

EconoPACK™3 module with Trench/Fieldstop IGBT4 and Emitter Controlled 4 diode and NTC

Features

- Electrical features
 - Low V_{CEsat}
 - Trench IGBT 4
 - $T_{vj op} = 150\text{ °C}$
- Mechanical features
 - Al_2O_3 substrate with low thermal resistance
 - Copper base plate
 - PressFIT contact technology
 - H_2S ruggedness



Typical appearance

Potential applications

- Motor drives
- Servo drives

Product validation

- Qualified for industrial applications according to the relevant tests of IEC 60747, 60749 and 60068

Description

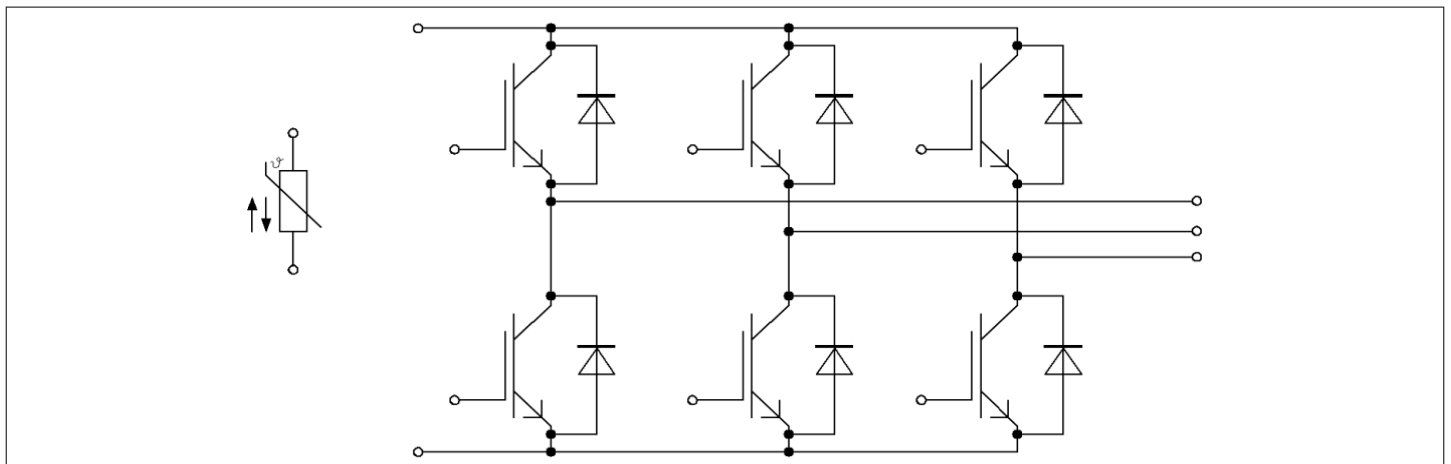


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1 Package

1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	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}			21		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25^\circ\text{C}$, per switch		1.8		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting torque for modul mounting	M	- Mounting according to valid application note	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}	$T_{vj} = 25^\circ\text{C}$	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj \max} = 175^\circ\text{C}$ $T_C = 100^\circ\text{C}$	185	A
Repetitive peak collector current	I_{CRM}	$t_p = 1 \text{ ms}$	400	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	$V_{CE\ sat}$	$I_C = 200\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		1.75	2.10	V
			$T_{vj} = 125\ ^\circ C$		2.05		
			$T_{vj} = 150\ ^\circ C$		2.10		
Gate threshold voltage	V_{GEth}	$I_C = 7.6\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$		5.20	5.80	6.40	V
Gate charge	Q_G	$V_{GE} = \pm 15\ V, V_{CE} = 600\ V$			1.66		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$			3.5		Ω
Input capacitance	C_{ies}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			14		nF
Reverse transfer capacitance	C_{res}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			0.5		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1200\ V, V_{GE} = 0\ V$	$T_{vj} = 25\ ^\circ C$			1	mA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\ V, V_{GE} = 20\ V, T_{vj} = 25\ ^\circ C$				400	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 200\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.1\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.140		μs
			$T_{vj} = 125\ ^\circ C$		0.150		
			$T_{vj} = 150\ ^\circ C$		0.150		
Rise time (inductive load)	t_r	$I_C = 200\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.1\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.030		μs
			$T_{vj} = 125\ ^\circ C$		0.035		
			$T_{vj} = 150\ ^\circ C$		0.040		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 200\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.1\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.320		μs
			$T_{vj} = 125\ ^\circ C$		0.400		
			$T_{vj} = 150\ ^\circ C$		0.420		
Fall time (inductive load)	t_f	$I_C = 200\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.1\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.090		μs
			$T_{vj} = 125\ ^\circ C$		0.160		
			$T_{vj} = 150\ ^\circ C$		0.180		
Turn-on energy loss per pulse	E_{on}	$I_C = 200\ A, V_{CE} = 600\ V, L_\sigma = 30\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 1.1\ \Omega, di/dt = 5400\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		10.5		mJ
			$T_{vj} = 125\ ^\circ C$		18.5		
			$T_{vj} = 150\ ^\circ C$		20.5		
Turn-off energy loss per pulse	E_{off}	$I_C = 200\ A, V_{CE} = 600\ V, L_\sigma = 30\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 1.1\ \Omega, dv/dt = 5000\ V/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		11		mJ
			$T_{vj} = 125\ ^\circ C$		16.5		
			$T_{vj} = 150\ ^\circ C$		18.5		
SC data	I_{SC}	$V_{GE} \leq 15\ V, V_{CC} = 800\ V, V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_P \leq 10\ \mu s, T_{vj} = 150\ ^\circ C$		800		A
Thermal resistance, junction to case	R_{thJC}	per IGBT				0.150	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, $\lambda_{grease} = 1 \text{ W/(m}^2\text{K)}$		0.0850		K/W
Temperature under switching conditions	$T_{vj\text{ op}}$		-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}	$T_{vj} = 25 \text{ °C}$	1200	V
Continuous DC forward current	I_F		200	A
Repetitive peak forward current	I_{FRM}	$t_P = 1 \text{ ms}$	400	A
I^2t - value	I^2t	$t_P = 10 \text{ ms}, V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ °C}$	A^2s
			$T_{vj} = 150 \text{ °C}$	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$	1.70	2.15	V
			$T_{vj} = 125 \text{ °C}$	1.65		
			$T_{vj} = 150 \text{ °C}$	1.65		
Peak reverse recovery current	I_{RM}	$V_R = 600 \text{ V}, V_{GE} = -15 \text{ V},$ $-di_F/dt = 5400 \text{ A/}\mu\text{s}$ ($T_{vj} = 150 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$	240		A
			$T_{vj} = 125 \text{ °C}$	250		
			$T_{vj} = 150 \text{ °C}$	260		
Recovered charge	Q_r	$V_R = 600 \text{ V}, V_{GE} = -15 \text{ V},$ $-di_F/dt = 5400 \text{ A/}\mu\text{s}$ ($T_{vj} = 150 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$	18.5		μC
			$T_{vj} = 125 \text{ °C}$	33.5		
			$T_{vj} = 150 \text{ °C}$	38.5		
Reverse recovery energy	E_{rec}	$V_R = 600 \text{ V}, V_{GE} = -15 \text{ V},$ $-di_F/dt = 5400 \text{ A/}\mu\text{s}$ ($T_{vj} = 150 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$	8.1		mJ
			$T_{vj} = 125 \text{ °C}$	14.5		
			$T_{vj} = 150 \text{ °C}$	16		
Thermal resistance, junction to case	R_{thJC}	per diode			0.260	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, $\lambda_{grease} = 1 \text{ W/(m}^2\text{K)}$		0.148		K/W
Temperature under switching conditions	$T_{vj op}$		-40		150	°C

4 NTC-Thermistor

Table 7 Characteristic values

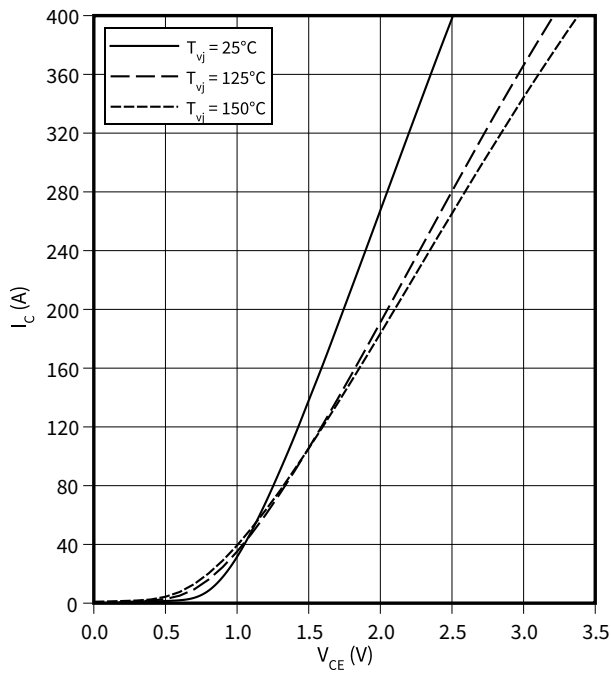
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	$T_{NTC} = 25 \text{ °C}$		5		kΩ
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100 \text{ °C}$, $R_{100} = 493 \text{ Ω}$	-5		5	%
Power dissipation	P_{25}	$T_{NTC} = 25 \text{ °C}$			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298,15 \text{ K}))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298,15 \text{ K}))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298,15 \text{ K}))]$		3433		K

Note: Specification according to the valid application note.

5 Characteristics diagrams

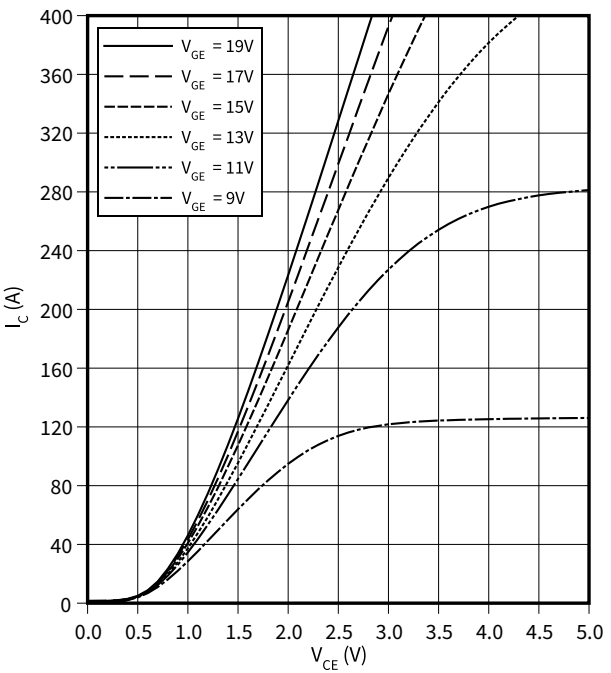
output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$
 $V_{GE} = 15\text{ V}$



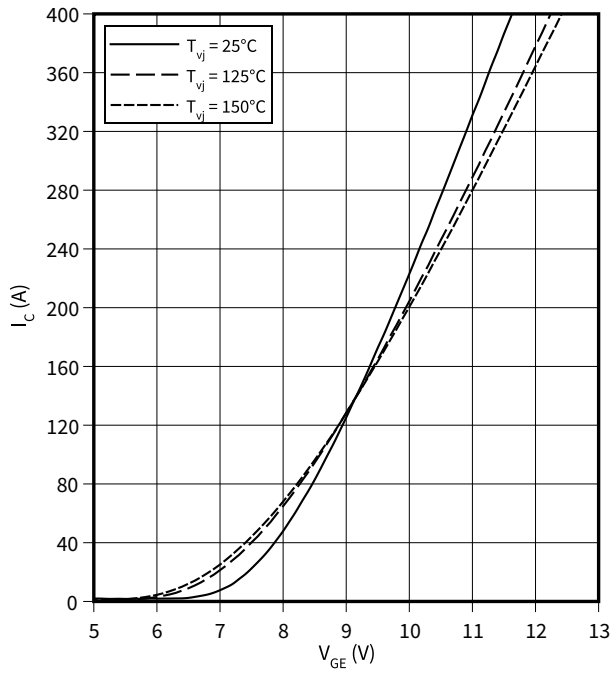
output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$
 $T_{vj} = 150\text{ °C}$



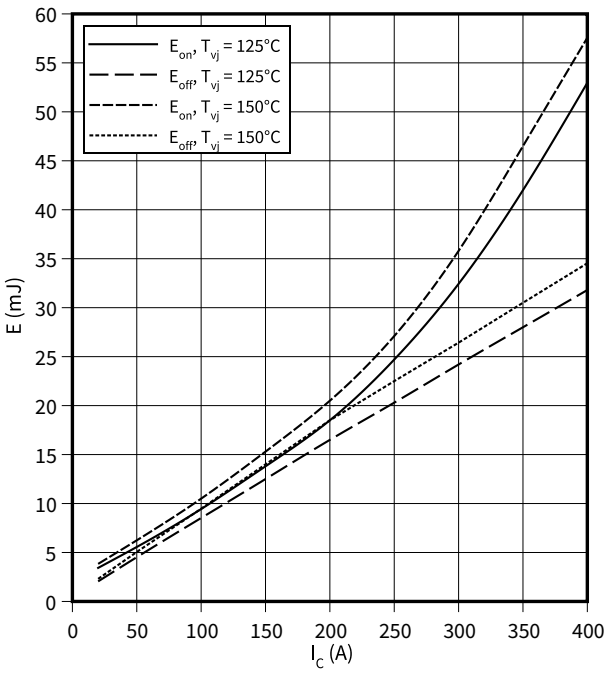
transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$
 $V_{CE} = 20\text{ V}$



switching losses (typical), IGBT, Inverter

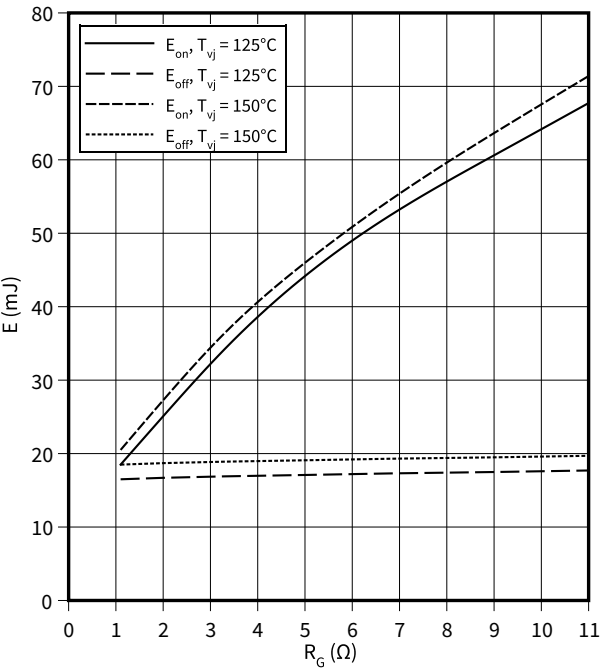
$E = f(I_C)$
 $R_{Goff} = 1.1\text{ }\Omega$, $R_{Gon} = 1.1\text{ }\Omega$, $V_{CE} = 600\text{ V}$, $V_{GE} = \pm 15\text{ V}$



5 Characteristics diagrams

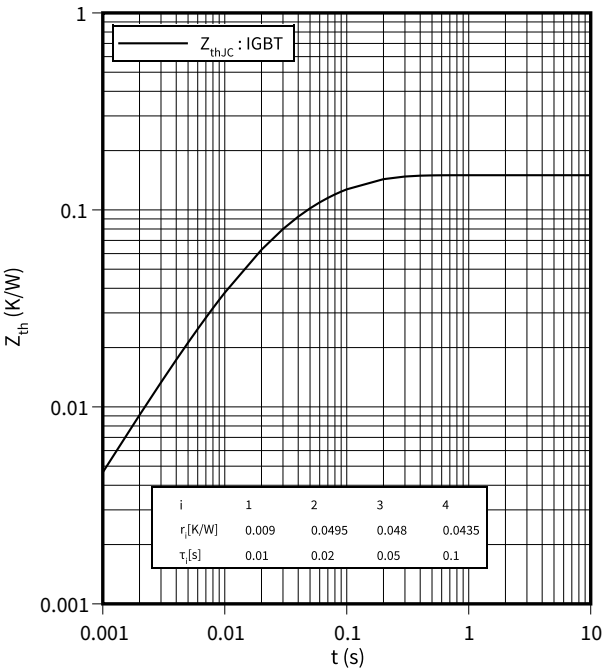
switching losses (typical), IGBT, Inverter

$E = f(R_G)$
 $I_C = 200\text{ A}$, $V_{CE} = 600\text{ V}$, $V_{GE} = \pm 15\text{ V}$



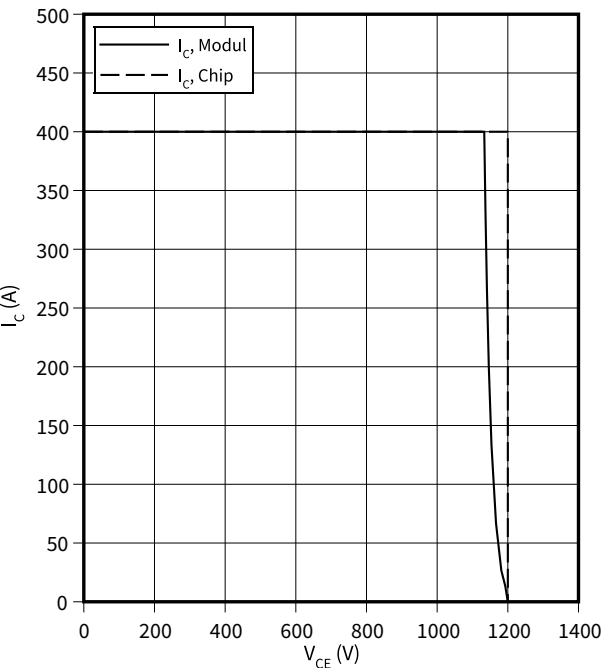
transient thermal impedance , IGBT, Inverter

$Z_{th} = f(t)$



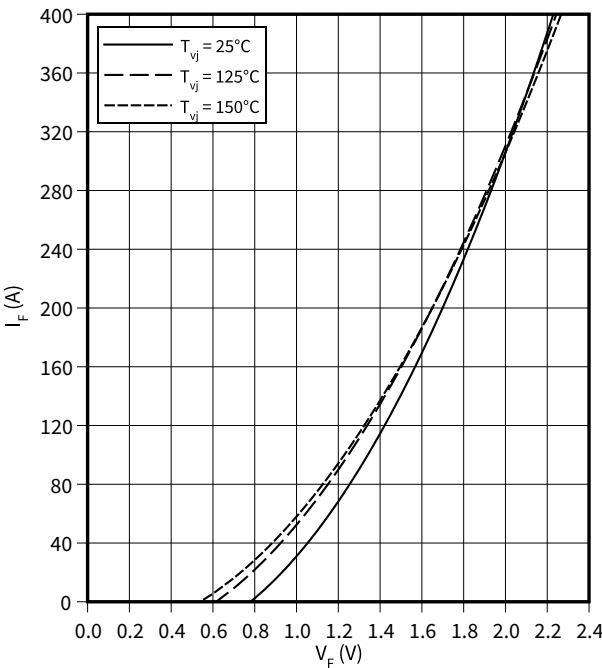
reverse bias safe operating area (RBSOA), IGBT, Inverter

$I_C = f(V_{CE})$
 $R_{Goff} = 1.1\ \Omega$, $V_{GE} = \pm 15.0\text{ V}$, $T_{vj} = 150^\circ\text{C}$



forward characteristic (typical), Diode, Inverter

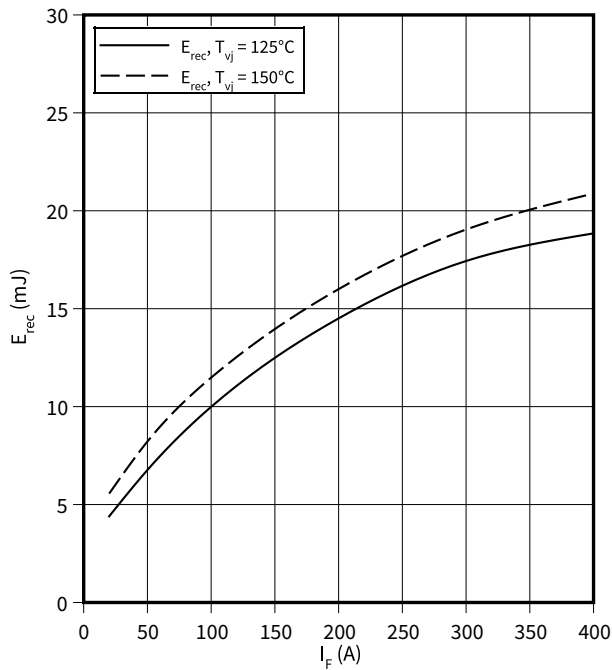
$I_F = f(V_F)$



5 Characteristics diagrams

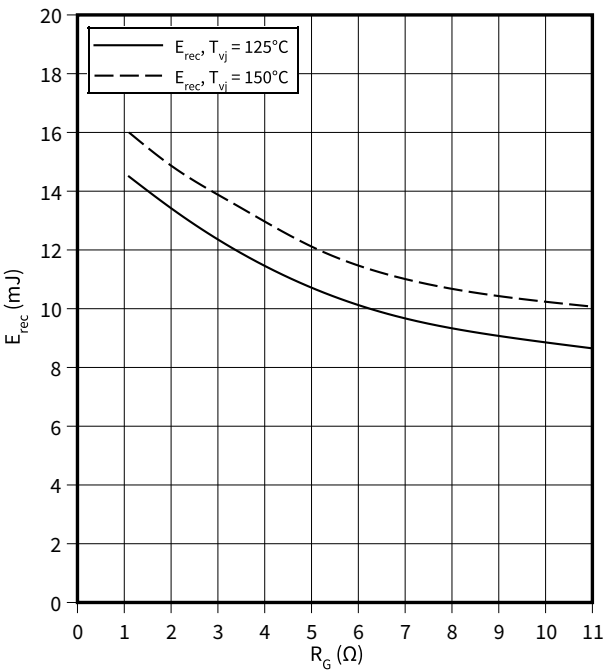
switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$
 $V_{CE} = 600\text{ V}, R_{Gon} = R_{Gon}(IGBT)$



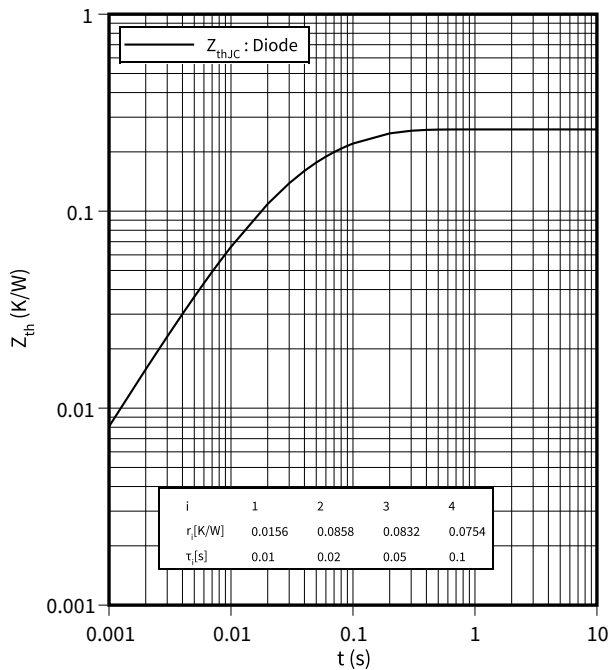
switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$
 $V_{CE} = 600\text{ V}, I_F = 200\text{ A}$



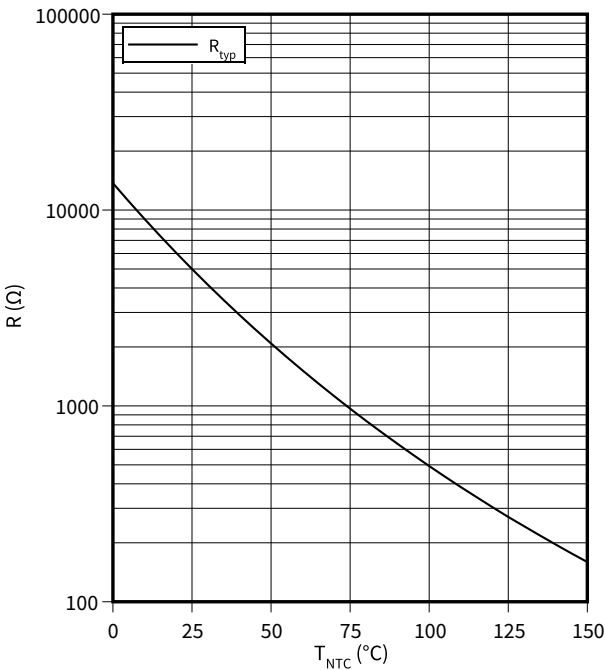
transient thermal impedance , Diode, Inverter

$Z_{th} = f(t)$



temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



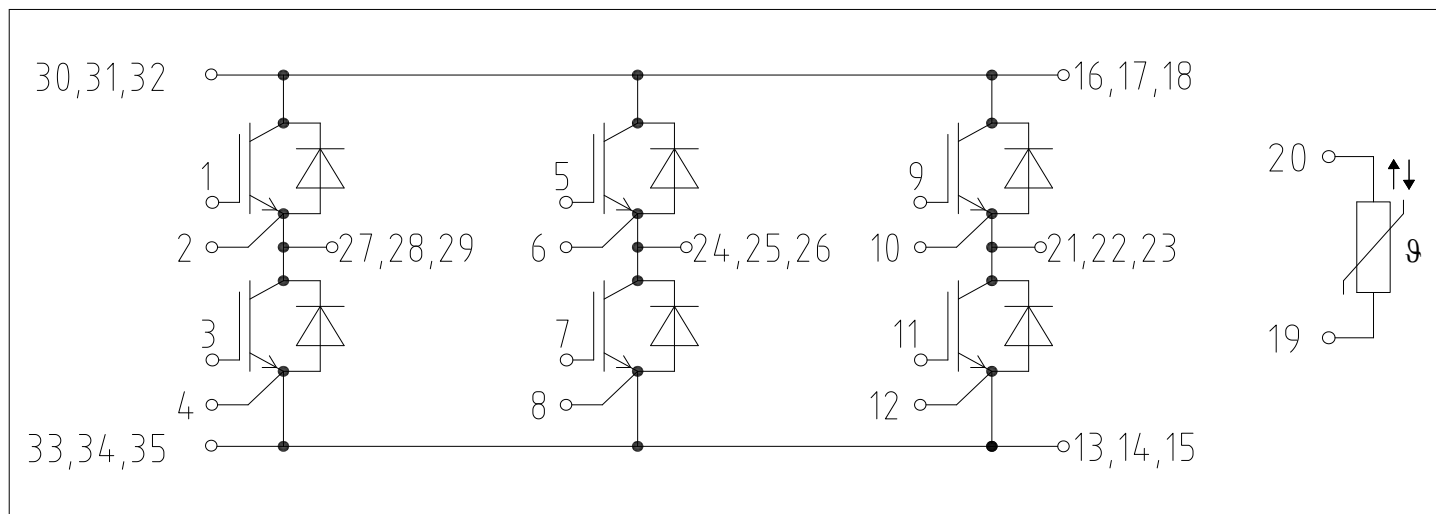


Figure 2



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Edition 2021-03-04

Published by

Infineon Technologies AG
81726 Munich, Germany

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