

Final datasheet

EconoPACK™3 module with Trench/Fieldstop IGBT4 and emitter controlled diode and NTC

Features

- Electrical features
 - $V_{CES} = 1700\text{ V}$
 - $I_{C\text{ nom}} = 100\text{ A} / I_{CRM} = 200\text{ A}$
 - Low $V_{CE,sat}$
 - $T_{vj,op} = 150^{\circ}\text{C}$
 - Trench IGBT 4
 - $V_{CE,sat}$ with positive temperature coefficient
- Mechanical features
 - Integrated NTC temperature sensor
 - Standard housing
 - Solder contact technology
 - Isolated base plate



Typical appearance

Potential applications

- High-power converters
- Medium-voltage converters

Product validation

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

Description

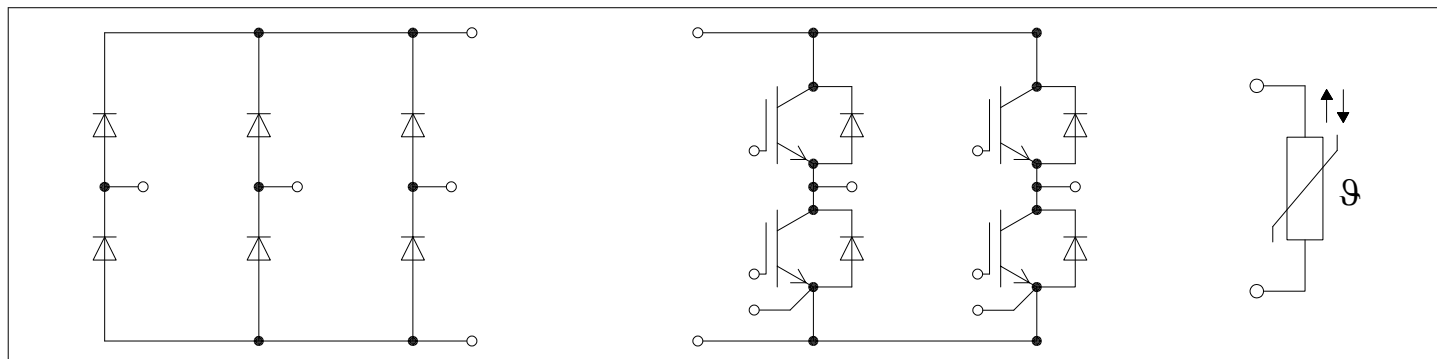


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1 Package

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)	Al_2O_3	
Creepage distance	d_{Creep}	terminal to heatsink	10.0	mm
Clearance	d_{Clear}	terminal to heatsink	7.5	mm
Comparative tracking index	CTI		> 225	
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}			33		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	$T_C = 25 \text{ °C}$, per switch		4		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25 \text{ °C}$, per switch		3		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
Weight	G			300		g

2 IGBT, Inverter

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		$T_{vj} = 25 \text{ °C}$	1700	V
Continuous DC collector current	I_{CDC}	$T_{vj \text{ max}} = 175 \text{ °C}$	$T_C = 95 \text{ °C}$	100	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj \text{ op}}$		200	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	$V_{CE\ sat}$	$I_C = 100\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		1.90	2.25	V
			$T_{vj} = 125\ ^\circ C$		2.30		
			$T_{vj} = 150\ ^\circ C$		2.40		
Gate threshold voltage	V_{GETh}	$I_C = 4\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$		5.35	5.80	6.25	V
Gate charge	Q_G	$V_{GE} = \pm 15\ V$			1.2		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$			7.5		Ω
Input capacitance	C_{ies}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			9		nF
Reverse transfer capacitance	C_{res}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			0.29		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1700\ V, V_{GE} = 0\ V$	$T_{vj} = 25\ ^\circ C$			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}	$I_C = 100\ A, V_{CC} = 900\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.91\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.191		μs
			$T_{vj} = 125\ ^\circ C$		0.213		
			$T_{vj} = 150\ ^\circ C$		0.218		
Rise time (inductive load)	t_r	$I_C = 100\ A, V_{CC} = 900\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.91\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.052		μs
			$T_{vj} = 125\ ^\circ C$		0.056		
			$T_{vj} = 150\ ^\circ C$		0.058		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 100\ A, V_{CC} = 900\ V, V_{GE} = \pm 15\ V, R_{Goff} = 0.91\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.409		μs
			$T_{vj} = 125\ ^\circ C$		0.562		
			$T_{vj} = 150\ ^\circ C$		0.599		
Fall time (inductive load)	t_f	$I_C = 100\ A, V_{CC} = 900\ V, V_{GE} = \pm 15\ V, R_{Goff} = 0.91\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.289		μs
			$T_{vj} = 125\ ^\circ C$		0.507		
			$T_{vj} = 150\ ^\circ C$		0.556		
Turn-on energy loss per pulse	E_{on}	$I_C = 100\ A, V_{CC} = 900\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 0.91\ \Omega, di/dt = 1050\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		27.9		mJ
			$T_{vj} = 125\ ^\circ C$		38.2		
			$T_{vj} = 150\ ^\circ C$		40.9		
Turn-off energy loss per pulse	E_{off}	$I_C = 100\ A, V_{CC} = 900\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 0.91\ \Omega, dv/dt = 3050\ V/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		19		mJ
			$T_{vj} = 125\ ^\circ C$		31.1		
			$T_{vj} = 150\ ^\circ C$		34.9		
SC data	I_{SC}	$V_{GE} \leq 15\ V, V_{CC} = 1000\ V, V_{CEmax} = V_{CES} - L_{sCE} * di/dt$	$t_P \leq 10\ \mu s, T_{vj} = 150\ ^\circ C$		460		A

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to case	R_{thJC}	per IGBT			0.267	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, $\lambda_{grease} = 1 \text{ W/(m}\cdot\text{K)}$		0.0680		K/W
Temperature under switching conditions	$T_{vj\text{ op}}$		-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}		$T_{vj} = 25 \text{ °C}$	1700	V
Continuous DC forward current	I_F			100	A
Repetitive peak forward current	I_{FRM}	$t_P = 1 \text{ ms}$		200	A
I^2t - value	I^2t	$t_P = 10 \text{ ms}, V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ °C}$	1130	A^2s
			$T_{vj} = 150 \text{ °C}$	1100	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 100 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$		1.80	V
			$T_{vj} = 125 \text{ °C}$		1.90	
			$T_{vj} = 150 \text{ °C}$		1.95	
Peak reverse recovery current	I_{RM}	$V_{CC} = 900 \text{ V}, I_F = 100 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 1050 \text{ A/}\mu\text{s} (T_{vj} = 150 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		71.4	A
			$T_{vj} = 125 \text{ °C}$		77.9	
			$T_{vj} = 150 \text{ °C}$		79.9	
Recovered charge	Q_r	$V_{CC} = 900 \text{ V}, I_F = 100 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 1050 \text{ A/}\mu\text{s} (T_{vj} = 150 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		23.2	μC
			$T_{vj} = 125 \text{ °C}$		40.5	
			$T_{vj} = 150 \text{ °C}$		46.1	
Reverse recovery energy	E_{rec}	$V_{CC} = 900 \text{ V}, I_F = 100 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 1050 \text{ A/}\mu\text{s} (T_{vj} = 150 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		11.9	mJ
			$T_{vj} = 125 \text{ °C}$		22.8	
			$T_{vj} = 150 \text{ °C}$		26.4	

(table continues...)

Table 6 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to case	R_{thJC}	per diode			0.465	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$		0.0700		K/W
Temperature under switching conditions	$T_{vj, op}$		-40		150	°C

4 Diode, Rectifier

Table 7 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		$T_{vj} = 25 \text{ °C}$	1800	V
Maximum RMS forward current per chip	I_{FRMSM}	$T_C = 80 \text{ °C}$		100	A
Maximum RMS current at rectifier output	I_{RMSM}	$T_C = 80 \text{ °C}$		150	A
Surge forward current	I_{FSM}	$t_P = 10 \text{ ms}$	$T_{vj} = 25 \text{ °C}$	829	A
			$T_{vj} = 150 \text{ °C}$	705	
I^2t - value	I^2t	$t_P = 10 \text{ ms}$	$T_{vj} = 25 \text{ °C}$	3440	A^2s
			$T_{vj} = 150 \text{ °C}$	2490	

Table 8 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 150 \text{ A}$	$T_{vj} = 150 \text{ °C}$		1.15		V
Threshold voltage	$V_{(TO)}$	$T_{vj} = 150 \text{ °C}$			0.78		V
Slope resistance	r_t	$T_{vj} = 150 \text{ °C}$			2.4		mΩ
Reverse current	I_r	$T_{vj} = 150 \text{ °C}, V_R = 1800 \text{ V}$			1		mA
Thermal resistance, junction to case	R_{thJC}	per diode				0.552	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$			0.0740		K/W
Temperature under switching conditions	$T_{vj, op}$			-40		150	°C

5 NTC-Thermistor

Table 9 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}	$\Delta R/R$	$T_{NTC} = 100\text{ °C}, R_{100} = 493\text{ Ω}$	-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

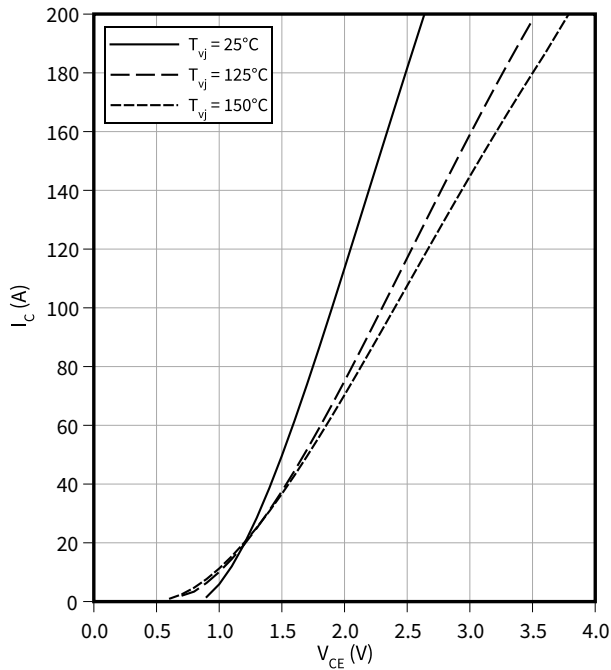
Note: Specification according to the valid application note.

6 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

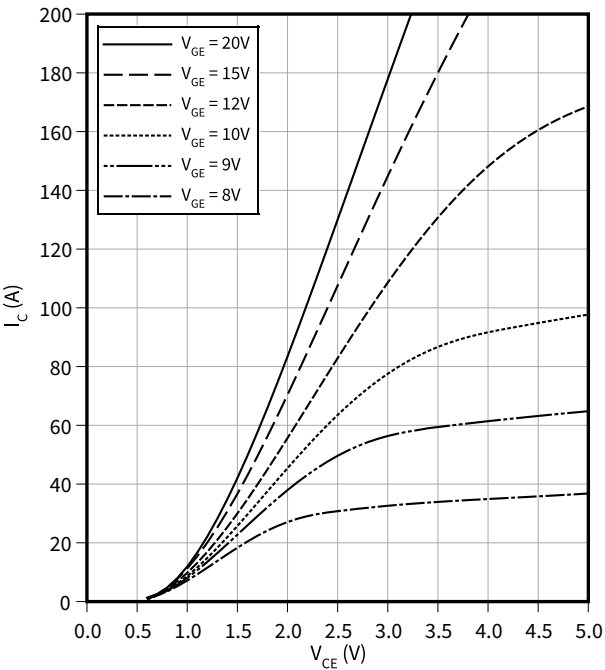
$V_{GE} = 15\text{ V}$



Output characteristic field (typical), IGBT, Inverter

$I_C = f(V_{CE})$

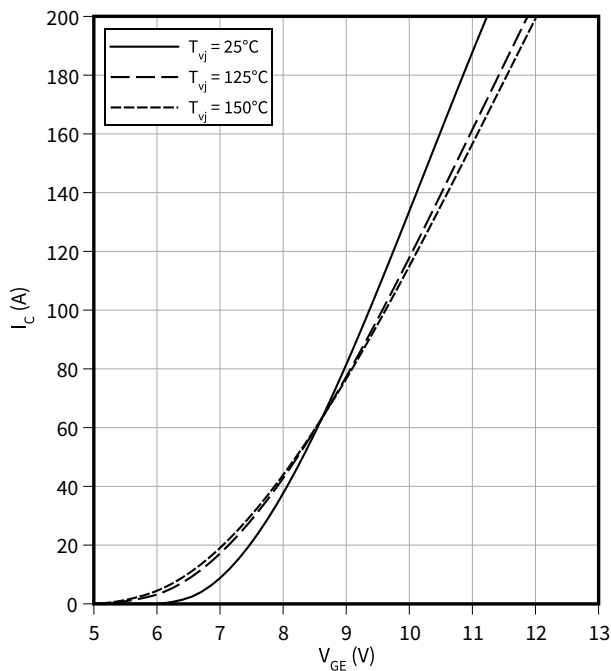
$T_{vj} = 150\text{ °C}$



Transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

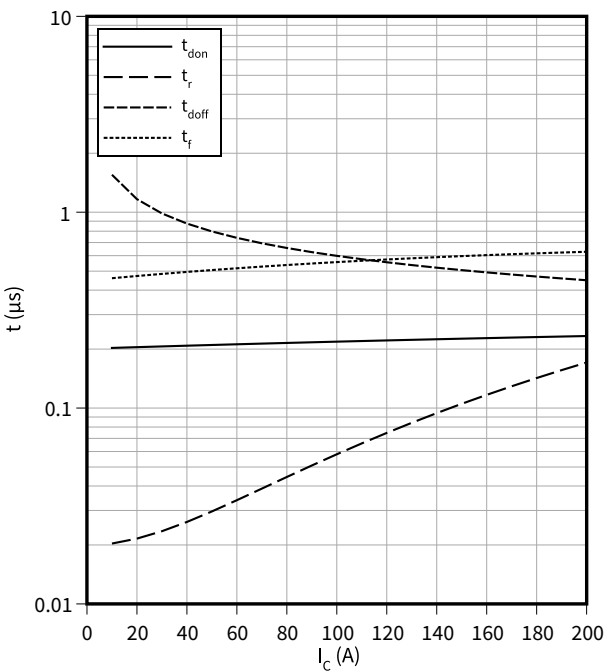
$V_{CE} = 20\text{ V}$



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

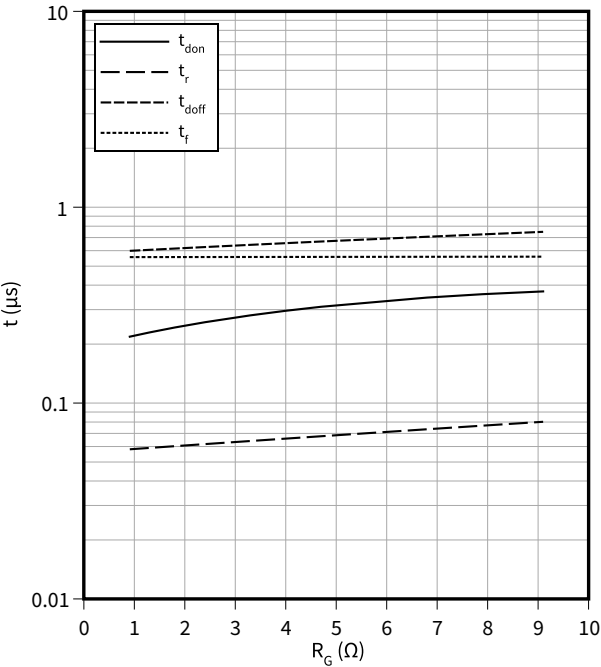
$V_{CC} = 900\text{ V}, R_{Goff} = 0.91\text{ }\Omega, R_{Gon} = 0.91\text{ }\Omega, V_{GE} = \pm 15\text{ V}, T_{vj} = 150\text{ °C}$



6 Characteristics diagrams

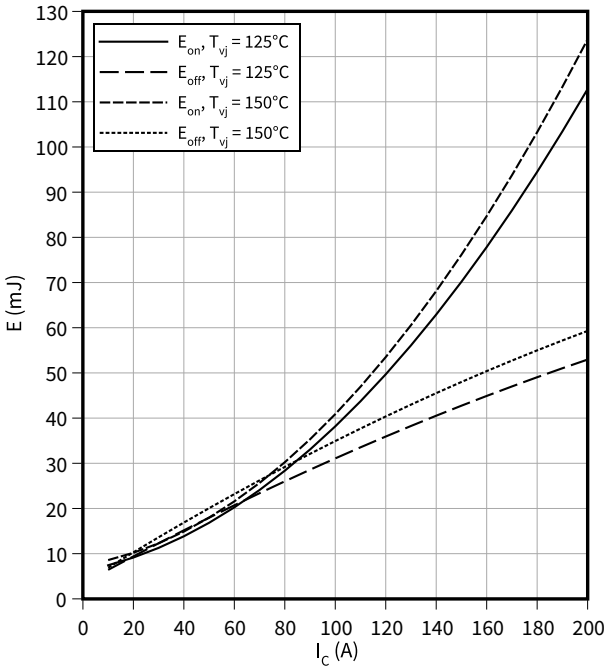
Switching times (typical), IGBT, Inverter

$t = f(R_G)$
 $V_{GE} = \pm 15\text{ V}$, $I_C = 100\text{ A}$, $V_{CC} = 900\text{ V}$, $T_{vj} = 150\text{ }^\circ\text{C}$



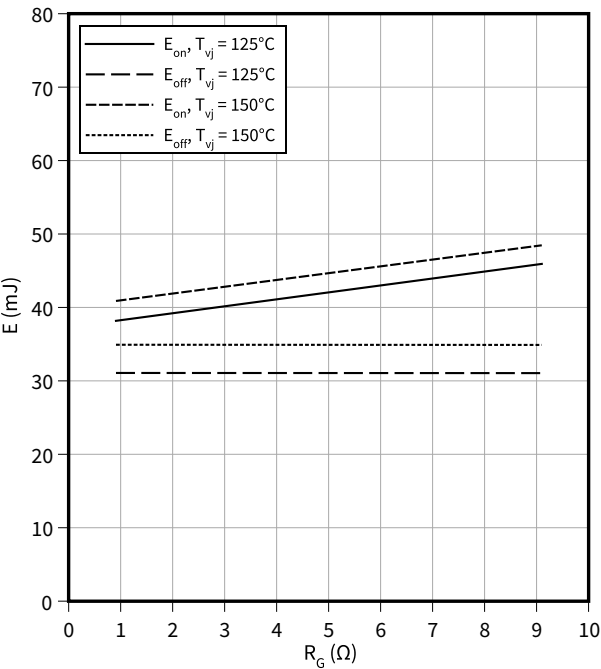
Switching losses (typical), IGBT, Inverter

$E = f(I_C)$
 $R_{Goff} = 0.91\text{ }\Omega$, $R_{Gon} = 0.91\text{ }\Omega$, $V_{CC} = 900\text{ V}$, $V_{GE} = \pm 15\text{ V}$



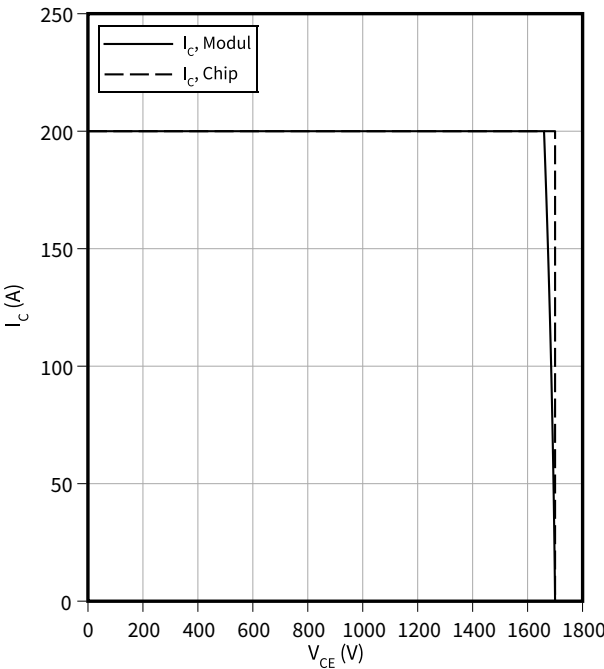
Switching losses (typical), IGBT, Inverter

$E = f(R_G)$
 $I_C = 100\text{ A}$, $V_{CC} = 900\text{ V}$, $V_{GE} = \pm 15\text{ V}$



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

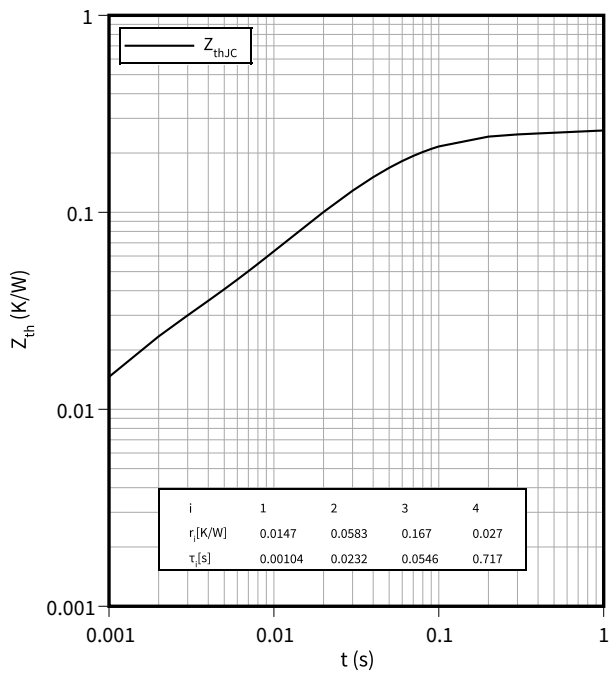
$I_C = f(V_{CE})$
 $R_{Goff} = 0.91\text{ }\Omega$, $V_{GE} = \pm 15\text{ V}$, $T_{vj} = 150\text{ }^\circ\text{C}$



6 Characteristics diagrams

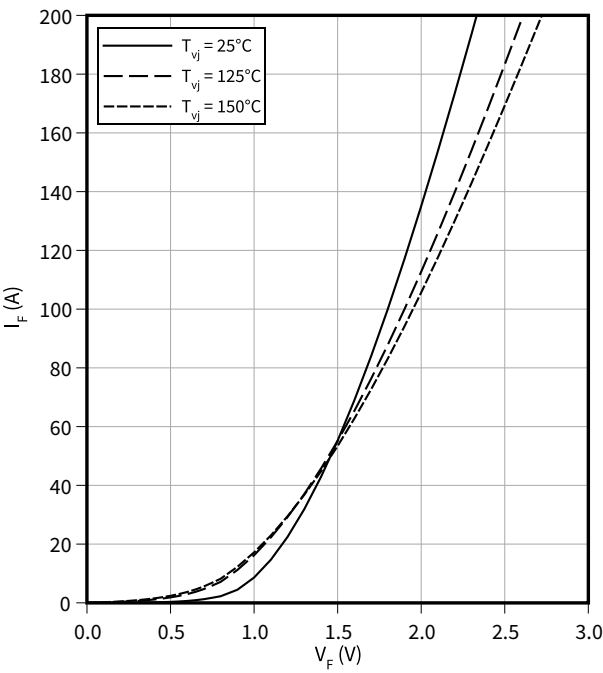
Transient thermal impedance, IGBT, Inverter

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, Inverter

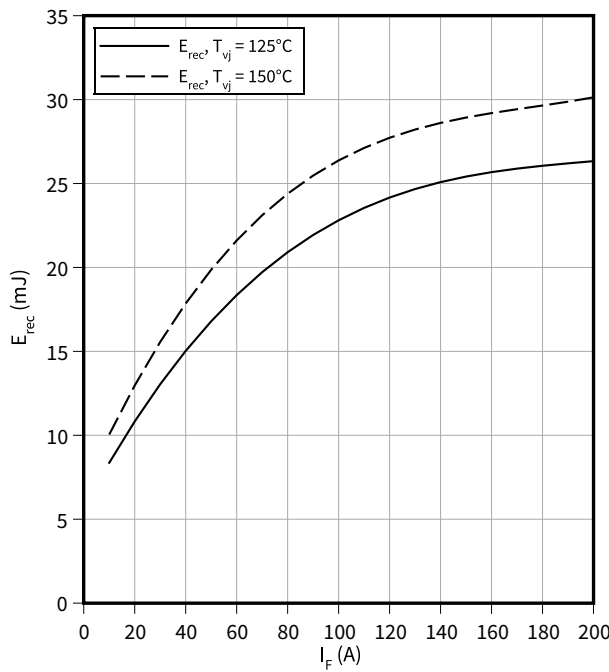
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

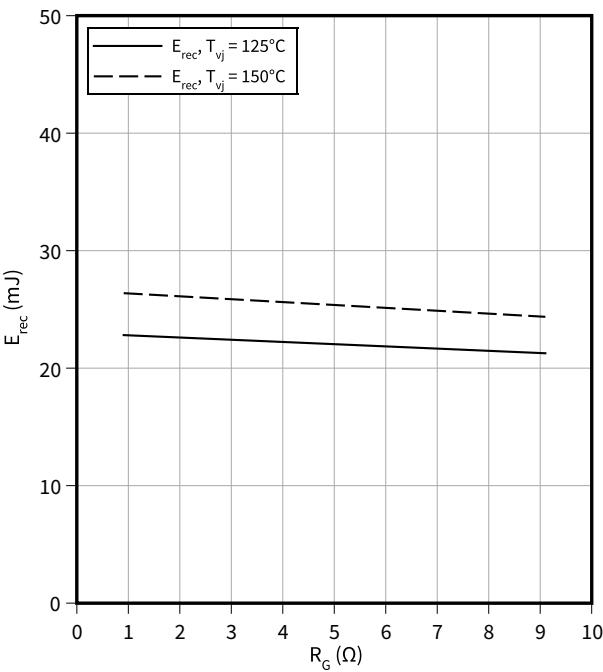
$R_{Gon} = R_{Gon}(IGBT) , V_{CC} = 900 V$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$

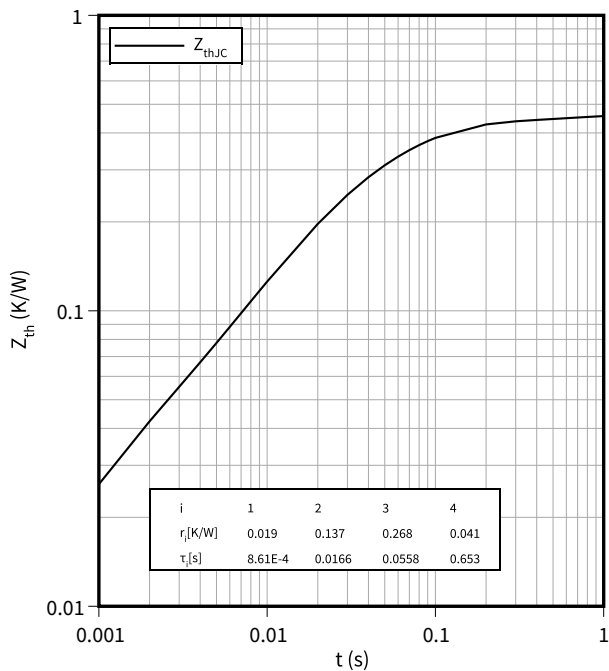
$I_F = 100 A, V_{CC} = 900 V$



6 Characteristics diagrams

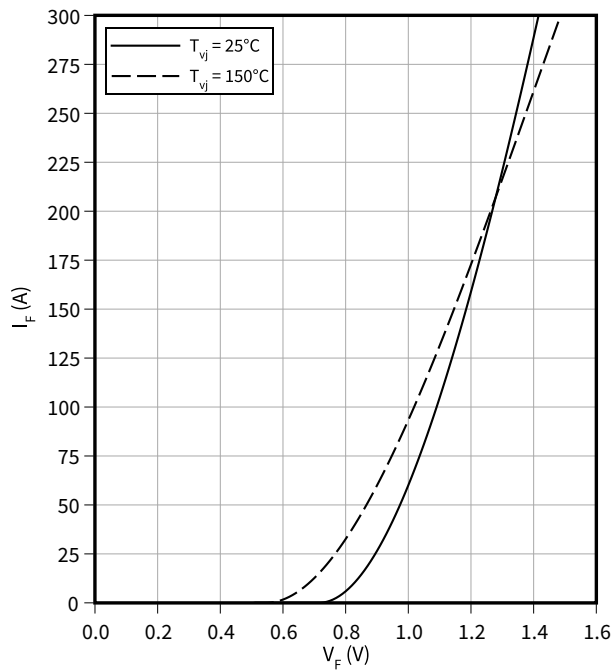
Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



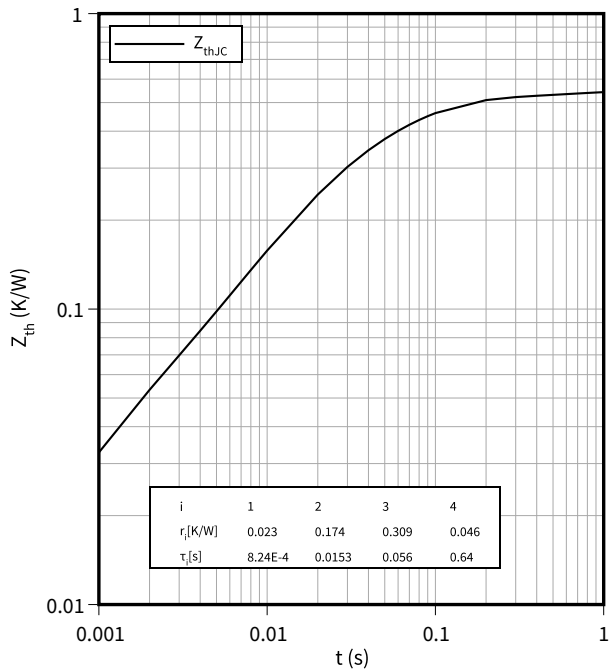
Forward characteristic (typical), Diode, Rectifier

$I_F = f(V_F)$



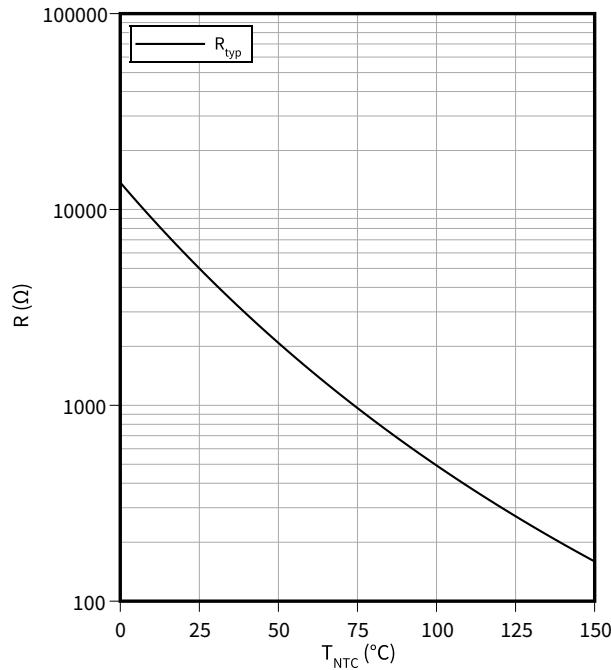
Transient thermal impedance, Diode, Rectifier

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



7 **Circuit diagram**

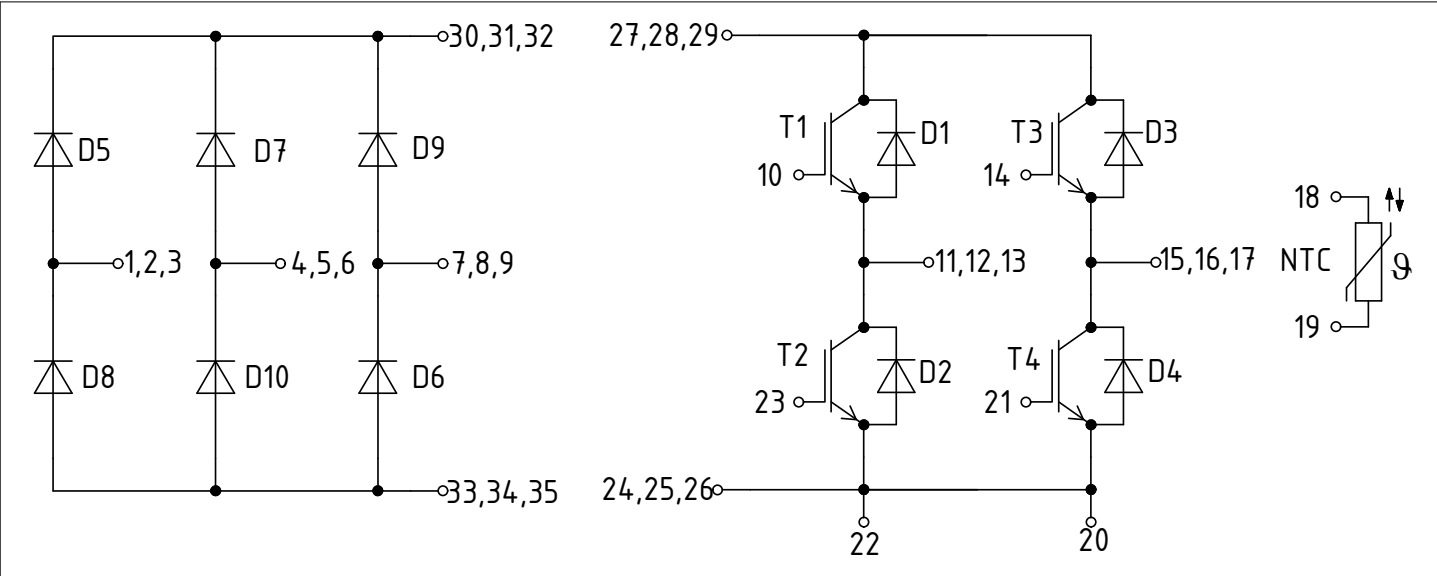


Figure 1

8 Package outlines

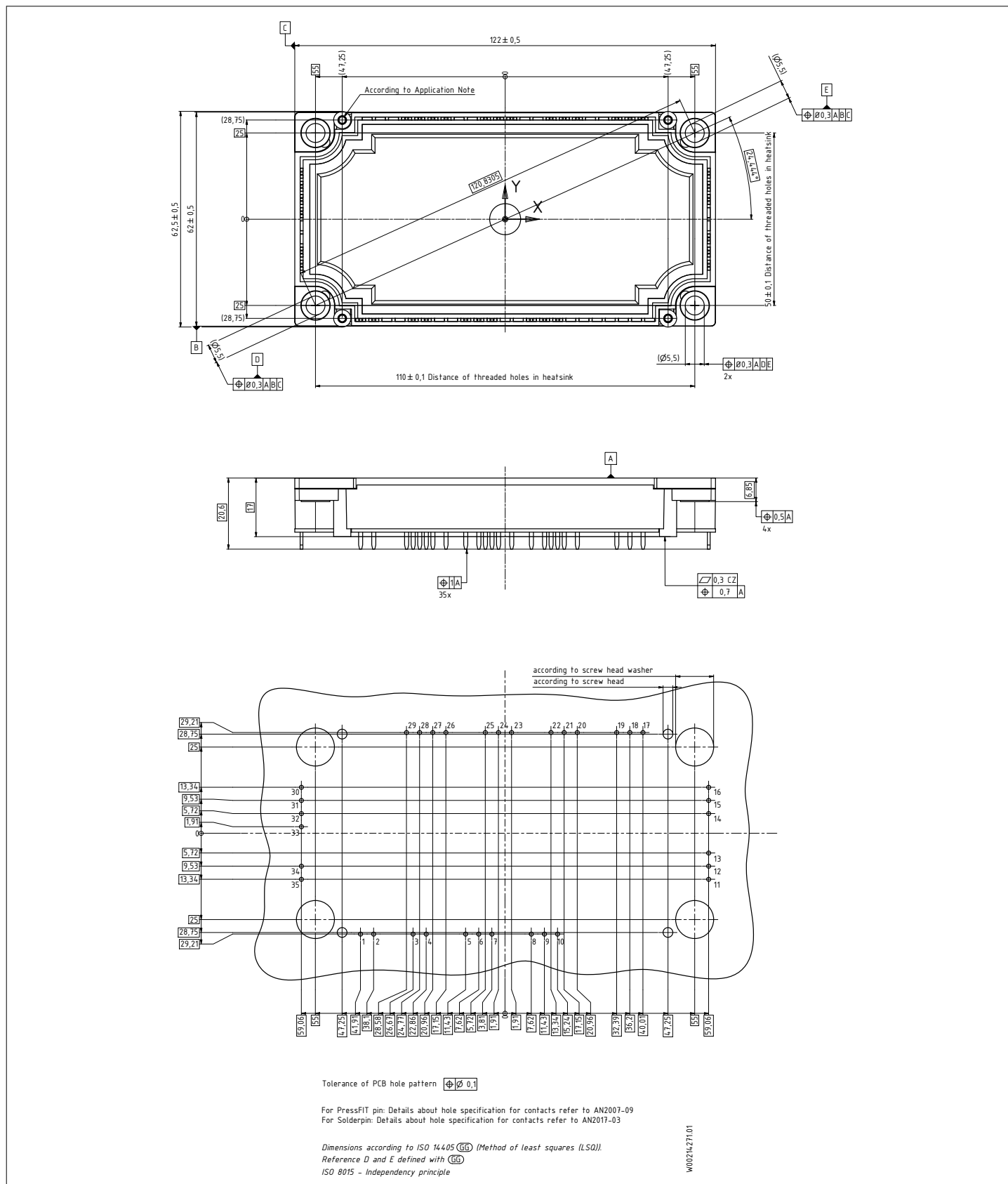


Figure 2

9 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

Revision history

Document revision	Date of release	Description of changes
1.00	2021-04-16	Final
1.10	2024-10-07	Final datasheet

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