

N-Channel Super Junction Power MOSFET

General Description

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.

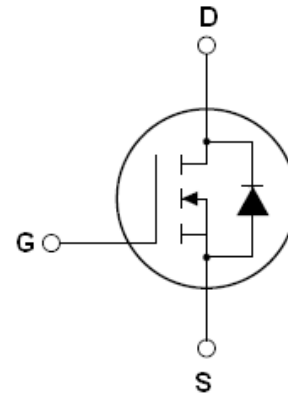
Features

- 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

Application

- Power factor correction (PFC)
- Switched mode power supplies(SMPS)
- Uninterruptible Power Supply (UPS)

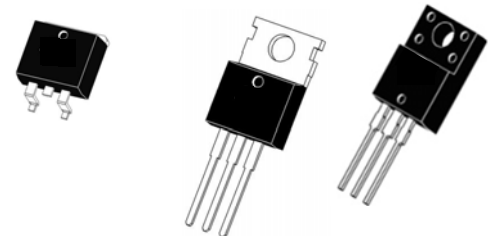
| | | |
|------------------|-----|----|
| V_{DS} | 650 | V |
| $R_{DS(ON) MAX}$ | 180 | mΩ |
| I_D | 21 | A |



Schematic diagram

Package Marking And Ordering Information

| Device | Device Package | Marking |
|-------------|----------------|------------|
| FTK65T180 | TO-220 | NCE65T180 |
| FTK65T180F | TO-220F | NCE65T180F |
| FTK65T180DD | TO-263 | NCE65T180 |



TO-263

TO-220

TO-220F

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

| Parameter | Symbol | FTK65T180 | FTK65T180F | Unit |
|---|-----------------|-------------|------------|---------------------|
| | | FTK65T180DD | | |
| Drain-Source Voltage ($V_{GS}=0V$) | V_{DS} | 650 | | V |
| Gate-Source Voltage ($V_{DS}=0V$), AC ($f>1$ Hz) | V_{GS} | ± 30 | | V |
| Continuous Drain Current at $T_C=25^\circ\text{C}$ | $I_{D(DC)}$ | 21 | 21* | A |
| Continuous Drain Current at $T_C=100^\circ\text{C}$ | $I_{D(DC)}$ | 13.2 | 13.2* | A |
| Pulsed drain current (Note 1) | $I_{DM(pluse)}$ | 84 | 84* | A |
| Maximum Power Dissipation($T_C=25^\circ\text{C}$) | P_D | 188 | 33.8 | W |
| Derate above 25°C | | 1.5 | 0.27 | W/ $^\circ\text{C}$ |
| Single pulse avalanche energy (Note 2) | E_{AS} | 441 | | mJ |
| Avalanche current (Note 1) | I_{AR} | 10.5 | | A |
| Repetitive Avalanche energy, t_{AR} limited by T_{Jmax} (Note 1) | E_{AR} | 0.7 | | mJ |



FTK65T180/F/DD

| Parameter | Symbol | FTK65T180 FTK65T180DD | FTK65T180F | Unit |
|--|----------------|--------------------------|------------|------|
| Drain Source voltage slope, $V_{DS} \leq 480$ V | dv/dt | 50 | | V/ns |
| Reverse diode dv/dt, $V_{DS} \leq 480$ V, $I_{SD} < I_D$ | 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 | FTK65T180 FTK65T180DD | FTK65T180F | Unit |
|---|------------|--------------------------|------------|-------|
| Thermal Resistance, Junction-to-Case (Maximum) | R_{thJC} | 0.66 | 3.69 | °C /W |
| Thermal Resistance, Junction-to-Ambient (Maximum) | R_{thJA} | 62.5 | 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(Tc=25°C) | I_{DSS} | $V_{DS}=650V, V_{GS}=0V$ | | 0.05 | 1 | μA |
| Zero Gate Voltage Drain Current(Tc=125°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 | $R_{DS(ON)}$ | $V_{GS}=10V, I_D=10.5A$ | | 150 | 180 | mΩ |
| Dynamic Characteristics | | | | | | |
| Forward Transconductance | g_{FS} | $V_{DS} = 20V, I_D = 10.5A$ | | 16 | | S |
| Input Capacitance | C_{ISS} | $V_{DS}=50V, V_{GS}=0V,$ $F=1.0MHz$ | | 2250 | | PF |
| Output Capacitance | C_{OSS} | | | 83 | | PF |
| Reverse Transfer Capacitance | C_{RSS} | | | 1.6 | | PF |
| Total Gate Charge | Q_g | | $V_{DS}=480V, I_D=21A,$ $V_{GS}=10V$ | | 36 | |
| Gate-Source Charge | Q_{gs} | | | 14 | | nC |
| Gate-Drain Charge | Q_{gd} | | | 8.5 | | nC |
| Switching times | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}=380V, I_D=11A,$ $R_G=4\Omega, V_{GS}=10V$ | | 11 | | nS |
| Turn-on Rise Time | t_r | | | 6 | | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 61 | | nS |
| Turn-Off Fall Time | t_f | | | 4.5 | | nS |
| Source- Drain Diode Characteristics | | | | | | |
| Source-drain current(Body Diode) | I_{SD} | $T_C=25^\circ C$ | | | 21 | A |
| Pulsed Source-drain current(Body Diode) | I_{SDM} | | | | 84 | A |
| Forward on voltage | V_{SD} | $T_J=25^\circ C, I_{SD}=21A, V_{GS}=0V$ | | 0.9 | 1.3 | V |
| Reverse Recovery Time | t_{rr} | $T_J=25^\circ C, I_F=21A, di/dt=100A/\mu s$ | | 310 | | nS |
| Reverse Recovery Charge | Q_{rr} | | | 5 | | uC |
| Peak Reverse Recovery Current | I_{rrm} | | | 28 | | 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 for TO-220/TO-263

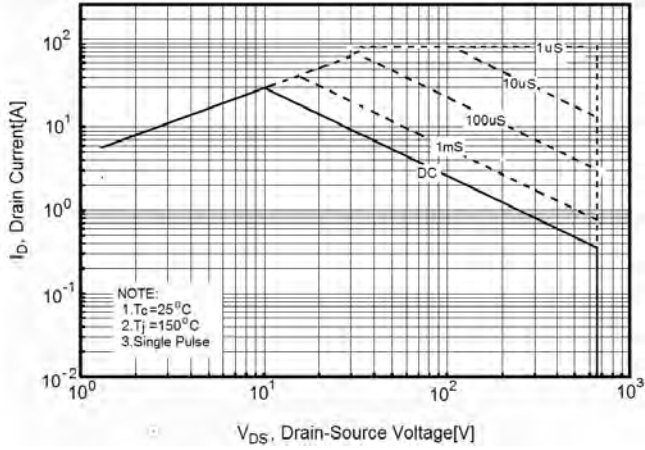


Figure2. Safe operating area for TO-220F

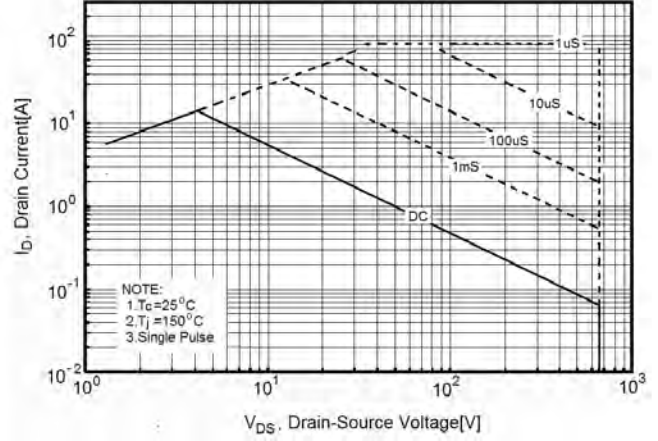


Figure3. Source-Drain Diode Forward Voltage

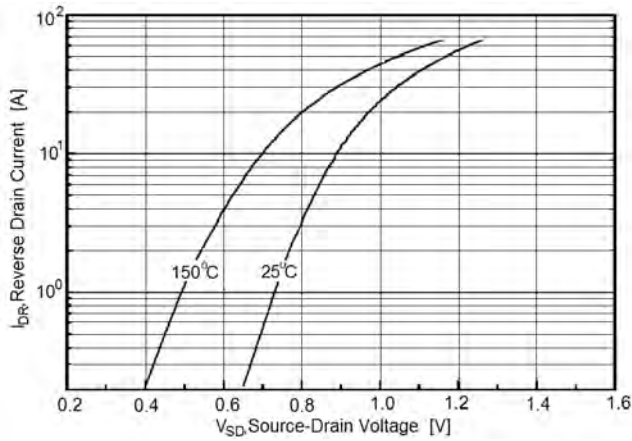


Figure4. Output characteristics

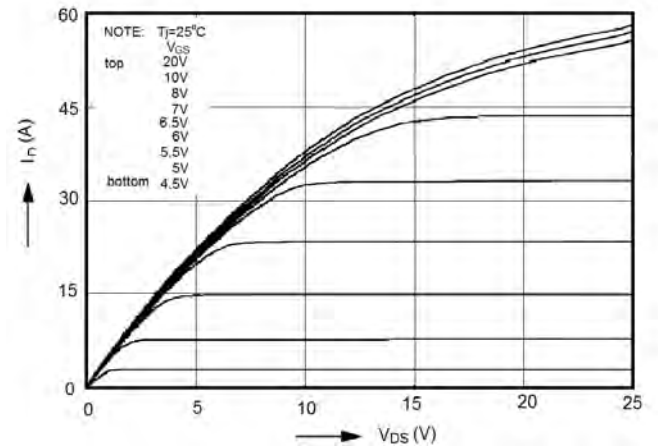


Figure5. Transfer characteristics

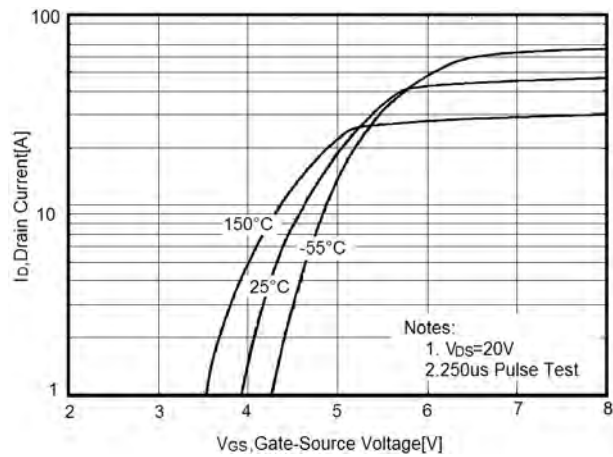


Figure6. Static drain-source on resistance

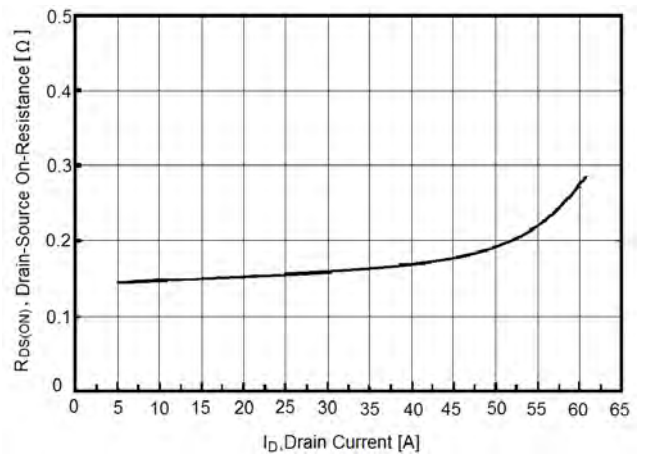


Figure7. $R_{DS(ON)}$ vs Junction Temperature

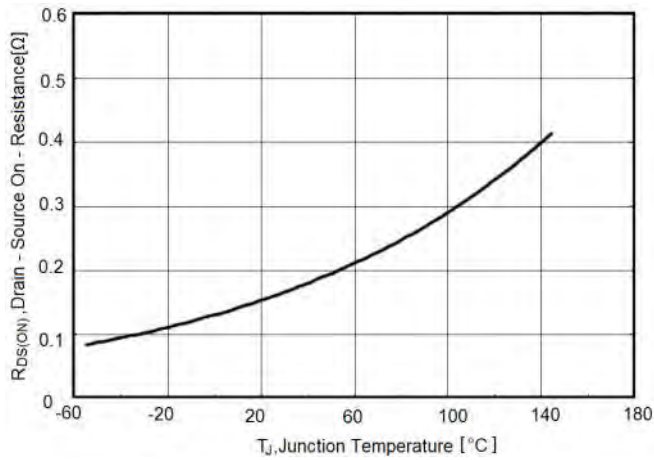


Figure8. BV_{DSS} vs Junction Temperature

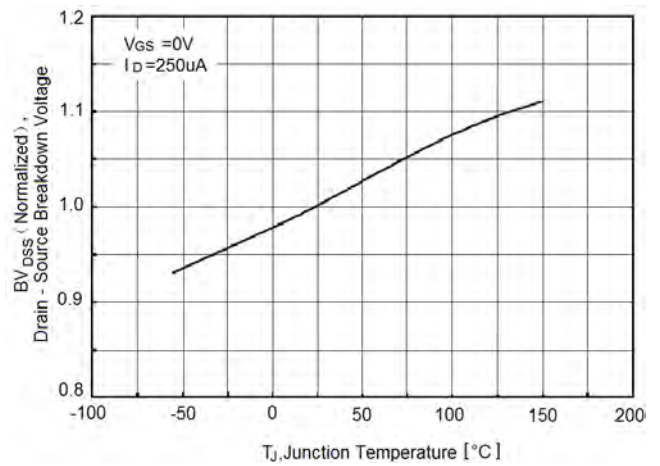


Figure9. Maximum I_D vs Junction Temperature

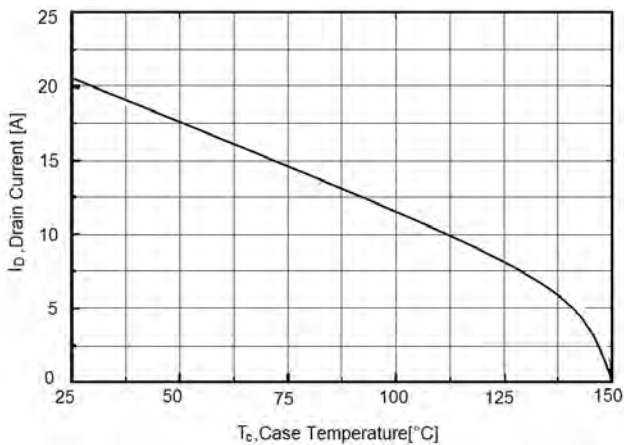


Figure10. Transient Thermal Impedance for TO-220

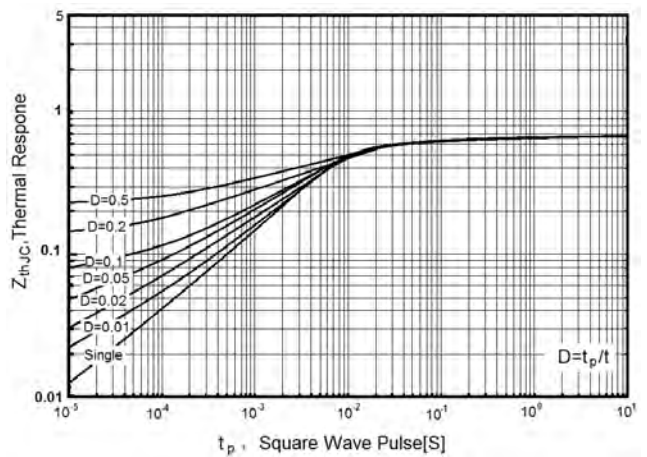


Figure11. Transient Thermal Impedance for TO-220F

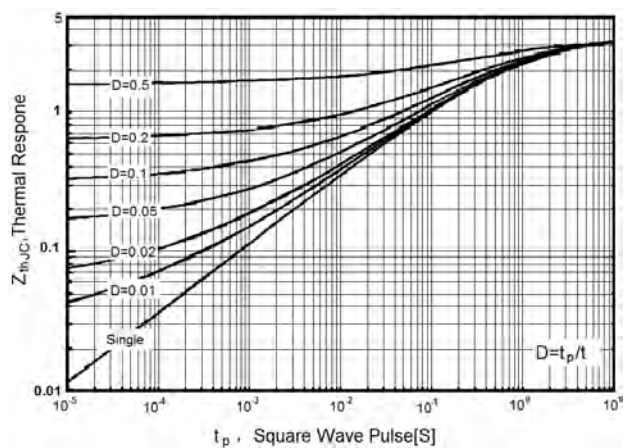


Figure12. Gate charge waveforms

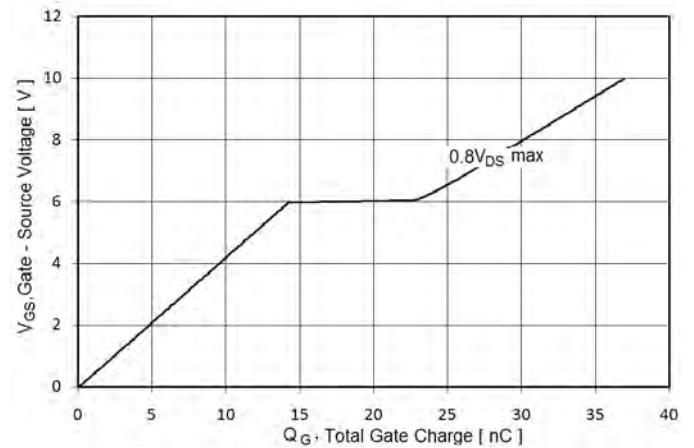
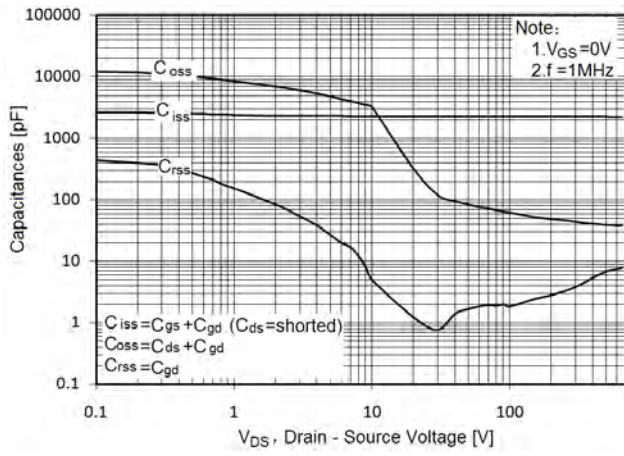
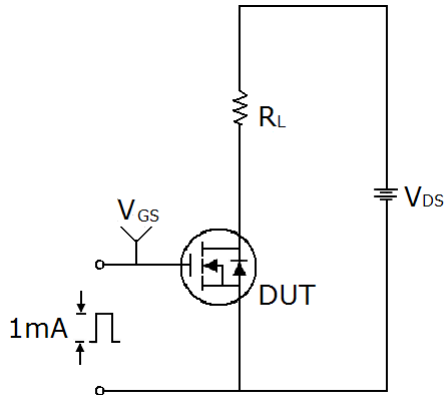


Figure13. Capacitance

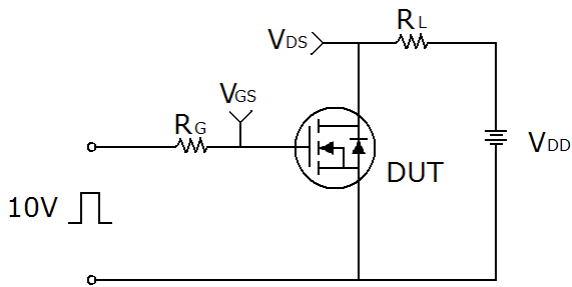


Test circuit

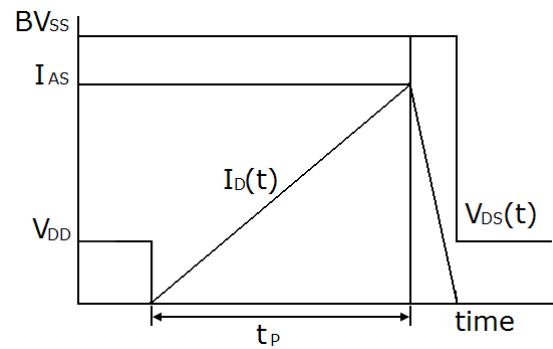
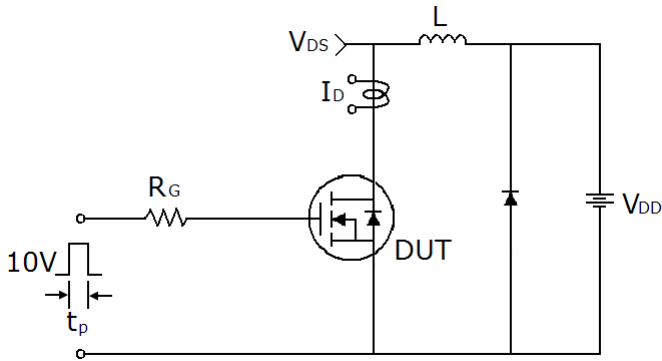
1) Gate charge test circuit & Waveform



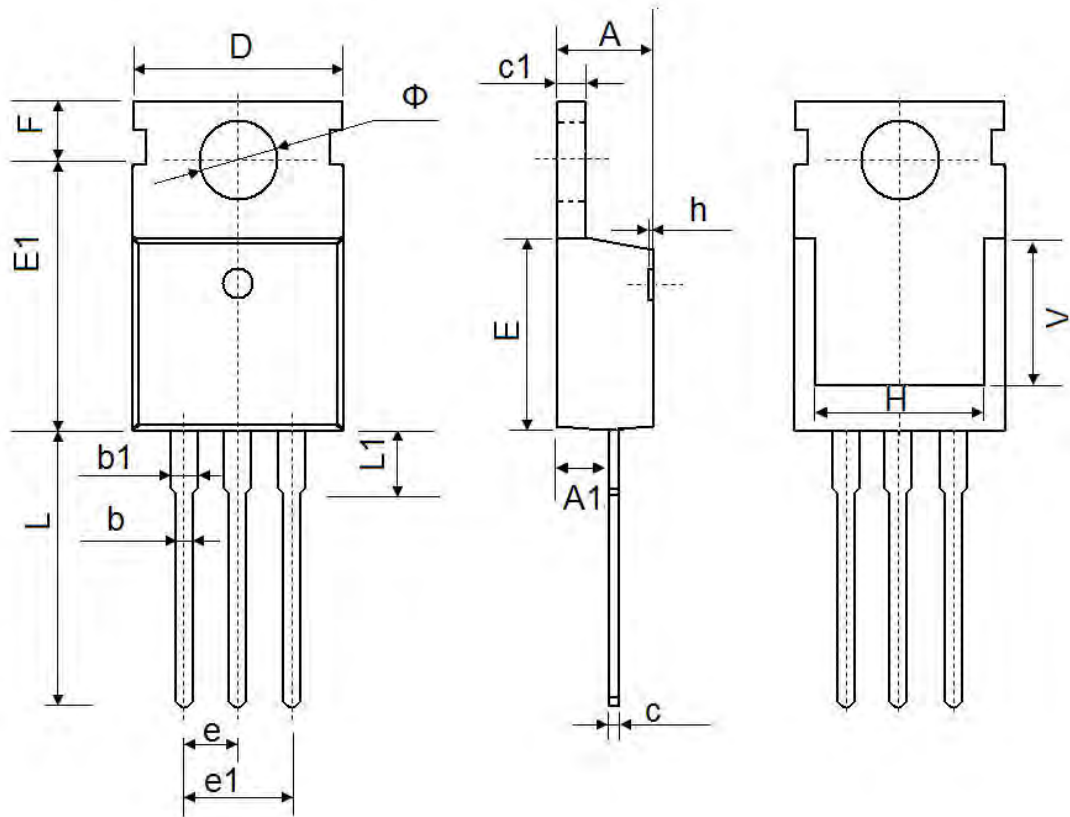
2) Switch Time Test Circuit



3) Unclamped Inductive Switching Test Circuit & Waveforms

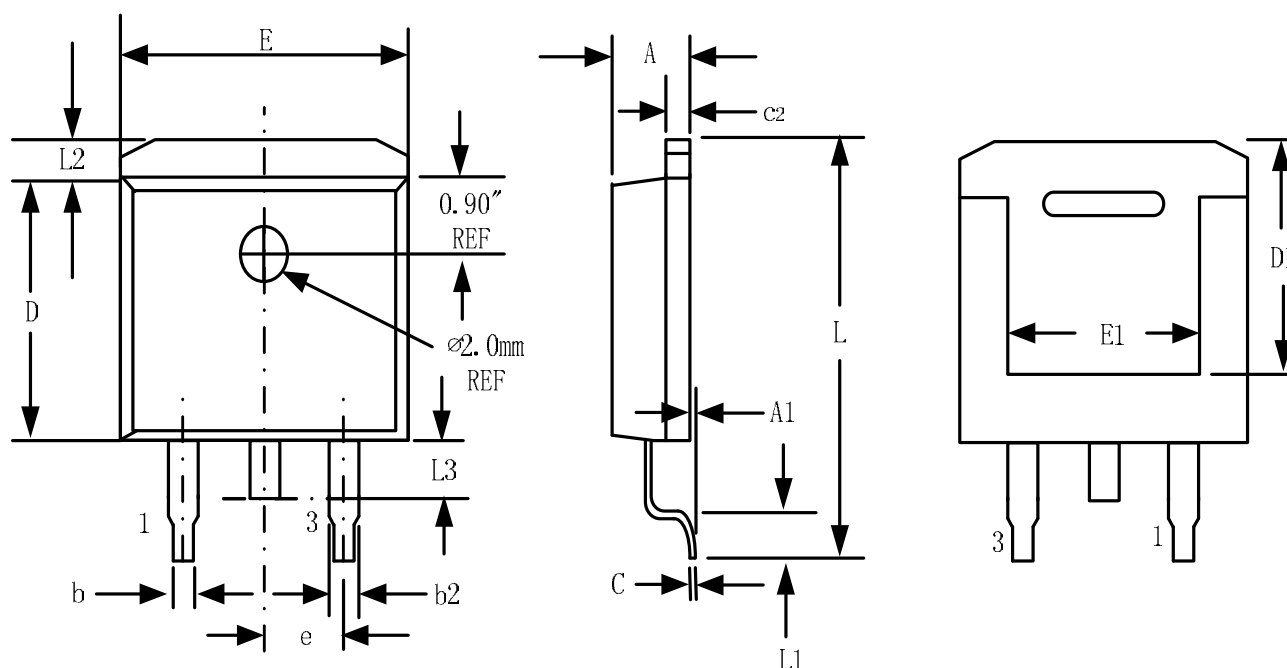


TO-220 Package Information



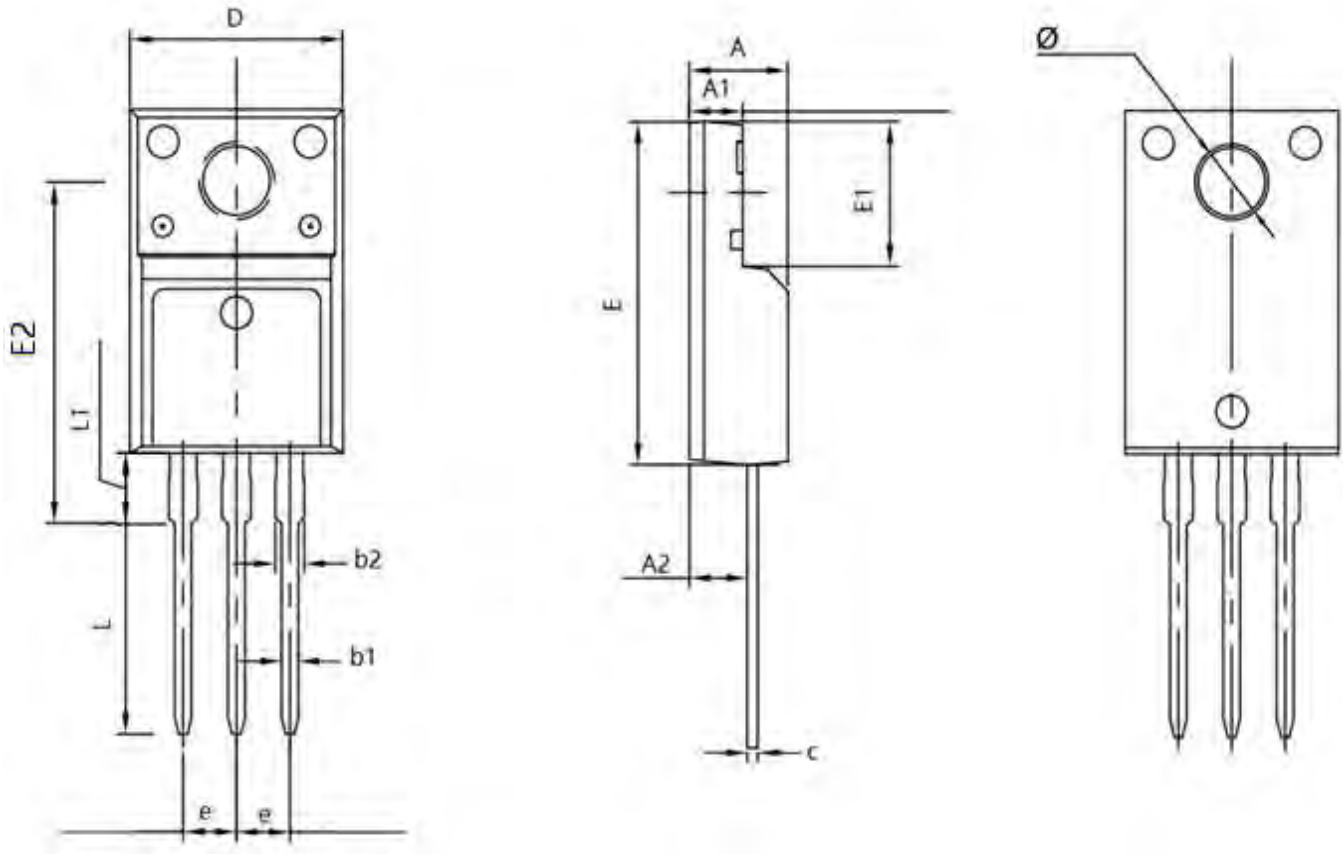
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|--------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 4.400 | 4.600 | 0.173 | 0.181 |
| A1 | 2.250 | 2.550 | 0.089 | 0.100 |
| b | 0.710 | 0.910 | 0.028 | 0.036 |
| b1 | 1.170 | 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-263 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-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 | |
| Ø | 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 |