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# MCF-LW06485 Operating Manual

## Important safety information



Read this manual before attempting to install the device! Failure to observe recommendations included in this manual may be dangerous or cause a violation of the law. The manufacturer will not be held responsible for any loss or damage resulting from not following the instructions of this operating manual.

- Do not dismantle or modify in any way.
- Avoid mechanical stress
- Do not use any detergent or alcohol to clean the device.

## Disposal information for users



**Pursuant to and in accordance with Article 14 of the Directive 2012/19/EU of the European Parliament on waste electrical and electronic equipment (WEEE), and pursuant to and in accordance with Article 20 of the Directive 2013/56/EU of the European Parliament on batteries and accumulators and waste batteries.**

The barred symbol of the rubbish bin shown on the equipment indicates that, at the end of its useful life, the product must be collected separately from other waste.

Please note that the lithium batteries must be removed from the equipment before it is given as waste and disposed separately. To remove the batteries refer to the specifications in the user manual. For additional information and how to carry out disposal, please contact the certified disposal service providers.

## 1. Description

This device can be interfaced to any Modbus RTU RS485 device to read and write any register of the connected device (up to 31 slaves or 512 bytes of data for every message) through the LoRaWAN® platform. Configuration is simply made using a configuration file uploaded to the interface via USB or with downlinks.



MCF-LW06485 is available with DIN rail option (MCF-DIN105):



## 2. Overview

## 2.1 Technical data

- CPU Cortex M4
- RTC
- EEPROM 32KB
- Flash 1MB
- Encryption AES 128 bit
- LiPo 800mAh rechargeable battery
- Class C LoRaWAN® stack EU868, AS923, AU915, US915
- Modbus RTU RS485
- Integrated termination and polarization resistors
- USB On The Go
- IoT node setup and firmware upgrade via USB interface
- Power supply 10÷36Vdc
- Storage temperature range -20°C ÷ +80°C
- Working temperature range -10°C ÷ +70°C
- Dimensions L x H x P: 81 x 60 x 24mm

## 3 Installation

### 3.1 Connection

#### 3.1.1 Connection as stand-alone device

Please refer to following connections:



| pin  | Name | Description              |
|------|------|--------------------------|
| J3.7 | IO5  | Modbus A (+) yellow wire |
| J3.8 | IO6  | Modbus B (-) white wire  |

|       |     |  |
|-------|-----|--|
| J3.9  | GND | Negative power supply                  |
| J3.10 | VDD | Positive power supply range [10-36Vdc] |

Power can also be supplied by USB.

### 3.1.2 Connection with DIN rail option

Please refer to following connections:



Modbus data lines:

| Pin  | Name | Description  |
|------|------|--------------|
| J1.7 | IO5  | Modbus A (+) |
| J1.8 | IO6  | Modbus B (-) |

Power supply:

| Pin  | Name | Description                            |
|------|------|--|
| J2.1 | Vdc  | Positive power supply range [10-36Vdc] |
| J2.2 | GND  | Negative power supply                  |

Power can also be supplied by USB.

### 3.1.3 Termination/Polarization



- dip1 ON/OFF = 120 OHM termination on Modbus INSERTED/NOT INSERTED
- dip2 ON/OFF = Modbus B line polarization INSERTED/NOT INSERTED\*
- dip3 ON/OFF = Modbus A line polarization INSERTED/NOT INSERTED\*

\*Polarizations are available only if MCF-LW06485 is 10-36Vdc supplied. Please note dip2 and dip3 must have same status.

### 3.1.4 Antenna

The magnetic antenna must be positioned on a metal body. It should preferably be vertical and at least 30 cm away from other metal bodies. The installation must take place in a place where the LoRaWAN® signal coverage is good (SF=7 optimal, SF=12 weak). Use the provided clip to hold the antenna connector in place, as in the picture:



## 3.2 Configuration







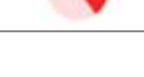
To deploy the sensor, use **LoRaWEB** online tool, to setup LoRaWAN® credentials and other preferences (only available for Windows®) :

[LoRaWEB Tool](http://iot.mcf88.cloud/LoRaWeb) (iot.mcf88.cloud/LoRaWeb)



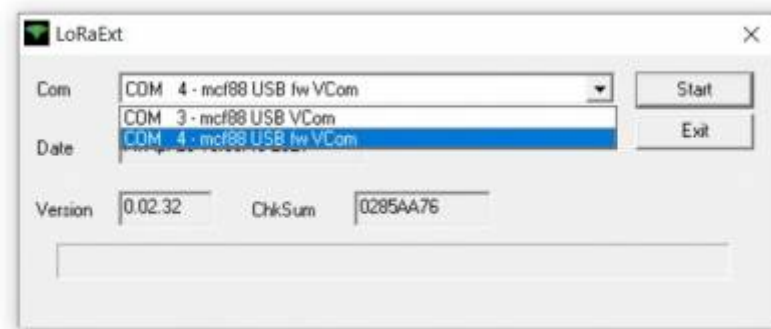




|                         |   |                    |
|-------------------------|---|--------------------|
| LoRaWAN® not configured |  | Slow flashing      |
| Joining                 |  | Quick flashing     |
| Sending                 |  | Quick flashing     |
| Receiving               |  | Quick flashing     |
| Steady state            |  | Fixed              |
| Data error              |  | Flashing 2 seconds |
| Connection error        |  | Flashing 1 second  |

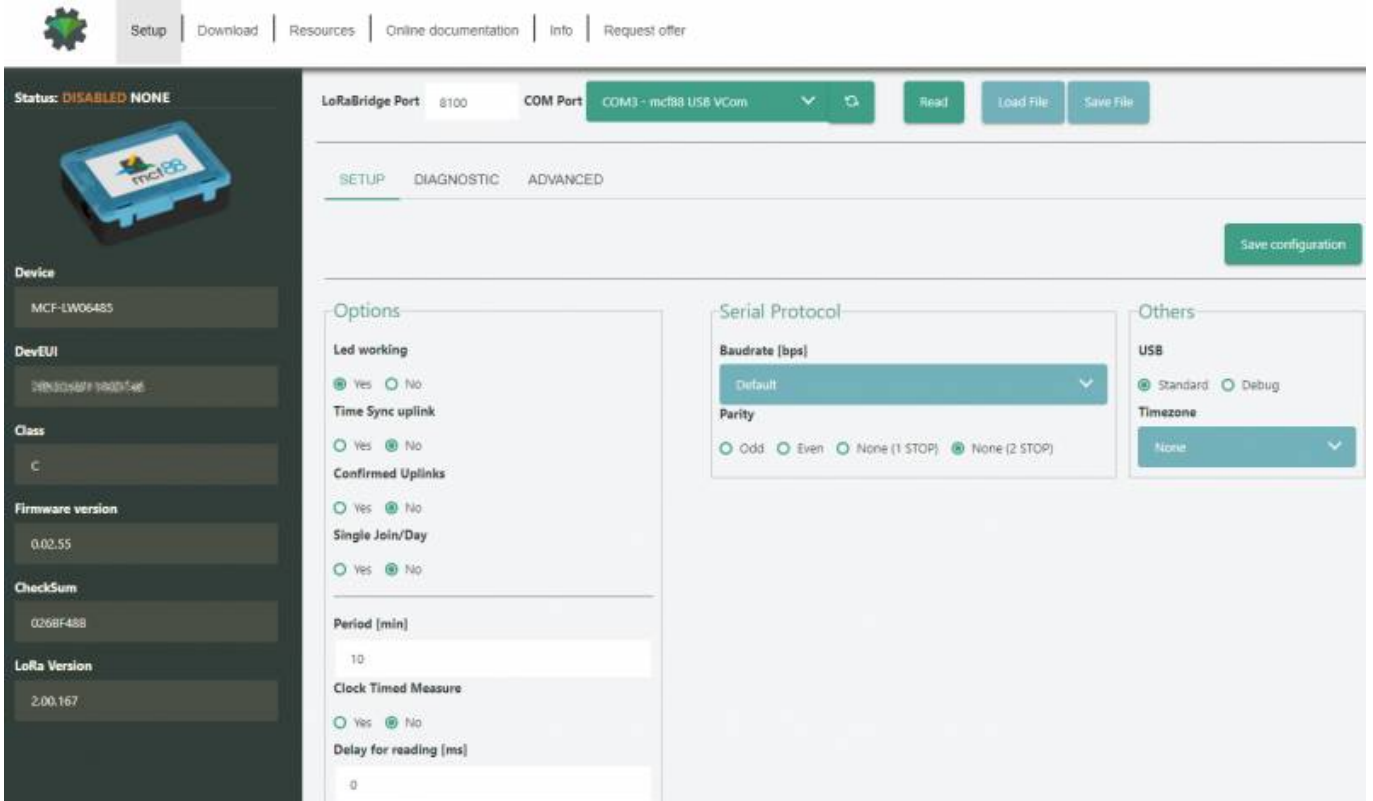
### 3.4 Firmware update

Save the new firmware file (.exe) on the PC, run the file, select the USB FW port and start the update:



and waiting for the end message.

## 4. Setup



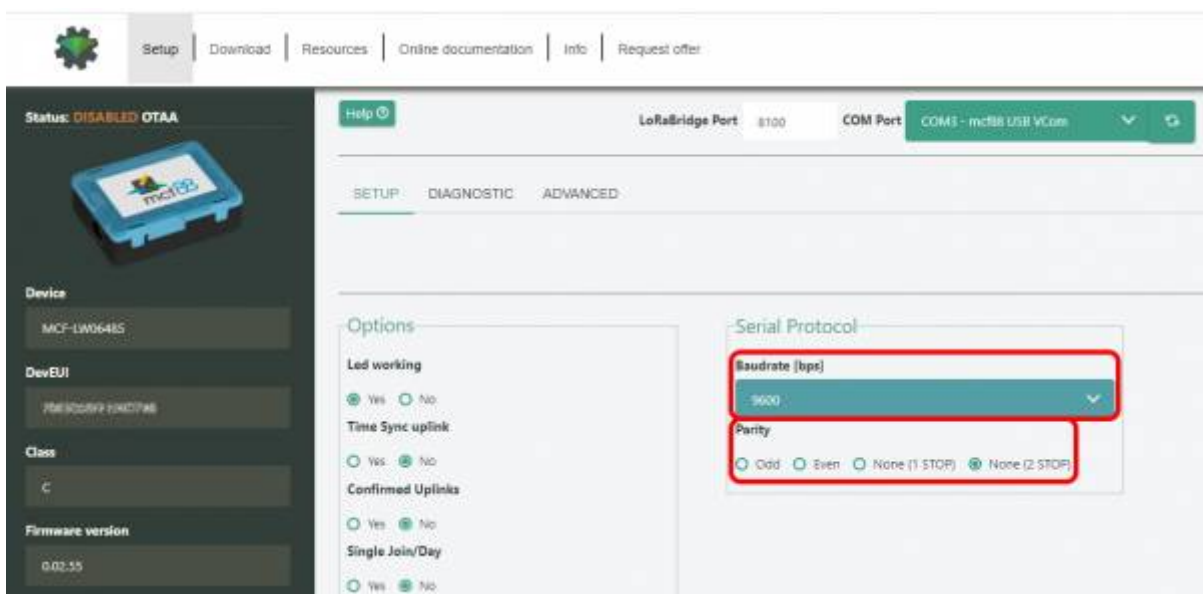
## 4.1 Period

Period is the interval (in minutes) between one measure and the next one. The sensor sends one measures for every transmission. Value can be between 15 and 65535 minutes (default: 30 minutes).

Period interval can be set with App or with downlink command.

## 4.2 Modbus settings

### 4.2.1 Serial line settings



**Baudrate [bps]:**

set the baudrate for the serial line (default = off).

**Parity:**

set the Modbus frame parity.

**Note:**

when saving these parameters, the system asks if you want to save only or to save and load the Modbus configuration file.

**4.2.2 Registers map configuration**

Basic configuration is made through an .XLS file containing, for every row, the parameters of the register(s) to be read or write.

|   | A     | B              | C               | D           | E             | F    | G              | H           |
|---|-------|----------------|-----------------|-------------|---------------|------|----------------|-------------|
| 1 | Label | Modbus address | Modbus function | Dec address | Modbus length | Data | Baudrate (bps) | Parity/stop |
| 2 |       |                |                 |             |               |      |                |             |
| 3 |       |                |                 |             |               |      |                |             |
| 4 |       |                |                 |             |               |      |                |             |

Template file can be downloaded here:

[Modbus configuration file template](#)

File can be uploaded via USB or sent with LoRaWAN® dowlinks.

Due to the radio regulation, the amount of data that the interface can send during a period of time can vary, and depends also from duty cycle, spreading factor and data rate.

For example, with EU868 band, the MCF-LW06485 can send from 1KB (SF = 12) to 30KB (SF = 7) every hour. In case of periodic transmission, you have to set the reading period related to the amount of data you have to send for every reading from the slaves.

**4.2.3 Configuration file format**

**Label:**

mnemonic label of the register.

**Modbus address:**

slave address (expressed as decimal value)

**Modbus function:**

| Function Code | Register Type          |
|---------------|------------------------|
| 1             | Read Coil              |
| 2             | Read Discrete Input    |
| 3             | Read Holding Registers |
| 4             | Read Input Registers   |
| 5             | Write Single Coil      |

| Function Code | Register Type                    |
|---------------|----------------------------------|
| 6             | Write Single Holding Register    |
| 15            | Write Multiple Coils             |
| 16            | Write Multiple Holding Registers |

**Dec address:**

register starting address (expressed as decimal value), without offset.

**Note:**

please check [Modbus addressing](#)

**Modbus length:**

length (in word) of the register to be read or write

**Data:**

in case of write command, data to be write, hexadecimal values formatted as string.

**Baudrate (bps):**

serial line baudrate, only needed if different from the settings in LoRaWEB.

Allowed values: 1200, 2400, 4800, 9600, 19200. 38400, 57600, 115200.

**Parity/stop:**

serial line parity/stop, only needed if different from the settings in LoRaWEB.

Allowed values: 8-n-1, 8-n-2, 8-e-1, 8- o -1 for none, even or odd

**Examples:**

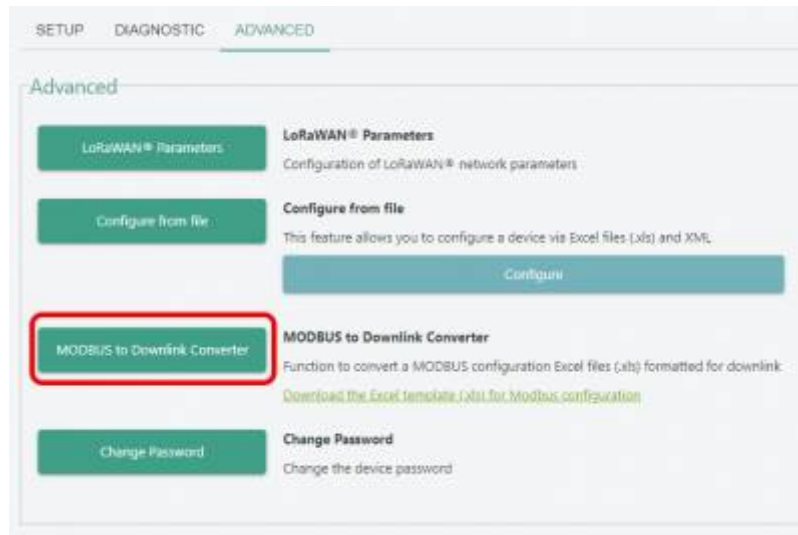
reading a 2 byte holding register, starting from address 10001 of slave 1

| Label        | Modbus address | Modbus function | Dec address | Modbus length | Data | Baudrate (bps) | Parity/stop |
|--------------|----------------|-----------------|-------------|---------------|------|----------------|-------------|
| Input status | 1              | 3               | 10001       | 1             |      |                |             |

writing a 2 byte holding register (with value 1000h), starting from address 53 of slave 2:

| Label           | Modbus address | Modbus function | Dec address | Modbus length | Data | Baudrate (bps) | Parity/stop |
|-----------------|----------------|-----------------|-------------|---------------|------|----------------|-------------|
| Analog output 1 | 2              | 6               | 53          | 1             | 1000 |                |             |

#### 4.2.4 Configuration with downlinks



### MODBUS to Downlink converter:

convert the .XLS configuration file in one or more downlink payload to be sent to the device instead using USB port-.



### Temporary Downlink:

the configuration file is executed and then discarded.

### Configuration Downlink:

the configuration file is saved in memory and executed periodically.

## 4.3 Other settings

### Delay for reading [ms]:

delay added between the reading of one Modbus register and the one (default = 0).

### DST:

set to change DST (default: none).

### Time sync uplink:

set to disable time synchronization request (default: enabled).



Normally sensor asks for a time sync at every power on (uplink starting with 01) or once a week. If no or wrong reply received, it will retry after 1 week.

If not handled in the right way can generate unnecessary traffic on the network.

Please check chapter 2.1 [DATA FRAME FORMAT](#).

### Confirmed Uplinks:

set for unconfirmed uplinks (default: confirmed uplink).

### Single join/day:

set for to allow only one join per day (default: multiple join allowed).

### LED working:

Set OFF to turn off the diagnostic led.

### USB:

Internal use.

## 5. Diagnostic

Setup | Download | Resources | Info | Request offer

Change language | Access your private area

Help | LoRaBridge Port: 8100 | COM Port: COM3 - mcF88 USB VCom | Password 1 | Password 2 | Read | Load File | Save File

**Attention** Password for device's access are unchanged, a change is recommended. [CLICK HERE to change them now](#)

SETUP | **DIAGNOSTIC** | ADVANCED

Check

Status: OK  
Report: A2

Press **Check** to verify the correct communication between the LoRaWAN® interface and the slave(s).

## 6 LoRaWAN network

The sensor is compliant with LoRaWAN® **specification 1.0.2, regional 1.0.2b**.

## LoRaWAN® Parameters



LoRaWAN®

|  |                      |
|--|----------------------|
| Network Key                                      | App Key              |
| <input type="text"/>                             | <input type="text"/> |
| Device Address                                   |                      |
| <input type="text"/>                             |                      |
| AppEUI   | DevEUI               |
| <input type="text"/>                             | <input type="text"/> |
| LoRa Band  |                      |
| <input type="text" value="EU 868 MHz - Europe"/> |                      |

LoRaWAN® Activation

NONE  OTAA MCF88  OTAA ENGINKO  OTAA  ABP

Network settings

Any  Objenious

Network type

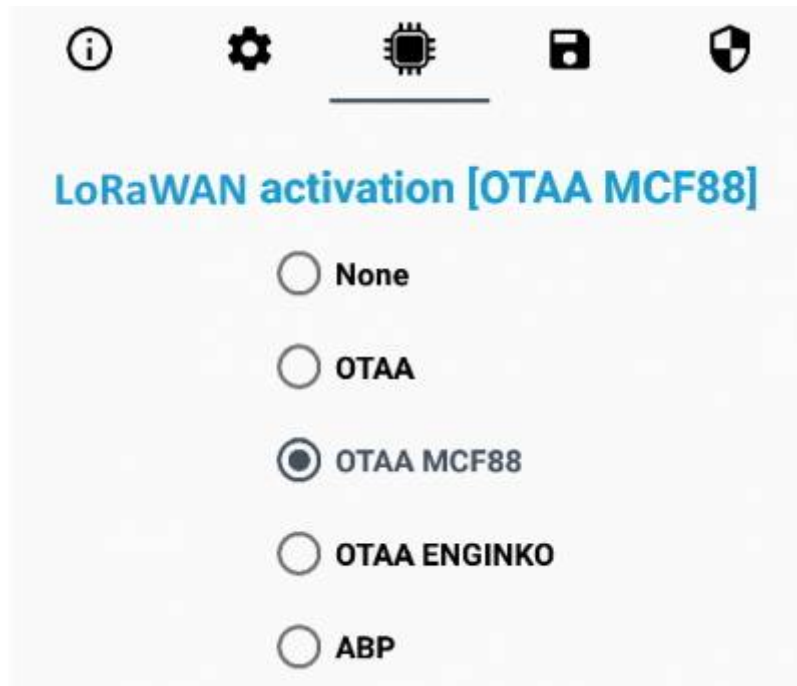
Public Network  Private Network

## 6.1 Activation

The device supports the following activations on a LoRaWAN® network:

1. **NONE**: sensor not activated
2. **OTAA**: the JoinEUI and the AppKey not setted, must be written to the device;
3. **OTAA MCF88**: Over the air activation, fixed keys: JoinEUI = 904e915000000002, AppKey on request;
4. **OTAA ENGINKO**: Over the air activation, fixed keys: JoinEUI = 904e915000000002, AppKey on request;
5. **ABP**: requires writing to the device of NwkSkey, AppSkey, DevAddr.





The device exits factory activated with **NONE** mode. On request devices can be shipped already activated.

Note: in **OTAA** AppKey is write only, in reading the field will always be empty, even if set.

## 6.2 Other settings

### Network settings:

please keep "Any" settings. Change it only if Objenious network is used (default\_ any).

### Network type:

LoRa syncword can be setted as "private"(0x12) instead "public" (0x34), but the NS must be setted accordingly (default: public).

### Band:

select the right LoRaWAN ® band settings accodingly to country requirements.

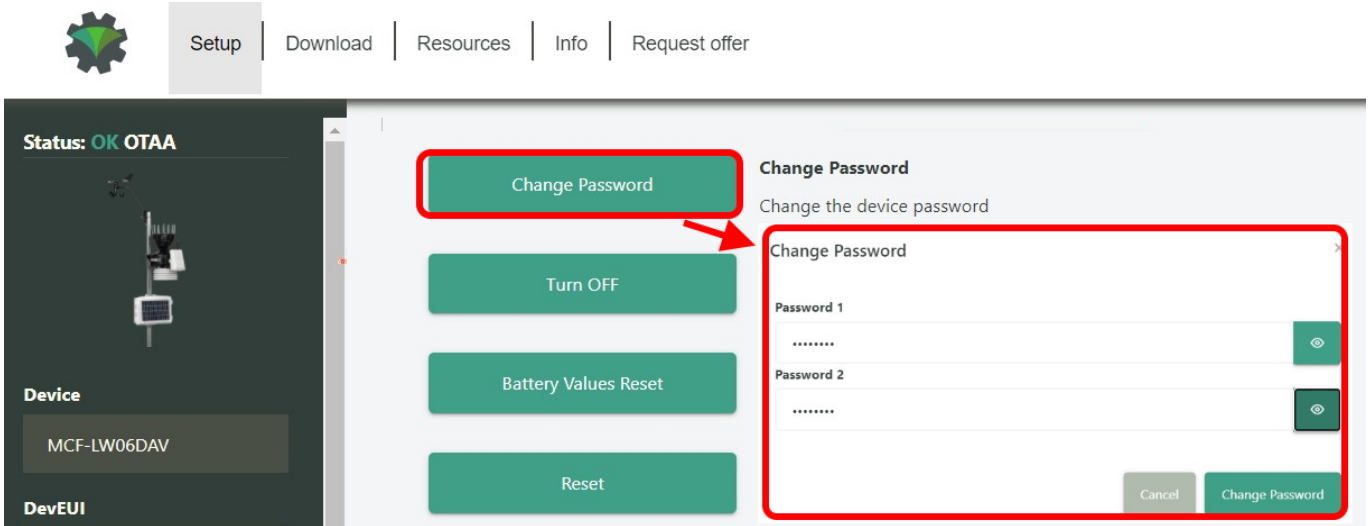
## 7 Passwords

The device can be protected by passwords, to avoid unauthorized persons to read data or modify parameters.

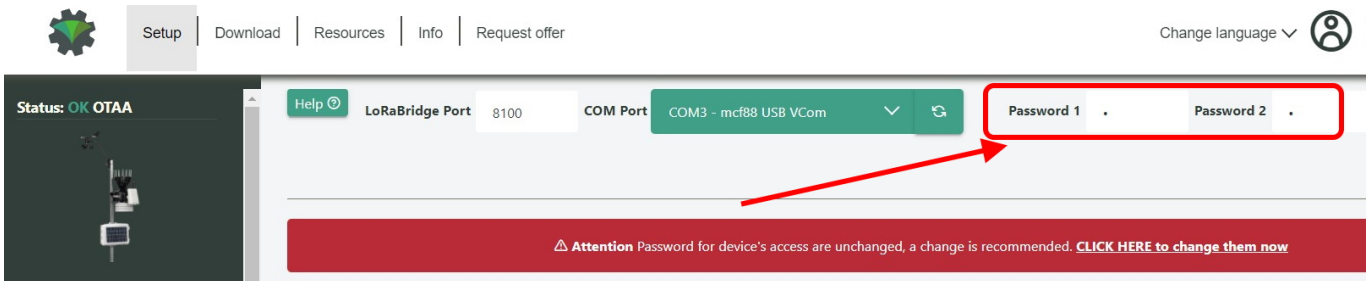
As default passwords are equal to 0.

Allowed values range from 0 to 999999999 (only numbers).

To change the passwords, set the new values with LoRaWEB:



Once the passwords are setted, to gain access from LoRaWEB to the sensor, set the right values before reading from the device:

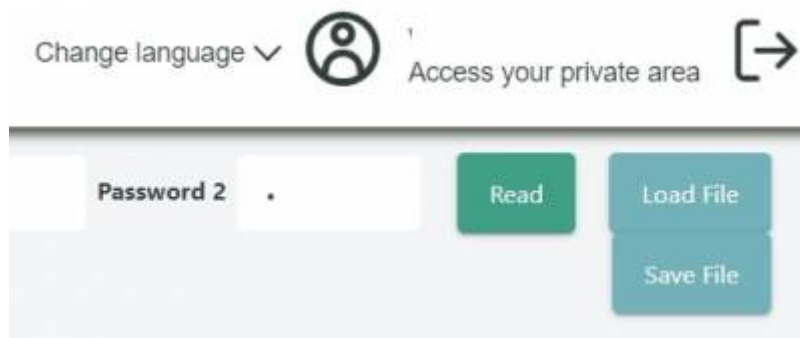


To bring back the sensor to factory default and reset the passwords, a reset code must be requested to enginko (please provide the DevEUI of the sensor when you ask for that code).

## 8 General configuration file

With LoRaWEB is possible to configure the device using an XML file, instead to manually adjust the parameters (for details about the file format please ask to enginko). This is very useful especially in case of multiple devices configuration.

With "Save" button an XML file with the actual configuration of the sensor will be generated. This is useful to store or clone the configuration, or to send it to enginko's support if needed.





## 9 Payload

For payload descriptions, uplinks and downlinks format and available commands please refer to this document:

[DATA FRAME FORMAT](#)

## 10 Ordering code

| Code           | Description                                      |
|----------------|--|
| MCF-LW06485    | ModBus RTU RS485 to LoRaWAN® interface EU863-870 |
| MCF-LW06485-AS | ModBus RTU RS485 to LoRaWAN® interface AS920-925 |
| MCF-LW06485-US | ModBus RTU RS485 to LoRaWAN® interface US902-928 |
| MCF-LW06485-AU | ModBus RTU RS485 to LoRaWAN® interface AU915-928 |

For payload descriptions, uplinks and downlinks format and available commands please refer to this document:

[DATA FRAME FORMAT](#)

## 11 Modbus overview

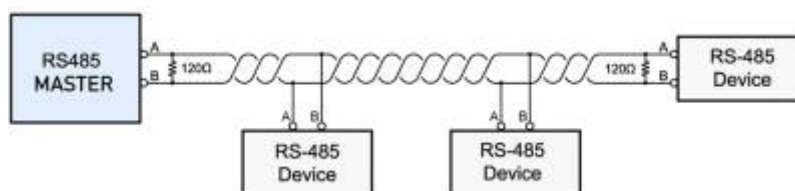
### 11.1 Modbus RTU basics

Modbus RTU is based on an RS485 bus: TIA/EIA-485 (RS-485) is a single differential balanced line (half duplex).

- It provides a robust communication interface which is inherently noise tolerant since it uses differential as opposed to ground referenced signals.
- It can be cheaply deployed & the cabling is simple, a single pair of wires plus a ground wire.
- Up to 32 devices can be daisy-chained together in a network.

### 11.2 Modbus RTU basics: termination resistors

In order to avoid signal reflections, a 120 Ohm termination resistance must be fitted on each end of the main cable:



If the data rate is low or cables are short, termination may be unnecessary. As data rates and/or cable

lengths increase, which is most cases, termination becomes mandatory. If the total length of the main cable is less than 50m termination resistances can be avoided at the ends of the main cable.

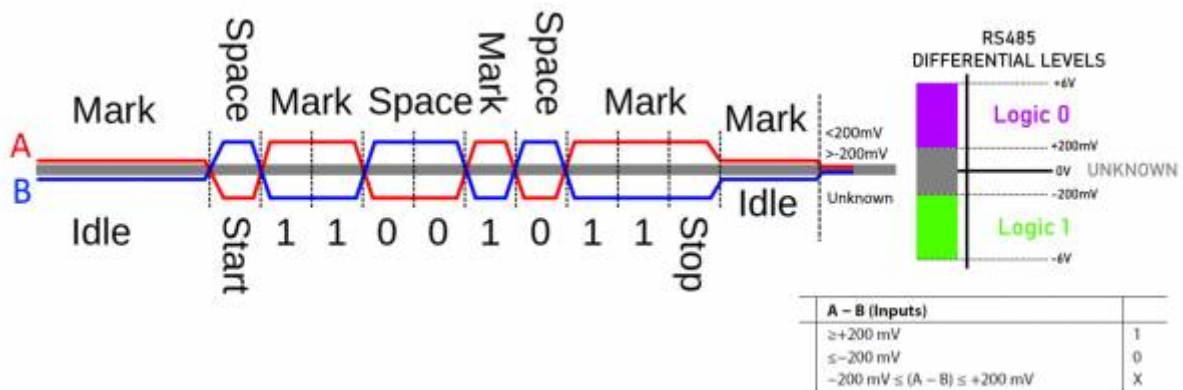
Note: Since is a differential line, the cable to be used is a shielded twisted pair.



The cable shield must be earthed only in one point. Normally, this connection is made at one end of the main cable.

### 11.3 Modbus RTU basics: bias resistors

With RS485 networks, there are periods of time when no driver is actively driving the bus (tri-state) And the termination resistors collapse the differential bus voltage to 0V, which is an undefined input level for many RS485 receivers.



The objective of biasing is to make sure that the RS485 line remains in a known, non-fluctuating state when no devices are transmitting. Polarization of the pair must be implemented at one location for the whole serial bus. Biasing the entire network requires a single pair of polarization resistors: a pull-up resistor to +5V attached to the "+" signal line, and a pull-down resistor to ground attached to the "-" signal line.

### 11.4 Modbus RTU basics: data format

The format for each byte ( 11 bits ) in RTU mode is :

- 1 start bit
- 8 data bits ( least significant bit sent first)
- 1 bit for parity completion
- 1 stop bit

With Parity Checking

|       |   |   |   |   |   |   |   |   |     |      |
|-------|---|---|---|---|---|---|---|---|-----|------|
| Start | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Par | Stop |
|-------|---|---|---|---|---|---|---|---|-----|------|

Without Parity Checking

|       |   |   |   |   |   |   |   |   |      |      |
|-------|---|---|---|---|---|---|---|---|------|------|
| Start | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Stop | Stop |
|-------|---|---|---|---|---|---|---|---|------|------|

Even parity is required, other modes ( odd parity, no parity ) may also be used. In order to ensure a maximum compatibility with other products, it is recommended to support also No parity mode. The default parity mode must be even parity. Remark: the use of no parity requires 2 stop bits.

**11.5 Modbus RTU basics: registers addressing**

Modbus registers by definition are associated with a function, and an offset within that function. The two common (16-bit) data register types are commonly known as “Holding Registers” and “Input Registers” (function 03 and function 04 respectively). The specific register within the function is referenced by an offset (starting at 0). This is the actual data which is transmitted during the data query.

At some point, certain PLC manufacturers starting using a “3xxxx” or “4xxxx” reference designation in an attempt to provide an absolute address to the register (ie: which would reference both the function and the register). Some device manufacturers start their “4xxxx” references at 40001, and some start at 40000. The starting register corresponds to offset “0” within the given function.

| Modbus “Standard”    | 4xxxx (base 1) | 4xxxx (base 0) |
|----------------------|----------------|----------------|
| Function 3, Offset 0 | 40001          | 40000          |
| Function 3, Offset 1 | 40002          | 40001          |

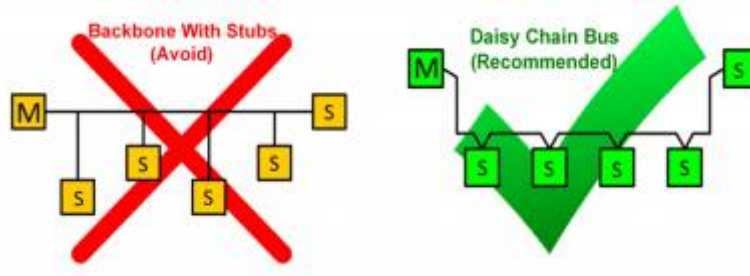
**11.6 Modbus RTU addressing**

The types of registers referenced in Modbus devices include the following:

- Coil (Discrete Output)
- Discrete Input (or Status Input)
- Input Register
- Holding Register







- Double check the addressing of the registers (standard, absolute, offset base 1, offset base 0...)

## 12 Declaration of conformity

Hereby, enginko Srl declares that MCF-LW06485 complies with the essential requirements and other relevant provisions of Directive 2014/53/EU.

## 13 FCC compliance for MCF-LW06485-US

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

**Contains FCC ID: 2AWAL409810**

## 14 Contacts

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E : info@enginko.com

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