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EQUOBOX SIN.EQLC250 M-Bus Level Converter Adapter/Repeater

User Guide

Rev 1.0

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1. M-BUS OVERVIEW

1.1 DESCRIPTION of the M-Bus System

The M-Bus (Meter Bus) system is a communication protocol compliant with the EN13757-2 standard. The M-Bus System provides the following advantages:

- High level of data transmission security
- Low wiring costs
- Long distances without requiring repeaters
- Large number of central units
- Detection of both battery-powered and mains-powered devices
- Automatic device recognition
- Vast array of systems and components available
- Different types of bus topology: linear, star, and tree

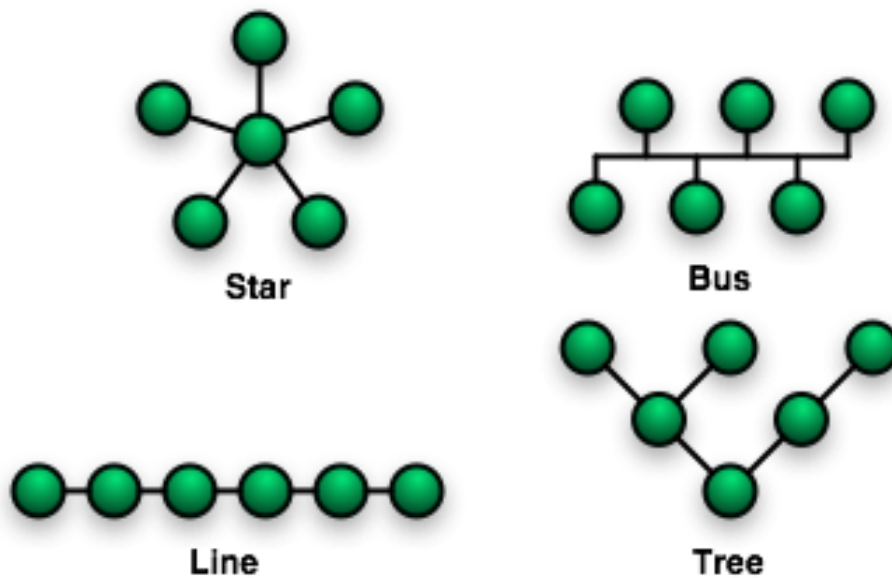


Figure 1 - Bus topologies

1.2 Addressing

The M-Bus uses two types of addressing modes to detect the devices:

- Primary address: up to 250 primary addresses can be allocated within an M-Bus plant. The primary address is normally allocated while setting up the central units.
- Secondary address: the secondary address consists of 8 bytes and allows the allocation of any number. By default, the secondary address of the devices is the same as the manufacturer serial number. This type of allocation prevents bus conflicts.

1.3 Sizing the M-Bus System

Cable type

- Shielded telephone cable 0.5mm²
- Cable maximum capacitive load: 152 nF/km

If you are using a cable with lower section, adapt the maximum length and the number of slaves

Follow the instructions provided in the table to size the M-Bus system

Type of plant	Maximum distance	Overall cable length	Cross-section	Number of devices (slaves)	Max. transmission rate
Small residential buildings	350 m	1000 m	0.8 mm ²	250	9600 Baud
Large residential buildings	350 m	4000 m	0.8 mm ²	250	2400 Baud
				64	9600 Baud
Small complex	1000 m	4000 m	0.8 mm ²	64	2400 Baud
Large developments	...3000 m*	5000 m	1.5 mm ²	64	2400 Baud
Direct vicinity	...5000 m*	7000 m	1.5 mm ²	16	300 Baud
Point-to-point connection	...10000 m*	10000 m	1.5 mm ²	1	300 Baud

*Shielded cabling required at a distance in excess of 1000 m (see EN13757-2).

1.4 BUS signal specifications

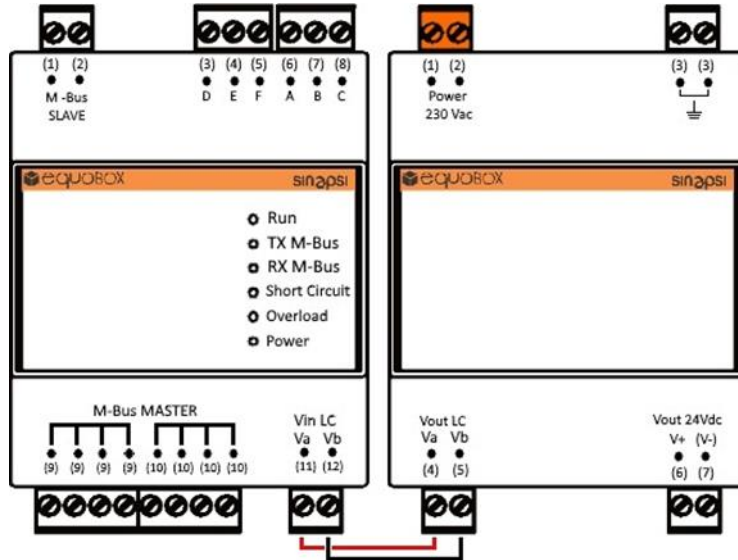
M-Bus system	u.m.	Condition	Minimum	Typical	Maximum	Unit of measurement
Number of devices per segment	n	SIN.EQLC250	0		250	
Transmission rate	T	$C_{segment} \leq 382nF$	300	2400	9600	Bd
Bus Voltage (Master)	U_M	$I_M=0...400mA$	30	39	42	V
Bus Voltage (slave)	$U_{S,R}$	$I_S \leq 1.5mA$	30		42	V
Bus current (Master)	$I_{M,V}$	SIN.EQLC250	0		375	mA
Current (slave)	$I_{S,R}$	$U_S=30...42V$	0.75	1.2	1.5	mA

2. SIN.EQLC250 INSTALLATION

2.1 Description of the SIN.EQLC250

SIN.EQLC250 is a unit that reads M-Bus devices in compliance with the EN 13757-2 standard.

The level converter/repeater SIN.EQLC250 is the interface between M-Bus device and a read system. It consists of a level converter and the associated power supply. In fact, the level converter and associated power supply form a unit: no addition transformer or auxiliary power required.



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The SIN.EQLC250 unit can be used in different ways:

- Connect up to 250 M-Bus devices (max. 250 simply M-Bus loads (*))
- Can be connected with the M-Bus web server of Equobox family (SIN.EQRTUEVO1T, SIN.EQRTU1, SIN.EQRTU1T, SIN.EQRTU1X, SIN.EQRTU4), PXC devices, other M-Bus read / configuration systems
- Up to 6 level converters connected in parallel on an M-Bus network
- Up to 5 level converters as repeater (in series) on an M-Bus network
- Via RS-232 or RS-485 interfaces to read device data via the PXC device or a PC (level converter)
- Remote reading of M-Bus devices via M-Bus web server SIN.EQRTUEVO1T (Cloud).

* A unit M-Bus load is $\leq 1,5\text{mA}$

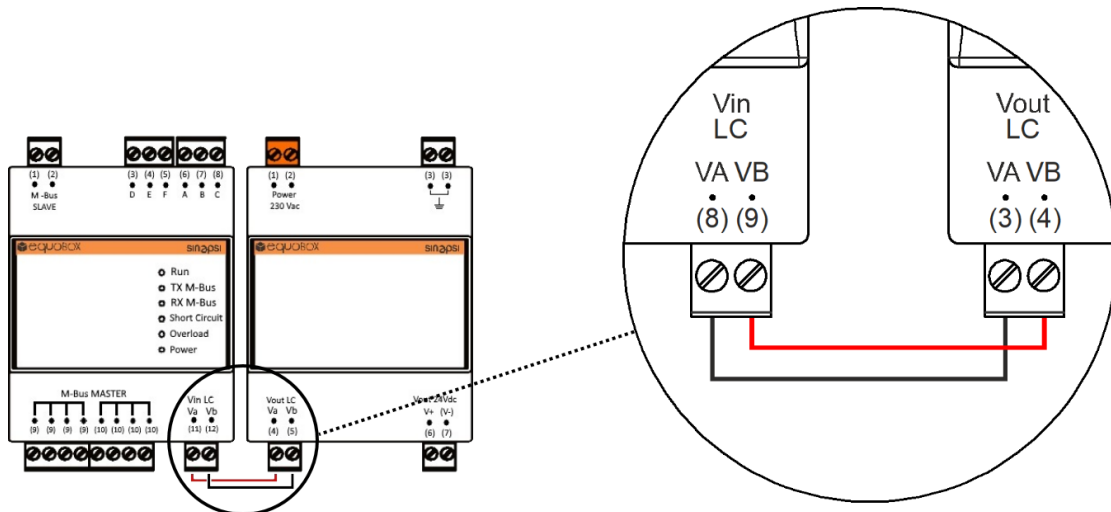
NOTE: You can use the level converter at your own risk as an interface as well to suitable software and devices by third-party manufacturers.

NOTE: The level converter is galvanically isolated. It protects against short circuits.

2.2 Operating modes of power supply

The power supply can be employed as follows:

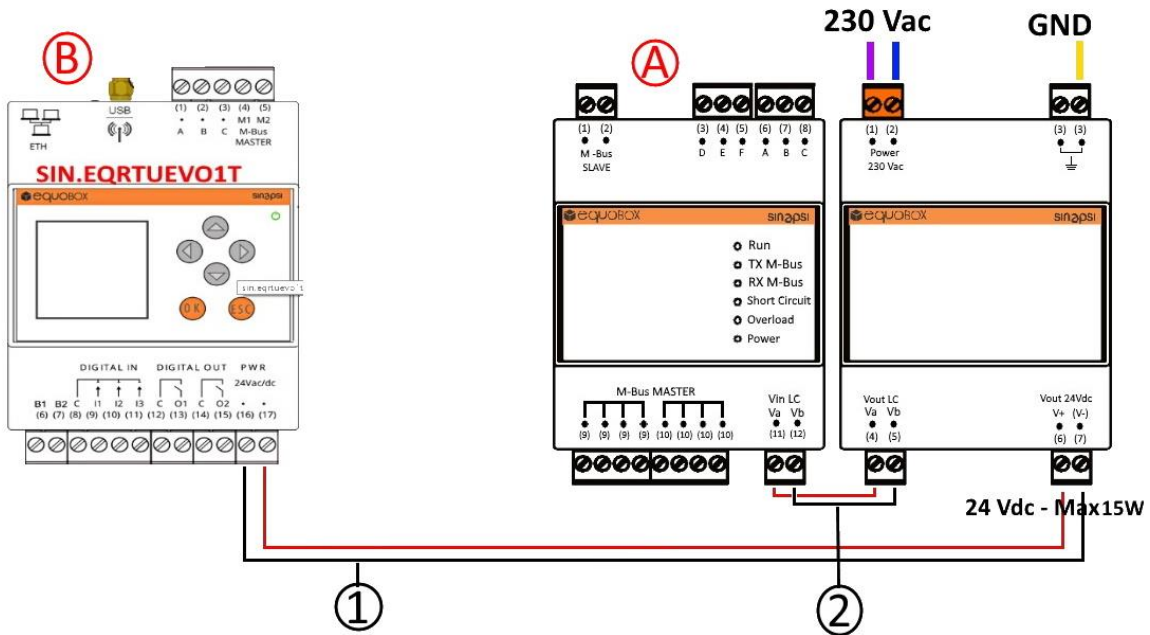
- To power the level converter



1 Level converter / repeater

2 Power supply

- To power the M-Bus web server SIN.EQRTUxxx (*). In the example below there is the datalogger SIN.EQRTUEVO1T.



A Web server SIN.EQRTUxxx.

B Level converter/repeater SIN.EQLC250

1 Connection web server SIN.EQRTUxxx with auxiliary power supply (24Vdc) of SIN.EQLC250

2 Connection level converter/repeater with power supply

* SIN.EQRTUxxx: SIN.EQRTU1, SIN.EQRTU4, SIN.EQRTU1T, SIN.EQRTU1X, SIN.EQRTUEVO1T

2.3 Connection terminals

SIN.EQLC250 looks like a device for mounting on DIN rail. The connectors/LEDs present are listed below:

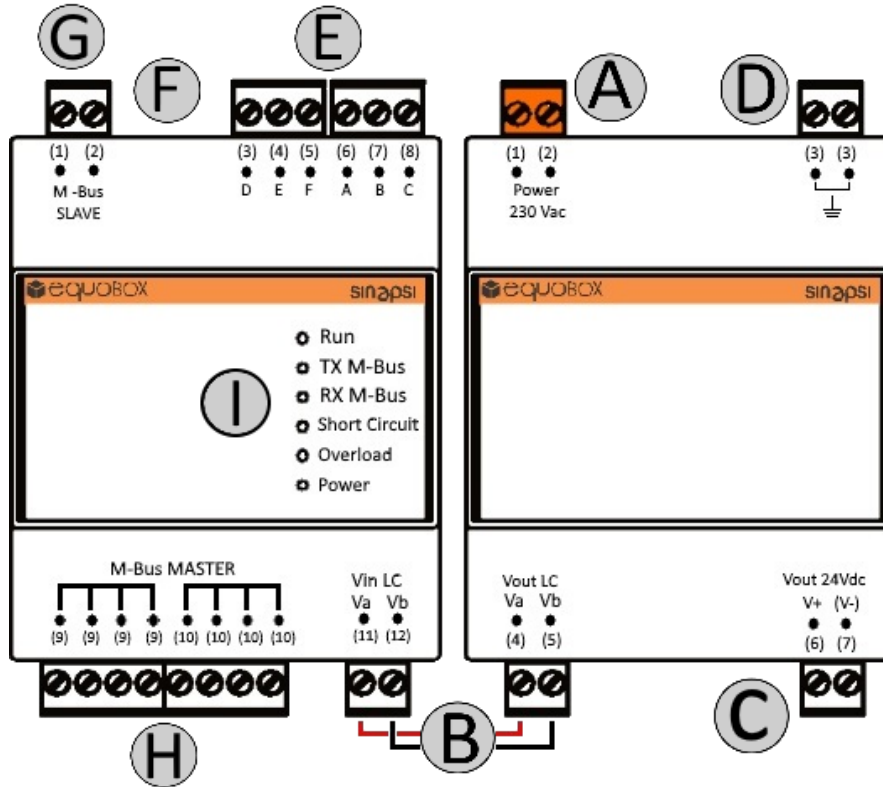


Figure 2 – Features and connectors Level Converter (SIN.EQLC250)

A	Main voltage AC 230 V	B	Power supply for level converter
	(1) – Pin 1 for main power – 230 Vac (2) – Pin 2 for main power – 230 Vac		(4) – power supply = (11) level converter (5) – power supply = (12) level converter
C	Power out 24Vdc for web server (15W)	D	Electrical grounding
	(6) - Pin V+ Output for datalogger (7) - Pin V- Output for datalogger		(3) - Earth
E	Serial interface	F	Firmware update button
	Serial interface RS232 and RS485 to connect to a PC or M-Bus master. RS-232: A = TX, B = RX, C = GND RS-485: D = REF, E = D-, F = D+		Push button for reset and firmware update
G	M-Bus Slave	H	M-BUS Master interface
	(1) – Pin 1 for M-Bus network to extend (Repeater mode) (2) – Pin 2 for M-Bus network to extend (Repeater mode)		(9) – Pin 1 for connection M-Bus devices (Master mode) (10) – Pin 2 for connection M-Bus devices (Master mode)
I	Status LED		
	Ref. Chap 2.6		

2.4 Topology and connection of the M-Bus network

M-Bus technology allows good freedom of choice regarding network topology. It is possible to connect the devices present in the plant according to a star, linear, tree topology or mixed as seen in 3 and 4. However, ring topology (Figure 5 – Ring topology NOT ALLOWED) is not allowed. It is also **not necessary to observe any polarity of the bus**, thus simplifying installation.

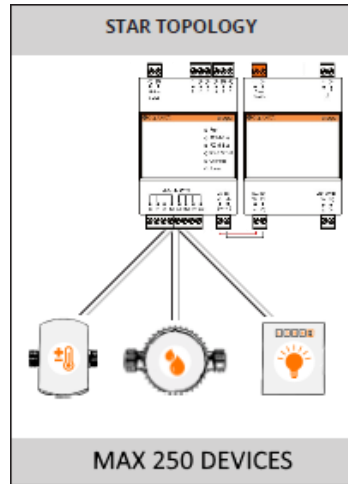


Figure 3 – Star Topology

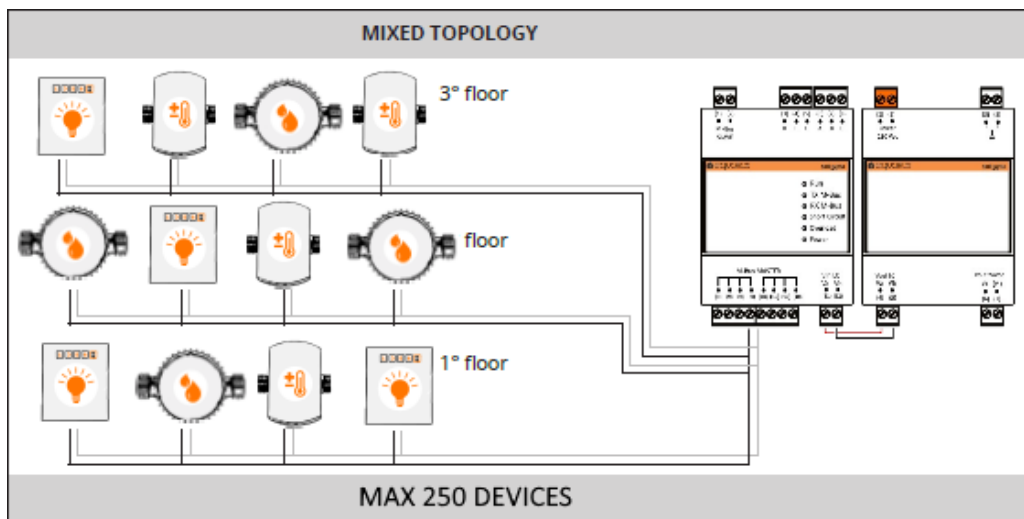


Figure 4 – Mixed Topology

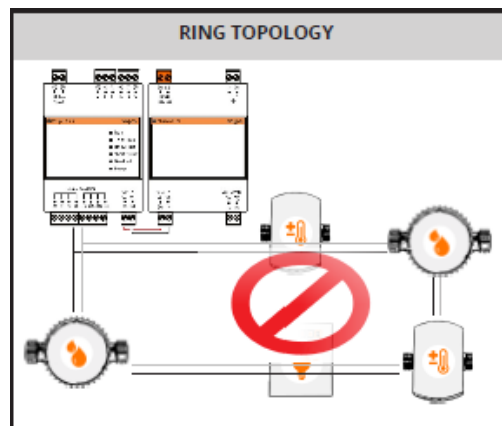


Figure 5 – Ring topology NOT ALLOWED

2.5 SIN.EQLC250 operation modes

SIN.EQLC250 can be used with M-Bus communication interface for SIN.EQRTUxxx datalogger (Figure 6) or with a PC with EQUOBOX TOOLKIT software (SIN.EQSW1) (Figure 7) or as a repeater/extender of an M-Bus network (Figure 8). The following figures show the connection diagrams for the different operation modes.

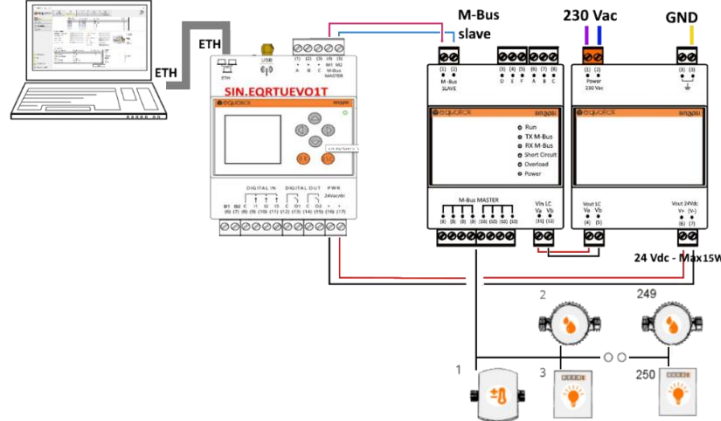


Figure 6 – M-Bus communication interface for SIN.EQRTUxxx datalogger

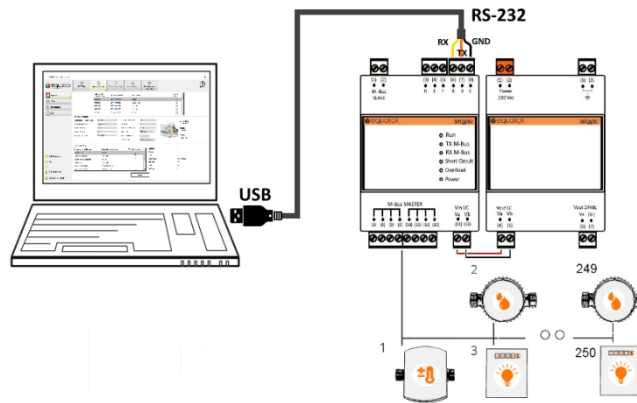


Figure 7 – Connection a PC with EQUOBOX TOOLKIT software (SIN.EQSW1)

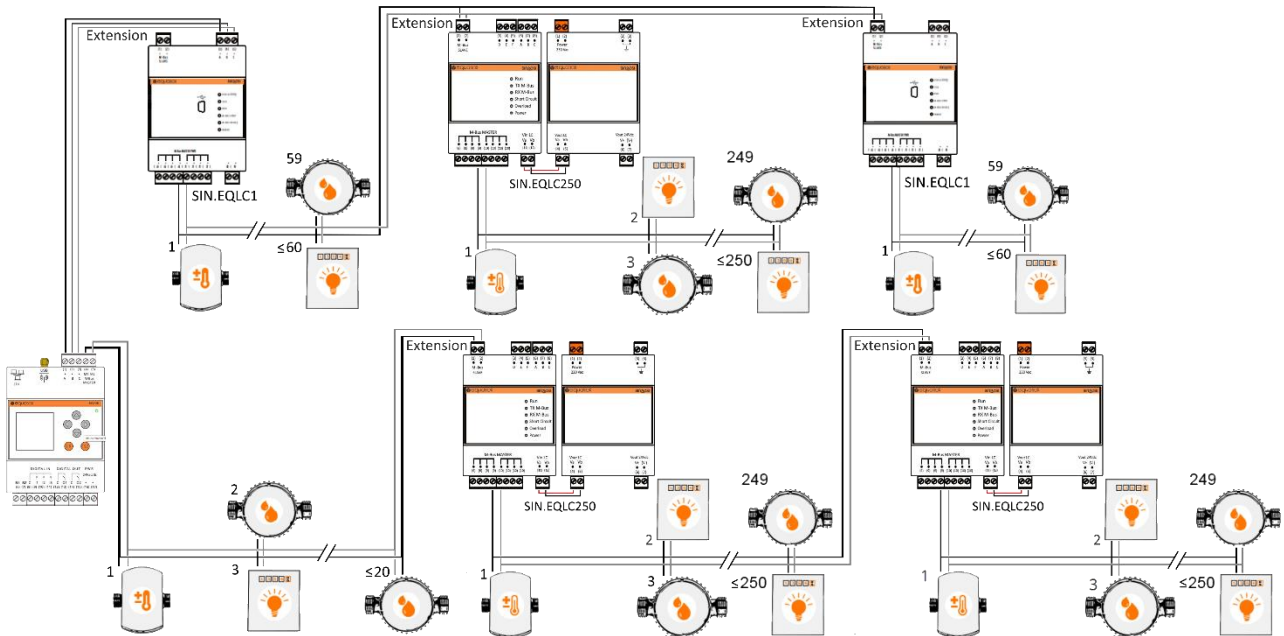


Figure 8 – Repeater/extender of an M-Bus network

2.6 Status LED

There are 6 LEDs present on the SIN.EQLC250 device, which indicate the operating status as shown in the figure:

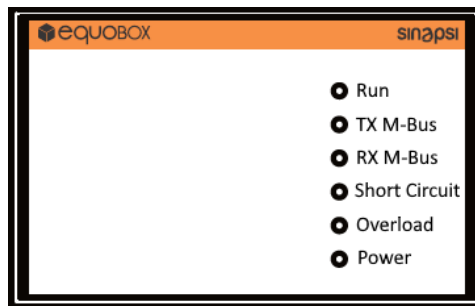


Figure 9 - Status indicators

Run

The (green) LED indicates the operational state of the device.

- Blinking at 1 Hz (slow) -> Device functions are being set up. No communication.
- Blinking at 10 Hz (fast) -> Device update pending.
- On -> The device is operational.

TX M-Bus

The (green) LED indicates the transmission state on the M-Bus network (terminals 9 and 10).

- On -> Data is transmitting.
- Off -> No data is transmitting.

RX M-Bus

The (orange) LED indicates the receive state of data on the M-Bus network (terminals 9 and 10).

- On -> Data is being received.
- Off -> No data is being received.

Short Circuit

The (red) LED indicates a short circuit on the bus, very high traffic, or a collision.

Overload

The (orange) LED indicates a bus overload that may prevent correct operation.

- On -> Bus overload that detected.
- Off -> No bus overload detected.

Power

The (green) LED indicates the state of the level converter power supply.

- On -> The device power supply is correct.
- Off -> Device power is not correct or unavailable.

2.7 Short circuit protection

During normal operation of the level converter, if a data collision occurs during communication with the meters on the "M-Bus Master" bus, the "Short Circuit" LED may turn on.

In the case instead of a real c.c. (short circuit) in the absence of communication, the "M-Bus Master" bus is disconnected ($\Delta V_{M-Bus} = 0$) for a time equal to:

- 5 seconds to the first short circuit detected.
- 60 seconds per second consecutive short circuit detected.
- 5 minutes to the third consecutive short circuit.
- 24 hours from the fourth attempt onwards until the short circuit situation is resolved.

NOTE: If the conflict causing the short circuit signal is resolved during the power suspension on the "M-Bus Master" bus, the level converter will continue to keep the bus de-energized until the expected reset or until the device restarts or it feeds itself manually.

2.8 Firmware update

Through the EQUOBOX TOOLKIT Lite software (SIN.EQSW1) from version 2.0.15, it is possible to update the version of firmware in SIN.EQLC250 if it is necessary (*).

- Enter the default credentials:
 - User: **admin**
 - Password: **admin**
- Select the **Settings** menu (1)
- Select the **M-Bus interface** tab (2)
- If unchecked, check the **Serial Interface (UART)**
- Select the COM port where the device is connected
- **Connect** to the device (3)
- In the **Firmware Level Converter 250 (SIN.EQLC250)** section:
 - Select the firmware version to be installed.
 - Press the button: **Update Firmware** (4)
 - Follow the software step by step instructions:



Figure 10 – Login to "Equobox Toolkit Lite"

- Disconnect the SIN.EQLC250 power supply without disconnecting the USB / RS232 cable.
- Power the device and after 2 seconds press and hold the 'PROG' button (F in fig. 2) until the update process starts

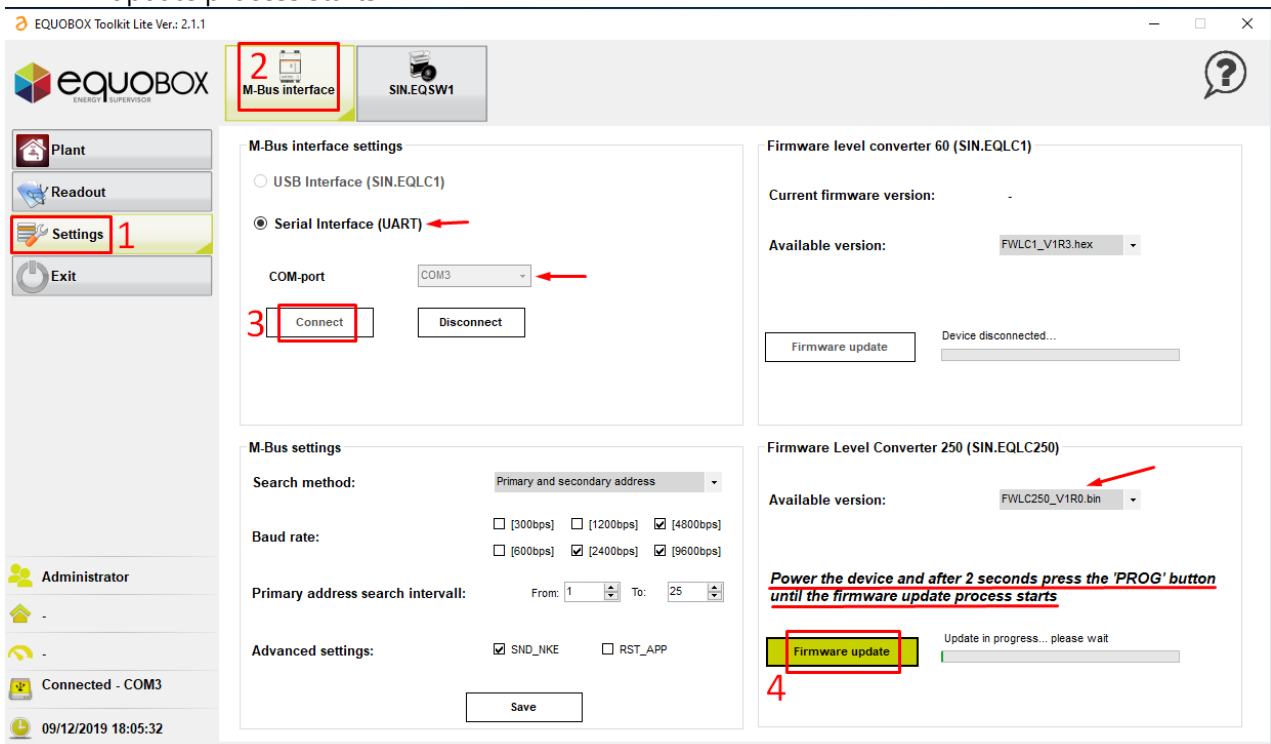


Figure 11 – Firmware update of SIN.EQLC250

* It is not possible to check the firmware version currently installed in SIN.EQLC250



3. Troubleshooting

1) The device does not turn on (Power LED off)

- Check with multimeter that the supply voltage to the terminals (11) and (12) is ≈ 40 V.

2) LED Overload on:

- If the LED is on without any communication (RX and TX LEDs do not blink), there is an overload caused by a possible short-circuits between the two poles of the bus or from an excessive number of connected devices. Check the wiring.

3) The datalogger connected to the terminal does not detect some or all devices:

- Check the correct bus connection between the datalogger and terminal G of the SIN.EQLC250
- Check with the multimeter that the voltage on devices not recognized is between 32Vdc-42Vdc
- Verify that the communication settings of the M-Bus datalogger or the SW are compatible with the devices (speed of communication, addressing)

4) The devices connected to the level converter in repeater mode do not communicate:

- Check the correct power supply
- Check the Run LED is on
- Check that the Short Circuit LED is off
- Check that the M-Bus network is connected to the G terminal of the SIN.EQLC250
- Check the correct voltage in terminals G and H of the repeater which must be between 32 Vdc - 42 Vdc

4. Technical features

POWER SUPPLY

Rated Voltage	AC 110...240 V
AC frequency	47...63 Hz
M-Bus Slave port absorption (in series)	≤ 3 mA (2 M-Bus Loads)
Rated Power	6W + 0.07 W for each connected M-Bus slave
Maximum consumption	45W, 45VA
Internal fuse	Vout: DC 24 V, max. 15 VA PTC resistance and varistor
Fusing of supply lines	Circuit breaker: Max 13 A, type B, C, D per EN 60898 or Power supply with current limitation at 10 A

CONNECTIONS

M-Bus Slave (terminals 1 and 2):	Connections as a repeater / extender
M-Bus Master (terminals 9 and 10):	Connection to the M-Bus meters
Vout LC (terminals 4 and 5 on power supply) /	Power supply for level converter/repeater
Vin LC (terminals 11 and 12 on level converter)	40 Vdc
Vout 24 Vdc (terminals 6 and 7 on power supply)	DC 24 V, max 15 VA

INTERFACE

RS-232 (terminals A, B and C)	Connections as master to PC (using SIN.EQUSB232) or to data logger Connect to a PC: <ul style="list-style-type: none"> – Terminal A: RX (PC/data logger receiving line) – Terminal B: TX (PC/data logger transmission line) – Terminal C: GND (interface reference voltage) Connection for the M-Bus web server SIN.EQ: <ul style="list-style-type: none"> – Terminal 6[A] RS-232 with terminal 1[A] web server – Terminal 7[B] RS-232 with terminal 2[B] web server – Terminal 8[C] RS-232 with terminal 3[C] web server
RS-485 (terminals D, E and F)	Connection to connect to a PC or M-Bus devices Connections to connect to PC/data logger as master: <ul style="list-style-type: none"> – Terminal D: REF (interface reference voltage) – Terminal E: D- (Receive/transmission line potential -) – Terminal F: D+ (Receive/transmission line potential +)

M-BUS SECTION

Reference standard	EN13757-2 (Physical Layer)
Max. number of M-Bus devices (loads)	250 (≤1,5 mA)
Max. number of devices that can be connected in cascade mode	6 level converters, of which 5 repeaters
Transmission speed (baud rate)	Minimum: 300bps Typical: 2400bps Maximum: 9600bps
M-Bus Master voltage	42V – 32V
Bus current	Maximum 395 mA
Short circuit protection	Yes
Galvanic isolation	- RS-232 interface - M-Bus interface

DIRECTIVES AND STANDARDS

Product standards	EN 62368-1 Information Technology Equipment Safety
Electromagnetic compatibility	For residential and industrial environments
EU conformity (CE)	MOD 07 AA Rev.0

ENVIRONMENTAL COMPATIBILITY

The product environmental declaration MOD 07 AA Rev.0 contains data on environmentally compatible product design and assessments (RoHS compliance).

DEGREE OF PROTECTION

IP class	IP20 per EN60529
Protection class	II as per EN 62368-1

AMBIENT CONDITIONS

Storage	as per EN 60721-3-1:	
	Climatic conditions:	Class 1K3
	Temperature:	-25...+65 °C
	Air humidity:	5... 95% r.h.
Transportation	as per EN 60721-3-3:	
	Climatic conditions:	Class 2K3
	Temperature:	-20...+65 °C
	Air humidity:	5... 95% r.h.
Operation	as per EN 60721-3-3:	
	Climatic conditions:	Class 3K5
	Temperature:	-20...+55 °C
	Air humidity:	5... 95% r.h.
	as per EN 60721-3-3:	
	Climatic conditions:	Class 3M2
	Temperature:	-20...+55 °C
	Air humidity:	5... 95% r.h.

MECHANICAL FEATURES

Dimensions (HxLxD)	110x71x62 mm (including terminals)
Installation type	35mm DIN rails (EN60715)
Materials and colours	Housing. PC + ASA, RAL 9010 (white)
Weight (level converter with mounting instructions)	0.392 kg for both devices
Packaging	0.055 kg