Active Load Balancing via Modbus TCP/IP

Information document

ALFEN

POWER TO ADAPT

TABLE OF CONTENTS

ENGLISH

1. INTRODUCTION

In the energy transition period we are currently experiencing, companies and households are increasingly expected to deal with their energy consumption in a more sustainable way. This has created the need for smart applications to distribute the available power to all devices with power demand. Thanks to these kind of applications the maximum grid capacity is not exceeded and a costly increase in grid capacity can be prevented. Due to the application of such provisions, grid reinforcements can be prevented at many locations and the existing equipment is protected from overload.

The smart application developed by Alfen is called Active Load Balancing. This solution ensures that the local power consumption is monitored in order to actively adjust the charging speed if needed.

Active Load Balancing has two technical implementations. One of these uses the DSMR protocol via the P1 port, a commonly-used application in the Netherlands. From firm-ware update 3.4.0 and up, Modbus TCP/IP is also supported.

This document describes the conditions, possibilities and settings for Active Load Balancing via Modbus TCP/IP. This functionality is available for a single Alfen charging station, or the Alfen Smart Charging Network.

To increase the scope and to better support the current international solutions, Alfen offers the possibility to connect different types of energy meters from now on. The only condition is that the energy meter supports the Modbus TCP/IP functionality. A directive for this application is defined in the *Modbus MESSAGING ON TCP/IP IMPLEMENTATION GUIDE V1.0b.* The software in the Alfen chargers complies with the requirements specified in this directive.

REMARK

Do you want to know more about Modbus or about the TCP/IP directive? You can find this by clicking on the following link www.MODBUS.org/docs/MODBUS_Messaging_Implementation_Guide_V1_0b.pdf.

2.1 Client and Server

Devices communicating through *Modbus TCP/IP* take on the role of Client or Server, respectively Master and Slave.

Alfen Charging Equipment is programmed as *Client*, the energy meter can therefore function as *Server*. In future, the Alfen charging station can also function as *Server*.

The Alfen charging station (Client) requests the energy meter to send data. The energy meter supplies the requested data and therefore acts as Server. The charging station uses port 502 as 'listening port'.

2.2 Preconditions functional system

Preconditions for a well-functioning Modbus TCP/IP Active Load Balancing system:

Alfen charging station(s):
- Equipped with an activated Modbus TCP/IP Active Load Balancing functionality

Energy meter:
- Installed to the local grid connection/main power supply
- Supports Modbus TCP/IP communication
- Max. 1 energy meter connected to a charging station
- Max. 1 energy meter connected to the Smart Charging Network

Network:
- Charging station in the same local network as the energy meter
- Both meter and charging station connected via (at least) CAT5e UTP/Ethernet RJ45 cable, CAT6 for cable runs exceeding 100 metres in length.
- 10Mbps or 100Mbps network (Power over Ethernet is not supported)
- Fixed IP address for energy meter, supplied by the IT department of the local network. The IP address must comply with the IPv4 protocol; IPv6 addresses are not supported by Alfen Charging Equipment
- Understand and have access to settings of the local network to configure the energy meter and charging station (IPv4 Address, Subnet Mask, Default Gateway)

Configuration tool
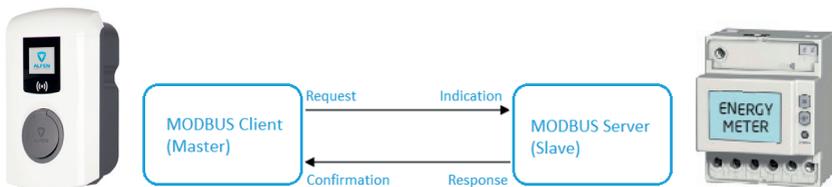- Alfen Service Installer (at least version 2.3.4.97)

MODBUS Client (Master) — Request → Indication → MODBUS Server (Slave) — Confirmation ← Response ← ENERGY METER

Figure 2: Overview Client and Server

2. MODBUS TCP/IP

2.3 Safety and liability

⚠️ **WARNING** ──────────────
Installation and configuration requires an installer with expertise in network systems and knowledge of how to handle electrotechnical equipment safely.
──────────────────────

In the event that the configuration and installation is not conducted according to the instructions as described in this document, Alfen ICU B.V. cannot guarantee the optimal functioning of the Active Load Balancing via Modbus TCP/IP.

Alfen ICU B.V. is in no way liable for the suboptimal functioning of the Active Load Balancing or any form of damage, when:

• Non-compliance to these instructions for installations
• Improper use of the product
• Installation and/or configuration by unqualified staff
• Independent adjustments or customisations are applied to the product
• External calamities

The Modbus TCP/IP Active Load Balancing functionality can be applied in different ways. A single energy meter, installed in-line with the charging station, is shown as an example (figure 3). When the relevant charging station is part of a Smart Charging Network, it will exchange information with the other stations in the network.
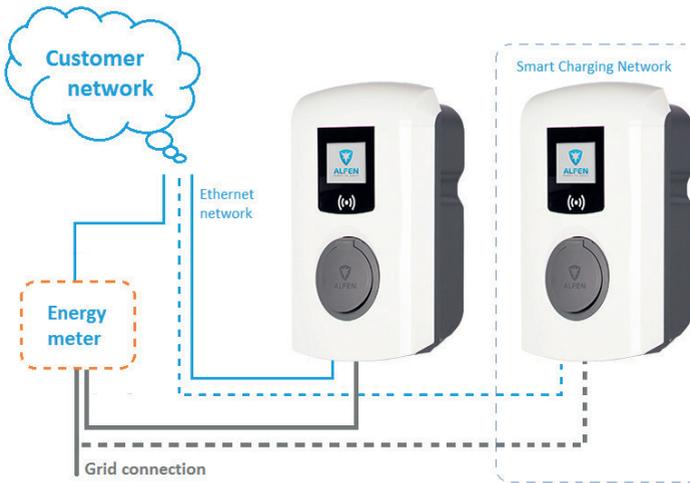

Figure 3: Installation energy meter combined with an independent charging station and Smart Charging Network

⚠ WARNING

Alfen strongly recommends to connect a single energy meter to a Smart Charging Network in order to prevent conflicts in information streams.

The setup of the network, the energy meter and the charging station(s) make up an important part of the configuration of the entire installation.

The following paragraphs describe how the different components are to be installed and configured. The starting point is an installation in which both the energy meter and the Alfen charging station are connected to the same (local) grid.

3.1 Installation energy meter

⚠ WARNING

The installation of the Socomec Countis E27 energy meter is described in the appendix. Use this energy meter in combination with firmware 3.4.0 or up to use Active Load Balancing via Modbus TCP/IP optimally.

For the correct measurement of the available energy and therefore optimal effectiveness of Active Load Balancing, it is paramount that the energy meter is installed to the grid connection/main power supply. The energy meter must be selected such that it matches the requirements of the local grid. (maximum load and power values, number of phases, etc.).

In the event that energy-consuming or energy-supplying devices are connected to the grid connection in addition to the charging station, the consumption data of this group is measured by the energy meter and communicated to the charging station. The charging station compares this data to the maximum capacity of the local grid. that has been set in the charging station. This way the charging station is always aware of the available capacity for charging.

⚠ DANGER!

Incorrect installation can be life threatening! When working with electricity, not abiding by installation and environment regulations can lead to hazardous situations.

For more information on safe installation of the energy meter, please consult the supplier's product manual.

3. CONFIGURATION AND INSTALLATION

3.1.1 Connecting Ethernet cable

Use an Ethernet cable (RJ45) to connect the installed energy meter (via the switch/router of the local network) to the Alfen charging station. If the cable run is less than 100 metres, a CAT5e UTP/Ethernet RJ45 cable may be used. If the cable run exceeds 100 metres, a CAT6 cable is required.
Depending on the type of charging station;
• The Ethernet connector is located on the controller in the charging station
• The Ethernet cable can be attached to a designated Ethernet connector on the casing

Figure 4: Location Ethernet connector charging stations

REMARK

For more information about safely installing and configuring the Alfen charging station, the reader is referred to the product manuals by following the link https://alfen.com/en/ev-charge-points/alfen-product-range

3.2 Network configuration

Alfen recommends to provide the energy meter with a fixed IP address. The benefit of using a fixed IP address is that an address change from a DHCP server is avoided. This way, the configuration of the energy meter and the charging station has to be conducted only once. Caution: the Alfen charging stations software supports IPv4 addresses only (not IPv6).

The correct user right are required to add a new IP address to a network. The network administrator of the local network must:
- Configure the network settings such that the network allows fixed IP addresses
- Make a fixed IP address available for the energy meter. This IP address:
  • Should not conflict with any other devices connected to the network
  • Must comply with the regulations of the network configuration
  • Is preferably selected in the top end of the range of available addresses.

The energy meter and the Alfen charging station must be connected to the same network. The IP address of the charging station can be assigned by a DHCP server or can be set as a fixed IP address.

The IP address of the energy meter is configured in the Alfen charging station. This way, the energy meter and the charging station form a connection that enables the energy meter to send data to the charging station through Modbus TCP/IP.

3.3 Energy meter configuration

The exchange of energy data between the energy meter and the charging station requires the installation of several parameters in the energy meter and the Alfen charging station:
• Subnet mask of the local network
• IP address of the energy meter assigned by grid operator
• Energy meter modbus address
• Default Gateway of the local network

The parameters listed above are dependent on the settings of the local network. For more information about the configuration of the parameters, the reader is referred to the product manual of the energy meter.

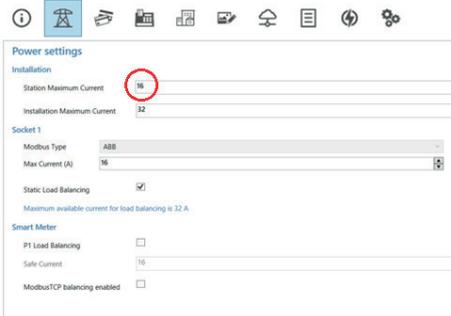## 3.4 Configuration Alfen charging station

To make optimal use of the Modbus TCP/IP Active Load Balancing, the charging station (Client) must be able to connect to the energy meter (Server). Correct configuration of the charging station is therefore necessary. To do so, the Service Installer Application is used.

REMARK

The installation, commissioning and maintenance of an Alfen charging station may only be executed by a qualified technician (an Alfen qualified partner)

Carry out the following configuration procedure to install the charging station correctly:

1. Connect the computer to the Alfen charging station with the Ethernet cable
2. Log on to the Service Installer
3. Click on ⚡ to open the tab *Power settings*
4. Enter the maximum current at *Station-MaxCurrent*. Caution: this value may never exceed the maximum currents supported by the charging station!

5. Enter the maximum value of the (grid) connection at the *Installation-MaxCurrent* bar
6. Tick the *ModbusTCP balancing enabled* box

7. Enter the following parameters:

Parameters	Description/value
MODBUSTCP Mode	Default for *Socomec*
MODBUSTCP ConnectionType	*MODBUS_master_TCP*
MODBUSTCP IP Address	The IP address of the energy meter (depending on the settings of the local network, Alfen recommends the use of a fixed IP address for the energy meter)
MODBUSTCP Slave Address	Energy meter Modbus address
Load Balancing Safe Current (A)	Current that remains available for the charging station (or charging hub) when the connection between energy meter and charging station is lost. Caution: if charging stations are in the same Smart Charging Network, this value represents the available power for the **entire** SCN. This value must be entered in one of the charging stations of the SCN.

4. WARNINGS AND ERROR NOTIFICATIONS

The connection between an energy meter and the Alfen charging station can be lost for several reasons:
- Disruption of the connection of the network;
- Interruption of the Ethernet cable;
- Defective energy meter.

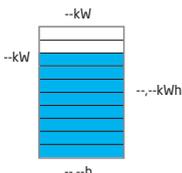### 4.1 Notifications charging station
If such a disruption prevents the Alfen charging station from monitoring energy meter values, the following will happen:

1. The notification "*Communication **warning** for modbus unit <physical address energy meter>* " will appear in the Service Installer.
2. Charging station (or Smart Charging Network) will apply the value configured in the *Load Balancing Safe Current* as the maximum available charging current (12A in the example below) and adjust the charging current if needed.

3. Charging station with LED indication: if the situation presented above occurs during an active charging session, the LED light will change from 'steady blue' to 'interrupted blue'.
Charging station with user display: if the situation presented above occurs during an active charging session, the reduced charging capacity will be presented on the display. The value of the current charging capacity is adjusted:

4. If no connection can be made with the Socomec energy meter after 2 minutes or if the values are not monitored correctly, the following notification will appear on the Service Installer:
"*Communication **error** for modbus unit <physical address energy meter>*"
5. The charging station continues to supply the charging current as calculated in step 2
6. If the connection with the Socomec energy meter is re-established:
   - The following notification will appear:
   "*TCP MODBUS unit 5 connected via <IP address energy meter: listening portal>*"
   (for example: 192.168.0.4:502)
   - The charging station will gradually return to the MaxCurrent charging intensity the station was set to (16A in the example).

REMARK
Please contact Alfen Service (+31 (0)36 54 93 401) should the connection with the energy meter not be restored.

5.1 Installation Socomec energy meter

The Socomec Countis E27 energy meter is provided with an Ethernet communication connection (on top). The meter can be installed on a standard 35mm DIN rail. The display shows several values such as voltage, current, capacity, power factor, frequency, etc.

The Socomec E27 energy meter can be installed in a 3P+N network up to 80A. Install the energy meter according to the instructions in the product manual. You can find the manual for safe installation of the energy meter on www. socomec.com/en/countis-e2x.

Figure 5: Location Ethernet connectors charging stations

5.2 Configuration Socomec energy meter

The two buttons on the Socomec E27 energy meter can be used to configure the settings; the *UP button* and the *ENTER button*.

The default settings of the Socomec E27 energy meter are as such:
- IP address: 192.168.0.4
- Subnet Mask: 255.255.255.0
- Gateway: 192.168.0.1
- Modbus address: 5

On default, the Modbus address in the Socomec energy meter is set to '5'. This value can be changed by selecting the 'enabled' option in the web browser page of the energy meter. Consult the supplier manual on how to open the web browser.

To change the addresses, carry out the following configuration procedure. Caution: the Modbus address cannot be changed.

1. Turn on the power and apply voltage to the electricity meter; the home screen appears.
2. Press the ENTER button repeatedly until the following screen appears:

   `SEtUP.P`

3. Hold down the ENTER button for at least 3 seconds. The following screen appears:

   `EtH SdEF`

4. Press the UP button once. The following screen appears:

   `IP 1    192`

5. Press the ENTER button; the first digit will start to flash.
6. Press the UP button to select the desired digit.
7. Press ENTER to confirm the digit; the second digit will start flashing.
8. Repeat step 6 and 7 until all desired digits have been entered. The first part of the IP address has now been set, for example 192.xxx.xxx.xxx.
9. Press UP to set the remaining digits of the IP address in the same way. Repeat steps 5 to 8.
   The IP address (for example 192.168.0.10) of the Socomec meter has been composed in the menu as such: IP1.IP2.IP3.IP4 (IP1 - 192, IP2 = 168, IP3 = 0 and IP4 = 10)
10. After setting the IP address, follow the same procedure to set the Netmask and Gateway addresses. The setup of the addresses corresponds with that of the IP address: NET1.NET2.NET3.NET4 for Subnet Mask and GAT1.GAT2.GAT3.GAT4 for the Default Gateway. Select NET1 and GAT1 to set Subnet Mask and Default Gateway respectively in step 4. Repeat steps 4 - 9 for both.
11. Once you have set all addresses, press and hold ENTER for at least 3 seconds. The following screen appears:

    `SAUE.P :y`

12. Press ENTER to save the settings. The following screen appears:

    `rEL 1  I22`

13. Press ENTER to return to the home screen.

REMARK

To configure the remaining settings, the reader is referred to the complete Socomec E27 energy meter manual www. socomec.com/en/countis-e2X

5. APPENDIX

5.3 Error notifications Socomec meter
The Socomec meter generates a number of notifications on the home screen sharing important information with the user.

Notification	Explanation
	1 or more phases are not detected. The exclamation mark in the top left corner of the screen is flashing. Consult the product manual of the energy meter and contact the supplier.
	If the phase is detected in the order 123, the symbol ⌒ will appear. If the phase is detected in the order 132, the symbol ⌒ will appear.
	The meter is defective and needs to be replaced. Contact your supplier.

Contact

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