

**EconoPACK™3 module with Trench/Fieldstop IGBT4 and Emitter Controlled 4 diode and NTC**

**Features**

- Electrical features
  - Low  $V_{CEsat}$
  - Trench IGBT 4
  - $T_{vj op} = 150\text{ }^{\circ}\text{C}$
- Mechanical features
  - $\text{Al}_2\text{O}_3$  substrate with low thermal resistance
  - Copper base plate
  - PressFIT contact technology
  - $\text{H}_2\text{S}$  ruggedness



Typical appearance

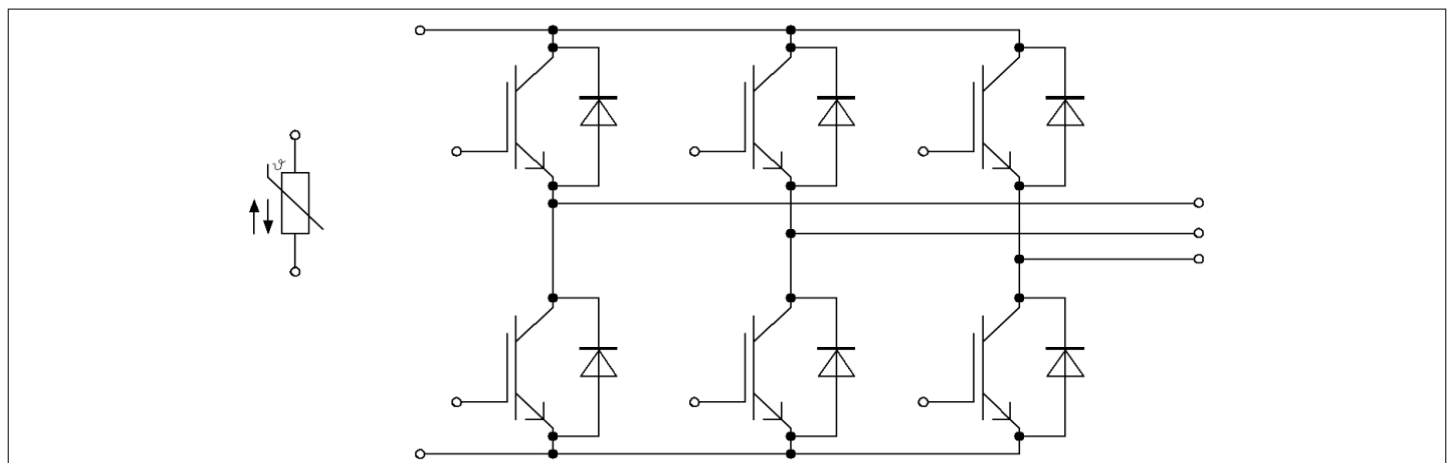
**Potential applications**

- 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

## 1 Package

**Table 1** Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	$V_{ISOL}$	RMS, $f = 50 \text{ Hz}$ , $t = 1 \text{ min}$	2.5	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	10.0	mm
Clearance	$d_{Clear}$	terminal to heatsink	7.5	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	$L_{SCE}$			21		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25^\circ\text{C}$ , per switch		1.8		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
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	$V_{CES}$	$T_{vj} = 25^\circ\text{C}$	1200	V
Continuous DC collector current	$I_{CDC}$	$T_{vj \text{ max}} = 175^\circ\text{C}$ $T_C = 100^\circ\text{C}$	185	A
Repetitive peak collector current	$I_{CRM}$	$t_p = 1 \text{ ms}$	400	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	$V_{CE\ sat}$	$I_C = 200\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		1.75	2.10	V
			$T_{vj} = 125\ ^\circ C$		2.05		
			$T_{vj} = 150\ ^\circ C$		2.10		
Gate threshold voltage	$V_{GEth}$	$I_C = 7.6\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$		5.20	5.80	6.40	V
Gate charge	$Q_G$	$V_{GE} = \pm 15\ V, V_{CE} = 600\ V$			1.66		$\mu C$
Internal gate resistor	$R_{Gint}$	$T_{vj} = 25\ ^\circ C$			3.5		$\Omega$
Input capacitance	$C_{ies}$	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			14		nF
Reverse transfer capacitance	$C_{res}$	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			0.5		nF
Collector-emitter cut-off current	$I_{CES}$	$V_{CE} = 1200\ V, V_{GE} = 0\ V$	$T_{vj} = 25\ ^\circ C$			1	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)	$t_{don}$	$I_C = 200\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.1\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.140		$\mu s$
			$T_{vj} = 125\ ^\circ C$		0.150		
			$T_{vj} = 150\ ^\circ C$		0.150		
Rise time (inductive load)	$t_r$	$I_C = 200\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.1\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.030		$\mu s$
			$T_{vj} = 125\ ^\circ C$		0.035		
			$T_{vj} = 150\ ^\circ C$		0.040		
Turn-off delay time (inductive load)	$t_{doff}$	$I_C = 200\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.1\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.320		$\mu s$
			$T_{vj} = 125\ ^\circ C$		0.400		
			$T_{vj} = 150\ ^\circ C$		0.420		
Fall time (inductive load)	$t_f$	$I_C = 200\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.1\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.090		$\mu s$
			$T_{vj} = 125\ ^\circ C$		0.160		
			$T_{vj} = 150\ ^\circ C$		0.180		
Turn-on energy loss per pulse	$E_{on}$	$I_C = 200\ A, V_{CE} = 600\ V, L_\sigma = 30\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 1.1\ \Omega, di/dt = 5400\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		10.5		mJ
			$T_{vj} = 125\ ^\circ C$		18.5		
			$T_{vj} = 150\ ^\circ C$		20.5		
Turn-off energy loss per pulse	$E_{off}$	$I_C = 200\ A, V_{CE} = 600\ V, L_\sigma = 30\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 1.1\ \Omega, dv/dt = 5000\ V/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		11		mJ
			$T_{vj} = 125\ ^\circ C$		16.5		
			$T_{vj} = 150\ ^\circ C$		18.5		
SC data	$I_{SC}$	$V_{GE} \leq 15\ V, V_{CC} = 800\ V, V_{CEmax} = V_{CES} - L_{sCE} * di/dt$	$t_p \leq 10\ \mu s, T_{vj} = 150\ ^\circ C$		800		A
Thermal resistance, junction to case	$R_{thJC}$	per IGBT				0.150	K/W

**Table 4** Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, case to heatsink	$R_{thCH}$	per IGBT, $\lambda_{grease} = 1 \text{ W/(m}^2\text{K)}$		0.0850		K/W
Temperature under switching conditions	$T_{vjop}$		-40		150	°C

### 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	$I_F$		200	A	
Repetitive peak forward current	$I_{FRM}$	$t_p = 1 \text{ ms}$	400	A	
$I^2t$ - value	$I^2t$	$t_p = 10 \text{ ms}, V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ }^\circ\text{C}$	5200	$\text{A}^2\text{s}$
			$T_{vj} = 150 \text{ }^\circ\text{C}$	5000	

**Table 6** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	$V_F$	$V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		1.70	2.15	V
			$T_{vj} = 125 \text{ }^\circ\text{C}$		1.65		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		1.65		
Peak reverse recovery current	$I_{RM}$	$V_R = 600 \text{ V}, V_{GE} = -15 \text{ V},$ $-di_F/dt = 5400 \text{ A}/\mu\text{s}$ ( $T_{vj} = 150 \text{ }^\circ\text{C}$ )	$T_{vj} = 25 \text{ }^\circ\text{C}$		240		A
			$T_{vj} = 125 \text{ }^\circ\text{C}$		250		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		260		
Recovered charge	$Q_r$	$V_R = 600 \text{ V}, V_{GE} = -15 \text{ V},$ $-di_F/dt = 5400 \text{ A}/\mu\text{s}$ ( $T_{vj} = 150 \text{ }^\circ\text{C}$ )	$T_{vj} = 25 \text{ }^\circ\text{C}$		18.5		$\mu\text{C}$
			$T_{vj} = 125 \text{ }^\circ\text{C}$		33.5		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		38.5		
Reverse recovery energy	$E_{rec}$	$V_R = 600 \text{ V}, V_{GE} = -15 \text{ V},$ $-di_F/dt = 5400 \text{ A}/\mu\text{s}$ ( $T_{vj} = 150 \text{ }^\circ\text{C}$ )	$T_{vj} = 25 \text{ }^\circ\text{C}$		8.1		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$		14.5		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		16		
Thermal resistance, junction to case	$R_{thJC}$	per diode			0.260	K/W	

**Table 6** Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, case to heatsink	$R_{thCH}$	per diode, $\lambda_{grease} = 1 \text{ W/(m}^2\text{K)}$		0.148		K/W
Temperature under switching conditions	$T_{vjop}$		-40		150	°C

## 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

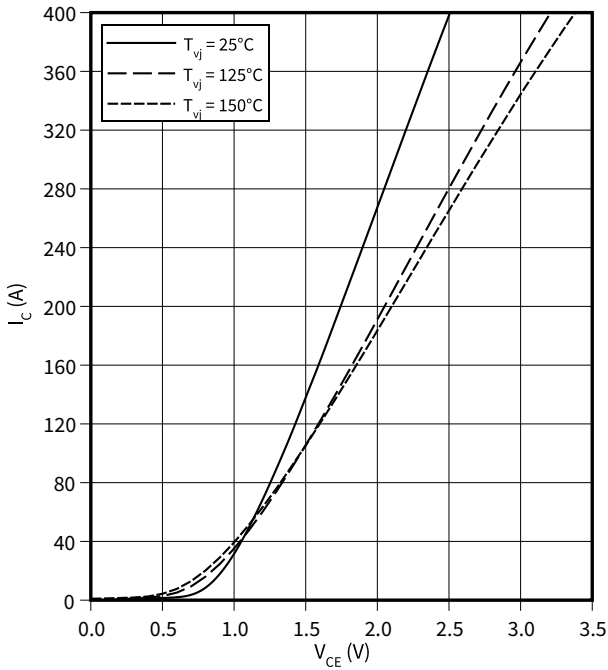
Note: Specification according to the valid application note.

## 5 Characteristics diagrams

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

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

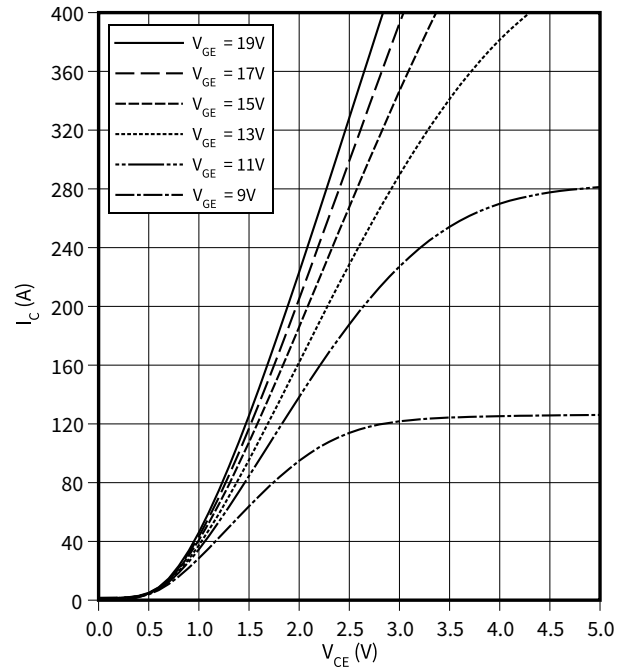
$$V_{GE} = 15 \text{ V}$$



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

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

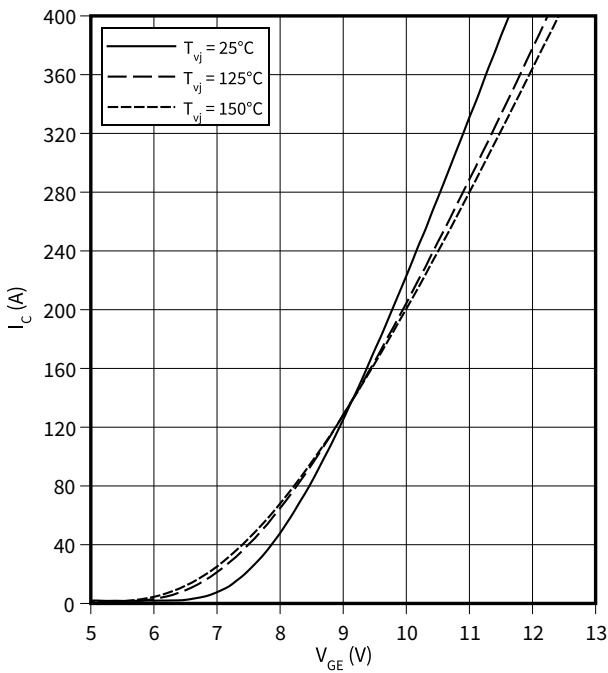
$$T_{vj} = 150 \text{ °C}$$



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

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

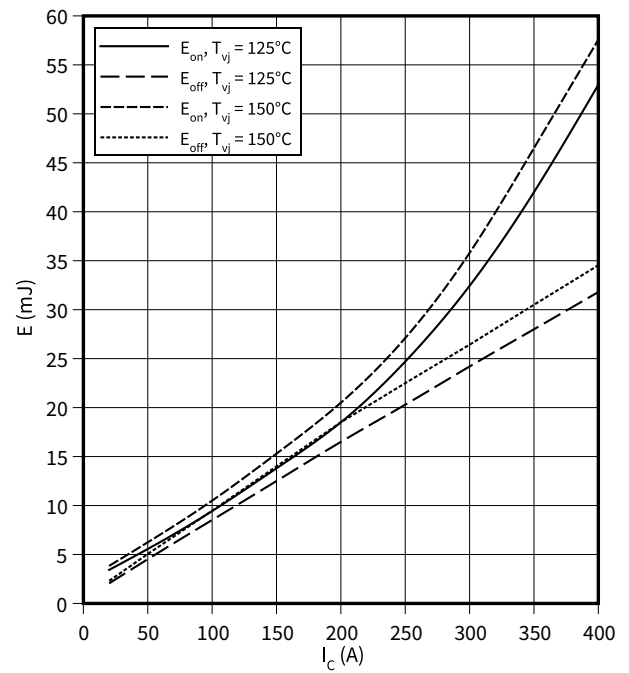
$$V_{CE} = 20 \text{ V}$$



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

$$E = f(I_C)$$

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

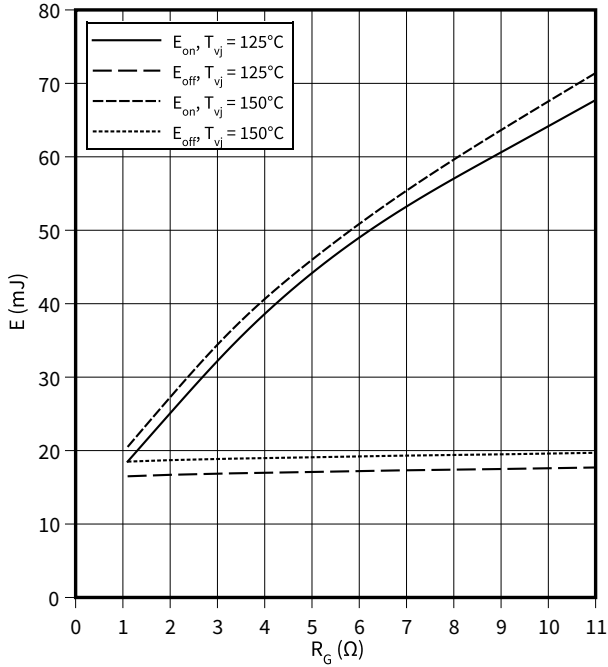


5 Characteristics diagrams

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

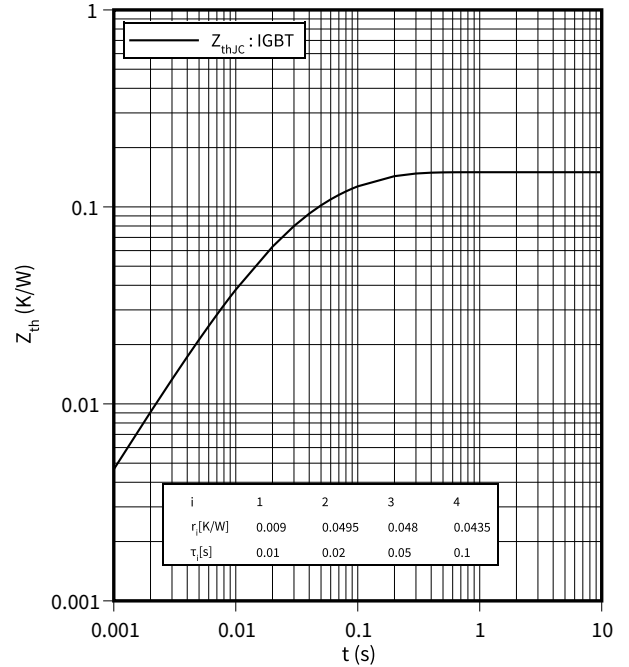
$E = f(R_G)$

$I_C = 200 \text{ A}$ ,  $V_{CE} = 600 \text{ V}$ ,  $V_{GE} = \pm 15 \text{ V}$



**transient thermal impedance, IGBT, Inverter**

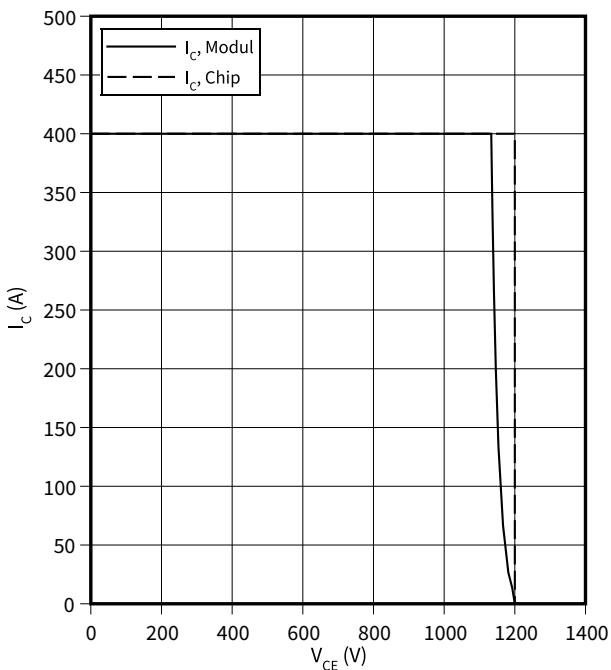
$Z_{th} = f(t)$



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

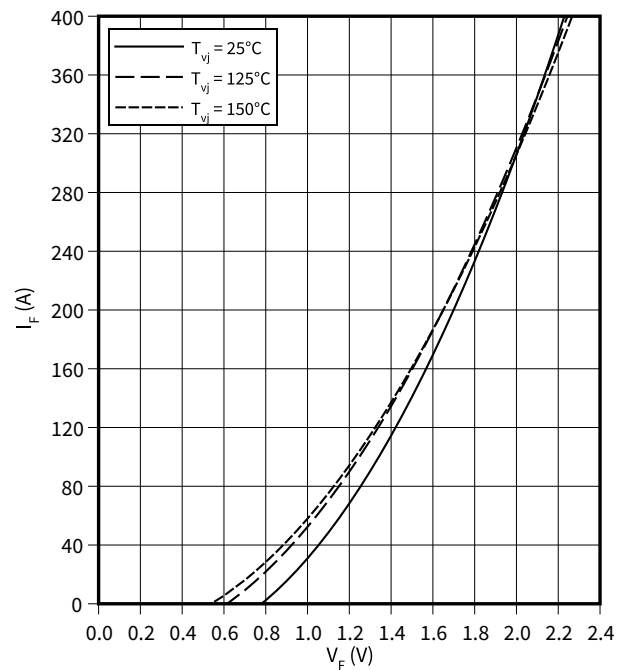
$I_C = f(V_{CE})$

$R_{Goff} = 1.1 \Omega$ ,  $V_{GE} = \pm 15.0 \text{ V}$ ,  $T_{vj} = 150 \text{ °C}$



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

$I_F = f(V_F)$



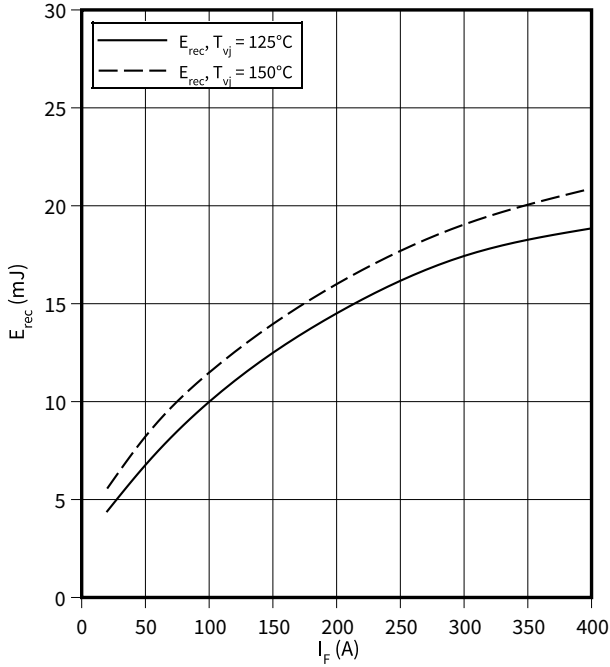


5 Characteristics diagrams

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

$E_{rec} = f(I_F)$

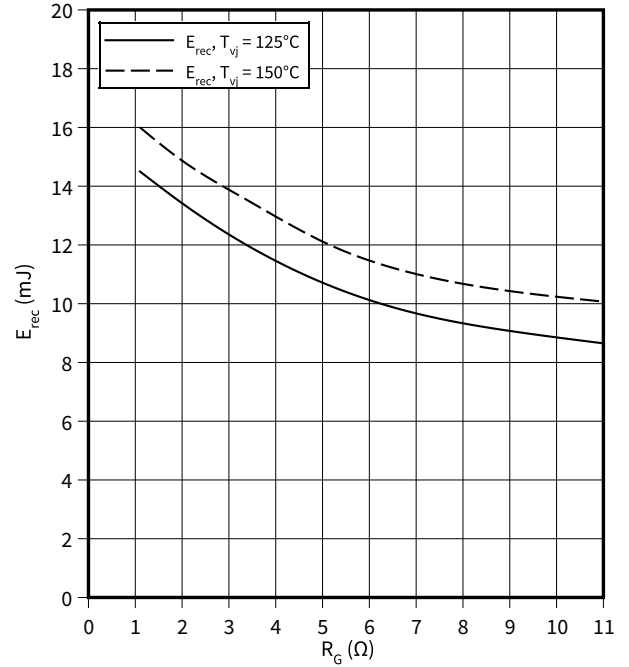
$V_{CE} = 600\text{ V}, R_{Gon} = R_{Gon}(IGBT)$



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

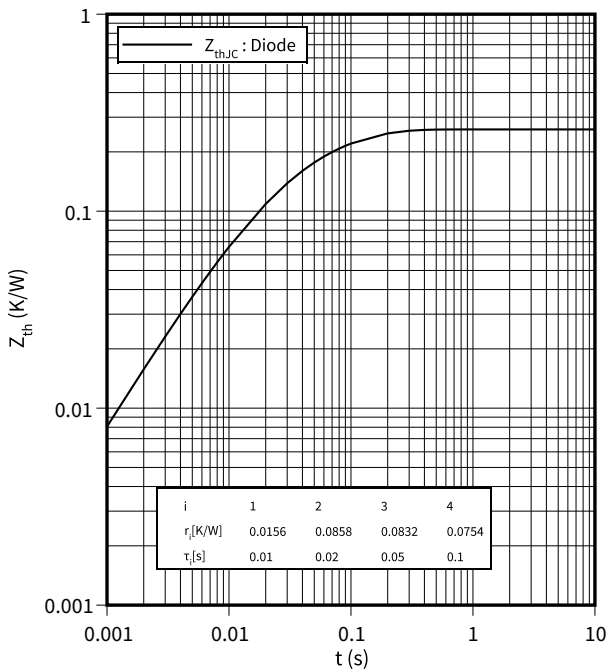
$E_{rec} = f(R_G)$

$V_{CE} = 600\text{ V}, I_F = 200\text{ A}$



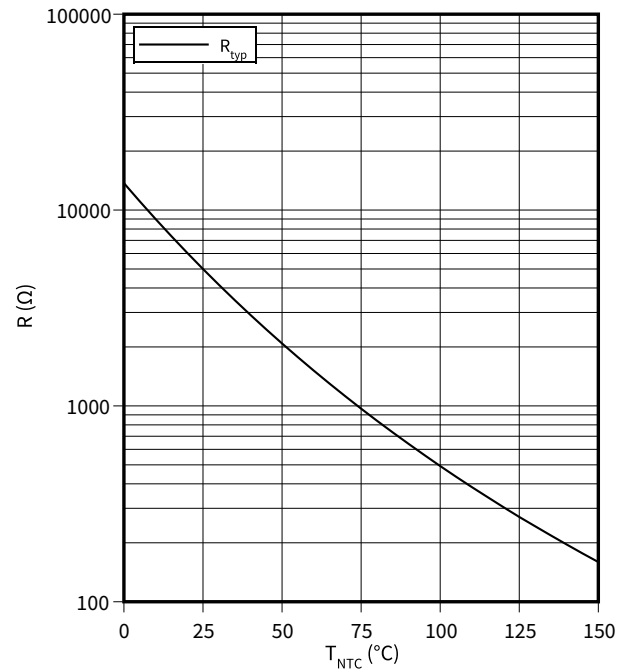
**transient thermal impedance , Diode, Inverter**

$Z_{th} = f(t)$



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

$R = f(T_{NTC})$



## 6 Circuit diagram

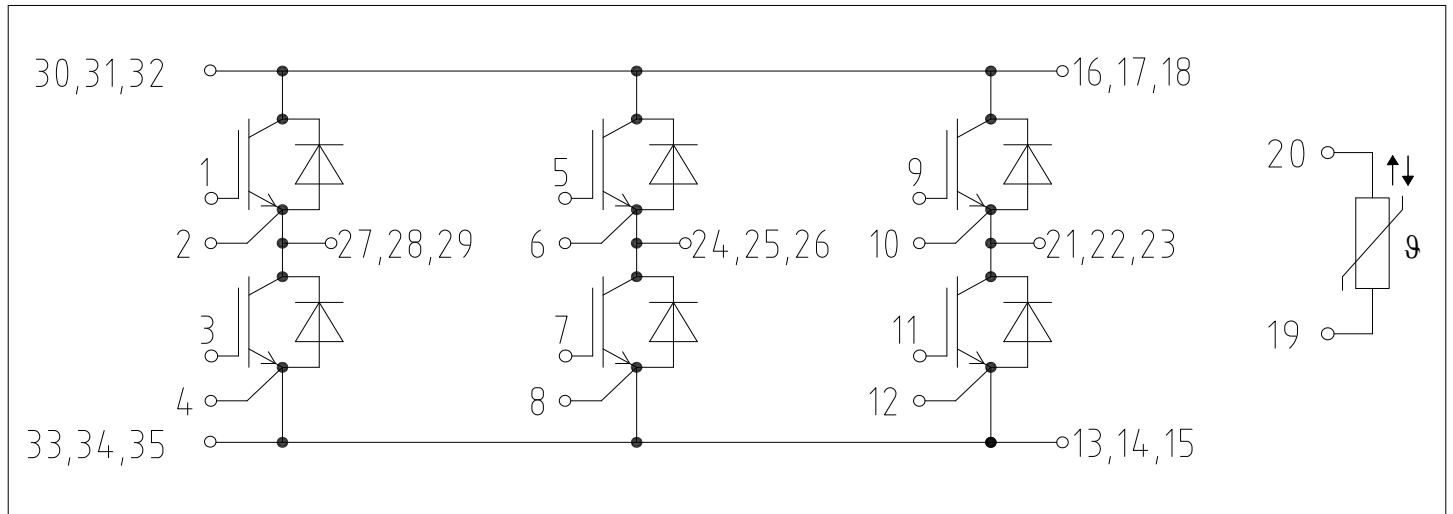


Figure 2

## 7 Package outlines

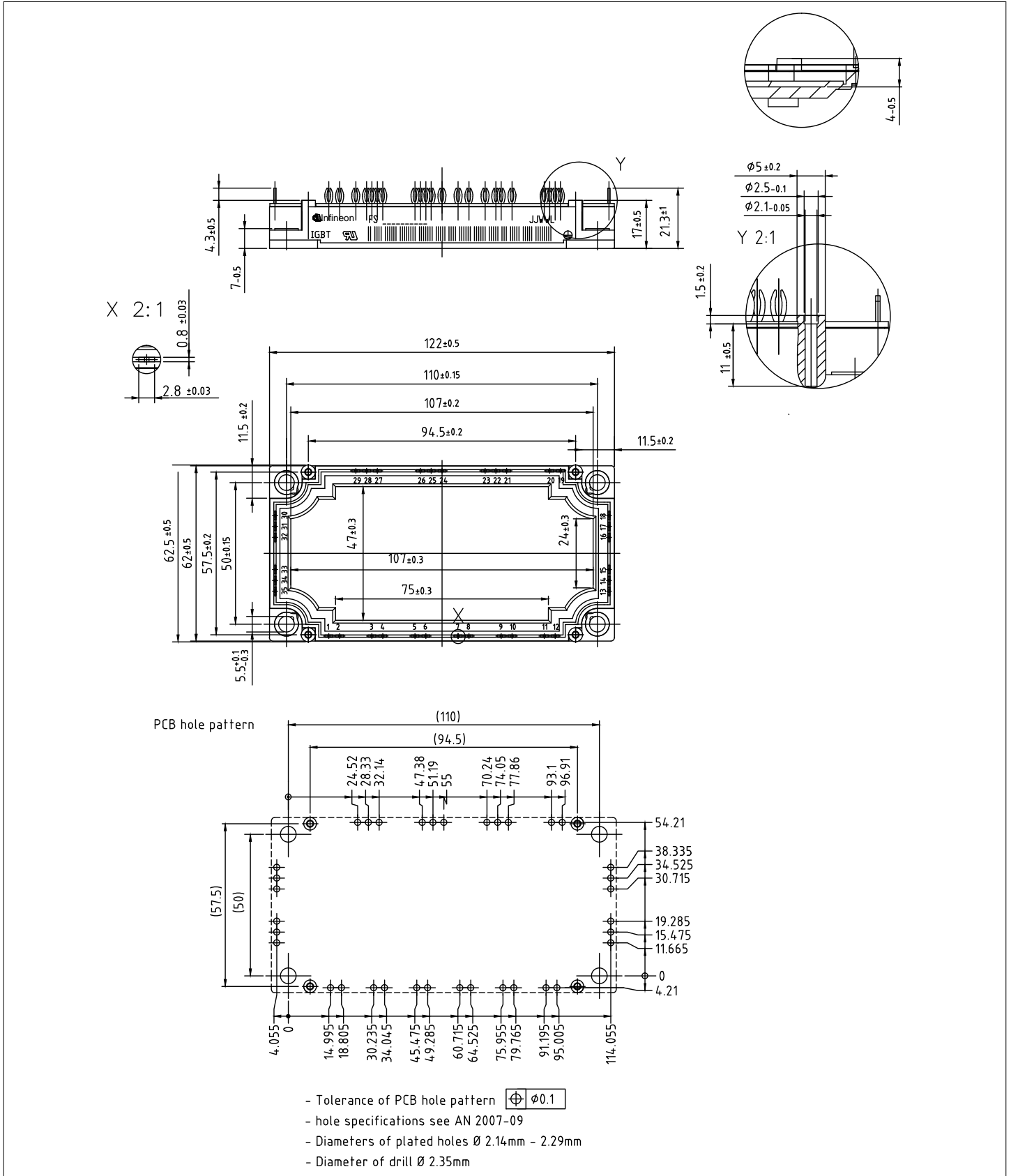


Figure 3

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