Manual

Activation Modbus TCP/IP protocol
for Compleo eBOXes professional and touch

Version 2.0
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1.   Introduction

This document describes the implementation of the Modbus functionality for the eBOXes professional and touch.

The Modbus TCP/IP protocol allows communication between several devices in a local network. In general, a distinction is made between the roles of a Node (also slave or client) and Controller (also master or server). The Controller initiates the connection to a Node and sends requests (read/write) to certain parameters (Modbus register).

This manual covers the configuration of the eBOX as a Node and the set-up of a connection to any energy management system via the Modbus TCP/IP protocol.

One possible application is so-called smart charging, for example local load management. This refers to the targeted control of energy consumption. The term is often used in the context of electromobility and means here the ability of charging stations to draw power only when the capacity in the power grid is sufficient. In addition to balancing the grid voltage, this solution can significantly improve the efficiency of charging operations at charging parks. The basic functions include:

- Monitoring of network utilization and avoidance of load peaks.
- Provide a minimum power for each vehicle.

The Modbus protocol thus allows the loading speed to be actively adjusted if required.

The technical implementation of Modbus TCP/IP is available from firmware 1.3.0 for the eBOXes professional and touch.

These instructions are intended to show in detail the configuration, the necessary preconditions and the possibilities of the Modbus TCP/IP protocol with the eBOX.

Preparations:

- Please make sure that the eBOX is correctly assembled and wired. You will find a detailed setup description in the operating manual that you received with your eBOX.

- To connect to the WebConfig of the eBOX, you need a working laptop and a LAN cable. Make sure that the PUK of the respective eBOX is available in order to gain access to the web interface.

- Make sure that you have installed the latest, at least firmware version 1.3.0 on the eBOX.

- For further details on the configuration of the eBOX, please refer to the "WebConfig documentation".

Network requirements:

- External energy management system (controller) with static IP assignment.

- LAN connection (Ethernet) of the eBOX to the controller.

- IP addresses must comply with the IPv4 protocol.

- Access to the local network and the web interface for configuring the charging station

2.   General

The Modbus TCP/IP functionality can be activated and configured via the web interface of the eBOX.

For the configuration of the protocol, the eBOX must be running with firmware version 1.3.0 at least.

The setup and wiring of the eBOX as well as the correct setup of the network and the charging station is an important part of the entire installation. The following sections describe how to configure the individual components.

2.1   Structure and wiring

The starting point of the setup is the correct cabling of the eBOX to enable communication between the Controller and Node.

The operation of the eBOX in an energy management system (EMS) requires a wired connection (LAN).

The charging point is connected to the Controller via port 2a (LAN2) to enable control of the eBOX via Modbus TCP/IP.
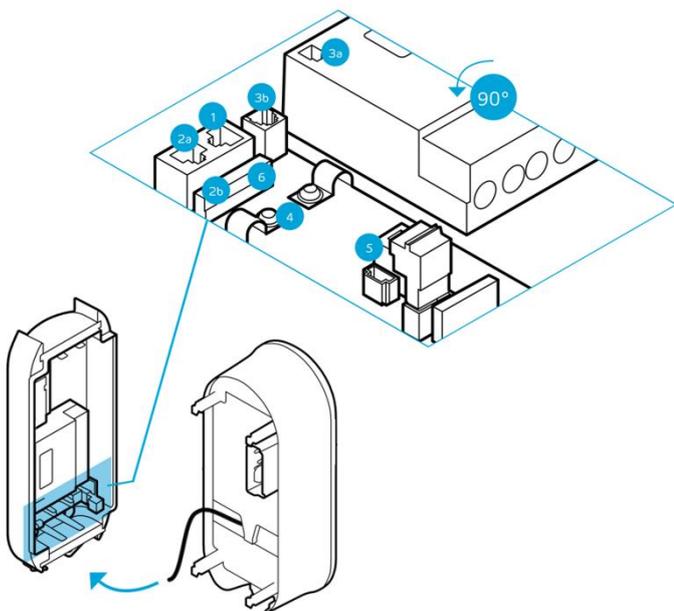
(Figure 1: Port overview eBOX)

Note: Port 2a is used for communication with the external controller and at the same time for access to the web interface of the eBOX. Use port 2a initially for the configuration of the eBOX and change the port for the energy management system afterwards.

2.2   Network

All charging points, Controller and Nodes, must be connected to the same local network.

To avoid connection problems, it is necessary to assign static IP addresses for the devices connected in the network.

The IP address of the charging point can be configured via the local web interface of the eBOX. Make sure that

- the IP address is uniquely assigned and does not cause conflicts with other devices on the network.
- the IP address 192.168.1.1 is not used (default IP address of the eBOX).
- the DHCP server of the router assigns fixed IP addresses.

Please also note that the user must have the appropriate rights to make settings on the router's network.

2.3   Modbus options

The current Modbus implementation supports the connection to a Modbus TCP/IP Controller. Parallel connections to other Controllers are not possible, UDP is not supported.

The Modbus controller should connect to the IP of the wired Ethernet connection of the Node on port 5555.

A detailed description of possible requests via specific node addresses is shown in the register overview at the end of this manual.

2.3.1 Read-register

The Modbus implementation supports reading holding registers with Modbus function code 3. Multiple registers can be requested within a Modbus request as long as they are contiguous. Whenever a register is reserved or unavailable, the register response is filled with "Not a Number" (NaN), which is set to 0xFFFF for a 16-bit register.

There is one Modbus register that contains the String data type. String registers contain strings, where each 16-bit Modbus register contains two 8-bit ASCII characters. A string always contains a trailing zero.

Note: Reading registers is done in network byte order.

2.3.2 Write-register

The Modbus implementation supports the writing of holding registers. If a value is written with a data type that contains multiple Modbus registers, then all registers should be written within one write request.

For example, if a variable is a 32-bit float, both consecutive 16-bit registers should be written in one Modbus request.

If the Modbus write request does not write all registers, the request is rejected and a Modbus error is returned.

Note: Reading registers is done in network byte order

2.3.3 Maximum-current

The maximum current is the maximum current for the charging process set by the controller.

MaxCurrentOfNode represents the upper limit for the electrical current value at a Node. This value is identical for all three phases and cannot be configured individually. As a rule, a three-phase connected eBOX (Node) is always protected by three identical fuses (e.g. 16A or 32A). Like the MaxCurrentOfNode register value, the FallbackCurrent and

OperatingCurrent registers cannot be used individually.

Although the values for each phase can be written into the individual registers, a minimum of these 3 values is always used on the Node side. Therefore, a value FallbackCurrent and a value OperatingCurrent for all three phases are distributed identically by the load management.

2.3.4 Fallback-current

The fallback current (also safety mode) describes a safe operating mode into which the eBOX switches as soon as the safety mode detection timeout expires and no communication to the Controller takes place.

If the Node loses the TCP connection to the load management system (Controller) after the defined time period, the FallbackCurrent is applied as long as the communication is interrupted.

After the TCP connection is restored, the current value of the node is reset to the last transmitted OperatingCurrent. The fallback current is always recalculated and redistributed with every significant change within the cluster (cluster parameters are MaxCurrentOfCluster, Re-ductionFactor and NumberOfNodes).

2.3.5 Phase-rotation

Charging points are usually designed as single or three-phase. The phase angle to each other is always 120°.

In order for the load management to optimally distribute the charging current and avoid unbalanced loads, the information of the phase position or phase rotation must be set or communicated for each charging point. To be able to distribute loads better, the phases are rotated on the subdistribution side.

3   ConfigurationConnection setup

After successful installation and setup of the system, the eBox must be configured and Modbus must be activated. For this, a connection to the web interface is necessary.

1. Connect your computer to the eBox via an Ethernet cable using port 2a (LAN2) (see Fig. 1).

2. If no IP address has been assigned yet, the configuration menu can be accessed via https://172.16.0.1 in the web browser.

3. A Alternatively, the web interface must be called via the configured IP address: (https://<set-IP>).

4. The log-in data for accessing the eBox are as follows:
   Username: admin
    Password:<eBox PUK>

(Figure 2: Access to the web interface of the eBox)

Note: For a detailed description of access and configuration options of the eBox, read the WebConfig tutorial.

3.2   Firmware update

First make sure which firmware version the eBox has [System → System data → ACCU firmware version].

If the firmware is older than 1.3.0, the eBox must be updated. To do this, navigate to the Update menu item [ECU → Update] and execute the update via a local source.
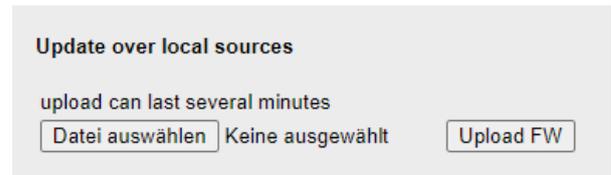
(Figure 3: Firmware update)

3.3   Network configuration

To establish a connection to the backend (optional), an internet connection must be set up via the LTE interface.

In the WAN menu item [Network → interface], the "lte1" interface must first be selected.
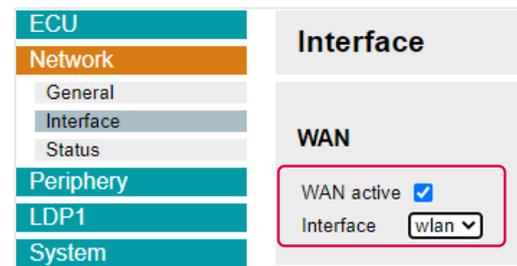
(Figure 4: Interface settings)

Finally, the user name, password and APN must be entered under LTE [Network → Interface].

(Figure 5: APN settings)

Note: Further information on the network settings can be found in the "WebConfig documentation".

In order for the charging point to be addressed via the Controller, each Node must be assigned a fixed IP address in the local network.

You can assign an IP address under the menu item [Network → Interface] in the "Ethernet" section.

Make sure that the network and static IP is set active and enter a unique IP address for the node in the "Static IP address" field.

Ethernet

Network 1 Settings

Network active ☑

Start DHCP client ☐

Static IP active ☑

Static IP address 172.16.0.2

Netmask 24

Start DHCP server ☐

(Figure 6: Static IP address)

Note: By default, the eBox uses the IP <172.16.0.1>. To avoid later confusion and IP conflicts on the switch, it is recommended not to use this IP.

Finish the configuration with "Ok".

3.4   Phase mapping

To correctly assign the phases coming from the sub-distribution and connected to the eBOX, the phase sequence must be documented in the eBOX configuration.

Only through this configuration is it possible for the connected energy management system to make the correct adjustments in the event of unbalanced loads.

To avoid the effects of unbalanced loads when connecting several charging points, we recommend rotating the phase sequence of different eBOXes in the same network. In this way, unbalanced loads caused by single-phase charging can be limited.

Common

LDP server ID: 059C306600E2D0

Max. current [A] of charge point's: 16

Resistor of fix attached cable: 100 220 680 1500

Number of phases: 1

Open Interlock after expiring max load time ☐

SLAC attenuation profile: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

Phase setup L1: 3

Phase setup L2: 2

Phase setup L3: 1

(Figure 7: Phase mapping)

3.5   Modbus activation

In this step, the Modbus protocol is activated for the eBox.

In the configuration menu, navigate to the *[LDP1 →Load management]* section and select Modbus in the drop-down menu under "Load management type".

Loadmanagement

Load management type: modbus_tcp ▾

Load adaption by offline ECU ◉ ICON   ○ Control Computer

Current limiting [A]: 32

Nominal voltage : 230   Currency: EUR

Operator Current Limit

Current limiting [A]: 32

State dynamic load adaption:

inactive > 16 A

Modbus TCP

Interface net1 ▾

Port 502

OK   Save settings

(Figure 8: Modbus activation)

With activation of Modbus, the eBox automatically adopts the role of the Node (slave).

Complete this configuration step by clicking on "Ok".

3.6   Behavior in case of error

Finally, the behavior of the charging point in the event of a system error/offline case must be defined.

Change to the *[LDP1 →Load management]* tab and set the "Control computer" field to active.

Finally, in the field below, the "Current limit [A]" must be selected for an offline case.

Depending on the application and setup, a value between 6A -10A is recommended.

Loadmanagement

Load management type: modbus_tcp ▾

Load adaption by offline ECU ◉ ICON   ○ Control Computer

Current limiting [A]: 32

(Figure 9: Behavior of eBox in case of error)

4. Register specification

4.1   Modbus Register Specification

Description	Datapoint	Access	Start address	Quantity	Datatype	Unit	Value Range	Example Value
ChargeBoxID	ChargeBoxID	R	0	25	STRING	-	-	ebox6867
Serial Number	SerialNumber	R	25	25	STRING	-	-	LE006867
Active Protocol	ActiveProtocol	R	50	25	STRING	-	-	homebox
Manufacturer	Manufacturer	R	100	25	STRING	-	-	Compleo Charging Technologies GmbH
Platform Type	PlatformType	R	125	25	STRING	-	-	n/a
Product Type	ProductType	R	150	25	STRING	-	-	n/a
Modbus table version	ModbusTableVersion	R	175	1	UNSIGNED16	-	-	5
Firmware version	FirmwareVersion	R	200	25	STRING	-	-	1.3.26
Number of sockets	NumberOfSockets	R	225	1	UNSIGNED16	-	0 - 9	1
OCPP state	OcppState	R	250	1	UNSIGNED16	-	-	0
Socket 1: Mode 3 State	Socket1Mode3State (States from IEC 61851-1 Ed3)	R	275	2	STRING	-	A, B1, B2, C1, C2, D1, D2, E, F	C2
Socket 1: Cable State	Socket1CableState	R	300	1	UNSIGNED16	-	0 – no cable 1 – cable without the car 2 – unlocked cable without the car 3 – locked cable with car	3
Actual max. current phase 1 applied, which is influenced by all box conditions	ActualMaxCurrent-Phase1	R	1000	2	FLOAT32	[A]	6 - 32	16

Actual max. current phase 1 applied, which is influenced by all box conditions	ActualMaxCurrent-Phase2	R	1002	2	FLOAT32	[A]	6 – 32	16
Actual max. current phase 1 applied, which is influenced by all box conditions	ActualMaxCurrent-Phase3	R	1004	2	FLOAT32	[A]	6 – 32	16
Phase 1 current	CurrentPhase1	R	1006	2	FLOAT32	[A]	0 – 32	9.88
Phase 2 current	CurrentPhase2	R	1008	2	FLOAT32	[A]	0 – 32	0
Phase 3 current	CurrentPhase3	R	1010	2	FLOAT32	[A]	0 – 32	0
Maximum phase 1 current	MaxCurrentPhase1	RW	1012	2	FLOAT32	[A]	6 – 32	16
Maximum phase 2 current	MaxCurrentPhase2	RW	1014	2	FLOAT32	[A]	6 – 32	16
Maximum phase 3 current	MaxCurrentPhase3	RW	1016	2	FLOAT32	[A]	6 – 32	16
Fallback load adaption current for phase 1	FallbackMaxCurrent1	RW	1018	2	FLOAT32	[A]	6 – 32	14
Fallback load adaption current for phase 2	FallbackMaxCurrent2	RW	1020	2	FLOAT32	[A]	6 – 32	14
Fallback load adaption current for phase 3	FallbackMaxCurrent3	RW	1022	2	FLOAT32	[A]	6 – 32	14
Timeout until fallback load adaption is applied	RemainingTimeBefore-Fallback	RW	1024	1	UNSIGNED16	[sec]	60 – 3600	60
Station phase setup for L1	StationPhaseSetupL1	RW	1025	1	UNSIGNED16	–	1 – 3	2
Station phase setup for L2	StationPhaseSetupL2	RW	1026	1	UNSIGNED16	–	0 – 3	3
Station phase setup for L3	StationPhaseSetupL3	RW	1027	1	UNSIGNED16	–	0 – 3	1
Operative state of Box	Availability	RW	1028	1	UNSIGNED16	–	–	1

According to Modbus Register Specification there are essentially four (4) electrical current types at a node which can either be read or set for each phase:

Current type (Register name)	Register	Access	Description	Mapping
ActualMaxCurrentPhase1	1000	R	The maximum allowed electrical current of the node respectively the electrical fuse protection of the node for phase 1	MaxCurrentOfNode
ActualMaxCurrentPhase2	1002	R	The maximum allowed electrical current of the node respectively the electrical fuse protection of the node for phase 2	MaxCurrentOfNode
ActualMaxCurrentPhase3	1004	R	The maximum allowed electrical current of the node respectively the electrical fuse protection of the node for phase 3	MaxCurrentOfNode
CurrentPhase1	1006	R	The electrical current measured by the node on phase 1 (continuously)	MeasuredCurrentP1
CurrentPhase2	1008	R	The electrical current measured by the node on phase 2 (continuously)	MeasuredCurrentP2
CurrentPhase3	1010	R	The electrical current measured by the node on phase 3 (continuously)	MeasuredCurrentP3
FallbackMaxCurrent1	1018	R/W	Fallback value for electrical current in case of loss of the TCP connection for phase 1	FallbackCurrent
FallbackMaxCurrent2	1020	R/W	Fallback value for electrical current in case of loss of the TCP connection for phase 2	FallbackCurrent
FallbackMaxCurrent3	1022	R/W	Fallback value for electrical current in case of loss of the TCP connection for phase 3	FallbackCurrent
MaxCurrentPhase1	1012	R/W	The maximum allowed electrical current of the node calculated and distributed by load management system for phase 1	OperatingCurrent
MaxCurrentPhase2	1014	R/W	The maximum allowed electrical current of the node calculated and distributed by load management system for phase 2	OperatingCurrent

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