FP50R12N2T7P

EconoPIM™2 module

EconoPIM™2 module with TRENCHSTOP™IGBT7 and emitter controlled 7 diode and NTC / pre-applied thermal interface material

Features

- Electrical features
  - V_{CES} = 1200 V
  - $I_{C\,nom}$ = 50 A / I_{CRM} = 100 A
  - TRENCHSTOP™ IGBT7
  - Low $V_{CE,sat}$
  - Overload operation up to 175°C
- Mechanical features
  - High power and thermal cycling capability
  - Integrated NTC temperature sensor
  - Copper base plate
  - Al_2O_3 substrate with low thermal resistance
  - Pre-applied thermal interface material
  - Solder contact technology

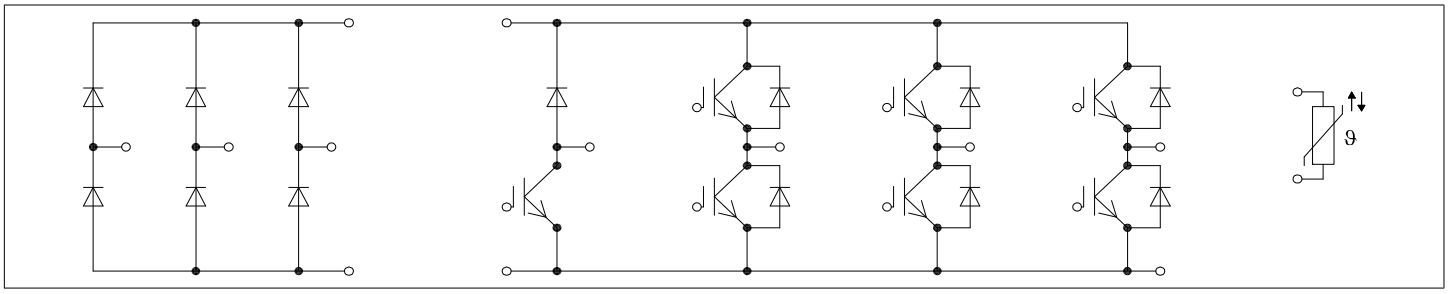
Potential applications

- 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}				35		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	T_H=25°C, per switch			5.5		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_H=25°C, per switch			4.8		mΩ
Storage temperature	T_{stg}			-40		125	°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
Weight	*G*				180		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

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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_H = 90 °C	50	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 = 1 ms	100	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 = 50 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 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			0.92		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			11.1		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.039		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 = 50 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 7.5 Ω	T_{vj} = 25 °C		0.059		µs
			T_{vj} = 125 °C		0.061		
			T_{vj} = 175 °C		0.062		
Rise time (inductive load)	t_r	I_C = 50 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 7.5 Ω	T_{vj} = 25 °C		0.043		µs
			T_{vj} = 125 °C		0.047		
			T_{vj} = 175 °C		0.049		
Turn-off delay time (inductive load)	t_{doff}	I_C = 50 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 7.5 Ω	T_{vj} = 25 °C		0.290		µs
			T_{vj} = 125 °C		0.380		
			T_{vj} = 175 °C		0.420		
Fall time (inductive load)	t_f	I_C = 50 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 7.5 Ω	T_{vj} = 25 °C		0.110		µs
			T_{vj} = 125 °C		0.200		
			T_{vj} = 175 °C		0.270		
Turn-on energy loss per pulse	E_{on}	I_C = 50 A, V_{CE} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 7.5 Ω, di/dt = 900 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		5.07		mJ
			T_{vj} = 125 °C		6.76		
			T_{vj} = 175 °C		7.72		

(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 = 50 A, V_{CE} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 7.5 Ω, dv/dt = 2900 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		3.37		mJ
			T_{vj} = 125 °C		5.31		
			T_{vj} = 175 °C		6.58		
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		190		A
			t_P ≤ 7 µs, T_{vj}=175 °C		180		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, Valid with IFX pre-applied Thermal Interface Material				0.777	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			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	465	A^2s
			T_{vj} = 175 °C	420	

Table 6 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		

(table continues...)

Table 6 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Peak reverse recovery current	I_{RM}	I_F = 35 A, V_R = 600 V, V_{GE} = -15 V, -di$_F$/dt = 900 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		31		A
			T_{vj} = 125 °C		39		
			T_{vj} = 175 °C		45		
Recovered charge	Q_r	I_F = 50 A, V_R = 600 V, V_{GE} = -15 V, -di$_F$/dt = 900 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		3.96		µC
			T_{vj} = 125 °C		7.37		
			T_{vj} = 175 °C		9.89		
Reverse recovery energy	E_{rec}	I_F = 50 A, V_R = 600 V, V_{GE} = -15 V, -di$_F$/dt = 900 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		1.31		mJ
			T_{vj} = 125 °C		2.52		
			T_{vj} = 175 °C		3.46		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, Valid with IFX pre-applied Thermal Interface Material				1.13	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 = 60 °C		70	A
Maximum RMS current at rectifier output	I_{RMSM}	T_H = 60 °C		100	A
Surge forward current	I_{FSM}	t_P = 10 ms	T_{vj} = 25 °C	560	A
			T_{vj} = 150 °C	435	
I^{2}t - value	I^2t	t_P = 10 ms	T_{vj} = 25 °C	1570	A^{2}s
			T_{vj} = 150 °C	945	

Table 8 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 50 A	T_{vj} = 150 °C		1.05		V

Table 8 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Reverse current	I_r	T_{vj} = 150 °C, V_R = 1600 V		1		mA
Thermal resistance, junction to heat sink	R_{thJH}	per diode, Valid with IFX pre-applied Thermal Interface Material			1.10	K/W
Temperature under switching conditions	$T_{vj, op}$		-40		150	°C

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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_H = 110 °C	25	A
Repetitive peak collector current	I_{CRM}	t_P = 1 ms		50	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 = 25 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.60	1.85	V
			T_{vj} = 125 °C		1.74		
			T_{vj} = 175 °C		1.82		
Gate threshold voltage	V_{GEth}	I_C = 0.525 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			0.395		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			4.77		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.017		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			0.004	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 = 25 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 9.1 Ω	T_{vj} = 25 °C		0.041		µs
			T_{vj} = 125 °C		0.043		
			T_{vj} = 175 °C		0.044		

Table 10 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Rise time (inductive load)	t_r	I_C = 25 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 9.1 Ω	T_{vj} = 25 °C		0.025		µs
			T_{vj} = 125 °C		0.028		
			T_{vj} = 175 °C		0.030		
Turn-off delay time (inductive load)	t_{doff}	I_C = 25 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 9.1 Ω	T_{vj} = 25 °C		0.230		µs
			T_{vj} = 125 °C		0.320		
			T_{vj} = 175 °C		0.350		
Fall time (inductive load)	t_f	I_C = 25 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 9.1 Ω	T_{vj} = 25 °C		0.140		µs
			T_{vj} = 125 °C		0.220		
			T_{vj} = 175 °C		0.280		
Turn-on energy loss per pulse	E_{on}	I_C = 25 A, V_{CE} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 9.1 Ω, di/dt = 810 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		1.47		mJ
			T_{vj} = 125 °C		2.05		
			T_{vj} = 175 °C		2.39		
Turn-off energy loss per pulse	E_{off}	I_C = 25 A, V_{CE} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 9.1 Ω, dv/dt = 3120 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		1.65		mJ
			T_{vj} = 125 °C		2.58		
			T_{vj} = 175 °C		3.13		
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		90		A
			t_P ≤ 7 µs, T_{vj}=175 °C		85		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, Valid with IFX pre-applied Thermal Interface Material				1.19	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.

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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			25	A

(table continues...)

Table 11 (continued) Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		50	A
I^2t - value	I^2t	V_R = 0 V, t_P = 10 ms	T_{vj} = 125 °C	125	A^2s
			T_{vj} = 175 °C	95	

Table 12 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 25 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.83	2.30	V
			T_{vj} = 125 °C		1.70		
			T_{vj} = 175 °C		1.63		
Peak reverse recovery current	I_{RM}	I_F = 25 A, V_R = 600 V, V_{GE} = -15 V, -di$_F$/dt = 810 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		21.7		A
			T_{vj} = 125 °C		26.7		
			T_{vj} = 175 °C		29.8		
Recovered charge	Q_r	I_F = 25 A, V_R = 600 V, V_{GE} = -15 V, -di$_F$/dt = 810 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		1.69		µC
			T_{vj} = 125 °C		3.29		
			T_{vj} = 175 °C		4.29		
Reverse recovery energy	E_{rec}	I_F = 25 A, V_R = 600 V, V_{GE} = -15 V, -di$_F$/dt = 810 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.63		mJ
			T_{vj} = 125 °C		1.28		
			T_{vj} = 175 °C		1.69		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, Valid with IFX pre-applied Thermal Interface Material				1.63	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

(table continues...)

Table 13 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2\text{-}1/(298{,}15\ K))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2\text{-}1/(298{,}15\ K))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2\text{-}1/(298{,}15\ K))]$		3433		K

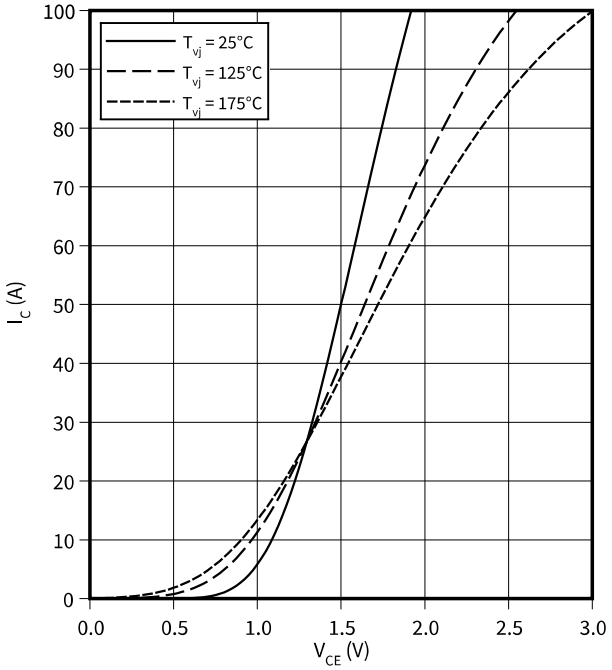
Note: Specification according to the valid application note.

8 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

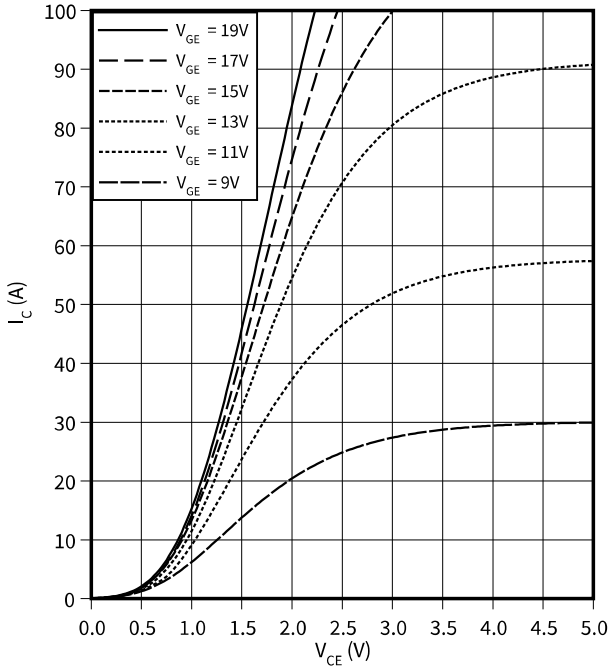
V_{GE} = 15 V



Output characteristic field (typical), IGBT, Inverter

$I_C = f(V_{CE})$

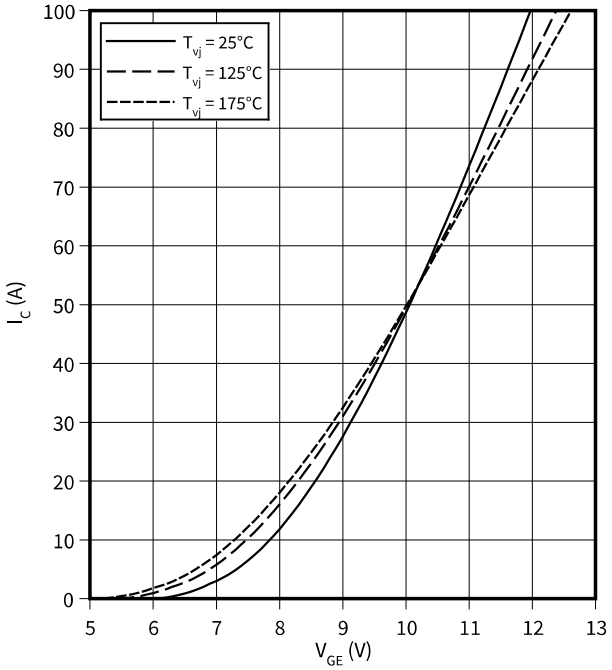
T_{vj} = 175 °C



Transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

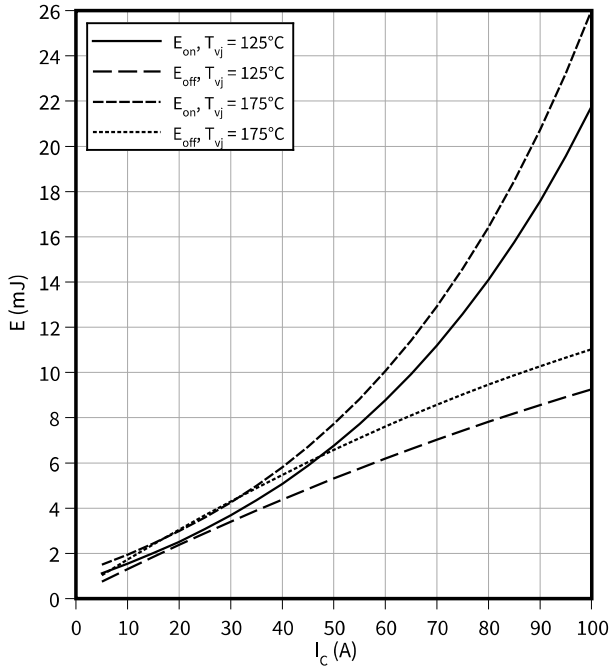
V_{CE} = 20 V



Switching losses (typical), IGBT, Inverter

$E = f(I_C)$

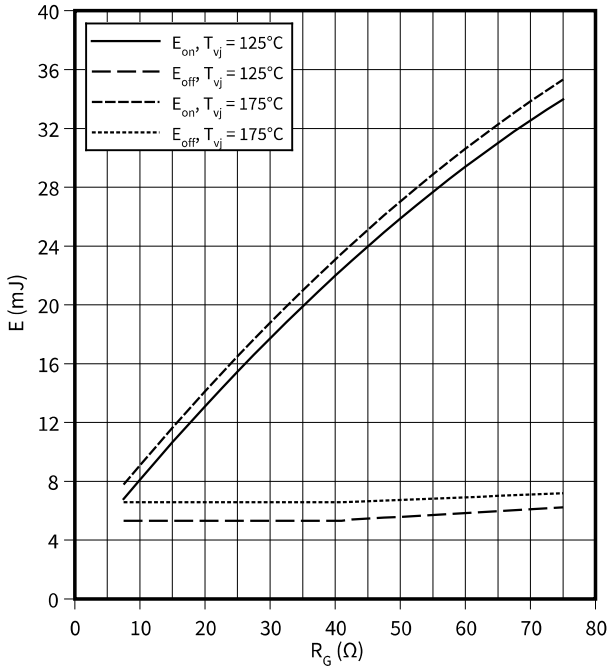
R_{Goff} = 7.5 Ω, R_{Gon} = 7.5 Ω, V_{CE} = 600 V, V_{GE} = ± 15 V



Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

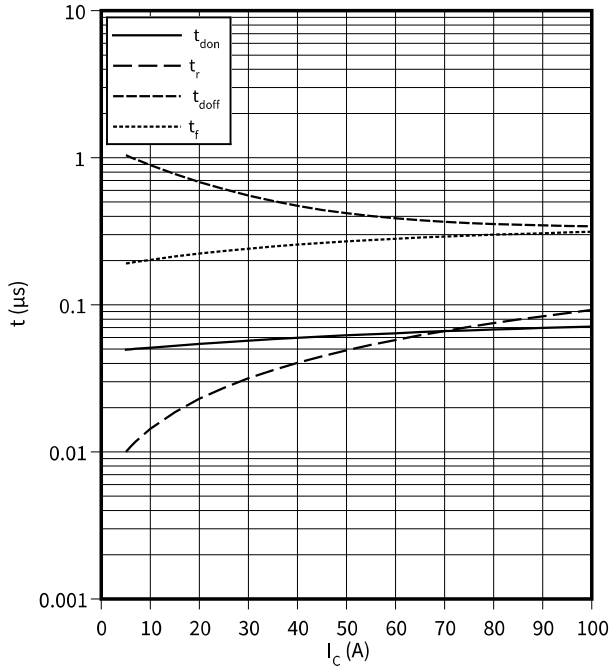
$I_C = 50\ A$, $V_{CE} = 600\ V$, $V_{GE} = \pm 15\ V$



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

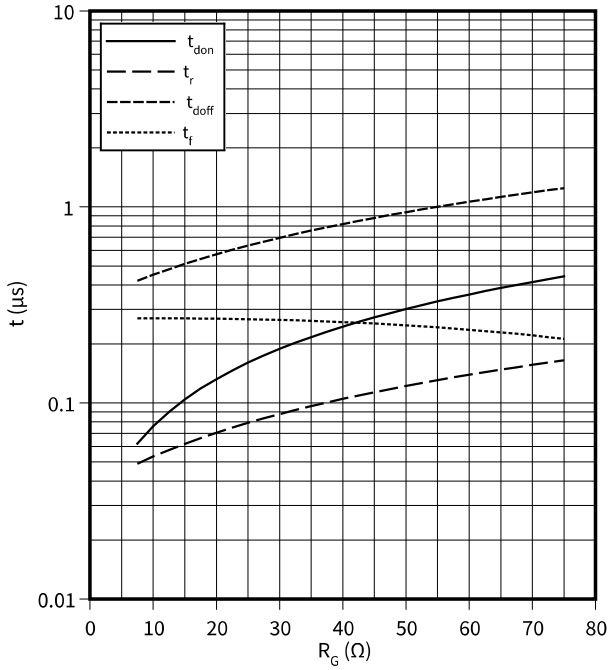
$R_{Goff} = 7.5\ \Omega$, $R_{Gon} = 7.5\ \Omega$, $V_{CE} = 600\ V$, $V_{GE} = \pm 15\ V$, $T_{vj} = 175\ °C$



Switching times (typical), IGBT, Inverter

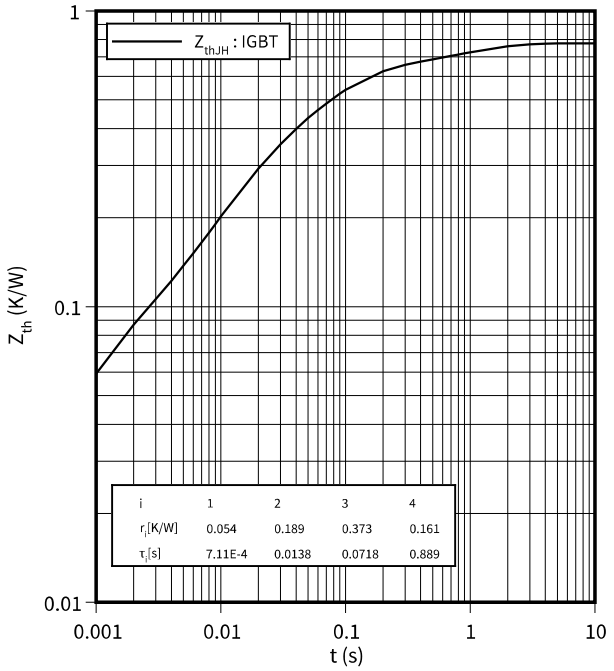
$t = f(R_G)$

$I_C = 50\ A$, $V_{CE} = 600\ V$, $V_{GE} = \pm 15\ V$, $T_{vj} = 175\ °C$



Transient thermal impedance , IGBT, Inverter

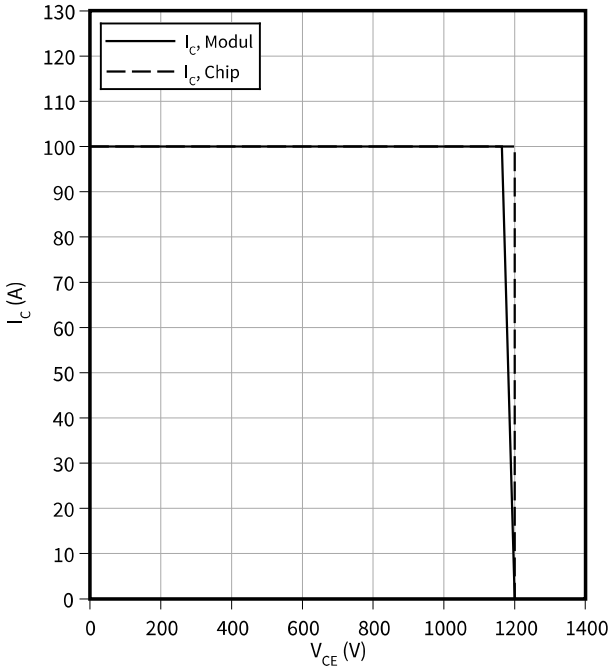
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

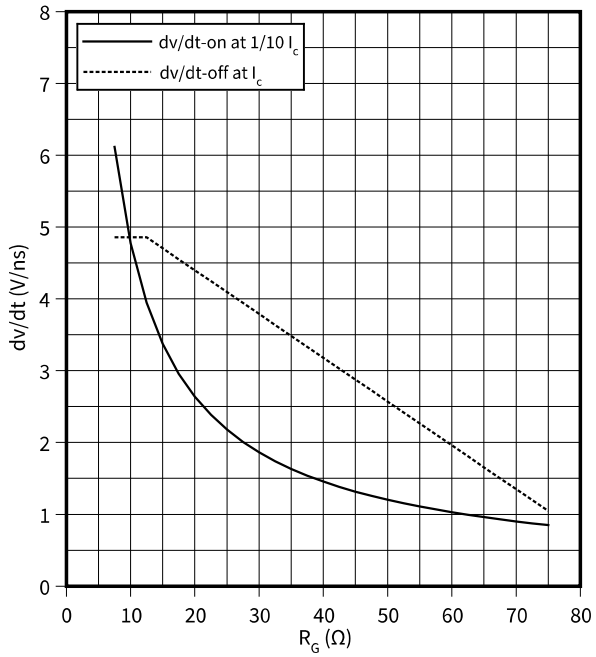
$R_{Goff} = 7.5\ \Omega$, $V_{GE} = \pm 15$ V, $T_{vj} = 175$ °C



Voltage slope (typical), IGBT, Inverter

$dv/dt = f(R_G)$

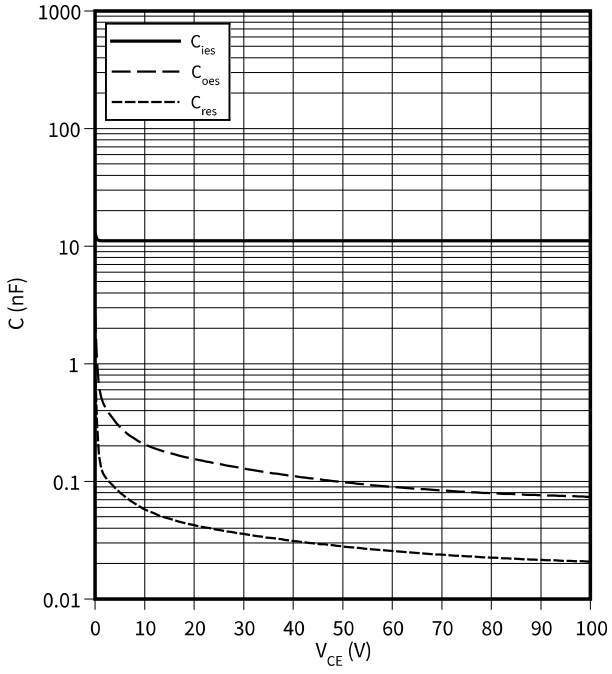
$I_C = 50$ A, $V_{CE} = 600$ V, $V_{GE} = \pm 15$ V, $T_{vj} = 25$ °C



Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

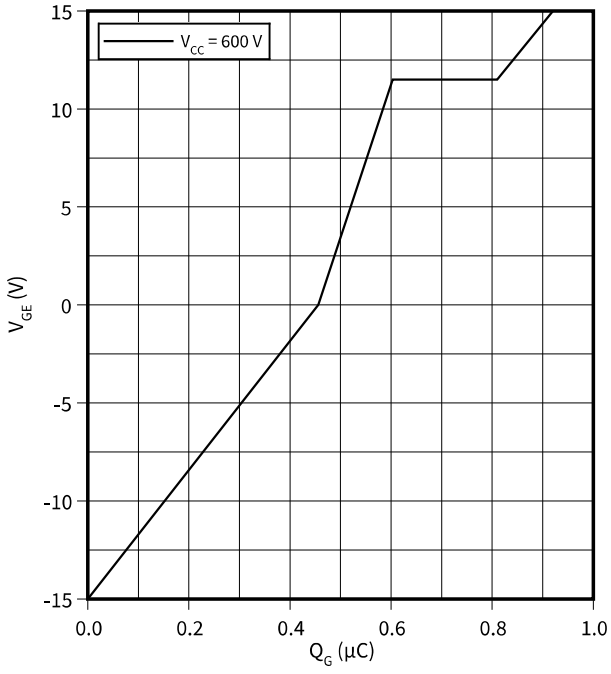
$f = 100$ kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



Gate charge characteristic (typical), IGBT, Inverter

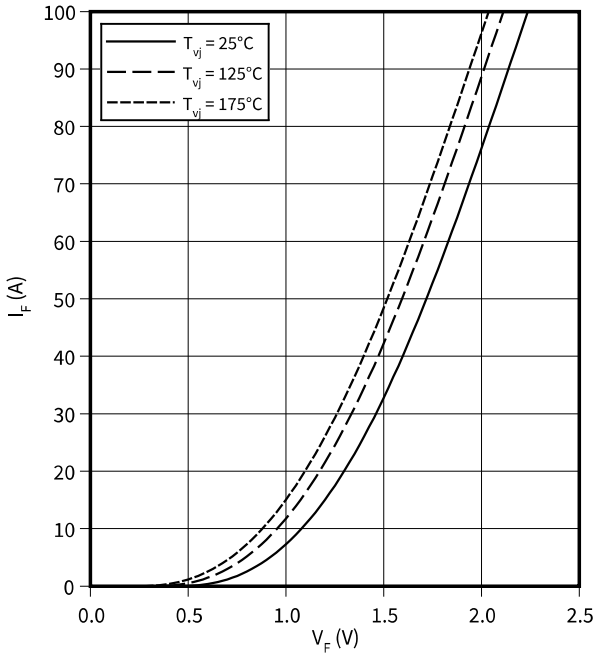
$V_{GE} = f(Q_G)$

$I_C = 50$ A, $T_{vj} = 25$ °C



Forward characteristic (typical), Diode, Inverter

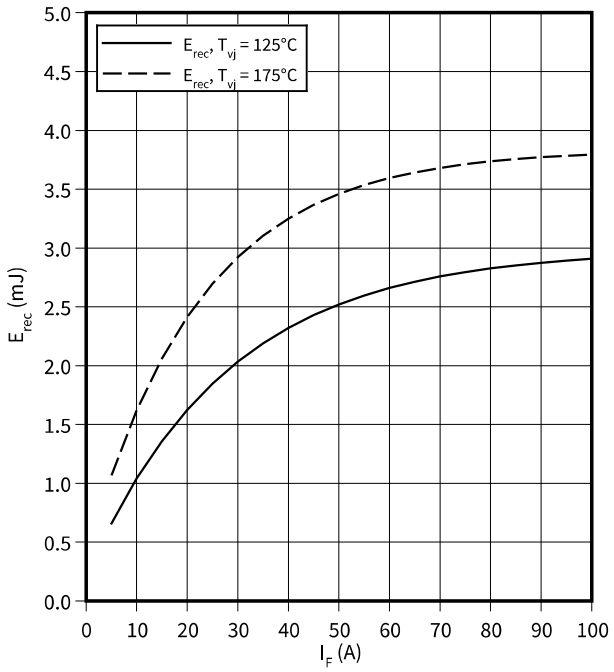
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

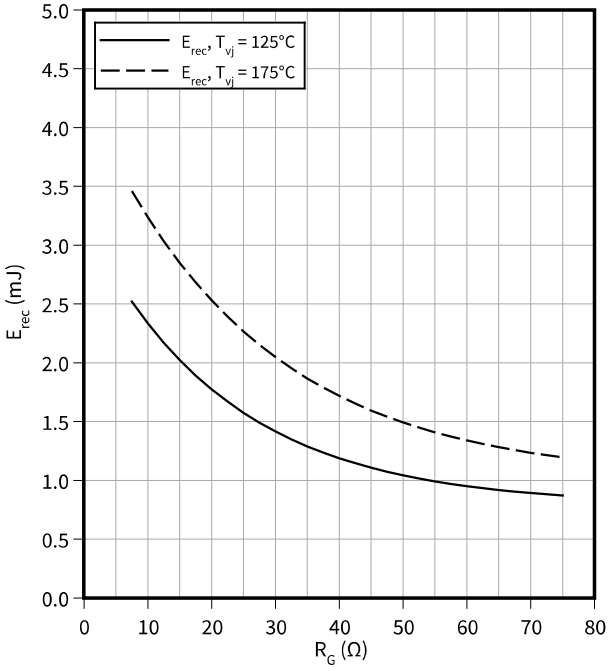
$V_{CE} = 600\ V$, $R_{Gon} = 7.5\ \Omega$



Switching losses (typical), Diode, Inverter

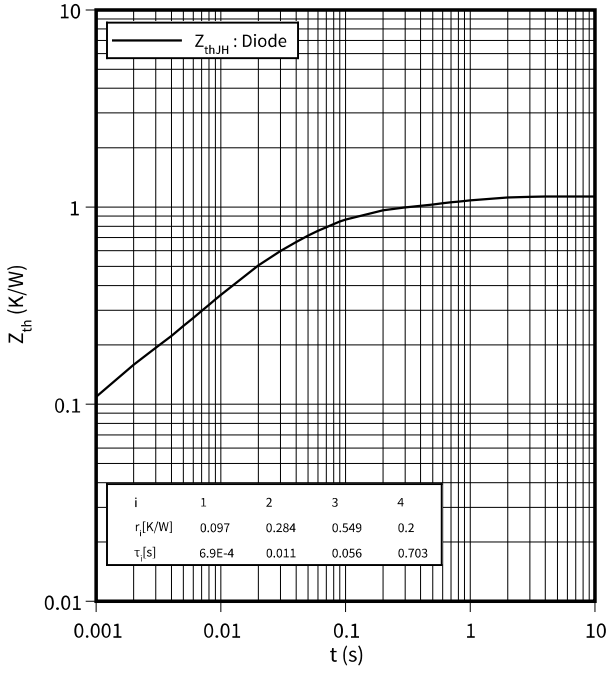
$E_{rec} = f(R_G)$

$V_{CE} = 600\ V$, $I_F = 50\ A$



Transient thermal impedance, Diode, Inverter

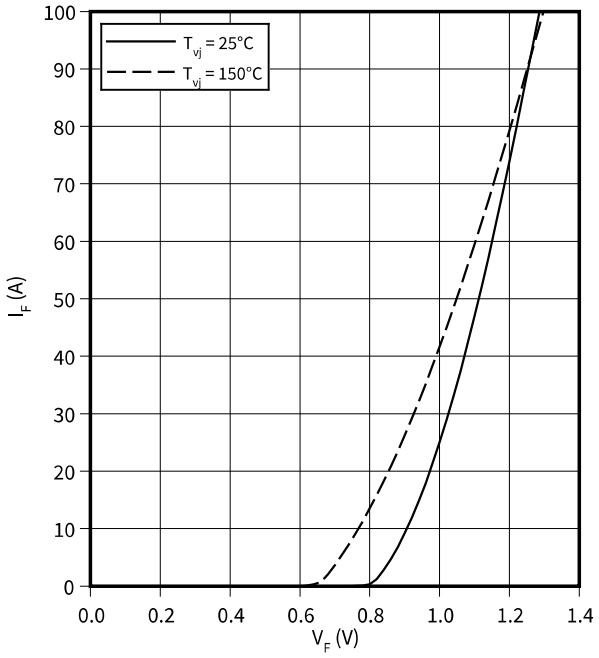
$Z_{th} = f(t)$



8 Characteristics diagrams

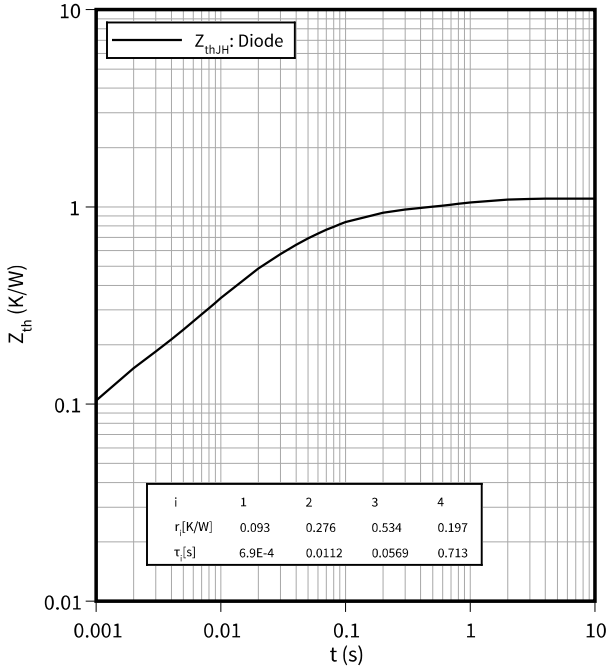
Forward characteristic (typical), Diode, Rectifier

$I_F = f(V_F)$



Transient thermal impedance, Diode, Rectifier

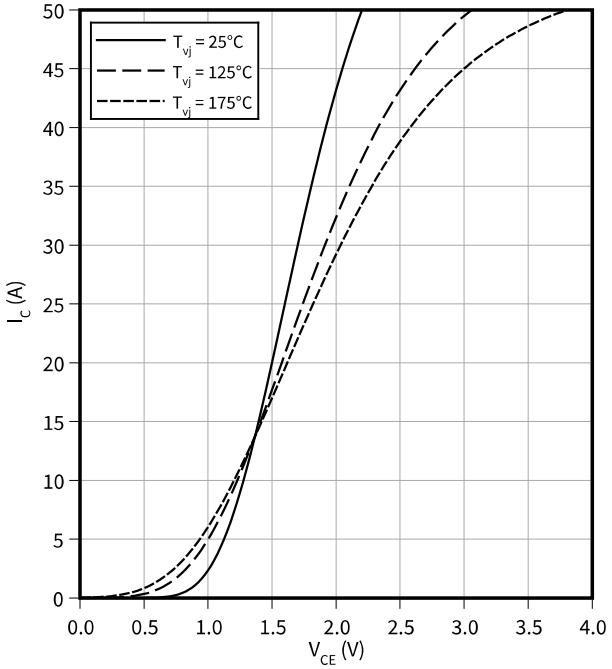
$Z_{th} = f(t)$



Output characteristic (typical), IGBT-Chopper

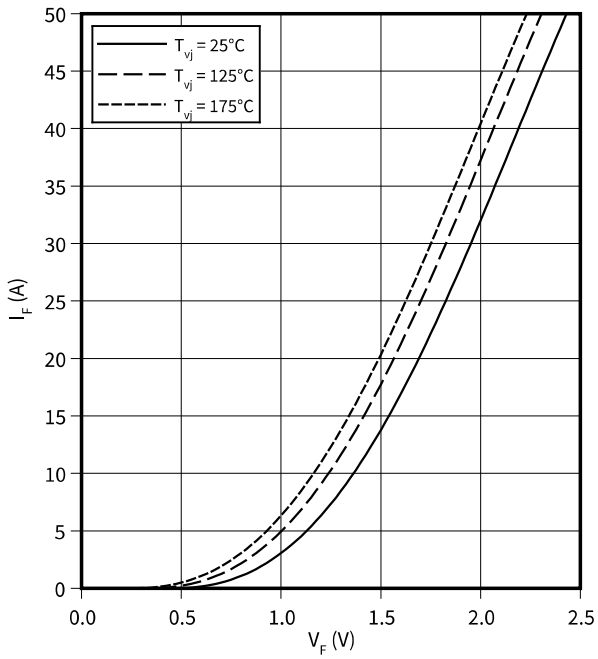
$I_C = f(V_{CE})$

$V_{GE} = 15\ V$



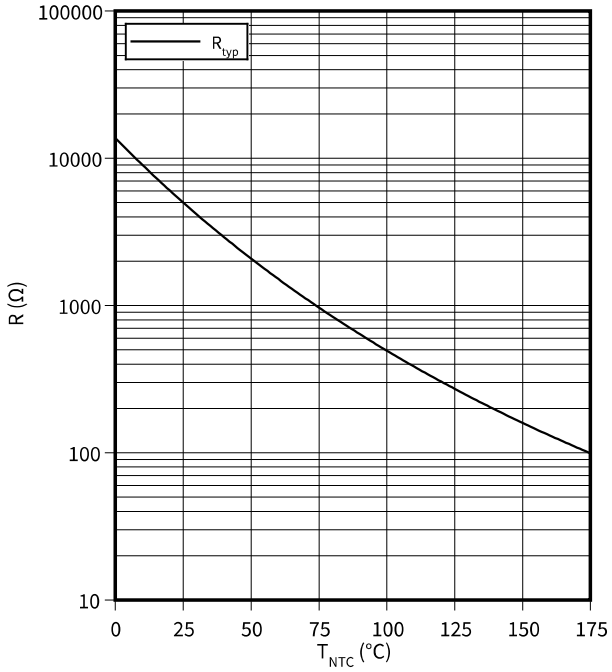
Forward characteristic (typical), Diode, Chopper

$I_F = f(V_F)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



9 Circuit diagram

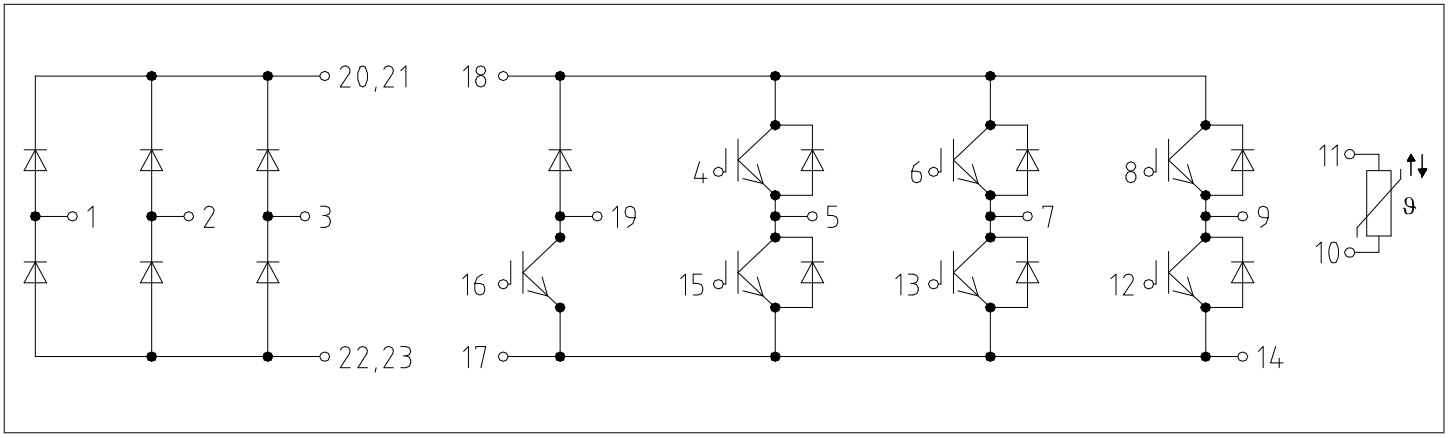


Figure 1

10 Package outlines

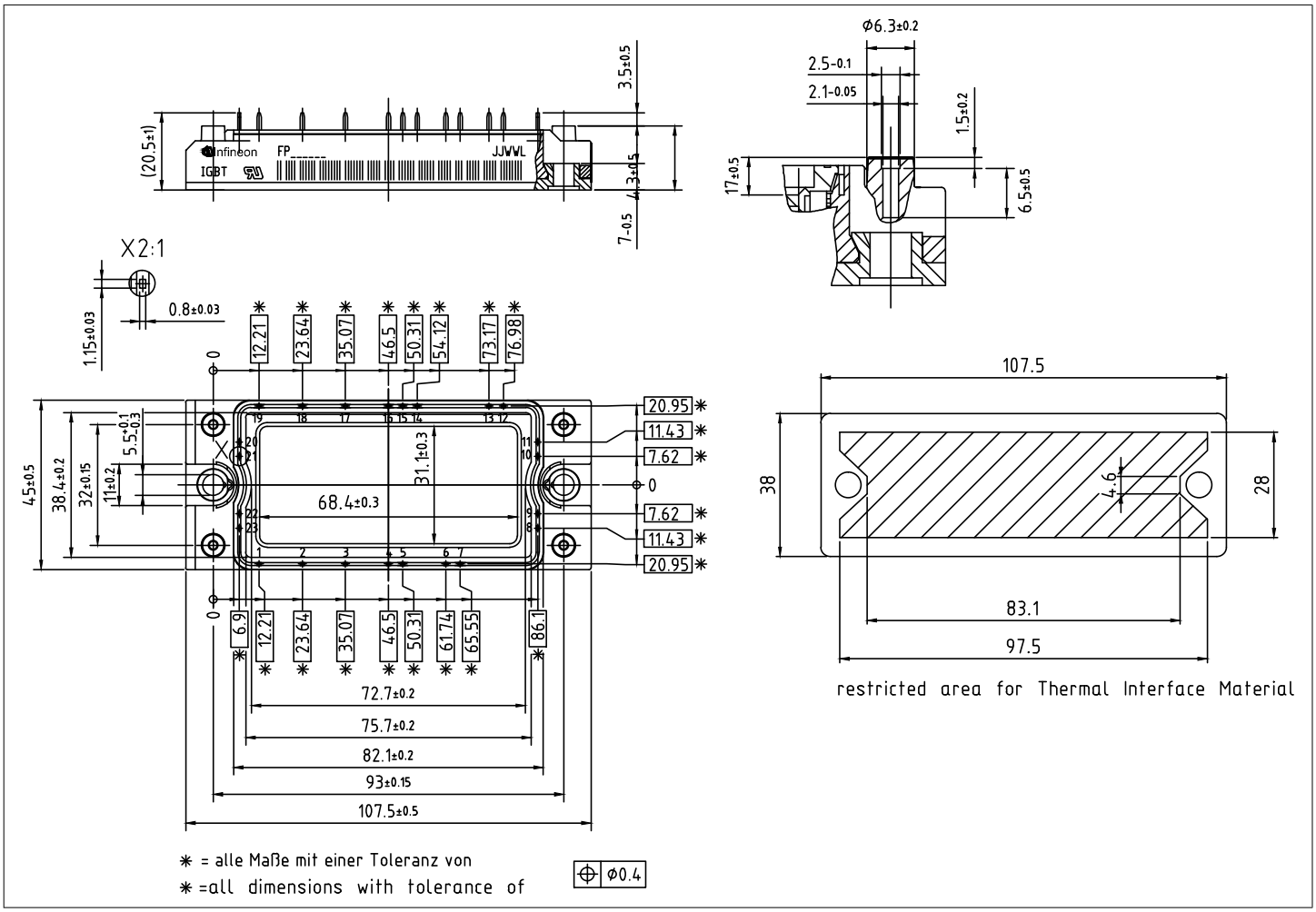


Figure 2

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	 7154914284655054991530		 7154914284655054991530

Figure 3

Revision history

Document revision	Date of release	Description of changes
1.00	2022-02-01	Initial version

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