Integration of a Terra AC Wallbox into a KNX System via the Modbus KNX Gateway

BUILDING AND HOME AUTOMATION SOLUTIONS					
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Introduction

ABB Modbus KNX Gateway and Terra AC Wallbox

A Terra AC Wallbox can communicate with the ABB Modbus KNX Gateway via the integrated RS485 interface using the Modbus protocol. The meter data measured by the wallbox can thus be further processed in a KNX system. Charging can be started/stopped and the charging current can be specified via KNX. This means that depending on the availability of electrical energy, the charging of an electric car can be controlled.

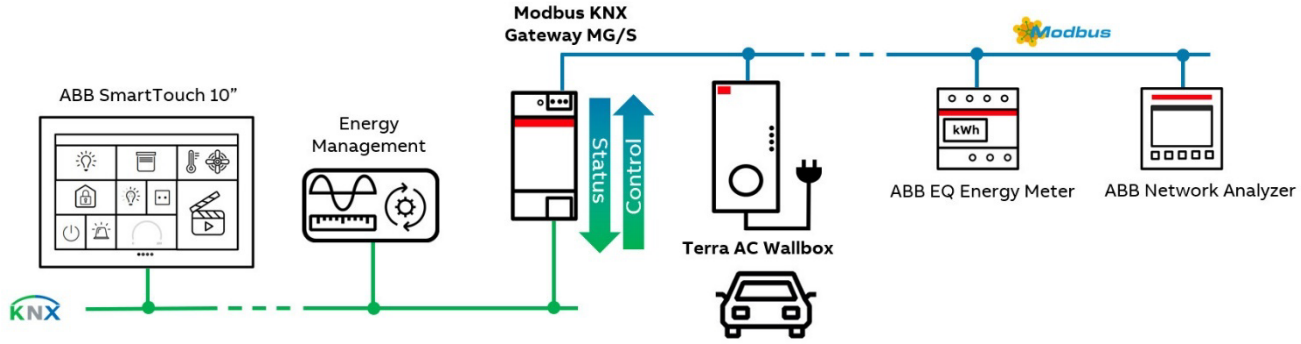

Fig. 1 System Overview Modbus KNX Gateway

Objectives of the document

This document is intended to support you in the correct commissioning of a Modbus KNX Gateway MG/S and a Terra AC Wallbox. We explain the necessary parameterization step by step.

ABB Modbus KNX Gateway

The ABB Modbus KNX Gateway (→ Link) is a compact modular installation device for the integration of Modbus RTU servers and KNX TP devices. The Modbus RTU - KNX TP Gateway is a bidirectional gateway with 100 freely configurable data points. The device functions as a Modbus RTU client and makes it easy to integrate Modbus servers that support the RTU protocol via RS-485.

Technical features:

- The device functions as a Modbus RTU client
- Up to 100 Modbus data points
- Up to 100 Modbus RTU servers
- Up to 254 Modbus RTU addresses
- Uses KNX standard data point types (DPTs)
- The device is powered via the bus and requires no additional auxiliary voltage
- ETS (Engineering Tool Software) is used to parameterize the device
- A Device Configuration App (DCA) is also available for easy configuration

Fig. 2 ABB Modbus KNX Gateway MG/S11.100.1.1

Electric vehicle charging stations

ABB offers a total EV charging solution from compact, high quality AC Wallboxes, reliable DC fast charging stations with robust connectivity, to innovative on-demand electric bus charging systems, we deploy infrastructure that meet the needs of the next generation of smarter mobility.

The Terra AC Wallbox is a powerful yet cost-effective charging solution for electric vehicles, which is characterized by its range of functions, in particular through digital integration in the apps and portals or energy management systems supplied. Whether in a single/multi-family house, functional building or in the parking garage.

Technical features:

- Load management (build-in energy meter, set up for external energy meter integration for dynamic load management and ready for integration with smart building energy systems)
- Built-in safety (overcurrent, overvoltage & undervoltage, ground fault, surge protection and PE continuity monitoring)
- Design (IEC variants: Single phase up to 7.4 kW/32A and three phase up to 22 kW/32 A and UL variants up to 19 kW/80 A)
- Connectivity (Ethernet RJ45, Bluetooth, Wi-Fi, 4G variants, RS485 for connection to energy meter, and OCPP)

Fig. 3 ABB EV charging solution

Fig. 4 Terra AC Wallbox

Step-by-Step Commissioning

1. General

This document is based on

- Terra AC Wallbox
  - Terra AC W22-T-R-C-0 (three phase, 22kW, 32A, socket type 2, RFID, 4G)
  - Firmware version V1.6.6
  - App “TerraConfig” V1.9.3
- Modbus KNX Gateway MG/S 11.100.1.1
  - ETS Application (.knxprod) 1.1
  - Firmware 1.0.1.0

2. Prerequisites

- ETS version: 5.7.7 / ETS 6 or higher
- ETS Device Configuration App “ABB MGS Template Configuration” (recommended for import of ready-made device templates)
- The Modbus KNX Gateway was installed and commissioned in accordance with the product manual and is ready for operation
- The Terra Wallbox was installed and configured according to the installation manual and is ready for operation
- The Terra Wallbox was wired to the Modbus KNX Gateway according to the Modbus guidelines
- The “TerraConfig” app was installed on the mobile phone and communicates with the Terra Wallbox

3. Configuration of the Terra Wallbox

The Modbus KNX Gateway is the only “Primary Device” (=client) and all other Modbus devices – including the Terra Wallbox – are “Secondary Devices” (=servers). A Modbus secondary device reads and writes from the Modbus local controller primary device.

When delivered, the Terra Wallbox works as a primary device. When operated on a Modbus KNX Gateway, however, it has to work as a secondary device!

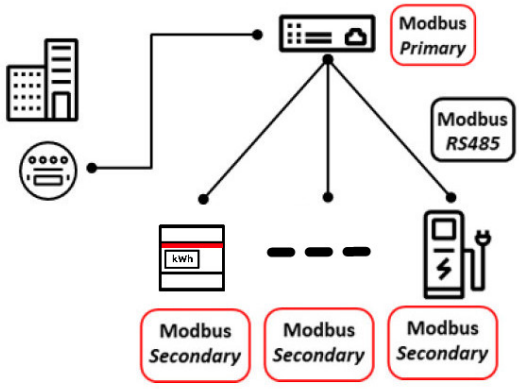

Fig. 5 Topology with one local controller and multiple meters and chargers

Setting the Terra Wallbox as a secondary device

- Open the “TerraConfig” app and connect to the wallbox
- Go to the menu “Configuration” and press “Load Balance”
  - Enable “Modbus”
  - Select “Multiple chargers via local controller”
  - Select “Modbus RTU (RS485)”
  - Set the Modbus address, baud rate, parity, stop bit and data bit (depending on the Modbus devices already configured) and press the “Save” button
- Close the “TerraConfig” app

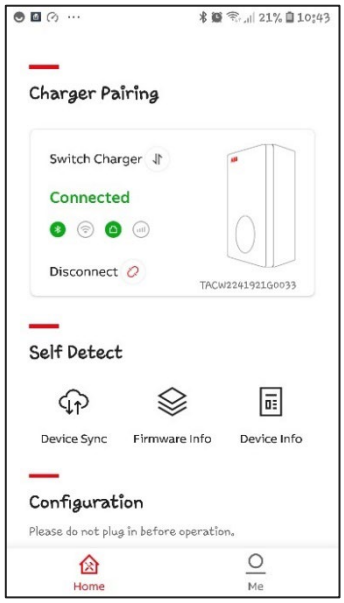

Fig. 6 TerraConfig

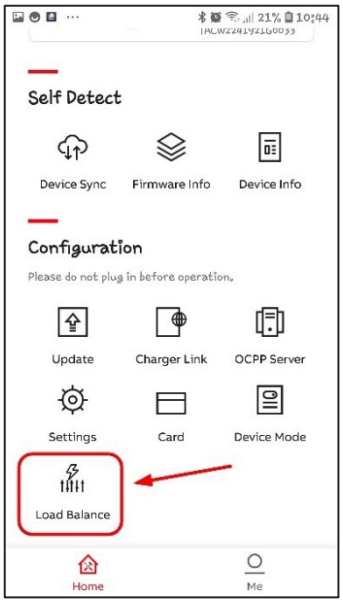

Fig. 7 Load Balance

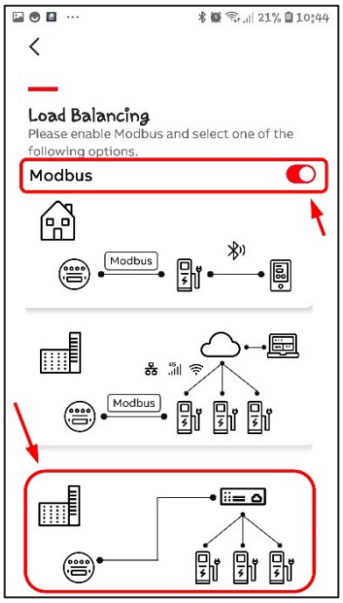

Fig. 8 Load Balance - Modbus

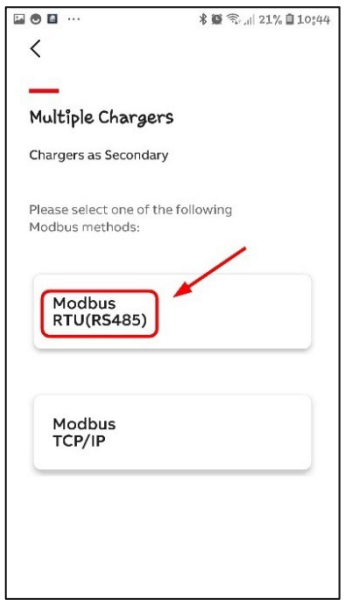

Fig. 9 Load Balance - Chargers

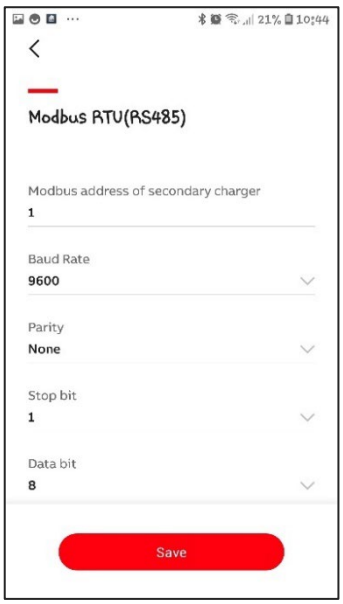

Fig. 10 Load Balance - Modbus RTU

The Terra Wallbox is now in the secondary mode and provides these data below
Source: "TAC Modbus Communication - Modbus RTU – RS485 and TCP/IP" V1.7 July 2022 → Link
and firmware version V1.6.6

Start Register		Name	Reg. size	Res.	Unit	Data Type	Attr.
4000h	16384d	Serial Number	4	-	-	Unsign.	RO
4004h	16388d	Firmware version	2	-	-	Unsign.	RO
4006h	16390d	Max rated/user settable current	2	0.001	A	Unsign.	RO
4008h	16392d	Error Code	2	-	-	Unsign.	RO
400Ah	16394d	Socket lock state	2	-	-	Unsign.	RO
400Ch	16396d	Charging state	2	-	-	Unsign.	RO
400Eh	16398d	Current charging current limit	2	0.001	A	Unsign.	RO
4010h	16400d	Charging current phase 1	2	0.001	A	Unsign.	RO
4012h	16402d	Charging current phase 2	2	0.001	A	Unsign.	RO
4014h	16404d	Charging current phase 3	2	0.001	A	Unsign.	RO
4016h	16406d	Voltage phase 1	2	0.1	V	Unsign.	RO
4018h	16408d	Voltage phase 2	2	0.1	V	Unsign.	RO
401Ah	16410d	Voltage phase 3	2	0.1	V	Unsign.	RO
401Ch	16412d	Active power	2	1	W	Unsign.	RO
401Eh	16414d	Energy delivered in charging session	2	1	Wh	Unsign.	RO
4020h	16416d	Communication timeout	1	1	sec	Unsign	RO
4022h	16418d	Charging current limit set by Modbus	2	0.001	A	Unsign.	RO
4100h	16640d	Set charging current limit (A)	2	0.001	A	Unsign.	WO
4103h	16643d	Lock/Unlock Socket Cable	1	-	-	Unsign	WO
4105h	16645d	Start/Stop Charging Session	1	-	-	Unsign	WO
4106h	16646d	Communication timeout	1	1	sec	Unsign	WO

Modbus uses 16-bit registers for data exchange. The smallest unit here is 16 bits or 2 bytes.
The register size of 2 thus corresponds to 32 bits or 4 bytes.
Order of bytes:

- Register size of 2 (Unsigned 32 bit, UINT32): AB CD
- Register size of 4 (Unsigned 64 bit, UINT64): AB CD EF GH

4. Configuration of the Modbus KNX Gateway MG/S

For easy configuration, the ETS Device Configuration App (DCA) “ABB MGS Template Configuration” is recommended. The DCA can be used to import ready-made device templates from a database. The DCA is available for download from the KNX Online Shop https://my.knx.org/ (free of charge) or product detail page → Download Link

Commissioning – Steps in ETS

- Set the parameters
  - General for KNX and Modbus
  - Per Modbus device
- Import device templates
  or
  map the Modbus KNX data points manually
- Set the desired KNX sending behavior for changing Modbus data in the deadband
- Link group addresses
- Download individual address and application

Modbus KNX Gateway MG/S parameters

- Set the parameters in the “GENERAL” menu for KNX and Modbus

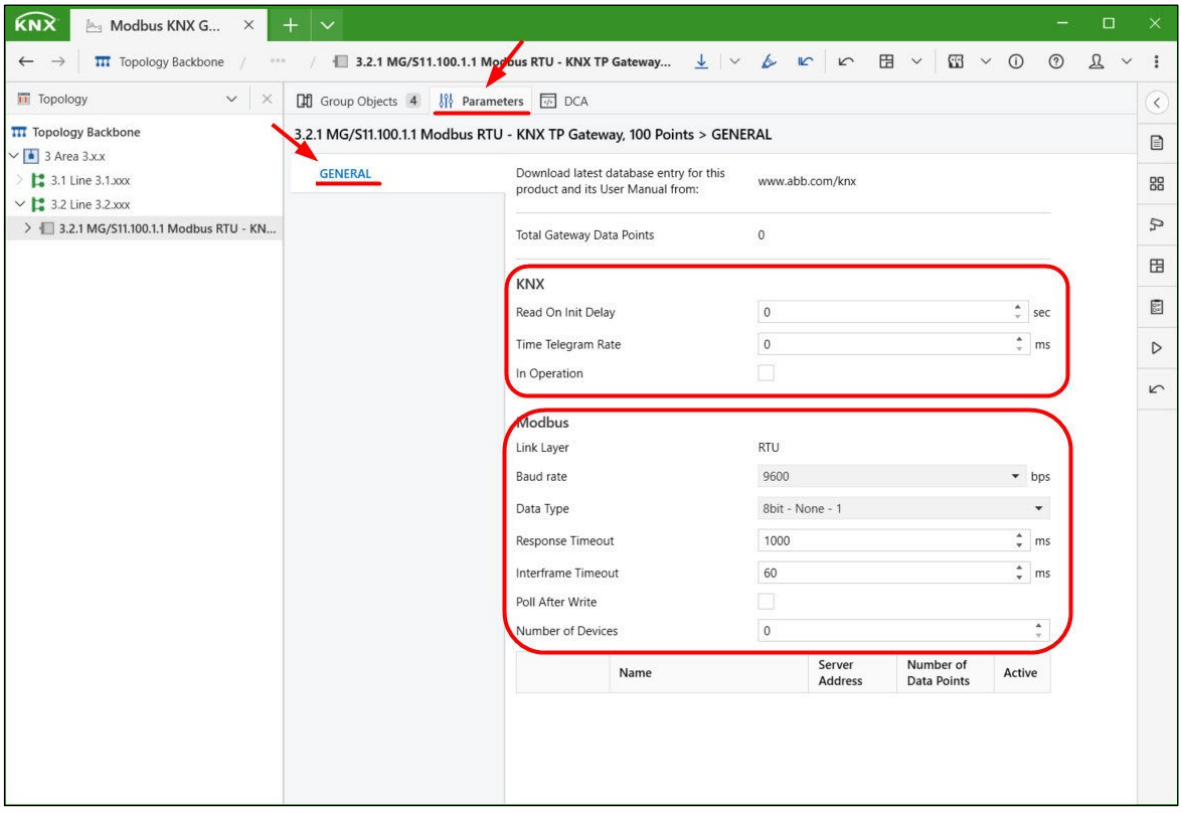

Fig. 11 General ETS Parameters

- A device template is available for the Terra Wallbox
  - Import the device template from an online database/local storage
  - Activate or deactivate data points by selecting them manually
  - Video clip “Video clip “How to know if a mapping template is available?” → Link
  - Video clip “How to import a mapping template?” → Link

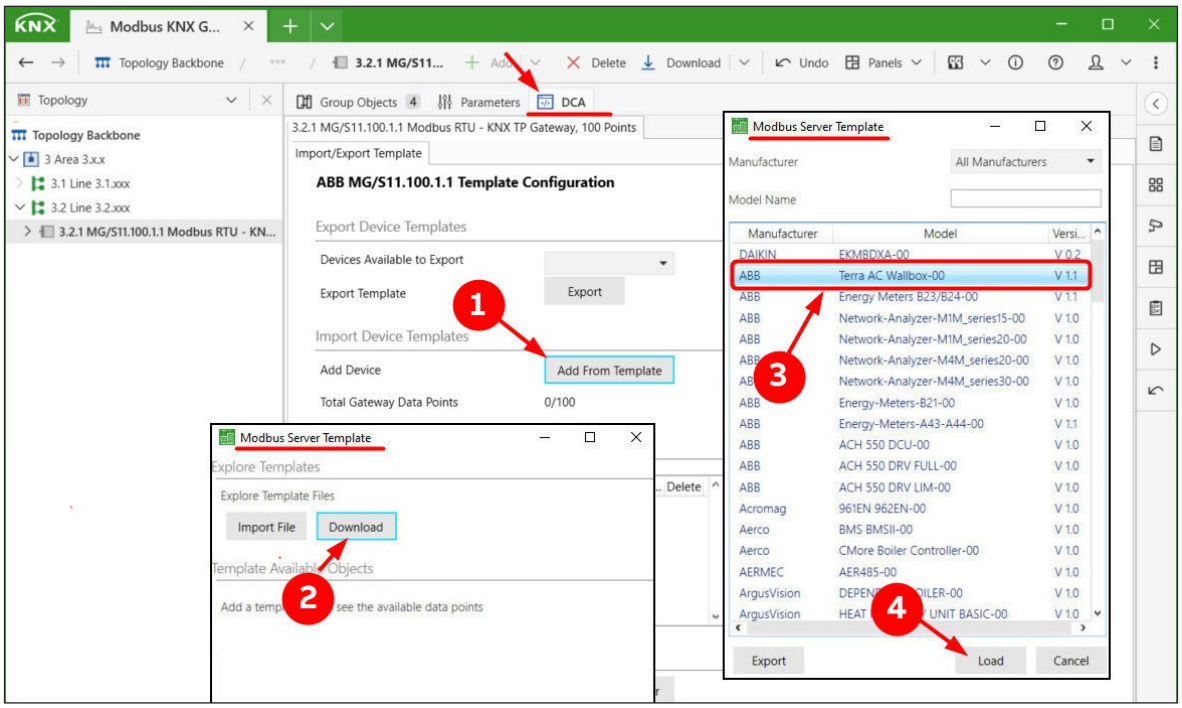

Fig. 12 Device template

  - The Modbus KNX Gateway will create a new device that includes the active data points with parameter settings e.g. object name, KNX data point type, read/write function, data format, length, byte order, register addresses, operation, …

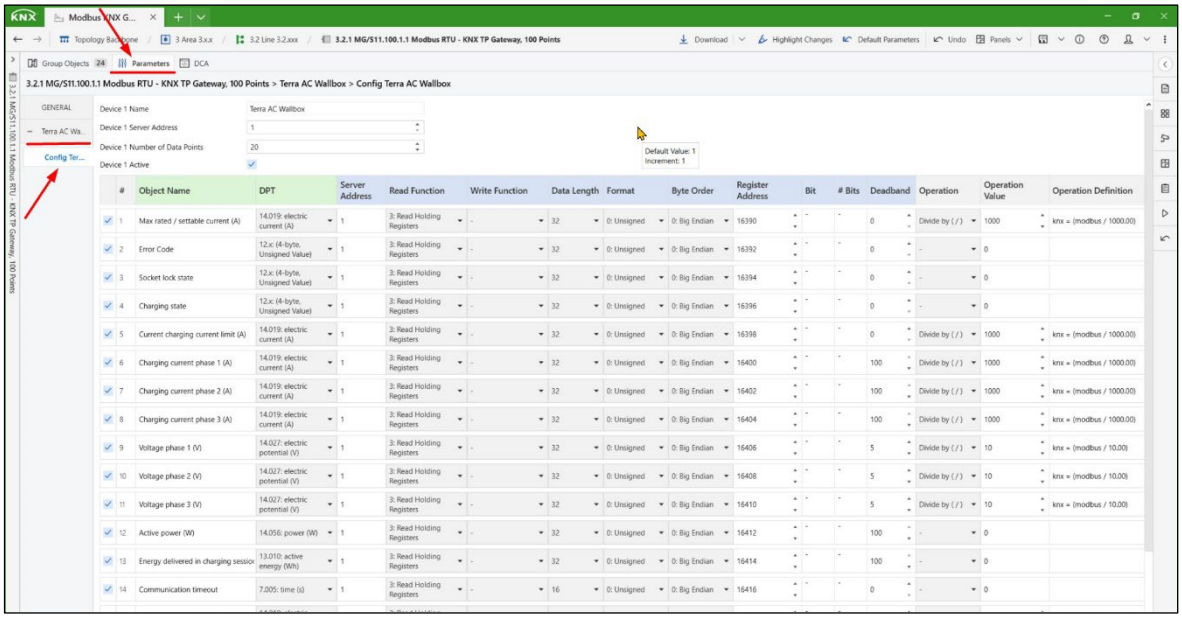

Fig. 13 Data points

- Set the desired KNX sending behavior for changing Modbus data in the deadband
  - The deadband defines the minimum value change of the Modbus data before the new value is written to the associated KNX status group object (KNX sending behavior)
  - This avoids excessive KNX sending when making minimal Modbus value changes
  - When calculating the deadband, always take the value and resolution of the Modbus raw data into account!
  - Example
    - A Terra Wallbox stores the voltage “phase 1” value of “230.8V” as “2308” with a resolution of “0.1” in the Modbus register

      → KNX value = “Register value” multiplied by the “Resolution”

      → KNX value = “Register value” divided by the inverse “Resolution” (=operation value)
    - For a minimum change in value of 0.5 V, the deadband should be set to “5”

      Deadband = “KNX min. change value” multiplied by inverse “Resol.” (=operation value)

      Deadband = “KNX min. change value” divided by “Resolution”

      5 = 0.5 / 0.1

#	Object Name	DPT	Register Address	Deadband	Operation	Operation Value	Operation Definition
9	Voltage phase 1 (V)	14.027: electric potential (V)	16406	5	Divide by (/)	10	knx = (modbus / 10.00)

Fig. 14 Deadband

- Link group addresses, download individual address and application

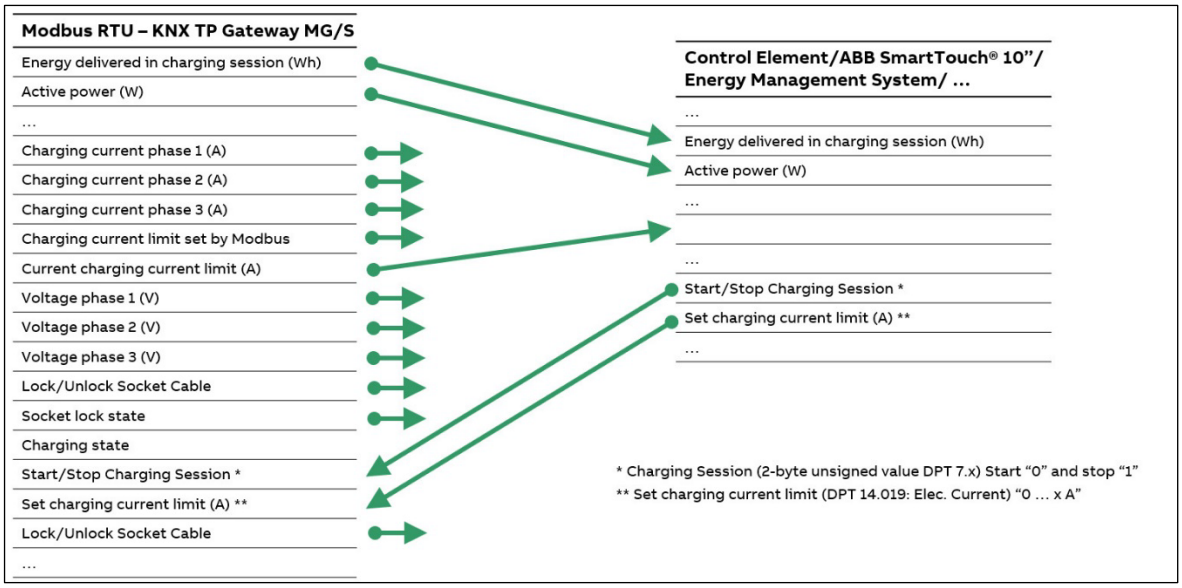

Fig. 15 Linked group addresses

- Example of communication between a Modbus KNX Gateway and a Terra AC Wallbox
  - Sending status messages to KNX
  - Starting/stopping the charging session and setting the max. charging current limit via KNX

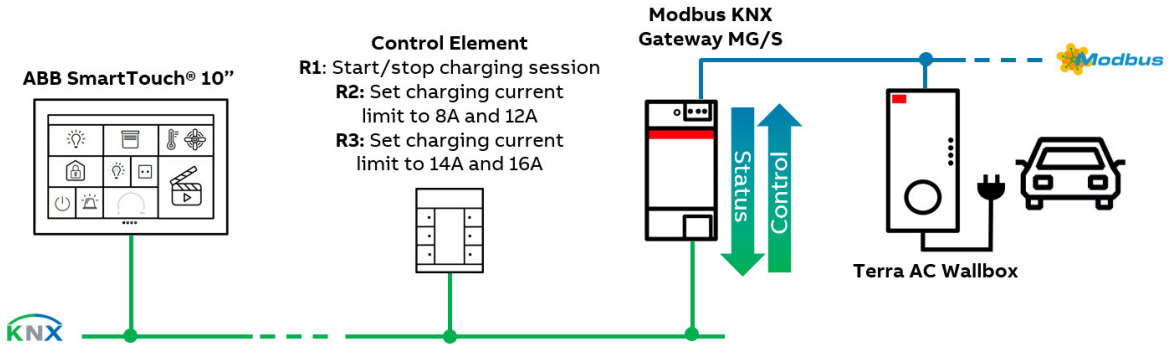

Fig. 16 Communication between Modbus and KNX

  - Parameter settings of the Control Element
    - Rocker 1: Left “Start” and right “Stop” charging session
      2-button value transmitter: 2-byte unsigned DPT 7.x, first button value “0” (=start) and second button value “1” (=stop)
    - Rocker 2: Set the max. charging current limit to 8A and 12A
      2-button value transmitter: 4-byte float, first button value “8” and second button value “12”
    - Rocker 3: Set the max. charging current limit to 14A and 16A
      2-button value transmitter: 4-byte float, first button value “14” and second button value “16”

  - Status from Modbus: Car connected to wallbox, ready to charge and charging not yet started

#	Source /	Source	Destination	Destination Name	DPT	Info
13	3.2.1	MG/S	2/4/201	Gateway Status In Operation 1-Active	1.011 state	$01 | Active
14	3.2.1	MG/S	2/4/1	TerraWB Status - Max rated / settable current (A)	14.019 electric current (A)	41 80 00 00 | 16 A
15	3.2.1	MG/S	2/4/2	TerraWB Status - Error Code	12.* 4-byte unsigned value	00 00 00 00 | 0
16	3.2.1	MG/S	2/4/3	TerraWB Status - Socket lock state	12.* 4-byte unsigned value	00 00 00 00 | 0
17	3.2.1	MG/S	2/4/4	TerraWB Status - Charging state	12.* 4-byte unsigned value	00 00 81 00 | 33024
18	3.2.1	MG/S	2/4/5	TerraWB Status - Current charging current limit (A)	14.019 electric current (A)	41 80 00 00 | 16 A
19	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	00 00 00 00 | 0 A
20	3.2.1	MG/S	2/4/7	TerraWB Status - Charging current phase 2 (A)	14.019 electric current (A)	00 00 00 00 | 0 A
21	3.2.1	MG/S	2/4/8	TerraWB Status - Charging current phase 3 (A)	14.019 electric current (A)	00 00 00 00 | 0 A
22	3.2.1	MG/S	2/4/9	TerraWB Status - Voltage phase 1 (V)	14.027 electric potential (V)	43 6A B3 33 | 234,7 V
23	3.2.1	MG/S	2/4/10	TerraWB Status - Voltage phase 2 (V)	14.027 electric potential (V)	43 6A 80 00 | 234,5 V
24	3.2.1	MG/S	2/4/11	TerraWB Status - Voltage phase 3 (V)	14.027 electric potential (V)	43 6A 4C CD | 234,3 V
25	3.2.1	MG/S	2/4/12	TerraWB Status - Active power (W)	14.056 power (W)	00 00 00 00 | 0 W
26	3.2.1	MG/S	2/4/13	TerraWB Status - Energy delivered in charging session (Wh)	13.010 active energy (Wh)	00 00 00 00 | 0 Wh
27	3.2.1	MG/S	2/4/14	TerraWB Status - Communication timeout	7.005 time (s)	00 3C | 60 s
28	3.2.1	MG/S	2/4/15	TerraWB Status - Charging current limit set by Modbus	14.019 electric current (A)	42 00 00 00 | 32 A
29	3.2.1	MG/S	2/4/20	TerraWB Status - Firmware version	12.* 4-byte unsigned value	01 06 06 00 | 17171968

Fig. 17 ETS Group monitor

- Start charging session via KNX

#	Source A	Source	Destination	Destination Name	DPT	Info
1	Start	SBR/U	2/4/18	TerraWB Control - Start/Stop Charging Session	7.* 2-byte unsigned value	00 00 | 0
2	3.2.1	MG/S	2/4/4	TerraWB Status - Charging state	12.* 4-byte unsigned value	00 00 82 00 | 33280
3	3.2.1	MG/S	2/4/4	TerraWB Status - Charging state	12.* 4-byte unsigned value	00 00 84 00 | 33792
4	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	3F 66 66 66 | 0,9 A
5	3.2.1	MG/S	2/4/10	TerraWB Status - Voltage phase 2 (V)	14.027 electric potential (V)	43 6A E6 66 | 234,9 V
6	3.2.1	MG/S	2/4/12	TerraWB Status - Active power (W)	14.056 power (W)	43 23 00 00 | 163 W
7	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	41 52 14 7B | 13,13 A
8	3.2.1	MG/S	2/4/9	TerraWB Status - Voltage phase 1 (V)	14.027 electric potential (V)	43 67 80 00 | 231,5 V
9	3.2.1	MG/S	2/4/12	TerraWB Status - Active power (W)	14.056 power (W)	45 2A 50 00 | 2725 W
10	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	41 66 3D 71 | 14,39 A
11	3.2.1	MG/S	2/4/12	TerraWB Status - Active power (W)	14.056 power (W)	45 4B 00 00 | 3248 W
12	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	41 71 EB 85 | 15,12 A
13	3.2.1	MG/S	2/4/12	TerraWB Status - Active power (W)	14.056 power (W)	45 57 D0 00 | 3453 W
14	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	41 73 85 1F | 15,22 A
15	3.2.1	MG/S	2/4/13	TerraWB Status - Energy delivered in charging session (Wh)	13.010 active energy (Wh)	00 00 00 64 | 100 Wh

Fig. 18 ETS Group monitor: Start charging

- Charging in progress, set max. charging current to 8A via KNX

#	Source A	Source	Destination	Destination Name	DPT	Info
max.8A		SBR/U	2/4/16	TerraWB Control - Set charging current limit (A)	14.019 electric current (A)	41 00 00 00 | 8 A
2	3.2.1	MG/S	2/4/15	TerraWB Status - Charging current limit set by Modbus	14.019 electric current (A)	41 00 00 00 | 8 A
3	3.2.2	MG/S	2/4/5	TerraWB Status - Current charging current limit (A)	14.019 electric current (A)	41 00 00 00 | 8 A
4	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	41 69 47 AE | 14,58 A
5	3.2.1	MG/S	2/4/12	TerraWB Status - Active power (W)	14.056 power (W)	44 F4 00 00 | 1952 W
6	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	40 E8 00 00 | 7,25 A
7	3.2.1	MG/S	2/4/12	TerraWB Status - Active power (W)	14.056 power (W)	44 CD A0 00 | 1645 W
8	3.2.1	MG/S	2/4/13	TerraWB Status - Energy delivered in charging session (Wh)	13.010 active energy (Wh)	00 00 02 C0 | 704 Wh

Fig. 19 ETS Group monitor: Set max. charging current

- Charging in progress, set max. charging current to 14A via KNX

#	Source A	Source	Destination	Destination Name	DPT	Info
max.14A		SBR/U	2/4/16	TerraWB Control - Set charging current limit (A)	14.019 electric current (A)	41 60 00 00 | 14 A
2	3.2.1	MG/S	2/4/5	TerraWB Status - Current charging current limit (A)	14.019 electric current (A)	41 60 00 00 | 14 A
3	3.2.1	MG/S	2/4/15	TerraWB Status - Charging current limit set by Modbus	14.019 electric current (A)	41 60 00 00 | 14 A
4	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	40 ED 1E B8 | 7,41 A
5	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	41 02 B8 52 | 8,17 A
6	3.2.1	MG/S	2/4/12	TerraWB Status - Active power (W)	14.056 power (W)	44 DF 40 00 | 1786 W
7	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	41 0E 8F 5C | 8,91 A
8	3.2.1	MG/S	2/4/12	TerraWB Status - Active power (W)	14.056 power (W)	44 FC 40 00 | 2018 W
9	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	41 2A E1 48 | 10,68 A
10	3.2.1	MG/S	2/4/12	TerraWB Status - Active power (W)	14.056 power (W)	45 14 10 00 | 2369 W
11	3.2.1	MG/S	2/4/12	TerraWB Status - Active power (W)	14.056 power (W)	45 22 D0 00 | 2605 W
12	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	41 43 85 1F | 12,22 A
13	3.2.1	MG/S	2/4/12	TerraWB Status - Active power (W)	14.056 power (W)	45 2A 40 00 | 2724 W
14	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	41 50 28 F6 | 13,01 A
15	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	41 55 47 AE | 13,33 A

Fig. 20 ETS Group monitor: Set max. charging current

- Stop charging session via KNX

#	Source A	Source	Destination	Destination Name	DPT	Info
1	Stop	SBR/U	2/4/18	TerraWB Control - Start/Stop Charging Session	7.* 2-byte unsigned value	00 01 | 1
2	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	40 8A 8F 5C | 4,33 A
3	3.2.1	MG/S	2/4/12	TerraWB Status - Active power (W)	14.056 power (W)	45 10 C0 00 | 2316 W
4	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	3F 66 66 66 | 0,9 A
5	3.2.1	MG/S	2/4/12	TerraWB Status - Active power (W)	14.056 power (W)	3F 80 00 00 | 1 W
6	3.2.1	MG/S	2/4/4	TerraWB Status - Charging state	12.* 4-byte unsigned value	00 00 85 00 | 34048
7	3.2.1	MG/S	2/4/6	TerraWB Status - Charging current phase 1 (A)	14.019 electric current (A)	00 00 00 00 | 0 A
8	3.2.1	MG/S	2/4/12	TerraWB Status - Active power (W)	14.056 power (W)	00 00 00 00 | 0 W

Fig. 21 ETS Group monitor: Stop charging

More information and training material

Training & Qualification Database

- The database contains extensive training content (Webinar, learning sessions, presentations, video tutorials, and more …):
  https://new.abb.com/low-voltage/products/building-automation/service-and-tools/training-and-qualification/training-qualification-database
- Webinar Presentation “Modbus RTU – KNX TP Gateway MG/S 11.100.1.1”:
  https://search.abb.com/library/Download.aspx?DocumentID=9AKK108468A1548&LanguageCode=en&DocumentPartId=PDF&Action=Launch
- Webinar Recording “Modbus RTU – KNX TP Gateway MG/S 11.100.1.1”:
  https://search.abb.com/library/Download.aspx?DocumentID=9AKK108468A1548&LanguageCode=en&DocumentPartId=MP4&Action=Launch

ABB Terra AC Wallbox

- Microsite (overview, introduction, manuals, …):
  https://new.abb.com/ev-charging/terra-ac-wallbox
- Terra AC Quick Start Guide:
  https://abb-quickstartguide.s3-eu-west-1.amazonaws.com/tac_quickstart_EN/index.html#/

ABB Modbus KNX Gateway MG/S

- Microsite (overview, introduction, manuals, …):
  https://new.abb.com/low-voltage/products/building-automation/product-range/abb-i-bus-knx/modbus-knx-gateway
- Product Manual
  https://search.abb.com/library/Download.aspx?DocumentID=9AKK108467A5941&LanguageCode=en&DocumentPartId=EN_PDF&Action=Launch
- ETS Device Configuration App “ABB MGS Template Configuration”
  → Link

References to other documents

- FAQ Home and Building Automation
- Engineering Guide Database
- News-Ticker
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