SKAI 45 A2 GD12-W12DI

HV SKAI 2

Three-phase IGBT inverter

SKAI 45 A2 GD12-W12DI

Target Data

Features

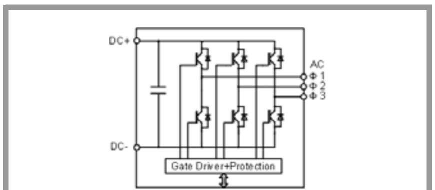
- Optimized for HEV and EV
- high power density
- high overload capability
- Compact integration in IP67 Enclosure:
  V, I, T sensors
  Gate driver with protection features
  EMI filters
  Liquid cooling
  DC link capacitor

Typical Applications*

- commercial application vehicle
- hybrid vehicle
- battery driven vehicle

No. 14282015

Characteristics					
Symbol	**Conditions**	**min.**	**typ.**	**max.**	**Unit**
Electrical Data					
V_{isol}	DC, t = 1 s		4000		V
V_{CC}	DC supply voltage		750	800	V
I_{nom}	rms @ rated conditions: dV/dt = 10l/min, 50% Glykol/ 50% $H_2$0, f_{sw} = 4kHz, V_{CC} = 750V, V_{out} = 400V, f_{out} = 50Hz, cos(phi) = 0.85, M = 0.87, $T_{coolant}$ = 65 °C, T_{air} = 65 °C		300		A
f_{sw}	Switching frequency	1		20	kHz
C_{DC}	DC Bus Capacitance	0.9		1.25	mF
C_y	EMI Capacitor; DC to enclosure		0.66		µF
R_F	DC+ to enclosure, DC- to enclosure		7.5		MΩ
R_{BL}	DC+ to DC-		1		MΩ
Mechanical Data					
Weight			15		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 (recommended)		10		Nm
M_e	Assembly of enclosure; thread (l): > 15mm — M8 screw			20	Nm
	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
P	Power dissipation to coolant; rated conditions		2.4		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} > 85°C	-40		105	°C
$T_{coolant}$	Operating range, derating for $T_{coolant}$ > 65°C	-40		75	°C
IP	Enclosure protection level		IP67		
	With external connector protection		IP6K9K		
Altitude	V_{cc} = 800 V			2000	m



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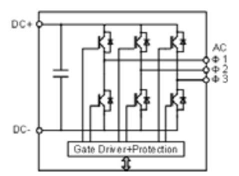

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Characteristics					
Symbol	**Conditions**	**min.**	**typ.**	**max.**	**Unit**
Interface parameters					
V_s	Auxiliary supply voltage primary side	8	12	16	V
I_{SO}	Auxiliary supply current primary side without driving a gate (V_s = 12 V)			900	mA
I_S	Auxiliary supply current primary side, driving the gates (V_s = 12 V)			1740	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		0.1	0.9	s
t_{pRESET}	Error reset time			3	s
Controller switching parameters					
$t_{d(on)IO}$	Input-output turn-on propagation time		0.5	0.6	µs
$t_{d(off)IO}$	Input-output turn-off propagation time		0.5	0.6	µs
t_{jitter}	Signal transfer prim - sec (total jitter)			50	ns
t_{SIS}	Short pulse suppression time	0.2	0.25	0.3	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		1	µs
$t_{d(err)OCP}$	Error input-output propagation time for OCP error		4	10	µs
$t_{d(err)TMP}$	Error input-output propagation time for temperature error			50	ms
t_{TD}	Top-Bot interlock dead time		4	4.1	µs
t_{bl}	VCE monitoring blanking time		5	5.1	µs
Protection functions					
$T_{PCBtrip}$	Over temperature protection trip level (PCB)	100			°C
T_{CStrip}	Over temperature protection trip level on ceramic-substrate	120			°C
$T_{RelPCBtrip}$	Release temperature for PCB overtemperature trip level	90			°C
$T_{RelCStrip}$	Release temperature for ceramic substrate 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			7	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	16.2	16.695	17.205	mV/A
$BW_{Ioutsens}$	Bandwidth (3 dB) of AC current sensing		17		kHz
V_{DCsens}	Measurable DC-link-voltage	0		1000	V
$m_{VDCsens}$	Gradient of DC-link voltage sensing	9.835	10.034	10.236	mV/V
$BW_{VDCsens}$	Bandwidth (3 dB) of DC-link voltage sensing		0.25		kHz
T_{CSsens}	Temperature sensing range on ceramic substrate	30		150	°C
$m_{TCSsens}$	Gradient of temperature sensing on ceramic-substrate		83.3		mV/°C
$BW_{TCSsens}$	Bandwidth of temperature sensing on ceramic-substrate		100		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	CAN_GND	GND	Ground of CAN bus

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_DIAG, CMN_HALT, CMN_GPIO	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: 5 mA Nominal voltage range: 0…10 V
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	CAN_L	INPUT/OUTPUT CAN interface LOW line	Input impedance = 121 Ω Specification: ISO 11783 (2.5V, 250 kbit/sec minimum, quad twisted cable) or J1939/11 (250 kbit/sec minimum, twisted shielded pair).
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	CMN_DIAG	INPUT/OUTPUT Single line CAN communication [dominant/recessive]	Dominant/Recessive diagnose input/output signal. All connected units can communicate using this serial signal for setting/getting parameters of the unit and reading error information from unit registers.
X1:27	CMN_DCL	OUTPUT DC-Link voltage signal [analog]	This pin is used to transmit the DC-Link voltage level. Max. output current: 5 mA Nominal voltage range: 0….+10 V Bandwidth 3dB = 250Hz at load resistance of 2kΩ
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: 5 mA Nominal voltage range: -10 … +10 V 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

PIN	Signal	Function	Specifications
X1:31	HB2_I	OUTPUT Current sensor out for HB2 [analog]	Max. output current: 5 mA Nominal voltage range: -10 … +10 V 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: 5 mA Nominal voltage range: -10 … +10 V 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	CAN_H	INPUT/OUTPUT CAN interface HIGH line	Input impedance = 121 Ω Specification: ISO 11783 (2.5V, 250 kbit/sec minimum, quad twisted cable) or J1939/11 (250 kbit/sec minimum, twisted shielded pair).

Power Connectors

Terminal	Function	cable harness cross section Cu / mm^2
DC+	HVDC Bus "+"	≤ 70
DC-	HVDC Bus "-"	≤ 70
L1	Phase L1	≤ 70
L2	Phase L2	≤ 70
L3	Phase L3	≤ 70

Coolant fittings

Terminal	Function
IN	Coolant Inlet
OUT	Coolant Outlet

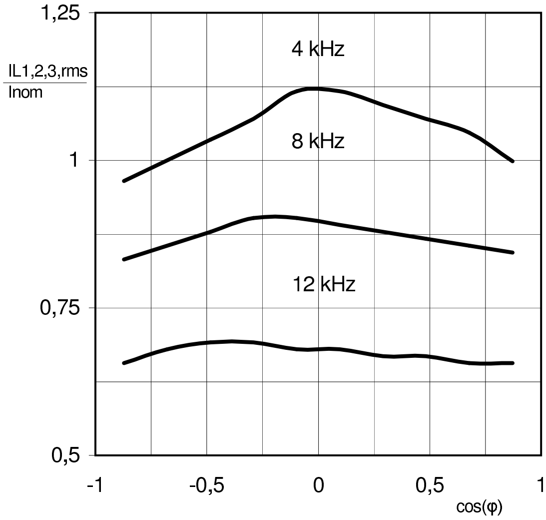


Fig. 1: Normalized output current vs. cos(phi)

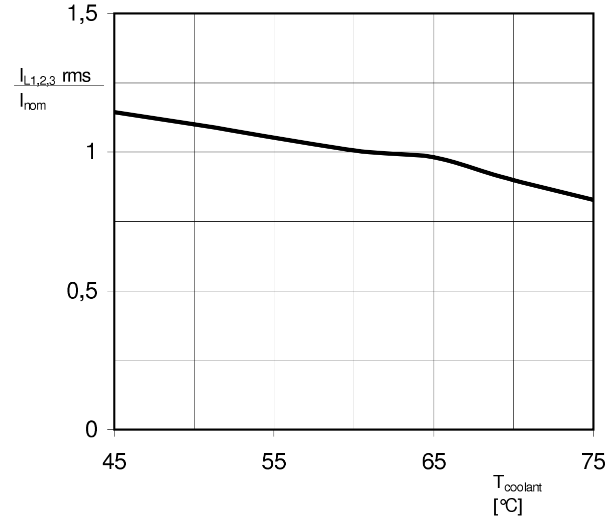


Fig. 2: Normalized output current vs. coolant temperature

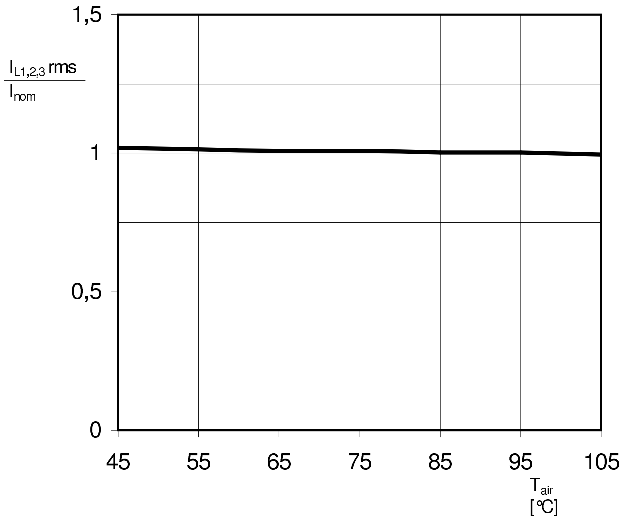


Fig. 3: Normalized output current vs. ambient temperature

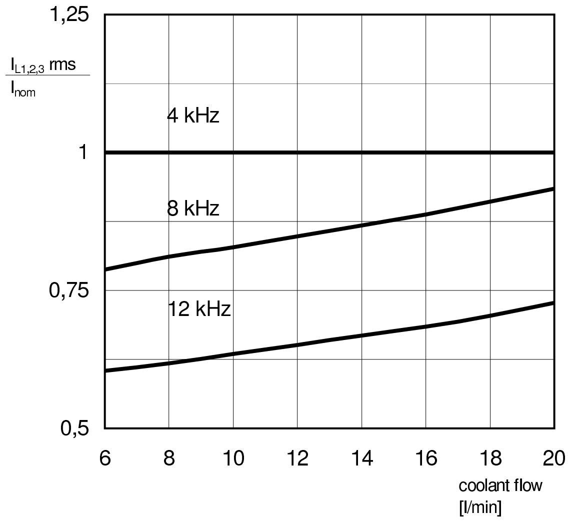


Fig. 4: Normalized output current vs. coolant flow

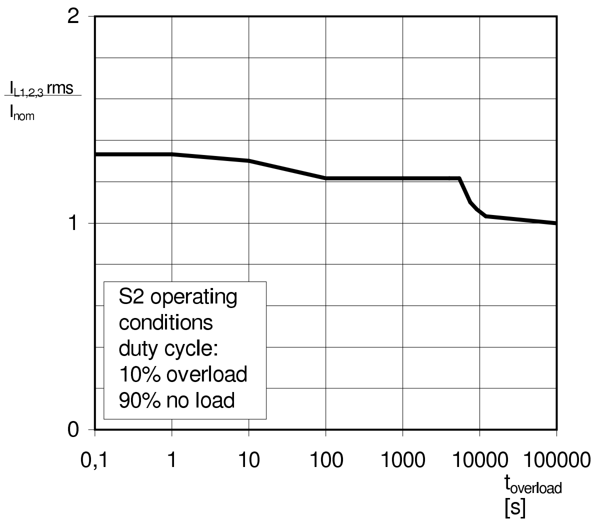


Fig. 5: Overload capability

Operating point:
if not specified otherwise

$T_{coolant}$		65	°C
T_{air}		65	°C
dV/dt	coolant flow	10	l/min
f_{sw}	switching frequency	4	kHz
V_{CC}	DC supply voltage	750	V
V_{out}	output voltage	400	V
f_{out}	output frequency	50	Hz
cos(φ)		0,85	
I_{nom}	normalized current	300	A
M	modulation factor	0,87	

Fig. 6: Legend

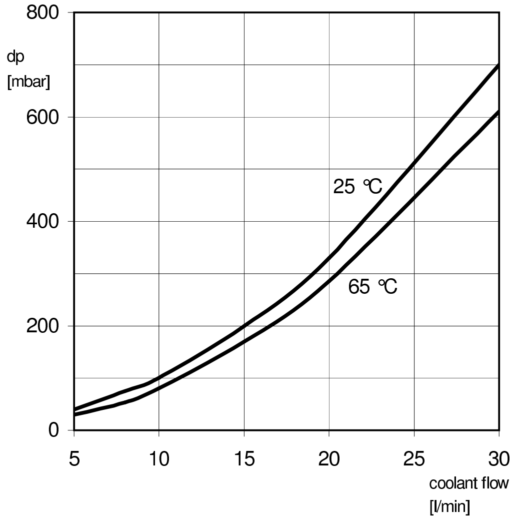


Fig. 7: Pressure drop characteristic

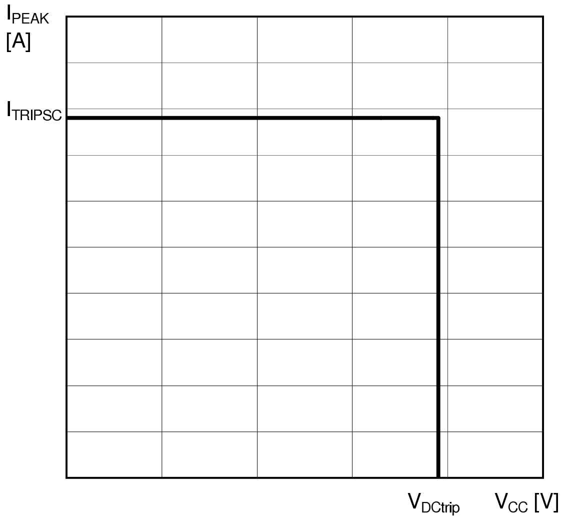


Fig. 8: Safe operating area

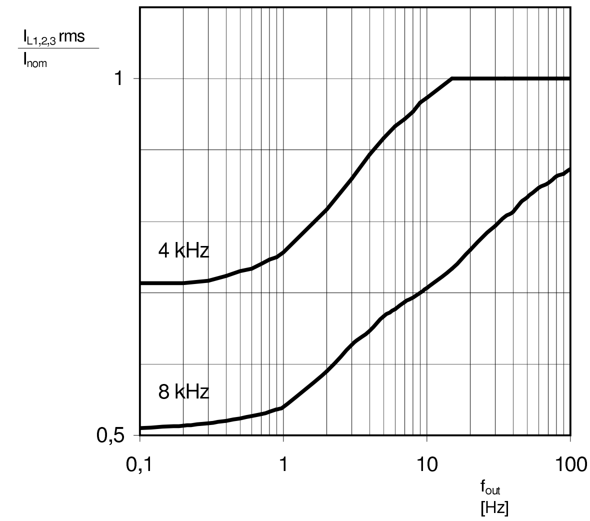
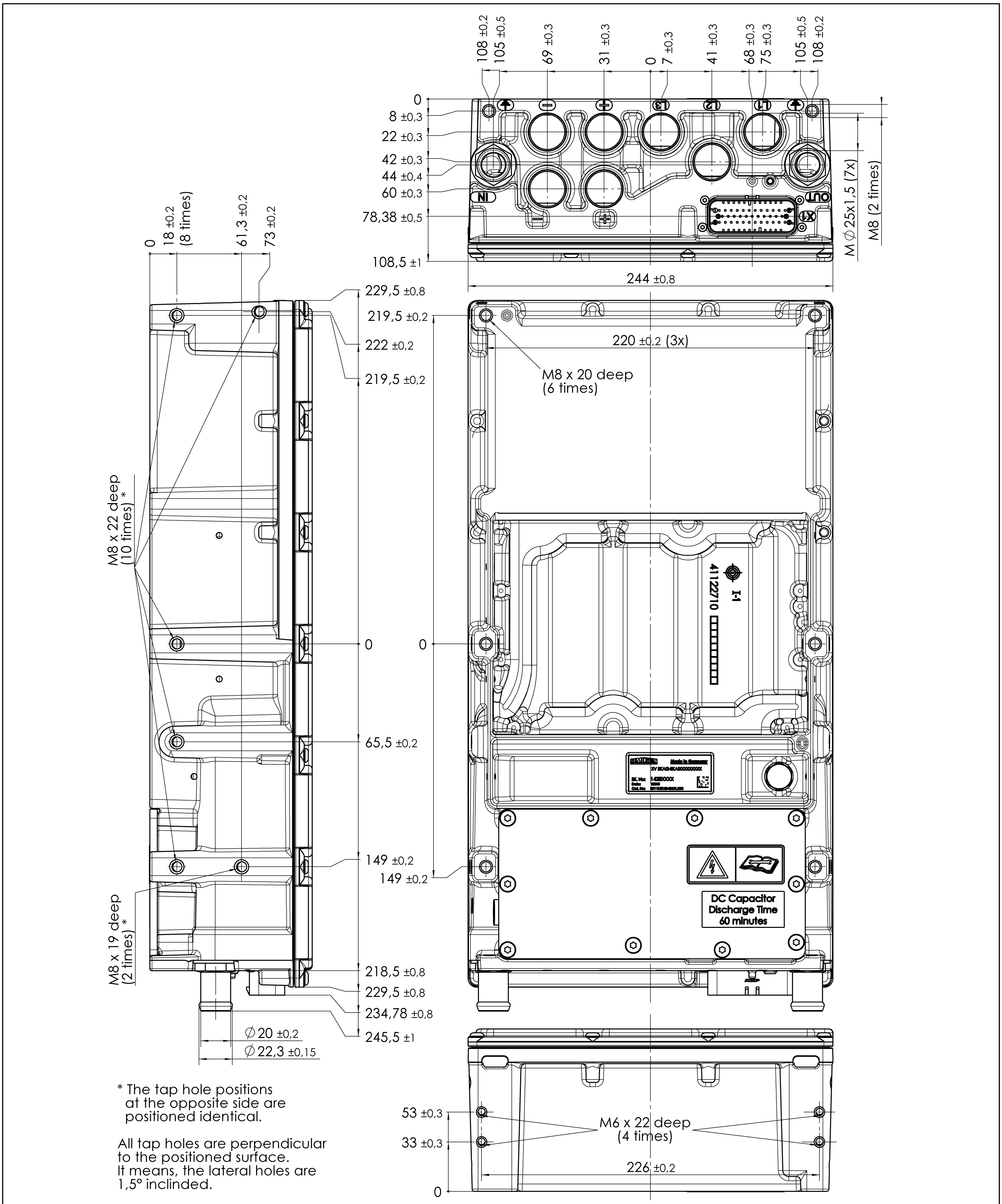


Fig. 9: Normilized output current vs. output frequency



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.

