Washwater Monitoring System
MES 1003 User Guide

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Table of Contents

1. Introduction

1.1. Purpose of the Manual

This manual provides information on functionality and maintenance of the Washwater Monitoring System. Descriptions of functional modes and display examples will enable the user to understand the different user interfaces.

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Other available resources:
- *MES 1003 - Data Sheet* (100602-DSH)
- *MES 1003 - Installation Guide* (100838-MAN)
- *MES 1003 - Spare Parts Catalogue (101155-CAT)*

These documents are available for download at the Danfoss IXA website, or from the supplier of the marine emission sensor.

1.2. Abbreviations and Definitions

Abbreviation	Description
ADU	Application Data Unit
CSV	Comma-Separated Values
DHCP	Dynamic Host Configuration Protocol
EGCS	Exhaust Gas Cleaning System
EOCR	Electrical Over Current Relay
LAN	Local Area Network
LCP	Local Control Panel
MBAP	Modbus Application
PDU	Protocol Data Unit
SPE	Signal Processing Engine
SU	Sample Unit
TCP	Transmission Control Protocol
WAU	Washwater Analyzing Unit
WMS	Washwater Monitoring System
WSR	Washwater Sample Pressure Reduction Unit
WSU	Washwater Sample Unit

Table 1: Abbreviations

Term	Description
Alarm	An alarm covers conditions where the WMS either malfunctions or exceeds the operational limits.
Modbus	Communication protocol.
Operational mode	The WMS has the following operational modes: • Standby Mode The WMS remains idle and does not perform any measurements. • Starting The WMS starts the pumps but is not yet measuring • Sensing Mode / Operation The WMS is measuring. • Verifying The WMS remains idle and all pumps etc. are shut off – but the WMS is measuring

Table 2: Definitions

1.3. Product Description

The MES1003 operating principle is based on the standard MEPC.340(77) which in overall terms defines how to measure the three required substances: PAH, Turbidity and pH.

The system consists of Washwater Analyzing Unit (WAU) and one of two Sample Units: WSU which offers a sample pump and WSR which offers pressure reduction.

The WAU contains all components which control and perform the measurements. This includes the computer which controls all operations in the system and the measurement chamber with the three sensors measuring PAH, Turbidity and pH. The measured values will be recorded and reported to the user and is available through the display on the front door and through the Modbus.

The WSU contain the de-bubbler, temperature sensor and relay for the sample pump. The temperature sensor is used to report the temperature in the sampling point. The de-bubbler is a passive component which removes any bubbles in the sample water as they interfere with the turbidity measurement. Turning the pump on/off is controlled by the computer in the WAU. Two protection devices are built into to WSU in order to protect the pump and motor from breaking down in case of lack of sample water and motor overload.

The WSR contain the de-bubbler, temperature senor and a pressure reduction valve. The temperature sensor is used to report the temperature in the sampling point. The de-bubbler is a passive component which removes any bubbles in the sample water as they interfere with the turbidity measurement. The pressure reduction valve reduces a high water pressure at the input to a lower pressure at the output suitable for the WAU. The WSR also contains a safety function which will lead water to the bilge in case of a pressure reduction valve fault.

The MES1003 interfaces to external systems through Modbus TCP/IP. A local display enables the user to perform setup and control the system.

Illustration 1: Washwater Monitoring System

1.4. Functional Features

The Washwater Analyzing Unit (WAU) cabinet is equipped with a control panel with a relevant button layout for local operation. The integrated control panel on the lid of the WAU gives the user access to information about the system and the measured values for PAH, turbidity and pH.

Among available local control features and information are:

- Visual Power ON indication.
- Visual Warning indication.
- Visual Alarm indication.
- Control interface status of the systems operational modes.
- Control interface notifications in case of an error or warning.
- Menu for setting up the system.

1.5. Startup

Make sure that both the WAU and the SU are connected with the ship's power grid and that the breaker for WMS systems power supply is ON.

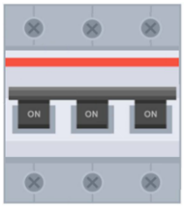


Illustration 2: illustration of a Breaker for a WMS system

Applying power
When power is applied to the WMS system, the software starts booting. When the display is lit, the WMS is ready for operation. The system start out in standby mode and the WMS starts measuring after having received a command to do so.

The startup procedure works in the following way:

- The screen is illuminated and an IXA animation starts:

- All LEDs are turned on.
- When the animation is finished, the LEDs turn off, except On LED and Status LED.
- Warning LED will turn on if a warning is active.
- Alarm LED will flash if an alarm is active.

1.6. First Time Setup

The WMS is initially configured with date and time at the time of its production, however during shipping the clock may have drifted. To ensure correct operation and logging, the time must be set before it is taken into use. The WMS will continuously broadcast an alarm until the time is adjusted.

When the WMS is powered on for the first time, it will automatically enter the time setup menu on the local control panel from where the time can be set immediately. For manual setup of the time see 2.2.2 - *Menu Display Examples.*

2. User Interfaces

2.1. Local Control Panel

NOTICE

The contrast level of the display can be altered by pressing and holding the Status button, and at the same time pressing the up and down buttons.

NOTICE

The backlight of the display can be turned off/on by pressing and holding the Status button and at the same time pressing the Back button.

2.1.1. LCP Layout

The LCP is divided into 4 functional groups (A-D), see Illustration 3: LCP Layout

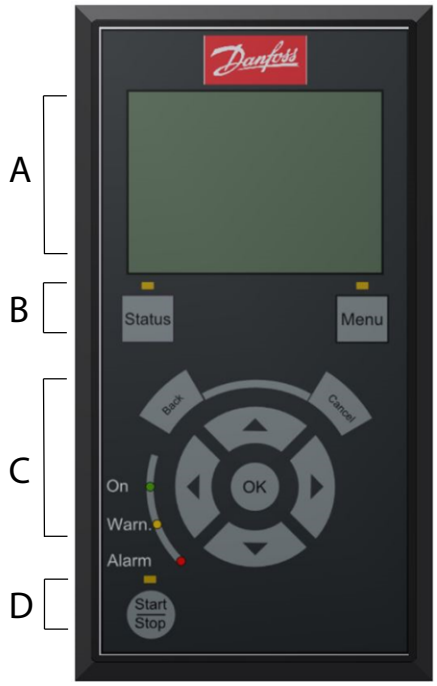


Illustration 3: LCP Layout

A. Display area.

B. Display menu keys for changing the display to show status options and menu.

C. Navigation keys for programming functions and moving the display cursor. Also included are the status indicator lights.

D. Start/Stop Key.

2.1.2. Display Area (A)

The display is divided into 3 sections.

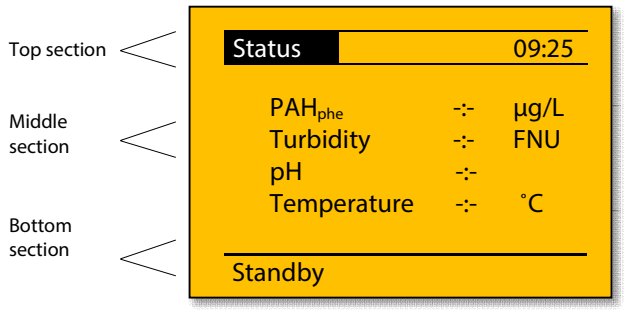


Illustration 4: Display Area

Top section	Heading
Middle section	Displays information and values.
Bottom section	Shows current WMS mode and/or alarm info and current sample point.

Table 3: Legend to Illustration 4: Display Area

2.1.3. Display Menu Keys (B)

The display menu keys are used for menu access for parameter setup, toggling through status display modes during normal operation, and viewing fault log data.

Illustration 5: Display Menu Keys

Key	Function
Status	Selects Status view (LED) Press to go to Status screen from any menu
Menu	Gives access to menus (LED) Press to go to the Main Menu from any other display view.

Table 4: Legend to Illustration 5: Display Menu Keys

2.1.4. Navigation Keys (C)

Navigation keys are used for editing parameters, moving the display cursor, and selecting display views.

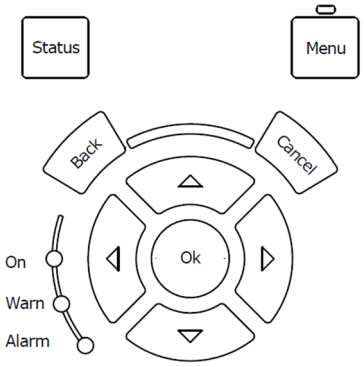


Illustration 6: Navigation Keys

Key	Function
Back	Return/deselect Go to the nearest higher level view/Menu. The top level view is the Status view.
Cancel	Cancels selection Cancels the last change or command as long as the display mode has not changed.
OK	Enter/select Use to access parameter groups or to enable a selection.
Navigation keys	Use the 4 navigation keys to move between items in the menu and toggle between Status views. ▲ Arrow up ▼ Arrow down ◀ Arrow left ▶ Arrow right

Table 5: Legend to Illustration 6: Navigation Keys

2.1.5. Indicator Lights (LEDs)

If certain threshold values are exceeded, the alarm and/or warning LED light up. A status and alarm text appears on the control panel. At the same time, the back light is on.

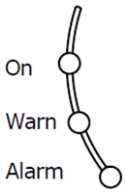


Illustration 7: Indicator Lights (LEDs)

LED	Function
On - green LED	Power on
Warn - yellow LED	On when a warning is active.
Alarm - red LED	Blinking when an alarm is active.

Table 6: Legend to Illustration 7: Indicator Lights (LEDs)

The following 3 symbols are used in the display and will be visible when one of the events is active:

Warning	Alarm	Maintenance
!		

Table 7: Icons Used by the Display

2.1.6. Start/Stop Key (D)

The Start/Stop key is located at the bottom of the LCP.

Illustration 8: Start/Stop Key

Key	Function
Start/Stop	Starts/stops measurements (LED)

Table 8: Legend to Illustration 8

The Start/Stop key starts the measurements.

In Calibration mode:
- The Start/Stop LED flashes.

In Sensing mode:
- The Start/Stop LED is lit continuously.

When Stop is pressed again, the LED turns off and the WMS enters Standby mode.

NOTICE

If the WMS operation is controlled via Modbus, the Start/Stop key is ignored.

2.1.7. Status

The following are examples of different status displays and readouts. Use the left (◄) and right (►) arrow to navigate between the different status windows.

Illustration 9: Sensing mode and sensor values

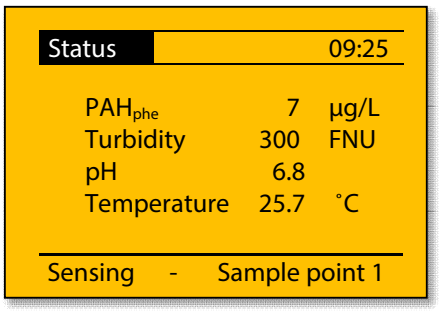


Illustration 10: WSU suction pressure status and Warning Situation

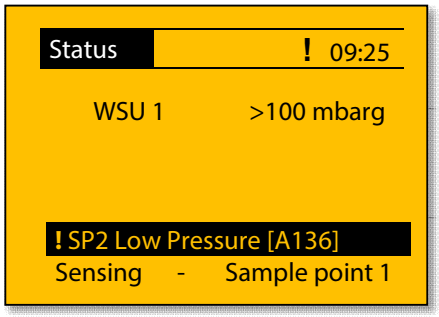


Illustration 11: Sensing SU temperature status

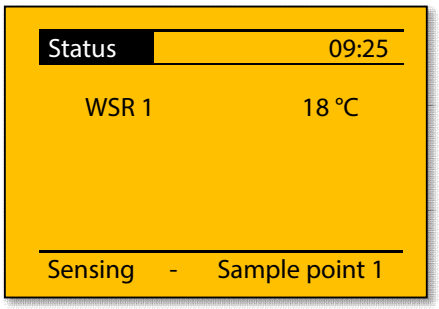
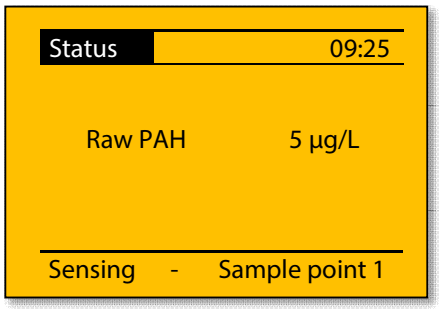


Illustration 12: Non corrected PAH value



2.1.8. Menu

All menus and parameters are numbered according to their category and tier with 3 digits. The leftmost digit designates the top-level menu, e.g. *3-** Interfaces*. The next tier contains submenus, e.g. *3-1* LAN Setup*, which contain the parameters, e.g. *3-11 LAN IP address*. See 2.2 Menu Structure or Appendix 1 – Parameter Overview for an overview of parameters.

Illustration 13: Main Menu with Scroll Bar

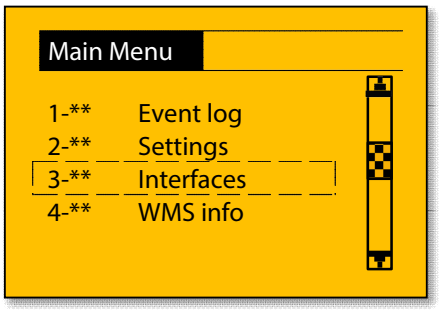


Illustration 14: Submenu 1, Reference to Main Menu Number

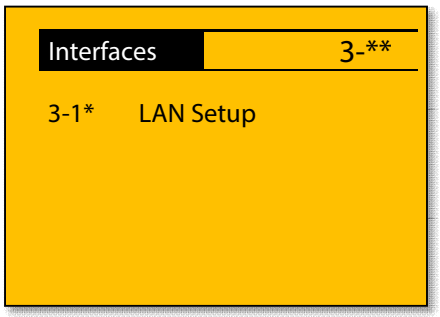
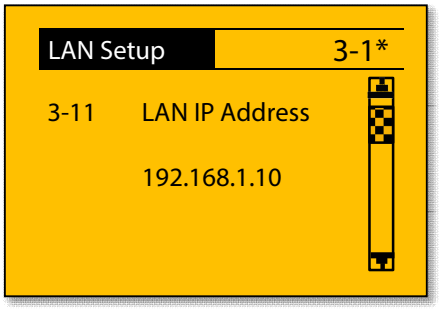


Illustration 15: Selection Screen



2.1.9. Editing Parameters

Changing Parameter Options

1. Enter the desired menu and use the Up (▲) and Down (▼) navigation keys to select a parameter.
2. Press OK to highlight options (for example Enabled/Disabled). Use the Up (▲) and Down (▼) navigation keys to view other options. Press Cancel to abort or press OK to confirm the new setting. The colors are now inverted.

Illustration 16: Step 1

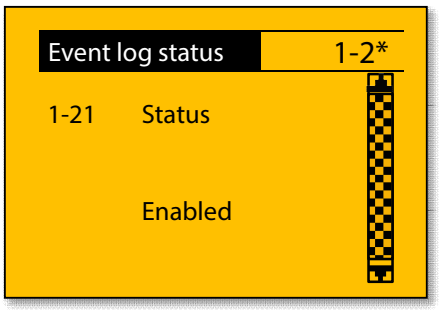
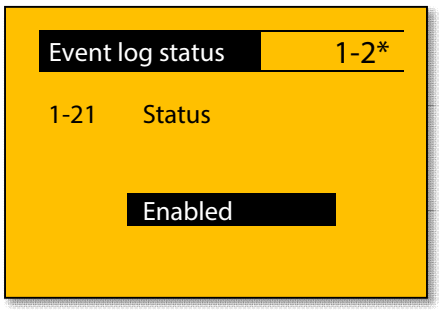


Illustration 17: Step 2



2.2. Menu Structure

See Appendices
Appendix 1 – Parameter Overview for default values and ranges.

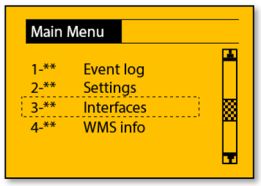
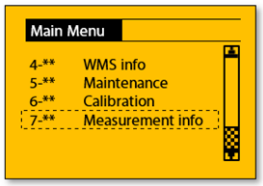
2.2.1. Menu Overview

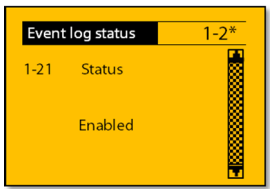
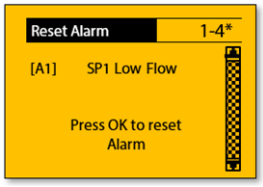
Main Menu

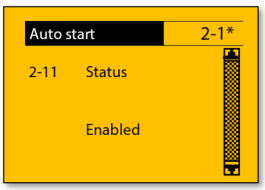
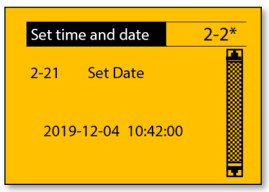
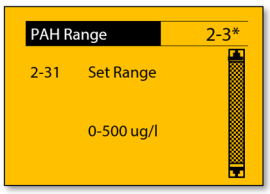
1. Event Log	2. Settings	3. Interfaces	4. WMS info	5. Maintenance	6. Calibration	7. Measurement info
1.1 Event Log Show 1.11 Event Log 1.2 Event Log Status 1.21 Status 1.3 Help 1.4 Reset Alarm	2.1 Auto Start 2.11 Status 2.2 Set Time and Date 2.21 Set Date 2.3 PAH Range 2.31 Set Range 2.4 Display PAH 2.41 Status	3.1 LAN Setup 3.11 LAN IP Address 3.12 LAN Gateway 3.13 LAN Network mask 3.14 Reboot 3.15 WMS Hostname 3.16 DHCP	4.1 Part Number 4.11 WAU Part Number 4.2 Serial Number 4.21 WAU Serial Number 4.3 SW Rev Number 4.31 SW Revision Number 4.4 OS Rev Number 4.41 Operating System	5.1 Local Contol 5.2 Reset Password 5.3 Diagnostics Report 5.4 Update Software 5.5 Save Setup 5.6 Restore Setup	6.1 Verification Mode 6.2 pH Calibration 6.3 Turb. Calibration 6.4 PAH Calibration	7.1 Set Start Date 7.2 Set End Date 7.3 Save Log

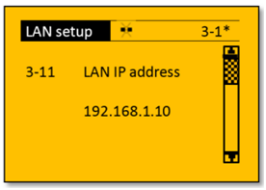
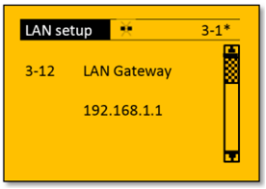
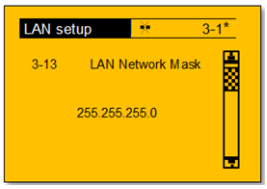
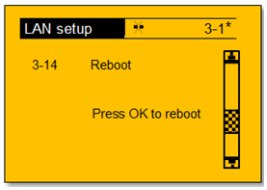
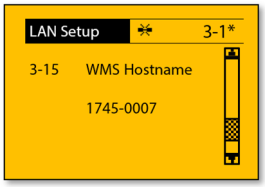
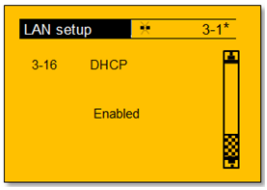
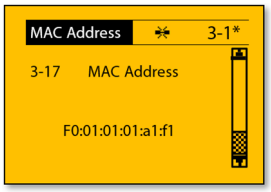
Illustration 18: Menu Overview

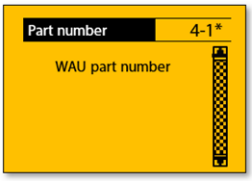
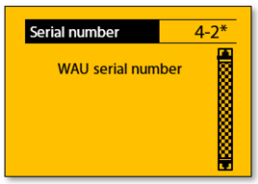
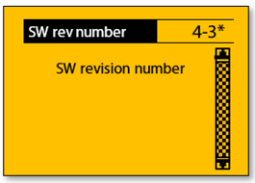
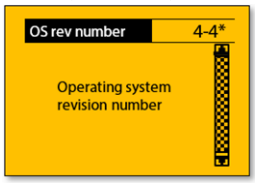
2.2.2. Menu Display Examples

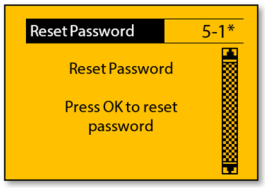
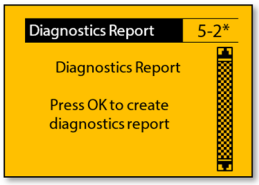
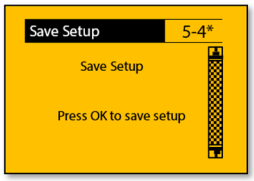
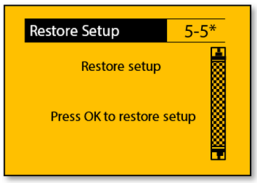
Main Menu		
1-** Event 2-** Settings 3-** Interfaces 4-** Sensor info 5-** Maintenance 6-** Calibration 7-** Measurement info		
See ***Appendices*** ***Appendix 1 – Parameter Overview***		

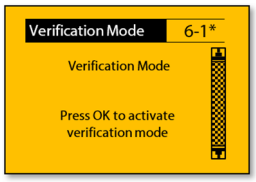
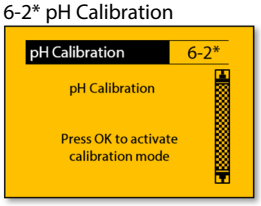
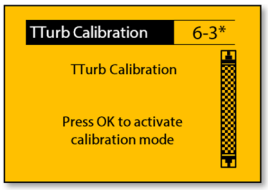
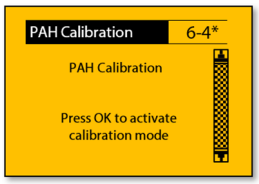
1- Event log**		
1-1* Event log show *(view only Event Details)* - select 1-11 Event log *(options List of Log IDs. If there are no Events, the list is empty.)*  	1-2* Event log status - select 1-21 Status *(options Enabled, Disabled)*  	1-3* Help 
1-4* Reset Alarm - select Reset Alarm  		
See ***Appendices*** ***Appendix 1 – Parameter Overview***		

2- Settings**		
2-1* Auto start - select 2-11 Auto start status  	2-2* Set time and date - select 2-21 Set Date  	2-3* PAH Range - select 2-31 Set Range *(options 0-50 ug/l, 0-500 ug/l)* 
2-4* Display PAH - select 2-41 Display PAH		
Auto start: When Auto start is disabled on the WMS, the system enters Standby mode when the system is turned on or restarted. If Auto-start is enabled, the systems immediately starts Sensing mode.		
See ***Appendices*** ***Appendix 1 – Parameter Overview***		

3- Interfaces**		
Note: The symbol indicates a link connection.		
3-1* LAN setup - select 3-11 LAN IP Address 	- select 3-12 LAN Gateway 	- select 3-13 LAN Network mask 
- select 3-14 Reboot 	- select 3-15 Sensor Hostname 	- select 3-16 DHCP 
- select 3-17 MAC Address 		
See ***Appendices*** ***Appendix 1 – Parameter Overview***		

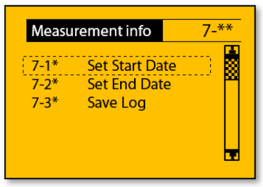
5- WMS Info**		
4-1* Part number *- read only WAU part number* 	4-2* Serial number *- read only WAU serial number* 	4-3* SW rev number *- read only SW revision number* 
4-4* OS rev number *- read only Operating system revision number* 		
See ***Appendices*** ***Appendix 1 – Parameter Overview***		

5- Maintenance**		
5-1* Local Control - status	5-2* Reset Password - select Reset Password 	5-3* Diagnostics Report - select Diagnostics Report 
5-4* Update Software - select Update Software 	5-5* Save Setup 	5-6* Restore Setup 
See ***Appendices*** ***Appendix 1 – Parameter Overview***		

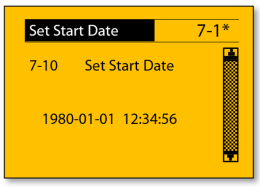
6- Calibration**		
6-1* Verification Mode 	6-2* pH Calibration 	6-3* Turb. Calibration 
6-4* PAH Calibration 		
See ***Appendices*** ***Appendix 1 – Parameter Overview***		

7- Measurement Info**

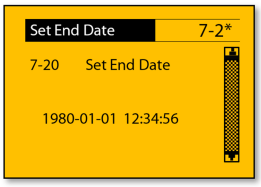
7-** Measurement info



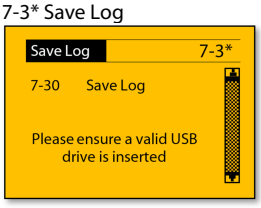
7-1* Set Start Date

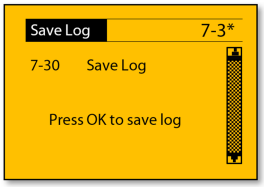


6-3* Set End Date



7-3* Save Log





See ***Appendices***
Appendix 1 – Parameter Overview

2.3. Local Control

Local Control can be used when the system is inspected or calibrated by crew. When Local Control is enabled, the WMS can only be started and stopped from the LCP. Local Control can be enabled using the Modbus interface or using the LCP Local Control can only be disabled using the LCP. Local Control ensures that the sensor is not started unintentionally by another system thus allowing crew to perform inspection and maintenance operation on the system.

When Local Control is disabled, the WMS must be started and stopped using command through the Modbus.

When Local Control is enabled, readings from the sensor can still be obtained over Modbus. The only difference is that the system can't be started over Modbus.

2.4. USB Interface

The USB interface, located in the WAU inside the controller box, can be used in combination with the local control panel and a USB drive to update the sensor software, extract a diagnostics report or download a measurement log. The USB interface also includes the possibility to save/restore setup. The placement of the USB port can be seen in Illustration 19; it is located behind the cover of the control box in the WAU.

NOTICE

The USB stick must comply with the following:

- Max 16 G
- 1 partition only
- Formatted to FAT32

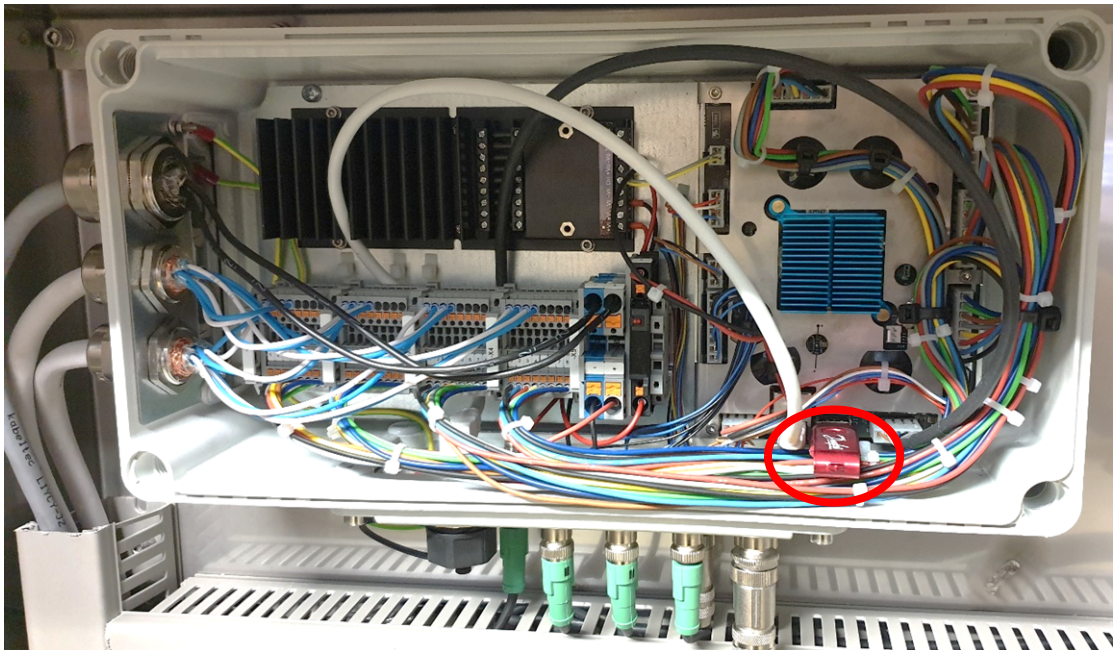


Illustration 19: Placement of the USB port

2.4.1. Diagnostics Report

The diagnostics report is an important tool to help service personnel analyze the WMS's behavior. If a query regarding the WMS's performance is submitted as in 5.5 Alarms and Troubleshooting, a diagnostics report may be required to find the source of technical issues.

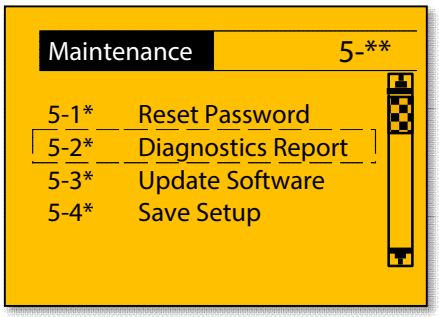
NOTICE

Ensure the USB drive is working and is not full, before creating the diagnostics report.

To create a diagnostics report:

1. Insert a USB drive
2. Navigate to the maintenance menu
3. Select Diagnostics Report

Illustration 20: Maintenance submenu



Follow the instructions on the screen and proceed by pressing OK.

Illustration 21: Step 1

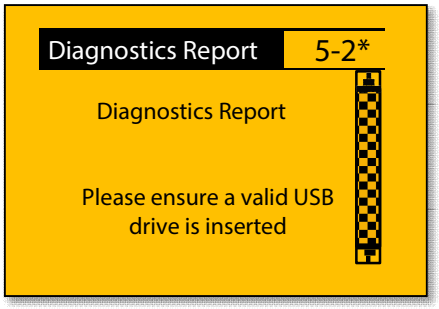


Illustration 22: Step 2

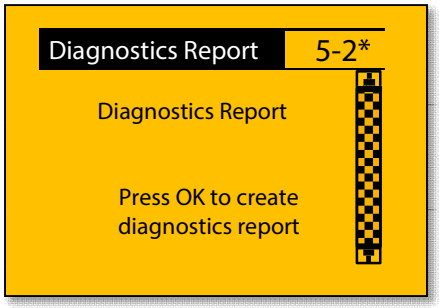


Illustration 23: Step 3

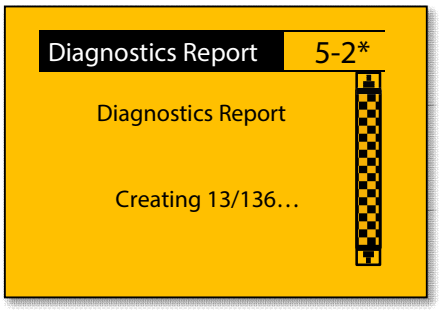
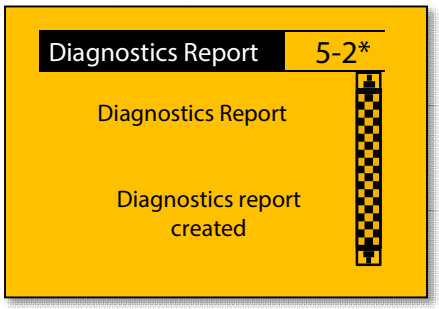


Illustration 24: Step 4



After successful completion, a directory named Diagnostics will be placed in the root folder of the USB drive.
If a USB device is not found, check or replace the USB drive, and start the sequence again by pressing OK.

2.4.2. Updating Software

The software package obtained from Danfoss IXA consists of a directory with several files used for updating the software suite. The entire software directory must be placed on a USB drive before it is inserted into the WMS. Make sure that only one software folder exists on the USB drive, to ensure the intended version will be installed.

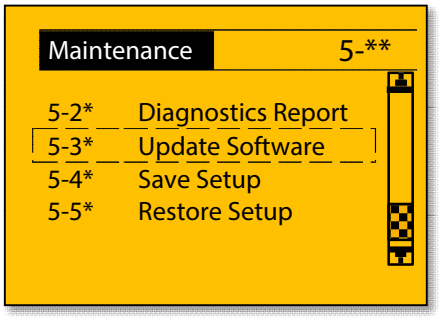
NOTICE

Do not turn the WMS off after beginning a software update, the WMS will automatically reboot when finished.

To update software:

1. Insert the USB drive with the software suite in the WMS
2. Navigate to the Maintenance submenu on the LCP
3. Select Update Software.

Illustration 25: Maintenance submenu



Proceed through the guide by pressing OK, and if the directory is found, the software update will begin. The update can take several minutes. Wait for the sensor to reboot, the LCP screen may freeze during the update.

Illustration 26: Step 1

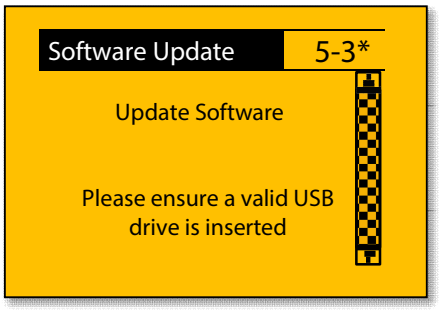


Illustration 27: Step 2

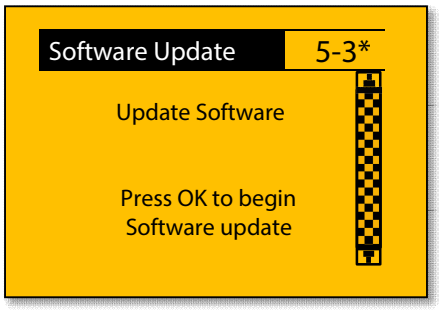
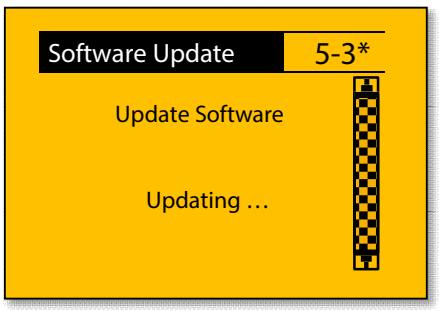


Illustration 28: Step 3



If a USB device with a valid software package is not found, the update will not start, and an error message will be displayed. Ensure that the complete directory is present on the device and try again. Press OK to restart the guide.

2.4.3. Save Setup

To Save Setup:

1. Insert USB stick
2. Navigate to the Maintenance sub menu
3. Select Save Setup.

The Save Setup function saves the customizations of the WMS to a USB stick. The USB stick can later be used to restore the same or another WMS to an identical setup. The functionality can be used to create a backup of the WMS settings before changing some of the parameters available for customization in the LCP. The functionality is also able to carry customizations between several WMS systems that require identical setups.

2.4.4. Restore Setup

To Restore Setup:

1. Insert USB stick
2. Navigate to the Maintenance sub menu
3. Select Restore Setup

The Restore Setup function restores the customizations of the WMS to those found on a USB stick. The functionality is also able to carry customizations between several WMS systems that require identical setups.

2.4.5. Measurement Log

The measurement log is an important tool to help service personnel analyze the WMS's behavior. If a query regarding the WMS's performance is submitted as in 5.5 Alarms and Troubleshooting, a measurement log may be required to find the source of technical issues.

NOTICE

Ensure the USB drive is working and is not full, before creating the measurement log.

To create a measurement log:

1. Insert a USB drive
2. Navigate to the measurement info menu

Illustration 29: Measurement info submenu

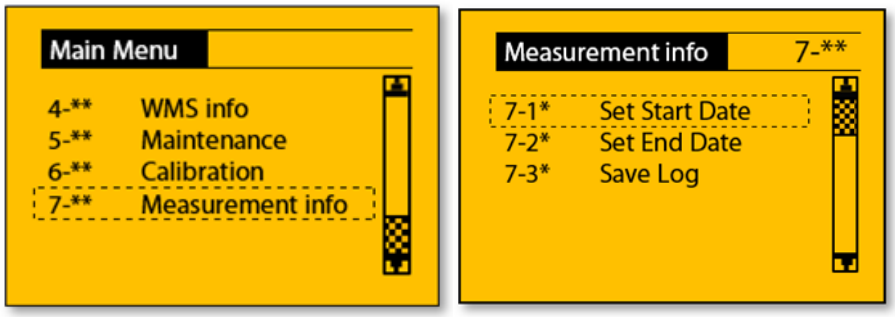


Illustration 30: Step 1

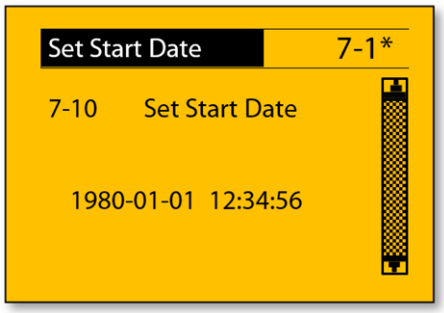


Illustration 31: Step 2

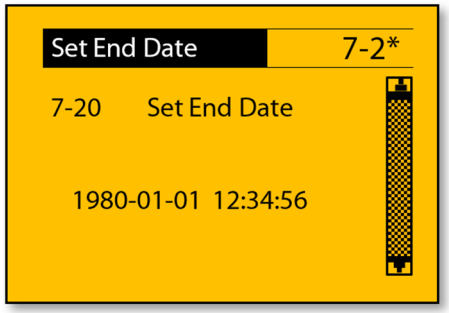


Illustration 32: Step 3

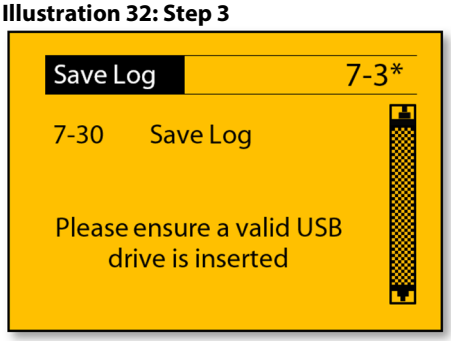


Illustration 33: Step 4

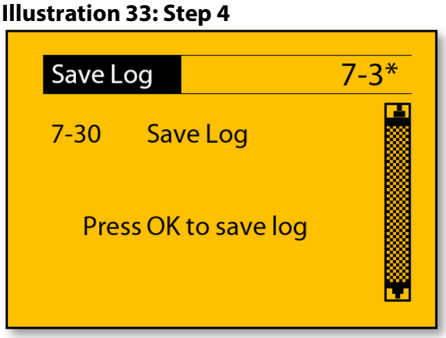


Illustration 34: Step 5

After successful completion, a directory named "*measurementlog.csv*" will be placed in the root folder of the USB drive. If a USB device is not found, check or replace the USB drive, and start the sequence again by pressing OK.

3. Logging

The sensor logs measurements, events, warnings and alarms. As a minimum, each line in the log is given a time-stamped starting date, hours, minutes, seconds and a description of the measurement/event/warning/ alarm. The log is available for at least the last 18 months, depending on logging intervals. Refer to section 2.4.1 – Diagnostics Report and section 2.4.5 – Measurement Log for procedures on how to download log files.

3.1. Example of Measurement Log

The data in Table 9 is the result of a measurement log generated as a csv file.

Date	Time	Sample Point	Corrected PAH	Turbidity	pH	System temp.	Temp.	Raw PAH	Temperature SP1	Temperature SP2	Temperature SP3	Temperature SP4	Pressure SP 1	Pressure SP 2	Pressure SP3	Pressure SP 4	Flow Switch	State
2019.06.19	14:02:00	1	5.8	152.4	6.9	50.5	25.1	32.5	15.6	19.8	9999	9999	112.2	110.8	9999	9999	1	2
2019.06.19	14:03:00	2	47.4	159.7	6.5	50.5	25.4	280.9	15.6	19.8	9999	9999	111.8	111.2	9999	9999	1	2
2019.06.19	14:04:00	1	5.2	151.9	6.9	50.6	25.2	31.8	15.6	19.7	9999	9999	112.1	110.6	9999	9999	1	2
2019.06.19	14:05:00	2	48.6	160.4	6.6	50.6	25.3	295.6	15.6	19.8	9999	9999	112.0	110.9	9999	9999	1	2
2019.06.19	14:06:00	1	5.1	151.6	6.9	50.5	25.2	31.2	15.6	19.7	9999	9999	111-9	111.1	9999	9999	1	2

Table 9: Example of Measurement Log

Column name	Description
Date	Measurement date
Time	Measurement time
Sample Point	Which sample point is being measured: 1 = Sample point 1 2 = Sample point 2 3 = Sample point 3 (optional) 4 = Sample point 4 (optional)
Corrected PAH	Corrected PAH value (turbidity and phenanthrene equivalent)
Turbidity	Measured value for turbidity
pH	Measured value for pH
System temperature	Temperature of the controller
Temperature	Measured temperature (with pH sensor)
Raw PAH	Output from PAH Sensor
Temperature WSU 1	Sample water temperature in sample point 1 in °C
Temperature WSU 2	Sample water temperature in sample point 2 in °C
Temperature WSU 3	Sample water temperature in sample point 3 in °C (optional)
Temperature WSU 4	Sample water temperature in sample point 4 in °C (optional)
Pressure WSU 1	Pressure before sample pump in WSU 1 in mbar(g)
Pressure WSU 2	Pressure before sample pump in WSU 2 in mbar(g)
Pressure WSU 3	Pressure before sample pump in WSU 3 in mbar(g) (optional)
Pressure WSU 4	Pressure before sample pump in WSU 4 in mbar(g) (optional)
Flow switch	Indicates flow switch state: 0 = Off (low flow) 1 = On (sufficient flow)
State	Indicates operational mode: 0 (standby) 1 (starting) 2 (sensing) 3 (stopping) 4 (disconnected)

Table 10: Legend to Table 9

4. IXA Modbus TCP/IP

4.1. Introduction

This chapter explains how to establish and configure communication between the WMS and a controller using the Modbus TCP/IP protocol.

4.2. Example

Port number 502 and 1502
The supported protocol is Modbus TCP/IP ADU consisting of a MBAP header and a PDU, which is the standard default format.

ModBus RECV:	**00 01 00 00 00 06** *00* 01 <u>00 00 00 05</u>
ModBus SEND:	**00 01 00 00 00 04** *00* <u>01 01 00</u>

Table 11

Bold	**MBAP header**	2 bytes for MBAP transaction id – usually increasing 2 bytes for MBAP protocol – 00 00 2 bytes for data to follow
Italic	*Unit id*	Not used in Modbus TCP/IP
<u>Underlined</u>	<u>PDU</u>	In the above example: RECV: Read Coils (01), starting Offset 0 (00 00), 5 coils (00 05) SEND: Read Coils (01), coil values is 01 00

Table 12: Legend to Table 11

4.3. Exception Answers

If parameters are out of range, not allowed, or unsupported functions are used, then an exception is returned as defined by the Modbus standard. The standard defines that the Modbus function is returned with the high bit set followed by an exception code. For example, an exception on the Modbus function 0x5 will return 0x85.

Example: Attempting to enter Standby mode on a WMS already in Standby mode:

REQ:	**00 05 00 00 00 06** *00* <u>05 00 00 00 00</u>	Write coil (5), address 00 00, value 00 00
RESP:	**00 05 00 00 00 03** *00* <u>85 03</u>	Exception on write coil (85) – invalid parameter (03)

Table 13

4.4. Supported Functions

4.4.1. Read Coils (Modbus Function 1)

The read coils shown below is total coils available including support for previous versions of the WMS. The dimmed coils must not be used.

Supports 42 coils – on/off values (1 bit each, Offset 0, 42 coils)

Coil 0	Operating state	ON when sensing, otherwise OFF
Coil 1	Standby state	ON when SPE active without measuring, otherwise OFF
Coil 2	Sample Point 1 measurements ready	ON when samples from WSU 1 is ready, otherwise OFF
Coil 3	Sample Point 2 measurements ready	ON when samples from WSU 2 is ready, otherwise OFF
Coil 4	Sample Point 3 measurements ready	ON when samples from WSU 3 is ready, otherwise OFF
Coil 5	Sample Point 4 measurements ready	ON when samples from WSU 4 is ready, otherwise OFF
Coil 6	Alarms state	ON when alarms active, OFF when no alarms
Coil 7	Warnings state	ON when warnings active, OFF when no alarms
Coil 8	Low Flow Sample Point 1 Alarm	ON if a there is no signal from the flow switch while sample sequence for WSU 1 is active, otherwise OFF
Coil 9	Low Flow Sample Point 2 Alarm	ON if a there is no signal from the flow switch while sample sequence for WSU 2 is active, otherwise OFF
Coil 10	Low Flow Sample Point 3 Alarm	ON if a there is no signal from the flow switch while sample sequence for WSU 3 is active, otherwise OFF
Coil 11	Low Flow Sample Point 4 Alarm	ON if a there is no signal from the flow switch while sample sequence for WSU 4 is active, otherwise OFF
Coil 12	Thermal Trip WSU 1 Alarm	ON if EOCR in WSU 1 is active, otherwise OFF
Coil 13	Thermal Trip WSU 2 Alarm	ON if EOCR in WSU 2 is active, otherwise OFF
Coil 14	Thermal Trip WSU 3 Alarm	ON if EOCR in WSU 3 is active, otherwise OFF
Coil 15	Thermal Trip WSU 4 Alarm	ON if EOCR in WSU 4 is active, otherwise OFF
Coil 16	Low Pressure WSU 1 Alarm	ON if the pressure transmitter in WSU 1 measures a pressure below the low-pressure limit otherwise OFF
Coil 17	Low Pressure WSU 2 Alarm	ON if the pressure transmitter in WSU 2 measures a pressure below the low-pressure limit otherwise OFF
Coil 18	Low Pressure WSU 3 Alarm	ON if the pressure transmitter in WSU 3 measures a pressure below the low-pressure limit otherwise OFF
Coil 19	Low Pressure WSU 4 Alarm	ON if the pressure transmitter in WSU 4 measures a pressure below the low-pressure limit otherwise OFF
Coil 20	High Temperature WSU 1 Warning	ON if the temperature sensor in WSU 1 measures a temperature above the high-temperature limit, otherwise OFF
Coil 21	High Temperature WSU 2 Warning	ON if the temperature sensor in WSU 2 measures a temperature above the high-temperature limit, otherwise OFF
Coil 22	High Temperature WSU 3 Warning	ON if the temperature sensor in WSU 3 measures a temperature above the high-temperature limit, otherwise OFF
Coil 23	High Temperature WSU 4 Warning	ON if the temperature sensor in WSU 4 measures a temperature above the high-temperature limit, otherwise OFF
Coil 24	Invalid WMS Configuration	On if the WMS contains an incorrect sample sequence configuration, otherwise OFF
Coil 25	Time must be setup on WMS	ON when the time has not been setup properly on the sensor, otherwise OFF
Coil 26	pH Sensor Disconnected Alarm	ON when the signal from the pH sensors is lost, otherwise OFF
Coil 27	Turbidity Sensor Disconnected Alarm	ON when the signal from the Turbidity sensors is lost, otherwise OFF
Coil 28	PAH Sensor Disconnected Alarm	ON when the signal from the PAH sensors is lost, otherwise OFF
Coil 29	Pressure Transmitter Sample Point 1 Disconnected Alarm	On when the signal from the pressure transmitter in WSU 1 is lost, otherwise OFF

Coil 30	Pressure Transmitter Sample Point 2 Disconnected Alarm	On when the signal from the pressure transmitter in WSU 2 is lost, otherwise OFF
Coil 31	Pressure Transmitter Sample Point 3 Disconnected Alarm	On when the signal from the pressure transmitter in WSU 3 is lost, otherwise OFF
Coil 32	Pressure Transmitter Sample Point 4 Disconnected Alarm	On when the signal from the pressure transmitter in WSU 4 is lost, otherwise OFF
Coil 33	Temperature Transmitter Sample Point 1 Disconnected Alarm	On when the signal from the temperature transmitter in WSU 1 is lost, otherwise OFF
Coil 34	Temperature Transmitter Sample Point 2 Disconnected Alarm	On when the signal from the temperature transmitter in WSU 2 is lost, otherwise OFF
Coil 35	Temperature Transmitter Sample Point 3 Disconnected Alarm	On when the signal from the temperature transmitter in WSU 3 is lost, otherwise OFF
Coil 36	Temperature Transmitter Sample Point 4 Disconnected Alarm	On when the signal from the temperature transmitter in WSU 4 is lost, otherwise OFF
Coil 37	False Flow Alarm	On if the flow switch doesn't indicate "zero flow" in between sample point sequences, otherwise OFF
Coil 38	WSR 1 Draining to bilge Alarm	On if the flow switch in WSR 1 doesn't indicate "zero flow" otherwise off
Coil 39	WSR 2 Draining to bilge Alarm	On if the flow switch in WSR 2 doesn't indicate "zero flow" otherwise off
Coil 40	WSR 3 Draining to bilge Alarm	On if the flow switch in WSR 3 doesn't indicate "zero flow" otherwise off
Coil 41	WSR 4 Draining to bilge Alarm	On if the flow switch in WSR 4 doesn't indicate "zero flow" otherwise off
Coil 42	Local Control State	On if Local Control is Enabled otherwise off

Table 14: Read Coils

4.4.2. Read Holding Registers (Modbus Function 3)

Supports 28 registers – each 2 bytes: AB
Supports 5 strings registers – each spanning 50 addresses (100 bytes)

Floating point addresses (4 bytes)		
Offset 0 + Offset 1	PAH level	float value AB_0AB_1
Offset 2 + Offset 3	Turbidity level	float value AB_2AB_3
Offset 4 + Offset 5	pH level	float value AB_4AB_5
Offset 6 + Offset 7	Temperature level	float value AB_6AB_7
Offset 8 + Offset 9	Non corrected PAH level	float value AB_8AB_9
Offset 10 + Offset 11	WSU 1 pressure	float value $AB_{10}AB_{11}$
Offset 12 + Offset 13	WSU 2 pressure	float value $AB_{12}AB_{13}$
Offset 14 + Offset 15	WSU 3 pressure	float value $AB_{14}AB_{15}$
Offset 16 + Offset 17	WSU 4 pressure	float value $AB_{16}AB_{17}$
Offset 18 + Offset 19	WSU 1 temperature	float value $AB_{18}AB_{19}$
Offset 20 + Offset 21	WSU 2 temperature	float value $AB_{20}AB_{21}$
Offset 22 + Offset 23	WSU 3 temperature	float value $AB_{22}AB_{23}$
Offset 24 + Offset 25	WSU 4 temperature	float value $AB_{24}AB_{25}$
Offset 64 + Offset 65	PAHphe level	float value $AB_{64}AB_{65}$

Table 15: Read Holding Registers – Floating Point

Unsigned addresses (2 bytes)		
Offset 60	WMS state	AB unsigned value 0 (standby) 1 (starting) 2 (sensing) 3 (stopping) 4 (disconnected)

Table 16: Read Holding Registers – Unsigned

Unsigned integer addresses (4 bytes)		
Offset 10006 + Offset 10007	Size of measurement data as specified by register 10000 and 10002	Integer value $AB_{10006}AB_{10007}$
Offset 1000 – Offset 1049	WMS part number string	e.g. "1234" represented as $12_{1000}34_{1001}$
Offset 1050 – Offset 1099	WMS revision number string	e.g. "1234" represented as $12_{1050}34_{1051}$
Offset 1100 – Offset 1149	WMS serial number string	e.g. "1234" represented as $12_{1100}34_{1101}$
Offset 1150 – Offset 1199	WMS software revision string	e.g. "2.2.0" represented as $2._{1150}2._{1151}0_{1152}$
Offset 1200 – Offset 1249	WMS OS version string	e.g. "Linux" represented as $Li_{1200}nu_{1201}x_{1202}$

Table 17: Read Holding Registers – Unsigned Integer

All addresses are filled with zeros when requesting more addresses than the string represents, e.g. if the sensor part number is "1234" and address 1000 – 1002 (3 registers of 2 bytes) is requested, then

Offset	High byte	Low byte
1000	'1'	'2'
1001	'3'	'4'
1002	0	0

4.4.3. Write Single Coil (Modbus function 5)

Supports 1 coil

Coil 0	Start measuring	When set to 0xFF00 start measuring. When set to 0x0000 stop measuring. Any other value returns exception. Measuring may be started (0xff00) if the sensor is in Standby mode. Otherwise an exception is returned and the sensor stays in Standby mode. Measuring may be stopped (0x0000) if the sensor is in Operating mode. Otherwise an exception is returned and the sensor stays in Operating mode. Read coil 0 to determine if the sensor is in Operating mode. Read coil 1 to determine if the sensor is in Standby mode.
Coil 50	Local Control	When set to 0xFF00 Local Control is enabled. Cannot be set to 0x0000 an exception will be returned. Any other value returns and exception. Local Control may be enabled using Modbus. Local control can only be disabled using the Lcp. Read coil 42 to determine if Local Control is enabled

Table 18

4.4.4. Write Multiple Registers (ModBus Function 0x10)

Supports 6 registers – each 2 bytes: AB

Unsigned integer addresses (4 bytes)		
Offset 10000 + Offset 10001	Measurement log start time in seconds since 1970	integer value AB_0AB_1
Offset 10002 + Offset 10003	Measurement log end time in seconds since 1970	integer value AB_2AB_3
Offset 10004 + Offset 10005	Start measurement log download offset	integer value AB_4AB_5

Table 19

5. Service and maintenance

5.1. General

When performing maintenance or service on the Washwater Monitoring System spilling may occur. The spilling can both be sea water, scrubber discharge water and closed loop scrubber water.

CAUTION

During maintenance spilling can occur. The pH level of the content being spilled can potentially be rather acidic. Please make sure to use proper protection for eyes and skin to avoid any direct contact.

NOTICE

If spilling occurs inside the WAU or SU cabinets, please soak up the spilled water and make sure that the cabinets are left dry and clean.

5.2. Maintenance

The Washwater Monitoring System is an easy to maintain product.

- Maintenance and inspection shall be carried out according to the Table 20.

CAUTION

Personnel conducting maintenance must be:

- Trained and authorized in general safety rules for work on electrical equipment.
- Familiar with local requirements, rules, and regulations for the installation.

5.2.1. Maintenance Tasks

Maintenance task	Frequency	Who	What (how)
Check LCP for alarms	Weekly	Crew	Go to the WAU and: • Check display for alarms. Alarm list and troubleshooting guide is described in 5.5
Visual inspection	Biweekly	Crew	Go to the WAU and SU: • Check for mechanical damage • Check flanges, bolts, screw fittings, etc. • Check for leakage Also check the piping for the WMS system for any leakages
pH sensor calibration	Monthly	Crew	Go to the WAU and: • Calibrate the pH sensor using the dedicated buffer solutions
Cleaning - Measurement chamber - Sensors	Every 3 months	Crew	Go to the WAU and: • Clean the measurement chamber • Clean the sensors
Clean SU inlet filter	Every 3 months	Crew	Go to the SU and: • Clean the SU inlet filter
Inspect WSU pump (if applicable)	Every 3 months	Crew	Go to the WSU and: • Check for leakages from shaft sealing and from pump cover plate. • Check condition of pump impeller, shaft sealing, pump shaft, pump cover plate and O-ring for pump cover plate. • Replace worn out parts as necessary.
Replace salt bridge and electrolyte in pH sensor	Every 12 months	Crew	Go to the WAU and: • Replace salt bridge and electrolyte in pH sensor
Turbidity sensor calibration	Every 24 months	Crew	Go to the WAU and: • Calibrate Turbidity sensor using the dedicated calibration tool
PAH sensor calibration	Every 24 months	Crew	Go to the WAU and: • Calibrate the PAH sensor using the dedicated calibration tool
Replace PAH sensor lamp	Every 48 months	Supplier	Go to the WAU and: • Note the serial number of the WAU and contact ixa.service@danfoss.com to arrange replacement of the PAH sensor. • Disconnect and remove PAH sensor. • Make sure that both the PAH sensor and it's paired DryCAL-set are shipped back to the WMS supplier for lamp replacement.

Table 20: Maintenance Tasks

5.2.2. Cleaning the measurement chamber

The measurement chamber can be accessed from outside the WAU cabinet. This minimizes the spilling inside the WAU cabinet.

The measuring chamber should be cleaned every 3 months, if the water is very dirty it is advised to clean the chamber more frequently.

NOTICE

When unscrewing the bottom of the chamber some content from the system will be spilled. ensure draining through the drain valve at the bottom of the chamber.

Procedure:

1. To prevent damaging the pH sensor, remove the sensor as described in 5.2.3
2. Unscrew the 6 bolts shown in Illustration 35
3. Clean the measuring chamber using a soft cloth and clean water
4. When the measurement chamber is cleaned, mount bottom part of the measurement chamber again.

NOTICE

Tighten the 6 bolts holding the bottom part of the measurement chamber with a cross pattern to ensure even pressure on the gasket. Tighten with torque 1.98 Nm.

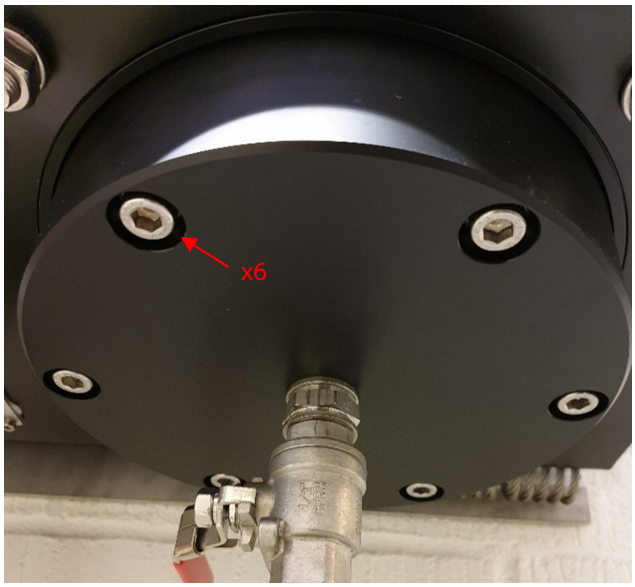


Illustration 35: Removing the bottom of the measurement chamber

5.2.3. Cleaning the sensors

The three sensors should be cleaned every 3 months, if the water is very dirty it is advised to clean the sensors more frequently.

NOTICE
To maintain sensors functionality, it is important to clean the sensors regularly.

The pH sensor must be removed from the measuring chamber in order to clean it properly without damaging it. Unscrew the four bolts holding the sensor in place. See Illustration 36 on which bolts to remove.

Illustration 36: Removal of the pH sensor for cleaning

NOTICE
Be careful not to damage the sensor when it is removed from the measurement chamber. Rest the sensor on a soft surface e.g. a clean rag.

Cleaning the PAH sensor
The window can be cleaned with a few drops of acetone and a lint-free cloth or a clean paper towel.

When cleaning the window, a thin film will appear, which can be removed with a soft cloth or clean water.

NOTICE
Be sure not to touch the window surface with your fingers!

NOTICE
Do not use any aggressive cleaning solutions, putty, sandpaper or cleaning solutions that contain abrasive substances to remove dirt.

Cleaning the Turbidity sensor
Clean the sensor windows with a soft cloth and then wipe it with isopropanol.

NOTICE
Do not use any aggressive cleaning solutions, putty, sandpaper or cleaning solutions that contain abrasive substances to remove dirt.

If precipitates such as carbonates or iron oxides appears, then use a handkerchief moisted in citric acid. Place it on the windows for a few minutes and wipe with a soft cloth.

Cleaning the pH sensor
NOTICE
Do not disassemble the sensor for cleaning and maintenance.

- The sensor should always be kept clean. If there is a biofilm on the sensors, this can lead to measurement errors.
- A dirty sensor should be cleaned with buffer solution.
- If possible, mechanical influences on the glass membrane should be avoided.
- For stubborn soiling, a very soft brush or a soft sponge can be used carefully.
- For more solid deposits, the sensor can be immersed in a diluted HCl solution or a base. Pepsin can also be used in the case of organic deposits.

NOTICE
After cleaning, always rinse the sensor carefully with distilled water.

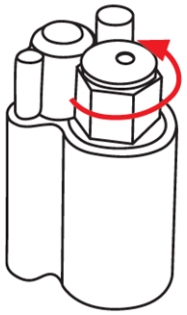
NOTICE
Avoid touching the sensors, as they could be damaged. If this is the case, the functionality of the sensor can no longer be guaranteed.

Refit sensor, tighten the bolts with 0.39 Nm

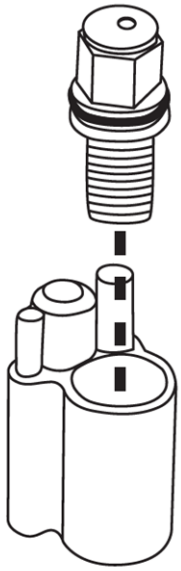
5.2.4. Salt bridge replacement – pH sensor

The average lifetime of the pH sensor is about 12 months. The sensors lifetime can be extended by replacing the electrolyte and the salt bridge.

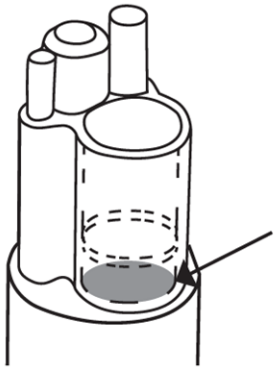
It is recommended to replace electrolyte and salt bridge once every 12 months. Follow these steps:



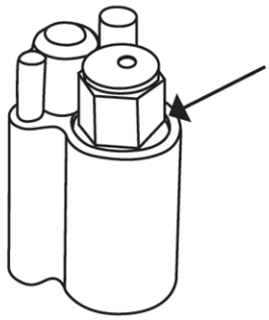
1. Remove the salt bridge by carefully turning it counter-clockwise with a spanner or pliers



2. Pull up the salt bridge to remove it



3. Fill the cell with standard cell buffer (refill solution) to the level shown in the figure (below the housing limit)



4. Insert the new salt bridge by turning it clockwise. Do not overtighten! Make sure the O-ring is properly seated. The salt bridge should be slightly below the surface.

5.2.5. SU inlet filters

- The SU inlet filter should be checked and cleaned occasionally (every 3 months is recommended).

NOTICE
When unscrewing the filter mesh nut some content from the system will be spilled.

- Check and clean the filter by unscrewing the filter mesh mounting nuts.
- Rinse in a bucket to get foreign objects out of the mesh.
- If the mesh is teared apart, then install a new mesh.
- Mount the cleaned filter mesh and check for any leaks.

5.2.6. Spare parts

Please contact the supplier of the Washwater Monitoring System for an overview of available spare parts for the system.

5.3. Calibration

5.3.1. pH Sensor Calibration

Calibration must be performed with buffer solution pH7 and pH4. The selected pH buffer solutions must be with an accuracy of +/- 0.01pH. Fresh or newly prepared solutions must be used for each calibration.

Tools needed for pH calibration:

- Allen key size 5
- Distilled water
- pH Buffer solution 4
- pH Buffer solution 7

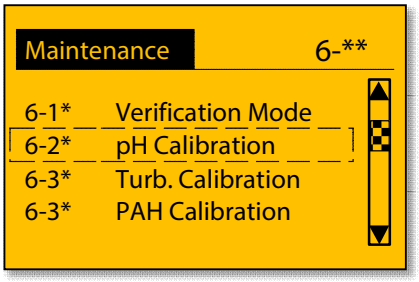
NOTICE
Switch off the power for the SU pump (if applicable), close all isolation valves for the WMS system and drain the measurement chamber before starting the pH calibration.

NOTICE
Do not let the pH sensor get dry. If the sensor is dry, it must first be re-conditioned for several hours (>12h) in pH4 buffer.

Remove the pH sensor from the measuring chamber by loosening the four M6 bolts holding the pH sensor in place. Insert the sensor in a container with distilled water to prevent the sensor from getting dry.

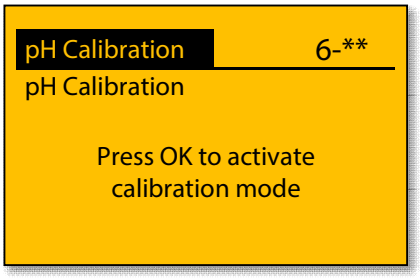
pH calibration
To perform the pH calibration, go to the pH Calibration menu 6-2*. The following illustrations shows LCP when performing the pH calibration.

Illustration 37: Maintenance submenu



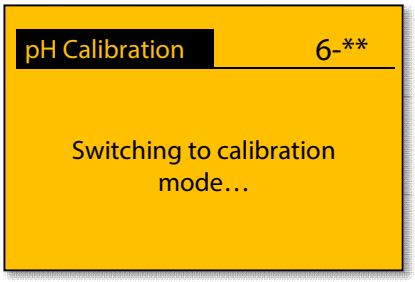
Press OK to enter the pH Calibration menu.

Illustration 38: pH Calibration menu



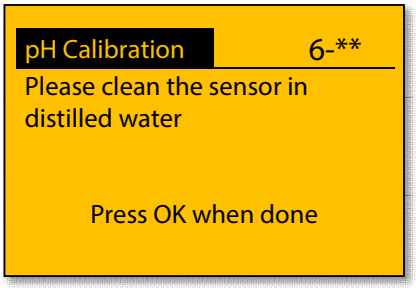
Press OK to activate calibration mode.

Illustration 39: Switching to calibration mode



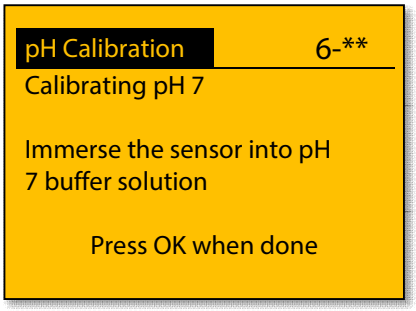
Wait until sensor LED gets blue.

Illustration 40: Clean the sensor in distilled water



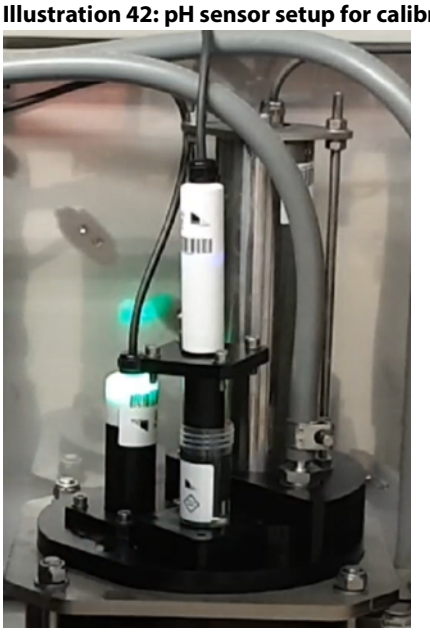
The pH sensor should be cleaned in distilled water.

Illustration 41: Immerse the sensor into pH 7 buffer solution



The pH sensor should be immersed in pH 7 buffer solution after the sensor has been cleaned in distilled water.

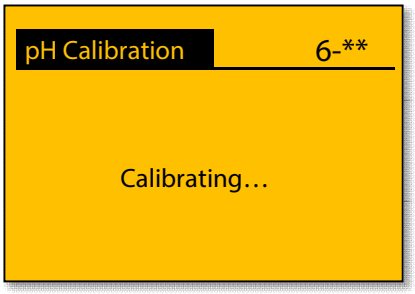
Illustration 42: pH sensor setup for calibration of pH



The container with pH buffer solution can be placed on top of the measurement chamber and the pH sensor can be inserted in the buffer solution. The setup can be seen in above illustration.

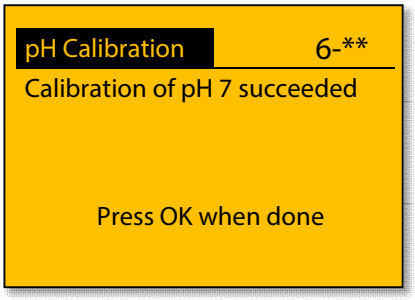
Press OK to start the calibration.

Illustration 43: Calibrating the pH sensor



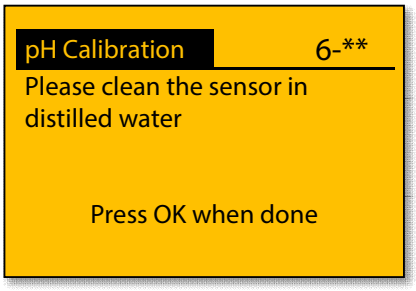
Wait for the calibration to finish

Illustration 44: Calibration of pH 7 succeeded



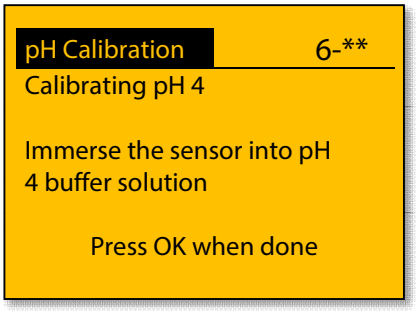
Calibration of pH 7 has succeded. Press OK to continue to calibration with pH 4 buffer solution.

Illustration 45: Clean sensor in distilled water



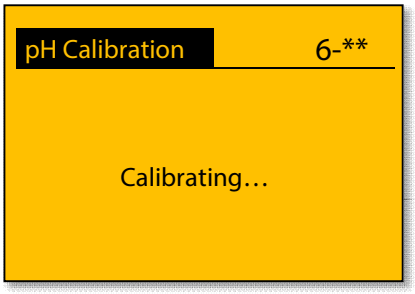
Remove the pH sensor from the pH 7 buffer solution and clean the sensor in distilled water. Press OK when done.

Illustration 46: Immerse sensor in pH 4 buffer solution



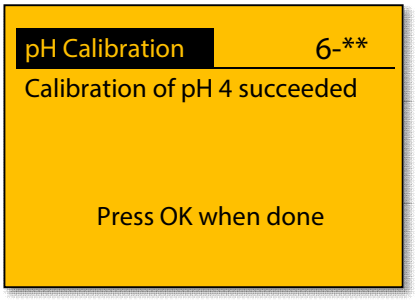
The pH sensor should be immersed in pH 4 buffer solution after the sensor has been cleaned in distilled water. Refer to Illustration 42 to see how to setup the pH sensor and buffer solution for calibration of pH. Press OK when done.

Illustration 47: Calibrating the pH sensor



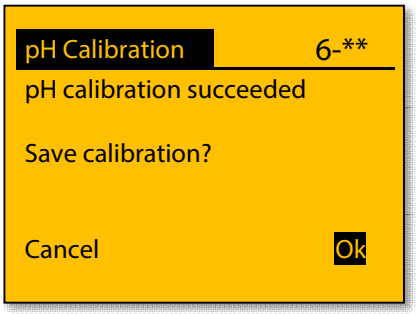
Wait for the calibration to finish

Illustration 48: Calibration of pH 4 succeeded



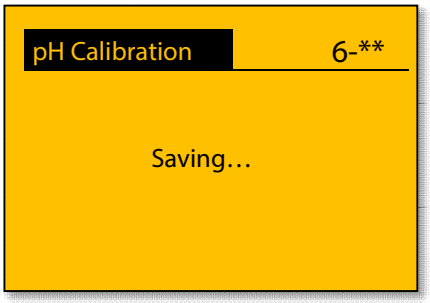
Calibration of pH 4 has succeded. Press OK to continue to saving the calibration.

Illustration 49: Confirmation of pH calibration before saving



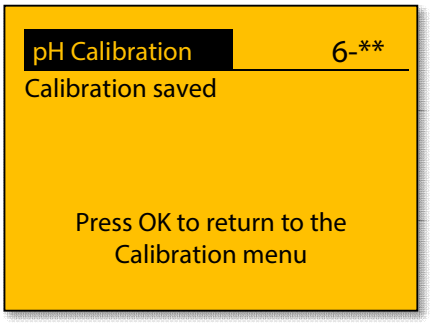
Press OK to save the pH calibration of the sensor. Press Cancel if the pH calibration should be dismissed.

Illustration 50: Saving the calibration



Wait for the calibration to be saved.

Illustration 51: pH Calibration saved



The calibration has been saved. Press OK to return to the Calibration menu.

5.3.2. Turbidity Sensor Calibration

The turbidity sensor can be re-calibrated with a one-point calibration for scaling. The calibration must be performed following the procedure as described in this section.

Tools needed for turbidity calibration:

- Allen key size 5
- TTurbCAL
- Lint free cloth & clean water

NOTICE

Incorrect calibration always leads to incorrect measured values. Always use a TTurbCAL paired with the specific turbidity sensor when calibrating to prevent an incorrect calibration.

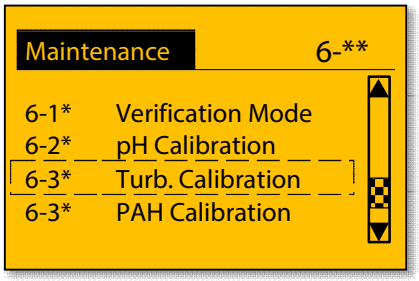
NOTICE

Switch off the power for the WSU pumps, close all isolation valves for the WMS system and drain the measurement chamber before starting the turbidity calibration.

Turbidity calibration

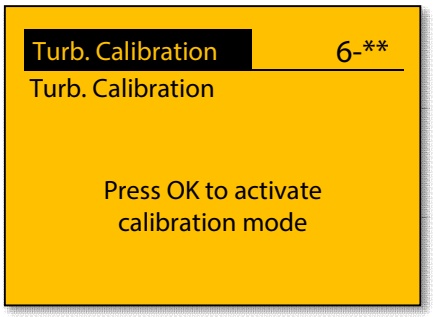
To start the turbidity calibration, go to the Turb. Calibration menu 6-3*. The following illustrations shows LCP when performing the turbidity calibration.

Illustration 52: Maintenance submenu



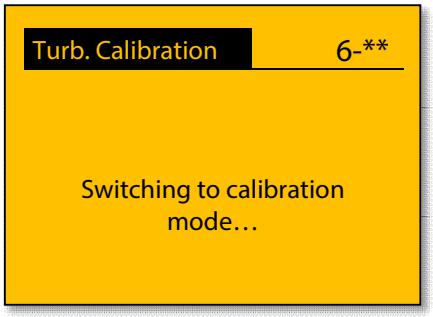
Press OK to enter the Turb. Calibration menu.

Illustration 53: Turb. Calibration menu



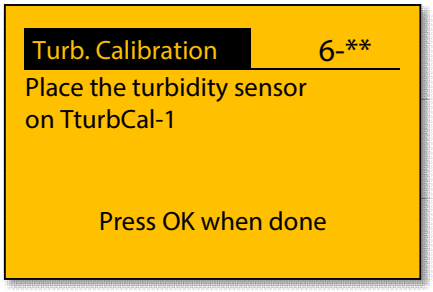
Press OK to activate the Turb. calibration mode.

Illustration 54: Switching to calibration mode



Wait until the sensor has switched to calibration mode.

Illustration 55: Place the turbidity sensor on TTurbCAL



Remove the turbidity sensor by loosening the four M6 bolts holding the sensor in place. Clean the optical part of the sensor with clean water using lint free cloth and place it on the TTurbCAL.

Before placing the turbidity sensor on the TTurbCAL read the reference turbidity value printed on the side of the TTurbCAL and remember the value or write it down for later use.

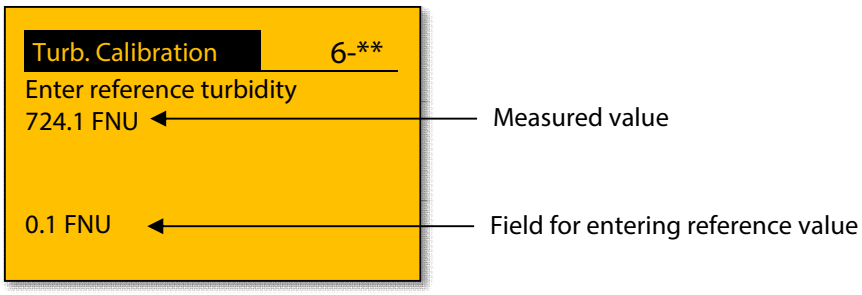
NOTICE

Holding the turbidity sensor by hand while calibrating can cause incorrect calibration. To prevent this from happening rest the TTurbCAL and the sensor on the bottom of the WAU cabinet.

NOTICE

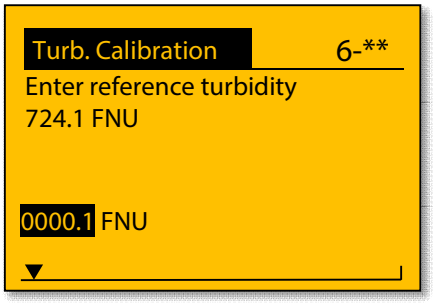
Remember to close the cabinet door before continuing to prevent light from interfering with the calibration.

Illustration 56: Enter reference turbidity



Press OK to enter reference turbidity value.

Illustration 57: Enter refernce turbidity



Toggle the digits by moving the cursor up, down, left and right.

NOTICE

Pressing OK before reference value is entered will start the calibration process, so be sure to check that the reference value is correct before pressing OK.

Illustration 58: Enter reference turbidity

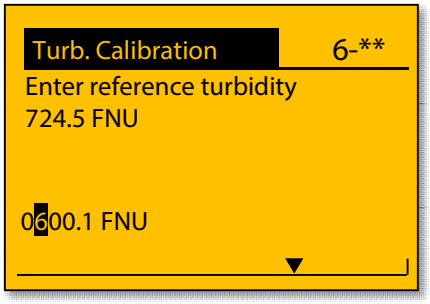


Illustration 59: Enter reference turbidity

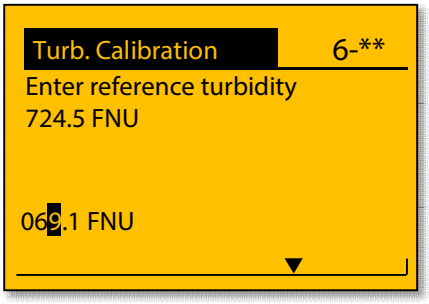


Illustration 60: Enter reference turbidity

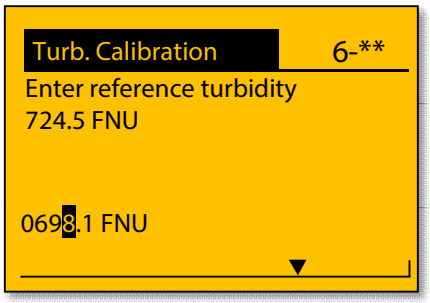
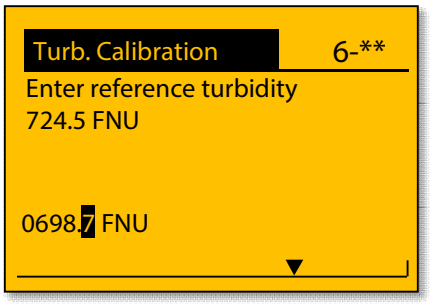
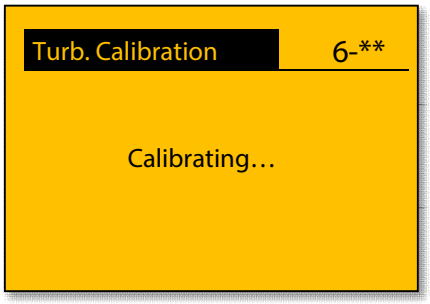


Illustration 61: Enter reference turbidity



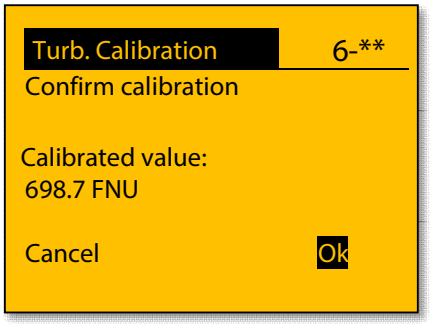
Press OK when the reference turbidity is entered.

Illustration 62: Calibrating the turbidity sensor



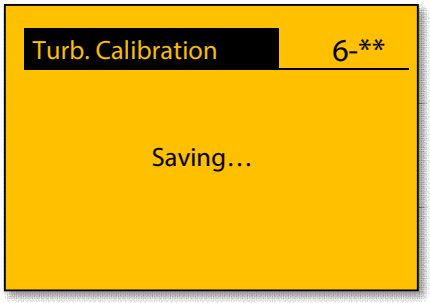
Wait for the calibration to finish.

Illustration 63: Confirmation of the calibration



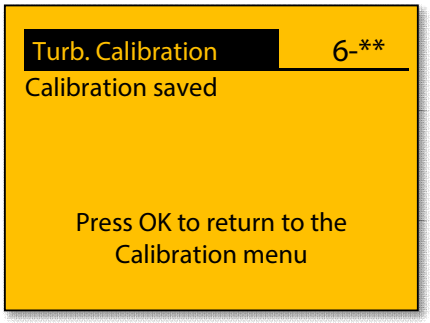
Press OK to confirm the calibration. The values shown on the LCP is the measured turbidity value of the TTurbCAL and should be equal to the TTurbCAL reference turbidity concentration ± 5 % + 0,5 FNU.

Illustration 64: Saving the calibration



Wait for the calibration to be saved.

Illustration 65: Calibration saved



The calibration has been saved. Press OK to return to the Calibration menu.

5.3.3. PAH calibration

The PAH sensor can be re-calibrated with a two-point calibration procedure. The two-point calibration consists of an offset calibration and a scaling calibration. The calibration must be performed with a DryCal-0 for offset, a DryCal-1 for scaling by following the procedure as described in this section .

Tools needed for PAH calibration:

- Spanner size 13
- DryCal-0
- DryCal-1
- Lint free cloth and clean water

NOTICE

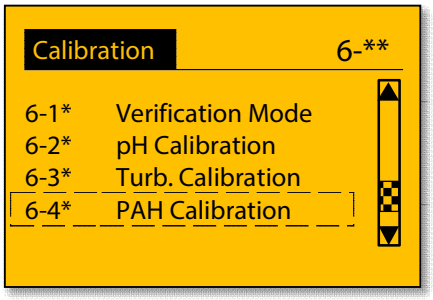
Incorrect calibration always leads to incorrect measured values. Always use a DryCal-0 and DryCal-1 paired with the specific PAH Sensor when calibrating to prevent an incorrect calibration.

NOTICE

Switch off the power for the WSU pumps, close all isolation valves for the WMS system and drain the measurement chamber before starting the PAH calibration.

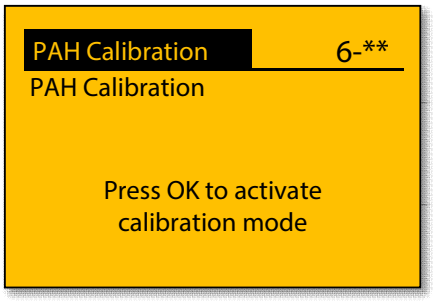
PAH Calibration

Illustration 66: Calibration submenu



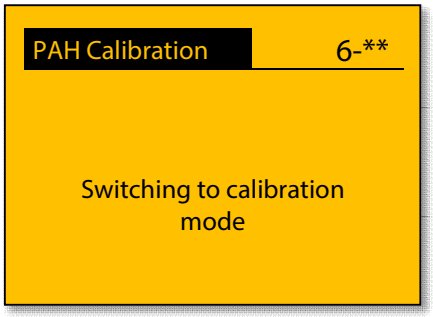
Press OK to enter the PAH Calibration menu.

Illustration 67: PAH Calibration menu



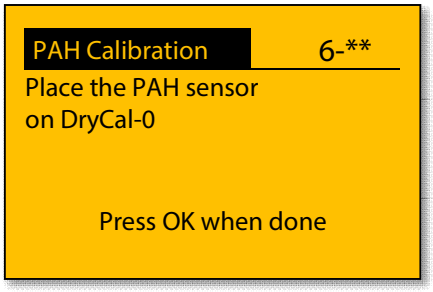
Press OK to activate the PAH calibration mode.

Illustration 68: Switching to calibration mode



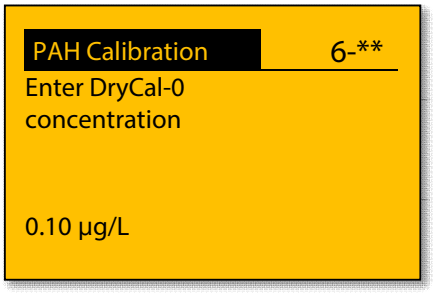
Wait until the sensor has switched to calibration mode.

Illustration 69: Place the PAH sensor on DryCal-0



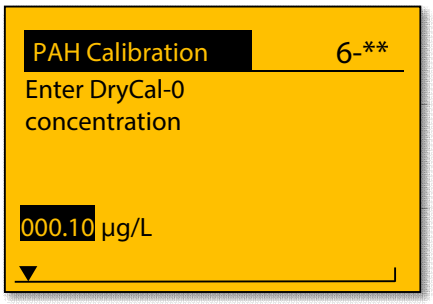
Remove the PAH sensor by loosening the two M8 nuts holding the sensor in place. Before placing the PAH sensor on the DryCAL-0 read the reference PAH value printed on the side of the DryCAL-0 and remember the value or write it down for later use. Clean the optical part of the sensor with clean water using lint free cloth and place it on the DryCAL-0.

Illustration 70: Enter DryCal-0 PAH concentration



Press OK to enter DryCal-0 PAH concentration.

Illustration 71: Enter DryCal-0 PAH concentration



Toggle the digits by moving the cursor up, down, left and right.

Illustration 72: Enter DryCal-0 PAH concentration

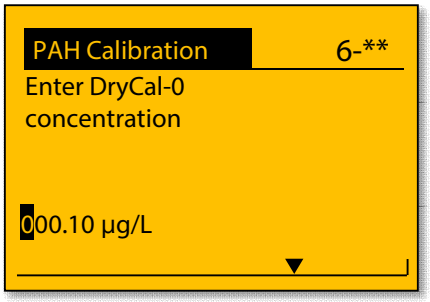


Illustration 73: Enter DryCal-0 PAH concentration

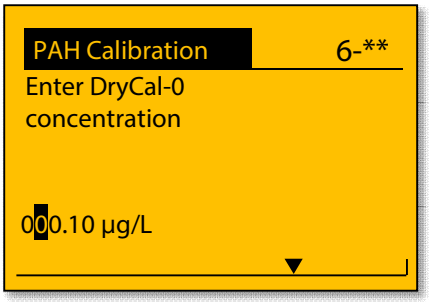


Illustration 74: Enter DryCal-0 PAH concentration

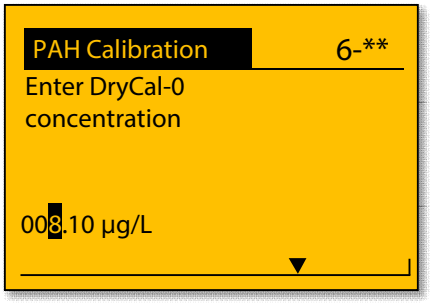


Illustration 76: Enter DryCal-0 PAH concentration

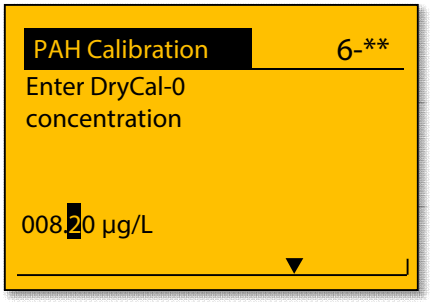
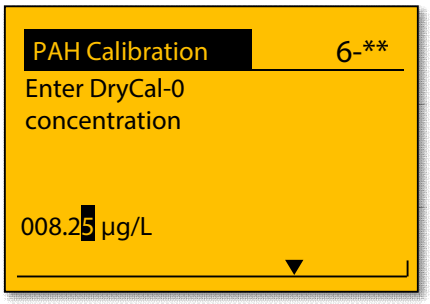
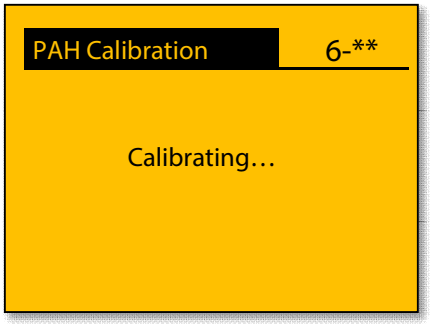


Illustration 75: Enter DryCal-0 PAH concentration



Press OK when the DryCal-0 PAH concentration is entered.

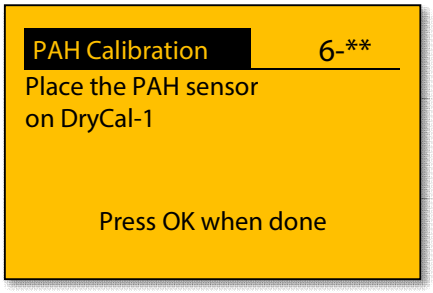
Illustration 77: Calibrating



Wait for the offset calibration to finish.

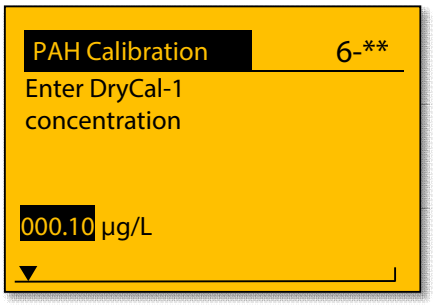
After the calibration is performed with DryCal-0 repeat the process using DryCal-1.

Illustration 78: Place the PAH sensor on DryCal-1



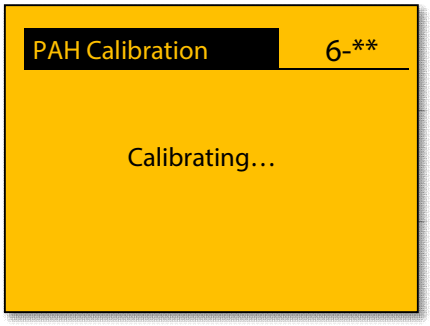
Place the PAH sensor on the DryCal-1 and press OK.

Illustration 79: Enter DryCal-1 PAH concentration



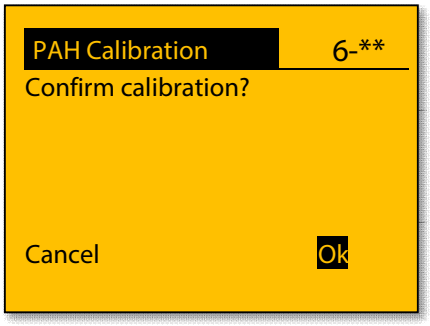
Enter the DryCal-1 concentration and press OK.

Illustration 80: Calibrating



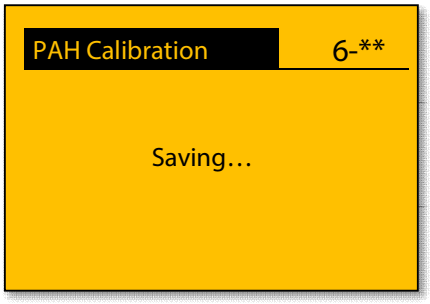
Wait for the scaling calibration to finish.

Illustration 81: Confirm PAH calibration



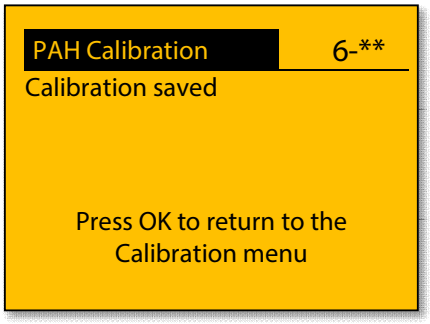
Press OK to confirm and save the PAH calibration. Press Cancel to dismiss the PAH calibration.

Illustration 82: Saving the calibration



Wait for the calibration to be saved.

Illustration 83: Calibration saved



The calibration has been saved. Press OK to return to the Calibration menu.

5.4. Verification mode

The system has a verification mode which enables the LCP to show live measurements from all sensors when the verification mode is activated. These live measurements can be used to verify the measurements from all sensors.

NOTICE

Local Control must be disabled through the LCP. Remember to disable Local Control after verification for Modbus control to work.

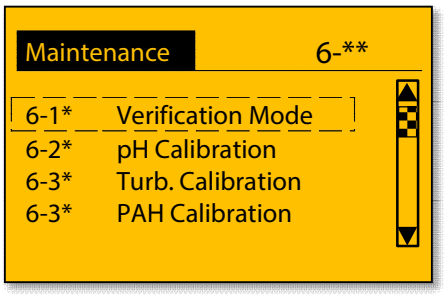
5.4.1. Activate/deactivate verification mode

The following procedure describes how to activate and deactivate verification mode.

Activate verification mode

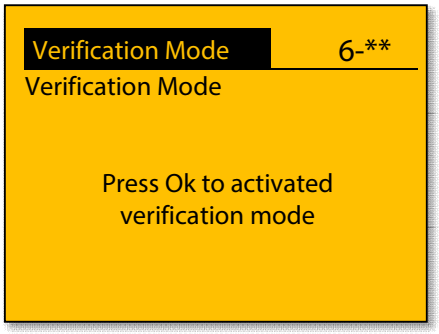
To activate verification mode, go to the verification mode menu 6-1*

Illustration 84: Maintenance submenu



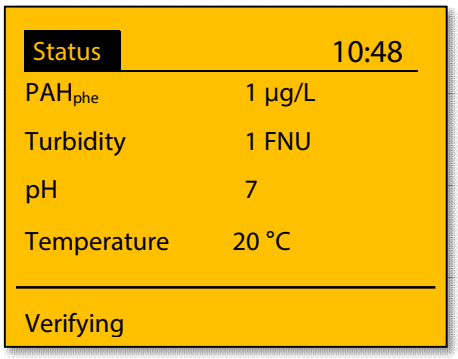
Press OK to enter the verification mode menu.

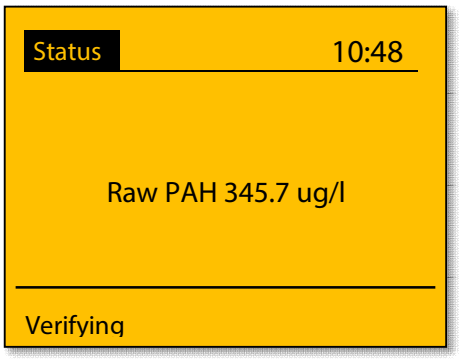
Illustration 85: Activation of verification Mode



Press OK to activate verification mode and then press Status on LCP to get to the measurement status windows.

Illustration 86: Measurement status window in verification mode

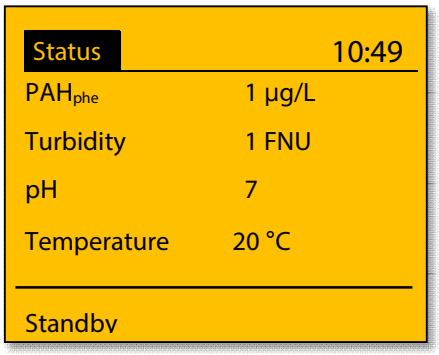




Relevant measurement status windows when the system is in verification mode

Deactivate verification mode

Illustration 87: Deactivate with Start/Stop



Press Start/Stop on LCP to deactivate verification mode and the system returns to standby mode as shown above.

5.4.2. Verification of measurements

The following describes verification of pH, turbidity and PAH measurements.

NOTICE

Switch off the power for the SU pump (where applicable), close all isolation valves for the WMS system and drain the measurement chamber before starting verification of measurements.

Tools needed for verification:

- Allen key size 5
- Allen key size 8
- pH buffer solution 4 or 7
- TTurbCAL
- DryCal-0 or DryCal-1
- Distilled water
- Lint free cloth

Verification of pH measurement

1. Activate verification mode as described in 5.4.1
2. Remove the pH sensor from the measuring chamber as described in 5.3.1
3. Clean the pH sensor in distilled water
4. Immerse the sensor in pH buffer solution 4 or 7
5. Verify the measurement on the LCP
6. Reinstall the pH sensor in the measuring chamber
7. Deactivate verification mode as described in 5.4.1

Verification of turbidity measurement

1. Activate verification mode as described in 5.4.1
2. Remove the turbidity sensor from the measuring chamber as described in 5.3.2
3. Clean the optical part of the turbidity sensor with clean water and a lint free cloth
4. Place the turbidity sensor on the TTurbCAL
5. Verify the measurement on the LCP
6. Reinstall the turbidity sensor in the measuring chamber
7. Deactivate verification mode as described in 5.4.1

Verification of PAH measurement

1. Activate verification mode as described in 5.4.1
2. Remove the bottom half of the measuring chamber as described in 5.2.2
3. Clean the optical part of the PAH sensor with clean water and a lint free cloth
4. Place the DryCal-0 or DryCal-1 on the PAH sensor as shown on in the illustration below
5. Verify the measurement on the LCP
6. Reinstall the bottom half of the measuring chamber
7. Deactivate verification mode as described in 5.4.1

Illustration 88: Placing the DryCal-0 or DryCal-1 on the PAH sensor for verification

5.5. Alarms and Troubleshooting

Technical support and customer service can be contacted to resolve any technical issues that may arise in relation to usage of the WMS.

By phone: +45 74888500
By e-mail: ixa.service@danfoss.com
By website: www.danfoss-ixa.com

Before contacting service, check Table 21 and Table 22.

SP = Sample Point
[Ax] = Alarm number
[Wx] = Warning number

Alarm name	Alarm description	Trigger	Consequence	Possible cause (Troubleshooting)
SP1 Low Flow [A126]	Water flow through measurement chamber too low while SP1 active.	Alarm is activated if there is not detected enough flow from flow-switch while sample point 1 is active.	Power for sample pump 1 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP1 to be set to -1.	1. Defect pump impeller in WSU 1 pump 2. Leakage in sample point 1 pipe line 3. Blockage in sample point 1 pipe line 4. Defect solenoid valve for sample point 1 5. Too high resistance in discharge pipe line 6. Any manual valve in sample point 1 pipe line closed 7. Shaft seal in WSU 1 pump is defect
SP2 Low Flow [A134]	Water flow through measurement chamber too low while SP2 active.	Alarm is activated if there is not detected enough flow from flow-switch while sample point 2 is active.	Power for sample pump 2 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP2 to be set to -1.	1. Defect pump impeller in WSU 2 pump 2. Leakage in sample point 2 pipe line 3. Blockage in sample point 2 pipe line 4. Defect solenoid valve for sample point 2 5. Too high resistance in discharge pipe line. 6. Any manual valve in sample point 2 pipe line closed 7. Shaft seal in WSU 2 is defect
SP3 Low Flow [A142]	Water flow through measurement chamber too low while SP3 active.	Alarm is activated if there is not detected enough flow from flow-switch while sample point 3 is active.	Power for sample pump 3 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP3 to be set to -1.	1. Defect pump impeller in WSU 3 pump. 2. Leakage in sample point 3 pipe line 3. Blockage in sample point 3 pipe line 4. Defect solenoid valve for sample point 3 5. Too high resistance in discharge pipe line 6. Any manual valve in sample point 3 pipe line closed 7. Shaft seal in WSU 3 is defect
SP4 Low Flow [A150]	Water flow through measurement chamber too low while SP4 active.	Alarm is activated if there is not detected enough flow from flow-switch while sample point 4 is active.	Power for sample pump 4 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP4 to be set to -1.	1. Defect pump impeller in WSU 4 pump 2. Leakage in sample point 4 pipe line 3. Blockage in sample point 4 pipe line 4. Defect solenoid valve for sample point 4 5. Too high resistance in discharge pipe line 6. Any manual valve in sample point 4 pipe line closed 7. Shaft seal in WSU 4 is defect

Alarm name	Alarm description	Trigger	Consequence	Possible cause (Troubleshooting)
SP1 Thermal Trip [A132]	EOCR for sample pump 1 active.	Alarm if the EOCR for sample pump 1 is activated.	Power for sample pump 1 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP1 to be set to -1.	1. Incorrect adjustment of EOCR in WSU1 2. Defect motor in WSU 1 3. Blocked or jammed pump in WSU 1
SP2 Thermal Trip [A140]	EOCR for sample pump 2 active.	Alarm if the EOCR for sample pump 2 is activated.	Power for sample pump 2 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP2 to be set to -1.	1. Incorrect adjustment of EOCR in WSU2 2. Defect motor in WSU 2 3. Blocked or jammed pump in WSU 2
SP3 Thermal Trip [A148]	EOCR for sample pump 3 active.	Alarm if the EOCR for sample pump 3 is activated.	Power for sample pump 3 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP3 to be set to -1.	1. Incorrect adjustment of EOCR in WSU3 2. Defect motor in WSU 3 3. Blocked or jammed pump in WSU 3
SP4 Thermal Trip [A156]	EOCR for sample pump 4 active.	Alarm if the EOCR for sample pump 4 is activated.	Power for sample pump 4 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP4 to be set to -1.	1. Incorrect adjustment of EOCR in WSU4 2. Defect motor in WSU 4 3. Blocked or jammed pump in WSU 4
SP1 Low pressure [A128]	Inlet pressure in WSU 1 is too low.	Inlet pressure in WSU 1 is below the low-pressure limit.	Power for sample pump 1 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP1 to be set to -1.	1. No water supply to WSU 1 2. Blocked filter in WSU 1 inlet pipe 3. Any manual valve in WSU 1 inlet pipeline closed
SP2 Low pressure [A136]	Inlet pressure in sample pump 2 is low.	Inlet pressure in WSU 2 is below the low-pressure limit.	Power for sample pump 2 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP2 to be set to -1.	1. No water supply to WSU 2 2. Blocked filter in WSU 2 inlet pipe 3. Any manual valve in WSU 2 inlet pipeline closed
SP3 Low pressure [A144]	Inlet pressure in sample pump 3 is low.	Inlet pressure in WSU 3 is below the low-pressure limit.	Power for sample pump 3 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP3 to be set to -1.	1. No water supply to WSU 3 2. Blocked filter in WSU 3 inlet pipe 3. Any manual valve in WSU 3 inlet pipeline closed
SP4 Low pressure [A152]	Inlet pressure in sample pump 4 is low.	Inlet pressure in WSU 4 is below the low-pressure limit.	Power for sample pump 4 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP4 to be set to -1.	1. No water supply to WSU 4 2. Blocked filter in WSU 4 inlet pipe 3. Any manual valve in WSU 4 inlet pipeline closed

Alarm name	Alarm description	Trigger	Consequence	Possible cause (Troubleshooting)
SP1 High Water Temp. [W130]	Water temperature is too high in Sample Point 1.	Water temperature in measuring point 1 is higher than the high-temperature limit.	Warning is issued as long as the temperature is above the temperature limit.	EGCS water is above the specified WMS sample water temp.
SP2 High Water Temp. [W138]	Water temperature is too high in Sample Point 2.	Water temperature in measuring point 2 is higher than the high-temperature limit.	Warning is issued as long as the temperature is above the temperature limit.	EGCS water is above the specified WMS sample water temp.
SP3 High Water Temp. [W146]	Water temperature is too high in Sample Point 3.	Water temperature in measuring point 3 is higher than the high-temperature limit.	Warning is issued as long as the temperature is above the temperature limit.	EGCS water is above the specified WMS sample water temp.
SP4 High Water Temp. [W154]	Water temperature is too high in Sample Point 4.	Water temperature in measuring point 4 is higher than the high-temperature limit.	Warning is issued as long as the temperature is above the temperature limit.	EGCS water is above the specified WMS sample water temp.
pH sensor disconnected [A158]	The WMS controller has lost connection to the pH sensor.	If the WMS controller loses connection to the pH sensor.	The cyclical sampling sequence continues but the pH measurement is set to -1.	1. Connector to pH sensor unplugged 2. Defect sensor 3. Damaged cable or loose connection
Turbidity sensor disconnected [A160]	The WMS controller has lost connection to the turbidity sensor.	If the WMS controller loses connection to the Turbidity sensor.	The cyclical sampling sequence continues but the turbidity measurement is set to -1.	1. Connector to turb. Sensor unplugged 2. Defect sensor 3. Damaged cable or loose connection
PAH sensor disconnected [A162]	The WMS controller has lost connection to the PAH sensor.	If the WMS controller loses connection to the PAH sensor.	The cyclical sampling sequence continues but the PAH measurement is set to -1.	1. Connector to PAH sensor unplugged 2. Defect sensor 3. Damaged cable or loose connection
SP1 Pressure sensor disconnected [A164]	The WMS controller has lost connection to the pressure transmitter in WSU 1.	Alarm if the WMS controller loses connection to the pressure transmitter in WSU 1.	Power for sample pump 1 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP1 to be set to -1.	1. Connector to pressure transmitter unplugged 2. Defect sensor 3. Damaged cable or loose connection
SP2 Pressure sensor disconnected [A166]	The WMS controller has lost connection to the pressure transmitter in WSU 2.	Alarm if the WMS controller loses connection to the pressure transmitter in WSU 2.	Power for sample pump 2 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP2 to be set to -1.	1. Connector to pressure transmitter unplugged 2. Defect sensor 3. Damaged cable or loose connection

Alarm name	Alarm description	Trigger	Consequence	Possible cause (Troubleshooting)
SP3 Pressure sensor disconnected [A168]	The WMS controller has lost connection to the pressure transmitter in WSU 3	Alarm if the WMS controller loses connection to the pressure transmitter in WSU 3	Power for sample pump 3 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP3 to be set to -1.	1. Connector to pressure transmitter unplugged 2. Defect sensor 3. Damaged cable or loose connection
SP4 Pressure sensor disconnected [A170]	The WMS controller has lost connection to the pressure transmitter in WSU 4.	Alarm if the WMS controller loses connection to the pressure transmitter in WSU 4.	Power for sample pump 4 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP4 to be set to -1.	1. Connector to pressure transmitter unplugged 2. Defect sensor 3. Damaged cable or loose connection
SP1 Temperature sensor disconnected [A172]	The WMS controller has lost connection to the temperature transmitter in WSU 1.	Alarm if the WMS controller loses connection to the pressure transmitter in WSU 1.	Power for sample pump 1 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP1 to be set to -1.	1. Connector to temperature transmitter unplugged 2. Defect sensor 3. Damaged cable or loose connection
SP2 Temperature sensor disconnected [A174]	The WMS controller has lost connection to the temperature transmitter in WSU 2.	Alarm if the WMS controller loses connection to the pressure transmitter in WSU 2.	Power for sample pump 2 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP2 to be set to -1.	1. Connector to temperature transmitter unplugged 2. Defect sensor 3. Damaged cable or loose connection
SP3 Temperature sensor disconnected [A176]	The WMS controller has lost connection to the temperature transmitter in WSU 3.	Alarm if the WMS controller loses connection to the pressure transmitter in WSU 3.	Power for sample pump 3 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP3 to be set to -1.	1. Connector to temperature transmitter unplugged 2. Defect sensor 3. Damaged cable or loose connection
SP4 Temperature sensor disconnected [A178]	The WMS controller has lost connection to the temperature transmitter in WSU 4.	Alarm if the WMS controller loses connection to the pressure transmitter in WSU 4.	Power for sample pump 4 to be disconnected, and the sample point ignored in the cyclical sampling sequence. All stored sensor values for SP4 to be set to -1.	1. Connector to temperature transmitter unplugged 2. Defect sensor 3. Damaged cable or loose connection
Leakage flow when switching sample point [A180]	The flow switch has detected a flow while switching from one sample point to another.	If the flow switch doesn't reach "zero flow" during the switching from one sample point to another.	The cyclical sample sequence is stopped, and the WMS system goes into stand-by mode.	1. Flow switch needs adjustment. Refer to section 5.5.2 for procedure. 2. Leakage from a 3/2-Valve. Refer to section 5.5.3 for procedure. 3. Manual override function of 3/2-Valve is engaged

Table 21: Alarms and Troubleshooting

Possible error	Information and action
WMS not functioning	
Power supply is not connected.	Check power cable and connections.
Power supply has failed.	Check power supply.
Internal software is not functioning.	Only in case of internal malfunction. Switch off and on.
Measured values are clearly incorrect	
WMS is not ready for operation.	Check start-up procedure. Contact skilled personnel or service.
Corrosion on piping, suspension etc.	
Corrosion appears	Possible cause: Unsuitable materials. Remedy: Check project planning.

Table 22: Further WMS troubleshooting

5.5.1. Reset alarms

When receiving an alarm from the WMS system an action must be taken. The alarms in the WMS-system will not stop the WMS system from running,

When the cause has be corrected go to the Menu 1. Event Log through the LCP display and select 1-4* Reset Alarm. The Active Alarm will be showing, press OK to reset it.

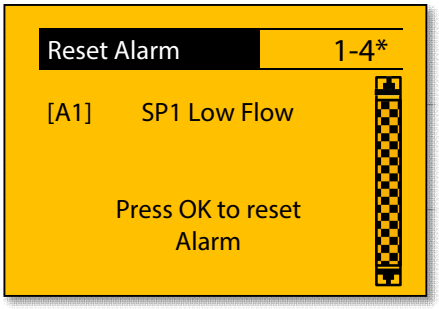


Illustration 89: Reset Alarm display

If the alarm does activate again, the alarm has been handled. If the alarm is triggered once again, the right corrections has still not been made. If correcting alarms as described in Table 21 still has not worked, please contact the supplier of the WMS.

5.5.2. WAU Flow Switch Adjustment

Adjusting the flow switch should only be done when there is a normal flow passing through the measuring chamber.

NOTICE

Ensure that all strainers and filters in the WMS piping system is cleaned and that all isolation valves in the WMS piping system are opened all the way before adjusting the flow switch

Follow the procedure below for correct adjustment of the flow switch:

1. Go to the LCP display of the WAU and Check that the WMS system is in standby mode.

2. Make sure that water flows through the WAU.

3. Adjustment of the flow switch.

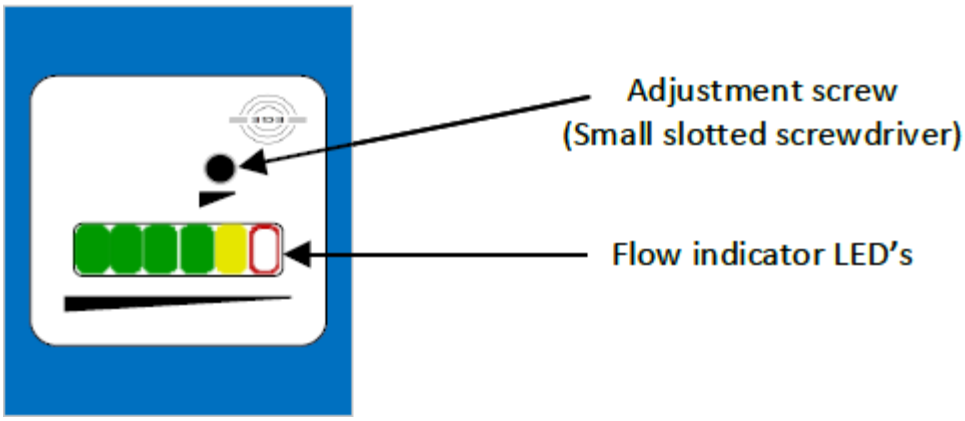


Illustration 90: Flow switch overview

4. Turn the adjustment screw counter-clockwise until 1 x yellow LED or 1 x yellow + 1 x green LED is shown on the flow switch. See the illustration below.

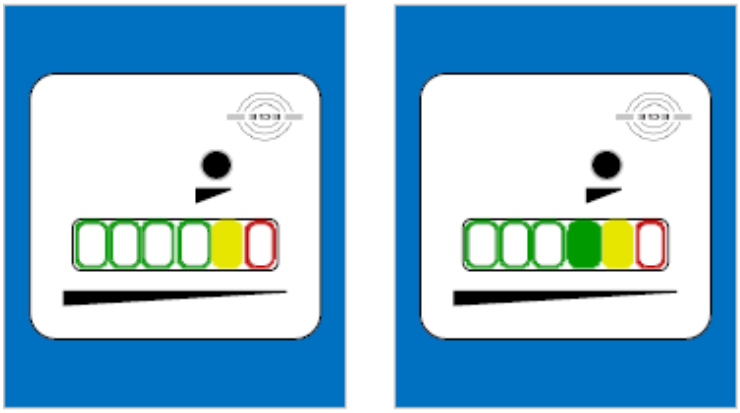


Illustration 91: Flow indicator LED's when adjusting the flow switch

5. Turn the adjustment screw 4,5 times clockwise

The flow switch is now adjusted to factory setting and should be indicating minimum 2 green LED's under a normal flow. Check the illustration below to see correct adjustment of the flow switch

Illustration 92: Indication when the flow switch is correctly adjusted and the flow is normal.

If the green LED's are not showing carefully adjust the adjustment screw ½ turn clockwise until minimum two green LED's are shown.

6. Disengage the manual override function of the 3/2-valve and shut OFF the WSU pump to check that the flow switch is indicating 1 x red LED when the flow is zero.

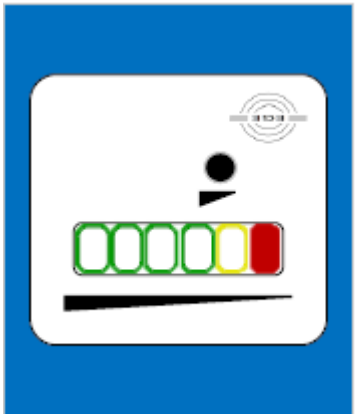


Illustration 93: Indication when the flow switch is correctly adjusted and the flow through the measurement chamber is zero

If the 1 x red LED is not showing carefully adjust the adjustment screw ½ turn counterclockwise until the red LED is activated when the flow is zero.

7. Start the WMS and observe that the flow switch is indicating correctly during operation, which is minimum 2 x green LED's when the WMS is operating.

6. Appendices

6.1. Appendix 1 – Parameter Overview

No.	Parameter description	Default value	Range
1- Event log**			
1-1*	Event log Show		
1-11	Event log	Empty	List of Log ID's; If there are no Events, the list is empty.
1-2*	Event log Status		
1-21	Status	Enabled	Enabled, Disabled
1-3*	Help	http:\\www.danfoss-ixa.com/support	
1-4*	Reset Alarm		
2- Settings**			
2-1*	Auto start		
2-11	Status	Disabled	Enabled, Disabled
2-2*	Set time and date		
2-21	Set Date	None	yyyy-mm-dd HH:MM:SS
2-3*	PAH Range		
2-31	Set Range	0-500	0-50, 0-500
3- Interfaces**			
3-1*	LAN setup		
3-11	LAN IP Address	192.168.1.10	
3-12	LAN Gateway	192.168.1.1	
3-13	LAN Network mask	255.255.255.0	
3-14	Reboot		
3-15	WMS Hostname		Letters (a - z) case insensitive and Numbers (0 - 9) + hyphen (-). Max 63 characters long.
3-16	DHCP	Disabled	Enabled, Disabled
3-17	MAC Address	Controller MAC address	
4- WMS info**			
4-1*	Part number		
4-11	WAU Part number	WAU Part Number	
4-2*	Serial number		
4-21	WAU Serial number	WAU Serial Number	
4-3*	SW rev number		
4-31	SW rev number	SW Revision	
4-4*	OS rev number		
4-41	OS rev number	Operating Software revision number	
5- Maintenance**			
5-1*	Reset Password		
5-2*	Diagnostics Report		
5-3*	Update Software		
5-4*	Save Setup		
5-5*	Restore Setup		
6- Calibration**			
6-1*	Verification Mode		
6-2*	pH Calibration		
6-3*	Turb. Calibration		
6-4*	PAH Calibration		
7- Measurement info**			
7-1*	Set Start Date		
7-2*	Set End Date		
7-3*	Save Log		

Table 23: Parameter overview

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