

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

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



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

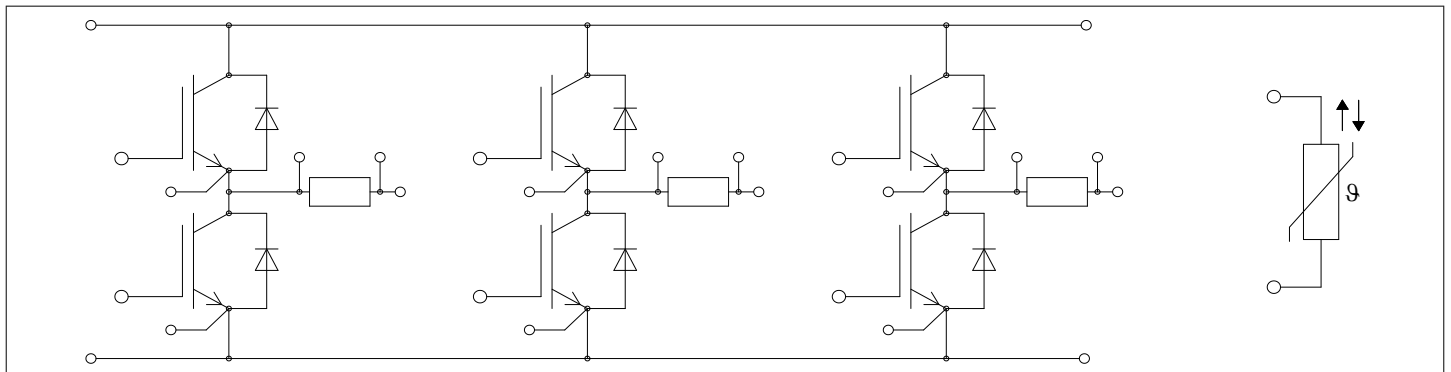


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1 Package

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	$R_{CC'+EE'}$	$T_C = 25^\circ\text{C}$, per switch		1.8		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting torque for modul mounting	M	- Mounting according to valid application note	M5, Screw	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.

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
Continous DC collector current	I_{CDC}	$T_{vj \text{ max}} = 175^\circ\text{C}$ $T_C = 90^\circ\text{C}$	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	$V_{CE\ sat}$	$I_C = 200\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$	1.75	2.10	V
			$T_{vj} = 125\ ^\circ C$	2.00		
			$T_{vj} = 150\ ^\circ C$	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}	$I_C = 200\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.140		μs
			$T_{vj} = 125\ ^\circ C$	0.150		
			$T_{vj} = 150\ ^\circ C$	0.150		
Rise time (inductive load)	t_r	$I_C = 200\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.028		μs
			$T_{vj} = 125\ ^\circ C$	0.034		
			$T_{vj} = 150\ ^\circ C$	0.035		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 200\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.320		μs
			$T_{vj} = 125\ ^\circ C$	0.410		
			$T_{vj} = 150\ ^\circ C$	0.440		
Fall time (inductive load)	t_f	$I_C = 200\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.043		μs
			$T_{vj} = 125\ ^\circ C$	0.079		
			$T_{vj} = 150\ ^\circ C$	0.088		
Turn-on energy loss per pulse	E_{on}	$I_C = 200\ A, V_{CE} = 600\ V, L_\sigma = 30\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 1\ \Omega, di/dt = 5500\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$	13		mJ
			$T_{vj} = 125\ ^\circ C$	21		
			$T_{vj} = 150\ ^\circ C$	23.5		
Turn-off energy loss per pulse	E_{off}	$I_C = 200\ A, V_{CE} = 600\ V, L_\sigma = 30\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 1\ \Omega, dv/dt = 3300\ V/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$	15.5		mJ
			$T_{vj} = 125\ ^\circ C$	24		
			$T_{vj} = 150\ ^\circ C$	26.5		
SC data	I_{SC}	$V_{GE} \leq 15\ V, V_{CC} = 800\ V, V_{CEmax} = V_{CES} - L_{sCE} * di/dt$	$t_p \leq 10\ \mu s, T_{vj} = 150\ ^\circ C$	800		A
Thermal resistance, junction to case	R_{thJC}	per IGBT			0.160	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, $\lambda_{grease} = 1 \text{ W/(m}^2\text{K)}$		0.0540		K/W
Temperature under switching conditions	T_{vjop}		-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}	$T_{vj} = 25 \text{ }^\circ\text{C}$	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	$t_p = 10 \text{ ms}, V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ }^\circ\text{C}$	7800	A^2s
			$T_{vj} = 150 \text{ }^\circ\text{C}$	7400	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	V_F	$I_F = 200 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		1.70	2.15	V
			$T_{vj} = 125 \text{ }^\circ\text{C}$		1.65		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		1.65		
Peak reverse recovery current	I_{RM}	$V_R = 600 \text{ V}, I_F = 200 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 5500 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		195		A
			$T_{vj} = 125 \text{ }^\circ\text{C}$		215		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		220		
Recovered charge	Q_r	$V_R = 600 \text{ V}, I_F = 200 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 5500 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		18		μC
			$T_{vj} = 125 \text{ }^\circ\text{C}$		33		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		37		
Reverse recovery energy	E_{rec}	$V_R = 600 \text{ V}, I_F = 200 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 5500 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		8.85		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$		17.5		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		20		
Thermal resistance, junction to case	R_{thJC}	per diode			0.250	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, $\lambda_{grease} = 1 \text{ W/(m}^2\text{K)}$		0.0720		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}	$T_{NTC} = 25 \text{ }^\circ\text{C}$		5		kΩ
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100 \text{ }^\circ\text{C}$, $R_{100} = 493 \text{ } \Omega$	-5		5	%
Power dissipation	P_{25}	$T_{NTC} = 25 \text{ }^\circ\text{C}$			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 Shunt

Table 8 Characteristic values

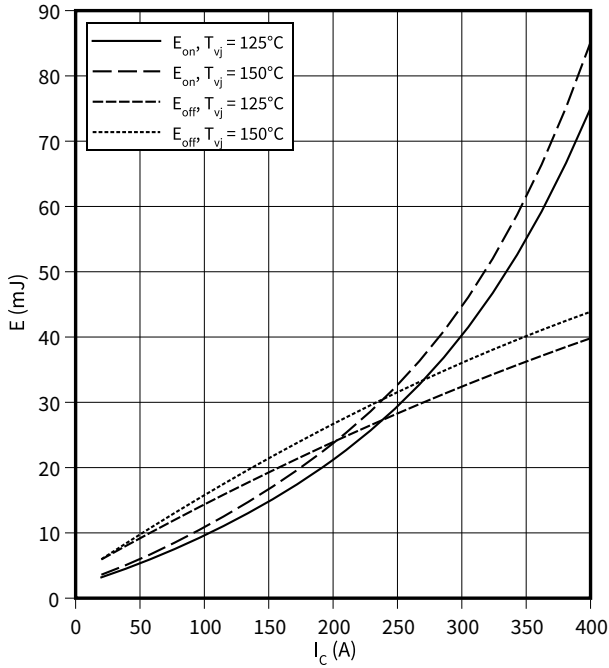
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{20}			0.53		mΩ
Temperature coefficient	TCR	$T_{Range} = +20/+60 \text{ }^\circ\text{C}$			30	ppm/K
Operation temperature	$T_{vj\ op}$				200	°C
Thermal resistance, junction to case	R_{thJC}	per shunt			6.55	K/W
Thermal resistance, case to heatsink	R_{thCH}	per shunt		0.312		K/W

6 Characteristics diagrams

switching losses (typical), IGBT, Inverter

$$E = f(I_C)$$

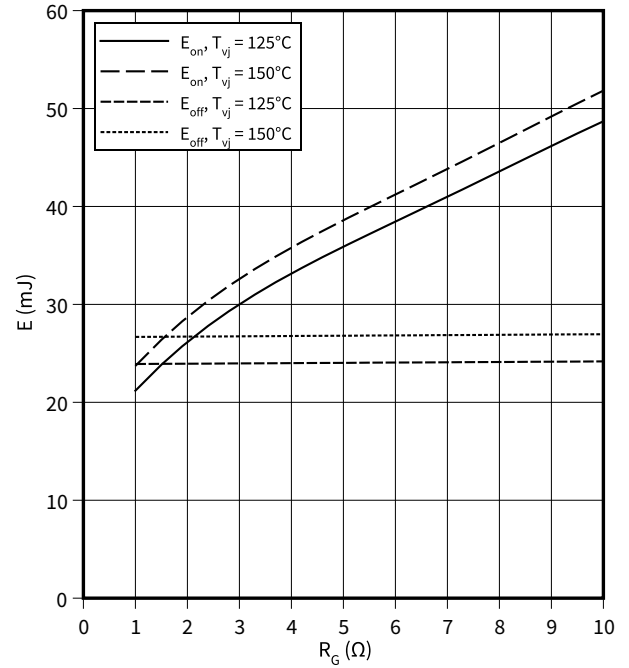
$$R_{Goff} = 1 \Omega, R_{Gon} = 1 \Omega, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}$$



switching losses (typical), IGBT, Inverter

$$E = f(R_G)$$

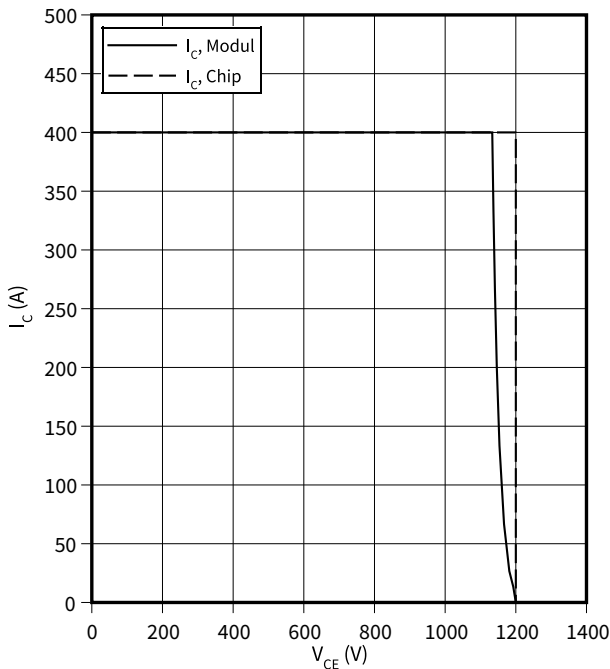
$$I_C = 200 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}$$



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

$$I_C = f(V_{CE})$$

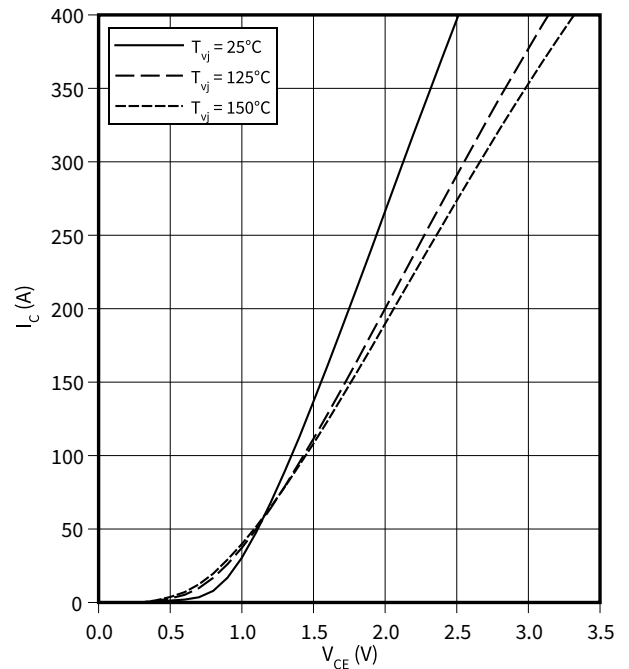
$$R_{Goff} = 1 \Omega, V_{GE} = \pm 15 \text{ V}, T_{vj} = 150 \text{ }^\circ\text{C}$$



output characteristic (typical), IGBT, Inverter

$$I_C = f(V_{CE})$$

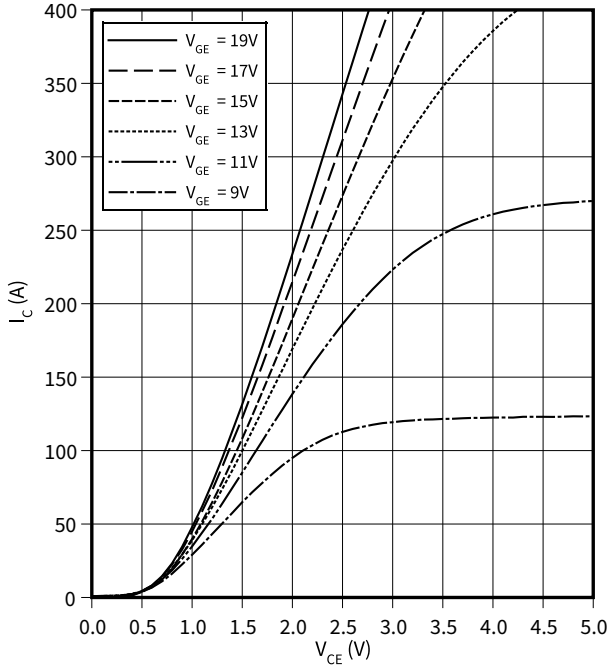
$$V_{GE} = 15 \text{ V}$$



6 Characteristics diagrams

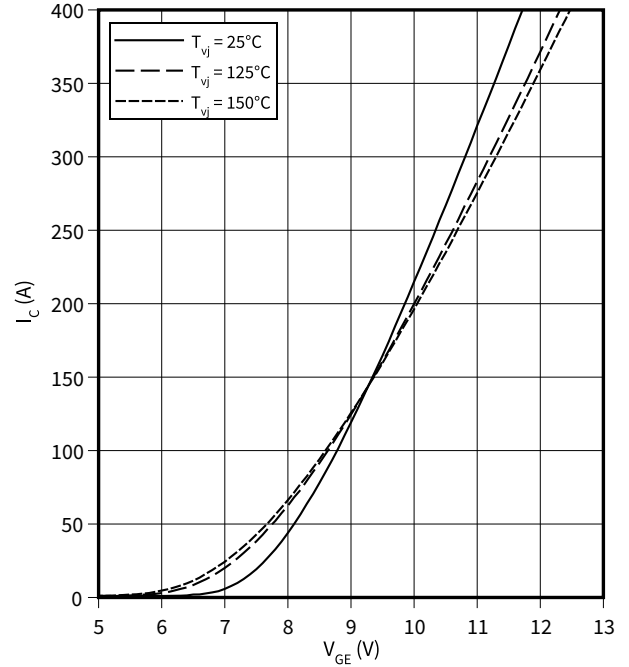
output characteristic (typical), IGBT, Inverter

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



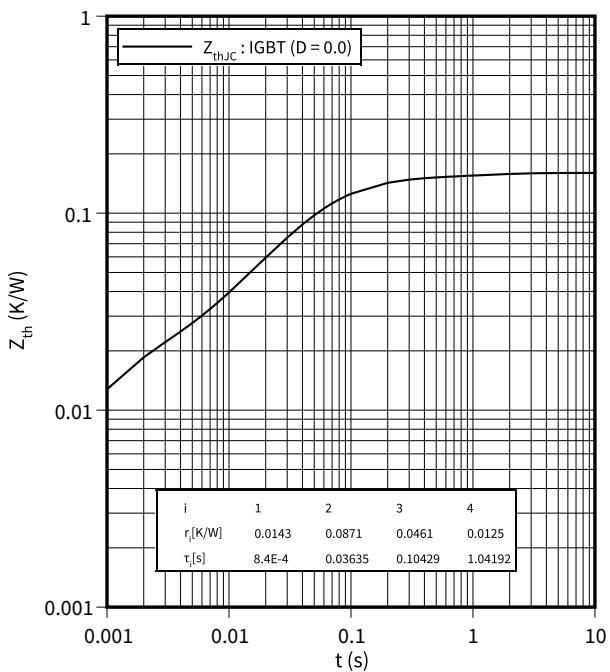
transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$
 $V_{CE} = 600\text{ V}$



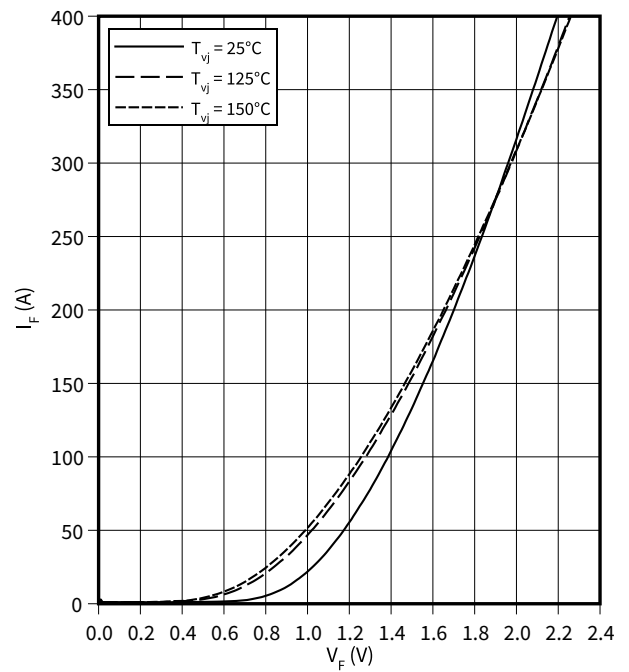
transient thermal impedance , IGBT, Inverter

$Z_{th} = f(t)$



forward characteristic (typical), Diode, Inverter

$I_F = f(V_F)$

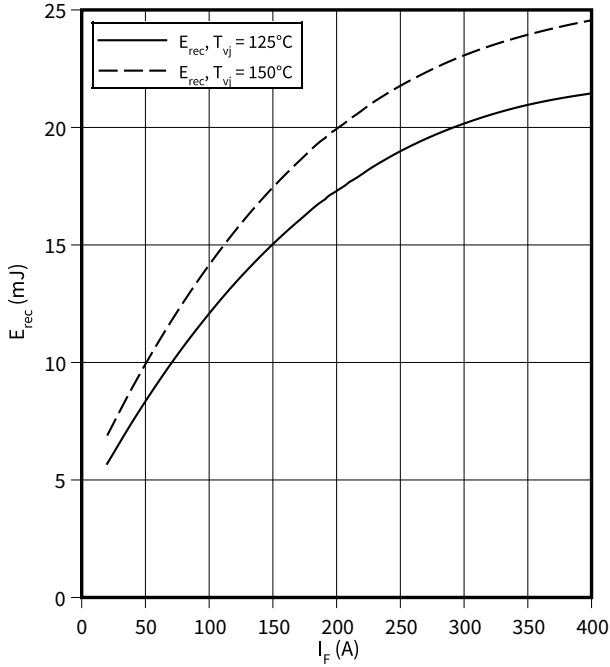


6 Characteristics diagrams

switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

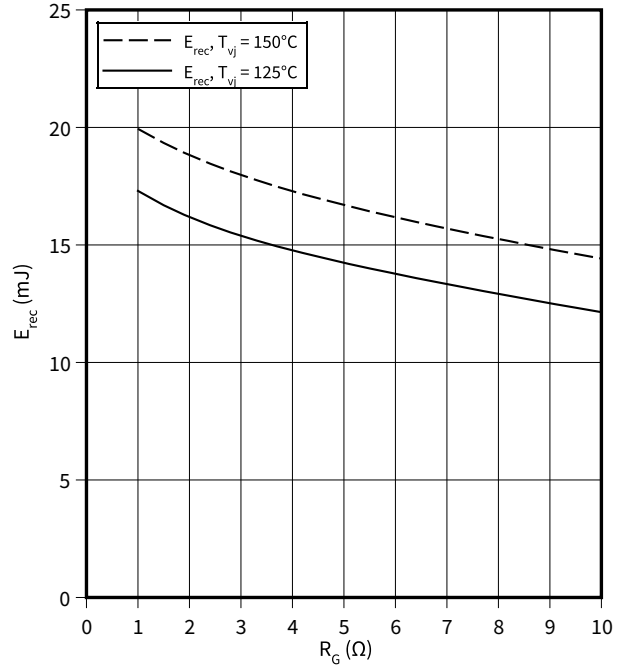
$V_{CE} = 600\text{ V}, R_{Gon} = R_{Gon}(IGBT)$



switching losses (typical), Diode, Inverter

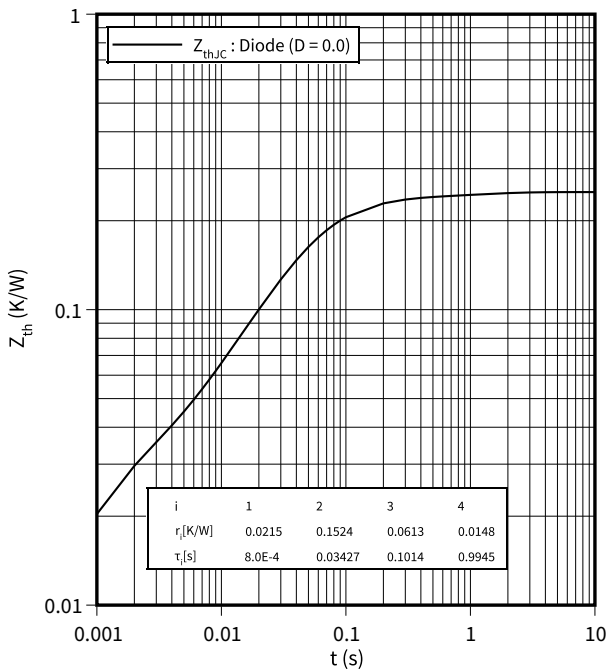
$E_{rec} = f(R_G)$

$V_{CE} = 600\text{ V}, I_F = 200\text{ A}$



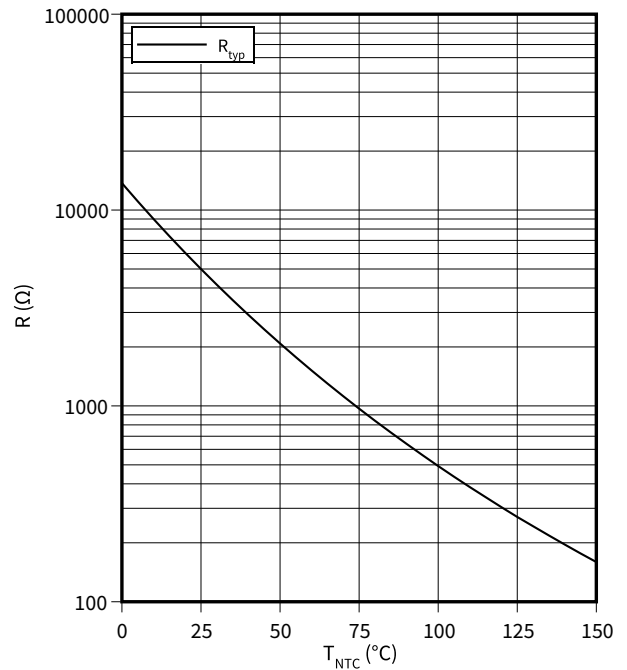
transient thermal impedance , Diode, Inverter

$Z_{th} = f(t)$



temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



7 Circuit diagram

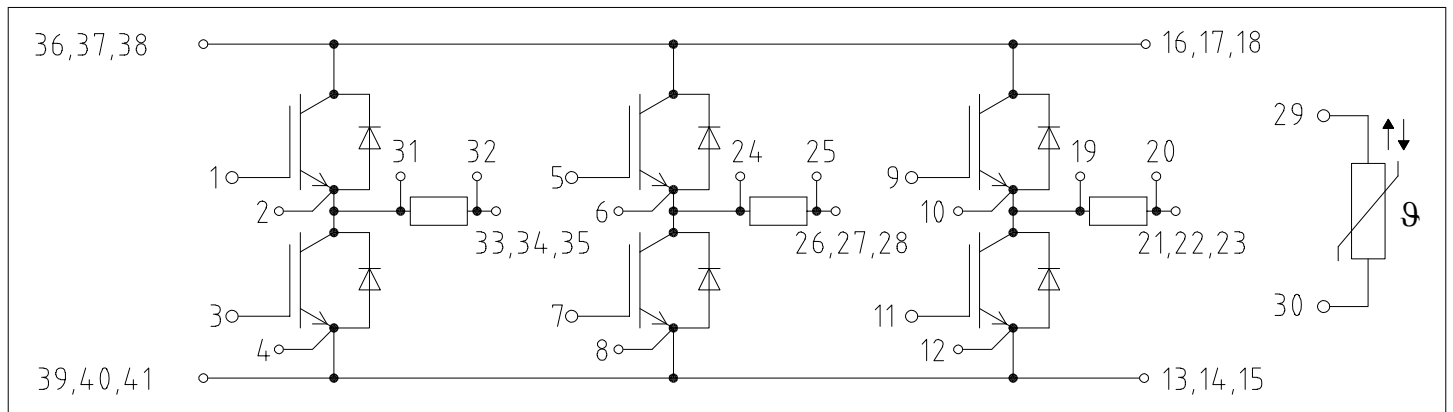


Figure 2

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