SKiiP 2414 GB12E4-4DUW

SKiiP® 4

2-pack-integrated intelligent Power System

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Features

- Intelligent Power Module
- Integrated current and temperature measurement
- Integrated DC-link measurement
- Solder free power section
- IGBT4 and CAL4F technology
- T_{jmax} = 175°C
- Safety isolated switching and sensor signals
- Digital signal transmission
- CAN Interface
- 100% tested IPM
- RoHS compliant
- UL file no. E242581

Typical Applications*

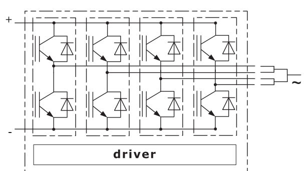
- Renewable energies
- Traction
- Elevators
- Industrial drives

Remarks

For further information please refer to SKiiP®4 Technical Explanation

Footnotes

[1)] With assembly of suitable MKP capacitor per terminal
[2)] The specified maximum operation junction temperature T_{vjop} is 150°C



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Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
System				
V_{CC} [1)]	Operating DC link voltage		900	V
V_{isol}	DC, t = 1 s, each polarity		4300	V
$I_{t(RMS)}$	per AC terminal, rms, sinusoidal current		500	A
$I_{max\ (peak)}$	max. peak current of power section		3600	A
I_{FSM}	T_j = 175 °C, t_p = 10 ms, sin 180°		15885	A
I^2t	T_j = 175 °C, t_p = 10 ms, diode		1262	kA^2s
f_{out}	fundamental output frequency (sinusoidal)		1	kHz
T_{stg}	storage temperature		-40 ... 85	°C
IGBT				
V_{CES}	T_j = 25 °C		1200	V
I_C	T_j = 175 °C	T_s = 25 °C	3109	A
		T_s = 70 °C	2528	A
I_{Cnom}			2400	A
T_j [2)]	junction temperature		-40 ... 175	°C
Diode				
V_{RRM}	T_j = 25 °C		1200	V
I_F	T_j = 175 °C	T_s = 25 °C	2369	A
		T_s = 70 °C	1878	A
I_{Fnom}			2400	A
T_j [2)]	junction temperature		-40 ... 175	°C
Driver				
V_s	power supply		19.2 ... 28.8	V
V_{iH}	input signal voltage (high)		V_s + 0.3	V
dv/dt	secondary to primary side		75	kV/µs
f_{sw}	switching frequency		10	kHz

Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
IGBT						
$V_{CE(sat)}$	I_C = 2400 A at terminal	T_j = 25 °C		2.01	2.26	V
		T_j = 150 °C		2.49	2.69	V
V_{CE0}		T_j = 25 °C		0.80	0.90	V
		T_j = 150 °C		0.70	0.80	V
r_{CE}	at terminal	T_j = 25 °C		0.51	0.57	mΩ
		T_j = 150 °C		0.75	0.79	mΩ
$E_{on} + E_{off}$	I_C = 2400 A, T_j = 150 °C	V_{CC} = 600 V		936		mJ
		V_{CC} = 900 V		1680		mJ
$R_{th(j-s)}$	per IGBT switch				0.0159	K/W
$R_{th(j-r)}$	per IGBT switch				0.0115	K/W

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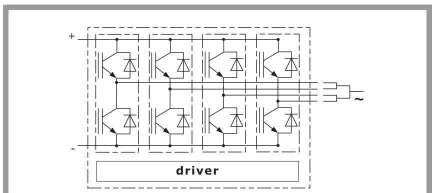

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Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
Diode						
$V_F = V_{EC}$	I_F = 2400 A at terminal	T_j = 25 °C		2.33	2.65	V
		T_j = 150 °C		2.35	2.66	V
V_{F0}		T_j = 25 °C		1.30	1.50	V
		T_j = 150 °C		0.90	1.10	V
r_F	at terminal	T_j = 25 °C		0.43	0.48	mΩ
		T_j = 150 °C		0.61	0.65	mΩ
E_{rr}	I_F = 2400 A T_j = 150 °C	V_R = 600 V		159		mJ
		V_R = 900 V		200		mJ
$R_{th(j-s)}$	per diode switch				0.0281	K/W
$R_{th(j-r)}$	per diode switch				0.0241	K/W
Driver						
V_s	supply voltage non stabilized		19.2	24	28.8	V
I_{S0}	bias current @V_s= 24V, f_{sw} = 0, I_{AC} = 0			260		mA
I_S	k_1 = 32 mA/kHz, k_2 = 0,00015 mA/A^2, f_{out} =50Hz, sinusoidal current		= 260	+ k_1* f_{sw}	+ k_2 * I_{AC}^2	mA
V_{IT+}	input threshold voltage (HIGH)		0,7*V_s			V
V_{IT-}	input threshold voltage (LOW)				0,3*V_s	V
R_{IN}	input resistance			13		kΩ
C_{IN}	input capacitance			1		nF
t_{pRESET}	error memory reset time			500		ms
$t_{pReset(OCP)}$	Over current reset time					µs
t_{TD}	top / bottom switch interlock time			3		µs
t_{jitter}	jitter clock time			50	58	ns
t_{SIS}	short pulse suppression time			0.6		µs
t_{POR}	Power-On-Reset completed				1	s
$I_{digiout}$	digital output sink current (HALT-signal)				16	mA
$V_{it+ HALT}$	input threshold voltage HIGH HALT (Low -->High)		0,6*V_s			V
$V_{it-HALT}$	input threshold voltage LOW HALT (High --> Low)				0.4*V_s	V
$t_{d(err)}$	Error delay time (from detection to HALT), (depends on kind of error)		3		370	µs
I_{TRIPSC}	over current trip level		3600			A_{PEAK}
I_{LL}				n.a.		A_{PEAK}
T_{trip}	over temperature trip level		128	135	142	°C
$T_{DriverTrip}$	over temperature PCB trip level		113	120	124	°C
V_{DCtrip}	over voltage trip level,		950	980	1010	V
$V_{DCtripLL}$				n.a.		V

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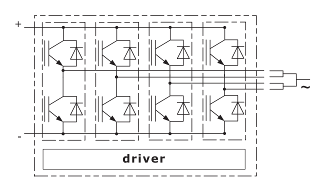

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Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
System						
$t_{d(on)IO}$	V_{CC} = 600 V, I_C = 2400 A, T_j = 25 °C	turn on propagation delay time		2.8		µs
$t_{d(off)IO}$		turn off propagation delay time		3.8		µs
dV_{CE}/dt_{on}	T_j = 25 °C, V_{CC} = 600 V	I_C = 0 A		9		kV/µs
		I_C = 2400 A		3		kV/µs
dV_{CE}/dt_{off}		I_C = 2400 A		3		kV/µs
$R_{th(s-a)}$	flow rate = 15 l/min, T_{Fluid}=40°C, water/glycol ratio 50%:50%				0.0065	K/W
$R_{CC'+EE'}$	measured per switch, T_s = 25 °C			0.0675		mΩ
L_{CE}	commutation inductance			4.5		nH
C_{CHC}	coupling capacitance secondary to heat sink			6		nF
C_{ps}	coupling capacitance primary to secondary			0.08		nF
I_{CES} + I_{RD}	V_{GE} = 0 V, V_{CE} = 1200 V, T_j = 25 °C			0.209		mA
M_{dc}	DC terminals		6		8	Nm
M_{ac}	AC terminals		13		15	Nm
w	SKiiP System w/o heat sink			3.22		kg
w_h	heat sink			4.25		kg

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	4000m
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	8000m
Maximum transient peak voltage between low voltage circuit and mains	1900V
Pollution degree acc. to IEC 60664-1 outside the moulded power section	2
Overvoltage cat. acc. to IEC 60664-1 for mains	III
Overvoltage cat. acc. to UL 840 within mains	I
Overvoltage cat. acc. to UL 840 between mains and ground	III
Overvoltage cat. acc. to UL 840 between mains and low voltage circuit	III
Basic isolation	between heat sink and mains
Reinforced isolation	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(1)	2K2(1)	3K3(1)	5K1(1)	6K1(1)
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(2)	5M3(3)	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

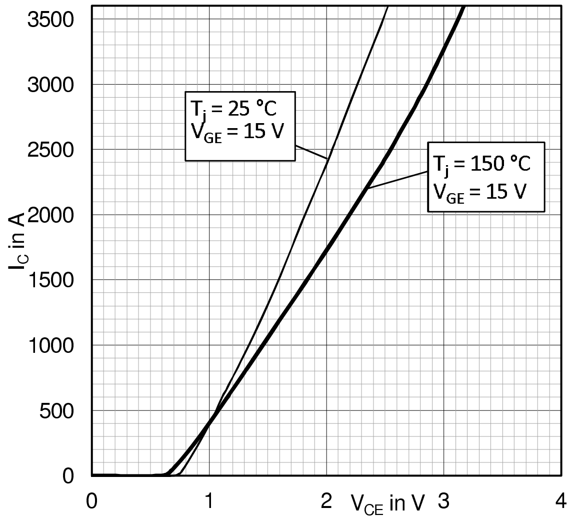


Fig. 1: Typical IGBT output characteristics

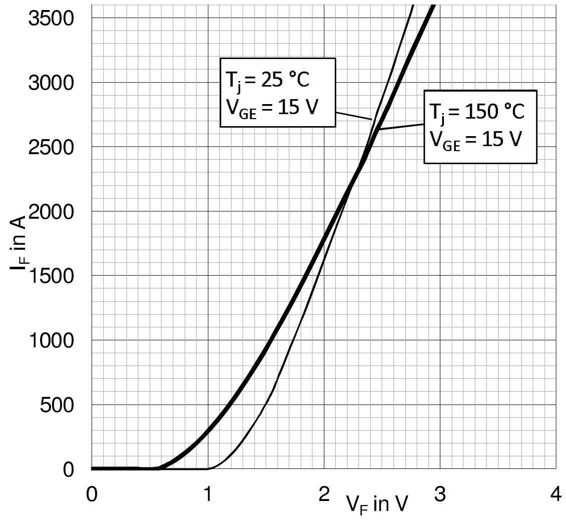


Fig. 2: Typical diode output characteristics

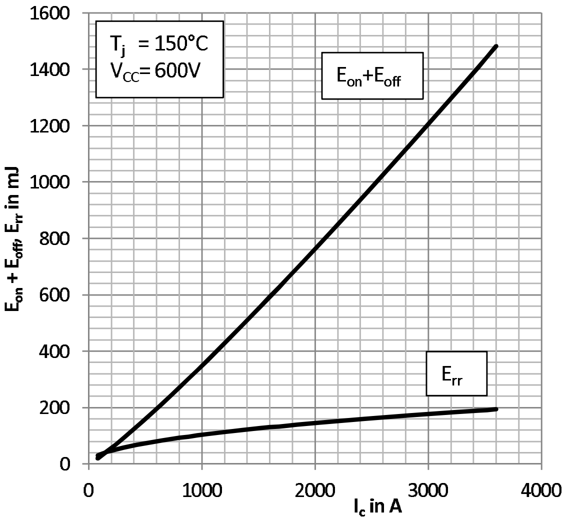


Fig. 3: Typical switching energy E = f(I_c)

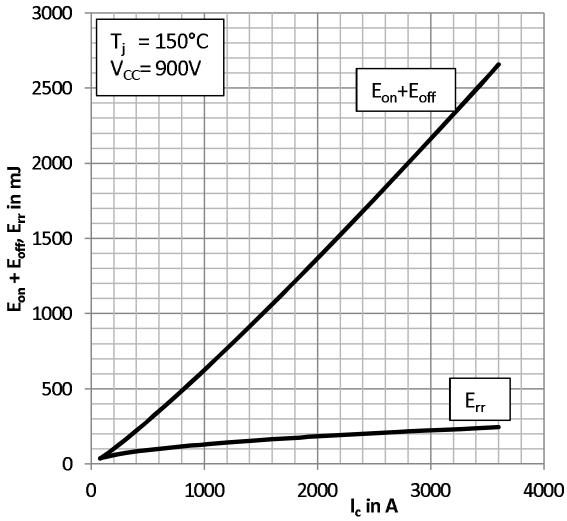


Fig. 4: Typical switching energy E = f(I_c)

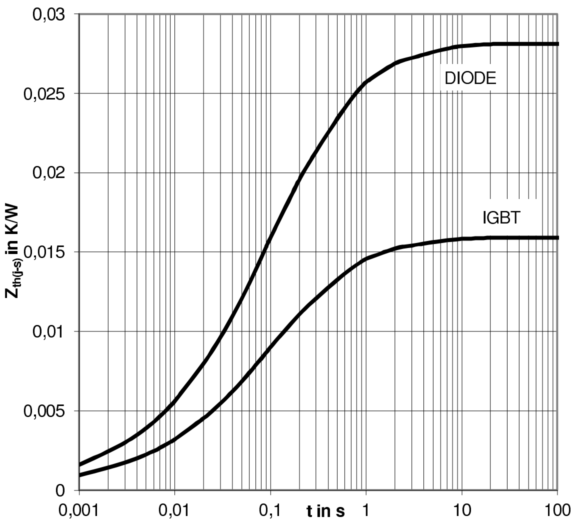


Fig. 5: Transient thermal impedance Zth(j-s)

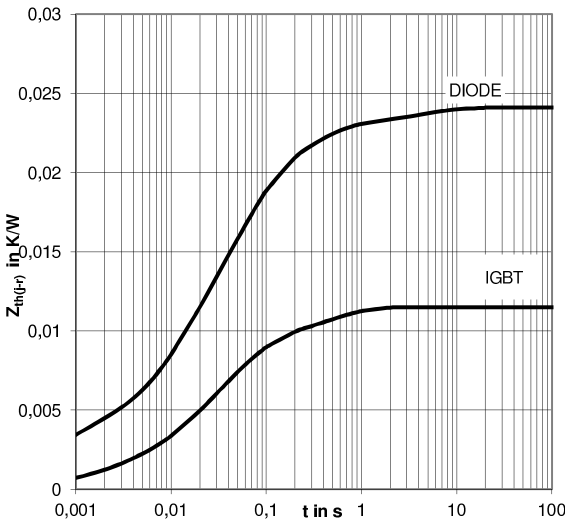


Fig. 6: Transient thermal impedance Zth(j-r)

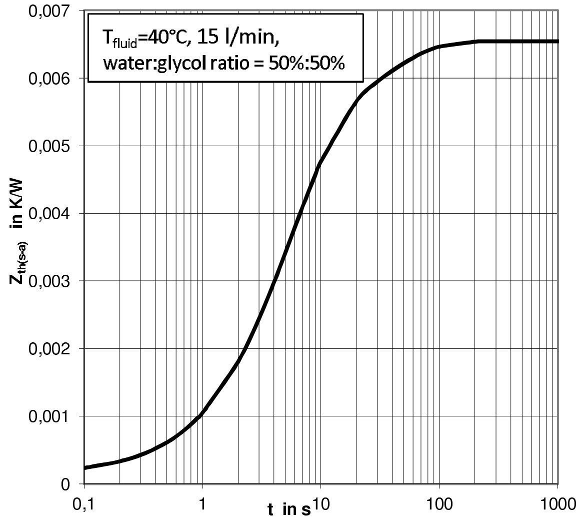


Fig. 7: Transient thermal impedance Zth(s-a)

	R_{th} [K/W]				
	1	2	3	4	5
$Z_{th(j-s)}$ I	0,0011	0,0057	0,0063	0,0019	0,0009
$Z_{th(j-s)}$ D	0,0020	0,0100	0,0112	0,0034	0,0015
$Z_{th(j-r)}$ I	0,0023	0,0056	0,0027	0,0009	
$Z_{th(j-r)}$ D	0,0012	0,0039	0,0104	0,0054	0,0032
$Z_{th(s-a)}$	0,0014	0,0050	0,0001		
	tau [s]				
	1	2	3	4	5
$Z_{th(j-s)}$ I	3,6500	0,4100	0,0650	0,0090	0,0008
$Z_{th(j-s)}$ D	3,6500	0,4100	0,0650	0,0090	0,0008
$Z_{th(j-r)}$ I	0,4500	0,0475	0,0142	0,0016	
$Z_{th(j-r)}$ D	4,1546	0,2644	0,0497	0,0107	0,0005
$Z_{th(s-a)}$	34,2609	5,2284	0,0005		

Fig. 8: Coefficients of thermal impedances

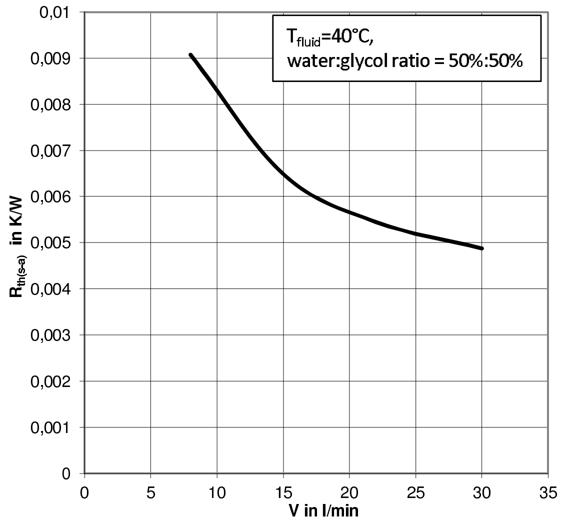


Fig. 9: Thermal resistance Rth(s-a) versus flow rate V

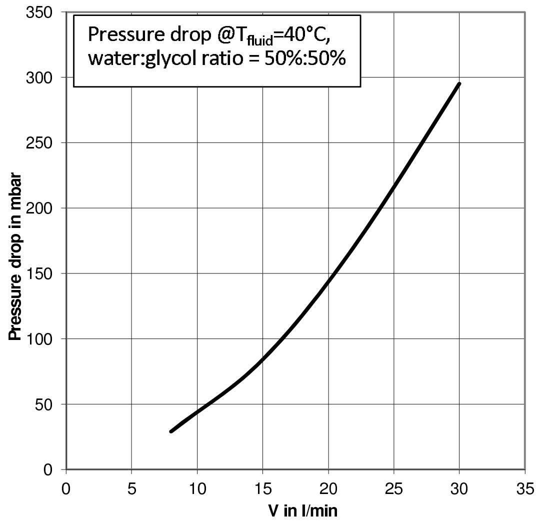
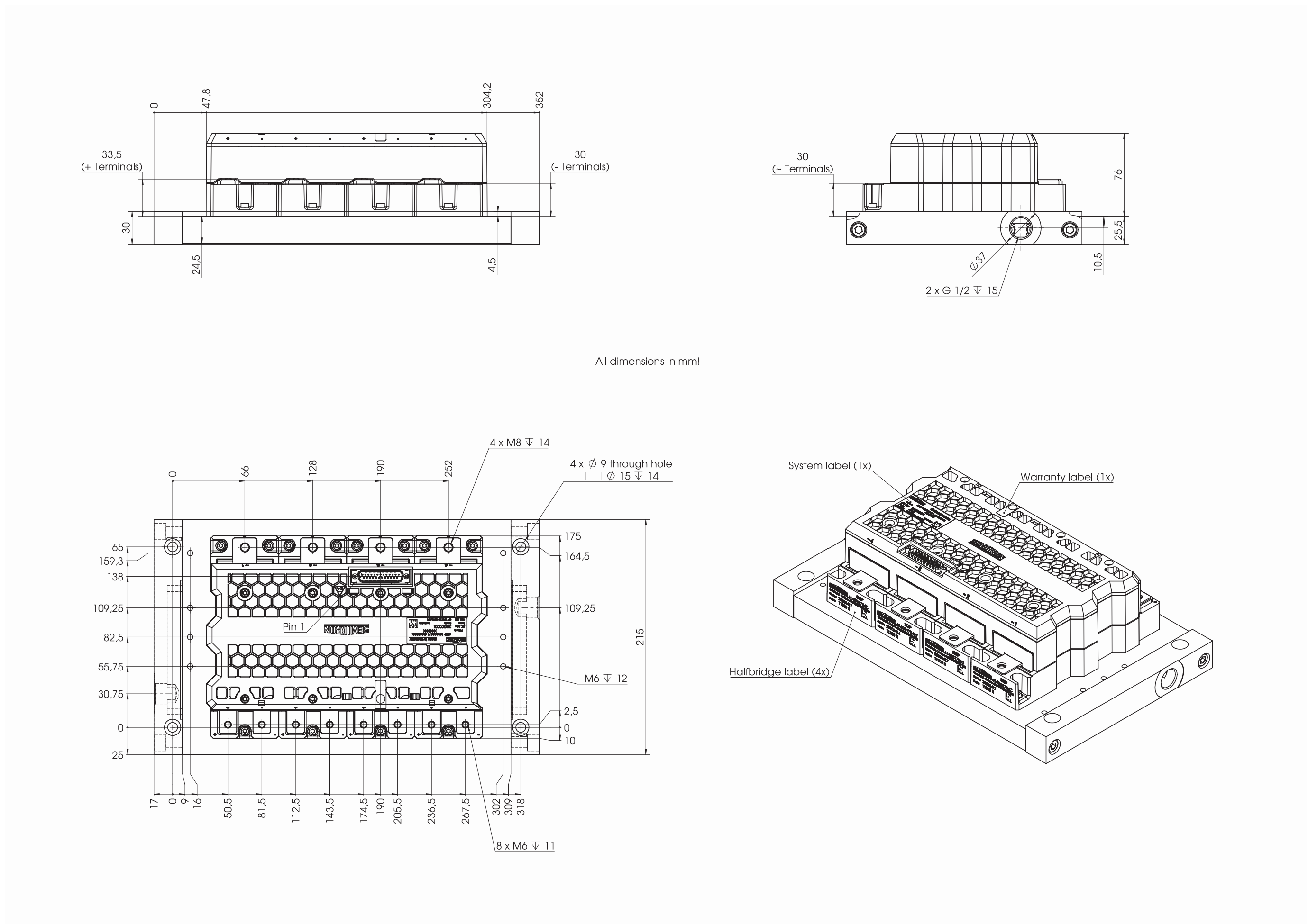


Fig. 10: Pressure drop Δp versus flow rate V



System

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

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