

MIPAQ™ base module with Trench/Fieldstop IGBT4 and Emitter Controlled HE diode and NTC / shunt / pre-applied TIM

Features

- Electrical features
 - $V_{CES} = 1200\text{ V}$
 - $I_{C\text{ nom}} = 200\text{ A} / I_{CRM} = 400\text{ A}$
 - Low switching losses
 - Low V_{CESat}
 - $T_{vj\text{ op}} = 150\text{ °C}$
- Mechanical features
 - High power and thermal cycling capability
 - Isolated base plate
 - Copper base plate
 - Solder contact technology
 - Standard housing
 - Pre-applied Thermal Interface Material



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

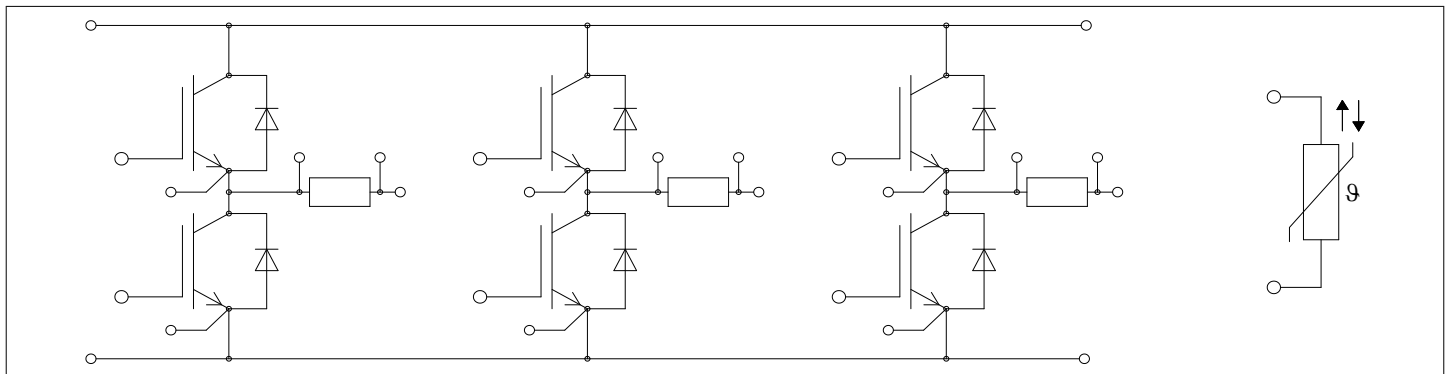




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1 Package

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}			20		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_H = 25^\circ\text{C}$, per switch		1.8		mΩ
Storage temperature	T_{stg}		-40		125	°C
Maximum baseplate operation temperature	T_{BPmax}				125	°C
Mounting torque for modul mounting	M	- Mounting according to M5, Screw 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. The shunt value is not a part of the $R_{CC'+EE'}$ resistance.

Storage and shipment of modules with TIM => see AN2012-07

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}	$T_{vj \max} = 175^\circ\text{C}$ $T_H = 60^\circ\text{C}$	200	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	$V_{CE\ sat}$	$I_C = 200\ A, V_{GE} = 15\ V$ $T_{vj} = 25\ ^\circ C$ $T_{vj} = 125\ ^\circ C$ $T_{vj} = 150\ ^\circ C$		1.75	2.10	V
				2.00		
				2.05		
Gate threshold voltage	V_{GEth}	$I_C = 7.6\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$	5.25	5.80	6.35	V
Gate charge	Q_G	$V_{GE} = \pm 15\ V, V_{CE} = 600\ V$		1.65		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}	$V_{CE} = 0\ V, V_{GE} = 20\ V, T_{vj} = 25\ ^\circ C$			100	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 200\ A, V_{CE} = 600\ V,$ $V_{GE} = \pm 15\ V, R_{Gon} = 1\ \Omega$ $T_{vj} = 25\ ^\circ C$ $T_{vj} = 125\ ^\circ C$ $T_{vj} = 150\ ^\circ C$		0.140		μs
				0.150		
				0.150		
Rise time (inductive load)	t_r	$I_C = 200\ A, V_{CE} = 600\ V,$ $V_{GE} = \pm 15\ V, R_{Gon} = 1\ \Omega$ $T_{vj} = 25\ ^\circ C$ $T_{vj} = 125\ ^\circ C$ $T_{vj} = 150\ ^\circ C$		0.028		μs
				0.034		
				0.035		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 200\ A, V_{CE} = 600\ V,$ $V_{GE} = \pm 15\ V, R_{Goff} = 1\ \Omega$ $T_{vj} = 25\ ^\circ C$ $T_{vj} = 125\ ^\circ C$ $T_{vj} = 150\ ^\circ C$		0.320		μs
				0.410		
				0.440		
Fall time (inductive load)	t_f	$I_C = 200\ A, V_{CE} = 600\ V,$ $V_{GE} = \pm 15\ V, R_{Goff} = 1\ \Omega$ $T_{vj} = 25\ ^\circ C$ $T_{vj} = 125\ ^\circ C$ $T_{vj} = 150\ ^\circ C$		0.043		μs
				0.079		
				0.088		
Turn-on energy loss per pulse	E_{on}	$I_C = 200\ A, V_{CE} = 600\ V,$ $L_\sigma = 30\ nH, V_{GE} = \pm 15\ V,$ $R_{Gon} = 1\ \Omega, di/dt = 5500\ A/\mu s$ ($T_{vj} = 150\ ^\circ C$) $T_{vj} = 25\ ^\circ C$ $T_{vj} = 125\ ^\circ C$ $T_{vj} = 150\ ^\circ C$		13		mJ
				21		
				23.5		
Turn-off energy loss per pulse	E_{off}	$I_C = 200\ A, V_{CE} = 600\ V,$ $L_\sigma = 30\ nH, V_{GE} = \pm 15\ V,$ $R_{Goff} = 1\ \Omega, dv/dt = 3300\ V/\mu s$ ($T_{vj} = 150\ ^\circ C$) $T_{vj} = 25\ ^\circ C$ $T_{vj} = 125\ ^\circ C$ $T_{vj} = 150\ ^\circ C$		15.5		mJ
				24		
				26.5		
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 heatsink	R_{thJH}	per IGBT, Valid with IFX pre-applied Thermal Interface Material			0.227	K/W

3 Diode, Inverter

Table 4 Characteristic Values (continued)

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
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}	$T_{vj} = 25\ ^\circ\text{C}$	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	$V_R = 0\ \text{V}, t_p = 10\ \text{ms}$	$T_{vj} = 125\ ^\circ\text{C}$	A^2s
			$T_{vj} = 150\ ^\circ\text{C}$	

Table 6 Characteristic Values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 200\ \text{A}, V_{GE} = 0\ \text{V}$		$T_{vj} = 25\ ^\circ\text{C}$	2.15	V
				$T_{vj} = 125\ ^\circ\text{C}$	1.65	
				$T_{vj} = 150\ ^\circ\text{C}$	1.65	
Peak reverse recovery current	I_{RM}	$I_F = 200\ \text{A}, V_R = 600\ \text{V}, V_{GE} = -15\ \text{V}, -di_F/dt = 5500\ \text{A}/\mu\text{s} (T_{vj} = 150\ ^\circ\text{C})$		$T_{vj} = 25\ ^\circ\text{C}$	195	A
				$T_{vj} = 125\ ^\circ\text{C}$	215	
				$T_{vj} = 150\ ^\circ\text{C}$	220	
Recovered charge	Q_r	$I_F = 200\ \text{A}, V_R = 600\ \text{V}, V_{GE} = -15\ \text{V}, -di_F/dt = 5500\ \text{A}/\mu\text{s} (T_{vj} = 150\ ^\circ\text{C})$		$T_{vj} = 25\ ^\circ\text{C}$	18	μC
				$T_{vj} = 125\ ^\circ\text{C}$	33	
				$T_{vj} = 150\ ^\circ\text{C}$	37	
Reverse recovery energy	E_{rec}	$I_F = 200\ \text{A}, V_R = 600\ \text{V}, V_{GE} = -15\ \text{V}, -di_F/dt = 5500\ \text{A}/\mu\text{s} (T_{vj} = 150\ ^\circ\text{C})$		$T_{vj} = 25\ ^\circ\text{C}$	8.85	mJ
				$T_{vj} = 125\ ^\circ\text{C}$	17.5	
				$T_{vj} = 150\ ^\circ\text{C}$	20	
Thermal resistance, junction to heatsink	R_{thJH}	per diode, Valid with IFX pre-applied Thermal Interface Material			0.337	K/W
Temperature under switching conditions	$T_{vj\ op}$		-40		150	°C

4 Shunt

4 Shunt

Table 7 Characteristic Values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{20}			0.53		mΩ
Temperature coefficient	TCR	$T_{Range} = +20/+60\text{ °C}$			30	ppm/K
Operation temperature	$T_{vj\ op}$				200	°C
Thermal resistance, junction to heatsink	R_{thJH}	per shunt, Valid with IFX pre-applied Thermal Interface Material			7.00	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

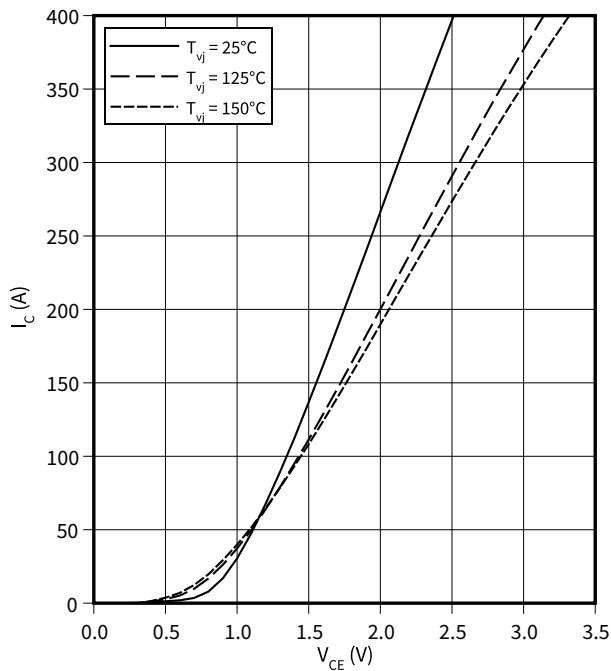
Note: Specification according to the valid application note.

6 Characteristics diagrams

6 Characteristics diagrams

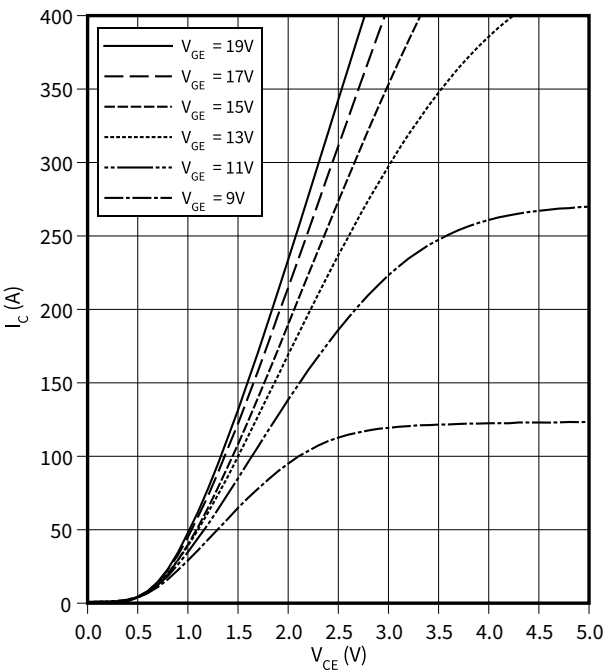
output characteristic (typical), IGBT, Inverter

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



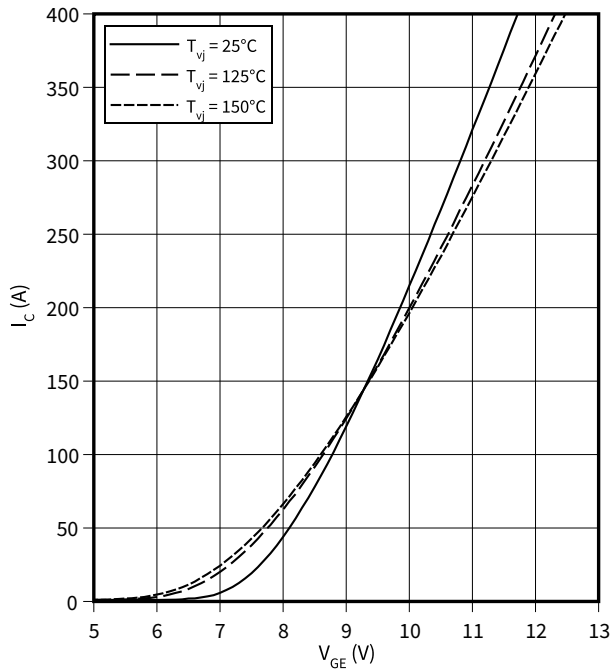
output characteristic (typical), IGBT, Inverter

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



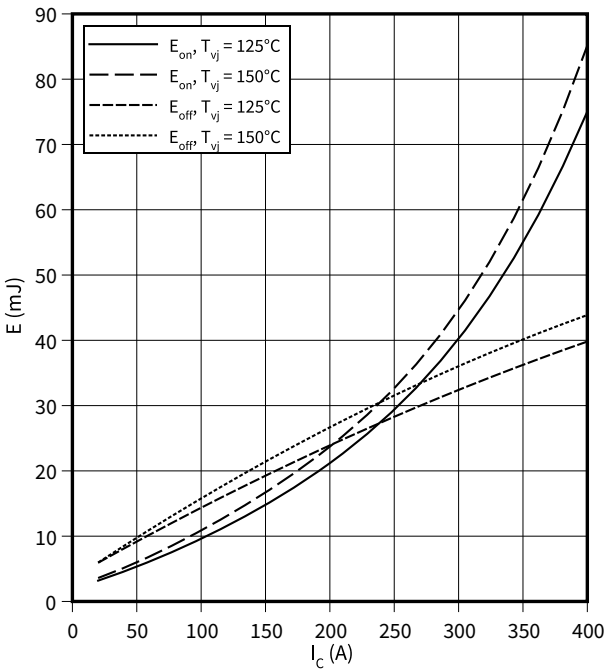
transfer characteristic (typical), IGBT, Inverter

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



switching losses (typical), IGBT, Inverter

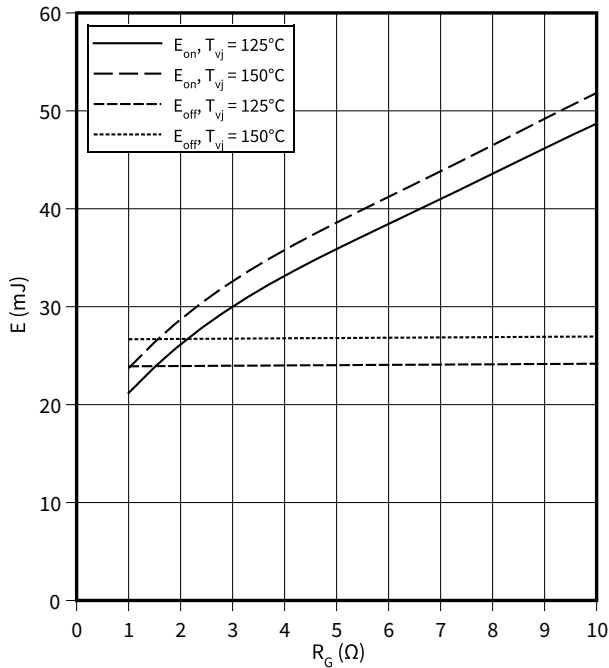
$E = f(I_C)$
 $R_{Goff} = 1\text{ }\Omega$, $R_{Gon} = 1\text{ }\Omega$, $V_{CE} = 600\text{ V}$, $V_{GE} = \pm 15\text{ V}$



6 Characteristics diagrams

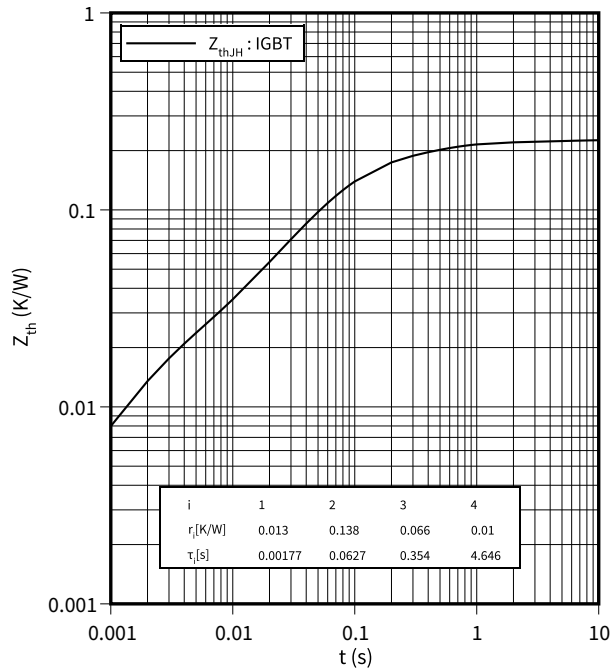
switching losses (typical), IGBT, Inverter

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



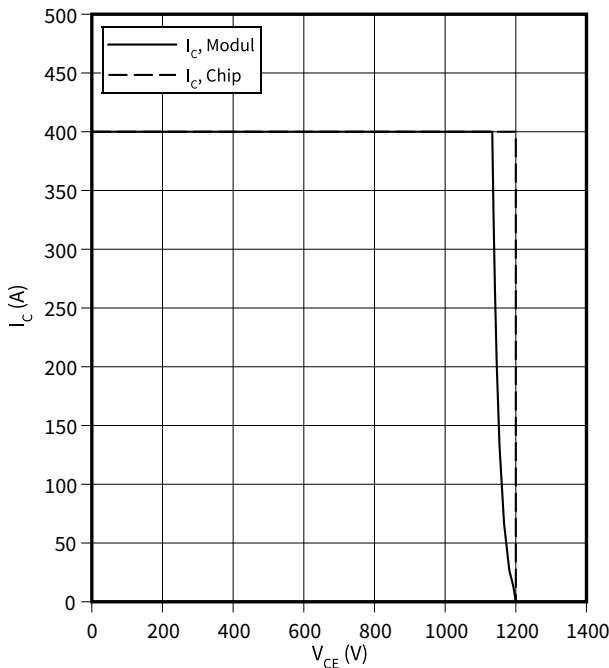
transient thermal impedance , IGBT, Inverter

$Z_{th} = f(t)$



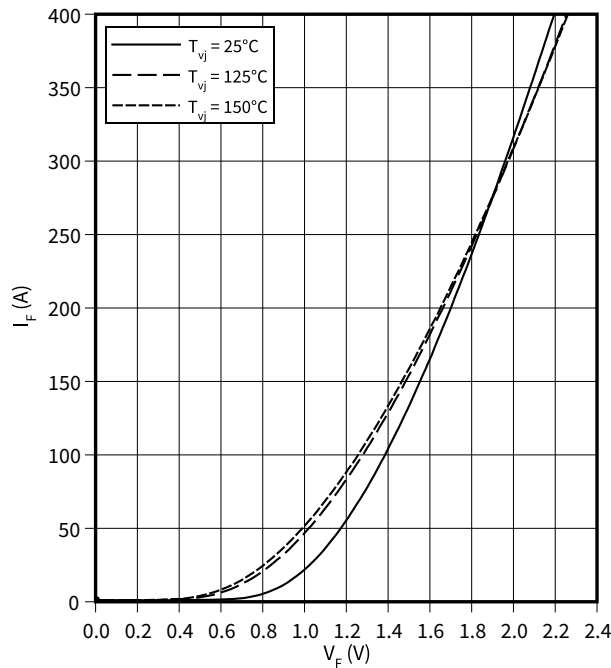
reverse bias safe operating area (RBSOA), IGBT, Inverter

$I_C = f(V_{CE})$
 $R_{Goff} = 1\text{ }\Omega$, $V_{GE} = \pm 15\text{ V}$, $T_{vj} = 150\text{ }^\circ\text{C}$



forward characteristic (typical), Diode, Inverter

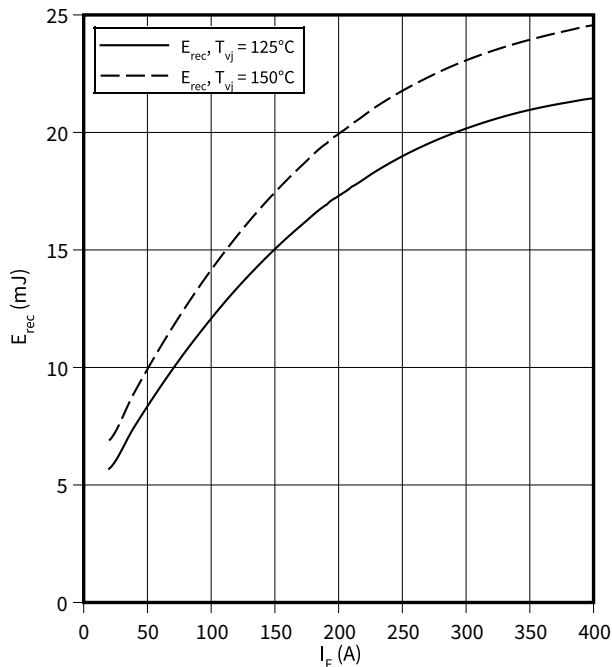
$I_F = f(V_F)$



6 Characteristics diagrams

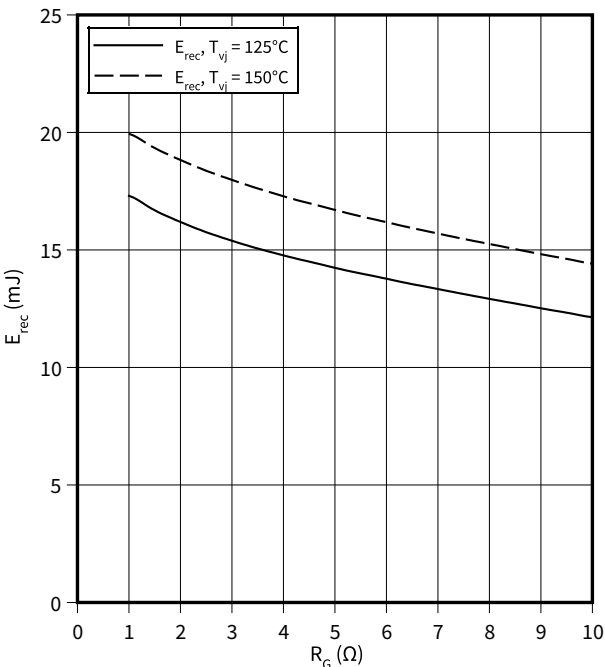
switching losses (typical), Diode, Inverter

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



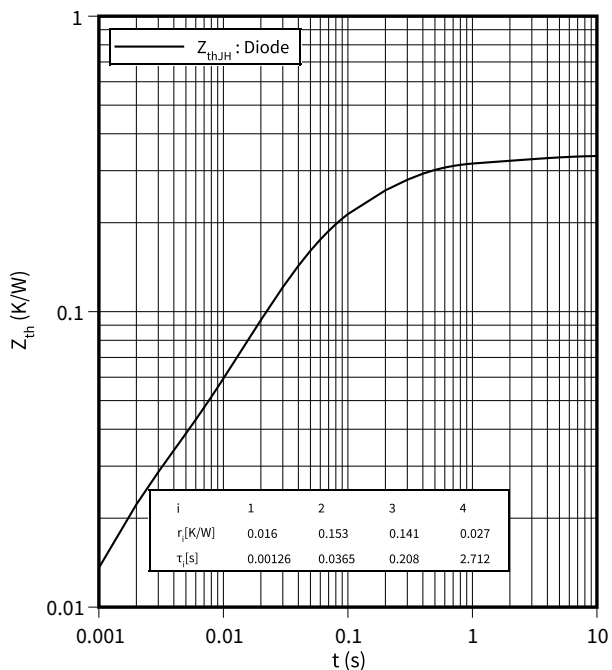
switching losses (typical), Diode, Inverter

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



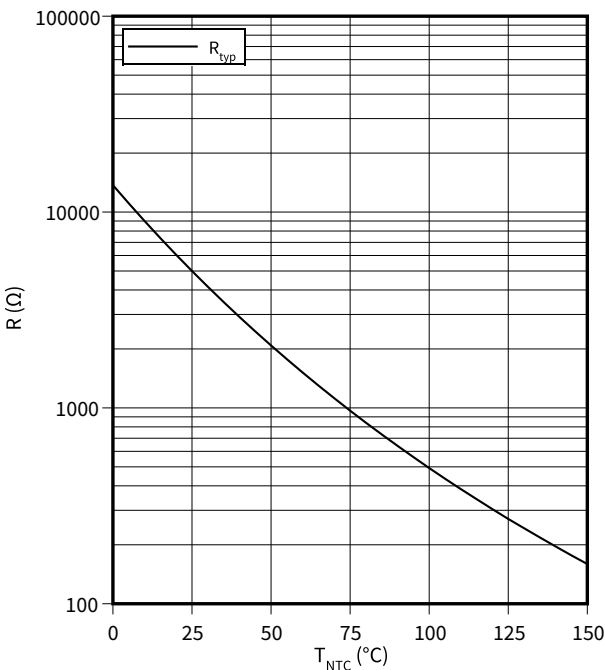
transient thermal impedance , Diode, Inverter

$Z_{th} = f(t)$



temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



7 **Circuit diagram**

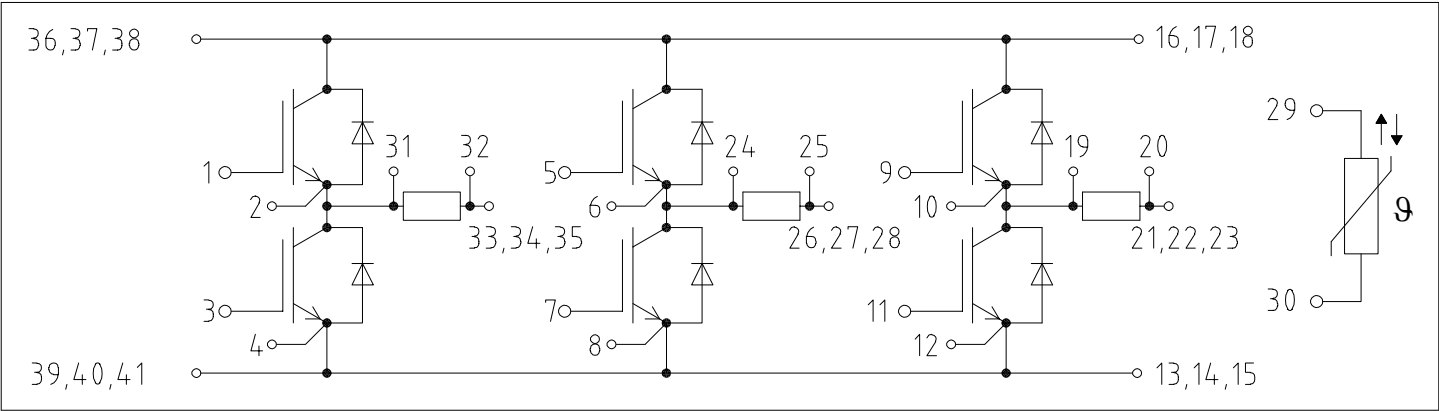


Figure 2

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 4

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