SKAI 45 A2 GD12-WDI

HV SKAI 2

Three-phase IGBT inverter

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Features

- Optimized for HEV and EV
- High power density
- High overload capability
- Compact integration in IP67 enclosure:
  V, I, T sensors
  Gate driver with protection features
  Active DC-link discharge unit
  EMI filters
  Liquid cooling
  DC-link capacitor
  Suitable environmental conditions in accordance to ISO 16750-(B,F)-N-K-D-Z-IP(6K7;6K9K)

Typical Applications*

- Commercial application vehicle
- Hybrid vehicle
- Battery driven vehicles (not suitable for mains applications)

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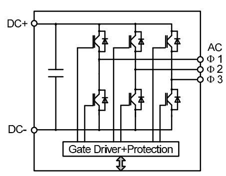

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Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
Electrical Data					
V_{isol}	DC, t = 1 s, (routine test acc. EN 50178)		3000		V
	DC, t = 1 min, (type test, acc. ISO 6469-3)		4000		V
V_{CC}	DC supply voltage		750	800	V
I_{nom}	rms @ nominal conditions: dV/dt = 10l/min, 50% Glykol/ 50% H_20, f_{sw} = 6kHz, V_{CC} = 750V, V_{out} = 350Vrms, f_{out} = 50Hz, cos(phi) = 0.85, $T_{coolant}$ = 60 °C, T_{air} = 65 °C		300		A
f_{sw}	Switching frequency	1		12	kHz
C_{DC}	DC-link capacitance	0.9		1.25	mF
C_y	EMI capacitor; DC to enclosure		0.66		µF
R_F	DC+ to enclosure, DC- to enclosure		6		MΩ
R_{BL}	DC+ to DC-		0.33		MΩ
Mechanical Data					
Weight			13.9		kg
Height			109		mm
Width			244		mm
Length			475		mm
M_t	AC / DC terminals (M8 screw)	13	14	15	Nm
M_c	Cover of terminal box (M5x16 flat-head-screw)	3.5	4	4.5	Nm
M_{cg}	AC / DC cable glands (at 7mm length of thread engagement)			20	Nm
M_e	Assembly of enclosure; thread (l): > 15mm — M8 screw			20	Nm
	Assembly of enclosure; thread (l): > 15mm — M6 screw			14	Nm
M_{gnd}	Ground connection	13	14	15	Nm
Hydraulical Data					
dp	Pressure drop@ 10l/min, $T_{coolant}$ = 25°C		100		mbar
p	Operating pressure			2	bar
$V_{Coolant}$	Coolant quantity of integrated cooling circuit		300		cm^3
P	Power dissipation to coolant; nominal conditions		3.5		kW
Environmental Data					
T_{stg}	Storage temperature	-40		85	°C
T_{no}	Non operating temperature range	-40		105	°C
T_{air}	Operating range, derating for T_{air} > 65°C with -3A / °C	-40		105	°C
$T_{coolant}$	Operating range, derating for $T_{coolant}$ > 60°C	-40		75	°C
IP	Enclosure protection level		IP67		
	With external connector protection		IP6K9K		
Altitude	V_{CC} = 800V			4000	m
Active Discharge Unit					
t_d	Discharge time to V_{CC} < 60V			5	s
R_{dis}	PTC discharge resistor (at 25°C)	245	350	455	Ω

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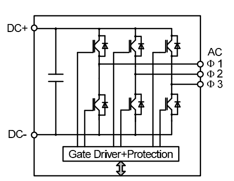

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Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
Interface Parameters						
V_s	Auxiliary supply voltage primary side		8		32	V
I_{S0}	Auxiliary supply current primary side without driving the IGBT gates	Supply current @ Vs = 12V			900	mA
		Supply current @ Vs = 24V			450	mA
I_s	Auxiliary supply current primary side with IGBT gate driving	Supply current @ Vs = 12V			2100	mA
		Supply current @ Vs = 24V			1050	mA
V_{iH}	Input signal voltage (HIGH)		0.7 * Vs		Vs + 0.3	V
V_{iL}	Input signal voltage (LOW)		GND - 0.3		0.3 * Vs	V
t_{POR}	Power-on reset completed				5	s
t_{pRESET}	Error reset time				5000	ms
Controller Switching Parameters						
$t_{d(on)IO}$	Input-output turn-on propagation time			0.5	0.8	µs
$t_{d(off)IO}$	Input-output turn-off propagation time			0.5	0.8	µs
t_{jitter}	Signal transfer prim - sec (total jitter)				50	ns
t_{SIS}	Short pulse suppression time		0.2	0.25	0.45	µs
t_{et}	Input impulse extension time		0.9	1	1.1	µs
$t_{d(err)DSCP}$	Error input-output propagation time for DSCP error		0.2		6	µs
$t_{d(err)OCP}$	Error input-output propagation time for OCP error			4	20	µs
$t_{d(err)TMP}$	Error input-output propagation time for temperature error				50	ms
t_{TD}	Top-Bot interlock dead time			2.5	2.6	µs
t_{bl}	V_{CE} monitoring blanking time			5	5.1	µs
Protection Functions						
$T_{DCBtrip}$	Over temperature protection trip level on DCB		120			°C
$T_{RelDCBtrip}$	Release temperature for DCB overtemperature trip level		85			°C
V_{DCtrip}	DC-Link voltage trip level		800			V
V_{VStrip}	Under voltage protection trip level of board primary side				8	V
V_{VSrst}	Threshold voltage level for driver reset after failure event		8			V
I_{TRIPSC}	Overcurrent trip level		567			A_{PEAK}
$I_{outsens}$	AC sensing range		-616		616	A
$m_{Ioutsens}$	Gradient of output current sensing		16.20	16.70	17.21	mV/A
$BW_{Ioutsens}$	Bandwidth (-3dB) of I_{AC} sensing			17		kHz
V_{DCsens}	Measurable DC-link voltage		0		1000	V
$m_{VDCsens}$	Gradient of DC-link voltage sensing		9.80	10.00	10.20	mV/V
$BW_{VDCsens}$	Bandwidth (-3dB) Vcc voltage sensing			98		kHz
$T_{DCBsens}$	Temperature sensing range on DCB		30		150	°C
$m_{TDCBsens}$	Gradient of temperature sensing on DCB			83.3		mV/°C
$BW_{TDCBsen}$	Bandwidth (-3dB) of temperature sensing on DCB			1		Hz

Signal Connector

PIN	Signal	Function	Specifications
X1:01	PWR_VP	INPUT Auxiliary power supply / battery "+"	Supply voltage V_s
X1:02	PWR_GND	Auxiliary power supply ground	Ground of auxiliary power supply
X1:03	DC_LINK_DISCHARGE	INPUT	HIGH, NOT CONNECTED (n.c.) or module not supplied with Auxiliary power = DC Link discharge active LOW = DC Link discharge disabled (internal pull-up resistor, external pull-up resistor required as well)
X1:04	CMN_HALT	INPUT/OUTPUT	All connected units have to change the signal mode to „dominant" if following happens: The unit is not ready to operate Error happened All connected units must be able to process (read) the signal. In case of recognised dominant signal, following steps need to be performed: The unit must be switched to a defined safe operation mode The unit must interrupt the main process unitl a recessive signal has been recognised LOW (dominant) = not ready to operate HIGH (recessive) = ready to operate
X1:05	CMN_TEMP_GND	Ground for temperature sensor signal CMN_TEMP	Internally connected to PWR_GND
X1:06	HB1_TOP	INPUT Switching PWM signal [push/pull]	Digital PWR_VP logic LOW = IGBT off HIGH = IGBT on
X1:07	HB1_BOT	INPUT Switching PWM signal [push/pull]	Digital PWR_VP logic LOW = IGBT off HIGH = IGBT on
X1:08	HB2_TOP	INPUT Switching PWM signal [push/pull]	Digital PWR_VP logic LOW = IGBT off HIGH = IGBT on
X1:09	HB2_BOT	INPUT Switching PWM signal [push/pull]	Digital PWR_VP logic LOW = IGBT off HIGH = IGBT on
X1:10	HB3_TOP	INPUT Switching PWM signal [push/pull]	Digital PWR_VP logic LOW = IGBT off HIGH = IGBT on
X1:11	HB3_BOT	INPUT Switching PWM signal [push/pull]	Digital PWR_VP logic LOW = IGBT off HIGH = IGBT on
X1:12	Reserved		

PIN	Signal	Function	Specifications
X1:13	PWR_VP	INPUT Auxiliary power supply / battery “+”	Supply voltage V_s
X1:14	PWR_GND	Auxiliary power supply ground	Ground of auxiliary power supply
X1:15	CMN_GND	Ground for CMN_HALT and DC_LINK_DISCHARGE	Internally connected to PWR_GND
X1:16	CMN_TEMP	OUTPUT Temperature sensor signal CMN_TEMP	This pin is used to transmit the temperature sensor analog signal. Max. output current: 4mA. Nominal voltage range: 0…10V;
X1:17	Reserved		
X1:18	HB1_GND	Ground for HB1_TOP, HB1_BOT	Internally connected to PWR_GND
X1:19	Reserved		
X1:20	HB2_GND	Ground for HB2_TOP, HB2_BOT	Internally connected to PWR_GND
X1:21	Reserved		
X1:22	HB3_GND	Ground for HB3_TOP, HB3_BOT	Internally connected to PWR_GND
X1:23	Reserved		
X1:24	PWR_VP	INPUT Auxiliary power supply / battery “+”	Supply voltage V_s
X1:25	PWR_GND	Auxiliary power supply ground	Ground of auxiliary power supply
X1:26	Reserved		
X1:27	CMN_DCL	OUTPUT DC-Link voltage signal [analog]	This pin is used to transmit the DC-Link voltage level. Max. output current: 4mA Nominal voltage range: 0….+10V Bandwidth (-3dB) for load resistance of 2kΩ: see datasheet value $BW_{VDCsens}$.
X1:28	CMN_DCL_GND	Ground for DC-Link voltage signal CMN_DCL	Internally connected to PWR_GND
X1:29	HB1_I	OUTPUT Current sensor out for HB1 [analog]	Max. output current: 4mA Nominal voltage range: -10 … +10V Bandwidth (-3dB): 17kHz at load resistance of 2kΩ; (18kHz at load resistance of 10kΩ);
X1:30	HB1_I_GND	Ground for HB1_I	Internally connected to PWR_GND
X1:31	HB2_I	OUTPUT Current sensor out for HB2 [analog]	Max. output current: 4mA Nominal voltage range: -10 … +10V Bandwidth (-3dB): 17kHz at load resistance of 2kΩ; (18kHz at load resistance of 10kΩ);
X1:32	HB2_I_GND	Ground for HB2_I	Internally connected to PWR_GND
X1:33	HB3_I	OUTPUT Current sensor out for HB3 [analog]	Max. output current: 4mA Nominal voltage range: -10 … +10V Bandwidth (-3dB): 17kHz at load resistance of 2kΩ; (18kHz at load resistance of 10kΩ);
X1:34	HB3_I_GND	Ground for HB3_I	Internally connected to PWR_GND
X1:35	Reserved		

Power Connectors

Terminal	Function	cable harness Ø Cu/mm^2	V rated terminal	I rated terminal
DC +	HVDC Bus "+"	@ 50	900V DC	300A rms
DC -	HVDC Bus "-"	@ 50	900V DC	300A rms
L1	Phase L1	@ 50	900V DC	300A rms
L2	Phase L2	@ 50	900V DC	300A rms
L3	Phase L3	@ 50	900V DC	300A rms

Coolant Fittings

Terminal	Function
IN	Coolant Inlet
OUT	Coolant Outlet

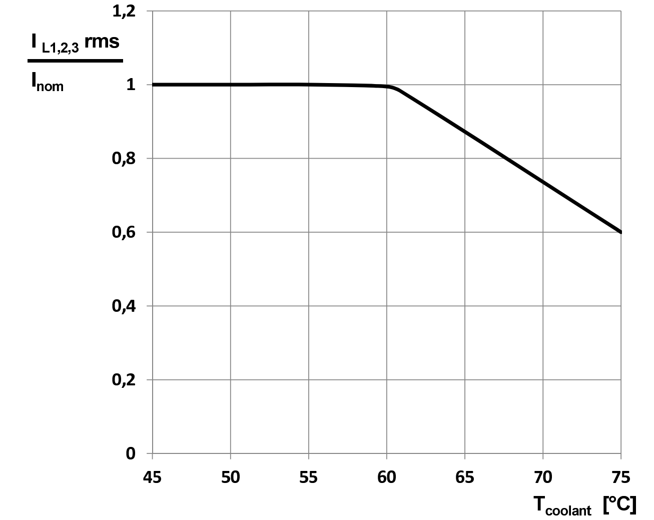


Fig. 1: Normalized output current vs. coolant temperature (temperature at coolant inlet "IN")

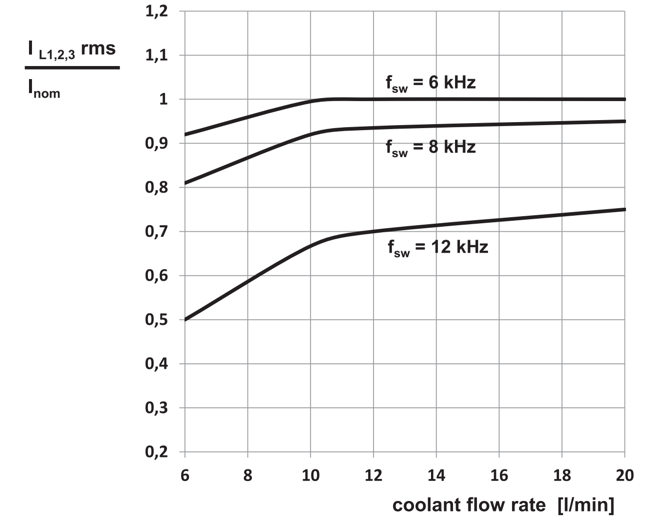


Fig. 2: Normalized output current vs. coolant flow

Operating point: (if not specified otherwise)			
f_{sw}	switching frequency	6	kHz
I_{norm}	normalized current	300	A rms
$T_{coolant}$		60	°C
$T_{ambient}$		65	°C
dV/dt	cooolant flow rate	10	l/min
V_{CC}	DC link supply voltage	750	V
V_{OUT}	output voltage	350	V rms
f_{OUT}	output frequency	50	Hz
cos (φ)	power factor	0.85	

Fig. 3: Legend

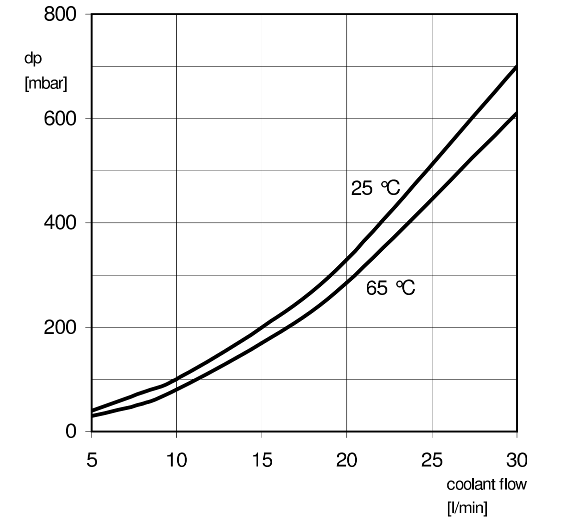


Fig. 4: Pressure drop characteristic

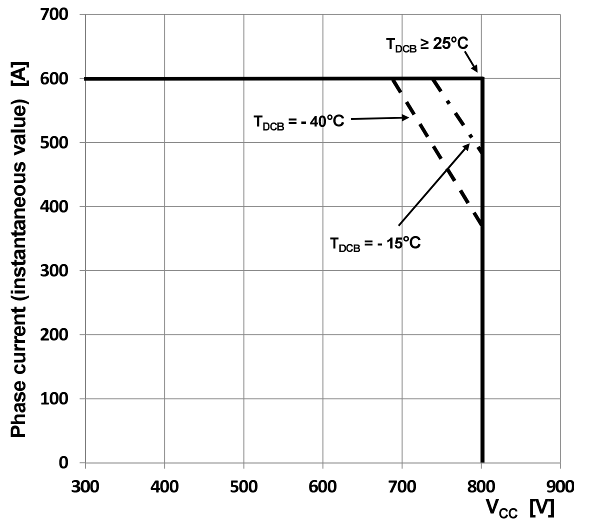


Fig. 5: Safe operating area

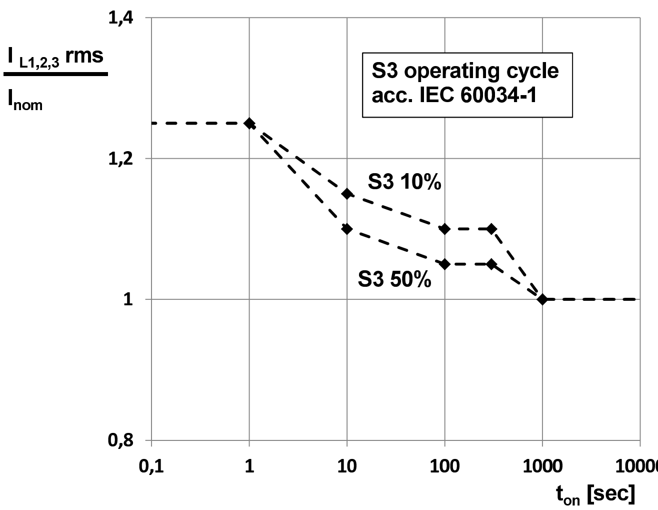


Fig. 6: Overload capability

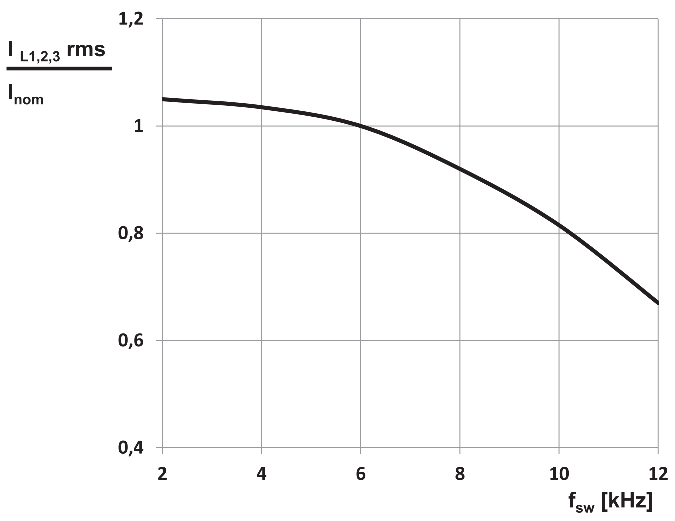


Fig. 7: Normalized output current vs. switching frequency f_{sw}

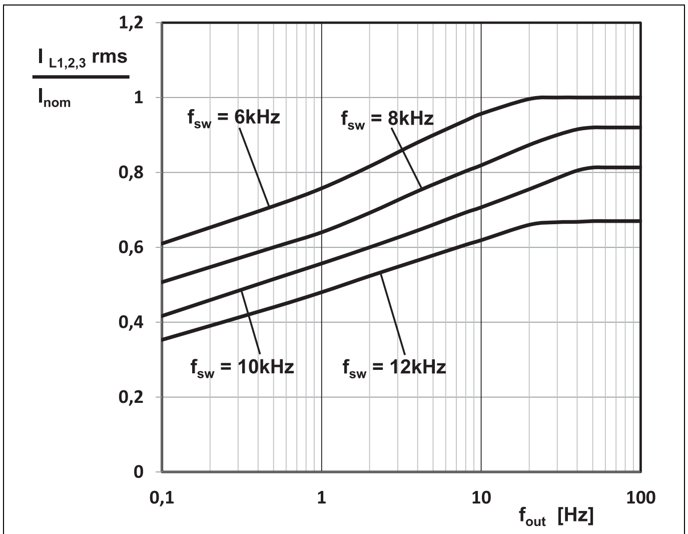
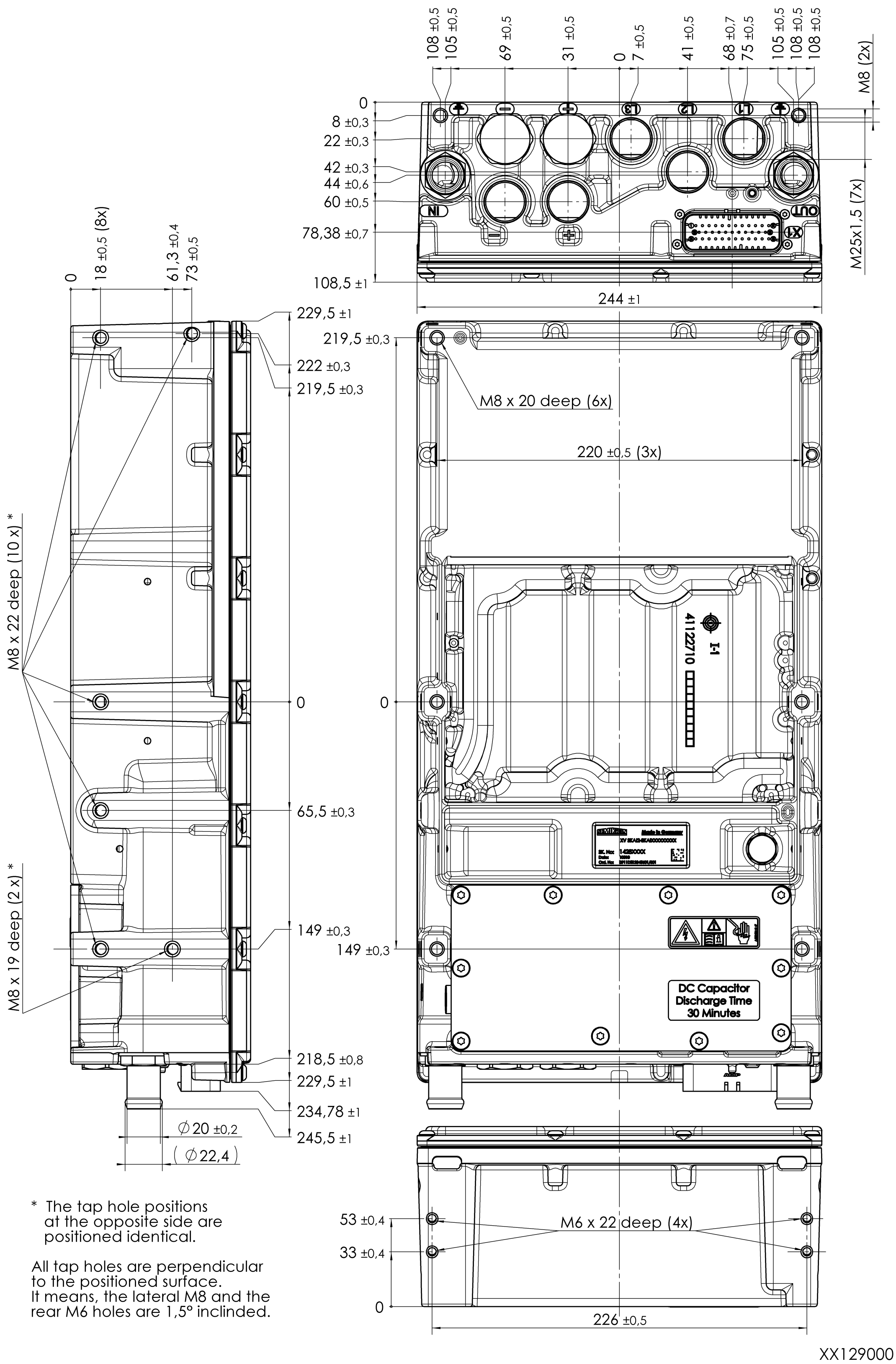
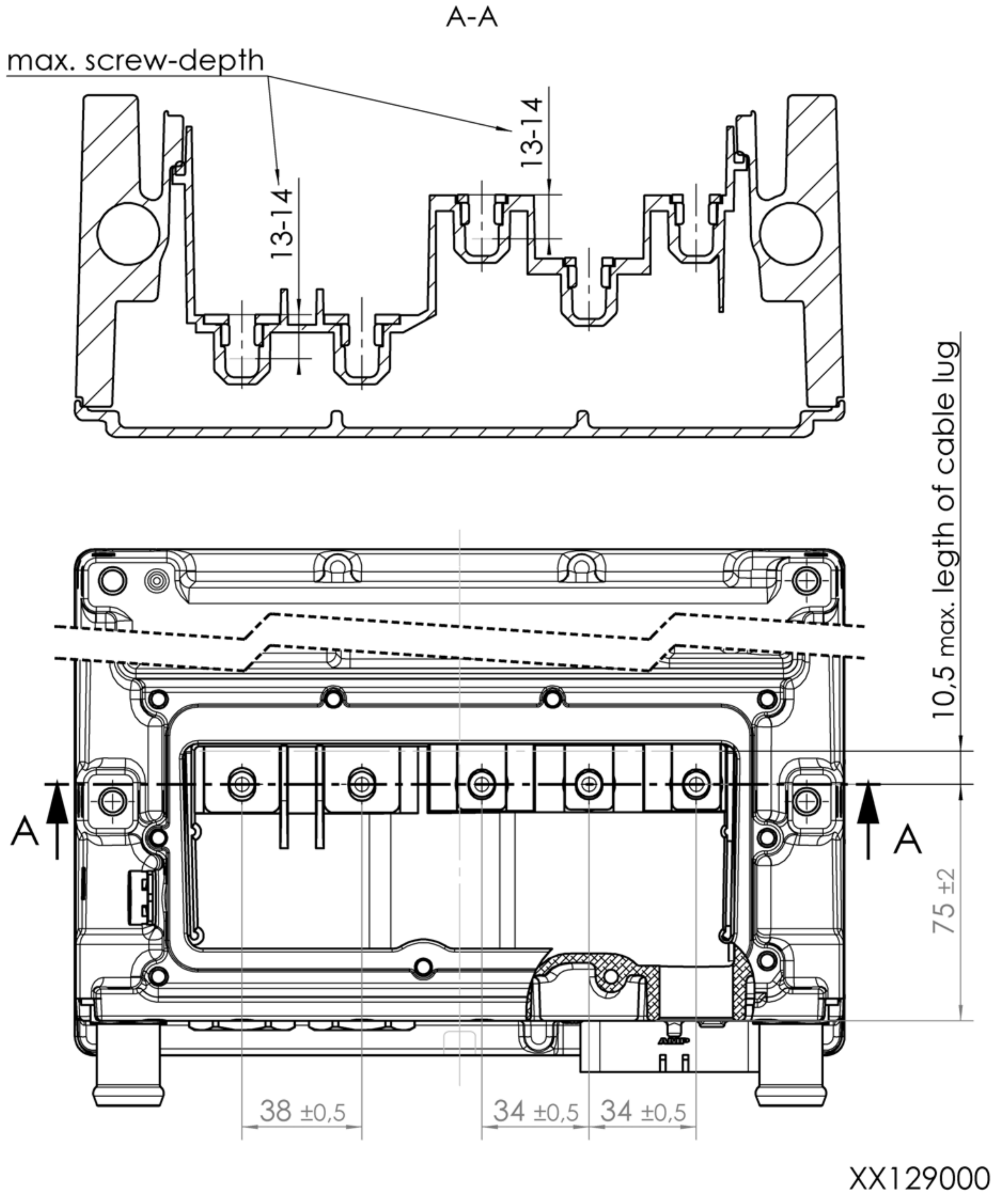


Fig. 8: Normalized output current vs. inverter output frequency


108 ±0,5
105 ±0,5
69 ±0,5
31 ±0,5
0
7 ±0,5
41 ±0,5
68 ±0,7
75 ±0,5
105 ±0,5
108 ±0,5
108 ±0,5
M8 (2x)
M25x1,5 (7x)
0
8 ±0,3
22 ±0,3
42 ±0,3
44 ±0,6
60 ±0,5
78,38 ±0,7
108,5 ±1
IN
OUT
X1
L3
L2
L1
244 ±1
0
18 ±0,5 (8x)
61,3 ±0,4
73 ±0,5
229,5 ±1
219,5 ±0,3
222 ±0,3
219,5 ±0,3
M8 x 20 deep (6x)
220 ±0,5 (3x)
M8 x 22 deep (10 x) *
0
0
4112710
65,5 ±0,3
149 ±0,3
149 ±0,3
M8 x 19 deep (2 x) *
DC Capacitor
Discharge Time
30 Minutes
218,5 ±0,8
229,5 ±1
234,78 ±1
245,5 ±1
∅20 ±0,2
(∅22,4)
53 ±0,4
33 ±0,4
0
M6 x 22 deep (4x)
226 ±0,5
* The tap hole positions at the opposite side are positioned identical.
All tap holes are perpendicular to the positioned surface.
It means, the lateral M8 and the rear M6 holes are 1,5° inclinded.
XX129000

Case 7



Dimension of connecting box and screwing terminals

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

* The specifications of our components may not be considered as an assurance of component characteristics. Components have to be tested for the respective application. Adjustments may be necessary. The use of SEMIKRON products in life support appliances and systems is subject to prior specification and written approval by SEMIKRON. We therefore strongly recommend prior consultation of our staff.