

## Preliminary datasheet

### EconoPIM™3 module with TRENCHSTOP™ IGBT7 and Emitter Controlled 7 diode and PressFIT / NTC

#### Features

- Electrical features
  - $V_{CES} = 1200\text{ V}$
  - $I_{C\text{ nom}} = 100\text{ A} / I_{CRM} = 200\text{ A}$
  - TRENCHSTOP™ IGBT7
  - Low  $V_{CESat}$
  - Overload operation up to  $175^{\circ}\text{C}$
- Mechanical features
  - High power and thermal cycling capability
  - Integrated NTC temperature sensor
  - Copper base plate
  - $\text{Al}_2\text{O}_3$  substrate with low thermal resistance
  - PressFIT contact technology



Typical appearance

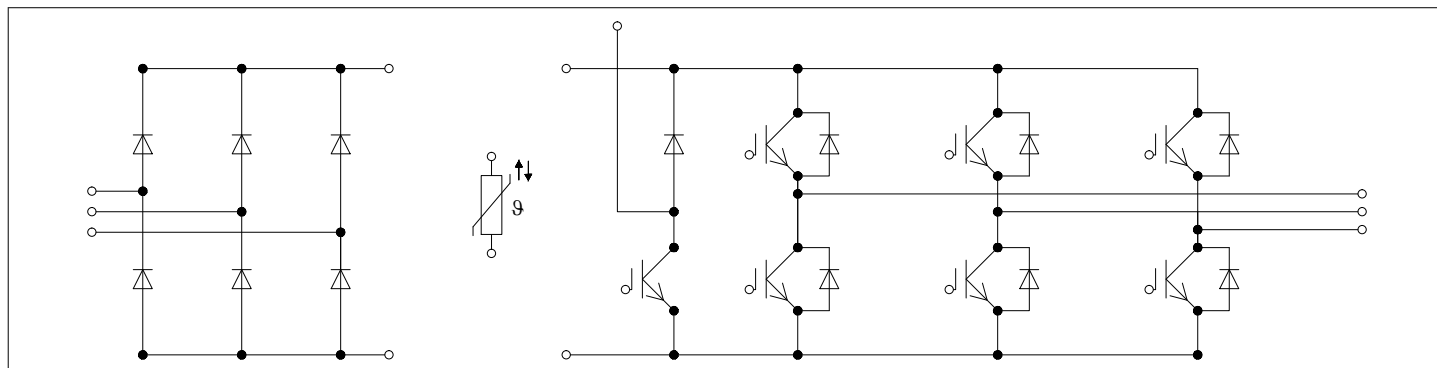
#### Potential applications

- Auxiliary inverters
- Motor drives
- Servo drives

#### Product validation

- Qualified for industrial applications according to the relevant tests of IEC 60747, 60749 and 60068

#### Description



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## 1 Package

**Table 1** Insulation coordination

| Parameter                    | Symbol      | Note or test condition                         | Values    | Unit |
|------------------------------|-------------|------------------------------------------------|-----------|------|
| Isolation test voltage       | $V_{ISOL}$  | RMS, $f = 50 \text{ Hz}$ , $t = 1 \text{ min}$ | 2.5       | kV   |
| Material of module baseplate |             |                                                | Cu        |      |
| Internal Isolation           |             | basic insulation (class 1, IEC 61140)          | $Al_2O_3$ |      |
| Creepage distance            | $d_{Creep}$ | terminal to heatsink                           | 10.0      | mm   |
| Clearance                    | $d_{Clear}$ | terminal to heatsink                           | 7.5       | mm   |
| Comparative tracking index   | $CTI$       |                                                | > 200     |      |
| RTI Elec.                    | $RTI$       | housing                                        | 140       | °C   |

**Table 2** Characteristic values

| Parameter                                | Symbol        | Note or test condition                         | Values    |      |      | Unit |
|------------------------------------------|---------------|------------------------------------------------|-----------|------|------|------|
|                                          |               |                                                | Min.      | Typ. | Max. |      |
| Stray inductance module                  | $L_{SCE}$     |                                                |           | 35   |      | nH   |
| Module lead resistance, terminals - chip | $R_{AA'+CC'}$ | $T_C = 25^\circ\text{C}$ , per switch          |           | 4.1  |      | mΩ   |
| Module lead resistance, terminals - chip | $R_{CC'+EE'}$ | $T_C = 25^\circ\text{C}$ , per switch          |           | 3.9  |      | mΩ   |
| Storage temperature                      | $T_{stg}$     |                                                | -40       |      | 125  | °C   |
| Mounting torque for modul mounting       | $M$           | - Mounting according to valid application note | M5, Screw | 3    | 6    | Nm   |
| Weight                                   | $G$           |                                                |           | 300  |      | g    |

## 2 IGBT, Inverter

**Table 3** Maximum rated values

| Parameter                         | Symbol    | Note or test condition            |                             | Values | Unit |
|-----------------------------------|-----------|-----------------------------------|-----------------------------|--------|------|
| Collector-emitter voltage         | $V_{CES}$ |                                   | $T_{vj} = 25^\circ\text{C}$ | 1200   | V    |
| Continuous DC collector current   | $I_{CDC}$ | $T_{vj \max} = 175^\circ\text{C}$ | $T_C = 100^\circ\text{C}$   | 100    | A    |
| Repetitive peak collector current | $I_{CRM}$ | $t_P = 1 \text{ ms}$              |                             | 200    | A    |
| Gate-emitter peak voltage         | $V_{GES}$ |                                   |                             | ±20    | V    |

**Table 4**                      **Characteristic values**

| Parameter                            | Symbol        | Note or test condition                                                                                                                         |                                             | Values |       |      | Unit     |
|--------------------------------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------|-------|------|----------|
|                                      |               |                                                                                                                                                |                                             | Min.   | Typ.  | Max. |          |
| Collector-emitter saturation voltage | $V_{CE\ sat}$ | $I_C = 100\ A, V_{GE} = 15\ V$                                                                                                                 | $T_{vj} = 25\ ^\circ C$                     |        | 1.50  | TBD  | V        |
|                                      |               |                                                                                                                                                | $T_{vj} = 125\ ^\circ C$                    |        | 1.64  |      |          |
|                                      |               |                                                                                                                                                | $T_{vj} = 175\ ^\circ C$                    |        | 1.72  |      |          |
| Gate threshold voltage               | $V_{GEth}$    | $I_C = 2.5\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$                                                                                        |                                             | 5.15   | 5.80  | 6.45 | V        |
| Gate charge                          | $Q_G$         | $V_{GE} = \pm 15\ V, V_{CE} = 600\ V$                                                                                                          |                                             |        | 1.8   |      | $\mu C$  |
| Internal gate resistor               | $R_{Gint}$    | $T_{vj} = 25\ ^\circ C$                                                                                                                        |                                             |        | 1.5   |      | $\Omega$ |
| Input capacitance                    | $C_{ies}$     | $f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$                                                                           |                                             |        | 21.7  |      | nF       |
| Reverse transfer capacitance         | $C_{res}$     | $f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$                                                                           |                                             |        | 0.076 |      | nF       |
| Collector-emitter cut-off current    | $I_{CES}$     | $V_{CE} = 1200\ V, V_{GE} = 0\ V$                                                                                                              | $T_{vj} = 25\ ^\circ C$                     |        |       | 0.01 | mA       |
| Gate-emitter leakage current         | $I_{GES}$     | $V_{CE} = 0\ V, V_{GE} = 20\ V, T_{vj} = 25\ ^\circ C$                                                                                         |                                             |        |       | 100  | nA       |
| Turn-on delay time (inductive load)  | $t_{don}$     | $I_C = 100\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 3.6\ \Omega$                                                                     | $T_{vj} = 25\ ^\circ C$                     |        | 0.159 |      | $\mu s$  |
|                                      |               |                                                                                                                                                | $T_{vj} = 125\ ^\circ C$                    |        | 0.176 |      |          |
|                                      |               |                                                                                                                                                | $T_{vj} = 175\ ^\circ C$                    |        | 0.184 |      |          |
| Rise time (inductive load)           | $t_r$         | $I_C = 100\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 3.6\ \Omega$                                                                     | $T_{vj} = 25\ ^\circ C$                     |        | 0.054 |      | $\mu s$  |
|                                      |               |                                                                                                                                                | $T_{vj} = 125\ ^\circ C$                    |        | 0.058 |      |          |
|                                      |               |                                                                                                                                                | $T_{vj} = 175\ ^\circ C$                    |        | 0.062 |      |          |
| Turn-off delay time (inductive load) | $t_{doff}$    | $I_C = 100\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 3.6\ \Omega$                                                                    | $T_{vj} = 25\ ^\circ C$                     |        | 0.330 |      | $\mu s$  |
|                                      |               |                                                                                                                                                | $T_{vj} = 125\ ^\circ C$                    |        | 0.420 |      |          |
|                                      |               |                                                                                                                                                | $T_{vj} = 175\ ^\circ C$                    |        | 0.460 |      |          |
| Fall time (inductive load)           | $t_f$         | $I_C = 100\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 3.6\ \Omega$                                                                    | $T_{vj} = 25\ ^\circ C$                     |        | 0.100 |      | $\mu s$  |
|                                      |               |                                                                                                                                                | $T_{vj} = 125\ ^\circ C$                    |        | 0.190 |      |          |
|                                      |               |                                                                                                                                                | $T_{vj} = 175\ ^\circ C$                    |        | 0.260 |      |          |
| Turn-on energy loss per pulse        | $E_{on}$      | $I_C = 100\ A, V_{CE} = 600\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 3.6\ \Omega, di/dt = 1350\ A/\mu s (T_{vj} = 175\ ^\circ C)$  | $T_{vj} = 25\ ^\circ C$                     |        | 11.5  |      | mJ       |
|                                      |               |                                                                                                                                                | $T_{vj} = 125\ ^\circ C$                    |        | 15.1  |      |          |
|                                      |               |                                                                                                                                                | $T_{vj} = 175\ ^\circ C$                    |        | 17.2  |      |          |
| Turn-off energy loss per pulse       | $E_{off}$     | $I_C = 100\ A, V_{CE} = 600\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 3.6\ \Omega, dv/dt = 2900\ V/\mu s (T_{vj} = 175\ ^\circ C)$ | $T_{vj} = 25\ ^\circ C$                     |        | 6.95  |      | mJ       |
|                                      |               |                                                                                                                                                | $T_{vj} = 125\ ^\circ C$                    |        | 10.9  |      |          |
|                                      |               |                                                                                                                                                | $T_{vj} = 175\ ^\circ C$                    |        | 13.4  |      |          |
| SC data                              | $I_{SC}$      | $V_{GE} \leq 15\ V, V_{CC} = 800\ V, V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$                                                                | $t_P \leq 8\ \mu s, T_{vj} = 150\ ^\circ C$ |        | 370   |      | A        |
|                                      |               |                                                                                                                                                | $t_P \leq 7\ \mu s, T_{vj} = 175\ ^\circ C$ |        | 350   |      |          |

**Table 4** Characteristic values (continued)

| Parameter                              | Symbol             | Note or test condition                                   | Values |        |       | Unit |
|----------------------------------------|--------------------|----------------------------------------------------------|--------|--------|-------|------|
|                                        |                    |                                                          | Min.   | Typ.   | Max.  |      |
| Thermal resistance, junction to case   | $R_{thJC}$         | per IGBT                                                 |        |        | 0.373 | K/W  |
| Thermal resistance, case to heatsink   | $R_{thCH}$         | per IGBT, $\lambda_{grease} = 1 \text{ W/(m}^2\text{K)}$ |        | 0.0680 |       | K/W  |
| Temperature under switching conditions | $T_{vj\text{ op}}$ |                                                          | -40    |        | 175   | °C   |

Note:  $T_{vj\text{ op}} > 150^\circ\text{C}$  is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.

### 3 Diode, Inverter

**Table 5** Maximum rated values

| Parameter                       | Symbol    | Note or test condition                   |                              | Values | 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                    |
| $I^2t$ - value                  | $I^2t$    | $t_P = 10 \text{ ms}, V_R = 0 \text{ V}$ | $T_{vj} = 125^\circ\text{C}$ | 1980   | $\text{A}^2\text{s}$ |
|                                 |           |                                          | $T_{vj} = 175^\circ\text{C}$ | 1710   |                      |

**Table 6** Characteristic values

| Parameter                     | Symbol   | Note or test condition                                                                                                                 | Values                       |      |      | Unit          |
|-------------------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------|------|------|---------------|
|                               |          |                                                                                                                                        | Min.                         | Typ. | Max. |               |
| Forward voltage               | $V_F$    | $I_F = 100 \text{ A}, V_{GE} = 0 \text{ V}$                                                                                            | $T_{vj} = 25^\circ\text{C}$  |      | 1.72 | TBD           |
|                               |          |                                                                                                                                        | $T_{vj} = 125^\circ\text{C}$ |      | 1.59 |               |
|                               |          |                                                                                                                                        | $T_{vj} = 175^\circ\text{C}$ |      | 1.52 |               |
| Peak reverse recovery current | $I_{RM}$ | $V_R = 600 \text{ V}, I_F = 100 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 1350 \text{ A}/\mu\text{s} (T_{vj} = 175^\circ\text{C})$ | $T_{vj} = 25^\circ\text{C}$  |      | 51   | A             |
|                               |          |                                                                                                                                        | $T_{vj} = 125^\circ\text{C}$ |      | 68   |               |
|                               |          |                                                                                                                                        | $T_{vj} = 175^\circ\text{C}$ |      | 78   |               |
| Recovered charge              | $Q_r$    | $V_R = 600 \text{ V}, I_F = 100 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 1350 \text{ A}/\mu\text{s} (T_{vj} = 175^\circ\text{C})$ | $T_{vj} = 25^\circ\text{C}$  |      | 6.9  | $\mu\text{C}$ |
|                               |          |                                                                                                                                        | $T_{vj} = 125^\circ\text{C}$ |      | 13.5 |               |
|                               |          |                                                                                                                                        | $T_{vj} = 175^\circ\text{C}$ |      | 18.3 |               |

**Table 6** Characteristic values (continued)

| Parameter                              | Symbol             | Note or test condition                                                                                                                         | Values                   |        |       | Unit |
|----------------------------------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--------|-------|------|
|                                        |                    |                                                                                                                                                | Min.                     | Typ.   | Max.  |      |
| Reverse recovery energy                | $E_{rec}$          | $V_R = 600\text{ V}$ , $I_F = 100\text{ A}$ ,<br>$V_{GE} = -15\text{ V}$ , $-di_F/dt = 1350\text{ A}/\mu\text{s}$ ( $T_{vj} = 175\text{ °C}$ ) | $T_{vj} = 25\text{ °C}$  | 2.05   |       | mJ   |
|                                        |                    |                                                                                                                                                | $T_{vj} = 125\text{ °C}$ | 4.31   |       |      |
|                                        |                    |                                                                                                                                                | $T_{vj} = 175\text{ °C}$ | 6.05   |       |      |
| Thermal resistance, junction to case   | $R_{thJC}$         | per diode                                                                                                                                      |                          |        | 0.612 | K/W  |
| Thermal resistance, case to heatsink   | $R_{thCH}$         | per diode, $\lambda_{grease} = 1\text{ W}/(\text{m}^*\text{K})$                                                                                |                          | 0.0770 |       | K/W  |
| Temperature under switching conditions | $T_{vj\text{ op}}$ |                                                                                                                                                | -40                      |        | 175   | °C   |

Note:  $T_{vj\text{ op}} > 150\text{ °C}$  is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.

## 4 Diode, Rectifier

**Table 7** Maximum rated values

| Parameter                               | Symbol      | Note or test condition  |                          | Values | Unit             |
|-----------------------------------------|-------------|-------------------------|--------------------------|--------|------------------|
| Repetitive peak reverse voltage         | $V_{RRM}$   | $T_{vj} = 25\text{ °C}$ |                          | 1600   | V                |
| Maximum RMS forward current per chip    | $I_{FRMSM}$ | $T_C = 110\text{ °C}$   |                          | 100    | A                |
| Maximum RMS current at rectifier output | $I_{RMSM}$  | $T_C = 110\text{ °C}$   |                          | 150    | A                |
| Surge forward current                   | $I_{FSM}$   | $t_p = 10\text{ ms}$    | $T_{vj} = 25\text{ °C}$  | 1250   | A                |
|                                         |             |                         | $T_{vj} = 150\text{ °C}$ | 990    |                  |
| $I^2t$ - value                          | $I^2t$      | $t_p = 10\text{ ms}$    | $T_{vj} = 25\text{ °C}$  | 8250   | A <sup>2</sup> s |
|                                         |             |                         | $T_{vj} = 150\text{ °C}$ | 4950   |                  |

**Table 8** Characteristic values

| Parameter                            | Symbol     | Note or test condition                                          | Values |        |       | Unit |
|--------------------------------------|------------|-----------------------------------------------------------------|--------|--------|-------|------|
|                                      |            |                                                                 | Min.   | Typ.   | Max.  |      |
| Forward voltage                      | $V_F$      | $I_F = 100\text{ A}$ , $T_{vj} = 150\text{ °C}$                 |        | 1.02   |       | V    |
| Reverse current                      | $I_r$      | $T_{vj} = 150\text{ °C}$ , $V_R = 1600\text{ V}$                |        | 1      |       | mA   |
| Thermal resistance, junction to case | $R_{thJC}$ | per diode                                                       |        |        | 0.498 | K/W  |
| Thermal resistance, case to heatsink | $R_{thCH}$ | per diode, $\lambda_{grease} = 1\text{ W}/(\text{m}^*\text{K})$ |        | 0.0710 |       | K/W  |

**Table 8** Characteristic values (continued)

| Parameter                              | Symbol       | Note or test condition | Values |      |      | Unit |
|----------------------------------------|--------------|------------------------|--------|------|------|------|
|                                        |              |                        | Min.   | Typ. | Max. |      |
| Temperature under switching conditions | $T_{vj, op}$ |                        | -40    |      | 150  | °C   |

## 5 IGBT, Brake-Chopper

**Table 9** Maximum rated values

| Parameter                         | Symbol    | Note or test condition        |                         | Values | Unit |
|-----------------------------------|-----------|-------------------------------|-------------------------|--------|------|
| Collector-emitter voltage         | $V_{CES}$ |                               | $T_{vj} = 25\text{ °C}$ | 1200   | V    |
| Continuous DC collector current   | $I_{CDC}$ | $T_{vj\ max} = 175\text{ °C}$ | $T_C = 115\text{ °C}$   | 50     | A    |
| Repetitive peak collector current | $I_{CRM}$ | $t_P = 1\text{ ms}$           |                         | 100    | A    |
| Gate-emitter peak voltage         | $V_{GES}$ |                               |                         | ±20    | V    |

**Table 10** Characteristic values

| Parameter                            | Symbol        | Note or test condition                                                                       |                          | Values |       |       | Unit |
|--------------------------------------|---------------|----------------------------------------------------------------------------------------------|--------------------------|--------|-------|-------|------|
|                                      |               |                                                                                              |                          | Min.   | Typ.  | Max.  |      |
| Collector-emitter saturation voltage | $V_{CE\ sat}$ | $I_C = 50\text{ A}, V_{GE} = 15\text{ V}$                                                    | $T_{vj} = 25\text{ °C}$  |        | 1.50  | TBD   | V    |
|                                      |               |                                                                                              | $T_{vj} = 125\text{ °C}$ |        | 1.64  |       |      |
|                                      |               |                                                                                              | $T_{vj} = 175\text{ °C}$ |        | 1.72  |       |      |
| Gate threshold voltage               | $V_{GEth}$    | $I_C = 1.28\text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25\text{ °C}$                               |                          | 5.15   | 5.80  | 6.45  | V    |
| Gate charge                          | $Q_G$         | $V_{GE} = \pm 15\text{ V}, V_{CE} = 600\text{ V}$                                            |                          |        | 0.92  |       | μC   |
| Internal gate resistor               | $R_{Gint}$    | $T_{vj} = 25\text{ °C}$                                                                      |                          |        | 0     |       | Ω    |
| Input capacitance                    | $C_{ies}$     | $f = 100\text{ kHz}, T_{vj} = 25\text{ °C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$       |                          |        | 11.1  |       | nF   |
| Reverse transfer capacitance         | $C_{res}$     | $f = 100\text{ kHz}, T_{vj} = 25\text{ °C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$       |                          |        | 0.039 |       | nF   |
| Collector-emitter cut-off current    | $I_{CES}$     | $V_{CE} = 1200\text{ V}, V_{GE} = 0\text{ V}$                                                | $T_{vj} = 25\text{ °C}$  |        |       | 0.007 | mA   |
| Gate-emitter leakage current         | $I_{GES}$     | $V_{CE} = 0\text{ V}, V_{GE} = 20\text{ V}, T_{vj} = 25\text{ °C}$                           |                          |        |       | 100   | nA   |
| Turn-on delay time (inductive load)  | $t_{don}$     | $I_C = 50\text{ A}, V_{CE} = 600\text{ V}, V_{GE} = \pm 15\text{ V}, R_{Gon} = 7.5\text{ Ω}$ | $T_{vj} = 25\text{ °C}$  |        | 0.059 |       | μs   |
|                                      |               |                                                                                              | $T_{vj} = 125\text{ °C}$ |        | 0.061 |       |      |
|                                      |               |                                                                                              | $T_{vj} = 175\text{ °C}$ |        | 0.062 |       |      |
| Rise time (inductive load)           | $t_r$         | $I_C = 50\text{ A}, V_{CE} = 600\text{ V}, V_{GE} = \pm 15\text{ V}, R_{Gon} = 7.5\text{ Ω}$ | $T_{vj} = 25\text{ °C}$  |        | 0.041 |       | μs   |
|                                      |               |                                                                                              | $T_{vj} = 125\text{ °C}$ |        | 0.046 |       |      |
|                                      |               |                                                                                              | $T_{vj} = 175\text{ °C}$ |        | 0.048 |       |      |

**Table 10** Characteristic values (continued)

| Parameter                               | Symbol             | Note or test condition                                                                                                                                                                                                                          | Values                                                             |        |       | Unit              |
|-----------------------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|--------|-------|-------------------|
|                                         |                    |                                                                                                                                                                                                                                                 | Min.                                                               | Typ.   | Max.  |                   |
| Turn-off delay time<br>(inductive load) | $t_{\text{doff}}$  | $I_C = 50 \text{ A}$ , $V_{\text{CE}} = 600 \text{ V}$ ,<br>$V_{\text{GE}} = \pm 15 \text{ V}$ , $R_{\text{Goff}} = 7.5 \Omega$                                                                                                                 | $T_{\text{vj}} = 25^\circ \text{C}$                                | 0.290  |       | $\mu\text{s}$     |
|                                         |                    |                                                                                                                                                                                                                                                 | $T_{\text{vj}} = 125^\circ \text{C}$                               | 0.380  |       |                   |
|                                         |                    |                                                                                                                                                                                                                                                 | $T_{\text{vj}} = 175^\circ \text{C}$                               | 0.420  |       |                   |
| Fall time (inductive load)              | $t_f$              | $I_C = 50 \text{ A}$ , $V_{\text{CE}} = 600 \text{ V}$ ,<br>$V_{\text{GE}} = \pm 15 \text{ V}$ , $R_{\text{Goff}} = 7.5 \Omega$                                                                                                                 | $T_{\text{vj}} = 25^\circ \text{C}$                                | 0.110  |       | $\mu\text{s}$     |
|                                         |                    |                                                                                                                                                                                                                                                 | $T_{\text{vj}} = 125^\circ \text{C}$                               | 0.200  |       |                   |
|                                         |                    |                                                                                                                                                                                                                                                 | $T_{\text{vj}} = 175^\circ \text{C}$                               | 0.270  |       |                   |
| Turn-on energy loss per pulse           | $E_{\text{on}}$    | $I_C = 50 \text{ A}$ , $V_{\text{CE}} = 600 \text{ V}$ ,<br>$L_\sigma = 35 \text{ nH}$ , $V_{\text{GE}} = \pm 15 \text{ V}$ ,<br>$R_{\text{Gon}} = 7.5 \Omega$ , $di/dt = 785 \text{ A}/\mu\text{s}$ ( $T_{\text{vj}} = 175^\circ \text{C}$ )   | $T_{\text{vj}} = 25^\circ \text{C}$                                | 4.78   |       | mJ                |
|                                         |                    |                                                                                                                                                                                                                                                 | $T_{\text{vj}} = 125^\circ \text{C}$                               | 6.12   |       |                   |
|                                         |                    |                                                                                                                                                                                                                                                 | $T_{\text{vj}} = 175^\circ \text{C}$                               | 6.78   |       |                   |
| Turn-off energy loss per pulse          | $E_{\text{off}}$   | $I_C = 50 \text{ A}$ , $V_{\text{CE}} = 600 \text{ V}$ ,<br>$L_\sigma = 35 \text{ nH}$ , $V_{\text{GE}} = \pm 15 \text{ V}$ ,<br>$R_{\text{Goff}} = 7.5 \Omega$ , $dv/dt = 2950 \text{ V}/\mu\text{s}$ ( $T_{\text{vj}} = 175^\circ \text{C}$ ) | $T_{\text{vj}} = 25^\circ \text{C}$                                | 3.29   |       | mJ                |
|                                         |                    |                                                                                                                                                                                                                                                 | $T_{\text{vj}} = 125^\circ \text{C}$                               | 5.2    |       |                   |
|                                         |                    |                                                                                                                                                                                                                                                 | $T_{\text{vj}} = 175^\circ \text{C}$                               | 6.4    |       |                   |
| SC data                                 | $I_{\text{SC}}$    | $V_{\text{GE}} \leq 15 \text{ V}$ , $V_{\text{CC}} = 800 \text{ V}$ ,<br>$V_{\text{CEmax}} = V_{\text{CES}} - L_{\text{sCE}} \cdot di/dt$                                                                                                       | $t_P \leq 8 \mu\text{s}$ ,<br>$T_{\text{vj}} = 150^\circ \text{C}$ | 190    |       | A                 |
|                                         |                    |                                                                                                                                                                                                                                                 | $t_P \leq 7 \mu\text{s}$ ,<br>$T_{\text{vj}} = 175^\circ \text{C}$ | 180    |       |                   |
| Thermal resistance, junction to case    | $R_{\text{thJC}}$  | per IGBT                                                                                                                                                                                                                                        |                                                                    |        | 0.598 | K/W               |
| Thermal resistance, case to heatsink    | $R_{\text{thCH}}$  | per IGBT, $\lambda_{\text{grease}} = 1 \text{ W}/(\text{m}^2\text{K})$                                                                                                                                                                          |                                                                    | 0.0760 |       | K/W               |
| Temperature under switching conditions  | $T_{\text{vj op}}$ |                                                                                                                                                                                                                                                 | -40                                                                |        | 175   | $^\circ \text{C}$ |

Note:  $T_{\text{vj op}} > 150^\circ \text{C}$  is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.

## 6 Diode, Brake-Chopper

**Table 11** Maximum rated values

| Parameter                       | Symbol           | Note or test condition              | Values | Unit |
|---------------------------------|------------------|-------------------------------------|--------|------|
| Repetitive peak reverse voltage | $V_{\text{RRM}}$ | $T_{\text{vj}} = 25^\circ \text{C}$ | 1200   | V    |
| Continuous DC forward current   | $I_F$            |                                     | 35     | A    |
| Repetitive peak forward current | $I_{\text{FRM}}$ | $t_P = 1 \text{ ms}$                | 70     | A    |

**Table 11** Maximum rated values (continued)

| Parameter      | Symbol | Note or test condition                   | Values                       | Unit                 |
|----------------|--------|------------------------------------------|------------------------------|----------------------|
| $I^2t$ - value | $I^2t$ | $t_p = 10 \text{ ms}, V_R = 0 \text{ V}$ | $T_{vj} = 125^\circ\text{C}$ | $\text{A}^2\text{s}$ |
|                |        |                                          | $T_{vj} = 175^\circ\text{C}$ |                      |

**Table 12** Characteristic values

| Parameter                              | Symbol              | Note or test condition                                                                                                               | Values                       |       |      | Unit             |
|----------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-------|------|------------------|
|                                        |                     |                                                                                                                                      | Min.                         | Typ.  | Max. |                  |
| Forward voltage                        | $V_F$               | $I_F = 35 \text{ A}, V_{GE} = 0 \text{ V}$                                                                                           | $T_{vj} = 25^\circ\text{C}$  | 1.72  | TBD  | V                |
|                                        |                     |                                                                                                                                      | $T_{vj} = 125^\circ\text{C}$ | 1.59  |      |                  |
|                                        |                     |                                                                                                                                      | $T_{vj} = 175^\circ\text{C}$ | 1.52  |      |                  |
| Peak reverse recovery current          | $I_{RM}$            | $V_R = 600 \text{ V}, I_F = 35 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 755 \text{ A}/\mu\text{s} (T_{vj} = 175^\circ\text{C})$ | $T_{vj} = 25^\circ\text{C}$  | 20    |      | A                |
|                                        |                     |                                                                                                                                      | $T_{vj} = 125^\circ\text{C}$ | 26    |      |                  |
|                                        |                     |                                                                                                                                      | $T_{vj} = 175^\circ\text{C}$ | 30    |      |                  |
| Recovered charge                       | $Q_r$               | $V_R = 600 \text{ V}, I_F = 35 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 755 \text{ A}/\mu\text{s} (T_{vj} = 175^\circ\text{C})$ | $T_{vj} = 25^\circ\text{C}$  | 2.36  |      | $\mu\text{C}$    |
|                                        |                     |                                                                                                                                      | $T_{vj} = 125^\circ\text{C}$ | 4.7   |      |                  |
|                                        |                     |                                                                                                                                      | $T_{vj} = 175^\circ\text{C}$ | 6.22  |      |                  |
| Reverse recovery energy                | $E_{rec}$           | $V_R = 600 \text{ V}, I_F = 35 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 755 \text{ A}/\mu\text{s} (T_{vj} = 175^\circ\text{C})$ | $T_{vj} = 25^\circ\text{C}$  | 0.75  |      | mJ               |
|                                        |                     |                                                                                                                                      | $T_{vj} = 125^\circ\text{C}$ | 1.64  |      |                  |
|                                        |                     |                                                                                                                                      | $T_{vj} = 175^\circ\text{C}$ | 2.24  |      |                  |
| Thermal resistance, junction to case   | $R_{thJC}$          | per diode                                                                                                                            |                              |       | 1.06 | K/W              |
| Thermal resistance, case to heatsink   | $R_{thCH}$          | per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m} \cdot \text{K})$                                                                |                              | 0.137 |      | K/W              |
| Temperature under switching conditions | $T_{vj \text{ op}}$ |                                                                                                                                      | -40                          |       | 175  | $^\circ\text{C}$ |

Note:  $T_{vj \text{ op}} > 150^\circ\text{C}$  is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.

## 7 NTC-Thermistor

**Table 13** Characteristic values

| Parameter              | Symbol       | Note or test condition                              | Values |      |      | Unit       |
|------------------------|--------------|-----------------------------------------------------|--------|------|------|------------|
|                        |              |                                                     | Min.   | Typ. | Max. |            |
| Rated resistance       | $R_{25}$     | $T_{NTC} = 25^\circ\text{C}$                        |        | 5    |      | k $\Omega$ |
| Deviation of $R_{100}$ | $\Delta R/R$ | $T_{NTC} = 100^\circ\text{C}, R_{100} = 493 \Omega$ | -5     |      | 5    | %          |
| Power dissipation      | $P_{25}$     | $T_{NTC} = 25^\circ\text{C}$                        |        |      | 20   | mW         |

**Table 13**                      **Characteristic values (continued)**

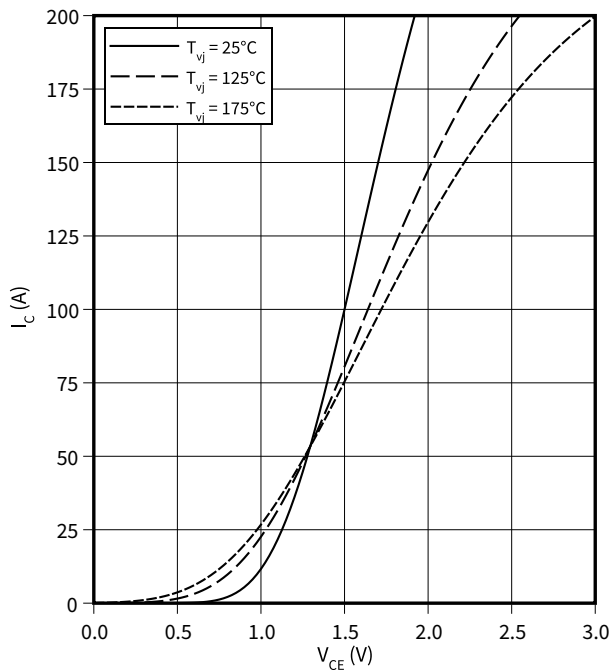
| Parameter | Symbol       | Note or test condition                                        | Values |      |      | Unit |
|-----------|--------------|---------------------------------------------------------------|--------|------|------|------|
|           |              |                                                               | Min.   | Typ. | Max. |      |
| B-value   | $B_{25/50}$  | $R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298,15 \text{ K}))]$  |        | 3375 |      | K    |
| B-value   | $B_{25/80}$  | $R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298,15 \text{ K}))]$  |        | 3411 |      | K    |
| B-value   | $B_{25/100}$ | $R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298,15 \text{ K}))]$ |        | 3433 |      | K    |

*Note:*                      *Specification according to the valid application note.*

8 Characteristics diagrams

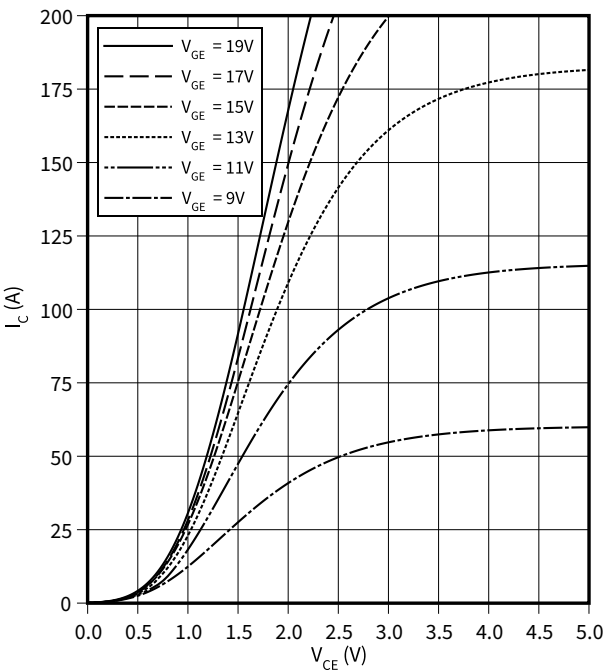
output characteristic (typical), IGBT, Inverter

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



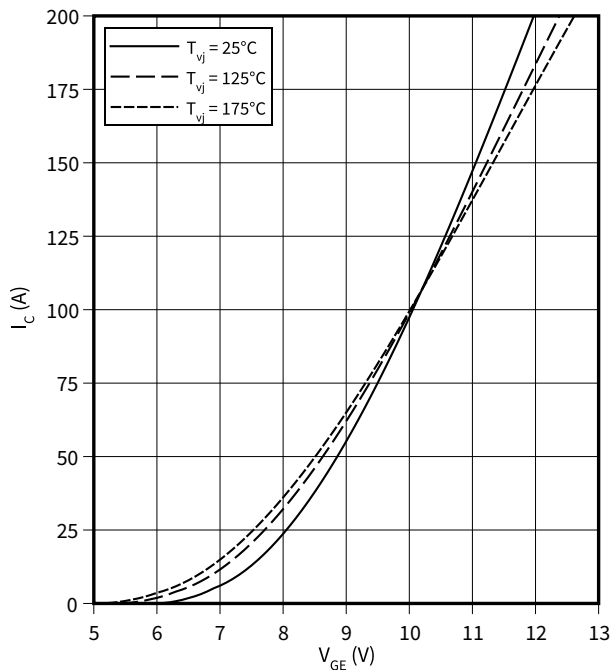
output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$   
 $T_{vj} = 175\text{ °C}$



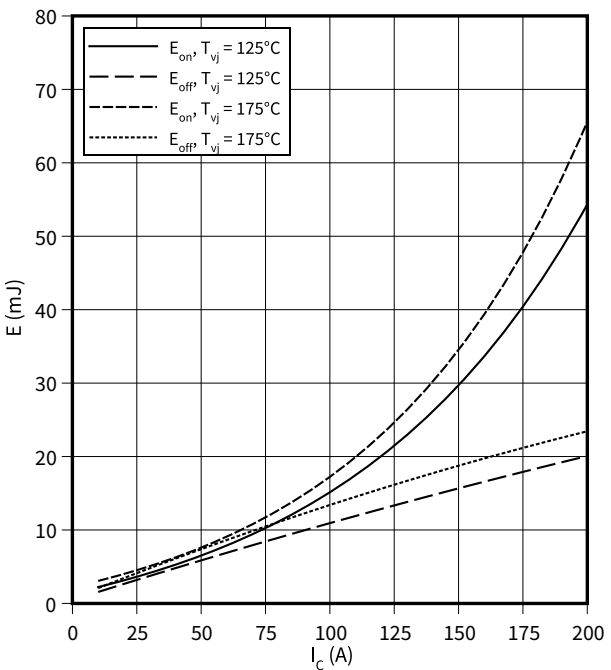
transfer characteristic (typical), IGBT, Inverter

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



switching losses (typical), IGBT, Inverter

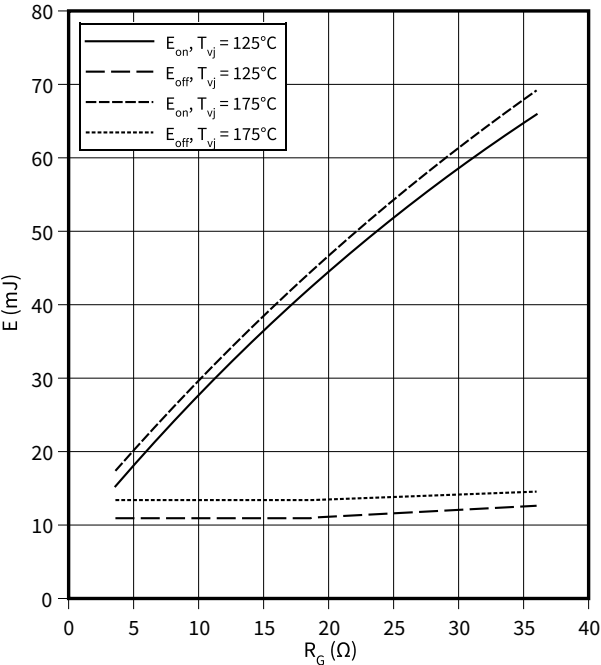
$E = f(I_C)$   
 $R_{Goff} = 3.6\text{ }\Omega$ ,  $R_{Gon} = 3.6\text{ }\Omega$ ,  $V_{GE} = \pm 15\text{ V}$ ,  $V_{CE} = 600\text{ V}$



8 Characteristics diagrams

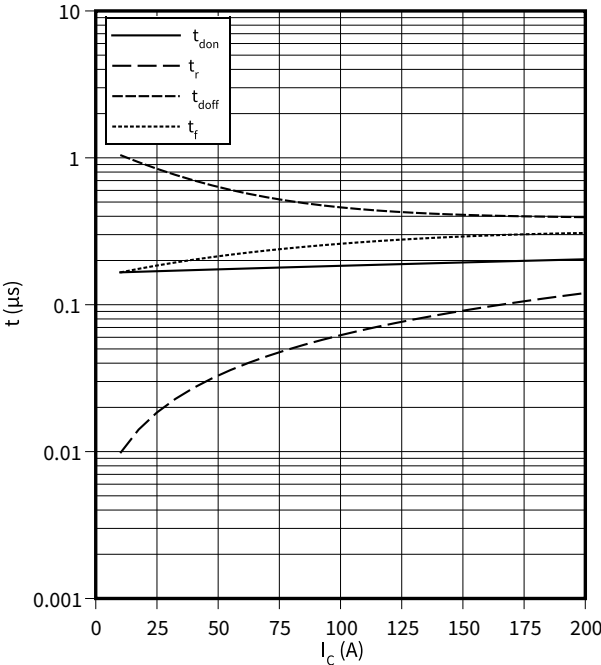
switching losses (typical), IGBT, Inverter

$E = f(R_G)$   
 $I_C = 100\text{ A}$ ,  $V_{CE} = 600\text{ V}$ ,  $V_{GE} = \pm 15\text{ V}$



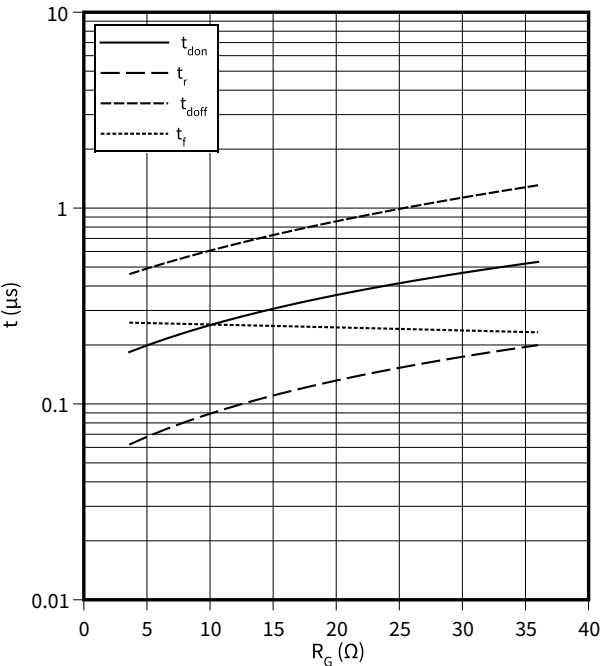
switching times (typical), IGBT, Inverter

$t = f(I_C)$   
 $R_{Goff} = 3.6\text{ }\Omega$ ,  $R_{Gon} = 3.6\text{ }\Omega$ ,  $V_{GE} = \pm 15\text{ V}$ ,  $V_{CE} = 600\text{ V}$ ,  $T_{vj} = 175\text{ }^\circ\text{C}$



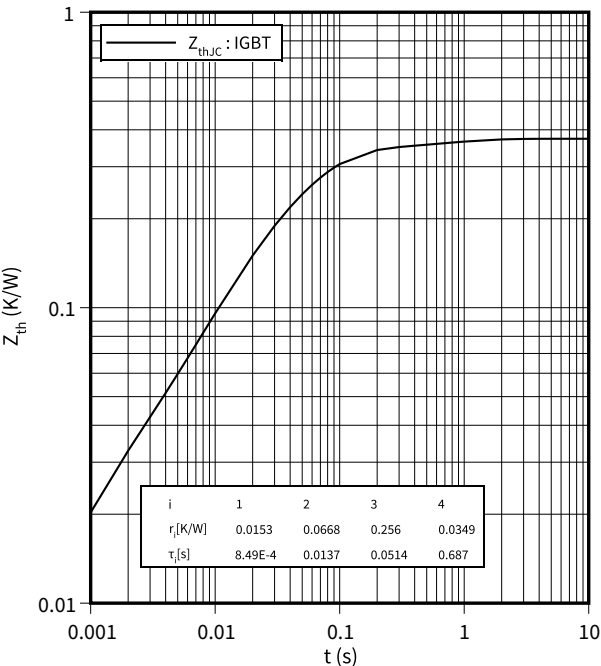
switching times (typical), IGBT, Inverter

$t = f(R_G)$   
 $V_{GE} = \pm 15\text{ V}$ ,  $I_C = 100\text{ A}$ ,  $V_{CE} = 600\text{ V}$ ,  $T_{vj} = 175\text{ }^\circ\text{C}$



transient thermal impedance , IGBT, Inverter

$Z_{th} = f(t)$

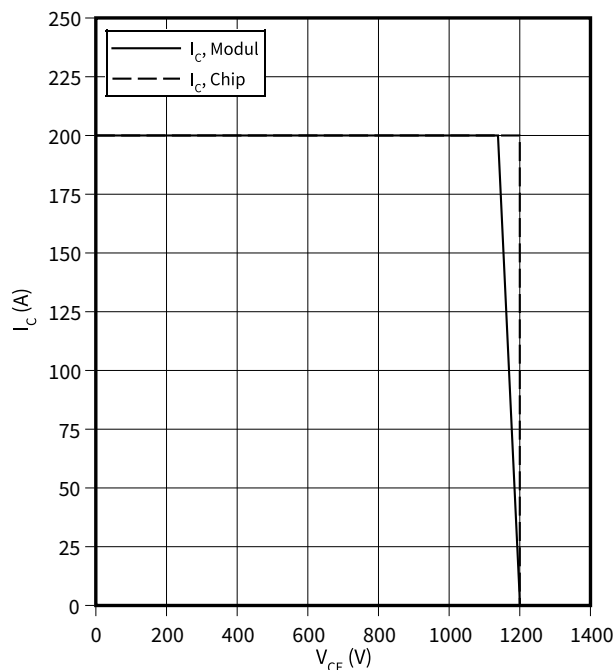


8 Characteristics diagrams

**reverse bias safe operating area (RBSOA), IGBT, Inverter**

$$I_C = f(V_{CE})$$

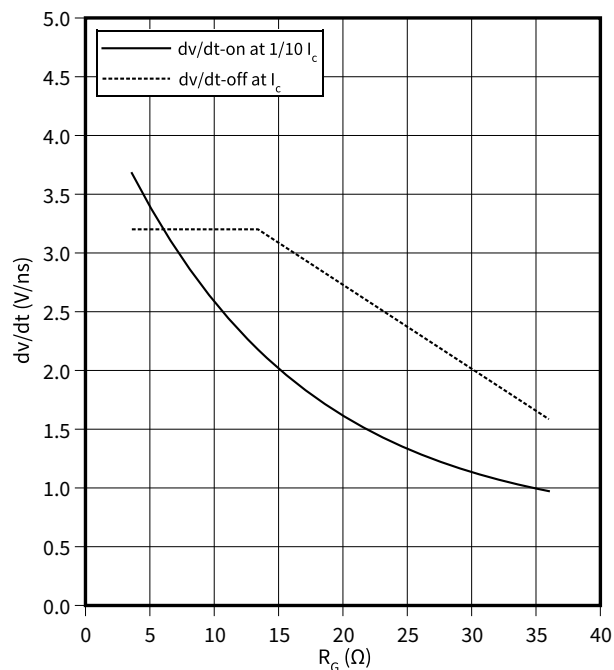
$$R_{Goff} = 3.6 \, \Omega, V_{GE} = \pm 15 \, V, T_{vj} = 175 \, ^\circ C$$



**Voltage slope (typical), IGBT, Inverter**

$$dv/dt = f(R_G)$$

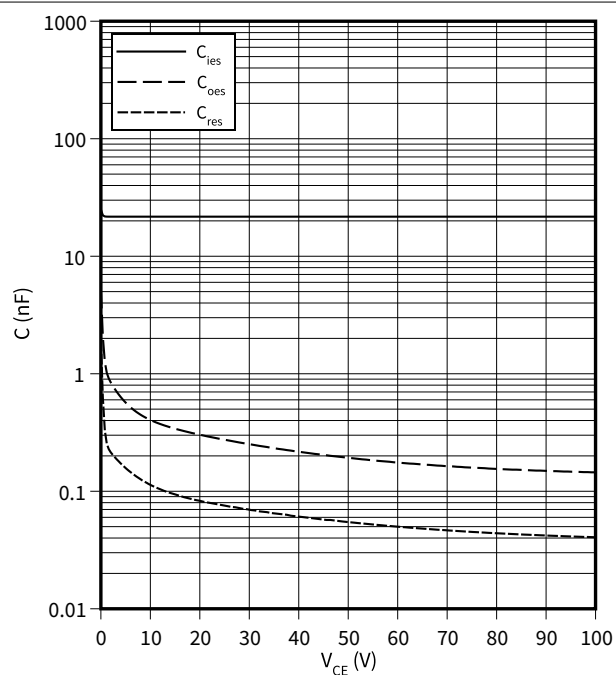
$$I_C = 100 \, A, V_{CE} = 600 \, V, V_{GE} = \pm 15 \, V, T_{vj} = 25 \, ^\circ C$$



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

$$C = f(V_{CE})$$

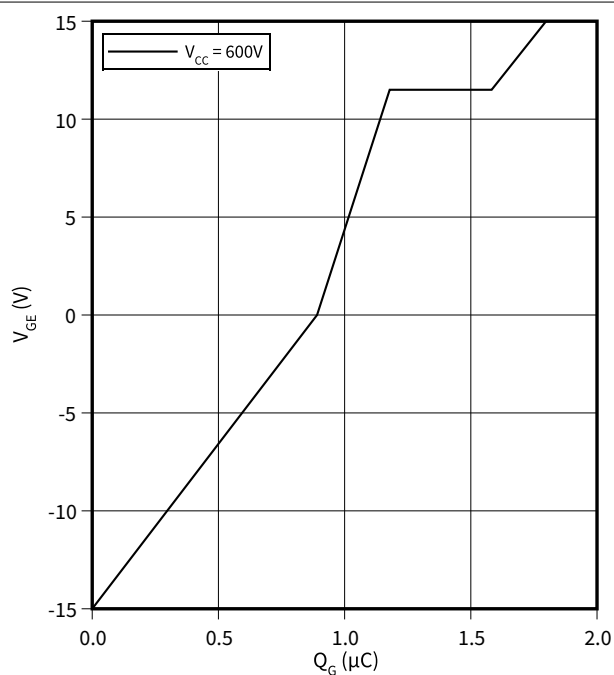
$$f = 100 \, kHz, V_{GE} = 0 \, V, T_{vj} = 25 \, ^\circ C$$



**gate charge characteristic (typical), IGBT, Inverter**

$$V_{GE} = f(Q_G)$$

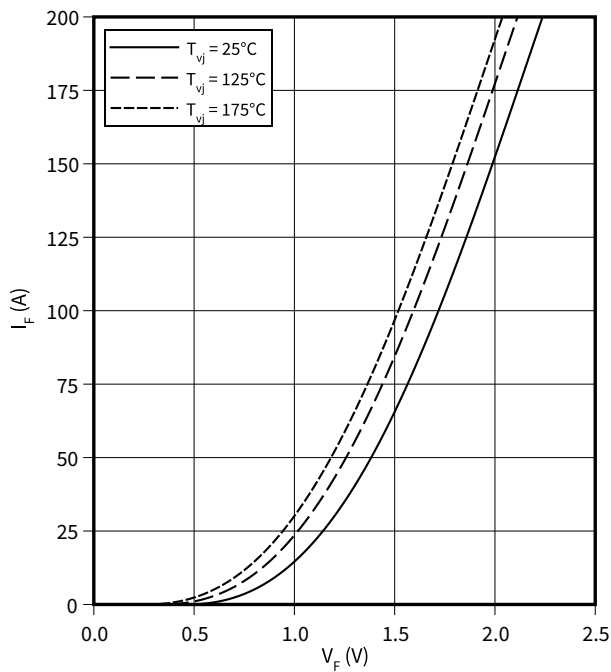
$$I_C = 100 \, A, T_{vj} = 25 \, ^\circ C$$



8 Characteristics diagrams

forward characteristic (typical), Diode, Inverter

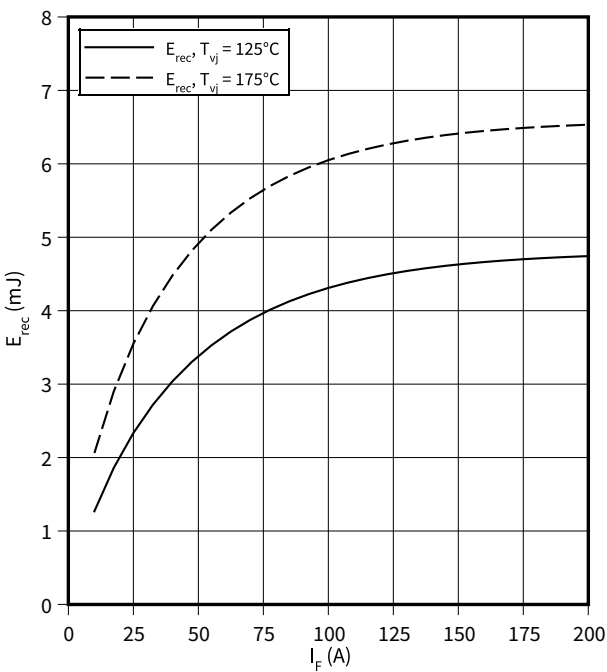
$I_F = f(V_F)$



switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

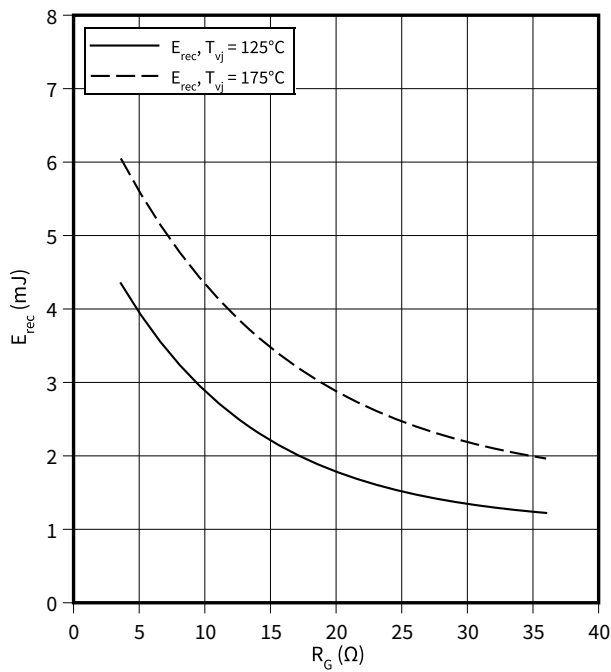
$R_{Gon} = 3.6\ \Omega, V_{CE} = 600\ \text{V}$



switching losses (typical), Diode, Inverter

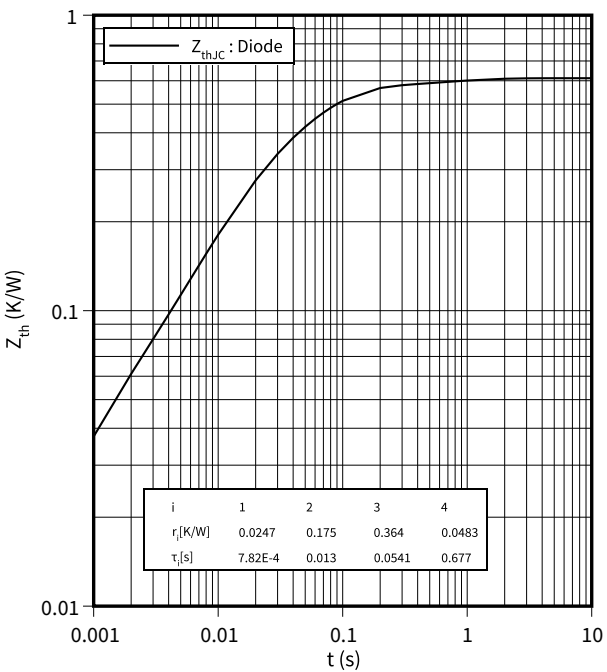
$E_{rec} = f(R_G)$

$V_{CE} = 600\ \text{V}, I_F = 100\ \text{A}$



transient thermal impedance , Diode, Inverter

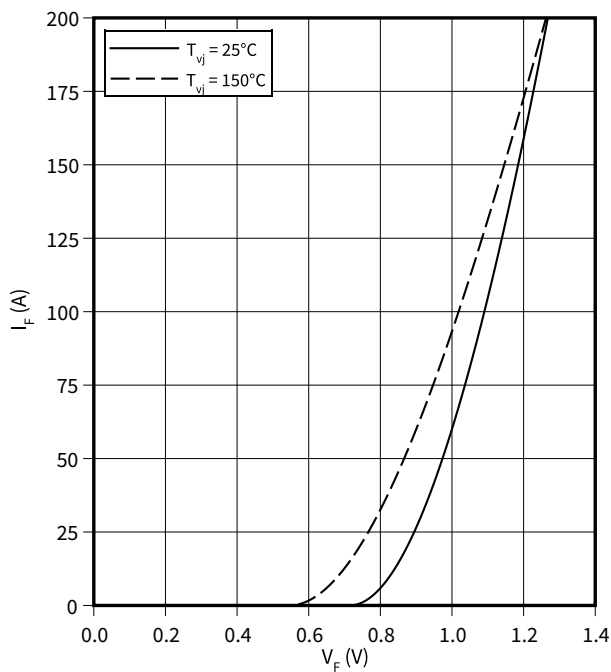
$Z_{th} = f(t)$



8 Characteristics diagrams

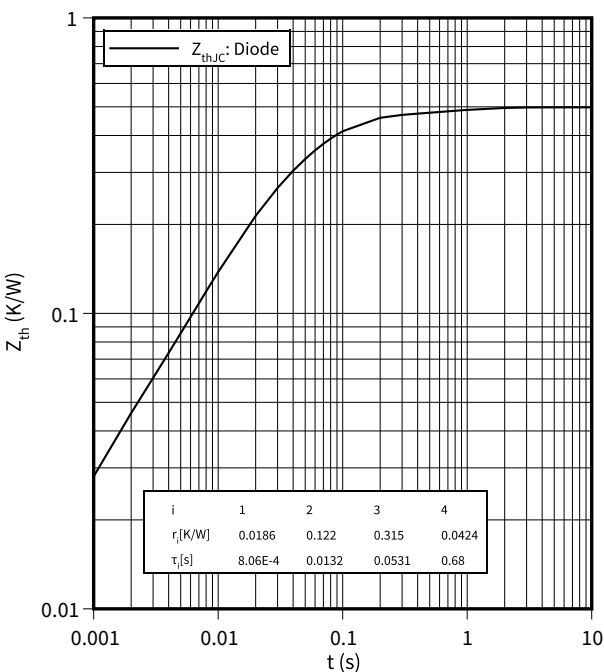
forward characteristic (typical), Diode, Rectifier

$I_F = f(V_F)$



transient thermal impedance , Diode, Rectifier

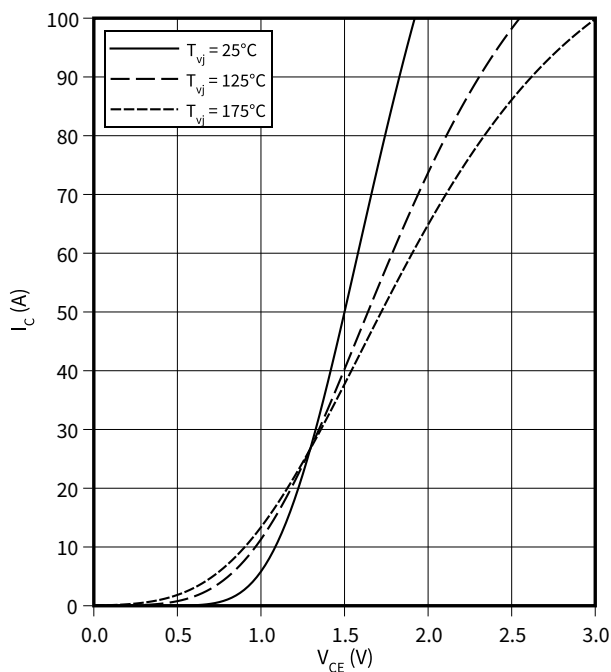
$Z_{th} = f(t)$



output characteristic (typical), IGBT, Brake-Chopper

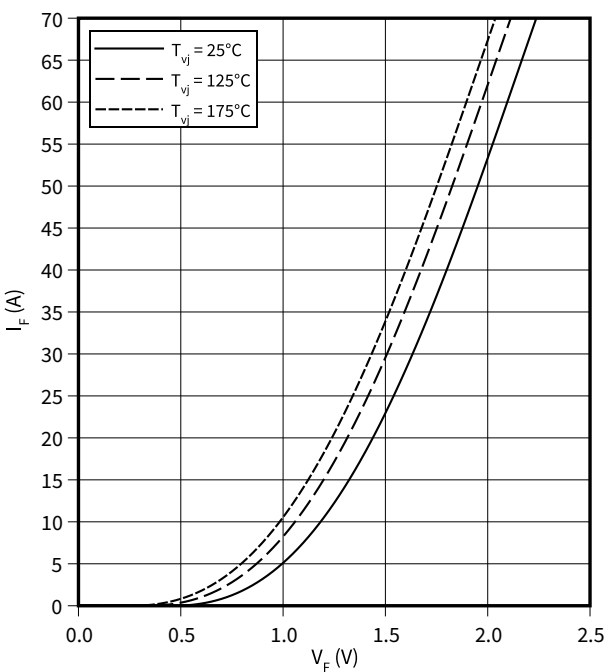
$I_C = f(V_{CE})$

$V_{GE} = 15\text{ V}$



forward characteristic (typical), Diode, Brake-Chopper

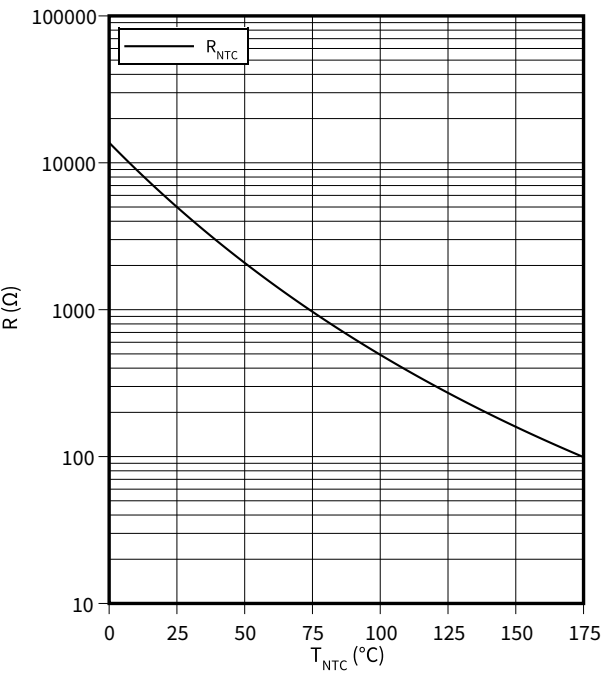
$I_F = f(V_F)$



8 Characteristics diagrams

temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



9 Circuit diagram

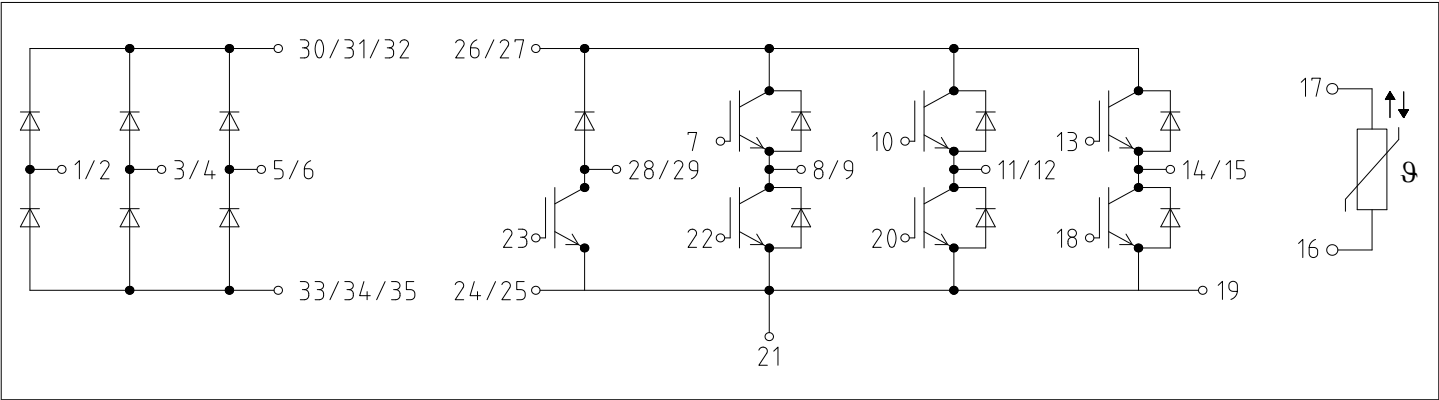


Figure 2



11 Module label code

| Module label code       |                                                                                     |                         |                 |
|-------------------------|-------------------------------------------------------------------------------------|-------------------------|-----------------|
| Code format             | Data Matrix                                                                         |                         | Barcode Code128 |
| Encoding                | ASCII text                                                                          |                         | Code Set A      |
| Symbol size             | 16x16                                                                               |                         | 23 digits       |
| Standard                | IEC24720 and IEC16022                                                               |                         | IEC8859-1       |
| Code content            | <i>Content</i>                                                                      | <i>Digit</i>            | <i>Example</i>  |
|                         | Module serial number                                                                | 1 – 5                   | 71549           |
|                         | Module material number                                                              | 6 - 11                  | 142846          |
|                         | Production order number                                                             | 12 - 19                 | 55054991        |
|                         | Date code (production year)                                                         | 20 – 21                 | 15              |
|                         | Date code (production week)                                                         | 22 – 23                 | 30              |
| Example                 |   |                         |                 |
|                         |  |                         |                 |
| 71549142846550549911530 |                                                                                     | 71549142846550549911530 |                 |

Figure 4

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Revision history

## Revision history

| Document revision | Date of release | Description of changes |
|-------------------|-----------------|------------------------|
| 0.10              | 2021-06-17      | Initial version        |

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