



E502650

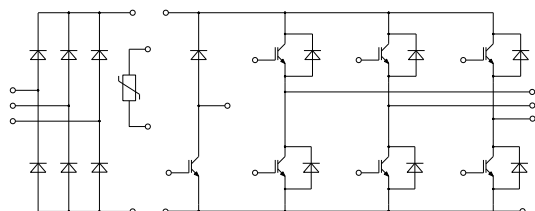
## Features

- Low Switching Losses
- Low  $V_{ce(sat)}$  with Positive Temperature Coefficient
- Including Fast & Soft Recovery Anti-parallel FWD
- Low Inductance Case
- High Short Circuit Capability(10 $\mu$ s)
- Maximum Junction Temperature 175°C
- Epoxy Meets UL 94 V-0 Flammability Rating
- Lead Free Finish/RoHS Compliant ("P" Suffix Designates RoHS Compliant. See Ordering Information)

## Applications

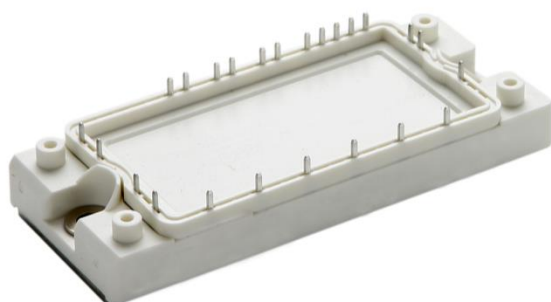
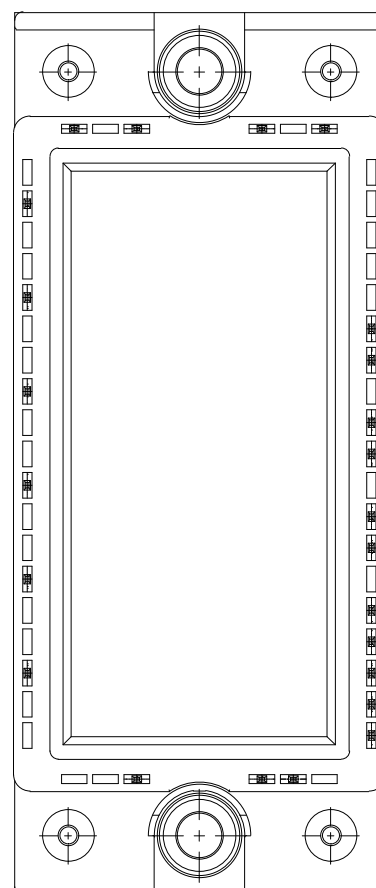
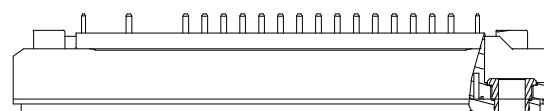
- Motor Drivers
- AC and DC Servo Drive Amplifier
- UPS (Uninterruptible Power Supplies)

## Circuit Diagram



# IGBT Modules 1200V 25A

E1



## ● IGBT- Inverter

### Maximum Ratings

| Parameter                         | Symbol    | Test Conditions                            | Rating   | Unit |
|-----------------------------------|-----------|--------------------------------------------|----------|------|
| Collector-Emitter Voltage         | $V_{CES}$ | $V_{GE}=0V, I_C=1mA, T_{vj}=25^{\circ}C$   | 1200     | V    |
| Continuous Collector Current      | $I_C$     | $T_C=100^{\circ}C, T_{vjmax}=175^{\circ}C$ | 25       | A    |
| Repetitive Peak Collector Current | $I_{CRM}$ | $t_p=1ms$                                  | 50       | A    |
| Gate-Emitter Voltage              | $V_{GES}$ | $T_{vj}=25^{\circ}C$                       | $\pm 20$ | V    |
| Total Power Dissipation           | $P_{tot}$ | $T_C=25^{\circ}C, T_{vjmax}=175^{\circ}C$  | 166      | W    |

### Electrical Characteristics

| Parameter                            | Symbol        | Test Conditions                                                                      | Min | Typ  | Max  | Unit    |
|--------------------------------------|---------------|--------------------------------------------------------------------------------------|-----|------|------|---------|
| Gate-Emitter Threshold Voltage       | $V_{GE(th)}$  | $V_{GE}=V_{CE}, I_C=0.8mA, T_{vj}=25^{\circ}C$                                       | 5.2 | 6.0  | 6.8  | V       |
| Collector-Emitter Cut-off Current    | $I_{CES}$     | $V_{CE}=1200V, V_{GE}=0V, T_{vj}=25^{\circ}C$                                        |     |      | 1    | mA      |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $I_C=25A, V_{GE}=15V, T_{vj}=25^{\circ}C$                                            |     | 1.85 | 2.25 | V       |
|                                      |               | $I_C=25A, V_{GE}=15V, T_{vj}=125^{\circ}C$                                           |     | 2.15 |      | V       |
|                                      |               | $I_C=25A, V_{GE}=15V, T_{vj}=150^{\circ}C$                                           |     | 2.25 |      | V       |
| Gate Charge                          | $Q_g$         |                                                                                      |     | 0.2  |      | $\mu C$ |
| Input Capacitance                    | $C_{ies}$     | $V_{CE}=25V, V_{GE}=0V, f=1MHz$                                                      |     | 1.45 |      | nF      |
| Reverse Transfer Capacitance         | $C_{res}$     |                                                                                      |     | 0.05 |      |         |
| Gate-Emitter leakage current         | $I_{GES}$     | $V_{CE}=0V, V_{GE}=20V, T_{vj}=25^{\circ}C$                                          |     |      | 400  | nA      |
| Turn-On Delay Time                   | $t_{d(on)}$   | $V_{CE}=600V, I_C=25A, V_{GE}=\pm 15V, R_G=18\Omega, T_{vj}=25^{\circ}C$             |     | 158  |      | ns      |
| Rise Time                            | $t_r$         |                                                                                      |     | 32   |      |         |
| Turn-Off Delay Time                  | $t_{d(off)}$  |                                                                                      |     | 331  |      |         |
| Fall Time                            | $t_f$         |                                                                                      |     | 83   |      |         |
| Turn-On Energy                       | $E_{on}$      |                                                                                      |     | 1.8  |      | mJ      |
| Turn-Off Energy                      | $E_{off}$     |                                                                                      |     | 1.4  |      |         |
| Turn-On Delay Time                   | $t_{d(on)}$   | $V_{CE}=600V, I_C=25A, V_{GE}=\pm 15V, R_G=18\Omega, T_{vj}=125^{\circ}C$            |     | 172  |      | ns      |
| Rise Time                            | $t_r$         |                                                                                      |     | 435  |      |         |
| Turn-Off Delay Time                  | $t_{d(off)}$  |                                                                                      |     | 154  |      |         |
| Fall Time                            | $t_f$         |                                                                                      |     | 212  |      |         |
| Turn-On Energy                       | $E_{on}$      |                                                                                      |     | 2.4  |      | mJ      |
| Turn-Off Energy                      | $E_{off}$     |                                                                                      |     | 2.18 |      |         |
| SC Data                              | $I_{SC}$      | $T_p \leq 10\mu s, V_{GE}=15V, T_{vj}=150^{\circ}C, V_{CC}=900V, V_{CEM} \leq 1200V$ |     | 120  |      | A       |

## ● Diode- Inverter

### Maximum Ratings

| Parameter                       | Symbol    | Test Conditions                        | Rating | Unit   |
|---------------------------------|-----------|----------------------------------------|--------|--------|
| Repetitive Peak Reverse Voltage | $V_{RRM}$ | $T_{vj}=25^{\circ}C$                   | 1200   | V      |
| Continuous DC Forward Current   | $I_F$     |                                        | 25     | A      |
| Repetitive Peak Forward Current | $I_{FRM}$ | $t_p=1ms$                              | 50     | A      |
| $I^2t$ -value                   | $I^2t$    | $V_R=0, t_p=10ms, T_{vj}=125^{\circ}C$ | 90     | $A^2s$ |
|                                 |           | $V_R=0, t_p=10ms, T_{vj}=150^{\circ}C$ | 75     |        |

### Electrical Characteristics

| Parameter                     | Symbol    | Test Conditions                                               | Min | Typ  | Max | Unit    |
|-------------------------------|-----------|---------------------------------------------------------------|-----|------|-----|---------|
| Forward Voltage               | $V_F$     | $I_F=25A, T_{vj}=25^{\circ}C$                                 |     | 2.1  | 2.5 | V       |
|                               |           | $I_F=25A, T_{vj}=125^{\circ}C$                                |     | 2.2  |     | V       |
|                               |           | $I_F=25A, T_{vj}=150^{\circ}C$                                |     | 2.2  |     | V       |
| Recovered Charge              | $Q_{rr}$  | $I_F=25A, V_R=600V, -di_F/dt=680A/\mu s, T_{vj}=25^{\circ}C$  |     | 2.52 |     | $\mu C$ |
| Peak Reverse Recovery Current | $I_{rr}$  |                                                               |     | 28.5 |     | A       |
| Reverse Recovery Energy       | $E_{rec}$ |                                                               |     | 0.94 |     | mJ      |
| Recovered Charge              | $Q_{rr}$  | $I_F=25A, V_R=600V, -di_F/dt=680A/\mu s, T_{vj}=125^{\circ}C$ |     | 50.8 |     | $\mu C$ |
| Peak Reverse Recovery Current | $I_{rr}$  |                                                               |     | 30.5 |     | A       |
| Reverse Recovery Energy       | $E_{rec}$ |                                                               |     | 1.75 |     | mJ      |

## ● IGBT- Brake-chopper

### Maximum Ratings

| Parameter                         | Symbol    | Test Conditions                            | Rating   | Unit |
|-----------------------------------|-----------|--------------------------------------------|----------|------|
| Collector-Emitter Voltage         | $V_{CES}$ | $V_{GE}=0V, I_C=1mA, T_{vj}=25^{\circ}C$   | 1200     | V    |
| Continuous Collector Current      | $I_C$     | $T_C=100^{\circ}C, T_{vjmax}=175^{\circ}C$ | 15       | A    |
| Repetitive Peak Collector Current | $I_{CRM}$ | $t_p=1ms$                                  | 30       | A    |
| Gate-Emitter Voltage              | $V_{GES}$ | $T_{vj}=25^{\circ}C$                       | $\pm 20$ | V    |
| Total Power Dissipation           | $P_{tot}$ | $T_C=25^{\circ}C, T_{vjmax}=175^{\circ}C$  | 155      | W    |

### Electrical Characteristics

| Parameter                            | Symbol        | Test Conditions                                                                      | Min | Typ  | Max  | Unit    |
|--------------------------------------|---------------|--------------------------------------------------------------------------------------|-----|------|------|---------|
| Gate-Emitter Threshold Voltage       | $V_{GE(th)}$  | $V_{GE}=V_{CE}, I_C=0.5mA, T_{vj}=25^{\circ}C$                                       | 5.2 | 6.0  | 6.8  | V       |
| Collector-Emitter Cut-off Current    | $I_{CES}$     | $V_{CE}=1200V, V_{GE}=0V, T_{vj}=25^{\circ}C$                                        |     |      | 1    | mA      |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $I_C=15A, V_{GE}=15V, T_{vj}=25^{\circ}C$                                            |     | 1.85 | 2.25 | V       |
|                                      |               | $I_C=15A, V_{GE}=15V, T_{vj}=125^{\circ}C$                                           |     | 2.15 |      | V       |
|                                      |               | $I_C=15A, V_{GE}=15V, T_{vj}=150^{\circ}C$                                           |     | 2.25 |      | V       |
| Gate Charge                          | $Q_g$         |                                                                                      |     | 0.09 |      | $\mu C$ |
| Input Capacitance                    | $C_{ies}$     | $V_{CE}=25V, V_{GE}=0V, f=1MHz$                                                      |     | 1.35 |      | nF      |
| Reverse Transfer Capacitance         | $C_{res}$     |                                                                                      |     | 0.08 |      |         |
| Gate-Emitter leakage current         | $I_{GES}$     | $V_{CE}=0V, V_{GE}=20V, T_{vj}=25^{\circ}C$                                          |     |      | 400  | nA      |
| Turn-On Delay Time                   | $t_{d(on)}$   | $V_{CE}=600V, I_C=15A, V_{GE}=\pm 15V, R_G=39\Omega, T_{vj}=25^{\circ}C$             |     | 46   |      | ns      |
| Rise Time                            | $t_r$         |                                                                                      |     | 45   |      |         |
| Turn-Off Delay Time                  | $t_{d(off)}$  |                                                                                      |     | 182  |      |         |
| Fall Time                            | $t_f$         |                                                                                      |     | 168  |      |         |
| Turn-On Energy                       | $E_{on}$      |                                                                                      |     | 0.92 |      | mJ      |
| Turn-Off Energy                      | $E_{off}$     |                                                                                      |     | 0.56 |      |         |
| Turn-On Delay Time                   | $t_{d(on)}$   | $V_{CE}=600V, I_C=15A, V_{GE}=\pm 15V, R_G=39\Omega, T_{vj}=125^{\circ}C$            |     | 46   |      | ns      |
| Rise Time                            | $t_r$         |                                                                                      |     | 63   |      |         |
| Turn-Off Delay Time                  | $t_{d(off)}$  |                                                                                      |     | 248  |      |         |
| Fall Time                            | $t_f$         |                                                                                      |     | 220  |      |         |
| Turn-On Energy                       | $E_{on}$      |                                                                                      |     | 1.37 |      | mJ      |
| Turn-Off Energy                      | $E_{off}$     |                                                                                      |     | 0.81 |      |         |
| SC Data                              | $I_{SC}$      | $T_p \leq 10\mu s, V_{GE}=15V, T_{vj}=150^{\circ}C, V_{CC}=900V, V_{CEM} \leq 1200V$ |     | 55   |      | A       |

## ● Diode- Brake-chopper

### Maximum Ratings

| Parameter                       | Symbol    | Test Conditions                        | Rating | Unit   |
|---------------------------------|-----------|----------------------------------------|--------|--------|
| Repetitive Peak Reverse Voltage | $V_{RRM}$ | $T_{vj}=25^{\circ}C$                   | 1200   | V      |
| Continuous DC Forward Current   | $I_F$     |                                        | 15     | A      |
| Repetitive Peak Forward Current | $I_{FRM}$ | $t_p=1ms$                              | 30     | A      |
| $I^2t$ -value                   | $I^2t$    | $V_R=0, t_p=10ms, T_{vj}=125^{\circ}C$ | 40     | $A^2s$ |
|                                 |           | $V_R=0, t_p=10ms, T_{vj}=150^{\circ}C$ | 34     |        |

### Electrical Characteristics

| Parameter                     | Symbol    | Test Conditions                                               | Min | Typ  | Max  | Unit    |
|-------------------------------|-----------|---------------------------------------------------------------|-----|------|------|---------|
| Forward Voltage               | $V_F$     | $I_F=15A, T_{vj}=25^{\circ}C$                                 |     | 2.0  | 2.65 | V       |
|                               |           | $I_F=15A, T_{vj}=125^{\circ}C$                                |     | 2.1  |      | V       |
|                               |           | $I_F=15A, T_{vj}=150^{\circ}C$                                |     | 2.1  |      | V       |
| Recovered Charge              | $Q_{rr}$  | $I_F=15A, V_R=600V, -di_F/dt=600A/\mu s, T_{vj}=25^{\circ}C$  |     | 1.2  |      | $\mu C$ |
| Peak Reverse Recovery Current | $I_{rr}$  |                                                               |     | 13.0 |      | A       |
| Reverse Recovery Energy       | $E_{rec}$ |                                                               |     | 0.37 |      | mJ      |
| Recovered Charge              | $Q_{rr}$  | $I_F=15A, V_R=600V, -di_F/dt=550A/\mu s, T_{vj}=125^{\circ}C$ |     | 2.4  |      | $\mu C$ |
| Peak Reverse Recovery Current | $I_{rr}$  |                                                               |     | 19.4 |      | A       |
| Reverse Recovery Energy       | $E_{rec}$ |                                                               |     | 0.86 |      | mJ      |

## ● Diode- Rectifier

### Maximum Ratings

| Parameter                                      | Symbol      | Test Conditions                                  | Rating | Unit                 |
|------------------------------------------------|-------------|--------------------------------------------------|--------|----------------------|
| Repetitive Peak Reverse Voltage                | $V_{RRM}$   | $T_J=25^{\circ}\text{C}$                         | 1600   | V                    |
| Average On-state Current<br>50/60Hz, sine wave | $I_{F(AV)}$ | $T_C=100^{\circ}\text{C}$                        | 35     | A                    |
| Maximum RMS Current at Rectifier Output        | $I_{RMSM}$  | $T_C=100^{\circ}\text{C}$                        | 60     | A                    |
| Surge Forward Current                          | $I_{FSM}$   | $V_R=0, t_p=10\text{ms}, T_J=45^{\circ}\text{C}$ | 320    | A                    |
| $I^2t$ -value                                  | $I^2t$      | $V_R=0, t_p=10\text{ms}, T_J=45^{\circ}\text{C}$ | 510    | $\text{A}^2\text{s}$ |

### Electrical Characteristics

| Parameter             | Symbol | Test Conditions                             | Min | Typ  | Max | Unit |
|-----------------------|--------|---------------------------------------------|-----|------|-----|------|
| Diode Forward Voltage | $V_F$  | $I_F=25\text{A}, T_J=150^{\circ}\text{C}$   |     | 1.02 |     | V    |
| Reverse Current       | $I_r$  | $T_J=125^{\circ}\text{C}, V_R=1600\text{V}$ |     |      | 2   | mA   |

## ● NTC-Thermistor

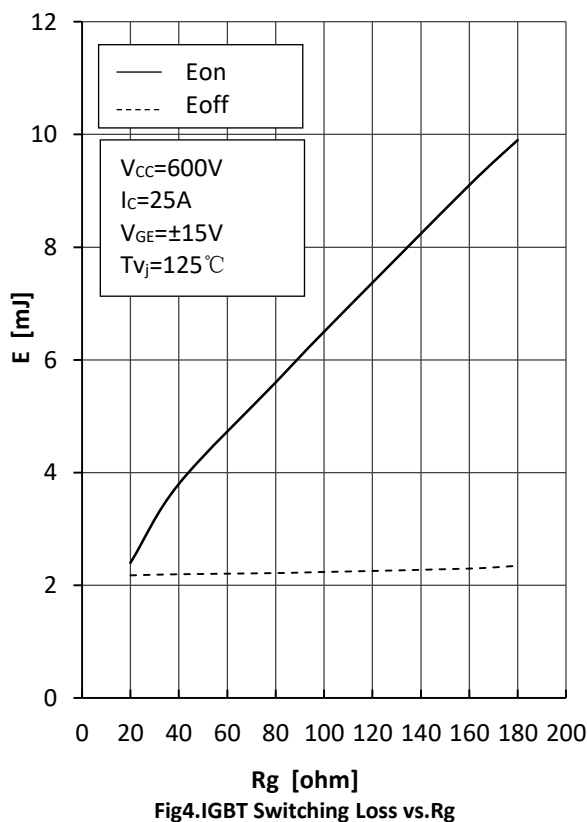
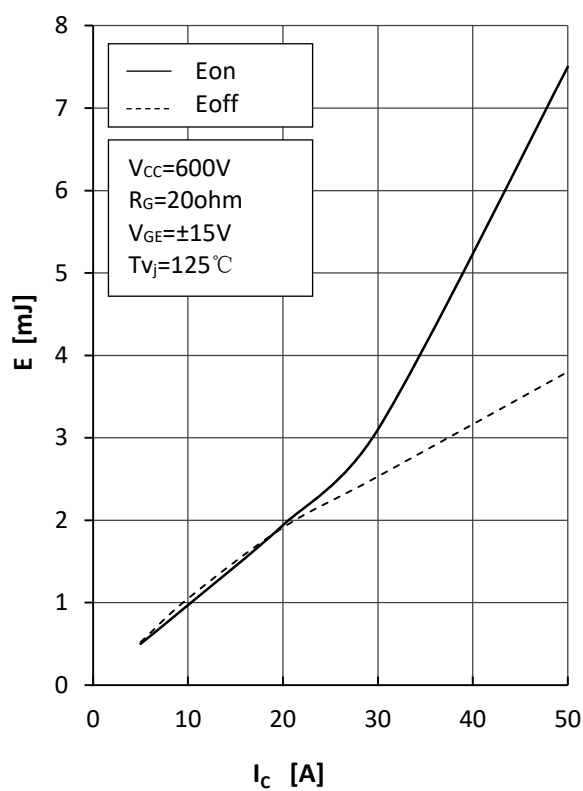
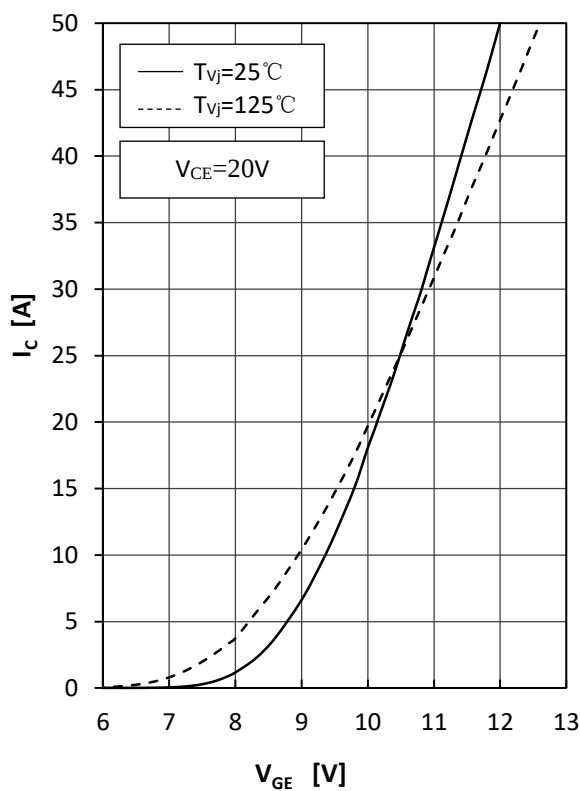
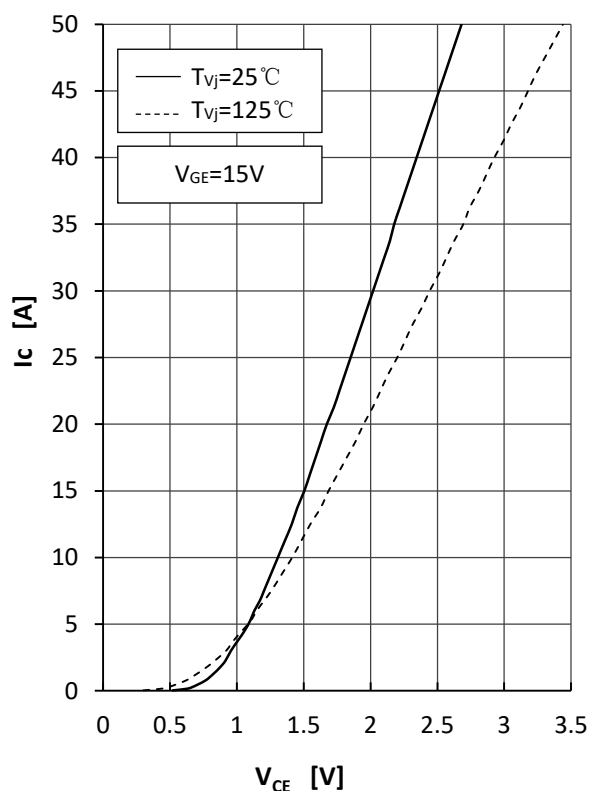
### Electrical Characteristics

| Parameter         | Symbol       | Test Conditions                                       | Min | Typ  | Max | Unit       |
|-------------------|--------------|-------------------------------------------------------|-----|------|-----|------------|
| Rated Resistance  | $R_{25}$     |                                                       |     | 5    |     | k $\Omega$ |
| Deviation of R100 | $\Delta R/R$ | $T_C=100, R_{100}=493.3\Omega$                        | -5  |      | 5   | %          |
| Power Dissipation | $P_{25}$     |                                                       |     |      | 20  | mW         |
| B-value           | $B_{25/50}$  | $R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$ |     | 3375 |     | K          |

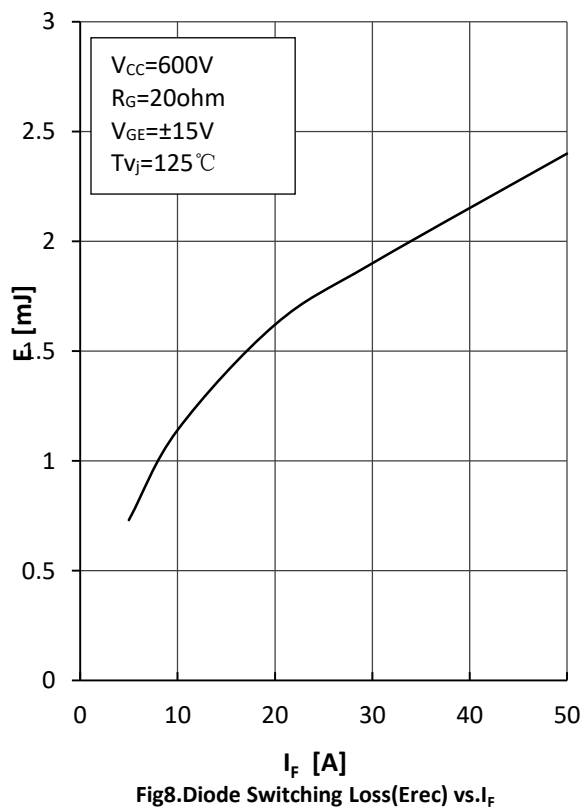
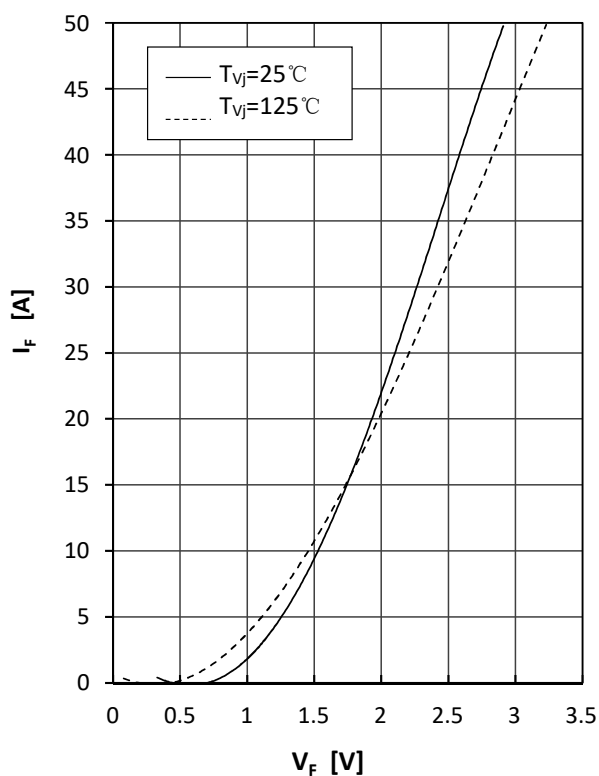
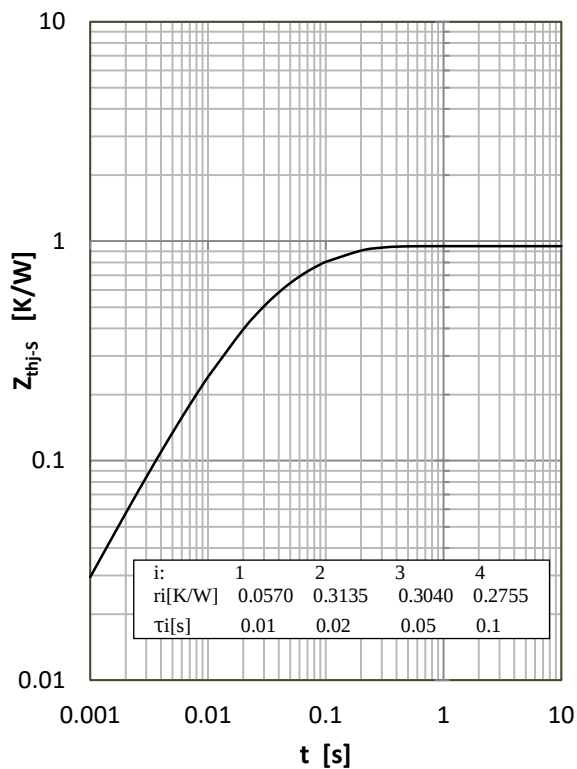
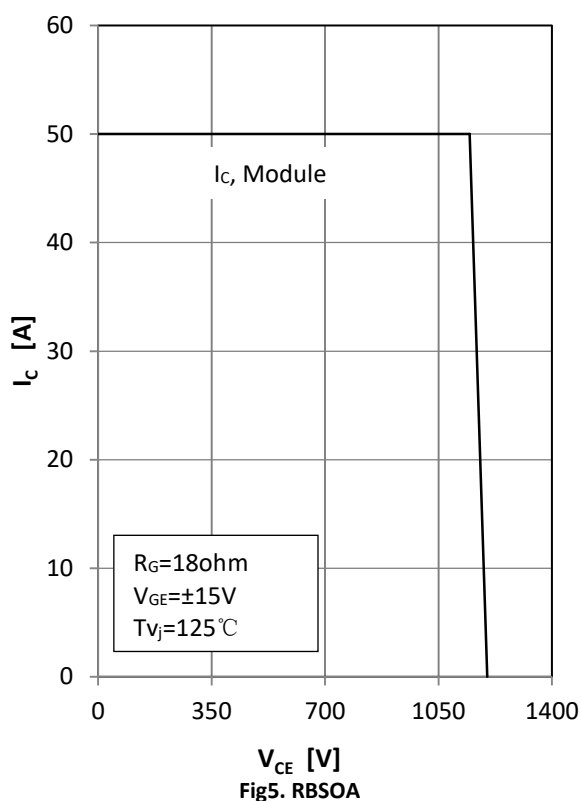
● Module Characteristics( $T_c=25^{\circ}\text{C}$  unless otherwise specified)

| Parameter                                    | Symbol                 | Test Conditions                       | Min  | Typ  | Max  | Unit               |
|----------------------------------------------|------------------------|---------------------------------------|------|------|------|--------------------|
| Isolation voltage                            | $V_{\text{isol}}$      | $t=1\text{min}, f=50\text{Hz}$        | 2500 |      |      | V                  |
| Maximum Junction Temperature                 | $T_{\text{jmax}}$      | Inverter, brake                       |      |      | 175  | $^{\circ}\text{C}$ |
|                                              |                        | rectifier                             |      |      | 150  |                    |
| Operating Junction Temperature               | $T_{\text{vj op}}$     |                                       | -40  |      | 150  | $^{\circ}\text{C}$ |
| Operating Junction Temperature               | $T_{\text{stg}}$       |                                       | -40  |      | 125  | $^{\circ}\text{C}$ |
| Stray Inductance                             | $L_{\text{CE}}$        |                                       |      | 60   |      | nH                 |
| Module Lead Resistance ,<br>Terminal to Chip | $R_{\text{cc'+EE'}}$   | TC=25 $^{\circ}\text{C}$ , per switch |      | 4    |      | m $\Omega$         |
|                                              | $R_{\text{AA'+CC'}}$   |                                       |      | 3    |      |                    |
| Thermal Resistance<br>Junction to Case       | $R_{\theta\text{j c}}$ | per IGBT-inverter                     |      |      | 0.90 | K/W                |
|                                              |                        | per Diode-inverter                    |      |      | 1.2  |                    |
|                                              |                        | per IGBT-brake-chopper                |      |      | 1.2  |                    |
|                                              |                        | per Diode-chopper                     |      |      | 1.5  |                    |
|                                              |                        | per Diode-rectifier                   |      |      | 1.15 |                    |
| Thermal Resistance<br>Case to Sink           | $R_{\theta\text{cs}}$  | per IGBT-inverter                     |      | 0.33 |      | K/W                |
|                                              |                        | per Diode-inverter                    |      | 0.46 |      |                    |
|                                              |                        | per IGBT-brake-chopper                |      | 0.46 |      |                    |
|                                              |                        | per Diode-chopper                     |      | 0.70 |      |                    |
|                                              |                        | per Diode-rectifier                   |      | 0.49 |      |                    |
|                                              |                        | per Module                            |      | 0.02 |      |                    |
| Module-to-Sink Torque                        | $M_{\text{S}}$         |                                       | 3    |      | 6    | N·m                |
| Weight of Module                             | G                      |                                       |      | 180  |      | g                  |

## Curve Characteristics



## Curve Characteristics



## Curve Characteristics

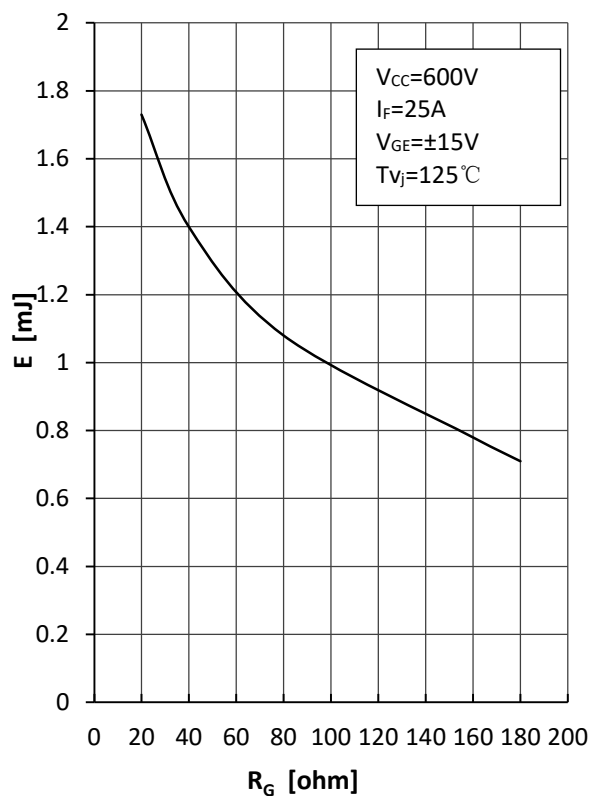


Fig9.Diode Switching Loss( $E_{rec}$ ) vs. $R_g$

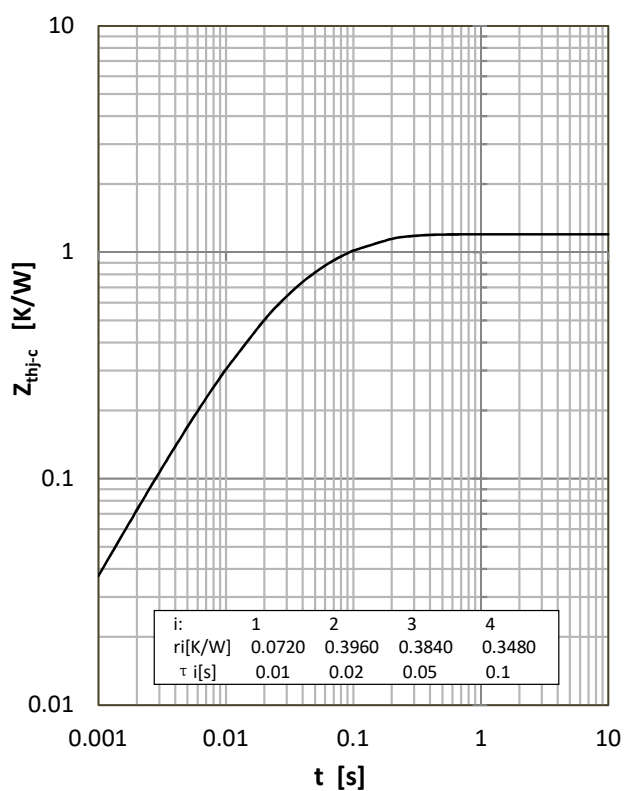


Fig10.Diode Transient Thermal Impedance

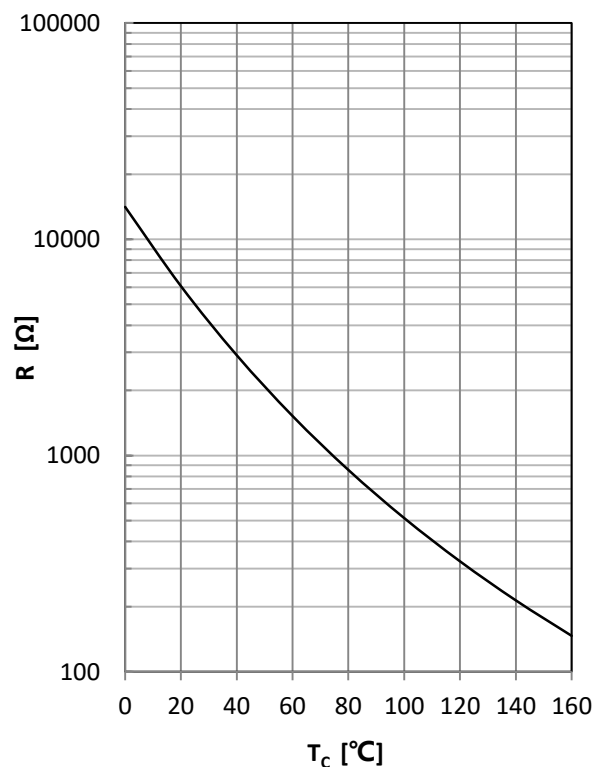
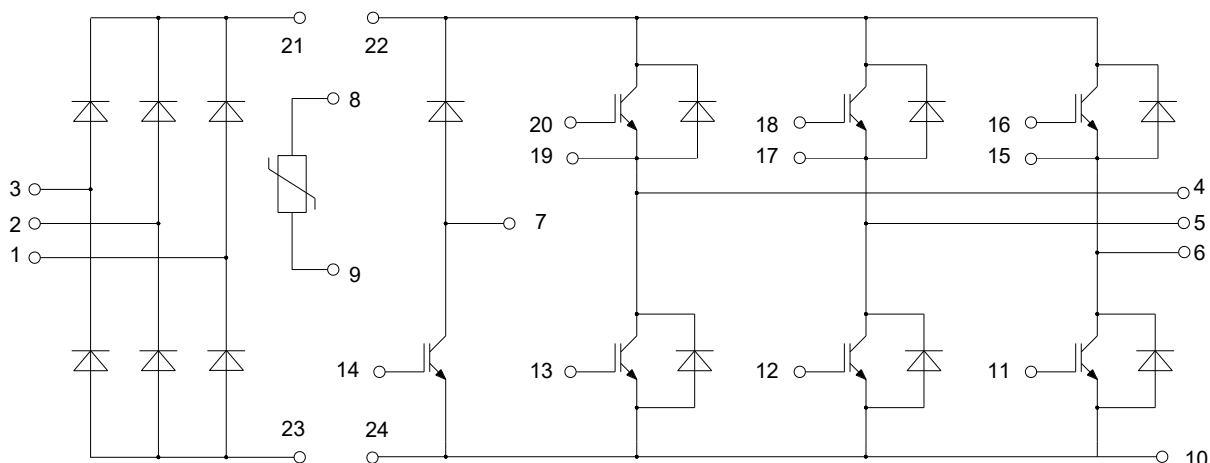


Fig 11. NTC Temperature Characteristic

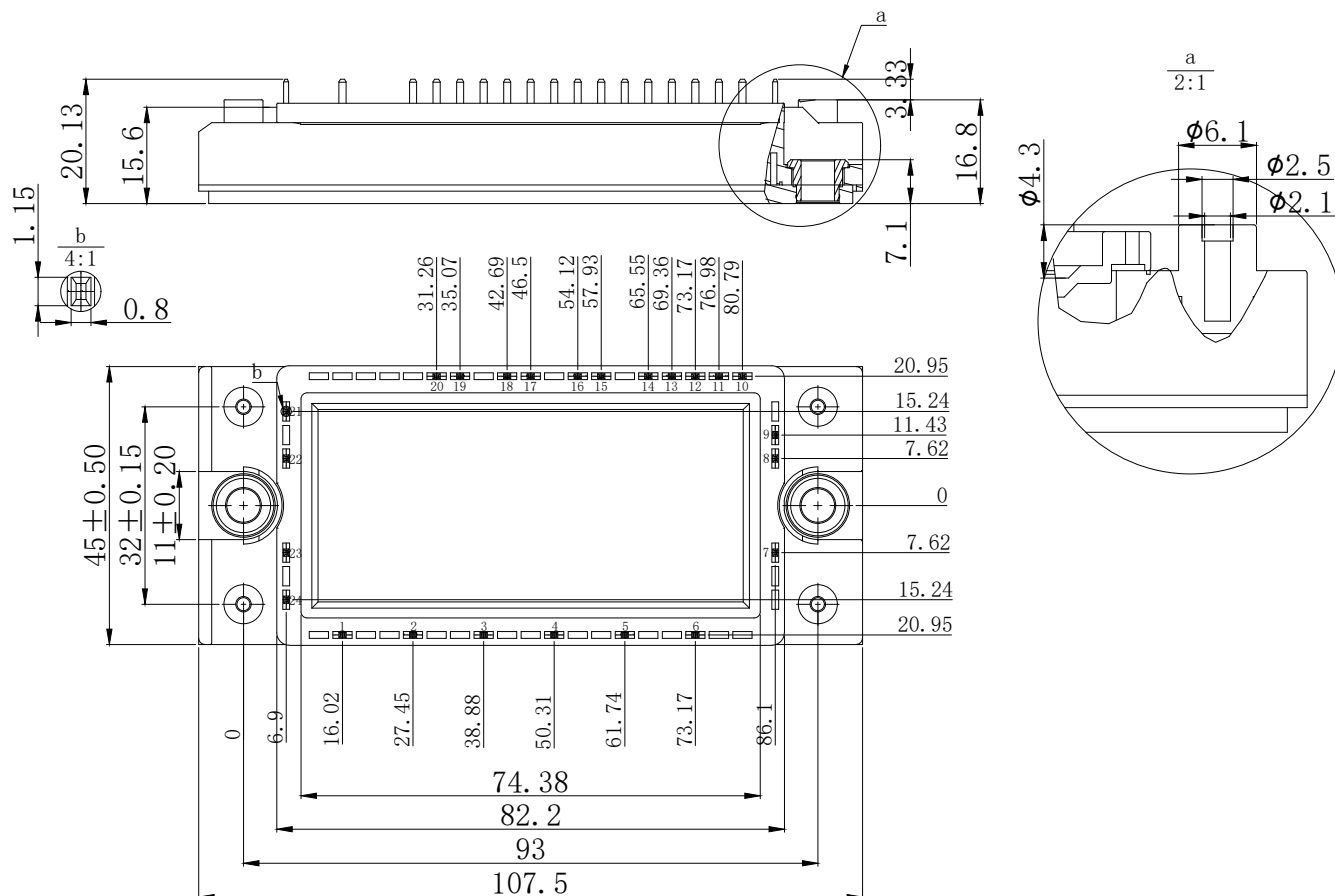
## Circuit Diagram



## Package Dimensions

**E1**

Dimensions in mm



## Ordering Information

| Device         | Packing                     |
|----------------|-----------------------------|
| Part Number-BP | Bulk: 10pcs/Box ; 70pcs/Ctn |

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