

Data Sheet

EC-C1200-450

Liquid cooled heavy duty converter

FEATURES

- Extremely compact design – converter unit only 14 kg
- High enclosure class IP6K9K – sealed from moisture and dust
- Liquid cooled with water-glycol mixture
- Ambient temperature from -40°C to +105°C
- Allowed coolant temperature up to +65°C
- Robust design withstanding high levels of mechanical vibrations and shocks
- Designed especially for highly cyclical loads typical in heavy mobile work machines

SOFTWARE FEATURES

- 2x Isolated CAN ports supporting CANopen and SAE J-1939 protocols
- Bidirectional energy flow control
- High performance current and voltage control
- Interleaved PWM between phases for lower ripple current and voltage
- Wide selection of protective functions
- PowerUSER PC-program for commissioning and diagnostics available



GENERAL

The device is a heavy-duty converter designed especially for electric or hybrid drive trains for mobile work machines, buses or marine vessels. It can act as motor inverter, active front end, create a microgrid or as a DC/DC-converter depending on the options selected.

TYPICAL APPLICATIONS

- Boosting battery voltage to higher DC-link voltage (+DC option)
- Charging high voltage batteries from higher DC-link voltage (+DC option)
- Controlling the speed and torque of electrical traction motors (+MC option)
- Converting alternating current (AC) from electrical generator to direct current (DC) for energy storage (+MC option)
- Active Front End for connecting to AC grid with regenerative power and low harmonic (+AFE option)
- Microgrid (+UG option)

+DC option requires an external inductance unit. See Danfoss EC-LTS data sheets for more information. (Contact Danfoss Editron)

+AFE and +UG options require an external LCL-filter unit. See Danfoss EC-LCL1200 data sheets for more information. (Contact Danfoss Editron)

SPECIFICATIONS

DC connection (+DC option)	
HV-side voltage range	0-850 V _{DC}
HV-side nominal voltage	750 V _{DC}
HV-side nominal current	350 A _{DC}
LV-side typical voltage	75-750 V _{DC} (maximum transformation ratio between LV and HV voltages is 1:10)
LV-side nominal current	See Table 1
Nominal power	See Table 1 (output power is limited by the LV-side voltage and current)
HV-side voltage range	0-850 V _{DC}
Switching frequency	8 kHz

DC connection (+MC/+AFE/+UG option)	
DC link voltage range	0-850 V _{DC}
DC link nominal voltage	750 V _{DC}

AC connection (+MC/+AFE/+UG option)	
AC output voltage	0-560 V _{EFF} (U _{DC} = 800 V _{DC})
Maximum power	300 kW (500 V _{AC} , 350 A _{RMS})
Output frequency	0...580 Hz (Up to 1000 Hz as option)
Switching frequency	8 kHz

Control voltage input	
Voltage range	7-33 V _{DC}
Power	14.4 W
Nominal current	0.6 A @ 24 V _{DC} 1.2 A @ 12 V _{DC}

Mechanical	
Dimensions (W x H x L)	244 x 109 x 482 mm
Weight	14 kg + -2 % (no options)
Main materials	Enclosure (including coolant circuit): AlSi12Cu1(Fe) Coolant connections: CuZn39Pb3 CE1 / CE2 option: AlSi12

Cooling	
Cooling liquid	Plain water with appropriate corrosive inhibitor (max. 50 % corrosive inhibitor)
Cooling liquid mixture	Nominal mixture 50/50 water/glycol (max. 52 % glycol allowed with 1 % current derating per 1 % mixture increase above 50 % glycol content)
Cooling liquid glycol type	Ethylene glycol (Glysantin G48 recommended)
Minimum cooling liquid flow	10 l/min
Maximum continuous pressure	2 bar
Lowest absolute pressure	1 kPa (for vacuum filling)
Coolant volume	300 cm ³
Pressure loss	100 mbar with 10 l/min (+25°C coolant)
Cooling liquid temperature	-40°C ... +65°C (with derating 1 % / 1°C max. +75°C)

Ambient Conditions	
Storage temperature	-40°C...+105°C
Operating temperature	-40°C...+105°C (with nominal coolant temp.)
Altitude	max. 2000 m
Relative humidity	100 %
Enclosure class	IP6K9K, IP67
Mechanical vibration	10 G ISO 16750-3 Test VII – Commercial vehicle, sprung masses – Table 12 Notes: test duration 8h per each axis (x, y and z axes tested) total spectral acceleration 5.91 G _{RMS}
Mechanical shock	50 G ISO 16750-3 4.2.2 Test for devices on rigid points on the body and on the frame Notes: –acceleration: 500 m/s ² ; –duration: 6 ms; –number of shocks: 10 per test direction

Connections	
Coolant connection	2 x 20 mm coolant hose connector (see dimension drawing for details)
HV cable recommended type	HUBER+SUHNER Radox Elastomer S, screened, single core, automotive cable (FHLR4GC13X) www.hubersuhner.com
HV cable cross section	≤70 mm ² (Cu) Phase cables up to 120mm ² (+CE2 option only)
HV cable glands	Pflitsch blueglobe TRI bg 225ms tri (M25 thread) Pflitsch blueglobe TRI bg 232ms tri (M32 thread) (see option list and +CGx options for details)
HV cable lug	35-8, 50-8, 70-8, 95-8, 120-8
Recommended cable lug	35 mm ² : Druseidt with narrow flange 03901 50 mm ² : Druseidt with narrow flange 03903 70 mm ² : Druseidt with narrow flange 03906 95 mm ² : Druseidt with narrow flange 03910 (only compatible for phase cables with +CE2 option) 120 mm ² : Druseidt with narrow flange 03914 (only compatible for phase cables with +CE2 option) www.druseidt.de
LV connector	35-pin Tyco electronics AMPSEAL connector www.te.com
LV connector type	part no. 776163-1
LV mating connector type	TE 776164-1
LV mating connector pin type	0.5-1.25 mm ² : TE 770854-3 (gold plated)
LV connector pin configuration	See section SIGNAL CONNECTOR PINOUT
CAN connections	2x isolated and unterminated CAN channels (see section SIGNAL CONNECTOR PINOUT)
CAN protocols	SAE J-1939 CANopen
IO/analog output	5x isolated IO/analog output (see section SIGNAL CONNECTOR PINOUT)

DC/DC control characteristics (+DC option)	
Converter topology	Bidirectional (Buck or Boost)
Control principle	Current control Voltage control Power control

Motor control characteristics (+MC option)	
Controllable motor types	Synchronous permanent magnet motors Asynchronous induction motors Danfoss synchronous reluctance assisted permanent magnet motors (SRPM)
Control principle	Rotor flux oriented current vector control
Control methods	Torque reference motor control Speed reference motor control DC-link voltage control
Field weakening control	Maximizes the field weakening performance by optimizing the use of inverter current and torque production capability of the motor
Working point optimization	Maximum torque per ampere working point optimization is used to improve efficiency of the motor

Protections	
HW overcurrent trip	750 A _{peak} (reaction time <15μs)
HW short circuit trip	2700 A _{peak} (self-limiting, reaction time <2μs)
HW overvoltage trip	1050 V _{DC}
SW overcurrent trip	Programmable level
SW overvoltage trip	Programmable level
Short circuit protection	Yes
High-Voltage interlock loop	HV loop on signal connector for external monitoring, HV loop pins are connected on the inverter side
Inverter temperature protection	Sophisticated thermal model that can lower the current if needed
Inverter temperature trip	Yes
External temperature measurement	Yes, programmable warning, fault and trip levels

Standards and classifications	
IEC 60664-1 Pollution degree class 2	
IEC 60664-1 Overvoltage category III	
EN 61800-5-1: 2007 Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy.	
EN ISO 13766-1:2018 Construction machinery. Electromagnetic compatibility of machines with internal electrical power supply.	
UN Regulation No. 10 Revision 4 and Revision 5 Uniform provisions concerning the approval of vehicles regarding electromagnetic compatibility.	

POWER AND CURRENT VARIANTS

Basic product type	Nominal power [kW]	Nominal current [A _{DC}]	Conditions
EC-C1200-450-L+DC150	90	150	LV-side voltage 600 V _{DC} , HV-side voltage 750 V _{DC}
EC-C1200-450-L+DC250	150	250	LV-side voltage 600 V _{DC} , HV-side voltage 750 V _{DC}
EC-C1200-450-L+DC300	180	300	LV-side voltage 600 V _{DC} , HV-side voltage 750 V _{DC}
EC-C1200-450-L+DC400	240	400	LV-side voltage 600 V _{DC} , HV-side voltage 750 V _{DC}

Table 1 Device current and power ratings for +DC option

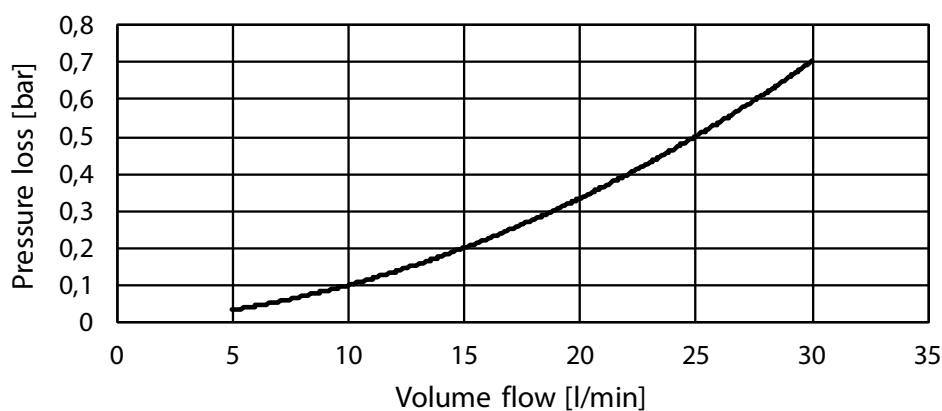
“-S” and “-L” versions have same ratings, see section SMALL/LARGE SYSTEM DIFFERENCES.

Basic product type	Nominal power [kVA]	Nominal current [A _{RMS}]	Peak current, time unlimited [A _{RMS}]
EC-C1200-450-L+MC70+AFE70+UG70	50	70	70
EC-C1200-450-L+MC120+AFE120+UG120	100	120	120
EC-C1200-450-L+MC180+AFE180+UG180	150	180	180
EC-C1200-450-L+MC240+AFE240+UG240	200	240	240
EC-C1200-450-L+MC300+AFE300+UG300	250	300	300
EC-C1200-450-L+MC350+AFE350+UG350	300	350	350

Table 2 Device current and power ratings for +MC, +AFE and +UG options

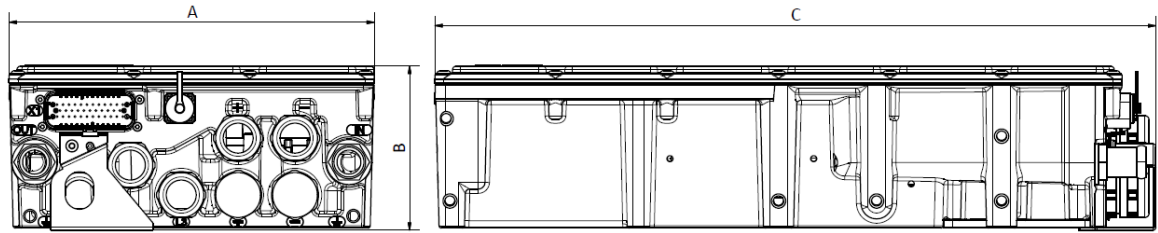
“-S” and “-L” versions have same ratings, see section SMALL/LARGE SYSTEM DIFFERENCES.

PRESSURE LOSS VS COOLANT FLOW

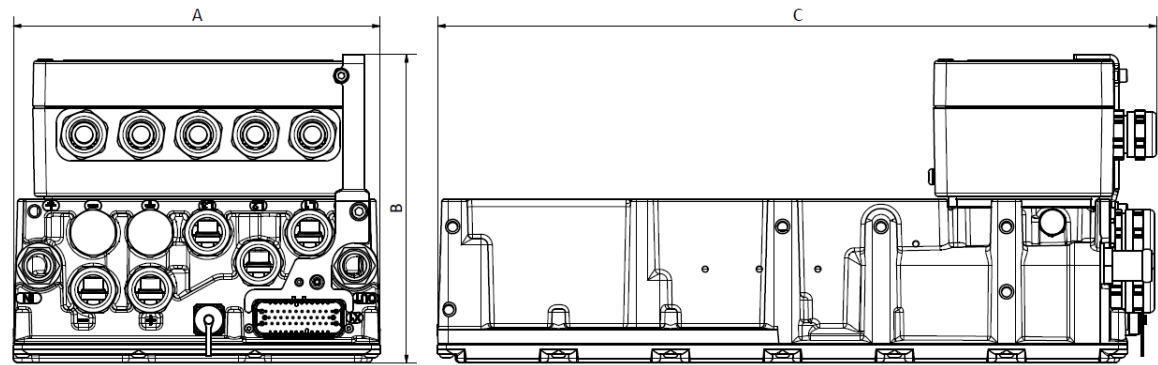


Picture 1 Device pressure loss vs coolant flow

DIMENSIONS



Picture 2 Device dimensions

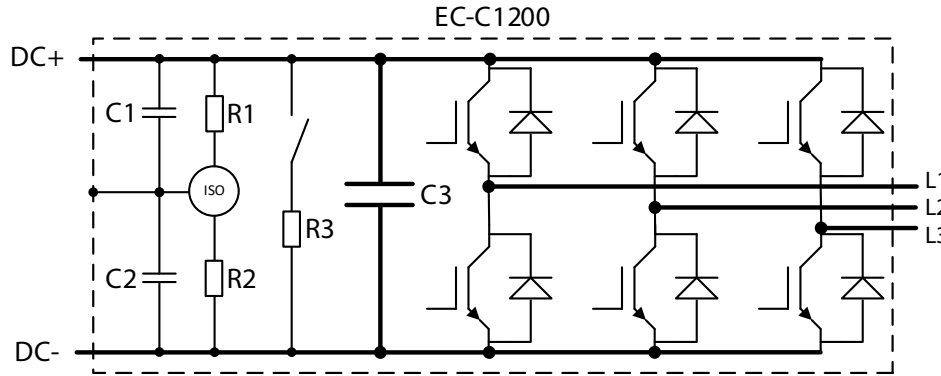


Picture 3 Device dimensions with +CE1 or +CE2 option

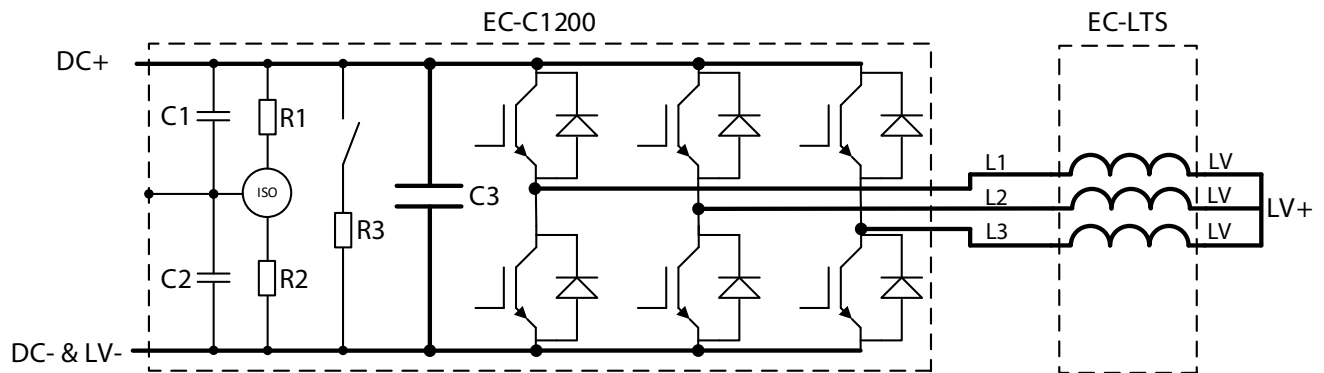
Dimension	Lengths for EC-C1200-450	Lengths for EC-C1200-450 with +CE1 or +CE2 option
A	244 mm	244 mm
B	109 mm	205 mm
C	482 mm	479 mm

SMALL/LARGE SYSTEM DIFFERENCES

The electric device has option for small systems (-S) and large systems (-L). Small system option is typical for vehicle applications and large system option is standard in marine applications because of the marine regulations. Complete system should be looked when choosing the option as for example vehicle system with many devices could also need the L-option to keep the isolation resistance or Y-capacitors at reasonable level. In large and small system options, there are differences in the isolation measurement resistance, DC-link discharge resistor and Y-capacitor values as shown in Picture 5 and Table 3.



Picture 4 EC-C1200-450 internal schematic



Picture 5 EC-C1200-450 internal schematic and application example when used in combination with external inductance unit EC-LTS

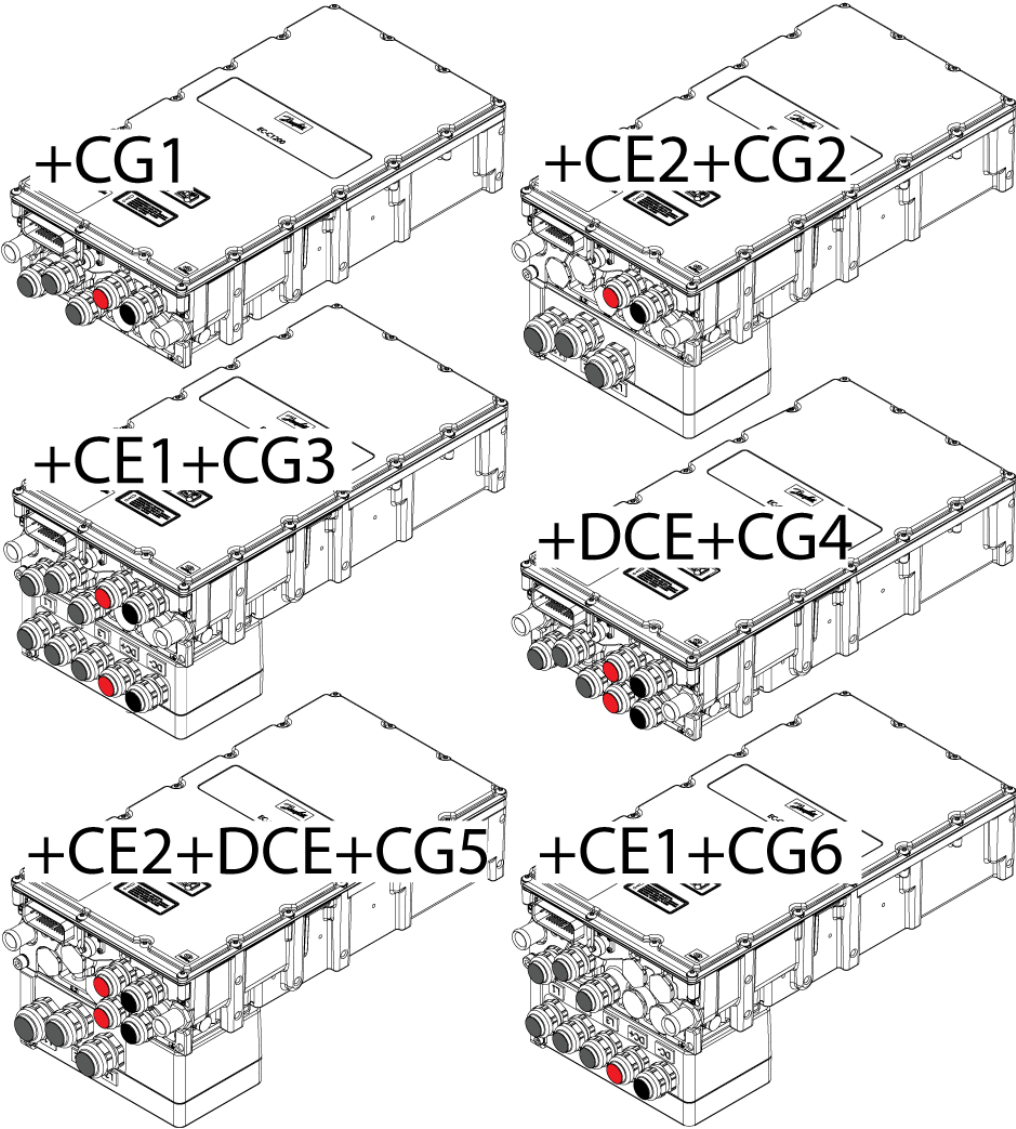
Component	Small-system option	Large-system option
Isolation measurement R1, R2	12 M Ω	240 M Ω
Discharge resistor R3	3.9 k Ω	39 k Ω
Y-capacitor C1, C2	330 nF	3.3 nF
DC-link capacitor C3	1 mF	1 mF
Isolation resistance from DC-link to enclosure	6 M Ω	120 M Ω

Table 3 S/L-system differences

Device with +MC, +AFE or +UG option has internal schematic shown in Picture 4. Possible additional equipment like LCL-filter or motor is connected to the phases L1, L2 and L3. Options +AFE and +UG are not compatible with the -S version of the device. Generally, option -L is recommended for all applications.

Device with +DC option requires external inductors to work as seen in application example shown in Picture 5. LV+ and LV- can be connected, for example, to battery and DC+ and DC- to a higher voltage DC-link. Device is in control of the discharging and charging of the battery. +DCE option is recommended when using the device in combination with the external inductance unit.

Different connection options of the electric device are shown below.



Picture 6 Connection options of EC-C1200-450

Color	Meaning
Gray	Cable glands for phases
Red	Cable glands for DC+
Black	Cable glands for DC-

Table 4 Color coding

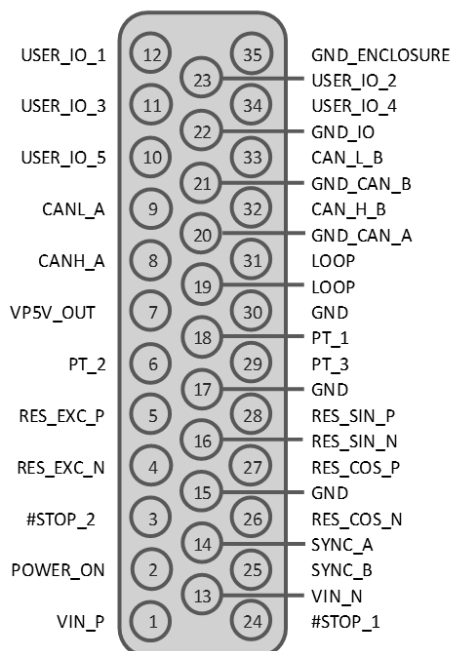
PARAMETRIZING, MONITORING AND DIAGNOSTIC OF THE DEVICE

PowerUSER monitoring and diagnostics software uses service connector on the device and PSSC service cable for connecting to the device. The PSSC is isolated RS485 and shielded cable specially designed for the demanding environments where the inverters are used, and it is available in 3 meter (PSSC-3M) and 10 meter version (PSSC-10M). The service cable is ordered separately.

Product code	Cable length	Description
PSSC-3M	3 meters	USB to RS485 isolated service cable
PSSC-10M	10 meters	USB to RS485 isolated service cable

Table 5 Service cables; ordered separately, needed for parametrizing, monitoring and diagnostics

SIGNAL CONNECTOR PINOUT



Pin number	Signal name	RevR/S/T Comments
1	VIN_P	Positive Power Supply (7-33V)
2	POWER_ON	Active High, Turn ON @ >7.4V, Turn OFF @ < 5.8V
3	#STOP_2	Active Low, STOP @ < 1.2V, RUN @ > 4.65V Pulling one #STOP down stops the inverter
4	RES_EXC_N	Resolver excitation, use twisted pair and shield
5	RES_EXC_P	Resolver excitation, use twisted pair and shield
6	PT_2	PT100 or PT1000 temperature sensor input Connect sensor against signal GND
7	VP5V_OUT	+5V/200mA output for external sensors. Software control
8	CANH_A	CAN bus A, isolated (Functional isolation <100 VDC)
9	CANL_A	CAN bus A, isolated (Functional isolation <100 VDC)
10	USER_IO_5	Digital input ('1' @ 3V, '0' @ 2V) (max. 10 mA) Digital output ('1' = 4.8V, '0' = 0V) (max. 10 mA) Digital output open collector (max. 80mA)
11	USER_IO_3	Digital input ('1' @ 3V, '0' @ 2V) (max. 10 mA) Digital output ('1' = 4.8V, '0' = 0V) (max. 10 mA) Digital output open collector (max. 80 mA) Analog input (0-32V) (input impedance ~100 kOhm)
12	USER_IO_1	Digital input ('1' @ 3V, '0' @ 2V) (max. 10 mA) Digital output ('1' = 4.8V, '0' = 0V) (max. 10 mA) Digital output open collector (max. 80 mA) Analog input (0-32V) (input impedance ~100 kOhm)
13	VIN_N	Negative Power Supply (0V)
14	SYNC_A	SYNC_A for Master/Slave
15	GND	Signal GND / PT100 or PT1000 GND
16	RES_SIN_N	Resolver input, use twisted pair and shield
17	GND	Signal GND / PT100 or PT1000 GND
18	PT_1	PT100 or PT1000 temperature sensor input Connect sensor against signal GND
19	LOOP	High Voltage Diagnostic Loop
20	GND_CAN_A	GND for CAN bus A
21	GND_CAN_B	GND for CAN bus B
22	GND_IO	GND for IO, IO is isolated (Functional isolation <100 VDC)
23	USER_IO_2	Digital input ('1' @ 3V, '0' @ 2V) (max. 10 mA) Digital output ('1' = 4.8V, '0' = 0V) (max. 10 mA) Digital output open collector (max. 80 mA) Analog input (0-32V) (input impedance ~100 kOhm)
24	#STOP_1	Active Low, STOP @ < 1.2V, RUN @ > 4.65V Pulling one #STOP down stops the inverter
25	SYNC_B	SYNC_B for Master/Slave
26	RES_COS_N	Resolver input, use twisted pair and shield
27	RES_COS_P	Resolver input, use twisted pair and shield
28	RES_SIN_P	Resolver input, use twisted pair and shield
29	PT_3	PT100 or PT1000 temperature sensor input Connect sensor against signal GND
30	GND	Signal GND / PT100 or PT1000 GND
31	LOOP	High Voltage Diagnostic Loop
32	CAN_H_B	CAN bus B, isolated (Functional isolation <100 VDC)
33	CAN_L_B	CAN bus B, isolated (Functional isolation <100 VDC)
34	USER_IO_4	Digital input ('1' @ 3V, '0' @ 2V) (max. 10 mA) Digital output ('1' = 4.8V, '0' = 0V) (max. 10 mA) Digital output open collector (max. 80 mA) Analog input (0-32V) (input impedance ~100 kOhm)
35	GND_ENCLOSURE	Enclosure ground

Picture 7 Signal connector pinout

PRODUCT CODE AND OPTIONS

Use product code including all needed options for ordering. Standard options do not need to be listed in the code as they are selected by default if a non-standard option is not selected. Standard options are indicated by a star (*).

Device with +DC option requires external inductors to work. Separate inductor unit can be ordered with product name EC-LTS1200-410 (see EC-LTS1200-410 data sheet for details).

Any combination of control options +MC, +AFE and +UG is available. Option +DC is only available alone.

Options +AFE and +UG are not compatible with the option -S. **Generally, option -L is recommended for all applications.**

Product code	Description
EC-C1200-450-L-SW11+MC300	L-version unit for controlling motor with 300 A current limit
EC-C1200-450-L-SW11+MC300+CG1	L-version unit for controlling motor with cable glands and 300 A current limit
EC-C1200-450-S-SW11+DC400+DCE	S-version unit for DCDC applications with double DC-connections and 400 A _{DC} current limit

Table 6 Product code examples

Variant	Code	Description	Additional information
System size	-S	Small system	Default EC-C unit for individual or small system installations
	-L	Large system	EC-C unit for large system installations
Software version	*	Software version 7.x	7-series software development is in maintenance mode. No new features will be added. Not recommended for new designs
	-SW11	Software version 11.x	Software version of the unit is the latest version of 11-series software
Control	+MC70	Motor control, current limit 70 A	Converter for motor/generator applications
	+MC120	Motor control, current limit 120 A	Converter for motor/generator applications
	+MC180	Motor control, current limit 180 A	Converter for motor/generator applications
	+MC240	Motor control, current limit 240 A	Converter for motor/generator applications
	+MC300	Motor control, current limit 300 A	Converter for motor/generator applications
	+MC350	Motor control, current limit 350 A	Converter for motor/generator applications
	+AFE70	Active front end, current limit 70 A	Converter for active front end applications
	+AFE120	Active front end, current limit 120 A	Converter for active front end applications
	+AFE180	Active front end, current limit 180 A	Converter for active front end applications
	+AFE240	Active front end, current limit 240 A	Converter for active front end applications
	+AFE300	Active front end, current limit 300 A	Converter for active front end applications
	+AFE350	Active front end, current limit 350 A	Converter for active front end applications
	+UG70	Microgrid, current limit 70 A	Converter for microgrid applications
	+UG120	Microgrid, current limit 120 A	Converter for microgrid applications
	+UG180	Microgrid, current limit 180 A	Converter for microgrid applications
	+UG240	Microgrid, current limit 240 A	Converter for microgrid applications
	+UG300	Microgrid, current limit 300 A	Converter for microgrid applications
	+UG350	Microgrid, current limit 350 A	Converter for microgrid applications
	+DC150	DCDC control, current limit 150 A _{DC}	Converter for DC/DC applications
	+DC250	DCDC control, current limit 250 A _{DC}	Converter for DC/DC applications
	+DC300	DCDC control, current limit 300 A _{DC}	Converter for DC/DC applications
	+DC400	DCDC control, current limit 400 A _{DC}	Converter for DC/DC applications

Speed option	*	Normal speed version (<580 Hz output frequency)	EC-C with motor/generator control firmware, capable of speeds below 580 Hz
	+HS	High speed version (>580 Hz output frequency)	EC-C with motor/generator control firmware, capable of speeds up to 1000 Hz
Communication	*	CAN1939	EC-C with Standard SAE1939-communication
	+CO	CANopen	EC-C with CANopen-communication
Connections	*	Normal connections	EC-C with default HV connections
	+CE1	Connection extension 1	EC-C with double DC and AC connectivity with connection extension box 1 (double M25 cable gland threads) (Not compatible with +DCE option)
	+CE2	Connection extension 2	EC-C with M32 cable gland threads on AC connection with connection extension box 2 (choose also +DCE if double DC connection is required)
	+DCE	DC-extension	EC-C with double DC-connections: copper bushings for double connection (compatible with +CE2/+CG4/+CG5)
Cable glands	*	No cable glands	EC-C with no cable glands or plugs
	+CG1	Default M25 cable glands	EC-C with 5x M25 cable glands and 2x M25 plugs
	+CG2	Default M25/M32 cable glands	EC-C with 2x M25 cable glands, 3xM32 cable glands and 3xM25 plugs (for +CE2 option)
	+CG3	Default M25 cable glands	EC-C with 10x M25 cable glands (for +CE1 option with double DC-link connections)
	+CG4	Default M25 cable glands	EC-C with 7x M25 cable glands (for +DCE option)
	+CG5	Default M25/M32 cable glands	EC-C with 4x M25 cable glands, 3xM32 cable glands and 3xM25 plugs (for combined +CE2 and +DCE options)
	+CG6	Default M25 cable glands	EC-C with 8x M25 cable glands and 2x M25 plugs (for +CE1 option with single DC-link connections)
Marine classification	*	No marine classification	
	+CL1		ABS American Bureau of Shipping
	+CL2		BV Bureau Veritas
	+CL3		DNV
	+CL4		LR Lloyd's Register
	+CL5		RINA
	+CL6		CCS China Classification Society
Customer specific	*	Default unit firmware-wise	EC-C with default parameters and application
	+CS	Customer specific parameters or application in FW	EC-C with separately specified application and/or parameters

* Standard option

Table 7 Option list

NOTE! Products delivered with high speed option (+HS option) are subject to export control as dual-use items when transported outside of European community according to CE 428/2009 regulation.

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