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TERRA AC WALLBOX

# **TAC Modbus Communication**

## Modbus RTU – RS485 and TCP/IP

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# 1. Purpose

This document provides an overview of Modbus interface supported by Terra AC charger. And describes the Modbus registers details for anyone who is indented to establish communication with charger and scope of the document is designed to focus only on communication details.

# 2. Modbus Topology with Charger

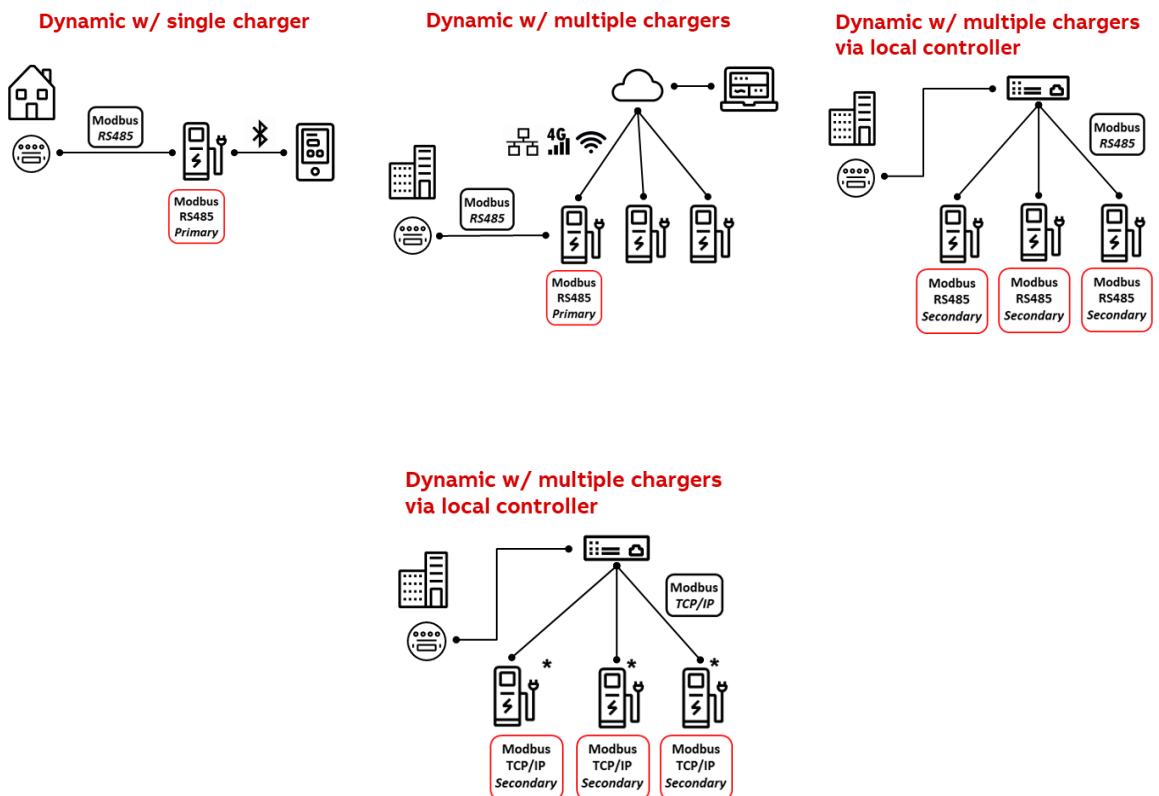
Modbus protocol enable to transmit information over serial lines between different systems/devices. Modbus devices communication works on the principle of Primary-Secondary (in Modbus RTU terminology) or Client-Server (in Modbus TCP/IP terminology).

The system which is requesting information/action is called Modbus Primary/Client (referred in this document as Primary Device) and the external system which is connected via serial line and responding/performing the action is called Modbus Secondary/Server (referred in this document as Secondary Device).

In essence, chargers act as a primary device mode if Modbus interface is used for reading an external meter or as a secondary device mode charger is controlled by any external system (often called local controller) which is managing the chargers.

For wiring/connection details with charger, refer “Electrical installation” section in the Terra AC Installation Manual.

There are different topology possible with charger and could be configured in the “Load Balance” option in the Terra Config app.



For more details refer to Load Management user manual.

### 3. Charger as a Primary Device

An external meter could be integrated with charger via Modbus RTU – RS485 where charger reads the external meter data via Modbus registers and uses for load management.

#### 3.1. Modbus RTU (RS485) configuration

To establish successful communication, protocol related settings need to be matched between meter and charger. For this purpose, Terra Config mobile app provides “communication Settings” options for example speed/ baud rate of Modbus.

Address	Baud rate	Data bits	Parity	Stop bit
Configurable to identify meter in the serial line, must be a unique address in the range from 1 to 247.	Configurable to select below speed (in bits per second) <ul style="list-style-type: none"> <li>• 4800</li> <li>• 9600</li> <li>• 19200</li> <li>• 38400</li> <li>• 57600</li> <li>• 115200</li> </ul>	8	<ul style="list-style-type: none"> <li>• None</li> <li>• Odd</li> <li>• Even</li> </ul>	1 or 2

##### 3.1.1. Compatible meters

Here is the list of meters compatible with charger to act as secondary device.

Meter Manufacturer	Model number	Connection Type
ABB	B21 xx2-xxx	Direct
	EV1 xx2-xxx	
	A41 xx2-xxx	
	B23 xx2-xxx	
	EV3 xx2-xxx	
	A43-xx2-xxx	
	A42 xx2-xxx	Indirect
	B24 xx2-xxx	
	A44-xx2-xxx	
Siemens	PAC3100	Indirect
Schneider	iEM3000 Series	Indirect
	PM5300 series	

Remark:

Terra Config also provides an option to configure phase related setting of a meter according to the installation.

## 4. Charger as Secondary Device

Charger supports to establish a network with primary device by Modbus RTU or TCP/IP. When charger is in secondary mode connected to local controller, recommended polling interval for readable data is 30s~90s. Based on the polling operation (at least read a register) and configurable timeout period, charger could understand whether Modbus communication is healthy or not. In case of unhealthy, charger could get into error state and stop the charging session.

### 4.1. Modbus RTU (RS485) configuration

Terra Config mobile app provides below options to establish connection.

Address	Baud rate	Data bits	Parity	Stop bit
Configurable to identify charger in the serial line, must be a unique address in the range from 1 to 247.	Configurable to select below speed (in bits per second) <ul style="list-style-type: none"> <li>• 4800</li> <li>• 9600</li> <li>• 19200</li> <li>• 38400</li> <li>• 57600</li> <li>• 115200</li> </ul>	8	<ul style="list-style-type: none"> <li>• None</li> <li>• Odd</li> <li>• Even</li> </ul>	1 or 2

Remark:

Many chargers could be daisy chained by wiring as a serial line. In this case, cable electrical characteristics and length choice, and other, may influence the overall setup. In such case a repeater may be helpful to improve the signal level.

### 4.2. Modbus TCP/IP configuration

Terra Config mobile app provides the options below to establish connection.

LAN IP setting	Server Port
Network IP settings for charger	TCP port number to listen.

Remark:

Note that while configuring the Modbus TCP, the mobile app indicates to disable LAN for Charger Link to enforce dedicated purpose. In general, chargers could be connected as different topology with LAN/Ethernet port to form a network with the primary device. Also, note that few variants of chargers come with “Daisy-chain”, refer brochure for more details.

## 5. Modbus Map

Charger supports below Modbus map (i.e.) where, what and how the data is stored.

Register Address	Register Type	Name/Purpose	Register Size	Resolution	Unit	Data type
4000h	Read Only	Serial Number	4	-	-	Unsigned
4004h	Read Only	Firmware version	2	-	-	Unsigned
4006h	Read Only	User Settable Max Current	2	0.001	A	Unsigned
4008h	Read Only	Error Code	2	-	-	Unsigned
400Ah	Read Only	Socket Lock State	2	-	-	Unsigned
400Ch	Read Only	Charging State	2	-	-	Unsigned
400Eh	Read Only	Charging Current Limit	2	0.001	A	Unsigned
4010h	Read Only	Charging Current L1	2	0.001	A	Unsigned
4012h	Read Only	Charging Current L2	2	0.001	A	Unsigned
4014h	Read Only	Charging Current L3	2	0.001	A	Unsigned
4016h	Read Only	Voltage L1	2	0.1	V	Unsigned
4018h	Read Only	Voltage L2	2	0.1	V	Unsigned
401Ah	Read Only	Voltage L3	2	0.1	V	Unsigned
401Ch	Read Only	Active Power	2	1	W	Unsigned
401Eh	Read Only	Energy Delivered	2	1	Wh	Unsigned
4020h	Read Only	Communication timeout	1	1	second	Unsigned
4100h	Write Only	Set Charging Current Limit	2	0.001	A	Unsigned
4103h	Write Only	Lock/Unlock Socket Cable	1	-	-	Unsigned
4105h	Write Only	Start/Stop Charging Session	1	-	-	Unsigned
4106h	Write Only	Communication timeout	1	1	second	Unsigned

## 5.1. Serial Number

This register provides information about serial number of the charger.

Note that it's an encoded/extracted information in the below format from actual serial number.

Byte	Field	Value significance	Example
7	Connector Type	<ul style="list-style-type: none"> <li>0x47 is Type 2 Cable represented as G.</li> <li>0x50 is Type 1 Cable represented as P.</li> <li>0x53 is Type 2 Socket with Shutter represented as S.</li> <li>0x54 is Type 2 Socket represented as T.</li> </ul>	Value 0x54 0x22 0x04 0x00 0x49 0x20 0x00 0x25 indicates the product serial number is TACW22-4-4920-T0025, the prefix "TACW" is not part of this message
6	Rated Power	<ul style="list-style-type: none"> <li>0x07 is 7kW</li> <li>0x11 is 11kW</li> <li>0x22 is 22 kW</li> </ul>	

Byte	Field	Value significance	Example
5	Plant ID	0x04	
4	Spare	0x00	
3	Production Week	build week of the calendar year 0x01~0x53	
2	ProductionYear	last 2 digits of the build calendar year 0x00~0x99	
1	Unique serial number high	0x00~0x99	
0	Unique serial number low	0x00~0x99	

## 5.2. Firmware version

This register provides the firmware version of the charger.

For example, value 0x01 0x02 0x13 0x00 indicates the firmware version is v1.2.13, the last byte is reserved.

## 5.3. User Settable Max Current

This register provides the maximum current value that can be supported by the hardware of the charger which is settable by Terra Config app.

## 5.4. Error Code

This register provides the error code of the charger. Value 0 represents No error. For other error code refer section “Troubleshooting” in the Terra AC user manual.

## 5.5. Socket Lock State

This register provides the below possible state. ‘Connector Type’ in the Serial number provides the information about whether the charging cable is socket version or not. Lock is possible only with socket version.

Value	Description	Socket	Non-socket
0x0000	No cable is plugged.	Applicable	Not applicable
0x0001	Cable is connected to the charging station unlocked.	Applicable	Applicable
0x0011	Cable is connected to the charging station locked.	Applicable	Not applicable
0x0101	Cable is connected to the charging station and the electric vehicle, unlocked in charging station.	Applicable	Applicable
0x0111	Cable is connected to the charging station and the electric vehicle, locked in charging station.	Applicable	Not applicable

## 5.6. Charging State

Byte 3	Byte 2	Byte 1		Byte 0
Spare	Spare	Bit 7	Bit 6 to 0	Spare
		0 - charging at rated current.	0 – State A (i.e.) Idle.	
		1 –Below the commanded value by 4100h.	1 - State B1 (i.e.) EV Plug in, pending authorization.	
			2 - State B2 (i.e.) EV Plug in, EVSE ready for charging (PWM).	
			3 - State C1 (i.e.) EV Ready for charge, S2 closed (no PWM).	
			4 - State C2 (i.e.) Charging Contact closed, energy delivering.	
5 - Others				

- The ‘State x’ above are represented from IEC 61851-1, however no intention to reflect all state in this register.

## 5.7. Charging Current Limit

This register provides the current limit chosen by the charger based on the various condition which include the 4100h register value.

## 5.8. Charging Current

This register provides the measured current value on each phase.

## 5.9. Voltage

This register provides the measured voltage value on each phase.

And values are based on the “Electrical Grid Network Type” configuration settings via Terra Config mobile app (i.e.) voltage value represents whether Line to Neutral or Line to Line.

## 5.10. Active Power

This register provides the active power.

## 5.11. Communication timeout

This register provides readback from 4106h.

## 5.12. Energy Delivered

This register provides the transferred energy of the current charging session.



### 5.13. Set Charging Current Limit

This provides an option to set charging current limit of the charger.

Since the charger uses an internal algorithm for load management, the current limit which is set may not be same as charger's load management decision. For this purpose, read back 400E register provides knowledge to the user.

In addition to that charging session will enter Pause state when the current limit is less than 6A. After that when current limit is set above 6A, then charging session will be resumed. The choice of 6A is derived from IEC 61851-1.

### 5.14. Lock/Unlock Socket Cable

This register provides an option only for Socket cable to lock or unlock on Charger side.

Value	Description
0	Unlock the cable/connector. Precaution is advised to make sure that no ongoing charging session prior to setting this state.
1	Cable will be locked irrespective of charging session until unlock is set or power cycle performed.

### 5.15. Start/Stop Charging Session

This register provides an option to start or stop a charge session.

Value	Description
0	Start charging session
1	Stop charging session

### 5.16. Communication timeout

This register provides an option to configure when the charger could decide whether charger lost communication with primary device as no operation (for example no read operation/pooling) performed within this timeout period in seconds.

The default value is 60 seconds. The range possible is from 10 to 65535.

## 6. Additional Information

### 6.1. Listing of related documents

Ref #	Document Kind, Title	Document No.
1	Modbus Specification <a href="http://www.modbus.org/">http://www.modbus.org/</a>	
2	IEC 61851-1:2017 Electric vehicle conductive charging system – Part 1: General requirements	
3	Terra AC User Manual	
4	Terra AC installation Manual	

Ref #	Document Kind, Title	Document No.
5	Terra AC Load Management user manual	

## 7. Addendum

### 7.1. Modbus protocol message format

This section provides the supporting information from the Modbus specification. For detailed information, refer Modbus specification.

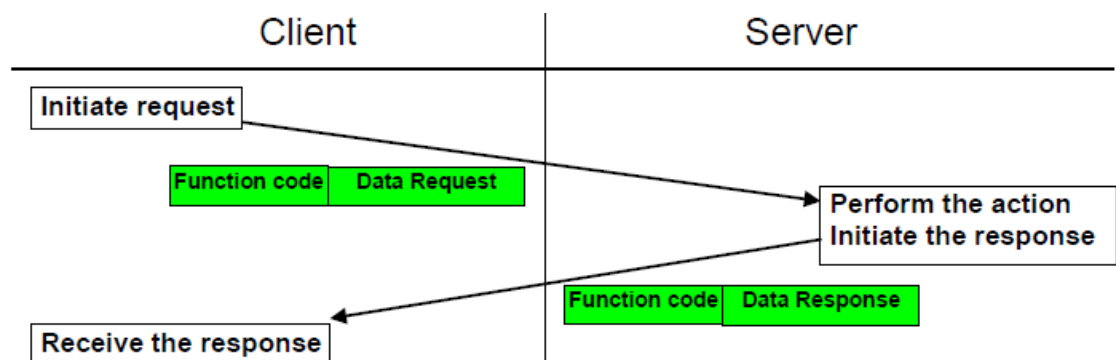
Primary tables	Object type	Type of	Comments
Discretes Input	Single bit	Read-Only	This type of data can be provided by an I/O system.
Coils	Single bit	Read-Write	This type of data can be alterable by an application program.
Input Registers	16-bit word	Read-Only	This type of data can be provided by an I/O system
Holding Registers	16-bit word	Read-Write	This type of data can be alterable by an application program.

Modbus map is organized as table and each register is 1 word = 16 bits = 2 bytes. And Modbus uses a “big-Endian” representation for addresses and data items. This means that when a numerical quantity larger than a single byte is transmitted, the most significant byte is sent first.

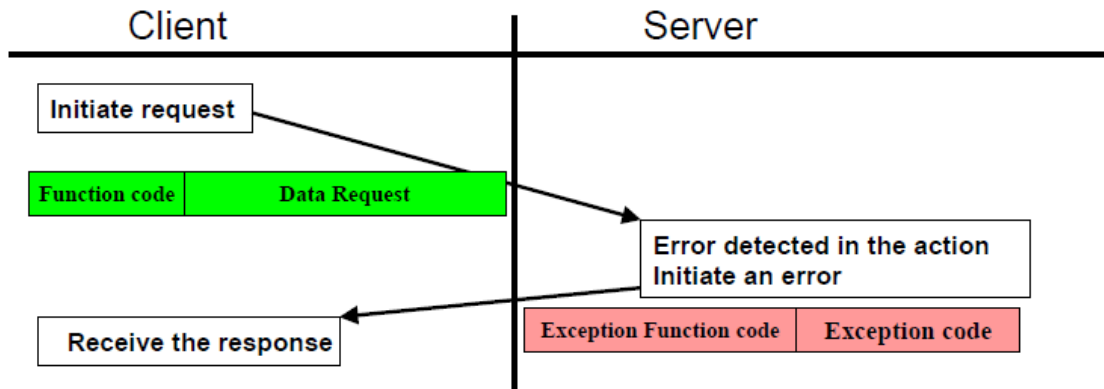
Below indicates the general Modbus frame structure which is used for Modbus message transaction.



The Modbus data could be obtained in the below sequence during error free scenario.



Here is the sequence during error scenario.



### 7.1.1. Charger supported Function Code

Charger designed to support only the below Function Code.

Function Code	Action	Table Name
3	Read	Holding Registers
6	Write single	Holding Register
16	Write multiple	Holding Registers

### 7.1.2. Exception code

If an error should occur while processing a request, then the charger gives an exception response that contains an exception code. In the exception response the function code is set to the function code of the request plus 0x80.

Exception code	Exception	Description
1	Illegal function	A function code that is not supported has been used.
2	Illegal data address	The requested register is outside the allowed range.
3	Illegal data value	The structure of a received message is incorrect.
4	Secondary device failure	Processing the request fail due to an internal error in the meter.

## 8. Revisions

Rev.	Page (P) Chapt. (C)	Description	Date Dept./Init.
1.7		<ul style="list-style-type: none"> <li>Document restructure and cleanup from TACWB Modbus Communication-0129 document.</li> <li>New registers are added for 'communication timeout'.</li> <li>'Set Charging Current Limit' behavior improvement.</li> </ul>	July 2022 PM/VJ