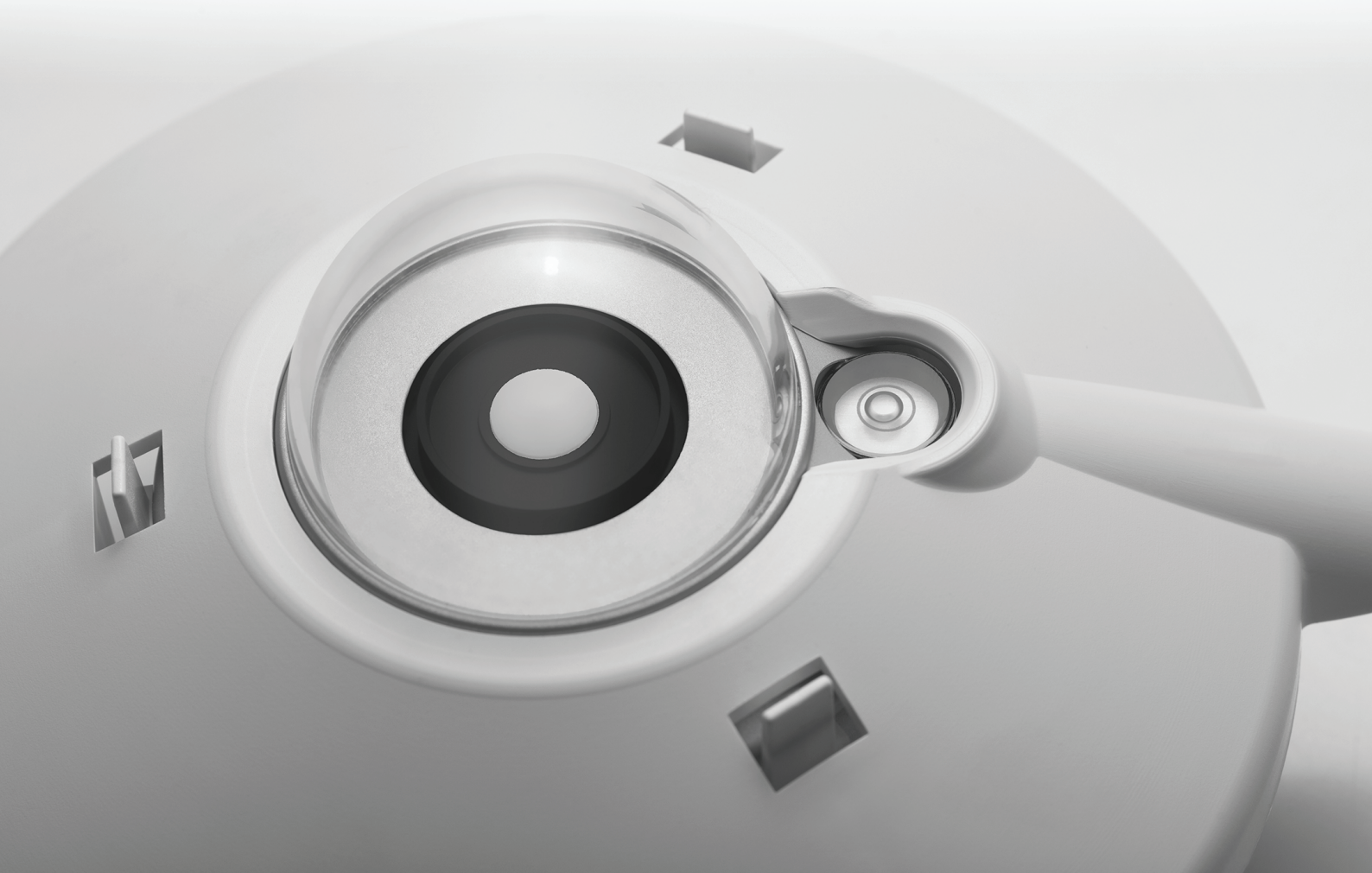




SMP12 Smart Pyranometer

Modbus® instructions



14. Appendices

14.1. Modbus®

This section describes the interfacing with the instrument. For more detail please check the document “KippZonen_Reference_Manual_SMP_Appendices”

14.2. Commonly used Modbus® commands

The commands are all according to the Modbus RTU protocols described in the document: ‘Modbus® over serial line V1.02’ and ‘MODBUS application protocol V1.1b’ available from the Modbus® organization (www.modbus.org). The commands can be tested using software tools, such as the program ‘Modbus Poll’ from www.modbustools.com or QModbusMaster.

The following commands are implemented:

Function	Sub function	Description
0x01	N/A	Read Coils
0x02	N/A	Read Discrete Inputs
0x03	N/A	Read Holding Registers
0x04	N/A	Read Input Register
0x05	N/A	Write Single Coil
0x06	N/A	Write Holding Register
0x10	N/A	Write multiple Registers

The SMP12 does not make a difference between a “coil” and a “discrete input.” The only difference is that a discrete input is read only. The SMP12 does not make a difference between a holding register and an input register. The only difference is that an input register is read only.

14.3. Commonly used input registers

Real-time Processed Data

PDU address	Parameter	Name	R/W	Type	Mode	Description
0	IO_DEVICE_TYPE	DevType	R	U16	All	Device type of the sensor. 633 for the SMP12
1	IO_DATAMODEL_VERSION	DataSet	R	U16	All	Version of the object data model 107 for the SMP12
2	IO_OPERATIONAL_MODE	DevMode	R	U16	All	Operational mode: normal, service, calibration and factory
3	IO_STATUS_FLAGS	Status	R	U16	All	Device Status flags. Zero means "all OK"
4	IO_SCALE_FACTOR	Scale	R	S16	All	Scale factor for sensor data (determines number of decimal places) value 1 for SMP12 meaning the scale factor is 10
5	IO_SENSOR1_DATA	Sensor1	R	S16	N,S	Temperature compensated radiation in W/m ² (1)
6	IO_RAW_SENSOR1_DATA	RSensor1	R	S16	N,S	Raw, not linearized and temperature compensated radiation (1)
7	IO_STDEV_SENSOR1	StDev1	R	S16	N,S	Standard deviation IO_SENSOR1_DATA
8	IO_BODY_TEMPERATURE	BodyTemp	R	S16	N,S	Body temperature in 0.1 °C
9	IO_EXT_POWER_SENSOR	VSupply	R	S16	N,S	External power voltage on the connector
15	IO_TILT	Tilt	R	U16	N,S	Tilt of the sensor in the horizontal plane in 0.1°
16	IO_RH	RelativeHum	R	U16	N,S	Internal relative humidity of the sensor in 0.1%
41	IO_BATCH_NUMBER	Batch nمبر	R	U16	All	Production batch number = year in YY
42	IO_SERIAL_NUMBER	Serial nمبر	R	U16	All	Serial number in xxxx
43	IO_SOFTWARE_VERSION	Software	R	U16	All	Software version
44	IO_HARDWARE_VERSION	Hardware	R	U16	All	Hardware version
45	IO_NODE_ID	Address	R	U16	All	(MODBUS®/SMA) device address RS-485
332	IO_CALIBRATION_DATE	Calibration	R	F32	N,S	Floating Point ABCD number (32 bit Big endian) that represents the calibration date as yymmdd
10000	U_DEVICE_TYPE		R	U16	All	Device type of the sensor (see register IO_DEVICE_TYPE)
10001	U_OPERATIONAL_MODE		R	U16	All	Operational mode, normal, service, calibration
10002	U_ERROR_CODE	ErrCode	R	U16	All	Most recent/ actual error code (see register IO_ERROR_CODE)
10003	U_STATUS_FLAGS		R	U16	All	Device Status flags (see register U_STATUS_FLAGS)
10004	U_BATCH_NR		R	U16	All	Production Batch number (see register IO_BATCH_NUMBER)
10005	U_SERIAL_NR		R	U16	All	Serial number (see register IO_SERIAL_NUMBER)
10006	FL_SENSOR1_DATA	FSensor1	R	F32	All	Temperature compensated radiation 1 in W/m ² with decimal point set by scale factor (32 bit float Big endian)
10008	FL_STDEV_SENSOR1	FStdDev1	R	F32	All	Standard deviation Sensor 1 with decimal point
10010	FL_SENSOR2_DATA	FSensor2	R	F32	All	Not applicable to SMP12, always 0
10102	FL_STDEV_SENSOR2	FStdDev2	R	F32	All	Not used, always 0
10014	FL_BODY_TEMPERATURE		R	F32	All	Body temperature in ° Kelvin with decimal point

(1) The scale factor defines the format and number of decimal places

LEGEND			
PDU address	PDU address + 1 = Modbus® register number		
Parameter	Name	Name of the register	
R/W	Read write	R	Read only
		R/W	Read/write
Type	Type and size	U16	16 bit unsigned integer
		S16	16 bit signed integer
		S32	32 bit signed integer
		F32	32 bit floating point
Mode	Operation mode	N	available in normal mode
		S	available in service mode

14.4. Input register details

Many of the registers and controls are for remote diagnostics. In this chapter only the most relevant registers and controls are described.

Register 0 IO_DEVICE_TYPE

The device type defines which device is connected. This register can be used to check the type of the connected device.

Register 1 IO_DATAMODEL_VERSION

The data-model describes the functions supported by the smart sensor. This document is valid for data-model version: 1.07

Register 2 IO_OPERATIONAL_MODE

The operation mode defines the state of the smart sensor. The operational modes are 1 = Normal Mode, 2 = Service Mode, 3 = Calibration Mode, 4 = Factory Mode and 5 = Error mode. The standby mode (mode 0) is not supported.

After power on the operation mode (1) is set. When the **IO_CLEAR_ERROR** is set then the smart sensor always returns to the normal mode. When the Error mode (5) is set, then there is a fatal error.

Register 3 IO_STATUS_FLAGS

This register defines the status of the smart sensor and the validity of the data. Each bit has a special meaning. Bit 0 is the first (least significant) bit.

Bit #	Individual bit representation	Remark
Bit 0	Quality of the signal	see IO_VOID_DATA_FLAG
Bit 1	Overflow	see IO_OVERFLOW_ERROR
Bit 2	Underflow	see IO_UNDERFLOW_ERROR
Bit 3	Error flag	see IO_ERROR_FLAG
Bit 4	ADC Error	see IO_ADC_ERROR
Bit 5	DAC Error	see IO_DAC_ERROR
Bit 6	Calibration Error	see IO_CALIBRATION_ERROR
Bit 7	Update EEPROM error	see IO_UPDATE_FAILED

Register 4 IO_SCALE_FACTOR

The scale factor defines the number of fractional digits, the range and the position of the decimal point for the following registers: IO_SENSOR1_DATA. The scale factor is read only. The default value of the scale factor is a copy of register 34 IO_DEF_SCALE_FACTOR, made during power up.

If the register IO_SCALE_FACTOR is not set to 0 then you must multiply or divide the data of the above mentioned four IO_SENSOR registers.

Scale Factor	Calculation
2	floating point result = integer register X / 100
1	floating point result = integer register X / 10
0	floating point result = integer register X
-1	floating point result = integer register X * 10

The default value of register IO_SCALE_FACTOR is 1 and the floating point value to process is integer register /10.

However, if IO_AUTO_RANGE is set or a different value is written to the register IO_DEF_SCALE_FACTOR this will can be different.

Register 5 IO_SENSOR1_DATA

This register holds the actual data (solar radiation) measured by the sensor. The solar radiation is measured in W/m².

If the register IO_SCALE_FACTOR is not set to 0 then you must multiply or divide the data as described under register 4.

The raw data from the sensor is calibrated, linearized; temperature compensated and filtered.

Register 6 IO_RAW_SENSOR1_DATA

The raw sensor data is calibrated but not linearized and temperature compensated. If the register IO_SCALE_FACTOR is not set to 0 then you must multiply or divide the data as described under register 4, IO_SCALE_FACTOR.

Register 7 IO_STDEV_SENSOR1

This register is used to calculate the standard deviation over the signal. When the register is read the data is sent to the computer and at the same time a new calculation is started. The next time register 7 is read the standard deviation over the last period is sent to the computer and a new calculation is started. If the poll frequency is quite high (for example 1 poll per second) then the standard deviation will be zero or almost zero, but if the poll frequency is very low then the standard deviation can be quite high, indicating that the data in register 5 or 6 changed dramatically since the last poll. The standard deviation is measured in 0.1 W/m². To convert the data to a floating point, make the following calculation:

floating point result = integer register (IO_STDEV_SENSOR1) / 10

Register 8 IO_BODY_TEMPERATURE

The body temperature sensor measures the temperature of the body in 0.1°C. To convert the data to a floating point number, make the following calculation:

floating point result = integer register (IO_BODY_TEMPERATURE) / 10

Register 9 IO_EXT_POWER_SENSOR

The Ext power sensor measures the external voltage applied to the chassis socket in 0.1 Volt. To convert the data to a floating point number, make the following calculation:

floating point result = integer register (IO_EXT_POWER_SENSOR) / 10

Register 15 IO_TILT

The tilt sensor measures the tilt of the sensor in the horizontal plane in 0.1°. To convert the data to a floating-point number, make the following calculation:

floating point result = integer register (IO_TILT) / 10

Register 16 IO_RH

The RH sensor measures the Internal relative humidity of the sensor in 0.1%. To convert the data to a floating-point number, make the following calculation:

floating point result = integer register (IO_RH) / 10

14.5. Read-write Holding registers

Device Control

PDU address	Parameter	R/W	Type	Mode	Description
34	IO_DEF_SCALE_FACTOR	R/W	S16	All	Default scale factor
35-40	Factory use only				

14.6. Holding register details

Register 34 IO_DEF_SCALE_FACTOR

The default scale factor is set in the factory mode or service mode and is stored in non-volatile memory. The default scale factor stored in non-volatile memory is always set after a power-on. However it is possible to change the default setting during operation by writing a value to the register 34.

Note : This value is not stored in non-volatile memory and is overwritten with the default value at power on.

The following values are valid:

Scale factor = 2

Scale factor = 1

Scale factor = 0

Scale factor = -1