Hamilton Warranty
Please refer to the General Terms of Sales (GTS).

Important Note
Copyright © 2019 Hamilton Bonaduz AG, Bonaduz Switzerland. All rights reserved. The reproduction of any part of this document in any form is forbidden without the express written agreement of Hamilton Bonaduz AG.

Contents of this manual can be modified without previous announcement. Technical modifications reserved. Greatest possible care was used on the correctness of the information in this manual. If errors should be discovered nevertheless, Hamilton Bonaduz AG is pleased to be informed about it. Regardless of this, Hamilton Bonaduz AG cannot assume liability for any errors in this manual or for their consequences.
# Table of Contents

1 General Information ........................................................................................................... 4  
   1.1 Intended Use ................................................................................................................. 4  
   1.2 About these Operating Instructions ............................................................................. 4  
2 Liability............................................................................................................................... 4  
3 Safety Precautions and Hazards ......................................................................................... 5  
   3.1 General Precautions .................................................................................................... 5  
   3.2 Operation of VisiFerm DO SU Sensor ......................................................................... 5  
   3.3 Earthing ....................................................................................................................... 6  
   3.4 Electrical Safety Precautions ..................................................................................... 7  
   3.5 Chemical, Radioactive or Biological Hazard Precautions ........................................... 7  
4 Product Description ........................................................................................................... 7  
   4.1 General Description .................................................................................................... 7  
   4.2 Hardware Description ................................................................................................ 8  
   4.3 Optical DO measurement ............................................................................................ 8  
   4.4 VisiFerm DO SU with Micro-Transmitter inside ......................................................... 9  
5 Installation ......................................................................................................................... 9  
   5.1 Unpacking and Cleaning ............................................................................................. 9  
   5.2 Electrical Connection .................................................................................................. 10  
   5.3 Connection to PCS or Controller ............................................................................. 10  
      5.3.1 Layout and Overview ......................................................................................... 10  
      5.3.2 Electrical connection of the 4-20 mA current interfaces ....................................... 11  
      5.3.3 Electrical connection for the digital RS485 interface ......................................... 13  
   5.4 Connection to PC or Mobile ....................................................................................... 14  
      5.4.1 Layout and Overview ......................................................................................... 14  
      5.4.2 Installing ArcAir Basic on the Computer ............................................................ 15  
      5.4.3 Connecting VisiFerm DO SU Sensor to ArcAir ................................................... 16  
      5.4.4 Create User Accounts ....................................................................................... 16  
      5.4.5 Configuring the VisiFerm DO SU Sensor Parameters .......................................... 17  
      5.4.6 Configuring the analog interface for your process control system ....................... 18  
      5.4.7 Defining a measuring point name for identification of the process ....................... 18  
6 Operation .......................................................................................................................... 18  
   6.1 Connecting the VisiFerm DO SU to the SU ODO Cap .................................................. 19  
   6.2 Calibration ................................................................................................................. 19  
   6.3 Disconnecting the VisiFerm DO SU from the SU ODO Cap .......................................... 21  
7 Troubleshooting ............................................................................................................... 21  
   7.1 VisiFerm DO SU and SU ODO Cap Self-Diagnostics .................................................. 21  
      7.1.1 Verify Status of VisiFerm DO SU and SU ODO Cap .............................................. 21  
      7.1.2 Warnings ............................................................................................................. 22  
      7.1.3 Errors ................................................................................................................ 23  
   7.2 Getting Technical Support .......................................................................................... 23  
   7.3 Returning VisiFerm DO SU for Repair ....................................................................... 23  
8 Disposal .............................................................................................................................. 24  
9 Ordering Information ....................................................................................................... 24  
   9.1 VisiFerm DO SU ........................................................................................................... 24  
   9.2 SU ODO Cap ............................................................................................................... 25  
   9.3 Parts and Accessories ............................................................................................... 25  
   9.4 Services ..................................................................................................................... 27
1 General Information

1.1 Intended Use

The VisiFerm DO SU sensors are intended for the measurement of dissolved oxygen (DO) in a single use container together with a Hamilton SU ODO Cap. If the sensor is used in contact with gaseous or liquid organic solvents, the resulting measurement accuracy in this application must be separately checked and validated by the customer.

⚠️ ATTENTION! VisiFerm DO SU is not intended to be used in hazardous atmospheres.

⚠️ ATTENTION! The measurement values transmitted over wireless communication are not intended to be used for process control.

⚠️ ATTENTION! The VisiFerm DO SU sensor has a built-in temperature sensor (NTC 22 kOhm). This temperature sensor is to be used only for monitoring the sensor conditions, not for controlling the process temperature.

1.2 About these Operating Instructions

These Operating Instructions are designed to support the integration, operation and qualification of the VisiFerm DO SU sensors together with Hamilton SU ODO Cap built-in in the SU container. To achieve this, it will describe the features of the VisiFerm DO SU and its integration in Process Control Systems (PCS). Both the mechanical connection to the Hamilton SU ODO Cap and the communication between the VisiFerm DO SU and Process Control Systems are described detailed in this manual. After reading this manual the user should be capable of installing and operating VisiFerm DO SU sensors.

⚠️ ATTENTION! Essential information for avoiding personal injury or damage to equipment.

NOTE: Important instructions or interesting information.

2 Liability

The liability of Hamilton Bonaduz AG is detailed in the document «General Terms and Conditions of Sale and Delivery».

Hamilton is expressly not liable for direct or indirect losses arising from use of the sensors. It must in particular be insured in this conjunction that malfunctions can occur on account of the inherently limited useful life of sensors contingent upon their relevant applications. The user is responsible for the calibration, maintenance
and regular replacement of the sensors. In the case of critical sensor applications, Hamilton recommends using back-up measuring points in order to avoid consequential damages. The user is responsible for taking suitable precautions in the event of a sensor failure.

NOTE: The VisiFerm DO SU sensor is not intended and specified as a safety device. A SIL (Safety Integrity Level) certification is not available. It is in the sole responsibility of the user to validate the VisiFerm DO SU sensor according the safety requirements of his application.

3 Safety Precautions and Hazards

ATTENTION! Read the following safety instructions carefully before installing and operating the VisiFerm DO SU sensor.

3.1 General Precautions

For safe and correct use of VisiFerm DO SU, it is essential that both operating and service personnel follow generally accepted safety procedures as well as the safety instructions given in this document (see chapter 4.2), the VisiFerm DO SU Operating Instructions.

The specification given in the «Specification Sheet» (available on www.hamiltoncompany.com) as regards temperature, pressure etc. may under no circumstances be exceeded. Inappropriate use or misuse can be dangerous.

The lifetime of the VisiFerm DO SU highly depends on the specific conditions of the application. Temperature, pressure, chemicals used may accelerate the ageing of both the sensor and its SU ODO Cap.

The sensor can not be repaired by the operator and has to be sent back to Hamilton for inspection.

Necessary precautions should be taken when transporting the sensors. For repair or shipment the sensor should be sent back in the original reusable packaging box. Every VisiFerm DO SU sent back for repair must be cleaned or decontaminated if it was accidently in contact with process media.

If the conditions described in these Operating Instructions are not adhered to or if there is any inappropriate interference with the equipment, all of our manufacturer’s warranties become obsolete.

3.2 Operation of VisiFerm DO SU Sensor

When cleaning and using the VisiFerm DO SU sensors in process environment suitable protective clothing, safety glasses and protective gloves must be worn, particularly when dealing with a malfunction where the risk of contamination from spilled liquids exists. Installation and maintenance of sensors must be performed only by trained personnel. The mobile devices and sensors must be used for their intended applications, and in optimum safety and operational conditions.

Use only wired digital or analog connection for the process control. The Arc wireless interface is designed for sensor monitoring, maintenance and service purposes.

Make sure that the thread is not damaged when screwing the sensor into the process. Even when all required
safety measures have been complied with, potential risks still exist with respect to leaks or mechanical damage to the armature. Wherever there are seals or screws, gases or liquids may leak out undetected. Always make sure that no process medium can be accidentally spilled before removing the sensor from its measurement setup. Make sure that no air or gas bubbles sticks to the sensitive part of the sensor. As a consequence, the measurement value could be unstable. Do not put stress on the system by vibration, bending or torsion. Before use, verify that the sensor is properly configured for your application.

Failure to observe and carry out the maintenance procedures may impair the reliability and correct functioning of the measurement system.

The integrated 4-20 mA analog output has been configured according to factory defaults. Please find details, including serial number and most important specifications, on the certificate provided with each sensor. Before use, verify that the sensor is properly configured for your application.

Make sure that following cross sensitivities and resistances of SU ODO Caps are respected.

<table>
<thead>
<tr>
<th>Cross sensitivities and resistances of SU ODO Cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement not influenced by Carbon Dioxide</td>
</tr>
<tr>
<td>Wetted parts resistant to Ethanol (&lt;70%)</td>
</tr>
<tr>
<td>Wetted parts not resistant to Chlorine, Ozone and Organic Solvents such as Acetone, Tetrahydrofuran (THF*)</td>
</tr>
</tbody>
</table>

*Tested for 30 min at 25°C

If the sensor is used in contact with gaseous or liquid organic solvents, the resulting measurement accuracy in this application must be separately checked and validated by the customer.

### 3.3 Earthing

It is recommended to assign the VP8 cable shield to ground or earth especially in electromagnetically noisy environments. This significantly improves noise immunity and signal quality. The VP8 thread is connected to the metallic housing of the VisiFerm DO SU sensor.

**NOTE:** Avoid earth loops (see figure 1), and damage of the sensor due to electrostatic discharge while mounting and dismounting of the sensor or the cable. Do not touch contacts of the connector.

![Figure 1: Single use container with no earth connection: Connect cable shield to earth.](image)
3.4 Electrical Safety Precautions

Do not connect the sensor to a power source of any voltage beyond the range stated in the power rating «Specification Sheet» (www.hamiltoncompany.com).

Always use Hamilton VP8 cables for safe connection. Cables are available in a broad range of lengths (Chapter 10). Make sure the cable is intact and properly plugged to avoid any short circuit.

Keep VisiFerm DO SU away from other equipment which emits electromagnetic radio frequency fields, and minimize static electricity in the immediate environment of the optical measuring parts. Carefully follow all the instructions in chapter 6 to avoid electrical damage to the sensor. The contacts must be clean and dry before sensor is connected to the cable.

⚠️ ATTENTION! Switch off the power supply and unplug the connector before dismounting the VisiFerm DO SU.

⚠️ ATTENTION! Particular precaution is required if the optics is unprotected.

⚠️ ATTENTION! If the power supply 230 VAC or 24 VDC is switched off or disconnected the reading on the PCS is wrong.

3.5 Chemical, Radioactive or Biological Hazard Precautions

Selection of the appropriate safety level and implementation of the required safety measures for working with VisiFerm DO SU is the sole responsibility of the user.

If working with hazardous liquids observe and carry out the maintenance procedures, paying particular attention to cleaning and decontamination. If VisiFerm DO SU becomes contaminated with biohazardous, radioactive or chemical material, it should be cleaned. Failure to observe and carry out the maintenance procedures may impair the reliability and correct functioning of the measuring module.

4 Product Description

4.1 General Description

The VisiFerm DO SU sensors are intended for the measurement of dissolved oxygen together with a Hamilton SU ODO Cap as integral part of a single use container. With their micro-transmitter, VisiFerm DO SU sensors enable direct communication to the process control system via 4-20 mA standard signal or digital Modbus. Wireless communication with the Arc Wireless Adapter may be used for monitoring, configuration and calibration, and saves time without compromising the quality of the wired connection.

The VisiFerm DO SU technology is one to one comparable to the proven performance of your existing re-useable VisiFerm DO SU sensors. It offers rapid start-up with no polarization time, and simplified maintenance.
With the easy calibration of the SU ODO Cap using the integrated calibration values on each cap, the sensor is ready to use within very short time.

With the SU ODO Cap integrated in the SU container, the VisiFerm DO SU is reusable without risk of contamination, making the setup reliable and very cost effective.

Key benefits include:

- Reusable VisiFerm DO SU (electronic)
- Calibration fast and easy (with integrated calibration values provided with each SU ODO Cap)
- Direct digital Modbus or analog communication to the process control system via 4-20 mA standard signal
- Full online wireless option via Bluetooth 4.0 for easy monitoring, configuration and calibration
- Robust industrial design
- No separate transmitter needed

### 4.2 Hardware Description

The VisiFerm DO SU sensor consists of a sensor head with integrated electronic and a sensor shaft. The sensor shaft is terminated by the SU ODO Cap, carrying the oxygen sensitive luminophore. During development, special attention was paid to an optimum sanitary design. All materials in contact with the solution meet the FDA requirements.

![Figure 2: VisiFerm DO SU hardware description.](image)

### 4.3 Optical DO measurement

The optical measurement principle is based on the so-called luminescence quenching. The luminescence of certain organic pigments (luminophore) is quenched in the presence of oxygen. The luminophore absorbs the excitation light and release a part of the absorbed energy by emission of fluorescence. In the presence of oxygen, energy transfer takes place from the excited luminophore to oxygen. The luminophore does not emit fluorescence and the measurable fluorescence signal decreases.
4.4 VisiFerm DO SU with Micro-Transmitter inside

With the micro-transmitter integrated, VisiFerm DO SU sensors offer fully compensated signal directly to the process control system. Communication protocols include standard analog 4–20 mA. The micro-transmitter located in the sensor head stores all relevant sensor data, including calibration and diagnostic information, simplifying calibration and maintenance.

5 Installation

5.1 Unpacking and Cleaning

1. Carefully unpack the VisiFerm DO SU. Enclosed you will find the sensor, the VisiFerm DO SU Quick Guide and Declaration of Quality.
2. Inspect the sensor for shipping damages or missing parts.
3. For cleaning purposes of the VisiFerm DO SU, soak a paper towel with Ethanol 70% or Isopropanol 70% and wipe down the sensor. After cleaning the sensor, air dry the VisiFerm DO SU prior to connecting with the SU ODO Cap. Make sure that all contacts of the VisiFerm DO SU are completely dry to prevent electrical damage (short circuit).

NOTE: VisiFerm DO SU is not designed for gamma or steam sterilization.
5.2 Electrical Connection

The VisiFerm DO SU is fitted with a VP8 socket head. The eight golden contacts are denoted as pin A to pin H. For easy identification of each pin, the head has a notch between pin A and pin B. For the easiest and safest connection of VisiFerm DO SU, always use Hamilton VP8 cables, available in a range of different lengths.

<table>
<thead>
<tr>
<th>VP Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>–</td>
</tr>
<tr>
<td>B</td>
<td>4-20 mA Interface (#1)</td>
</tr>
<tr>
<td>C</td>
<td>Power supply: +24 VDC</td>
</tr>
<tr>
<td>D</td>
<td>Power supply: Ground</td>
</tr>
<tr>
<td>E</td>
<td>–</td>
</tr>
<tr>
<td>F</td>
<td>–</td>
</tr>
<tr>
<td>G</td>
<td>RS485 (A)</td>
</tr>
<tr>
<td>H</td>
<td>RS485 (B)</td>
</tr>
</tbody>
</table>

Figure 5: Pin Configuration

5.3 Connection to PCS or Controller

5.3.1 Layout and Overview

The VisiFerm DO SU can be connected to the PCS or controller by a wired connection (for reference numbers see also «Parts and Accessories»):

Figure 6: Layout wired connection to PCS or controller.
The digital RS485 interface of the VisiFerm DO SU can be accessed by operators when integrated by the OEM system supplier. The three-tier operator levels and factory default passwords are shown in the table below.

<table>
<thead>
<tr>
<th>Operator Status</th>
<th>Operator Level</th>
<th>Password</th>
<th>Read</th>
<th>Calibrate</th>
<th>Configure</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>U</td>
<td>-</td>
<td>✔</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Administrator</td>
<td>A</td>
<td>18111978</td>
<td>✔</td>
<td>✔</td>
<td>-</td>
</tr>
<tr>
<td>Specialist</td>
<td>S</td>
<td>16021966</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

5.3.2 Electrical connection of the 4-20 mA current interfaces

The 4-20 mA interface enables direct connection of the VisiFerm DO SU to a data recorder, indicator, control unit or PCS with analog I/O. The VisiFerm DO works as a current sink sensor and is passive. Connect the sensor according to the pin designations (Chapter 6.2). The 4–20 mA interface of the VisiFerm DO sensors is pre-configured with default values for the 4–20 mA range, and measurement unit. Configure the 4–20 mA interface according to your requirements for proper measurement (Chapter 6.4.6).

Controlling 4-20 mA current interface signals by pulse-width modulation

Hamilton VisiFerm DO SU use the method of pulse-width modulation (PWM) to adjust the DC currents of the 4-20 mA interfaces corresponding to the measured values. In principle, the pulse width (t) of a rectangular signal with a constant frequency, the pulse duty factor (t / T), is modulated and afterwards demodulated by a low-pass filter to generate continuous analog DC signals. The resulting value yi corresponds to the average of the PWM signal (see Figures 7 and 8). The PWM-loads of the VisiFerm DO SU have low-pass filters which are not able to eliminate all AC fractions of the used PWM frequency of 3.5 kHz due to technical impossibilities. Therefore, the current signals of the 4-20 mA interfaces are still overlaid by a certain AC current which should be masked by lag smearing or input filters of the current input card of the process control system (PCS). Recommended PCS settings are a sampling rate below 3 kHz, an averaging over more than 1 s, and the use of galvanically separated inputs to avoid oscillations. It is also possible to use mathematical functions or isolating amplifiers for signal processing filtering if necessary. For detailed technical advice about suitable isolating amplifiers, please contact Hamilton technical support.

Figure 7: Progress of a rectangular signal with a period T and a pulse duration t_i for the generation of an analog signal with the value y_i.
Figure 8: Progress of a rectangular signal with a period $T$ and a pulse duration $t_2$ for the generation of an analog signal with the value $y_2$.

⚠️ **ATTENTION!** The VisiFerm DO SU generates the 4-20 mA signals by pulse-width modulation (PWM) which is not compatible to all PCS systems. Also a galvanic separation between the power supply and the PCS is necessary for correct sensor functionality when used in 4-20 mA setups (see Figure 10).

Analog interface 1

Galvanically not isolated, pulse-width modulation with 5 kHz, recommended PCS settings:

- Use galvanically separated inputs
- Sampling rate $< 3$ kHz and $\neq n \times 3.5$ kHz
- Average over $> 1$ s

Examples of circuit arrangement

Figure 9: Three-wire loop wiring diagram for the 4-20 mA interfaces.
5.3.3 Electrical connection for the digital RS485 interface

The digital RS485 interface enables communication with VisiFerm DO SU and Arc sensor to perform measurements, calibrate the sensor and change the sensor’s configuration parameters. VisiFerm DO SU are always connected to digital controlling devices as a Modbus slave. To function, they require a power supply (VP 8 pins C and D, see below). The section entitled «Configuring the VisiFerm DO SU parameters» describes operation in digital mode.

Additional information


⚠️ ATTENTION! Because all VisiFerm DO SU are delivered with factory-default settings, each sensor must be configured for its specific application before first use (see section entitled «Configuration of the VisiFerm DO SU» for more information).

In an electromagnetically noisy environment, it is advisable to connect the VP cable shield to the ground. This significantly improves resistance to noise and signal quality.

Example of circuit arrangement

Figure 11: Wiring diagram for the RS485 interface.
Figure 12: Multi-drop bus wiring for the Modbus two-wire mode. Each sensor functions as a Modbus slave.

NOTE: In order to avoid signal reflection on the lines the use of line termination resistors (120 Ohm each) is recommended. The effect of signal reflections becomes more relevant with long cable length and/or high baud rates.

NOTE: In the connection scheme shown above, each sensor must have the unique Modbus device address for proper communication.

The serial Modbus connection between the RS485 port of the master and the corresponding interfaces of the sensors has to be ensured according to the EIA/TIA RS485 standard. Only one sensor can communicate with the master at any time.

5.4 Connection to PC or Mobile

5.4.1 Layout and Overview

The Hamilton Arc View Mobile represents an ideal solution for Arc sensor management. This includes an automated calibration by scanning the QR-code of the SU ODO Cap sensor tag. The Arc View Mobile included in the package is a compact mobile wireless device with long battery lifetime and broad functionality. When using with a mobile device, each VisiFerm DO SU requires an Arc Wi Adapter BT and an Arc USB Power Cable for external power supply. The Arc View Mobile is based on the Samsung Galaxy Tab Active tablet and comes pre-configured with ArcAir™ App, app blocker application, power supply cable, Operating Instructions and Quick Guide.
### 5.4.2 Installing ArcAir Basic on the Computer

The ArcAir™ App can be used to display measurement values, for configuration and calibration or to generate GMP reports for calibration, verification, communication and configuration. It can be downloaded from App Store, Google Play or for PC on www.hamiltoncompany.com.

2. Unpack the ZIP file.
3. Do not plug in the Wireless Converter before the installation of ArcAir is completed.
4. Install ArcAir by double clicking «ArcAir.exe» and follow the instructions on the screen.

To upgrade your PC version from Basic to Advanced version, you must connect your PC using the Arc Wireless Converter BT with your mobile device. For this purpose, the mobile device must run on the correct ArcAir version (Advanced) to activate the upgrade on your PC (for more details, see also «ArcAir™ App – Operating Instructions» on www.hamiltoncompany.com).

**ArcAir Lite** (read only) user can read sensor information such as:
- VisiFerm DO SU and sensor status (e.g. warnings and errors or quality indicator)
- Measurement values
- VisiFerm DO SU and sensor information serial number (SN), reference number (Ref) and manufacturing number (Lot)
- VisiFerm DO SU and sensor settings
**ArcAir Basic** user can use ArcAir Lite functionality and in addition:

- Execute initial calibration including calibration report (see chapter 7.2)
- Product calibration (follow the wizard of the ArcAir™ App)
- Configure the VisiFerm DO SU and sensor setting including configuration report

**ArcAir Advanced** user can use ArcAir Basic functionality and in addition can create:

- GMP-reports for verification and communication settings
- Configuration profile

VisiFerm DO SU sensors require application specific configuration. To configure and set up the VisiFerm DO SU sensors at least ArcAir Basic is required. In the table below you will find the different ArcAir licenses and their functionality:

<table>
<thead>
<tr>
<th>ArcAir Version</th>
<th>Read</th>
<th>Calibrate</th>
<th>Configure</th>
<th>Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lite</td>
<td>✓</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Basic</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>–</td>
</tr>
<tr>
<td>Advanced</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

**NOTE:** For more detail information and configuration see Hamilton Arc System Operating Instructions.

### 5.4.3 Connecting VisiFerm DO SU Sensor to ArcAir

1. Connect a sensor with the power supply, e.g. Arc USB Power Cable
2. Switch on the mobile’s Bluetooth connection or connect a Wireless Converter BT to USB Port of your computer (only for wireless connection)
3. The ArcAir application recognizes and displays the connected sensors automatically

**ATTENTION!** For automatic sensor login a unique and global Operator Level S password for all intelligent sensors is required. Please make sure you have added the same Operator Level S Password for all Arc sensors in the ArcAir application under Backstage/Settings/Operator Level S Password.

### 5.4.4 Create User Accounts

1. Start ArcAir application on computer
2. Click on «Backstage» left upper corner
3. Select «User Management»
4. Click the «Add» Button for opening the user editor
5. Type in the user details and password
6. Select the specific rights for the user

**ATTENTION!** First user is the administrator and all user rights are assigned as default.
NOTE: Initial operation of ArcAir is in the laboratory mode (see also ArcAir™ Operating Instructions) as long as no user account is created. Laboratory mode does not require a login password and enables all features in the installed license version.

5.4.5 Configuring the VisiFerm DO SU Sensor Parameters

1. Start the ArcAir application
2. Select the desired sensor
3. Open the drawer «Settings» (make sure you have the «Sensor Settings» user right)
4. Configure the sensor

A description of the available settings is given below:

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Description</th>
<th>Default Setting</th>
<th>Range</th>
<th>Configuration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement Unit</td>
<td>These are the measurement physical units</td>
<td>%sat.</td>
<td>%vol %sat ug/l ppb mg/l ppm mbar</td>
<td>Required</td>
<td>Measurement Settings</td>
</tr>
<tr>
<td>Temperature unit</td>
<td>These are the temperature physical units</td>
<td>°C</td>
<td>°C</td>
<td>Required</td>
<td>Measurement Settings</td>
</tr>
<tr>
<td>Salinity</td>
<td>The concentration of dissolved oxygen in saturated water is dependent on the salinity</td>
<td>0 mS/cm</td>
<td>0 to 50</td>
<td>Default parameter recommended</td>
<td>Measurement Settings</td>
</tr>
<tr>
<td>Atmospheric pressure</td>
<td>The partial pressure of oxygen is proportional to the atmospheric pressure or the pressure of the air supply to the process</td>
<td>1013 mbar</td>
<td>10 to 12000</td>
<td>Required, application dependent</td>
<td>Measurement Settings</td>
</tr>
<tr>
<td>Moving average</td>
<td>The sensor uses a moving average 1-30 over the measuring points</td>
<td>0 (auto)</td>
<td>1 to 30</td>
<td>Recommended default parameter</td>
<td>Measurement Settings</td>
</tr>
<tr>
<td>Resolution</td>
<td>The resolution interval can be set between 8-16. The measuring interval is on itself an average over 8-16 individual sub-measurements</td>
<td>0 (auto)</td>
<td>1 to 13</td>
<td>Recommended default parameter</td>
<td>Measurement Settings</td>
</tr>
<tr>
<td>Measuring interval</td>
<td>The measuring interval can be set between 1-300 sec. The LED flashes once in the set measure interval</td>
<td>3 sec.</td>
<td>0 to 300</td>
<td>Recommended default parameter</td>
<td>Measurement Settings</td>
</tr>
<tr>
<td>Sensing Material</td>
<td>Sensing Material are different types of SU ODO Cap which can be set by entering the REF of the SU ODO Caps</td>
<td>243461</td>
<td>243461 10068804 10077858</td>
<td>Must</td>
<td>Calibration/ Enter Calibration Data</td>
</tr>
</tbody>
</table>
5.4.6 Configuring the analog interface for your process control system

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Description</th>
<th>Default Setting</th>
<th>Range</th>
<th>Configuration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Mode</td>
<td>The output of the 4-20 mA can be configured linear, bilinear or with a fix value</td>
<td>4-20 mA linear</td>
<td>4-20 mA</td>
<td>Recommended default</td>
<td>Infoface</td>
</tr>
<tr>
<td>Value at 4 mA</td>
<td>Defined measurement value for 4 mA output</td>
<td>0 %sat.</td>
<td>not empty</td>
<td>Must (application dependent)</td>
<td>Infoface</td>
</tr>
<tr>
<td>Value at 20 mA</td>
<td>Defined measurement value for 20 mA output</td>
<td>300 %sat.</td>
<td>not empty</td>
<td>Must (application dependent)</td>
<td>Infoface</td>
</tr>
<tr>
<td>Mode in event of warning</td>
<td>Current output mode in case of warnings</td>
<td>No output</td>
<td>Off Continuous Warning</td>
<td>Recommended default parameter</td>
<td>Infoface</td>
</tr>
<tr>
<td>Mode in event of errors</td>
<td>Current output mode in case of errors</td>
<td>Continuous output</td>
<td>Off Continuous Error</td>
<td>Recommended default parameter</td>
<td>Infoface</td>
</tr>
<tr>
<td>Output in event of warning</td>
<td>Current output in case of warnings</td>
<td>3.5 mA</td>
<td>not empty</td>
<td>Recommended default parameter</td>
<td>Infoface</td>
</tr>
<tr>
<td>Output in event of error</td>
<td>Current output in case of error</td>
<td>3.5 mA</td>
<td>not empty</td>
<td>Recommended default parameter</td>
<td>Infoface</td>
</tr>
<tr>
<td>Output for T out of limit</td>
<td>Current output in case of temperature out of limit</td>
<td>3.5 mA</td>
<td>not empty</td>
<td>Recommended default parameter</td>
<td>Infoface</td>
</tr>
</tbody>
</table>

5.4.7 Defining a measuring point name for identification of the process

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Description</th>
<th>Default Setting</th>
<th>Range</th>
<th>Configuration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring point</td>
<td>User can define a sensor name for better identification of the measuring point</td>
<td>243258-1234</td>
<td>not empty</td>
<td>Recommended default parameter</td>
<td>Info / Measurement Point or Settings / Measurement Settings</td>
</tr>
</tbody>
</table>

6 Operation

NOTE: This operation description refers to ArcAir™ App. For operation with PCS refer to operating instructions from the OEM system supplier.

ATTENTION! Only use the VisiFerm DO SU according to the «Specification Sheet» on www.hamiltoncompany.com. Failure to do so may lead to damages or measurement failures.
6.1 Connecting the VisiFerm DO SU to the SU ODO Cap

⚠️ ATTENTION! Do not apply excessive force while connecting the VisiFerm DO SU to the SU ODO Cap to avoid any leakage.

⚠️ ATTENTION! Please remove the protective cap from the sensor shaft before mounting into the ODO Cap. Handle with care to avoid glass breakage.

The VisiFerm DO SU mechanical design is compatible with the Hamilton SU ODO Cap. Before installing you should test that the parts are all in working order. Ensure that there is no damage to the sensor or the cap.

Prepare the sensor for measurement as follows:

1. Carefully remove the protective caps from the optical sensor tip.
2. Connect the VisiFerm DO SU to the SU ODO Cap (Screw in the VisiFerm DO SU and move up against it slightly blocks in the cap. Do not apply excessive force (torque < 0.5 Nm).
3. Carefully remove protection cap from the VP8 connector.
4. Connect the VisiFerm DO SU and the SU ODO Cap according to the section «Electrical Connection» in the desired configuration (analog 4-20 mA interface, digital RS485 interface or both). Make sure that the VisiFerm DO SU is configured as required. If in doubt, test as described in chapter 6.3 «Connection to PCS or Controller». The signal stabilizes itself within a few minutes. The VisiFerm DO SU is programmed with default calibration values. To achieve best accuracy, execute calibration of the sensor (chapter 7.2).

6.2 Calibration

The SU ODO Cap has been pre-calibrated at 100% and 0% saturation at 25 °C; hence calibration prior to the process is not necessary. The calibration values for Phase 0 and Stern-Volmer coefficient (SV-Coefficient) can be found on the label attached to the SU ODO Cap.

![Figure 15: Example sensor label with calibration data](image)

1. Read the Phase 0 (°) and SV-Coefficient (-) written on the sensor label (see figure 15).
2. Enter the calibration and sensor data into the VisiFerm DO SU:
   - **Calibration data (mandatory):**
     - Phase 0
     - SV-Coefficient
Sensor data (enter data for traceability):
- Ref-number
- Name
- Lot-number
- Manufacturing date
- SN-number
- Sensor ID
- a-length

Push the save button to save the data.

3. If required, perform a product calibration step to increase accuracy.
4. Save the data to the VisiFerm DO SU

**NOTE:** The Arc View Mobile supports automatic calibration for predefined calibration values by scanning the QR-code. Use ArcAir software on tablet or PC to perform manual input of the calibration data.

The concept behind Hamilton single use Arc System enables calibration based on the pre-calibrated values. Additional 2-point calibration for the installation in the process setup is not required.

**Product calibration**

The product calibration is an in-process calibration procedure in order to adjust the measurement to specific process conditions. Product calibration is an additional calibration procedure to a standard calibration. If product calibration is activated, the VisiFerm DO SU calibration curve is calculated from the data of last calibration at point 1 and from the data of the product calibration (Figure 16). In order to restore the original standard calibration curve, the product calibration can be at any time by selecting on the Product calibration command «cancel». A new standard calibration cancels a product calibration as well.

![Effect of Product Calibration CP6 on CP1 / CP2](image)

*Figure 16: Effect of a product calibration (CP6) on an existing standard calibration function based on the Zero Point Calibration (CP 1) and the Air Calibration (CP 2).*

**NOTE:** The product calibration is possible for DO values in the range of 2 to 55 %-vol (20 – 550 mbar pO2).
A product calibration is performed as follows:

1. Connect the VisiFerm DO SU to the power supply, e.g. by using the Arc USB Power Cable on a standard USB port (see figure 1)
2. Select the desired sensor from the sensor list
3. Go to «Process Settings»
4. Click «Start» to start the product calibration wizard of the ArcAir™ App
5. Follow the instruction on the screen

**NOTE:** Alternatively, the product calibration may be performed with a mobile device on site the measuring point.

### 6.3 Disconnecting the VisiFerm DO SU from the SU ODO Cap

**ATTENTION!** Do not apply excessive force while disconnecting the VisiFerm DO SU from the SU ODO Cap to avoid any leakage.

1. Remove the connecting cable and carefully attach the protective cap to the VP8 connector
2. Hold the SU ODO Cap (if possible)
3. Unscrew the VisiFerm DO SU
4. Remove the VisiFerm DO SU from the SU ODO Cap and carefully attach the protective cap to the optical sensor tip

The SU ODO Cap is a single use sensor element meant to be discarded with the container. If the process requires disconnection, the SU ODO Cap must be decontaminated prior to disposal.

### 7 Troubleshooting

#### 7.1 VisiFerm DO SU and SU ODO Cap Self-Diagnostics

#### 7.1.1 Verify Status of VisiFerm DO SU and SU ODO Cap

The VisiFerm DO SU and SU ODO Cap provides a self-diagnosis functionality to detect and identify the most common sensor malfunctions. The communication interfaces can be used for warning and error massages. The analog 4-20 mA interface can be configured according to the NAMUR recommendations to indicate an abnormal event. Use the ArcAir™ App for monitoring the sensor status and for troubleshooting. The following types of messages are provided by the self-diagnosis function.
7.1.2 Warnings

<table>
<thead>
<tr>
<th>Warning</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO reading below lower limit</td>
<td>The oxygen reading is too low (DO &lt; 0%-sat)</td>
<td>Apply / set calibration data. Execute a new product calibration in nitrogen saturated medium (Chapter 7.2)</td>
</tr>
<tr>
<td>DO reading above upper limit</td>
<td>The oxygen reading is too high upper limit (DO &gt; 300 %-sat)</td>
<td>Apply / set calibration data. Execute a new product calibration in air saturated medium (Chapter 7.2)</td>
</tr>
<tr>
<td>DO reading unstable</td>
<td>Air bubbles attached to sensor cap due to process settings</td>
<td>Change steering speed or media composition if possible. If the problem appears repeatedly, contact Hamilton Technical Support</td>
</tr>
<tr>
<td>Verify / set calibration data</td>
<td>No calibration executed</td>
<td>Apply / set calibration data (Chapter 7.2)</td>
</tr>
<tr>
<td>Temperature out of measurement range</td>
<td>The measured temperature is outside the defined measurement range (4-50 °C)</td>
<td>If the process temperature is outside this range, the sensor will not perform DO readings</td>
</tr>
<tr>
<td>Measurement not running</td>
<td>The measurement interval is set to 0 or the measurement temperature is out of the range</td>
<td>Check measurement settings</td>
</tr>
<tr>
<td>DO calibration recommended</td>
<td>No calibration executed</td>
<td>Apply / set calibration data (Chapter 7.2)</td>
</tr>
<tr>
<td>4-20 mA value below 4 mA</td>
<td>The measurement value is below the lower limit of the 4-20 mA interface output</td>
<td>Reconfigure the 4-20 mA interface (Chapter 7.2)</td>
</tr>
<tr>
<td>4-20 mA value above 20 mA</td>
<td>The measurement value is above the upper limit of the 4-20 mA interface output</td>
<td>Reconfigure the 4-20 mA interface (Chapter 6.3.2)</td>
</tr>
</tbody>
</table>
## Troubleshooting

<table>
<thead>
<tr>
<th>Warning</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-20 mA current set-point</td>
<td>The 4-20 mA interface is not able to regulate the current requested for the current measurement value according to your 4-20 mA interface configuration</td>
<td>Check the 4-20 mA wiring and supply voltage (Chapter 6.3.2)</td>
</tr>
<tr>
<td>not met</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor supply voltage too</td>
<td>The sensor supply voltage is too low for the sensor to operate correctly</td>
<td>Ensure stable supply voltage written in the sensor specifications</td>
</tr>
<tr>
<td>low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor supply voltage too</td>
<td>The sensor supply voltage is too high for the sensor to operate correctly</td>
<td>Ensure stable supply voltage written in the sensor specifications</td>
</tr>
<tr>
<td>high</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Errors

<table>
<thead>
<tr>
<th>Errors (failures)</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO reading failure</td>
<td>Sensor cap is missing or the sensor is broken</td>
<td>Connect to SU ODO Cap or replace VisiFerm DO SU</td>
</tr>
<tr>
<td>DO(pO₂) exceeds air pressure</td>
<td>Measured partial pressure of oxygen is higher than the air pressure set by the operator</td>
<td>Reconfigure the air pressure parameter (Chapter 6.4.5)</td>
</tr>
<tr>
<td>T sensor defective</td>
<td>The internal temperature sensor is defect</td>
<td>Please contact Hamilton Technical Support</td>
</tr>
<tr>
<td>DO sensor cap missing</td>
<td>The SU ODO Cap has been removed</td>
<td>Connect to SU ODO Cap</td>
</tr>
<tr>
<td>Red channel failure</td>
<td>Measurement channel failure</td>
<td>Please contact Hamilton Technical Support</td>
</tr>
<tr>
<td>Sensor supply voltage far</td>
<td>The sensor supply voltage is below 6 V</td>
<td>Please check your power supply</td>
</tr>
<tr>
<td>too low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor supply voltage far</td>
<td>The sensor supply voltage is above 40 V</td>
<td>Please check your power supply</td>
</tr>
<tr>
<td>too high</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature out of</td>
<td>The measurement temperature is outside the defined operating temperature range (0 to 60 °C)</td>
<td>The sensor can be damaged</td>
</tr>
<tr>
<td>operating range</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Getting Technical Support

If a problem persists even after you have attempted to correct it, contact Hamilton’s Customer Support: Please refer to the contact information at the back of this Manual.

### Returning VisiFerm DO SU for Repair

Before returning the VisiFerm DO SU to Hamilton for repair, contact our Customer Service and request: a Returned Material Authorization (RMA) number.

Do not return the VisiFerm DO SU to Hamilton without a RMA number. This number assures proper tracking of your sensor. VisiFerm DO SU that are returned without an RGA number will be sent back to the customer without being repaired. Decontaminate the VisiFerm SO SU and remove health hazards, such as radiation, hazardous chemicals, infectious agents, etc. Provide the complete description of any hazardous materials that have been in contact with the sensor.
8 Disposal

The design of Hamilton sensors optimally considers environmental compatibility. In accordance with the EC guideline 2012/19/EU Hamilton sensors that are worn out or no longer required must be sent to a dedicated collection point for electrical and electronic devices, alternatively, must be sent to Hamilton for disposal. Sensors must not be sent to an unsorted waste disposal point.

9 Ordering Information

9.1 VisiFerm DO SU

<table>
<thead>
<tr>
<th>Ref</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>243258</td>
<td>VisiFerm DO SU Arc 120</td>
</tr>
<tr>
<td>10078255</td>
<td>VisiFerm DO SU Arc 120 C</td>
</tr>
</tbody>
</table>
9.2  SU ODO Cap

<table>
<thead>
<tr>
<th>Ref</th>
<th>Description</th>
<th>Wetted Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>243461</td>
<td>SU ODO Cap S0</td>
<td>PPA (cycloaliphatic polyamide), Silicone, EPDM</td>
</tr>
</tbody>
</table>

**Description:** The Hamilton ODO Cap S0 kit is an optical dissolved oxygen sensor cap that can be integrated into single use bags.

<table>
<thead>
<tr>
<th>Ref</th>
<th>Description</th>
<th>Wetted Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>10077858</td>
<td>SU ODO Cap S2</td>
<td>PPA (cycloaliphatic polyamide), Silicone, EPDM</td>
</tr>
</tbody>
</table>

**Description:** The Hamilton ODO Cap S2 kit is an optical dissolved oxygen sensor cap that can be integrated into single use rigid container.

9.3  Parts and Accessories

<table>
<thead>
<tr>
<th>Ref</th>
<th>Product Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>10071111</td>
<td>Arc View Mobile Basic for none Ex environment</td>
</tr>
</tbody>
</table>

**Description:** The pre-configured Arc View Mobile, Hamilton’s mobile solution for monitoring measurement values, calibrating Arc sensors and configuring various parameters with the unified user interface for pH, DO, Conductivity and ORP. The Arc View Mobile is based on the Samsung Galaxy Tab Active tablet and comes pre-configured with the ArcAir basic, app blocker application, power supply cable, instruction manual and Hamilton quick guide.

<table>
<thead>
<tr>
<th>Ref</th>
<th>Product Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>10071113</td>
<td>Arc View Mobile Advanced for none Ex environment</td>
</tr>
</tbody>
</table>

**Description:** The pre-configured Arc View Mobile, Hamilton’s mobile solution for monitoring measurement values, calibrating Arc sensors and configuring various parameters with the unified user interface for pH, DO, Conductivity and ORP. The Arc View Mobile is based on the Samsung Galaxy Tab Active tablet and comes pre-configured with the ArcAir advanced application, including features for CFR 21 Part 11 and Eudralex Volume 4 Annex 11 compliance, app blocker application, power supply cable, instruction manual and Hamilton quick guide.
### Ref | Description
--- | ---
243490-01 | Arc USB Power Cable with VP8 connector (for the Arc Wi 1G Adapter BT)
243490-02 | Arc USB Power Cable with M12 8-pole connector (for the Arc Wi 2G Adapter BT)

**Description:** The Arc USB Power Cable provides power supply via USB port for Arc sensors and digital communication.

### Ref | Description
--- | ---
243460 | Arc Wi 1G Adapter BT
243470 | Arc Wi 2G Adapter BT

**Description:** Designed to add Bluetooth communication to VisiFerm DO SU sensors when connecting directly to the PLC via modbus. The Arc Wi 2G Adapter BT also simplifies analog connection (4-20 mA) to the PLC.

### Ref | Description
--- | ---
242333 | Wireless Converter BT

**Description:** Designed for wireless communication between ArcAir and VisiFerm mA sensor.

### Ref | Description
--- | ---
355263 | Sensor Data Cable VP8, 1m
355264 | Sensor Data Cable VP8, 3m
355265 | Sensor Data Cable VP8, 5m
355266 | Sensor Data Cable VP8, 10m
355267 | Sensor Data Cable VP8, 15m
355268 | Sensor Data Cable VP8, 20m
ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Ref</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10070910</td>
<td>Data Cable VP8/M12, 1m</td>
</tr>
<tr>
<td>10071905</td>
<td>Data Cable VP8/M12, 3m</td>
</tr>
<tr>
<td>10067844</td>
<td>Data Cable VP8/M12, 5m</td>
</tr>
<tr>
<td>10067846</td>
<td>Data Cable VP8/M12, 10m</td>
</tr>
</tbody>
</table>

9.4 Services

Hamilton service engineers provide customers with on-site services. Hamilton offers a wide range of services from technical support to initial operation, qualification and maintenance of the sensors. Various tailored services are offered especially for OEM customers. Experienced service engineers ensure an optimal and professional service.

In order to find your local service support please visit: www.hamiltoncompany.com/process-analytics/support

Overview of service offers

- Online service
- Technical support
- Initial Operation/Calibration
- Qualification (IQ/OQ)
- Service packages
- Maintenance
- Training