

## IGBT Modules



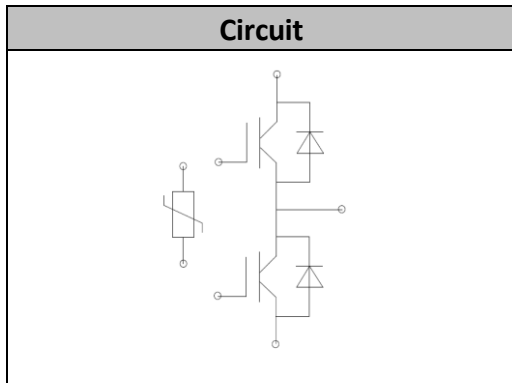
$V_{CES}$  1200V  
 $I_C$  300A

## Applications

- Motion/sevo control
- High frequency switching application
- UPS (Uninterruptible Power Supplies)
- Welding machine

## Features

- Low  $V_{ce(sat)}$  with Trench technology
- Low switching losses especially  $E_{off}$
- $V_{ce(sat)}$  with positive temperature coefficient
- High short circuit capability(10us)
- Including ultra fast & soft recovery anti-parallel FWD
- Low inductance package
- Maximum junction temperature 175°C



## ● IGBT

### Absolute Maximum Ratings

| Parameter                         | Symbol    | Conditions                                     | Value    | Unit |
|-----------------------------------|-----------|------------------------------------------------|----------|------|
| Collector-Emitter Voltage         | $V_{CES}$ | $V_{GE}=0V$ , $I_C=1mA$ , $T_{vj}=25^{\circ}C$ | 1200     | V    |
| Continuous Collector Current      | $I_C$     | $T_c=100^{\circ}C$                             | 300      | A    |
| Repetitive Peak Collector Current | $I_{CRM}$ | $t_p=1ms$                                      | 600      | A    |
| Gate-Emitter Voltage              | $V_{GES}$ | $T_{vj}=25^{\circ}C$                           | $\pm 20$ | V    |
| Total Power Dissipation           | $P_{tot}$ | $T_c=25^{\circ}C$<br>$T_{vjmax}=175^{\circ}C$  | 1850     | W    |



## Characteristic values

| Parameter                               | Symbol        | Conditions                                                                                             | Value |      |      | Unit     |
|-----------------------------------------|---------------|--------------------------------------------------------------------------------------------------------|-------|------|------|----------|
|                                         |               |                                                                                                        | Min.  | Typ. | Max. |          |
| Gate-emitter Threshold Voltage          | $V_{GE(th)}$  | $V_{GE}=V_{CE}$ , $I_C=11mA$ , $T_{vj}=25^{\circ}C$                                                    | 5.2   | 5.8  | 6.4  | V        |
| Collector-Emitter Cut-off Current       | $I_{CES}$     | $V_{CE}=1200V$ , $V_{GE}=0V$ , $T_{vj}=25^{\circ}C$                                                    |       |      | 1.0  | mA       |
| Collector-Emitter Saturation Voltage    | $V_{CE(sat)}$ | $I_C=300A$ , $V_{GE}=15V$ , $T_{vj}=25^{\circ}C$                                                       |       | 1.90 | 2.30 | V        |
|                                         |               | $I_C=300A$ , $V_{GE}=15V$ , $T_{vj}=125^{\circ}C$                                                      |       | 2.20 |      |          |
|                                         |               | $I_C=300A$ , $V_{GE}=15V$ , $T_{vj}=150^{\circ}C$                                                      |       | 2.35 |      |          |
| Gate Charge                             | $Q_G$         |                                                                                                        |       | 2.65 |      | uC       |
| Internal Gate Resistance                | $R_{Gint}$    |                                                                                                        |       | 1.25 |      | $\Omega$ |
| Input Capacitance                       | $C_{ies}$     | $V_{CE}=25V$ , $V_{GE}=0V$ ,<br>$f=1MHz$ , $T_{vj}=25^{\circ}C$                                        |       | 39.0 |      | nF       |
| Reverse Transfer Capacitance            | $C_{res}$     |                                                                                                        |       | 0.53 |      | nF       |
| Gate-Emitter leakage current            | $I_{GES}$     | $V_{CE}=0V$ , $V_{GE}=20V$ , $T_{vj}=25^{\circ}C$                                                      |       |      | 400  | nA       |
| Turn-on Delay Time                      | $t_{d(on)}$   | $I_C=300A$<br>$V_{CE}=600V$<br>$V_{GE}=\pm 15V$<br>$R_G=1.5\Omega$<br>$T_{vj}=25^{\circ}C$             |       | 127  |      | ns       |
| Rise Time                               | $t_r$         |                                                                                                        |       | 59   |      | ns       |
| Turn-off Delay Time                     | $t_{d(off)}$  |                                                                                                        |       | 234  |      | ns       |
| Fall Time                               | $t_f$         |                                                                                                        |       | 138  |      | ns       |
| Energy Dissipation During Turn-on Time  | $E_{on}$      |                                                                                                        |       | 23.5 |      | mJ       |
| Energy Dissipation During Turn-off Time | $E_{off}$     |                                                                                                        |       | 18.7 |      | mJ       |
| Turn-on Delay Time                      | $t_{d(on)}$   | $I_C=300A$<br>$V_{CE}=600V$<br>$V_{GE}=\pm 15V$<br>$R_G=1.5\Omega$<br>$T_{vj}=125^{\circ}C$            |       | 156  |      | ns       |
| Rise Time                               | $t_r$         |                                                                                                        |       | 78   |      | ns       |
| Turn-off Delay Time                     | $t_{d(off)}$  |                                                                                                        |       | 289  |      | ns       |
| Fall Time                               | $t_f$         |                                                                                                        |       | 152  |      | ns       |
| Energy Dissipation During Turn-on Time  | $E_{on}$      |                                                                                                        |       | 31.4 |      | mJ       |
| Energy Dissipation During Turn-off Time | $E_{off}$     |                                                                                                        |       | 24.8 |      | mJ       |
| Turn-on Delay Time                      | $t_{d(on)}$   | $I_C=300A$<br>$V_{CE}=600V$<br>$V_{GE}=\pm 15V$<br>$R_G=1.5\Omega$<br>$T_{vj}=150^{\circ}C$            |       | 168  |      | ns       |
| Rise Time                               | $t_r$         |                                                                                                        |       | 85   |      | ns       |
| Turn-off Delay Time                     | $t_{d(off)}$  |                                                                                                        |       | 326  |      | ns       |
| Fall Time                               | $t_f$         |                                                                                                        |       | 175  |      | ns       |
| Energy Dissipation During Turn-on Time  | $E_{on}$      |                                                                                                        |       | 36.5 |      | mJ       |
| Energy Dissipation During Turn-off Time | $E_{off}$     |                                                                                                        |       | 29.6 |      | mJ       |
| SC Data                                 | $I_{sc}$      | $t_p \leq 10\mu s$ , $V_{GE}=15V$ ,<br>$T_{vj}=150^{\circ}C$ , $V_{cc}=900V$ ,<br>$V_{CEM} \leq 1200V$ |       | 1400 |      | A        |



## ● Diode

## Absolute Maximum Ratings

| Parameter                       | Symbol    | Conditions                                                   | Value | Unit                 |
|---------------------------------|-----------|--------------------------------------------------------------|-------|----------------------|
| Repetitive Peak Reverse Voltage | $V_{RRM}$ | $T_{vj}=25^{\circ}\text{C}$                                  | 1200  | V                    |
| Continuous DC Forward Current   | $I_F$     |                                                              | 300   | A                    |
| Repetitive Peak Forward Current | $I_{FRM}$ | $t_p=1\text{ms}$                                             | 600   | A                    |
| $I^2t$ -value                   | $I^2t$    | $V_R=0\text{V}, t_p=10\text{ms}, T_{vj}=125^{\circ}\text{C}$ | 18200 | $\text{A}^2\text{s}$ |
|                                 |           | $V_R=0\text{V}, t_p=10\text{ms}, T_{vj}=150^{\circ}\text{C}$ | 14500 |                      |

## Characteristic values

| Parameter                     | Symbol    | Conditions                                               | Value |      |      | Unit          |
|-------------------------------|-----------|----------------------------------------------------------|-------|------|------|---------------|
|                               |           |                                                          | Min.  | Typ. | Max. |               |
| Forward Voltage               | $V_F$     | $I_F=300\text{A}, T_{vj}=25^{\circ}\text{C}$             |       | 1.95 |      | V             |
|                               |           | $I_F=300\text{A}, T_{vj}=125^{\circ}\text{C}$            |       | 1.80 |      |               |
|                               |           | $I_F=300\text{A}, T_{vj}=150^{\circ}\text{C}$            |       | 1.75 |      |               |
| Recovered Charge              | $Q_{rr}$  | $I_F=300\text{A}$                                        |       | 24.5 |      | $\mu\text{C}$ |
| Peak Reverse Recovery Current | $I_{rr}$  | $V_R=600\text{V}$<br>$-di_F/dt=5800\text{A}/\mu\text{s}$ |       | 160  |      | A             |
| Reverse Recovery Energy       | $E_{rec}$ | $T_{vj}=25^{\circ}\text{C}$                              |       | 9.8  |      | mJ            |
| Recovered Charge              | $Q_{rr}$  | $I_F=300\text{A}$                                        |       | 35.7 |      | $\mu\text{C}$ |
| Peak Reverse Recovery Current | $I_{rr}$  | $V_R=600\text{V}$<br>$-di_F/dt=5800\text{A}/\mu\text{s}$ |       | 175  |      | A             |
| Reverse Recovery Energy       | $E_{rec}$ | $T_{vj}=125^{\circ}\text{C}$                             |       | 18.4 |      | mJ            |
| Recovered Charge              | $Q_{rr}$  | $I_F=300\text{A}$                                        |       | 40.5 |      | $\mu\text{C}$ |
| Peak Reverse Recovery Current | $I_{rr}$  | $V_R=600\text{V}$<br>$-di_F/dt=5800\text{A}/\mu\text{s}$ |       | 180  |      | A             |
| Reverse Recovery Energy       | $E_{rec}$ | $T_{vj}=150^{\circ}\text{C}$                             |       | 25.5 |      | mJ            |

## ● NTC-Thermistor

## Characteristic values

| Parameter              | Symbol       | Conditions                                            | Value |      |      | Unit             |
|------------------------|--------------|-------------------------------------------------------|-------|------|------|------------------|
|                        |              |                                                       | Min.  | Typ. | Max. |                  |
| Rated Resistance       | $R_{25}$     |                                                       |       | 5.0  |      | $\text{k}\Omega$ |
| Deviation of $R_{100}$ | $\Delta R/R$ | $T_C=100, R_{100}=493.3\Omega$                        | -5    |      | 5    | %                |
| Power Dissipation      | $P_{25}$     |                                                       |       |      | 20.0 | mW               |
| B-value                | $B_{25/50}$  | $R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$ |       | 3375 |      | K                |



## ● Module Characteristics

 $T_C=25^{\circ}\text{C}$  unless otherwise specified

| Parameter                              | Symbol                  | Conditions                     | Value |       |      | Unit               |
|----------------------------------------|-------------------------|--------------------------------|-------|-------|------|--------------------|
|                                        |                         |                                | Min.  | Typ.  | Max. |                    |
| Isolation voltage                      | $V_{\text{isol}}$       | $t=1\text{min}, f=50\text{Hz}$ | 2500  |       |      | V                  |
| Maximum Junction Temperature           | $T_{\text{jmax}}$       |                                |       |       | 175  | $^{\circ}\text{C}$ |
| Operating Junction Temperature         | $T_{\text{vj op}}$      |                                | -40   |       | 150  | $^{\circ}\text{C}$ |
| Storage Temperature                    | $T_{\text{stg}}$        |                                | -40   |       | 125  | $^{\circ}\text{C}$ |
| Thermal Resistance<br>Junction-to Case | $R_{\theta \text{ JC}}$ | per IGBT                       |       |       | 0.08 | K/W                |
|                                        |                         | per Diode                      |       |       | 0.10 |                    |
| Thermal Resistance<br>Case-to Sink     | $R_{\theta \text{ CS}}$ | Conductive grease applied      |       | 0.008 |      | K/W                |
| Comparative Tracking Index             | CTI                     |                                |       | >200  |      |                    |
| Module Electrodes Torque               | $M_t$                   | Recommended(M5)                | 3.0   |       | 5.0  | N·m                |
| Module-to-Sink Torque                  | $M_s$                   | Recommended(M6)                | 3.0   |       | 5.0  | N·m                |
| Weight of Module                       | G                       |                                |       | 345   |      | g                  |

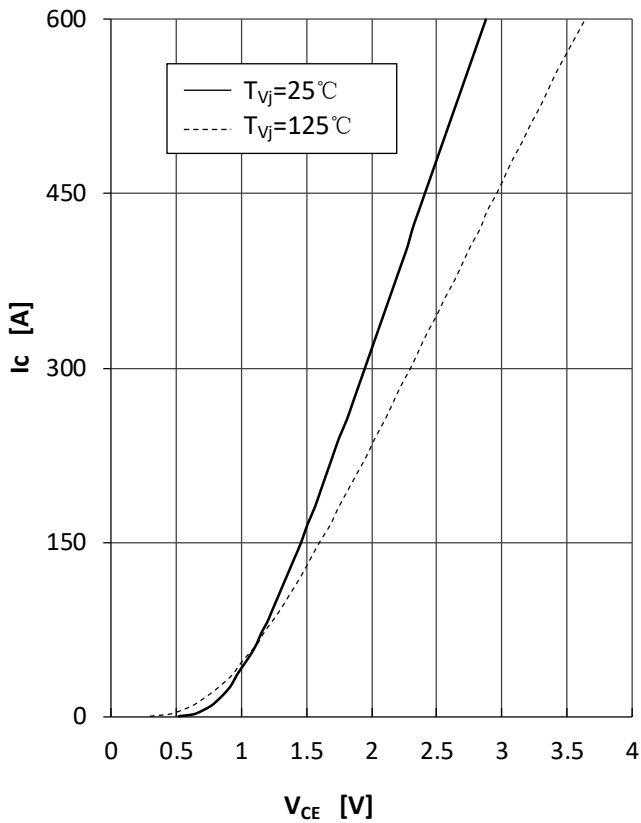


Fig1.IGBT Output Characteristics

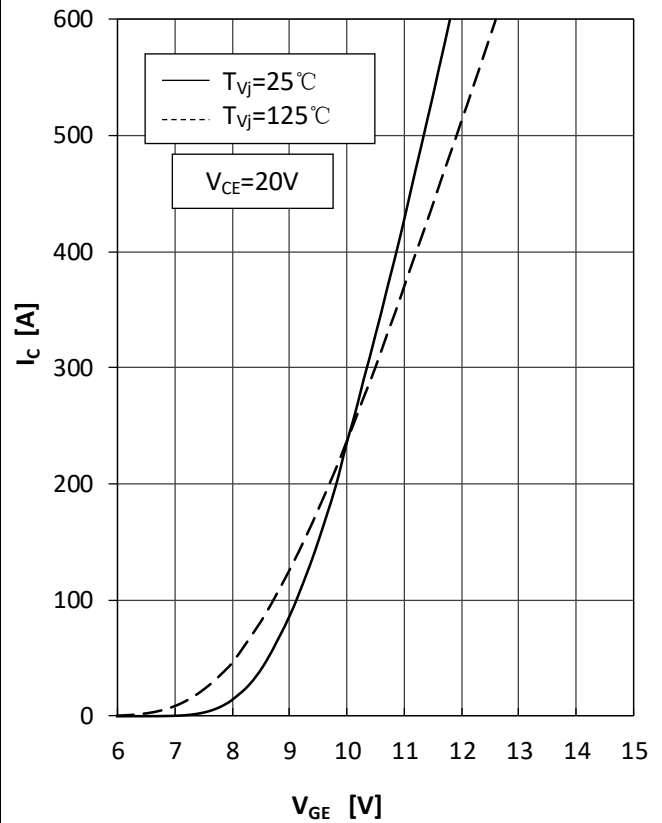


Fig2.IGBT Transfer Characteristics

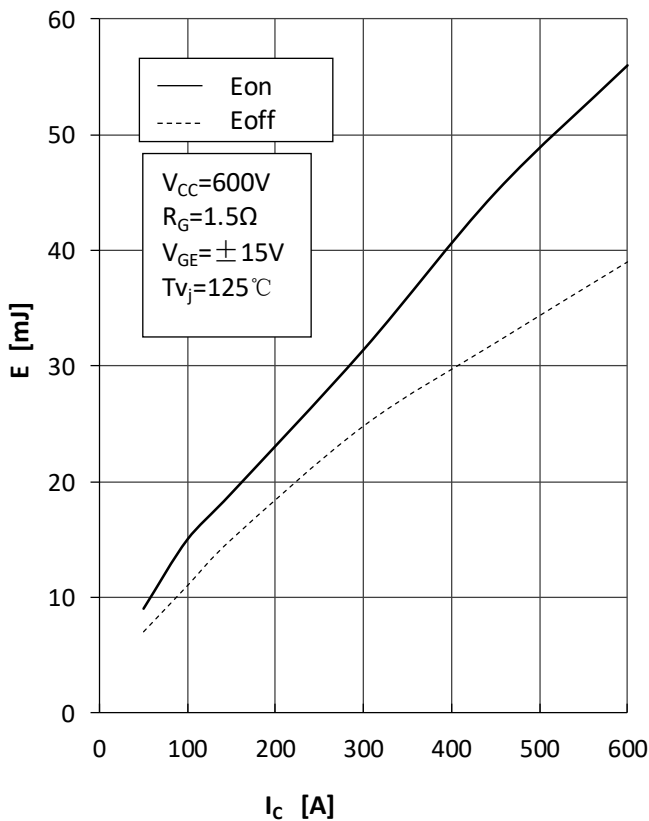


Fig3.IGBT Switching Loss vs. $I_c$

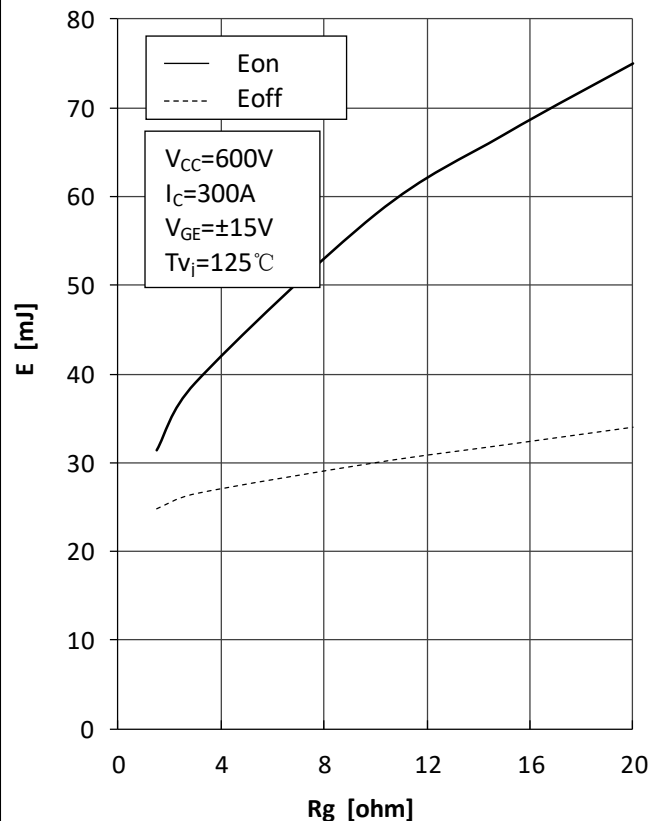
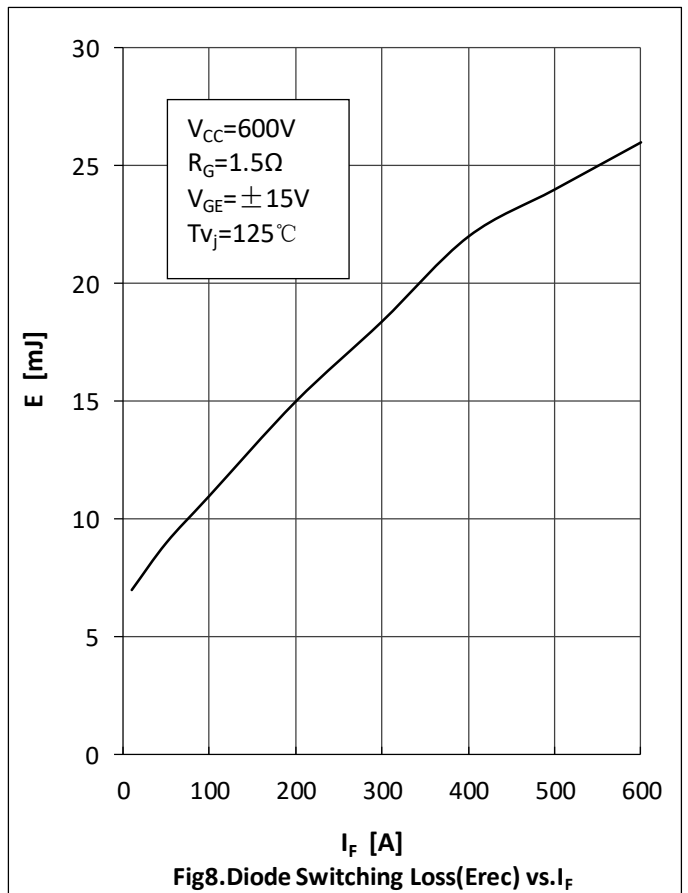
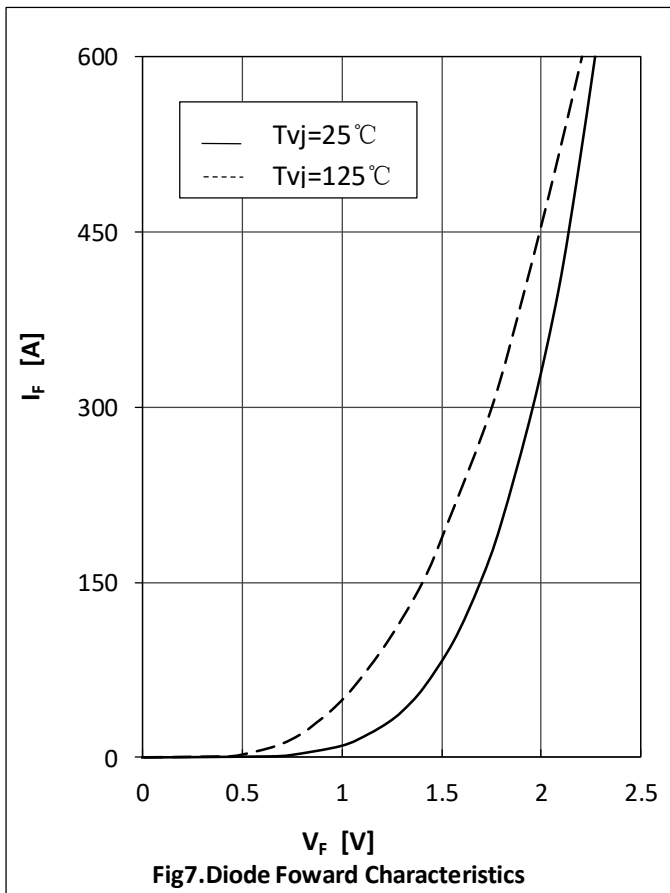
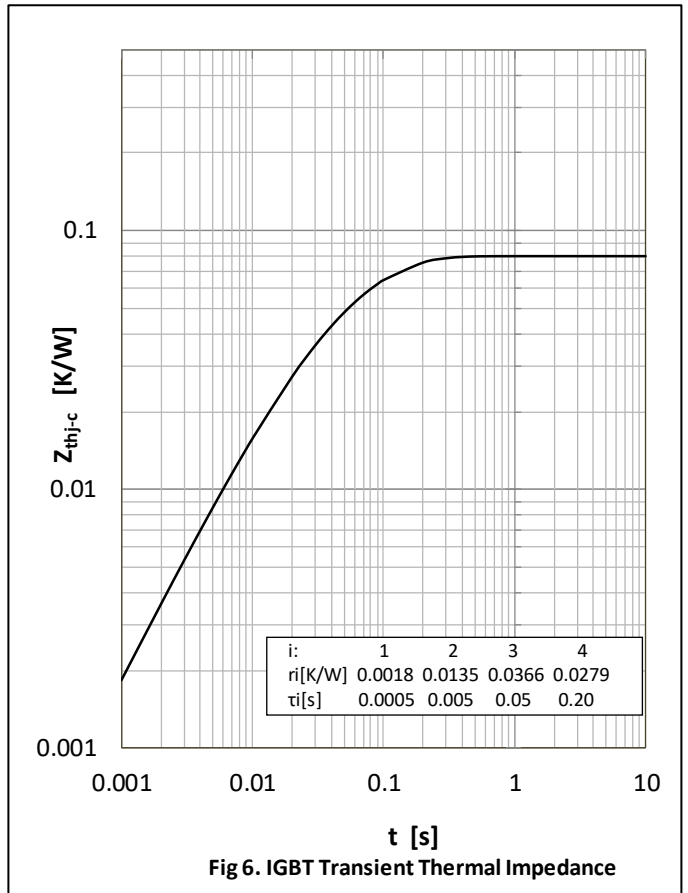
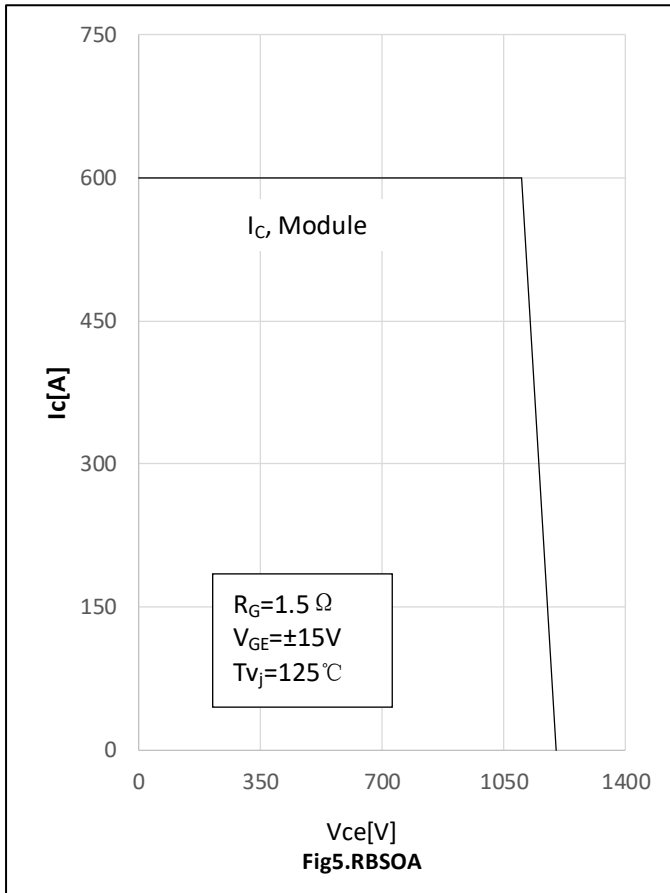
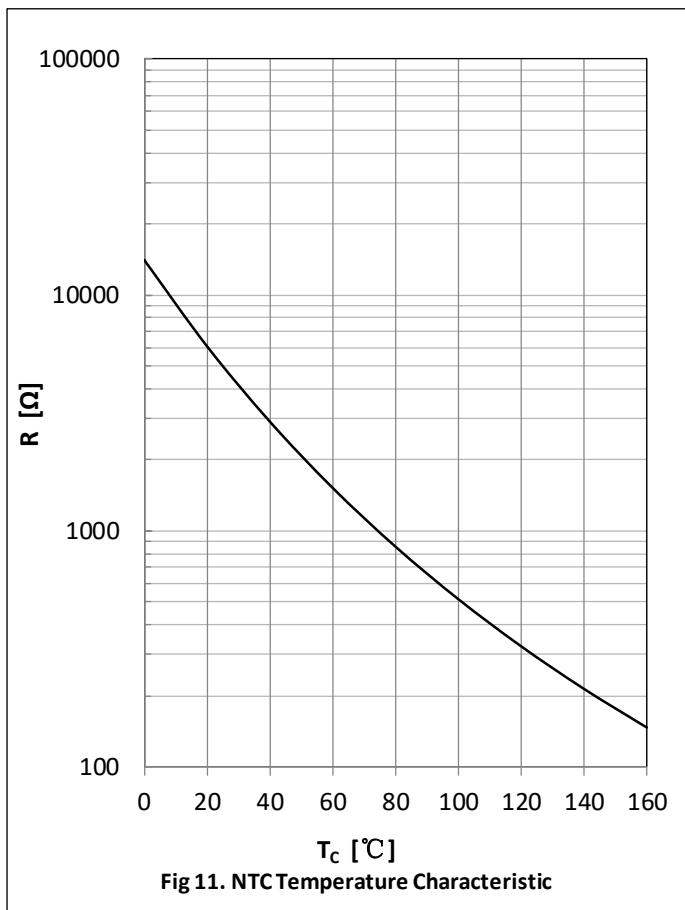
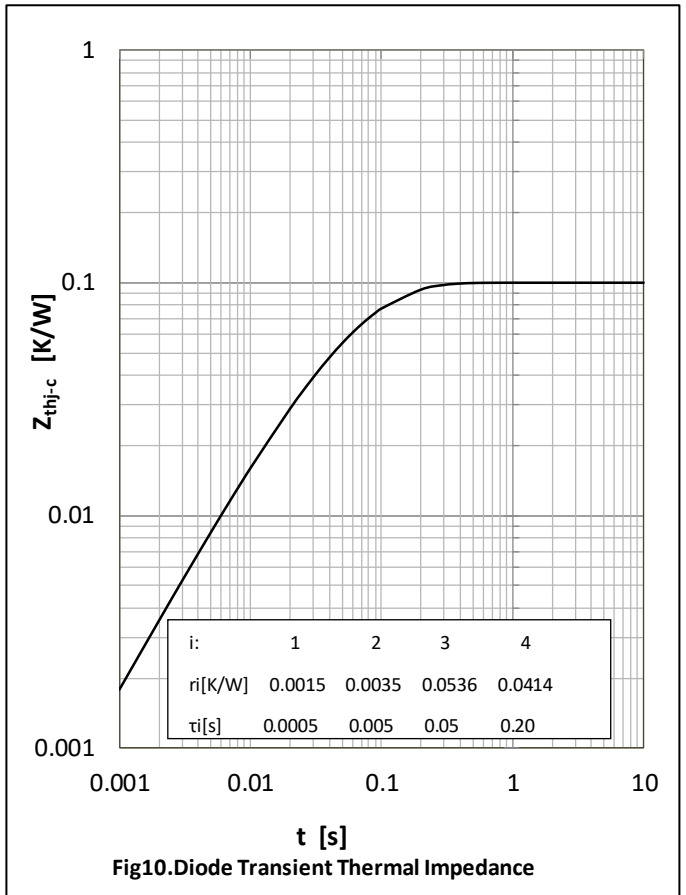
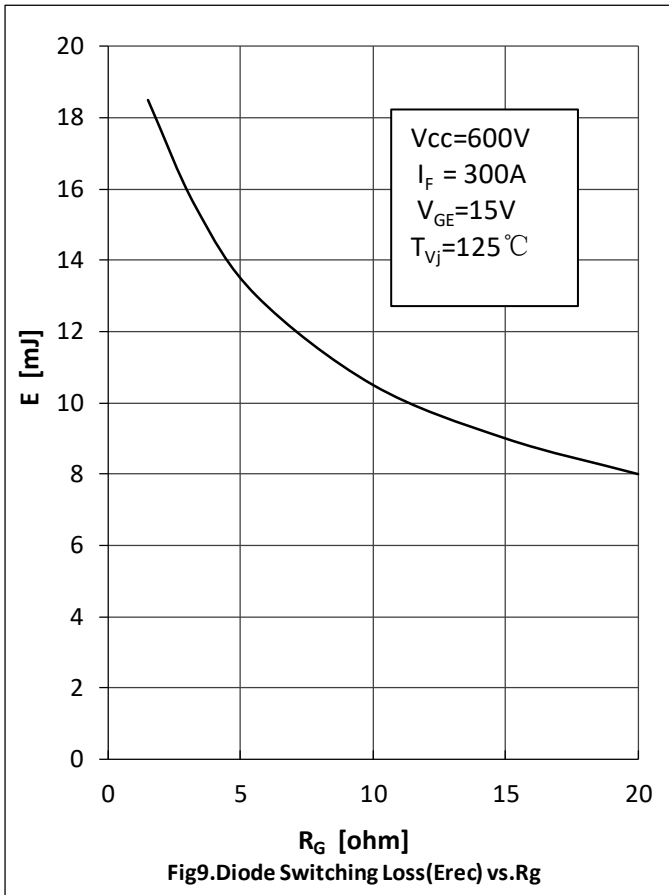
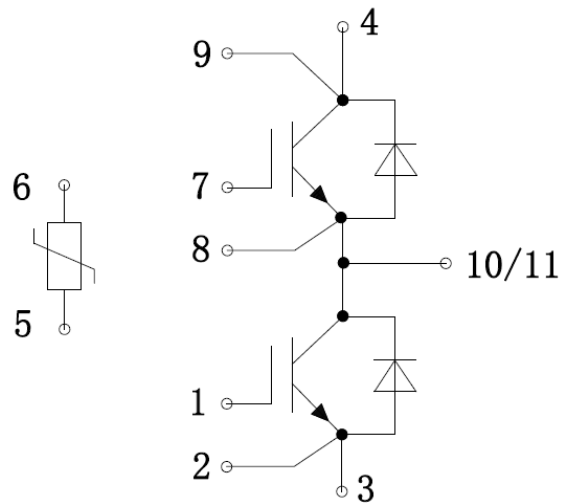


Fig4.IGBT Switching Loss vs. $R_g$

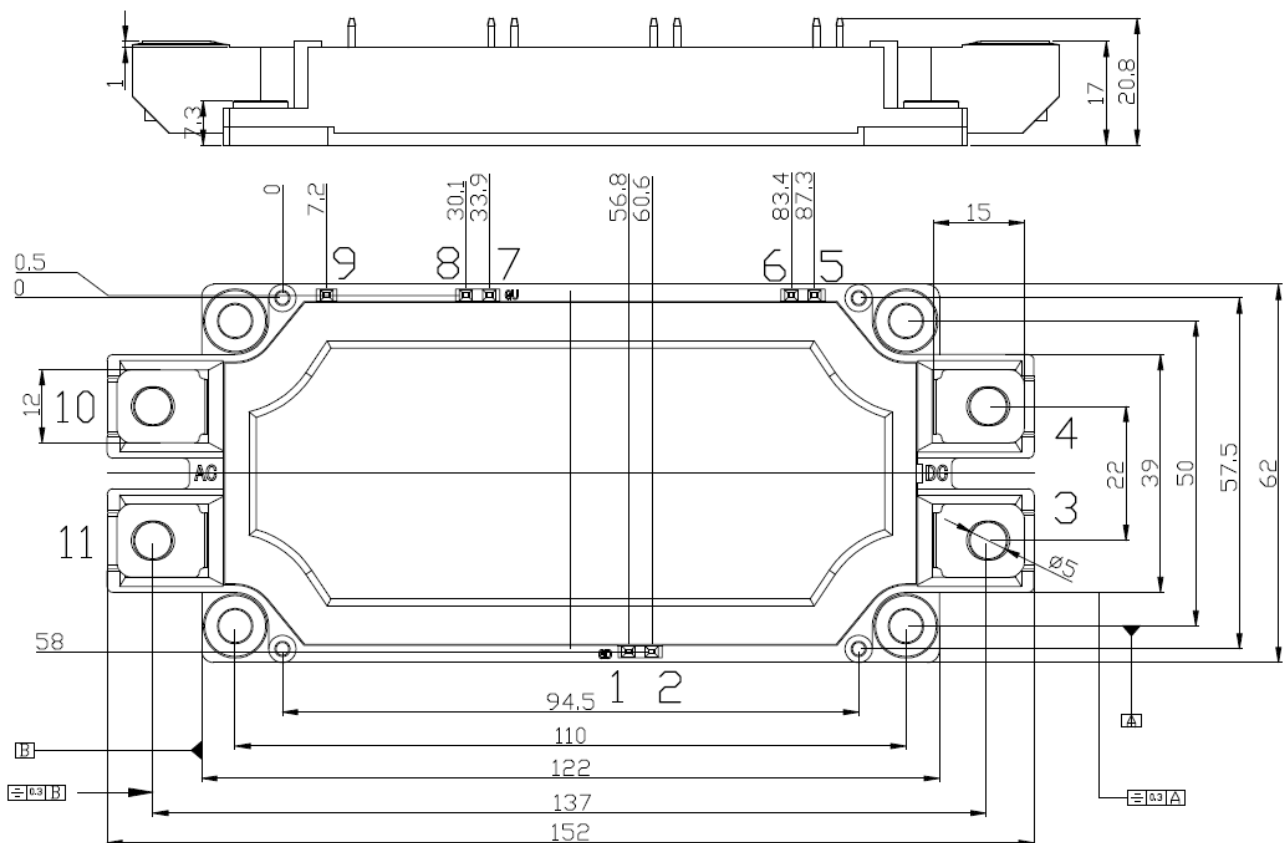




## ● Circuit Diagram



## ● Package Outline Information





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