CredoSense User Resources

User Manual

Universal Environmental Meter

Please use this Manual for best user's experience

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Disclaimer

The CredoSense Universal Environmental Meter (CS-UEM-04) is designed only to accurately read, record, and display data from various sensors connected to it. It does not monitor the quality of the accompanying products, goods, or commodities.

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Colophon

This User Manual was typeset using the KOMA-Script and LATEX using the kaobook class. The source code of kaobook is available at:https://github.com/fmarotta/kaobook.

Publisher

First Published in March 2022 by CredoSense Inc. (Ltd.) support@credosense.com www.credosense.com We dedicate this resource to the people who keep on trying when there appeared to be no hope at all and working hard to make our world a better place.

CredoSense – Resilient, Accurate, Affordable

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Introduction

The CredoSense Universal Environmental Meter (CS-UEM-04) is a unique device that reads, records, and displays data from four different sensors, one of which is a dedicated CredoSense Soil Moisture Sensor (CS-SM2). The device (Figure 2.1) can read sensors that use analog voltage, current, and SDI-12 as outputs. It can read any analog sensor with an output voltage ranging from 0–5 V and a current ranging from 0–150 mA. For SDI-12 sensors, it can automatically detect the sensor address and display up to three outputs simultaneously.

With an ergonomic and rugged design, the OLED display of the UEM offers outstanding visibility both in dark and bright environments. The display graphically and numerically shows live data from sensors that can be saved to a microSD card with a user-selectable stability criterion. The data is stored in CSV format on a large capacity (32 GB) microSD card that is easily accessible to users.

1.1 What this manual is about?

This document has been written as a User's Manual and knowledge-base resource¹ for the CredoSense Universal Environmental Meter (CS-UEM-04). We also have demonstrated how the CS-UEM-04 should be used to get the best user experience. Upon careful reading of this manual, a user should be able to:

- ► Connect sensors to the meter.
- ► Configure and program the CS-UEM-04.
- ▶ Retrieve recorded data on a computer.
- ▶ Read, record, and display sensor data.

1.1 What this manual is about? . . 1

1: We have provided detailed information on working principles and important scientific references (where applicable) related to the Universal Environmental Meter. We believe in quality data and hope that this will help our users take educated measurements of their variables of interest.

Features and Specifications

This chapter highlights some key features of the CS-UEM-04. Figure 2.1 shows the outlook of a CredoSense Universal Environmental Meter.





Figure 2.1: CredoSense Universal Environmental Meter (CS-UEM-04)

2.1 Key features

- Coefficient of variance-based stability detection (default 1%, customizable) for logged data (mean of 100 readings as default but customizable).
- Voltage, current, and soil moisture measurements are graphed in real time.
- Offers customizable excitation output voltage (3.5–12 VDC) to suit the users' particular sensor needs.
- WiFi-enabled automatic detection of date and time and has a dedicated clock for precise timekeeping.
- ► Each datapoint is recorded with a date-time stamp.
- Automatic detection of the SDI-12 sensor address, which can also be configured for faster operation.

2.2 Specifications

- ► Resolution: 1 mV | 0.1 mA
- ▶ Input (from sensor) voltage range: 0 to 5000 mV
- ▶ Input (from sensor) current range: 0 to 150 mA
- ► Data storage capacity: 32 GB (maximum)
- Storage type: microSD Card
- ▶ Voltage output (to sensor) range: 0–12 VDC
- Power requirement: 9–12 VDC
- ► Operating temperature: -40 °C to +60 °C

2.3 Unique features

The CS-UEM-04 is the only research-grade portable meter on the market that can read all kinds of sensors — analog voltage, analog current, and SDI-12. It can also power the sensor that requires an excitation voltage ranging from 3.5 to 12 VDC. It also allows multiple sensors to be connected simultaneously and toggle between sensors using the "Mode" button. The meter can be powered by a 9 V battery or a 9-12 VDC power supply.

Buttons, Ports, and Display

This chapter familiarizes the CS-UEM-04 to the user. Figure 3.2 and Figure 3.3 show buttons, display, excitation voltage selector, microSD card location, external power port, and sensor connection ports.

3.1 Buttons, microSD slot, and display locations

- ▶ Power switch (1): Power on or off upon pushing the button.
- ► Mode button (2): Switch modes by pushing the button.
- ► Save button (3): Push the button to save on-screen displayed data to the microSD card.
- ► Display (4): See live data on screen—Figure 3.1 showing locations of different elements on the CS-UEM-04 display.
- microSD slot (5): Insert a microSD card here to store data and configure the device.
- Excitation voltage selector (6): use the knob to adjust the excitation voltage (Vout).



Figure 3.2: Top-view of the CS-UEM-04 showing various buttons, microSD slot, and the display

3.2 Sensor and power ports

- Connect any sensor (in series) that outputs current ranging from 0 to 150 mA.
- Connect any SDI-12 supported sensor and select the specific excitation voltage; typically, it is 12 V for SDI-12 supported sensors.
- CS-SM2 port (9): A dedicated port for the CS-SM2 soil moisture sensor from the CredoSense. Set the excitation voltage to 3.3 V for this sensor.
- Connect any sensor (in series) that outputs voltage ranging from 0 to 5000 mv.

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► DC jack (11): A 3.5 mm DC jack for external power (IN) source ranging from 9-12 VDC.

Figure 3.3: Showing ports for sensor and external DC power supply

3.3 Adapter

To connect third party sensors, an additional 3.5 mm adapter is required. Connect the specific wires (as outlined by the sensor manufacturers) to the specific terminal of the adapter (Figure 3.4) and tight screws properly for a secure connection (Figure 3.5).



Figure 3.4: An adapter connected to the CS-UEM-04 for third party sensor connection



Figure 3.5: Screws location to tighten the sensor wires

The adapter consists of four different terminals i.e., Vout, Vin/SDI-12 Data, NC (No connection), and Ground, indicated with 1, 2, 3, and 4 respectively (Figure 3.6).

- ► Vout (1): Vout is the output voltage or the supply voltage from the CS-UEM-04 to the sensor. It is also known as the excitation voltage.
- Vin/SDI-12 Data (2): Vin is the voltage sensing terminal (the voltage output from the connected sensor). It is also known as voltage out/analog out in a third party sensor. SDI-12 is a digital output format and sensors using this format should be connected to this terminal.
- NC (3): NC stands for No Connection. Avoid any connection to this terminal.
- ► Ground (4): Terminal 4 is the Ground.



Figure 3.6: Showing four different terminals on the adapter

Sensors	Vout (1)	Vin/SDI-12 (2)	NC (3)	Ground (4)
Voltage port	Yes	Yes	x	Yes
Current port	Yes	Х	х	Yes
SDI-12	Yes	Yes	х	Yes

Configuration

4.1 Standard configuration

In order to configure the device, the user will need a microSD card (up to 32GB) formatted in the FAT32 system and follow the steps below:

- Step 1: Insert a microSD card at position 5 (Figure 3.2), and power on the meter.
- Step 2: The meter will automatically generate files (in the config folder) on the microSD card with default settings.
- Step 3: Take out the microSD card from the meter and connect it to a computer.
- Step 4: Use a text editor to configure the device according to the user's need.
- Step 5: Follow the instructions and examples provided in the files for configuration.

Once the configuration is successfully edited, the user needs to save it on the microSD card, put the microSD card back in the meter, and the device is now ready for use. When the CS-UEM-04 is connected to a wifi network, it automatically updates the date and time.

[**NOTE**: It is highly recommended to use a branded microSD card for desired performance. Please read this article on how to identify a fake microSD card.]

4.2 Setting up wifi

The user can set time from the internet by connecting the device to a 2.4GHz wifi network. Write the credentials (SSID and password) on the config file (wifi.txt) of the microSD card. A default wifi.txt will look like this:

```
ENABLE_WIFI=FALSE
1
      SSID=
2
      PASSWORD=
3
4
5
      #For connecting to wifi set ENABLE_WIFI=TRUE and enter the
       wifi credentials that you want to connect to.
      #Note: SSID is the name of the wifi. Both SSID and Password
6
       are case-sensitive. Make sure there is no space after '='
       sign.
7
      #Example:
8
      #ENABLE_WIFI=TRUE
9
      #SSID=myWifi
10
      #PASSW0RD=123456789
```

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4.3 Setting the time zone

Time zone can be set using the time.txt file. A default time.txt will look as follows:

```
1 TIME_ZONE=UTC+06:00
2 DAYLIGHT_SAVING=+00:00
3
4 #Enter in +/-Hour:Minute format.
5 #Example:
6 #TIME_ZONE=UTC-05:30
7 #DAYLIGHT_SAVING=+01:45
```

For the date and time in Daylight Saving (DST), use the appropriate hour in DAYLIGHT_SAVING.

```
        1
        TIME_ZONE=UTC-05:00

        2
        DAYLIGHT_SAVING=+01:00
```

[**NOTE**: Make sure there is no space after '=' sign.]

4.4 Coefficient of variance (CoV)

At the beginning of each measurement, the sensor data can be a bit unstable. If an average reading is taken on the unstable data, accuracy can be seriously affected. To tackle this, users choose sample size for which the average and coefficient of variance (CoV) will be calculated. In a continuous moving window equal to the sample size, the meter calculates CoV for the particular window. If the calculated CoV is within the threshold, the meter calculates the mean, otherwise move to the next window until the desired CoV is achieved.

A default config_CV.txt look as follows:

```
THRESHOLD=1
1
2
      VOLTAGE_SAMPLES=50
       CURRENT_SAMPLES=5
3
4
5
       #Example:
6
       #THRESHOLD=0.5
       #VOLTAGE_SAMPLES=100
7
       #CURRENT_SAMPLES=10
8
9
10
      #In case of of the example, the device will take mean of 100
       consecutive data points for voltage mode and 10 data points
       for current mode, when the CoV is under 0.5%.
11
       #Make sure there is no space after '=' sign.
```

[**IMPORTANT**: The meter will not run if there is no microSD card inserted in the meter.]

Operation and Download Data

Make sure a functional 9V battery is installed in place, and no sensors are connected to any of the ports of the CS-UEM-04. Follow the instructions below to operate the CS-UEM-04:

5.1 Step-by-step guide

- ► Step 1: Press the power button.
- ► Step 2: Set the excitation voltage for your sensor using the knob.
- ► Step 3: Press and hold the Mode button to set the excitation voltage.
- ▶ Step 4: Connect a sensor to the designated port.
- Step 5: Press the Mode button to observe sensor data. There are four different modes in this device: Voltage Mode, Current Mode, CS-SM2 Mode, and SDI-12 Mode. By pressing the Mode button, you can toggle between modes until you see the desired Mode.
- Step 6: If the user intends to save the data displayed on the screen to the microSD card, press the Save button.

[**IMPORTANT**: Make sure to power off the meter before taking out the microSD card to prevent accidental data corruption]

5.2 Download data

Data saved on the microSD card be downloaded using the following steps:

Step 1: Insert the microSD card to a computer using a card reader. Go to the microSD card drive and the user will find two folders as shown in Figure 5.1.

Drive (E:)				
Name	Date modified	Туре	✓ Size	
onfig		File folder		
sensor_data		File folder		

Figure 5.1: Folders in microSD card

Step 2: Click on the folder 'sensor_data', the saved data will appear in a excel file, which is named after the saved date (Figure 5.2).

Drive (E:) > sensor_data			
Name	Date modified	Туре	Size
🖬 5-Apr		Microsoft Excel C	1 KB

Figure 5.2: Data saved in the Microsoft Excel file format

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► Step 3: Open the excel file and the saved data will be arranged as follows (Figure 5.3):

Α	В	С	D	E
Date-Time	voltage(V)	current(mA)	sdi-12	CS-SM2
05/04/2022 15:13				Input:3.27V Temp:27.8C Output:1.7198V
05/04/2022 15:14				Input:3.27V Temp:27.8C Output:1.4755V
05/04/2022 15:14				Input:3.27V Temp:28.2C Output:1.3033V

Figure 5.3: Saved data are arranged in a microsoft excel file

5.3 Battery and power supply

The CS-UEM-04 operates at 9 VDC. The power could be supplied either with a 9V battery or an adapter (9V-2A). The port number 11 (Figure 3.3) shows a DC jack for connecting an adapter.

[**IMPORTANT**: Make sure to use one power source in the device at a time, using a battery and an adapter at the same time might damage the device.]