

N-Channel Super Junction Power MOSFET IV

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.

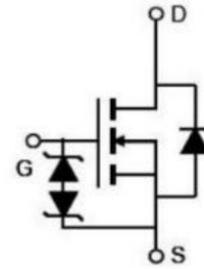
Features

- Optimized body diode reverse recovery performance
- 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)
- LLC Half-bridge

| | | |
|------------------------|-----|------------|
| $V_{DS\ min@T_{jmax}}$ | 710 | V |
| $R_{DS(ON)TYP.}$ | 260 | m Ω |
| I_D | 13 | A |
| Q_g | 15 | nC |



Schematic diagram

Package Marking And Ordering Information

| Device | Device Package | Marking |
|------------|----------------|------------|
| NCE65N290F | TO-220F | NCE65N290F |



TO-220F

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

| Parameter | Symbol | Value | 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 |
| Gate-Source Voltage ($V_{DS}=0V$), DC | V_{GS} | ± 20 | V |
| Continuous Drain Current at $T_c=25^\circ\text{C}$ | $I_{D(DC)}$ | 13 | A |
| Continuous Drain Current at $T_c=100^\circ\text{C}$ | $I_{D(DC)}$ | 9.1 | A |
| Pulsed drain current (Note 1) | $I_{DM (pluse)}$ | 39 | A |
| Maximum Power Dissipation($T_c=25^\circ\text{C}$) | P_D | 32.9 | W |
| Derate above 25°C | | 0.22 | W/ $^\circ\text{C}$ |
| Single pulse avalanche current (Note 2) | I_{AS} | 3 | A |
| Reverse diode dv/dt , $V_{DS} \leq 480\text{ V}, I_{SD} < I_D$ | dv/dt | 15 | V/ns |
| Drain Source voltage slope, $V_{DS} \leq 480\text{ V}$ | dv/dt | 50 | V/ns |
| Operating Junction and Storage Temperature Range | T_J, T_{STG} | -55...+175 | $^\circ\text{C}$ |

Table 2. Thermal Characteristic

| Parameter | Symbol | Value | Unit |
|---|------------|-------|-----------------------------|
| Thermal Resistance, Junction-to-Case (Maximum) | R_{thJC} | 4.56 | $^{\circ}\text{C}/\text{W}$ |
| Thermal Resistance, Junction-to-Ambient (Maximum) | R_{thJA} | 62 | $^{\circ}\text{C}/\text{W}$ |

Table 3. Electrical Characteristics ($T_J=25^{\circ}\text{C}$ unless otherwise noted)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|--|--------------|---|-----|------|-----------|---------------|
| On/off states | | | | | | |
| Drain-Source Breakdown Voltage | BV_{DSS} | $V_{GS}=0V, I_D=250\mu\text{A}$ | 650 | | | V |
| Zero Gate Voltage Drain Current($T_c=25^{\circ}\text{C}$) | I_{DSS} | $V_{DS}=650V, V_{GS}=0V$ | | | 1 | μA |
| Zero Gate Voltage Drain Current($T_c=125^{\circ}\text{C}$) | I_{DSS} | $V_{DS}=650V, V_{GS}=0V$ | | | 50 | μA |
| Gate-Body Leakage Current | I_{GSS} | $V_{GS}=\pm 20V, V_{DS}=0V$ | | | ± 200 | nA |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu\text{A}$ | 3 | | 4 | V |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}=10V, I_D=6.5A$ | | 260 | 290 | m Ω |
| Dynamic Characteristics | | | | | | |
| Gate Resistance | R_g | F=1MHZ, D-S short | | 16 | | Ω |
| Input Capacitance | C_{iss} | $V_{DS}=50V, V_{GS}=0V,$ F=1MHz | | 847 | | pF |
| Output Capacitance | C_{oss} | | | 37 | | pF |
| Reverse Transfer Capacitance | C_{riss} | | | 5 | | pF |
| Total Gate Charge | Q_g | $V_{DS}=450V, I_D=6.5A,$ $V_{GS}=10V$ | | 15 | 18 | nC |
| Gate-Source Charge | Q_{gs} | | | 2 | | nC |
| Gate-Drain Charge | Q_{gd} | | | 5 | | nC |
| Gate plateau voltage | V_{gp} | | | 5.3 | | V |
| Switching times | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}=380V, I_D=6.5A,$ $R_G=4\Omega, V_{GS}=10V$ | | 10 | | nS |
| Turn-on Rise Time | t_r | | | 9 | | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 55 | | nS |
| Turn-Off Fall Time | t_f | | | 9 | | nS |
| Source- Drain Diode Characteristics | | | | | | |
| Source-drain current(Body Diode) | I_{SD} | $T_c=25^{\circ}\text{C}$ | | | 13 | A |
| Pulsed-Source-drain current(Body Diode) | I_{SDM} | | | | 39 | A |
| Forward on voltage | V_{SD} | $T_J=25^{\circ}\text{C}, I_{SD}=13A, V_{GS}=0V$ | | 0.9 | 1.1 | V |
| Reverse Recovery Time | t_{rr} | $T_J=25^{\circ}\text{C}, I_F=6.5A,$ $di/dt=100A/\mu\text{s}$ | | 230 | | nS |
| Reverse Recovery Charge | Q_{rr} | | | 1.84 | | μC |
| Peak reverse recovery current | I_{rrm} | | | 16 | | A |

Notes: 1. Repetitive Rating: Pulse width limited by maximum junction temperature
 2. $T_J=25^{\circ}\text{C}, V_{DD}=50V, V_G=10V, R_G=25\Omega$

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

Figure1. Safe operating area

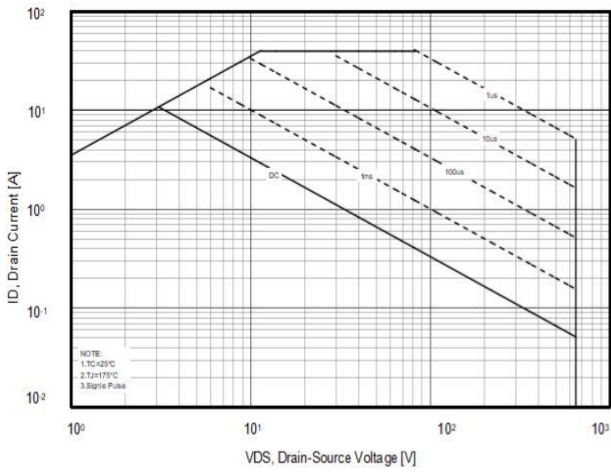


Figure2. Source-Drain Diode Forward Voltage

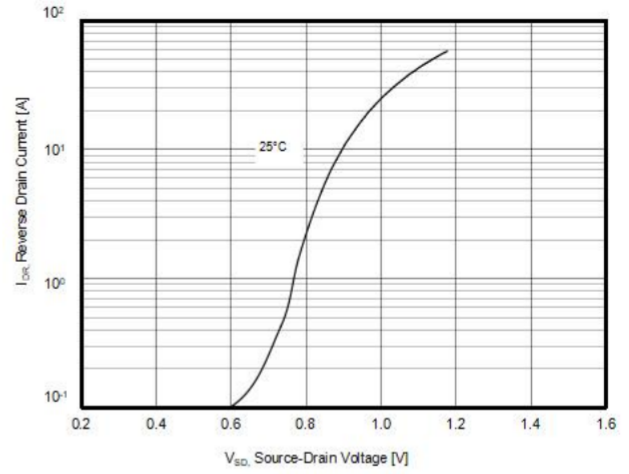


Figure3. Transfer characteristics

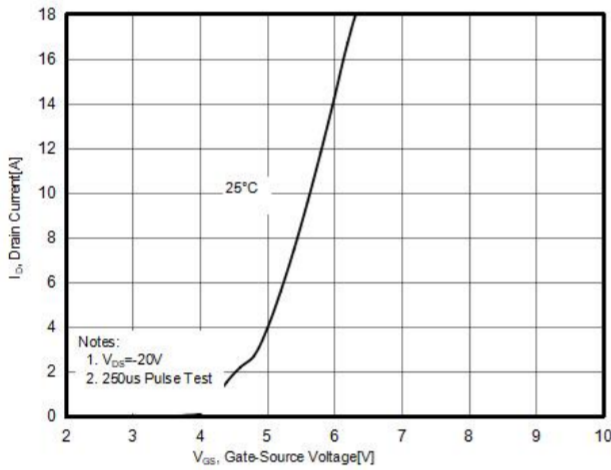


Figure4. Output characteristics

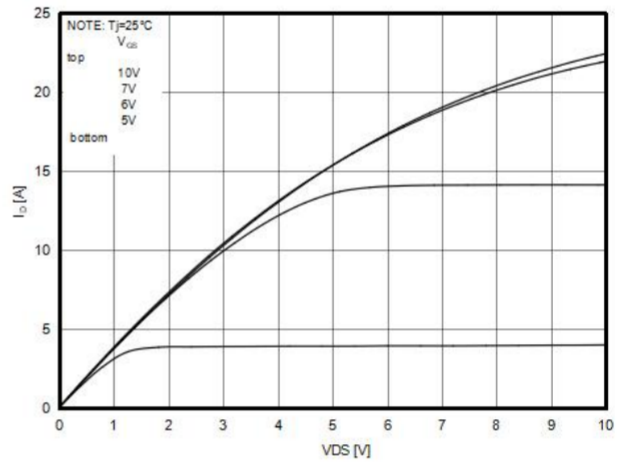


Figure5. Static drain-source on resistance

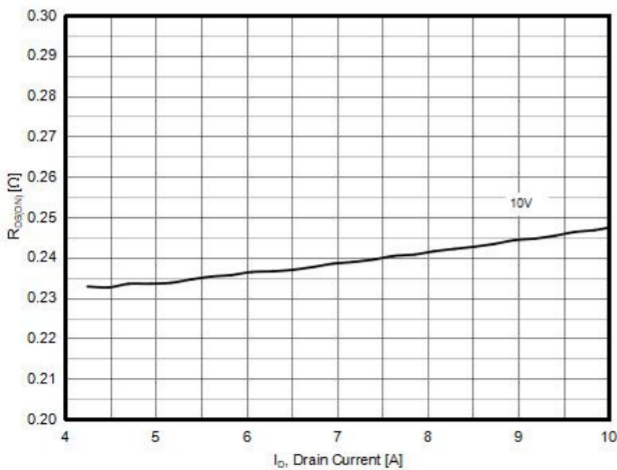


Figure6. R_DS(ON) vs Junction Temperature

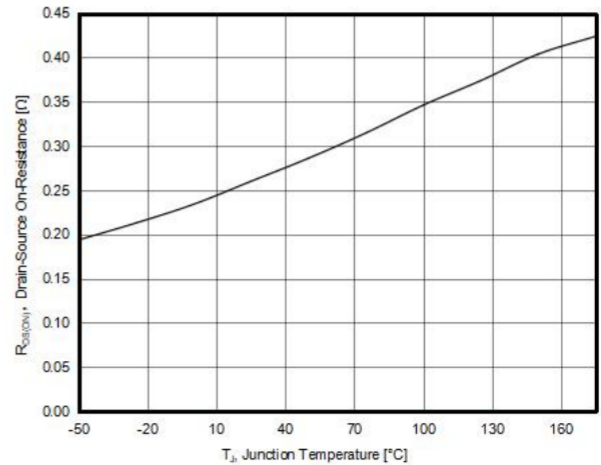


Figure7. BV_{DSS} vs Junction Temperature

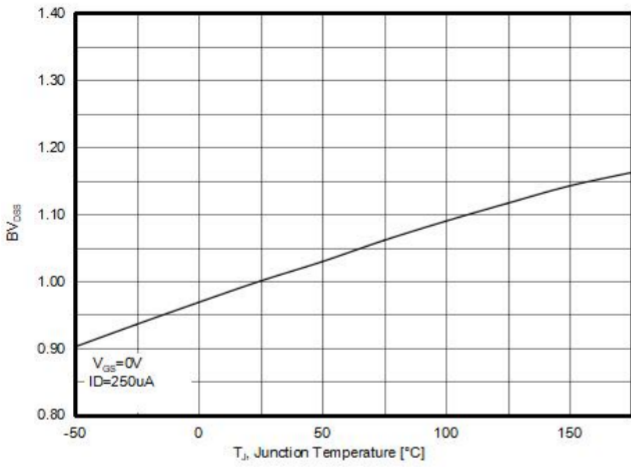


Figure8. Maximum I_D vs Junction Temperature

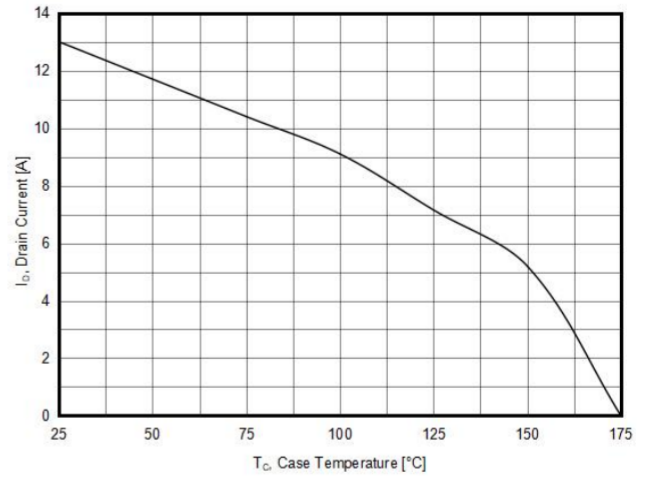


Figure9. Gate charge waveforms

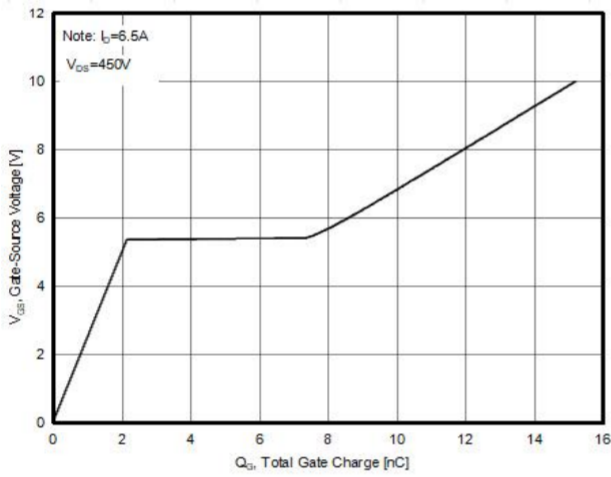
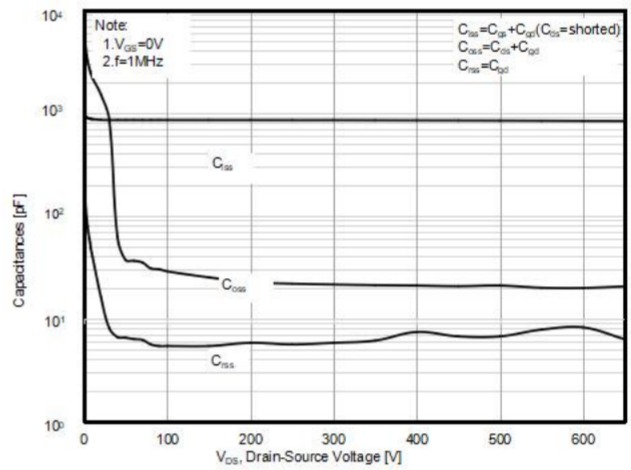
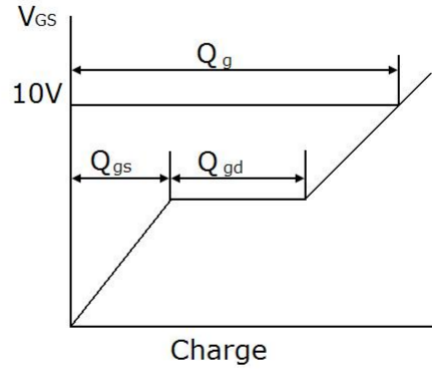
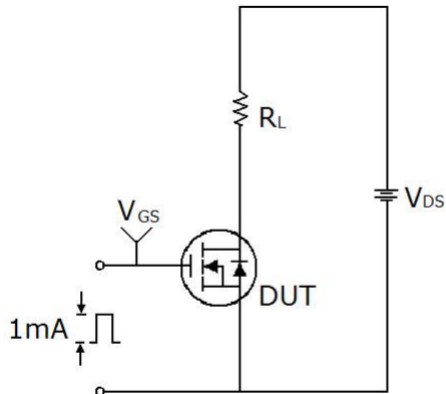


Figure10. Capacitance

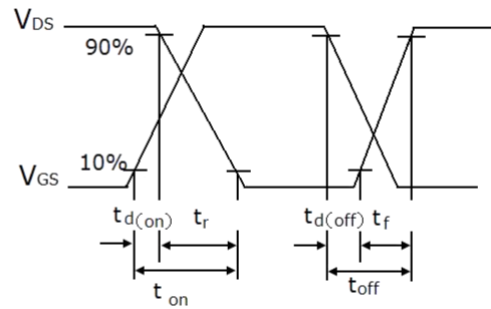
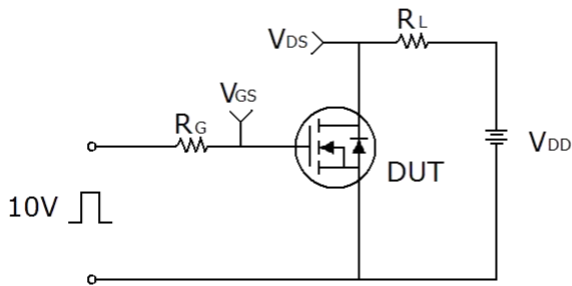


Test circuit

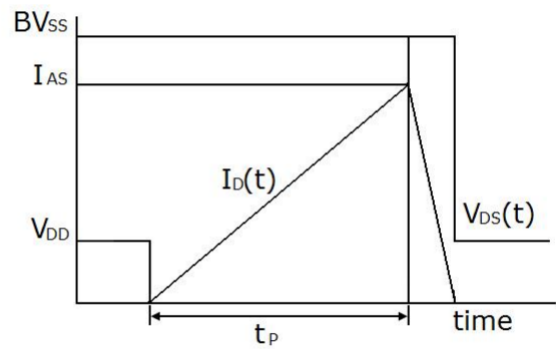
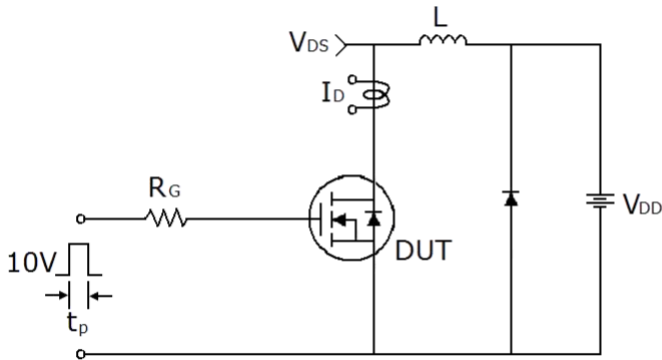
1) Gate charge test circuit & Waveform



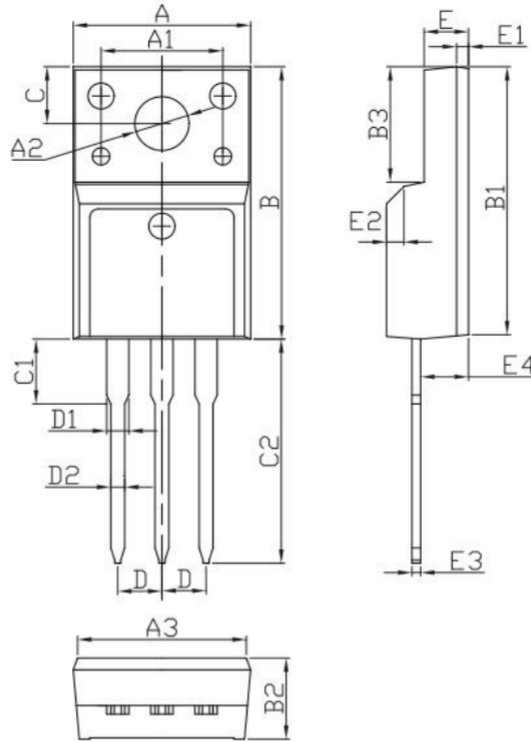
2) Switch Time Test Circuit:



3) Unclamped Inductive Switching Test Circuit & Waveforms

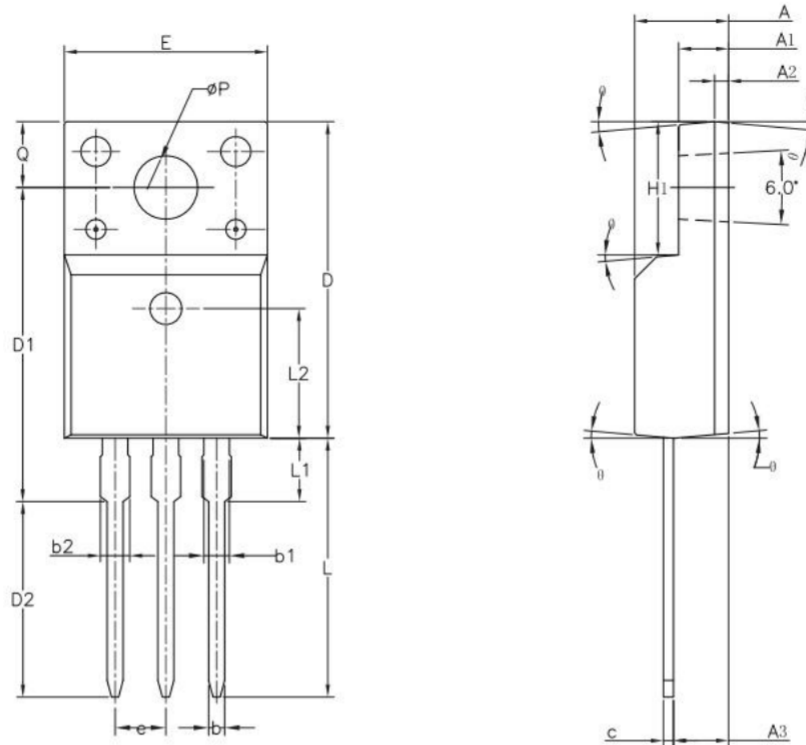


TO-220F-3L-L Package Information



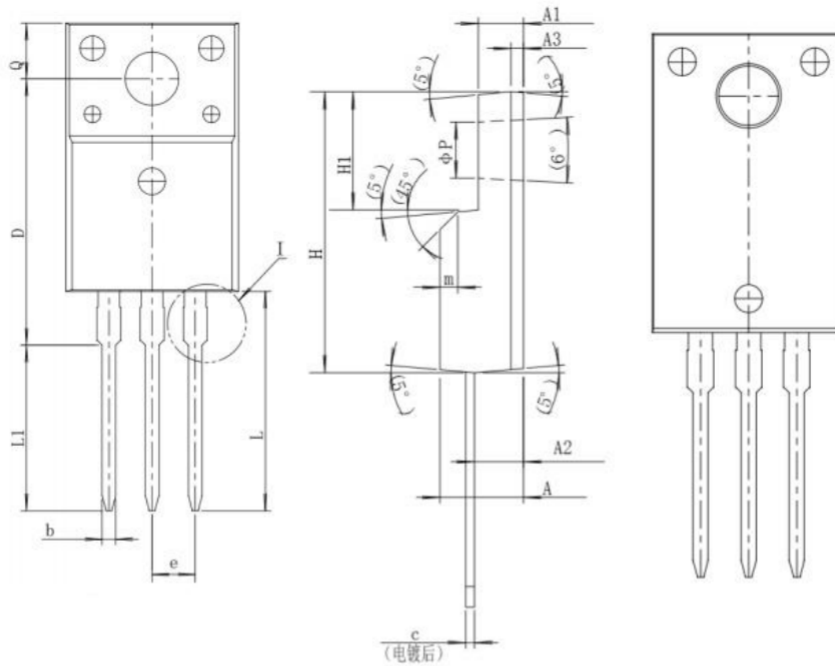
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 9.96 | 10.36 | 0.391 | 0.407 |
| A1 | 6.85 | 7.15 | 0.269 | 0.281 |
| A2 | 2.97 | 3.27 | 0.117 | 0.128 |
| A3 | 9.50 | 9.90 | 0.373 | 0.389 |
| B | 15.70 | 16.10 | 0.617 | 0.633 |
| B1 | 15.40 | 15.80 | 0.605 | 0.621 |
| B2 | 4.50 | 4.90 | 0.177 | 0.193 |
| B3 | 6.50 | 6.90 | 0.255 | 0.271 |
| C | 3.10 | 3.50 | 0.122 | 0.138 |
| C1 | 3.05 | 3.45 | 0.120 | 0.136 |
| C2 | 12.80 | 13.20 | 0.503 | 0.519 |
| D | 2.54 BSC | | 0.100 BSC | |
| D1 | 1.13 | 1.43 | 0.044 | 0.056 |
| D2 | 0.65 | 0.95 | 0.026 | 0.037 |
| E | 2.35 | 2.75 | 0.092 | 0.108 |
| E1 | 0.55 | 0.85 | 0.022 | 0.033 |
| E2 | 45.0° | | 45.00° | |
| E3 | 0.35 | 0.65 | 0.014 | 0.026 |
| E4 | 2.55 | 2.95 | 0.100 | 0.116 |

TO-220F-3L-P Package Information



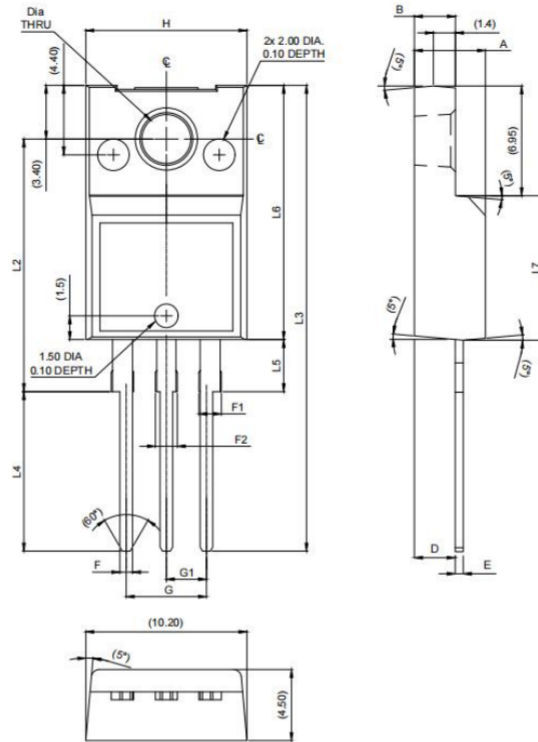
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 4.50 | 4.83 | 0.177 | 0.190 |
| A1 | 2.34 | 2.74 | 0.092 | 0.108 |
| A2 | 0.70 REF | | 0.028 REF | |
| A3 | 2.56 | 2.93 | 0.101 | 0.115 |
| b | 0.70 | 0.90 | 0.028 | 0.035 |
| b1 | 1.18 | 1.38 | 0.046 | 0.054 |
| b2 | -- | 1.47 | -- | 0.058 |
| c | 0.45 | 0.60 | 0.018 | 0.024 |
| D | 15.67 | 16.07 | 0.616 | 0.631 |
| D1 | 15.55 | 15.95 | 0.611 | 0.627 |
| D2 | 9.60 | 10.00 | 0.377 | 0.393 |
| E | 9.96 | 10.36 | 0.391 | 0.407 |
| e | 2.54 BSC | | 0.100 BSC | |
| H1 | 6.48 | 6.88 | 0.255 | 0.270 |
| L | 12.68 | 13.28 | 0.498 | 0.522 |
| L1 | -- | 3.50 | -- | 0.138 |
| L2 | 6.50 REF | | 0.255 REF | |
| ∅ P | 3.08 | 3.28 | 0.121 | 0.129 |
| Q | 3.20 | 3.40 | 0.126 | 0.134 |

TO-220F-3L-M Package Information



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|----------|---------------------------|-------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 4.60 | 4.80 | 0.181 | 0.189 |
| A1 | 2.44 | 2.64 | 0.096 | 0.104 |
| A2 | 2.65 | 2.85 | 0.104 | 0.112 |
| A3 | 0.70 REF | | 0.028 REF | |
| b | 0.70 | 0.90 | 0.028 | 0.035 |
| b2 | 1.18 | 1.39 | 0.046 | 0.055 |
| b1 | 1.28 | 1.47 | -- | 0.058 |
| c | 0.45 | 0.60 | 0.018 | 0.024 |
| D | 15.64 | 15.85 | 0.614 | 0.623 |
| E | 10.06 | 10.26 | 0.395 | 0.403 |
| e | 2.54 BSC | | 0.100 BSC | |
| H | 15.77 | 15.97 | 0.620 | 0.627 |
| H1 | 6.58 | 6.78 | 0.259 | 0.266 |
| L | 12.68 | 13.28 | 0.498 | 0.522 |
| L1 | 9.60 | 10.00 | 0.377 | 0.393 |
| ϕP | 3.08 | 3.28 | 0.121 | 0.129 |
| Q | 3.20 | 3.40 | 0.126 | 0.134 |

TO-220F-3L-B Package Information



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 4.40 | 4.60 | 0.173 | 0.181 |
| B | 2.50 | 2.70 | 0.098 | 0.106 |
| D | 2.50 | 2.75 | 0.098 | 0.108 |
| E | 0.45 | 0.70 | 0.018 | 0.028 |
| F | 0.75 | 1.00 | 0.029 | 0.039 |
| F1 | 1.15 | 1.50 | 0.045 | 0.059 |
| F2 | 1.15 | 1.50 | 0.045 | 0.059 |
| G | 4.95 | 5.20 | 0.19 | 0.20 |
| G1 | 2.40 | 2.70 | 0.09 | 0.11 |
| H | 10.00 | 10.40 | 0.39 | 0.41 |
| L2 | 16.00 | | 0.63 | |
| L3 | 28.60 | 30.60 | 1.12 | 1.20 |
| L4 | 9.80 | 10.60 | 0.39 | 0.42 |
| L5 | 2.90 | 3.60 | 0.11 | 0.14 |
| L6 | 15.90 | 16.40 | 0.62 | 0.64 |
| L7 | 9.00 | 9.30 | 0.35 | 0.37 |
| Dia | 3.00 | 3.20 | 0.12 | 0.13 |

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