



## IGBT Modules

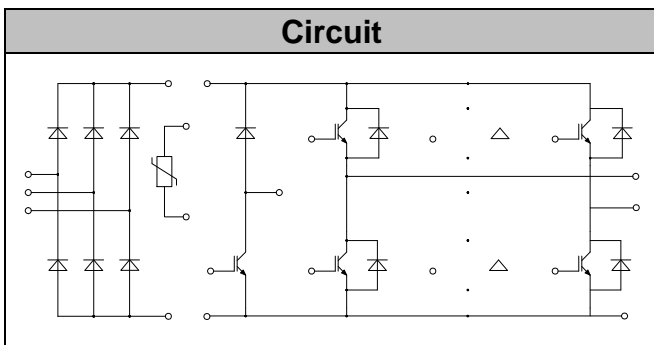
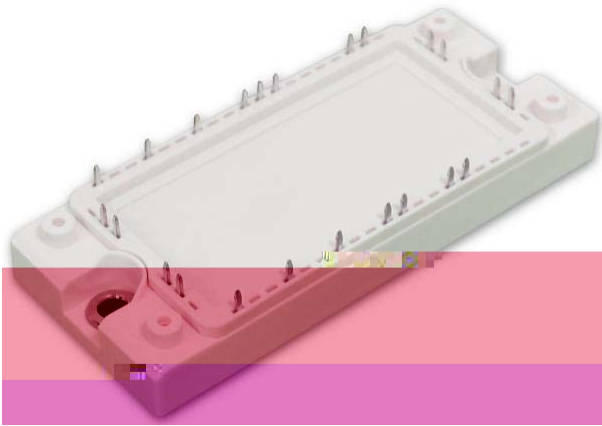
$V_{CES}$             1200V  
 $I_C$                 50A

## Applications

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

## 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(10us)
- Maximum junction temperature 175°C



### ● IGBT- inverter

#### Absolute Maximum Ratings

| Parameter                         | Symbol    | Conditions                      | Value | Unit |
|-----------------------------------|-----------|---------------------------------|-------|------|
| Collector-Emitter Voltage         | $V_{CES}$ | $V_{GE}=0V, I_C=1mA, T_{vj}=25$ | 1200  | V    |
| Continuous Collector Current      | $I_C$     | $T_c=100$ $v_{jmax}$ 175        | 50    | A    |
| Repetitive Peak Collector Current | $I_{CRM}$ | $tp=1ms$                        | 100   | A    |
| Gate-Emitter Voltage              | $V_{GES}$ | $T_{vj}=25$                     | 20    | V    |
| Total Power Dissipation           | $P_{tot}$ | $T_c=25$<br>$T_{vjmax}=175$     | 288   | W    |



## ● IGBT- inverter

### Characteristic values

| Parameter                               | Symbol        | Conditions  | Value |      |      | Unit |
|---|---------------|---|-------|------|------|------|
|   |               |   | Min.  | Typ. | Max. |      |
| Gate-emitter Threshold Voltage          | $V_{GE(th)}$  | $V_{GE}=V_{CE}, I_C=2.0mA, T_{vj}=25$   | 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    | $V_{CE(sat)}$ | $I_C=50A, V_{GE}=15V, T_{vj}=25$  |       | 1.90 | 2.30 | V    |
|   |               | $I_C=50A, V_{GE}=15V, T_{vj}=125$   |       | 2.30 |      |      |
|   |               | $I_C=50A, V_{GE}=15V, T_{vj}=150$   |       | 2.40 |      |      |
| Gate Charge                             | $Q_G$         |   |       | 0.35 |      | uC   |
| Input Capacitance                       | $C_{ies}$     | $V_{CE}=25V, V_{GE}=0V,$<br>$f=1MHz, T_{vj}=25^{\circ}C$                          |       | 2.60 |      | nF   |
| Reverse Transfer Capacitance            | $C_{res}$     |   |       | 0.10 |      | nF   |
| Gate-Emitter leakage current            | $I_{GES}$     | $V_{CE}=0V, V_{GE}=20V, T_{vj}=25$  |       |      | 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>$T_{vj}=25$   |       | 168  |      | ns   |
| Rise Time                               | $t_r$         |   |       | 34   |      | ns   |
| Turn-off Delay Time                     | $t_{d(off)}$  |   |       | 320  |      | ns   |
| Fall Time                               | $t_f$         |   |       | 78   |      | ns   |
| Energy Dissipation During Turn-on Time  | $E_{on}$      |   |       | 5.42 |      | mJ   |
| Energy Dissipation During Turn-off Time | $E_{off}$     |   |       | 4.15 |      | 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>$T_{vj}=125$  |       | 175  |      | ns   |
| Rise Time                               | $t_r$         |   |       | 42   |      | ns   |
| Turn-off Delay Time                     | $t_{d(off)}$  |   |       | 426  |      | ns   |
| Fall Time                               | $t_f$         |   |       | 148  |      | ns   |
| Energy Dissipation During Turn-on Time  | $E_{on}$      |   |       | 7.26 |      | mJ   |
| Energy Dissipation During Turn-off Time | $E_{off}$     |   |       | 5.80 |      | mJ   |
| SC Data                                 | $I_{sc}$      | $T_p \leq 10\mu s, V_{GE}=15V, T_{vj}=150$ ,<br>$V_{cc}=900V, V_{CEM} \leq 1200V$ |       | 260  |      | A    |



## ● Diode-inverter

### Absolute Maximum Ratings

| Parameter                       | Symbol    | Conditions                    | Value | Unit             |
|---------------------------------|-----------|-------------------------------|-------|------------------|
| Repetitive Peak Reverse Voltage | $V_{RRM}$ | $T_{vj}=25$                   | 1200  | V                |
| Continuous DC Forward Current   | $I_F$     |                               | 50    | A                |
| Repetitive Peak Forward Current | $I_{FRM}$ | $t_p=1ms$                     | 100   | A                |
| $I^2t$ -value                   | $I^2t$    | $V_R=0, t_p=10ms, T_{vj}=125$ | 560   | A <sup>2</sup> s |
|                                 |           | $V_R=0, t_p=10ms, T_{vj}=150$ | 480   |                  |

### Characteristic values

| Parameter                     | Symbol    | Conditions                          | Value |      |      | Unit |
|-------------------------------|-----------|-------------------------------------|-------|------|------|------|
|                               |           |                                     | Min.  | Typ. | Max. |      |
| Forward Voltage               | $V_F$     | $I_F=50A, T_{vj}=25$                |       | 1.95 | 2.50 | V    |
|                               |           | $I_F=50A, T_{vj}=125$               |       | 1.80 |      |      |
|                               |           | $I_F=50A, T_{vj}=150$               |       | 1.70 |      |      |
| Recovered Charge              | $Q_{rr}$  | $I_F = 50 A$                        |       | 5.8  |      | uC   |
| Peak Reverse Recovery Current | $I_{rr}$  | $V_R=600V$<br>$-di_F/dt = 1500A/us$ |       | 56   |      | A    |
| Reverse Recovery Energy       | $E_{rec}$ | $T_{vj}=25$                         |       | 1.85 |      | mJ   |
| Recovered Charge              | $Q_{rr}$  | $I_F = 50 A$                        |       | 9.1  |      | uC   |
| Peak Reverse Recovery Current | $I_{rr}$  | $V_R=600V$<br>$-di_F/dt = 1500A/us$ |       | 58   |      | A    |
| Reverse Recovery Energy       | $E_{rec}$ | $T_{vj}=125$                        |       | 3.30 |      | mJ   |



● IGBT-brake-chopper  
Absolute Maximum Ratings

| Parameter                         | Symbol    | Conditions                      | Value | Unit |
|-----------------------------------|-----------|---------------------------------|-------|------|
| Collector-Emitter Voltage         | $V_{CES}$ | $V_{GE}=0V, I_C=1mA, T_{vj}=25$ | 1200  | V    |
| Continuous Collector Current      | $I_C$     | $T_c=100$ $v_{jmax}$ 175        | 35    | A    |
| Repetitive Peak Collector Current | $I_{CRM}$ | $t_p=1ms$                       | 70    | A    |
| Gate-Emitter Voltage              | $V_{GES}$ | $T_{vj}=25$                     | 20    | V    |
| Total Power Dissipation           | $P_{tot}$ | $T_c=25$<br>$T_{vjmax}=175$     | 227   | W    |

Characteristic values

| Parameter                               | Symbol        | Conditions  | Value |      |      | Unit |
|---|---------------|---|-------|------|------|------|
|   |               |   | Min.  | Typ. | Max. |      |
| Gate-emitter Threshold Voltage          | $V_{GE(th)}$  | $V_{GE}=V_{CE}, I_C=1.4mA, T_{vj}=25$   | 5.2   | 6.0  | 6.8  | V    |
| Collector-Emitter Cut-off Current       | $I_{CES}$     | $V_{CE}=1200V, V_{GE}=0V, T_{vj}=25^\circ C$                                    |       |      | 1.0  | mA   |
| Collector-Emitter Saturation Voltage    | $V_{CE(sat)}$ | $I_C=35A, V_{GE}=15V, T_{vj}=25$  |       | 1.90 | 2.30 | V    |
|   |               | $I_C=35A, V_{GE}=15V, T_{vj}=125$   |       | 2.20 |      |      |
|   |               | $I_C=35A, V_{GE}=15V, T_{vj}=150$   |       | 2.30 |      |      |
| Gate Charge                             | $Q_G$         |   |       | 0.27 |      | uC   |
| Input Capacitance                       | $C_{ies}$     | $V_{CE}=25V, V_{GE}=0V,$<br>$f=1MHz, T_{vj}=25^\circ C$                         |       | 2.00 |      | nF   |
| Reverse Transfer Capacitance            | $C_{res}$     |   |       | 0.07 |      | nF   |
| Gate-Emitter leakage current            | $I_{GES}$     | $V_{CE}=0V, V_{GE}=20V, T_{vj}=25$  |       |      | 400  | nA   |
| Turn-on Delay Time                      | $t_{d(on)}$   | $I_C=35A$<br>$V_{CE}=600V$<br>$V_{GE}=\pm 15V$<br>$R_G=12\Omega$<br>$T_{vj}=25$ |       | 25   |      | ns   |
| Rise Time                               | $t_r$         |   |       | 13   |      | ns   |
| Turn-off Delay Time                     | $t_{d(off)}$  |   |       |      | 124  | ns   |
| Fall Time                               | $t_f$         |   |       |      | 115  | ns   |
| Energy Dissipation During Turn-on Time  | $E_{on}$      |   |       |      | 1.90 | mJ   |
| Energy Dissipation During Turn-off Time | $E_{off}$     |   |       |      | 2.00 | mJ   |



|   |              |  |   |     |
|---|--------------|--|---|-----|
| Turn-on Delay Time                      | $t_{d(on)}$  | $I_C = 35\text{ A}$<br>$V_{CE} = 600\text{ V}$<br>$V_{GE} = \pm 15\text{ V}$<br>$R_G = 12\Omega$<br>$T_{vj} = 125$ | 38  | ns  |
| Rise Time                               | $t_r$        |  | 21  | ns  |
| Turn-off Delay Time                     | $t_{d(off)}$ |  | 178   | ns  |
| Fall Time                               | $t_f$        |  | 170   | ns  |
| Energy Dissipation During Turn-on Time  | $E_{on}$     |  | 2.90  | mJ  |
| Energy Dissipation During Turn-off Time | $E_{off}$    |  | 2.90  | mJ  |
| SC Data                                 | $I_{sc}$     |  | $T_p \leq 10\mu s, V_{GE} = 15\text{ V}, T_{vj} = 150$ ,<br>$V_{cc} = 900\text{ V}, V_{CEM} \leq 1200\text{ V}$ | 150 |

## ● Diode-Brake-Chopper

### Absolute Maximum Ratings

| Parameter                       | Symbol    | Conditions                               | Value | Unit             |
|---------------------------------|-----------|--|-------|------------------|
| Repetitive Peak Reverse Voltage | $V_{RRM}$ | $T_j = 25$                               | 1200  | V                |
| Continuous DC Forward Current   | $I_F$     |  | 15    | A                |
| Repetitive Peak Forward Current | $I_{FRM}$ | $t_p = 1\text{ ms}$                      | 30    | A                |
| $I^2t$ -value                   | $I^2t$    | $V_R = 0, t_p = 10\text{ ms}, T_j = 125$ | 48.0  | A <sup>2</sup> s |
|                                 |           | $V_R = 0, t_p = 10\text{ ms}, T_j = 150$ | 42.0  |                  |

### Characteristic values

| Parameter                     | Symbol    | Conditions  | Value |      |      | Unit |
|-------------------------------|-----------|---|-------|------|------|------|
|                               |           |   | Min.  | Typ. | Max. |      |
| Forward Voltage               | $V_F$     | $I_F = 15\text{ A}, T_{vj} = 25$                        |       | 1.95 |      | V    |
|                               |           | $I_F = 15\text{ A}, T_{vj} = 125$                       |       | 1.80 |      |      |
|                               |           | $I_F = 15\text{ A}, T_{vj} = 150$                       |       | 1.70 |      |      |
| Recovered Charge              | $Q_{rr}$  | $I_F = 15\text{ A}$                                     |       | 1.10 |      | uC   |
| Peak Reverse Recovery Current | $I_{rr}$  | $V_R = 600\text{ V}$<br>$-di_F/dt = 550\text{ A}/\mu s$ |       | 12.0 |      | A    |
| Reverse Recovery Energy       | $E_{rec}$ | $T_{vj} = 25$   |       | 0.30 |      | mJ   |
| Recovered Charge              | $Q_{rr}$  | $I_F = 15\text{ A}$                                     |       | 1.90 |      | uC   |
| Peak Reverse Recovery Current | $I_{rr}$  | $V_R = 600\text{ V}$<br>$-di_F/dt = 550\text{ A}/\mu s$ |       | 14.0 |      | A    |
| Reverse Recovery Energy       | $E_{rec}$ | $T_{vj} = 125$  |       | 0.60 |      | mJ   |



## ● Diode-Rectifier

### Absolute Maximum Ratings

| Parameter                                    | Symbol      | Conditions                | Value | Unit   |
|--|-------------|---------------------------|-------|--------|
| Repetitive Peak Reverse Voltage              | $V_{RRM}$   | $T_j=25$                  | 1600  | V      |
| Average output Current<br>50/60Hz, sine wave | $I_{F(AV)}$ | $T_c=100$                 | 50    | A      |
| Maximum RMS Current at<br>Rectifier Output   | $I_{RMSM}$  | $T_c=100$                 | 100   | A      |
| Surge Forward Current                        | $I_{FSM}$   | $V_R=0, t_p=10ms, T_j=45$ | 525   | A      |
| $I^2t$ -value                                | $I^2t$      | $V_R=0, t_p=10ms, T_j=45$ | 1378  | $A^2s$ |

### Characteristic values

| Parameter             | Symbol | Conditions           | Value |      |      | Unit |
|-----------------------|--------|----------------------|-------|------|------|------|
|                       |        |                      | Min.  | Typ. | Max. |      |
| Diode Forward Voltage | $V_F$  | $I_F=50A, T_j=125$   |       | 1.0  |      | V    |
| Reverse Current       | $I_R$  | $T_j=125, V_R=1600V$ |       |      | 1.5  | mA   |

## ● NTC-Thermistor

### Characteristic values

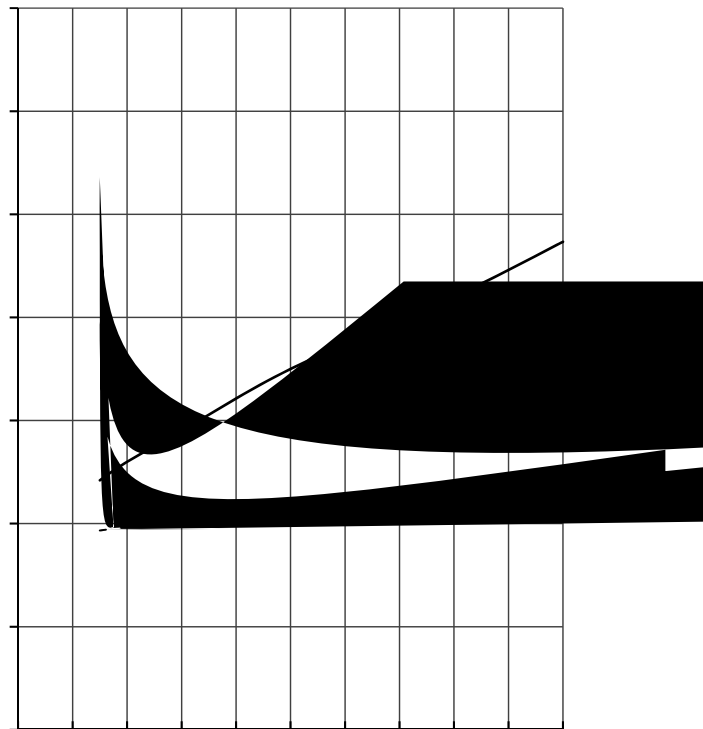
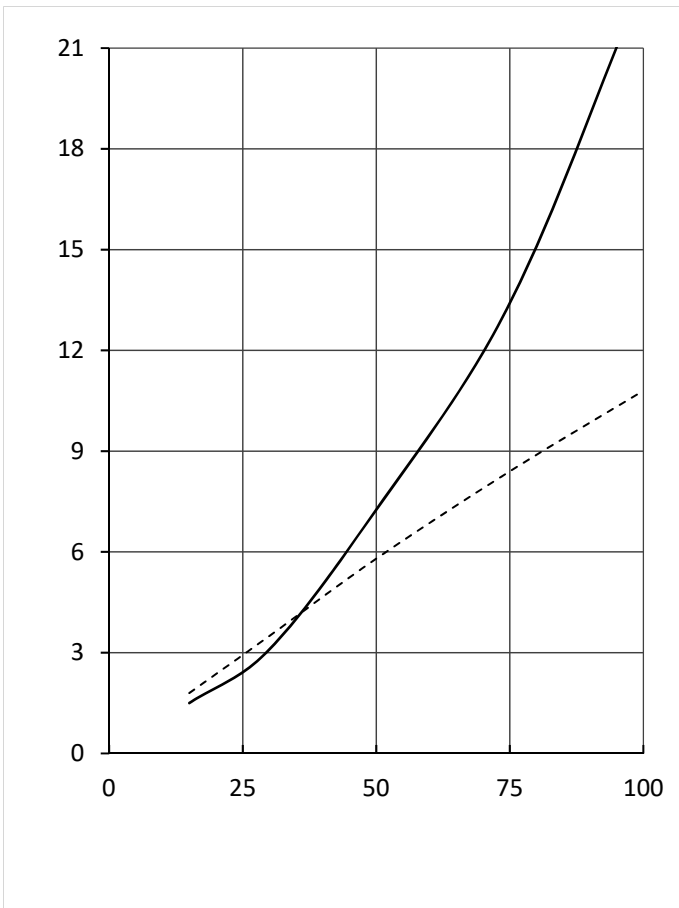
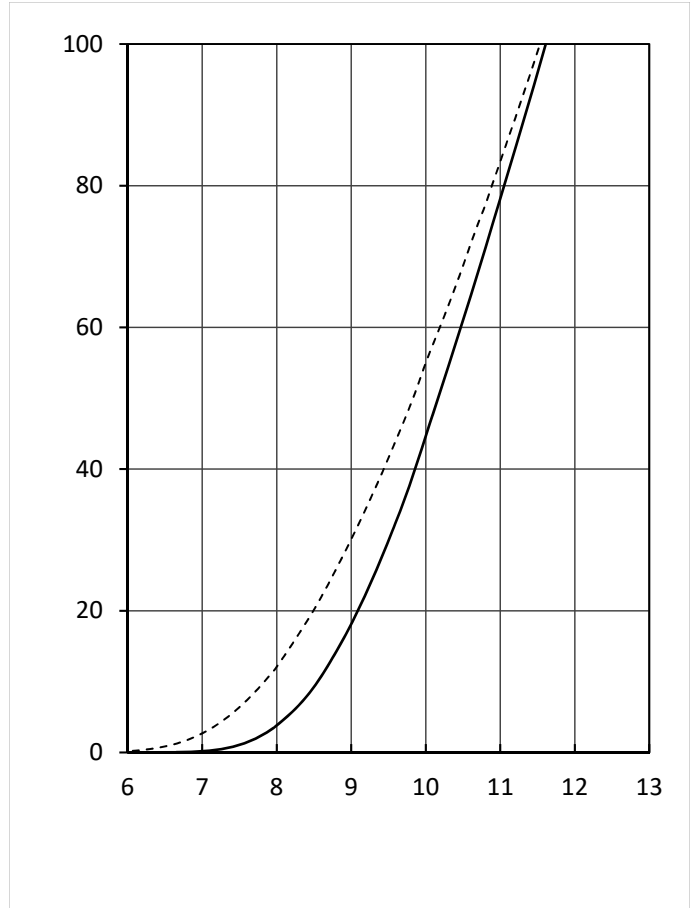
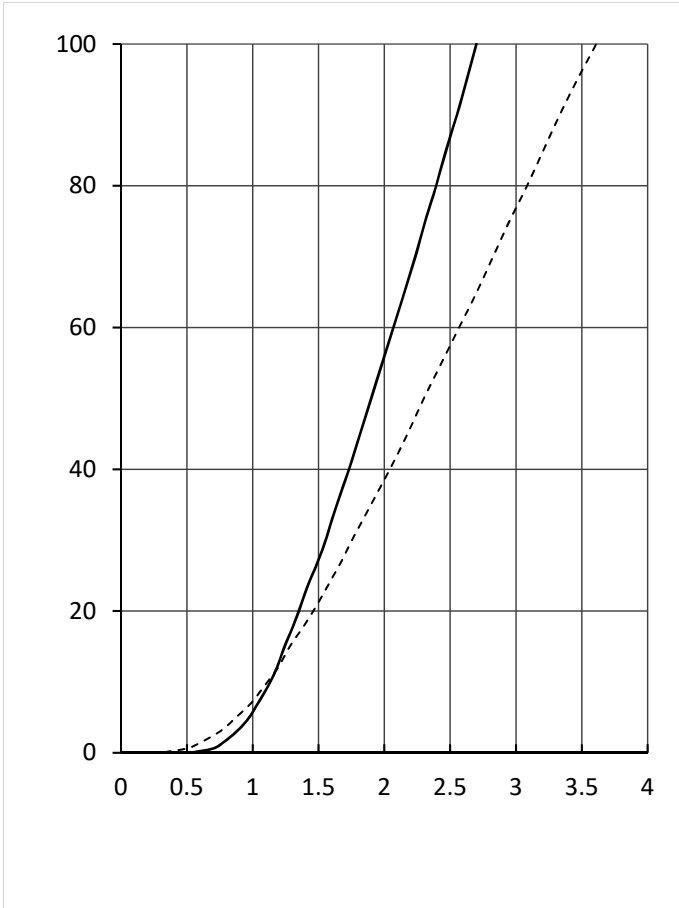
| Parameter         | Symbol       | Conditions                                      | Value |      |      | Unit |
|-------------------|--------------|---|-------|------|------|------|
|                   |              |   | Min.  | Typ. | Max. |      |
| Rated Resistance  | $R_{25}$     |   |       | 5.0  |      | k    |
| Deviation of R100 | $\Delta R/R$ | $T_c=100, R_{100}=493.3$                        | -5    |      | 5    | %    |
| Power Dissipation | $P_{25}$     |   |       |      | 20.0 | mW   |
| B-value           | $B_{25/50}$  | $R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15 K))]$ |       | 3375 |      | K    |



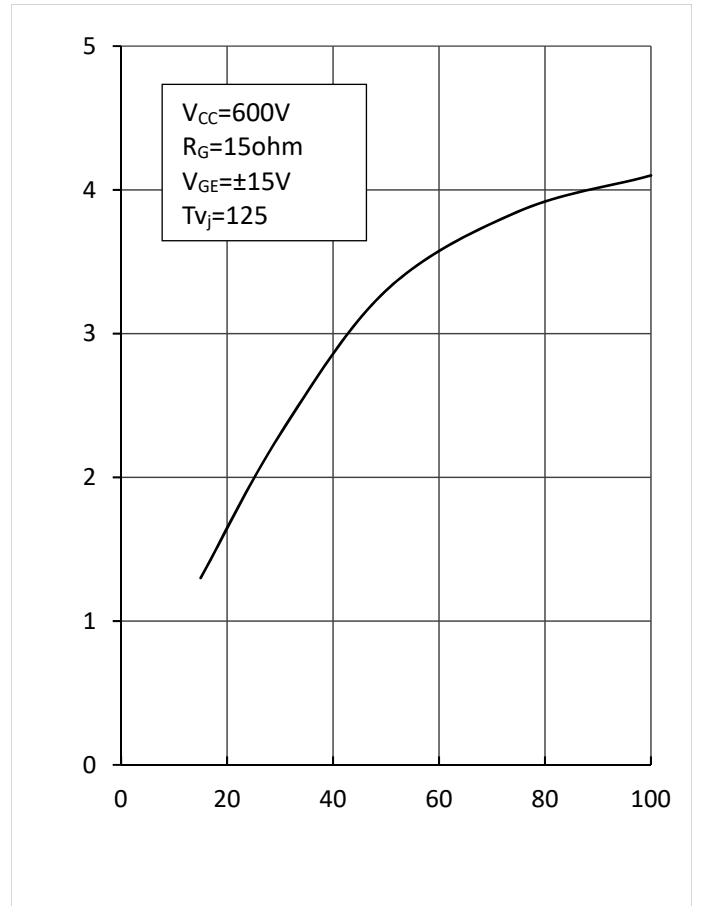
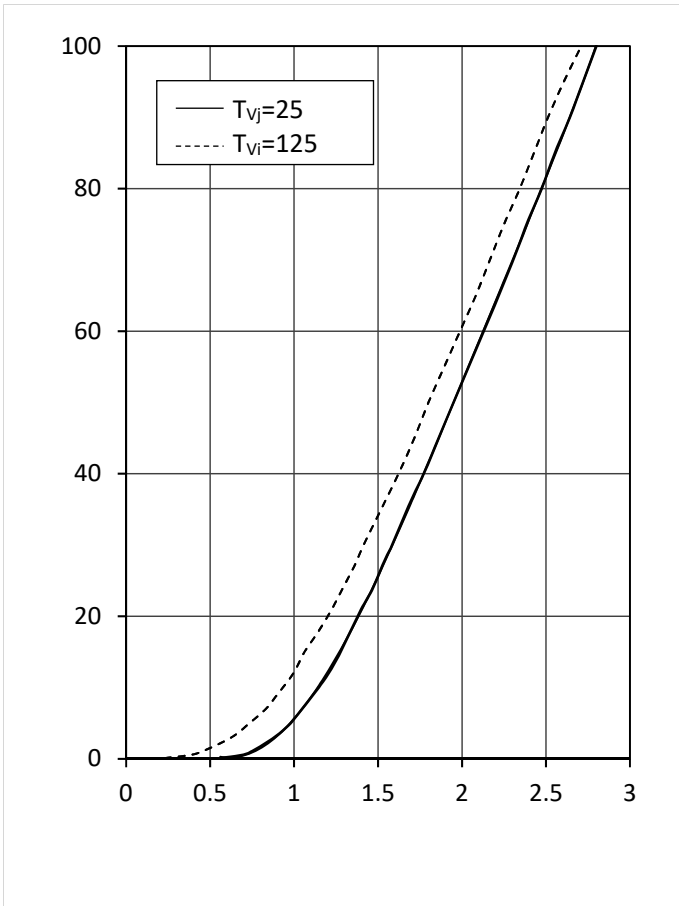
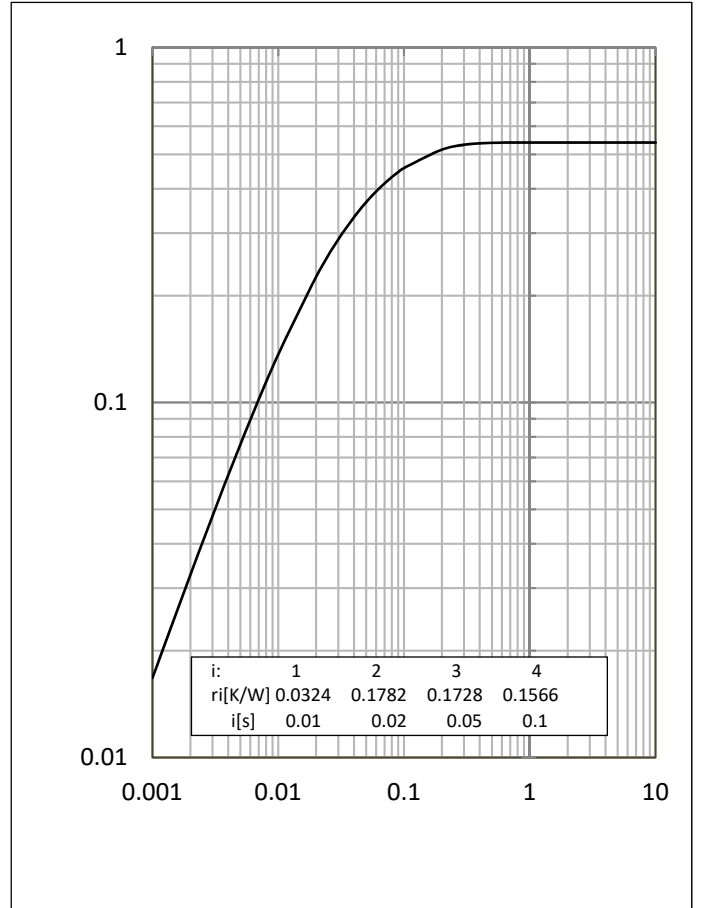
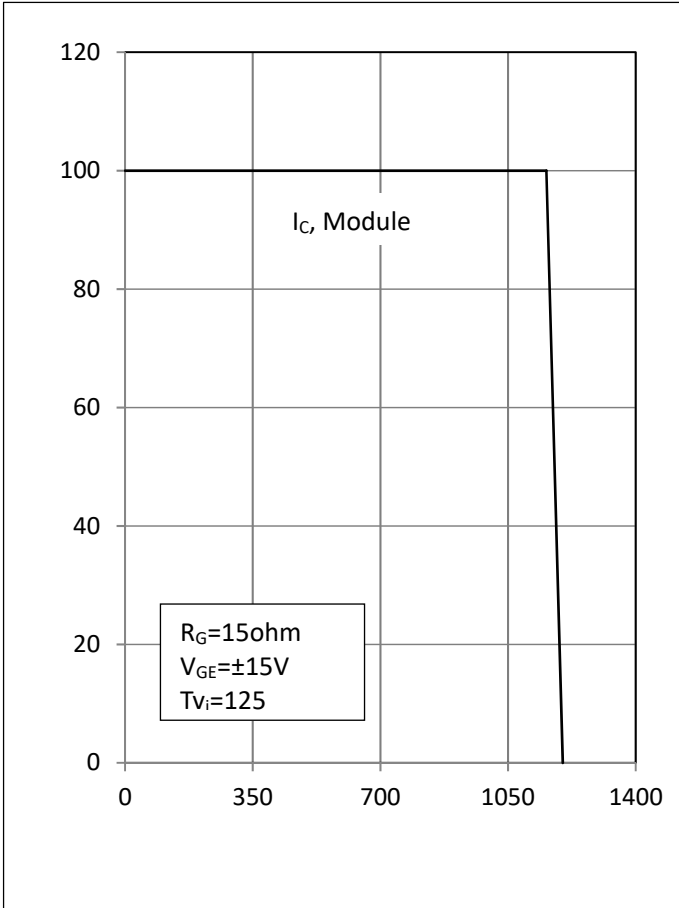
## ● Module Characteristics

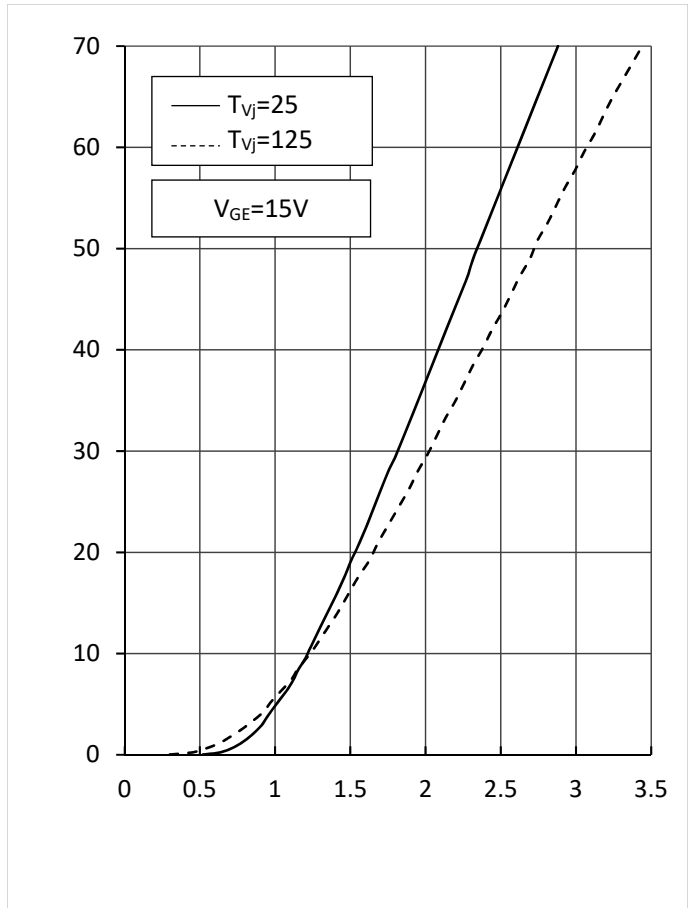
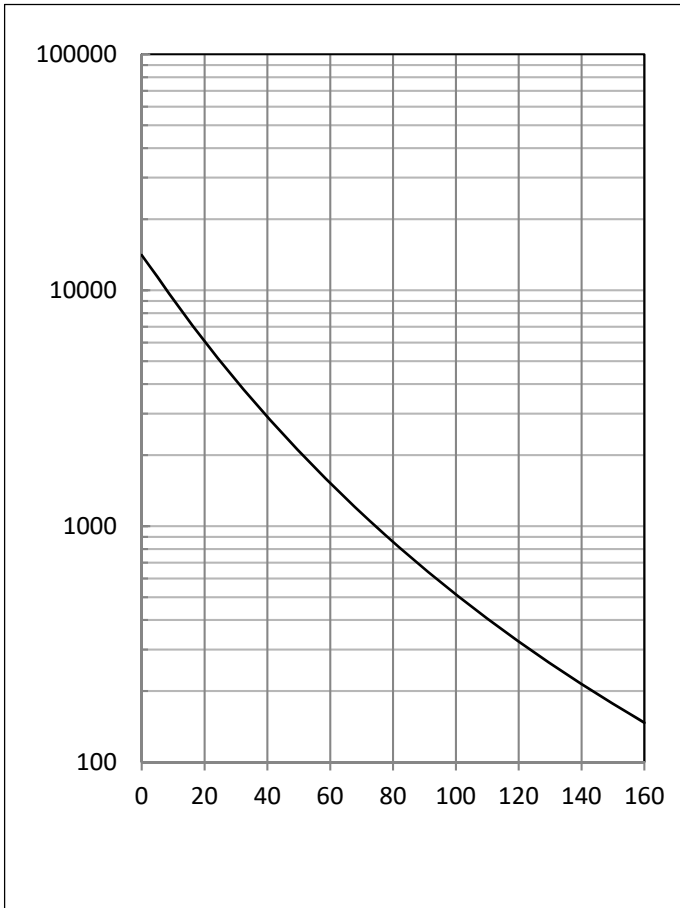
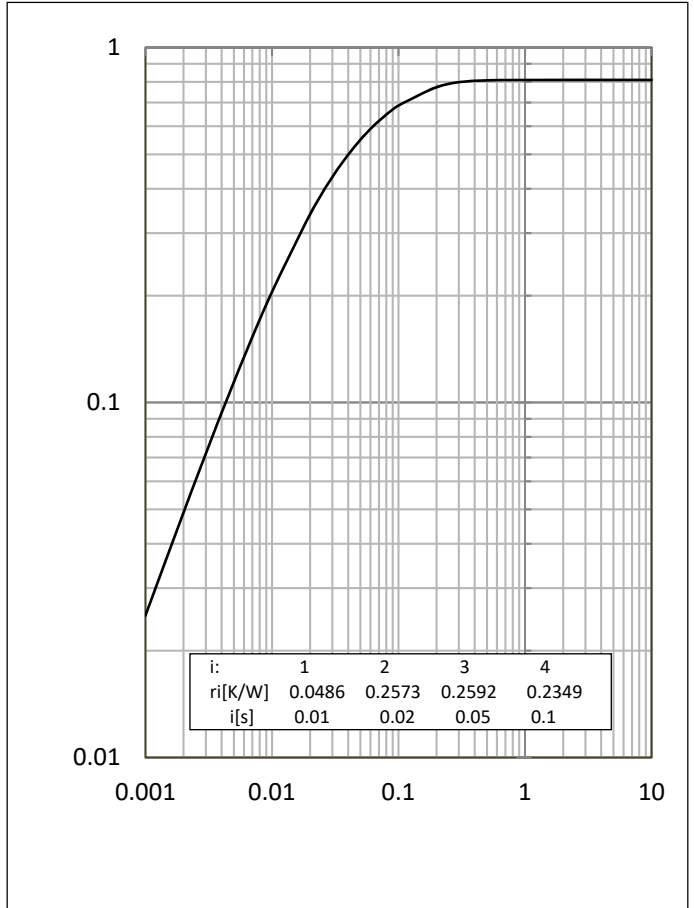
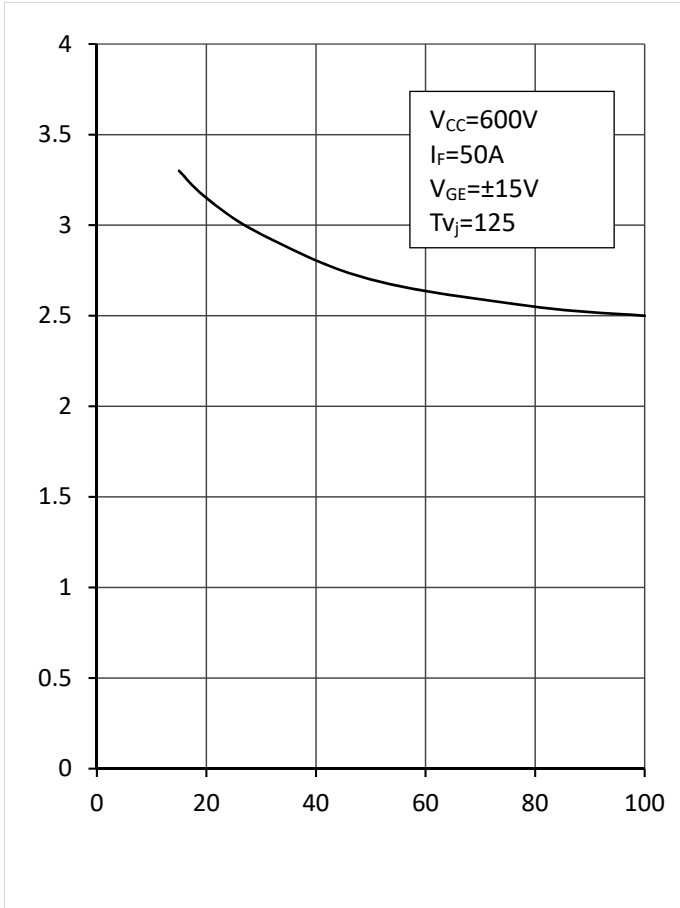
$T_C=25^{\circ}\text{C}$  unless otherwise specified

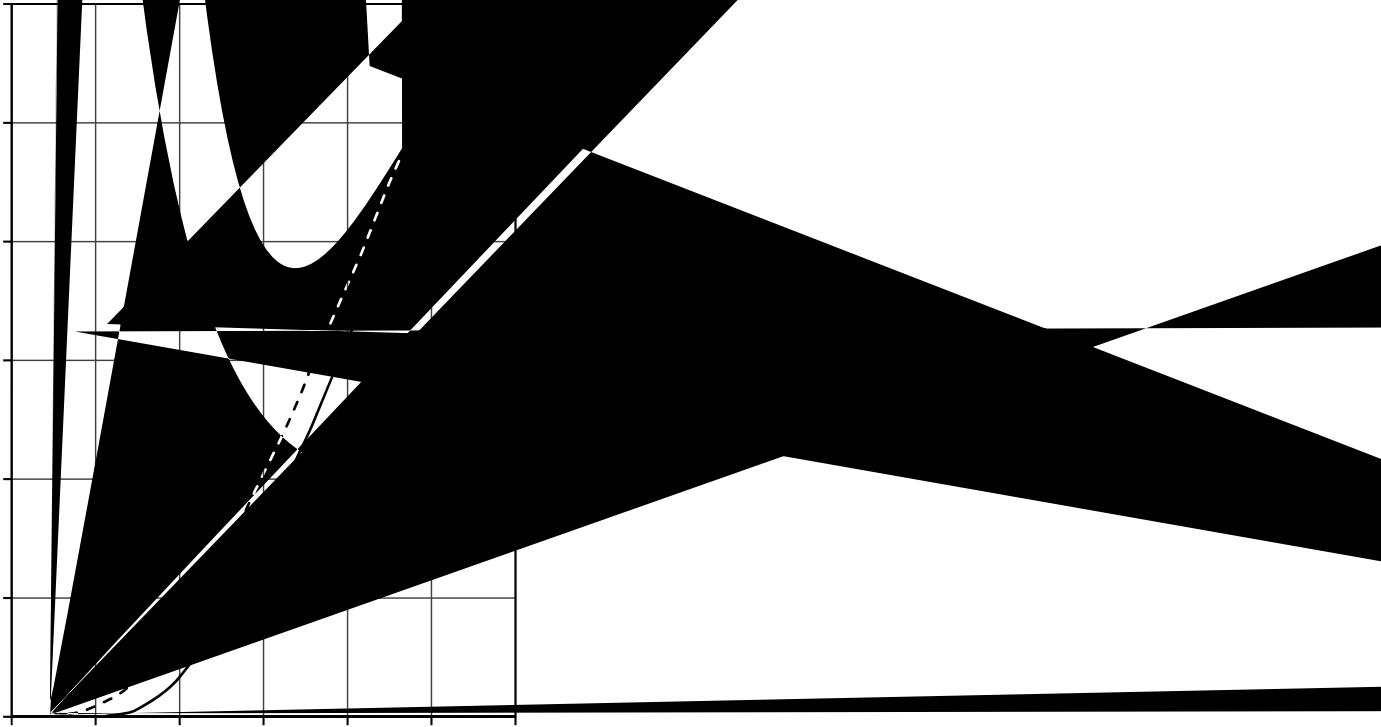
| Parameter                              | Symbol                      | Conditions                            | Value |      |      | Unit |
|--|-----------------------------|---------------------------------------|-------|------|------|------|
|  |                             |                                       | 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  |      |
| Operating Junction Temperature         | $T_{\text{vj op}}$          |                                       | -40   |      | 150  |      |
| Storage Temperature                    | $T_{\text{stg}}$            |                                       | -40   |      | 125  |      |
| Stray-inductance-module                | $L_{\text{SCE}}$            |                                       |       | 60   |      |      |
| Module lead resistance, terminals-chip | $R_{\text{CC}'+\text{EE}'}$ | $T_C=25^{\circ}\text{C}$ , per switch |       | 4.0  |      |      |
|  | $R_{\text{AA}'+\text{CC}'}$ |                                       |       | 3.0  |      |      |
| Thermal Resistance Junction-to Case    | $R_{\text{JC}}$             | per IGBT-inverter                     |       |      | 0.52 | K/W  |
|  |                             | per Diode-inverter                    |       |      | 0.81 |      |
|  |                             | per IGBT-brake-copper                 |       |      | 0.66 |      |
|  |                             | per Diode-chopper                     |       |      | 1.50 |      |
|  |                             | per Diode-rectifier                   |       |      | 0.75 |      |
| Thermal Resistance Case-to Sink        | $R_{\text{CS}}$             | per IGBT-inverter                     |       | 0.31 |      | K/W  |
|  |                             | per Diode-inverter                    |       | 0.48 |      |      |
|  |                             | per IGBT-brake-copper                 |       | 0.33 |      |      |
|  |                             | per Diode-chopper                     |       | 0.70 |      |      |
|  |                             | per Diode-rectifier                   |       | 0.36 |      |      |
|  |                             | per Module                            |       | 0.02 |      |      |
| Mounting Force Per Clamp               | F                           |                                       | 3.0   |      | 6.0  | N    |
| Weight of Module                       | G                           |                                       |       | 180  |      | g    |





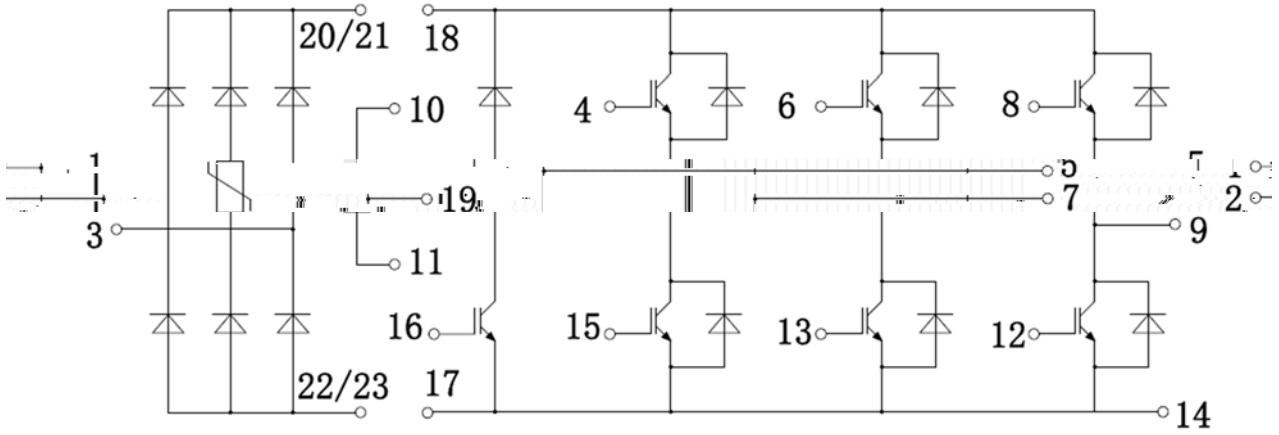








## ● Circuit Diagram



## ● Package Outline Information

