_J = 25^\circ\text{C}$ , unless otherwise noted



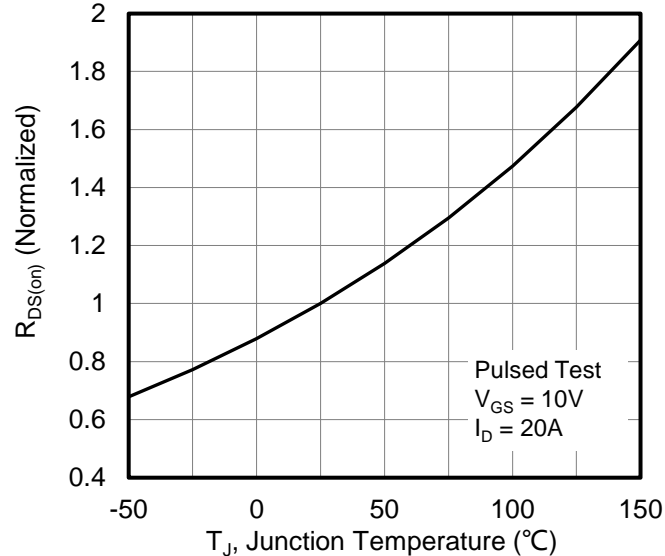
**Figure 6. Typical Transfer Characteristics**



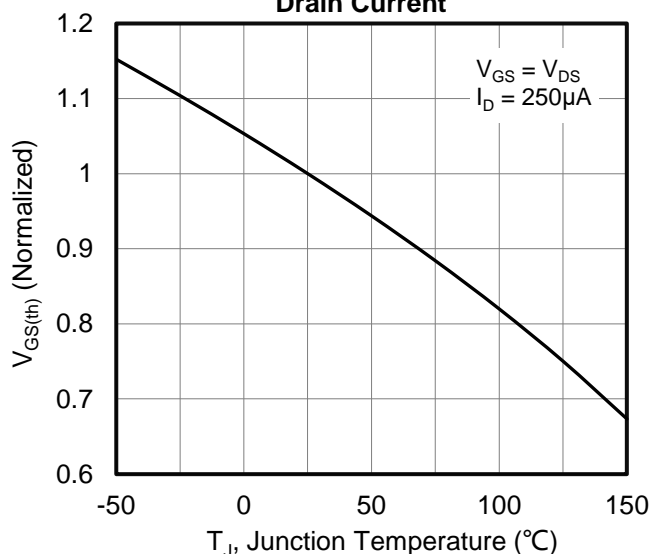
**Figure 7. Typical Body Diode Transfer Characteristics**



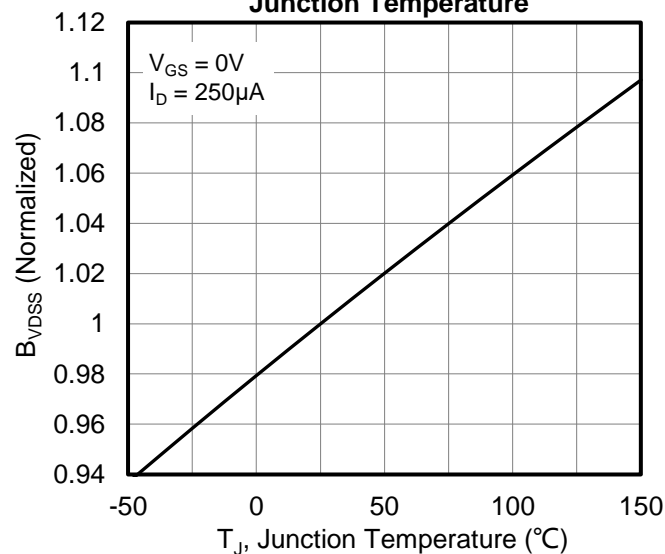
**Figure 8. Drain-to-Source On Resistance vs Drain Current**



**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  $T_j = 25^\circ\text{C}$ , unless otherwise noted

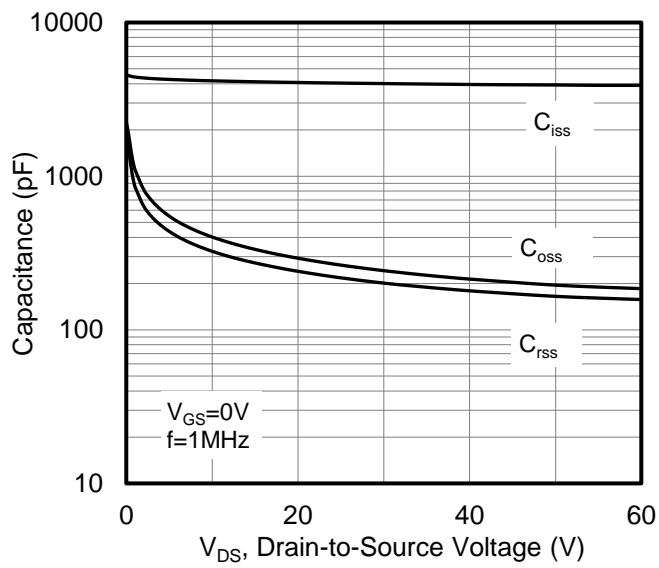


Figure 12. Capacitance Characteristics

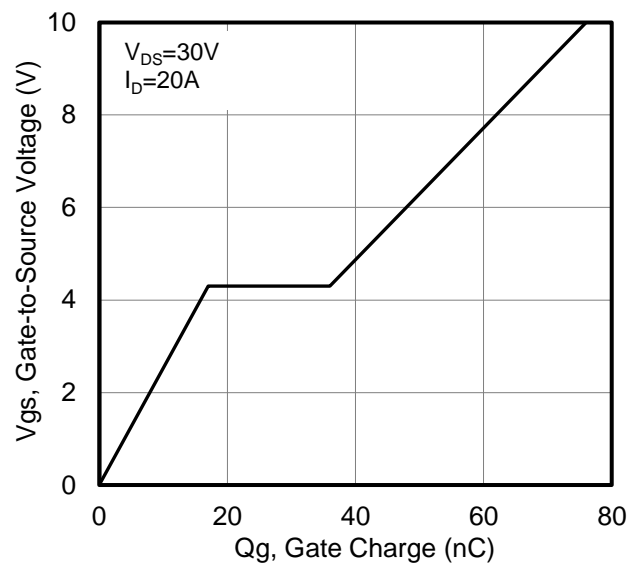


Figure 13. Typical Gate Charge vs Gate to Source Voltage

Figure A: Gate Charge Test Circuit and Waveform

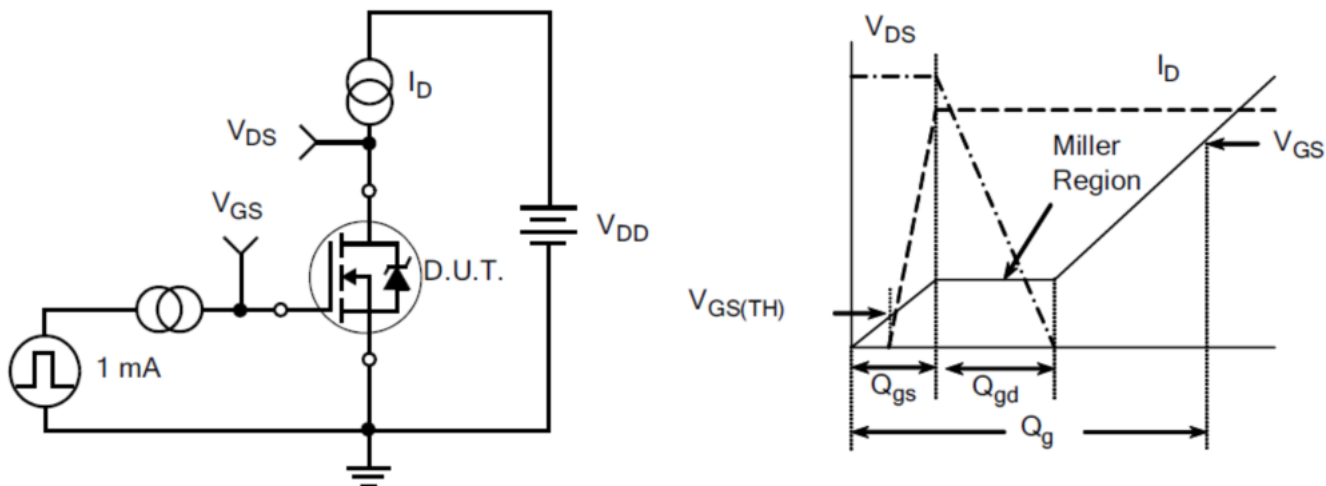


Figure B: Resistive Switching Test Circuit and Waveform

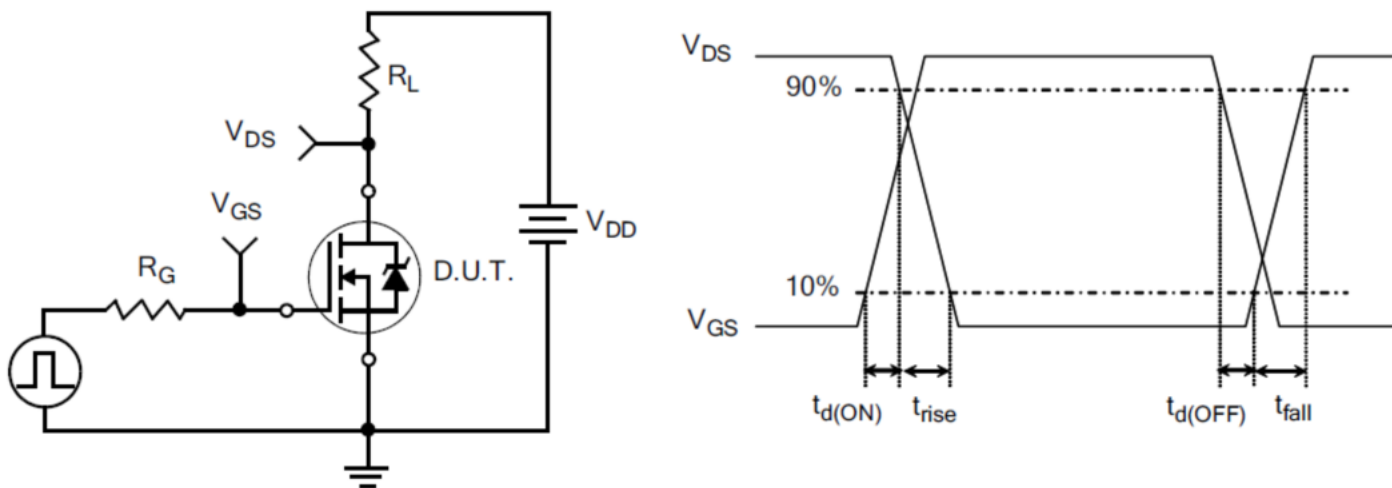
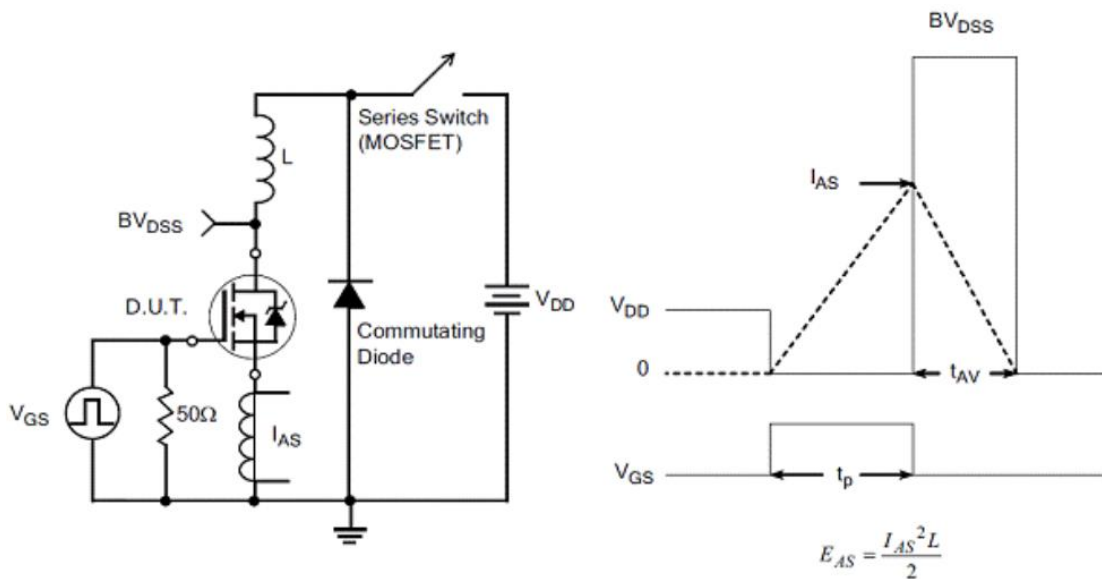
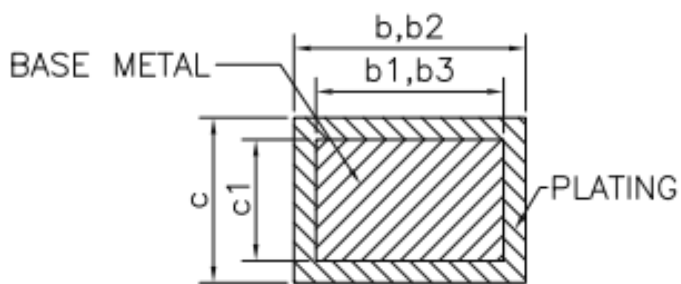
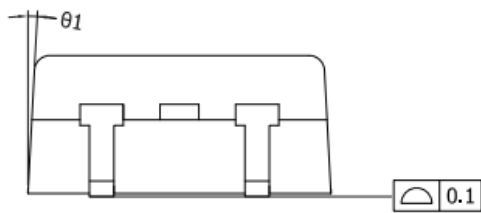
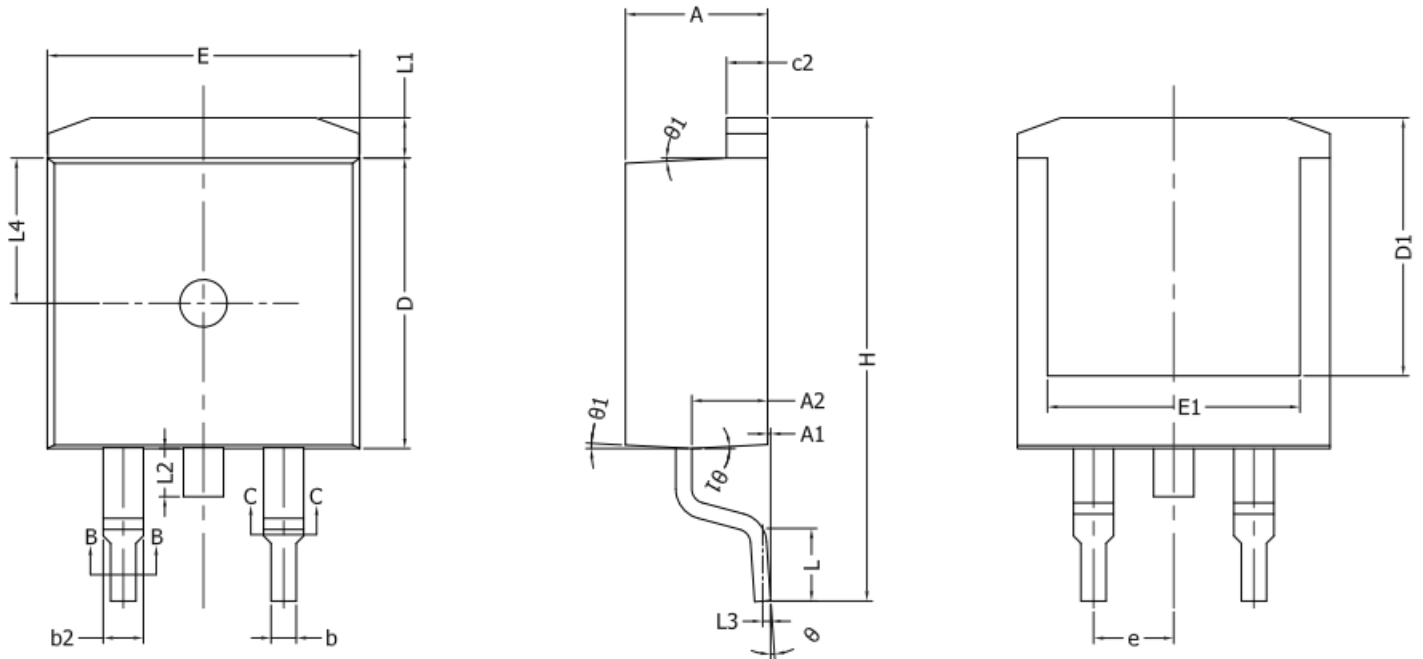


Figure C: Unclamped Inductive Switching Test Circuit and Waveform





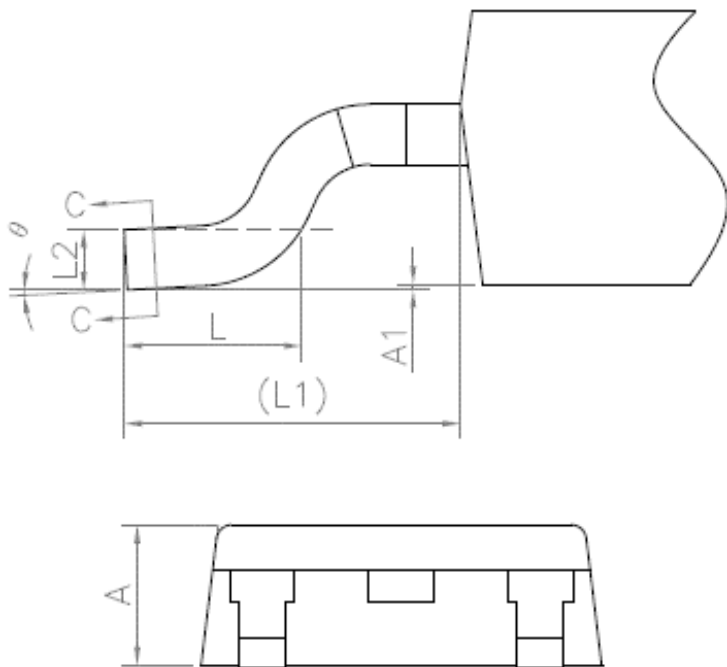
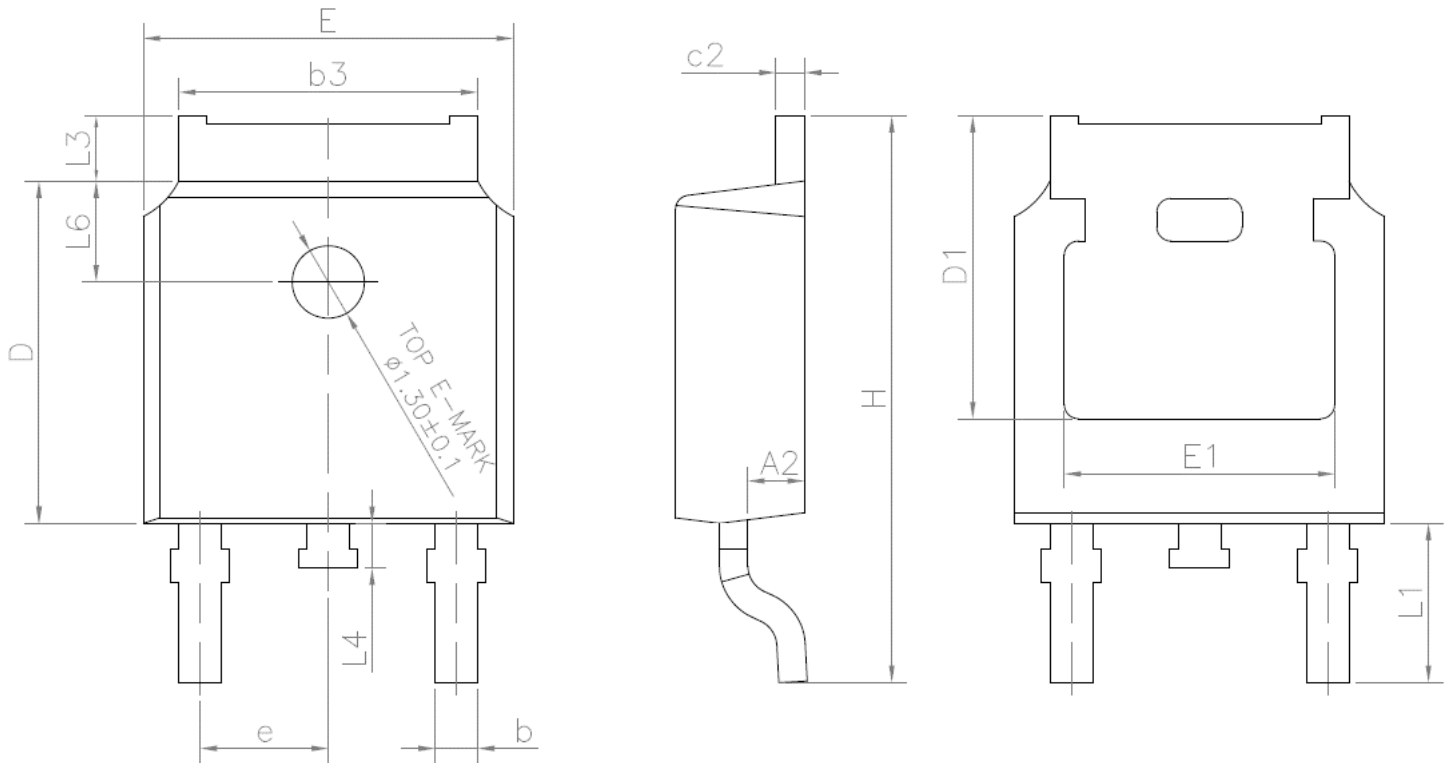
## Outlines TO-263 Package



SECTION B-B&C-C

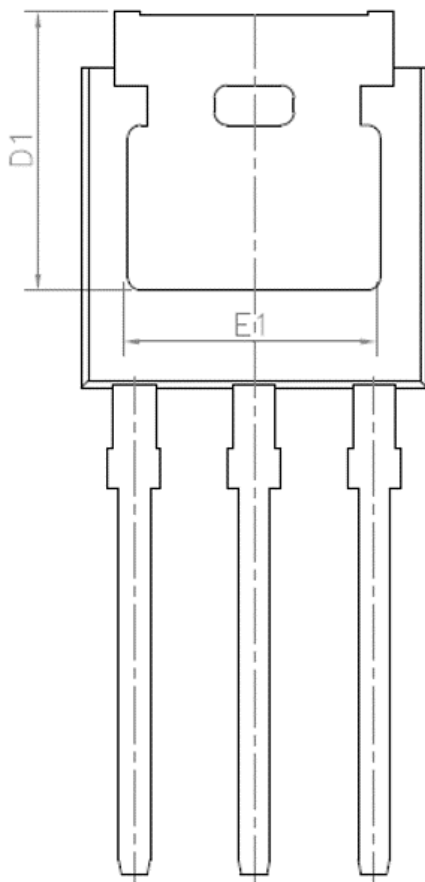
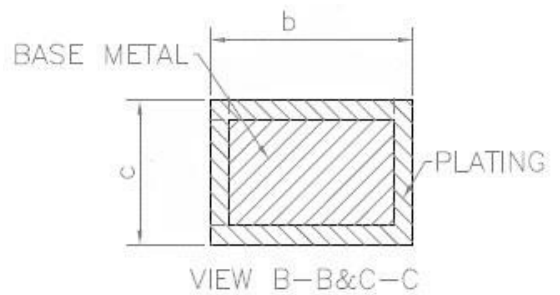
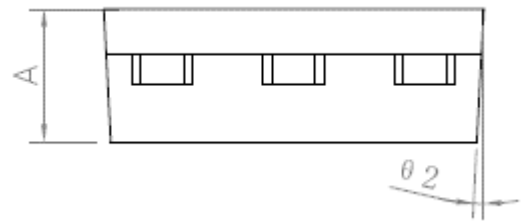
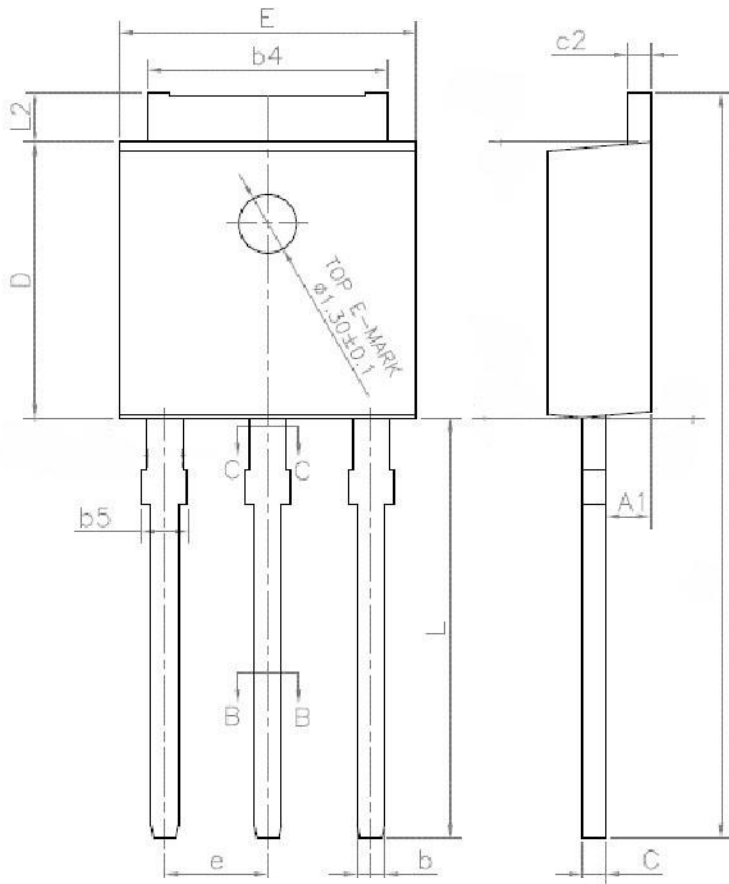
SYMBOL	MIN	NOM	MAX
A	4.4	4.5	4.6
A1	0	0.1	0.25
A2	2.2	2.4	2.6
b	0.76	--	0.89
b1	0.75	0.8	0.85
b2	1.23	--	1.37
b3	1.22	1.27	1.32
c	0.47	--	0.6
c1	0.46	0.51	0.56
c2	1.25	1.3	1.35
D	9.1	9.2	9.3
D1	8	--	--
E	9.8	9.9	10
E1	7.8	--	--
e	2.54 BSC		
H	14.9	15.3	15.7
L	2	2.3	2.6
L1	1.17	1.27	1.4
L2	--	--	1.75
L3	0.25 BSC		
L4	4.60 REF		
θ	0°	--	8°
θ1	1°	3°	5°

## Outlines TO-252 Package



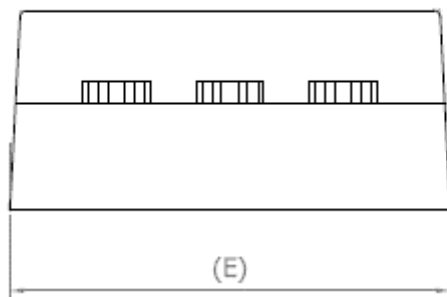
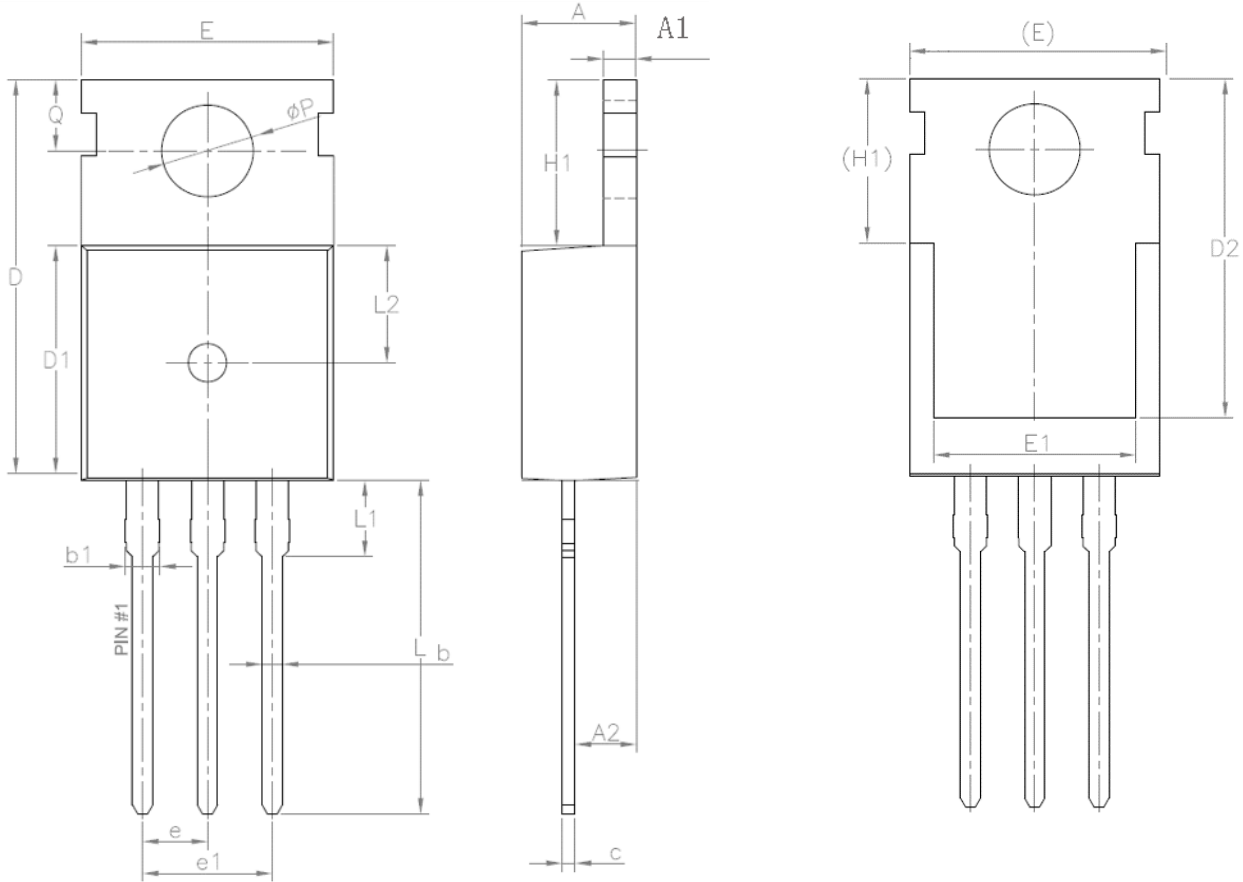
SYMBOL	MIN	NOM	MAX
A	2.2	2.3	2.4
A1	0	--	0.2
A2	0.9	1.035	1.17
b	0.645	--	0.9
b3	5.13	5.326	5.46
c	0.43	--	0.61
c2	0.41	--	0.61
D	5.98	6.1	6.22
D1	5.244	--	--
E	6.4	6.6	6.73
E1	4.63	--	--
e	2.186	2.286	2.386
H	9.4	10.04	10.5
L	1.38	1.5	1.75
L1	2.6	2.872	3
L2	0.5	0.509	0.52
L3	0.88	--	1.28
L4	0.5	--	1
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
$\phi P$	3.4	3.67	3.8
Q	2.6	---	3

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