FIELD MICROOPTODE METER USER MANUAL

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UNISENSE A/S

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WARRANTY AND LIABILITY

This product is for research use only. Not for use in human diagnostic or therapeutic procedures.

WARNING
Microsensors have very pointed tips and must be handled with care, to avoid personal injury, and only by trained personnel.
Unisense A/S recommends users to attend instruction courses to ensure proper use of the products.

WARRANTY AND LIABILITY
The Field MicroProfiling System is covered by a one year limited warranty.

The warranty does not include repair or replacement necessitated by accident, neglect, misuse, unauthorized repair, or modification of the product. In no event will Unisense A/S be liable for any direct, indirect, consequential or incidental damages, including lost profits, or for any claim by any third party, arising out of the use, the results of use, or the inability to use this product.

REPAIR OR ADJUSTMENT
Sensors and electrodes cannot be repaired. Equipment that is not covered by the warranty will, if possible, be repaired by Unisense A/S with appropriate charges paid by the customer. In case of return of equipment please contact us for return authorization.

For further information please see the documents General Terms of Sale and Delivery of Unisense A/S, and Warranty and Shipping Information as well as the manuals for the respective products.

SENSORTRACE SUITE SOFTWARE
Unisense SensorTrace Suite software is checked and validated for the Windows platform as given in the specification.
Customer must ensure PC is fully updated and no conflicting third party software is installed. Unisense do not warrant compliance with any other operating systems, language settings or third party software.

For instrumentation and sensors, please refer to our warranty conditions as given in the document "General Terms of Sale and Delivery of Unisense A/S" found on www.unisense.com

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The following terms shall apply to the software provided by Unisense A/S ("Unisense") in connection with the simultaneous sale to you ("Customer") of a Unisense SensorTrace Suite Software.

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CONGRATULATIONS WITH YOUR NEW PRODUCT

The Field MicroProfiling System uses Unisense Microsensors which are miniaturized Clark-type sensors that facilitate reliable and fast measurements with a high spatial resolution designed for research applications in the field and laboratory.

SUPPORT, ORDERING, AND CONTACT INFORMATION

If you wish to order additional products or if you encounter any problems and need scientific/technical assistance, please do not hesitate to contact our sales and support team. We will respond to your inquiry within one working day.

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Further documentation and support is available at our website: www.unisense.com

Note: If you find errors in this manual or have suggestions to improvements, do not hesitate to contact us at sales@unisense. com

OVERVIEW

The Field MicroOptode Meter is used together with Field MicroOptodes and is built for outdoor use. The Field MicroOptode Meter housing and fiber connectors as well as the Field MicroOptodes can be fully submerged in water.

Unisense offers two types of Field MicroOptode Meters:

1. Field MicroOptode Meter: is connected to the Field Microsensor Multimeter. It is waterproof to 30 m depth.

2. Field MicroOptode Meter for DeepSea: is connected to the Field DataLogger and is rated to a water depth of 4000 m.

Both types of Field MicroOptode Meters are based on the same technology where only the casing and cables are different. It uses the latest near infrared technology and has a good signal to noise ratio and a fast response time. The Field MicroOptode Meter can also be connected to the Field DataLogger and the Field MicroOptode Meter – DeepSea to the Field Microsensor Multimeter by using special cables (can be ordered separately).

When you connect the Field MicroOptode Meter to your Field Microsensor Multimeter or Field DataLogger, new features that are specifically related to the Field MicroOptode Meter, will be available in the (Remote) User Interface. In this manual, we will describe the function of these new features. General information on how to use the Field Microsensor Multimeter is found in the Field Microsensor Multimeter user manual. General information about the Field Data Logger is found in the MP4/8 MicroProfiling System manual.

PROPERTIES OF THE FIELD MICROOPTODE METER

- Waterproof to 30 meters

- 2 Field MicroOptode channels

- Individual temperature channel for each optode for live temperature compensation

- Operated via Field Microsensor Multimeter or Field DataLogger with firmware v2.2.0 or newer

- Special waterproof MicroOptode connections and cables

- Samples optode data with up to 10 Hz

- Simple two-point calibration

- SensorTrace Suite software v2.8.0 or newer is used for operation and data download

PROPERTIES OF THE FIELD MICROOPTODE METER FOR DEEPSEA

- Waterproof to 4000 meters

- Built-in temperature sensor for live temperature compensation

- Operated via Field DataLogger or Field Microsensor Multimeter with firmware v2.2.0 or newer

- Special waterproof MicroOptode connections and cables

- Sample optode data with up to 10 Hz

- Simple two-point calibration

- SensorTrace Suite software v2.8.0 or newer is used
  for operation and data download

Software for Field MicroOptode Meter

SensorTrace Logger is our freeware for data acquisition and visu-
alization. Field MicroOptode measurements can be calibrated and
saved directly in SensorTrace Logger when the Field Microsensor
Multimeter or the Field DataLogger is connected to the PC.

Field Optode data collected on the Field MicroSensor Multimeter
or the Field DataLogger using Logger sequence templates or by
custom sequences made in Programming Tool can be downloaded
to the PC using SensorTrace Logger. All data can be exported into
Excel or CSV files.

SensorTrace Profiling is the profiling program from SensorTrace
Suite. Profiling experiments can be operated directly and saved in
SensorTrace Profiling when the Field Microsensor Multimeter or
the Field DataLogger is connected to the PC.
Field MicroOptode data collected by Profiling 1D, Profiling 2D
sequence templates or custom sequences made in Programming
Tools can be downloaded on to the PC using SensorTrace Profiling.
SensorTrace Profiling stores and visualizes the measurements and
calculates consumption and production rates from the measured
profiles. All data can be exported into Excel or CSV files.

Programming Tool is freeware and part of the SensorTrace Suite software package. It contains the Remote User Interface for the Field DataLogger. For more advanced use, you can program custom sequences that can be uploaded to the Field Microsensor Multimeter or the Field DataLogger (Firmware version 2 or later). All data stored on the Field Microsensor Multimeter and the Field DataLogger can be downloaded using Programming Tool and exported into Excel or CSV files. In this manual, we will briefly describe how to use Programming Tool together with the Field MicroOptode Meter. A detailed description on how to use Programming Tool can be found in the Programming Tool manual.
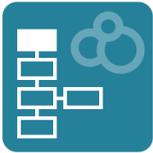
MINIMUM COMPUTER REQUIREMENTS

- 2 GHz PC

- Windows 7 or newer, 32 bit/64 bit

- 200 MB free hard disk space

- Ports to connect Unisense instruments

- 4 GB RAM

- Screen resolution 1280 x 800

GETTING STARTED

In this section we will briefly describe how to operate the Field MicroOptode Meter.

SET-UP FOR FIELD WORK

1. Update your Field Microsensor Multimeter or Field DataLogger with the latest firmware version available and install the latest version of SensorTrace Suite on your computer. Both the Firmware and SensorTrace Suite are available for download on the Unisense website: http://www.unisense.com/Software_download/

2. Connect the Field MicroOptode Meter to Serial Port 1 on the Field Microsensor Multimeter or Field DataLogger.

3. If you are using a Field DataLogger, connect it to a computer with the provided cable. Open Programming Tool and select the Remote User Interface:

4. In the Sensor Window, verify that the instrument recognizes the Field MicroOptode Meter. Four new channels should appear (two Optode channels and two Temperature channels) at the bottom of the Sensor window.

5. Check that red flashing light is visible from both microoptode ports on the Field MicroOptode Meter.

6. Connect a Field MicroOptode and a Temperature Sensor to the Field MicroOptode Meter (the Deep Sea version has a built-in temperature sensor).

IMPORTANT
It is important to connect the Field MicroOptode to channel 1 on the Field MicroOptode Meter and the Field MicroOptode Meter to Serial Port 1 on the Field Microsensor Multimeter or Field DataLogger if you plan to use the Logger-, Profiling 1D – or Profiling 2D sequence templates. Other channels and Serial Ports can be used when using custom-made sequences, programmed in Programming Tool.

7. A red light will flash at the tip of the MicroOptode.

8. Verify that the raw signal read by the Optode channel is in the range between 15° and 60° with a standard deviation below 1°. Temperature sensors are pre-calibrated, but verify that the temperature reading is correct.

9. Now the instrument is ready to calibrate the Field MicroOptode.

Calibration of the Field MicroOptode

1. Enter the calibration menu for each active MicroOptode.

2. Add the sensor and calibration parameters.

3. Prepare calibration solutions and calibrate the MicroOptode at 100% and 0% air saturation, respectively. Make sure the sensor reacts as described in the sensor manual.

4. Once all sensors are calibrated they are ready to be used. The unit of the calibrated oxygen concentration is µmol/L.

Autonomous Deployment e.g. a Profiling 1D

1. Make a sequence in the Sequences window e.g. a Profiling 1D sequence. For the profiling sequences a motor is needed.

2. Place the instrument at the study site.

3. Move the motor to the start position.

4. In the Motor window select RESET POSITION in the menu for Motor 1.

5. To start the autonomous sequence, enter the Sequences window and activate the sequence by selecting MARK AS ACTIVE. The active sequence can be started directly from here by selecting RUN or

Run without delay. On the Field Microsensor Multi-meter the sequence can also be started by pressing the Start button. On the Field DataLogger the sequence is started when the Start Plug is inserted in the Field DataLogger.

Data export using SensorTrace Profiling

1. Connect the Field Microsensor Multimeter or the Field DataLogger to the computer

2. Start SensorTrace Profiling. Select File and Download Profiling experiment from device.

3. Select the deployment(s) you want to download. Profiling experiments are downloaded as .upro files.

4. Make your post data analysis of your profiles in SensorTrace Profiling.

5. All data and calculations can be exported into Excel or CSV files.

Set-up for lab work

For lab work, SensorTrace Suite can be used to calibrate the Field MicroOptodes, visualize and log live optode and temperature data. Connect the Field Microsensor Multimeter or Field Data Logger to the computer and open SensorTrace Suite. In the Settings window, make sure the software has recognized the Field MicroOptode and Temperature sensor.
For further information on how to calibrate the Field MicroOptode and log data using SensorTrace Suite go to the SensorTrace Suite Manual.

FIELD OPTODE USER INTERFACE

When a Field MicroOptode Meter is connected to the Field Microsensor Multimeter or a Field DataLogger, new features will be available in the Sensor Window of the (Remote) User Interface.

Below we will describe the functions of these new features. General information on how to use the Field Microsensor Multimeter is found in the Field Microsensor Multimeter user manual. General information on how to use the Field DataLogger is available in the MiniProfiler MP4/8 Micro-profiling System Manual.

SENSORS

Channel 5		-
Std. dev.		-
Amperometric		-

Channel 6		-
Std. dev.		-
Potentiometric		-

Channel 7		-
Std. dev.		-
Potentiometric		-

Channel 8		-
Std. dev.		-
Temperature		-

FOM 1 - Channel 1 - Optode		21.96 °
Std. dev.		0.05 °
Oxygen		255.63 µmol/L

FOM 1 - Channel 1 - Temperature		25.50 °C
Std. dev.		0.02 °C
Temperature		25.50 °C

FOM 1 - Channel 2 - Optode		21.55 °
Std. dev.		0.10 °
Oxygen		331.25 µmol/L

|		
FOM 1 - Channel 2 - Temperature		25.59 °C
Std. dev.		0.02 °C
Temperature		25.59 °C

When connecting the Field MicroOptode Meter to a Field Data-Logger or Field Microsensor Multimeter four new channels will appear (two Optode channels and two Temperature channels) at the bottom of the Sensor window – you might have to scroll down the Sensor window to find them. The raw MicroOptode signal is shown in degrees and should range between 15° and 60° with a standard deviation below 1°. Calibrated signals are expressed as µmol/L. Temperature sensors are pre-calibrated, but make sure that the temperature reading is correct using a thermometer.

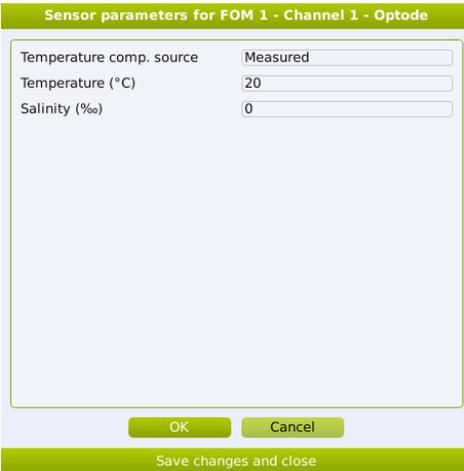For each optode channel the calibration and sensor parameters can be set.
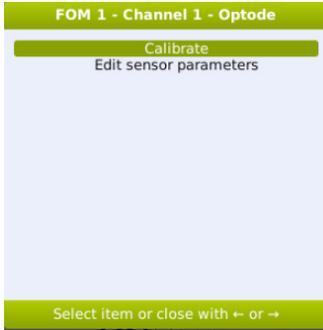
CALIBRATE AND SENSOR PARAMETERS

In the Calibration window, 'Calibration parameters …' and 'Sensor parameters …' should be set before starting the MicroOptode calibration. After calibrating the MicroOptode, the 'Calibration parameters' cannot be changed. If you need to change the 'Calibration parameters …', first press DISCARD, then enter the correct calibration parameters, and finally make a new calibration. Field MicroOptodes can be calibrated both in air and in liquid. After calibration, the measurements are expressed in µmol/L assuming the measurements are performed in a liquid solution.
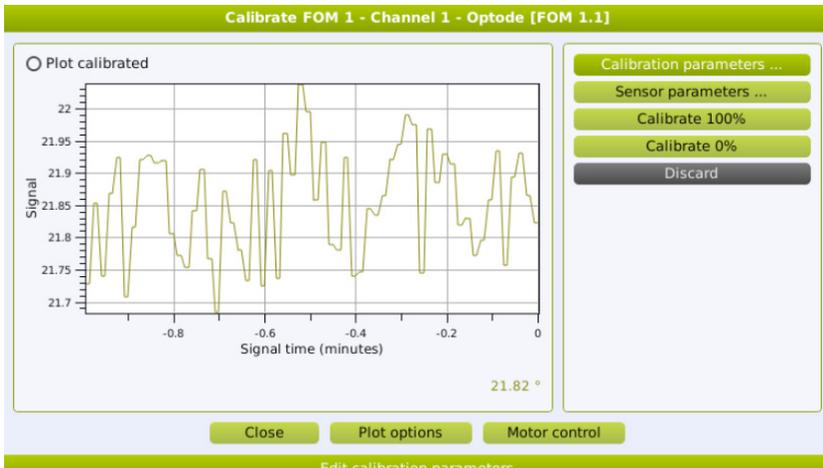
Sensor parameters

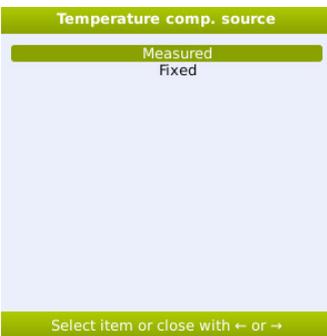Here you add information about the environment the MicroOptode will measure in.

Temperature comp. source: The correct temperature at the optode tip is needed for accurate measurement of the oxygen concentration. The temperature source can be set in this menu. When the Temperature sensor is used select MEASURED. If you are working at a fixed temperature e.g. in a water bath, select FIXED and add the correct temperature in the TEMPERATURE line.

Temperature (°C): When working at a fixed temperature add the working temperature here.

Salinity (‰): Write the salinity in the sample solution. The salinity is necessary to calculate the oxygen concentration.

Calibration parameters

Here information about the MicroOptode and the calibration environment is added.

Calibration parameters for FOM 1 - Channel 1 - Optode

Sensor code	68
Pressure (mbar)	1013
Relative humidity	100

OK   Cancel

Save changes and close

Sensor code: Add the sensor code. You find the sensor code label on the Field MicroOptode. The code refers to the optimal settings for the specific MicroOptode.

Pressure (mbar): This parameter is used to calculate the oxygen pressure in the 100% air saturation solution. Please enter the pressure of the air in which you are calibrating or that is in contact with your calibration solution. By default, a pressure of 1013 mbar is used.

Relative humidity (%): The Field MicroOptode can be calibrated in air or in liquid. By default, 100% humidity is used for calibration in water. When calibrating the MicroOptode in air enter the % humidity in air during calibration. The calibration corrects for the O_2 concentration in air based on the humidity. After calibration, the calibrated values are expressed in the unit µmol/L, assuming 100% humidity in your measuring environment, e.g. assuming

IMPORTANT
Make sure to set the correct sensor code. Wrong sensor codes will give wrong measurements

that measurements are performed in water.

Two-point calibration

Calibrate 100%: Place the Field MicroOptode in a 100% air-saturated solution and select C<small>ALIBRATE</small> 100% when the optode signal is stable. We recommend to calibrate the MicroOptode at the same temperature and salinity as in your sample. If you use a temperature sensor, make sure to place it in the 100% air saturated calibration solution together with oxygen Field MicroOptode.

Calibrate 0%: Place the Field MicroOptode (and temperature probe) into a 0% oxygen solution and select C<small>ALIBRATE</small> 0% when the sensor signal is stable.

Select P<small>LOT</small> C<small>ALIBRATED</small> when the sensor is calibrated. The calibrated signal is now shown in μmol/L.
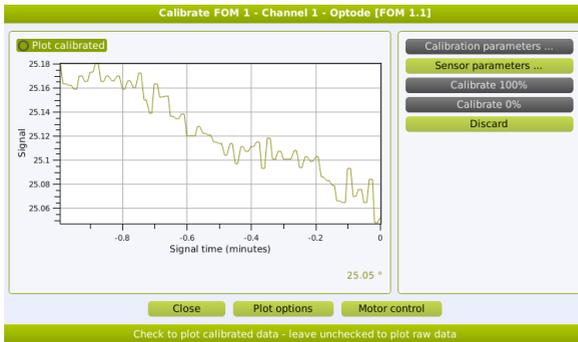
Raw and calibrated oxygen Field MicroOptode measurements

Discard: Press to discard a calibration. After discarding you will be able to make a new calibration.

DOWNLOAD DEPLOYMENT FILES

MicroOptode data stored on the Field Microsensor Multimeter or Field DataLogger can be downloaded using SensorTrace Logger or SensorTrace Profiling in the following way:

1. Connect the Field Microsensor Multimeter or the Field Data Logger to the computer

2. Start SensorTrace Logger or Profiling. Select FILE and DOWNLOAD LOGGER/PROFILING EXPERIMENT FROM DEVICE.

3. Select the deployment(s) you want to download. Logger experiments are downloaded as .ulog files and profiling experiments are downloaded as .upro files.

4. All data and calculations can be exported into Excel or CSV files.

How to download data using Programming Tool is described in the Field MicroOptode Meter and Programming Tool section.

FIELD MICROOPTODE METER AND PROGRAMMING TOOL

Here we briefly explain how to program simple sequences including the Field MicroOptode Meter in Programming Tool. For more information about how to use Programming Tool see the Programming Tool manual.

In Programming Tool custom sequences can be made, e.g. when the Field MicroOptode Meter should run with a frequency different from 1 Hz, when the Field MicroOptode Meter is connected to a Serial Port different from 1. Simple logger-, 1D- or 2D profiling sequences are made in the Sequence window in the (Remote) User Interface. For more information about how to make sequences in the Sequence window see the Field Microsensor Multimeter manual or the MP4/8 Microprofiling System Manual.
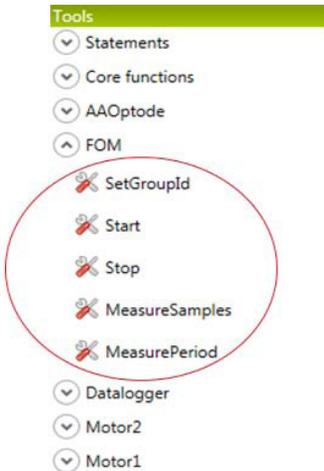
When Programming Tool recognizes a Field MicroOptode Meter, special Field MicroOptode Meter tools will be visible in the Tools Window of Programming Tool. These tools can be used to build sequences.

In the following we will give two examples on how to

program sequences including the Field MicroOptode Meter in Programming Tool:

1. A sequence that logs data from two Field MicroOptodes at the same time with a frequency of 5 Hz

2. A profiling sequence that logs data from a Field MicroOptode Meter

EXAMPLE 1: LOGGER SEQUENCE USING TWO FIELD MICROOPTODES

In the first example two MicroOptodes can be started and log data at the same time. The sequence includes a start block for each MicroOptode and a waiting block where the logging time is specified:
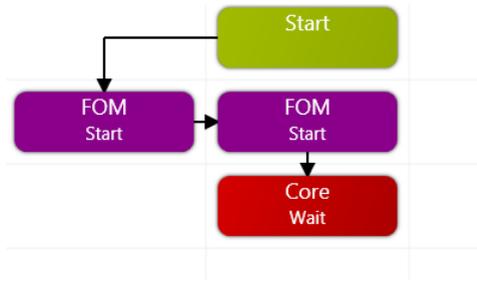
Foe each box different properties can be added:

FOM Start

SerialPort: Add the Serial Port on the Field Microsensor Multimeter / Field DataLogger where the Field MicroOptode Meter is connected. If there are more than 4 Serial channels on the DataLogger, the Field Optode Meter should be connected to one of the first 4 serial channels.

Channel: Enter the Field MicroOptode Meter channel number (channel 1 or channel 2) to which the Field MicroOptode is connected. When both channels on a Field Microsensor Multi-meter / Field DataLogger are used, the sequence should have two start blocks: one where the Field MicroOptode on channel 1 is started, and one block where the Field MicroOptode on channel 2 is started.

Frequency: Here you define how fast the Field MicroOptode collects data. It can range from 0.001 Hz to 10 Hz.

Wait: Here you add the logging time (in seconds) for the Field MicroOptode Meter.

Example 2: Profiling sequence including a Field MicroOptode

In the second example the Field MicroOptode can be used for making oxygen profiles, when the oxygen MicroOptode is mounted on a motorized stage. Alternatively, the Field MicroOptode can be placed in the water column to monitor oxygen concentrations while e.g. the Clark-type microsensors are used for profiling. In both cases the sequence can look like the following:
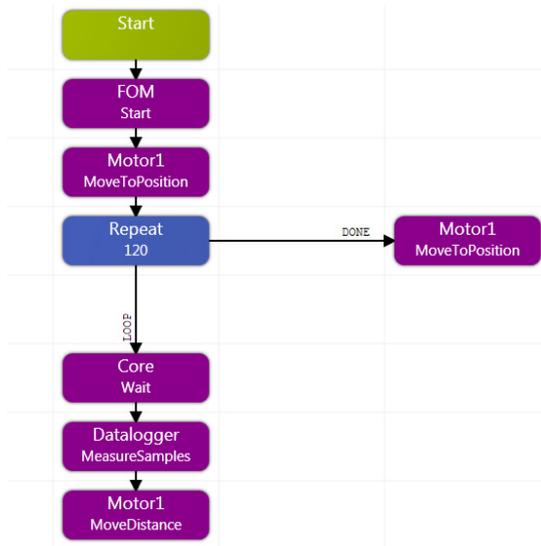
The sequence start with a 'FOM start' block where the Field Microsensor Multimeter / Field DataLogger, starts to log data from the Field MicroOptode Meter. It will log data until the profiling sequence ends. After the MicroOptode Meter starts to log data, the motor is moved to the start position of the profiling sequence. The profiling sequence consists of 120 steps. In each step there is first a wait period, then a specified number of samples are measured on all active channels (pA, mV, T) on the Field Microsensor Multimeter / Field DataLogger and finally the motor moves a predefined distance. When the profiling part is finished the motor moves to the end position and the Field MicroOptode Meter stops recording.

For more information about how to program profiling sequence see the Programming Tool manual.

DATA DOWNLOAD TO PC USING PROGRAMMING TOOL

1. Connect the Field Microsensor Multimeter or the Field DataLogger to the computer.

2. Start Programming Tool. Make sure the target IP address under 'Connections' is correct.

3. Select CONNECT and make sure the Field Microsensor Multimeter or the Field DataLogger is recognized by the software.

4. Under Target/Services/Deployment data service select the Deployments you want to download.

5. Each Deployment contains of a package of text files which can be imported into e.g. Excel.

    1. ddmmyyyy_hhmmss_data.txt

    2. ddmmyyyy_hhmmss_calibration.txt

    3. ddmmyyyy_hhmmss_log.txt

    4. ddmmyyyy_hhmmss_optode1.txt

STORAGE AND MAINTENANCE

Remember to add protection caps on all channels before rinsing the Field MicroOptode Meter. Avoid water, salt and dust to get into the connecors as this can damage the instrument.

Rinse sand, dirt and salt of the Field MicroOptode Meter with water and dry it afterwards. To remove stains, use mild soap only.

TROUBLESHOOTING

Problem	The MicroOptode cannot be calibrated.
Possible cause 1	The MicroOptode is broken or there is no or little dye at the tip of the optical fiber.
Solution 1	Replace the MicroOptode
Possible cause 2	The optical fiber is bend.
Solution 2	Replace the MicroOptode and be careful not to bend the optical fiber.
Possible cause 3	The connection between the MicroOptode and the Field MicroOptode Meter is loose.
Solution 3	Tighten the connection.

Problem	No or noisy Field MicroOptode data have been stored
Possible cause 1	The Field Field MicroOptode Meter has been connected to Serial port 2 or 3 and sequences where made using the templates in the Sequence window.
Solution 1	Connect the Field MicroOptode Meter to Serial port 1 and repeat the sequence.
Possible cause 2	The Field MicroOptode has been connected to Channel 2 on the Field MicroOptode Meter and sequences where made using the templates in the Sequence window.
Solution 2	Connect the Field MicroOptode to Channel 1 on the Field MicroOptode and repeat the sequence.

Problem	The Field MicroOptode Meter is not recognized by the Field Microsensor Multimeter/Field DataLogger.
Possible cause	The Field MicroOptode Meter is not connected properly to the Field Microsensor Multimeter/Field DataLogger
Solution	Disconnect and reconnect them again.

If you encounter other problems and need scientific/technical assistance, please contact sales@unisense.com for online support (we will answer you within one workday