

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

### Features

- Electrical features
  - $V_{CES} = 1700\text{ V}$
  - $I_{C\text{nom}} = 225\text{ A} / I_{CRM} = 450\text{ A}$
  - Integrated temperature sensor
  - High current density
  - Low  $V_{CE,\text{sat}}$
  - Overload operation up to  $175^\circ\text{C}$
  - TRENCHSTOP™ IGBT7
  - $V_{CE,\text{sat}}$  with positive temperature coefficient
- Mechanical features
  - High power density
  - Isolated base plate
  - PressFIT contact technology
  - Standard housing



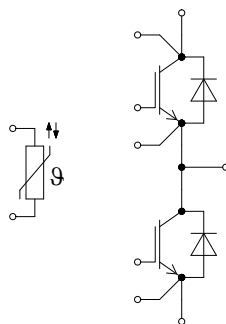
### Potential applications

- High-power converters
- Medium-voltage converters
- Motor drives
- Wind turbines

### 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	3.4	kV
Material of module baseplate			Cu	
Internal isolation		basic insulation (class 1, IEC 61140)	Al2O3	
Creepage distance	$d_{Creep}$	terminal to heatsink	15.0	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	
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	$R_{CC'+EE'}$	T=25°C, per switch		1		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
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	$V_{CES}$	$T_{vj} = 25$ °C	1700	V
Continuous DC collector current	$I_{CDC}$	$T_{vj\ max} = 175$ °C $T_C = 100$ °C	225	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{vj\ op}$	450	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	$V_{CE\ sat}$	$I_C = 225\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		1.70	1.85	V
			$T_{vj} = 125\ ^\circ C$		1.95		
			$T_{vj} = 150\ ^\circ C$		2.05		
			$T_{vj} = 175\ ^\circ C$		2.10		
Gate threshold voltage	$V_{GEth}$	$I_C = 4.62\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$		5.15	5.80	6.45	V
Gate charge	$Q_G$	$V_{GE} = \pm 15\ V, V_{CE} = 900\ V$			2.1		$\mu C$
Internal gate resistor	$R_{Gint}$	$T_{vj} = 25\ ^\circ C$			1		$\Omega$
Input capacitance	$C_{ies}$	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			22.9		nF
Reverse transfer capacitance	$C_{res}$	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			0.08		nF
Collector-emitter cut-off current	$I_{CES}$	$V_{CE} = 1700\ V, V_{GE} = 0\ V$	$T_{vj} = 25\ ^\circ C$			5	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)	$t_{don}$	$I_C = 225\ A, V_{CE} = 900\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.5\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.110		$\mu s$
			$T_{vj} = 125\ ^\circ C$		0.120		
			$T_{vj} = 150\ ^\circ C$		0.125		
			$T_{vj} = 175\ ^\circ C$		0.130		
Rise time (inductive load)	$t_r$	$I_C = 225\ A, V_{CE} = 900\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.5\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.025		$\mu s$
			$T_{vj} = 125\ ^\circ C$		0.030		
			$T_{vj} = 150\ ^\circ C$		0.032		
			$T_{vj} = 175\ ^\circ C$		0.034		
Turn-off delay time (inductive load)	$t_{doff}$	$I_C = 225\ A, V_{CE} = 900\ V, V_{GE} = \pm 15\ V, R_{Goff} = 6.2\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.467		$\mu s$
			$T_{vj} = 125\ ^\circ C$		0.553		
			$T_{vj} = 150\ ^\circ C$		0.570		
			$T_{vj} = 175\ ^\circ C$		0.586		
Fall time (inductive load)	$t_f$	$I_C = 225\ A, V_{CE} = 900\ V, V_{GE} = \pm 15\ V, R_{Goff} = 6.2\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.271		$\mu s$
			$T_{vj} = 125\ ^\circ C$		0.494		
			$T_{vj} = 150\ ^\circ C$		0.567		
			$T_{vj} = 175\ ^\circ C$		0.640		
Turn-on energy loss per pulse	$E_{on}$	$I_C = 225\ A, V_{CE} = 900\ V, L_\sigma = 25\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 1.5\ \Omega, di/dt = 5100\ A/\mu s (T_{vj} = 175\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		28.2		mJ
			$T_{vj} = 125\ ^\circ C$		49.4		
			$T_{vj} = 150\ ^\circ C$		55.5		
			$T_{vj} = 175\ ^\circ C$		61.5		

(table continues...)

**Table 4 (continued) Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Turn-off energy loss per pulse	$E_{off}$	$I_C = 225\text{ A}, V_{CE} = 900\text{ V}, L_\sigma = 25\text{ nH}, V_{GE} = \pm 15\text{ V}, R_{Goff} = 6.2\ \Omega, dv/dt = 3500\text{ V}/\mu\text{s} (T_{vj} = 175\text{ }^\circ\text{C})$	$T_{vj} = 25\text{ }^\circ\text{C}$		37.3		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$		59.4		
			$T_{vj} = 150\text{ }^\circ\text{C}$		65.5		
			$T_{vj} = 175\text{ }^\circ\text{C}$		71.5		
SC data	$I_{SC}$	$V_{GE} = 15\text{ V}, V_{CC} = 1000\text{ V}, V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_p \leq 8\ \mu\text{s}, T_{vj} = 150\text{ }^\circ\text{C}$		870		A
			$t_p \leq 6\ \mu\text{s}, T_{vj} = 175\text{ }^\circ\text{C}$		840		
Thermal resistance, junction to case	$R_{thJC}$	per IGBT				0.145	K/W
Thermal resistance, case to heat sink	$R_{thCH}$	per IGBT, $\lambda_{grease} = 1\text{ W}/(\text{m} \cdot \text{K})$			0.0270		K/W
Temperature under switching conditions	$T_{vj\ op}$		-40			175	$^\circ\text{C}$

Note:  $T_{vj\ op} > 150\text{ }^\circ\text{C}$  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	$V_{RRM}$	$T_{vj} = 25\text{ }^\circ\text{C}$	1700	V	
Continuous DC forward current	$I_F$		225	A	
Repetitive peak forward current	$I_{FRM}$	$t_p = 1\text{ ms}$	450	A	
$I^2t$ - value	$I^2t$	$t_p = 10\text{ ms}, V_R = 0\text{ V}$	$T_{vj} = 125\text{ }^\circ\text{C}$	4660	$\text{A}^2\text{s}$
			$T_{vj} = 175\text{ }^\circ\text{C}$	3860	

**Table 6** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	$V_F$	$I_F = 225 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$		2.35	2.50	V
			$T_{vj} = 125 \text{ °C}$		2.25		
			$T_{vj} = 150 \text{ °C}$		2.20		
			$T_{vj} = 175 \text{ °C}$		2.10		
Peak reverse recovery current	$I_{RM}$	$V_R = 900 \text{ V}, I_F = 225 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6700 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		332		A
			$T_{vj} = 125 \text{ °C}$		356		
			$T_{vj} = 150 \text{ °C}$		360		
			$T_{vj} = 175 \text{ °C}$		363		
Recovered charge	$Q_r$	$V_R = 900 \text{ V}, I_F = 225 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6700 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		30.4		$\mu\text{C}$
			$T_{vj} = 125 \text{ °C}$		57.2		
			$T_{vj} = 150 \text{ °C}$		66		
			$T_{vj} = 175 \text{ °C}$		75.3		
Reverse recovery energy	$E_{rec}$	$V_R = 900 \text{ V}, I_F = 225 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6700 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		16.1		mJ
			$T_{vj} = 125 \text{ °C}$		33		
			$T_{vj} = 150 \text{ °C}$		38.7		
			$T_{vj} = 175 \text{ °C}$		44.4		
Thermal resistance, junction to case	$R_{thJC}$	per diode			0.237	K/W	
Thermal resistance, case to heat sink	$R_{thCH}$	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}^*\text{K})$		0.0300		K/W	
Temperature under switching conditions	$T_{vj op}$		-40		175	°C	

Note:  $T_{vj op} > 150 \text{ °C}$  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	$R_{25}$	$T_{NTC} = 25 \text{ °C}$		5		k $\Omega$
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

(table continues...)

**Table 7** (continued) **Characteristic values**

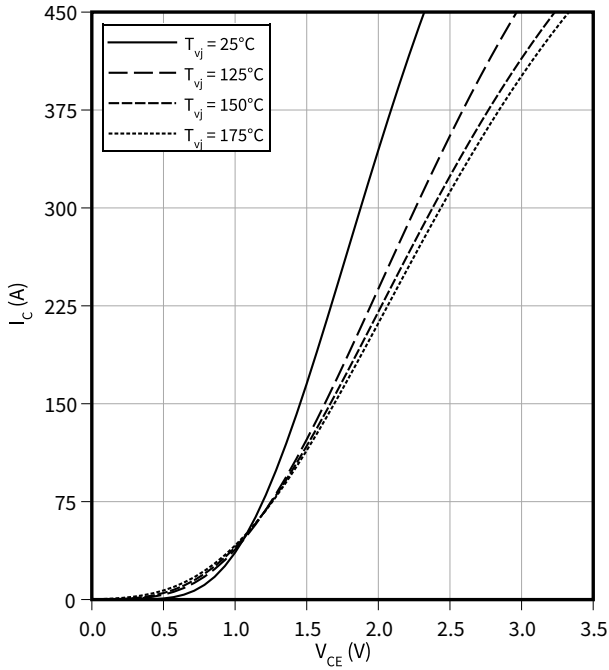
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298,15 \text{ K}))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298,15 \text{ K}))]$		3433		K

Note: Specification according to the valid application note.

## 5 Characteristics diagrams

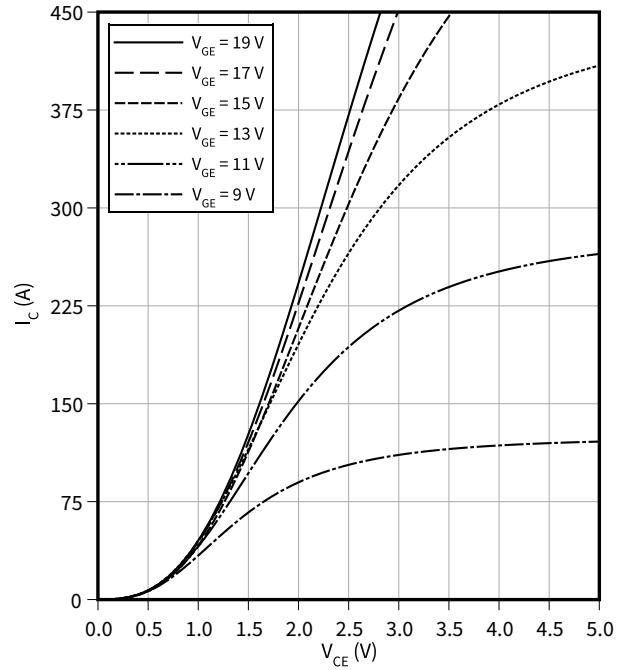
**Output characteristic (typical), IGBT, Inverter**

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



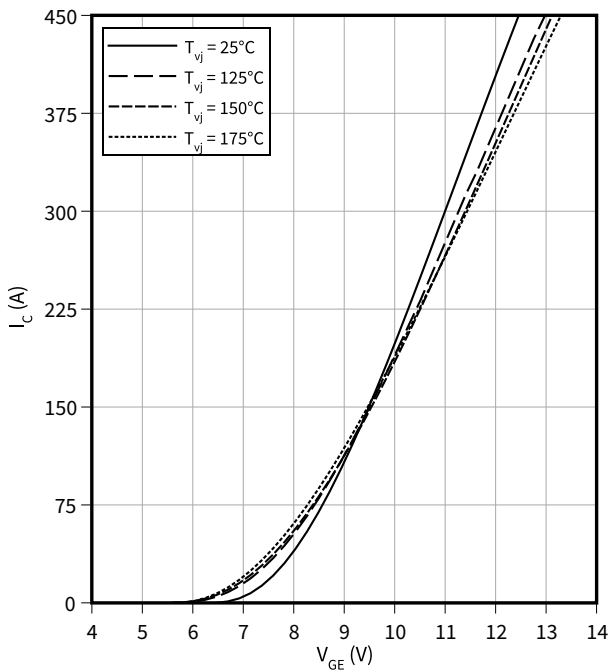
**Output characteristic field (typical), IGBT, Inverter**

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



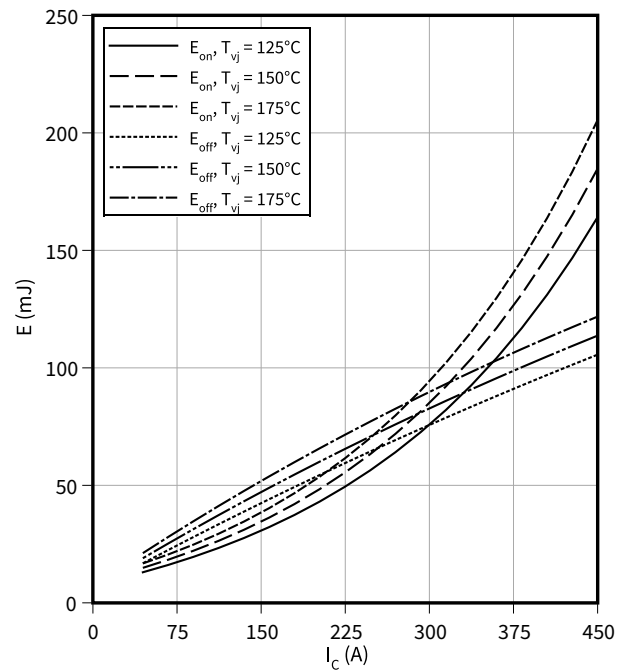
**Transfer characteristic (typical), IGBT, Inverter**

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



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

$E = f(I_C)$   
 $R_{Goff} = 6.2 \text{ } \Omega$ ,  $R_{Gon} = 1.5 \text{ } \Omega$ ,  $V_{CE} = 900 \text{ V}$ ,  $V_{GE} = \pm 15 \text{ V}$



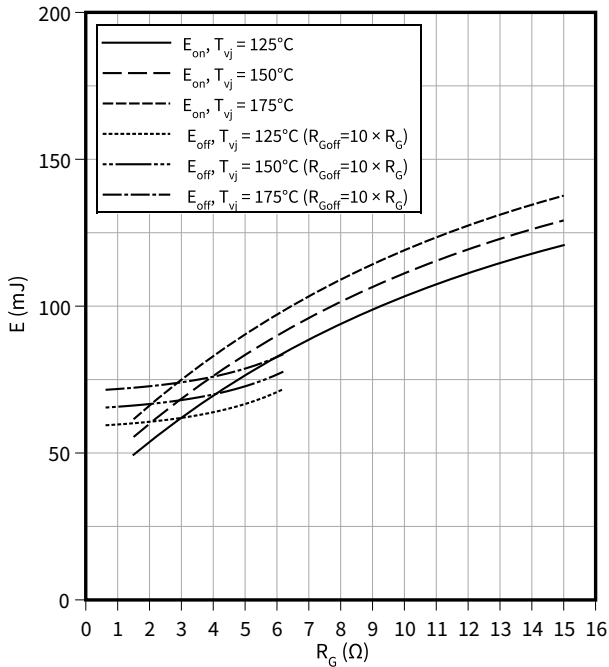


**5 Characteristics diagrams**

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

$E = f(R_G)$

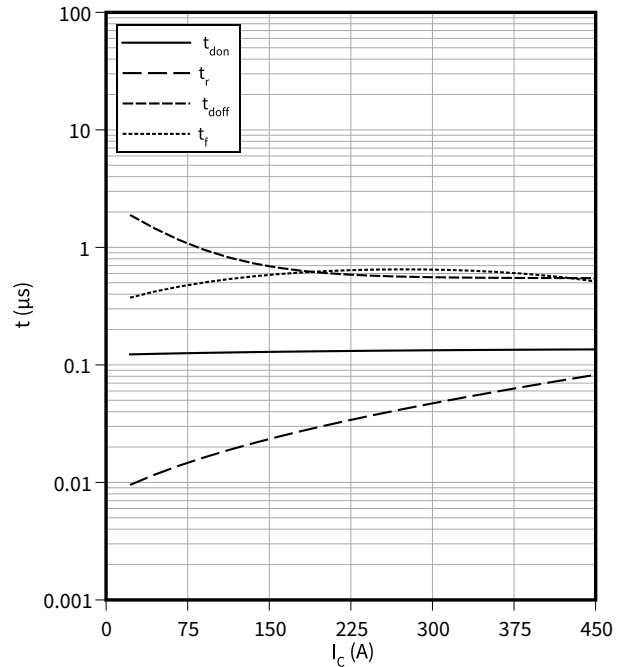
$I_C = 225 \text{ A}, V_{CE} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}$



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

$t = f(I_C)$

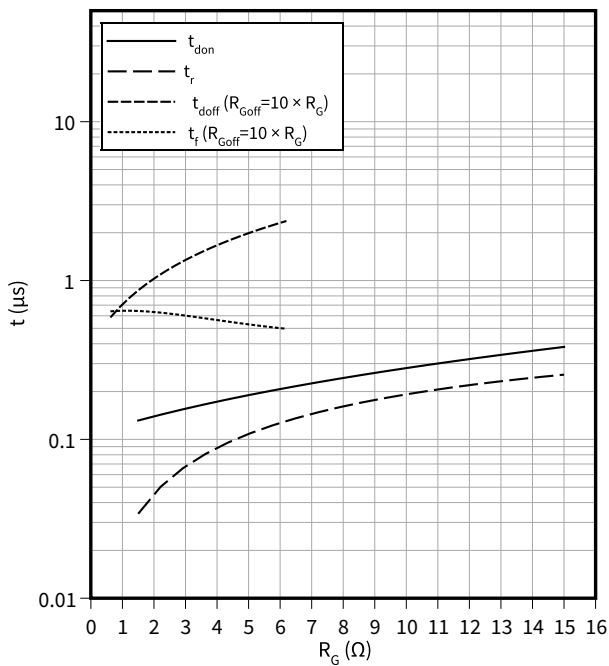
$R_{Goff} = 6.2 \Omega, R_{Gon} = 1.5 \Omega, V_{CE} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175^\circ\text{C}$



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

$t = f(R_G)$

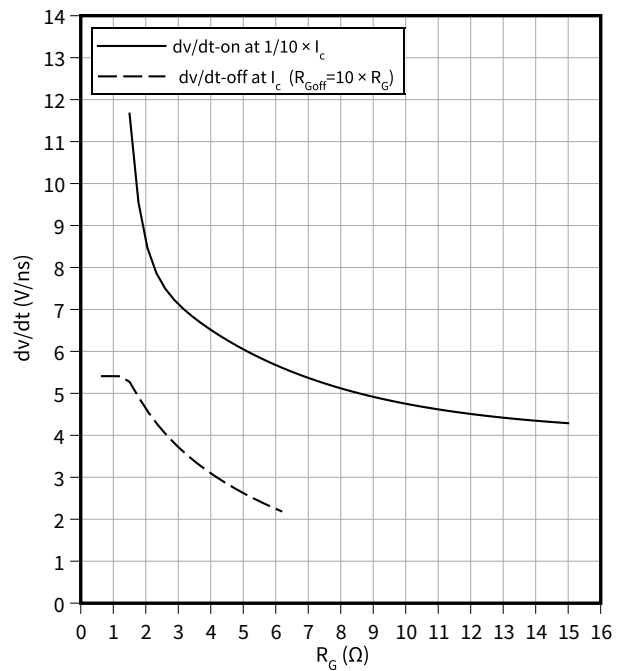
$I_C = 225 \text{ A}, V_{CE} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175^\circ\text{C}$



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

$dv/dt = f(R_G)$

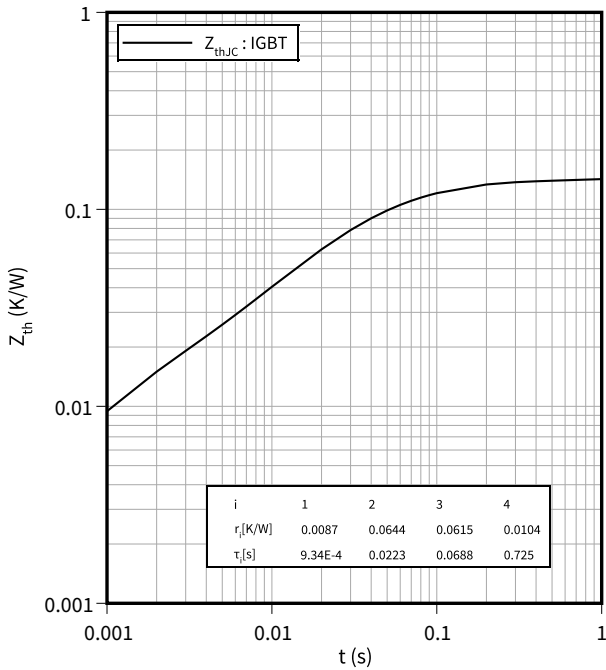
$I_C = 225 \text{ A}, V_{CE} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 25^\circ\text{C}$



**5 Characteristics diagrams**

**Transient thermal impedance , IGBT, Inverter**

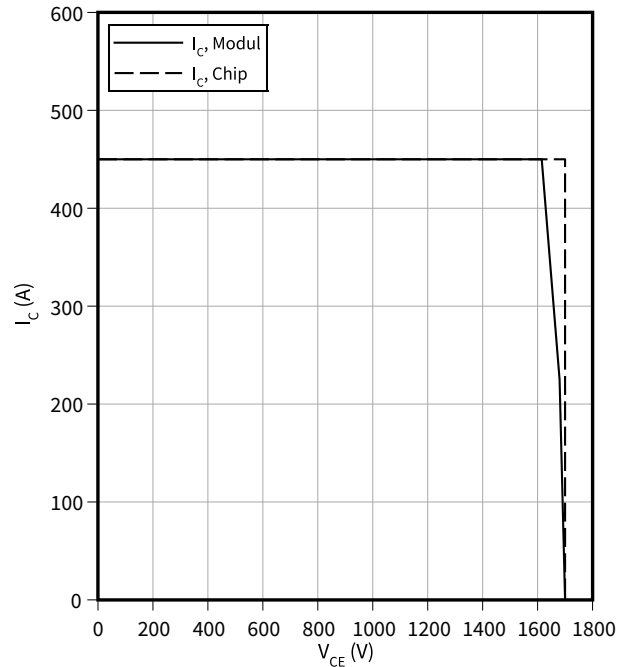
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

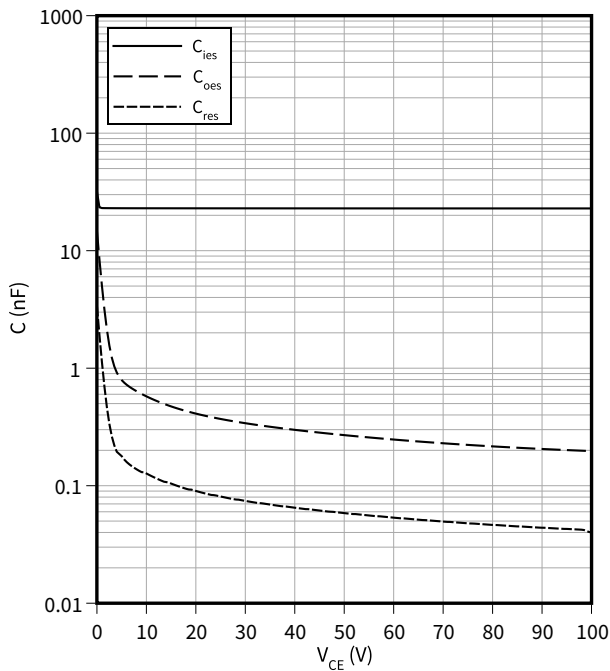
$R_{Goff} = 6.2 \Omega, V_{GE} = \pm 15 V, T_{vj} = 175 \text{ }^\circ\text{C}$



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

$C = f(V_{CE})$

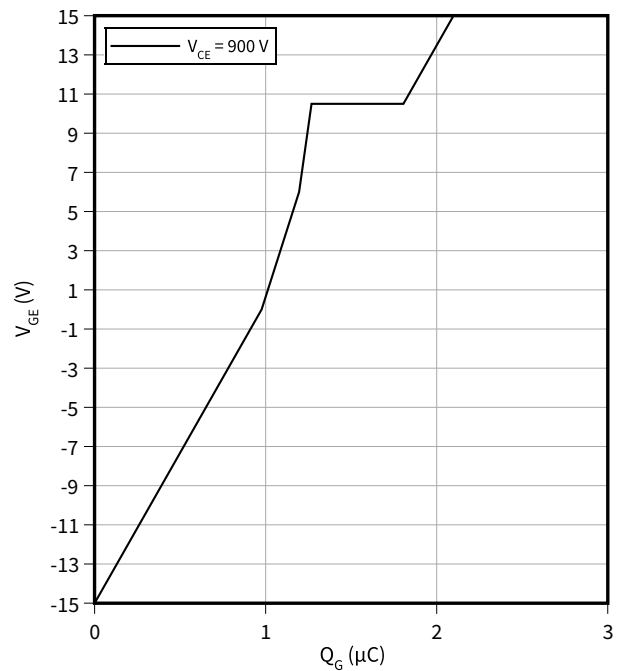
$f = 100 \text{ kHz}, V_{GE} = 0 V, T_{vj} = 25 \text{ }^\circ\text{C}$



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

$V_{GE} = f(Q_G)$

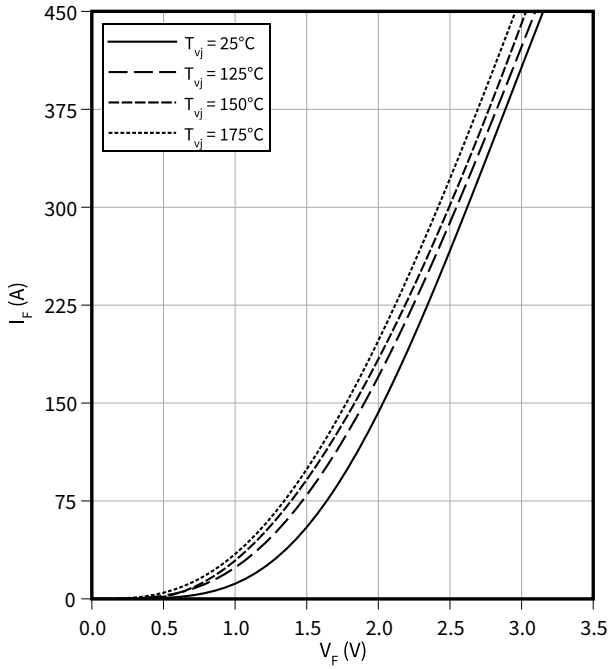
$I_C = 225 A, T_{vj} = 25 \text{ }^\circ\text{C}$



5 Characteristics diagrams

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

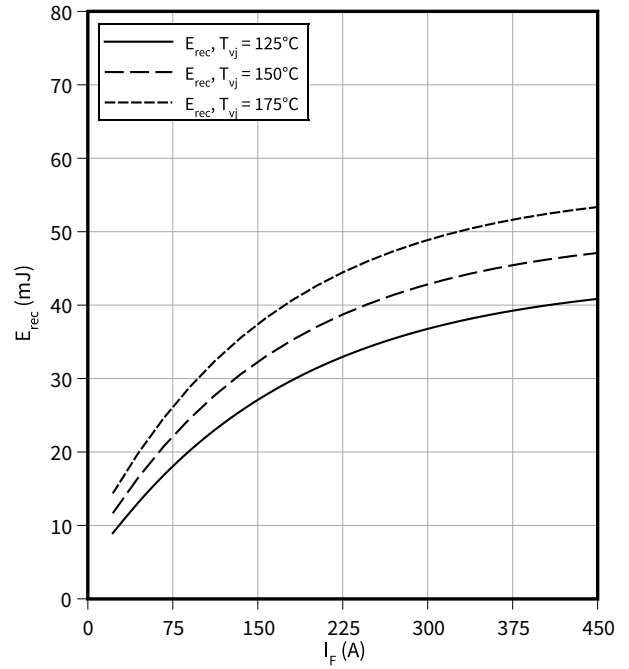
$I_F = f(V_F)$



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

$E_{rec} = f(I_F)$

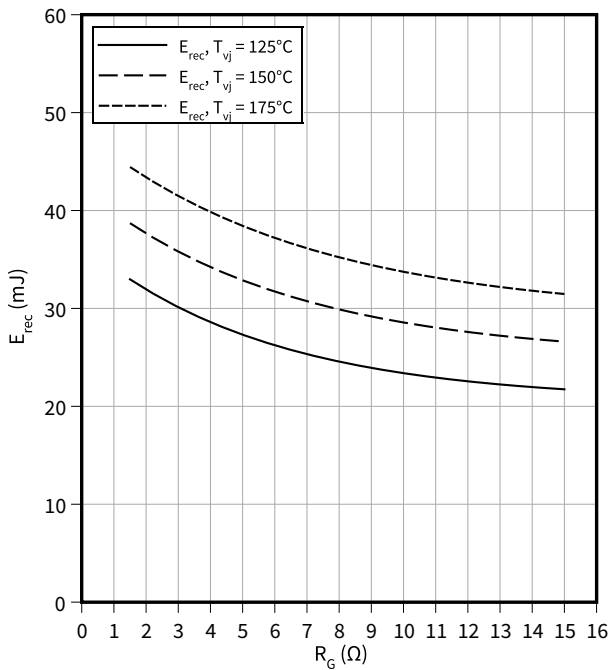
$R_{Gon} = 1.5 \Omega, V_R = 900 V$



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

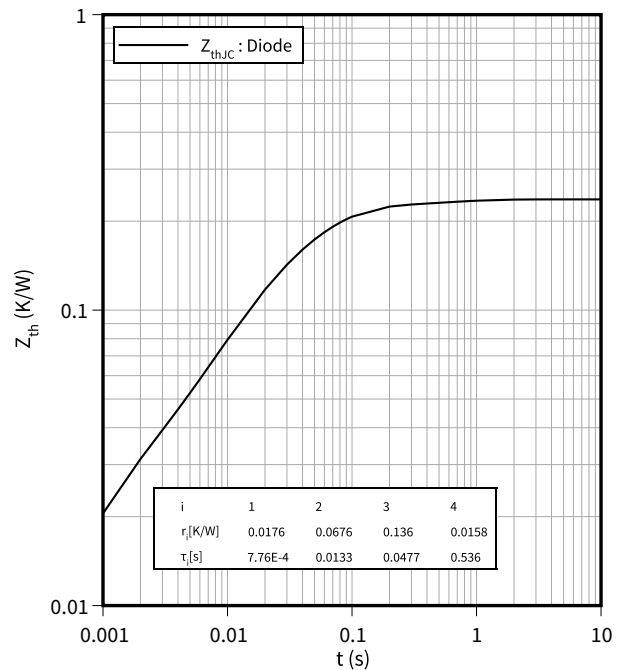
$E_{rec} = f(R_G)$

$I_F = 225 A, V_R = 900 V$



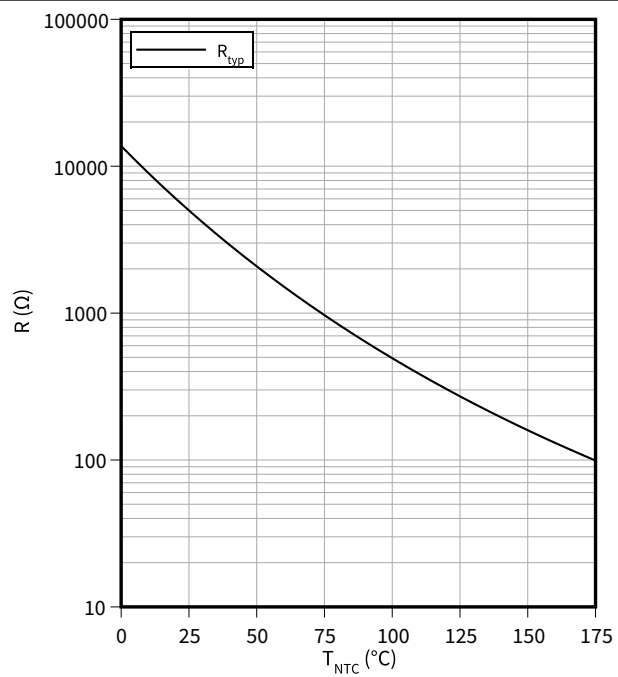
**Transient thermal impedance, Diode, Inverter**

$Z_{th} = f(t)$

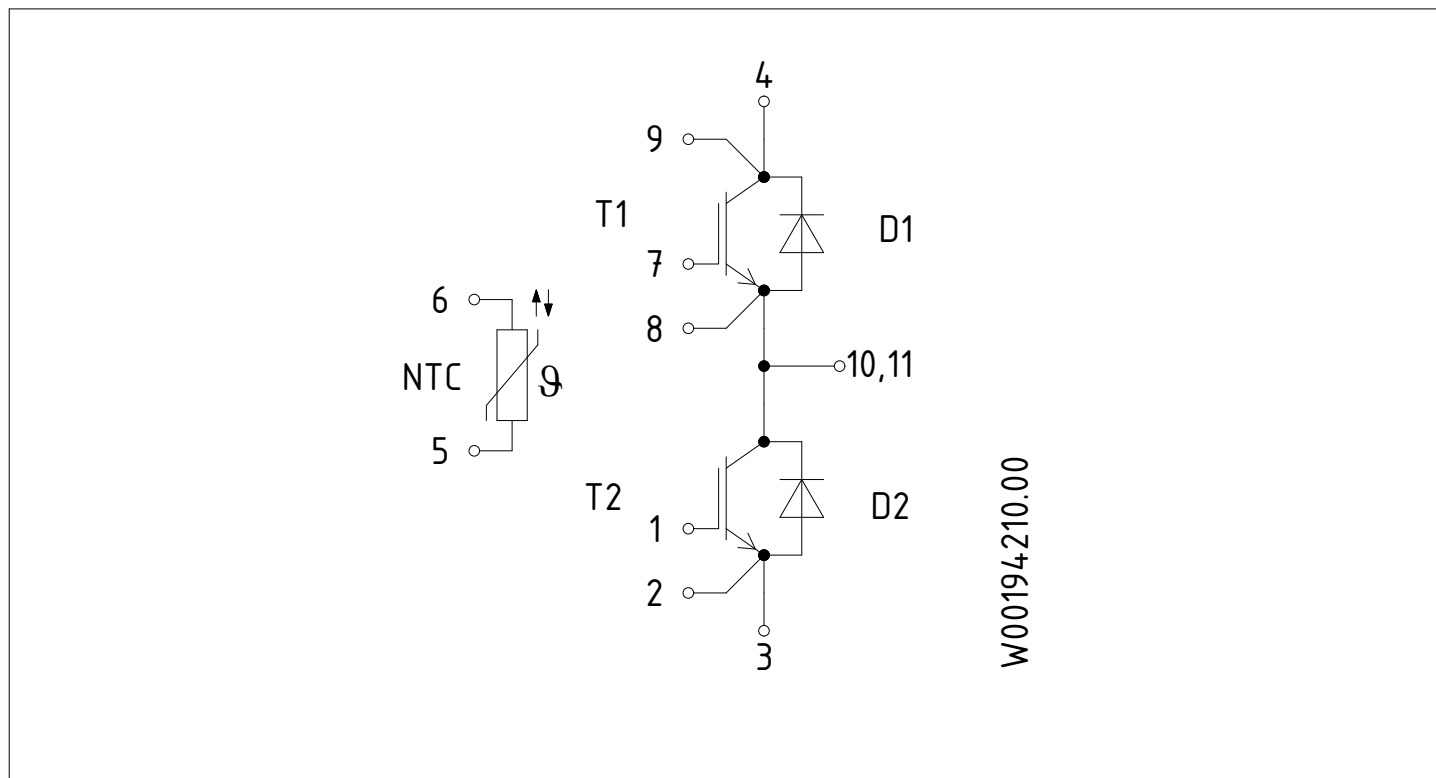


Temperature characteristic (typical), NTC-Thermistor

$$R = f(T_{NTC})$$



## 6 Circuit diagram



W00194210.00

Figure 1

## 7 Package outlines

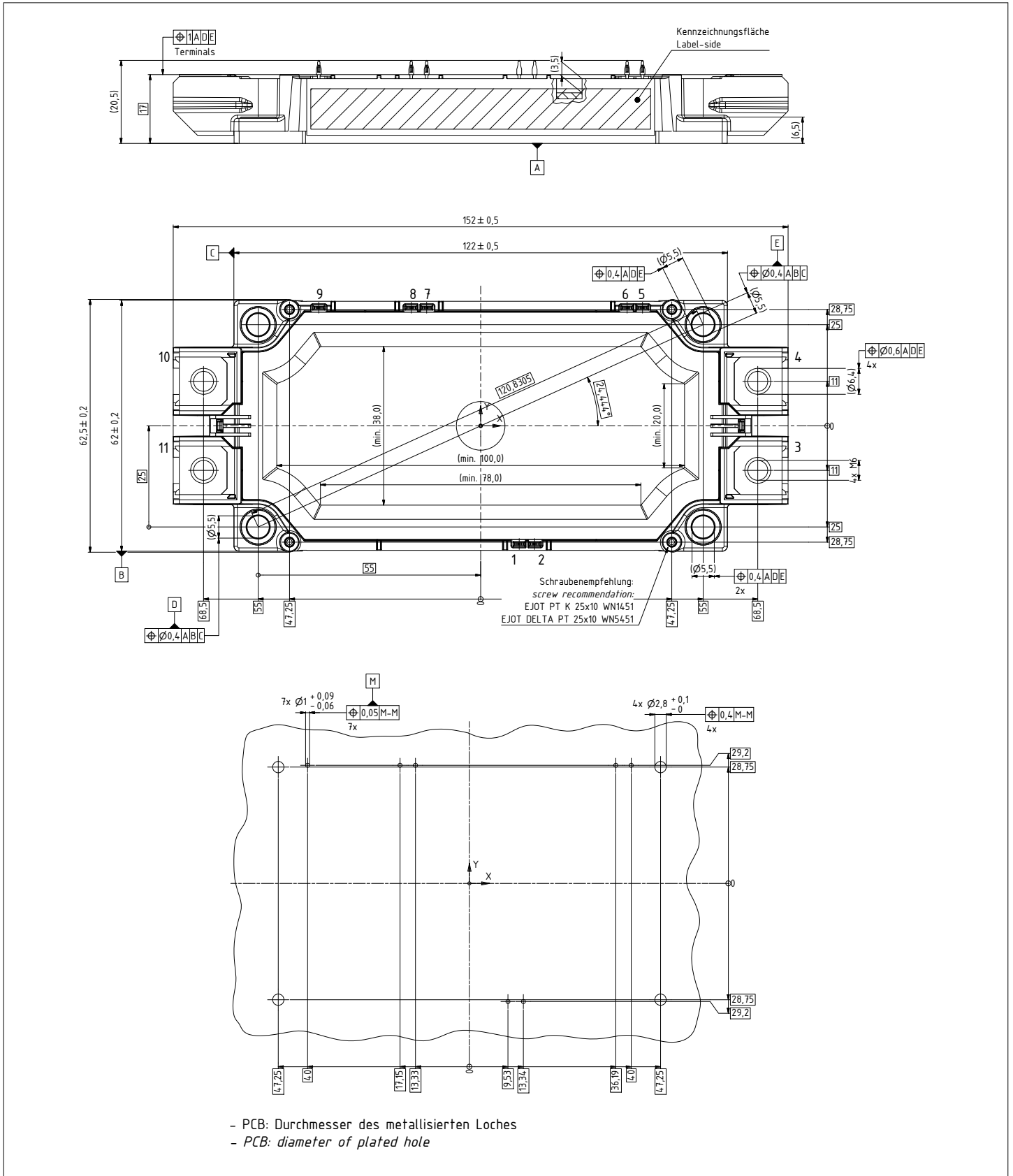

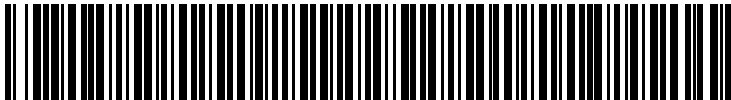


Figure 2

## 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	<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 3**

## Revision history

Document revision	Date of release	Description of changes
1.00	2022-03-10	Initial version
1.10	2022-03-18	Final datasheet



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