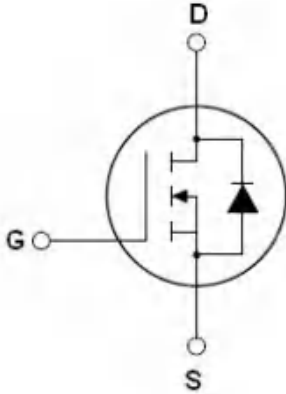


QIAOXIN N-Channel Super Junction Power MOSFET III

| | | | | | | | | | | |
|---|---|-----------|-----|---|-----------------|-----|-----------|-------|------|---|
| <p>General Description</p> <p>The series of devices use advanced trench gate super junction technology and design to provide excellent $R_{DS(ON)}$ with low gate charge. This super junction MOSFET fits the industry's AC-DC SMPS requirements for PFC, AC/DC power conversion, and industrial power applications.</p> <p>Features</p> <ul style="list-style-type: none"> ● New technology for high voltage device ● Low on-resistance and low conduction losses ● small package ● Ultra Low Gate Charge cause lower driving requirements ● 100% Avalanche Tested ● ROHS compliant <p>Application</p> <ul style="list-style-type: none"> ● Power factor correction (PFC) ● Switched mode power supplies(SMPS) ● Uninterruptible Power Supply (UPS) | <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <tr> <td style="padding: 2px;">V_{DS}</td> <td style="padding: 2px;">650</td> <td style="padding: 2px;">V</td> </tr> <tr> <td style="padding: 2px;">$R_{DS(ON)TYP}$</td> <td style="padding: 2px;">290</td> <td style="padding: 2px;">$m\Omega$</td> </tr> <tr> <td style="padding: 2px;">I_D</td> <td style="padding: 2px;">11.5</td> <td style="padding: 2px;">A</td> </tr> </table> <div style="text-align: center;">  <p>Schematic diagram</p> </div> | V_{DS} | 650 | V | $R_{DS(ON)TYP}$ | 290 | $m\Omega$ | I_D | 11.5 | A |
| V_{DS} | 650 | V | | | | | | | | |
| $R_{DS(ON)TYP}$ | 290 | $m\Omega$ | | | | | | | | |
| I_D | 11.5 | A | | | | | | | | |

Package Marking And Ordering Information

| Device | Device Package | Marking |
|-------------|----------------|-------------|
| VCRR65T360D | TO-263 | VCRR65T360D |
| VCRR65T360 | TO-220 | VCRR65T360 |
| VCRR65T360F | TO-220F | VCRR65T360F |

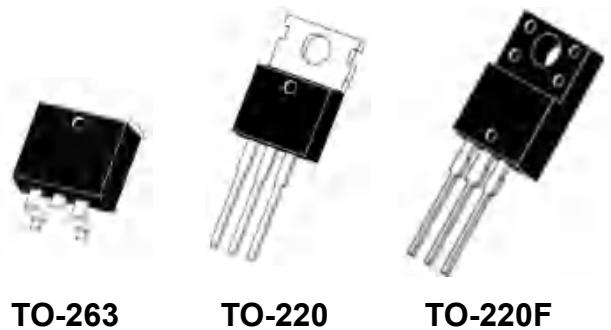


Table 1. Absolute Maximum Ratings ($T_c=25^\circ\text{C}$)

| Parameter | Symbol | VCRR65T360D VCRR65T360 | VCRR65T360F | Unit |
|---|-----------------|---------------------------|-------------|---------------------------|
| Drain-Source Voltage ($V_{GS}=0V$) | V_{DS} | 650 | | V |
| Gate-Source Voltage ($V_{DS}=0V$), AC($f>1\text{HZ}$) | V_{GS} | ± 30 | | V |
| Continuous Drain Current at $T_c = 25^\circ\text{C}$ | $I_{D(DC)}$ | 11.5 | 11.5* | A |
| Continuous Drain Current at $T_c = 100^\circ\text{C}$ | $I_{D(DC)}$ | 7 | 7* | A |
| Pulsed drain current (Note 1) | $I_{DM(pluse)}$ | 46 | 46* | A |
| Maximum Power Dissipation($T_c=25^\circ\text{C}$) | P_D | 101 | 32.6 | W |
| Derate above 25°C | | 0.81 | 0.26 | $\text{W}/^\circ\text{C}$ |
| Single pulse avalanche energy (Note2) | E_{AS} | 144 | | mJ |
| Avalanche current(Note 1) | I_{AR} | 6 | | A |
| Repetitive Avalanche energy , t_{AR} limited by T_{jmax} (Note 1) | E_{AR} | 0.5 | | mJ |

| Parameter | Symbol | VCRR65T360D | VCRR65T360F | Unit |
|---|----------------|-------------|-------------|------|
| | | VCRR65T360 | | |
| Drain Source voltage slope, $V_{DS} \leq 480V$, | dv/dt | 50 | | V/ns |
| Reverse diode dv/dt, $V_{DS} \leq 480V, I_{SD} < I_D$ | dv/dt | 15 | | V/ns |
| Operating Junction and Storage Temperature Range | T_J, T_{STG} | -55...+150 | | °C |

* limited by maximum junction temperature

Table 2. Thermal Characteristic

| Parameter | Symbol | VCRR65T360D | VCRR65T360F | Unit |
|---|------------|-------------|-------------|------|
| | | VCRR65T360 | | |
| Thermal Resistance, Junction-to-Case (Maximum) | R_{thJC} | 1.24 | 3.83 | °C/W |
| Thermal Resistance, Junction-to-Ambient (Maximum) | R_{thJA} | 62 | 80 | °C/W |

Table 3. Electrical Characteristics (TA=25°C unless otherwise noted)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|--|--------------|---|-----|------|-----------|------------|
| On/off states | | | | | | |
| Drain-Source Breakdown Voltage | BV_{DSS} | $V_{GS}=0V, I_D=250\mu A$ | 650 | | | V |
| Zero Gate Voltage Drain Current($T_C=25^\circ C$) | I_{DSS} | $V_{DS}=650V, V_{GS}=0V$ | | 0.05 | 1 | μA |
| Zero Gate Voltage Drain Current($T_C=125^\circ C$) | I_{DSS} | $V_{DS}=650V, V_{GS}=0V$ | | | 100 | μA |
| Gate-Body Leakage Current | I_{GSS} | $V_{GS}=\pm 20V, V_{DS}=0V$ | | | ± 100 | nA |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$ | 3 | 3.5 | 4 | V |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}=10V, I_D=7A$ | | 290 | 360 | m Ω |
| Dynamic Characteristics | | | | | | |
| Input Capacitance | C_{iss} | $V_{DS}=50V, V_{GS}=0V,$ $F=1.0MHz$ | | 870 | | pF |
| Output Capacitance | C_{oss} | | | 54 | | pF |
| Reverse Transfer Capacitance | C_{rss} | | | 1.8 | | pF |
| Total Gate Charge | Q_g | $V_{DS}=480V, I_D=11.5A,$ $V_{GS}=10V$ | | 19 | | nC |
| Gate-Source Charge | Q_{gs} | | | 6 | | nC |
| Gate-Drain Charge | Q_{gd} | | | 6.5 | | nC |
| Switching times | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}=380V, I_D=5.5A,$ $R_G=3\Omega, V_{GS}=10V$ | | 11 | | nS |
| Turn-on Rise Time | t_r | | | 8 | | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 58 | 70 | nS |
| Turn-Off Fall Time | t_f | | | 9 | 14 | nS |
| Source- Drain Diode Characteristics | | | | | | |
| Source-drain current(Body Diode) | I_{SD} | $T_C=25^\circ C$ | | | 11.5 | A |
| Pulsed Source-drain current(Body Diode) | I_{SDM} | | | | 46 | A |
| Forward on voltage | V_{SD} | $T_J=25^\circ C, I_{SD}=11.5A, V_{GS}=0V$ | | 0.9 | 1.2 | V |
| Reverse Recovery Time | t_{rr} | $T_J=25^\circ C, I_F=5.8A,$ $di/dt=100A/\mu s$ | | 220 | | nS |
| Reverse Recovery Charge | Q_{rr} | | | 2.2 | | μC |
| Peak Reverse Recovery Current | I_{rrm} | | | 19 | | A |

Notes: 1.Repetitive Rating: Pulse width limited by maximum junction temperature

2. $T_J=25^\circ C, V_{DD}=50V, V_G=10V, R_G=25\Omega$

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

Figure1. Safe operating area

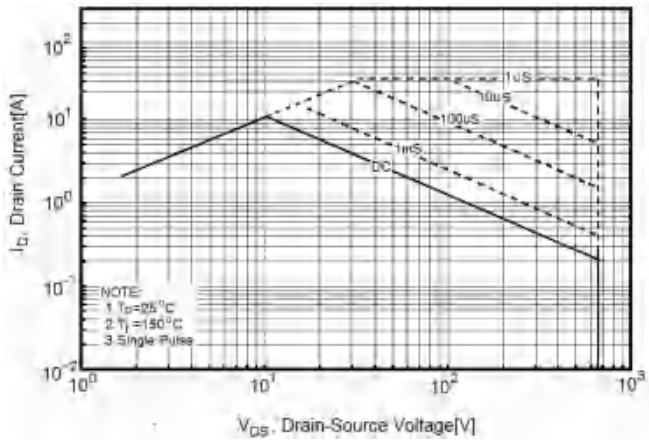


Figure2. Safe operating area for TO-220F

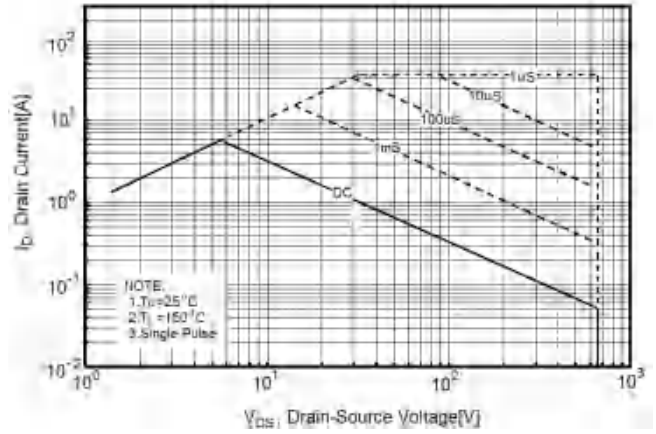


Figure3. Source-Drain Diode Forward Voltage

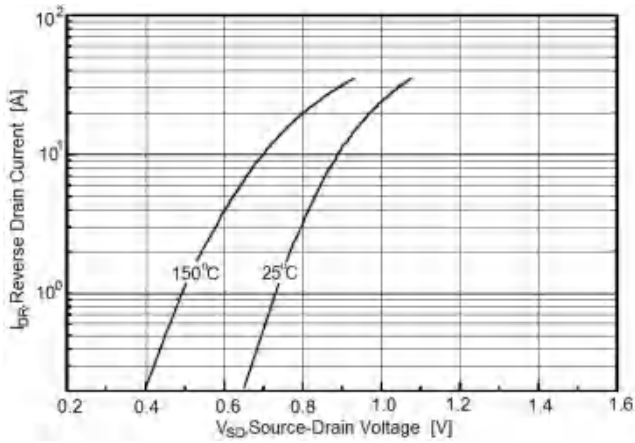


Figure4. Output characteristics

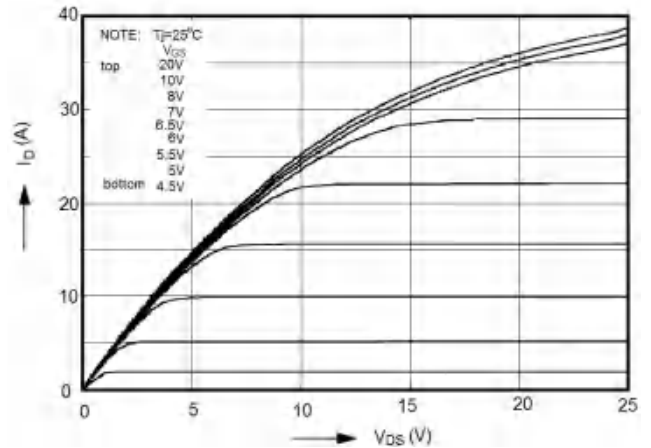


Figure5. Transfer characteristics

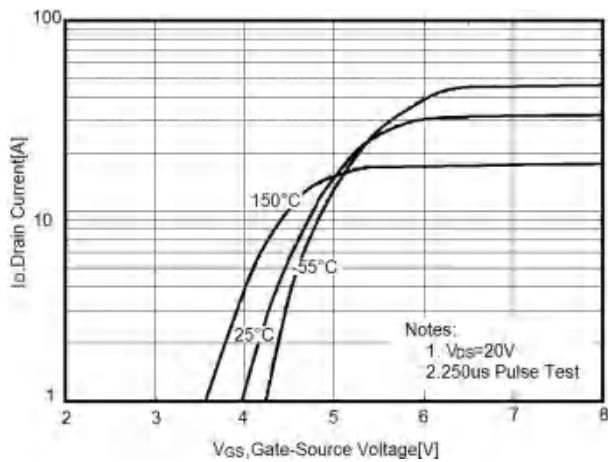


Figure6. Static drain-source on resistance

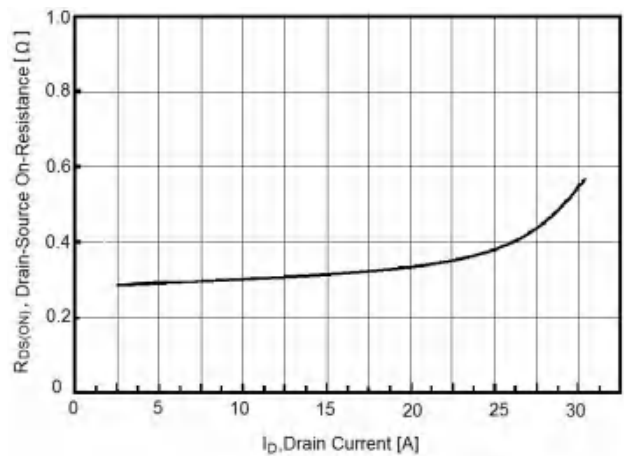


Figure7. $R_{DS(ON)}$ vs Junction Temperature

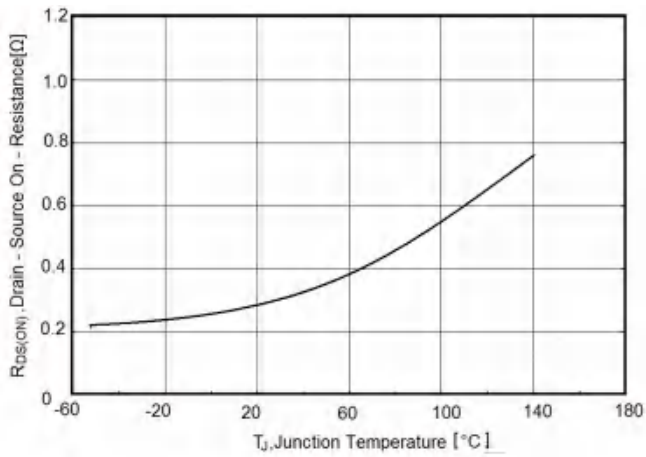


Figure8. BV_{DSS} vs Junction Temperature

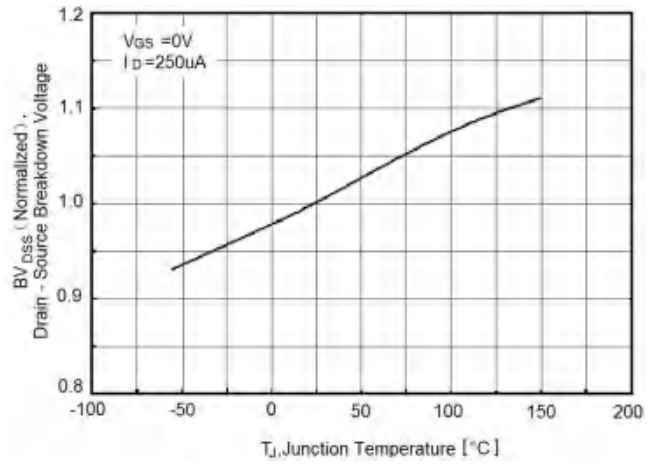


Figure9. Maximum I_D vs Junction Temperature

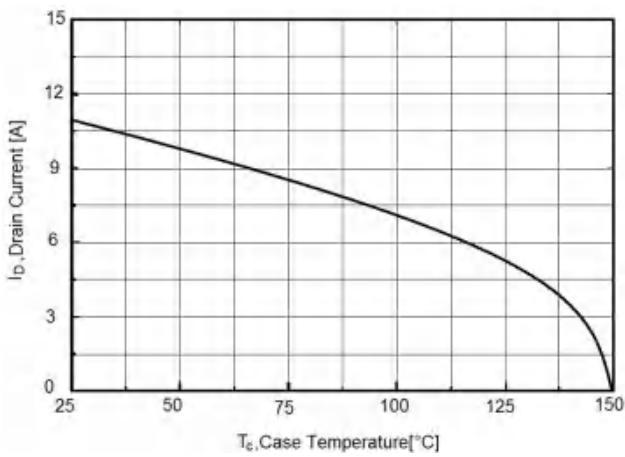


Figure10. Gate charge waveforms

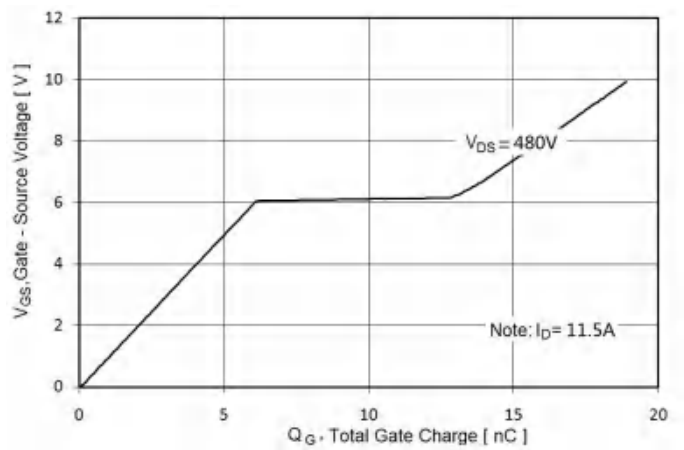


Figure11. Capacitance

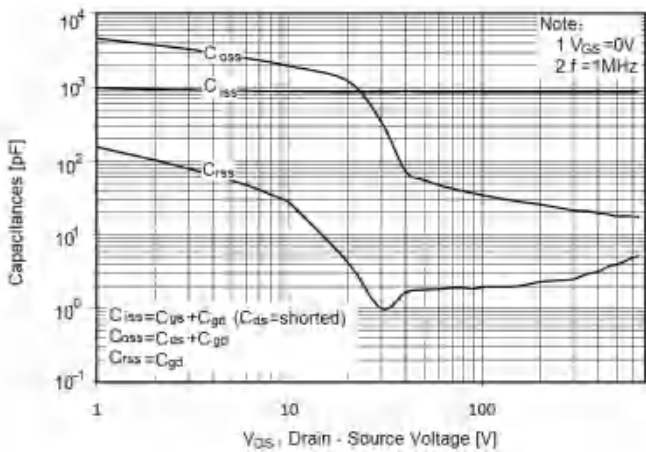


Figure12. Transient Thermal Impedance

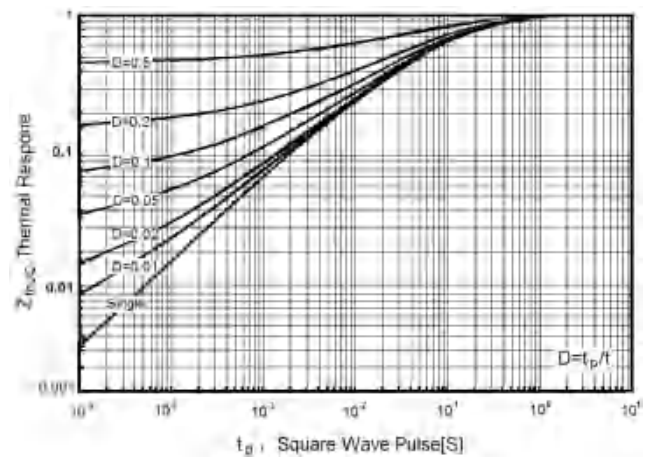
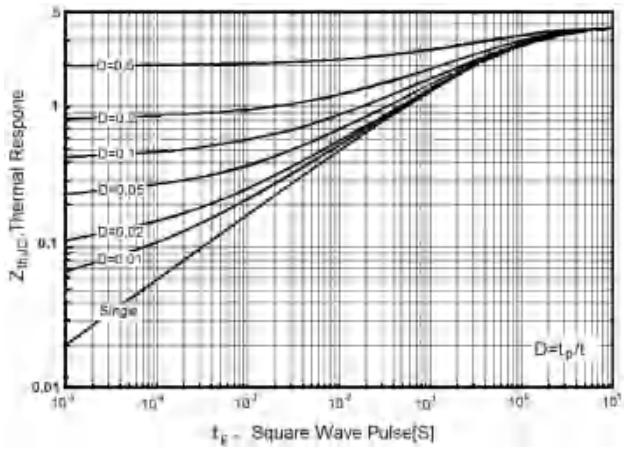
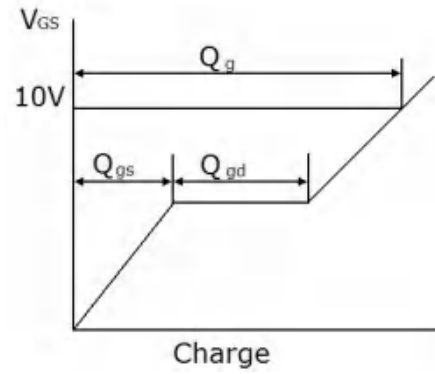
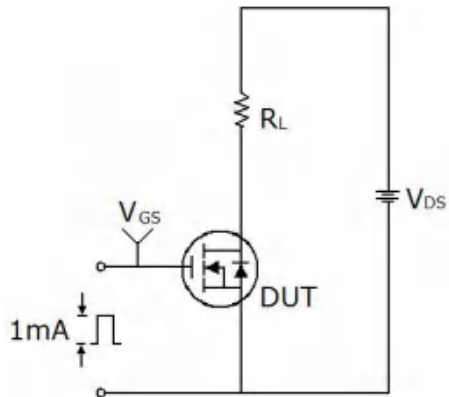


Figure13. Transient Thermal Impedance for TO-220F

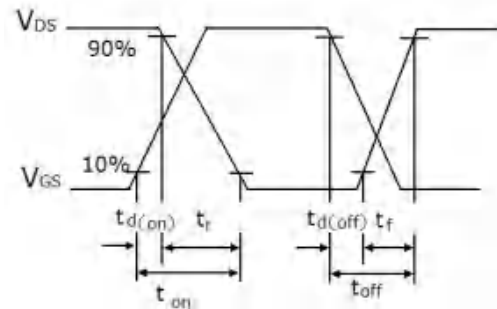
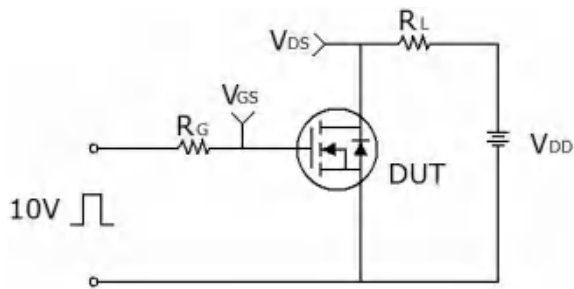


Test circuit

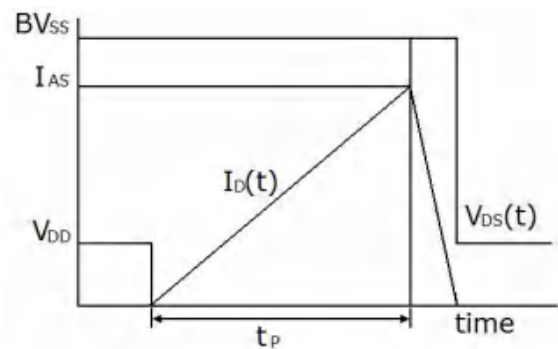
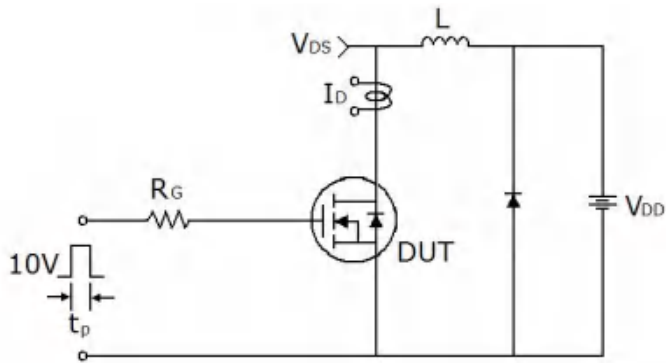
1) Gate charge test circuit & Waveform



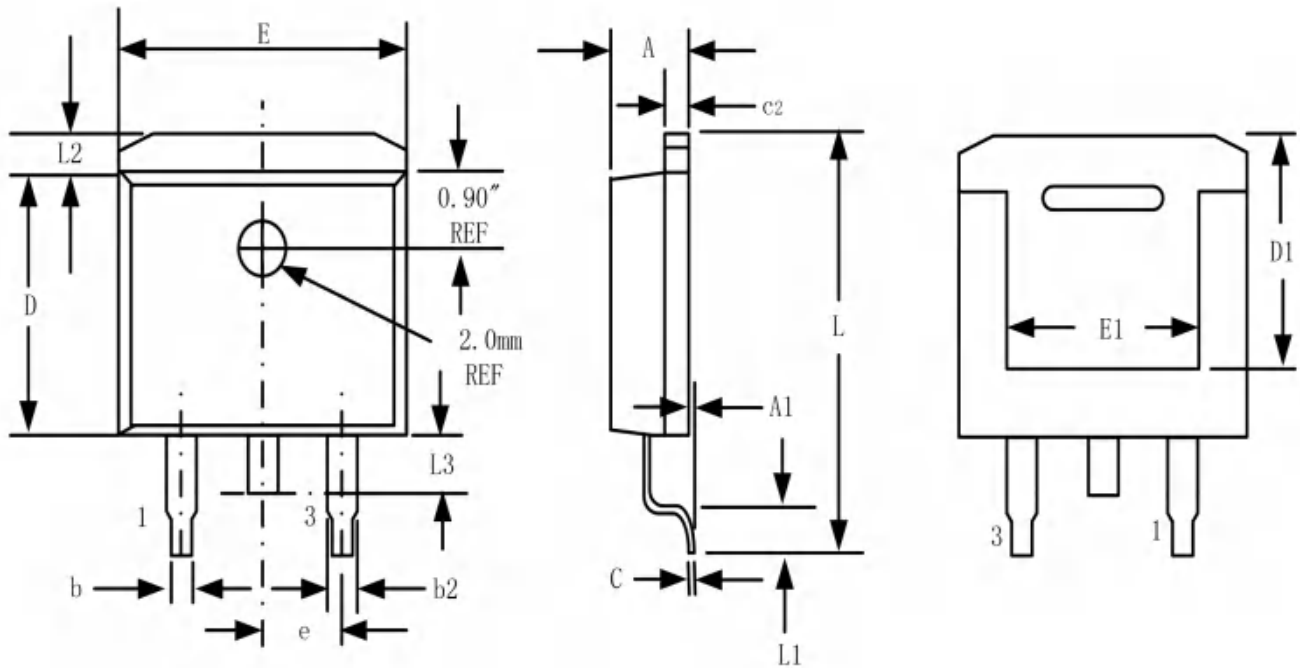
2) Switch Time Test Circuit:



3) Unclamped Inductive Switching Test Circuit & Waveforms

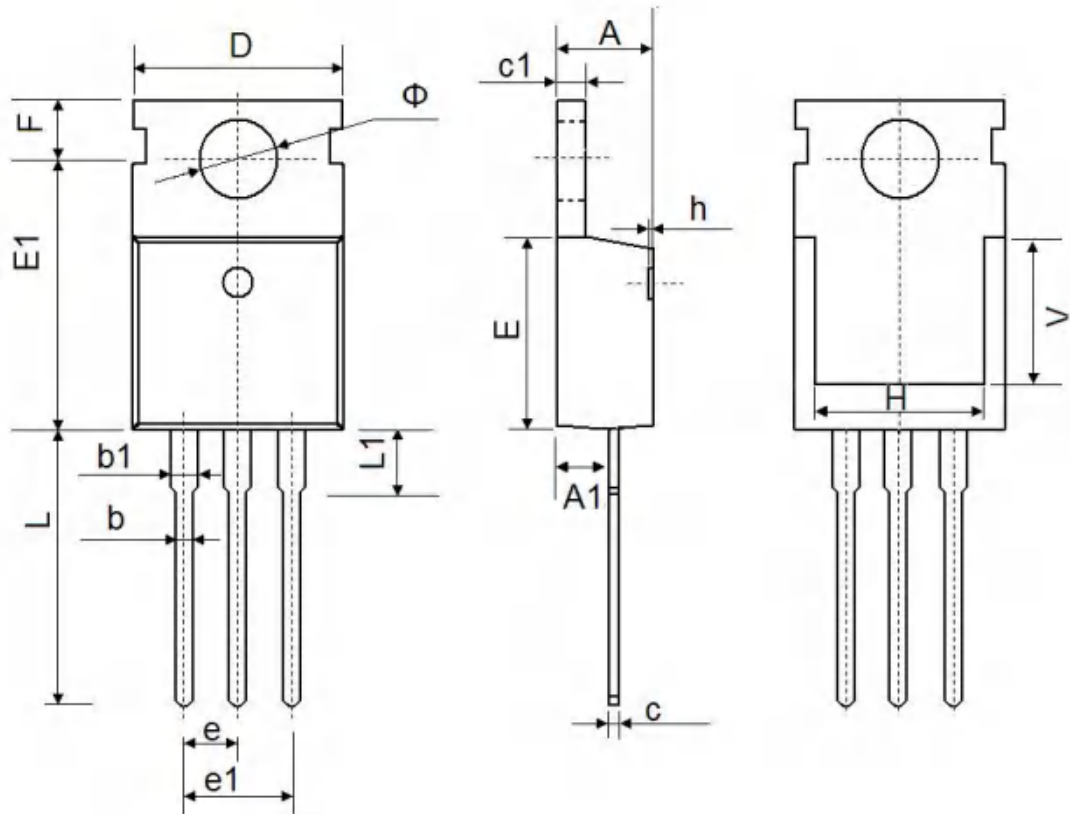


TO-263-3L Package Information



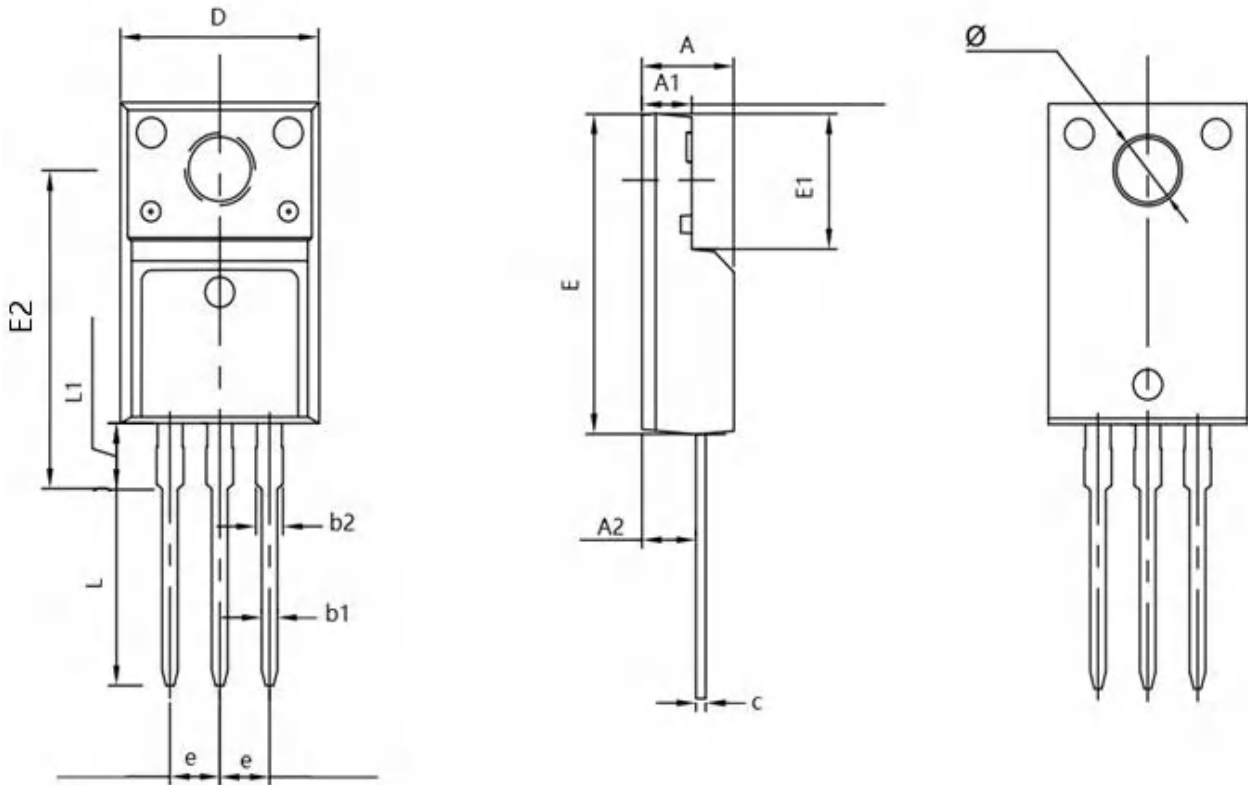
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 4.32 | 4.57 | 0.170 | 0.180 |
| A1 | - | 0.25 | | 0.010 |
| b | 0.71 | 0.94 | 0.028 | 0.037 |
| b2 | 1.15 | 1.40 | 0.045 | 0.055 |
| c | 0.46 | 0.61 | 0.018 | 0.024 |
| c2 | 1.22 | 1.40 | 0.048 | 0.055 |
| D | 8.89 | 9.40 | 0.350 | 0.370 |
| D1 | 8.01 | 8.23 | 0.315 | 0.324 |
| E | 10.04 | 10.28 | 0.395 | 0.405 |
| E1 | 7.88 | 8.08 | 0.310 | 0.318 |
| e | 2.54 BSC | | 0.100 BSC | |
| L | 14.73 | 15.75 | 0.580 | 0.620 |
| L1 | 2.29 | 2.79 | 0.090 | 0.110 |
| L2 | 1.15 | 1.39 | 0.045 | 0.055 |
| L3 | 1.27 | 1.77 | 0.050 | 0.070 |

TO-220-3L-C Package Information



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|--------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 4.400 | 4.600 | 0.173 | 0.181 |
| A1 | 2.250 | 2.550 | 0.089 | 0.100 |
| b | 0.710 | 0.910 | 0.028 | 0.036 |
| b1 | 1.170 | 1.370 | 0.046 | 0.054 |
| c | 0.330 | 0.650 | 0.013 | 0.026 |
| c1 | 1.200 | 1.400 | 0.047 | 0.055 |
| D | 9.910 | 10.250 | 0.390 | 0.404 |
| E | 8.9500 | 9.750 | 0.352 | 0.384 |
| E1 | 12.650 | 12.950 | 0.498 | 0.510 |
| e | 2.540 TYP. | | 0.100 TYP. | |
| e1 | 4.980 | 5.180 | 0.196 | 0.204 |
| F | 2.650 | 2.950 | 0.104 | 0.116 |
| H | 7.900 | 8.100 | 0.311 | 0.319 |
| h | 0.000 | 0.300 | 0.000 | 0.012 |
| L | 12.900 | 13.400 | 0.508 | 0.528 |
| L1 | 2.850 | 3.250 | 0.112 | 0.128 |
| V | 7.500 REF. | | 0.295 REF. | |
| Φ | 3.400 | 3.800 | 0.134 | 0.150 |

TO-220F Package Information



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|--------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 4.500 | 4.900 | 0.177 | 0.193 |
| A1 | 2.340 | 2.740 | 0.092 | 0.108 |
| A2 | 2.560 | 2.960 | 0.101 | 0.117 |
| b1 | 0.700 | 0.900 | 0.028 | 0.035 |
| b2 | 1.180 | 1.580 | 0.046 | 0.062 |
| c | 0.400 | 0.600 | 0.016 | 0.024 |
| D | 9.960 | 10.360 | 0.392 | 0.408 |
| E | 15.670 | 15.970 | 0.617 | 0.629 |
| E1 | 6.500 | 6.900 | 0.256 | 0.272 |
| E2 | 15.500 | 16.100 | 0.610 | 0.634 |
| e | 2.540 TYP | | 0.100 TYP | |
| Φ | 3.080 | 3.280 | 0.121 | 0.129 |
| L | 12.640 | 13.240 | 0.498 | 0.521 |
| L1 | 3.030 | 3.430 | 0.119 | 0.135 |

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