Loligo Systems OXY-REG Oxygen Analyzer and Regulator System User Manual

Loligo® Systems

OXY-REG Oxygen Analyzer and Regulator System
User Manual

OXY-REG with DO-SET (optional) Oxygen Analyzer and Regulator System
User manual version 2.4.1

The OXY-REG system is used for monitoring and regulating dissolved oxygen content of sea or fresh water in fish tanks, respirometers, aquaria etc.

Contents

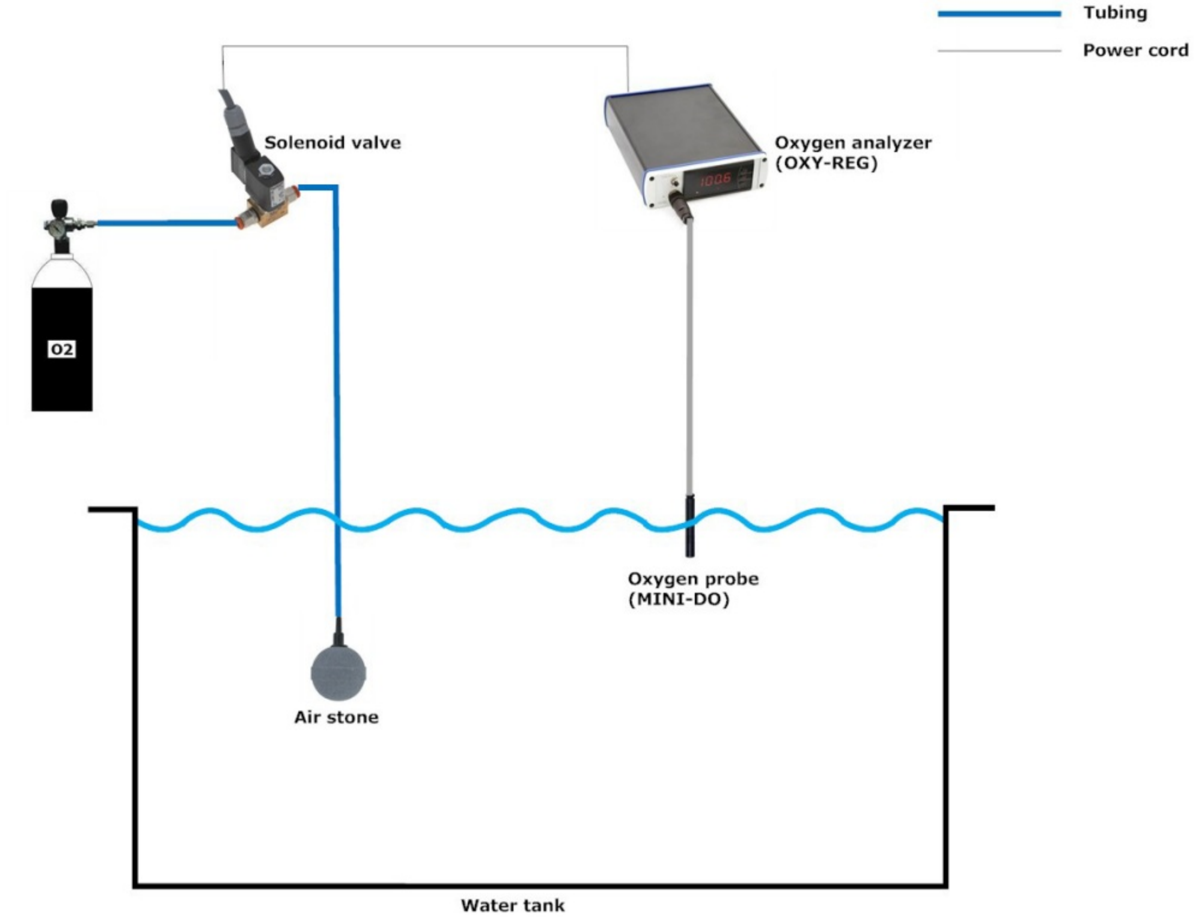
LIST OF PARTS

1. Controller instrument
2. Data cable
3. MINI-DO galvanic cell oxygen probe
4. Maintenance kit for O2 probe
5. Membrane tool 6) Power cord

6. Converter piece
7. User manual
8. DO-SET (OPTIONAL)
   – Solenoid valve with w/push-in fittings
   – PU tubing – Air stone

SETUP

Connect the MINI-DO galvanic oxygen probe to the input labeled IN on the front side of the OXY-REG instrument. Now connect the power cord to the input labeled POWER on the backside of the OXY-REG instrument. The OXY-REG will now turn on and start reading oxygen values. There are two relays on the backside of the instrument which can be used to control the activity of a solenoid valve to regulate oxygen saturation in the water. Also, there is a button labeled 0-cal, this button is used for zero calibration only.



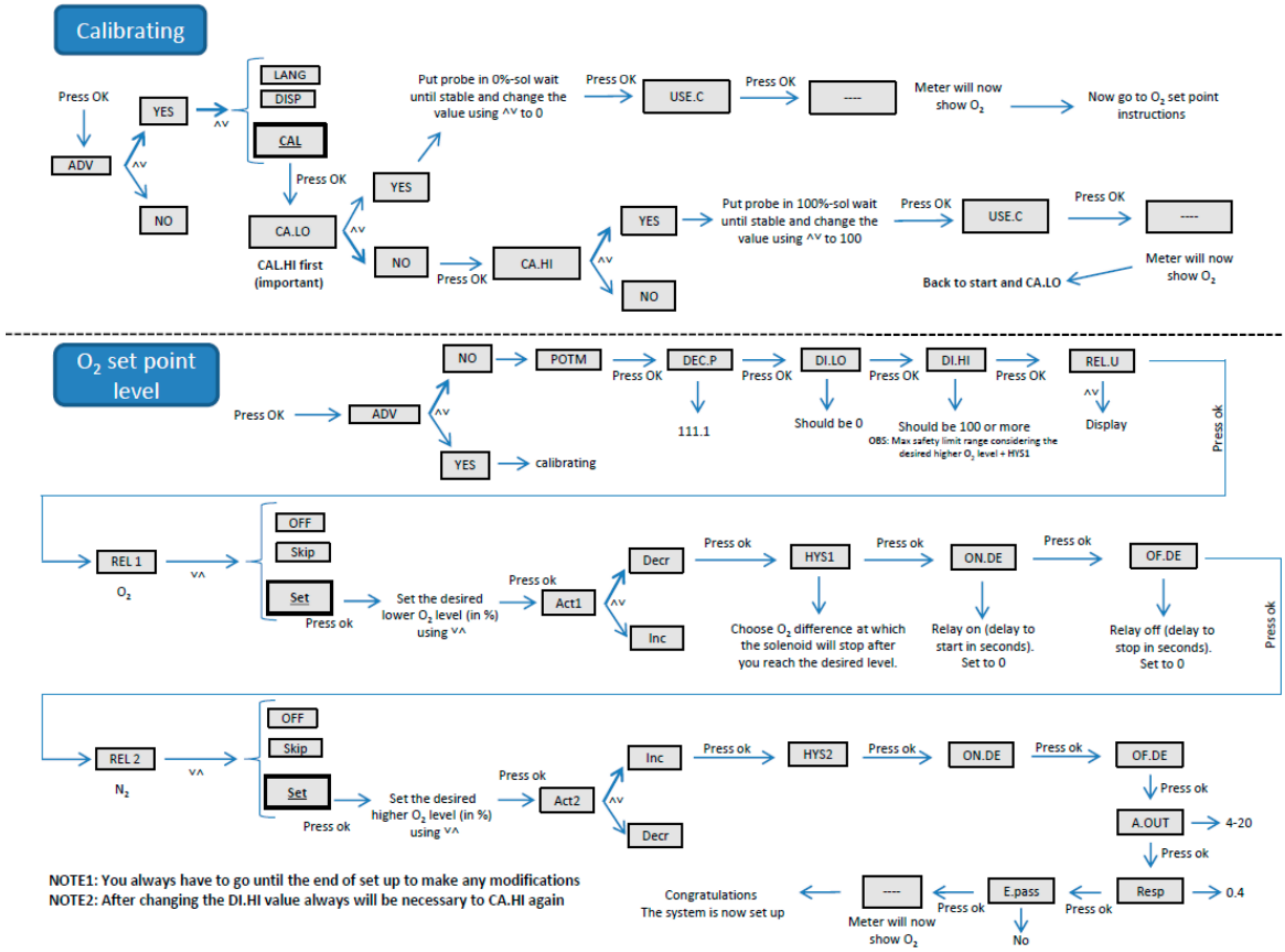
CONFIGURATION / OPERATING THE FUNCTION KEYS

The OXY-REG is a menu-driven instrument. The front panel has three buttons for operation, e.g. two arrow buttons (∧ **and** ∨) and one **OK** button. Use these three buttons to scroll through the menu and accept instrument settings. For each menu there is a scrolling help text which is automatically shown in the display, this starts after five seconds if no key has been activated. Use the menu to calibrate the oxygen probe, and set relay action and level of control.
∧ will increase the numerical value or choose the next parameter.
V will decrease the numerical value or choose the previous parameter.
OK will accept the chosen value and end the menu.
To summarize, the ∧ **and** ∨ buttons are used to toggle between options. The **OK** button is used to accept settings and go to the next option. Press and hold the **OK** button for 0.5 seconds, to get the last option available. Once the entire configuration has been entered, the display will show "—-".
The following two pages show the complete menu routing diagram and scrolling help texts.
NB! Please note that the OXY-REG is password protected. The Password is 1234. The OXY-REG is calibrated

from Loligo Systems to the MINI-DO. The RE1 is set to act on a decreasing signal, the RE2 is set to act on an increasing signal. Use the fast set point adjustment to adjust the set point.

FAST SET POINT ADJUSTMENT

It is possible to quickly change set point values without having to scroll through the whole instrument menu. With the instrument turned on, press the button once. Now choose relay 1 (or 2), and press the **OK** button. Then change the set point value using the arrow buttons. Finish by pressing the **OK** button.
Test relay functions, by pressing both arrow buttons simultaneously. The LED diode will toggle its state. When done, press the OK button several times until the display reads "—-".



SCROLLING HELP TEXT

Display in default state xxxx, hardware error:
SE.BR --> SENSOR WIRE BREAKAGE
SE.SH --> SENSOR SHORT CIRCUIT
IN.HI --> INPUT OVERRANGE
IN.LO --> INPUT UNDERRANGE
9.9.9.9 --> DISPLAY OVERRANGE
-1.9.9.9 --> DISPLAY UNDERRANGE
HW.ER --> HARDWARE ERROR
EE.ER --> EEPROM ERROR - CHECK CONFIGURATION
RA.ER --> RAM MEMORY ERROR
CJ.ER --> CJC SENSOR ERROR

Fastset (Enabled):
F.SET
REL1 --> FAST SET MENU - SELECT RELAY
REL2 -->

SETP
xxxx --> RELAY SETPOINT - PRESS OK TO SAVE

Fastset (Disabled):
SETP
xxxx --> RELAY SETPOINT - READ ONLY

Configuration menus:
LANG
DE --> DE - WAEHLE DEUTSCHEN HILFETEXT
DK --> DK - VAELG DANSK HJAELPETEKST
ES --> ES - SELECCIONAR TEXTO DE AYUDA EN ESPANOL
FR --> FR - SELECTION TEXTE D'AIDE EN FRANCAIS
IT --> IT - SELEZIONARE TESTI DI AIUTO ITALIANI
SE --> SE - VALJ SVENSK HJALPTEXT
UK --> UK - SELECT ENGLISH HELPTEXT
CZ --> CZ - VYBER CESKOU NAPOVEDU

PASS
xxxx --> SET CORRECT PASSWORD

IN
C.LIN* --> TEXT ENTERED BY USER IN PRESET
CURR --> CURRENT INPUT
VOLT --> VOLTAGE INPUT
POTM --> POTENTIOMETER INPUT
TEMP --> TEMPERATURE SENSOR INPUT

RANG **When current selected:**
0-20 --> INPUT RANGE IN mA
4-20 --> INPUT RANGE IN mA

RANG **When voltage selected:**
0-10 --> INPUT RANGE IN VOLT
2-10 --> INPUT RANGE IN VOLT
0.0-1 --> INPUT RANGE IN VOLT
0.2-1 --> INPUT RANGE IN VOLT

CA.LO
YES --> CALIBRATE POTENTIOMETER LOW
NO --> CALIBRATE POTENTIOMETER LOW

CA.HI
YES --> CALIBRATE POTENTIOMETER HIGH
NO --> CALIBRATE POTENTIOMETER HIGH

DEC.P
1111 --> DECIMAL POINT POSITION
111.1 --> DECIMAL POINT POSITION
11.11 --> DECIMAL POINT POSITION
1.111 --> DECIMAL POINT POSITION

DI.LO
xxxx --> DISPLAY READOUT LOW

DI.HI -->
xxxx --> DISPLAY READOUT HIGH

REL.U
PERC --> SET RELAY IN PERCENTAGE
DISP --> SET RELAY IN DISPLAY UNITS

TYPE
PT --> SELECT PT SENSOR TYPE
NI --> SELECT NI SENSOR TYPE
TC --> SELECT TC SENSOR TYPE

PT.TY
10 --> SELECT PT SENSOR TYPE
20 --> SELECT PT SENSOR TYPE
50 --> SELECT PT SENSOR TYPE
100 --> SELECT PT SENSOR TYPE
200 --> SELECT PT SENSOR TYPE
250 --> SELECT PT SENSOR TYPE
300 --> SELECT PT SENSOR TYPE
400 --> SELECT PT SENSOR TYPE
500 --> SELECT PT SENSOR TYPE
1000 --> SELECT PT SENSOR TYPE

NI.TY
50 --> SELECT NI SENSOR TYPE
100 --> SELECT NI SENSOR TYPE
120 --> SELECT NI SENSOR TYPE
1000 --> SELECT NI SENSOR TYPE

CONN **When Pt and Ni sensor selected**
2W --> SELECT 2-WIRE SENSOR CONNECTION
3W --> SELECT 3-WIRE SENSOR CONNECTION
4W --> SELECT 4-WIRE SENSOR CONNECTION

TC.TY
TC. B --> SELECT TC SENSOR TYPE
TC. E --> SELECT TC SENSOR TYPE
TC. J --> SELECT TC SENSOR TYPE
TC. K --> SELECT TC SENSOR TYPE
TC. L --> SELECT TC SENSOR TYPE
TC. N --> SELECT TC SENSOR TYPE
TC. R --> SELECT TC SENSOR TYPE
TC. S --> SELECT TC SENSOR TYPE
TC. T --> SELECT TC SENSOR TYPE
TC. U --> SELECT TC SENSOR TYPE
TC.W3 --> SELECT TC SENSOR TYPE
TC.W5 --> SELECT TC SENSOR TYPE
TC.LR --> SELECT TC SENSOR TYPE

DEC.P **When temperature selected**
1111 --> DECIMAL POINT POSITION
111.1 --> DECIMAL POINT POSITION

UNIT
°C --> DISPLAY AND RELAY SETUP IN CELSIUS
°F --> DISPLAY AND RELAY SETUP IN FAHRENHEIT

REL1
SET --> ENTER RELAY 1 SETUP
SKIP --> SKIP RELAY 1 SETUP
OFF --> RELAY 1 DISABLED

SETP
xxxx --> RELAY SETPOINT

ACT1
INCR --> ACTIVATE AT INCREASING SIGNAL
DECR --> ACTIVATE AT DECREASING SIGNALL

HYS1
xxxx --> RELAY HYSTERESIS

ERR1
HOLD --> HOLD RELAY AT ERROR
ACTI --> ACTIVATE RELAY AT ERROR
DEAC --> DEACTIVATE RELAY AT ERROR
NONE --> UNDEFINED STATUS AT ERROR

ON.DE
xxxx --> RELAY ON-DELAY IN SECONDS

OF.DE
xxxx --> RELAY OFF-DELAY IN SECONDS

REL2
SET --> ENTER RELAY 2 SETUP
SKIP --> SKIP RELAY 2 SETUP
OFF --> RELAY 2 DISABLED

SETP
xxxx --> RELAY SETPOINT

ACT2
INCR --> ACTIVATE AT INCREASING SIGNAL
DECR --> ACTIVATE AT DECREASING SIGNAL

HYS2
xxxx --> RELAY HYSTERESIS

ERR2
HOLD --> HOLD RELAY AT ERROR
ACTI --> ACTIVATE RELAY AT ERROR
DEAC --> DEACTIVATE RELAY AT ERROR
NONE --> UNDEFINED STATUS AT ERROR

ON.DE
xxxx --> RELAY ON-DELAY IN SECONDS

OF.DE
xxxx --> RELAY OFF-DELAY IN SECONDS

A.OUT
0-20 --> OUTPUT RANGE IN mA
4-20 --> OUTPUT RANGE IN mA
20-0 --> OUTPUT RANGE IN mA
20-4 --> OUTPUT RANGE IN mA

O.LO
xxxx --> DISPLAY VALUE FOR OUTPUT LOW

O.HI
xxxx --> DISPLAY VALUE FOR OUTPUT HIGH

O.ERR
23 mA --> NAMUR NE43 UPSCALE AT ERROR
3,5 mA --> NAMUR NE43 DOWNSCALE AT ERROR
0mA --> DOWNSCALE AT ERROR
NONE --> UNDEFINED OUTPUT AT ERROR

RESP
xxx,x --> ANALOGUE OUTPUT RESPONSE TIME IN SECONDS

E.PAS
NO --> ENABLE PASSWORD PROTECTION
YES --> ENABLE PASSWORD PROTECTION

N.PAS
xxxx --> SELECT NEW PASSWORD

CALIBRATING THE OXYGEN PROBE

A galvanic type oxygen probe is stable and quite rugged, but it sometimes needs re-calibration like all other oxygen sensors in order to adjust for signal drift.
Standard two-point calibration procedure

1. Connect the probe to the oxygen instrument and turn on the instrument.
2. Place the tip of the probe in a mixed air-equilibrated water sample. This can be achieved by purging atmospheric air into sample water, e.g. with an air pump and air stone.
3. Wait for the reading to stabilize, and then press the **OK** button until the display reads CA.HI. Use the ∧ **and** ∨ button to toggle to YES, and press the **OK** button to accept the current probe signal for the high calibration value. If you cannot perform the CA.HI calibration, or if you experience calibration issues, try doing the CA.LO calibration first (see step 8), and then the CA.HI calibration.
4. Press the **OK** button until the display reads DI.HI. and the ∧ **and** ∨ button to adjust the high calibration value to 100 (% air saturation). Press the **OK** button to accept the value.
5. Then press the **OK** button several times, until the display reads "—-" to finish the high calibration.
6. Next, place the tip of the probe in an oxygen-free water sample. This can be achieved by purging nitrogen gas into sample water or by dissolving approximately 10 grams of Na2SO3 in 500 mL of distilled water.
7. Wait for the reading to stabilize, and then press the **OK** button until the display reads **CA.LO.** Use the ∧ **and** ∨ button to toggle to YES, and press the **OK** button to accept the current probe signal for the low calibration value.
8. Press the **OK** button until the display reads **DI.LO.** and the ∧ **and** ∨ button to adjust the low calibration value to 0 (% air saturation). Press the **OK** button to accept the value.
   Usually, it is not necessary to perform a zero calibration procedure like described above (6-8) when using galvanic-type oxygen sensors. An easy alternative is to short-circuit the signal wires by using the 0-cal button on the front of the **OXYREG** instrument. Press and hold this button for approximately 20 seconds to allow the signal to stabilize and then accept by pressing the **OK** button at the same time.
9. Finally press the **OK** button several times, until the display reads "—-" to finish the zero calibration.
10. Rinse the probe with distilled water.
11. Place the probe into the sample, and record the sample oxygen saturation when the reading is stable.

MAINTENANCE

Between sample measurements, immerse the tip of the probe in distilled water. For long-time storage keep the probe in a dark and moist environment to avoid the very small volume of electrolyte fluid (c. 0.1 ml) from evaporating and to protect the membrane from direct sunlight. It is also a good idea to short-circuit the two signal wires to avoid deterioration of the probe anode.

RENOVATING PROBE

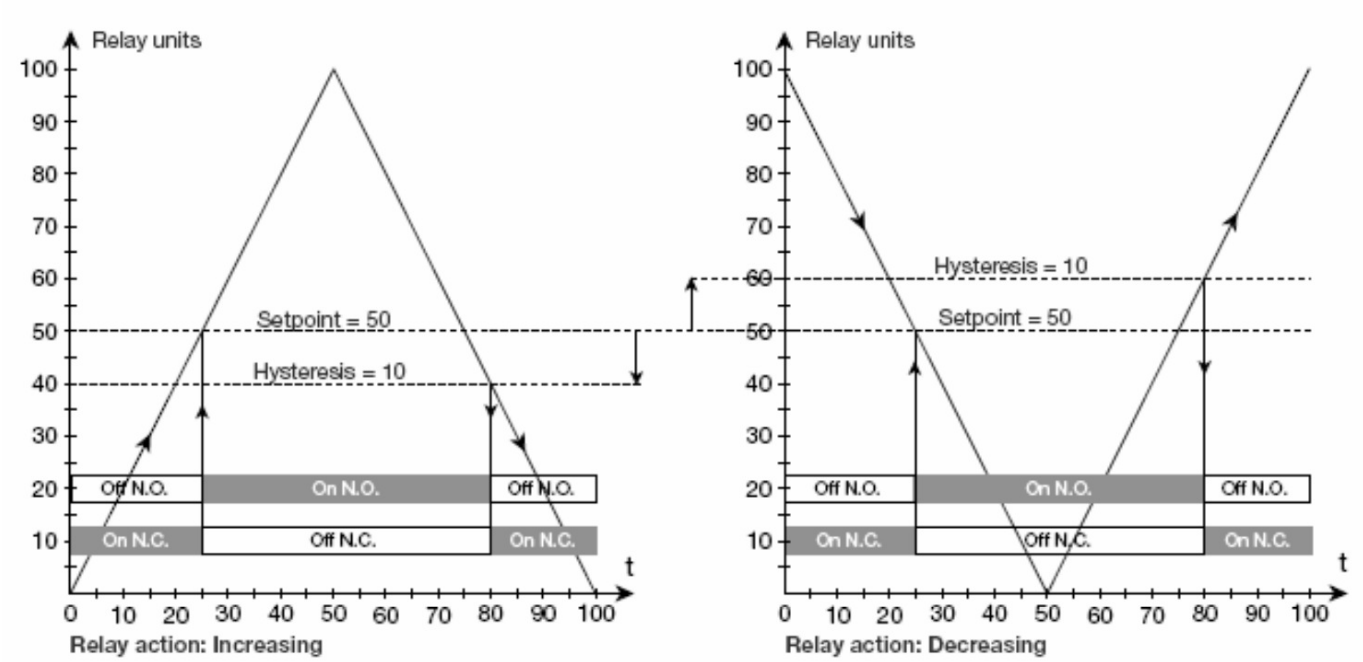
Renovating the probe should only be necessary if used under extreme conditions, or if the probe dried completely out during long-term storage.
Even changing the membrane should not be necessary during normal use, unless it has been damaged or got very dirty. However, a damaged or dirty membrane will result in poor performance and erroneous readings and eventually will require changing.

1. Place the ring, chamfered edge down, into the base
2. Place a new membrane on the base above the ring.
3. Place the guide over the base, and
4. place the cap in the hole in the guide
5. Press the cap firmly down by hand
6. Fill the cap with electrolyte fluid and screw it slowly up onto the probe
7. Excess electrolyte fluid should dribble from the thread

USING THE RELAYS

The OXY-REG instrument has two independent relays to control the activity of solenoid valves. For each relay choose a set point and a hysteresis value. Now decide if the relay should be activated when the signal drops below a set point (DECR), or if it should be activated when it rises above (INCR), e.g. for hypoxic control the relay should act on an increasing (INCR) signal since oxygen saturation will increase above the set point due to atmospheric re-equilibration.

Graphic depiction of the relay function setpoint:



Example how to keep oxygen saturation high despite fish respiration

Set up the OXY-REG system in the following way, to keep oxygen saturation at say 90% in aquaria with fish consuming oxygen at high rates.

1. Connect the solenoid valve to relay 1 on the back side of the OXY-REG instrument (relay 2 is not used in this example).
2. Connect a supply of air or pure oxygen gas to the solenoid valve input labeled P, using the blue PU tubing.
3. Connect the large air stone to the solenoid valve output labeled A, using the blue PU tubing.
4. Place the air stone in the aquarium. Now, when the relay turns on, the solenoid valve will open, and air or pure oxygen will bubble through the water and increase oxygen saturation in the water.
5. Press the **OK** button several times until the display reads REL1. Wait for one second, and the display now reads SET, or toggle using arrow buttons until it reads SET, and then press **OK.**
6. Now use the ∧ **OR** ∨ buttons to increase or decrease the set point value. Set it to 90 (% air saturation), and then press OK.
7. Set the action of the relay to DECR, and then press OK.
8. Now enter the hysteresis value. Use arrow buttons to set the value to 1%, and then press OK.
9. Press the **OK** button several times, until the display reads "—-" to finish.

Relay 1 will be activated every time oxygen saturation drops below 90%, allowing air or pure oxygen gas to pass the valve, tube, and air stone into the water. This will cause the oxygen saturation of the water to increase, and as it reaches 91% the relay de-activates. After some time oxygen saturation will drop below 90% again due to fish respiration, and relay 1 is activated once more.

In this way, oxygen saturation in the aquarium is automatically kept at 90-91% air saturation at all times.

PASSWORD PROTECTION

Using a password will stop access to some of the menu and parameters. There are two levels of password protection. Passwords between 0000-4999 will allow access to the fast set point adjustment and relay test. (Using this password stops access to all other parts of the menu). Passwords between 5000-9999 stop access to all parts of the menu, fast set point, and relay test. (Current set point is still shown). By using the master password 2008, all configuration menus are available.

If you want to enable password protection, press the OK button several times, until the display reads E.PAS. Use an arrow button to choose YES, and then press OK. Now set the password using the arrow buttons, and press OK when done. If you want to disable password protection, go to the menu option E.PAS. again and set it to NO.

Finish by pressing the OK button.

DEFAULT SETTINGS

The OXY-REG instrument is delivered with the following default settings:

INPUT TYPE: DECIMAL POINT: DISPLAY LOW VALUE: DISPLAY HIGH VALUE: RELAY 1 UNIT:	POTMETER 111.1 0.0 100.0 DISP
REL1 SETP ACT HYS ON.DE OF.DE	50.0 DECR 1.0 0 0
REL2 SETP ACT HYS ON.DE OF.DE	50.0 INCR 1.0 0 0
ANALOG OUTPUT: RESP E.PASS N.PASS	4-20 (converted into a 0-5V instrument output) 0.4 YES 1234

USING THE CONTROLLER FOR DATA ACQUISITION

The instrument produces a 0-5 Volts analog output signal for data acquisition purposes. Connect the data cable to the socket marked Out on the backside of the OXY-REG instrument. Connector pin 1 is positive (+), connector pin 4 is 0 (zero).
The low instrument value (DI.LO) corresponds to a 0 V output, and the high value (DI.HI) corresponds to a 5 V output. This means, that the gain becomes HI value/5 V. With the default values the gain is then 20% air saturation/V, e.g. if the output voltage is 4 V, the calculated % air saturation value is 80%.

CHANGE OXYGEN UNITS

It is possible to measure and control oxygen in other units than % air saturation. In this case, the high display value (DI.HI) should be changed accordingly, e.g. for oxygen measurements in mmHg the DI.HI, the value should be changed to a value close to 160 mm depending on the calibration conditions etc.
Please note, that when using oxygen units other than % air saturation, it is important to keep the water temperature and salinity constant.

OXY-REG SPECIFICATIONS

Supply voltage (universal):	21.6-253 VAC, 50-60 Hz or 19.2-300 VDC
Internal consumption:	3.2 W
Max. consumption:	3.5 W
Isolation voltage (test / operation):	2.3 HVAC / 250 VAC
Signal- / noise ratio:	Min. 60 dB (0-100 kHz)
Response time, programmable:	0.4-60 s
Calibration temperature:	20-28°C
Accuracy:	≤±0.1% of reading
Temperature Coefficient:	≤±0.01% of reading/ °C
EMC immunity influence:	≤±0.5% of reading
Potentiometer input, min:	10 Ω
Potentiometer input, max:	100 kΩ
Relay function:	Setpoint
Hysteresis, in % / display, counts:	0.1-25% / 1-2999
On and Off delay:	0-3600 s
Sensor error detection:	Make / Break / Hold
Max. voltage:	250 VRMS
Max. current:	2 A / AC
Max. AC power:	500 VA
Max. a current at 24 VDC:	1 A

IMPORTANT: DO NOT connect relays to >500W equipment (max 2 A, 250 V).
Marine approval
Det Norske Veritas, Ships & Offshore Standard for Certification No. 2.4
Observed authority requirements:
Standard: EMC 2004/108/EC
Emission and immunity
EN 61326
LVD 73/23/EEC
EN 61010-1
UL, Standard for Safety UL 508

MINI-DO SPECIFICATIONS

Dimensions	dia 15mm, length 90mm
Measuring principle	galvanic cell, self-temperature compensating
Type	% saturation
Output	c. 25 mV at 100% O2 saturation, output impedance is c. 2 kOhm
Wiring	The white wire is zero (0 or GND,) brown wire is positive
Flow requirements	typically 1 cm/sec, depending on oxygen saturation and temp
Cable	3 m, other lengths available on request
Measuring range	0-200%
Accuracy	typically better than ± 1% of the measured value, depending on the calibration
Repeatability	typically better than ± 0.5% of the measured value
Response time	T90 (90% of end value) is <20 sec

File: PO2 kPa.xls

Partial pressure of oxygen (pO2) at different barometric pressures and temperatures = ((Pbp-Pvap)*.2094)																
Temperature (deg C)	0	2	4	6	8	10	12	14	16	18	20	25	30	35	37	40
Pvap (kPa)	0,61	0,71	0,81	0,93	1,07	1,23	1,40	1,60	1,82	2,06	2,34	3,17	4,24	5,62	6,28	7,38
Pbp (kPa)																
97,32	20,256	20,237	20,215	20,191	20,163	20,132	20,097	20,058	20,013	19,964	19,909	19,742	19,526	19,248	19,117	18,895
97,59	20,312	20,292	20,271	20,246	20,218	20,187	20,152	20,113	20,068	20,019	19,963	19,796	19,579	19,301	19,169	18,947
97,85	20,367	20,348	20,326	20,302	20,274	20,242	20,207	20,167	20,123	20,073	20,018	19,850	19,633	19,353	19,221	18,999
98,12	20,423	20,403	20,382	20,357	20,329	20,298	20,262	20,222	20,178	20,128	20,072	19,904	19,686	19,406	19,274	19,050
98,39	20,478	20,459	20,437	20,412	20,384	20,353	20,317	20,277	20,233	20,183	20,127	19,958	19,739	19,459	19,326	19,102
98,65	20,534	20,514	20,492	20,467	20,439	20,408	20,372	20,332	20,288	20,237	20,182	20,012	19,793	19,512	19,378	19,154
98,92	20,589	20,570	20,548	20,523	20,495	20,463	20,427	20,387	20,342	20,292	20,236	20,066	19,846	19,564	19,431	19,206
99,19	20,645	20,625	20,603	20,578	20,550	20,518	20,482	20,442	20,397	20,347	20,291	20,121	19,900	19,617	19,483	19,257
99,45	20,700	20,681	20,658	20,633	20,605	20,573	20,537	20,497	20,452	20,402	20,345	20,175	19,953	19,670	19,536	19,309
99,72	20,756	20,736	20,714	20,689	20,660	20,628	20,593	20,552	20,507	20,456	20,400	20,229	20,007	19,722	19,588	19,361
99,99	20,811	20,791	20,769	20,744	20,716	20,684	20,648	20,607	20,562	20,511	20,454	20,283	20,060	19,775	19,640	19,413
100,25	20,866	20,847	20,825	20,799	20,771	20,739	20,703	20,662	20,617	20,566	20,509	20,337	20,114	19,828	19,693	19,464
100,52	20,922	20,902	20,880	20,855	20,826	20,794	20,758	20,717	20,671	20,620	20,563	20,391	20,167	19,881	19,745	19,516
100,79	20,977	20,958	20,935	20,910	20,881	20,849	20,813	20,772	20,726	20,675	20,618	20,445	20,221	19,933	19,797	19,568
101,05	21,033	21,013	20,991	20,965	20,937	20,904	20,868	20,827	20,781	20,730	20,672	20,499	20,274	19,986	19,850	19,620
101,32	21,088	21,069	21,046	21,021	20,992	20,959	20,923	20,882	20,836	20,784	20,727	20,553	20,328	20,039	19,902	19,672
101,59	21,144	21,124	21,102	21,076	21,047	21,015	20,978	20,937	20,891	20,839	20,782	20,607	20,381	20,092	19,955	19,723
101,85	21,199	21,180	21,157	21,131	21,102	21,070	21,033	20,992	20,946	20,894	20,836	20,661	20,435	20,144	20,007	19,775
102,12	21,255	21,235	21,212	21,187	21,158	21,125	21,088	21,047	21,000	20,948	20,891	20,715	20,488	20,197	20,059	19,827
102,39	21,310	21,290	21,268	21,242	21,213	21,180	21,143	21,102	21,055	21,003	20,945	20,770	20,542	20,250	20,112	19,879
102,65	21,366	21,346	21,323	21,297	21,268	21,235	21,198	21,157	21,110	21,058	21,000	20,824	20,595	20,303	20,164	19,930
102,92	21,421	21,401	21,378	21,353	21,323	21,290	21,253	21,212	21,165	21,113	21,054	20,878	20,649	20,355	20,216	19,982
103,19	21,477	21,457	21,434	21,408	21,379	21,346	21,308	21,267	21,220	21,167	21,109	20,932	20,702	20,408	20,269	20,034
103,45	21,532	21,512	21,489	21,463	21,434	21,401	21,363	21,321	21,275	21,222	21,163	20,986	20,756	20,461	20,321	20,086

Oxygen solubility in mg O2/liter/kPa at different temperatures and salinities								From Green & Carrit (1967). J. Mar. Biol. 25; 140-147.						1 kPa = 7,501 mmHg					
Salinity (o/oo)	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36
Temperature (deg C)																			
0	0,6976	0,6878	0,6781	0,6685	0,6591	0,6498	0,6406	0,6316	0,6227	0,6139	0,6053	0,5967	0,5883	0,5800	0,5719	0,5638	0,5559	0,5480	0,5403
1	0,6788	0,6694	0,6600	0,6509	0,6418	0,6329	0,6241	0,6154	0,6068	0,5984	0,5900	0,5818	0,5737	0,5657	0,5579	0,5501	0,5424	0,5349	0,5274
2	0,6608	0,6517	0,6428	0,6339	0,6252	0,6166	0,6082	0,5998	0,5916	0,5834	0,5754	0,5675	0,5597	0,5520	0,5444	0,5369	0,5295	0,5223	0,5151
3	0,6436	0,6349	0,6263	0,6178	0,6094	0,6011	0,5929	0,5849	0,5769	0,5691	0,5614	0,5537	0,5462	0,5388	0,5315	0,5243	0,5171	0,5101	0,5032
4	0,6272	0,6188	0,6104	0,6022	0,5942	0,5862	0,5783	0,5706	0,5629	0,5553	0,5479	0,5405	0,5333	0,5261	0,5190	0,5121	0,5052	0,4984	0,4917
5	0,6114	0,6033	0,5953	0,5874	0,5796	0,5719	0,5643	0,5568	0,5494	0,5421	0,5349	0,5278	0,5208	0,5139	0,5071	0,5004	0,4937	0,4872	0,4807
6	0,5963	0,5885	0,5808	0,5731	0,5656	0,5582	0,5508	0,5436	0,5365	0,5294	0,5225	0,5156	0,5089	0,5022	0,4956	0,4891	0,4827	0,4763	0,4701
7	0,5818	0,5743	0,5668	0,5595	0,5522	0,5450	0,5379	0,5310	0,5241	0,5172	0,5105	0,5039	0,4974	0,4909	0,4845	0,4782	0,4720	0,4659	0,4598
8	0,5680	0,5607	0,5535	0,5463	0,5393	0,5324	0,5255	0,5188	0,5121	0,5055	0,4990	0,4926	0,4863	0,4800	0,4739	0,4678	0,4618	0,4558	0,4500
9	0,5547	0,5476	0,5406	0,5338	0,5270	0,5203	0,5136	0,5071	0,5006	0,4943	0,4880	0,4818	0,4756	0,4696	0,4636	0,4577	0,4519	0,4461	0,4405
10	0,5419	0,5351	0,5283	0,5217	0,5151	0,5086	0,5022	0,4959	0,4896	0,4834	0,4774	0,4713	0,4654	0,4595	0,4537	0,4480	0,4424	0,4368	0,4313
11	0,5297	0,5231	0,5165	0,5101	0,5037	0,4974	0,4912	0,4851	0,4790	0,4730	0,4671	0,4613	0,4555	0,4498	0,4442	0,4387	0,4332	0,4278	0,4224
12	0,5179	0,5115	0,5052	0,4989	0,4928	0,4867	0,4806	0,4747	0,4688	0,4630	0,4573	0,4516	0,4460	0,4405	0,4351	0,4297	0,4244	0,4191	0,4139
13	0,5067	0,5005	0,4943	0,4882	0,4823	0,4763	0,4705	0,4647	0,4590	0,4534	0,4478	0,4423	0,4369	0,4315	0,4262	0,4210	0,4158	0,4107	0,4057
14	0,4959	0,4898	0,4839	0,4780	0,4721	0,4664	0,4607	0,4551	0,4496	0,4441	0,4387	0,4333	0,4281	0,4229	0,4177	0,4126	0,4076	0,4026	0,3977
15	0,4855	0,4796	0,4738	0,4681	0,4624	0,4568	0,4513	0,4459	0,4405	0,4352	0,4299	0,4247	0,4196	0,4145	0,4095	0,4046	0,3997	0,3948	0,3901
16	0,4755	0,4698	0,4641	0,4586	0,4531	0,4476	0,4423	0,4370	0,4317	0,4266	0,4214	0,4164	0,4114	0,4065	0,4016	0,3968	0,3920	0,3873	0,3827
17	0,4659	0,4603	0,4549	0,4494	0,4441	0,4388	0,4336	0,4284	0,4233	0,4183	0,4133	0,4084	0,4035	0,3987	0,3940	0,3893	0,3846	0,3800	0,3755
18	0,4567	0,4513	0,4459	0,4407	0,4354	0,4303	0,4252	0,4202	0,4152	0,4103	0,4054	0,4006	0,3959	0,3912	0,3866	0,3820	0,3775	0,3730	0,3686
19	0,4478	0,4426	0,4374	0,4322	0,4271	0,4221	0,4171	0,4122	0,4074	0,4026	0,3979	0,3932	0,3886	0,3840	0,3795	0,3750	0,3706	0,3662	0,3619
20	0,4393	0,4342	0,4291	0,4241	0,4191	0,4142	0,4094	0,4046	0,3999	0,3952	0,3906	0,3860	0,3815	0,3770	0,3726	0,3683	0,3640	0,3597	0,3555
21	0,4311	0,4261	0,4212	0,4163	0,4114	0,4066	0,4019	0,3972	0,3926	0,3880	0,3835	0,3791	0,3747	0,3703	0,3660	0,3617	0,3575	0,3534	0,3493
22	0,4233	0,4184	0,4135	0,4087	0,4040	0,3993	0,3947	0,3901	0,3856	0,3812	0,3767	0,3724	0,3681	0,3638	0,3596	0,3554	0,3513	0,3473	0,3432
23	0,4157	0,4109	0,4062	0,4015	0,3969	0,3923	0,3878	0,3833	0,3789	0,3745	0,3702	0,3659	0,3617	0,3575	0,3534	0,3494	0,3453	0,3413	0,3374
24	0,4084	0,4037	0,3991	0,3945	0,3900	0,3855	0,3811	0,3767	0,3724	0,3681	0,3639	0,3597	0,3556	0,3515	0,3475	0,3435	0,3395	0,3356	0,3318
25	0,4014	0,3968	0,3923	0,3878	0,3833	0,3790	0,3746	0,3703	0,3661	0,3619	0,3578	0,3537	0,3497	0,3457	0,3417	0,3378	0,3339	0,3301	0,3263
26	0,3947	0,3902	0,3857	0,3813	0,3770	0,3727	0,3684	0,3642	0,3601	0,3560	0,3519	0,3479	0,3439	0,3400	0,3361	0,3323	0,3285	0,3248	0,3211
27	0,3882	0,3838	0,3794	0,3751	0,3708	0,3666	0,3624	0,3583	0,3542	0,3502	0,3462	0,3423	0,3384	0,3346	0,3308	0,3270	0,3233	0,3196	0,3160
28	0,3819	0,3776	0,3733	0,3691	0,3649	0,3608	0,3567	0,3526	0,3486	0,3447	0,3408	0,3369	0,3331	0,3293	0,3256	0,3219	0,3182	0,3146	0,3110
29	0,3759	0,3717	0,3674	0,3633	0,3592	0,3551	0,3511	0,3471	0,3432	0,3393	0,3355	0,3317	0,3279	0,3242	0,3205	0,3169	0,3133	0,3098	0,3063
30	0,3701	0,3659	0,3618	0,3577	0,3537	0,3497	0,3457	0,3418	0,3380	0,3341	0,3304	0,3266	0,3229	0,3193	0,3157	0,3121	0,3086	0,3051	0,3017

Constants:			
	-7,424	-0,1288	273,16
	4417	53,44	
	-2,927	-0,0044	
	0,04238	0,00071	

John Fleng Steffensen, 2002

Documents / Resources

	Loligo Systems OXY-REG Oxygen Analyzer and Regulator System [pdf] User Manual OXY-REG Oxygen Analyzer and Regulator System, OXY-REG, Oxygen Analyzer and Regulato r System