Technical Information

SunSpec® Modbus® Interface for SUNNY BOY / SUNNY TRIPOWER

SunSpec_Modbus-TI-en-15 | Version 1.5

ENGLISH

Legal Provisions

Trademarks

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1 Information on this Document

Validity

This document is valid for the device types listed in Section 2.6 "Supported SMA Inverters", page 10. It describes how the data points of the supported SMA inverters are displayed in the SunSpec Modbus profile. The basis of this figure is the file **PICS.xls** contained in the version "SunSpec Specification from June 2013".

This document does not contain any information on the Modbus registers provided in detail by the SMA inverters and which minimum firmware versions have to be installed on the devices (firmware version and device-specific Modbus registers, see technical information SunSpec Modbus Interface).

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

Target Group

This document is intended for qualified persons. Only persons with appropriate skills are allowed to perform the tasks described in this document (see Section 2.2 "Skills of Qualified Persons", P. 8).

Additional Information

SMA Documents

Additional information is available at www.SMA-Solar.com (not all documents are available in all languages):

Document title	Document type
Order Form for the SMA Grid Guard Code	Order form
SMA Speedwire Fieldbus	Technical information
SMA Speedwire/Webconnect Data Module	Installation manual
SMA Speedwire Data Module for Sunny Island	Installation manual
Sunny Explorer	User manual
SunSpec Modbus Interface	Technical information

Additional Documents

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

Symbols

Symbol	Explanation
⚠ DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury
⚠ WARNING	Indicates a hazardous situation which, if not avoided, can result in death or serious injury
⚠ CAUTION	Indicates a hazardous situation which, if not avoided, can result in minor or moderate injury
NOTICE	Indicates a situation which, if not avoided, can result in property damage
🛈	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

Typographies

Typography	Use	Example
bold	• File names • Parameters	• The file **PICS.xls** • The values **Major** and **Minor**
>	• Connects several elements to be selected	• Select **External communication > Modbus**.
[**Button/Key**]	• Button or key to be selected or pressed	• Select [**Save**].
Scaling	• Exponential scale factor	• $VArtg * 10^{VARtg\_SF}$

Nomenclature

Complete designation	Designation in this document
Modbus register	Register
SMA Grid Guard code	Grid Guard code
SMA inverter	Inverter
SMA Speedwire Fieldbus	Speedwire

Abbreviations

Abbreviation	Designation	Explanation
ECP	Electrical connection point	Grid connection point in a PV plant to which the energy resource is connected to.
EVU	-	Energy supplier
PCC	Point of common coupling	Grid connection point at which the PV plant is connected to the grid of the electricity supplier.
PICS	Protocol Implementation Conformance Statement	SunSpec conformal collection of data points of a device that is conformal with the SunSpec specifications.
Speedwire	-	Speedwire is a cable-based type of communication based on the Ethernet standard and an SMA communication protocol. This enables inverter-optimized 10/100 Mbit data transmission between SMA devices with Speedwire/Webconnect interfaces in PV systems.
WMax	Set active power limitation	The device can generate active power up to this limit.

2 Safety

2.1 Intended Use

The Modbus interface of the supported SMA devices is designed for industrial use and has the following tasks:

- Remote control of the grid management services of a PV system
- Remote-controlled querying of the measured values of a PV system
- Remote-controlled changing of the parameters of a PV system.

The Modbus interface can be used via TCP and via UDP. With UDP, no answers are generated.

The enclosed documentation is an integral part of this product:

- Read and observe the documentation.
- Keep the documentation in a convenient place for future reference.

2.2 Skills of Qualified Persons

The tasks described in this document must be performed by qualified persons only. Qualified persons must have the following skills:

- Knowledge of IP-based network protocols
- Training in the installation and configuration of IT systems
- Knowledge of the Modbus specifications
- Knowledge of the SunSpec specifications
- Knowledge of and compliance with this document and all safety precautions

2.3 Safety Precautions

This section contains safety precautions that must be observed at all times when working on or with the product. To prevent personal injury and property damage and to ensure long-term operation of the product, read this section carefully and follow all safety precautions at all times.

NOTICE

Damage to SMA inverters

The parameters of the SMA inverters that can be changed with writable Modbus registers (RW/WO) are intended for long-term storage of device settings. Cyclical changing of these parameters leads to destruction of the flash memory of the devices.

- Device parameters must not be changed cyclically.

Parameters for the control and limitation of the nominal PV system power - identified in this document with the appendix **Parameter for PV system control** - are an exception. Such parameters can be changed cyclically.

2.4 Information on Data Security

Data security in Ethernet networks

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

- Take appropriate protective measures, e.g.:
  - 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.

Access to data points after activation of the Modbus interface

After activation of the Modbus interface accessing all of the data points that are not protected by SMA Grid Guard code is possible without entering a further password via Modbus.

After a reset of the inverter to factory settings please check whether the Modbus interface is still active (Activation of the Modbus interface see Section 4 “Commissioning and Configuration“, page 15).

2.5 SMA Grid Guard Code

Certain parameters are protected via the SMA Grid Guard code. If you would like to changes these parameters, you must first unlock the individual inverters via a personal SMA Grid Guard code. When unlocked, the inverter changes its configuration mode to the Grid Guard mode.

SMA Grid Guard code

You can obtain the SMA Grid Guard code via SMA Service or via the "Order Form for the SMA Grid Guard Code" at www.SMA-Solar.com (see also Section 8 "Contact", page 49). Further information about logging into a device with the Grid Guard code and Sunny Explorer see user manual of Sunny Explorer.

Parameter overview SMA Grid Guard code

You will find an overview of the parameters that can be changed with an activated SMA Grid Guard code in Section 5.3 "SunSpec (PICS) – Grid Guard Parameters", page 41.

Exclusive login to inverters with SMA Grid Guard code

With a Grid Guard code only one person, one communication device or one software instance can exclusively login to the inverters. If you like to change parameters with your Modbus client that are protected by Grid Guard, you must not login to the inverters with a Grid Guard code at the same time with Sunny Explorer or with a data logger.

Login and logout

- The SMA Grid Guard code as well as the code for logging out of the Grid Guard mode are described in the Modbus register 43090 under the Unit ID = 3.
- Log out of the Grid Guard mode with the code = 0.
- Login with the Grid Guard code is only possible with the IP address used during login.

Inverter-restart during Grid Guard mode

- If an inverter is restarted during Grid Guard mode, the Grid Guard code must be transmitted again.

Recording the parameter changes

- Changes to parameters in Grid Guard mode will be recorded by the inverter.

2.6 Supported SMA Inverters

You will find information on which SMA inverters with integrated Speedwire interface or a retrofitted Speedwire/Webconnect data module are supported by the Modbus interface and thereby the SunSpec Modbus profile in the technical information SunSpec Modbus Interface at www.SMA-Solar.com. Moreover, this document shows the minimum firmware versions that have to be installed on the devices.

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.

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. SMA devices with Modbus interface).

The Modbus profile specially developed by SunSpec is the SunSpec Modbus profile.

The assignment of the SMA data model to the SunSpec data model is defined in the SunSpec Modbus profile for SMA devices.

3.2 SunSpec Modbus Profile for SMA Devices

The SunSpec Modbus profile from the SunSpec Alliance contains a comprehensive set of measured values and parameters for energy-generating devices in PV systems. SMA has performed a mapping of the special data points of the supported SMA devices on the data points required by SunSpec. The supported SMA devices therefore conform with the SunSpec Modbus profile of the underlying specification version (see Section 1 "Information on this Document", P. 5).

The SunSpec Modbus profile for SMA devices starts at the Modbus register number 40001 and can be addressed via the Unit ID = 126 (see Section 3.4 "Addressing and Data Transmission in the Modbus Protocol", page 11).

3.3 PV System Topology

An SMA device with Speedwire interface is connected with the SCADA system of the electric utility company or the grid operator via Ethernet. The Speedwire interface also enables communication via the Modbus protocol.

From the perspective of the Modbus protocol, an SMA device with Speedwire interface constitutes a Modbus server that supports the SunSpec Modbus profile.

3.4 Addressing and Data Transmission in the Modbus Protocol

3.4.1 Unit IDs

The Unit ID is a higher-level addressing type in the Modbus protocol. The SunSpec Modbus profile for SMA devices is set to the Unit ID = 126. For transmission of the SMA Grid Guard code to the inverters, you use additionally the Unit ID = 3 and the Modbus Register 43090.

3.4.2 Modbus Register Number, Register Width and Data Block

A Modbus register is 16 bits wide. For wider data items, connected Modbus registers are used and considered as data blocks. The number (CNT) of connected Modbus registers is indicated in the SunSpec allocation tables. The register number of the first Modbus register in a data block is the start address of the data block. The numbering of registers starts with 40001.

Offset of Modbus register number (No)

To read or to write Modbus registers in each case use register numbers reduced by the offset of 1. Example: Modbus register address = Modbus register number in SunSpec Modbus profile – offset = 40001 - 1 = 40000.

3.4.3 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 3.5.

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

3.5 Reading and Writing of Data

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 RW Modbus registers.

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

Modbus command	Hexadecimal value	Data volume (number of registers)[1]
Read Holding Registers	0x03	1 to 125
Read Input Registers	0x04	1 to 125
Write Single Register	0x06	1
Write Multiple Registers	0x10	1 to 123
Read Write Multiple Registers	0x17	Read: 1 to 125, Write: 1 to 121

[1] Number of Modbus registers transferable as data block per command

3.6 SunSpec Data Types and NaN Values

The following table shows the data types used in the SunSpec Modbus profile and the possible NaN values. The SunSpec data types are listed in the **Type** column of the allocation tables. They describe the data width and the format of the data value saved at a register address. The format, such as bit field, describes how SunSpec data is to be interpreted. The formats are important, for example, for the displaying of data or for its further processing:

Type	Description	NaN value
acc32	Accumulated value (32 bit). Is used for all sequentially increasing values.	0x0000 0000
acc64	Accumulated value (64 bit). Is used for all sequentially increasing values. Only positive values are permitted. The overflow of the number range takes place at 0x7FFF FFFF FFFF FFFF.	0x0000 0000 0000 0000
bitfield16	Bit field (16 bit). A combination of individual bits. Is used for multi-value alarm messages or status. Value range 0 to 0x7FFF. If the MSB is set in a bit field, all other bits are ignored.	0xFFFF
bitfield32	Bit field (32 bit). A combination of individual bits. Is used for multi-value alarm messages or status. Value range 0 to 0x7FFF FFFF. If the MSB is set in a bit field, all other bits are ignored.	0xFFFF FFFF
enum16	Number code (16 bit). The breakdown of the possible codes can be found directly under the designation of the Modbus register in the SunSpec Modbus profile allocation tables.	0xFFFF
int16	Signed integer (16 bit).	0x8000
int32	Signed integer (32 bit).	0x8000 0000
string	String (multiple of 2 bytes). A zero-terminating value or a value of fixed length.	0x0000 to nnnn
sunssf	SunSpec scale factor as signed integer (16 bit). Scale factors are used as exponents of a power of ten. Negative scale factors push the decimal point to the left, positive scale factors to the right.	0x8000

uint16	Unsigned integer (16 bit).	0xFFFF
uint32	Unsigned integer (32 bit).	0xFFFF FFFF
uint64	Unsigned integer (64 bit).	0xFFFF FFFF FFFF FFFF

3.7 SMA Firmware Data Format (FW)

The SMA firmware data format (abbreviation: FW) describes how SMA firmware data is to be interpreted. The SMA firmware data format is used, for example, in register 40045.

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
0	N	No revision number
1	E	Experimental release
2	A	Alpha release
3	B	Beta release
4	R	Release
5	S	Special release
> 5	As number	No special interpretation

Example:

Firmware version of the product: 1.05.10.R
Values from DWORD: Major: 1, Minor: 05, Build: 10, Release type: 4
(Hex: 0x1 0x5 0xA 0x4)

4 Commissioning and Configuration

The Modbus TCP server and the Modbus UDP server are deactivated by default in the supported SMA devices (supported SMA devices, see Section 2.6 "Supported SMA Inverters", Page 9). You must activate the Modbus servers to use them. You can activate the communication ports of both Modbus protocols upon activation of the servers.

Requirements:

☐ All SMA devices with Speedwire interface must be commissioned (see installation manual of the inverter or of the retrofitted Speedwire interface).

☐ Sunny Explorer must be installed on the computer (Sunny Explorer is available free of charge at www.SMA-Solar.com).

Access to data points after activation of the Modbus interface

After activation of the Modbus interface accessing all of the data points that are not protected by SMA Grid Guard code is possible without entering a further password via Modbus.

After a reset of the inverter to factory settings please check whether the Modbus interface is still active.

Procedure:

1. Start Sunny Explorer on the computer and create a Speedwire system (see Sunny Explorer user manual).
2. Log into the Speedwire system as **Installer**.
3. Select the SMA inverter to be configured in the system tree.
4. Select the tab **Settings**.
5. Select the parameter group **External Communication**.
6. Select [**Edit**].
   ☑ You will see the categories **TCP Server** and **UDP Server** under the parameter group **Modbus**.
7. To activate the TCP server, make the following settings in the group **Modbus > TCP Server**:
   - In the **Activated** drop-down list, select the entry **Yes**.
   - If necessary, change the port in the **Port** field (default setting: 502).
8. To activate the UDP server, make the following settings in the group **Modbus > UDP Server**:
   - In the **Activated** drop-down list, select the entry **Yes**.
   - If necessary, change the port in the **Port** field (default setting: 502).
9. Select [**Save**].

5 SunSpec Modbus Profile - Allocation Tables

5.1 Information on the Allocation Tables

The following sub-sections are sorted in the order of the SunSpec PlugFest Protocol Implementation Conformance Statement (PICS). Unsupported PICS tables are not listed. The tables are divided into the sections "Header" and "Fixed Block", in accordance with the PICS. In addition, "Repeating Block" can be listed. In the tables you will only find the Modbus addresses that must be implemented and those that are implemented optionally.

The columns of the tables show the following information:

Information	Explanation
No (DEC)	Decimal Modbus address (see also Section 3.4.2 "Modbus Register Number, Register Width and Data Block", page 12 onwards).
Description/Number Code(s)	[SunSpec description of the Modbus register][(SunSpec name of the Modbus register)]{<, (SMA: SMA parameter designation>}{<: Parameter>}{<: Number code(s)) = Designation(s)> <(SMA: SMA Number code designation)>} The following description scheme is also used in the table sections "Fixed Block" and "Repeating Block": • [SunSpec description of the Modbus register] [(SunSpec name of the Modbus register)], <Unit><*$10^{\text{SunSpec scale factor}}$ (Register address of the scale factor)>, <(SMA: SMA parameter designation> For scale factors: • [Description of the scale factor (SunSpec scale factor): (integer)] Legend: [...] Mandatory entry, <...> Optional entry, {...} Parameter group
CNT (WORD)	Number of combined Modbus registers at this Modbus address (No).
Type	Data type, e.g. uint32 = 32 bits without prefix (see Section 3.6, page 13).
Access	Access type: RO: Read only (only Modbus TCP) RW: Read and write (only Modbus TCP). All RW registers are only writeable under Modbus UDP (WO registers). WO: Write only If an access type is not allowed, a Modbus exception is generated in the event of access with an access type that is not allowed.

NOTICE

Damage to SMA inverters

The parameters of the SMA inverters that can be changed with writable Modbus registers (RW/WO) are intended for long-term storage of device settings. Cyclical changing of these parameters leads to destruction of the flash memory of the devices.

- Device parameters must not be changed cyclically.

Parameters for the control and limitation of the nominal PV system power - identified in this document with the appendix **Parameter for PV system control** - are an exception. Such parameters can be changed cyclically.

Offset of Modbus register number (No)

To read or to write Modbus registers in each case use register numbers reduced by the offset of 1. Example: Modbus register address = Modbus register number in SunSpec Modbus profile – offset = 40001 - 1 = 40000.

Device-dependent availability of the Modbus registers

Depending on the SMA device type used, only certain Modbus registers are available. You will find a table of Modbus registers supported by each inverter type in the technical information SunSpec Modbus Interface at www.SMA-Solar.com

Value range of cos φ

The value range of cos φ depends on the device. The value range that can be set via the Modbus protocol cannot be converted by every inverter to physical values (displacement power factor cos φ, see the operating manual of the inverter).

Reactive power in SunSpec Modbus Profile

For all of the Modbus registers in this document which reactive power is measured or specified with the following has to be considered: According to IEC convention and to a four-quadrant generator system a positive reactive power is “inductive“ and a negative reactive power is “capacitive”.

This is valid for the following Modbus registers: 40206, 40274 and 40359.

5.2 SunSpec (PICS) - Allocation Tables

5.2.1 Table C 001 (Common Model)

No (DEC)	Description/Number Code(s)	CNT (WORD)	Type	Access
Header:				
40001	SunSpec ID (SID): 0x53756e53 = SunSpec Modbus Map	2	uint32	RO
40003	Model ID (ID): 1 = SunSpec Common Model	1	uint16	RO
40004	Number of the following Modbus registers in accordance with the PICS table (L): 66	1	uint16	RO
Fixed Block:				
40005	Manufacturer (Mn): "SMA"	16	string	RO
40021	Model (Md): „"Solar Inverter"	16	string	RO
40037	Options (Opt), (SMA: Device type): Numerical identification of the SMA device type (Breakdown see technical information SunSpec Modbus Interface)	8	string	RO
40045	Version (Vr), (SMA: Firmware number): see Section 3.7 "SMA Firmware Data Format", page 14	8	string	RO
40053	Serial number (SN)	16	string	RO

5.2.2 Table NC 011 (Ethernet Link Layer Model)

No (DEC)	Description/Number code	CNT (WORD)	Type	Access
Header:				
40071	Model ID (ID): 11 = SunSpec Ethernet link layer model	1	uint16	RO
40072	Number of the following Modbus registers in accordance with the PICS table (L): 13	1	uint16	RO
Fixed Block:				
40073	Ethernet data transfer rate (Spd), (SMA: Data transfer rate of network terminal A): 10 = 10 Mbit/s 100 = 100 Mbit/s	1	uint16	RO
40074	Interface status (CfgSt), (SMA: Duplex mode of network terminal A): Bit 1 = Full duplex	1	bitfield 16	RO
40075	Connection status (St), (SMA: Speedwire connection status of network terminal A): 1 = Activated 2 = Deactivated	1	enum 16	RO
40076	MAC address (MAC)	4	uint64	RO

5.2.3 Table NC 012 (IPv4 Model)

No (DEC)	Description/Number code	CNT (WORD)	Type	Access
Header:				
40086	Model ID (ID): 12 = SunSpec IPv4 Model	1	uint16	RO
40087	Number of the following Modbus registers in accordance with the PICS table (L): 98	1	uint16	RO

Fixed Block:				
40092	Configuration status (CfgSt): 1 = valid setting (current setting is valid)	1	enum 16	RO
40093	Change status (ChgSt): Bit 0 = pending change	1	bitfield 16	RO
40094	Change capability (Cap): Bit 5 = hardware configuration possible	1	bitfield 16	RO
40095	IPv4 Configuration (Cfg), (SMA: Automatic Speedwire configuration switched on): 0 = manual configuration (see information "Network Configuration") 1 = Use DHCP	1	enum 16	RW
40096	Configure service use (Ctl): 0 = Activate DNS	1	enum 16	RO
40097	IP address (Addr), (SMA: Speedwire IP address): XXX.XXX.XXX.XXX (see information „Network Configuration“, below)	8	string	RW
40105	Net mask (Msk), (SMA: Speedwire subnet mask): XXX.XXX.XXX.XXX (see information "Network Configuration", below)	8	string	RW
40113	Gateway (Gw), (SMA: Speedwire gateway address): XXX.XXX.XXX.XXX (see information „Network Configuration“, below)	8	string	RW
40121	DNS 1 (DNS1), (SMA: Speedwire DNS server address): XXX.XXX.XXX.XXX (see information „Network Configuration“, below)	8	string	RW

Network Configuration

A change to the network configuration will only be adopted by the SMA device if each of the registers 40095, 40097, 40105, 40113 and 40121 are changed. If, for example, you change the IPv4 configuration (Cfg) with the register 40095 to the value **0** (manual configuration) and would like to change the IP address with the register 40097, you must change the other three registers within 60 seconds, or reset them to the same values.

5.2.4 Tables I 101, 102, 103 (Inverter Integer Map)

The following table is valid for each of the three connection models (Model ID). If, for example, the connection model "Delta connection" is present, table I 102 with the ID = 102 is valid.

No (DEC)	Description/Number code	CNT (WORD)	Type	Access
Header:				
40186	Model ID (ID): 101 = SunSpec Inverter Model (phsA, phsB, phsC) 102 = SunSpec Inverter Model (phsAB, phsAC, phsBC) 103 = SunSpec Inverter Model (phsABC)	1	uint16	RO
40187	Number of the following Modbus registers in accordance with the PICS table (L): 50	1	uint16	RO
Fixed Block:				
40188	AC current (A), in $A*10^{A\_SF}$ (40192).	1	uint16	RO
40189	Current, line conductor L1 (AphA), in $A*10^{A\_SF}$ (40192).	1	uint16	RO
40190	Current, line conductor L2 (AphB), in $A*10^{A\_SF}$ (40192).	1	uint16	RO
40191	Current, line conductor L3 (AphC), in $A*10^{A\_SF}$ (40192).	1	uint16	RO
40192	Scale factor current (A_SF): -1	1	sunssf	RO
40193	Voltage, line conductor L1 to L2 (PPVphAB), in $V*10^{V\_SF}$ (40199).	1	uint16	RO
40194	Voltage, line conductor L2 to L3 (PPVphBC), in $V*10^{V\_SF}$ (40199).	1	uint16	RO
40195	Voltage, line conductor L3 to L1 (PPVphCA), in $V*10^{V\_SF}$ (40199).	1	uint16	RO
40196	Voltage, line conductor L1 to N (PhVphA), in $V*10^{V\_SF}$ (40199).	1	uint16	RO
40197	Voltage, line conductor L2 to N (PhVphB), in $V*10^{V\_SF}$ (40199).	1	uint16	RO

40198	Voltage, line conductor L3 to N (PhVphC), in V*10^{V_SF} (40199).	1	uint16	RO
40199	Scale factor voltage (V_SF): -1	1	sunssf	RO
40200	Active power (W), in W*10^{W_SF} (40201).	1	int16	RO
40201	Scale factor active power (W_SF): 1	1	sunssf	RO
40202	Power frequency (Hz), in Hz*10^{Hz_SF} (40203).	1	uint16	RO
40203	Scale factor power frequency (Hz_SF): -2	1	sunssf	RO
40204	Apparent power (VA), in VA*10^{VA_SF} (40205).	1	int16	RO
40205	Scale factor apparent power (VA_SF): 1	1	sunssf	RO
40206	Reactive power (VAr), in var*10^{VAr_SF} (40207).	1	int16	RO
40207	Scale factor reactive power (VAr_SF): 1	1	sunssf	RO
40208	Displacement power factor cos φ (PF)*10^{PF_SF} (40209).	1	int16	RO
40209	Scale factor displacement power factor (PF_SF): -3	1	sunssf	RO
40210	Total yield (WH), in Wh*10^{WH_SF} (40212).	2	acc32	RO
40212	Scale factor total yield (WH_SF): 1	1	sunssf	RO
40217	DC power (DCW), in W*10^{DCW_SF} (40218).	1	int16	RO
40218	Scale factor DC power (DCW_SF): 2	1	sunssf	RO
40219	Internal temperature (TmpCab), in °C	1	int16	RO
40222	Other Temperature (TmpOt), in °C*10^{Tmp_SF} (40223), (SMA: External temperature).	1	int16	RO
40223	Scale factor temperature (Tmp_SF): 0	1	sunssf	RO
40224	Operating status (St): 1 = Off 2 = Wait for PV voltage 3 = Starting 4 = MPP 5 = Regulated 6 = Shutting down 7 = Error 8 = Waiting for electric utility company	1	enum 16	RO

40226	Event number (Evt1): Bit 0 = Grounding error / insulation error Bit 1 = DC overvoltage Bit 4 = Grid disconnected Bit 5 = Enclosure open Bit 6 = Shut down manually Bit 7 = Overtemperature Bit 8 = Overfrequency Bit 9 = Underfrequency Bit 10 = AC overvoltage Bit 11 = AC undervoltage Bit 12 = String fuse defective Bit 13 = Under temperature Bit 14 = Storage or communication error Bit 15 = Error during hardware test	2	bitfield 32	RO

5.2.5 Table IC 120 (Inverter Controls Nameplate Ratings)

No (DEC)	Description/Number code	CNT (WORD)	Type	Access
Header:				
40238	Model ID (ID): 120 = SunSpec Nameplate Model	1	uint16	RO
40239	Number of the following Modbus registers in accordance with the PICS table (L): 26	1	uint16	RO
Fixed Block:				
40240	DER type (DERTyp), (SMA: Device type): 4 = PV device	1	enum 16	RO
40241	Continuous active power capability (WRtg), in $W*10^{WRtg\_SF}$ (40242), (SMA: Maximum device active power).	1	uint16	RO
40242	Scale factor continuous active power capability (WRtg_SF): 2	1	sunssf	RO

40243	Continuous apparent power capability (VARtg) in VA*10^{VARtg_SF} (40244), (SMA: Maximum device apparent power).	1	uint16	RO
40244	Scale factor continuous apparent power capability (VARtg_SF): 2	1	sunssf	RO
40245	Continuous reactive power capability in quadrant 1 (VArRtgQ1), in VAr*10^{VArRtg_SF} (40249), (SMA: Maximum device reactive power in quadrant 1).	1	int16	RO
40246	Continuous reactive power capability in quadrant 2 (VArRtgQ2), in VAr*10^{VArRtg_SF} (40249), (SMA: Maximum device reactive power in quadrant 2).	1	int16	RO
40247	Continuous reactive power capability in quadrant 3 (VArRtgQ3), in VAr*10^{VArRtg_SF} (40249), (SMA: Maximum device reactive power in quadrant 3).	1	int16	RO
40248	Continuous reactive power capability in quadrant 4 (VArRtgQ4), in VAr*10^{VArRtg_SF} (40249), (SMA: Maximum device reactive power in quadrant 4).	1	int16	RO
40249	Scale factor continuous reactive power capability (VArRtg_SF): 2	1	sunssf	RO
40250	Continuous RMS current capability (ARtg), in A*10^{ARtg_SF} (40251), (SMA: nominal current across all line conductors).	1	uint16	RO
40251	Scale factor continuous RMS current capability (Artg_Rtg): 0	1	sunssf	RO
40252	Minimum displacement power factor capability in Q 1 ((PFRtgQ1)*10^{PFRtg_SF} (40256), (SMA: Minimum displacement power factor cos φ in Q 1).	1	int16	RO
40253	Minimum displacement power factor capability in Q 2 ((PFRtgQ2)*10^{PFRtg_SF} (40256), (SMA: Minimum displacement power factor cos φ in Q 2).	1	int16	RO
40254	Minimum displacement power factor capability in Q 3 ((PFRtgQ3)*10^{PFRtg_SF} (40256), (SMA: Minimum displacement power factor cos φ in Q 3).	1	int16	RO

40255	Minimum displacement power factor capability in Q 4 ((PFRtgQ4)*10^{PFRtg_SF} (40256), (SMA: Minimum displacement power factor cos φ in Q 4).	1	int16	RO
40256	Scale factor minimum displacement power factor capability (PFRtg_SF): -1	1	sunssf	RO
40257	Nominal capacity of the storage device (WHRtg), in Wh*10^{WHRtg_SF} (40258), (SMA: Nominal capacity of the battery).	1	uint16	RO
40258	Scale factor nominal capacity (WHRtg_SF): 2	1	sunssf	RO
40259	Usable Ah capacity of the battery (AhrRtg), in Ah*10^{AhrRtg_SF} (40260), (SMA: Usable nominal capacity of the battery).	1	uint16	RO
40260	Scale factor usable Ah capacity (AhrRtg_SF): 0	1	sunssf	RO
40261	Maximum energy transfer rate to the storage device (MaxChaRte), in W*10^{MaxChaRte_SF} (40262), (SMA: Maximum charging power of the battery).	1	uint16	RO
40262	Scale factor maximum energy transfer rate to the storage device (MaxChaRte_SF): 2	1	sunssf	RO
40263	Maximum energy transfer rate from the storage device (MaxDisChaRte), in W*10^{MaxDisChaRte_SF} (40264), (SMA: Maximum discharging power of the battery).	1	uint16	RO
40264	Scale factor maximum energy transfer rate from the storage device (MaxDisChaRte_SF): 2	1	sunssf	RO

5.2.6 Table IC 121 (Inverter Controls Basic Settings)

No (DEC)	Description/Number code	CNT (WORD)	Type	Access
Header:				
40266	Model ID (ID): 121 = SunSpec Basic Settings Model	1	uint16	RO
40267	Number of the following Modbus registers in accordance with the PICS table (L): 30	1	uint16	RO

Fixed Block:				
40268	Setting for maximum output active power (WMax), in W*10^{WMax_SF} (40288), (SMA: Set active power limit).	1	uint16	RW
40269	Voltage at the PCC (VRef), in V*10^{VRef_SF} (40289), (SMA: Reference voltage for the system control).	1	uint16	RW
40270	Offset between PCC and inverter (VRefOfs), in V*10^{VRefOfs_SF} (40290), (SMA: Reference correction voltage for the system control).	1	int16	RW
40273	Set value for maximum apparent power (VAMax), in VA*10^{VAMax_SF} (40292), (SMA: Set apparent power limit).	1	uint16	RW
40274	Maximum reactive power in Q 1 (VArMaxQ1), in var*10^{VArMax_SF} (40293), (SMA: Set reactive power limit).	1	int16	RW
40278	Standard active power increase rate (WGra), in % of (WMax/min)*10^{WGra_SF} (40294), (SMA: active power gradient).	1	uint16	RW
40283	VAr action when changing between charging and discharging (VArAct), (SMA: Reaction of the excitation when changing the direction of power flow): 1 = Change excitation type 2 = Do not change excitation type	1	enum 16	RW
40286	Set value for nominal frequency (ECPNomHz), in Hz*10^{ECPNomHz_SF} (40297), (SMA: Nominal frequency).	1	uint16	RW
40287	Identity of the line conductor in single-phase inverters (ConnPh), (SMA: Line conductor assignment): 1 = Line conductor L1 2 = Line conductor L2 3 = Line conductor L3	1	enum 16	RW
40288	Scale factor for output active power (WMax_SF): 2	1	sunssf	RO
40289	Scale factor reference current (VRef_SF): 0	1	sunssf	RO
40290	Scale factor for offset (VRefOfs_SF): 0	1	sunssf	RO
40292	Scale factor for apparent power (VAMax_SF): 2	1	sunssf	RO
40293	Scale factor for reactive power (VArMax_SF): 2	1	sunssf	RO
40294	Scale factor active power increase rate (WGra_SF): 0	1	sunssf	RO
40297	Scale factor nominal frequency (ECPNomHz_SF): 0	1	sunssf	RO

5.2.7 Table IC 122 (Inverter Controls Extended Measurements)

No (DEC)	Description/Number code	CNT (WORD)	Type	Access
Header:				
40298	Model ID (ID): 122 = SunSpec Measurements Status Model	1	uint16	RO
40299	Number of the following Modbus registers in accordance with the PICS table (L): 44	1	uint16	RO
Fixed Block:				
40300	PV inverter availability status (PVConn), (SMA: Status of the grid relay): Bit 0 = Connected Bit 1 = Available Bit 2 = In operation	1	bitfield 16	RO
40301	Battery inverter availability status (StorConn), (SMA: Status of the battery): Bit 0 = Connected Bit 1 = Available Bit 2 = In operation	1	bitfield 16	RO
40302	ECP connection status (ECPConn), (SMA: PV system utility grid connection): Bit 0 = Connected	1	bitfield 16	RO
40303	Total active power yield (ActWh), in Wh, (SMA: Total yield).	4	acc64	RO
40342	Insulation resistance (Ris), in $\Omega * 10^{Ris\_SF}$ (40343).	1	uint16	RO
40343	Scale factor insulation resistance (Ris_SF): 4	1	sunssf	RO

5.2.8 Table IC 123 (Immediate Inverter Controls)

No (DEC)	Description/Number code	CNT (WORD)	Type	Access
Header:				
40344	Model ID (ID): 123 = SunSpec Immediate Controls Model	1	uint16	RO
40345	Number of the following Modbus registers in accordance with the PICS table (L): 24	1	uint16	RO
Fixed Block:				
40348	**Parameter for PV system control :** Connection control (Conn), (SMA: Quick disconnect): 0 = Not connected 1 = Connected	1	enum 16	WO
40349	**Parameter for PV system control :** Set power to default value ((WMaxLimPct), in % of WMax*$10^{WMaxLimPct\_SF}$ (40367), (SMA: Normalized active power limitation via the system control).	1	uint16	WO
40353	Choking (WMaxLim_Ena), (SMA: Operating mode of the feed-in management): 1 = Activated	1	enum 16	RW
40354	**Parameter for PV system control :** Set power factor to a certain value (OutPFSet)*$10^{OutPFSet\_SF}$ (40368), (SMA: specification of the displacement power factor cos φ via the system control).	1	int16	WO
40358	Fixed power factor (OutPFSet_Ena), (SMA: operating mode of the static voltage stability): 1 = Activated	1	enum 16	RW
40359	**Parameter for PV system control :** Reactive power (VArWMaxPct), in % of WMax*10^{VArPct_SF} (40369), (SMA: Normalized reactive power limitation via the system control).	1	int16	WO

40365	Mode of the percentile reactive power limitation (VArPct_Mod): 1 = in % of WMax	1	enum 16	RO
40366	Control of the reactive power limitation (VArPct_Ena), (SMA: Operating mode of the static voltage stability): 1 = Activated	1	enum 16	RW
40367	Scale factor power specification value (WMaxLimPct_SF): 0	1	sunssf	RO
40368	Scale factor power factor (OutPFSet_SF): -4	1	sunssf	RO
40369	Scale factor reactive power (VArPct_SF): -1	1	sunssf	RO

5.2.9 Table IC 124 (Basic Storage Controls)

No (DEC)	Description/Number code	CNT (WORD)	Type	Access
Header:				
40370	Model ID (ID): 124 = SunSpec Storage Model	1	uint16	RO
40371	Number of the following Modbus registers in accordance with the PICS table (L): 24	1	uint16	RO
Fixed Block:				
40372	Set value for maximum charging active power (WChaMax), in $W*10W^{ChaMax\_SF}$ (40388). Reference value for WChaGra and WDisChaGra, (SMA maximum charging power of the battery manufacturer).	1	uint16	RW
40375	Activation of the storage control mode (StorCtl_Mod), (SMA: operating mode of the battery management system): Bit 0 = Battery charging Bit 1 = Battery discharging	1	bitfield 16	RW
40378	Current available energy (ChaState), in % of $AhrRtg*10^{ChaState\_SF}$ (40392), (SMA: Current battery state of charge).	1	uint16	RO
40380	Battery internal voltage (InBatV), in $V*10^{InBatV\_SF}$ (40394), (SMA: Battery voltage).	1	uint16	RO

40381	State of charge of the storage device (ChaSt), (SMA: Operating status of battery): 1 = Off 3 = Discharging 4 = Charging 6 = Float charge	1	enum 16	RO
40388	Scale factor charging active power (WChaMax_SF): 0	1	sunssf	RO
40392	Scale factor available energy (ChaState_SF): 0	1	sunssf	RO
40394	Scale factor battery-internal voltage (InBatV_SF): -2	1	sunssf	RO

5.2.10 Table IC 126 (Static Volt-VAR Arrays)

No (DEC)	Description/Number code	CNT (WORD)	Type	Access
Header:				
40396	Model ID (ID): 126 = SunSpec Static Volt-VAR Model	1	uint16	RO
40397	Number of the following Modbus registers in accordance with the PICS table (L): 64	1	uint16	RO
Fixed Block:				
40398	Index of the active curve (ActCrv): 0 = No curve active (deactivated) 1 = Curve 1 active	1	uint16	RW
40399	Volt-VAR control active (ModEna), (SMA: operating mode of the static voltage stability): Bit 0 = Activated	1	bitfield 16	RW
40403	Number of supported curves (NCrv): 1	1	uint16	RO
40404	Number of supported curve points (NPt): 12	1	uint16	RO
40405	Scale factor voltage points (V_SF): -2	1	sunssf	RO
40406	Scale factor reference variables (DeptRef_SF): -2	1	sunssf	RO
40407	Scale factor ramp (RmpIncDec_SF): -1	1	sunssf	RO

Repeating Block (see number of supported curves (40403)): Static volt-VAR curve definition.				
40408	Number of active points in the array (ActPt), (SMA: Characteristic curve, number of points for use on the characteristic curve)	1	uint16	RW
40409	Assigning of the reference variables (DeptRef)*$10^{DeptRef\_SF}$ (40406): 1 = WMax	1	enum 16	RO
40410	Point 1 volt (V1), in % of VRef*10^{V_SF} (40405), (SMA: X value 1 of characteristic curve 1).	1	uint16	RW
40411	Point 1 VAr (VAr1)*$10^{DeptRef\_SF}$ (40406), (SMA: Y value 1 of characteristic curve 1).	1	int16	RW
40412	Point 2 volts (V2), in % of VRef*10^{V_SF} (40405), (SMA: X value 2 of characteristic curve 1).	1	uint16	RW
40413	Point 2 VAr (VAr2)*$10^{DeptRef\_SF}$ (40406), (SMA: Y value 2 of characteristic curve 1).	1	int16	RW
40414	Point 3 volts (V3), in % of VRef*10^{V_SF} (40405), (SMA: X value 3 of characteristic curve 1).	1	uint16	RW
40415	Point 3 VAr (VAr3)*$10^{DeptRef\_SF}$ (40406), (SMA: Y value 3 of characteristic curve 1).	1	int16	RW
40416	Point 4 volts (V4), in % of VRef*10^{V_SF} (40405), (SMA: X value 4 of characteristic curve 1).	1	uint16	RW
40417	Point 4 VAr (VAr4)*$10^{DeptRef\_SF}$ (40406), (SMA: Y value 4 of characteristic curve 1).	1	int16	RW
40418	Point 5 volts (V5), in % of VRef*10^{V_SF} (40405), (SMA: X value 5 of characteristic curve 1).	1	uint16	RW
40419	Point 5 VAr (VAr5)*$10^{DeptRef\_SF}$ (40406), (SMA: Y value 5 of characteristic curve 1).	1	int16	RW
40420	Point 6 volts (V6), in % of VRef*10^{V_SF} (40405), (SMA: X value 6 of characteristic curve 1).	1	uint16	RW
40421	Point 6 VAr (VAr6)*$10^{DeptRef\_SF}$ (40406), (SMA: Y value 6 of characteristic curve 1).	1	int16	RW
40422	Point 7 volts (V7), in % of VRef*10^{V_SF} (40405), (SMA: X value 7 of characteristic curve 1).	1	uint16	RW

40423	Point 7 VAr (VAr7)*$10^{DeptRef\_SF}$ (40406), (SMA: Y value 7 of characteristic curve 1).	1	int16	RW
40424	Point 8 volts (V8), in % of VRef*10^{V_SF} (40405), (SMA: X value 8 of characteristic curve 1).	1	uint16	RW
40425	Point 8 VAr (VAr8)*$10^{DeptRef\_SF}$ (40406), (SMA: Y value 8 of characteristic curve 1).	1	int16	RW
40426	Point 9 volts (V9), in % of VRef*10^{V_SF} (40405), (SMA: X value 9 of characteristic curve 1).	1	uint16	RW
40427	Point 9 VAr (VAr9)*$10^{DeptRef\_SF}$ (40406), (SMA: Y value 9 of characteristic curve 1).	1	int16	RW
40428	Point 10 volts (V10), in % of VRef*10^{V_SF} (40405), (SMA: X value 10 of characteristic curve 1).	1	uint16	RW
40429	Point 10 VAr (VAr10)*$10^{DeptRef\_SF}$ (40406), (SMA: Y value 10 of characteristic curve 1).	1	int16	RW
40430	Point 11 volts (V11), in % of VRef*10^{V_SF} (40405), (SMA: X value 11 of characteristic curve 1).	1	uint16	RW
40431	Point 11 VAr (VAr11)*$10^{DeptRef\_SF}$ (40406), (SMA: Y value 11 of characteristic curve 1).	1	int16	RW
40432	Point 12 volts (V12), in % of VRef*10^{V_SF} (40405), (SMA: X value 12 of characteristic curve 1).	1	uint16	RW
40433	Point 12 VAr (VAr12)*$10^{DeptRef\_SF}$ (40406), (SMA: Y value 12 of characteristic curve 1).	1	int16	RW
40459	The maximum rate at which the VAr value is decreased depending on voltage changes (RmpDecTmm), in % of DeptRef (40409)*$10^{RmpIncDec\_SF}$ (40407), (SMA: Decrease ramp for achieving the characteristic curve operating point).	1	uint16	RW
40460	The maximum rate at which the VAr value is increased depending on voltage changes (RmpIncTmm), in % of DeptRef (40409)*$10^{RmpIncDec\_SF}$ (40407), (SMA: Increase ramp for achieving the characteristic curve operating point).	1	uint16	RW
40461	Boolean flag, which indicates whether the curve points can be changed or not (ReadOnly): 0 = Activated	1	enum 16	RO

5.2.11 Table IC 127 (Parameterized Frequency-Watt)

No (DEC)	Description/Number code	CNT (WORD)	Type	Access
Header:				
40462	Model ID (ID): 127 = SunSpec Frequency-Watt Parameter Model	1	uint16	RO
40463	Number of the following Modbus registers in accordance with the PICS table (L): 10	1	uint16	RO
Fixed Block:				
40464	Gradient of the reduction of the maximum active power as a function of the frequency (WGra), in % of PM/Hz*10^{WGra_SF} (40470), (SMA: Active power gradient, configuration of the linear gradients of the current power).	1	uint16	RW
40465	Frequency deviation from the nominal frequency (ECPNomHz), at which the current power is used as limiting value for the output power (HzStr), in Hz*$10^{HzStrStop\_SF}$ (40471), (SMA: Distance of the start frequency from the power frequency, configuration of the linear gradients of the current power).	1	int16	RW
40466	Frequency deviation from the nominal frequency (ECPNomHz), at which the limited current power returns to the normal value and the limiting is removed (HzStop), in Hz*$10^{HzStrStop\_SF}$ (40471), (SMA: Distance of the reset frequency from the power frequency, configuration of the linear gradients of the current power).	1	int16	RW
40467	Activation of the hysteresis (HysEna), (SMA: Activation of the stay-set indicator function, configuration of the linear gradients of the current power): Bit 0 = Activated	1	bitfield 16	RW
40468	Configured frequency-power control (ModEna), (SMA: Operating mode of the active power reduction with overfrequency P(f)): Bit 0 = Activated	1	bitfield 16	RW

40469	Maximum rate of change at which an output power limited through overfrequency returns to normal power (HzStopWGra), in % of WMax/min*$10^{RmpIncDec\_SF}$ (40472), (SMA: Active power gradient after reset frequency, configuration of the linear gradients of the current power (P-HzStopWGra).	1	uint16	RW
40470	Scale factor gradient (WGra_SF): 0	1	sunssf	RO
40471	Scale factor frequency deviation (HzStrStop_SF): -2	1	sunssf	RO
40472	Scale factor ramp (RmpIncDec_SF): 0	1	sunssf	RO

5.2.12 Table IC 128 (Dynamic Reactive Current)

No (DEC)	Description/Number code	CNT (WORD)	Type	Access
Header:				
40474	Model ID (ID): 128 = SunSpec Dynamic Reactive Current Model	1	uint16	RO
40475	Number of the following Modbus registers in accordance with the PICS table (L): 14	1	uint16	RO
Fixed Block:				
40476	Indicates whether a gradient it to run on the edge or in the center of the deadband against zero (ArGraMod), (SMA: Reactive current droop, configuration of the full dynamic grid support): 0 = Edge 1 = Center	1	enum 16	RW
40477	Gradient for the increase in leading, dynamic current (ArGraSag), in % of ARtg/dV*10^{ArGra_SF} (40487), (SMA: Gradient K of the reactive current droop for undervoltage with dynamic grid support).	1	uint16	RW
40478	Gradient for the increase in lagging, dynamic current (ArGraSwell), in % of ARtg/dV*10^{ArGra_SF} (40487), (SMA: Gradient K of the reactive current droop for overvoltage with dynamic grid support).	1	uint16	RW

40479	Activates the dynamic reactive voltage model (ModEna), (SMA: Operating mode of the dynamic grid support, configuration of the dynamic grid support): Bit 0 = Activated	1	bitfield 16	RW
40480	Time period for the calculation of the sliding voltage average (FilTms), in s: 60	1	uint16	RO
40481	Lower voltage deadband, below which voltage changes do not cause changes to the dynamic grid support (DbVMin), in % of VRef*$10^{VRefPct\_SF}$ (40488), (SMA: Lower limit voltage deadband, configuration of the full dynamic grid support).	1	uint16	RW
40482	Upper voltage deadband, above which voltage changes do not cause changes to the dynamic grid support (DbVMax), in % of VRef*$10^{VRefPct\_SF}$ (40488), (SMA: Upper limit voltage deadband, configuration of the full dynamic grid support).	1	uint16	RW
40483	Voltage of the block zone, below which no dynamic current will be produced (BlkZnV), in % of VRef*$10^{VRefPct\_SF}$ (40488), (SMA: PWM cut-off voltage, configuration of the dynamic grid support).	1	uint16	RW
40485	Time period of the block zone, within which no changes to the dynamic current occur (BlkZnTmms), in s*10^{-3}, (SMA: PWM cut-off delay, configuration of the dynamic grid support).	1	uint16	RW
40487	Scale factor gradient (ArGra_SF): -2	1	sunssf	RO
40488	Scale factor block zone (VRefPct_SF): 0	1	sunssf	RO

5.2.13 Table IC 131 (Watt-Power Factor)

No (DEC)	Description/Number code	CNT (WORD)	Type	Access
Header:				
40490	Model ID (ID): 131 = SunSpec Watt-PF Model	1	uint16	RO
40491	Number of the following Modbus registers in accordance with the PICS table (L): 64	1	uint16	RO

Fixed Block:				
40492	Index of the active curve (ActCrv): 0 = No curve active (deactivated) 1 = Curve 1 active	1	uint16	RW
40493	Watt-PF mode active (ModEna), (SMA: operating mode of the static voltage stability): Bit 0 = Activated	1	bitfield 16	RW
40498	Number of supported curve points (NPt): 2	1	uint16	RO
40499	Scale factor power points (W_SF): 0	1	sunssf	RO
40500	Scale factor cos φ points (PF_SF): -2	1	sunssf	RO
Repeating Block: Watt-PF curve definition.				
40502	Number of active points in the array (ActPt): 2	1	uint16	RO
40503	Point 1 watt (W1), in % of WMax*10^{W_SF} (40499), (SMA: Active power of the start point, configuration of the cos φ(P) characteristic curve).	1	int16	RW
40504	Point 1 PF in EEI notation (PF1), cos φ*10^{PF_SF} (40500), (SMA: cos φ of the start point, configuration of the cos φ (P) characteristic curve).	1	int16	RW
40505	Point 2 watts (W2), in % of WMax*10^{W_SF} (40499), (SMA: Active power of the end point, configuration of the cos φ(P) characteristic curve).	1	int16	RW
40506	Point 2 PF in EEI notation (PF2), cos φ*10^{PF_SF} (40500), (SMA: cos φ of the end point, configuration of the cos φ (P) characteristic curve).	1	int16	RW
40554	Boolean flag, which indicates whether the curve points can be changed or not (ReadOnly): 0 = Activated	1	enum 16	RO

5.2.14 Table IC 132 (Volt-Watt)

No (DEC)	Description/Number code	CNT (WORD)	Type	Access
Header:				
40556	Model ID (ID): 132 = SunSpec Volt-Watt Model	1	uint16	RO
40557	Number of the following Modbus registers in accordance with the PICS table (L): 64	1	uint16	RO
Fixed Block:				
40558	Index of the active curve (ActCrv): (SMA: Characteristic curve number): 1 = Curve 1 active	1	uint16	RW
40559	Volt-watt control active (ModEna), (SMA: Configuration of the active power/voltage characteristic curve P(V)): Bit 0 = Activated	1	bitfield 16	RW
40563	Number of supported curves (NCrv): 1	1	uint16	RO
40564	Number of supported curve points (NPt): 12	1	uint16	RO
40565	Scale factor voltage points (V_SF): -2	1	sunssf	RO
40566	Scale factor reference variables (DeptRef_SF): -2	1	sunssf	RO
Repeating Block (see number of supported curves (40563)): Volt-watt curve definition.				
40568	Number of active points in the array (ActPt)	1	uint16	RW
40569	Assigning of the reference variables (DeptRef)*$10^{DeptRef\_SF}$ (40566): 1 = in % of WMax	1	enum 16	RO
40570	Point 1 volt (V1), in % of VRef*10^{V_SF} (40565), (SMA: X value 1 of characteristic curve 1).	1	uint16	RW
40571	Point 1 watt (W1), in % of DeptRef*$10^{DeptRef\_SF}$ (40566), (SMA: Y value 1 of characteristic curve 1).	1	int16	RW
40572	Point 2 volts (V2), in % of VRef*10^{V_SF} (40565), (SMA: X value 2 of characteristic curve 1).	1	uint16	RW

40573	Point 2 watts (W2), in % of DeptRef*$10^{DeptRef\_SF}$ (40566), (SMA: Y value 2 of characteristic curve 1).	1	int16	RW
40574	Point 3 volts (V3), in % of VRef*10^{V_SF} (40565), (SMA: X value 3 of characteristic curve 1).	1	uint16	RW
40575	Point 3 watts (W3), in % of DeptRef*$10^{DeptRef\_SF}$ (40566), (SMA: Y value 3 of characteristic curve 1).	1	int16	RW
40576	Point 4 volts (V4), in % of VRef*10^{V_SF} (40565), (SMA: X value 4 of characteristic curve 1).	1	uint16	RW
40577	Point 4 watts (W4), in % of DeptRef*$10^{DeptRef\_SF}$ (40566), (SMA: Y value 4 of characteristic curve 1).	1	int16	RW
40578	Point 5 volts (V5), in % of VRef*10^{V_SF} (40565), (SMA: X value 5 of characteristic curve 1).	1	uint16	RW
40579	Point 5 watts (W5), in % of DeptRef*$10^{DeptRef\_SF}$ (40566), (SMA: Y value 5 of characteristic curve 1).	1	int16	RW
40580	Point 6 volts (V6), in % of VRef*10^{V_SF} (40565), (SMA: X value 6 of characteristic curve 1).	1	uint16	RW
40581	Point 6 watts (W6), in % of DeptRef*$10^{DeptRef\_SF}$ (40566), (SMA: Y value 6 of characteristic curve 1).	1	int16	RW
40582	Point 7 volts (V7), in % of VRef*10^{V_SF} (40565), (SMA: X value 7 of characteristic curve 1).	1	uint16	RW
40583	Point 7 watts (W7), in % of DeptRef*$10^{DeptRef\_SF}$ (40566), (SMA: Y value 7 of characteristic curve 1).	1	int16	RW
40584	Point 8 volts (V8), in % of VRef*10^{V_SF} (40565), (SMA: X value 8 of characteristic curve 1).	1	uint16	RW
40585	Point 8 watts (W8), in % of DeptRef*$10^{DeptRef\_SF}$ (40566), (SMA: Y value 8 of characteristic curve 1).	1	int16	RW
40586	Point 9 volts (V9), in % of VRef*10^{V_SF} (40565), (SMA: X value 9 of characteristic curve 1).	1	uint16	RW
40587	Point 9 watts (W9), in % of DeptRef*$10^{DeptRef\_SF}$ (40566), (SMA: Y value 9 of characteristic curve 1).	1	int16	RW
40588	Point 10 volts (V10), in % of VRef*10^{V_SF} (40565), (SMA: X value 10 of characteristic curve 1).	1	uint16	RW

40589	Point 10 watts (W10), in % of DeptRef*$10^{DeptRef\_SF}$ (40566), (SMA: Y value 10 of characteristic curve 1).	1	int16	RW
40590	Point 11 volts (V11), in % of VRef*10^{V_SF} (40565), (SMA: X value 11 of characteristic curve 1).	1	uint16	RW
40591	Point 11 watts (W11), in % of DeptRef*$10^{DeptRef\_SF}$ (40566), (SMA: Y value 11 of characteristic curve 1).	1	int16	RW
40592	Point 12 volts (V12), in % of VRef*10^{V_SF} (40565), (SMA: X value 12 of characteristic curve 1).	1	uint16	RW
40593	Point 12 watts (W12), in % of DeptRef*$10^{DeptRef\_SF}$ (40566), (SMA: Y value 12 of characteristic curve 1).	1	int16	RW
40619	The maximum rate, at which the watt value is decreased depending on voltage changes (RmpDecTmm), in % of DeptRef (40569), (SMA: Decrease ramp for achieving the characteristic curve operating point).	1	uint16	RO
40620	The maximum rate, at which the watt value is increased depending on voltage changes (RmpIncTmm), in % of DeptRef (40569), (SMA: Increase ramp for achieving the characteristic curve operating point).	1	uint16	RO
40621	Boolean flag, which indicates whether the curve points can be changed or not (ReadOnly): 0 = Activated	1	enum 16	RO

5.2.15 Table I 160 (MPPT Inverter Extension Model)

No (DEC)	Description/Number code	CNT (WORD)	Type	Access
Header:				
40622	Model ID (ID): 160 = SunSpec Multiple MPPT Inverter Extension Model	1	uint16	RO
40623	Number of the following Modbus registers in accordance with the PICS table (L): 48	1	uint16	RO
Fixed Block:				
40624	Scale factor current (DCA_SF): -1	1	sunssf	RO
40625	Scale factor voltage (DCV_SF): 0	1	sunssf	RO
40626	Scale factor power (DCW_SF): 2	1	sunssf	RO
40630	Number of modules (N): 2	1	uint16	RO
Repeating Block (see number of supported modules (40630)): Multiple MPP Tracking Inverter Extension Model.				
40632	ID of the MPP tracker (ID): 1	1	uint16	RO
40641	DC current input 1 (DCA), in $A*10^{DCA\_SF}$ (40624).	1	uint16	RO
40642	DC voltage input 1 (DCV), in $V*10^{DCV\_SF}$ (40625).	1	uint16	RO
40643	DC power input 1 (DCW), in $W*10^{DCW\_SF}$ (40626).	1	uint16	RO
40652	ID of the MPP tracker (ID): 2	1	uint16	RO
40661	DC current input 2 (DCA), in $A*10^{DCA\_SF}$ (40624).	1	uint16	RO
40662	DC voltage input 2 (DCV), in $V*10^{DCV\_SF}$ (40625).	1	uint16	RO
40663	DC power input 2 (DCW), in $W*10^{DCW\_SF}$ (40626).	1	uint16	RO

5.3 SunSpec (PICS) – Grid Guard Parameters

In the following table you will find an overview of the SunSpec Modbus profile parameters that you can only change after prior transmission of an SMA Grid Guard code.

SMA Grid Guard code

You will find information on the SMA Grid Guard code in Section 2.5 "SMA Grid Guard Code", page 10.

PICS table	Modbus register
NC 011	40076
NC 012	40121
IC 120	40250
IC 121	40269
	40270
	40278
	40286
IC 123	40353
	40358
IC 126	40398
	40399
	40408
	40410 to 40432 (in steps of 2)
	40411 to 40433 (in steps of 2)
IC 127	40464
	40465
	40466
	40467
	40468
	40469
IC 128	40476
	40477
	40478
	40479
	40481
	40482
	40483
	40485
IC 131	40493
	40503
	40504
	40505
	40506
IC 132	40558
	40559
	40568
	40570 to 40592 (in steps of 2)
	40571 to 40593 (in steps of 2)

Save the Grid Guard code under the Unit ID = 3 in the register 43090 in each inverter. You will find a detailed description of the register 43090 in the following table:

No (DEC)	Description/Number code	Type	Format	Access
43090	**SMA Grid Guard code:** **Reading the register**: 0 = Not logged in with the Grid Guard code 1 = Logged in with the Grid Guard code **Writing to the register**: Log in and activate the Grid Guard mode using the SMA Grid Guard code. **Logging out**: Write **0** in the register to log out of Grid Guard mode.	U32	FIX0	RW

6 Troubleshooting

Problem	Cause and corrective measure
The SMA device with Speedwire interface is not available for the Modbus client.	The necessary Modbus server in the SMA device with Speedwire interface may not be enabled. **Corrective measures:** • Ensure that the required Modbus server is enabled (see Section 4 "Commissioning and Configuration", page 15)
	The correct IP address for the SMA device with Speedwire interface may not be set in the Modbus client. **Corrective measures:** • Read off the IP address of the SMA device with Speedwire interface (see router manual). • Ensure that the correct IP address for the SMA device with Speedwire interface is set in the Modbus client (see the Modbus client manufacturer manual).
	The firewall may not be set correctly. **Corrective measures:** • Enable port 502 in the firewall (see firewall manual).
The SMA device with Speedwire interface does not send a reply within the response time specified by the Modbus client.	The Modbus server of the SMA device may be currently overloaded. **Corrective measures:** • Extend the response time set in the Modbus client successively by one second respectively.

A NaN value is returned when reading a Modbus register (see Section 3.6 "SunSpec Data Types and NaN Values", page 13).	You may be trying to read from a Modbus register that is not supported by the inverter. **Corrective measures:** • Contrast and compare the available measured values for your SMA device with the requested Modbus registers (see technical information SunSpec Modbus Interface at www.SMA-Solar.com).
	You may be trying to read a Modbus register that is not defined in the SunSpec Modbus profile. **Corrective measures:** • Remove the requested Modbus address from data processing. • Install an up-to-date Modbus profile by means of a firmware update.
	The NaN value 255 is returned. You may be trying to read a configuration of a non-existing device. **Corrective measures:** • Set the Unit ID = 126 in the Modbus client for the desired SMA device with Speedwire interface. • Check if the configuration to be read is supported by the device.
	You may be trying to read an overflown counter (e.g. energy counter in Wh). In this case the counter contains a NaN value according to the counter's data type. **Corrective measures:** • Try to read a counter in a larger unit (e.g. energy counter in in kWh).
	You may be trying to read a write-only Modbus register. **Corrective measures:** • Read off the access type of the Register to be written to from the "Access" column of the corresponding allocation table and correct in the Modbus client.

Modbus exception 1 "Illegal Function" is reported in the Modbus client.	You may be trying to write a data block to an address range that contains read-only registers. **Corrective measures:** • Check if all registers to be written are of access type RW.
	You, software or a data logger may try to login to a device several times with a Grid Guard-Code. **Corrective measures:** • Check that only one person, one software instance or one data logger exclusively tries to login to a device with a Grid Guard code.
Modbus exception 2 "Illegal Data Address" is reported in the Modbus client.	You may be trying to write to a Modbus register that is not defined in the SunSpec Modbus profile. **Corrective measures:** • In the Modbus client check the Modbus address to be written to for errors.
	You may be trying to write or to read a data block, which start address or which end address does not match to those of a register (alignment mismatch). **Corrective measures:** • Check the start address or the end address of the data block. • Check the registers at the start address or at the end address of the data block for consistency. May be one of both registers is not consistent.
	You may be trying to write a data block and one of the registers is not supported by the device. **Corrective measures:** • Check if the register to be written to is supported by your device (see technical information SunSpec Modbus Interface at www.SMA-Solar.com).

Modbus exception 3 "Illegal Data Value" is reported in the Modbus client.	You may be trying to write a data block (Modbus commands 0x10 and 0x17) and one of the values has a data type that is not permitted. **Corrective measures:** • Read off the data type of the register to be written to from the "Type" column of the corresponding allocation table and correct in the Modbus client.
Modbus exception 4 “Slave Device Failure” is reported in the Modbus client.	You may be trying to read or to write a Modbus register using a Unit ID that is not allowed. **Corrective measures:** • Set the Unit ID = 126 in the Modbus client for the desired SMA device with Speedwire interface.
Other Modbus exceptions	**Corrective measures:** • Modbus exceptions see "Modbus Application Protocol Specification" at http://www.modbus.org/specs.php.
Other errors	**Corrective measures:** • For troubleshooting of the SMA devices, go to Modbus address 40226 and use the event messages displayed here or the error code shown in the display. To decrypt the event messages of low- to medium-power inverters, you require additional information (event messages, see the inverter service manual at www.SMA-Solar.com).

7 Technical Data

7.1 Modbus Communication Ports

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

Network protocol	Communication port, default setting
TCP	502
UDP	502

Use free communication ports

You should only use free communication ports. The following range is generally available: 49152 to 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 one of the communication ports, you must also change the corresponding communication port of a connected Modbus client system. Otherwise, the SMA device can no longer be accessed via the Modbus protocol.

7.2 Data Processing and Time Behavior

In this section, you will find typical data processing and reaction times of the Speedwire Modbus interface.

NOTICE

Damage to SMA inverters

The parameters of the SMA inverters that can be changed with writable Modbus registers (RW/WO) are intended for long-term storage of device settings. Cyclical changing of these parameters leads to destruction of the flash memory of the devices.

- Device parameters must not be changed cyclically.

Parameters for the control and limitation of the nominal PV system power - identified in this document with the appendix **Parameter for PV system control** - are an exception. Such parameters can be changed cyclically.

Signal Runtime via the SMA Device with Speedwire Interface

The signal runtime via the SMA device with Speedwire interface is at maximum 100 ms.

The signal runtime is the time required by the SMA device to process incoming Modbus commands.

Data Transfer Interval via the Modbus Protocol

For system stability reasons, the time period between data transfers via the Modbus protocol must be at least ten seconds. No more than five parameters and measured values should be transmitted per inverter at the same time.

Reaction Time of the Modbus Interface

The reaction time of the Modbus interface is 5 to 10 seconds

The reaction time of the Modbus interface is the time between the arrival of the parameter specifications in the SMA device until the corresponding measured values are provided to the Modbus interface. Due to this reaction time, parameter specifications can only be displayed via a Modbus client system (e.g. a SCADA system) at a corresponding or larger interval.

8 Contact

If you have technical problems concerning 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
- Type of the communication interface between the inverter and the SCADA system
- Type, serial number and software version of the inverter

Australia	SMA Australia Pty Ltd. Sydney	Toll free for Australia: 1800 SMA AUS (1800 762 287) International: +61 2 9491 4200
Belgien/Belgique/België	SMA Benelux BVBA/SPRL Mechelen	+32 15 286 730
Brasil	Vide España (Espanha)	
Česko	SMA Central & Eastern Europe s.r.o. Praha	+420 235 010 417
Chile	Ver España	
Danmark	Se Deutschland (Tyskland)	
Deutschland	SMA Solar Technology AG Niestetal	Medium Power Solutions Wechselrichter: +49 561 9522-1499 Kommunikation: +49 561 9522-2499 SMA Online Service Center: www.SMA.de/Service
		Hybrid Energy Solutions Sunny Island: +49 561 9522-399 PV-Diesel Hybridsysteme: +49 561 9522-3199
		Power Plant Solutions Sunny Central: +49 561 9522-299

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Luxemburg/Luxembourg	Siehe Belgien Voir Belgique	
Magyarország	lásd Česko (Csehország)	
Nederland	zie Belgien (België)	
Österreich	Siehe Deutschland	
Perú	Ver España	
Polska	Patrz Česko (Czechy)	
Portugal	SMA Solar Technology Portugal, Unipessoal Lda, Lisboa	Isento de taxas em Portugal: 800 20 89 87 Internacional: +351 212 377 860
România	Vezi Česko (Cehia)	
Schweiz	Siehe Deutschland	
Slovensko	pozri Česko (Česká republika)	
South Africa	SMA Solar Technology South Africa Pty Ltd. Centurion (Pretoria)	08600 SUNNY (08600 78669) International: +27 (12) 643 1785

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