PrimePACK™2 module with TRENCHSTOP™IGBT7 and emitter controlled 7 diode and NTC

Features

- Electrical features
  - V_{CES} = 1200 V
  - $I_{C\,nom}$ = 1600 A / I_{CRM} = 3200 A
  - Extended operating temperature $T_{vj\,op}$
  - Low $V_{CE,sat}$
- Mechanical features
  - 4 kV AC 1 min insulation
  - High creepage and clearance distances
  - High power and thermal cycling capability
  - High power density

Potential applications

- Motor drives
- Construction, commercial, and agriculture vehicles
- UPS systems
- Energy storage systems

Product validation

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

Description

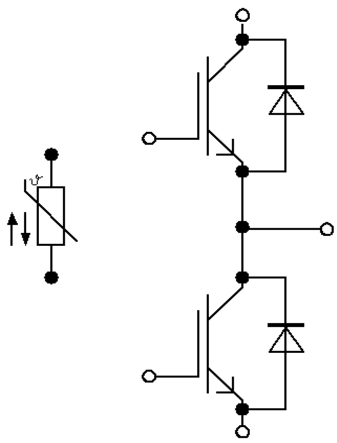


Table of contents

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	
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	d_{Creep}	terminal to heatsink	33.0	mm
Creepage distance	d_{Creep}	terminal to terminal	33.0	mm
Clearance	d_{Clear}	terminal to heatsink	19.0	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}				18		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	T_C=25°C, per switch			0.22		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_C=25°C, per switch			0.3		mΩ
Storage temperature	T_{stg}			-40		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*				825		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	1200	V
Implemented collector current	I_{CN}			1600	A
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_C = 90 °C	1600	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 $T_{vj\ op}$	3200	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 = 1600 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.27	1.79	V
			T_{vj} = 125 °C		1.37	1.82	
			T_{vj} = 175 °C		1.43	1.85	
Gate threshold voltage	V_{GEth}	I_C = 32 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.15	5.80	6.45	V
Gate charge	Q_G	V_{GE} = ±15 V, V_{CC}=600 V			25.4		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0.5		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			217		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			1.28		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			5	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 = 1600 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 0.35 Ω	T_{vj} = 25 °C		0.700		µs
			T_{vj} = 125 °C		0.800		
			T_{vj} = 175 °C		0.870		
Rise time (inductive load)	t_r	I_C = 1600 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 0.35 Ω	T_{vj} = 25 °C		0.130		µs
			T_{vj} = 125 °C		0.150		
			T_{vj} = 175 °C		0.160		
Turn-off delay time (inductive load)	t_{doff}	I_C = 1600 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 1 Ω	T_{vj} = 25 °C		1.050		µs
			T_{vj} = 125 °C		1.150		
			T_{vj} = 175 °C		1.250		
Fall time (inductive load)	t_f	I_C = 1600 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 1 Ω	T_{vj} = 25 °C		0.200		µs
			T_{vj} = 125 °C		0.400		
			T_{vj} = 175 °C		0.500		
Turn-on energy loss per pulse	E_{on}	I_C = 1600 A, V_{CC} = 600 V, L_σ = 30 nH, V_{GE} = ±15 V, R_{Gon} = 0.35 Ω, di/dt = 9350 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		125		mJ
			T_{vj} = 125 °C		225		
			T_{vj} = 175 °C		290		

(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 = 1600 A, V_{CC} = 600 V, L_σ = 30 nH, V_{GE} = ±15 V, R_{Goff} = 1 Ω, dv/dt = 2100 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		260		mJ
			T_{vj} = 125 °C		360		
			T_{vj} = 175 °C		410		
SC data	I_{SC}	V_{GE} ≤ 15 V, V_{CC} = 800 V, V_{CEmax}=V_{CES}-L_{sCE}*di/dt	t_P ≤ 6 µs, T_{vj} ≤ 150 °C		5300		A
			t_P ≤ 6 µs, T_{vj} ≤ 175 °C		5100		
Thermal resistance, junction to case	R_{thJC}	per IGBT				27.4	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per IGBT			20.6		K/kW
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

Note: *Maximum RMS module DC-terminal current according to application note AN2009-08.*

$T_{vj\,op}$ > 150 °C is only allowed for operation at overload conditions. For detailed specifications please refer to AN2018-14.

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	1200	V
Continuous DC forward current	I_F			1600	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		3200	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	150	kA^2s
			T_{vj} = 175 °C	145	

Table 6 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 1600 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.70	2.03	V
			T_{vj} = 125 °C		1.65	1.96	
			T_{vj} = 175 °C		1.55	1.91	

(table continues...)

Table 6 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Peak reverse recovery current	I_{RM}	V_{CC} = 600 V, I_F = 1600 A, V_{GE} = -15 V, -di_F/dt = 9350 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		865		A
			T_{vj} = 125 °C		1080		
			T_{vj} = 175 °C		1180		
Recovered charge	Q_r	V_{CC} = 600 V, I_F = 1600 A, V_{GE} = -15 V, -di_F/dt = 9350 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		160		µC
			T_{vj} = 125 °C		305		
			T_{vj} = 175 °C		400		
Reverse recovery energy	E_{rec}	V_{CC} = 600 V, I_F = 1600 A, V_{GE} = -15 V, -di_F/dt = 9350 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		75		mJ
			T_{vj} = 125 °C		130		
			T_{vj} = 175 °C		170		
Thermal resistance, junction to case	R_{thJC}	per diode				50.7	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per diode			25.2		K/kW
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

Note: *$T_{vj\,op}$ > 150 °C is only allowed for operation at overload conditions. For detailed specifications please refer to AN2018-14.*

4 NTC-Thermistor

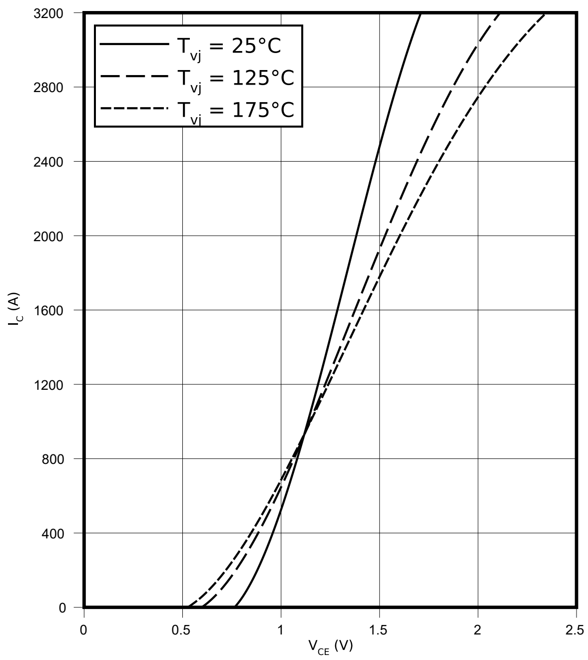
Table 7 **Characteristic values**

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

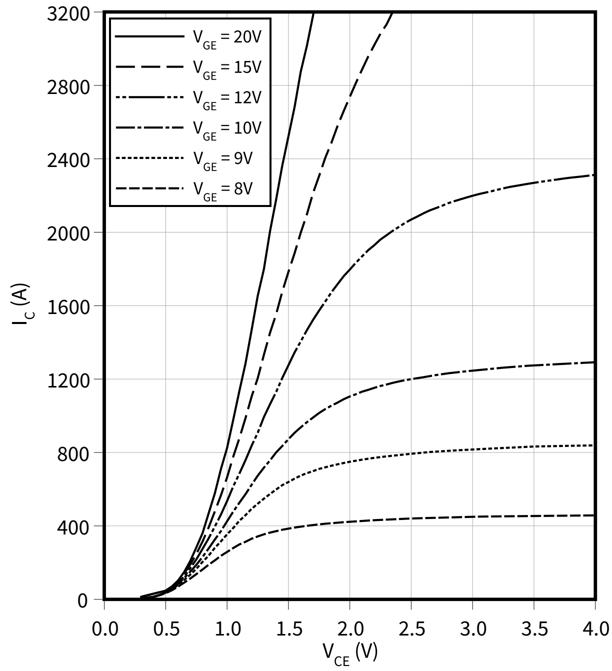
Note: *For detailed specifications please refer to AN2009-10.*

5 Characteristics diagrams

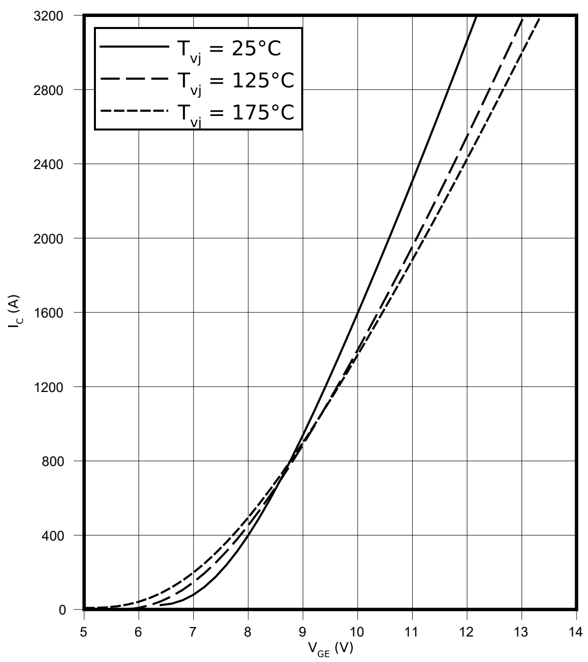
Output characteristic (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



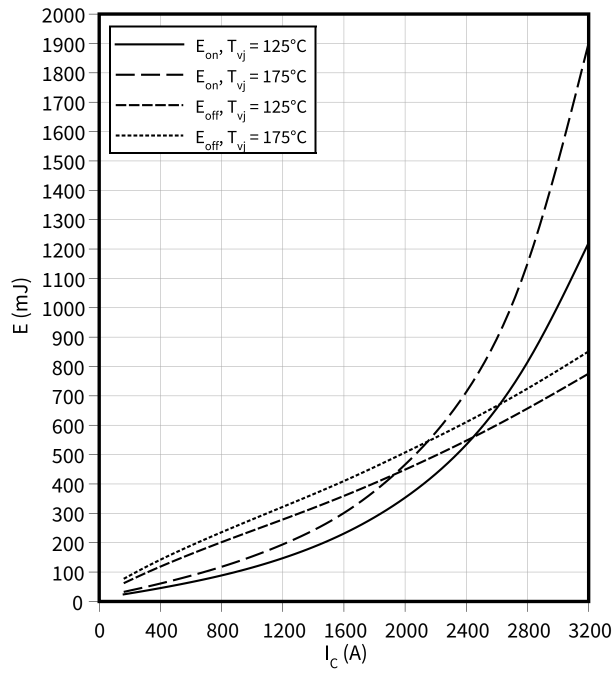
Output characteristic field (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$T_{vj} = 175$ °C



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



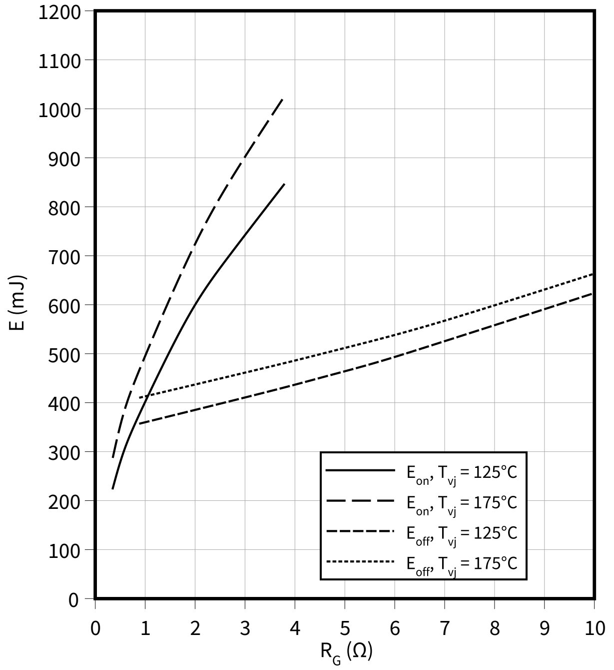
Switching losses (typical), IGBT, Inverter
$E = f(I_C)$
$R_{Goff} = 1\ \Omega$, $R_{Gon} = 0.35\ \Omega$, $V_{CC} = 600$ V, $V_{GE} = \pm 15$ V



Switching losses (typical), IGBT, Inverter

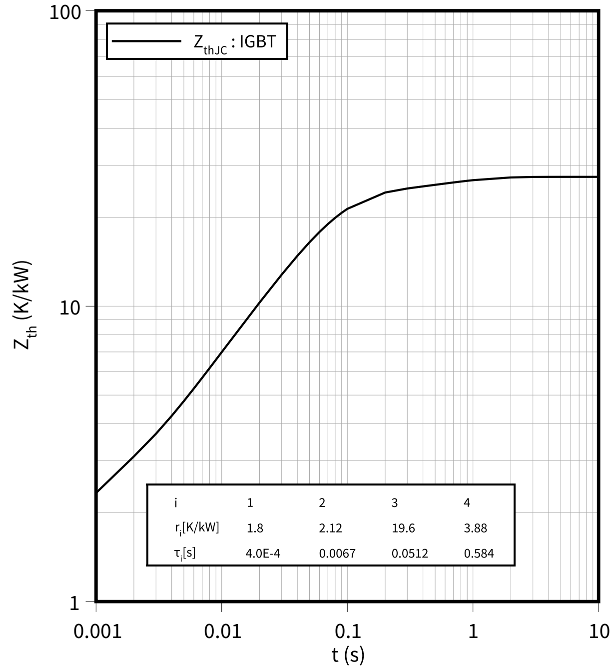
$E = f(R_G)$

I_C = 1600 A, V_{CC} = 600 V, V_{GE} = ± 15 V



Transient thermal impedance , IGBT, Inverter

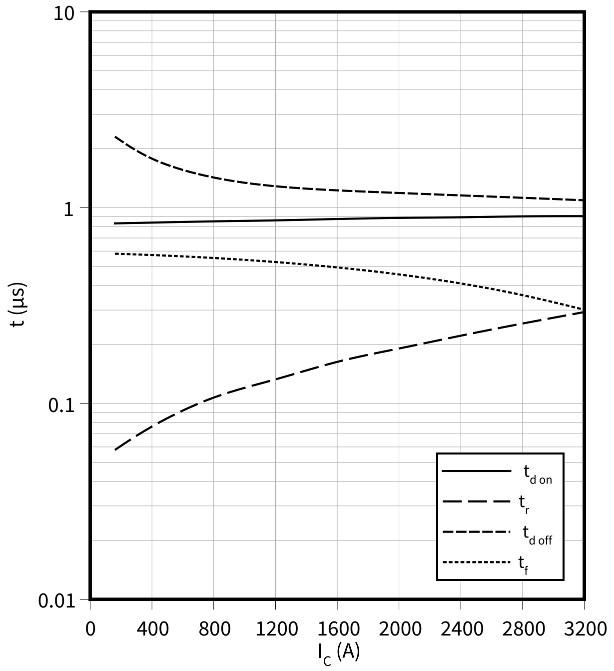
$Z_{th} = f(t)$



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

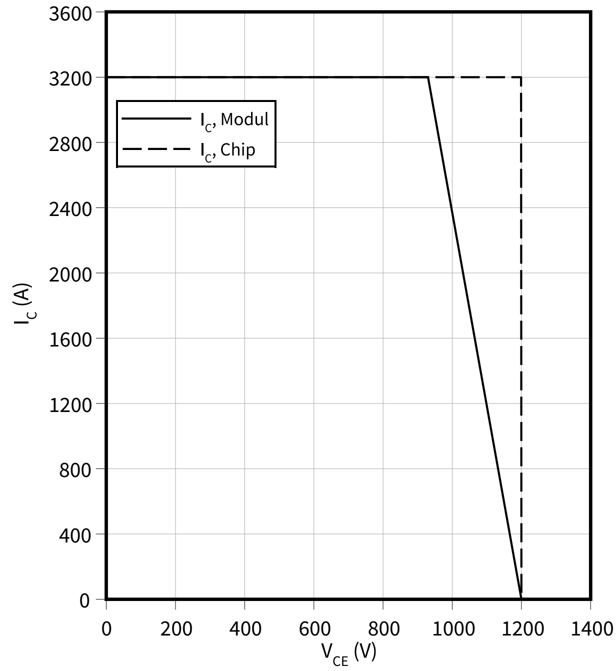
R_{Goff} = 1 Ω, R_{Gon} = 0.35 Ω, V_{CC} = 600 V, V_{GE} = ± 15 V, T_{vj} = 175 °C



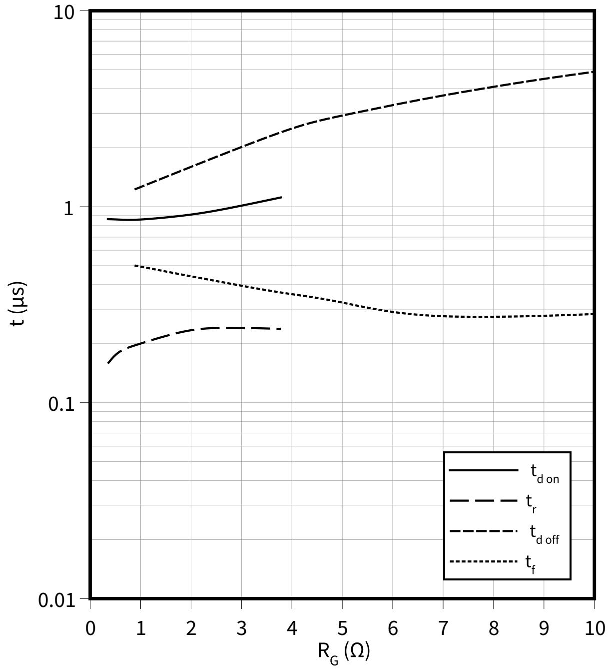
Reverse bias safe operating area (RBSOA), IGBT, Inverter

$I_C = f(V_{CE})$

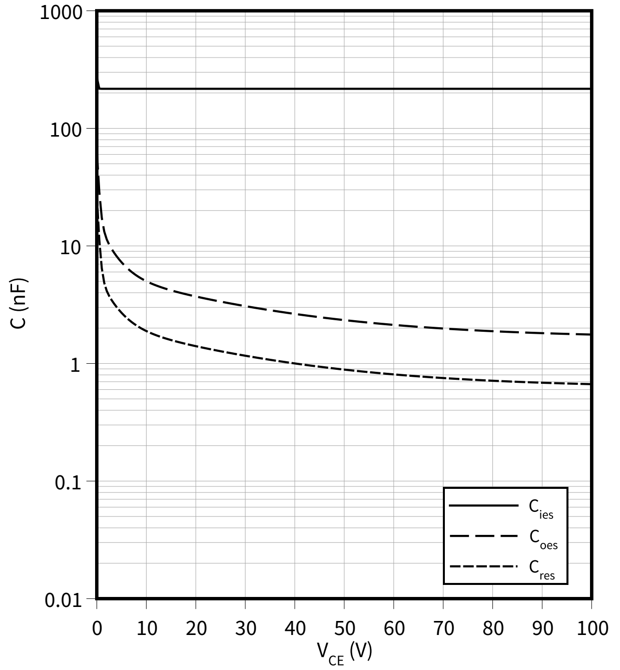
R_{Goff} = 1 Ω, V_{GE} = ±15 V, T_{vj} = 175 °C



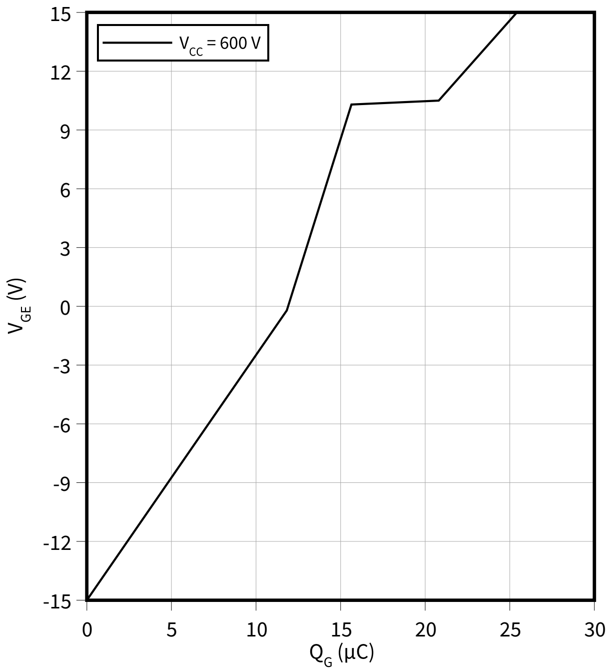
Switching times (typical), IGBT, Inverter
$t = f(R_G)$
I_C = 1600 A, V_{CC} = 600 V, V_{GE} = ± 15 V, T_{vj} = 175 °C



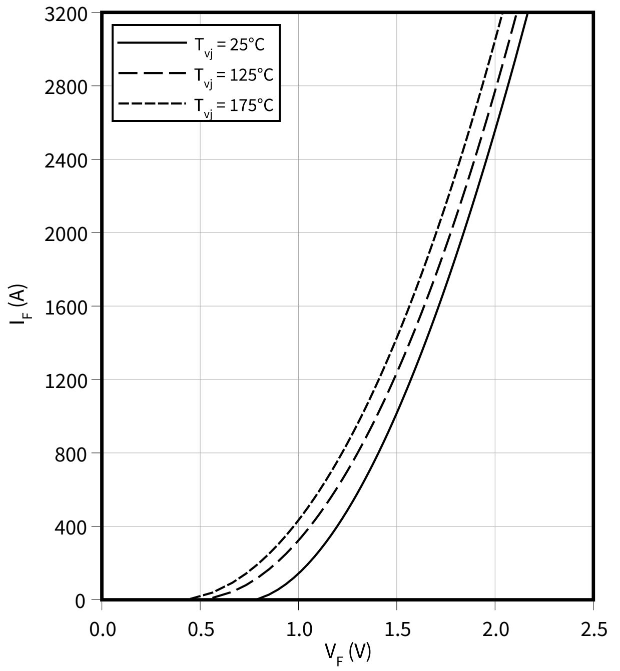
Capacity characteristic (typical), IGBT, Inverter
$C = f(V_{CE})$
f = 100 kHz, V_{GE} = 0 V, T_{vj} = 25 °C



Gate charge characteristic (typical), IGBT, Inverter
$V_{GE} = f(Q_G)$
I_C = 1600 A, T_{vj} = 25 °C



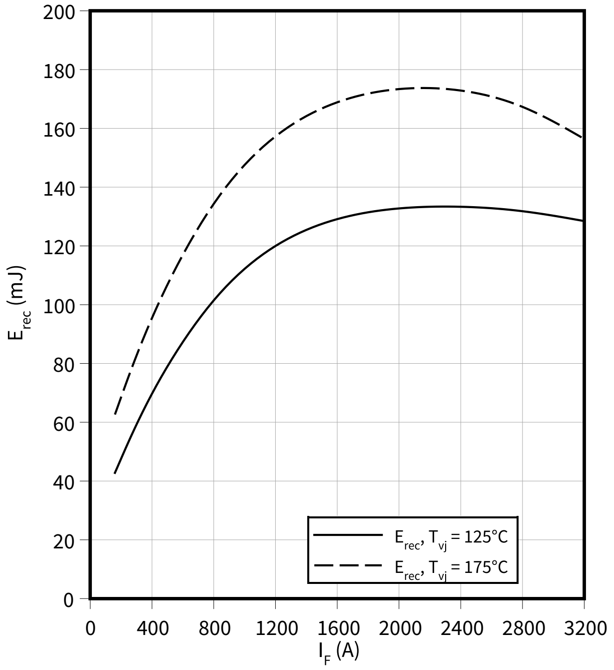
Forward characteristic (typical), Diode, Inverter
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

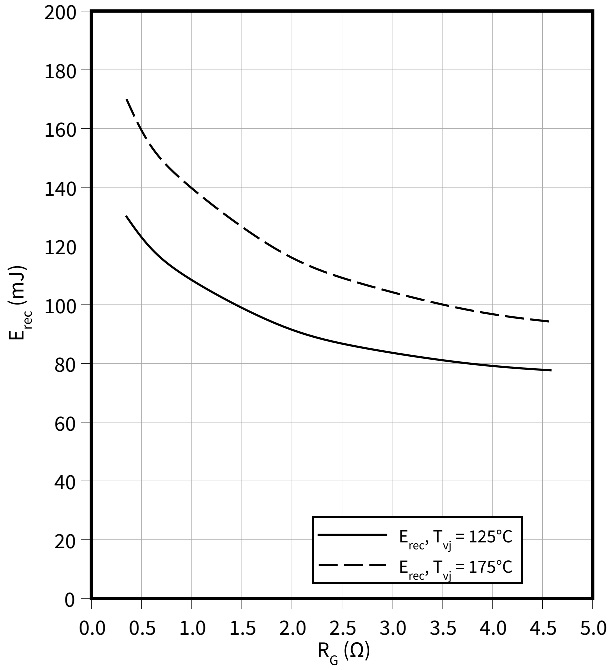
$R_{Gon} = R_{Gon}(IGBT)$, $V_{CC} = 600$ V



Switching losses (typical), Diode, Inverter

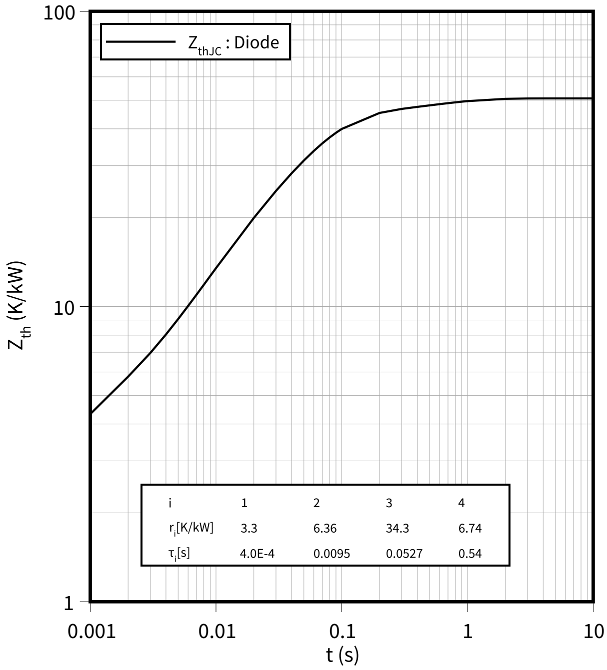
$E_{rec} = f(R_G)$

$I_F = 1600$ A, $V_{CC} = 600$ V



Transient thermal impedance, Diode, Inverter

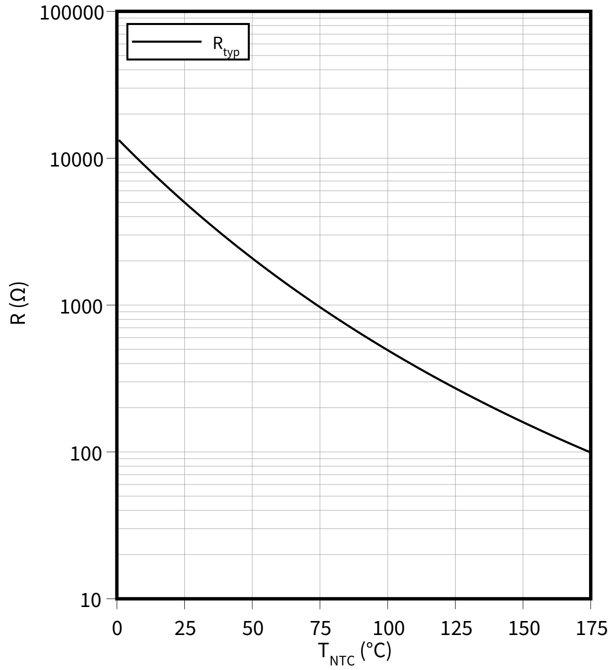
$Z_{th} = f(t)$



i	1	2	3	4
r_i[K/kW]	3.3	6.36	34.3	6.74
τ_i[s]	4.0E-4	0.0095	0.0527	0.54

Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 Circuit diagram

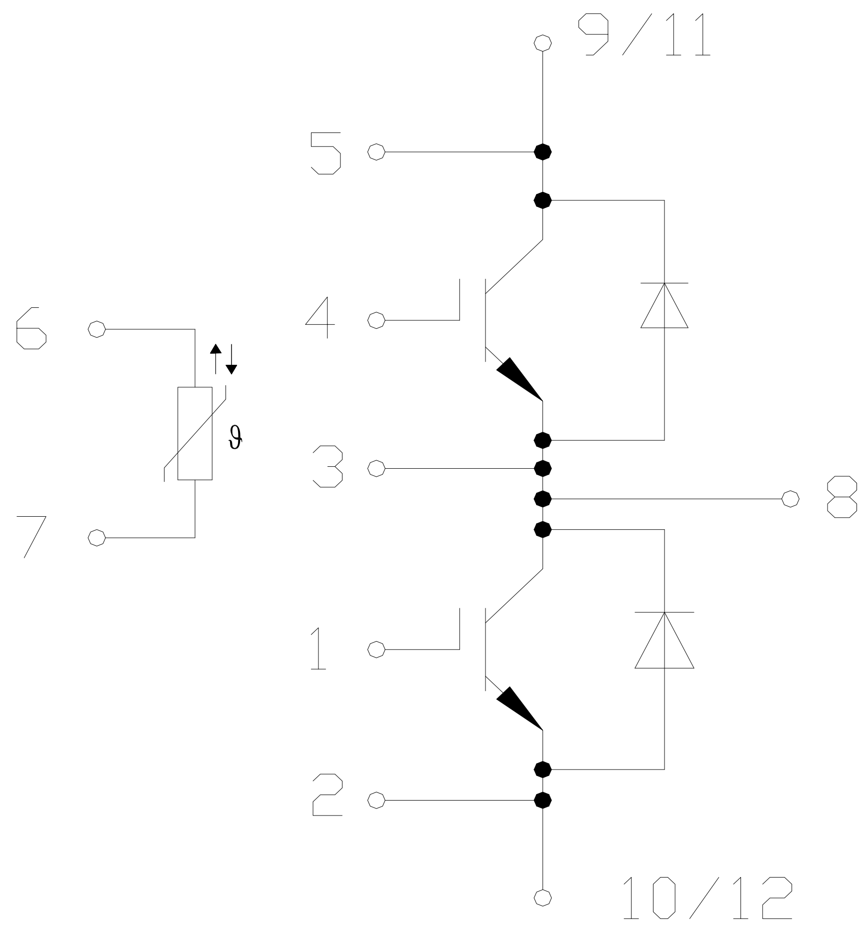


Figure 1

7 Package outlines

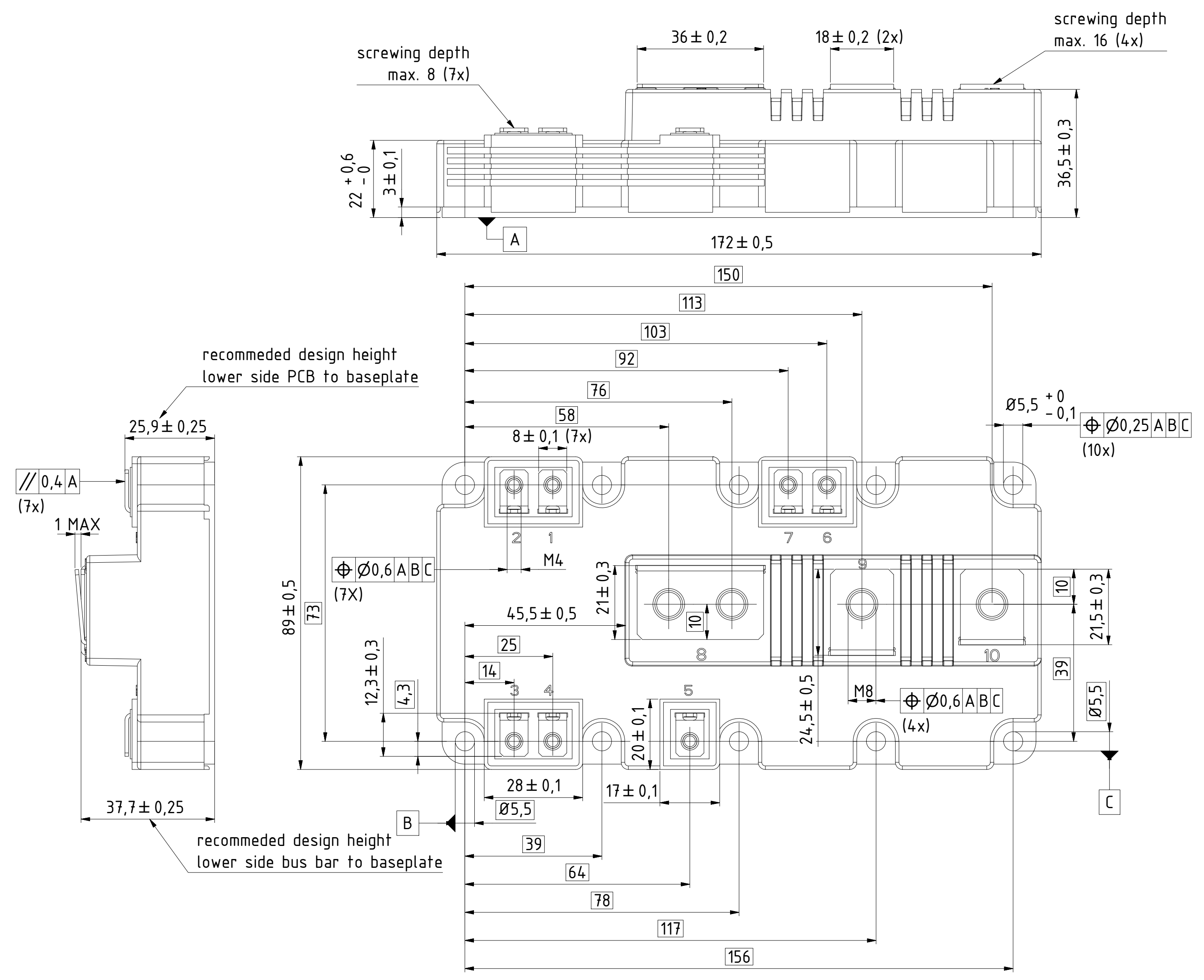


Figure 2

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
V1.0	2020-02-18	Target datasheet
V1.1	2020-08-21	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
1.10	2020-11-18	
1.11	2022-05-17	Final datasheet

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