

60V N-Channel Power MOSFET

MOSFET

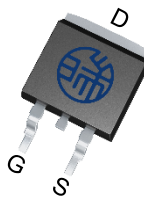
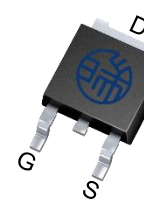

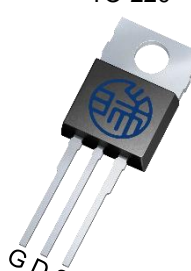
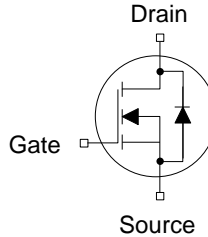

Metal Oxide Semiconductor Field Effect Transistor

HRT60N08x Data Sheet

Rev. 2020 V1.0



60V N-Channel Power MOSFET

| | | |
|---|---|-----------------------------|
| <p>Description</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 $R_{DS(on)}$, which leads to extremely communication and conduction losses. So it is very suitable for AC/DC power conversion, load switch and industrial power applications.</p> | <div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="text-align: center;"> <p>TO-263</p>  </div> <div style="text-align: center;"> <p>TO-252</p>  </div> <div style="text-align: center;"> <p>TO-251</p>  </div> <div style="text-align: center;"> <p>TO-220</p>  </div> </div> | |
| <p>Features</p> <ul style="list-style-type: none"> ● Low FOM $R_{DS(on)} \times Q_{gd}$ ● 100% avalanche tested ● Easy to use/drive ● RoHS compliant | <div style="display: flex; align-items: center; justify-content: center;">  <div style="margin-left: 20px;">  </div> </div> | |
| <p>Applications</p> <ul style="list-style-type: none"> ● DC/DC Converter ● Battery Protection Charge/Discharge ● Load Switch ● Synchronous Rectification | | |
| <p>Key Performance Parameters</p> | | |
| <p>Parameter</p> | <p>Value</p> | <p>Unit</p> |
| <p>$V_{DS@T_c=25^\circ C}$</p> | <p>60</p> | <p>V</p> |
| <p>$R_{DS(on),max@10V}$</p> | <p>8</p> | <p>mΩ</p> |
| <p>$Q_{g,typ}$</p> | <p>76</p> | <p>nC</p> |
| <p>$I_{D@T_c=25^\circ C}$</p> | <p>80</p> | <p>A</p> |
| <p>$I_{D,pulse}$</p> | <p>320</p> | <p>A</p> |
| <p>$E_{AS}^{1)}$</p> | <p>244</p> | <p>mJ</p> |
| <p>Device Marking and Package Information</p> | | |
| <p>Device</p> | <p>Package</p> | <p>Marking</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 ²⁾ | I_D | $T_C = 25^\circ\text{C}$ | 80 |
| | | $T_C = 100^\circ\text{C}$ | 51 |
| Pulsed Drain Current ³⁾ | $I_{D,pulse}$ | 320 | A |
| Gate-Source Voltage | V_{GSS} | ± 20 | V |
| Single Pulse Avalanche Energy ¹⁾ | 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. | |
| Static Characteristics | | | | | | |
| 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 | μA |
| | | $V_{DS} = 60V$ $V_{GS} = 0V, T_J = 125^\circ\text{C}$ | -- | -- | 100 | |
| Gate-Source Leakage Current | I_{GSS} | $V_{GS} = \pm 20V$ | -- | -- | ± 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 Ω |
| Gate Resistance | R_G | $f = 1.0\text{MHz}$ open drain | -- | 1.6 | -- | Ω |
| Dynamic Characteristics | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0V, V_{DS} = 30V$ $f = 1.0\text{MHz}$ | -- | 4009 | -- | μF |
| 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 | -- | |
| Drain-Source Body Diode Characteristics | | | | | | |
| 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

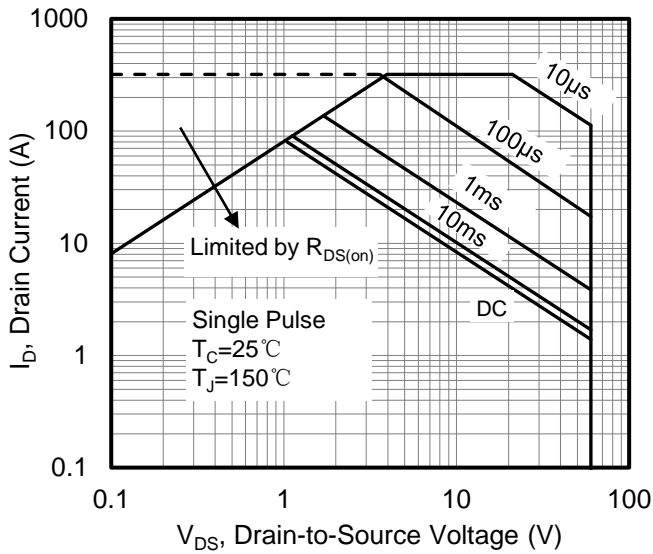


Figure 1. Maximum Safe Operating Area

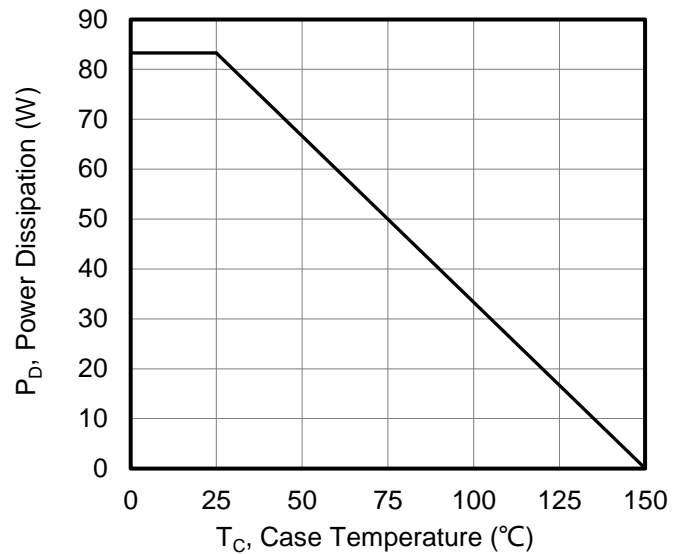


Figure 2. Maximum Power Dissipation vs Case Temperature

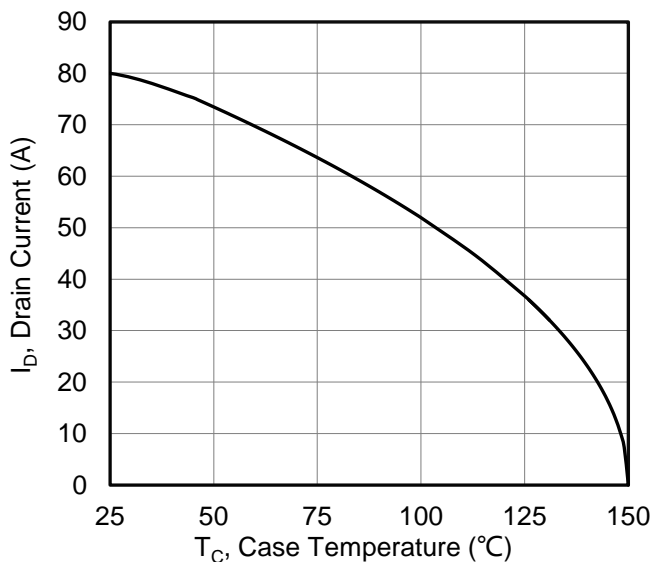


Figure 3. Maximum Continuous Drain Current vs Case Temperature

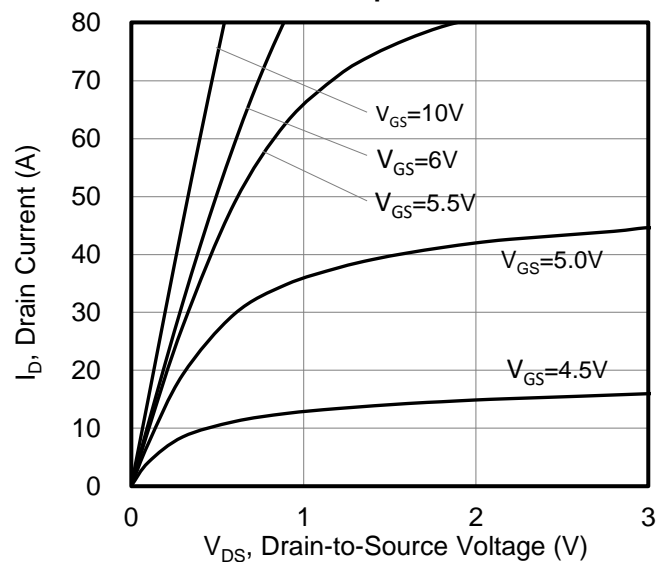


Figure 4. Typical output Characteristics

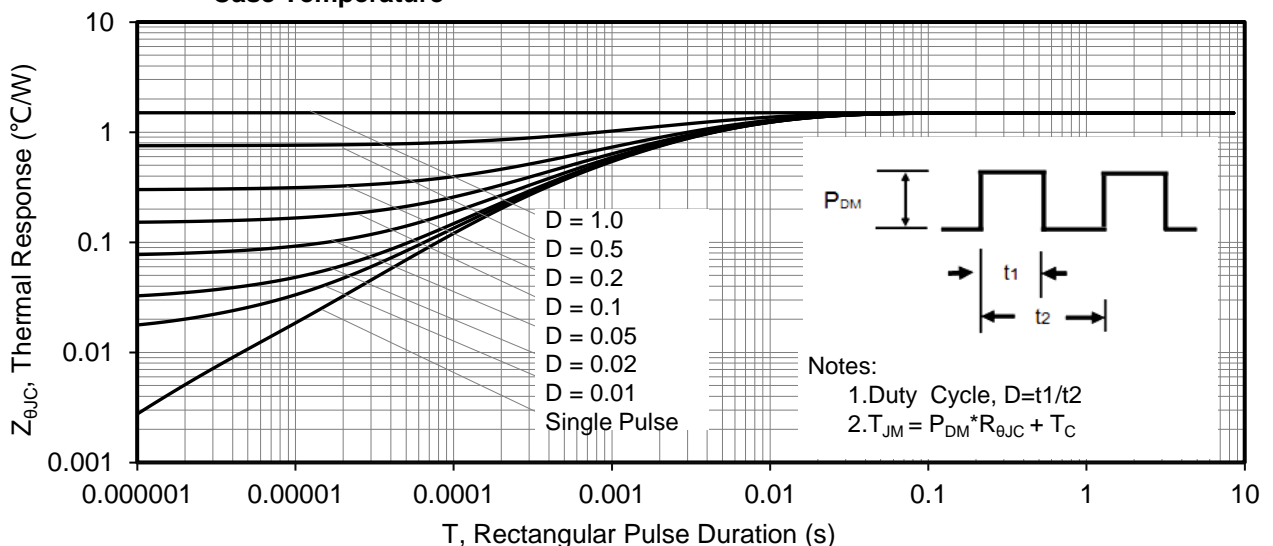


Figure 5. Maximum Effective Thermal Impedance, Junction to Case

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

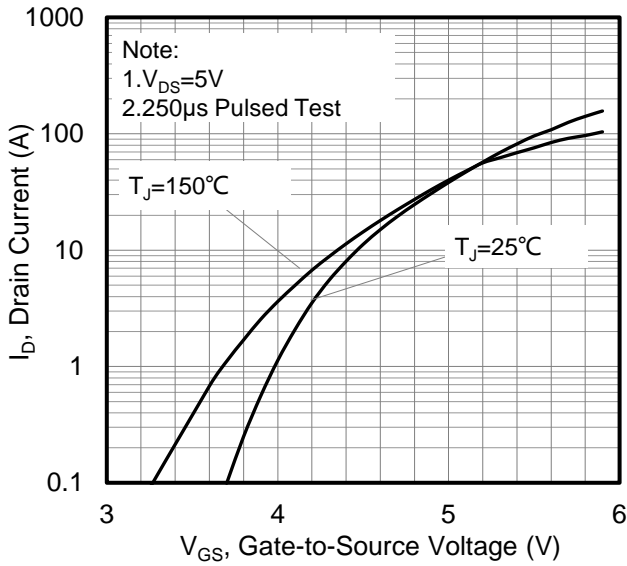


Figure 6. Typical Transfer Characteristics

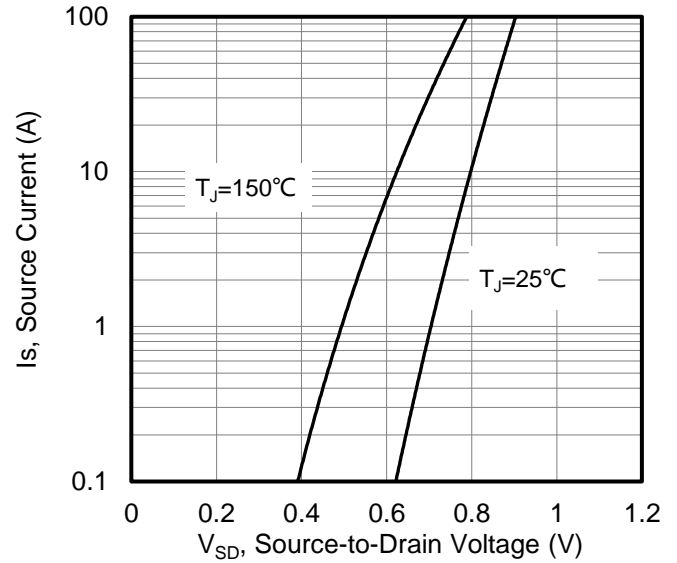


Figure 7. Typical Body Diode Transfer Characteristics

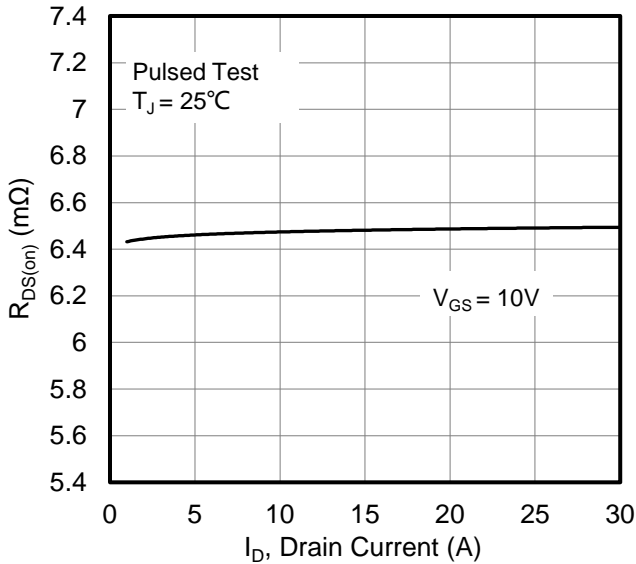


Figure 8. Drain-to-Source On Resistance vs Drain Current

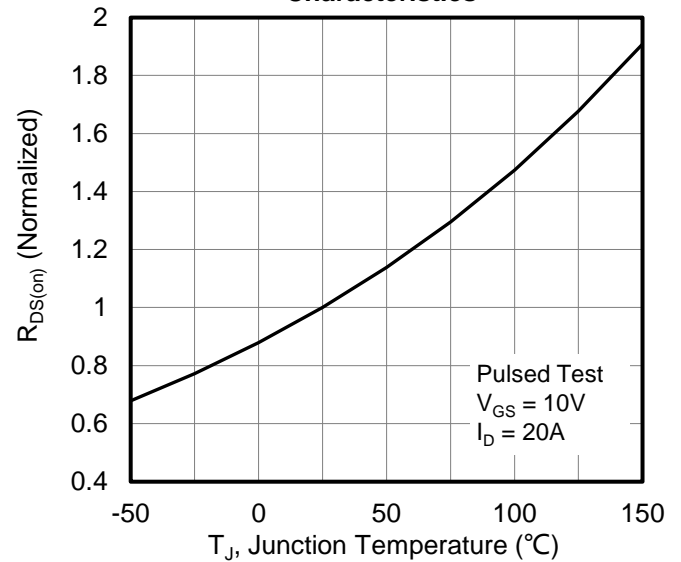


Figure 9. Normalized On Resistance vs Junction Temperature

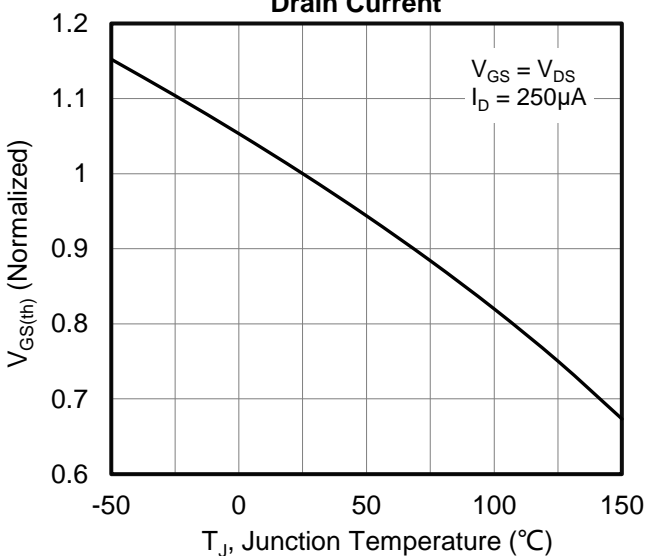


Figure 10. Normalized Threshold Voltage vs Junction Temperature

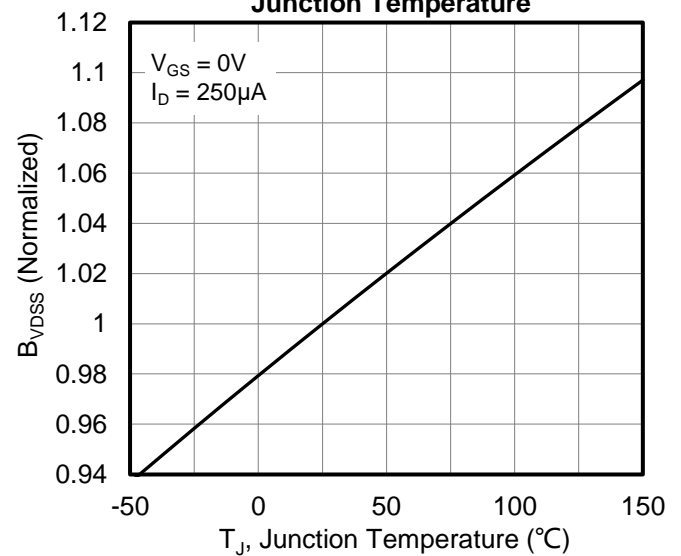


Figure 11. Normalized Breakdown Voltage vs Junction Temperature

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

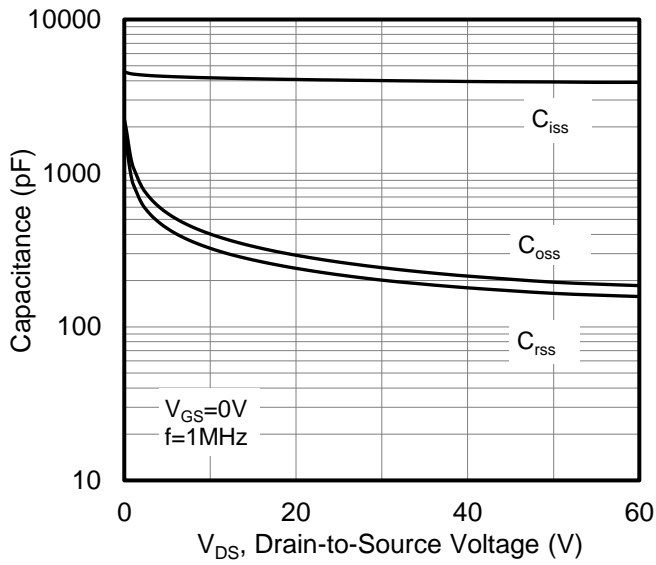


Figure 12. Capacitance Characteristics

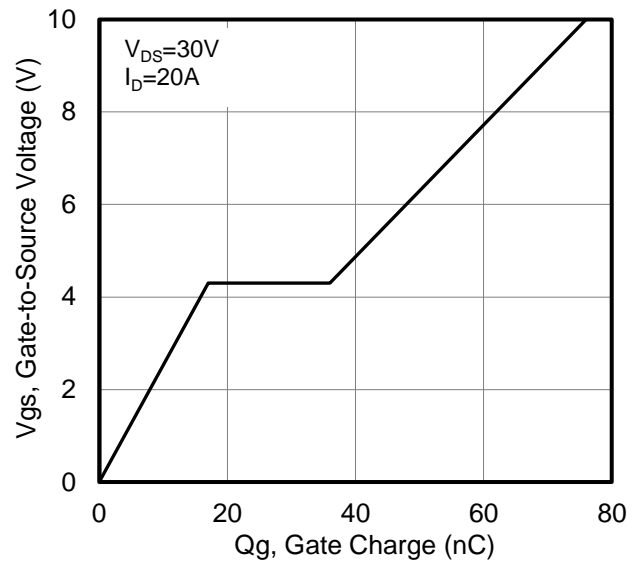


Figure 13. Typical Gate Charge vs Gate to Source Voltage

Figure A: Gate Charge Test Circuit and Waveform

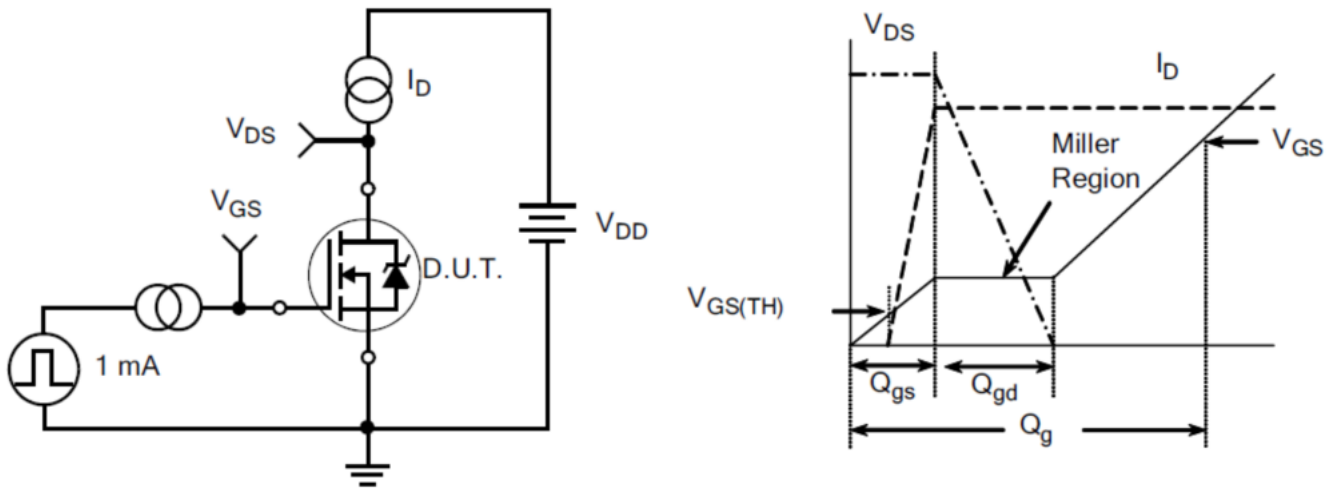


Figure B: Resistive Switching Test Circuit and Waveform

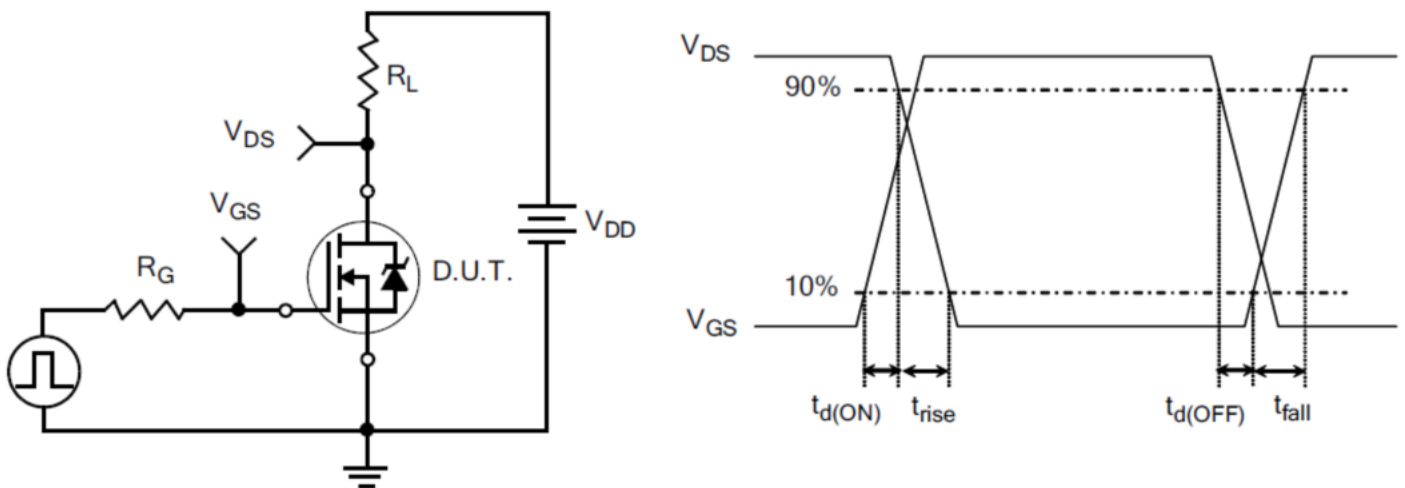
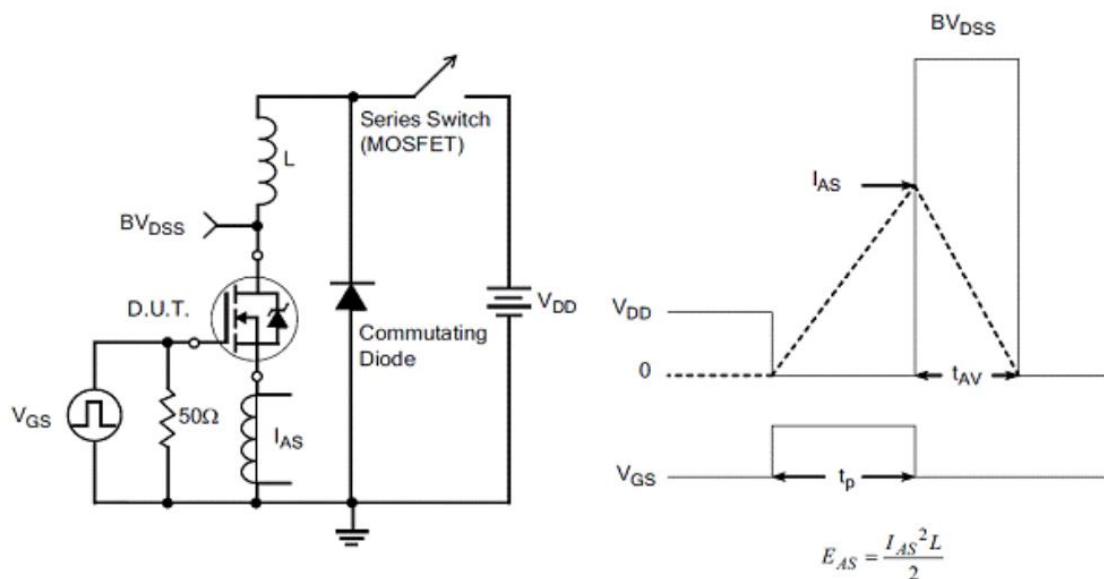
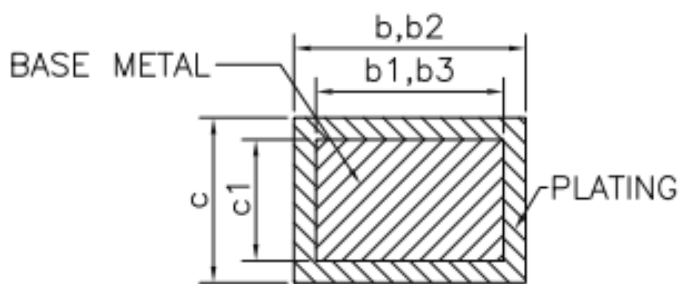
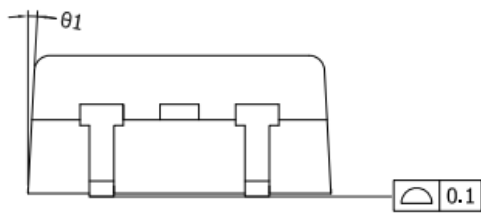
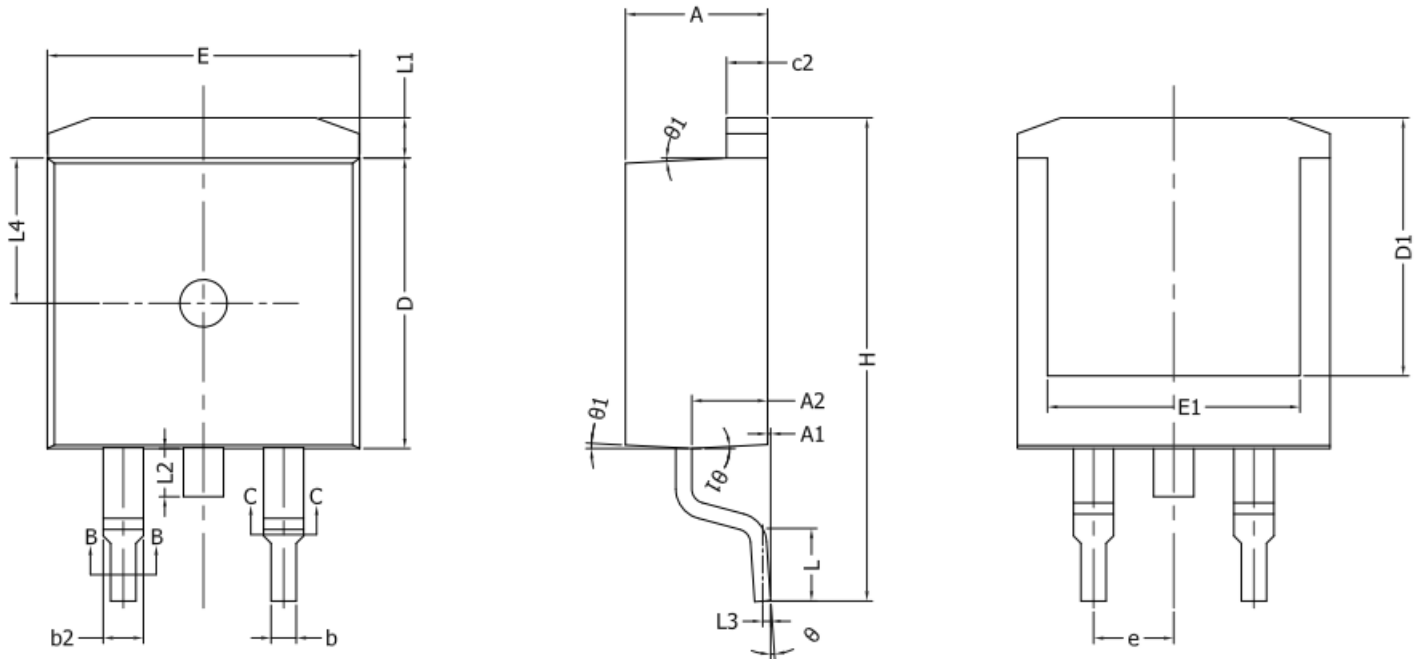


Figure C: Unclamped Inductive Switching Test Circuit and Waveform



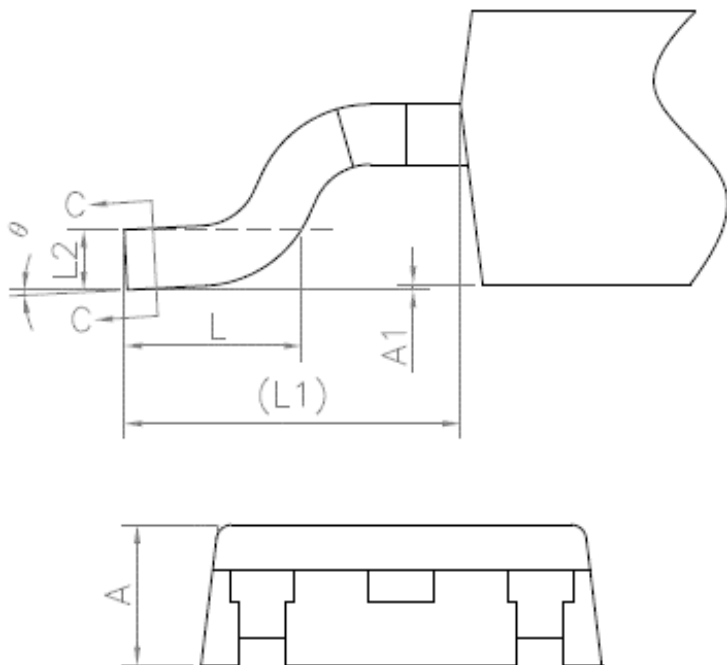
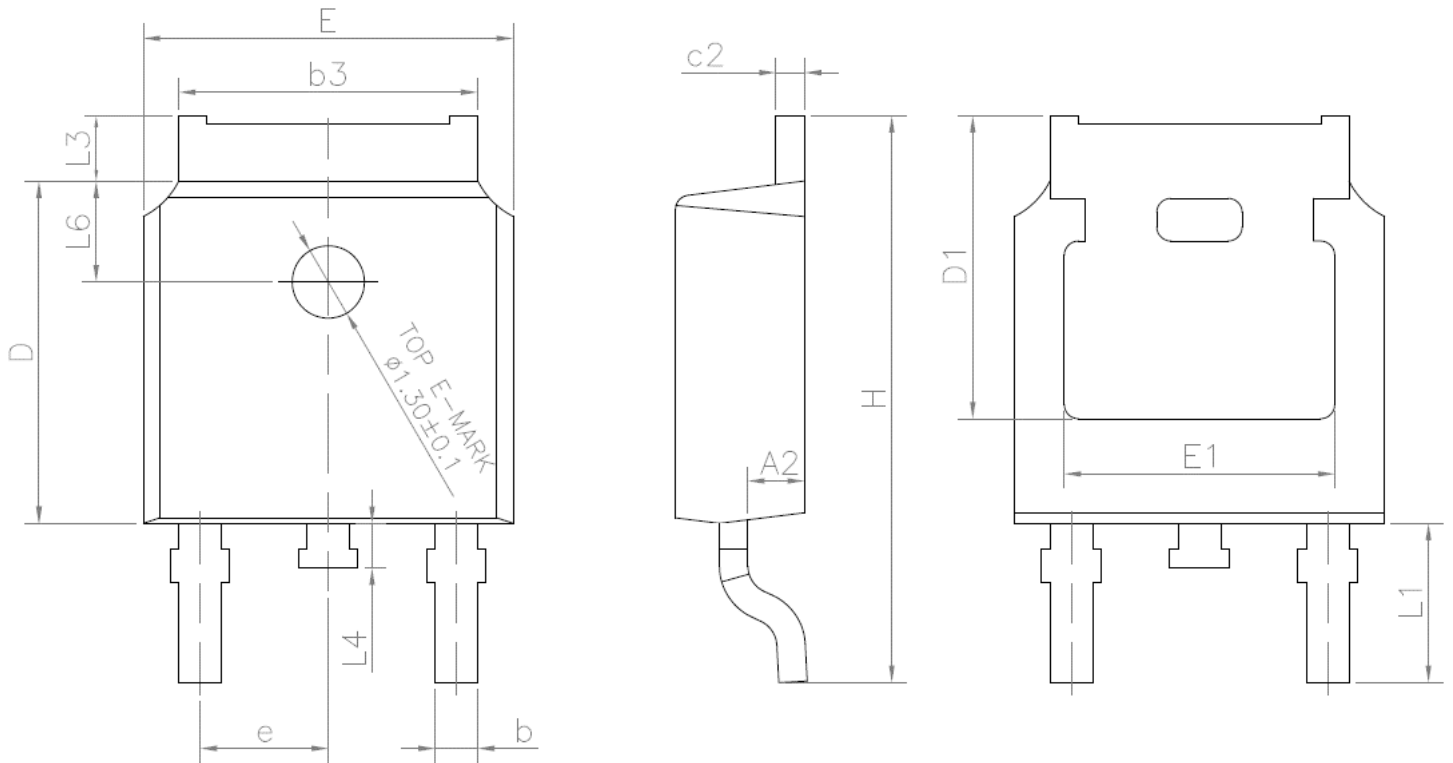
Outlines TO-263 Package



SECTION B-B&C-C

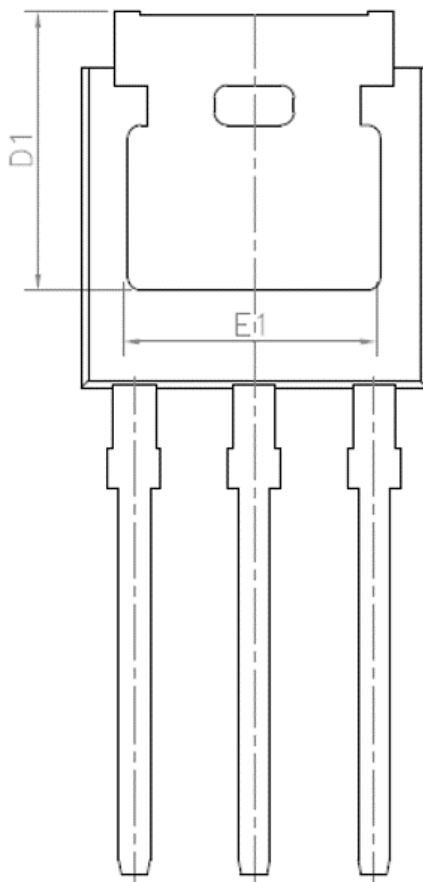
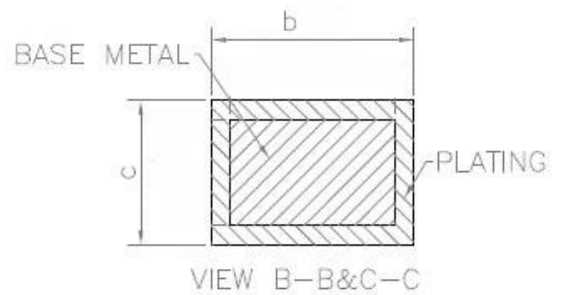
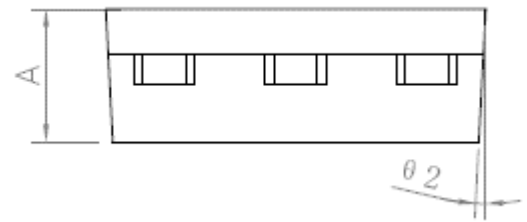
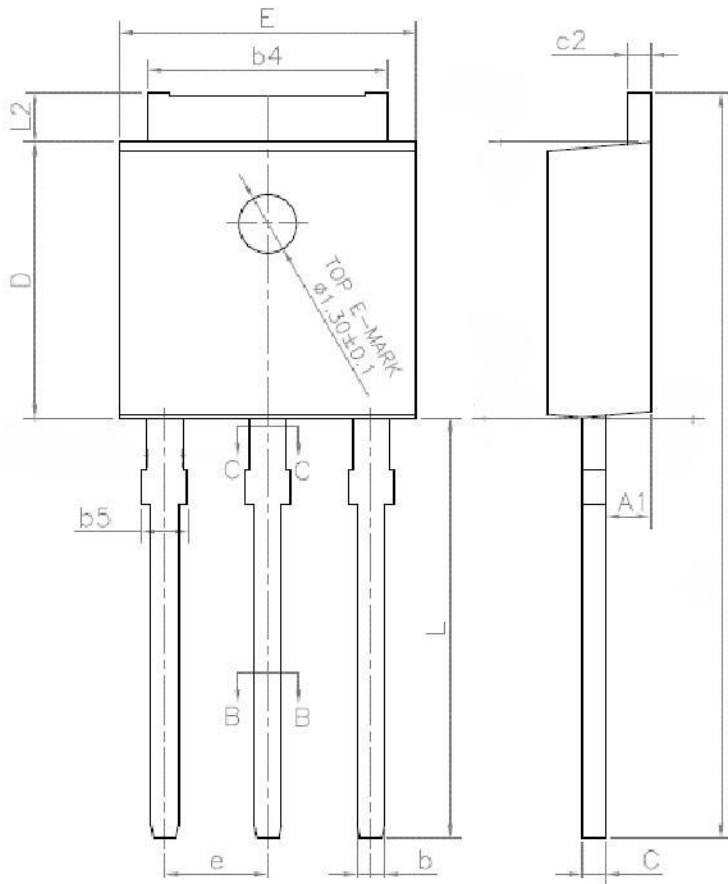
| SYMBOL | MIN | NOM | MAX |
|------------|----------|------|------|
| A | 4.4 | 4.5 | 4.6 |
| A1 | 0 | 0.1 | 0.25 |
| A2 | 2.2 | 2.4 | 2.6 |
| b | 0.76 | -- | 0.89 |
| b1 | 0.75 | 0.8 | 0.85 |
| b2 | 1.23 | -- | 1.37 |
| b3 | 1.22 | 1.27 | 1.32 |
| c | 0.47 | -- | 0.6 |
| c1 | 0.46 | 0.51 | 0.56 |
| 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° |
| θ_1 | 1° | 3° | 5° |

Outlines TO-252 Package



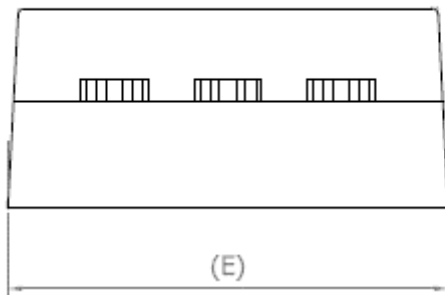
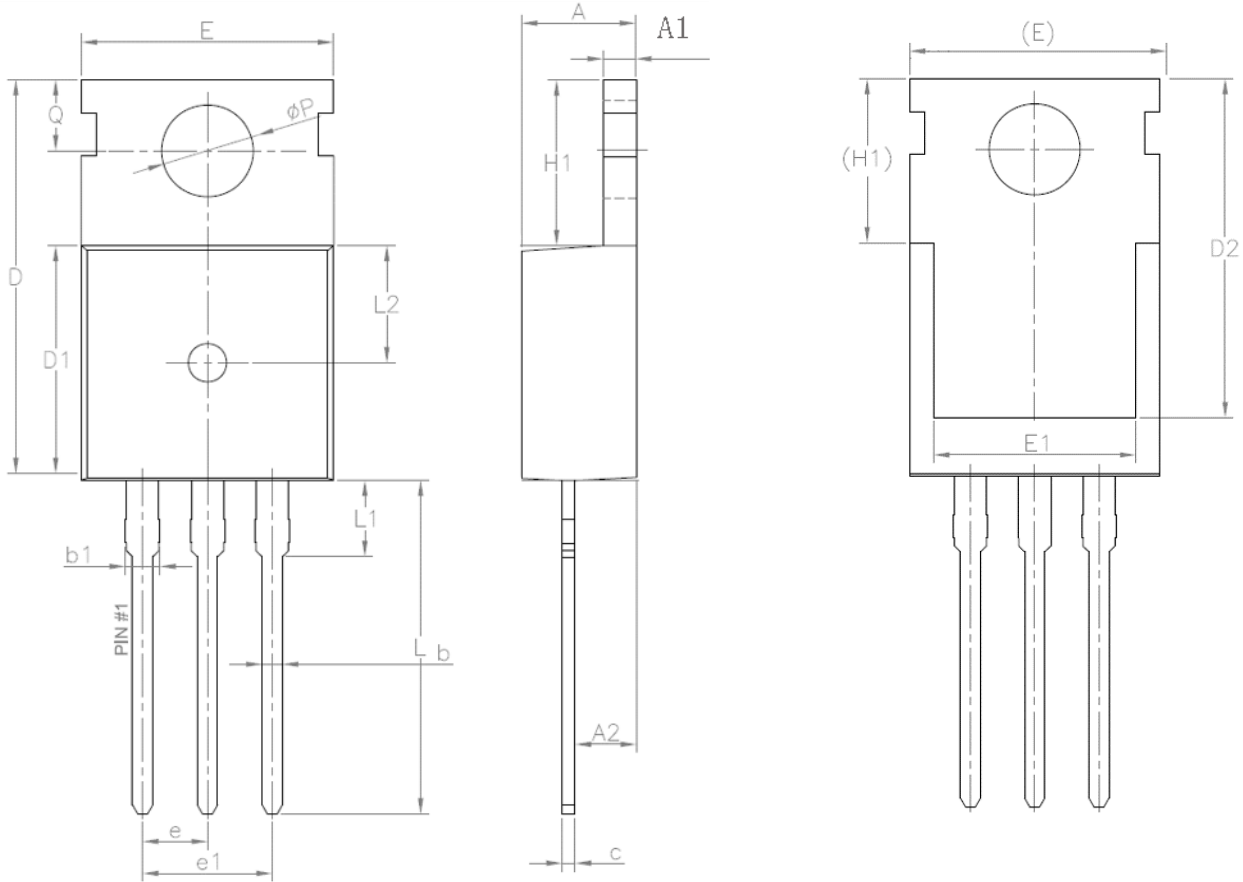
| SYMBOL | MIN | NOM | MAX |
|----------|-------|-------|-------|
| A | 2.2 | 2.3 | 2.4 |
| A1 | 0 | -- | 0.2 |
| A2 | 0.9 | 1.035 | 1.17 |
| b | 0.645 | -- | 0.9 |
| b3 | 5.13 | 5.326 | 5.46 |
| c | 0.43 | -- | 0.61 |
| c2 | 0.41 | -- | 0.61 |
| D | 5.98 | 6.1 | 6.22 |
| D1 | 5.244 | -- | -- |
| E | 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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