Modbus specifications for Digital Sensors

CIRCULATION

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CHANGE MANAGEMENT

REVISIONS	DATE	ACTION	CHANGE IDENTIFICATION
001	15/11/2007	Issue	
002	17/01/07		Calibration validation, addition on sensor detection
003	26/03/08		Addition concerning error messages and dialogues between masters and sensors
004	28/8/2008		Example of a Modbus frame
005	9/9/2008		Modification of the addressing
006	16/10/2008		Improvement of layout
007	14/11/08		Translation in English
008	9/12/2008		Addition new Modbus adresses
009	08/01/2009		Addition of pictures
010	30/01/2009		Addition of software pictures
011	08/10/2012		Addition of OPTOD calibration for gain adjustment only
016	25/06/2013		Small corrections on the frames, float format Sensors answer to the address 255
017	17/09/2013		Correction of the Modbus adress 0x00AA to 0x0002 page 12 Adding of the frame at the address 0x004C (page 23)
018	24/06/2013		Answer of the sensors to the address 255, calibration of the annular ORP sensor and Turbidity/Sludge blanket detection sensor.
019	06/09/2016		Addition of calibrations pH in several points

CONTENTS

1 Link protocol frame: MODBUS RTU

The link protocol must correspond to MODBUS RTU.
See document:

- Modbus_over_serial_line_V1_02.pdf
- Modbus_Application_Protocol_V1_1a.pdf
- Modbus memory for
- digital Sensors : SENSOR_TramesCom_xxx_UK.xls

The Modbus memory plane is identical for each parameter of the Sensors.
The Modbus protocol for the Sensors allows you to measure the parameter (+ temperature) of the Sensor and to calibrate the parameter (+ temperature). Furthermore, there are certain numbers of functions such as:

- Select the averaging value
- Read the Sensor description
- Return to default coefficients
- Modify the Sensor address
- Information on measures conducted (Out Of Specification measures, measures in progress, etc.).
- Date and name of the operator who performed the calibration
- etc.

1.1 Hardware configuration:

- Transmission medium: RS485 half duplex
- 9600 bauds
- 8 data bits
- Parity and stop bit : (modified by the Modbus address 0x00BC)
  - 2 stop bit and no parity (default factory settings)
  - 1 stop bit and even parity,
  - 1 stop bit and odd parity,

Be careful : If a digital sensor is not configured 2 stop bits, it can no longer communicate with one Calsens or one Odeon.

1.2 Addresses:

The sensors have an address with a value between 1 and 230
The Modbus protocol requires that the address 0 is not used as well as the addresses 248 to 255.

All sensors deal the information and answer when the master calls the address 255'.
Be careful : This feature should only be used with one single sensor connected to the network, otherwise there will be a conflict between the various sensors.

All the sensors process information when the master calls the 0 address.
IMPORTANT: The sensors never respond when the master sends a frame to the 0 address.

All the sensors handle the information and answer when master calls up to the address ' 255 '.
ATTENTION: this feature must be only used with 1 only sensor connected to the network, otherwise there will be a conflict between the various Sensors.

In the default parameters, each parameter of the sensors has a different address (which is allocated by the Modbus memory plane file).

1.3 Modbus functions used:

The sensors process 4 Modbus functions:

- 0x03: Reading of n consecutive output words (from 1 to 125 bytes).
- 0x06: Writing of 1 output word.
- 0x10: Writing of n output words; use this function when there are at least 2 consecutive registers.
- 0x11: Identification reading. The Sensor returns its description (Modbus address : 0x0D00).

Note: The Identification function is used to perform a scan on the Modbus network. This is because the Identification function uses the shortest communication form. As such the scanning time for all the addresses is optimized.

Note : The "float" correspond to the ANSI / IEEE standard Std 754-1985 - precision (32 bits)
(MSB in mind, 'big- endian')

Remark: integrators have access to 10 bytes in read/write in Flash. (Send: of 0x02D2 has 0x02D6 included)

1.4 Equipment useful for integrating the digital Sensors :

- A RS485/USB converter with 1 sensor input
- A stabilized power supply 5V to12V DC.
- The Modbus memory report : SENSOR_TramesCom_0xx.xls
- The specification of Modbus : Modbus_Specifications_0xx_integrateur.pdf
- 1 Digital probe

SENSOR consumption in standby between 10 and 40 µA depending on the setting of the Sensor.
This can help ensure that the sensor is powered.

1.5 Modbus error messages:

- For the error codes, use:
  - When the sensor returns the error code “FF”. There is a communication problem.
  - When the sensor returns the error code “01”. The function code is not recognized by the Sensor.
  - When the sensor returns the error code “02”. The address is not valid.
  - When the sensor returns the error code “03”. The data format is incorrect.

2 Modbus communication sequence and frame:

15 : Configuration the measurement type.
60 : Compensate by one or more external parameters (if required, depending on the measurement configuration).
70 : Order for launching a given measurement.
80 : Read measurement(s) status(es) (measurement ready or in progress) and request for one or more measurements.
100 : Read of calibration statuses for the current calibration or calibration 1 to 10 or the temporary calibration for given parameters or coefficients.
110 : Write the averaging value for the measurements.
120 : Return to default parameters for given coefficients.
170 : Calculate a given calibration point.
180 : Special case of a calibration, offset of ORP, request for forced electronic zeroing of ORP.
190 : Special case of the calibration point, offset of ORP, request calculate the calibration coefficient and to remove forcing of electronic zeroing.
200 : particular case of calibration point: the offset of the redox enables to go out of the calibration point without changing anything and remove forcing of electronic ZERO
210 : Validate calibration coefficients.
230 : Fill out the list of “temporary coefficients to be used for the measurement”.
300 : Frame to inform the site name to calibrate
310 : Frame to call back a site or a history

2.1 Sequence and frame for measurement requests: 15, 60, 70, 80, 100

IMPORTANT: Never communicate with a Sensor between the start measurement order (com 70) and the read measurement request (com 80) to avoid disrupting measurement.

To request a measurement the master must perform, at the most, the following communication sequence: 15, 60, 70, 80, 100.

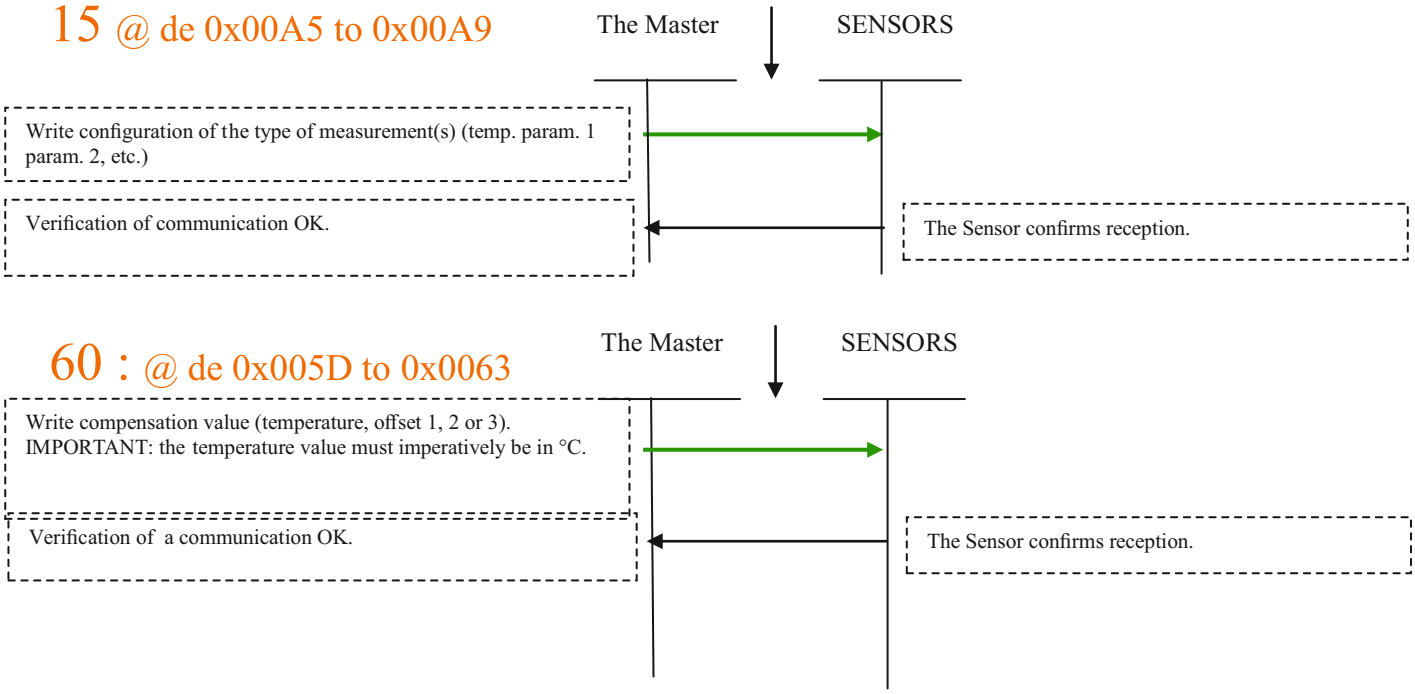
The master returns com 60 only if the measurement must be compensated by an external parameter for the Sensor.

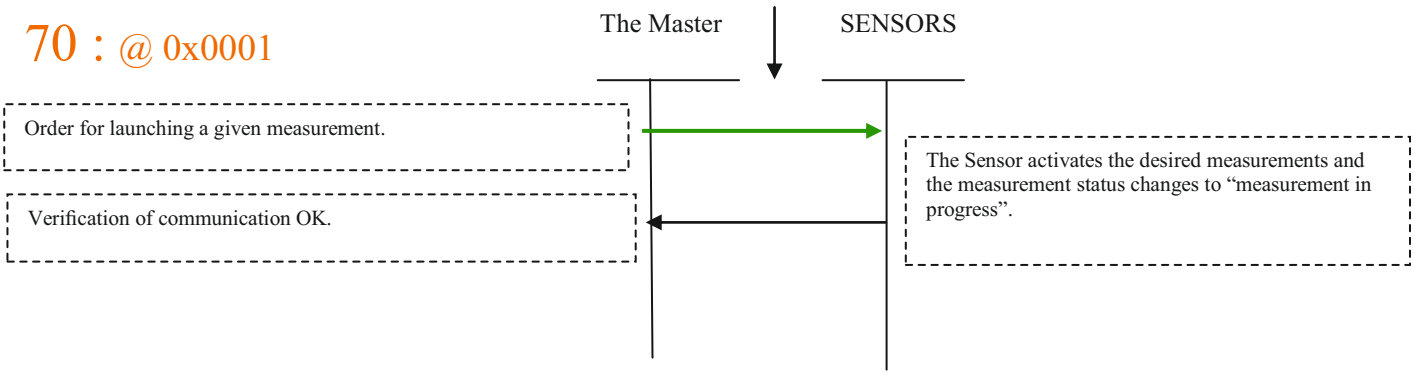
The master returns com 15 only if the configuration of the measurement must be modified, otherwise the Sensor retains the old set-up.

The master must await a minimum period to get measurements (value entered by the Sensor 0x00A4 address). He then proceeds to step 80.

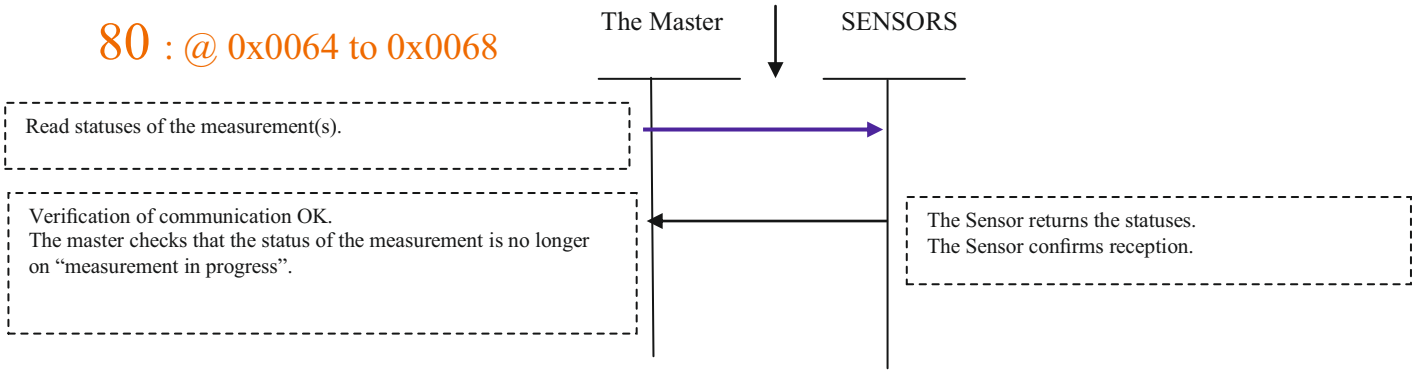
In order for not disturbing the measurements, it is recommended not to transmit order to the sensors between order to make a measurement and the advertised expired time.

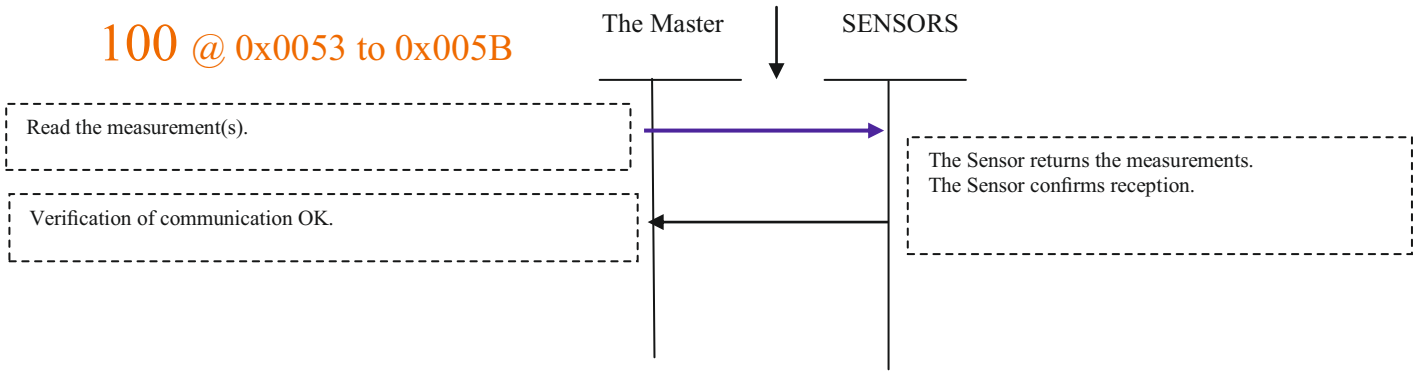
Before recovering the measure, it is recommended to ask if the measure is ready or not (in Status of the measurement 80).





The master waits for the minimum time set for obtaining the measurements (value entered by the Sensor, see Modbus memory plane). It then passes to step 80.



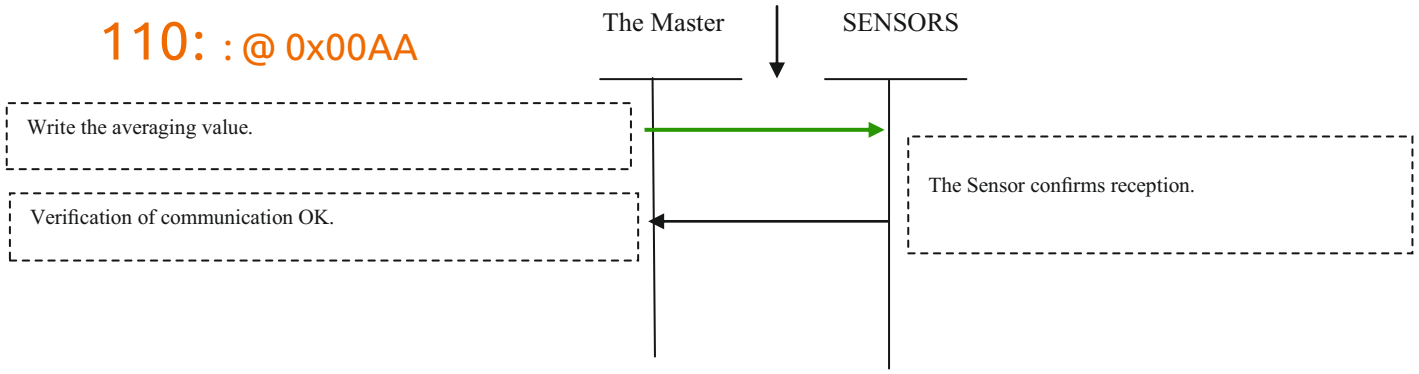


Note: The master must not switch off the SENSORS after having given the order to start a measurement.

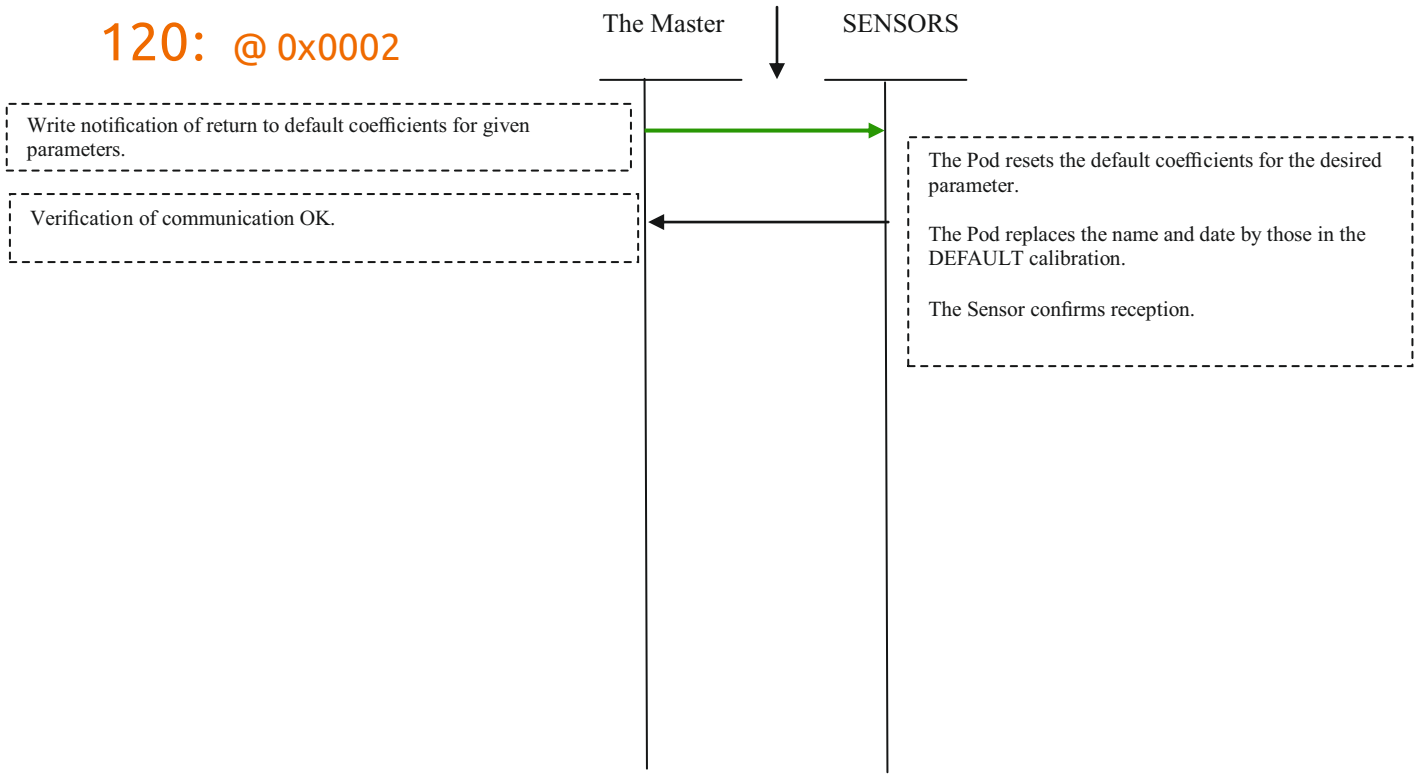
2.2 Frame for configuring measurement averaging: 110

The temperature is NEVER averaged. The averaging value is incorporated for parameters 1, 2, 3 and 4.

Information:
When the master returns an order to write the averaging value, the Sensor reinitializes the averaging.
However, when the power supply is cut, the Sensor saves the values to calculate the averaging.



2.3 Frame for returning to the default coefficient:120



2.4 Calibration request:

General:

For full calibration or calibration of a single coefficient, the coefficient(s) to be modified are only processed by the Sensor when the master sends the name of the operator and the date in the Temporary calibration.

Advice: when the master wants to conduct a calibration, force averaging '1' via com 110.

2.4.1 Example sequence for temperature calibration:

Temperature calibration:
1st step: Calculate offset
Sensor fully immersed in an ice/water bath.
230 with the value set to '0'

Calibration standard value: 0.00 °C
Measurement: 0.12 °C
60, 70, 80, 100 looped, to refresh the measurement.

When the operator validates this step: 170 and 230 (when putting to '1' the coefficient corresponding to the temperature offset)

0.00°C: this corresponds to information supplied by the operator.
0.12°C: this corresponds to information returned by the Sensor.

If the operator wishes to exit the calibration without considering anything (no matter which of the 3 steps) : 230 with the value of '0'.

Temperature calibration:
2nd step: Calculate gradient
Sensor fully immersed in a bath heated at 25°C for example.

230, setting the coefficient for the temperature offset to '1'.

Calibration standard value: 25.00°C
Measurement: 22.48°C
60, 70, 80, 100 in a continuous loop, to refresh the measurement.

When the operator validates this step: 170 and 230 when putting to '1' the coefficient corresponding to the oxygen offset and to the temperature slope).

Temperature calibration:
Validation of entire calibration

Operator's name: J. Doe
Date: 01/10/08

Validation by the operator: 210, 230 with the value set to '0'.
Or Cancellation of the entire calibration by the operator:
230 with the value set to '0'.

2.4.2 Example sequence for OPTOD calibration : calibration in 2 points

OPTOD calibration:
1st step: Calculate offset
Place the sensor in an aqueous solution of 2% sodium sulfite at ambient temperature.
230 with the value set to '0'

Calibration standard value: 0.00%
Measurement: 0.12%
60, 70, 80, 100 in a continuous loop, to refresh the measurement.

When the operator validates this step: 170 and 230 when putting to '1' the coefficient corresponding to the oxygen ~~offset gend'oxygène~~

0.00: this corresponds to information supplied by the operator.
0.12: this corresponds to information returned by the Sensor.

Note: The master does not return the calibration standard value, so the value is necessarily set at 0.00%.

If the operator wishes to exit the calibration without considering anything (no matter which of the 3 steps) : 230 with the value of '0'.

OPTOD calibration:
2nd step: Calculate gradient
Place the sensor in 100% saturated air.

230, setting the coefficient for the DO offset to '1'.

Calibration standard value: 100.00%
Measurement: 102.48%
60, 70, 80, 100 looped, to refresh the measurement.

When the operator validates this step: 170 and 230
(when putting to '1' the coefficient corresponding to the oxygen offset and to the oxygen slope)

Note: The master does not return the calibration standard value, so the value is necessarily set at 100.00%.

OPTOD calibration:
Validation of entire calibration

Operator's name: J. Doe
Date: 01/10/08

Validation by the operator: 210, 230 with the value set to '0'.
Or Cancellation of the entire calibration by the operator:
230 with the value set to '0'.

2.4.3 Example sequence for OPTOD calibration : just the gain adjustme nt:

OPTOD CALIBRATION :
1st step : Calculate gradiant
Place the sensor in 100% saturated air.
230 with the value set to '0'

Calibation standard value : 100.00%
Measurement : 102.48%
60, 70, 80, 100 in a continuous loop, to refresh the measurement.

When the operator validates this step: 170 and 230 (with the value set to 'the corresponding coeff in the gain of the oxygen)

OPTOD calibration:
Validation of the calibration

Operator's name : J. Dupont
Date : 01/10/08

Validation by the operator: 210, 230 with the value set to '0'.

102.48 : Corresponds to an information sent back by the sensor.

If the operator wishes to go out of the calibration, without taking into account anything 230 with the value set to '0'.

Note : The standard is necessarily in ' 100 % ', the value is not modifiable.

2.4.4 Example sequence for turbidity calibration:

Choose the range to be calibrated from the 4 available ranges, designated CgGamme.

Turbidity calibration:
1st step: Calculate offset
Place the sensor in demineralized water.
230 with the value set to '0'

Calibration standard value: 0.00 NTU
Measurement: 0.12 NTU
60, 70, 80, 100 looped, to refresh the measurement.

When the operator validates this step: 170 with the calibration standard value for the range chosen for the measurement.
And 230 when putting to '1' the coefficient corresponding to the turbidity offset in the correct range.

0.00: This corresponds to information supplied by the operator.
0.12: This corresponds to information returned by the Sensor.

If the operator wishes to exit the calibration without considering anything (no matter which of the 3 steps) : 230 with the value of '0'.

Turbidity calibration:
2nd step: Calculate gradient
Place the sensor in a formazine calibration solution.

230, setting the coefficient for the turbidity offset to '1' in the appropriate range.

Calibration standard value: 100.00 NTU
Measurement: 102.48 NTU
60, 70, 80, 100 looped, to refresh the measurement.

When the operator validates this step: 170 with the calibration standard value for the range chosen for the measurement.
Et 230 (when putting to '1' the coefficient corresponding to offset and to the turbidity slope.

Turbidity calibration:
Validation of entire calibration

Operator's name: J. Doe
Date: 01/10/08

Validation by the operator: 210, 230 with the value set to '0'.
Or Cancellation of the entire calibration by the operator:
230 with the value set to '0'.

For this step, 1 range is calibrated.
Carry out this operation for each range to be calibrated (a maximum of 4 times).
For the gradient, use a calibration standard suited to the range chosen for the measurement.

2.4.5 Example sequence for conductivity calibration C4E-CTZN:

Choose the range to be calibrated from the 4 available ranges, designated CgGamme.

Conductivity calibration:
1st step: Calculate offset
Place the sensor in the open air.
230 with the value set to '0'

Calibration standard value: 0.00 µS/cm
Measurement: 0.12 µS/cm
60, 70, 80, 100 in a continuous loop, to refresh the measurement.

When the operator validates this step: 170 with the calibration standard value for the range chosen for the measurement. Et 230 when putting to '1' the coefficient corresponding to the offset in the correct range.

0.00: this corresponds to information supplied by the operator.
0.12: this corresponds to information returned by the Sensor.

If the operator wishes to exit the calibration without considering anything (no matter which of the 3 steps) : 230 with the value to '0'.

Conductivity calibration:
2nd step: Calculate gradient
Place the sensor in a calibration solution.

230, setting the coefficient for the conductivity offset to '1' in the appropriate range.

Calibration standard value: 84.00 µS/cm
Measurement: 86.48 µS/cm
60, 70, 80, 100 in a continuous loop, to refresh the measurement.

When the operator validates this step: 170 with the calibration standard value for the range chosen for the measurement. Et 230 (when putting to '1' the coefficient corresponding to the offset in the correct range)

Conductivity calibration:
Validation of entire calibration

Operator's name: J. Doe
Date: 01/10/08

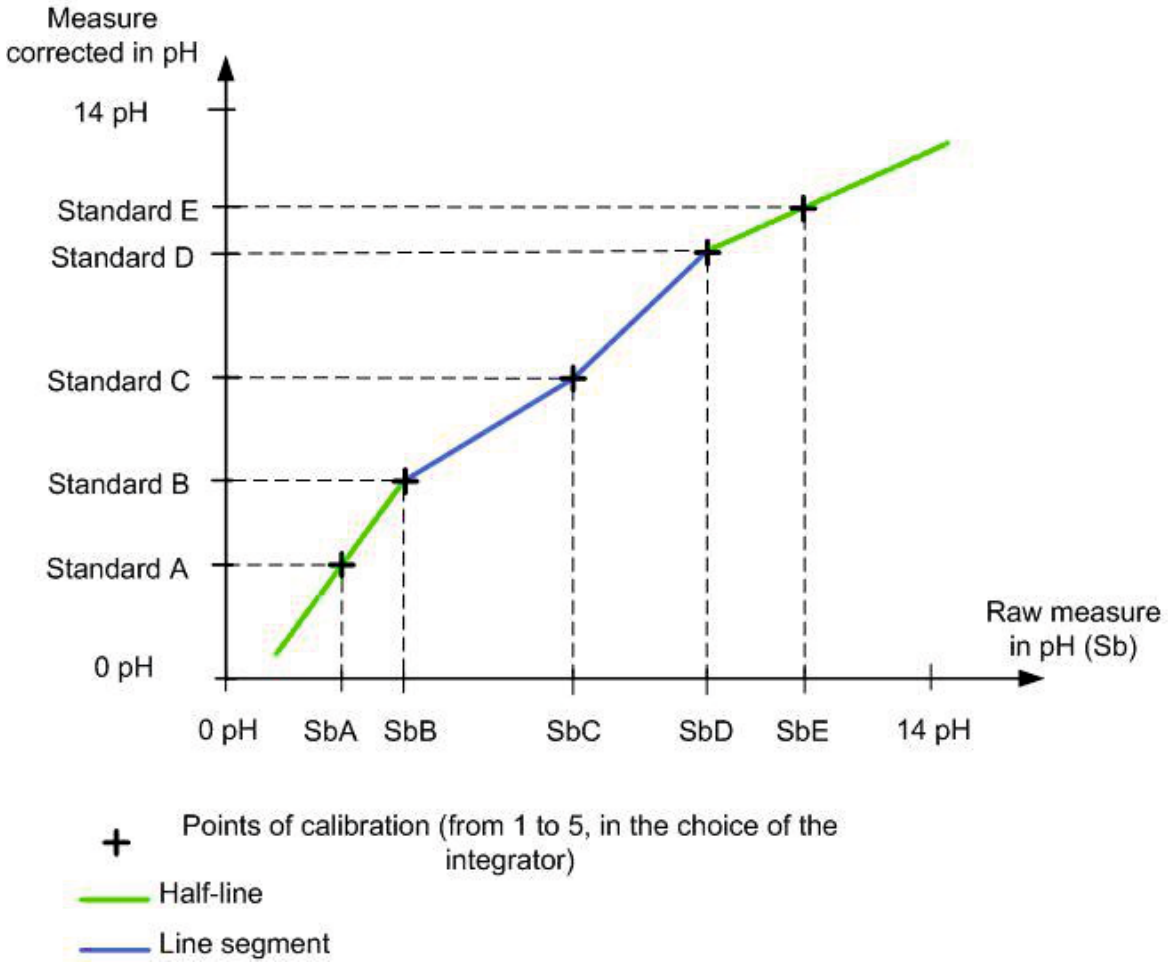
Validation by the operator: 210, 230 with the value set to '0'.
Or Cancellation of the entire calibration by the operator:
230 with the value set to '0'.

For this step, 1 range is calibrated.
Carry out this operation for each range to be calibrated (a maximum of 4 times).
For the gradient, use a calibration standard suited to the range chosen for the measurement.

Note: The salt content and TDS are not calibrated. Instead, these parameters are deducted from the conductivity measurement.

2.4.6 Example sequence for pH calibration:

This calibration is particular, we can calibrate this parameter on 1, 2, 3, 4 or 5 points of calibration.
The algorithm of calibration detects the order of the points of calibration and uses the principle of right segment between every point of calibration.



Remark: in the Modbus memory plan, we number the standards " standard 1 ", " standard 2 ", " standard 5 ", " standard 6 ", " standard 7 ". The digital sensor gets back all the data (standards and raw measure) and place automatically the data in the increasing order by obtaining " standard A ", " standard B ", " standard C ", " standard D " and " standard E ".

This allows the integrator to inform any value of standard (of 0 in 14pH) in import 5 compartments memory of the standards.

pH calibration:

1st step: Calculate offset

Place the sensor in a calibration standard with a pH of 7.

230 with the value set to '0'

Calibration standard value: 7.00 pH
Measurement: 7.12 pH

60, 70, 80, 100 looped, to refresh the measurement.

When the operator validates this step: 170. et 230 (when putting to '1' the coefficient corresponding to the offset)

pH calibration:

2nd step: Calculate gradient

Place the sensor in a calibration standard with a pH of 4 (for example).

230, setting the coefficient for the pH offset to '1'.

Calibration standard value: 4.00 pH
Measurement: 4.48 pH

60, 70, 80, 100 looped, to refresh the measurement.

When the operator validates this step: 170 et 230 (when putting to '1' the coefficient corresponding to the offset and to the slope)

pH calibration:

3rd step: Calculate gradient

Place the sensor in a calibration standard with a pH of 2 (for example).

230, setting the coefficient for the pH offset to '1'.

Calibration standard value: 2.00 pH
Measurement: 2.04 pH

60, 70, 80, 100 looped, to refresh the measurement.

When the operator validates this step: 170 et 230 (when putting to '1' the coefficient corresponding to the offset and to the slope)

pH calibration:

4th step: Calculate gradient

Place the sensor in a calibration standard with a pH of 6 (for example).

230, setting the coefficient for the pH offset to '1'.

Calibration standard value: 6.00 pH
Measurement: 6.08 pH

60, 70, 80, 100 looped, to refresh the measurement.

When the operator validates this step: 170 et 230 (when putting to '1' the coefficient corresponding to the offset and to the slope)

0.00: this corresponds to information supplied by the operator.

0.12: this corresponds to information returned by the Sensor.

If the operator wishes to exit the calibration without considering anything (no matter which of the 3 steps) : 230 with the value to '0'.

Note: The calibration standards pH4, pH9 and pH10 can be used.

pH calibration:

5th step: Calculate gradient

Place the sensor in a calibration standard with a pH of 6 (for example).

230, setting the coefficient for the pH offset to '1'.

Calibration standard value: 10.00 pH

Measurement: 9.91 pH

60, 70, 80, 100 looped, to refresh the measurement.

When the operator validates this step: 170 et 230 (when putting to '1' the coefficient corresponding to the offset and to the slope)

pH calibration:

Validation of entire calibration

Operator's name: J. Doe

Date: 01/10/08

Validation by the operator: 210, 230 with the value set to '0'.

Or Cancellation of the entire calibration by the operator:

230 with the value set to '0'.

2.4.7 Example sequence for ORP calibration (PHEHT and ORP sensor)

ORP calibration:
1st step: Calculate offset
AUTOMATIC ZEROING
230 with the value set to '0'
180 (activation of automatic zeroing).

Measurement: 2.12 mV
60, 70, 80, 100 in a continuous loop, to refresh the measurement.

When the operator validates this step: 190. et 230 (when putting to '1' the coefficient corresponding to the offset)
If the operator wishes to exit the calibration without considering anything : 200 (deactivation of the electronic Zero).

ORP calibration:
2nd step: Calculate gradient
Place the sensor in a 240 mV calibration standard (for example).
230, setting the coefficient for the Redox offset to '1'.

Calibration standard value: 240 mV
Measurement: 246 mV
60, 70, 80, 100 in a continuous loop, to refresh the measurement.

When the operator validates this step: 170 et 230 (when putting to '1' the coefficient corresponding to the offset and to the slope)

ORP calibration:
Validation of entire calibration

Operator's name: J. Doe
Date: 01/10/08

Validation by the operator : 210, 230 with the value set to '0'.
Or Cancellation of the entire calibration by the operator:
230 with the value set to '0'.

0.00: this corresponds to information supplied by the operator.
0.12: this corresponds to information returned by the Sensor.

The sensor can be placed in the open air since the Redox offset is conducted electronically.

If the operator wishes to exit the calibration without considering anything (no matter which of the 3 steps) : 230 with the value of '0'.

2.4.8 Chronology example for turbidity calibration in mg/l (or in g/L)(Calibration by dry weight) – Step1 - :

The sensor does not record the last 10 calibrations for this parameter but the sensor can save 10 different sites chosen by the operator.

Turbidity calibration in mg/l:
1st step : Calculating of the offset,
Put the sensor in demineralized water
230 with the value to '0'

Value of the measure : 0.00 mg/l
Maesurement : 0.12 mg/l
60, 70, 80, 100 in a continuous loop, to up-date the measurement.

When the operator confirms this step : 170 with the value of measure and 230 when putting to '1' the coeff icient corresponding to the offset of turbidity.

0.00 : This corresponds to an information given by the operator
0.12 : This corresponds to an information returned by the Sensor.

If the operator wishes to exit the calibration without considering anything (no matter which of the 3 steps) : 230 with the value of '0'.

Turbidity calibration in mg/l:
2nd Step : Recording of the value of the material
Put the sensor in the material.

Maesurement : 102.48 mg/l
60, 70, 80, 100 in a continuous loop, in order to up-date the measurement.

When the operator confirms this step : 15 (CgDif of param 3 to 0b01), 170 with any standard value.

The slope calibration coefficient is calculated in a delayed manner.
This step can only know the extent obtained by the sensor of the material. The real value of the material is obtained by Dry Weight and then returned to the sensor

Turbidity calibration in en mg/l :
Complete calibration validation

1- Site 1
2- Bassin°1
3-
4- Bassin°2
5-
6- Site 2
7-
8-
9- Bassin°5
10-

Operator's name : J. Dupont
Date : 01/10/08

Validation by the operator : 300, 210, 230 avec la valeur a '0'.

The operator must select the location of the site to be calibrated between 1 and 10.
The operator must appoint or reappoint the site.

Notes: the site names contains up to 8 characters

2.4.9 Chronology example for turbidity calibration in mg/l(or in g/L) (Calibration by dry weight) – Step2 - :

This step enables to achieve the parameter calibration in mg / l, the operator will enter the value of the Dry Weight to allow the Sensor to calculate the slope of the turbidity.

Turbidity calibration in mg/l:
3rd Step : Value of dry weight

230 with the value to '0'

1- Site 1
2- Bassin°1
3-
4-
5- Bassin°2
6-
7- Site 2
8-
9- Bassin°5

Value of dry weight : 1000 mg/l

When the operator confirms this step : 310 call back the site, 15 (CgDif of param 3 to 0b10), 170 with dry weight as measure of slope. 230 when putting to '1' the coefficient corresponding to the turbidity slope.

The operator must choose the site to get back.

If this site has an outstanding dry weight we can then confirm this step (information given by the calibration status of the slope coefficient). Otherwise you have to prevent the operator to validate the step.

If the operator wishes to exit the calibration without considering anything (no matter which of the 2 steps):
230 with the value to '0'.

Turbidity calibration in mg/l:
Validation of entire calibration

Operator's name : J. Dupont
Date : 01/10/08

Validation by the operator : 300, 210, 230 with the value to '0'.

2.4.10 Chronology example for turbidity calibration in FAU :

Calibration of the Turbidity in FAU :
1st step : Calculating of the offset,
Put the sensor in demineralized water.
230 with the value to '0'

Value of the standard : 0.00 FAU
Measure : 0.12 FAU
60, 70, 80, 100 in a continuous loop, to up-date the measurement.

When the operator confirms this step : 170 with the value of measure and 230 when putting to '1' the coeff icient corresponding to the offset of the FAU.

0.00 FAU : This corresponds to an information given by the operator
0.12 FAU : This corresponds to an information returned by the Sensor.

If the operator wishes to exit the calibration without considering anything (no matter which of the 3 steps) : 230 with the value of '0'.

Calibration of the Turbidityin FAU :
2nde step : Calculate gradient

Value of the standard : 2000 FAU
Measure : 2048 FAU
60, 70, 80, 100 in a continuous loop, to up-date the measurement.

When the operator validates this step: 170 et 230 (when putting to '1' the coefficient corresponding to the offset and to the slope)

We recommends to put the sensor in a solution in 2000 FAU (middle of the range).

Calibration of the Turbidity in FAU :
Validation of entire calibration

Operator's name : J. Dupont
Date : 01/10/08

Validation by the operator : 210, 230 with the value to '0'.

2.4.11 Exemple de chronologie pour l'étalonnage de l'offset du VB:

Etalonnage du Voile de boue

1er Etape : Calcul de l'offset

Mettre le capteur dans l'eau déminéralisé, soit 100%.

230 avec la valeur à '0'

Valeur de l'étalon : 100.00 %

Mesure : 102.48 %

60, 70, 80, 100 en boucle, pour rafraîchir la mesure.

Lorsque l'opérateur valide cette étape : 170 et 230 (en mettant à '1' le coeff correspondant à l'offset de VB)

Etalonnage du Voile de Boue

Validation de l 'étalonnage

Nom de l'opérateur : J. Dupont

Date : 01/10/08

Validation par l'opérateur : 210, 230 avec la valeur a '0'.

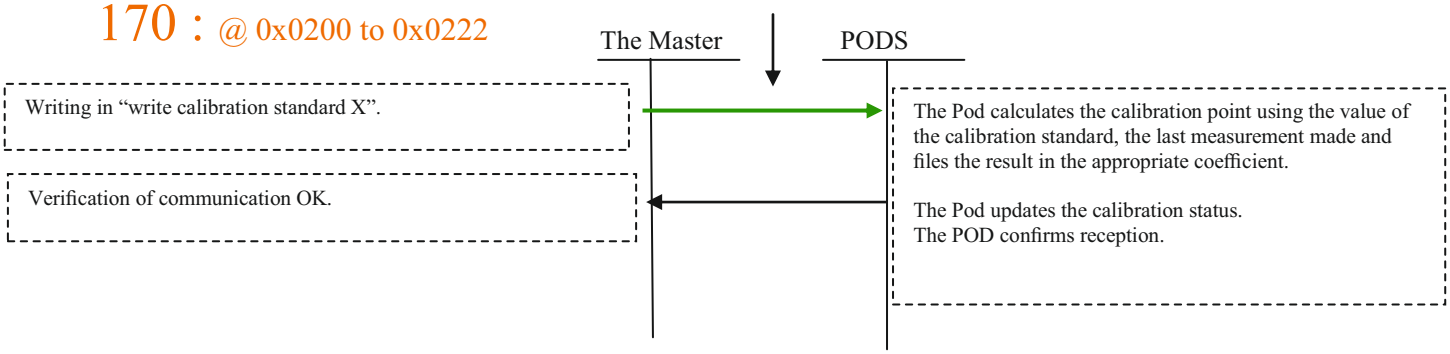
102.48 : This corresponds to an information returned by the Sensor.

If the operator wishes to exit the calibration without considering anything (no matter which of the 2 steps) : 230 with the value of '0'.

2.4.12 Frame for calculation of a given calibration point: 170, 180, 190

This communication is used by the master when it needs to validate a calibration point. The Sensor conducts calculation of the calibration coefficient. This calculation is performed when the master writes “calibration standard X” in the memory box for the value of the solution in which the Sensor is placed. For the calculation, the Sensor retrieves the last measurement point.

170 : @ 0x0200 to 0x0222



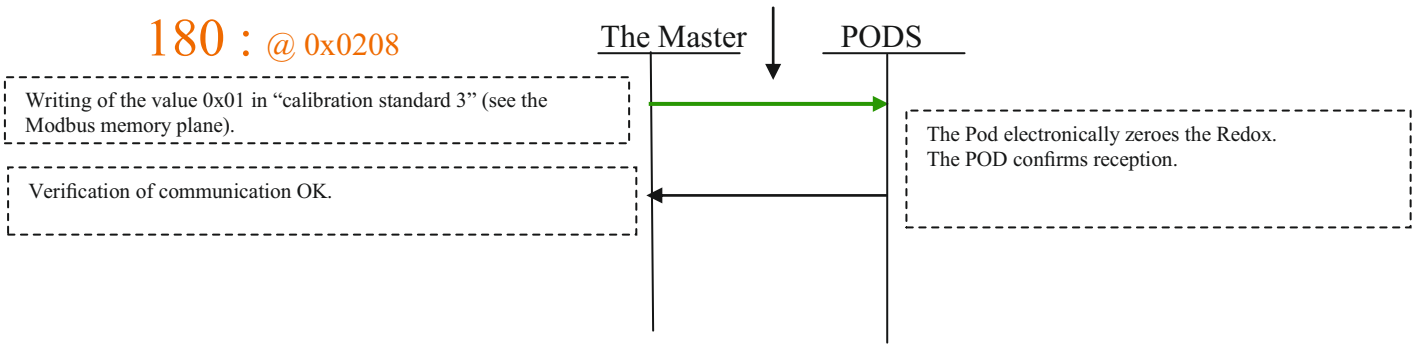
“Calibration standard X” depends on the calibration point performed by the operator (either calibration 1 of the temperature, calibration 2 for the temperature, or calibration 1, or calibration 2, etc. up to calibration 16).

The description of each calibration standard is designated in the Modbus memory plane.

Special case of the ORP offset:

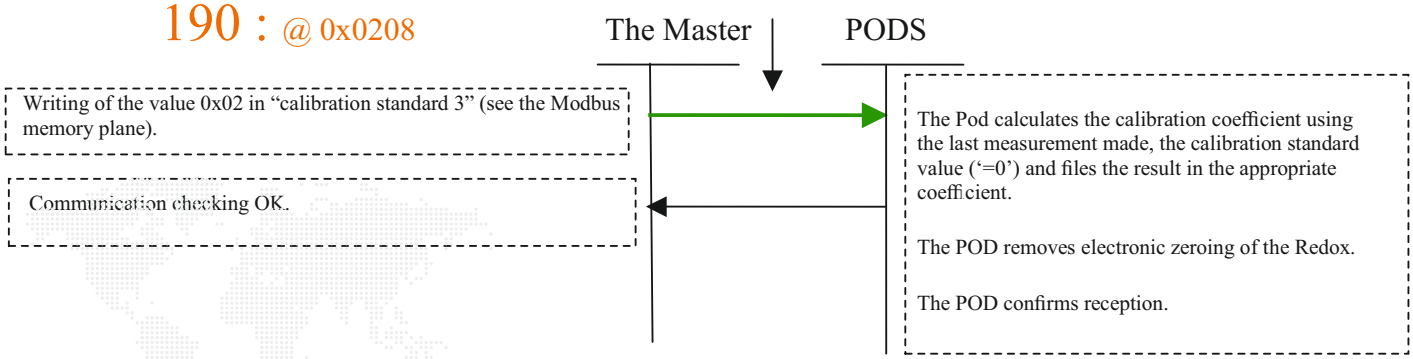
For the Redox offset “calibration standard 3”, the master must send com 180. The sensor can be placed in the open air since the offset is conducted electronically.

180 : @ 0x0208



Communication 190 is used by the master to validate the ORP offset, then the sensor starts calculation of the offset. For the calculation, the Sensor retrieves the last measurement point.

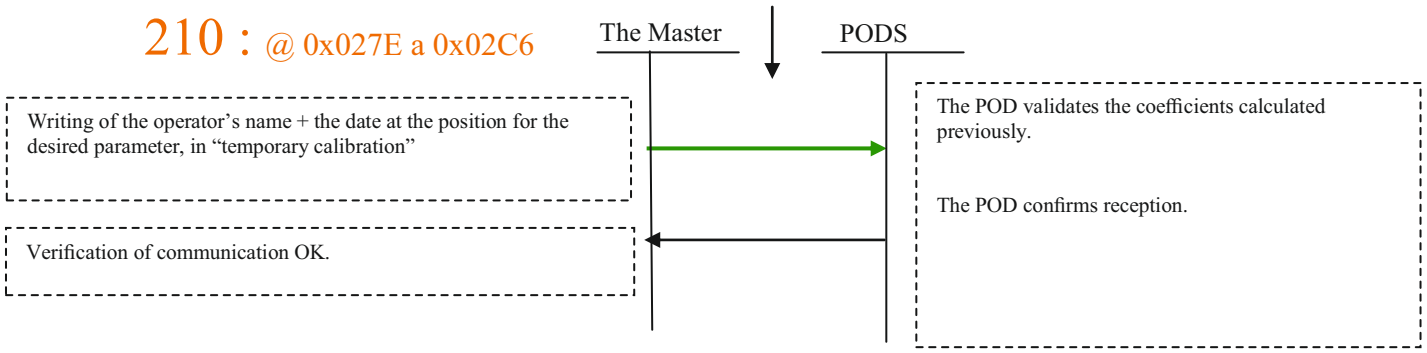
190 : @ 0x0208



2.4.13 Frame for validating a calibration 210

Calibration of one or more coefficients is validated by the Sensor when the master sends this communication signal (210).

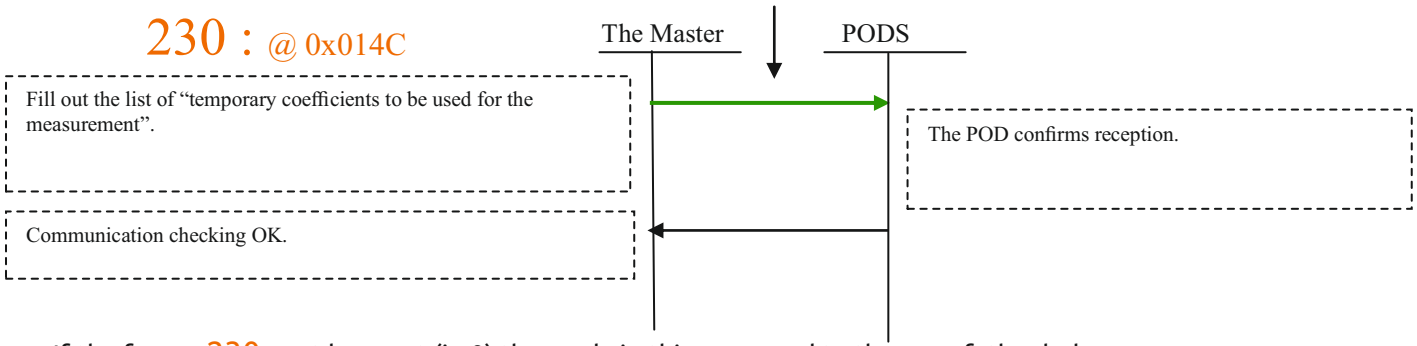
Important: If the master does not send this frame (and 230 is set to the value 0x0000), then the calibration will not be taken into account when the master requests a measurement.



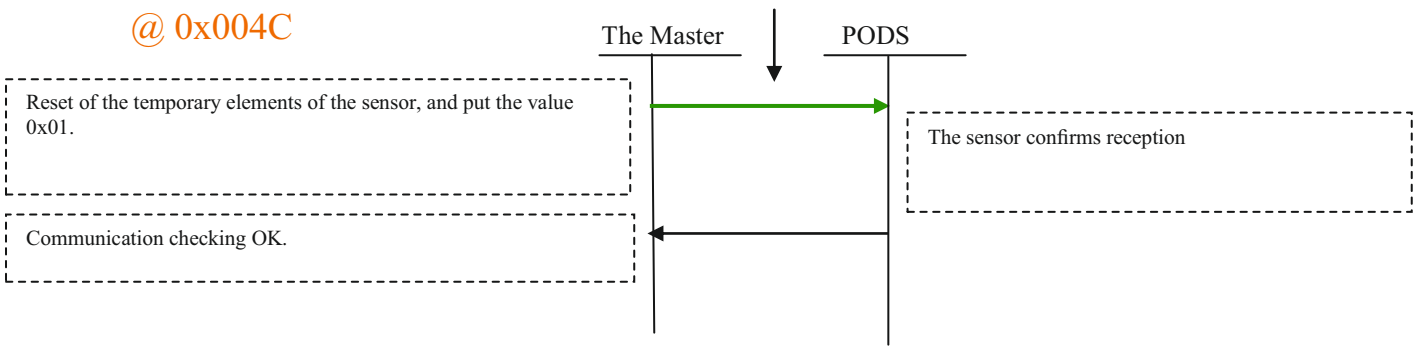
2.4.14 Frame for filling out the list of "temporary coefficients to be used for the measurement" 230

Activating a given coefficient in this list enables the SENSOR to return the measurement not with the correction coefficient from the current calibration, but the one from the temperature calibration coefficient.

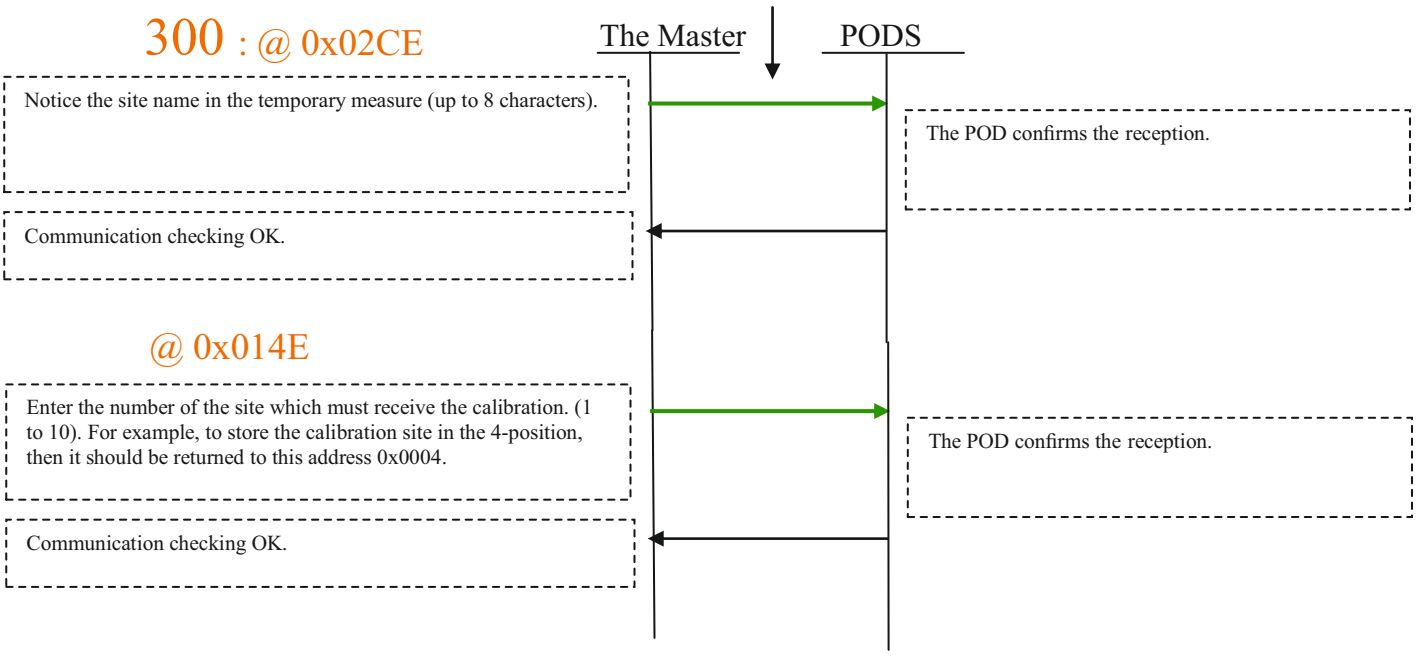
IMPORTANT : when the operator exits the calibration menu by cancelling the previous actions, each coefficient in the list is zeroed.



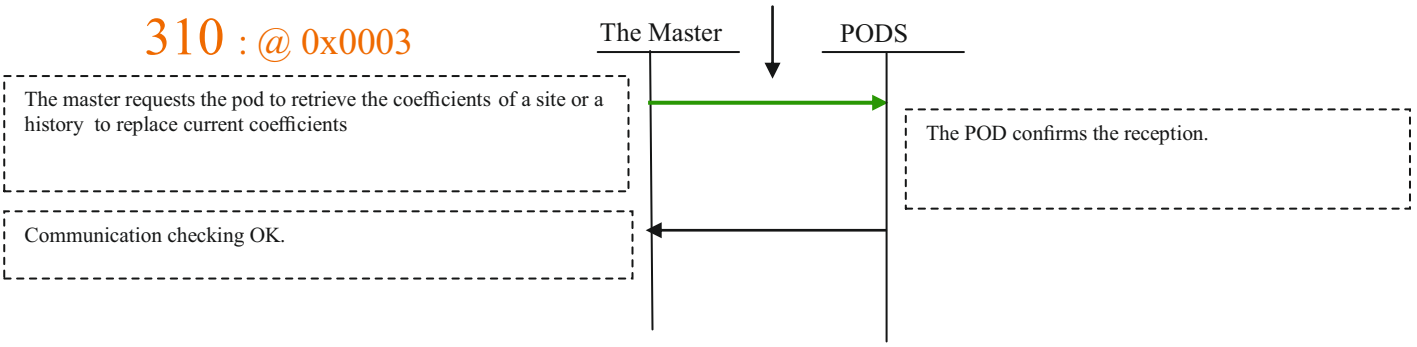
If the frame 230 must be reset (in 0) then only in this case send to the sensor the frame below



2.4.15 Frame to inform the site name to calibrate 300



2.4.16 Frame to call back a site or a history 310



3 Modbus communication frame example:

3.1 Apply the 11 address (0x0B) to all the SENSORS connected:

Emission frame:

SENSOR address	Function code	Register address (see Modbus memory plane)		Registry value		CRC 16	
0x00	0x06	0x00	0xA3	0x00	0x0B	0x39	0xFE

Reception frame: none (with the 0 address, no Sensor replies).

3.2 Start a measurement ordefor all parameters on alSENSOR S with the 11 address:

Emission frame:

SENSOR address	Function code	Register address (see Modbus memory plane)		Registry value		CRC	
0x0B	0x06	0x00	0x01	0x00	0x1F	0x99	0x68

Reception frame:

SENSOR address	Function code	Register address (see Modbus memory plane)		Registry value		CRC	
0x0B	0x06	0x00	0x01	0x00	0x1F	0x99	0x68

3.3 Read the status of the measurement from SENSOR S with the 11 address:

Emission frame:

SENSOR address	Function code	Register address (see Modbus memory plane)		Registry value		CRC	
0x0B	0x03	0x00	0x52	0x00	0x01	0x25	0x71

Reception frame:

SENSOR address	Function code	Nb octet	Registry value		CRC	
0x0B	0x03	0x02	0x49	0x20	0x16	0x0D

Registry value: StmT: 0 (measurement OK)
Stm1: 4 (measurement impossible, out of specifications)
Stm2: 4 (measurement impossible, out of specifications)
Stm3: 4 (measurement impossible, out of specifications)
Stm4: 4 (measurement impossible, out of specifications)

3.4 Read the temperature measurement for SENSOR S with the 11 address:

Emission frame:

SENSOR address	Function code	Register address (see Modbus memory plane)		Registry value		CRC	
0x0B	0x03	0x00	0x53	0x00	0x02	0x34	0XB0

Reception frame:

SENSOR address	Function code	Nb octet	Registry value (0x53)		Registry value (0x53)		CRC	
0x0B	0x03	0x04	0x41	0xCE	0XF2	0x88	0x60	0XF6

Registry value: 25.86842°C