



WIO 200B and WIOI200B Water in oil sensor

User manual Rev. 1.11

111881-944 Rev. 1.11 WIO200B User manual

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Introduction

This user manual provides technical data regarding the WIO (water in lubrication oil, gear box oil, diesel oil, hydraulic oil or transformer oil) sensor system. The system consist of a WIO Sensor, terminal box and cables. The WIO Sensor is an insitu sensor which measures water content in lubrication oils on ship engine or similar. The Terminal box connects the sensor to power supply and to the ships surveillance system. The supplied cables are for connection between the WIO Sensor and the Terminal box





Safety Advice

For your safety

The *WIO200B* (WIO) is designed as water in oil monitoring system, with a relay switch-off function.

Before use please read the user manual and carefully store it in a safe place. Install and operate the device only after reading and comprehending the instruction manual, and after you are familiar with the valid rules on work safety and accident prevention.

Please use the device only as specified. For this purpose please also note the values in section "Technical data".

During transport, storage and operation please adhere to the conditions listed in "Technical data".

IMPORTANT

Only qualified personnel may assemble start-up and maintain the unit when it is in a zero voltage state. Only qualified electricians may work on electrical installations.

The connection and instruction manual contains information that enables the proper and efficient use of the WIO monitoring system. PAJ Sensors A/S is not liable for damage caused by improper use of this device. This manual is an integral part of the basic knowledge necessary for proper use of the system.

Rights

PAJ Sensors A/S reserves the right to alter its products without prior notice.

Copying and using the instruction manual for other purposes is only allowed with the acceptance from PAJ Sensors A/S.

PAJ Sensors A/S accepts no responsibility for possible errors and deficiencies in brochures, catalogues and other printed material.

PAJ Sensors A/S guarantees correct function as well as fulfillment of the safety requirements only when connections are made in accordance with instructions.



Safety observations

The comments about safety in this document will not discuss safety observations of individual machine parts where safety devices (usually safety relays) are applied. Here the respective instruction manuals will be referenced! This document merely describes how to establish a WIO and how to start it up.

WARNING

The monitoring system during machine operation cannot be guaranteed if the system is connected incorrectly or not used as specified. This may lead to fatal injuries. Interventions and changes to the WIO monitoring system are not permitted, unless they are explicitly described in this user manual or be written from PAJ Sensors A/S.

The regional legal regulations and conditions of the liability insurance of the employer must be maintained.

Area of application

The WIO monitoring system is usually used in engines where a WIO will monitor the water content in lubrication oil, gear box oil, diesel oil, hydraulic oil or transformer oil.

The advantage of this monitoring system is the simple 4-20 mA interface and the two relays indicating alarms, with digital readout.

Normally the WIO sensor is calibrated in Taro30 lubrication oil, if nothing else is defined from customer.



Function

Short description of the function

PAJ Sensors A/S has developed a water in oil (WIO) monitoring system. The fundamental idea of the WIO system is to easily and continuously monitor the water activity (a_w) in oil. The output is converted into a standard 4-20 mA output.

The system also includes two relays indicating when too much water is present in the oil. Default alarm values are set to 0,5 a_w (high alarm) and 0,9 a_w (high high alarm)

By use of the WIO-Software it is possible to change HHA and HA levels. Furthermore you can continuously read out and graph the a_w (or PPM) of water in the oil.

WARNING

Do not use the sensor or relays to automatically enable/turn on or disable/shut down engine. The decision to enable/turn on or disable/shut down an engine, based on the sensor data, must be taken by proper trained crew personnel, not by the sensor system.



Normal operation

Water activity (a_w) provides the relative availability of water in oil where pure oil has an activity of zero and oil saturated with distilled water has an activity of exactly one. Under normal operation the WIO200B continuously supplies an output analogue signal of 4 to 20 mA corresponding to 0.01 to 1.00 a_w . Alarm indications with 0.03 a_w hysteresis via 2 relays are provided for each sensor. These data can also be read out from the sensor on the RS485 Modbus communication line.

Default alarm values are 0,5 a_w and 0,9 a_w . Assumes these alarm values:

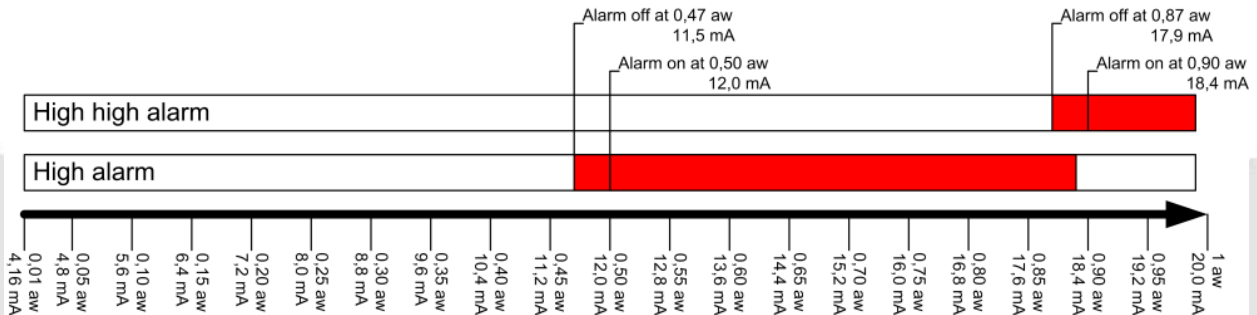
High alarm on at 0,50 a_w (12 mA).

High alarm off at 0,47 a_w (11,5 mA)

High high alarm on at 0,90 a_w (18,4 mA).

High high alarm off at 0,87 a_w (17,9 mA).

High high alarm will disable high alarm, thus only one alarm can be active.





Failure indication

Internal function failure will be indicated by activating both alarm relays at the same time, or indicated as defined in the NAMUR NE43.

Internal failures includes:

- Sensor reading out of range.
- Sensor reading CRC error.
- Unstable Sensor reading.

NAMUR NE43 is a German fault detection standard for 4-20mA analogue signals. It allows the user to know if there is a fault within the instrument, by sending analogue signal below 4mA and/or above 20mA. In accordance with NAMUR NE43, the failure is indicated by:

- Fault indicated by analogue output = <2,0 mA



Self test for alarm functions



On the WIO Sensor there is a button for testing the alarm functions. By pushing the Test button for 5 sec the high alarm relay turns on, and by pushing the Test button for 10 sec the high alarm relay turns off and the high high alarm turns on. When the Test button has been pushed continuously for more than 15 sec, it will be ignored by the software, and the relays return to normal operation.

Test Button	Mode	Output Relay	Analogue Output
Un-pressed	Normal operation and no alarm	Relay 1 Open Relay 2 Open	Normal
Pressed longer than 5 sec	Test of high alarm	Relay 1 Closed Relay 2 Open	Normal
Pressed longer than 10 sec	Test of high high alarm	Relay 1 Open Relay 2 Closed	Normal
Pressed longer than 15 sec	Normal operation	Normal	Normal



Test Button	Mode	Output Relay	Analogue Output
Un-pressed	Normal operation, with high alarm active	Relay 1 Closed Relay 2 Open	Normal
Pressed longer than 5 sec	Test of high alarm	Relay 1 Closed Relay 2 Open	Normal
Pressed longer than 10 sec	Test of high high alarm	Relay 1 Open Relay 2 Closed	Normal
Pressed longer than 15 sec	Normal operation	Normal	Normal



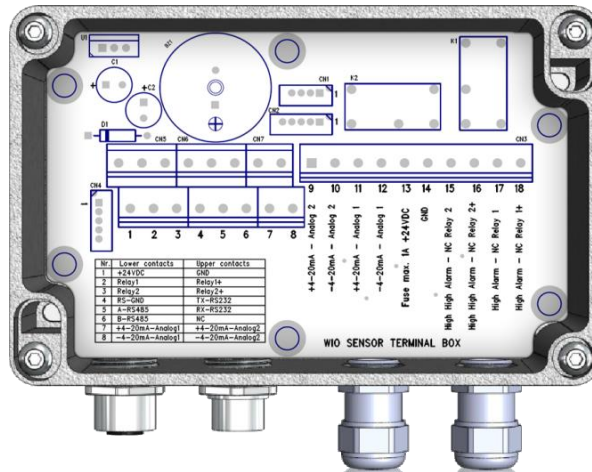
Before installation



IMPORTANT

Only qualified personnel may assemble and maintain the unit. Only qualified personnel may install the unit.

Screw in probe pressure-tight directly in the center of the oil pipe where the measurement is to take place. The threads should be sealed with Loctite® 271. The sensor should be mounted with max. torque of 35 Nm. Connect the cables from the WIO sensor to the Terminal box. Use a hexagon wrench size 30.



To sensor

Power and Alarms

IMPORTANT

Only qualified personnel may assemble start-up and maintain the terminal box(s) when it is in a zero voltage state. Only qualified electricians may work on electrical installations.

Install +24 VDC and GND into the terminal box and connect the 4-20 mA to an external device if needed. Connect the relay to external device if needed.

If the terminal box has a (a_w) or PPM display, there must be a short circuit between terminals 11 and 12. This short circuit produces the needed closed loop for mA measurement.

If the terminal box has a °C or °F display, there must be a short circuit between terminals 9 and 10. This short circuit produces the needed closed loop for mA measurement. **Only for WIO and WIOI 300/400/500**

After installing the WIO-Software can PC and terminal box be connected through DB9 connector. **Only for WIO and WIOI 300/400/500**

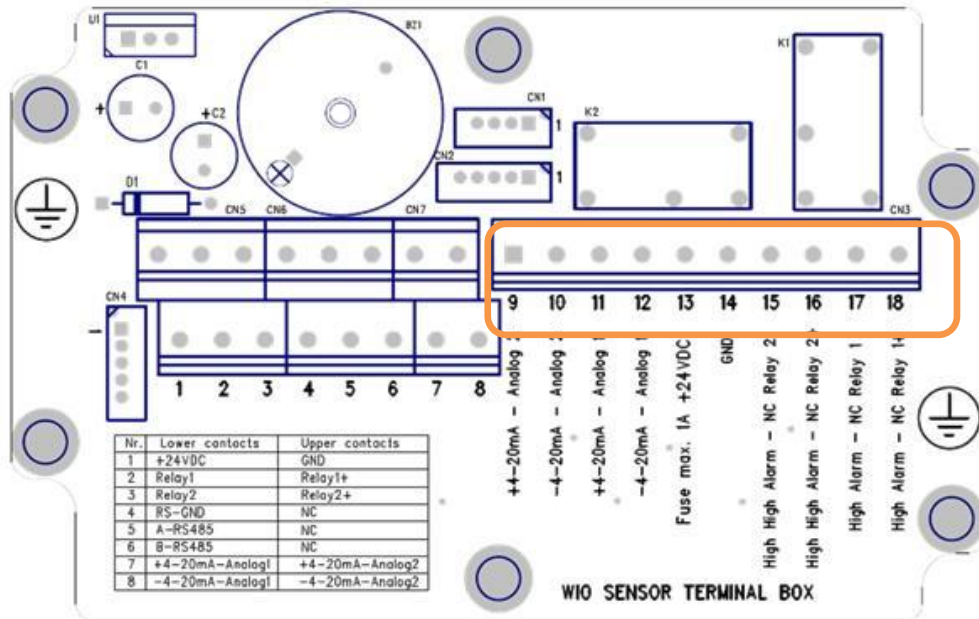
Last connect the cables from the Terminal box to the sensor.

It is allowed (but not necessary) to connect screw terminal 10 and 12 "-4-20 mA" to screw terminal 14 "GND", thus creating common ground for the output and the power.

Terminal boxes with display. Screw terminal pin 11 and 12 or screw terminal pin 9 and 10 can be connected to external equipment, but only in a closed loop for mA measurement.



Terminal Box Connection



Contact Assignment

There is only one connector **CN3** for using of the terminal box contacts.

Contact-Number	Description
9	+4 – 20 mA positive analog output signal for indication of temperature in oil. This option is not available for WIO200B Only for WIO and WIOI 300/400/500
10	-4 – 20 mA return analog signal for indication of temperature in oil. This option is not available for WIO200B Only for WIO and WIOI 300/400/500
11	+4 – 20 mA positive analog output signal for indication of a_w or PPM in oil.
12	-4 – 20 mA return analog signal for indication of a_w or PPM in oil.
13	Power supply, 24VDC \pm 10% and with max. residual voltage ripple 10%
14	Power supply ground terminal contact
15	Relay contact for HH Alarm
16	Relay contact for HH Alarm
17	Relay contact for H Alarm
18	Relay contact for H Alarm

In connection more than one terminal box please refer to:

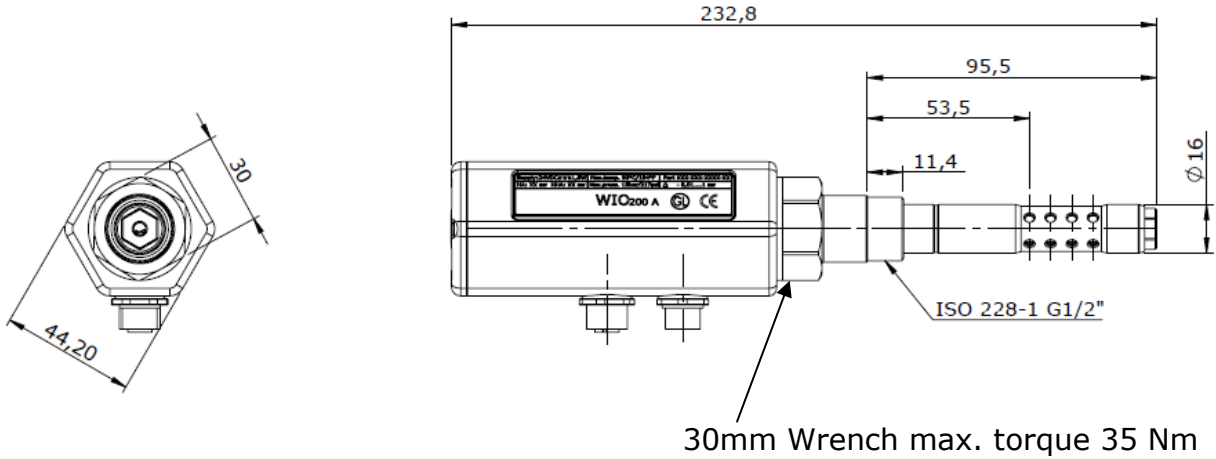
- Appendix A1
- Appendix A2
- Appendix A3

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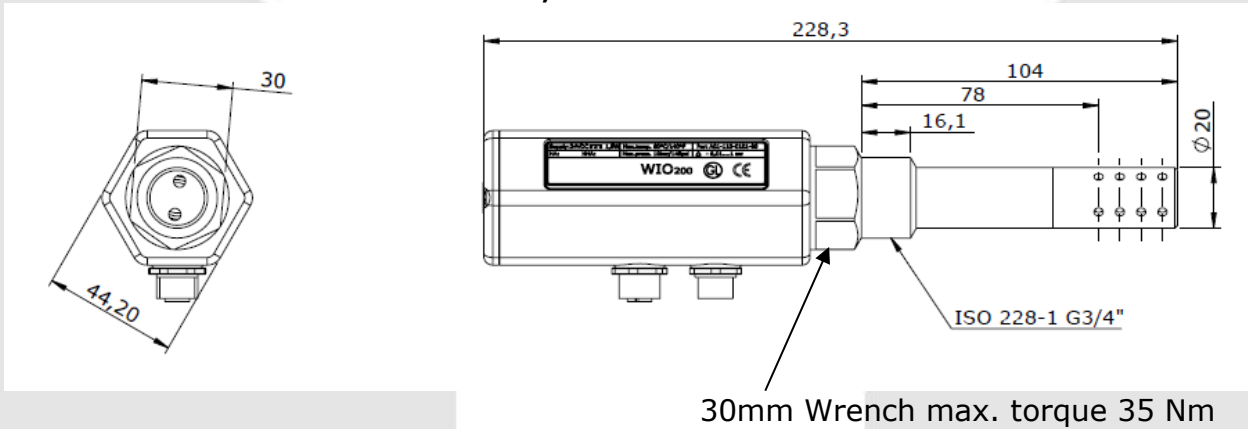


WIO Sensor dimensions in mm

WIO Standard 1/2" thread Sensor, Short dimensions in mm:

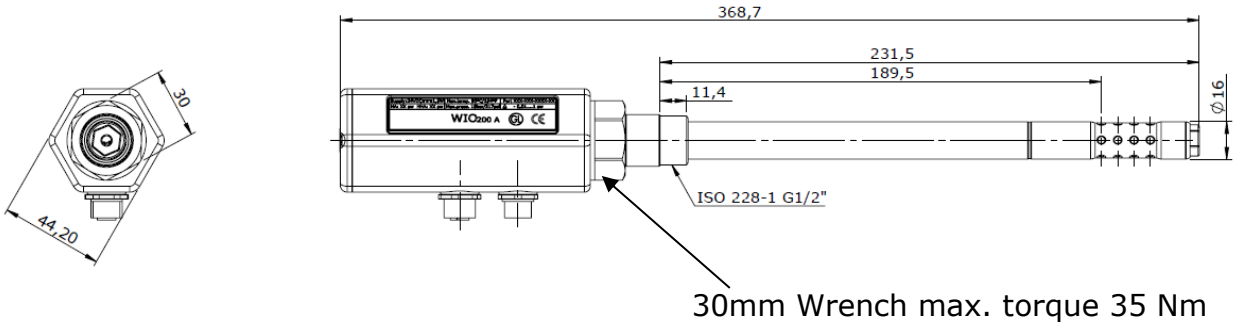


WIO Standard 3/4" thread Sensor, Short dimensions in mm:



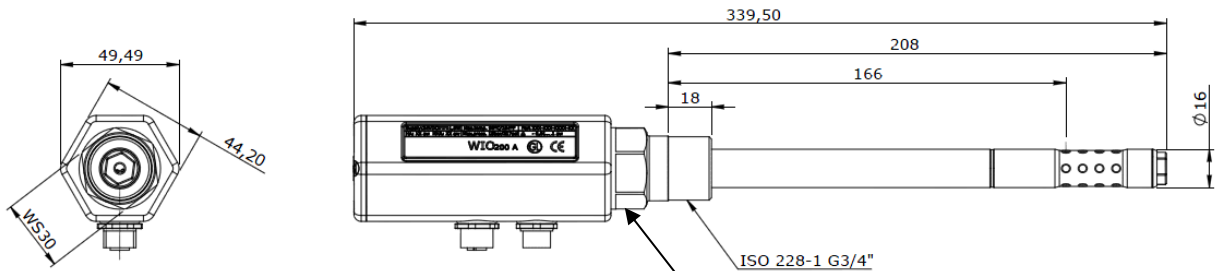


WIO Ball Valve pipe 1/2" thread Sensor, Long dimensions in mm:



30mm Wrench max. torque 35 Nm

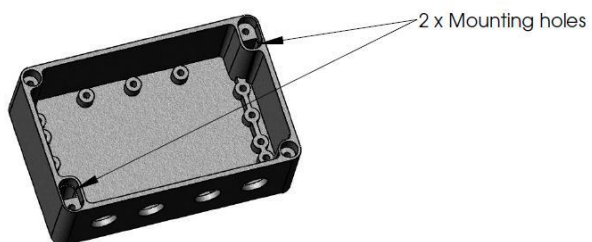
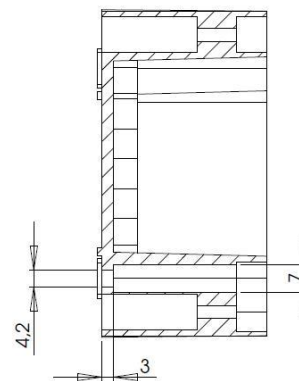
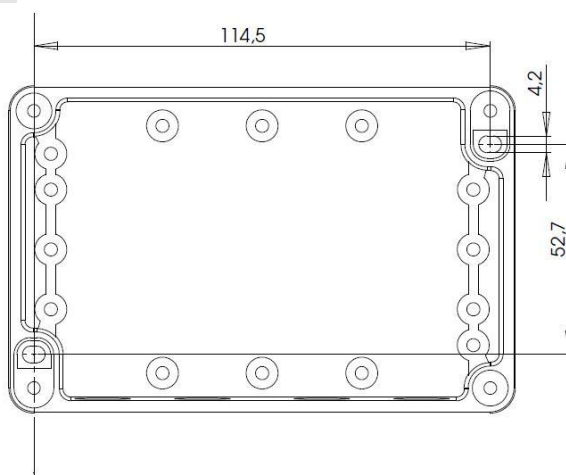
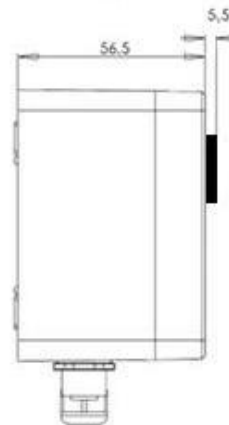
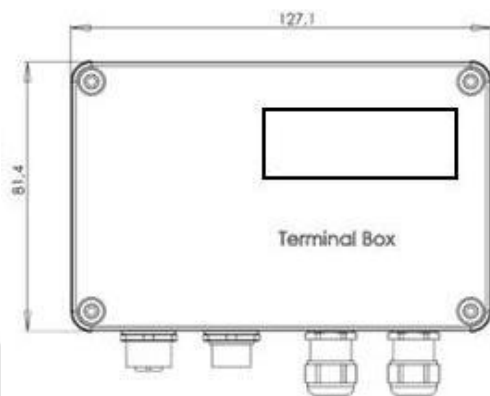
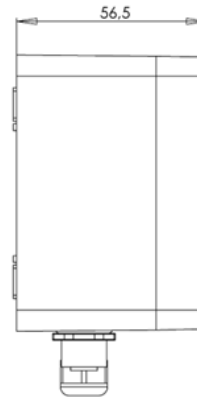
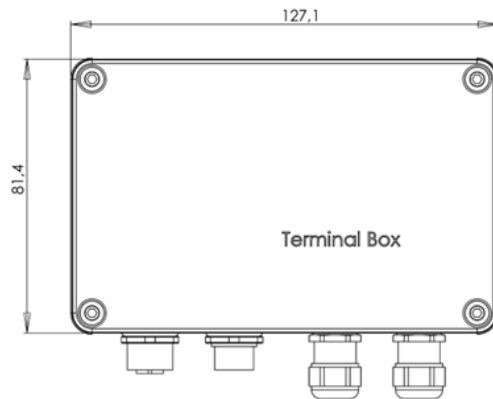
WIO Ball Valve pipe 3/4" thread Sensor, Long dimensions in mm:



30mm Wrench max. torque 35 Nm

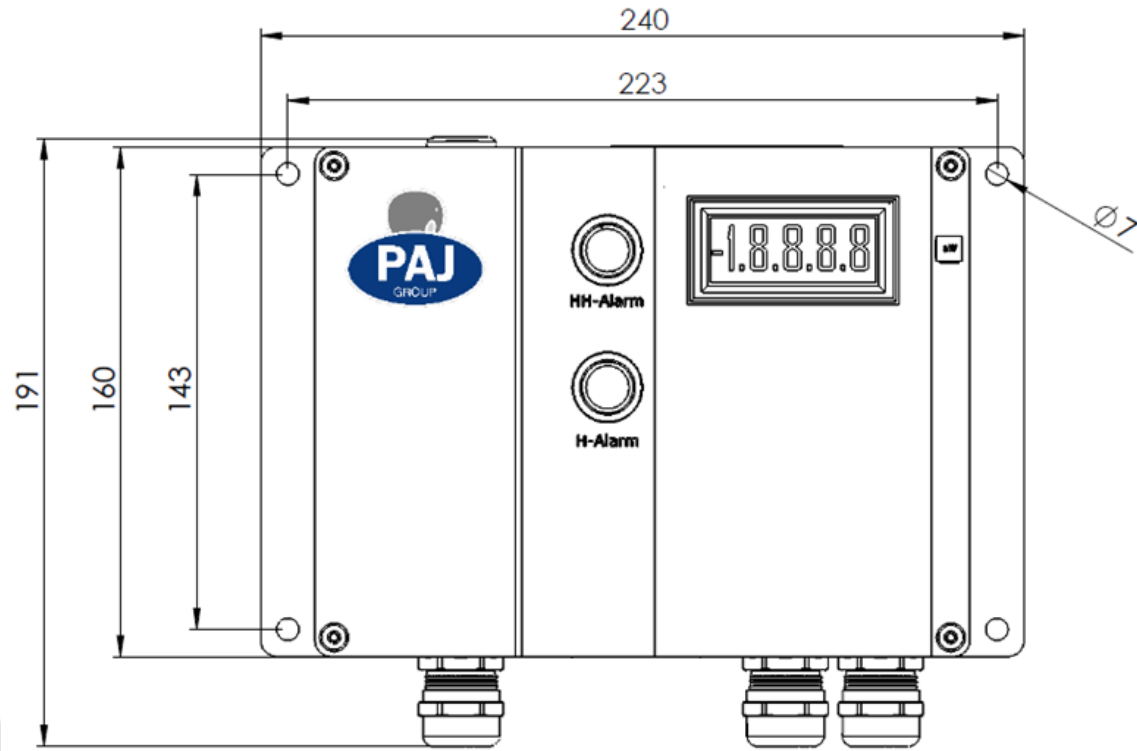


Terminal box dimensions in mm

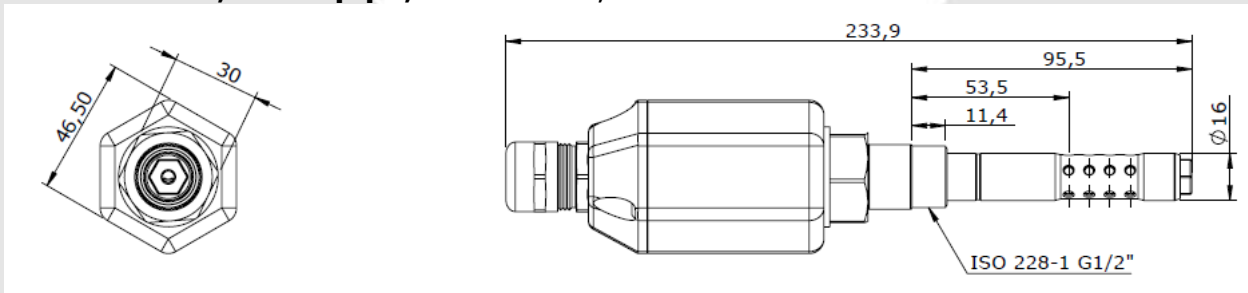




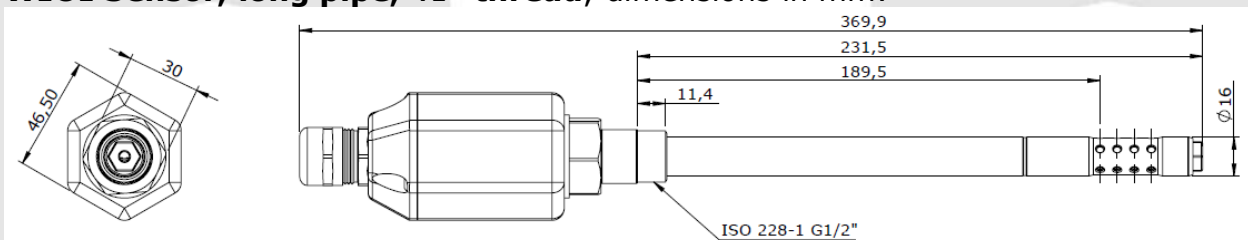
WIO Integrated (WIOI) dimensions in mm



WIOI Sensor, short pipe, 1/2" thread, dimensions in mm:

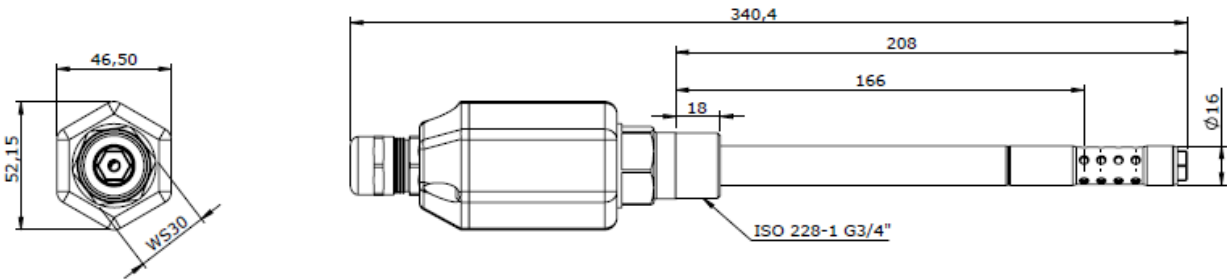


WIOI Sensor, long pipe, 1/2" thread, dimensions in mm:





WIOI Sensor, long pipe, 3/4" thread, dimensions in mm:





Technical data, Sensors



WIO Standard 3/4" (ISO 228-1 G3/4"), Short



WIO Standard 1/2" (ISO 228-1 G1/2"), Short



WIO Ball Valve pipe, Long

Output	
Analogue output (galvanic isolated)	4 – 20 mA for a_w
Max. Load (analogue output)	< 500 Ω
Measurement Range (4 – 20 mA)	0,01 – 1,00 a_w
Accuracy (0,05-0,95 a_w)	\pm 0,03 a_w
Accuracy (outside 0,05-0,95 a_w)	\pm 0,05 a_w
Resolution	< 0,004 a_w
Input	
Supply nominal voltage	24V DC \pm 10%
Max. residual voltage ripple	10%
Maximum Load current	200 mA
Max. Power input	< 4,8 VA



Relays	
Contact arrangement	2 x Normally Closed (NC)
Rated voltage	60V
Rated current (40°C)	1A
Max. DC Load breaking capacity	
Relay 1	„High Alarm“
Relay 2	„High High Alarm“
Default High Alarm	0,50 a _w
Default High High Alarm	0,90 a _w

Socket specification	
Connector design	1x male socket, 1x female socket
Connector locking system	Screw-locking, M12x1
Wire gauge	0,25 mm ²
Contacts	8 Pol
Rated voltage	60V
Rated current (40°C)	1A

Cable specification	
Cable design	Multipair overall screened cable
Outlet diameter	9,9 mm
Voltage class	0,6/1kV
Wires	4x2 twisted pair
Wire gauge	0,75 mm ²

Media for measurement	
Lubrication oil	Grade SAE 30/TBN 5-10
Max. Oil temperature	90°C
Max. Oil pressure	Sensor mounting method in application: Ball valve mounted: Max. 10 Bar Thread mounted: Max. 20 Bar



Response times	
Delay before valid data from start-up	< 30 s
Delay before valid data from installation (first use)	10 minutes
Device Failure Indication	
Analogue output	< 2 mA
Manual test	
Press sensor test button for 5 seconds	High Alarm turns on for 5 seconds
Press sensor test button for 10 seconds	High Alarm turns off High High Alarm turns on for 5 seconds
Press sensor test button for 15 seconds	Normal operating and test button ignored
Miscellaneous	
Ambient Temperature, running / storage	0 - 90°C / -30 - +95°C
Relative humidity for running and storage	10% up to 95%, no condensation
Re calibration	Recommended with max 3 years interval
Warranty	2 years
Approvals	
Germanischer Loyd	WIO products are EU approval under 75 965 - 09 HH date 2009-11-30
Enclosure	
Weight for WIO standard	650 grams
Weight for WIO Ball valve pipe	790 grams
Connection (mechanical)	ISO 228-1 G 1/2" or 3/4" thread 2 x 8-pole connectors, male and female, M12x1 thread
Enclosure material	Stainless Steel/Aluminum EN44100 (Former 4261)
Protective type	IP66



Technical Data Terminal Box



Output	
Analogue output	See the specifications for sensor's analogue output
Digital output	See the specifications for sensor's digital output
Input	
Supply nominal voltage	24V DC \pm 10%
Max. residual voltage ripple	10%
Maximum Load current	200 mA
Max. Power input	< 4,8 VA
Relays	
Contact arrangement	2 x Normally Open (NO)
Rated voltage	250 VAC
Max. switching voltage	400VAC
Rated current	2A
Breaking capacity max.	1250VA
Enclosure	
Weight	650 grams
Connection to sensor (mechanical)	2 x 8-pole connectors, male and female, M12x1 thread
Connection (mechanical)	2 x M20 gland, cable diameter 6 to 12 mm
Enclosure material	Aluminum
Protective type	IP66
Warranty	2 years

FUNCTIONING

Terminal box shall be provided with 24vdc.
Terminal box supply 24vdc on to WIO sensor.
WIO sensor delivers mA, digital values and relay status to the terminal box.



Technical Data Terminal Display Box



Output	
Analogue output	See the specifications for sensor's analogue output
Digital output	See the specifications for sensor's digital output
Input	
Supply nominal voltage	24V DC \pm 10%
Max. residual voltage ripple	10%
Maximum Load current	200 mA
Max. Power input	< 4,8 VA
Relays	
Contact arrangement	2 x Normally Open (NO)
Rated voltage	250 VAC
Max. switching voltage	400VAC
Rated current	2A
Breaking capacity max.	1250VA
Display version - a_w (water activity from 0,01 to 1,00)	
Accuracy (0,05-0,95 a_w)	\pm 0,03 a_w
Resolution	<0,004 a_w
Display version - PPM (H₂O)	
Accuracy (0,05-0,95 a_w)	\pm 30%
Resolution	1 PPM
Enclosure	
Weight	650 grams
Connection to sensor (mechanical)	2 x 8-pole connectors, male and female, M12x1 thread
Connection (mechanical)	2 x M20 gland, cable diameter 6 to 12 mm
Enclosure material	Aluminum
Protective type	IP66
Warranty	2 years



FUNCTIONING

Terminal box shall be provided with 24vdc.
Terminal box supply 24vdc on to WIO sensor.
Terminal box measuring mA from the sensor, and convert it to a_w or PPM value.
WIO sensor delivers mA, digital value and relay status to the terminal box.

IMPORTANT

The display is an indication of the water level in the oil. Display can be shipped as PPM or a_w .

Upon ordering a PPM display the customer must specify the water saturation point in PPM of the used oil at the preferred working temperature of the oil. The saturation point is typically between 3000-10000 PPM. Alternatively the customer can ship 10 liters of oil to PAJ Sensor A/S for inspection including specification of the working oil temperature.

WARNING

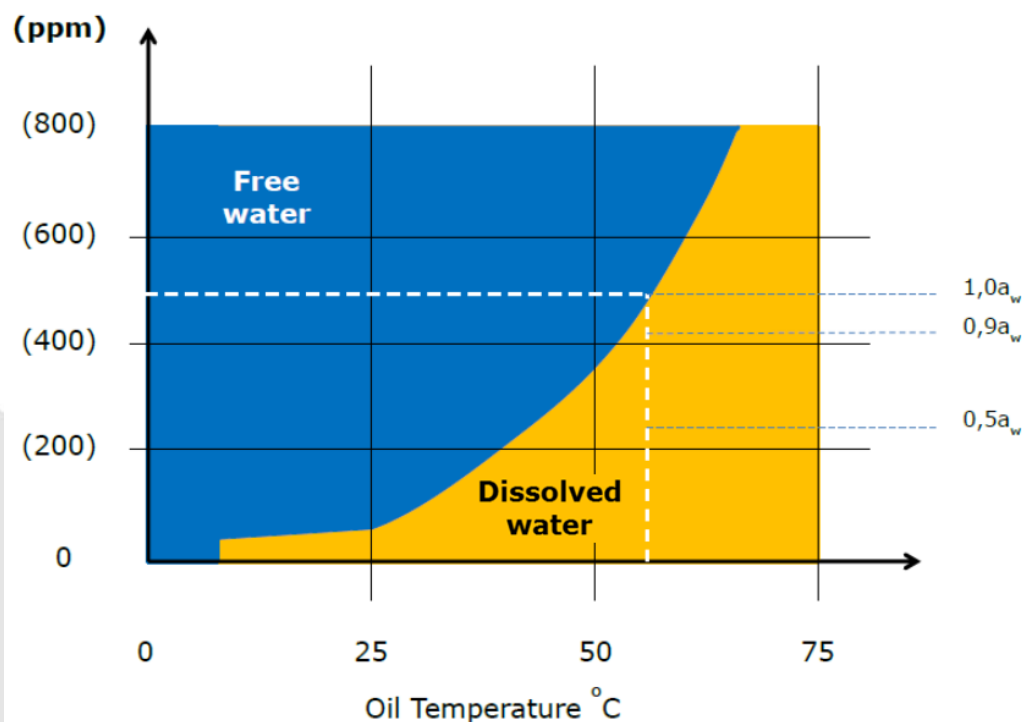
All displays will show from positive values when operating properly. There will appear a negative value during start-up, after 5 seconds the value will be in positive measurement range. Otherwise, if a negative value is present the Terminal box might have been installed incorrectly.



NOTE

WIO200B uses 3 different units for the measurement of water in oil:

- 1) **a_w** : WIO measures humidity in **a_w** . The range is 0.01...1.00 a_w .
- 2) **%RH** (relative humidity) is identical to the unit a_w multiplied by 100. The range is 1...100 %RH
- 3) **ppm**: WIO can convert **a_w** to **ppm**. In this case the saturation point, at a given temperature, must be known. Output in ppm is only reliable at this temperature.





Technical Data Terminal Box Alarm



Output	
Analogue output	See the specifications for sensor's analogue output
Digital output	See the specifications for sensor's digital output
Input	
Supply nominal voltage	24V DC \pm 10%
Max. residual voltage ripple	10%
Maximum Load current	200 mA
Max. Power input	< 4,8 VA
Relays	
Contact arrangement	2 x Normally Open (NO)
Rated voltage	250 VAC
Max. switching voltage	400VAC
Rated current	2A
Breaking capacity max.	1250VA
Buzzer	
Oscillation frequency	3000 \pm 500 Hz
Sound pressure level	85db by open housing
Tone	Pulsed
Button with LED	
Blink frequency	2 Hz
Color	RED
Enclosure	
Weight	530 grams
Connection to sensor (mechanical)	2 x 8-pole connectors, male and female, M12x1 thread
Connection (mechanical)	2 x M20 gland, cable diameter 6 to 12 mm
Enclosure material	Aluminum
Protective type	IP66
Warranty	2 years



FUNCTIONING

Terminal box shall be provided with 24vdc.
Terminal box supply 24vdc on to WIO sensor.
Terminal box indicate the relay status from the WIO sensor.
WIO sensor delivers mA, digital values and relay status to the terminal box.

H-Alarm LED is for indication of the High Alarm relay state from the WIO sensor. When the alarm condition is generated by the WIO sensor, then the High Alarm relay is open and the H-Alarm LED flash red ON/OFF sequence to show the High Alarm state, and the alarm signal buzzer will be switched ON.

HH-Alarm LED is for indication of the High High Alarm relay state from the WIO sensor. When the alarm condition is generated by the WIO sensor, then the High High Alarm relay is open and the HH-Alarm LED flash red ON/OFF sequence to show the High High Alarm state, and the alarm signal buzzer will be switched ON.

The H-Alarm LED or HH-Alarm LED will stay in blinking mode until the H-Alarm or HH-Alarm button is pressed, then the LED constantly turned on. The alarm signal buzzer will stay on until the H-Alarm or HH-Alarm button is pressed.



Abstract representation of the H-Alarm and HH-Alarm button and LED function:

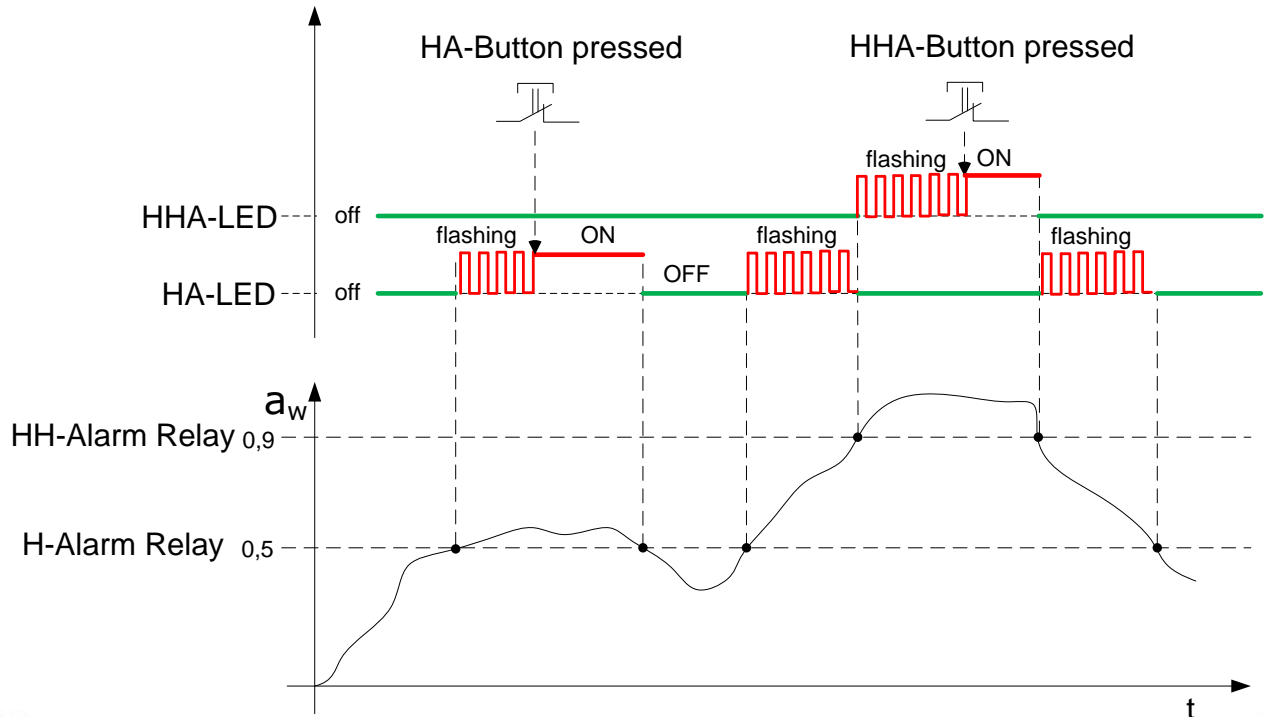


Figure 1: H-Alarm and HH-Alarm button function



Technical Data Terminal Box Alarm Buzzer



Output	
Analogue output	See the specifications for sensor's analogue output
Digital output	See the specifications for sensor's digital output
Input	
Supply nominal voltage	24V DC \pm 10%
Max. residual voltage ripple	10%
Maximum Load current	200 mA
Max. Power input	< 4,8 VA
Relays	
Contact arrangement	2 x Normally Open (NO)
Rated voltage	250 VAC
Max. switching voltage	400VAC
Rated current	2A
Breaking capacity max.	1250VA
Display version - a_w (water activity from 0,01 to 1,00)	
Accuracy (0,05-0,95 a_w)	\pm 0,03 a_w
Resolution	<0,004 a_w
Display version - PPM (H₂O)	
Accuracy (0,05-0,95 a_w)	\pm 30%
Resolution	1 PPM
Buzzer	
Oscillation frequency	3000 \pm 500 Hz
Sound pressure level	85db by open housing
Tone	pulsed



Button with LED	
Blink frequency	2 Hz
Color	RED
Enclosure	
Weight	650 grams
Connection to sensor (mechanical)	2 x 8-pole connectors, male and female, M12x1 thread
Connection (mechanical)	2 x M20 gland, cable diameter 6 to 12 mm
Enclosure material	Aluminum
Protective type	IP66
Warranty	2 years

FUNCTIONING

Terminal box shall be provided with 24vdc.
Terminal box supply 24vdc on to WIO sensor.
Terminal box measuring mA from the sensor, and convert it to a_w or PPM value.
WIO sensor delivers mA, digital values and relay status to the terminal box.

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HH-Alarm LED is for indication of the High High Alarm relay state from the WIO sensor. When the alarm condition is generated by the WIO sensor, then the High High Alarm relay is open and the HH-Alarm LED flash red ON/OFF sequence to show the High High Alarm state, and the alarm signal buzzer will be switched ON.

The H-Alarm LED or HH-Alarm LED will stay in blinking mode until the H-Alarm or HH-Alarm button is pressed, then the LED constantly turned on. The alarm signal buzzer will stay on until the H-Alarm or HH-Alarm button is pressed.



Abstract representation of the H-Alarm and HH-Alarm button and LED function:

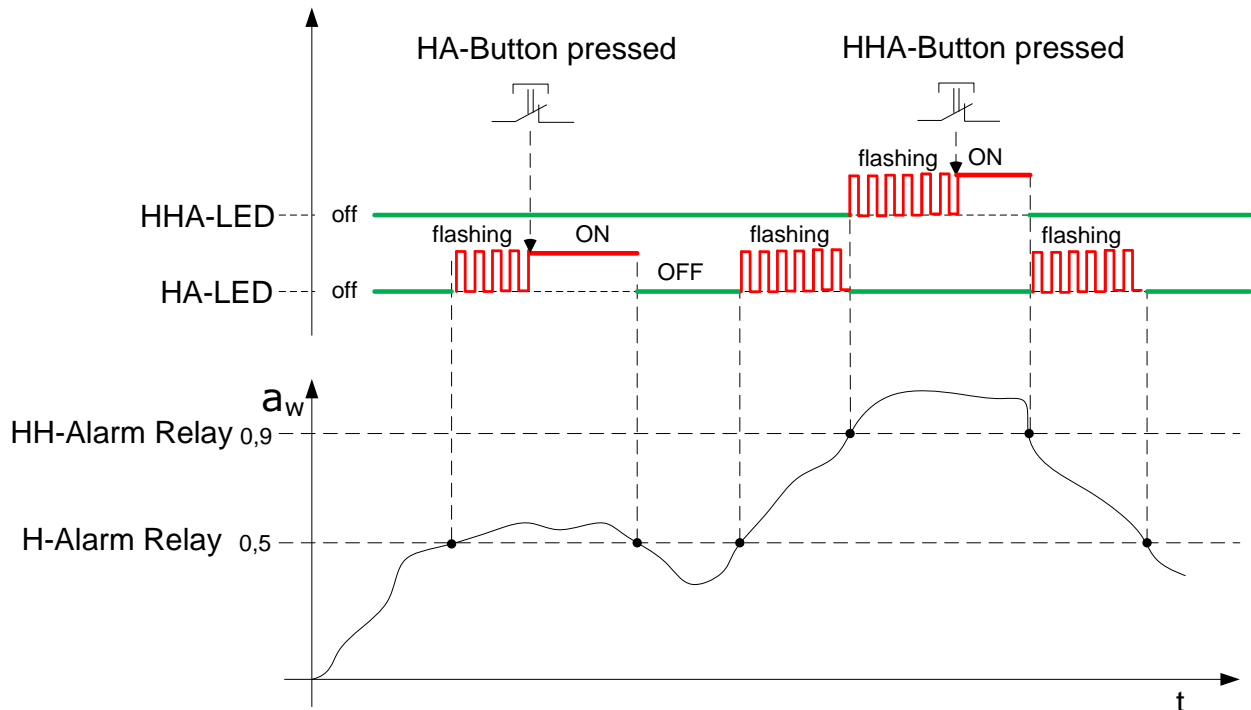


Figure 2: H-Alarm and HH-Alarm button function

IMPORTANT

The display is an indication of the water level in the oil. Display can be shipped as PPM or a_w .

Upon ordering a PPM display the customer must specify the water saturation point in PPM of the used oil at the preferred working temperature of the oil. The saturation point is typically between 3000-10000 PPM. Alternatively the customer can ship 10 liters of oil to PAJ Sensor A/S for inspection including specification of the working oil temperature.

WARNING

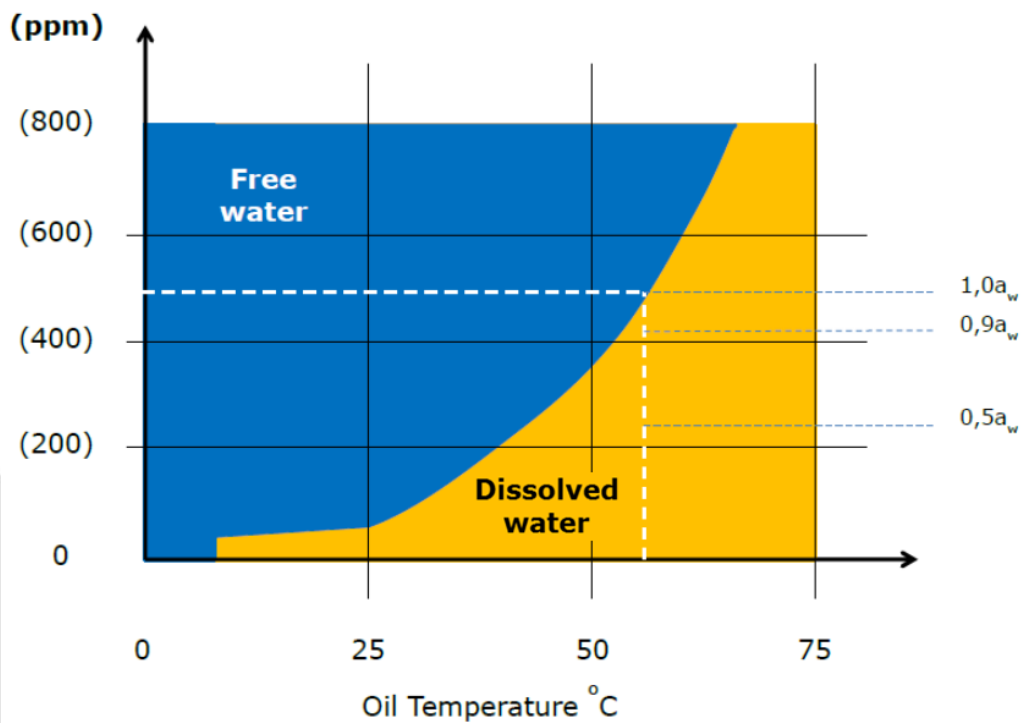
All displays will show from positive values when operating properly. There will appear a negative value during start-up, after 5 seconds the value will be in positive measurement range. Otherwise, if a negative value is present the Terminal box might have been installed incorrectly.



NOTE

WIO200B uses 3 different units for the measurement of water in oil:

- 1) **a_w** : WIO measures humidity in **a_w** . The range is 0.01...1.00 a_w .
- 2) **%RH** (relative humidity) is identical to the unit a_w multiplied by 100. The range is 1...100 %RH
- 3) **ppm**: WIO can convert **a_w** to **ppm**. In this case the saturation point, at a given temperature, must be known. Output in ppm is only reliable at this temperature.





Technical data, WIOI (WIO Integrated)



Output	
Analogue output (galvanic isolated)	4 – 20 mA for a_w
Max. Load (analogue output)	< 500 Ω
Measurement Range (4 – 20 mA)	0,01 – 1,00 a_w
Accuracy (0,05-0,95 a_w)	$\pm 0,03 a_w$
Accuracy (outside 0,05-0,95 a_w)	$\pm 0,05 a_w$
Resolution	< 0,004 a_w
Input	
Supply nominal voltage	24V DC $\pm 10\%$
Max. residual voltage ripple	10%
Maximum Load current	200 mA
Max. Power input	< 4,8VA



Relays	
Contact arrangement	2 x Normally Open (NO)
Rated voltage	250VAC
Max. switching voltage	400VAC
Rated current	2A
Breaking capacity max.	1250VA
Max. DC Load breaking capacity	
Relay 1	„High Alarm“
Relay 2	„High High Alarm“
Default High Alarm	0,50 a _w
Default High High Alarm	0,90 a _w

Cable specification	
Cable design	Multipair overall screened cable
Outlet diameter	9,9 mm
Voltage class	0,6/1kV
Wires	4x2 twisted pair
Wire gauge	0,75 mm ²

Media for measurement	
Lubrication oil	Grade SAE 30/TBN 5-10
Max. Oil temperature	90°C
Max. Oil pressure	Sensor mounting method in application: Ball valve mounted: Max. 10 Bar Thread mounted: Max. 20 Bar

Response times	
Delay before valid data from start-up	< 30 s
Delay before valid data from installation (first use)	10 minutes



Device Failure Indication	
Analogue output	< 2 mA
Manual test	
Press sensor test-button for 5 seconds	High Alarm turns on for 5 seconds
Press sensor test-button for 10 seconds	High Alarm turns off High High Alarm turns on for 5 seconds
Press sensor test-button for 15 seconds	Normal operating and test button ignored
Display version - a_w (water activity from 0,01 to 1,00)	
Accuracy (0,05-0,95 a _w)	± 0,03 a _w
Resolution	<0,004 a _w
Display version - PPM (H₂O)	
Accuracy (0,05-0,95 a _w)	±30%
Resolution	1 PPM
Buzzer	
Oscillation frequency	3000±500 Hz
Sound pressure level	85db by open housing
Tone	pulsed
Button with LED	
Blink frequency	2 Hz
Color	RED
Enclosure	
Weight	4000 grams
Connection (mechanical)	ISO 228-1 G ½" or ¾" thread 2 x gland M20, cable diameter 6 to 12 mm
Enclosure material	Stainless Steel/Aluminum EN44100 (Former 4261)
Protective type	IP66



Miscellaneous	
Ambient Temperature, running / storage	0 - 90°C / -30 - +95°C
Relative humidity for running and storage	10% up to 95%, no condensation
Re calibration	Recommended with max 3 years interval
Warranty	2 years
Approvals	
Germanischer Lloyd	WIO products are EU approval under 75 965 - 09 HH date 2009-11-30

FUNCTIONING

Terminal box shall be provided with 24vdc.
Terminal box supply 24vdc on to WIO sensor.
Terminal box measuring mA from the sensor, and convert it to a_w or PPM value.
WIO sensor delivers mA, digital values and relay status to the terminal box.

H-Alarm LED is for indication of the High Alarm relay state from the WIO sensor. When the alarm condition is generated by the WIO sensor, then the High Alarm relay is open and the H-Alarm LED flash red ON/OFF sequence to show the High Alarm state, and the alarm signal buzzer will be switched ON.

HH-Alarm LED is for indication of the High High Alarm relay state from the WIO sensor. When the alarm condition is generated by the WIO sensor, then the High High Alarm relay is open and the HH-Alarm LED flash red ON/OFF sequence to show the High High Alarm state, and the alarm signal buzzer will be switched ON.

The H-Alarm LED or HH-Alarm LED will stay in blinking mode until the H-Alarm or HH-Alarm button is pressed, then the LED constantly turned on. The alarm signal buzzer will stay on until the H-Alarm or HH-Alarm button is pressed.



Abstract representation of the H-Alarm and HH-Alarm button and LED function:

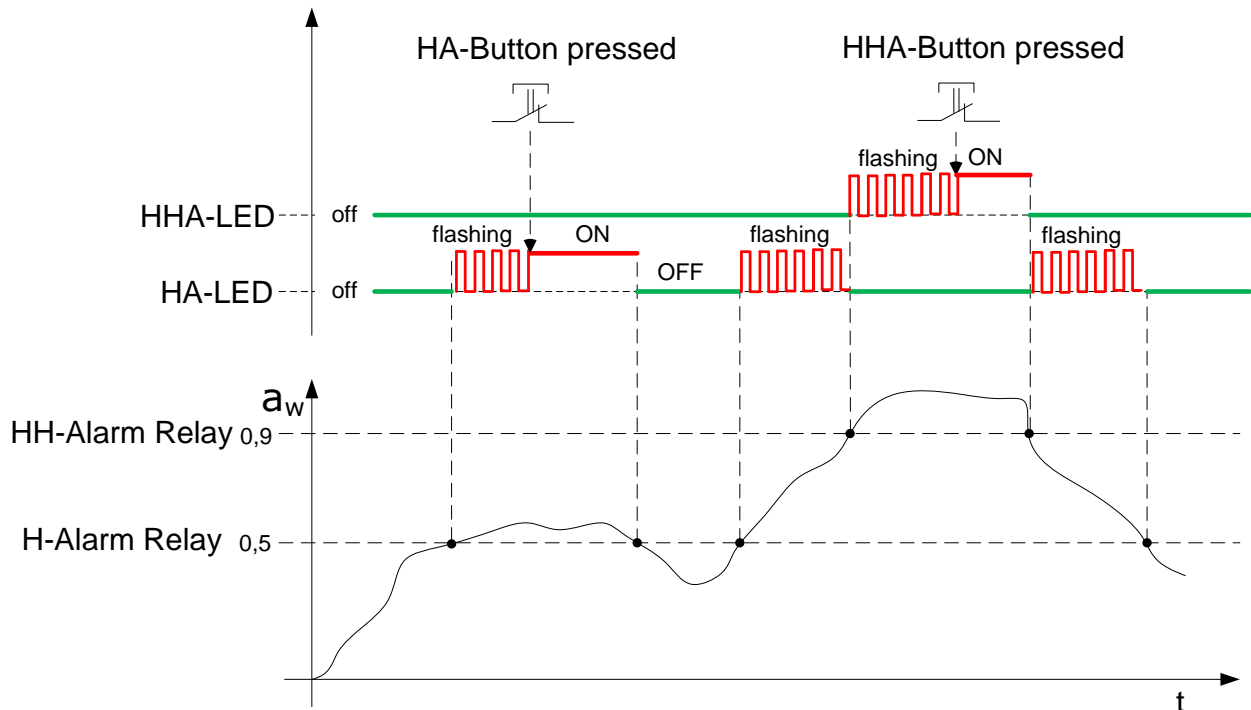


Figure 2: H-Alarm and HH-Alarm button function

IMPORTANT

The display is an indication of the water level in the oil. Display can be shipped as PPM or a_w .

Upon ordering a PPM display the customer must specify the water saturation point in PPM of the used oil at the preferred working temperature of the oil. The saturation point is typically between 3000-10000 PPM. Alternatively the customer can ship 10 liters of oil to PAJ Sensor A/S for inspection including specification of the working oil temperature.

WARNING

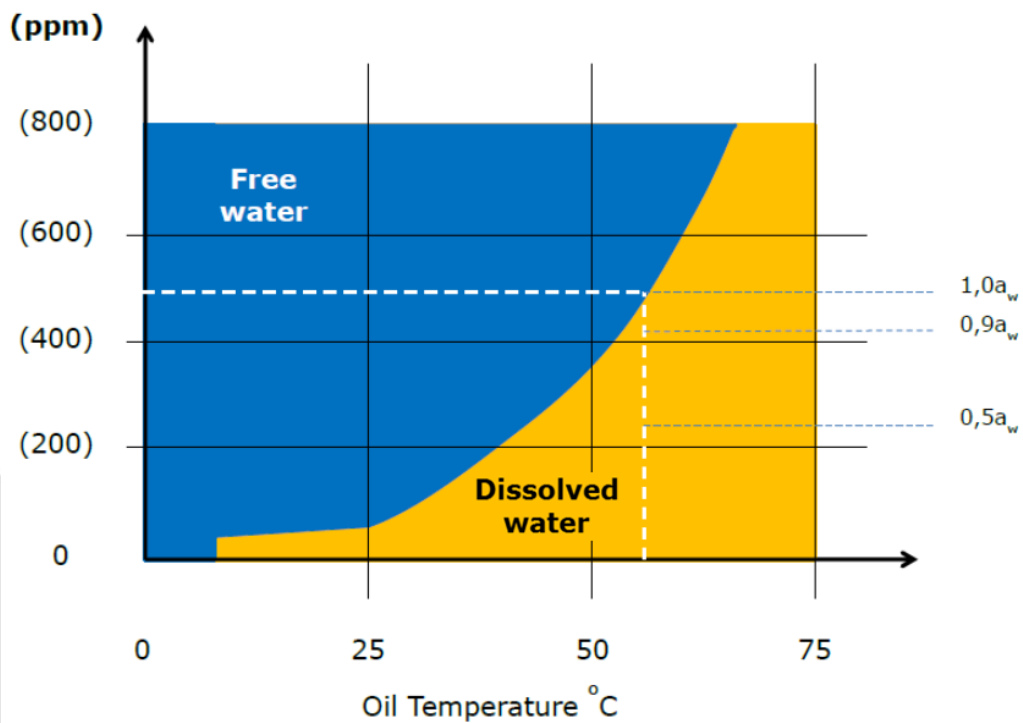
All displays will show from positive values when operating properly. There will appear a negative value during start-up, after 5 seconds the value will be in positive measurement range. Otherwise, if a negative value is present the Terminal box might have been installed incorrectly.



NOTE

WIOI200B uses 3 different units for the measurement of water in oil:

- 1) **a_w** : WIO measures humidity in **a_w** . The range is 0.01...1.00 a_w .
- 2) **%RH** (relative humidity) is identical to the unit a_w multiplied by 100. The range is 1...100 %RH
- 3) **ppm**: WIO can convert **a_w** to **ppm**. In this case the saturation point, at a given temperature, must be known. Output in ppm is only reliable at this temperature.





EC-Declaration of Conformity

PAJ Group, Grundtvigs Allé 163, DK-6400 Sønderborg, Denmark Manufactory	
Declare under our sole responsibility that the product:	
unit identification: WIO200 – WIO300 – WIO400 – WIO500	product classification: Water In Oil measuring instrument
is a safety tested component according to EC Guideline: 2004/108/EC Electromagnetic compatibility 2006/95/EC Low voltage directive	
to which this declaration relates is in conformity with the following standard(s) or other normative documents(s): IEC 61326-1:2006-11-03, EN 61010-1:2001, EN 60529 Edition 2.1 2001-02, IEC 60068-1:1988, IEC 60068-2-2:2007, IEC 60068-2-1:2007, IEC 60068-2-30:2005, IEC 60068-2-6:2007, IEC 61000-4-16:1998-01, IEC 61000-4-6:2007, IEC 61000-4-3:2006, IEC 61000-4-5:2005, IEC 61000-4-2:2001, IEC 61000-4-4:2004	
The described product corresponds to the following European Directives: 2004/108/EC Electromagnetic compatibility 2006/95/EC Low voltage directive	
Consistency of a production sample device with the marked product in accordance with the Directives No: 2004/108/EC Electromagnetic compatibility 2006/95/EC Low voltage directive	
Notified agency/Address:	Germanischer Lloyd AG Head Office Deputy Head of Department Automation, Navigation and Communication (MC-EA) Vorsetzen 35 D-20459 Hamburg/Germany
75 956 – 09 HH Certification number	2009-11-30 Date of issue
The marked product is consistent with the examined production sample device.	
Technical documentation:	
Poul Jessen	
Grundtvigs Allé 163 • DK-6400 Sønderborg • Tel: +45 74 43 71 81 • E-Mail: paj@paj.dk	
Sønderborg, 15.04.2011 Date of issue	Poul Jessen, Managing Director Name and signature



Type Approval Certificate

Germanischer Lloyd

This is to certify that the undernoted product(s) has/have been tested in accordance with the relevant requirements of the GL Type Approval System.

Certificate No. **7595609 HH**

Company **PAJ Systemteknik
Grundtvigs Allé 163
6400 Sønderborg, DENMARK**

Product Description **Water in Oil Monitor**

Type **WIO200**

Environmental Category **D, EMC 2**

Technical Data /
Range of Application **Sensor which measures water content in lubrication oils on ship engine
Condition Monitoring Component (according to GL I-1-17, Section 2, D.2.)

WIO Sensor system nr: A01-110-0100-00
Consists of:
- WIO Sensor nr: A01-110-0101-00
- Terminal Box nr: A01-110-0102-00
- Sensor cables 2 pcs. Order nr: A01-110-0103-00

The technical specification is shown on page 2.

Software Version 111197-810 Rev 1.00**

Test Standard **Guidelines for the Performance of Type Approvals Chapter 2, Edition 2003**

Documents **Test report : 2009-02260 EMC, 2009-01456, 2009-01456R2LM, 2009-02373
111197-900 WIO Sensor Specifications Rev.1.00, Datasheet 111197-902 Rev.1.00
Software Questionnaire according to requirement class 3, dated 28.09.2009**

Remarks **Rules GL I-1-17 to be observed for Condition Monitoring (CM). Alarm settings have to be specified by engine manufacturer if sensor is used for CM.**

Valid until **2014-11-29**

Page **1 of 2**

Type Approval Symbol



File No. **I.A.10**

Hamburg, 2009-11-30

Germanischer Lloyd

Jürgen Wittburg

Marco Rinkel

This certificate is issued on the basis of "Regulations for the Performance of Type Tests, Part 0, Procedure".

Internet Publication: GL-Approvals



Type Approval Certificate

Germanischer Lloyd

This is to certify that the undernoted product(s) has/have been tested in accordance with the relevant requirements of the GL Type Approval System.

Certificate No. **7595609 HH**

Technical Specification:

Measuring range: 0,01 to 1,00 aw water content.
Accuracy: $\pm 0,03$ aw for the range 0...1 aw water content
Resolution: Minimum 0,01 aw water content.
Analogue output: 4 to 20 mA (galvanic isolated) 0,01 to 1 aw water content linear
Max. Load (analogue outp.) < 500Ohm
Alarm indications. Alarm indication via 2 x Alarm relays (NC).
Media for measurement: Lubrication oil: Grade SAE 30/TBN 5-10
Service temperature of media: 10 to 60 °C.
Pressure range: 0 to 10 bar

Valid until **2014-11-29**

Page **2 of 2**

File No. **I.A.10**

Hamburg, 2009-11-30

Type Approval Symbol



Germanischer Lloyd

Jürgen Wittburg

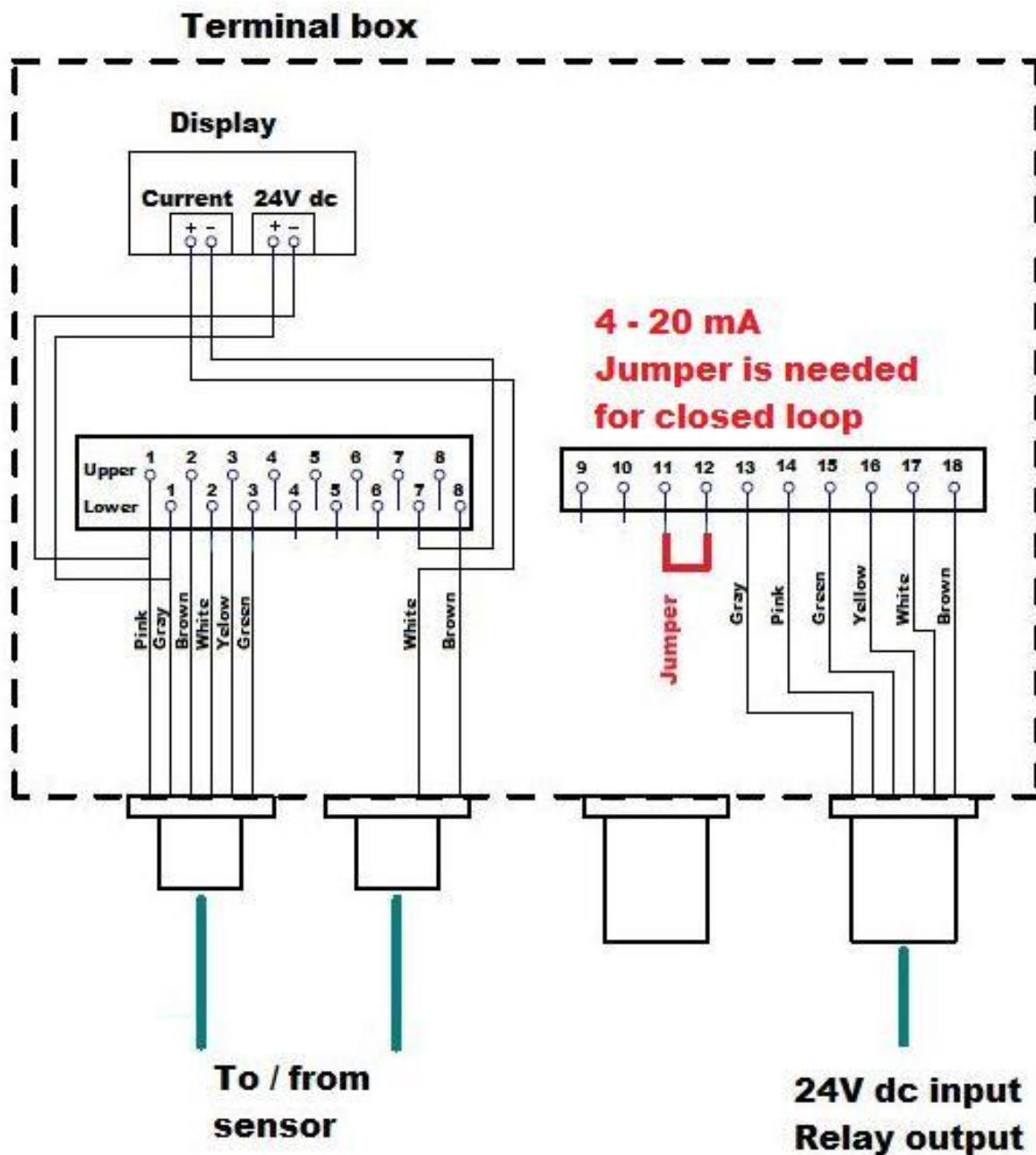
Marco Rinkel

This certificate is issued on the basis of "Regulations for the Performance of Type Tests, Part 0, Procedure".

Internet Publication: GL-Approvals



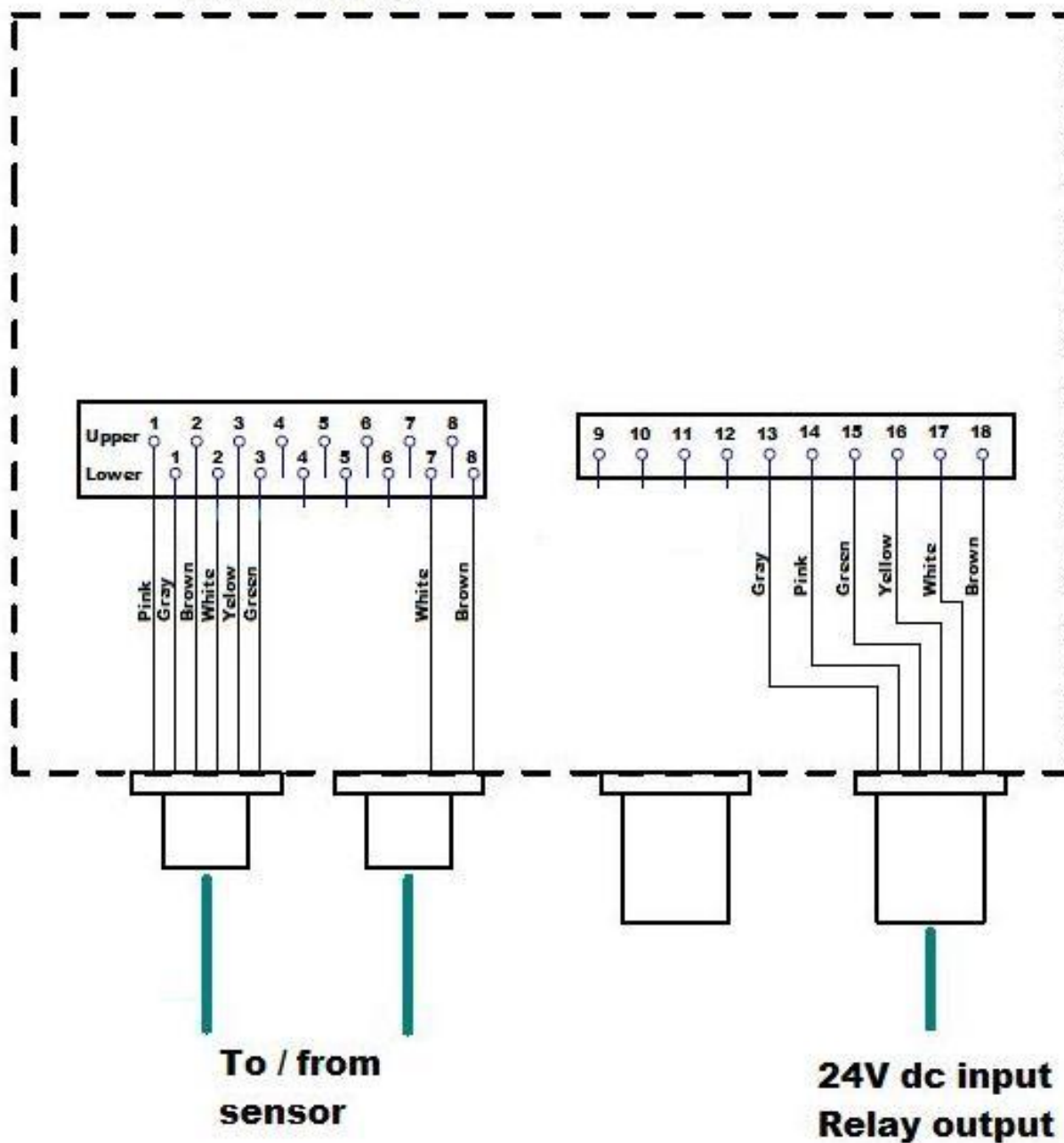
Appendix A1: Install 1 Terminal Box with 1 display





Appendix A2: Install 1 Terminal Box with no display

Terminal box

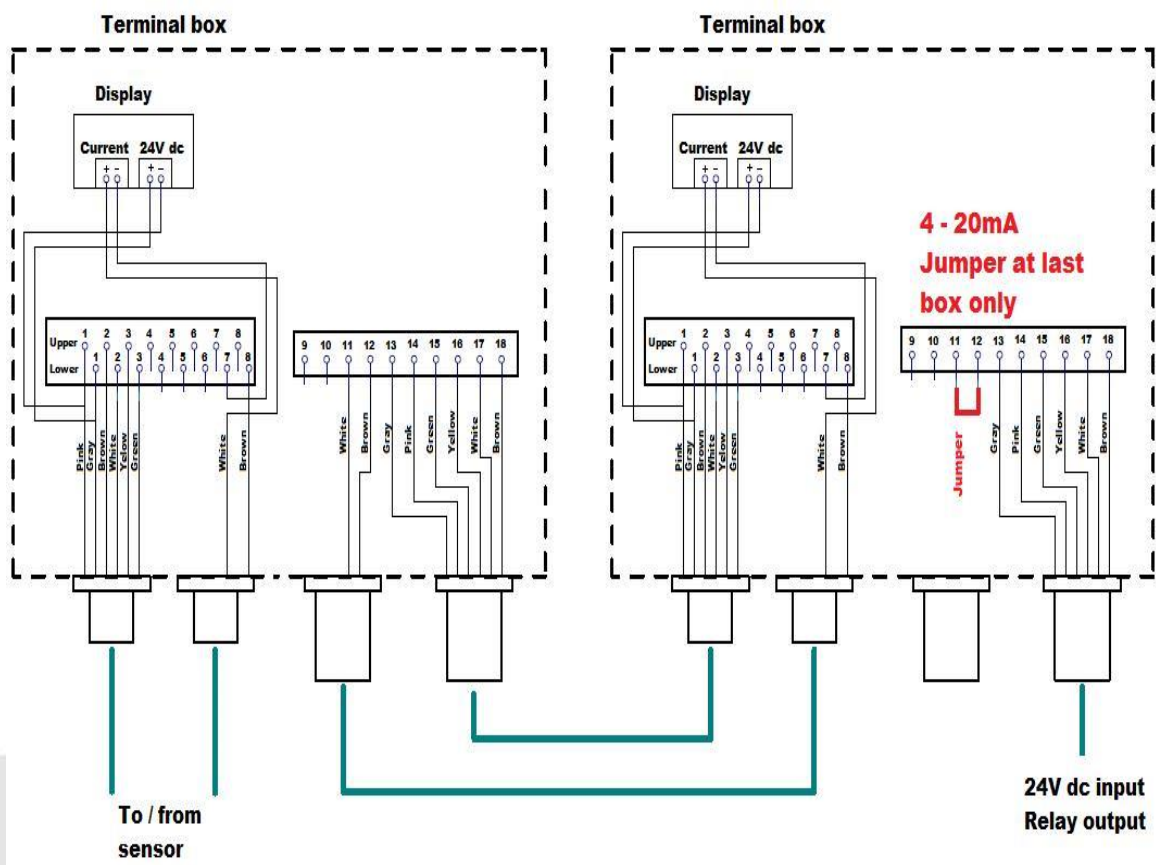


To / from
sensor

24V dc input
Relay output

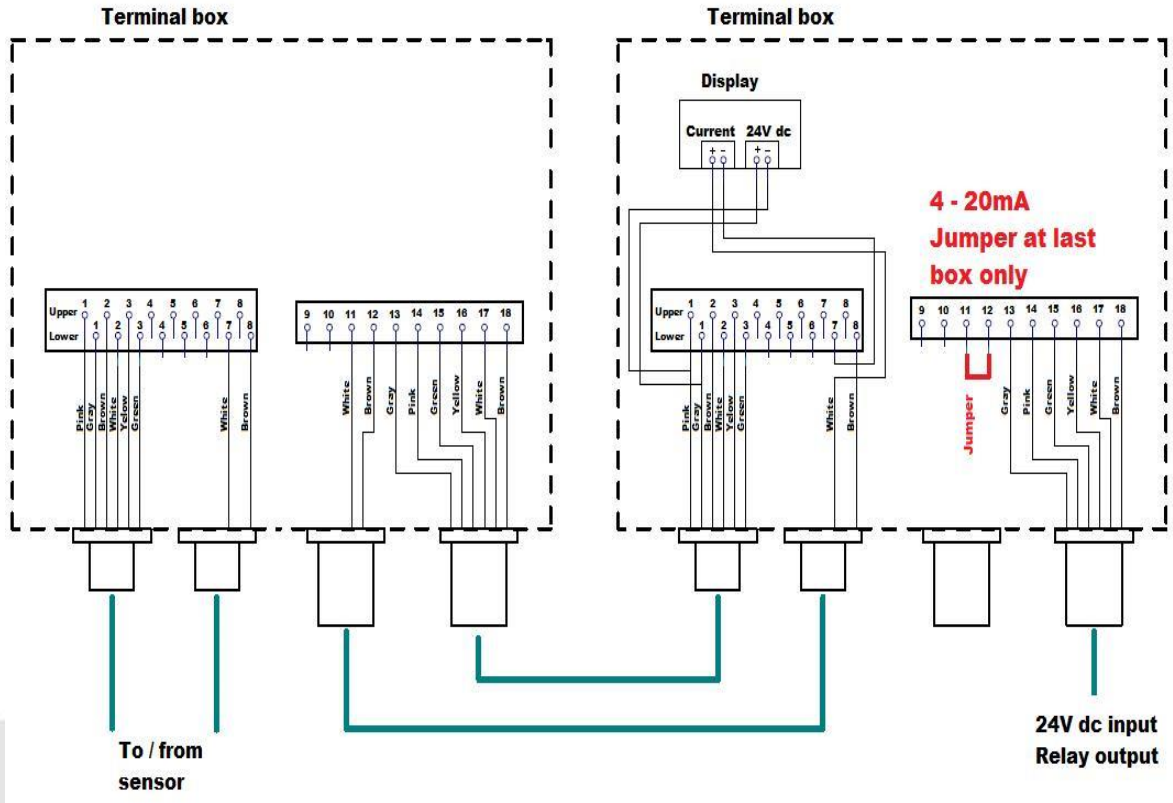


Appendix A3: Install 2 Terminal Boxes with 2 display



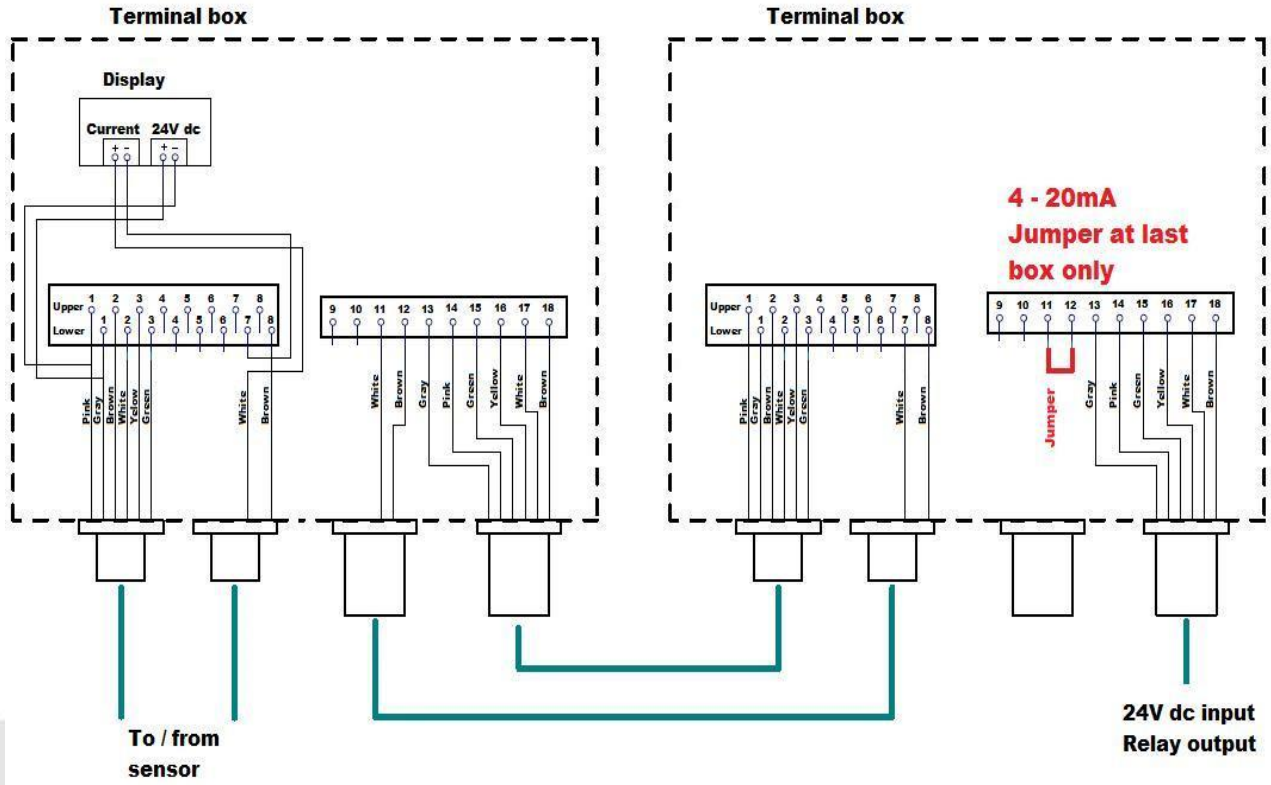


Appendix A4: Install 2 Terminal Boxes with 1 display



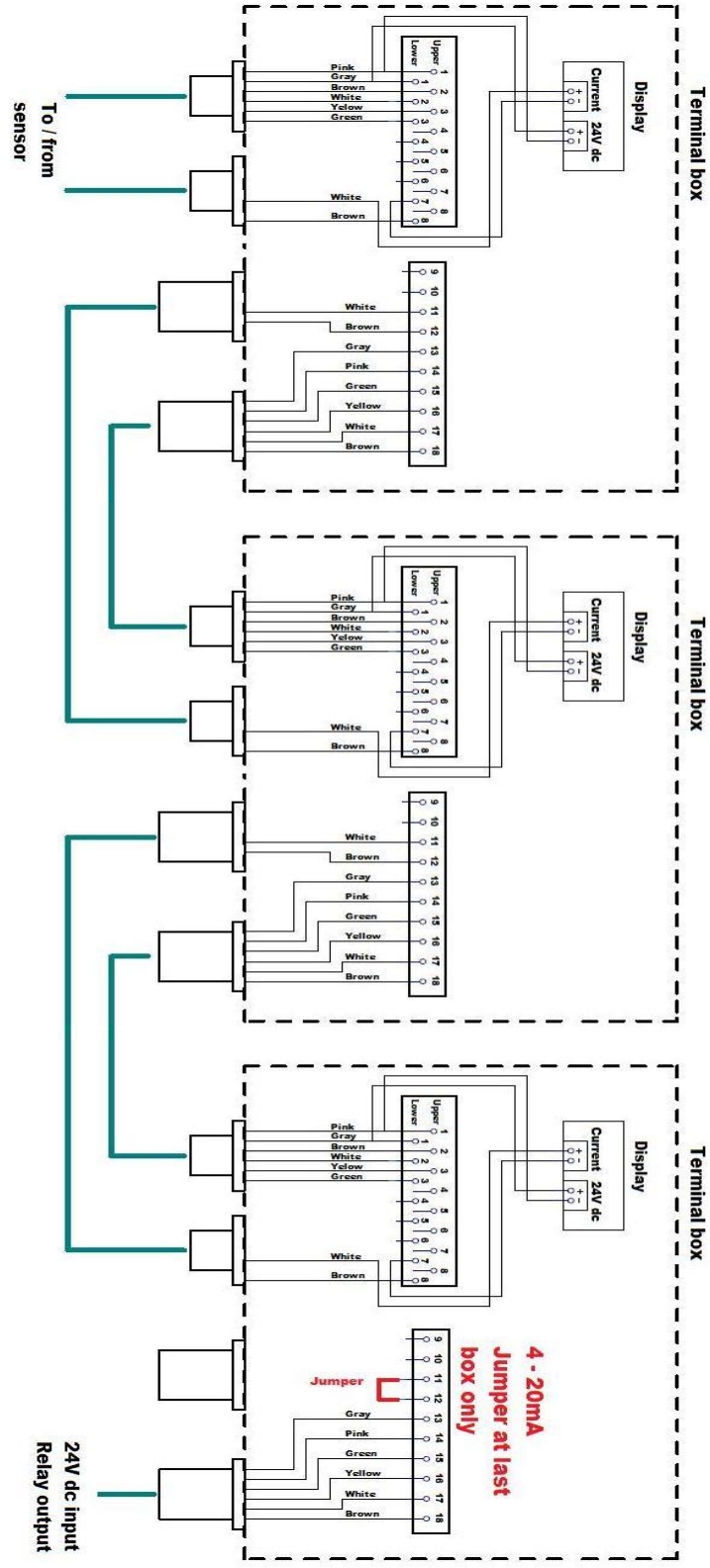


Appendix A5: Install 2 Terminal Boxes with 1 display



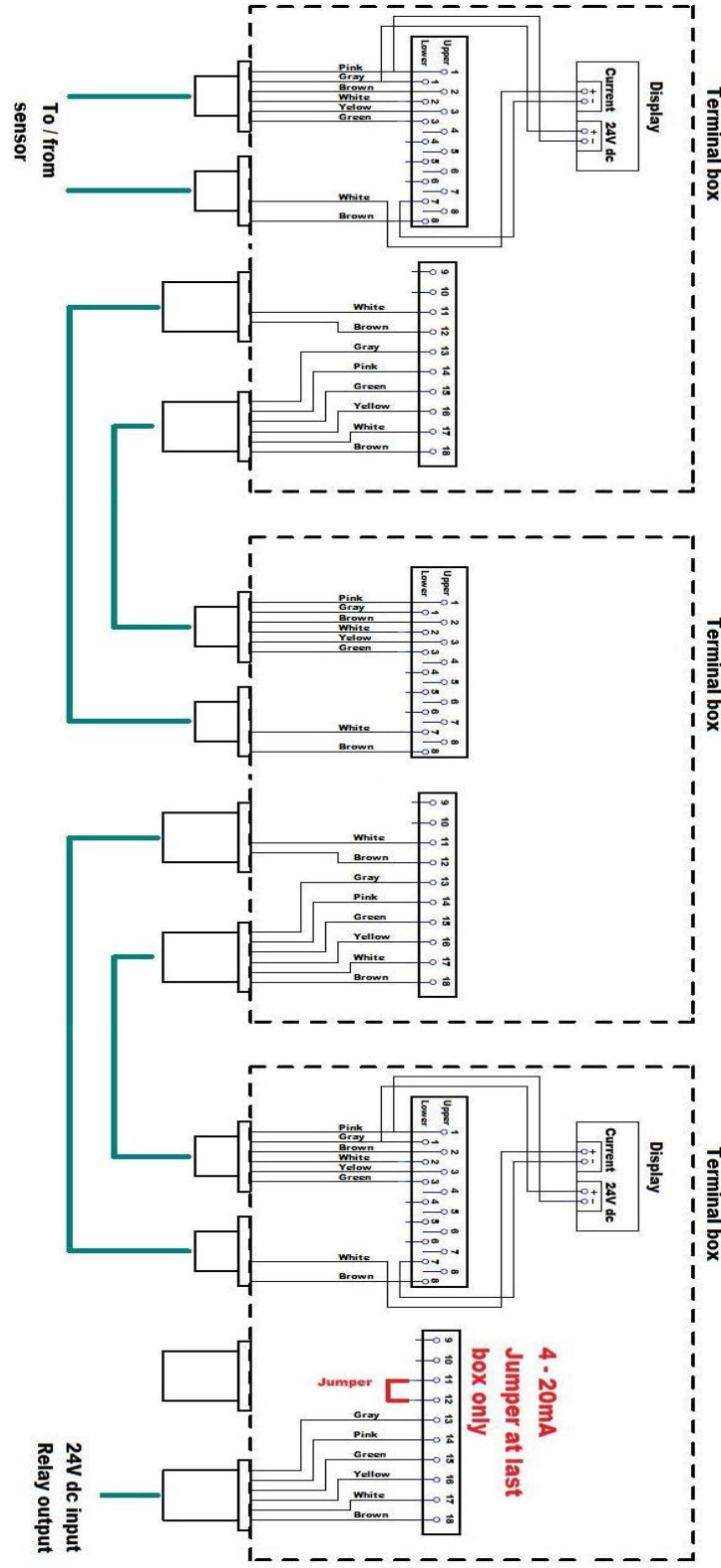


Appendix A6: Install 3 Terminal Boxes with 3 display



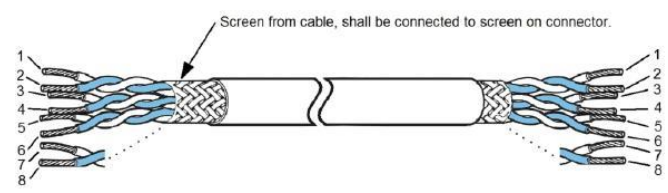
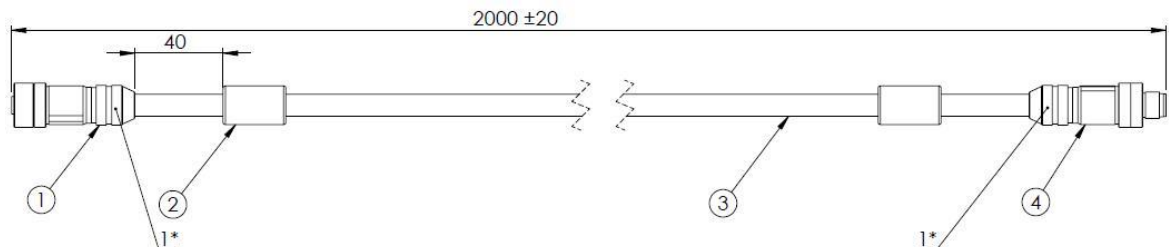


Appendix A7: Install 3 Terminal Boxes with 2 display





Appendix A9: CABLE Specification



1* - Must be ensured that these parts will not unscrew by it self. Must be tightened so that by hands it would not be possible to disassemble them.

8 pol. Connectors pin layout			
Female		Male	
	Assignment	Assignment	
	Socket	Plug	Wire
	1	1	1
	2	2	2
	3	3	3
	4	4	4
	5	5	5
	6	6	6
7	7	7	
8	8	8	

Item No.	Description	Qty.
1	Female Plug	1
4	Ferrite Core	2
2	CL105 4x2x0.75-PO - 2m	1
3	Male Plug	1



How to adjust the display in a WIO/WIOI

When the display is adjusted by PAJ Group, it is adjusted for either **a_w** or **ppm** reading.

a_w reading: 4 mA = .0000 a_w 20 mA = 1.0000 a_w

ppm reading: 4 mA = 0000 ppm 20 mA = * ppm

*If a customer wishes the display to indicate ppm-values, he must specify to PAJ Group:

- The specific temperature of the sample/medium, at which, WIO/WIOI shall measure.
- Which ppm-value equals 1.00 a_w, at that specific temperature.

However, a few customers wish to be able to adjust the display or change the **ppm**-value-range of the display.

Here is a description of how to do it:

DISCLAIMER: The warranty of WIO/WIOI is void, if you adjust the display yourself.

Connection diagram

Make a wire connection with two power supply equipments as shown below:

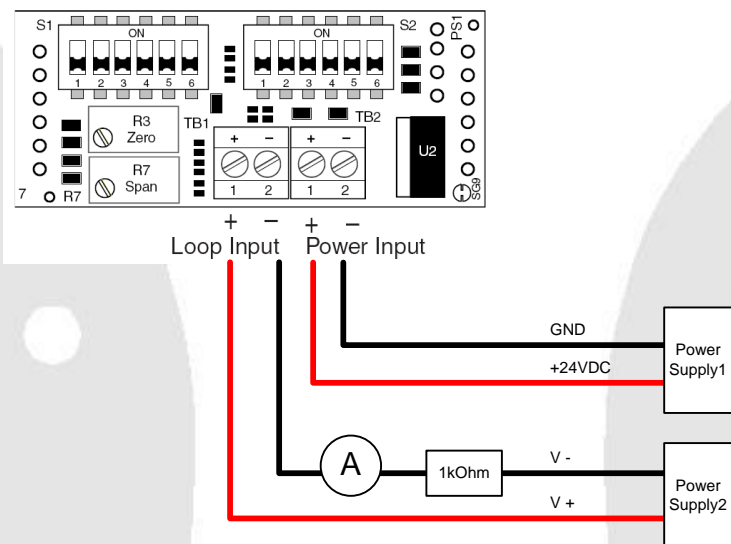


Figure 1



Start condition

Set R3(zero point adjust) and R7(max. point / span adjust) fully clockwise, roughly 20 turns.

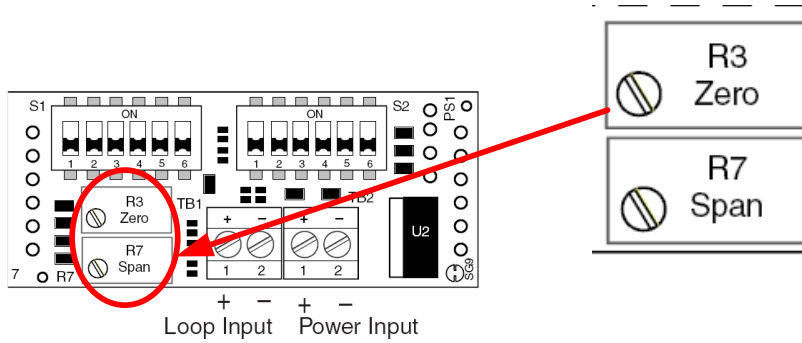


Figure 2

Setting DIP-switches on S1 and S2:

The range/span of the display is set by DIP-switches, located on the back of the display.

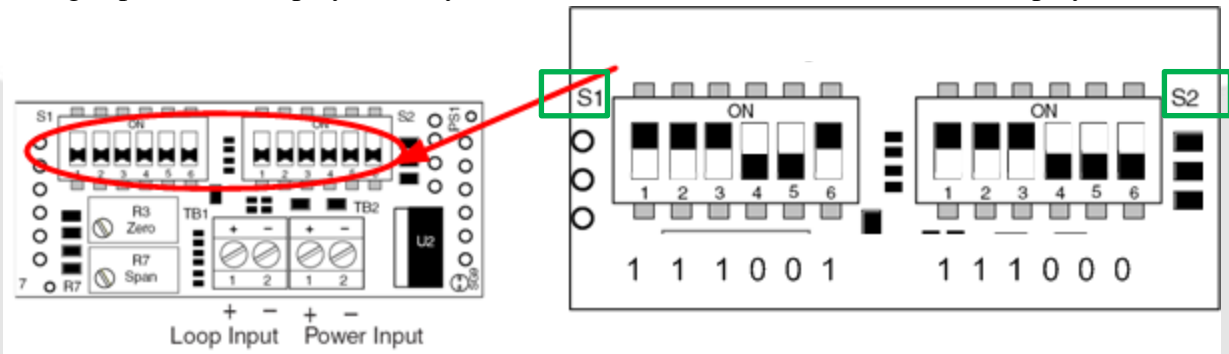


Figure 3

The display in WIO/WIOI is a newer revision, than shown in figure 3. It has a different physical appearance (figure 4), but the DIP-switches have same functionality. The switch-sliders (figure 3) are indicated as black. In reality they are white.



Figure 4



Setting DIP-switches for a_w-reading:

Desired readings:

4 mA = .0000 a_w

20 mA = 1.0000 a_w

DIP-switch settings (for a_w):

The switch-sliders are indicated as black. In reality they are white.

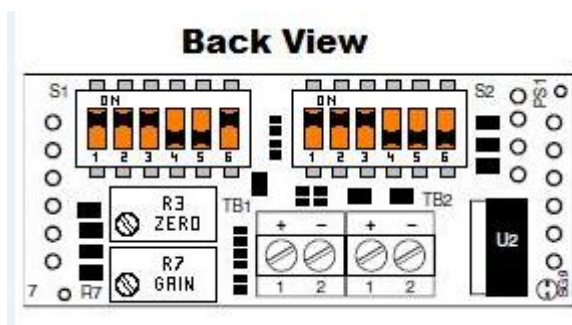


Figure 5



Setting DIP-switches for ppm-reading:

DIP-switches must be set according to Table 1 and Table 2.

Table 1. DIP-Switch Settings

	Display Reading		SW1	SW2	Switch S1				Switch S2	
	4mA	20mA			SW3	SW4	SW5	SW6	SW1	SW2
1.	0000	2250-2500	Off	On	On	On	Off	Off	On	On
2.	0000	2500-2800	Off	On	On	On	Off	Off	Off	On
3.	0000	2800-3200	Off	On	On	On	Off	Off	On	Off
4.	0000	3200-3850	Off	On	On	On	Off	Off	Off	Off
5.	0000	3850-4300	On	Off	On	On	Off	Off	On	On
6.	0000	4300-4900	On	Off	On	On	Off	Off	Off	On
7.	0000	4900-5600	On	Off	On	On	Off	Off	On	Off
8.	0000	5600-6200	On	Off	On	On	Off	Off	Off	Off
9.	0000	6200-6800	Off	Off	On	On	Off	Off	On	On
10.	0000	6800-7750	Off	Off	On	On	Off	Off	Off	On
11.	0000	7750-8600	On	On	Off	On	On	Off	On	On
12.	0000	8600-9850	On	On	Off	On	On	Off	Off	On
13.	0000	9850-11000	On	On	On	Off	Off	On	On	On
14.	0000	11000-12000	On	On	On	Off	Off	On	Off	On
15.	0000	12000-13000	On	Off	Off	On	Off	On	On	On
16.	0000	13000-14000	On	Off	Off	On	Off	On	Off	On
17.	0000	14000-15300	On	Off	On	Off	On	On	On	On
18.	0000	15300-16300	On	Off	On	Off	On	On	Off	On
19.	0000	16300-17800	Off	Off	On	Off	On	On	On	On
20.	0000	17800-20000	Off	Off	On	Off	On	On	Off	On

Table 2. Decimal Point Settings

Switch S2			
SW3	SW4	SW5	SW6
DP1	DP2	DP3	DP4

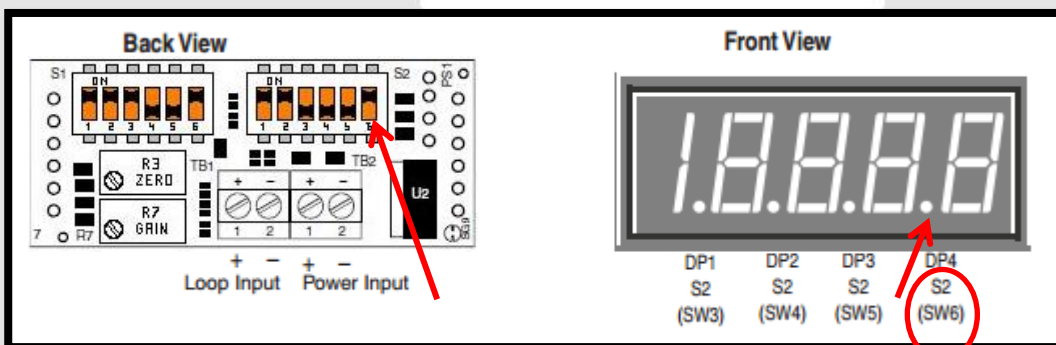


Figure 6

Decimal points 1 through 4 (DP1) is switched ON by setting S2/SW3 through S2/SW6 to ON (see Table 2)

Example (figure 6): Decimal point 4 (DP1) is switched ON by setting S2/SW6 to ON.



Table 1. DIP-Switch Settings

Display Reading	4mA	20mA	Switch S1						Switch S2	
			SW1	SW2	SW3	SW4	SW5	SW6	SW1	SW2
1.	0000	2250-2500	Off	On	On	On	Off	Off	On	On
2.	0000	2500-2800	Off	On	On	On	Off	Off	Off	On
3.	0000	2800-3200	Off	On	On	On	Off	Off	On	Off
4.	0000	3200-3850	Off	On	On	On	Off	Off	Off	Off
5.	0000	3850-4300	On	Off	On	On	Off	Off	On	On
6.	0000	4300-4900	On	Off	On	On	Off	Off	Off	On
7.	0000	4900-5600	On	Off	On	On	Off	Off	On	Off
8.	0000	5600-6200	On	Off	On	On	Off	Off	Off	Off
9.	0000	6200-6800	Off	Off	On	On	On	Off	On	On
10.	0000	6800-7750	Off	Off	On	On	On	Off	Off	On
11.	0000	7750-8600	On	On	Off	On	On	Off	On	On
12.	0000	8600-9850	On	On	Off	On	On	Off	Off	On
13.	0000	9850-11000	On	On	On	Off	Off	On	On	On
14.	0000	11000-12000	On	On	On	Off	Off	On	Off	On
15.	0000	12000-13000	On	Off	Off	On	Off	On	On	On
16.	0000	13000-14000	On	Off	Off	On	Off	On	Off	On
17.	0000	14000-15300	On	Off	On	Off	On	On	On	On
18.	0000	15300-16300	On	Off	On	Off	On	On	Off	On
19.	0000	16300-17800	Off	Off	On	Off	On	On	On	On
20.	0000	17800-20000	Off	Off	On	Off	On	On	Off	On

Table 2. Decimal Point Settings

Switch S2			
SW3	SW4	SW5	SW6
DP1	DP2	DP3	DP4

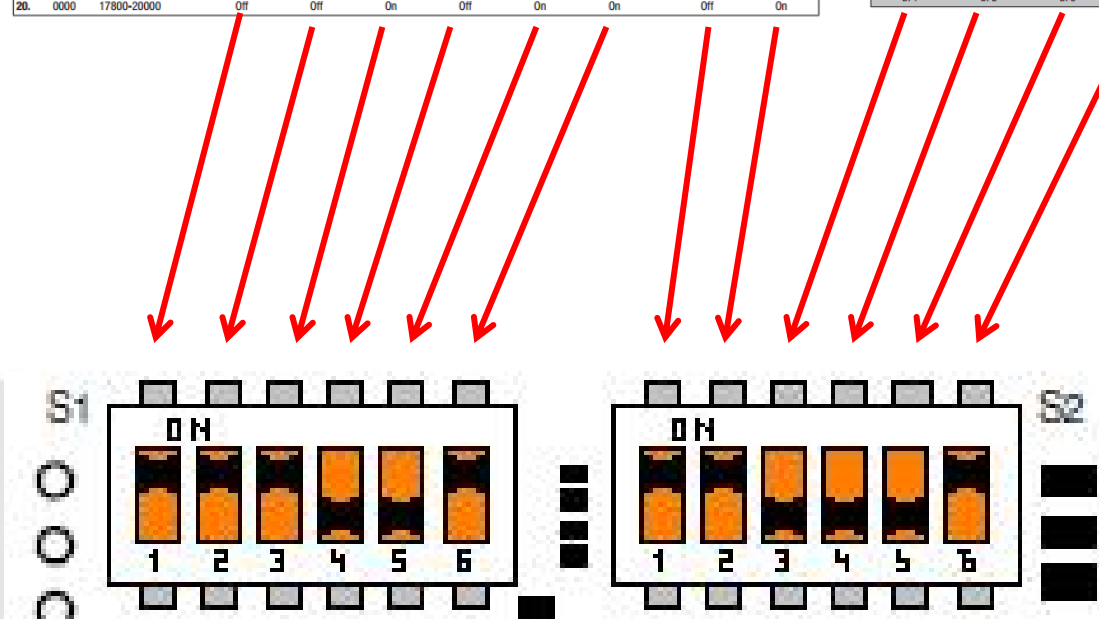


Figure 7

Since these tables can be difficult to overview, we will show a couple of examples:



Example 1:

Desired readings:

4 mA = 0000 ppm

20 mA = 1000.0 ppm

DIP-switch settings:

The switch-sliders are indicated as black. In reality they are white.

Back View

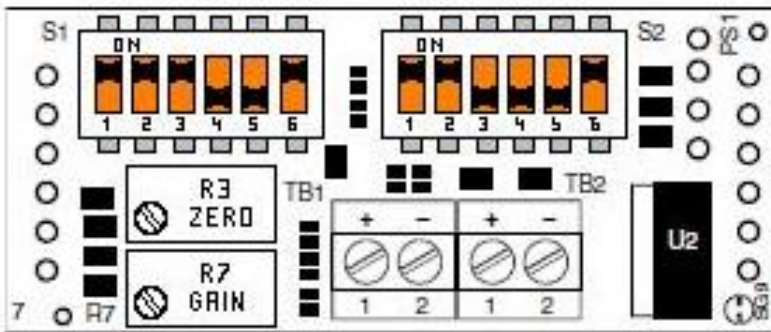


Table 1. DIP-Switch Settings

	Display Reading		Switch S1						Switch S2	
	4mA	20mA	SW1	SW2	SW3	SW4	SW5	SW6	SW1	SW2
1.	0000	2250-2500	Off	On	On	On	Off	Off	On	On
2.	0000	2500-2800	Off	On	On	On	Off	Off	Off	On
3.	0000	2800-3200	Off	On	On	On	Off	Off	On	Off
4.	0000	3200-3850	Off	On	On	On	Off	Off	Off	Off
5.	0000	3850-4300	On	Off	On	On	Off	Off	On	On
6.	0000	4300-4900	On	Off	On	On	Off	Off	Off	On
7.	0000	4900-5600	On	Off	On	On	Off	Off	On	Off
8.	0000	5600-6200	On	Off	On	On	Off	Off	Off	Off
9.	0000	6200-6800	Off	Off	On	On	On	Off	On	On
10.	0000	6800-7750	Off	Off	On	On	On	Off	Off	On
11.	0000	7750-8600	On	On	Off	On	On	Off	On	On
12.	0000	8600-9850	On	On	Off	On	On	Off	Off	On
13.	0000	9850-11000	On	On	On	Off	Off	On	On	On
14.	0000	11000-12000	On	On	On	Off	Off	On	Off	On
15.	0000	12000-13000	On	Off	Off	On	Off	On	On	On

Table 2. Decimal Point Settings

Switch S2			
SW3	SW4	SW5	SW6
DP1	DP2	DP3	DP4



Example 2:

Desired readings:

4 mA = 0000 ppm

20 mA = 4700 ppm

DIP-switch settings:

The switch-sliders are indicated as black. In reality they are white.

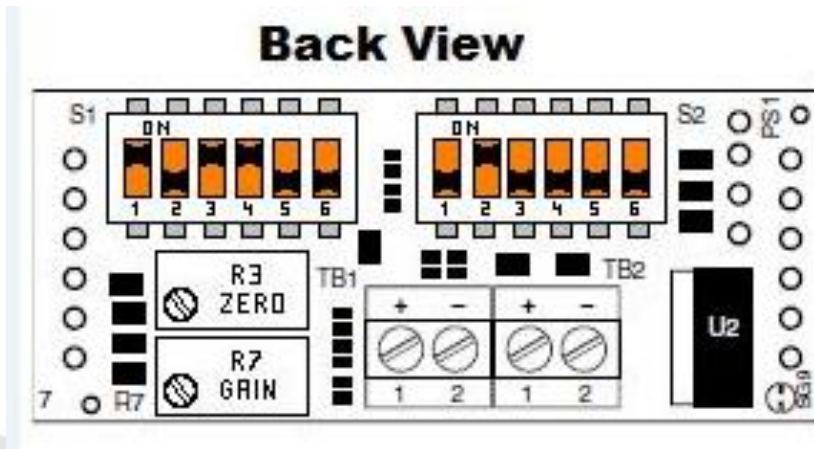


Table 1. DIP-Switch Settings

Display Reading	Switch S1								Switch S2	
	SW1	SW2	SW3	SW4	SW5	SW6	SW1	SW2		
4mA										
20mA										
1. 0000	2250-2500	Off	On	On	On	Off	Off	On	On	
2. 0000	2500-2800	Off	On	On	On	Off	Off	Off	On	
3. 0000	2800-3200	Off	On	On	On	Off	Off	On	Off	
4. 0000	3200-3850	Off	On	On	On	Off	Off	Off	Off	
5. 0000	3850-4300	On	Off	On	On	Off	Off	On	On	
6. 0000	4300-4900	On	Off	On	On	Off	Off	Off	On	
7. 0000	4900-5600	On	Off	On	On	Off	Off	On	Off	
8. 0000	5600-6200	On	Off	On	On	Off	Off	Off	Off	
9. 0000	6200-6800	Off	Off	On	On	On	Off	On	On	
10. 0000	6800-7750	Off	Off	On	On	On	Off	Off	On	
11. 0000	7750-8600	On	On	Off	On	On	Off	On	On	
12. 0000	8600-9850	On	On	Off	On	On	Off	Off	On	
13. 0000	9850-11000	On	On	On	Off	Off	On	On	On	
14. 0000	11000-12000	On	On	On	Off	Off	On	Off	On	
15. 0000	12000-13000	On	Off	Off	On	Off	On	On	On	

Table 2. Decimal Point Settings

Switch S2			
SW3	SW4	SW5	SW6
DP1	DP2	DP3	DP4



Zero point adjustment

Set PowerSupply1 to 24VDC and switch ON.

Set PowerSupply2 to 4V ($1V/(1k\Omega + R_{display}) = 1mA$) and switch ON.

Adjust PowerSupply2 until the Ampere meter indicates 4.00 mA.

Adjust R3 potentiometer until the display reads "0000"

Max. point adjustment

Set PowerSupply2 to 20V.

Adjust PowerSupply2 until the Ampere meter indicates 20.00 mA.

Notice: The signal from the WIO/WIOI Sensor to the Terminalbox/display, is as follows:

$20\text{ mA} = 1.0000\text{ a}_w = 100\% \text{RH}$ (=)* The desired max.-ppm-value adjusted on display

*ppm-displayadjustment will only be correct at 1 specific temperature measured in a medium, which has the desired max.-ppm-value (= 1.0 a_w) at this specific temperature.

Adjust R7 potentiometer until the display reads "1.0000" (or **desired max.-ppm-value**), as shown below:



END OF SETTING

Remove the display from power supply equipments.



The display is now ready for reading the analog signal from 4mA up to 20mA and it is configured for the indication



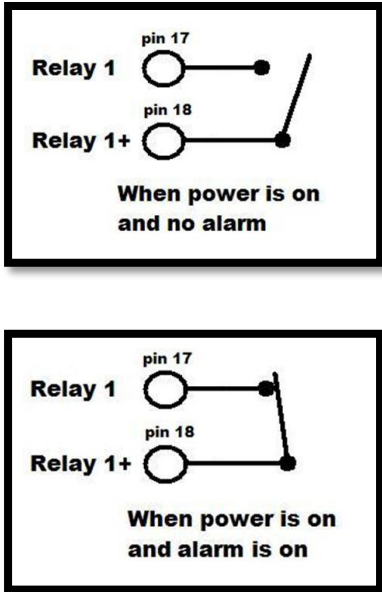
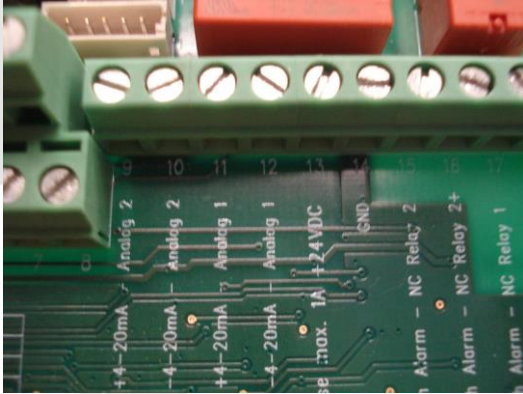
from 0.0000 to 1.0000 a_w or

from 0000 to desired max.-ppm-value

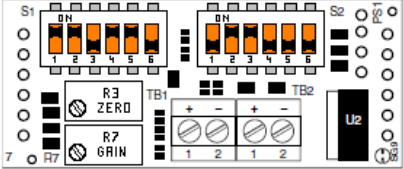
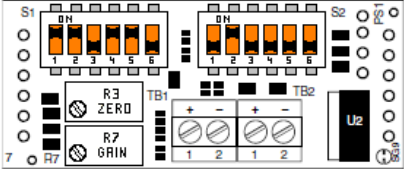


Appendix A10: Error / failure FAQ

Failure type	Description	Possible reasons
PPM display failure	Display shows only negative numbers 	<ol style="list-style-type: none"> 1. Sensor is not connected. 2. The error caused by missing jumper in terminal box pin 11 and pin 12. See Appendix A1 3. Check that the jumper is properly installed, it is seen that the jumper has been installed but the jumper had no proper connection 4. The wires are reversed in terminal box pin 7 and pin 8 lower part. After changing and there is no change in the display, then the fault is either 1, 2 or 3.
a _w display failure	Display shows only negative numbers 	<ol style="list-style-type: none"> 1. Sensor is not connected. 2. The error caused by missing jumper in terminal box pin 11 and pin 12. See Appendix A1 3. Check that the jumper is properly installed, it is seen that the jumper has been installed but the jumper had no proper connection 4. The wires are reversed in terminal box pin 7 and pin 8 lower part. After changing and there is no change in the display, then the fault is either 1, 2 or 3.

<p>Dead display</p>	<p>Display indicate nothing</p> 	<p>Maybe is 24V dc supply interrupted to the display. There shall be 24V dc at this connector.</p> 
<p>Relay</p>	<p>Relay-state while alarm is on</p>	
<p>Sensor</p>	<p>How to check the mA output from sensor?</p> 	<p>Remove jumper in pin 11 and pin 12. In order to ensure that there can be measured mA must pin 11 and pin 12 must be screwed. Remember to set the measuring instrument in dc mA and connect test leads correctly in the measuring instrument. Sensor is alright when measuring a value between 4 and 20 mA. Is the result about 2 mA then there is an internal sensor error, so the sensor must be sent for repair. Is the result 0 mA, tjek if the sensor get 24 Vdc power.</p>



Dip Switch a _w	Are the dip switches still positioned correctly?	Correct positions: <p style="text-align: center;">Back View</p> 
Dip Switch PPM	Are the dip switches still positioned correctly?	Correct positions: <p style="text-align: center;">Back View</p> 
Broken cables between Sensor and terminal box	No mA will can be measured on: Analog 1: Terminal 11 and 12 and Analog 2: Terminal 9 and 10	



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