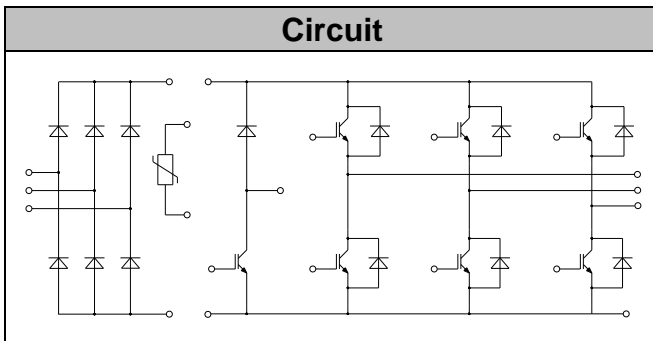


## IGBT Modules

**V<sub>CEs</sub>**            1200V  
**I<sub>C</sub>**                 50A

## Applications

- Motor Drivers
- AC and DC servo drive amplifier
- UPS (Uninterruptible Power Supplies)



## Features

- Low  $V_{ce(sat)}$  with Planner technology
- Low  $V_{ce(sat)}$  with positive temperature coefficient
- Including fast & soft recovery anti-parallel FWD
- Low inductance case
- High short circuit capability(10us)
- Maximum junction temperature 175°C

### ● IGBT- inverter

#### 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      | $I_C$     | $T_c=80^{\circ}C, T_{vjmax}=150^{\circ}C$  | 50       | A    |
| Repetitive Peak Collector Current | $I_{CRM}$ | $tp=1ms$                                   | 100      | A    |
| Gate-Emitter Voltage              | $V_{GES}$ | $T_{vj}=25^{\circ}C$                       | $\pm 20$ | V    |
| Total Power Dissipation           | $P_{tot}$ | $T_c=25^{\circ}C, T_{vjmax}=150^{\circ}C$  | 368      | W    |



## Characteristic values

| Parameter                               | Symbol        | Conditions  | Value   |      |      | Unit     |    |
|---|---------------|---|---|------|------|----------|----|
|   |               |   | Min.  | Typ. | Max. |          |    |
| Gate-Emitter Threshold Voltage          | $V_{GE(th)}$  | $V_{GE}=V_{CE}, I_C=2mA, T_{vj}=25^{\circ}C$  | 5.0   | 5.8  | 6.5  | 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    | $V_{CE(sat)}$ | $I_C=50A, V_{GE}=15V, T_{vj}=25^{\circ}C$   |   | 1.95 | 2.25 | V        |    |
|   |               | $I_C=50A, V_{GE}=15V, T_{vj}=125^{\circ}C$  |   | 2.15 |      |          |    |
|   |               | $I_C=50A, V_{GE}=15V, T_{vj}=150^{\circ}C$  |   | 2.20 |      |          |    |
| Gate Charge                             | $Q_G$         |   |   | 0.60 |      | uC       |    |
| Input Capacitance                       | $C_{ies}$     | $V_{CE}=25V, V_{GE}=0V,$<br>$f=1MHz, T_{vj}=25^{\circ}C$                                  |   | 3.80 |      | nF       |    |
| Reverse Transfer Capacitance            | $C_{res}$     |   |   | 0.26 |      | nF       |    |
| Internal Gate Resistance                | $R_{gint}$    |   |   | 2.5  |      | $\Omega$ |    |
| Gate-Emitter leakage current            | $I_{GES}$     | $V_{CE}=0V, V_{GE}=20V, T_{vj}=25^{\circ}C$   |   |      | 400  | nA       |    |
| Turn-on Delay Time                      | $t_{d(on)}$   | $I_C=50A$<br>$V_{CE}=600V$<br>$V_{GE}=\pm 15V$<br>$R_G=15\Omega$<br>$T_{vj}=25^{\circ}C$  |   | 40   |      | ns       |    |
| Rise Time                               | $t_r$         |   |   | 65   |      | ns       |    |
| Turn-off Delay Time                     | $t_{d(off)}$  |   |   | 390  |      | ns       |    |
| Fall Time                               | $t_f$         |   |   | 36   |      | ns       |    |
| Energy Dissipation During Turn-on Time  | $E_{on}$      |   |   | 6.05 |      | mJ       |    |
| Energy Dissipation During Turn-off Time | $E_{off}$     |   |   | 3.30 |      | mJ       |    |
| Turn-on Delay Time                      | $t_{d(on)}$   |   | $I_C=50A$<br>$V_{CE}=600V$<br>$V_{GE}=\pm 15V$<br>$R_G=15\Omega$<br>$T_{vj}=125^{\circ}C$ |      | 45   |          | ns |
| Rise Time                               | $t_r$         |   |   |      | 70   |          | ns |
| Turn-off Delay Time                     | $t_{d(off)}$  |   |   |      | 440  |          | ns |
| Fall Time                               | $t_f$         |   |   |      | 41   |          | ns |
| Energy Dissipation During Turn-on Time  | $E_{on}$      |   |   | 8.0  |      | mJ       |    |
| Energy Dissipation During Turn-off Time | $E_{off}$     |   |   | 5.50 |      | mJ       |    |
| SC Data                                 | $I_{sc}$      | $T_p \leq 10\mu s, V_{GE}=15V, T_{vj}=150^{\circ}C,$<br>$V_{cc}=900V, V_{CEM} \leq 1200V$ |   |      | 320  |          | A  |



## ● Diode-inverter

### 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   | $I_F$     |                             | 50    | A    |
| Repetitive Peak Forward Current | $I_{FRM}$ | $t_p=1\text{ms}$            | 100   | A    |

### Characteristic values

| Parameter                     | Symbol    | Conditions  | Value |      |      | Unit          |
|-------------------------------|-----------|---|-------|------|------|---------------|
|                               |           |   | Min.  | Typ. | Max. |               |
| Forward Voltage               | $V_F$     | $I_F=50\text{A}, T_{vj}=25^{\circ}\text{C}$             |       | 1.95 | 2.25 | V             |
|                               |           | $I_F=50\text{A}, T_{vj}=125^{\circ}\text{C}$            |       | 2.05 |      |               |
|                               |           | $I_F=50\text{A}, T_{vj}=150^{\circ}\text{C}$            |       | 2.10 |      |               |
| Recovered Charge              | $Q_{rr}$  | $I_F=50\text{A}$  |       | 3.5  |      | $\mu\text{C}$ |
| Peak Reverse Recovery Current | $I_{rr}$  | $V_R=600\text{V}$<br>$-di_F/dt=900\text{A}/\mu\text{s}$ |       | 40   |      | A             |
| Reverse Recovery Energy       | $E_{rec}$ | $T_{vj}=25^{\circ}\text{C}$                             |       | 1.35 |      | mJ            |
| Recovered Charge              | $Q_{rr}$  | $I_F=50\text{A}$  |       | 6.5  |      | $\mu\text{C}$ |
| Peak Reverse Recovery Current | $I_{rr}$  | $V_R=600\text{V}$<br>$-di_F/dt=900\text{A}/\mu\text{s}$ |       | 50   |      | A             |
| Reverse Recovery Energy       | $E_{rec}$ | $T_{vj}=125^{\circ}\text{C}$                            |       | 2.00 |      | mJ            |

● **IGBT-brake-chopper****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      | $I_C$     | $T_C=100^{\circ}C, T_{vjmax}=175^{\circ}C$ | 40       | A    |
| Repetitive Peak Collector Current | $I_{CRM}$ | $t_p=1ms$                                  | 80       | A    |
| Gate-Emitter Voltage              | $V_{GES}$ | $T_{vj}=25^{\circ}C$                       | $\pm 20$ | V    |
| Total Power Dissipation           | $P_{tot}$ | $T_C=25^{\circ}C, T_{vjmax}=175^{\circ}C$  | 300      | W    |

**Characteristic values**

| Parameter                               | Symbol        | Conditions   | Value |      |      | Unit    |
|---|---------------|--|-------|------|------|---------|
|   |               |  | Min.  | Typ. | Max. |         |
| Gate-Emitter Threshold Voltage          | $V_{GE(th)}$  | $V_{GE}=V_{CE}, I_C=1.2mA, T_{vj}=25^{\circ}C$                           | 5.8   | 6.7  | 7.2  | 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    | $V_{CE(sat)}$ | $I_C=40A, V_{GE}=15V, T_{vj}=25^{\circ}C$                                |       | 1.95 | 2.35 | V       |
|   |               | $I_C=40A, V_{GE}=15V, T_{vj}=125^{\circ}C$                               |       | 2.30 |      |         |
|   |               | $I_C=40A, V_{GE}=15V, T_{vj}=150^{\circ}C$                               |       | 2.40 |      |         |
| Gate Charge                             | $Q_G$         |  |       | 0.27 |      | $\mu C$ |
| Input Capacitance                       | $C_{ies}$     | $V_{CE}=25V, V_{GE}=0V, f=1MHz, T_{vj}=25^{\circ}C$                      |       | 2.00 |      | nF      |
| Reverse Transfer Capacitance            | $C_{res}$     |  |       | 0.07 |      | nF      |
| Gate-Emitter leakage current            | $I_{GES}$     | $V_{CE}=0V, V_{GE}=20V, T_{vj}=25^{\circ}C$                              |       |      | 400  | nA      |
| Turn-on Delay Time                      | $t_{d(on)}$   | $I_C=40A, V_{CE}=600V, V_{GE}=\pm 15V, R_G=12\Omega, T_{vj}=25^{\circ}C$ |       | 28   |      | ns      |
| Rise Time                               | $t_r$         |  |       | 16   |      | ns      |
| Turn-off Delay Time                     | $t_{d(off)}$  |  |       | 26   |      | ns      |
| Fall Time                               | $t_f$         |  |       | 125  |      | ns      |
| Energy Dissipation During Turn-on Time  | $E_{on}$      |  |       | 2.40 |      | mJ      |
| Energy Dissipation During Turn-off Time | $E_{off}$     |  |       | 2.25 |      | mJ      |



|   |              |  |  |      |     |    |
|---|--------------|--|--|------|-----|----|
| Turn-on Delay Time                      | $t_{d(on)}$  | $I_C = 40\text{ A}$<br>$V_{CE} = 600\text{ V}$<br>$V_{GE} = \pm 15\text{ V}$<br>$R_G = 12\Omega$<br>$T_{vj} = 125^\circ\text{C}$ |  | 28   |     | ns |
| Rise Time                               | $t_r$        |  |  | 18   |     | ns |
| Turn-off Delay Time                     | $t_{d(off)}$ |  |  | 310  |     | ns |
| Fall Time                               | $t_f$        |  |  | 190  |     | ns |
| Energy Dissipation During Turn-on Time  | $E_{on}$     |  |  | 3.60 |     | mJ |
| Energy Dissipation During Turn-off Time | $E_{off}$    |  |  | 3.20 |     | mJ |
| SC Data                                 | $I_{sc}$     |  | $T_p \leq 10\mu\text{s}, V_{GE} = 15\text{ V}, T_{vj} = 150^\circ\text{C},$<br>$V_{cc} = 900\text{ V}, V_{CEM} \leq 1200\text{ V}$ |      | 130 |    |

## ● Diode-Brake-Chopper

### Absolute Maximum Ratings

| Parameter                       | Symbol    | Conditions   | Value | Unit             |
|---------------------------------|-----------|--|-------|------------------|
| Repetitive Peak Reverse Voltage | $V_{RRM}$ | $T_j = 25^\circ\text{C}$                               | 1200  | V                |
| Continuous DC Forward Current   | $I_F$     |  | 40    | A                |
| Repetitive Peak Forward Current | $I_{FRM}$ | $t_p = 1\text{ ms}$                                    | 80    | A                |
| $I^2t$ -value                   | $I^2t$    | $V_R = 0, t_p = 10\text{ ms}, T_j = 125^\circ\text{C}$ | 240   | A <sup>2</sup> s |
|                                 |           | $V_R = 0, t_p = 10\text{ ms}, T_j = 150^\circ\text{C}$ | 220   |                  |

### Characteristic values

| Parameter                     | Symbol    | Conditions   | Value |      |      | Unit          |
|-------------------------------|-----------|--|-------|------|------|---------------|
|                               |           |  | Min.  | Typ. | Max. |               |
| Forward Voltage               | $V_F$     | $I_F = 40\text{ A}, T_{vj} = 25^\circ\text{C}$                 |       | 1.75 | 2.25 | V             |
|                               |           | $I_F = 40\text{ A}, T_{vj} = 125^\circ\text{C}$                |       | 1.75 |      |               |
|                               |           | $I_F = 40\text{ A}, T_{vj} = 150^\circ\text{C}$                |       | 1.75 |      |               |
| Recovered Charge              | $Q_{rr}$  | $I_F = 40\text{ A}$  |       | 4.15 |      | $\mu\text{C}$ |
| Peak Reverse Recovery Current | $I_{rr}$  | $V_R = 600\text{ V}$<br>$-di_F/dt = 1600\text{ A}/\mu\text{s}$ |       | 42   |      | A             |
| Reverse Recovery Energy       | $E_{rec}$ | $T_{vj} = 25^\circ\text{C}$                                    |       | 1.30 |      | mJ            |



|                               |           |  |  |      |  |               |
|-------------------------------|-----------|--|--|------|--|---------------|
| Recovered Charge              | $Q_{rr}$  | $I_F = 40\text{ A}$<br>$V_R = 600\text{ V}$<br>$-di_F/dt = 1600\text{ A/us}$<br>$T_{vj} = 125^\circ\text{C}$ |  | 8.00 |  | $\mu\text{C}$ |
| Peak Reverse Recovery Current | $I_{rr}$  |  |  | 46   |  | A             |
| Reverse Recovery Energy       | $E_{rec}$ |  |  | 2.38 |  | mJ            |

## ● Diode-Rectifier

### Absolute Maximum Ratings

| Parameter                                      | Symbol      | Conditions   | Value | Unit                 |
|--|-------------|--|-------|----------------------|
| Repetitive Peak Reverse Voltage                | $V_{RRM}$   | $T_j = 25^\circ\text{C}$                             | 1600  | V                    |
| Average On-state Current<br>50/60Hz, sine wave | $I_{F(AV)}$ | $T_c = 100^\circ\text{C}$                            | 65    | A                    |
| Maximum RMS Current at<br>Rectifier Output     | $I_{RMSM}$  | $T_c = 100^\circ\text{C}$                            | 110   | A                    |
| Surge Forward Current                          | $I_{FSM}$   | $V_R = 0, t_p = 10\text{ms}, T_j = 45^\circ\text{C}$ | 850   | A                    |
| $I^2t$ -value                                  | $I^2t$      | $V_R = 0, t_p = 10\text{ms}, T_j = 45^\circ\text{C}$ | 3610  | $\text{A}^2\text{s}$ |

### Characteristic values

| Parameter             | Symbol | Conditions                                    | Value |      |      | Unit |
|-----------------------|--------|---|-------|------|------|------|
|                       |        |   | Min.  | Typ. | Max. |      |
| Diode Forward Voltage | $V_F$  | $I_F = 50\text{A}, T_j = 150^\circ\text{C}$   |       | 1.00 |      | V    |
| Reverse Current       | $I_R$  | $T_j = 125^\circ\text{C}, V_R = 1600\text{V}$ |       |      | 1.5  | mA   |

## ● NTC-Thermistor

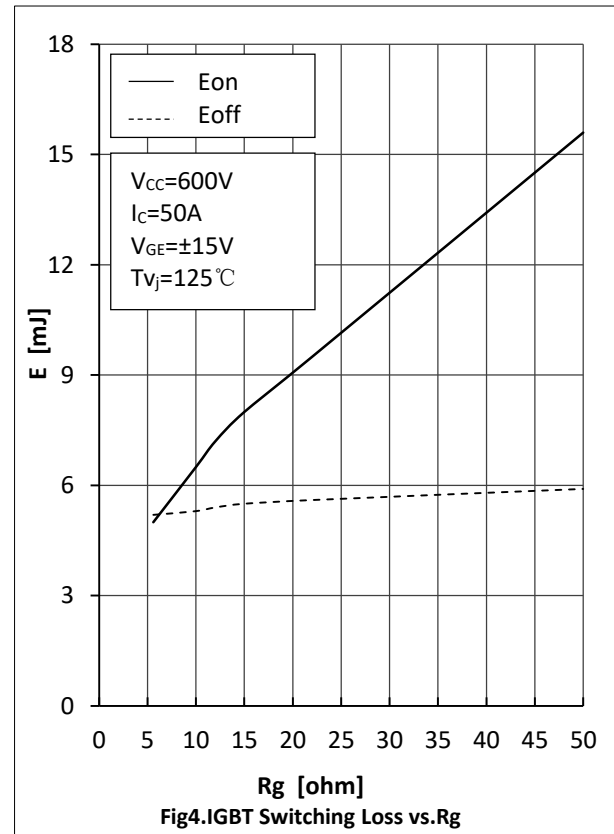
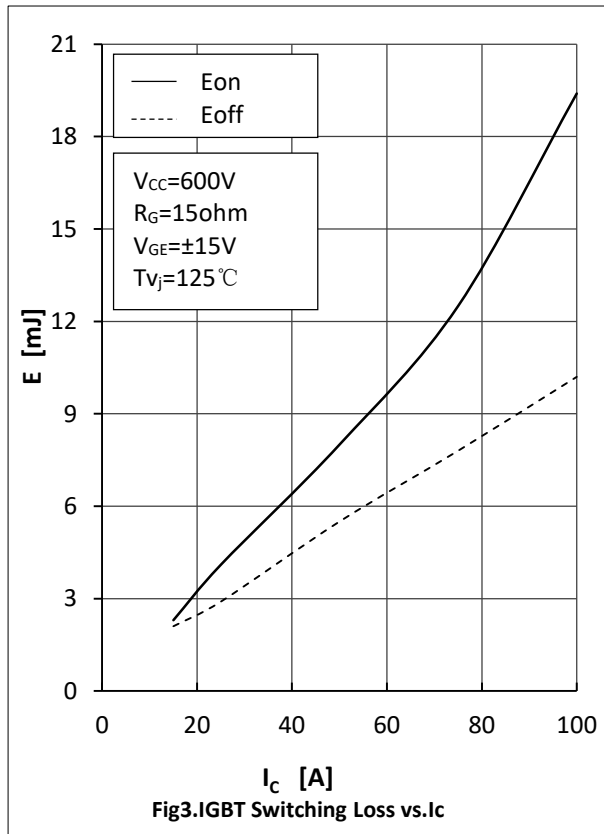
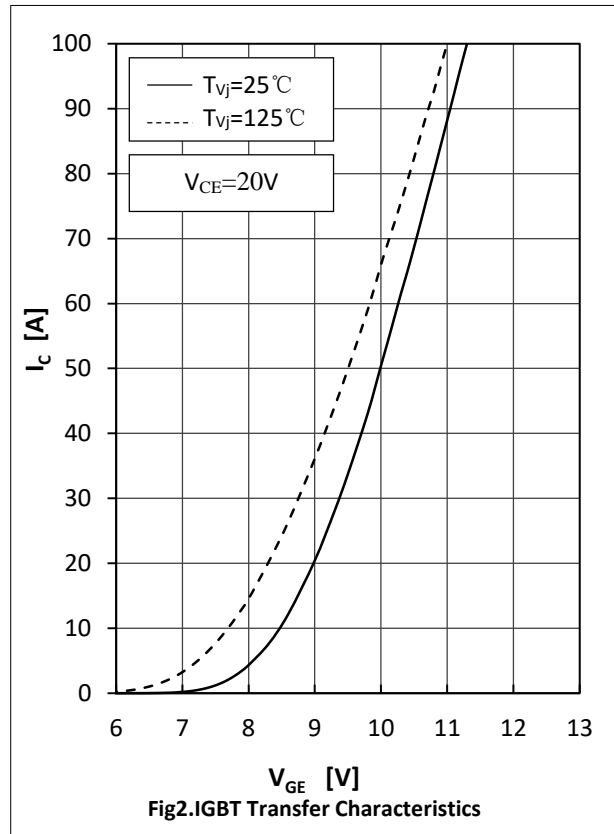
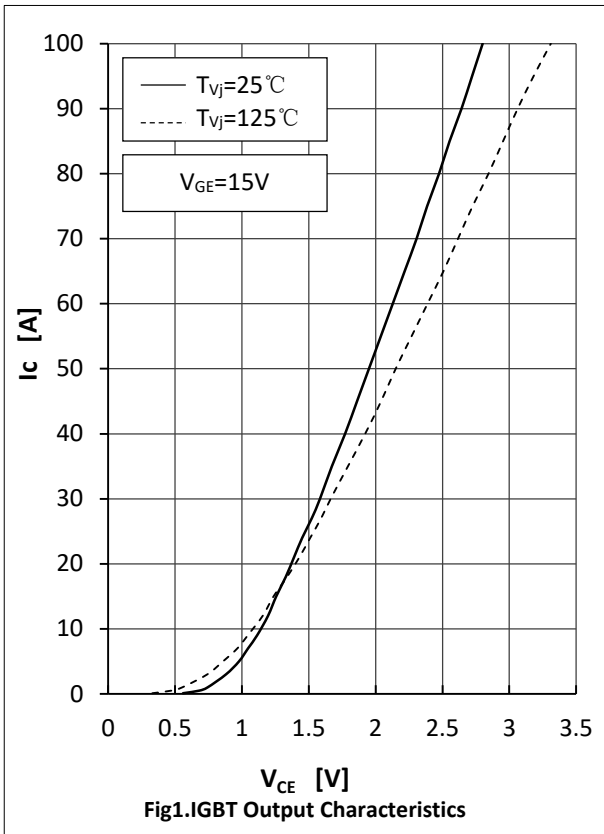
### Characteristic values

| 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                |

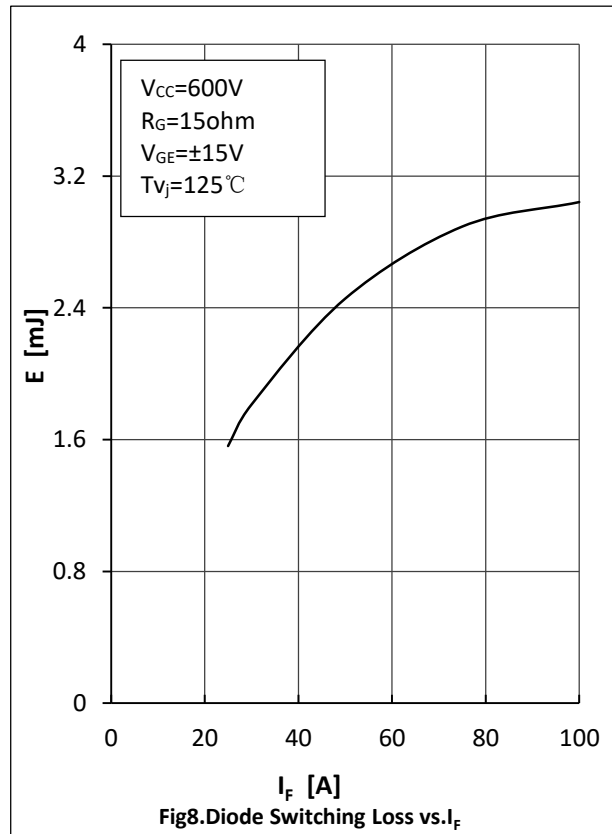
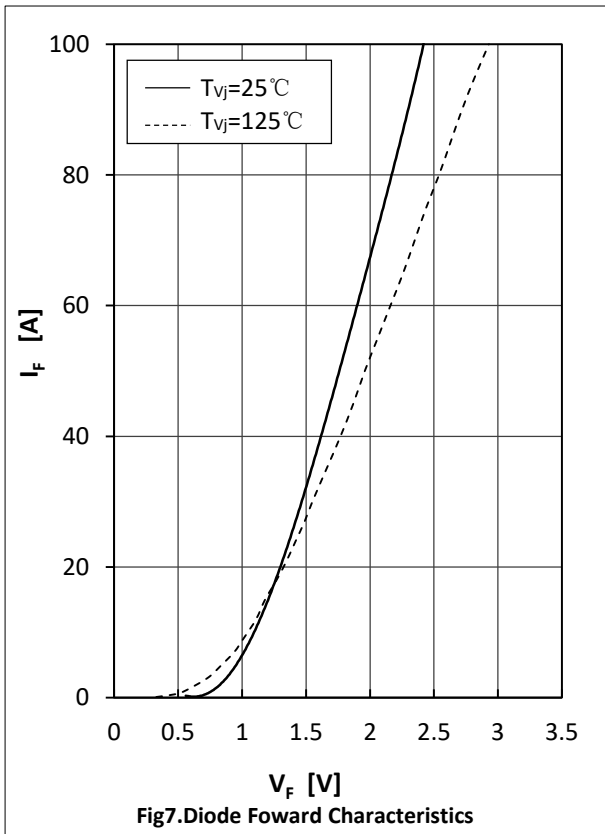
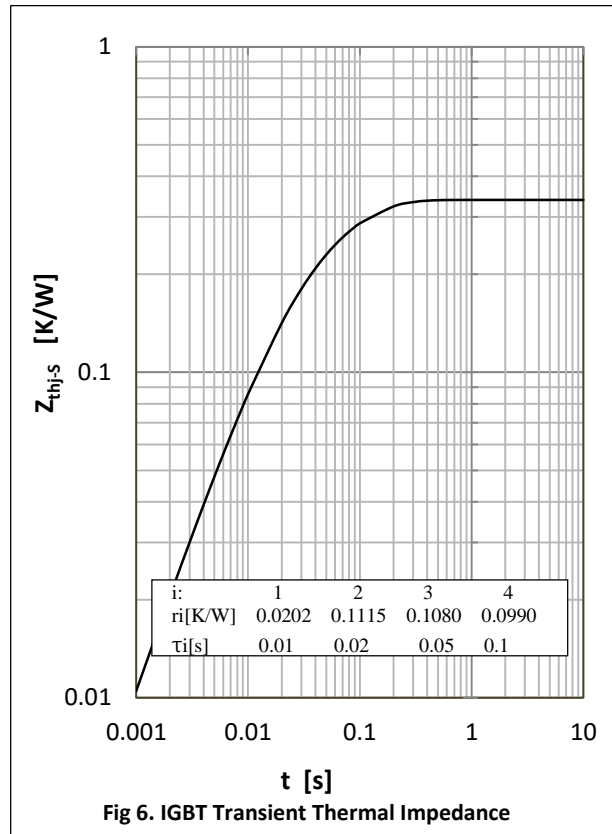
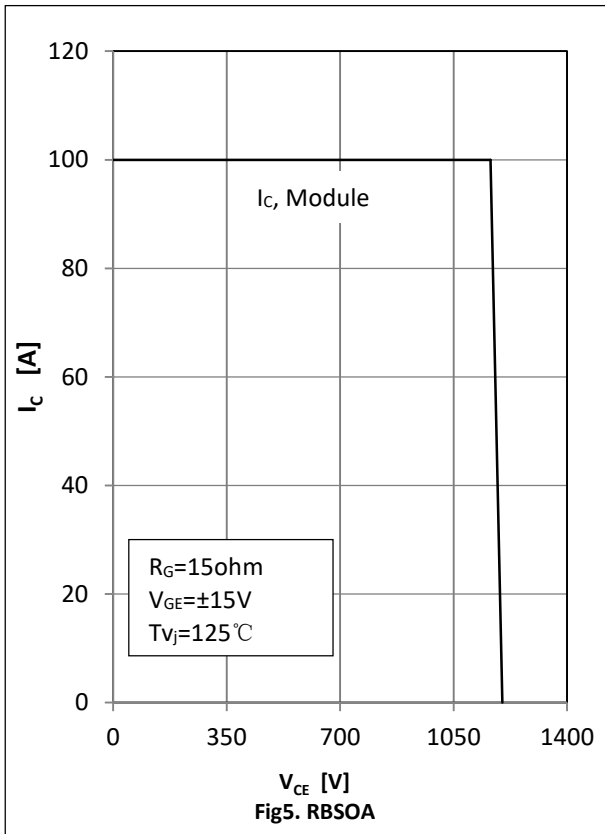


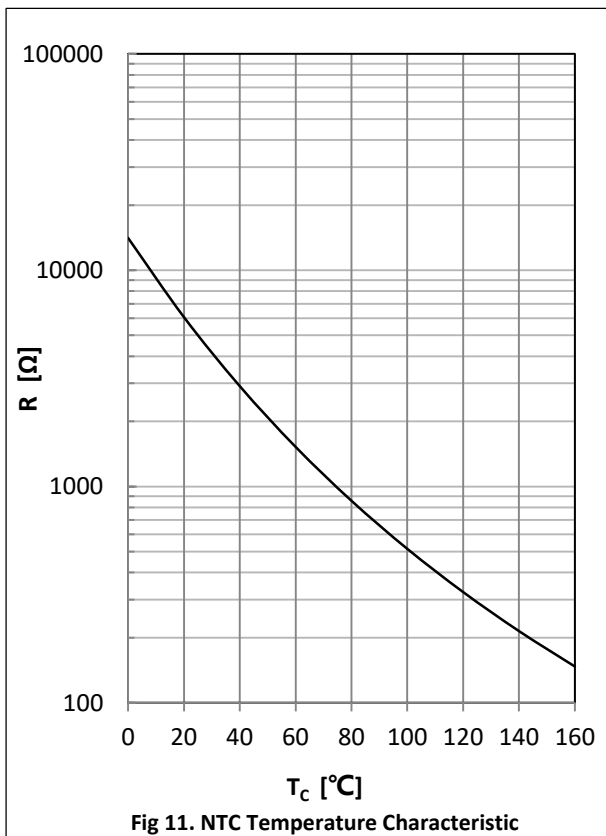
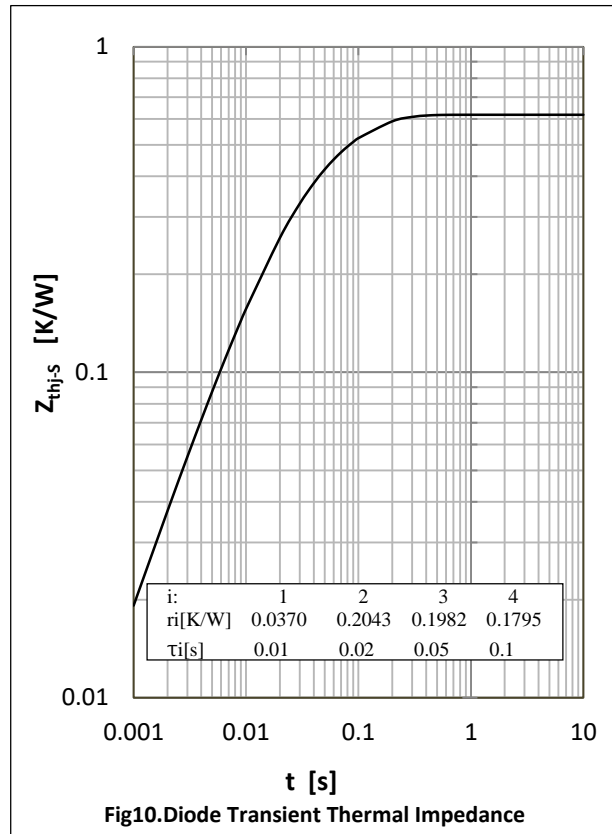
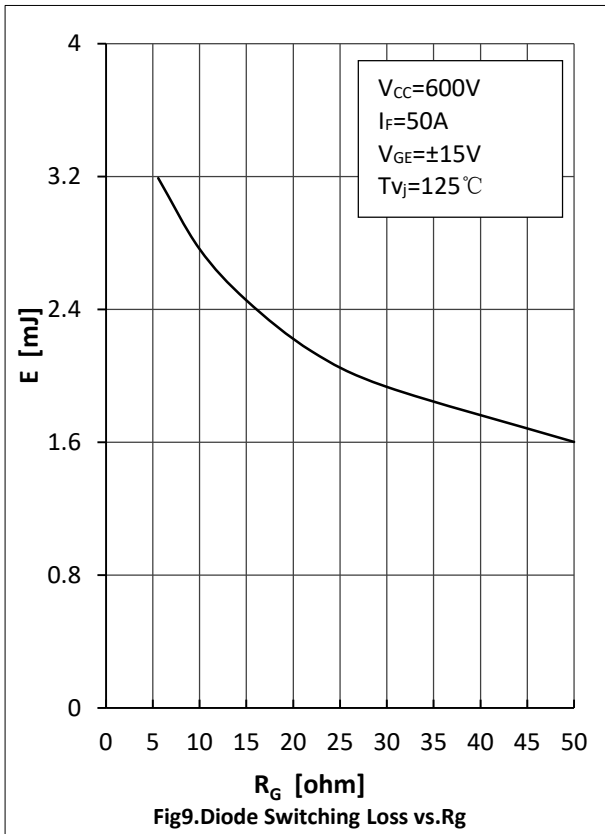
● **Module Characteristics**  $T_C=25^{\circ}\text{C}$  unless otherwise specified

| Parameter                                | Symbol          | Conditions                            | Value |       |       | Unit               |
|--|-----------------|---------------------------------------|-------|-------|-------|--------------------|
|  |                 |                                       | Min.  | Typ.  | Max.  |                    |
| Isolation voltage                        | $V_{isol}$      | $t=1\text{min}, f=50\text{Hz}$        | 2500  |       |       | V                  |
| Maximum Junction Temperature             | $T_{jmax}$      | Inverter, brake                       |       |       | 175   | $^{\circ}\text{C}$ |
|  |                 | rectifier                             |       |       | 150   |                    |
| Operating Junction Temperature           | $T_{vj\ op}$    |                                       | -40   |       | 150   | $^{\circ}\text{C}$ |
| Storage Temperature                      | $T_{stg}$       |                                       | -40   |       | 125   | $^{\circ}\text{C}$ |
| Stray Inductance                         | $L_{CE}$        |                                       |       | 60    |       | nH                 |
| Module Lead Resistance ,Terminal to Chip | $R_{cc'+EE'}$   | $T_C=25^{\circ}\text{C}$ , per switch |       | 4.0   |       | m $\Omega$         |
|  | $R_{AA'+CC'}$   |                                       |       | 2.0   |       |                    |
| Thermal Resistance Junction-to Case      | $R_{\theta jc}$ | per IGBT-inverter                     |       |       | 0.339 | K/W                |
|  |                 | per Diode-inverter                    |       |       | 0.619 |                    |
|  |                 | per IGBT-brake-copper                 |       |       | 0.500 |                    |
|  |                 | per Diode-chopper                     |       |       | 1.266 |                    |
|  |                 | per Diode-rectifier                   |       |       | 0.635 |                    |
| Thermal Resistance Case-to Sink          | $R_{\theta cs}$ | per IGBT-inverter                     |       | 0.121 |       | K/W                |
|  |                 | per Diode-inverter                    |       | 0.221 |       |                    |
|  |                 | per IGBT-brake-copper                 |       | 0.180 |       |                    |
|  |                 | per Diode-chopper                     |       | 0.452 |       |                    |
|  |                 | per Diode-rectifier                   |       | 0.227 |       |                    |
|  |                 | per Module                            |       | 0.009 |       |                    |
| Module-to-Sink Torque                    | $M_s$           |                                       | 3.0   |       | 6.0   | N·m                |
| Weight of Module                         | G               |                                       |       | 300   |       | g                  |

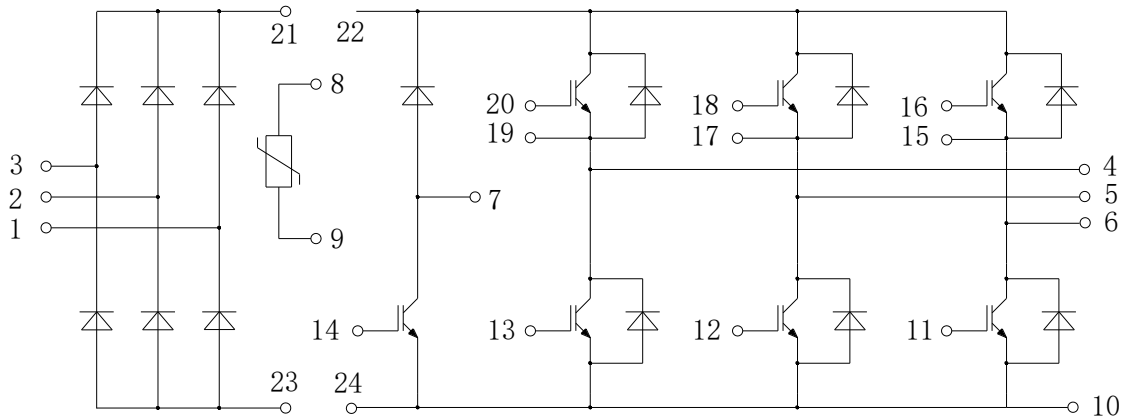








## ● Circuit Diagram



## ● Package Dimensions

