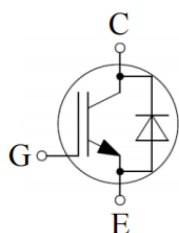




## IGBT Discrete

|                       |      |   |
|-----------------------|------|---|
| $V_{CE}$              | 650  | V |
| $I_C$                 | 10   | A |
| $V_{CE(SAT)} I_C=10A$ | 1.40 | V |

### Circuit



## Applications

- Soft switching applications
- Air conditioning
- Motor drive inverter

## Features

- High speed smooth switching device for hard & soft switching
- Maximum junction temperature 175°C
- Positive temperature coefficient
- High ruggedness, temperature stable

## Maximum Ratings

| Parameter                                                                               | Symbol      | Value    | Unit    |
|-----------------------------------------------------------------------------------------|-------------|----------|---------|
| Collector-Emitter Breakdown Voltage                                                     | $V_{CE}$    | 650      | V       |
| DC Collector Current, limited by $T_{jmax}$<br>$T_C=25^{\circ}C$<br>$T_C=100^{\circ}C$  | $I_C$       | 20<br>10 | A       |
| Diode Forward Current, limited by $T_{jmax}$<br>$T_C=25^{\circ}C$<br>$T_C=100^{\circ}C$ | $I_F$       | 20<br>10 | A       |
| Continuous Gate-Emitter Voltage                                                         | $V_{GE}$    | $\pm 20$ | V       |
| Transient Gate-Emitter Voltage<br>( $t_p \leq 10\mu s, D < 0.010$ )                     | $V_{GE}$    | $\pm 30$ | V       |
| Turn off Safe Operating Area $V_{CE} \leq 600V$ ,<br>$T_j \leq 150^{\circ}C$            |             | 40       | A       |
| Pulsed Collector Current, $V_{GE}=15V$ ,<br>$t_p$ limited by $T_{jmax}$                 | $I_{CM}$    | 40       | A       |
| Short Circuit Withstand Time, $V_{GE}=15V$ ,<br>$V_{CE} \leq 400V$                      | $T_{SC}$    | 5        | $\mu s$ |
| Diode Pulsed Current, $t_p$ limited by $T_{jmax}$                                       | $I_{Fpuls}$ | 40       | A       |
| Power Dissipation, $T_j=175^{\circ}C, T_C=25^{\circ}C$                                  | $P_{tot}$   | 100      | W       |



|                                                                          |       |            |    |
|--------------------------------------------------------------------------|-------|------------|----|
| Operating Junction Temperature                                           | $T_j$ | -40...+175 | °C |
| Storage Temperature                                                      | $T_s$ | -55...+150 | °C |
| Soldering Temperature, wave soldering 1.6mm (0.063in.) from case for 10s |       | 260        | °C |

**Electrical Characteristics of the IGBT** ( $T_j = 25^\circ\text{C}$  unless otherwise specified):

| Parameter                            | Symbol        | Conditions                                                                                            | Min. | Typ.                 | Max.         | Unit |
|--------------------------------------|---------------|-------------------------------------------------------------------------------------------------------|------|----------------------|--------------|------|
| <b>Static</b>                        |               |                                                                                                       |      |                      |              |      |
| Collector-Emitter Breakdown Voltage  | $BV_{CES}$    | $V_{GE}=0V, I_C=250\mu A$                                                                             | 650  |                      | -            | V    |
| Gate Threshold Voltage               | $V_{GE(th)}$  | $V_{GE}=V_{CE}, I_C=1mA$                                                                              | 5.0  | 5.8                  | 6.5          | V    |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_{GE}=15V, I_C=10A$<br>$T_j=25^\circ\text{C}$<br>$T_j=125^\circ\text{C}$<br>$T_j=150^\circ\text{C}$ |      | 1.40<br>1.55<br>1.60 | 1.70         | V    |
| Zero Gate Voltage Collector Current  | $I_{CES}$     | $V_{CE}=650V, V_{GE}=0V$<br>$T_j=25^\circ\text{C}$<br>$T_j=150^\circ\text{C}$                         |      |                      | 0.25<br>1.00 | mA   |
| Gate-Emitter Leakage Current         | $I_{GES}$     | $V_{CE}=0V, V_{GE}=\pm 20V$                                                                           |      |                      | $\pm 200$    | nA   |

| Parameter                       | Symbol      | Conditions                                                                           | Min. | Typ.  | Max. | Unit |
|---------------------------------|-------------|--------------------------------------------------------------------------------------|------|-------|------|------|
| <b>Dynamic</b>                  |             |                                                                                      |      |       |      |      |
| Input Capacitance               | $C_{ies}$   | $V_{CE}=25V, V_{GE}=0V,$<br>$f=1MHz$                                                 | -    | 0.89  | -    | nF   |
| Output capacitance              | $C_{oes}$   |                                                                                      | -    | 0.04  | -    |      |
| Reverse Transfer Capacitance    | $C_{res}$   |                                                                                      | -    | 0.01  | -    |      |
| Gate Charge                     | $Q_G$       | $V_{CC}=300V, I_C=10A,$<br>$V_{GE}=15V$                                              | -    | 0.059 | -    | uC   |
| Short circuit collector current | $I_{C(SC)}$ | $V_{GE}=15V, t_{SC} \leq 5\mu s$<br>$V_{CC}=400V,$<br>$T_{j,start}=25^\circ\text{C}$ | -    | 110   | -    | A    |

**Electrical Characteristics of the Diode** ( $T_j = 25^\circ\text{C}$  unless otherwise specified):

| Parameter             | Symbol | Conditions                                                                                                 | Min. | Typ.                 | Max. | Unit |
|-----------------------|--------|------------------------------------------------------------------------------------------------------------|------|----------------------|------|------|
| <b>Static</b>         |        |                                                                                                            |      |                      |      |      |
| Diode Forward Voltage | $V_F$  | $I_F = 10\text{A}$<br>$T_j = 25^\circ\text{C}$ ,<br>$T_j = 125^\circ\text{C}$<br>$T_j = 150^\circ\text{C}$ |      | 1.70<br>1.50<br>1.40 | 2.20 | V    |

**Switching Characteristic, Inductive Load**

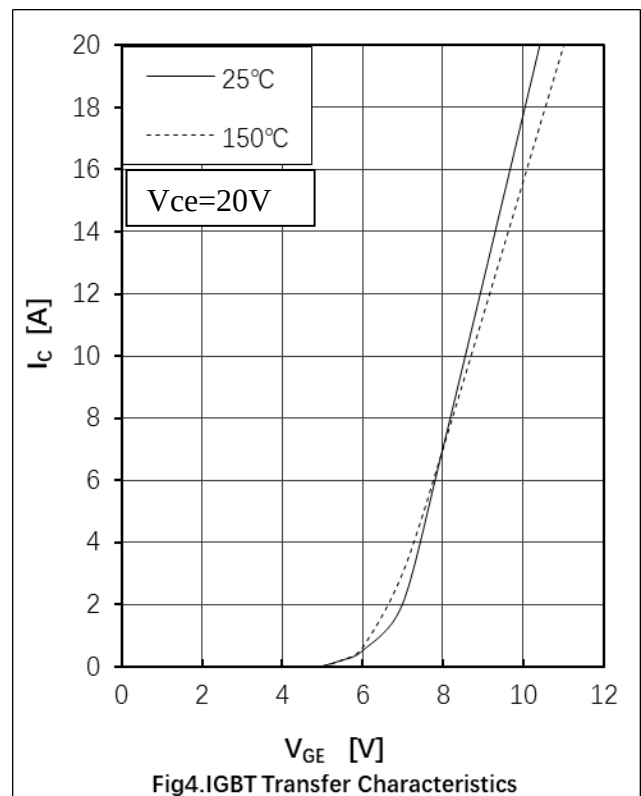
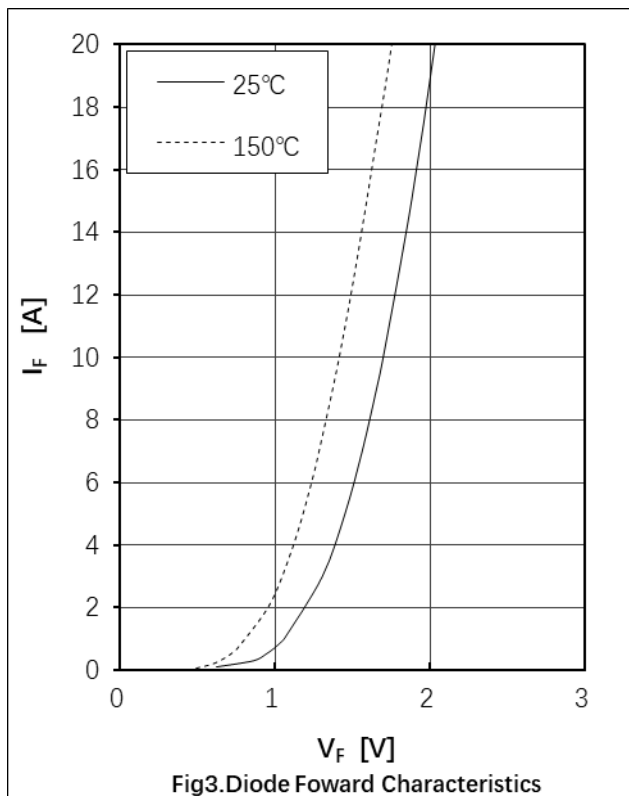
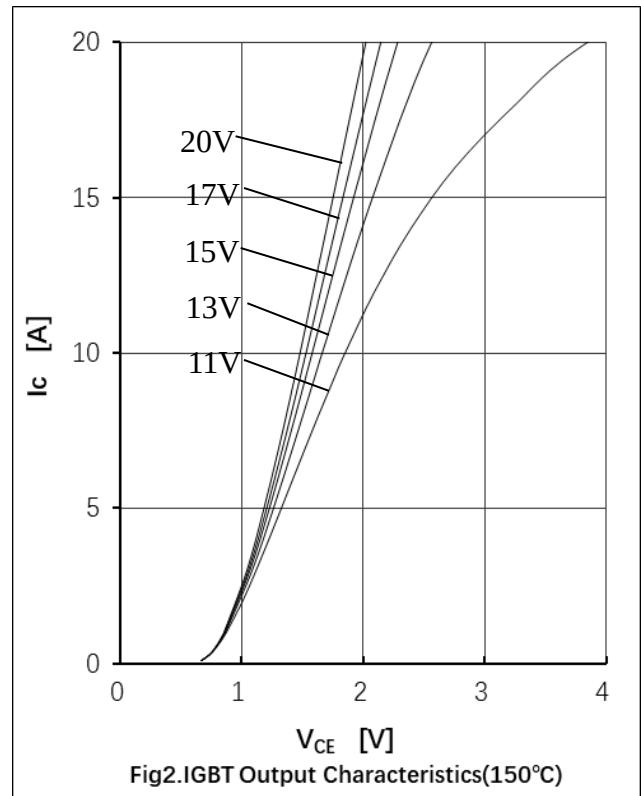
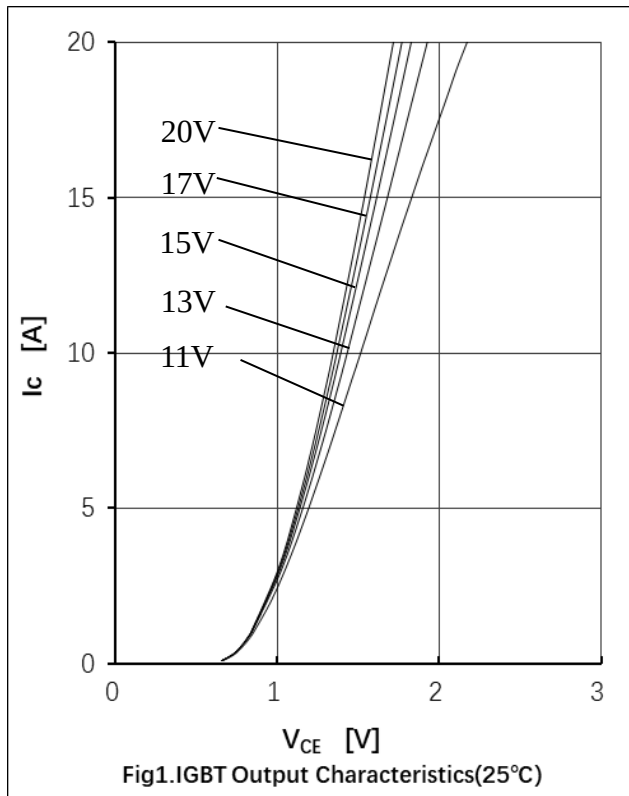
| Parameter                          | Symbol              | Conditions                                                                                                                   | Min. | Typ. | Max. | Unit |
|------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| Dynamic , at T <sub>j</sub> = 25℃  |                     |                                                                                                                              |      |      |      |      |
| Turn-on Delay Time                 | t <sub>d(on)</sub>  | T <sub>j</sub> =25℃<br>V <sub>CC</sub> = 300V,<br>I <sub>C</sub> =10A,<br>V <sub>GE</sub> =-5V~15V,<br>R <sub>g</sub> =51 Ω  | -    | 10   | -    | ns   |
| Rise Time                          | t <sub>r</sub>      |                                                                                                                              | -    | 26   | -    | ns   |
| Turn-on Energy                     | E <sub>on</sub>     |                                                                                                                              | -    | 0.36 | -    | mJ   |
| Turn-off Delay Time                | t <sub>d(off)</sub> |                                                                                                                              | -    | 68   | -    | ns   |
| Fall Time                          | t <sub>f</sub>      |                                                                                                                              | -    | 135  | -    | ns   |
| Turn-off Energy                    | E <sub>off</sub>    |                                                                                                                              | -    | 0.17 | -    | mJ   |
| Dynamic , at T <sub>j</sub> = 125℃ |                     |                                                                                                                              |      |      |      |      |
| Turn-on Delay Time                 | t <sub>d(on)</sub>  | T <sub>j</sub> =125℃<br>V <sub>CC</sub> = 300V,<br>I <sub>C</sub> =10A,<br>V <sub>GE</sub> =-5V~15V,<br>R <sub>g</sub> =51 Ω | -    | 14   | -    | ns   |
| Rise Time                          | t <sub>r</sub>      |                                                                                                                              | -    | 35   | -    | ns   |
| Turn-on Energy                     | E <sub>on</sub>     |                                                                                                                              | -    | 0.42 | -    | mJ   |
| Turn-off Delay Time                | t <sub>d(off)</sub> |                                                                                                                              | -    | 68   | -    | ns   |
| Fall Time                          | t <sub>f</sub>      |                                                                                                                              | -    | 162  | -    | ns   |
| Turn-off Energy                    | E <sub>off</sub>    |                                                                                                                              | -    | 0.29 | -    | mJ   |
| Dynamic , at T <sub>j</sub> = 150℃ |                     |                                                                                                                              |      |      |      |      |
| Turn-on Delay Time                 | t <sub>d(on)</sub>  | T <sub>j</sub> =150℃<br>V <sub>CC</sub> = 300V,<br>I <sub>C</sub> =10A,<br>V <sub>GE</sub> =-5V~15V,<br>R <sub>g</sub> =51 Ω | -    | 16   | -    | ns   |
| Rise Time                          | t <sub>r</sub>      |                                                                                                                              | -    | 41   | -    | ns   |
| Turn-on Energy                     | E <sub>on</sub>     |                                                                                                                              | -    | 0.46 | -    | mJ   |
| Turn-off Delay Time                | t <sub>d(off)</sub> |                                                                                                                              | -    | 69   | -    | ns   |
| Fall Time                          | t <sub>f</sub>      |                                                                                                                              | -    | 181  | -    | ns   |
| Turn-off Energy                    | E <sub>off</sub>    |                                                                                                                              | -    | 0.33 | -    | mJ   |

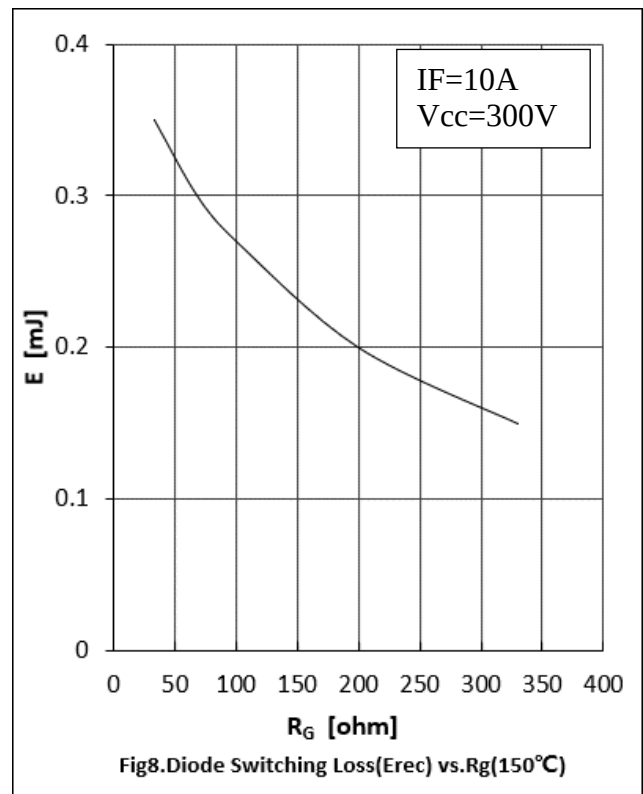
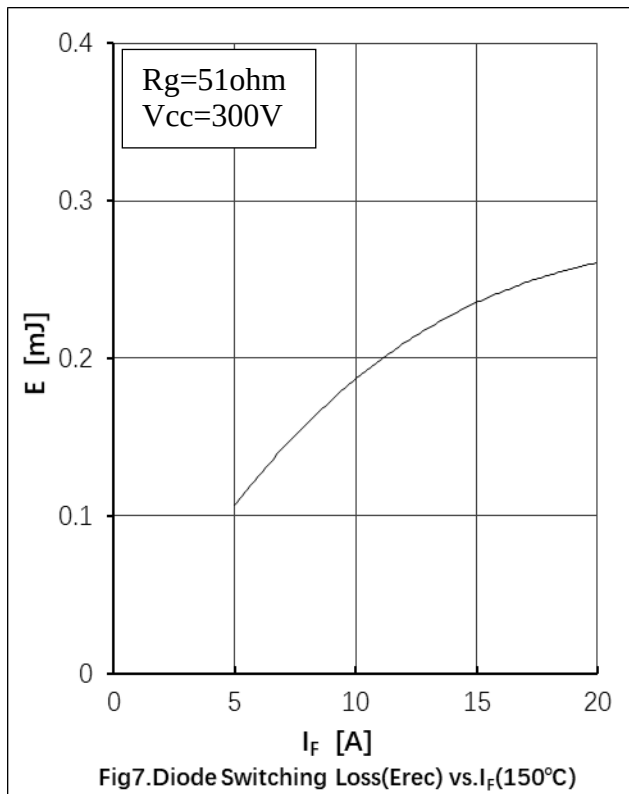
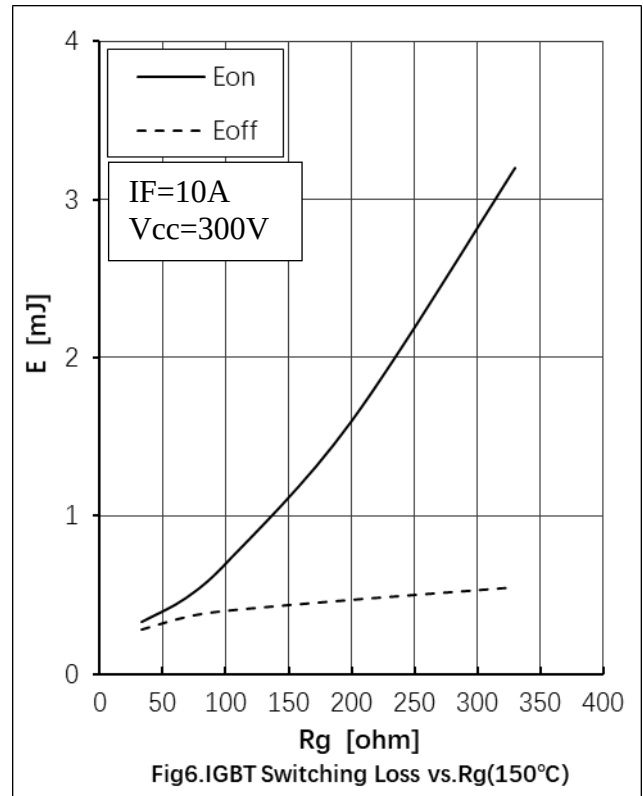
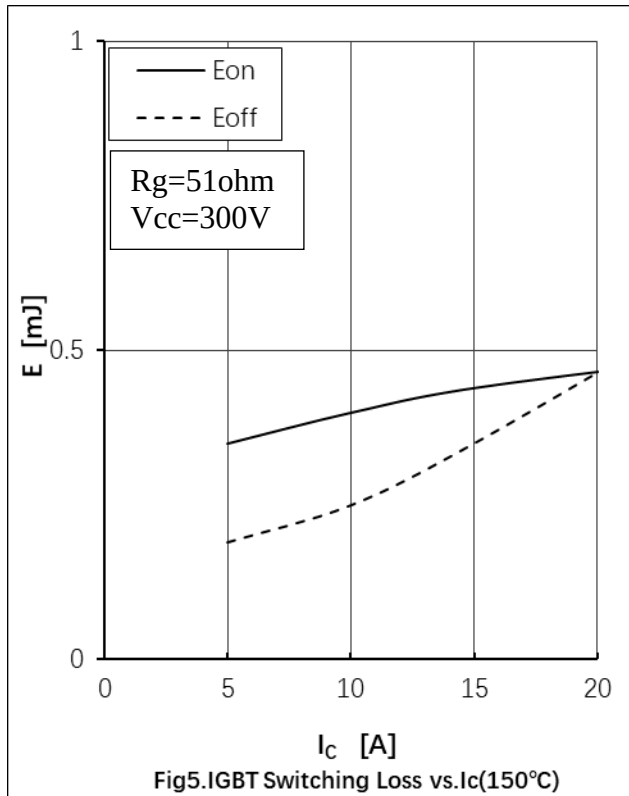
**Electrical Characteristics of the DIODE**

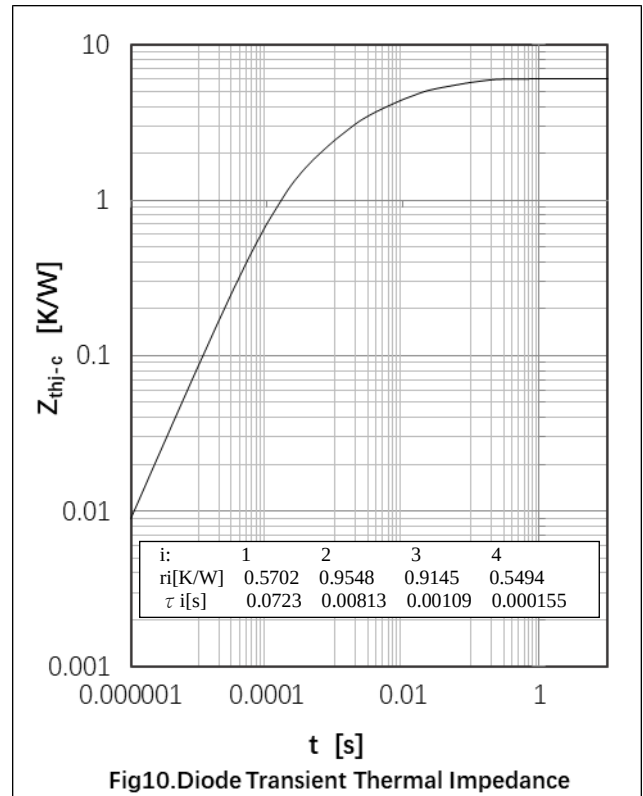
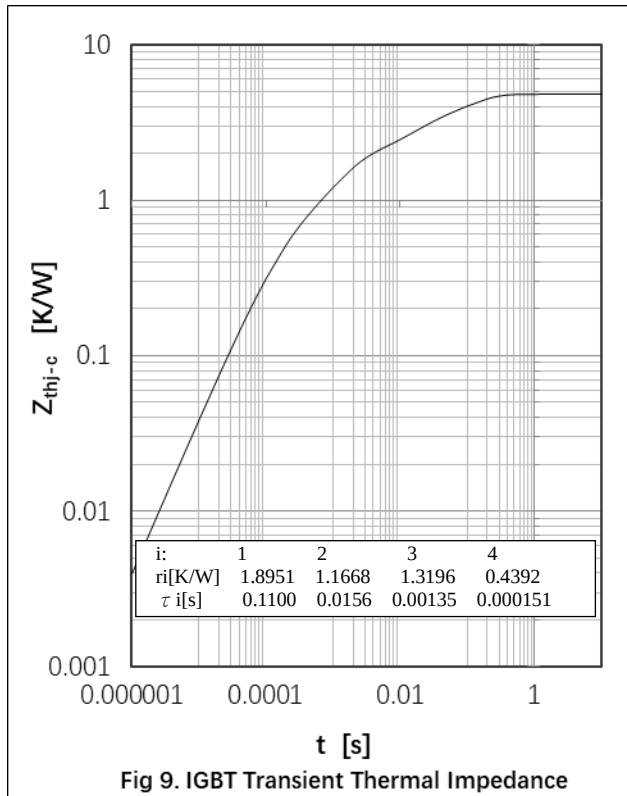
| Parameter                           | Symbol           | Conditions                                                        | Min. | Typ. | Max. | Unit |
|-------------------------------------|------------------|-------------------------------------------------------------------|------|------|------|------|
| Dynamic , at T <sub>j</sub> = 25°C  |                  |                                                                   |      |      |      |      |
| Reverse Recovery Current            | I <sub>rr</sub>  | I <sub>F</sub> =10A,<br>V <sub>R</sub> =300V,<br>-di/dt= 400A/μs, | -    | 9    | -    | A    |
| Reverse Recovery Charge             | Q <sub>rr</sub>  |                                                                   | -    | 0.16 | -    | uC   |
| Reverse Recovery Energy             | E <sub>rec</sub> |                                                                   | -    | 0.05 | -    | mJ   |
| Dynamic , at T <sub>j</sub> = 125°C |                  |                                                                   |      |      |      |      |
| Reverse Recovery Current            | I <sub>rr</sub>  | I <sub>F</sub> =10A,<br>V <sub>R</sub> =300V,<br>-di/dt= 400A/μs, | -    | 12   | -    | A    |
| Reverse Recovery Charge             | Q <sub>rr</sub>  |                                                                   | -    | 0.63 | -    | uC   |
| Reverse Recovery Energy             | E <sub>rec</sub> |                                                                   | -    | 0.16 | -    | mJ   |
| Dynamic , at T <sub>j</sub> = 150°C |                  |                                                                   |      |      |      |      |
| Reverse Recovery Current            | I <sub>rr</sub>  | I <sub>F</sub> =10A,<br>V <sub>R</sub> =300V,<br>-di/dt= 400A/μs, | -    | 14   | -    | A    |
| Reverse Recovery Charge             | Q <sub>rr</sub>  |                                                                   | -    | 0.85 | -    | uC   |
| Reverse Recovery Energy             | E <sub>rec</sub> |                                                                   | -    | 0.19 | -    | mJ   |

**Thermal Resistance**

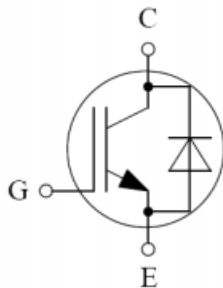
| Parameter                                 | Symbol               | Max. Value | Unit |
|-------------------------------------------|----------------------|------------|------|
| IGBT Thermal Resistance, Junction - Case  | R <sub>th(j-c)</sub> | 4.8        | K/W  |
| Diode Thermal Resistance, Junction - Case | R <sub>th(j-c)</sub> | 6.0        | K/W  |
| Thermal Resistance, Junction - Ambient    | R <sub>th(j-a)</sub> | 60         | K/W  |





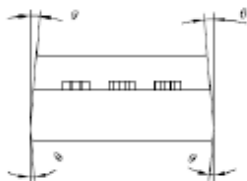
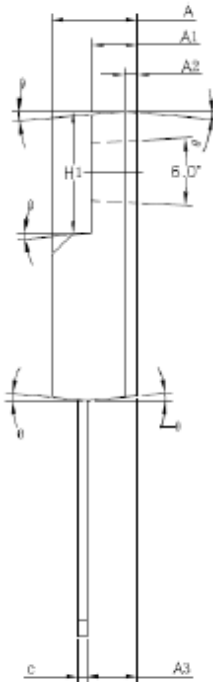
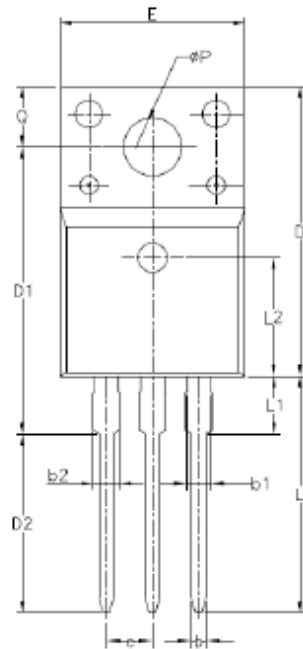


● **Circuit Diagram**



● **Package Outline Information**

**TO-220F package information**



| SYMBOL | MIN      | NOM   | MAX   |
|--------|----------|-------|-------|
| A      | 4.50     | 4.70  | 4.83  |
| A1     | 2.34     | 2.54  | 2.74  |
| A2     | 0.70 REF |       |       |
| A3     | 2.56     | 2.76  | 2.93  |
| b      | 0.70     | —     | 0.90  |
| b1     | 1.18     | —     | 1.38  |
| b2     | —        | —     | 1.47  |
| c      | 0.45     | 0.50  | 0.60  |
| D      | 15.67    | 15.87 | 16.07 |
| D1     | 15.55    | 15.75 | 15.95 |
| D2     | 9.60     | 9.80  | 10.0  |
| E      | 9.96     | 10.16 | 10.36 |
| e      | 2.54BSC  |       |       |
| H1     | 6.48     | 6.68  | 6.88  |
| L      | 12.68    | 12.98 | 13.28 |
| L1     | —        | —     | 3.50  |
| L2     | 6.50REF  |       |       |
| øP     | 3.08     | 3.18  | 3.28  |
| Q      | 3.20     | —     | 3.40  |
| ø1     | 1*       | 3*    | 5*    |