

EconoDUAL™3 module with TRENCHSTOP™ IGBT7 and Emitter Controlled 7 diode and NTC

Features

- Electrical features
 - $V_{CES} = 1200\text{ V}$
 - $I_{C\text{nom}} = 450\text{ A} / I_{CRM} = 900\text{ A}$
 - V_{CESat} with positive temperature coefficient
 - TRENCHSTOP™ IGBT7
 - Integrated temperature sensor
- Mechanical features
 - High power density
 - Isolated base plate
 - PressFIT contact technology
 - Standard housing



Typical appearance

Potential applications

- Commercial Agriculture Vehicles
- High power converters
- Motor drives
- Servo drives
- UPS systems

Product validation

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

Description

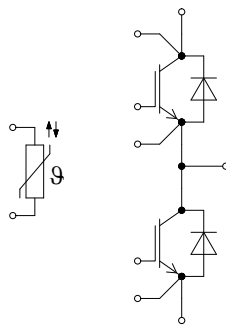


Table of contents

| | | |
|----------|---------------------------------------|----|
| | Description | 1 |
| | Features | 1 |
| | Potential applications | 1 |
| | Product validation | 1 |
| | Table of contents | 2 |
| 1 | Package | 3 |
| 2 | IGBT, Inverter | 3 |
| 3 | Diode, Inverter | 5 |
| 4 | NTC-Thermistor | 6 |
| 5 | Characteristics diagrams | 7 |
| 6 | Circuit diagram | 11 |
| 7 | Package outlines | 12 |
| 8 | Module label code | 13 |
| | Revision history | 14 |
| | Disclaimer | 15 |

1 Package

Table 1 Insulation coordination

| Parameter | Symbol | Note or test condition | Values | Unit |
|------------------------------|-------------|--|-------------------------|------|
| Isolation test voltage | V_{ISOL} | RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$ | 3.4 | kV |
| Material of module baseplate | | | Cu | |
| Internal Isolation | | basic insulation (class 1, IEC 61140) | Al_2O_3 | |
| Creepage distance | d_{Creep} | terminal to heatsink | 14.5 | mm |
| Creepage distance | d_{Creep} | terminal to terminal | 13.0 | mm |
| Clearance | d_{Clear} | terminal to heatsink | 12.5 | mm |
| Clearance | d_{Clear} | terminal to terminal | 10.0 | 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} | | | 20 | | nH |
| Module lead resistance, terminals - chip | $R_{CC'+EE'}$ | $T_C = 25^\circ\text{C}$, per switch | | 0.8 | | 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 |
| Terminal connection torque | M | - Mounting according to valid application note | M6, Screw | 3 | 6 | Nm |
| Weight | G | | | 345 | | 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} | $T_{vj \text{ max}} = 175^\circ\text{C}$ $T_C = 90^\circ\text{C}$ | 450 | A |
| Repetitive peak collector current | I_{CRM} | $t_p = 1 \text{ ms}$ | 900 | 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 | $V_{CE\ sat}$ | $I_C = 450\ A, V_{GE} = 15\ V$ | $T_{vj} = 25\ ^\circ C$ | | 1.50 | 1.75 | V |
| | | | $T_{vj} = 125\ ^\circ C$ | | 1.65 | | |
| | | | $T_{vj} = 175\ ^\circ C$ | | 1.75 | | |
| Gate threshold voltage | V_{GEth} | $I_C = 9\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$ | | 5.15 | 5.80 | 6.45 | V |
| Gate charge | Q_G | $V_{GE} = \pm 15\ V, V_{CE} = 600\ V$ | | | 7.2 | | μC |
| Internal gate resistor | R_{Gint} | $T_{vj} = 25\ ^\circ C$ | | | 0.8 | | Ω |
| Input capacitance | C_{ies} | $f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$ | | | 69 | | nF |
| Reverse transfer capacitance | C_{res} | $f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$ | | | 0.35 | | nF |
| Collector-emitter cut-off current | I_{CES} | $V_{CE} = 1200\ V, V_{GE} = 0\ V$ | $T_{vj} = 25\ ^\circ C$ | | | 40 | μA |
| 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} | $I_C = 450\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.6\ \Omega$ | $T_{vj} = 25\ ^\circ C$ | | 0.250 | | μs |
| | | | $T_{vj} = 125\ ^\circ C$ | | 0.270 | | |
| | | | $T_{vj} = 175\ ^\circ C$ | | 0.290 | | |
| Rise time (inductive load) | t_r | $I_C = 450\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.6\ \Omega$ | $T_{vj} = 25\ ^\circ C$ | | 0.057 | | μs |
| | | | $T_{vj} = 125\ ^\circ C$ | | 0.065 | | |
| | | | $T_{vj} = 175\ ^\circ C$ | | 0.068 | | |
| Turn-off delay time (inductive load) | t_{doff} | $I_C = 450\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 0.6\ \Omega$ | $T_{vj} = 25\ ^\circ C$ | | 0.390 | | μs |
| | | | $T_{vj} = 125\ ^\circ C$ | | 0.470 | | |
| | | | $T_{vj} = 175\ ^\circ C$ | | 0.510 | | |
| Fall time (inductive load) | t_f | $I_C = 450\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 0.6\ \Omega$ | $T_{vj} = 25\ ^\circ C$ | | 0.140 | | μs |
| | | | $T_{vj} = 125\ ^\circ C$ | | 0.270 | | |
| | | | $T_{vj} = 175\ ^\circ C$ | | 0.360 | | |
| Turn-on energy loss per pulse | E_{on} | $I_C = 450\ A, V_{CE} = 600\ V, L_\sigma = 25\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 0.6\ \Omega, di/dt = 6400\ A/\mu s (T_{vj} = 175\ ^\circ C)$ | $T_{vj} = 25\ ^\circ C$ | | 25 | | mJ |
| | | | $T_{vj} = 125\ ^\circ C$ | | 43 | | |
| | | | $T_{vj} = 175\ ^\circ C$ | | 53 | | |
| Turn-off energy loss per pulse | E_{off} | $I_C = 450\ A, V_{CE} = 600\ V, L_\sigma = 25\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 0.6\ \Omega, dv/dt = 3100\ V/\mu s (T_{vj} = 175\ ^\circ C)$ | $T_{vj} = 25\ ^\circ C$ | | 35 | | mJ |
| | | | $T_{vj} = 125\ ^\circ C$ | | 57 | | |
| | | | $T_{vj} = 175\ ^\circ C$ | | 69 | | |
| SC data | I_{SC} | $V_{GE} \leq 15\ V, V_{CC} = 800\ V, V_{CEmax} = V_{CES} - L_{sCE} * di/dt$ | $t_p \leq 8\ \mu s, T_{vj} = 150\ ^\circ C$ | | 2000 | | A |
| | | | $t_p \leq 6\ \mu s, T_{vj} = 175\ ^\circ C$ | | 1900 | | |

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 | | | 0.0875 | K/W |
| Thermal resistance, case to heatsink | R_{thCH} | per IGBT, $\lambda_{grease} = 1 \text{ W}/(\text{m}^2\text{K})$ | | 0.0186 | | K/W |
| Temperature under switching conditions | $T_{vj\ op}$ | | -40 | | 175 | °C |

Note: $T_{vj\ op} > 150^\circ\text{C}$ 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 | | 450 | A | |
| Repetitive peak forward current | I_{FRM} | $t_P = 1 \text{ ms}$ | 900 | A | |
| I^2t - value | I^2t | $t_P = 10 \text{ ms}, V_R = 0 \text{ V}$ | $T_{vj} = 125^\circ\text{C}$ | 17500 | A^2s |
| | | | $T_{vj} = 175^\circ\text{C}$ | 12000 | |

Table 6 Characteristic values

| Parameter | Symbol | Note or test condition | Values | | | Unit | |
|-------------------------------|----------|--|------------------------------|------|------|------|---------------|
| | | | Min. | Typ. | Max. | | |
| Forward voltage | V_F | $I_F = 450 \text{ A}, V_{GE} = 0 \text{ V}$ | $T_{vj} = 25^\circ\text{C}$ | | 1.80 | 2.10 | V |
| | | | $T_{vj} = 125^\circ\text{C}$ | | 1.70 | | |
| | | | $T_{vj} = 175^\circ\text{C}$ | | 1.60 | | |
| Peak reverse recovery current | I_{RM} | $V_R = 600 \text{ V}, I_F = 450 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6400 \text{ A}/\mu\text{s} (T_{vj} = 175^\circ\text{C})$ | $T_{vj} = 25^\circ\text{C}$ | | 306 | | A |
| | | | $T_{vj} = 125^\circ\text{C}$ | | 407 | | |
| | | | $T_{vj} = 175^\circ\text{C}$ | | 464 | | |
| Recovered charge | Q_r | $V_R = 600 \text{ V}, I_F = 450 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6400 \text{ A}/\mu\text{s} (T_{vj} = 175^\circ\text{C})$ | $T_{vj} = 25^\circ\text{C}$ | | 30.5 | | μC |
| | | | $T_{vj} = 125^\circ\text{C}$ | | 60 | | |
| | | | $T_{vj} = 175^\circ\text{C}$ | | 82.5 | | |

Table 6 Characteristic values (continued)

| Parameter | Symbol | Note or test condition | Values | | | Unit |
|--|--------------------|---|--------------------------|--------|-------|------|
| | | | Min. | Typ. | Max. | |
| Reverse recovery energy | E_{rec} | $V_R = 600\text{ V}$, $I_F = 450\text{ A}$, $V_{GE} = -15\text{ V}$, $-di_F/dt =$ $6400\text{ A}/\mu\text{s}$ ($T_{vj} = 175\text{ °C}$) | $T_{vj} = 25\text{ °C}$ | 13.5 | | mJ |
| | | | $T_{vj} = 125\text{ °C}$ | 27.5 | | |
| | | | $T_{vj} = 175\text{ °C}$ | 37.5 | | |
| Thermal resistance, junction to case | R_{thJC} | per diode | | | 0.164 | K/W |
| Thermal resistance, case to heatsink | R_{thCH} | per diode, $\lambda_{grease} = 1\text{ W}/(\text{m}^*\text{K})$ | | 0.0214 | | 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 NTC-Thermistor

Table 7 Characteristic values

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

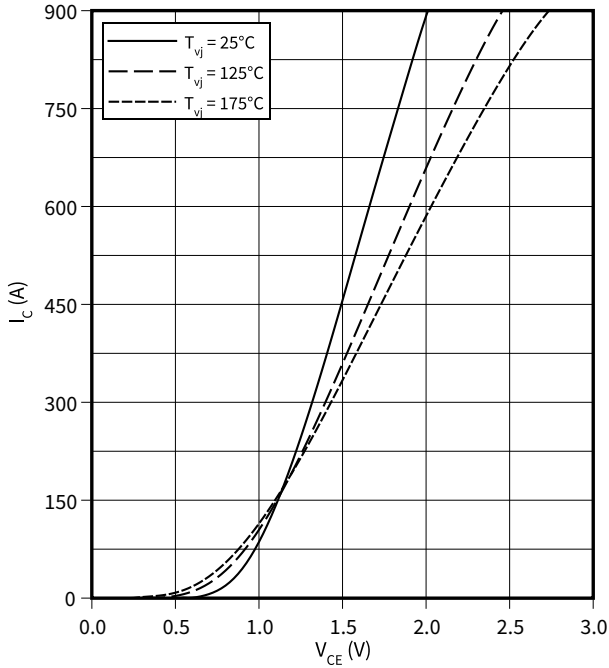
Note: Specification according to the valid application note.

5 Characteristics diagrams

output characteristic (typical), IGBT, Inverter

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

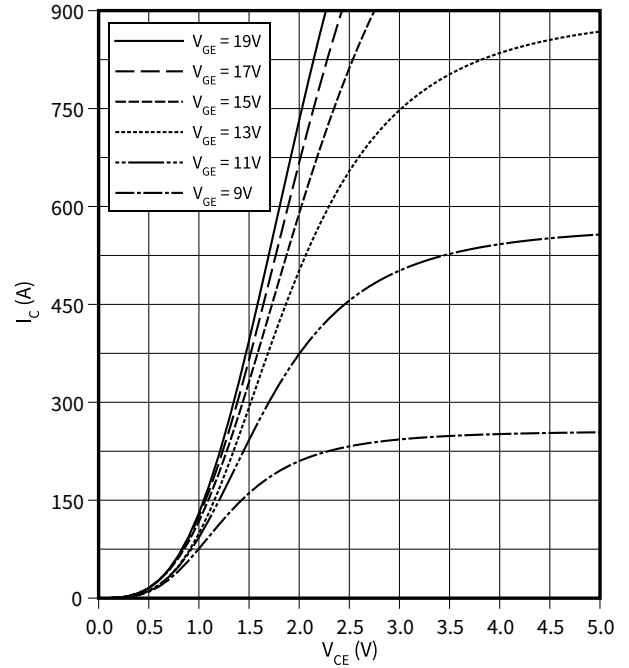
$$V_{GE} = 15 \text{ V}$$



output characteristic (typical), IGBT, Inverter

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

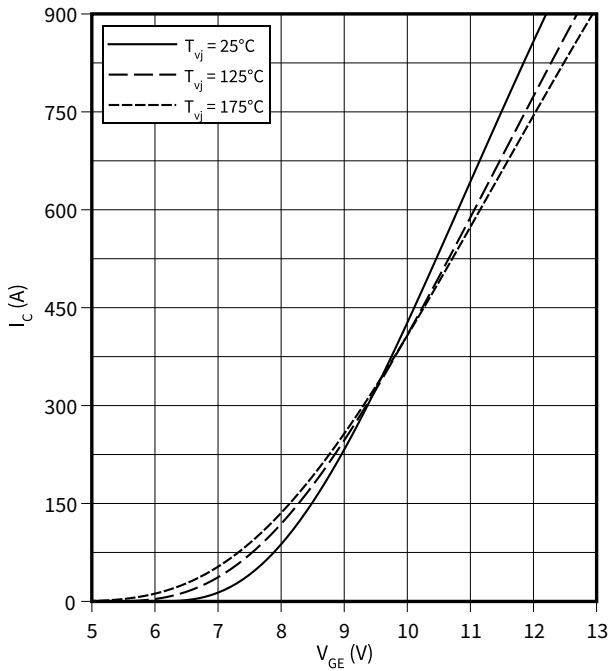
$$T_{vj} = 175 \text{ °C}$$



transfer characteristic (typical), IGBT, Inverter

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

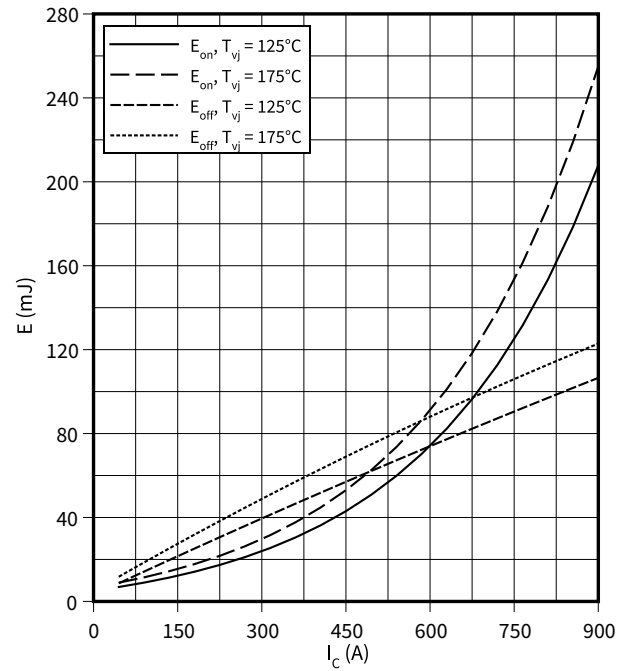
$$V_{CE} = 20 \text{ V}$$



switching losses (typical), IGBT, Inverter

$$E = f(I_C)$$

$$R_{Goff} = 0.6 \text{ } \Omega, R_{Gon} = 0.6 \text{ } \Omega, V_{CE} = 600 \text{ V}, V_{GE} = -15 / 15 \text{ V}$$

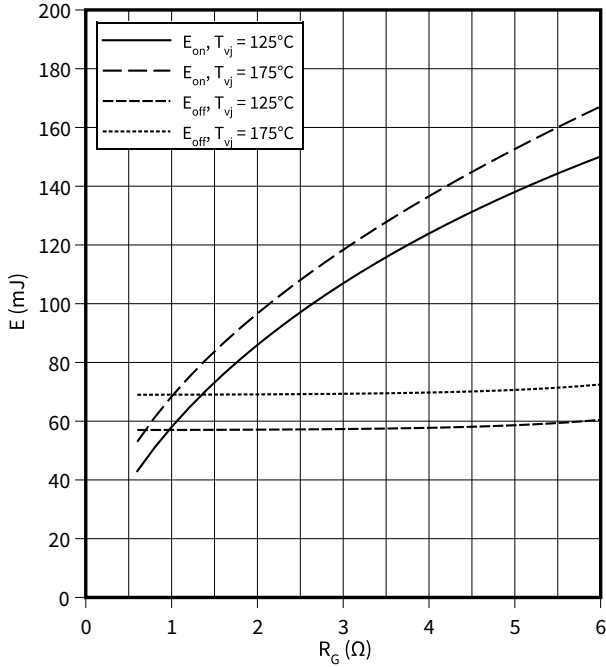


5 Characteristics diagrams

switching losses (typical), IGBT, Inverter

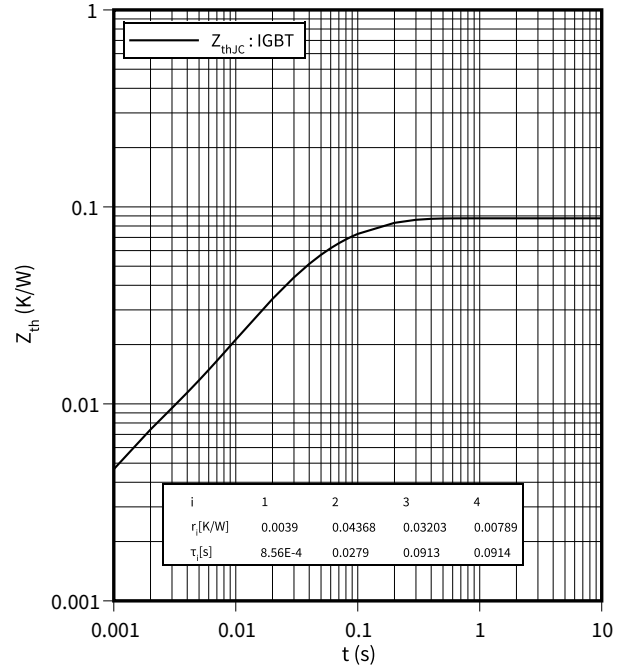
$E = f(R_G)$

$I_C = 450 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = -15 / 15 \text{ V}$



transient thermal impedance , IGBT, Inverter

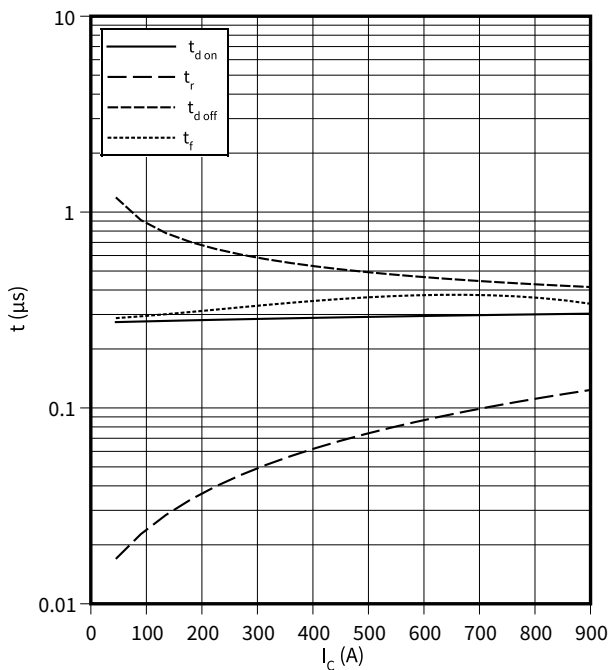
$Z_{th} = f(t)$



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

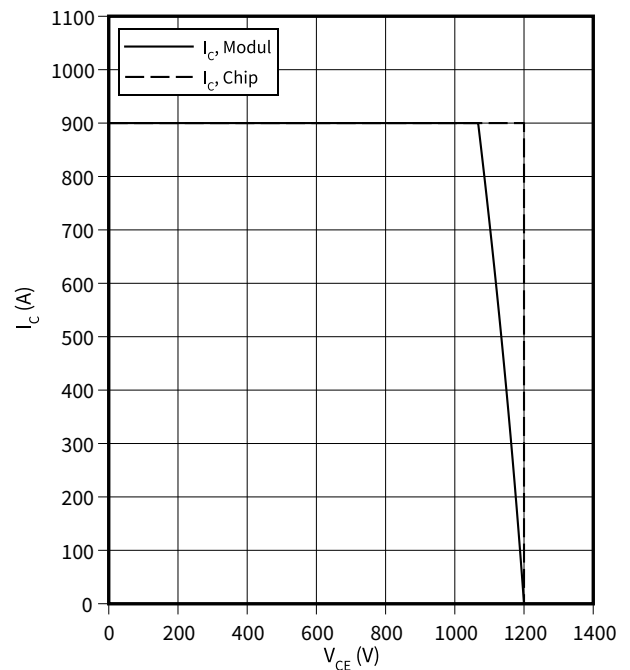
$V_{CE} = 600 \text{ V}, R_{Goff} = 0.6 \Omega, R_{Gon} = 0.6 \Omega, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175 \text{ °C}$



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

$I_C = f(V_{CE})$

$T_{vj} = 175 \text{ °C}, R_{Goff} = 0.6 \Omega, V_{GE} = \pm 15 \text{ V}$

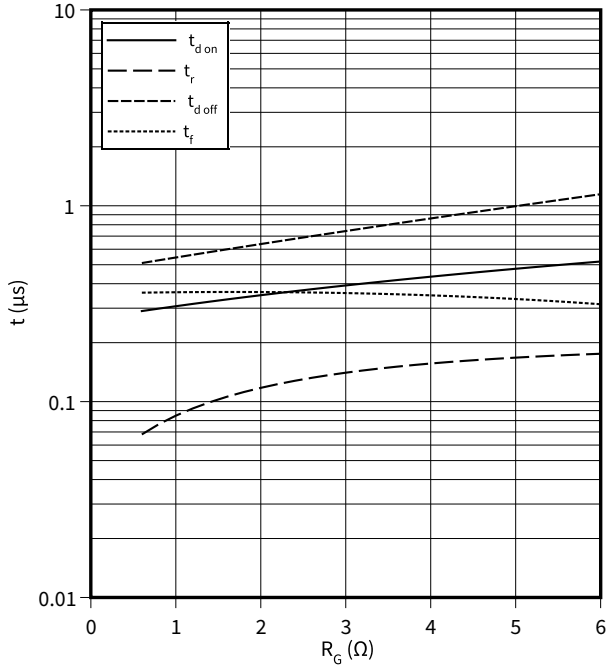


5 Characteristics diagrams

Switching times (typical), IGBT, Inverter

$t = f(R_G)$

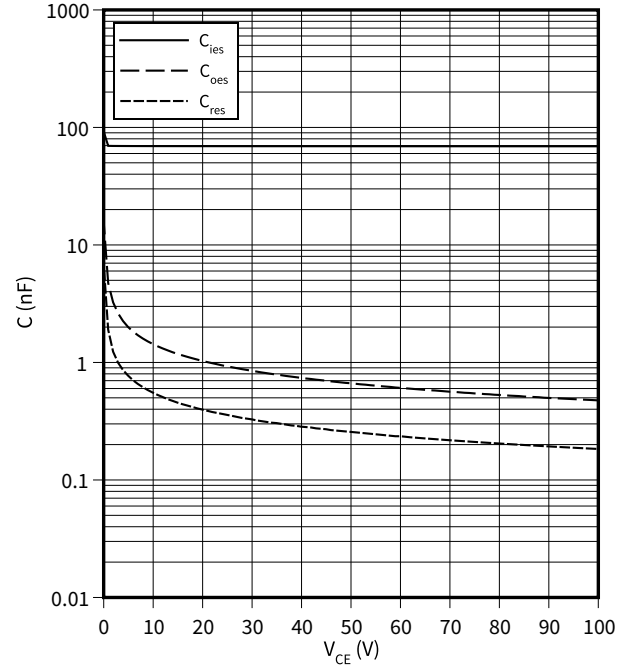
$V_{GE} = \pm 15 \text{ V}, I_C = 450 \text{ A}, V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}$



capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

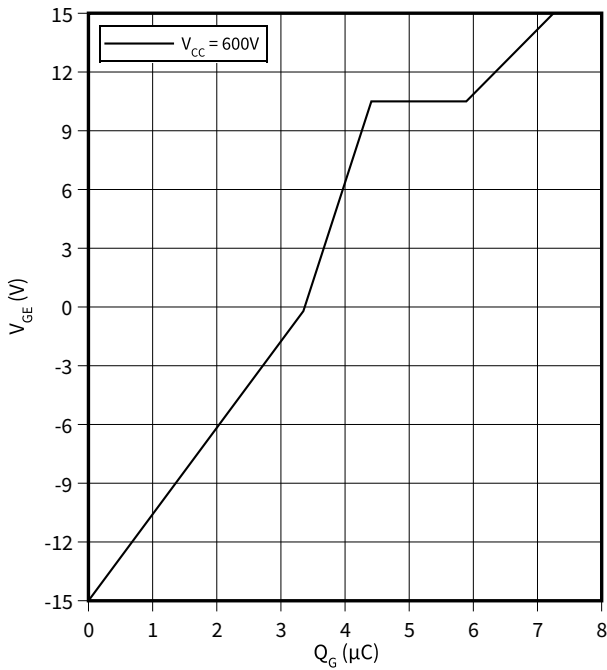
$f = 100 \text{ kHz}, V_{GE} = 0 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}$



gate charge characteristic (typical), IGBT, Inverter

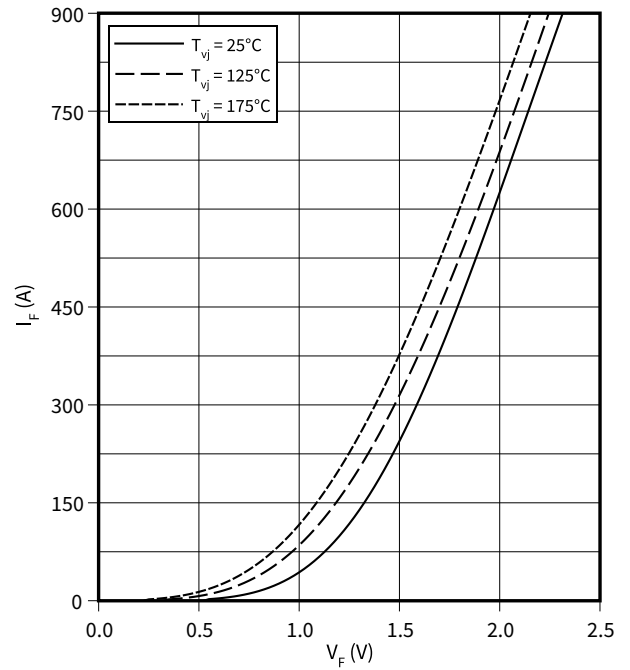
$V_{GE} = f(Q_G)$

$I_C = 450 \text{ A}, T_{vj} = 25 \text{ }^\circ\text{C}$



forward characteristic (typical), Diode, Inverter

$I_F = f(V_F)$

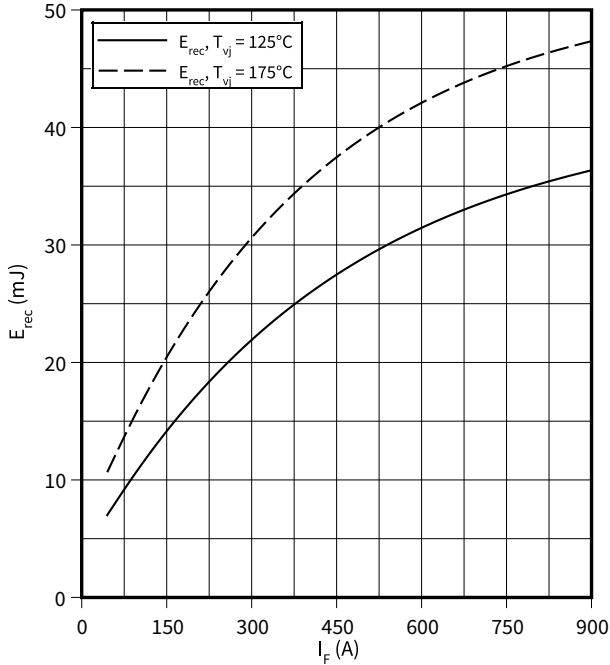


5 Characteristics diagrams

switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

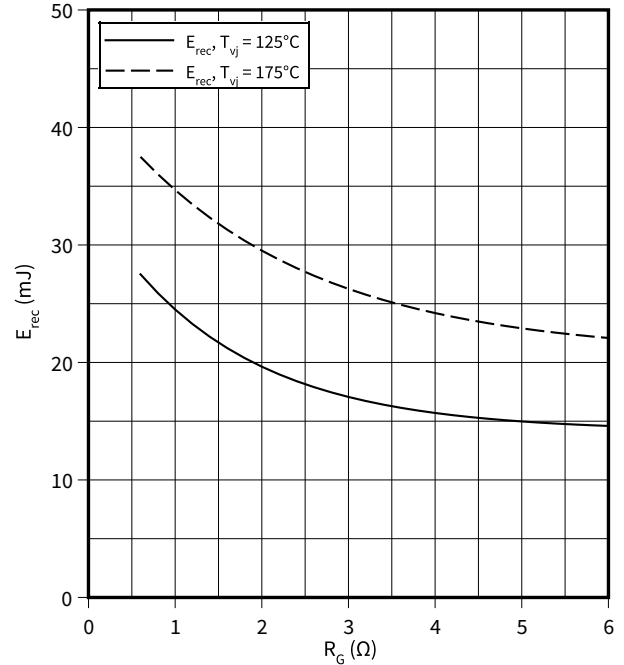
$R_{Gon} = 0.6 \Omega, V_{CE} = 600 V$



switching losses (typical), Diode, Inverter

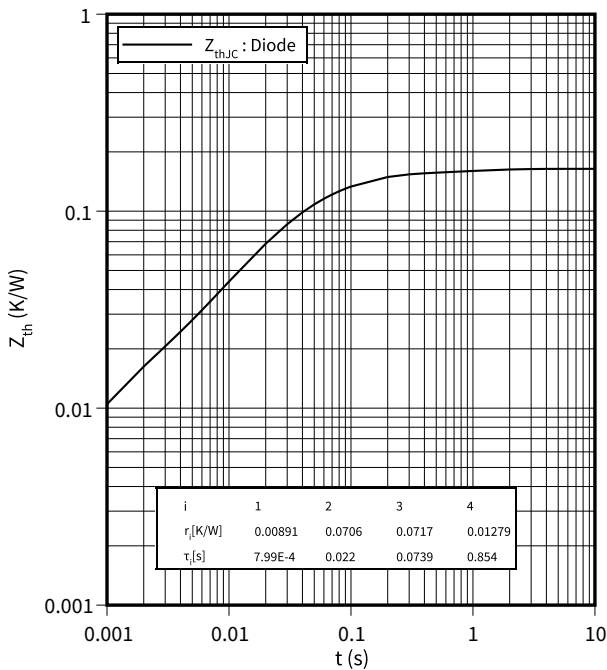
$E_{rec} = f(R_G)$

$V_{CE} = 600 V, I_F = 450 A$



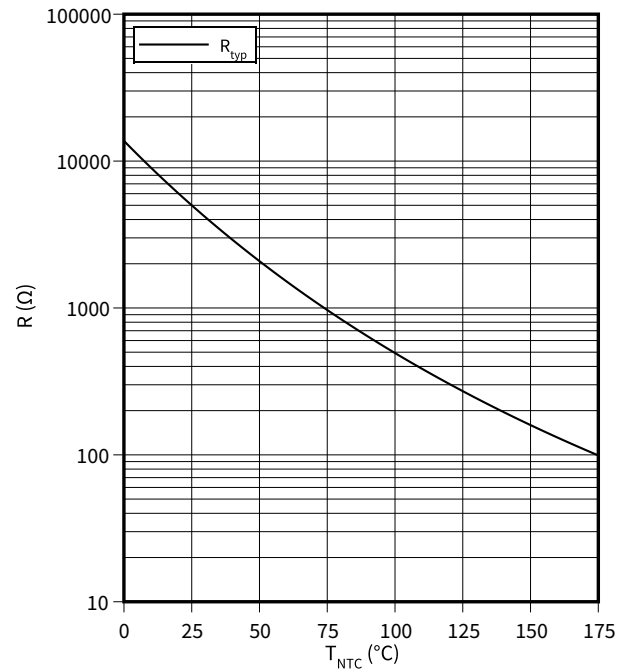
transient thermal impedance , Diode, Inverter

$Z_{th} = f(t)$

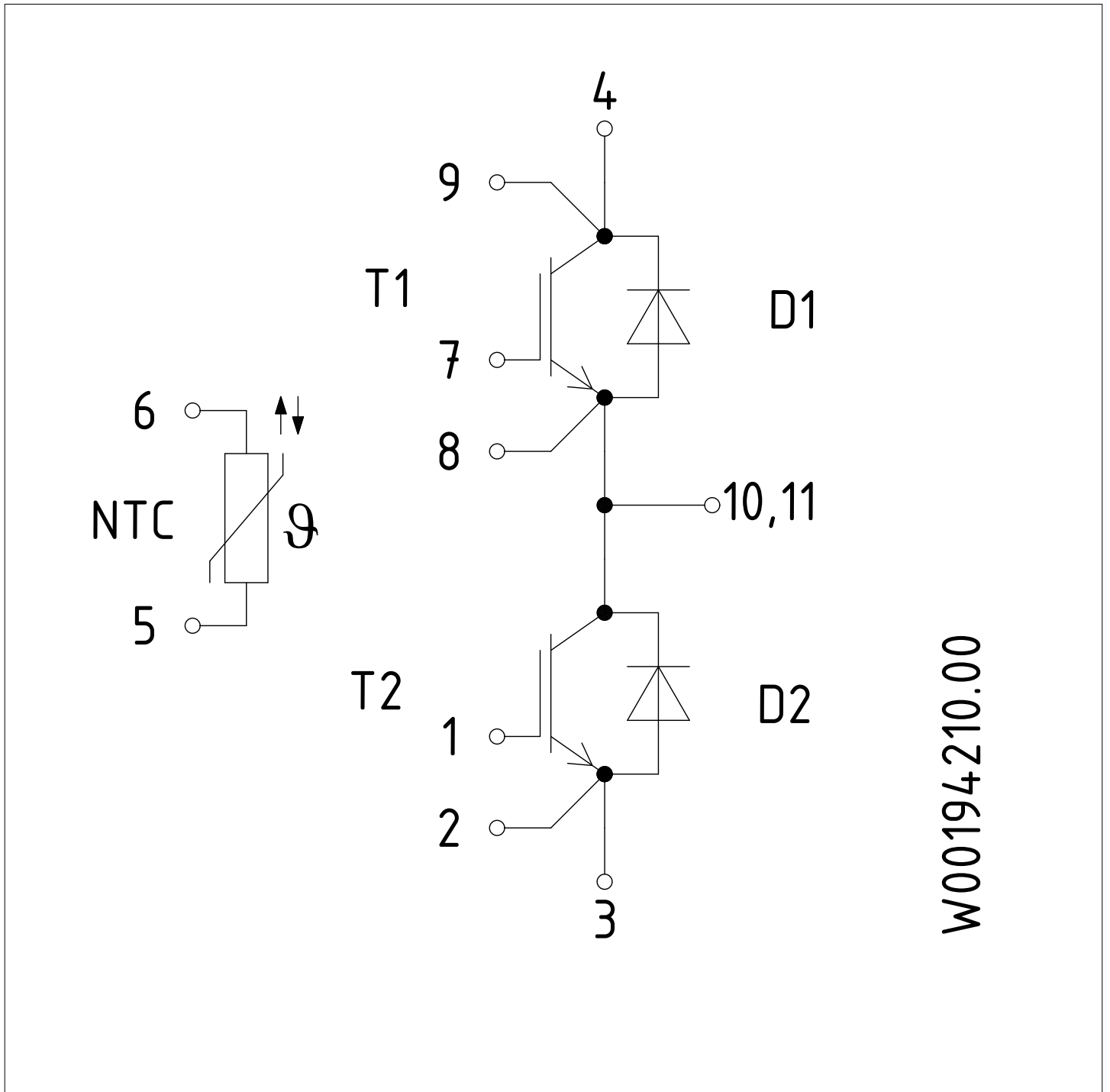


Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 Circuit diagram



W00194210.00

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 | <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

Revision history

Revision history

| Document revision | Date of release | Description of changes |
|-------------------|-----------------|------------------------|
| 0.10 | 2020-11-26 | |
| 1.00 | 2021-05-28 | Final |
| 1.10 | 2021-08-05 | Final datasheet |

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