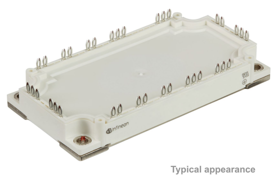
EconoPIM™3 module with TRENCHSTOP™IGBT7 and emitter controlled 7 diode and PressFIT / NTC / TIM

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
  - Pre-applied thermal interface material

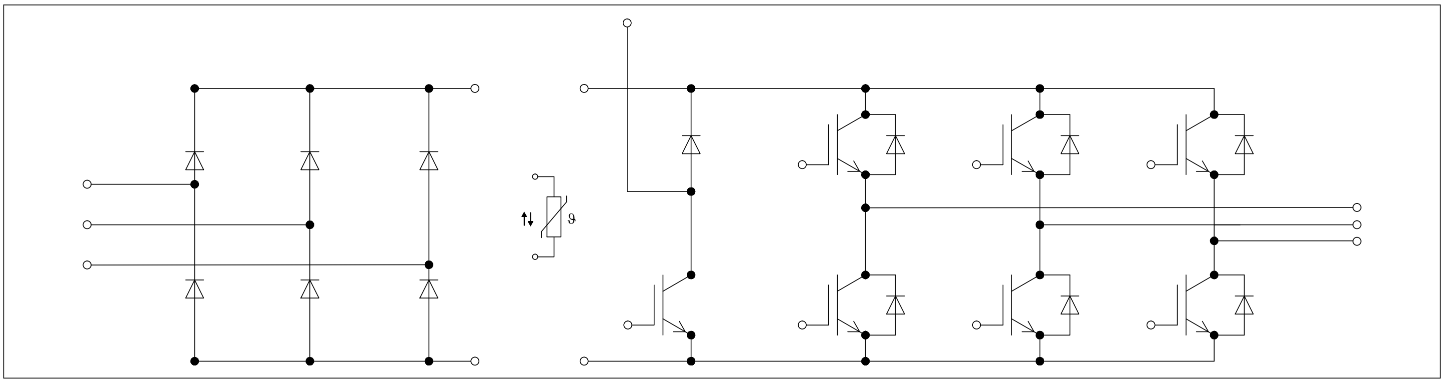
Potential applications

- 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	
RTI Elec.	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_H=25°C, per switch			1.1		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_H=25°C, per switch			1.6		mΩ
Storage temperature	T_{stg}			-40		125	°C
Maximum baseplate operation temperature	T_{BPmax}					125	°C
Mounting torque for modul 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.*
Storage and shipment of modules with TIM => see AN2012-07

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
Continous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_H = 50 °C	150	A
Repetitive peak collector current	I_{CRM}	t_P = 1 ms		300	A

Table 3 **Maximum rated values (continued)**

Parameter	Symbol	Note or test condition	Values	Unit
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 4 **Characteristic values (continued)**

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 heatsink	R_{thJH}	per IGBT, Valid with IFX pre-applied Thermal Interface Material				0.374	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
Continous DC forward current	I_F			150	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		300	A
I^2t - value	I^2t	V_R = 0 V, t_P = 10 ms	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}	I_F = 150 A, V_R = 600 V, 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 6 **Characteristic values (continued)**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Recovered charge	Q_r	I_F = 150 A, V_R = 600 V, 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}	I_F = 150 A, V_R = 600 V, 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 heatsink	R_{thJH}	per diode, Valid with IFX pre-applied Thermal Interface Material				0.581	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_H = 105 °C		150	A
Maximum RMS current at rectifier output	I_{RMSM}	T_H = 105 °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
Thermal resistance, junction to heatsink	R_{thJH}	per diode, Valid with IFX pre-applied Thermal Interface Material				0.435	K/W

Table 8 Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
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
Continous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_H = 75 °C	100	A
Repetitive peak collector current	I_{CRM}	t_P = 1 ms		200	A
Gate-emitter peak voltage	V_{GES}			±20	V

Table 10 Characteristic values

Parameter	Symbol	Note or test condition		Min.	Typ.	Max.	Unit
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
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		

Table 10 Characteristic values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
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 heatsink	R_{thJH}	per IGBT, Valid with IFX pre-applied Thermal Interface Material				0.474	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
Continous DC forward current	I_F			50	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		100	A
I^2t - value	I^2t	V_R = 0 V, t_P = 10 ms	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}	I_F = 50 A, V_R = 600 V, 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	I_F = 50 A, V_R = 600 V, 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}	I_F = 50 A, V_R = 600 V, 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 heatsink	R_{thJH}	per diode, Valid with IFX pre-applied Thermal Interface Material				1.07	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

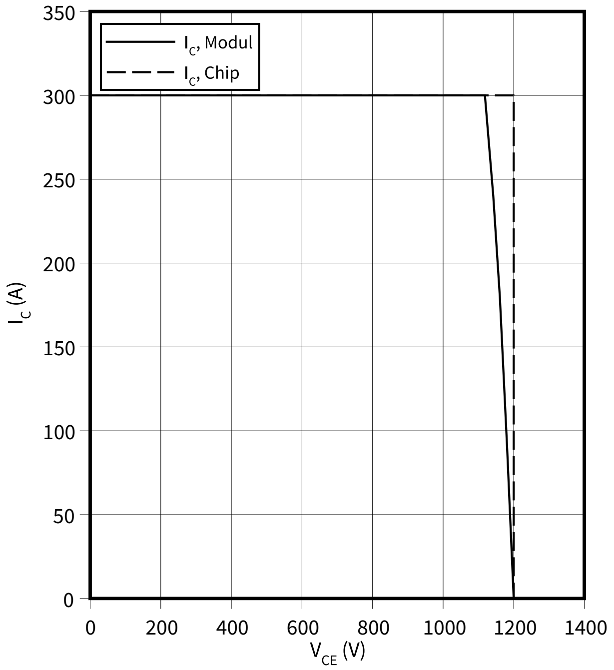
Table 13 **Characteristic values**

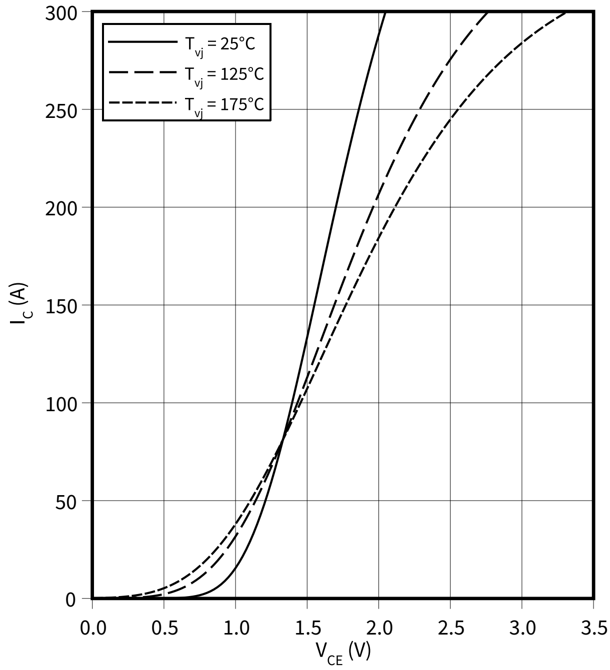
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	T_{NTC} = 25 °C		5		kΩ
Deviation of R_{100}	$\Delta R/R$	T_{NTC} = 100 °C, R_{100} = 493 Ω	-5		5	%
Power dissipation	P_{25}	T_{NTC} = 25 °C			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25}\exp[B_{25/50}(1/T_2-1/(298{,}15\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

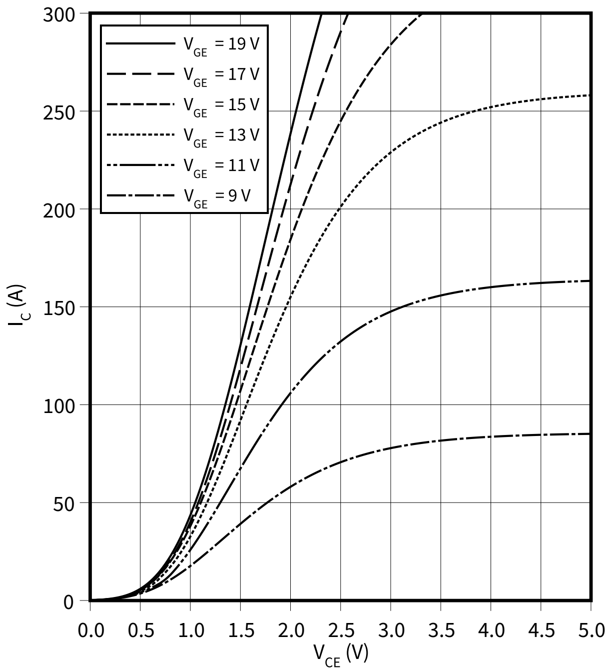
8 Characteristics diagrams

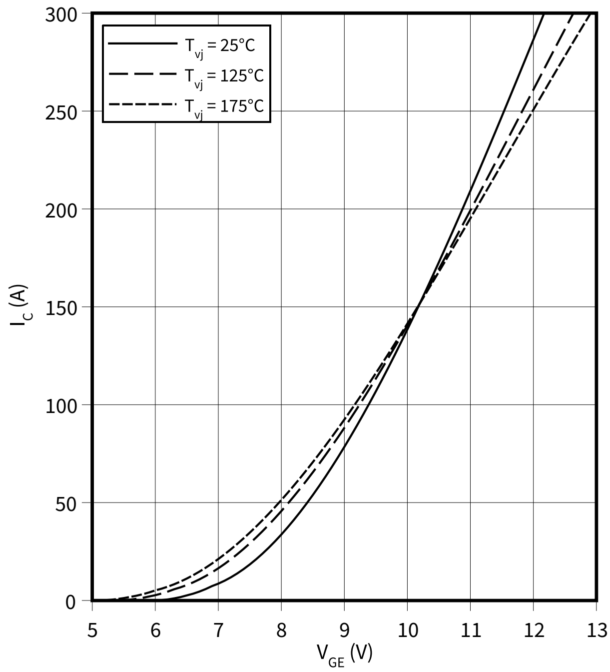
reverse bias safe operating area (RBSOA), IGBT, Inverter	output characteristic (typical), IGBT, Inverter
$I_C = f(V_{CE})$	$I_C = f(V_{CE})$
$R_{Goff} = 3.3\ \Omega$, $V_{GE} = 15$ V, $T_{vj} = 175$ °C	$V_{GE} = 15$ V





output characteristic (typical), IGBT, Inverter	transfer characteristic (typical), IGBT, Inverter
$I_C = f(V_{CE})$	$I_C = f(V_{GE})$
$T_{vj} = 175$ °C	$V_{CE} = 20$ V

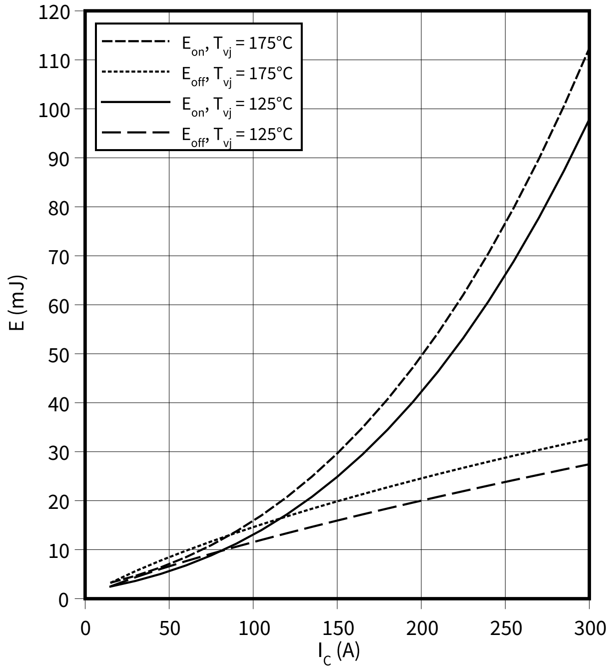




switching losses (typical), IGBT, Inverter

$E = f(I_C)$

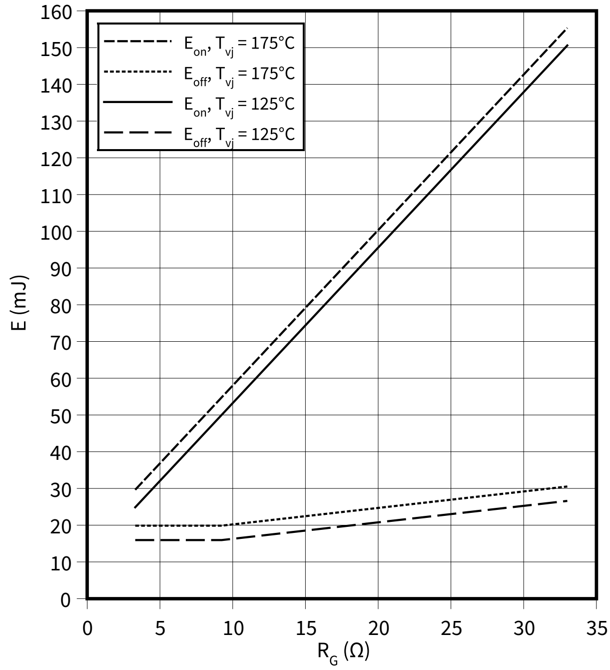
$R_{Goff} = 3.3\ \Omega$, $R_{Gon} = 3.3\ \Omega$, $V_{CE} = 600$ V, $V_{GE} = -15 / 15$ V



switching losses (typical), IGBT, Inverter

$E = f(R_G)$

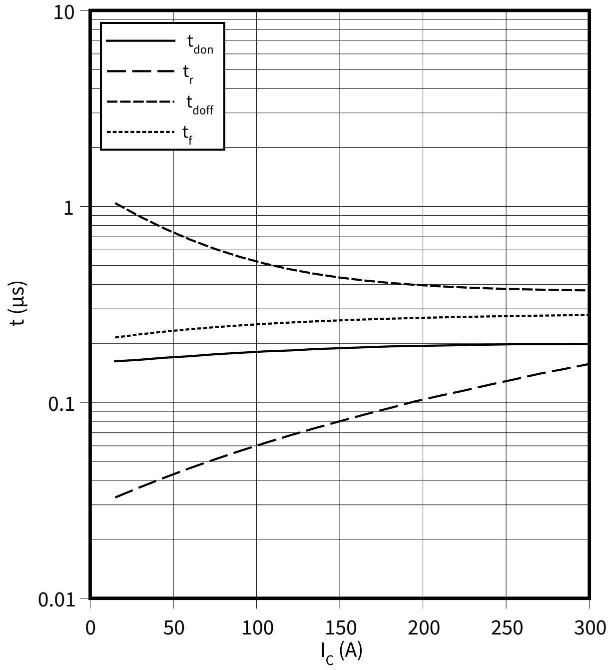
$I_C = 150$ A, $V_{CE} = 600$ V, $V_{GE} = -15 / 15$ V



switching times (typical), IGBT, Inverter

$t = f(I_C)$

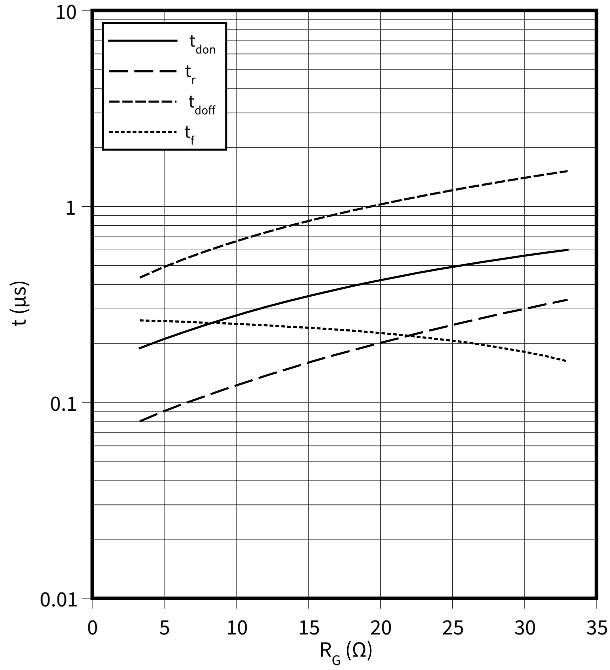
$R_{Goff} = 3.3\ \Omega$, $R_{Gon} = 3.3\ \Omega$, $V_{CE} = 600$ V, $V_{GE} = -15 / 15$ V, $T_{vj} =$ 175 °C



switching times (typical), IGBT, Inverter

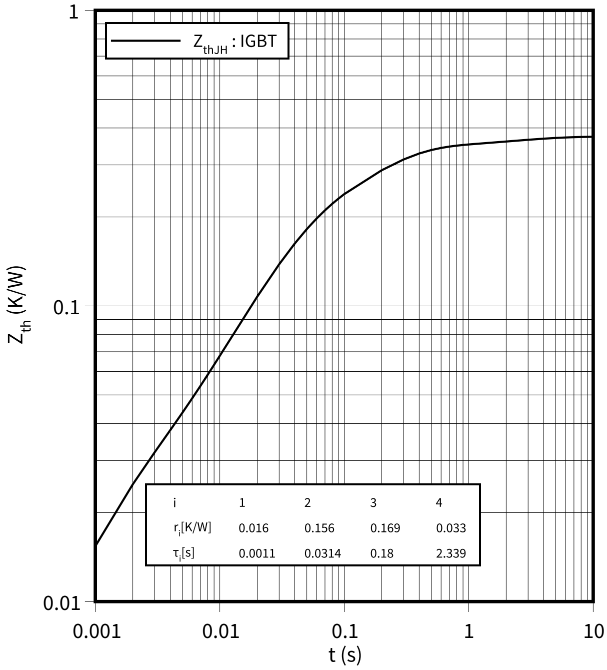
$t = f(R_G)$

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



transient thermal impedance , IGBT, Inverter

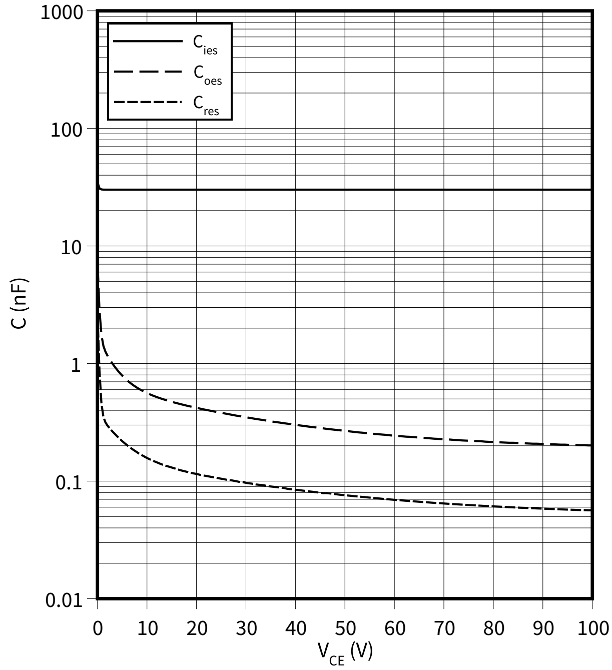
$Z_{th} = f(t)$



capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

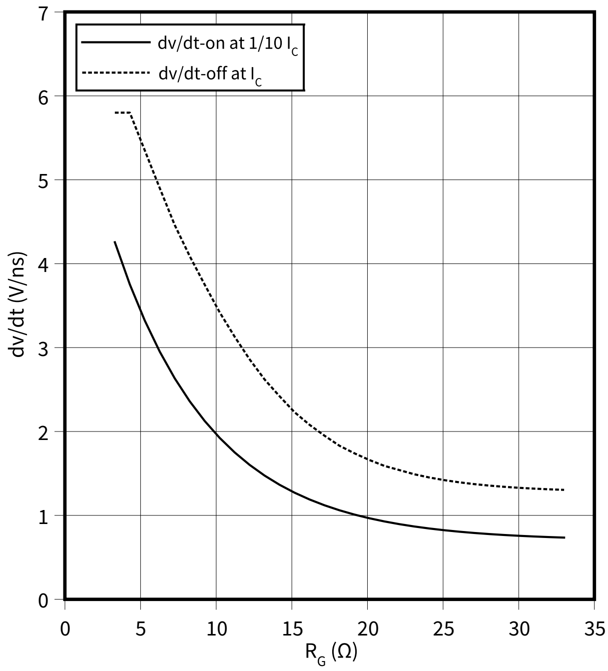
$f = 100$ kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



Voltage slope (typical), IGBT, Inverter

$dv/dt = f(R_G)$

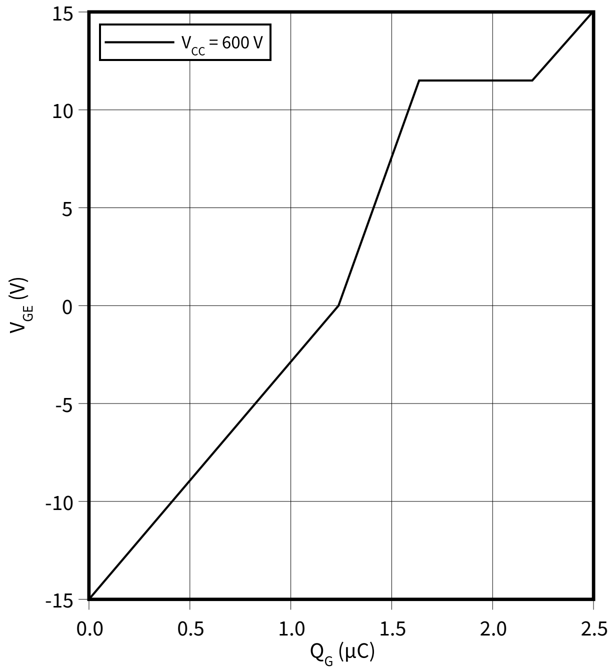
$I_C = 150$ A, $V_{CE} = 600$ V, $V_{GE} = \pm15$ V, $T_{vj} = 25$ °C



gate charge characteristic (typical), IGBT, Inverter

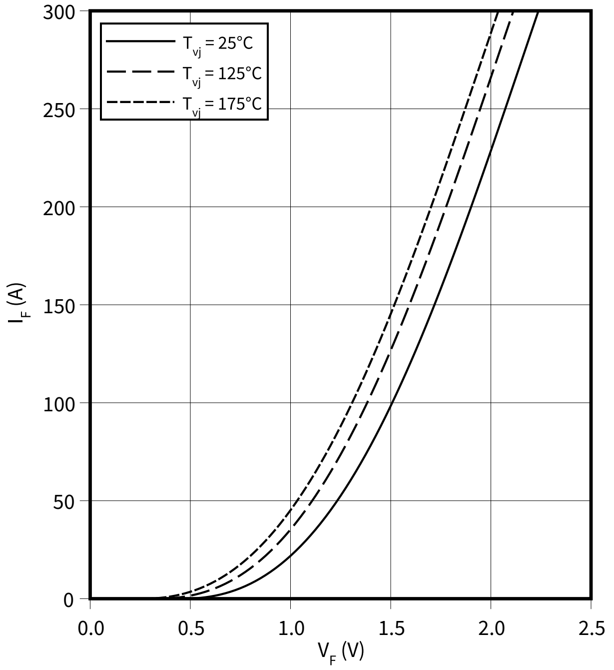
$V_{GE} = f(Q_G)$

$I_C = 150$ A, $T_{vj} = 25$ °C



forward characteristic (typical), Diode, Inverter

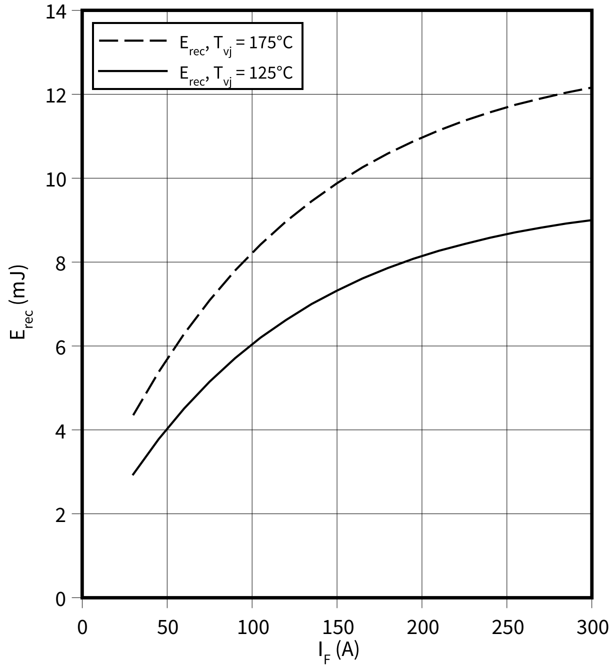
$I_F = f(V_F)$



switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

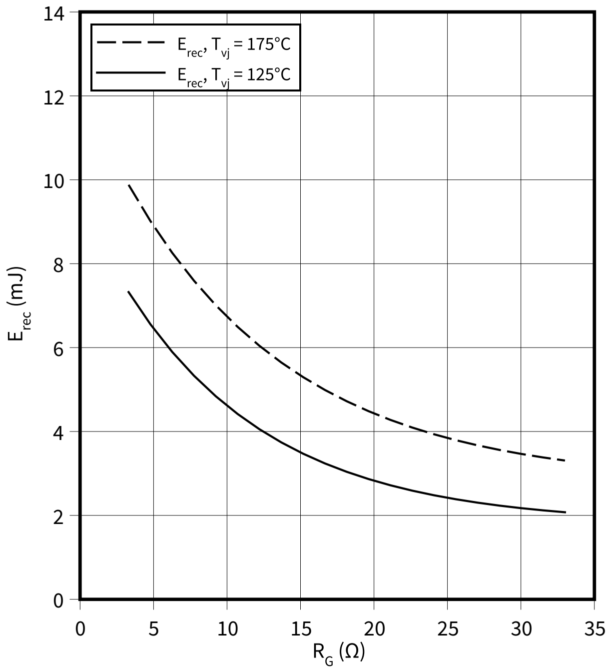
$R_{Gon} = 3.3\ \Omega$, $V_{CE} = 600$ V



switching losses (typical), Diode, Inverter

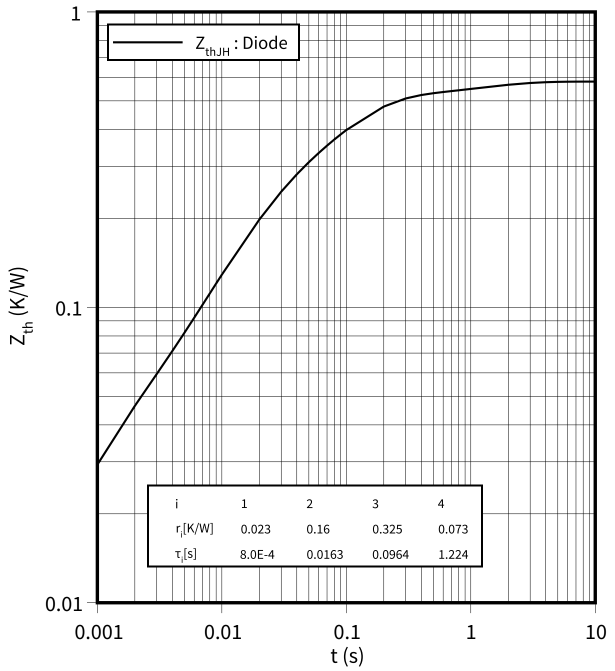
$E_{rec} = f(R_G)$

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



transient thermal impedance , Diode, Inverter

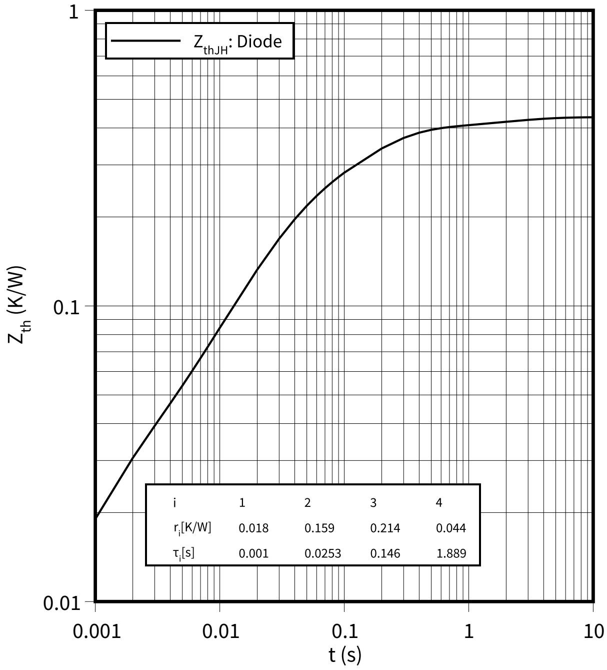
$Z_{th} = f(t)$



i	1	2	3	4
r_i[K/W]	0.023	0.16	0.325	0.073
τ_i[s]	8.0E-4	0.0163	0.0964	1.224

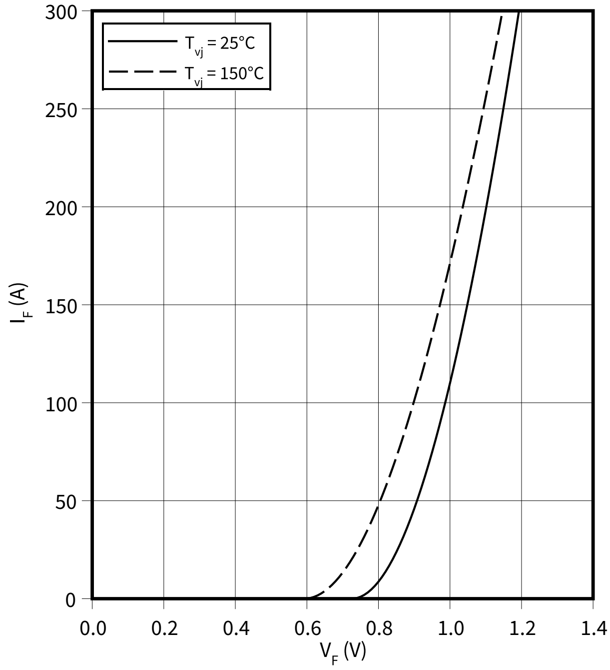
transient thermal impedance , Diode, Rectifier

$Z_{th} = f(t)$



forward characteristic (typical), Diode, Rectifier

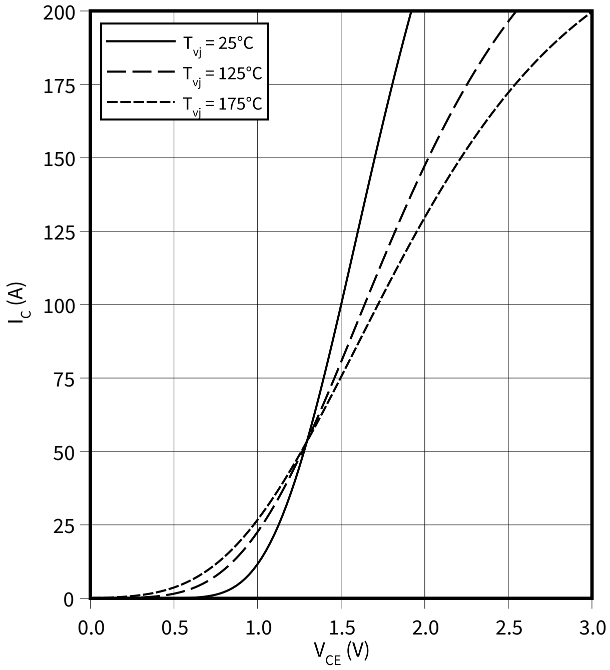
$I_F = f(V_F)$



output characteristic (typical), IGBT, Brake-Chopper

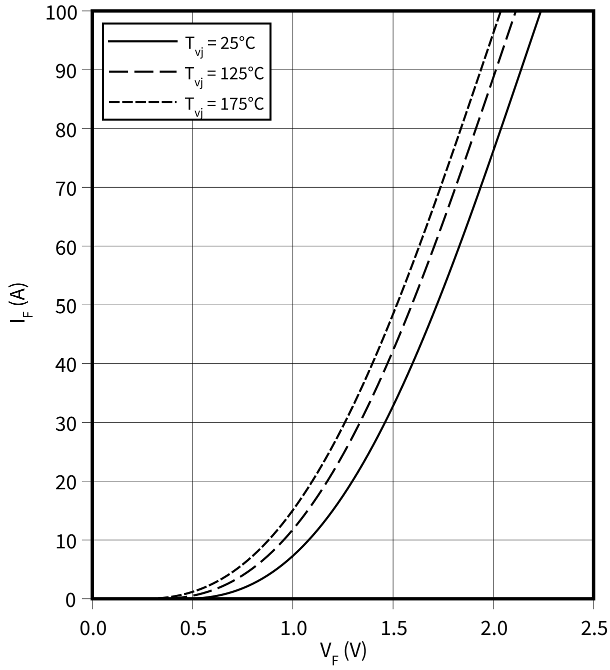
$I_C = f(V_{CE})$

$V_{GE} = 15$ V

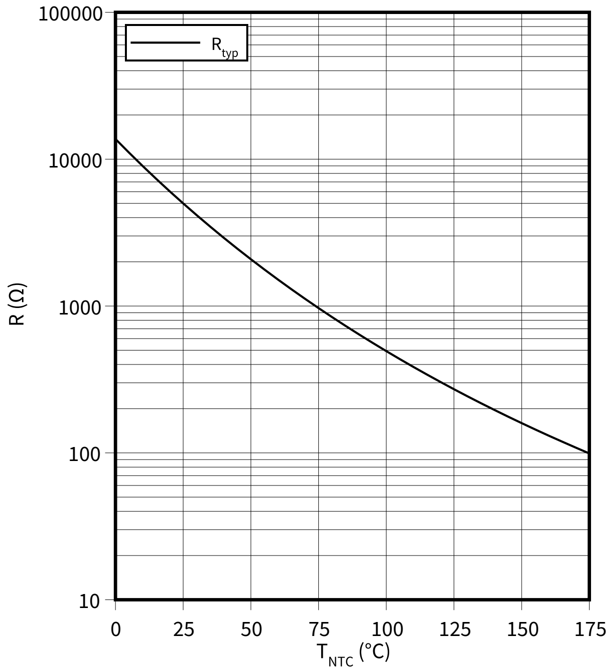


forward characteristic (typical), Diode, Brake-Chopper

$I_F = f(V_F)$



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



9 Circuit diagram

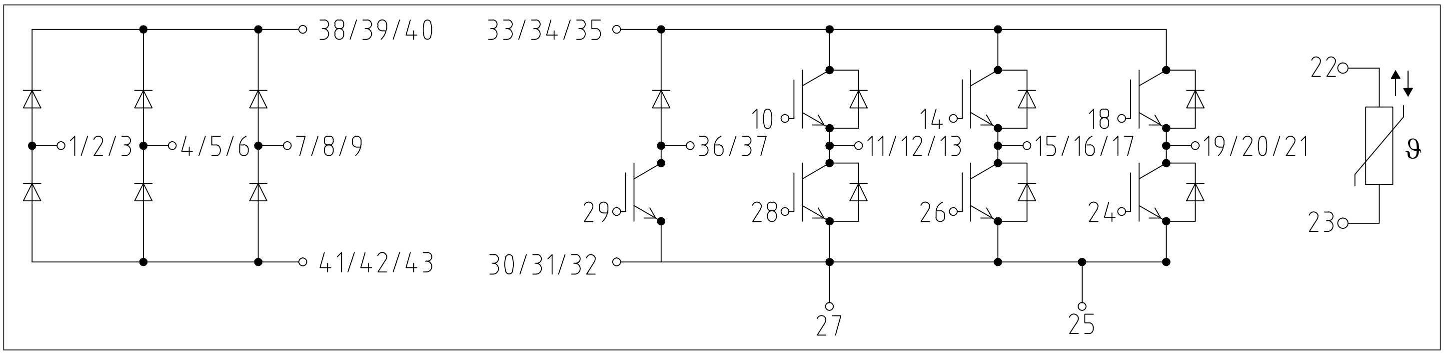


Figure 2

10 Package outlines

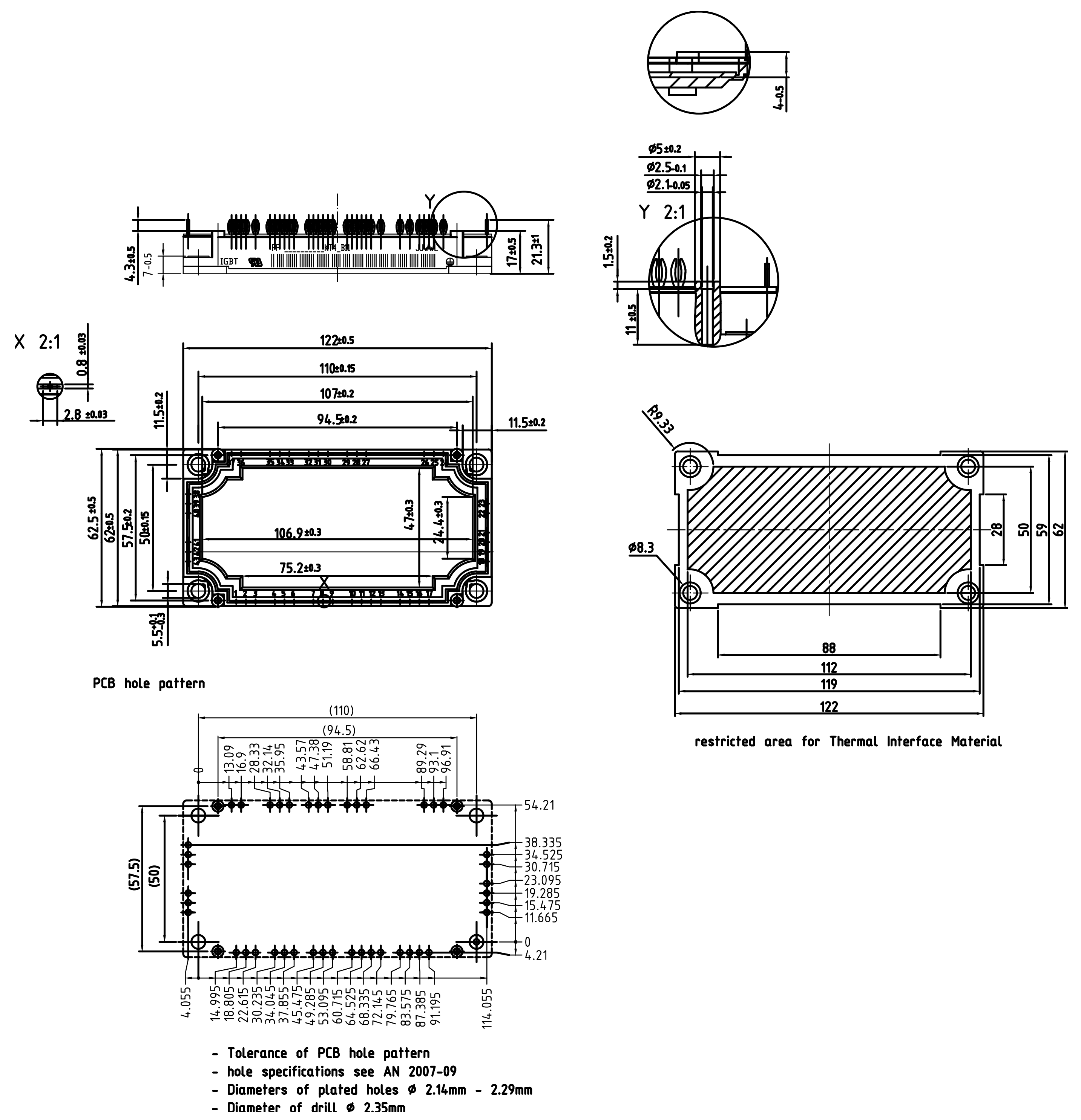


Figure 3

Revision history

Document revision	Date of release	Description of changes
1.00	2021-09-22	Initial version

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