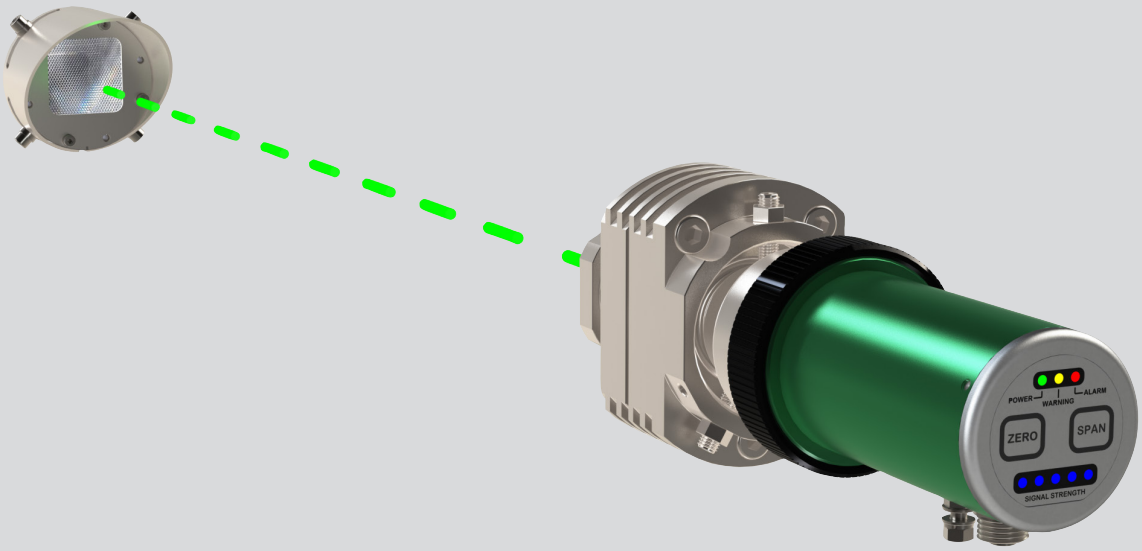
Hotbox Oil Mist Detection System

Instruction Manual



Document ID number.: 103342

Green Instruments

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1 Introduction

1.1 About this Manual

This manual contains data and instructions for the installation, operation, and maintenance of the Hotbox Oil Mist Detection system.

The instructions are given in general terms and do not take into consideration a specific installation. The figures used in the manual are only for general illustration purposes. This instruction manual is designed for the Hotbox Oil Mist Detection system delivered by Green Instruments A/S.

Note that each Hotbox Oil Mist Detection system is deliveried with a default configuration from the factory. Therefore, please study this manual and the Technical Drawings for each system in their entirety to ensure correct operation.

This manual does not describe all possible situations, but only the most common and known situations. It cannot replace the necessary education and training of the personnel. Should situations not described in this manual occur that cannot be solved in accordance with normal known practice and good workmanship, the operator should contact Green Instruments A/S for instructions.

Attention

Before operation, read all instructions and warnings within this manual and associated documentation. Improper use may cause personal injury and/or damage of equipment and may void the warranty. Green Instruments A/S disclaims any responsibility for damage and/or injury caused by improper installation, use or maintenance of the equipment

Green Instruments A/S reserves the right to minor alterations and improvements owing to developments without being obliged to enter the corresponding changes in this manual.

1.2 Inquiries and Feedback

All claims and inquiries for spare parts shall be addressed to Green Instruments A/S or our distributors. In all correspondence, or when ordering spare parts, please carefully state the equipment type and serial number, which can be found on the label on the equipment.

Green Instruments A/S appreciates all feedback and suggestions for improvement. If any questions appear or any discrepancies are found in this manual, kindly contact Green Instruments:

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1.3 About the System

The Hotbox Oil Mist Detection system is designed to detect small concentrations of oil mist in engine hotboxes and thus, provides early fire hazard warning, leak detection, spray detection. The system is usually installed onto the engine hotbox in engine rooms.

The transceiver uses a green laser light beam based on the line of sight light transmission. A light beam with specific spectral characteristics is projected across the hotbox space to be monitored for oil mist leakage. The transceiver emits light that passes through the hotbox space where it hits the reflector positioned opposite to the transceiver.

The reflector returns the light to the transceiver and the transceiver detects the returned amount of light. The transceiver compares the returned light with a reference light intensity obtained during zero calibration. If the intensity of the returned light is reduced, then this is an indication of oil mist or other particulate matters in the hotbox space. Based on this, a warning or an alarm is given.

Please note that besides reacting to oil mist, the transceiver will also react to other obstructions intercepting the light beam e.g. smoke and water mist. Consequently, an alarm might be triggered and depending on the application, this might be perceived as "a false alarm". However, in this scenario, such an alarm will typically indicate another type of malfunction that would require attention.

1.3.1 System Components

Hotbox Monitor Cabinet

The monitoring unit is arranged with a touchscreen, connection terminals and cable glands.

The monitoring system interacts with the vessels alarm system or Alarm Monitoring Control System via bus-communication and/or relays. The control and monitoring unit can be configured to monitor up to 8 transceivers.

Transceiver

The transceiver assembly contains the laser source, optical components, electronics, and data processer capacity to control and shape the light beam projected across space to the reflector assembly. The transceiver is mounted outside the hotbox enclosure.

Reflector

The reflector assembly reflects the light back to the transceiver assembly where the light attenuation is measured. The reflector assembly contains a precision reflector to direct the light beam back to the transceiver assembly. The reflector assembly is mounted inside the hotbox and comes with means of fine alignment and a spray cover.

Alignment Bracket

The alignment bracket is used to mount the transceiver to the outside of the hotbox structure.

The alignment bracket is constructed as a ball joint and thus provides a movement of the light beam across the hotbox space. This movement allows for fine adjustment and alignment to ensure that the light beam hits the center of the reflector.

1.3.2 Optional Components

- Junction Box (JB): if the connection cable between the transceiver assembly and the control and monitoring unit is required to be more than 15 m, there shall be a junction box to support the connection between the transceiver and the control and monitoring unit.

  For installation with more than 2 transceivers, a junction box is required for each extra transceiver. Please refer to the documentation package.

- Optional Side Mount: used to angle the reflector onto the hotbox structure in cases where a straight mount through a drilled hole is impossible. The bracket also compensates for angular differences due to its fine adjustment features.

- Audit Filters: used to verify Zero and Span Calibration (audit the calibration).

2 Specifications

Hotbox Monitor Cabinet	
Power Supply Input	Standard 210…250VAC – 50/60 Hz – 200VA max.
Ambient Temperature	0…55°C
Interfaces	16 x Relay
	Modbus RTU server (To customer system)
Display	0…100% opacity level Alarm List Trend
Transceiver	
Measurements	Opacity
Measuring Principle	Transmission double pass
Measuring Range	0…100% Opacity
Scanning Distance	Optimal: 2.0…9.0 m
	Possible: 1.0…15.0 m
Power Supply	24 VDC +/- 10%
Communication Interface	Modbus RTU server
Ambient Temperature	5…55°C (Class A)
Humidity	Above dew point
Vibration	Class B
EMC	Class A (EN 61326-1 Table 2)
Enclosure	Class B/IP 66
Dimensions & Weight	Refer to Installation Layout
Reflector	
Ambient Temperature	0…90°C (Class A)
Humidity	Above dew point
Vibration	Class B
Enclosure	Class B/IP 54
Dimensions & Weight	Refer to Installation Layout
Optional Equipment (Refer to Spare Part Section)	
Junction Box	Refer to Electrical Drawings
Optional Side Mount	Refer to Figure 5-8, Figure 5-9, Figure 5-11, Figure 5-13
Audit Targets	100, 22 & 8 % Opacity (+/÷ 2% of full range) Useable for field validation
Approvals and Certificates	
Download the product certificates at https://greeninstruments.com/	

3 Safety Aspects

WARNING!

Follow the installation and operating instructions! Please read the instructions carefully in its entirety before starting on the system.

Hazardous Voltage!

Disconnect power before servicing the system. Ignoring this warning can result in severe personal injury or material damage. Observe the instructions carefully to ensure the correct connection of all power and signal leads.

Ensure that the correct power supply is connected to the control and monitoring unit (See the rating marked on the label of the equipment).

Circuit Breaker!

The installation must include a means of switching off electrical power by a clearly marked switch or circuit breaker external to the control and monitoring unit. The external switch or circuit breaker must be placed in close proximity to the monitoring unit and within reach of the operator.

Overload Protection!

To comply with safety requirements IEC 61010-1 (2003), the installation must include a means of overcurrent protection to protect against excessive energy being drawn from the power supply system in case of a fault in the equipment.

Protective Earth!

The monitoring unit must be connected to protective earth.

Installation and Fault Finding!

Electrical installation and fault finding on the system should only be undertaken by a suitably trained and qualified engineer.

Warning Laser Hazard

Visible laser radiation! Avoid eye exposure to direct or scattered radiation.

Symbol Identification

 Caution, risk of danger

 Caution, risk of electrical shock

Warning Laser Hazard. Visible laser radiation! Avoid eye exposure to direct or scattered radiation.

Protective earth

CE

The CE mark proves the compliance of the instrument with the requirements of the relevant EU directives

4 Control at Delivery

Upon receipt of the system, please inspect and confirm that the received items are in accordance with the packing list and not damaged. Any discrepancy should be reported to the supplier immediately.

If any of the received parts are damaged, the shipping company should be informed and new parts made available before completing the installation.

5 Installation

Read this chapter in its entirety before installing the system.

5.1 General

Attention

Installation and operation of the system and associated equipment must be carried out by quality workmanship.

Green Instruments A/S does not take any responsibility for the operation of the system and associated equipment whatsoever.

The equipment must only be applied as specified by Green Instruments. If the equipment is used in a manner not specified by Green Instruments, the protection provided by the equipment may be impaired.

The successful and safe operation of this equipment is dependent upon proper handling, installation, operation, and maintenance.

To avoid possible damage to the equipment or errors in the monitoring readings and alarm function, it is important to comply with the following points carefully:

- The transceiver must be installed outside the hotbox using the alignment bracket. Choose a location that is easily accessible and that is not inconvenient for the operation and maintenance of the engine - Figure 5-1.
- The reflector must be installed inside the hotbox. The location must be suitable for service and cleaning while also protecting the equipment from any mechanical damage - Figure 5-1.

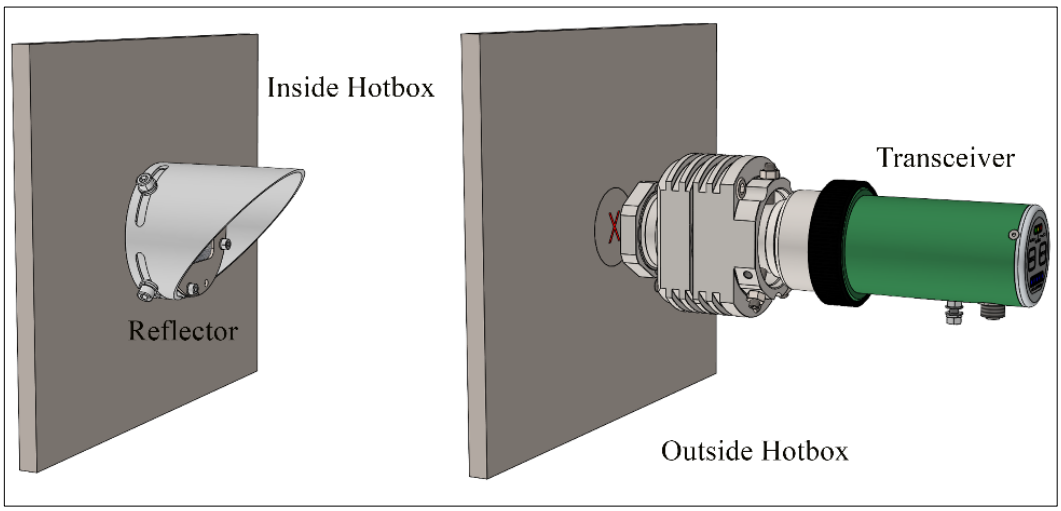


Figure 5-1: Illustration of Reflector & Transceiver

- The transceiver must be installed at an ambient temperature between 5…55°C. The reflector must be installed at an ambient temperature between 0…90°C.
- The equipment must be installed onto a solid structure to ensure a vibrational stable location for the transceiver and reflector assemblies. If mounted onto structures thinner than 6 mm, it is recommended to reinforce such structure e.g. by fitting purpose-built brackets or stiffening plates. A robust installation is vital for optimal system functionality.
- The transceiver and reflector must be properly aligned, mounted firmly and stable with a line of sight opposite each other.

5.2 Mounting Transceiver & Alignment Bracket

- Point out a suitable location and mark this with a marker pen. Take the alignment bracket, mount the transceiver, and hold this assembly up to the marked location to confirm that accessibility is satisfactory, and that line of sight is possible through the hotbox - Figure 5-2.

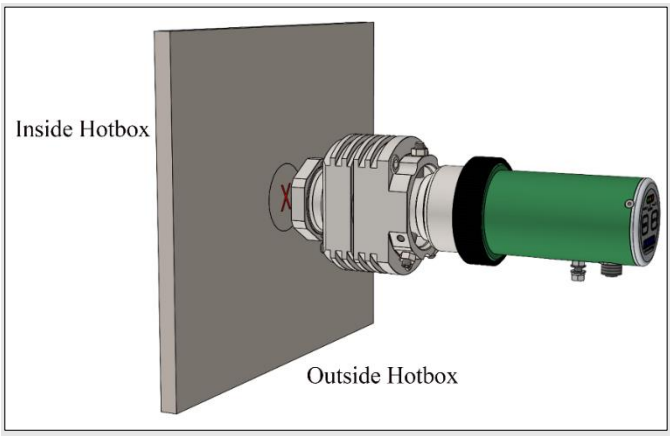


Figure 5-2: Mark the Location where mounting Transceiver

- At the transceiver end of the engine, drill a Ø45 mm hole through the engine hotbox wall structure.
- Mount the alignment bracket following Figure 5-3 & Figure 5-4.

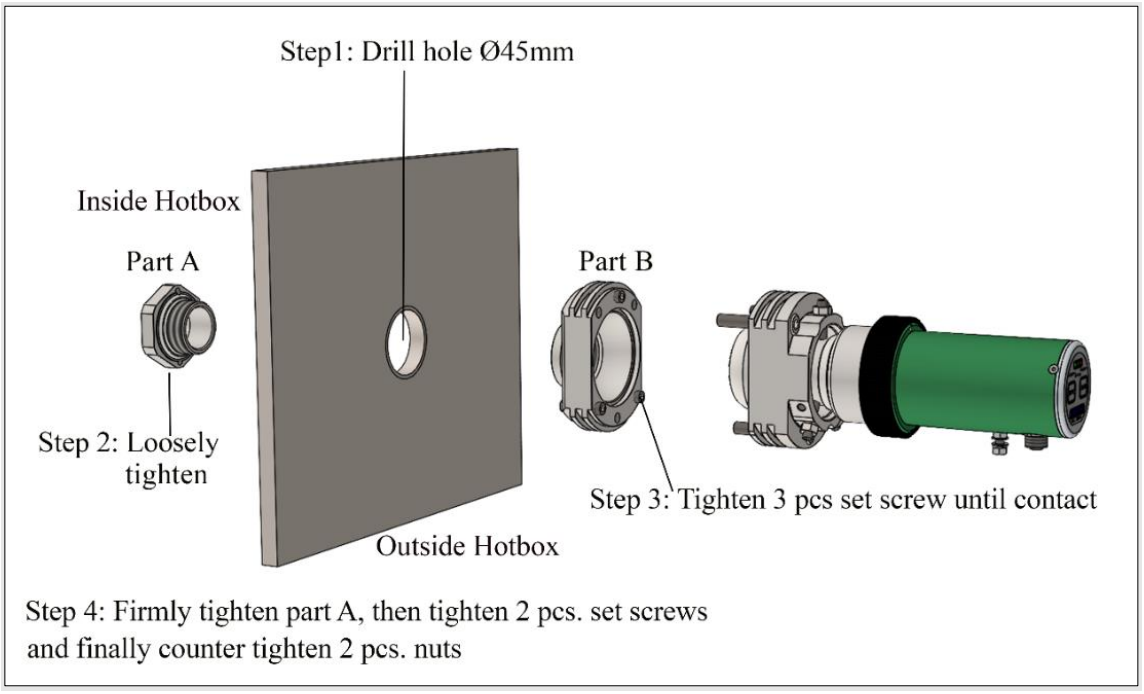


Figure 5-3: Installation of Transceiver – Mount the Alignment Bracket

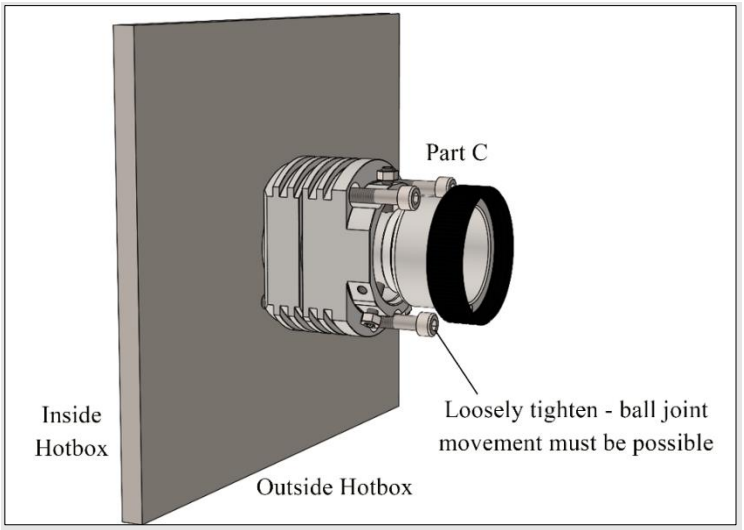


Figure 5-4: Installation of Transceiver - Remount Part C to Part B

- Mount and power up the transceiver. Ensure that the line of sight cannot be obstructed by any obstacles. If any obstruction occurs, realign the light beam using the alignment function of the bracket.

- Secure the alignment position and refit the transceiver – Figure 5-5.

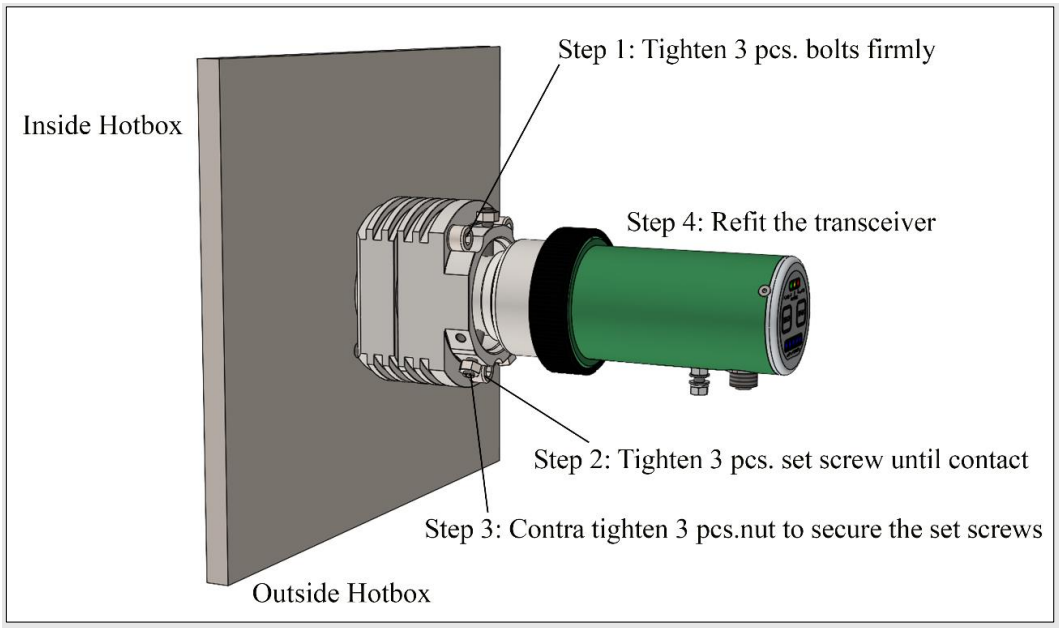


Figure 5-5: Refit the Transceiver

- Check that the bolts of the alignment bracket are tightened. Grab and shake the transceiver to check the robustness.
- Use a marking pen to mark the spot where the light beam hits the hotbox wall structure opposite the transceiver - Figure 5-6. Mounting Reflector - refers to section 5.3.

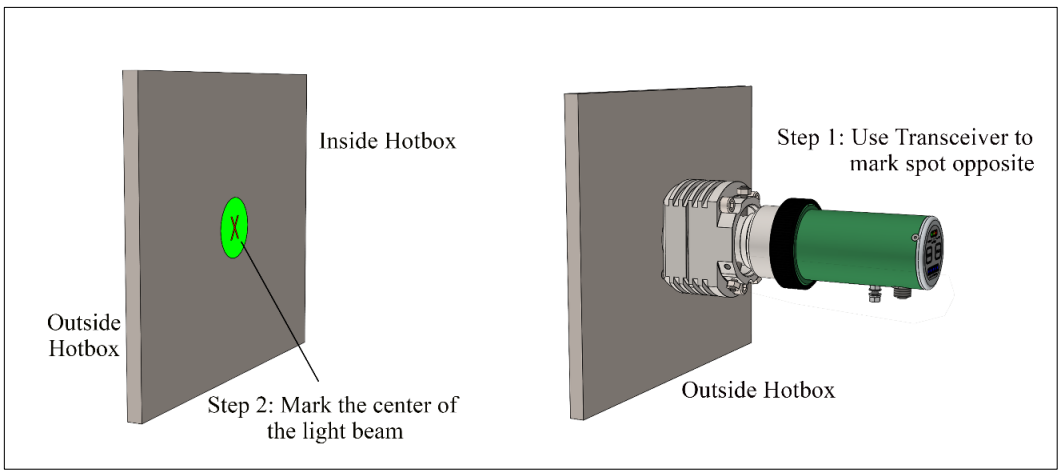


Figure 5-6: Mark the center of the light beam

- Special consideration must be taken to fixate the cable from the transceiver to avoid excessive stress on cable and connector. Therefore, please fixate the cable as close to the transceiver as practically possible.
- Avoid mounting the cable on surfaces where temperature can exceed 80ºC.

5.3 Mounting Reflector and Optional Side Mount

Note

The reflector is intended for rear mounting onto the hotbox structure.

If this is not possible, then the optional side mount can be used.

The side mount is intended for the following orientations: vertical mounting e.g. standing or hanging and for horizontal mounting e.g. left/right orientation.

- Locate the marking “X” which indicates the centre of the light beam. Drill a Ø11 mm hole at the marked position – Figure 5-7.
- For optional side mount: Position the side mount a minimum of 50 mm away from the back wall to allow for adjustments. Check that the beam of light hits the center of the reflector. If this is not the case, then redo the transceiver alignment so that the laser hits the center of the side mount hole marked on (Figure 5-8). Once aligned mark the center hole of the side mount bracket with an X (Figure 5-8).

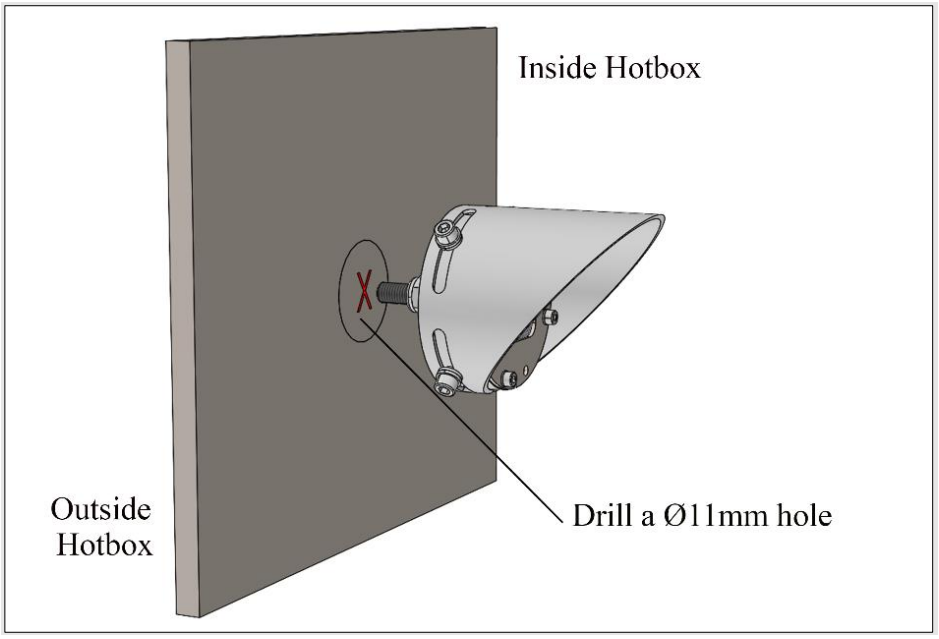


Figure 5-7: Drill a Hole at the Marked Spot

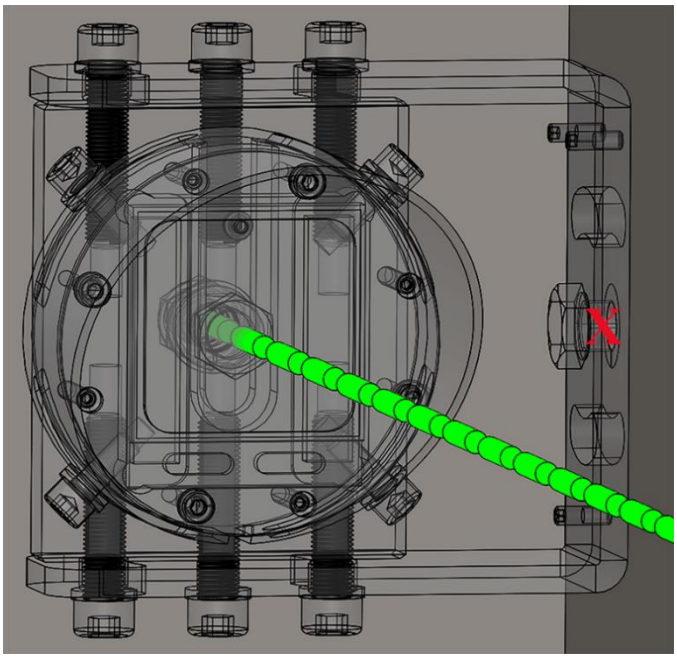


Figure 5-8: Drill a Hole at the Marked Spot – Optional Side Mount

- For optional side mount: Mount the bracket assembly using the M10 bolt, nuts and washers (Figure 5-9).

Note

It is possible to rotate the bracket to compensate for radial misalignment. Once in position, carefully lock the position between the bracket and the hotbox structure by means of the 3 pcs. set screws (Figure 5-9).

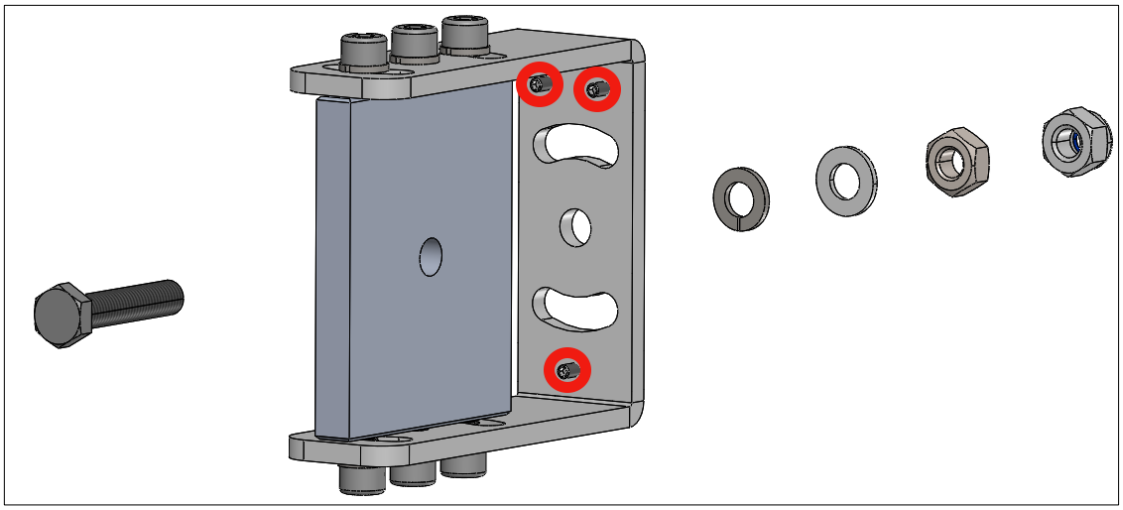


Figure 5-9: Mount the Bracket Assembly – Optional Side Mount

- Then mount the reflector following - Figure 5-10.

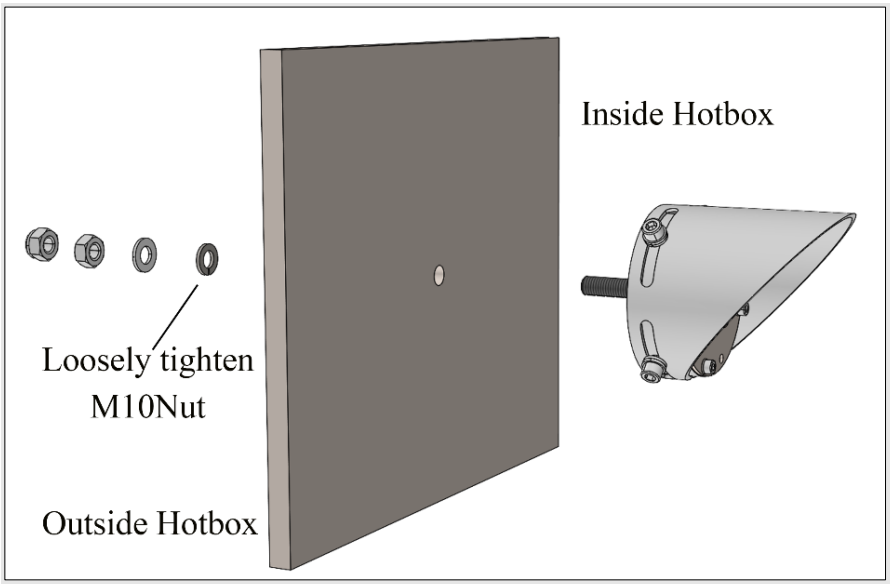


Figure 5-10: Mount the Reflector

- For optional side mount: Mount the reflector in the same way following (Figure 5-11).

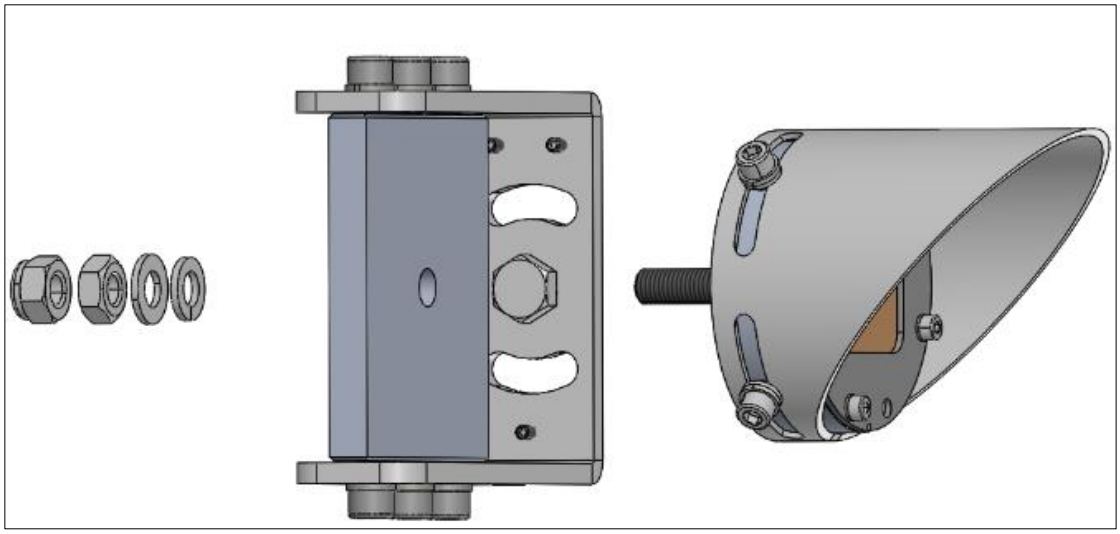


Figure 5-11: Mount the Reflector – with Optional Side Mount

- Fine adjust the position of the reflector by means of the sliding function between the M10 bolt and the housing - Figure 5-12. Ensure that the light beam hits the exact center of the reflective area refer to section 7.2.

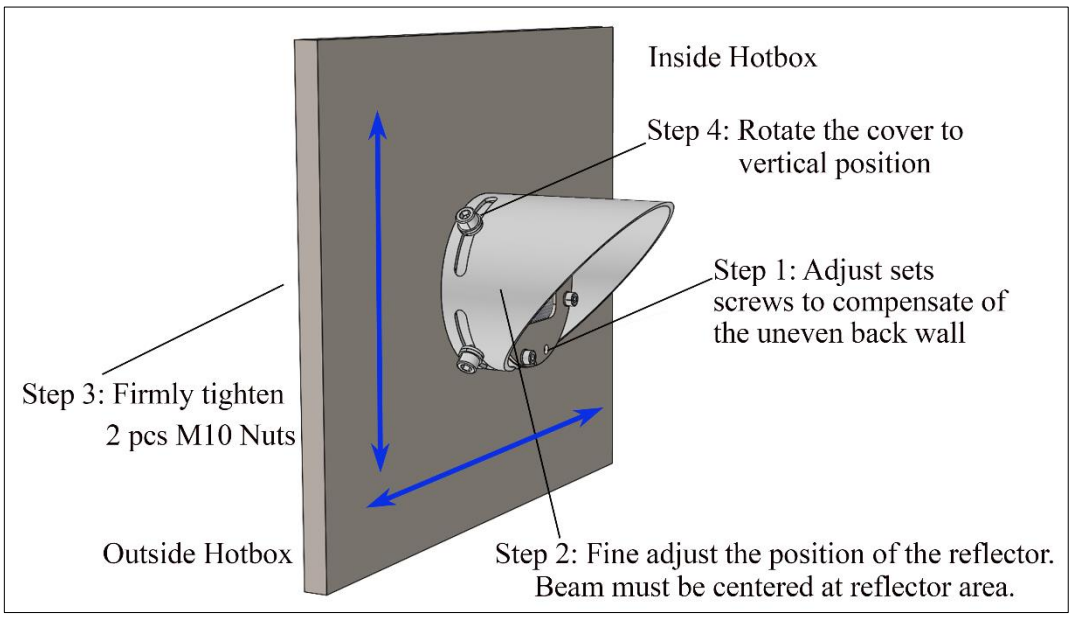


Figure 5-12: Adjust the Alignment

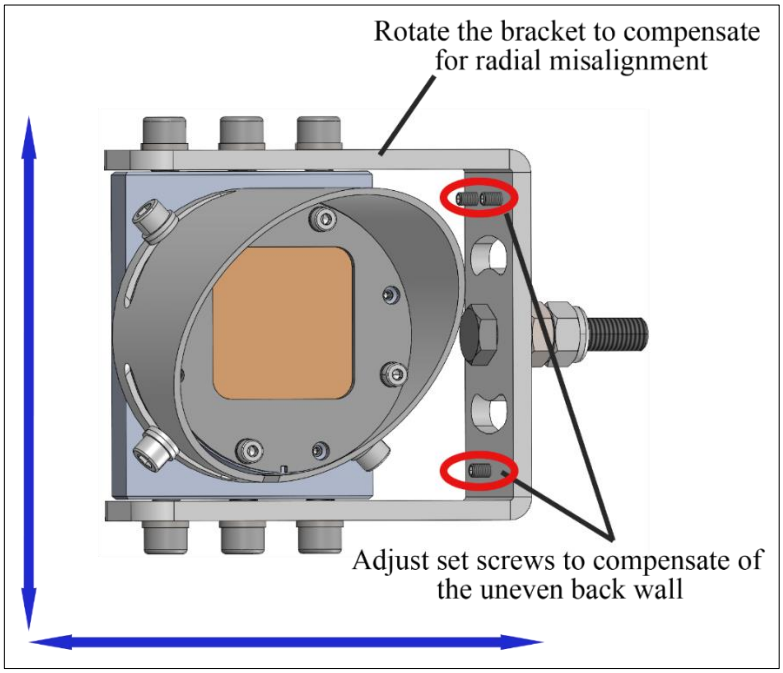


Figure 5-13: Adjust the Alignment – Optional Side Mount

- For optional side mount: Fine adjust the position of the reflector by means of the sliding function between the M10 bolt and the housing and/or the adjusting function on the side mount – Figure 5-13. Ensure that the light beam hits the exact center of the reflective area refer to section 7.2.
- Tighten the set screws until they contact the structure surface to compensate the uneven back wall. Note that at least 3 sets screws have contact with the hotbox surface.

- Tighten the M10 Nut and contra tighten using the M10 locking nut for reflector (and side mount if used).
- Re-orientate the protective cover if needed.
- Check that the bolts of the reflector are tight. Grab and shake the reflector to check the robustness.

5.4 Hotbox Monitor Cabinet

The Hotbox Monitor Cabinet must be installed in a location with ease of access. Pay attention to ventilation draft and keep temperature specifications in mind when placing the Hotbox Monitor Cabinet. Please refer to Installation Layout found in the Documentation Package.

5.5 Junction box

The junction box is an optional item used in cases where the cable(s) between the Hotbox Monitor Cabinet and the transceive exceeds 15 meters, and/or in cases where more than two transceivers are daisy chained together. Daisy chained is a term used to describe a communication line connected in series to create a common bus line.

If the scope of supply includes a junction box, the junction box is pre-mounted with a connection cable for easy connection with the transceiver.

Refer to the electrical diagram for guidance regarding cabling.

5.6 Electrical Connections

5.6.1 Connections

Before connecting the power supply, please make sure that the power supply rating for the Hotbox Monitor Cabinet corresponds with the power supply available.

Please see the electrical drawings relevant for installation attached to each system.

5.6.2 Cable

Refer to the electrical documentation.

- Cables must meet marine standards.
- Cables must have sufficient means of protection
- Laying of cables must be done according to good workmanship. Special consideration must be taken to fixate the cable from the transceiver to avoid excessive stress on cable and connector.

6 Commissioning

Before starting the system for the first time after completing the installation, please check and confirm that all parts are installed correctly according to the instructions and that all the connections are secured. Check and confirm all the electrical connections are correct according to the instructions.

6.1 Start of the System

The system may now be started (switch on the power supply). Configure, verify and potentially fine-tune alignment, preparing the system for a test.

The following actions should be carried out to configure each transceiver:

Align the Transceiver and Reflector: refer to section 7.2.

Set Unit Address: refer to section 7.3.

6.2 Calibration

Calibrate the system following the instructions in section 7.4.

6.3 Setting of Alarm Levels

Alarm level shall be set up following the requirement of each application. Please follow the instruction to configure the alarm level for each transceiver in section 8.3.7 Sensor Setup & Default Settings.

6.4 Alarm and Warning Relays

Each system is configured with relay outputs to provide warnings and alarms to an external system if Modbus is not used. Refer to the electrical diagram for connection.

6.5 Modbus Integration

6.5.1 Communication Configuration

Serial	RS485
Baudrate	19200
Data Bits	8
Parity	NONE
Stop Bits	1
Modbus Type	RTU
Device ID (address)	1

6.5.2 Modbus Mapping

Name	**Description**	**Type** **Read/Write** **Range**	**Address** (Holding Register Function Code 03)	**Priority**
Product	Unique Product Number.	Uint16 Read 0-255	0	5
ModbusMap Major	Modbus Map Major Rev. Update breaks backward compatibility.	Uint16 Read 0-255	1	3
ModbusMap Minor	Modbus Map Minor Rev. Update will only add registers. Will be backward compatible.	Uint16 Read 0-255	2	3
SwMajor	SW Rev. Major update may break backward compatibility.	Uint16 Read 0-255	3	5
SwMinor	Minor SW Rev. Minor update will be backwards compatible but may have new features.	Uint16 Read 0-255	4	5
SwBugfix	Bugfix SW Rev.	Uint16 Read 0-255	5	5
Check	Simple sanity check. Sum of above 6 registers.	Uint16 Read 0-1530	6	5

Name	Description	Type Read/Write Range	Address (Holding Register Function Code 03)	Priority
System Status	System Status.	Bit array 0 = System Err 1 = Missing sensors 2 - 15 = Reserved	7	2
SensorsOnline	SensorsOnline.	Bit array 0 = sensor 1 1 = sensor 2 … 7 = sensor 8	8	3
SensorCount	Number of configured sensors	Uint16 Read 1-8	9	3
Sensor Alarm	SensorAlarm	Uint16 Read Bit array 0 = sensor 1 1 = sensor 2 … 7 = sensor 8	10	2
SensorWarn	Sensor Warning	Bit array Read 0 = sensor 1 1 = sensor 2 … 7 = sensor 8	11	2
CommonAlarm	Common Alarm	Uint16 Read 0 - No alarm 1 = One or more sensors in alarm	12	1
Sensor 1				
Absolute Opacity_1	Absolute opacity low pass filtered	Real Read -25-100	100	4

Name	Description	Type Read/Write Range	Address (Holding Register Function Code 03)	Priority
Opacity_1	Opacity change over time Auto zero and auto adjusting for expected fouling	Real Read 0-100	102	4
WarningLevel_1	Warning level for opacity / Fouling warning	Real Read 0-100	104	4
AlarmLevel_1	Alarm level for opacity / Delta opacity	Real Read 0-100	106	4
Sensor x (x = 2 => 8)				
Absolute Opacity_x	Absolute opacity low pass filtered	Real Read -25-100	x00	4
Opacity_x	Opacity change over time Auto zero and auto adjusting for expected fouling	Real Read 0-100	x02	4
WarningLevel_x	Warning level for opacity / Fouling warning	Real Read 0-100	x04	4
AlarmLevel_x	Alarm level for opacity / Delta opacity	Real Read 0-100	x06	4

Table 6-1: Modbus Mapping

Note

Only relevant addresses will be in use depending on each specific system configuration.

7 Transceiver Menu Structure

Videos of Transceiver Setup and Transceiver Calibration can be found using the links below. Kindly note that the videos are made as general guidelines.

https://vimeopro.com/user82890052/g1626/video/448544937

https://vimeopro.com/user82890052/g1626/video/448545115

7.1 Transceiver Button Function

Figure 7-1: Transceiver Interface

The transceiver user interface consists of a green power LED, a yellow warning LED and a red alarm LED, a zero and a span button, and 5 signal strength LEDs.

- Power: Green illuminating LED means power ON
- Warning: Yellow illuminating LED means Transceiver issue
- Alarm: Red illuminating LED means suspected Oil Mist is present
- Signal Strength LEDs: Under normal operation, the signal strength LEDs indicate how close the transceiver is to triggering the alarm.
- When the signal strength LED on the right illuminates, it indicates the transceiver is far from triggering an alarm – refer to Figure 7-2.
- When the signal strength LED on the left illuminates, it indicates the transceiver is close to triggering/ already triggered an alarm. Please See Figure 7-3.

Figure 7-2: Illustration of the strongest signal → no obstructions to the light beam

- When the illumination changes to one of the LEDs to the left, it indicates that the reflected beam becomes weaker, i.e., the beam is scattered or blocked. The signal strength LEDs can thus be used as a quick indication of how far the transceiver is from triggering an alarm. Please See Figure 7-3.

Figure 7-3: Illustration of the weakest signal → obstructions to the light beam

- Besides the indication of signal strength, the blue LEDs are also used as an indication of correct initial alignment and address settings.
- Zero and Span: The Zero and Span buttons are used for calibration and initial settings of light beam strength and transceiver address. These buttons are also used to enter service mode.

7.2 Set Laser Aligning Function

Attention

Once laser aligning function is started, section 7.2, it is necessary to continue with setting unit address, section 7.3, until the new settings are saved.

Visible laser radiation! When the transceiver operates in pulsed mode, the laser is classified as Class 1, which is safe under all conditions of normal use. When it operates in the continuous mode (i.e. there is a steady light beam in the aligning mode), the laser is classified as Class 3R. Thus, please avoid eye exposure to direct or scattered radiation when the transceiver operates in the continuous mode.

During the laser aligning step, all possible obstructions to the light beam (such as oil mist, smoke, and water mist) must be absent in the section between the transceiver and the reflector.

- To enter laser Alignment Mode, please press and hold SPAN and ZERO buttons and wait approximately 5 seconds until all signal strength LEDs are ON. Then, release SPAN and ZERO.
- The signal strength is indicated by means of one of the blue LEDs. Note that alarm and warning functions will be deactivated while the steady/continuous beam of light is ON.
- The light beam can now be adjusted to hit the centre of the reflector by adjusting the alignment bracket and the position of the reflector.
- For centring the light beam, it is recommended to place a paper or thin cardboard over the reflector. The beam will be projected onto the paper or cardboard and the position of the beam will be clearly indicated for fine adjustment of the centre of the reflector.

  A cut-off shape which is not centred nicely onto the reflector indicates a poor alignment. A circular shape nicely centred onto the reflector indicates a good alignment – Figure 7-4.

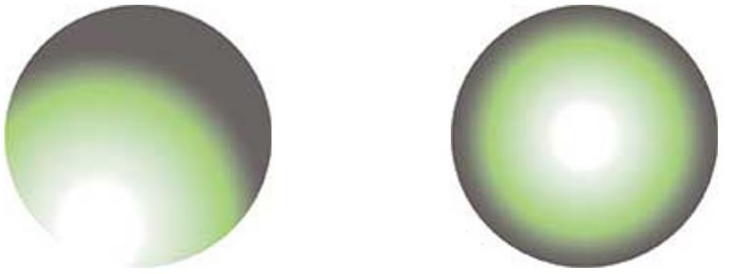


Illustration of poor alignment Illustration of good alignment

Figure 7-4: Illustration of Poor and Good Alignment

- After fine adjustment of the beam to the centre of the reflector, tighten all the bolts and screws on the alignment bracket and reflector. Remove the paper or the cardboard used. Consult section 5.2 and 5.3. Go to the next step – set unit address.

7.3 Set Unit Address

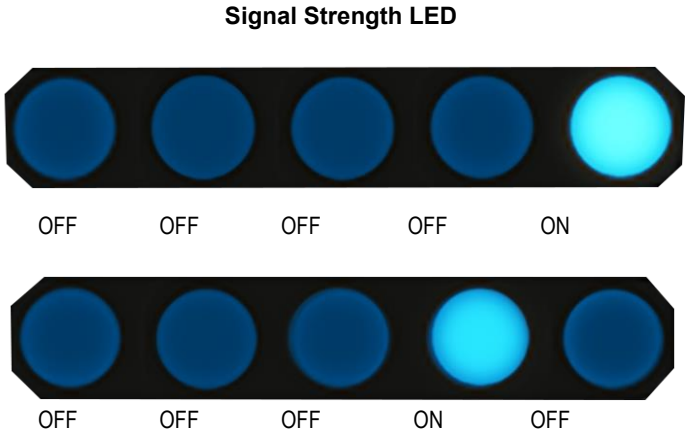
- Section 7.2 Set Laser Aligning Function must precede this step or alternatively: Press and hold SPAN and ZERO buttons and wait approximately 5 seconds until all signal strength LEDs are ON. Laser is ON.
- Press and hold SPAN and ZERO buttons and wait approximately 5 seconds until all signal strength LEDs are ON. Laser is OFF. The unit address is now shown on the signal strength LEDs as described in Figure 7-6.
- To step through the addresses press and hold Zero and release when signal strengths LEDs shows the wanted address. Note, addresses can be set between 1 and 16 where only 1 – 8 is used in this standard application. Address will restart at address 1 if zero is kept pressed. Note the default address for all new transceivers is address 1. All transceivers in a system must be assigned an unique address in a system.

  Videos of Set Unit Address can be found using the links below. Kindly note that the videos are made as general guidelines.

  https://vimeopro.com/user82890052/g1626/video/448544937

Address 1

Address 2



Signal Strength LEDs					
Address	●	●	●	●	●
1					ON
2				ON	
3				ON	ON
4			ON		
5			ON		ON
6			ON	ON	
7			ON	ON	ON
8		ON			
9		ON			ON
10		ON		ON	
11		ON		ON	ON
12		ON	ON		
13		ON	ON		ON
14		ON	ON	ON	
15		ON	ON	ON	ON
16	ON				

Figure 7-5: Transceiver Address Settings

- To save the new address settings and return to normal operating mode, press and hold SPAN until all signal strength LEDs turn ON. While SPAN is pressed, press ZERO. Wait approximately 5 seconds until all signal strength LEDs turn ON again
- Kindly note that the as standard Hotbox Monitor Cabinet only supports up to 8 transceivers. Each Transceiver must have a unique address between address 1 and 8.

7.4 Calibration

Note

ZERO and SPAN are used to set the endpoints.

ZERO: 0% Opacity = 100% Transmission = All light Transmitted (Clear)

SPAN: 100% Opacity = 0% Transmission = No light Transmitted (Dark)

During ZERO calibration, all possible obstructions to the light beam (such as oil mist, smoke or water mist) must be absent in the section between the transceiver and the reflector.

7.4.1 Zero Calibration

- First, ensure there are no obstructions to the light beam
- Then press and hold ZERO until all blue signal LEDs illuminate.
- After releasing ZERO, the first and last signal strength LEDs on the far left and far right will turn ON, which indicates the transceiver has entered Auto SPAN Calibration mode, see section 7.4.2.

To skip the Auto SPAN Calibration, press the ZERO button for minimum 0.5 seconds until all signal strength LEDs are OFF, or wait 60 seconds. This will bring the transceiver back to normal operation mode again.

7.4.2 Auto SPAN Calibration

- After successful ZERO calibration (see section 7.4.1), the transceiver will automatically enter Auto SPAN Calibration mode (see Figure 7-6). To complete the Auto SPAN calibration, the beam of light must be blocked for at least 1 second (within 60 seconds after Zero calibration is completed).

Figure 7-6: Auto span calibration ready to start after the zero calibration is complete (left and right SIGNAL STRENGTH LEDs illuminated)

- After the beam has been blocked, the 3 center SIGNAL STRENGTH LEDs will indicate a valid SPAN calibration (see Figure 7-7). The interface will continue to show this indication until the timeout period of 60 seconds has passed.
- To go into normal operation mode immediately and skip the 60 second timeout period, press the SPAN button for a minimum of 0.5 seconds until all signal strength LEDs turn OFF.

Figure 7-7: Signal Strength LEDs indicate successful Auto SPAN Calibration

Please note that the beam of light still needs to be blocked during an Auto SPAN Calibration. The Auto SPAN Calibration mode only eliminates the need of pressing the SPAN button, while simultaneously blocking the beam. This feature is intended to give the operator the possibility to block the beam in installations, where this is not possible, while also standing beside the transceiver. Another advantage is the alarm is switched OFF during Auto SPAN Calibration, thus no false alarms.

It is also possible to perform a manual Span Calibration. Please check the next section.

7.5 Manual Span Calibration

Videos of Transceiver Setup and Transceiver Calibration can be found using the links below. Kindly note that the videos are made as general guidelines.

https://vimeopro.com/user82890052/g1626/video/448544937

https://vimeopro.com/user82890052/g1626/video/448545115

Auto SPAN Calibration will normally be preferred; however, a Manual SPAN calibration can be used as another possibility.

- First, block the light beam after the transceiver. Note, an alarm will probably be triggered. Then press and hold SPAN until all blue signal LEDs illuminate.
- After releasing SPAN, unblock the light beam. The transceiver will now return to normal operating mode, as shown in Figure 7-8.

Figure 7-8: Transceiver in normal Operation Mode

If the warning LED is ON after you unblock the light beam, this indicates that the unit has not been calibrated successfully. Thus, the calibration must be carried out again, starting with ZERO, then SPAN calibration. Refer to the alarm log if the cause of the failed calibration is not obvious.

7.6 Enabling Service Mode

Attention

Please note, the light beam can be turned off and transceiver alarms can be ignored by putting the transceiver into Service Mode.

During service on, in and around the installation, the light beam can accidentally be blocked causing a false alarm. To avoid this, a Service Mode function has been created, which can be enabled before service of the installation is carried out.

Service Mode is enabled by pressing and holding the ZERO button until the 2 outer signal strength LEDs light up. When this is noticed, please immediately release ZERO, then press and hold ZERO again until 2 outer signal strength LEDs light up, then release once this is noticed - Figure 7-9.

Figure 7-9: Signal Strength LEDs showing when to release ZERO to enter Service Mode

Please note, the ZERO button must be released before the 2 outer signal strength LEDs turn OFF in order for Service Mode to be entered. (i.e. do not press ZERO button too long).

The unit will now be in Service Mode which is indicated by a flashing warning LED. In Service Mode, the laser and alarms will turn OFF and the reported opacity will be 0%. The default timer sets the Service Mode to 10 minutes (no Signal Strength LEDs illuminated, as seen in Figure 7-10.

Figure 7-10: Service Mode (flashing warning LED)

Pressing SPAN will add 10 minutes to the default timer - Figure 7-10. The Service Mode can last up to 60 minutes (10 mins. per. LED) - Figure 7-11. The remaining time can be seen on signal Strength LEDs.

Figure 7-11: Service Mode (1 Signal Strength LED represents 10 minutes added to default Service Mode)

Figure 7-12: The Service Mode Timer indication max 60 minutes

Service Mode can be cancelled in the same way as it is entered i.e. by pressing and holding ZERO until the 2 outer signal strength LEDs light up - Figure 7-9, immediately releasing ZERO and pressing and holding ZERO again until 2 outer signal strength LEDs light up once more, then releasing once again.

8 Hotbox Monitor Cabinet

The following sections describes the normal use and setup of the Hotbox Monitor Cabinet.

8.1 System Menu

Press the Setting button to access the Setting Menu. The Setting Menu as shown in Figure 8-1 will appear.

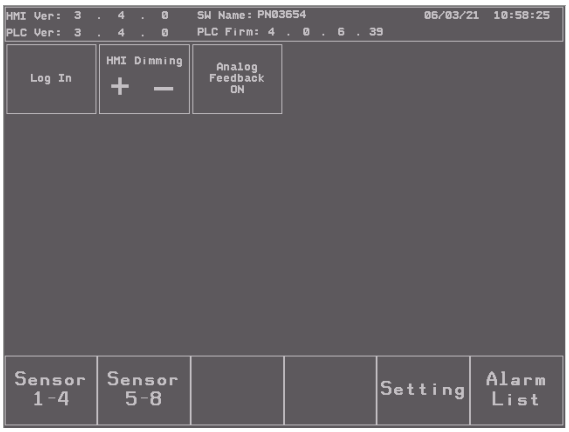


Figure 8-1: Setting Menu with No Login

For access to the HMI Log, Admin login is required. When pressing the Copy HMI Log to USB button, all logged data in the HMI will be copied to the USB, - see Figure 8-2.

The HMI Log holds Opacity level Log and is meant for incident investigation. The logged file is originally encrypted. For decryption of the file, please consult the service team at Green Instruments.

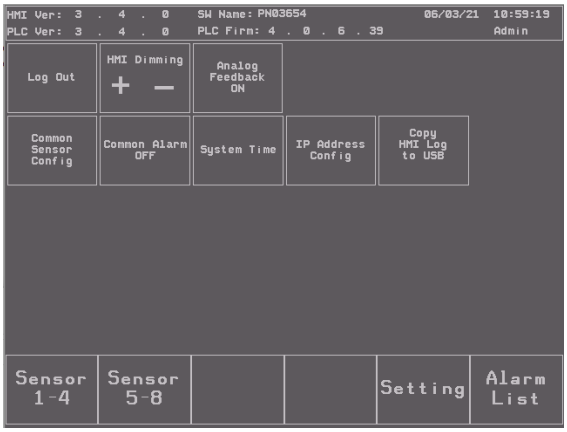


Figure 8-2: Setting menu as "Admin login"

- Login/Logout: See section 8.6.
- Dim: Dimming of the HMI backlight.
- Analog feedback ON/OFF should be activated, if the system is equipped with analog output modules to support a 4-20mA signal interface to the customer instead of the standard Modbus TCP/IP interface. The analog output signals are scaled in % showing the opacity.
- Common Sensor Config is to setup the most common settings to all sensors in on time.
- Common Alarm OFF All active alarms will be energized.
- System Time: Possible to set the time and date manually, see Figure 8-3.
- IP-Address Configuration, see Figure 8-4.

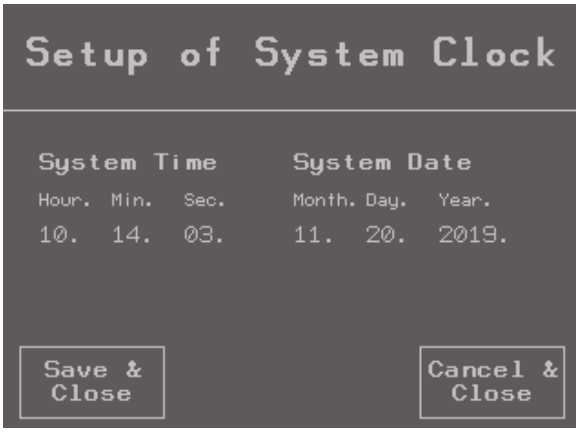


Figure 8-3: Setup of System Time

It requires Admin login to set System Time. Press on each value that needs to be changed/corrected, then save and close.

Same procedures are used for changing the IP-Address, see Figure 8-4.

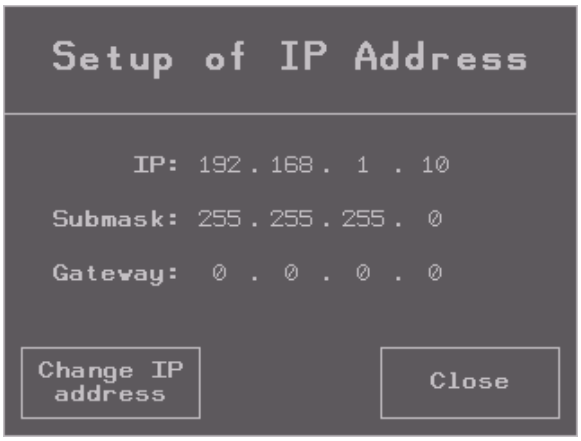


Figure 8-4: IP Address Configuration

8.2 Login and Logout

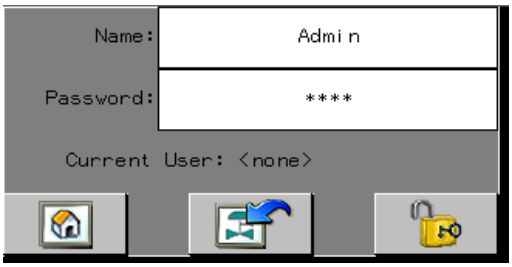
If Admin login is required, a pop-up box will appear.

Name: Admin

Password: 1234

After typing Name and Password, press the padlock  to unlock and then the Go To Current Page  or the Go To Home Page  .

To logout press the Green logo and press Logout in the System Menu.



8.3 Configure System Parameter

8.3.1 About Opacity and Oil Mist

The alarm level must be adjusted to the lowest possible value without risk of generating false alarms. The setting must ensure that lower explosion level is not exceeded without generating an alarm.

Regarding the size of oil droplets, in general, smaller oil droplets have lower ignition temperatures due to the larger surface to volume ratios. Larger oil droplets are less dangerous due to higher ignition temperatures. This corresponds well with the fact that smaller droplets have a higher opacity effect and are thus easier to detect than larger droplets.

The overall goal during system configuration is to set the smoothing factor and alarm level as low as possible without getting false alarms. Please see section 8.3.3 for a detailed description of the parameters.

In order to understand the relationship between opacity, oil mist concentration and the path length of the oil mist, two fictive examples are given in Figure 8-5. The figure illustrates

different oil mist opacity levels corresponding with different oil concentrations and path lengths for the oil droplets ranging from 10…20 µm.

The figure shows that:

- Even an oil mist cloud with a concentration of only 0.2 mg/l and a path length of approximately 2 meters will already trigger the 10 % alarm.
- For the concentration of 2.5 mg/l (the maximum alarm level stated in IACS's M67, which is the standard for crankcase Hotbox), a mist cloud intersecting the line of sight by only 25 cm is enough to trigger the 10 % alarm.
- The 50 mg/l oil mist threshold, which gives risk of oil mist fire/explosion, can be detected in the hotbox application if only a length down to 1cm of the laser beam is intersected by the oil mist. For smaller oil droplet size (3…10 µm), much smaller oil mist clouds will trigger the alarm.

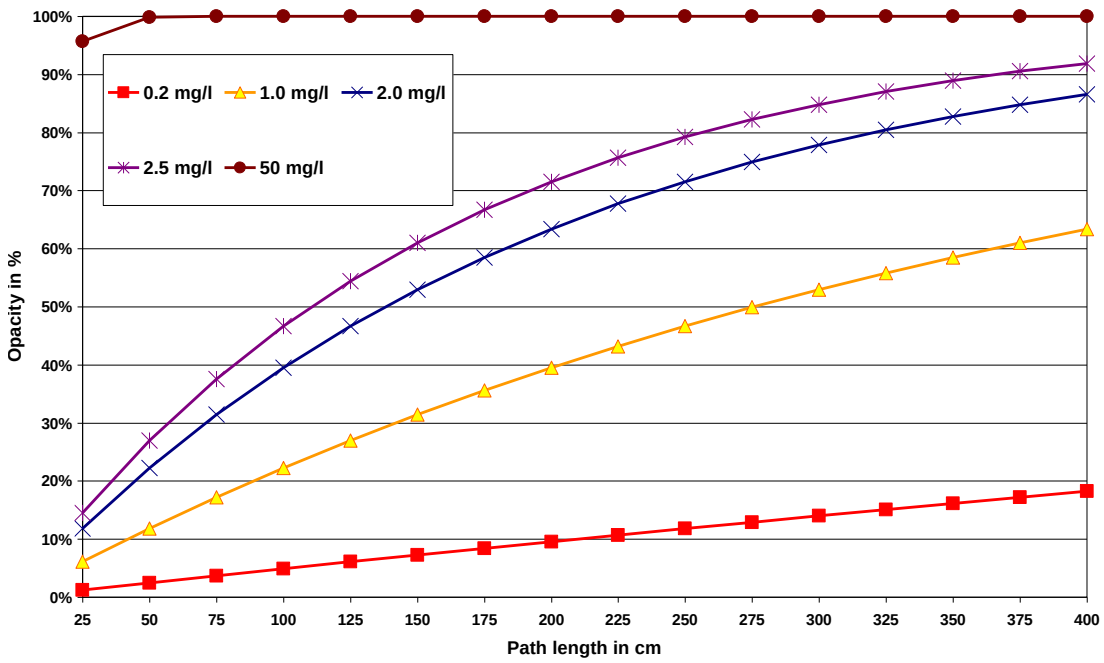


Figure 8-5 Opacity versus path length for different concentration (calculated for oil droplets of 10…20µm)

8.3.2 Basic Alarm Principles

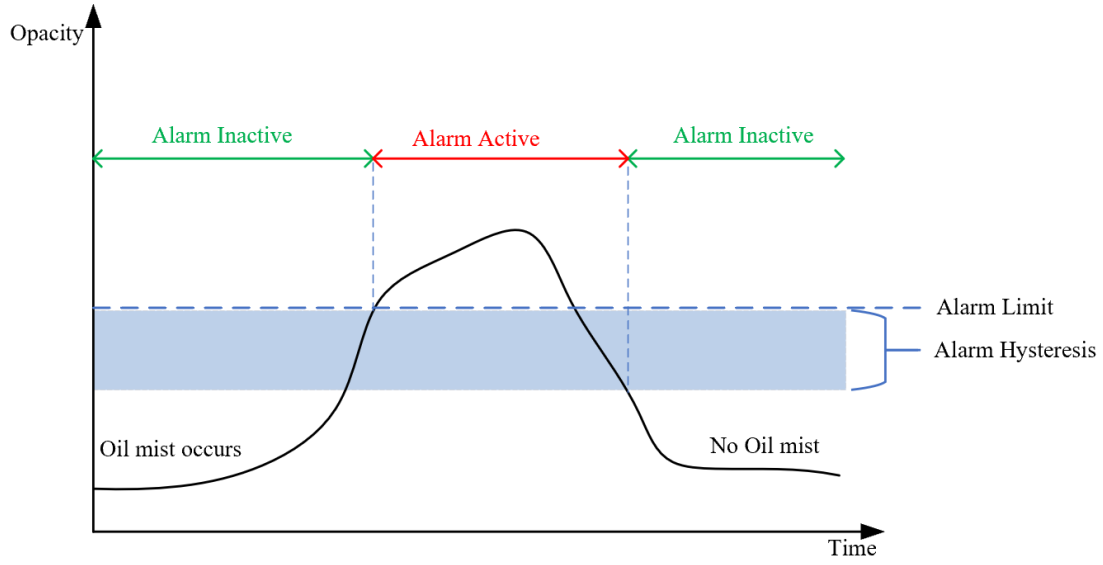


Figure 8-6: Alarm Illustration

Refer to Figure 8-12 Sensor Setup.

The alarm is based on sudden changes in opacity. This means the alarm is not based on the absolute measured opacity, it is based on the relative change of the opacity. Follow the steps below to find the adjustment parameters for a specific installation.

Entering of the adjustment parameters is described in 8.3.7 Sensor Setup and Default Settings.

8.3.3 Step 1: Set Smoothing Factor

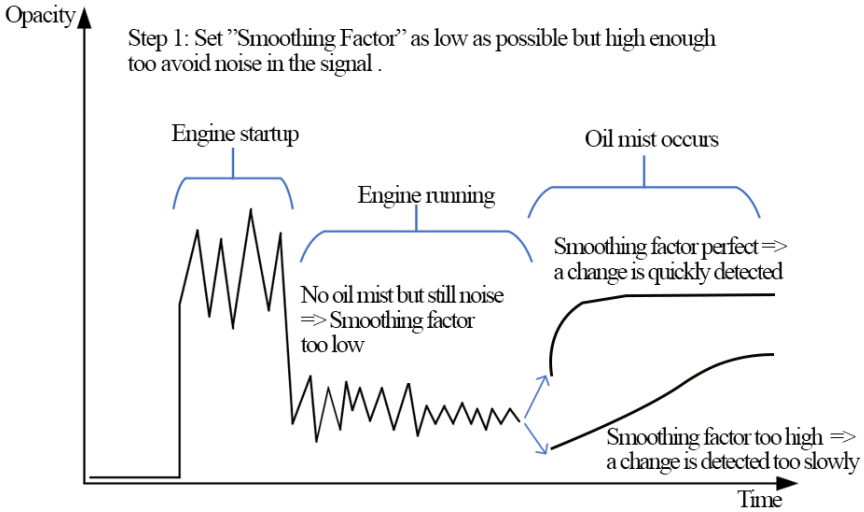


Figure 8-7: Step 1 Set Smoothing Factor

Refer to Figure 8-12 Sensor Setup.

The opacity is measured up to 500 times per second and the individual measurements can fluctuate due to engine vibrations. The transceiver and reflector are not affected directly, however, the vibrations may result in the light beam not hitting the center of the reflector.

The smoothing factor can be set between 0 and 100. This should be set high enough to ensure the signal is free from noise, however, not too high that the alarm is unnecessarily delayed.

Real-time noise in the signal can be seen on the home screen (see Figure 8-17). The values on the home screen can be used to make an initial adjustment of the smoothing factor while the engine is running. Start with a low smoothing factor and increase until the signal is steady (within +/- 1%). To evaluate if noise is present under specific operating conditions (e.g. under certain load conditions), the trend function can be used. See Figure 8-8. Switch between “9 min” and “24 h” trend.

Figure 8-8: Sensor 1 Setup - Trend

8.3.4 Step 2: Set Alarm Limit

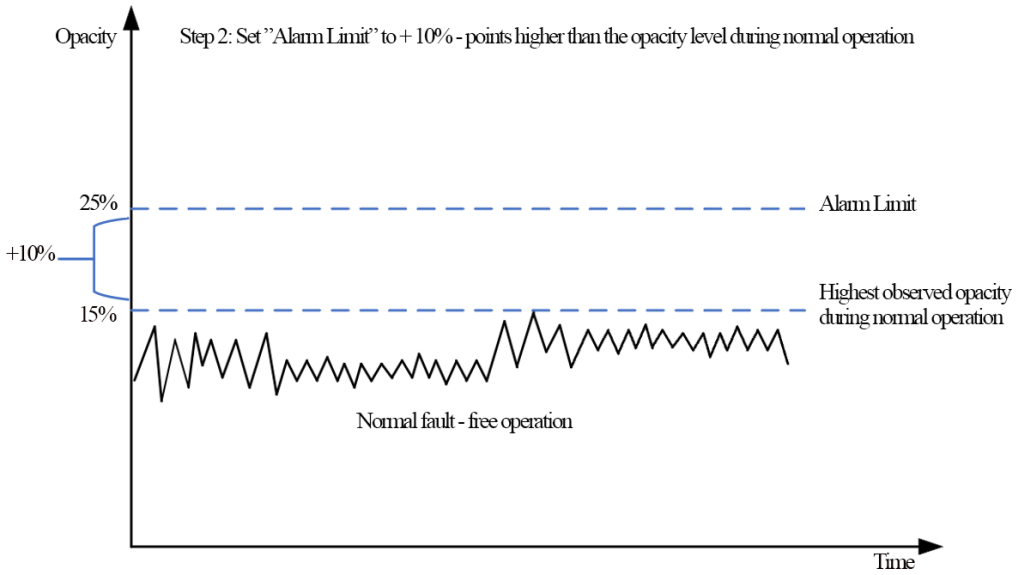


Figure 8-9: Step 2 Set Alarm Limit

Refer to Figure 8-12 Sensor Setup.

After the smoothing factor is set and the engine has been running for some time, check the trend - see Figure 8-8. Note down the highest observed value obtained over this period, where the engine has been running with various load conditions. Set the alarm limit so that it is approximately 10% higher than the highest observed value (see Figure 8-9).

8.3.5 Step 3: Set Warning/Fouling Limit

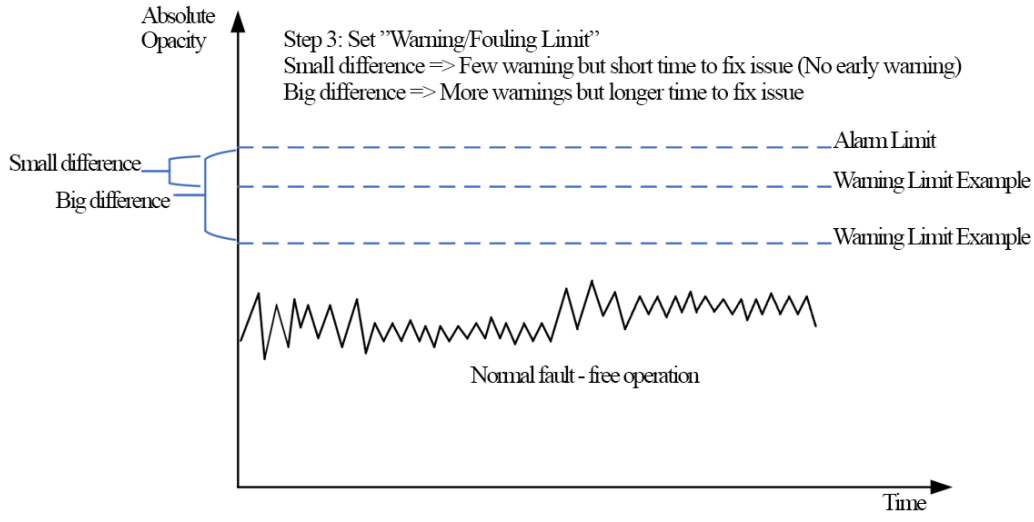


Figure 8-10: Step 3 Set Warning/Fouling Limit

Refer to Figure 8-12 Sensor Setup.

Over time, it is expected that the optical window of the transceiver and the reflector will be contaminated. Over a certain absolute opacity value (50%), this will generate an alarm to indicate detection of oil leak is no longer possible.

To avoid a false alarm, a fouling warning limit can be set to ensure there will be time to clean the transceiver/reflector before the alarm is trigged.

If the fouling limit is set high (Small difference), there will be a short amount of time before an alarm is triggered.

If the fouling limit is set low (Big difference), it will give more time before an alarm is triggered, however the interval between cleaning will be shorter. See section 8.3.7 for more details.

8.3.6 Step 4: Set Fouling/Day

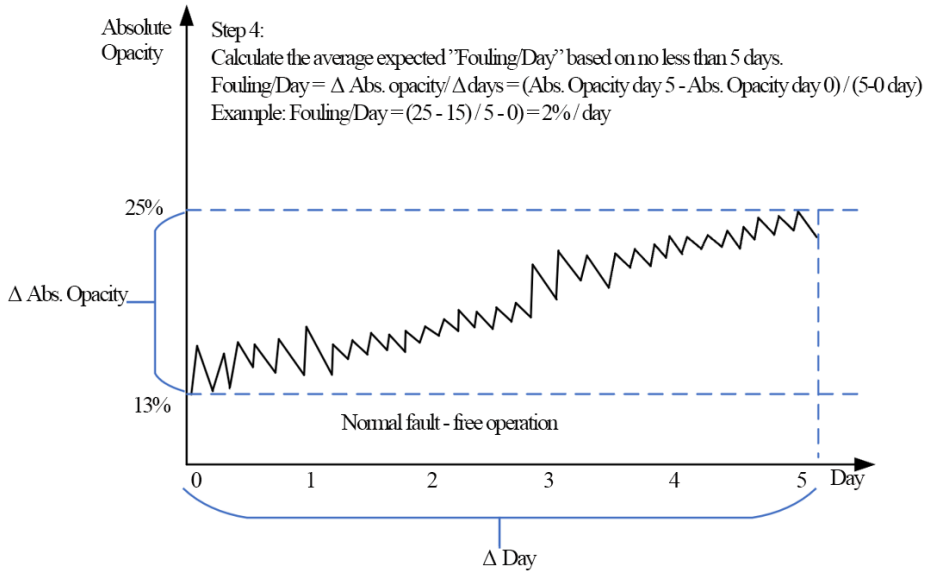


Figure 8-11: Step 4 Set Fouling/Day

Refer to Figure 8-12 Sensor Setup.

The system can compensate for slow contamination of the optical window of the transceiver and reflector. This is set with the parameter Fouling/Day, which indicates the highest expected increase of absolute opacity each day due to contamination. If this is set too low, a false alarm can be generated, whereas if this is set too high, a low concentration of oil mist might not be detected.

The aim is to set the parameter as low as possible without getting false alarms due to slow contamination. Use the absolute opacity trend (see Figure 8-11) over a minimum period of 5 days to calculate the daily opacity increase. See Figure 8-11 for example.

8.3.7 Sensor Setup and Default Settings

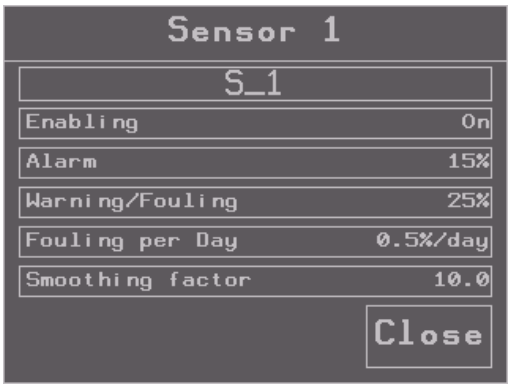


Figure 8-12: Sensor Setup

Each sensor has a sensor menu that displays the following information:

- Sensor name: S_1 as default sensor name for sensor 1
- Alarm condition: refer to section 8.4.
- Go to sensor status menu by pressing S_1 bar in for 3 sec.

Description	Default	Min	Max
Smoothing Factor	10.0	0.0	100.0
Alarm Limit	15%	0%	100%
Warning/Fouling Limit	25%	0%	50%
Fouling/Day	0.5%/day	0%/day	5%/day

Table 8-1: Sensor Setup - Alarm Settings

8.3.8 Unit Name

The default names are set at the factory. However, the name of each sensor can be changed e.g. S_1 sensor can be changed to Main Engine.

To change the name of the unit, press on the sensor name in the Home Menu, this requires Admin Login. A pop-up screen will appear, press again on the sensor name to enter the desired texts and numbers.

8.3.9 Alarm Level

The alarm level is default set at 15 % opacity. The alarm level can be freely configured from 1 to 100 %.

Warning/Fouling level is default set at 25% absolute opacity. The warning/fouling level can be freely configured from 1 to 50 %.

8.3.10 Relay Out

Alarm/Warnings are active when relays are not energized:

Output Signal at Active Warning or Alarm	Setting
Relay energized	No Alarm/Warning
Relay not energized	Alarm/Warning

8.4 Alarm List Menu

By pressing Alarm List on the Menu, the Alarm List menu shown in Figure 8-13 will appear.

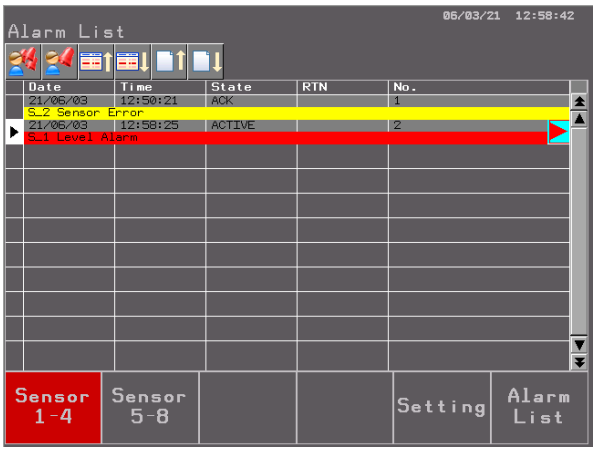


Figure 8-13: Alarm List Menu

A message box will pop up as shown in Figure 8-13, press Close to continue.

- The red alarms mean the alarms are currently active.
- The green alarms mean the alarms are recovered.
- The yellow alarms is an accepted alarm. Press the arrow on the right of the alarm list to give a description of the alarm.

Note

All alarms & warnings will be cleared if the system power is interrupted.

8.5 Initial Startup

The first step after first power on is to align, set addresses and calibrate the transceivers. Please refer to section 7.2, 7.3 & section 7.4.

Note

Transceiver addresses must be unique and be set from 1 to 8. Transceiver with address 1 will be shown first on HMI. Transceiver with address 2 will be shown next in line (See Figure 8-14 where S_x position corresponds to transceiver address).

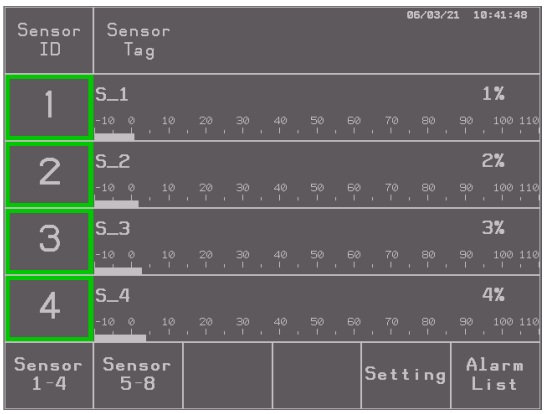


Figure 8-14: Default Home Screen Example - Showing 8 Enabled Sensors

8.6 Setup

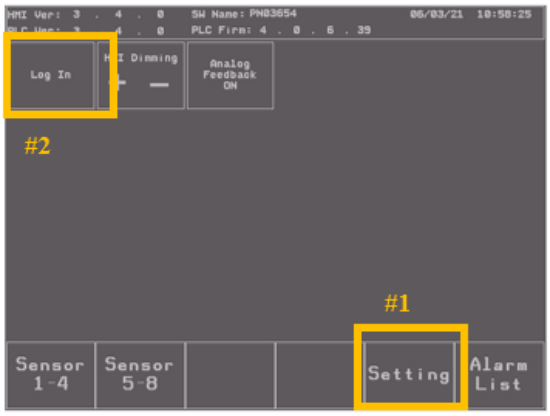


Figure 8-15: Showing Area to Click in order to Access Admin Login

To login, press the area which corresponds to one of the sensors (e.g. the area marked with orange on Figure 8-15).

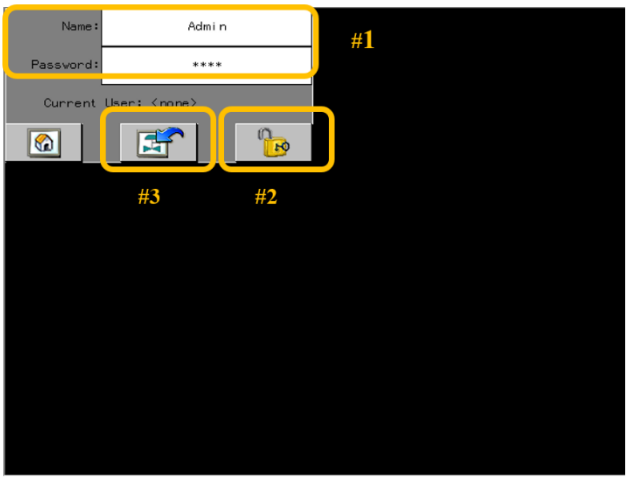


Figure 8-16 Login Screen

A login screen will appear as shown in Figure 8-16.

Use Admin as Name and 1234 as Password. Press the unlock symbol.

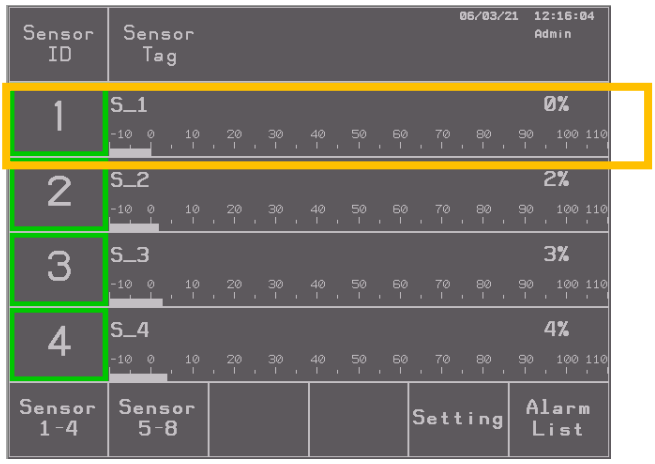


Figure 8-17: Home Screen. Admin logged in

The user Admin is now logged in and changes in setup are allowed. Admin will automatically be logged out after 10 minutes of inactivity. As shown in Figure 8-17, Admin will be displayed if the user is logged in.

Press on the sensor where setup changes are desired (e.g Sensor 1 as shown in Figure 8-18).

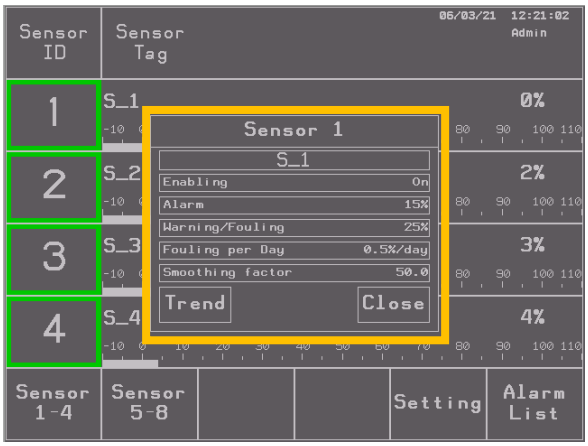


Figure 8-18: Sensor 1 Setup Example

Pressing on the area where S_1 is written in Figure 8-18 will allow the user to change the logical name. This name is shown on the home screen and in the alarm list. The name e.g. can be changed to e.g. Engine 1.

Pressing the area beside Alarm and Warning/Fouling will allow the user to set the opacity levels at which the alarm and warning/fouling are triggered.

Pressing the area beside Fouling per Day will allow the user to set the fouling per day from 0 to 5%.

Enabling can be set to On or Off. If set to Off, the specific sensor will be ignored. This feature can be used during maintenance to avoid generating unnecessary alarms.

Pressing the area beside Smoothing Factor will allow the user to add damping on the measured signal, a value between 0…100. A clearly slower response at 100 and instant response at 0 will be noticable. Refer to section 8.3.3 Step 1 Set Smoothing Factor.

Pressing Trend to open the trends for the specific sensor.

Select Close to go back to the Home screen.

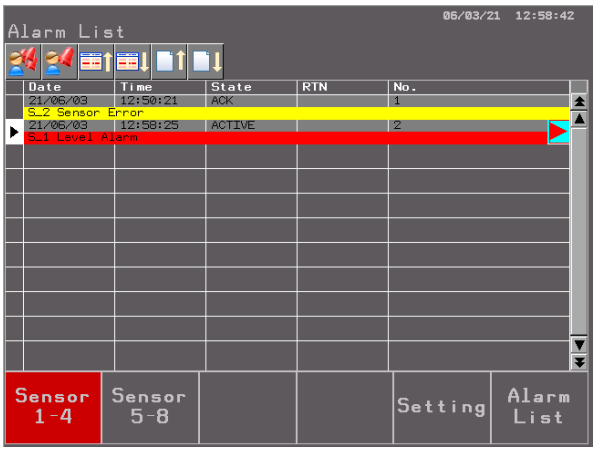


Figure 8-19: Alarm List

To bring up an alarm description, press first on the specific alarm and then on the arrow on the right side of the alarm line - refer to Figure 8-20.

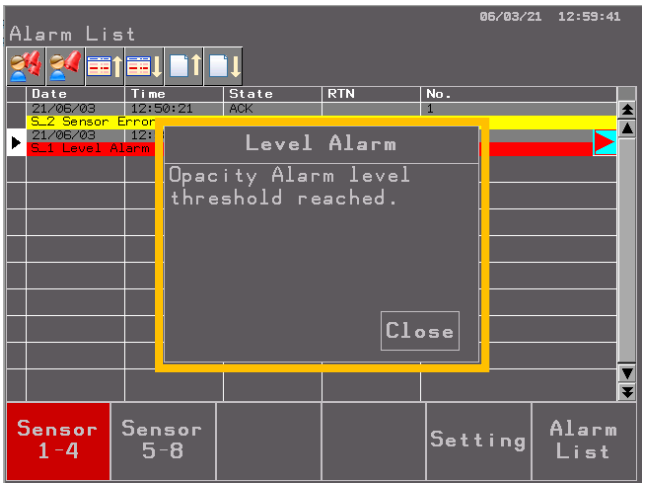


Figure 8-20: Alarm Description

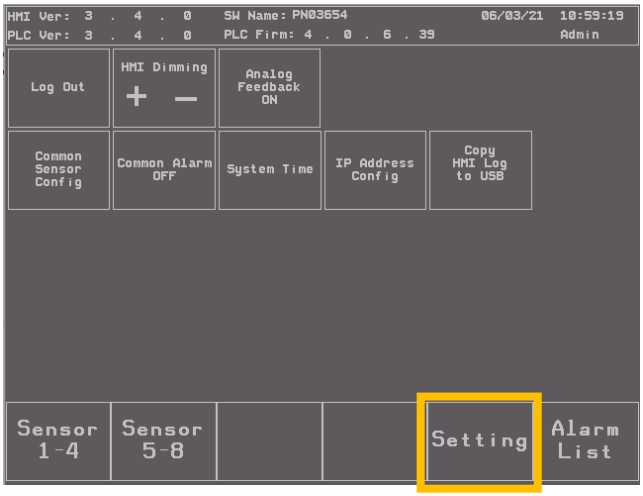


Figure 8-21: System Setup

To bring up system setup, press Setting in the Menu.

The system setup is shown in Figure 8-21.

Login / Logout: To Login or Logout as the administrator.

HMI Dimming: Dims the backlight.

Analog Feedback: Show always the opacity level in procent and the scale for each sensor.

Common Sensor Config: Configure the most common sensor settings for all sensors.

Common Alarm: In case of a wish of only one alarm trigger.

System Time: Change the time and date in the system.

IP Address Config: Change the IP Addresse.

Copy HMI Log to USB: Copying logged data from the internal memory to a USB.

8.7 Normal use

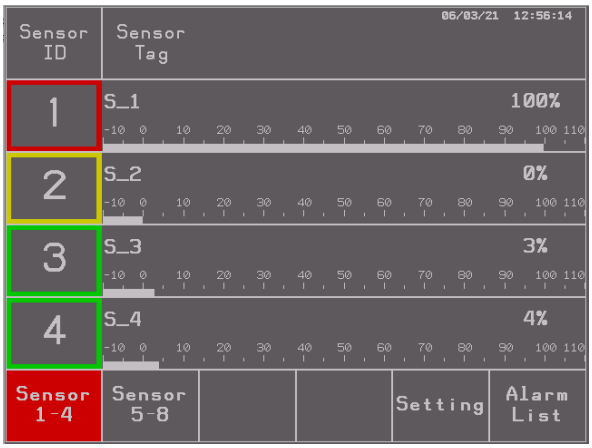


Figure 8-22: Home Screen

The home screen will show opacity and alarm state of the 8 locally connected opacity sensors.

In Figure 8-22 an example is shown.

S_1 is in alarm state, indicated by a red rectangle around the sensor.

S_2 is in warning state, indicated by a yellow rectangle around the sensor.

S_3 and S_4 are in normal state, indicated by the green rectangle around the sensors.

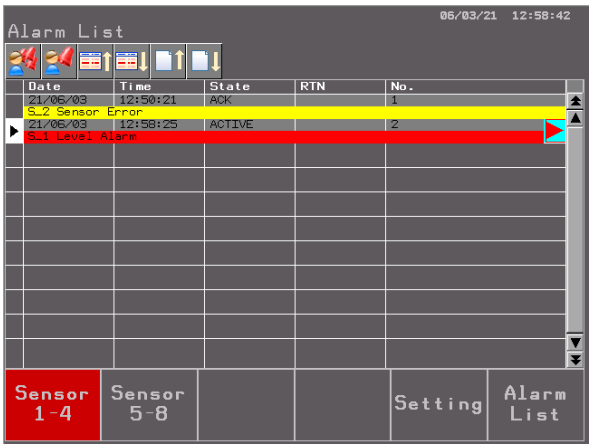


Figure 8-23: Alarm List

In Figure 8-23 the alarm list is shown. In this example, the “S_2 Sensor Error” is acknowledged.

To acknowledge a single alarm, press on the alarm so it is selected. (the alarm with an arrow to the left is the currently selected alarm). Press the symbol with a single bell in the upper left corner (see Figure 8-24).

To acknowledge all alarms, press the symbol in the upper left corner with multiple bells.

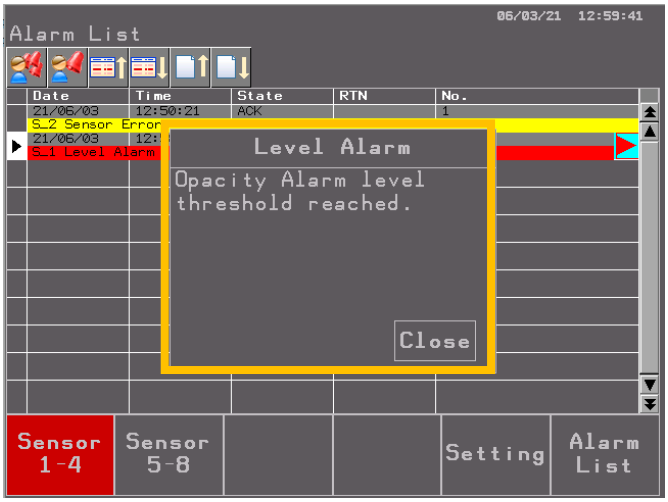


Figure 8-24: Alarm Help

It is possible to activate a help window for the currently selected alarm. To activate this, press on the arrow on the right side of the selected alarm. An example can be seen in Figure 8-24.

8.8 External communication

There is a common Modbus RTU server interface which can be used to communicate with external equipment. Please refer to section 6.5.

8.9 Debugging

To debug a sensor individually, press the specific sensor and then press and hold headline sensor number for 3 sec.

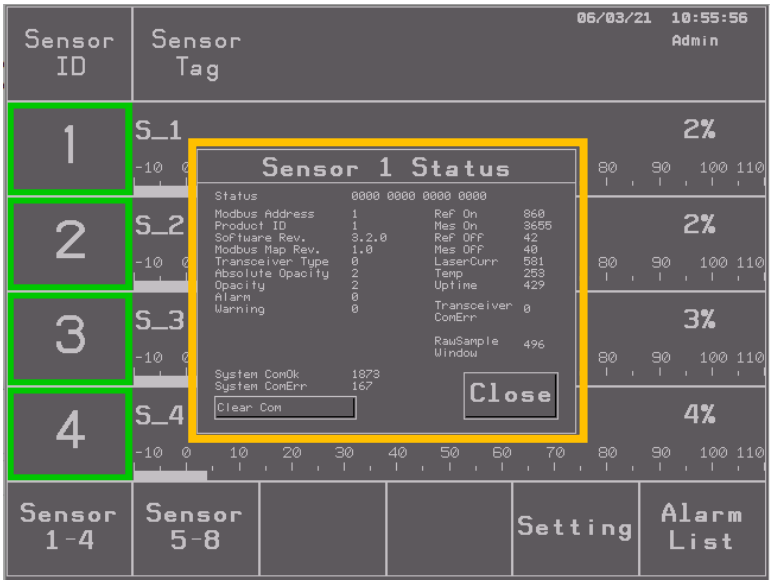


Figure 8-25: Typical Debug Screen Without Issues – Below A List Of Relevant Items.

Status: all zeroes meaning no issues to report.

Modbus Address: is the sensors Modbus address (address 1 in this case)

Software Rev: is firmware version (3.2.0 in this case)

Modbus Map Rev: the revision of the Modbus map the sensor refers to.

Transceiver Type: 0 = Hotbox or 1 = Other.

Absolute Opacity: Current measurement 0…100.

Opacity: Current measurement 0…100.

Ref On: Reference light and amount of light sent out (limited to raw 4095)

Mes On: Measured return light, which is essentially signal strength (limited to raw 4095)

Ref Off : Reference light measured when laser is off

Mes Off : Measured return light measured when laser is off. Indicates level of ambient light

Laser Cur: Laser output in mA (range 0 and limited to 1650)

Temp: Transceiver temperature in Celsius times 10.

Uptime: The time the sensor had been active. Freeze after 65535 sec.

Alarm: 0 = no alarm, 1 = alarm

Warning: 0 = no warning, 1 = warning.

Transceiver ComErr: Modbus packet error since restart

ComOK: Communication packages successfully sent and received.

ComErr: Lost communication packages.

Laser Cur and Mes: During sensor initial setup, the transceiver is brought into a 'solid light' mode. The purpose of solid light mode is to get the laser current/output adjusted to the distance of the reflector. The transceiver is capable of scanning between 1 to 15m. Full power on the laser output is not desired on short distances since the laser 'blinds' itself. Neither is insufficient power desired in case the laser output must scan upto 15m.

Laser Output is adjusted gradually – takes about 15 sec to go the full range.

- **Laser Cur** is increased as long Mes or Ref has not reached 3500 (good and strong signal).
- **Laser Cur** will stop increasing when either Laser Cur reaches 150 (max power) or Mes / Ref reaches 3500 (max light output).
- **Perfect alignment** is minimum output (Laser Cur 50…60) and strongest signal (Mes 3500) on an empty stack with zero obstruction of light. However, in a normal operational scenario, an output (Laser Cur) of 50…100 and (Mes) 2200…3500 is accpetable.

ComOK and ComErr: These debug values keep track of the quality of communication.

- **ComOK** will keep increasing and by this saying communication packages are sent and received ok.
- **ComErr**, packages may be lost every now and then, which is acceptable. However, should ComErr keep counting or 60 packages are lost in a row, an Offline error will apprear. Transceiver could have been disconnected, accidental node address change, failed unit, or bus wiring has come loose, been cut or incorrectly wired.

Clear Com: Pressing **Clear Com** to reset Communication counter any time wished**.**

9 Maintenance

Besides normal cleaning of the lenses, the system does not require any maintenance.

The lenses must be carefully cleaned with a cleaning pad (part no. 02398).

It is strongly recommended to calibrate the system after cleaning the transceiver lens and the reflector. Refer to the section 7.4 Calibration. Please note that any kind of oil, smoke and water mist must not be present in the section between the transceiver and reflector during calibration.

Cleaning intervals depend on the usual amount of oil, smoke and water mist that contaminate the lenses. The accumulation of dirt on the transceiver lens/reflector will result in higher opacity readings and might therefore give false alarms. Refer to section 8.3.6.

The warning will be trigged if the fouling limit is reached and it can be used as a lens-cleaning alarm. When the warning alarm is ON, please clean the transceiver lens and the reflector.

The lifetime of the Transceiver is mainly limited to the lifetime of the laser light source. Several factors such as temperature, current consumption and system application affect the lifetime. Expected lifetime is more than 4 years.

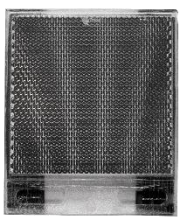
10 Troubleshooting

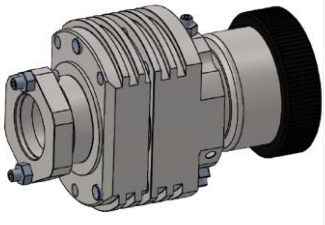
Troubleshooting should always be carried out by skilled personnel. The Hotbox Oil Mist Detection system is connected to hazardous electric voltages, which can cause personal injury if not handled correctly.

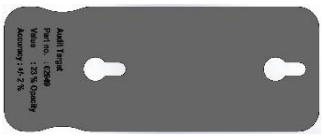
Trouble	Possible Cause →Action
No display at all	Incorrect Power Supply →Check the power supply fuse– the power supply needs to be connected to the correct voltage. Check Power to monitor box
No communication with one or more transceivers	Check green Power LED is lit on all transceivers. Check transceiver address 7.3. Check for duplicate addresses, especially if communication is missing on one or more transceivers.
Incorrect indication of opacity level	The alignment has changed (e.g. due to vibration or some impact) →realign the transceiver and the reflector – this can be checked by following the instruction in section 7.2. Lens contaminated with dirt →clean the transceiver lens and the reflector (using cleaning pad). The transceiver/reflector might have been damaged →replace the defected part. Zero and/or Span have drifted →see section 7.4 Scanning distance out of range →Please see the system specification.
Incorrect alarm level	Incorrect alarm level settings →change at Hotbox Monitor Cabinet (See section 8.6).
No alarm despite opacity between the lenses	Incorrect alarm level settings → change at Hotbox Monitor Cabinet (See section 8.6). Damaged/faulty parts →replace the respective part.
False alarm	Refer to section 8.3.7 Sensor Setup and Default Settings

11 Spare Parts

Spare parts are not included in the standard delivery. Spare parts can be ordered when necessary. When ordering spare parts, please mention the serial number of the equipment, which can be found on the label of the equipment.

Part No.	Part Description	The specific appearance of the parts list is subject change without notice; the function, however, will not change
00505	Fuse Automatic C 6KA 4A 2P	
103247	Hotbox Monitor Unit	
103350	G26.1 Hotbox Opacity Transceiver	
103336	Hotbox High Temperature Reflector	
103337	Reflector Square	

Part No.	Part Description	The specific appearance of the parts list is subject change without notice; the function, however, will not change
103338	ModbusTCP to RTU Converter	
03121	Alarm Relay	
02939	Cable with 5p Multiconnector - Length 2m	
03163	Cable with 5p Multiconnector - length 15m	
103368	O-ring 45 x 3.0 NBR 70 (set of 2 pcs)	
02398	Cleaning Pad	
103342	Hotbox Oil Mist Detection Manual.	
03865	Alignment Bracket	
Optional		
02905	Junction Box for Transceiver	

Part No.	Part Description	The specific appearance of the parts list is subject change without notice; the function, however, will not change
103636	Hotbox Reflector Side Mount Unit	
02947	Audit Target 100% Opacity (+/÷ 2% of full range)	
02949	Audit Target 22% Opacity (+/÷ 2% of full range)	
02950	Audit Target 8% Opacity (+/÷ 2% of full range)	
102191	Counter Piece Long (This part is component of part no.03865)	

12 Appendix

System Type	Hotbox Oil Mist Detection System	
Task:	**Updating of Firmware and Software for PLC and HMI**	
Task description:	This instruction identifies how to update Firmware and Software for the PLC and HMI	
Difficulty 1-5	Overhaul Interval	Estimated Time Consumption
🔧🔧	When necessary	30 min

Note: This operation must only be carried out by a skilled technician

Instructions

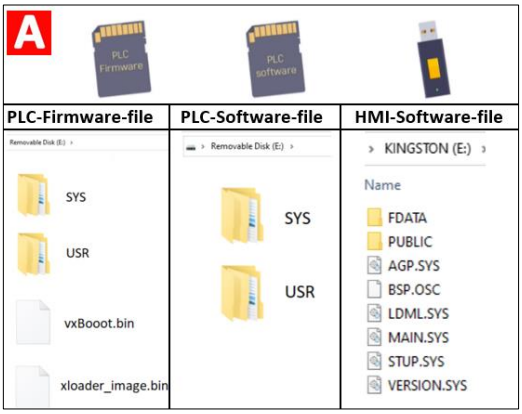
- Firmware and Software is loaded on SD-Card and USB-Stick, see picture A

SD-Card: Firmware for PLC

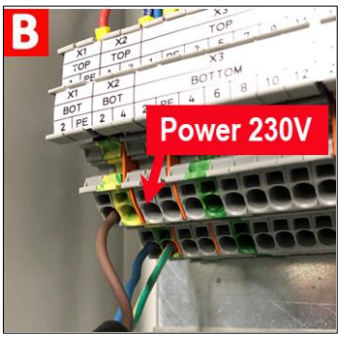
SD-Card: Software for PLC

USB-Stick: Software for HMI

- Check the content of the SD-Card and USB-Stick. Make sure the files are unzipped to the root folder of the SD-card and USB-Stick, see picture A



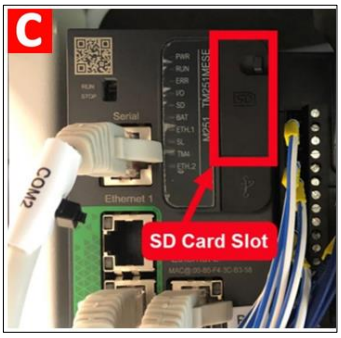
1. Install 230V cable in X1 terminal Blue cable in 1 TOP, Brown cable in 2 BOT and yellow cable in X1 yellow terminal for GND, see picture B.



Download Firmware (FW) for the PLC:

2. Insert SD-Card with FW in PLC in SD-Card Slot

- Swich on the cabinet - 230V.
- Wait approx. 3 min. The SD diode will turn green.
- Eject the SD-Card by pressing the SD-Card, see picture C.



Leave the power on the system.

Download Software (SW) for the PLC:

3. Insert the SD-Card with the SW for the PLC in the SD-Card slot

- Wait approx. 15 sec. The PLC diode will start flashing. ERR indicates that the SW has been downloaded.
- Eject the SD-Card by pressing the SD-Card.

Download SW - HMI Panel

4. Insert the USB-Stick with the HMI SW in the USB Slot 1, see picture D.

Follow the instruction on the screen. Requires Admin login:

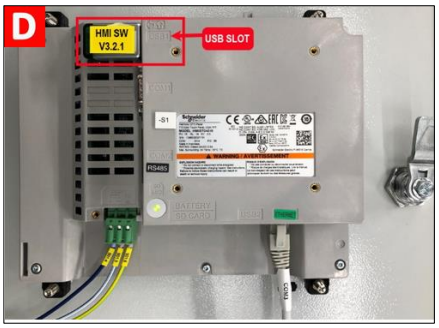
- Username: Admin
- Password: 1234

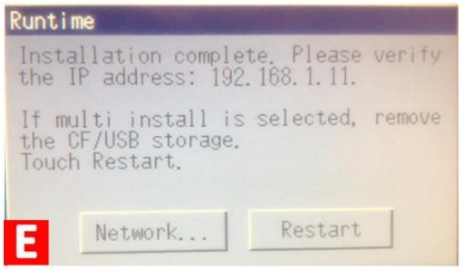
5. The system has successfully downloaded the SW, see picture E

- Remove the USB-Stick
- Reboot the system.

6. Check the SW is properly loaded.

- Press Setting at the display and check the Software name is the same for PLC and HMI, see picture F.





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