Installation instruction

Ultra Capacitor System (UCC 4, UCM 90)

- Easy installation
- 90 V DC – up to 35A Output
- Serial and parallel connection up to 450 V DC
- Monitoring and surveillance of operation
- Balancing to save energy

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Document no.: 4189360003a

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NOTE:
Read the instruction manual before installing or using this device. All instructions given in the manual must be observed. If they are not followed, all warranty claims are likely to be forfeited!

1 Safety Instructions

	**WARNING** Commissioning and maintenance work on this device may only be carried out by a qualified electrician. Improper handling of the voltages or capacitors may lead to electrical arcing and cause serious burns.
	**DANGER** All work on the device must be carried out with no voltages present. Observe the five safety rules. Supply and outlet cables must be adequately dimensioned and fuse protected. Non-observance of this warning carries the risk of electric shock and electrical arcing that can cause severe burns.
	**DANGER** Even long after the buffer module has been disconnected from the supply, large amounts of energy may be stored in the capacitor. Before working on the capacitor bank, a controlled discharge should be performed on the capacitors. When no voltage remains, the buffer module or bank of modules should be short-circuited. Otherwise there is a danger that residual energy in the capacitors could cause the build-up of a hazardous voltage. Non-observance of this warning carries the risk of electric shock and electrical arcing that can cause severe burns.
	**DANGER** Even low residual voltages on the capacitor may cause large currents when short-circuited. It is therefore important that the buffer module or bank of modules is always completely discharged. Non-observance of this warning carries the risk of electric shock and electrical arcing that can cause severe burns.
	**WARNING** Applying a short circuit to capacitors with a voltage across them carries the risk of intense heat generation and electrical arcing, which can cause severe burns.
	**WARNING** The permitted ambient temperature range must be observed.
	**NOTE:** The relevant VDE regulations, particularly DIN VDE 0100 and EN 60204, must be observed.
	**NOTE:** In the event of a fault we recommend that you return the unit to the manufacturer.
	**NOTE:** Power supply of protection class I and of protection degree IP20. Do not use outside or in wet or damp rooms.

2 General information

The Ultra Capacitor safe energy system from DEIF is designed to the rough environment in a pitch system of a wind turbine, where it is exposed to major mechanical stress, EMC and temperature fluctuations. As it is part of the wind turbines security concept, it is equipped with additional security systems and diagnostics possibilities.

The system consists of Ultra Capacitor modules “UCM” and Ultra Capacitor Charger “UCC”. The UCM and UCC are like bricks and there are several possiblities to connect the individual modules, from a single UCM up to five modules. For UCM 90 the voltage will be from 90 V DC with one module up to 450V DC for five modules in series.

When the supply to the UCC charger is interrupted, the energy stored on the ultra capacitors UCM is available to the load as a buffer. The UC modules continue to supply the load until it is discharged. The buffer time available is a function of the charge level of the UCM’s and the discharge current.

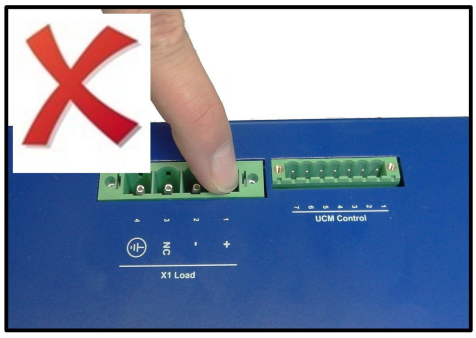
To secure the mechanical stability the UC modules are mounted with fishplates on top from 3-5 modules.

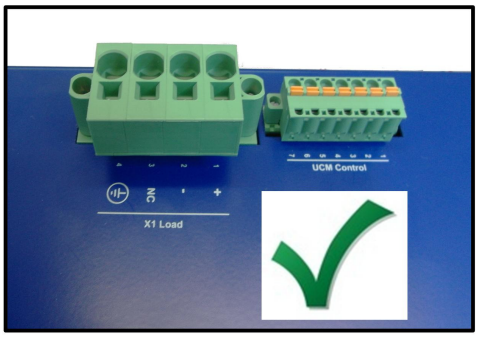
2.1 Advantages

- Convection cooling. No moving parts
- Maintenance-free with long-life ultra capacitors
- Microcontroller-supported monitoring of the ultra capacitors UCM
- Operating status monitoring via signals to the charger UCC
- Balancing to save energy
- Great mechanical stability, base-mounting.
- Overvoltage protected
- High temperature protected
- Reverse polarity protected
- Wide working temperature range
- PLC or PC interface via RS485 COM ports or status signalling contacts
- Individual monitoring of the UC modules regarding temperature, polarity reversal and overvoltage
- Led indicators for power OK and alarm indication
- Capacity measuring and limit monitoring
- Optimum charging of the UC modules with constant current
- High efficiency
- High reliability, long life

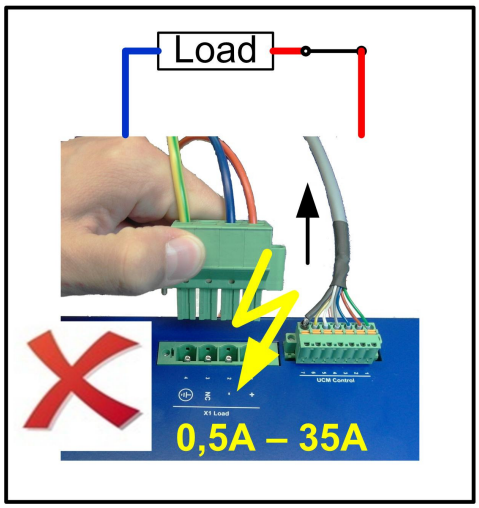
3 Rules of Ultra Capacitor Modules

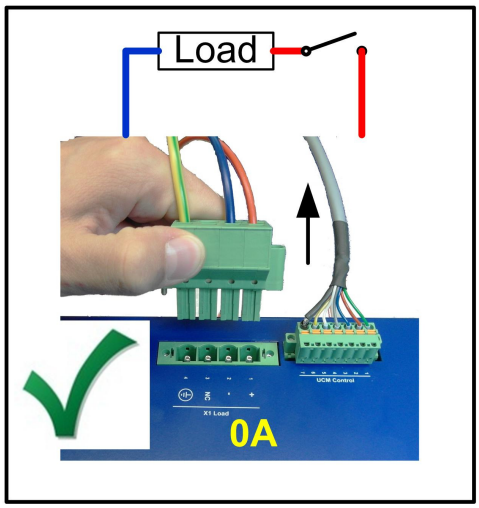
3.1 Put always a plug on open terminals



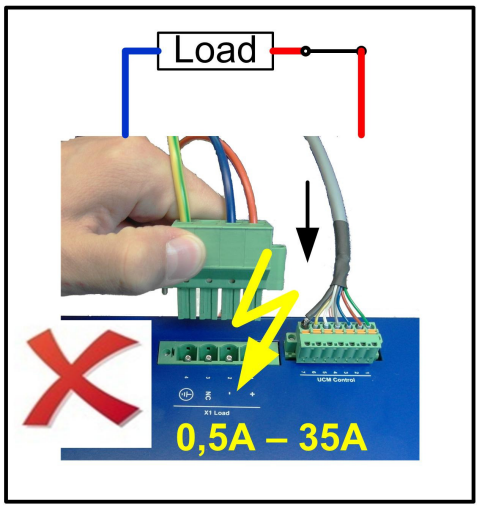


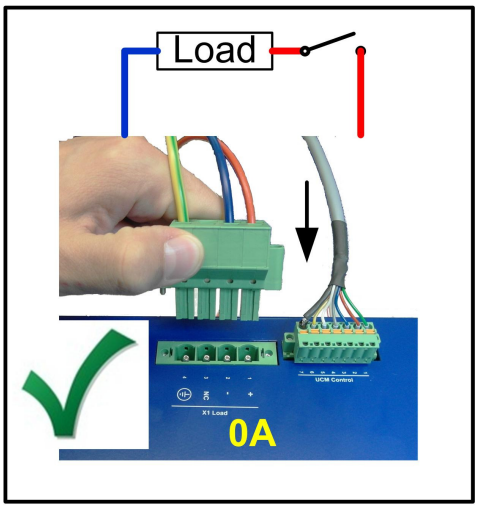
3.2 Don’t remove plug if any current flow





3.3 Don’t connect plug with load or short circuit





4 Discharging UCM 90

Don't discharge a UCM module higher than 35A

It is important to regard the electrical data in the UCM datasheet, to calculate a discharging device!

4.1 Electronic load

An Electronic Load can be set to a fixed current level, which has the big advantage. The discharge of the UCM 90 module will very quick and constant. A electronic load needs a power supply which in some locations can be a disadvantage.

Discharge time with 35A(max) = (C*U)/I = (10F*90V)/35A = **25,7 sec**

4.2 Resistor

Discharging by a Resistor discharging will give a quick discharging at the beginning.
As the voltage is going down, the discharging time is will be longer. If stepping in resistor value is possible the discharging can be made faster. Be aware of the heat of the resistor, be careful in handling.

Minimum resistor size = U/I = 90V/35A = 2,57 -> **2,7 Ω**

Power = P = U^2/R = 90^2/2,7 Ω = **3000 W**

$\mathbb{T}$ = R*C = 2,7Ω*10F = 27 sec t = 5*$\mathbb{T}$ = 5*27sec = **135 sec**

5 Installation

Before connecting, check that the mains supply specification is equivalent to that on the rating plate of the device. Connect the device in accordance with the terminal designations.

All mounting points must always be used. During installation, the device must be covered insofar as drilling chips can fall onto the device or enter it. (Short circuit danger!)

Ensure that there is sufficient air circulation when installing the module. The specified ambient temperature should not be exceeded.

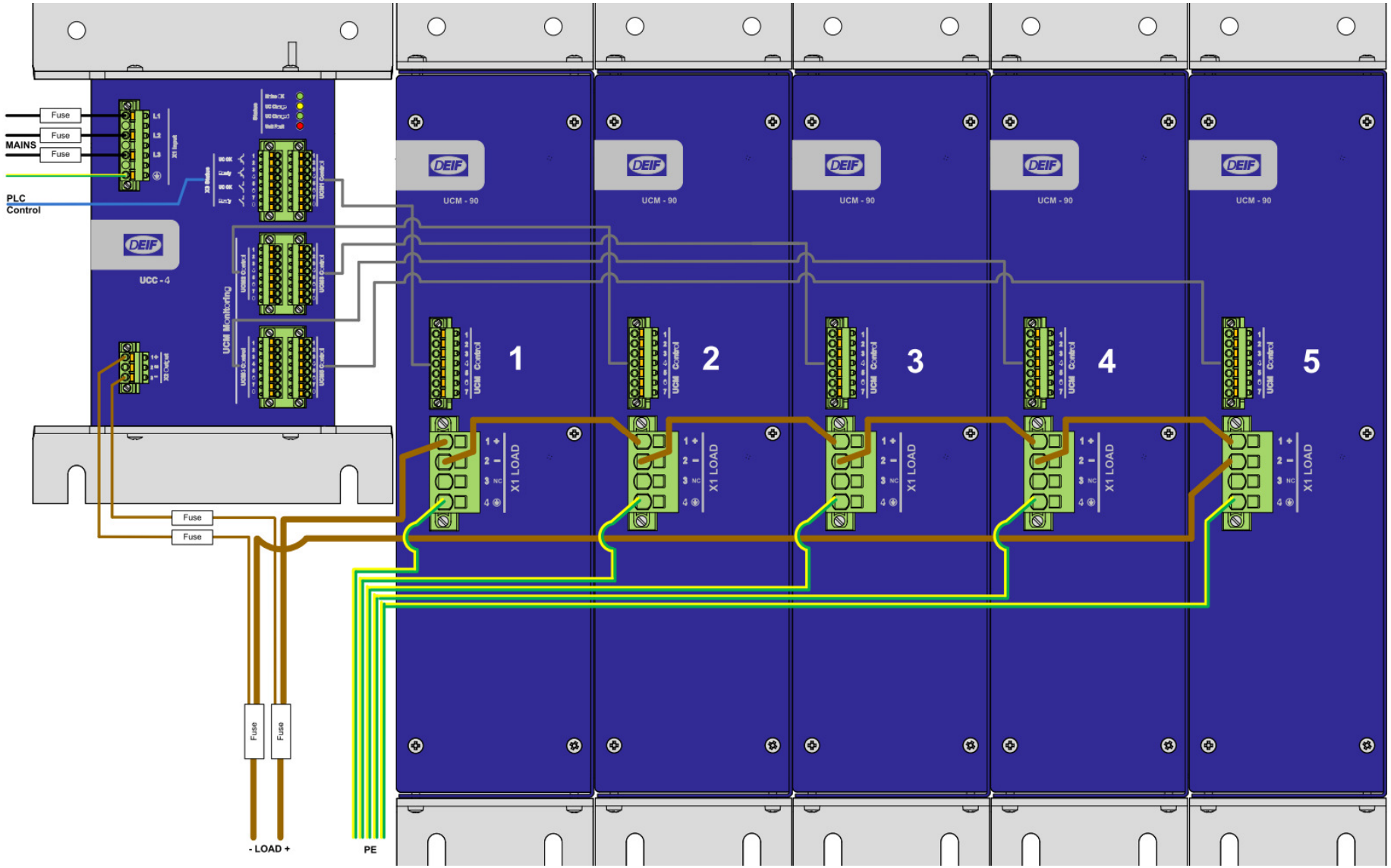
ATTENTION
When connecting the terminals, check that the nominal voltages and polarities are connected correctly. Not observing this warning carries the risk of intense heat generation and electrical arcing, which can cause severe burns.

NOTE
The unit should be covered during installation to prevent borings falling on top of or entering the interior. Risk of short circuit.

NOTE
This device is designed to be fitted into a permanent installation. It should only be operated in dry conditions. The module is designed to withstand pollution level 2.

The UCM modules must be safely secured by the 4 holes in the base mounting, suitable screws or bolts up to 8 mm. The UCM 90 modules are tightened together by the fishplates in 3-4-5 module sizes, with the top screws on each UCM 90 module.

5.1 UCC 4, UCM 90 connection diagram



6 Decommissioning

The UCM modules should be discharged in a controlled manner. Decommissioning is carried out by disconnecting the power to the UCC input power X1.

For carrying out work on the capacitor system, the UCC must be placed out of operation and the capacitors must be discharged under control via a discharge resistance to 0V. See Discharging UMC 90 section.

The state of charge of the UC modules must be individually determined module by module.

After discharging, check that no voltage is present on any module or on the overall capacitor bank. When 0 V is reached the UCM modules must be short-circuited.

The UCM control terminal can be disconnected whether the module is charged or discharged.

In case of connected UCM modules, the system is supplied via the output lines and the internal controller continues running until the voltage Ua has declined to below 10V.

WARNING
Never disconnect electrical connections during operation or if the UC modules are charged! You may also not create any current linkages during operations or in the case of charged UC modules!.

WARNING
Modules that are not short-circuited can produce a voltage even after they have been discharged. These entails a risk of electric shock, and / or high short-circuit currents. It is therefore crucial that discharged modules are shorted out before you begin working on the capacitor bank.

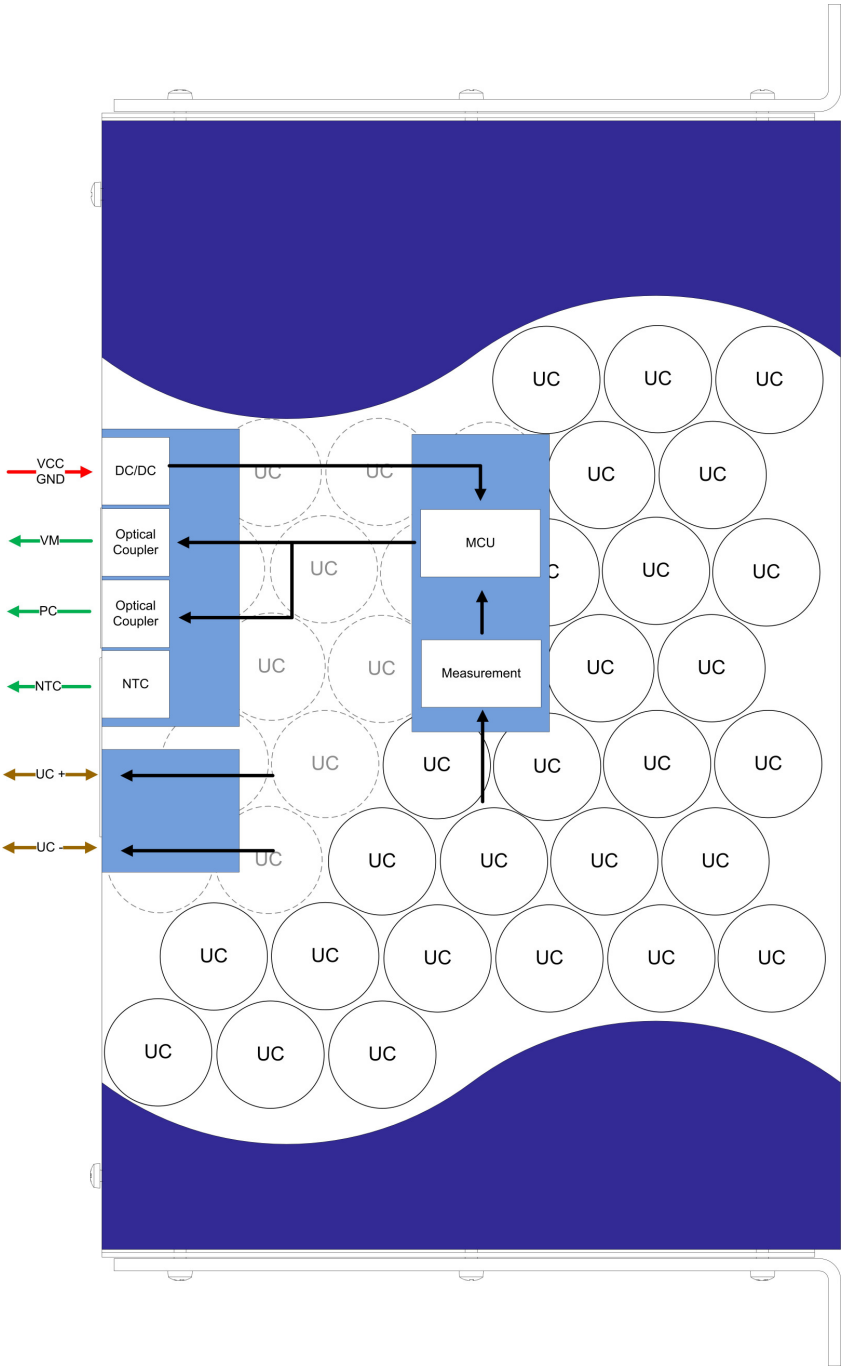
DANGER
Even low residual voltages on the capacitor may cause large currents when short-circuited. It is therefore important that the buffer module or bank of modules is always completely discharged. Non-observance of this warning carries the risk of electric shock and electrical arcing that can cause severe burns.

ATTENTION
Do not break or make any electrical connection while the module is in operation. Not observing this warning carries the risk of electrical arcing, which can cause severe burns.

7 UCM 90 Technical information

The UCM 90 consists of 36 pieces of Ultra capacitors in series, with passive balancing and temperature, voltage and polarity check monitoring.
The monitoring electronics are activated when the control voltage VCC is applied. The UCC charger receives the signal at the VM and PC terminals that the UC module is ready for charging. If the UC supply has been wrongly connected the PC(Polarity Check) will be active.
The UltraCapacitor cells are monitored constantly. Should a cell lie below the average voltage during charging, this is signaled at the VM(Voltage Monitoring). Should a cell's voltage rise above a critical threshold level or above the overall module voltage, this is also indicated on VM.
Faults that occur are stored in the EEPROM of the microcontroller unit.

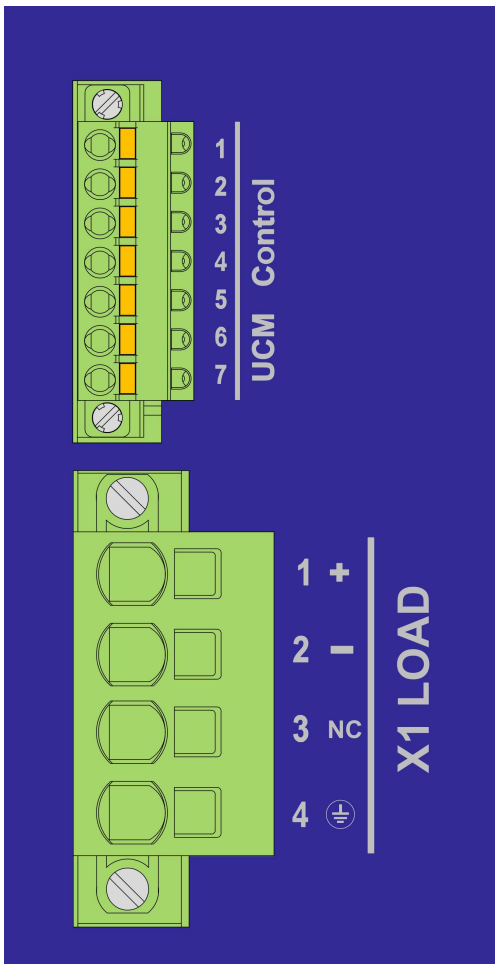
The UC + and UC – is the charge and load terminals directly connected to the UltraCapacitors.



7.1 General

Cooling	Cooling Convection. Ensure that there is sufficient air circulation when installing the module
Maintenance	None
Mounting	4 pcs. Ø9 mm holes for screw mounting. 2-5 modules connect by fish plates to make stabile construction to reduce Vibration, bump and shock impact.
Distance for convection	≥00 mm
Capacitance	10 Fahrad
Internal resistance	< 120 mΩ

7.2 Input and Output specifications



7.2.1 UCM Control

Voltage: 5 VDC
Current: < 100 mA DC
Digital Output (VM, PC): 5 VDC max. 7 mA
NTC: R: 10.0 kΩ +/- 3 % at 25 ˚C B constant: B25/B85=3435K +/- 1%

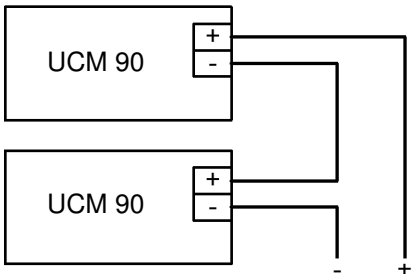
7.2.2 X1 LOAD

Input specifications
Voltage: 90 VDC (0…93 VDC)
Max charge current: 10 A

Output specifications
Voltage: 0…90 VDC
Current: 0…35 A
Peak current: 40 A(3s), 76(1s)

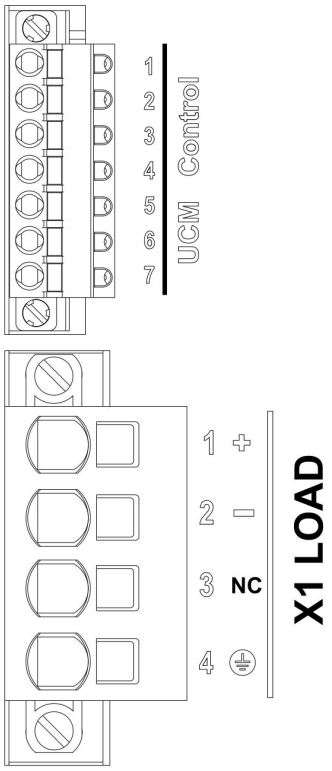
Fuse: Max. melting fuse 40 A T or aut. type C-characteristic DC. The fuse always have to be chosen to match wires and load for each system.

The UCM 90 can be connected in series up to 5 modules.

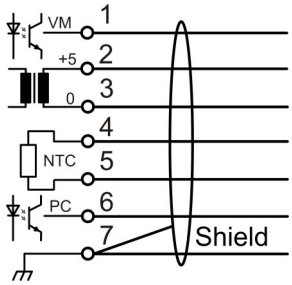


System voltage: 90(1), 180(2), 270(3), 360(4), 450(5) VDC

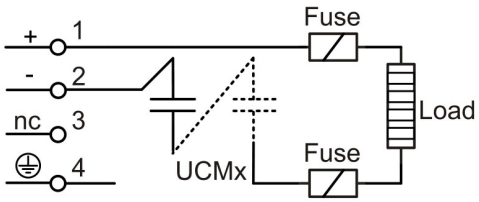
7.3 Connections



7.3.1 UCM Control



7.3.2 X1 LOAD



UCM Control

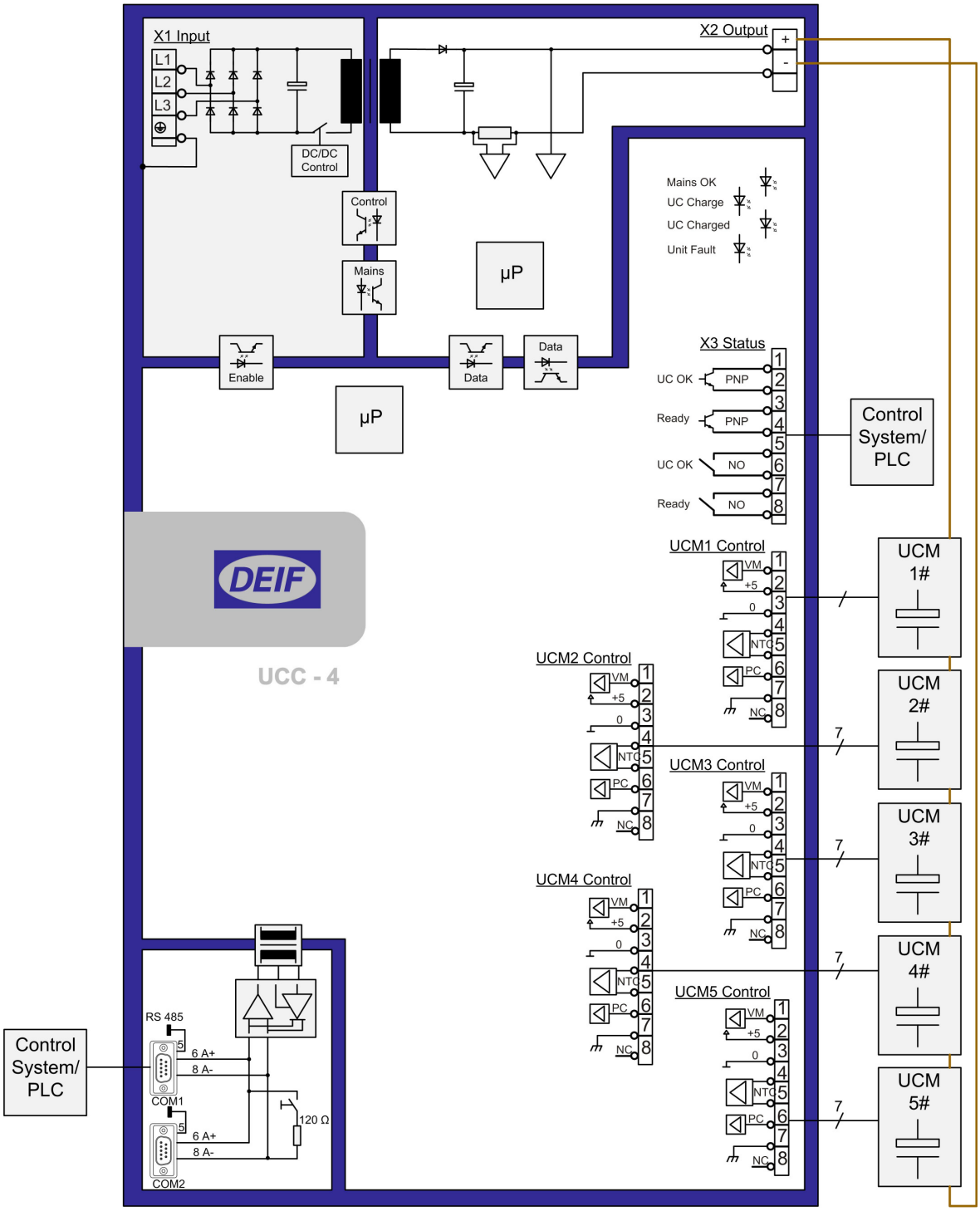
Term. no.	(Spring terminal 0.25mm² - 2.5mm²)
1	VM, Digital voltage monitoring output
2	VCC (5V) supply voltage input
3	GND (0V)
4	NTC temperature sensor “+“
5	NTC temperature sensor “-“
6	PC, Digital polarity check output
7	Shield

X1 Load

Term. no.	(Spring terminals 0.75mm² - 6mm²)
1	Load +
2	Load -
3	NC (not connected)
4	PE

8 UCC 4 Technical information

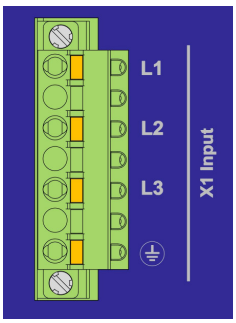
The UCC charger consists of different galvanic separated areas. The charger is supplied by 3 phase 400 V AC bridged for the charger circuit on 90-450 VDC output.
If the X1 input is disconnected the UCC is supplied back from the UC modules and is able to maintain the supervision and surveillance of the UC system. Status signals from outputs or RS 485 interface can be connected to control system for external interface.



8.1 General

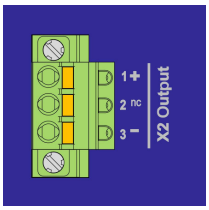
Cooling	Cooling Convection Ensure that there is sufficient air circulation when installing the module
Maintenance	None
Mounting	4 pcs. Ø9 mm holes for screw mounting.
Distance for Convection	≥80mm. Always mount in such a way that sufficient air circulation can be ensured through the device.

8.2 Input and Output specifications



8.2.1 X1 Input

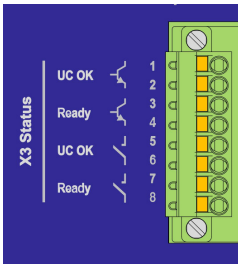
Voltage: 3 x 400 VAC ± 15%
Frequency: 45…65 Hz
Current eff.: 1.7 A (Ue = 400 V AC)
Current start: max 15 A/0.5 msec
Power: 185 W (X2 Output = 450 V DC)
Efficiency: Typ 90% (X2 Output = 450 V DC, Iout = 3,5 A and X1 Input = 400 V AC)
Max. permissible stress: up to 105% Umax without destruction
Fuse protection: Max. Melting fuse 3 x 4A T or automatic type C3



8.2.2 X2 Output

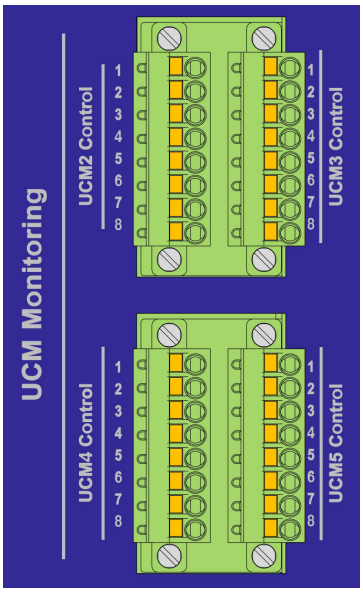
Voltage: 90… 450 V DC (1…5 UCM-90)
Current: Nom 3.5 A, Max (short cct.): 3.5 A
Charging characteristic: Constant 3.5 A DC, Derating 2.5 A DC
Charging time: 10 F Modules: max 5 min (25°C)
Note! Charging time is the same for all system variations (90V,180V,270V,360V,450V)
Effeciency: 185 W (X2 Output = 450 V DC)
Discharge current (without input)**:** < 50 mA
Earth leakage current: < 3.5 mA
Fuse: Max. melting fuse 6 A T or aut. type C-characteristic DC

Capacity measurement
1st measurement: When Un is reached
2nd measurement: 30 min. after 1st measurement
Further measurements every 24 hours
(after a power failure, repetition of this sequence)
Voltage variation during capacity measurement
Un –5.0 / +4.0 V DC



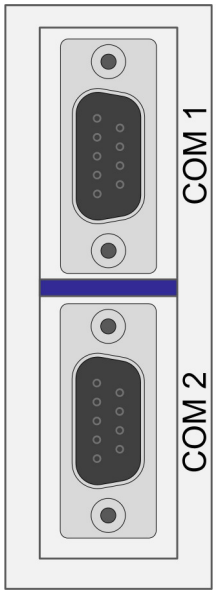
8.2.3 X3 Status

PNP Transistor output: Short circuit, 24V DC/ 10mA
Potential-free relay contact: max. contact rating 50 V DC/ 0.5A



8.2.4 UCM(1…5) Control

Voltage Supply: 5 V DC, < 100 mA DC (VCC, GND)
Voltage Input: 5 V DC, < 10 mA DC (VM, PC to GND)
NTC input: R: 10.0 kΩ +/- 3 % at 25 ˚C B constant: B25/B85=3435K +/- 1%

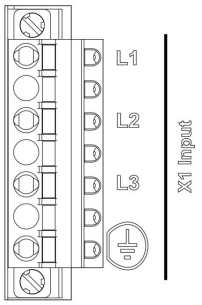


8.2.5 RS 485 COM 1 & COM 2

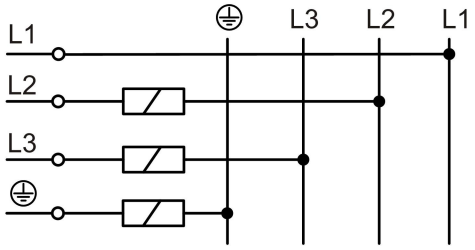
Serial interface RS485 (EIA-485) with two connectors (The two DSUB9 connectors are bridged). Isolated from all other parts of the device.

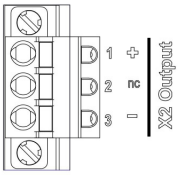
Baud rate: 19200
Data bits: 8
Parity: No parity
Stop bits: 1

8.3 Connections

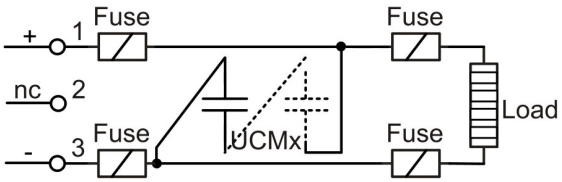


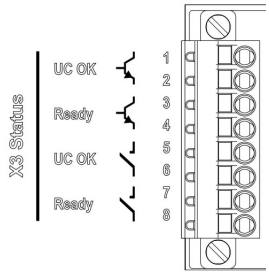
8.3.1 X1 Input



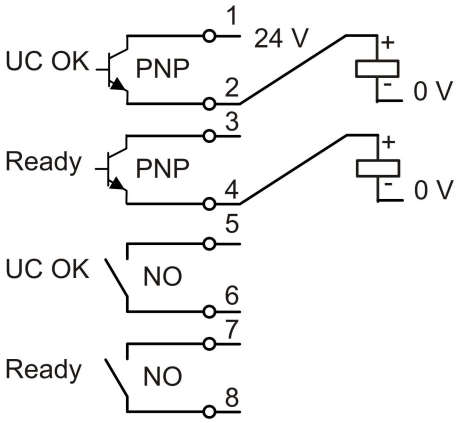


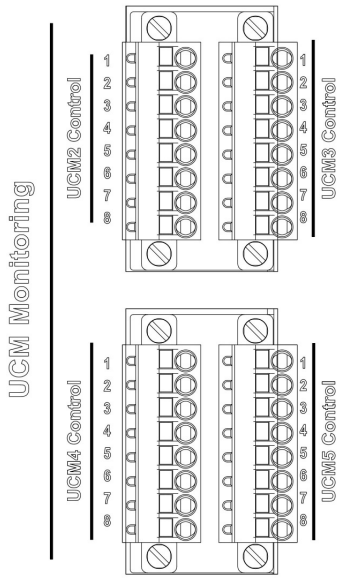
8.3.2 X2 Output



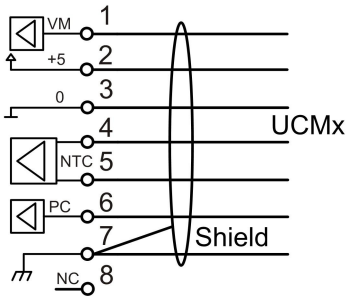


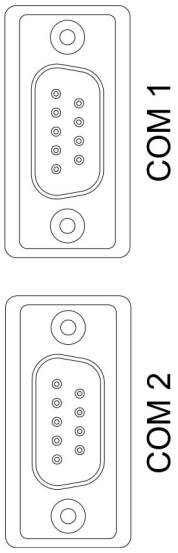
8.3.3 X3 Status



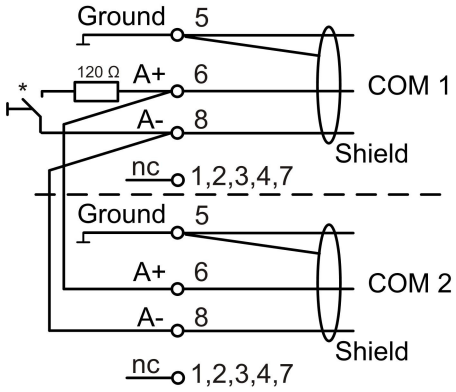


8.3.4 UCM(1…5) Control





8.3.5 RS 485 COM 1 & COM 2



X1 Input

Term. no.	(Spring terminal 0.25mm² - 2.5mm²)
L1	L1 Mains power input
L2	L2 Mains power input
L3	L3 Mains power input
⏚	Earth/Ground Mains input

X2 Output

Term. no.	(Spring terminal 0.25mm² - 2.5mm²)
1	+ (0…450 V DC)
2	Not connected
3	- (0…450 V DC)

X3 Status

Term. no.	(Spring terminal 0.25mm² - 1.5mm²)
1	UC OK, PNP
2	UC OK, 0V
3	Ready, PNP
4	Ready, 0V
5	UC OK, Relay NO
6	UC OK, Relay COM
7	Ready, Relay NO
8	Ready, Relay COM

UCMx Control

Term. no.	(Spring terminal 0.25mm² - 1.5mm²)
1	VM, Digital voltage monitoring output
2	VCC (5V) supply voltage input
3	GND (0V)
4	NTC temperature sensor “+“
5	NTC temperature sensor “-“
6	PC, Digital polarity check output
7	Shield
8	Not connected

RS 485 Serial interface com1 & com2

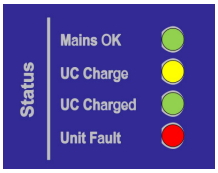
Pin. no.	D-sub 9 (female), 9 pin	
	Terminal text	Description
1,2,3,4,7	nc	-
5	Ground	Ground
6	A+	DATA +
8	A-	DATA -
	Housing	Housing is connected internally to the UCC earth (PE)

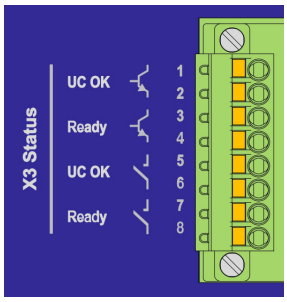
9 General technical information

EMC	**Electromagnetic compatibility (EMC)**	EN 61000-6-2/4
	Electrostatic discharge (ESD): Contact: 7.2 kV Air: 9.6 kV	EN 61000-4-2
	Radiated E-field emission: 30...230 MHz: 40 dB (µ V/m) 230...1000 MHz: 47 dB (µ V/m)	IEC 60255-25
	Conducted emission: IEC 60255-26 **Fast transients (burst):** Power: 2.4 kVp Signal: 1.2 kVp	IEC 60255-22-4, GL, LR, DNV, EN 61000-4-4
	Slow transients (surge): Power: DM 2 kVp, CM 4 kVp Signal: CM 2 kVp Frequency: CM 1,2 kVp	IACS E10, IEC60533, EN 60945, IEC 60255-26, EN 61000-4-5
	RF E-field (electric) immunity: 80...2000 MHz: 12 V/m 2...3 GHz: 10 V/m	IEC 60255-26, EN60945, GL, LR, BV, DNV, EN 61000-4-3
	RF conducted immunity 0.15...80 MHz: 12 VRMS	IEC 60255-26, EN 60945, GL, LR, BV, DNV, EN 61000-4-6
	Power frequency H-field (magnetic) immunity: Field: 400 A/m	IEC 60051, EN 61000-4-8
Safety	Safety IEC EN 60950/IEC EN 61010-1	
Temperature	-30...60°C (operating, free convection) -40...70°C (storage)	IEC 60068-2-1 IEC 60068-2-2
Humidity	-95% R.H. (non-condensing)	
Protection	Class I	
Degree of protection	IP 20	IEC/EN 60529
Altitude	0 – 2000 meters: 424 – 810 VDC 2000 – 4000 meters: 212 – 424 VDC 4000 – 8000 meters: 0 – 212 VDC	
[1] **Vibration**	3…13.2 Hz: 2 mm_{pp} 13.2…100 Hz: 0.7 g 3…13.2 Hz: 6 mm_{pp} 13.2…50 Hz: 2.1 g	IEC 60068-2-6 & DNV Class A IEC 60068-2-6 & DNV Class C
[1] **Bump**	20 g, 16 msec, half sine 1000 bumps in each direction. 2 directions in each axis. A total of 6000 bumps.	IEC 60068-2-27 IEC 60255-21-2(class 2)
[1] **Shock (Base mount)**	10 g, 11 msec, half sine 30 g, 11 msec, half sine 50 g, 11 msec, half sine Tested with 3 impacts in each direction in all 3 axes. A total of 18 impacts per test.	IEC 60255-21-2 Response (class 2) IEC 60255-21-2 Withstand (class 2) IEC 60068-2-27

[1] Min. 3 UCM with mounted fish plates.

10 Led indication and status relays



Function	LED	Relay/ PNP output	Description
Mains OK	Green	-	X1 Input OK Supply voltage X1 is within the applicable range
UC Charge	Yellow	-	Charging Rated output voltage X2 has not yet been reached 1 UCM-90 = 90 V DC……5 UCM-90 = 450 V DC
UC Charged	Green	-	Charged Rated voltage has been reached. Off when voltage have dropped to minimum output voltage (**Ubmin**).
Unit Fault	Red	-	Fault • UCM module high temperature • UCM module capacity below the limit • UCM module polarity reversal PC • UCM module overvoltage VM • Incorrect system configuration
			
UC OK	-	ON	System OK • UCC are not in error state • UCM modules are not in error state
Ready	-	ON	System ready UCM and/or UCC are not in error state and the UCM modules are fully charged. The UCM modules are charged if **Un** is reached and the voltage is then higher than **Ubmin**.

11 System operation

11.1 Startup

After power up of the UCC charger is initialized. The LED 'Mains OK' is on. If there are no faults, the contact 'UC OK' closes and the rated output current flows and the yellow LED 'UC Charge' is on. When the rated voltage UC Ready has been reached, the yellow LED goes off and standby operation is indicated by the green LED 'UC Charged' being on. At the same time, the transistor output and contact 'Ready' activates.

11.2 Buffer operation

If the mains are switched off or goes below the minimum input voltage, the device goes into buffer operating mode. The LED 'Mains OK' goes off. Now, the capacitor modules discharge either through being used or through self-discharging. If the output voltage goes lower than Ubmin, the contact 'Ready' opens and indicates the critical charging situation.

11.3 Fault clearance

Any malfunctions within the UCC charger and faults of the capacitor modules are indicated by the LED 'Unit Fault'. The charging of the capacitor modules is stopped. The contact 'UC OK' or the LED 'Unit Fault' has a collective fault signal function. The individual causes of the faults are described below.
We distinguish between two kinds of faults:

Power-cut faults switch off the output voltage of the UCC charger with a lasting effect and can only be reset through switching the input voltage OFF and ON.

Automatic reset faults switch off the output voltage of the UCC charger, however they switch on again immediately as soon as the fault does not exist anymore.

Fault type	Fault description	Reaction to the fault	Type of reaction
„UCM x reverse polarity fault, PC“ (assessment of individual modules)	Module with reverse polarity	Switching off the output voltage X2 Output Connecting the X2 Output after switching the X1 Input power supply off and on	Power down
„UCM x voltage fault“ (assessment of individual modules)	Overvoltage signal high if Uc less than limit 1 Overvoltage signal low if Uc more than limit 2	Switching off the output voltage X2 Output Connecting the X2 Output when clearing the fault.	Automatic reset
“Fault UCM x module number”	Number of the connected UCM modules is not in line with the set parameters	Switching off the output voltage X2 Output Connecting the X2 Output after switching the X1 Input power supply off and on	Power down
„UCM x exceeds temperature“ (assessment of individual modules)	Fault if limiting temperature is exceeded **Tc**	Switching off the output voltage X2 Output Connecting the X2 Output if the temperature is under the limit	Automatic reset

“Capacity fault”	Capacity under minimum **Cmin**	Switching off the output voltage X2 Output Connecting the X2 Output after switching the X1 Input power supply off and on	Power down
X1 Input Power failure	Supply voltage collapses	Switching off the output voltage X2 Output Is not signalized via the signal outputs Connecting the X2 Output after re-activating the X1 Input power supply	Automatic reset

11.4 Derating in the case of a high ambient temperature

An internal temperature sensor protects the UCC charger against overheating. This sensor is located next to the component which is most exposed to heat, on a heat sink. In case of high ambient temperatures, the internal limit typ. 95°C can be reached the charger will start to derate. The UCC derates by limiting the charging current until the internal temperature have been reduced under the limit again. The charging cycle will increase in time.

11.5 Capacity measurement

In standby operation, the UC modules' current capacity is determined once per day during ongoing operations. To make the capacity check, the output X2 voltage is initially reduced by 5V. After the voltage drop, the UC modules are charged with a constant current until an additional voltage of 9V have been reached. And hereafter the voltage decreases again to the rated output voltage.

NB: UC modules which have been discharged for several hours will require significantly more time for recharging again for the first time. Thus, a higher (apparent) capacity is determined with the first capacity measurement immediately after the UC modules have been recharged. The second measurement, after about 30 min., provides a value which hardly differs from the following measurements.

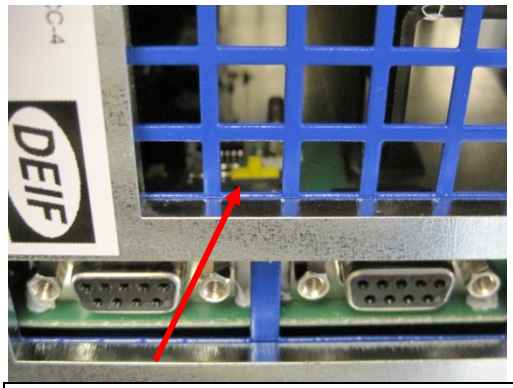
12 UCC 4 serial interface

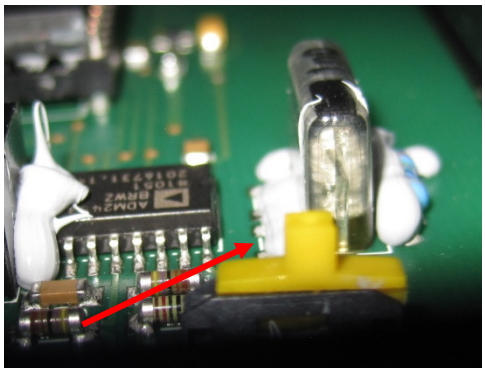
12.1 COM 1 & COM 2 Hardware description

The UCC has one serial interface RS485 (EIA-485) with two connectors (The two DSUB9 connectors are bridged). Their interface is isolated from all other parts of the device. You can use the Windows software “DEIF UC Manager” to read the UCC’s parameters and adjust them.

12.1.1 Electrical Connection of the EIA 485 Interface

The two signal lines of the two-wire bus can be adapted to the overall system using a connectable resistance of 120 Ohms. If the UCC is the last device connected to the two-wire bus EIA 485, then the resistor should be connected too. A DIP switch is located between the COM1 and COM2 ports and can be operated externally (**only activate the switch when UCC is disconnected!).**





DIP switch COM1, COM2	**Switch position** [1]
Without adjustment resistance 120 Ohms	**OFF**[2] **(Factory setting)**
With adjustment resistance 120 Ohms	ON

[1] Can also be measured with a Ohm meter between pins A+ und A- .For this, both interfaces must not be connected.
[2] Default setting

12.1.2 Electrical Connection to a Computer with a Standard Serial Port RS232

You cannot directly connect the EIA-485 port of the UCC to your serial port at the computer. A USB to EIA-485 converter is needed which has the USB port on one side and the EIA-485 signals on the other side.

12.1.3 Serial Interface Settings.

Baud rate: 19200
Data bits: 8
Parity: No parity
Stop bits: 1

The software DEIF UC Manager automatically sets the communication settings. This must not be configured.

12.2 Data Format

To communicate with the UCC charger a data format has to be implemented in the PLC or controller connected. Commands can be sent to the UCC to get status information and set parameters.

The Data format consists of several parts:

Table of one datagram (X=1Character)

XX	XX	XX	XX	XXXX	XX	XXXX
GA	UA	DL	Command	Parameter Number	Data Word	CRC16

Please notice that the data sent consists of ASCII-characters. For instance if the command is 0x09 (Read Command) then the byte data is 0x30 0x39

Description of the data format

GA	**Group Address (Hex)** The group address of a group of chargers on the same RS 485 bus, the GA can be changed with the Windows software "UC Manager" or by external command. Range: Min: 0x00 … Max: 0xE
UA	**Sub Address (Hex)** The sub address UA of a single charger. Range: Min: 0x00 … Max: 0xEF
DL	**Data Length Counter (Hex)** The length of one message block Min: 16 (0x10h)
Command	**Command** (Hex) The command value is used to do read/write/etc. the command list is describe in following section.
Parameter Number	**Parameter Number (Hex)** The first two characters are the menu number The next two characters are the parameter number ex. menu 4, parameter 8 => 0408 => 0x04 0x08 => 0x0408 menu 10, parameter 25 => 1025 => 0x0A 0x19 => 0x0A19 If a command does not need a parameter number fill it with 0x0000
Data Word	**Data Word (Hex)** One word consists of two characters (4 bytes)
CRC16	CRC16 Cyclic Redundancy Check of the datagram is calculated and the 4 bytes are added at the end (calculation formula: $x^{16} + X^{12} + X^5 + 1$ Also called CRC-CCITT (XModem). An online calculator can be found here: http://www.lammertbies.nl/comm/info/crc-calculation.html)

Hint: Despites of direct addressing with GA and UA you can use a broadcast address 0xFFFF and send the command 'address request' to get the address GA and UA of the connected UCC.

12.3 Communication Sequence

A datagram consisting of ASCII-characters is sent and terminated with a <CR> (Carriage Return).

Example: Read the current DC output voltage. Send: 55 AA 10 09 02 00 BC0B <CR>
ASCII-Code: GA: 0x55; UA: 0xAA; DL: 0x10; command: 0x09; parameter number: 0x02; CRC: 0xBC0B <CR>
Hex-Code: 35 35 41 41 31 30 30 39 30 32 30 30 42 43 30 42 0D
After receiving this datagram the UCC responses:
Receive: 55 AA 14 09 02 00 0000 ECAA <CR> (Voltage in this example: 0V)

Hint: Before you can query the UCC for the output voltage you must first initialize the communication.

12.4 Changing settings in the UCC (AV and IV parameter tables)

To change parameters or changing an error mask it must be written into the UCC. There are two tables of parameters in the UCC.
The AV table (Actual Values) is for temporary tests. Changes are lost after powering off.
The IV table (Initial values) is for keeping the data forever. The data is stored in an EEPROM.
After powering on, the data from IV is automatically copied to the AV table in the RAM.
Hint: For security reasons you must first log on before you can change settings.

12.5 Logging On to Change Settings

The password '1234' must be send.

12.6 Command 'Save Actual Values to Initial'

Once you have tested a new setting in the AV table and want to save it, send the command 'Save AV to IV' for a single parameter. This must be done, for each parameter that you want to save.

12.7 Command List

0x04	**Connect-Test** Testing the connection over the RS485 (Can be done periodically, max 2 per second) Send: 55 AA 10 04 FD00 FDA5 <CR> Receive: 55 AA 14 09 01 07 0009 63CF <CR>
0x05	**ADDRESS-Request** Should be the first datagram send to the UCC The UCC is required to send his GA and UA. This is done with a broadcast address. Send: FF FF 10 05 0000 FE47 <CR> Receive: 55 AA 10 05 010F 6DD6 <CR>
0x07	**Logon with Password** To modify settings and parameters a password is required pwd ('1234' = 31 32 33 34) Send: 55 AA 18 07 00 00 31 32 33 34 3E89 <CR> The UCC answers with the OK-response: FD006590 <CR>
0x08	**Logoff** If you are logged on and do not power off, then the UCC is open until the next power down. With this command you can logoff.
0x09	**Read Parameter** Read one Actual Value AV
0x11	**Write Parameter** Write one Actual Value AV
0x19	Copy one parameter from AV to IV
0x27	Read one Initial Value parameter IV

12.8 List of Parameters

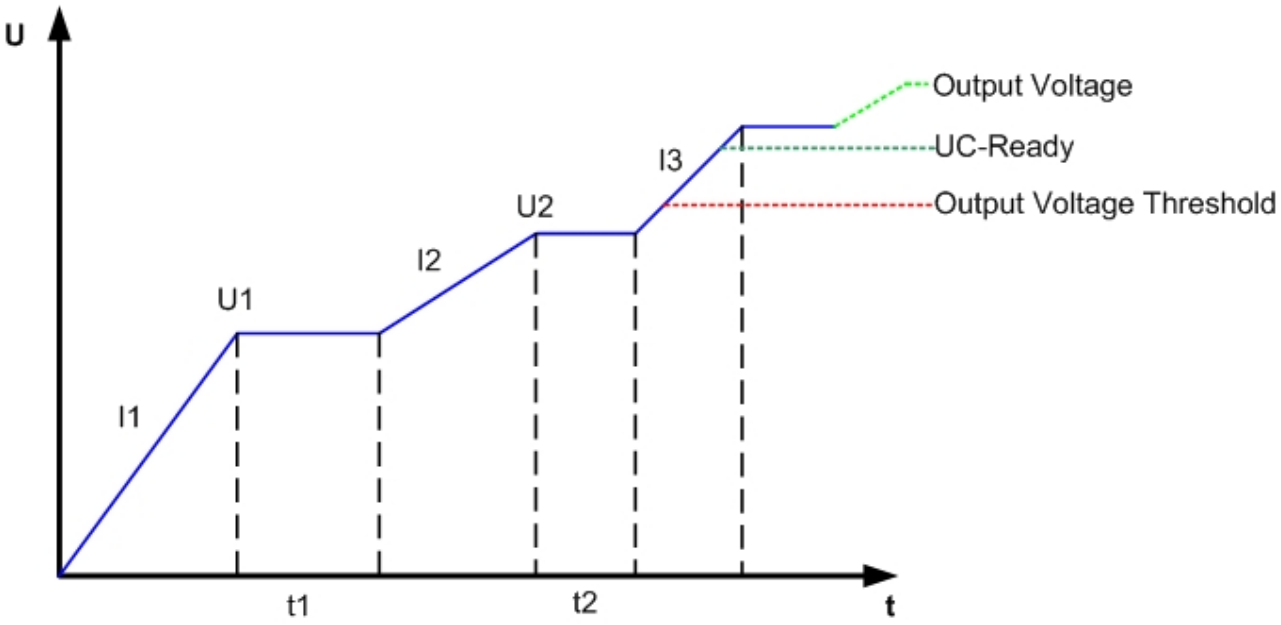
This is the list of all values and addresses which can be read or written or addresses

Parameter Code	Description	Access Type	Value Range (default value in decimal and real value)	Factory setting
01.00	**Un** System voltage in Volt (must be 1,2,3,4 or 5 times the module voltage (Umod)). Calc: Output Voltage Un = Decimal value x 2	R/W	0-230 (0 – 460V)	225 (450V)
01.01	**Ubmin** Voltage below which the UC modules are "discharged". Calc: Voltage Ubmin = Decimal value x 2	R/W	0-230 (0 – 460V)	200 (400V)
01.02	**Umod** Module voltage of an UC module. Calc: Voltage Umod = Decimal value x 2	R/W	0-230 (0 - 460V)	45 (90V)
01.03	**Upegel_U** Lower monitoring level when charging. Below this voltage the overvoltage signal may not be high. (Module count x30V). Calc: Voltage Upegel_u = Decimal value x 2 **Must be 0 don't change!**	R/W	0-230 (0 - 460V)	0
01.04	**Upegel_O** Upper monitoring level during charging. Above this voltage, the overvoltage signal must be high. (Mod. quantity x 50V). Calc: Voltage Upegel_o = Decimal value x 2 **Must be 0 don't change!**	R/W	0-230 (0 - 460V)	0
01.05	**Cmin** Min. capacity in F x 4 (Cn x 0.7 x 4) (about 70% of the rated capacity) resolution 0.25F; Calc: Capacity Cmin = Decimal value / 4 (UCC with Un < 300V: Cmin = Decimal value / 8)	R/W	0-255 (Capacity depending on the connected module capacity)	5 (1.25F)
01.06	**Tc** Max. cell temperature in °C; Calc: Temperature Tc = Decimal value	R/W	0-80 (typ 52°C)	60 (60°C)
01.08	**UC Ready** (in V). When this voltage threshold is reached, the charger goes into 'UC Ready' state. Calc: UC Ready Voltage U = Decimal value x 2	R/W	0-230 (0 – 460V)	215 (430V)
01.09	**OV Delay** (Overvoltage delay in sec). Overvoltage Error Event Delay in sec; After an OV event occurred and the 'OV Filter' time has passed, this time period begins. When it is passed, then the OV error is signaled; the relays 'UC OK' and 'UC Ready' are operated. Calc: OV Error Delay = Decimal value x 5	R/W	0-127 (0 – 635 sec)	0
01.10	**OV Filter** (Overvoltage filter in msec). The period an OV error is ignored. After overvoltage is signaled by a module this timer starts; after this time the charger stops charging. Calc: OV Filter Time = Decimal value x 50	R/W	0-127 (0 – 6350msec)	120 (6000msec)

01.10	**Error_maske_0** Bit 0 = Unit fault (Status LED); Bit 1 = UC Charged (Status LED); Bit 2 = UC Charge (Status LED); Bit 3 = Mains OK (Status LED); Bit 4 = Capacity measurement active; Bit 5 = reserved; Bit 6 = Ready (Status output); Bit 7 = UC OK(Status output); Each bit set releases the corresponding status bit of the status 02.12 for fault evaluation	R/W	B'00000000' - B'01111000' (Evaluating "Module x exists" as a fault does not make sense) (B'00000000')	
01.11	**Error_maske_3** Bit 0 = module 4 connected; Bit 1 = module 5 connected; Bit 2 = module 4 OV fault; Bit 3 = module 5 OV fault; Bit 4 = module 4 excess temperature; Bit 5 = module 5 excess temperature; Bit 6 = module 4 reversed; Bit 7 = module 5 reversed; Each bit set releases the corresponding status bit of the status 02.13 for fault evaluation	R/W	B'00000000' - B'01111000' (Evaluating "Module x exists" as a fault does not make sense) (B'00000000')	
01.12	**Error_maske_1** Bit 0 = module 1 connected; Bit 1 = module 2 connected; Bit 2 = module 3 connected; Bit 3 = module 1 OV fault; Bit 4 = module 2 OV fault; Bit 5 = module 3 OV fault; Bit 6 = fault module quantity; Each bit set releases the corresponding status bit of the status 02.14 for fault evaluation	R/W	B'00000000' - B'01111000' (Evaluating "Module x exists" as a fault does not make sense) (B'00000000')	
01.13	**Error_maske_2** Bit 0 = module 1 excess temperature; Bit 1 = module 2 excess temperature; Bit 2 = module 3 excess temperature; Bit 3 = module 1 reversed; Bit 4 = module 2 reversed; Bit 5 = module 3 reversed; Bit 6 = capacitor capacity too low; Each bit set releases the corresponding status bit of the Status_1 02.15 for fault evaluation	R/W	B'00000000' - B'01111111' (B'00000000')	
01.14	**GA** Group address of the charger	R/W	0x00-0xFE (0x55)	1
01.15	**GAUA** Group and sub-address as a word (so that the entire address can be changed with one command)	R/W	0x0000-0xFEFE 0xGAUA (85-170 - 0x55AA)	
01.16	**OV Restart** (Overvoltage restart in sec). After an overvoltage error has occurred this time delay starts. After this delay has passed the charging restarts. Calc: OV Error Delay = Decimal value x 0.5	R/W	0-240 (0 – 120 sec)	40 (20sec)
01.17[1)]	**I1** (in A). The current during the first charging period.	R/W	380V: 0-9 (0 – 4.5A)	7 (3.5A)

	It stops when output voltage U1 is reached. Calc: I1 = Decimal value x 0.5.		450V: 0-7 (0 - 3.5A)	
01.18[1)]	**U1** (in V). The capacitor modules are charged with current I1 until U1 is reached. Then charging stops and the charging pause time t2 begins. Calc: U1 = Decimal value x 2	R/W	380V: 0-200 (0 – 400V) 450V: 0-230 (0 – 460V)	217 (434V)
01.19[1)]	**t2** (in sec). Charging pause time after U1 is reached. Calc: t2 = Decimal value x 5	R/W	0 -240 (0 – 1200 sec)	0
01.20[1)]	**I2** (in A). After pause time t2 is over charging with I2 starts. Calc: I2 = Decimal value x 0.5	R/W	380V: 0-9 (0 – 4.5A) 450V: 0-7 (0 - 3.5A)	4 (2A)
01.21[1)]	**U2** (in V). When output voltage U2 is reached charging stops. Now the pause time t3 starts. Calc: U2 = Decimal value x 2	R/W	380V: 0-200 (0 – 400V) 450V: 0-230 (0 – 460V)	223 (446V)
01.22[1)]	**t3** (in sec). Charging pause time after U2 is reached. Calc: t3 = Decimal value x 5	R/W	0-240 (0 – 1200 sec)	0
01.23[1)]	**I3** (in A). After pause time t3 is over, charging with I3 starts until the nominal output voltage is reached. Calc: I1 = Decimal value x 0.5	R/W	380V: 0-9 (0 – 4.5A) 450V: 0-7 (0 - 3.5A)	1 (0.5A)

12.9 Charging profile



[1)] Not in all Chargers available – See also Picture 1 in appendix – Do not use if not needed

12.10 List of real time values

Realtime Values	Description	Access Type	Value Range (default value in decimal and real value)
02.00	**UA_ist** Output voltage, actual value in Volt, Ua = value x 2	R	0-230
02.01	**IA_ist** Output current, actual value in 50mA steps IA = value x 48,8mA = Decimal value / 20	R	0-93
02.02	**Mod_1_Temp** Temperature module 1 Range –20°C … +80°C accuracy 0.5°C. Temperature = (value / 2) –20	R	0-200
02.03	**Mod_2_Temp** Temperature module 2 Range –20°C … +80°C accuracy 0.5°C. Temperature = (value / 2) –20	R	0-200
02.04	**Mod_3_Temp** Temperature module 3 Range –20°C … +80°C accuracy 0.5°C. Temperature = (value / 2) –20	R	0-200
02.05	**C_ist** Measurement value of the capacity range 0-31F resolution 0.25F Capacity = (value / 4) (UCC with Un < 300V: Capacity = (value / 8)	R	0-250
02.06	**Mod_4_Temp** Temperature module 4 Range –20°C … +80°C accuracy 0.5°C. Temperature = (value / 2) –20	R	0-200
02.07	**Mod_5_Temp** Temperature module 5 Range –20°C … +80°C accuracy 0.5°C. Temperature = (value / 2) –20	R	0-200
02.12	**Status** Status register 0 (definition of the bits see 01.10)	R	0-255
02.13	**Status** Status register 3 (definition of the bits see 01.11)	R	0-255
02.14	**Status** Status register 1 (definition of the bits see 01.12)	R	0-255
02.15	**Status** Status register 2 (definition of the bits see 01.13)	R	0-255

12.11 Return Codes

The UCC responses for each datagram with different codes

List of Return Codes:

0xFD00	OK – The datagram received has been understood and the command executed
0xFE04	Command does not exist – Nothing was done
0xFE08	Password Login for this command is needed – Nothing was done
0xFE0C	Parameter does not exist – Nothing was done
0xFE1x	Password Login Error – Nothing was done

12.12 Example of a Typical Serial Communication

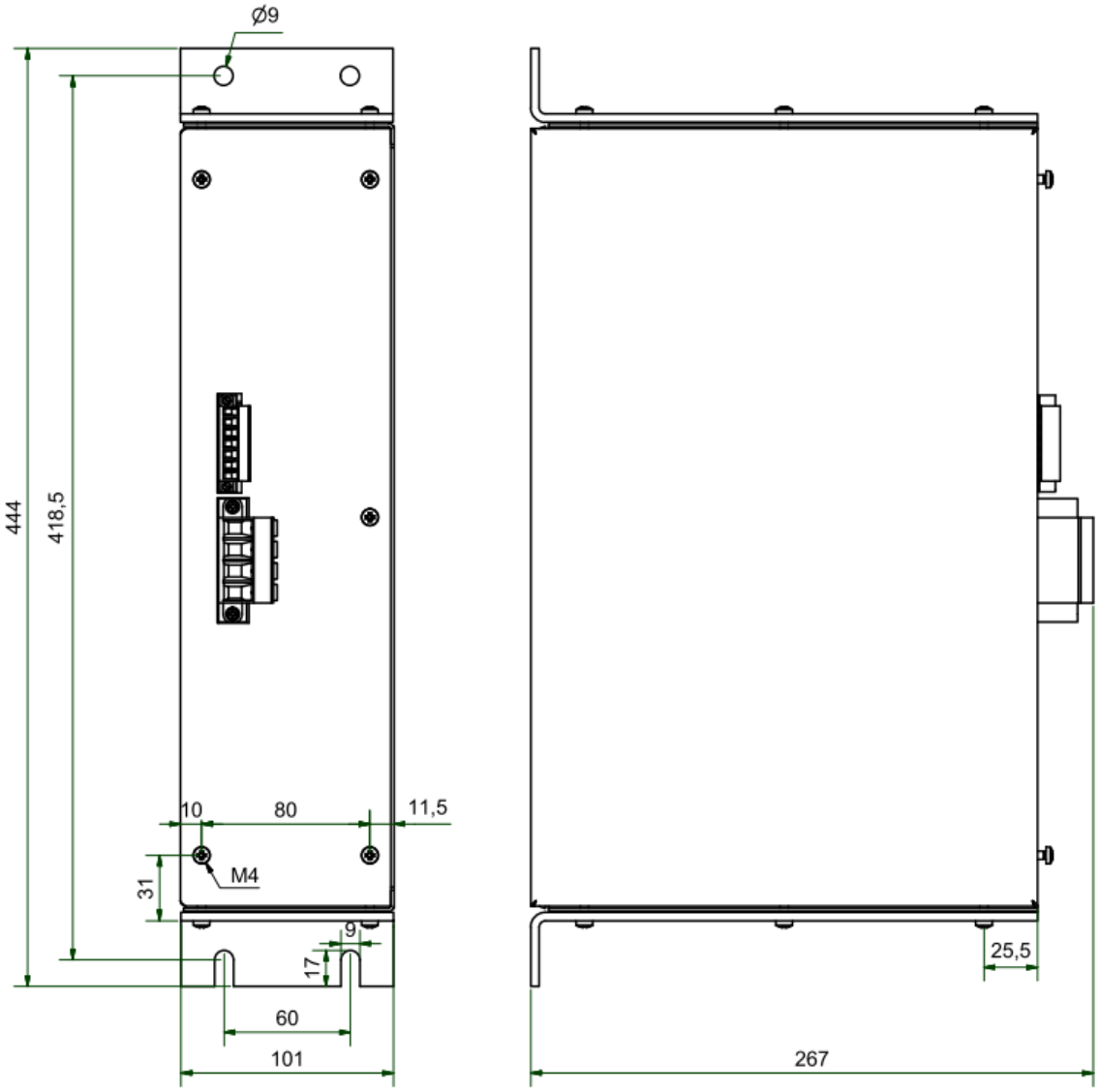
This is a log the Windows software “UC Manager” of the cyclic query of voltage, current, temperature, status.

Value	Parameter	Send	Receive
OK-Message		55AA1004FD00FDA5	
Voltage	02.00	55AA10090200BC0B	55AA140902000000ECAA
Current	02.01	55AA10090201AC2A	55AA140902010000DB9A
Temp Mod 1	02.02	55AA100902029C49	55AA14090202000082CA
Temp Mod 2	02.03	55AA100902038C68	55AA140902030000B5FA
Temp Mod 3	02.04	55AA10090204FC8F	55AA140902040000306A
Capacity	02.05	55AA10090205ECAE	55AA140902050000075A
Temp Mod 4	02.06	55AA10090206DCCD	55AA1409020600005E0A
Temp Mod 5	02.07	55AA10090207CCEC	55AA140902070000693A
Status 1	02.14	55AA1009020E5DC5	55AA1409020E0040BF6F
Status 2	02.15	55AA1009020F4DE4	55AA1409020F0000C09B
Status 3	02.13	55AA1009020D6DA6	55AA1409020D0000AEFB

13 Mechanical specifications

13.1 UCM 90 Dimensions

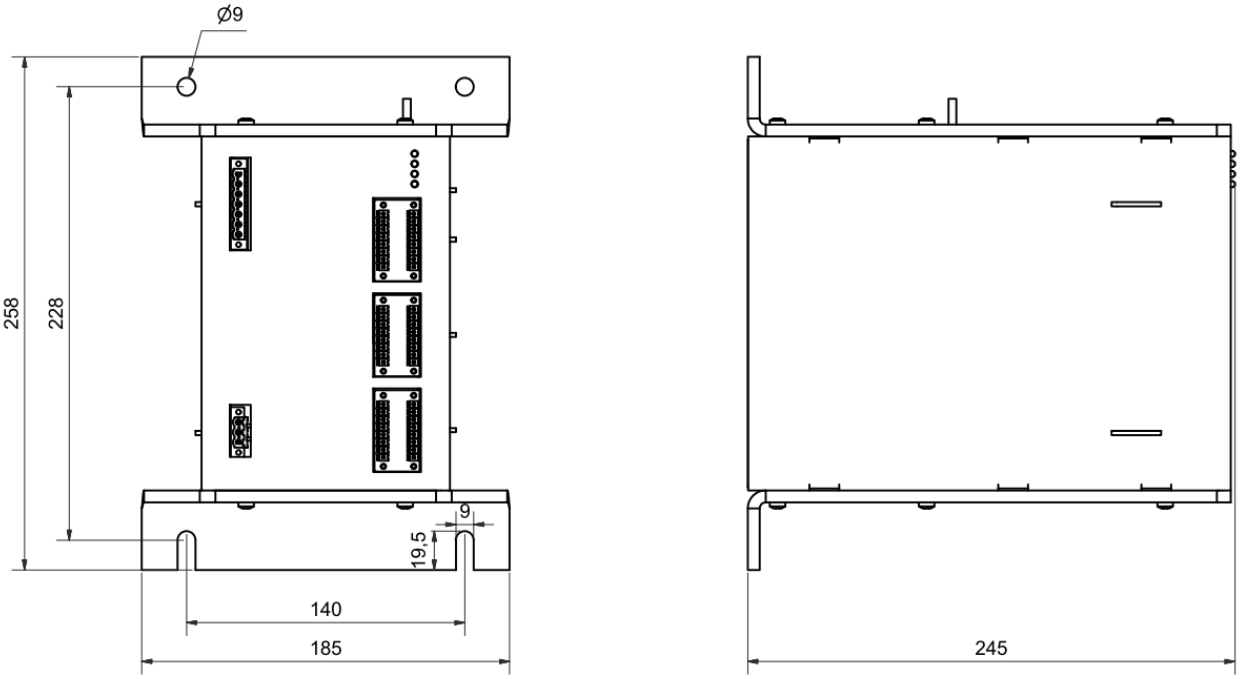
Case	Chassis: 1.5 mm painted steel, dark blue RAL 5002 Mounting-angels: 4.0 mm pre-zinked
Weight	9.3 kg (20.5 lbs)
Dimensions (WxHxD)	101 mm (3.98”) x 444 mm (17.48”) x 267 mm (10.51”)



All dimensions are in mm.

13.2 UCC 4 Dimensions

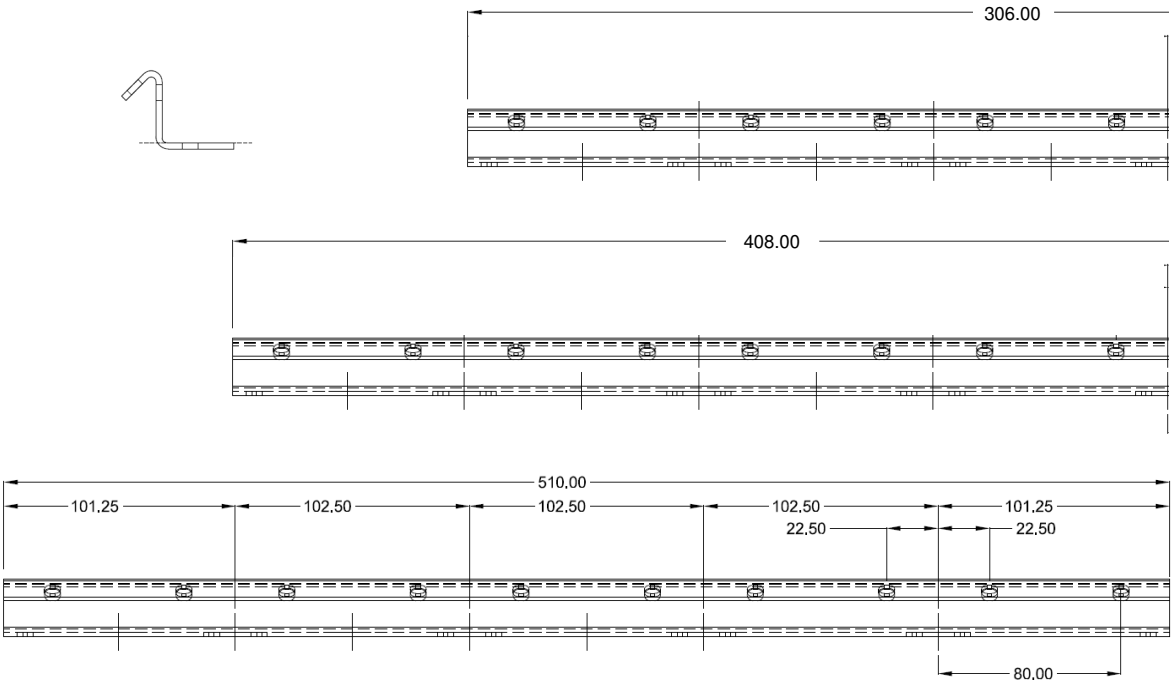
Case	Chassis: 1.5 mm painted steel, dark blue RAL 5002 Mounting-angels: 4.0 mm pre-zinked
Weight	7 kg (15.4 lbs)
Dimensions (WxHxD)	185 mm (7.28”) x 258 mm (10.16”) x 245 mm (9.65”)



All dimensions are in mm.

13.3 Fishplate 3-4-5 UCM-90 Dimensions

Case	2 mm pre-zinked
Weight	3 UCM-90: 2.7 kg (5.95 lbs) 4 UCM-90: 3.7 kg (8.16 lbs) 5 UCM-90: 4.6 kg (10.14 lbs)
Dimensions (WxHxD)	3 UCM-90: 40 mm (1.57") x 25 mm (0.98") x 306 mm (12.05") 4 UCM-90: 40 mm (1.57") x 25 mm (0.98") x 408 mm (16.06") 5 UCM-90: 40 mm (1.57") x 25 mm (0.98") x 510 mm (20.08")



14 Ordering information

14.1 Order specifications

UCM 90, DEIF no. 1240040003
UCC 4, DEIF no. 1240040004

Fishplate 3 UCM, DEIF no. 4155112084
Fishplate 4 UCM, DEIF no. 4155112085
Fishplate 5 UCM, DEIF no. 4155112086