

N-Channel Super Junction Power MOSFET III

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.

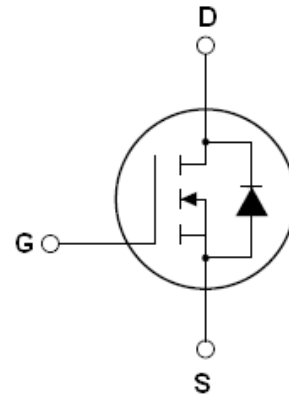
Features

- 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)

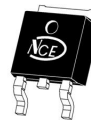
| | | |
|------------------|------|------------|
| V_{DS} | 700 | V |
| $R_{DS(ON)TYP.}$ | 1100 | m Ω |
| I_D | 4 | A |



Schematic diagram

Package Marking And Ordering Information

| Device | Device Package | Marking |
|------------|----------------|------------|
| NCE70T1K2I | TO-251 | NCE70T1K2I |
| NCE70T1K2K | TO-252 | NCE70T1K2K |



TO-252



TO-251

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

| Parameter | Symbol | Value | Unit |
|--|-----------------|----------|---------------------|
| Drain-Source Voltage ($V_{GS}=0V$) | V_{DS} | 700 | V |
| Gate-Source Voltage ($V_{DS}=0V$), AC ($f>1\text{ Hz}$) | V_{GS} | ± 30 | V |
| Continuous Drain Current at $T_c=25^\circ\text{C}$ | $I_{D(DC)}$ | 4 | A |
| Continuous Drain Current at $T_c=100^\circ\text{C}$ | $I_{D(DC)}$ | 2.5 | A |
| Pulsed drain current (Note 1) | $I_{DM(pluse)}$ | 16 | A |
| Maximum Power Dissipation ($T_c=25^\circ\text{C}$) | P_D | 41 | W |
| Derate above 25°C | | 0.328 | W/ $^\circ\text{C}$ |
| Single pulse avalanche energy (Note2) | E_{AS} | 27 | mJ |
| Avalanche current (Note 1) | I_{AR} | 0.7 | A |
| Repetitive Avalanche energy, t_{AR} limited by T_{jmax} (Note 1) | E_{AR} | 0.1 | mJ |

| Parameter | Symbol | Value | Unit |
|---|----------------|------------|------|
| 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 |

Table 2. Thermal Characteristic

| Parameter | Symbol | Value | Unit |
|---|------------|-------|------|
| Thermal Resistance, Junction-to-Case (Maximum) | R_{thJC} | 3.0 | °C/W |
| Thermal Resistance, Junction-to-Ambient (Maximum) | R_{thJA} | 62 | °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} | $V_{GS}=0V, I_D=250\mu A$ | 700 | | | V |
| Zero Gate Voltage Drain Current($T_C=25^\circ C$) | I_{DSS} | $V_{DS}=700V, V_{GS}=0V$ | | | 1 | μA |
| Zero Gate Voltage Drain Current($T_C=125^\circ C$) | I_{DSS} | $V_{DS}=700V, V_{GS}=0V$ | | | 50 | 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 | | 4 | V |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}=10V, I_D=2A$ | | 1100 | 1300 | m Ω |
| Dynamic Characteristics | | | | | | |
| Input Capacitance | C_{iss} | $V_{DS}=50V, V_{GS}=0V,$ $F=1.0MHz$ | | 304 | | PF |
| Output Capacitance | C_{oss} | | | 17 | | PF |
| Reverse Transfer Capacitance | C_{rss} | | | 0.5 | | PF |
| Total Gate Charge | Q_g | $V_{DS}=480V, I_D=4A,$ $V_{GS}=10V$ | | 8.8 | 12 | nC |
| Gate-Source Charge | Q_{gs} | | | 2.3 | | nC |
| Gate-Drain Charge | Q_{gd} | | | 4 | | nC |
| Switching times | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}=380V, I_D=2.5A,$ $R_G=5\Omega, V_{GS}=10V$ | | 8 | | nS |
| Turn-on Rise Time | t_r | | | 4 | | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 52 | 70 | nS |
| Turn-Off Fall Time | t_f | | | 9 | 18 | nS |
| Source- Drain Diode Characteristics | | | | | | |
| Source-drain current(Body Diode) | I_{SD} | $T_C=25^\circ C$ | | | 4 | A |
| Pulsed Source-drain current(Body Diode) | I_{SDM} | | | | 16 | A |
| Forward On Voltage | V_{SD} | $T_J=25^\circ C, I_{SD}=4A, V_{GS}=0V$ | | 0.9 | 1.2 | V |
| Reverse Recovery Time | t_{rr} | $T_J=25^\circ C, I_F=2A, di/dt=100A/\mu s$ | | 200 | | nS |
| Reverse Recovery Charge | Q_{rr} | | | 0.6 | | μC |
| Peak reverse recovery current | I_{rrm} | | | 6 | | 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

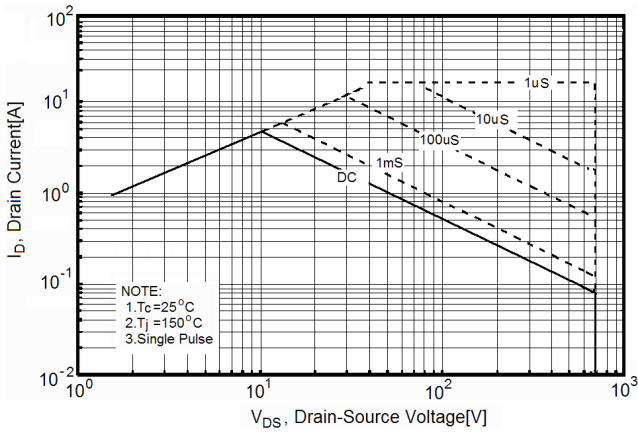


Figure2. Source-Drain Diode Forward Voltage

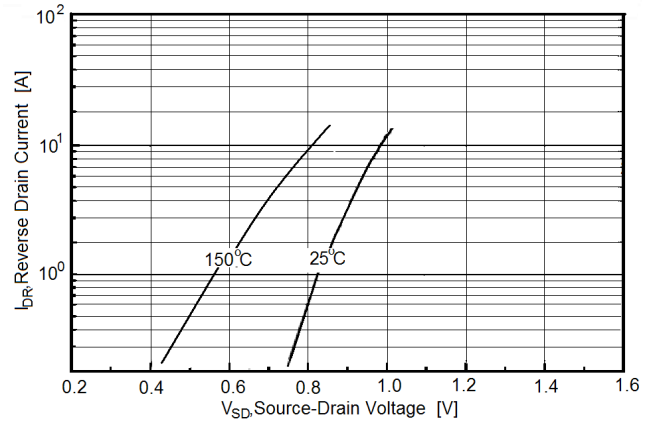


Figure3. Output characteristics

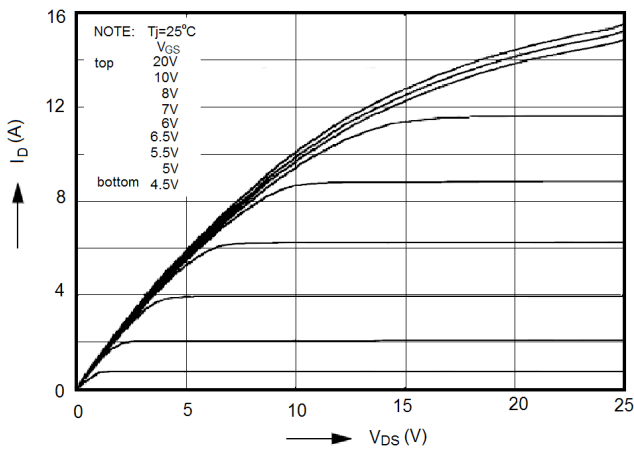


Figure4. Transfer characteristics

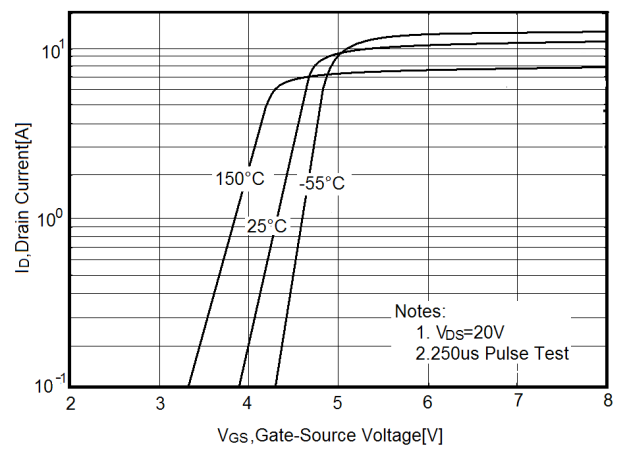


Figure5. Static drain-source on resistance

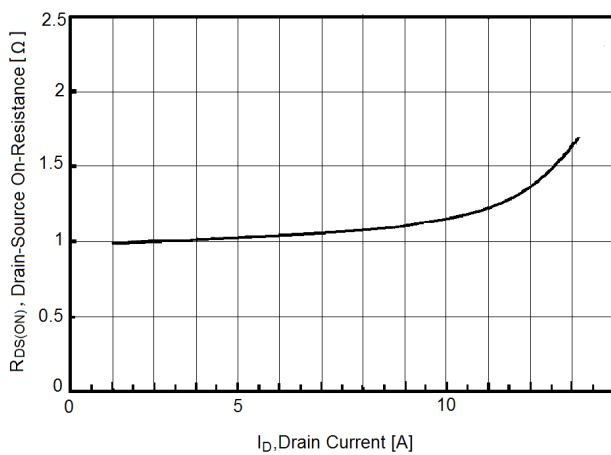


Figure6. $R_{DS(ON)}$ vs Junction Temperature

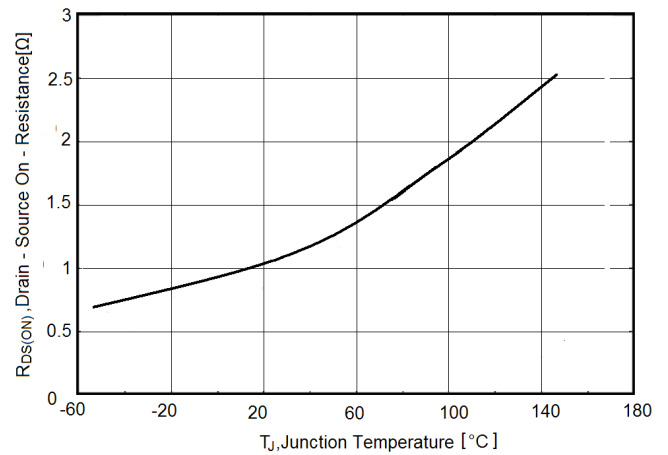


Figure7. BV_{DSS} vs Junction Temperature

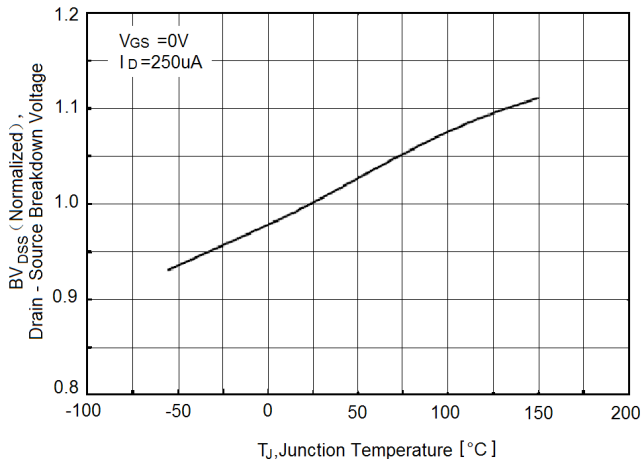


Figure8. Maximum I_D vs Junction Temperature

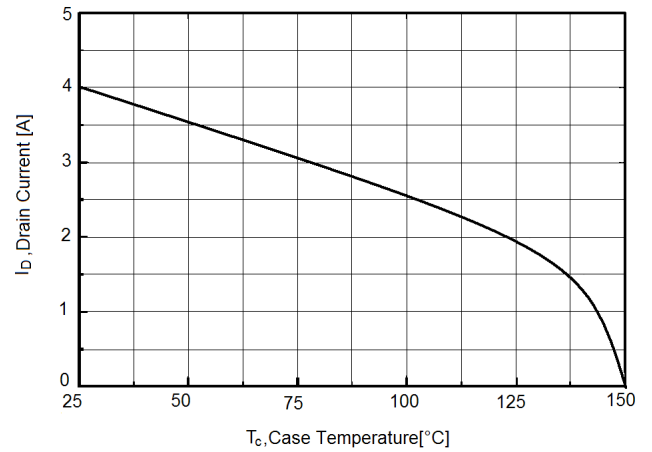


Figure9. Gate charge waveforms

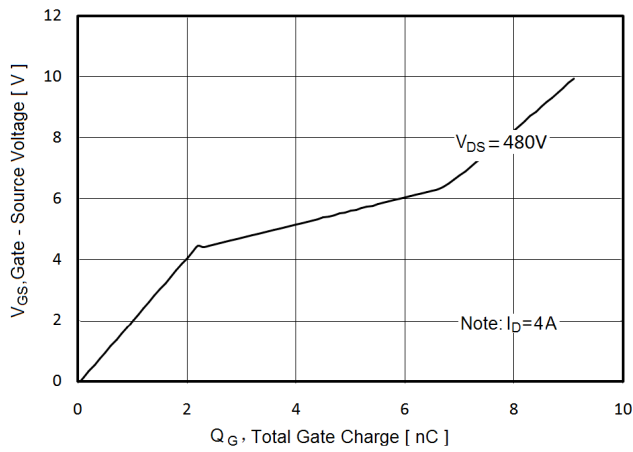


Figure10. Capacitance

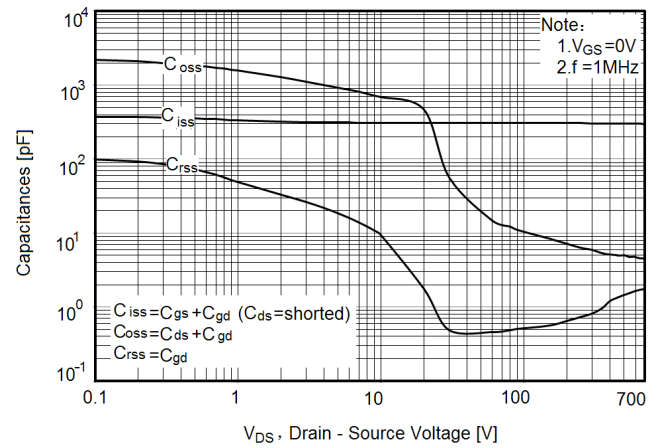
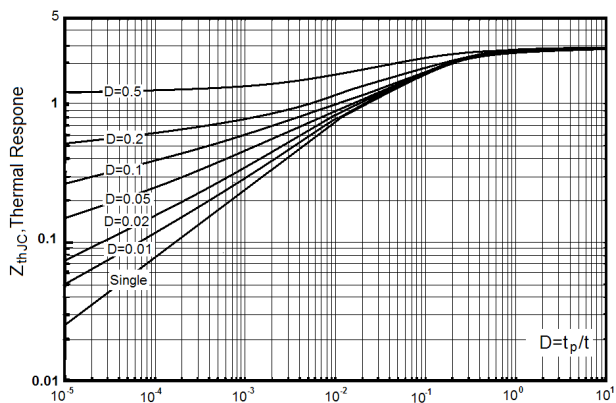
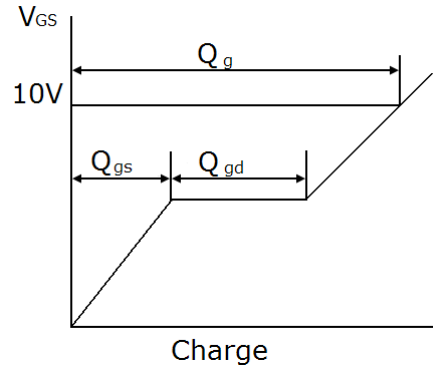
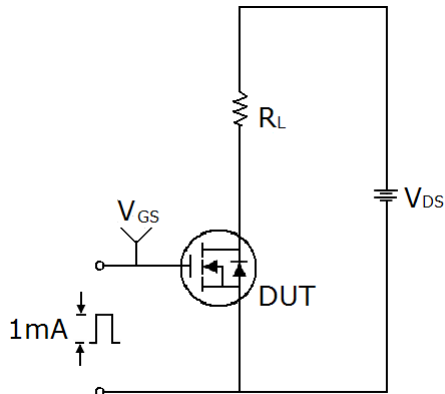


Figure11. Transient Thermal Impedance

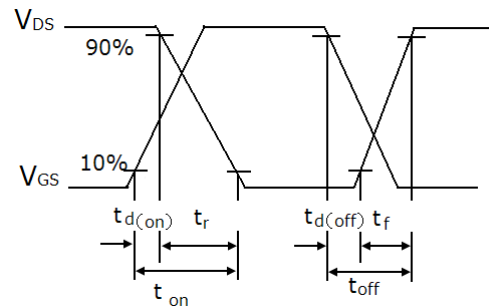
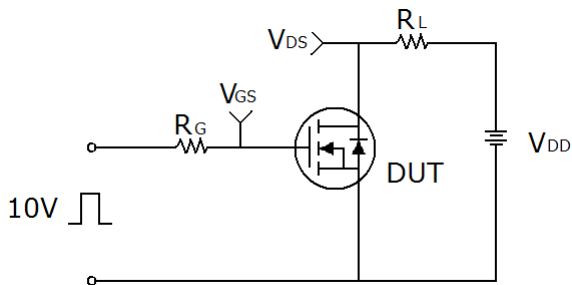


Test circuit

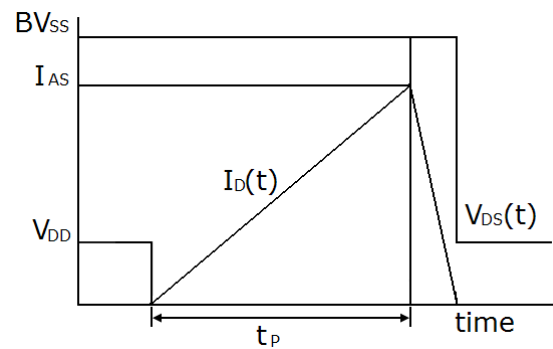
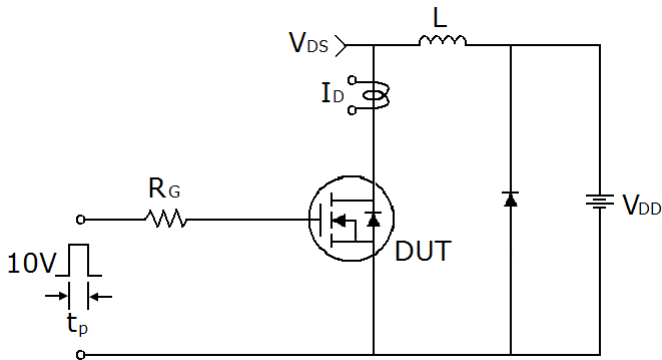
1) Gate charge test circuit & Waveform



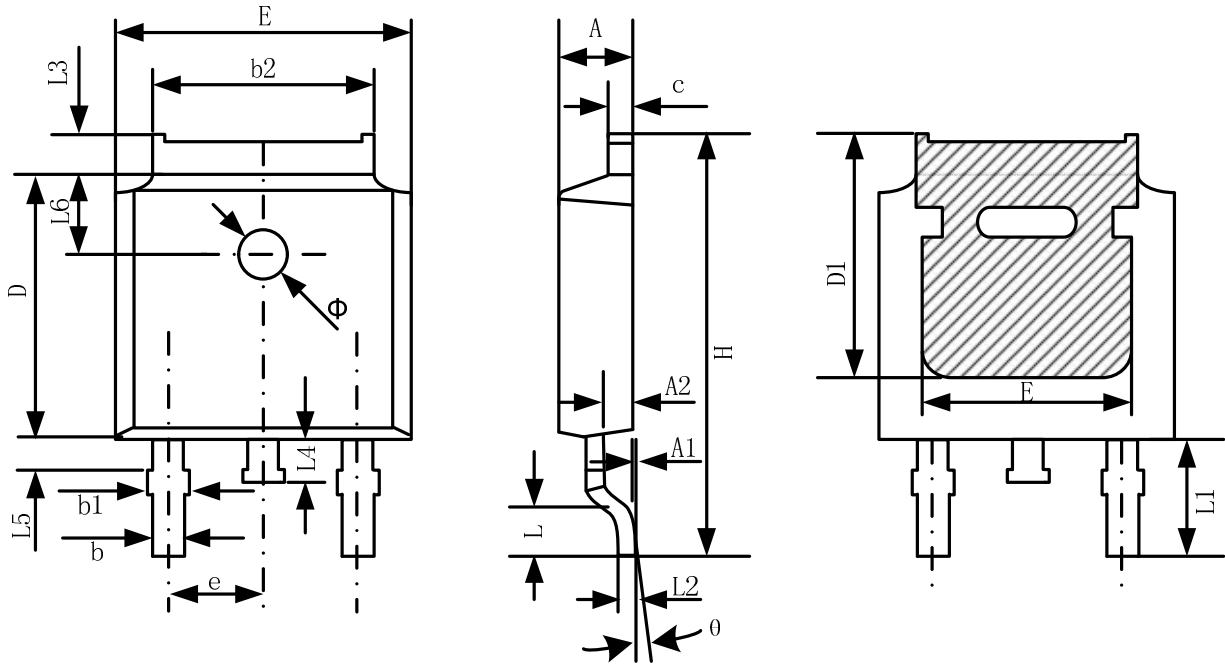
2) Switch Time Test Circuit:



3) Unclamped Inductive Switching Test Circuit & Waveforms

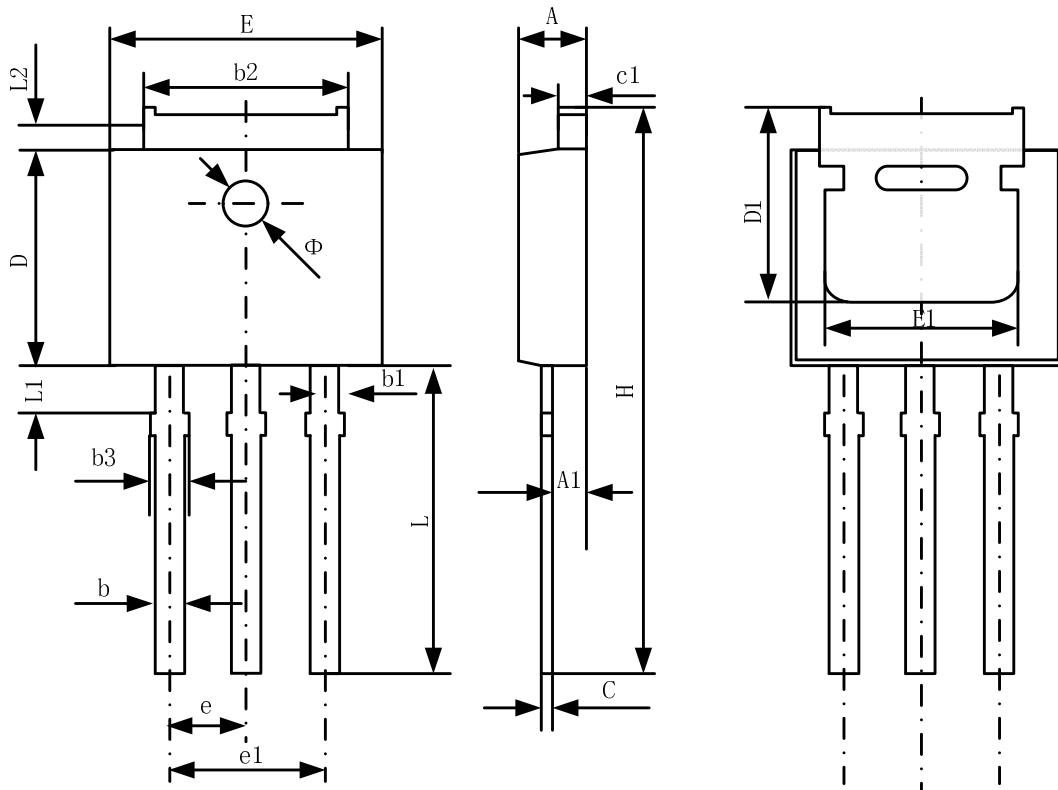


TO-252-2 Package Information



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 2.20 | 2.38 | 0.087 | 0.094 |
| A1 | 0.00 | 0.10 | 0.000 | 0.004 |
| A2 | 0.90 | 1.10 | 0.035 | 0.043 |
| b | 0.72 | 0.85 | 0.028 | 0.033 |
| b1 | 0.72 | 0.90 | 0.028 | 0.035 |
| b2 | 5.13 | 5.46 | 0.202 | 0.215 |
| c | 0.47 | 0.60 | 0.019 | 0.024 |
| D | 6.00 | 6.20 | 0.236 | 0.244 |
| D1 | 5.25 | -- | 0.207 | -- |
| E | 6.50 | 6.70 | 0.256 | 0.264 |
| E1 | 4.70 | -- | 0.185 | -- |
| e | 2.19 | 2.39 | 0.086 | 0.094 |
| H | 9.80 | 10.40 | 0.386 | 0.409 |
| L | 1.40 | 1.70 | 0.055 | 0.067 |
| L1 | 2.90 REF | | 0.114 REF | |
| L2 | 0.508 BSC | | 0.020 BSC | |
| L3 | 0.90 | 1.25 | 0.035 | 0.049 |
| L4 | 0.60 | 1.00 | 0.024 | 0.039 |
| L5 | 0.15 | 0.75 | 0.006 | 0.030 |
| L6 | 1.80 REF | | 0.071 REF | |
| Φ | 1.20 | 1.40 | 0.047 | 0.055 |
| θ | 0° | 8° | 0° | 8° |

TO-251 Package Information



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 2.20 | 2.35 | 0.087 | 0.093 |
| A1 | 0.90 | 1.10 | 0.035 | 0.043 |
| b | 0.56 | 0.69 | 0.022 | 0.027 |
| b1 | 0.77 | 0.90 | 0.030 | 0.035 |
| b2 | 5.23 | 5.43 | 0.206 | 0.214 |
| b3 | | 1.05 | 0.000 | 0.041 |
| C | 0.46 | 0.59 | 0.018 | 0.023 |
| c1 | 0.46 | 0.59 | 0.018 | 0.023 |
| D | 6.00 | 6.20 | 0.236 | 0.244 |
| D1 | 5.20 | | 0.205 | |
| E | 6.50 | 6.70 | 0.256 | 0.264 |
| E1 | 4.60 | 5.00 | 0.181 | |
| e | 2.24 | 2.34 | 0.088 | 0.092 |
| e1 | 4.47 | 4.67 | 0.176 | 0.184 |
| H | 16.18 | 16.78 | 0.637 | 0.661 |
| L | 9.00 | 9.60 | 0.354 | 0.378 |
| L1 | 0.95 | 1.35 | 0.037 | 0.053 |
| L2 | 0.90 | 1.25 | 0.035 | 0.049 |

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