

Features

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- Chopper applications
- Three-level applications
- Motor drives

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

The diagram shows a differential amplifier circuit. It consists of two input transistors, M_1 and M_2 , whose sources are connected to a common source node. This node is connected to ground through a resistor R_{SS} . The gates of M_1 and M_2 are connected to a common gate node, which is biased by a DC voltage V_{GS} . The drains of M_1 and M_2 are connected to a common drain node through load resistors R_D . This drain node is connected to a positive supply voltage V_{DD} . The output voltages V_{out1} and V_{out2} are taken from the drains of M_1 and M_2 , respectively.

Table of contents

	Description	1
	Features	1
	Potential applications	1
	Product validation	1
	Table of contents	2
1	Package	3
2	IGBT, Brake-Chopper	3
3	Diode, Brake-Chopper	5
4	Diode, Reverse	6
5	Characteristics diagrams	7
6	Circuit diagram	11
7	Package outlines	12
8	Module label code	13
	Revision history	14
	Disclaimer	15

1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	4.0	kV
Material of module baseplate			Cu	
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	d_{Creep}	terminal to heatsink	29.0	mm
Creepage distance	d_{Creep}	terminal to terminal	23.0	mm
Clearance	d_{Clear}	terminal to heatsink	23.0	mm
Clearance	d_{Clear}	terminal to terminal	11.0	mm
Comparative tracking index	CTI		> 400	
Relative thermal index (electrical)	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		0.7		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting torque for module mounting	M	- Mounting according to valid application note	M6, Screw	3	6	Nm
Terminal connection torque	M	- Mounting according to valid application note	M6, Screw	2.5	5	Nm
Weight	G			340		g

2 IGBT, Brake-Chopper

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}	$T_{vj \max} = 175^\circ\text{C}$ $T_C = 100^\circ\text{C}$	450	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj \text{ op}}$	900	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	$V_{CE\ sat}$	$I_C = 450\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		1.75	2.15	V
			$T_{vj} = 125\ ^\circ C$		2.00		
			$T_{vj} = 150\ ^\circ C$		2.05		
Gate threshold voltage	V_{GETh}	$I_C = 16.4\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$		5.25	5.80	6.35	V
Gate charge	Q_G	$V_{GE} = \pm 15\ V, V_{CC} = 600\ V$			3.7		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$			1.9		Ω
Input capacitance	C_{ies}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			28		nF
Reverse transfer capacitance	C_{res}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			1.1		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}	$I_C = 450\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V$	$T_{vj} = 25\ ^\circ C$		0.200		μs
			$T_{vj} = 125\ ^\circ C$		0.250		
			$T_{vj} = 150\ ^\circ C$		0.270		
Rise time (inductive load)	t_r	$I_C = 450\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V$	$T_{vj} = 25\ ^\circ C$		0.045		μs
			$T_{vj} = 125\ ^\circ C$		0.050		
			$T_{vj} = 150\ ^\circ C$		0.055		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 450\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.500		μs
			$T_{vj} = 125\ ^\circ C$		0.600		
			$T_{vj} = 150\ ^\circ C$		0.620		
Fall time (inductive load)	t_f	$I_C = 450\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.100		μs
			$T_{vj} = 125\ ^\circ C$		0.160		
			$T_{vj} = 150\ ^\circ C$		0.180		
Turn-on energy loss per pulse	E_{on}	$I_C = 450\ A, V_{CC} = 600\ V, L_\sigma = 30\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 1\ \Omega, di/dt = 9000\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		19		mJ
			$T_{vj} = 125\ ^\circ C$		30		
			$T_{vj} = 150\ ^\circ C$		36		
Turn-off energy loss per pulse	E_{off}	$I_C = 450\ A, V_{CC} = 600\ V, L_\sigma = 30\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 1\ \Omega, dv/dt = 4000\ V/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		33		mJ
			$T_{vj} = 125\ ^\circ C$		50		
			$T_{vj} = 150\ ^\circ C$		56		
SC data	I_{SC}	$V_{GE} \leq 15\ V, V_{CC} = 800\ V, V_{CEmax} = V_{CES} - L_{sCE} * di/dt$	$t_P \leq 10\ \mu s, T_{vj} = 150\ ^\circ C$		1800		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			0.0624	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT		0.0400		K/W
Temperature under switching conditions	$T_{vj\,op}$		-40		150	°C

3 Diode, Brake-Chopper

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			450	A
Repetitive peak forward current	I_{FRM}	$t_P = 1\,\text{ms}$		900	A
I^2t - value	I^2t	$t_P = 10\,\text{ms}, V_R = 0\,\text{V}$	$T_{vj} = 125\,^{\circ}\text{C}$	34000	A^2s
			$T_{vj} = 150\,^{\circ}\text{C}$	32000	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 450\,\text{A}, V_{GE} = 0\,\text{V}$	$T_{vj} = 25\,^{\circ}\text{C}$		1.70	V
			$T_{vj} = 125\,^{\circ}\text{C}$		1.75	
			$T_{vj} = 150\,^{\circ}\text{C}$		1.75	
Peak reverse recovery current	I_{RM}	$V_{CC} = 600\,\text{V}, I_F = 450\,\text{A}, V_{GE} = -15\,\text{V}, -di_F/dt = 9000\,\text{A}/\mu\text{s} (T_{vj} = 150\,^{\circ}\text{C})$	$T_{vj} = 25\,^{\circ}\text{C}$		490	A
			$T_{vj} = 125\,^{\circ}\text{C}$		550	
			$T_{vj} = 150\,^{\circ}\text{C}$		560	
Recovered charge	Q_r	$V_{CC} = 600\,\text{V}, I_F = 450\,\text{A}, V_{GE} = -15\,\text{V}, -di_F/dt = 9000\,\text{A}/\mu\text{s} (T_{vj} = 150\,^{\circ}\text{C})$	$T_{vj} = 25\,^{\circ}\text{C}$		44	μC
			$T_{vj} = 125\,^{\circ}\text{C}$		80	
			$T_{vj} = 150\,^{\circ}\text{C}$		90	
Reverse recovery energy	E_{rec}	$V_{CC} = 600\,\text{V}, I_F = 450\,\text{A}, V_{GE} = -15\,\text{V}, -di_F/dt = 9000\,\text{A}/\mu\text{s} (T_{vj} = 150\,^{\circ}\text{C})$	$T_{vj} = 25\,^{\circ}\text{C}$		19	mJ
			$T_{vj} = 125\,^{\circ}\text{C}$		35	
			$T_{vj} = 150\,^{\circ}\text{C}$		39	

(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			0.108	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode		0.0430		K/W
Temperature under switching conditions	$T_{vj\,op}$		-40		150	°C

4 Diode, Reverse

Table 7 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			450	A
Repetitive peak forward current	I_{FRM}	$t_P = 1\,\text{ms}$		900	A
I^2t - value	I^2t	$t_P = 10\,\text{ms}, V_R = 0\,\text{V}$	$T_{vj} = 125\,^{\circ}\text{C}$	34000	A^2s
			$T_{vj} = 150\,^{\circ}\text{C}$	32000	

Table 8 Characteristic values

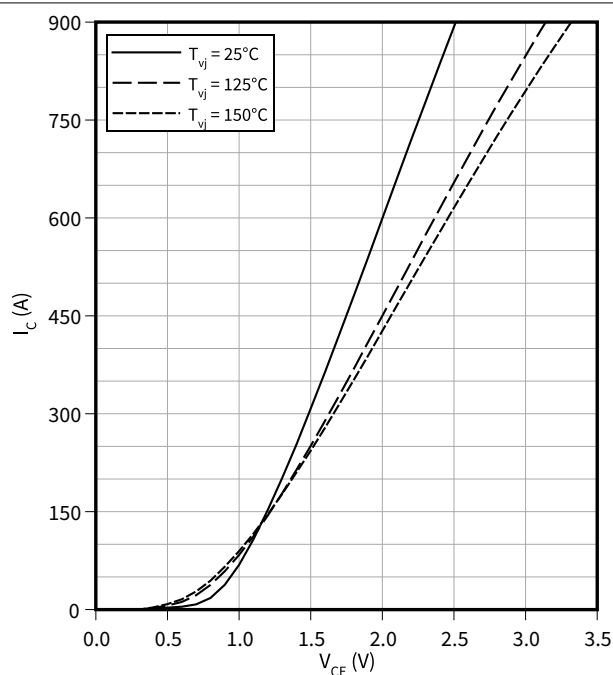
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 450\,\text{A}, V_{GE} = 0\,\text{V}$	$T_{vj} = 25\,^{\circ}\text{C}$		1.70	2.25	V
			$T_{vj} = 125\,^{\circ}\text{C}$		1.75		
			$T_{vj} = 150\,^{\circ}\text{C}$		1.75		
Thermal resistance, junction to case	R_{thJC}	per diode				0.108	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode			0.0430		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		150	°C

5 Characteristics diagrams

Output characteristic (typical), IGBT, Brake-Chopper

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

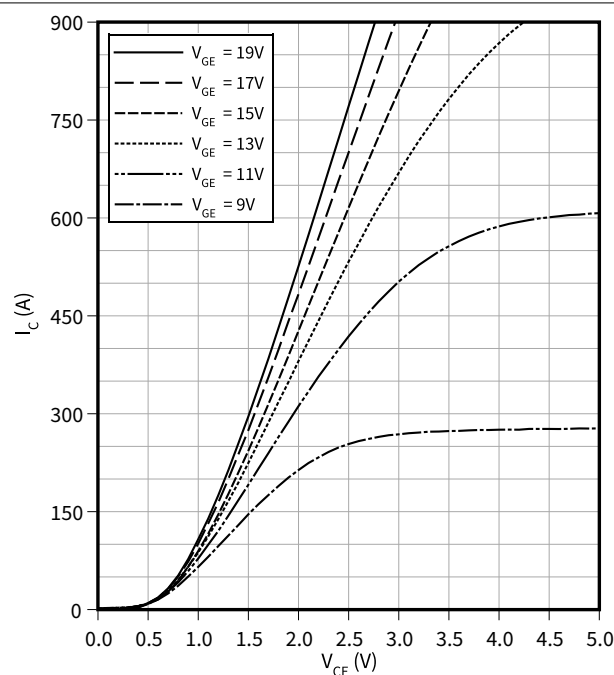
$$V_{GE} = 15 \text{ V}$$



Output characteristic field (typical), IGBT, Brake-Chopper

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

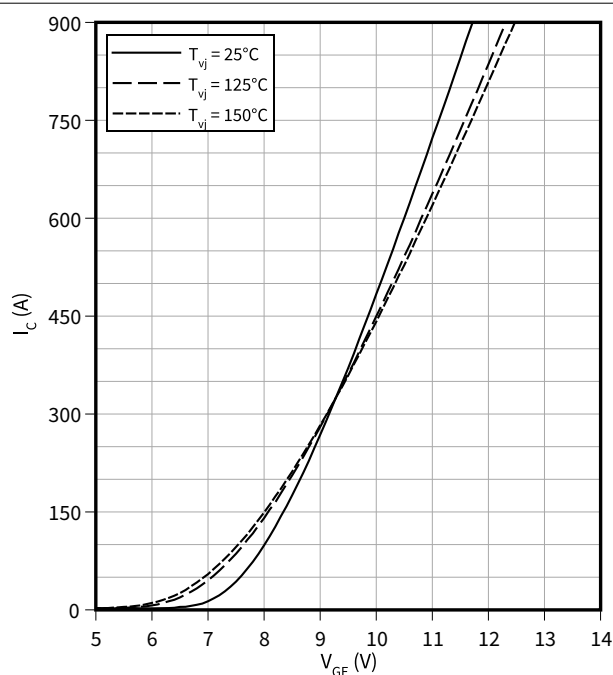
$$T_{vj} = 150 \text{ °C}$$



Transfer characteristic (typical), IGBT, Brake-Chopper

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

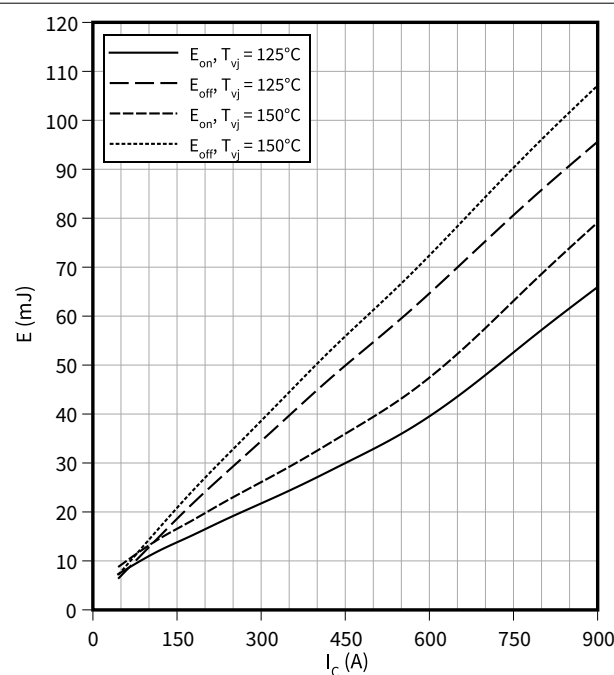
$$V_{CE} = 20 \text{ V}$$



Switching losses (typical), IGBT, Brake-Chopper

$$E = f(I_C)$$

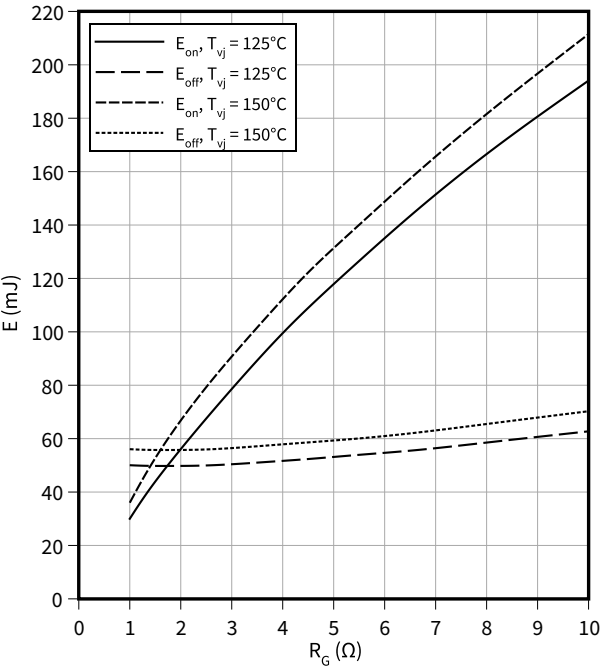
$$R_{Goff} = 1 \text{ } \Omega, R_{Gon} = 1 \text{ } \Omega, V_{GE} = \pm 15 \text{ V}, V_{CC} = 600 \text{ V}$$



5 Characteristics diagrams

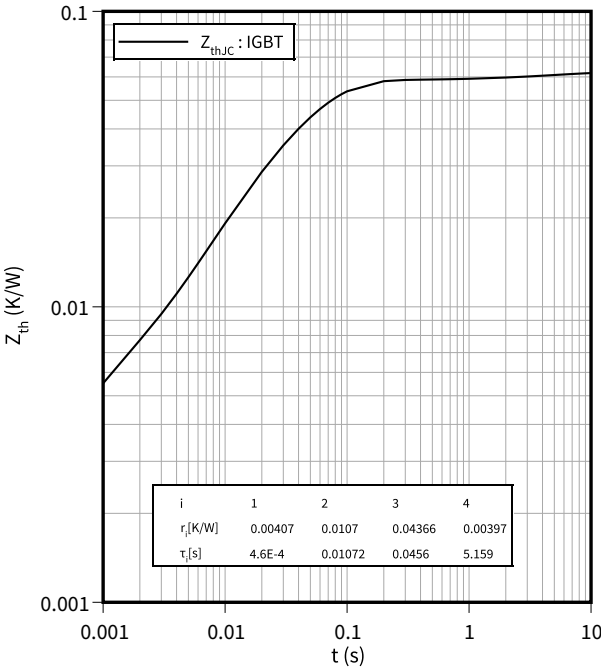
Switching losses (typical), IGBT, Brake-Chopper

$E = f(R_G)$
 $V_{GE} = \pm 15\text{ V}$, $I_C = 450\text{ A}$, $V_{CC} = 600\text{ V}$



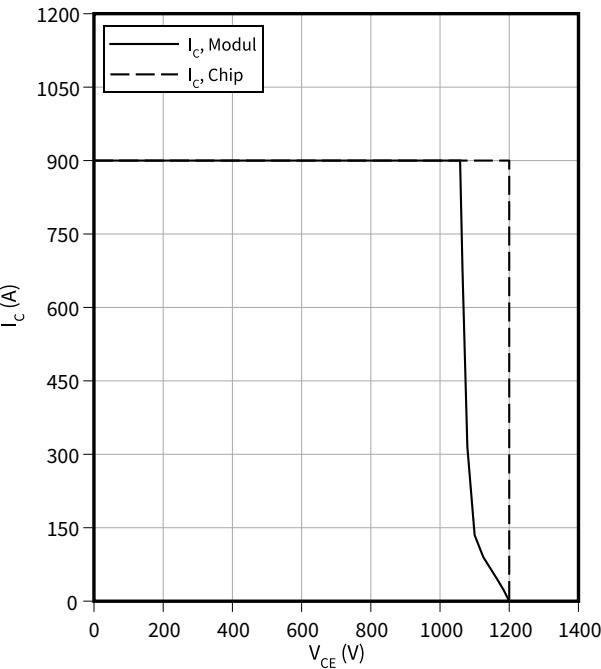
Transient thermal impedance, IGBT, Brake-Chopper

$Z_{th} = f(t)$



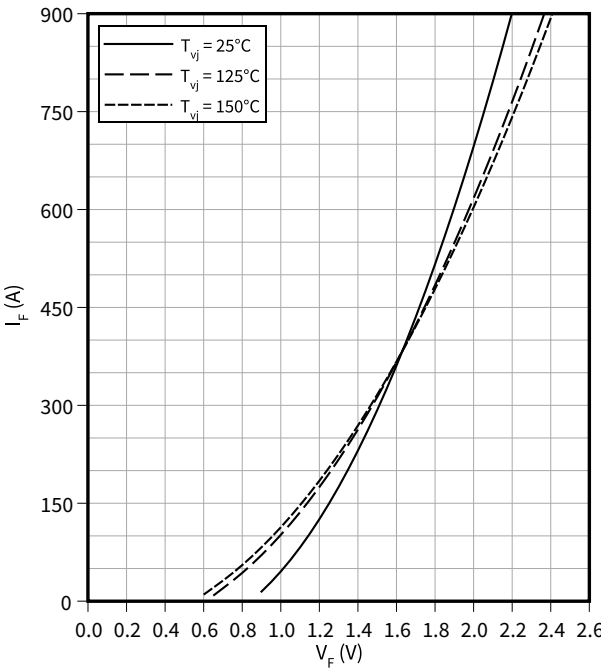
Reverse bias safe operating area (RBSOA), IGBT, Brake-Chopper

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



Forward characteristic (typical), Diode, Brake-Chopper

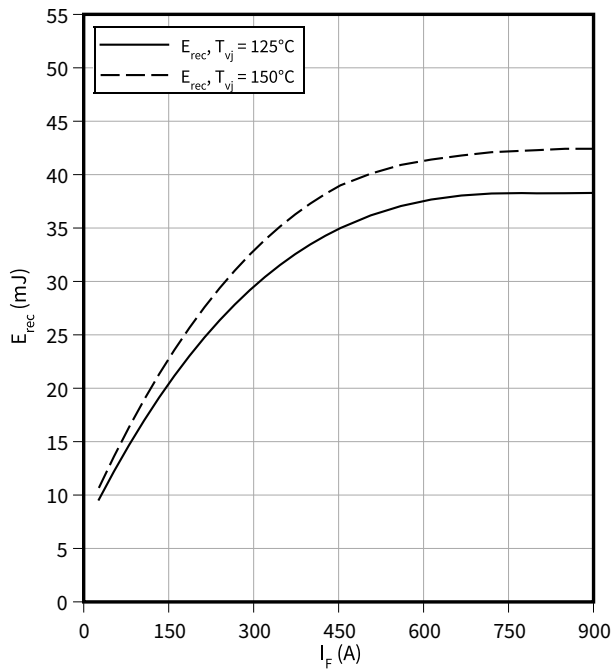
$I_F = f(V_F)$



5 Characteristics diagrams

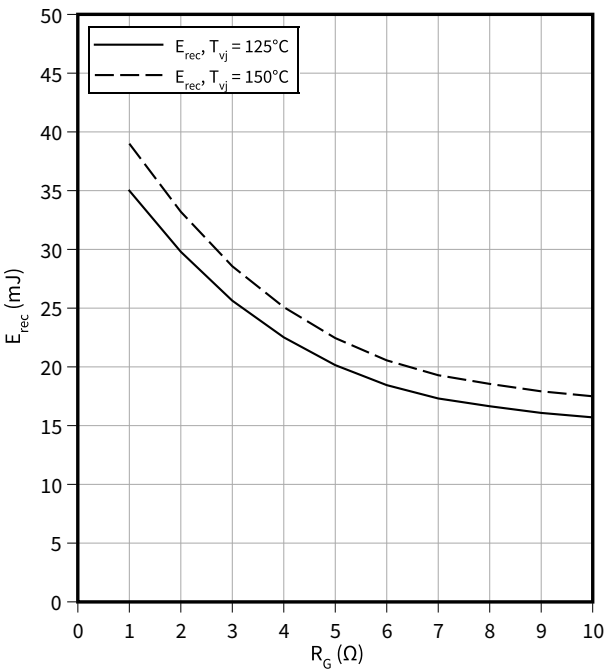
Switching losses (typical), Diode, Brake-Chopper

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



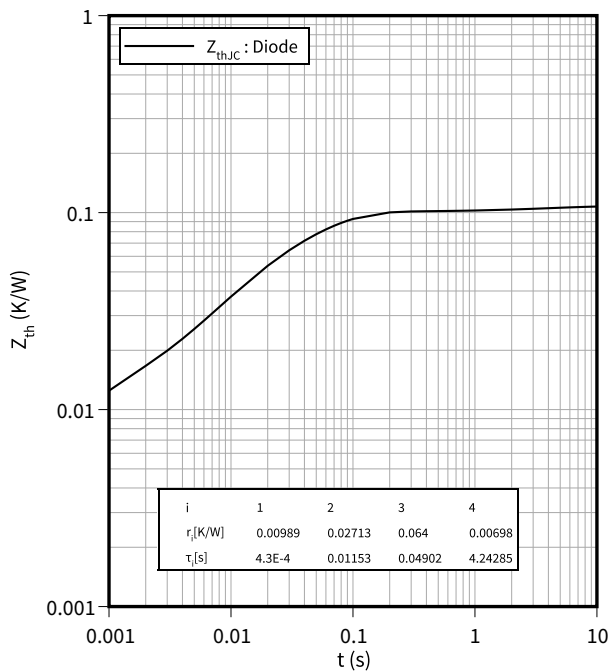
Switching losses (typical), Diode, Brake-Chopper

$E_{rec} = f(R_G)$
 $I_F = 450\text{ A}$, $V_{CC} = 600\text{ V}$



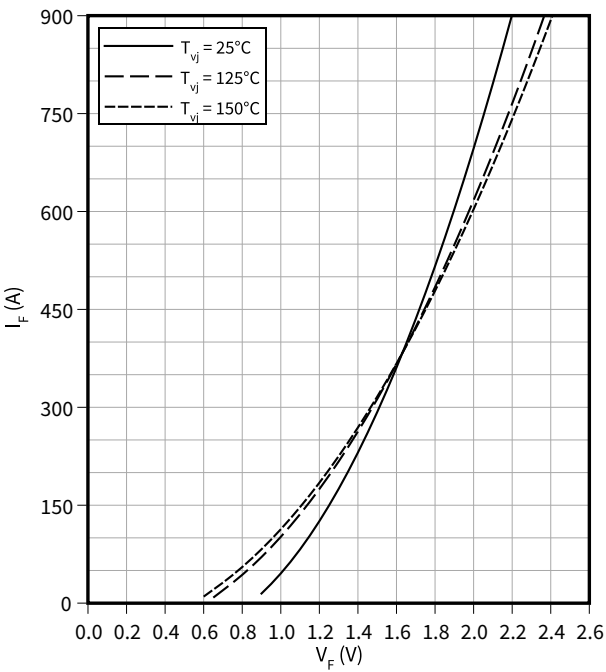
Transient thermal impedance, Diode, Brake-Chopper

$Z_{th} = f(t)$



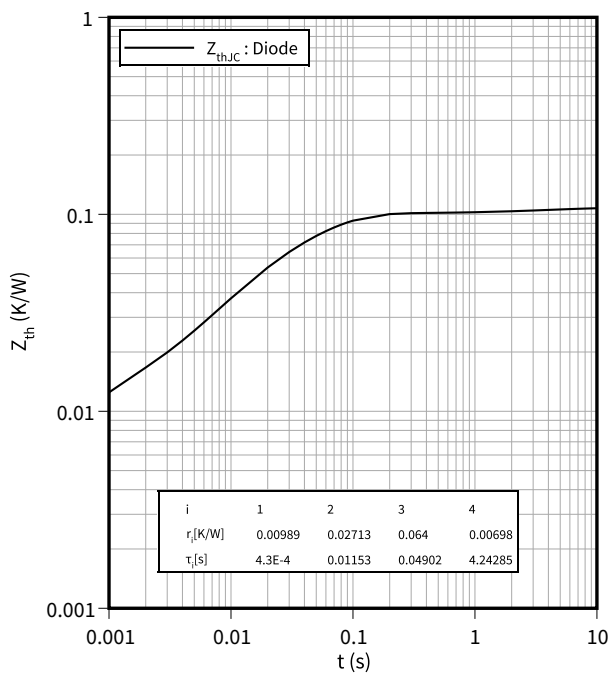
Forward characteristic (typical), Diode, Reverse

$I_F = f(V_F)$



Transient thermal impedance, Diode, Reverse

$Z_{th} = f(t)$



6 **Circuit diagram**

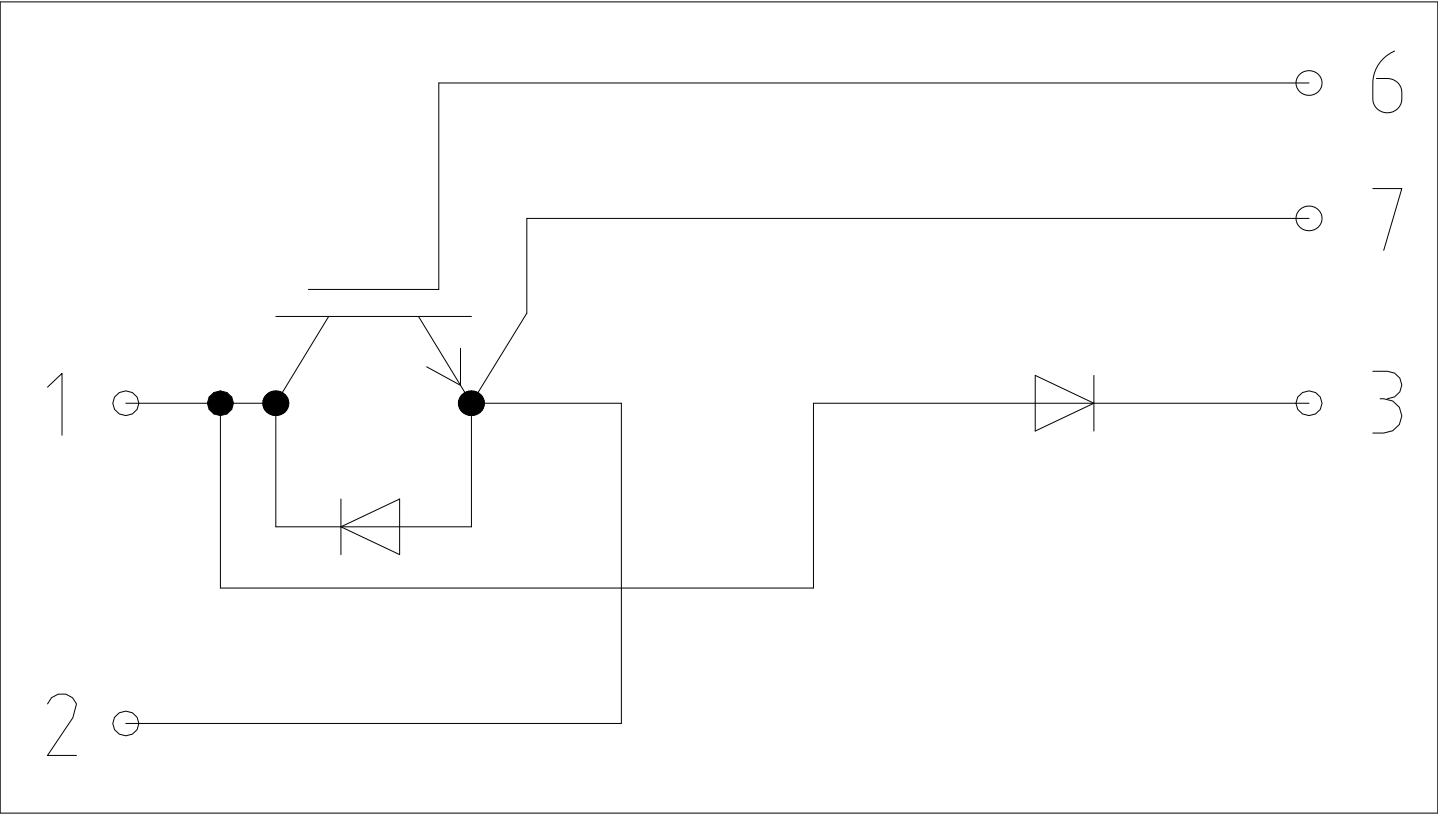


Figure 1

7 Package outlines

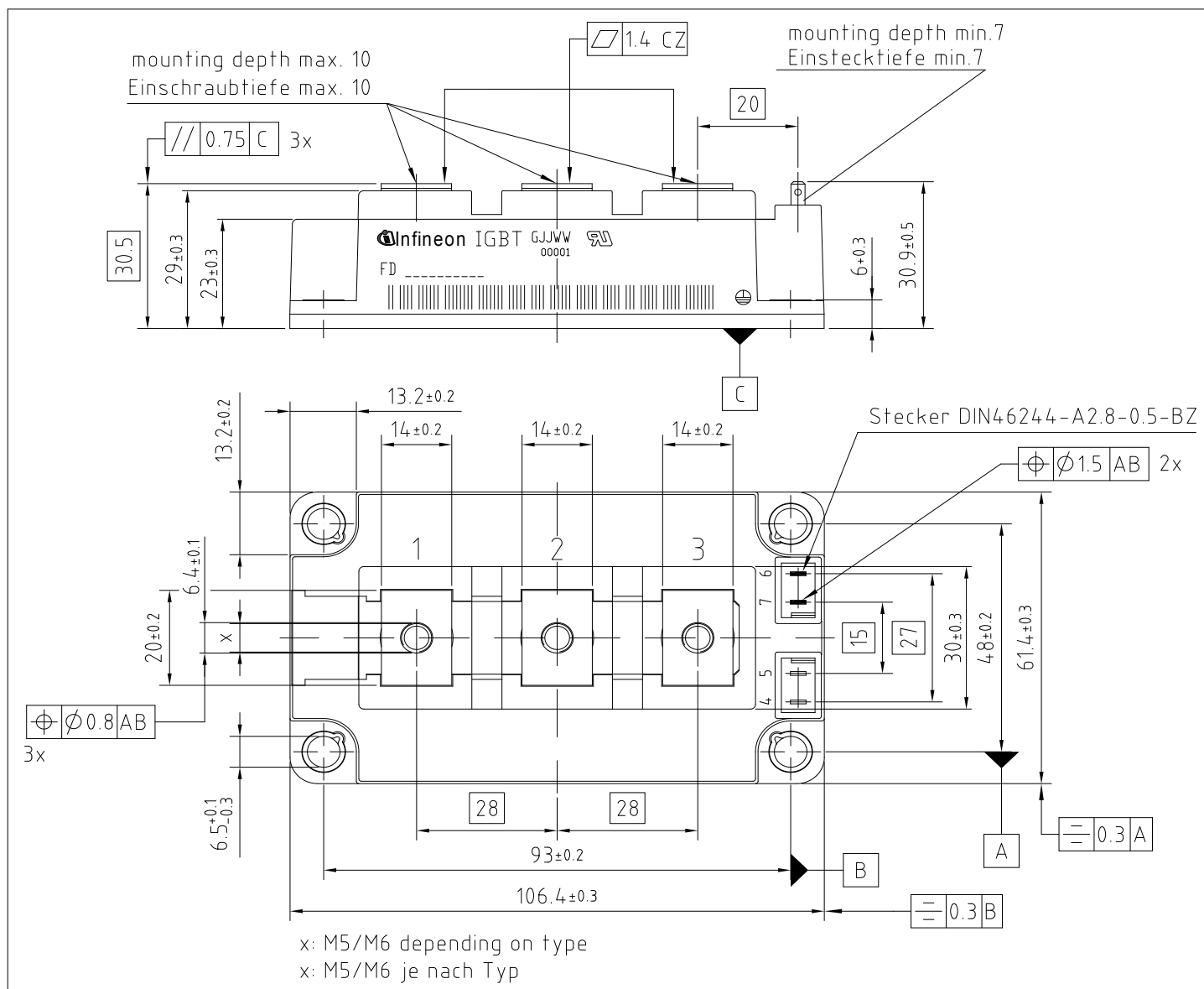


Figure 2

8 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

Document revision	Date of release	Description of changes
1.00	2022-05-24	Initial version

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