EconoPIM™3 module with Trench/Fieldstop IGBT4 and emitter controlled diode and NTC

Features


Typical appearance

- Electrical features
  - V_{CES} = 1700 V
  - $I_{C\ nom}$ = 75 A / I_{CRM} = 150 A
  - Low $V_{CE,sat}$
  - Trench IGBT 4
  - $V_{CE,sat}$ with positive temperature coefficient
  - 2.2 kV rectifier diodes
- Mechanical features
  - Solder contact technology
  - Standard housing
  - Integrated NTC temperature sensor
  - Isolated base plate

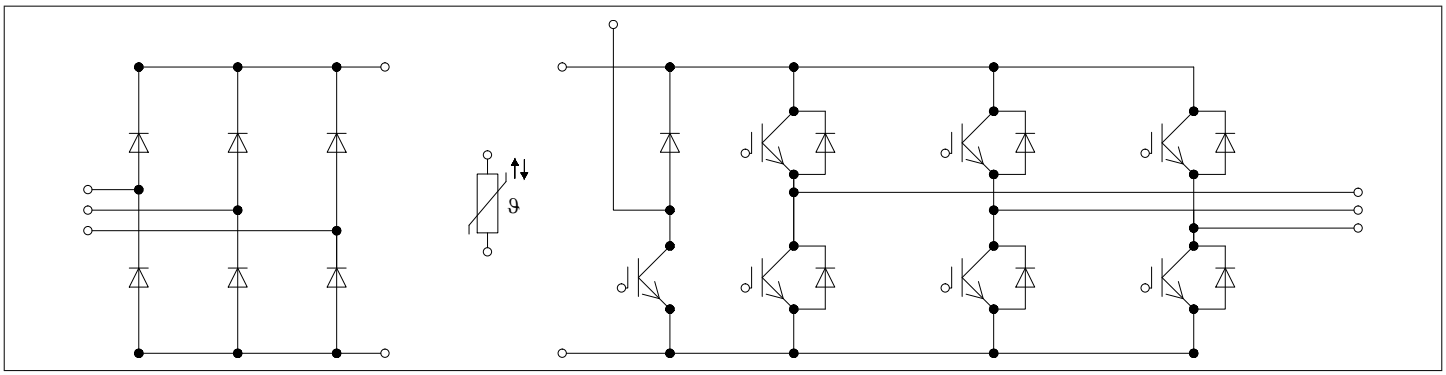
Potential applications

- Motor 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* = 60 s	3.4	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}				40		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	T_C=25°C, per switch			3		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_C=25°C, per switch			4		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	1700	V
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_C = 100 °C	75	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		150	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 = 75 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.95	2.30	V
			T_{vj} = 125 °C		2.35		
			T_{vj} = 150 °C		2.45		
Gate threshold voltage	V_{GEth}	I_C = 3 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.25	5.80	6.35	V
Gate charge	Q_G	V_{GE} = ±15 V, V_{CC} = 900 V			0.9		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			8.5		Ω
Input capacitance	C_{ies}	f = 1000 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			6.8		nF
Reverse transfer capacitance	C_{res}	f = 1000 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.22		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1700 V, V_{GE} = 0 V	T_{vj} = 25 °C			1	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 = 75 A, V_{CC} = 900 V, V_{GE} = ±15 V, R_{Gon} = 4.3 Ω	T_{vj} = 25 °C		0.230		µs
			T_{vj} = 125 °C		0.250		
			T_{vj} = 150 °C		0.260		
Rise time (inductive load)	t_r	I_C = 75 A, V_{CC} = 900 V, V_{GE} = ±15 V, R_{Gon} = 4.3 Ω	T_{vj} = 25 °C		0.036		µs
			T_{vj} = 125 °C		0.040		
			T_{vj} = 150 °C		0.045		
Turn-off delay time (inductive load)	t_{doff}	I_C = 75 A, V_{CC} = 900 V, V_{GE} = ±15 V, R_{Goff} = 4.3 Ω	T_{vj} = 25 °C		0.460		µs
			T_{vj} = 125 °C		0.600		
			T_{vj} = 150 °C		0.640		
Fall time (inductive load)	t_f	I_C = 75 A, V_{CC} = 900 V, V_{GE} = ±15 V, R_{Goff} = 4.3 Ω	T_{vj} = 25 °C		0.080		µs
			T_{vj} = 125 °C		0.150		
			T_{vj} = 150 °C		0.160		
Turn-on energy loss per pulse	E_{on}	I_C = 75 A, V_{CC} = 900 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 4.3 Ω, di/dt = 2150 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		13.1		mJ
			T_{vj} = 125 °C		18.8		
			T_{vj} = 150 °C		20.2		
Turn-off energy loss per pulse	E_{off}	I_C = 75 A, V_{CC} = 900 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 4.3 Ω, dv/dt = 3000 V/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		14.7		mJ
			T_{vj} = 125 °C		25.2		
			T_{vj} = 150 °C		28.4		
SC data	I_{SC}	V_{GE} ≤ 15 V, V_{CC} = 1000 V, V_{CEmax}=V_{CES}-L_{sCE}*di/dt	t_P ≤ 10 µs, T_{vj} ≤ 150 °C		350		A

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to case	R_{thJC}	per IGBT			0.327	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, λ_{grease} = 1 W/(m·K)		0.0678		K/W
Temperature under switching conditions	$T_{vj\,op}$		-40		150	°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	1700	V
Continuous DC forward current	I_F			75	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		150	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	1350	A^2s
			T_{vj} = 150 °C	1150	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 75 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.80	2.20	V
			T_{vj} = 125 °C		1.90		
			T_{vj} = 150 °C		1.95		
Peak reverse recovery current	I_{RM}	V_{CC} = 900 V, I_F = 75 A, V_{GE} = -15 V, -di$_F$/dt = 2150 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		105		A
			T_{vj} = 125 °C		125		
			T_{vj} = 150 °C		130		
Recovered charge	Q_r	V_{CC} = 900 V, I_F = 75 A, V_{GE} = -15 V, -di$_F$/dt = 2150 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		13.5		µC
			T_{vj} = 125 °C		25.4		
			T_{vj} = 150 °C		29.4		
Reverse recovery energy	E_{rec}	V_{CC} = 900 V, I_F = 75 A, V_{GE} = -15 V, -di$_F$/dt = 2150 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		8.6		mJ
			T_{vj} = 125 °C		17.2		
			T_{vj} = 150 °C		20.2		

(table continues...)

Table 6 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to case	R_{thJC}	per diode			0.529	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, λ_{grease} = 1 W/(m·K)		0.0730		K/W
Temperature under switching conditions	$T_{vj\,op}$		-40		150	°C

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	2200	V
Maximum RMS forward current per chip	I_{FRMSM}	T_C = 105 °C		81	A
Maximum RMS current at rectifier output	I_{RMSM}	T_C = 105 °C		140	A
Surge forward current	I_{FSM}	t_P = 10 ms	T_{vj} = 25 °C	670	A
			T_{vj} = 125 °C	585	
			T_{vj} = 150 °C	540	
I^2t - value	I^2t	t_P = 10 ms	T_{vj} = 25 °C	2240	A^2s
			T_{vj} = 125 °C	1710	
			T_{vj} = 150 °C	1460	

Table 8 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 75 A	T_{vj} = 25 °C		1.15		V
			T_{vj} = 125 °C		1.10		
			T_{vj} = 150 °C		1.10		
Thermal resistance, junction to case	R_{thJC}	per diode				0.651	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, λ_{grease} = 1 W/(m·K)			0.0800		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	1700	V
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_C = 100 °C	75	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		150	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 = 75 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.95	2.30	V
			T_{vj} = 125 °C		2.35		
			T_{vj} = 150 °C		2.45		
Gate threshold voltage	V_{GEth}	I_C = 3 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.25	5.80	6.35	V
Gate charge	Q_G	V_{GE} = ±15 V, V_{CC} = 900 V			0.9		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			8.5		Ω
Input capacitance	C_{ies}	f = 1000 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			6.8		nF
Reverse transfer capacitance	C_{res}	f = 1000 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.22		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1700 V, V_{GE} = 0 V	T_{vj} = 25 °C			1	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 = 75 A, V_{CC} = 900 V, V_{GE} = ±15 V, R_{Gon} = 4.3 Ω	T_{vj} = 25 °C		0.230		µs
			T_{vj} = 125 °C		0.250		
			T_{vj} = 150 °C		0.260		
Rise time (inductive load)	t_r	I_C = 75 A, V_{CC} = 900 V, V_{GE} = ±15 V, R_{Gon} = 4.3 Ω	T_{vj} = 25 °C		0.036		µs
			T_{vj} = 125 °C		0.040		
			T_{vj} = 150 °C		0.045		
Turn-off delay time (inductive load)	t_{doff}	I_C = 75 A, V_{CC} = 900 V, V_{GE} = ±15 V, R_{Goff} = 4.3 Ω	T_{vj} = 25 °C		0.460		µs
			T_{vj} = 125 °C		0.600		
			T_{vj} = 150 °C		0.640		

(table continues...)

Table 10 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Fall time (inductive load)	t_f	I_C = 75 A, V_{CC} = 900 V, V_{GE} = ±15 V, R_{Goff} = 4.3 Ω	T_{vj} = 25 °C		0.080		µs
			T_{vj} = 125 °C		0.150		
			T_{vj} = 150 °C		0.160		
Turn-on energy loss per pulse	E_{on}	I_C = 75 A, V_{CC} = 900 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 4.3 Ω, di/dt = 2150 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		13		mJ
			T_{vj} = 125 °C		19		
			T_{vj} = 150 °C		20		
Turn-off energy loss per pulse	E_{off}	I_C = 75 A, V_{CC} = 900 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 4.3 Ω, dv/dt = 3000 V/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		14.5		mJ
			T_{vj} = 125 °C		25.2		
			T_{vj} = 150 °C		28.5		
SC data	I_{SC}	V_{GE} ≤ 15 V, V_{CC} = 1000 V, V_{CEmax}=V_{CES}-L_{sCE}*di/dt	t_P ≤ 10 µs, T_{vj} ≤ 150 °C		350		A
Thermal resistance, junction to case	R_{thJC}	per IGBT				0.327	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, λ_{grease} = 1 W/(m·K)			0.0678		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		150	°C

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	1700	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	310	A^2s
			T_{vj} = 150 °C	260	

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		1.80	2.20	V
			T_{vj} = 125 °C		1.90		
			T_{vj} = 150 °C		1.95		
Peak reverse recovery current	I_{RM}	V_{CC} = 900 V, I_F = 50 A, V_{GE} = -15 V, -di$_F$/dt = 1500 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		55		A
			T_{vj} = 125 °C		64		
			T_{vj} = 150 °C		68		
Recovered charge	Q_r	V_{CC} = 900 V, I_F = 50 A, V_{GE} = -15 V, -di$_F$/dt = 1500 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		15		µC
			T_{vj} = 125 °C		21.3		
			T_{vj} = 150 °C		24.3		
Reverse recovery energy	E_{rec}	V_{CC} = 900 V, I_F = 50 A, V_{GE} = -15 V, -di$_F$/dt = 1500 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		10		mJ
			T_{vj} = 125 °C		13.5		
			T_{vj} = 150 °C		16		
Thermal resistance, junction to case	R_{thJC}	per diode				0.692	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, λ_{grease} = 1 W/(m·K)			0.0840		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		150	°C

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

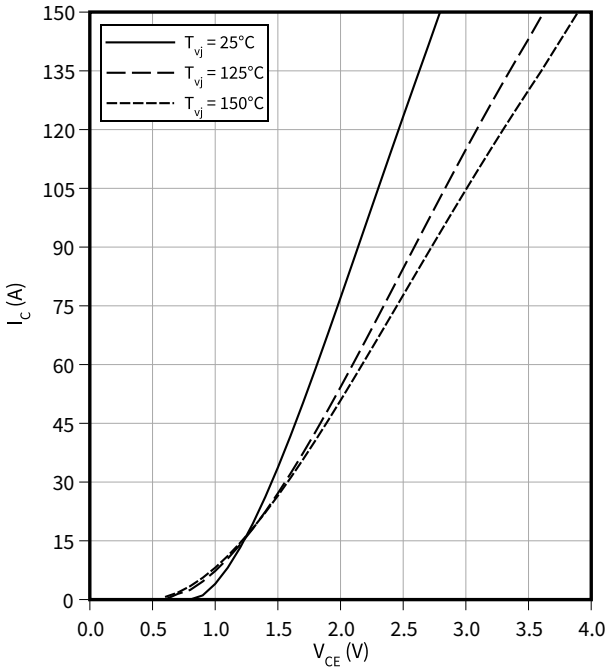
***Note**: Specification according to the valid application note.*

8 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

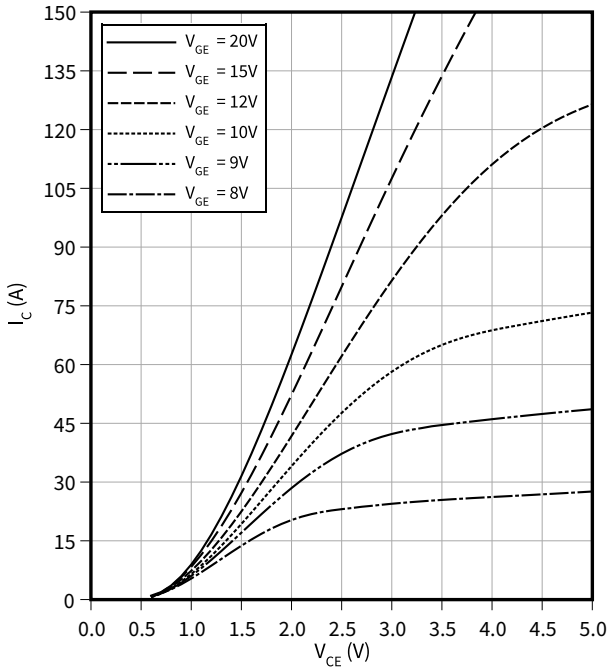
$V_{GE} = 15$ V



Output characteristic field (typical), IGBT, Inverter

$I_C = f(V_{CE})$

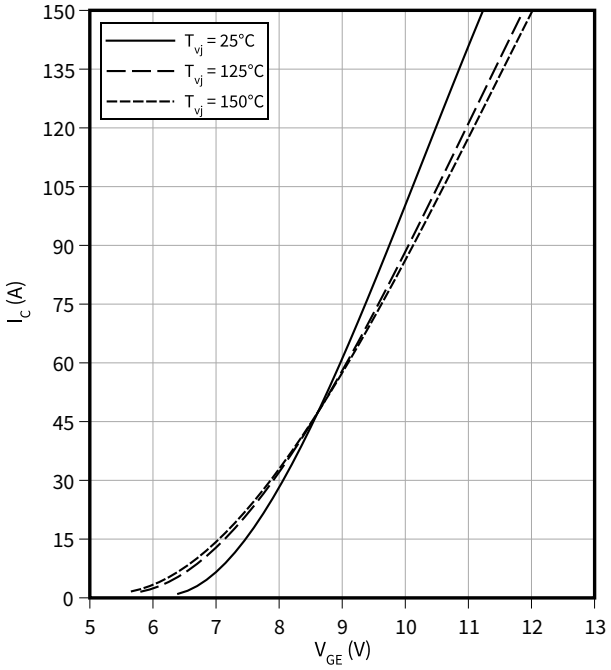
$T_{vj} = 150$ °C



Transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

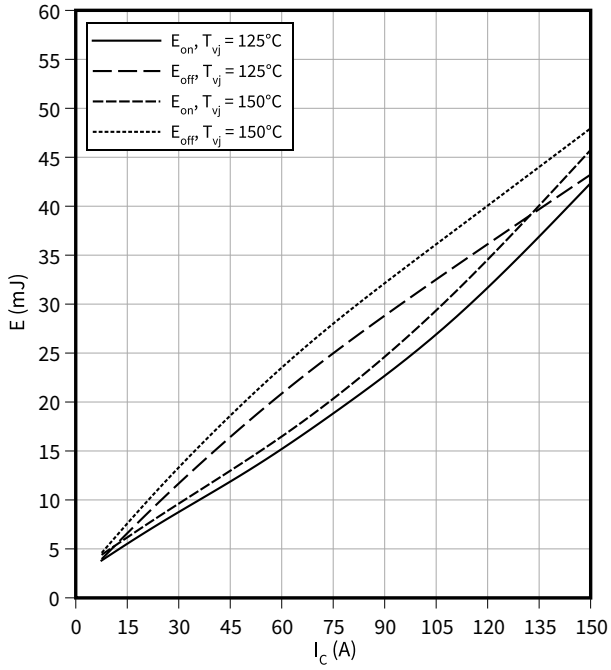
$V_{CE} = 20$ V



Switching losses (typical), IGBT, Inverter

$E = f(I_C)$

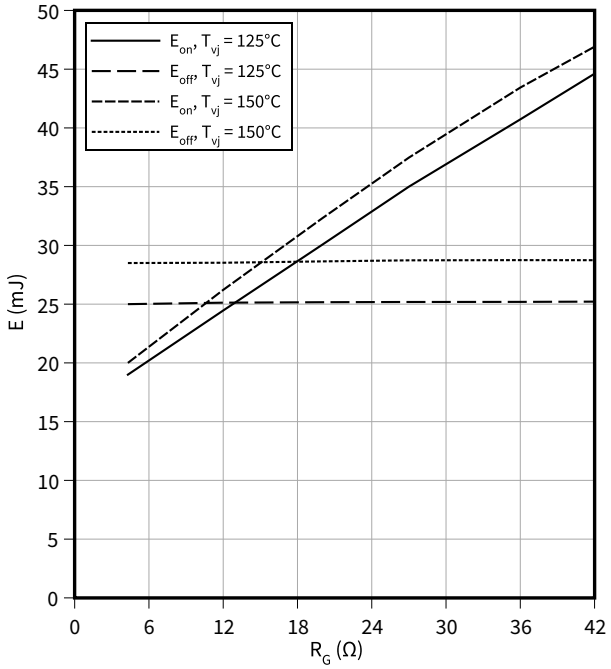
$R_{Goff} = 4.3\ \Omega$, $R_{Gon} = 4.3\ \Omega$, $V_{CC} = 900$ V, $V_{GE} = \pm 15$ V



Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

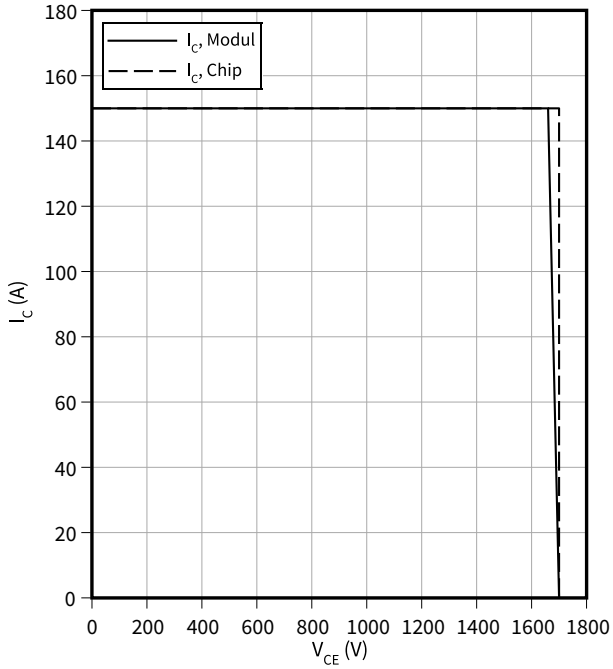
$I_C = 75\ A$, $V_{CC} = 900\ V$, $V_{GE} = \pm 15\ V$



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

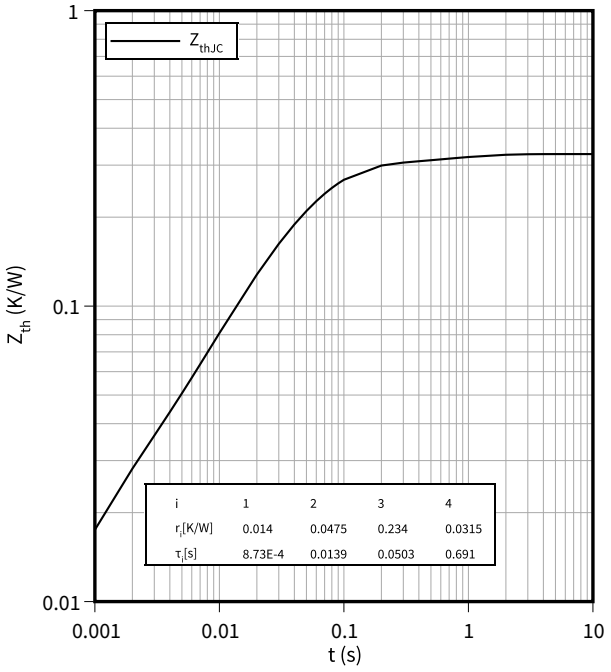
$I_C = f(V_{CE})$

$R_{Goff} = 4.3\ \Omega$, $V_{GE} = \pm 15\ V$, $T_{vj} = 150\ °C$



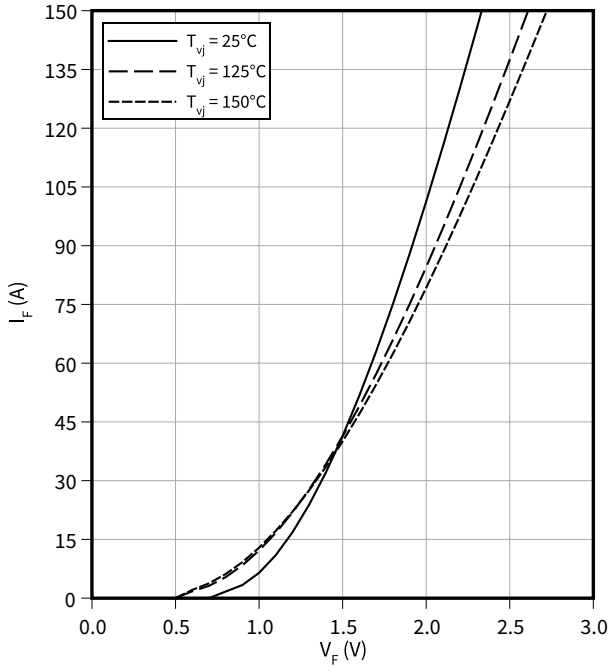
Transient thermal impedance, IGBT, Inverter

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, Inverter

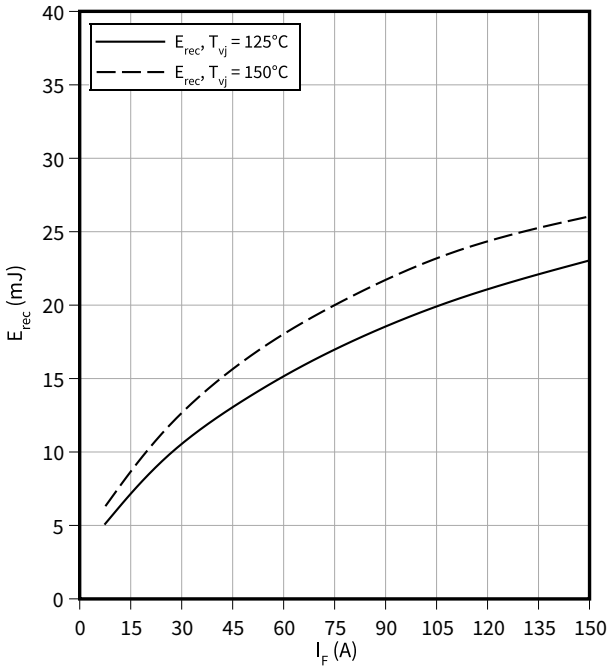
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

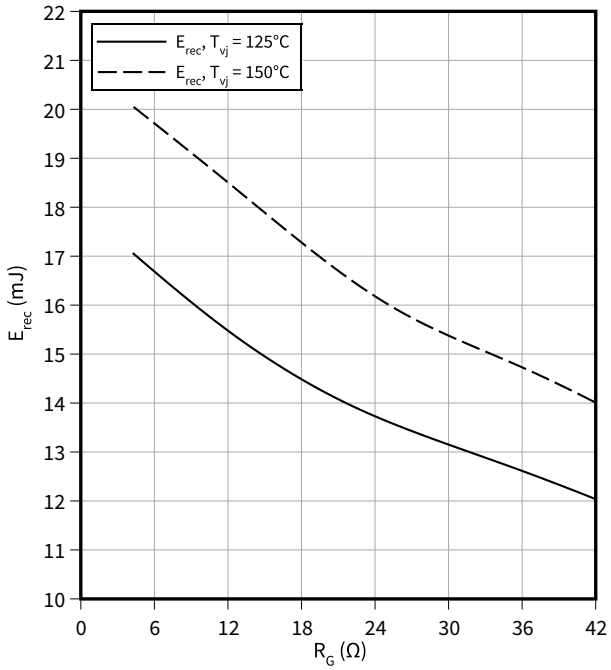
$R_{Gon} = R_{Gon}(IGBT)$, $V_{CC} = 900$ V



Switching losses (typical), Diode, Inverter

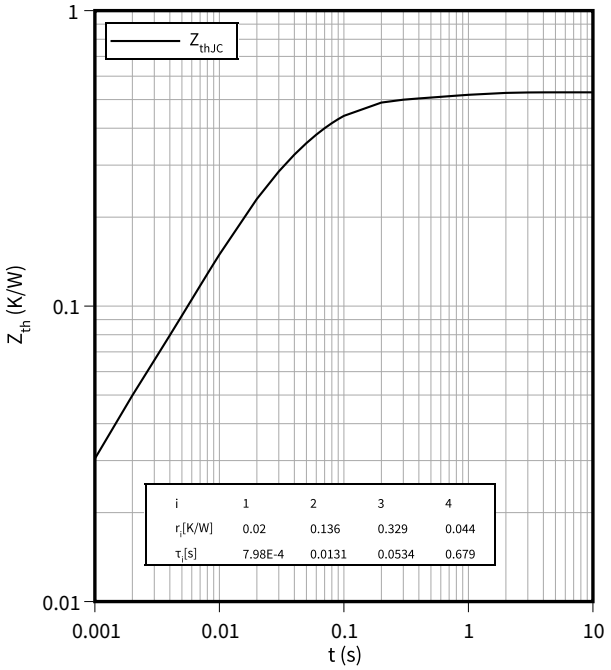
$E_{rec} = f(R_G)$

$I_F = 75$ A, $V_{CC} = 900$ V



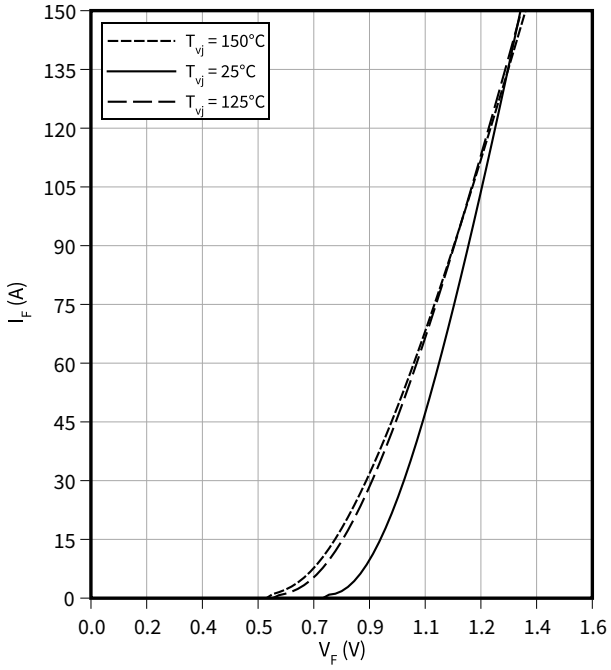
Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



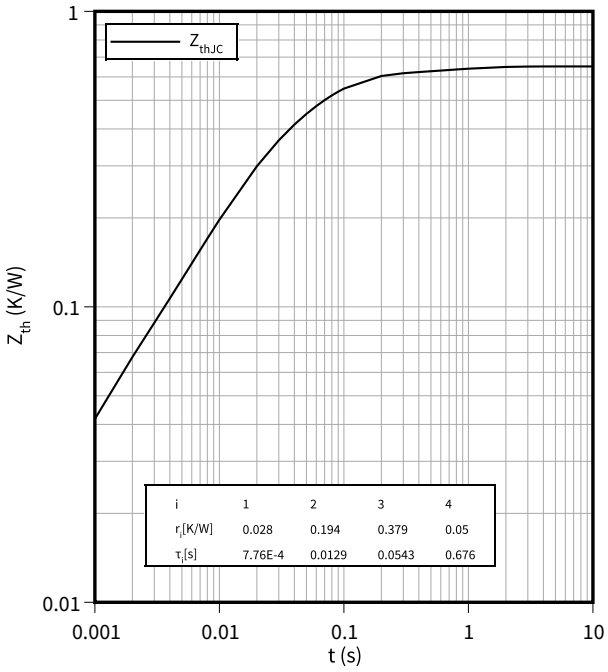
Forward characteristic (typical), Diode, Rectifier

$I_F = f(V_F)$



Transient thermal impedance, Diode, Rectifier

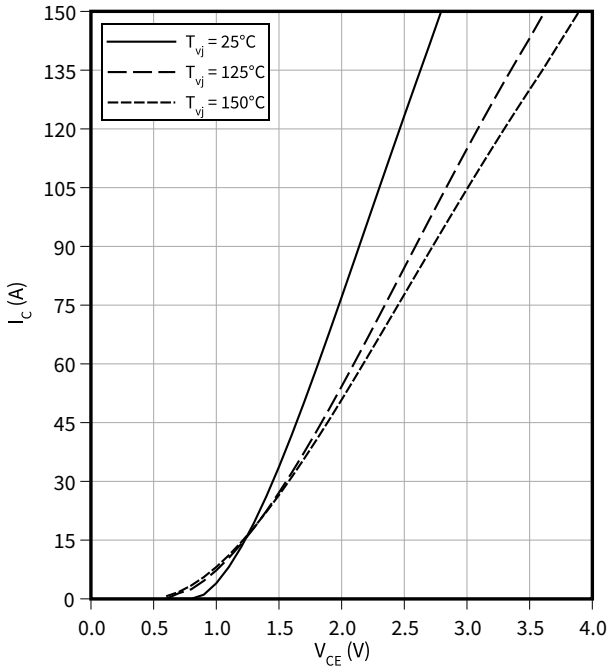
$Z_{th} = f(t)$



Output characteristic (typical), IGBT, Brake-Chopper

$I_C = f(V_{CE})$

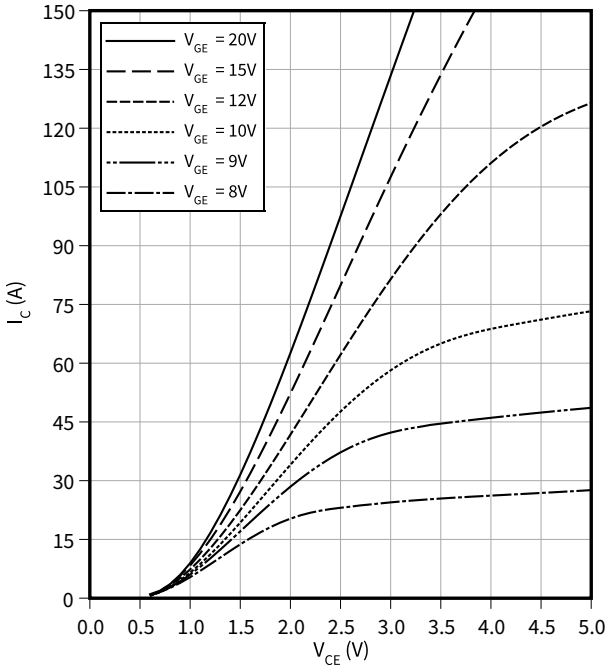
$V_{GE} = 15\ V$



Output characteristic field (typical), IGBT, Brake-Chopper

$I_C = f(V_{CE})$

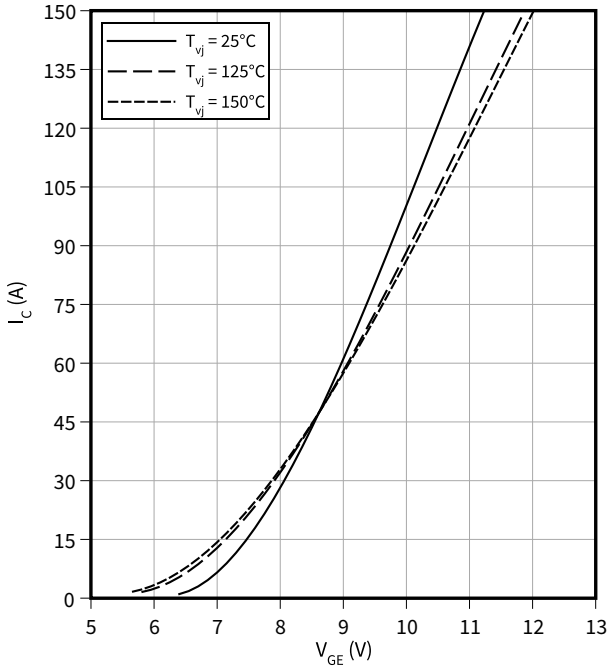
$T_{vj} = 150\ °C$



Transfer characteristic (typical), IGBT, Brake-Chopper

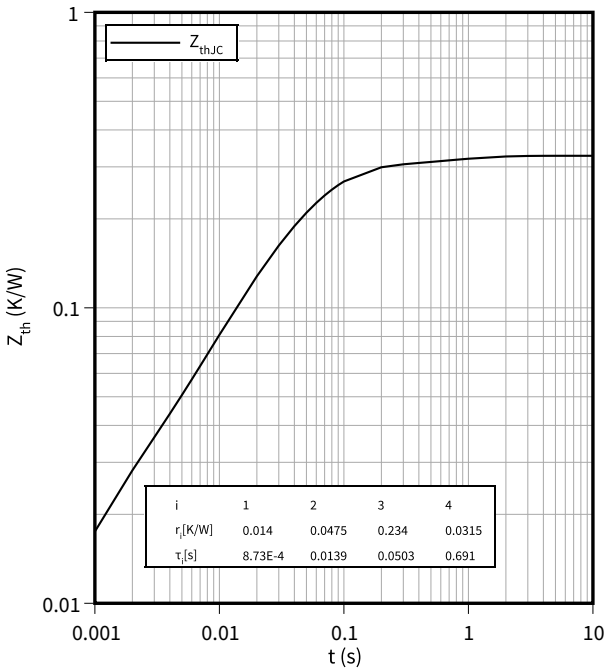
$I_C = f(V_{GE})$

$V_{CE} = 20\ V$



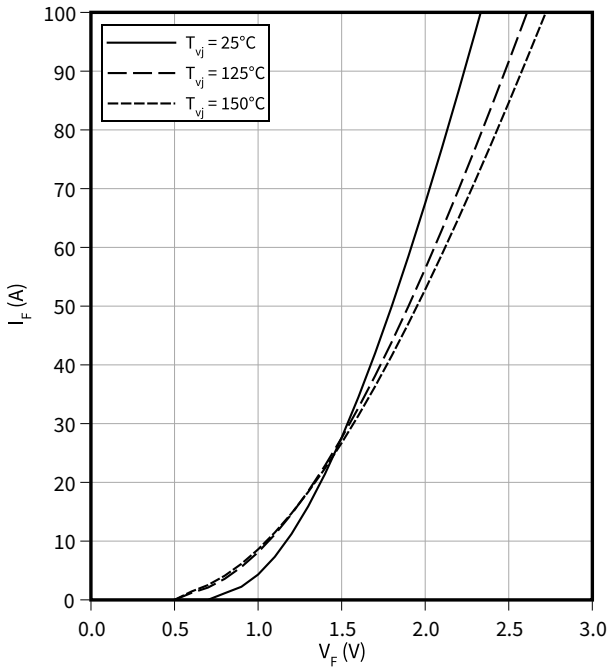
Transient thermal impedance, IGBT, Brake-Chopper

$Z_{th} = f(t)$



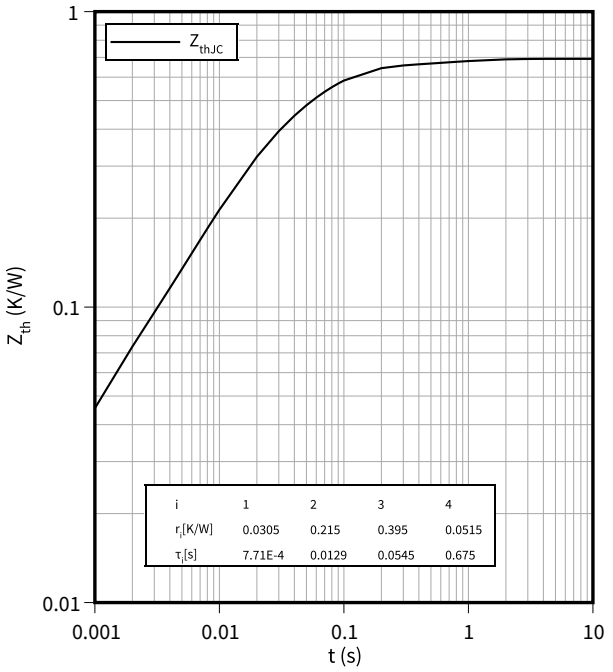
Forward characteristic (typical), Diode, Brake-Chopper

$I_F = f(V_F)$



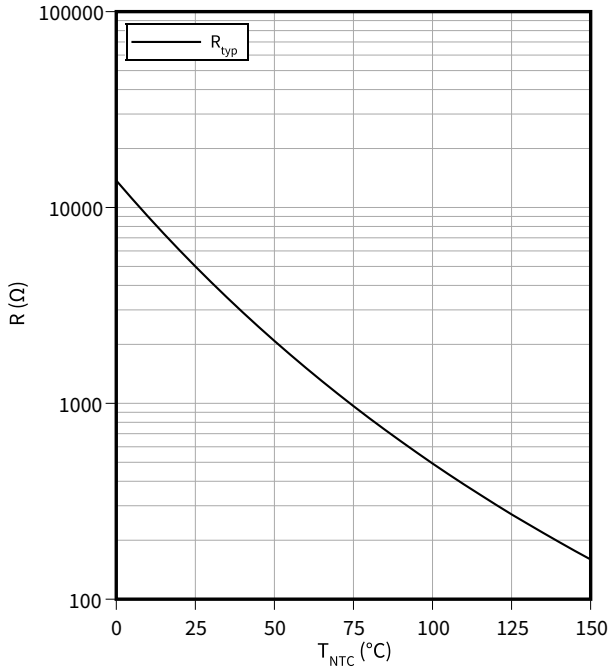
Transient thermal impedance, Diode, Brake-Chopper

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



9 Circuit diagram

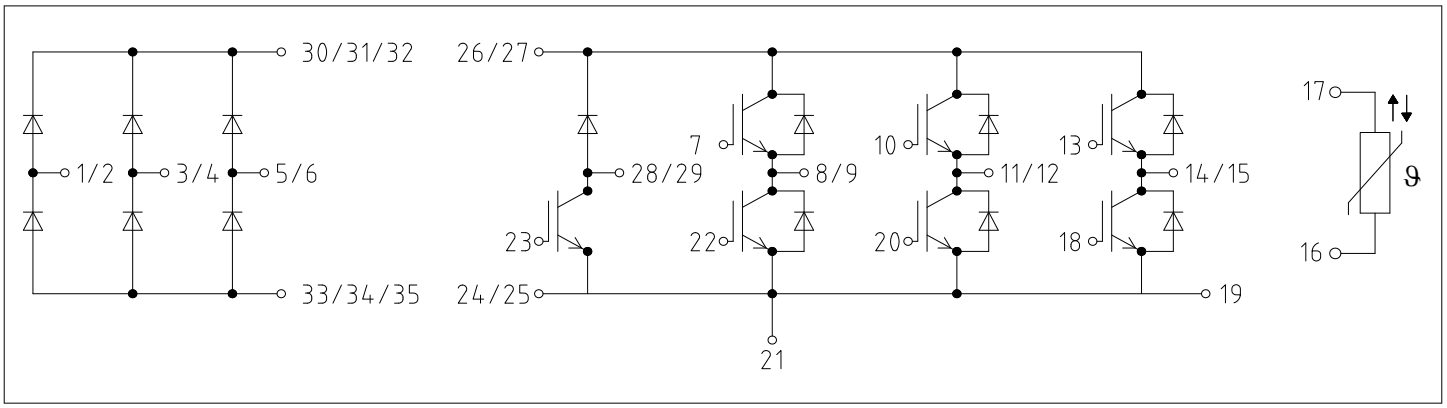


Figure 1

10 Package outlines

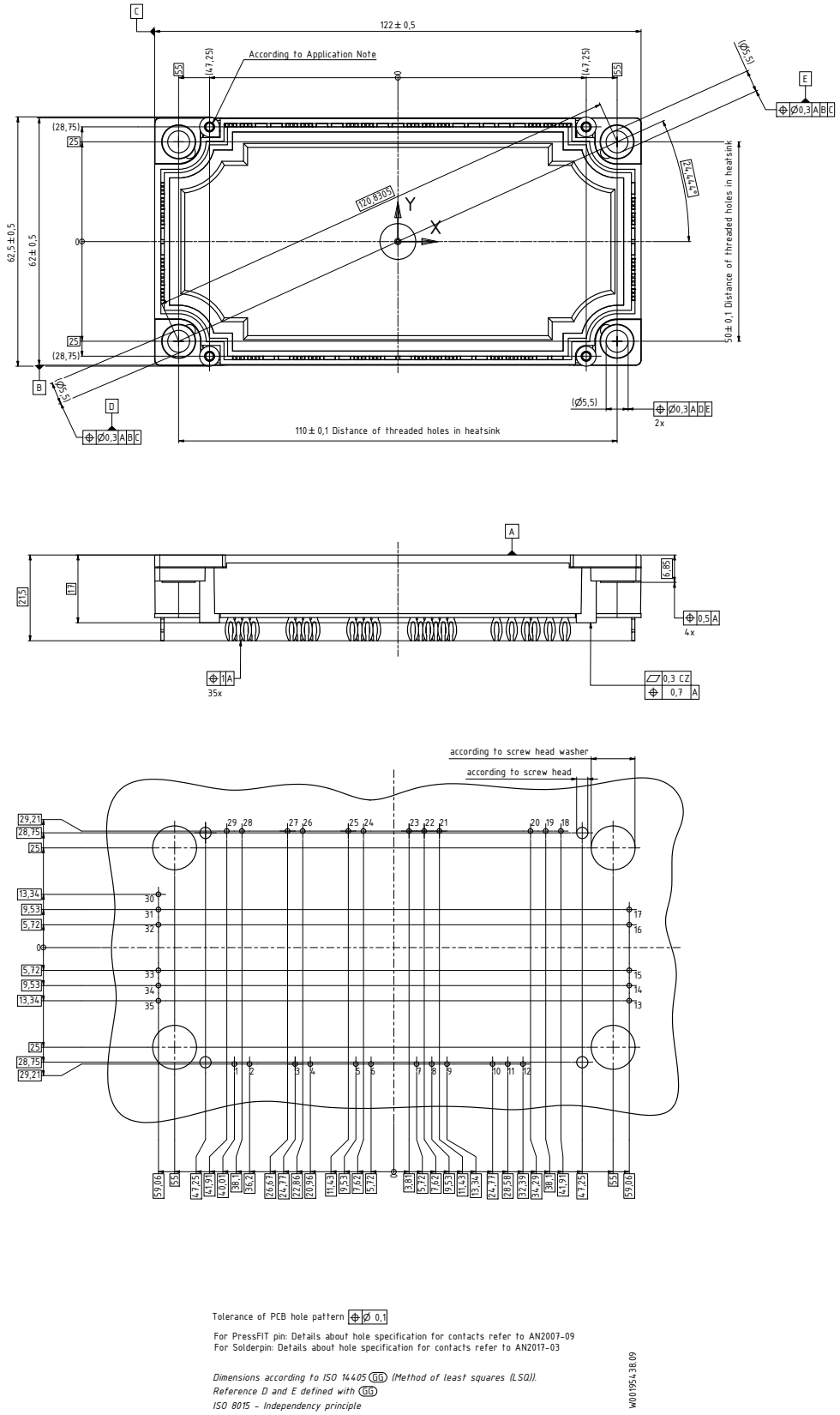


Figure 2

11 Module label code

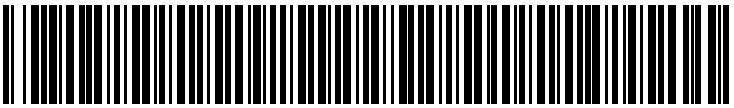
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production 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	2021-12-16	Initial version
1.00	2024-07-03	Final datasheet

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