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

Features

- Electrical features
  - V_{CES} = 1700 V
  - $I_{C\,nom}$ = 2000 A / I_{CRM} = 4000 A
  - Low switching losses
  - High current density
  - High surge current capability
  - $T_{vj,op}$ = 175°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

Product validation

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

Description

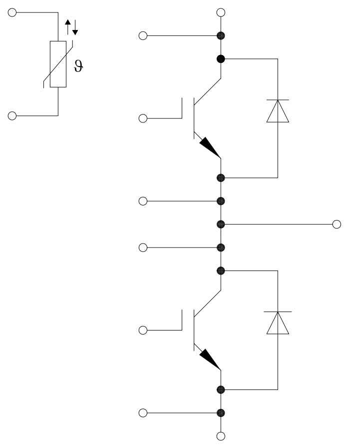


Table of contents

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}			2000	A
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_C = 90 °C	2000	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 $T_{vj\,op}$	4000	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 = 2000 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.90	2.27	V
			T_{vj} = 125 °C		2.30	2.64	
			T_{vj} = 175 °C		2.45	2.82	
Gate threshold voltage	V_{GEth}	I_C = 72 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.35	5.80	6.25	V
Gate charge	Q_G	V_{GE} = ±15 V, V_{CC}=900 V			8.5		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0.75		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			101		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			3.5		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1700 V, V_{GE} = 0 V	T_{vj} = 125 °C			10	mA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V, T_{vj} = 25 °C				400	nA
Turn-on delay time (inductive load)	t_{don}	I_C = 2000 A, V_{CC} = 900 V, V_{GE} = ±15 V, R_{Gon} = 0.3 Ω	T_{vj} = 25 °C		0.285		µs
			T_{vj} = 125 °C		0.300		
			T_{vj} = 175 °C		0.310		
Rise time (inductive load)	t_r	I_C = 2000 A, V_{CC} = 900 V, V_{GE} = ±15 V, R_{Gon} = 0.3 Ω	T_{vj} = 25 °C		0.160		µs
			T_{vj} = 125 °C		0.175		
			T_{vj} = 175 °C		0.185		
Turn-off delay time (inductive load)	t_{doff}	I_C = 2000 A, V_{CC} = 900 V, V_{GE} = ±15 V, R_{Goff} = 1.1 Ω	T_{vj} = 25 °C		0.765		µs
			T_{vj} = 125 °C		0.875		
			T_{vj} = 175 °C		0.925		
Fall time (inductive load)	t_f	I_C = 2000 A, V_{CC} = 900 V, V_{GE} = ±15 V, R_{Goff} = 1.1 Ω	T_{vj} = 25 °C		0.115		µs
			T_{vj} = 125 °C		0.270		
			T_{vj} = 175 °C		0.385		
Turn-on energy loss per pulse	E_{on}	I_C = 2000 A, V_{CC} = 900 V, L_σ = 30 nH, V_{GE} = ±15 V, R_{Gon} = 0.3 Ω, di/dt = 10700 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		335		mJ
			T_{vj} = 125 °C		485		
			T_{vj} = 175 °C		575		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values Min.	Values Typ.	Values Max.	Unit
Turn-off energy loss per pulse	E_{off}	I_C = 2000 A, V_{CC} = 900 V, L_σ = 30 nH, V_{GE} = ±15 V, R_{Goff} = 1.1 Ω, dv/dt = 2400 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		425		mJ
			T_{vj} = 125 °C		590		
			T_{vj} = 175 °C		690		
SC data	I_{SC}	V_{GE} ≤ 15 V, V_{CC} = 1000 V, V_{CEmax}=V_{CES}-L_{sCE}*di/dt	t_P ≤ 10 µs, T_{vj} ≤ 175 °C		9200		A
Thermal resistance, junction to case	R_{thJC}	per IGBT				15.0	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, λ_{grease} = 1 W/(m·K)			9.70		K/kW
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°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 °C	1700	V
Continuous DC forward current	I_F			2000	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		4000	A
I²t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	710	kA²s
			T_{vj} = 175 °C	610	
Maximum power dissipation	P_{RQM}		T_{vj} = 175 °C	1300	kW

Table 6 Characteristic values

Parameter	Symbol	Note or test condition		Values Min.	Values Typ.	Values Max.	Unit
Forward voltage	V_F	I_F = 2000 A, V_{GE} = 0 V	T_{vj} = 25 °C		2.00	2.23	V
			T_{vj} = 125 °C		2.05	2.33	
			T_{vj} = 175 °C		2.00	2.32	
Peak reverse recovery current	I_{RM}	V_{CC} = 900 V, I_F = 2000 A, V_{GE} = -15 V, -di_F/dt = 11500 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		1500		A
			T_{vj} = 125 °C		1760		
			T_{vj} = 175 °C		1920		

(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 V, I_F = 2000 A, V_{GE} = -15 V, -di_F/dt = 11500 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		315		µC
			T_{vj} = 125 °C		595		
			T_{vj} = 175 °C		510		
Reverse recovery energy	E_{rec}	V_{CC} = 900 V, I_F = 2000 A, V_{GE} = -15 V, -di_F/dt = 11500 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		190		mJ
			T_{vj} = 125 °C		390		
			T_{vj} = 175 °C		525		
Thermal resistance, junction to case	R_{thJC}	per diode				38.6	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per diode, λ_{grease} = 1 W/(m·K)			14.2		K/kW
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

4 NTC-Thermistor

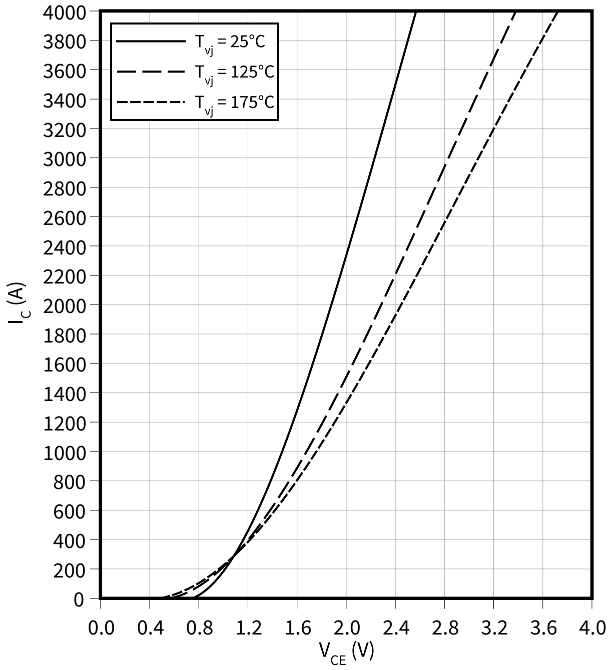
Table 7 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	T_{NTC} = 25 °C		5		kΩ
Deviation of R_{100}	$\Delta R/R$	T_{NTC} = 100 °C, R_{100} = 493 Ω	-5		5	%
Power dissipation	P_{25}	T_{NTC} = 25 °C			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298,15\ K))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298,15\ K))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298,15\ K))]$		3433		K

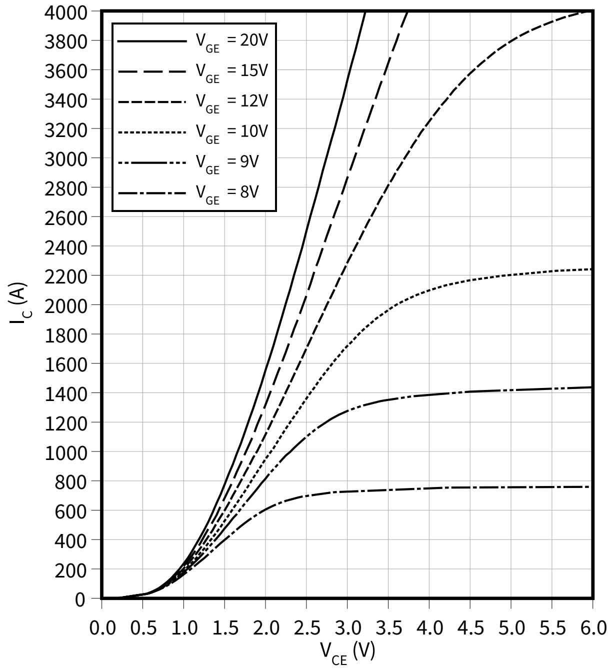
Note: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4.

5 Characteristics diagrams

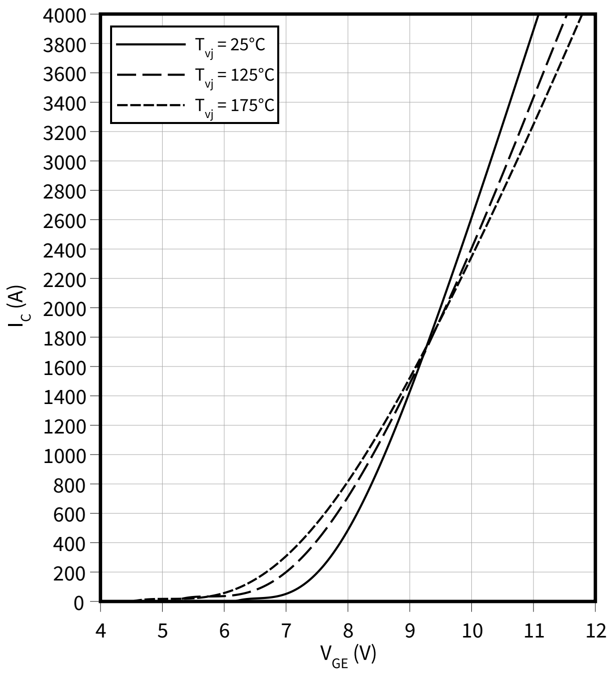
Output characteristic (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



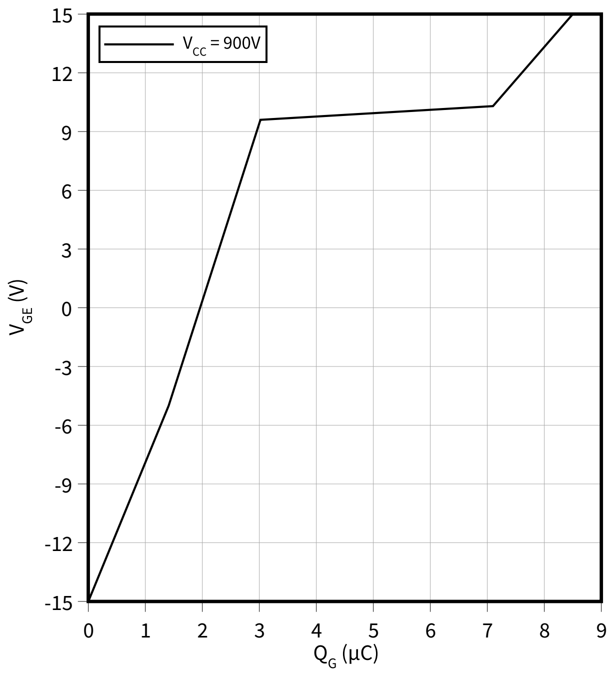
Output characteristic field (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$T_{vj} = 175$ °C



Transfer characteristic (typical), IGBT, Inverter
$I_C = f(V_{GE})$
$V_{CE} = 20$ V



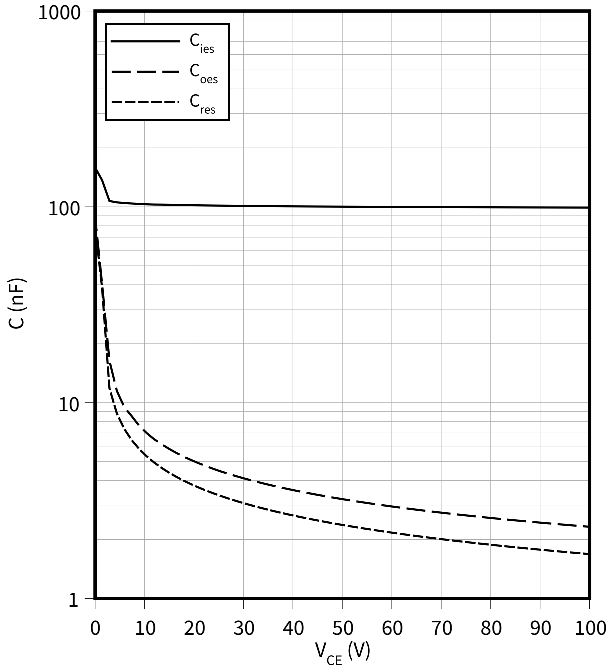
Gate charge characteristic (typical), IGBT, Inverter
$V_{GE} = f(Q_G)$
$I_C = 2000$ A, $T_{vj} = 25$ °C



Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

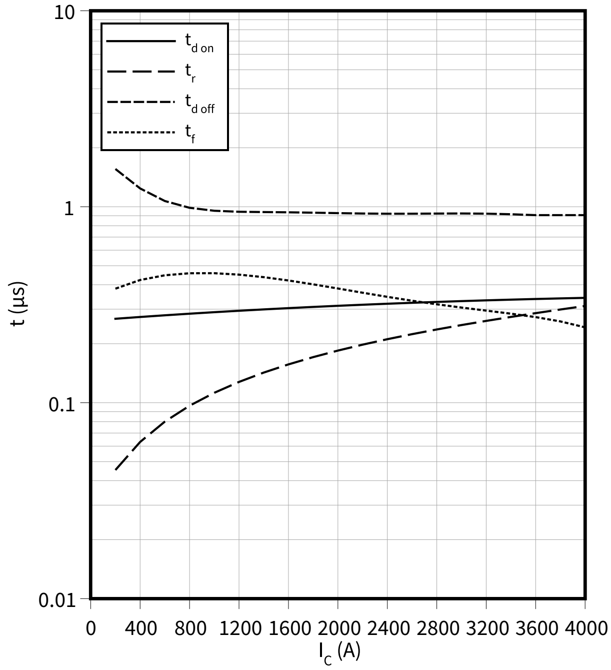
$f = 100$ kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

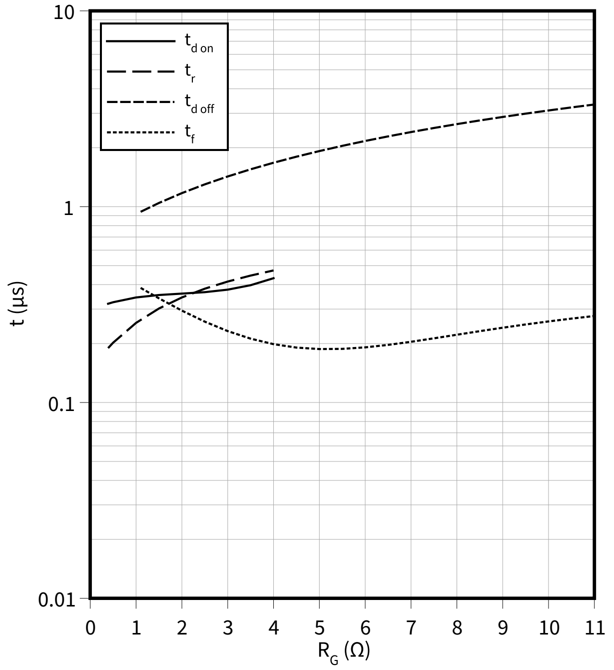
$R_{Goff} = 1.1\ \Omega$, $R_{Gon} = 0.3\ \Omega$, $V_{GE} = \pm 15$ V, $V_{CC} = 900$ V, $T_{vj} = 175$ °C



Switching times (typical), IGBT, Inverter

$t = f(R_G)$

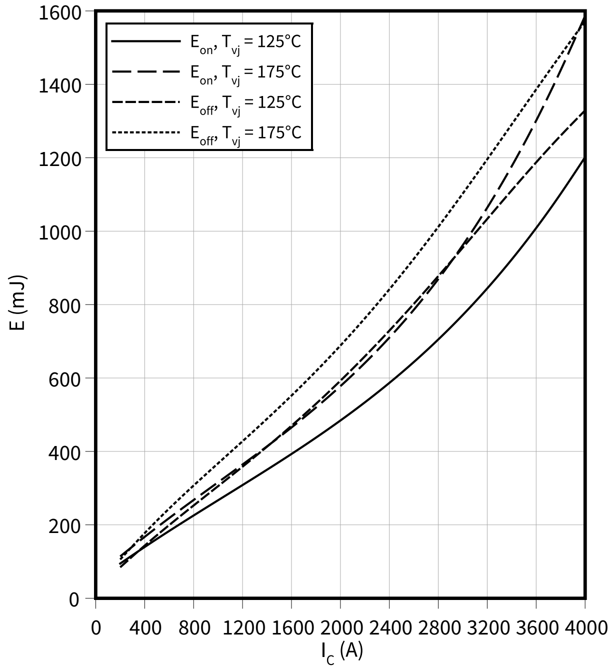
$V_{GE} = \pm 15$ V, $I_C = 2000$ A, $V_{CC} = 900$ V, $T_{vj} = 175$ °C



Switching losses (typical), IGBT, Inverter

$E = f(I_C)$

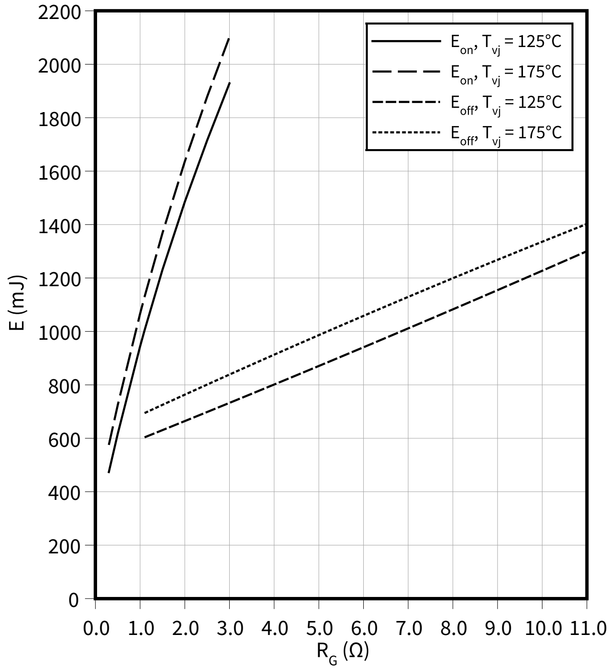
$R_{Goff} = 1.1\ \Omega$, $R_{Gon} = 0.3\ \Omega$, $V_{CC} = 900$ V, $V_{GE} = \pm 15$ V



Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

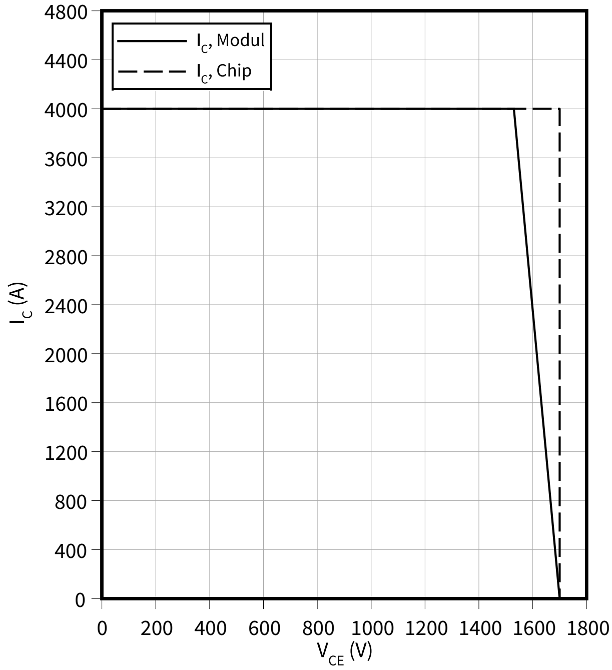
$I_C = 2000$ A, $V_{CC} = 900$ V, $V_{GE} = \pm 15$ V



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

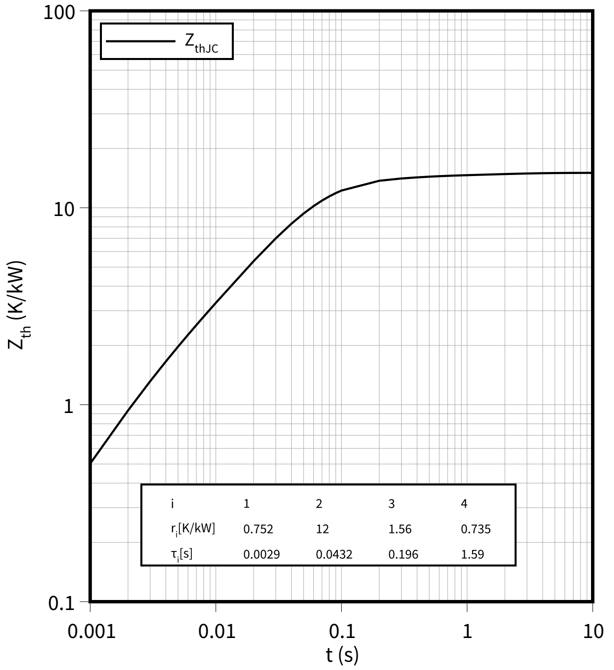
$I_C = f(V_{CE})$

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



Transient thermal impedance, IGBT, Inverter

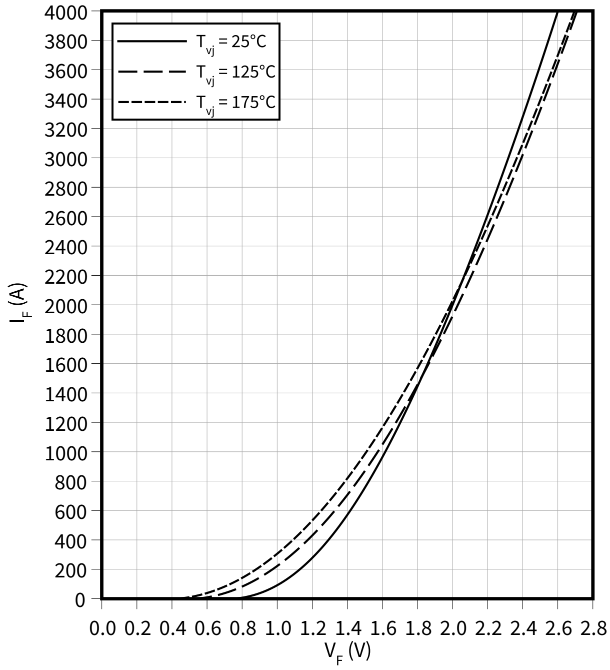
$Z_{th} = f(t)$



i	1	2	3	4
r_i[K/kW]	0.752	12	1.56	0.735
τ_i[s]	0.0029	0.0432	0.196	1.59

Forward characteristic (typical), Diode, Inverter

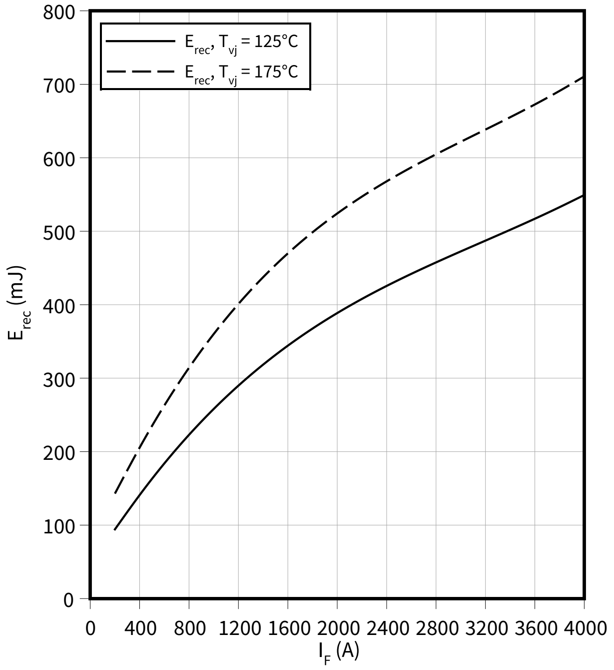
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

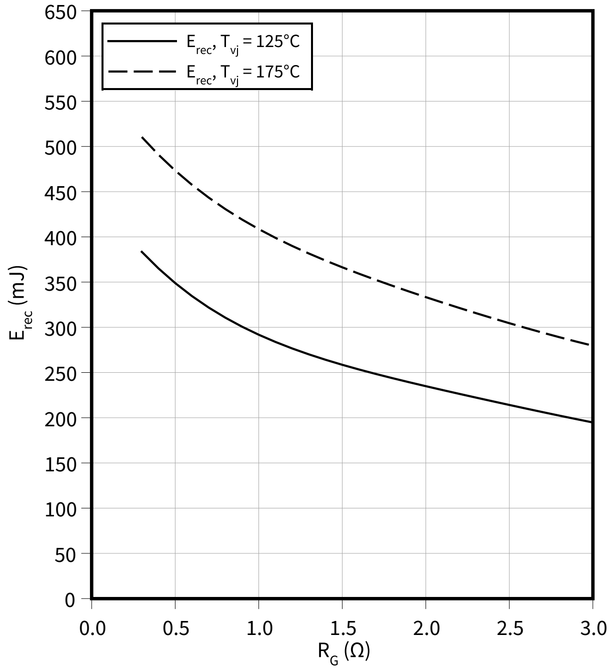
$R_{Gon} = R_{Gon}(IGBT)$, $V_{CC} = 900$ V



Switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$

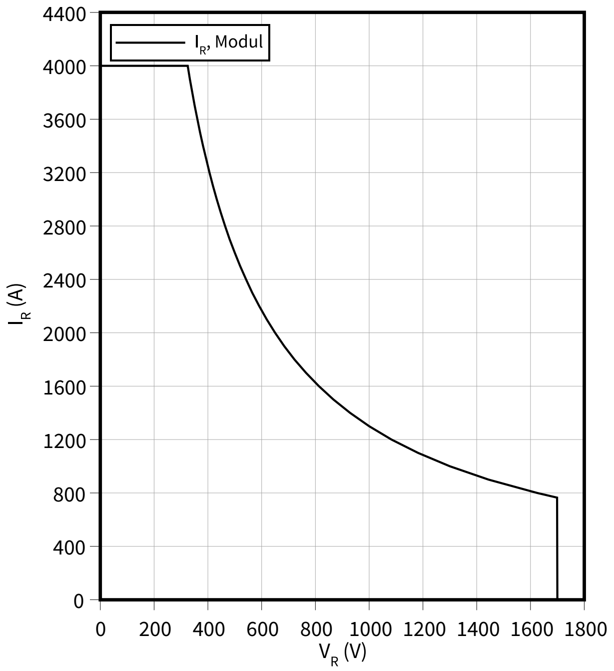
$I_F = 2000$ A, $V_{CC} = 900$ V



Safe operating area (SOA), Diode, Inverter

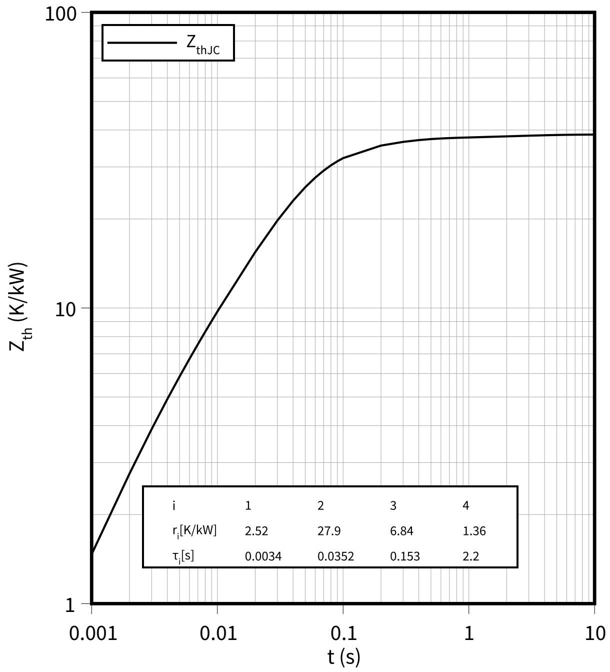
$I_R = f(V_R)$

$T_{vj} = 175$ °C

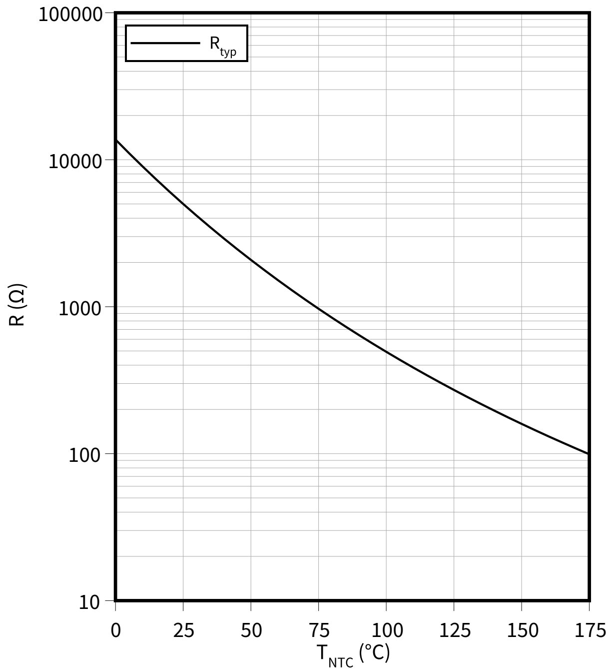


Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



i	1	2	3	4
r_i[K/kW]	2.52	27.9	6.84	1.36
τ_i[s]	0.0034	0.0352	0.153	2.2

Temperature characteristic (typical), NTC-Thermistor $R = f(T_{NTC})$	
	

6 Circuit diagram

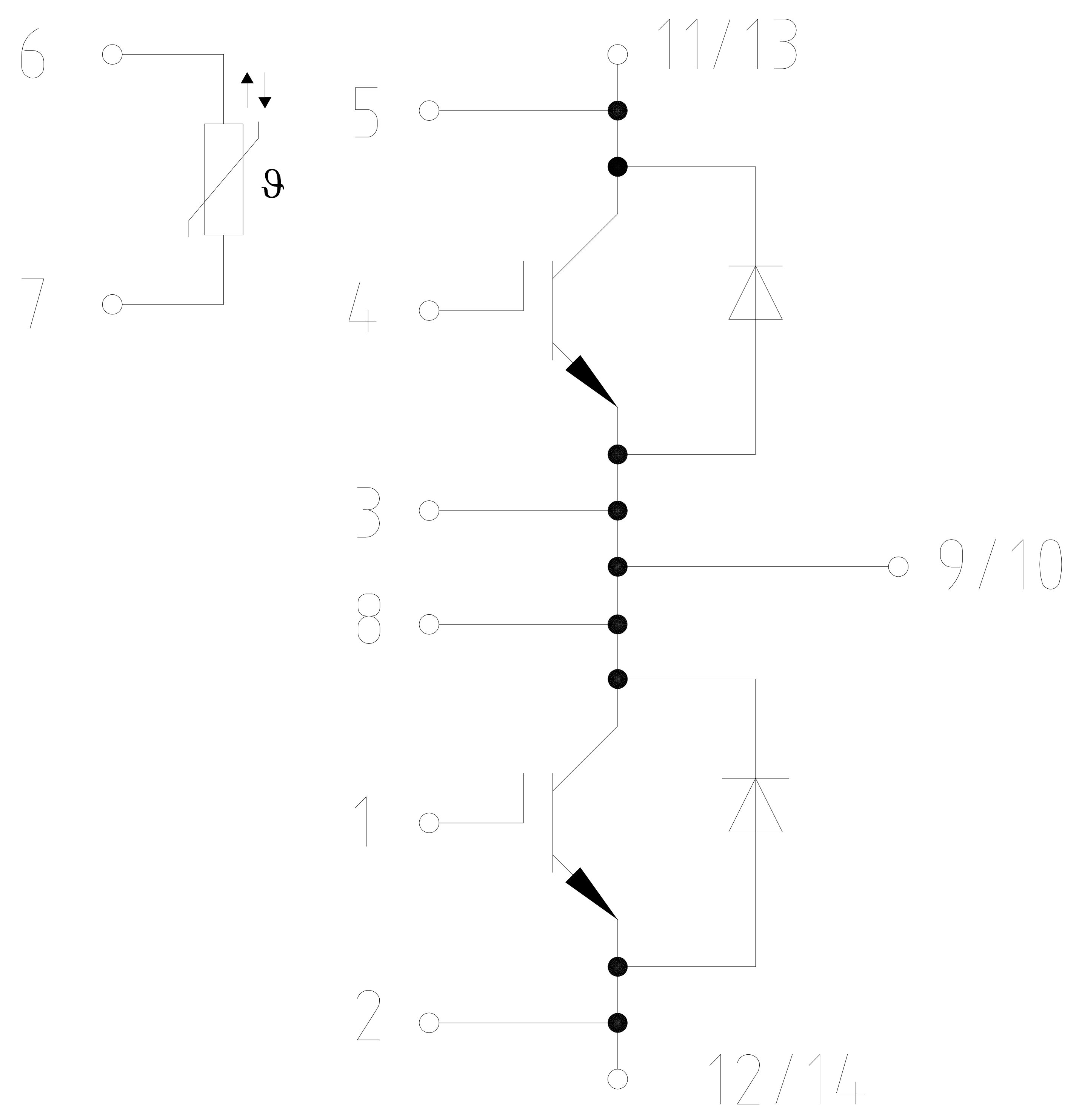


Figure 1

7 Package outlines

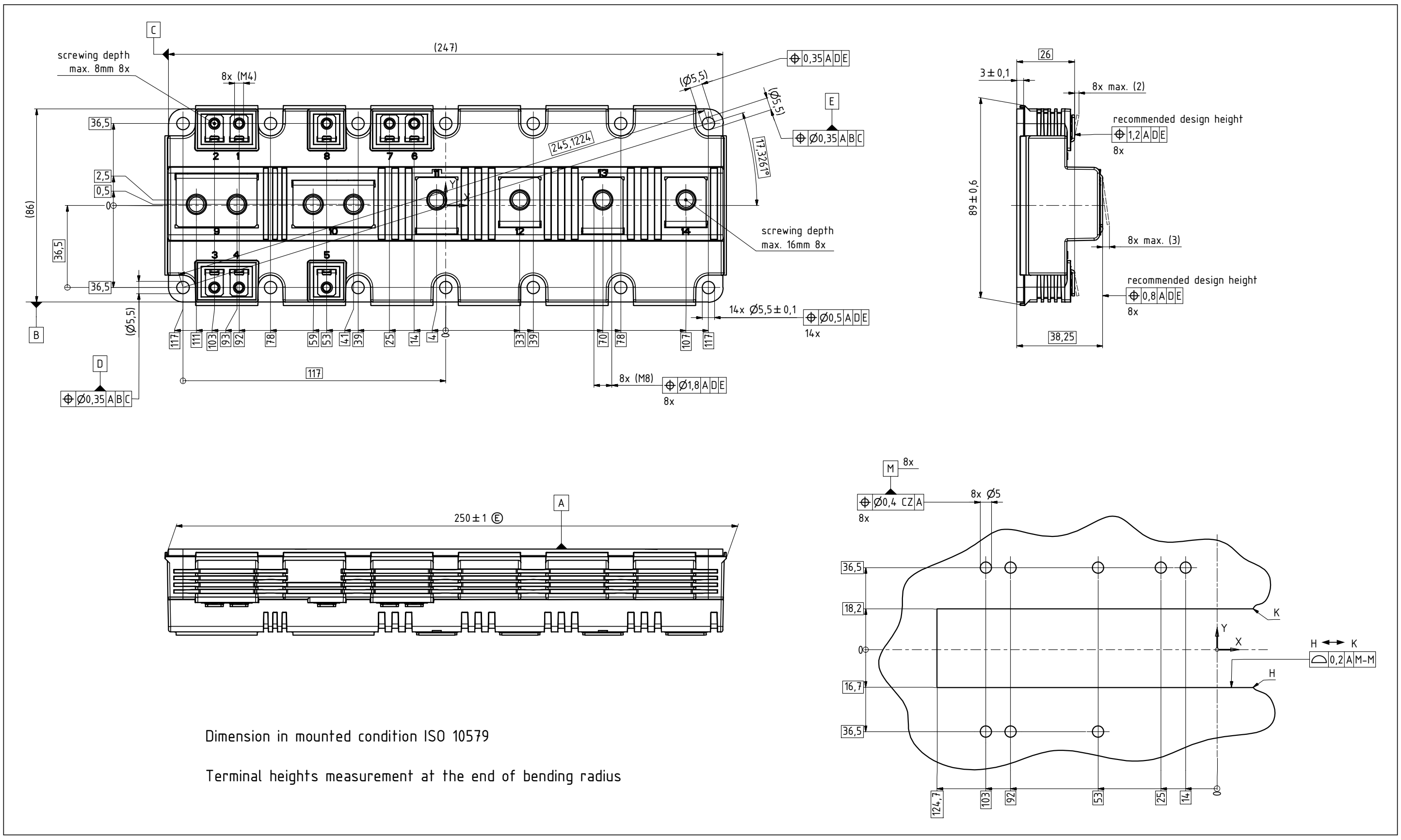


Figure 2

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* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Digit* 1 – 5 6 - 11 12 - 19 20 – 21 22 – 23	*Example* 71549 142846 55054991 15 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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