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

## Features


Typical appearance

- Electrical features
  - $V_{CES}$ = 1200 V
  - $I_{C\ nom}$ = 300 A / $I_{CRM}$ = 600 A
  - Low $V_{CE,sat}$
  - Overload operation up to 175°C
  - TRENCHSTOP™ IGBT7
- Mechanical features
  - High power and thermal cycling capability
  - Solder contact technology
  - Integrated NTC temperature sensor
  - Copper base plate
  - $Al_2O_3$ substrate with low thermal resistance

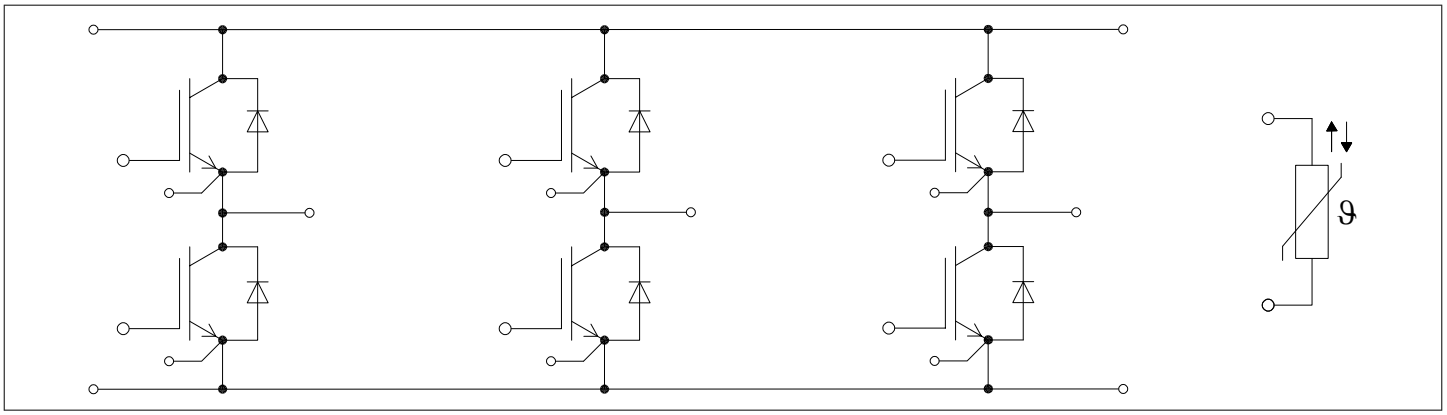
## Potential applications

- 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 Hz, *t* = 1 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 | |
| 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 | $L_{sCE}$ | | | | 25 | | nH |
| Module lead resistance, terminals - chip | $R_{CC'+EE'}$ | $T_C$=25°C, per switch | | | 1.8 | | mΩ |
| Storage temperature | $T_{stg}$ | | | -40 | | 125 | °C |
| Mounting torque for module mounting | *M* | - Mounting according to valid application note | M5, Screw | 3 | | 6 | Nm |
| Weight | *G* | | | | 300 | | g |

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

# 2 IGBT, Inverter

**Table 3 Maximum rated values**

| Parameter | Symbol | Note or test condition | | Values | Unit |
|---|---|---|---|---|---|
| Collector-emitter voltage | $V_{CES}$ | | $T_{vj}$ = 25 °C | 1200 | V |
| Continuous DC collector current | $I_{CDC}$ | $T_{vj\,max}$ = 175 °C | $T_C$ = 70 °C | 300 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{vj\,op}$ | | 600 | 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 | $V_{CE\,sat}$ | $I_C$ = 300 A, $V_{GE}$ = 15 V | $T_{vj}$ = 25 °C | | 1.50 | 1.75 | V |
| | | | $T_{vj}$ = 125 °C | | 1.65 | | |
| | | | $T_{vj}$ = 175 °C | | 1.75 | | |
| Gate threshold voltage | $V_{GEth}$ | $I_C$ = 6.14 mA, $V_{CE}$ = $V_{GE}$, $T_{vj}$ = 25 °C | | 5.15 | 5.80 | 6.45 | V |
| Gate charge | $Q_G$ | $V_{GE}$ = ±15 V, $V_{CE}$ = 600 V | | | 4.8 | | µC |
| Internal gate resistor | $R_{Gint}$ | $T_{vj}$ = 25 °C | | | 1.5 | | Ω |
| Input capacitance | $C_{ies}$ | $f$ = 100 kHz, $T_{vj}$ = 25 °C, $V_{CE}$ = 25 V, $V_{GE}$ = 0 V | | | 46 | | nF |
| Reverse transfer capacitance | $C_{res}$ | $f$ = 100 kHz, $T_{vj}$ = 25 °C, $V_{CE}$ = 25 V, $V_{GE}$ = 0 V | | | 0.23 | | nF |
| Collector-emitter cut-off current | $I_{CES}$ | $V_{CE}$ = 1200 V, $V_{GE}$ = 0 V | $T_{vj}$ = 25 °C | | | 0.1 | mA |
| Gate-emitter leakage current | $I_{GES}$ | $V_{CE}$ = 0 V, $V_{GE}$ = 20 V, $T_{vj}$ = 25 °C | | | | 100 | nA |
| Turn-on delay time (inductive load) | $t_{don}$ | $I_C$ = 300 A, $V_{CE}$ = 600 V, $V_{GE}$ = ±15 V, $R_{Gon}$ = 1.1 Ω | $T_{vj}$ = 25 °C | | 0.355 | | µs |
| | | | $T_{vj}$ = 125 °C | | 0.385 | | |
| | | | $T_{vj}$ = 175 °C | | 0.404 | | |
| Rise time (inductive load) | $t_r$ | $I_C$ = 300 A, $V_{CE}$ = 600 V, $V_{GE}$ = ±15 V, $R_{Gon}$ = 1.1 Ω | $T_{vj}$ = 25 °C | | 0.058 | | µs |
| | | | $T_{vj}$ = 125 °C | | 0.068 | | |
| | | | $T_{vj}$ = 175 °C | | 0.075 | | |
| Turn-off delay time (inductive load) | $t_{doff}$ | $I_C$ = 300 A, $V_{CE}$ = 600 V, $V_{GE}$ = ±15 V, $R_{Goff}$ = 1.1 Ω | $T_{vj}$ = 25 °C | | 0.408 | | µs |
| | | | $T_{vj}$ = 125 °C | | 0.498 | | |
| | | | $T_{vj}$ = 175 °C | | 0.545 | | |
| Fall time (inductive load) | $t_f$ | $I_C$ = 300 A, $V_{CE}$ = 600 V, $V_{GE}$ = ±15 V, $R_{Goff}$ = 1.1 Ω | $T_{vj}$ = 25 °C | | 0.159 | | µs |
| | | | $T_{vj}$ = 125 °C | | 0.310 | | |
| | | | $T_{vj}$ = 175 °C | | 0.408 | | |
| Turn-on energy loss per pulse | $E_{on}$ | $I_C$ = 300 A, $V_{CE}$ = 600 V, $L_\sigma$ = 35 nH, $V_{GE}$ = ±15 V, $R_{Gon}$ = 1.1 Ω, di/dt = 3650 A/µs ($T_{vj}$ = 175 °C) | $T_{vj}$ = 25 °C | | 29.6 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 42.3 | | |
| | | | $T_{vj}$ = 175 °C | | 49.5 | | |
| Turn-off energy loss per pulse | $E_{off}$ | $I_C$ = 300 A, $V_{CE}$ = 600 V, $L_\sigma$ = 35 nH, $V_{GE}$ = ±15 V, $R_{Goff}$ = 1.1 Ω, dv/dt = 3050 V/µs ($T_{vj}$ = 175 °C) | $T_{vj}$ = 25 °C | | 24.4 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 39.1 | | |
| | | | $T_{vj}$ = 175 °C | | 48 | | |

**(table continues...)**

**Table 4 (continued) Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| SC data | $I_{SC}$ | $V_{GE} \le 15$ V, $V_{CC} = 800$ V, $V_{CEmax}=V_{CES}-L_{sCE}*di/dt$ | $t_P \le 8$ µs, $T_{vj}=150$ °C | | 1050 | | A |
| | | | $t_P \le 7$ µs, $T_{vj}=175$ °C | | 990 | | |
| Thermal resistance, junction to case | $R_{thJC}$ | per IGBT | | | | 0.169 | K/W |
| Thermal resistance, case to heat sink | $R_{thCH}$ | per IGBT, $\lambda_{grease} = 1$ W/(m·K) | | | 0.0700 | | K/W |
| Temperature under switching conditions | $T_{vj\,op}$ | | | -40 | | 175 | °C |

*Note: $T_{vj\,op} > 150$ °C is only 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 | $V_{RRM}$ | | $T_{vj} = 25$ °C | 1200 | V |
| Continuous DC forward current | $I_F$ | | | 300 | A |
| Repetitive peak forward current | $I_{FRM}$ | $t_P = 1$ ms | | 600 | A |
| $I^2t$ - value | $I^2t$ | $t_P = 10$ ms, $V_R = 0$ V | $T_{vj} = 125$ °C | 8390 | $A^2s$ |
| | | | $T_{vj} = 175$ °C | 5110 | |

**Table 6 Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Forward voltage | $V_F$ | $I_F = 300$ A, $V_{GE} = 0$ V | $T_{vj} = 25$ °C | | 1.80 | 2.10 | V |
| | | | $T_{vj} = 125$ °C | | 1.70 | | |
| | | | $T_{vj} = 175$ °C | | 1.60 | | |
| Peak reverse recovery current | $I_{RM}$ | $V_R = 600$ V, $I_F = 300$ A, $V_{GE} = -15$ V, $-di_F/dt = 3650$ A/µs ($T_{vj} = 175$ °C) | $T_{vj} = 25$ °C | | 151 | | A |
| | | | $T_{vj} = 125$ °C | | 178 | | |
| | | | $T_{vj} = 175$ °C | | 192 | | |

**(table continues...)**

**Table 6 (continued) Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Recovered charge | $Q_r$ | $V_R$ = 600 V, $I_F$ = 300 A, $V_{GE}$ = -15 V, -di$_F$/dt = 3650 A/µs ($T_{vj}$ = 175 °C) | $T_{vj}$ = 25 °C | | 18.5 | | µC |
| | | | $T_{vj}$ = 125 °C | | 38.9 | | |
| | | | $T_{vj}$ = 175 °C | | 52.9 | | |
| Reverse recovery energy | $E_{rec}$ | $V_R$ = 600 V, $I_F$ = 300 A, $V_{GE}$ = -15 V, -di$_F$/dt = 3650 A/µs ($T_{vj}$ = 175 °C) | $T_{vj}$ = 25 °C | | 5.84 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 13 | | |
| | | | $T_{vj}$ = 175 °C | | 18.2 | | |
| Thermal resistance, junction to case | $R_{thJC}$ | per diode | | | | 0.276 | K/W |
| Thermal resistance, case to heat sink | $R_{thCH}$ | per diode, $\lambda_{grease}$ = 1 W/(m·K) | | | 0.0700 | | K/W |
| Temperature under switching conditions | $T_{vj\,op}$ | | | -40 | | 175 | °C |

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

## 4 NTC-Thermistor

**Table 7 Characteristic values**

| Parameter | Symbol | Note or test condition | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Rated resistance | $R_{25}$ | $T_{NTC}$ = 25 °C | | 5 | | kΩ |
| Deviation of $R_{100}$ | $\Delta R/R$ | $T_{NTC}$ = 100 °C, $R_{100}$ = 493 Ω | -5 | | 5 | % |
| Power dissipation | $P_{25}$ | $T_{NTC}$ = 25 °C | | | 20 | mW |
| B-value | $B_{25/50}$ | $R_2 = R_{25} \exp[B_{25/50}(1/T_2-1/(298{,}15\ K))]$ | | 3375 | | K |
| B-value | $B_{25/80}$ | $R_2 = R_{25} \exp[B_{25/80}(1/T_2-1/(298{,}15\ K))]$ | | 3411 | | K |
| B-value | $B_{25/100}$ | $R_2 = R_{25} \exp[B_{25/100}(1/T_2-1/(298{,}15\ K))]$ | | 3433 | | K |

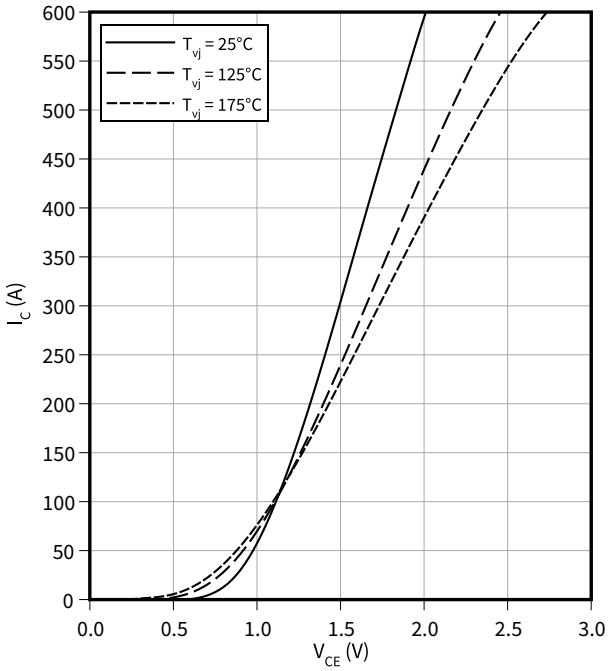
*Note: Specification according to the valid application note.*

# 5 Characteristics diagrams

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

$I_C = f(V_{CE})$

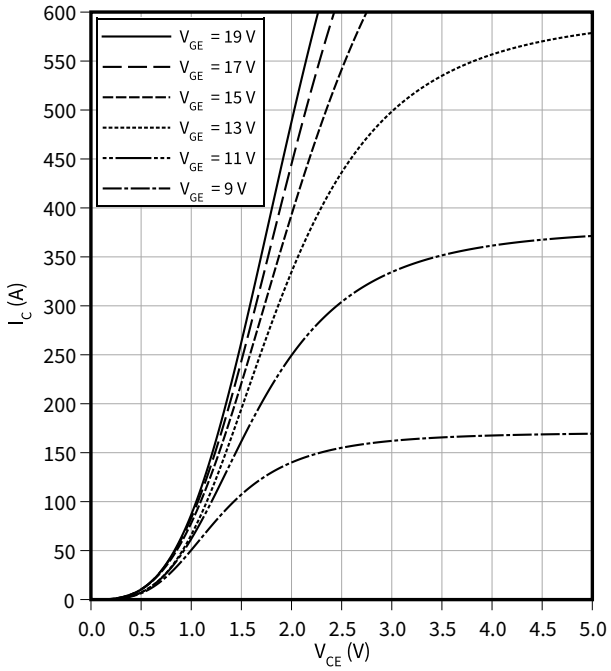
$V_{GE} = 15$ V




**Output characteristic field (typical), IGBT, Inverter**

$I_C = f(V_{CE})$

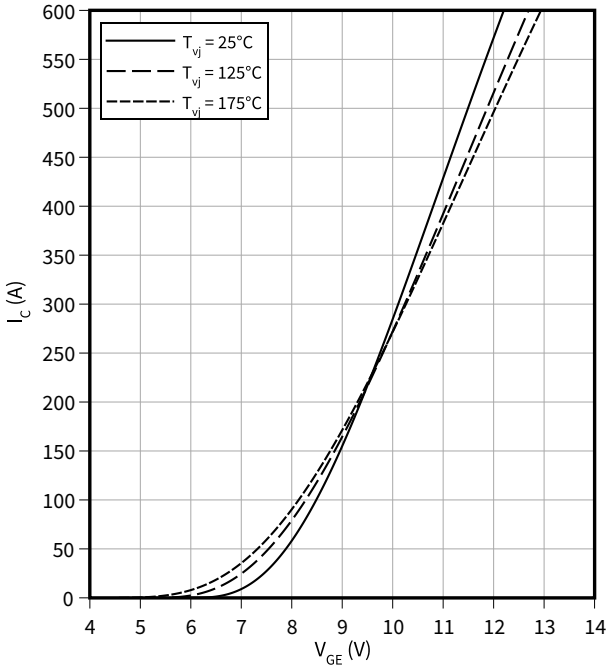
$T_{vj} = 175$ °C




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

$I_C = f(V_{GE})$

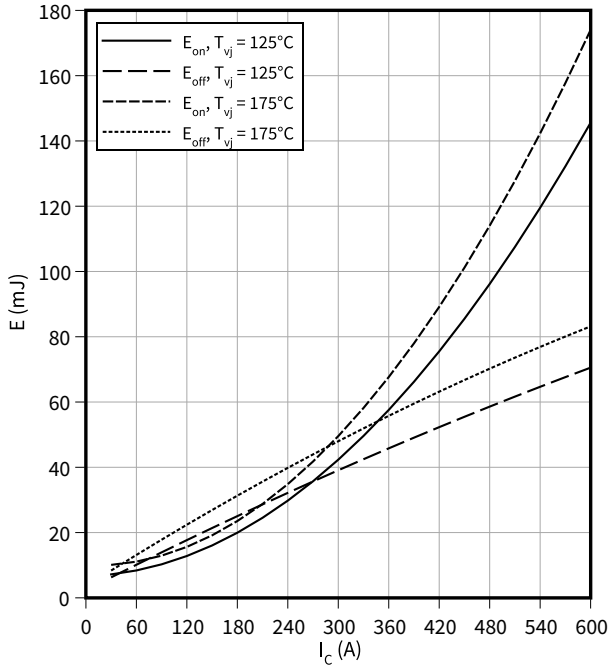
$V_{CE} = 20$ V




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

$E = f(I_C)$

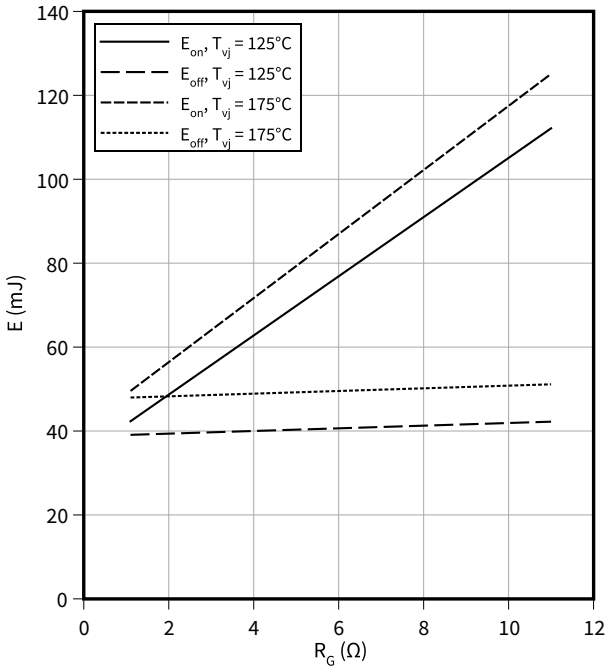
$R_{Goff} = 1.1\ \Omega$, $R_{Gon} = 1.1\ \Omega$, $V_{CE} = 600$ V, $V_{GE} = \pm 15$ V



### Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

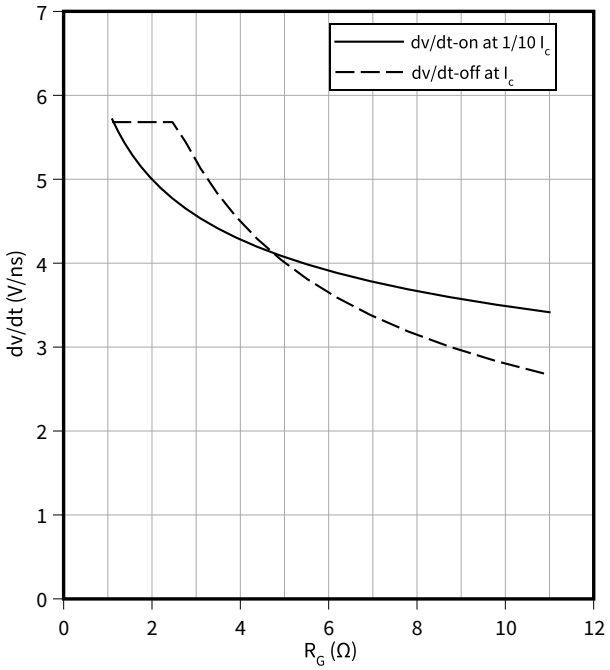
$I_C = 300\ A$, $V_{CE} = 600\ V$, $V_{GE} = \pm 15\ V$




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

$dv/dt = f(R_G)$

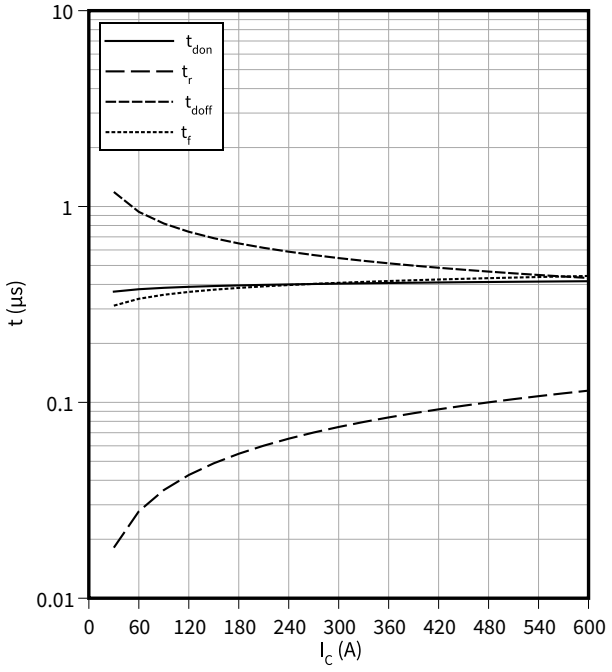
$I_C = 300\ A$, $V_{CE} = 600\ V$, $V_{GE} = \pm 15\ V$, $T_{vj} = 25\ °C$




### Switching times (typical), IGBT, Inverter

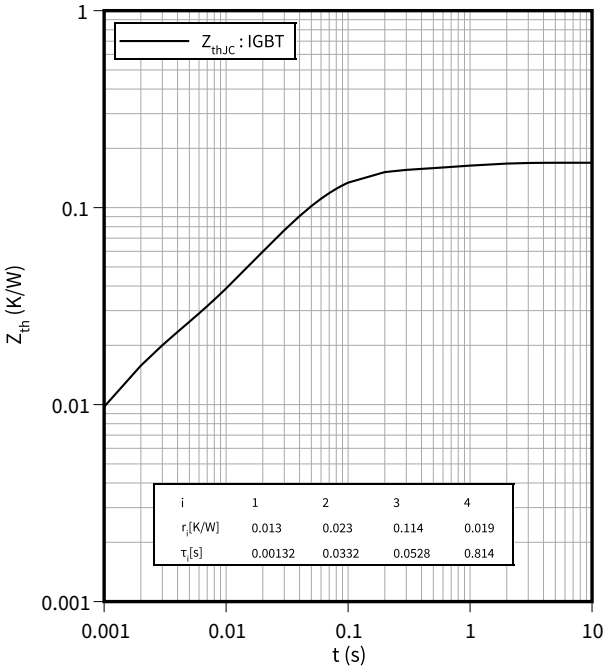
$t = f(I_C)$

$R_{Goff} = 1.1\ \Omega$, $R_{Gon} = 1.1\ \Omega$, $V_{CE} = 600\ V$, $V_{GE} = \pm 15\ V$, $T_{vj} = 175\ °C$




### Transient thermal impedance , IGBT, Inverter

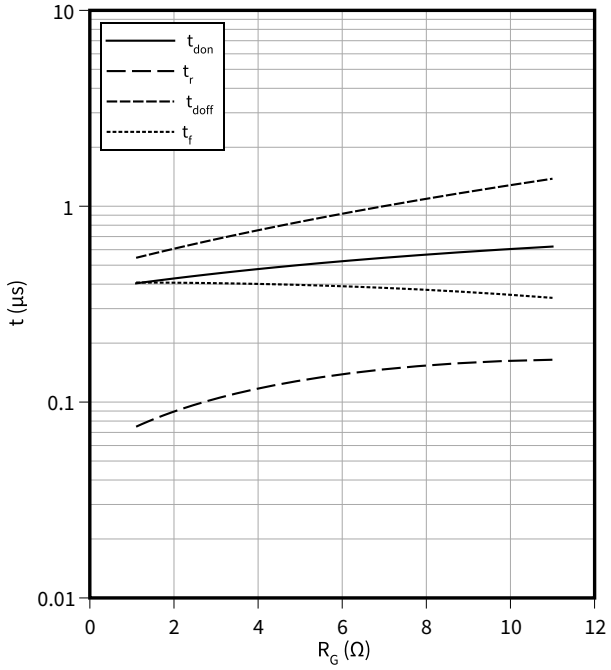
$Z_{th} = f(t)$



### Switching times (typical), IGBT, Inverter

$t = f(R_G)$

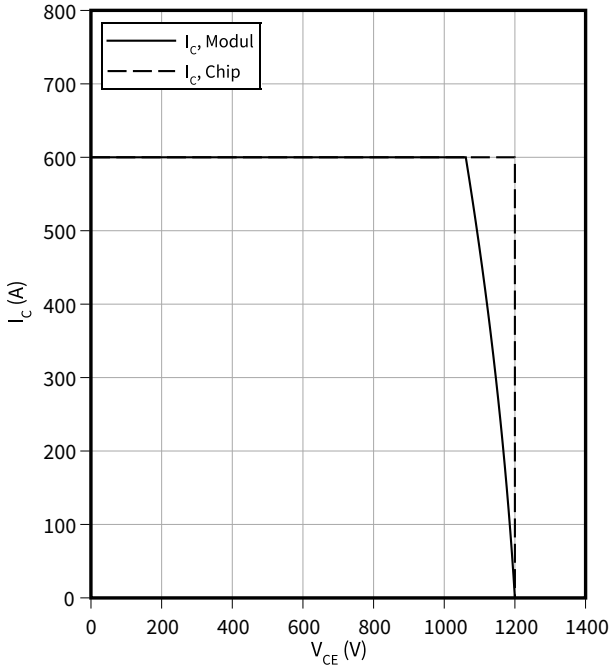
$I_C = 300\ A$, $V_{CE} = 600\ V$, $V_{GE} = \pm 15\ V$, $T_{vj} = 175\ °C$




### Reverse bias safe operating area (RBSOA), IGBT, Inverter

$I_C = f(V_{CE})$

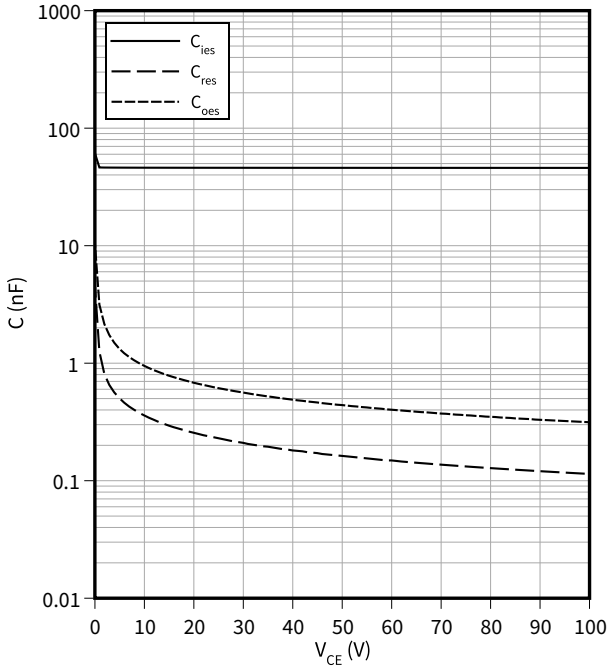
$R_{Goff} = 1.1\ \Omega$, $V_{GE} = \pm 15\ V$, $T_{vj} = 175\ °C$




### Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

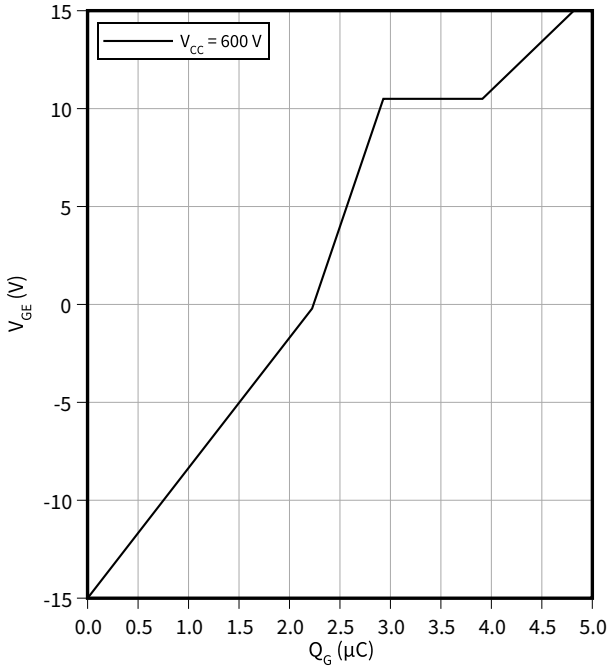
$f = 100\ kHz$, $V_{GE} = 0\ V$, $T_{vj} = 25\ °C$




### Gate charge characteristic (typical), IGBT, Inverter

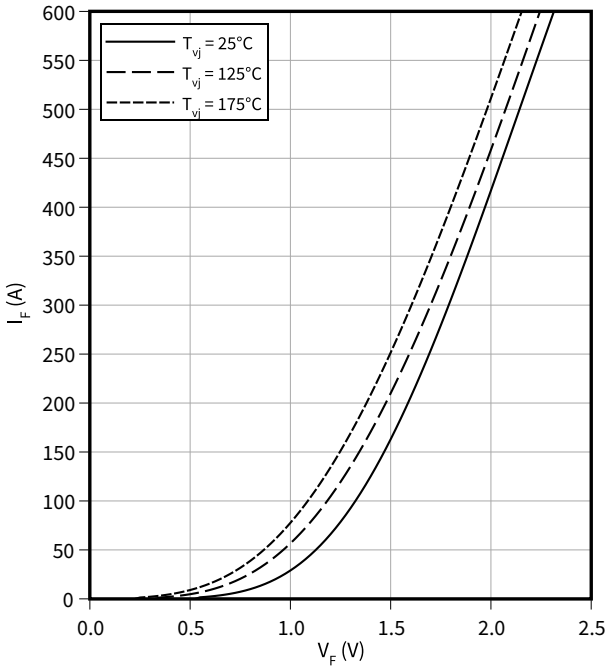
$V_{GE} = f(Q_G)$

$I_C = 300\ A$, $T_{vj} = 25\ °C$



### Forward characteristic (typical), Diode, Inverter

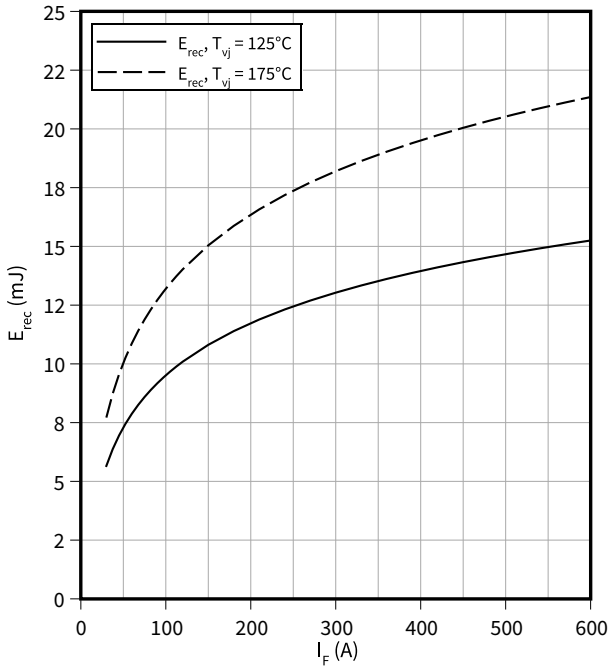
$I_F = f(V_F)$




### Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

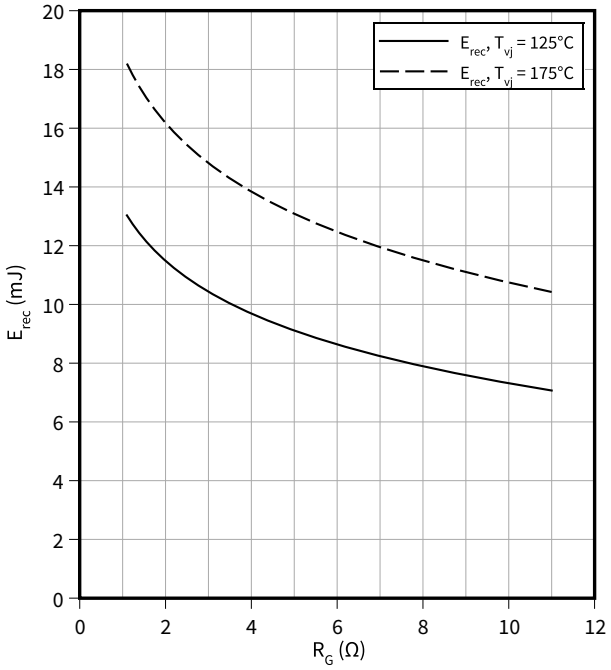
$R_{Gon} = 1.1\ \Omega$, $V_R = 600$ V




### Switching losses (typical), Diode, Inverter

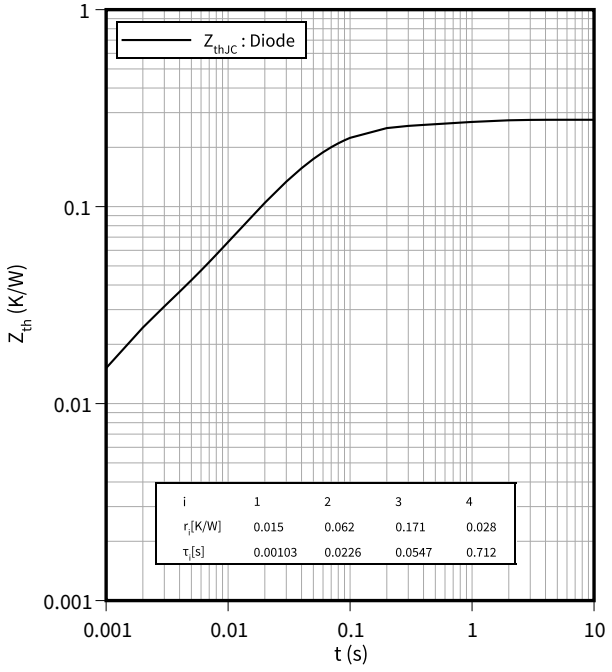
$E_{rec} = f(R_G)$

$I_F = 300$ A, $V_R = 600$ V



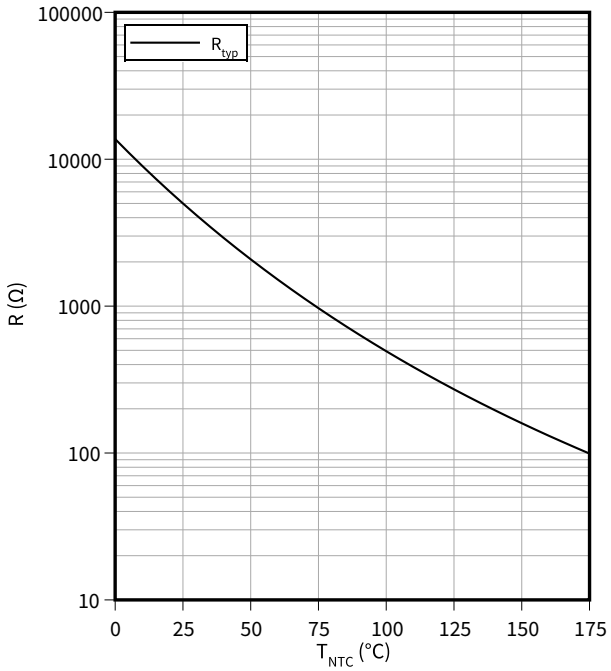

### Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



**Temperature characteristic (typical), NTC-Thermistor**

$R = f(T_{NTC})$



# 6 Circuit diagram

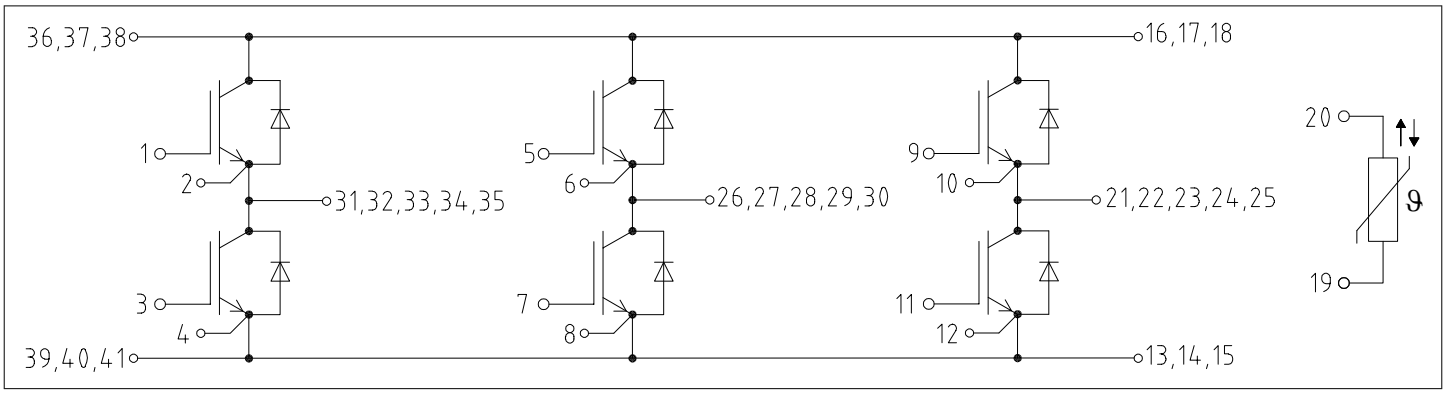



**Figure 1**

# 7 Package outlines

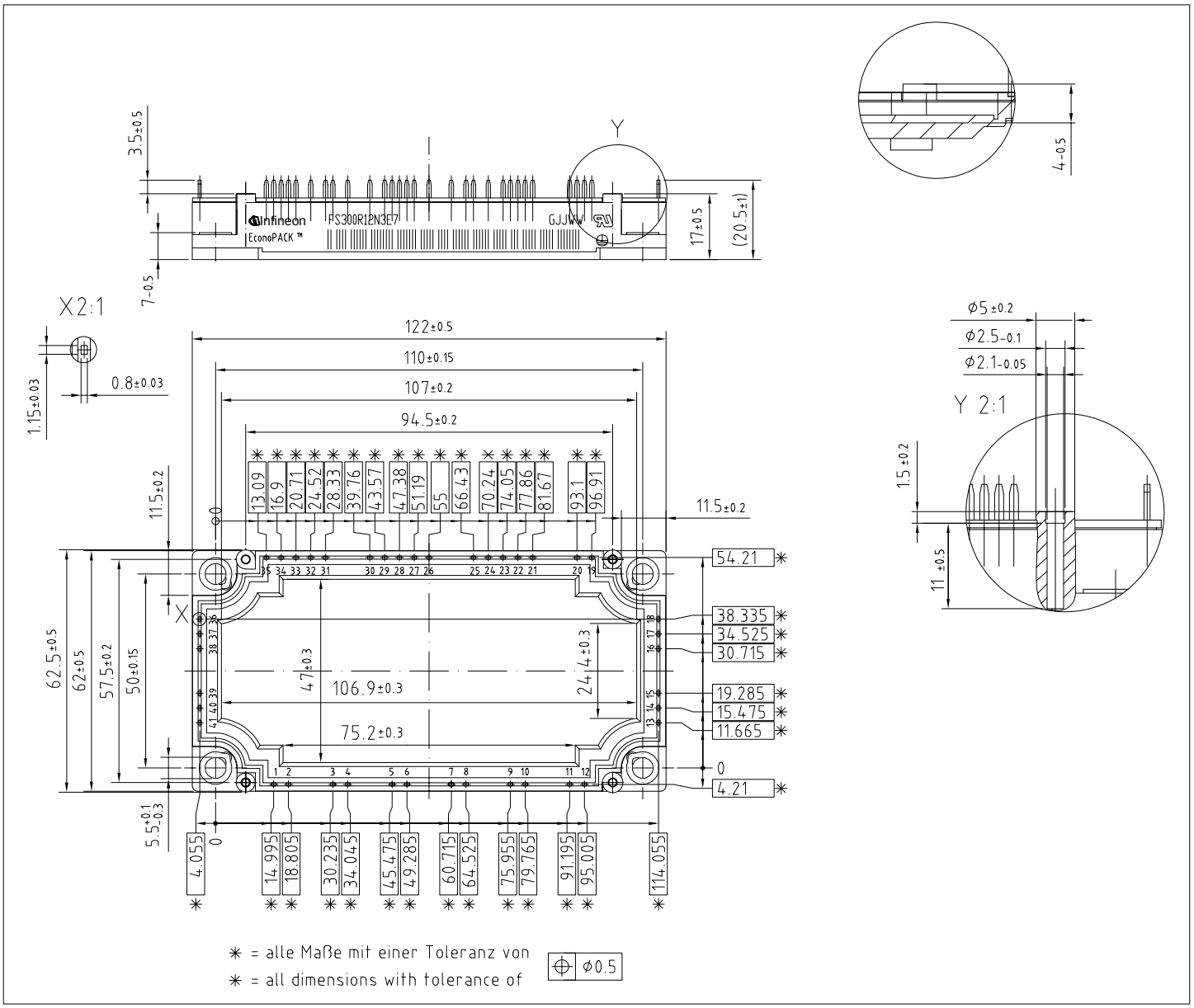



**Figure 2**

# 8 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 | *Content*<br>Module serial number<br>Module material number<br>Production order number<br>Date code (production year)<br>Date code (production week) | *Digit*<br>1 – 5<br>6 - 11<br>12 - 19<br>20 – 21<br>22 – 23 | *Example*<br>71549<br>142846<br>55054991<br>15<br>30 |
| Example | 7154914284655054991530 | | 7154914284655054991530 |

**Figure 3**

# Revision history

| Document revision | Date of release | Description of changes |
|---|---|---|
| 0.10 | 2021-11-11 | Initial version |
| 1.00 | 2022-05-16 | Final datasheet |

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