UviTec™ Field Meter
BOD/COD, TOC/DOC

Measurement made easy

UviTec Field Meter
BOD/COD, TOC/DOC

Introduction

ABB's portable UviTec field meter provides simple and affordable testing of organic matter in water and wastewater for various water quality parameters depending on the specific model of the field meter.

This manual applies to both BOD/COD and TOC/DOC field meters.

Operation is straightforward with accurate and repeatable results obtained in seconds. An optional battery pack allows for sampling anywhere, anytime giving the user true portability.

For more information

Further publications for UviTec products are available for free download from:
abb.com/wateranalysis
or by scanning this code:

Links and reference numbers for related documents:

	Search for/click:
UviTec BOD/COD field meter – Data sheet	DS/AUV101
UviTec TOC/DOC field meter – Data sheet	DS/AUV102
Liquid Ai data management software – Operating instruction	OI/LIQUIDAIDMS

Contents

1 Health and safety

1.1 Document symbols

Symbols that appear in this document are explained below:

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

Note:
Indicates operator tips, particularly useful information or important information about the product or its further uses. **Note** does not indicate a dangerous or harmful situation.

1.2 Safety precautions

⚠ WARNING

Toxic material

This product can expose you to chemicals including mercury which is known in the State of California to cause birth defects or other reproductive harm.

⚠ WARNING

Optical radiation

The UviTec field meters contain a UV light, which emits light at the UV 254 nm wavelength. Do not look directly at the UV light, as it could cause permanent eye damage and burn unprotected skin.

⚠ WARNING

Electricity hazard

Do not disassemble the field meter without unplugging the power supply first. Turn off the field meter before you do servicing on it.

⚠ CAUTION

Improper use of the field meter may cause injury.

⚠ CAUTION

Keep the field meter out of reach of children.

⚠ CAUTION

Do not leave the field meter unattended.

Visually examine the field meter before operation. If the quartz cuvette or UV light are broken or damaged, do not use the field meter.

Make sure that all responsible personnel carefully read this manual before operating or servicing the field meter.

Failure to properly operate and maintain the field meter may impact the effectiveness of the field meter and warranty.

1.3 Product recycling and disposal (Europe only)

ABB is committed to ensuring that the risk of any environmental damage or pollution caused by any of its products is minimized as far as possible. The European Waste Electrical and Electronic Equipment (WEEE) Directive that initially came into force on August 13 2005 aims to reduce the waste arising from electrical and electronic equipment, and improve the environmental performance of all those involved in the life cycle of electrical and electronic equipment. In conformity with European local and national regulations, electrical equipment marked with the above symbol may not be disposed of in European public disposal systems after 12 August 2005.

NOTICE

For return for recycling, please contact the equipment manufacturer or supplier for instructions on how to return end-of-life equipment for proper disposal.

1.4 Information on RoHS Directive 2011/65/EU (RoHS II)

ABB, Process Automation, Measurement & Analytics, fully supports the objectives of the RoHS II directive. All in-scope products placed on the market by PAMA on and following the 22nd of July 2017, will be compliant to the RoHS directive, 2011/65/EU.

2 Overview

2.1 Measurement principle

ABB's innovative UviTec field meter provides superior measurement performance across multiple wavelengths of light using UV and visible LEDs. Many compounds absorb light in the UV-VIS spectrum including organic compounds.

Absorbance data at specific wavelengths of interest can then be related and approximated to BOD, COD, TOC, DOC or other parameters, therefore providing a monitoring solution for these critically important water quality parameters without the use of hazardous reagents or waiting for lengthy lab turnaround times. Process control improvements can then be implemented when it matters the most, providing cost savings, optimization and event detection, thus improving operators' ability to meet water quality goals.

Since correlations between absorbance and traditional BOD, COD, TOC and DOC vary depending on the type of organic compounds that are making up these aggregate parameters, it is important that the field meter utilizes a correlation, also known as a calibration or data model, that matches the site-specific water characteristics to ensure most accurate results.

2.2 Liquid Ai custom calibration-enabled

The field meter comes programmed with several starter calibrations. Access to additional starter calibration models can be obtained by connecting via USB to a PC with Liquid Ai™ data management software. Refer to the Liquid Ai data management software operating instruction, OI/LIQUIDAIDMS.

In addition to starter calibration models, site-specific calibration models can be created and loaded onto the field meter using the software. In the field, measurements can be taken using any of the calibration models previously loaded onto the field meter. Users can also build upon their site-specific calibrations over time to further increase the accuracy and robustness of measurements for any given monitoring site.

2.3 Split-Sense technology

The field meter's innovative, patented Split-Sense technology is designed to take sensor readings before and after insertion of the quartz cuvette containing the water sample. The two sensor measurements allow for automatic compensation of minor UV LED fluctuations that can occur between the time the test is taken and the time the field meter was calibrated. Therefore, the need to frequently re-zero the field meter between uses is eliminated

2.4 Battery and non battery-equipped field meters

The field meter is powered in one of two ways depending on whether the battery option was selected at the time of purchase.

2.4.1 Standard non-battery version

Powered from a wall or car power adapter both supplied with the field meter. Wall adapter plugs come in various shapes and sizes to accommodate your region's electrical outlets.

2.4.2 Battery version

Powered from a battery pack or battery charger power supply supplied with the field meter. The battery's charge lasts for 2 to 3 hours to enable remote testing. When the battery is switched off, the adapter supplies power directly to the field meter.

3 Unpack the field meter

Remove the field meter from the packaging and carefully examine it to make sure that no damage occurred during shipping.

The field meter includes the items in Table 1:

Table 1 Items and quantity list for unpacking

Item	Applicability	Quantity
Field meter	All	1
2 mm cuvette	All	1
10 mm cuvette	All	1
Wall adapter	Field meters without battery pack	1
Car adapter	Field meters without battery pack	1
12 V battery pack with battery charger	Field meters with battery pack	1
Mini USB-B cable	All	1

Note:
The image shows the a field meter that does not have a battery pack.

4 Operator interface overview

4.1 Operator interface guidelines

Read the items that follow before you operate the field meter:

- The field meter should be zeroed before you use it for the first time.
- Always touch the cuvette by the frosted sides.
- Make sure that the black dot on the cuvette aligns with the front of the field meter.
- Always use the same cuvette for both zeroing and testing.

4.2 Operator interface description

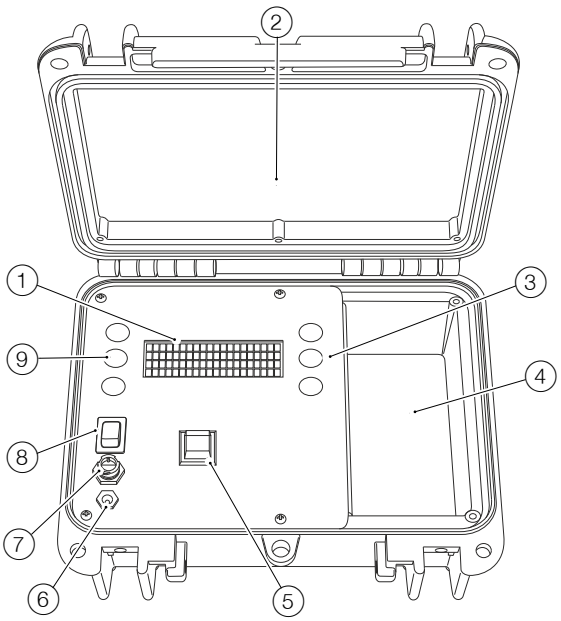


Figure 1 Operator interface

Table 2 Operator interface descriptions

Item	Description
1	4-line × 20-character backlit LCD
2	Rugged and convenient watertight carrying case
3	Selection and menu navigation buttons
4	Storage compartment for power supply and spare cuvette (if applicable). Not available with battery pack option
5	Cuvette holder for insertion of water sample using the supplied cuvette
6	Power jack for provided power supply
7	Mini USB port for connecting to Liquid Ai PC-based software
8	Power switch
9	Menu, Compute, Zero buttons

4.3 Main measurement screen

After turning on the field meter using the power switch (8), the main measurement screen of the field meter is displayed.

After power up, the field meter will show a measurement value of 0.000 on the top line of the display, along with water quality parameter label and measurement units based on the previously activated data model for the field meter.

The bottom line of the display will show *Stabilizing* for a short warm-up period, after which, the bottom line of the display will change to *Ready*. This indicates that the field meter is ready for use.

If the *Stabilizing* message does not change to *Ready* after one or two minutes, or if an error message shows, refer to "Troubleshooting" on page 24.

Note:
The parameter that shows will change depending on the model series of the field meter.

…4 Operator interface overview

4.4 Menu items

The field meter is equipped with a hierarchical menu system operated using the ▲, ▼, and **Enter** buttons along with the **Menu** button.

The **Menu** button lets you toggle between the main display screen and the menu.

Table 3 describes each item in the menu of the field meter. Parameters included will vary depending on the model series of the field meter.

Table 3 Description of menu entries

Menu item		Example entry	Description
-Sample log			Provides access to sample data and attributes from last 100 samples. Refer to "Test a water sample" on page 11 for more information
	View log		Allows to scroll through sample data from each previous sample one at a time, and allow 'selection' of any sample for further information on that sample to be displayed in 'SampleLog' menu, outlined below. Pressing **Menu** will reset the SampleLog menu to display sample data for the last measured sample
	#	35	Shows the 'sample slot' used by the currently selected sample (up to 100 samples can be stored onboard the meter)
	Label:	PrimEff2	User created label for the sample
	Param	BOD	Water quality parameter of the sample, based on the 'active' data model at time of measurement
	Value	98.2	Measured value of the sample
	Units	mg/L	Units of the sample, based on the 'active' data model at time of measurement
	Time	10:14	Time at which the sample was taken (24 hour clock using built-in real-time clock)
	Date	04-10-2020	Date of the sample being taken
	MdlName	MnWW_BPE	Name of the 'active' data model at time of measurement
	MdlSN	211	Serial number of the 'active' data model at time of measurement
	Pathlen	2.0	Specified path length required for the 'active' data model at time of measurement
	Dilut	0	Specified dilution ratio required for the 'active' data model at time of measurement
	Span	1.0	User-configurable span for the 'active' data model set prior to time of measurement
	Offset	0.0	User-configurable offset for the 'active' data model set prior to time of measurement
	Abs1	0.04	Raw absorbance value for wavelength 1 of the sample
	Abs2	0.05	Raw absorbance value for wavelength 2 of the sample
	Abs3	0.02	Raw absorbance value for wavelength 3 of the sample
	Abs4	0.01	Raw absorbance value for wavelength 4 of the sample
	LedSet	1	The LED set associated with this particular meter version and also with the 'active' data model at time of measurement
-DeleteLog			
	AreYouSure?		Allows to delete sample data from all 100 sample slots
-ParamModel			Provides access to data model information and attributes. The field meter can store up to 10 data models at a time, and only one data model can be 'active' at a time. Refer to "Data models (calibrations to correlated parameters)" on page 15 for more information
	SelectModel		Allows to scroll through the data models currently loaded onto the meter. Up to 10 data models can be stored in the meter at a given time. User can activate any loaded data model causing all subsequent measurements to be based on data model attributes of the 'active' data model.
	#	4	Shows the 'model slot' used by the currently selected model (up to 10 data models can be stored onboard the meter)
	Name	MnWW_BPE	Name of the 'active' data model
	Vers	1	Data model version of the 'active' data model
	Serial#	211	Serial number of the 'active' data model

Menu item		Example entry	Description
	Param	BOD	Water quality parameter associated with the 'active' data model
	Units	mg/L	Units associated with the 'active' data model
	Err,%	4	Predicted % error associated with the 'active' data model
	Pathlen	2	Specified path length to use with the 'active' data model
	Date	02-03-2020	Date of creation of the 'active' data model, date format is month/day/year
	Min	100	Minimum measurement value specified as valid for the 'active' data model
	Max	0.0	Maximum measurement value specified as valid for the 'active' data model
	LedSet	1	The LED set associated with this particular meter version and also with the 'active' data model
	Dilut	0	Specified dilution ratio to use with the 'active' data model. Allows extended range of the meter.
	Span:	1.05	User configurable fine adjustment of the 'active' data model. Recorded in sample attributes of sample measured using the 'active data model.
	Offset:	0.0	User configurable fine adjustment of the 'active' data model. Recorded in sample attributes of sample measured using the 'active' data model.
-OutputData			Displays raw transmittance and absorbance measurement data for last measurement taken for troubleshooting purposes
	Param	150	Water quality parameter value of last measurement for 'active' data model at time of measurement
	%T1	100.0	Transmittance value for wavelength 1 of last measurement
	%T2	100.0	Transmittance value for wavelength 2 of last measurement
	%T3	100.0	Transmittance value for wavelength 3 of last measurement
	%T4	100.0	Transmittance value for wavelength 4 of last measurement
	Abs1	0.0	Absorbance value for wavelength 1 of last measurement
	Abs2	0.0	Absorbance value for wavelength 2 of last measurement
	Abs3	0.0	Absorbance value for wavelength 3 of last measurement
	Abs4	0.0	Absorbance value for wavelength 4 of last measurement
-Settings			Factory settings for the meter. Only change under instruction of ABB
	+Enable LED		Factory setting
	+LED current,mA		Factory setting
	+Gain		Factory setting
	+FlashDuration		Factory setting
	+CorrCoeff		Factory setting
	MeasPeriod	1000	Factory setting
	Averaging	10	Factory setting
	RawDarkMax	100	Factory setting
	FluctThres	5	Factory setting
	+AutoPwrOff		Allows adjustment of auto-shutoff time period (30min, 1h, 2h)

…4 Operator interface overview

…Menu items

Table 3 Description of menu entries (continued)

Menu item		Example entry	Description
	+Reset		Factory setting
-Secondary			Displays continuously updated measurement data for last measurement taken for troubleshooting purposes
	-Led1		Displays raw measurement data for troubleshooting purposes
	Water	2700	Measurement through the water sample
	Lamp	2900	Measurement with cuvette removed
	Dark	5	Measurement with no LEDs turned on
	Cal Water	2700	Calibration value of water value
	Cal Lamp	2900	Calibration value of lamp value
	Cal Dark	5	Calibration value of dark value
	+Led2		Displays raw measurement data for troubleshooting purposes
	+Led3		Displays raw measurement data for troubleshooting purposes
	+Led4		Displays raw measurement data for troubleshooting purposes
	Counter	222	Displays raw measurement counter
	LED t,C	28.3	Displays current temperature of LED module
-Battery			Displays information about optional battery and charging
	Charge,%	82	Charge level of battery as a percentage of full charge
	Voltage	12.3	Battery voltage for troubleshooting purposes
-Date&Time			Allows setting the date and time for the portable (note date and time can also be updated via connecting to Liquid Ai Data Management software)
	Time	13:16	Set the time
	Date	02/03/2020	Set the date, format is month/day/year
-DeviceInfo			Device-specific information
	Serial#	2048	Serial number of this particular field meter
	FW vers	1.4	Product firmware version

5 Test a water sample

When you turn on the field meter for first time, it will display the main measurement screen. Wait for a few moments for the LED light sources to warm up and become stable. When Ready appears on the bottom line of the display, the field meter is ready to measure a water sample.

Any system errors will also be shown on the bottom line of the main measurement screen. Refer to "Troubleshooting" on page 24 if you see system errors.

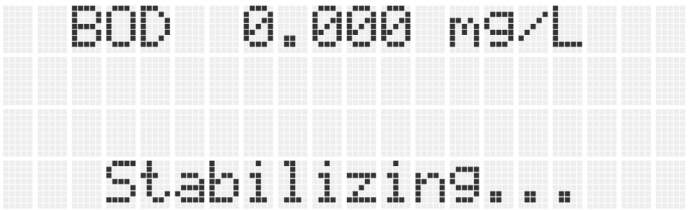
It is recommended to zero the field meter when convenient, but this is not necessary for operation of the field meter. Refer to "Zero the field meter" on page 13.

5.1 Water sample test procedure

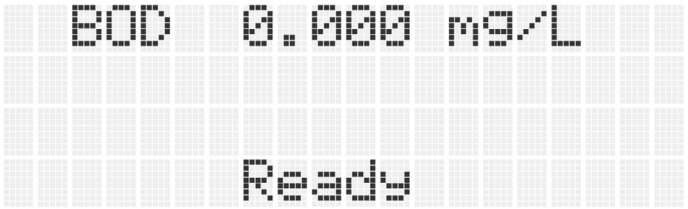
1 Plug in the power cord for the field meter, or if your field meter is equipped with a battery pack, slide the switch on the battery pack to the **On** position.

2 Remove the cuvette from the field meter.

3 Use the power switch to turn on the field meter. The field meter will display as follows during the short warm-up time while the LEDs light sources warm up and stabilize.

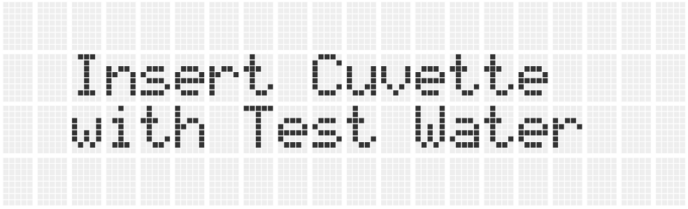


4 After the LED light sources are stabilized the field meter will display Ready.



5 Add sample water to test into the quartz cuvette, but do not insert the cuvette into the cuvette holder of the field meter.

6 Press the **Compute** button. The meter will display Wait for a few seconds, and after a short time the meter will display Insert Cuvette with Test Water.



7 After ensuring the outside of the quartz cuvette is clean and dry, insert the cuvette containing the test water, with the black dot on the cuvette aligned to the front of the field meter.

8 The field meter will automatically detect the insertion of the cuvette and for a brief time, it will display Measuring before displaying the results of the measurement. The result of the measurement will be displayed along with the water quality parameter and units associated with the 'active' data model.

- To perform another test without saving the sample test results to memory press the **Menu** button. The field meter will display Not Saved briefly before displaying Ready, indicating the it is ready for another test to be performed.
- To save the sample test results to memory, press **Enter**. The field meter will display Saved briefly before displaying Ready indicating it is ready for another test to be performed. Saved sample results can be viewed along with various sample attributes from the Samples menu and a sample 'Label' can be created in order to identify the sample later. Refer to "5.2 View and edit sample attributes" on page 12.

9 To perform another measurement, remove the cuvette from the test chamber, rinse the cuvette twice (preferably with sample water) before inserting the new sample to measure, and repeat steps 5 thru 7.

10 When finished measuring samples, clean and dry the cuvette thoroughly before reinserting into the cuvette holder of the field meter for storage.

11 Press **Power** to turn off the field meter.

…5 Test a water sample

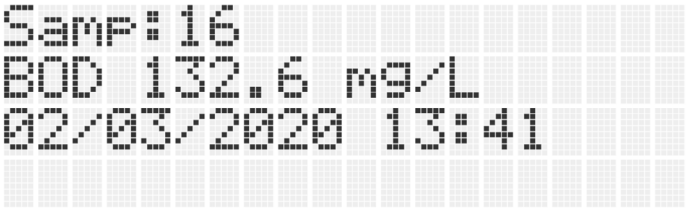
5.2 View and edit sample attributes

The sample data for the last sample saved, along various sample attributes associated with that sample, can be viewed by pressing **Menu** to go to the menu and opening the SampleLog sub-menu using the ▲, ▼ and **Enter** buttons. Scroll down to view the sample data for the most recent sample along with its sample attributes.

For more information regarding individual sample attributes refer to Table 3 on page 8.

5.3 ViewLog

Pressing **Enter** after scrolling to ViewLog will open the sample log for all previously saved samples. The sample log screen will show basic information for the most recent sample. Use the ▲ and ▼ buttons to scroll through all stored sample data. Press **Menu** to go back to the menu.

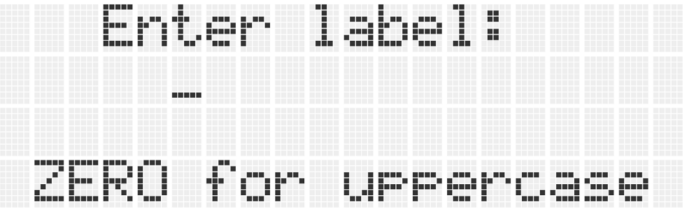


Pressing **Enter** on a particular stored sample selects that sample and goes back to the main menu and populates the SampleLog sub-menu with the sample data and attributes for the selected sample. This allows viewing of more detailed sample information for the selected sample, and also allows editing the sample Label of the selected sample, which can be used to conveniently identify the sample later.

Pressing **Menu** again will go back to the main measurement screen and will re-populated the SampleLog sub-menu with the sample information from the last measured sample instead of the selected sample. Therefore, when viewing a previous test sample, to display the most recent test sample, press **Menu** twice. The sample now displayed in the SampleLog sub-menu will now be for the most recent sample again.

5.4 Create and edit a sample label

A sample Label can be created to identify the sample later. Select the Label: entry in the SampleLog menu and press **Enter** to create or edit a sample label. Use the ▲, ▼ buttons to cycle through alphanumeric characters, and **Enter**, **Menu** buttons to move the cursor back and forth. The label is created when **Enter** is pressed on the last character of the label.



Note:
Samples can also be identified using the sample time and date that are automatically associated with a sample at time of measurement, in addition to associated water quality parameter, the particular data model used, etc. Therefore, the sample label is usually used as a location designator such as ‘Well #3’ or ‘PrEfPlt2’ for example.

Only the Label sample attribute can be created or edited by the user. All other attributes are fixed at time of measurement based on the ‘active’ data model and other settings at time of measurement.

6 Zero the field meter

Zeroing the field meter is a simple process that allows the underlying measurement of the field meter to be referenced against a pure water sample.

It is recommended to zero the field meter when convenient, but this is not necessary for operation of the field meter. Zeroing is especially recommended if the field meter:

- Has not been used for several days or weeks.
- A new cuvette is being used.
- The cuvette was dirty and has been recently cleaned since the last zero was performed.

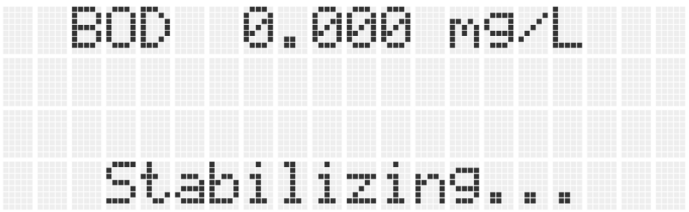
When the field meter is first turned on it will display the main measurement screen. Wait a few moments for the LED light sources to warm up and stabilize. When Ready appears on the bottom line of the display, the field meter is ready to be zeroed.

Any system errors will also be shown on the bottom line of the main measurement screen. Refer to "Troubleshooting" on page 24 if any system errors are displayed.

6.1 Zeroing procedure

1 Connect the power cord for the field meter, or if your field meter is equipped with a battery pack, move the switch on the battery pack to the **On** position.

2 Use the power switch to turn on the field meter. The field meter will display as follows during the short warm-up time while the LED light sources warm up and become stable.



3 After the LED light sources are stabilized the field meter will display Ready.

Note:
The measurement displayed is 0.000 after the field meter is turned on.

4 Add zero water to test to the quartz cuvette, but do not insert the cuvette into the cuvette holder of the field meter.

5 Press the **Zero** button. The field meter will display Wait for a few seconds, and after a short time the field meter will display ZEROING Insert Cuvette with DI Water.
Note that 'DI' refers to deionized water.
Refer to "Water appropriate for testing" on page 14.

6 After ensuring the outside of the quartz cuvette is clean and dry, insert the cuvette containing the zero water with the black dot on the cuvette aligned to the front of the field meter.

7 The field meter will automatically detect the insertion of the cuvette and for a brief time the meter will display Measuring before displaying Calibrated.

8 Pressing **Enter** will display the main measurement screen, ready for the next measurement. Note that the main measurement screen may now display a negative or positive measurement value. This is expected if the 'active' data model incorporates an 'offset' as part of the data model, and therefore has a using range that does not extend to 0 or pure water, which is often the case.

The field meter is now zeroed and ready to take a measurement.

6.2 Zeroing memory

The field meter retains the results of the zeroing procedure in memory. This feature eliminates the need to zero the field meter before each individual water sample being tested (even after powering the field meter off and on).

…6 Zero the field meter

6.3 When I do a zero check, why does my field meter not display 0.000?

If pure water is put into the cuvette and tested as if it were a test sample, the result displayed on the screen may be confusing. The measurement result may be negative or positive, but will likely not be zero. The only way the measurement result for pure water can be 0.000 is if the 'active' data model does not incorporate any offset value, which is often not the case. In effect, the pure water can be considered to be outside of the valid measurement range of the data model and therefore results in an inaccurate measurement when measuring pure water samples.

In general, offset values in a data model are normal and essential in many cases to account for compounds in the water that do not absorb light significantly but do in fact contribute to the water quality parameter associated with the 'active' data model. Alternatively, an offset value may account for compounds in the water that do significantly absorb light but do not contribute to the water quality parameter.

Note:
If there is a positive offset incorporated into a data model, then the specified 'using range' of the data model will specify that the data model is not valid within the range of the offset. Refer to "Data models (calibrations to correlated parameters)" on page 15.

6.4 Check the zero of a field meter

Since the measurement result of a pure water sample during zeroing is meaningless due to the likely use of offsets incorporated into the 'active' data model, the field meter is able to provide raw Absorbance and Transmittance information for each wavelength of the meter for the purpose of 'checking' the zero of the meter.

This can be done either after performing a zero procedure or after performing a sample test with a pure water sample.

Immediately after sample results are displayed (either after zeroing or regular sample test), press the **Menu** button and then scroll to and open the *OutputData* sub-menu. The resulting measurement information from the most recent sample (in this case the pure water sample) is shown. Along with the water quality parameter measurement result (which as discussed above may be a positive or negative offset value), the sub-menu also shows the transmittance and absorbance values for each wavelength. When the field meter has been zeroed or a pure water sample has been tested, the measurements for all %T (percent light transmission) values should be close to 100.0, and the measurements for Abs (absorbance of light) should be close to 0.000.

Note:
There will be a %T and Abs pair for each wavelength of the field meter, up to four.

If the displayed %T and Abs are not close to 100.0 and 0.000 respectively after performing a test with DI water in the cuvette, then the field meter should be re-zeroed.

If the field meter has been zeroed and the transmittance and absorbance values are not close to 100.0 and 0.000 respectively, this could indicate a wet or dirty cuvette, or could indicate the presence of bubbles in the cuvette.

6.5 Water appropriate for testing

Certain water types are appropriate for zeroing the field meter including deionized (DI) water, steam-distilled water, and some RO water (water treated using reverse osmosis).

Tap water is not recommended because it can contain significant UV light-absorbing compounds, and additionally, the de-pressurization of tap water can cause dissolved air to come out of solution to form micro-bubbles inside the quartz cuvette, which can significantly affect the measurement.

7 Data models (calibrations to correlated parameters)

In order to use the field meter, it is not necessary to understand the science of exactly how data models are used to interpret the raw absorbance measurements of the meter to produce a measurement of a common water quality parameter.

All that is needed to be understood is that several data models can be stored on the field meter at a time, and the user selects the appropriate data model for the sample test that is desired.

For example, if the user wants to measure the BOD of primary effluent water at a municipal sewage plant, they will first select the data model associated with this application, and then proceed to take a sample measurement.

For more details around how the field meter does all this refer to "Science of data models for water quality measurements" on page 18.

7.1 Using data models

The field meter allows storage of up to 10 data models. The user can cycle through the stored data models on the field meter and 'activate' a particular data model as desired. The next measurement taken will use the 'active' data model to interpret the raw absorbance measurements, and output a measurement of the water quality parameter associated with the 'active' data model.

One data model is able to be selected at a time. Therefore, if you would like to measure two different water quality parameters at a site, then two tests must be performed one after another, ensuring to select the appropriate data model from the ParamModel menu before each sample is tested.

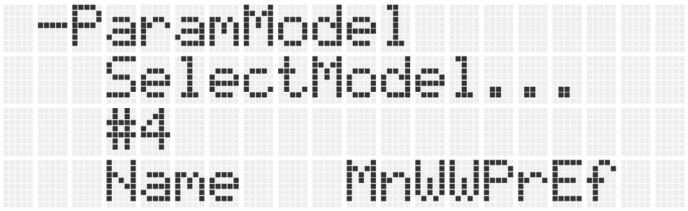
The 'active' data model is the data model that will be used for new sample tests until another active data model is selected.

The field meter comes with a number of different data models preloaded for a variety of applications as requested at time of purchase. For information on acquiring more data models or for improving or creating new data models, refer to the Liquid Ai data management software operating instruction, OI/LIQUIDAIDMS.

Not all 10 model 'slots' need to be filled with a data model. For example, if only two data models are currently loaded on the field meter, then the user can only select an active data model from between these two loaded data models.

7.2 Active data models

The 'active' data model, along with various data model attributes associated with that data model, can be quickly viewed by pressing **Menu** to go to the menu and opening the ParamModel sub-menu using the ▲, ▼ and **Enter** buttons. Scroll down to view the active data model along with its data model attributes.



Pressing **Enter** after scrolling to SelectModel will open the model selection screen allowing access to all data models currently loaded into the field meter. The model selection screen will show basic information each stored data model. Use the ▲ and ▼ buttons to scroll through all stored data models. Press **Menu** to go back to the menu without making any change to the 'active' data model.

The data model information shown on the model selection screen is a less detailed than is provided in the ParamModel sub-menu. The model selection screen includes:

In addition, if the currently viewed data model is the 'active' data model, then ACTIVE is shown on the bottom line of the display.

Pressing **Enter** on a particular stored data model 'activates' that data model and goes back to the main menu.
The ParamModel sub-menu will now be populated with the data model attributes of the new 'active' data model.

The ParamModel sub-menu provides more detailed data model information for the 'active' data model and also allows editing of the span and offset data model attributes by the user.

...7 Data models (calibrations to correlated parameters)

7.3 View and edit active data model attributes

The ParamModel sub-menu displays all the data model attributes of the currently selected 'active' data model. Most of these attributes cannot be changed as they are set during the model building process using the Liquid Ai Data Management software. Some of the attributes are important to understand when selecting a data model for use, such as the path length requirement of the cuvette to be used with the model.
Other data model attributes can be edited by the user, such as the span and offset attribute settings, refer to "Adjust a data model" on page 20.

Note that when a sample is measured the model attributes of the active data model at the time the sample is measured are recorded along with the sample. In this way, if the sample data is later reviewed either onboard the meter, or in the Liquid Ai Data Management software after uploading the sample data to a PC, the data model that was used to produce the sample measurement value will be viewable along with the sample measurement itself. This includes any edited model attributes such as data model slope and offset.

Table 4 shows the various model attributes in the ModelParam sub-menu and their descriptions.

Table 4 Data model attributes

Data model attribute	Example value	Description
#	4	Shows the 'model slot' used by the currently selected model (up to 10 data models can be stored onboard the meter)
Name	MnWW_BPE	Name of the 'active' data model. Generally this label refers to the specified monitoring location, water type, industry sector, treatment type, etc. that the data model is intended to be used for.
Vers	1	Data model version of the 'active' data model to provide additional description or differentiation between different data models.
Serial#	211	Serial number of the 'active' data model. All data models available from ABB have a serial number associated with them. User created data models may enter their own serial number when building data models with the Liquid Ai Data Management software.
Param	BOD	Water quality parameter associated with the 'active' data model
Units	mg/L	Units associated with the 'active' data model
Err,%	4	Predicted % error associated with the 'active' data model. Note this error value is determined during model building through a process of cross-validation between training samples for the model. If the water quality has significantly changed since the data model was built, or if using a data model at a site for the first time this error value may not be representative.
Pathlen	2	Specified path length to use with the 'active' data model. Important, using a cuvette with path length other than the path length specified by the data model will cause significant inaccuracy in the results.
Date	02/03/2020	Date of creation of the 'active' data model.
Min	20	Minimum measurement value specified as valid for the 'active' data model. If a measurement is made that is lower than the specified minimum value of for the data model, then the stated accuracy of the data model is not valid and the measurement accuracy will be unpredictable.
Max	150	Maximum measurement value specified as valid for the 'active' data model. If a measurement is made that is higher than the specified maximum value of for the data model, then the stated accuracy of the data model is not valid and the measurement accuracy will be unpredictable.
LedSet	1	The LED set associated with this particular meter version and also with the 'active' data model. A data model produced for a different set of wavelengths from those of the meter will be invalid for the meter. However, the meter will not allow downloading of a data model that does not have a matching LedSet with the meter.
Span:	1.05	User configurable fine adjustment of the 'active' data model. Recorded in sample attributes of sample measured using the 'active data model. If a data model is producing measurement results that are consistently a few percent too high or too low, a small span adjustment can be made to the data model to improve results. Note that this is a relatively crude approach to data model adjustment and is not intended to correct more than a few percent of consistent inaccuracy.
Offset:	0.0	User configurable fine adjustment of the 'active' data model. Recorded in sample attributes of sample measured using the 'active data model. If a data model is producing measurement results that are consistently a few percent too high or too low, a small offset adjustment can be made to the data model to improve results. Note that this is a relatively crude approach to data model adjustment and is not intended to correct more than a few percent of consistent inaccuracy.
Dilut	0	Specified dilution ratio to use with the 'active' data model. Dilution ratio adjusts the measurement output for the data model based on pre-measurement dilution of the sample. Used for extended range measurements. Settings: 0 – no dilution, 1 – 1:1 dilution, 2 – 2:1 dilution. Max setting of 10 – 10:1 dilution. If the wrong dilution ratio is used with a data model then the stated accuracy of the data model is not valid and the measurement accuracy will be unpredictable.

7.4 Select a data model

The available data models programmed and ready for immediate use is dependent on the specific model series of the field meter purchased. For example, the field meter for BOD/COD will come ready with data models designed for wastewater, the field meter for TOC/DOC will come ready with data models designed for drinking water.

Table 5 gives details of a few examples of the immediately available data models. Up to 10 data models can be loaded to the field meter at one time.

Note:
More data models may be available that are not included in Table 5. New data models are being added all the time.

Table 5 Available data model examples

Model name	Parameter	Unit	Path	Dilution	Min.	Max.	Validation accuracy*	Application/water quality description
PrEfMuB1	BOD	mg/L	2	0	10	375	—	Primary effluent municipal wastewater
PrEfMuB2	BOD	mg/L	2	0	10	375	—	Primary effluent municipal wastewater
PrEfMuC1	COD	mg/L	2	0	25	750	—	Primary effluent municipal wastewater
FiEfMuC1	COD	mg/L	10	0	5	150	—	Final effluent municipal wastewater
FiEfMuC2	COD	mg/L	10	0	5	150	—	Final effluent municipal wastewater AC treated
DRawWwC1	COD	mg/L	2	0	350	7000	—	Dairy raw wastewater
DRawWwC2	COD	mg/L	2	0	500	20,000	—	Dairy raw wastewater
PPprEfB1	BOD	mg/L	2	0	10	200	—	Pulp and Paper primary treated wastewater
PPprEfC1	COD	mg/L	2	0	50	1000	—	Pulp and Paper primary treated wastewater
FRawWwB1	BOD	mg/L	2	0	20	500	—	Food Processing raw wastewater
SWuntrT1	TOC	mg/L	10	0	0.2	40	—	Untreated surface water
SWuntrT2	TOC	mg/L	10	0	0.2	40	—	Untreated surface water
DWmbtrD1	DOC	mg/L	10	0	0.2	40	—	Membrane treated drinking water
DWpermP1	MnO4	mg/L	10	0	0.25	50	—	Permanganate for drinking water applications

The data models in Table 5 can often serve as good starter calibrations for specific water quality parameters under particular application or water quality conditions. In many cases, these data models may provide adequately accurate results right away. However, it is highly recommended to create site specific data models in order to ensure best possible measurement accuracy for a given measurement location or application. Refer to the Liquid Ai data management software operating instruction, OI/LIQUIDAIDMS for more details.

It is important to be familiar with the various data models available as well as the attributes of those data models in order to ensure the most appropriate data model is loaded and selected for the particular application, water type and water quality parameter.

Additional data models are available upon request from ABB.

* For a discussion on validation accuracy, refer to "Science of data models for water quality measurements" on page 18.

...7 Data models (calibrations to correlated parameters)

7.5 More data models

All data models are available as individual data model files that can be opened in the Liquid Ai data management software and then downloaded to the field meter where they can be selected and used for a sample test.

Although a number of application specific data models are available to be used right away, since every site is different, ABB recommends creating site specific data models for best accuracy. ABB makes it possible to update and improve an existing data model for a given site or to create entirely new data models using the Liquid Ai Data Management software.

Note:
Only user-created data models can be updated with one or more new samples. Factory data models, such as those installed in the field meter, can be used for taking measurements but cannot be updated with additional samples by the user.

The above data model features are outside the scope of this manual. Refer to the Liquid Ai data management software operating instruction, OI/LIQUIDAIDMS.

7.6 Science of data models for water quality measurements

The fundamental test method of the field meter is as follows:

1. Absorbance values of a water sample are measured for each wavelength of the meter.
2. The measured absorbance values are entered into a data model.
3. The data model interprets the meaning of the measured absorbance values to produce a useful and familiar water quality parameter measurement result.

This is made possible by the fact that different compounds in water will absorb differently at different wavelengths of light. Therefore, by measuring the absorbance at several key wavelengths of light, it is possible to say something about the composition of the water. When combined with the Beer-Lambert Law which states that the absorbance of a water sample is directly proportional to the concentration of an absorbing compound in the water, this means that this absorbance information can readily be used to quickly and accurately give concentration information on a number of common water quality parameters.

It is the job of the data model to interpret the raw absorbance information to produce concentration information for a given water quality parameter.

Since the particular composition of the water will affect how the data model interprets the absorbance information for a given water quality parameter, one data model will be suited to only certain water compositions. Therefore, a given data model will be specific to a water quality type, industry sector, treatment process, etc., in addition to the particular water quality parameter of interest.

Because of the above, it is necessary to have a number of different data models to select from to be activated for a particular measurement location, water quality parameter, etc.

7.7 Accuracy statement of data models

The accuracy of a data model is based on how well the data model predicts its intended water quality parameter based on prediction of validation samples. When a new or updated data model is produced using the Liquid Ai data management software, a process of cross-validation is used to determine the predicted accuracy of the data model. How well the new model predicts the cross-validation samples determines the data model accuracy or % error associated with the data model.

Note:
The accuracy of the data model is valid when measuring samples where the water quality parameter measurement value is within the bounds of the max and min values of the training sample set. For example, if a COD data model is developed with training samples ranging from 60 mg/L to 120 mg/L then that data model should only be used for samples measured to be within this range.

If a measurement was made with this data model where the measured value was 190 mg/L then it would be recommended to add the 190 mg/L sample to the training sample set using the Liquid Ai data management software to update the current data model to include this sample. The updated data model will include a new accuracy and range statement based on the addition of the new samples and the min and max of the training samples will now be 60 mg/L to 190 mg/L and therefore, the accuracy statement will now be valid within this range.

In general, the accuracy statements of data models are intended to describe the statistical case of absolute average error between lab values and values measured by the field meter. For example, if an accuracy statement for a data model is 10%, this means that for a given batch of 10 samples the average error margin for those 10 samples will be 10 %. However, this also means that some of these samples may have higher error margin and some of them lower error margin than 10 %. Also, this assumes consistency of water composition across training samples and new measured samples.

The accuracy of data models is determined based on a process of cross-validation of the training sample set used when the data model was created. Although this accuracy measurement does provide indication of the prediction strength of the data model, it does not guarantee this accuracy for all future test samples.

For example, if there is a significant composition change in the process water being tested that was not represented in any of the training samples, even though the measured value might be in range of the training sample set, the composition change could affect the data model validity regardless. In this case, additional samples may need to be added to the data model to further characterize the process water to increase the accuracy of the model under the new water quality condition or composition.

For factory data models, including those installed in the field meter at time of purchase, the accuracy statement of the data models is not available. Although the factory data models may be accurate enough for many applications, it is difficult to predict data model accuracy for a new measurement location or application due to unpredictable water compositions from one site to the next. Therefore, for factory data models this accuracy statement is not provided and a value of ‘N/A’ is shown in place of the % Error statement of accuracy. It is highly recommended to create site specific data models in order to ensure best possible measurement accuracy for a given measurement location or application.

All new data models created using site specific sample data will include an accuracy statement. Refer to the Liquid Ai data management software operating instruction, OI/LIQUIDAIDMS.

8 Adjust a data model

For any data model loaded into the field meter, you can make minor adjustments to the data model via the menu in the form of slope and offset adjustments.

Note:
If at least one grab sample measurement with lab reference measurement is available for a given data model, we recommend to update the data model using Liquid Ai for best measurement accuracy instead of adjusting span and offset of an existing data model.
Manual span and offset adjustment are intended only as a convenience when only a minor adjustment is required and it is not feasible to update the data model right away.

8.1 Span adjustment for a data model

1 Ensure the active data model is set to the correct data model for which slope change is required.

2 Record the 'existing span value' set for the data model as displayed in the Models menu under Span.

3 Record the result of a sample measurement value for the active data model for which the slope change is desired, referred to below as 'measured value'

4 Record a lab tested reference sample measurement value, the 'lab value' for the same water sample recorded previously for the 'measured value'

5 The relationship between the measured value and the lab value can then be determined using this formula:

$$Span\ to\ enter = Existing\ span\ value \times (Lab\ value / Measured\ value)$$

6 When you have determined the span, enter it as described below. In a similar way an offset value can also be entered.

7 The computed value of the measured water quality parameter will now incorporate the newly adjusted span or offset values.

The span can be re-determined anytime using the above steps.

Alternatively, the span can be determined using multiple grab samples over a period of time. This can provide a better result for the span. In this case, the span can be calculated simply using a spreadsheet package to plot a best fit straight line through several test points. Contact ABB for help with this if needed.

Note:
The data model offset can be adjusted using a similar method to above as required.

9 Connect to Liquid Ai

A variety of data model and sample management activities can be performed using the field meter with ABB's Liquid Ai Data Management software package. Refer to the Liquid Ai data management software operating instruction, OI/LIQUIDAIDMS.

9.1 Connect to Liquid Ai data management software

1 Start Liquid Ai data management software on the PC.

2 Turn on the field meter.

3 Connect the provided mini USB-B cable to the field meter by inserting the cable into the port and tightening the collar of the connecting cable

4 Connect the USB-B cable to the PC.

5 Select the appropriate COM port in the Liquid Ai software under the **Device Config** tab.

6 The user can now start performing a variety of data model and sample management activities using the Liquid Ai software.

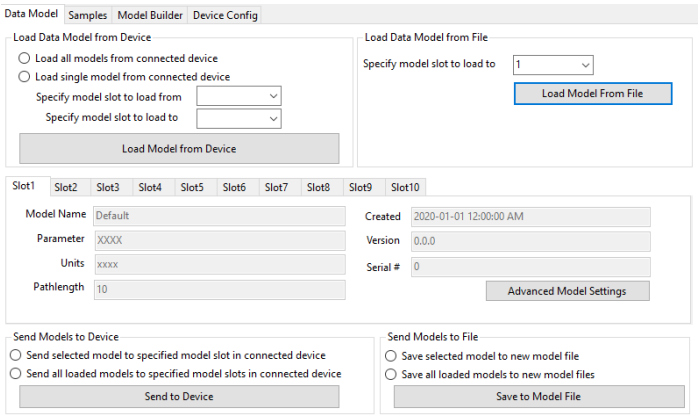


Figure 2 Liquid Ai data management software window

9.2 Disconnect from Liquid Ai

Disconnect the USB-B cable from the PC.

10 Sample handling and conditioning

The correct sample handling is important for the most accurate results from the field meter. This section gives some of the best practices to follow for transferring samples, using cuvettes, and filtering samples.

10.1 Sample handling

Samples transferred into a measuring cuvette need to be truly representative of the water being tested. This can be difficult to achieve especially when samples contain high levels of suspended solids, because they tend to settle relatively fast and can be distributed unevenly in the water column. For this reason, in some cases filtering of samples may be beneficial. To reduce sampling errors, please always ensure that the container used for collecting the sample is well mixed before transferring a portion of the sample into the measuring cuvette. The measurement in the meter should take place without delay to avoid further settling of solids in the cuvette.

The cuvettes have a limited volume, approximately 4 mL in a 10 mm cuvette and 0.8 mL in a 2 mm cuvette. Therefore, it is recommended to use pipettes or syringes to inject samples into the cuvette, to avoid spilling the sample on the outside of the cuvette.

It is good practice to rinse the cuvette three times with the sample to be measured before actually doing the measurement. To fully empty the cuvette—in particular the 2 mm cuvette—it might be necessary to remove the sample with a pipette or a syringe. For disposable pipettes that can be acquired through ABB, refer to "Parts and accessories" on page 26.

Make sure that the cuvettes are clean, free of fingerprints, liquid droplets on the outside, and are oriented consistently the same way in the cuvette holder (the black dot on the cuvette is aligned to the front of the field meter). There must be no air bubbles on the cuvette windows. You can gently tap the cuvette to dislodge the air bubbles.

10.2 Filtering

The user may filter the samples if the use case justifies filtration. In general, UV absorbance-based measuring methods work best for dissolved substances, e.g., soluble organics. Solids in the water interfere with the measurements to a certain degree. However, the user may find more value in estimating the total organics concentration rather than the soluble only portion. In this case, the accuracy may be lower than that of a filtered sample but the readings of the field meter would be more representative of the water quality and what needs to be tracked for process control and decision making.

Filtered samples are likely to have reduced values for aggregate organics parameters such as BOD, COD and TOC as a portion of the organics are present as suspended solids. Highly water soluble contaminants such as nitrate and nitrite are typically not affected by filtration.

ABB recommends the disposable syringe filters listed in "Parts and accessories" on page 26 if sample filtering is desired. Note that if filtering of samples is used this may affect measurement correlation with online or probe based instruments

11 Dilute samples for extended range testing

Dilution can help extend the range of the field meter and would be necessary to measure high-strength wastewater samples. However, as sample conditioning through dilution introduces additional errors to the measurement, dilution should be avoided when possible. It is recommended that when sample absorbance exceeds 1.5 absorbance per path, the sample be diluted. When diluting the samples, make sure to use the highest quality purified water to minimize error from contamination. The quality of the dilution water can be checked using the field meter by inserting a cuvette filled with dilution water into the field meter and checking absorbance readings. Absorbance readings for the dilution water should be less than 0.005 absorbance for all wavelengths.

Volumetric measurements play a very important role in accurate dilution. Therefore, it is recommended to use graduated cylinders and regularly calibrated pipettes for diluting the samples. Any dilution ratio can be used, however, it is best to dilute as little as possible to minimize errors associated with volumetric measurements.

All data models are specified to be used with one dilution ratio. If samples are diluted by a ratio other than that specified by the data model, the measurement results will be inaccurate. Dilution ratios are set at the time the data model is created and cannot be changed without producing a new data model via the Liquid Ai data management software. To see which dilution ratio is to be used with a particular data model, refer to the ModelParam sub-menu on the field meter.

The dilution ratio for a data model is displayed in the menu of the field meter as parts of dilution water used per one part of sample. For example, a dilution ratio of 1 is 1 part dilution water and 1 part sample water, that is 1:1, and hence equal to 2 times dilution.

If a new measuring location or application requires a dilution ratio that is not specified by any available data models in order to extend measurement range for that location or application, then it is recommended to take several training sample measurements with the desired dilution ratio in order to create a new data model for use with that specific dilution ratio. Refer to the Liquid Ai data management software manual for more information.

12 Cleaning

Ensuring the quartz cuvette is clean will contribute to optimal performance of the field meter. Not only should the outside of the cuvette be clean and dry, the inside of the cuvette should also be cleaned regularly to avoid accumulation of mineral deposits and other fouling agents present in the test water.

1 Using a cleaning solution and small cleaning object, such as a cotton swab, clean the inside of the cuvette.

2 Rinse the cuvette with pure water and polish the outside with a low-lint wipe.

Table 6 Chemical cleaning solutions

Solution	Fouling agents|
Lactic acid <20 % solution (CLR®)	Removes lime, calcium, rust, magnesium, and other dissolved minerals
Sulfamic acid <10 % solution (Lime-A-Way®)	Removes lime, calcium, rust, magnesium, and other dissolved minerals
Phosphoric acid <30 % solution (Hagesan® Blue)	Removes lime, calcium, rust and color staining
Citric acid <20 % solution	Removes mineral scaling
Sodium hypochlorite <6 % solution (bleach)	Removes bio-film, oil and grease
Acetic acid <20 % solution	Removes oil and grease
Sulfuric acid <10 % solution	Removes oil and grease

13 Battery pack option

The battery pack allows for two to three hours of testing. A Battery Low warning on the display will indicate charging is required. The field meter will stay on for 10 to 15 minutes following this warning before the battery is fully depleted and powers off.

To recharge the battery, plug the field meter in using the battery charger. Make sure that the switch on the battery pack is in the **On** position. The battery pack will require one to two hours to achieve a full charge.

The field meter will not be damaged by being left on the charger.

The battery pack option features smart-charge circuitry that allows the field meter to be used for sampling or calibration while recharging.

14 Storage/transport

14.1 Packing the field meter

The field meter is designed as a portable test meter and is appropriately housed in an IP65-rated rugged carrying case with handle. Even so, care should be taken to avoid bumping the field meter during travel.

When storing or transporting the field meter it is important to ensure the cuvette is clean and free of water. The clean and dry cuvette should be inserted into the test chamber and the lid securely fastened.

14.2 Storage of field meters with battery pack

Transport with the battery pack switch in the **Off** position.

Table 7 Battery pack switch positions for storage

Length of storage (days)	Battery pack switch position
0 to 7	On
7 to 21	Off
21 and over	On with charger plugged in

15 Troubleshooting

For any issue that is not quickly resolved, contact ABB for assistance.

15.1 Displayed error messages

Several error messages can be displayed on the main display screen of the field meter including a detected issue with the LED light sources, an over temperature or under temperature condition, improper insertion of the cuvette during a measurement, among others. These messages allow the user to quickly troubleshoot and correct issues.

This section shows possible error messages that can be displayed on the main display screen of the field meter.

15.2 Stabilizing

Condition

`Stabilizing`

Cause
The UV LED light source module has not reached stability required for a proper measurement.

Recovery action

1. This is normal for the first 90 seconds after the field meter is turned on. If the message persists, turn off the field meter and turn back on try again.
2. If the message still displays this could indicate the LED light source module needs to be replaced. Check to ensure that there is no residual sample in the cuvette and the cuvette outer surface is free from dampness/interfering particles. Clean the cuvette (inside and outside walls using clean water and a foam swab) and wipe the cuvette completely dry.
3. If the above did not work and the field meter is still stabilizing, remove the cuvette from the field meter and wait for 90 to 120 seconds to see if the field meter goes to Ready. If all else fails, contact ABB for assistance.

15.3 Lamp low

Condition

`Lamp low`

Cause
One of the LED light sources is too low for an accurate measurement to be taken.

Recovery action

1. This may indicate the lamp needs to be replaced. Contact ABB for assistance.

15.4 Lamp high

Condition

`Lamp high`

Cause
One of the LED light sources is too high for an accurate measurement to be taken.

Recovery action

1. This may occur after installation of a new LED light source module.
2. Adjust the LED mA settings or gain settings in the field meter.
3. Contact ABB for assistance with this as incorrect setting can affect measurement accuracy.

15.5 Temp high

Condition

`Temp high`

Cause
The measured internal temperature of the LED light source module is too hot for an accurate measurement to be taken.

Recovery action

1. Move to a cooler location or a shaded location if in full sun.

15.6 Temp low

Condition

`Temp low`

Cause
The measured internal temperature of the LED light source module is too cold for an accurate measurement to be taken.

Recovery action

1. Move to a warmer location.

15.7 Cuvette insertion error

Condition

Cuvette insertion error

Cause

During a measurement, the cuvette is inserted after the compute or zero button is pressed. However, if the cuvette is inserted to slowly or if it is not fully inserted, then an accurate measurement cannot be completed.

Recovery action

1. Remove the cuvette, and replace it in the cuvette holder when prompted. If the error still displays then power off the field meter and try again. If still the error displays it may indicate damage to the microswitches requiring service to the field meter.
2. If the field meter is still stabilizing, remove the cuvette from the field meter and wait for 90 to 120 seconds to see if the field meter changes to Ready.
3. Contact ABB for assistance.

16 Parts and accessories

Table 8 Parts and accessories

Part number	Part name	Description
3KXA300000U0046	UviTec calibration bottle	For use with calibration water (DI water, etc.) or for use with sample water under test (separate bottles should be used for calibration water and sample water)
3KXA300000U0052	Cuvette – 2 mm	2 mm path length quartz cuvette
3KXA300000U0053	Cuvette – 10 mm	10 mm path length quartz cuvette
3KXA300000U0055	Wall adapter	UviTec wall adapter, 12 V DC
3KXA300000U0056	Car adapter	UviTec car adapter, 12 V DC
3KXA300000U0057	Battery charger	12 V DC battery charger for SP series meters with battery pack
3KXA300000U0160	UviTec replacement pipettes – 10 pack	5 mL disposable low-density polyethylene pipettes for transferring sample into measuring cuvettes
3KXA300000U0161	UviTec replacement syringe filter (3.1 µm) – 10 pack	For sample filtration before measurement, glass fiber syringe filter, 3.1 µm, 25 mm
3KXA300000U0162	UviTec replacement syringe filter (5 µm) – 10 pack	For sample filtration before measurement, PTFE membrane syringe filter, 5 µm, 13 mm

Trademarks

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- Phillips is a registered trademark of Phillips Screw Company.
- UviTec is a trademark of ABB Limited.

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