# N-Channel Super Junction Power MOSFET Ⅳ

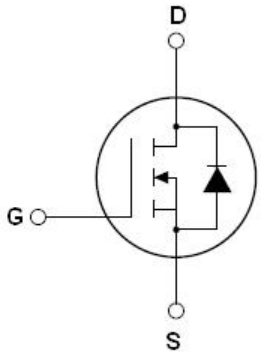
## General Description

The series of devices use advanced trench gate super junction technology and design to provide ultra-low $R_{DS(ON)}$ and low gate charge and With a rapid recovery body diode.This super junction MOSFET fits the industry's AC-DC SMPS requirements for PFC, AC/DC power conversion, industrial power applications,Fast charger, new energy vehicle charging pile, on-board OBC etc.

| | | |
|---|---|---|
| $V_{DS\ min@Tjmax}$ | 650 | V |
| $R_{DS(ON)TYP}$ | 95 | mΩ |
| ID | 29 | A |
| Qg | 41 | nC |

## Features

- ●New technology for high voltage device
- ●Ultra low on-resistance and ultra low conduction losses
- ●Ultra Low Gate Charge cause lower driving requirements
- ●Diode reverse recovery speed is super fast
- ●High reliability
- ●ROHS compliant&Halogen Free




**Schematic diagram**

## Application

- Power factor correction（PFC）
- Switched mode power supplies(SMPS)
- Uninterruptible Power Supply（UPS）
- On-board charger(OBC)

✧ **Intrinsic fast-recovery body diode**

## Package Marking And Ordering Information

| Device | Device Package | Marking |
|---|---|---|
| NCE60NF110 | TO-220-3L | NCE60NF110 |




TO-220

## Table 1. Absolute Maximum Ratings ($T_J$=25℃)

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Drain-Source Voltage ($V_{GS}$=0V） | $V_{DS}$ | 600 | V |
| Gate-Source Voltage ($V_{DS}$=0V) AC (f>1 Hz) | $V_{GS}$ | ±30 | V |
| Gate-Source Voltage ($V_{DS}$=0V) DC | $V_{GS}$ | ±20 | V |
| Continuous Drain Current at Tc=25°C | $I_{D\ (DC)}$ | 29 | A |
| Continuous Drain Current at Tc=100°C | $I_{D\ (DC)}$ | 20.3 | A |
| Pulsed drain current **(Note 1)** | $I_{DM\ (pluse)}$ | 87 | A |
| Maximum Power Dissipation(Tc=25℃)<br>Derate above 25°C | $P_D$ | 241<br>1.60 | W<br>W/°C |
| Avalanche current**(Note 1)** | $I_{AS}$ | 5 | A |
| Drain Source voltage slope, $V_{DS}$ ≤480 V, | dv/dt | 50 | V/ns |
| Reverse diode dv/dt， $V_{DS}$ ≤480 V,$I_{SD}$<$I_D$ | dv/dt | 50 | V/ns |
| Operating Junction and Storage Temperature Range | $T_J$,$T_{STG}$ | -55...+175 | °C |

* limited by maximum junction temperature

## Table 2. Thermal Characteristic

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Thermal Resistance，Junction-to-Case（Maximum） | $R_{thJC}$ | 0.62 | °C /W |
| Thermal Resistance，Junction-to-Ambient （Maximum） | $R_{thJA}$ | 62 | °C /W |

## Table 3. Electrical Characteristics ($T_J$=25℃unless otherwise noted)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **On/off states** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | $V_{GS}$=0V $I_D$=1mA | 600 | | | V |
| Zero Gate Voltage Drain Current(Tc=25℃) | $I_{DSS}$ | $V_{DS}$=600V,$V_{GS}$=0V | | | 10 | μA |
| Zero Gate Voltage Drain Current(Tc=125℃) | $I_{DSS}$ | $V_{DS}$=600V,$V_{GS}$=0V | | | 400 | μA |
| Gate-Body Leakage Current | $I_{GSS}$ | $V_{GS}$=±20V,$V_{DS}$=0V | | | ±100 | nA |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$,$I_D$=250uA | 3.5 | 4.2 | 5.0 | V |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}$=10V, $I_D$=14A | | 95 | 110 | mΩ |
| **Dynamic Characteristics** | | | | | | |
| Input Capacitance | $C_{lss}$ | $V_{DS}$=50V,$V_{GS}$=0V, F=1.0MHz | | 2099 | | pF |
| Output Capacitance | $C_{oss}$ | | | 83 | | pF |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 6.7 | | pF |
| Total Gate Charge | $Q_g$ | $V_{DS}$=480V,$I_D$=14A, $V_{GS}$=10V | | 41.2 | | nC |
| Gate-Source Charge | $Q_{gs}$ | | | 16.3 | | nC |
| Gate-Drain Charge | $Q_{gd}$ | | | 12.8 | | nC |
| Gate plateau voltage | Vgp | | | 7.0 | | V |
| Intrinsic gate resistance | $R_G$ | f = 1 MHz open drain | | 1.5 | | Ω |
| **Switching times** | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}$=380V,$I_D$=14A, $R_G$=1.7Ω,$V_{GS}$=10V | | 32 | | nS |
| Turn-on Rise Time | $t_r$ | | | 15 | | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 90 | | nS |
| Turn-Off Fall Time | $t_f$ | | | 8 | | nS |
| **Source- Drain Diode Characteristics** | | | | | | |
| Source-drain current(Body Diode) | $I_{SD}$ | $T_C$=25°C | | | 29 | A |
| Pulsed Source-drain current(Body Diode) | $I_{SDM}$ | | | | 87 | A |
| Forward On Voltage | $V_{SD}$ | Tj=25°C,$I_{SD}$=29A,$V_{GS}$=0V | | 1.0 | 1.2 | V |
| Reverse Recovery Time | $t_{rr}$ | Tj=25°C,$I_F$=14A,di/dt=100A/μs | | 115 | | nS |
| Reverse Recovery Charge | $Q_{rr}$ | | | 0.47 | | uC |
| Peak Reverse Recovery Current | $I_{rrm}$ | | | 8 | | A |

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

2. Tj=25℃,VDD=50V,VG=10V, $R_G$=25Ω

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

**Figure1. Safe operating area**

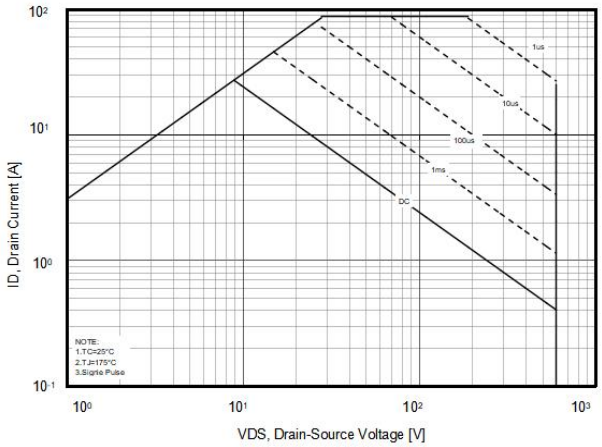



**Figure2. Capacitance**

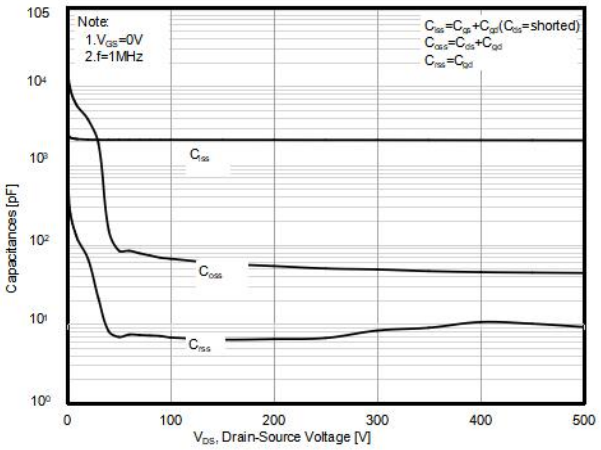



**Figure3. Source-Drain Diode Forward Voltage**

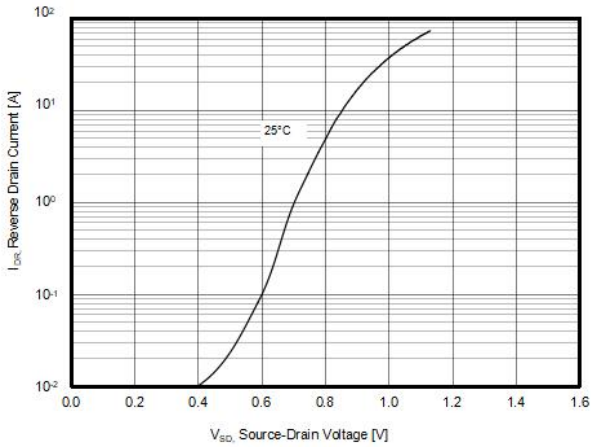



**Figure4. Maximum $I_D$ vs Junction Temperature**

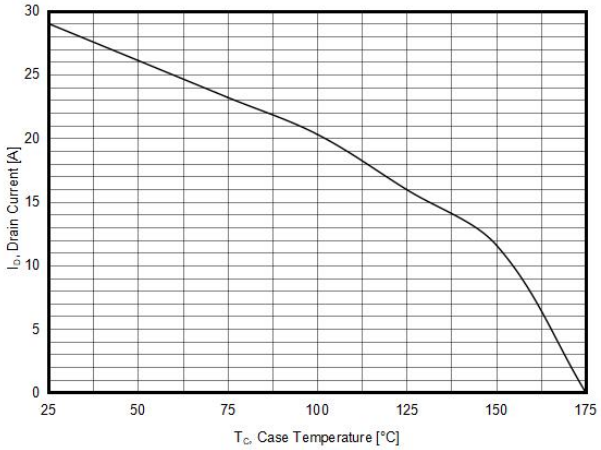



**Figure5. Static drain-source on resistance**

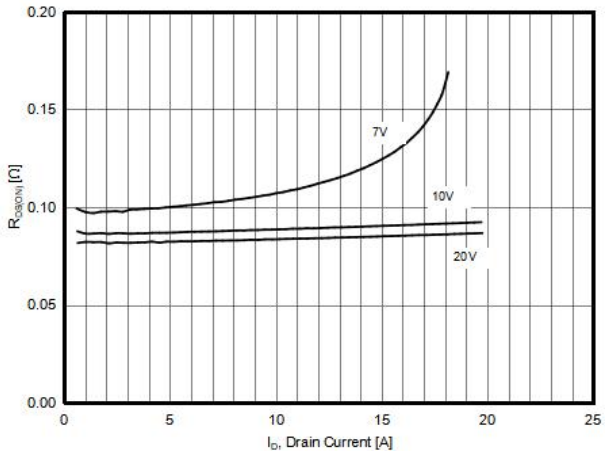



**Figure6. Transfer characteristics**

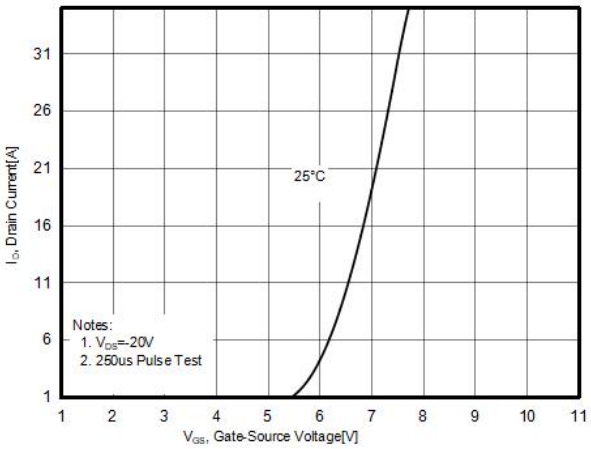


**Figure7. $R_{DS(ON)}$ vs Junction Temperature**

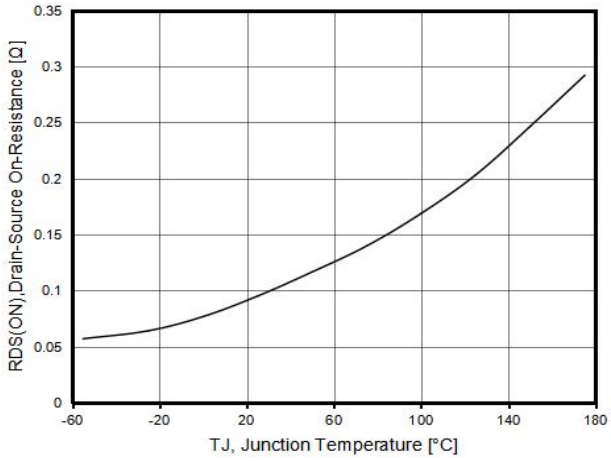



**Figure8. $BV_{DSS}$ vs Junction Temperature**

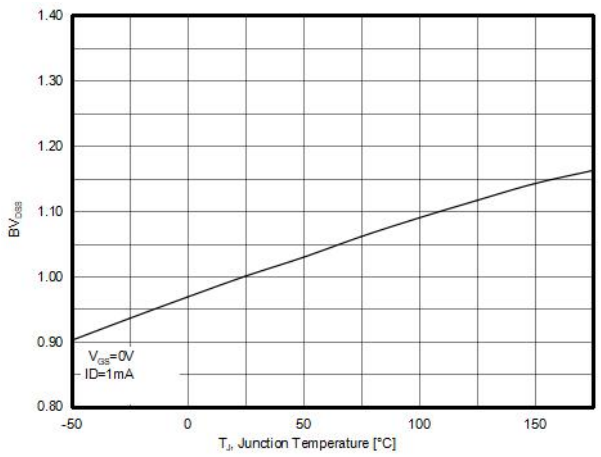



**Figure9. Output characteristics**

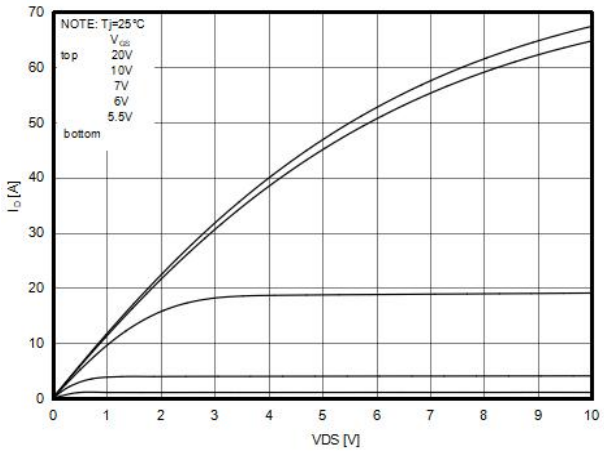
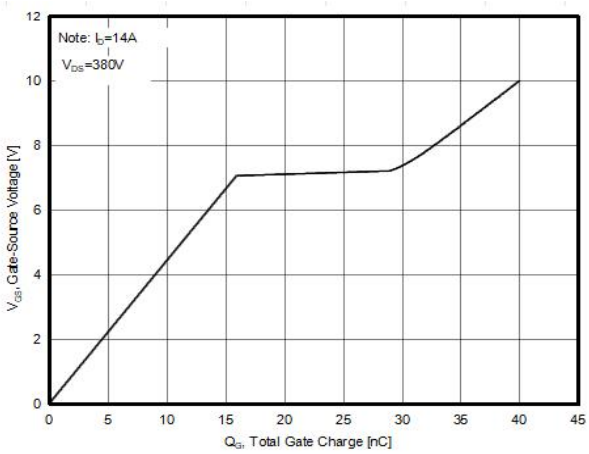
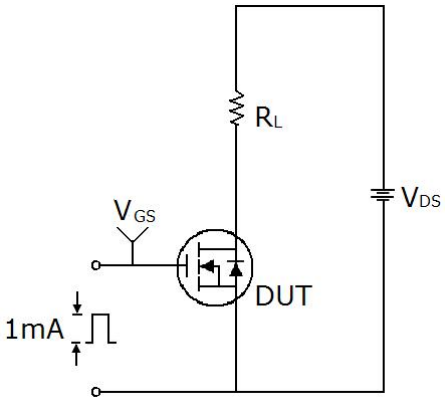


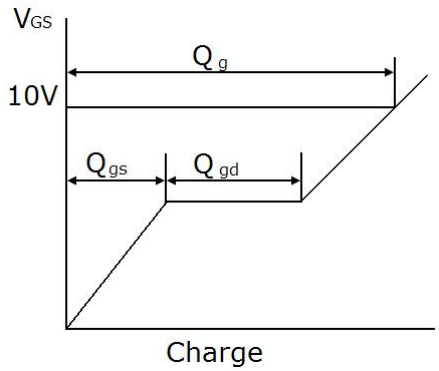

**Figure10. Gate charge waveforms**



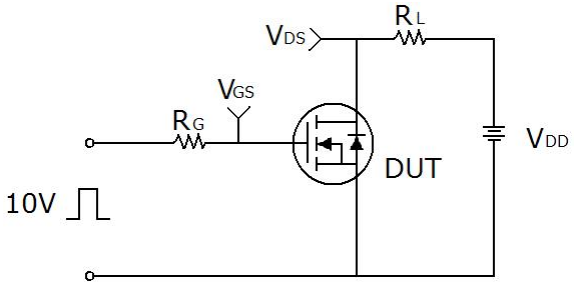
Test circuit

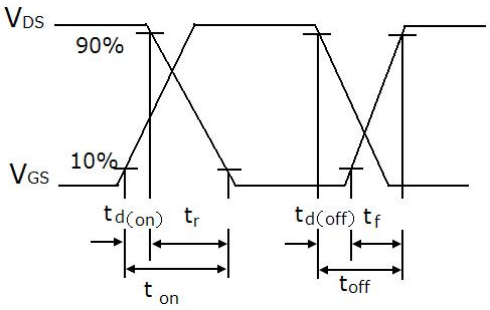
**1）Gate charge test circuit & Waveform**



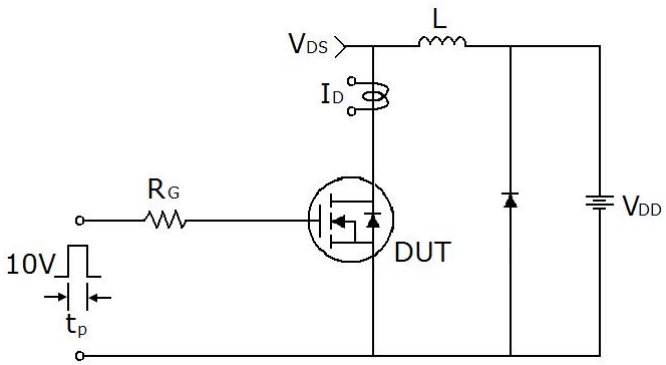



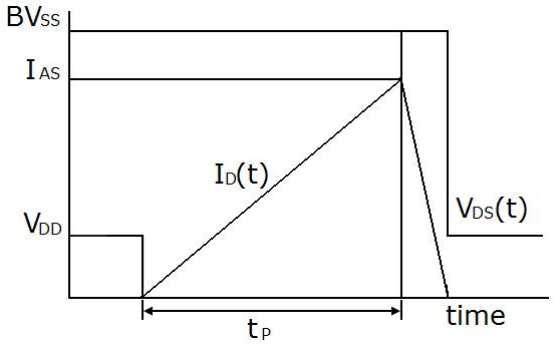

**2）Switch Time Test Circuit：**



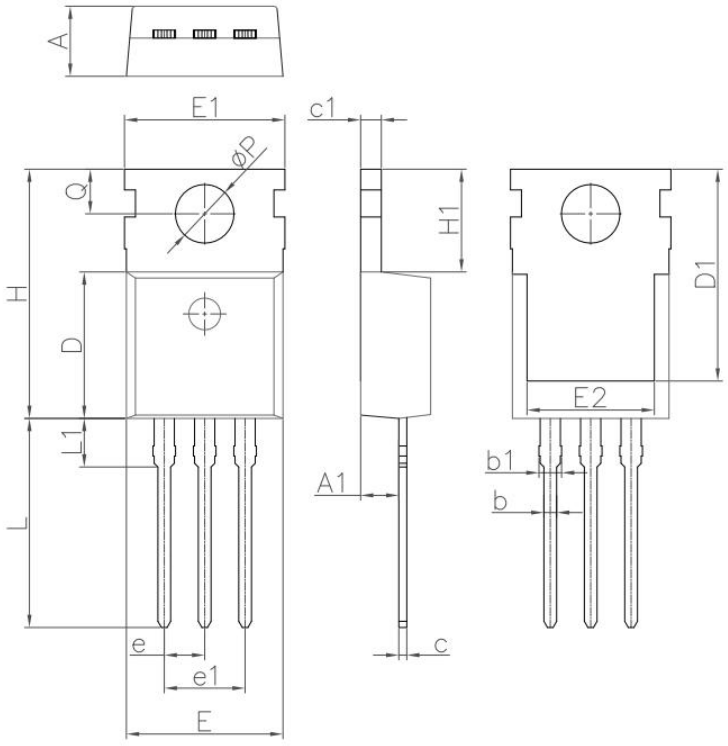




**3）Unclamped Inductive Switching Test Circuit & Waveforms**



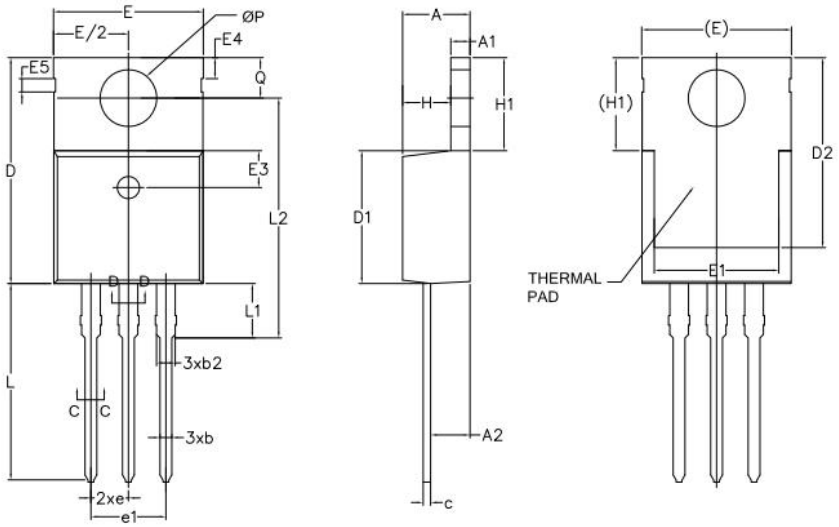



# TO-220-E Package Information




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 4.20 | 4.60 | 0.165 | 0.181 |
| A1 | 2.25 | 2.55 | 0.089 | 0.100 |
| b | 0.70 | 0.90 | 0.028 | 0.035 |
| b1 | 1.17 | 1.37 | 0.046 | 0.054 |
| c | 0.33 | 0.65 | 0.013 | 0.026 |
| c1 | 1.20 | 1.40 | 0.047 | 0.055 |
| D | 8.95 | 9.75 | 3.524 | 3.839 |
| D1 | 13.10 | 13.50 | 5.157 | 5.315 |
| E | 9.74 | 10.04 | 3.835 | 3.953 |
| E1 | 9.91 | 10.25 | 3.902 | 4.035 |
| E2 | 7.90 | 8.10 | 3.110 | 3.189 |
| e | 2.54BSC | | 0.100BSC | |
| e1 | 5.08BSC | | 0.200BSC | |
| H | 15.45 | 15.85 | 6.083 | 6.240 |
| H1 | 6.30 | 6.60 | 2.480 | 2.598 |
| L | 12.90 | 13.40 | 5.079 | 5.276 |
| L1 | 2.85 | 3.25 | 1.122 | 1.280 |
| Q | 2.65 | 2.95 | 1.043 | 1.161 |
| ΦP | 3.40 | 3.80 | 1.339 | 1.496 |

# TO-220-J Package Information




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 4.47 | 4.67 | 0.176 | 0.184 |
| A1 | 1.20 | 1.40 | 0.047 | 0.055 |
| A2 | 2.35 | 2.90 | 0.093 | 0.114 |
| b | 0.71 | 0.91 | 0.028 | 0.036 |
| b1 | 0.71 | 0.86 | 0.028 | 0.034 |
| b2 | 1.22 | 1.36 | 0.048 | 0.054 |
| c | 0.47 | 0.60 | 0.019 | 0.024 |
| c1 | 0.47 | 0.55 | 0.019 | 0.022 |
| D | 14.70 | 15.80 | 0.579 | 0.622 |
| D1 | 8.90 | 9.47 | 0.350 | 0.373 |
| D2 | 11.75 | 13.60 | 0.463 | 0.535 |
| E | 9.70 | 10.37 | 0.382 | 0.408 |
| E1 | 7.00 | 8.89 | 0.276 | 0.350 |
| E2 | 9.80 | 10.20 | 0.386 | 0.402 |
| E3 | 2.40 | 2.60 | 0.094 | 0.102 |
| E4 | 1.27 | 1.57 | 0.050 | 0.062 |
| e | 2.54BSC | | 0.100BSC | |
| e1 | 5.08BSC | | 0.200BSC | |
| H | 3.00 | 3.40 | 0.118 | 0.134 |
| L | 12.90 | 14.80 | 0.508 | 0.583 |
| L1 | 2.54 | 3.84 | 0.100 | 0.151 |
| L2 | 12.13 | 16.50 | 0.478 | 0.650 |
| ΦP | 3.60 | 3.90 | 0.142 | 0.154 |
| Q | 2.65 | 2.95 | 0.104 | 0.116 |

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