KACO new energy.

Modbus Protocol
blueplanet 3.0-10.0 TL3
blueplanet 15.0-20.0 TL3
blueplanet 50.0 TL3
Powador 39.0-72.0 TL3
blueplanet 87.0-150 TL3

Application Note

EN-US

Operating Instructions

Modbus Protocol

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1 General information

1.1 Scope

This document describes the general aspects of the MODBUS protocol of the KACO string inverter series. The inverters support a subset of data models according to the SunSpec specification. For a detailed description of particular models refer to [8]. In this document the supported subset is highlighted.

Besides that KACO supports some vendor specific models which will be described in [9].

Supported MODBUS protocols (legacy devices with local GUI)

- Modbus TCP/UDP

Supported MODBUS protocols (new devices with dedicated web interface)

- Modbus TCP/UDP

Supported Inverter Model

- blueplanet TL1/TL3 series
- Powador TL3 series

Supported SW Version

Inverter family	Firmware Version	Supported Models Device ID
Kaco blueplanet 3.0 – 10.0 TL3; Kaco blueplanet 15.0-20.0 TL3; Kaco blueplanet 50.0 TL3	V2.02 till 3.1x	Read only inverter models 001, 102, 103
	V3.22 till V3.xy	001, 102, 103, 122, 123
	V4.00 till V 4.xy	001, 102, 103, 122, 123, 112, 113, 129, 130, 135, 136, 160
	V5.00 till V 5.xy	001, 102, 103, 122, 123, 112, 113, 120, 121, 122, 123, 126, 129, 130, 132, 135, 136, 160
blueplanet 87.0-150TL3	V1.00 till V 1.xy	001, 103, 113, 120, 121, 122, 123, 126, 129, 130, 132, 135, 136, 160
	V2.00 till V 2.xy	001, 103, 113, 120, 121, 122, 123, 126, 129, 130, 132, 135, 136, 160
Powador 39.0-72.0 TL3	V2.10 till V2.xy	Read only inverter models 001, 102, 103
	V3.00 till V3.xy	001, 102, 103, 122, 123
	V4.00 till V4.xy	001, 102, 103, 122, 123, 112, 113, 129, 130, 135, 136, 160
	V5.00 till V5.xy	001, 102, 103, 122, 123, 112, 113, 120, 121, 122, 123, 126, 129, 130, 132, 135, 136, 160

Tab. 1: Supported SW Version

To see all supported models and registers of this software version, see the attached excel charts.

SunSpec-Information-Model-Reference.xlsx

SunSpec-Information-Model-Reference-Kaco.xlsx

1.2 More information

Modbus Organization

[1] http://www.modbus.org

[2] Modbus_Application_Protocol_V1_1b3.pdf

[3] Modbus_Messaging_Implementation_Guide_V1_0b.pdf

SunSpec Specification

[4] http://www.sunspec.org

[5] SunSpec-Alliance-Specification-Common-Models-v1.5.pdf

[6] SunSpec Alliance Specification - Inverter Models v1.1.pdf

[7] SunSpec Information Models – 12041.pdf (SunSpec Information Model Specification SunSpec Alliance Interoperability Specification V1.8)

SunSpec Models

[8] SunSpec-Information-Model-Reference.xlsx

[9] SunSpec-Information-Model-Reference-Kaco.xlsx

1.3 Target group

All activities described in the document may only be carried out by specially trained personnel with the following qualifications:

- Knowledge about IP-based network protocols
- Knowledge of the modbus specifications
- Knowledge of the SunSpec modbus specifications
- Education concerning the installation and configuration of IT systems
- Training in the handling of hazards and risks during the installation and operation of electrical devices and systems.
- Education concerning the installation and start-up of electrical devices and systems.
- Knowledge of applicable standards and directives.
- Knowledge and adherence to this document with all safety notices.

2 Register Map

2.1 Scaling factors

“SF” in below table is an abbreviation of “Scaling Factor”. You can calculate a real value of specific address using SF value, received value via MODBUS and following equation.

{Read Value}={Received value via MODBUS}*$10^{\{SF\}}$

Example:

Address offset 29 and 30 mean DC voltage and the DCV-SF value is -1. If a received value via MODBUS is 5042, DC voltage is as follow.

{DC Voltage}=(5042)*$10^{(-1)}$=504.2 Volt

The way to use Scale Factor is the same of SunSpec specifications.

2.2 SunSpec register map

The register map must start with the SunSpec ID, indicating that the following registers are Modbus/SunSpec registers. The base register address is 40001, and has the following representation:

Address Start	Address End	Size	R/W	Name	Type	Units	SF	Description	Value Range
40001	40002	2	R	SunSpec ID	uint32	-	-	Uniquely identifies this as a SunSPec Modbus Map	0x53756e53

After this SunSpecID the supported SunSpec models follow one by one. To retrieve the offsets for the supported SunSpec models in the register map, the headers for each have to be parsed until a specific “END_OF_MAP” model is found. This model has the following content:

Address Offsett	Block off-set	Size	R/W	Name	Type	Units	SF	Descrip-tion	Value Range
0	-	1	R	SunSpec DID	uint16	-	-	End of Reg-ister map	0xFFFF
1	-	1	R	SunSpec Length	uint16	-	-	Model length	0

2.3 Adress calculation example

WARNING! If a device does not contain the same firmware version according to the specification "SunSpec Modbus Interface" version, parameters may be called incorrectly. If Modbus-UDP is activated, all connected devices need same firmware-version.

NOTE: In a Modbus communication robustly constructed against model changes, first all models are read out and then the register addresses are calculated.

1. Search for the string "Su"nS" -> in the example 40001 [Pos. 1]
2. Advance by the length of the string: i.e. + 2 auf 40003
3. Reading the model names -> 1 [Pos. 2]
4. Reading the model length -> 66 [Pos. 3]
5. Advance to the next model -> 40003 + 2 + 66 = 40071 [Pos. 4]
6. Reading the name (result depends on which models are supported)
7. Reading the length (result depends on which models are supported)
8. Move forward to the next model [Pos. 5]
9. Repeat the procedure to the end. [Pos. 6]

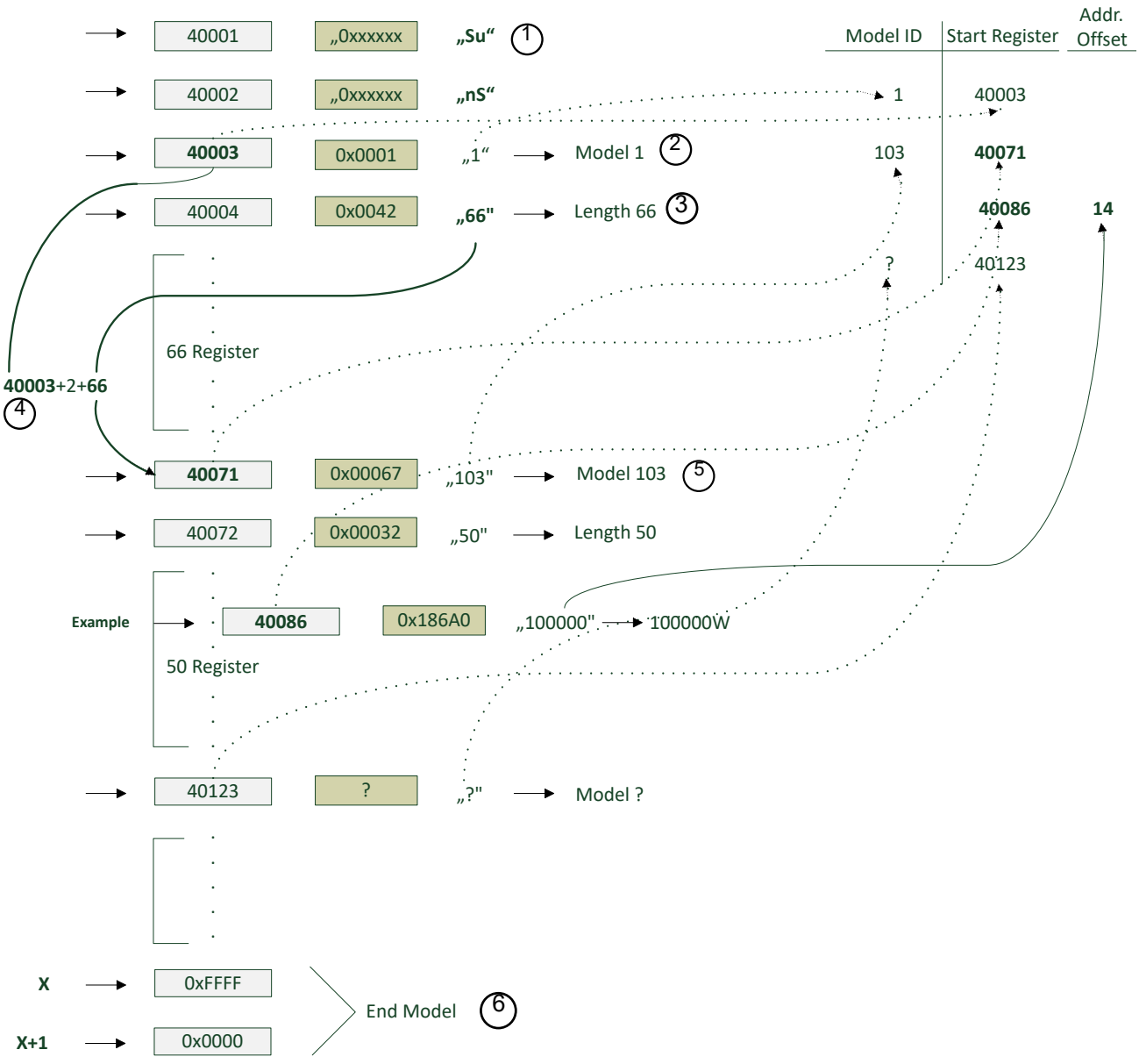

Fig. 1: Address calculation model

This method to enumerate all supported models can be repeated, until the “END_OF_MAP” model with DID 0xFFFF is found.

To retrieve an explicit value from a certain model, the offset of that value has to be added to the models offset retrieved in the manner above.

2.4 Adress calculation example

Example for power control over Model DID123

This example will show, how to set a power control value of 50% P over SunSpec model DID123.

1. During init phase run the SunSpec register map lookup (as described in chapter 4.2 [See section 2.2▸ Page 4]) to find out the offset of the start register of SunSpec model DID123. This step has to be preformed only once during init phase.
2. For this example we assume, that this step gives us a start address of SunSpec model DID123 of 40290 ((be aware of the difference between register number and its address as described in chapter 4.2 [See section 2.2▸ Page 4])
3. Setting ‘WMaxLimPct’ register in SunSpec model DID123. For this we need to lookup the relative address offset of ‘WMaxLimPct’ register address within the model definition of SunSpec model DID123 to retrieve its absolute address within the register map:

```
WMaxLimPct relativer Adress-Offset = 5
DID123-Startadresse = 40290
WMaxLimPct absolute Adresse = 40290 + 5 = 40295
```

1. Now that we have the absolute register offset to write, the desired power control value need to be correctly scaled. Therefor the scale facter ‘WMaxLimPct_SF’ is needed. In our example reading this will return a scale factor of ‘-1’. With this we calculate the value to set to the ‘WMaxLimPct’ register (like described in chapter 4.1 [See section 2.1▸ Page 4]):

```
Register value = 50.0(%) / 10-1 = 500
```

1. Now the desired value 500 (=0x01f4) may be set using a Modbus write command on the absolute address 40295 (=0x9d67). The value set must be in legal ranges, otherwise a Modbus exception will be returned. For example using the ModbusTCP write single register command 0x06:

```
TX:00 0c 00 00 00 06 01 06 9d 67 01 f4
RX:00 0c 00 00 00 06 01 06 9d 67 01 f4
```

1. Enable power limitation by writing ‘WMaxLim_Ena’ Register. Like in the previous step, we need to lookup the absolute address of ‘WMaxLim_Ena’ register.

```
WMaxLim_Ena relative address offset = 9
DID123 start address = 40290
WMaxLim_Ena absolute address = 40290 + 9 = 40299
```

1. Writing a ‘1’ = ENABLED to the register address 40299 will start external power control. For example using the ModbusTCP write single register command 0x06:

```
TX: 00 0d 00 00 00 06 01 06 9d 6b 00 01
RX: 00 0d 00 00 00 06 01 06 9d 6b 00 01
```

Example for requesting string combiner values

This example shall demonstrate how to request SunSpec registers from a string combiner board over the ModbusTCP-RS485 bridge of the new inverters with dedicated web interface. Therefor the magic ID “SunS” shall be read from the start address 40000 from the string combiner device.

1. Check string combiner address to request SunSpec values from. In our example the string combiner board has been configured with the unit address 11:

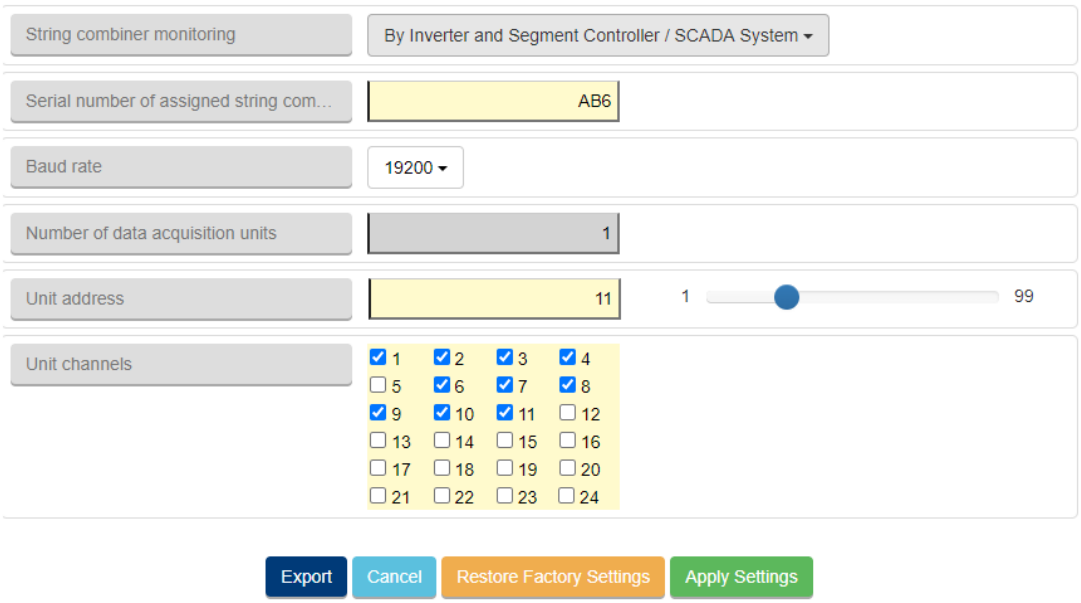

Fig. 2: string combiner board

1. To read the magic ID “SunS” (=0x53 0x75 0x6e 0x53) from the string combiner device at start address 40000 (=0x9c40), use the configured unit address 11 (=0x0b) as unit ID in the Modbus read holding register request (command 0x03) to read two registers:
2. `TX: 00 02 00 00 00 06 0b 03 9c 40 00 02`
3. `RX: 00 02 00 00 00 07 0b 03 04 53 75 6e 53`

3 Register description

NOTE

For a detailed description of particular models / registers refer to SunSpec Models xls.!

NOTE

Again – keep in mind, that when you refer to a specific address in a model you´ve to use the register_address – 1 > on the wire!

NOTE

Setting specific functions via model 123

Refer to the Chapter “Specifications” in the device manual. You will find additional explanations of functions there, as well as examples that use sample parameters.

3.1 Common Block (Device ID001)

The register description for “Common Block (DID 001) is only an example may not reflect the current implementation.

Address Offset	Block Offset	Size	R/W	Name	Type	Units	SF	Description	Value Range
0	-	1	R	SunSpec DID	unit16	-	-	SunSpec Common Model	001 (dec)
1	-	1	R	SunSpec Length	uint16	-	-	Model Length	66 (dec)
2	0	16	R	Manufacturer	string	-	-		„KACO new energy“

Address Offset	Block Offset	Size	R/W	Name	Type	Units	SF	Description	Value Range
18	16	16	R	Model	string	-	-	KACO inverter name	e.g. “Powador 39.0 TL3”
34	32	8	R	Options	string	-	-	Data logger ID-String	e.g. “390TL“
42	40	8	R	Version	string	-	-	The packet version of the currently installed software	e.g. “V2.10”
50	48	16	R	Serial Number	string	-	-	Serial number set during production process	e.g. “39.0TL011 23456”
66	64	1	-	Device Address	uint16	-	-	Not implemented	-
67	65	1	R	-	pad	-	-	Force even alignment	0

4 FAQ

Fault	Cause
What communication protocol should be used?	The SunSpec protocol provided and the KACO extension list pave the way for dynamic addressing. Update these protocols at regular intervals.
What should I do if the device does not answer?	Check whether you can reach the device using a ping (device address). In the event of a fault, please check the communication line.
Modbus is not displaying the value expected.	Check whether you have performed the calculation via the chosen start address in accordance with the example - Calculation model addresses. Adress calculation example [See section 2.3 Page 6] You can obtain a demo tool from our service team that will assist you in calculating the required register address.

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