Data Sheet

EC-C1700B-420

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 +85°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 or create a microgrid depending on the options selected.

TYPICAL APPLICATIONS

- 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)

+AFE and +UG options require an external LCL-filter or transformer with integrated LC-filter unit.

SPECIFICATIONS

DC connection (+MC/+AFE/+UG option)	
DC link voltage range	0-1200 V_{DC}
DC link nominal voltage	1050 V_{DC}

AC connection (+MC/+AFE/+UG option)	
AC output voltage	0-700 V_{EFF} (U_{DC} = 1200 V_{DC})
Maximum power	250 kVA (690 V_{AC}, 210 A_{RMS})
Output frequency	0...400 Hz
Switching frequency	4 kHz

Control voltage input	
Voltage range	7-33 V_{DC}
Power	12 W
Nominal current	0.5 A @ 24 V_{DC} 1.0 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	20 l/min
Maximum continuous pressure	2 bar
Lowest absolute pressure	1 kPa (for vacuum filling)
Coolant volume	300 cm³
Pressure loss	340 mbar with 20 l/min (+25°C coolant)
Cooling liquid maximum temperature	+65°C

Ambient Conditions	
Storage temperature	-40°C…+85°C
Operating temperature	-40°C…+85°C (with nominal coolant temp.)
Altitude	max. 3000 m
Relative humidity	98 %
Enclosure class	IP6K9K, IP67

Mechanical vibration	5.91 G_{RMS} 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 (only compatible with +CE2 option)
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)

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 overvoltage trip	1300 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 6 Uniform provisions concerning the approval of vehicles regarding electromagnetic compatibility. See user guide for more information.

POWER AND CURRENT VARIANTS

With option +MCxxx, +AFExxx, +UGxxx	Nominal power [kVA]	Nominal current [A$_{RMS}$]	Peak current, time unlimited [A$_{RMS}$]
+MC95 / +AFE95 / +UG95	100	95	95
+MC130 / +AFE130 / +UG130	150	130	130
+MC175 / +AFE175 / +UG175	200	175	175
+MC210 / +AFE210 / +UG210	250	210	210

Table 1 Device current and power ratings for +MC, +AFE and +UG options
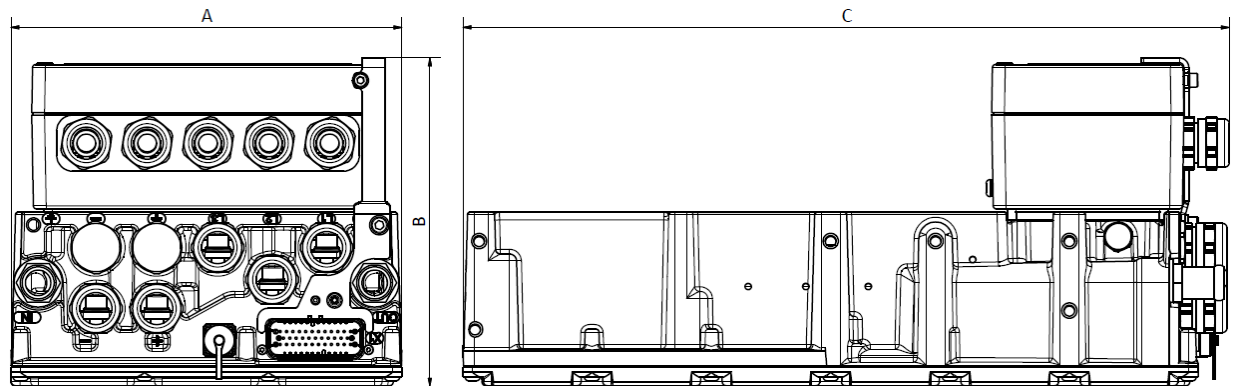
PRESSURE LOSS VS COOLANT FLOW
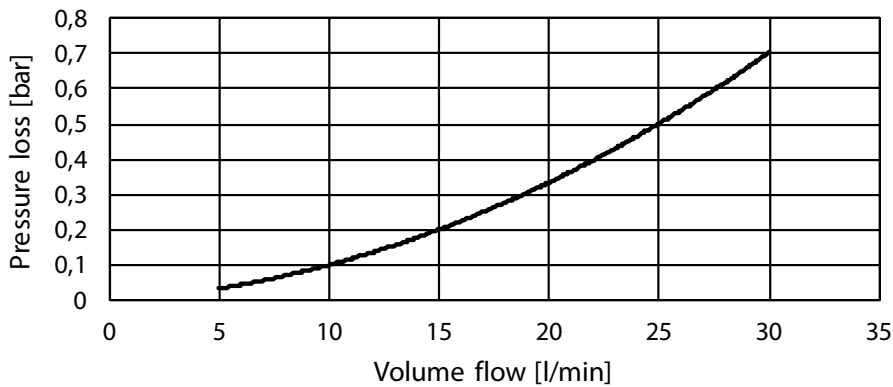
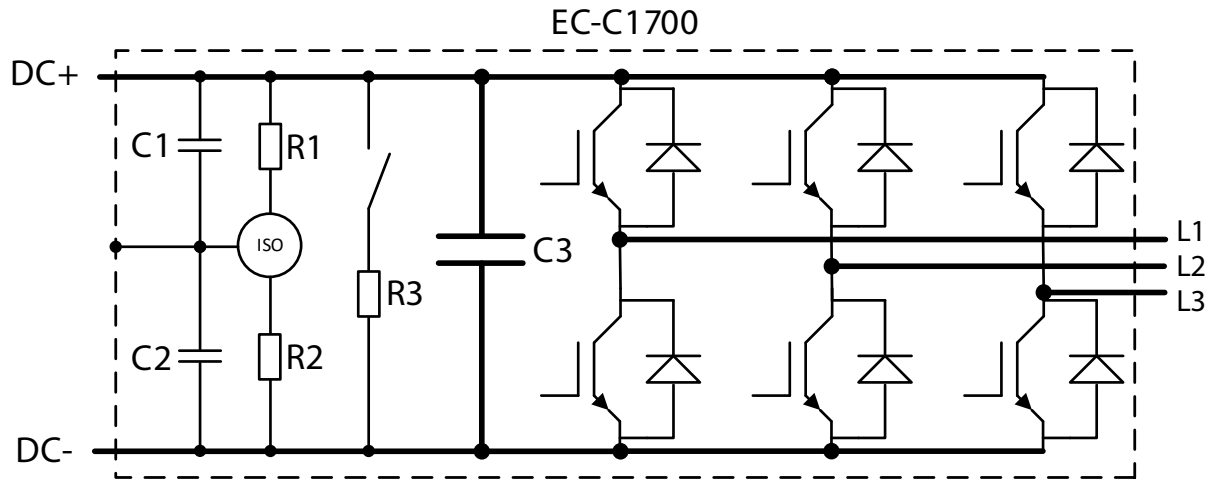Picture 1 Device pressure loss vs coolant flow

DIMENSIONS
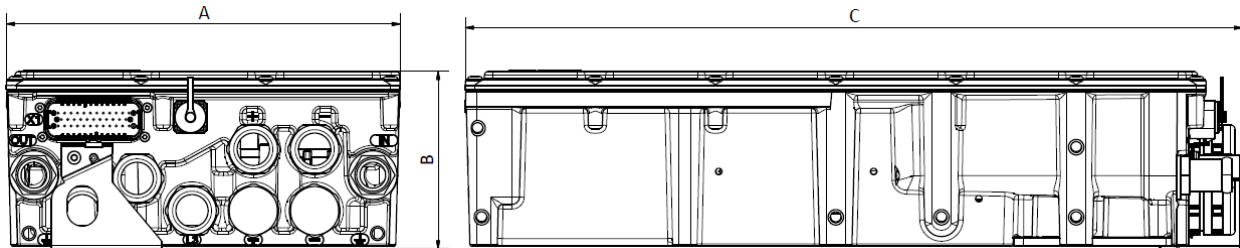
Picture 2 Device dimensions

Picture 3 Device dimensions with +CE1 or +CE2 option

Dimension	Lengths	Lengths for EC-C1700B-420 with +CE1 or +CE2 option
A	244 mm	244 mm
B	109 mm	205 mm
C	482 mm	479 mm

DEVICE INTERNAL SCHEMATIC

Picture 4 Device internal schematic

Component	Value
Isolation measurement R1, R2	240 MΩ
Discharge resistor R3	68 kΩ
Y-capacitor C1, C2	3.3 nF
DC-link capacitor C3	0.55 mF
Isolation resistance from DC-link to enclosure	120 MΩ

Table 2 Device internal components
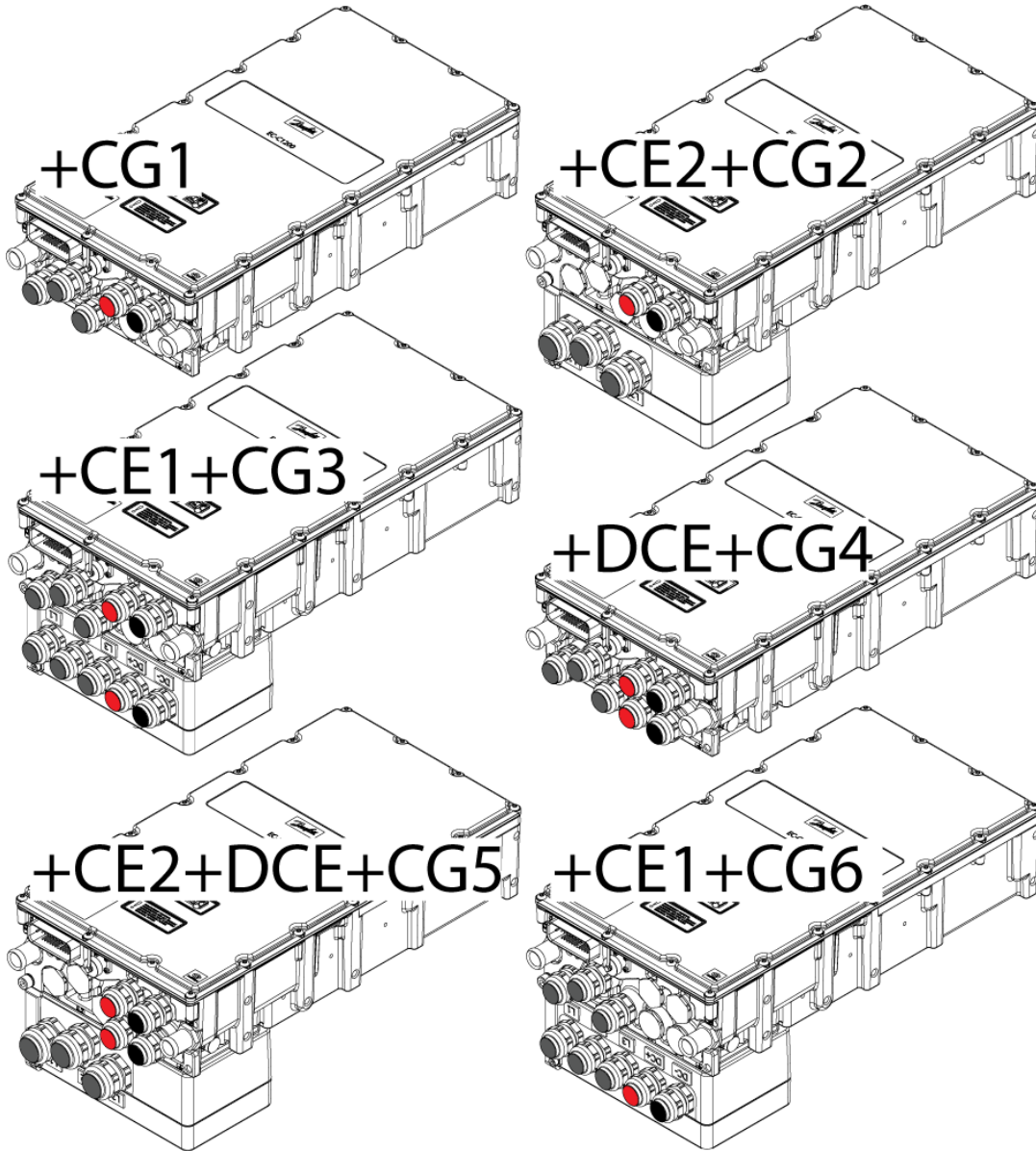
Picture 5 Connection options of EC-C1700B-420

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

Table 3 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 4 Service cables; ordered separately, needed for parametrizing, monitoring and diagnostics

SIGNAL CONNECTOR PINOUT

Pin number	Signal name	Rev E/F/G 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 exitation, use twisted pair and shield
5	RES_EXC_P	Resolver exitation, 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
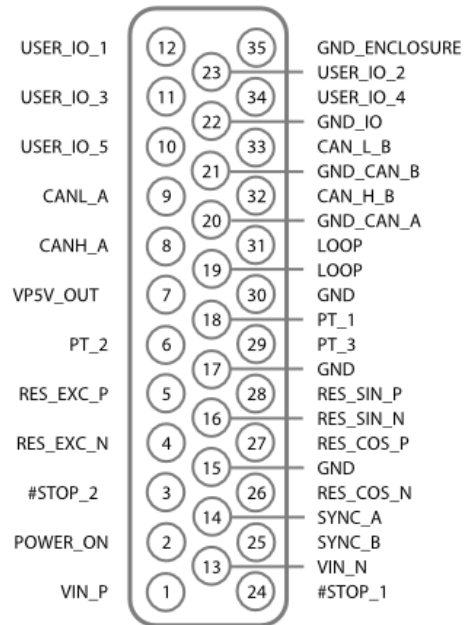
PRODUCT CODE AND OPTIONS

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 (*).

Any combination of control options +MC, +AFE and +UG is available.

Product code	Description
EC-C1700B-420-L-SW11+MC175	Standard unit for controlling motor with 175 A current limit
EC-C1700B-420-L-SW11+MC210+DCE	Device for controlling motor with double DC-connections and 210 A current limit

Table 5 Product code examples

Variant	Code	Description	Additional information
Hardware variant	-L	Device internal components	Definition for isolation resistance, discharge resistor and y-capacitance sizing
Software version	-SW11	Software version 11.x	Software version of the unit is the latest version of 11-series software
Control	+MC95	Motor control, current limit 95 A	Converter for motor/generator applications
	+MC130	Motor control, current limit 130 A	Converter for motor/generator applications
	+MC175	Motor control, current limit 175 A	Converter for motor/generator applications
	+MC210	Motor control, current limit 210 A	Converter for motor/generator applications
	+AFE95	Active front end, current limit 95 A	Converter for active front end applications
	+AFE130	Active front end, current limit 130 A	Converter for active front end applications
	+AFE175	Active front end, current limit 175 A	Converter for active front end applications
	+AFE210	Active front end, current limit 210 A	Converter for active front end applications
	+UG95	Microgrid, current limit 95 A	Converter for microgrid applications
	+UG130	Microgrid, current limit 130 A	Converter for microgrid applications
	+UG175	Microgrid, current limit 175 A	Converter for microgrid applications
	+UG210	Microgrid, current limit 210 A	Converter for microgrid applications
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 +CG4 option)
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
	+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)
	+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 default parameters and application
	+CS	Customer specific parameters or application in FW	EC-C with separately specified application and/or parameters

* Standard option

Table 6 Option list