

Technical Information

SA11 Smart Adapter
MODBUS Communication

TI 12A06S01-00EN-P



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Introduction

This document describes MODBUS communication by the SENCOM Smart Adapter, model SA11, for a basic user. Some functionality is reserved for Yokogawa expert HOST only, and therefore not explained in detail in this document.

Before communication using the MODBUS protocol, refer to the User's Manual of the SA11 Smart Adapter (IM 12A06S01-00EN) for details of the parameters.

Latest revision of the User's Manual can be downloaded from the website:

<https://www.yokogawa.com/solutions/products-platforms/process-analyzers/liquid-analyzers/#Downloads>

You can use the QR-code for quick-access.



NOTE

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1. General

SA11 Smart Adapter is a slave device which can be configured or is sending process data using Bi-directional digital communication (RS485, half-duplex) with full MODBUS (RTU) support. The power for the SA11 Smart Adapter must be supplied by a HOST or by a separate power supply in the range +2.7VDC up to +5.5VDC.

NOTE

Before powering the SA11, it is of importance that the sensor is connected to the SA11 to guarantee correct configuration of this device. This is done automatically by reading the ID-chip content of the sensor. When all wiring is completed, turn on the power of the HOST system. The start-up procedure of the SA11 can take up to 11 seconds

1.1 MODBUS setup

The following list shows the required setting by HOST to establish communication between the HOST as master device and the SA11 Smart Adapter as slave device. The procedure for changing list items is explained in the following chapters in this document.

| | |
|----------------|---|
| Slave address | : 1 to 247 (initial value 1) |
| Serial Profile | : 9600 bps (8, E, 1), 19200 bps (8, N, 2) |

NOTE

In case of using multiple SA11 Smart Adapters in a bus system, connected to one HOST, the Slave addresses of all the SA11 Smart Adapters must be unique. Because initial setting of address is 1 it is recommended to change the initial address value to prevent communication conflicts in case a new purchased SA11 Smart Adapter is added to the bus

1.2 Function code / Exception code

MODBUS Function codes used for SA11:

| Function | Function code (hex) |
|----------------------------|---------------------|
| Read Coils | 01 |
| Write Single Coil | 05 |
| Write Multiple Coils | 0F |
| Read Input Register | 04 |
| Read Holding Register | 03 |
| Write Single Register | 06 |
| Write Multiple Registers | 10 |
| Read Device Identification | 2B |

Exception codes used for SA11:

| Name | Exception code | Meaning |
|----------------------|----------------|---|
| Illegal Function | 0x01 | The Function code received is not an allowable action for the slave |
| Illegal Data Address | 0x02 | The Data Address received is not an allowable address for the slave |

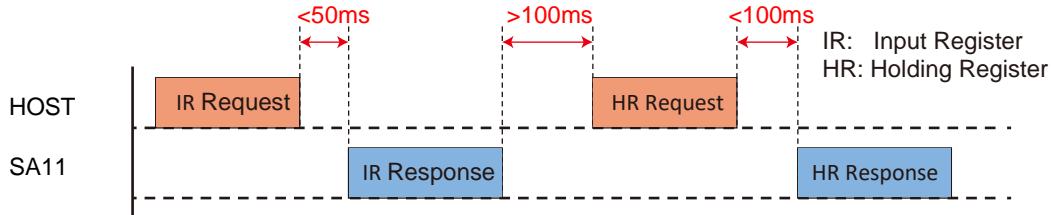
1.3 MODBUS communication

If the SA11 Smart Adapter is used with a HOST, the following must be considered.

- **MODBUS response timing**

The SA11 Smart Adapter's IR (Input Register) response to a HOST IR Read request is within 50 ms. To other requests, the SA11 Smart Adapter replies within 100 ms.

The timing in between a response and a new request must be at least 100 ms.



- **Input Register renewal cycle**

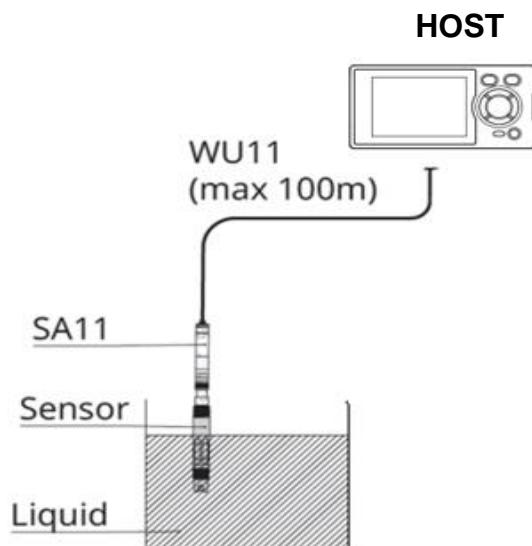
Process value sent in Input Register is renewed every 500 ms.

1.4 Connection

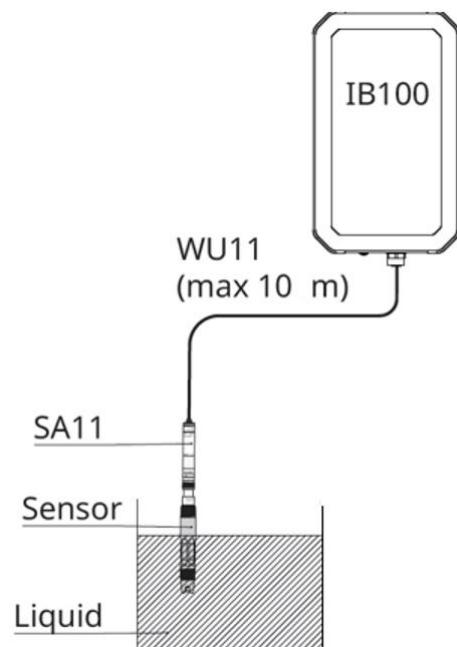
- **BUS system**

- One SA11 Smart Adapter on the BUS

Wired connection:

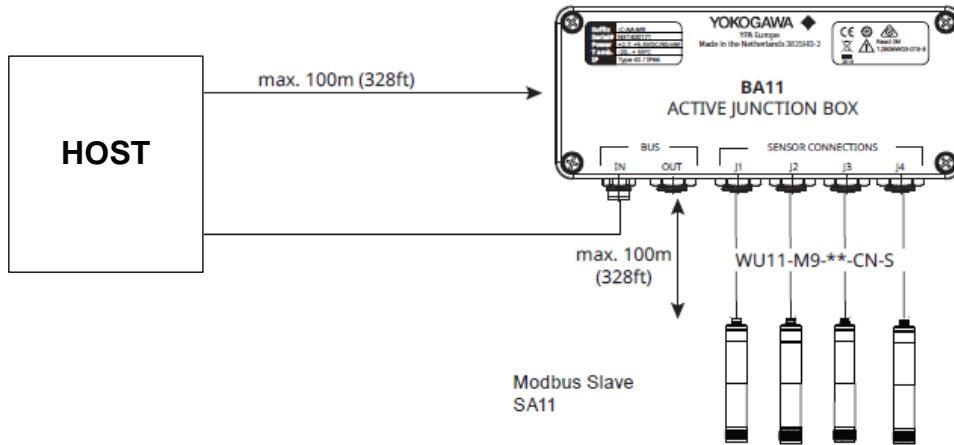


Wireless connection:



■ Multiple SA11 Smart Adapters on the BUS

Wired connection



NOTE

In case of an indirect connection of the SA11 Smart Adapter to a HOST, via the BA11 Active Junction Box or IB100 Interface Box, the connection cable must be type WU11-M9-xx-CN-S
In case of a direct connection of the SA11 Smart Adapter to a HOST, the connection cable must be type WU11-M9-xx-WP-S (xx: defining the cable length).

2. MODBUS map

Data type for SA11 Smart Adapter MODBUS map:

| Data type | Definition |
|------------|--|
| Float | floating point (4byte, ABCD) IEEE754 NaN: 0x7FFFFFFF |
| Int16 | 16 bit signed integer |
| Uint16 | 16 bit unsigned integer |
| Uint32 | 32 bit unsigned integer |
| ASCII | character set (using one byte per character), multiple registration possible |
| Bit fields | data assigning information on bit |

Access (load/import) to multiple data types, such as Float, Uint32, ASCII etc., must be implemented at once. The current version does not support Script yet.

| Access | | Function | Function Code (hex) |
|-------------|-------------|----------------------------|---------------------|
| Data Access | Blt | Read Coils | 01 |
| | | Write Single Coil | 05 |
| | | Write Multiple Coils | 0F |
| | 16 bits | Read Input Register | 04 |
| | | Read Holding Registers | 03 |
| | | Write Single Register | 06 |
| | | Write Multiple Register | 10 |
| | | Read Device Identification | 2B |
| | Diagnostics | | |

Coil Registers are Read/Write (R/W).

Input Registers are Read only (R).

Hold Registers are Read only (R) or Read/Write (R/W).

Identification Registers are Read only (R).

NOTE

The content of this Modbus Map is based upon SA11 firmware 01.xx,xx.

2.1 COIL: Coil register pH

| Address | Item name | Data type | Value / description |
|---------|------------------------------------|-----------|--|
| 0050 | Run_stop | Bit field | 1= run, 0= stop |
| 0051 | Sensor_reset | Bit field | 1= trigger reset (reboot SA11), automatically return to 0 |
| 0052 | ID_sync | Bit field | 1= error enabled, 0= error disabled |
| 0053 | Reset_sensor_wellness | Bit field | 1= trigger reset of wellness data, including operating time of sensor, automatically return to 0 |
| 0054 | Safely_remove SA11 | Bit field | 1= trigger safely remove of SA11, automatically return to 0 |
| 0055 | Safely_remove sensor | Bit field | 1= trigger safely remove of sensor, automatically return to 0 after SA11 reset |
| 0056 | Set_default_IDvalue | Bit field | 1= trigger factory default settings ID-chip, automatically return to 0 |
| 0057 | Factory default | Bit field | 1= trigger factory default settings SA11, automatically return to 0 |
| 0058 | Erase_logbook_calibration | Bit field | 1= trigger erase of logbook calibration information, automatically return to 0 |
| 0059 | Erase_logbook_alarm_event | Bit field | 1= trigger erase of logbook alarm events, automatically return to 0 |
| 0100 | Temperature_too_high_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 0101 | Temperature_too_low_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 0102 | pH_too_high_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 0103 | pH_too_low_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 0104 | ORP_too_high_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 0105 | ORP_too_low_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 0106 | rH_too_high_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 0107 | rH_too_low_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 0108 | Reserved | Bit field | No function |
| 0109 | Impedance1_too_high_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 0110 | Impedance1_too_low_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 0111 | Reserved | Bit field | No function |
| 0112 | Impedance2_too_high_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 0113 | Impedance2_too_low_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 0114 | pH_temp_comp_error_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 0115 | SSA_temp_out_Operating_spec_switch | Bit field | 1= error indication ON, 0= error indication OFF |

| Address | Item name | Data type | Value / description |
|---------|------------------------------|-----------|--|
| 0200 | Calib_accept | Bit field | 1= trigger acceptance of calibration results, automatically return to 0 |
| 0201 | Calib_start | Bit field | 1= trigger start of calibration, 0= trigger stop of calibration |
| 0202 | SampleCalib_takeSample | Bit field | 1= trigger start of take sample calibration, 0= trigger stop of take sample calibration |
| 0203 | SampleCalib_calibration | Bit field | 1= trigger start of calibration routine for take sample calibration for pHZERO, 0= trigger stop of calibration |
| 0204 | SampleCalib_calibration_grab | Bit field | 1= trigger start of calibration routine for take sample calibration for pHGRAB, 0= trigger stop of calibration |
| 0205 | Calib_next_basic | Bit field | 1= trigger acceptance of basic calibration results, automatically return to 0 |
| 0206 | Calib_start_basic | Bit field | 1= trigger start of basic calibration, 0= trigger stop of basic calibration |
| | | | |
| 0505 | Enable_impedance_meas. | Bit field | 1= enable impedance measurement, 0= disable impedance measurement |
| 0510 | Hold | Bit field | 1= hold enabled, automatically return to 0 after SA11 reset |

2.2 INPUT: Input register pH

If applicable, in the Value/description field the Low limit calculated result (L) and High limit calculated result (H) are explained. If not explained, a calculated result outside limits will result in NaN (Not a Number).

| Address | Item name | Data type | Value / description | |
|---------|--------------------|-----------|--|----------|
| 0000 | Device_failure | Uint16 | Bit assignment of device failure(s), see section 2.5.1 for details | |
| 0001 | Sensor_failure | Uint16 | Bit assignment of sensor failure(s)/status, see section 2.5.2 for details | |
| 0002 | Meas_warning | Uint16 | Bit assignment of measurement alarm(s), see section 2.5.3 for details | |
| 0003 | Device_status | Uint16 | Bit assignment of device status, see section 2.5.4 for details | |
| 0004 | Temp_measure | Float | Temperature (measurement) calculated output value [°C] used for calculation(s) | |
| | | | L: -30 | H: +140 |
| 0006 | pH_measure | Float | pH calculated output value [pH] | |
| | | | L: -2 | H: +16 |
| 0008 | ORP_measure | Float | ORP calculated output value [mV] | |
| | | | L: -1500 | H: +1500 |
| 0010 | rH_measure | Float | rH calculated output value Remark: same as input register 42 | |
| | | | L: 0 | H: 100 |
| 0012 | Temp_unit | Uint16 | 1= Degrees Celcius, 2= Degrees Fahrenheit | |
| 0013 | Reserved | Uint16 | | |
| 0014 | Voltage_pH | Float | pH measurement value [mV] | |
| 0016 | Voltage_ORP1 | Float | ORP1 measurement value, REF-LE [mV] | |
| 0018 | Voltage_ORP2 | Float | ORP2 measurement value, pH-LE [mV] | |
| 0020 | Imp_pHORP | Float | Impedance measurement value of input 1 | |
| 0022 | Imp_ref | Float | Impedance measurement value of input 2 | |
| 0024 | Temp_raw | Float | Temperature calculated output value [°C], uncompensated for temperature offset | |
| | | | L: -30 | H: +140 |
| 0026 | pH_uncomp | Float | pH calculated output value [pH], uncompensated for process parameters | |
| | | | L: -2 | H: +16 |
| 0028 | pH_comp_temp_coeff | Float | pH calculated output value [pH], compensated by temperature coefficient | |
| | | | L: -2 | H: +16 |
| 0030 | pH_comp_matrix | Float | pH calculated output value [pH], compensated by matrix | |
| | | | L: -2 | H: +16 |

| Address | Item name | Data type | Value / description | |
|---------|----------------------|-----------|---|----------|
| 0032 | pH_comp_NEN6411 | Float | pH calculated output value [pH], compensated by NEN6411 | |
| | | | L: -2 | H: +16 |
| 0034 | ORP1_uncomp | Float | ORP1 calculated output value [mV], uncompensated for process parameters | |
| | | | L: -1500 | H: +1500 |
| 0036 | ORP1_comp_temp_coef | Float | ORP1 calculated output value [mV], compensated by temperature coefficient | |
| | | | L: -1500 | H: +1500 |
| 0038 | ORP2_uncomp | Float | ORP2 calculated output value [mV], uncompensated for process parameters | |
| | | | L: -1500 | H: +1500 |
| 0040 | ORP2_comp_temp_coef | Float | ORP2 calculated output value [mV], compensated by temperature coefficient | |
| | | | L: -1500 | H: +1500 |
| 0042 | rH | Float | rH calculated output value by pH_uncomp and ORP1_uncomp | |
| | | | L: 0 | H: 100 |
| 0044 | pH_Grab_offset_calc | Float | Grab sample offset calculated output value [mV] | |
| | | | L: -300 | H: +300 |
| | | | | |
| 0060 | Device_failure_basic | Uint16 | Bit assignment of device failure(s), see section 2.5.1 for details | |
| 0061 | sensor_failure_basic | Uint16 | Bit assignment of sensor failure(s)/status, see section 2.5.2 for details | |
| 0062 | Meas_warning_basic | Uint16 | Bit assignment of measurement alarm(s), see section 2.5.3 for details | |
| 0063 | Device_status_basic | Uint16 | Bit assignment of device status, see section 2.5.4 for details | |
| | | | | |
| 0100 | Diag_total | Uint16 | Sensor wellness result overall: 0 (bad) ... 4(good) | |
| 0101 | Diag_prg_time | Uint16 | Sensor wellness result of progress time: 0 (bad) ... 4(good), 5=OFF | |
| 0102 | Diag_heat_cycle | Uint16 | Sensor wellness result of heat cycle: 0 (bad) ... 4(good), 5=OFF | |
| 0103 | Diag_zero | Uint16 | Sensor wellness result of ZERO: 0 (bad) ... 4(good) | |
| 0104 | Diag_slope | Uint16 | Sensor wellness result of SLOPE: 0 (bad) ... 4(good) | |
| 0105 | Diag_imp_pHORP | Uint16 | Sensor wellness result of impedance input 1: 0 (bad) ... 4(good), 5=OFF | |
| 0106 | Diag_imp_ref | Uint16 | Sensor wellness result of impedance input 2: 0 (bad) ... 4(good), 5=OFF | |
| 0107 | Reserved | Uint16 | | |
| 0108 | Last_calib_date | Uint32 | Time stamp of last sensor calibration date | |
| 0110 | Next_calib_date | Uint32 | Time stamp of next sensor calibration date | |
| | | | | |

| Address | Item name | Data type | Value / description | |
|---------|-----------------------------|-----------|--|----------|
| 0112 | Pred_maint_time | Uint16 | Predict period up to next sensor maintenance | |
| 0113 | Pred_maint_status | Uint16 | Reliability of predictive maintenance | |
| 0114 | Pred_replace_time | Uint16 | Predict period up to next sensor replacement | |
| 0115 | Pred_replace_status | Uint16 | Reliability of predictive replacement | |
| 0116 | Max_temp_exposed | Float | The maximum exposed temperature of sensor [°C] | |
| | | | L: -30 | H: +140 |
| 0118 | Sterilization | Uint16 | Number of sterilizations of sensor | |
| 0119 | Reserved | Uint16 | | |
| 0120 | Sterilization_date | Uint32 | Time stamp of last sensor sterilization date | |
| 0122 | High_temp1_time | Uint32 | Total time [hours] the sensor is exposed above the high temp1 setting (HR0532). Maximum number of hours is 87600 (10 years) | |
| | | | L: 0 | H: 87600 |
| 0124 | High_temp1_date | Uint32 | Time stamp of last High_temp1 date | |
| 0126 | High_temp2_time | Uint32 | Total time [hours] the sensor is exposed above the high temp2 setting (HR0534). Maximum number of hours is 87600 (10 years) | |
| | | | L: 0 | H: 87600 |
| 0128 | High_temp2_date | Uint32 | Time stamp of last High_temp2 date | |
| 0130 | High_ph_time | Uint32 | Total time [hours] the sensor is exposed above the high pH value setting (HR0536). Maximum number of hours is 87600 (10 years) | |
| | | | L: 0 | H: 87600 |
| 0132 | Low_ph_time | Uint32 | Total time [hours] the sensor is exposed below the low pH value setting (HR0538). Maximum number of hours is 87600 (10 years) | |
| | | | L: 0 | H: 87600 |
| 0134 | Low_temp_time | Uint32 | Total time [hours] the sensor is exposed below the low temp setting (HR0540). Maximum number of hours is 87600 (10 years) | |
| | | | L: 0 | H: 87600 |
| | | | | |
| 0140 | Total_operating_time_sensor | Uint32 | Total time [hours] the sensor is in operation. Maximum number of hours is 87600 (10 years). Parameter is reset by Reset_sensor_wellness (Coil 0053) Remark: Supported only by SA11 device | |
| | | | L: 0 | H: 87600 |
| 0142 | Total_operating_time_SSA | Uint32 | Total time [hours] the sensor is in operation. Maximum number of hours is 87600 (10 years). Remark: Supported only by SA11 device | |
| | | | L: 0 | H: 87600 |
| 0144 | Mode | Uint16 | Mode setting of SA11: 1= basic mode, 2= expert mode | |
| | | | | |

| Address | Item name | Data type | Value / description |
|---------|-----------------------------|-----------|--|
| 0200 | Calibration_status | Bit field | Status of calibration process, for expert HOST only |
| 0201 | Calibration_status_basic | Uint16 | <p>Status codes of basic calibration process with pre-defined buffer set:</p> <p>0= Calibration mode OFF 11= Place sensor in 1st buffer and wait for stable value 12= 1st buffer recognized with stable value 21= Place sensor in 2nd buffer and wait for stable value 22= 2nd buffer recognized with stable value 923= Calibration (sub)routine finished</p> <p>Error codes during calibration:</p> <p>910= 1st buffer not recognized 914= Calibration routine stopped due to ZERO out of limits 920= 2nd buffer not recognized 924= Calibration routine stopped due to SLOPE out of limits 934= Calibration routine stopped due to temperature of standard solution out of limits</p> |
| 0202 | Stable_process_value | Float | Stable uncompensated process measurement value after stability check during calibration |
| 0204 | Stable_temp_value | Float | Temperature value used for (1) temperature compensation of Stable_process_value (IR0202) and/or for (2) offset compensation of temp_measure (IR0004) |
| 0206 | Take_sample_date | Uint32 | Time stamp of last Take_sample_date |
| 0208 | Measurement_value_for_calib | Float | Process measurement during calibration used by HOST to check stability |
| 0210 | Calib_solution_1st | Float | 1 st calculated calibration solution used during auto calibration |
| 0212 | Calib_solution_2nd | Float | 2 nd calculated calibration solution used during auto calibration |
| 0214 | Calib_solution_3rd | Float | 3 rd calculated calibration solution used during auto calibration |
| 0216 | New_calc_value | Float | Accepted compensated process value |
| 0218 | New_zero | Float | Accepted ZERO value |
| 0220 | New_slope | Float | Accepted SLOPE value |
| 0222 | New_zero2 | Float | Accepted ZERO2 value |
| 0224 | New_slope2 | Float | Accepted SLOPE2 value |
| 0226 | New_ITP | Float | Accepted ITP value |
| 0228 | New_temp_offset | Float | Accepted temperature offset value |
| 0230 | New_grab_offset | Float | Accepted grab sample offset value |

2.3 HOLD: Hold register pH

If applicable, in the Value/description field the Factory Default setting (D), Low limit setting (L) and High limit setting (H) are explained. NaN does mean that there is Not a Number defined. Incorrect settings or settings outside the specified limits are not accepted.

| Address | Item name | Data type | Access | Value / description | | |
|---------|------------------|-----------|--------|--|---------|---------|
| 0000 | Sensor_type | Uint16 | R | 1= pH 2= ORP 3= pH + ORP | | |
| | | | | D: 3 | | |
| 0001 | pH_meas_select | Uint16 | R/W | 1= pH_uncomp 2= pH_lin 3= pH_matrix 4= pH_nen | | |
| | | | | D: 1 | | |
| 0002 | ORP_meas_select | Uint16 | R/W | 1= ORP (ref) 2= ORP (ref)_lin 3= ORP (pH) 4= ORP (pH)_lin | | |
| | | | | D: 1 | | |
| 0003 | Temp_measurement | Uint16 | R/W | 1= Manual 2= Automatic 3= External | | |
| | | | | D: 2 | | |
| 0004 | Temp_offset | Float | R/W | Temperature offset value [°C/F] | | |
| | | | | D: 0 | L: -10 | H: +10 |
| 0006 | Manual_temp | Float | R/W | Manual temperature value [°C] | | |
| | | | | D: +25 | L: -40 | H: +260 |
| 0008 | Temp_ref | Float | R/W | Reference temperature value [°C] | | |
| | | | | D: +25 | L: -40 | H: +260 |
| 0010 | pH_temp_coef | Float | R/W | pH temperature coefficient value | | |
| | | | | D: 0 | L: -0.1 | H: +0.1 |
| 0012 | ORP1_temp_coef | Float | R/W | ORP1 temperature coefficient value | | |
| | | | | D: 0 | L: -10 | H: +10 |
| 0014 | ORP2_temp_coef | Float | R/W | ORP2 temperature coefficient value | | |
| | | | | D: 0 | L: -10 | H: +10 |
| 0016 | pH_grab_offset | Float | R/W | pH grab sample offset value [mV] | | |
| | | | | D: 0 | L: -300 | H: +300 |
| 0018 | pH_zero | Float | R/W | pH ZERO value [mV] | | |
| | | | | D: 0 | L: -600 | H: +600 |
| 0020 | pH_slope | Float | R/W | pH SLOPE value [%] | | |
| | | | | D: 100 | L: 70 | H: 110 |

| Address | Item name | Data type | Access | Value / description | | |
|---------|-------------------------|-----------|--------|--|----------|----------|
| 0022 | pH_ITP | Float | R/W | pH ITP value [pH] | | |
| | | | | D: 7 | L: 0 | H: 14 |
| 0024 | pH_zero2 | Float | R | pH ZERO 2 value [mV] | | |
| | | | | D: 0 | L: -600 | H: +600 |
| 0026 | pH_slope2 | Float | R | pH SLOPE 2 value [%] | | |
| | | | | D: 100 | L: 70 | H: 110 |
| 0028 | ORP1_grab_offset | Float | R/W | ORP1 grab sample offset [mV] | | |
| | | | | D: 0 | L: -500 | H: +500 |
| 0030 | ORP1_zero | Float | R/W | ORP1 ZERO value [mV] | | |
| | | | | D: 0 | L: -500 | H: +500 |
| 0032 | ORP1_slope | Float | R/W | ORP1 SLOPE value [%] | | |
| | | | | D: 100 | L: 70 | H: 110 |
| 0034 | ORP2_grab_offset | Float | R/W | ORP2 grab sample offset [mV] | | |
| | | | | D: 0 | L: -500 | H: +500 |
| 0036 | ORP2_zero | Float | R/W | ORP2 ZERO value [mV] | | |
| | | | | D: 0 | L: -500 | H: +500 |
| 0038 | ORP2_slope | Float | R/W | ORP2 SLOPE value [%] | | |
| | | | | D: 100 | L: 70 | H: 110 |
| 0040 | Imp_pHORP_setting | Uint16 | R/W | 1= HIGH 2= LOW | | |
| | | | | D: 1 | | |
| 0041 | Imp_ref_setting | Uint16 | R/W | 1= HIGH 2= LOW | | |
| | | | | D: 2 | | |
| 0042 | 3P_flag | Uint16 | R | 0= None 1= ITP 2= ZERO/SLOPE 1/2 | | |
| | | | | D: 1 | | |
| 0043 | Temp_warning_high_limit | Float | R/W | Temp warning high limit value [°C] | | |
| | | | | D: +260 | L: -40 | H: +260 |
| 0045 | Temp_warning_low_limit | Float | R/W | Temp warning low limit value [°C] | | |
| | | | | D: -40 | L: -40 | H: +260 |
| 0047 | pH_warning_high_limit | Float | R/W | pH warning high limit value [pH] | | |
| | | | | D: +16 | L: -2 | H: +16 |
| 0049 | pH_warning_low_limit | Float | R/W | pH warning low limit value [pH] | | |
| | | | | D: -2 | L: -2 | H: +16 |
| 0051 | ORP_warning_high_limit | Float | R/W | ORP warning high limit value [mV] | | |
| | | | | D: +1500 | L: -1500 | H: +1500 |

| Address | Item name | Data type | Access | Value / description | | |
|---------|----------------------------------|-----------|--------|--|----------|----------|
| 0053 | ORP_warning_low_limit | Float | R/W | ORP warning low limit value [mV] | | |
| | | | | D: -1500 | L: -1500 | H: +1500 |
| 0055 | rH_warning_high_limit | Float | R/W | rH warning high limit value | | |
| | | | | D: -100 | L: 0 | H: 100 |
| 0057 | rH_warning_low_limit | Float | R/W | rH warning low limit value | | |
| | | | | D: 0 | L: 0 | H: 100 |
| 0059 | Imp_pHORP_low_warning_high_limit | Float | R/W | Impedance pH/ORP LOW warning high limit value [kΩ] | | |
| | | | | D: 200 | L: 1 | H: 1000 |
| 0061 | Imp_pHORP_low_warning_low_limit | Float | R/W | Impedance pH/ORP LOW warning low limit value [kΩ] | | |
| | | | | D: 1 | L: 1 | H: 1000 |
| 0063 | Imp_ref_low_warning_high_limit | Float | R/W | Impedance ref LOW warning high limit value [kΩ] | | |
| | | | | D: 200 | L: 1 | H: 1000 |
| 0065 | Imp_ref_low_warning_low_limit | Float | R/W | Impedance ref LOW warning low limit value [kΩ] | | |
| | | | | D: 1 | L: 1 | H: 1000 |
| 0067 | Reserved | Float | R | | | |
| 0069 | Reserved | Float | R | | | |
| 0071 | Zero_high_limit | Float | R/W | ZERO high limit value [mV] | | |
| | | | | D: +120 | L: 0 | H: +600 |
| 0073 | Zero_low_limit | Float | R/W | ZERO low limit value [mV] | | |
| | | | | D: -120 | L: -600 | H: 0 |
| 0075 | Slope_high_limit | Float | R/W | SLOPE high limit value [%] | | |
| | | | | D: 110 | L: 100 | H: 110 |
| 0077 | Slope_low_limit | Float | R/W | SLOPE low limit value [%] | | |
| | | | | D: 70 | L: 70 | H: 100 |
| 0079 | ORP_zero_high_limit | Float | R/W | ORP ZERO high limit value [mV] | | |
| | | | | D: +120 | L: 0 | H: +500 |
| 0081 | ORP_zero_low_limit | Float | R/W | ORP ZERO low limit value [mV] | | |
| | | | | D: -120 | L: -500 | H: 0 |
| 0083 | ORP_slope_high_limit | Float | R/W | ORP SLOPE high limit value [%] | | |
| | | | | D: 110 | L: 100 | H: 110 |
| 0085 | ORP_slope_low_limit | Float | R/W | ORP SLOPE low limit value [%] | | |
| | | | | D: 70 | L: 70 | H: 100 |

| Address | Item name | Data type | Access | Value / description | | |
|---------|----------------------|-----------|--------|--|---------|----------|
| 0087 | Stabilization_time | Uint16 | R/W | Stabilization time value [sec] | | |
| | | | | D: 5 | L: 2 | H: 30 |
| 0088 | pH_step_range | Float | R/W | pH step range value [pH] | | |
| | | | | D: 0.01 | L: 0.01 | H: 1.00 |
| 0090 | ORP_step_range | Float | R/W | ORP step range value [mV] | | |
| | | | | D: 1 | L: 1 | H: 100 |
| 0092 | rH_step_range | Float | R/W | rH step range value | | |
| | | | | D: 0.05 | L: 0.01 | H: 10.00 |
| 0094 | Calibration_interval | Uint16 | R/W | Calibration interval value [days] | | |
| | | | | D: 250 | L: 1 | H: 250 |
| | | | | | | |
| | | | | | | |
| 0100 | Calibration_status | Bit field | R/W | Status of calibration process, for expert HOST only | | |
| | | | | D: 0 | | |
| 0101 | Reserved | Uint16 | R | | | |
| | | | | | | |
| 0102 | Input_calib_val_1st | Float | R/W | 1 st calibration manual input value | | |
| | | | | | | |
| 0104 | Input_calib_val_2nd | Float | R/W | 2 nd calibration manual input value | | |
| | | | | | | |
| 0106 | Input_calib_val_3rd | Float | R/W | 3 rd calibration manual input value | | |
| | | | | | | |
| 0108 | Calibration_type | Uint16 | R/W | 1= Temperature calibration 2= pH calibration (ITP) 3= pH calibration (ZERO 2, SLOPE 2) 4= ORP1 calibration 5= rH calibration | | |
| | | | | D: 2 | | |
| 0109 | Buffer_select | Bit field | R/W | Buffer selection/sequence, for expert HOST only | | |
| | | | | D: 0 | | |
| 0110 | Buffer_pHvalue1 | Float | R | Representative pH value of buffer belonging to setting in HR0118 | | |
| | | | | | | |
| 0112 | Buffer_pHvalue2 | Float | R | Representative pH value of buffer belonging to setting in HR0118 | | |
| | | | | | | |
| 0114 | Buffer_pHvalue3 | Float | R | Representative pH value of buffer belonging to setting in HR0118 | | |
| | | | | | | |

| Address | Item name | Data type | Access | Value / description | | |
|---------|-------------------------|-----------|--------|--|----------|---------|
| 0116 | Buffer_pHvalue4 | Float | R | Representative pH value of buffer belonging to setting in HR0118 | | |
| | | | | | | |
| 0118 | Buffers_set | Uint16 | R/W | 1= NIST/DIN 2= DIN 3= US 4= User Defined | | |
| | | | | D: 1 | | |
| 0119 | Buffer_acceptance_range | Float | R/W | Acceptance range of buffer value [pH] | | |
| | | | | D: 1 | L: 0.001 | H: 5 |
| 0200 | Temp_unit | Uint16 | R/W | 1= °C (degrees Celcius) 2= °F (degrees Fahrenheit) | | |
| | | | | D: 1 | | |
| 0201 | pH_zero_unit | Uint16 | R/W | 1= mV 2= pH | | |
| | | | | D: 1 | | |
| 0202 | pH_slope_unit | Uint16 | R/W | 1= % 2= mV/pH | | |
| | | | | D: 1 | | |
| 0203 | pH_grab_unit | Uint16 | R/W | 1= pH 2= mV | | |
| | | | | D: 1 | | |
| | | | | | | |
| | | | | | | |
| 0300 | External_temp | Float | R/W | External temperature value [°C] | | |
| | | | | D: NaN | L: -30 | H: +140 |
| | | | | | | |
| | | | | | | |
| 0400 | Modbus_address | Uint16 | R/W | Modbus address setting | | |
| | | | | D: 1 | L: 1 | H: 247 |
| 0401 | Serial_profile | Uint16 | R/W | 1= 9600, E, 8, 1 2= 19200, N, 8, 2 | | |
| | | | | D: 1 | | |
| | | | | | | |
| | | | | | | |
| 0515 | Imp_measure_switch | Uint16 | R/W | 1= Impedance diagnostics OFF 2= Impedance diagnostics ON | | |
| | | | | D: 2 | | |
| 0516 | Diag_imp_pHORP_fine | Float | R/W | Impedance pH/ORP setting [$M\Omega$] for diagnostics | | |
| | | | | D: 10 | L: 1 | H: 10 |
| 0518 | Diag_imp_ref_fine | Float | R/W | Impedance ref setting [$M\Omega$] for diagnostics | | |
| | | | | D: 10 | L: 1 | H: 10 |

| Address | Item name | Data type | Access | Value / description | | |
|---------|------------------------------|-----------|--------|---|--------|----------|
| 0520 | Diag_progress_time_enabled | Uint16 | R/W | 1= Progress time enabled in diagnostics 2= Progress time disabled in diagnostics | | |
| | | | | D: 2 | | |
| 0521 | Diag_progress_time_bad_limit | Uint16 | R/W | Progress time limit setting [days] for diagnostics | | |
| | | | | D: 2000 | L: 1 | H: 10000 |
| 0522 | Diag_heat_cycle_enabled | Uint16 | R/W | 1= Heat cycle enabled in diagnostics 2= Heat cycle disabled in diagnostics | | |
| | | | | D: 2 | | |
| 0523 | Diag_heat_cycle_bad_limit | Uint16 | R/W | Heat cycle setting [no. of cycles] for diagnostics | | |
| | | | | D: 500 | L: 10 | H: 1000 |
| 0524 | Diag_heat_cycle_temp | Float | R/W | Heat cycle temperature setting [°C] for diagnostics | | |
| | | | | D: 50 | L: 1 | H: 250 |
| 0526 | Diag_heat_cycle_time | Float | R/W | Heat cycle time setting [min.] for diagnostics | | |
| | | | | D: 10 | L: 0.1 | H: 60 |
| 0528 | Sterilized_temp | Float | R/W | Sterilization temperature [°C] | | |
| | | | | D: 140 | L: 0 | H: 140 |
| 0530 | Sterilized_time | Float | R/W | Sterilization time [min.] | | |
| | | | | D: 100 | L: 0 | H: 100 |
| 0532 | High_temp1 | Float | R/W | High exposure temperature1 setting [°C] | | |
| | | | | D: +140 | L: -30 | H: +140 |
| 0534 | High_temp2 | Float | R/W | High exposure temperature2 setting [°C] | | |
| | | | | D: +140 | L: -30 | H: +140 |
| 0536 | High_ph_value | Float | R/W | High exposure pH setting [pH] | | |
| | | | | D: +13 | L: -2 | H: +16 |
| 0538 | Low_ph_value | Float | R/W | Low exposure pH setting [pH] | | |
| | | | | D: +1 | L: -2 | H: +16 |
| 0540 | Low_temp | Float | R/W | Low exposure temperature setting [°C] | | |
| | | | | D: -30 | L: -30 | H: +140 |
| | | | | | | |
| | | | | | | |
| 0900 | Product_code | ASCII | R | SA11 alphanumeric product code: 16 bytes, 8 addresses | | |
| | | | | | | |
| 0908 | Internal_serial_no_PL | ASCII | R | SA11 alphanumeric production location code: 2 bytes, 1 address | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

| Address | Item name | Data type | Access | Value / description | | |
|---------|---------------------------|-----------|--------|--|--|--|
| 0909 | Internal_serial_no_YM | ASCII | R | SA11 alphanumeric Year/Month code: 2 bytes, 1 address | | |
| | | | | | | |
| 0910 | Internal_serial_no_XXXXXX | Uint16 | R | SA11 Serial Number | | |
| | | | | | | |
| 0911 | Production_date | Uint32 | R | SA11 production date in seconds with reference to 2000/01/01 00:00:00 | | |
| | | | | | | |
| 0913 | Hardware_major | Uint16 | R | SA11 hardware configuration, major version | | |
| | | | | | | |
| 0914 | Hardware_minor | Uint16 | R | SA11 hardware configuration, minor version | | |
| | | | | | | |
| 0915 | Hardware_revision | Uint16 | R | SA11 hardware configuration, subminor version | | |
| | | | | | | |
| 0916 | Software_major | Uint16 | R | SA11 software configuration, major version | | |
| | | | | | | |
| 0917 | Software_minor | Uint16 | R | SA11 software configuration, minor version | | |
| | | | | | | |
| 0918 | Software_revision | Uint16 | R | SA11 software configuration, subminor version | | |
| | | | | | | |
| 0919 | Reserved | Uint16 | R | | | |
| | | | | | | |
| 0920 | SENS_product_code | ASCII | R | Sensor alphanumeric product code: 16 bytes, 8 addresses | | |
| | | | | | | |
| 0928 | SENS_serial_number | ASCII | R | Sensor alphanumeric serial number: 12 bytes, 6 address | | |
| | | | | | | |
| 0934 | SENS_production_date | Uint32 | R | Sensor production date in seconds with reference to 2000/01/01 00:00:00 | | |
| | | | | | | |
| 0936 | SENS_hardware_revision | ASCII | R | Sensor hardware revision: 12 bytes, 6 addresses | | |
| | | | | D: 01.00.00 | | |
| 0942 | SENS_serial_number_PL | ASCII | R | Sensor alphanumeric production location code: 2 bytes, 1 address | | |
| | | | | | | |

| Address | Item name | Data type | Access | Value / description | | |
|---------|----------------------------------|-----------|--------|--|--|--|
| 0943 | SENS_serial_number_YM | ASCII | R | Sensor alphanumeric Year/Month code: 2 bytes, 1 address | | |
| | | | | | | |
| 0944 | SENS_serial_number_XXXXXX | Uint16 | R | Sensor Serial Number | | |
| | | | | | | |
| 0945 | SENS_hardware_major | Uint16 | R | Sensor hardware configuration, major version | | |
| | | | | D: 01 | | |
| 0946 | SENS_hardware_minor | Uint16 | R | Sensor hardware configuration, minor version | | |
| | | | | D: 00 | | |
| 0947 | SENS_hardware_rev | Uint16 | R | Sensor hardware configuration, subminor version | | |
| | | | | D: 00 | | |
| 0948 | ID_chip type | Uint16 | R | ID-chip type | | |
| | | | | | | |
| 0949 | ID_chip mem_major | Uint16 | R | ID-chip software configuration, major version | | |
| | | | | | | |
| 0950 | ID_chip mem_minor | Uint16 | R | ID-chip software configuration, minor version | | |
| | | | | | | |
| 0960 | Sensor operating temp high limit | Float | R | Sensor high operating temperature [°C] | | |
| | | | | | | |
| 0962 | Sensor operating temp low limit | Float | R | Sensor low operating temperature [°C] | | |
| | | | | | | |
| 0964 | Sensor operating pH high limit | Float | R | Sensor high operational pH value [pH] | | |
| | | | | | | |
| 0966 | Sensor operating pH low limit | Float | R | Sensor low operational pH value [pH] | | |
| | | | | | | |

2.4 IDENTIFICATION: Identification register pH

| Object ID | Object name | Data type | Value / description | | |
|-----------|-----------------------------|-----------|---|--|--|
| 0000 | Vendor_name | ASCII | Vendor name: YOKOGAWA | | |
| 0001 | Product_code | ASCII | Product code: e.g. SA11-C1-AA-N-VP | | |
| 0002 | Major_minor_rev | ASCII | Configuration: a.b.c | | |
| 0003 | Vendor_url | ASCII | www.yokogawa.com/solutions/products-platforms/process-analyzers/ | | |
| 0004 | Product_name | ASCII | Product name: SENCOM | | |
| 0005 | Model_name | ASCII | Measuring Parameter: PH | | |
| 0006 | User_app_name | ASCII | User application ID | | |
| | | | | | |
| 0128 | Internal_serial_no | ASCII | SA11 serial number: PLYMX ₁ X ₂ X ₃ X ₄ X ₅ PL: Production Location no. YM: Year Month code X ₁ X ₂ X ₃ X ₄ X ₅ : Sequence no. | | |
| 0129 | Software_revision | ASCII | SA11 software revision | | |
| 0130 | Hardware_revision | ASCII | SA11 hardware revision | | |
| 0131 | Reserved | ASCII | | | |
| 0132 | Serial_profile | | SA11 serial profile: e.g. 9600, 8, E, 1 | | |
| 0133 | Input_req_fifo_update_cycle | Uint32 | Input register renewal cycle [ms]. See section 1.3 for details | | |
| | | | D: 500 | | |
| 0134 | Input_req_res_time | Uint32 | Input register response time after HOST input register request [ms]. See section 1.3 for details | | |
| | | | D: 50 | | |
| 0135 | Hold_req_res_time | Uint32 | HOLD register response time after HOST HOLD register request [ms]. See section 1.3 for details | | |
| | | | D: 100 | | |
| 0136 | Next_req_wait_time | Uint32 | Wait time in between response and next request [ms]. See section 1.3 for details | | |
| | | | D: 100 | | |
| 0137 | Start_address | Uint16 | Start address of SA11-P1/P2 registers | | |
| | | | D: 0000 | | |
| 0138 | SENS_product_code | ASCII | Sensor alphanumeric product code, 16 characters max, non-used characters presented as spaces. e.g. FU20-VS-T1-NPT | | |
| 0139 | SENS_serial_number | ASCII | Sensor alphanumeric serial number, 12 characters max, non-used characters presented as spaces. e.g. N3TC00012 | | |

2.5 Failures and warnings pH

2.5.1 Device failures

Device failures are checked and identified by bit content (0 or 1) in specific input register (IR0000). The definition of each bit is explained in table 2.5.1.

Table 2.5.1: Bit assignment for SA11-P1/P2 device failures

| Bit# | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------------|---------------------------|---------------------|------------------------|-------------------------|-------------------------|----------------------|-------------------|------------------|---------------------|--------------------|-----------------------|----------------------|-----------------------|----------------------|---|--|
| Bit definition | Non-Volatile Memory error | User data CRC error | Factory data CRC error | SA11 device not working | Critical sensor failure | ID-chip sync failure | Temp_raw too high | Temp_raw too low | pH_voltage too high | pH_voltage too low | ORP1_voltage too high | ORP1_voltage too low | ORP2_voltage too high | ORP2_voltage too low | | SA11 internal temperature out of design spec |

2.5.2 Sensor failures/warnings

Sensor failures/warnings are identified by bit content (0 or 1) in specific input register (IR0001). The definition of each bit is explained in table 2.5.2.

Table 2.5.2: Bit assignment for pH sensor failures/warnings

| Bit# | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------------|------------------|-------------------------------|--------------------------|-------------------------------------|-----------------|--------------------|--|-------------------------------------|---|---|---|---|---|---|---|---|
| Bit definition | Sensor detection | Temperature element detection | Sensor ID-chip detection | Liquid Earth element (LE) detection | Calibration due | Sensor safe remove | Impedance pH/ORP glass break detection | Impedance ref glass break detection | | | | | | | | |

2.5.3 Measurement warnings

Measurement warnings are identified by bit content (0 or 1) in specific input register (IR0002). The definition of each bit is explained in table 2.5.3.

Table 2.5.3: Bit assignment for pH measurement warnings

| Bit# | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------------|----------------------|---------------------|-------------|------------|--------------|-------------|-------------|------------|---|-------------------------------|------------------------------|---|----------------------------|---------------------------|---|---|
| Bit definition | Temperature too high | Temperature too low | pH too high | pH too low | ORP too high | ORP too low | rH too high | rH too low | | Impedance pH/ORP_low too high | Impedance pH/ORP_low too low | | Impedance ref_low too high | Impedance ref_low too low | pH temperature compensation not correct | SA11 internal temperature out of operational spec |

2.5.4 Device status

Device status is identified by bit content (0 or 1) in specific input register (IR0003). The definition of each bit is explained in table 2.5.4.

Table 2.5.4: Bit assignment for SA11-P1/P2 device status

| Bit# | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------------|---------------|----|--------------|----|----------|----------|----------------------|--------------------------|-------------------|-------------|---|---|---|-----------------------------------|--------------------------------|---|
| Bit definition | Write counter | | Read counter | | Reserved | Reserved | Calculation disabled | SA11 in calibration mode | SA11 in HOLD mode | SA11 remove | | | | Non-Volatile Memory write flag ID | Non-Volatile Memory write flag | 0 |

2.6 COIL: Coil register SC

| Address | Item name | Data type | Value / description |
|---------|------------------------------------|-----------|--|
| 1050 | Run_stop | Bit field | 1= run, 0= stop |
| 1051 | Sensor_reset | Bit field | 1= trigger reset (reboot SA11), automatically return to 0 |
| 1052 | ID_sync | Bit field | 1= error enabled, 0= error disabled |
| 1053 | Reset_sensor_wellness | Bit field | 1= trigger reset of wellness data, including operating time of sensor, automatically return to 0 |
| 1054 | Safely_remove SA11 | Bit field | 1= trigger safely remove of SA11, automatically return to 0 |
| 1055 | Safely_remove sensor | Bit field | 1= trigger safely remove of sensor, automatically return to 0 after SA11 reset |
| 1056 | Set_default_IDvalue | Bit field | 1= trigger factory default settings ID-chip, automatically return to 0 |
| 1057 | Factory default | Bit field | 1= trigger factory default settings SA11, automatically return to 0 |
| 1058 | Erase_logbook_calibration | Bit field | 1= trigger erase of logbook calibration information, automatically return to 0 |
| 1059 | Erase_logbook_alarm_event | Bit field | 1= trigger erase of logbook alarm events, automatically return to 0 |
| 1100 | Temperature_too_high_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 1101 | Temperature_too_low_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 1102 | Conductivity_too_high_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 1103 | Conductivity_too_low_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 1104 | Temp_comp1_warning_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 1105 | Temp_comp2_warning_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 1106 | USP_limit_exceeded_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 1107 | USP_margin_exceeded_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 1108 | Measurement_unstable_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 1109 | Polarization_detected_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 1110 | Matrix1_error_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 1111 | Matrix2_error_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 1112 | Conc_table_error_switch | Bit field | 1= error indication ON, 0= error indication OFF |
| 1113 | Reserved | Bit field | No function |
| 1114 | Reserved | Bit field | No function |
| 1115 | SSA_temp_out_Operating_spec_switch | Bit field | 1= error indication ON, 0= error indication OFF |

| Address | Item name | Data type | Value / description |
|---------|-------------------------|-----------|--|
| 1200 | Calib_accept | Bit field | 1= trigger acceptance of calibration results, automatically return to 0 |
| 1201 | Calib_start | Bit field | 1= trigger start of calibration, 0= trigger stop of calibration |
| 1202 | SampleCalib_takeSample | Bit field | 1= trigger start of take sample calibration, 0= trigger stop of take sample calibration |
| 1203 | SampleCalib_calibration | Bit field | 1= trigger start of calibration routine for take sample calibration for pHZERO, 0= trigger stop of calibration |
| 1204 | Reserved | Bit field | No function |
| 1205 | Calib_next_basic | Bit field | 1= trigger acceptance of basic calibration results, automatically return to 0 |
| 1206 | Calib_start_basic | Bit field | 1= trigger start of basic calibration, 0= trigger stop of basic calibration |
| | | | |
| 1510 | Hold | Bit field | 1= hold enabled, automatically return to 0 after SA11 reset |

2.7 INPUT: Input register SC

If applicable, in the Value/description field the Low limit calculated result (L) and High limit calculated result (H) are explained. If not explained, a calculated result outside limits will result in NaN (Not a Number).

| Address | Item name | Data type | Value / description | |
|---------|---------------------|-----------|---|----------|
| 1000 | Device_failure | Uint16 | Bit assignment of device failure(s), see section 2.10.1 for details | |
| 1001 | Sensor_failure | Uint16 | Bit assignment of sensor failure(s)/status, see section 2.10.2 for details | |
| 1002 | Meas_warning | Uint16 | Bit assignment of measurement alarm(s), see section 2.10.3 for details | |
| 1003 | Device_status | Uint16 | Bit assignment of device status, see section 2.10.4 for details | |
| 1004 | Temp_measure | Float | Temperature (measurement) calculated output value used for calculation(s) [°C] | |
| | | | L: -20 | H: +250 |
| 1006 | SC1_measure | Float | Conductivity1 (or Resistivity1) calculated output value. Value and limits depend on the selected measurement. | |
| 1008 | SC2_measure | Float | Conductivity2 (or Resistivity2) calculated output value. Value and limits depend on the selected measurement. | |
| 1010 | Concentration1 | Float | Concentration1 calculated output value. Unit of value and limits are specified by table (ppb, ppm, ppt or %) | |
| | | | L: 0.001 | H: 999.9 |
| 1012 | Concentration2 | Float | Concentration1 calculated output value. Unit of value and limits are specified by table (ppb, ppm, ppt or %) | |
| | | | L: 0.001 | H: 999.9 |
| 1014 | Temp_unit | Uint16 | 1= Degrees Celcius, 2= Degrees Fahrenheit | |
| 1015 | SC1_unit | Uint16 | 1= S/cm 2= S/m 3= Ohm x cm 4= Ohm x m | |
| 1016 | SC2_unit | Uint16 | 1= S/cm 2= S/m 3= Ohm x cm 4= Ohm x m | |
| 1017 | Concentration1_unit | Uint16 | 1= % 2= ppm 3= ppb 4= ppt 5= None | |
| 1018 | Concentration2_unit | Uint16 | 1= % 2= ppm 3= ppb 4= ppt 5= None | |
| 1019 | Reserved | Uint16 | | |

| Address | Item name | Data type | Value / description | |
|---------|-----------------------------|-----------|---|-----------------------|
| 1020 | Sensor_ohm | Float | Resistance measurement value of sensor input [Ω] | |
| | | | L: 0 | H: 1×10^8 |
| 1022 | Polarization | Float | Polarization calculated output value | |
| 1024 | USP | Float | USP calculated output value | |
| | | | L: -9999 | H: +99.99 |
| 1026 | Temp_raw | Float | Temperature calculated output value [°C], uncompensated for temperature offset | |
| | | | L: -20 | H: +250 |
| 1028 | Conduct_uncomp | Float | Conductivity calculated output value [S/cm], uncompensated for process parameters | |
| | | | L: -1×10^{-5} | H: 5 |
| 1030 | Conduct_comp_temp_coef1 | Float | Conductivity calculated output value [S/cm], compensated by temperature coefficient 1 | |
| | | | L: -1×10^{-5} | H: 5 |
| 1032 | Conduct_comp_temp_coef2 | Float | Conductivity calculated output value [S/cm], compensated by temperature coefficient 2 | |
| | | | L: -1×10^{-5} | H: 5 |
| 1034 | Conduct_comp_nacl | Float | Conductivity calculated output value [S/cm], compensated by NaCl | |
| | | | L: -1×10^{-5} | H: 5 |
| 1036 | Conduct_comp_matrix1 | Float | Conductivity calculated output value [S/cm], compensated by matrix 1 | |
| | | | L: -1×10^{-5} | H: 5 |
| 1038 | Conduct_comp_matrix2 | Float | Conductivity calculated output value [S/cm], compensated by matrix 2 | |
| | | | L: -1×10^{-5} | H: 5 |
| 1040 | Resistivity_uncomp | Float | Resistivity calculated output value [Ω], uncompensated for process parameters | |
| | | | L: 0 | H: 9.99×10^8 |
| 1042 | Resistivity_comp_temp_coef1 | Float | Resistivity calculated output value [Ω], compensated by temperature coefficient 1 | |
| | | | L: 0 | H: 9.99×10^8 |
| 1044 | Resistivity_comp_temp_coef2 | Float | Resistivity calculated output value [Ω], compensated by temperature coefficient 2 | |
| | | | L: 0 | H: 9.99×10^8 |
| 1046 | Resistivity_comp_nacl | Float | Resistivity calculated output value [Ω], compensated by NaCl | |
| | | | L: 0 | H: 9.99×10^8 |
| 1048 | Resistivity_comp_matrix1 | Float | Resistivity calculated output value [Ω], compensated by matrix 1 | |
| | | | L: 0 | H: 9.99×10^8 |
| 1050 | Resistivity_comp_matrix2 | Float | Resistivity calculated output value [Ω], compensated by matrix 2 | |
| | | | L: 0 | H: 9.99×10^8 |

| Address | Item name | Data type | Value / description | |
|---------|----------------------|-----------|--|----------|
| 1060 | Device_failure_basic | Uint16 | Bit assignment of device failure(s), see section 2.10.1 for details | |
| 1061 | sensor_failure_basic | Uint16 | Bit assignment of sensor failure(s)/status, see section 2.10.2 for details | |
| 1062 | Meas_warning_basic | Uint16 | Bit assignment of measurement alarm(s), see section 2.10.3 for details | |
| 1063 | Device_status_basic | Uint16 | Bit assignment of device status, see section 2.10.4 for details | |
| | | | | |
| 1100 | Diag_total | Uint16 | Sensor wellness result overall: 0 (bad) ... 4(good) | |
| 1101 | Diag_prg_time | Uint16 | Sensor wellness result of progress time: 0 (bad) ... 4(good), 5=OFF | |
| 1102 | Diag_heat_cycle | Uint16 | Sensor wellness result of heat cycle: 0 (bad) ... 4(good), 5=OFF | |
| 1103 | Diag_cell_const | Uint16 | Sensor wellness result of Cell Constant: 0 (bad) ... 4(good) | |
| 1104 | Diag_polarization | Uint16 | Sensor wellness result of polarization: 0 (bad) ... 4(good) | |
| 1105 | Reserved | Uint16 | | |
| 1106 | Last_calib_date | Uint32 | Time stamp of last sensor calibration date | |
| 1108 | Next_calib_date | Uint32 | Time stamp of next sensor calibration date | |
| 1110 | Pred_maint_time | Uint16 | Predict period up to next sensor maintenance | |
| 1111 | Pred_maint_status | Uint16 | Reliability of predictive maintenance | |
| 1112 | Max_temp_exposed | Float | The maximum exposed temperature of sensor [°C] | |
| | | | L: -20 | H: +250 |
| 1114 | Sterilization | Uint16 | Number of sterilizations of sensor | |
| | | | L: 0 | H: 9999 |
| 1115 | Reserved | Uint16 | | |
| 1116 | Sterilization_date | Uint32 | Time stamp of last sensor sterilization date | |
| 1118 | High_temp1_time | Uint32 | Total time [hours] the sensor is exposed above the high temp1 setting (HR1532). Maximum number of hours is 87600 (10 years) | |
| | | | L: 0 | H: 87600 |
| 1120 | High_temp1_date | Uint32 | Time stamp of last High_temp1 date | |
| 1122 | High_temp2_time | Uint32 | Total time [hours] the sensor is exposed above the high temp2 setting (HR1534). Maximum number of hours is 87600 (10 years) | |
| | | | L: 0 | H: 87600 |
| 1124 | High_temp2_date | Uint32 | Time stamp of last High_temp2 date | |
| 1126 | Low_temp_time | Uint32 | Total time [hours] the sensor is exposed below the low temp setting (HR1540). Maximum number of hours is 87600 (10 years) | |
| | | | L: 0 | H: 87600 |
| | | | | |

| Address | Item name | Data type | Value / description | |
|---------|-----------------------------|-----------|--|----------|
| 1140 | Total_operating_time_sensor | Uint32 | Total time [hours] the sensor is in operation. Maximum number of hours is 87600 (10 years). Parameter is reset by Reset_sensor_wellness (Coil 1053) Remark: Supported only by SA11 device | |
| | | | L: 0 | H: 87600 |
| 1142 | Total_operating_time_SSA | Uint32 | Total time [hours] the sensor is in operation. Maximum number of hours is 87600 (10 years). Remark: Supported only by SA11 device | |
| | | | L: 0 | H: 87600 |
| 1144 | Mode | Uint16 | Mode setting of SA11: 1= basic mode, 2= expert mode | |
| | | | | |
| 1200 | Calibration_status | Bit field | Status calibration process, for expert HOST only | |
| 1201 | Calibration_status_basic | Uint16 | Status codes of basic calibration process with pre-defined standard solution: 0= Calibration mode OFF 11= Place sensor in standard solution and wait for stable value 12= Standard solution stable 923= Calibration routine finished | |
| | | | Error codes during calibration: 914= Calibration routine stopped due to Cell Constant out of limits 934= Calibration routine stopped due to temperature of standard solution out of limits | |
| 1202 | Stable_process_value | Float | Stable uncompensated process measurement value after stability check during calibration | |
| 1204 | Stable_temp_value | Float | Temperature value used for (1) temperature compensation of Stable_process_value (IR1202) and/or for (2) offset compensation of temp_measure (IR1004) | |
| 1206 | Take_sample_date | Uint32 | Time stamp of last Take_sample_date | |
| 1208 | Measurement_value_for_calib | Float | Process measurement during calibration used by HOST to check stability | |
| 1210 | Calib_solution | Float | Calculated calibration solution used during auto calibration | |
| 1212 | New_calc_value | Float | Accepted compensated process value | |
| 1214 | New_cell_const | Float | Accepted Cell Constant value | |
| 1216 | New_temp_offset | Float | Accepted temperature offset value | |
| 1218 | New_temp_coef | Float | Accepted temperature coefficient value | |

2.8 HOLD: Hold register SC

If applicable, in the Value/description field the Factory Default setting (D), Low limit setting (L) and High limit setting (H) are explained. NaN does mean that there is Not a Number defined. Incorrect settings or settings outside the specified limits are not accepted.

| Address | Item name | Data type | Access | Value / description | | |
|---------|--------------------|-----------|--------|--|-----------------|--------------|
| 1000 | Sensor_type | Uint16 | R | 1= 2-electrode 2= 4-electrode | | |
| | | | | D: 1 | | |
| 1001 | SC1_meas_select | Uint16 | R/W | 1= SC_uncomp 2= SC_TC1 3= SC_NaCl 4= SC_Matrix 1 5= Resistivity_uncomp 6= Resistivity_TC1 7= Resistivity_NaCl 8= Resistivity_Matrix 1 | | |
| | | | | D: 3 | | |
| 1002 | SC2_meas_select | Uint16 | R/W | 1= SC_uncomp 2= SC_TC2 3= SC_NaCl 4= SC_Matrix 2 5= Resistivity_uncomp 6= Resistivity_TC2 7= Resistivity_NaCl 8= Resistivity_Matrix 2 | | |
| | | | | D: 1 | | |
| 1003 | Temp_measurement | Uint16 | R/W | 1= Manual 2= Automatic 3= External | | |
| | | | | D: 2 | | |
| 1004 | Temp_offset | Float | R/W | Temperature offset value [°C/F] | | |
| | | | | D: 0 | L: -10 | H: +10 |
| 1006 | Manual_temp | Float | R/W | Manual temperature value [°C] | | |
| | | | | D: +25 | L: -20 | H: +250 |
| 1008 | Temp_ref | Float | R/W | Reference temperature value [°C] | | |
| | | | | D: +25 | L: -20 | H: +250 |
| 1010 | Temp_coef1 | Float | R/W | Temperature coefficient 1 value [%/°C] | | |
| | | | | D: 2.1 | L: 0 | H: 10 |
| 1012 | Temp_coef2 | Float | R/W | Temperature coefficient 2 value [%/°C] | | |
| | | | | D: 2.1 | L: 0 | H: 10 |
| 1014 | Cell_const_factory | Float | R/W | Cell Constant Factory setting [cm ⁻¹] | | |
| | | | | D: 0.1 | L: 0.005 | H: 50 |
| 1016 | Cell_const_adj | Float | R/W | Cell Constant adjusted [cm ⁻¹] | | |
| | | | | D: 0.1 | L: 0.005 (-20%) | H: 50 (+20%) |

| Address | Item name | Data type | Access | Value / description | | | |
|---------|----------------------------|-----------|--------|--|--------|---------|--|
| 1018 | Air_adjust_offset | Float | R/W | Air Calibration offset value [μ S] | | | |
| | | | | D: 0 | L: -20 | H: +20 | |
| 1020 | Matrix1_setting | Uint16 | R/W | Matrix 1 selection: 1= NH ₃ 0...50ppb 2= Morpholine 0...500ppb 3= NH ₃ 15...30% 4= H ₂ SO ₄ 1...5% 5= H ₂ SO ₄ 0...27% 6= NaOH 1...5% 7= NaOH 0...15% 8= HCl 0...200ppb 9= HCl 0...5% 10= HCl 0...18% 11= HNO ₃ 1...5% 12= HNO ₃ 0...25% 21= User programmable 1 22= User programmable 2 | | | |
| | | | | D: 1 | | | |
| 1021 | Matrix2_setting | Uint16 | R/W | Matrix 2 selection: 1= NH ₃ 0...50ppb 2= Morpholine 0...500ppb 3= NH ₃ 15...30% 4= H ₂ SO ₄ 1...5% 5= H ₂ SO ₄ 0...27% 6= NaOH 1...5% 7= NaOH 0...15% 8= HCl 0...200ppb 9= HCl 0...5% 10= HCl 0...18% 11= HNO ₃ 1...5% 12= HNO ₃ 0...25% 21= User programmable 1 22= User programmable 2 | | | |
| | | | | D: 1 | | | |
| 1022 | Concentration1_meas_select | Uint16 | R/W | Concentration 1 selection: 1= Matrix 1 2= Table and SC1 | | | |
| | | | | D: 1 | | | |
| 1023 | Concentration2_meas_select | Uint16 | R/W | Concentration 2 selection: 1= Matrix 2 2= Table and SC2 | | | |
| | | | | D: 1 | | | |
| 1024 | USP_safety_margin | Float | R/W | USP safety margin setting [%] | | | |
| | | | | D: 0 | L: 0 | H: 100 | |
| 1026 | Temp_warning_high_limit | Float | R/W | Temp warning high limit value [°C] | | | |
| | | | | D: +260 | L: -40 | H: +260 | |
| 1028 | Temp_warning_low_limit | Float | R/W | Temp warning low limit value [°C] | | | |
| | | | | D: -40 | L: -40 | H: +260 | |

| Address | Item name | Data type | Access | Value / description | | |
|---------|--------------------------------|-----------|--------|---|--------|--------------------|
| 1030 | Conductance_warning_high_limit | Float | R/W | Conductance warning high limit value [S] | | |
| | | | | D: 0.25 | L: 0 | H: 500 |
| 1032 | Conductance_warning_low_limit | Float | R/W | Conductance warning low limit value [S] | | |
| | | | | D: 1×10^{-8} | L: 0 | H: 500 |
| 1034 | Resistance_warning_high_limit | Float | R/W | Resistance warning high limit value [Ω] | | |
| | | | | D: 2×10^6 | L: 0 | H: 1×10^8 |
| 1036 | Resistance_warning_low_limit | Float | R/W | Resistance warning low limit value [Ω] | | |
| | | | | D: 0.2 | L: 0 | H: 1×10^8 |
| 1038 | Polarisation_high_limit | Float | R/W | Polarisation limit value [%] | | |
| | | | | D: 15 | L: 0 | H: 50 |
| 1040 | Cc_high_limit | Float | R/W | Cell Constant high limit value [cm^{-1}] | | |
| | | | | D: 120 | L: 100 | H: 120 |
| 1042 | Cc_low_limit | Float | R/W | Cell Constant low limit value [cm^{-1}] | | |
| | | | | D: 80 | L: 80 | H: 100 |
| 1044 | Reserved | Uint32 | R/W | | | |
| | | | | | | |
| 1046 | Step_range | Float | R/W | Step range value [%] | | |
| | | | | D: 1 | L: 0.1 | H: 20 |
| 1048 | Stabilization_time | Uint16 | R/W | Stabilization time value [sec] | | |
| | | | | D: 5 | L: 2 | H: 30 |
| 1049 | Calib_interval | Uint16 | R/W | Calibration interval value [days] | | |
| | | | | D: 250 | L: 1 | H: 250 |
| 1050 | Temp_element | Uint16 | R | 1= Pt1000 | | |
| | | | | D: 1 | | |
| 1051 | Reserved | Uint16 | R/W | | | |
| | | | | | | |
| 1100 | Calibration_status | Bit field | R/W | Status of calibration process, for expert HOST only | | |
| | | | | D: 0 | | |
| 1101 | Reserved | Uint16 | R | | | |
| | | | | | | |
| 1102 | Input_calib_val | Float | R/W | Calibration manual input value | | |
| | | | | | | |

| Address | Item name | Data type | Access | Value / description | | |
|---------|------------------------------|-----------|--------|---|--------|----------|
| 1104 | Calibration_type | Uint16 | R/W | 1= Temperature calibration 2= SC1 calibration 3= SC2 calibration 4= Uncompensated SC calibration 5= AIR calibration 6= Temperature coefficient 1 calibration 7= Temperature coefficient 2 calibration | | |
| | | | | D: 1 | | |
| 1105 | Buffer_select | Uint16 | R/W | 1= 1.000 KCl [mol/l] 2= 0..100 KCl [mol/l] 4= 0.010 KCl [mol/l] 8= 0.005 KCl [mol/l] 16= 0.002 KCl [mol/l] 32= 0.001 KCl [mol/l] | | |
| | | | | D: 0 | | |
| | | | | | | |
| | | | | | | |
| 1200 | Temp_unit | Uint16 | R/W | 1= °C (degrees Celcius) 2= °F (degrees Fahrenheit) | | |
| | | | | D: 1 | | |
| 1201 | Cell_const_unit | Uint16 | R/W | 1= cm ⁻¹ 2= m ⁻¹ | | |
| | | | | D: 1 | | |
| | | | | | | |
| | | | | | | |
| 1300 | External_temp | Float | R/W | External temperature value [°C] | | |
| | | | | D: NaN | L: -20 | H: +250 |
| | | | | | | |
| | | | | | | |
| 1400 | Modbus_address | Uint16 | R/W | Modbus address setting | | |
| | | | | D: 1 | L: 1 | H: 247 |
| 1401 | Serial_profile | Uint16 | R/W | 1= 9600, E, 8, 1 2= 19200, N, 8, 2 | | |
| | | | | D: 1 | | |
| | | | | | | |
| | | | | | | |
| 1520 | Diag_progress_time_enabled | Uint16 | R/W | 1= Progress time enabled in diagnostics 2= Progress time disabled in diagnostics | | |
| | | | | D: 2 | | |
| 1521 | Diag_progress_time_bad_limit | Uint16 | R/W | Progress time limit setting [days] for diagnostics | | |
| | | | | D: 2000 | L: 1 | H: 10000 |
| 1522 | Diag_heat_cycle_enabled | Uint16 | R/W | 1= Heat cycle enabled in diagnostics 2= Heat cycle disabled in diagnostics | | |
| | | | | D: 2 | | |

| Address | Item name | Data type | Access | Value / description | | |
|---------|---------------------------|-----------|--------|--|--------|---------|
| 1523 | Diag_heat_cycle_bad_limit | Uint16 | R/W | Heat cycle setting [no. of cycles] for diagnostics | | |
| | | | | D: 500 | L: 10 | H: 1000 |
| 1524 | Diag_heat_cycle_temp | Float | R/W | Heat cycle temperature setting [°C] for diagnostics | | |
| | | | | D: 50 | L: 1 | H: 250 |
| 1526 | Diag_heat_cycle_time | Float | R/W | Heat cycle time setting [min.] for diagnostics | | |
| | | | | D: 10 | L: 0.1 | H: 60 |
| 1528 | Sterilized_temp | Float | R/W | Sterilization temperature [°C] | | |
| | | | | D: 150 | L: 0 | H: 150 |
| 1530 | Sterilized_time | Float | R/W | Sterilization time [min.] | | |
| | | | | D: 100 | L: 0 | H: 100 |
| 1532 | High_temp1 | Float | R/W | High exposure temperature1 setting [°C] | | |
| | | | | D: +250 | L: -20 | H: +250 |
| 1534 | High_temp2 | Float | R/W | High exposure temperature2 setting [°C] | | |
| | | | | D: +250 | L: -20 | H: +250 |
| 1536 | Low_temp | Float | R/W | Low exposure temperature setting [°C] | | |
| | | | | D: -20 | L: -20 | H: +250 |
| | | | | | | |
| | | | | | | |
| 1900 | Product_code | ASCII | R | SA11 alphanumeric product code: 16 bytes, 8 addresses | | |
| | | | | | | |
| 1908 | Internal_serial_no_PL | ASCII | R | SA11 alphanumeric production location code: 2 bytes, 1 address | | |
| | | | | | | |
| 1909 | Internal_serial_no_YM | ASCII | R | SA11 alphanumeric Year/Month code: 2 bytes, 1 address | | |
| | | | | | | |
| 1910 | Internal_serial_no_XXXXX | Uint16 | R | SA11 Serial Number | | |
| | | | | | | |
| 1911 | Production_date | Uint32 | R | SA11 production date in seconds with reference to 2000/01/01 00:00:00 | | |
| | | | | | | |
| 1913 | Hardware_major | Uint16 | R | SA11 hardware configuration, major version | | |
| | | | | | | |
| 1914 | Hardware_minor | Uint16 | R | SA11 hardware configuration, minor version | | |
| | | | | | | |

| Address | Item name | Data type | Access | Value / description | | |
|---------|--------------------------|-----------|--------|---|--|--|
| 1915 | Hardware_revision | Uint16 | R | SA11 hardware configuration, subminor version | | |
| | | | | | | |
| 1916 | Software_major | Uint16 | R | SA11 software configuration, major version | | |
| | | | | | | |
| 1917 | Software_minor | Uint16 | R | SA11 software configuration, minor version | | |
| | | | | | | |
| 1918 | Software_revision | Uint16 | R | SA11 software configuration, subminor version | | |
| | | | | | | |
| 1919 | Reserved | Uint16 | R | | | |
| | | | | | | |
| 1920 | SENS_product_code | ASCII | R | Sensor alphanumeric product code: 16 bytes, 8 addresses | | |
| | | | | | | |
| 1928 | SENS_serial_number | ASCII | R | Sensor alphanumeric serial number: 12 bytes, 6 address | | |
| | | | | | | |
| 1934 | SENS_production_date | Uint32 | R | Sensor production date in seconds with reference to 2000/01/01 00:00:00 | | |
| | | | | | | |
| 1936 | SENS_hardware_revision | ASCII | R | Sensor hardware revision: 12 bytes, 6 addresses | | |
| | | | | D: 01.00.00 | | |
| 1942 | SENS_serial_number_PL | ASCII | R | Sensor alphanumeric production location code: 2 bytes, 1 address | | |
| | | | | | | |
| 1943 | SENS_serial_number_YM | ASCII | R | Sensor alphanumeric Year/Month code: 2 bytes, 1 address | | |
| | | | | | | |
| 1944 | SENS_serial_number_XXXXX | Uint16 | R | Sensor Serial Number | | |
| | | | | | | |
| 1945 | SENS_hardware_major | Uint16 | R | Sensor hardware configuration, major version | | |
| | | | | D: 01 | | |
| 1946 | SENS_hardware_minor | Uint16 | R | Sensor hardware configuration, minor version | | |
| | | | | D: 00 | | |
| 1947 | SENS_hardware_rev | Uint16 | R | Sensor hardware configuration, subminor version | | |
| | | | | D: 00 | | |

| Address | Item name | Data type | Access | Value / description |
|---------|----------------------------------|-----------|--------|---|
| 1948 | ID_chip type | Uint16 | R | ID-chip type |
| | | | | |
| 1949 | ID_chip mem_major | Uint16 | R | ID-chip software configuration, major version |
| | | | | |
| 1950 | ID_chip mem_minor | Uint16 | R | ID-chip software configuration, minor version |
| | | | | |
| | | | | |
| | | | | |
| 1960 | Sensor operating temp high limit | Float | R | Sensor high operating temperature [°C] |
| | | | | |
| 1962 | Sensor operating temp low limit | Float | R | Sensor low operating temperature [°C] |
| | | | | |

2.9 IDENTIFICATION: Identification register SC

| Object ID | Object name | Data type | Value / description | | |
|-----------|-----------------------------|-----------|--|--|--|
| 0000 | Vendor_name | ASCII | Vendor name: YOKOGAWA | | |
| 0001 | Product_code | ASCII | Product code: e.g. SA11-C1-AA-N-VP | | |
| 0002 | Major_minor_rev | ASCII | Configuration: a.b.c | | |
| 0003 | Vendor_url | ASCII | www.yokogawa.com/solutions/products-platforms/process-analyzers/ | | |
| 0004 | Product_name | ASCII | Product name: SENCOM | | |
| 0005 | Model_name | ASCII | Measuring Parameter: SC | | |
| 0006 | User_app_name | ASCII | User application ID | | |
| | | | | | |
| 0128 | Internal_serial_no | ASCII | SA11 serial number: PLYMx1X ₂ X ₃ X ₄ X ₅ PL: Production Location no. YM: Year Month code X ₁ X ₂ X ₃ X ₄ X ₅ : Sequence no. | | |
| 0129 | Software_revision | ASCII | SA11 software revision | | |
| 0130 | Hardware_revision | ASCII | SA11 hardware revision | | |
| 0131 | | | | | |
| 0132 | Serial_profile | | SA11 serial profile: e.g. 9600, 8, E, 1 | | |
| 0133 | Input_req_fifo_update_cycle | Uint32 | Input register renewal cycle [ms]. See section 1.3 for details | | |
| | | | D: 500 | | |
| 0134 | Input_req_res_time | Uint32 | Input register response time after HOST input register request [ms]. See section 1.3 for details | | |
| | | | D: 50 | | |
| 0135 | Hold_req_res_time | Uint32 | HOLD register response time after HOST HOLD register request [ms]. See section 1.3 for details | | |
| | | | D: 100 | | |
| 0136 | Next_req_wait_time | Uint32 | Wait time in between response and next request [ms]. See section 1.3 for details | | |
| | | | D: 100 | | |
| 0137 | Start_address | Uint16 | Start address of SA11-C1 registers | | |
| | | | D: 1000 | | |
| 0138 | SENS_product_code | ASCII | Sensor alphanumeric product code, 16 characters max, non-used characters presented as spaces. e.g. SC4A-T-AD-15-010 | | |
| 0139 | SENS_serial_number | ASCII | Sensor alphanumeric serial number, 12 characters max, non-used characters presented as spaces. e.g. N3TC00012 | | |

2.10 Failures and warnings SC

2.10.1 Device failures

Device failures are checked and identified by bit content (0 or 1) in specific input register (IR1000). The definition of each bit is explained in table 2.10.1.

Table 2.10.1: Bit assignment for SA11-C1 device failures

| Bit# | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------------|---------------------------|---------------------|------------------------|-------------------------|-------------------------|----------------------|-------------------|----------|---------------------------|--------------------------|---|---|---|---|---|--|
| Bit definition | Non-Volatile Memory error | User data CRC error | Factory data CRC error | SA11 device not working | Critical sensor failure | ID-chip sync failure | Temp_raw too high | Temp_low | Input Resistance too high | Input Resistance too low | | | | | | SA11 internal temperature out of design spec |

2.10.2 Sensor failures/warnings

Sensor failures/warnings are identified by bit content (0 or 1) in specific input register (IR1001). The definition of each bit is explained in table 2.10.2.

Table 2.10.2: Bit assignment for SC sensor failures/warnings

| Bit# | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------------|------------------|-------------------------------|--------------------------|----|-----------------|----|---|---|---|---|---|---|---|---|---|---|
| Bit definition | Sensor detection | Temperature element detection | Sensor ID-chip detection | | Calibration due | | | | | | | | | | | |

2.10.3 Measurement warnings

Measurement warnings are identified by bit content (0 or 1) in specific input register (IR1002). The definition of each bit is explained in table 2.10.3.

Table 2.10.3: Bit assignment for SC measurement warnings

| Bit# | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------------|----------------------|---------------------|-----------------------|----------------------|------------------------------------|------------------------------------|--------------------|---------------------|---|------------------------|---------------|---------------|---------------------------|---|---|---|
| Bit definition | Temperature too high | Temperature too low | Conductivity too high | Conductivity too low | Temperature compensation 1 warning | Temperature compensation 2 warning | USP limit exceeded | USP margin exceeded | | Polarization detection | Matrix1 error | Matrix2 error | Concentration table error | | SA11 internal temperature out of operational spec | |

2.10.4 Device status

Device status is identified by bit content (0 or 1) in specific input register (IR1003). The definition of each bit is explained in table 2.10.4.

Table 2.10.4: Bit assignment for SA11-C1 device status

| Bit# | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------------|---------------|----|--------------|----|----------|----------|----------------------|--------------------------|-------------------|-------------|---|---|-----------------------------------|---|--------------------------------|---|
| Bit definition | Write counter | | Read counter | | Reserved | Reserved | Calculation disabled | SA11 in calibration mode | SA11 in HOLD mode | SA11 remove | | | Non-Volatile Memory write flag ID | | Non-Volatile Memory write flag | 0 |

3. Revision History

November 2019

1st Draft

February 2020

Final version, 1st Edition

February 2022

Change default value SC sterilization temperature HR: 1528