EconoPACK™3 module with Trench/Fieldstop IGBT4 and Emitter Controlled diode and NTC

Features

- Electrical features
  - V_{CES} = 1700 V
  - $I_{C\ nom}$ = 150 A / I_{CRM} = 300 A
  - Low V_{CEsat}
  - $T_{vj\ op}$ = 150 °C
  - Trench IGBT 4
  - V_{CEsat} with positive temperature coefficient
- Mechanical features
  - Integrated NTC temperature sensor
  - Standard housing
  - Solder contact technology
  - Isolated base plate

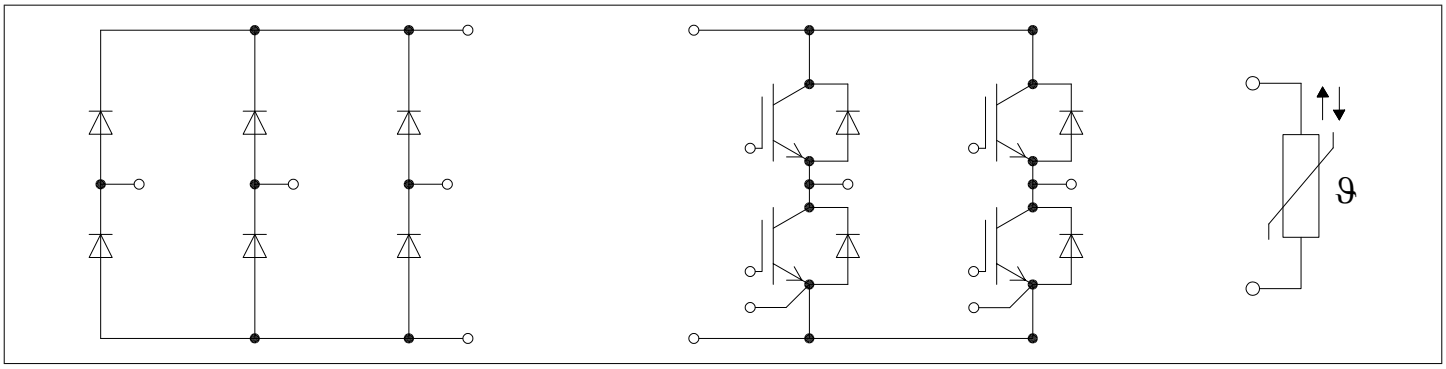
Potential applications

- High power converters
- Medium voltage converters

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	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*		> 225	
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}				33		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			2		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*				300		g

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
Implemented collector current	I_{CN}			150	A
Continous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_C = 90 °C	150	A
Repetitive peak collector current	I_{CRM}	t_P = 1 ms		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		1.70	2.20	V
			T_{vj} = 125 °C		2.05		
			T_{vj} = 150 °C		2.10		
Gate threshold voltage	V_{GEth}	I_C = 6 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.35	5.80	6.25	V
Gate charge	Q_G	V_{GE} = ±15 V			1.53		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			4.6		Ω
Input capacitance	C_{ies}	f = 1000 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			12.3		nF
Reverse transfer capacitance	C_{res}	f = 1000 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.4		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 = 150 A, V_{CE} = 900 V, V_{GE} = ±15 V, R_{Gon} = 0.91 Ω	T_{vj} = 25 °C		0.205		µs
			T_{vj} = 125 °C		0.228		
			T_{vj} = 150 °C		0.234		
Rise time (inductive load)	t_r	I_C = 150 A, V_{CE} = 900 V, V_{GE} = ±15 V, R_{Gon} = 0.91 Ω	T_{vj} = 25 °C		0.064		µs
			T_{vj} = 125 °C		0.074		
			T_{vj} = 150 °C		0.076		
Turn-off delay time (inductive load)	t_{doff}	I_C = 150 A, V_{CE} = 900 V, V_{GE} = ±15 V, R_{Goff} = 0.91 Ω	T_{vj} = 25 °C		0.525		µs
			T_{vj} = 125 °C		0.680		
			T_{vj} = 150 °C		0.713		
Fall time (inductive load)	t_f	I_C = 150 A, V_{CE} = 900 V, V_{GE} = ±15 V, R_{Goff} = 0.91 Ω	T_{vj} = 25 °C		0.594		µs
			T_{vj} = 125 °C		0.833		
			T_{vj} = 150 °C		0.892		
Turn-on energy loss per pulse	E_{on}	I_C = 150 A, V_{CE} = 900 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 0.91 Ω, di/dt = 1250 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		47.6		mJ
			T_{vj} = 125 °C		63.9		
			T_{vj} = 150 °C		68.8		
Turn-off energy loss per pulse	E_{off}	I_C = 150 A, V_{CE} = 900 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 0.91 Ω, dv/dt = 4150 V/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		50.8		mJ
			T_{vj} = 125 °C		69.3		
			T_{vj} = 150 °C		74.2		
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		600		A
Thermal resistance, junction to case	R_{thJC}	per IGBT				0.195	K/W

Table 4 Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, case to heatsink	R_{thCH}	per IGBT, λ_{grease}= 1 W/(m*K)		0.0700		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
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	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	3950	A^2s
			T_{vj} = 150 °C	3750	

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		1.80	2.65	V
			T_{vj} = 125 °C		1.90		
			T_{vj} = 150 °C		1.95		
Peak reverse recovery current	I_{RM}	V_R = 900 V, I_F = 150 A, V_{GE} = -15 V, -di_F/dt = 1250 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		93.3		A
			T_{vj} = 125 °C		101		
			T_{vj} = 150 °C		102		
Recovered charge	Q_r	V_R = 900 V, I_F = 150 A, V_{GE} = -15 V, -di_F/dt = 1250 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		33.9		µC
			T_{vj} = 125 °C		57.9		
			T_{vj} = 150 °C		64.7		
Reverse recovery energy	E_{rec}	V_R = 900 V, I_F = 150 A, V_{GE} = -15 V, -di_F/dt = 1250 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		17.3		mJ
			T_{vj} = 125 °C		32.8		
			T_{vj} = 150 °C		37.1		
Thermal resistance, junction to case	R_{thJC}	per diode				0.365	K/W

Table 6 Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, case to heatsink	R_{thCH}	per diode, λ_{grease}= 1 W/(m*K)		0.0680		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	1800	V
Maximum RMS forward current per chip	I_{FRMSM}	T_C = 95 °C		150	A
Maximum RMS current at rectifier output	I_{RMSM}	T_C = 95 °C		150	A
Surge forward current	I_{FSM}	t_P = 10 ms	T_{vj} = 25 °C	1460	A
			T_{vj} = 150 °C	1260	
I^2t - value	I^2t	t_P = 10 ms	T_{vj} = 25 °C	10700	A^2s
			T_{vj} = 150 °C	7940	

Table 8 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	T_{vj} = 150 °C, I_F = 150 A		1.00		V
Threshold voltage	$V_{(TO)}$	T_{vj} = 150 °C		0.76		V
Slope resistance	r_t	T_{vj} = 150 °C		1.6		mΩ
Reverse current	I_r	T_{vj} = 150 °C, V_R = 1800 V		1		mA
Thermal resistance, junction to case	R_{thJC}	per diode			0.364	K/W
Thermal resistance, case to heatsink	R_{thCH}	per diode, λ_{Paste}= 1 W /(m*K) / λ_{grease}= 1 W/(m*K)		0.0680		K/W
Temperature under switching conditions	$T_{vj,\,op}$		-40		150	°C

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

5 NTC-Thermistor

Table 9 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

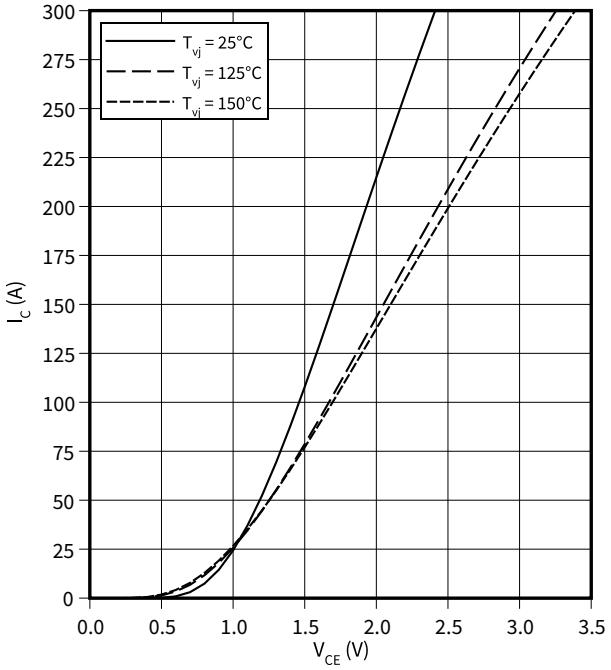
Note: Specification according to the valid application note.

6 Characteristics diagrams

output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

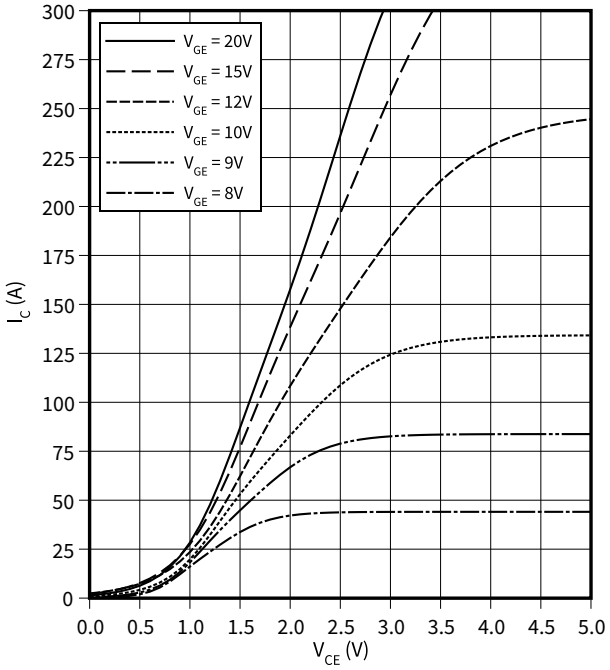
V_{GE} = 15 V



output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

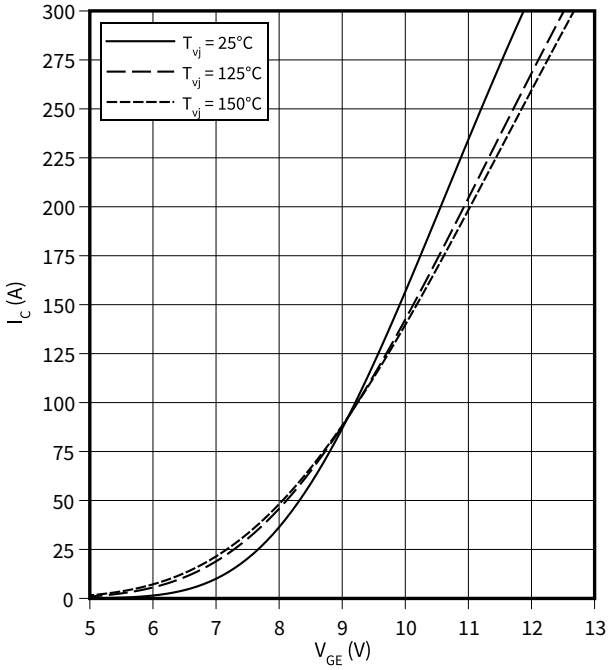
T_{vj} = 150 °C



transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

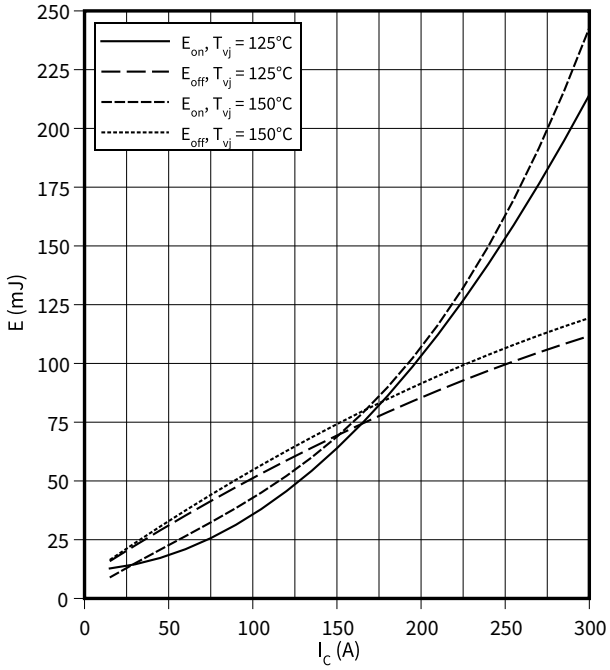
V_{CE} = 20 V



switching losses (typical), IGBT, Inverter

$E = f(I_C)$

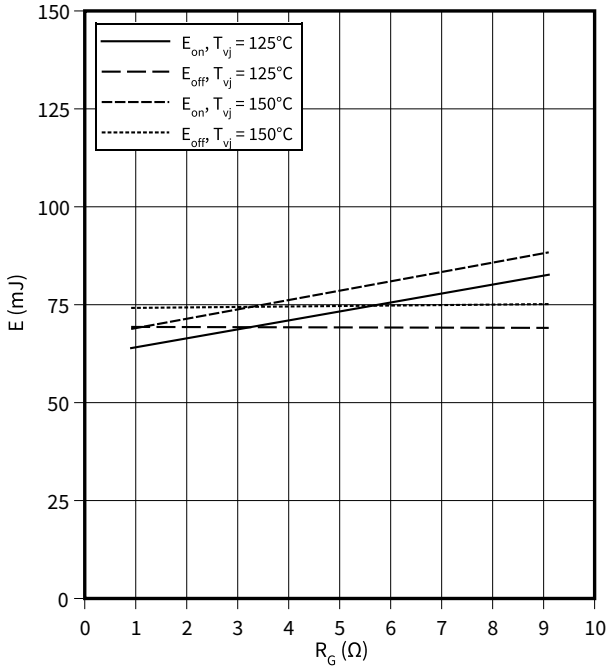
R_{Goff} = 0.91 Ω, R_{Gon} = 0.91 Ω, V_{CE} = 900 V, V_{GE} = -15 / 15 V



switching losses (typical), IGBT, Inverter

$E = f(R_G)$

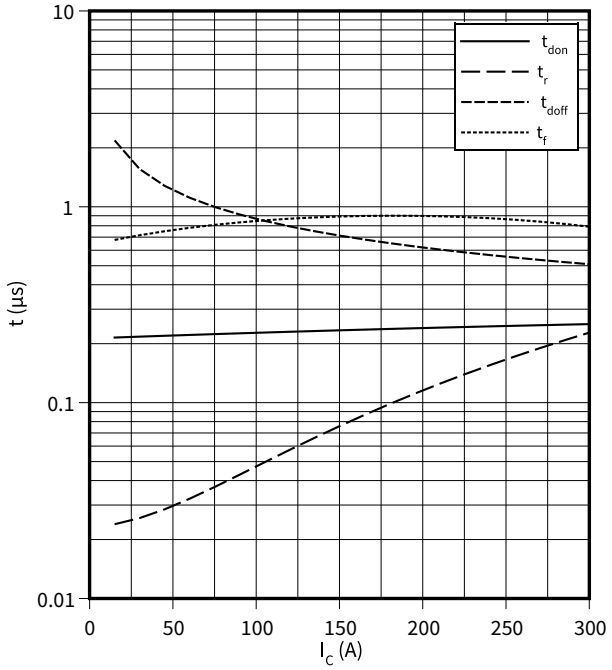
$I_C = 150\ A$, $V_{CE} = 900\ V$, $V_{GE} = -15 / 15\ V$



switching times (typical), IGBT, Inverter

$t = f(I_C)$

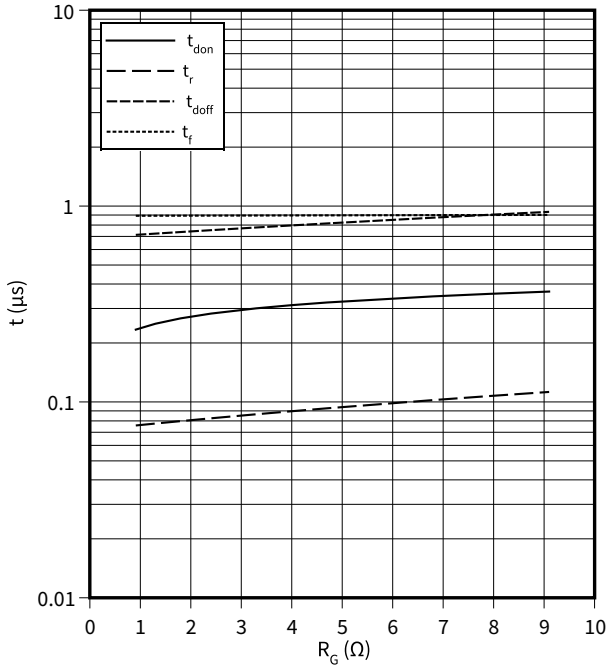
$R_{Goff} = 0.91\ \Omega$, $R_{Gon} = 0.91\ \Omega$, $V_{CE} = 900\ V$, $V_{GE} = -15 / 15\ V$, $T_{vj} = 150\ °C$



switching times (typical), IGBT, Inverter

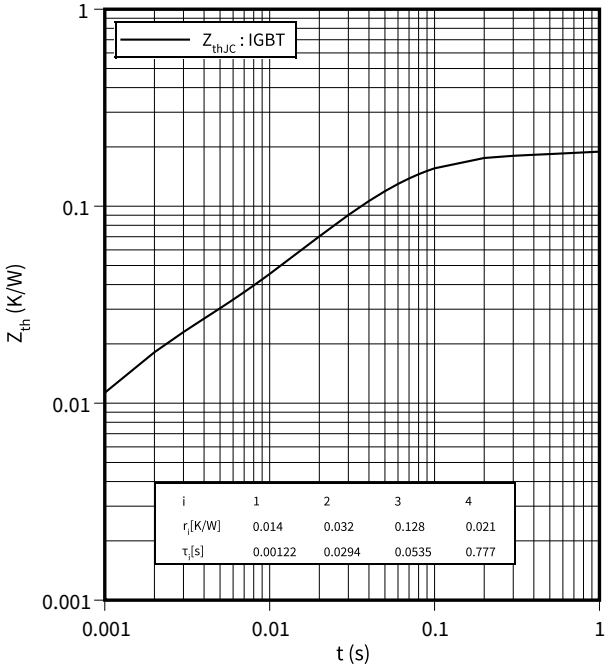
$t = f(R_G)$

$I_C = 150\ A$, $V_{CE} = 900\ V$, $V_{GE} = -15 / 15\ V$, $T_{vj} = 150\ °C$



transient thermal impedance , IGBT, Inverter

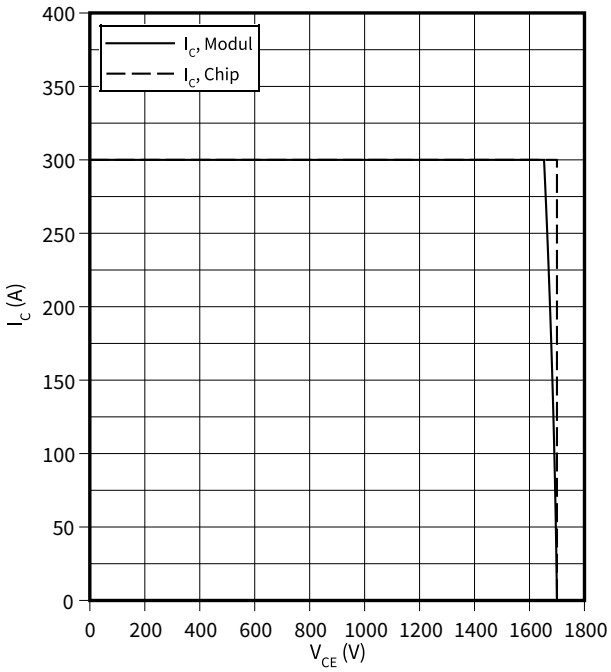
$Z_{th} = f(t)$



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

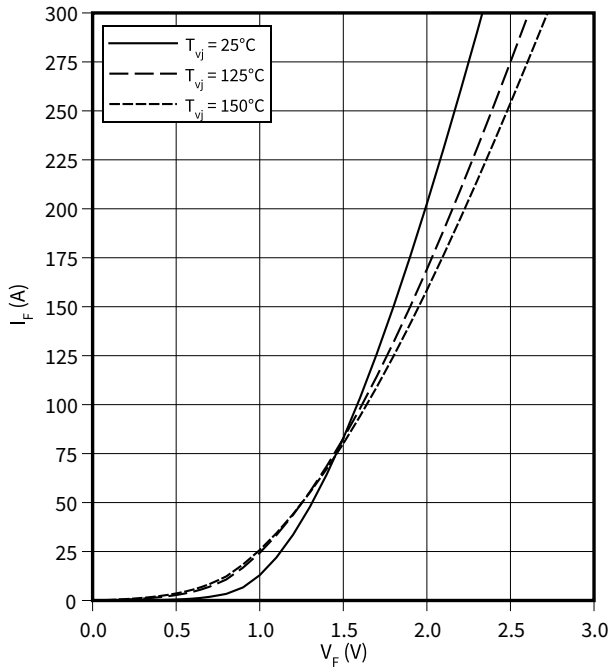
$I_C = f(V_{CE})$

$R_{Goff} = 0.91\ \Omega$, $V_{GE} = \pm 15$ V, $T_{vj} = 150$ °C



forward characteristic (typical), Diode, Inverter

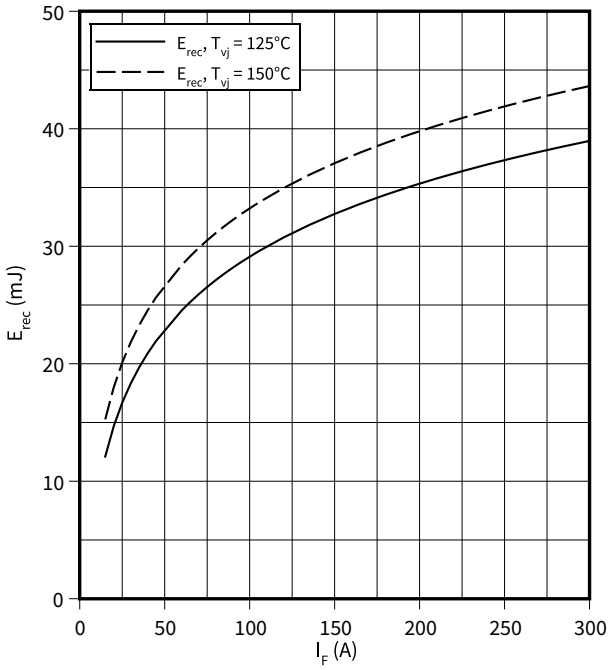
$I_F = f(V_F)$



switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

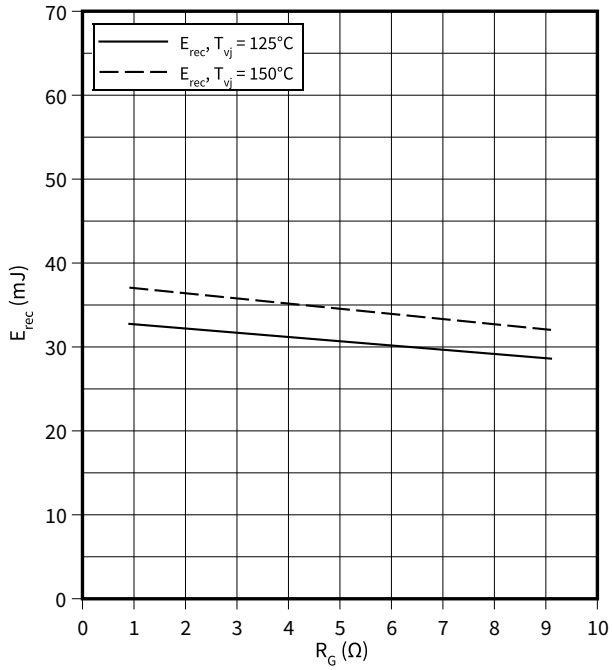
$V_{CE} = 900$ V, $R_{Gon} = R_{Gon(IGBT)}$



switching losses (typical), Diode, Inverter

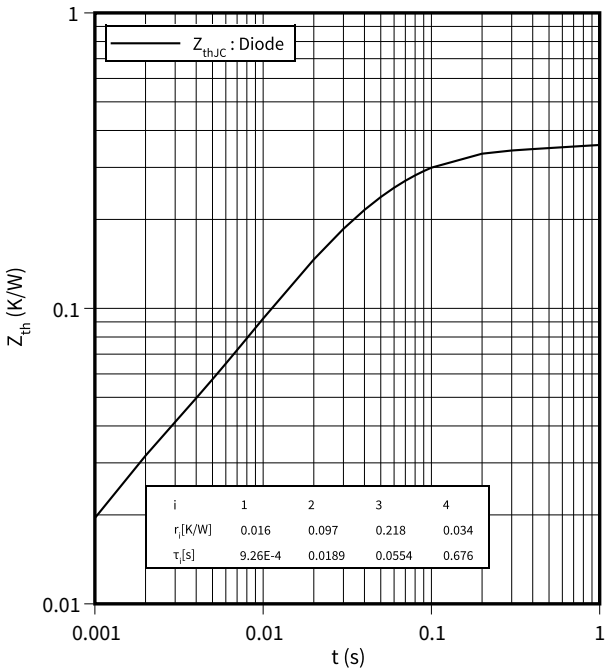
$E_{rec} = f(R_G)$

$V_{CE} = 900$ V, $I_F = 150$ A



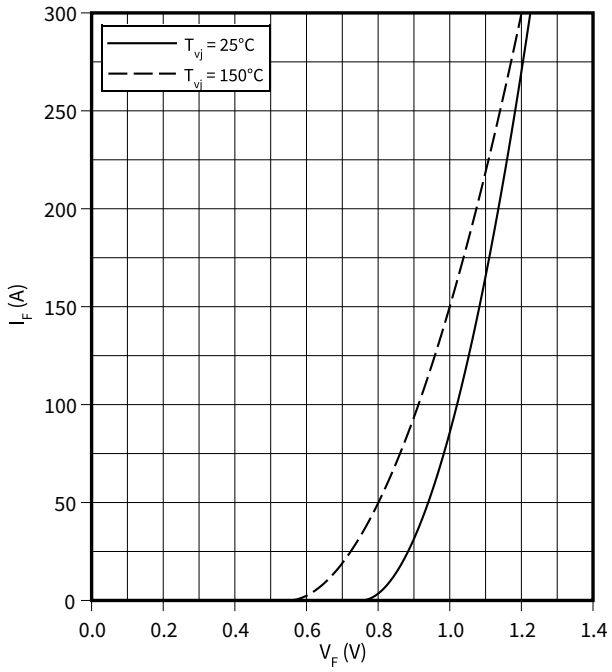
transient thermal impedance , Diode, Inverter

$Z_{th} = f(t)$



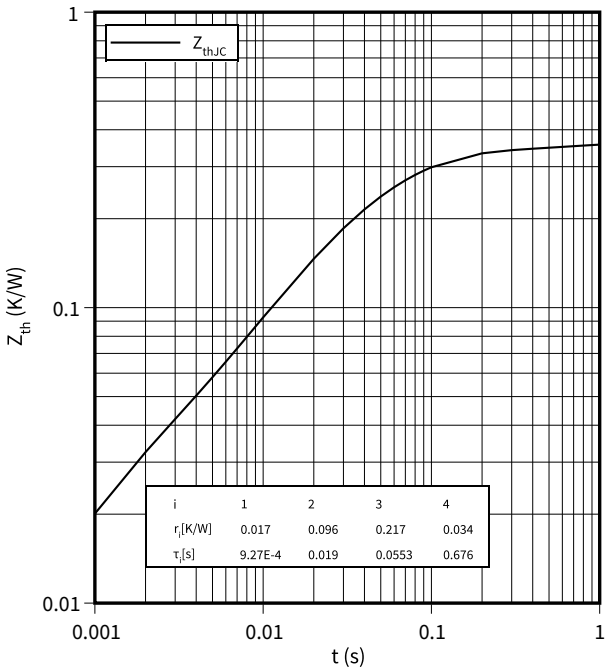
Forward characteristic (typical), Diode, Rectifier

$I_F = f(V_F)$



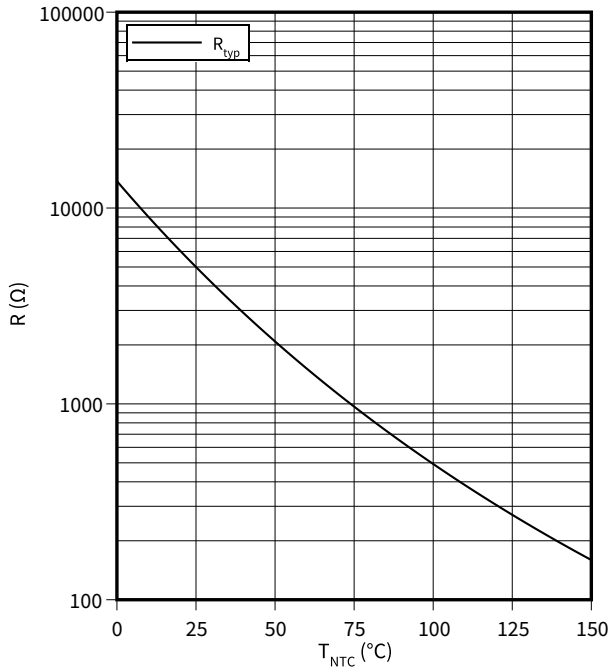
Transient thermal impedance, Diode, Rectifier

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



7 Circuit diagram

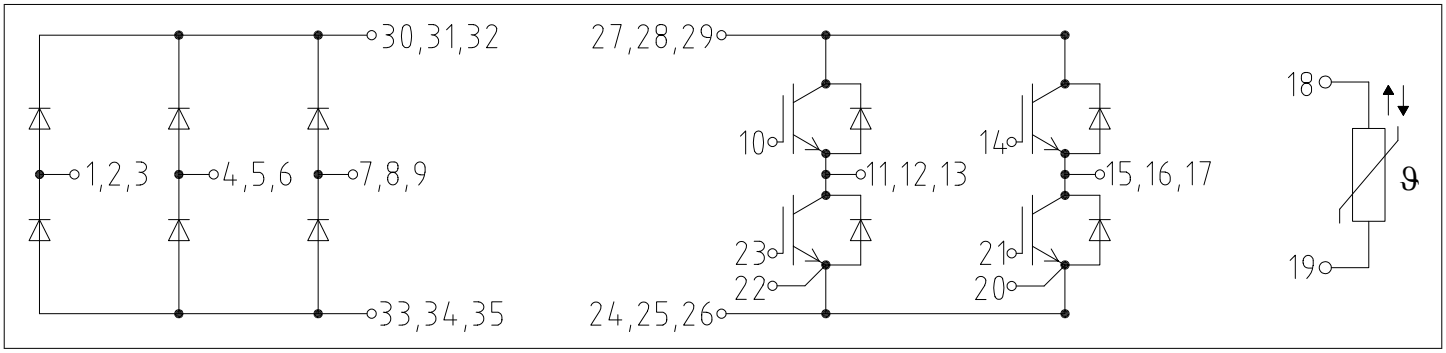


Figure 2

8 Package outlines

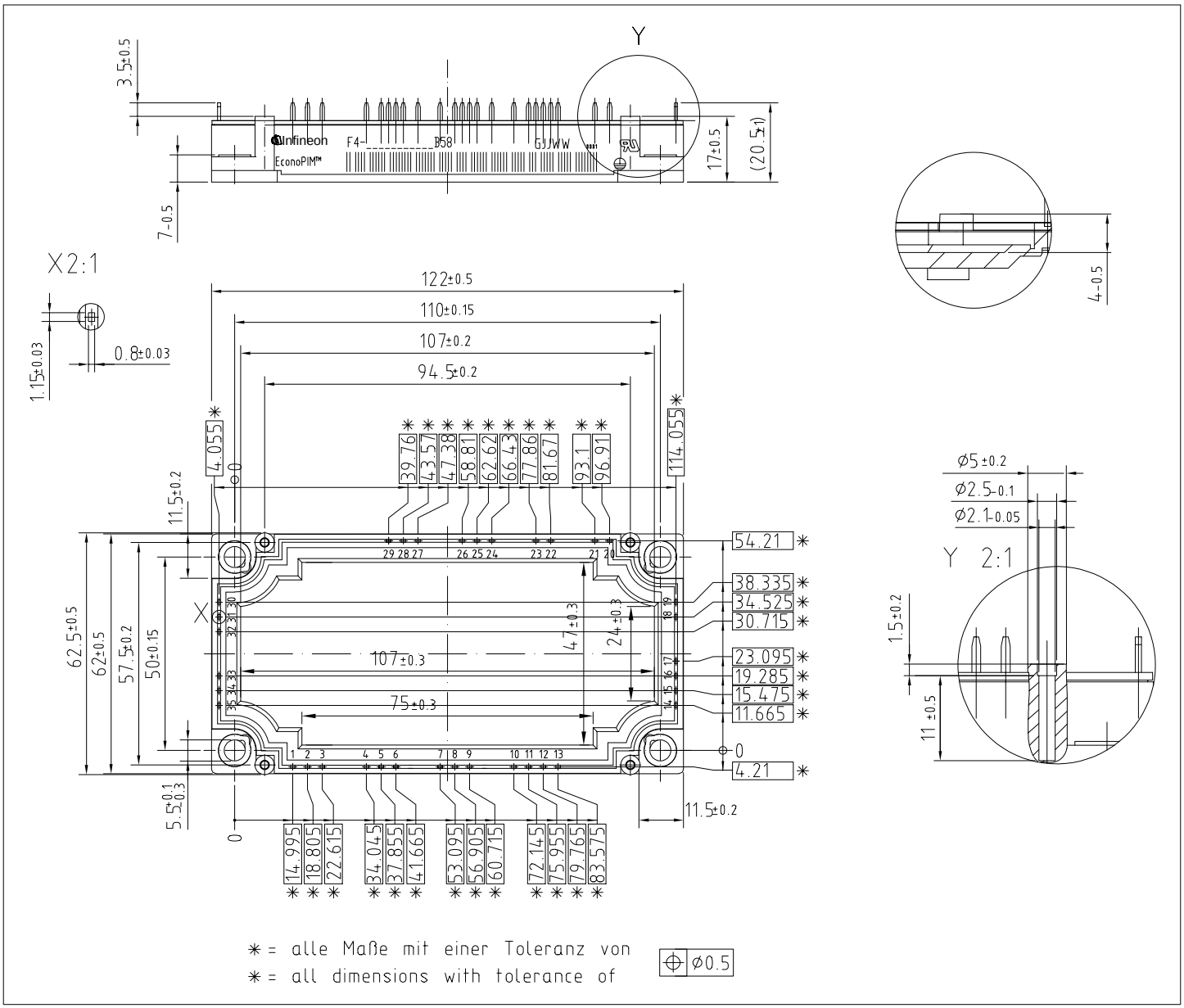


Figure 3

Revision history

Document revision	Date of release	Description of changes
1.00	2021-05-11	Final datasheet

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