

## General Description

The Sanrise SRC65R100B is a high voltage power MOSFET, fabricated using advanced super junction technology. The resulting device has extremely low on resistance, low gate charge and fast switching time, making it especially suitable for applications which require superior power density and outstanding efficiency.

The SRC65R100B break down voltage is 650V and it has a high rugged avalanche characteristics. The SRC65R100B is available in TO-220F, TO-263-2, TO-220C and TO-247 packages.

## Features

- Ultra Low  $R_{DS(ON)} = 100m\Omega @ V_{GS} = 10V$ .
- Ultra Low Gate Charge,  $Q_g = 86nC$  typ.
- Intrinsic Fast-Recovery Body Diode
- Fast switching capability
- Robust design with better EAS performance
- Non-automotive Qualified
- Ultra-fast body diode

## Application

- AC/DC Power Supply
- EV Charger
- PC / Server / Telecom

## Ordering Information

## Symbol

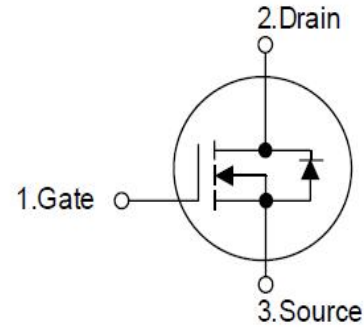


Figure 1 Symbol of SRC65R100B

## Package Type

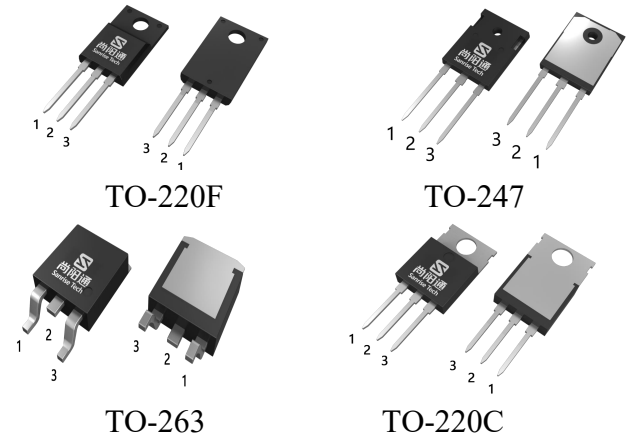


Figure 2 Package Types of SRC65R100B

|                |       |                 |
|----------------|-------|-----------------|
| SRC65R100B□□-□ |       |                 |
| Circuit Type   | _____ | E: Lead Free    |
| Package        | _____ | G: Green        |
| TF: TO-220F    |       | Blank: Tube     |
| T: TO-247      |       | TR: Tape & Reel |
| S2: TO-263-2   |       |                 |
| TC: TO-220C    |       |                 |

| Package  | Part Number      | Marking ID    | Packing Type |
|----------|------------------|---------------|--------------|
| TO-220F  | SRC65R100BTF-G   | SRC65R100BTFG | Tube         |
| TO-247   | SRC65R100BT-G    | SRC65R100BTG  | Tube         |
| TO-263-2 | SRC65R100BS2TR-G | SRC65R100BS2G | Tape & Reel  |
| TO-220C  | SRC65R100BTC-G   | SRC65R100BTCG | Tube         |

**Absolute Maximum Ratings**<sup>Note 1</sup>

| Parameter                                                                 |                           | Symbol        | Rating     | Unit             |
|---------------------------------------------------------------------------|---------------------------|---------------|------------|------------------|
| Drain-Source Voltage                                                      |                           | $V_{DS}$      | 650        | V                |
| Gate-Source Voltage (static)                                              |                           | $V_{GSS}$     | ±20        | V                |
| Gate-Source Voltage (dynamic), AC ( $f > 1$ Hz)                           |                           | $V_{GSS}$     | ±30        | V                |
| Continuous Drain Current                                                  | $T_C = 25^\circ\text{C}$  | $I_D$         | 36.9       | A                |
|                                                                           | $T_C = 100^\circ\text{C}$ |               | 23.3       |                  |
|                                                                           | $T_C = 125^\circ\text{C}$ |               | 16.5       |                  |
| Pulsed Drain Current (Note 2)                                             |                           | $I_{DM}$      | 110.7      | A                |
| Avalanche Energy, Single Pulse (Note 3)                                   |                           | $E_{AS}$      | 100        | mJ               |
| Avalanche Energy, Repetitive (Note 2)                                     |                           | $E_{AR}$      | 0.6        | mJ               |
| Avalanche Current, Repetitive (Note 2)                                    |                           | $I_{AR}$      | 4.5        | A                |
| Continuous Diode Forward Current                                          |                           | $I_S$         | 36.9       | A                |
| Diode Pulse Current                                                       |                           | $I_{S,PULSE}$ | 110.7      | A                |
| MOSFET $dv/dt$ Ruggedness, $V_{DS} \leq 480\text{V}$                      |                           | $dv/dt$       | 80         | V/ns             |
| Reverse Diode $dv/dt$ , $V_{DS} \leq 480\text{V}$ , $I_{SD} \leq I_D$     |                           | $dv/dt$       | 50         | V/ns             |
| Power Dissipation ( $T_C = 25^\circ\text{C}$ , TO-220F)                   |                           | $P_{tot}$     | 35.7       | W                |
| Power Dissipation ( $T_C = 25^\circ\text{C}$ , TO-220C, TO-263-2, TO-247) |                           | $P_{tot}$     | 291        | W                |
| Operating Junction Temperature                                            |                           | $T_J$         | 150        | $^\circ\text{C}$ |
| Storage Temperature                                                       |                           | $T_{STG}$     | -55 to 150 | $^\circ\text{C}$ |
| Lead Temperature (Soldering, 10 sec)                                      |                           | $T_{LEAD}$    | 260        | $^\circ\text{C}$ |

Note:

1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.
2. Repetitive Rating: Pulse width limited by maximum junction temperature
3.  $I_{AS} = 4.5\text{A}$ ,  $V_{DD} = 60\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$

**Thermal characteristics**

| Parameter                               |          | Symbol     | Min | Typ | Max  | Unit                        |
|-----------------------------------------|----------|------------|-----|-----|------|-----------------------------|
| Thermal resistance, Junction-to-Case    | TO-220F  | $R_{thJC}$ |     |     | 3.5  | $^\circ\text{C} / \text{W}$ |
|                                         | TO-220C  |            |     |     | 0.43 |                             |
|                                         | TO-263-2 |            |     |     | 0.43 |                             |
|                                         | TO-247   |            |     |     | 0.43 |                             |
| Thermal resistance, Junction-to-Ambient | TO-220F  | $R_{thJA}$ |     |     | 70   | $^\circ\text{C} / \text{W}$ |
|                                         | TO-220C  |            |     |     | 58   |                             |
|                                         | TO-263-2 |            |     |     | 58   |                             |
|                                         | TO-247   |            |     |     | 58   |                             |

## Electrical Characteristics

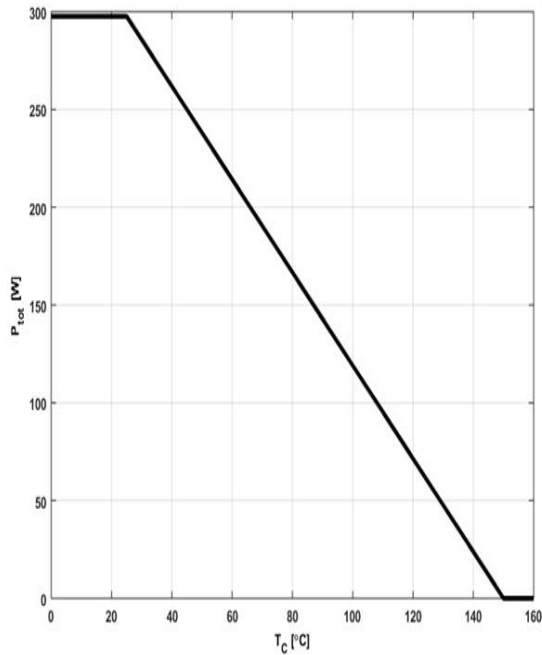
$T_J = 25^{\circ}\text{C}$ , unless otherwise specified.

| Parameter                                                     |         |                   | Symbol                                     | Test Conditions                                                                          | Min | Typ  | Max  | Unit |
|---------------------------------------------------------------|---------|-------------------|--------------------------------------------|------------------------------------------------------------------------------------------|-----|------|------|------|
| Statistic Characteristics                                     |         |                   |                                            |                                                                                          |     |      |      |      |
| Drain-Source Breakdown Voltage                                |         |                   | BV <sub>DSS</sub>                          | V <sub>GS</sub> =0V, I <sub>D</sub> =250uA                                               | 650 |      |      | V    |
| Zero Gate Voltage Drain Current                               |         |                   | I <sub>DSS</sub>                           | V <sub>DS</sub> =650V, V <sub>GS</sub> =0V                                               |     |      | 10   | uA   |
|                                                               |         |                   |                                            | V <sub>DS</sub> =650V, V <sub>GS</sub> =0V, T <sub>j</sub> =125℃ , TO-247, TO-263        |     |      | 1200 |      |
| Gate-Body Leakage Current                                     | Forward | I <sub>GSSF</sub> | V <sub>GS</sub> =20V, V <sub>DS</sub> =0V  |                                                                                          |     |      | 100  | nA   |
|                                                               | Reverse | I <sub>GSSR</sub> | V <sub>GS</sub> =-20V, V <sub>DS</sub> =0V |                                                                                          |     |      | -100 | nA   |
| Gate Threshold Voltage                                        |         |                   | V <sub>GS(TH)</sub>                        | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =800uA                                 | 3.0 | 4.0  | 5.0  | V    |
| Static Drain-Source On-Resistance                             |         |                   | R <sub>DS(ON)</sub>                        | V <sub>GS</sub> =10V, I <sub>D</sub> =18A                                                |     | 82   | 100  | mΩ   |
| Gate Resistance                                               |         |                   | R <sub>G</sub>                             | f=1MHz, Open Drain                                                                       |     | 0.7  |      | Ω    |
| Dynamic Characteristics                                       |         |                   |                                            |                                                                                          |     |      |      |      |
| Input Capacitance                                             |         |                   | C <sub>ISS</sub>                           | V <sub>DS</sub> =25V, V <sub>GS</sub> =0V, f=1MHz                                        |     | 3333 |      | pF   |
| Output Capacitance                                            |         |                   | C <sub>OSS</sub>                           |                                                                                          |     | 3466 |      |      |
| Reverse Transfer Capacitance                                  |         |                   | C <sub>RSS</sub>                           |                                                                                          |     | 46.9 |      |      |
| Effective output capacitance, energy related <sup>NOTE5</sup> |         |                   | C <sub>O(er)</sub>                         | V <sub>GS</sub> =0V, V <sub>DS</sub> =0...400V                                           |     | 98.2 |      | pF   |
| Effective output capacitance, time related <sup>NOTE6</sup>   |         |                   | C <sub>O(tr)</sub>                         |                                                                                          |     | 601  |      |      |
| Turn-on Delay Time                                            |         |                   | t <sub>d(on)</sub>                         | V <sub>DD</sub> =400V, I <sub>D</sub> =18A<br>R <sub>G</sub> =1.8Ω, V <sub>GS</sub> =10V |     | 24   |      | ns   |
| Rise Time                                                     |         |                   | t <sub>r</sub>                             |                                                                                          |     | 38   |      |      |
| Turn-off Delay Time                                           |         |                   | t <sub>d(off)</sub>                        |                                                                                          |     | 48   |      |      |
| Fall Time                                                     |         |                   | t <sub>f</sub>                             |                                                                                          |     | 10   |      |      |
| Gate Charge Characteristics                                   |         |                   |                                            |                                                                                          |     |      |      |      |
| Gate to Source Charge                                         |         |                   | Q <sub>gs</sub>                            | V <sub>DD</sub> =480V, I <sub>D</sub> =18A<br>V <sub>GS</sub> =0 to 10V                  |     | 22.9 |      | nC   |
| Gate to Drain Charge                                          |         |                   | Q <sub>gd</sub>                            |                                                                                          |     | 42.6 |      |      |
| Gate Charge Total                                             |         |                   | Q <sub>g</sub>                             |                                                                                          |     | 86   |      |      |
| Gate Plateau Voltage                                          |         |                   | V <sub>plateau</sub>                       |                                                                                          |     | 6.5  |      | V    |
| Reverse Diode Characteristics                                 |         |                   |                                            |                                                                                          |     |      |      |      |
| Drain-Source Diode Forward Voltage                            |         |                   | V <sub>SD</sub>                            | V <sub>GS</sub> =0V, I <sub>SD</sub> =18A                                                |     | 0.9  | 1.1  | V    |
| Reverse Recovery Time                                         |         |                   | t <sub>rr</sub>                            | V <sub>R</sub> =100V, I <sub>F</sub> =18A<br>dI <sub>F</sub> /dt=100A/us                 |     | 152  |      | ns   |
| Reverse Recovery Charge                                       |         |                   | Q <sub>rr</sub>                            |                                                                                          |     | 0.89 |      | uC   |
| Peak Reverse Recovery Current                                 |         |                   | I <sub>rrm</sub>                           |                                                                                          |     | 11.6 |      | A    |

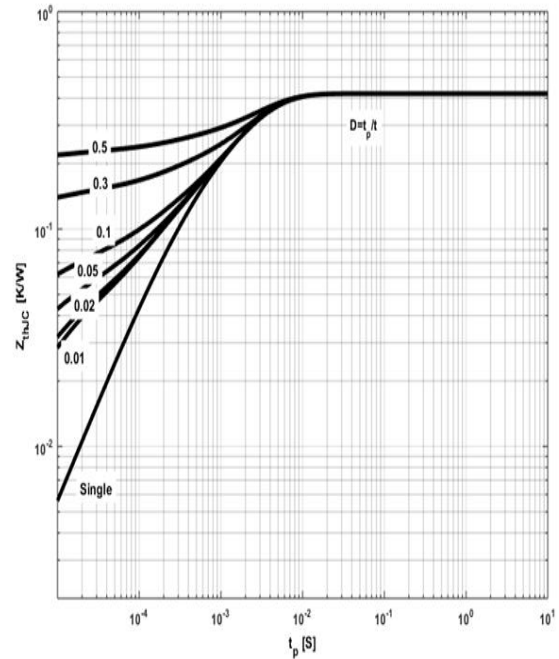
Note:

5.  $C_{O(er)}$  is a fixed capacitance that gives the same stored energy as  $C_{OSS}$  while  $V_{DS}$  is rising from 0 to 480V

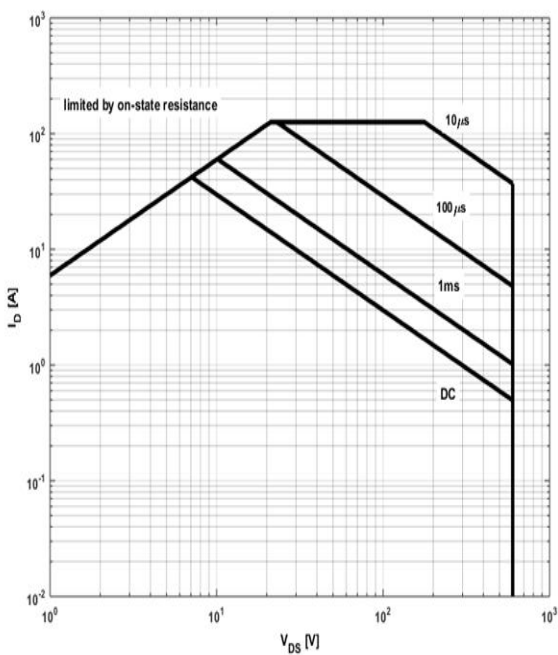
6.  $C_{O(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{OSS}$  while  $V_{DS}$  is rising from 0 to 480 V

**Typical Performance Characteristics**
**Figure 3: Power Dissipation**


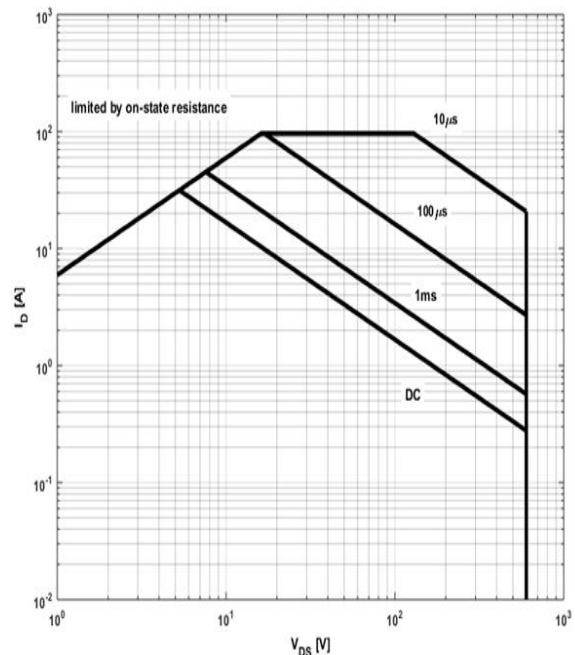
$$P_{tot} = f(T_c)$$

**Figure 4: Max. Transient Thermal Impedance**


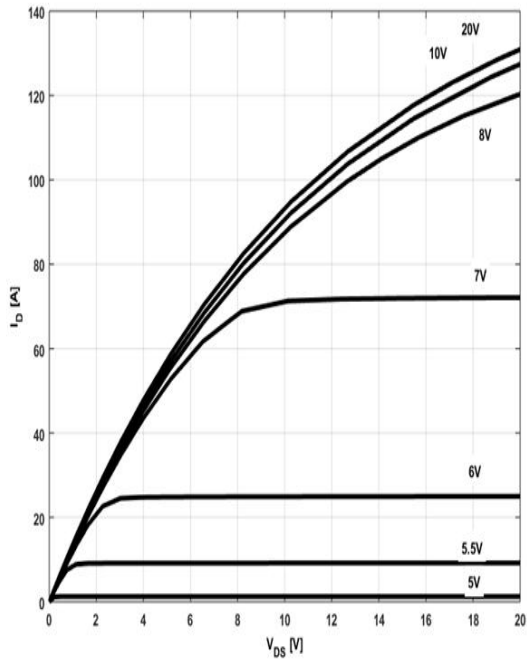
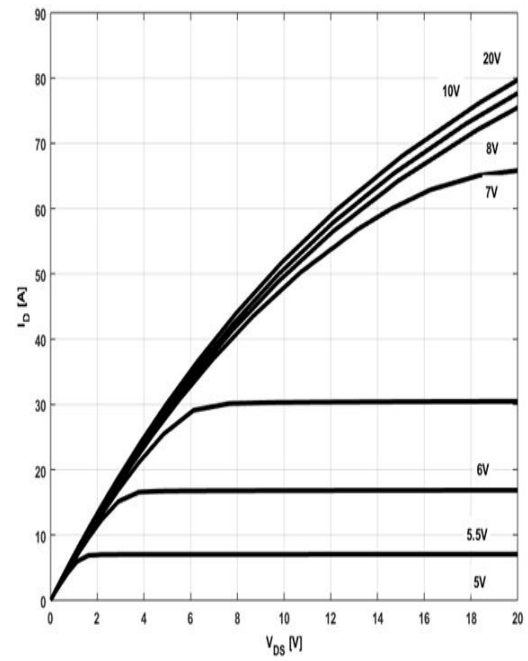
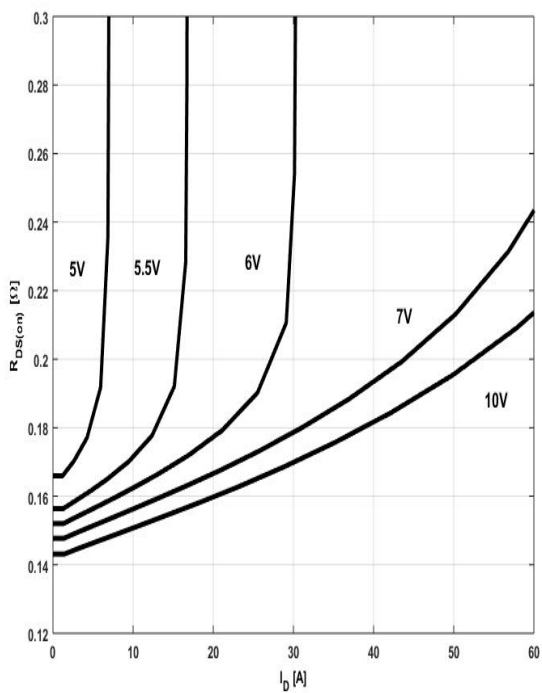
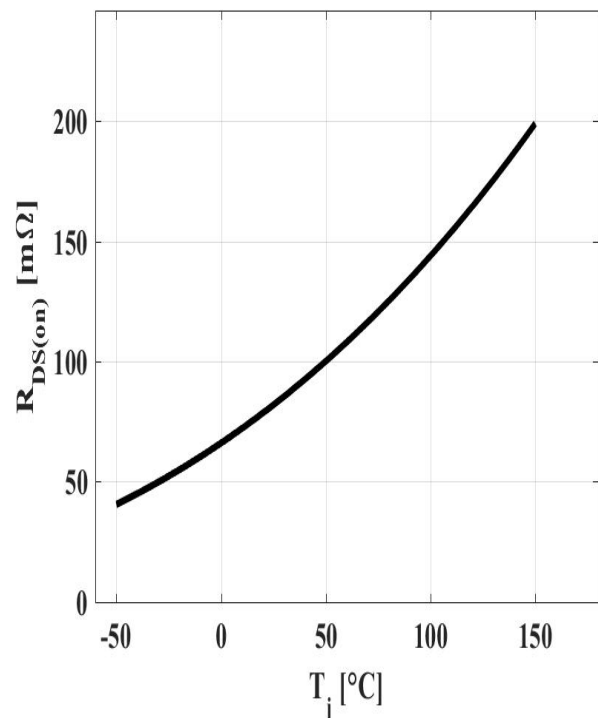
$$Z_{thJC} = f(t_p); \text{ parameter: } D = t_p / T$$

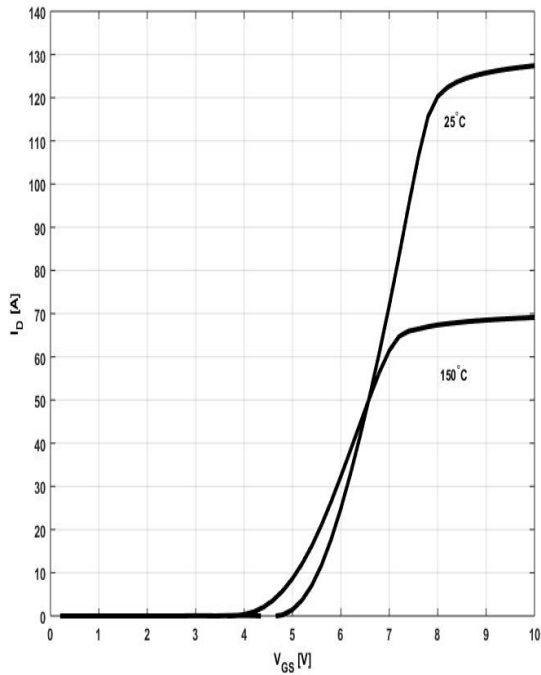
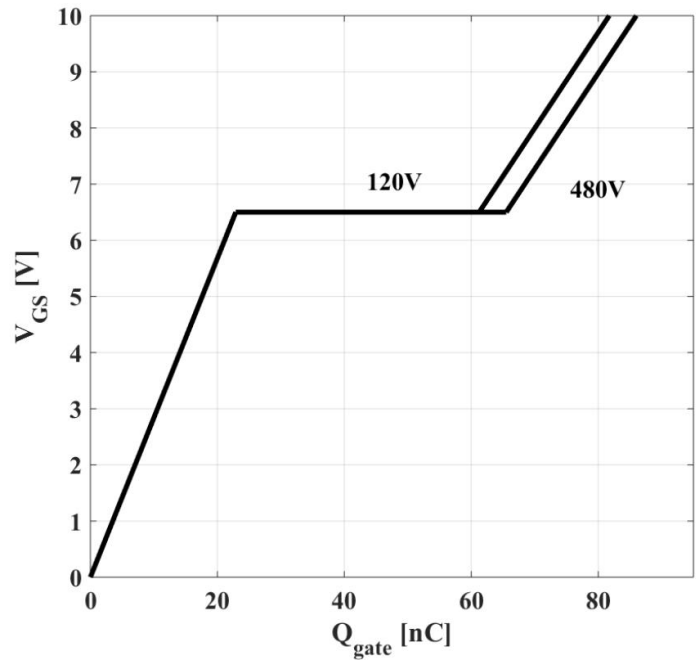
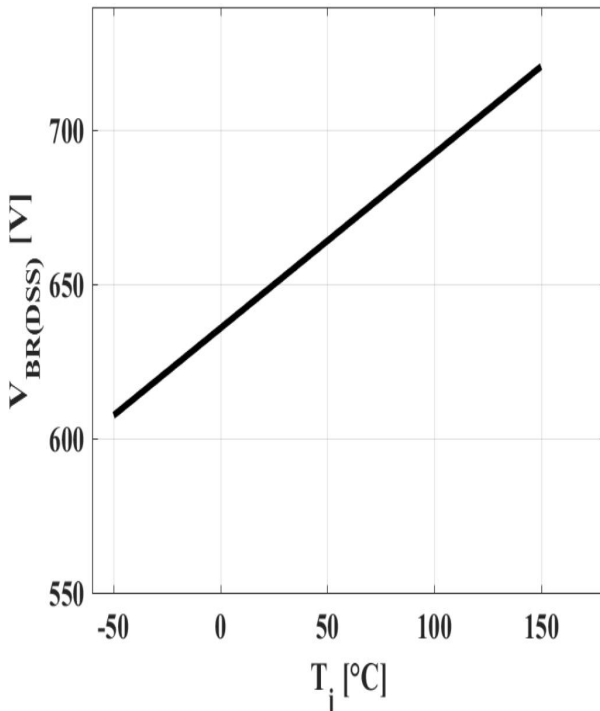
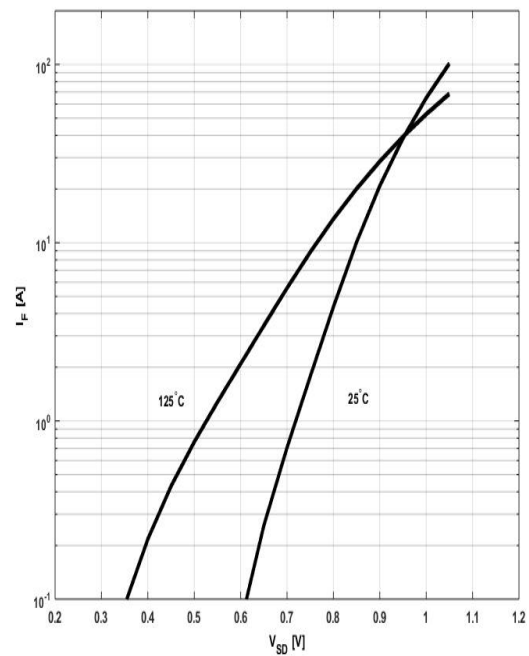
**Figure 5: Safe Operating Area**


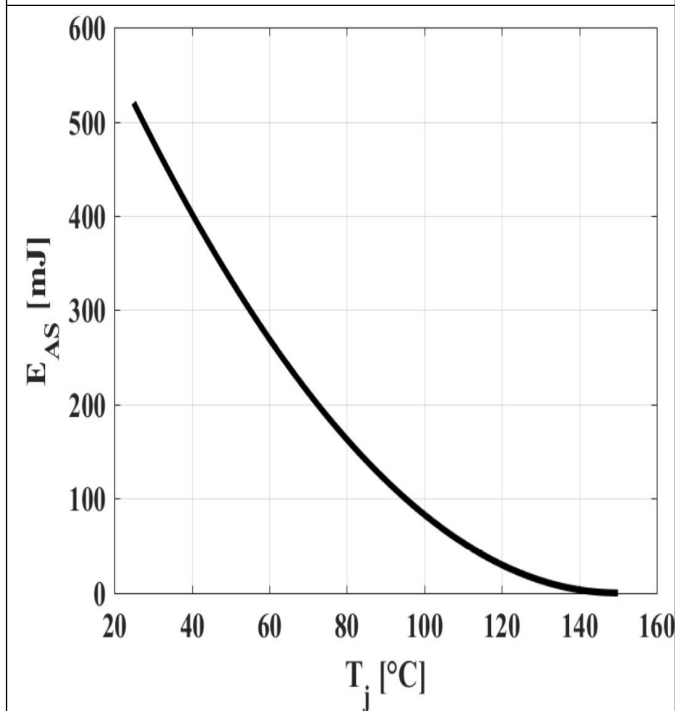
$$I_D = f(V_{DS}); T_c = 25^\circ\text{C}; V_{GS} > 7\text{V}; \text{ parameter } t_p$$

**Figure 6: Safe Operating Area**


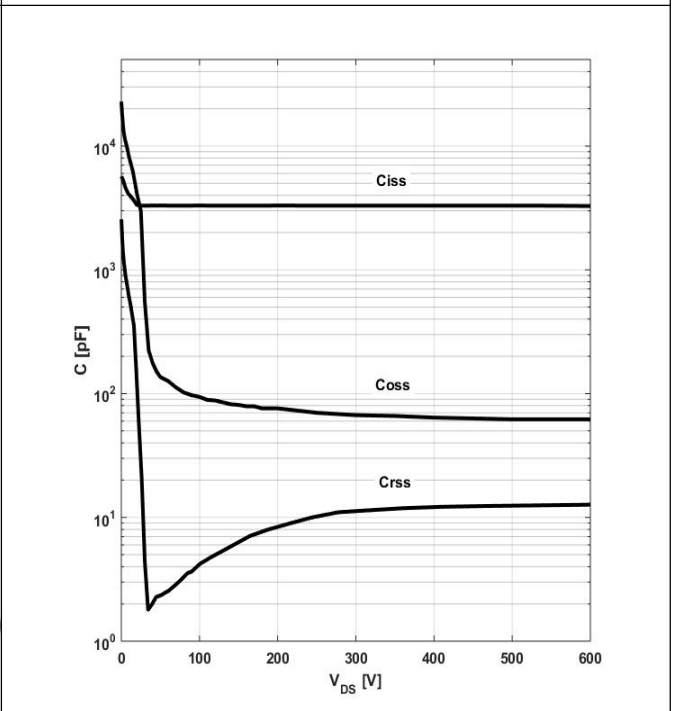
$$I_D = f(V_{DS}); T_c = 80^\circ\text{C}; V_{GS} > 7\text{V}; \text{ parameter } t_p$$

**Figure 7: Typ. Output Characteristics**

 $I_D = f(V_{DS}); T_j = 25^\circ\text{C}; \text{parameter: } V_{GS}$ 
**Figure 8: Typ. Output Characteristics**

 $I_D = f(V_{DS}); T_j = 125^\circ\text{C}; \text{parameter: } V_{GS}$ 
**Figure 9: Typ. Drain-Source On-State Resistance**

 $R_{DS(ON)} = f(I_D); T_j = 125^\circ\text{C}; \text{parameter: } V_{GS}$ 
**Figure 10: Typ. Drain-Source On-State Resistance**

 $R_{DS(ON)} = f(T_j); I_D = 18\text{A}; V_{GS} = 10\text{V}$

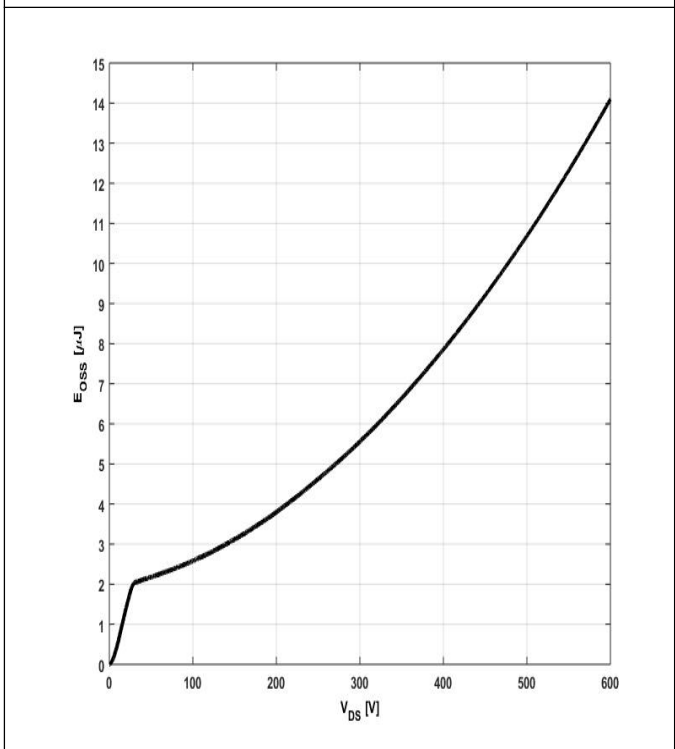
**Figure 11: Typ. Transfer Characteristics**

 $I_D = f(V_{GS}); V_{DS} = 20V$ 
**Figure 12: Typ. Gate Charge**

 $V_{GS} = f(Q_{gate}), I_D = 18A \text{ pulsed}$ 
**Figure 13: Drain-Source Breakdown Voltage**

 $V_{BR(DSS)} = f(T_j); I_D = 10mA$ 
**Figure 14: Forward Characteristics of Reverse Diode**

 $I_F = f(V_{SD}); \text{parameter: } T_j$

**Figure 15: Avalanche Energy**


$$E_{AS}=f(T_j); I_D=4.5A; V_{DD}=60V$$

**Figure 16: Typ. Capacitances**


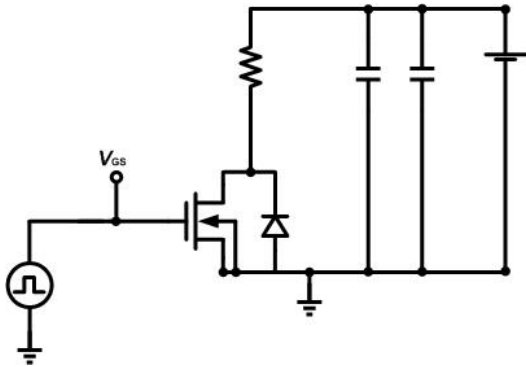
$$C=f(V_{DS}); V_{GS}=0; f=1MHz$$

**Figure 17: Coss Stored Energy**


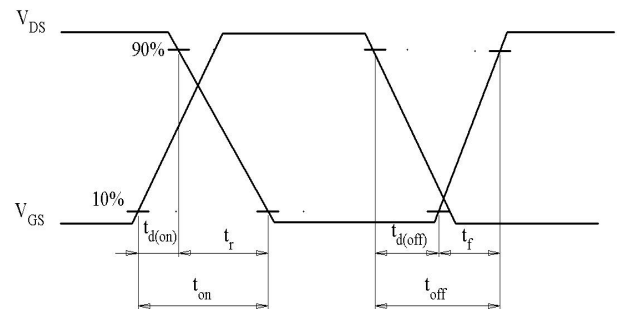
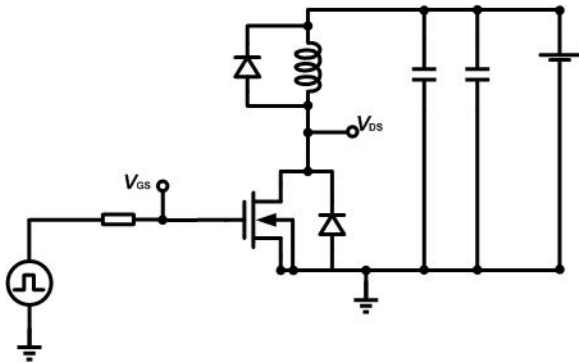
$$E_{OSS}=f(V_{DS})$$

## Test Circuits

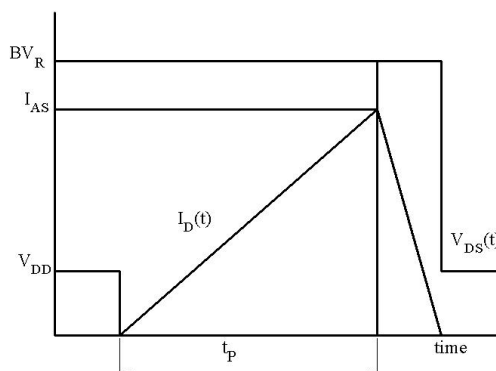
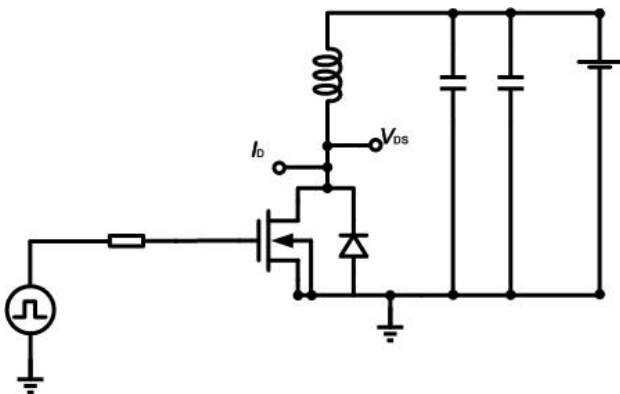
### 1. Gate Charge Test Circuit & Waveform



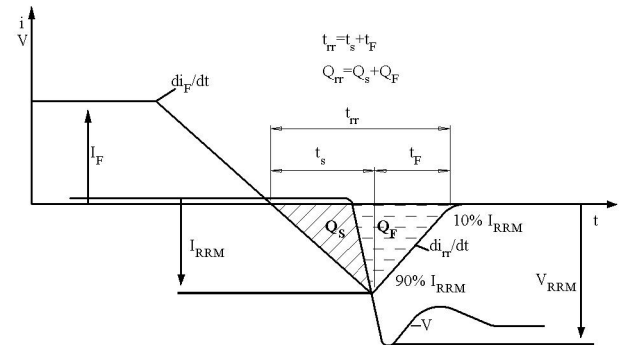
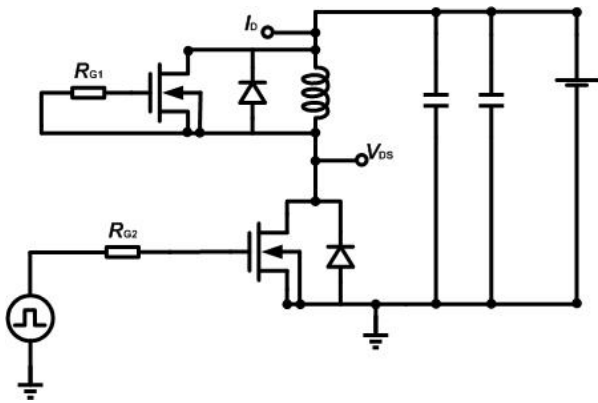
### 2. Switch Time Test Circuit

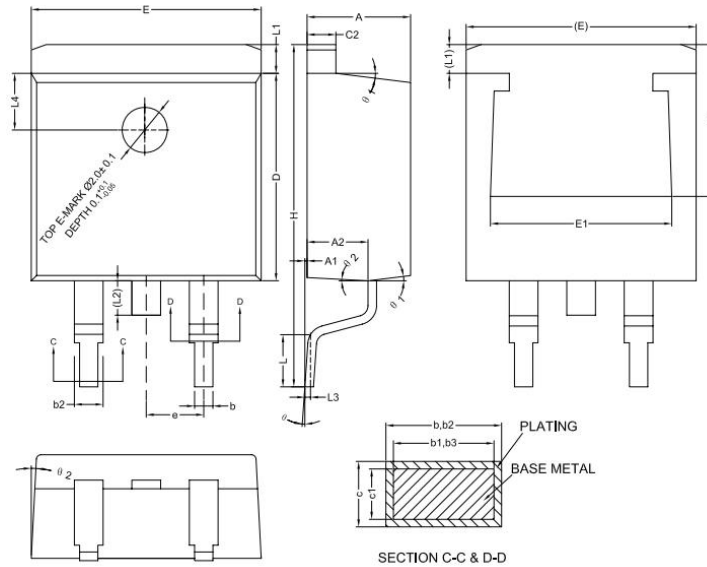


### 3. Unclaimed Inductive Switching Test Circuit & Waveforms



#### 4. Test Circuit and Waveform for Diode Characteristics

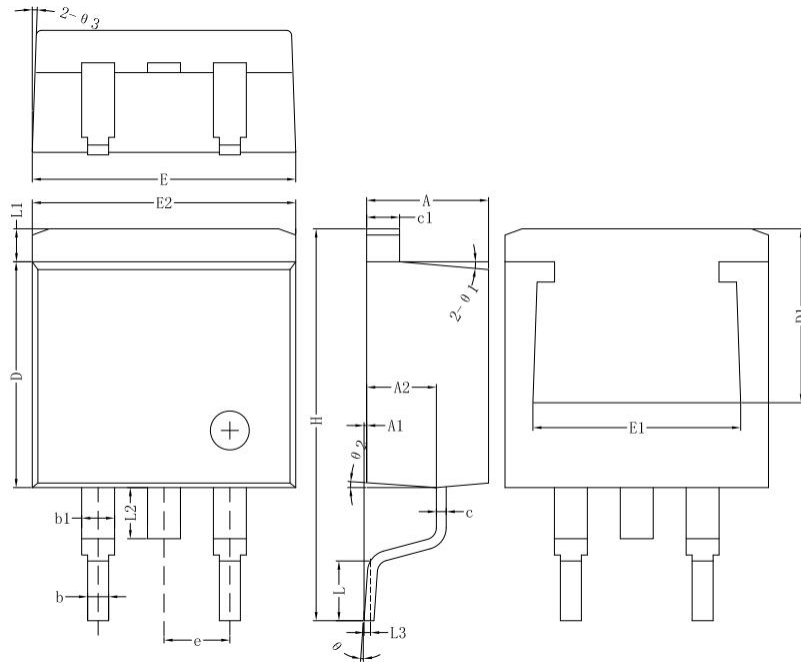


**Mechanical Dimensions**
**TO-263-2 (Package 1)**
**Unit: mm**


| Symbol | Dimensions(mm) |       |       |
|--------|----------------|-------|-------|
|        | Min.           | Typ.  | Max.  |
| A      | 4.40           | 4.57  | 4.70  |
| A1     | 0.00           | 0.10  | 0.25  |
| A2     | 2.59           | 2.69  | 2.79  |
| b      | 0.77           | -     | 0.90  |
| b1     | 0.76           | 0.81  | 0.86  |
| b2     | 1.23           | -     | 1.36  |
| b3     | 1.22           | 1.27  | 1.32  |
| c      | 0.34           | -     | 0.47  |
| c1     | 0.33           | 0.38  | 0.43  |
| c2     | 1.22           | -     | 1.32  |
| D      | 9.05           | 9.15  | 9.25  |
| D1     | 6.60           | -     | -     |
| E      | 10.06          | 10.16 | 10.26 |
| E1     | 7.80           | -     | 8.20  |
| e      | 2.54(BSC)      |       |       |
| H      | 14.70          | 15.10 | 15.50 |
| L      | 2.00           | 2.30  | 2.60  |
| L1     | 1.17           | 1.27  | 1.40  |
| L2     | -              | -     | 1.75  |
| L3     | 0.25BSC        |       |       |
| L4     | 2.00REF        |       |       |
| θ      | 0°             | -     | 8°    |
| θ1     | 5°             | 7°    | 9°    |
| θ2     | 1°             | 3°    | 5°    |

**Mechanical Dimensions**
**TO-263-2 (Package 2)**

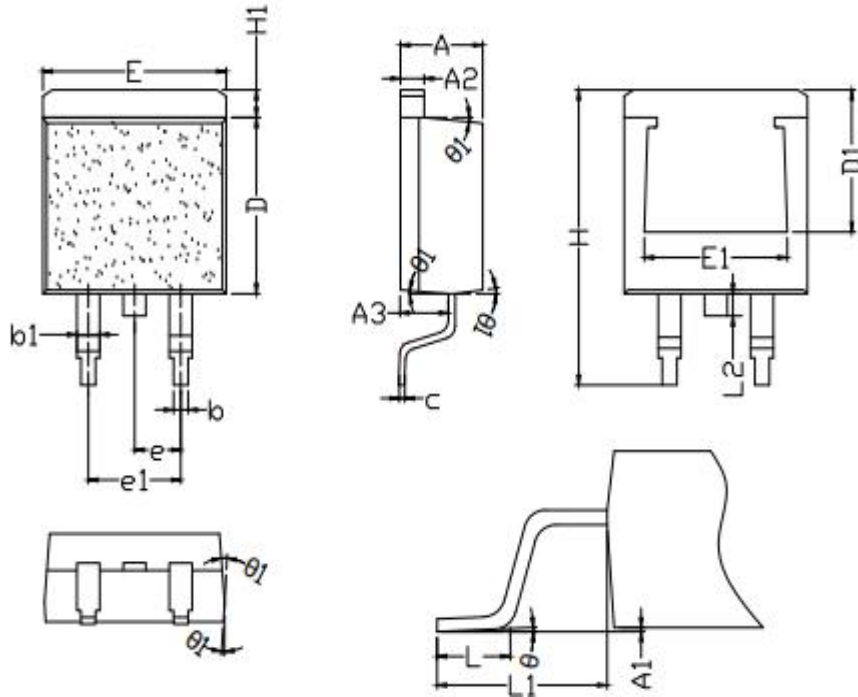
Unit: mm



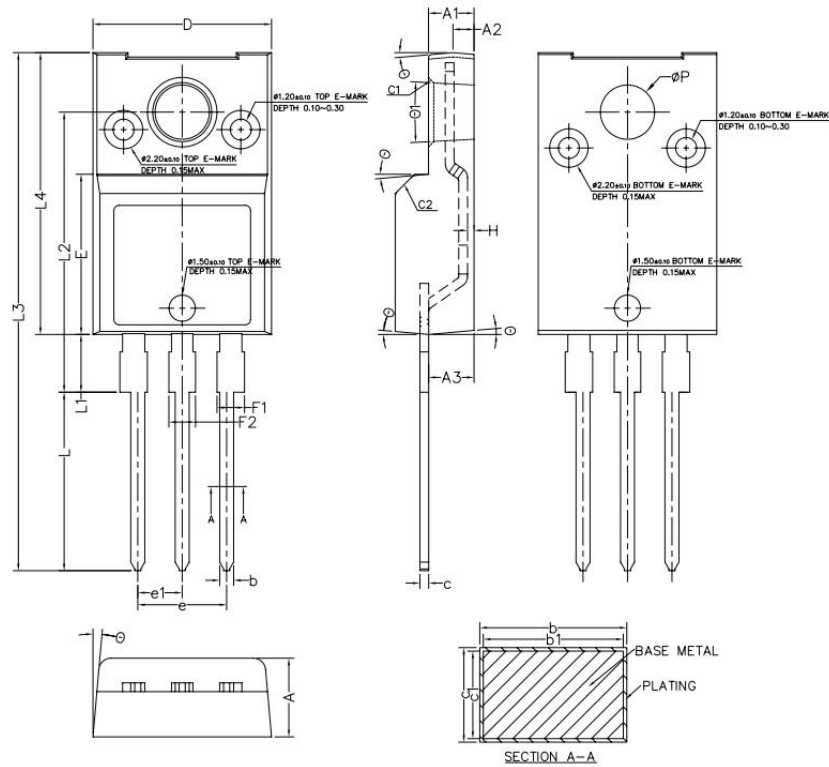
| Symbol | Dimensions(mm) |         |       |
|--------|----------------|---------|-------|
|        | Min.           | Typ.    | Max.  |
| A      | 4.55           | 4.70    | 4.85  |
| A1     | 0.00           | 0.10    | 0.25  |
| A2     | 2.59           | 2.69    | 2.89  |
| b      | 0.71           | 0.81    | 0.96  |
| b1     | -              | 1.27    | -     |
| c      | 0.36           | 0.38    | 0.61  |
| c1     | 1.17           | 1.27    | 1.37  |
| D      | 8.55           | 8.70    | 8.85  |
| D1     | -              | 7.2     | -     |
| E      | 10.01          | 10.16   | 10.31 |
| E1     | -              | 7.80    | -     |
| E2     | 9.98           | 10.08   | 10.18 |
| e      | -              | 2.54    | -     |
| H      | 14.70          | 15.10   | 15.50 |
| L      | 2.00           | 2.30    | 2.70  |
| L1     | 1.17           | 1.27    | 1.40  |
| L2     | -              | -       | 2.20  |
| L3     | -              | 0.25BSC | -     |
| θ      | 0°             | -       | 8°    |
| θ1     |                | 5°      |       |
| θ2     |                | 4°      |       |
| θ3     |                | 4°      |       |

**Mechanical Dimensions**
**TO-263-2 (Package 3)**

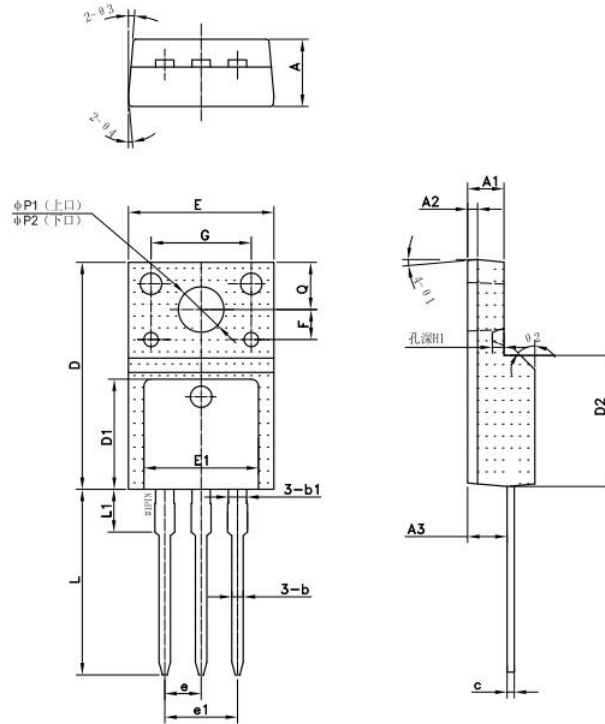
Unit: mm



| Symbol | Dimensions(mm) |       |       |
|--------|----------------|-------|-------|
|        | Min.           | Typ.  | Max.  |
| A      | 4.42           | 4.52  | 4.62  |
| A1     | 0.00           | 0.10  | 0.25  |
| A2     | 1.24           | 1.27  | 1.32  |
| A3     | 2.50           | 2.60  | 2.70  |
| b      | 0.77           | 0.81  | 0.84  |
| b1     | 1.23           | 1.28  | 1.41  |
| c      | 0.33           | 0.38  | 0.43  |
| D      | 8.80           | 8.95  | 9.10  |
| D1     | 7.2REF         |       |       |
| E      | 9.92           | 10.07 | 10.22 |
| E1     | 7.85REF        |       |       |
| e      | 2.50           | 2.54  | 2.58  |
| e1     | 5.08REF        |       |       |
| H      | 14.80          | 15.10 | 15.30 |
| H1     | 1.12           | 1.28  | 1.42  |
| L      | 2.10           | 2.23  | 2.36  |
| L1     | 4.55           | 4.75  | 4.95  |
| L2     | 1.10           | 1.30  | 1.50  |
| θ      | 0°             | 2°    | 5°    |
| θ1     | 3°             | -     | 5°    |

**Mechanical Dimensions**
**TO-220F (Package 1)**
**Unit: mm**


| Symbol | Dimensions(mm) |       |       |
|--------|----------------|-------|-------|
|        | Min.           | Typ.  | Max.  |
| A      | 4.40           | 4.50  | 4.60  |
| A1     | 2.50           | 2.60  | 2.70  |
| A2     | 1.10           | 1.20  | 1.30  |
| A3     | 2.49           | 2.59  | 2.69  |
| b      | 0.76           | -     | 0.89  |
| b1     | 0.75           | 0.80  | 0.85  |
| c      | 0.46           | -     | 0.59  |
| c1     | 0.45           | 0.50  | 0.55  |
| C1     | 0.20           | 0.30  | 0.40  |
| C2     | 1.00           | 1.10  | 1.20  |
| D      | 10.10          | 10.20 | 10.30 |
| E      | 9.05           | 9.15  | 9.25  |
| e      | 4.98           | 5.08  | 5.18  |
| e1     | 2.44           | 2.54  | 2.64  |
| F1     | 1.22           | -     | 1.60  |
| F2     | 1.17           | -     | 1.55  |
| H      | 0.32           | 0.37  | 0.42  |
| L      | 10.00          | 10.20 | 10.40 |
| L1     | 3.15           | 3.30  | 3.45  |
| L2     | 15.85          | 16.00 | 16.15 |
| L3     | 29.30          | 29.60 | 29.90 |
| L4     | 16.00          | 16.10 | 16.20 |
| P      | 3.00           | 3.10  | 3.20  |
| θ      | 3°             | 5°    | 7°    |
| θ1     | 4°             | 6°    | 8°    |

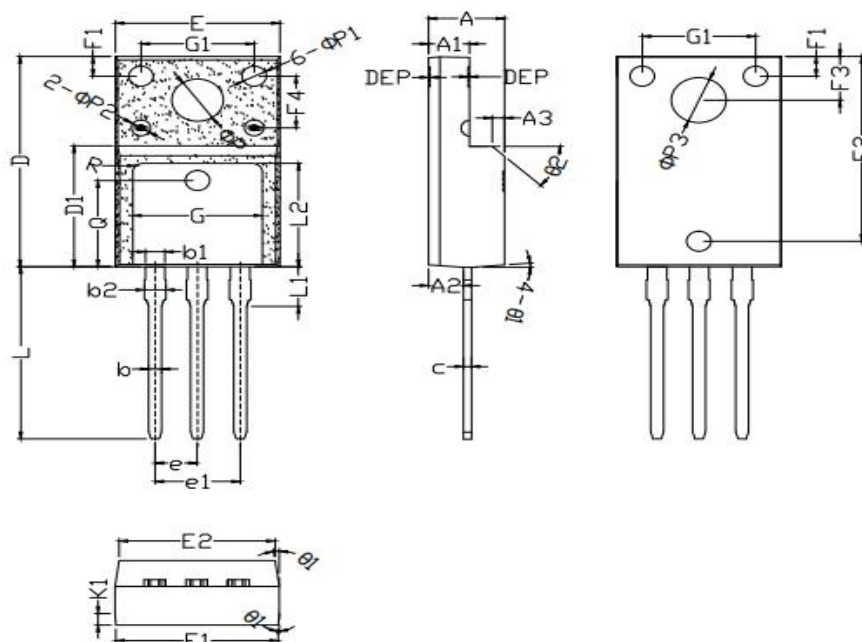
**Mechanical Dimensions**
**TO-220F (Package 2)**
**Unit: mm**


| Symbol   | Dimensions(mm) |       |       |
|----------|----------------|-------|-------|
|          | Min.           | Typ.  | Max.  |
| A        | 4.50           | 4.70  | 4.90  |
| A1       | 2.34           | 2.54  | 2.70  |
| A2       | -              | 0.70  | -     |
| A3       | 2.56           | 2.76  | 2.96  |
| b        | 0.70           | 0.80  | 0.95  |
| b1       | -              | 1.28  | -     |
| c        | 0.45           | 0.50  | 0.65  |
| D        | 15.67          | 15.87 | 16.07 |
| D1       | -              | 7.70  | -     |
| D2       | -              | 9.12  | -     |
| E        | 9.96           | 10.16 | 10.36 |
| E1       | -              | 8.00  | -     |
| e        | 2.54           |       |       |
| e1       |                | 5.08  |       |
| F        |                | 2.1   |       |
| G        |                | 7     |       |
| H1       | -              | 0.81  | -     |
| L        | 12.48          | 12.98 | 13.20 |
| L1       | -              | 2.93  | -     |
| ΦP1 (上口) | 2.98           | 3.18  | 3.38  |
| ΦP2 (下口) | 3.20           | 3.40  | 3.60  |
| Q        | 3.10           | 3.30  | 3.50  |
| θ1       |                | 5°    |       |
| θ2       |                | 45°   |       |
| θ2       |                | 5°    |       |
| θ3       |                | 5°    |       |

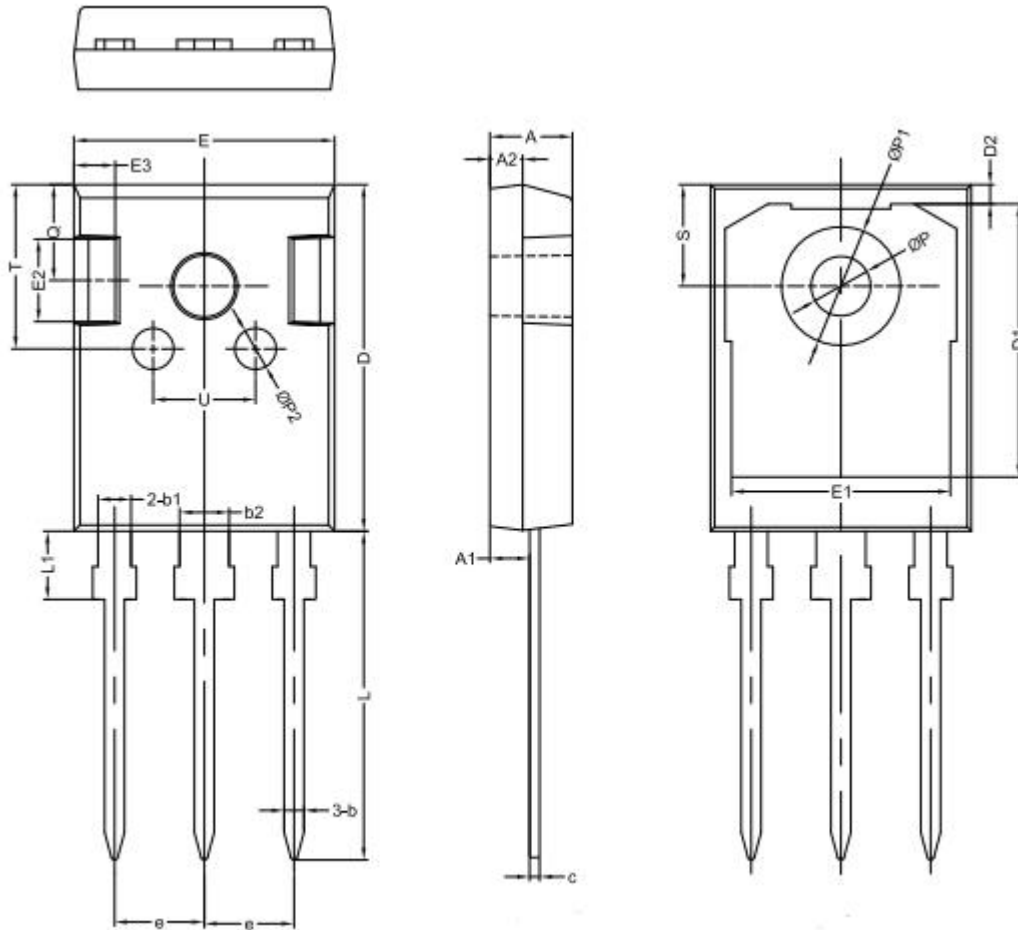
## Mechanical Dimensions

## TO-220F (Package 3)

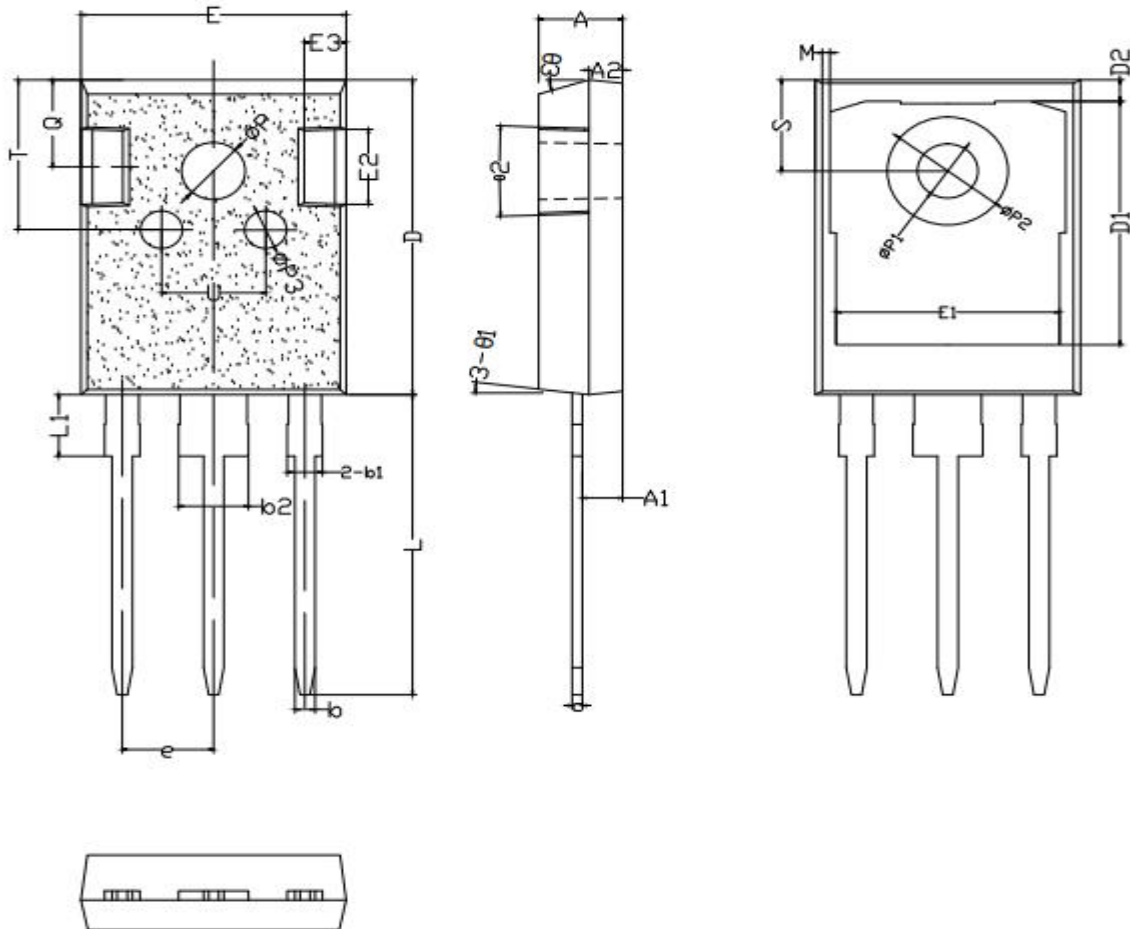
Unit: mm



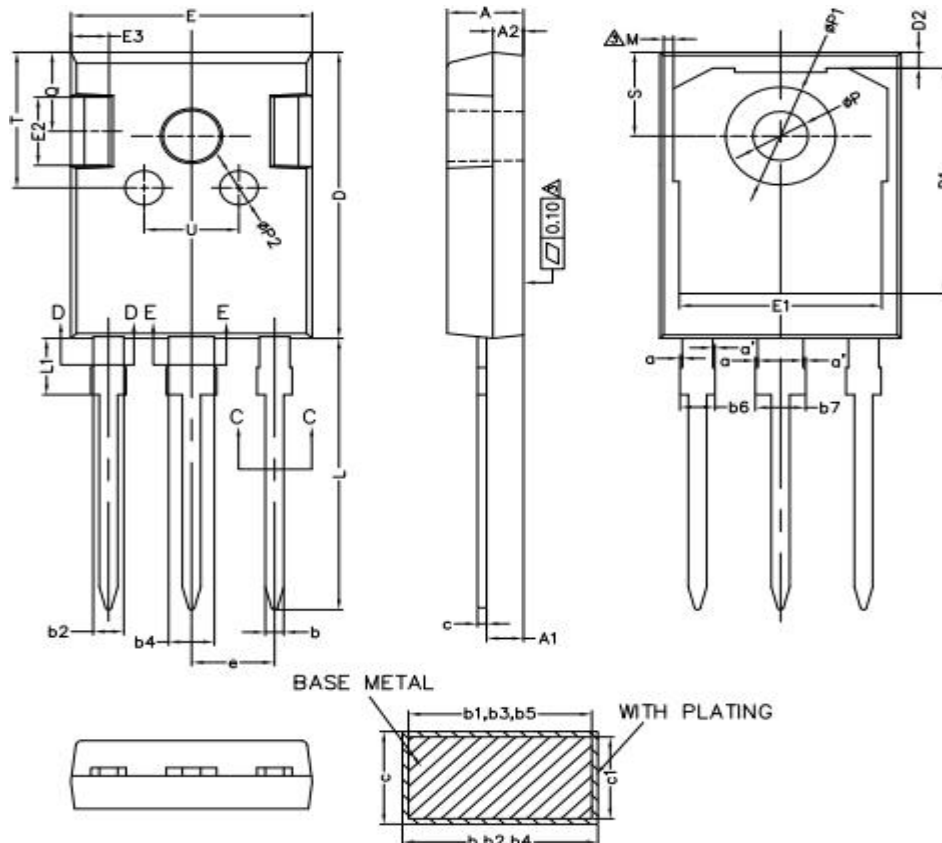
| Symbol | Dimensions(mm) |       |       |
|--------|----------------|-------|-------|
|        | Min.           | Typ.  | Max.  |
| A      | 4.50           | 4.70  | 4.90  |
| A1     | 2.34           | 2.54  | 2.74  |
| A2     | 2.60           | 2.80  | 2.95  |
| A3     | 1.0REF         |       |       |
| b      | 0.75           | 0.80  | 0.85  |
| b1     | 1.18           | 1.20  | 1.24  |
| b2     | 1.18           | 1.24  | 1.30  |
| c      | 0.45           | 0.50  | 0.55  |
| D      | 15.67          | 15.87 | 16.07 |
| D1     | 9.04           | 9.12  | 9.20  |
| E      | 10.00          | 10.16 | 10.30 |
| E1     | 9.94           | 10.06 | 10.30 |
| E2     | 9.40           | 9.50  | 9.60  |
| e      | 2.50           | 2.54  | 2.58  |
| e1     | 5.08REF        |       |       |
| L      | 12.78          | 12.98 | 13.18 |
| L1     | 2.70           | 2.92  | 3.20  |
| L2     | 7.70           | 7.80  | 7.90  |
| Q      | 6.50REF        |       |       |
| ΦP     | 3.08           | 3.18  | 3.28  |
| ΦP1    | 1.45           | 1.55  | 1.65  |
| ΦP2    | 0.95           | 1.15  | 1.35  |
| ΦP3    | 3.30           | 3.40  | 3.50  |
| θ1     | 3°             | 5°    | 7°    |
| θ2     | 42°            | 45°   | 48°   |
| F1     | 1.40           | 1.50  | 1.60  |
| F2     | 13.80          | 13.90 | 14.00 |
| F3     | 3.20           | 3.30  | 3.40  |
| F4     | 3.70           | 3.90  | 4.10  |
| G      | 7.80           | 8.00  | 8.20  |
| G1     | 6.90           | 7.00  | 7.10  |
| K1     | 0.65           | 0.70  | 0.75  |

**Mechanical Dimensions**
**TO-247(Package 1)**
**Unit: mm**


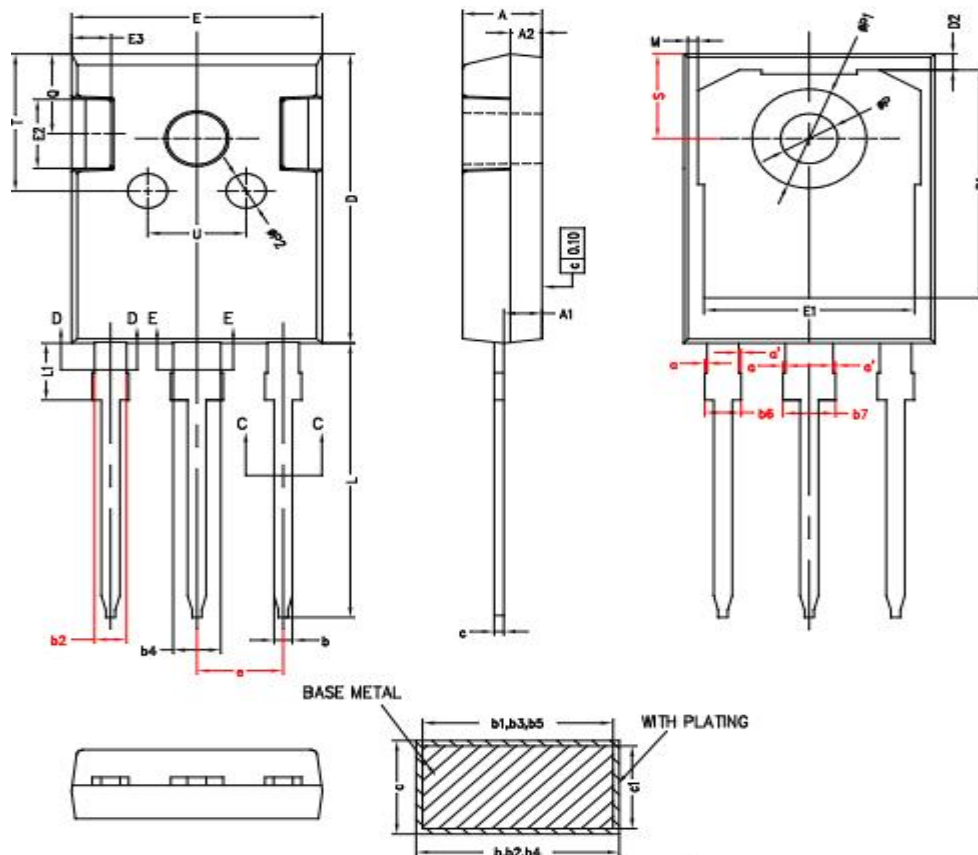
| Symbol | Dimensions(mm) |       |       | Symbol | Dimensions(mm) |       |       |
|--------|----------------|-------|-------|--------|----------------|-------|-------|
|        | Min.           | Typ.  | Max.  |        | Min.           | Typ.  | Max.  |
| A      | 4.80           | 5.00  | 5.20  | E1     | -              | 13.30 | -     |
| A1     | 2.21           | 2.41  | 2.61  | E2     | -              | 5.00  | -     |
| A2     | 1.90           | 2.00  | 2.10  | E3     | -              | 2.50  | -     |
| b      | 1.10           | 1.20  | 1.35  | L      | 19.42          | 19.92 | 20.42 |
| b1     | -              | 2.00  | -     | L1     | -              | 4.13  | -     |
| b2     | -              | 3.00  | -     | P      | 3.50           | 3.60  | 3.70  |
| c      | 0.55           | 0.60  | 0.75  | P1     | -              | 7.19  | -     |
| D      | 20.80          | 21.00 | 21.20 | P2     | -              | 2.50  | -     |
| D1     | -              | 16.55 | -     | Q      | -              | 5.80  | -     |
| D2     | -              | 1.20  | -     | S      | 6.05           | 6.15  | 6.25  |
| E      | 15.60          | 15.80 | 16.0  | T      | -              | 10.00 | -     |
| U      | -              | 6.20  | -     |        |                |       |       |

**Mechanical Dimensions**
**TO-247(Package 2)**
**Unit: mm**


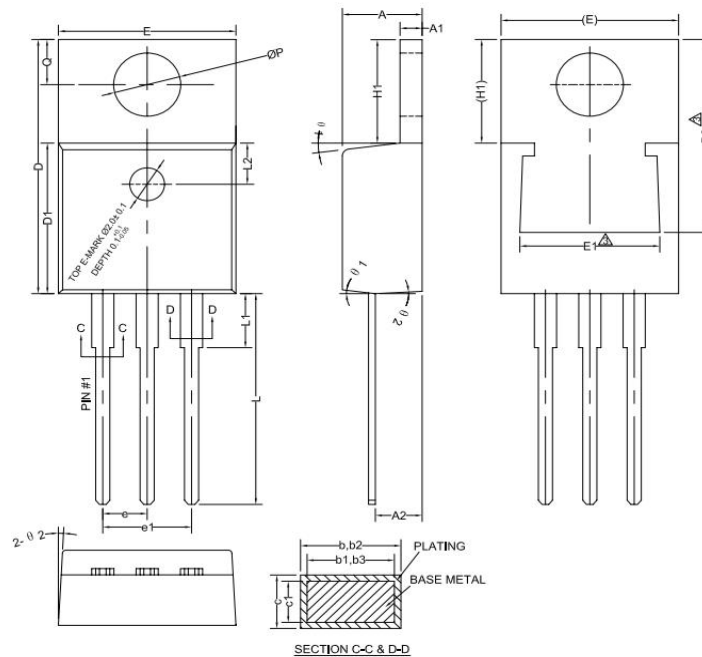
| Symbol | Dimensions(mm) |       |       | Symbol | Dimensions(mm) |       |       |
|--------|----------------|-------|-------|--------|----------------|-------|-------|
|        | Min.           | Typ.  | Max.  |        | Min.           | Typ.  | Max.  |
| A      | 4.90           | 5.00  | 5.10  | E1     | 13.10          | 13.25 | 13.40 |
| A1     | 2.31           | 2.41  | 2.51  | E2     | 4.85           | 4.95  | 5.10  |
| A2     | 1.90           | 2.00  | 2.10  | E3     | 2.40           | 2.50  | 2.60  |
| b      | 1.15           | 1.20  | 1.25  | L      | 19.80          | 19.98 | 20.15 |
| b1     | 1.95           | 2.10  | 2.25  | L1     | -              | -     | 4.30  |
| b2     | 2.95           | 3.10  | 3.25  | ΦP     | 3.60           | 3.70  | 3.80  |
| c      | 0.55           | 0.60  | 0.65  | ΦP1    | 3.40           | 3.50  | 3.60  |
| D      | 20.90          | 21.00 | 21.10 | ΦP2    | 6.90           | 7.10  | 7.30  |
| D1     | 16.35          | 16.55 | 16.75 | Q      | 5.60           | 5.80  | 6.00  |
| D2     | 1.05           | 1.20  | 1.35  | S      | 6.05           | 6.15  | 6.25  |
| E      | 15.70          | 15.80 | 15.90 | T      | 9.80           | 10.00 | 10.20 |
| U      | 6.00           | 6.20  | 6.40  | e      | 5.40           | 5.44  | 5.48  |
| Ø1     | 5°             | 7°    | 9°    | ΦP3    | 2.40           | 2.50  | 2.60  |
| Ø2     | 1°             | 3°    | 5°    | Ø3     | 13°            | 15°   | 17°   |

**Mechanical Dimensions**
**TO-247(Package 3)**
**Unit: mm**


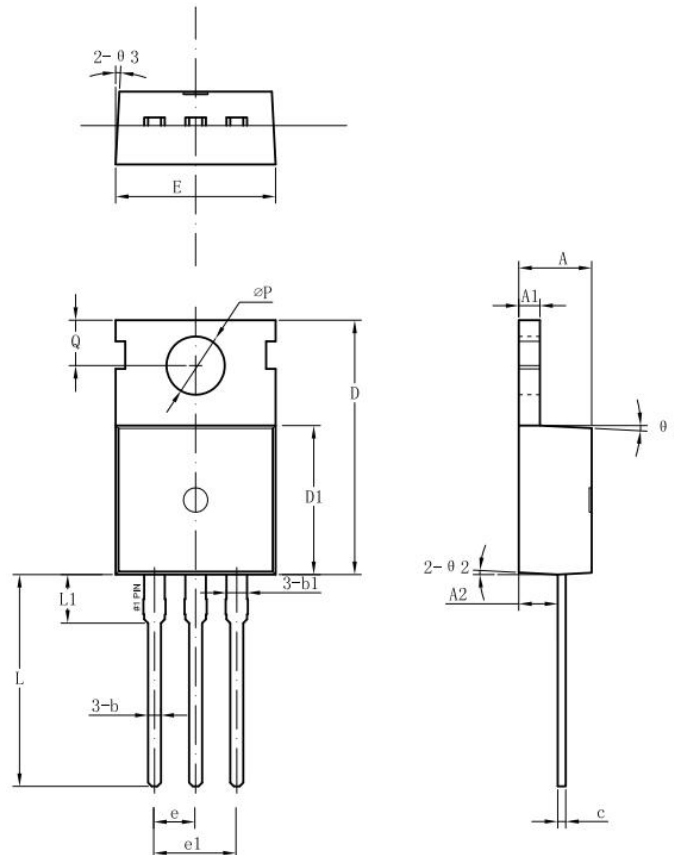
| Symbol | Dimensions(mm) |      |      | Symbol | Dimensions(mm) |       |       |
|--------|----------------|------|------|--------|----------------|-------|-------|
|        | Min.           | Typ. | Max. |        | Min.           | Typ.  | Max.  |
| A      | 4.90           | 5.00 | 5.10 | c1     | 0.58           | 0.60  | 0.62  |
| A1     | 2.31           | 2.41 | 2.51 | D      | 20.90          | 21.00 | 21.10 |
| A2     | 1.90           | 2.00 | 2.10 | D1     | 16.25          | 16.55 | 16.85 |
| b      | 1.16           | -    | 1.26 | D2     | 1.05           | 1.20  | 1.35  |
| b1     | 1.15           | 1.20 | 1.22 | E      | 15.70          | 15.80 | 15.90 |
| b2     | 1.96           | -    | 2.06 | E1     | 13.10          | 13.30 | 13.50 |
| b3     | 1.95           | 2.00 | 2.02 | E2     | 4.90           | 5.00  | 5.10  |
| b4     | 2.96           | -    | 3.06 | E3     | 2.40           | 2.50  | 2.60  |
| b5     | 2.95           | 3.00 | 3.02 | e      | 5.34           | 5.44  | 5.54  |
| b6     | -              | -    | 2.25 | L      | 19.80          | 19.92 | 20.10 |
| b7     | -              | -    | 3.25 | L1     | 3.95           | 4.13  | 4.30  |
| c      | 0.59           | -    | 0.66 | M      | 0.35           | -     | 0.95  |
| P      | 3.50           | 3.60 | 3.70 | P1     | 7.00           | -     | 7.40  |
| P2     | 2.40           | 2.50 | 2.60 | Q      | 5.60           | -     | 6.00  |
| S      | 6.05           | 6.15 | 6.25 | T      | 9.80           | -     | 10.20 |
| U      | 6.00           | -    | 6.40 | a      | 0              | -     | 0.15  |
| a'     | 0              | -    | 0.15 |        |                |       |       |

**Mechanical Dimensions**
**TO-247(Package 4)**
**Unit: mm**


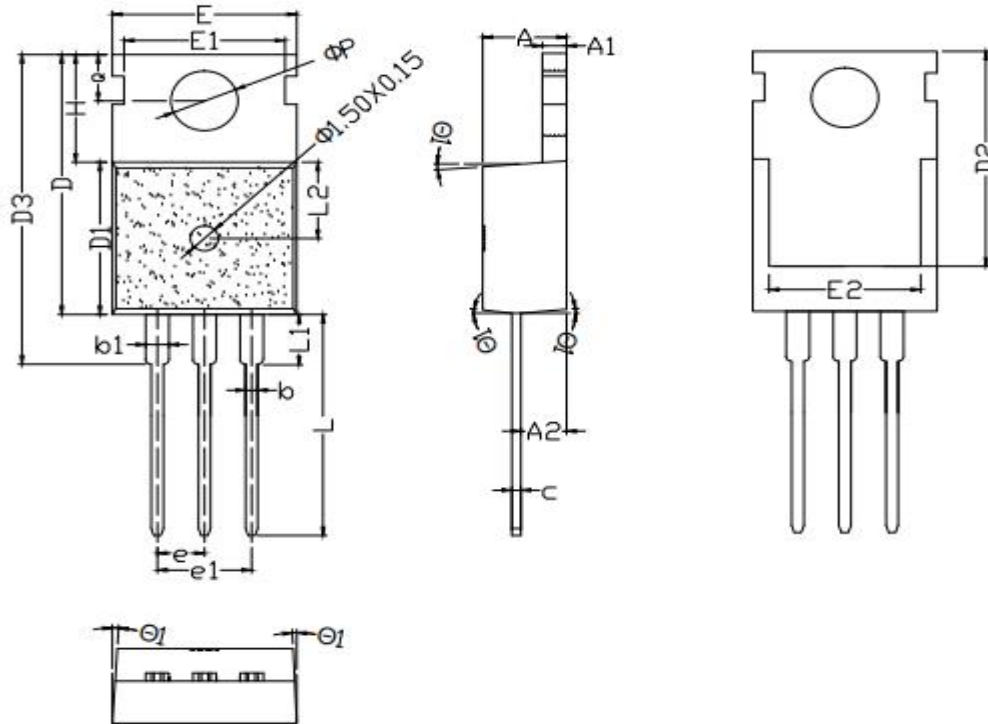
| Symbol | Dimensions(mm) |       |       | Symbol | Dimensions(mm) |       |       |
|--------|----------------|-------|-------|--------|----------------|-------|-------|
|        | Min.           | Typ.  | Max.  |        | Min.           | Typ.  | Max.  |
| A      | 4.90           | 5.00  | 5.10  | E2     | 4.90           | 5.00  | 5.10  |
| A1     | 2.31           | 2.41  | 2.51  | E3     | 2.40           | 2.50  | 2.60  |
| A2     | 1.90           | 2.00  | 2.10  | e      | 5.34           | 5.44  | 5.54  |
| b      | 1.12           | -     | 1.22  | L      | 19.80          | 19.92 | 20.10 |
| b1     | 1.11           | 1.16  | 1.18  | L1     | 3.95           | 4.13  | 4.30  |
| b2     | 1.96           | -     | 2.06  | P      | 3.50           | 3.60  | 3.70  |
| c      | 0.59           | -     | 0.66  | P1     | 7.00           | -     | 7.40  |
| D      | 20.90          | 21.00 | 21.10 | P2     | 2.40           | 2.50  | 2.60  |
| D1     | 16.25          | 16.55 | 16.85 | Q      | 5.60           | -     | 6.00  |
| D2     | 1.05           | 1.20  | 1.35  | S      | 6.05           | 6.15  | 6.25  |
| E      | 15.70          | 15.80 | 15.90 | T      | 9.80           | -     | 10.20 |
| E1     | 13.10          | 13.30 | 13.50 | U      | 6.00           | -     | 6.40  |
| b3     | 1.95           | 2.00  | 2.02  | b6     | -              | -     | 2.25  |
| b4     | 2.96           | -     | 3.06  | b7     | -              | -     | 3.25  |
| b5     | 2.95           | 3.00  | 3.02  | c1     | 0.58           | 0.60  | 0.62  |
| M      | 0.35           | -     | 0.95  | a      | 0              | -     | 0.15  |
| a'     | 0              | -     | 0.15  |        |                |       |       |

**Mechanical Dimensions**
**TO-220C (Package 1)**
**Unit: mm**


| Symbol | Dimensions(mm) |       |       |
|--------|----------------|-------|-------|
|        | Min.           | Typ.  | Max.  |
| A      | 4.40           | 4.57  | 4.70  |
| A1     | 1.22           | -     | 1.32  |
| A2     | 2.59           | 2.69  | 2.79  |
| b      | 0.77           | -     | 0.90  |
| b1     | 0.76           | 0.81  | 0.86  |
| b2     | 1.23           | -     | 1.36  |
| b3     | 1.22           | 1.27  | 1.32  |
| c      | 0.34           | -     | 0.47  |
| c1     | 0.33           | 0.38  | 0.43  |
| D      | 15.15          | 15.45 | 15.75 |
| D1     | 9.05           | 9.15  | 9.25  |
| D2     | 11.40          | -     | 12.88 |
| E      | 9.96           | 10.16 | 10.36 |
| E1     | 6.86           | -     | 8.89  |
| e      | 2.44           | 2.54  | 2.64  |
| e1     | 4.98           | 5.08  | 5.18  |
| H1     | 6.10           | 6.30  | 6.50  |
| L      | 12.70          | -     | 13.12 |
| L1     | -              | -     | 3.90  |
| ØP     | 3.80           | 3.84  | 3.88  |
| Q      | 2.60           | -     | 2.90  |
| θ1     | 5°             | 7°    | 9°    |
| θ2     | 1°             | 2°    | 5°    |

**Mechanical Dimensions**
**TO-220C (Package 2)**
**Unit: mm**


| Symbol | Dimensions(mm) |       |       |
|--------|----------------|-------|-------|
|        | Min.           | Typ.  | Max.  |
| A      | 4.30           | 4.50  | 4.70  |
| A1     | 1.25           | 1.30  | 1.40  |
| A2     | 2.20           | 2.40  | 2.60  |
| b      | 0.70           | 0.80  | 0.95  |
| b1     | -              | 1.27  | -     |
| c      | 0.40           | 0.50  | 0.65  |
| D      | 15.20          | 15.70 | 16.20 |
| D1     | 9.00           | 9.20  | 9.40  |
| E      | 9.70           | 10.00 | 10.20 |
| e      |                | 2.54  |       |
| e1     |                | 5.08  |       |
| L      | 12.60          | 13.08 | 13.60 |
| L1     | -              | 3.00  | -     |
| ΦP     | 3.50           | 3.60  | 3.80  |
| Q      | 2.60           | 2.80  | 3.00  |
| θ1     |                | 3°    |       |
| θ2     |                | 3°    |       |
| θ2     |                | 3°    |       |

**Mechanical Dimensions**
**TO-220C (Package 3)**
**Unit: mm**


| Symbol | Dimensions(mm) |       |       |
|--------|----------------|-------|-------|
|        | Min.           | Typ.  | Max.  |
| A      | 4.40           | 4.50  | 4.60  |
| A1     | 1.25           | 1.30  | 1.35  |
| A2     | 2.30           | 2.40  | 2.50  |
| b      | 0.70           | 0.80  | 0.90  |
| b1     | 1.25           | 1.33  | 1.42  |
| c      | 0.45           | 0.50  | 0.55  |
| D      | 15.50          | 15.75 | 16.00 |
| D1     | 9.10           | 9.20  | 9.30  |
| D2     | 12.90          | 13.10 | 13.30 |
| D3     | 15.45          | 15.80 | 16.15 |
| E      | 9.80           | 10.02 | 10.15 |
| e      | 2.54BSC        |       |       |
| e1     | 5.08BSC        |       |       |
| L      | 13.00          | 13.28 | 13.45 |
| L1     | -              | -     | 3.40  |
| ΦP     | 3.55           | 3.65  | 3.75  |
| Q      | 2.65           | 2.75  | 2.85  |
| θ1     | 2°             | -     | 7°    |
| E1     | 8.55           | 8.70  | 8.85  |
| E2     | 7.40           | 7.60  | 7.80  |
| H      | 6.40           | 6.50  | 6.60  |
| L2     | 4.50           | 4.65  | 4.80  |



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