USER GUIDE FOR PROCESS FLAT PH SENSOR WITH MODBUS OUTPUT MBRTU-PHFLAT

JUL-2021

This document is applied for the following products

1. Introduction

MBRTU-PHFLAT is a general purpose in-line (continuous measurement) pH sensor offering affordable, flat sensor application coverage for many water applications such as drinking water, industrial water, aquaculture, tank installations or related applications. The flat surface sensor is often referred to as "self-cleaning" when installed in a process stream since the water flow has a tendency to "shear off" biofouling and other debris from the sensor surface. Output is Modbus RTU for easily integrating with any PLC, controller, SCADA, BMS or IoT gateway.

- Robust pH electrode for continuous measurement;
- Self-cleaning flat electrode;
- Standard ModbusRTU output;
- Plug & Play.

Typical Applications: Drinking water, Waste water, Industrial water, Aquaculture,...



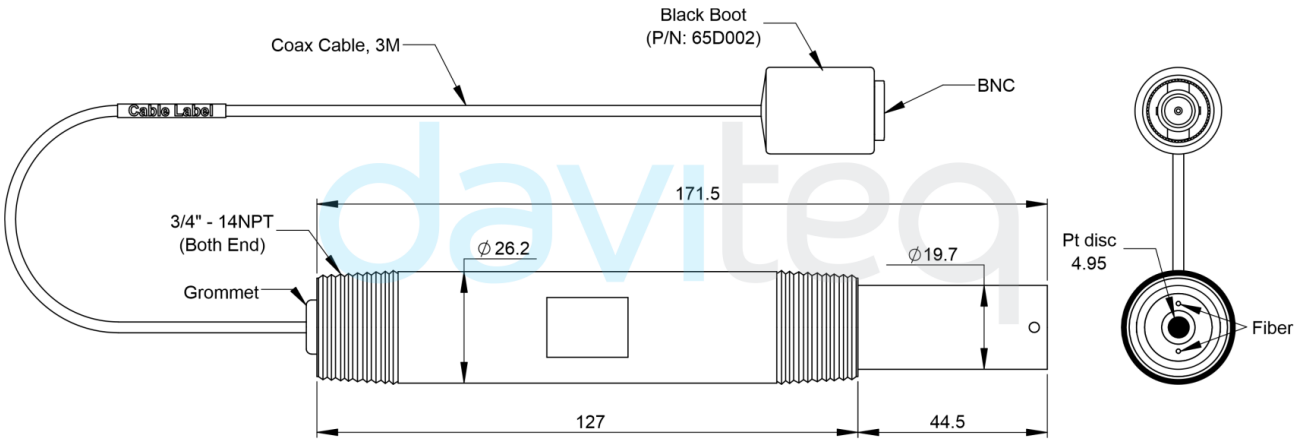
MBRTU-PHFLAT-H1.PNG

2. Specification

pH SENSOR SPECIFICATION	
Sensing Technology	Glass, combine electrode with Pt100 temperature sensor
Measuring range	pH 0 .. 14

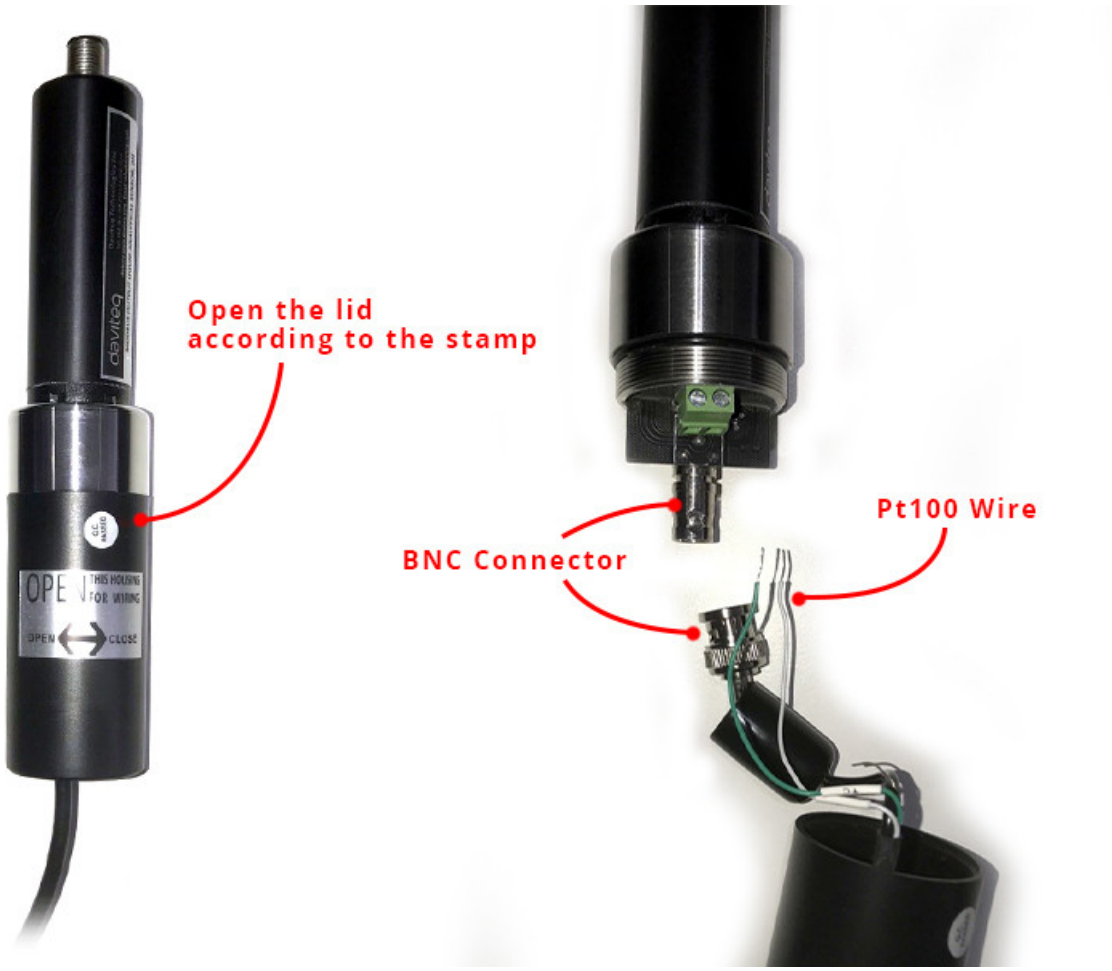
Resolution	pH 0.1
Accuracy	+/- 0.1
Working temperature	0 .. 100 oC (compensated)
Working pressure	0 .. 100 psig
Process connection	3/4" NPT both ends
Wetted parts	PVC
Sensor Cable	6m with BNC connector
Rating	IP68
Sensor Dimension	D27 x 172 (mm)
Sensor net weight	< 200 grams
pH TRANSMITTER SPECIFICATION	
Inputs	pH and Pt100
Output	RS485, ModbusRTU protocol, max 19200 baud
Power supply	9..36VDC, avg. < 200mA
Mounting	DIN Rail
Working temperature	-40 .. 85 oC
Working humidity	0 .. 95% RH, non-condensing
Housing	Engineered Plastic
Ingress Protection	IP20
Dimension	93 x 40 (mm)
Net weight	<200 grams

3. Dimensions



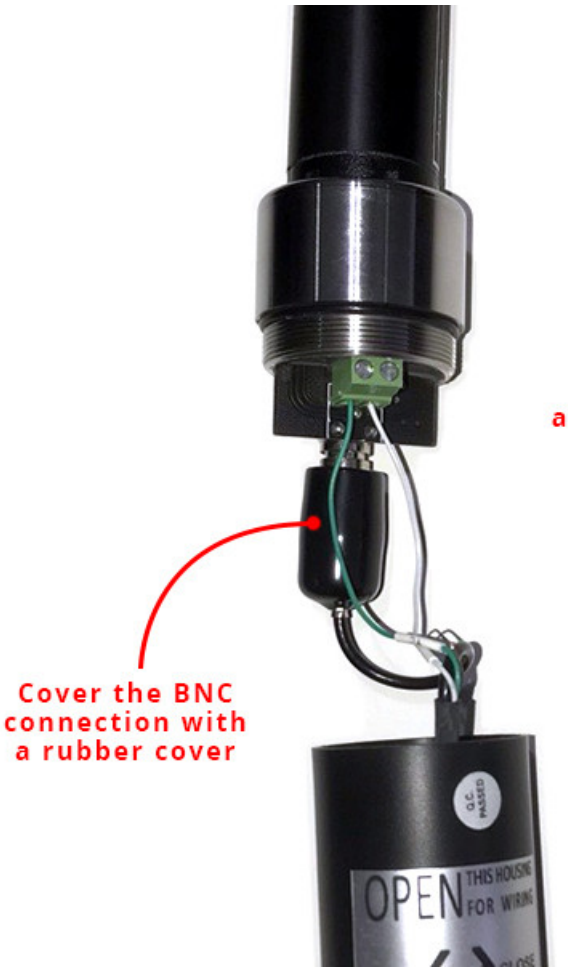
4. Wiring

Please wiring as shown below:




Connect Pt100 wire
to the domino
connector


Connect the BNC
connector


Cover the BNC
connection with
a rubber cover
OPEN
THIS HOUSING
FOR WIRING


Close the lid
according to the stamp
OPEN
CLOSE

5. Memmap registers

Function Code: 3 (Read); 16 (Write)

Modbus Register (Dec)	Modbus Register (Hex)	Function Code (Read)	Function Code (Write)	# of Registers	Description	Range	Default	Format	Property	Comment
2	2	3		4	Firmware version			string	Read	
6	6	3		2	Hardware version			string	Read	
9	9	3		2	pH (prm 1)			float	Read	
11	B	3		1	error & sensor type			uint16	Read	Hi-Byte is error code, Lo-Byte is sensor type
12	C	3		2	Temperature (prm 2)			float	Read	
14	E	3		2	pH_Adc			float	Read	
16	10	3		2	pH_mV			float	Read	
18	12	3		2	tempRes			float	Read	
256	100	3	16	1	Modbus address	1-247	1	uint16	Read/Write	Modbus address of device
257	101	3	16	1	Modbus baudrate	0-1	0	uint16	Read/Write	Baudrate: 0: 9600, 1: 19200
258	102	3	16	1	Modbus parity	0-2	0	uint16	Read/Write	Parity: 0: none, 1: odd, 2: even
280	118	3	16	2	a1		1	float	Read/Write	Scale value of parameter_1 = (a1 * Raw sensor value of parameter_1 + b1
282	11A	3	16	2	b1		0	float	Read/Write	Scale value of parameter_1 = (a1 * Raw sensor value of parameter_1 + b1
284	11C	3	16	2	a2		1	float	Read/Write	Scale value of parameter_2 = (a2 * Raw sensor value of parameter_2 + b2

286	11E	3	16	2	b2		0	float	Read/Write	Scale value of parameter_2 = (a2 * Raw sensor value of parameter_2 + b2
298	12A	3	16	1	calcTime (sec)		1	uint16	Read/Write	Set default **1 sec** for MBRTU
299	12B	3	16	1	calibEnb		0	uint16	Read/Write	Before calibration, must turn on **caribE = 1.** After calibration, set **calibEnb = 0**
300	12C	3	16	2	pHFeedback			float	Read/Write	**Step 1:** Calibrate with standard solution **pH = 7.01**, wait for about **3 minutes** for the reading to stabilize, write **7** down to pHFeedback **Step 2:** Calibrate with standard solution **pH = 4.01** or **10.01**, wait about **3 minutes** for reading to stabilize, write down **pHFeedbac** pH value of solution
302	12E	3	16	2	pHFactor			float	Read	
304	130	3	16	2	pH7_adc			float	Read	
306	132	3	16	2	pH7_mV			float	Read	
308	134	3	16	2	wire resistance		1.74	float	Read/Write	Compensate for conductor resistance
310	136	3	16	2	Manual_Tem			float	Read/Write	
312	138	3	16	1	Manual_Tem		0	uint16	Read/Write	When there is no temperature sensor, turn on **Manual_Te = 1**, then **Temperatu (prm 2) = Manual_Te**

Note 1: Before calibrating the sensor, set **calibEnb = 1**, after calibrating the sensor, set **calibEnb = 0**

Note 2:

- **Step 1:** Calibrate with standard solution **pH = 7.01**, wait about **3 minutes** for the reading from the sensor to stabilize, write **7** down to pHFeedback
- **Step 2:** Calibrate with standard solution **pH = 4.01** or **10.01**, wait about **3 minutes** for the reading to stabilize, write down the pHFeedback pH value of the solution.

Note 3: When there is no temperature sensor, set **Manual_Temp_Enb = 1**, then **Temperature (prm 2) = Manual_Temp_Input**

6. Required Equipment and Solutions

- pH meter (a temperature compensator is recommended for increased pHmeasurement accuracy)
- pH Buffer **4.01** or **10.01**
- pH Buffer **7.01**
- Reference filling solution (see list for particular pH electrode type)
- Wash bottle filled with distilled or de-ionized water
- Laboratory magnetic stirrer and magnetic stir bars
- Lab wipes
- Clean beakers

7. Preparation of the Electrode for Initial Use

1. Remove the protective bottle or cover from the electrode and thoroughly rinse the electrode with distilled water. Wipe carefully with a clean lab wipe.
2. During shipment, air bubbles may have migrated into the electrode sensing bulb. Hold the electrode up to the light and inspect the sensing bulb for air bubbles. If air is seen, carefully shake the electrode downward (like a thermometer) to dispel the air bubble from the sensing bulb at the tip of the electrode.
3. For refillable models, uncover the filling port to expose the electrode reference chamber fill hole (for sealed, gel filled electrodes, disregard this operation).
4. Fill the reference chamber with the appropriate pH reference filling solution. Electrodes that have been filled with the incorrect filling solution are not covered under warranty.

8. Reference Filling Solution Selection

- For pH combination electrodes with Calomel and Double Junction Ag/AgCI reference half cells, use 4 M KCI reference filling solution.
- For pH combination electrodes with Single Junction Ag/AgCI reference half cells, use 4 M KCI saturated with AgCI reference filling solution.

9. Calibration

Before use, the instrument should be calibrated with standard solutions;

The first is calibration with standard solution **pH = 7.01**. Buy standard solutions here:

- https://www.hannavietnam.com/detail-product/chuan-ph-701-500ml-19
- https://www.hannainstruments.co.uk/ph-7-01-buffer-solution.html

The next step is to calibrate with standard solution **pH = 4.01** or **10.01**. Buy standard solutions here:

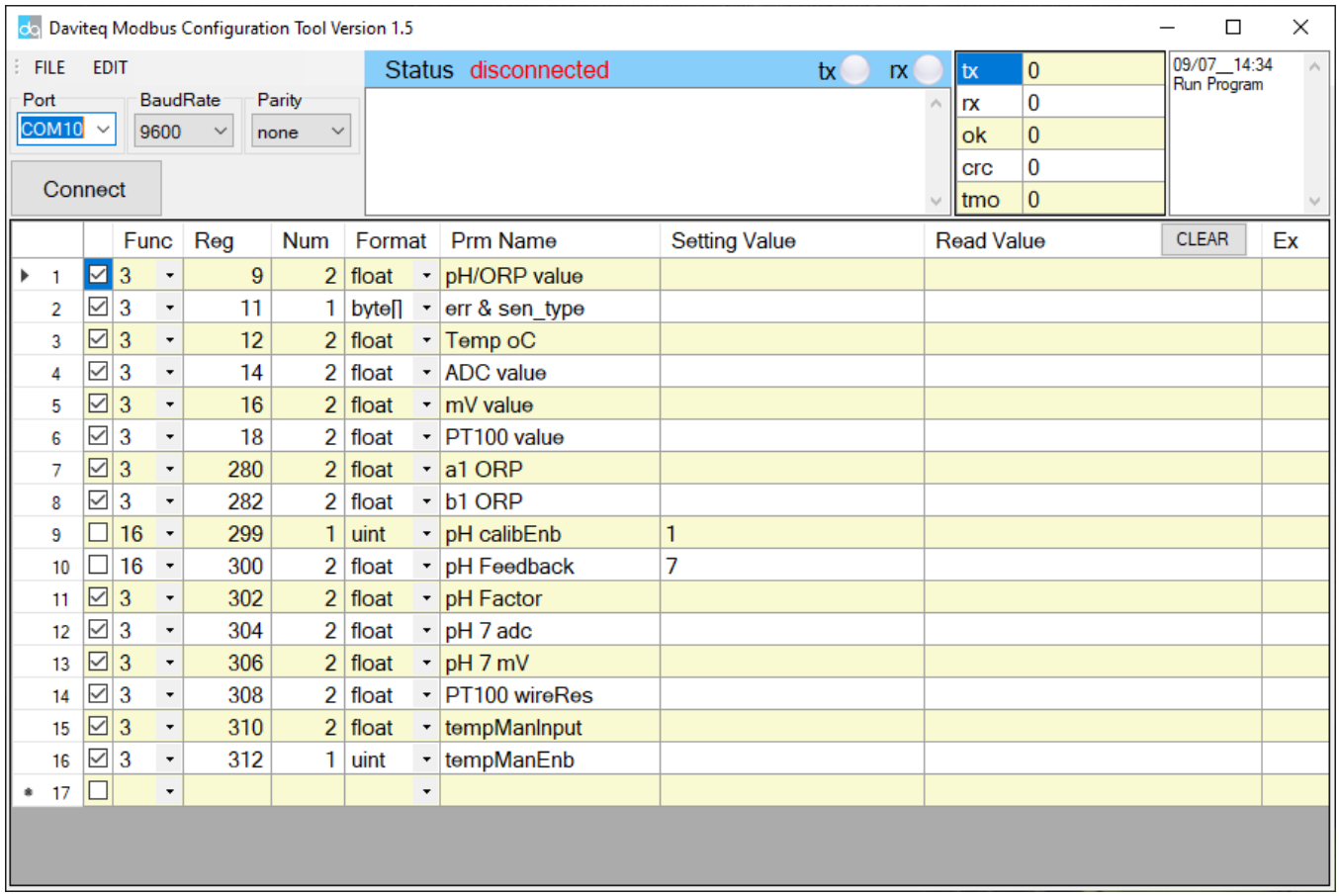
- https://www.hannavietnam.com/detail-product/chuan-ph-1001-500ml-20
- https://www.hannainstruments.co.uk/ph-10-01-buffer-solution.html

> **Note the ambient temperature at the time of calibration to input the standard pH value according to the temperature (indicated on the body of the standard bottle)**

Use any modbus master tool to calibrate the sensor. Or use Daviteq's Modbus software, along with a configuration cable...

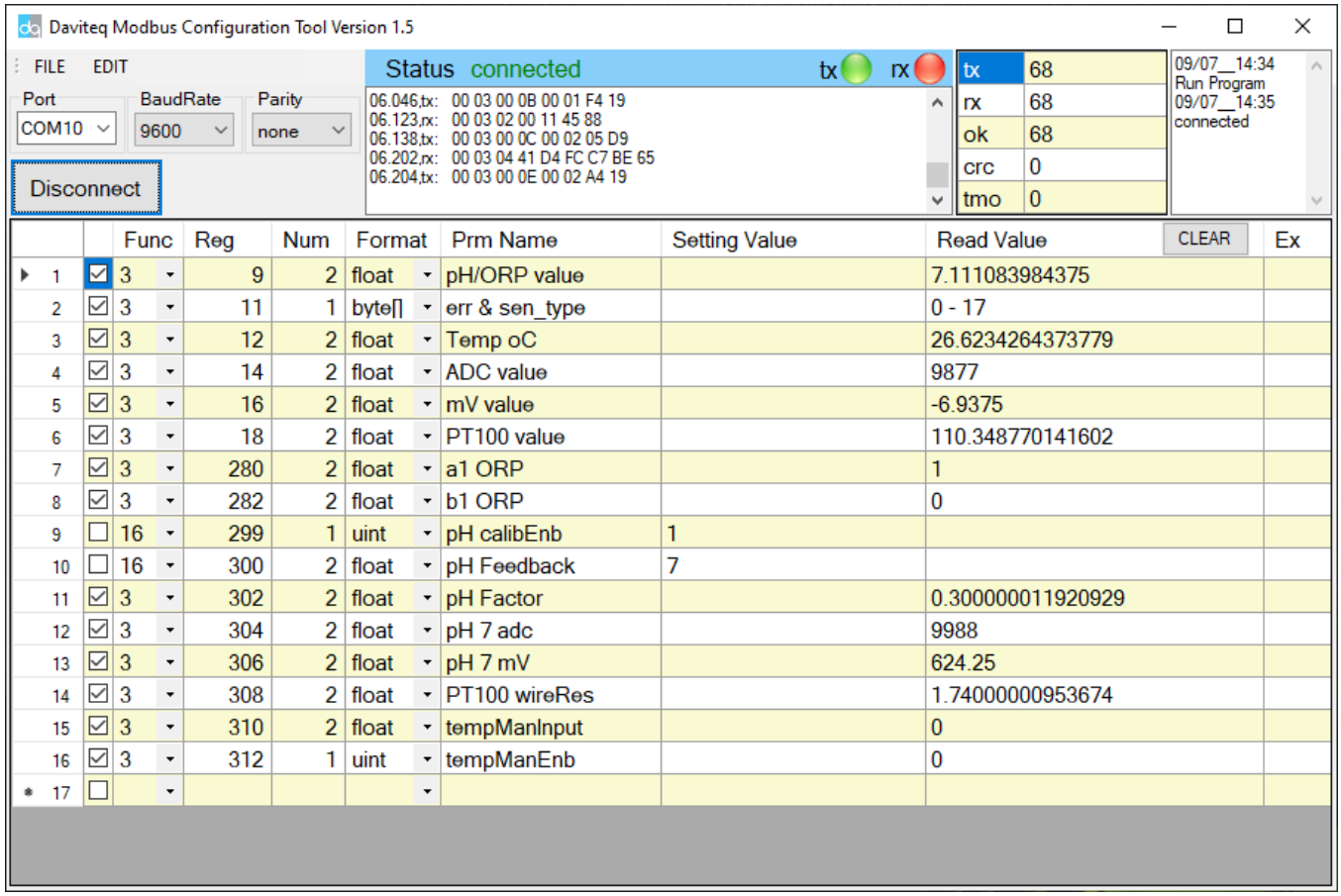
How to use Modbus Configuration Tool (Click Here)

Step 1: Import the Template file into Modbus Configuration Tool



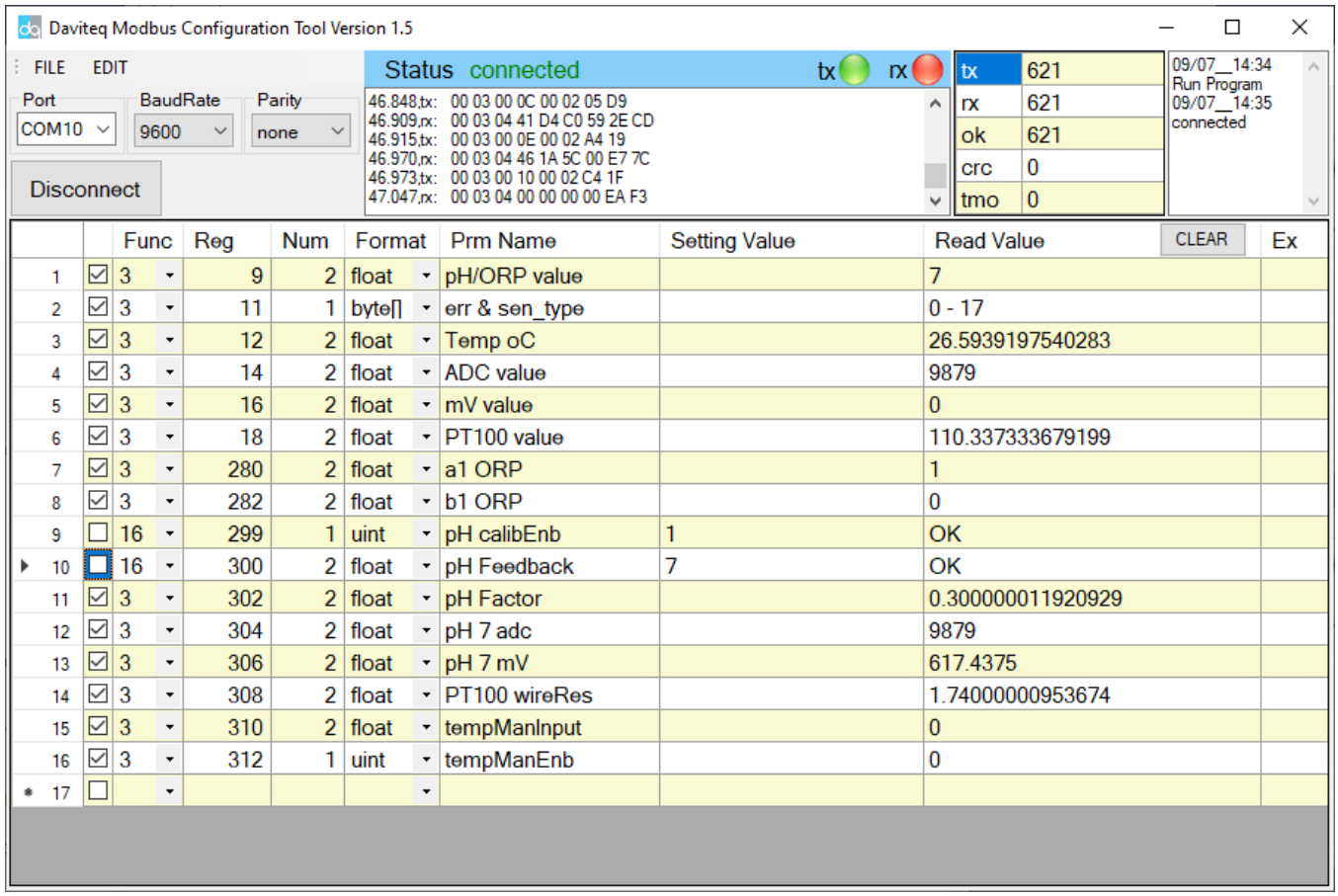
		Func	Reg	Num	Format	Prm Name	Setting Value	Read Value	Ex
1	☑	3	9	2	float	pH/ORP value			
2	☑	3	11	1	byte[]	err & sen_type			
3	☑	3	12	2	float	Temp oC			
4	☑	3	14	2	float	ADC value			
5	☑	3	16	2	float	mV value			
6	☑	3	18	2	float	PT100 value			
7	☑	3	280	2	float	a1 ORP			
8	☑	3	282	2	float	b1 ORP			
9	☐	16	299	1	uint	pH calibEnb	1		
10	☐	16	300	2	float	pH Feedback	7		
11	☑	3	302	2	float	pH Factor			
12	☑	3	304	2	float	pH 7 adc			
13	☑	3	306	2	float	pH 7 mV			
14	☑	3	308	2	float	PT100 wireRes			
15	☑	3	310	2	float	tempManInput			
16	☑	3	312	1	uint	tempManEnb			
17	☐								

Step 2: Place pH sensor tointo a beaker containing pH=7.01 buffer but not calibrated yet

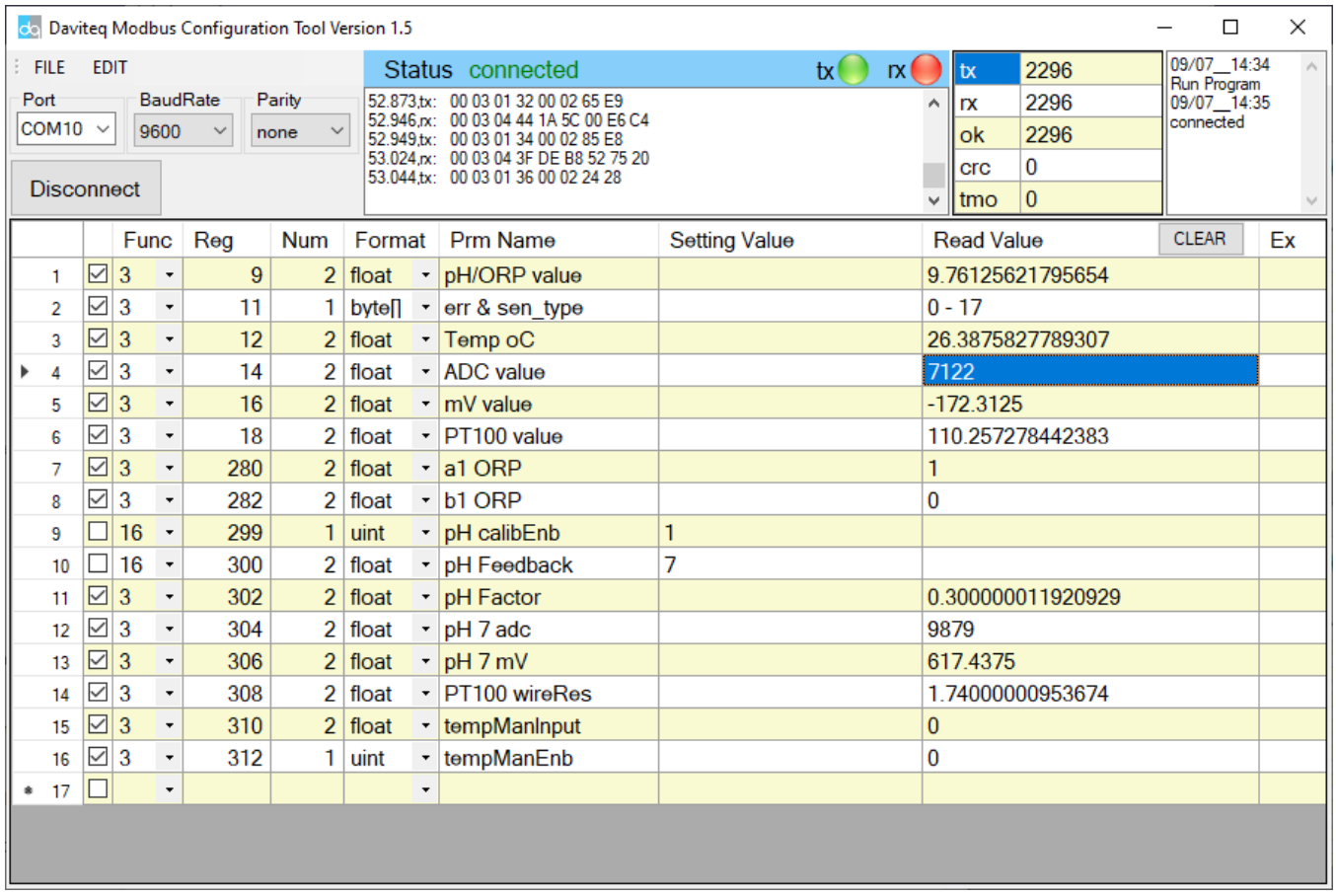


		Func	Reg	Num	Format	Prm Name	Setting Value	Read Value	Ex
1	☑	3	9	2	float	pH/ORP value		7.111083984375	
2	☑	3	11	1	byte[]	err & sen_type		0 - 17	
3	☑	3	12	2	float	Temp oC		26.6234264373779	
4	☑	3	14	2	float	ADC value		9877	
5	☑	3	16	2	float	mV value		-6.9375	
6	☑	3	18	2	float	PT100 value		110.348770141602	
7	☑	3	280	2	float	a1 ORP		1	
8	☑	3	282	2	float	b1 ORP		0	
9	☐	16	299	1	uint	pH calibEnb	1		
10	☐	16	300	2	float	pH Feedback	7		
11	☑	3	302	2	float	pH Factor		0.300000011920929	
12	☑	3	304	2	float	pH 7 adc		9988	
13	☑	3	306	2	float	pH 7 mV		624.25	
14	☑	3	308	2	float	PT100 wireRes		1.74000000953674	
15	☑	3	310	2	float	tempManInput		0	
16	☑	3	312	1	uint	tempManEnb		0	
17	☐								

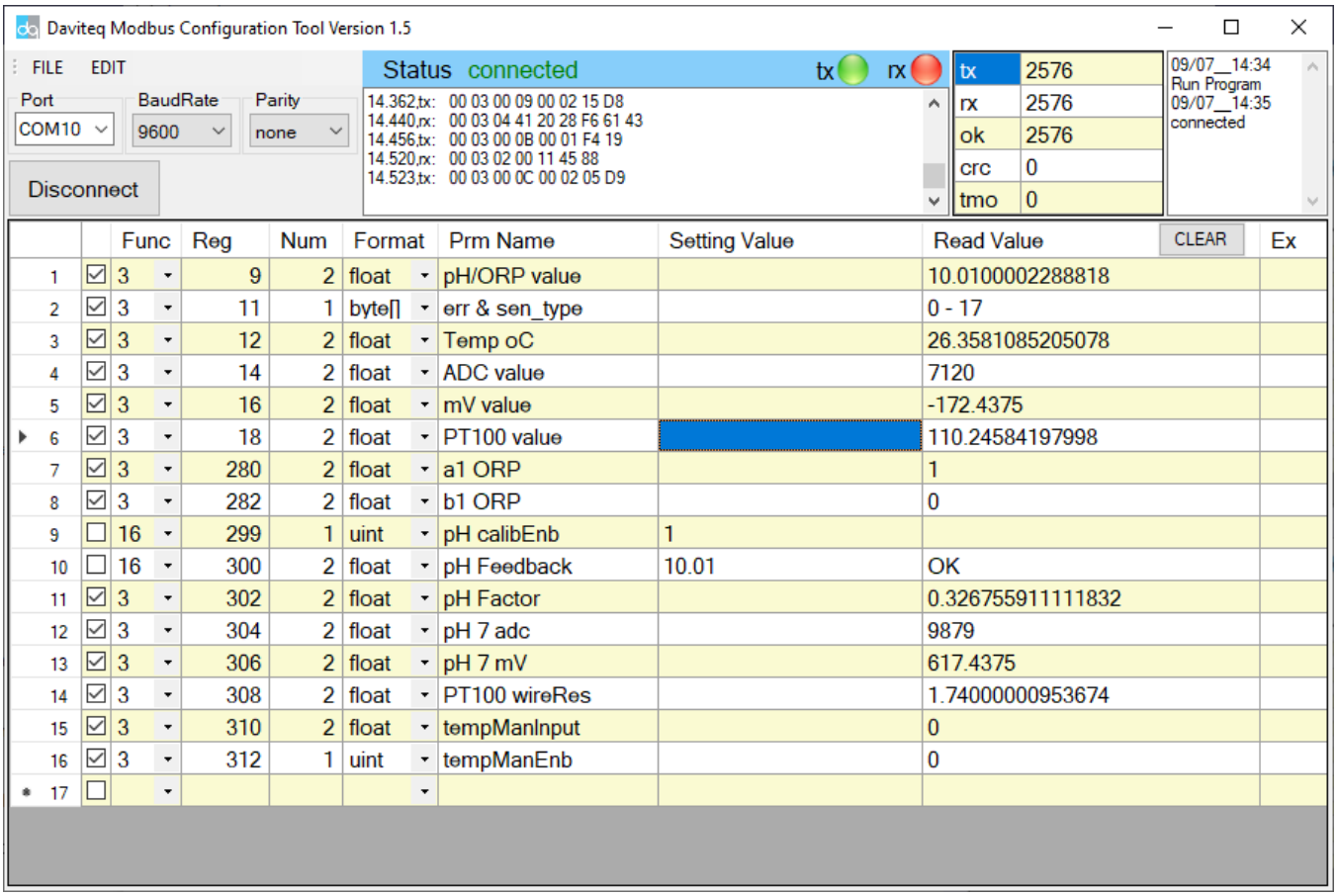
Step 3: Wait about **3 minutes** for the reading from the sensor to stabilize, write**7** down into pHFeedback **Register 300** and value=1 for phcalibEnb **Reg 299** by using Func 16



Step 4: Remove the electrode from the buffer. Rinse with distilled water and blot with a lab wipe then put it to **pH=10.01** standard



Step 5: Wait about **3 minutes** for the reading to stabilize, write down the pHFeedback with**10** into **Reg 300**



Step 6: Write down the pHcalibEnb with **0** into **Reg 299** to stop the calibration. Then rinse the electrode with distilled water and wipe carefully with a clean lab wipe.

10. Reading a Sample with the Electrode

1. Rinse the electrode with distilled water and blot with a lab wipe. Place the electrode in a beaker containing the sample and a stir bar. The sample should be at the same temperature as the buffers used to standardize the electrode. Stir as before. Record the pH when the reading is stable.
2. Remove the electrode from the sample, rinse the electrode with distilled water over the "waste" beaker. Blot the electrode dry with a lab wipe. The electrode is now ready to read the pH of other samples.

11. Storing the Electrode

1. Sort Term

Between measurements, store the pH electrode in a beaker containing pH**4.01** buffer.

2. Long Term

When storing for longer periods, store the pH electrode in the storage bottle or the protective boot which came with the electrode. Ensure that the foam in the storage bottle or the cotton ball in the protective boot is totally wetted with pH storage solution to keep a wet environment around the pH bulb and junction. Maintain the wet environment in the storage bottle or in the protective boot during storage.

If the pH electrode is equipped with a fill hole cover, slip the cover over the fill hole.

12. Electrode Cleaning

Do not use strong solvents (e.g. acetone, carbon tetrachloride, etc.) to clean the pH electrode. Be sure to recalibrate the electrode after cleaning.

1. If the electrode has become coated with oil or grease, carefully wash the electrode under warm tap water using dish-washing detergent. Rinse thoroughly with fresh tap water followed by a rinse with distilled water. Soak the electrode in pH electrode storage solution for 30 minutes after this cleaning procedure. Recalibrate the electrode before use.

2. If the electrode has been exposed to protein or similar materials, soak in acidic pepsin for 5 minutes. Rinse thoroughly with distilled water. Soak in storage solution for 30 minutes prior to recalibration.

3. If the previous cleaning procedures fail to restore response, soak the electrode in 0.1 N HCI for 30 minutes. Rinse thoroughly with distilled water. Recalibrate before use.

4. If electrode response is not restored still, replace the electrode.

13. Contact

Manufacturer
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