



OPERATION MANUAL

TT-MA ANALYSER

+ Dissolved Oxygen



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Safety Precautions

Before attempting to unpack, set up, or operate this instrument, please read this entire manual.


- Make certain the unit is disconnected from the power source before attempting to service or remove any component.
- Make certain the unit is disconnected from other sources of force or pressure (for example, pneumatic or hydraulic), before attempting to service or remove any component.
- Failure to follow these precautions could result in personal injury and damage to the equipment.






General

This manual contains basic information to be noted during installation, operation and maintenance. It is therefore essential that this manual be read by the contractor before installing and commissioning the system, as well as by the relevant operating personnel/owner of the unit. It must remain available for reference at all times. In addition to the general safety instructions under this main heading Safety Precautions, the special safety precautions outlined in other sections must also be observed.

Warnings used in this manual

This manual contains vital information relating to the safety of people and the environment, the analyser and any equipment attached. These statements are identified by the following symbols:

Danger Electric shock risk		Disconnect electrical supply before working on this equipment.
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 Danger	DANGER Refers to an imminent danger. Non-compliance can lead to death or extremely serious injury.
 Warning	WARNING Refers to a potential hazardous situation. Non-compliance can lead to death or extremely serious injury.
 Caution	CAUTION Refers to a potential hazardous situation. Non-compliance can lead to minor injury or property damage.
 Notice	NOTICE Appears in conjunction with safety instructions which may endanger the analyser and its operation if disregarded.
 Important	IMPORTANT Draws attention to supplementary information to make the work easier and ensure trouble-free operation. Markings which are affixed directly to the equipment must be observed without fail, and must remain full legible at all times.

Qualification and Training of Personnel

The personnel employed for installation, operation, inspection, and maintenance, must be suitably qualified for this work. The areas of responsibility, competence and supervision of the personnel must be precisely defined by the owner. Personnel who do not have the required know-how must be trained and instructed. In addition, the owner of the system must ensure that the relevant personnel are fully familiar with and have understood the contents of this manual. Should training be required please contact your Turtle Tough distributor

Important Safety Instructions

When installing and using this electrical equipment, basic safety precautions should always be observed, including the following:

 Danger	NOTICE Read and follow all instructions. Save these instructions.
 Warning	WARNING To reduce the risk of injury, do not permit children to use this product.
 Electric Shock Hazard	WARNING Risk of Electric Shock. Connect only to a suitable isolated, hard wired electrical outlet. It is recommended that the outlet is protected by an RCD (Residual Current Detector) or is in any event in compliance with all local electrical regulations. Do not bury electrical supply cable.
 Electric Shock Hazard	WARNING To reduce the risk of electric shock, replace damaged electrical cable immediately.
 Danger Electric Shock Hazard	WARNING To reduce the risk of electric shock, do not use an extension cable to connect the unit to an electric supply; provide a properly located outlet

Hazards due to Non-compliance

Failure to comply with the safety instructions may endanger not only people, but also the environment and the system.

The following hazards in particular may arise:

- Failure of major system functions.
- Failure of specified methods for maintenance and repair.
- Danger to people due to electrical, mechanical and chemical effects.

Safe Operation

The safety instructions contained in this manual must be observed.

The owner is responsible for ensuring compliance with local safety regulations.

Safety Instructions for the Owner/Operator

Danger due to electric current must be excluded. Refer to local electrical safety standards and regulations.

Installation, Maintenance and Inspection

The owner must ensure that all maintenance, inspection and installation work is undertaken by authorised and duly qualified personnel who have also studied this manual.



- Sensors must always be isolated before starting any work.
- Please be aware that the connected sensor(s) and the associated analyser may be controlling chemical dosing and as such shutting down the unit without due regard to the systems it is controlling can lead to chemical release.

Impermissible Modes of Operation

Usage other than as described in this manual will lead to the immediate cancellation of the warranty and any other manufacturer's liability.



Unauthorised Modification

Usage other than as described in this manual will lead to the immediate cancellation of the warranty and any other manufacturer's liability.



Chemicals

Should the sensor(s) be in contact with hazardous chemicals, great care must be taken when handling them.



CAUTION

When handling this equipment, the accident prevention regulations applicable on site must be observed and the specified personal protective equipment worn.

PPE: examples of protective clothing, gloves and goggles.



DANGER Fire hazard. No parts are suitable for use in a hazardous rated area.

IMPORTANT

Please unpack the equipment and ordered accessories carefully in order not to miss small parts. Immediately compare the scope of delivery to the delivery note. If there are any discrepancies, contact your Turtle Tough Representative.



Sensors

Health and Safety

Before making or breaking any electrical or signal connections, ensure that the instrument is isolated from the electrical supply. When handling the sensor please wear the appropriate PPE.



Environmental Considerations

Please use this product in a manner sensitive to the environment and at the end of its life dispose or recycle in a manner appropriate at that time that is in compliance with local regulations.

Introduction

Congratulations on purchasing a Turtle Tough TT-MAD Analyser System. Turtle Tough sensors are handmade with care and precision, combining state-of-the art technology and materials to deliver superior performance under extreme conditions. The TT-MAD Digital Modular Analysers have been specifically developed to achieve the optimum performance from your Turtle Tough Digital Sensor.

This instruction manual provides information for the correct installation and use of a Turtle Tough TT-MAD Analyser System to ensure you get the maximum life and performance.

Through our experience in the world's toughest applications we have developed systems that have been optimised for high hydrofluoric acid, saturated sodium, high sulphide, organic solvents, high temperature and slurry/viscous applications. Our application specific sensors include industrial, waste water, acid etching, Nickel, Gold, Titanium Dioxide, Food and Beverage and Pharmaceutical.

Please ensure that the system you are using is suitable for your intended application. You can locate your specific sensor in the sensor selection matrix, which can be found under support at: www.turtlesensors.com

System Contents

All Turtle Tough instruments undergo a thorough quality control and calibration before delivery and always include a detailed instruction manual.

Your TT-MAD System includes the following items:

- 110-240V AC Power Supply
- pH/ORP Analyser Module
- Dissolved Oxygen Analyser Module
- Conductivity Analyser Module
- Ion Selective Analyser Module
- Datalogger Module
- Temperature Module
- TOT pH Compensation Module
- Relay Module
- IP65 Enclosure
- pH/ORP Digital Sensor
- Dissolved Oxygen Sensor
- Conductivity Sensor
- Ion Selective Sensor
- User's manual

Installation



Danger
Electric
Shock
Hazard

As with all instrumentation the installation and commissioning of this instrument is crucial to its safe and effective operation. This instrument must only be used for its purpose as outlined in this manual. It must be installed and commissioned in accordance with this manual and by trained, qualified personnel.

Site Selection

Please choose a suitable location for the installation of the electronics. The choice of installation point on any site is a compromise and is best undertaken by an experienced installation engineer. The following is a list of the factors that need to be taken into consideration. This list is not intended as a check-list neither is it implied that the list is complete.



Important

- Ensure that the mounting allows access to all serviceable parts.
- Try to mount the electronics in a position where they are not habitually hosed down in a cleaning process.
- The electronics enclosure should be mounted away from sources of heat or direct sunlight.
- Consider the length of wiring runs when mounting the instrument.
- Try to keep the electronics away from substations, motors or other large EMI emitters.
- Consider whether the sample will be representative and well mixed.
- Consider sample line run times.
- Consider sample return points.
- In a plastic run, with a low conductivity liquid sample, consider earthing the sample.
- If the instrument is controlling a dosing pump, size the pump appropriately.

Note: This list is not intended as a check-list neither is it implied that the list is complete.

Unpacking

- Please have a copy of your order with you when you unpack your instrument.
All orders are checked when they leave the factory.
- Please check that you have all the parts that were ordered as soon as you open the box.
- If anything is missing, or damaged, please contact your sales outlet immediately.
- If the instrument needs to be returned for any reason please follow the return instructions given in this manual.
- Please dispose of the packing in an environmentally responsible manner and in compliance with local regulations.



Important

GALVANIC DISSOLVED OXYGEN (DO) ANALYSER MODULE



Specifications

Power supply	24VDC \pm 10%
Consumption	60 mA max
Resolution	0.01 ppm anywhere in the range
Galvanic Sensor	1.0-6.0 mV per ppm
Response Range	0.25-2.50 mV per % saturation
Accuracy	\pm 1% Excluding Sensor (Ideal)
Temp Sensor	Pt100, Pt1000
Temp Range	0-50°C \pm 0.2°C
Temp comp	Automatic in all configurations
Analogue output	0-20mA or 4-20mA, max. 500 Ω
Housing	Lexan UL94V-0 (Upper part) Noryl UL94V-0 (Lower part)
Mounting	M36 for 35 mm DIN rail
Ip class	Housing IP40. Connector IP20
Connector	Max 16A. Max 2.5mm ² Max torque 0.6 Nm
Temperature	Usage -15 to +50 °C (Storage -35 to +75 °C)
Weight	75 grams (2.64 ounces)
Dimensions	L 86 x W 36 x H 58 mm (3.4" X 1.4" X 2.3")
Ce mark:	EN61326A

Sensor Theory of Operation

A membrane-type dissolved oxygen sensor using a galvanic cell consists of a:

- Cathode
- Anode
- Electrolyte which is an alkaline solution
- Membrane which is highly oxygen-permeable and usually Teflon

Oxygen is consumed by the cathode which will create a partial pressure across the membrane. Oxygen then diffuses into the electrolyte solution. In short, a Dissolved Oxygen meter actually measures the pressure caused by movements of oxygen molecules in water or any other medium. Galvanic Electrodes produce a millivolt output directly proportional to the oxygen present in the sample. The electrode reaction is instantaneous and a result is obtained immediately.

In theory, the amount of Dissolved Oxygen in a solution is dependent on three factors, namely temperature, salinity and atmospheric pressure.

1. Temperature

Solubility of oxygen reduces as temperature increases. Hence, the colder the water, the more dissolved oxygen it contains. Since temperature affects both the solubility and diffusion rate of oxygen, temperature compensation is necessary for any standardised DO measurements.

2. Salinity

The amount of dissolved oxygen increases as salinity level decreases. In other words, freshwater holds more oxygen than saltwater. Since the presence of dissolved salts limits the amount of oxygen that can dissolve in water, the relationship between the partial pressure and concentration of oxygen varies with the salinity of the sample.

3. Atmospheric Pressure

There is a direct proportional relationship between the solubility of dissolved oxygen and the surrounding atmospheric pressure. As pressure decreases with increase in altitude, the amount of dissolved oxygen found in water reduces.

Electrical and Sensor Connections

Installation

As with all instrumentation, the installation and commissioning of this sensor is crucial to its safe and effective operation. This sensor must only be used for its purpose as outlined in this manual. It must be installed and commissioned in accordance with this manual and by trained, qualified personnel.



Sensor Site Selection

Please choose a suitable location for the installation of the sensor. The choice of installation point on any site is a compromise and is best undertaken by an experienced installation engineer. The following is a list of the factors that need to be taken into consideration.



- Ensure that the sensor is positioned to ensure adequate flow.
- Avoid installing the sensor within 1m of any dosing point.
- Minimise all potential sources of electrical interference.
- Static and Ground Loop Faults can damage the sensor or cause erroneous readings and all precautions should be taken to avoid them.

Note: This list is not intended as a check-list neither is it implied that the list is complete.

Unpacking

- Please have a copy of your order with you when you unpack your instrument. All orders are checked when they leave the factory.
- Please check that you have all the parts that were ordered as soon as you open the box.
- If anything is missing, or damaged, please contact your sales outlet immediately.
- If the instrument needs to be returned please follow the return instructions given in this manual.
- Please dispose of the packing in an environmentally responsible manner and in compliance with local regulations.



Mounting

A Turtle Tough Dissolved Oxygen Sensor has been engineered for installation into industrial processes. Use within the specifications is highly recommended to obtain optimal sensor life.



Care should be taken to avoid any moisture ingress through the cable inlet/outlet.

All Dissolved Oxygen Sensors can be installed in-line. Submersible installation is also possible provided adequate waterproofing is selected at time of order or adequate sealing is made between the sensor and installation hardware at time of installation for example.

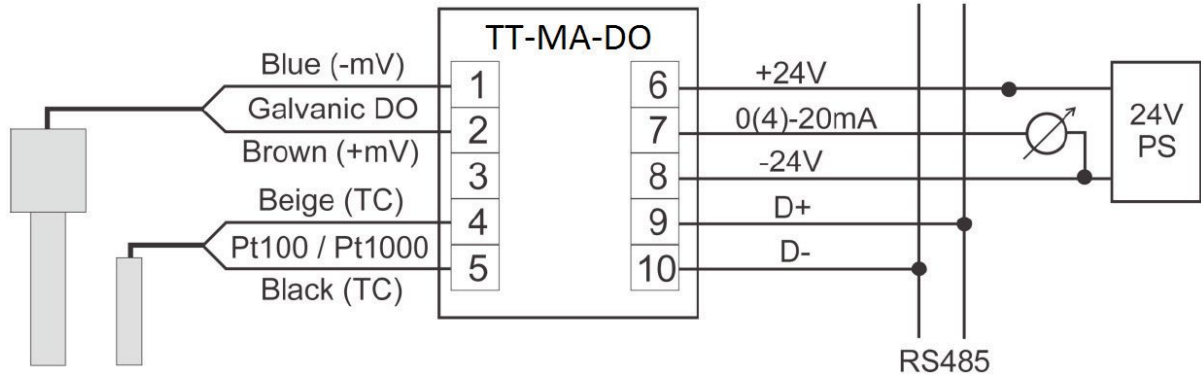
Turtle Tough has a range of installation hardware available as optional accessories including but not limited to Stainless Steel Immersion Rods, Stainless Steel Sanitary Sensor Holders and Extension Tubes and Valve Retractable Assemblies.

Contact your Turtle Tough Distributor for technical support on the optimal installation hardware to suit your application.

Please Note: Avoid excessive force when installing Dissolved Oxygen Sensors.

Wiring

Wiring of a Dissolved Oxygen Sensor to the TT-MA is as follows:

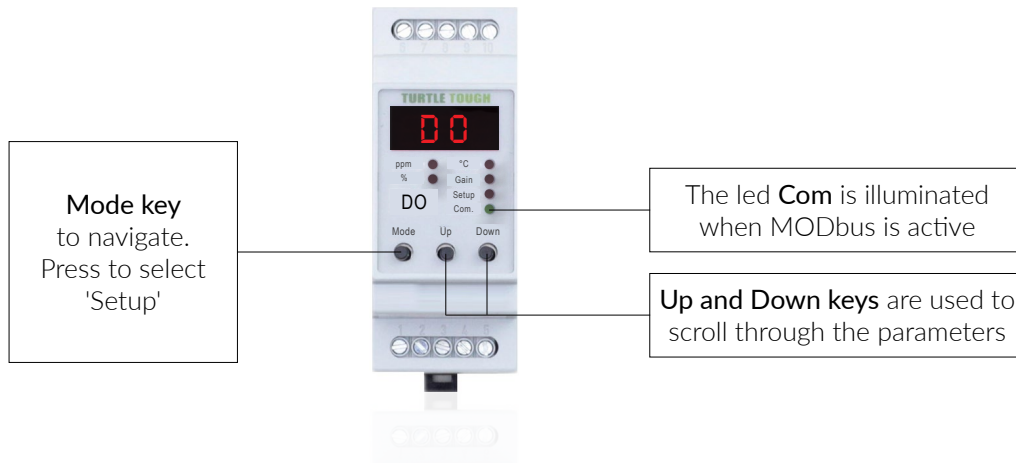


Note:

1. Please consult the Turtle Tough website turtletoughsensors.com for additional wiring information.

Menu Navigation

The TT-MAD Analyser Module has a 3 digit display and 6 LEDs for setup and displaying values. The *Mode* key is used to navigate. The LED marked *Com* is illuminated when MODbus is active. Programming the module is accessed by use of the 3 keys located on the front panel. The *Mode* key is for selecting setup and the *Up* and *Down* keys are used to scroll through the parameters. To adjust a parameter select it with the *Mode* key then modify the value using the *Up* and *Down* keys.



Important

Lock Function (IMPORTANT)

Please note: Parameter No. 01 is a LOCK function which MUST be turned OFF to change ANY parameter. The default for the lock is ON. Once the lock is OFF, if there is a period of inactivity for 60 seconds the lock then defaults back to ON.

Function and Programming

No	Parameter	Description	Range	Default
01	Lock	Software Lock	On / Off	On
02	Address	MODbus	Off, 1...247	Off
03	Temperature	Type of Input	Set, Pt100, or Pt1000	Pt100
04	Manual Temp	Fixed Temp	0...50	25
05	Barometric Air Pressure	pressure in mm Hg units	600 to 900	760
06	Salinity	PSU Units	0 to 50	0
07	Wire Gauge	Sensor AWG	20, 22, 24	20
08	Cable Length	Length in feet	1...999 feet	23
09	% Saturation Computation	Computation % Saturation	Automatic or Manual	Auto
10	Manual Saturation	ppm for 100% Saturation	4.0 to 40.0 ppm	10.0
11	Input for lout	Input used for output	DO ppm or % Saturation	DO ppm
12	lout	Type of output	4-20mA, 0-20mA	4-20mA
13	lout mode	lout mode	Non-inverted, inverted	Non-inverted
14	0/4mA Set	Low Set point	0%-90% of Full Range	0%
15	20mA Set	High Set point	10%-100% of Full Range	100%
16	Working Gain (Slope)	Gain/Cal on DO Cell	± 50% from Nominal	1.10mV
17	0/4mA Offset	Trim Low	±9.99%	0.00
18	20mA Gain	Trim High	±9.99%	0.00
19	Energy Save	Energy Save	On / Off	On
20	Baud rate	MODbus	9,600/19,200	19,200
21	Reset to Default	Reset to Default	Def = Reset, Par = No Reset	Par

Parameters Explained

To access the programmable parameters see Menu Navigation.

The following is a description of each parameter settings.

Parameter	Description
P01	Software lock. If the software lock is set to ON the parameter can only be read. Set Software Lock to OFF to change values.
P02	Sets the module's address for MODbus communication.
P03	Indicates the sensor type for the temperature input.
P04	Sets the temperature when temperature compensation of the DO measurement is set to manual mode.
P05	Sets the ambient barometric air pressure in units of mm of Hg. This value is used in the gain calibration and for calculating the % DO saturation.
P06	Input for the salinity of the process sample in units of PSU.
P07	Input for the wire gauge (AWG) for the sensor cable used.
P08	Input for the length of sensor cable in units of feet.
P09	Sets the scheme used to compute % saturation. The default automatic mode takes the measured DO in ppm units and computes the % saturation against the stored theoretical value at the given temperature, ambient air pressure and salinity. Manual mode uses a fixed DO ppm value for this computation.
P10	Defines the DO ppm that constitutes 100% saturation condition when P09 is set to manual mode.
P11	Selects the analogue output (and MODbus output mode if present) of the dissolved oxygen (DO) analyser in units of ppm or % saturation and these units are also used for P14 and P15. between P11 and P12 must be at least 10% of full range scaling per parameter P21.
P12	Sets the analogue output to either 0-20 mA or 4-20 mA
P13	Allows setting the output to be inverted (i.e. for use in control) with the output corresponding to 20-0mA or 20-4mA
P14	Sets 0/4mA output scaling in DO ppm or % sat units.
P15	Sets 20mA output scaling in DO ppm or % sat units. The difference between low and high output set points (P14 & P15) must be at least 10% of full range scaling in the chosen units.
P16	Displays the result of the gain calibration and also allows manual modification. Units are mV per ppm.
P17	Offset adjustments for 0/4mA low analogue output trim
P18	Gain adjustment for 20mA high analogue output trim
P19	If no keys are pressed for 10 minutes the display will show a flashing bar (Energy Save). Pressing any key to return
P20	The MODbus standard requires a baud rate of 9,600 or 19,200 set in accordance with the MODbus master
P21	Feature to reset the analyser back to factory default

Calibration

Calibration of the system is performed in two parts – Temperature and DO Sensor.
Ensure software lock is **Off** prior to commencement.

Using **Mode** select **Gain**. Before removing the DO sensor from service, the TT-MA-DO should be placed into the gain calibrate mode. The gain calibration is performed when the sensor is clean and dry and exposed to only air. In cases where the relative humidity is not 100%, the sensor should be suspended in air over a source of water for best results.

Sufficient time must be allowed for the temperature and sensor reading to be fully stabilised in this condition to ensure a good calibration. The TT-MA-DO analyser determines from the temperature (measured or entered) together with the entered barometric pressure the theoretical 100% saturated DO ppm value.

Temperature Calibration

Ensure software lock is **Off** prior to commencement.

The temperature is calibrated with the **Up** or **Down** keys in the temperature display (°C) mode.

This should be done against the sensor body temperature (established by an external device) and after the internal temperature compensator has had sufficient time to reach the operating environment temperature.

DO Sensor Calibration

Ensure software lock is **Off** prior to commencement.

Auto Calibration Routine

To initiate an automatic calibration, simultaneously hold the **Up** & **Down** keys until the display flashes CAL.

After eight seconds, the unit will either return a value of **Go** to indicate success or **Err** to indicate a failed calibration.

You must press **Mode** to exit the automatic calibrate mode.

Manual Calibration Routine

For a manual gain calibration, adjust using the **Up** or **Down** keys until the display reads **exactly 0.0**.

Positive deviations are shown as X.X or XX. Negative deviations are shown as -X.X or -XX.

If a positive value is shown adjust using the **Down** key and if a negative value is shown adjust with the **Up** key.

You must press the **Mode** key to exit the manual calibrate mode.

Cleaning and Maintenance of a Turtle Tough DO Sensor

IMPORTANT NOTE BEFORE CHANGING MEMBRANE!

The TT-MA-DO sensor should not be taken apart for service unless the membrane is damaged, the response (slope) is significantly reduced by fouling or deposits on the membrane that cannot be cleaned off. This is typically only the case after some prolonged period of use or an exceedingly aggressive process condition during a shorter time.

PREPARATION FOR CHANGING MEMBRANE

Unscrew the cap, rinse with water and clean the anode ONLY with a PLASTIC scouring pad.



Important

NEVER USE A METAL SCOURING PAD ON THE ANODE!

If the cathode is tarnished it can be cleaned with a 600 grade wet or dry paper.

DO NOT POLISH THE CATHODE!

QUICK TEST

After the anode and (if necessary the cathode) was cleaned it is possible to perform a simple test to ensure the integrity of the sensor. Dry the top part of the sensor quite thoroughly, especially the cathode and the area surrounding it. Measure the output of the sensor when connected to the mating TT-MA dissolved oxygen transmitter. It should show zero ppm on the display. If your display does not read zero (or very near zero) contact factory for assistance.

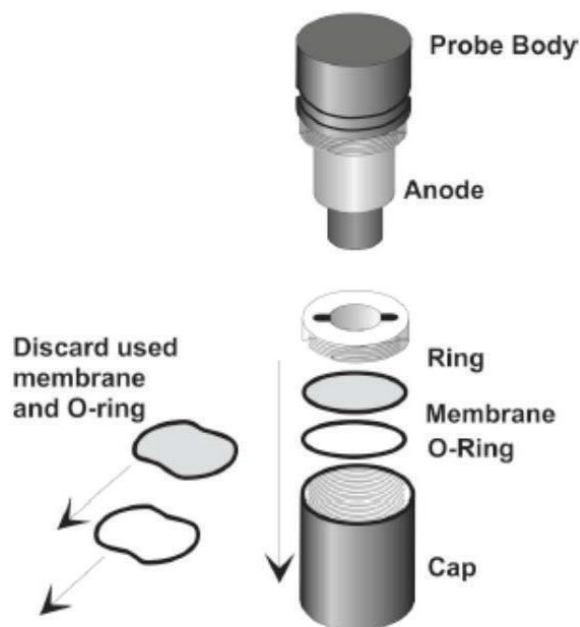
Membrane Replacement Procedure

See drawing to right for all referenced components in instructions:

1. Use the tool provided to unscrew the ring
2. Remove the used membrane and O-ring
3. Rinse the cap and ring. Dry both parts thoroughly
4. Put a new O-ring in the bottom of the cap
5. Put a membrane on top of the O-ring
6. Replace ring and tighten it firmly with the supplied tool

Precautions and Caveats:

- It is very important that all parts must be clean and dry before performing this procedure.
- Membrane must not be wrinkled before or after it is installed. If the membrane is wrinkled at any point in time it must be replaced with a new membrane immediately.
- Fill the cap to the brim with electrolyte. Hold probe upright and slowly screw on cap until it is completely flush. Some electrolyte solution may leak out during this step.
- Wait one hour before performing a calibration after changing the membrane. For best results calibrate once again approximately 24 hours after membrane is changed as the galvanic dissolved oxygen cell will have reached full equilibrium by this point in time.



Spare Parts

Suggested spare parts are Membranes, O-rings, and Electrolyte. Stock of these parts will enable you to replace a damaged membrane in a few minutes. If desired you can also stock a spare sensor in which case you will then be able to replace a sensor that is accidentally mechanically destroyed, damaged, or lost. A spare sensor can be kept ready-to-use for years at a time if stored in the proper manner and conditions. Spare sensors should be stored in a cool, dry place without any electrolyte (filling solution) in the cap (completely dry). When a dry, unfilled spare sensor is taken from stock for use, follow the steps outlined on the previous pages to prepare it for installation.

A stock of one or more spare caps will make it easy to renovate sensors with damaged or “old” membranes. You can also keep one or more spare anodes.

Part Number	Description
TT-ACC-DO-MEM	Set of 10 each membrane with small O-rings
TT-GP1-DO-Cap	Cap for TT-DO membrane
TT-ACC-DO-G	Membrane protector
TT-ACC-DO-ELEC	125 ml Electrolyte (Filling Solution)
TT-ACC-DO-ELEC-L	1 Litre Electrolyte (Filling Solution)
TT-DO-INLINE	Inline Low-Flow Cell Adapter TT-DO sensors for ¼” Process Lines
TT-DO-TOOL	Membrane ring removal tool

MODbus Communication Output

MODbus communication is an option for the Galvanic Dissolved Oxygen Analyser Module and must be specified at time of order. Turtle Tough Analyser Modules may be used as a slave for the Datalogging Module or as a slave in a SCADA data acquisition system. The setup and communication for each case is explained below.

Datalogging Module and MODbus

If the Dissolved Oxygen Module is used with the Datalogging Module, the baud rate on the Dissolved Oxygen Module as well as the address should be noted. The baud rate (P20) must be set to the baud rate of the Datalogging Module. Whether a baud rate of 19,200 or 9,600 is used is of no importance, as long as all units connected to the Datalogging Module are set to the same baud rate.

The address (P02) must be unique in the network; Two units cannot have the same address. In a network with the Datalogging Module as the master, all addresses must be assigned in series; i.e. if 3 units are connected the addresses 1, 2 and 3 must be assigned to the three units. The order of the addresses is of no importance. In a network with a Datalogging Module, up to 63 Analyser Modules (slaves) may be connected.

SCADA System and MODbus

The baud rate (P20) must be set to the baud rate of the SCADA system. The address (P02) must be unique in the network and up to 247 Analyser Modules may be connected on a single network.

MODbus Scaling

MODbus scaling for Dissolved Oxygen process measurement is the same as the analogue output set by P14 & P15. The DO ppm and % saturation are sent via MODbus scaled together with a 10-fold factor, keyed by the units selected in P11. If P11 is DO ppm and scaled as 2-10 ppm, the corresponding % saturation will be 20-100 %. If P11 is DO % saturation and scaled as 50-200%, the corresponding DO ppm will be 5-20 ppm. Temperature is always scaled as 0-100 °C.

The Galvanic Dissolved Oxygen Analyser Module contains 2 measured values (Dissolved Oxygen ppm and temperature) and 1 computed value (% saturation).

Access is gained through the function code Read_Input_Registers (04).

Read Input Registers

Function Code	Start Address	Number of Values
04	1	1 or 2

Value 1 is DO in ppm units,

Value 2 is the DO in % saturation units

Value 3 is Temperature

All three values are transmitted in sequence; If 3 values are chosen then DO ppm, % saturation and temperature are transmitted. All values are rated to 0-1000 corresponding to the scaled range; the scaled DO ppm range is sent as 0-1000, the % saturation (always 10 times the DO ppm scaling) as 1024-2024 and finally the full scale temperature range (0-100 °C) is transmitted as 2048-3048.

The Module gives access to different diagnostic values as well via Diagnostics (08) as shown in the table below.

Function Code	Sub Code (HEX)	Description
08	00	Return Query Data
	0A	Clear counters and diagnostics register
	0B	Return Bus Message Count
	0C	Return Bus Message Communication Error
	0D	Return Exception Error count
	0E	Return Slave Message count
	0F	Return Slave No Response count
	12	Return Bus Character Overrun count

WARRANTY

Product Warranty

Every Turtle Tough product is thoroughly inspected and tested before leaving the factory and prior to shipping. In addition to any statutory rights and remedies you may have, Turtle Tough warrants all of its products against defective workmanship and faulty materials for 12 months from the date of purchase and undertakes, at its option, to repair or replace, free of charge, each product or part thereof on condition that:

- The complete product is returned to Turtle Tough or one of its authorised service agents, in person or freight pre-paid by you, and found, on examination, to be suffering from a manufacturing defect;
- The product or relevant part has not been subject to misuse, neglect, or been involved in an accident; and
- The repairs are not required as a result of normal wear and tear.
- Damage caused by wear and tear, inadequate maintenance, corrosion, or by the affects of chemical processes is excluded from this warranty coverage

The above warranty excludes sensors. Please see sensor warranty below.

Sensor Warranty

Turtle Tough sensors are electrochemical devices and as such have a limited operating life. Life expectancy depends on the field of application such as the medium, pressure and temperature. It can vary between a number of weeks to several years. There are special cases in extreme environments where operating life will only be a few days. Characteristic and response time will also change with aging. As such electrochemical sensor are articles of consumption and are not subject to a common guarantee. Replacements or exchanges are generally excluded unless a manufacturing defect is determined to be the cause. It is not possible to predict the rate of deterioration for a particular process, nor can we provide a guarantee on sensor life because it is impossible to predict the rate of exposure, contamination and deterioration. Damage caused by wear and tear, inadequate maintenance, corrosion, or by the effects of chemical processes is excluded from this warranty coverage. Our agents or representatives may provide you with a life expectancy guide based on similar applications we have experienced; however this in no-way constitutes a warranty of performance and is a general indicator.

Shelf Life Warranty

The standard shelf life for a Turtle Tough Sensor sensors is one year from the date of shipment. Sensors stored longer than this period may still be functional but are no longer under warranty. Sensors should be stored in a cool, dry location with the sensor tip (where the pH/ORP element is located) oriented toward the ground. All pH/ORP/ISE sensors come standard with a conditioning solution in the cap. This conditioning solution is 50% pH 4 buffer and 50% saturated potassium chloride (mixed by volume). The sensor cap should be keep tightly affixed to the sensor body and sealed with common piping teflon tape when the sensor is not in use. Sensors that are to be returned for shelf life warranty claim must have the original sensor cap and conditioning solution intact to be eligible for warranty replacement.

Blown Preamplifiers (Preamps)

Damaged preamplifiers are not covered under warranty. Preamps are electrical devices that are sensitive to electrostatic discharge. Sensors with preamps are clearly marked and extra care must be taken when handling these sensors as human contact with the electrical connections can discharge static to the preamplifier causing it to blow. This will render the product inoperable. Sensors with preamplifiers undergo additional quality checks prior to shipment to ensure that preamplifiers are 100% operational upon delivery. Ground loop or analyser problems may also cause blown preamplifiers and damage to sensors by faulty installations is not covered by warranty.

RETURN GOODS

For all return goods the following information must be included in the letter accompanying the returned goods:

- Model Code and Serial Number
- Original Purchase Order and Date
- Length of time in service and description of the process
- Description of the fault and circumstances of the failure
- Process/environmental conditions that may be related to the failure of the sensor
- Statement as to whether warranty or non-warranty service is requested
- Complete shipping and billing instructions for return of material, plus the name and phone number of a contact person that can be reached for further information
- Clean Statement: returned goods that have been in contact with process fluids must be decontaminated and disinfected prior to shipment. Goods should carry a certificate to this effect, for the health and safety of our employees. Material Safety Data sheets must be included for all components of the process to which the sensor(s) have been exposed.

All sensor returns are to be accompanied by a completed Return Material Authorisation Document clearly stating the reason for the return and the with the Clean Statement Return filled in.

See the warranty and returns section under support on our website turtleoughsensors.com for details.

IMPORTANT!

Please note that for sensors, cables must NOT be cut or this will void the warranty. The cable contains a unique identifier laminated to the cable end, and if this is removed we have no way of tracing the product. Sensors dying or expiring in the course of use is not covered by the product warranty.

SUPPORT

For technical support please contact our head office **1300 781 701** or visit our website turtleoughsensors.com for information on sensor care, calibration, wiring and installation related issues.