Modbus for ACE

Configuration Guide

ALFEN
POWER TO ADAPT

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1. REVISION HISTORY

Revision	Date	Description
1.0	May 2025	First version of the document. This document contains information about Modbus registers starting from ACE service installer version 3.4.10-130 and firmware version 4.10. Earlier versions may not be supported.

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2. PREFACE

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2.1 About this document

This document describes how the customer's charging station can connect with the ACE Service Installer in order to read and write Modbus messages.

When the Modbus protocol based connection is correctly established the customer can remotely control the charging station.

This document applies to the ACE Service Installer version: 3.4.10- 130.

Firmware version: 4.10

NOTE

This manual contains information about all possible features of the charging station, based on the latest software release. Applicability may differ.
Users can thus not invoke the contents of this manual.

2.2 Disclaimer

This document has been subjected to rigorous review before being published. It is revised with each new software version. Although Alfen has made its best efforts to keep the document as precise and up-to-date as possible, Alfen does not assume any liability for defects and damage which results from the use of the information contained herein.

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2.3 Copyright

2.4 Languages

The English version of this document is the original source. Documents in other languages are translations of this source.

2.5 Complimentary documentation

The Modbus communication protocol is used in combination with one or more Eve Single charging stations.

Eve Single Smart Charging	https://alfen.com/media/1935/download?attachment
Eve Single Pro-line Installation manual	https://alfen.com/media/1376/download?attachment

3. SOFTWARE DESCRIPTION

3.1 Modbus Overview

Modbus is a type of communication protocol you can use to manage the operation of your NG9xx charging station.

3.2 Holding registers

To control Eve Single via the ACE Service Installer a proper configuration of Modbus registers should be done. For this, the Holding registers in the Modbus protocol are used.

Holding registers are the most universal 16-bit registers they can be read or written, and can be used for a variety of things including inputs, outputs, configuration data, or any requirement for "holding" data.

The procedures are specified in this manual.

Applicable Modbus registers are mentioned in the text and an overview of the register set is shown in the Appendix.

3.3 ACE Connection Setup

To manage a charging station using the ACE Service Installer, a link must be established between the application and the charging station.

Follow the instruction located in the Alfen Knowledge Base to download, install and apply for credentials you need to log into the ACE Service Installer.

You can access the Knowledge Base by clicking this link: https://knowledge.alfen.com/space/IN/837713926/ACE+Service+Installer

To use the ACE Service Installer to configure one or more charging stations, both must be on the same local network or connected by Ethernet cable.

NOTE

Make sure the charging station is within the same IP range as the laptop, otherwise they cannot communicate with each other.
To use the ACE Service Installer, the Windows Defender firewall must be set up correctly. See the instructions located in the Alfen Knowledge Base.

3.4 Modbus messages

Modbus is a request-response protocol where the client sends a request to a Modbus server, and the Modbus server sends a response. Both requests and responses are send in the form of Modbus messages.

A Modbus message is composed from the following information:

- Transaction ID
- Protocol
- Length
- Unit Address
- Message

The Modbus data is read and written as **registers**. All Modbus registers are **holding** registers and can be used for a variety of things including inputs, outputs, configuration data or any requirement for holding data.

NOTE

Reading or writing registers is done in network byte order.

Register 1 has an offset from 0. For example holding register 360 in a read holding registers call (function codes 03) has Modbus address 359.

Always subtract **1** from the register value to get the Modbus address value.

The following function codes are allowed:

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Function code	Description
3	Read holding registers
6	Write a single holding register
16	Write multiple holding registers

The number of holding registers that can be read at once is limited by what can fit into a single Modbus message: 125 registers of 16-bit values.

NOTE

32-bit values (that span 2 registers) cannot be read through two separate queries, they are always read through a single query.

For 16-bit registers, the write to multiple registers limit is 125 registers. Commonly, the number of available registers is lower, because the limit applies to a continuous range of writable registers.

The 32-bit values are mixed-Endian: the 16-bit words are big Endian (high byte first), the 32-bit words are little Endian (low word first).

Sometimes a register value is used as a bit field, where every bit has a separate meaning. An example of this is the Meter type, register 305. Bit 0 is the least significant bit.

4.1 ACE Modbus protocol

Modbus is a communication protocol that is used to manage one or more NG9xx charging stations.

Modbus is a client/server data communication protocol in the application layer and is used to support communication between multiple devices connected to the same cable or Ethernet network.

The current Modbus implementation supports up to two simultaneously connected Modbus TCP/IP clients, UDP is not supported.

The Modbus client should connect to the IP of the Modbus server wired Ethernet connection on port 502.

Requests are accepted from specific server addresses:

- 200 for charging station related Modbus registers.
- 1 or 2 for socket related Modbus registers, depending on the socket.

NOTE
All communication must be in the little Endian format.

You can use the ACE Service Installer to configure the Modbus server functionality if:

- You have an ACE Service Installer account.
- You have a version 4.0 or higher service account.

NOTE
To enable Modbus functionality the charging station must have Active Load Balancing functionality enabled. Enabling Active Load Balancing requires a license key. For more information, contact Alfen.

The following configuration settings are persistent and are preserved in case the charging station reboots.

Name	Function
Allow reading	Allow reading of Modbus registers via TCP/IP. **NOTE** By default this is turned off.
Allow writing maximum currents	Allow writing maximum current Modbus registers. **NOTE** By default this is turned off.
Enable sockets	This setting enables the charging station to take the written maximum current values for sockets into account when calculating the actual maximum current for all the sockets.
Enable Smart Charging Network	This setting enables the charging station to take the written maximum current values for Smart Charging Network (SCN) into account when calculating the actual maximum current for all the SCN phases.

4. CONFIGURATION

Name	Function
Valid time	The validity time is the time in seconds in which the charging station requires an updated maximum current from a Modbus client before falling back to the safe current. The validity time is equal for all maximum currents, but each maximum current has its own remaining valid time which is updated every time that maximum current is set via Modbus. The default validity time is 60 seconds. **NOTE** It is recommended that the polling time of a Modbus client is lower than the validity time.
IP Address allocation	DHCP or fixed IP
Port	502
Modbus server addresses	• 1: measurement socket 1 • 2: measurement socket 2
Supported Modbus functions	• 0x03: Read Holding Registers • 0x06: Write Single Register • 0x10: Write Multiple Registers

The Modbus server implementation supports reading of holding registers with Modbus function code 3.

Multiple registers can be requested within one Modbus request, as long as they are contiguous.

If a register is reserved or not available, the register reply is filled with Not a Number (NaN), which is set to 0xFFFF for a 16 bit register.

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

NOTE
Reading registers is done in network byte order.

The Modbus server implementation supports writing of holding registers.

When writing a value with a data type that contains multiple Modbus registers, then all registers should be written within one write request.

For example, when a variable is a 32 bit float, both consecutive 16 bit registers should be written in one Modbus request. When the Modbus write request does not write all registers, the request will be denied and a Modbus error will be returned.

NOTE
Writing registers is done in network byte order.

4.2 Maximum current

You can use Modbus to set the maximum current for a specific socket, or a phase of the Smart Charging Network (SCN).

Each maximum current has additional registers that are read only for the enabled property, actual maximum current, the configured safe current and the remaining valid time. Each time the maximum current is written via Modbus, the remaining valid time is updated with the validity time. For example, when the validity time is 60 seconds and the maximum current has been written most recently 10 seconds ago, then reading of the remaining valid time register will result in 50.

The maximum current and remaining valid time are not preserved during a reboot of the charging station. Since the enabled and safe current settings are persistent, the behaviour of the charging station will be such that it will first fall back to the safe current and wait for the Modbus client to rewrite the maximum current.

When a maximum current is enabled and the Modbus client did not update this for a certain time, the charging station will fall back to its safe current. The safe current has to be set before the maximum current can be set via Modbus. This value can also be configured by the backoffice.

Then internal handling of a newly written maximum current by the charging station can require some time.

The time before the actual used current by the connected car is adapted to the newly written maximum current relies on multiple factors, for starters on the response speed of the car itself.

NOTE

The system must be in *Energy Management System* mode to write maximum current.

4.3 Phase Rotation

Phase mapping is used to determine the available power in the electrical installation multiple charging stations are connected to one Modbus server. This mapping charging stations to different phase rotations benefits the maximum power available per socket.

The amount of power needed for each socket is calculated and distributed based on the phase mapping.

Applying different phase rotations also prevents uneven load distribution when 1-phase EVs are charging on the SCN. The load is divided equally over the separate phases.

NOTE

The phase labels depend on the installation. For individual charging stations phase names are relative to the incoming phase rotation.

4.3.1 Example:

Two charging stations are present.

Charging station 1 is connected in order of the incoming phase connection: L1 - L2 - L3.

Charging station 2 is connected in order L2 - L3 - L1.

This means that if you want to read out the current through phase L1 through the Modbus client, you have to read the register of the phase L1 for charging station 1 and the register for phase L2 of charging station 2.

NOTE

The system must be in *Energy Management System* mode to switch phases.

4.4 Configuring Active Load Balancing

Active Load Balancing (ALB) measures the current used by the entire electrical installation of a location to prevent overload. To use this feature the electrical installation must include a smart meter or an external energy meter.

Active Load Balancing uses the Modbus Client TCP/IP to communicate.

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NOTE

Active Load Balancing is a paid feature on the charging station.
If you purchase this feature at Alfen, a license key will be issued to you to unlock this feature.

To unlock and configure ALB, an account for the Service Installer application (SIA) is required. If you do not have an account, visit https://support.alfen.com to request an account.

4.4.1 Active Load Balancing Activation

To activate Active Load Balancing:

1. Log into the ACE Service Installer.
2. Select the charging station from the sidebar on the left.
   You will be prompted to log into the charging station.
3. In the menu ribbon at the top of the ACE Service Installer, click **Load Balancing** (scales icon) to open the Load balancing tab.
4. Select **Active balancing** from the left sidebar menu, the Active Load Balancing parameters are displayed.
5. Select the **Active Load Balancing** checkbox.
6. Select from the *Data Source* dropdown menu:
   - Energy Management System
     This option activates the *Server* role for the charging station.
     As a server, the charging station is prompted by an external device such as an EMS. The external device determines the priority of charging and distributes the available load accordingly. The charging station ramps up or down only when prompted.
   - Meter
     This option activates the *Client* role for the charging station.
     As the client, the charging station calculates the available budget for charging vehicles. Other consumers, such as household appliences, are considered a higher priority. Charging only ramps up if possible.
7. From the *Received Measurements* dropdown menu select:
   - Include Charging EV
     If the charging station is connected to the same external energy meter as other loads, for example household equipment.
   - Exclude Charging EV
     If the charging station is connected to a different external energy meter from the other loads.
8. Select **Modbus TCP/IP** as the communication protocol in the *Protocol Selection* dropdown menu.
9. Enter the *Maximum smart meter current* in Ampere.
10. Enter the *Safe current* in Ampere.
11. Select the **Allow 1- and 3- phase charging** checkbox.
    This checkbox allows the EMS to switch between single- phase and three- phase current while charging.

NOTE

Use the ACE Service Installer to select this checkbox locally for each individual charging station that is part of the charging network.

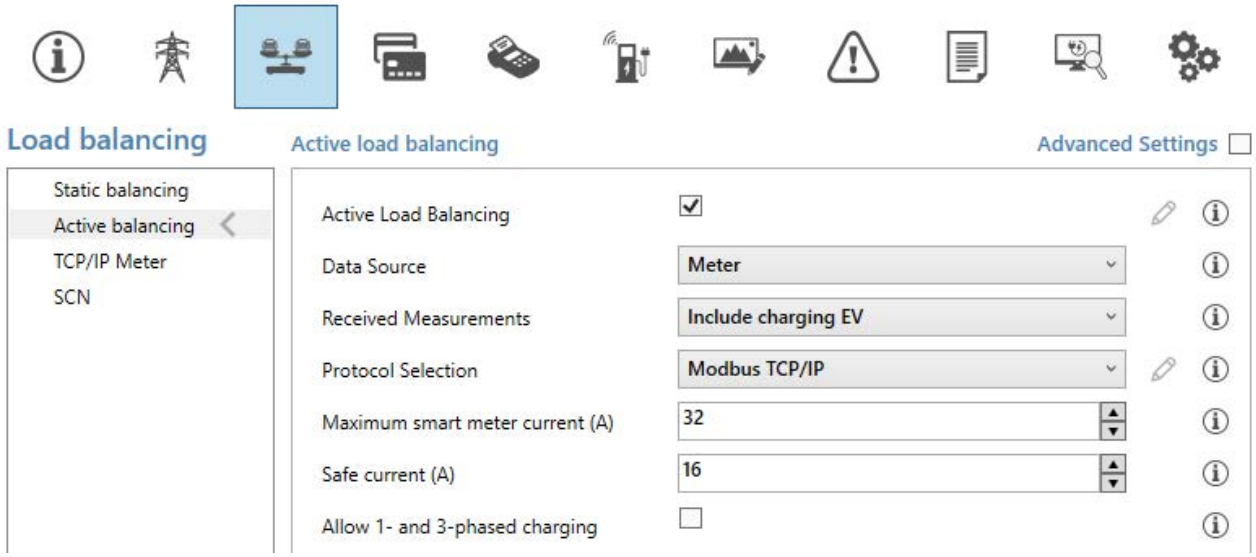

Figure 4.1: Activation Active Load Balancing

4.5 Configuring The Energy Management System

To configure the interface between the Energy Management System and the charging station follow these steps:

1. In the left sidebar menu click *TCP/IP EMS*, the Modbus TCP/IP EMS parameters are displayed.
2. Select the control mode:
   - Socket
     Each socket is controlled individually.
   - SCN
     The charging station is controlled as a whole, or as a part of a Smart Charging Network as one entity.
3. Enter the *Validity time* in seconds.
   Validity time, is the period of time after which the charging station assumes the EMS is no longer available.
   If the charging stations registers the EMS as not available, the charging station defaults to the *Safe Current* values specified in the Active Balancing parameters.
   Register values must be rewritten before validity time expires.

4.6 Configuring Charging Station Connectivity

By default, the charging station is configured to work with automatic IP allocation using DHCP. The automatic IP allocation can be used for Modbus server TPC/IP operation.

To retrieve the identity of the station, use mDNS to retrieve the charging station DNS name.

NOTE

All serial and identification numbers are examples.

- Service type: **_alfen._tcp.local**
- Assigned IP address
- Port: **80**
- Modelname- serial number: **NG920-61001-ACE0012345**
- Station Identifier: **ALF_HBW**
- SCN name (if applicable): **ALF_HBW**

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NOTE

You can choose to assign a fixed IP address to the charging station on the network.

To enter a fixed IP address follow these steps:

- Click *Connectivity* on the ribbon menu at the top of the ACE Service Installer.
- In the left sidebar, click *Wired* to open the wired parameters.
- Select the **Fixed IP address** checkbox.
- Enter the IP address details.

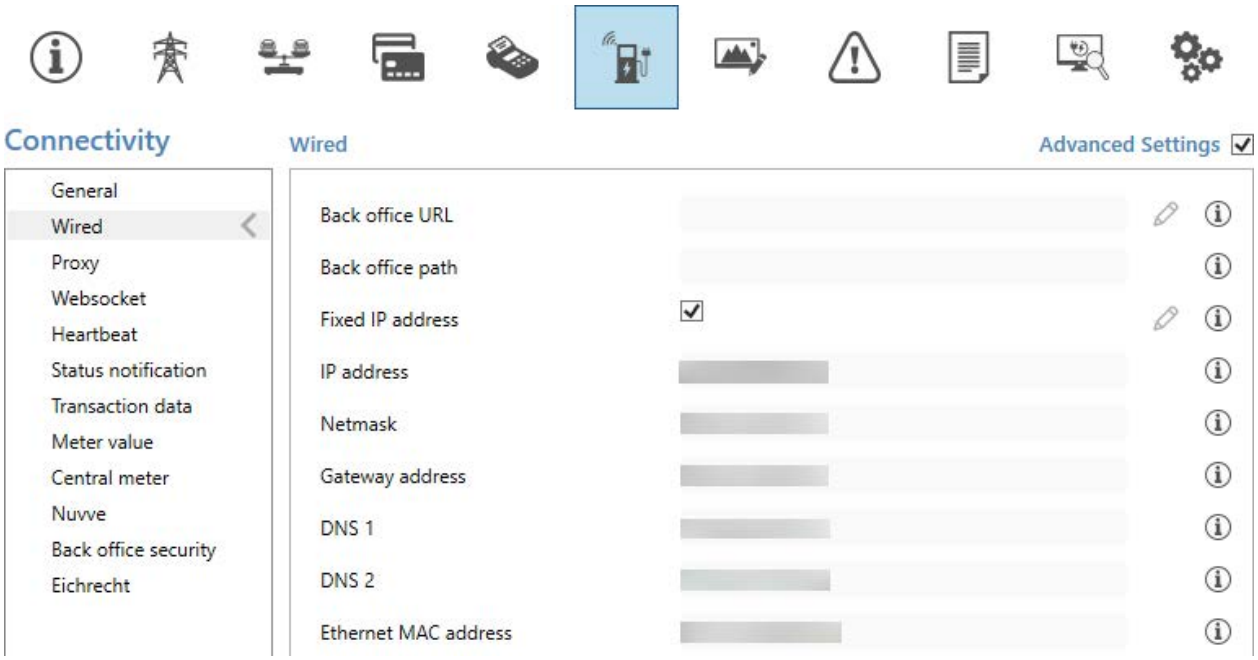

Figure 4.2: ACE Service Installer Connectivity Tab

APPENDIX A. REGISTERS OVERVIEW

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A. Registers Overview

The Modbus registered are grouped by functionality:

- Product identification registers
- Station status registers
- SCN registers
- Socket measurement registers

B. Product identification registers

Use the registers in this table to identify the charging station.

Description	Address	Number of 16 bit registers	R/W	Data type	Step size and units	Additional information
Name	100..116	17	R	STRING	-	ALF_1000
Manufacturer	117..121	5	R	STRING	-	Alfen B.V.
Modbus table version	122	1	R	SIGNED16	-	1
Firmware version	123..139	17	R	STRING	-	3.4.0- 2990
Platform type	140..156	17	R	STRING	-	NG910
Station serial number	157..167	11	R	STRING	-	00000R000
Date year	168	1	R	SIGNED16	1 yr	2024
Date month	169	1	R	SIGNED16	1 month	03
Date day	170	1	R	SIGNED16	l day	11
Time hour	171	1	R	SIGNED16	l hr	12
Time minute	172	1	R	SIGNED16	1 min	01
Time second	173	1	R	SIGNED16	1 s	04
Uptime	174..177	4	R	UNSIGNED64	0.001 s	100
Time zone	178	1	R	SIGNED16	1 min	Time zone offset by UTC in minutes

C. Station status registers

To reach the station status registers use server address 200.

Description	Address	Number of 16 bit registers	R/W	Step size and units	Additional information
Station Active Max Current	1100..1101	2	R	1A	The actual maximum current
Temperature	1102..1103	2	R	1° C	Board temperature, does not reflect environment temperature

APPENDIX D. SMART CHARGING NETWORK REGISTERS

Description	Address	Number of 16 bit registers	R/W	Step size and units	Additional information
OCPP state	1104..1105	1	R	-	To verify whether back office is connected
Number of sockets	1105	1	R	-	Number of sockets

D. Smart Charging Network registers

Use server address 200 to reach the smart charging network registers.

Description	Address	Number of 16 bit registers	R/W	Data Type	Step size and units	Additional information
SCN name	1400..1403	4	R	STRING	--	
SCN Sockets	1404	1	R	UNSIGNED16	1A	Number of connected sockets
SCN Total Consumption Phase L1	1405..1406	2	R	FLOAT32	1A	
SCN Total Consumption Phase L2	1407..1408	2	R	FLOAT32	1A	
SCN Total Consumption Phase L3	1409..1410	2	R	FLOAT32	1A	
SCN Actual Max Current Phase L1	1411..1412	2	R	FLOAT32	1A	
SCN Actual Max Current Phase L2	1413..1414	2	R	FLOAT32	1A	
SCN Actual Max Current Phase L3	1415..1416	2	R	FLOAT32	1A	
SCN Max Current for each Phase L1	1417..1418	2	R/W	FLOAT32	1A	
SCN Max Current for each Phase L2	1419..1420	2	R/W	FLOAT32	1A	
SCN Max Current for each Phase L3	1421..1422	2	R/W	FLOAT32	1A	

Description	Address	Number of 16 bit registers	R/W	Data Type	Step size and units	Additional information
Remaining valid time Max Current Phase L	1423..1424	2	R	UNSIGNED32	1s	Max current valid time
Remaining valid time Max Current Phase L2	1425..1426	2	R	UNSIGNED32	1s	Max current valid time
Remaining valid time Max Current Phase L3	1427..1428	2	R	UNSIGNED32	1s	Max current valid time
SCN Safe current	1429..1430	2	R	FLOAT32	1A	Configured SCN safe current
SCN Modbus Server Max Current enable	1431	1	R	UNSIGNED16	--	0 Disabled 1 Enabled

E. Socket Measurement registers

The socket measurements show information about the energy meter that is connected to the single socket in case of a single socket charging station, or the left socket in case of a dual socket charging station and can be reached using server address 1. In case of a dual socket station, the right socket related energy measurements can be reached using server address 2.

NOTE

Register 1214, Modbus server received setpoint accounted for, indicates if the received maximum current values, registers 1210..1211 Max Current, also called a setpoint, is taken into account to determine the actual applied maximum value, registers 1206..1207 Actual Applied Max Current.
Depending on other setpoints, registers 1206..1206 Actual Applied Max Current can read the settings requested by the external device such as the EMS.

Description	Address	Number of 16 bit registers	Read or Write	Data Type	Step size & Units	Additional info
Energy measurements						
Meter state	300	1	R	UNSIGNED 16	-	Bitmask with state: • 0x01: Initialised • 0x02: Updated • 0x04: Warning • 0x08: Error
Meter last value timestamp	301..304	4	R	UNSIGNED 64	0.001s	Milliseconds since last received measurements

APPENDIX E. SOCKET MEASUREMENT REGISTERS

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Description	Address	Number of 16 bit registers	Read or Write	Data Type	Step size & Units	Additional info
Meter type	305	1	R	UNSIGNED 16	-	• 0: RTU • 1: TCP/IP • 2: UDP • 3: P1 • 4: Other
Voltage Phase V (L1- N)	306..307	2	R	FLOAT32	1V	-
Voltage Phase V (L2- N)	308..309	2	R	FLOAT32	1V	-
Voltage Phase V(L3-N)	310..311	2		FLOAT32	1V	-
Voltage Phase V(L1-L2)	312..313	2	R	FLOAT32	1V	-
Voltage Phase V(L2-L3)	314..315	2	R	FLOAT32	1V	-
Voltage Phase V(L3-L1)	316..317	2	R	FLOAT32	1V	-
Current N	318..319	2	R	FLOAT32	1A	-
Current Phase L1	320..321	2	R	FLOAT32	1A	-
Current Phase L2	322..323	2	R	FLOAT32	1A	-
Current Phase L3	324..325	2	R	FLOAT32	1A	-
Current Sum	326..327	2	R	FLOAT32	1A	
Power Factor Phase L1	328..329	2	R	FLOAT32	-	-
Power Factor Phase L2	330..331	2	R	FLOAT32	-	-

NOTE

Chargers with a ABB power meter, produced before 2021 export all measured values and will return a numeric value for this register. Chargers with a Reallin power meter produced after 2021 export a subset of values and will return a NAN (not a number) value.

APPENDIX E. SOCKET MEASUREMENT REGISTERS

Description	Address	Number of 16 bit registers	Read or Write	Data Type	Step size & Units	Additional info
Power Factor Phase L3	332..333	2	R	FLOAT32	-	-
Power Factor Sum	334..335	2	R	FLOAT32	-	-
Frequency	336..337	2	R	FLOAT32	1Hz	-
Real Power Phase L1	338..339	2	R	FLOAT32	1W	-
Real Power Phase L2	340..341	2	R	FLOAT32	1W	-
Real Power Phase L3	342..343	2	R	FLOAT32	1W	-
Real Power Sum	344..345	2	R	FLOAT32	1W	-
Apparent Power Phase L1	346..347	2	R	FLOAT32	1VA	-
Apparent Power Phase L2	348..349	2	R	FLOAT32	1VA	-
Apparent Power Phase L3	350..351	2	R	FLOAT32	1VA	-
Apparent Power Sum	352..353	2	R	FLOAT32	1VA	**NOTE** Chargers with a ABB power meter, produced before 2021 export all measured values and will return a numeric value for this register. Chargers with a Reallin power meter produced after 2021 export a subset of values and will return a NAN (not a number) value.
Reactive Power Phase L1	354..355	2	R	FLOAT32	1VAr	-
Reactive Power Phase L2	356..357	2	R	FLOAT32	1VAr	-
Reactive Power Phase L3	358..359	2	R	FLOAT32	1VAr	-

APPENDIX E. SOCKET MEASUREMENT REGISTERS

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Description	Address	Number of 16 bit registers	Read or Write	Data Type	Step size & Units	Additional info
Reactive Power Sum	360..361	2	R	FLOAT32	1VAr	**NOTE** Chargers with a ABB power meter, produced before 2021 export all measured values and will return a numeric value for this register. Chargers with a Reallin power meter produced after 2021 export a subset of values and will return a NAN (not a number) value.
Real Energy Delivered Phase L1	362..365	4	R	FLOAT64	1Wh	-
Real Energy Delivered Phase L2	366..369	4	R	FLOAT64	1Wh	-
Real Energy Delivered Phase L3	370..373	4	R	FLOAT64	1Wh	-
Real Energy Delivered Sum	374..377	4	R	FLOAT64	1Wh	-
Real Energy Consumed Phase L1	378..381	4	R	FLOAT64	1Wh	-
Real Energy Consumed Phase L2	382..385	4	R	FLOAT64	1Wh	-
Real Energy Consumed Phase L3	386..389	4	R	FLOAT64	1Wh	-
Real Energy Consumed Sum	390..393	4	R	FLOAT64	1Wh	**NOTE** Chargers with a ABB power meter, produced before 2021 export all measured values and will return a numeric value for this register. Chargers with a Reallin power meter produced after 2021 export a subset of values and will return a NAN (not a number) value.
Apparent Energy Phase L1	394..397	4	R	FLOAT64	1VAh	-

APPENDIX F. MODE 3 STATE LISTING

Description	Address	Number of 16 bit registers	Read or Write	Data Type	Step size & Units	Additional info
Apparent Energy Phase L2	398..401	4	R	FLOAT64	1VAh	-
Apparent Energy Phase L3	402..405	4	R	FLOAT64	1VAh	-
Apparent Energy Sum	406..409	4	R	FLOAT64	1VAh	-
Reactive Energy Phase L1	410..413	4	R	FLOAT64	1VArh	-
Reactive Energy Phase L2	414..417	4	R	FLOAT64	1VArh	-
Reactive Energy Phase L3	418..421	4	R	FLOAT64	1VArh	-
Reactive Energy Sum	422..425	4	R	FLOAT64	1VArh	-
Status and Transaction Registers						
Availability	1200	1	R	UNSIGNED 16	-	• 1: Operative • 0: Inoperative
Mode 3 state	1201..1205	5	R	STRING	-	61851 states
Actual Applied Max Current	1206..1207	2	R	FLOAT32	1A	Actual Applied overall Max Current for socket
Modbus Server Max Current valid time	1208..1209	2	R	UNSIGNED 32	1s	Remaining time before fallback to safe current
Modbus Server Max Current	1210..1211	2	R/W	FLOAT32	1A	-
Active Load Balancing Safe Current	1212..1213	2	R	FLOAT32	1A	Active Load Balancing safe current
Modbus Server received setpoint accounted for	1214	1	R	UNSIGNED 16	-	• 1: Yes • 0: No
Charge using 1 or 3 phases	1215	1	R/W	UNSIGNED 16	phases	• 1: 1 phase • 3: 3 phase

F. Mode 3 State Listing

APPENDIX F. MODE 3 STATE LISTING

State	Signal voltage (DC)	PWM signal applied	Vehicle connected	Charging
A	12V	No	No	No
B1	9V	No	Yes	No
B2	9V	Yes	Yes	No
C1	6V	No	Yes	No
C2	6V	Yes	Yes	Yes
D1	3V	No	Yes	No
D2	3V	Yes	Yes	Yes
E	0V	No	No	No
F	-12V	No	No	No

NOTE

State F and E are error states.