



pH Arc Sensors

Operating Instructions



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The liability of Hamilton AG is described in detail in the document “General Terms and Conditions of Sale and Delivery” in their current version. Hamilton expressly disclaims liability for direct or indirect damages resulting from the use of the sensors. Users are reminded that sensors have a limited-service life, which depends on the specific application and operating conditions. Malfunctions may therefore occur at any time.

The user is solely responsible for the calibration, maintenance, and regular replacement of the sensors. For critical sensor applications, Hamilton recommends the use of backup measuring points to avoid consequential damage. The user is responsible for taking appropriate precautions in the event of sensor failure.

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1 Introduction

This chapter provides information about the intended use of the EasyFerm, Polilyte and MecoTrode Arc Sensors and the operating instructions.

The pH Arc Sensors Operating Instructions is intended to support users/operators with the integration, operation, and qualification of the EasyFerm, Polilyte and MecoTrode Arc Sensor families. This manual describes the features of the EasyFerm, Polilyte and MecoTrode Arc Sensor families and their integration into a Process Control System (PCS).

You must not exceed the specifications, thus the electrical wiring, temperature and pressure ranges provided in the Specification document for the pH Sensors family.

Both the hardware and communication between the pH Arc Sensor and the PCS are described in detail in this manual. After reading this manual, the user must be able to install and operate the pH Arc Sensors with the ArcAir application.

You must read and understand this manual and observe all safety precautions before using the sensor in your process setup. Hamilton assumes no responsibility for damage and operational disruptions arising from failure to observe these instructions.

1.1 Intended Use



Caution!

- The pH Arc Sensors are not intended for hazardous atmospheres.
- The measurement values transmitted over wireless communication are not intended to be used for process control.



Notice: The pH Arc Sensors have a built-in temperature sensor (NTC 22 kΩ). This temperature sensor is used to monitor the sensor conditions only and does not control the process temperature.



Notice:

- The measurement values transmitted over wireless communication are not intended to be used for Process Control System (PCS).
- The pH Arc Sensors are intended for use in an industrial electromagnetic environment and comply with IEC / EN 61326-2-3.

The EasyFerm, Polilyte and MecoTrode Arc Sensor families (pH Arc Sensors) are intended for the measurement of pH. You must observe the Safety Precautions and Hazards described in Chapter 2.

1.2 Initial operation

Check the sensor for damage at the time of unpacking. A damaged sensor must be returned to your Hamilton dealer in the original packaging.

You must follow the maintenance procedures by paying particular attention to cleaning and decontamination if you work with hazardous liquids. You must decontaminate the sensor if it becomes contaminated with biohazardous, radioactive, or chemical substance.

1.3 General precautions

For safe and correct use of the pH Arc Sensors, it is important that both operating and service personnel follow standard safety procedures and observe the safety precautions and hazards described in Chapter 2.

Only authorized/trained service personnel can assemble/install, operate, clean, calibrate, maintain the sensor or do other service-related tasks.

The service life of a the pH Arc Sensor is determined by the specific conditions of the applications. The measuring conditions, especially high temperatures, pressure, and aggressive chemicals/solutions can shorten the service life of the pH Arc Sensor. For details about replacement conditions, see Chapter 7.

2 Safety Precautions and Hazards



Caution! Safety precautions and hazards:

- Carefully read and observe the following safety precautions and hazards before installing, setting up, and operating the sensor.
- Failure to observe and follow through with the maintenance procedures can affect the reliability and correct function of the system.
- Failure to observe the safety precautions and hazards described in this manual, improper use of the sensor, and unauthorized interference with the sensor by external devices will void all warranties provided by the manufacturer.
- Do not expose the sensor to corrosive media or substances. This will help to protect the sensor from deterioration.

You should only use the sensor for its intended purpose while observing the necessary safety precautions. Incorrect use or misuse of the sensor can be dangerous for personnel and can cause damage to equipment. Make sure the sensor is in good condition before use.

2.1 Operating precautions for the pH Arc Sensor

When using pH sensors in process environments, 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 connections for the process control. The Arc wireless interface is designed for sensor monitoring, maintenance and service purposes.

Make sure that the PG 13.5 thread and the O-ring are not damaged when screwing the sensor into the process. O-rings are consumable parts which must be replaced regularly (at least once a year). Even if all the required safety measures have been observed, there are potential risks in terms of leaks or mechanical damage to the fitting. Wherever there are seals or screws, gases or liquids can escape unnoticed.

Always make sure no process medium can be accidentally spilled before removing the sensor from its measurement setup. Make sure that no air or gas bubbles stick to the sensitive part of the sensor. As a consequence, the measurement value could be unstable. Do not expose the system to stresses such as vibrations, bending or twisting. Before use, make sure that the sensor is correctly configured for your application.

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



Notice: You must always store the sensor in a cap with storage solution (REF 238931). This prevents the sensor diaphragm from drying out and minimizes a possible decrease in the performance.

2.2 Electrical safety precautions



Caution! Before you remove/disconnect the sensor from the process tank, benchtop, or bioreactor, you must always turn off the power supply and disconnect the cable connector from the sensor.



Notice: The PCS will show incorrect readings when the power supply (230 VAC / 24 VDC) is turn off or disconnected.

Do not connect the sensor to a power source of any voltage beyond the range stated in the Power Rating Technical Specifications. For details, refer to the Hamilton Process Analytics website (www.hamiltoncompany.com).

Always use Hamilton VP8 cables for safe connection. Cables are available in a broad range of lengths (see Chapter 9.2). Make sure the cable is intact and plugged in correctly to prevent short circuit.

Keep the pH Arc Sensors away from other equipment which emit electromagnetic radio frequency fields, and minimize static electricity in the immediate environment of the measuring parts. Carefully follow all the instructions in Section 4.3 to avoid electrical damage to the sensor. Make sure the electrical contacts on the pH Sensor head in clean and dry before you connect the sensor data cable.

2.3 Chemical, radioactive or biological hazard precautions

Selection of the appropriate safety level and implementation of the required safety measures for working with pH Arc Sensors is the sole responsibility of the user.

You must follow the maintenance procedures by paying particular attention to cleaning and decontamination if you work with hazardous liquids. You must decontaminate the pH Arc Sensor if it becomes contaminated with a biohazardous, radioactive, or chemical substance.

3 Product Description

3.1 General Description

The pH Arc Sensors measure critical and control parameters for many liquid processes. Hamilton offers a wide selection of sensors for use in all bio-processes, as well as many other industries that require high accuracy and reliability from their sensors. Hamilton is one of the few manufacturers to have multiple pH membrane glass options and reference designs to tailor the sensor for the specific application.

The pH Arc Sensors feature an integrated micro-transmitter that enables direct communication with the process control system via a 4–20 mA standard signal or digital Modbus communication. Wireless communication via the Arc Wi Adapter can be used for monitoring, configuration, and calibration, saving time without compromising the quality of the wired connection.

The integrated micro-transmitter stores all relevant sensor data, including calibration and diagnostic information, simplifying calibration and maintenance. The integrated quality indicator provides an estimation of the remaining sensor lifetime.

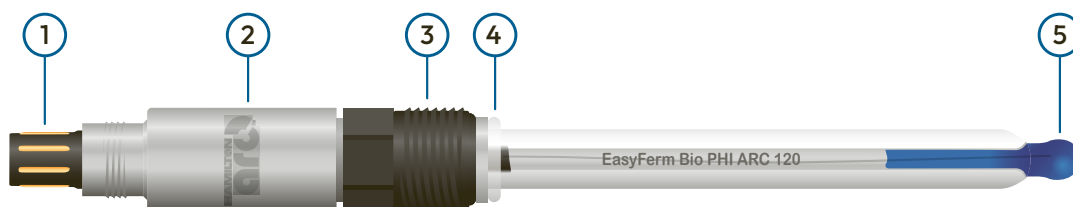
Key benefits include:

- Multiple pH membrane glass options for different applications
- No separate transmitter needed
- Easy to install
- Direct digital Modbus or analog communication to the process control system via 4–20 mA standard signal
- Wireless option via Arc Wi Adapter for easy monitoring, configuration, and calibration

3.2 Hardware Description

The pH Arc Sensor consists of a sensor head with integrated electronics and a sensitive pH sensor glass membrane. During the development of the pH Arc Sensor, we placed particular value on achieving an optimum sanitary design.

The pH glass shaft is terminated by the sensitive glass membrane and diaphragm with the reference measurement system. The sensitive pH sensor glass membrane comes in contact with the measured medium. All materials in contact with the solution meet FDA requirements.



- 1 VP8 connector
- 2 Sensor head with integrated microtransmitter
- 3 Process connection, PG 13.5 thread
- 4 O-ring
- 5 Sensitive glass membrane

Figure 1: Overview of the pH Arc Sensor

3.3 pH Arc Sensor with integrated micro-transmitter

With the micro-transmitter integrated, pH Arc Sensors offer fully compensated signals 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, which can help simplify calibration and maintenance procedures.

4 Hardware and Software Installation

This chapter provides information, and instructions on how to install and set up the pH Arc Sensors and its hardware as well as the ArcAir software.

4.1 Unpacking

1. Carefully unpack the pH Arc Sensor. Enclosed you will find the pH Arc Sensor, and the Declaration of Quality.
2. Inspect the sensor for shipping damages or missing parts.



Figure 2: Overview of the pH Arc Sensor delivery package contents: pH Arc Sensor, DoQ

4.2 Configuring the pH Arc Sensor with ArcAir application

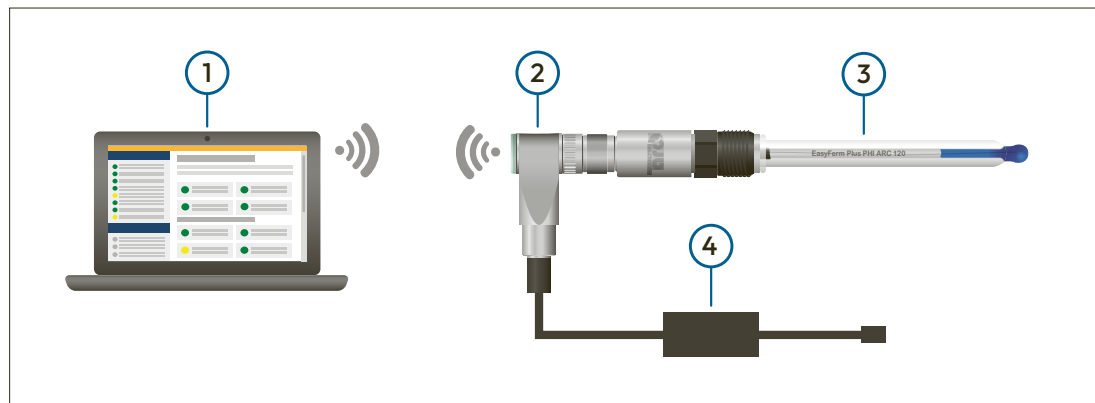
Arc Sensors require an application-specific configuration. The following parts are required to configure and calibrate Arc Sensors:

- Arc View Mobile or ArcAir application
- External Power Supply with Arc USB Power Cable (REF 243490-xx)
- Arc View Mobile: REF 10071111 (Standard Version), REF 10071113 (Advanced Version)

To configure and set up the Arc sensors, at least the ArcAir Basic application is required.

ArcAir version	Read	Calibrate	Configure	Documentation	Remark
Basic	✓	✓	✓	–	Free download from Hamilton website or App Store / Play Store • Intended for PC, mobile phone, or tablet • Basic functions, including: Measuring, Sensor status, Experiment function, Configuration, Firmware update
Advanced	✓	✓	✓	✓	• Update from the basic version • Intended for PC, mobile phone, or tablet • Offers all the ArcAir Basic functions, including: Verification, Communication validation, User management, Audit trail, Report functionality

Table 1: Provides an overview of the different ArcAir licenses and their functionality



- 1 ArcAir application installed on PC
- 2 Arc Wi Pivot adapter
- 3 pH Arc Sensor
- 4 Arc USB power cable

Figure 3: Arc system setup: pH Arc Sensor configuration with ArcAir application

4.2.1 Installing ArcAir Basic on a computer

1. Download the ArcAir.zip file from the Hamilton website www.hamiltoncompany.com (search for ArcAir).
2. Unpack the Zip file.
3. Do not connect the Wireless Converter before the ArcAir installation is completed.
4. Install the ArcAir application by double-clicking the ArcAir.exe file, then follow the instructions on the screen.

4.2.2 Connecting a pH Arc Sensor to ArcAir application

1. Connect the power supply cable, e.g. Arc USB Power Cable (REF 243490-xx) to the sensor or connect the optional Arc Wi Adapter BT.
2. Switch on the Bluetooth connection on the mobile device (only for wireless connection).
3. The ArcAir application recognizes and displays the connected sensor automatically.

 **Notice:** For automatic sensor login, a unique and global Operator Level S password for all intelligent sensors is required. 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.

4.2.3 Create user accounts

1. Start the ArcAir application on your computer.
2. Click **Backstage** in the upper left corner.
3. Select **User Management**.
4. Click the **Add** button to open the **User Editor** window.
5. Type in the user details and password.
6. Select the specific rights for the user.

 **Notice:**

- Initial operation of the ArcAir application will be in laboratory mode as long as no user account is created. Laboratory mode does not require a login password and enables all features that are available with the license version installed.
- The first user is the administrator and all user rights are assigned by default.

4.2.4 Configuring the pH Arc Sensor parameters

1. Start the ArcAir application.
2. Select the desired sensor.
3. Open the Settings menu . Make sure you have the Sensor Settings user rights.
4. Configure the sensor.

A description of the available settings is provided below:

Parameter Name	Description	Default Setting	Range	Configuration	Location
Measurement Unit	These are the measurement physical units	pH	pH, mV	Required	Measurement Settings
Temperature unit	These are the temperature physical units	°C	°C, K	Required	Measurement Settings
Moving average	The sensor uses a moving average 1-150 over the measuring points	2	1 to 150	Recommended default parameter	Measurement Settings

Moving average Resistance	The sensor uses a moving average 1-150 over the measuring points	4	1 to 150	Recommended default parameter	Measurement Settings
Min. / Max. Custom Measurement Temperature	It is possible to set a minimum and maximum measurement temperature	0 °C to 110 °C	0 °C to 110 °C	Recommended default parameter	Measurement Settings

Table 2: pH Arc Sensor

4.2.5 Configuring the temperature settings for SIP/CIP process

Parameter Name	Description	Default value	Configuration	Location
SIP process definition	User defines conditions for the SIP counter	Temp. min.: 120 °C Temp. max.: 130 °C Time: 20 min.	Recommend default parameter	Status / SIP / CIP
CIP process definition	User defines conditions for CIP counter	Temp. min.: 80 °C Temp. max.: 100 °C Time: 20 min.	Recommend default parameter	Status / SIP / CIP

Table 3: Configuring the temperature setting for the Sterilization in Place (SIP) / Cleaning in Place (CIP) process

4.2.6 Configuring the analog interface for the process control system

Parameter Name	Description	Default value	Configuration	Location
Interface Mode	The output of the 4-20 mA can be configured as linear, bi-linear or with a fixed value	4- 20 mA	Recommend default parameter	Interface/Analog Output
Value at 4 mA	Defined measurement value for 4 mA output	0 pH / 0 °C	Required	Interface/Analog Output
Value at 20 mA	Defined measurement value for 20 mA output	14 pH / 40 °C	Required	Interface/Analog Output
Mode in the event of a warning	Current output mode in case of a warning	No output	Recommend default parameter	Interface/Analog Output
Mode in the event of an error	Current output mode in case of an error	Continuous output	Recommend default parameter	Interface/Analog Output
Output in the event of a warning	Current output mode in case of a warning	3.5 mA	Recommend default parameter	Interface/Analog Output
Output in the event of an error	Current output mode in case of an error	3.5 mA	Recommend default parameter	Interface/Analog Output
Output for T out of limit	Current output mode in case of temperature out of limit	3.5 mA	Recommend default parameter	Interface/Analog Output

Table 4: Configuring the analog interface for the process control system

4.2.7 Defining a measuring point name for the process identification

Parameter Name	Description	Default value	Configuration	Location
Measuring point	User can define a sensor name for better identification of the measuring point	REF-SN (e.g. 243605-9999)	Optional	Information / Info User Space

Table 5: Defining a measuring point name for the for the process identification

4.3 Install a pH Arc sensor in the measuring loop

This chapter provides information, and instructions on how to install and set up the pH Arc Sensor and its hardware in the measuring loop.

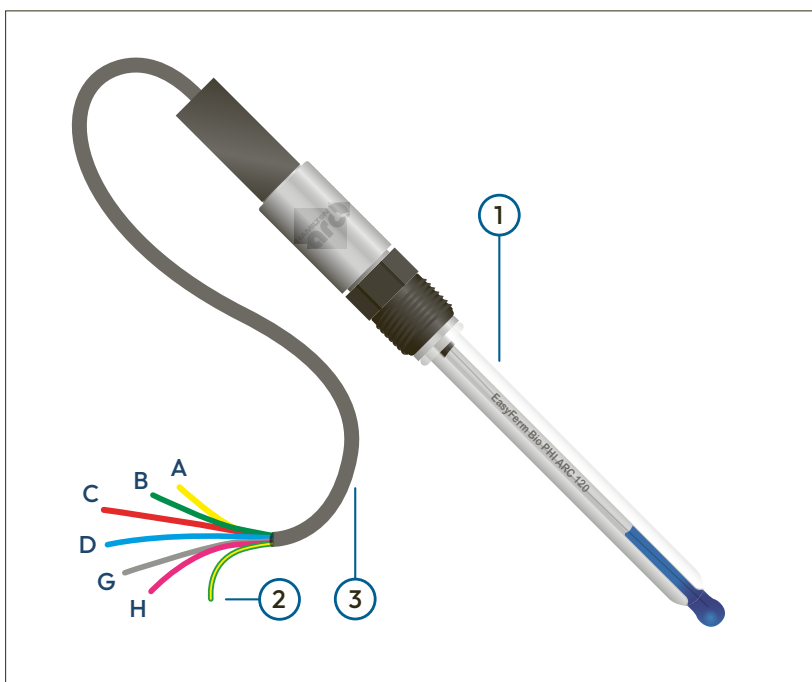
4.3.1 Mechanical process connection

Sensor installation tips

- Before you install the housing, you must test the seal for tightness and the functionality of the sensor parts.
- Make sure that there is no damage to the sensor or the housing.
- Make sure that each O-ring is in the appropriate groove and not damaged.
- To prevent mechanical damage to O-rings, apply a small amount of grease to the O-rings before you install the sensor in a reactor.

4.3.2 VP8 PIN designation

Always use Hamilton Sensor Data Cables, which are available in different lengths (see Chapter 9). For example, use the VP8 Cable for safe system connection.



- 1 pH Arc Sensor
- 2 Earth/ground cable (yellow/green) for the metal shaft of the sensor
- 3 Cable shield: Double coaxial open-end cable and data cable conductor

Figure 4: pH Arc Sensor electrical connection: VP8 connector PIN assignment

VP Pin	Function	Color
A	4-20 mA interface # 2	Yellow
B	4-20 mA interface # 1	Green
C	Power supply: + 24 VDC (10 VDC to 27 VDC)	Red
D	Power supply: Ground	Blue
E	Not used	Brown
F	Not used	White
G	RS-485 (A)	Gray
H	RS-485 (B)	Pink

Figure 5: Pin description for electrical connection of pH Arc sensors

4.3.3 Controlling 4–20 mA current interface signals with pulse-width modulation (PWM)

Hamilton pH Arc Sensors 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_i) of a rectangular signal with a constant frequency, the pulse duty factor (t_i/T), is modulated and afterwards demodulated by a low-pass filter to generate continuous analog DC signals. The resulting value (y_i) corresponds to the average of the PWM signal (see Figure Figure 6 and Figure 7).

The PWM-loads of the sensors have low-pass filters which are not able to eliminate all AC fractions of the used PWM frequency of 7.32 kHz due to technical impossibilities. Therefore, the current signals of the 4–20 mA interfaces are still overlaid by a certain AC which should be masked by lag smearing or input filters of the current input card of the Process Control System (PCS).

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, contact Hamilton Technical Support.

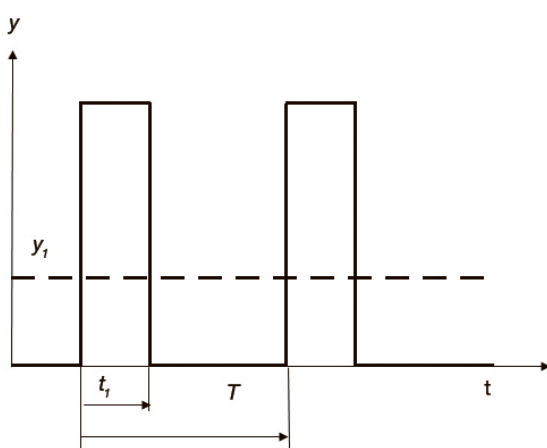


Figure 6: Graph showing a rectangular signal with a period (T) and pulse duration (t_i) used to generate an analog signal value (y_i)

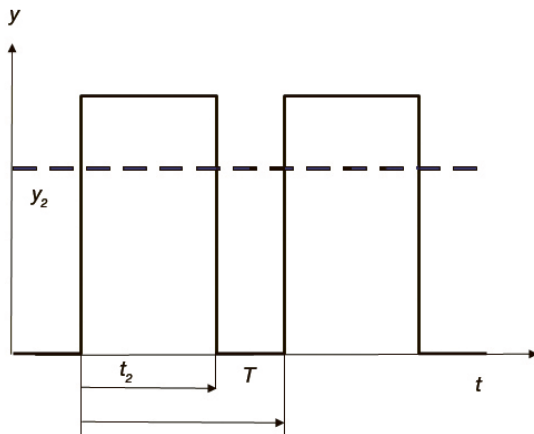


Figure 7: Graph showing a rectangular signal with a period (T) and pulse duration (t_2) used to generate an analog signal value (y_2)



Caution!

- The pH Arc Sensor 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. Figure Multi-drop bus wiring illustrates a solution for such situation.

Analog interface 1 and 2

Galvanically not isolated, pulse width modulation with 7.32 kHz, recommended PCS settings:

- Use galvanically separated inputs
- Sampling rate < 6.27 kHz and $\neq n \cdot 7.32$ KHz
- Average over > 1 s

4.3.4 Electrical connection for analog 4–20 mA connection

The 4–20 mA interface enables direct connection of the pH Arc Sensor to a data recorder, indicator, control unit or PCS with analog I/O. The pH Arc Sensor works as a current sink sensor and is passive. Connect the sensor according to the PIN designations (see Chapter 4.3.2).

The 4–20 mA interface of the pH Arc Sensor 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 (see Chapter 4.2.6).

Examples of a circuit arrangement

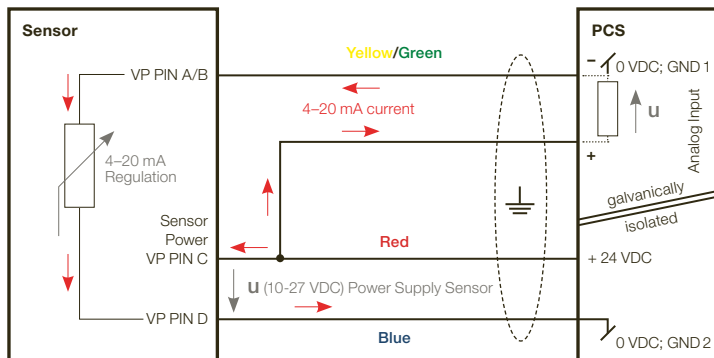


Figure 8: Three-wire loop wiring diagram for the 4-20 mA interface

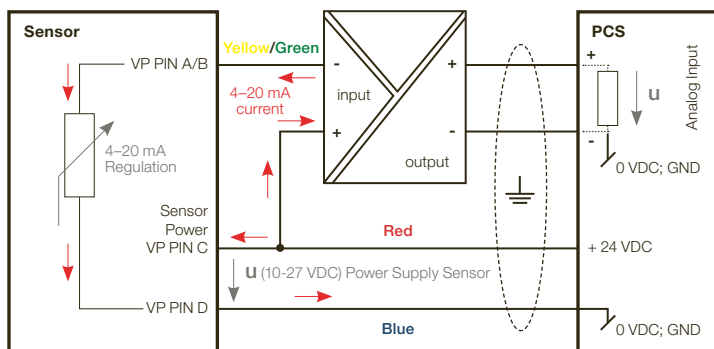


Figure 9: The safest form of wiring diagram with an isolation amplifier

4.3.5 Electrical connection for the digital RS485 interface

The digital RS485 interface enables communication with pH Arc Sensors for performing measurements and for calibrating and changing the configuration parameters. pH Arc Sensors are always connected to digital controlling devices as a Modbus server. To function, they require a power supply (VP8 PINS C and D, see below). Chapter 4.2 describes the configuration for digital mode.

Additional information: Modbus RTU communication protocol

The Modbus RTU communication protocol corresponds to the Modbus-IDA standard. For more information, refer to the Modbus organization website (<https://modbus.org/>). The Modbus physical layer is described in detail with requirements on cabling and line termination in the Modbus Serial line Protocol and Implementation Guide.

For more information on the Modbus physical layer, navigate through the Modbus Serial line Protocol and Implementation Guide > Technical Resources > Modbus Specifications.



Caution!

- All the sensors are delivered with the factory-default setting. Each sensor must be configured for its specific application before first use (see Chapter 4.2).
- In an electromagnetically noisy environment, we recommend that you connect the VP cable shield to the earth/ground. This significantly reduces noise interferences and improves the signal quality.

Examples of the circuit arrangement

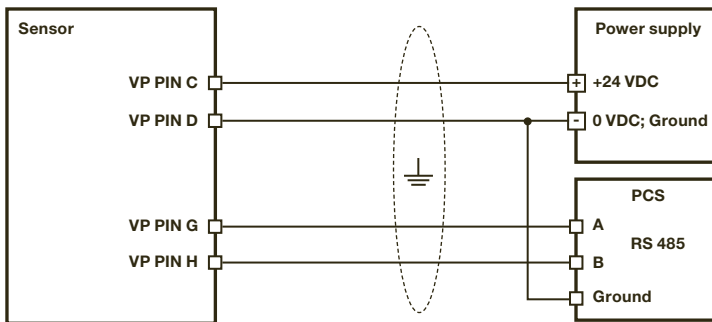


Figure 10: Wiring diagram for the RS485 interface.

Table 6 provides an overview of the PIN assignment for the RS485 digital interface with the VP cable conductor.

VP Pin	Function	Color
C	Power Supply: + 24 VDC (10 VDC to 27 VDC)	Red
D	Power Supply: Ground	Blue
G	RS485 (A)	Gray
H	RS485 (B)	Pink
Shaft	Shield	Green/Yellow

Table 6: PIN assignment for RS485 digital interface

Caution! You must assign a unique Modbus device address to each sensor to ensure correct communication for the wiring configuration shown Figures 10 & 11.

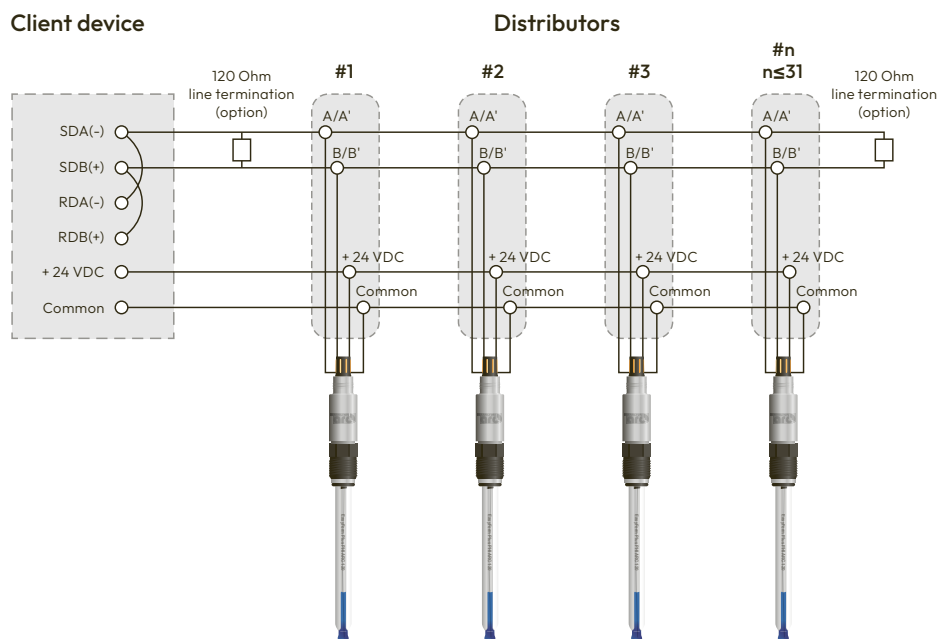


Figure 11: Multi-drop bus wiring: Two-wire mode for the Modbus connection



Notice: Modbus communication guidelines:

- Each sensor functions as a Modbus server.
- Only one sensor can communicate with the client at a time.
- To prevent signal reflection on the lines, use a 120 Ω line termination resistor on each line.
- Signal reflection effects become noticeable with long cables and/or high baud rates.
- The serial Modbus connection between the client's RS-485

5 Operation



Caution!

- To protect the analog electronics and extend the lifespan (service life) of the sensor, analog measurements at temperatures above 110 °C are prohibited.
- Only use the sensor within the specifications (see www.hamiltoncompany.com). Failure to do so may lead to damages or measurement failure.

1. Remove the watering caps from the tip of the pH Arc Sensor, and yellow cap from the VP8 sensor head.
2. Make sure the O-ring on the sensor shaft is not damaged and check for shipping damages or missing parts.
3. Verify the functionality of the sensor (see Section Verify sensor status).
4. Calibrate the sensor (see Section Calibration).
5. Connect the sensor to the process control system (see Section Install a pH Arc Sensor in the measuring loop)
6. Verify the measurement in standard solution and on your control system.
7. Install the sensor into the housing or process connection (see Section Install a pH Arc Sensor in the measuring loop).

The signal stabilizes itself within a few minutes. The pH Arc Sensor is programmed with default calibration values. To achieve the best accuracy, execute calibration of the sensor (Chapter 6.2).

6 Maintenance

You must do regular maintenance routines to ensure safe and reliable operation and accurate measurements with the sensor and its accessories.

 **WARNING!** Do not expose the sensor/equipment to corrosive media or substances. This will help protect the sensor/equipment from deterioration.

6.1 Verify sensor status

1. Power the sensor with the Sensor Power Cable and connect the sensor to the ArcAir application.
2. Control the traffic lights (see Table Description of the traffic lights on the ArcAir application).
3. Refer to the troubleshooting (see Chapter Troubleshooting) for the next steps if the sensor status indicator is not green.
4. Control the quality of the sensor in **Sensor Status > Quality Counter and Temperature > Quality Indicator**.

Indicator status	What does it mean?
 The Status symbol in the ArcAir App is green.	The connectivity to the sensor is OK. The sensor is operating correctly and no warnings or errors have been registered.
 The Status symbol in the ArcAir App is yellow.	The connection to the sensor is OK. However, the sensor indicates a warning. Verify the sensor warnings in “Info > Status”.
 The Status symbol in the ArcAir App is red.	The connection to the sensor is OK. However, the sensor indicates an error. Verify the sensor error in “Info > Status”.
 The Status symbol in the ArcAir App is grey.	The ArcAir™ App lost connection to the sensor.

6.2 Calibration

The pH Arc Sensors provide two kinds of sensor calibration: automatic standard calibration and process calibration in situ. The automatic standard calibration and the process calibration in situ can be performed by using the ArcAir application. For details on the sensor calibration procedure, see Chapter 6.2.

The pH Arc Sensors can be calibrated automatically with the buffer solution defined in the sensor configuration profile.



Notice: For greater measurement accuracy, make sure that the temperature difference between the calibration medium and the process medium is minimal.

Six sets of the pH calibration standards are provided with each pH Arc Sensor:

- Hamilton
- Merck Titrisol®
- DIN 19267
- NIST Standard
- METTLER TOLEDO
- Radiometer

 **Caution!** Do not use the same buffer solution for two different calibration points. This will cause the sensor to produce an error and reject the calibration.

 **Notice:** The concept behind Arc pH Sensors is to enable calibration and configuration in the lab before use in the process control. This eliminates additional calibration in the process setup at the point of installation.

The pH Arc sensors are pre-calibrated at the factory using two Hamilton standards: pH 4 (Calibration Point 1), and pH 7 (Calibration Point 2) at room temperature. The following buffers within Hamilton standards set are defined as factory default for calibration with automatic buffer recognition: pH 4.01, pH 7.00 and pH 10.01.

6.2.1 One-point calibration in pH buffer solution

1. Power the pH Arc Sensor and connect the sensor to the ArcAir application via Bluetooth or Arc USB Power Cable.
2. Clamp the sensor to hold it in position inside the buffer solution bottle (see Figure 12).
3. Select the applicable sensor in the sensor list in the ArcAir application.
4. Open the **Calibration** tab.
5. Select **Calibration Point 1**.
6. Immerse the sensor in the buffer solution (default buffer solution: pH 4.0).
7. Click **Start** to start the calibration wizard.
8. Follow the instructions on the screen to complete the calibration process.

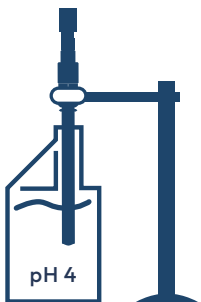


Figure 12: Sensor calibration setup with pH 4 buffer solution

6.2.2 Two-point calibration in pH buffer solution

1. Power the pH Arc Sensor and connect the sensor to the ArcAir application via Bluetooth or Arc USB Power Cable.
2. Clamp the sensor to hold it in position inside the buffer solution bottle (see Figure 13).
3. Select the applicable sensor in the sensor list in the ArcAir application.
4. Open the **Calibration** tab.
5. Select **Calibration Point 2**.
6. Immerse the sensor in the buffer solution (default buffer solution: pH 7.0).
7. Click **Start** to start the calibration wizard.
8. Follow the instructions on the screen to complete the calibration process.

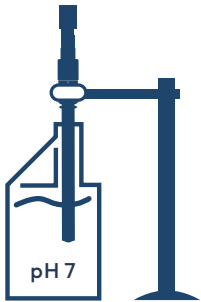


Figure 13: Sensor calibration setup with pH 7 buffer solution

6.2.3 Process calibration

The process calibration is an in situ sensor calibration procedure performed to adjust the measurement for specific process conditions in case the sensor cannot be removed for the standard calibration.

Process calibration adapts the standard calibration to the current process conditions by applying an offset correction (CP6). To restore the standard calibration, the process calibration (CP6) can be deleted at any time via the ArcAir application. Note that performing a new standard calibration will delete the previous process calibration.



Caution! The difference between initial measurement and laboratory values for pH sensors can not be greater than two pH units.

Figure 14 shows the effect of process calibration (CP6) compared with an existing standard calibration function (CP1/CP2).

pH Arc Sensor Calibration (CP6) in situ Compared with Standard Calibration (CP1/CP2)

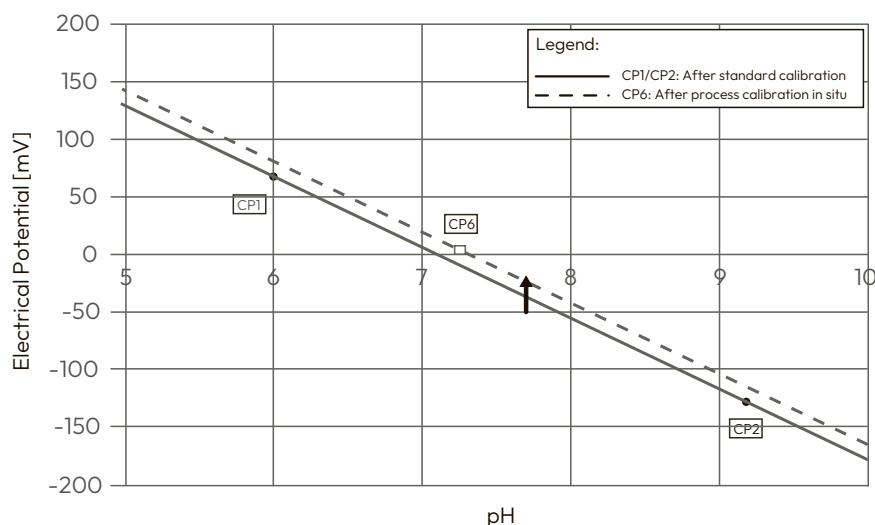


Figure 14: Graph illustrating the in situ calibration (CP6) of the pH Arc Sensor, compared to an established standard calibration function (CP1/CP2).

Process calibration in situ

To do the process calibration, follow these steps:

1. Connect the sensor to the ArcAir application via Bluetooth or Arc USB Power Cable.
2. Select the applicable sensor in the sensor list in the ArcAir application.
3. Click the **Process Settings** tab.
4. Click the **Start** button to start the process calibration wizard.
5. Follow the instructions on the screen to complete the calibration process.



Notice: Alternatively, the process calibration may be performed with a field device on the side of the measuring point.

6.3 Cleaning



Caution!

- Only authorized/trained service personnel can install, operate, clean, calibrate, maintain the pH Arc Sensor or do other service-related tasks.
- Always make sure that the system is depressurized and cold, and that no process medium can be accidentally spilled before you remove the sensor from the measuring system.
- Always wear protective eyewear and gloves before you remove the sensor from the system, for example, cleaning the bioreactor.
- Do not use abrasive tissues or cleaning agents/solutions other than the recommended standard cleaning agents/solutions to clean the sensor.
- You must decontaminate every sensor or product before shipping it back to Hamilton Process Analytics for repair.

In general, you can clean the sensor/electrodes for brief periods with acids, alkaline solutions, and commonly used solvents suitable for sensors with a glass shaft. Depending on the application, pH sensors may also be cleaned or sanitized using hydrogen peroxide solutions at concentrations of 1-5%. Compatibility and effectiveness must be verified by the user for the specific process conditions. After cleaning or sanitization, thoroughly rinse the sensor with purified water, deionized water, or water for injection.

Ceramic diaphragm

If protein contamination occurs, you must immerse the sensor in a solution of 0.4% HCl + 5 g/L pepsin for several hours. If the diaphragm shows visible discoloration (blackened by silver compounds), you must immerse the sensor in a solution of 0.4% HCl + 76 g/L thiourea. The Cleaning Solution Set (REF 238290) can be used to clean all the contaminations described.

Sterilization

Hamilton pH sensors are designed for sterilization using saturated steam under specified autoclave and SIP conditions. Exposure to dry or superheated steam is not recommended, as it may lead to dehydration of the pH-sensitive glass membrane and reference system and may introduce additional mechanical stress, potentially affecting sensor performance, service life, or causing sensor damage. Where possible, saturated steam conditions should be maintained throughout the sterilization process.



Notice: It is possible that the electrodes will show a slow response time for a short time after cleaning/sterilization. To stabilize the response time, place the electrodes in a storage solution for 15 minutes after cleaning/sterilization.

7 Troubleshooting

This chapter provides troubleshooting guidelines, tips for self-diagnosis, Hamilton's Technical Support details, and product return procedures.

7.1 Sensor self-diagnostic



Caution! Corrective actions for warning and error:

- You must acknowledge Warnings by following through with the recommended corrective actions. The required corrective action will vary for each warning depending on the root cause. The warning will be displayed continuously until the corrective action is completed.
- You must address sensor Errors by following through with the recommended corrective actions.

The pH Arc Sensors provide a self-diagnostic functionality to detect and identify the most common sensor malfunctions. Both interfaces, analog 4–20 mA and digital Modbus, may provide warning and error messages. The analog 4–20 mA interface can be configured according to the NAMUR recommendations to indicate an abnormal event.

Use the ArcAir application for monitoring the sensor status and for troubleshooting. The following types of messages are provided by the self-diagnosis function.

For additional information about the sensor status and the diagnostics features, refer to this pH Arc Sensors Operating Instructions or the pH Arc Sensors Programmer's Manual (REF 111008861).

7.1.1 Warnings

The status indicator of the sensor lights up Yellow when a warning is registered.

Warning	Cause	Solution
Measurement not running	Measurement Hold Mode is in Hold- or Off mode.	Turn on the hold mode.
pH calibration recommended	The Quality Indicator (QI) of the sensor is below 30%.	Apply calibration data (Chapter 6.2).
Replace sensor	The Quality Indicator (QI) of the sensor is below 30%. The quality of the sensor is sufficient for reliable measurement, but a replacement of the sensor must be considered.	Apply calibration data (Chapter 6.2). Replace the sensor.
Sensor supply voltage too low	Applied voltage is too low.	Make sure the sensor operating voltage range is between 10 to 27 VDC.
Sensor supply voltage too high	Applied voltage is too high.	Make sure the sensor operating voltage range is between 10 to 27 VDC.
Temperature reading below lower limit	The temperature is below the user-defined measurement temperature range.	Adjust the lower temperature limit to the predefined temperature value.
Temperature reading above upper limit	The temperature is above the user-defined measurement temperature range.	Adjust the upper temperature limit to the predefined temperature value.

Table 7: Warnings

7.1.2 Errors

The status indicator of the sensor lights up Red when a warning is registered.

Error	Cause	Solution
EEPROM comm. (I2C) error (user-end)	EEPROM communication error.	Reset the sensor and try again. Contact Hamilton Technical Support for assistance (see Chapter 7.2).
Glass resistance too high	The sensor is not properly, immersed in solution (media/buffer) or is broken.	Immerse the tip of the probe in solution (media/buffer). Replace the sensor.
Glass resistance too low	The reference system of the sensor is broken.	Replace the sensor.
Internal communication (I2C) failure (user-end)	Internal I2C communication error.	Reset the sensor and try again. Contact Hamilton Technical Support for assistance (see Chapter 7.2).
Internal communication failure (front-end)	No communication between front-end and user-end.	Reset the sensor and try again. Contact Hamilton Technical Support for assistance (see Chapter 7.2).
pH reading failure	The sensor is not properly, immersed in solution (media/buffer) or is broken.	Immerse the tip of the probe in solution (media/buffer) Replace the sensor.
Sensor failure	The sensor is defective or the sensor Quality Indicator (QI) is below 15%. The quality of the sensor is not sufficient for reliable measurement.	Replace the sensor.
Stackoverflow	Internal memory failure.	Reset the sensor and try again. Contact Hamilton Technical Support for assistance (see Chapter 7.2).
Temperature reading far below min	The measured temperature is outside the specified operating temperature range (e.g. 0-140 °C).	Adjust operating temperature. Contact Hamilton Technical Support for assistance (see Chapter 7.2).
Temperature reading far above max	The measured temperature is outside the specified operating temperature range (e.g. 0-140 °C).	Adjust operating temperature. Contact Hamilton Technical Support for assistance (see Chapter 7.2).
Temperature sensor defective	The temperature sensor is broken.	Replace the sensor.

Table 8: Errors

7.2 Request for 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.

7.3 Return the sensor for repair



WARNING!

- Make sure you decontaminate the pH Arc Sensors and remove health hazards such as radiation, hazardous chemicals, or infectious agents before returning the sensor to Hamilton.
- Provide a complete description of any hazardous materials that have been in contact with the sensor.



Caution! Corrective actions for warning and error:

- Do not return an Arc Sensor to Hamilton without an RMA number. The RMA number ensures that your sensor can be tracked, so your request can be handled by the right department.
- pH Arc Sensors that are returned without an RMA number will be sent back to the customer without being repaired

Before returning an Arc sensor to Hamilton for repair, contact our Technical Support and request a Return Material Authorization (RMA) number.

8 Disposal

-  **Caution! Product disposal and recycling:**
- Do not dispose of products at an unsorted waste disposal point.
 - Hamilton products that are worn out or no longer required must be sent to a dedicated collection point for electrical and electronic devices.

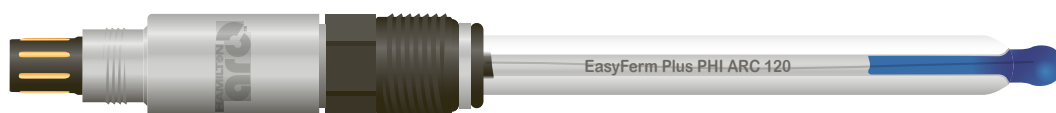
The design of the Hamilton products optimally considers environmental compatibility and regulations compliance (see Table 9).

Symbol	Definition
	Dispose of in accordance with the EU Directive 2012/19/EU or WEEE (Waste Electrical and Electronic Equipment)
	有關危險物質的列表，請參閱 Hamilton Process Analytics 符合性聲明。如需了解更多信息，請訪問 Hamilton 的網站：www.hamiltoncompany.com。 For a list of hazardous substances, see the Hamilton Process Analytics Declaration of Conformity. For additional information, visit the Hamilton website: www.hamiltoncompany.com.

Table 9: Symbols used on the product labels and packaging

9 Ordering Information

9.1 pH Arc Sensors



REF	Product Name
238633-1313	EasyFerm Plus PHI Arc 120
238633-1323	EasyFerm Plus PHI Arc 160
238633-1333	EasyFerm Plus PHI Arc 200
238633-1343	EasyFerm Plus PHI Arc 225
238633-1353	EasyFerm Plus PHI Arc 325
238633-1373	EasyFerm Plus PHI Arc 425
238633-2313	EasyFerm Plus HB Arc 120
238633-2323	EasyFerm Plus HB Arc 160
238633-2333	EasyFerm Plus HB Arc 200
238633-2343	EasyFerm Plus HB Arc 225
238633-2353	EasyFerm Plus HB Arc 325
238633-2373	EasyFerm Plus HB Arc 425
243632-1313	EasyFerm Bio PHI Arc 120
243632-1323	EasyFerm Bio PHI Arc 160
243632-1333	EasyFerm Bio PHI Arc 200
243632-1343	EasyFerm Bio PHI Arc 225
243632-1353	EasyFerm Bio PHI Arc 325
243632-1373	EasyFerm Bio PHI Arc 425
243632-2313	EasyFerm Bio HB Arc 120
243632-2323	EasyFerm Bio HB Arc 160
243632-2333	EasyFerm Bio HB Arc 200
243632-2343	EasyFerm Bio HB Arc 225
243632-2353	EasyFerm Bio HB Arc 325
243632-2373	EasyFerm Bio HB Arc 425
10110152	MecoTrode H Arc 120
242428-2313	Polilyte Plus HB Arc 120
242428-2323	Polilyte Plus HB Arc 225
242428-2333	Polilyte Plus HB Arc 325
242428-2353	Polilyte Plus HB Arc 425
242428-4313	Polilyte Plus PHI Arc 120

REF	Product Name
242428-4323	Polilyte Plus PHI Arc 225
242428-4333	Polilyte Plus PHI Arc 325
242428-4353	Polilyte Plus PHI Arc 425
242428-1313	Polilyte Plus H Arc 120
242428-1323	Polilyte Plus H Arc 225
242428-1333	Polilyte Plus H Arc 325
242428-1353	Polilyte Plus H Arc 425
242428-3313	Polilyte Plus HF Arc 120
242428-3323	Polilyte Plus HF Arc 225
242428-3333	Polilyte Plus HF Arc 325
242428-3353	Polilyte Plus HF Arc 425

9.2 Parts and Accessories

Arc View Mobile Basic/Advanced for none Ex environment



REF	Product Name
10071111	Arc View Mobile Basic
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.	
10071113	Arc View Mobile Advanced
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.	

ArcAir Application

PC version: download from www.hamiltoncompany.com / Mobile version: download from App Store oder Google Play Store



 **Notice:** In some territories, such as China, ArcAir is available as well after downloading on Android devices the Amazon Appstore as described at www.amazon.cn/androidapp

ArcAir Advanced USB License Key

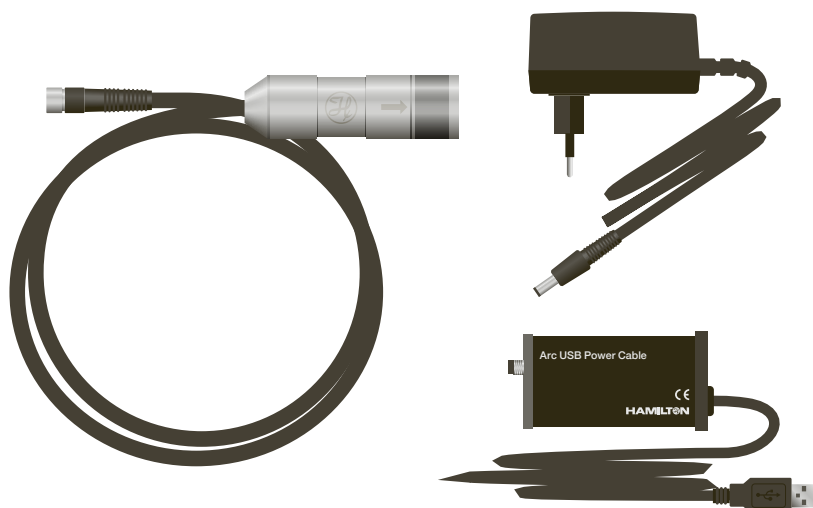
The License Key is a physical USB device that, when connected to a system running the standard ArcAir software, upgrades it to the Advanced version.



REF	Product Name	Description
10155643	ArcAir Advanced USB License Key	This key is essential for enabling features tailored for environments requiring adherence to Good Manufacturing Practices.

Arc USB power cable: USB/VP8 or USB/M12-8 Pole Connector

The Arc USB power cable provides power supply for the Arc Module and Arc Wi Adapter (see page 9) and enables digital communication to ArcAir installed on a computer.



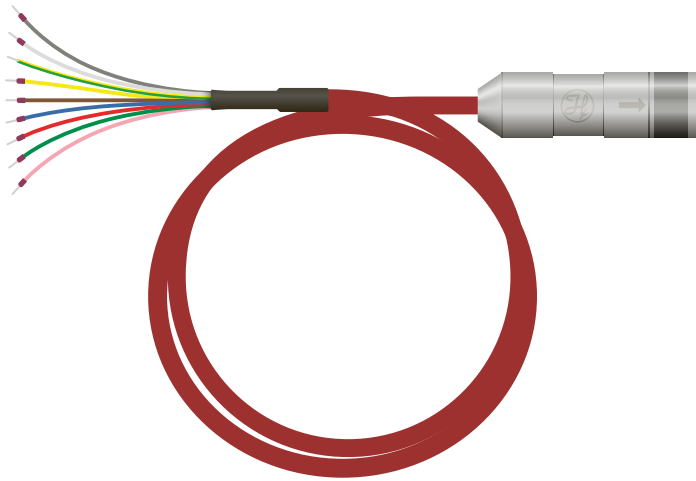
REF	Product Name	Description
243490-01	Arc USB Power Cable VP8	For the use of the Arc Module SU pH alone or together with the Arc Wi Pivot BT.
243490-02	Arc USB Power Cable M12	For the use of the Arc Module SU pH together with the Arc Wi Pivot mA 2 or Arc Wi Pivot BT mA 2.

Arc Wi Pivot Adapter



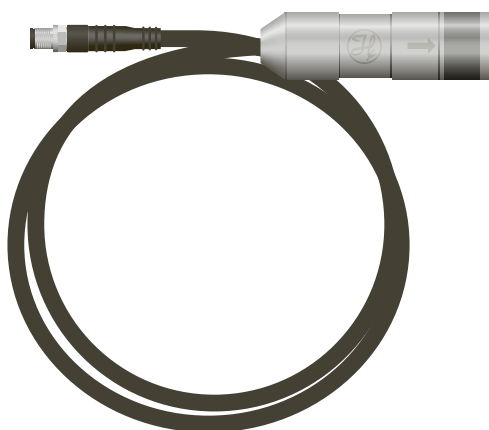
REF	Product Name	Description
10191873-1110	Arc Wi Pivot BT Adapter	Enables Bluetooth communication for sensor configuration and monitoring.
10191873-1202	Arc Wi Pivot mA 2	Converts Modbus digital communication protocol to 4-20 mA signals. No Bluetooth communication.
10191879-1212	Arc Wi Pivot BT mA 2	Converts Modbus digital communication protocol to 4-20 mA signals and enables Bluetooth communication for sensor configuration and monitoring.

Sensor Data Cable VP8



REF	Product Name	Length
355263	Sensor Data Cable VP8	1 m
355264	Sensor Data Cable VP8	3 m
355265	Sensor Data Cable VP8	5 m
355266	Sensor Data Cable VP8	10 m
355267	Sensor Data Cable VP8	15 m
355268	Sensor Data Cable VP8	20 m

Data Cable VP8 / M12



REF	Product Name	Length
10070910	Data Cable VP8 / M12	1 m
10071905	Data Cable VP8 / M12	3 m
10067844	Data Cable VP8 / M12	5 m
10067846	Data Cable VP8 / M12	10 m

9.3 Services

Hamilton field service engineers provide customers with on-site services. Hamilton offers a wide range of services from technical support to installation support, qualification, and maintenance of the sensors.

Various tailored services are offered especially for OEM customers. Experienced field service engineers ensure an optimal and professional service.

In order to find your local service support please refer to the contact information at the back of this manual.

Overview of service offers



Complete service portfolio

To access our complete service portfolio and offering, scan the following QR code:



You can also access our complete service portfolio via this link:

www.hamilton-company.com/process-analytics/services-and-support

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HAMILTON 

To find a representative in your area,
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