



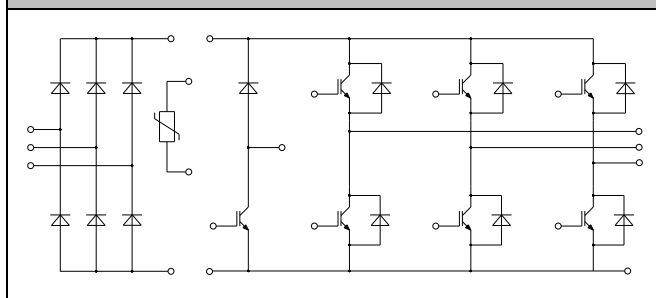
## IGBT Modules

|                        |       |
|------------------------|-------|
| <b>V<sub>CES</sub></b> | 1200V |
| <b>I<sub>C</sub></b>   | 100A  |

### Applications

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

### Circuit



### 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      | $I_C$     | $T_c=80^{\circ}C, T_{vjmax}=150^{\circ}C$ | 100      | A    |
| Repetitive Peak Collector Current | $I_{CRM}$ | $t_p=1ms$                                 | 200      | A    |
| Gate-Emitter Voltage              | $V_{GES}$ | $T_{vj}=25^{\circ}C$                      | $\pm 20$ | V    |
| Total Power Dissipation           | $P_{tot}$ | $T_c=25^{\circ}C, T_{vjmax}=175^{\circ}C$ | 625      | W    |



## Characteristic values

| Parameter                               | Symbol        | Conditions                                                                                  | Value |      |      | Unit     |
|-----------------------------------------|---------------|---------------------------------------------------------------------------------------------|-------|------|------|----------|
|                                         |               |                                                                                             | Min.  | Typ. | Max. |          |
| Gate-Emitter Threshold Voltage          | $V_{GE(th)}$  | $V_{GE}=V_{CE}, I_C=4mA, T_{vj}=25^{\circ}C$                                                | 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       |
|                                         |               | $V_{CE}=1200V, V_{GE}=0V, T_{vj}=125^{\circ}C$                                              |       |      | 5.0  | mA       |
| Collector-Emitter Saturation Voltage    | $V_{CE(sat)}$ | $I_C=100A, V_{GE}=15V, T_{vj}=25^{\circ}C$                                                  |       | 1.95 | 2.25 | V        |
|                                         |               | $I_C=100A, V_{GE}=15V, T_{vj}=125^{\circ}C$                                                 |       | 2.15 |      |          |
| Input Capacitance                       | $C_{ies}$     | $V_{CE}=25V, V_{GE}=0V, f=1MHz, T_{vj}=25^{\circ}C$                                         |       | 5.80 |      | nF       |
| Output Capacitance                      | $C_{oes}$     |                                                                                             |       | 0.60 |      | nF       |
| Reverse Transfer Capacitance            | $C_{res}$     |                                                                                             |       | 0.40 |      | 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                      | $t_{d(on)}$   | $I_C=100A$<br>$V_{CE}=600V$<br>$V_{GE}=\pm 15V$<br>$R_G=5.1\Omega$<br>$T_{vj}=25^{\circ}C$  |       | 240  |      | ns       |
| Rise Time                               | $t_r$         |                                                                                             |       | 55   |      | ns       |
| Turn-off Delay Time                     | $t_{d(off)}$  |                                                                                             |       | 395  |      | ns       |
| Fall Time                               | $t_f$         |                                                                                             |       | 178  |      | ns       |
| Energy Dissipation During Turn-on Time  | $E_{on}$      |                                                                                             |       | 4.1  |      | mJ       |
| Energy Dissipation During Turn-off Time | $E_{off}$     |                                                                                             |       | 7.3  |      | mJ       |
| Turn-on Delay Time                      | $t_{d(on)}$   | $I_C=150A$<br>$V_{CE}=600V$<br>$V_{GE}=\pm 15V$<br>$R_G=5.1\Omega$<br>$T_{vj}=125^{\circ}C$ |       | 260  |      | ns       |
| Rise Time                               | $t_r$         |                                                                                             |       | 68   |      | ns       |
| Turn-off Delay Time                     | $t_{d(off)}$  |                                                                                             |       | 420  |      | ns       |
| Fall Time                               | $t_f$         |                                                                                             |       | 280  |      | ns       |
| Energy Dissipation During Turn-on Time  | $E_{on}$      |                                                                                             |       | 5.3  |      | mJ       |
| Energy Dissipation During Turn-off Time | $E_{off}$     |                                                                                             |       | 9.1  |      | mJ       |
| SC Data                                 | $I_{sc}$      | $T_p \leq 10\mu s, V_{GE}=15V, T_{vj}=150^{\circ}C, V_{cc}=600V, V_{CEM} \leq 1200V$        |       | 700  |      | 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   | $I_F$     |                             | 100   | A    |
| Repetitive Peak Forward Current | $I_{FRM}$ | $t_p=1\text{ms}$            | 200   | A    |

### Characteristic values

| Parameter                     | Symbol    | Conditions                                                                                          | Value |      |      | Unit          |
|-------------------------------|-----------|-----------------------------------------------------------------------------------------------------|-------|------|------|---------------|
|                               |           |                                                                                                     | Min.  | Typ. | Max. |               |
| Forward Voltage               | $V_F$     | $I_F=100\text{A}, T_{vj}=25^{\circ}\text{C}$                                                        |       | 1.80 | 2.00 | V             |
|                               |           | $I_F=100\text{A}, T_{vj}=125^{\circ}\text{C}$                                                       |       | 1.85 |      |               |
| Recovered Charge              | $Q_{rr}$  | $I_F=100\text{A}$<br>$V_R=600\text{V}$<br>$-di_F/dt=2300\text{A/us}$<br>$T_{vj}=25^{\circ}\text{C}$ |       | 4.5  |      | $\mu\text{C}$ |
| Peak Reverse Recovery Current | $I_{rr}$  |                                                                                                     |       | 80   |      | A             |
| Reverse Recovery Time         | $t_{rr}$  |                                                                                                     |       | 85   |      | ns            |
| Reverse Recovery Energy       | $E_{rec}$ |                                                                                                     |       | 2.5  |      | mJ            |
| Recovered Charge              | $Q_{rr}$  |                                                                                                     |       | 9.2  |      | $\mu\text{C}$ |
| Peak Reverse Recovery Current | $I_{rr}$  |                                                                                                     |       | 95   |      | A             |



## ● 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      | $I_C$     | $T_C=80^{\circ}C, T_{vjmax}=150^{\circ}C$ | 50       | A    |
| Repetitive Peak Collector Current | $I_{CRM}$ | $t_p=1ms$                                 | 100      | A    |
| Gate-Emitter Voltage              | $V_{GES}$ | $T_{vj}=25^{\circ}C$                      | $\pm 20$ | V    |
| Total Power Dissipation           | $P_{tot}$ | $T_C=25^{\circ}C, T_{vjmax}=150^{\circ}C$ | 222      | W    |

### Characteristic values

| Parameter                               | Symbol        | Conditions                                                                               | Value |      |      | Unit |
|-----------------------------------------|---------------|------------------------------------------------------------------------------------------|-------|------|------|------|
|                                         |               |                                                                                          | Min.  | Typ. | Max. |      |
| Gate-Emitter Threshold Voltage          | $V_{GE(th)}$  | $V_{GE}=V_{CE}, I_C=1.2mA, T_{vj}=25^{\circ}C$                                           | 5.0   | 6.2  | 7.0  | 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    | $V_{CE(sat)}$ | $I_C=50A, V_{GE}=15V, T_{vj}=25^{\circ}C$                                                |       | 1.85 | 2.35 | V    |
|                                         |               | $I_C=50A, V_{GE}=15V, T_{vj}=125^{\circ}C$                                               |       | 2.05 |      |      |
|                                         |               | $I_C=50A, V_{GE}=15V, T_{vj}=150^{\circ}C$                                               |       | 2.10 |      |      |
| Gate Charge                             | $Q_G$         |                                                                                          |       | 0.54 |      | uC   |
| Input Capacitance                       | $C_{ies}$     | $V_{CE}=25V, V_{GE}=0V, f=1MHz, T_{vj}=25^{\circ}C$                                      |       | 4.30 |      | nF   |
| Reverse Transfer Capacitance            | $C_{res}$     |                                                                                          |       | 0.20 |      | nF   |
| Gate-Emitter leakage current            | $I_{GES}$     | $V_{CE}=0V, V_{GE}=20V, T_{vj}=25^{\circ}C$                                              |       |      | 400  | nA   |
| Turn-on Delay Time                      | $t_{d(on)}$   | $I_C=50A$<br>$V_{CE}=600V$<br>$V_{GE}=\pm 15V$<br>$R_G=15\Omega$<br>$T_{vj}=25^{\circ}C$ |       | 390  |      | ns   |
| Rise Time                               | $t_r$         |                                                                                          |       | 75   |      | ns   |
| Turn-off Delay Time                     | $t_{d(off)}$  |                                                                                          |       | 384  |      | ns   |
| Fall Time                               | $t_f$         |                                                                                          |       | 86   |      | ns   |
| Energy Dissipation During Turn-on Time  | $E_{on}$      |                                                                                          |       | 6.3  |      | mJ   |
| Energy Dissipation During Turn-off Time | $E_{off}$     |                                                                                          |       | 3.2  |      | mJ   |



|                                         |              |                                                                                                                                    |  |     |  |    |
|-----------------------------------------|--------------|------------------------------------------------------------------------------------------------------------------------------------|--|-----|--|----|
| Turn-on Delay Time                      | $t_{d(on)}$  | $I_C = 50\text{ A}$<br>$V_{CE} = 600\text{ V}$<br>$V_{GE} = \pm 15\text{ V}$<br>$R_G = 15\Omega$<br>$T_{vj} = 125^\circ\text{C}$   |  | 410 |  | ns |
| Rise Time                               | $t_r$        |                                                                                                                                    |  | 76  |  | ns |
| Turn-off Delay Time                     | $t_{d(off)}$ |                                                                                                                                    |  | 410 |  | ns |
| Fall Time                               | $t_f$        |                                                                                                                                    |  | 95  |  | ns |
| Energy Dissipation During Turn-on Time  | $E_{on}$     |                                                                                                                                    |  | 7.3 |  | mJ |
| Energy Dissipation During Turn-off Time | $E_{off}$    |                                                                                                                                    |  | 5.7 |  | mJ |
| SC Data                                 | $I_{sc}$     | $T_p \leq 10\mu\text{s}, V_{GE} = 15\text{ V}, T_{vj} = 150^\circ\text{C},$<br>$V_{cc} = 900\text{ V}, V_{CEM} \leq 1200\text{ V}$ |  | 274 |  | A  |

## ● 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   | $I_F$     |                                                        | 50    | A                    |
| Repetitive Peak Forward Current | $I_{FRM}$ | $t_p = 1\text{ ms}$                                    | 100   | A                    |
| $I^2t$ -value                   | $I^2t$    | $V_R = 0, t_p = 10\text{ ms}, T_j = 125^\circ\text{C}$ | 1550  | $\text{A}^2\text{s}$ |
|                                 |           | $V_R = 0, t_p = 10\text{ ms}, T_j = 150^\circ\text{C}$ | 1500  |                      |

### 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       | $E_{rec}$ | $T_{vj} = 25^\circ\text{C}$                                   |       | 1.4  |      | mJ            |



|                               |           |                                                                                                             |  |     |  |               |
|-------------------------------|-----------|-------------------------------------------------------------------------------------------------------------|--|-----|--|---------------|
| Recovered Charge              | $Q_{rr}$  | $I_F = 50\text{ A}$<br>$V_R = 600\text{ V}$<br>$-di_F/dt = 900\text{ A/us}$<br>$T_{vj} = 125^\circ\text{C}$ |  | 6.5 |  | $\mu\text{C}$ |
| Peak Reverse Recovery Current | $I_{rr}$  |                                                                                                             |  | 50  |  | A             |
| Reverse Recovery Energy       | $E_{rec}$ |                                                                                                             |  | 2.0 |  | 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 | $I_{F(AV)}$ | $T_c = 80^\circ\text{C}$                             | 100   | A                    |
| Maximum RMS Current at Rectifier Output        | $I_{RMSM}$  | $T_c = 80^\circ\text{C}$                             | 150   | A                    |
| Surge Forward Current                          | $I_{FSM}$   | $V_R = 0, t_p = 10\text{ms}, T_J = 25^\circ\text{C}$ | 1150  | A                    |
| $I^2t$ -value                                  | $I^2t$      | $V_R = 0, t_p = 10\text{ms}, T_J = 25^\circ\text{C}$ | 6600  | $\text{A}^2\text{s}$ |

### Characteristic values

| Parameter             | Symbol | Conditions                                     | Value |      |      | Unit |
|-----------------------|--------|------------------------------------------------|-------|------|------|------|
|                       |        |                                                | Min.  | Typ. | Max. |      |
| Diode Forward Voltage | $V_F$  | $I_F = 100\text{ A}, T_J = 150^\circ\text{C}$  |       | 1.0  |      | V    |
| Reverse Current       | $I_R$  | $T_J = 125^\circ\text{C}, V_R = 1600\text{ V}$ |       |      | 2.0  | mA   |

## ● NTC-Thermistor

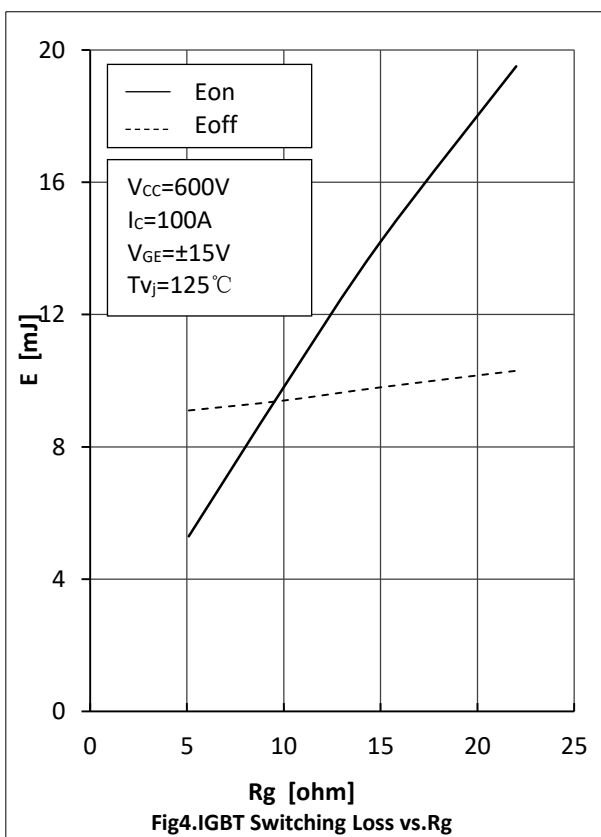
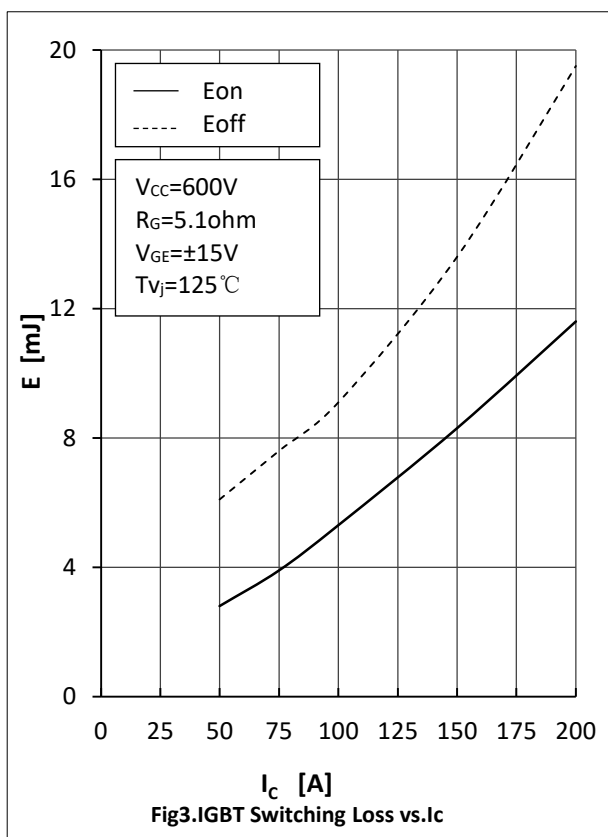
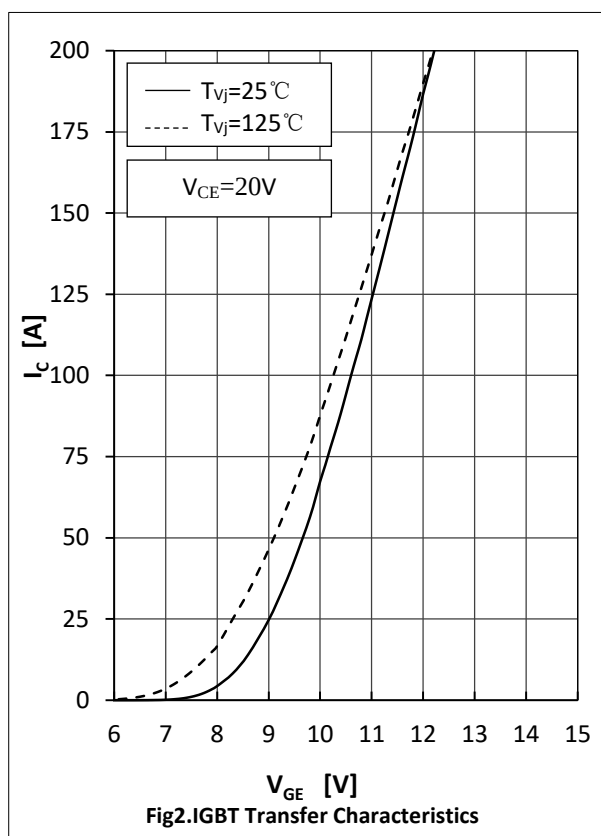
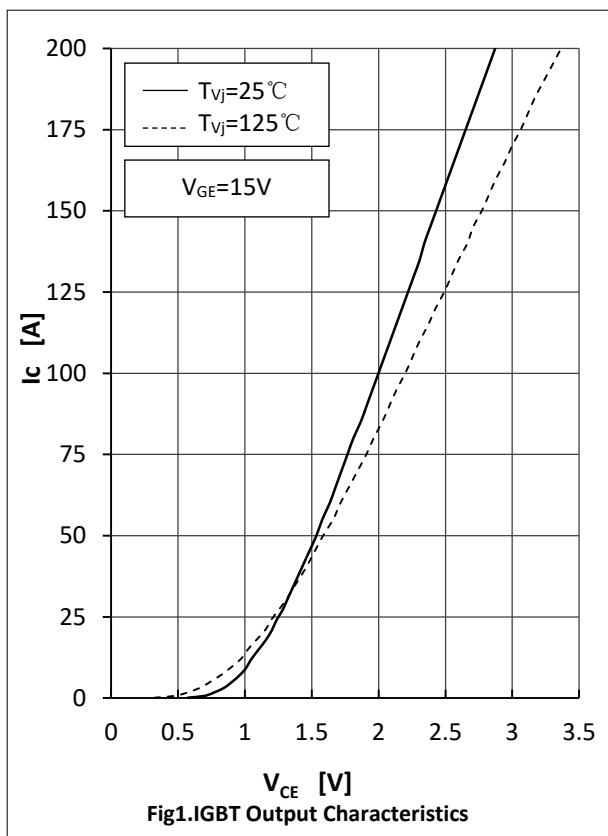
### Characteristic values

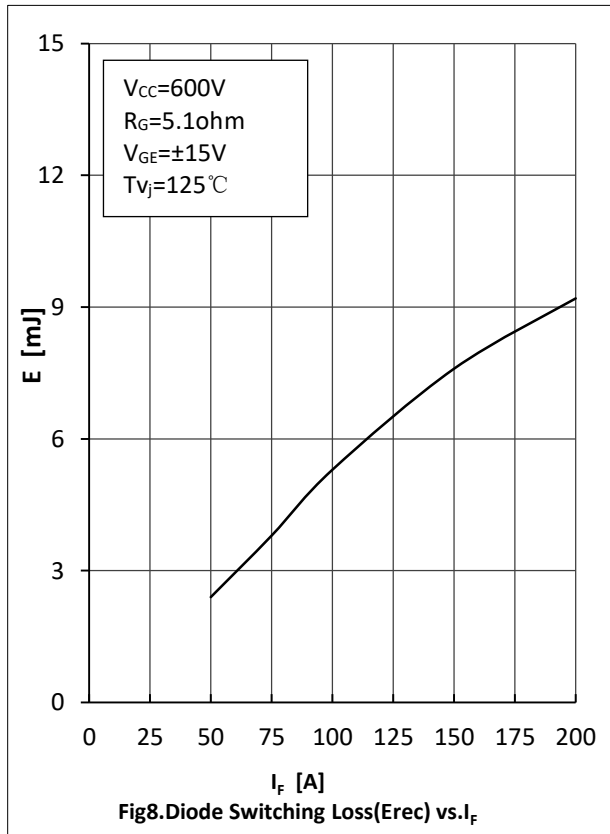
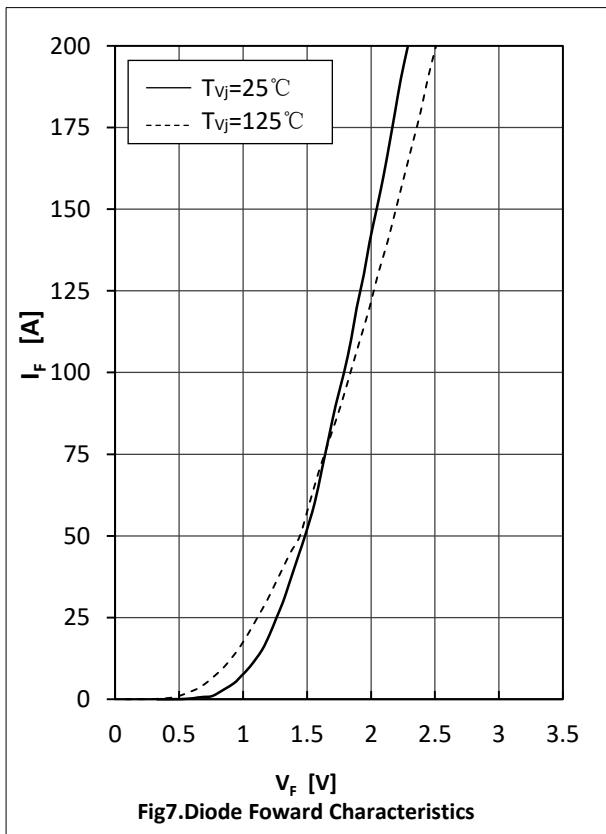
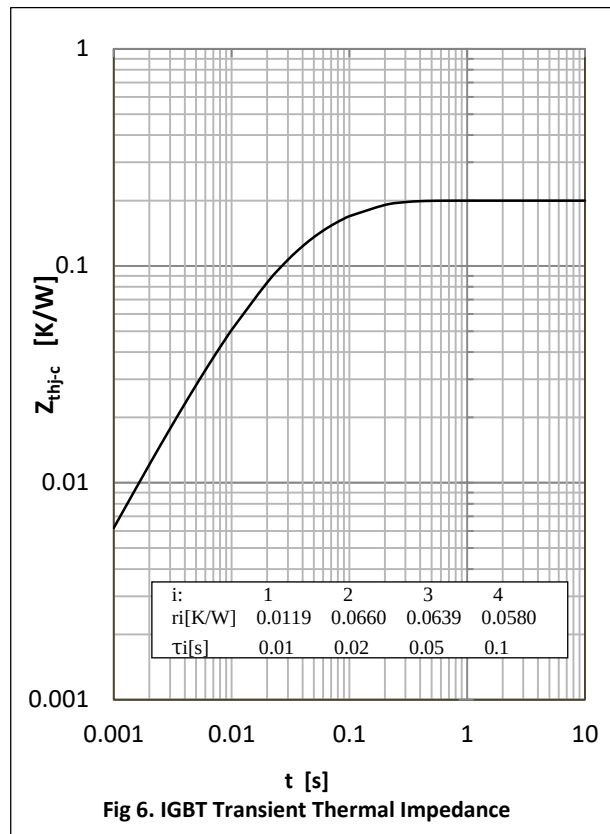
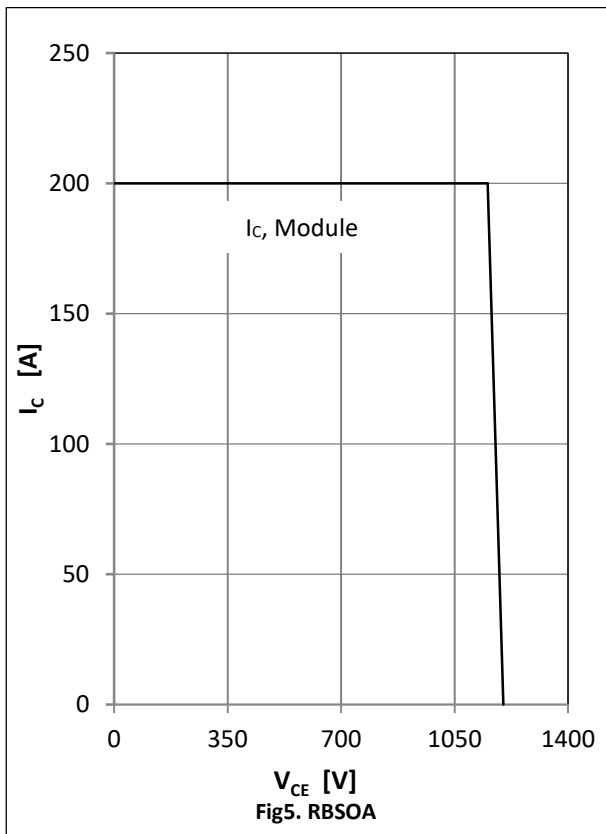
| Parameter              | Symbol       | Conditions                                                 | Value |      |      | Unit             |
|------------------------|--------------|------------------------------------------------------------|-------|------|------|------------------|
|                        |              |                                                            | 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                |

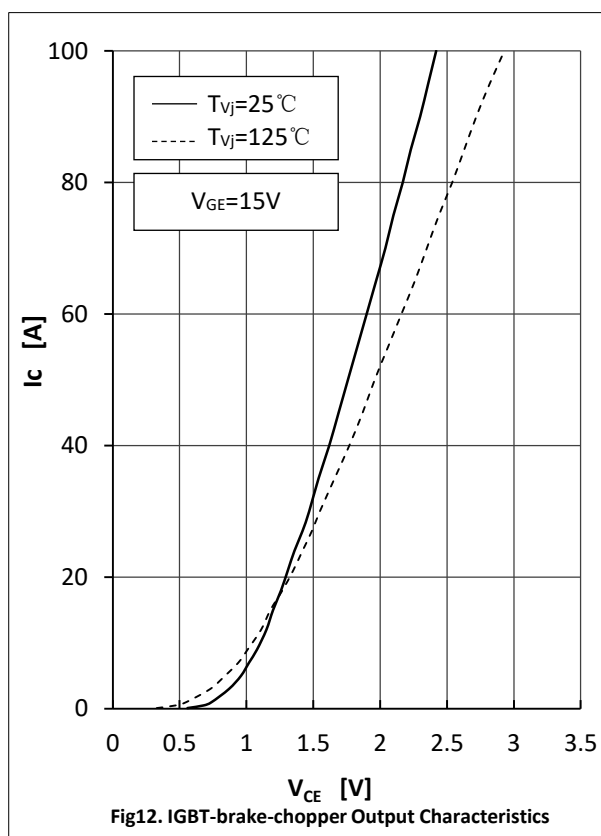
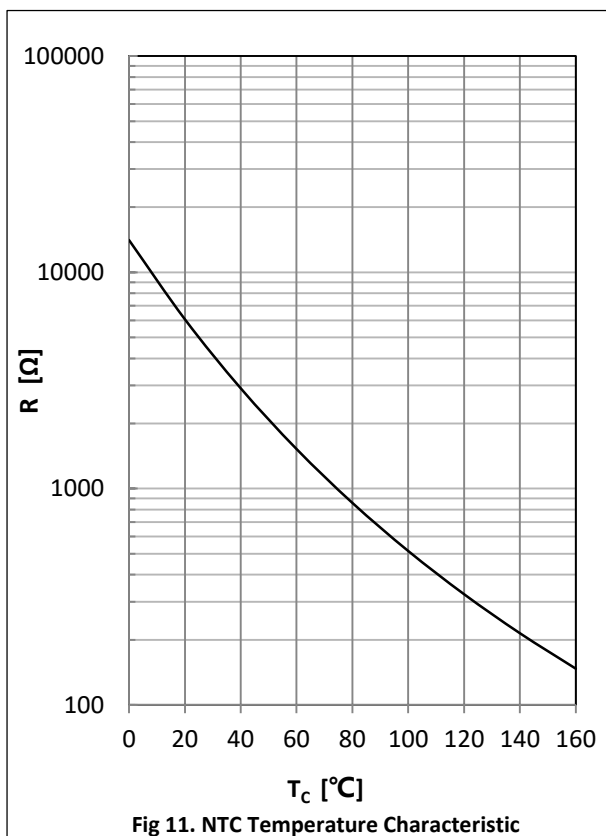
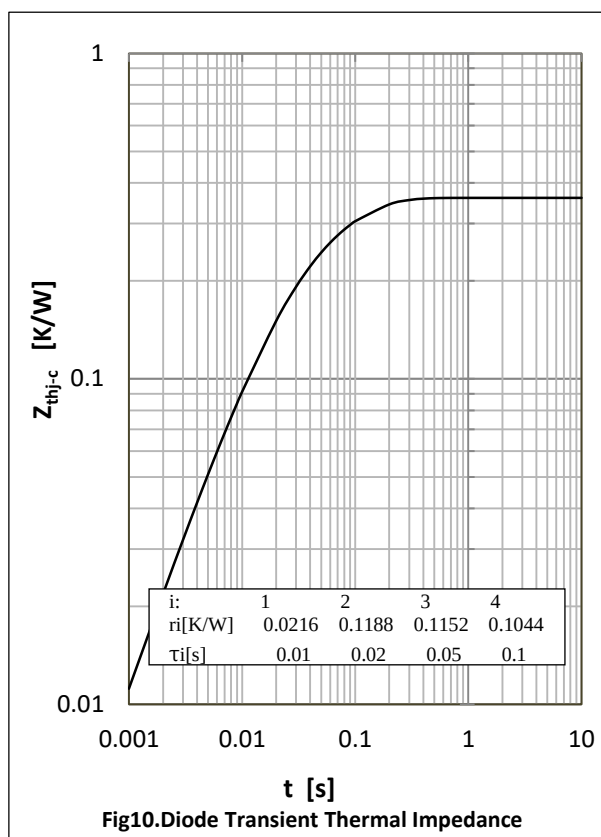
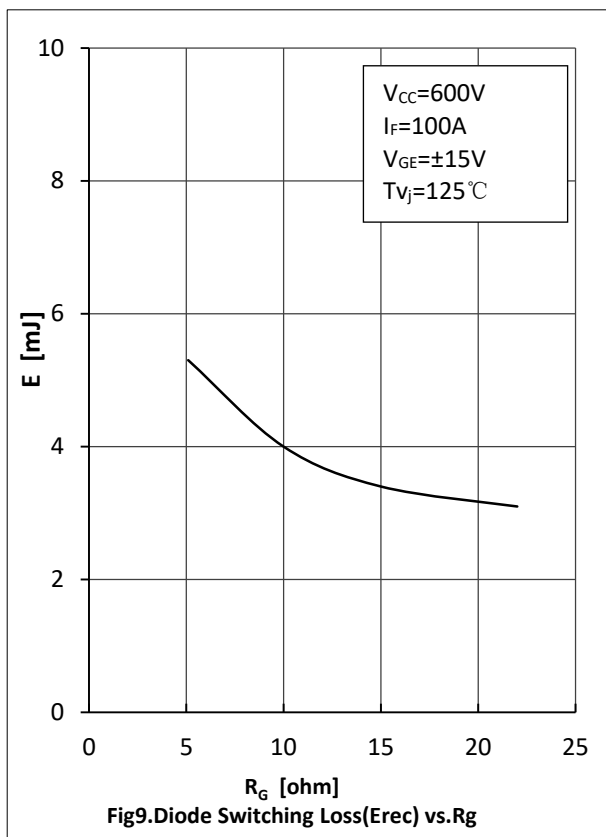


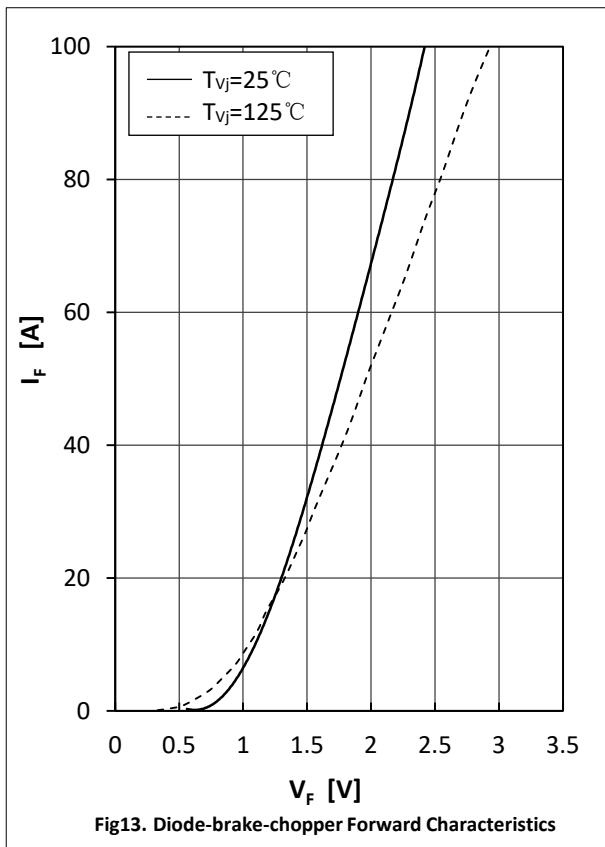
● **Module Characteristics**  $T_c=25^{\circ}\text{C}$  unless otherwise specified

| Parameter                                | Symbol                      | Conditions                            | Value |       |       | Unit               |
|------------------------------------------|-----------------------------|---------------------------------------|-------|-------|-------|--------------------|
|                                          |                             |                                       | Min.  | Typ.  | Max.  |                    |
| Isolation voltage                        | $V_{\text{isol}}$           | $t=1\text{min}, f=50\text{Hz}$        | 2500  |       |       | V                  |
| Maximum Junction Temperature             | $T_{j\text{max}}$           | Inverter, brake                       |       |       | 150   | $^{\circ}\text{C}$ |
|                                          |                             | rectifier                             |       |       | 125   |                    |
| Operating Junction Temperature           | $T_{vj\text{op}}$           |                                       | -40   |       | 125   | $^{\circ}\text{C}$ |
| Storage Temperature                      | $T_{\text{stg}}$            |                                       | -40   |       | 125   | $^{\circ}\text{C}$ |
| Stray Inductance                         | $L_{\text{CE}}$             |                                       |       | 40    |       | nH                 |
| Module Lead Resistance ,Terminal to Chip | $R_{\text{cc}'+\text{EE}'}$ | $T_c=25^{\circ}\text{C}$ , per switch |       | 4.0   |       | $\text{m}\Omega$   |
|                                          | $R_{\text{AA}'+\text{CC}'}$ |                                       |       | 3.0   |       |                    |
| Thermal Resistance Junction-to Case      | $R_{\theta\text{jc}}$       | per IGBT-inverter                     |       |       | 0.200 | K/W                |
|                                          |                             | per Diode-inverter                    |       |       | 0.360 |                    |
|                                          |                             | per IGBT-brake-copper                 |       |       | 0.321 |                    |
|                                          |                             | per Diode-chopper                     |       |       | 0.563 |                    |
|                                          |                             | per Diode-rectifier                   |       |       | 0.318 |                    |
| Thermal Resistance Case-to Sink          | $R_{\theta\text{CS}}$       | per IGBT-inverter                     |       | 0.104 |       | K/W                |
|                                          |                             | per Diode-inverter                    |       | 0.190 |       |                    |
|                                          |                             | per IGBT-brake-copper                 |       | 0.177 |       |                    |
|                                          |                             | per Diode-chopper                     |       | 0.310 |       |                    |
|                                          |                             | per Diode-rectifier                   |       | 0.175 |       |                    |
|                                          |                             | per Module                            |       | 0.009 |       |                    |
| Module-to-Sink Torque                    | $M_s$                       |                                       | 3.0   |       | 6.0   | N·m                |
| Weight of Module                         | G                           |                                       |       | 300   |       | g                  |

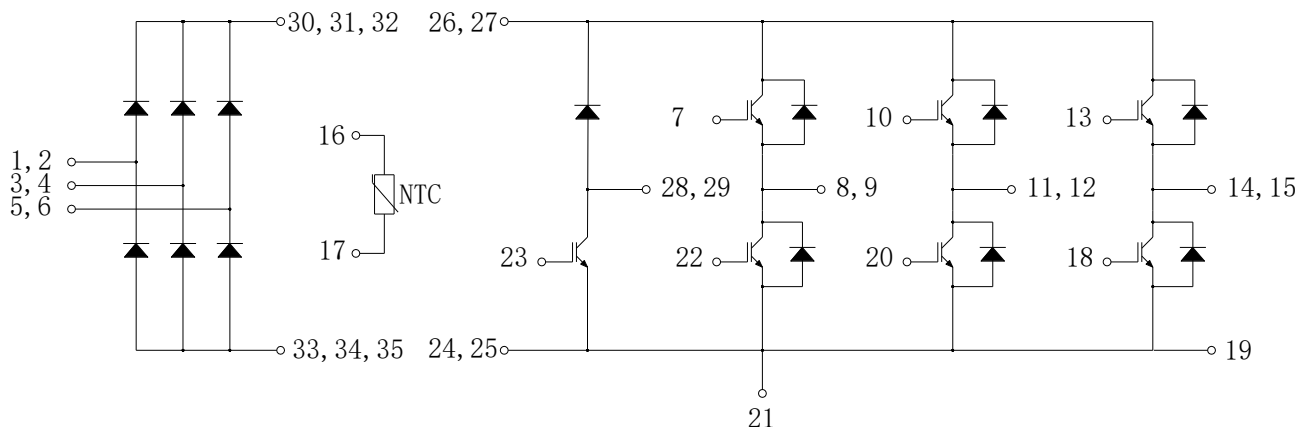








## ● Circuit Diagram



## ● Package Dimensions

