EconoPIM™3 module with TRENCHSTOP™IGBT7 and emitter controlled 7 diode and NTC

Features

- Electrical features
  - V_{CES} = 1200 V
  - $I_{C\ nom}$ = 150 A / I_{CRM} = 300 A
  - TRENCHSTOP™ IGBT7
  - Overload operation up to 175°C
  - Low $V_{CE,sat}$
- Mechanical features
  - Integrated NTC temperature sensor
  - PressFIT contact technology
  - Copper base plate
  - Al_2O_3 substrate with low thermal resistance

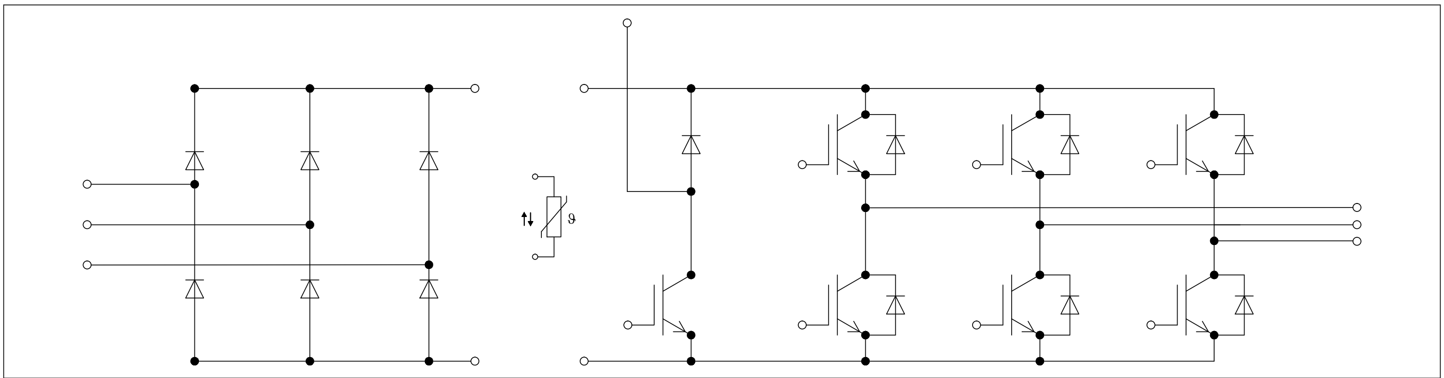
Potential applications

- Auxiliary inverters
- Motor drives
- Servo 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 = 1 min	2.5	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*		> 200	
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}				25		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	T_C=25°C, per switch			1.1		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_C=25°C, per switch			1.6		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

Note: The current under continuous operation is limited to 50 A rms per connector pin

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
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_C = 80 °C	150	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		300	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 = 150 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.55	1.80	V
			T_{vj} = 125 °C		1.69		
			T_{vj} = 175 °C		1.77		
Gate threshold voltage	V_{GEth}	I_C = 3.5 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.15	5.80	6.45	V
Gate charge	Q_G	V_{GE} = ±15 V, V_{CE} = 600 V			2.5		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			1		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			30.1		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.105		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			0.012	mA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V, T_{vj} = 25 °C				100	nA
Turn-on delay time (inductive load)	t_{don}	I_C = 150 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 3.3 Ω	T_{vj} = 25 °C		0.172		µs
			T_{vj} = 125 °C		0.183		
			T_{vj} = 175 °C		0.189		
Rise time (inductive load)	t_r	I_C = 150 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 3.3 Ω	T_{vj} = 25 °C		0.072		µs
			T_{vj} = 125 °C		0.077		
			T_{vj} = 175 °C		0.080		
Turn-off delay time (inductive load)	t_{doff}	I_C = 150 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 3.3 Ω	T_{vj} = 25 °C		0.331		µs
			T_{vj} = 125 °C		0.414		
			T_{vj} = 175 °C		0.433		
Fall time (inductive load)	t_f	I_C = 150 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 3.3 Ω	T_{vj} = 25 °C		0.103		µs
			T_{vj} = 125 °C		0.198		
			T_{vj} = 175 °C		0.262		
Turn-on energy loss per pulse	E_{on}	I_C = 150 A, V_{CE} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 3.3 Ω, di/dt = 1700 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		16.6		mJ
			T_{vj} = 125 °C		24.9		
			T_{vj} = 175 °C		29.6		
Turn-off energy loss per pulse	E_{off}	I_C = 150 A, V_{CE} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 3.3 Ω, dv/dt = 3200 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		10.4		mJ
			T_{vj} = 125 °C		15.9		
			T_{vj} = 175 °C		19.9		

(table continues...)

Table 4 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
SC data	I_{SC}	$V_{GE} \leq 15$ V, $V_{CC} = 800$ V, $V_{CEmax}=V_{CES}-L_{sCE}*di/dt$	$t_P \leq 8$ µs, $T_{vj}=150$ °C		520		A
			$t_P \leq 7$ µs, $T_{vj}=175$ °C		490		
Thermal resistance, junction to case	R_{thJC}	per IGBT				0.290	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, λ_{grease}= 1 W/(m*K)			0.0680		K/W
Temperature under switching conditions	$T_{vj\ op}$			-40		175	°C

Note: *$T_{vj\ op}$ > 150°C is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.*

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			150	A
Repetitive peak forward current	I_{FRM}	$t_P = 1$ ms		300	A
I^2t - value	I^2t	$t_P = 10$ ms, $V_R = 0$ V	$T_{vj} = 125$ °C	2700	A^2s
			$T_{vj} = 175$ °C	2250	

Table 6 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 150$ A, $V_{GE} = 0$ V	$T_{vj} = 25$ °C		1.72	2.10	V
			$T_{vj} = 125$ °C		1.59		
			$T_{vj} = 175$ °C		1.52		
Peak reverse recovery current	I_{RM}	$V_R = 600$ V, $I_F = 150$ A, $V_{GE} = -15$ V, $-di_F/dt$ = 1700 A/µs ($T_{vj} = 175$ °C)	$T_{vj} = 25$ °C		65.3		A
			$T_{vj} = 125$ °C		91.8		
			$T_{vj} = 175$ °C		107		

(table continues...)

Table 6 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Recovered charge	Q_r	V_R = 600 V, I_F = 150 A, V_{GE} = -15 V, -di_F/dt = 1700 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		10.3		µC
			T_{vj} = 125 °C		21.7		
			T_{vj} = 175 °C		28.6		
Reverse recovery energy	E_{rec}	V_R = 600 V, I_F = 150 A, V_{GE} = -15 V, -di_F/dt = 1700 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		3.27		mJ
			T_{vj} = 125 °C		7.32		
			T_{vj} = 175 °C		9.88		
Thermal resistance, junction to case	R_{thJC}	per diode				0.463	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, λ_{grease}= 1 W/(m*K)			0.0698		K/W
Temperature under switching conditions	$T_{vj\ op}$			-40		175	°C

Note: *$T_{vj\ op}$ > 150°C is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.*

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 °C	1600	V
Maximum RMS forward current per chip	I_{FRMSM}	T_C = 100 °C		150	A
Maximum RMS current at rectifier output	I_{RMSM}	T_C = 100 °C		150	A
Surge forward current	I_{FSM}	t_P = 10 ms	T_{vj} = 25 °C	1600	A
			T_{vj} = 150 °C	1400	
I^2t - value	I^2t	t_P = 10 ms	T_{vj} = 25 °C	12800	A^2s
			T_{vj} = 150 °C	9800	

Table 8 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 150 A	T_{vj} = 150 °C		0.97		V
Reverse current	I_r	T_{vj} = 150 °C, V_R = 1600 V			1		mA

(table continues...)

Table 8 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to case	R_{thJC}	per diode			0.333	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, λ_{grease}= 1 W/(m*K)		0.0670		K/W
Temperature under switching conditions	$T_{vj, op}$		-40		150	°C

5 IGBT, Brake-Chopper

Table 9 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		T_{vj} = 25 °C	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj\ max}$ = 175 °C	T_C = 90 °C	100	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\ op}$		200	A
Gate-emitter peak voltage	V_{GES}			±20	V

Table 10 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 °C		1.50	1.80	V
			T_{vj} = 125 °C		1.64		
			T_{vj} = 175 °C		1.72		
Gate threshold voltage	V_{GEth}	I_C = 2.5 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.15	5.80	6.45	V
Gate charge	Q_G	V_{GE} = ±15 V, V_{CE} = 600 V			1.8		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			1.5		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			21.7		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.076		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			0.01	mA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V, T_{vj} = 25 °C				100	nA

(table continues...)

Table 10 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-on delay time (inductive load)	t_{don}	I_C = 100 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 4.3 Ω	T_{vj} = 25 °C		0.169		µs
			T_{vj} = 125 °C		0.180		
			T_{vj} = 175 °C		0.187		
Rise time (inductive load)	t_r	I_C = 100 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 4.3 Ω	T_{vj} = 25 °C		0.063		µs
			T_{vj} = 125 °C		0.067		
			T_{vj} = 175 °C		0.070		
Turn-off delay time (inductive load)	t_{doff}	I_C = 100 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 4.3 Ω	T_{vj} = 25 °C		0.310		µs
			T_{vj} = 125 °C		0.390		
			T_{vj} = 175 °C		0.410		
Fall time (inductive load)	t_f	I_C = 100 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 4.3 Ω	T_{vj} = 25 °C		0.110		µs
			T_{vj} = 125 °C		0.190		
			T_{vj} = 175 °C		0.250		
Turn-on energy loss per pulse	E_{on}	I_C = 100 A, V_{CE} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 4.3 Ω, di/dt = 1100 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		7.12		mJ
			T_{vj} = 125 °C		11.7		
			T_{vj} = 175 °C		14.5		
Turn-off energy loss per pulse	E_{off}	I_C = 100 A, V_{CE} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 4.3 Ω, dv/dt = 2800 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		6.93		mJ
			T_{vj} = 125 °C		10.6		
			T_{vj} = 175 °C		13.3		
SC data	I_{SC}	V_{GE} ≤ 15 V, V_{CC} = 800 V, $V_{CEmax}=V_{CES}-L_{sCE}$*di/dt	t_P ≤ 8 µs, T_{vj}=150 °C		370		A
			t_P ≤ 7 µs, T_{vj}=175 °C		350		
Thermal resistance, junction to case	R_{thJC}	per IGBT				0.373	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, λ_{grease}= 1 W/(m*K)			0.0680		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

Note: $T_{vj\,op}$ *> 150°C is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.*

6 Diode, Brake-Chopper

Table 11 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			50	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		100	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	220	A^2s
			T_{vj} = 175 °C	200	

Table 12 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 50 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.72	2.10	V
			T_{vj} = 125 °C		1.59		
			T_{vj} = 175 °C		1.52		
Peak reverse recovery current	I_{RM}	V_R = 600 V, I_F = 50 A, V_{GE} = -15 V, -di_F/dt = 550 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		37.3		A
			T_{vj} = 125 °C		44.3		
			T_{vj} = 175 °C		49.6		
Recovered charge	Q_r	V_R = 600 V, I_F = 50 A, V_{GE} = -15 V, -di_F/dt = 550 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		3.86		µC
			T_{vj} = 125 °C		7.05		
			T_{vj} = 175 °C		10.1		
Reverse recovery energy	E_{rec}	V_R = 600 V, I_F = 50 A, V_{GE} = -15 V, -di_F/dt = 550 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		1.13		mJ
			T_{vj} = 125 °C		2.34		
			T_{vj} = 175 °C		3.23		
Thermal resistance, junction to case	R_{thJC}	per diode				0.909	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, λ_{grease}= 1 W/(m*K)			0.109		K/W
Temperature under switching conditions	$T_{vj\ op}$			-40		175	°C

Note: $T_{vj\ op}$ > 150°C *is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.*

7 NTC-Thermistor

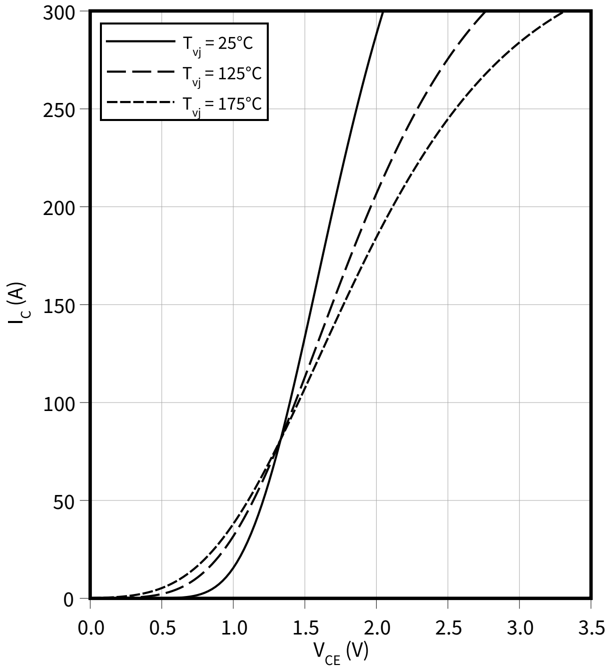
Table 13 Characteristic values

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

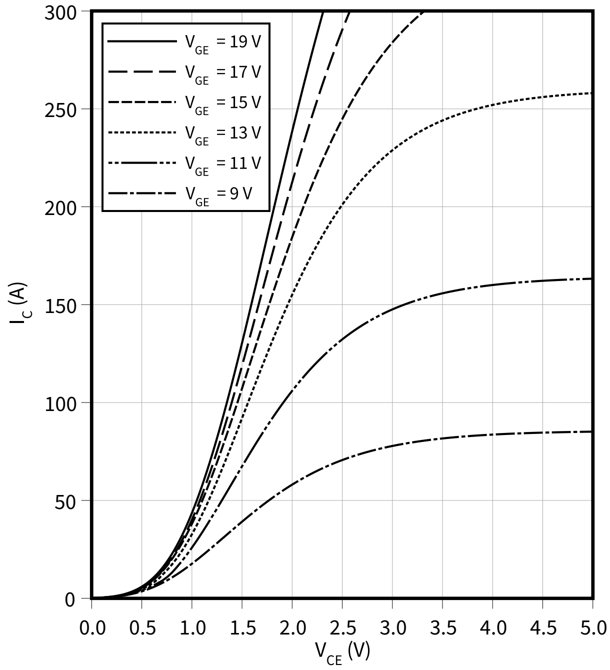
Note: Specification according to the valid application note.

8 Characteristics diagrams

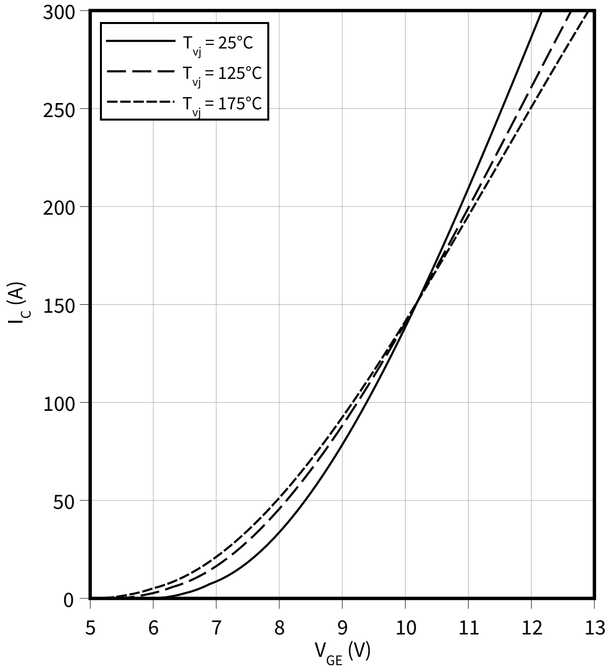
Output characteristic (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



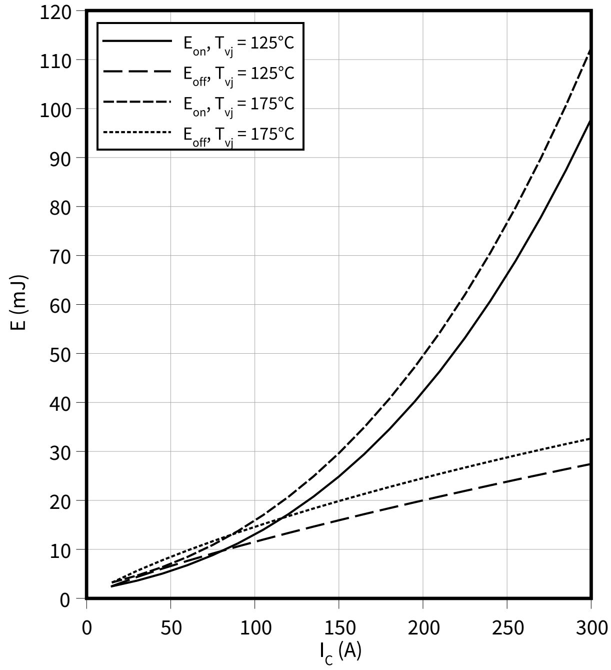
Output characteristic field (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$T_{vj} = 175$ °C



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



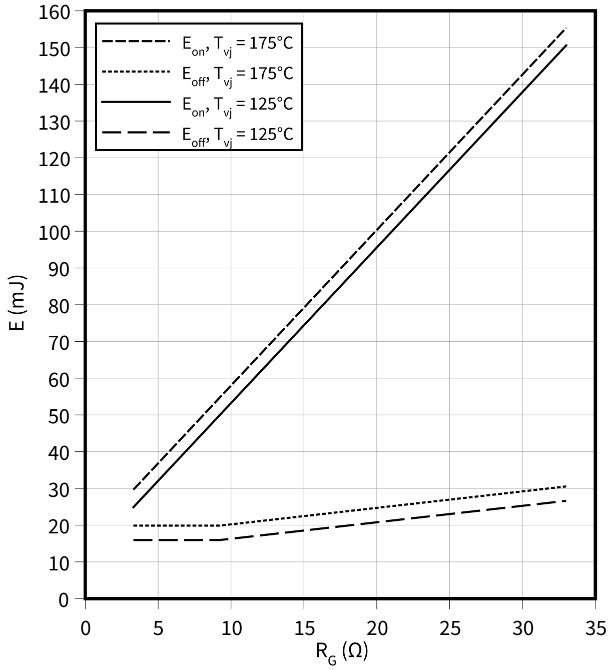
Switching losses (typical), IGBT, Inverter
$E = f(I_C)$
$R_{Goff} = 3.3\ \Omega$, $R_{Gon} = 3.3\ \Omega$, $V_{GE} = \pm 15$ V, $V_{CE} = 600$ V



Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

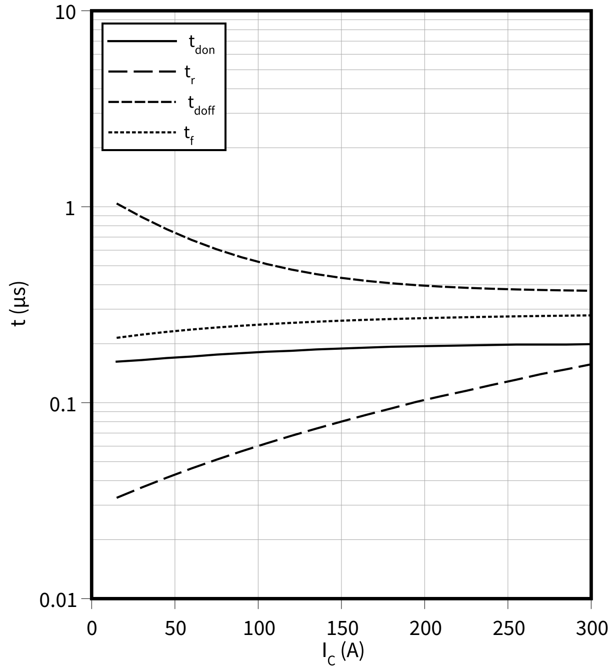
$V_{GE} = \pm 15$ V, $I_C = 150$ A, $V_{CE} = 600$ V



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

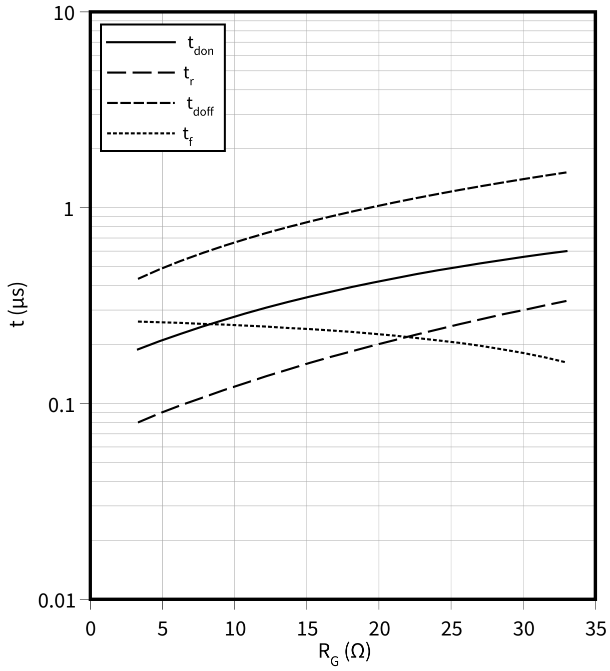
$R_{Goff} = 3.3$ Ω, $R_{Gon} = 3.3$ Ω, $V_{GE} = \pm 15$ V, $V_{CE} = 600$ V, $T_{vj} = 175$ °C



Switching times (typical), IGBT, Inverter

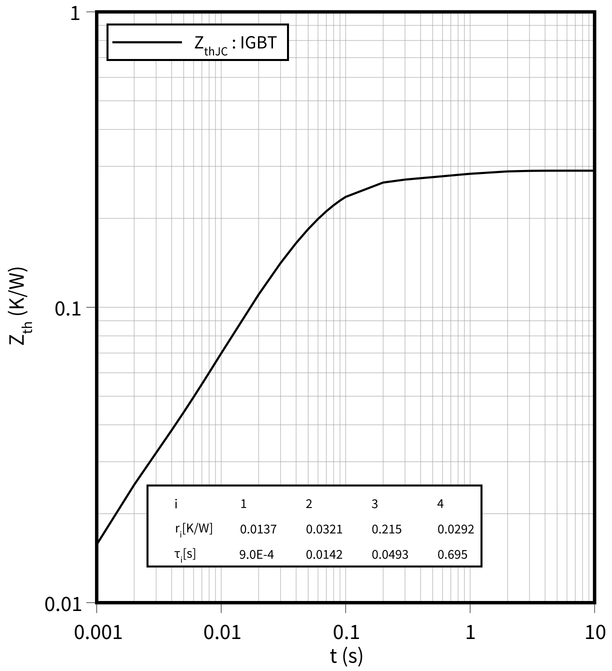
$t = f(R_G)$

$V_{GE} = \pm 15$ V, $I_C = 150$ A, $V_{CE} = 600$ V, $T_{vj} = 175$ °C

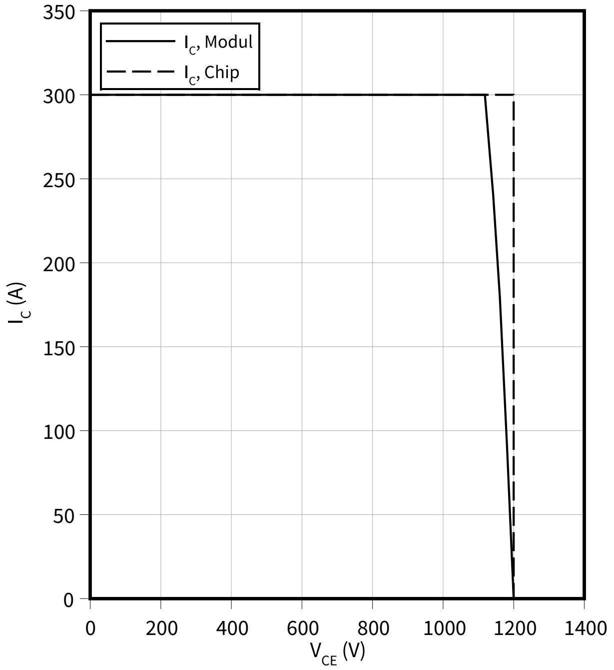


Transient thermal impedance , IGBT, Inverter

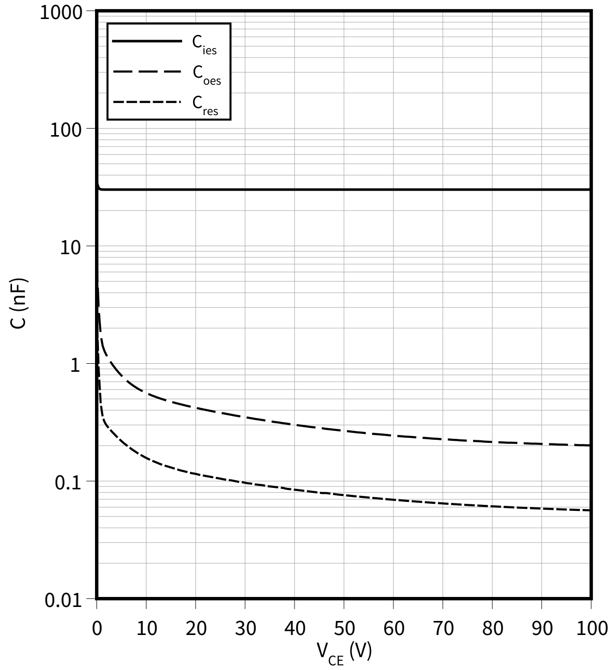
$Z_{th} = f(t)$



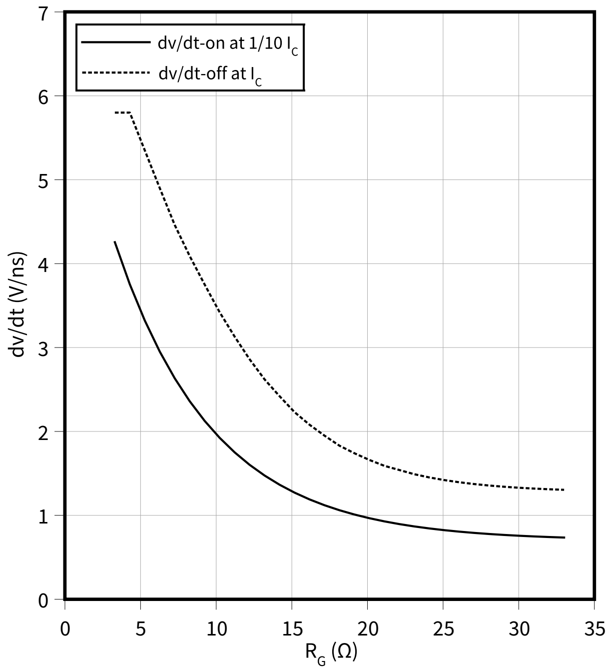
Reverse bias safe operating area (RBSOA), IGBT, Inverter
$I_C = f(V_{CE})$
$R_{Goff} = 3.3\ \Omega$, $V_{GE} = 15$ V, $T_{vj} = 175$ °C



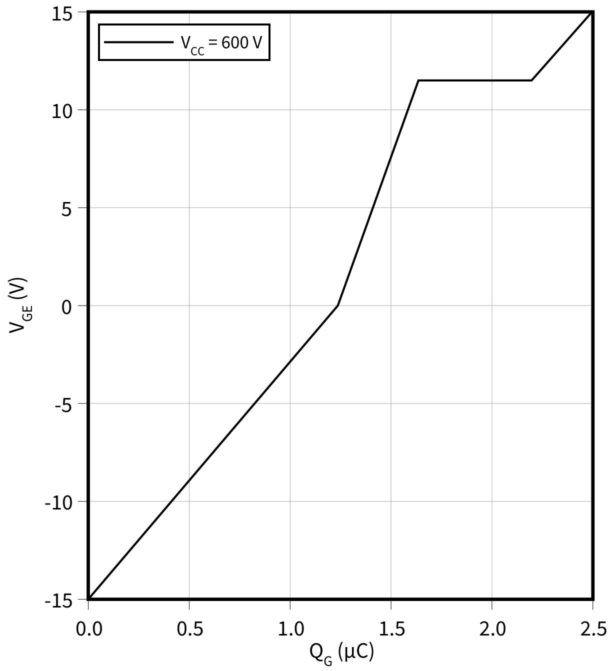
Capacity characteristic (typical), IGBT, Inverter
$C = f(V_{CE})$
f = 100 kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



Voltage slope (typical), IGBT, Inverter
$dv/dt = f(R_G)$
$I_C = 150$ A, $V_{CE} = 600$ V, $V_{GE} = \pm 15$ V, $T_{vj} = 25$ °C

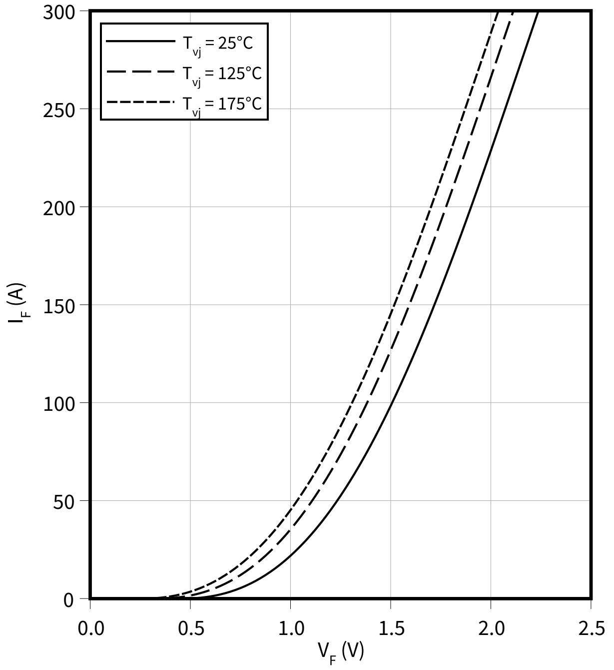


Gate charge characteristic (typical), IGBT, Inverter
$V_{GE} = f(Q_G)$
$I_C = 150$ A, $T_{vj} = 25$ °C



Forward characteristic (typical), Diode, Inverter

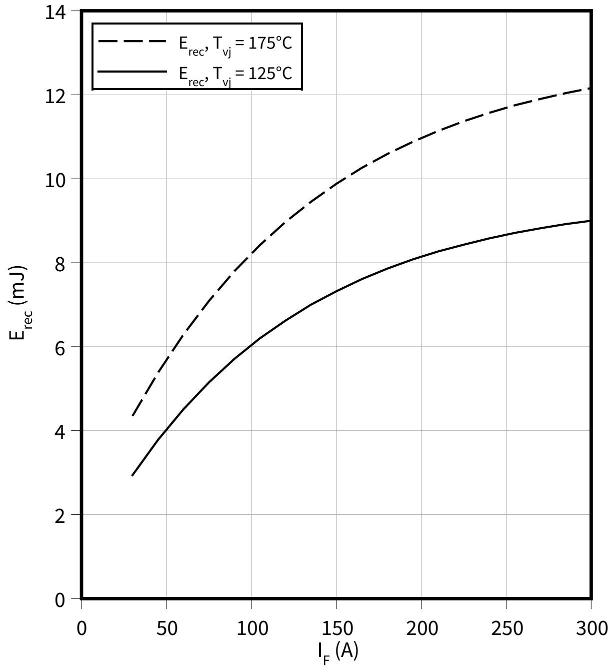
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

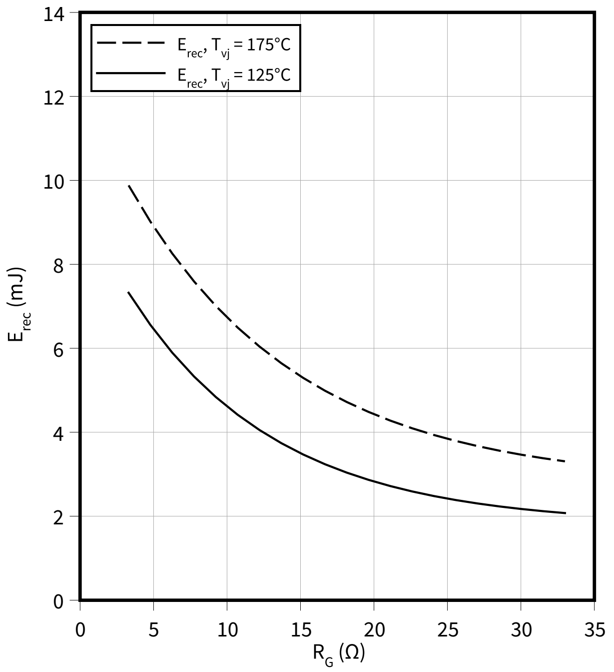
R_{Gon} = 3.3 Ω, V_{CE} = 600 V



Switching losses (typical), Diode, Inverter

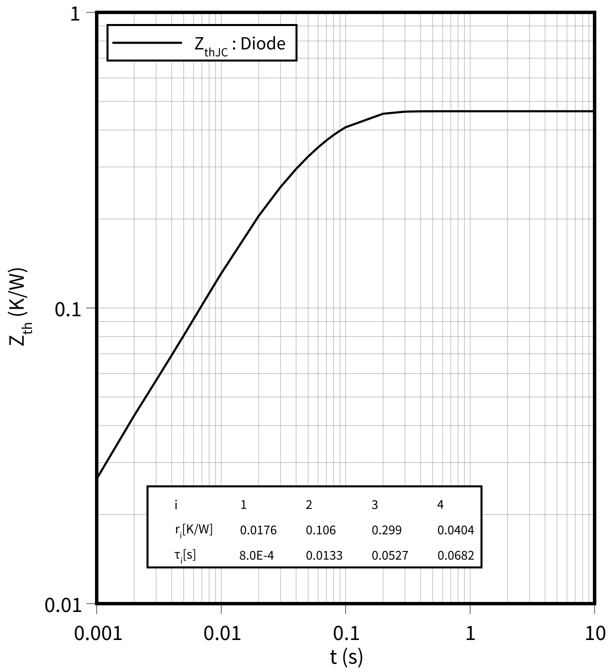
$E_{rec} = f(R_G)$

V_{CE} = 600 V, I_F = 150 A



Transient thermal impedance, Diode, Inverter

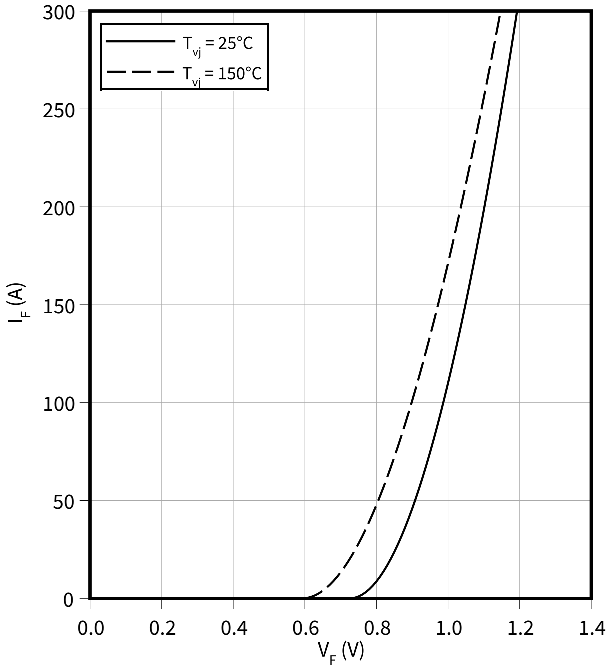
$Z_{th} = f(t)$



i	1	2	3	4
r_i[K/W]	0.0176	0.106	0.299	0.0404
$τ_i$[s]	8.0E-4	0.0133	0.0527	0.0682

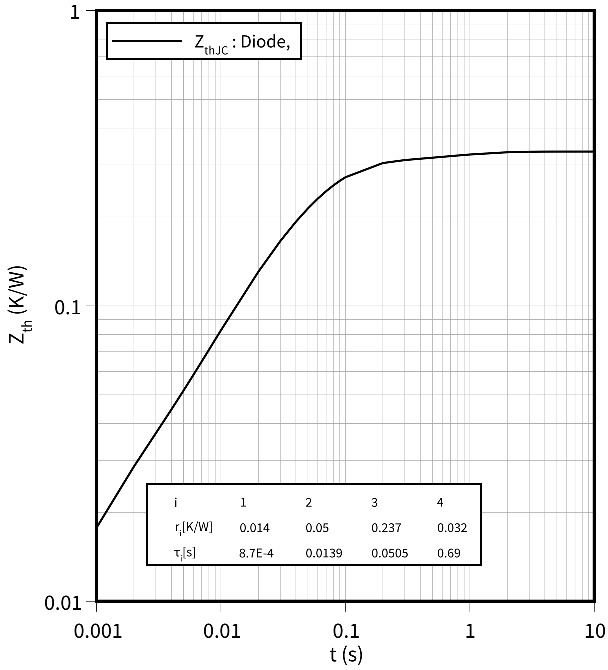
Forward characteristic (typical), Diode, Rectifier

$I_F = f(V_F)$



Transient thermal impedance, Diode, Rectifier

$Z_{th} = f(t)$

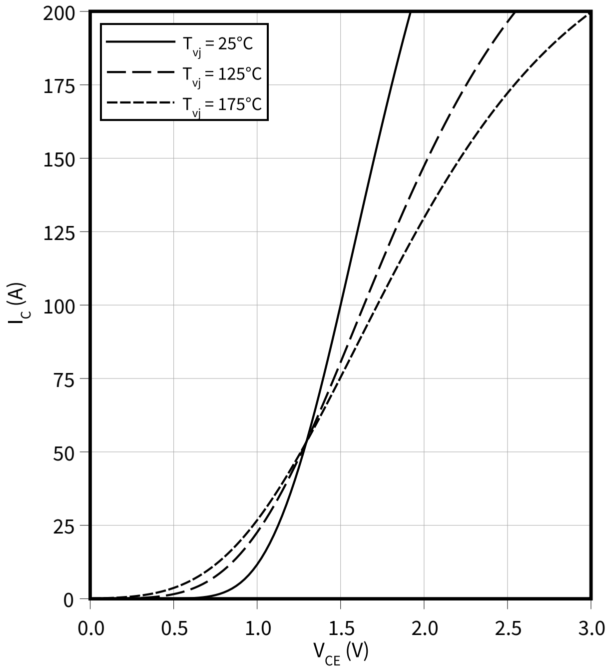


i	1	2	3	4
r_i[K/W]	0.014	0.05	0.237	0.032
τ_i[s]	8.7E-4	0.0139	0.0505	0.69

Output characteristic (typical), IGBT, Brake-Chopper

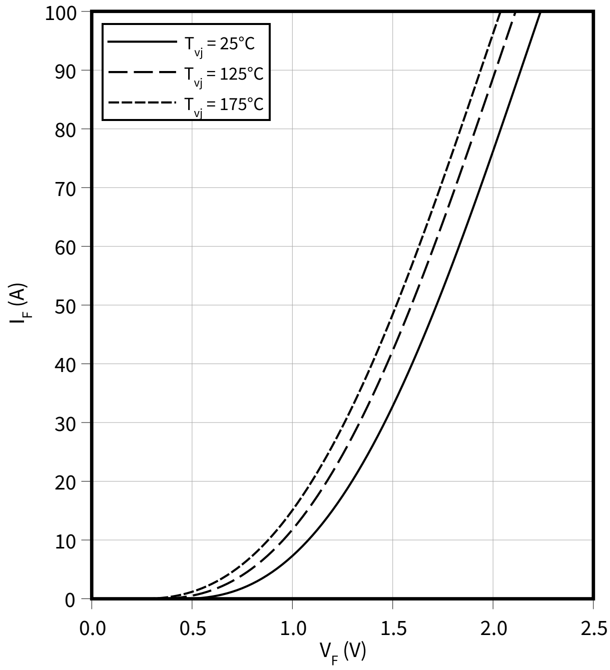
$I_C = f(V_{CE})$

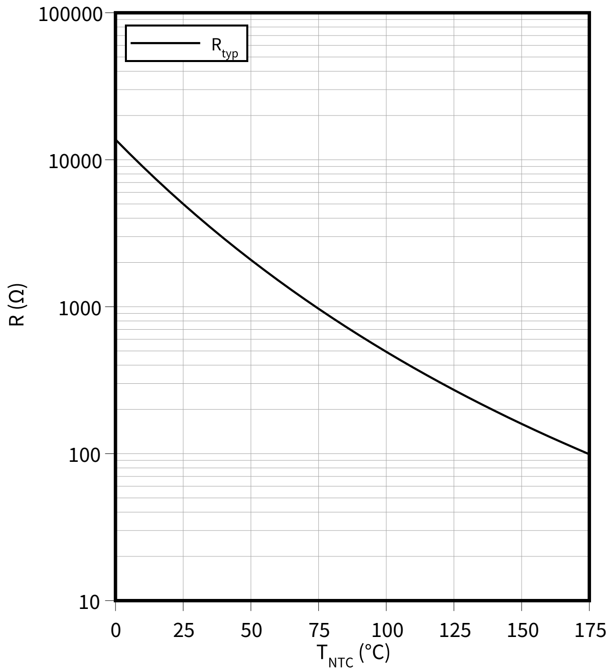
$V_{GE} = 15$ V



Forward characteristic (typical), Diode, Brake-Chopper

$I_F = f(V_F)$



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

9 Circuit diagram

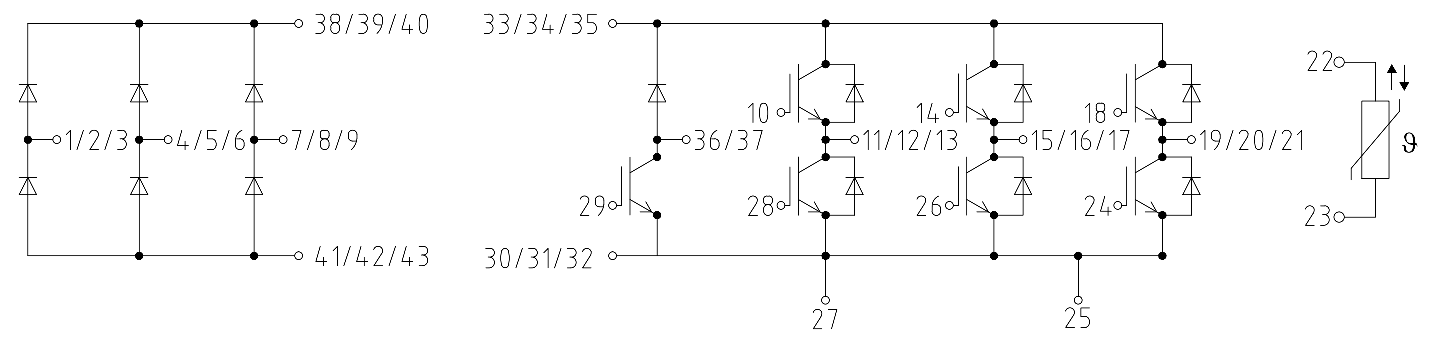


Figure 1

10 Package outlines

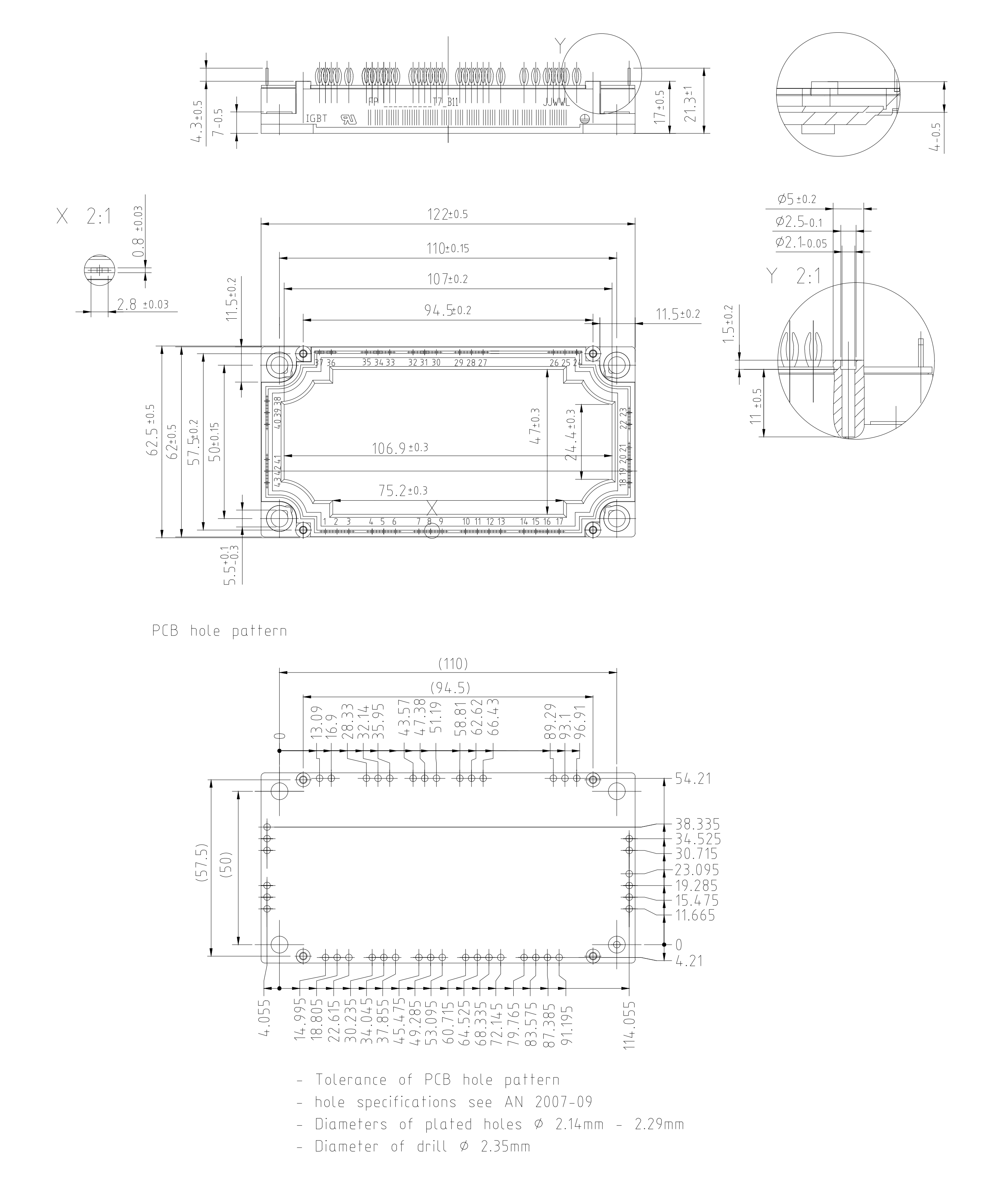


Figure 2

11 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	2021-08-23	Initial version
1.00	2022-03-28	Final datasheet

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