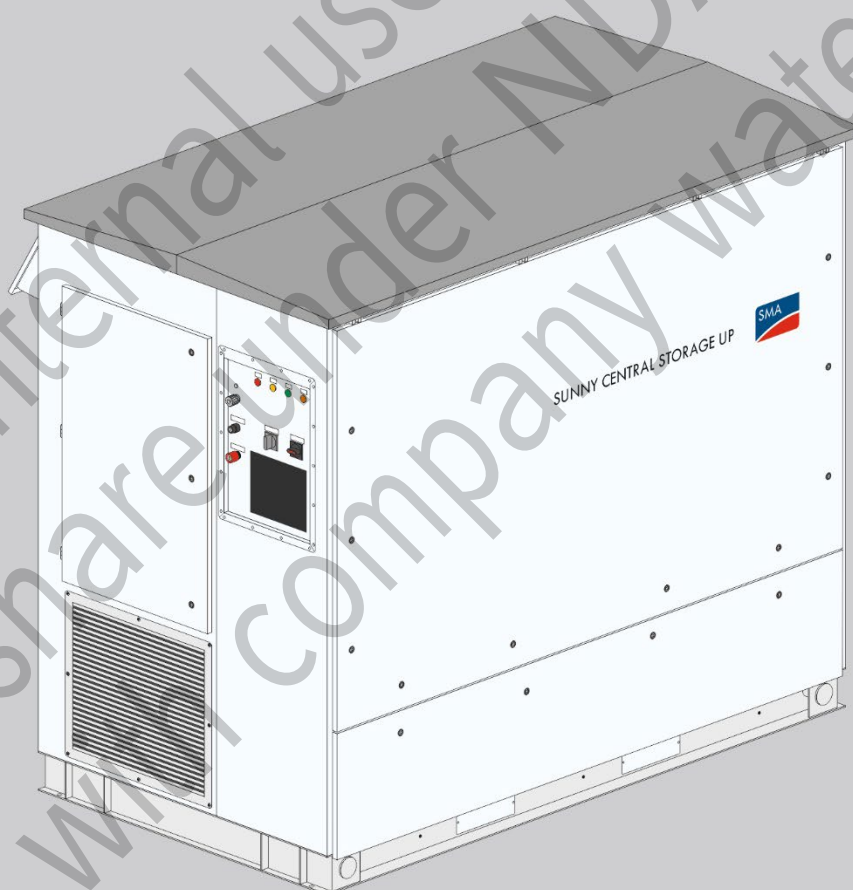




Technical Information

**Modbus® Interface for
SUNNY CENTRAL STORAGE**



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SMA recommends the use of the SMA Fuel Save Controller or Hybrid Controller for park control which is optimally matched to the entire storage system. It guarantees a reliable, efficient and stable system operation while observing required specifications, characteristic curves and tolerances.

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1 Information on this Document

1.1 Validity

This document is valid for the following device types from firmware version 10.02.xx.R:

- Sunny Central Storage 1900 (SCS-1900)
- Sunny Central Storage 2200 (SCS-2200)
- Sunny Central Storage 2475 (SCS-2475)
- Sunny Central Storage 2900 (SCS-2900)
- Sunny Central Storage 2500-EV (SCS-2500-EV)
- Sunny Central Storage 2750-EV (SCS-2750-EV)
- Sunny Central Storage 3000-EV (SCS-3000-EV)
- Sunny Central Storage 2200-US (SCS-2200-US)
- Sunny Central Storage 2475-US (SCS-2475-US)
- Sunny Central Storage 2900-US (SCS-2900-US)
- Sunny Central Storage 3450 UP (SCS3450 UP)
- Sunny Central Storage 3600 UP (SCS3600 UP)
- Sunny Central Storage 3800 UP (SCS3800 UP)
- Sunny Central Storage 3950 UP (SCS3950 UP)
- Sunny Central Storage 2300 UP-XT (SCS2300 UP-XT)
- Sunny Central Storage 2400 UP-XT (SCS2400 UP-XT)
- Sunny Central Storage 2530 UP-XT (SCS2530 UP-XT)
- Sunny Central Storage 2630 UP-XT (SCS 2630 UP-XT)
- Sunny Central Storage 3450 UP-XT (SCS3450 UP-XT)
- Sunny Central Storage 3600 UP-XT (SCS3600 UP-XT)
- Sunny Central Storage 3800 UP-XT (SCS3800 UP-XT)
- Sunny Central Storage 3950 UP-XT (SCS3950 UP-XT)
- Sunny Central Storage 3450 UP-US (SCS3450 UP-US)
- Sunny Central Storage 3600 UP-US (SCS3600 UP-US)
- Sunny Central Storage 3800 UP-US (SCS3800 UP-US)
- Sunny Central Storage 3950 UP-US (SCS3950 UP-US)
- Sunny Central Storage 2300 UP-XT-US (SCS2300 UP-XT-US)
- Sunny Central Storage 2400 UP-XT-US (SCS2400 UP-XT-US)
- Sunny Central Storage 2530 UP-XT-US (SCS2530 UP-XT-US)
- Sunny Central Storage 2630 UP-XT-US (SCS2630 UP-XT-US)
- Sunny Central Storage 3450 UP-XT-US (SCS3450 UP-XT-US)
- Sunny Central Storage 3600 UP-XT-US (SCS3600 UP-XT-US)
- Sunny Central Storage 3800 UP-XT-US (SCS3800 UP-XT-US)
- Sunny Central Storage 3950 UP-XT-US (SCS3950 UP-XT-US)

It describes the variant of the communication protocol "Modbus[®] Application Protocol" implemented by SMA Solar Technology AG and the corresponding parameters, measured values and data exchange formats.

This document does not contain any information on software which can communicate with the Modbus interface (see the software manufacturer's manual).

1.2 Target Group

This document is intended for qualified persons. The activities described in this document are to be performed by qualified persons only. Qualified persons must have the following skills:

- Knowledge of IP-based network protocols
- Knowledge of installation and configuration of IT systems
- Knowledge of how SMA inverters work and are operated
- Training in how to deal with dangers and risks associated with operating electrical devices and systems
- Knowledge of and compliance with this document

1.3 Additional Information

SMA documents

Refer to the inverter operating manual for information on operating the inverter. Additional information is available at www.SMA-Solar.com:

Additional Documents

Document title	Source
Service Name and Transport Protocol Port Number Registry	http://www.iana.org/assignments/service-names-port-numbers/service-names-port-numbers.xml
Modbus Application Protocol Specification	http://www.modbus.org/specs.php

1.4 Symbols

Symbol	Explanation
	Information that is important for a specific topic or goal, but is not safety-relevant.
	Indicates a requirement for meeting a specific goal.
	Desired result.
	A problem that might occur.

1.5 Typographies

Typography	Use	Example
bold	File names Elements to be selected Elements on a user interface Elements to be entered Parameter	Select Settings . Read off the configured port in the field Port . Enter the value 502 in the field Port
>	Connects several elements to be selected	Select Settings > Port .
[Button/Key]	Button or key to be selected or pressed	Select [Next] .

Typography	Use	Example
[Source]	Data channel name	Reading of the system time (UTC) [SerTm]

1.6 Nomenclature

Complete designation	Designation in this document
SMA Modbus Client Profile	Modbus client profile
Battery storage system	System
Sunny Central Storage 1900 / 2200 / 2475 / 2500-EV / 2750-EV / 2900 / 3000-EV	Inverter
Sunny Central Storage 2200-US / 2475-US / 2500-EV-US / 2750-EV-US	
Sunny Central Storage 3475 UP / 3600 UP / 3800 UP / 3950 UP	
Sunny Central Storage 3475 UP-US / 3600 UP-US / 3800 UP-US / 3950 UP-US	
Sunny Central Storage 2300 UP-XT / 2400 UP-XT / 2530 UP-XT / 2630 UP-XT	
Sunny Central Storage 2300 UP-XT-US / 2400 UP-XT-US / 2530 UP-XT-US / 2630 UP-XT-US	
Sunny Central Storage 3475 UP-XT / 3600 UP-XT / 3800 UP-XT / 3950 UP-XT	
Sunny Central Storage 3475 UP-XT-US / 3600 UP-XT-US / 3800 UP-XT-US / 3950 UP-XT-US	

1.7 Terms and Abbreviations

Term/Abbreviation	Designation	Explanation
Attribute value	-	Changeable content of an XML attribute, e.g., attribute="My content".
DWORD	-	Data with a width of 32 bits, as per IEC 61131-3
Device ID	-	Numeric value that identifies a specific SMA device type, e.g., 36 = Battery storage system.
Hex	-	Hexadecimal number
IP	Internet Protocol	Network protocol for connections via the Internet.
NaN	Not a Number	No valid value is available
Source register	-	Modbus register that is assigned to a different Modbus address (destination register).
RO	Read Only	Value can only be read

Term/Abbreviation	Designation	Explanation
RW	Read/Write	Value can be read and written
SCADA	Supervisory Control and Data Acquisition	Control center software. In this document, SCADA is used as an example of a Modbus client system.
UTC	Coordinated Universal Time	Coordinated Universal Time
VPN	Virtual Private Network	VPN is used to establish a connection from one private computer network to another. The point of connection is established on both sides by a VPN gateway. In each case, the VPN gateway may be a computer or a router. The connection itself is described as a VPN tunnel. A secured data stream runs via the tunnel from one network to the other, providing VPN nodes from one network with access to services and devices of the other network.
WO	Write-Only value	Value can only be written
WORD	-	Data with a width of 16 bits, as per IEC 61131-3
Destination register	-	Modbus register to which a different Modbus address (source register) is assigned. The destination register is used instead of the source register for further data processing.

2 Safety

2.1 Intended Use

The Modbus interface of the inverter is designed for industrial use and has the following tasks:

- Remote control of a battery inverter.
- Remote-controlled querying of measured values of a battery inverter.
- Remote-controlled changing of parameters of a battery inverter.

The Modbus interface can be accessed via the LAN port of the inverter and it can be used via the protocol Modbus TCP and by the protocol Modbus UDP.

The parameters of the battery inverter must not be set cyclically via the Modbus interface. Depending on the contents of the register, restrictions concerning the speed of access must be taken into account (see Section 3.1.1 "Content-Based Grouping of the Registers", page 12).

A maximum of 10 Modbus clients can be connected simultaneously to the Modbus server.

The enclosed documentation is an integral part of this product. You must read and observe the documentation and keep it in a convenient place for future reference.

2.2 Information on Data Security



Data Security in Ethernet Networks

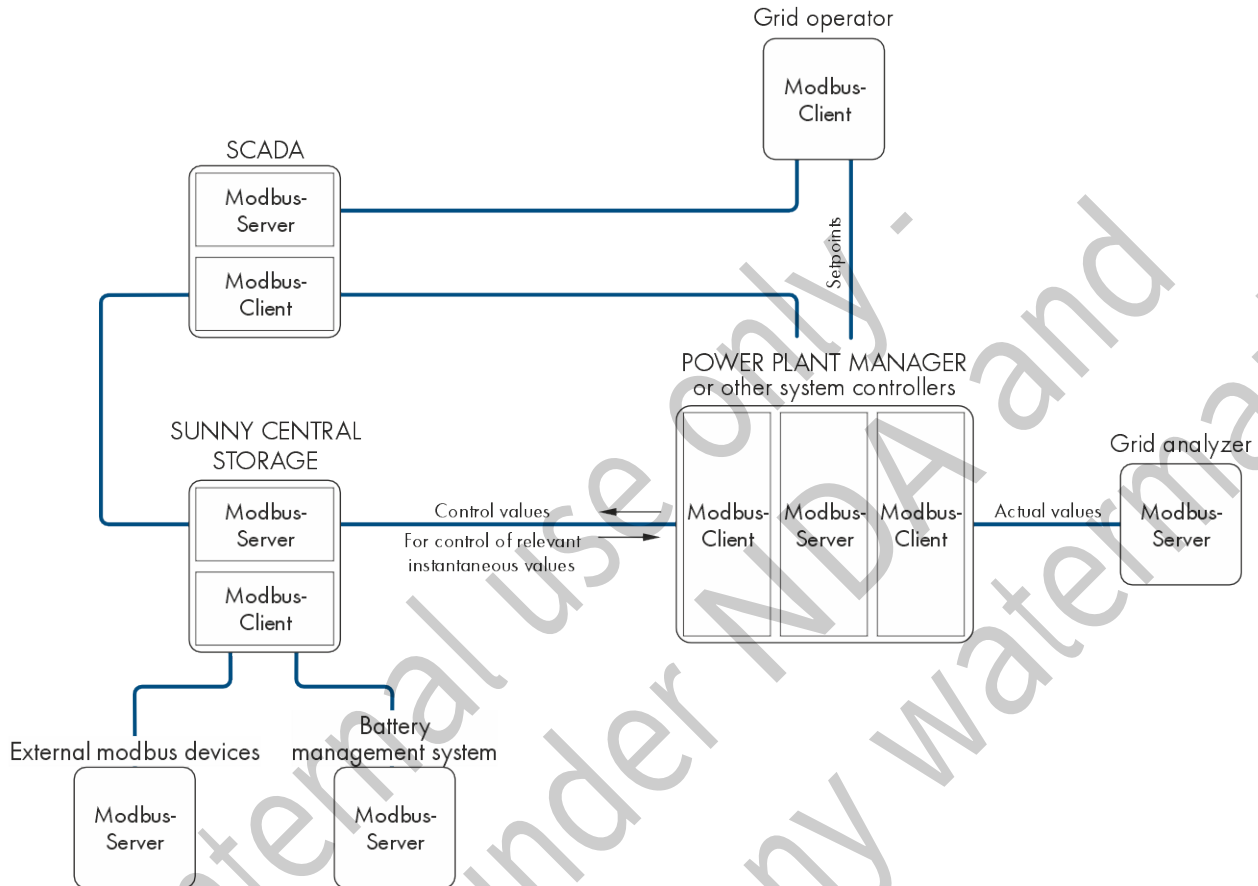
You can connect the inverter to the Internet. When connecting to the Internet, there is a risk that unauthorized users can access and manipulate the data of your system.

- Take appropriate protective measures, for example:
 - Set up a firewall
 - Close unnecessary network ports
 - Only enable remote access via VPN tunnel
 - Do not set up port forwarding at the Modbus port in use

3 Product Description

3.1 Modbus Protocol

The Modbus Application Protocol is an industrial communication protocol that is currently used in the solar sector mainly for system communication in PV power plants. Modbus protocol is based on a client/server architecture.



The Modbus protocol has been developed for reading data from or writing data to clearly defined data areas. The Modbus specification does not prescribe what data is within which data area. The data areas must be defined device-specifically in Modbus profiles. With knowledge of the device-specific Modbus profile, a Modbus client (e.g., a SCADA system) can access the data of a Modbus server (e.g., communication interface of the inverter).

The special Modbus profile for SMA devices is the SMA Modbus profile.

3.2 SMA Modbus Profile

The SMA Modbus profile contains definitions for selected SMA devices. A reduction of the available data on SMA devices was carried out for the definition and this was then assigned to the corresponding Modbus registers. The SMA Modbus profile contains, for example, the total and daily energy, current power, voltage and current levels. The assignment between SMA device data and Modbus addresses is split into ranges in the SMA Modbus profile and these can be addressed via unit IDs (see Section 3.6 "Addressing and Data Transmission in the Modbus Protocol", page 12).

To enable access to the data of an SMA device, a special gateway is required, which is provided via the communication interface of the inverter.

3.3 User-Defined Modbus Profile

The user-defined Modbus profile enables you to reassign Modbus addresses of the SMA Modbus profile and is recommended for external system controllers (see Section 8 "User-Defined Modbus Profile", page 66).

One advantage of reassigning Modbus addresses can be that the measured values and parameters which are relevant for a specific purpose, can be applied to consecutive Modbus addresses. These addresses can then be read or set in a single data block.

3.4 SMA Modbus Client Profile

The SMA Modbus client profile is an extension of the Modbus interface, which is used to access Modbus-capable server devices of other providers, e.g., battery management systems or flexible IO modules. Each external Modbus device has a separate profile (*.mmp) and is managed as a separate device in the inverter. The external devices can be accessed under the unit IDs = 16 to 31 and 36 (for the battery management system) via the Modbus server in the inverter.

Depending on the battery manufacturer, detailed information about the battery status up to module level can be called up via Modbus. Unit ID 36 is reserved for routing this special information. The registers can be defined in the corresponding profile (*.bap) (see Section 7.1 "Structure of the XML File for the Modbus Device Profile", page 60).

3.5 System Topology

The SMA Modbus profile was developed for a hierarchical system structure. In this structure the inverter has a communication interface that is equipped with a Modbus TCP/IP and Modbus UDP interface. All other Modbus-capable devices are subordinate to the inverter.

From the perspective of the Modbus protocol, the inverter represents a Modbus server that provides a gateway to the Modbus-capable devices. These devices can only be addressed via the gateway of the inverter by unit ID.

This also applies for the availability of the battery management system in the event of direct communication between inverter and battery.

If direct communication between inverter and battery is not required (Bsc.BatEna = Off), the battery management system is not addressed via the inverter, but directly in the customer network. In this case, the system control on the customer side must coordinate the interaction between inverter and battery.

3.6 Addressing and Data Transmission in the Modbus Protocol

3.6.1 Unit ID's

The Unit ID is a superordinate addressing type in the Modbus protocol. The SMA Modbus protocol has 247 Unit IDs, of which 245 can be assigned to individual devices. If a unit ID is assigned to a device, then the parameters and measured values of this device can be accessed.

The following table shows an overview of the unit IDs in the SMA Modbus profile: Individual unit IDs and unit ID ranges are reserved and are not used. With manual detection, however, these can be used:

Unit ID	Explanation
2	This unit ID is reserved for the system parameters.
3	This unit ID is reserved for the inverter.
4 to 15	Reserved
16 to 31	External Devices
32 to 35	Reserved
36 to 38	Battery Management System
39 to 99	Reserved
100	User-Defined Modbus Profile
101 to 247	Reserved
255	Devices that are assigned to this unit ID cannot be addressed. You must assign unit IDs from the range 3 to 247 to these devices.

3.6.2 Assignment of the Modbus Register to Unit IDs

The assignment of the parameters and measured values of the SMA devices to Modbus register addresses is achieved using assignment tables and is also shown in this document (see Section 5 "SMA Modbus Profile—Assignment Tables", page 19).

Parameters and measured values of the inverter and processed operating data based on the battery information are saved in the assignment table "PV System Parameters (unit ID = 2)."

In the assignment table "Inverter (unit ID = 3)", the parameters and measured values used in the inverter are saved.

In the assignment tables "External devices (unit ID = 16 to 31)", the channels used for the various external devices are saved.

3.6.3 File Formats Used

The Modbus protocols are saved in XML format. For easier assignment, the profiles of the various devices have different file extensions.

Expansion	Explanation
*.kmp	Modbus profile of the inverter
*.vdp	User-Defined Modbus Profile
*.mmp	Modbus profile of external devices
*.bap	Modbus profile of an external battery management system

3.6.4 Modbus Register Address, Register Width and Data Block

A Modbus register is 16 bits wide. For wider data types, connected Modbus registers are used and considered as data blocks. The number of connected Modbus registers is indicated in the assignment tables. The address of the first Modbus register in the data block is the start address of the data block. In addition, larger data blocks can be formed.

3.6.5 Address Range for the Modbus Register

For addressing Modbus registers, the address range 0 to 0xFFFF is available with 65536 addresses.

3.6.6 Data transmission

In accordance with the Modbus specification, only a specific volume of data can be transported in a single data transmission in a simple protocol data unit (PDU). The data also contains function-dependent parameters such as the function code, start address or number of Modbus registers to be transmitted. The amount of data depends on the Modbus command used and has to be taken into account during data transmission. You can find the number of possible Modbus registers per command in Section 3.8.

With data storage in the Motorola format "Big Endian", data transmission begins with the high byte and then the low byte of the Modbus register.

3.7 Address Types

The individual Modbus registers can be addressed with different data.

Address type	Explanation	Modbus function code
Coil	One bit, which can be written and read, is set, e.g., for digital signals.	FC 01 (0x01) – Read coils FC 05 (0x05) – Write single coil FC 15 (0x0F) – Write multiple coils
Discrete	One bit, which can be read, is set, e.g., for digital signals.	FC 02 (0x02) – Read discrete inputs
Input	The addressed registers contain measured values and can only be read (RO).	FC 04 (0x04) – Read input registers
Holding	The addressed registers contain parameters and can be written and read (RW).	FC 03 (0x03) – Read holding registers FC 06 (0x06) – Write single holding register FC 16 (0x10) – Write multiple holding registers

3.8 Reading and Writing Data in the Modbus Protocol

The Modbus interface can be used via the protocol Modbus TCP and by the protocol Modbus UDP. Using Modbus TCP enables read and write access (RW) and using Modbus UDP enables only write access (WO) to the Modbus register.

The following Modbus commands are supported by the implemented Modbus interface:

Modbus command	Modbus function code	Data volume (number of registers) ¹
Read Coils ²	FC 01 (0x01)	1 to 2000
Read Discrete Inputs	FC 02 (0x02)	1 to 2000
Read Holding Registers	FC 03 (0x03)	1 to 123
Read Input Registers	FC 04 (0x04)	1 to 125
Write Single Coil	FC 05 (0x05)	1
Write Single Holding Register	FC 06 (0x06)	1
Write Multiple Coils	FC 15 (0x0F)	1 to 1968
Write Multiple Registers	FC 16 (0x10)	1 to 123

Reading or writing a single Modbus register

If a Modbus register is accessed that is not contained in the Modbus profile, or if a Modbus command is incorrect, a Modbus exception is generated. Modbus exceptions are also generated when write access occurs on a read-only Modbus register or read access occurs on a write-only Modbus register.

Reading or writing of data blocks

To prevent inconsistencies, data blocks of associated registers or register ranges must be read or written consecutively.

Writing multiple Modbus registers as a data block

If multiple registers are written in the data block (Modbus command 0x10) and an error occurs when writing, the next register in the data block is used to proceed. If some data is dependent on other data, or if some data is mutually exclusive, the data is only processed if the entire data block is valid. Otherwise the entire data block is discarded. In the event of an error, a Modbus exception will be generated.

Reading multiple Modbus registers as a data block

If a data block is read and if at least one register defined in the Modbus profile can be determined in its data range, an answer is returned. If none of the Modbus registers are defined in the data range of a data block in the Modbus profile, the query is invalid, and a Modbus exception is generated.

Modbus exceptions

For Modbus exceptions, see "Modbus Application Protocol Specification" at <http://www.modbus.org/specs.php>.

¹ Number of Modbus registers transferable as a data block per command (16 bit)

² Only available for the SMA Modbus Client Profile.

3.9 SMA Data Types

3.9.1 Data types

The following table shows the data types used in the SMA Modbus profile. The SMA data types are listed in the assignment tables in the **Type** column. They describe the data widths of the assigned values:

Type	Description
U16	A word (16-bit/WORD) in the local processor format
S16	A signed word (16 bit/WORD) in the local processor format
U32	A double word (32 bit/DWORD) in the local processor format
S32	A signed double word (32 bit/DWORD) in the local processor format

3.9.2 16-Bit Integer Values

16-bit integers are stored in a Modbus register.

Modbus register	1
Byte	0 1
Bits	8 to 15 0 to 7

3.9.3 32-Bit Integer Values

32-bit integers are stored in two Modbus registers.

Modbus register	1	2
Byte	0	1
Bits	24 to 31	16 to 23

Example:

DcMs.TotAmp: UnitId: 3 Register: 8 Data type: S32 Fix0 Example value: -269 A

Modbus register	8	9
Value	65535	65267

InvMs.DclVol.Stk1: UnitId 3 Register 12 Data type S32 Fix1 Example value: 842.1 V

Modbus register	12	13
Value	0	8421

3.10 SMA Data Formats

The following SMA data formats describe how SMA data is to be interpreted. The data formats are used, for example, for the display of data or for its further processing. The SMA data formats are listed in the **Format** column of the assignment tables.

Format	Explanation
FIX0	Factor 1 Decimal number, commercially rounded, no decimal place.
FIX1 to FIX8	Scaling factor to define the decimal places (up to 8) Decimal number, commercially rounded, number of decimal places in accordance with the number (FIX2 corresponds to a decimal number with two decimal places)
ENUM	Coded numerical values. Display of settings in abbreviations, e.g., for operating states or selected procedures for setpoint. Here it is only possible to select one numerical value in each case. The breakdown of the possible codes can be found directly under the designation of the Modbus register in the SMA Modbus profile – assignment tables.
ENUM_FLAGS	Coded numerical values. Display of settings in abbreviations, e.g., for operating states or selected procedures for setpoint. Here it is possible to select multiple numerical values.
VERSION	Firmware version (see "Firmware version extract" below).
TIME_DDMMYY	Display as date, e.g., "020913" for September 2, 2013
TIME_YYYYMMDD	Display as date, e.g., "20130902" for September 2, 2013
TIME_HHMMSS	Display as time, e.g., "134725" for 13:47:25
TIME_YYYYMMDDHHMMSS	Display as date and time, e.g., "20130902134725" for September 2, 2013, 13:47:25
BITMASK	Assignment of meaning of the individual bits of the register
IPV4	Display as IP V4 address, e.g., "192.168.0.5"
DURATION	Display as duration, e.g., days h:min:sec or h:min:sec
BOOL	Display as checkbox or any other boolean display

Abstract firmware version, format FW

Four values are extracted from the delivered DWORD. The values **Major** and **Minor** are contained BCD-coded in bytes 1 and 2. Byte 3 contains the **Build** value (not BCD-coded).

Byte 4 contains the **Release Type** value according to the following table:

Release type	Release-type coding	Explanation
3	B	Beta release
4	R	Release
5	S	Special release
> 5	As number	No special interpretation

Example

Firmware version of the product: 1.5.10.R
Values from DWORD: Major: 1, Minor: 5, Build: 10, Release type: 4
(Hex: 0x1 0x5 0xA 0x4)

3.1.1 Content-Based Grouping of the Registers

The Modbus addresses described below are differentiated into three basic groups according to their function:

- Setpoints (S)
- Parameter (P)
- Measured values (M)

For optimum system control, a distinction must be made between these groups with regard to their use.

Setpoints

Setpoints encompass the requirements for the current operating point. Here, the signals for active and reactive power (**Wspt** and **VarSpt**) are the most important registers because they are also used by the inverter as a sign of life to monitor the communication connection. The processing of these signals is optimized for frequent transmission at high speed. Transmission can therefore be carried out, for example, every 100 ms. However, the cycle time should not be less than 50 ms to avoid an overload of the signal processing. To enable communication monitoring, these setpoints for active and reactive power must be sent independently of the current operating state.

Parameter

Parameters are generally provided as holding registers and can be read to determine the settings of the inverter. If you have write access, the registers can be written to change the settings of the inverter.

Every time these values are written, the settings database stored in the non-volatile memory is updated. These registers should only be written if the current setting needs to be adjusted.

Measured Values

Measured values are provided as input registers and can only be read. They contain information about the current inverter state and provide currently measured values of the inverter. The values are updated in every 100 ms cycle. The polling rate should preferably correspond to a multiple of this internal refresh rate.

Not all registers have to be used for correct communication.

Which registers are actually required should be decided depending on the application.

For a faster connection, registers of high relevance are indicated separately in the allocation tables (see 5. "SMA Modbus Profile—Assignment Tables", page 19).

4 Configuration

4.1 Detection of SMA Modbus Devices and Allocation of Unit IDs

With a new battery storage system, the Modbus is activated on commissioning and the Modbus-capable devices are detected on commissioning.

4.2 Importing the Modbus Profile File of External Devices

External Modbus devices can be connected to the inverter. In order to be able to access these devices via the Modbus protocol also, the external Modbus devices must be detected in the system.

Procedure:

1. Open Modbus profile of the external device in a UTF-8-capable editor (e.g., Notepad++).
2. In the Modbus profile, enter the IP address under which the device can be accessed.
3. Save change. Give the file a unique name. If multiple files of the same name are used, during an import the existing file will be overwritten in each case by the imported file.
4. Log in to the user interface of the inverter as installer (see the inverter user manual).
5. Import the changed Modbus profile (see inverter user manual). Here, select **Modbus Profiles** from the list of available types. A unit ID contained in the profile is assigned to the device automatically.

4.3 Exporting the Profile File

1. Log in to the user interface of the inverter as installer (see the inverter user manual).
2. In the main navigation, select **Export** (see inverter user manual).
3. Select **Modbus profiles** from the list of available types.
4. Select the Modbus profile to be exported.
5. If the profile file is to be saved to an external storage medium that is present in the inverter, select the **[Copy file to external device]** button.
If the profile file is to be saved on the computer, select the **[Download]** button.
6. Choose a storage location for the profile file and save it.

4.4 Deleting the Profile File

1. Log in to the user interface of the inverter as installer (see the inverter user manual).
2. In the main navigation, select **Export** (see inverter user manual).
3. Select **Modbus profiles** from the list of available types.
4. Select the Modbus profile to be deleted.
5. Select the button **[Delete files]**.

5 SMA Modbus Profile—Assignment Tables

Below, the registers available in the default setting are described with their standard address.

To enable optimized communication, the registers can be redirected via a virtual profile to customer-specific register addresses (see Section 8 "User-Defined Modbus Profile", page 66).

5.1 Information on the Assignment Tables

The following subsections are sorted by unit ID. Each contains tables of the Modbus addresses which can be accessed using this unit ID. The tables are divided according to the group parameters, measured values and setpoints and provide the following information:

Information	Explanation
Modbus address	Decimal address of the Modbus register (see Section 3.6 and onwards)
Channel name	Name of the channel
Explanation	Short description of the data channel of the Modbus register
Unique ID	Assignment to the channels on the user interface of the inverter
Data type	Data type, e.g., U32 = 32 bits without prefix (see Section 3.6)
Format	Data format of the saved value, e.g., FIX1 = output with n decimal places (see Section 3.10)
Access	Access type for Modbus TCP (see Section 3.8 "Reading and Writing Data in the Modbus Protocol", page 14): RO: Read only RW: Read and write If an access type is not supported, a Modbus exception will be generated.
Scaling	Specification of scaling factor with which the data must be converted
Offset	Specification of offset with which the data must be converted.
Unit	Specification of the unit in which the data is specified

The relevance of the individual Modbus registers must be identified by the labelling of the respective register:

Typography	Relevance
Bold	The register contains the data required for operation and must be used.
Standard	The use of this register is recommended.
<i>Italic</i>	This register should only be used when necessary.
*	The registers have been prepared for the SunSpec profile.

5.2 System Parameters (Unit ID = 2)

The PV system parameters represent measured values and parameters of the inverter and PV system devices that are connected via the Modbus protocol. Parameters such as time settings are transferred by the inverter to the devices of the PV system and there, depending on the device type, processed further. Measured values such as energy meter values are queried by the devices and made available as accumulated values.

5.2.1 Holding Register

In the following table, you can find the Modbus addresses, which you can access under unit ID = 2 and function code 0x03, 0x06 and 0x10 (see Section 3.6.1 "Unit ID's", page 12).

Parameter

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Format	Unit	Access
1104	Tm.Sys.Tm	Setting of the system time (UTC)	4502	U32	1	0	DT	s	RW
1106	Tm.Sys.TmZn	Setting of the time zone. For possible values (see Section 10.5 "Number Codes of the Time Zones", page 70)	4503	U32	1	0	ENUM	-	RW
2238	Bsc.InvStrMod	Setting the operating state of the inverter during start-up of the inverter	3941	U32	1	0	ENUM	-	RW
2276	AuxCtl.SCSCOpCmd	Operating command for battery inverter, specified externally	3960	U32	1	0	ENUM	-	RW
2278	AuxCtl.SOCOpMax	Upper SOC limit to which the battery is to be charged, specified externally	3961	S32	100	0	FIX2	%	RW
2280	AuxCtl.SOCOpMin	Lower SOC limit to which the battery is to be discharged, specified externally	3962	S32	100	0	FIX2	%	RW
2284	Bsc.WhRmgCalcSohEna	Calculation method for remaining energy incl. SOH	3964	U32	1	0	ENUM	-	

To provide a clear separation between writable and read-only values, the previous holding registers 2240 to 2262 in the input register with the same address have been changed (see 5.2.2 "Input Register", page 27).

Setpoints

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Format	Unit	Access
40018	FstStop	Disconnection of the inverter	-	U32	1	0	ENUM	-	RW
40022	VARspt	Reactive power setpoint Q, in % of the maximum reactive power (with regard to VARtg) of the inverter. Value range: -100.00% to < 0% = underexcited 0% = no reactive power < 0% to +100.00% = overexcited	-	S16	100	0	FIX2	%	RW
40023	WSpt	Active power setpoint P, in % of the maximum active power (with regard to WRtg) of the inverter. Value range: -100.00% to < 0% = load or charge mode 0% = No active power < 0% to +100.00% = generator or discharge mode	-	S16	100	0	FIX2	%	RW
40024	VARModCfg.PFCtl ComCfg.PF	Displacement power factor cos φ (see also Section 5.2.3 "Power Control with cos φ and Excitation Type" Holding-Register, page 30) 0.0000 to 0.9999	-	U16	10000	0	FIX4	-	RW
40025	VARModCfg.PFCtl ComCfg.PFExt	Excitation type of cos φ (also see Section 5.2.3 "Power Control with cos φ and Excitation Type" Holding-Register, page 30)	-	U32	1	0	ENUM	-	RW
41261	HzNomSpt	Nominal frequency for frequency-dependent control of active power / frequency setpoint		U32	1000	0	FIX3	Hz	RW

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Format	Unit	Access
41263	VolNomSpt	Nominal AC voltage for voltage-dependent reactive power control / AC voltage setpoint	-	U16	10000	0	FIX4	p.u	RW
41264	DcVolSpt	DC voltage setpoint, applicable in "DC Voltage Control" operating state	-	U16	10	0	FIX1	V	RW
41275	DcAmpDynMin	Maximum DC charging current May only used with channel Bsc.ExtDcAmpLimEna = On	-	U16	1	0	FIX0	A	RW
41276	DcAmpDynMax	Maximum DC discharge current May only used with channel Bsc.ExtDcAmpLimEna = On	-	U16	1	0	FIX0	A	RW
41297	DCAmpSpt	DC current setpoint, applicable in "DC Current Control" operating state	-	S32	10	0	FIX1	A	RW
44039	WSptMax	Higher priority limitation of the active power setpoint WSpt in % of the maximum active power of the inverter (referred to WExlSpt.RefVal ; the reference value can be defined via the parameter WExlSpt.RefMod). Value range: 0% = No active power < 0% to +100.00% = generator or discharge mode Use via communication must be enabled by GriMng.WMaxMod .	-	S32	100	0	FIX2	%	RW

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Format	Unit	Access
44041	WSptMin	Lower limitation of the active power setpoint WSpt in % of the maximum active power of the inverter (referred to WExlSpt.RefVal; the reference value can be defined via the parameter WExlSpt.RefMod). Value range: 0% = No active power < 0% to +100.00% = generator or discharge mode Use via communication must be enabled by GriMng.WMinMod	-	S32	100		FIX2	%	RW

Related ENUM Codes

The following table contains number codes which, as function coding in data format ENUM, are frequently used in the SMA Modbus profile. The column "Related text" contains the corresponding abbreviations.

Modbus address	Channel name	Unique ID	Return code	Related text
2238	Bsc.InvStrMod	3941	21413	AC start
			21414	DC start
			1438	Auto
2240	Bsc.SrcSel	3942	1744	Manual control
			21410	External control
			21097	External control (disabled monitoring)
2284	Bsc.WhRmgCalcSohEna	3964	303	Off
			308	On
2276	AuxCtl.SCSCOpCmd	3960	381	Stop
			2291	Battery standby
			21415	Inverter standby
			21416	Power control
			21417	DC Voltage Control
			21418	DC current control
			21454	QonDemand
			21521	Grid-forming mode
			22321	Grid Forming Angle Inertia and Voltage Droop
			22322	Grid Forming Frequency Droop and Voltage Inertia
			22323	Grid Forming Angle Inertia and Voltage Inertia
40018	FstStop	-	381	Standby
			1467	Start
			1749	Full Stop
40025	VArModCfg.PFCtlComCfg.PFExt	-	1041	Leading
			1042	Lagging
1106	Tm.Sys.TmZn	4503	973	–
			9523	(UTC-12:00) GMT-12
			9565	(UTC-11:00) Samoa
			9538	(UTC-10:00) Hawaii
			9501	(UTC-09:00) Alaska
			9559	(UTC-08:00) Tijuana
			9558	(UTC-08:00) Pacific
			9587	(UTC-07:00) Chihuahua
			9547	(UTC-07:00) Denver
			9574	(UTC-07:00) Arizona
			9583	(UTC-06:00) Chicago
			9520	(UTC-06:00) Guatemala
			9584	(UTC-06:00) Mexico_City
			9510	(UTC-06:00) Saskatchewan
			9563	(UTC-05:00) Bogota
			9528	(UTC-05:00) New_York
			9573	(UTC-05:00) East-Indiana
			9564	(UTC-04:30) Caracas

Modbus address	Channel name	Unique ID	Return code	Related text
			9591	(UTC-04:00) Argentina, San_Juan
			9594	(UTC-04:00) Asuncion
			9516	(UTC-04:00) Manaus
			9557	(UTC-04:00) Santiago
			9505	(UTC-04:00) Atlantic
			9554	(UTC-03:30) Newfoundland
			9562	(UTC-03:00) Buenos_Aires
			9593	(UTC-03:00) Cayenne
			9535	(UTC-03:00) Godthab
			9588	(UTC-03:00) Montevideo
			9527	(UTC-03:00) East
			9545	(UTC-02:00) South_Georgia
			9509	(UTC-01:00) Azores
			9511	(UTC-01:00) Cape_Verde
			9585	(UTC+00:00) Casablanca
			9536	(UTC+00:00) Monrovia
			9534	(UTC+00:00) London
			9577	(UTC+01:00) Lagos
			9578	(UTC+01:00) Berlin
			9560	(UTC+01:00) Paris
			9517	(UTC+01:00) Prague
			9518	(UTC+01:00) Warsaw
			9529	(UTC+02:00) Cairo
			9567	(UTC+02:00) Harare
			9551	(UTC+02:00) Windhoek
			9542	(UTC+02:00) Amman
			9546	(UTC+02:00) Beirut
			9541	(UTC+02:00) Jerusalem
			9537	(UTC+02:00) Athens
			9532	(UTC+02:00) Helsinki
			9526	(UTC+02:00) Minsk
			9524	(UTC+03:00) Nairobi
			9504	(UTC+03:00) Baghdad
			9502	(UTC+03:00) Kuwait
			9561	(UTC+03:00) Moscow
			9540	(UTC+03:30) Tehran
			9508	(UTC+04:00) Baku
			9503	(UTC+04:00) Dubai
			9533	(UTC+04:00) Tbilisi
			9582	(UTC+04:00) Caucasian Standard Time
			9512	(UTC+04:00) Yerevan
			9586	(UTC+04:00) Mauritius
			9500	(UTC+04:30) Kabul
			9579	(UTC+05:00) Karachi
			9589	(UTC+05:00) Tashkent
			9530	(UTC+05:00) Yekaterinburg
			9568	(UTC+05:30) Colombo
			9539	(UTC+05:30) Kolkata
			9552	(UTC+05:45) Katmandu
			9515	(UTC+06:00) Dhaka
			9550	(UTC+06:00) Novosibirsk
			9549	(UTC+06:30) Rangoon
			9566	(UTC+07:00) Bangkok

Modbus address	Channel name	Unique ID	Return code	Related text
			9556	(UTC+07:00) Krasnoyarsk
			9522	(UTC+08:00) Hong_Kong
			9555	(UTC+08:00) Irkutsk
			9544	(UTC+08:00) Kuala_Lumpur
			9569	(UTC+08:00) Taipei
			9592	(UTC+08:00) Ulan_Bator
			9576	(UTC+08:00) Perth
			9543	(UTC+09:00) Seoul
			9571	(UTC+09:00) Tokyo
			9581	(UTC+09:00) Yakutsk
			9513	(UTC+09:30) Adelaide
			9506	(UTC+09:30) Darwin
			9575	(UTC+10:00) Vladivostok
			9525	(UTC+10:00) Brisbane
			9570	(UTC+10:00) Hobart
			9507	(UTC+10:00) NSW
			9580	(UTC+10:00) Guam
			9519	(UTC+11:00) Magadan
			9595	(UTC+12:00) Kamchatka
			9553	(UTC+12:00) Auckland
			9531	(UTC+12:00) Fiji
			9572	(UTC+13:00) Tongatapu

5.2.2 Input Register

In the following table, you can find the Modbus addresses, which you can access under unit ID = 2 and function code 0x04 (see Section 3.6.1 "Unit ID's", page 12).

Measured Values

Modbus address	Channel name	Explanation	UniqueID	Data type	Scaling	Offset	Format	Unit	Access
2	SusylD	Device ID of the communication interface	-	U32	1	0	RAW	-	RO
4	SerNo	Serial number	-	U32	1	0	RAW	-	RO
6	DataChange	Modbus data change: Meter value is increased on each access.	-	U32	1	0	RAW	-	RO
300	Modbusd.Sys.Tm	Reading of the system time (UTC)	4307	U32	1	0	DT	s	RO
1006	Bat.Cnt.FullCycleCnt	Meter for complete battery cycles ¹	3803	U32	1	0	FIX0	-	RO
1028	Bat.SOCTot	Current battery state of charge (SOC) of all present battery strings ¹	3814	S32	10	0	FIX1	%	RO
1032	Bat.SOH	Battery: state of health	3816	S32	10	0	FIX1	%	RO
1034	Bat.NomWhConn	Nominal energy of all present battery strings	3817	S32	1	0	FIX0	kWh	RO
1036	Bat.DcVolTot	DC voltage of all present battery strings ¹	3818	S32	10	0	FIX1	V	RO
1038	Bat.NomWhTot	Nominal energy of all present battery strings	3819	S32	1	0	FIX0	kWh	RO
1040	Bat.TmpAvg	Battery: average temperature	3820	S32	10	0	FIX1	°C	RO
1042	Bat.TmpMin	Battery: lowest temperature ¹	3821	S32	10	0	FIX1	°C	RO
1044	Bat.TmpMax	Battery: highest temperature	3822	S32	10	0	FIX1	°C	RO
1048	Bat.TmpAmb	Battery: ambient temperature ¹	3824	S32	10	0	FIX1	°C	RO
1052	Bat.NoStrgConn	Number of switched-on battery strings	3826	U32	1	0	FIX0	-	RO
1054	Bat.NoStrgTot	Number of all present battery strings	3827	U32	1	0	FIX0	-	RO
1056	Bat.NomCapTot	Nominal capacity of all present battery strings	3828	S32	1	0	FIX0	Ah	RO

¹ Not available for all batteries

Modbus address	Channel name	Explanation	UniqueID	Data type	Scaling	Offset	Format	Unit	Access
1076	Bat.BmsStt	Status battery management system	3841	U32	1	0	ENUM	-	RO
1078	Bat.SOCConn	Current battery state of charge (SOC), connected battery strings	3842	S32	10	0	FIX1	%	RO
1080	Bat.DcVolConn	Battery tension of connected battery strings	3843	S32	10	0	FIX1	V	RO
1082	Bat.DcAmp	Battery current	3844	S32	10	0	FIX1	A	RO
1084	Bat.NomCapConn	Nominal battery capacity of connected battery strings	3845	S32	1	0	FIX0	Ah	RO
1108	Bsc.WhInRmg	Available charging energy of battery system	3857	S32	10	0	FIX1	kWh	RO
1110	Bsc.WhOutRmg	Available discharging energy of battery system	3858	S32	10	0	FIX1	kWh	RO
1118	Bsc.WInAval	Available power in direction of charging	3862	S32	10	0	FIX1	kW	RO
1122	Bsc.WOutAval	Available power in direction of discharging	3864	S32	10	0	FIX1	kW	RO
1126	Bsc.VarOxAval	Available leading reactive power (overexcited)	3866	S32	10	0	FIX1	kvar	RO
1130	Bsc.VarUxAval	Available lagging reactive power (underexcited)	3868	S32	10	0	FIX1	kvar	RO
2238	Bsc.InvStrMod	Setting the operating state of the inverter during start-up of the inverter	3941	U32	1	0	ENUM	-	RO
2240	Bsc.SrcSel	Selection for the data source for the setpoints	3942	U32	1	0	ENUM	-	RO
2258	Bsc.SOCOpHys	SOC limitation, hysteresis	3951	S32	100	0	FIX2	%	RO
2260	Bsc.SOCOpMax	Upper SOC limit to which the battery is to be charged, specified manually	3952	S32	100	0	FIX2	%	RO
2262	Bsc.SOCOpMin	Lower SOC limit to which the battery is to be discharged, specified manually	3953	S32	100	0	FIX2	%	RO

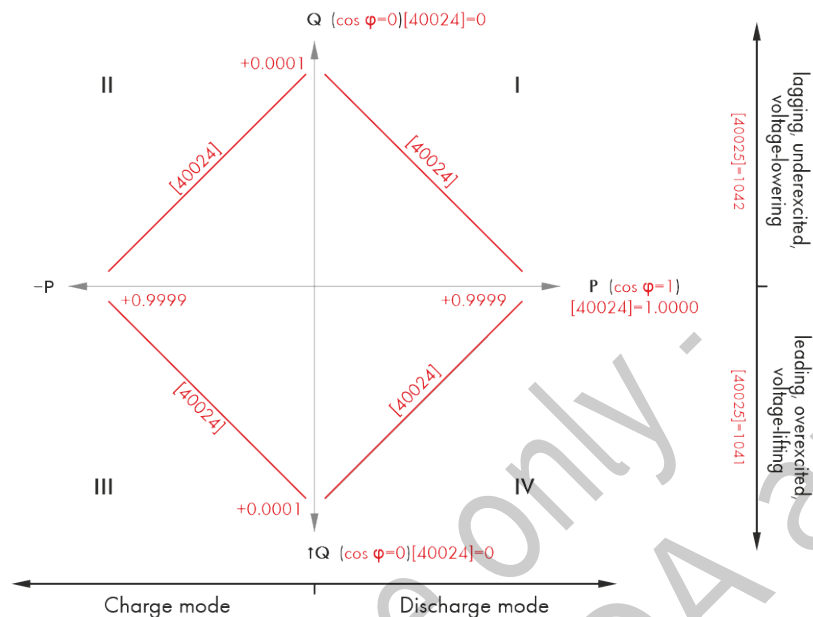
Related ENUM Codes

The following table contains number codes which, as function coding in data format ENUM, are frequently used in the SMA Modbus profile. The column "Related text" contains the corresponding abbreviations.

Modbus address	Channel name	Unique ID	Return code	Related text
1076	Bat.BmsStt Status battery management system	3841	303	Off
			1787	Init
			1295	Standby
			1788	Ready
			309	Operation
			35	Error
			21423	Unknown
2238	Bsc.InvStrMod Setting the operating state of the inverter during start-up of the inverter	3941	21413	AC start
			21414	DC start
			1438	Auto
2240	Bsc.SrcSel Selection for the data source for the setpoints	3942	1744	Manual control
			21410	External control
			21097	External control (disabled monitoring)

5.2.3 Power Control with $\cos \varphi$ and Excitation Type

The power control by means of $\cos \varphi$ [40024] and the excitation type [40025] are shown in a coordinate system in the following graphic (the square brackets contain the address of the register to be set):



The power can be controlled either via the desired reactive power value [40022] or via the displacement power factor $\cos \varphi$ and the type of excitation. In this case, the power control with $\cos \varphi$ [40024] and the excitation type [40025] is active only if the parameter **Gri.Mng.VarMod** is set to **PFCtlCom**.

5.3 Inverter Parameter (Unit ID = 3)

5.3.1 Holding Register

In the following table, you can find the Modbus addresses, which you can access under unit ID = 3 and function codes 0x03, 0x06 and 0x10 (see Section 3.6.1, "Unit ID's" page 12).

Parameter

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Data format	Unit
0	InvOpMod	Operating state of the inverter, setpoint	329	S32	1	0	ENUM	-
2	RemRdy	Put inverter into operation or standby	331	S32	1	0	ENUM	-
8	ErrClr	Acknowledgment of the present error	733	S32	1	0	ENUM	-
10	VADrtPriMod	Prioritizing of control of derating	730	S32	1	0	ENUM	-
12	WGrMod	Activates the active power gradient	725	S32	1	0	ENUM	-
14	WGr	Active power gradient	726	S32	1000	0	FIX3	pu/s
16	VArGrMod	Activates the reactive power gradient	727	S32	1	0	ENUM	-
18	VArGr	Reactive power gradient	728	S32	1000	0	FIX3	pu/s
20	ErrClr.ProErr	Acknowledging of safety-relevant errors	7211	S32	1	0	ENUM	-

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Data format	Unit
22	GriMng.InvVArMod	Grid management services: specification of reactive power setpoint by the inverter	6088	S32	1	0	ENUM	-
30	InstFunc	Installer functions, activation	7469	S32	1	0	ENUM	-
32	WCtlHzBatMod	P(f) mode for battery inverter This procedure works bidirectionally. The specification of this function is additionally added to the setpoint:	7534	S32	1	0	ENUM	-
34	PvGnd.OpnRemGfdi	Open the Remote GFDI	7682	S32	1	0	ENUM	-
36	StbySfCapacMod	Activation of the standby mode of the sine filter capacitor	7913	S32	1	0	ENUM	-
38	Aid.Mod*	Activation of active islanding detection	709	S32	1	0	ENUM	-
40	VCtl.Hi1Lim*	Monitoring the grid voltage: upper switch-off limit 1	446	S16	100	0	FIX2	pu
41	VCtl.Hi1LimTm*	Monitoring the grid voltage: waiting time upper switch-off limit 1	451	U32	1	0	FIX0	ms
43	VCtl.Hi2Lim*	Monitoring the grid voltage: upper switch-off limit 2	447	S16	100	0	FIX2	pu
44	VCtl.Hi2LimTm*	Monitoring the grid voltage: waiting time upper switch-off limit 2	452	U32	1	0	FIX0	ms
46	VCtl.Lo1Lim*	Monitoring the grid voltage: lower switch-off limit 1	456	S16	100	0	FIX2	pu
47	VCtl.Lo1LimTm*	Monitoring the grid voltage: waiting time lower switch-off limit 1	461	U32	1	0	FIX0	ms
49	VCtl.Lo2Lim*	Monitoring the grid voltage: lower switch-off limit 2	457	S16	100	0	FIX2	pu
50	VCtl.Lo2LimTm*	Monitoring the grid voltage: waiting time lower switch-off limit 2	462	U32	1	0	FIX0	ms
52	VCtl.Lo3Lim*	Monitoring the grid voltage: lower switch-off limit 3	458	S16	100	0	FIX2	pu
53	VCtl.Lo3LimTm*	Monitoring the grid voltage: waiting time lower switch-off limit 3	463	U32	1	0	FIX0	ms
55	VCtl.OpMaxNom*	Monitoring the grid voltage: upper switch-on limit	444	S16	100	0	FIX2	pu
56	VCtl.OpMinNom*	Monitoring the grid voltage: lower switch-on limit	445	S16	100	0	FIX2	pu
57	HzCtl.Hi1Lim*	Monitoring the grid frequency: upper switch-off limit 1	468	U16	100	0	FIX2	Hz

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Data format	Unit
58	HzCtl.Hi1LimTm*	Monitoring the grid frequency: waiting time upper switch-off limit 1	474	U32	1	0	FIX0	ms
60	HzCtl.Hi2Lim*	Monitoring the grid frequency: upper switch-off limit 2	469	U16	100	0	FIX2	Hz
61	HzCtl.Hi2LimTm*	Monitoring the grid frequency: waiting time upper switch-off limit 2	475	U32	1	0	FIX0	ms
63	HzCtl.Lo1Lim*	Monitoring the grid frequency: lower switch-off limit 1	480	U16	100	0	FIX2	Hz
64	HzCtl.Lo1LimTm*	Monitoring the grid frequency: waiting time lower switch-off limit 1	486	U32	1	0	FIX0	ms
66	HzCtl.Lo2Lim*	Monitoring the grid frequency: lower switch-off limit 2	481	U16	100	0	FIX2	Hz
67	HzCtl.Lo2LimTm*	Monitoring the grid frequency: waiting time lower switch-off limit 2	487	U32	1	0	FIX0	ms
69	HzCtl.OpMaxNom*	Monitoring the grid frequency: upper switch-on limit	466	U16	100	0	FIX2	Hz
70	HzCtl.OpMinNom*	Monitoring the grid frequency: lower switch-on limit	467	U16	100	0	FIX2	Hz
71	WGrStr*	Start-up ramp for active power	7523	S32	1000	0	FIX3	pu/s
73	VArCtlVol.LoVolRef3*	AC voltage-dependent reactive power control: reference point 3 (below reference point 1)	6051	S16	1000	0	FIX3	pu
74	VArCtlVol.LoVolRef2*	AC voltage-dependent reactive power control: reference point 2 (below reference point 1)	6050	S16	1000	0	FIX3	pu
75	VArCtlVol.LoVolRef1Hi VolRef1*	AC voltage-dependent reactive power control: reference point 1	6048	S16	1000	0	FIX3	pu
76	VArCtlVol.HiVolRef2*	AC voltage-dependent reactive power control: reference point 2 (via reference point 1)	6052	S16	1000	0	FIX3	pu
77	VArCtlVol.HiVolRef3*	AC voltage-dependent reactive power control: reference point 3 (via reference point 1)	6053	S16	1000	0	FIX3	pu
78	VArCtlVol.LoGra3*	AC voltage-dependent reactive power control: gradient 3 (from reference point 3)	6058	S16	100	0	FIX2	pu
79	VArCtlVol.LoGra2*	AC voltage-dependent reactive power control: gradient 2 (from reference point 2)	6056	S16	100	0	FIX2	pu

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Data format	Unit
80	VArCtlVol.LoGra1 *	AC voltage-dependent reactive power control: gradient 1 (from reference point 1)	6054	S16	100	0	FIX2	pu
81	VArCtlVol.HiGra1 *	AC voltage-dependent reactive power control: gradient 1 (from reference point 1)	6055	S16	100	0	FIX2	pu
82	VArCtlVol.HiGra2 *	AC voltage-dependent reactive power control: gradient 2 (from reference point 2)	6057	S16	100	0	FIX2	pu
83	VArCtlVol.HiGra3 *	AC voltage-dependent reactive power control: gradient 3 (from reference point 3)	6059	S16	100	0	FIX2	pu
84	WCtHzMod	Activation of frequency-dependent active power control This procedure works only in discharge direction. To enable settings for this procedure via Modbus, the parameter WCtHz.CfgMod must be set to W via the user interface.	361	S32	1	0	ENUM	-
86	WCtHz.Hz1	Frequency-dependent active power control: cutoff frequency of the 1st frequency band	364	U16	100	0	FIX2	Hz
87	WCtHz.Hz2	Frequency-dependent active power control: cutoff frequency of the 2st frequency band	365	U16	100	0	FIX2	Hz
88	WCtHz.Hz3	Frequency-dependent active power control: cutoff frequency of the 3st frequency band	366	U16	100	0	FIX2	Hz
89	WCtHz.Hz4	Frequency-dependent active power control: cutoff frequency of the 4st frequency band	708	U16	100	0	FIX2	Hz
90	WCtHz.W2 *	Frequency-dependent active power control: power referring to the inverter at the beginning of the second area	6584	S16	1000	0	FIX3	pu
91	WCtHz.W3 *	Frequency-dependent active power control: power referring to the inverter at the beginning of the third area	6586	S16	1000	0	FIX3	pu
92	WCtHz.W4 *	Frequency-dependent active power control: power referring to the inverter at the beginning of the fourth area	6588	S16	1000	0	FIX3	pu

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Data format	Unit
93	WCtlVol.Ena	Activation of voltage-dependent active power control	8156	S32	1	0	ENUM	-
95	WCtlVol.Vol1	Voltage-dependent active power control: voltage threshold of the first voltage band	8160	S16	10000	0	FIX4	pu
96	WCtlVol.Vol2	Voltage-dependent active power control: voltage threshold of the 2nd voltage band	8162	S16	10000	0	FIX4	pu
97	WCtlVol.Vol3	Voltage-dependent active power control: voltage threshold of the third voltage band	8164	S16	10000	0	FIX4	pu
98	WCtlVol.Vol4	Voltage-dependent active power control: voltage threshold of the fourth voltage band	8166	S16	10000	0	FIX4	pu
99	WCtlVol.W1	Voltage-dependent active power control: power referring to the inverter at the beginning of the first area	8168	S16	100	0	FIX42	pu
100	WCtlVol.W2	Voltage-dependent active power control: power referring to the inverter at the beginning of the second area	8170	S16	100	0	FIX42	pu
101	WCtlVol.W3	Voltage-dependent active power control: power referring to the inverter at the beginning of the third area	8172	S16	100	0	FIX42	pu
102	WCtlVol.W4	Voltage-dependent active power control: power referring to the inverter at the beginning of the fourth area	8174	S16	100	0	FIX42	pu
103	WCtlHzBat.Hz1	Frequency-dependent active power control cutoff frequency of the 1st frequency band (underfrequency)	7311	U16	100	0	FIX2	Hz
104	WCtlHzBat.Hz2	Frequency-dependent active power control cutoff frequency of the 2nd frequency band (underfrequency)	7313	U16	100	0	FIX2	Hz
105	WCtlHzBat.Hz3	Frequency-dependent active power control cutoff frequency of the 3rd frequency band (underfrequency)	7315	U16	100	0	FIX2	Hz
106	WCtlHzBat.Hz4	Frequency-dependent active power control cutoff frequency of the 4nd frequency band (underfrequency)	7317	U16	100	0	FIX2	Hz

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Data format	Unit
107	WCtHzBat.Hz5	Frequency-dependent active power control cutoff frequency of the 5th frequency band (overfrequency)	7319	U16	100	0	FIX2	Hz
108	WCtHzBat.Hz6	Frequency-dependent active power control cutoff frequency of the 6th frequency band (overfrequency)	7321	U16	100	0	FIX2	Hz
109	WCtHzBat.Hz7	Frequency-dependent active power control cutoff frequency of the 7th frequency band (overfrequency)	7323	U16	100	0	FIX2	Hz
110	WCtHzBat.Hz8	Frequency-dependent active power control cutoff frequency of the 8th frequency band (overfrequency)	7325	U16	100	0	FIX2	Hz
111	WCtHzBat.W1	Frequency-dependent active power control power referring to the inverter at the beginning of the 1th area (discharge direction)	7327	S16	1000	0	FIX3	pu
112	WCtHzBat.W2	Frequency-dependent active power control power referring to the inverter at the beginning of the 2th area (discharge direction)	7329	S16	1000	0	FIX3	pu
113	WCtHzBat.W3	Frequency-dependent active power control power referring to the inverter at the beginning of the 3th area (discharge direction)	7331	S16	1000	0	FIX3	pu
114	WCtHzBat.W4	Frequency-dependent active power control power referring to the inverter at the beginning of the 4th area (discharge direction)	7333	S16	1000	0	FIX3	pu
115	WCtHzBat.W5	Frequency-dependent active power control power referring to the inverter at the beginning of the 5th area (charge direction)	7335	S16	1000	0	FIX3	pu

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Data format	Unit
116	WCtlHzBat.W6	Frequency-dependent active power control power referring to the inverter at the beginning of the 6th area (charge direction)	7337	S16	1000	0	FIX3	pu
117	WCtlHzBat.W7	Frequency-dependent active power control power referring to the inverter at the beginning of the 7th area (charge direction)	7339	S16	1000	0	FIX3	pu
118	WCtlHzBat.W8	Frequency-dependent active power control power referring to the inverter at the beginning of the 8th area (charge direction)	7341	S16	1000	0	FIX3	pu
119	GriForm.AcCtl.DrpHz	The active power frequency droop in grid-forming operation	7576	S16	1000	0	FIX3	Hz/pu
120	GriForm.AcCtl.DrpVol	The reactive power voltage droop in grid-forming operation	7577	S16	1000	0	FIX3	-
121	WGraFlb	Active power gradient for the control in the event of a loss of communication	8568	S32	1000	0	FIX3	pu/s
123	VArGraFlb	Reactive power gradient for the control during a loss of communication	8572	S32	1000	0	FIX3	pu/s
125	VArCtlVol.VolPsNomHiLim	AC voltage-dependent reactive power control: upper limit for feedback voltage	8497	S16	10000	0	FIX4	pu
126	VArCtlVol.VolPsNomLoLim	AC voltage-dependent reactive power control: lower limit for feedback voltage	8499	S16	10000	0	FIX4	pu
127	ExlConn	External release for connection to the grid	8947	S32	1	0	-	ENUM
129	GriMng.ExtFlbErrClr	Grid management services: Extended fallback operation, acknowledging the error	8994	S32	1	0	-	ENUM
131	PvGnd.RisIsoWarnLim	Insulation resistance, threshold for warning	6640	U16	10	0	FIX1	kohm
132	PvGnd.RisIsoErrLim	Insulation resistance, threshold for error	6642	U16	10	0	FIX1	kohm
133	Reserved							

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Data format	Unit
134	Reserved							
135	GriForm.AcCtl.InertiaThetaH	Inertia: Voltage angle response constant $H_{\theta} = 0.5 * (dP/S_{nom}) / (RoCoF/F_{nom})$	8909	S32	10000	0	FIX4	s
137	GriForm.AcCtl.InertiaVolH	Inertia: Voltage amplitude response constant $H_{vol} = 0.5 * (dQ/S_{nom}) / (RoCoV/V_{nom})$	8917	S32	10000	0	FIX4	s
139	GriForm.AcCtl.InertiaHzDmp	Inertia: Voltage frequency damping gain of voltage angle inertia control	9194	S32	1000	0	FIX3	Hz/pu
141	GriForm.AcCtl.InertiaVolDmp	Inertia: Voltage magnitude damping gain of voltage magnitude inertia control	9200	S32	1000	0	FIX3	-
143	PvGnd.OpnRemGfdIsoMon	Activation of the insulation measurement with manually opened GFDI	9283	S32	1	0	ENUM	-

Related ENUM Codes

The following table contains number codes which, as function coding in data format ENUM, are frequently used in the SMA Modbus profile. The column "Related text" contains the corresponding abbreviations.

Modbus address	Channel name	Unique ID	Return code	Related text
0	InvOpMod	329	973	—
			381	Stop
			309	Operation
2	RemRdy	331	973	—
			308	Enabled
			303	Disabled
8	ErrClr	733	973	—
			26	Ackn
10	VADrtPriMod	730	16	VAr
			18	W
12	WGraMod	725	973	—
			308	Enable
16	VArGraMod	727	303	Disable
20	ErrClr.ProErr	7211	973	—
			21118	Gfdi
			28	Aid

Modbus address	Channel name	Unique ID	Return code	Related text
			2490	Pld
			21119	IsoBender
			21120	Frq
			21204	VCtl.LoLim
			21205	VCtl.HiLim
			20907	VCtl.PkLim
			21121	All
22	GriMng.InvVArMod	6088	303	Off
			21206	VArCtlVol
			21207	VArCtlVolPi
30	InstFunc	7469	973	—
			21488	Systemreset Acc, Dcc, Rio, Cont
32	WCtlHzBatMod	7534	973	—
			308	Enabled
			303	Disabled
36	StbySfCapacMod	7913	973	—
			21679	Standby with capacitor
			21680	Standby without capacitor
38	Aid.Mod	709	973	—
			308	Enabled
			303	Disabled
84	WCtlHzMod	361	973	—
			308	Enabled
			303	Disabled
93	WCtlVol.Ena	8156	973	—
			308	Enabled
			303	Disabled
127	ExlConn	7534	973	—
			308	Enabled
			303	Disabled
129	GriMng.ExtIdFlbErrClr	8994	973	—
			26	Ackn
143	PvGnd.OpnRemGfdilsoMon	9283	973	—
			308	Enable
			303	Disable

5.3.2 Input Register

In the following table, you can find the Modbus addresses, which you can access under unit ID = 3 and function code 0x04 (see Section 3.6.1 "Unit ID's", page 12).

Measured Values

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Data format	Unit
0	DcMs.Vol	DC voltage DC plus to DC minus	597	S32	10	0	FIX1	V
2	DcMs.Amp.Stk1	DC current inverter bridge 1	600	S32	1	0	FIX0	A
4	DcMs.Amp.Stk2	DC current inverter bridge 2	601	S32	1	0	FIX0	A
6	DcMs.Amp.Stk3	DC current inverter bridge 3	602	S32	1	0	FIX0	A
8	DcMs.TotAmp	DC current, total	6146	S32	1	0	FIX0	A
10	DcMs.TotWatt	DC power, total	603	S32	1	0	FIX0	kW
12	InvMs.DclVol.Stk1	DC voltage of the inverter bridge 1	616	S32	10	0	FIX1	V
14	InvMs.DclVol.Stk2	DC voltage of the inverter bridge 2	617	S32	10	0	FIX1	V
16	InvMs.DclVol.Stk3	DC voltage of the inverter bridge 3	618	S32	10	0	FIX1	V
18	InvMs.TotA.PhsA	AC current L1, total	408	S32	1	0	FIX0	A
20	InvMs.TotA.PhsB	AC current L2, total	409	S32	1	0	FIX0	A
22	InvMs.TotA.PhsC	AC current L3, total	410	S32	1	0	FIX0	A
24	InvMs.PF	Power factor (cos phi)	404	S32	10000	0	FIX4	-
26	InvMs.TotVA	Apparent power, total	401	S32	1	0	FIX0	kVA
28	InvMs.TotW	Active power, total	402	S32	1	0	FIX0	kW
30	InvMs.TotVAr	Reactive power, total	403	S32	1	0	FIX0	kVAr
32	GriMs.V.PhsAB	Line-to-line voltage L1-L2, utility grid	405	S32	10	0	FIX1	V
34	GriMs.V.PhsBC	Line-to-line voltage L2-L3, utility grid	406	S32	10	0	FIX1	V
36	GriMs.V.PhsCA	Line-to-line voltage L3-L1, utility grid	407	S32	10	0	FIX1	V
38	GriMs.Hz	Grid frequency	607	S32	100	0	FIX2	Hz
40	TmpCab.Acc	Temperature in the AC range	751	S32	10	0	FIX1	°C
42	TmpCab.Dcc	Temperature in the DC range	750	S32	10	0	FIX1	°C
44	TmpCab.Rio	Temperature in the electronics area	752	S32	10	0	FIX1	°C
46	TmpCab.Max	Temperature in interior, maximum value	6130	S32	10	0	FIX1	°C
48	TmpStk.IgbitMax	Temperature of the inverter bridge (switch), maximum value	6100	S32	10	0	FIX1	°C

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Data format	Unit
50	TmpStk.PcbMax	Temperature of the inverter bridge (assembly), maximum value	6099	S32	10	0	FIX1	°C
52	TmpExl	External temperature	759	S32	10	0	FIX1	°C
54	TmpTrf	Temperature of the MV transformer	6107	S32	10	0	FIX1	°C
56	DcSw1Stt	Switching status of the DC load-break switch 1	611	S32	1	0	ENUM	-
58	DcSw2Stt	Switching status of the DC load-break switch 2	721	S32	1	0	ENUM	-
60	DcSw3Stt	Switching status of the DC load-break switch 3	722	S32	1	0	ENUM	-
62	AcSwStt	Switching status of the AC circuit breaker	6202	S32	1	0	ENUM	-
66	CapacSwStt	Switching state of the capacitor contactor	6708	S32	1	0	ENUM	-
68	PrchrgSwStt	Switching status of the pre-charging contactor	6707	S32	1	0	ENUM	-
70	Cnt.TotFeedTm	Feed-in time	6779	U32	1	0	FIX0	s
72	Cnt.TotOpTm	Operating time	6777	U32	1	0	FIX0	s
74	Cnt.TotDcWhIn	DC energy drawn, total	7119	S32	100	0	FIX2	MWh
76	Cnt.TotAcWhOut	AC energy fed in, total	7118	S32	100	0	FIX2	MWh
78	Cnt.DcWhIn	DC energy drawn that day	6771	S32	100	0	FIX2	MWh
80	Cnt.AcWhOut	AC energy fed in that day	6767	S32	100	0	FIX2	MWh
82	Cnt.FanCab1Tm	Operating time of the interior fan 1	6793	U32	1	0	FIX0	s
84	Cnt.FanCab2Tm	Operating time of the interior fan 2	6795	U32	1	0	FIX0	s
86	Cnt.FanStkTm	Operating time of the inverter bridge fan	6791	U32	1	0	FIX0	s
88	Cnt.HtCabTm	Operating time of the interior heater	6797	U32	1	0	FIX0	s
90	Cnt.HtLoExlTm	Operating time of the -40°C interior heater	6799	U32	1	0	FIX0	s
92	ErrLcn	Error location of the present error	6968	U32	1	0	ENUM	-
94	ErrStt	Error status of the inverter	328	S32	1	0	ENUM	-
96	ErrNo	Error number of the present error	823	U32	1	0	FIX0	-
98	OpStt	Operating state of the inverter	332	S32	1	0	ENUM	-
100	Rio.KeySw	Switch status of the start-stop key switch	327	S32	1	0	ENUM	-

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Data format	Unit
102	WaitGriTm	Waiting time for grid connection	614	S32	10	0	FIX1	s
104	DevInf.SerNo	Serial number of the inverter	6763	U32	1	0	FIX0	-
106	GfdiSwStt	Switching status of the GFDI	6706	S32	1	0	ENUM	-
108	WSpt	Active power, setpoint	320	S32	1	0	FIX0	kW
110	VAMaxSpt	Maximum apparent power, setpoint	665	S32	10	0	FIX1	kVA
112	VARspt	Reactive power, setpoint	321	S32	1	0	FIX0	kVAr
114	PFSpt	Power factor cos (phi), setpoint	322	S32	10000	0	FIX4	-
116	TrfPro.Pres	Fast stop hermetic protection, pressure	7029	S32	1	0	ENUM	-
118	TrfPro.TmpTrp	Fast stop hermetic protection, temperature	506	S32	1	0	ENUM	-
120	TrfPro.GasOilLev	Hermetic protection, gas fill level	7170	S32	1	0	ENUM	-
122	TrfPro.TmpWrn	Hermetic pressure, temperature warning	7168	S32	1	0	ENUM	-
124	TmpStk1.lgbt	Temperature of inverter bridge 1 (switch)	756	S32	10	0	FIX1	°C
126	TmpStk2.lgbt	Temperature of inverter bridge 2 (switch)	757	S32	10	0	FIX1	°C
128	TmpStk3.lgbt	Temperature of inverter bridge 3 (switch)	758	S32	10	0	FIX1	°C
130	TmpStk1.Pcb	Maximum temperature of inverter bridge 1 (assembly)	753	S32	10	0	FIX1	°C
132	TmpStk2.Pcb	Maximum temperature of inverter bridge 2 (assembly)	754	S32	10	0	FIX1	°C
134	TmpStk3.Pcb	Maximum temperature of inverter bridge 3 (assembly)	755	S32	10	0	FIX1	°C
136	Cnt.YstdWhOut	AC energy fed in the previous day	7073	S32	100	0	FIX2	MWh
138	Cpu1UpTime	CPU running time since system start	7225	U32	1	0	FIX0	s
140	PvGnd.Rislso	Insulation resistance	6644	S32	10	0	FIX1	kohm
142	PresTrf	MV transformer pressure	7249	S32	100	0	FIX2	-
144	PresTrf.ErrStt	Error status of MV transformer pressure monitoring	7253	S32	0	0	ENUM	-
149	GriMs.Vol.PsNom	Normalized AC voltage, positive sequence	7233	S32	10000	0	FIX4	-
151	Cnt.TotDcWhOut	DC energy fed in, total	7300	S32	100	0	FIX2	MWh
153	Cnt.TotAcWhIn	AC energy drawn, total	7182	S32	100	0	FIX2	MWh

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Data format	Unit
155	Cnt.DcWhOut	DC energy fed in that day	7302	S32	100	0	FIX2	MWh
157	Cnt.AcWhIn	AC energy drawn that day	7180	S32	100	0	FIX2	MWh
159	DclVolSpt	DC voltage, setpoint	7488	S32	10	0	FIX1	V
161	DcAmpSpt	DC current, setpoint	7276	S32	1	0	FIX0	A
163	VolNomSpt	AC voltage-dependent reactive power control: setpoint AC voltage	7000	S32	10000	0	FIX4	-
167	AuxCtl.LifeSign	Life sign with valid setpoints	7355	U16	1	0	FIX0	-
168	InvPwrVolTyp	Inverter type	6338	S32	1	0	ENUM	-
170	HzNomSpt	Nominal frequency for frequency-dependent control of active power	7277	S32	100	0	FIX2	Hz
172	WAval	Available Active Power	7632	S32	10000	0	FIX4	pu
174	VArAval	Available reactive power	7633	S32	10000	0	FIX4	pu
176	DrtStt	Current derating status	830	S32	1	0	ENUM	-
178	PwrOffReas	Current cause of inverter disconnection	7221	S32	1	0	ENUM	-
180	DiagRmgTm	Time until the next inverter self test	7716	U32	1	0	FIX0	s
184	WRtg	Nominal value of active power	318	S32	1	0	FIX0	kW
188	ActErrNo1	Error number of the current error	8045	U32	1	0	FIX0	-
190	ActErrLcn1	Location where the current error was detected	8047	U32	1	0	ENUM	-
192	ActErrNo2	Error number of the current error	8048	U32	1	0	FIX0	-
194	ActErrLcn2	Location where the current error was detected	8050	U32	1	0	ENUM	-
196	ActErrNo3	Error number of the current error	8051	U32	1	0	FIX0	-
198	ActErrLcn3	Location where the current error was detected	8053	U32	1	0	ENUM	-
200	ActErrNo4	Error number of the current error	8054	U32	1	0	FIX0	-
202	ActErrLcn4	Location where the current error was detected	8056	U32	1	0	ENUM	-
204	ActErrNo5	Error number of the current error	8057	U32	1	0	FIX0	-

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Data format	Unit
206	ActErrLcn5	Location where the current error was detected	8059	U32	1	0	ENUM	-
208	ActErrNo6	Error number of the current error	8060	U32	1	0	FIX0	-
210	ActErrLcn6	Location where the current error was detected	8062	U32	1	0	ENUM	-
212	ActErrNo7	Error number of the current error	8063	U32	1	0	FIX0	-
214	ActErrLcn7	Location where the current error was detected	8065	U32	1	0	ENUM	-
216	ActErrNo8	Error number of the current error	8066	U32	1	0	FIX0	-
218	ActErrLcn8	Location where the current error was detected	8068	U32	1	0	ENUM	-
220	ActErrNo9	Error number of the current error	8069	U32	1	0	FIX0	-
222	ActErrLcn9	Location where the current error was detected	8071	U32	1	0	ENUM	-
224	ActErrNo10	Error number of the current error	8072	U32	1	0	FIX0	-
226	ActErrLcn10	Location where the current error was detected	8074	U32	1	0	ENUM	-
268	VArExlSpt.RefVal	Reference value for the external reactive power setpoint	8271	S16	1	0	FIX0	kVAr
269	WExlSpt.RefVal	Reference value for the external active power setpoint	8272	S16	1	0	FIX0	kW
270	VARtg	Nominal value of apparent power	323	S32	1	0	FIX0	kVA
272	InvTyp	Inverter type	7359	S32	1	0	ENUM	-
274	VArRtg	Nominal value of reactive power	319	S32	1	0	FIX0	kvar
276	DcMs.VolPosGnd	DC voltage of DC+ to ground	598	S32	10	0	FIX1	V
278	DcMs.VolNegGnd	DC voltage of DC- to ground	599	S32	10	0	FIX1	V
280	GriForm.OvAmpStt	Overload capability: Overcurrent status	8969	S32	1	0	ENUM	-
282	GriForm.OvAmp.AmpMaxFrtAval	Overload capability: Maximum available nominal current in FRT when virtual impedance is active	8970	S32	10000	0	FIX4	pu
284	GriForm.OvAmp.AmpMaxAval	Overload capability: Maximum available nominal current in grid-forming	8971	S32	10000	0	FIX4	pu

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Data format	Unit
286	GriMng.ExtFlbStt	Grid management services: Extended fallback operation, status	8993	S32	1	0	ENUM	-
288	ErrRmgTm	Remaining error waiting period	7114	U32	1	0	FIX0	s
290	Cnt.DcSw1	Number of switch cycles of DC switch 1	6803	U32	1	0	FIX0	-
292	Cnt.DcSw2	Number of switch cycles of DC switch 2	6805	U32	1	0	FIX0	-
294	Cnt.DcSw3	Number of switch cycles of DC switch 3	6807	U32	1	0	FIX0	-
296	Cnt.AcSw	Number of switch cycles of the AC switch	6801	U32	1	0	FIX0	-
298	DcPreChaRmgTm	Remaining time until next DC precharging	9114	U32	1	0	FIX0	s
300- 302	Reserved							
304	DcPreChaSwStt	Switching status of the DC precharging contactor	7719	S32	1	0	ENUM	-
306	GriForm.AcCtl.Inerti aThetaHMin	Inertia: Minimum voltage angle inertia constant	9186	S32	10000	0	FIX4	s
308	GriForm.AcCtl.Inerti aThetaHMax	Inertia: Maximum voltage angle inertia constant	9188	S32	10000	0	FIX4	s
310	GriForm.AcCtl.Inerti aVolHMin	Inertia: Minimum voltage magnitude inertia constant	9190	S32	10000	0	FIX4	s
312	GriForm.AcCtl.Inerti aVolHMax	Inertia: Maximum voltage magnitude inertia constant	9192	S32	10000	0	FIX3	s
314	GriForm.AcCtl.Inerti aHzDmpMin	Inertia: Minimum voltage frequency damping gain of voltage angle inertia control	9196	S32	1000	0	FIX3	Hz/pu
316	GriForm.AcCtl.Inerti aHzDmpMax	Inertia: Maximum voltage frequency damping gain of voltage angle inertia control	9198	S32	1000	0	FIX3	Hz/pu
318	GriForm.AcCtl.Inerti aVolDmpMin	Inertia: Minimum voltage magnitude damping gain of voltage magnitude inertia control	9202	S32	1000	0	FIX3	-

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Data format	Unit
320	GriForm.AcCtl.InertiaVolDmpMax	Inertia: Maximum voltage magnitude damping gain of voltage magnitude inertia control	9204	S32	1000	0	FIX3	-
322	GriForm.AcCtl.InertiaThetaHFb	Inertia: Feedback voltage angle inertia constant	9210	S32	10000	0	FIX4	s
324	GriForm.AcCtl.InertiaVolHFb	Inertia: Feedback voltage magnitude inertia constant	9211	S32	10000	0	FIX4	s
326	GriForm.AcCtl.InertiaHzDmpFb	Inertia: Feedback voltage frequency damping gain of voltage angle inertia control	9212	S32	1000	0	FIX3	Hz/pu
328	GriForm.AcCtl.InertiaVolDmpFb	Inertia: Feedback voltage magnitude damping gain of voltage magnitude inertia control	9213	S32	1000	0	FIX3	.
330	Cnt.DcSw1Uvr	Switch cycles of the DC load-break switch 1, undervoltage release	9314	U32	1	0	FIX0	-
332	Cnt.DcSw2Uvr	Switch cycles of the DC load-break switch 2, undervoltage release	9316	U32	1	0	FIX0	-
334	Cnt.DcSw3Uvr	Switch cycles of the DC load-break switch 3, undervoltage release	9318	U32	1	0	FIX0	-
336	Cnt.AcSwUvr	Switch cycles of the AC circuit breaker, undervoltage release	9312	U32	1	0	FIX0	-
338	WSptMin	Active power, minimum setpoint	8253	S16	1	0	FIX0	kW
339	WSptMax	Active power, maximum setpoint	8537	S16	1	0	FIX0	kW
340	RiHmdtRio	Relative humidity in the electronics area	760	S16	10	0	FIX1	%
341	RiHmdtAcc	Relative humidity in the AC area	761	S16	10	0	FIX1	%
342	RiHmdtDcc	Relative humidity in the DC area	762	S16	10	0	FIX1	%
343	DrtExlStt	Derating due to outside temperature	690	S32	1	0	ENUM	-
345	HmdtCtl.TmCnt	Time counter to activate/deactivate dehumidification	9515	U32	1	0	FIX0	s

Modbus address	Channel name	Explanation	Unique ID	Data type	Scaling	Offset	Data format	Unit
347	HmdtCtl.Stt	Status of dehumidification activation	9517	S32	1	0	ENUM	-

Related ENUM Codes

The following table contains number codes which, as function coding in data format ENUM, are frequently used in the SMA Modbus profile. The column "Related text" contains the corresponding abbreviations.

Modbus address	Channel name	Unique ID	Return code	Related text
56	DcSw1Stt	611	973	—
58	DcSw2Stt	721	311	Open
60	DcSw3Stt	722	51	Closed
62	AcSw1Stt	6202		
66	CapacSwStt	6708		
68	PrchrgSwStt	6707		
304	DcPreChaSwStt	7719		
92	ErrLcn	332	0	
190	ActErrLcn1	8047	238	Grid switch
194	ActErrLcn2	8050	267	Inverter
198	ActErrLcn3	8053	268	Insulation monitoring (components for DC monitoring)
202	ActErrLcn4	8056	302	—
206	ActErrLcn5	8059	422	Transformer
210	ActErrLcn6	8062	465	DC disconnection unit
214	ActErrLcn7	8065	512	Fuse of surge arrester / DC busbar
218	ActErrLcn8	8068	915	Battery management system
222	ActErrLcn9	8071	1396	AC-grid

Modbus address	Channel name	Unique ID	Return code	Related text
226	ActErrLcn10	8074	1887	System environment
			3278	SC30DST (internal SMA assembly)
			3279	SC30ACC (internal SMA assembly)
			3280	SC30DCC (internal SMA assembly)
			3281	SC30RIO (internal SMA assembly)
			3282	SC30CONT (internal SMA assembly)
			3283	SC30CONT CPU1 (internal SMA assembly)
			3284	SC30CONT CPU2 (internal SMA assembly)
			4260	DC busbar
			21006	SC30DST 1 (internal SMA assembly)
			21007	SC30DST 2 (internal SMA assembly)
			21008	SC30DST 3 (internal SMA assembly)
			21009	SC30DST 1 EEPROM (internal SMA assembly)
			21010	SC30DST 2 EEPROM (internal SMA assembly)
			21011	SC30DST 3 EEPROM (internal SMA assembly)
			21012	SC30APP (internal SMA assembly)
			21013	SC30DCC EEPROM (internal SMA assembly)
			21014	SC30ACC EEPROM (internal SMA assembly)
			21015	SC30DCSHUNT (internal SMA assembly)
			21016	Bender (Components for DC monitoring)
			21020	Pre-charge contactor
			21021	Sinusoidal filter capacitor contactor
			21055	GFDI (components for DC monitoring)
				Pre-charging contactor sine-wave filter capacitor
			21530	On-board power supply
			21534	Circuit breaker
			21535	SC30CONT FPGA (internal SMA assembly)
			21638	Float controller (components for DC monitoring)
			21677	DC load-break switch 1
			21819	DC load-break switch 2
			21820	DC load-break switch 3
			21821	SC40CHOP
			22024	AC switch surroundings
			22201	
272	InvTyp		21983	PV inverter
			21984	Battery inverter
			21985	PV and battery inverter
94	ErrStt	328	973	—
			307	OK
			1392	Error
98	OpStt	332	973	—
			1787	Init
			381	Stop
			1392	Error
			3522	Update
			3523	Reset
			1394	WaitAC
			3524	ConnectAC
			1393	WaitDC

Modbus address				
	Channel name	Unique ID	Return code	Related text
			3525	ConnectDC
			3526	GridFeed
			21429	GridForm
			21584	AcRampUp
			3527	FRT
			3528	Standby
			3529	QonDemand
			3530	RampDown
			1469	ShutDown
			375	Selftest
			3533	IOTest
			22509	HumidityMng
			973	—
100	Rio.KeySw	327	308	On
106	GfdiSwStt	6706	303	Off
			973	—
			311	Open
			51	Closed
116	TrfPro.Pres	7029	973	—
118	TrfPro.TmpTrp	506	307	OK
120	TrfPro.GasOilLev	7170	1392	Error
122	TrfPro.TmpWrn	7168		
144	PresTrf.ErrStt	7253		
168	InvPwrVolTyp	6338	9383	Sunny Central Storage 2200
			9384	Sunny Central Storage 2500-EV
			9385	Sunny Central Storage 2500-EV-US
			9386	Sunny Central Storage 2200-US
			9389	Sunny Central 2750-EV
			9390	Sunny Central 2750-EV-US
			9391	Sunny Central Storage 2475
			9392	Sunny Central Storage 2475-US
			9414	Sunny Central Storage 3000-EV
			9418	Sunny Central Storage 1900
			9419	Sunny Central Storage 1900-US
			9420	Sunny Central Storage 2900
			9421	Sunny Central Storage 2900-US
			19005	Sunny Central Storage 3450 UP
			19006	Sunny Central Storage 3450 UP-US
			19007	Sunny Central Storage 3600 UP
			19008	Sunny Central Storage 3600 UP-US
			19009	Sunny Central Storage 3800 UP
			19010	Sunny Central Storage 3800 UP-US
			19011	Sunny Central Storage 3950 UP

Modbus address	Channel name	Unique ID	Return code	Related text
176	DrtStt	830	19012	Sunny Central Storage 3950 UP-US
			9459	Sunny Central Storage 3450 UP-XT
			9460	Sunny Central Storage 3450 UP-XT-US
			9463	Sunny Central Storage 3600 UP-XT
			9464	Sunny Central Storage 3600 UP-XT-US
			9467	Sunny Central Storage 3800 UP-XT
			9468	Sunny Central Storage 3800 UP-XT-US
			9471	Sunny Central Storage 3950 UP-XT
			9472	Sunny Central Storage 3950 UP-XT-US
			82945	Sunny Central Storage 2300 UP-XT
			82947	Sunny Central Storage 2300 UP-XT-US
			83201	Sunny Central Storage 2400 UP-XT
			823203	Sunny Central Storage 2400 UP-XT-US
			83457	Sunny Central Storage 2530 UP-XT
			83459	Sunny Central Storage 2530 UP-XT-US
			83713	Sunny Central Storage 2630 UP-XT
			83715	Sunny Central Storage 2630 UP-XT-US
			973	—
			21585	Stk.DcAmpLim
			21586	Frt
			21587	AmpGra
			21588	AMax
			21589	VAMax
			21590	WCtlLoHz
			21591	WCtlHz
			21592	WGraRecon
			21593	WGra
			21594	WMax
			21595	WMaxExt
			21596	VecLen
			21597	Bat.DcAmp
			21598	Bat.DcVol
			21599	WGraStr
			21600	WCtlHzBat
			21601	WCtlVol
			21602	Mvps.WRvLim
			21651	VArPrio
			22056	WSptMax

Modbus address	Channel name	Unique ID	Return code	Related text
178	PwrOffReas	7221	22057	WSptMin
			973	—
			21603	No Power Off Reason
			21604	Error: Critical Error, ProErr active
			21605	Error
			21606	Stop: Key Switch
			21607	Stop: Parameter InvOpmod
			21608	Stop: Stop External X440:3
			21609	Stop: Scada or PPC, Modbus
			21610	Stop: unspecified
			21611	Stop: Battery System Controller
			21612	Standby: Scada or PPC, Modbus
			21613	Standby: AC Synchronization
			21614	Standby: Low DC Power
			21615	Standby: External Grid Error
			21616	Standby: Power Monitoring Module
			21617	Standby: Parameter RemRdy
			21618	Standby External X440:7
			21619	Standby: unspecified
			21620	WaitAc
			21621	WaitDc: DC Voltage
			21622	WaitDc: Bender
			21623	WaitDc: DC precharge waiting period
			21624	Selftest active
			21625	IO Test active
			21626	Low Power Set Point
			21627	Battery
			22327	No license for selected mode
			22273	not relevant
			22274	not relevant
272	InvTyp	7359	5047	Electrolyzer inverter
			21983	PV inverter
			21984	Battery inverter
			21985	PV and battery inverter
280	GriForm.OvAmpStt	8969	800	Disabled
			885	None
			2630	Normal
			22221	Short
			307	OK
286	GriMng.ExtFlbStt	8993	22232	Timeout, inactive

Modbus address	Channel name	Unique ID	Return code	Related text
343	DrtExlStt	690	22233	Timeout, 1 hour
			22234	Timeout, 30 seconds
			22235	Fallback and error
			973	–
			22463	No VAMax derating
			22464	Derating VAMax MVPS communication
			22465	Derating VAMax external temperature
347	HmdtCil.Stt	9517	22466	Derating VAMax transformer temperature
			973	–
			308	On
			303	Off

Explanation for the current derating statuses

Text	Explanation
–	Derating not active
Stk.DcAmpLim	The DC current limitation has been reached
Frt	The inverter is in the "FRT" operating state and supports the utility grid via dynamic grid support
AmpGra	The active power limitation is active because a gradual increase in the feed-in power is being performed.
AMax	The maximum AC current has been reached.
VAMax	The maximum apparent power has been reached.
WCilLoHz	Active power limitation is active due to underfrequency.
WCilHz	Active power limitation is active due to overfrequency.
WGraRecon	Active power limitation is active because of a grid error during the gradual increase in the feed-in power.
WGra	Active power limitation is active because of a gradual increase in the feed-in power in MPP operation.
WMax	The maximum AC power has been reached.
WMaxExt	The maximum AC power has been reached. Here, the limitation is specified via an external set value.
Veclen	The active power has reduced due to the DC voltage.
Bat.DcAmp	The maximum charge or minimum discharge current of the battery has been reached.
Bat.DcVol	The maximum charge or discharge voltage of the battery has been reached.
WGraStr	Active power limitation is active by gradually increasing the feed-in power when starting the inverter.
WCilVol	Active power limitation is active due to the grid voltage.
Mvps.WRvLim	Active power limitation is active to protect the MV transformer in the MV Power Station.
VARprio	The active power is reduced due to required reactive power feed-in.

Explanation for the cause of the inverter disconnecting and corrective measures

Text	Explanation	CORRECTIVE MEASURES
Invalid	The inverter has not initialized.	–
No Power Off Reason	The inverter is in operation, no disconnection is present.	–

Text	Explanation	CORRECTIVE MEASURES
Error: Critical Error, ProErr active	A safety critical error is present. The error number is to be found in the instantaneous value ErrNo .	- Check the cause of error. - Acknowledge the error once the cause has been remedied.
Error	An error is present. The error number is to be found in the instantaneous value ErrNo .	- Check the cause of error. - Acknowledge the error once the cause has been remedied.
Stop: Key Switch	The key switch is in the Off position.	Switch the key switch on.
Stop: Parameter InvOpMod	The parameter InvOpMod is not set to Operation .	Set the parameter InvOpMod to Operation.
Stop: Stop External X440:3	The signal to stop the inverter was sent via digital input X440:3 .	Measure input X440:3 and check the cable if necessary.
Stop: Scada or PPC, Modbus	The last request via Modbus was an inverter stop request.	Write 1467 (Start) to the register 40018.
Stop: unspecified	A reason for the inverter stopping could not be determined.	- Wait 30 seconds. - Restart the inverter. If the error is still present after startup, contact Service.
Stop: Battery System Controller	The Battery System Controller requires the inverter to stop. This also includes the stop command at the SCS via Modbus using the parameter AuxCtl.SCSOpCmd	- Check the battery management information. - Adapt the operating specifications as required.
Standby: Scada or PPC, Modbus	The last request via Modbus was an inverter standby request.	Write 1467 (Start) to the register 40018.
Standby: AC Synchronization	Synchronization with the AC grid is not possible.	Check the voltages at the inverter input.
Standby: Low DC Power	The inverter is in standby because the DC voltage is too low.	Wait for the DC voltage to increase.
Standby: External Grid Error	An external grid error was sent via Modbus.	- Delete the external grid error. - Acknowledge the error via Modbus.
Standby: Power Monitoring Module	The buffer module or the inverter-internal diagnostics requested standby mode.	- Check the voltage of the buffer module. - Check the external power specification.
Standby: Parameter RemRdy	The RemRdy parameter is set to Disable .	Set the parameter RemRdy to Enable.
Standby: Standby External X440:7	The signal to switch the inverter to standby was sent via digital input X440:7 .	Measure input X440:7 and check the cable if necessary.
Standby: unspecified	A reason for the inverter switching to standby could not be determined.	- Wait 30 seconds. - Restart the inverter. If the error is still present after startup, contact Service.
WaitAc	The inverter is waiting for a valid AC grid.	- Wait until the waiting time for grid connection specified in the instantaneous value WaitGriTm has elapsed. - Check the AC voltage and grid limits in the parameters VCl.xxx. If there a reason for the inverter switching off cannot be found, contact Service.
WaitDc: DC Voltage	The DC voltage is outside of the defined range.	Wait or change DC voltage.
WaitDc: Bender	The insulation monitoring device is measuring the insulation resistance of the PV system.	Wait until the insulation resistance measurement has been completed.

Text	Explanation	CORRECTIVE MEASURES
WaitDc: DC precharge waiting period	The waiting time for DC pre-charging has not elapsed.	Wait until the waiting time for DC pre-charging has elapsed.
Selftest active	The inverter is performing a self test.	Wait until the self test has been completed.
IO Test active	The inverter is in test mode.	Please contact SMA Service.
Low Power SetPoint	Low power values are preventing the inverter from starting up.	Increase the setpoints for active power in the parameter WSpt and reactive power in parameter VArSpt.
Battery	The battery prevents the feed-in.	Read out the battery information.

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6 Battery Communication

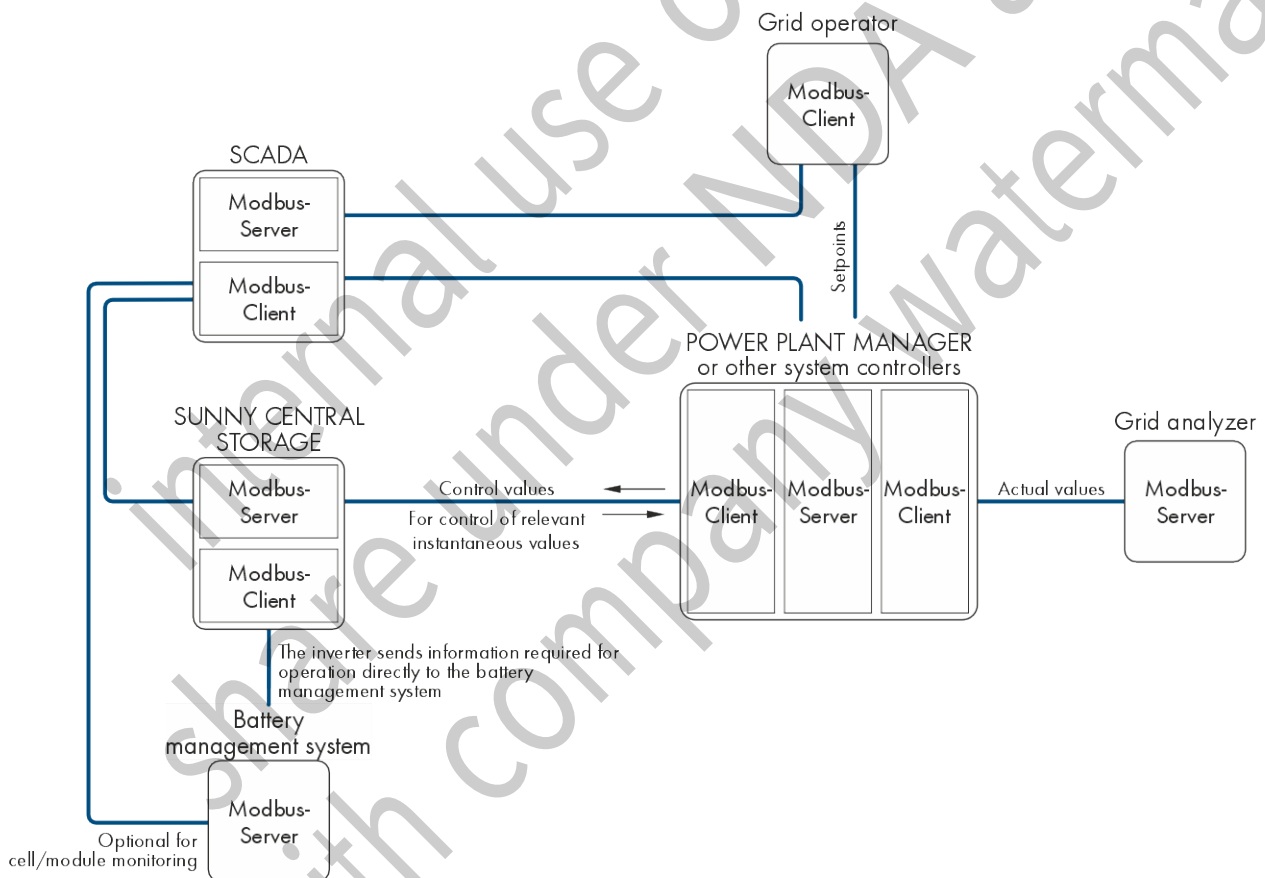
6.1 Structure of battery communication

For optimal operation, the inverter requires basic information about the battery connected in each case. This information must be provided to the inverter via the Modbus TCP/IP protocol if the system is controlled by SMA products.

The battery information can be provided in two different ways:

Option A: direct integration of the battery communication

For battery-management systems of different battery manufacturers, implementation and qualification have already been carried out by SMA Solar Technology AG and direct communication between the inverter and the battery-management system can be established. This communication is set up during commissioning by SMA Service. You can inquire with us about the battery-management systems approved for direct integration. Apart from necessary operating data of the inverter, batteries can often provide further information, e.g., warranty related information about the status of subcomponents. Via Modbus, this information can be also made accessible through the inverter.



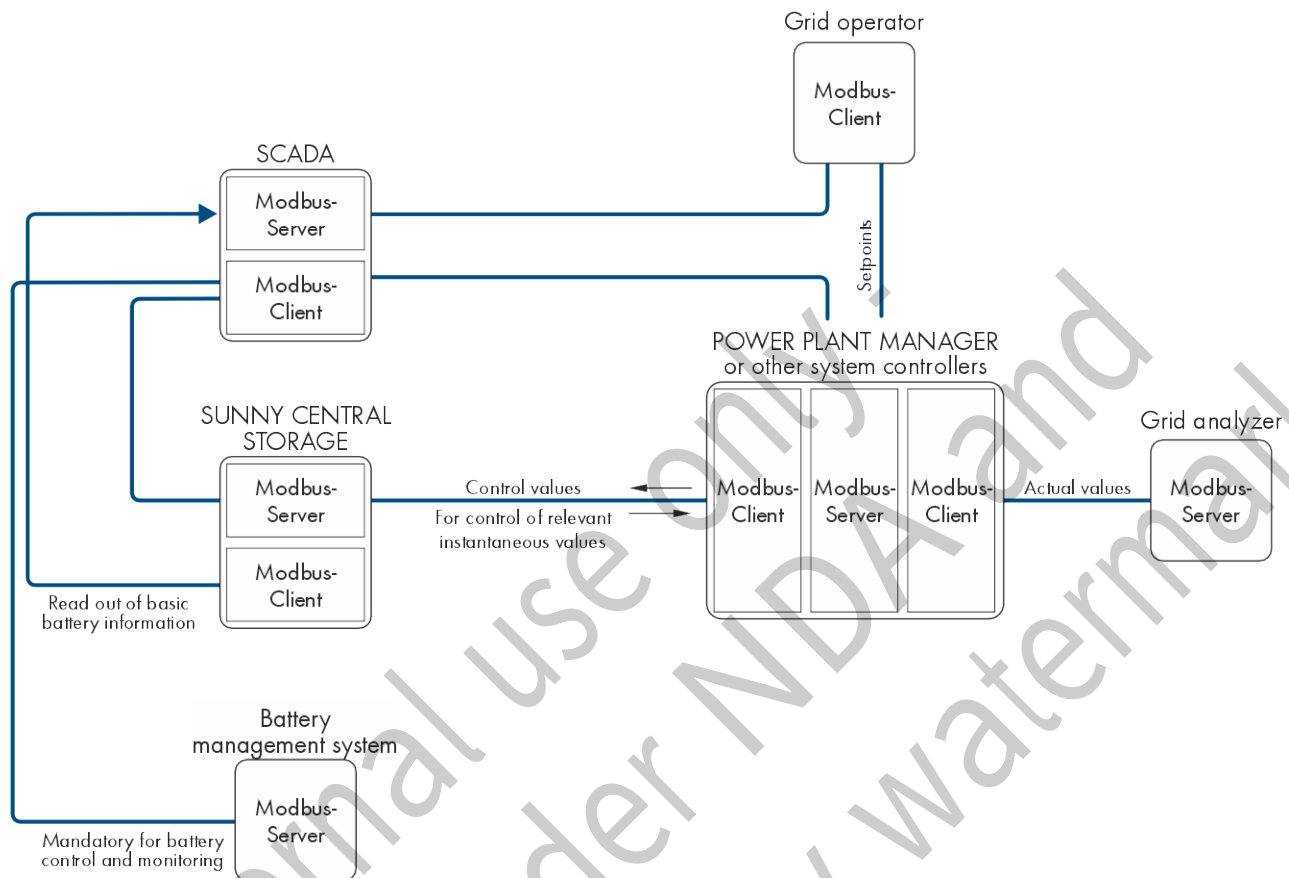
For this, the customer has the option to import another Modbus profile for the battery communication in the inverter. In this Modbus profile, the assignment of additional source registers can be set to target registers (on Unit ID 36 in the Modbus Server). The subdivision in two Modbus profiles is necessary to set up different communication cycles. You will find an example for a Modbus profile in Section 7.1, page 60.

Option B: indirect provision of the battery information

If direct integration of the utilized battery-management system is not possible, certain information must be provided via interfaces defined below.

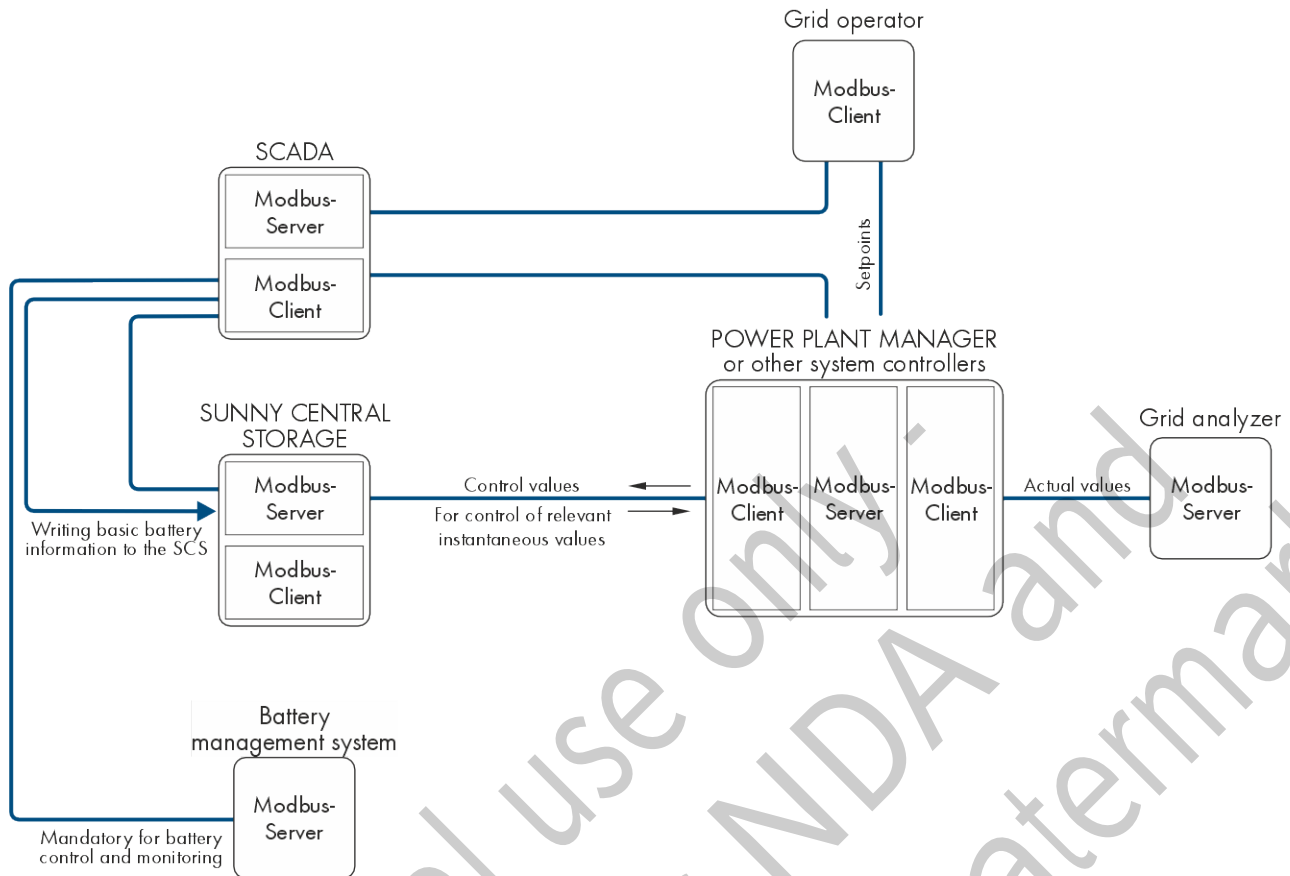
Both interfaces defined below require the same data points but can be designated as either a Modbus client or a Modbus server. The SMA Extended battery interface reads the values from a Modbus server. When the battery profile "SMA external" is used, the data can be written from a Modbus client to the inverter interface.

SMA Extended



The battery is controlled and monitored via SCADA or a customized system controller. The inverter receives only basic battery information by reading a special Modbus server provided by the customer. The basic battery information is sufficient for using an SMA system controller.

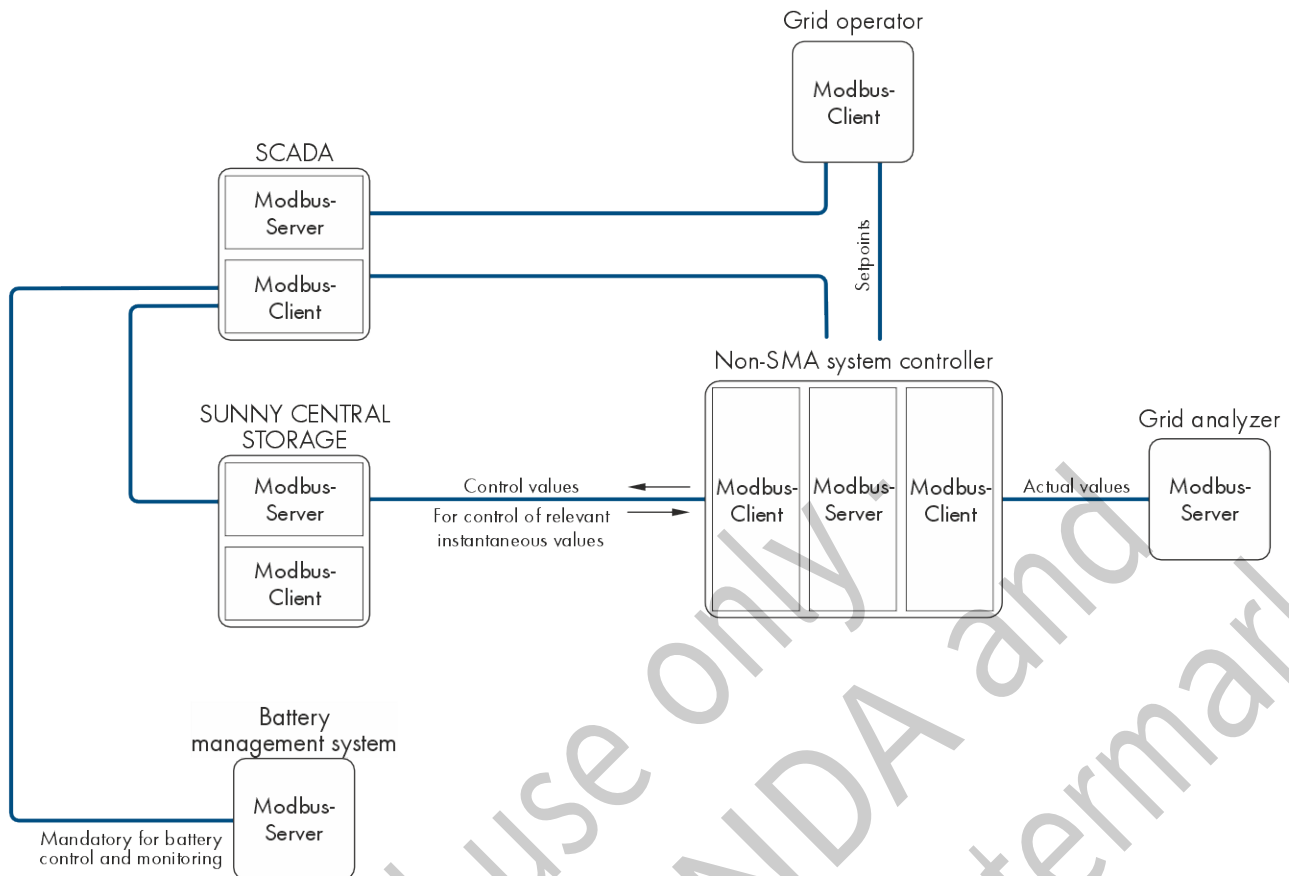
SMA External



The battery is controlled and monitored via SCADA or a customized system controller. Only basic battery information is transmitted to the inverter by writing it to the existing Modbus server (Modbus server). The basic battery information is sufficient for using an SMA system controller.

Option C: No battery information

It is possible to build the system without battery communication with the inverter. Battery control and monitoring are carried out via SCADA or system control. No battery information is available for the inverter. In that case, it is not possible to use an SMA system controller.



6.2 Battery Profile SMA Extended

The following table shows the battery signals that must be made available to the inverter as input registers in case of indirect provision of the battery information by a Modbus server. The Modbus server can be parameterized during commissioning by means of IP address, port and unit ID. The registers are retrieved by the inverter as a data block with the function code 0x04 at a polling rate of 1000 ms.

Address	Channel name	Value range	Exemplary values	Unique ID	Data type	Scaling	Data format	Unit
0	State of Charge	0% to 100%	53.4 %	-	U16	10	FIX1	%
1	State of Health	0% to 100%	98.7 %	-	U16	10	FIX1	%
2	Alarm		0	-	U16	1	FIX0	-
3	Maximum discharge current	0 A to 5000 A	3400 A	-	U32	10	FIX1	A
5	Maximum charge current	0 A to 5000 A	3300 A	-	U32	10	FIX1	A
7	Lifesign		-	-	U16	1	FIX0	-
8	Trip limit maximum discharge current	0 A to 5000 A	3600 A	-	U32	10	FIX1	A
10	Trip limit maximum charge current	0 A to 5000 A	3500 A	-	U32	10	FIX1	A
12	Maximum discharge voltage	0 V to 2000 V	1400 V	-	U16	1	FIX0	V
13	Minimum charge voltage	0 V to 2000 V	1200 V	-	U16	1	FIX0	V
14	Trip limit maximum discharge voltage	500 V to 2000 V	1430 V	-	U16	1	FIX0	V
15	Trip limit minimum charge voltage	500 V to 2000 V	1170 V	-	U16	1	FIX0	V

Address	Channel name	Value range	Exemplary values	Unique ID	Data type	Scaling	Data format	Unit
16	Bat.NomCap	0 Ah to 65000 Ah	50750 Ah	-	U16	1	FIX0	Ah

The signals are explained in detail in Section 6.4 "Explanation of Signals", page 59.

6.3 "SMA external" battery profile

The "SMA external" battery profile enables the customer to transfer the BMS values as a Modbus client to the inverter. In this case, the inverter acts as a Modbus server.

Initialization of the BMS is considered complete as soon as all holding registers of the relevant battery have been written at least once.

For access to the holding registers of all batteries, the corresponding holding registers have been added to the Modbus profile for Unit ID 36.

In the following table, you can find the parameters supported by the inverter, which you can access under unit ID = 36 and function codes 0x03, 0x06 and 0x10.

Address	Channel name	Value range	Exemplary values	Unique ID	Data type	Scaling	Data format	Unit
48101	State Of Charge	0% to 100%	53.4 %	-	U16	10	FIX1	%
48102	State Of Health	0% to 100%	98.7 %	-	U16	10	FIX1	%
48103	Alarm		0	-	U16	1	FIX0	-
48104	Maximum discharge current	0 A to 5000 A	3400 A	-	S32	10	FIX1	A
48106	Maximum charge current	-5000 A to 0 A	-3300 A	-	S32	10	FIX1	A
48108	Lifesign		-	-	U16	1	FIX0	-
48109	Trip limit maximum discharge current	0 A to 5000 A	3600 A	-	S32	10	FIX1	A
48111	Trip limit maximum charge current	-5000 A to 0 A	-3500 A	-	S32	10	FIX1	A
48113	Maximum charge voltage	0 V to 2000 V	1400 V	-	U16	1	FIX0	V
48114	Minimum discharge voltage	0 V to 2000 V	1200 V	-	U16	1	FIX0	V
48115	Trip limit maximum charge voltage	0 V to 2000 V	1430 V	-	U16	1	FIX0	V
48116	Trip limit minimum discharge voltage	0 V to 2000 V	1170 V	-	U16	1	FIX0	V
48117	Bat.NomCap	0 Ah to 65000 Ah	50750 Ah	-	U16	1	FIX0	Ah

6.4 Explanation of Signals

Signal	Explanation
State of Charge	State of charge of the specific battery unit
State of Health	State of health of the specific battery unit
Alarm	Signal for transmitting a battery error Wert = 0: Normal operation Wert ≠ 0: There is a battery error. This causes the inverter to shut down with error message 9307 .
Maximum discharge current	Maximum discharging current for power limitation of the specific inverter
Maximum charge current	Maximum charging current for power limitation of the specific inverter
Lifesign	Life sign for communication monitoring (cyclic meter value)
Trip limit maximum discharge current	Maximum discharging current as the switch-off threshold of the specific inverter It is recommended to configure the switch-off threshold to a higher value as the current threshold for power limitation. It is not recommended to set the switch-off limits for the discharge current to 0 A, because this will prevent the inverter from starting.
Trip limit maximum charge current	Maximum charging current as the switch-off threshold of the specific inverter It is recommended to configure the switch-off threshold to a higher value as the current threshold for power limitation. It is not recommended to set the switch-off limits for the charging current to 0 A, because this will prevent the inverter from starting.
Maximum charge voltage	Maximum charging voltage for power limitation of the specific inverter
Minimum discharge voltage	Minimum discharging voltage for power limitation of the specific inverter
Trip limit maximum charge voltage	Maximum charging voltage as the switch-off threshold of the specific inverter It is recommended to configure the switch-off threshold to a higher value as the voltage threshold for power limitation.
Trip limit minimum discharge voltage	Minimum discharge voltage as the switch-off threshold of the specific inverter It is recommended to configure the switch-off threshold to a lower value as the voltage threshold for power limitation.
Bat.NomCap	Nominal capacity of the total connected battery in Ah. This information is needed as a basis for the energy management of the entire system.

7 Modbus Profiles for External Devices

The Modbus device profile for external devices optionally allows the integration of third-party Modbus devices (servers) into the inverter. With the Modbus device profile, Modbus devices of another manufacturer behave like Modbus devices from the SMA Solar Technology AG when its data is obtained via the communication interface of the inverter.

The Modbus device profile is an XML file in which, for each channel tag, one Modbus register of a server device is allocated to any Modbus address. For the assignments, an address range from 0 to 65535 is available in each case. Currently, various Moxa IO modules from the iLogik series are supported (see Section 10.1 "Supported Modbus Devices from Other Manufacturers", page 69). The relevant XML templates can be acquired, adapted and imported from SMA Solar Technology AG.

The stored assignments are queried in a definable interval (default: 1000 ms).

Currently, the Modbus device profile contains register assignments for the following devices:

- "Moxa iLogik E1210-T" (see Section 7.2 "Moxa iLogik E1210-T – Assignment Table", page 63)
- "Moxa iLogik E1240-T" (see Section 7.3 "Moxa iLogik E1240-T – Assignment Table", page 63)
- "Moxa iLogik E1242-T" (see Section 7.4 "Moxa iLogik E1242-T – Assignment Table", page 64)
- "Moxa iLogik E1260-T" (see Section 7.5 "Moxa iLogik E1260-T – Assignment Table", page 65)
- Various battery management systems (see section 6 "Battery Communication", page 54)

7.1 Structure of the XML File for the Modbus Device Profile

The Modbus device profile is created in the file ***.mmp**. For Modbus battery profiles the suffix ***.bap** is used.

The basic structure of the XML file is as follows:

```
<?xml version="1.0" encoding="utf-8"?>

<ModbusMasterProfile>
  <ProfileVersion version="16777220"/>
  <ModbusDevices>
    <Device name="Moxa iLogik E1242-T" type="Remote I/O" description="Remote I/O">
      <Modbus ipaddress="192.168.100.16" port="502" dst_unitid="16" polling_ratio="1"/>
      <Mapping src_unitid="1">
        <Channel name="DigOut_0" source="0" destination="0" type="Coil" size="1"
          swap="0" datatype="Bool" scale="1" offset="0" min="0" max="1" representation="FIX0"
          unit=""/>
        <Channel name="DigOut_1" source="1" destination="1" type="Coil" size="1"
          swap="0" datatype="Bool" scale="1" offset="0" min="0" max="1" representation="FIX0"
          unit=""/>
        ...
      </Mapping>
    </Device>
  </ModbusDevices>
</ModbusMasterProfile>
```

Legend for XML tags and attributes:

The term "source register" in the following table stands for a specific Modbus register of the server device, which is used as source for the assignment.

XML tag / attribute	Explanation
<ModbusMasterProfile> </ModbusMasterProfile>	The Modbus device profile is defined within this XML structure.
<ModbusDevices> </ModbusDevices>	The Modbus device profile is defined within this XML structure.
Device name="aaa"	Here you can assign any term for the device name. The XML template contains an entry appropriate for the device.
type="bbb"	Here you can assign any term for the device type. The XML template contains an entry appropriate for the device, e.g., type "Battery".
description="ccc"	Here you can assign any term for the use. The XML template contains an entry appropriate for the device.
susyd="10xxx"	Explicit specification for the device ID of the communication interface (has to be different in case of several device profiles)
battype="42"	Unique designation number of the battery type (defined by SMA)
Modbus ipaddress ="192.168.100.16"	IPv4 address of the server device. The IP addresses can be assigned in the range from 192.168.100.16 to 192.168.100.31. For the battery management system should only be used the IP address 192.168.100.36.
port="502"	Modbus communication port of the server device. The default setting is 502.
dst_unitid	Unit ID under which the data read by the server device can be obtained from the communication interface of the inverter. The default setting for the battery profile is 36.
src_unitid	Unit ID of the server device (see manufacturer datasheet).
<Mapping> </ Mapping >	Within this XML structure, the profiles of the different channels are defined.
<Channel />	Within every channel tag, one source register of a server device is assigned to the Modbus profile.

The following attributes can be assigned to each channel:

XML attribute	Explanation
name="ddd"	Here you can assign any name to the assignment.
tagid_index	Numerical index as suffix to the name of a channel (e.g., Aln1, Aln2, Aln3). If no index is required, then this attribute can remain empty.
source	Decimal address of the source register (see attribute "destination"). You can find possible "source" values in the datasheet of the manufacturer of each Modbus device. Note: When entering numbers for the address, it must be considered that leading zeros cause the numerical value to be interpreted as an octal (base-8) number rather than a base-10 number.

XML attribute	Explanation
destination	Decimal address (0 to 65535) of the Modbus register to which the value is assigned (destination register). Observe the length (in WORD) of the source register (see attribute "size"). Note: When entering numbers for the address, it must be considered that leading zeros cause the numerical value to be interpreted as an octal (base-8) number rather than a base-10 number.
datatype	Data format of the saved value, e.g., U16 or S32 (see Section 3.9)
type	Type of the register, e.g., Holding (see Section 3.7)
dst_type	Type of target register, e.g., input (see Section 3.7), which is available for the data read by the server device from the communication interface of the inverter.
size	Length of the source register (in WORD) (1 = 16 or 2 = 32), depending on register type. Holding or input register: 1, 2 Coil: 1 Depending on the length of the source register (1 or 2 WORD), the target addresses should be set for the status register and quality register following the "destination" register, e.g., destination = 1000 (size = 2), status = 1002, quality = 1003 + 1004, ensuring that they do not overlap with the subsequent registers.
swap	Definition of the Modbus register sequence for 32 bit register data transmission 0 - first the low word and then the high word of the Modbus register, BigEndian format 1 - first the high word and then the low word of the Modbus register, LittleEndian format (standard) 2 - first the low word and then the high word of the Modbus register, LittleEndian format 3 - first the high word and then the low word of the Modbus register, BigEndian format
scale	Specification of scaling factor with which the data must be converted
offset	Signed offset value which is to be added to the source data. The default setting is 0.
min	Lower value of the permitted range for valid values of the channel
max	Upper value of the permitted range for valid values of the channel
representation	Data format of the saved value, e.g., DT = date, FIXn = output with n decimal places, TEMP = output as temperature (see Section 3.10)
unit	Displayed unit of the channel



Modbus exceptions

For Modbus exceptions, see "Modbus Application Protocol Specification" at <http://www.modbus.org/specs.php>.

7.2 Moxa ioLogik E1210-T – Assignment Table

In this section you will find a table with an overview of the Modbus registers that are saved in the client profile for the "Moxa ioLogik E1210-T". In accordance with the XML structure, each line of the table shows the attribute values of a Modbus register assignment. The attribute values in the columns "source", "type" and "size" correspond to the standard values of the "Moxa ioLogik E1210-T".

Changed settings of the Moxa ioLogik E1210-T

If you change the settings (e.g., ip, description, etc.) of the "Moxa ioLogik E1210-T", you also have to change the attribute values of the Modbus client profile.

The following channels are defined in the profile file:

Channel/name	source	destination	type	datatype	size (WORD)	swap	scale	offset	min	max	representation	unit
"DI_status_0" to "DI_status_15"	0 to 15	0 to 15	Discrete	Bool	1	0	1	0	0	1	FIX0	-

7.3 Moxa ioLogik E1240-T – Assignment Table

In this section you will find a table with an overview of the Modbus registers that are saved in the client profile for the "Moxa ioLogik E1240-T". In accordance with the XML structure, each line of the table shows the attribute values of a Modbus register assignment. The attribute values in the columns "source", "type" and "size" correspond to the standard values of the "Moxa ioLogik E1240-T".

Changed settings of the Moxa ioLogik E1240-T

If you change the settings (e.g., ip, description, etc.) of the "Moxa ioLogik E1240-T", you also have to change the attribute values of the Modbus client profile.

The following channels are defined in the profile file:

Channel/name	source	destination	type	datatype	size (WORD)	swap	scale	offset	min	max	representation	unit
"Aln_Raw_0" to "Aln_Raw_7"	0 to 7	0 to 7	Input	U16	1	0	1	0	0	65535	FIX0	-
"Aln_Float_0" to "Aln_Float_7"	8 to 22	8 to 22	Input	F32	2	0	1	0	4.0	20.0	FIX3	mA

7.4 Moxa ioLogik E1242-T – Assignment Table

In this section you will find a table with an overview of the Modbus registers that are saved in the client profile for the "Moxa ioLogik E1242-T". In accordance with the XML structure, each line of the table shows the attribute values of a Modbus register assignment. The attribute values in the columns "source", "type" and "size" correspond to the standard values of the "Moxa ioLogik E1242-T".



Changed settings of the Moxa ioLogik E1242-T

If you change the settings (e.g., ip, description, etc.) of the "Moxa ioLogik E1242-T", you also have to change the attribute values of the Modbus device profile.

<Channel />

Within every channel tag, **one** source register of a server device is assigned to the Modbus profile.

The register assignments for the individual devices can be found in the following sections.

The following channels are defined in the profile file:

Channel/name	source	destination	type	datatype	size (WORD)	swap	scale	offset	min	max	representation	unit
"DigOut_0" to "DigOut_3"	0 to 3	0 to 3	Coil	Bool	1	0	1	0	0	1	FIX0	-
"DigIn_0" to "DigIn_7"	0 to 7	0 to 7	Discrete	Bool	1	0	1	0	0	1	FIX0	-
DigIn_Value	48	48	Input	U16	1	0	1	0	0	65535	FIX0	-
"Aln_Raw_0" to "Aln_Raw_3"	512 to 515	512 to 515	Input	U16	1	0	0	0	0	65535	FIX0	-
"Aln_Float_0" to "Aln_Float_3"	520 to 526	520 to 526	Input	F32	2	0	1	0	4.0	20.0	FIX3	mA
DigOut_All	32	32	Holding	U16	1	0	1	0	0	65535	FIX0	-

7.5 Moxa ioLogik E1260-T – Assignment Table

In this section you will find a table with an overview of the Modbus registers that are saved in the client profile for the "Moxa ioLogik E1260-T". In accordance with the XML structure, each line of the table shows the attribute values of a Modbus register assignment. The attribute values in the columns "source", "type" and "size" correspond to the standard values of the "Moxa ioLogik E1260-T".



Changed settings of the Moxa ioLogik E1260-T

If you change the settings (e.g., ip, description, etc.) of the "Moxa ioLogik E1260-T", you also have to change the attribute values of the Modbus client profile.

XML tag or attribute	Explanation
<ModbusMasterProfile>	The Modbus device profile is defined within this XML structure.
</ModbusMasterProfile>	

The following channels are defined in the profile file:

Channel/name	source	destination	type	datatype	size (WORD)	swap	scale	offset	min	max	representation	unit
Clear watchdog alarm	4144	4144	Coil	Bool	1	0	1	0	0	1	FIX0	-
"Temperature_0" to "Temperature_5"	1536 to 1541	1536 to 1541	Input	U16	1	0	0.1	0	0	65535	FIX1	°C

8 User-Defined Modbus Profile

You can change the assignment of the Modbus addresses by creating a user-defined Modbus profile. In the user-defined Modbus profile, the address assignments that were defined in the SMA Modbus profile can be reassigned to other Modbus addresses. You can use the entire Modbus address range from 0 to 65535.

When using the user-defined Modbus profile, it must be taken into consideration that all user-defined registers are provided as holding registers. Therefore, measured values, which are provided as an input on the original register, are transmitted to the user-defined address as holding registers.

The user-defined Modbus profile can be called up via the gateway like an additional device and has a separate unit ID with a default setting of 100 (see Section 3.6.1 "Unit IDs", page 12).

When addressing the original register, a different offset must be used depending on the register type. For input registers, an offset of 30001 and for holding registers, an offset of 40001 must be added. Therefore, an input register with the original address 8, is to be addressed as 30009.

One advantage of the user-defined Modbus profile can be that the measured values and parameters which are relevant for controlling your system can be applied to consecutive Modbus addresses and can therefore be read out or set in one block.

8.1 Structure of the XML File for the User-Defined Modbus Profile

The user-defined Modbus profile is created in the file **VirtualDevice.vdp** in addition to the SMA Modbus profile.

The basic structure of the XML file is as follows:

```
<?xml version="1.0" encoding="utf-8"?>
<VirtualDeviceProfile>
  <Device name="Virtual device" type="virtual device" description="Merge channels of different devices to one device">
    <Mapping>
      <Channel unitid="aaa" source="bbbbbb" destination="cccc" />
    </Mapping>
  </VirtualDeviceProfile>
```

Legend for XML tags and attributes:

XML tag or attribute	Explanation
<VirtualDeviceProfile>	The user-defined Modbus profile is defined within the XML master element.
<Device>	The XML element defines the name (attribute "name"), type (attribute "type") and description (attribute "description") of the Modbus profile.
<Channel />	Within a channel tag, a Modbus address of a unit ID is redefined:
unitid="aaa"	The XML attribute specifies the unit ID of the device whose Modbus addresses are to be redefined. Possible unit IDs for individual devices are 3 to 247.
source="bbbbbb"	The XML attribute specifies a Modbus address of the device selected under "unitid" whose value is to be used as source. (Information on the assignment tables, see Section 5). Note: When entering numbers for the address, it must be considered that leading zeros cause the numerical value to be interpreted as an octal (base-8) number rather than a base-10 number.
destination="cccccc"	The XML attribute specifies the new Modbus address from which the value is to be retrieved (0 to 65535). Note the number of Modbus registers that are stored at the original address. The target registers must not overlap. If incomplete Modbus registers are called up later, a Modbus exception is generated. If register addresses are called up, which are not filled with values, 65535 (0xFFFF) is returned. Note: When entering numbers for the address, it must be considered that leading zeros cause the numerical value to be interpreted as an octal (base-8) number rather than a base-10 number.

**Modbus exceptions**

For Modbus exceptions, see "Modbus Application Protocol Specification" at <http://www.modbus.org/specs.php>.

9 Integration and Troubleshooting

9.1 Notes on integration

To ensure correct control of the inverter via the Modbus interface, at least the following points should be checked and taken into account:

- The **WSpt** and **VarSpt** setpoints must be written continuously, since they are used simultaneously to monitor communication (see Section 3.11 "Content-Based Grouping of the Registers", page 17).
- The setpoints **WSpt** and **VarSpt** are to be specified in % with two decimal places. The reference value for the percentage can be read in the registers **WExlSpt.RefVal** and **VarExlSpt.RefVal**.
- Setpoints may only be sent with a limited data transfer rate. We recommend a maximum of 20 times per second (see Section 3.11 "Content-Based Grouping of the Registers", page 17).
- Parameter registers must not be written continuously. Parameter registers should only be written when changed (see Section 3.11 "Content-Based Grouping of the Registers", page 17).
- Instantaneous values cannot be read more than 10 times per second (see Section 3.11 "Content-Based Grouping of the Registers", page 17).
- The SMA registers are distributed to different unit IDs (server IDs). The unit ID used is indicated above the register tables in each case.
- The **AuxCtl.SCSOpCmd** register is implemented as the central parameter for specifying the operating mode (see section 5.2 "System Parameters (Unit ID = 2)", page 20).
- Most signals are defined as double registers with the data type S32. Reading or writing to only one of the double registers is not accepted or returns invalid data.
- Registers with ENUM codes only accept the associated ENUM codes. Writing of other values is rejected as Modbus error.
- By using a customer defined Modbus profile, all registers can be defined to a common unit ID and in contiguous data blocks (see Section 8 "User-Defined Modbus Profile", page 66).
- **Bat.xx** signals are only in use if the inverter has its own battery information.

9.2 Troubleshooting

You can find information on error analysis of the SMA Modbus profile in Section 3.8 "Reading and Writing Data in the Modbus Protocol", page 14.

For troubleshooting of the SMA devices, go to Modbus address 96 (**ErrNo**) and use the event numbers displayed there.



The event numbers of the SMA devices cannot be decrypted with the number codes in this document

The event numbers of the SMA devices are device-specific and cannot be decrypted with the number codes in this document.

An explanation of the event numbers of central inverters and possible measures can be found in the operating manual or by contacting the SMA Service Line (see Section 10.5 "Number Codes of the Time Zones", page 70).

10Note

10.1 Supported Modbus Devices from Other Manufacturers

The Modbus client profile described in this document is valid for the following Modbus-capable devices from other manufacturers:

- Moxa ioLogik E1210-T
- Moxa ioLogik E1240-T
- Moxa ioLogik E1242-T
- Moxa ioLogik E1260-T
- Batteries approved by SMA Solar Technology AG

10.2 Modbus Communication Ports

The following table shows the default settings of the supported network protocols:

Network protocol	Communication port, default setting
TCP/UDP	502



Using free communication ports

You should only use free communication ports. Generell steht der folgende Bereich zur Verfügung: 49152 bis 65535.

You can find more information on occupied ports in the database "Service Name and Transport Protocol Port Number Registry" at <http://www.iana.org/assignments/service-names-port-numbers/service-names-port-numbers.xml>.



Changing the communication port

If you change the Modbus port of the inverter, you must also change the Modbus port of a connected Modbus client system. Otherwise the inverter can no longer be accessed via the Modbus protocol.

10.3 Refresh Rate

The typical refresh rate for measured values of the inverter (input register) is 100 ms.

The response time is the interval within which value changes in the SMA devices are available at the Modbus interface of the inverter for monitoring. Consequently, value changes in a Modbus client system (e.g., in a SCADA system) can only be displayed in a corresponding or larger interval.

10.4 Interval of the data request and number of the values

Limit of the data processing capacity

For system stability reasons, the time period between data transfers via the Modbus protocol should be at least 100 ms. 123 Modbus registers can be transferred per data block.

10.5 Number Codes of the Time Zones

The following table contains the most important time zones and their number codes in the SMA Modbus profile. If the location is known, you can determine the numerical key (code) and the time zone. In the tables in Section 5 "SMA Modbus Profile—Assignment Tables", from page 19, with specification of the time zone, this table is referenced.

City/Country	Code	Time zone
Abu Dhabi, Muscat	9503	UTC+04:00
Adelaide	9513	UTC+09:30
Alaska	9501	UTC-09:00
Amman	9542	UTC+02:00
Amsterdam, Berlin, Bern, Rome, Stockholm, Vienna	9578	UTC+01:00
Arizona	9574	UTC-07:00
Astana, Dhaka	9515	UTC+06:00
Asuncion	9594	UTC-04:00
Athens, Bucharest, Istanbul	9537	UTC+02:00
Atlantic (Canada)	9505	UTC-04:00
Auckland, Wellington	9553	UTC+12:00
Azores	9509	UTC-01:00
Baghdad	9504	UTC+03:00
Baku	9508	UTC+04:00
Bangkok, Hanoi, Jakarta	9566	UTC+07:00
Beirut	9546	UTC+02:00
Belgrade, Bratislava, Budapest, Ljubljana, Prague	9517	UTC+01:00
Bogotá, Lima, Quito	9563	UTC-05:00
Brasilia	9527	UTC-03:00
Brisbane	9525	UTC+10:00
Brussels, Copenhagen, Madrid, Paris	9560	UTC+01:00
Buenos Aires	9562	UTC-03:00
Canberra, Melbourne, Sydney	9507	UTC+10:00
Caracas	9564	UTC-04:30
Casablanca	9585	UTC+00:00
Cayenne	9593	UTC-03:00
Chennai, Kolkata, Mumbai, New Delhi	9539	UTC+05:30

Chicago, Dallas, Kansas City, Winnipeg	9583	UTC-06:00
Chihuahua, La Paz, Mazatlán	9587	UTC-07:00
Darwin	9506	UTC+09:30
Denver, Salt Lake City, Calgary	9547	UTC-07:00
Dublin, Edinburgh, Lisbon, London	9534	UTC+00:00
Yerevan	9512	UTC+04:00
Fiji, Marshall Islands	9531	UTC+12:00
Georgetown, La Paz, San Juan	9591	UTC-04:00
Greenland	9535	UTC-03:00
Guadalajara, Mexico City, Monterrey	9584	UTC-06:00
Guam, Port Moresby	9580	UTC+10:00
Harare, Pretoria	9567	UTC+02:00
Hawaii	9538	UTC-10:00
Helsinki, Kiev, Riga, Sofia, Tallinn, Vilnius	9532	UTC+02:00
Hobart	9570	UTC+10:00
Indiana (East)	9573	UTC-05:00
International Date Line (West)	9523	UTC-12:00
Irkutsk	9555	UTC+08:00
Islamabad, Karachi	9579	UTC+05:00
Yakutsk	9581	UTC+09:00
Yekaterinburg	9530	UTC+05:00
Jerusalem	9541	UTC+02:00
Kabul	9500	UTC+04:30
Cairo	9529	UTC+02:00
Cape Verde Islands	9511	UTC-01:00
Katmandu	9552	UTC+05:45
Caucasus Standard Time	9582	UTC+04:00
Krasnoyarsk	9556	UTC+07:00

Kuala Lumpur, Singapore	9544	UTC+08:00	Tashkent	9589	UTC+05:00
Kuwait, Riyadh	9502	UTC+03:00	Teheran	9540	UTC+03:30
Magadan, Solomon Islands, New Caledonia	9519	UTC+11:00	Tbilisi	9533	UTC+04:00
Manaus	9516	UTC-04:00	Tijuana, Lower California (Mexico)	9559	UTC-08:00
Midway Islands, Samoa	9565	UTC-11:00	Ulan Bator	9592	UTC+08:00
Minsk	9526	UTC+02:00	West-Central Africa	9577	UTC+01:00
Mid-Atlantic	9545	UTC-02:00	Windhoek	9551	UTC+02:00
Monrovia, Reykjavík	9536	UTC+00:00	Vladivostok	9575	UTC+10:00
Montevideo	9588	UTC-03:00	Yangon (Rangoon)	9549	UTC+06:30
Moscow, St. Petersburg, Volgograd	9561	UTC+03:00	Central America	9520	UTC-06:00
Nairobi	9524	UTC+03:00			
Newfoundland	9554	UTC-03:30			
New York, Miami, Atlanta, Detroit, Toronto	9528	UTC-05:00			
Novosibirsk	9550	UTC+06:00			
Nuku'alofa	9572	UTC+13:00			
Osaka, Sapporo, Tokyo	9571	UTC+09:00			
Pacific (U.S., Canada)	9558	UTC-08:00			
Beijing, Chongqing, Hong Kong, Ürümqi	9522	UTC+08:00			
Perth	9576	UTC+08:00			
Petropavlovsk-Kamchatsky	9595	UTC+12:00			
Port Louis	9586	UTC+04:00			
Santiago	9557	UTC-04:00			
Sarajevo, Skopje, Warsaw, Zagreb	9518	UTC+01:00			
Saskatchewan	9510	UTC-06:00			
Seoul	9543	UTC+09:00			
Sri Jayawardenepura	9568	UTC+05:30			
Taipei	9569	UTC+08:00			

11 Contact

If you have technical problems with our products, please contact the SMA Service Line.

We require the following information in order to provide you with the necessary assistance:

- Modbus client software or hardware used
- Software version of your communication product
- Type of communication interface between communication product and the inverters
- Type, serial numbers, and software version of the inverters connected to your PV system

You can find your country's contact information at:



<https://go.sma.de/service>

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