PrimePACK™3+ B-series module with TRENCHSTOP™IGBT7 and emitter controlled 7 diode and NTC / pre-applied thermal interface material

Features

- Electrical features
  - V_{CES} = 2300 V
  - $I_{C\ nom}$ = 1800 A / I_{CRM} = 3600 A
  - TRENCHSTOP™ IGBT7
  - $T_{vj,op}$ = 150°C
  - Overload operation up to 175°C
  - Low $V_{CE,sat}$
  - Low switching losses
  - High current density
  - Low inductive design
- Mechanical features
  - Package with CTI > 400
  - High creepage and clearance distances
  - High power density
  - Pre-applied thermal interface material

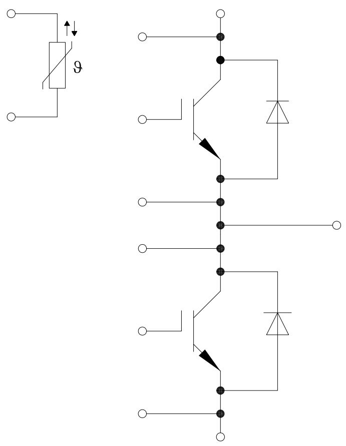
Potential applications

- Three-level applications
- Solar applications

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	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_H=25°C, per switch			0.09		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_H=25°C, per switch			0.1		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	2300	V
Implemented collector current	I_{CN}			1800	A
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 150 °C	T_H = 45 °C	1420	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 $T_{vj\,op}$	3600	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 = 1800 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.80	2.26	V
			T_{vj} = 125 °C		2.15	2.94	
			T_{vj} = 150 °C		2.25	3.13	
Gate threshold voltage	V_{GEth}	I_C = 49.5 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.15	5.80	6.45	V
Gate charge	Q_G	V_{GE} = ±15 V			14.6		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0.96		Ω
Input capacitance	C_{ies}	f = 1000 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			420		nF
Reverse transfer capacitance	C_{res}	f = 1000 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.5		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 2300 V, V_{GE} = 0 V	T_{vj} = 125 °C			30	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 = 1800 A, V_{CE} = 1200 V, V_{GE} = ±15 V, R_{Gon} = 0.1 Ω	T_{vj} = 25 °C		0.530		µs
			T_{vj} = 125 °C		0.550		
			T_{vj} = 150 °C		0.560		
Rise time (inductive load)	t_r	I_C = 1800 A, V_{CE} = 1200 V, V_{GE} = ±15 V, R_{Gon} = 0.1 Ω	T_{vj} = 25 °C		0.072		µs
			T_{vj} = 125 °C		0.078		
			T_{vj} = 150 °C		0.083		
Turn-off delay time (inductive load)	t_{doff}	I_C = 1800 A, V_{CE} = 1200 V, V_{GE} = ±15 V, R_{Goff} = 1.5 Ω	T_{vj} = 25 °C		0.955		µs
			T_{vj} = 125 °C		1.050		
			T_{vj} = 150 °C		1.080		
Fall time (inductive load)	t_f	I_C = 1800 A, V_{CE} = 1200 V, V_{GE} = ±15 V, R_{Goff} = 1.5 Ω	T_{vj} = 25 °C		0.770		µs
			T_{vj} = 125 °C		1.020		
			T_{vj} = 150 °C		1.100		
Turn-on time (resistive load)	t_{on_R}	I_C = 500 A, V_{CE} = 2000 V, V_{GE} = ±15 V, R_{Gon} = 0.1 Ω	T_{vj} = 25 °C	0.79			µs

(table continues...)

Table 4 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-on energy loss per pulse	E_{on}	I_C = 1800 A, V_{CE} = 1200 V, L_σ = 20 nH, V_{GE} = ±15 V, R_{Gon} = 0.1 Ω, di/dt = 17500 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		570		mJ
			T_{vj} = 125 °C		815		
			T_{vj} = 150 °C		915		
Turn-off energy loss per pulse	E_{off}	I_C = 1800 A, V_{CE} = 1200 V, L_σ = 20 nH, V_{GE} = ±15 V, R_{Goff} = 1.5 Ω, dv/dt = 4050 V/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		885		mJ
			T_{vj} = 125 °C		1160		
			T_{vj} = 150 °C		1240		
SC data	I_{SC}	V_{GE} ≤ 15 V, V_{CC} = 1200 V, V_{CEmax}=V_{CES}-L_{sCE}*di/dt	t_P ≤ 7 µs, T_{vj}=150 °C		8000		A
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, Valid with IFX pre-applied Thermal Interface Material				27.4	K/kW
Temperature under switching conditions	$T_{vj\,op}$			-40		150	°C

Note: R_{thJH} *max. value is valid for* T_C *= 105 °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	2300	V
Continuous DC forward current	I_F			1800	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		3600	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	220	kA^2s
			T_{vj} = 150 °C	205	
Maximum power dissipation	P_{RQM}		T_{vj} = 150 °C	2700	kW

Table 6 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 1800 A, V_{GE} = 0 V	T_{vj} = 25 °C		3.25	3.64	V
			T_{vj} = 125 °C		3.00	3.33	
			T_{vj} = 150 °C		2.95	3.22	

(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_R = 1200 V, I_F = 1800 A, V_{GE} = -15 V, -di$_F$/dt = 17500 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		1700		A
			T_{vj} = 125 °C		1870		
			T_{vj} = 150 °C		1880		
Recovered charge	Q_r	V_R = 1200 V, I_F = 1800 A, V_{GE} = -15 V, -di$_F$/dt = 17500 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		300		µC
			T_{vj} = 125 °C		625		
			T_{vj} = 150 °C		740		
Reverse recovery energy	E_{rec}	V_R = 1200 V, I_F = 1800 A, V_{GE} = -15 V, -di$_F$/dt = 17500 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		240		mJ
			T_{vj} = 125 °C		500		
			T_{vj} = 150 °C		590		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, Valid with IFX pre-applied Thermal Interface Material				53.6	K/kW
Temperature under switching conditions	$T_{vj\,op}$			-40		150	°C

Note: *R_{thJH} max. value is valid for T_C= 90 °C.*

4 IGBT, 3-Level

Table 7 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		T_{vj} = 25 °C	2300	V
Implemented collector current	I_{CN}			1800	A
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 150 °C	T_H = 45 °C	1420	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		3600	A
Gate-emitter peak voltage	V_{GES}			±20	V

Table 8 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\,sat}$	I_C = 1800 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.80	2.26	V
			T_{vj} = 125 °C		2.15	2.94	
			T_{vj} = 150 °C		2.25	3.13	
Gate threshold voltage	V_{GEth}	I_C = 49.5 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.15	5.80	6.45	V

(table continues...)

Table 8 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Gate charge	Q_G	V_{GE} = ±15 V			14.6		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0.96		Ω
Input capacitance	C_{ies}	f = 1000 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			420		nF
Reverse transfer capacitance	C_{res}	f = 1000 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.5		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 2300 V, V_{GE} = 0 V	T_{vj} = 125 °C			30	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 = 1800 A, V_{CE} = 600 V, V_{GE} = ±15 V	T_{vj} = 25 °C		0.555		µs
			T_{vj} = 125 °C		0.580		
			T_{vj} = 150 °C		0.590		
Rise time (inductive load)	t_r	I_C = 1800 A, V_{CE} = 600 V, V_{GE} = ±15 V	T_{vj} = 25 °C		0.190		µs
			T_{vj} = 125 °C		0.205		
			T_{vj} = 150 °C		0.215		
Turn-off delay time (inductive load)	t_{doff}	I_C = 1800 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 1.5 Ω	T_{vj} = 25 °C		0.885		µs
			T_{vj} = 125 °C		0.955		
			T_{vj} = 150 °C		0.980		
Fall time (inductive load)	t_f	I_C = 1800 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 1.5 Ω	T_{vj} = 25 °C		0.630		µs
			T_{vj} = 125 °C		0.875		
			T_{vj} = 150 °C		0.930		
Turn-on energy loss per pulse	E_{on}	I_C = 1800 A, V_{CE} = 600 V, L_σ = 50 nH, V_{GE} = ±15 V, R_{Gon} = 0.1 Ω, di/dt = 6700 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		240		mJ
			T_{vj} = 125 °C		380		
			T_{vj} = 150 °C		430		
Turn-off energy loss per pulse	E_{off}	I_C = 1800 A, V_{CE} = 600 V, L_σ = 50 nH, V_{GE} = ±15 V, R_{Goff} = 1.5 Ω, dv/dt = 3150 V/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		490		mJ
			T_{vj} = 125 °C		630		
			T_{vj} = 150 °C		665		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, Valid with IFX pre-applied Thermal Interface Material				27.4	K/kW
Temperature under switching conditions	$T_{vj\,op}$			-40		150	°C

Note: R_{thJH} *max. value is valid for* T_C *= 105 °C.*

5 Diode, 3-Level

Table 9 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		T_{vj} = 25 °C	2300	V
Continuous DC forward current	I_F			1800	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		3600	A

Table 10 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 1800 A, V_{GE} = 0 V	T_{vj} = 25 °C		3.25	3.64	V
			T_{vj} = 125 °C		3.00	3.33	
			T_{vj} = 150 °C		2.95	3.22	
Peak reverse recovery current	I_{RM}	V_R = 600 V, I_F = 1800 A, V_{GE} = -15 V, -di_F/dt = 8200 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		1120		A
			T_{vj} = 125 °C		1450		
			T_{vj} = 150 °C		1530		
Recovered charge	Q_r	V_R = 600 V, I_F = 1800 A, V_{GE} = -15 V, -di_F/dt = 8200 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		295		µC
			T_{vj} = 125 °C		580		
			T_{vj} = 150 °C		665		
Reverse recovery energy	E_{rec}	V_R = 600 V, I_F = 1800 A, V_{GE} = -15 V, -di_F/dt = 8200 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		170		mJ
			T_{vj} = 125 °C		320		
			T_{vj} = 150 °C		365		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, Valid with IFX pre-applied Thermal Interface Material				53.6	K/kW
Temperature under switching conditions	$T_{vj\,op}$			-40		150	°C

Note: *Dynamic data for 3-level valid in conjunction with FF2400RB12IP7.*

$T_{vj\,op}$ up to 175 °C is allowed for operations in overload conditions. For detailed specifications please refer to AN2021-11.

R_{thJH} max. value is valid for T_C= 90 °C.

6 NTC-Thermistor

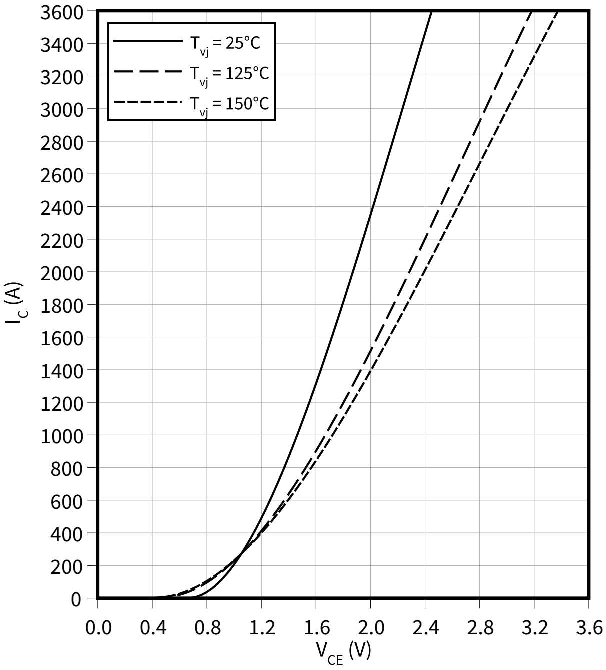
Table 11 Characteristic values

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

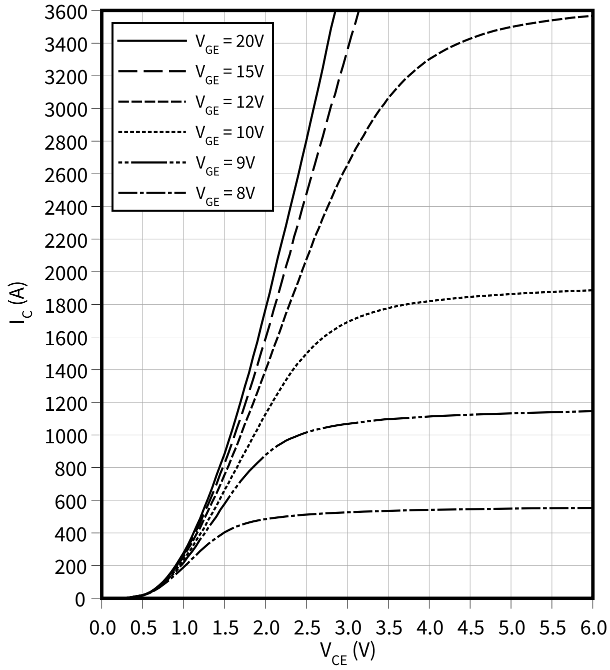
Note: For detailed specifications please refer to AN2009-10.

7 Characteristics diagrams

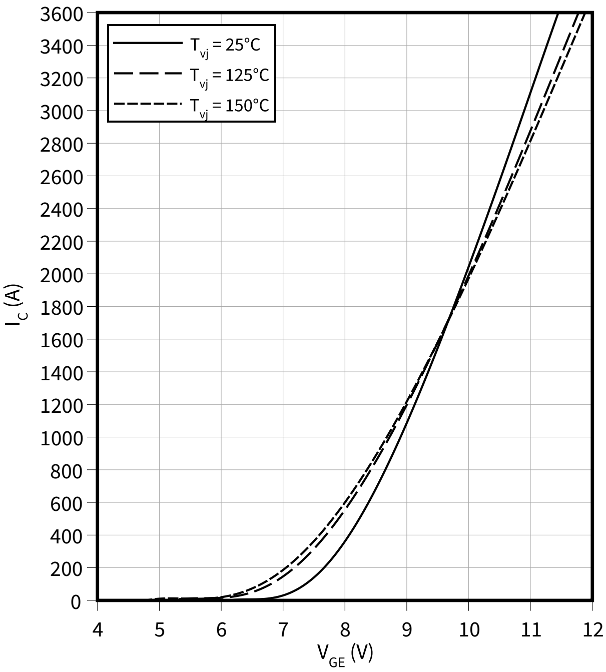
Output characteristic (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



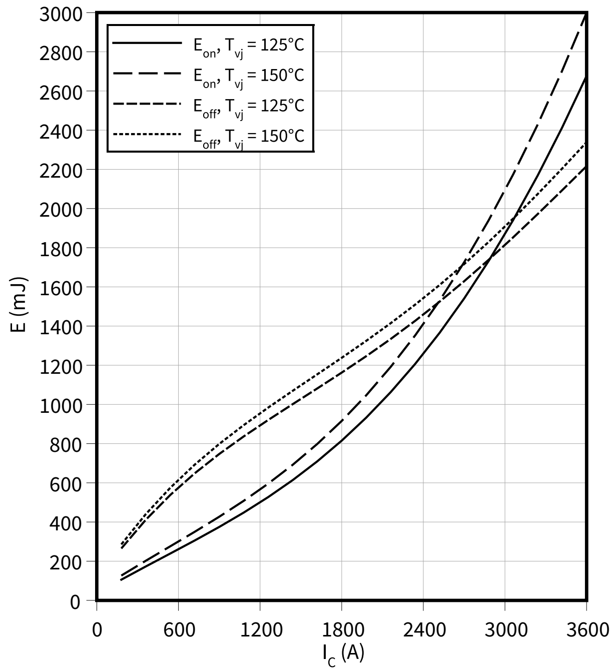
Output characteristic field (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$T_{vj} = 150$ °C



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



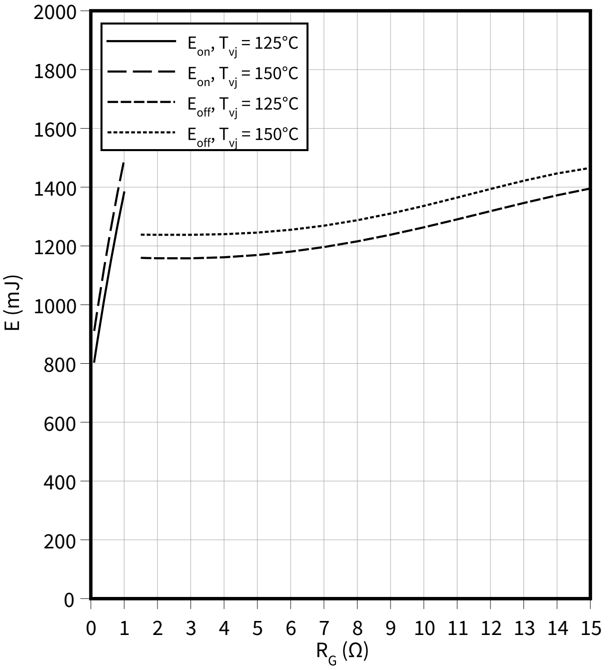
Switching losses (typical), IGBT, Inverter
$E = f(I_C)$
$R_{Goff} = 1.5\ \Omega$, $R_{Gon} = 0.1\ \Omega$, $V_{CE} = 1200$ V, $V_{GE} = \pm 15$ V



Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

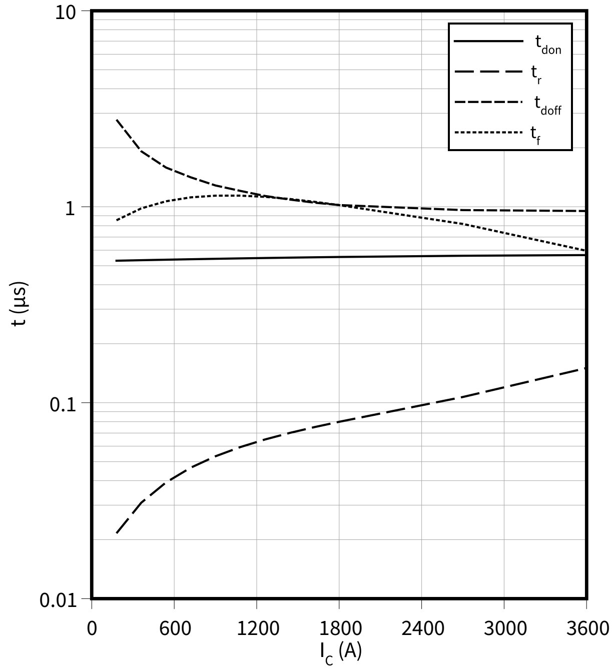
I_C = 1800 A, V_{CE} = 1200 V, V_{GE} = ± 15 V



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

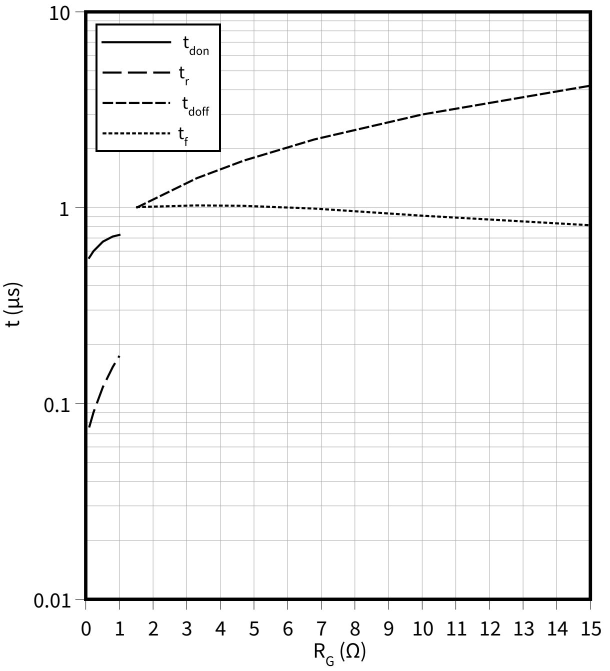
R_{Goff} = 1.5 Ω, R_{Gon} = 0.1 Ω, V_{CE} = 1200 V, V_{GE} = ± 15 V, T_{vj} = 150 °C



Switching times (typical), IGBT, Inverter

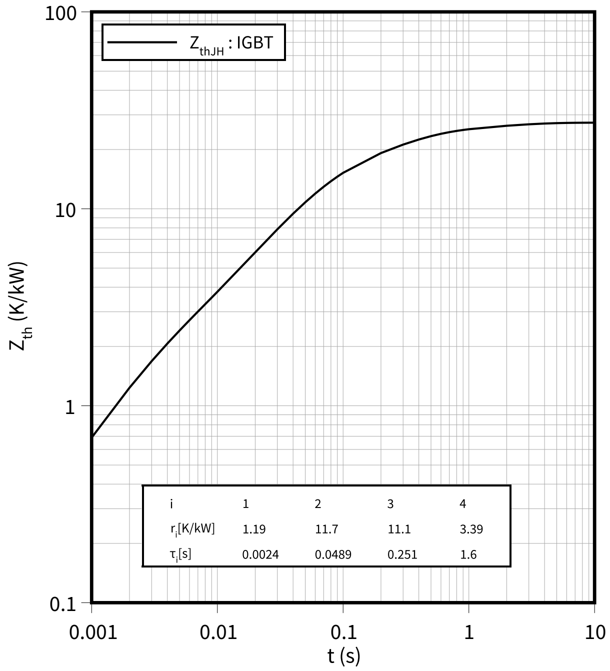
$t = f(R_G)$

V_{CE} = 1200 V, V_{GE} = ± 15 V, I_C = 1800 A, T_{vj} = 150 °C



Transient thermal impedance , IGBT, Inverter

$Z_{th} = f(t)$

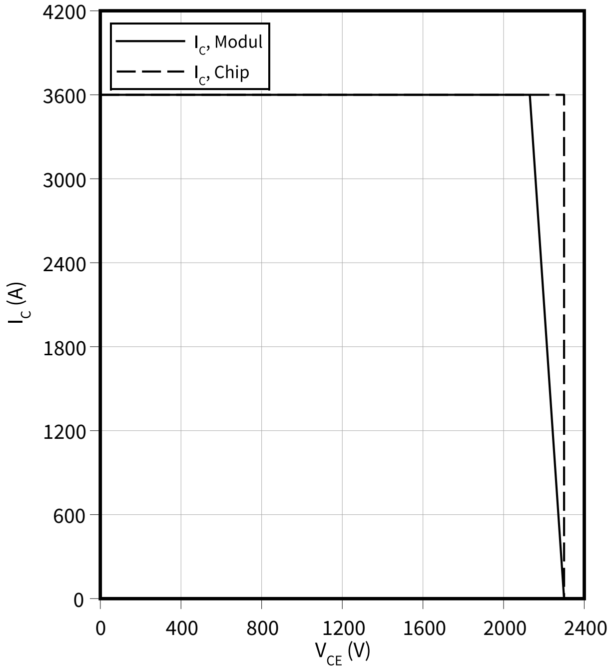


i	1	2	3	4
r_i[K/kW]	1.19	11.7	11.1	3.39
τ_i[s]	0.0024	0.0489	0.251	1.6

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

$I_C = f(V_{CE})$

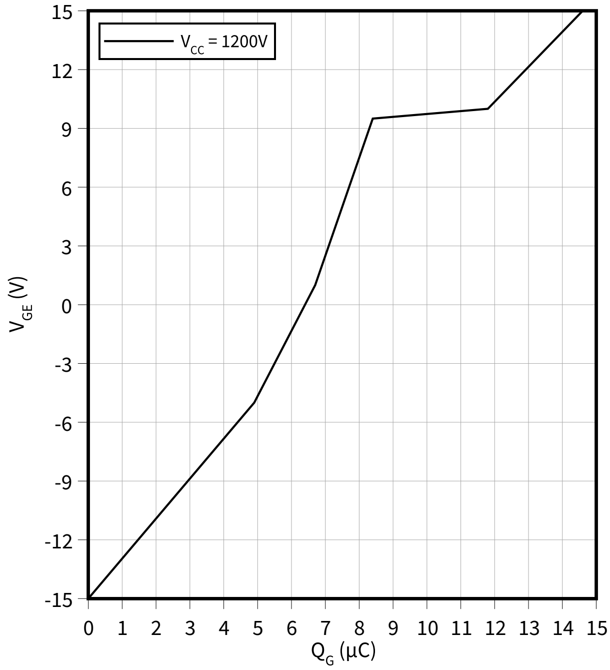
$R_{Goff} = 1.5\ \Omega$, $V_{GE} = \pm15$ V, $T_{vj} = 150$ °C



Gate charge characteristic (typical), IGBT, Inverter

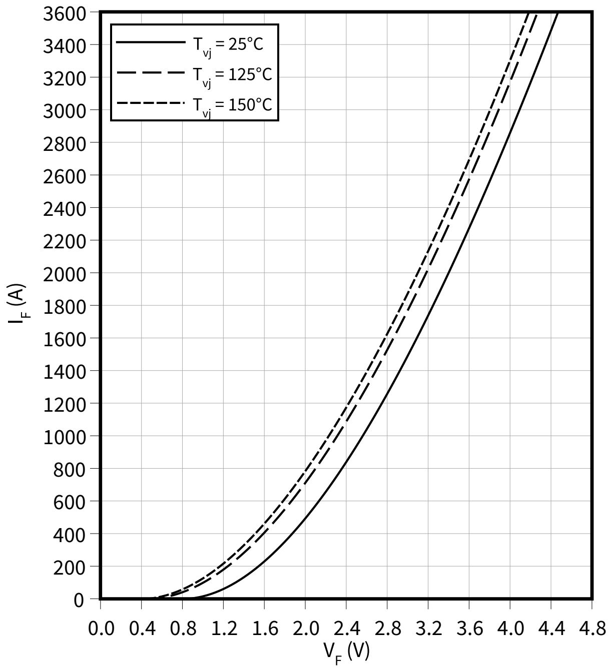
$V_{GE} = f(Q_G)$

$I_C = 1800$ A, $T_{vj} = 25$ °C



Forward characteristic (typical), Diode, Inverter

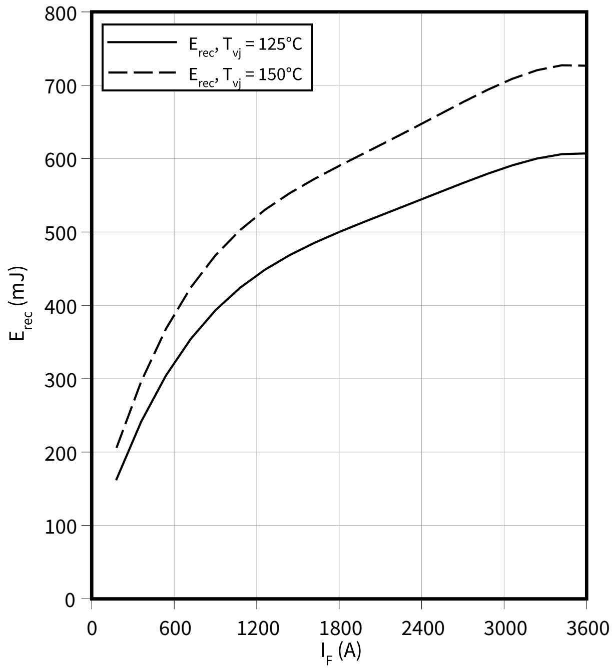
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

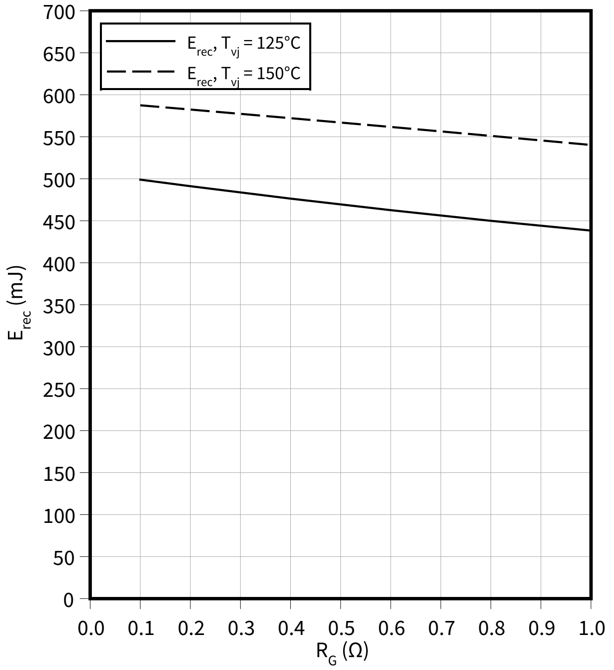
$V_{CE} = 1200$ V, $R_{Gon} = R_{Gon}$(IGBT)



Switching losses (typical), Diode, Inverter

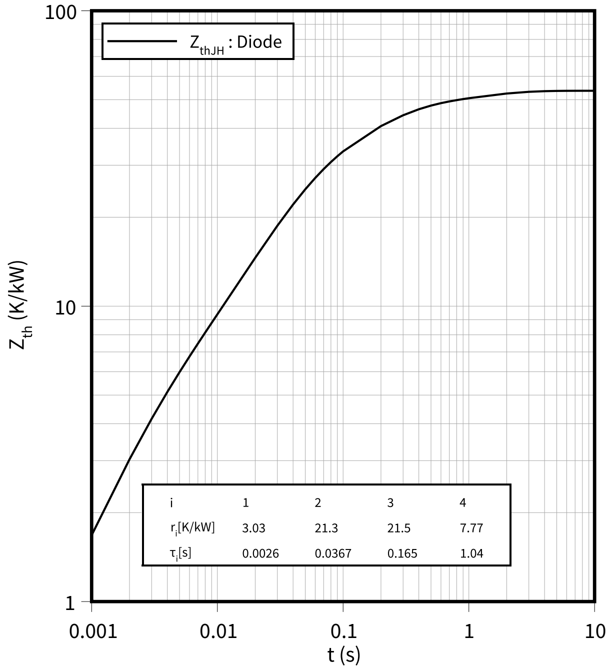
$E_{rec} = f(R_G)$

$I_F = 1800$ A, $V_{CE} = 1200$ V



Transient thermal impedance, Diode, Inverter

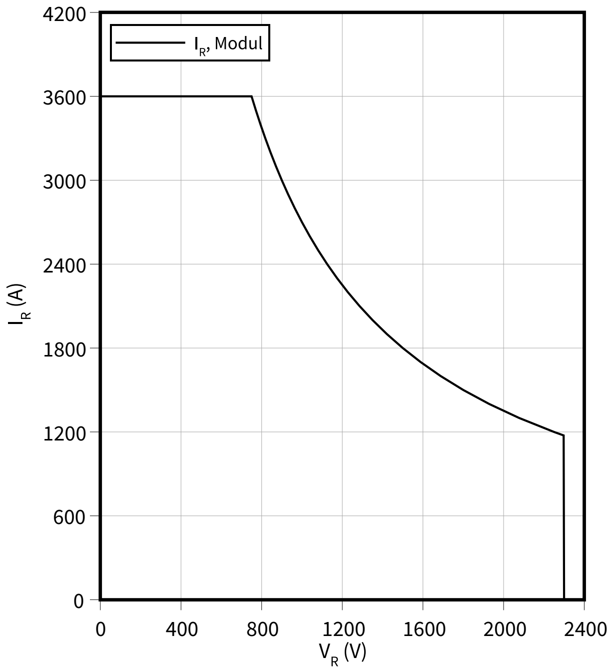
$Z_{th} = f(t)$



Safe operating area (SOA), Diode, Inverter

$I_R = f(V_R)$

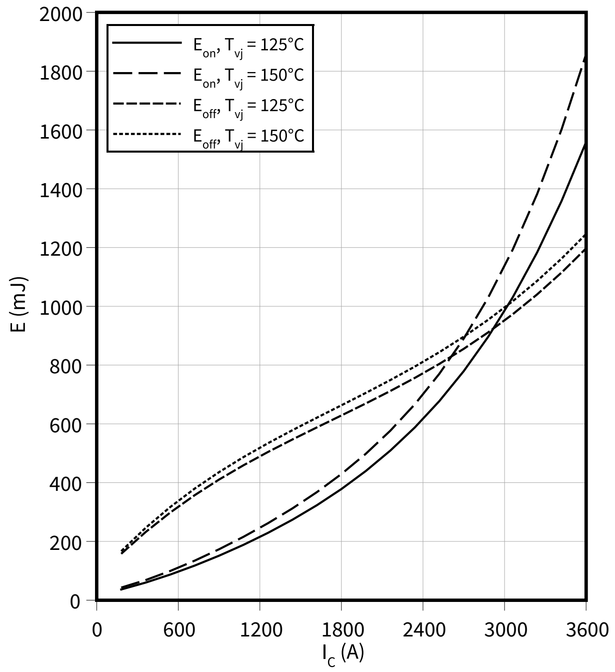
$T_{vj} = 150$ °C



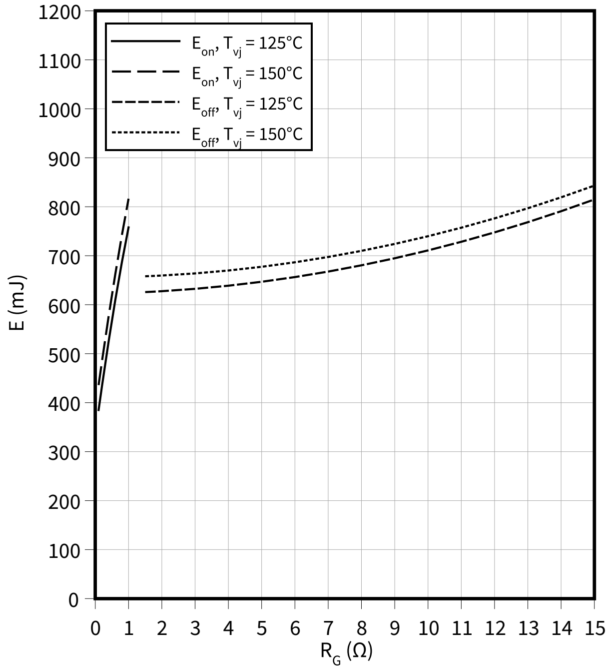
Switching losses (typical), IGBT, 3-Level

$E = f(I_C)$

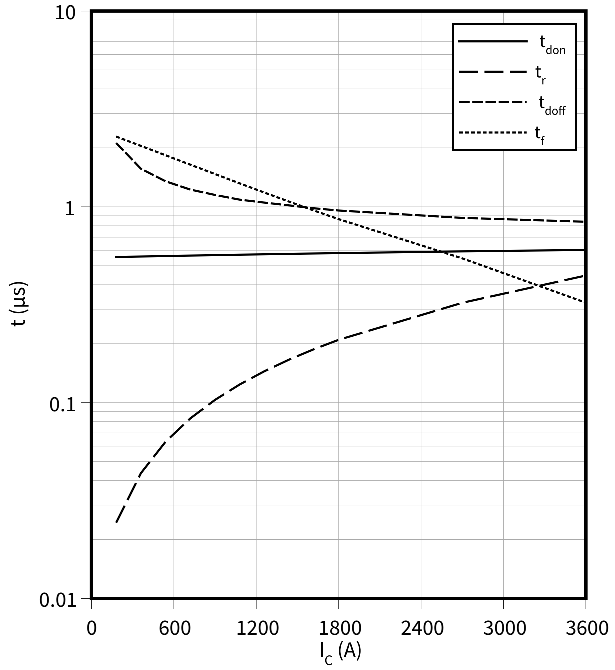
$R_{Goff} = 1.5$ Ω, $R_{Gon} = 0.1$ Ω, $V_{CE} = 600$ V, $V_{GE} = \pm 15$ V



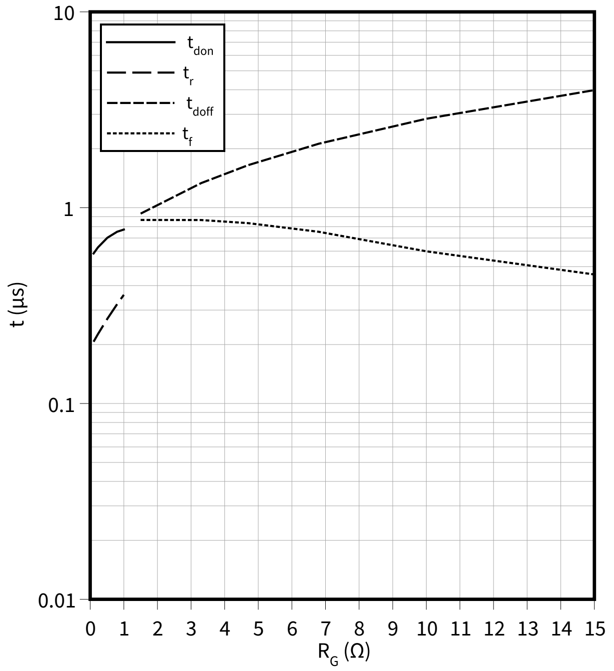
Switching losses (typical), IGBT, 3-Level
$E = f(R_G)$
I_C = 1800 A, V_{CE} = 600 V, V_{GE} = ± 15 V



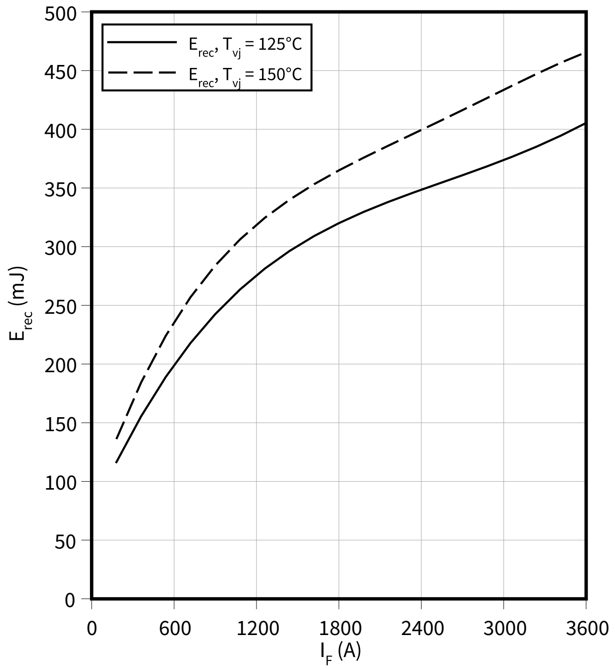
Switching times (typical), IGBT, 3-Level
$t = f(I_C)$
R_{Goff} = 1.5 Ω, R_{Gon} = 0.1 Ω, V_{CE} = 600 V, V_{GE} = ± 15 V, T_{vj} = 150 °C

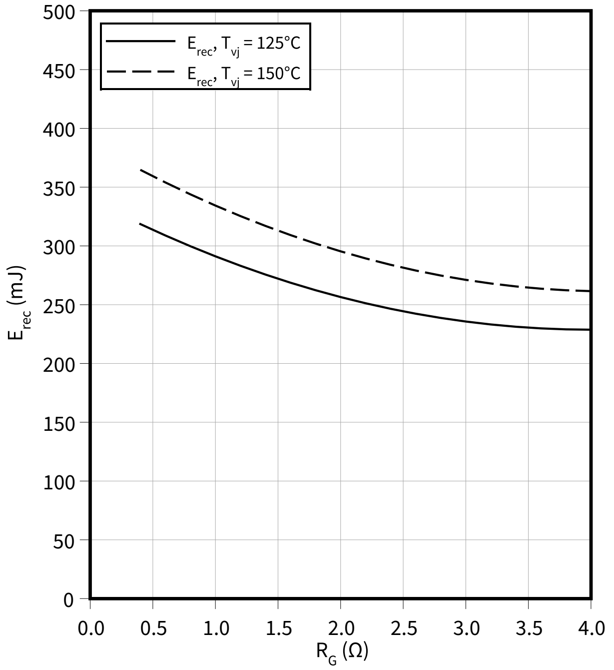
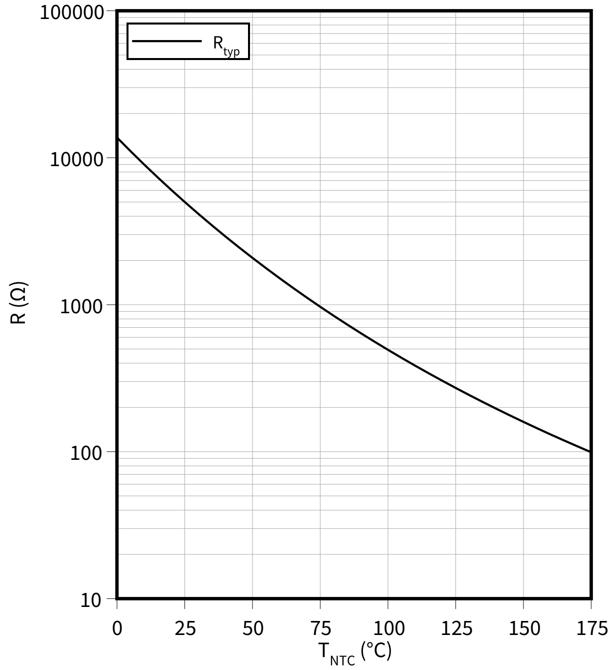


Switching times (typical), IGBT, 3-Level
$t = f(R_G)$
I_C = 1800 A, V_{CE} = 600 V, V_{GE} = ± 15 V, T_{vj} = 150 °C



Switching losses (typical), Diode, 3-Level
$E_{rec} = f(I_F)$
V_{CE} = 600 V, R_{Gon} = R_{Gon}(IGBT)



Switching losses (typical), Diode, 3-Level	**Temperature characteristic (typical), NTC-Thermistor**
$E_{rec} = f(R_G)$ V_{CE} = 600 V, I_F = 1800 A	$R = f(T_{NTC})$
	

8 Circuit diagram

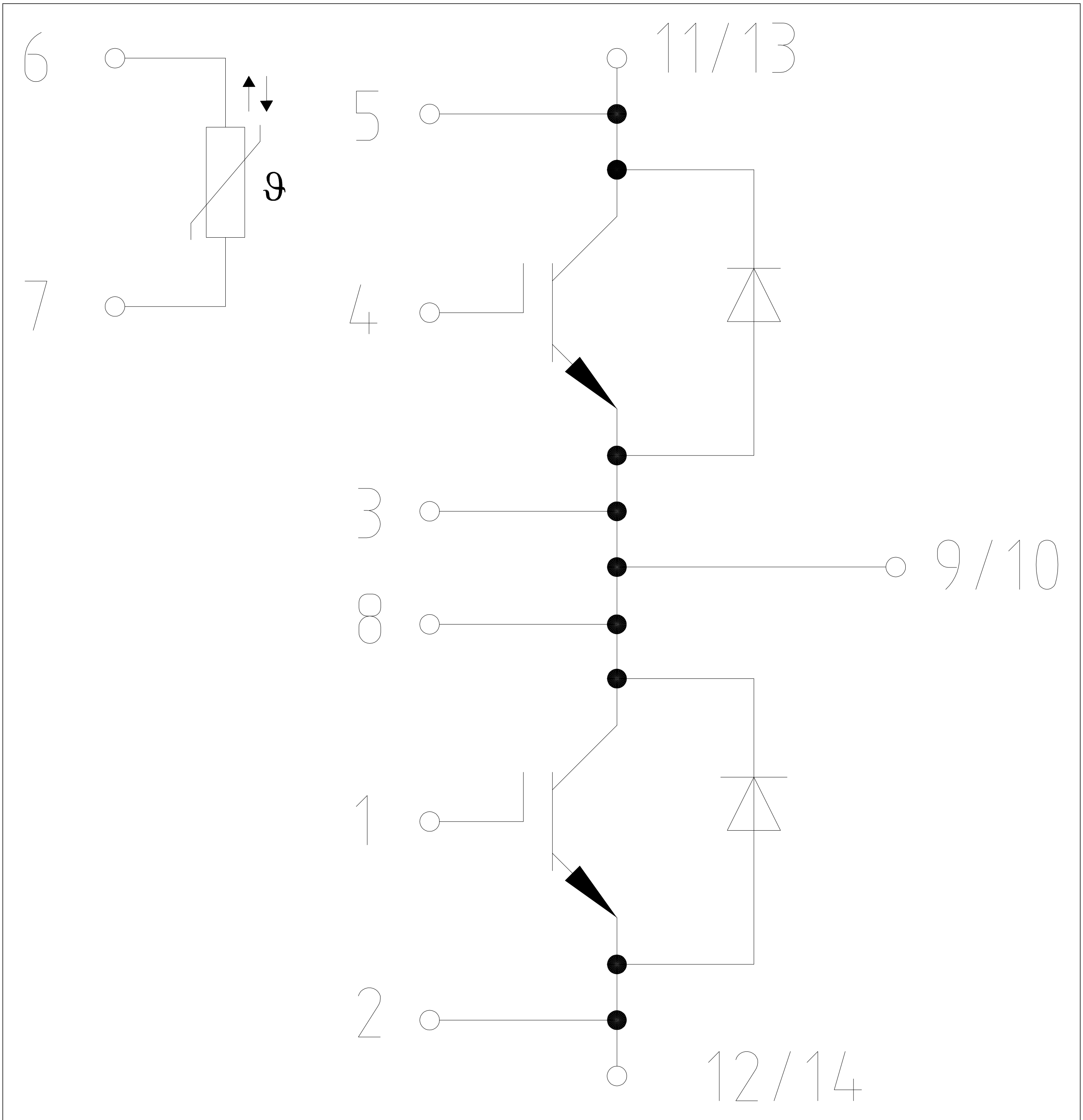


Figure 1

9 Package outlines

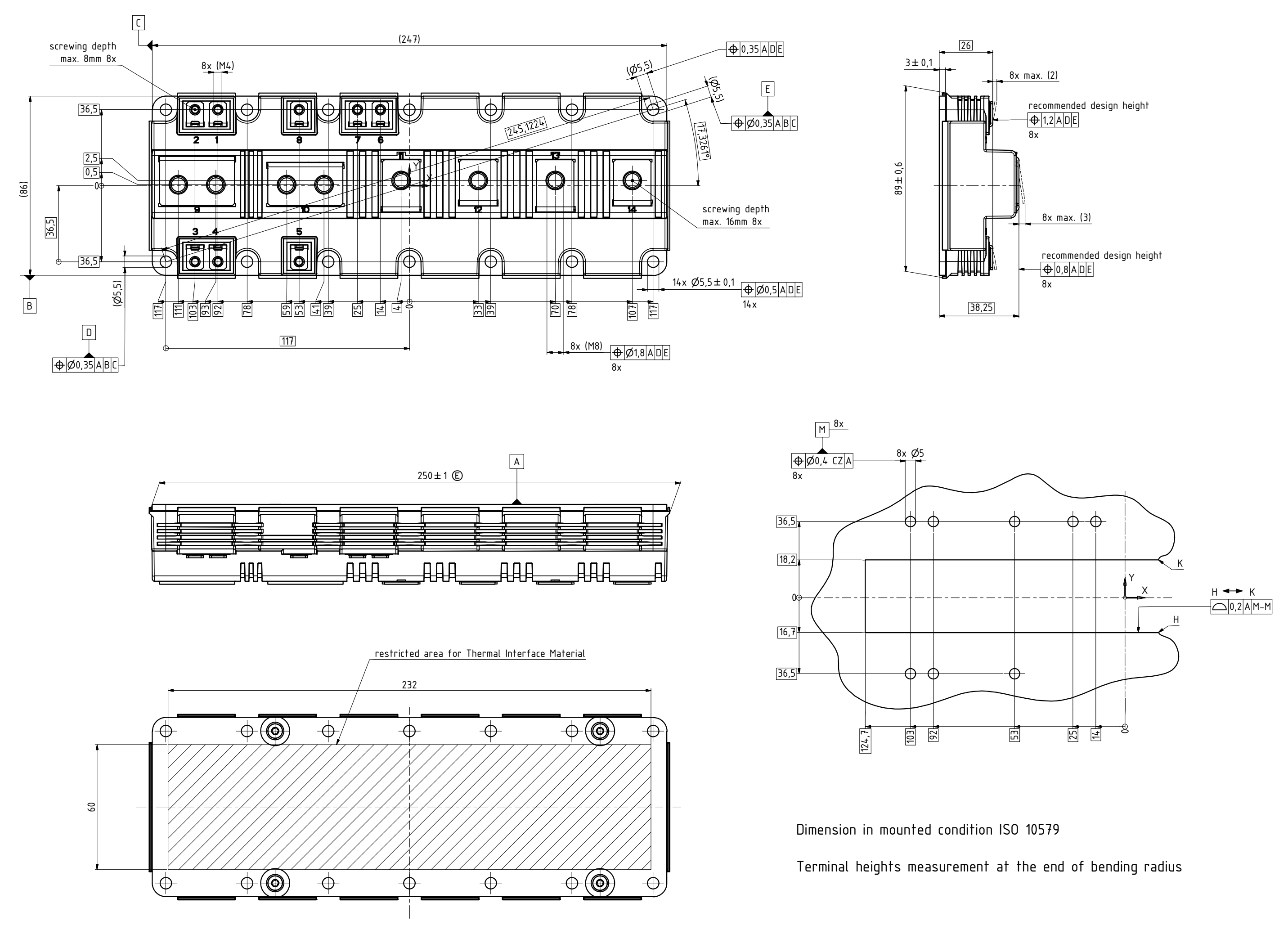


Figure 2

10 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
1.00	2022-05-03	Final datasheet

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