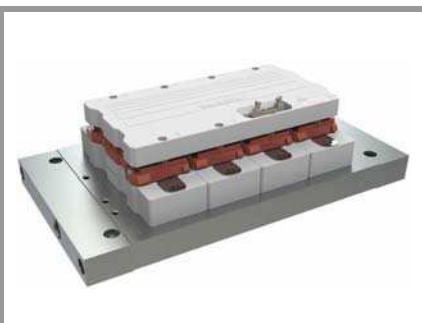


# SKiiP 2413 GB123-4DFW V3



SKiiP® 3

## 2-pack-integrated intelligent Power System

### SKiiP 2413 GB123-4DFW V3

#### Features

- SKiiP technology inside
- Trench IGBTs
- CAL HD diode technology
- Integrated current sensor
- Integrated temperature sensor
- Integrated heat sink
- Fiber optic interface
- UL recognized File no. E63532

#### Typical Applications\*

- Renewable energies
- Traction
- Elevators
- Industrial drives

#### Footnotes

<sup>1)</sup> With assembly of suitable MKP capacitor per terminal

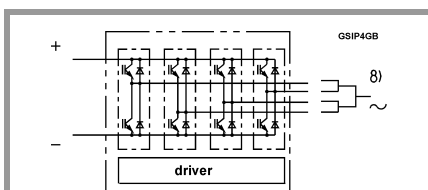
Absolute Maximum Ratings		$T_s = 25^\circ\text{C}$ unless otherwise specified	
Symbol	Conditions	Values	Unit
<b>System</b>			
$V_{CC}^{1)}$	Operating DC link voltage	900	V
$V_{isol}$	DC, $t = 1$ s, main terminals to heat sink	4300	V
$I_{t(RMS)}$	per AC terminal, $T_{terminal} < 115^\circ\text{C}$	400	A
$I_{FSM}$	$T_j = 150^\circ\text{C}$ , $t_p = 10$ ms, sin $180^\circ$	13500	A
$I^2t$	$T_j = 150^\circ\text{C}$ , $t_p = 10$ ms, diode	911	$\text{kA}^2\text{s}$
$f_{out}$	fundamental output frequency	1	kHz
$T_{stg}$	storage temperature	-40 ... 85	$^\circ\text{C}$

<b>IGBT</b>			
$V_{CES}$	$T_j = 25^\circ\text{C}$	1200	V
$I_C$	$T_j = 150^\circ\text{C}$	$T_s = 25^\circ\text{C}$	2280
		$T_s = 70^\circ\text{C}$	1756
$I_{Cnom}$		2400	A
$T_j$	junction temperature	-40 ... 150	$^\circ\text{C}$

<b>Diode</b>			
$V_{RRM}$	$T_j = 25^\circ\text{C}$	1200	V
$I_F$	$T_j = 150^\circ\text{C}$	$T_s = 25^\circ\text{C}$	1807
		$T_s = 70^\circ\text{C}$	1370
$I_{Fnom}$		1860	A
$T_j$	junction temperature	-40 ... 150	$^\circ\text{C}$

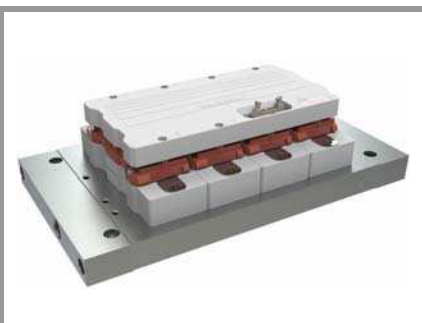
<b>Driver</b>			
$V_s$	power supply	13 ... 30	V
$V_{iH}$	input signal voltage (high)	15 + 0.3	V
$V_{isolIPD}$	QPD $\leq 10$ pC, PRIM to POWER	1170	V
$dv/dt$	secondary to primary side	75	$\text{kV}/\mu\text{s}$
$f_{sw}$	switching frequency	8	kHz

Characteristics		$T_s = 25^\circ\text{C}$ unless otherwise specified			
Symbol	Conditions	min.	typ.	max.	Unit
<b>IGBT</b>					
$V_{CE(sat)}$	$I_C = 1200$ A at terminal	$T_j = 25^\circ\text{C}$	1.7	2.1	V
		$T_j = 125^\circ\text{C}$	1.9		V
$V_{CE0}$		$T_j = 25^\circ\text{C}$	0.90	1.10	V
		$T_j = 125^\circ\text{C}$	0.80	1.00	V
$r_{CE}$	at terminal	$T_j = 25^\circ\text{C}$	0.7	0.8	$\text{m}\Omega$
		$T_j = 125^\circ\text{C}$	0.9	1.1	$\text{m}\Omega$
$E_{on} + E_{off}$	$I_C = 1200$ A $T_j = 125^\circ\text{C}$	$V_{CC} = 600$ V	442		mJ
		$V_{CC} = 900$ V	780		mJ
$R_{th(j-s)}$	per IGBT switch			0.015	K/W
$R_{th(j-r)}$	per IGBT switch			0.0175	K/W



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SKiiP® 3

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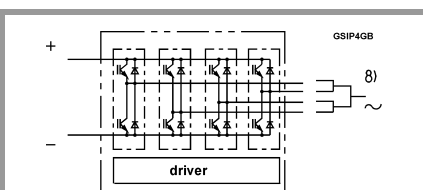
#### Typical Applications\*

- Renewable energies
- Traction
- Elevators
- Industrial drives

#### Footnotes

<sup>1)</sup> With assembly of suitable MKP capacitor per terminal

Characteristics		$T_s = 25^\circ\text{C}$ unless otherwise specified			
Symbol	Conditions	min.	typ.	max.	Unit
<b>Diode</b>					
$V_F = V_{EC}$	$I_F = 1200\text{ A}$ at terminal	$T_j = 25^\circ\text{C}$	1.50	1.80	V
		$T_j = 125^\circ\text{C}$	1.50		V
$V_{F0}$		$T_j = 25^\circ\text{C}$	0.9	1.10	V
		$T_j = 125^\circ\text{C}$	0.7	0.90	V
$r_F$	at terminal	$T_j = 25^\circ\text{C}$	0.5	0.6	m $\Omega$
		$T_j = 125^\circ\text{C}$	0.7	0.8	m $\Omega$
$E_{rr}$	$I_F = 1200\text{ A}$ $T_j = 125^\circ\text{C}$	$V_R = 600\text{ V}$	84		mJ
		$V_R = 900\text{ V}$	112		mJ
$R_{th(j-s)}$	per diode switch			0.029	K/W
$R_{th(j-r)}$	per diode switch			0.045	K/W
<b>Driver</b>					
$V_s$	supply voltage non stabilized	13	24	30	V
$I_{SO}$	bias current @ $V_s=24\text{V}$ , $f_{sw} = 0$ , $I_{AC} = 0$		330		mA
$I_s$	$k_1 = 55\text{ mA/kHz}$ , $k_2 = 0.00035\text{ mA/A}^2$	= 330	$+ k_1 * f_{sw} + k_2 * I_{AC}^2$		mA
$V_{IT+}$	input threshold voltage (HIGH)	12.3			V
$V_{IT-}$	Input threshold voltage (LOW)			4.6	V
$R_{IN}$	input resistance		10		k $\Omega$
$C_{IN}$	input capacitance		1		nF
$t_{pRESET}$	error memory reset time		0.0122		ms
$t_{TD}$	top / bottom switch interlock time		3		$\mu\text{s}$
$t_{jitter}$	jitter clock time		125		ns
$t_{SIS}$	short pulse suppression time		0.625	0.7	$\mu\text{s}$
$I_{TRIPSC}$	over current trip level	2940	3000	3060	A <sub>PEAK</sub>
$T_{trip}$	over temperature trip level	110	115	120	$^\circ\text{C}$
$V_{DCtrip}$	over voltage trip level,		not impl.		V
$t_{d(on)O}$	$V_{CC} = 900\text{ V}$ $I_C = 1200\text{ A}$ $T_j = 25^\circ\text{C}$	input-output turn-on propagation time	1.4		$\mu\text{s}$
$t_{d(off)O}$		input-output turn-off propagation time	1.4		$\mu\text{s}$
<b>System</b>					
$R_{th(r-a)}$	flow rate=8l/min, $T_{fluid}=50^\circ\text{C}$ , water/ glycol ratio 50%:50%			0.0092	K/W
$R_{CC+EE}$	measured per switch, $T_s = 25^\circ\text{C}$		0.13		m $\Omega$
$L_{CE}$	commutation inductance		3		nH
$C_{CHC}$	per phase, AC-side		6.8		nF
$I_{CES} + I_{RD}$	$V_{GE} = 0\text{ V}$ , $V_{CE} = 1200\text{ V}$ , $T_j = 25^\circ\text{C}$		4.8		mA
$M_{dc}$	DC terminals, SI Units	6		8	Nm
$M_{ac}$	AC terminals, SI Units	13		15	Nm
w	SKiiP System w/o heat sink		3.1		kg
$w_h$	heat sink		6.2		kg



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## Isolation coordination acc. to EN 50178 and IEC 61800-5-1

Maximum grid RMS voltage, line-to-line, grounded delta mains	480V+20%
Installation altitude for maximum grid RMS voltage, line-to-line, grounded delta mains	2000m
Maximum grid RMS voltage, line-to-line, star point grounded mains	480V+20%
Installation altitude for maximum grid RMS voltage, line-to-line, star point grounded mains	5000m
Maximum transient peak voltage between low voltage circuit and mains	1600V
Pollution degree acc. to IEC 60664-1 outside the moulded power section	2
Overvoltage cat. acc. to IEC 60664-1 for mains	III
Basic isolation	between heat sink and mains; between low voltage circuit and mains
Protection level acc. to IEC 60529	IP00

## Environmental conditions acc.to IEC 60721

	Storage	Transportation	Operation stationary use at weather protected locations	Operating ground vehicle installations	Operating ship environment
Climatic conditions	1K2 <sub>(1)</sub>	2K2 <sub>(1)</sub>	3K3 <sub>(1)</sub>	5K1 <sub>(1)</sub>	---
Biological conditions	1B1	2B1	3B1	5B1	6B1
Chemically active substances (excluded: salt spray)	1C2	2C1	3C2	5C2	6C2
Mechanically active substances	1S1	2S1	3S1	5S1	6S1
Mechanical conditions	1M3	(4)	3M6 <sub>(2)</sub>	5M3 <sub>(3)</sub>	6M3
Contaminating fluids	---	---	---	5F1	---

(1) expanded temperature range: -40°C / +85°C. Please note: by operation near 85°C the life time of product is reduced.

(2) 3M7 possible, but due to the mechanic load capacity of external components like DC-Link capacitors limited to 3M6

(3) 5M3 without impact of foreign bodies, stones

(4) no declaration due to customer-specific packing

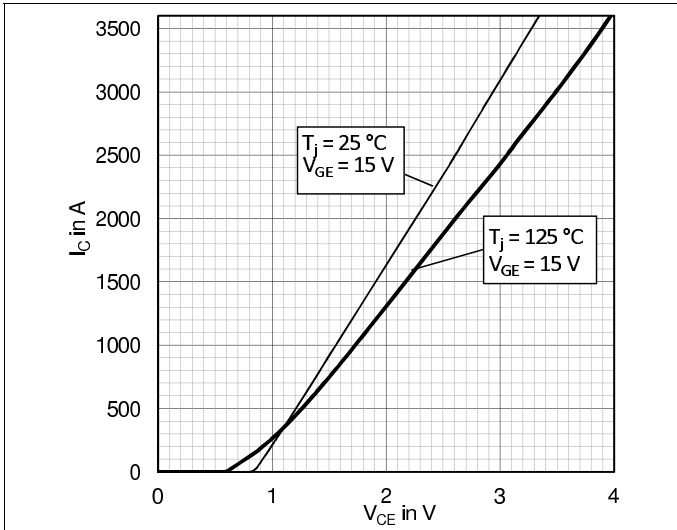


Fig. 1: Typical IGBT output characteristic

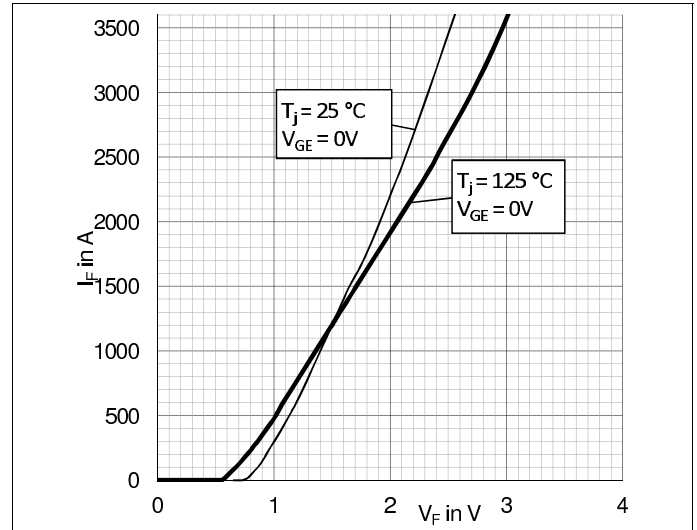


Fig. 2: Typical diode output characteristics

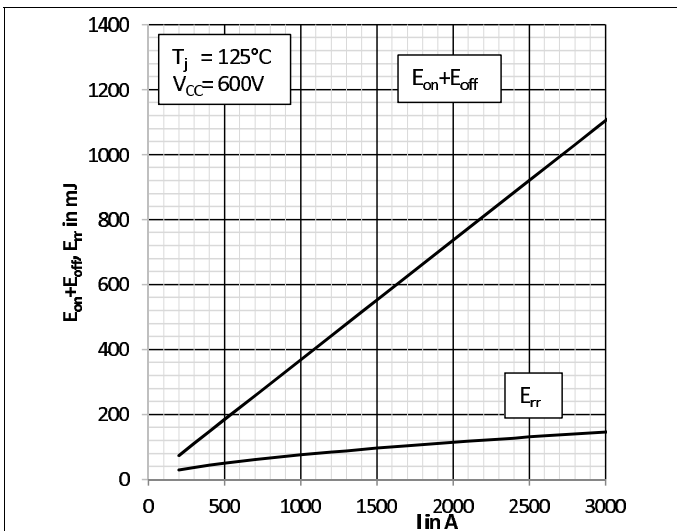


Fig. 3: Typical energy losses  $E = f(I_C, V_{CC})$

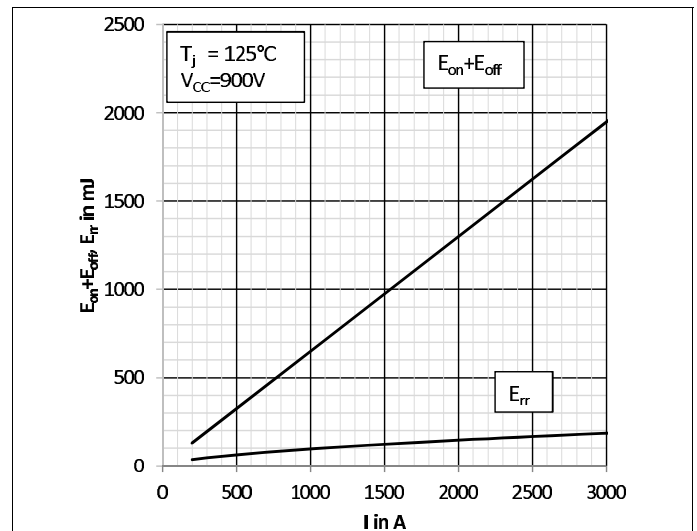


Fig. 4: Typical energy losses  $E = f(I_C, V_{CC})$

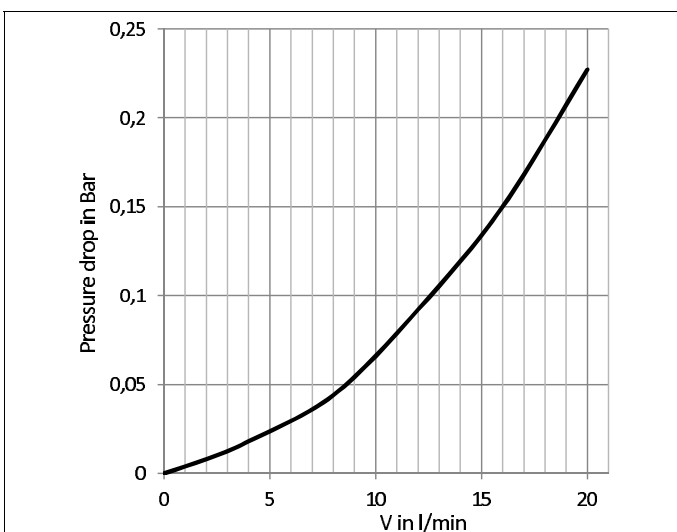


Fig. 5: Pressure drop  $\Delta p$  versus flow rate  $V$

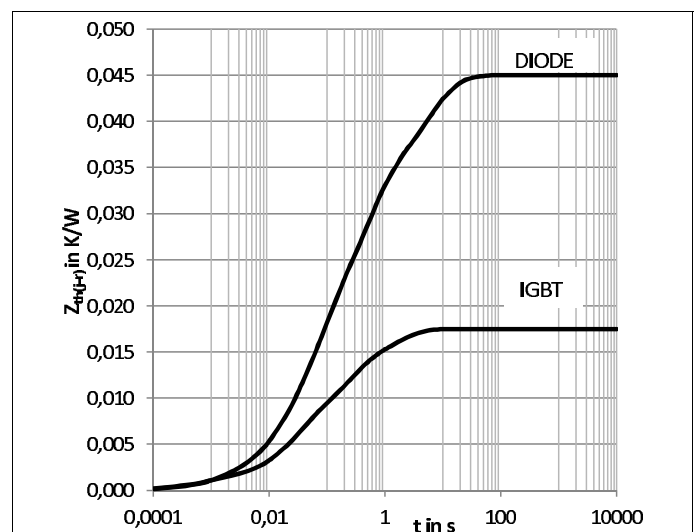


Fig. 6: Transient thermal impedance  $Z_{th(j-r)}$

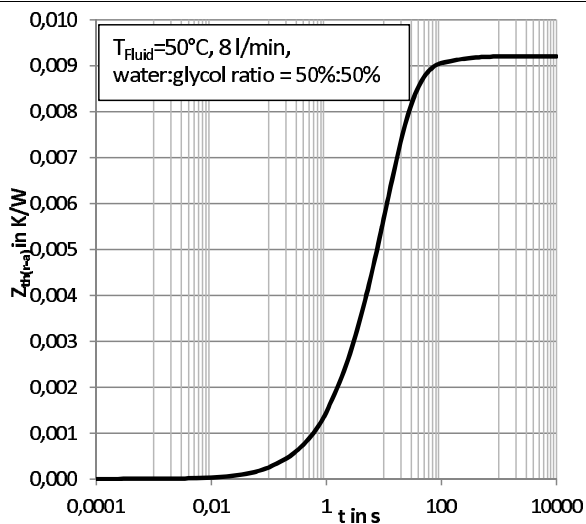


Fig. 7: Transient thermal impedance  $Z_{th}(r-a)$

	$R_{th} [K/W]$					
	1	2	3	4	5	6
$Z_{th}(j-r) I$	0,0011	0,0059	0,0063	0,0021	0,0021	0,0000
$Z_{th}(j-r) D$	0,0011	0,0042	0,0129	0,0150	0,0094	0,0024
$Z_{th}(r-a)$	0,0002	0,0012	0,0042	0,0034	0,0002	0,0000

	$\tau [s]$					
	1	2	3	4	5	6
$Z_{th}(j-r) I$	0,0007	0,0268	0,2165	1,0453	2,2456	1,0000
$Z_{th}(j-r) D$	0,0013	0,0142	0,0676	0,4902	5,0713	14,977
$Z_{th}(r-a)$	0,1382	1,4254	8,3077	20,093	189,77	1,0000

Fig. 8: Coefficients of thermal impedances

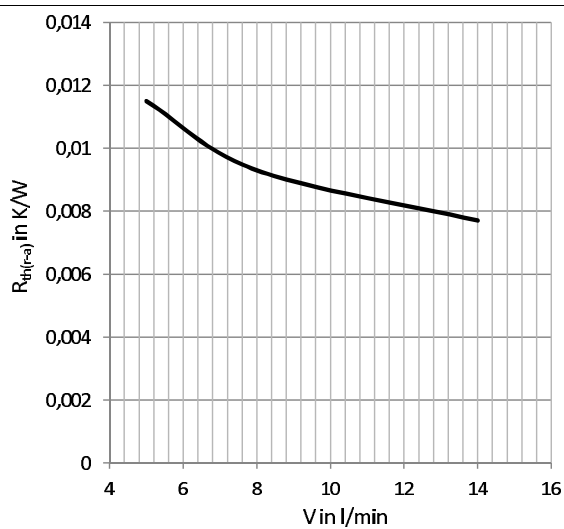
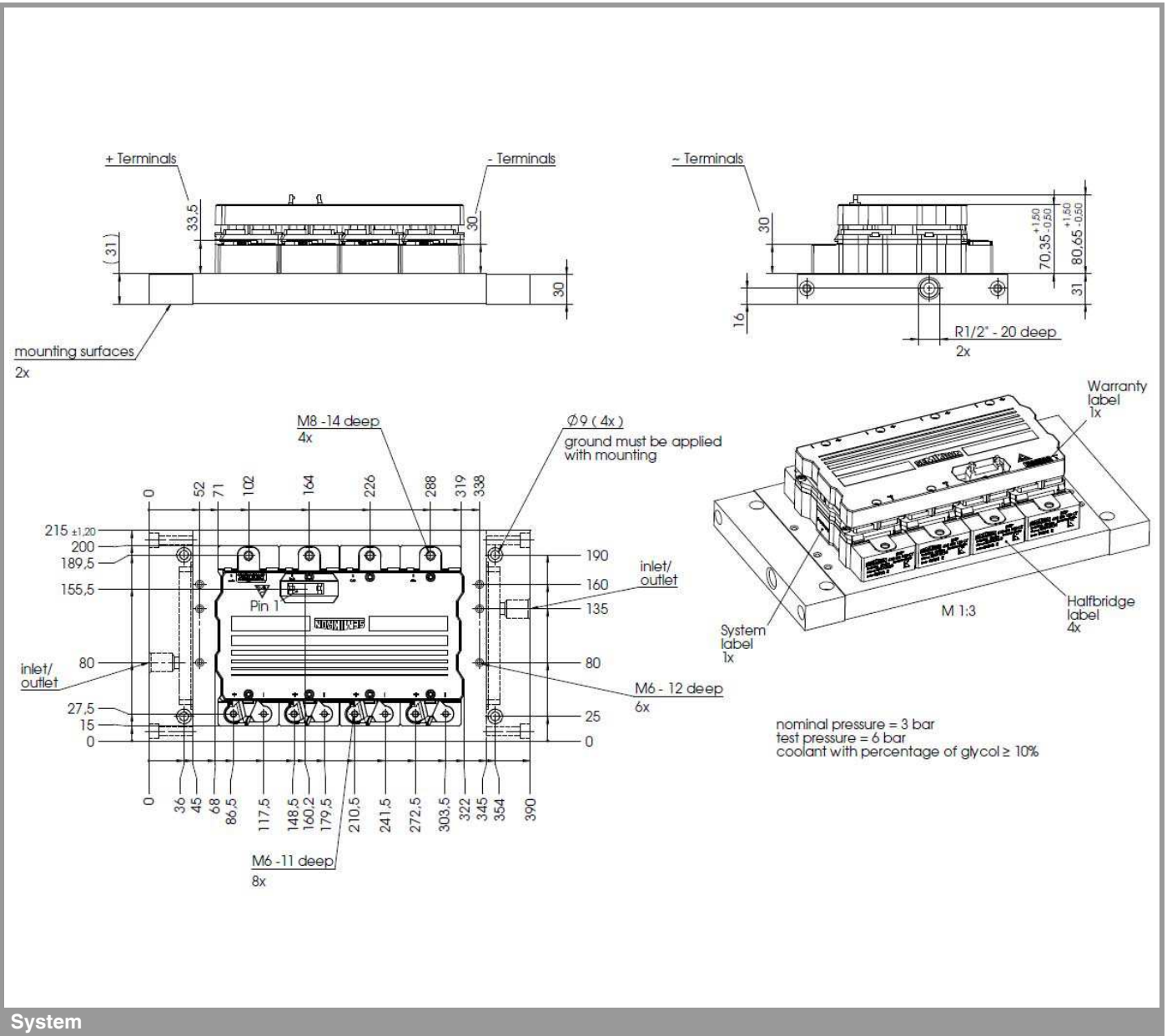


Fig. 9: Thermal resistance  $R_{th}(r-a)$  versus flow rate  $V$

# SKiP 2413 GB123-4DFW V3



This is an electrostatic discharge sensitive device (ESDS), international standard IEC 60747-1, chapter IX.

### \*IMPORTANT INFORMATION AND WARNINGS

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