

## Final datasheet

### EconoPACK™3 module with TRENCHSTOP™ IGBT7 and emitter controlled 7 diode and NTC

#### Features

- Electrical features
  - $V_{CES} = 950\text{ V}$
  - $I_{C\text{ nom}} = 600\text{ A} / I_{CRM} = 600\text{ A}$
  - Low switching losses
  - TRENCHSTOP™ IGBT7
  - Suitable Infineon gate drivers can be found under <https://www.infineon.com/gdfinder>
- Mechanical features
  - Compact design
  - Copper base plate
  - Integrated NTC temperature sensor
  - High power density



Typical appearance

#### Potential applications

- Solar applications
- Three-level applications

#### Product validation

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

#### Description

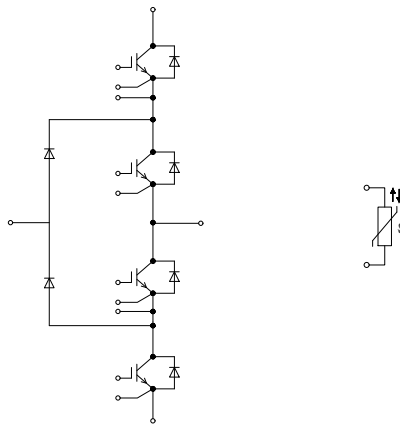


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## 1 Package

**Table 1** Insulation coordination

| Parameter                           | Symbol                  | Note or test condition                         | Values    | Unit |
|-------------------------------------|-------------------------|------------------------------------------------|-----------|------|
| Isolation test voltage              | $V_{ISOL}$              | RMS, $f = 50 \text{ Hz}$ , $t = 1 \text{ min}$ | 3.2       | kV   |
| Isolation test voltage NTC          | $V_{ISOL(NTC)}$         | RMS, $f = 50 \text{ Hz}$ , $t = 1 \text{ min}$ | 3.2       | kV   |
| Material of module baseplate        |                         |                                                | Cu        |      |
| Internal isolation                  |                         | basic insulation (class 1, IEC 61140)          | $Al_2O_3$ |      |
| Creepage distance                   | $d_{Creep \text{ nom}}$ | terminal to baseplate, nom.                    | 10.0      | mm   |
| Creepage distance                   | $d_{Creep \text{ min}}$ | terminal to baseplate, min.                    | 7.5       | mm   |
| Comparative tracking index          | $CTI$                   |                                                | > 200     |      |
| Relative thermal index (electrical) | $RTI$                   | housing                                        | 140       | °C   |

**Table 2** Characteristic values

| Parameter                                | Symbol        | Note or test condition                         | Values |      |      | Unit |
|------------------------------------------|---------------|------------------------------------------------|--------|------|------|------|
|                                          |               |                                                | Min.   | Typ. | Max. |      |
| Stray inductance module                  | $L_{sCE}$     |                                                |        | 20   |      | nH   |
| Module lead resistance, terminals - chip | $R_{AA'+CC'}$ | $T_C = 25 \text{ °C}$ , per switch             |        | 2    |      | mΩ   |
| Module lead resistance, terminals - chip | $R_{CC'+EE'}$ | $T_C = 25 \text{ °C}$ , per switch             |        | 1.5  |      | mΩ   |
| Storage temperature                      | $T_{stg}$     |                                                | -40    |      | 125  | °C   |
| Mounting torque for module mounting      | $M$           | - Mounting according to valid application note | 3      |      | 6    | Nm   |
| Weight                                   | $G$           |                                                |        | 300  |      | g    |

**Note:** The current under continuous operation is limited to 50A rms per connector pin

## 2 IGBT, T1 / T4

**Table 3** Maximum rated values

| Parameter                       | Symbol    | Note or test condition                |                          | Values | Unit |
|---------------------------------|-----------|---------------------------------------|--------------------------|--------|------|
| Collector-emitter voltage       | $V_{CES}$ |                                       | $T_{vj} = 25 \text{ °C}$ | 950    | V    |
| Implemented collector current   | $I_{CN}$  |                                       |                          | 600    | A    |
| Continuous DC collector current | $I_{CDC}$ | $T_{vj \text{ max}} = 175 \text{ °C}$ | $T_C = 115 \text{ °C}$   | 290    | A    |

(table continues...)

**Table 3 (continued) Maximum rated values**

| Parameter                         | Symbol    | Note or test condition        | Values   | Unit |
|-----------------------------------|-----------|-------------------------------|----------|------|
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{vj\ op}$ | 600      | A    |
| Gate-emitter peak voltage         | $V_{GES}$ |                               | $\pm 20$ | V    |

**Table 4 Characteristic values**

| Parameter                            | Symbol        | Note or test condition                                                                                                                        | Values                   |       |      | Unit     |
|--------------------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-------|------|----------|
|                                      |               |                                                                                                                                               | Min.                     | Typ.  | Max. |          |
| Collector-emitter saturation voltage | $V_{CE\ sat}$ | $I_C = 250\ A, V_{GE} = 15\ V$                                                                                                                | $T_{vj} = 25\ ^\circ C$  | 1.43  | 1.64 | V        |
|                                      |               |                                                                                                                                               | $T_{vj} = 125\ ^\circ C$ | 1.53  |      |          |
|                                      |               |                                                                                                                                               | $T_{vj} = 150\ ^\circ C$ | 1.55  |      |          |
| Gate threshold voltage               | $V_{GETh}$    | $I_C = 9.75\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$                                                                                      | 4.35                     | 5.1   | 5.85 | V        |
| Gate charge                          | $Q_G$         | $V_{GE} = \pm 15\ V, V_{CC} = 600\ V, T_{vj} = 25\ ^\circ C$                                                                                  |                          | 1.35  |      | $\mu C$  |
| Internal gate resistor               | $R_{Gint}$    | $T_{vj} = 25\ ^\circ C$                                                                                                                       |                          | 0.5   |      | $\Omega$ |
| Input capacitance                    | $C_{ies}$     | $f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$                                                                          |                          | 37.9  |      | nF       |
| Reverse transfer capacitance         | $C_{res}$     | $f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$                                                                          |                          | 0.117 |      | nF       |
| Collector-emitter cut-off current    | $I_{CES}$     | $V_{CE} = 950\ V, V_{GE} = 0\ V$                                                                                                              | $T_{vj} = 25\ ^\circ C$  |       | 0.11 | 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)  | $t_{don}$     | $I_C = 250\ A, V_{CC} = 500\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.8\ \Omega$                                                                    | $T_{vj} = 25\ ^\circ C$  | 0.059 |      | $\mu s$  |
|                                      |               |                                                                                                                                               | $T_{vj} = 125\ ^\circ C$ | 0.070 |      |          |
|                                      |               |                                                                                                                                               | $T_{vj} = 150\ ^\circ C$ | 0.070 |      |          |
| Rise time (inductive load)           | $t_r$         | $I_C = 250\ A, V_{CC} = 500\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.8\ \Omega$                                                                    | $T_{vj} = 25\ ^\circ C$  | 0.020 |      | $\mu s$  |
|                                      |               |                                                                                                                                               | $T_{vj} = 125\ ^\circ C$ | 0.022 |      |          |
|                                      |               |                                                                                                                                               | $T_{vj} = 150\ ^\circ C$ | 0.023 |      |          |
| Turn-off delay time (inductive load) | $t_{doff}$    | $I_C = 250\ A, V_{CC} = 500\ V, V_{GE} = \pm 15\ V, R_{Goff} = 0.75\ \Omega$                                                                  | $T_{vj} = 25\ ^\circ C$  | 0.190 |      | $\mu s$  |
|                                      |               |                                                                                                                                               | $T_{vj} = 125\ ^\circ C$ | 0.240 |      |          |
|                                      |               |                                                                                                                                               | $T_{vj} = 150\ ^\circ C$ | 0.250 |      |          |
| Fall time (inductive load)           | $t_f$         | $I_C = 250\ A, V_{CC} = 500\ V, V_{GE} = \pm 15\ V, R_{Goff} = 0.75\ \Omega$                                                                  | $T_{vj} = 25\ ^\circ C$  | 0.040 |      | $\mu s$  |
|                                      |               |                                                                                                                                               | $T_{vj} = 125\ ^\circ C$ | 0.080 |      |          |
|                                      |               |                                                                                                                                               | $T_{vj} = 150\ ^\circ C$ | 0.090 |      |          |
| Turn-on energy loss per pulse        | $E_{on}$      | $I_C = 250\ A, V_{CC} = 500\ V, L_\sigma = 15\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 1.8\ \Omega, di/dt = 8.8\ kA/\mu s (T_{vj} = 150\ ^\circ C)$ | $T_{vj} = 25\ ^\circ C$  | 3.1   |      | mJ       |
|                                      |               |                                                                                                                                               | $T_{vj} = 125\ ^\circ C$ | 3.88  |      |          |
|                                      |               |                                                                                                                                               | $T_{vj} = 150\ ^\circ C$ | 3.88  |      |          |

(table continues...)

**Table 4** (continued) Characteristic values

| Parameter                              | Symbol             | Note or test condition                                                                                                                                                                                                        | Values                                |        |       | Unit             |
|----------------------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|--------|-------|------------------|
|                                        |                    |                                                                                                                                                                                                                               | Min.                                  | Typ.   | Max.  |                  |
| Turn-off energy loss per pulse         | $E_{off}$          | $I_C = 250 \text{ A}$ , $V_{CC} = 500 \text{ V}$ ,<br>$L_\sigma = 15 \text{ nH}$ , $V_{GE} = \pm 15 \text{ V}$ ,<br>$R_{Goff} = 0.75 \Omega$ , $dv/dt = 4910 \text{ V}/\mu\text{s}$ ( $T_{vj} = 150 \text{ }^\circ\text{C}$ ) | $T_{vj} = 25 \text{ }^\circ\text{C}$  | 6.1    |       | mJ               |
|                                        |                    |                                                                                                                                                                                                                               | $T_{vj} = 125 \text{ }^\circ\text{C}$ | 10.2   |       |                  |
|                                        |                    |                                                                                                                                                                                                                               | $T_{vj} = 150 \text{ }^\circ\text{C}$ | 11.5   |       |                  |
| Thermal resistance, junction to case   | $R_{thJC}$         | per IGBT                                                                                                                                                                                                                      |                                       |        | 0.108 | K/W              |
| Thermal resistance, case to heat sink  | $R_{thCH}$         | per IGBT, $\lambda_{grease} = 5 \text{ W}/(\text{m}\cdot\text{K})$                                                                                                                                                            |                                       | 0.0240 |       | K/W              |
| Temperature under switching conditions | $T_{vj\text{ op}}$ |                                                                                                                                                                                                                               | -40                                   |        | 150   | $^\circ\text{C}$ |

### 3 IGBT, T2 / T3

**Table 5** Maximum rated values

| Parameter                         | Symbol    | Note or test condition                           |                                      | Values   | Unit |
|-----------------------------------|-----------|--------------------------------------------------|--------------------------------------|----------|------|
| Collector-emitter voltage         | $V_{CES}$ |                                                  | $T_{vj} = 25 \text{ }^\circ\text{C}$ | 1200     | V    |
| Implemented collector current     | $I_{CN}$  |                                                  |                                      | 450      | A    |
| Continuous DC collector current   | $I_{CDC}$ | $T_{vj\text{ max}} = 175 \text{ }^\circ\text{C}$ | $T_C = 115 \text{ }^\circ\text{C}$   | 335      | A    |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{vj\text{ op}}$              |                                      | 600      | A    |
| Gate-emitter peak voltage         | $V_{GES}$ |                                                  |                                      | $\pm 20$ | V    |

**Table 6** Characteristic values

| Parameter                            | Symbol              | Note or test condition                                                                                          | Values                                |       |      | Unit          |
|--------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------|---------------------------------------|-------|------|---------------|
|                                      |                     |                                                                                                                 | Min.                                  | Typ.  | Max. |               |
| Collector-emitter saturation voltage | $V_{CE\text{ sat}}$ | $I_C = 250 \text{ A}$ , $V_{GE} = 15 \text{ V}$                                                                 | $T_{vj} = 25 \text{ }^\circ\text{C}$  | 1.33  | 1.50 | V             |
|                                      |                     |                                                                                                                 | $T_{vj} = 125 \text{ }^\circ\text{C}$ | 1.34  |      |               |
|                                      |                     |                                                                                                                 | $T_{vj} = 175 \text{ }^\circ\text{C}$ | 1.35  |      |               |
| Gate threshold voltage               | $V_{GEth}$          | $I_C = 10.5 \text{ mA}$ , $V_{CE} = V_{GE}$ , $T_{vj} = 25 \text{ }^\circ\text{C}$                              | 5.15                                  | 5.8   | 6.45 | V             |
| Gate charge                          | $Q_G$               | $V_{GE} = \pm 15 \text{ V}$ , $V_{CC} = 600 \text{ V}$ , $T_{vj} = 25 \text{ }^\circ\text{C}$                   |                                       | 7.5   |      | $\mu\text{C}$ |
| Internal gate resistor               | $R_{Gint}$          | $T_{vj} = 25 \text{ }^\circ\text{C}$                                                                            |                                       | 0.33  |      | $\Omega$      |
| Input capacitance                    | $C_{ies}$           | $f = 100 \text{ kHz}$ , $T_{vj} = 25 \text{ }^\circ\text{C}$ , $V_{CE} = 25 \text{ V}$ , $V_{GE} = 0 \text{ V}$ |                                       | 90.4  |      | nF            |
| Reverse transfer capacitance         | $C_{res}$           | $f = 100 \text{ kHz}$ , $T_{vj} = 25 \text{ }^\circ\text{C}$ , $V_{CE} = 25 \text{ V}$ , $V_{GE} = 0 \text{ V}$ |                                       | 0.315 |      | nF            |

(table continues...)

**Table 6** (continued) **Characteristic values**

| Parameter                              | Symbol             | Note or test condition                                                                                                                                                                                                     |                           | Values |        |        | Unit          |
|----------------------------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|--------|--------|--------|---------------|
|                                        |                    |                                                                                                                                                                                                                            |                           | Min.   | Typ.   | Max.   |               |
| Collector-emitter cut-off current      | $I_{CES}$          | $V_{CE} = 1200 \text{ V}$ , $V_{GE} = 0 \text{ V}$                                                                                                                                                                         | $T_{vj} = 25 \text{ °C}$  |        |        | 0.024  | 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)    | $t_{don}$          | $I_C = 250 \text{ A}$ , $V_{CC} = 500 \text{ V}$ ,<br>$V_{GE} = \pm 15 \text{ V}$ , $R_{Gon} = 0.47 \text{ } \Omega$                                                                                                       | $T_{vj} = 25 \text{ °C}$  |        | 0.120  |        | $\mu\text{s}$ |
|                                        |                    |                                                                                                                                                                                                                            | $T_{vj} = 125 \text{ °C}$ |        | 0.130  |        |               |
|                                        |                    |                                                                                                                                                                                                                            | $T_{vj} = 175 \text{ °C}$ |        | 0.138  |        |               |
| Rise time (inductive load)             | $t_r$              | $I_C = 250 \text{ A}$ , $V_{CC} = 500 \text{ V}$ ,<br>$V_{GE} = \pm 15 \text{ V}$ , $R_{Gon} = 0.47 \text{ } \Omega$                                                                                                       | $T_{vj} = 25 \text{ °C}$  |        | 0.030  |        | $\mu\text{s}$ |
|                                        |                    |                                                                                                                                                                                                                            | $T_{vj} = 125 \text{ °C}$ |        | 0.034  |        |               |
|                                        |                    |                                                                                                                                                                                                                            | $T_{vj} = 175 \text{ °C}$ |        | 0.035  |        |               |
| Turn-off delay time (inductive load)   | $t_{doff}$         | $I_C = 250 \text{ A}$ , $V_{CC} = 500 \text{ V}$ ,<br>$V_{GE} = \pm 15 \text{ V}$ , $R_{Goff} = 0.47 \text{ } \Omega$                                                                                                      | $T_{vj} = 25 \text{ °C}$  |        | 0.360  |        | $\mu\text{s}$ |
|                                        |                    |                                                                                                                                                                                                                            | $T_{vj} = 125 \text{ °C}$ |        | 0.490  |        |               |
|                                        |                    |                                                                                                                                                                                                                            | $T_{vj} = 175 \text{ °C}$ |        | 0.560  |        |               |
| Fall time (inductive load)             | $t_f$              | $I_C = 250 \text{ A}$ , $V_{CC} = 500 \text{ V}$ ,<br>$V_{GE} = \pm 15 \text{ V}$ , $R_{Goff} = 0.47 \text{ } \Omega$                                                                                                      | $T_{vj} = 25 \text{ °C}$  |        | 0.065  |        | $\mu\text{s}$ |
|                                        |                    |                                                                                                                                                                                                                            | $T_{vj} = 125 \text{ °C}$ |        | 0.150  |        |               |
|                                        |                    |                                                                                                                                                                                                                            | $T_{vj} = 175 \text{ °C}$ |        | 0.210  |        |               |
| Turn-on energy loss per pulse          | $E_{on}$           | $I_C = 250 \text{ A}$ , $V_{CC} = 500 \text{ V}$ ,<br>$L_\sigma = 15 \text{ nH}$ , $V_{GE} = \pm 15 \text{ V}$ ,<br>$R_{Gon} = 0.47 \text{ } \Omega$ , $di/dt = 7.68 \text{ kA}/\mu\text{s}$ ( $T_{vj} = 175 \text{ °C}$ ) | $T_{vj} = 25 \text{ °C}$  |        | 4.45   |        | mJ            |
|                                        |                    |                                                                                                                                                                                                                            | $T_{vj} = 125 \text{ °C}$ |        | 6.96   |        |               |
|                                        |                    |                                                                                                                                                                                                                            | $T_{vj} = 150 \text{ °C}$ |        | 8.6    |        |               |
| Turn-off energy loss per pulse         | $E_{off}$          | $I_C = 250 \text{ A}$ , $V_{CC} = 500 \text{ V}$ ,<br>$L_\sigma = 15 \text{ nH}$ , $V_{GE} = \pm 15 \text{ V}$ ,<br>$R_{Goff} = 0.47 \text{ } \Omega$ , $dv/dt = 2200 \text{ V}/\mu\text{s}$ ( $T_{vj} = 175 \text{ °C}$ ) | $T_{vj} = 25 \text{ °C}$  |        | 16.5   |        | mJ            |
|                                        |                    |                                                                                                                                                                                                                            | $T_{vj} = 125 \text{ °C}$ |        | 28     |        |               |
|                                        |                    |                                                                                                                                                                                                                            | $T_{vj} = 150 \text{ °C}$ |        | 35.7   |        |               |
| Thermal resistance, junction to case   | $R_{thJC}$         | per IGBT                                                                                                                                                                                                                   |                           |        |        | 0.0930 | K/W           |
| Thermal resistance, case to heat sink  | $R_{thCH}$         | per IGBT, $\lambda_{grease} = 5 \text{ W}/(\text{m}\cdot\text{K})$                                                                                                                                                         |                           |        | 0.0220 |        | 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, D1 / D4

**Table 7** Maximum rated values

| Parameter                       | Symbol    | Note or test condition                 |                          | Values | Unit   |
|---------------------------------|-----------|----------------------------------------|--------------------------|--------|--------|
| Repetitive peak reverse voltage | $V_{RRM}$ |                                        | $T_{vj} = 25\text{ °C}$  | 950    | V      |
| Implemented forward current     | $I_{FN}$  |                                        |                          | 300    | A      |
| Continuous DC forward current   | $I_F$     |                                        |                          | 250    | A      |
| Repetitive peak forward current | $I_{FRM}$ | $t_P = 1\text{ ms}$                    |                          | 600    | A      |
| $I^2t$ - value                  | $I^2t$    | $t_P = 10\text{ ms}, V_R = 0\text{ V}$ | $T_{vj} = 125\text{ °C}$ | 3100   | $A^2s$ |
|                                 |           |                                        | $T_{vj} = 150\text{ °C}$ | 2900   |        |

**Table 8** Characteristic values

| Parameter                              | Symbol             | Note or test condition                                                                                                      | Values                   |        |       | Unit    |
|----------------------------------------|--------------------|-----------------------------------------------------------------------------------------------------------------------------|--------------------------|--------|-------|---------|
|                                        |                    |                                                                                                                             | Min.                     | Typ.   | Max.  |         |
| Forward voltage                        | $V_F$              | $I_F = 250\text{ A}, V_{GE} = 0\text{ V}$                                                                                   | $T_{vj} = 25\text{ °C}$  | 2.42   | 2.67  | V       |
|                                        |                    |                                                                                                                             | $T_{vj} = 125\text{ °C}$ | 2.22   |       |         |
|                                        |                    |                                                                                                                             | $T_{vj} = 150\text{ °C}$ | 2.16   |       |         |
| Peak reverse recovery current          | $I_{RM}$           | $V_{CC} = 500\text{ V}, I_F = 250\text{ A}, V_{GE} = -15\text{ V}, -di_F/dt = 7.8\text{ kA}/\mu s (T_{vj} = 150\text{ °C})$ | $T_{vj} = 25\text{ °C}$  | 208    |       | A       |
|                                        |                    |                                                                                                                             | $T_{vj} = 125\text{ °C}$ | 290    |       |         |
|                                        |                    |                                                                                                                             | $T_{vj} = 150\text{ °C}$ | 312    |       |         |
| Recovered charge                       | $Q_r$              | $V_{CC} = 500\text{ V}, I_F = 250\text{ A}, V_{GE} = -15\text{ V}, -di_F/dt = 7.8\text{ kA}/\mu s (T_{vj} = 150\text{ °C})$ | $T_{vj} = 25\text{ °C}$  | 8.6    |       | $\mu C$ |
|                                        |                    |                                                                                                                             | $T_{vj} = 125\text{ °C}$ | 18     |       |         |
|                                        |                    |                                                                                                                             | $T_{vj} = 150\text{ °C}$ | 22     |       |         |
| Reverse recovery energy                | $E_{rec}$          | $V_{CC} = 500\text{ V}, I_F = 250\text{ A}, V_{GE} = -15\text{ V}, -di_F/dt = 7.8\text{ kA}/\mu s (T_{vj} = 150\text{ °C})$ | $T_{vj} = 25\text{ °C}$  | 3      |       | mJ      |
|                                        |                    |                                                                                                                             | $T_{vj} = 125\text{ °C}$ | 6.6    |       |         |
|                                        |                    |                                                                                                                             | $T_{vj} = 150\text{ °C}$ | 8      |       |         |
| Thermal resistance, junction to case   | $R_{thJC}$         | per diode                                                                                                                   |                          |        | 0.257 | K/W     |
| Thermal resistance, case to heat sink  | $R_{thCH}$         | per diode, $\lambda_{grease} = 5\text{ W}/(m \cdot K)$                                                                      |                          | 0.0300 |       | K/W     |
| Temperature under switching conditions | $T_{vj\text{ op}}$ |                                                                                                                             | -40                      |        | 150   | °C      |

## 5 Diode, D2 / D3

**Table 9** Maximum rated values

| Parameter                       | Symbol    | Note or test condition                 |                          | Values | Unit   |
|---------------------------------|-----------|----------------------------------------|--------------------------|--------|--------|
| Repetitive peak reverse voltage | $V_{RRM}$ |                                        | $T_{vj} = 25\text{ °C}$  | 1200   | V      |
| Implemented forward current     | $I_{FN}$  |                                        |                          | 300    | A      |
| Continuous DC forward current   | $I_F$     |                                        |                          | 250    | A      |
| Repetitive peak forward current | $I_{FRM}$ | $t_P = 1\text{ ms}$                    |                          | 600    | A      |
| $I^2t$ - value                  | $I^2t$    | $t_P = 10\text{ ms}, V_R = 0\text{ V}$ | $T_{vj} = 125\text{ °C}$ | 4150   | $A^2s$ |
|                                 |           |                                        | $T_{vj} = 175\text{ °C}$ | 3600   |        |

**Table 10** Characteristic values

| Parameter                              | Symbol             | Note or test condition                           | Values |                          |       | Unit |
|----------------------------------------|--------------------|--------------------------------------------------|--------|--------------------------|-------|------|
|                                        |                    |                                                  | Min.   | Typ.                     | Max.  |      |
| Forward voltage                        | $V_F$              | $I_F = 250\text{ A}, V_{GE} = 0\text{ V}$        |        | $T_{vj} = 25\text{ °C}$  | 1.62  | V    |
|                                        |                    |                                                  |        | $T_{vj} = 125\text{ °C}$ | 1.49  |      |
|                                        |                    |                                                  |        | $T_{vj} = 175\text{ °C}$ | 1.42  |      |
| Thermal resistance, junction to case   | $R_{thJC}$         | per diode                                        |        |                          | 0.204 | K/W  |
| Thermal resistance, case to heat sink  | $R_{thCH}$         | per diode, $\lambda_{grease} = 5\text{ W/(m·K)}$ |        | 0.0290                   |       | 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.

## 6 Diode, D5 / D6

**Table 11** Maximum rated values

| Parameter                       | Symbol    | Note or test condition |                         | Values | Unit |
|---------------------------------|-----------|------------------------|-------------------------|--------|------|
| Repetitive peak reverse voltage | $V_{RRM}$ |                        | $T_{vj} = 25\text{ °C}$ | 1200   | V    |
| Continuous DC forward current   | $I_F$     |                        |                         | 200    | A    |
| Repetitive peak forward current | $I_{FRM}$ | $t_P = 1\text{ ms}$    |                         | 400    | A    |

(table continues...)

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

| Parameter      | Symbol | Note or test condition                   | Values                       | Unit                 |
|----------------|--------|------------------------------------------|------------------------------|----------------------|
| $I^2t$ - value | $I^2t$ | $t_p = 10 \text{ ms}, V_R = 0 \text{ V}$ | $T_{vj} = 125^\circ\text{C}$ | $\text{A}^2\text{s}$ |
|                |        |                                          | $T_{vj} = 150^\circ\text{C}$ |                      |
|                |        |                                          | 1800                         |                      |
|                |        |                                          | 1460                         |                      |

**Table 12** Characteristic values

| Parameter                              | Symbol      | Note or test condition                                                                                                                    | Values                       |        |       | Unit             |
|----------------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------|-------|------------------|
|                                        |             |                                                                                                                                           | Min.                         | Typ.   | Max.  |                  |
| Forward voltage                        | $V_F$       | $I_F = 200 \text{ A}, V_{GE} = 0 \text{ V}$                                                                                               | $T_{vj} = 25^\circ\text{C}$  | 1.45   | 1.75  | V                |
|                                        |             |                                                                                                                                           | $T_{vj} = 125^\circ\text{C}$ | 1.75   |       |                  |
|                                        |             |                                                                                                                                           | $T_{vj} = 150^\circ\text{C}$ | 1.85   |       |                  |
| Peak reverse recovery current          | $I_{RM}$    | $V_{CC} = 500 \text{ V}, I_F = 200 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 9.2 \text{ kA}/\mu\text{s} (T_{vj} = 150^\circ\text{C})$ | $T_{vj} = 25^\circ\text{C}$  | 76     |       | A                |
|                                        |             |                                                                                                                                           | $T_{vj} = 125^\circ\text{C}$ | 76     |       |                  |
|                                        |             |                                                                                                                                           | $T_{vj} = 150^\circ\text{C}$ | 76     |       |                  |
| Recovered charge                       | $Q_r$       | $V_{CC} = 500 \text{ V}, I_F = 200 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 9.2 \text{ kA}/\mu\text{s} (T_{vj} = 150^\circ\text{C})$ | $T_{vj} = 25^\circ\text{C}$  | 1.28   |       | $\mu\text{C}$    |
|                                        |             |                                                                                                                                           | $T_{vj} = 125^\circ\text{C}$ | 1.28   |       |                  |
|                                        |             |                                                                                                                                           | $T_{vj} = 150^\circ\text{C}$ | 1.28   |       |                  |
| Reverse recovery energy                | $E_{rec}$   | $V_{CC} = 500 \text{ V}, I_F = 200 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 9.2 \text{ kA}/\mu\text{s} (T_{vj} = 150^\circ\text{C})$ | $T_{vj} = 25^\circ\text{C}$  | 0.32   |       | mJ               |
|                                        |             |                                                                                                                                           | $T_{vj} = 125^\circ\text{C}$ | 0.32   |       |                  |
|                                        |             |                                                                                                                                           | $T_{vj} = 150^\circ\text{C}$ | 0.32   |       |                  |
| Thermal resistance, junction to case   | $R_{thJC}$  | per diode                                                                                                                                 |                              |        | 0.231 | K/W              |
| Thermal resistance, case to heat sink  | $R_{thCH}$  | per diode, $\lambda_{grease} = 5 \text{ W}/(\text{m}\cdot\text{K})$                                                                       |                              | 0.0290 |       | K/W              |
| Temperature under switching conditions | $T_{vj op}$ |                                                                                                                                           | -40                          |        | 150   | $^\circ\text{C}$ |

## 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         |
| 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          |

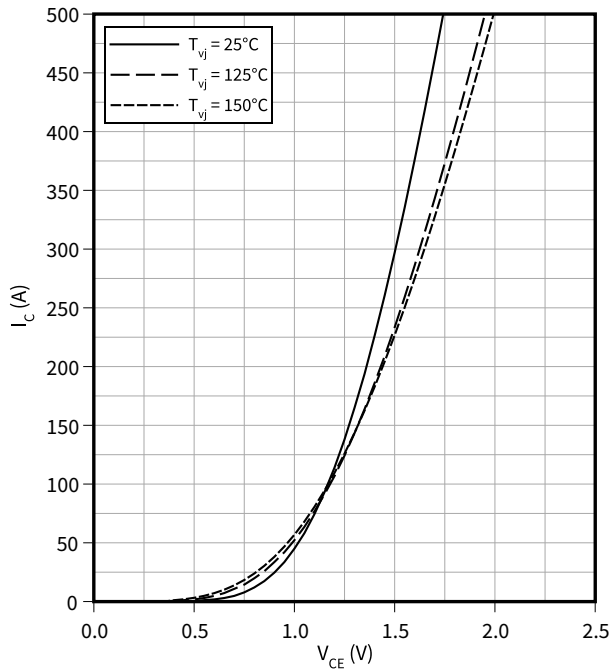
**Note:**      *For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4.*

8 Characteristics diagrams

Output characteristic (typical), IGBT, T1 / T4

$I_C = f(V_{CE})$

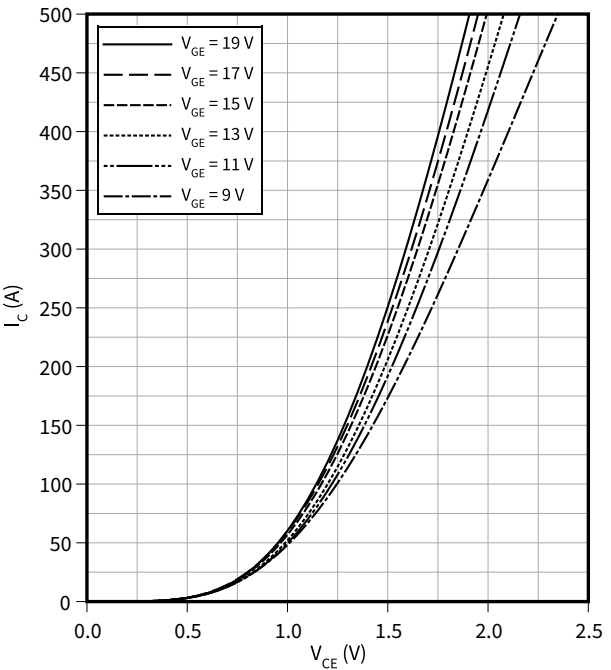
$V_{GE} = 15\text{ V}$



Output characteristic field (typical), IGBT, T1 / T4

$I_C = f(V_{CE})$

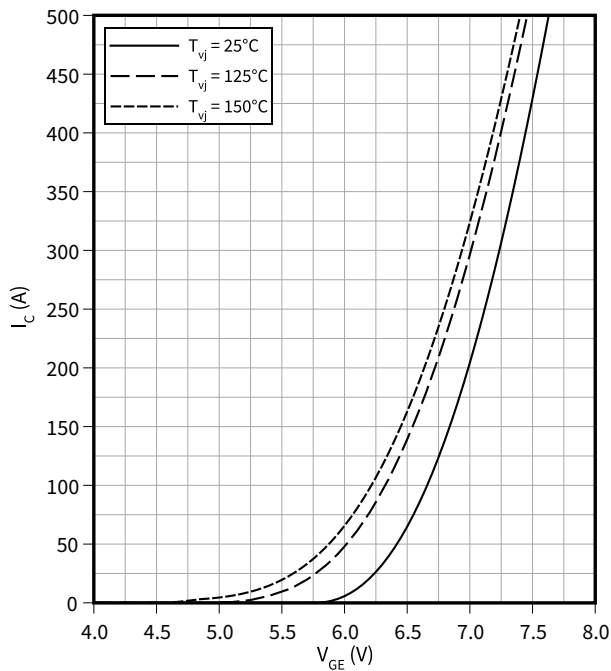
$T_{vj} = 150\text{ °C}$



Transfer characteristic (typical), IGBT, T1 / T4

$I_C = f(V_{GE})$

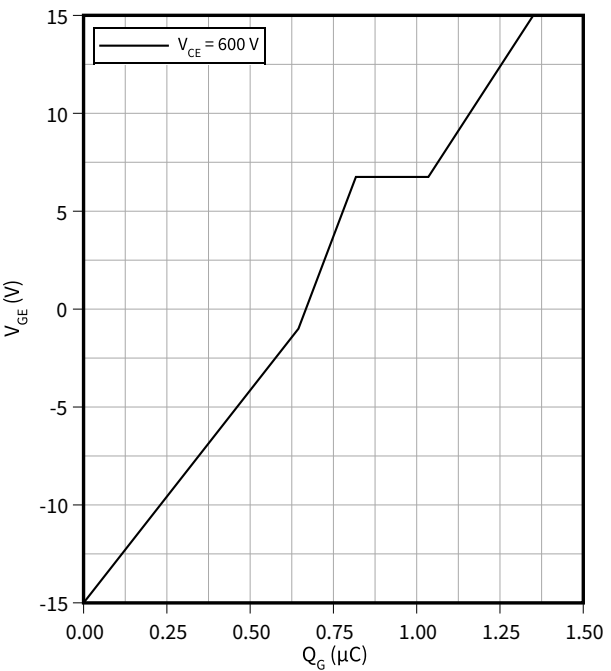
$V_{CE} = 20\text{ V}$



Gate charge characteristic (typical), IGBT, T1 / T4

$V_{GE} = f(Q_G)$

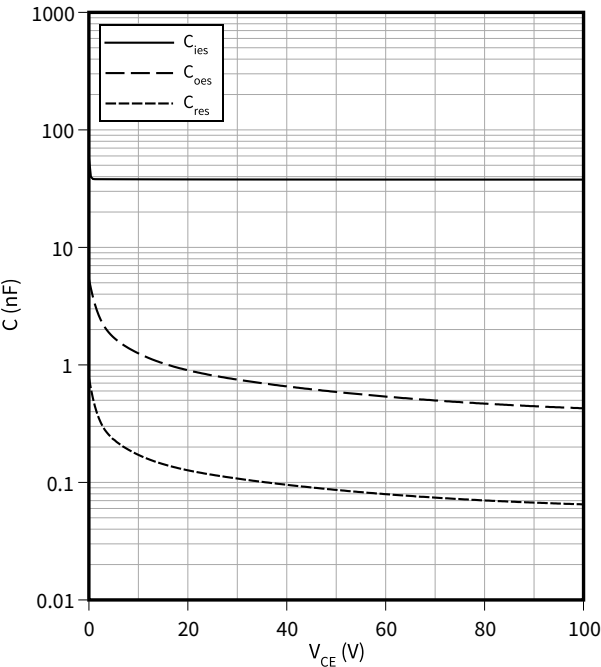
$I_C = 600\text{ A}, T_{vj} = 25\text{ °C}$



8 Characteristics diagrams

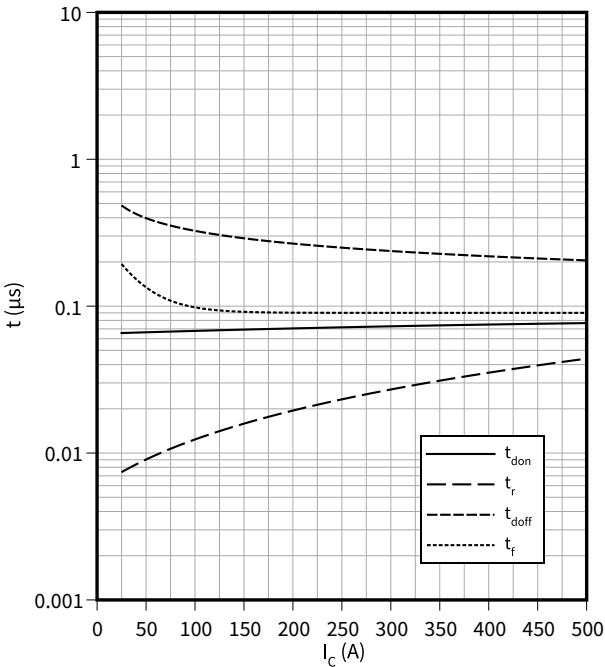
Capacity characteristic (typical), IGBT, T1 / T4

$C = f(V_{CE})$   
 $f = 100\text{ kHz}$ ,  $V_{GE} = 0\text{ V}$ ,  $T_{vj} = 25\text{ °C}$



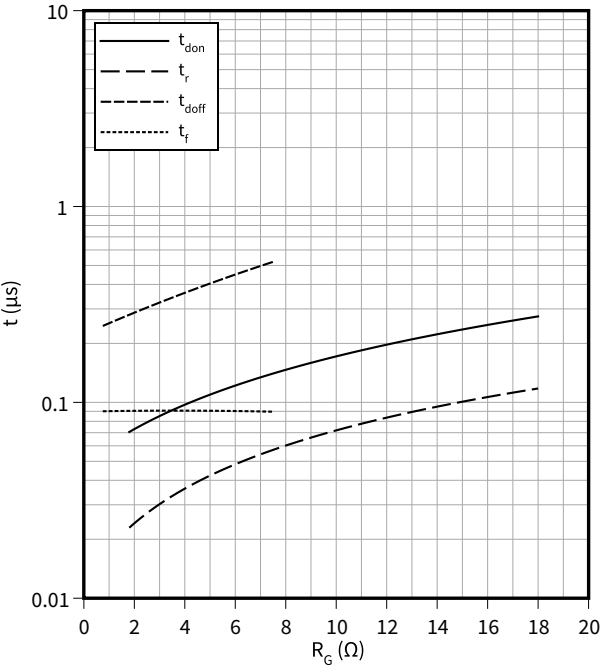
Switching times (typical), IGBT, T1 / T4

$t = f(I_C)$   
 $V_{CC} = 500\text{ V}$ ,  $T_{vj} = 150\text{ °C}$ ,  $R_{Goff} = 0.75\text{ }\Omega$ ,  $R_{Gon} = 1.8\text{ }\Omega$ ,  $V_{GE} = \pm 15\text{ V}$



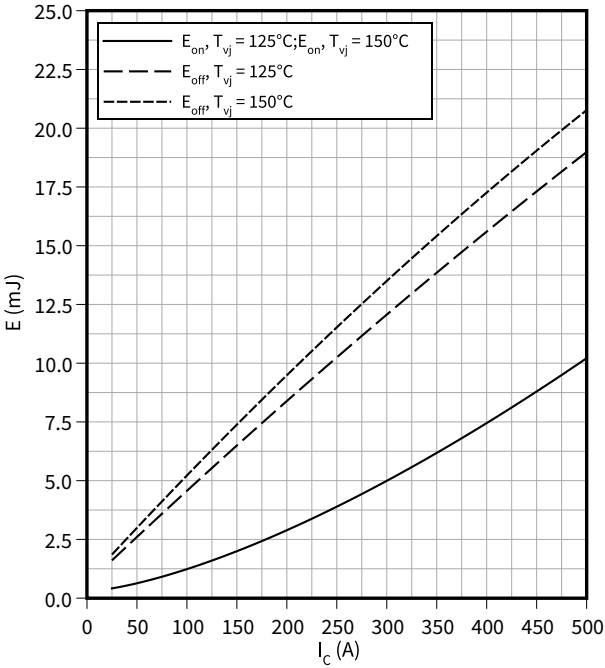
Switching times (typical), IGBT, T1 / T4

$t = f(R_G)$   
 $I_C = 250\text{ A}$ ,  $V_{CC} = 500\text{ V}$ ,  $-15 / 15\text{ V}$ ,  $T_{vj} = 150\text{ °C}$



Switching losses (typical), IGBT, T1 / T4

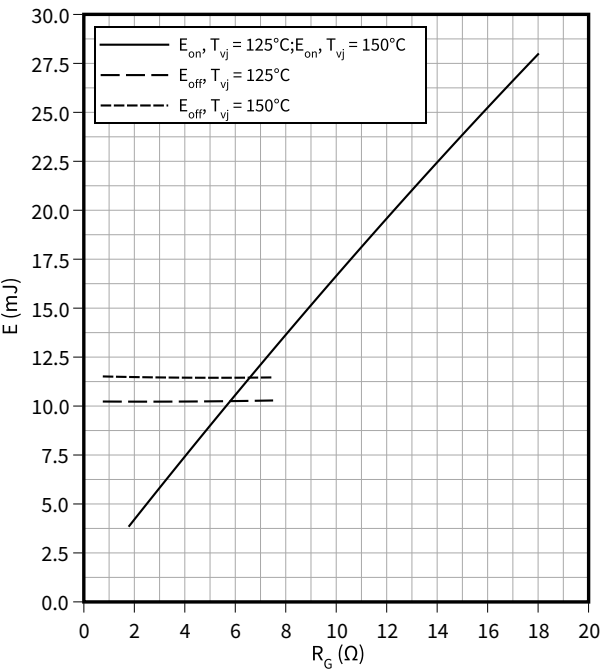
$E = f(I_C)$   
 $R_{Goff} = 0.75\text{ }\Omega$ ,  $R_{Gon} = 1.8\text{ }\Omega$ ,  $V_{CC} = 500\text{ V}$ ,  $-15 / 15\text{ V}$



8 Characteristics diagrams

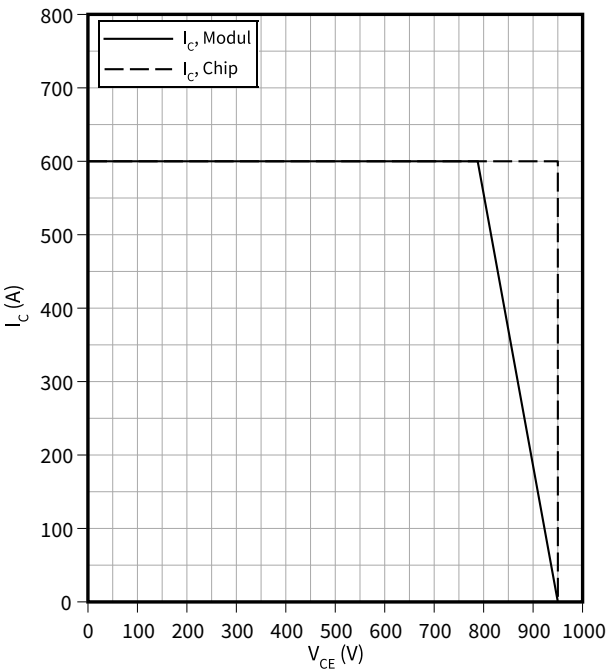
Switching losses (typical), IGBT, T1 / T4

$E = f(R_G)$   
 $I_C = 250\text{ A}$ ,  $V_{CC} = 500\text{ V}$ ,  $-15 / 15\text{ V}$



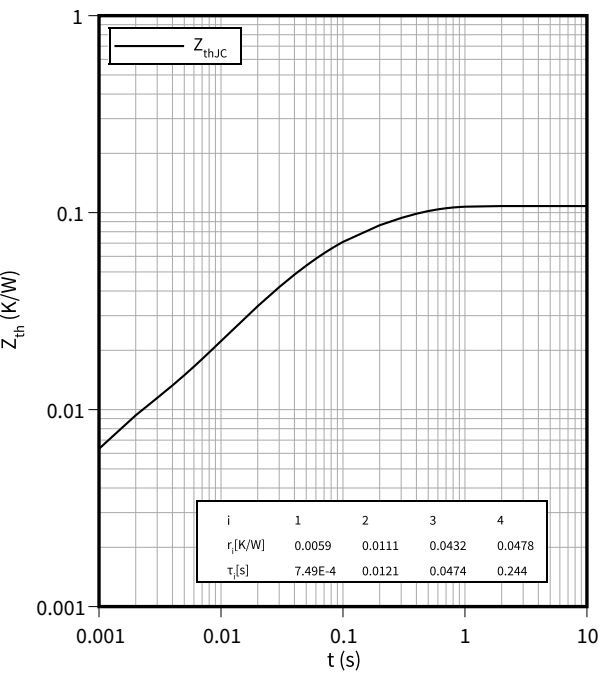
Reverse bias safe operating area (RBSOA), IGBT, T1 / T4

$I_C = f(V_{CE})$   
 $R_{Goff} = 0.75\text{ }\Omega$ ,  $V_{GE} = \pm 15\text{ V}$ ,  $T_{vj} = 150\text{ }^\circ\text{C}$



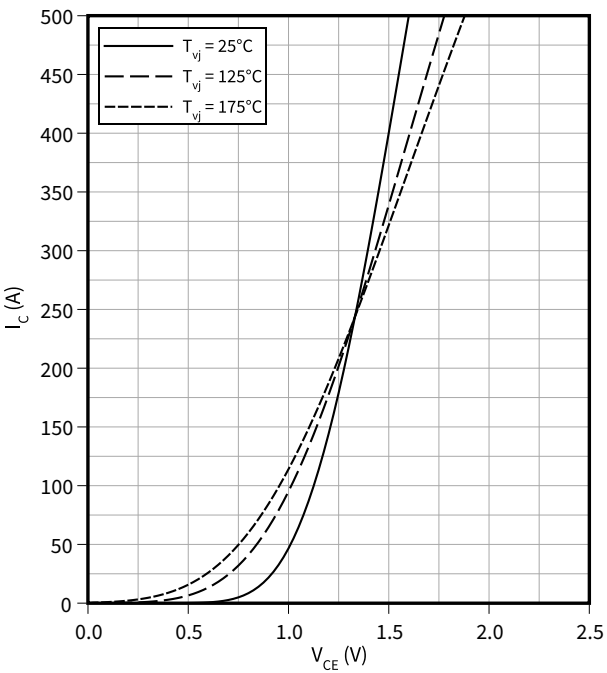
Transient thermal impedance, IGBT, T1 / T4

$Z_{th} = f(t)$



Output characteristic (typical), IGBT, T2 / T3

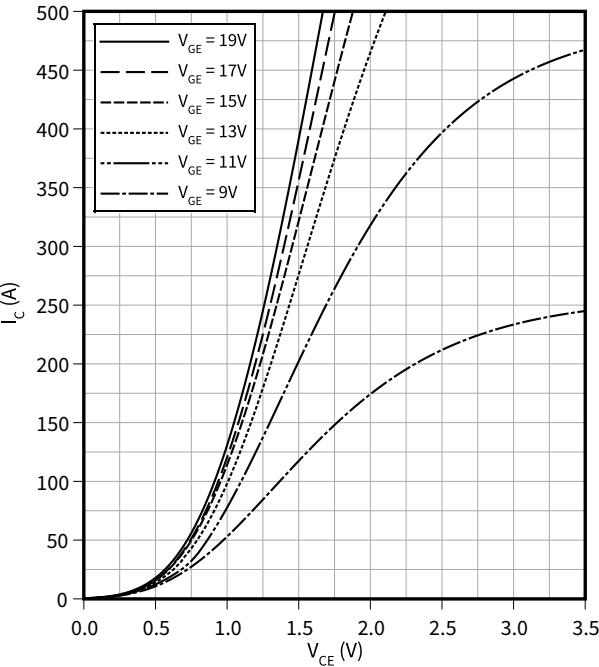
$I_C = f(V_{CE})$   
 $V_{GE} = 15\text{ V}$



8 Characteristics diagrams

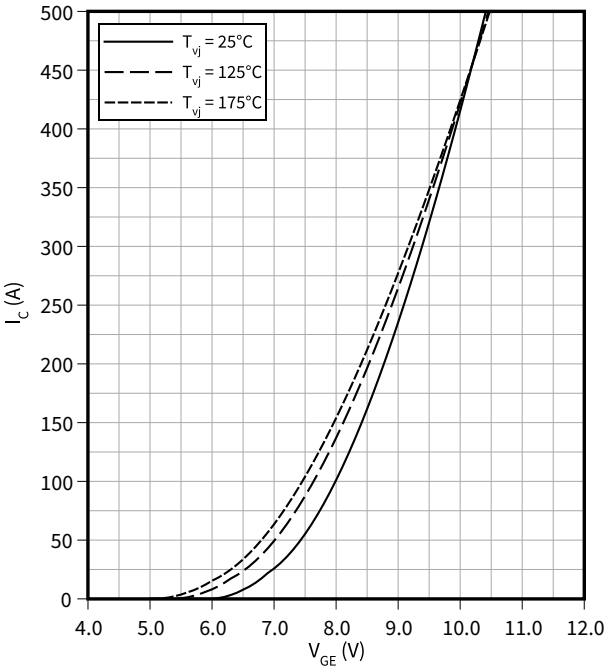
Output characteristic field (typical), IGBT, T2 / T3

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



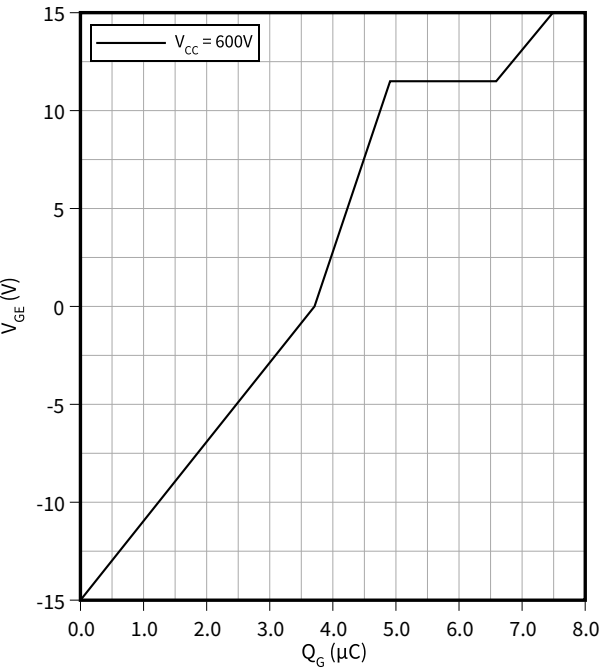
Transfer characteristic (typical), IGBT, T2 / T3

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



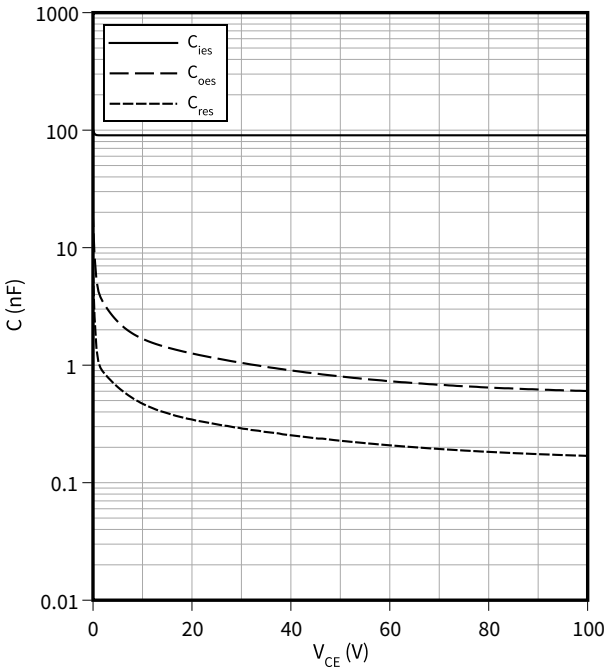
Gate charge characteristic (typical), IGBT, T2 / T3

$V_{GE} = f(Q_G)$   
 $I_C = 450\text{ A}, T_{vj} = 25\text{ °C}$



Capacity characteristic (typical), IGBT, T2 / T3

$C = f(V_{CE})$   
 $f = 100\text{ kHz}, V_{GE} = 0\text{ V}, T_{vj} = 25\text{ °C}$

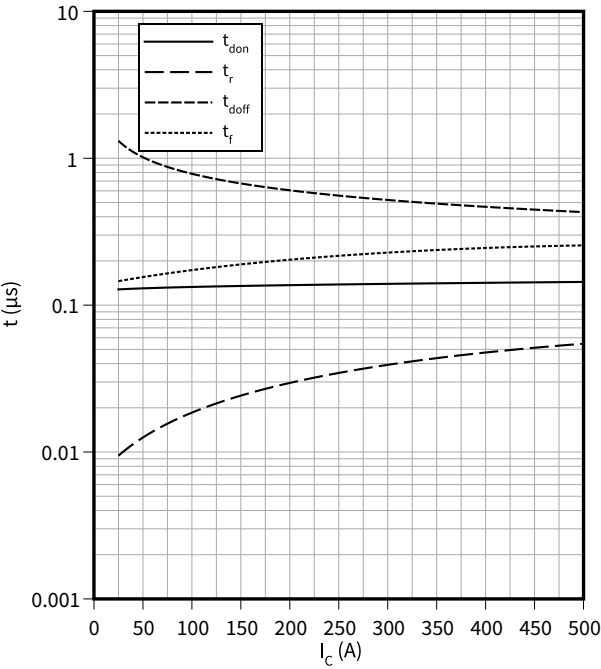


8 Characteristics diagrams

Switching times (typical), IGBT, T2 / T3

$t = f(I_C)$

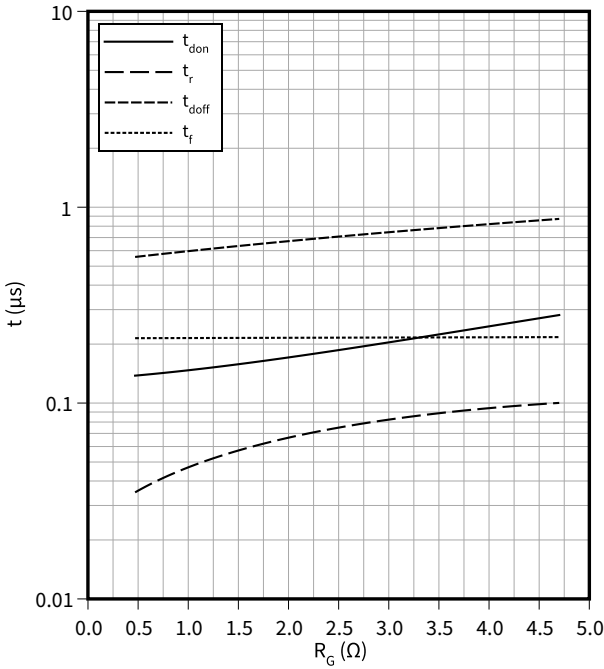
$R_{Goff} = 0.47 \, \Omega$ ,  $R_{Gon} = 0.47 \, \Omega$ ,  $V_{CC} = 500 \, V$ ,  $\pm 15 \, V$ ,  $T_{vj} = 175 \, ^\circ C$



Switching times (typical), IGBT, T2 / T3

$t = f(R_G)$

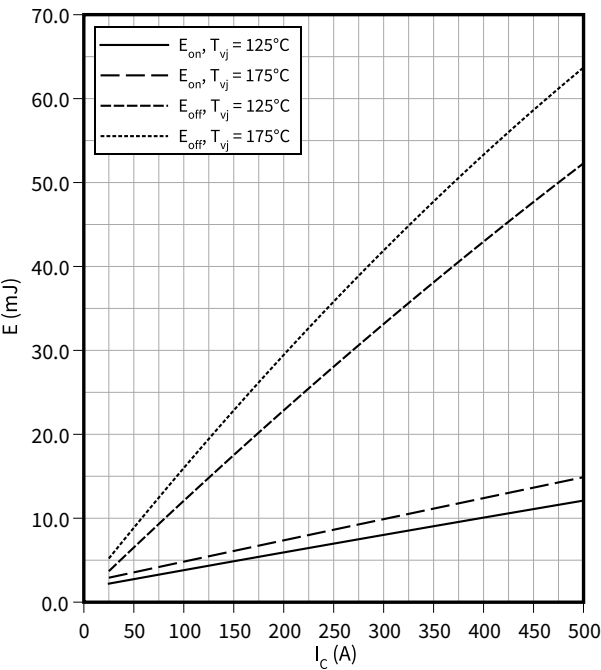
$I_C = 250 \, A$ ,  $V_{CC} = 500 \, V$ ,  $\pm 15 \, V$ ,  $T_{vj} = 175 \, ^\circ C$



Switching losses (typical), IGBT, T2 / T3

$E = f(I_C)$

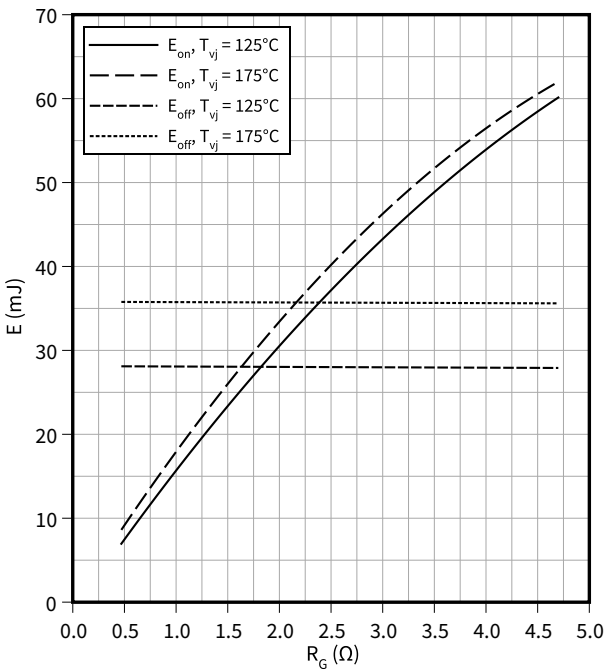
$R_{Goff} = 0.47 \, \Omega$ ,  $R_{Gon} = 0.47 \, \Omega$ ,  $V_{CC} = 500 \, V$ ,  $\pm 15 \, V$



Switching losses (typical), IGBT, T2 / T3

$E = f(R_G)$

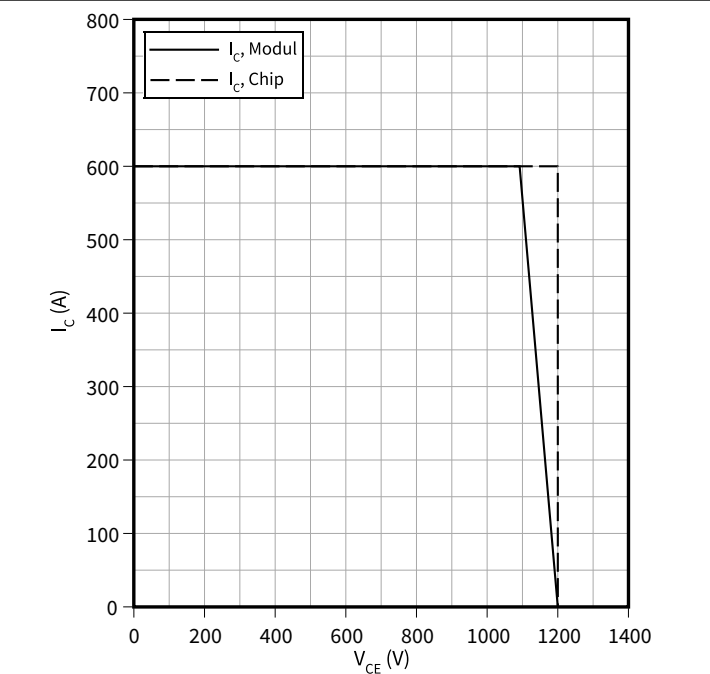
$I_C = 250 \, A$ ,  $V_{CC} = 500 \, V$ ,  $\pm 15 \, V$



8 Characteristics diagrams

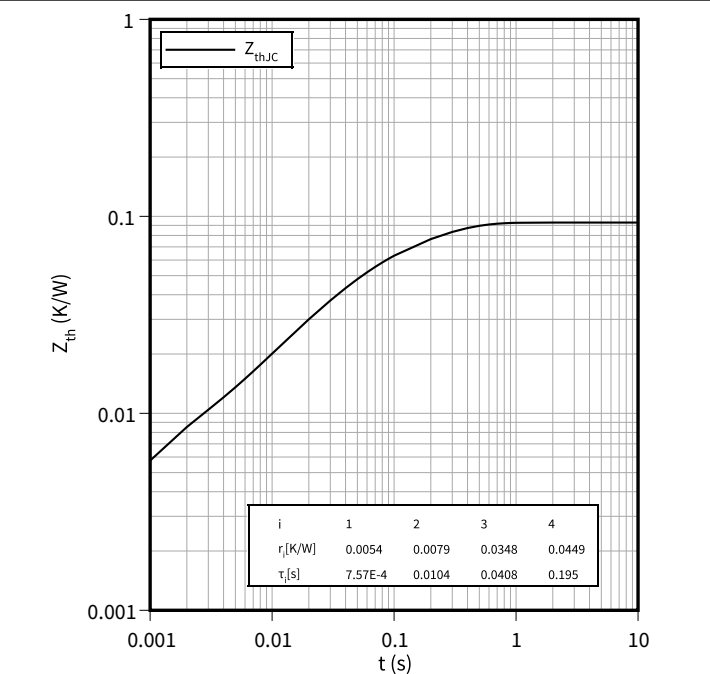
Reverse bias safe operating area (RBSOA), IGBT, T2 / T3

$I_C = f(V_{CE})$   
 $R_{Goff} = 0.47 \Omega$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  $T_{vj} = 175 \text{ }^\circ\text{C}$



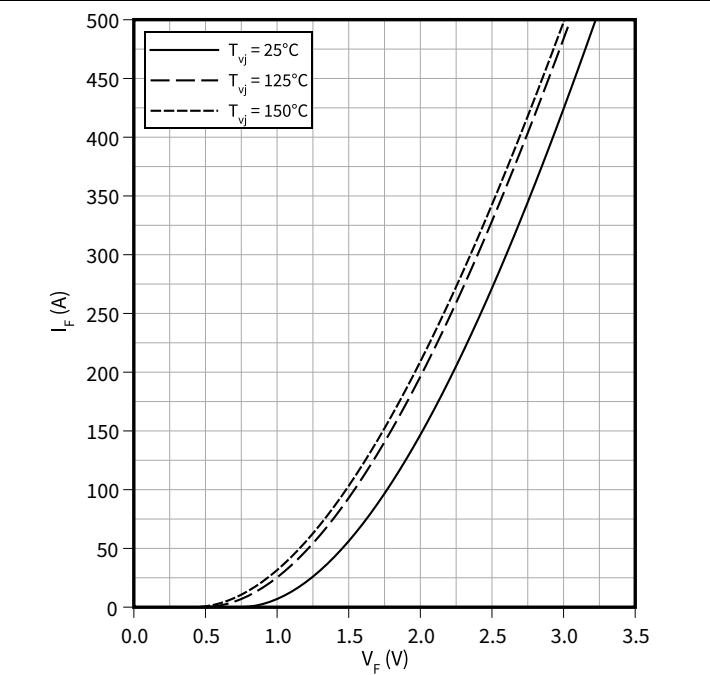
Transient thermal impedance, IGBT, T2 / T3

$Z_{th} = f(t)$



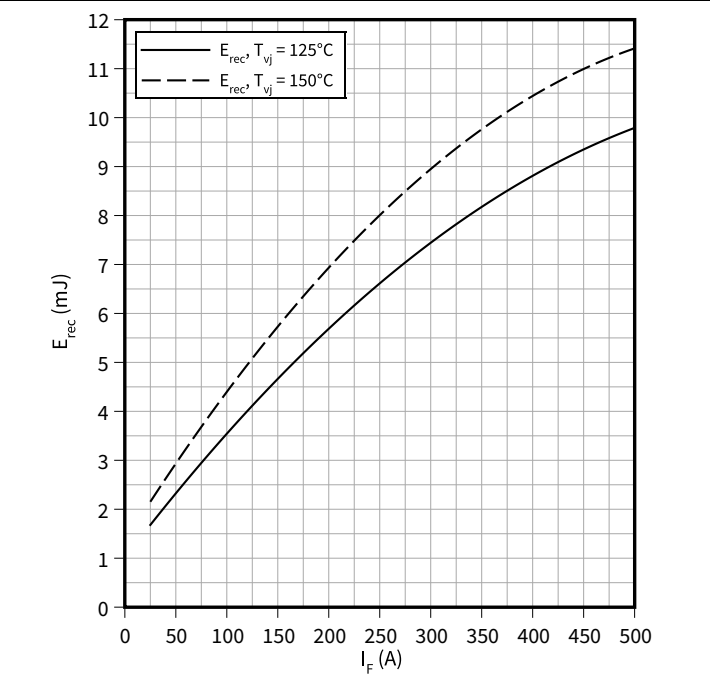
Forward characteristic (typical), Diode, D1 / D4

$I_F = f(V_F)$



Switching losses (typical), Diode, D1 / D4

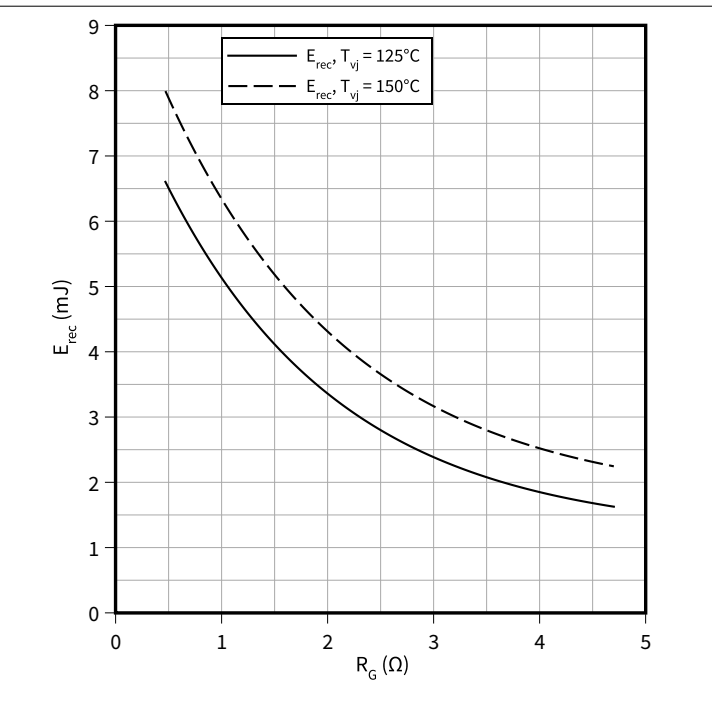
$E_{rec} = f(I_F)$   
 $R_G = 0.47 \Omega$ ,  $V_{CC} = 500 \text{ V}$



8 Characteristics diagrams

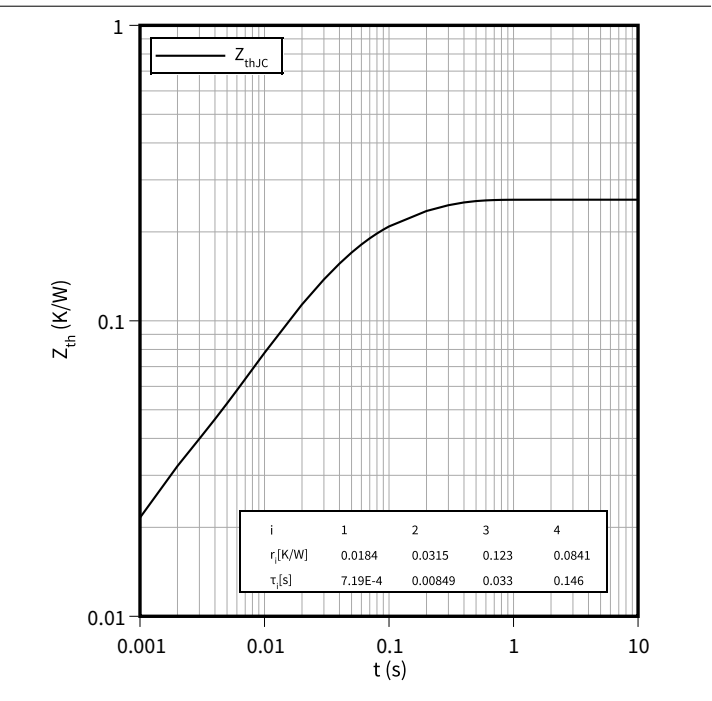
Switching losses (typical), Diode, D1 / D4

$E_{rec} = f(R_G)$   
 $I_F = 250\text{ A}$ ,  $V_{CC} = 500\text{ V}$



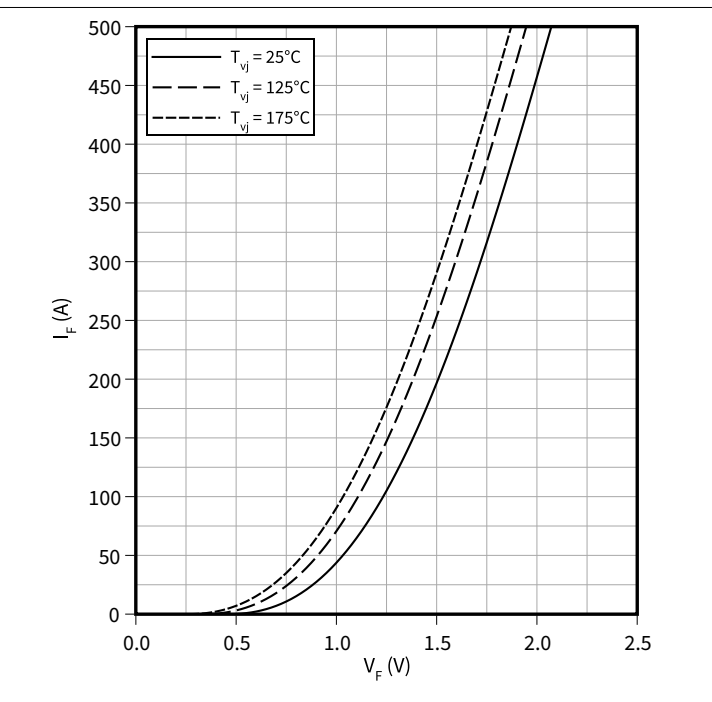
Transient thermal impedance, Diode, D1 / D4

$Z_{th} = f(t)$



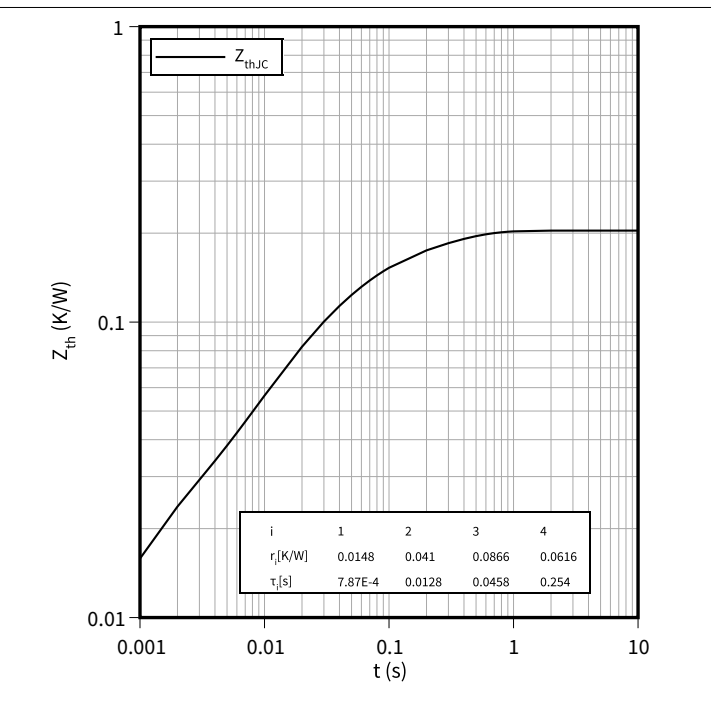
Forward characteristic (typical), Diode, D2 / D3

$I_F = f(V_F)$



Transient thermal impedance, Diode, D2 / D3

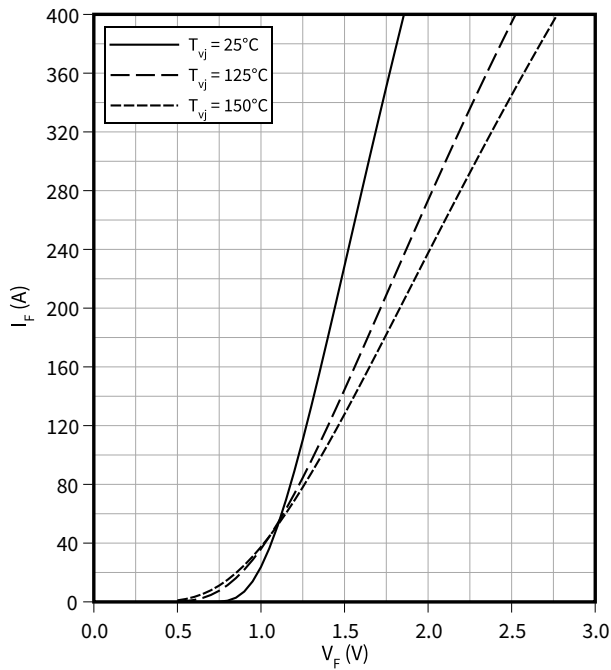
$Z_{th} = f(t)$



8 Characteristics diagrams

Forward characteristic (typical), Diode, D5 / D6

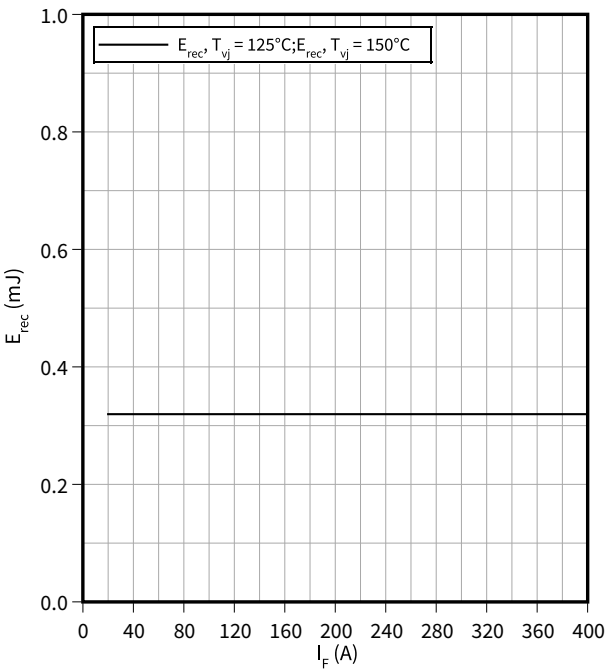
$I_F = f(V_F)$



Switching losses (typical), Diode, D5 / D6

$E_{rec} = f(I_F)$

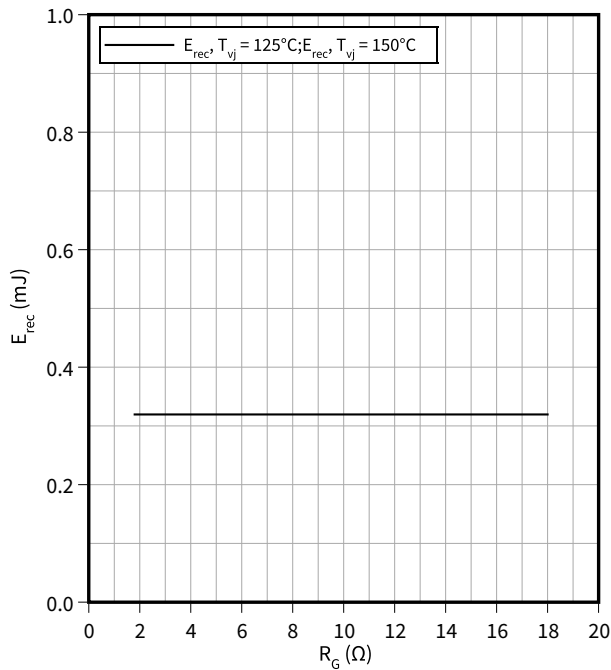
$R_{Gon} = 1.8\ \Omega, V_{CE} = 500\ \text{V}$



Switching losses (typical), Diode, D5 / D6

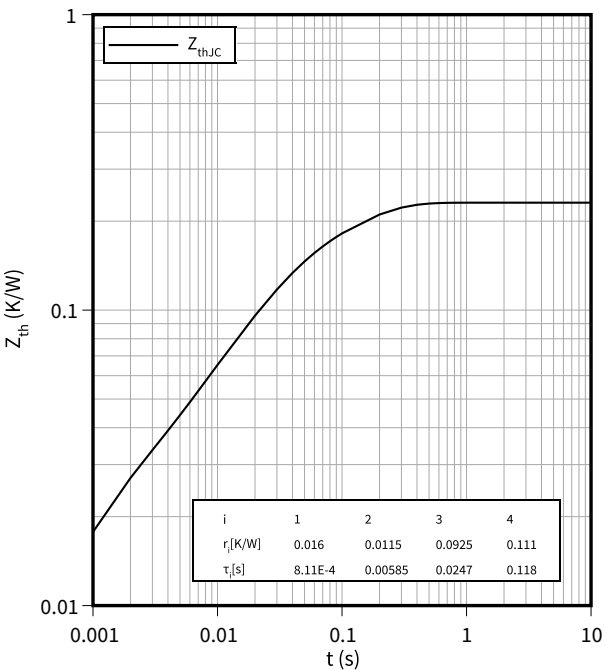
$E_{rec} = f(R_G)$

$V_{CE} = 500\ \text{V}, I_F = 200\ \text{A}$



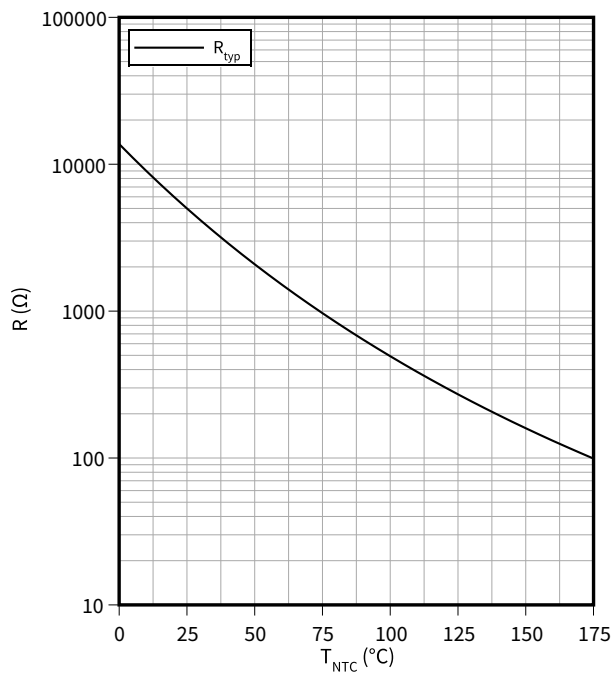
Transient thermal impedance, Diode, D5 / D6

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



9 Circuit diagram

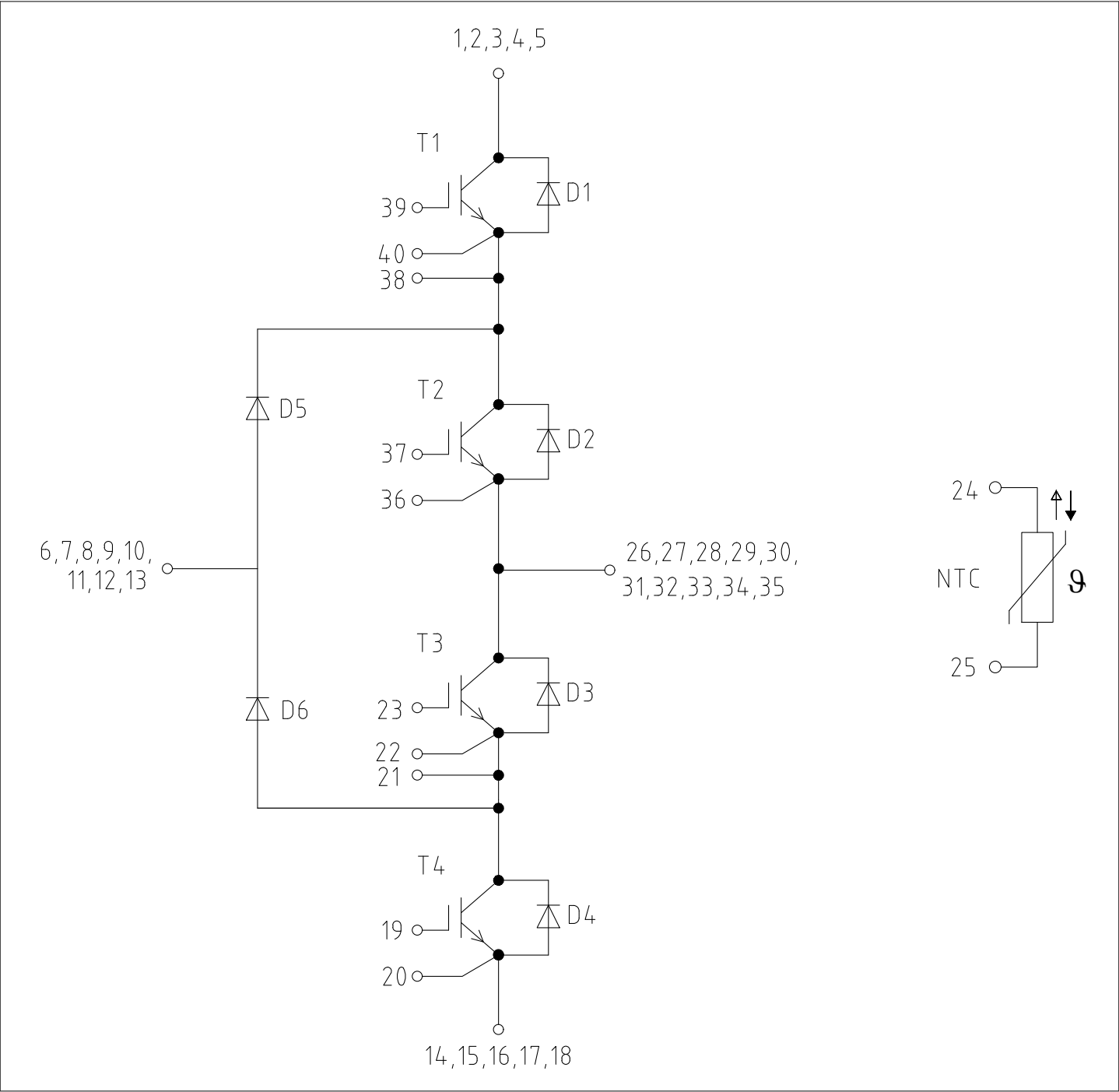


Figure 1

## 10 Package outlines

### 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           | <div><br/>71549142846550549911530</div> <div><br/>71549142846550549911530</div> |              |                 |

Figure 3



Revision history

Revision history

| Document revision | Date of release | Description of changes |
|-------------------|-----------------|------------------------|
| 0.10              | 2024-11-05      | Initial version        |
| 1.00              | 2024-12-18      | Final datasheet        |

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**IFX-ABK178-002**

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