

## 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

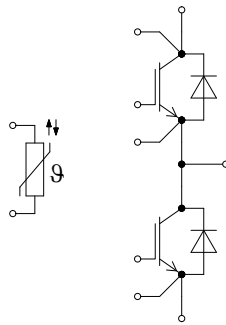
### Potential applications

- 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



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## 1 Package

**Table 1** Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	$V_{ISOL}$	RMS, $f = 50 \text{ Hz}$ , $t = 1 \text{ min}$	3.4	kV
Material of module baseplate			Cu	
Internal Isolation		basic insulation (class 1, IEC 61140)	$\text{Al}_2\text{O}_3$	
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		$\mu C$
Internal gate resistor	$R_{Gint}$	$T_{vj} = 25\ ^\circ C$		0.8		$\Omega$
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	$\mu A$
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		$\mu s$
			$T_{vj} = 125\ ^\circ C$	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		$\mu s$
			$T_{vj} = 125\ ^\circ C$	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		$\mu s$
			$T_{vj} = 125\ ^\circ C$	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		$\mu s$
			$T_{vj} = 125\ ^\circ C$	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	$\text{A}^2\text{s}$
			$T_{vj} = 175^\circ\text{C}$	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		$\mu\text{C}$
			$T_{vj} = 125^\circ\text{C}$		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

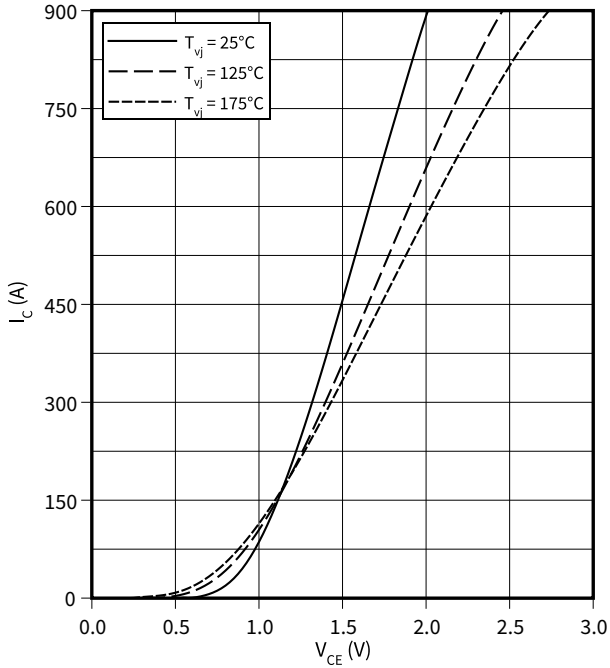
Note: Specification according to the valid application note.

## 5 Characteristics diagrams

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

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

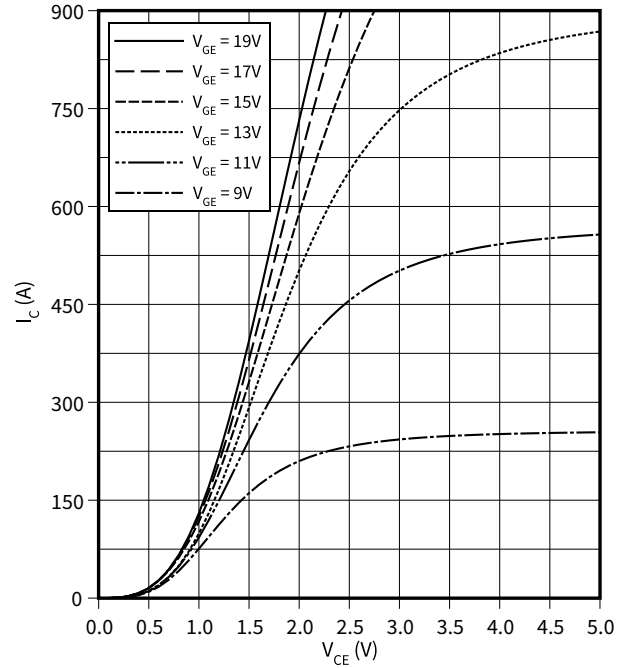
$$V_{GE} = 15 \text{ V}$$



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

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

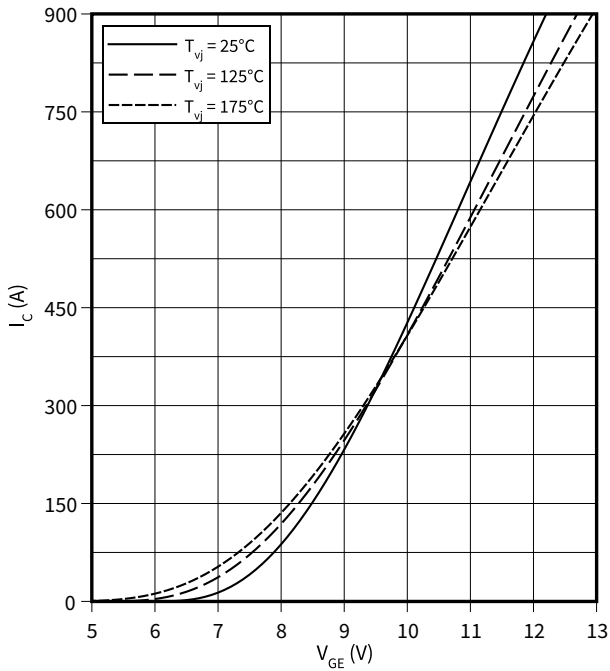
$$T_{vj} = 175 \text{ °C}$$



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

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

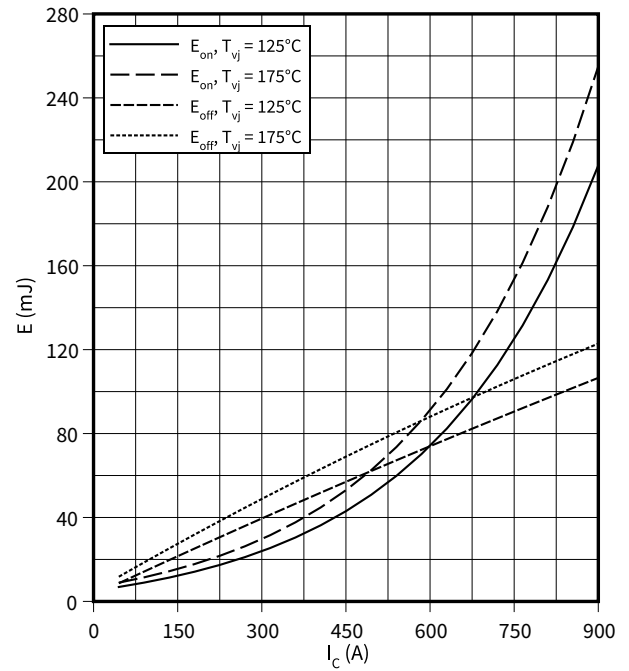
$$V_{CE} = 20 \text{ V}$$



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

$$E = f(I_C)$$

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

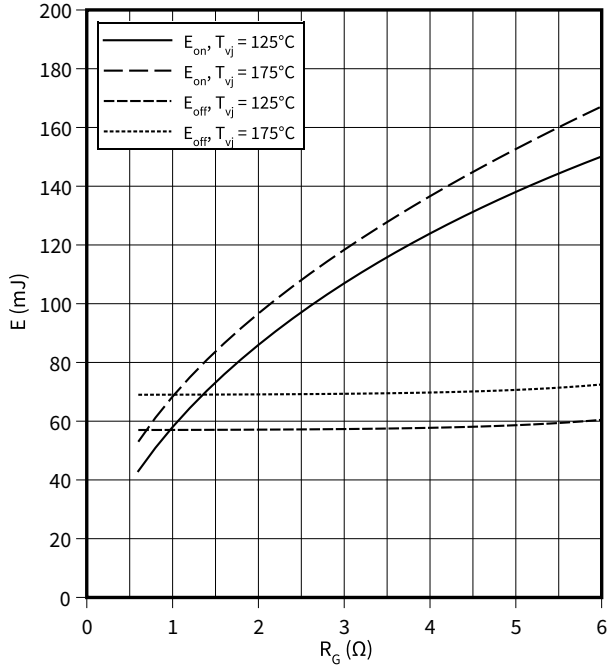


5 Characteristics diagrams

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

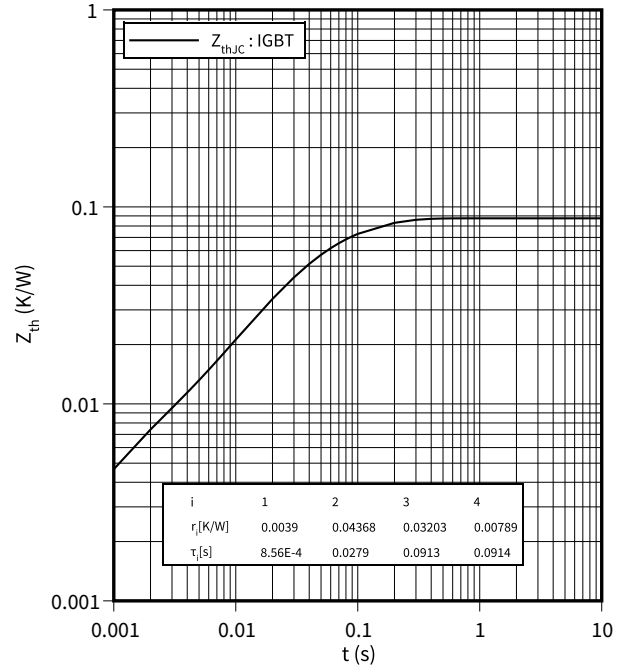
$E = f(R_G)$

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



**transient thermal impedance , IGBT, Inverter**

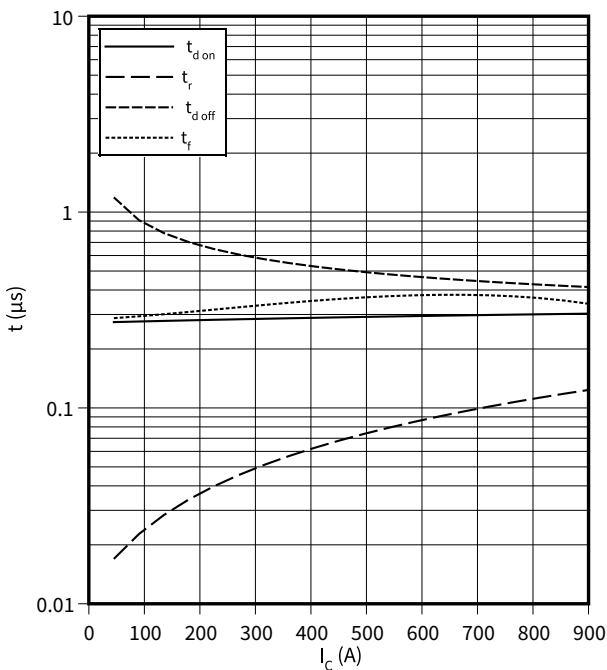
$Z_{th} = f(t)$



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

$t = f(I_C)$

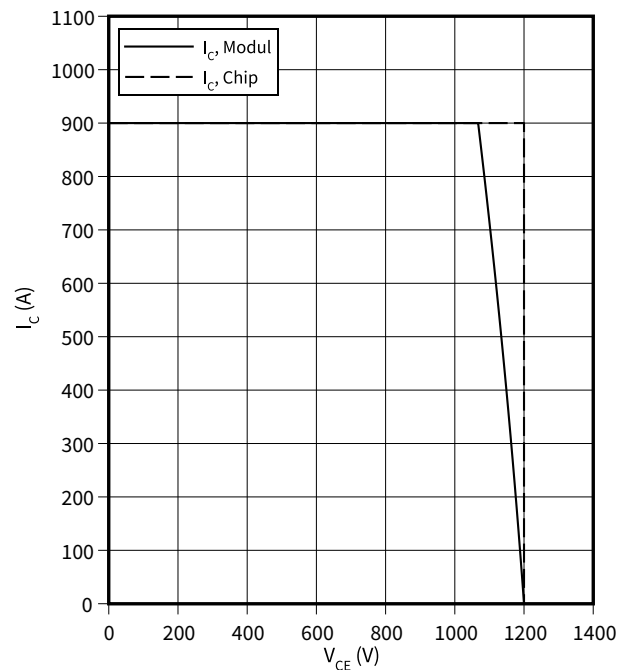
$V_{CE} = 600 \text{ V}, R_{Goff} = 0.6 \Omega, R_{Gon} = 0.6 \Omega, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175 \text{ °C}$



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

$I_C = f(V_{CE})$

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



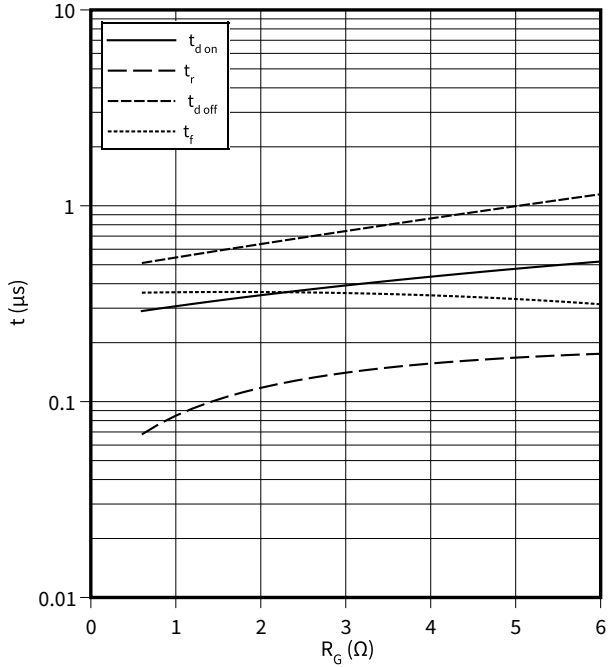


5 Characteristics diagrams

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

$t = f(R_G)$

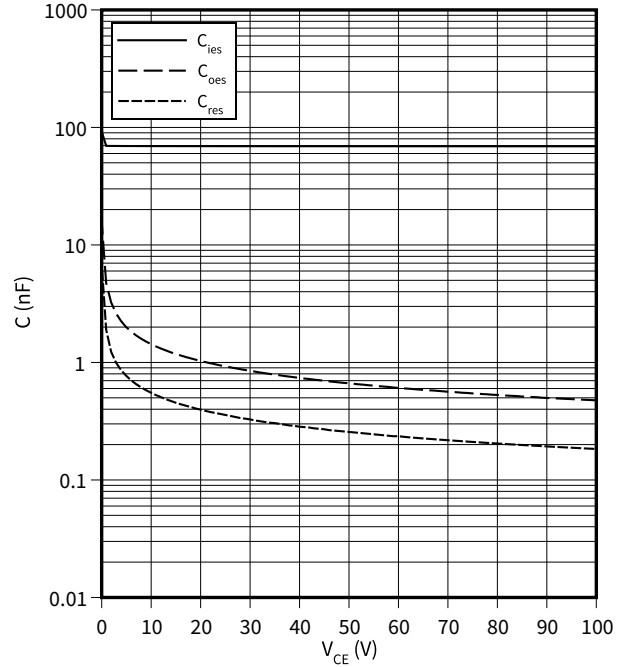
$V_{GE} = \pm 15 \text{ V}, I_C = 450 \text{ A}, V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}$



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

$C = f(V_{CE})$

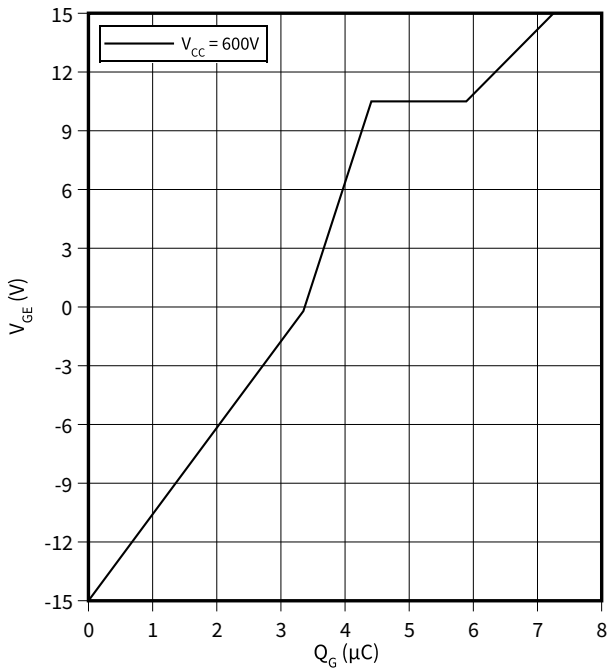
$f = 100 \text{ kHz}, V_{GE} = 0 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}$



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

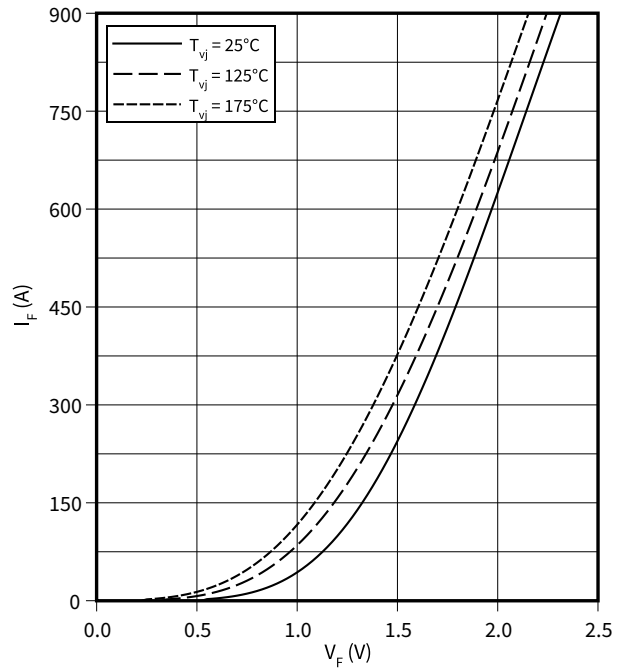
$V_{GE} = f(Q_G)$

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



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

$I_F = f(V_F)$

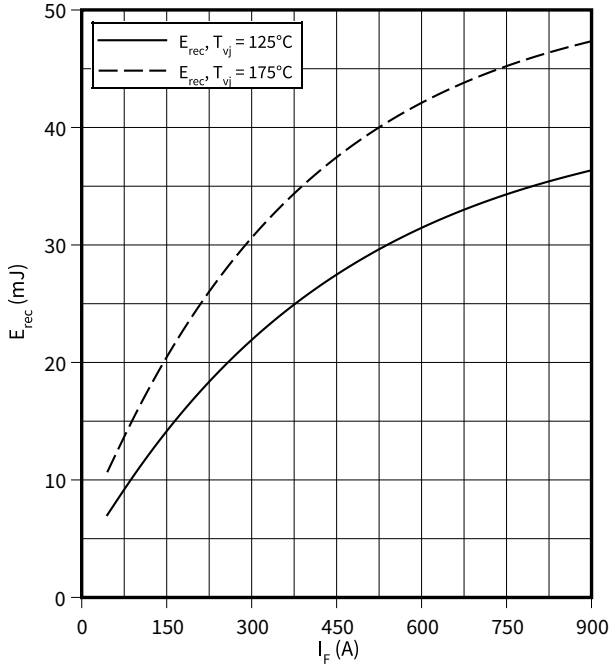


5 Characteristics diagrams

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

$E_{rec} = f(I_F)$

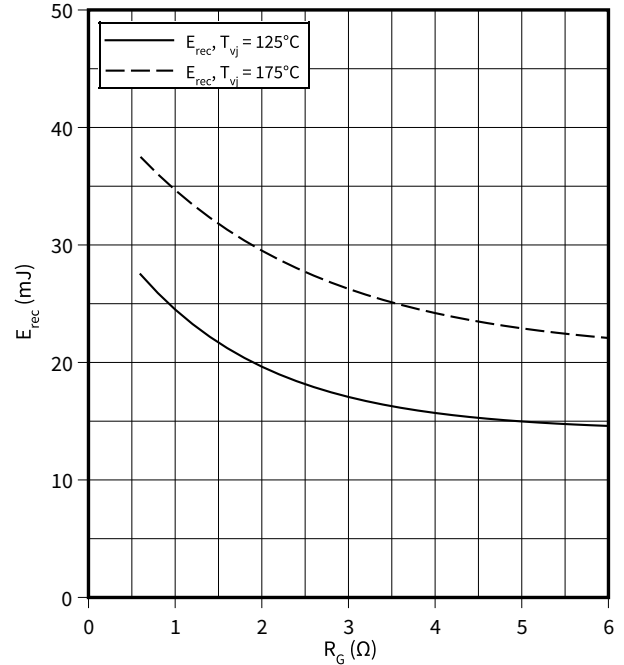
$R_{Gon} = 0.6 \Omega, V_{CE} = 600 V$



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

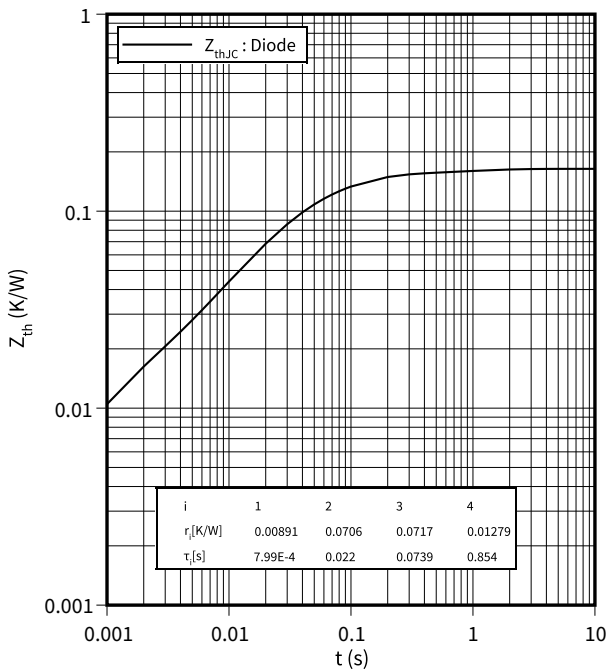
$E_{rec} = f(R_G)$

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



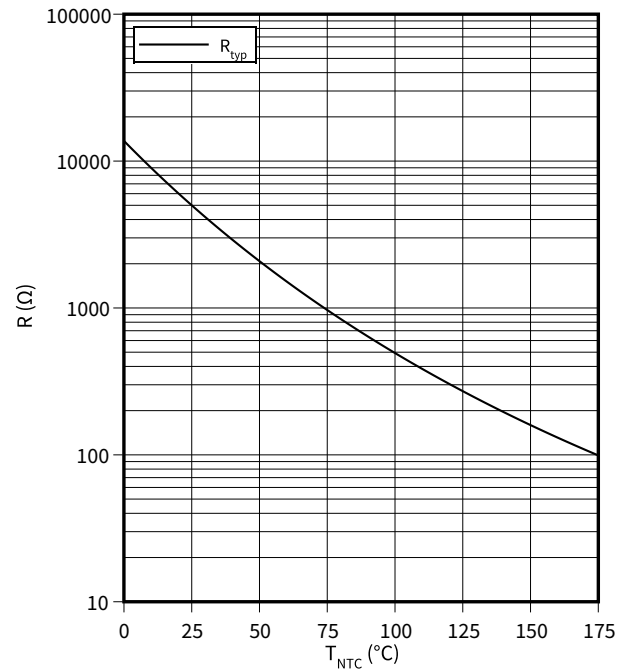
**transient thermal impedance , Diode, Inverter**

$Z_{th} = f(t)$

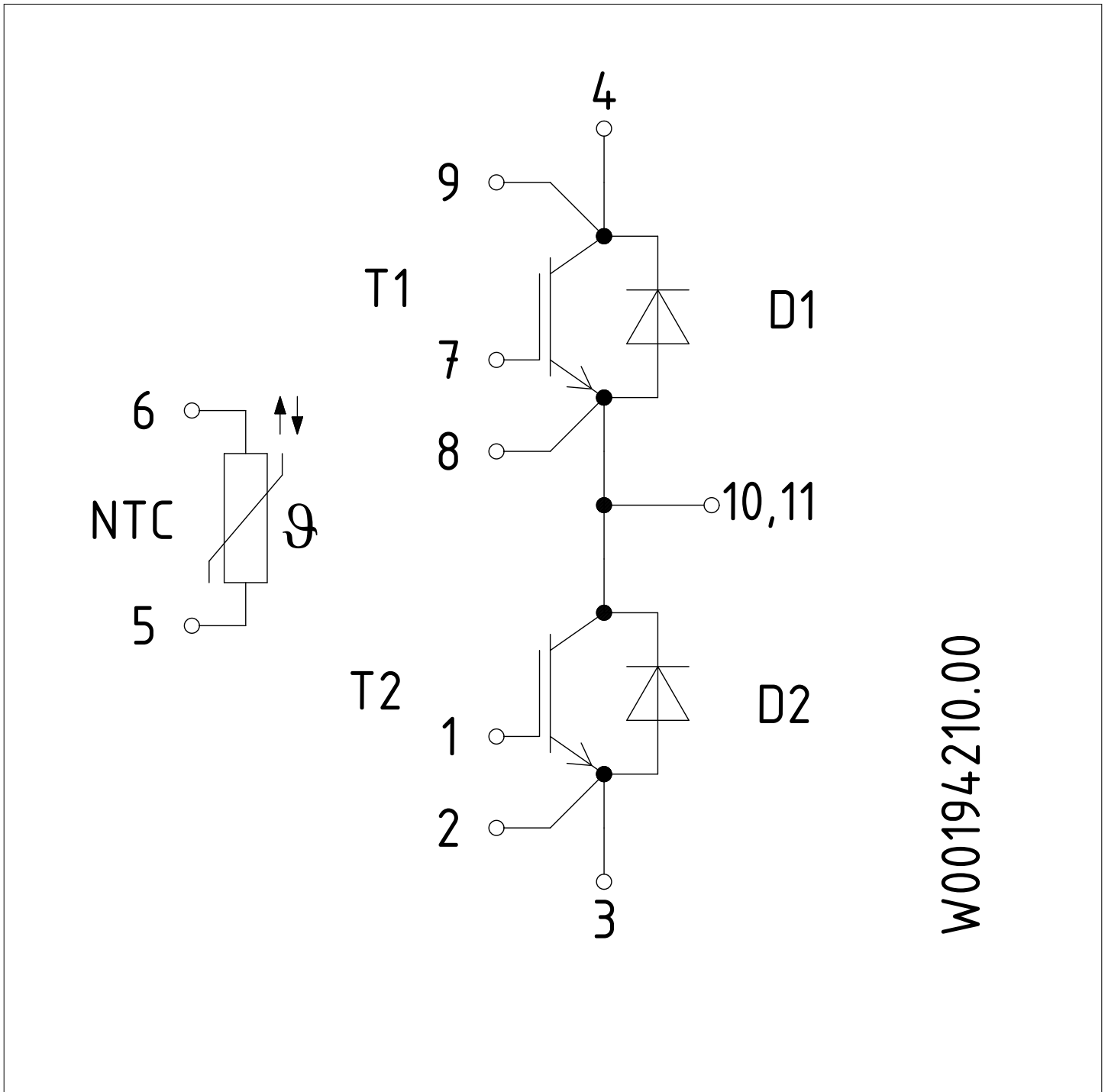


**Temperature characteristic (typical), NTC-Thermistor**

$R = f(T_{NTC})$



## 6 Circuit diagram



W00194210.00

Figure 2

## 7 Package outlines

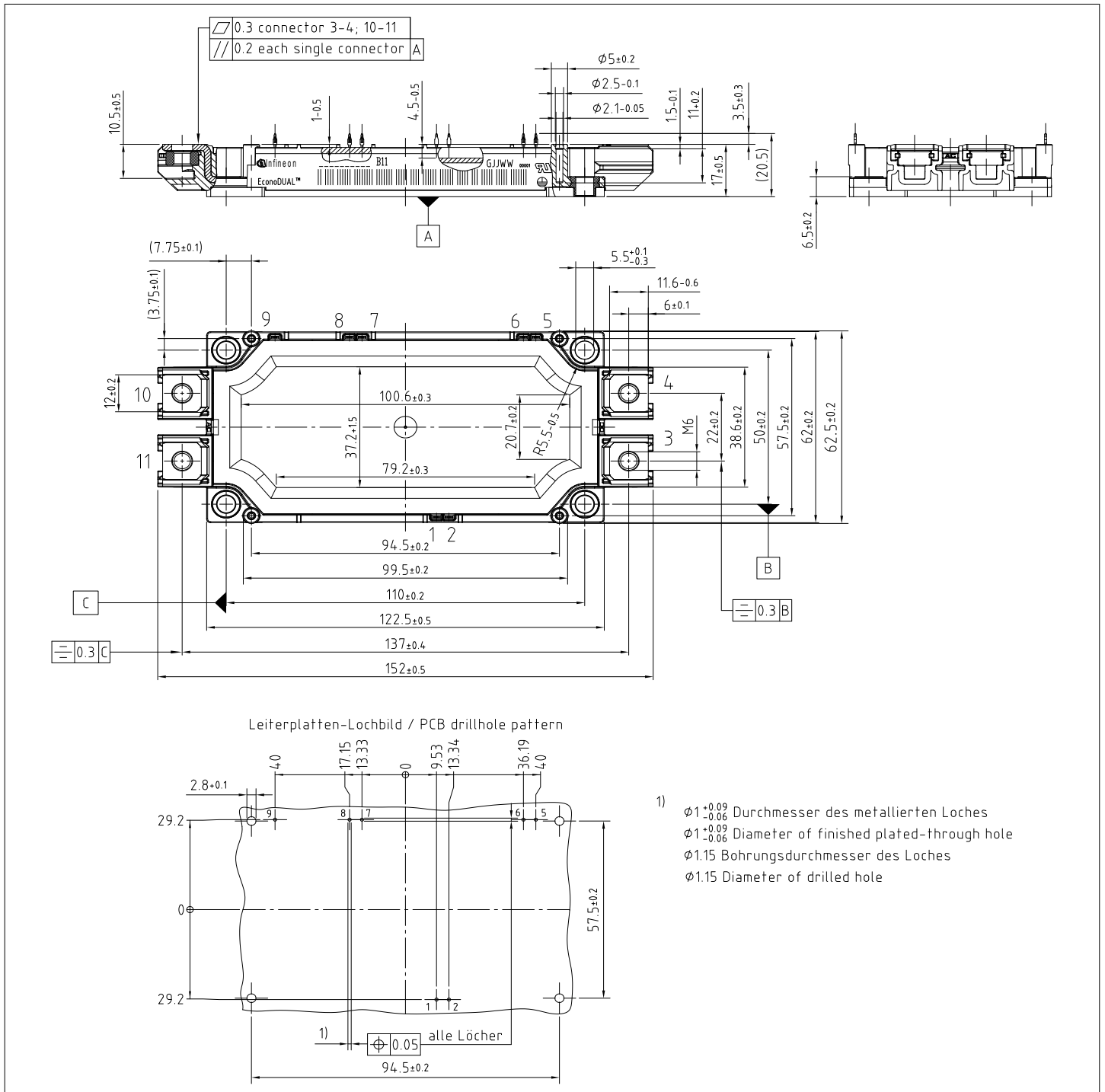




Figure 3

## 8 Module label code

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

**Figure 4**

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Revision history

## Revision history

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

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**Email: [erratum@infineon.com](mailto:erratum@infineon.com)**

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