

## 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.

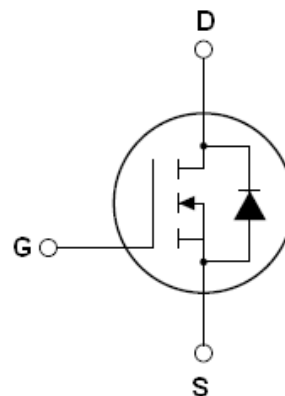
### Features

- 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)

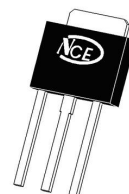
|                 |     |            |
|-----------------|-----|------------|
| $V_{DS}$        | 700 | V          |
| $R_{DS(ON)TYP}$ | 540 | m $\Omega$ |
| $I_D$           | 8   | A          |



Schematic diagram

### Package Marking And Ordering Information

| Device     | Device Package | Marking    |
|------------|----------------|------------|
| NCE70T540I | TO-251         | NCE70T540I |
| NCE70T540K | TO-252         | NCE70T540K |



TO-251



TO-252

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 ( $f>1$ Hz)                  | $V_{GS}$        | $\pm 30$ | V                   |
| Continuous Drain Current at $T_c=25^\circ\text{C}$                   | $I_{D(DC)}$     | 8        | A                   |
| Continuous Drain Current at $T_c=100^\circ\text{C}$                  | $I_{D(DC)}$     | 5.2      | A                   |
| Pulsed drain current (Note 1)  | $I_{DM(pluse)}$ | 32       | A                   |
| Maximum Power Dissipation( $T_c=25^\circ\text{C}$ )                  | $P_D$           | 69       | W                   |
| Derate above $25^\circ\text{C}$                                      |                 | 0.55     | W/ $^\circ\text{C}$ |
| Single pulse avalanche energy (Note2)                                | $E_{AS}$        | 156      | mJ                  |
| Avalanche current (Note 1)   | $I_{AR}$        | 1.7      | A                   |
| Repetitive Avalanche energy, $t_{AR}$ limited by $T_{jmax}$ (Note 1) | $E_{AR}$        | 0.3      | 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)    | $R_{thJC}$ | 1.81  | °C/W |
| Thermal Resistance, Junction-to-Ambient (Maximum) | $R_{thJA}$ | 62    | °C/W |

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

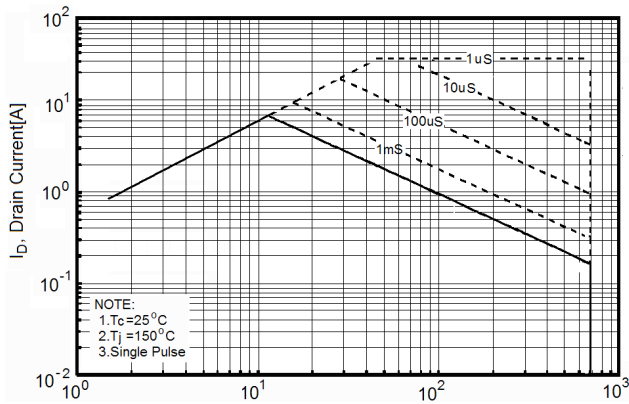
| Parameter  | Symbol       | Condition   | Min | Typ  | Max       | Unit       |
|--|--------------|---|-----|------|-----------|------------|
| <b>On/off states</b>                                 |              |   |     |      |           |            |
| Drain-Source Breakdown Voltage                       | $BV_{DSS}$   | $V_{GS}=0V, I_D=250\mu A$                             | 700 |      |           | V          |
| Zero Gate Voltage Drain Current( $T_C=25^\circ C$ )  | $I_{DSS}$    | $V_{DS}=700V, V_{GS}=0V$                              |     |      | 1         | $\mu A$    |
| Zero Gate Voltage Drain Current( $T_C=125^\circ C$ ) | $I_{DSS}$    | $V_{DS}=700V, V_{GS}=0V$                              |     |      | 100       | $\mu A$    |
| Gate-Body Leakage Current                            | $I_{GSS}$    | $V_{GS}=\pm 20V, V_{DS}=0V$                           |     |      | $\pm 100$ | nA         |
| Gate Threshold Voltage                               | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$                         | 3   |      | 4         | V          |
| Drain-Source On-State Resistance                     | $R_{DS(on)}$ | $V_{GS}=10V, I_D=4A$                                  |     | 540  | 600       | m $\Omega$ |
| <b>Dynamic Characteristics</b>                       |              |   |     |      |           |            |
| Input Capacitance                                    | $C_{iss}$    | $V_{DS}=50V, V_{GS}=0V,$<br>$F=1.0MHz$                |     | 590  |           | pF         |
| Output Capacitance                                   | $C_{oss}$    |   |     | 37   |           | pF         |
| Reverse Transfer Capacitance                         | $C_{rss}$    |   |     | 0.9  |           | pF         |
| Total Gate Charge                                    | $Q_g$        | $V_{DS}=480V, I_D=8A,$<br>$V_{GS}=10V$                |     | 14.6 | 22        | nC         |
| Gate-Source Charge                                   | $Q_{gs}$     |   |     | 4    |           | nC         |
| Gate-Drain Charge                                    | $Q_{gd}$     |   |     | 6.7  |           | nC         |
| <b>Switching times</b>                               |              |   |     |      |           |            |
| Turn-on Delay Time                                   | $t_{d(on)}$  | $V_{DD}=420V, I_D=4A,$<br>$R_G=4.7\Omega, V_{GS}=10V$ |     | 9    |           | nS         |
| Turn-on Rise Time                                    | $t_r$        |   |     | 6.5  |           | nS         |
| Turn-Off Delay Time                                  | $t_{d(off)}$ |   |     | 61   |           | nS         |
| Turn-Off Fall Time                                   | $t_f$        |   |     | 10   |           | nS         |
| <b>Source- Drain Diode Characteristics</b>           |              |   |     |      |           |            |
| Source-drain current(Body Diode)                     | $I_{SD}$     | $T_C=25^\circ C$                                      |     |      | 8         | A          |
| Pulsed Source-drain current(Body Diode)              | $I_{SDM}$    |   |     |      | 32        | A          |
| Forward On Voltage                                   | $V_{SD}$     | $T_J=25^\circ C, I_{SD}=8A, V_{GS}=0V$                |     | 0.9  | 1.2       | V          |
| Reverse Recovery Time                                | $t_{rr}$     | $T_J=25^\circ C, I_F=4A, di/dt=100A/\mu s$            |     | 230  |           | nS         |
| Reverse Recovery Charge                              | $Q_{rr}$     |   |     | 1.2  |           | $\mu C$    |
| Peak Reverse Recovery Current                        | $I_{rrm}$    |   |     | 10.5 |           | A          |

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

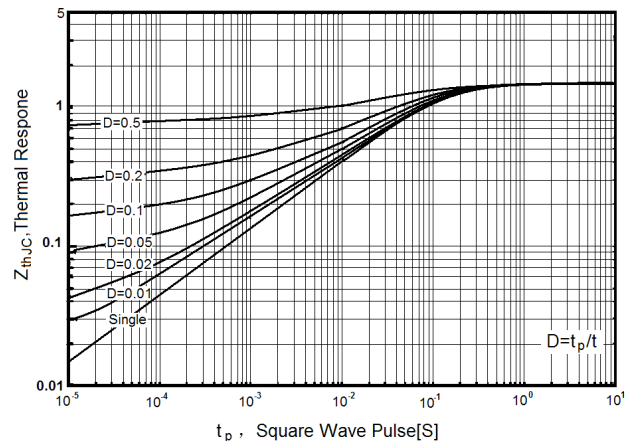
2.  $T_J=25^\circ C, V_{DD}=50V, V_G=10V, R_G=25\Omega$

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

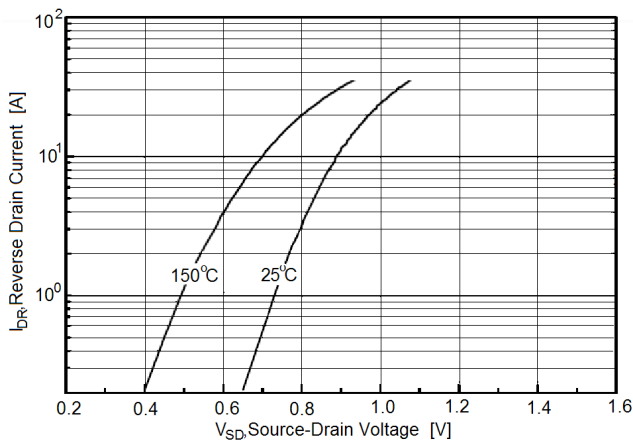
**Figure1. Safe operating area**



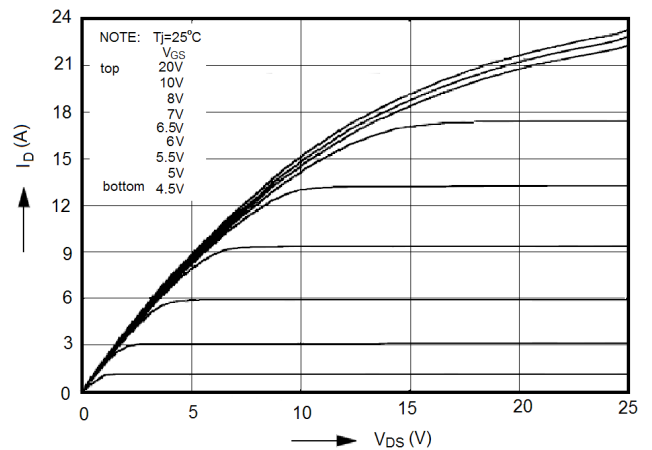
**Figure2. Transient Thermal Impedance**



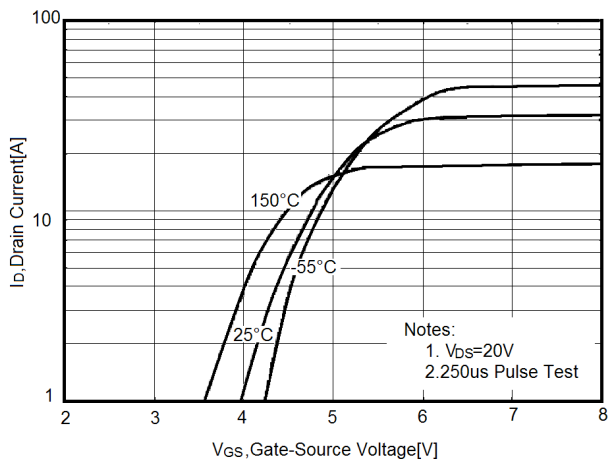
**Figure3. Source-Drain Diode Forward Voltage**



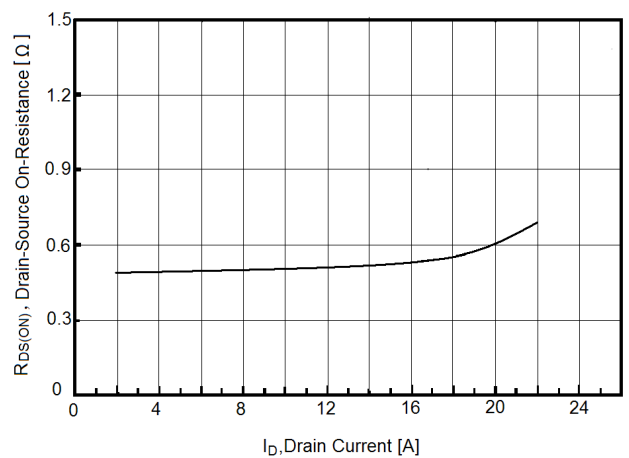
**Figure4. Output characteristics**



**Figure5. Transfer characteristics**



**Figure6. Static drain-source on resistance**



**Figure7. R<sub>DS(on)</sub> vs Junction Temperature**

**Figure8. BV<sub>DSS</sub> vs Junction Temperature**

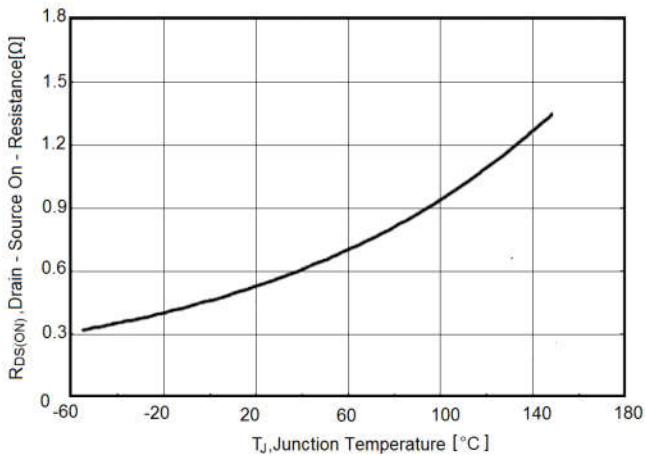


Figure9. Maximum  $I_D$  vs Junction Temperature

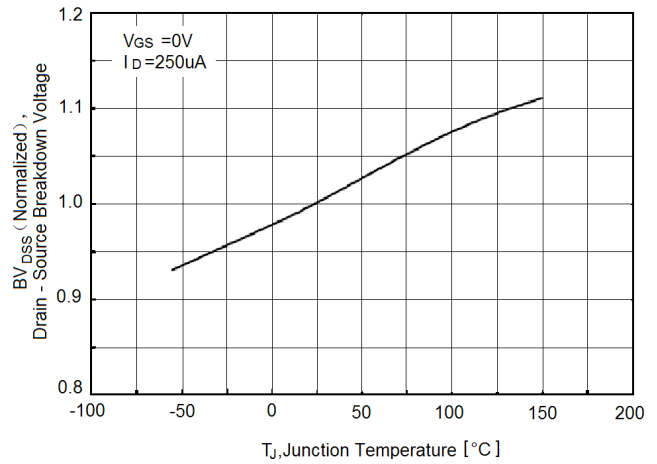


Figure10. Capacitance

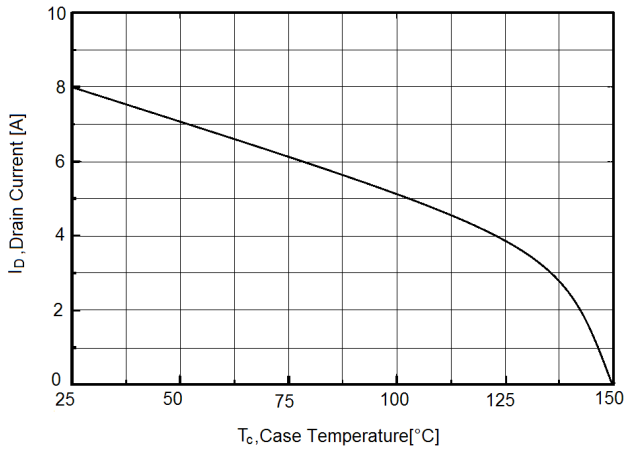
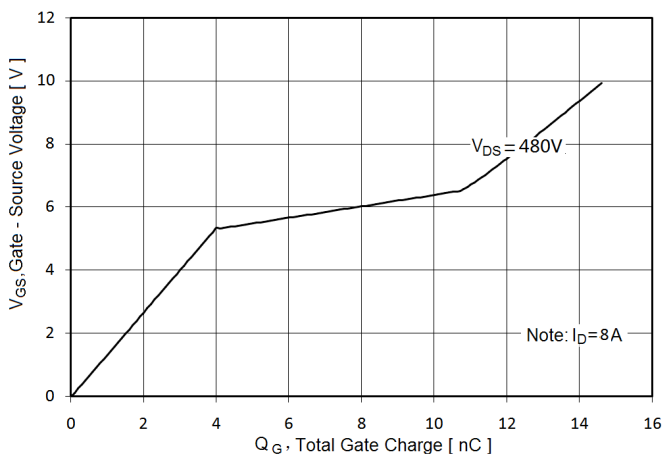
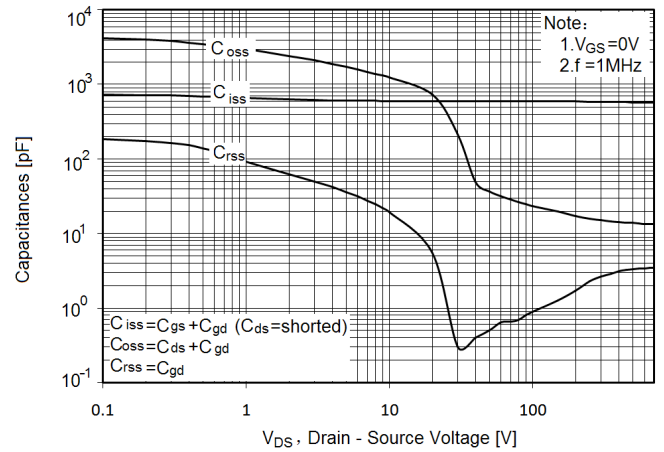
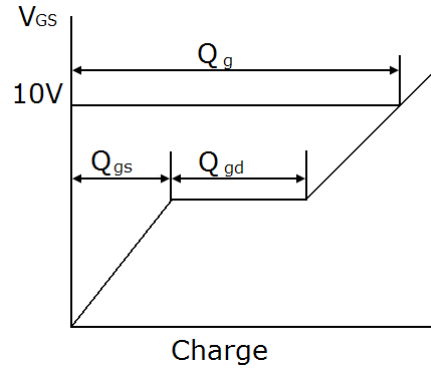
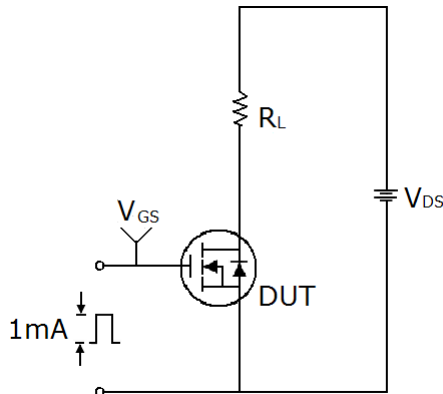


Figure11. Gate charge waveforms

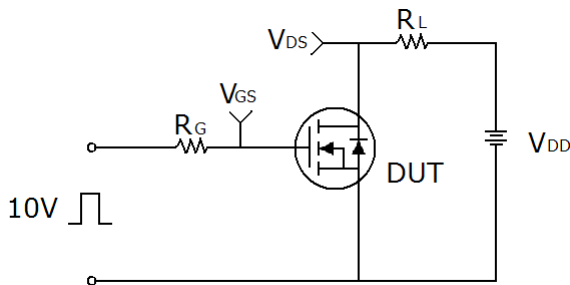


## Test circuit

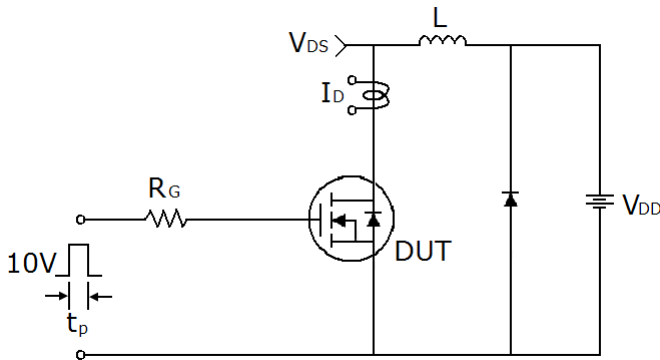
### 1) Gate charge test circuit & Waveform



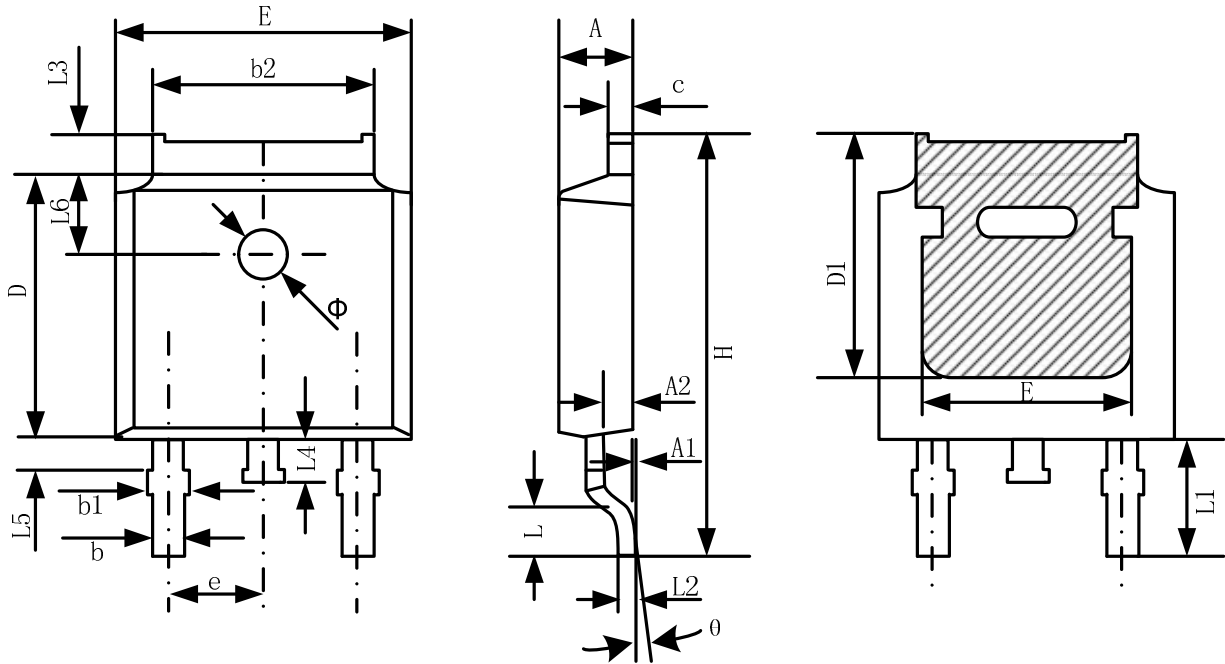
### 2) Switch Time Test Circuit:



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

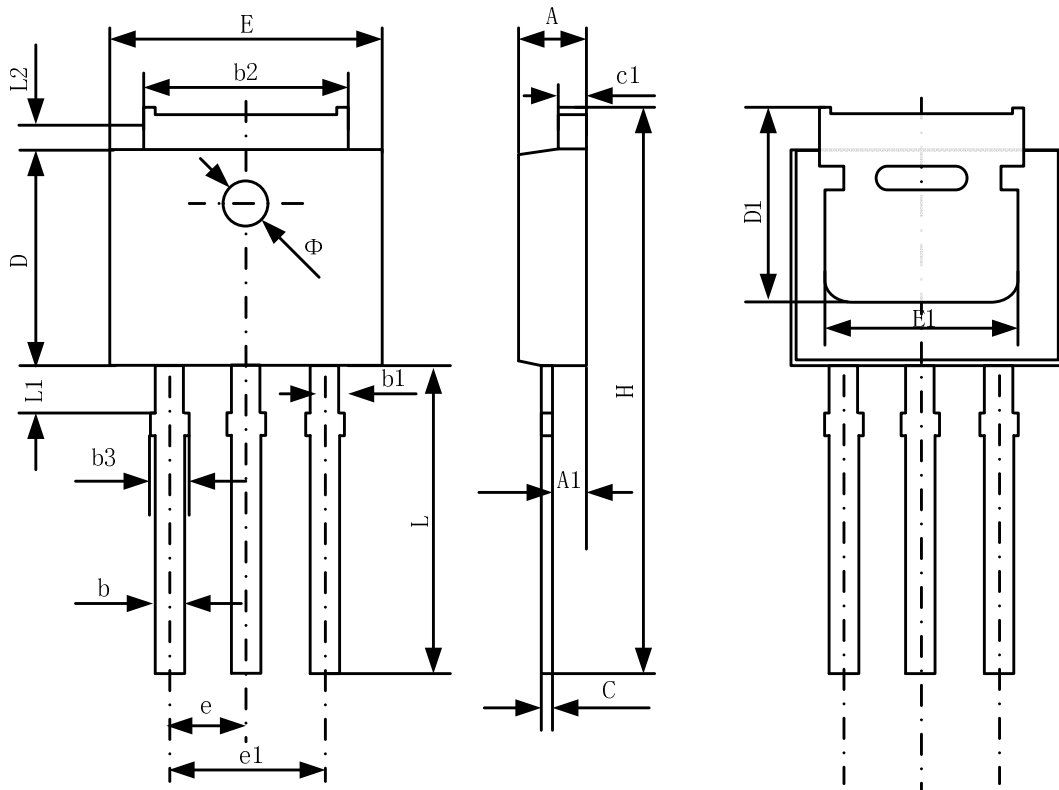


## TO-252-2 Package Information



| 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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