

# USER GUIDE FOR PROCESS FLAT ORP SENSOR WITH MODBUS OUTPUT MBRTU-ORPFLAT

JUL-2021

*This document is applied for the following products*

## 1. Introduction

MBRTU-ORPFLAT is a general purpose in-line (continuous measurement) ORP 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 ORP electrode for continuous measurement;
- Self-cleaning flat electrode;
- Standard ModbusRTU output;
- Plug & Play

**Typical Applications:** Common applications include disinfection using chlorine, ozone, and bromine. All of these species are strong oxidizers, so ORP is used as an indicator of sanitizing activity. ORP is also used in process applications to monitor destruction of chromate or cyanide, as well as in bleach production and wet scrubbers.

PROCESS ORP FLAT SENSOR  
MBRTU-ORPFLAT



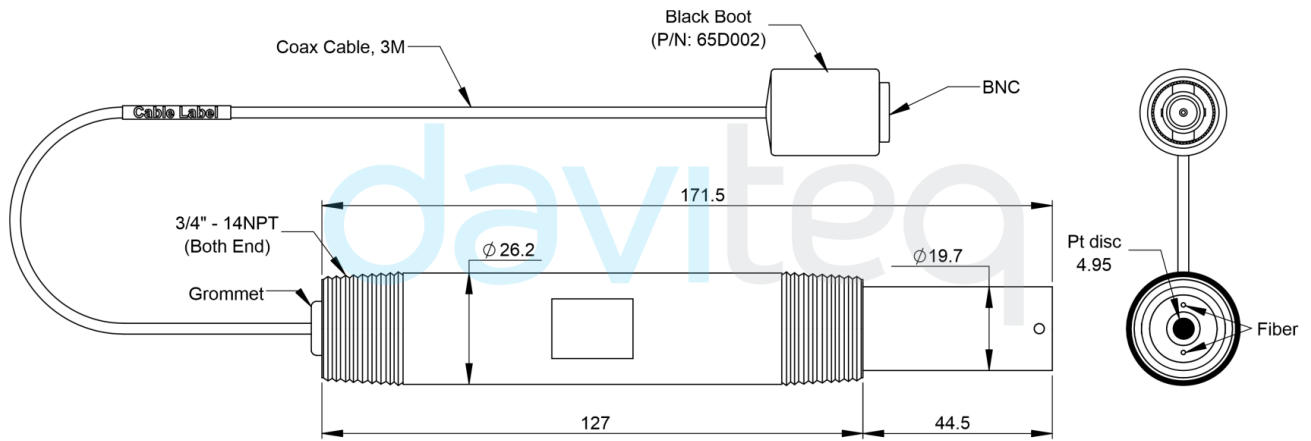
MBRTU-ORPFLAT-H1.PNG

## 2. Specification

ORP SENSOR SPECIFICATION	
Sensing Technology	Glass, combine electrode

Measuring range	+/- 2000 mV
Resolution	0.1 mV
Accuracy	+/- 1 mV
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
<b>ORP TRANSMITTER SPECIFICATION</b>	
Inputs	mV
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

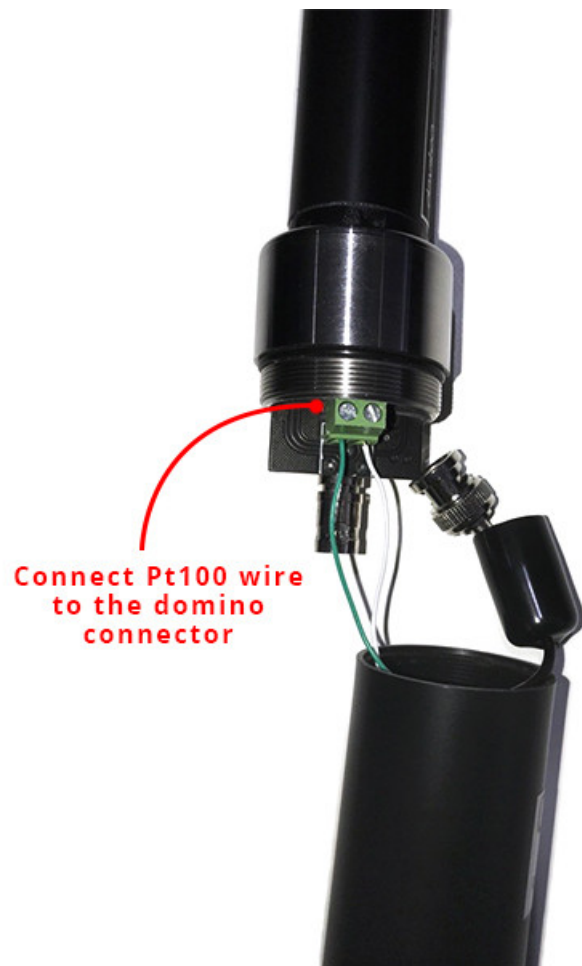
### 3. Dimensions



## 4. Wiring

Please wiring as shown below:





## 5. Memmap registers

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

Function Code	Modbus Register (Decimal)	# of Registers	Format Type	Parameter Name	Setting Value	Format	Note
3	9	2	float	pH/ORP value		Read	pH/ORp value measured from sensor
3	11	1	byte[]	err & sen_type		Read	Hi-Byte is error code, Lo-Byte is sensor type
3	12	2	float	Temp °C		Read	
3	14	2	float	ADC value		Read	
3	16	2	float	mV value		Read	
3	18	2	float	PT100 value		Read	
3	256	1	uint16	Modbus address	1	Read / Write	Modbus address of device
3	257	1	uint16	Modbus baudrate	0	Read / Write	Baudrate: 0: 9600, 1: 19200
3	258	1	uint16	Modbus parity	0	Read / Write	Parity: 0: none, 1: odd, 2: even
3	280	2	float	a1 ORP		Read / Write	Scale value of parameter_1 = (a1 * Raw sensor value of parameter_1) + b1
3	282	2	float	b1 ORP		Read / Write	Scale value of parameter_1 = (a1 * Raw sensor value of parameter_1) + b1
16	299	1	uint	pH calibEnb	1	Read / Write	
16	300	2	float	pH Feedback	7	Read / Write	
3	302	2	float	pH Factor		Read / Write	
3	304	2	float	pH 7 adc		Read / Write	
3	306	2	float	pH 7 mV		Read / Write	
3	308	2	float	PT100 wireRes		Read / Write	Offset resistor wires
3	310	2	float	tempManInput		Read / Write	
3	312	1	uint	tempManEnb		Read / Write	

## 6. Required Equipment and Solutions

- pH/mV meter
- pH buffer 4.01 saturated with Quinhydrone (Solution has 2 - 4 use life after mixing)
- pH buffer 7.00 saturated with Quinhydrone (Solution has 2 - 4 use life after mixing)
- Wash bottle filled with distilled or de-ionized water
- Lab wipes

- Laboratory magnetic stirrer and magnetic stir bars
- Clean beakers

## 7. Preparation of the Electrode for Initial Use

Mono ORP electrodes are shipped dry with a rubber boot covering the tip of the electrode to protect the sensing element.

Combination ORP electrodes are shipped with a storage bottle with storage solution. Keep the solution bottle and solution for future use.

Remove the bottle or the boot from the electrode and thoroughly rinse the electrode tip with distilled water. Wipe carefully with a clean lab wipe.

For refillable combination ORP models, uncover the filling port to expose the electrode reference chamber fill hole (for sealed, gel filled electrodes, disregard this operation). Fill the reference chamber with reference filling solution. Use the appropriate reference filling solution. Electrodes that have been filled with the incorrect filling solution are not covered under warranty.

## 8. Reference Filling Solution Selection

- For ORP combination electrodes with Calomel and Double Junction Ag/AgCl reference half cells, use 4 M KCl reference filling solution.
- For ORP combination electrodes with Single Junction Ag/AgCl reference half cells, use 4 M KCl saturated with AgCl reference filling solution.

## 9. Calibration

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

The first is calibration with standard solution **ORP240mV**. Buy standard solutions here:

- <https://www.hannavietnam.com/detail-product/chuan-orp-240-mv-500-ml-409>
- <https://www.hannainstruments.co.uk/orp-240mv-test-solution.html>

The next step is to calibrate with standard solution **ORP470mV**. Buy standard solutions here:

- <https://www.hannavietnam.com/detail-product/chuan-orp-470-mv-500-ml-410>
- <https://www.hannainstruments.co.uk/orp-470mv-test-solution.html>

**Note the ambient temperature at the time of calibration to input the standard mV 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

Daviteq Modbus Configuration Tool Version 1.5

FILE EDIT

Port: COM10 BaudRate: 9600 Parity: none

Connect

Status: disconnected tx rx

tx	0
rx	0
ok	0
crc	0
tmo	0

09/07\_14:34 Run Program

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

**Step 2:** Put ORP sensor to standard ORP**240mV** and record mV value

Daviteq Modbus Configuration Tool Version 1.5

FILE EDIT

Port: COM10 BaudRate: 9600 Parity: none

Disconnect

Status: connected tx rx

tx	15124
rx	14835
ok	14835
crc	0
tmo	288

09/07\_14:34 Run Program  
09/07\_14:35 connected

	Func	Reg	Num	Format	Prm Name	Setting Value	Read Value	CLEAR	Ex
1	<input checked="" type="checkbox"/>	3	9	2	float	pH/ORP value	124.0625		
2	<input checked="" type="checkbox"/>	3	11	1	byte[]	err & sen_type	0 - 27		
3	<input checked="" type="checkbox"/>	3	12	2	float	Temp oC	124.0625		
4	<input checked="" type="checkbox"/>	3	14	2	float	ADC value	11889		
5	<input checked="" type="checkbox"/>	3	16	2	float	mV value	124.0625		
6	<input checked="" type="checkbox"/>	3	18	2	float	PT100 value	9.18354961579912E-41		
7	<input checked="" type="checkbox"/>	3	280	2	float	a1 ORP	1		
8	<input checked="" type="checkbox"/>	3	282	2	float	b1 ORP	0		
9	<input type="checkbox"/>	16	299	1	uint	pH calibEnb			
10	<input type="checkbox"/>	16	300	2	float	pH Feedback			
11	<input checked="" type="checkbox"/>	3	302	2	float	pH Factor	0		
12	<input checked="" type="checkbox"/>	3	304	2	float	pH 7 adc	0		
13	<input checked="" type="checkbox"/>	3	306	2	float	pH 7 mV	0		
14	<input checked="" type="checkbox"/>	3	308	2	float	PT100 wireRes	1.40129846432482E-45		
15	<input checked="" type="checkbox"/>	3	310	2	float	tempManInput	4.54399096253863E-34		
16	<input checked="" type="checkbox"/>	3	312	1	uint	tempManEnb	0		
* 17	<input type="checkbox"/>								

**Step 3:** Remove the electrode from the buffer. Rinse with distilled water and blot with a lab wipe thenput to Standard ORP **470mV** and record mV value

**Daviteq Modbus Configuration Tool Version 1.5**

FILE EDIT

Port: COM10 BaudRate: 9600 Parity: none

Status: connected tx rx

37.411.tx: 00 03 01 32 00 02 65 E9  
 37.487.rx: 00 03 04 00 00 00 00 EA F3  
 37.508.tx: 00 03 01 34 00 02 85 E8  
 37.581.rx: 00 03 04 00 00 00 01 2B 33  
 37.596.tx: 00 03 01 36 00 02 24 28

tx: 16901 rx: 16613 ok: 16613 crc: 0 tmo: 288

09/07\_14:34 Run Program 09/07\_14:35 connected

Disconnect

	Func	Reg	Num	Format	Prm Name	Setting Value	Read Value	CLEAR	Ex
1	<input checked="" type="checkbox"/>	3	9	2 float	pH/ORP value		341.125		
2	<input checked="" type="checkbox"/>	3	11	1 byte[]	err & sen_type		0 - 27		
3	<input checked="" type="checkbox"/>	3	12	2 float	Temp oC		341.125		
4	<input checked="" type="checkbox"/>	3	14	2 float	ADC value		15362		
5	<input checked="" type="checkbox"/>	3	16	2 float	mV value		341.125		
6	<input checked="" type="checkbox"/>	3	18	2 float	PT100 value		1.83670992315982E-40		
7	<input checked="" type="checkbox"/>	3	280	2 float	a1 ORP		1		
8	<input checked="" type="checkbox"/>	3	282	2 float	b1 ORP		0		
9	<input type="checkbox"/>	16	299	1 uint	pH calibEnb				
10	<input type="checkbox"/>	16	300	2 float	pH Feedback				
11	<input checked="" type="checkbox"/>	3	302	2 float	pH Factor		0		
12	<input checked="" type="checkbox"/>	3	304	2 float	pH 7 adc		0		
13	<input checked="" type="checkbox"/>	3	306	2 float	pH 7 mV		0		
14	<input checked="" type="checkbox"/>	3	308	2 float	PT100 wireRes		1.40129846432482E-45		
15	<input checked="" type="checkbox"/>	3	310	2 float	tempManInput		4.54399096253863E-34		
16	<input checked="" type="checkbox"/>	3	312	1 uint	tempManEnb		0		
* 17	<input type="checkbox"/>								

29°C Light rain ENG

**Step 4:** Calculate a1 and b1 value for ORP by excel file then write them to Reg 280 and 282 by check in the box to run func 16.

Calculate a1 and b1 excel file: <https://filerun.daviteq.com/wl/?id=qTEXAavKI1dSbnkbUgSAQXdK2jEtr1qA>

**calc\_ab - Excel**

Home Insert Page Layout Formulas Data Review View Developer

Clipboard Font Alignment Number Conditional Formatting Styles Cells Editor

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1		READ AND ENTER THE FOLLOWING VALUES					NEW a1, b1 CONFIGURATION											
2	Two points	Standard value	Value read from Sensor				a1	b1										
3	1	240	124.0625				1.05960265	108.543046										
4	2	470	341.125															
5		CURRENT CONFIGURATION																
6		a1	b1															
7		1	0															
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**Daviteq Modbus Configuration Tool Version 1.5**

FILE EDIT

Port: COM10 BaudRate: 9600 Parity: none

Status: connected tx rx

36.670.tx: 00 03 01 36 00 02 24 28  
 36.733.rx: 00 03 04 08 17 00 00 58 97  
 36.736.tx: 00 03 01 36 00 01 05 EA  
 36.795.rx: 00 03 02 00 00 00 85 84  
 36.799.tx: 00 03 00 09 00 02 15 D8

tx: 17674 rx: 17386 ok: 17386 crc: 0 tmo: 288

09/07\_14:34 Run Program 09/07\_14:35 connected

Disconnect

	Func	Reg	Num	Format	Prm Name	Setting Value	Read Value	CLEAR	Ex
1	<input checked="" type="checkbox"/>	3	9	2 float	pH/ORP value		472.251647949219		
2	<input checked="" type="checkbox"/>	3	11	1 byte[]	err & sen_type		0 - 27		
3	<input checked="" type="checkbox"/>	3	12	2 float	Temp oC		343.25		
4	<input checked="" type="checkbox"/>	3	14	2 float	ADC value		15396		
5	<input checked="" type="checkbox"/>	3	16	2 float	mV value		343.25		
6	<input checked="" type="checkbox"/>	3	18	2 float	PT100 value		1.83670992315982E-40		
7	<input type="checkbox"/>	16	280	2 float	a1 ORP	1.059602649	OK		
8	<input type="checkbox"/>	16	282	2 float	b1 ORP	108.5430464	OK		
9	<input type="checkbox"/>	16	299	1 uint	pH calibEnb				
10	<input type="checkbox"/>	16	300	2 float	pH Feedback				
11	<input checked="" type="checkbox"/>	3	302	2 float	pH Factor		0		
12	<input checked="" type="checkbox"/>	3	304	2 float	pH 7 adc		0		
13	<input checked="" type="checkbox"/>	3	306	2 float	pH 7 mV		0		
14	<input checked="" type="checkbox"/>	3	308	2 float	PT100 wireRes		1.40129846432482E-45		
15	<input checked="" type="checkbox"/>	3	310	2 float	tempManInput		4.54399096253863E-34		
16	<input checked="" type="checkbox"/>	3	312	1 uint	tempManEnb		0		

## 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. Stir as before. Record the mV reading 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 ORP readings of other samples.

# 11. Storing the Electrode

Mono ORP electrodes should be stored clean and dry. Combination ORP electrodes should always remain immersed in storage solution. When storing for long periods, store the electrode in the storage bottle or boot which came with the electrode.

# 12. Electrode Cleaning

Contamination of the sensing element often results in slow response and inaccurate readings. Clean the element by one of the following procedures:

1. Inorganic Deposits: Immerse electrode tip in 0.1 N HCl for 10 minutes. Wash the tip with distilled water.
2. Organic Oil and Grease Films: Wash electrode tip in a liquid detergent and water.
3. After above treatment, soak the electrode tip in alcohol for 5 minutes and wipe dry, then, soak in quinhydrone saturated pH 4.01 for 15 minutes; rinse with distilled water afterwards.

**NOTE: DO NOT ATTEMPT TO SAND OR POLISH THE SENSING ELEMENT WITH SAND PAPER OR OTHER POLISHING MATERIAL!**

# 13. Contact



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