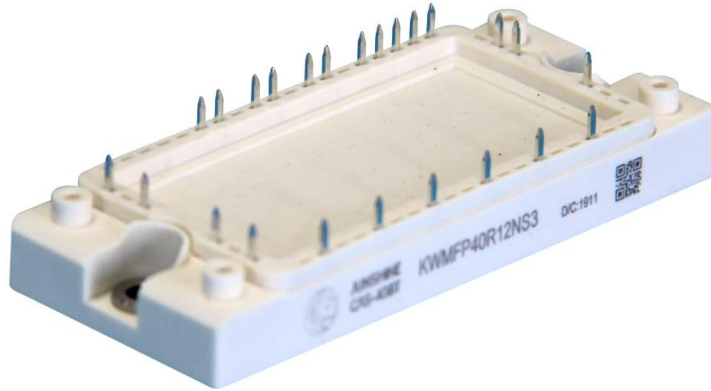




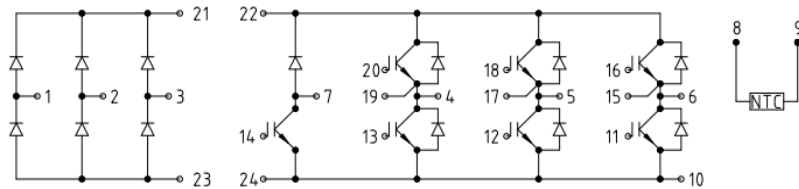
### Features

- High speed trench field-stop IGBT
- Epitaxial & platinum diffusion FRD
- Integrated NTC Temperature Sense
- High ruggedness
- Very tight parameter distribution
- 100% RBSOA test( $2 \cdot I_C$ )
- Low  $V_{cesat}(V_{CE}=2.0V)$
- Low switching losses( $E_{off}=2.05mJ$ )
- High short circuit capability(>10us)
- Lead free, RoHS compliant



### Typical Applications

- Motor Drives
- Servo driver



### IGBT, Inverter

#### Maximum Rated Values ( $T_j=25^\circ C$ , unless otherwise noted)

| Parameter                         | Symbol     | Conditions                                     | Values   | Units      |
|-----------------------------------|------------|--|----------|------------|
| Collector-emitter voltage         | $V_{CES}$  |  | 1200     | V          |
| Gate-emitter peak voltage         | $V_{GES}$  |  | $\pm 20$ |            |
| Continuous DC collector current   | $I_C$      | $T_C=25^\circ C$                               | 80       | A          |
|                                   |            | $T_C=100^\circ C$                              | 40       |            |
| Repetitive peak collector current | $I_{CRM}$  | $t_p=1ms$                                      | 80       |            |
| Total power dissipation           | $P_{tot}$  | $T_C=25^\circ C, T_{vj\ max}=150^\circ C$      | 192      | W          |
| SC stand time                     | $t_{SC}$   | $V_{GE}=15V, V_{CC}=600V$<br>$T_j=150^\circ C$ | >10      | $\mu s$    |
| Operating junction temperature    | $T_{vjop}$ |  | -40~150  | $^\circ C$ |

**IGBT, Inverter**
**Characteristic Values** ( $T_j=25^\circ\text{C}$ , unless otherwise noted)

| Parameter   | Symbol        | Conditions   | Min.   | Typ.         | Max.   | Unit |
|---|---------------|--|--------|--------------|--------|------|
| <b>Static Characteristics</b>                     |               |  |        |              |        |      |
| Collector-emitter Breakdown Voltage               | $V_{(BR)CES}$ | $V_{GE}=0V, I_C=1mA$   | 1200   | -            | -      | V    |
| Collector-emitter saturation Voltage              | $V_{CE(sat)}$ | $V_{GE}=15V, I_C=40A$<br>$T_j=25^\circ\text{C}$<br>$T_j=150^\circ\text{C}$ | -<br>- | 2.00<br>2.58 | -<br>- |      |
| Gate threshold voltage                            | $V_{GE(th)}$  | $I_C=1.5mA, V_{CE}=V_{GE}$   | -      | 6.10         | -      |      |
| Collector-emitter cut-off current                 | $I_{CES}$     | $V_{CE}=1200V, V_{GE}=0V$  | -      | -            | 3      | mA   |
| Gate-emitter leakage current                      | $I_{GES}$     | $V_{CE}=0V, V_{GE}=20V$  | -      | -            | 400    | nA   |
| <b>Dynamic Characteristic</b>                     |               |  |        |              |        |      |
| Input capacitance                                 | $C_{iss}$     | $V_{CE}=25V$<br>$V_{GE}=0V$<br>$f=1MHz$                                    | -      | 2820         | -      | pF   |
| Output capacitance                                | $C_{oss}$     |  | -      | 169          | -      |      |
| Reverse transfer capacitance                      | $C_{rss}$     |  | -      | 131          | -      |      |
| Gate charge                                       | $Q_G$         | $V_{CC}=600V, I_C=40A, V_{GE}=15V$   | -      | 187          | -      | nC   |
| Short circuit collector current                   | $I_{SC}$      | $V_{GE}=15V, V_{CC}=600V,$<br>$T_j=150^\circ\text{C}$                      | -      | 146          | -      | A    |
| <b>Switching Characteristics (Inductive load)</b> |               |  |        |              |        |      |
| Turn-on delay time                                | $t_{d(on)}$   | $T_j=25^\circ\text{C}$<br>$V_{CC}=600V$<br>$I_C=40A$                       | -      | 76           | -      | ns   |
| Rise time   | $t_r$         |  | -      | 150          | -      |      |
| Turn-off delay time                               | $t_{d(off)}$  |  | -      | 257          | -      |      |
| Fall time   | $t_f$         |  | -      | 103          | -      |      |
| Turn-on energy                                    | $E_{on}$      | $V_{GE}=\pm 15V$<br>$R_G=33\Omega$   | -      | 5.16         | -      | mJ   |
| Turn-off energy                                   | $E_{off}$     |  | -      | 2.05         | -      |      |
| Total switching energy                            | $E_{ts}$      |  | -      | 7.30         | -      |      |
| Turn-on delay time                                | $t_{d(on)}$   | $T_j=150^\circ\text{C}$<br>$V_{CC}=600V$<br>$I_C=40A$                      | -      | 66           | -      | ns   |
| Rise time   | $t_r$         |  | -      | 138          | -      |      |
| Turn-off delay time                               | $t_{d(off)}$  |  | -      | 292          | -      |      |
| Fall time   | $t_f$         |  | -      | 186          | -      |      |
| Turn-on energy                                    | $E_{on}$      | $V_{GE}=\pm 15V$<br>$R_G=33\Omega$   | -      | 5.30         | -      | mJ   |
| Turn-off energy                                   | $E_{off}$     |  | -      | 2.80         | -      |      |
| Total switching energy                            | $E_{ts}$      |  | -      | 8.10         | -      |      |
| Thermal resistance, junction to case              | $R_{thJC}$    | per IGBT   | -      | 0.65         | -      | K/W  |

## Diode, Inverter

### Maximum Rated Values ( $T_j=25^\circ\text{C}$ , unless otherwise noted)

| Parameter                       | Symbol     | Conditions  | Values   | Units                |
|---------------------------------|------------|---|----------|----------------------|
| Repetitive peak reverse voltage | $V_{RRM}$  |   | 1200     | V                    |
| Continuous DC forward current   | $I_F$      | $T_C=25^\circ\text{C}$<br>$T_C=100^\circ\text{C}$ | 80<br>40 | A                    |
| Repetitive peak forward current | $I_{FRM}$  | $t_p=1\text{ms}$                                  | 80       |                      |
| $I^2t$ - value                  | $I^2t$     | $t_p=10\text{ms}, T_C=100^\circ\text{C}$          | 85       | $\text{A}^2\text{s}$ |
| Operating junction temperature  | $T_{vjop}$ |   | -40~150  | $^\circ\text{C}$     |

## Diode, Inverter

### Characteristic Values ( $T_j=25^\circ\text{C}$ , unless otherwise noted)

| Parameter   | Symbol      | Test Conditions  | Min.   | Typ.         | Max.   | Units         |
|---|-------------|--|--------|--------------|--------|---------------|
| <b>Static Characteristics</b>                     |             |  |        |              |        |               |
| Forward voltage                                   | $V_F$       | $V_{GE}=0\text{V}, I_F=40\text{A}$<br>$T_j=25^\circ\text{C}$<br>$T_j=150^\circ\text{C}$          | -<br>- | 1.90<br>1.85 | -<br>- | V             |
| <b>Switching Characteristics (Inductive load)</b> |             |  |        |              |        |               |
| Recovered time                                    | $t_{rr}$    | $T_j=25^\circ\text{C}$<br>$V_R=600\text{V}, I_F=40\text{A}$<br>$-di/dt=600\text{A}/\mu\text{s}$  | -      | 185          | -      | ns            |
| Recovered charge                                  | $Q_{rr}$    |  | -      | 2.4          | -      | $\mu\text{C}$ |
| Peak reverse recovery current                     | $I_{rrm}$   |  | -      | 25.0         | -      | A             |
| Recovered time                                    | $t_{rr}$    | $T_j=150^\circ\text{C}$<br>$V_R=600\text{V}, I_F=40\text{A}$<br>$-di/dt=600\text{A}/\mu\text{s}$ | -      | 255          | -      | ns            |
| Recovered charge                                  | $Q_{rr}$    |  | -      | 4.8          | -      | $\mu\text{C}$ |
| Peak reverse recovery current                     | $I_{rrm}$   |  | -      | 30.0         | -      | A             |
| Thermal resistance, junction to case              | $R_{thJCD}$ | per diode  | -      | 0.9          | -      | K/W           |

## Diode, Rectifier

### Maximum Rated Values ( $T_j=25^\circ\text{C}$ , unless otherwise noted)

| Parameter                       | Symbol      | Conditions                               | Values  | Units                |
|---------------------------------|-------------|--|---------|----------------------|
| Repetitive peak reverse voltage | $V_{RRM}$   |  | 1600    | V                    |
| Average forward current         | $I_{F(AV)}$ | $T_C=80^\circ\text{C}$                   | 30      | A                    |
| Forward surge current           | $I_{FSM}$   | $t_p=10\text{ms}, T_C=150^\circ\text{C}$ | 360     |                      |
| $I^2t$ - value                  | $I^2t$      | $t_p=10\text{ms}, T_C=150^\circ\text{C}$ | 640     | $\text{A}^2\text{s}$ |
| Operating junction temperature  | $T_{vjop}$  |  | -40~150 | $^\circ\text{C}$     |

## Diode, Rectifier

### Characteristic Values ( $T_j=25^\circ\text{C}$ , unless otherwise noted)

| Parameter                            | Symbol      | Test Conditions                                | Min. | Typ. | Max. | Units |
|--------------------------------------|-------------|--|------|------|------|-------|
| Repetitive peak reverse voltage      | $V_{RRM}$   | $I_R=0.1\text{mA}$                             | 1600 | -    | -    | V     |
| Forward voltage                      | $V_F$       | $T_j=25^\circ\text{C} \quad I_F=40\text{A}$    | -    | 1.25 | -    | V     |
|                                      |             | $T_j=150^\circ\text{C} \quad I_F=40\text{A}$   | -    | -    | -    |       |
| Reverse current                      | $I_R$       | $T_j=25^\circ\text{C} \quad V_R=1600\text{V}$  | -    | -    | 1    | mA    |
|                                      |             | $T_j=150^\circ\text{C} \quad V_R=1600\text{V}$ | -    | -    | 5    |       |
| Thermal resistance, junction to case | $R_{thJCD}$ | per diode                                      | -    | 0.95 | -    | K/W   |

## IGBT, Brake-Chopper

### Maximum Rated Values ( $T_j=25^\circ\text{C}$ , unless otherwise noted)

| Parameter                         | Symbol     | Conditions   | Values   | Units            |
|-----------------------------------|------------|--|----------|------------------|
| Collector-emitter voltage         | $V_{CES}$  |  | 1200     | V                |
| Gate-emitter peak voltage         | $V_{GES}$  |  | $\pm 20$ |                  |
| Continuous DC collector current   | $I_C$      | $T_C=25^\circ\text{C}$   | 50       | A                |
|                                   |            | $T_C=100^\circ\text{C}$  | 25       |                  |
| Repetitive peak collector current | $I_{CRM}$  | $t_p=1\text{ms}$   | 50       |                  |
| Total power dissipation           | $P_{tot}$  | $T_C=25^\circ\text{C}$<br>$T_{vj\max}=150^\circ\text{C}$               | 156      | W                |
| SC stand time                     | $t_{SC}$   | $T_j=150^\circ\text{C}$<br>$V_{GE}=15\text{V}$<br>$V_{CE}=600\text{V}$ | >10      | $\mu\text{s}$    |
| Operating junction temperature    | $T_{vjop}$ |  | -40~150  | $^\circ\text{C}$ |

**IGBT, Brake-Chopper**
**Characteristic Values** ( $T_j=25^\circ\text{C}$ , unless otherwise noted)

| Parameter   | Symbol        | Conditions   | Min.   | Typ.       | Max.   | Unit |
|---|---------------|--|--------|------------|--------|------|
| <b>Static Characteristics</b>                     |               |  |        |            |        |      |
| Collector-emitter Breakdown Voltage               | $V_{(BR)CES}$ | $V_{GE}=0V, I_C=1mA$   | 1200   | -          | -      | V    |
| Collector-emitter saturation Voltage              | $V_{CE(sat)}$ | $V_{GE}=15V, I_C=25A$<br>$T_j=25^\circ\text{C}$<br>$T_j=150^\circ\text{C}$ | -<br>- | 2.0<br>2.6 | -<br>- |      |
| Gate threshold voltage                            | $V_{GE(th)}$  | $I_C=1mA, V_{CE}=V_{GE}$   | 5.2    | 5.9        | 6.7    |      |
| Collector-emitter cut-off current                 | $I_{CES}$     | $V_{CE}=1200V, V_{GE}=0V$  | -      | -          | 2      | mA   |
| Gate-emitter leakage current                      | $I_{GES}$     | $V_{CE}=0V, V_{GE}=20V$  | -      | -          | 500    | nA   |
| <b>Dynamic Characteristic</b>                     |               |  |        |            |        |      |
| Input capacitance                                 | $C_{iss}$     | $V_{CE}=25V$<br>$V_{GE}=0V$<br>$f=1MHz$                                    | -      | 1795       | -      | pF   |
| Output capacitance                                | $C_{oss}$     |  | -      | 125        | -      |      |
| Reverse transfer capacitance                      | $C_{rss}$     |  | -      | 80         | -      |      |
| Gate charge                                       | $Q_G$         | $V_{CC}=900V, I_C=25A,$  | -      | 100        | -      | nC   |
| Short circuit collector current                   | $I_{SC}$      | $V_{GE}=15V, V_{CC}=600V$<br>$T_j=150^\circ\text{C}$                       | -      | 93         | -      | A    |
| <b>Switching Characteristics (Inductive load)</b> |               |  |        |            |        |      |
| Turn-on delay time                                | $t_{d(on)}$   | $T_j=25^\circ\text{C}$<br>$V_{CC}=600V$<br>$I_C=25A$                       | -      | 70         | -      | ns   |
| Rise time   | $t_r$         |  | -      | 103        | -      |      |
| Turn-off delay time                               | $t_{d(off)}$  |  | -      | 110        | -      |      |
| Fall time   | $t_f$         |  | -      | 226        | -      |      |
| Turn-on energy                                    | $E_{on}$      | $V_{GE}=\pm 15V$<br>$R_G=47\Omega$   | -      | 2.85       | -      | mJ   |
| Turn-off energy                                   | $E_{off}$     |  | -      | 1.22       | -      |      |
| Total switching energy                            | $E_{ts}$      |  | -      | 4.07       | -      |      |
| Turn-on delay time                                | $t_{d(on)}$   | $T_j=150^\circ\text{C}$<br>$V_{CC}=600V$<br>$I_C=25A$                      | -      | 67         | -      | ns   |
| Rise time   | $t_r$         |  | -      | 105        | -      |      |
| Turn-off delay time                               | $t_{d(off)}$  |  | -      | 255        | -      |      |
| Fall time   | $t_f$         |  | -      | 237        | -      |      |
| Turn-on energy                                    | $E_{on}$      | $V_{GE}=\pm 15V$<br>$R_G=47\Omega$   | -      | 3.0        | -      | mJ   |
| Turn-off energy                                   | $E_{off}$     |  | -      | 1.67       | -      |      |
| Total switching energy                            | $E_{ts}$      |  | -      | 4.67       | -      |      |
| Thermal resistance, junction to case              | $R_{thJC}$    | per IGBT   | -      | 0.8        | -      | K/W  |

## Diode, Brake-Chopper

### Maximum Rated Values ( $T_j=25^\circ\text{C}$ , unless otherwise noted)

| Parameter                       | Symbol     | Conditions  | Values   | Units            |
|---------------------------------|------------|---|----------|------------------|
| Repetitive peak reverse voltage | $V_{RRM}$  |   | 1200     | V                |
| Continuous DC forward current   | $I_F$      | $T_C=25^\circ\text{C}$<br>$T_C=100^\circ\text{C}$ | 30<br>15 | A                |
| Repetitive peak forward current | $I_{FRM}$  | $t_p=1\text{ms}$                                  | 30       |                  |
| Operating junction temperature  | $T_{vjop}$ |   | -40~150  | $^\circ\text{C}$ |

## Diode, Brake-Chopper

### Characteristic Values ( $T_j=25^\circ\text{C}$ , unless otherwise noted)

| Parameter   | Symbol     | Test Conditions   | Min.   | Typ.         | Max.   | Units         |
|---|------------|---|--------|--------------|--------|---------------|
| <b>Static Characteristics</b>                     |            |   |        |              |        |               |
| Forward voltage                                   | $V_F$      | $V_{GE}=0\text{V}$ , $I_F=15\text{A}$<br>$T_j=25^\circ\text{C}$<br>$T_j=150^\circ\text{C}$          | -<br>- | 1.85<br>1.75 | -<br>- | V             |
| <b>Switching Characteristics (Inductive load)</b> |            |   |        |              |        |               |
| Recovered time                                    | $t_{rr}$   | $T_j=25^\circ\text{C}$<br>$V_R=600\text{V}$ , $I_F=15\text{A}$<br>$-di/dt=550\text{A}/\mu\text{s}$  | -      | 130          | -      | ns            |
| Recovered charge                                  | $Q_{rr}$   |   | -      | 1.07         | -      | $\mu\text{C}$ |
| Peak reverse recovery current                     | $I_{rrm}$  |   | -      | 18.0         | -      | A             |
| Recovered time                                    | $t_{rr}$   | $T_j=150^\circ\text{C}$<br>$V_R=600\text{V}$ , $I_F=15\text{A}$<br>$-di/dt=550\text{A}/\mu\text{s}$ | -      | 210          | -      | ns            |
| Recovered charge                                  | $Q_{rr}$   |   | -      | 2.15         | -      | $\mu\text{C}$ |
| Peak reverse recovery current                     | $I_{rrm}$  |   | -      | 22.0         | -      | A             |
| Thermal resistance, junction to case              | $R_{thJC}$ | per diode   | -      | 1.6          | -      | K/W           |

### NTC-Thermistor

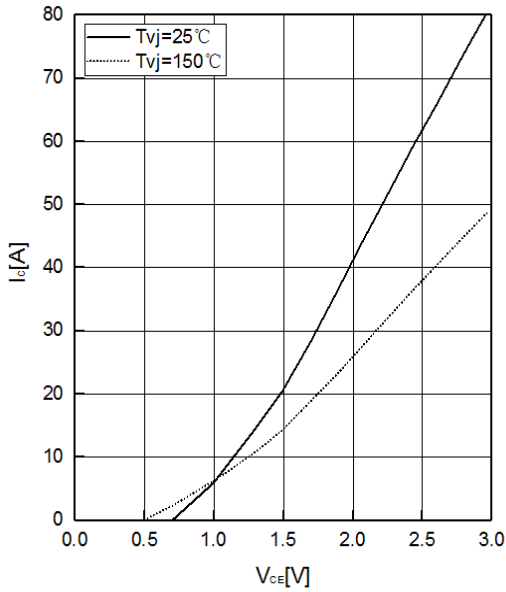
| Parameter         | Symbol       | Test Conditions                                       | Min. | Typ. | Max. | Units      |
|-------------------|--------------|---|------|------|------|------------|
| Rated resistance  | $R_{25}$     | $T_C=25^{\circ}\text{C}$                              | -    | 5    | -    | K $\Omega$ |
| Deviation of R100 | $\Delta R/R$ | $T_C=25^{\circ}\text{C}$ , $R_{100}=481\Omega$        | tbd  | -    | tbd  | %          |
| Power dissipation | $P_{25}$     | $T_C=25^{\circ}\text{C}$                              | -    | tbd  | -    | mW         |
| B--value          | $B_{25/50}$  | $R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$ | -    | 3380 | -    | K          |
| B--value          | $B_{25/80}$  | $R_2=R_{25}\exp[B_{25/80}(1/T_2-1/(298.15\text{K}))]$ | -    | 3440 | -    | K          |

### Module

| Parameter                            | Symbol                | Test Conditions             | Min. | Typ. | Max. | Units              |
|--------------------------------------|-----------------------|-----------------------------|------|------|------|--------------------|
| Isolation test voltage               | $V_{\text{ISOL}}$     | $f = 50\text{Hz}$ , 1minute | 2500 | -    | -    | V                  |
| Maximum junction temperature         | $T_{\text{vj max}}$   |                             | -    | -    | 150  | $^{\circ}\text{C}$ |
| Working junction temperature         | $T_j$                 |                             | -40  | -    | 150  | $^{\circ}\text{C}$ |
| Thermal resistance, case to heatsink | $R_{\theta\text{CS}}$ | per module                  | -    | 0.03 | -    | K/W                |
| Storage temperature                  | $T_{\text{stg}}$      |                             | -40  | -    | 125  | $^{\circ}\text{C}$ |
| Mounting torque                      | $M$                   | Mounting Screw:M5           | 4.0  | -    | 6.0  | N·m                |
| Weight                               | $G$                   |                             | -    | 175  | -    | g                  |

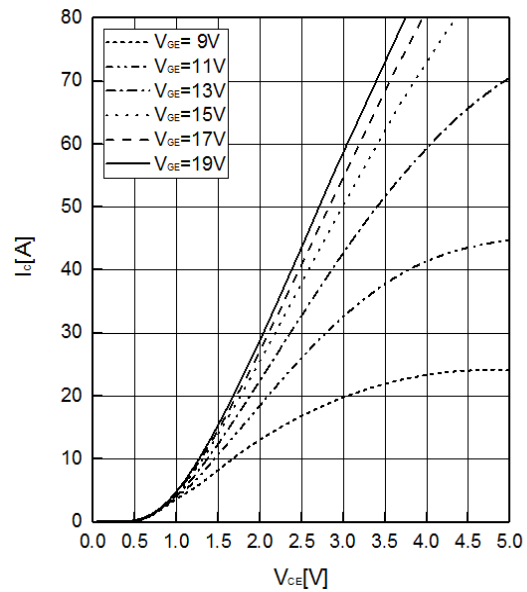
**output characteristic IGBT, Inverter (typical)**

$I_c = f(V_{CE})$ ,  $V_{GE} = 15\text{ V}$



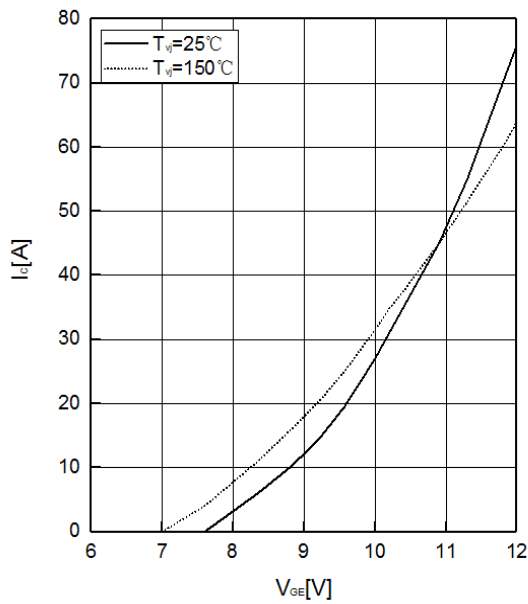
**output characteristic IGBT, Inverter (typical)**

$I_c = f(V_{CE})$ ,  $T_j = 150^\circ\text{C}$



**transfer characteristic IGBT, Inverter (typical)**

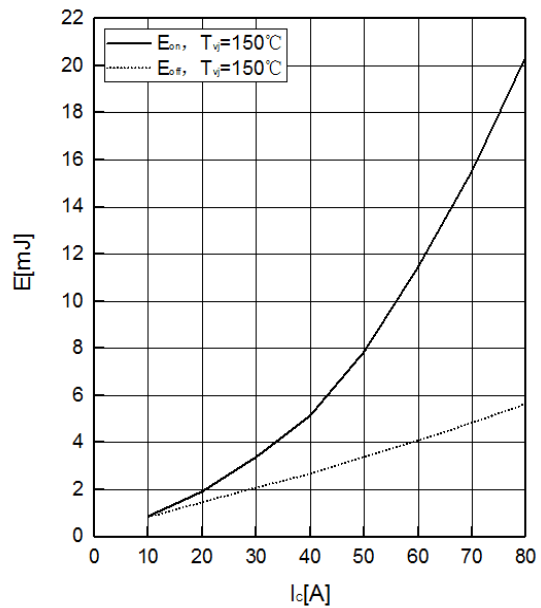
$I_c = f(V_{GE})$ ,  $V_{CE} = 20\text{ V}$



**switching losses IGBT, Inverter (typical)**

$E_{on} = f(I_c)$ ,  $E_{off} = f(I_c)$

$V_{GE} = \pm 15\text{ V}$ ,  $R_{Gon} = 33\ \Omega$ ,  $R_{Goff} = 33\ \Omega$ ,  $V_{CE} = 600\text{ V}$

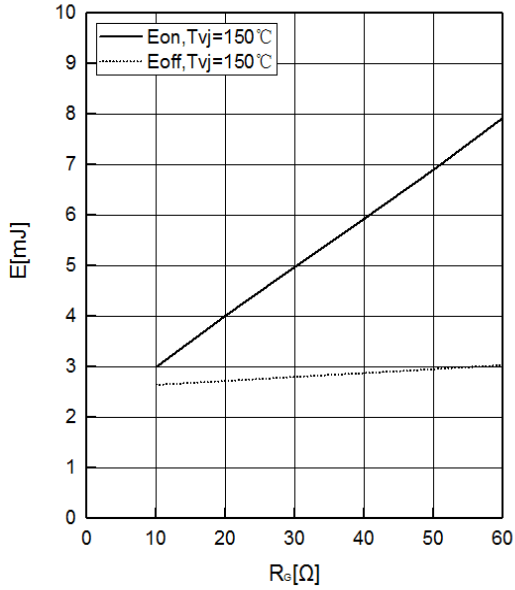




**switching losses IGBT, Inverter (typical)**

$E_{on} = f(R_G), E_{off} = f(R_G)$

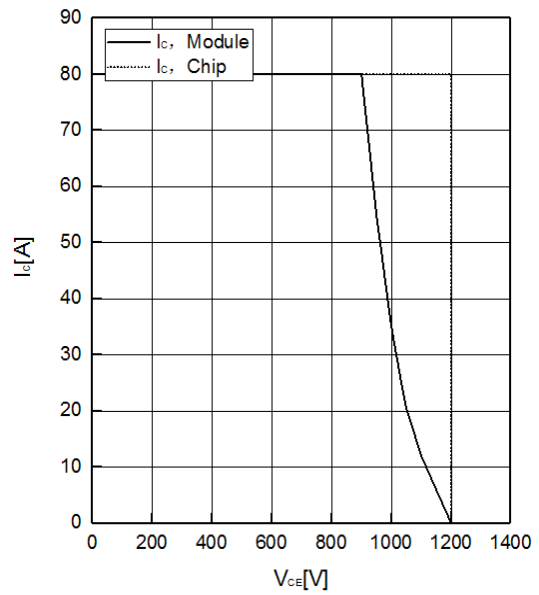
$V_{GE} = \pm 15\text{ V}, I_C = 40\text{ A}, V_{CE} = 600\text{ V}$



**reverse bias safe operating area IGBT, Inverter**

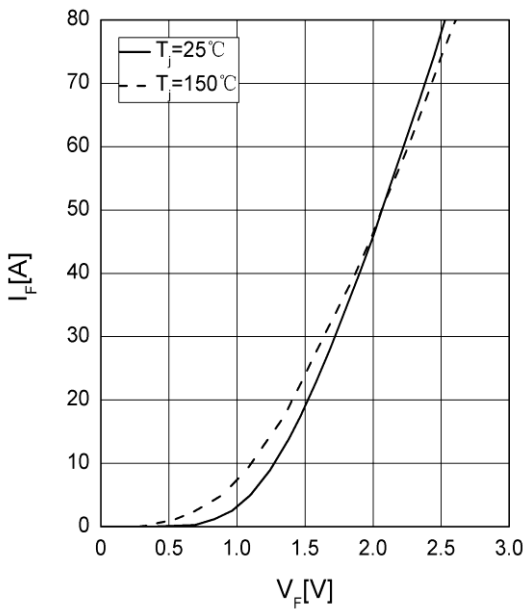
$I_C = f(V_{CE})$

$V_{GE} = \pm 15\text{ V}, R_{Goff} = 33\ \Omega, T_j = 150^\circ\text{C}$



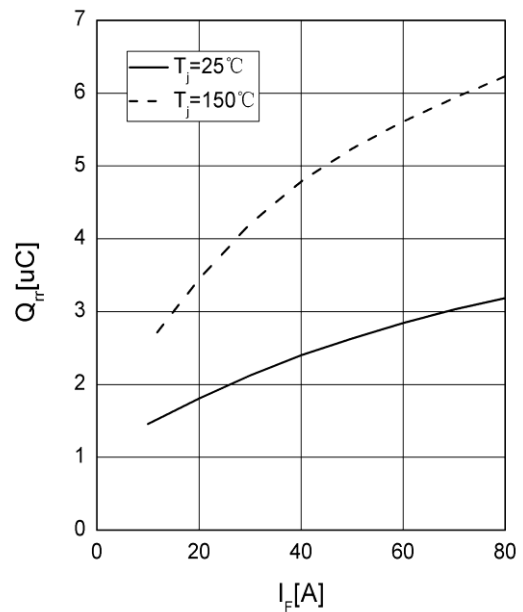
**forward characteristic of Diode, Inverter (typical)**

$I_F = f(V_F)$



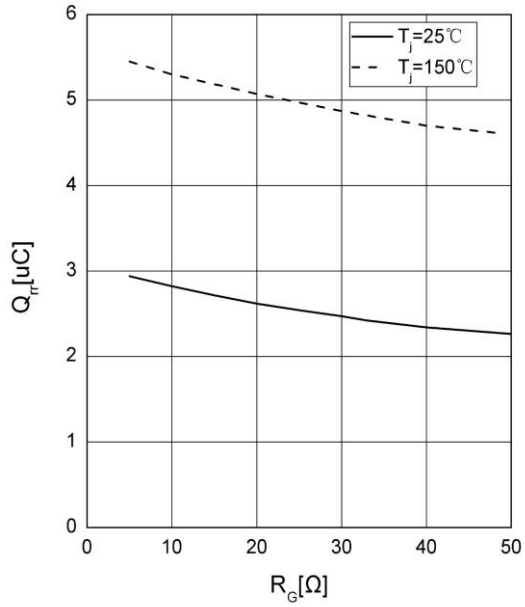
**recovered charge of Diode, Inverter (typical)**

$Q_{rr} = f(I_F)$



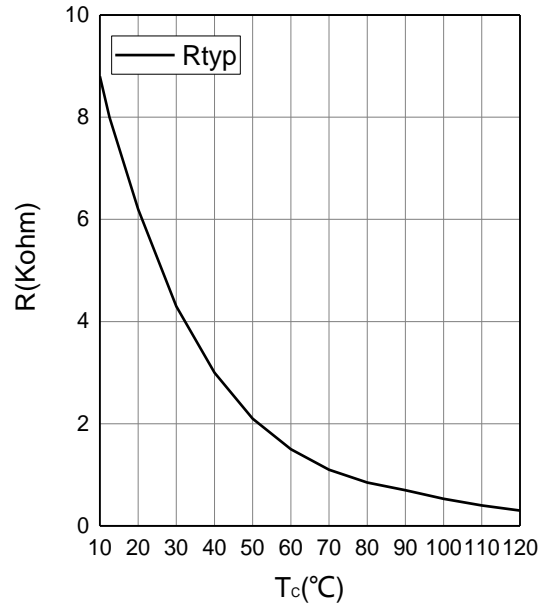
**recovered charge of Diode, Inverter (typical)**

$Q_{rr} = f(R_G)$ ,  $I_F = 40A$ ,  $V_{CE} = 600V$

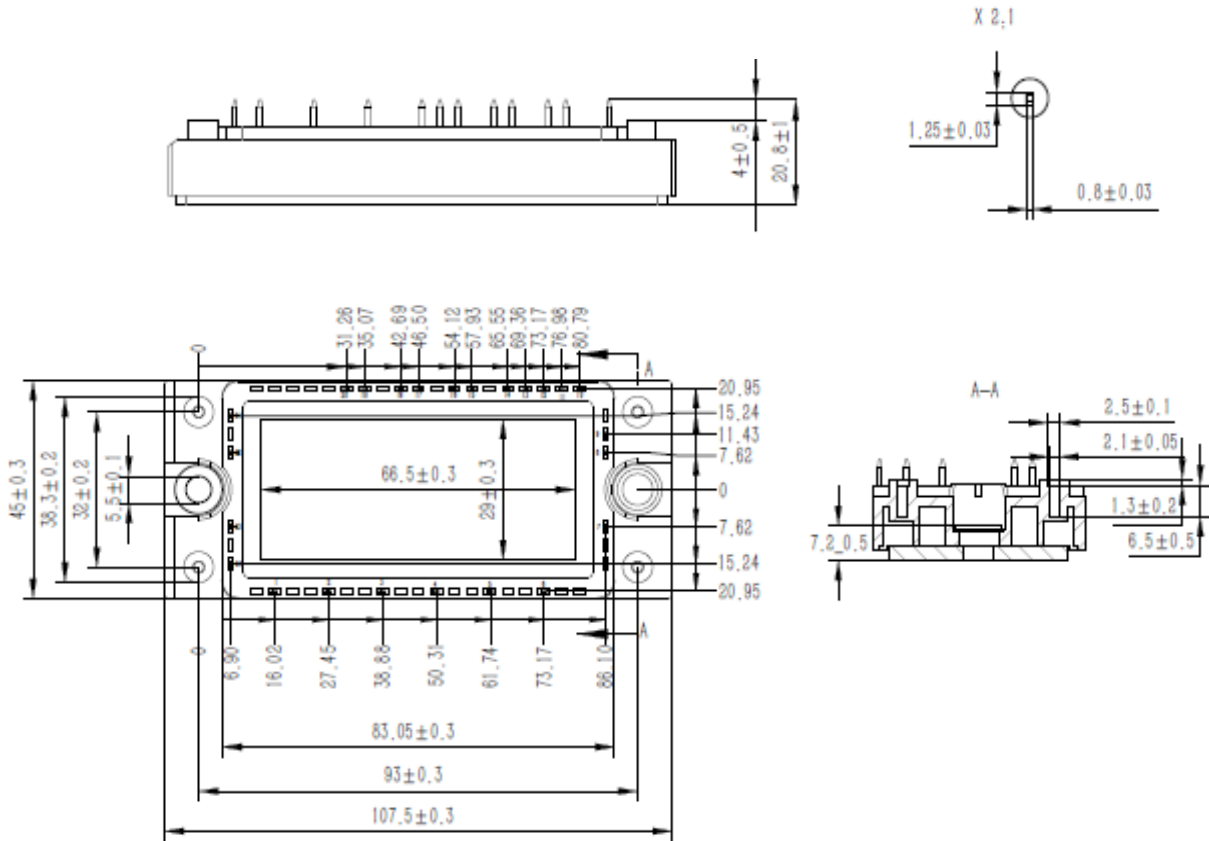


**NTC temperature characteristic (typical)**

$R = f(T)$



**Package outlines (Units: mm)**



**Circuit\_diagram\_headline**

