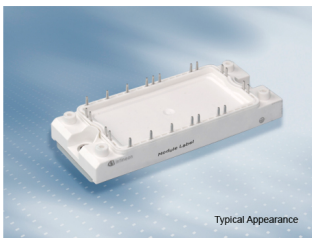
Preliminary

EconoPIM™2 module with TRENCHSTOP™IGBT7 and Emitter Controlled 7 diode and NTC

Features



- Electrical features
  - TRENCHSTOP™ IGBT7
  - Overload operation up to 175°C
  - Low V_{CEsat}
- Mechanical features
  - Integrated NTC temperature sensor
  - Copper base plate
  - High power and thermal cycling capability
  - Al_2O_3 substrate with low thermal resistance

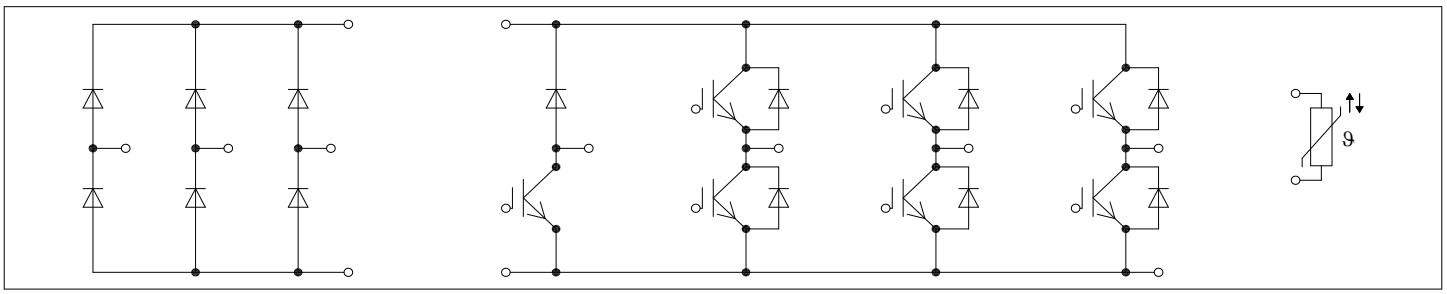
Potential applications

- 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
Comperative 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}			35		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	T_C=25°C, per switch		6.9		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_C=25°C, per switch		5.9		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting torque for modul mounting	*M*	- Mounting according to valid application note M5, Screw	3		6	Nm
Weight	*G*			180		g

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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
Continous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_C = 105 °C	35	A
Repetitive peak collector current	I_{CRM}	t_P = 1 ms		70	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 = 35 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.60	TBD	V
			T_{vj} = 125 °C		1.74		
			T_{vj} = 175 °C		1.82		
Gate threshold voltage	V_{GEth}	I_C = 0.75 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			0.548		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			6.62		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.023		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			0.007	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 = 35 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 8.2 Ω	T_{vj} = 25 °C		0.051		µs
			T_{vj} = 125 °C		0.052		
			T_{vj} = 175 °C		0.053		
Rise time (inductive load)	t_r	I_C = 35 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 8.2 Ω	T_{vj} = 25 °C		0.037		µs
			T_{vj} = 125 °C		0.040		
			T_{vj} = 175 °C		0.042		
Turn-off delay time (inductive load)	t_{doff}	I_C = 35 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 8.2 Ω	T_{vj} = 25 °C		0.250		µs
			T_{vj} = 125 °C		0.330		
			T_{vj} = 175 °C		0.350		

Table 4 Characteristic Values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Fall time (inductive load)	t_f	I_C = 35 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 8.2 Ω	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		0.120 0.220 0.290		µs
Turn-on energy loss per pulse	E_{on}	I_C = 35 A, V_{CE} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 8.2 Ω, di/dt = 725 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		2.9 4 4.66		mJ
Turn-off energy loss per pulse	E_{off}	I_C = 35 A, V_{CE} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 8.2 Ω, dv/dt = 3150 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		2.22 3.58 4.4		mJ
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 t_P ≤ 7 µs, T_{vj} = 175 °C		110 100		A
Thermal resistance, junction to case	R_{thJC}	per IGBT				0.802	K/W
Thermal resistance, case to heatsink	R_{thCH}	per IGBT, λ_{Paste}= 1 W /(m*K) / λ_{grease}= 1 W/(m*K)			0.157		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 5 Maximum Rated Values

Parameter	Symbol	Note or test condition	Values	Unit
Repetitive peak reverse voltage	V_{RRM}	T_{vj} = 25 °C	1200	V

Table 5 Maximum Rated Values (continued)

Parameter	Symbol	Note or test condition		Values	Unit
Continous DC forward current	I_F			35	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		70	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	210	A^2s
			T_{vj} = 175 °C	200	

Table 6 Characteristic Values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 35 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.72	TBD	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 = 35 A, V_{GE} = -15 V, $-di_F/dt$ = 725 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		21		A
			T_{vj} = 125 °C		27		
			T_{vj} = 175 °C		31		
Recovered charge	Q_r	V_R = 600 V, I_F = 35 A, V_{GE} = -15 V, $-di_F/dt$ = 725 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		2.77		µC
			T_{vj} = 125 °C		4.93		
			T_{vj} = 175 °C		6.66		
Reverse recovery energy	E_{rec}	V_R = 600 V, I_F = 35 A, V_{GE} = -15 V, $-di_F/dt$ = 725 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		1.04		mJ
			T_{vj} = 125 °C		1.81		
			T_{vj} = 175 °C		2.47		
Thermal resistance, junction to case	R_{thJC}	per diode				1.10	K/W
Thermal resistance, case to heatsink	R_{thCH}	per diode, λ_{Paste}= 1 W /(m*K) / λ_{grease}= 1 W/(m*K)			0.176		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 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 = 80 °C		70	A
Maximum RMS current at rectifier output	I_{RMSM}	T_C = 80 °C		80	A
Surge forward current	I_{FSM}	t_P = 10 ms	T_{vj} = 25 °C	560	A
			T_{vj} = 150 °C	435	
I^2t - value	I^2t	t_P = 10 ms	T_{vj} = 25 °C	1570	A^2s
			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 = 35 A	T_{vj} = 150 °C		0.95		V
Reverse current	I_r	T_{vj} = 150 °C, V_R = 1600 V			1		mA
Thermal resistance, junction to case	R_{thJC}	per diode				0.963	K/W
Thermal resistance, case to heatsink	R_{thCH}	per diode, λ_{Paste}= 1 W /(m*K) / λ_{grease}= 1 W/(m*K)			0.171		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
Continous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_C = 115 °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	TBD	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		
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		0.023		µs
			T_{vj} = 125 °C		0.027		
			T_{vj} = 175 °C		0.029		
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		0.250		µs
			T_{vj} = 125 °C		0.330		
			T_{vj} = 175 °C		0.360		

Table 10 Characteristic Values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
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 T_{vj} = 125 °C T_{vj} = 175 °C		0.120 0.210 0.270		µs
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 = 795 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		1.19 1.56 1.75		mJ
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 = 3020 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		1.62 2.59 3.2		mJ
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 t_P ≤ 7 µs, T_{vj} = 175 °C		80 75		A
Thermal resistance, junction to case	R_{thJC}	per IGBT				0.967	K/W
Thermal resistance, case to heatsink	R_{thCH}	per IGBT, λ_{Paste}= 1 W /(m*K) / λ_{grease}= 1 W/(m*K)			0.171		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

Table 11 Maximum Rated Values (continued)

Parameter	Symbol	Note or test condition		Values	Unit
Continous DC forward current	I_F			10	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		20	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	30	A^2s
			T_{vj} = 175 °C	25	

Table 12 Characteristic Values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 10 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.72	TBD	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 = 10 A, V_{GE} = -15 V, -di$_F$/dt = 250 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		10		A
			T_{vj} = 125 °C		14		
			T_{vj} = 175 °C		17		
Recovered charge	Q_r	V_R = 600 V, I_F = 10 A, V_{GE} = -15 V, -di$_F$/dt = 250 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.95		µC
			T_{vj} = 125 °C		1.85		
			T_{vj} = 175 °C		2.44		
Reverse recovery energy	E_{rec}	V_R = 600 V, I_F = 10 A, V_{GE} = -15 V, -di$_F$/dt = 250 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.39		mJ
			T_{vj} = 125 °C		0.83		
			T_{vj} = 175 °C		1.09		
Thermal resistance, junction to case	R_{thJC}	per diode				1.81	K/W
Thermal resistance, case to heatsink	R_{thCH}	per diode, λ_{Paste}= 1 W /(m*K) / λ_{grease}= 1 W/(m*K)			0.181		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	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2\text{-}1/(298{,}15\ K))]$		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

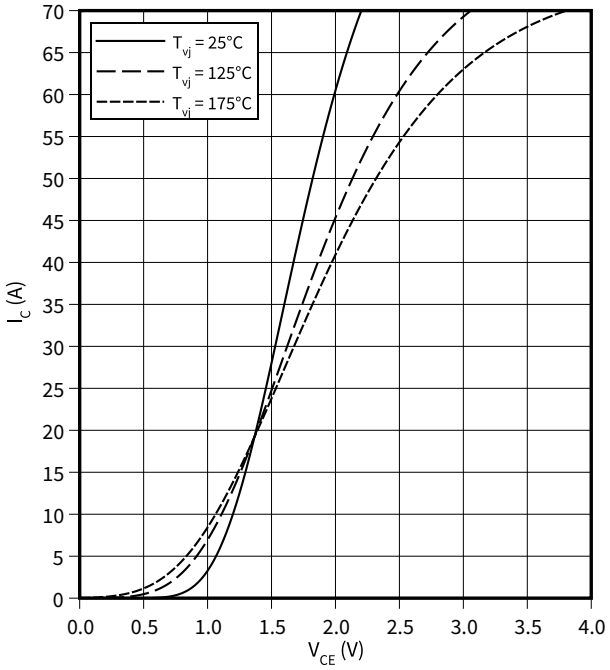
Note: Specification according to the valid application note.

8 Characteristics diagrams

output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

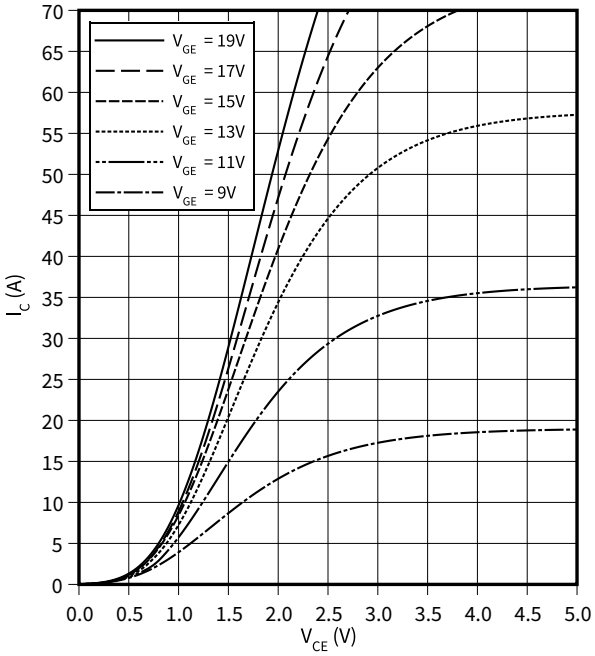
$V_{GE} = 15$ V



output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

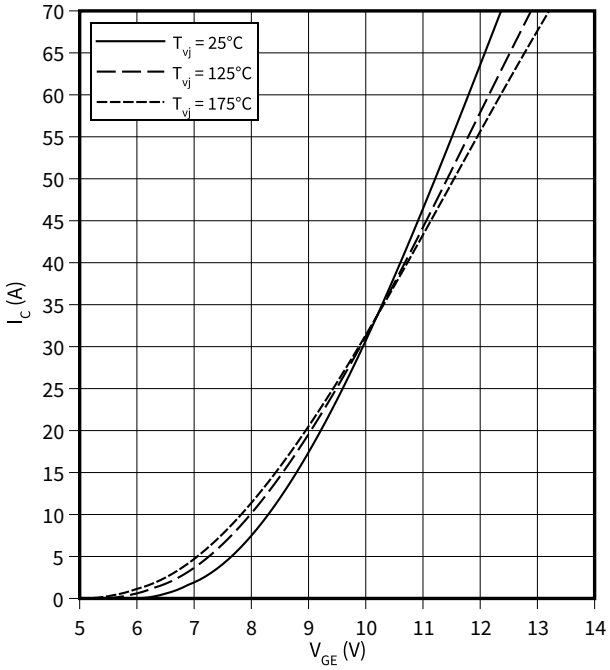
$T_{vj} = 175$ °C



transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

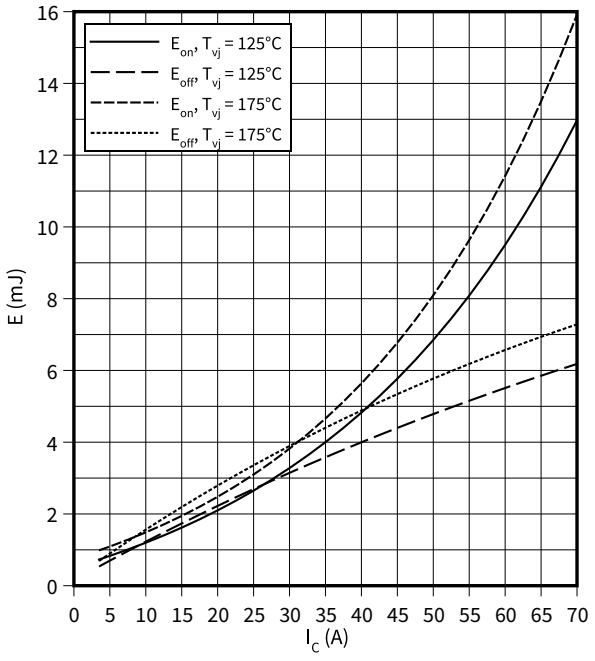
$V_{CE} = 20$ V



switching losses (typical), IGBT, Inverter

$E = f(I_C)$

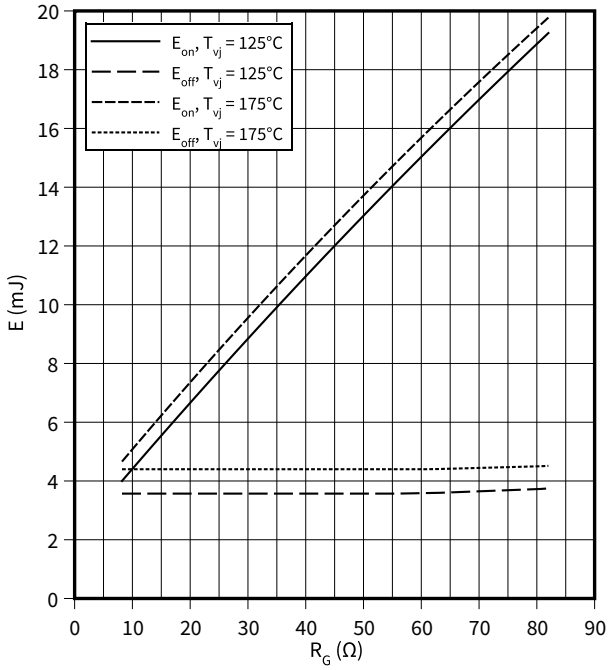
$R_{Goff} = 8.2\ \Omega$, $R_{Gon} = 8.2\ \Omega$, $V_{CE} = 600$ V, $V_{GE} = \pm 15$ V



switching losses (typical), IGBT, Inverter

E = f(R_G)

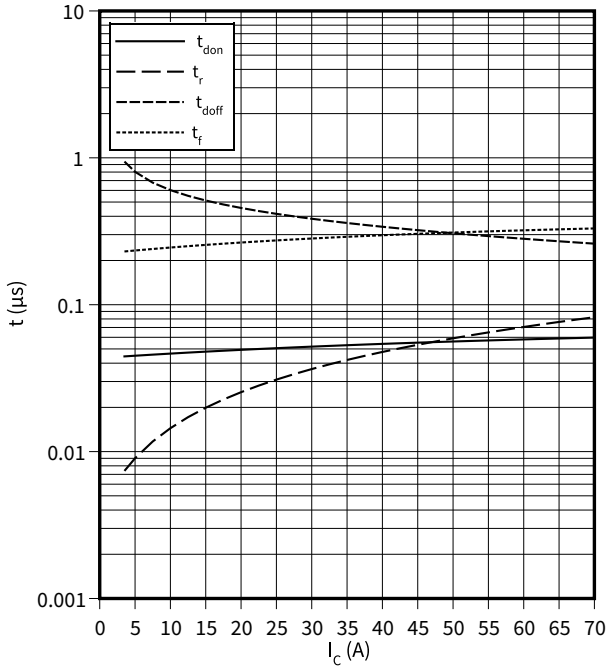
I_C = 35 A, V_{CE} = 600 V, V_{GE} = ± 15 V



switching times (typical), IGBT, Inverter

t = f(I_C)

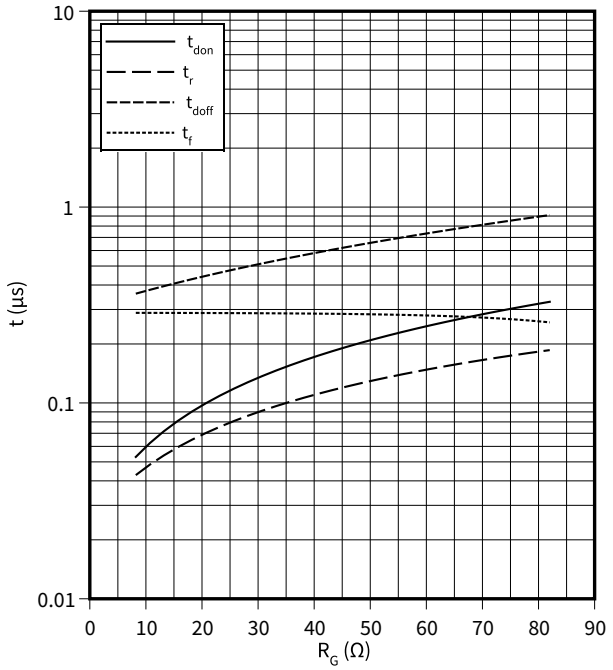
R_{Goff} = 8.2 Ω, R_{Gon} = 8.2 Ω, V_{CE} = 600 V, V_{GE} = ± 15 V, T_{vj} = 175 °C



switching times (typical), IGBT, Inverter

t = f(R_G)

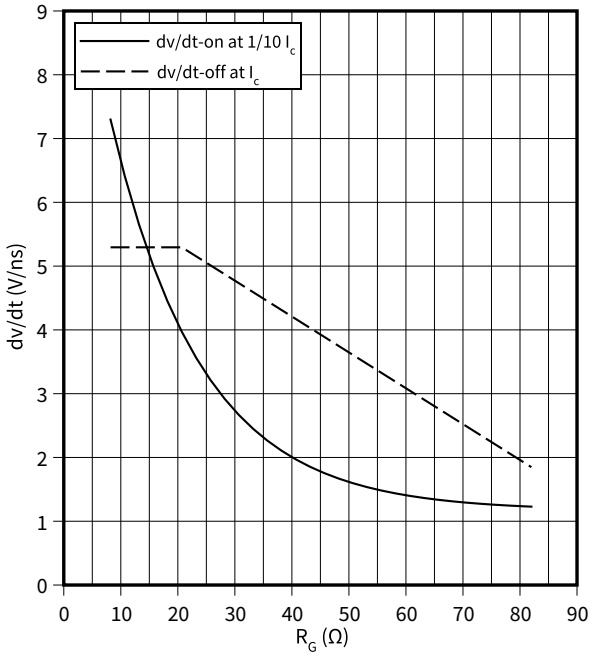
I_C = 35 A, V_{CE} = 600 V, V_{GE} = ± 15 V, T_{vj} = 175 °C



dv/dt (typical), IGBT, Inverter

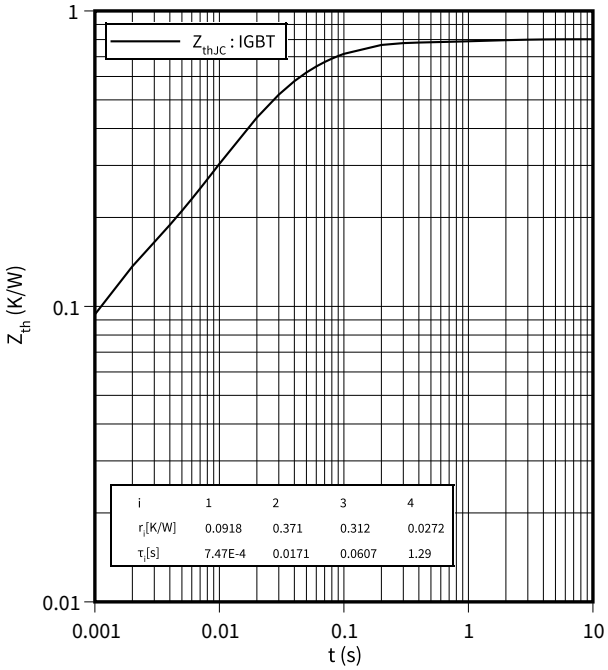
dv/dt = f(R_G)

I_C = 35 A, V_{CE} = 600 V, V_{GE} = ±15 V, T_{vj} = 25 °C



transient thermal impedance , IGBT, Inverter

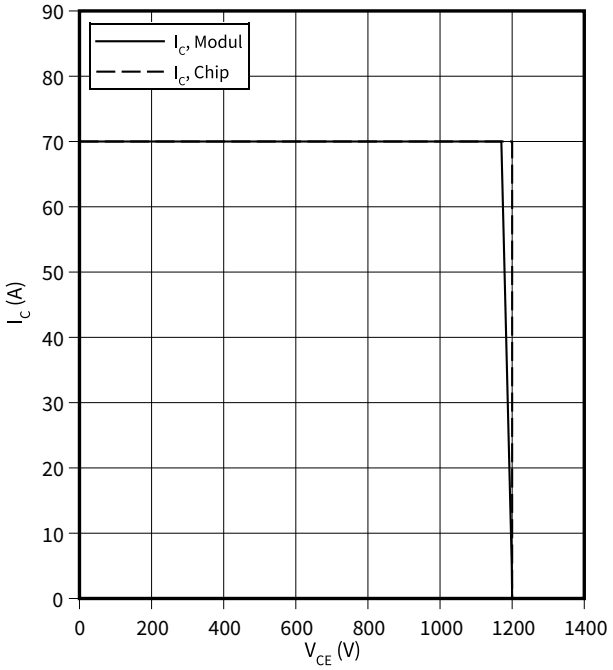
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

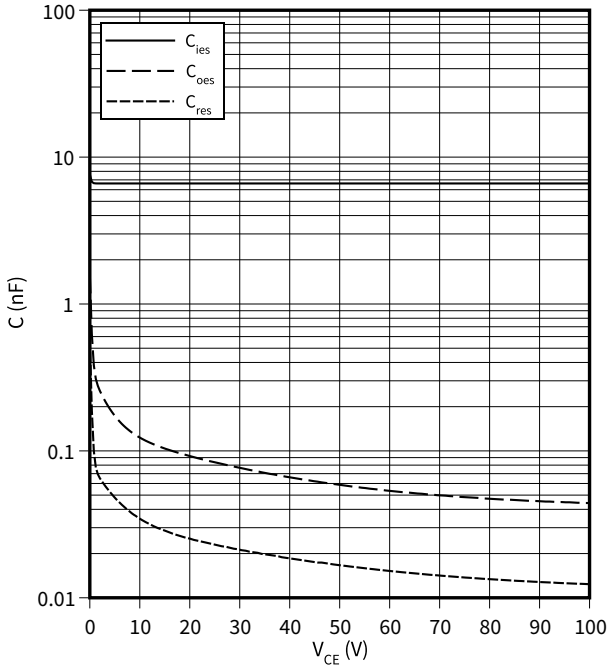
$R_{Goff} = 8.2\ \Omega$, $V_{GE} = \pm 15$ V, $T_{vj} = 175$ °C



capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

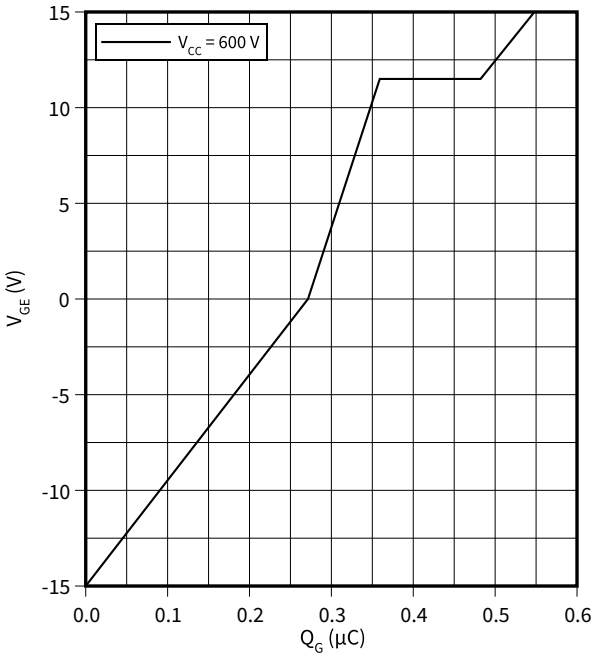
$f = 100$ kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



gate charge characteristic (typical), IGBT, Inverter

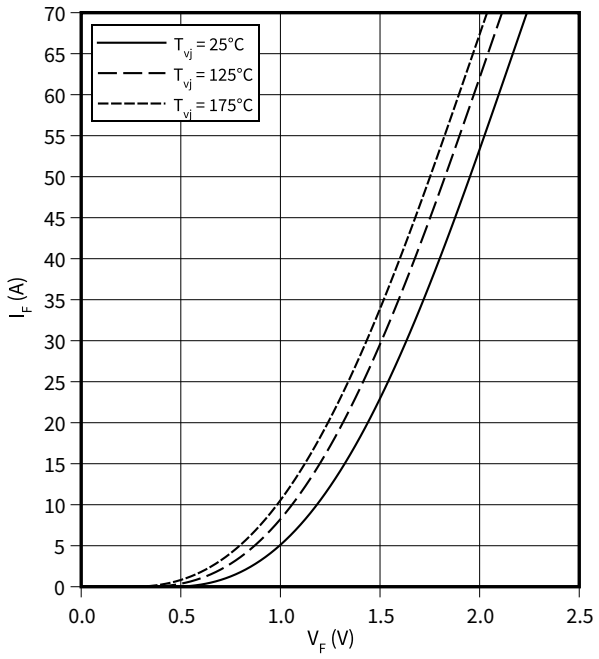
$V_{GE} = f(Q_G)$

$I_C = 35$ A, $T_{vj} = 25$ °C



forward characteristic (typical), Diode, Inverter

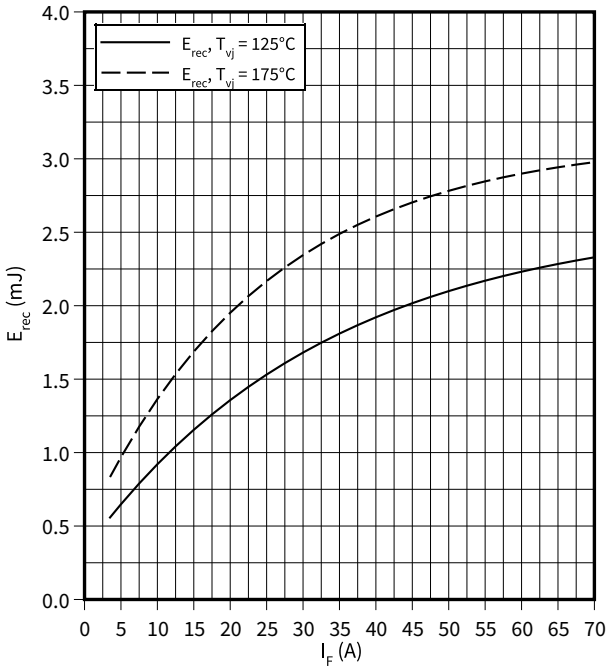
$I_F = f(V_F)$



switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

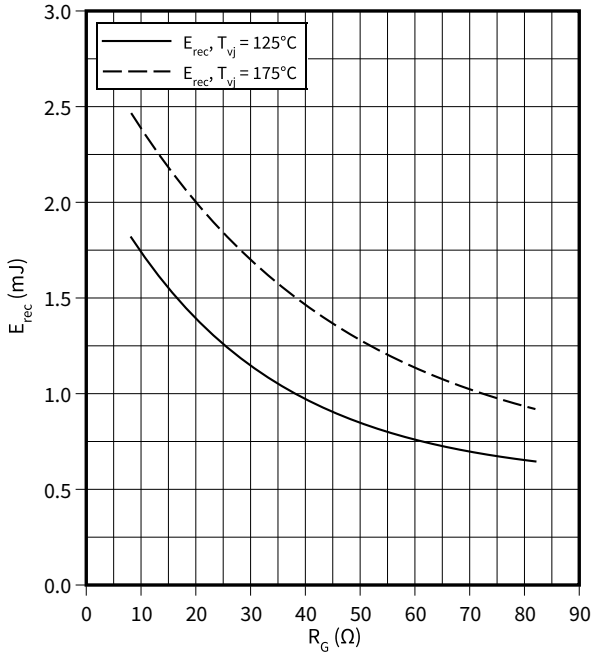
$R_{Gon} = 8.2\ \Omega$, $V_{CE} = 600\ V$



switching losses (typical), Diode, Inverter

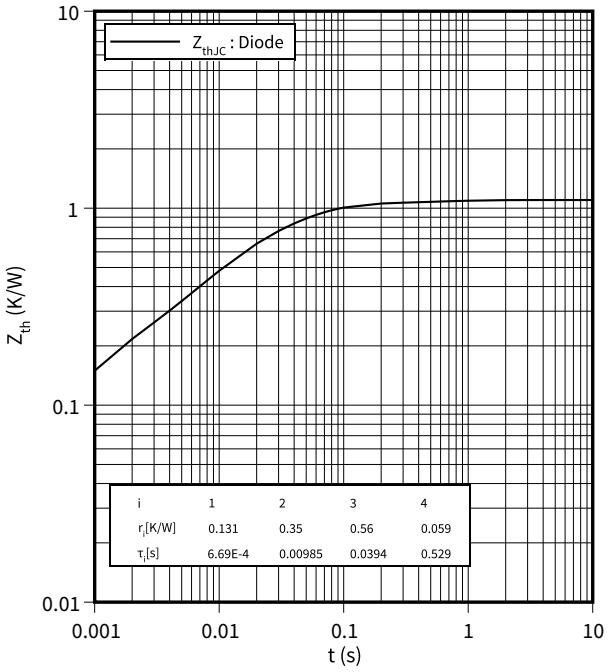
$E_{rec} = f(R_G)$

$V_{CE} = 600\ V$, $I_F = 35\ A$

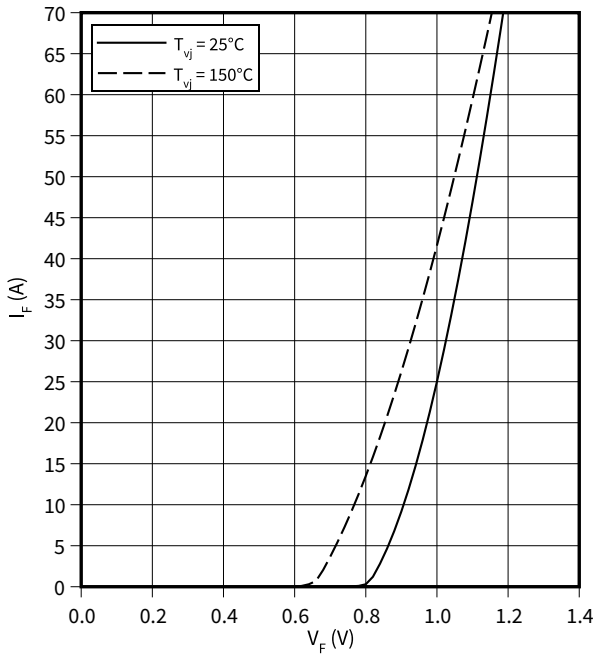


transient thermal impedance , Diode, Inverter

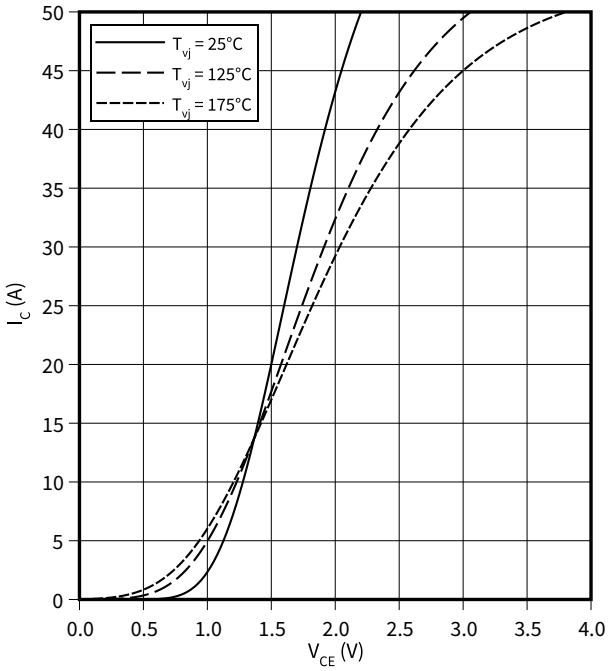
$Z_{th} = f(t)$



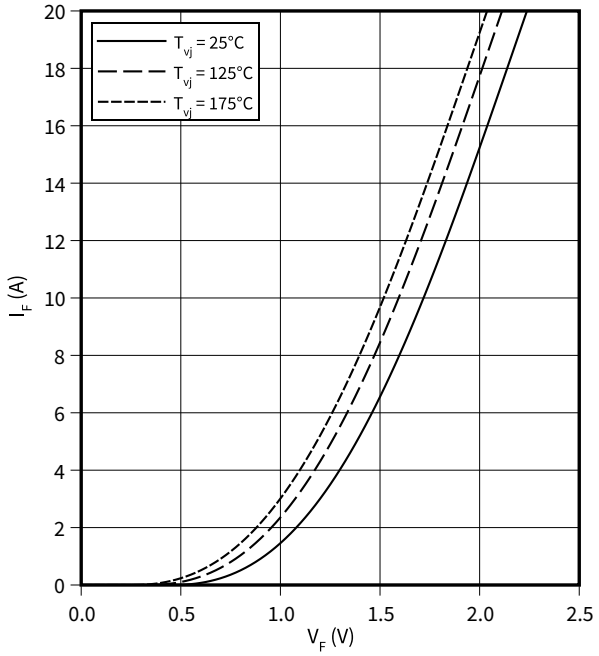
forward characteristic (typical), Diode, Rectifier
$I_F = f(V_F)$



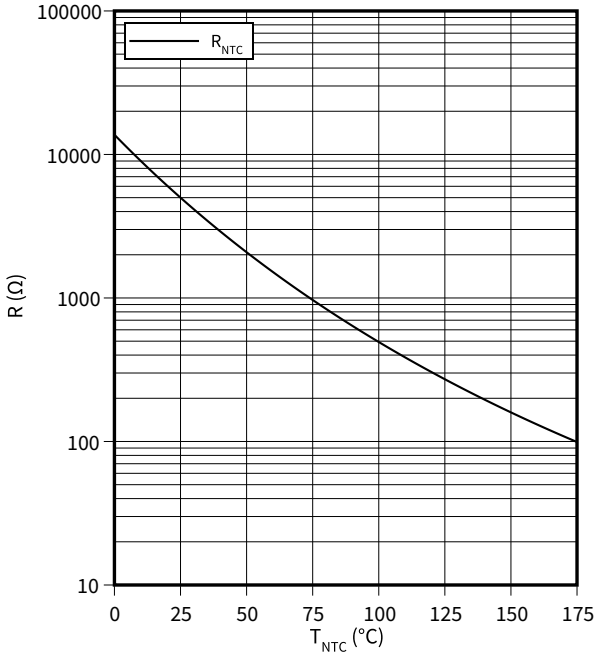
output characteristic (typical), IGBT-Chopper
$I_C = f(V_{CE})$
$V_{GE} = 15\ V$



forward characteristic (typical), Diode, Chopper
$I_F = f(V_F)$



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



9 Circuit diagram

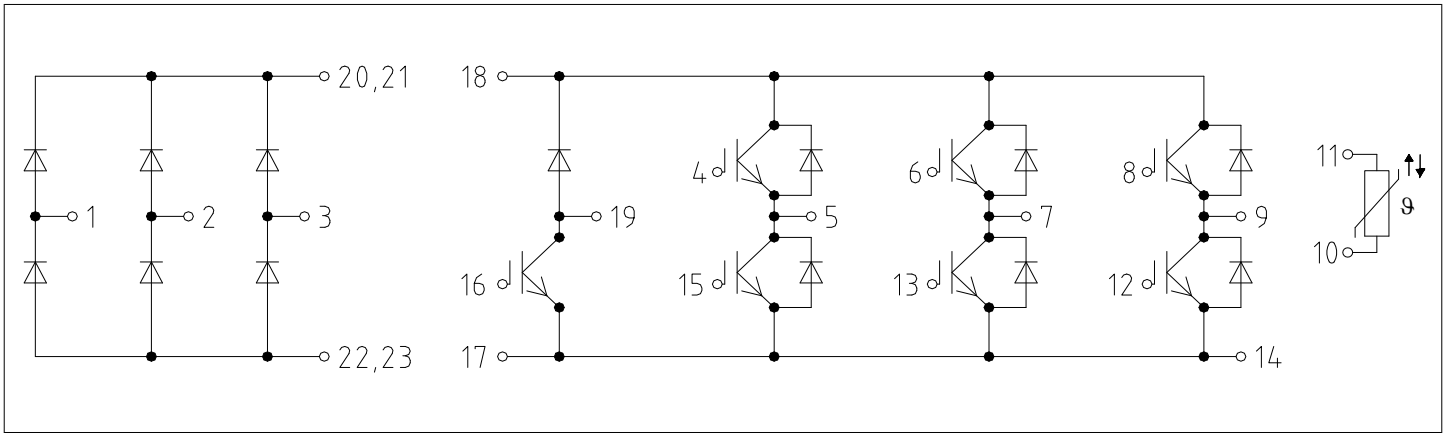


Figure 2

10 Package outlines

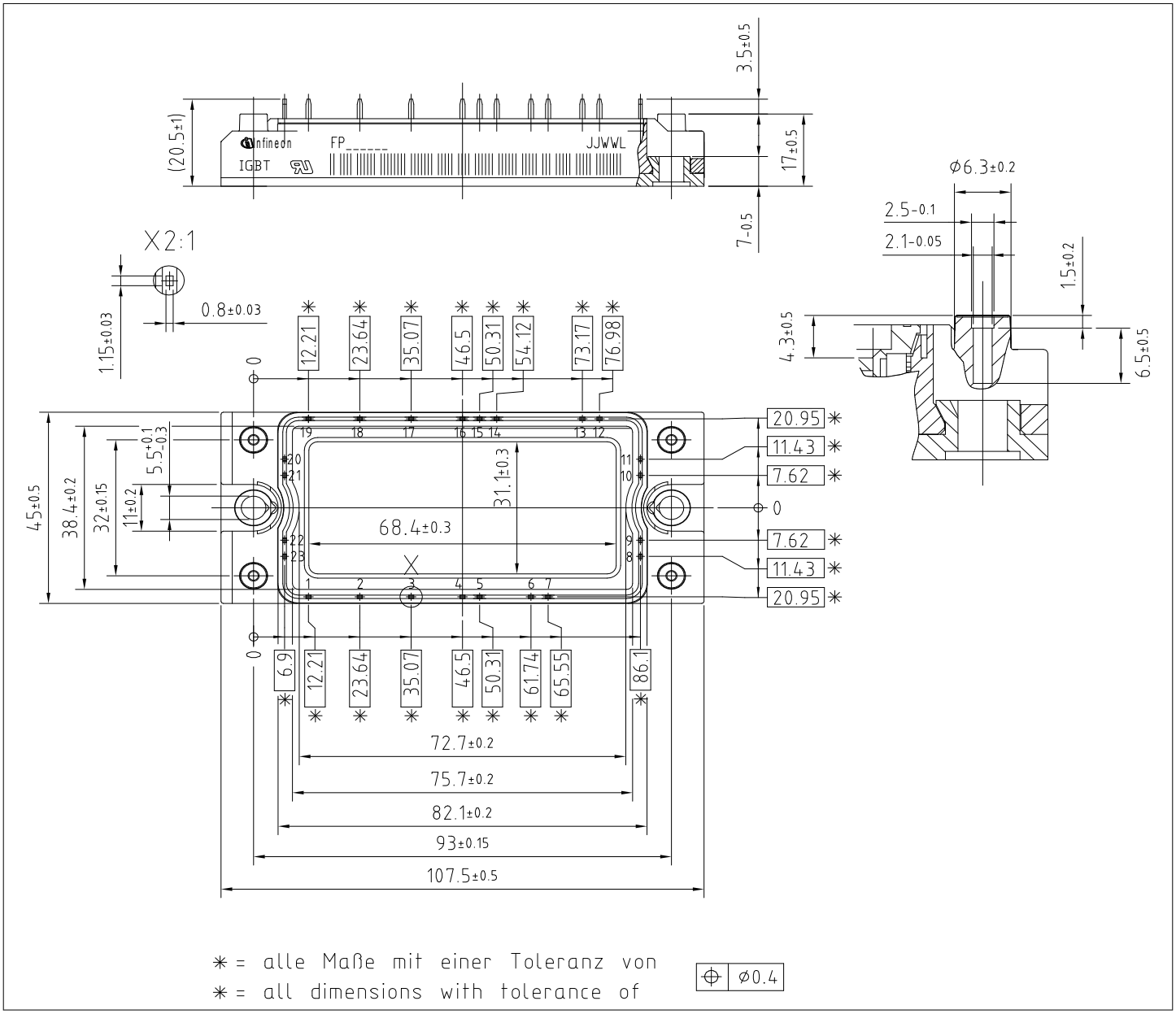


Figure 3

11 Module label code

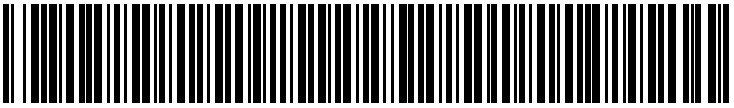
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Digit* 1 – 5 6 - 11 12 - 19 20 – 21 22 – 23	*Example* 71549 142846 55054991 15 30
Example	 71549142846550549911530	 71549142846550549911530	

Figure 4

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