

## EconoDUAL™3 module with Trench/Fieldstop IGBT4 and emitter controlled diode and PressFIT / NTC

### Features

- Electrical features
  - $V_{CES} = 1200\text{ V}$
  - $I_{C\text{nom}} = 600\text{ A} / I_{CRM} = 1200\text{ A}$
  - LOW  $V_{CE,sat}$
  - $T_{vj,op} = 150^{\circ}\text{C}$
  - $V_{CE,sat}$  with positive temperature coefficient
- Mechanical features
  - Direct-cooled base plate
  - Isolated base plate
  - High power density
  - Standard housing

### Potential applications

- High-power converters
- Motor drives
- Servo drives
- UPS systems
- Wind turbines

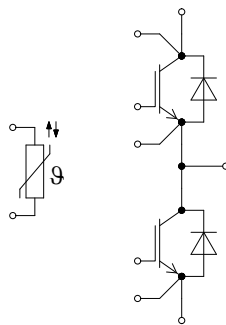
### Product validation

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

### Description



Typical appearance



## Table of contents

	<b>Description</b> .....	1
	<b>Features</b> .....	1
	<b>Potential applications</b> .....	1
	<b>Product validation</b> .....	1
	<b>Table of contents</b> .....	2
<b>1</b>	<b>Package</b> .....	3
<b>2</b>	<b>IGBT, Inverter</b> .....	3
<b>3</b>	<b>Diode, Inverter</b> .....	5
<b>4</b>	<b>NTC-Thermistor</b> .....	6
<b>5</b>	<b>Characteristics diagrams</b> .....	7
<b>6</b>	<b>Circuit diagram</b> .....	11
<b>7</b>	<b>Package outlines</b> .....	12
<b>8</b>	<b>Module label code</b> .....	13
	<b>Revision history</b> .....	14
	<b>Disclaimer</b> .....	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	
Relative thermal index (electrical)	$RTI$	housing	140	°C

**Table 2** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Pressure drop in cooling circuit	$\Delta p$	$\Delta V/\Delta t = 10.0 \text{ dm}^3/\text{min}$ , 50% water / 50% ethylen glycol, $T_F = 60 \text{ °C}$		65		mbar	
Maximum pressure in cooling circuit	$p$				3	bar	
Stray inductance module	$L_{SCE}$			20		nH	
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_F = 25 \text{ °C}$ , 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	$V_{CES}$	$T_{vj} = 25 \text{ °C}$	1200	V
Continuous DC collector current	$I_{CDC}$	$T_{vj \text{ max}} = 175 \text{ °C}$ $T_F = 45 \text{ °C}$	600	A

(table continues...)  
Datasheet

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

Parameter	Symbol	Note or test condition	Values	Unit
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{vj\ op}$	1200	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	$V_{CE\ sat}$	$I_C = 600\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$	1.75	2.10	V
			$T_{vj} = 125\ ^\circ C$	2.00		
			$T_{vj} = 150\ ^\circ C$	2.05		
Gate threshold voltage	$V_{GEth}$	$I_C = 22.8\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$	5.20	5.80	6.40	V
Gate charge	$Q_G$	$V_{GE} = \pm 15\ V, V_{CE} = 600\ V$		4.4		$\mu C$
Internal gate resistor	$R_{Gint}$	$T_{vj} = 25\ ^\circ C$		1.2		$\Omega$
Input capacitance	$C_{ies}$	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		37		nF
Reverse transfer capacitance	$C_{res}$	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		2.05		nF
Collector-emitter cut-off current	$I_{CES}$	$V_{CE} = 1200\ V, V_{GE} = 0\ V$			3	mA
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0\ V, V_{GE} = 20\ V, T_{vj} = 25\ ^\circ C$			400	nA
Turn-on delay time (inductive load)	$t_{don}$	$I_C = 600\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.5\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.160		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.210		
			$T_{vj} = 150\ ^\circ C$	0.210		
Rise time (inductive load)	$t_r$	$I_C = 600\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.5\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.090		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.090		
			$T_{vj} = 150\ ^\circ C$	0.100		
Turn-off delay time (inductive load)	$t_{doff}$	$I_C = 600\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.5\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.480		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.610		
			$T_{vj} = 150\ ^\circ C$	0.650		
Fall time (inductive load)	$t_f$	$I_C = 600\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.5\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.070		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.110		
			$T_{vj} = 150\ ^\circ C$	0.120		
Turn-on energy loss per pulse	$E_{on}$	$I_C = 600\ A, V_{CE} = 600\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 1.5\ \Omega, di/dt = 5100\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$	62.5		mJ
			$T_{vj} = 125\ ^\circ C$	83		
			$T_{vj} = 150\ ^\circ C$	90		

(table continues...)

**Table 4 (continued) Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Turn-off energy loss per pulse	$E_{off}$	$I_C = 600\text{ A}, V_{CE} = 600\text{ V}, L_\sigma = 35\text{ nH}, V_{GE} = \pm 15\text{ V}, R_{Goff} = 1.5\ \Omega, dv/dt = 3700\text{ V}/\mu\text{s} (T_{vj} = 150\text{ }^\circ\text{C})$	$T_{vj} = 25\text{ }^\circ\text{C}$		47	mJ	
			$T_{vj} = 125\text{ }^\circ\text{C}$		72		
			$T_{vj} = 150\text{ }^\circ\text{C}$		79.5		
SC data	$I_{SC}$	$V_{GE} \leq 15\text{ V}, V_{CC} = 800\text{ V}, V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_p \leq 10\ \mu\text{s}, T_{vj} = 150\text{ }^\circ\text{C}$		2400	A	
Thermal resistance, junction to cooling fluid <sup>1)</sup>	$R_{thJF}$	per IGBT, $\Delta V/\Delta t = 10\text{ dm}^3/\text{min}$ , cooling fluid = 50% water / 50% ethylen glycol, $T_f = 60\text{ }^\circ\text{C}$			0.0848	K/W	
Temperature under switching conditions	$T_{vjop}$				-40	150	$^\circ\text{C}$

1) Typical  $R_{thJF}$  value using the heat sink described in the relevant application note.

### 3 Diode, Inverter

**Table 5 Maximum rated values**

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	$V_{RRM}$	$T_{vj} = 25\text{ }^\circ\text{C}$	1200	V	
Continuous DC forward current	$I_F$		600	A	
Repetitive peak forward current	$I_{FRM}$	$t_p = 1\text{ ms}$	1200	A	
$I^2t$ - value	$I^2t$	$t_p = 10\text{ ms}, V_R = 0\text{ V}$	$T_{vj} = 125\text{ }^\circ\text{C}$	40000	$\text{A}^2\text{s}$
			$T_{vj} = 150\text{ }^\circ\text{C}$	37600	

**Table 6 Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	$V_F$	$I_F = 600\text{ A}, V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		1.65	2.10	V
			$T_{vj} = 125\text{ }^\circ\text{C}$		1.65		
			$T_{vj} = 150\text{ }^\circ\text{C}$		1.65		
Peak reverse recovery current	$I_{RM}$	$V_R = 600\text{ V}, I_F = 600\text{ A}, V_{GE} = -15\text{ V}, -di_F/dt = 5100\text{ A}/\mu\text{s} (T_{vj} = 150\text{ }^\circ\text{C})$	$T_{vj} = 25\text{ }^\circ\text{C}$		290	A	
			$T_{vj} = 125\text{ }^\circ\text{C}$		420		
			$T_{vj} = 150\text{ }^\circ\text{C}$		450		

(table continues...)

**Table 6 (continued) Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Recovered charge	$Q_r$	$V_R = 600 \text{ V}, I_F = 600 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 5100 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$	62		$\mu\text{C}$
			$T_{vj} = 125 \text{ }^\circ\text{C}$	115		
			$T_{vj} = 150 \text{ }^\circ\text{C}$	130		
Reverse recovery energy	$E_{rec}$	$V_R = 600 \text{ V}, I_F = 600 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 5100 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$	22		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$	44		
			$T_{vj} = 150 \text{ }^\circ\text{C}$	51		
Thermal resistance, junction to cooling fluid <sup>1)</sup>	$R_{thJF}$	per diode, $\Delta V/\Delta t = 10 \text{ dm}^3/\text{min}$ , cooling fluid = 50% water / 50% ethylenglycol, $T_f = 60 \text{ }^\circ\text{C}$		0.124		K/W
Temperature under switching conditions	$T_{vj op}$		-40		150	$^\circ\text{C}$

1) Typical  $R_{thJF}$  value using the heat sink described in the relevant application note.

## 4 NTC-Thermistor

**Table 7 Characteristic values**

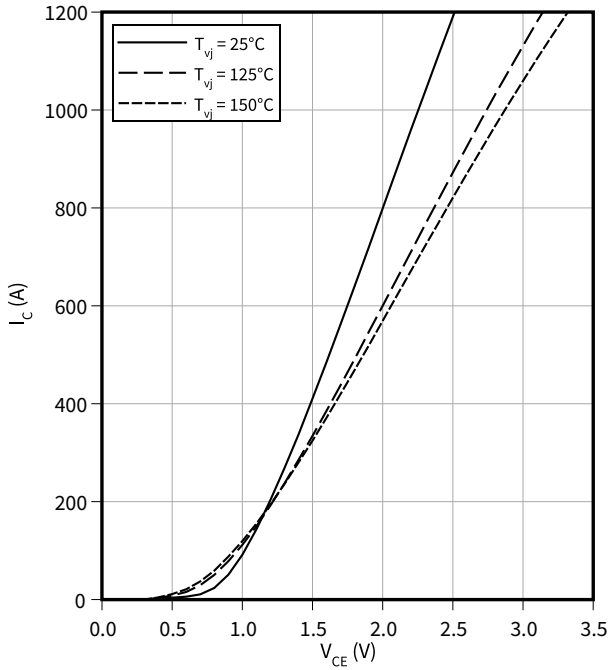
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	$R_{25}$	$T_{NTC} = 25 \text{ }^\circ\text{C}$		5		k $\Omega$
Deviation of $R_{100}$	$\Delta R/R$	$T_{NTC} = 100 \text{ }^\circ\text{C}, R_{100} = 493 \text{ } \Omega$	-5		5	%
Power dissipation	$P_{25}$	$T_{NTC} = 25 \text{ }^\circ\text{C}$			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: Specification according to the valid application note.

## 5 Characteristics diagrams

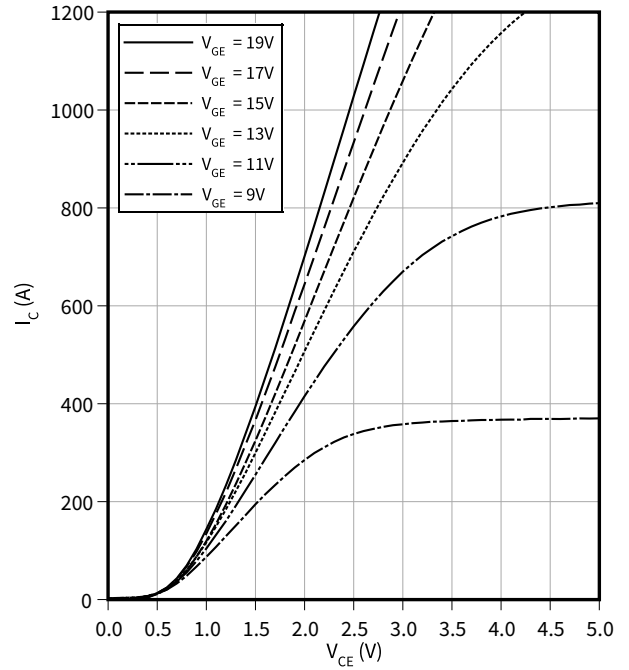
**Output characteristic (typical), IGBT, Inverter**

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



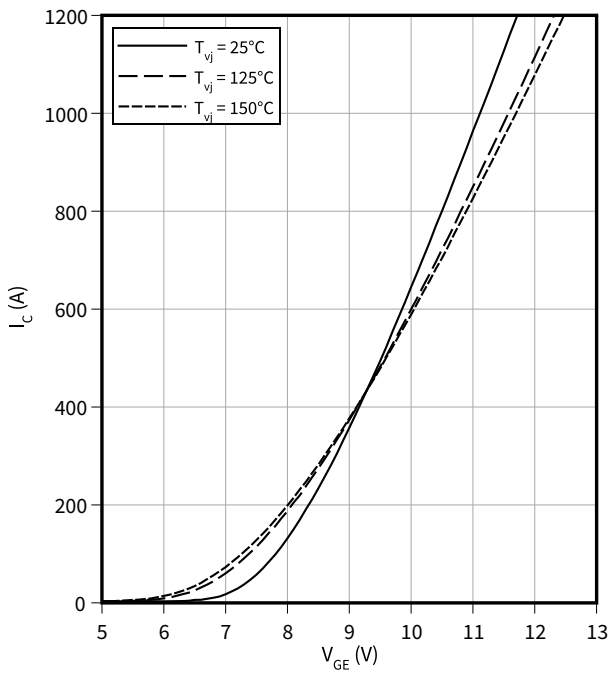
**Output characteristic field (typical), IGBT, Inverter**

$I_C = f(V_{CE})$   
 $T_{vj} = 150 \text{ °C}$



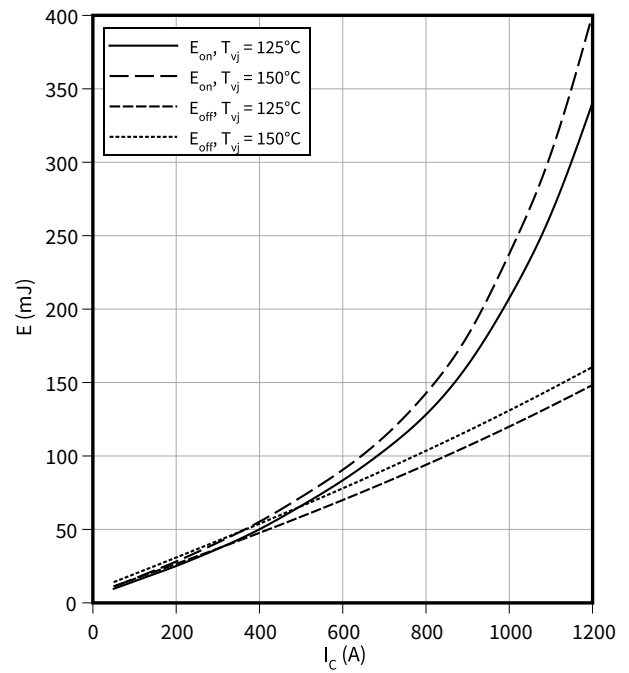
**Transfer characteristic (typical), IGBT, Inverter**

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



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

$E = f(I_C)$   
 $R_{Goff} = 1.5 \text{ } \Omega$ ,  $R_{Gon} = 1.5 \text{ } \Omega$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  $V_{CE} = 600 \text{ V}$

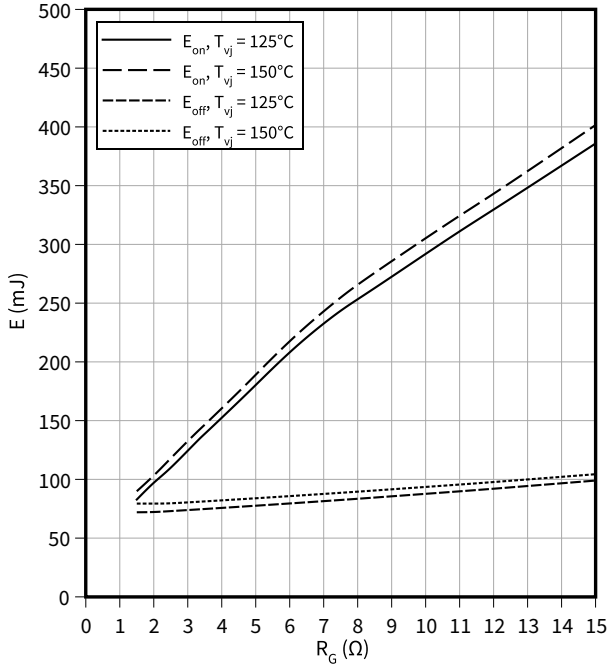


5 Characteristics diagrams

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

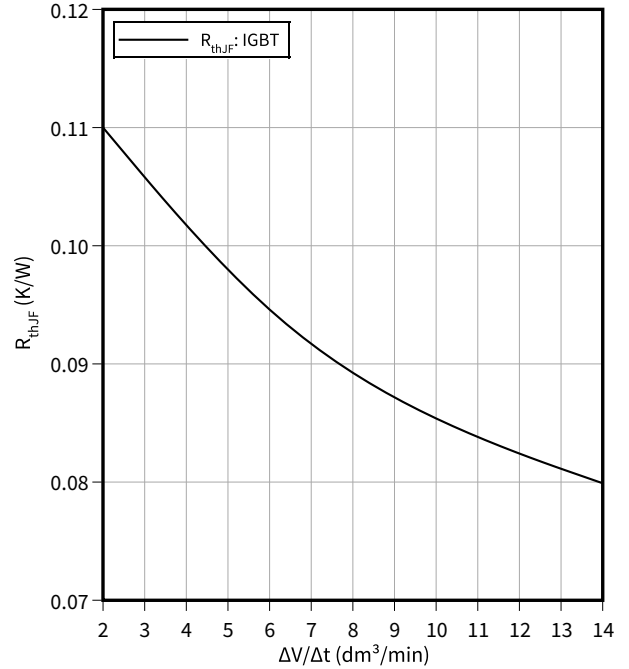
$E = f(R_G)$

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



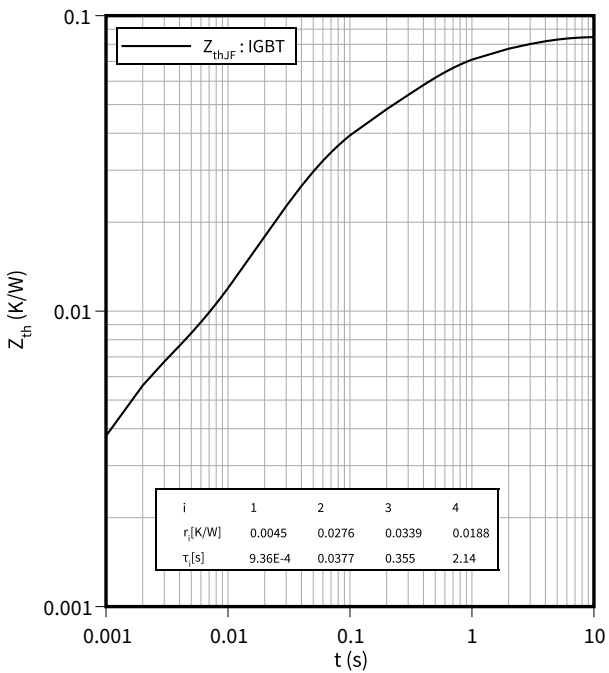
**Thermal impedance, IGBT, Inverter**

$R_{thJF} = f(\Delta V/\Delta t)$



**Transient thermal impedance, IGBT, Inverter**

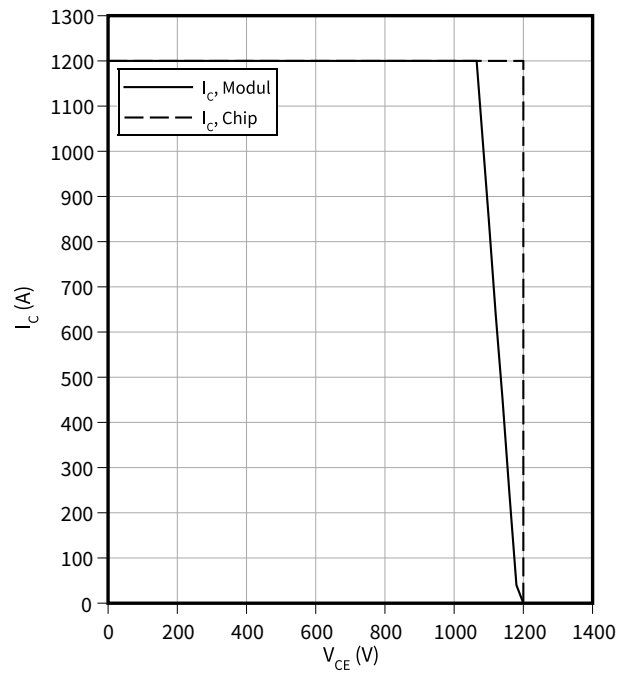
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

$R_{Goff} = 1.5 \Omega, V_{GE} = \pm 15 \text{ V}, T_{vj} = 150 \text{ °C}$

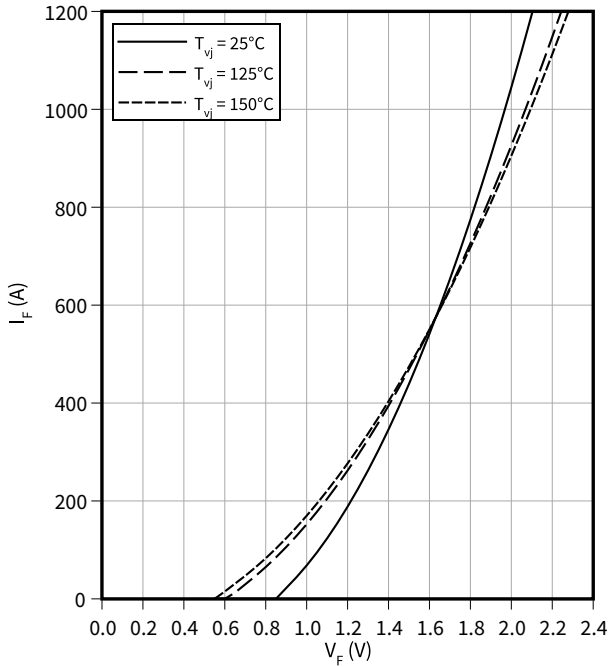




5 Characteristics diagrams

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

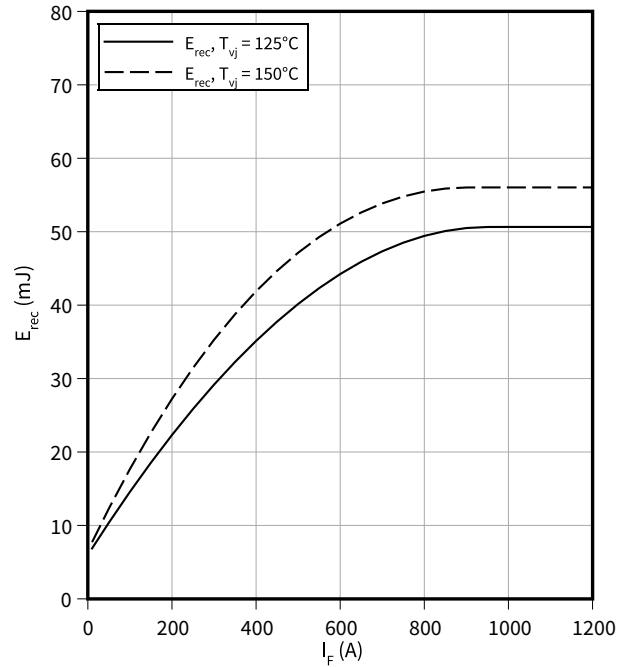
$I_F = f(V_F)$



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

$E_{rec} = f(I_F)$

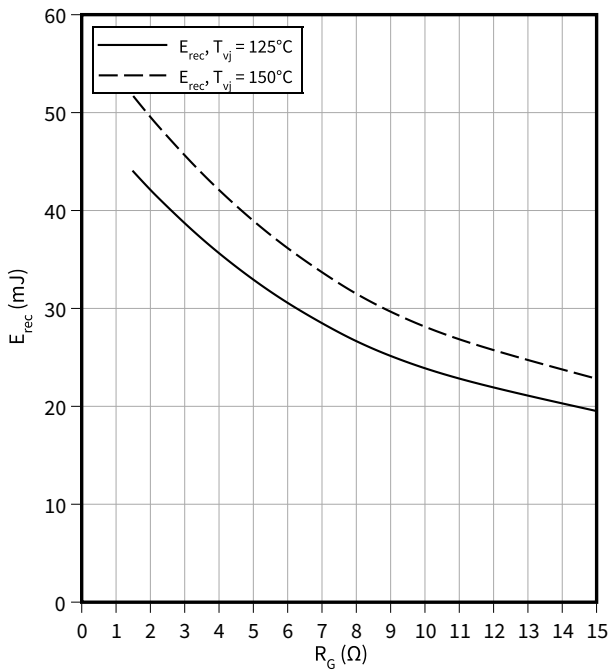
$V_{CE} = 600 \text{ V}, R_{Gon} = 1.5 \Omega$



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

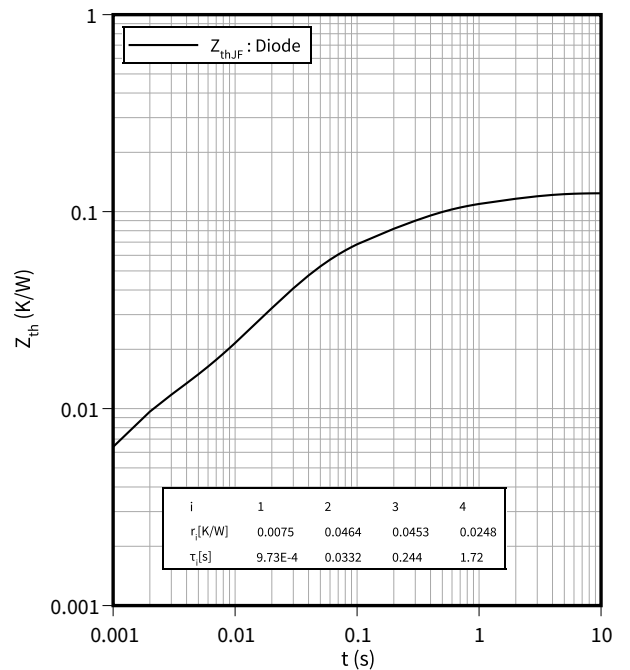
$E_{rec} = f(R_G)$

$V_{CE} = 600 \text{ V}, I_F = 600 \text{ A}$



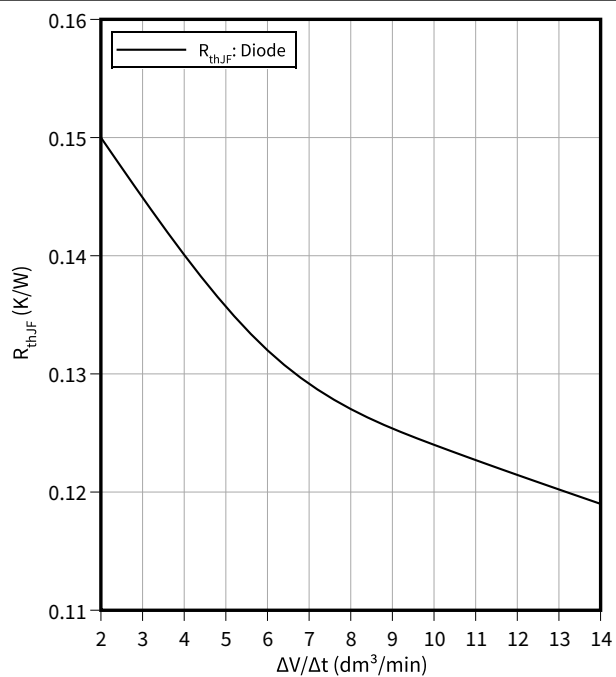
**Transient thermal impedance, Diode, Inverter**

$Z_{th} = f(t)$



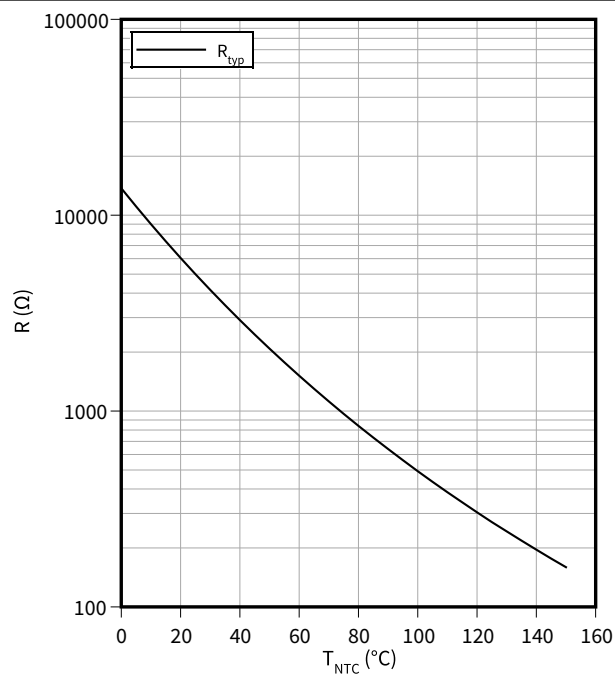
**Thermal impedance, Diode, Inverter**

$R_{thJF} = f(\Delta V/\Delta t)$



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

$R = f(T_{NTC})$



## 6 Circuit diagram

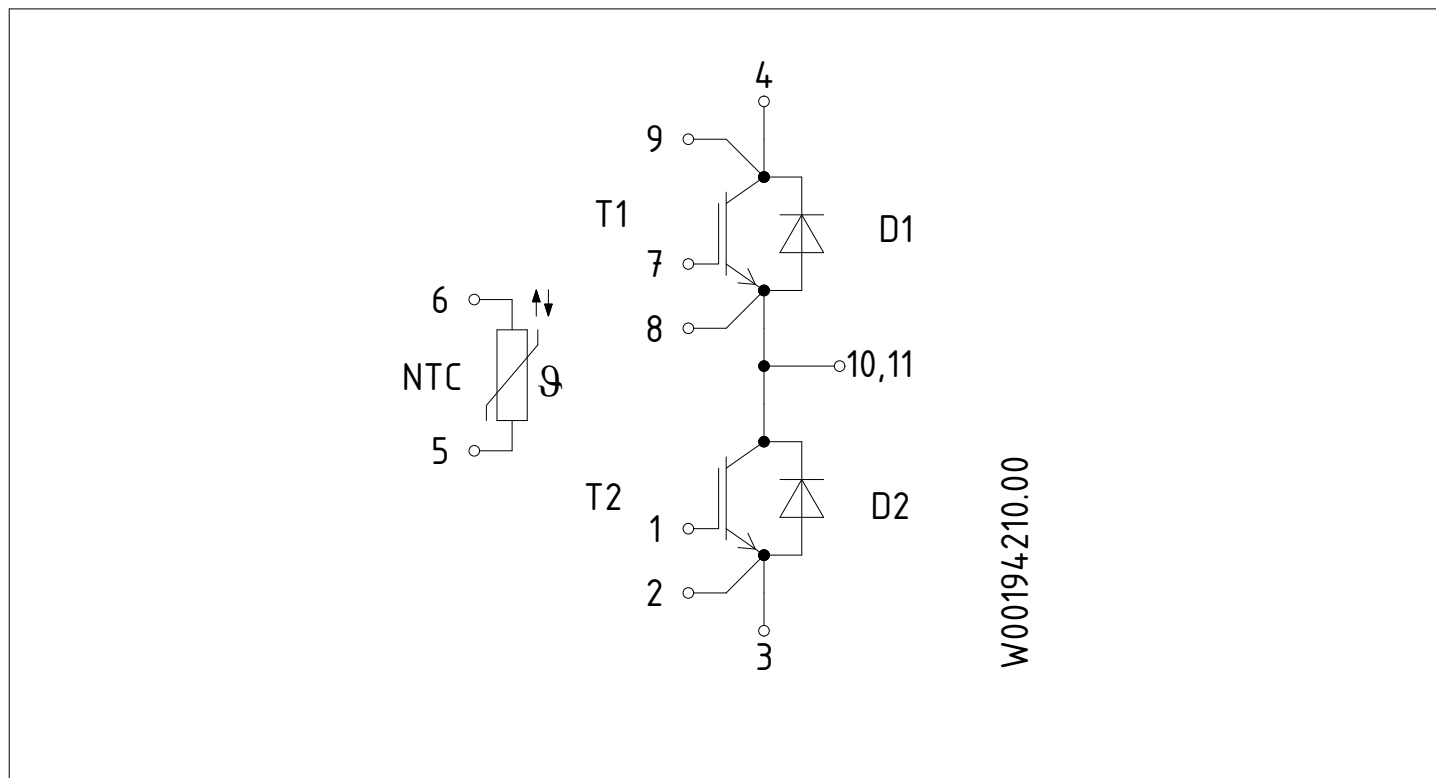


Figure 1

## 7 Package outlines

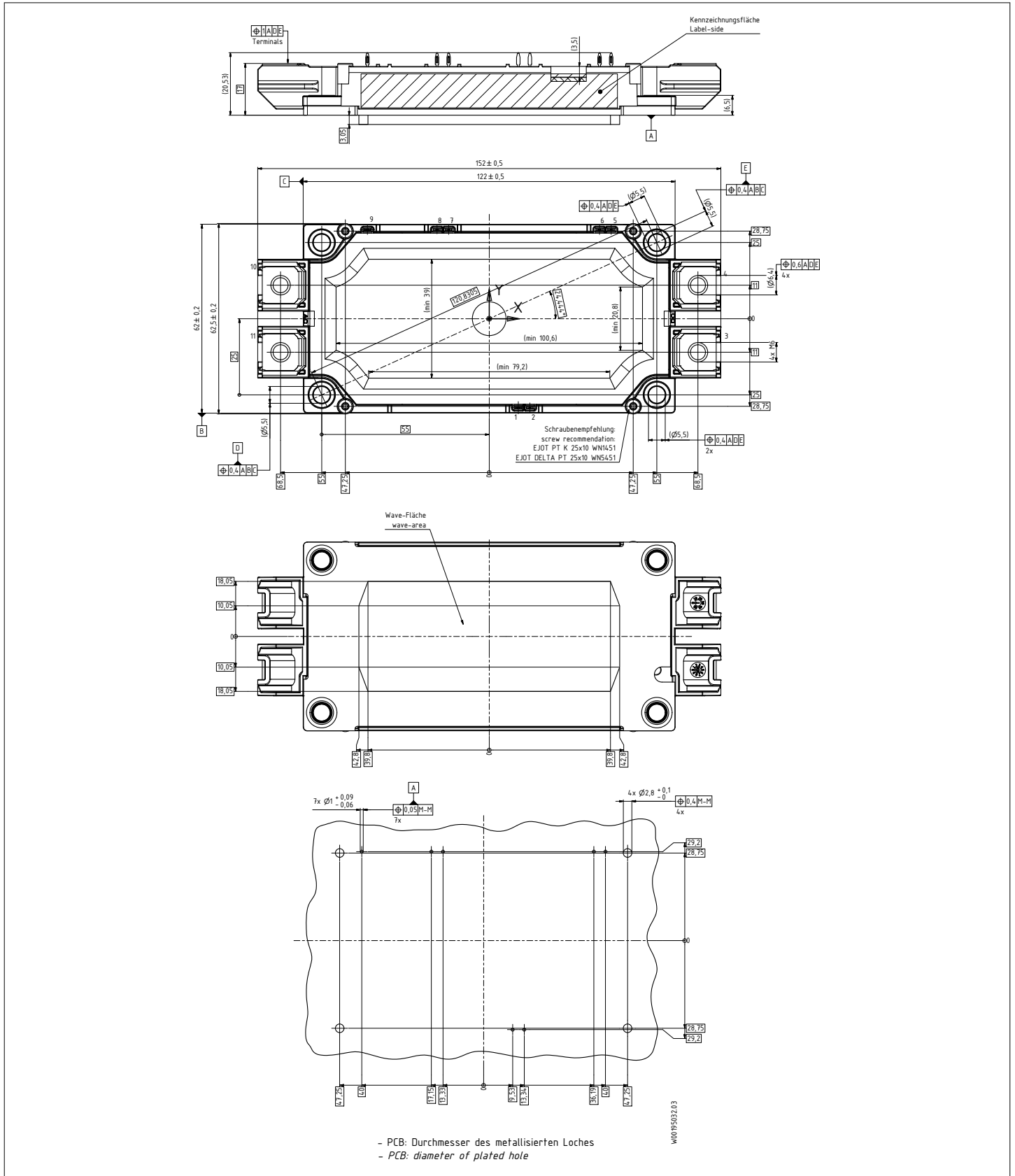


Figure 2

## 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	Digit	Example
	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
V1.0	2019-11-26	Target datasheet
n/a	2020-09-01	Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy
0.10	2021-08-30	Target datasheet
1.00	2022-04-01	Final datasheet