

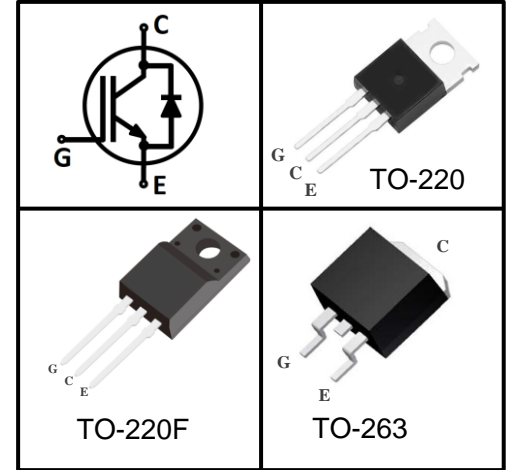
## Features

- Easy parallel switching capability due to positive temperature coefficient in  $V_{CEsat}$
- Low  $V_{CEsat}$ , fast switching
- High ruggedness, good thermal stability
- Very tight parameter distribution

| Type        | Marking   | Package Code |
|-------------|-----------|--------------|
| MPBP15N65EF | MP15N65EF | TO-220-3     |
| MPBA15N65EF | MP15N65EF | TO-220F-3    |
| MPBC15N65EF | MP15N65EF | TO-263       |

## Applications

- Motor Drives



## Maximum Rated Values <sup>1</sup>

| Parameter   | Symbol      | Value    |      |     | Unit             |
|---|-------------|----------|------|-----|------------------|
|   |             | 220      | 220F | 263 |                  |
| Collector-emitter voltage   | $V_{CE}$    | 650      |      |     | V                |
| DC collector current <sup>2</sup>   |             |          |      |     | A                |
| $T_C=25^\circ\text{C}$  | $I_C$       | 30       |      |     |                  |
| $T_C=100^\circ\text{C}$   |             | 15       |      |     |                  |
| Pulsed collector current <sup>3</sup>   | $I_{Cpuls}$ | 45       |      |     |                  |
| Diode forward current <sup>2</sup>  |             |          |      |     |                  |
| $T_C=25^\circ\text{C}$  | $I_F$       | 30       |      |     |                  |
| $T_C=100^\circ\text{C}$   |             | 15       |      |     |                  |
| Diode pulsed current <sup>3</sup>   | $I_{Fpuls}$ | 45       |      |     |                  |
| Short circuit withstanding time<br>$V_{GE} = 15\text{V}, V_{CC} \leq 400\text{V}, T_J \leq 150^\circ\text{C}$ | $t_{SC}$    | 10       |      |     | us               |
| Gate-emitter voltage  | $V_{GE}$    | $\pm 20$ |      |     | V                |
| Transient Gate-emitter voltage ( $t_p \leq 10\text{us}$ )   |             | $\pm 30$ |      |     |                  |
| Power dissipation   |             |          |      |     | W                |
| $T_C=25^\circ\text{C}$  | $P_{tot}$   | 125      | 52   | 107 |                  |
| $T_C=100^\circ\text{C}$   |             | 63       | 26   | 54  |                  |
| Operating junction temperature  | $T_j$       | -55~175  |      |     | $^\circ\text{C}$ |
| Storage temperature   | $T_{stg}$   | -55~150  |      |     |                  |

1:Reference standard: JESD-022 2: limited by  $T_{jmax}$  3:  $T_p$  limited by  $T_{jmax}$  ;

**Thermal Characteristics**

| Parameter                               | Symbol      | Max |      |     | Unit |
|---|-------------|-----|------|-----|------|
|   |             | 220 | 220F | 263 |      |
| IGBT thermal resistance, junction-case  | $R_{thJC}$  | 1.2 | 2.9  | 1.4 | K/W  |
| Diode thermal resistance, junction-case | $R_{thJCD}$ | 2.0 | 4.6  | 2.8 |      |
| Thermal Resistance, junction-ambient    | $R_{thJA}$  | 65  | 65   | 65  |      |

**Electrical Characteristics (at  $T_j=25^\circ\text{C}$ , unless otherwise specified)**  
**Static Characteristics**

| Parameter                            | Symbol        | Conditions                                     | Min | Typ  | Max  | Unit |
|--------------------------------------|---------------|--|-----|------|------|------|
| Collector-emitter breakdown voltage  | $V_{(BR)CES}$ | $V_{GE}=0V, I_C=0.25mA$                        | 650 | -    | -    | V    |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $V_{GE}=15V, I_C=15A, T_j=25^\circ\text{C}$    | -   | 1.45 | 1.95 |      |
|                                      |               | $T_j=125^\circ\text{C}$                        | -   | 1.60 | -    |      |
|                                      |               | $T_j=150^\circ\text{C}$                        | -   | 1.80 | -    |      |
| Diode forward voltage                | $V_F$         | $V_{GE}=0V, I_F=15A, T_j=25^\circ\text{C}$     | -   | 1.50 | 1.80 |      |
|                                      |               | $T_j=125^\circ\text{C}$                        | -   | 1.40 | -    |      |
|                                      |               | $T_j=150^\circ\text{C}$                        | -   | 1.30 | -    |      |
| G-E threshold voltage                | $V_{GE(th)}$  | $I_C=250\mu A, V_{CE}=V_{GE}$                  | 4.5 | 5.8  | 6.5  |      |
| C-E leakage current                  | $I_{CES}$     | $V_{CE}=650V, V_{GE}=0V, T_j=25^\circ\text{C}$ | -   | -    | 0.01 | mA   |
|                                      |               | $T_j=150^\circ\text{C}$                        | -   | -    | 1.0  |      |
| G-E leakage current                  | $I_{GES}$     | $V_{CE}=0V, V_{GE}=20V$                        | -   | -    | 250  | nA   |

## Dynamic Characteristics

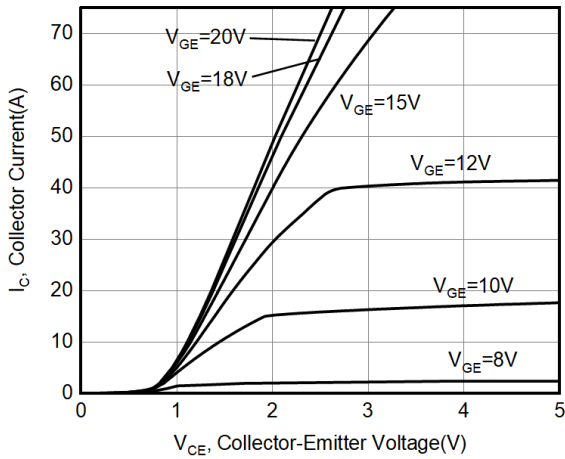
| Parameter                    | Symbol    | Conditions                                | Min | Typ  | Max | Unit |
|------------------------------|-----------|---|-----|------|-----|------|
| Input capacitance            | $C_{iss}$ | $V_{CE}=25V,$<br>$V_{GE}=0V,$<br>$f=1MHz$ | -   | 1285 | -   | pF   |
| Output capacitance           | $C_{oss}$ |   | -   | 69   | -   |      |
| Reverse transfer capacitance | $C_{rss}$ |   | -   | 9    | -   |      |
| Gate charge                  | $Q_G$     | $V_{CC}=300V, I_C=15A,$<br>$V_{GE}=15V$   | -   | 53   | -   | nC   |

## IGBT Switching Characteristics

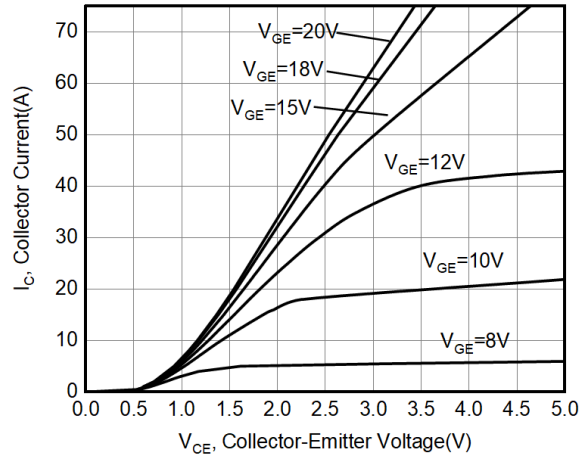
| Parameter              | Symbol       | Conditions  | Min | Typ  | Max | Unit |
|------------------------|--------------|---|-----|------|-----|------|
| Turn-on delay time     | $t_{d(on)}$  | $T_j=25^\circ C,$<br>$V_{CC}=400V,$<br>$I_C=15A,$<br>$V_{GE}=0/15V,$<br>$R_G=10\Omega,$<br>Inductive load | -   | 66   | -   | ns   |
| Rise time              | $t_r$        |   | -   | 35   | -   |      |
| Turn-off delay time    | $t_{d(off)}$ |   | -   | 126  | -   |      |
| Fall time              | $t_f$        |   | -   | 57   | -   |      |
| Turn-on energy         | $E_{on}$     |   | -   | 0.28 | -   | mJ   |
| Turn-off energy        | $E_{off}$    |   | -   | 0.30 | -   |      |
| Total switching energy | $E_{ts}$     |   | -   | 0.58 | -   |      |

## Diode Characteristics

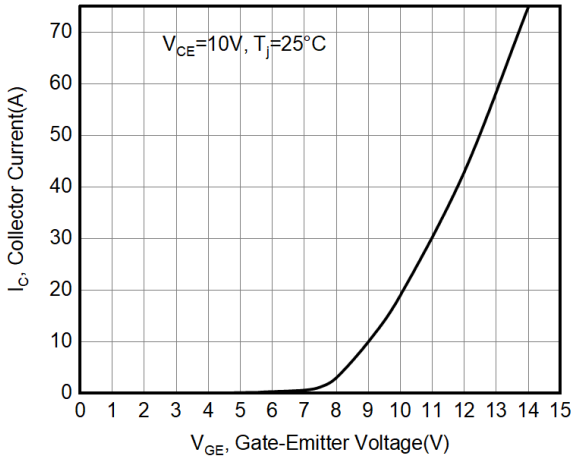
| Parameter                           | Symbol    | Conditions   | Min | Typ  | Max | Unit    |
|-------------------------------------|-----------|--|-----|------|-----|---------|
| Diode reverse recovery time         | $t_{rr}$  | $T_j=25^\circ C,$<br>$V_R=400V,$<br>$I_F=15A,$<br>$di_F/dt=570A/\mu s$ | -   | 82   | -   | ns      |
| Diode reverse recovery charge       | $Q_{rr}$  |  | -   | 0.40 | -   | $\mu C$ |
| Diode peak reverse recovery current | $I_{rrm}$ |  | -   | 8.5  | -   | A       |



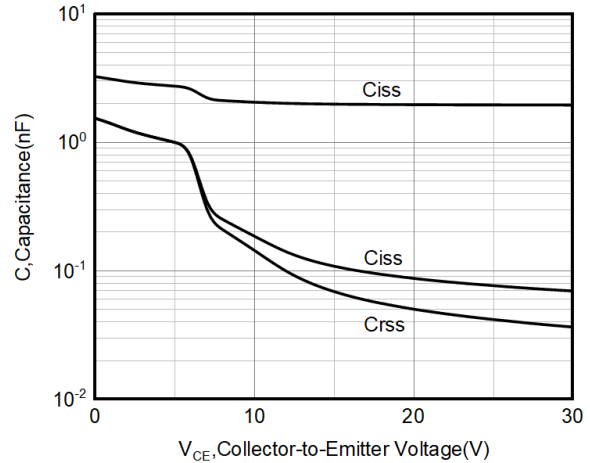
**Figure 1. Typical output characteristic**  
( $T_j = 25\text{ }^\circ\text{C}$ )



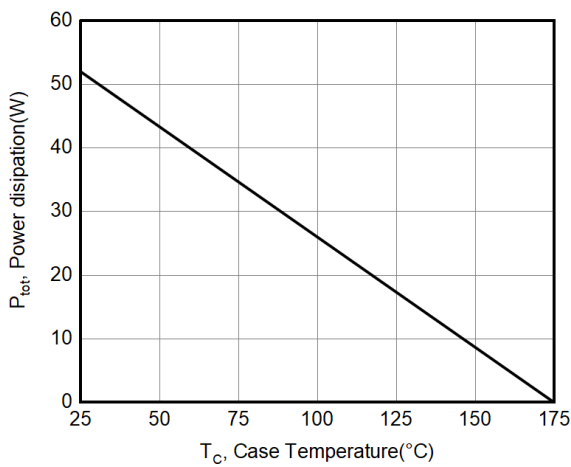
**Figure 2. Typical output characteristic**  
( $T_j = 150\text{ }^\circ\text{C}$ )



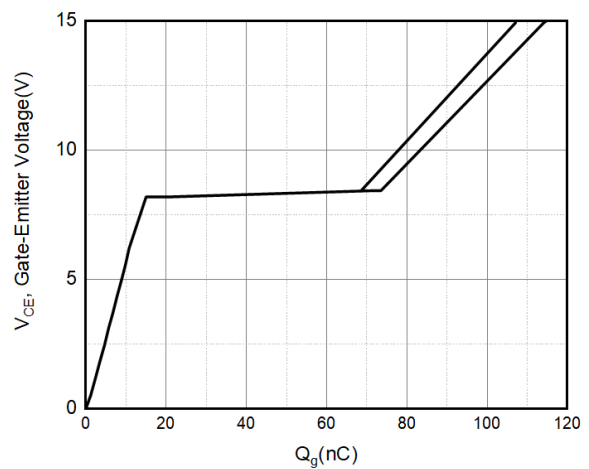
**Figure 3. Typical transfer characteristic**  
( $T_j = 25\text{ }^\circ\text{C}$ )



**Figure 4. Capacitance characteristic**  
( $V_{GE} = 0\text{V}$ ,  $f = 1\text{MHz}$ )



**Figure 5. Power dissipation as a function**  
**of case temperature ( $T_j \leq 175\text{ }^\circ\text{C}$ )**



**Figure 6. Typical gate charge ( $I_C = 15\text{A}$ )**

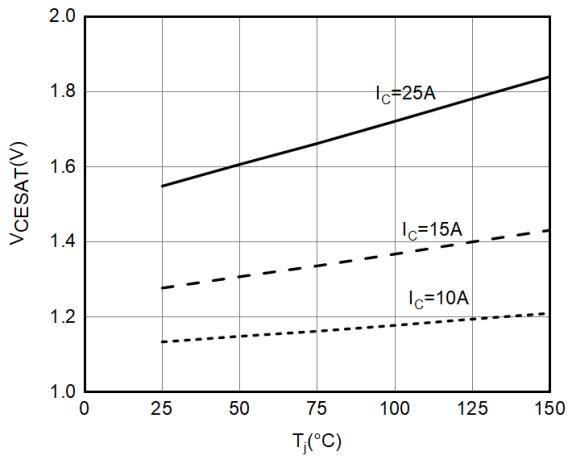


Figure 7.  $V_{CESAT}$  as a function of junction temperature ( $V_{GE}=15V$ )

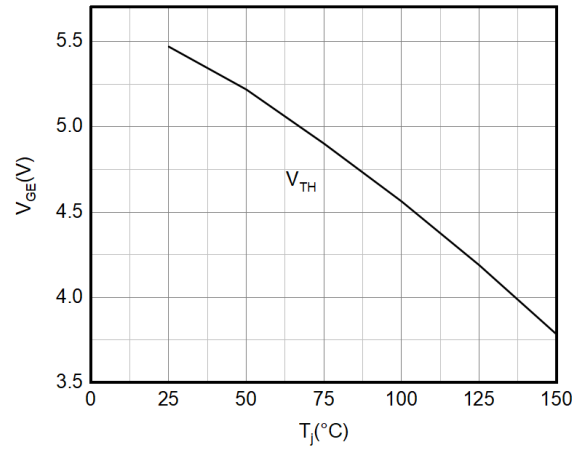


Figure 8.  $V_{TH}$  as a function of junction temperature ( $I_{CE}=250\mu A$ )

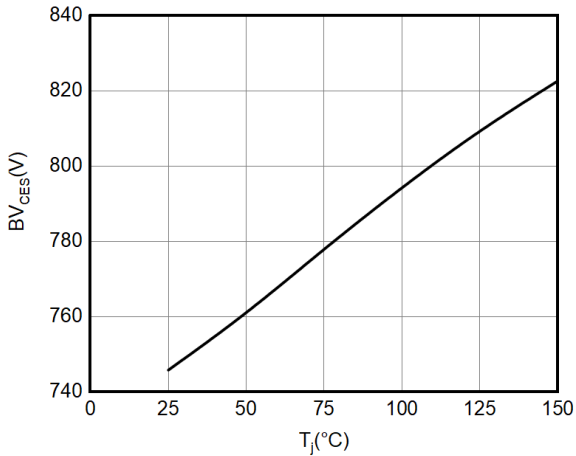


Figure 9.  $BV$  as a function of junction temperature ( $I_{CE}=250\mu A$ )

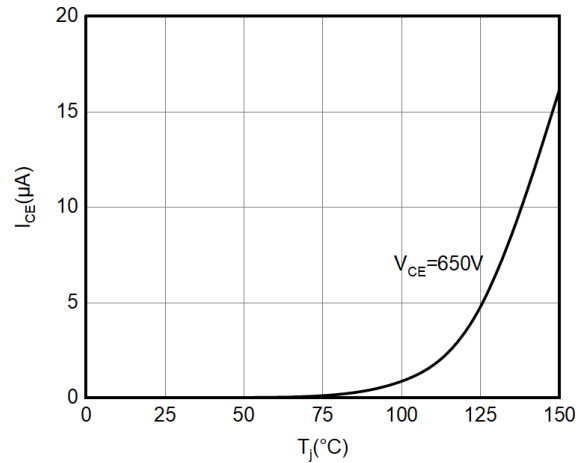


Figure 10.  $I_{CES}$  leakage current as a function of junction temperature

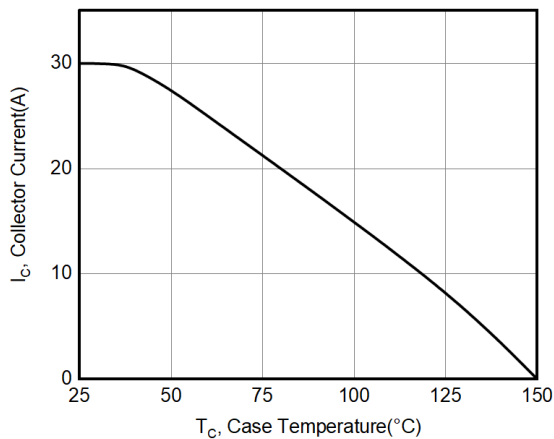


Figure 11. Collector current as a function of case temperature ( $V_{GE} \geq 15V$ ,  $T_j \leq 150^\circ C$ )

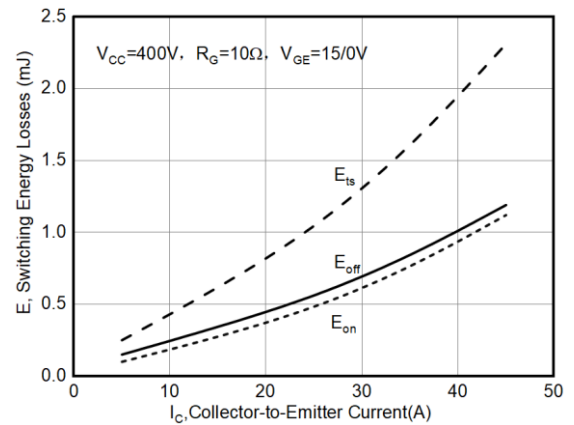


Figure 12.  $E_{on}$ ,  $E_{off}$  as a function of  $I_C$  ( $T_j=25^\circ C$ )

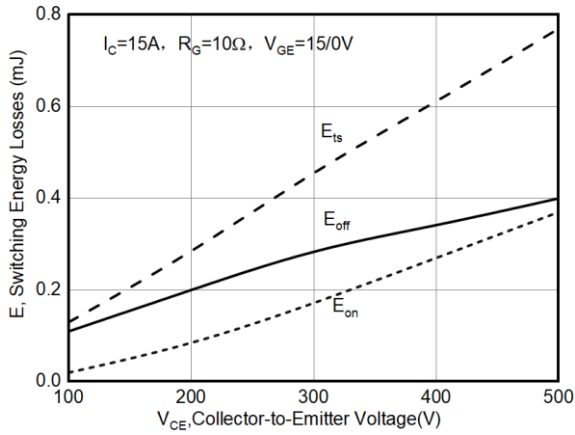


Figure 13.  $E_{on}$ ,  $E_{off}$  as a function of  $V_{CE}$  ( $T_j=25^\circ C$ )

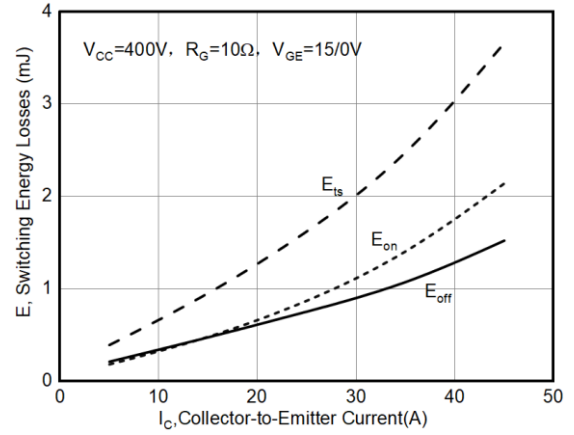


Figure 14.  $E_{on}$ ,  $E_{off}$  as a function of  $I_C$  ( $T_j=150^\circ C$ )

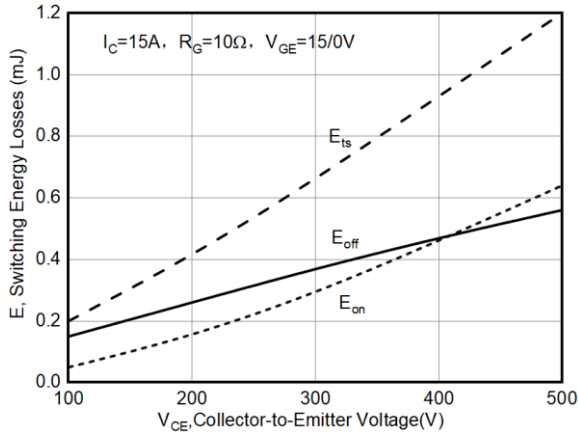


Figure 15.  $E_{on}$ ,  $E_{off}$  as a function of  $V_{CE}$  ( $T_j=150^\circ C$ )

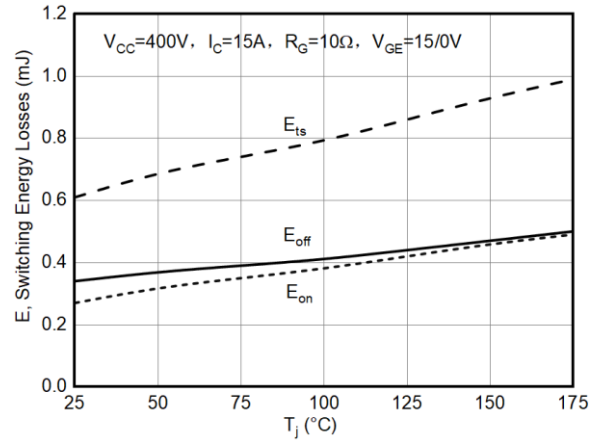


Figure 16.  $E_{on}$ ,  $E_{off}$  as a function of junction temperature

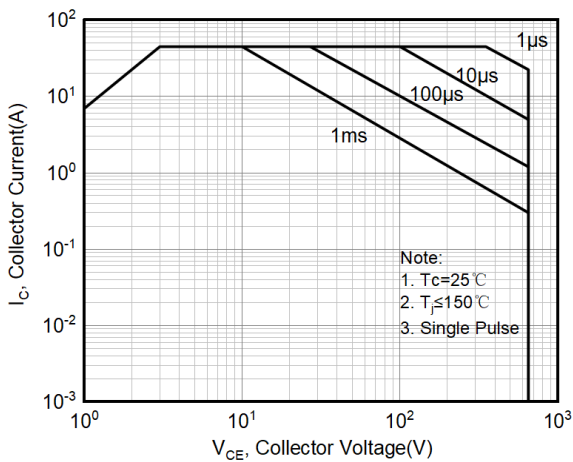
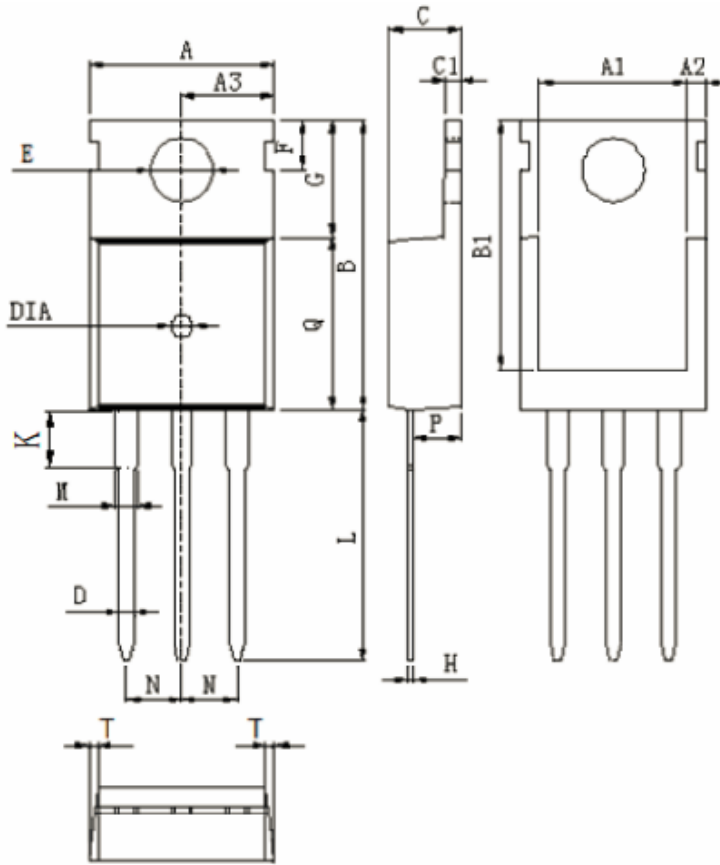


Figure 17. FBSOA

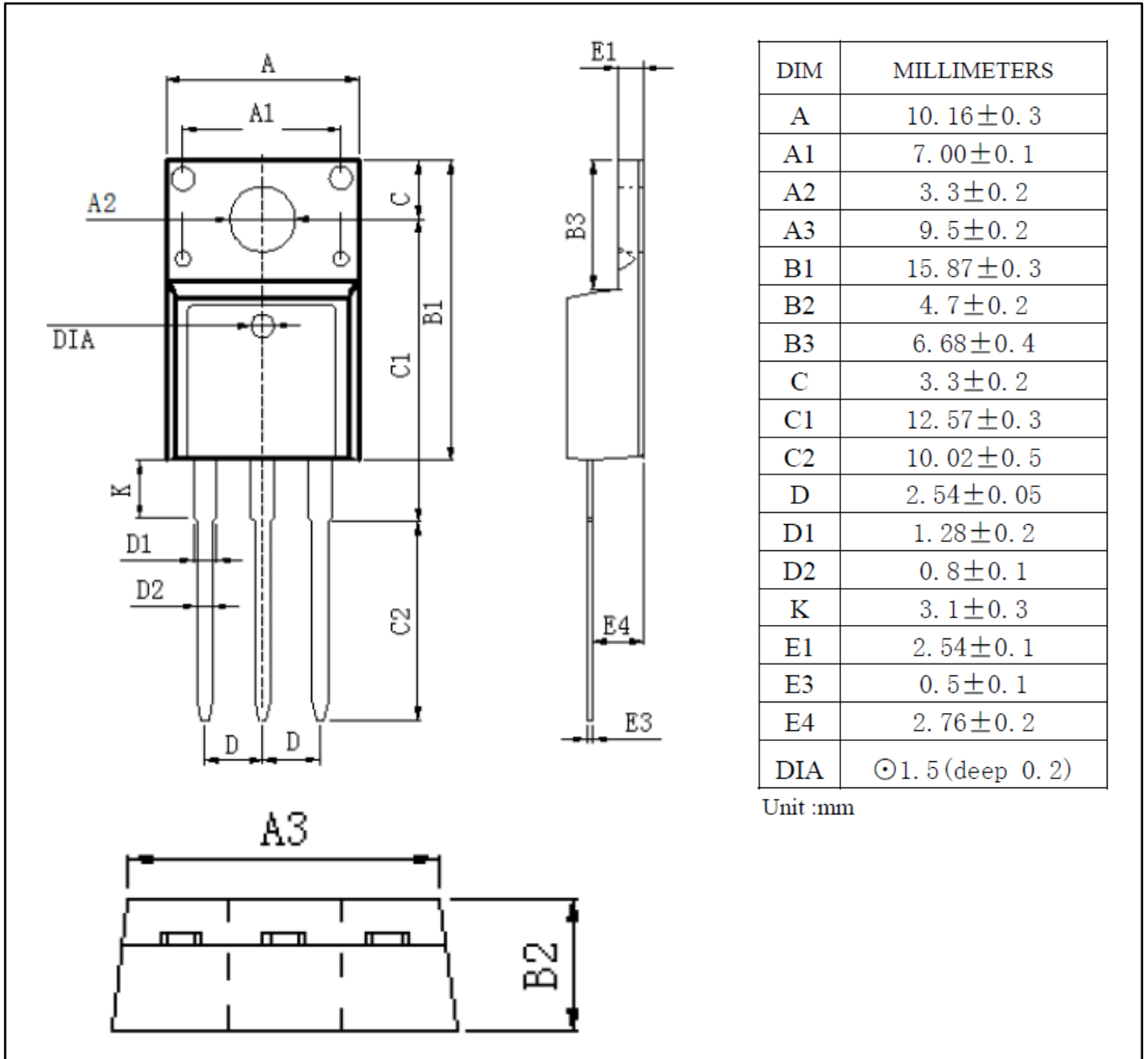
TO-220-3L



| DIM | MILLIMETERS     |
|-----|-----------------|
| A   | 10.0±0.3        |
| A1  | 8.64±0.2        |
| A2  | 1.15±0.1        |
| A3  | 5.0±0.2         |
| B   | 15.8±0.4        |
| B1  | 13.2±0.3        |
| C   | 4.56±0.1        |
| C1  | 1.3±0.2         |
| D   | 0.8±0.2         |
| E   | 3.6±0.2         |
| F   | 2.95±0.3        |
| G   | 6.5±0.3         |
| H   | 0.5±0.1         |
| K   | 3.1±0.2         |
| L   | 13.2±0.4        |
| M   | 1.25±0.1        |
| N   | 2.54±0.1        |
| P   | 2.4±0.3         |
| Q   | 9.0±0.3         |
| T   | W:0.35          |
| DIA | ⊙1.5 (deep 0.2) |

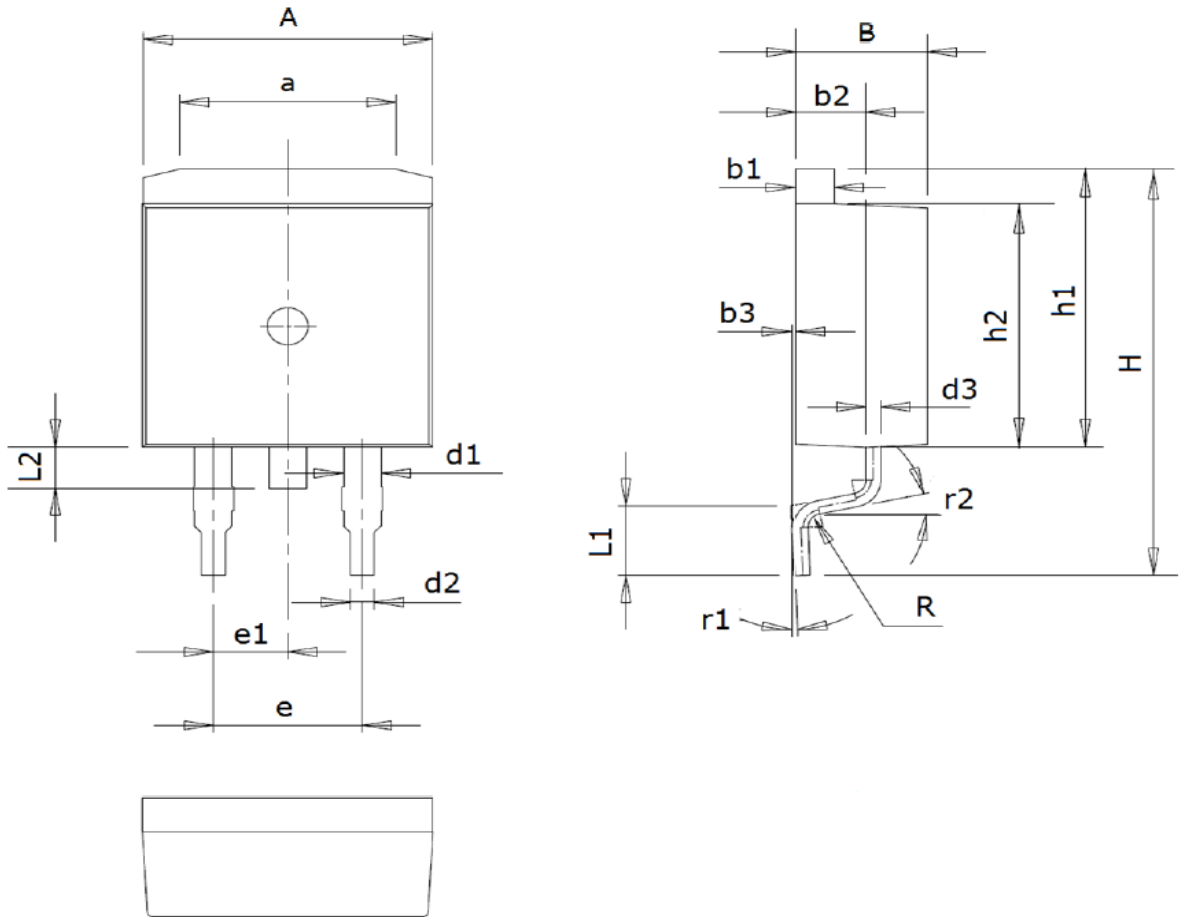
Unit :mm

TO-220F-3L





TO-263



| Symbol | Dimensions (mm) | Symbol | Dimensions (mm) | Symbol | Dimensions (mm) |
|--------|-----------------|--------|-----------------|--------|-----------------|
| A      | 9.86~10.26      | d2     | 0.7~0.96        | L1     | 2.0~2.6         |
| a      | 7.0~7.8         | d3     | 0.3~0.53        | L2     | 1.3~1.8         |
| B      | 4.37~4.77       | e      | 5.08            | R      | 0.5             |
| b1     | 1.22~1.42       | e1     | 2.54            | r1     | 0-9°            |
| b2     | 2.2~2.6         | H      | 14.7~15.5       | r2     | 12°             |
| b3     | 0~0.25          | h1     | 10.3~10.7       |        |                 |
| d1     | 1.17~1.47       | h2     | 9.1~9.4         |        |                 |



**Revision History:**

| Revision | Date    | Subjects (major changes since last revision) |
|----------|---------|--|
| 1.0      | 2022-04 | Initial version                              |
| 1.1      | 2022-09 | Add all the graphs                           |



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