

PrimePACK™3+ B-series module with Trench/Fieldstop IGBT5, enlarged emitter controlled 5 diode and NTC

Features

- Electrical features
 - $V_{CES} = 1700\text{ V}$
 - $I_{C\text{nom}} = 1700\text{ A} / I_{CRM} = 3400\text{ A}$
 - Low switching losses
 - High current density
 - High surge current capability
 - Enlarged diode
 - $T_{vj,op} = 175^{\circ}\text{C}$
- Mechanical features
 - High power and thermal cycling capability
 - High power density
 - High creepage and clearance distances
 - Package with CTI > 400



Potential applications

- Wind turbines
- High-power converters
- Motor drives
- Traction drives

Product validation

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

Description

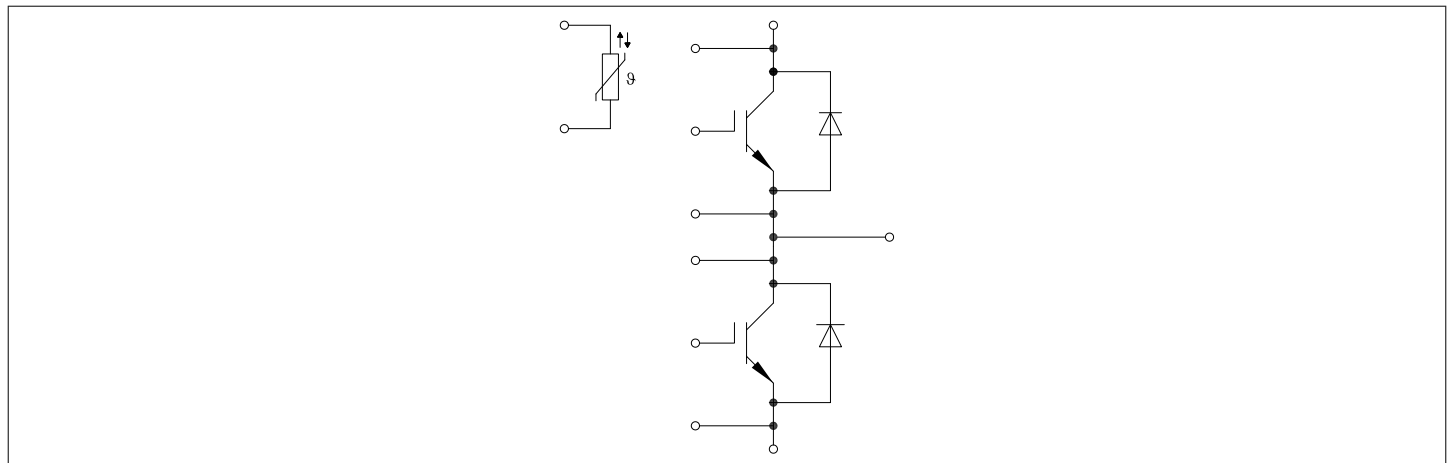


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50$ Hz, $t = 60$ s	4.0	kV
Material of module baseplate			Cu	
Creepage distance	d_{Creep}	terminal to heatsink	36.0	mm
Creepage distance	d_{Creep}	terminal to terminal	28.0	mm
Clearance	d_{Clear}	terminal to heatsink	21.0	mm
Clearance	d_{Clear}	terminal to terminal	19.0	mm
Comparative tracking index	CTI		> 400	

Table 2 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Stray inductance module	L_{SCE}			10		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	$T_C = 25$ °C, per switch		0.12		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25$ °C, per switch		0.13		mΩ
Storage temperature	T_{stg}		-40		150	°C
Maximum baseplate operation temperature	T_{BPmax}				150	°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	M4, Screw	1.8	2.1	Nm
			M8, Screw	8	10	
Weight	G			1400		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
Implemented collector current	I_{CN}		1700	A
Continuous DC collector current	I_{CDC}	$T_{vj max} = 175$ °C $T_C = 75$ °C	1700	A

(table continues...)

Table 3 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\ op}$	3400	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	$V_{CE\ sat}$	$I_C = 1700\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$	1.95	2.33	V
			$T_{vj} = 125\ ^\circ C$	2.35	2.79	
			$T_{vj} = 175\ ^\circ C$	2.55	2.97	
Gate threshold voltage	V_{GEth}	$I_C = 57\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$	5.35	5.80	6.25	V
Gate charge	Q_G	$V_{GE} = \pm 15\ V, V_{CC} = 900\ V$		6.75		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$		0.92		Ω
Input capacitance	C_{ies}	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		81		nF
Reverse transfer capacitance	C_{res}	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		3		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1700\ V, V_{GE} = 0\ V$			10	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}	$I_C = 1700\ A, V_{CC} = 900\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.39\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.260		μs
			$T_{vj} = 125\ ^\circ C$	0.275		
			$T_{vj} = 175\ ^\circ C$	0.285		
Rise time (inductive load)	t_r	$I_C = 1700\ A, V_{CC} = 900\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.39\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.145		μs
			$T_{vj} = 125\ ^\circ C$	0.165		
			$T_{vj} = 175\ ^\circ C$	0.170		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 1700\ A, V_{CC} = 900\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.1\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.680		μs
			$T_{vj} = 125\ ^\circ C$	0.765		
			$T_{vj} = 175\ ^\circ C$	0.820		
Fall time (inductive load)	t_f	$I_C = 1700\ A, V_{CC} = 900\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.1\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.120		μs
			$T_{vj} = 125\ ^\circ C$	0.315		
			$T_{vj} = 175\ ^\circ C$	0.425		
Turn-on energy loss per pulse	E_{on}	$I_C = 1700\ A, V_{CC} = 900\ V, L_\sigma = 30\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 0.39\ \Omega, di/dt = 9300\ A/\mu s (T_{vj} = 175\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$	400		mJ
			$T_{vj} = 125\ ^\circ C$	590		
			$T_{vj} = 175\ ^\circ C$	720		

(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}	$I_C = 1700\text{ A}$, $V_{CC} = 900\text{ V}$, $L_\sigma = 30\text{ nH}$, $V_{GE} = \pm 15\text{ V}$, $R_{Goff} = 1.1\ \Omega$, $dv/dt = 2650\text{ V}/\mu\text{s}$ ($T_{vj} = 175\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	335		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	460		
			$T_{vj} = 175\text{ }^\circ\text{C}$	540		
SC data	I_{SC}	$V_{GE} \leq 15\text{ V}$, $V_{CC} = 1000\text{ V}$, $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_p \leq 10\ \mu\text{s}$, $T_{vj} \leq 175\text{ }^\circ\text{C}$	7200		A
Thermal resistance, junction to case	R_{thJC}	per IGBT			19.2	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, $\lambda_{grease} = 1\text{ W}/(\text{m}\cdot\text{K})$		10.5		K/kW
Temperature under switching conditions	T_{vjop}		-40		175	$^\circ\text{C}$

3 Diode, Inverter

Table 5 **Maximum rated values**

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	V_{RRM}	$T_{vj} = 25\text{ }^\circ\text{C}$	1700	V	
Continuous DC forward current	I_F		1700	A	
Repetitive peak forward current	I_{FRM}	$t_p = 1\text{ ms}$	3400	A	
I^2t - value	I^2t	$t_p = 10\text{ ms}$, $V_R = 0\text{ V}$	$T_{vj} = 125\text{ }^\circ\text{C}$	1150	kA ² s
			$T_{vj} = 175\text{ }^\circ\text{C}$	1080	
Maximum power dissipation	P_{RQM}	$T_{vj} = 175\text{ }^\circ\text{C}$	2100	kW	

Table 6 **Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	V_F	$I_F = 1700\text{ A}$, $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		1.65	1.91	V
			$T_{vj} = 125\text{ }^\circ\text{C}$		1.60	1.96	
			$T_{vj} = 175\text{ }^\circ\text{C}$		1.55	1.89	
Peak reverse recovery current	I_{RM}	$V_{CC} = 900\text{ V}$, $I_F = 1700\text{ A}$, $V_{GE} = -15\text{ V}$, $-di_F/dt = 9750\text{ A}/\mu\text{s}$ ($T_{vj} = 175\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$		1430		A
			$T_{vj} = 125\text{ }^\circ\text{C}$		1750		
			$T_{vj} = 175\text{ }^\circ\text{C}$		1870		

(table continues...)

Table 6 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Recovered charge	Q_r	$V_{CC} = 900 \text{ V}$, $I_F = 1700 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 9750 \text{ A}/\mu\text{s}$ ($T_{vj} = 175 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$	340		μC
			$T_{vj} = 125 \text{ }^\circ\text{C}$	650		
			$T_{vj} = 175 \text{ }^\circ\text{C}$	865		
Reverse recovery energy	E_{rec}	$V_{CC} = 900 \text{ V}$, $I_F = 1700 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 9750 \text{ A}/\mu\text{s}$ ($T_{vj} = 175 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$	175		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$	375		
			$T_{vj} = 175 \text{ }^\circ\text{C}$	510		
Thermal resistance, junction to case	R_{thJC}	per diode			28.2	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$		11.5		K/kW
Temperature under switching conditions	$T_{vj\text{op}}$		-40		175	$^\circ\text{C}$

4 NTC-Thermistor

Table 7 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	$T_{NTC} = 25 \text{ }^\circ\text{C}$		5		k Ω
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

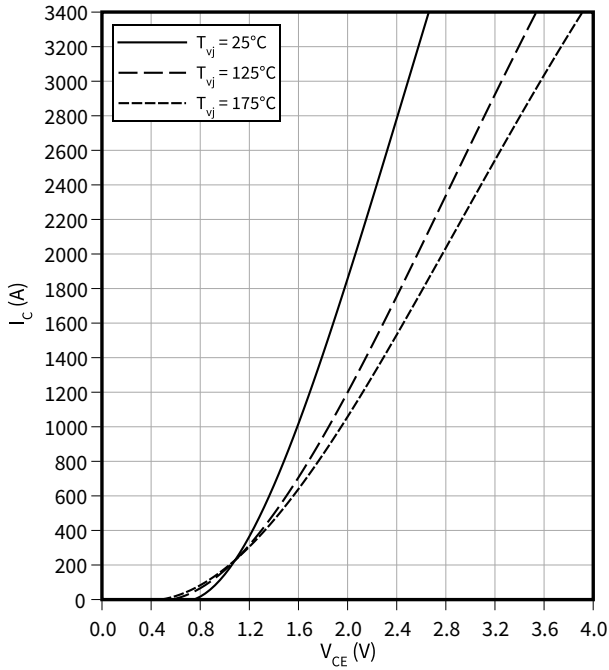
Note: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4.

5 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

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

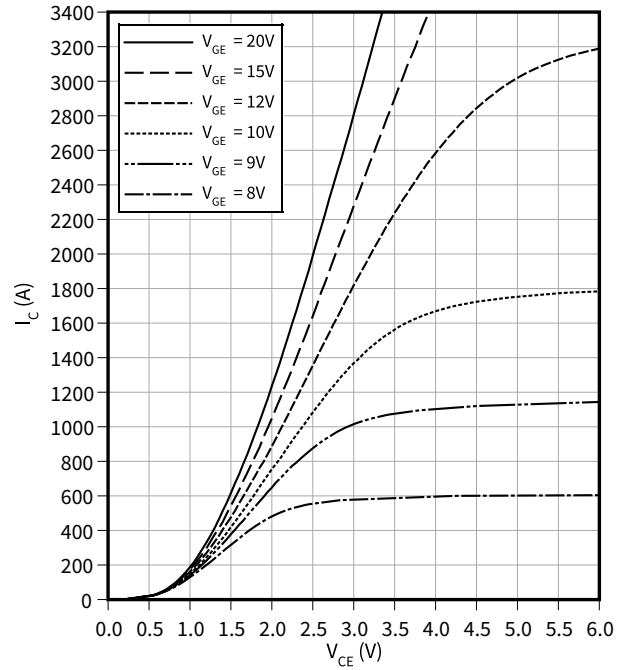
$$V_{GE} = 15 \text{ V}$$



Output characteristic field (typical), IGBT, Inverter

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

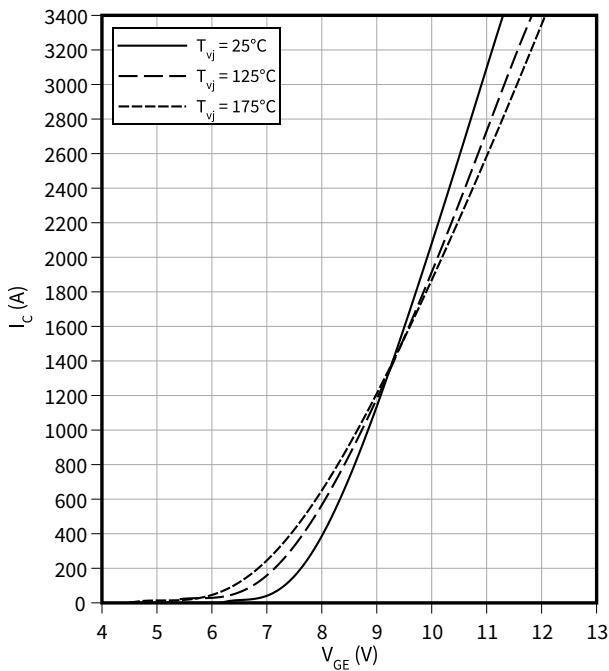
$$T_{vj} = 175 \text{ °C}$$



Transfer characteristic (typical), IGBT, Inverter

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

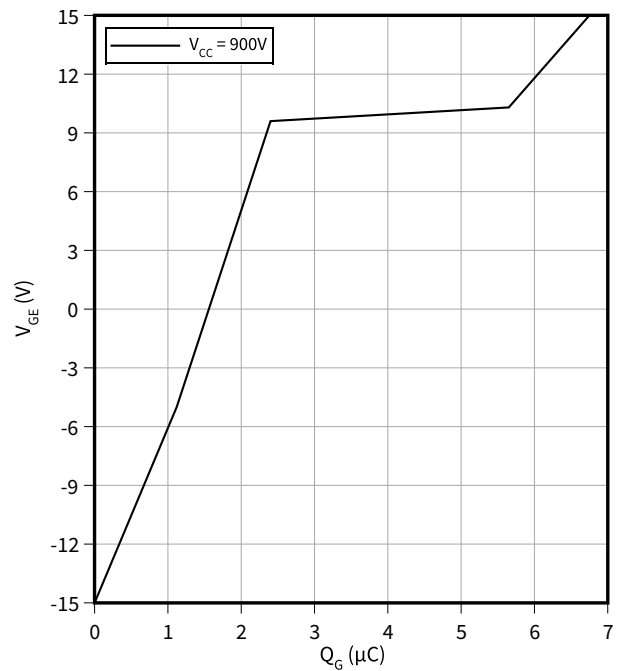
$$V_{CE} = 20 \text{ V}$$



Gate charge characteristic (typical), IGBT, Inverter

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

$$I_C = 1700 \text{ A}, T_{vj} = 25 \text{ °C}$$

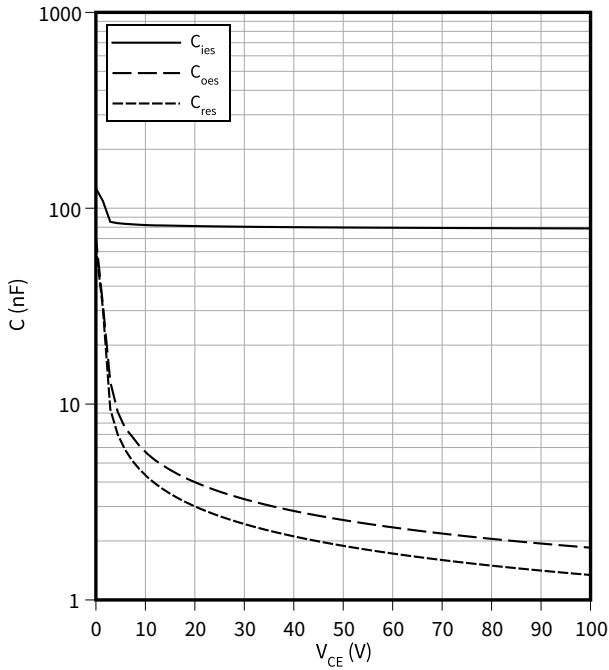


5 Characteristics diagrams

Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

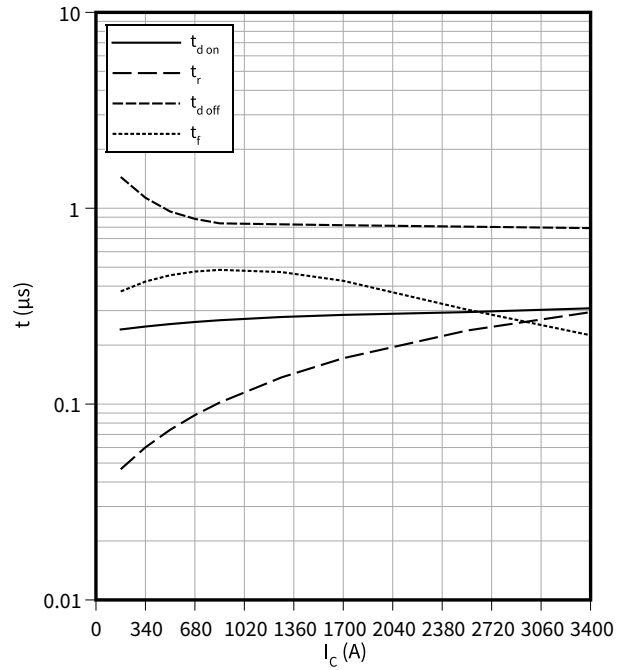
$f = 100 \text{ kHz}, V_{GE} = 0 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}$



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

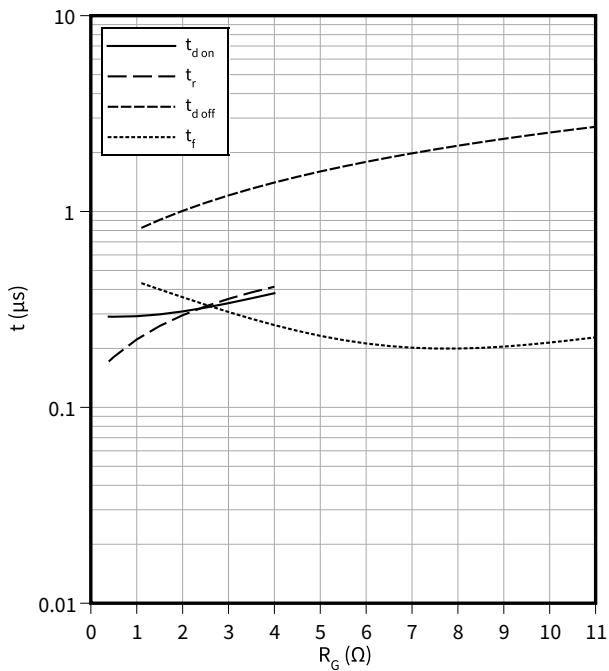
$R_{Goff} = 1.1 \text{ } \Omega, R_{Gon} = 0.39 \text{ } \Omega, V_{GE} = \pm 15 \text{ V}, V_{CC} = 900 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}$



Switching times (typical), IGBT, Inverter

$t = f(R_G)$

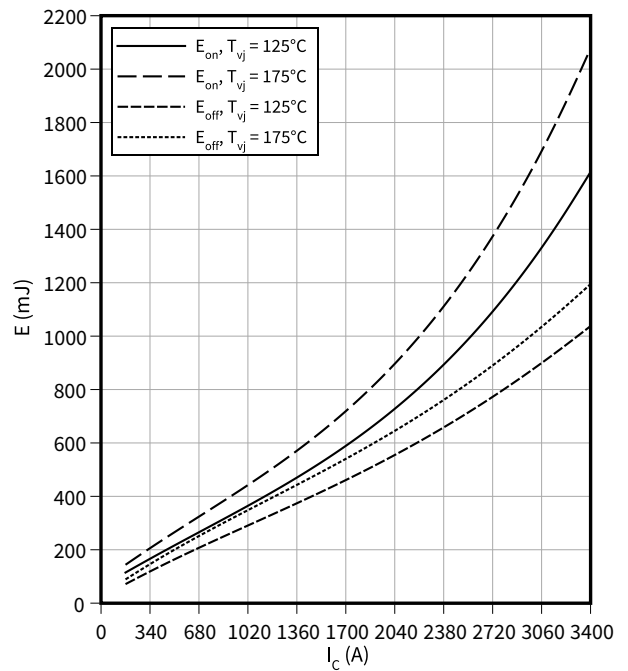
$V_{GE} = \pm 15 \text{ V}, I_C = 1700 \text{ A}, V_{CC} = 900 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}$



Switching losses (typical), IGBT, Inverter

$E = f(I_C)$

$R_{Goff} = 1.1 \text{ } \Omega, R_{Gon} = 0.39 \text{ } \Omega, V_{CC} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}$

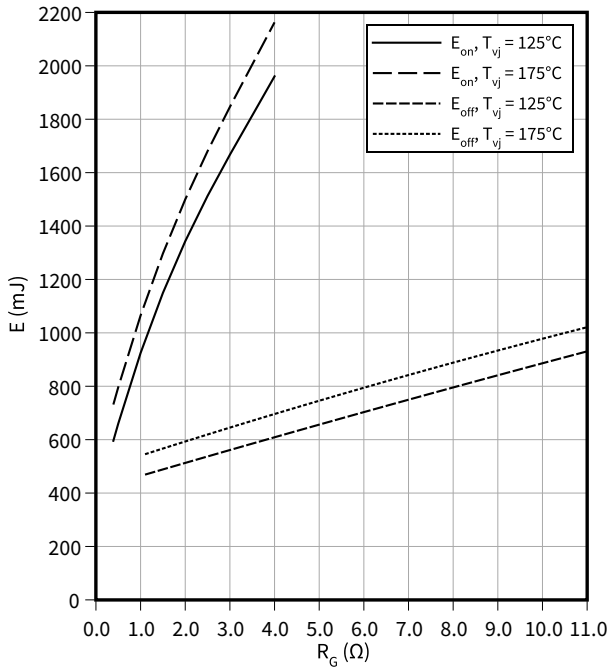


5 Characteristics diagrams

Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

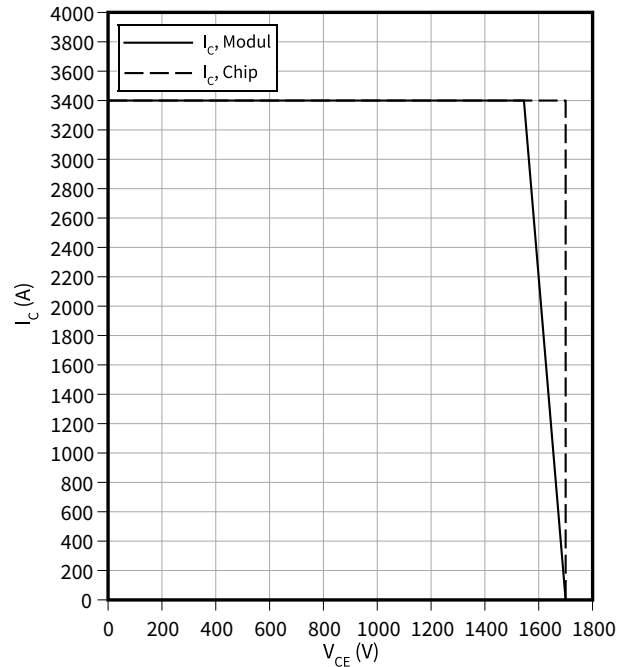
$V_{CC} = 900\text{ V}, V_{GE} = \pm 15\text{ V}, I_C = 1700\text{ A}$



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

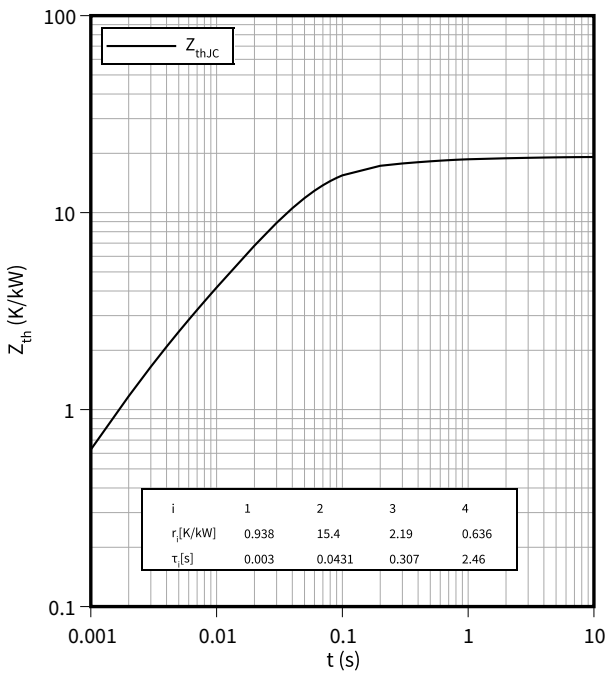
$I_C = f(V_{CE})$

$R_{Goff} = 1.1\ \Omega, V_{GE} = \pm 15\text{ V}, T_{vj} = 175\text{ °C}$



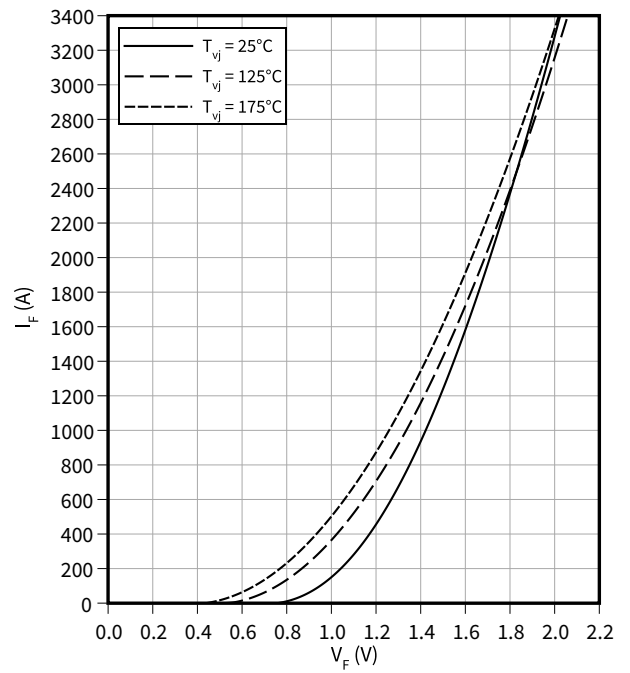
Transient thermal impedance, IGBT, Inverter

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, Inverter

$I_F = f(V_F)$

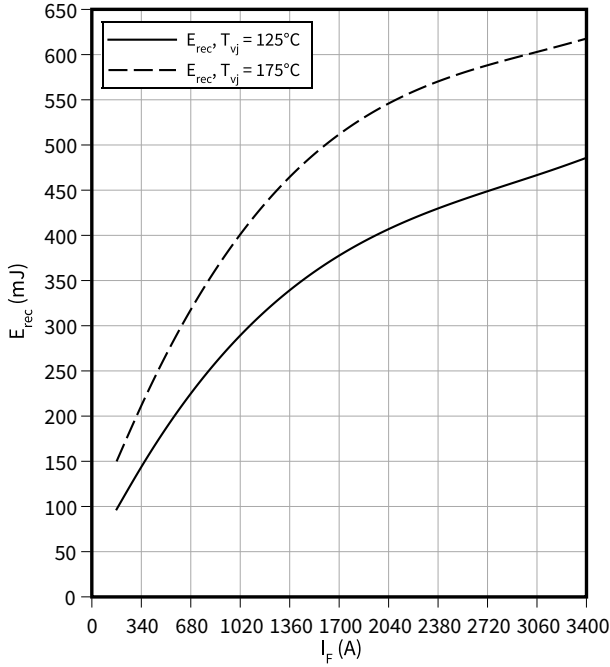


5 Characteristics diagrams

Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

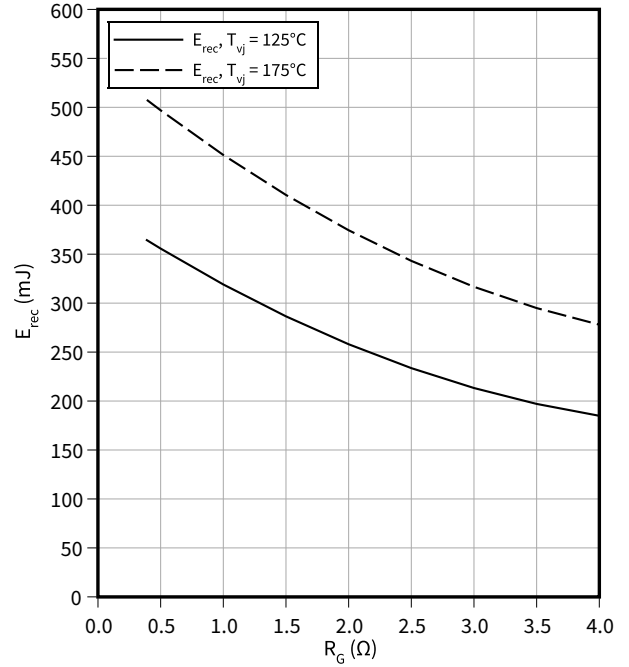
$R_{Gon} = R_{Gon}(IGBT), V_{CC} = 900 V$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$

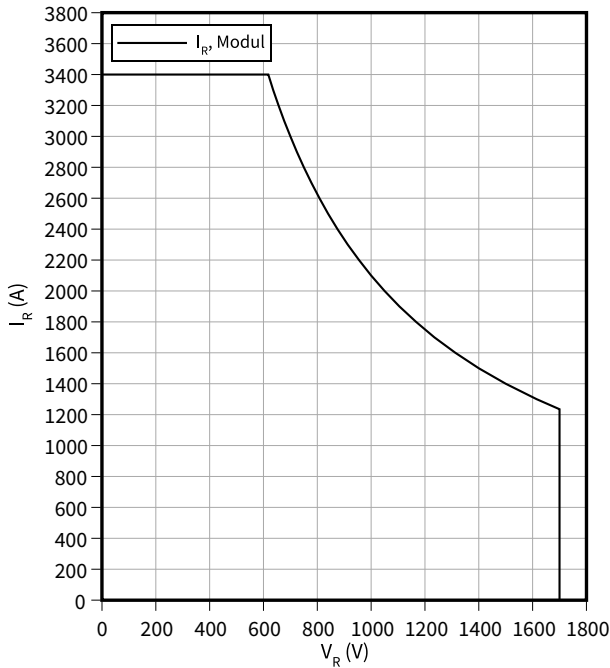
$I_F = 1700 A, V_{CC} = 900 V$



Safe operating area (SOA), Diode, Inverter

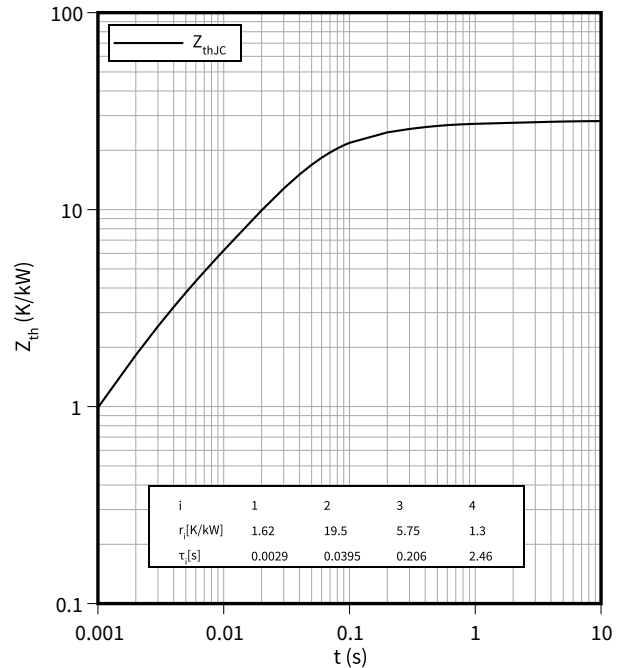
$I_R = f(V_R)$

$T_{vj} = 175 °C$



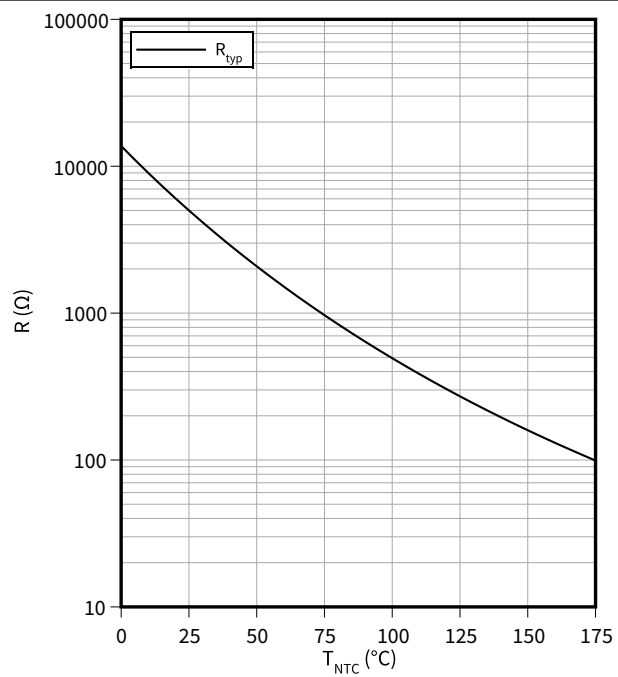
Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

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



6 Circuit diagram

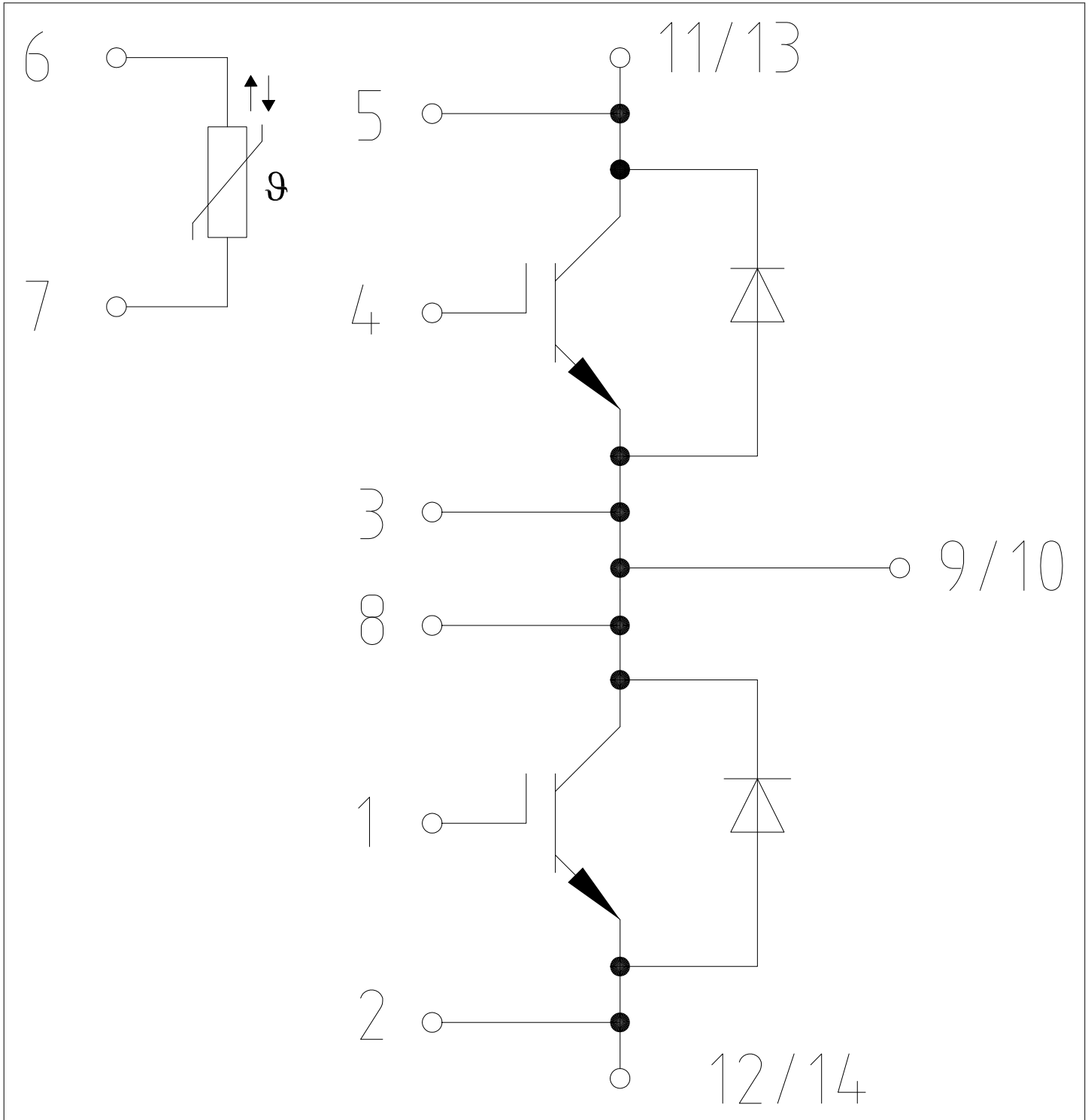


Figure 1

7 Package outlines

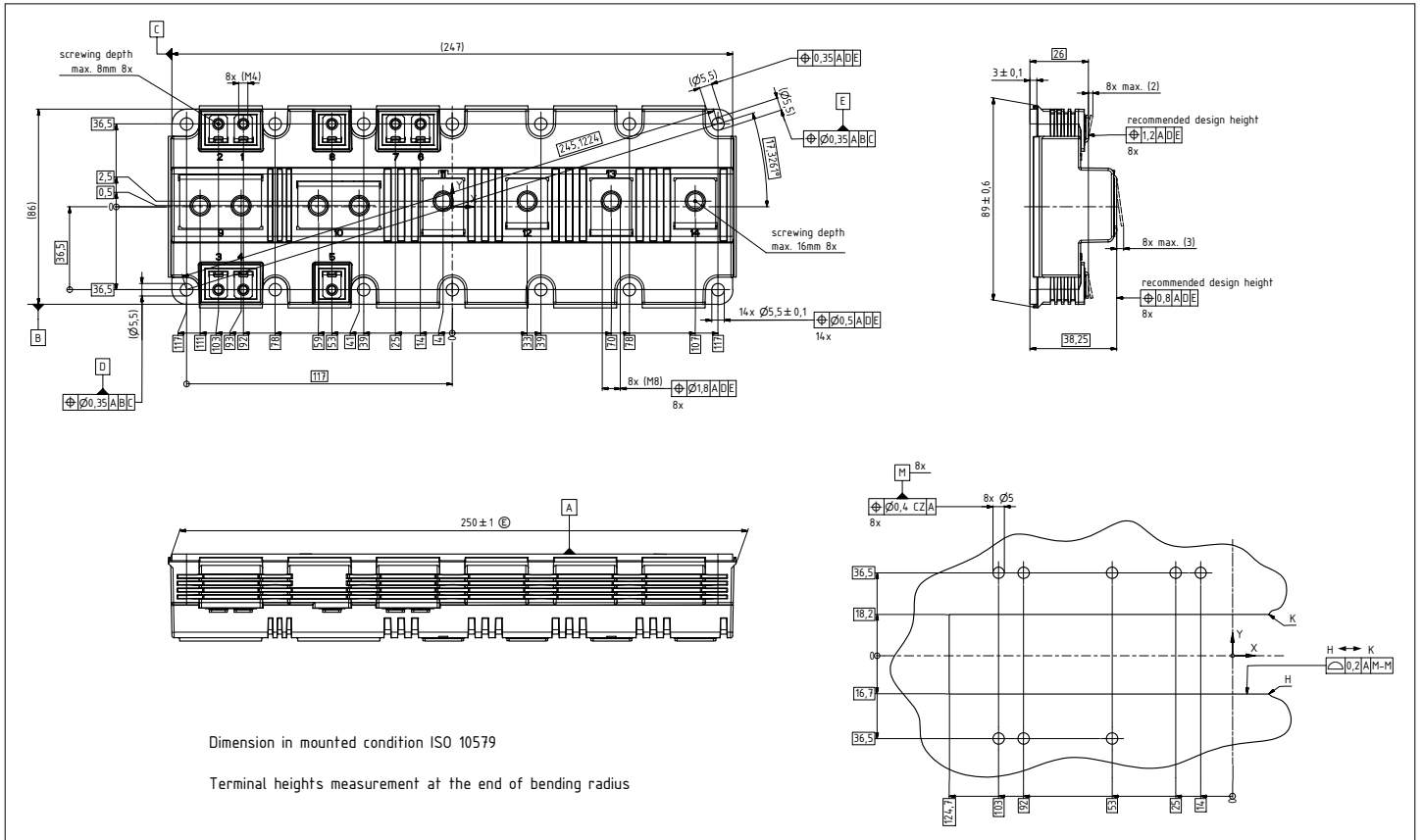


Figure 2

8 Module label code


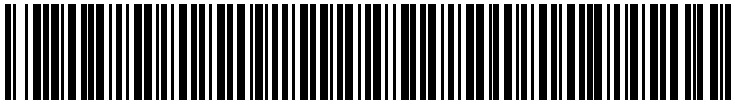
Module label code			
Code format	Data Matrix	Barcode Code128	
Encoding	ASCII text	Code Set A	
Symbol size	16x16	23 digits	
Standard	IEC24720 and IEC16022	IEC8859-1	
Code content	Content	Digit	Example
	Module serial number	1 - 5	71549
	Module material number	6 - 11	142846
	Production order number	12 - 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
0.10	2022-05-17	Initial version
0.20	2023-01-24	Target datasheet
1.00	2023-05-31	Final datasheet

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