

Preliminary datasheet

MIPAQ™base module with Trench/Fieldstop IGBT4 and emitter controlled 4 diode and current sense shunt

Features

- Electrical features
 - $V_{CES} = 1200\text{ V}$
 - $I_{C\text{ nom}} = 150\text{ A} / I_{CRM} = 300\text{ A}$
 - $T_{vj,op} = 150^{\circ}\text{C}$
 - Low $V_{CE,sat}$
 - Low switching losses
 - $V_{CE,sat}$ with positive temperature coefficient
- Mechanical features
 - Isolated base plate
 - Solder contact technology
 - Standard housing
 - High power and thermal cycling capability
 - Copper base plate



Typical appearance

Potential applications

- Servo drives
- Motor drives
- Auxiliary inverters

Product validation

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

Description

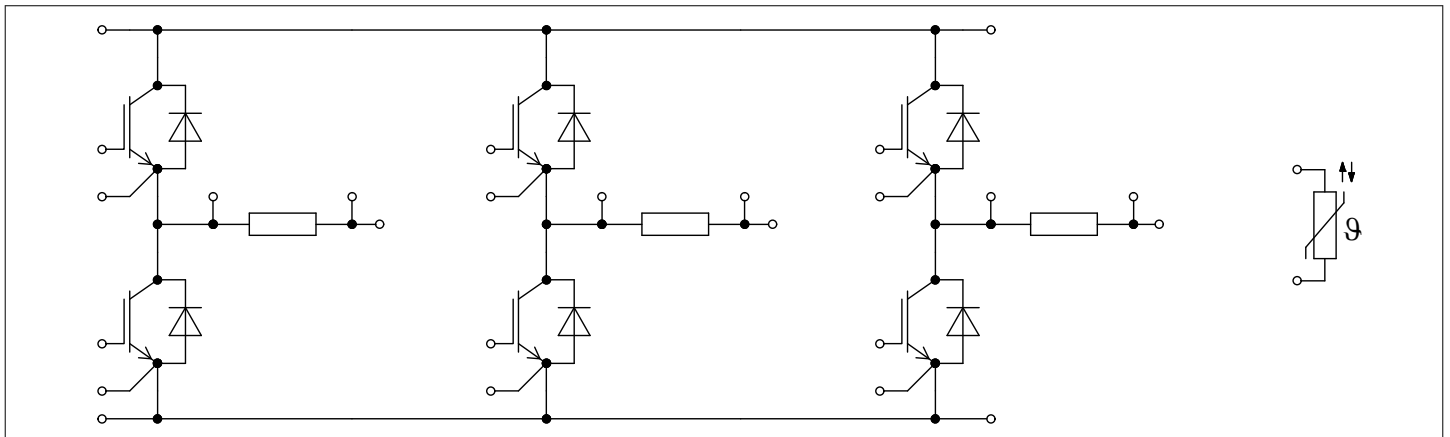


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	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	

Table 2 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, case to heat sink	R_{thCH}	$\lambda_{grease} = 1 \text{ W/(m}\cdot\text{K)}$		0.009		K/W
Stray inductance module	L_{sCE}			20		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25 \text{ }^\circ\text{C}$, per switch		1.8		mΩ
Storage temperature	T_{stg}		-40		125	$^\circ\text{C}$
Mounting torque for module mounting	M	- Mounting according to valid application note	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}		$T_{vj} = 25 \text{ }^\circ\text{C}$	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj \text{ max}} = 175 \text{ }^\circ\text{C}$	$T_C = 90 \text{ }^\circ\text{C}$	150	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj \text{ op}}$		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	$V_{CE\ sat}$	$I_C = 150\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		1.75	2.15	V
			$T_{vj} = 125\ ^\circ C$		2.00		
			$T_{vj} = 150\ ^\circ C$		2.05		
Gate threshold voltage	V_{GETh}	$I_C = 5.3\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$		5.20	5.80	6.40	V
Gate charge	Q_G	$V_{GE} = \pm 15\ V$			1.25		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$			5		Ω
Input capacitance	C_{ies}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			9.36		nF
Reverse transfer capacitance	C_{res}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			0.35		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}	$V_{CE} = 0\ V, V_{GE} = 20\ V, T_{vj} = 25\ ^\circ C$				100	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 150\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.1\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.190		μs
			$T_{vj} = 125\ ^\circ C$		0.200		
			$T_{vj} = 150\ ^\circ C$		0.210		
Rise time (inductive load)	t_r	$I_C = 150\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.1\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.025		μs
			$T_{vj} = 125\ ^\circ C$		0.030		
			$T_{vj} = 150\ ^\circ C$		0.030		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 150\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.1\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.400		μs
			$T_{vj} = 125\ ^\circ C$		0.480		
			$T_{vj} = 150\ ^\circ C$		0.510		
Fall time (inductive load)	t_f	$I_C = 150\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.1\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.060		μs
			$T_{vj} = 125\ ^\circ C$		0.110		
			$T_{vj} = 150\ ^\circ C$		0.130		
Turn-on energy loss per pulse	E_{on}	$I_C = 150\ A, V_{CC} = 600\ V, L_\sigma = 40\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 1.1\ \Omega, di/dt = 6000\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		5		mJ
			$T_{vj} = 125\ ^\circ C$		9		
			$T_{vj} = 150\ ^\circ C$		10		
Turn-off energy loss per pulse	E_{off}	$I_C = 150\ A, V_{CC} = 600\ V, L_\sigma = 40\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 1.1\ \Omega, dv/dt = 3600\ V/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		12		mJ
			$T_{vj} = 125\ ^\circ C$		18		
			$T_{vj} = 150\ ^\circ C$		19.2		
SC data	I_{SC}	$V_{GE} \leq 15\ V, V_{CC} = 800\ V, V_{CEmax} = V_{CES} - L_{sCE} * di/dt$	$t_P \leq 10\ \mu s, T_{vj} = 150\ ^\circ C$		600		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			0.200	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, $\lambda_{grease} = 1 \text{ W/(m}\cdot\text{K)}$		0.0830		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			150	A
Repetitive peak forward current	I_{FRM}	$t_P = 1 \text{ ms}$		300	A
I^2t - value	I^2t	$t_P = 10 \text{ ms}, V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ °C}$	3050	A^2s
			$T_{vj} = 150 \text{ °C}$	2950	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 150 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$	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}	$V_{CC} = 600 \text{ V}, I_F = 150 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6000 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ °C})$	$T_{vj} = 25 \text{ °C}$	220		A
			$T_{vj} = 125 \text{ °C}$	240		
			$T_{vj} = 150 \text{ °C}$	250		
Recovered charge	Q_r	$V_{CC} = 600 \text{ V}, I_F = 150 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6000 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ °C})$	$T_{vj} = 25 \text{ °C}$	14		μC
			$T_{vj} = 125 \text{ °C}$	25		
			$T_{vj} = 150 \text{ °C}$	28		
Reverse recovery energy	E_{rec}	$V_{CC} = 600 \text{ V}, I_F = 150 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6000 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ °C})$	$T_{vj} = 25 \text{ °C}$	7		mJ
			$T_{vj} = 125 \text{ °C}$	11.5		
			$T_{vj} = 150 \text{ °C}$	13.5		

(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			0.375	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W/(m}\cdot\text{K)}$		0.155		K/W
Temperature under switching conditions	$T_{vj op}$		-40		150	°C

4 Shunt

Table 7 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{20}	$T_C = 20 \text{ °C}$		1		mΩ
Temperature coefficient	TCR	$T_{Range} = 20...60 \text{ °C}$			30	ppm/K
Operation temperature	$T_{vj op}$				200	°C
Thermal resistance, junction to case	R_{thJC}	per shunt			6.00	K/W

5 NTC-Thermistor

Table 8 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

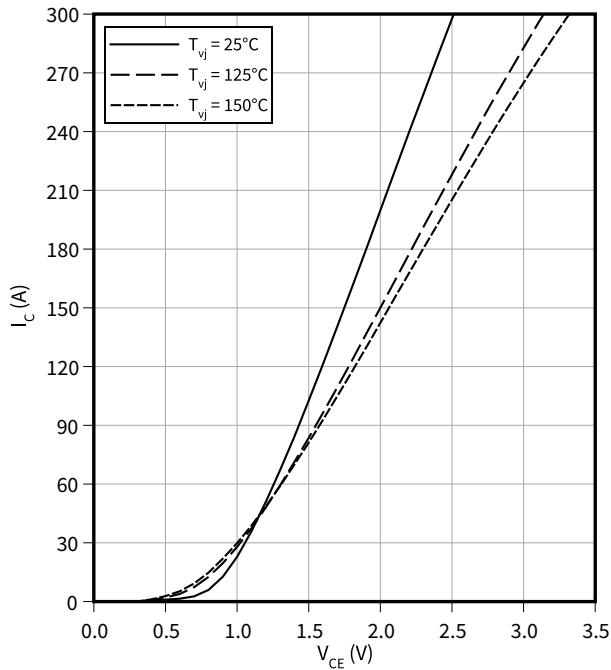
Note: Specification according to the valid application note.

6 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

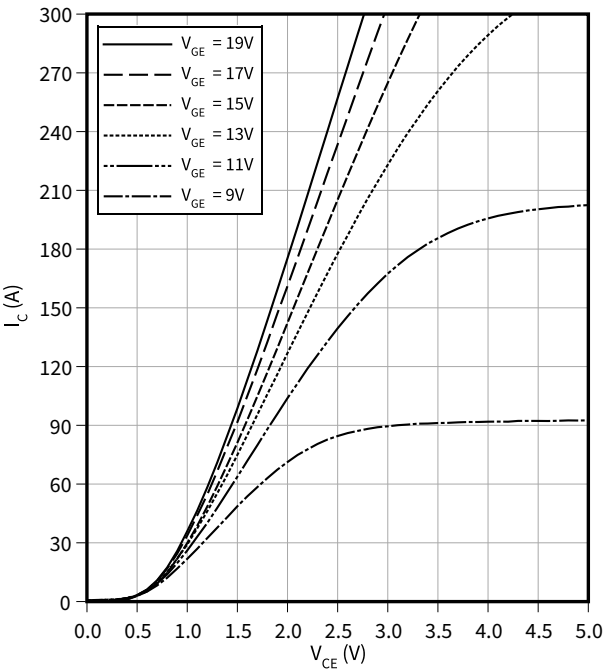
$V_{GE} \leq 15 \text{ V}$



Output characteristic field (typical), IGBT, Inverter

$I_C = f(V_{CE})$

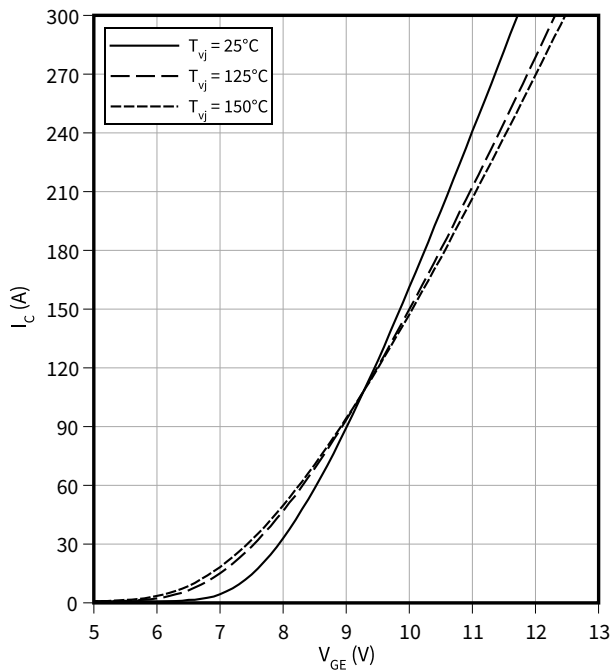
$T_{vj} = 150^\circ\text{C}$



Transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

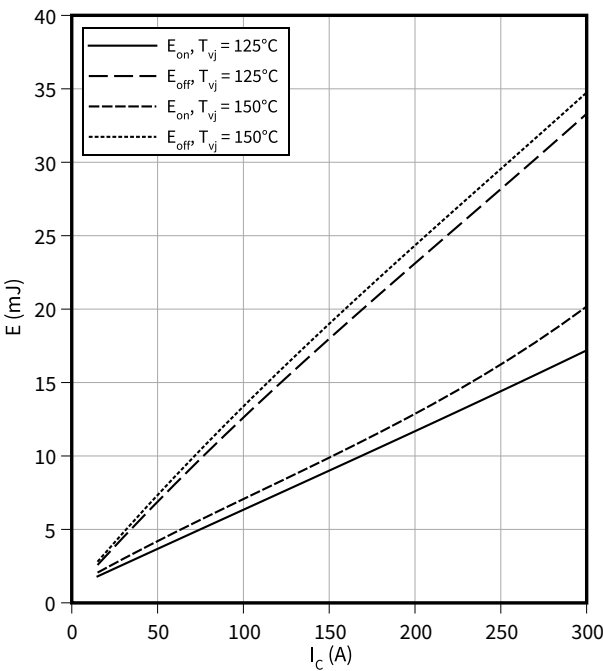
$V_{CE} = 20 \text{ V}$



Switching losses (typical), IGBT, Inverter

$E = f(I_C)$

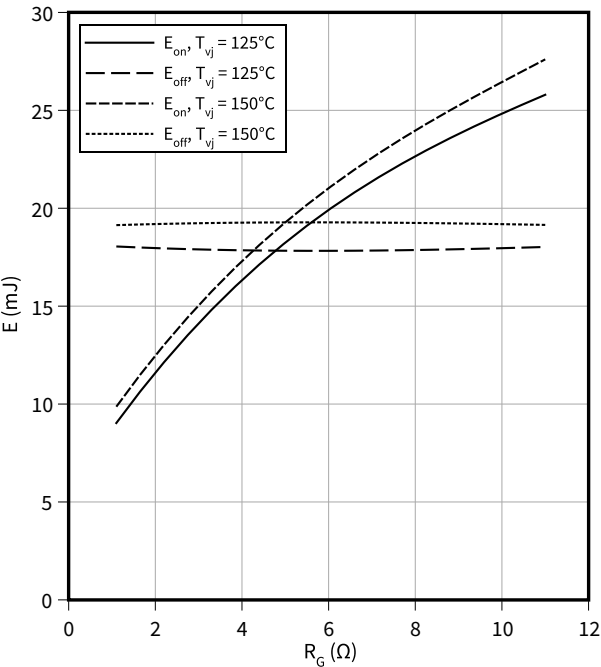
$R_{Goff} = 1.1 \Omega$, $R_{Gon} = 1.1 \Omega$, $V_{GE} = \pm 15 \text{ V}$, $V_{CC} = 600 \text{ V}$



6 Characteristics diagrams

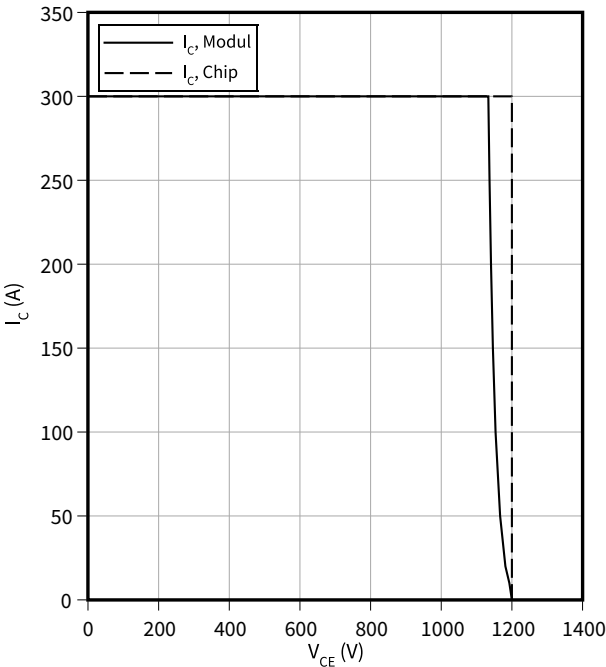
Switching losses (typical), IGBT, Inverter

$E = f(R_G)$
 $V_{GE} = \pm 15\text{ V}$, $I_C = 150\text{ A}$, $V_{CC} = 600\text{ V}$



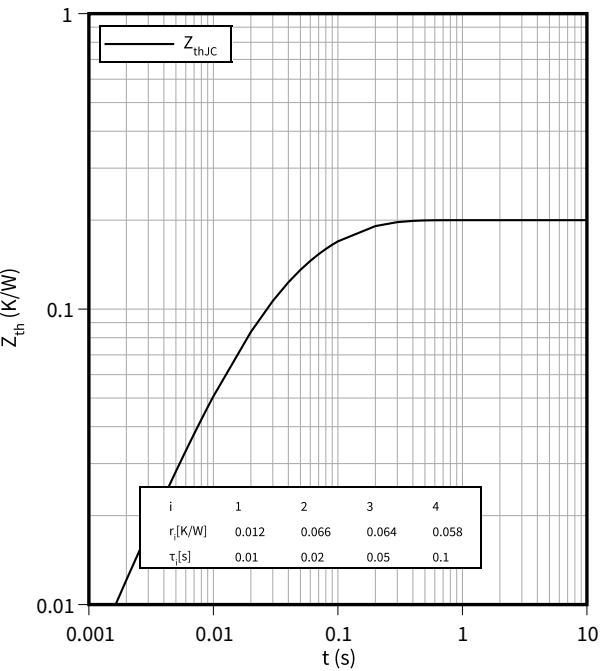
Reverse bias safe operating area (RBSOA), IGBT, Inverter

$I_C = f(V_{CE})$
 $R_{Goff} = 1.1\ \Omega$, $V_{GE} = \pm 15\text{ V}$, $T_{vj} = 150^\circ\text{C}$



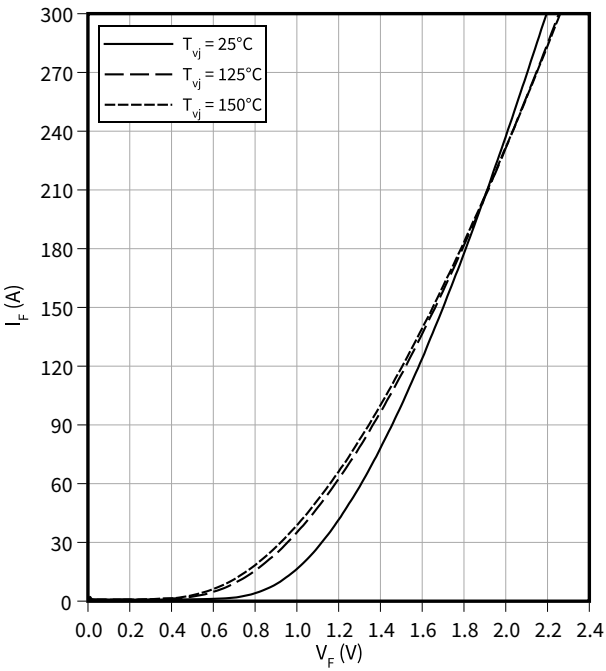
Transient thermal impedance, IGBT, Inverter

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, Inverter

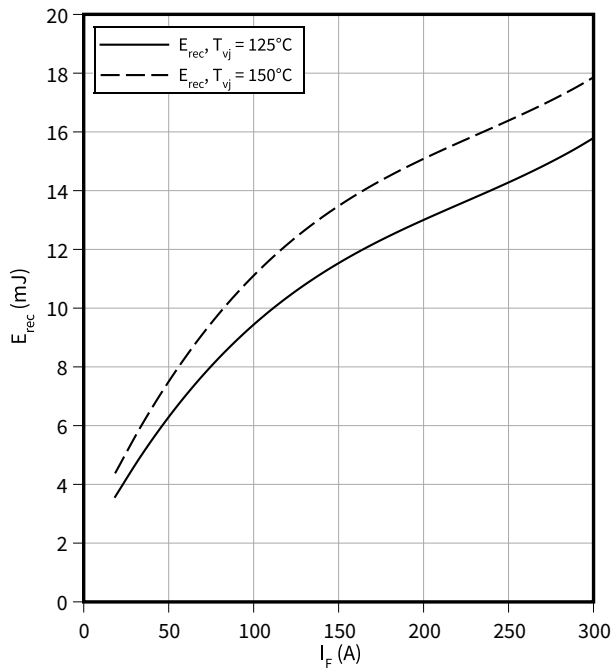
$I_F = f(V_F)$



6 Characteristics diagrams

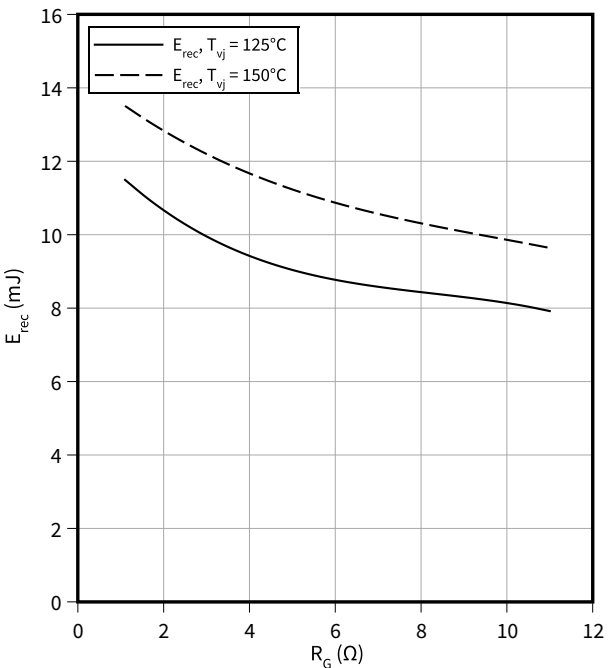
Switching losses (typical), Diode, Inverter

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



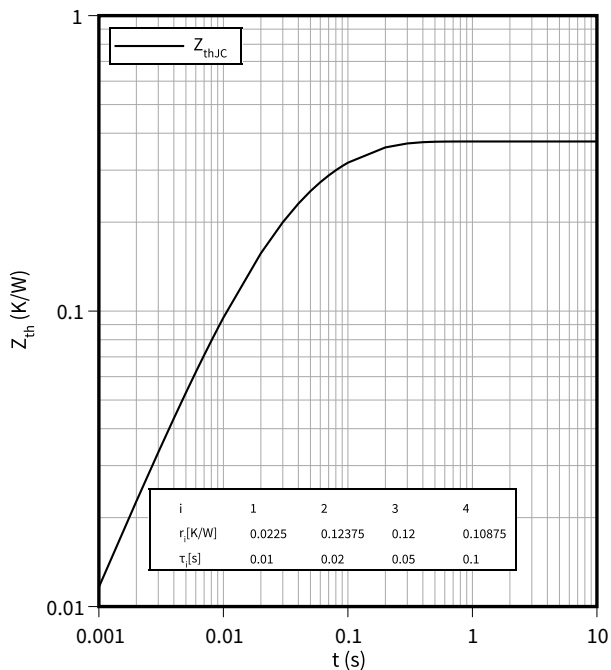
Switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$
 $I_F = 150\text{ A}, V_{CC} = 600\text{ V}$



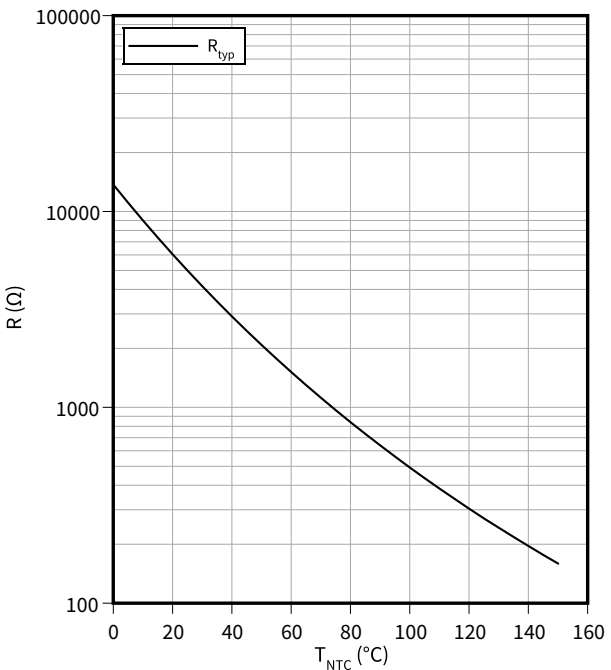
Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



7 Circuit diagram

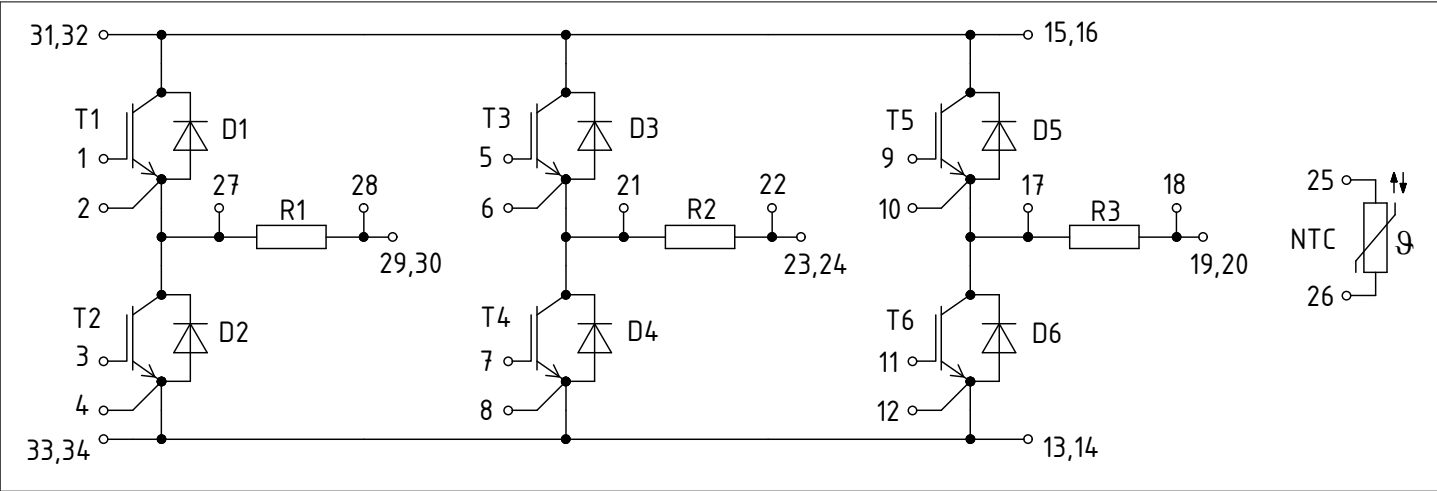


Figure 1

Figure 2

9 Module label code

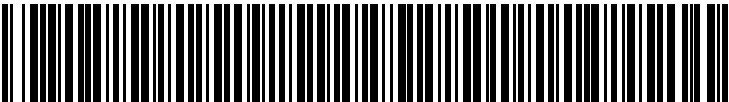
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	<i>Content</i>	<i>Digit</i>	<i>Example</i>
	Module serial number	1 – 5	71549
	Module material number	6 - 11	142846
	Production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

Figure 3



Revision history

Revision history

Document revision	Date of release	Description of changes
V1.0	2009-05-08	Target datasheet
V2.0	2010-06-16	Preliminary datasheet
n/a	2020-09-01	Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy
0.20	2024-08-29	Preliminary datasheet

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Email: erratum@infineon.com

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