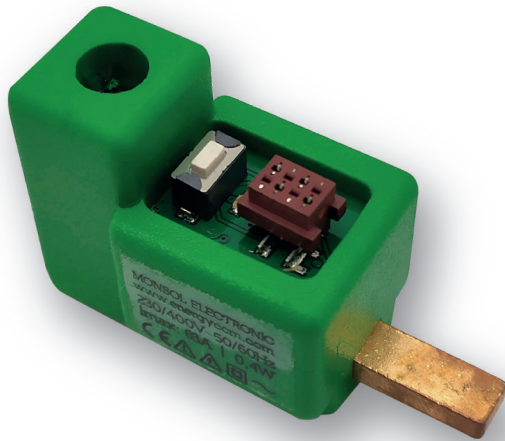


**MORE THAN
METERING**

**ENERGY
CCM**



CCM1-DC

**Individual
consumption
current meter**

USER MANUAL

CcM1-DC

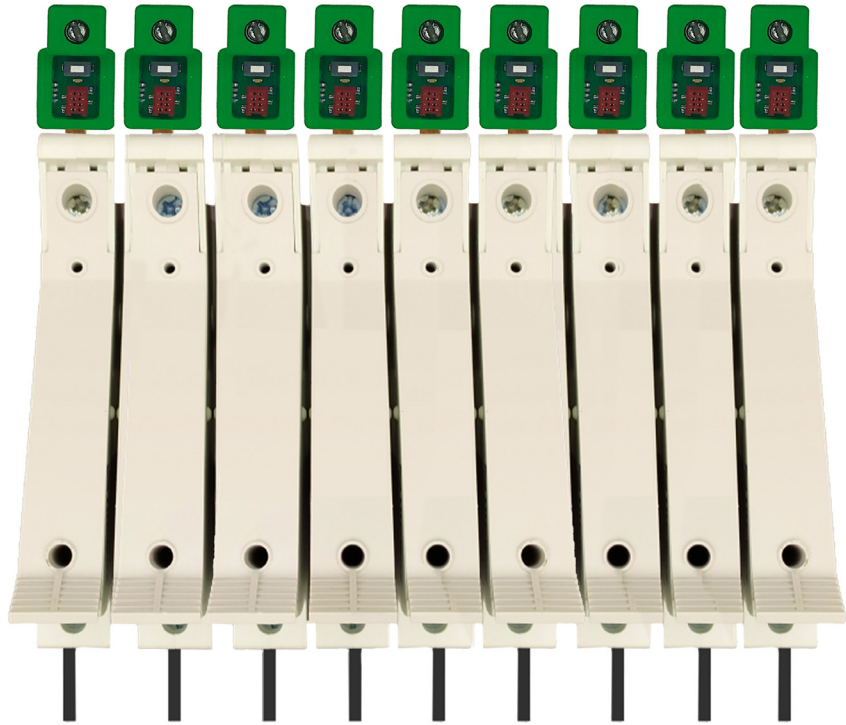
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1. INTRODUCTION

The CcM1-DC is one of the devices from the CcM product range, which serves to measure DC current using a magnetic sensor and to deliver these data via Modbus RTU connection using an RS-485 cable. The CcM meters product range consists of a set of devices used for the monitoring of electrical parameters inside electrical switchboards in single- and three-phase installations. It is best suitable for installation in thermal-magnetic switches or residual-current circuit breakers.

One section of the CcM devices is oriented to the solar sector, providing a perfect and universal solution for self-consumption installations. It is possible to know the power consumption and the power production in real time, to generate the photovoltaic load curve or to regulate the inverters to prevent the overturn to the grid (zero discharge).

In particular, the CcM1-DC is one of the “secondary” CcM devices of the product family because they only exist within the secondary bus and require a master to interrogate them. This master can be a PLC or the CcM-Solar Master, for photovoltaic applications. The CcM1-DC needs to be powered externally through a 12V source, or through the CcM-Solar Master.

As it can be combined and used with different devices within the product range, the CcM product family offers multiple configuration options and allows users to configure the most convenient solution for both, their domestic and industrial installations. Installations can be wireless or connected with a communication cable. The devices can be connected to each other and create communication buses, establishing configurable master-slave hierarchies.

The CcM1-DC can be installed in the base fuse holders of a combiner box of a photovoltaic system, on both the positive or negative pole.

1.1 CONTENTS OF THE BOX

Inside the box you should find:

- 2x CcM1-DC
- 1x flat cable RS-485 of 1m with already crimped male connector
- 4x male connectors RS-485 which may be crimped to the cable
- Data sheet

1.2 DEVICE DOCUMENTATION

CcM1-DC documentation includes this manual and its data sheet. All documents can be downloaded from our web page www.energyccm.com.

1.3 ABOUT THIS MANUAL

The aim of this manual is to explain and describe as clearly as possible the correct use and features of the CcM1-DC device, within the CcM product family. For this purpose, it includes technical data as well as user instructions and specifications to provide information about its correct functioning.

This document is subject to regular updates. The contents of this manual might change partially or completely and it is the responsibility of the users to make sure that they are using the latest version of the user manual. Monsol Electronic reserves the right to modify the manual without previous notice.

2. TECHNICAL SPECIFICATIONS

Maximum operation current	±50 A
Current measurement range in DC	[-30, +30] A
Current measurement error	< 1 % F.S.
Communication protocol	Modbus RTU
Average response time	0.1 s
Maximum consumption	100 mW
Typical power supply	12 VDC
Total dimensions	42 x 18 x 26 mm
Comb dimensions	12 x 5 x 3 mm

2.1 ENVIRONMENTAL CONDITIONS

Operating altitude	0...2000 m
Operating temperature	-25...+50 °C
Overvoltage category	III (according to IEC 61010-1 + IEC 61010-2-030)
Protection degree	IP20
Pollution degree	2
Relative humidity	0...95 % at 45 °C
Protection against over-current	External device (circuit breaker or fuse holder)

3. SAFETY INSTRUCTIONS

Please read and follow all the below safety instructions and precautions before installation and use of the CcM1-DC device.

3.1 SYMBOLS

The following symbols are used in this manual to highlight and emphasise important information. The general meanings of the different symbols used in the manual, and those present in the marking of the device, is as follows:



General caution



Electrical hazard



General information



Prohibited



Direct current



Reinforced insulation



CE marking

3.2 PURPOSE

This device is designed to measure current in one line of a single-phase electrical installation connected directly to the load side of the thermal-magnetic switch or residual-current circuit breaker for use in both industrial and domestic installations.

The system devices should only be used for this purpose. Monsol Electronic is not liable for any damages caused by an inappropriate installation, use or maintenance of the system.

To ensure safe use, the system modules must only be used in compliance with the instructions in this manual. Legal and safety regulations must also be considered to ensure correct use.

3.3 TRANSPORT DAMAGE CHECK

Immediately after receiving the package, make sure that the packaging as well as the device have no signs of damage. At the same time, check that the order is complete, having in mind the contents of the box defined in section 1.1. If the packaging shows any sign of damage, impact or tear, damage of the system modules themselves should be suspected and they should not be installed. If this occurs, please contact Monsol Electronic's customer service.

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3.4 STAFF

This system should be installed, handled and replaced solely by qualified staff. The final user of this manual is staff who is capable of handling the devices.

Qualification of the staff mentioned herein must meet all the safety-related standards, regulations and legislation applicable to the installation and operation of this system in the country concerned.



The responsibility to select qualified staff always lies with the company that the staff works for. It is also the responsibility of the company to assess the ability of the worker to carry out any kind of work and ensure their safety. At the same time, staff must comply with workplace health and safety regulations. It is the responsibility of the company to provide their staff with the training necessary for handling electrical devices and to make sure that they familiarize themselves with the contents of this user manual.

3.5 SPECIAL HAZARDS

The devices are designed to form a part of an industrial or domestic electrical installation. Corresponding safety measures must be observed. Additional safety requirements should be specified by the company who has installed or configured the system.



High amount of current constantly circulates through the system and any physical contact could cause a serious injury. Please ensure that only qualified staff has access to the devices and make sure that the system is switched off or disconnected during handling.

3.6 INSTALLATION PLACE

The devices within the CcM family should be installed in watertight enclosures that comply with IP65 standards outdoors and IP55 standards indoors to be protected from corrosion and humidity.

3.7 ALTERATIONS



It is strictly prohibited to carry out any kind of alterations or modifications to the system.

3.8 CLEANING AND MAINTENANCE

Cleaning and maintenance works should only be carried out when the devices are disconnected from the grid. Before taking any action, make sure that the system has been correctly disconnected, preventing the current to go through them, generally deactivating the circuit breaker where the device is connected.



Do not try to repair the device on your own in case of any malfunction. If this occurs, contact Monsol Electronic's customer service. The system does not require any special cleaning or maintenance, except for standard physical maintenance required by any current conducting electrical device connected with screws and terminals that need to be tightened.

3.9 GENERAL HAZARDS RESULTING FROM NON-COMPLIANCE WITH SAFETY STANDARDS

The technology employed in the manufacturing of the system modules ensures safe handling and operation. Nonetheless, the system might pose hazards if it is used by unqualified staff or handled in a way that is not specified in this user manual.

Any person in charge of the installation, putting into operation, maintenance or replacement of a CcM family device must first read and understand this user manual, especially the safety recommendations.

3.10 GENERAL SAFETY REQUIREMENTS



Operator

The person in charge of handling the electrical device is responsible for the safety of persons and property.



Disconnection

Before starting any work, disconnect the circuit breaker and check the absence of voltage in every cable that supplies voltage to the working site.



Prevention from inadvertent connection

Avoid re-connection of the system using signs, closing or blocking the working site. Accidental reconnection might cause serious injuries.



Verification of absence of voltage in the system

Determine conclusively, using a voltmeter, that there is no voltage in the system. Check all the terminals to make sure that there is no voltage in the system (every single phase).



Covering the adjacent components conducting voltage and restricting the access to electrical devices

Cover all the system components conducting voltage which could cause injuries while carrying out the works. Confirm that dangerous areas are clearly marked.

4. DEVICE DESCRIPTION

In Figure 1 the CcM1-DC is depicted.



Figure 1 Picture of the CcM1-DC device

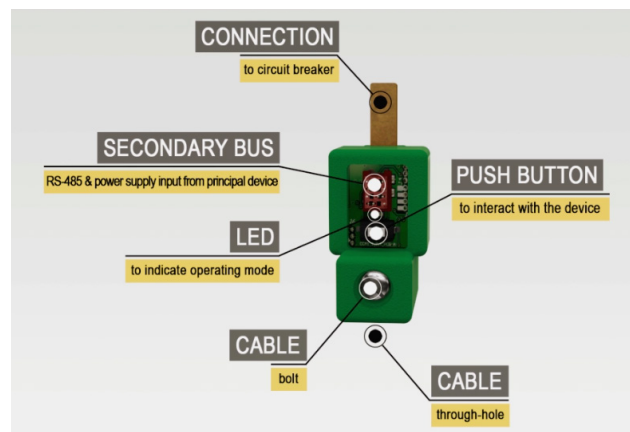


Figure 2 Description of CcM1-DC

As shown in Figure 2, the device consists of:

- **CONNECTION COMB:** It is a metallic contact, through which electric current is fed before it leaves through the cable connected on the opposite end. This comb is inserted in the hosting thermal-magnetic switch or residual-current circuit breaker.
- **LED:** This is a status LED that indicates operating mode of the device.
- **PUSH BUTTON:** A push button to interact with the device.
- **CABLE THROUGH-HOLE:** The hole serves as an entrance for the electric cable, which is fastened by the upper bolt.
- **CABLE BOLT:** Once the electric cable, through which the measured electric current will flow, is inserted, the bolt will ensure that it stays fixed in the right place at all times.
- **SECONDARY BUS CONNECTOR (RED):** Connection bus RS-485. It comprises of two power supply signals (VDC and GND) and the data signals (A+ and B-).

4.1. IDENTIFICATION

In the enclosure of the equipment, the user will find an identification sticker with a QR code like the one shown in Figure 3, in which the serial number of the device is coded. This serial number is unique and is also written next to the QR code.



Figure 3 Identification QR code

5. INSTALLATION



Due to electrical hazard during installation, it will be necessary to ensure that the installation zone meets the necessary safety conditions.

To install CcM1-DC follow these steps:

5.1 STEP 1: SAFETY



Make sure that the protection device is deactivated (thermal-magnetic switch or residual-current circuit breaker) by activation of the break switch marked in green in the following figures.

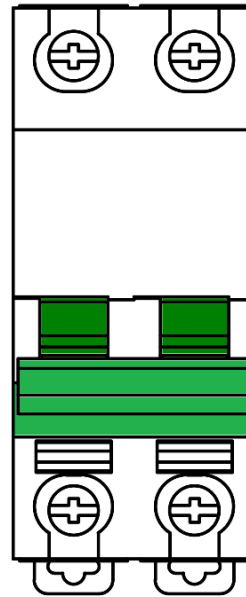


Figure 4 Circuit breaker



Figure 5 Fuse holder

5.2 STEP 2: DISCONNECTION OF THE CURRENT LINE

Loosen the bolt of the line where you wish you measure the current and remove the cable, which is linked to it (Figure 6).

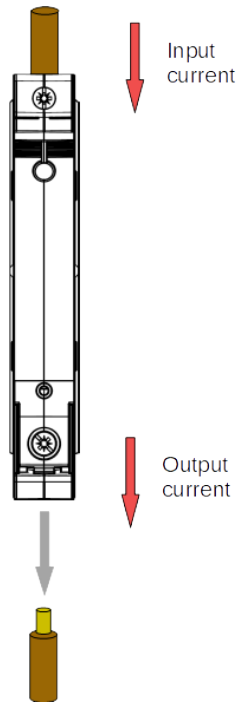


Figure 6 Disconnection of the current line

5.3 STEP 3: CONNECTION OF THE CABLES TO CCM1-DC

Once you unplug the output current cable, plug it at the back (the part furthest from the connection comb) of the CcM1-DC device and tighten the bolt to hold the cable (Figure 7).

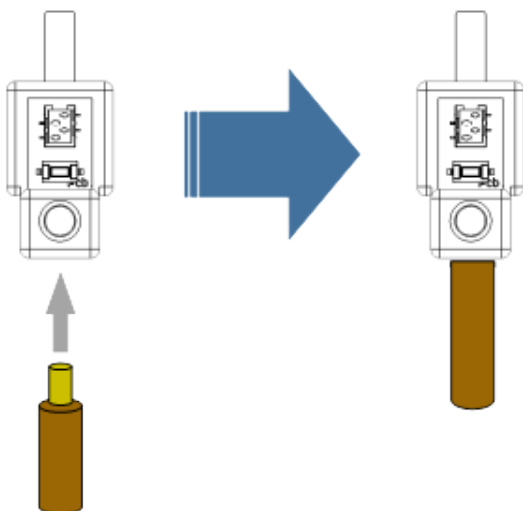


Figure 7 Connection of the cable in CcM1-DC

5.4 STEP 4: CONNECTION OF CCM1-DC TO THE SWITCH

Once the electric cable is inserted in the cable through-hole of the CcM1-DC, connect it to the protection device by inserting the comb in the output current cable through-hole and tighten the bolt of the switch until it is held properly and connects to electricity (Figure 8).

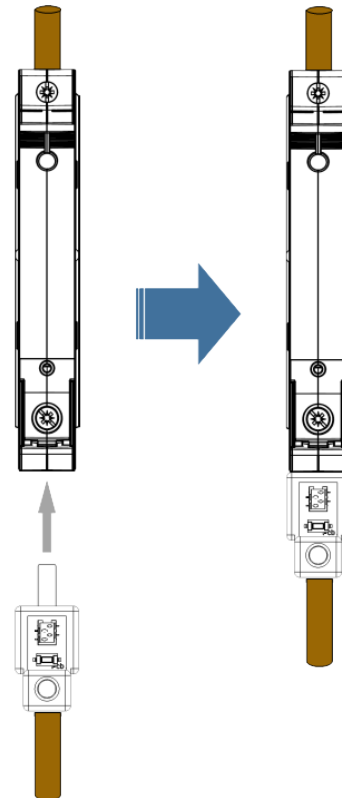


Figure 8 Connection of CcM1-DC to the switch



IMPORTANT! The device considers the positive charge to be flowing from the comb into the cable through-hole.

5.5 STEP 5: COMMUNICATION

The communication with the device takes place via communication cable using the communication protocol Modbus RTU where the CcM1-DC acts as a slave within the bus being a PLC or the CcM-Solar Master the master of the bus.

The supplied cable has a male connector (red) already crimped in one end of the cable; it may be used straight away. Nevertheless, if you need a connector in other position, you should use the provided male connectors (red) as indicated in Figure 9.

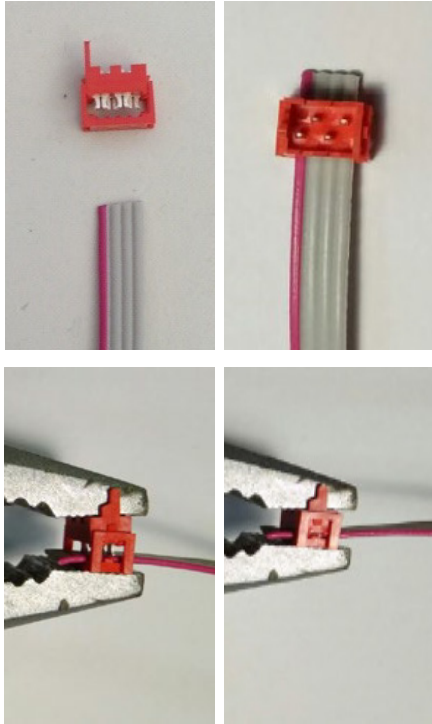


Figure 9 Crimp connector for RS-485 cable



Make sure that the polarisation slot of the connector is placed on the side of the red cable, which makes up one of the four wires of the flat cable.

You can regulate the distance between connectors by crimping them according to the distance that you consider most adequate for its installation and/or the existing distance between the devices connected to the cable or bus. **Take into consideration that all the supplied male connectors are red regardless of whether they will be connected to the principal bus or to the secondary one.**

The connectors have polarity (polarisation slot) positioned in such way that they cannot be connected to the connector of the CcM device in the other way. For correct use, the polarisation slot of the connector must match the opening of the female connector installed at the secondary bus input of the CcM1-DC device.

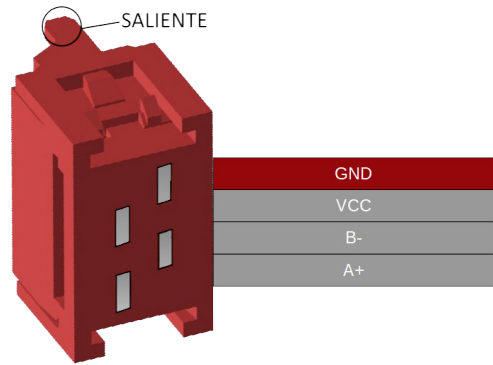


Figure 10 Connector RS-485

Once connected the result would be the following:

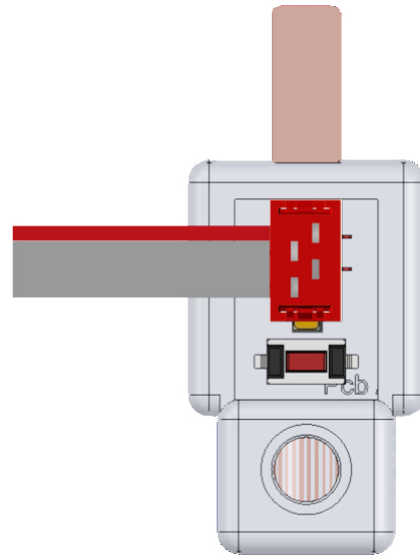


Figure 11 Connection bus to RS-485



With any modification that you make to the supplied flat cable (crimping of new connectors, cutting the cable to make it shorter, etc.) you need to make sure that all the devices connected to the cable in question are unpowered using the power cut in the thermal-magnetic switches/residual-current circuit breakers. Failure to meet this requirement could produce a short circuit between the signals that travel through the bus resulting in damage to the connected device.

6. OPERATION

6.1 OPERATING MODES

The device has three operating modes, which may be configured using the push button:

6.1.1 Reading mode

It is the default mode. The CcM1-DC is taking snapshot measures and the LED flashes twice every 10 seconds to indicate that everything works correctly.

6.1.2 Synchronisation mode

Select this mode to pair the CcM1-DC with the master device of the bus. To activate it, the push button should be pressed for more than 3 seconds and the status LED will start flashing fast indicating that the synchronisation mode has been correctly activated. To return to the reading mode, the push button should be pressed just once.

6.1.3 Reset mode

When this mode is activated, the CcM1-DC will boot and restore the default values thus losing any potentially stored pairing information. To perform this operation, it is necessary to keep the push button pressed for more than 10 seconds, after which the LED will flash and the button can be released. Subsequently, the CcM1-DC device will return to the reading mode, with Modbus address "1" and without any link to a principal device.

6.2 Connection configuration

There are various possible connection schemes when using the CcM1-DC devices together with the rest of the devices of the CcM product range. The CcM1-DC always acts as a slave within the secondary bus and it may be commanded by a Modbus RTU transceiver or by the CcM-Solar Master.

6.2.1 Transceiver Modbus RTU



It is recommended to always use a principal device from the CcM product range to send requests to a CcM1-DC, even though it can also be used directly and independently as explained in this section.

To set up this connection, it is important to consider the pinout of the device connection bus as referred to in section 4.

An external power supply source of 12 V will be needed to power the CcM1-DC connecting VDC and GND in the corresponding lines. The other two lines of the bus A+ and B- should be connected to the device, which will send requests to the CcM1-DC device as shown in Figure 12.

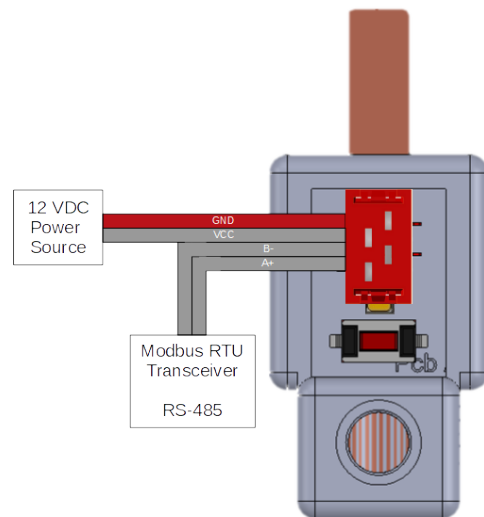


Figure 12 Connection of CcM1-DC to Modbus RTU transceiver

Once it is connected, you may send Modbus RTU commands using the bus to send requests to the CcM1-DC for any required values (see section 7, memory map).

6.2.2 Principal CcM device

In order to connect one or more CcM1-DC devices to a CcM-Solar Master, follow the instructions detailed in the manual of the device in question available at www.energyccm.com.

6.3 COMMUNICATION

The communication with the CcM1-DC device will by default take place using the communication port RS-485 described above.

6.3.1 Parameters of the communication interface RS-485

The CcM1-DC device supports the Modbus RTU protocol with the following parameters:

Baudrate	9600 bps
Format	8N1
Mode	asynchronous
Range of addresses	1...247

Table 1 Characteristics of interface RS-485

6.3.2 Address setting

The Modbus address of the CcM1-DC device is “1” by default. This means that to connect various CcM1-DC to one bus, their address should be changed to avoid collisions.

There are two options to change the address of a CcM1-DC according to the connection configuration.

6.3.2.1 Modbus RTU Transceiver

By using a Modbus RTU transceiver as described in section 6.2.1, it is possible to change the address of CcM1-DC in the following way:

- Using the standard Modbus commands. It is possible to assign addresses through commands sent from the Modbus device. There may be two different cases:
 - If the CcM1-DC device address that will be changed is known. The device in question must be in synchronisation mode and then the command to change its address will be sent to it (see for the memory map of the CcM1-DC in section 7).
 - If the address of the CcM1-DC device that will be changed is unknown. The device in question must be only in synchronisation mode, the remaining devices of the bus must be in

reading mode. Subsequently, the Modbus command to modify the address using the broadcast direction (255) will be sent.

If you select the Reset mode of the CcM1-DC, the device will go back to the default Modbus address “1”.

6.3.2.2 Principal CcM device

If there is a communication bus formed by a CcM-Solar Master, the device in question will be in charge to set addresses of the CcM1-DC secondary devices connected to the bus. For more information see the manual of the principal device in question available at www.energyccm.com.

7. MEMORY MAP

ID AND MEASUREMENT REGISTERS				
Description	Modbus register	Length	Type	Unit
Product identification code	0	1	R	hex
DC current	2	1	R	Arms x 100
Modbus ID	5	1	R/W	-
Serial Number	6	2	R	hex

Table 2 CcM1-DC memory map



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