

CCD DIGITAL Carbon Dioxide probe



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E-M-CCD-S-V1_0.docx	Instruction manual

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Scope:

This manual is applicable to the CCD probe series with firmware version V1.x. The low-order digit of the firmware version stands for minor changes, e.g. correction of errors that do not influence the main functionality of the device.

1 Overview

The CCD probe series is based on digital technology. The probes have a UART interface.

The CCD probe series is developed for use with all RMS data loggers, compatible from Firmware version RMS-LOG-868 (\geq V1.5) and RMS-LOG-L (\geq V1.4).

The CCD can be operated independently using the digital protocols, for example for integration into OEM applications. The following functions are available via the digital interface:

- Change device settings
- CO₂ adjustment
- Simulator mode

With the firmware update for the CCD, it is possible at any time to enable the latest CCD functions, even on older devices.

1.1 *Hardware and software compatibility*

The CCD is compatible only with RMS-generation devices. To change the CCD device configuration, the RMS-CONFIG software is required.

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2 Variants

The CCD comes only as the standard clip.

The CCD can be connected directly to a PC or network. Suitable accessories can be found in the **E-M-HC2-accessories** manual.

Climate measurements		
CCD-S-X2 CCD-S-X5 CCD-S-X10	Accuracy:	$\pm 50\text{ppm} \pm 3\%$ of read value @ 0-2000ppm $\pm 10\%$ of read value @ 2000-10'000 ppm
	Range of application:	0...50°C, 0...95% RH non-condensing
	Ambient pressure compensation:	300-1100 hPa
	Diameter:	32 mm (1.26")
	Length:	76 mm (3")
	Housing material:	Polycarbonate, black
	Standard filter:	Stainless steel
	Sensor:	NDIR
Weight:	55 g (0.35 oz)	

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3 General information

3.1 Power supply

The clip is created to be used directly connected to and powered by a RMS LAN Logger. Alternative a AC3001 (3.3V or 5.5V) can be used.

The RMS Clip CO₂ need to be powered permanently because the measurement principle. Therefore, it is not recommended to use a RMS RF Logger. Its battery capacity would drop down drastically from years to few days of permanent use.

The heating up phase is app.300sec. The measurement interval is 16sec. or higher. Lower intervals are set automatically to 16sec.

3.2 Measured parameters

The CCD measures carbon dioxide and has an integrated pressure sensor for pressure compensation.

3.3 Digital interface

The CCD probe has a UART interface, via which the probe can be addressed directly using the MODBUS protocol. To connect the probe to a PC, an AC3001 service cable is required (**E-M-HC2-accessories**).

Using the ROTRONIC RMS-CONFIG software, the following functions are available via the UART interface.

- Read out measurements
- Probe information: name, serial number, calibration and adjustment information, etc.
- Probe calibration and adjustment
- Configuration
- Firmware update

3.4 Communication protocol

The probe can be addressed directly using the MODBUS protocol, to request the measured CO₂ values. The parameters highlighted in yellow should be selected according to the table below.

Command: (MSB first)

Probe address	Command ID		Start address		Number records	of	MODBUS-CRC ¹
0x00	0x04	0x00	0x00	0x00	0x00		0x0000

Probe address: 0...255, if '0' then all probes respond regardless of the address.

Start address	Number of records	Return values
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¹ CRC calculation according to MODBUS standard

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0x00	0x04	Serial number	CO ₂		
		0x00000000	0x0000		
0x00	0x02	Serial number			
		0x00000000			

Response:

Probe address	Command ID	Number of data bytes	Data (4...10 bytes)	MODBUS CRC
0x00	0x04	0x00	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00	0x0000

Data format:

- Serial number (unsigned int): 0...2³²-1

Response in the event of an error:

Probe address		Error code	MODBUS CRC
0x00	0x84	0x00	0x0000

Error codes	Description
0x02	Start address and number of records invalid
0x03	Number of records invalid

Sensor faults:

In the event of a short circuit or open circuit at the probe, a value of 19999 is output for the measured value concerned.

Primary Tables	Type	Read / Write	Coils / Registers	Function Code	
Coils	Bit	Read/Write	1 ... 9'999	0x01	Read Coils
				0x05	Write Single Coil
				0x0F	Write Multiple Coils
Discrete Inputs	Bit	Read Only	10'001 ... 29'999	0x02	Read Discrete Inputs
Input Registers	16-bit	Read Only	30'001 ... 39'999	0x04	Read Input Register
Holding Registers	16-bit	Read/Write	40'001 ... 49'999	0x03	Read Holding Registers
				0x06	Write Single Register
				0x10	Write Multiple Registers

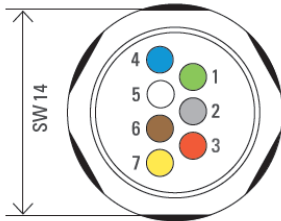
Attention!

Coils and registers in Modbus are addressed starting at zero. Therefore coils numbered 1...16 are addressed as 0...15 or registers numbered e.g. 10'001...10'016 are addressed as 10'000...10'015!

3.5 Connector

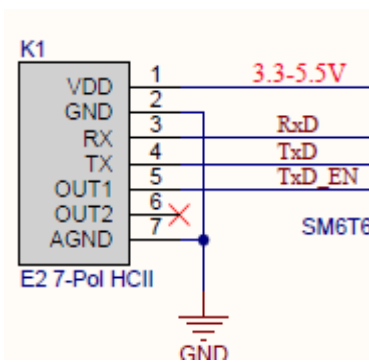
All CCD probes use the same connector (male).

Connection diagram (7-pin connector, male – view: probe side)



- 1) V+
- 2) GND
- 3) UART RxD
- 4) UART TxD
- 5) UART TxD_EN
- 6) –
- 7) GND

Connection diagram (7-pin connector, controller side)



3.6 Sensor protection (filters)

The CCD is supplied with a standard filter.

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4 User settings

The probe is supplied with the factory configuration as described in section 4.2 . Users can change this configuration as required. The probe also offers various functions which are described briefly here.

4.1 Function overview

Calibration	
Functions	Description
▶ CO ₂ adjustment	<ul style="list-style-type: none"> ○ 1-point or up to 9-point CO₂ adjustment/calibration ○ Reset to the factory adjustment <p>Note 1: In general, it is essential to pay attention that the reference value as well as the measured value. Make sure that the conditions are stable before carrying out a calibration or an adjustment.</p> <p>Note 2: The data acquisition need to be executed in real time. Meaning that the CO₂ levels acquired must be applied at the same moment. Calibration values (e. g. a calibration table with index- and measured values done in a separate calibration procedure) cannot be used for a data acquisition at a later date. The reason is the missing pressure compensation data.</p>
▶ Simulator mode	Is used to output fixed values for CO ₂ . The output value can be configured.
▶ Automatic calibration	<p>The automatic calibration is carried out via a baseline correction (ABC), where the baseline can be defined and the measurement period can also be defined.</p> <ul style="list-style-type: none"> ○ Can be set on/off (standard: on) ○ Baseline can be set (standard: 400ppm) ○ Period can be set (standard: 8 days) <p>The functionality of the ABC feature:</p> <p>Any drift of the sensor caused by the light source or the light receiver or other influences is corrected periodically by an automatic 1 point correction. This correction works as an offset.</p> <p>Following the assumption that the lowest possible level at ambient air is 400ppm (region dependent), the sensor logs internally the lowest measured value during a defined period (default 8 days).</p> <p>After the defined period, the sensor adds an offset of all futures measured values are corrected.</p>

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	<p>An example. If after 4 days, the measured value drops below 400 to minimum 360ppm than the sensor adds the difference of 40ppm to all future measured values after 8 days (end of ABC period). This is only working if it can be guaranteed that the ambient gets fresh air at least once a week.</p> <p>Period adaptation: If the application gets fresh air less than once a week (e. g. special ambient of greenhouses), the period can be adapted to a period where fresh air will be seen by the CCD.</p> <p>Baseline adaptation: The level of 400ppm might be changed only if the application can guarantee that the minimum possible level is known. Otherwise, we do not advise to change this baseline.</p>
▶ CO ₂ range	The CO ₂ range can be changed between 0...2'000ppm, 0...5'000ppm and 0...10'000ppm.
▶ Measurement period	The measurement period is set to 16 seconds. It is the lowest limit for the CCD and can be increased.
▶ CO ₂ filter	<p>The filter settings can be changed:</p> <ul style="list-style-type: none"> ○ Filter and APC: Filter and automatic pressure compensation ○ Filter: Only filter is on ○ APC: Only automatic pressure compensation is on

4.2 Factory defaults

Configurable settings	Factory default
Unit of measurement (metric/English)	Metric
Psychrometric calculation	None
Communication protocol	MODBUS
MODBUS address	0
Device name	CCD

Functions	Factory default
CO ₂ adjustment	Factory adjusted
CO ₂ ABC	Enabled, interval is set to 8 days
CO ₂ measurement range	0...2'000ppm, scalable 0...5'000/10'000ppm
CO ₂ measurement period	16s
CO ₂ filter	Filter and APC enabled
CO ₂ simulator	Disabled

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5 Mechanical installation

For best measurement results, observe the following points:

- For indoor air quality measurements, the CCD should be installed at the light switch height (roughly 1200mm from the floor)
- For life safety measurements, the CCD should be installed at socket level (roughly 450mm from the floor)

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6 Electrical installation

Use Rotronic extension cables. These allow a maximum length of 5 m.

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7 Maintenance

7.1 *Filter cleaning*

Depending on the application, the filter should be checked regularly for soiling, and replaced if necessary.

7.2 *Regular calibration*

CCD sensors have high long-term stability and do not require any additional calibration as supplied. The calibration period will depend on the activation of the automatic calibration function. If activated, then the customer should define their own calibration interval. If deactivated, then Rotronic recommends a calibration every 12 months. Calibration or adjustment can be carried out using the RMS-CONFIG or RMS-CLD/WEB software.

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8 Firmware update

Firmware updates are available to download from the ROTRONIC website. The AC3001 cable can be used to connect the CCD probe to a PC (see **E-M-HC2-accessories**). Firmware updates can be carried out using the RMS-CONFIG or RMS-WEB/CLD software.

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9 Technical specifications

General	
Device type	Carbon dioxide probe
Range of application	0...+50°C / 0...95%RH (non condensing)
IP protection	IP40

Power supply / connection	
Power supply (VDD)	3.3...5.5 VDC ±0%
Current consumption (16s interval)	20mA (average). 260mA (peak)
Polarity protection	Mechanical protection
Battery life	2.7 days with a 10s or 60s measurement interval

CO ₂ measurement	
Sensor	Infrared (NDIR)
Parameter	CO ₂ concentration (ppm/%)
Measurement range	0...2'000/5'000/10'000 ppm
Resolution	1 ppm
Measurement accuracy (after minimum 3 weeks ABC)	±50 ppm ±3 % of read value @ 0...2'000 ppm ±10 % of read value @ 2000...10,000 ppm
Medium	Air and non-aggressive gases
Ambient pressure and temperature compensation	Automatic (300...1100hPa)

Start time / measurement interval	
Startup time	<300 s
Measurement interval	16 s
Response time T63	130s when descending 87s when ascending

Digital interface	
Type	UART
Protocol	MODBUS RTU
Factory default	Baud rate 19200, tolerance 2 % Parity: none Data bits: 8 Stop bits: 1 Flow control: none

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Logic levels	Logic 0: ≤ 0.4 V Logic 1: $\geq 2 \dots 2.5$ V
Maximum cable length	5 m

General specifications	
Housing material	Polycarbonate (housing)
Thumb-screw material	Stainless steel, DIN 1.4305
Weight	55g

Conformity	
CE / EMC	EMC Directive: 2014/30/EU EN 61000-6-1:2007 EN 61000-6-2:2005 EN 61000-6-3:2007+A1:2011+AC:2012 EN 61000-6-4:2007+A1:2011 EN 61326-1: 2013 Performance criterion: www.rotronic.com
Fire protection class	Corresponds to UL94-V2
Soldering	Lead free (RoHS Directive 2011/65/EU)
FDA/GAMP guidance	Compatible

Accepted environmental conditions	
Storage/transportation	0...50°C / 0...95%RH, non-condensing
Range of application electronics	0...50°C / 0...95%RH, non-condensing

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10 Accessories

All accessories for the CCD probe such as extension cables, adapters, calibration material, etc. are to be found in the manual **E-M-HC2-accessories**.

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11 Additional documents

Document name	Contents
E-M-HC2-accessories	Accessory parts for probes and transmitters

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12 Document version

Version	Date	Remarks
V1_0	March 2018	First version