ABB MEASUREMENT & ANALYTICS | OPERATING INSTRUCTION

4690 Series
Turbidity systems

Accurate, reliable turbidity measurement

Measurement made easy

4690 / 4695 analyzer and a 7998 turbidity sensor

Introduction

An ABB Turbidity system comprises a 4690 / 4695 analyzer and a 7998 turbidity sensor.

The analyzer provides the operator interface and communications to other devices.

The signal from the turbidity sensor is converted by the analyzer and the information is presented on a large, custom-designed, easy-to-read, backlit liquid crystal display (LCD).

The analyzer can be programmed to work with any of the 7998 series sensors and the operating range can also be configured to meet users' requirements.

Available in wall- / pipe-mount or ¼ DIN panel-mount versions, the analyzer is protected to IP66, ensuring reliable operation in the most demanding situations. The same level of protection is maintained during programming and calibration.

For more information

Further publications for 4690 turbidity systems are available for free download from: http://new.abb.com/products/measurement-products

The Company

We are an established world force in the design and manufacture of measurement products for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

Contents

1 Safety

Information in this manual is intended only to assist our customers in the efficient operation of our equipment. Use of this manual for any other purpose is specifically prohibited and its contents are not to be reproduced in full or part without prior approval of the Technical Publications Department.

1.1 Electrical Safety

This equipment complies with the requirements of CEI/IEC 61010-1 Edition 3.1 2017-01 'Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use' and complies with US NEC 500, NIST and OSHA.

If the equipment is used in a manner NOT specified by the Company, the protection provided by the equipment may be impaired.

1.2 Symbols

One or more of the following symbols may appear on the equipment labelling:

	**Warning** – Refer to the manual for instructions
	**Caution** – Risk of electric shock
	Functional earth (ground) terminal
	Protective earth (ground) terminal

	Direct current supply only
	Alternating current supply only
	Both direct and alternating current supply
	The equipment is protected through double insulation

1.3 Health & Safety

Health and Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

- The relevant sections of these instructions must be read carefully before proceeding.
- Warning labels on containers and packages must be observed.
- Installation, operation, maintenance and servicing must be carried out only by suitably trained personnel and in accordance with the information given.
- Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and / or temperature.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address, together with servicing and spares information.

1.4 Product Disposal

Note. The following only applies to European customers.

ABB is committed to ensuring that the risk of any environmental damage or pollution caused by any of its products is minimized as far as possible. The European Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) that came into force on August 13 2005 aims to reduce the waste arising from electrical and electronic equipment; and improve the environmental performance of all those involved in the life cycle of electrical and electronic equipment.

In conformity with European local and national regulations (EU Directive 2002/96/EC stated above), electrical equipment marked with the above symbol may not be disposed of in European public disposal systems after 12 August 2005.

2 Turbidity Systems

2.1 7998 Sensors

Details of the individual sensors are shown in Table 2.1.

Sensor No.	Principle of Sensor	Type of Sensor	Minimum Range	Maximum Range
7998 011 (ISO 7027)	Infrared LED Nephelometric	Flow-through (with wiper unit)	0 to 1 NTU	0 to 40 NTU
7998 012 (ISO 7027)	Infrared LED Nephelometric	Flow-through (with wiper unit)	0 to 40 NTU	0 to 400 NTU
7998 016 (ISO 7027)	Infrared LED Nephelometric	Flow-through (without wiper unit)	0 to 1 NTU	0 to 40 NTU
7998 017 (ISO 7027)	Infrared LED Nephelometric	Flow-through (without wiper unit)	0 to 40 NTU	0 to 400 NTU

Table 2.1 7998 Sensor Range

2.2 Turbidity Measurement Systems

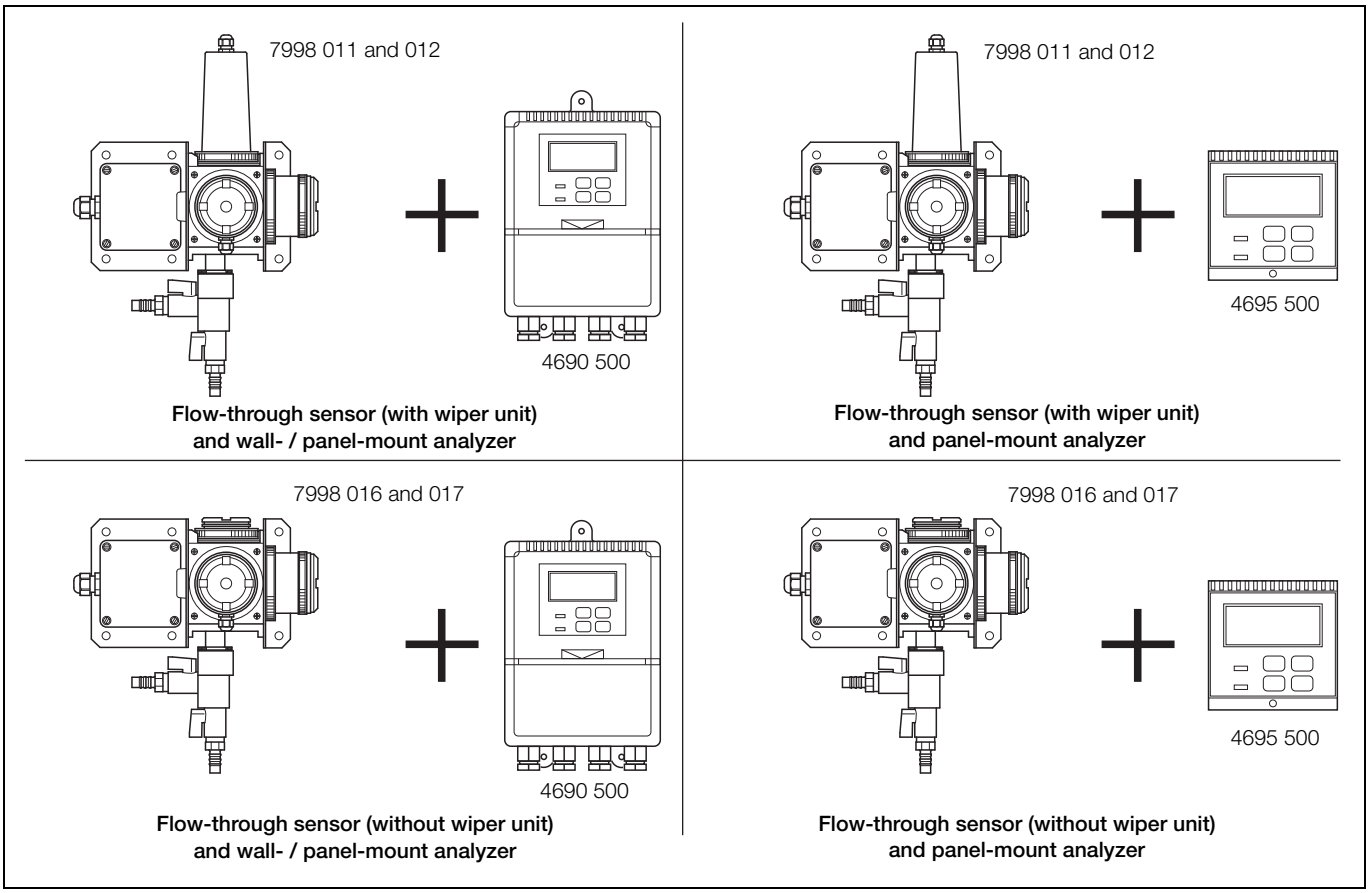


Fig. 2.1 System Arrangements

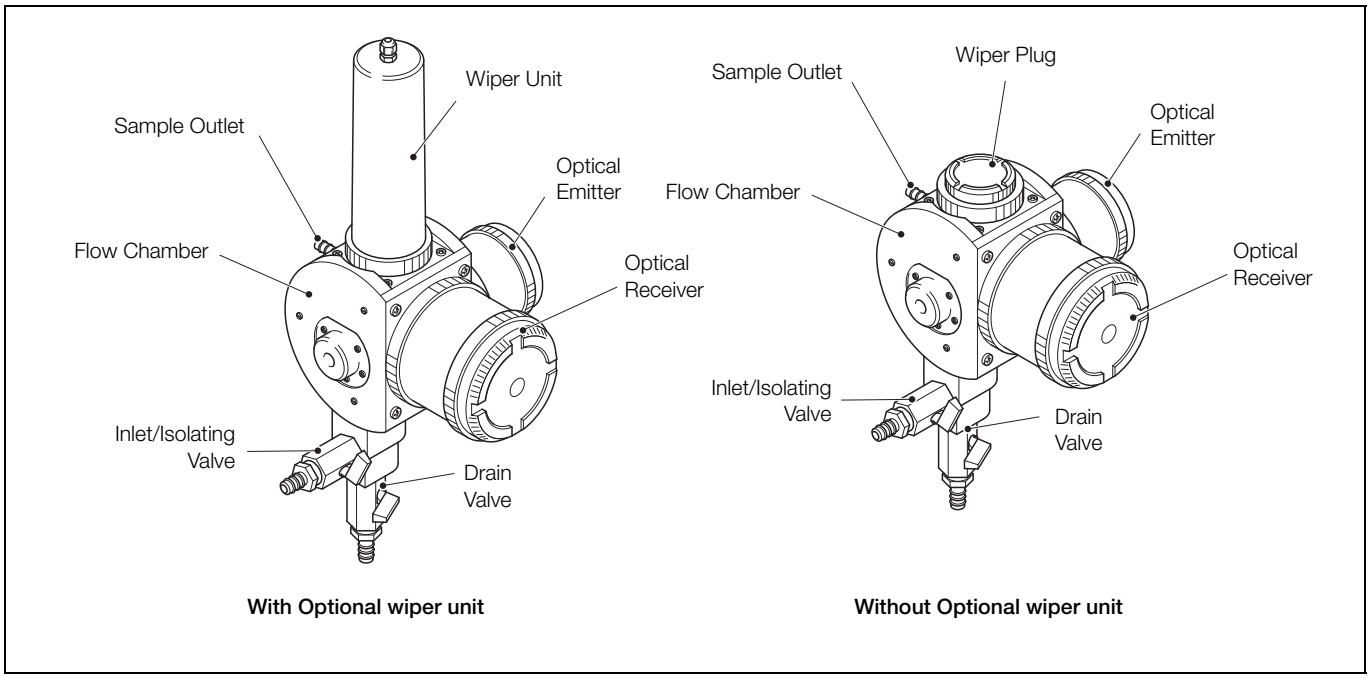


Fig. 2.2 Turbidity Sensors – Main Components

3 Installation

3.1 Siting Requirements

3.1.1 Analyzer

Caution.

- Mount in a location free from excessive vibration.
- Mount away from harmful vapors and dripping fluids.

Note. Mount the analyzer at eye level to enable an unrestricted view of the front panel displays and controls.

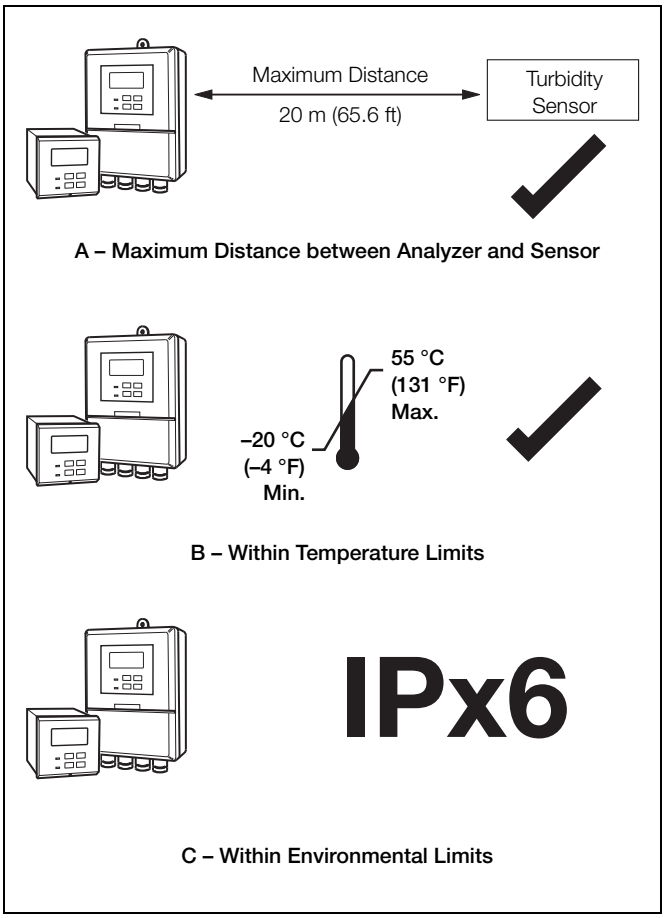


Fig. 3.1 Siting Requirements – Analyzer

3.1.2 Turbidity Sensor

To enable the turbidity sensor to be removed easily for maintenance, ensure an all-round clearance of 200 mm (7.9 in) – see Section 3.3, page 8 for the overall dimensions of the sensor.

Note. Ensure the sensor is located at an appropriate height to ensure ease of access during calibration and cleaning.

Caution. Mount the sensor in a location away from direct sunlight.

3.2 Mounting the Analyzer

3.2.1 Wall-mounting

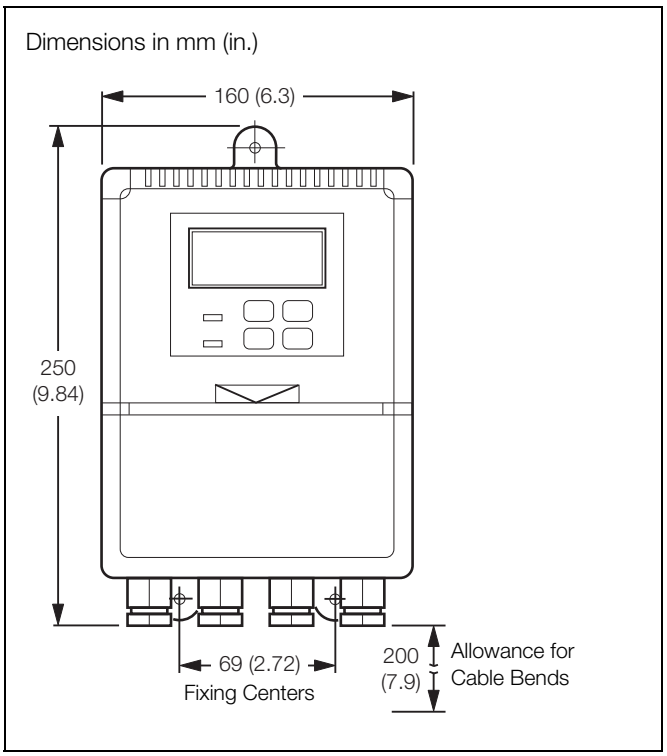


Fig. 3.2 Overall Dimensions

Referring to Fig. 3.3:

1. Mark fixing centers (see Fig. 3.2).
2. Drill suitable holes.
3. Secure analyzer to wall using suitable fixings.

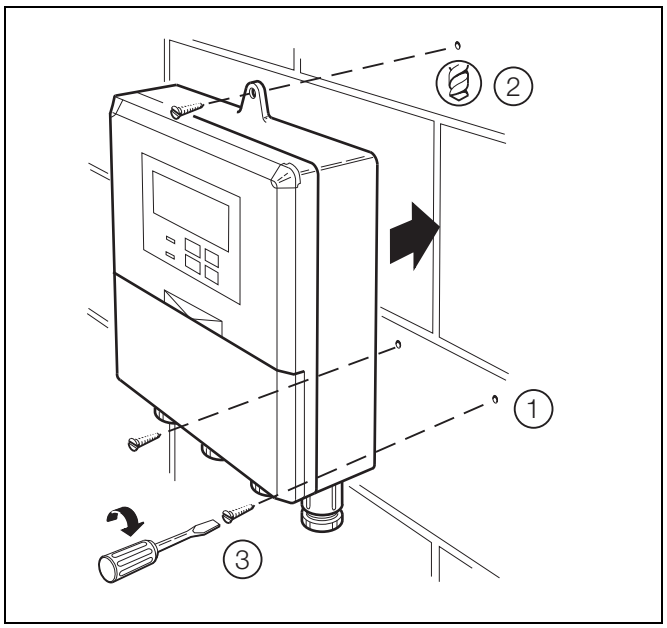


Fig. 3.3 Wall-mounting

3.2.2 Pipe-mounting

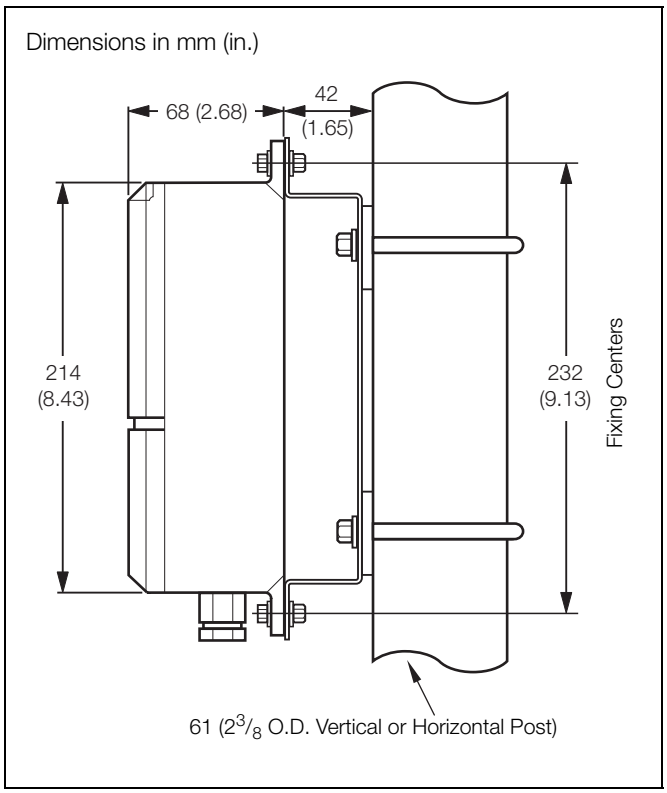


Fig. 3.4 Overall Dimensions

Referring to Fig. 3.5:

1. Position 'U' bolts on pipe.
2. Position plates over 'U' bolts.
3. Secure plates.
4. Secure analyzer to mounting plate.

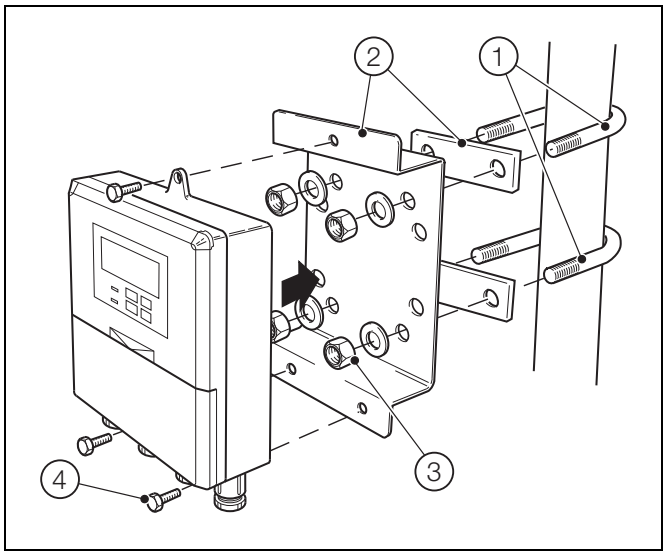


Fig. 3.5 Pipe-mounting

3.2.3 Panel-mounting

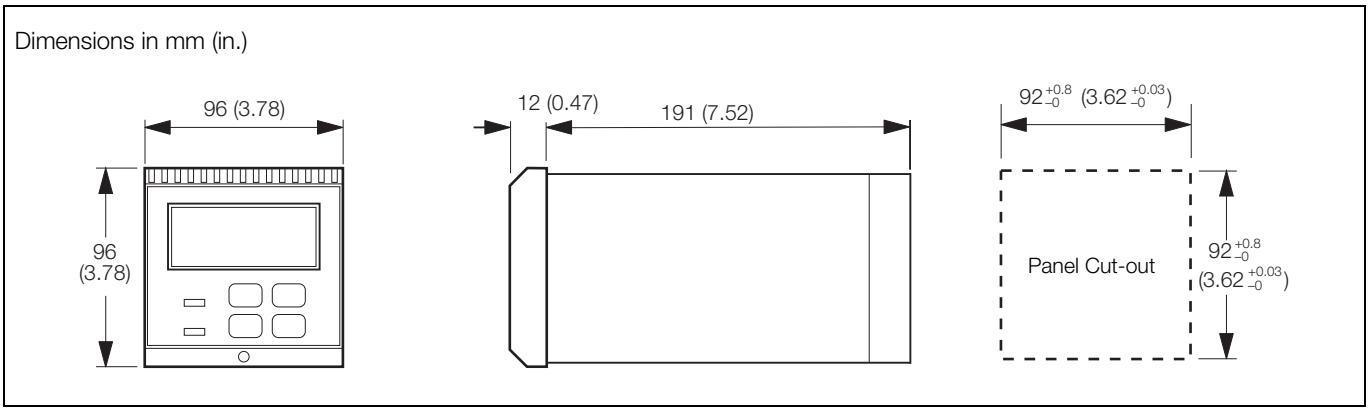


Fig. 3.6 Overall Dimensions

Referring to Fig. 3.5:

1. Cut a hole in the panel (see Fig. 3.6 for dimensions). Analyzers may be close stacked to DIN 43835.
2. Loosen the retaining screw on each panel clamp.
3. Remove the panel clamp and anchors from the analyzer case.
4. Insert the analyzer into the panel cut-out.
5. Refit the panel clamps to the case, ensuring that the panel clamp anchors are located correctly in their slot.
6. Secure the analyzer by tightening the panel clamp retaining screws.

Caution. The clamp must fit flat on the analyzer casing. If the clamp is bowed, the securing screw is overtight and sealing problems may occur.

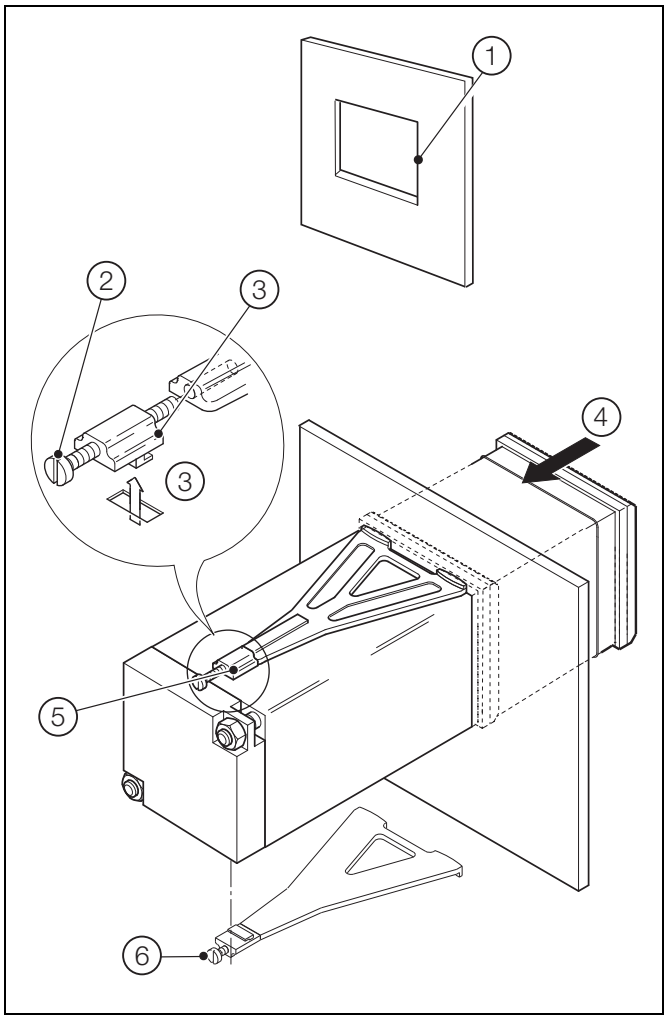


Fig. 3.7 Panel-mounting

3.3 Mounting the Turbidity Sensor

Systems and sensors are shown in Table 2.1 on page 3. The main components of each sensor are identified in Fig. 2.2 on page 4.

Referring to Figs 3.8 or 3.9:

1. Mount the sensor in the orientation shown using the bracket(s) provided, ensuring it is mounted within 5° of its vertical axis.
2. Connect the sample inlet and sample drain tubes.
3. Referring to Fig. 3.10, connect the sample outlet tube.

Dimensions in mm (in)

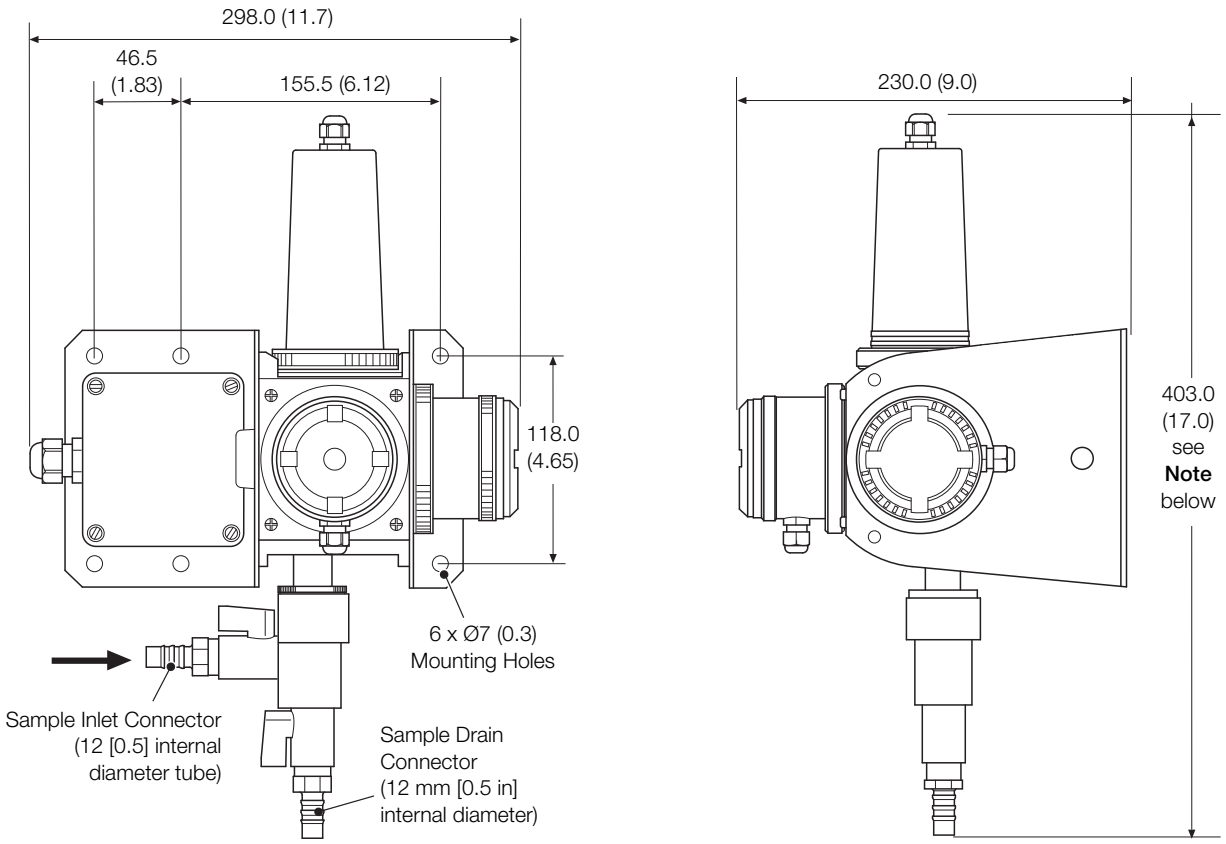


Fig. 3.8 Sensor Dimensions (With Optional Wiper Unit)

Note. Allow a further 30 mm (1.2 in) (approximately) clearance above the wiper unit for the bend in the wiper unit cable.

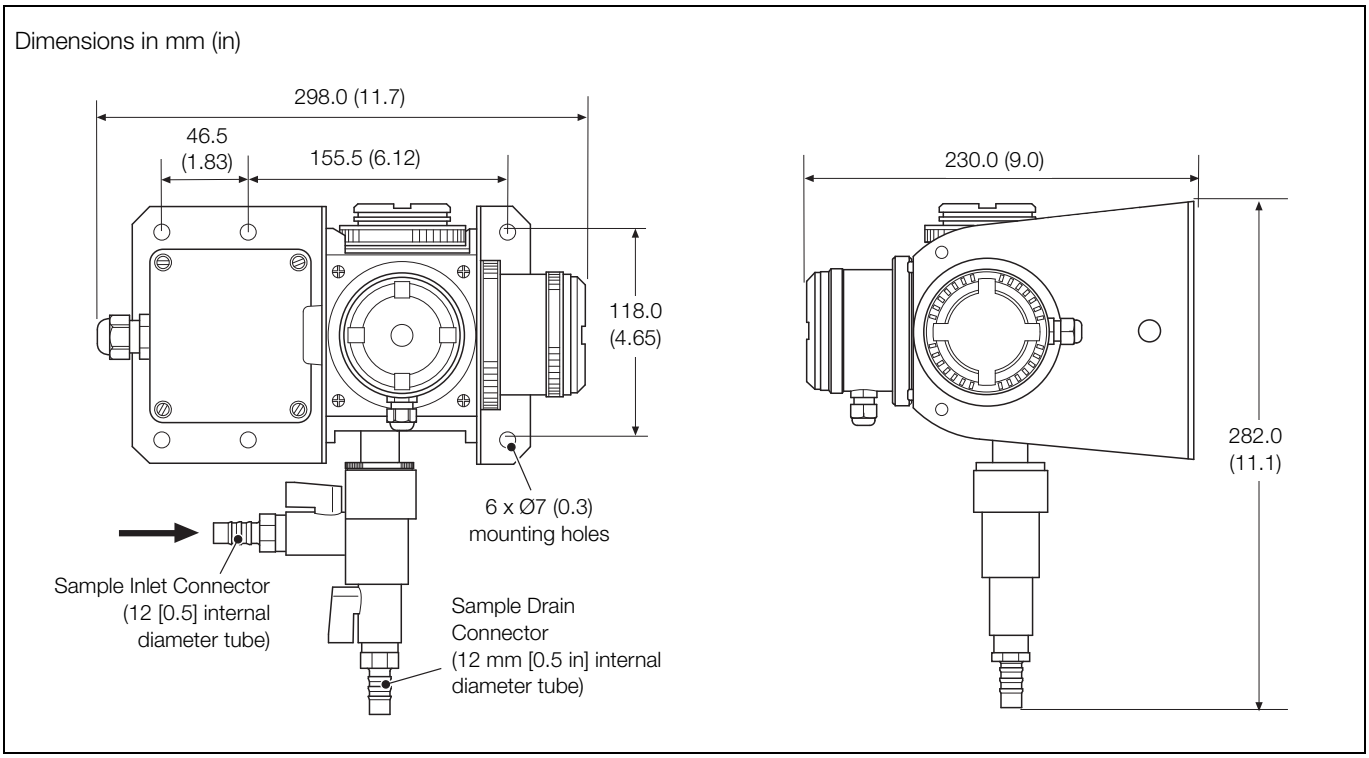


Fig. 3.9 Sensor Dimensions (Without Optional Wiper Unit)

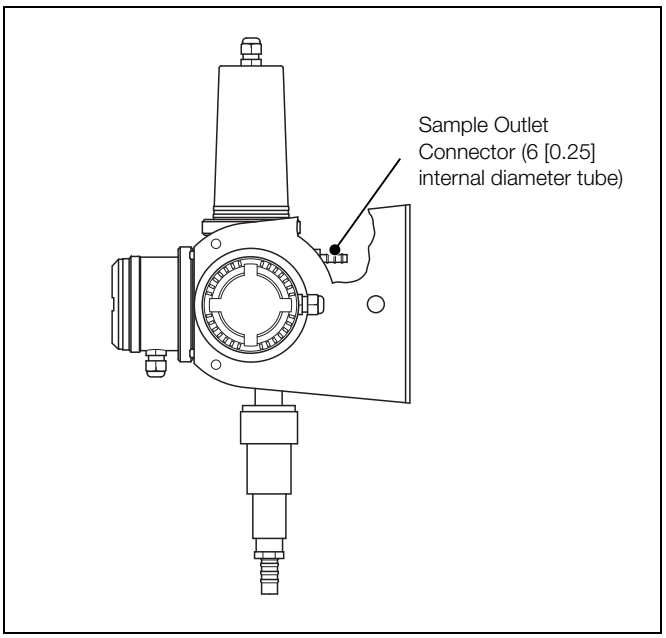


Fig. 3.10 7998 Series – Sample Outlet Connector Location

3.3.1 Sample Flowrate

Set a minimum flowrate of 0.5 l min^{-1} to prevent solids settling in the pipework. Increase the flowrate if necessary but **do not** exceed the maximum flow rate of 1.5 l min^{-1}.

When measuring turbidity, it is important that additional sources of light scattering, such as gas bubbles in the sample, are eliminated. An optional debubbler (part number 7997 500) is available to eliminate gas bubbles – refer to Section 3.4, page 10.

3.4 Installing the Optional De-bubbler

3.4.1 Mounting the De-bubbler

Note. The de-bubbler **MUST** be mounted vertically with the flow upwards.

Dimensions in mm (in)

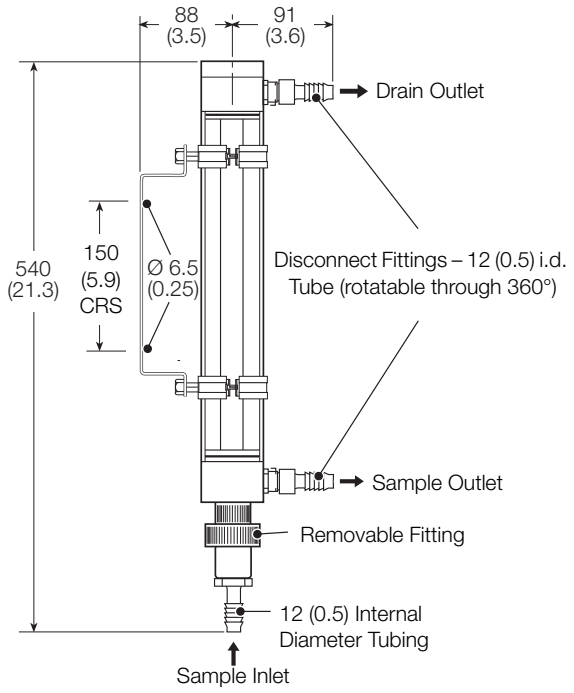


Fig. 3.11 De-Bubbler Mounting Information (Debubbler Part Number 7997 500)

3.4.2 Set Up Procedure for De-bubbler

With a system that includes a de-bubbler, referring to Fig. 3.12:

1. Open the 'sample in' isolating valve (A) such that the overflow from the de-bubbler is at a minimum.
2. Adjust the sample flow through the turbidity system using flow regulating valve (B).

Note. Sample regulating valves together with a flow indicator are recommended to ensure easy maintenance and consistent performance. These devices are not supplied with the 7998 Turbidity systems.

Dimensions in mm (in)

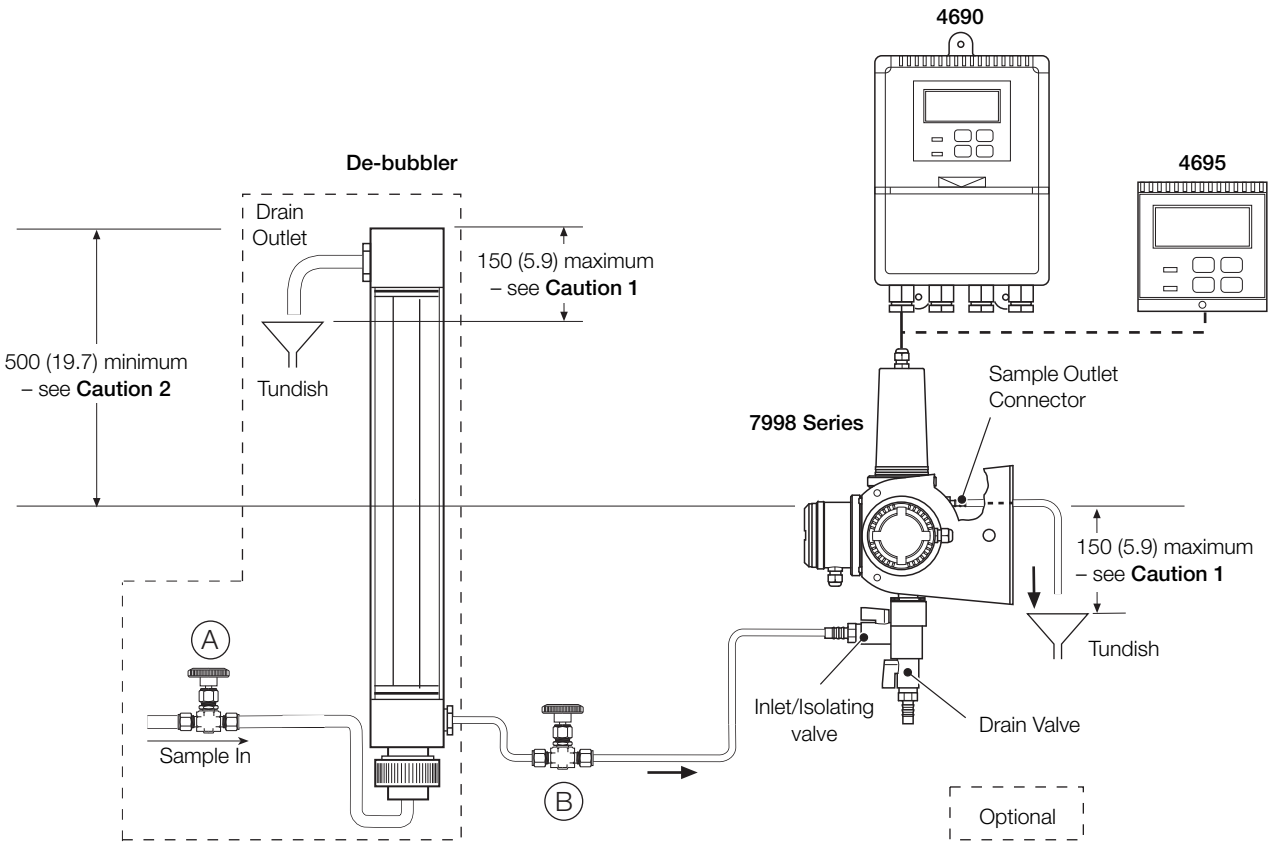


Fig. 3.12 Typical System Installation for 7998 Series Turbidity Systems

Caution.

1. To prevent degassing of the sample and very erratic readings, do not exceed this measurement.
2. This is the minimum installation distance that ensures adequate flowrate through the sensor. Increase this distance as necessary if using long or small-bore tubing.

4 Electrical Connections

Warning.

- The analyzer is not fitted with a switch – an isolation device such as a switch or circuit breaker conforming to local safety standards must be fitted to the final installation. It must be fitted in close proximity to the analyzer, within easy reach of the operator and marked clearly as the isolation device for the analyzer.
- Remove all power from supply and relays before accessing or making any connections. Use cable appropriate for the load currents: 3-core cable rated 3 A and 75 °C (167 °F) minimum, and voltage: 100 / 240V that conform to either IEC 60227 or IEC 60245, or to the National Electrical Code (NEC) for the US, or the Canadian Electrical Code for Canada.
- Use cable appropriate to the load currents.
  The 4690 (wall mounted) and 4695 (panel mounted) terminals accept cables AWG 24 to 14 (0.2 to 2 mm^2). All connections to secondary circuits must have insulation to required local safety standards. After installation, there must be no access to live parts, for example, terminals. Use screened cable for signal inputs and relay connections. Route signal leads and power cables separately, preferably in an earthed (grounded) flexible metal conduit.

USA and Canada only

- The supplied cable glands and use of cable / flexible cord for connection of the mains power source to the mains input and relay contact output terminals is not permitted in the USA or Canada.
- For connection to mains (the mains input and relay contact outputs), use only suitably rated field wiring insulated copper conductors rated min. 300 V, 16 AWG, 90 °C. Route wires through suitably rated flexible conduits and fittings.

Warning – Bodily injury

- If the analyzer is used in a manner not specified by the Company, the protection provided by the equipment may be impaired.
- The analyzer conforms to CEI/IEC 61010-1 Edition 3.1 2017-01 Installation Category II.
- All equipment connected to the analyzer's terminals must comply with local safety standards (IEC 60950, IEC 61010-1).

4.1 Access to Terminals

4.1.1 Wall- / Pipe-mount Analyzer

Referring to Fig. 4.1:

(1) Slide cover down, pull out slightly and slide it off.
(2) Release captive screws.
(3) Remove protection cover.

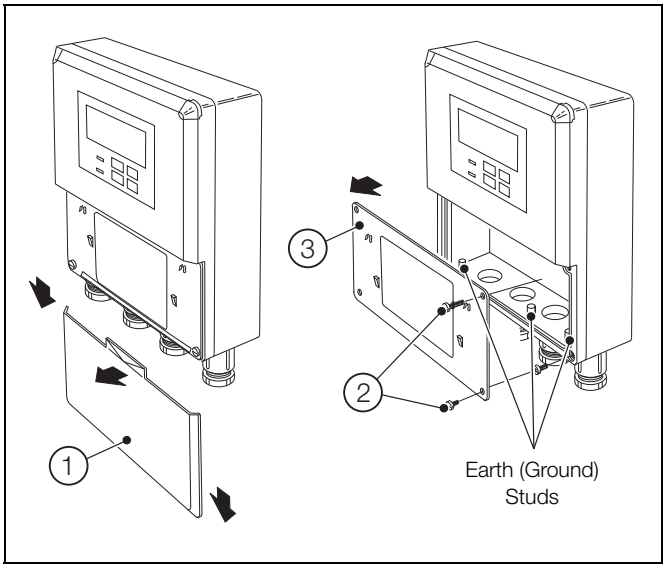


Fig. 4.1 Access to Terminals – Wall- / Pipe-mount Analyzer

4.1.2 Panel-mount Analyzer

Referring to Fig. 4.2:

(1) Remove securing nuts.
(2) Remove cover.
(3) Remove mains terminals protection cover.

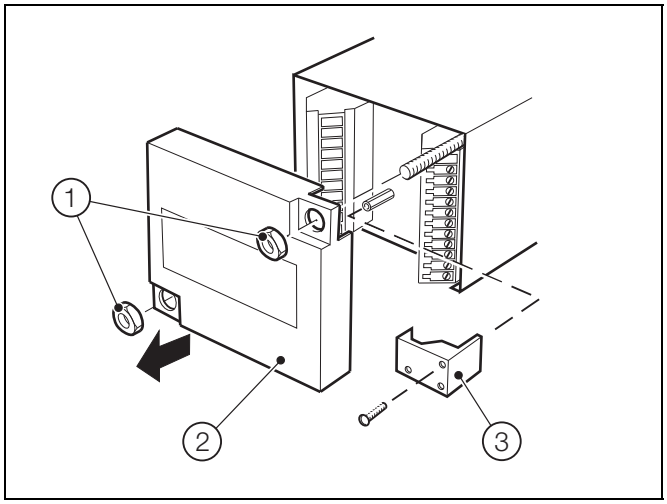


Fig. 4.2 Access to Terminals – Panel-mount Analyzer

4.2 Safety Information

Warning. The power supply earth (ground) **must** be connected to ensure safety to personnel, reduction of the effects of RFI and correct operation of the power supply interference filter.

Note.

- Stud terminal(s) is (are) fitted to the analyzer case for bus-bar earth (ground) connection – see Figs. 4.1, 4.4 and 4.5.
- The cable length between the turbidity sensor and the 4690 / 4695 analyzer is provided as ordered and terminated at the sensor. Shorten or lengthen the cable as required for the installation.
- Always route the signal cable and mains-carrying/relay cables separately, ideally in earthed (grounded) metal conduit.

  Ensure that the cables enter the analyzer through the glands nearest the appropriate screw terminals and are short and direct. Do not tuck excess cable into the terminal compartment.
- Ensure a moisture-tight fit when using cable glands, conduit fittings and blanking plugs/bungs (M20 holes). The M16 glands ready-fitted to wall-mount analyzers accept cable of between 4 and 7 mm diameter.
- The relay contacts are voltage-free and must be connected appropriately in series with the power supply and the alarm/control device that they are to actuate. Ensure that the contact rating is not exceeded. Refer also to Section 4.2.1 for relay contact protection details when the relays are to be used for switching loads.
- Do not exceed the maximum load specification for the selected current retransmission range – refer to Section 11, page 37.

  The retransmission output is isolated therefore the –ve terminal **must** be connected to earth (ground) if connecting to the isolated input of another device.

4.2.1 Relay Contact Protection and Interference Suppression

If the relays are used to switch loads on and off, the relay contacts can become eroded due to arcing. Arcing also generates radio frequency interference (RFI) that can cause analyzer malfunction and incorrect readings. To minimize the effects of RFI, arc suppression components are required; resistor/capacitor networks for AC applications or diodes for DC applications. These components can be connected either across the load or directly across the relay contacts. On 4690 / 4695 analyzers, fit the RFI components to the relay terminal block together with the supply and load wires – see Fig. 4.3.

For AC applications, the value of the resistor/capacitor network depends on the load current and inductance that is switched. Initially, fit a 100R/0.022 µF RC suppressor (part no. B9303) as shown in Fig. 4.3A. If the analyzer malfunctions (incorrect readings) or resets (display shows *88888*) the value of the RC network is too low for suppression – use an alternative value. If the correct value cannot be obtained, contact the manufacturer of the switched device for details on the RC unit required.

For DC applications, fit a diode as shown in Fig. 4.3B. For general applications use an IN5406 type (600 V peak inverse voltage at 3A – part no. B7363).

Note. For reliable switching, the minimum voltage must be greater than 12 V and the minimum current greater than 100 mA.

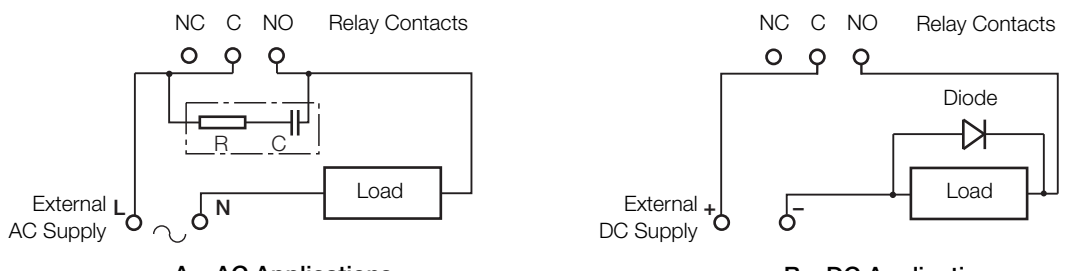


Fig. 4.3 Relay Contact Protection

4.3 Connections

Mounting	Terminal Number						
Wall	1	2	3	4	5	6	7
Panel	12	11	10	9	8	7	6
	Cleaner initiate pulse	+12 V Switched emitter supply	+12 V Cleaner / Receiver supply	Signal input	Cleaner detect signal		0 V common
							Link

Table 4.1 Analyzer Input Connections

4.3.1 Wall- / Pipe-mount Analyzer Connections

Note.

- Refer to Fig. 4.1, page 12 for access to terminals.
- Slacken terminal screws fully before making connections.

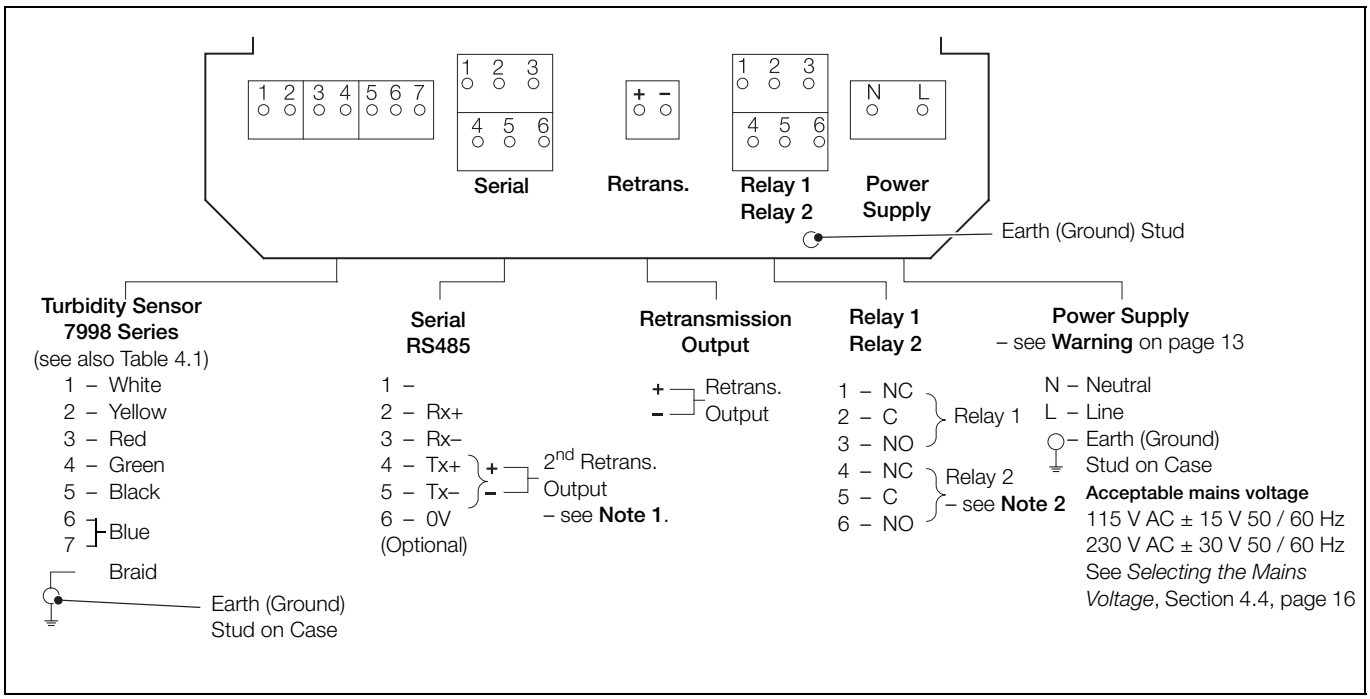


Fig. 4.4 Wall- / Pipe-mount Analyzer Connections

Note.

1. A second retransmission output is available if the RS485 serial communications facility is not used.
2. If **Test Cleaner** is set to YES (see page 28), Relay 2 becomes 'Failed Wiper Alarm' relay.

4.3.2 Panel-mount Analyzer Connections

Note.

- Refer to Fig. 4.2, page 12 for access to terminals.
- Slacken terminal screws fully before making connections.

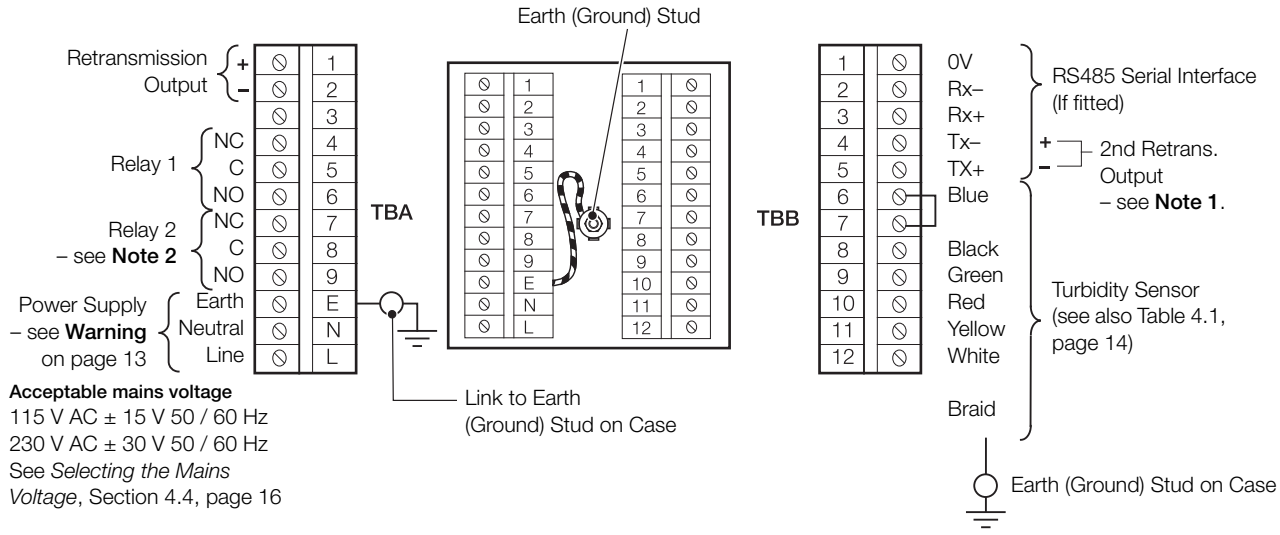


Fig. 4.5 Panel-mount Analyzer Connections

Note.

1. A second retransmission output is available if the RS485 serial communications facility is not used.
2. If **Test Cleaner** is set to YES (see page 28), Relay 2 becomes 'Failed Wiper Alarm' relay.

4.3.3 Power Supply Connections

Referring to Figures 4.4, page 15 and 4.5:

Make connections to the power supply terminals as follows:

- L (line), N (neutral), Stud on case (ground)

Note. Tighten terminal screws to a torque of 0.1 Nm (0.9 lbf.in).

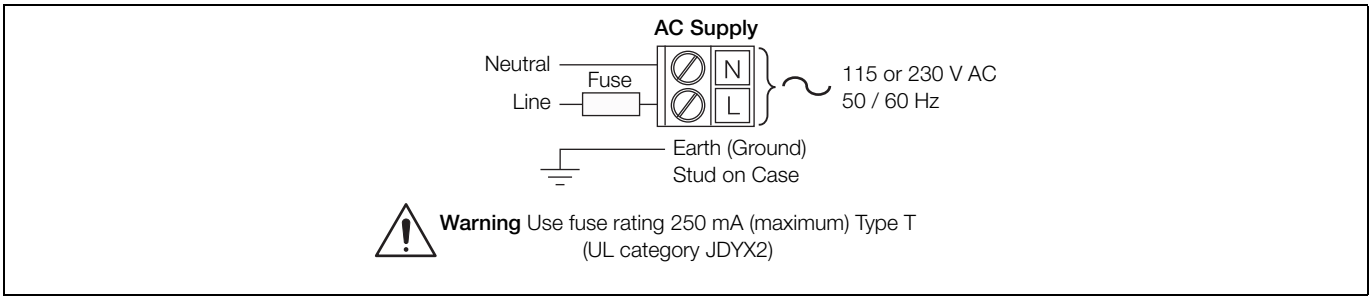


Fig. 4.6 AC Power Supply Connections

4.4 Selecting the Mains Voltage

4.4.1 Wall- / Pipe-mount Analyzer

Referring to Fig. 4.7:

1. Slide cover down, pull out slightly and slide it off.
2. Release 4 captive screws.
3. Remove protection cover.
4. Remove 2 screw caps (if fitted).
5. Remove 6 front panel screws.
6. Remove front panel.
7. Set voltage selector switch as required.

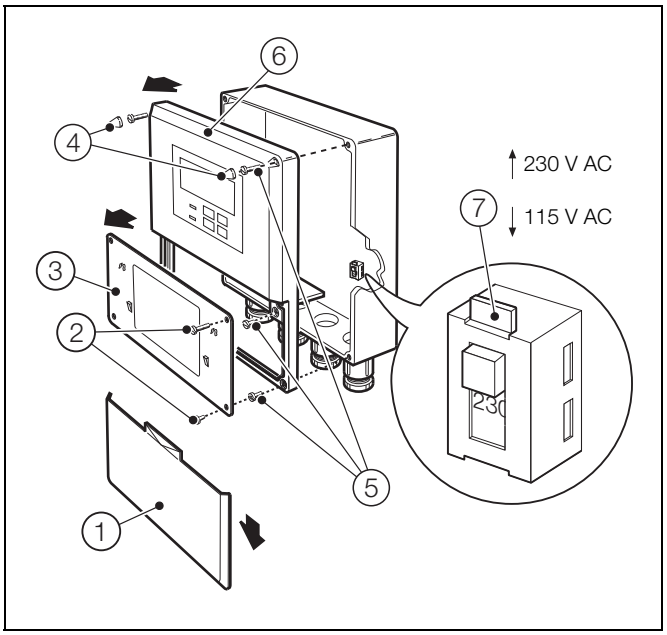


Fig. 4.7 Selecting Mains Voltage – Wall- / Pipe-mount Analyzer

4.4.2 Panel-mount Analyzer

Referring to Fig. 4.8:

1. Release captive screw.
2. Remove analyzer from its case.
3. Set voltage selector switch as required.

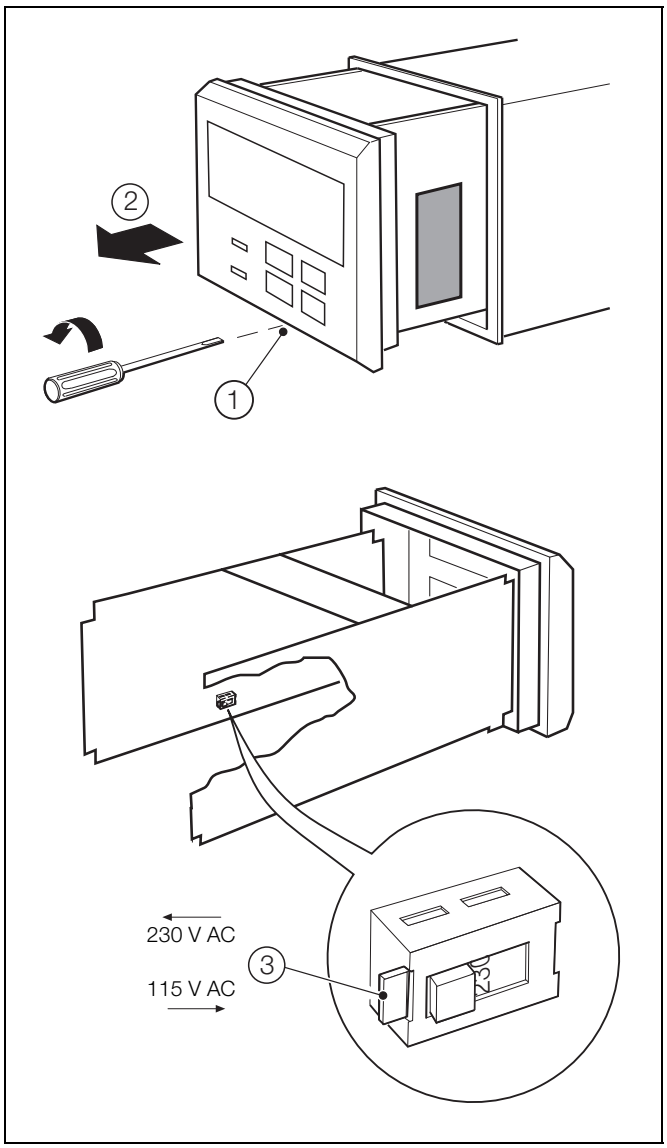


Fig. 4.8 Selecting Mains Voltage – Panel-mount Analyzer

4.5 Turbidity Sensor Connections

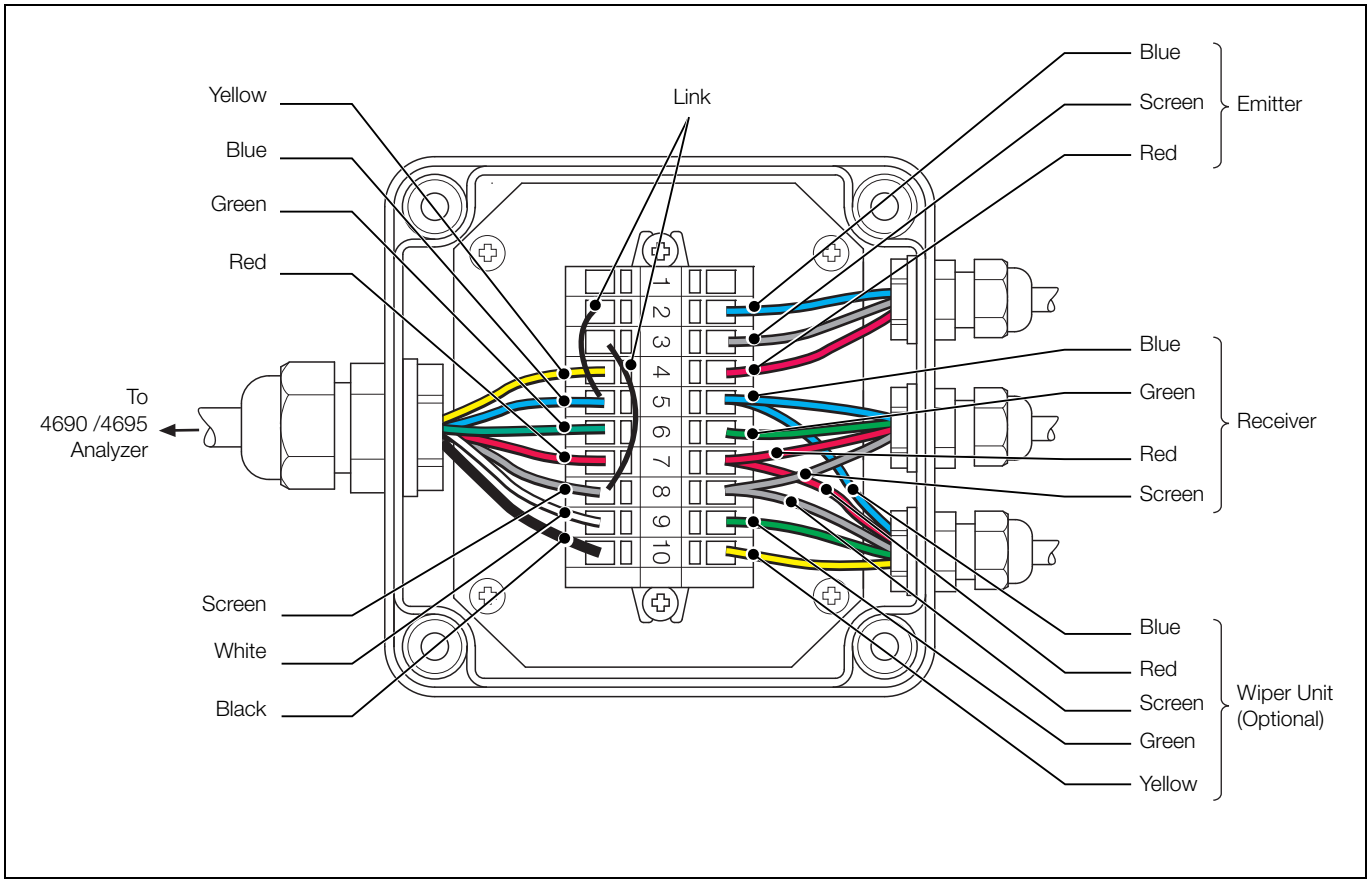


Fig. 4.9 Turbidity Sensor Junction Box Connections

5 Controls and Display

5.1 Display

The display comprises a 5-digit, 7-segment digital upper display line and a 16-character dot-matrix lower display line. The upper display line shows actual values of turbidity, temperature, alarm set points or programmable parameters. The lower display line shows the associated units or programming information.

5.2 Control Familiarization

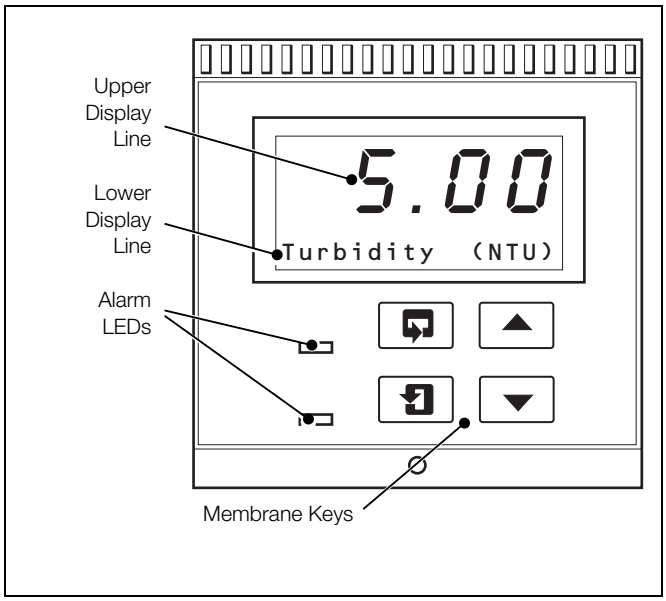


Fig. 5.1 Controls and Display

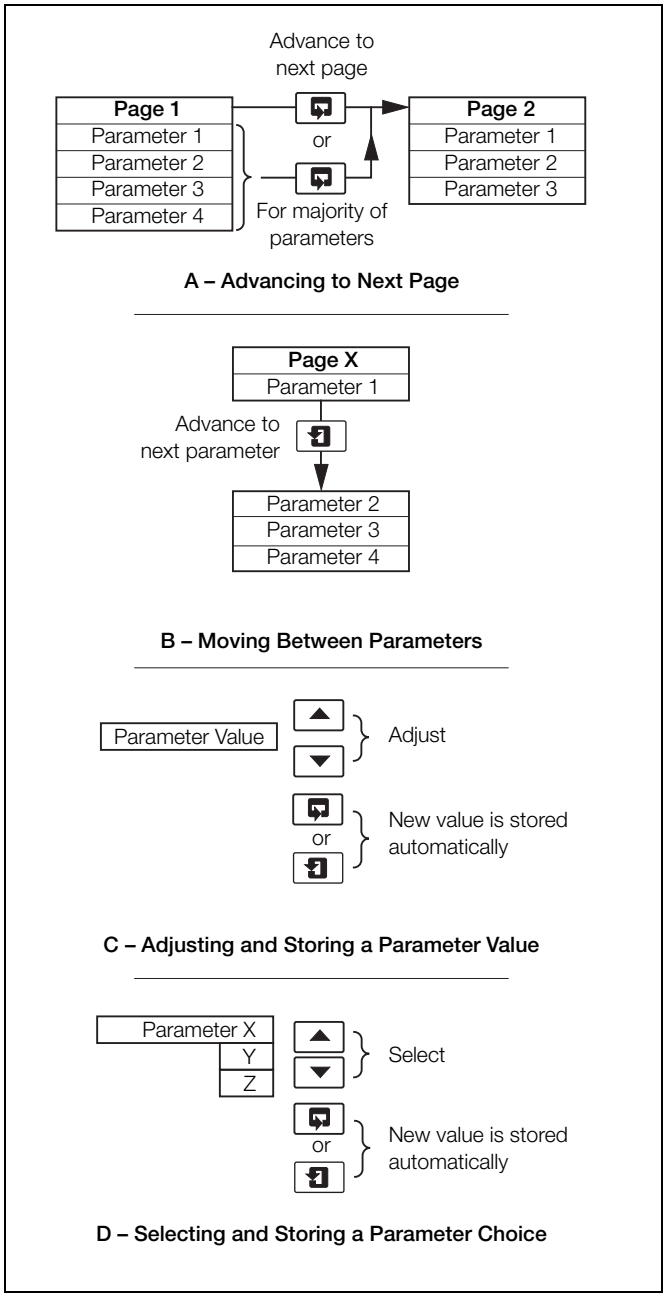


Fig. 5.2 Membrane Key Functions

6 Operation

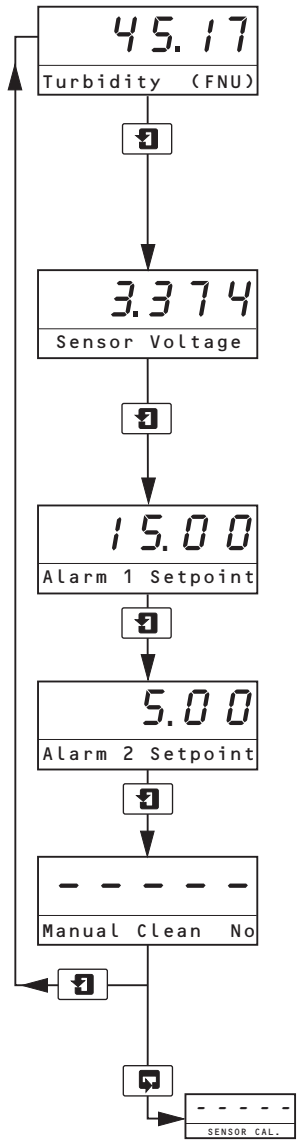
6.1 Analyzer Start-up

Ensure all electrical connections have been made and switch on the power supply. If the system is being commissioned for the first time, calibration (refer to Section 7, page 20) and parameter programming (refer to Section 8.3, page 27) are required.

6.2 Operation – Turbidity Measurement Mode

Operation in the Turbidity measurement mode comprises an **Operating** page and a **Turbidity Calibration** page. The **Operating** page is a general use page in which parameters are viewed only and cannot be altered. To alter or program a parameter, refer to the programming pages in Section 8. The **Turbidity Calibration** page enables a calibration to be carried out. A 5-digit calibration code is used to prevent unauthorized access to the **Turbidity Calibration** page. The value is preset at 00000 to allow access during commissioning, but should be changed to a unique value, known only to authorized operators, in the **Set Up Outputs** page – see page 30.

6.2.1 Operating Page



Measured Turbidity (Units)

The measured turbidity value is displayed in the units selected in the **Set Up Parameter** page – see Section 8.3, page 27.

Press ↵ to advance to next page

or

Press ▶ to advance to next parameter.

Sensor Voltage

The sensor voltage displayed is the output from the optical receiver. The optical system (the emitter and the receiver) are configured to produce the 0 to 3 V outputs from zero to full scale, providing an indication of the performance of the optical system.

Alarm 1 Set Point

The set point value and relay / LED action are programmable – refer to Section 8.4, page 29.

Alarm 2 Set Point

The set point value and relay / LED action are programmable – see refer to Section 8.4, page 29.

Manual Clean

Note. Displayed only if the turbidity sensor is fitted with a wiper unit – see Table 2.1, page 3.

Press the ▲ key to initiate a manual clean. `Manual Clean Yes` is displayed for one minute. The automatic clean sequence is then reset and `Manual Clean No` displayed.

Advance to **Calibration** page – see Section 7, page 20.

7 Calibration

A key feature of the 4690 Series Turbidity system is the dry secondary calibration standard. This is designed to simplify routine calibration verification and minimizes the need for chemical standards.

Each dry calibration standard is verified against a primary formazine standard before delivery and the nominal turbidity value is indicated on the label.

For regulatory monitoring, use the secondary calibration standard for monthly calibration verification and monitor it for deterioration periodically using a primary standard.

Definitions

- **Primary Standards**

  Turbidity standards that are traceable and equivalent to the reference turbidity standard, within statistical errors. Formazine is the most commonly acceptable form of primary standard. The other is a commercially manufactured liquid suspension of Styrene divinylbenzene polymer beads (SDB). Primary standards are used to calibrate a turbidity analyzer directly or to calibrate a secondary standard.

- **Secondary Standards**

  Standards that the manufacturer (or an independent testing organization) has certified give analyzer calibration results equivalent (within certain limits) to the results obtained when the analyzer is calibrated with a primary standard.

- **Calibration**

  A procedure that checks or adjusts an analyzer's accuracy by comparison with a defined standard or reference.

- **Calibration Verification**

  A procedure used to check whether or not the calibration of the analyzer is within certain limits.

7.1 Care and Maintenance of Secondary Standards

ABB's secondary standards may be used repeatedly but must be monitored for deterioration.

All secondary standards can change gradually with time. Deterioration can be detected by measuring the turbidity value of the secondary standard after calibration of the analyzer with a primary calibration standard.

It is recommended that secondary standards are rechecked against a primary standard on the analyzer they are intended to be used with every 3 months.

If comparison with a primary standard shows that the turbidity value of the secondary standard has changed the secondary standard can be assigned a new turbidity value for use in future calibration verification.

Included with each sensor is a calibration record card kit for recording the value of the secondary standard compared to the primary calibration data for each individual analyzer with which the secondary standard is used.

Additional calibration record card kits can be purchased from ABB (part no. 7998190 for pack of 3).

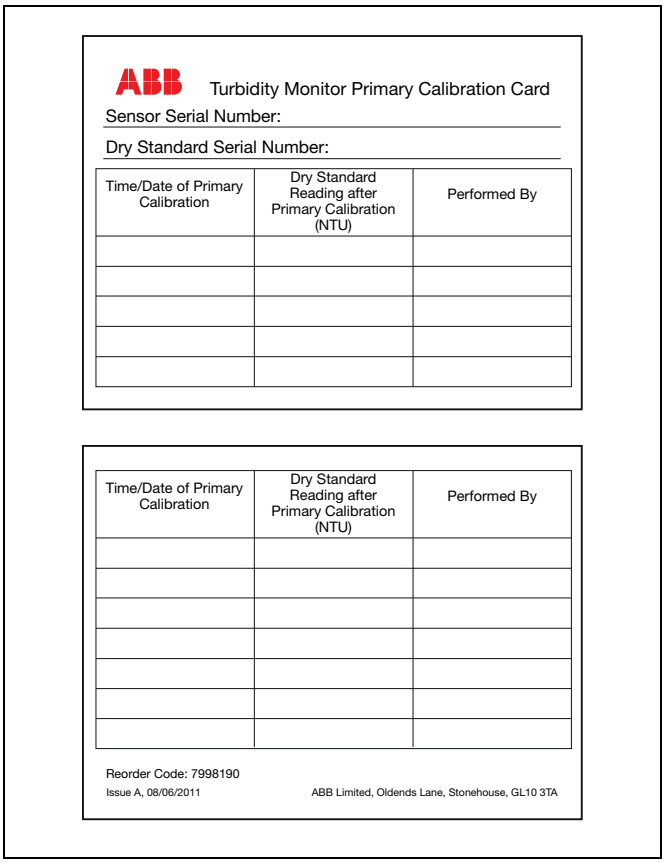


ABB Turbidity Monitor Primary Calibration Card

Sensor Serial Number:

Dry Standard Serial Number:

Time/Date of Primary Calibration	Dry Standard Reading after Primary Calibration (NTU)	Performed By

Time/Date of Primary Calibration	Dry Standard Reading after Primary Calibration (NTU)	Performed By

Reorder Code: 7998190

Issue A, 08/06/2011

ABB Limited, Oldends Lane, Stonehouse, GL10 3TA

Fig. 7.1 Example of Calibration Record Card

To minimize deterioration of the secondary standard:

- Carefully wipe off any residual moisture after use.
- Clean the prism with lint-free cloth.
- Avoid direct contact with the dry standard rod – fingerprints on the surface may alter its stated value.
- Store in the container provided when not in use and keep in a dry place.

7.2 Performing a Calibration Verification with a Secondary Standard

To check the calibration:

1. Close the isolating valve installed upstream of the sensor.
2. Close the sensor inlet valve and open the drain valve. Allow the sensor to drain.
3. Carefully remove the wiper unit (7998 011 and 012) or the wiper plug (7998 016 and 017) to aid complete drainage of the system. When the system is empty, close the drain valve.

   Caution. When removing the wiper unit **do not** put excessive leverage on the wiper as there is a risk of bending the wiper arm out of 90 °. On removal of wiper, check wiper arm has not been bent.

4. Thoroughly dry the flow chamber internally using clean tissue.
5. Thoroughly clean and dry the emitter and receiver lenses using clean tissue.

   Note. If condensation forms on the emitter and receiver lenses, leave the sensor open to enable the lenses to reach ambient temperature before attempting calibration.

6. Insert the dry calibration standard with the zero NTU indication (see Figs 7.2 or 7.3) facing the optical receiver, ensuring the locating lug engages correctly – see Fig. 7.4.

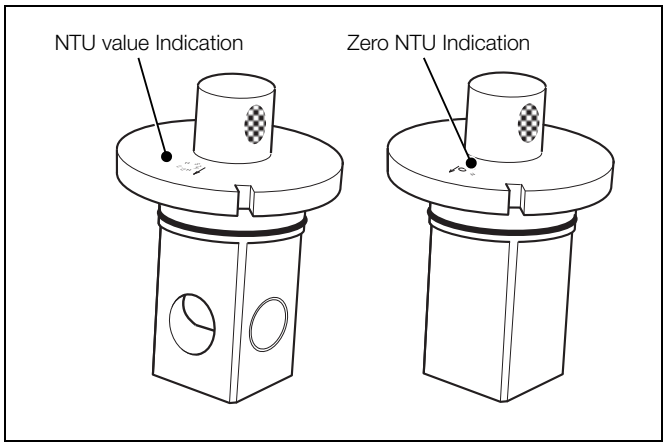


Fig. 7.2 Dry Calibration Standard for Low Range Sensors

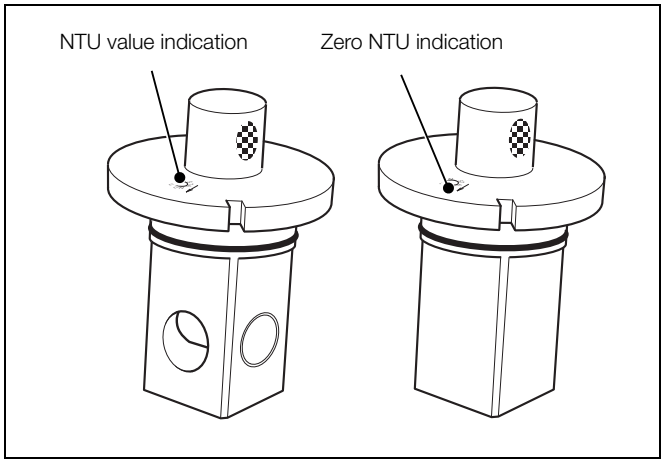


Fig. 7.3 Dry Calibration Standard for High Range Sensors

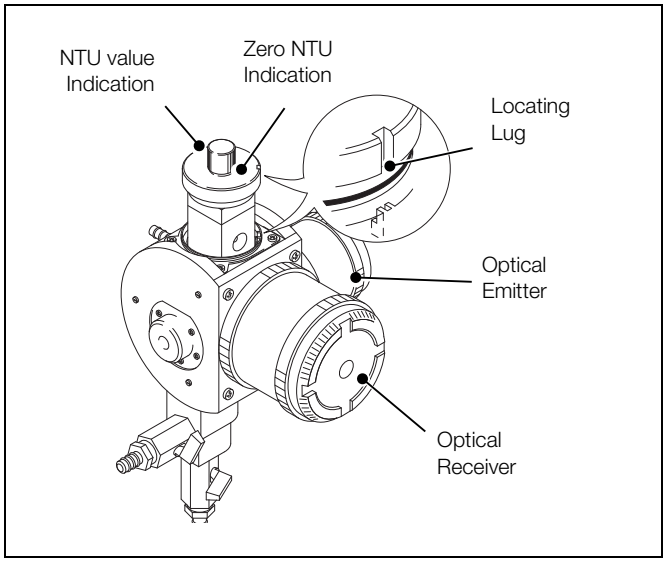


Fig. 7.4 Inserting Dry Standard

7. Note the reading on the display.

8. Remove the dry standard, rotate it through 180° and refit it, ensuring that the NTU value indication (see Figs 7.2 or 7.3) faces the receiver and the locating lug engages correctly – see Fig. 7.4.
9. Note the reading on the display.
10. If the readings noted at steps 7 and 9 exceed ±5 % of dry standard value, repeat the procedure from step 4. If readings are still outside this range, calibrate the sensor.
11. Remove the dry standard and place it in its storage container.
12. Refit the wiper unit (7998 011 and 012) or wiper plug (7998 016 and 017).
13. Open the inlet valve and ensure that the flow through the sensor is 0.5 to 1.5 l min^{-1}

7.3 Performing a Calibration with a Primary Standard

Note. Before performing a wet standard calibration, ensure a stock formazine solution is available. If a stock solution is not available, 24 hours must elapse before a freshly-prepared solution can be used.

To prepare the sensor assembly for wet (Formazine) calibration:

1. Close the isolating valve installed upstream of the sensor.
2. Close the sensor inlet valve and open the drain valve. Allow the sensor to drain.
3. Carefully remove the wiper unit (7998 011 and 012) or the wiper plug (7998 016 and 017) to aid complete drainage of the system. When the system is empty, close the drain valve.

   Caution. When removing the wiper unit **do not** put excessive leverage on the wiper as there is a risk of bending the wiper arm out of 90 °. On removal of wiper, check wiper arm has not been bent.

4. Thoroughly dry the flow chamber internally using clean tissue.
5. Thoroughly clean and dry the emitter and receiver lenses using clean tissue.

   Note. If condensation forms on the emitter and receiver lenses, leave the sensor open to enable the lenses to reach ambient temperature before attempting calibration.

6. Insert the dry calibration standard with the zero NTU indication (see Figs 7.5 or 7.6, page 23) facing the optical receiver, ensuring the locating lug engages correctly – see Fig. 7.7.

   Note. Do not touch the light reflecting parts of the standard.

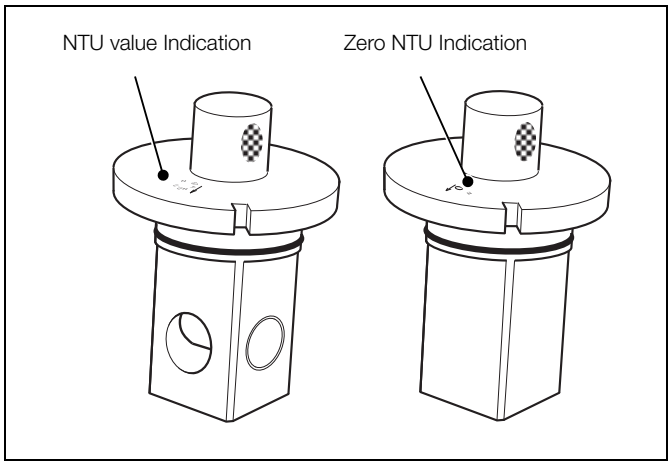


Fig. 7.5 Dry Calibration Standard for Low Range Sensors

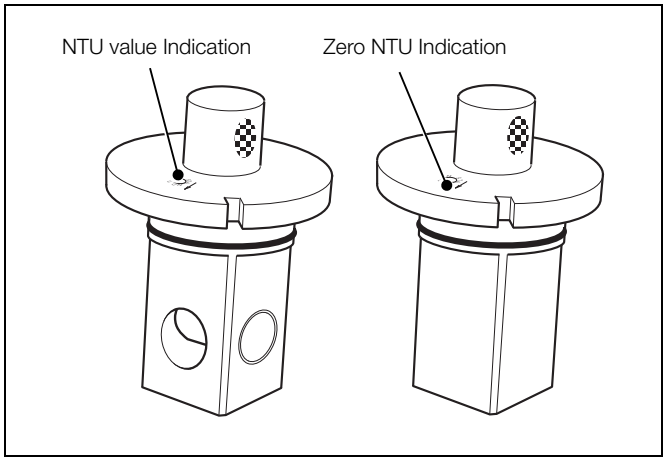


Fig. 7.6 Dry Calibration Standard for High Range Sensors

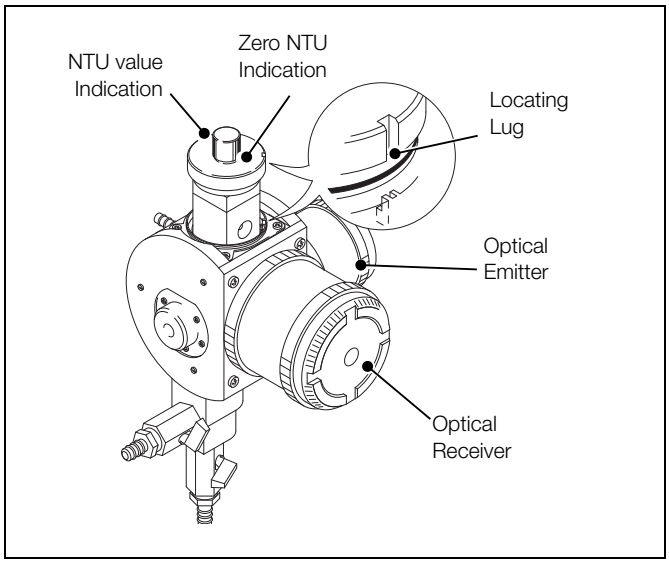
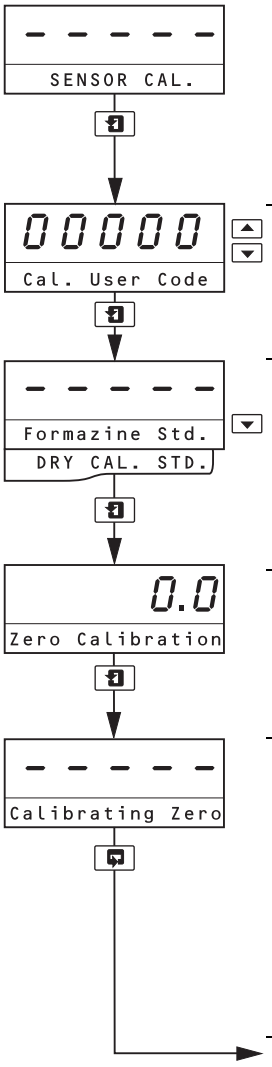


Fig. 7.7 Inserting Dry Standard

7. Calibrate the sensor as follows:



Sensor Calibration

Press ↵ to advance to next page

or

Press ↵ to advance to next parameter.

Calibration Security Code

Enter the required calibration code number, between 00000 and 19999. If an incorrect value is entered, access to calibration is prevented and the `SENSOR CAL.` page is displayed.

Dry Standard Calibration

Press the ▼ key to select `Formazine Std.`

Zero Calibration

Press the ↵ key. The display changes to `Calibrating Zero`.

Calibrating Zero

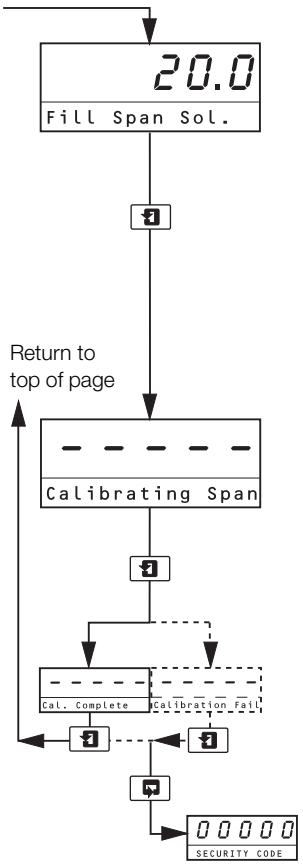
After approximately one minute, the display changes to `Fill Span Sol.` if zero calibration is successful.

If `Cal Fail` is displayed, remove the dry standard and ensure the emitter and receiver lenses are clean and dry. Refit the dry standard, ensuring it is fitted correctly (see step 6, page 22) and repeat the procedure.

Note. Do not touch the light reflecting parts of the standard.

Continued on next page.

Continued from previous page



Fill Span Solution

1. Remove the dry standard and place it in its storage container.

   Note. Do not touch the light reflecting parts of the standard.

2. Fill the flow chamber with the formazine span solution and refit the wiper unit or wiper plug.
3. Using the ▲ and ▼ keys, set the display to the NTU value of the formazine span solution.
4. Press the ↵ key. The display changes to `Calibrating Span`.

   Note. If span calibration is not required, press the ↵ key again to advance to `Cal. Complete`.

Calibrating Span

After approximately one minute, the display changes to `Cal. Complete` if calibration is successful.

1. Remove the wiper unit or wiper plug.
2. Drain the flow chamber, ensuring all the formazine span solution is removed.
3. Refit the wiper unit or wiper plug and open the inlet valve.

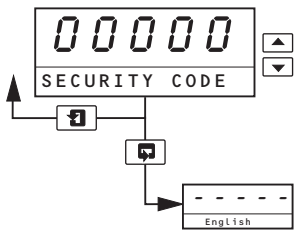
If `Cal Fail` is displayed, drain the flow chamber, remove the wiper unit or wiper plug and clean the emitter and receiver lenses. Repeat the calibration procedure ensuring that an in-date or fresh formazine solution is used and that the **Fill Span Solution** parameter is set to the NTU value of the formazine span solution.

Advance to **Access to Configuration** pages – see Section 8.1, page 26.

8 Configuration and Electrical Calibration

8.1 Access to Configuration Pages

A 5-digit security code is used to prevent unauthorized access to the configuration pages.

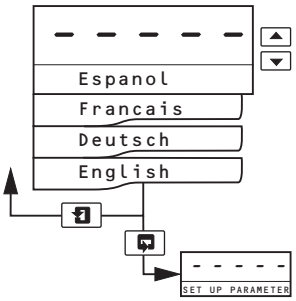


Security Code

Enter the required code number, between 00000 and 19999, to gain access to the configuration pages. If an incorrect value is entered, access to subsequent configuration pages is prevented and the Operating Page is displayed.

Advance to **Language** page – see Section 8.2 below.

8.2 Language Page

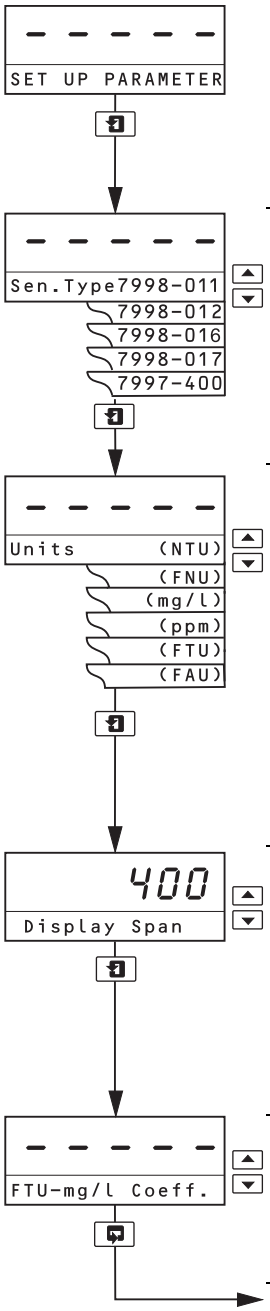


Language

Using the ▲ and ▼ keys, select the required language.

Advance to **Set Up Parameter** page – see Section 8.3, page 27.

8.3 Set Up Parameter Page



Set Up Parameter

Press ↵ to advance to next page

or

Press ↵ to advance to next parameter.

Sensor Type

Using the ▲ and ▼ keys, select the required sensor:

7998–011
7998–012
7998–016
7998–017

7998–400 (Refer to separate manual IM/4670)

Units

Using the ▲ and ▼ keys, select the required measurement units:

NTU (Nephelometry Units)

FNU (Formazine Nephelometry Units)

mg/l (milligrams suspended solids per litre) – 7998-012/017 sensors only

ppm (parts per million suspended solids) – 7998-012/017 sensors only

Note. FTU and FAU units are applicable only to 7997–400 series sensors – refer to IM/4670

Display Span

Using the ▲ and ▼ keys, select the required span value.

The minimum and maximum values that can be selected are determined by the **Sensor Type** selected above. The display flashes at turbidity values higher than the selected span value but indicates correctly up to the range of the sensor – see Table 2.1 on page 3.

The display span also sets the correct output span. Alarm values cannot be set outside this range.

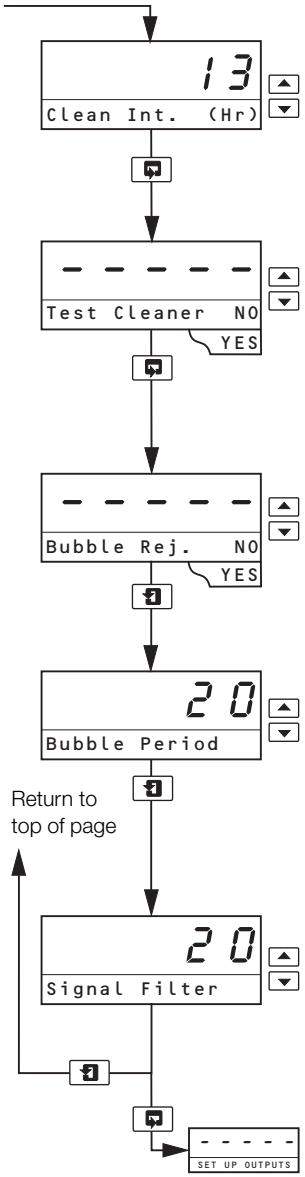
Correction Factor

Note. Displayed only if **Units** is set to mg/l or ppm

Using the ▲ and ▼ keys, select the required correction factor to between 0.2 and 5.0.

Continued on next page.

Continued from previous page



Cleaning Interval

Note. Displayed only if **Sensor Type** is set to 7998-011 or 7998-012.

Using the ▲ and ▼ keys, select the cleaning interval required. Values available are: 15 mins, 30 mins, 45 mins, 1 hr, then 1 hour increments to a maximum of 24 hours.

Test Cleaner

Note. Displayed only if **Sensor Type** is set to 7998-011 or 7998-012.

Select YES to activate the wiper unit diagnostics function and enable visual indication of wiper unit function.

Select No to deactivate the wiper unit diagnostics function.

Bubble Rejection

Use in applications where degassing of the sample takes place.

When set to YES, the analyzer ignores short duration spikes in the turbidity reading caused by the formation of small bubbles in the flowcell due to degassing.

Bubble Period

Note. Displayed only if **Bubble Rej.** is set to YES

Using the ▲ and ▼ keys, adjust the value to between 2 and 60 seconds until short duration spikes are no longer seen on the display.

Note. A value of 20 seconds is normally sufficient for most applications.

Signal Filter

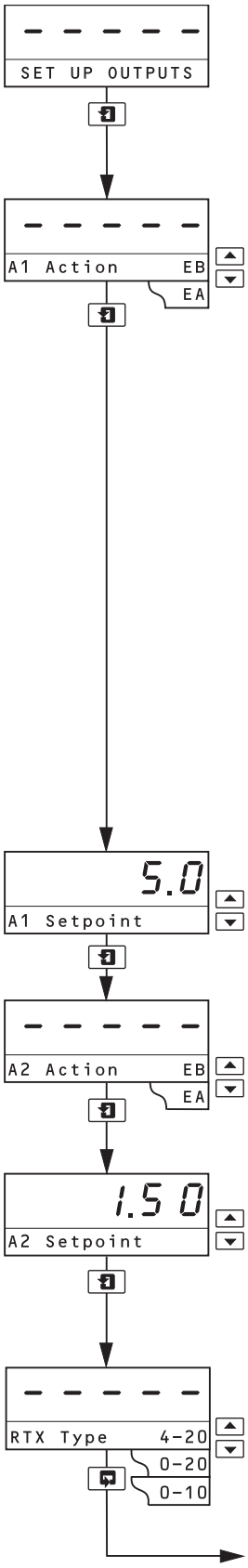
Use in applications where the turbidity readings are noisy.

Using the ▲ and ▼ keys, adjust the value to between 4 and 180 seconds.

Note. If **Bubble Rej.** is set to YES, set a value of 4 seconds for optimum performance.

Advance to **Set Up Outputs** page – see Section 8.4, page 29.

8.4 Set Up Outputs Page



Set Up Outputs

Press ↵ to advance to next page

or

Press ▶ to advance to next parameter.

Alarm 1 Action

For 'Fail-safe' alarm operation the relay's alarm state must be the same as the power-down state, (the relay is de-energized).

For high alarm operation the relay must be Energized Below (EB) the alarm set point.

For low alarm operation the relay must be Energized Above (EA) the alarm set point.

The alarm LEDs are lit in the alarm condition.

Select the required alarm 1 action from the following table:

Alarm Action	LED Condition for Input Above Set Point	LED Condition for Input Below Set Point	Relay Condition for Input Above Set Point	Relay Condition for Input Below Set Point
EB	ON	OFF	De-energized	Energized
EA	OFF	ON	Energized	De-energized

The set point band is defined as the actual value of the set point plus or minus the hysteresis value. The hysteresis value is ±1 % of the set points. Alarm action occurs if the input value is above or below the set point band. If the input moves within the set point band the last alarm action is maintained.

Alarm 1 Set Point

Using the ▲ and ▼ keys, set the alarm 1 set point to any value within the selected display span – see **Display Span** on page 27. The set point value is subject to hysteresis as detailed above.

Alarm 2 Action

Note. Displayed only if **Test Cleaner** is not set to YES – see **Test Cleaner** on page 28 (set automatically to Wiper Unit Failed Alarm if **Test Cleaner** is set to YES).

Repeat as for **Alarm 1 Action** above.

Alarm 2 Set Point

Note. Displayed only if **Test Cleaner** is not set to YES – see **Test Cleaner** on page 28 (set automatically to Wiper Unit Failed Alarm if **Test Cleaner** is set to YES).

Repeat as for **Alarm 1 Set Point** above.

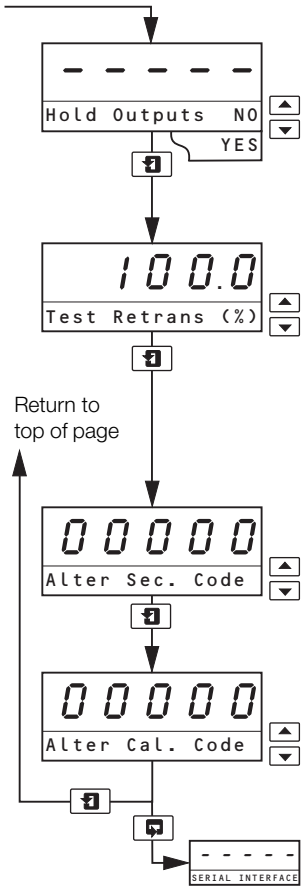
Retransmission Type

Using the ▲ and ▼ keys, select the retransmission current output range required, from 0 to 10, 0 to 20 or 4 to 20 mA.

The current output range is assigned to the selected display span – see **Display Span** on page 27.

Continued on next page.

Continued from previous page



Hold Outputs during Calibration

Select YES to hold the retransmission and alarm outputs to prevent inadvertent operation during calibration.

Test Retransmission Output

The analyzer transmits automatically a test signal of 0, 25, 50, 75 or 100 % of the retransmission range selected on page 29. The % test signal selected is shown on the upper display.

Example – for a selected range of 0 to 20 mA and 50 % retransmission test signal, 10 mA is transmitted.

Select the required retransmission test signal.

Alter Configuration Security Code

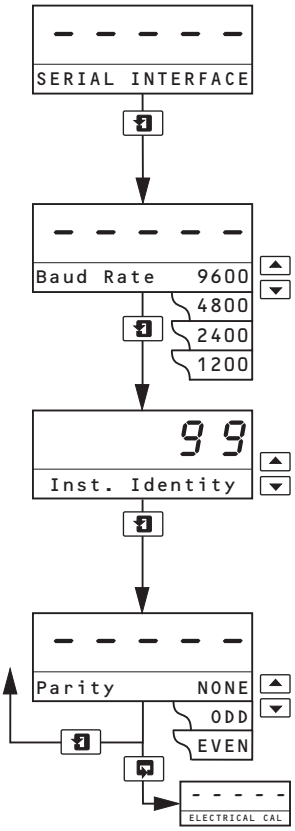
Set the security code to a value between 00000 and 19999.

Alter Calibration Security Code

Set the security code to a value between 00000 and 19999.

Advance to **Set Up Serial Interface** page.

8.5 Set Up Serial Interface Page



Serial Interface

Press ↵ to advance to next page

or

Press ↵ to advance to next parameter.

Baud Rate

Using the ▲ and ▼ keys, select the baud rate required from 1200, 2400, 4800 or 9600 baud.

Instrument Identity

Using the ▲ and ▼ keys, select a value between 1 and 99 to identify the analyzer on the network.

Parity

Using the ▲ and ▼ keys, select the parity required, None, Odd or Even.

Advance to **Electrical Calibration** page – see Section 8.6.3, page 33.

8.6 Electrical Calibration

Caution. The analyzer is calibrated by the Company prior to despatch and an electrical calibration should not be necessary. If an electrical calibration is carried out, suitably calibrated and verifiable test equipment must be used.

8.6.1 Equipment Required

1. Millivolt source: 0 to 4000 mV.
2. Digital milliammeter (current output measurement): 0 to 20 mA.

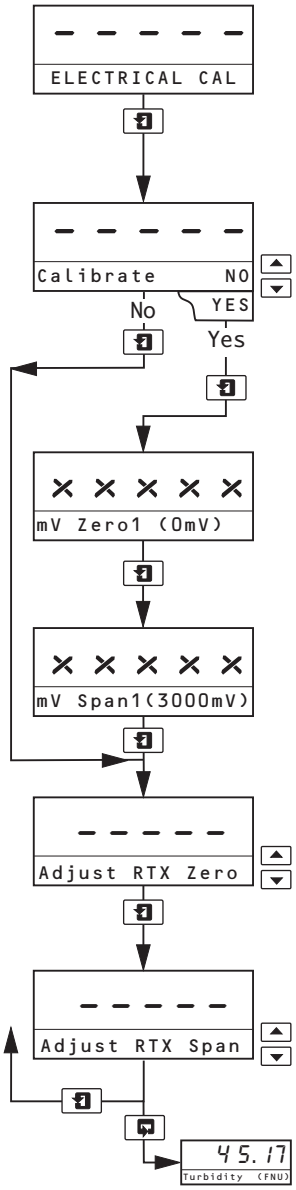
8.6.2 Preparation

1. Isolate the analyzer and turbidity sensor from the power supply and disconnect the sensor and current output from the analyzer's terminal block – see Fig. 4.4, page 14 (wall-/pipe-mount analyzer) or Fig. 4.5, page 15 (panel-mount analyzer).
2. **Wall- / Pipe-mount Analyzer**
   a. Connect the millivolt source '+' and '–' to terminals 4 and 7 respectively.
   b. Connect the milliammeter to the retransmission output terminals.
   c. Ensure the earth on the millivolt source is connected to the earth stud.

   Panel-mount Analyzer
   a. Connect the millivolt source '+' and '-' to terminals 9 and 6 respectively.
   b. Connect the milliammeter to the retransmission output terminals.
   c. Ensure the earth on the millivolt source is connected to the earth stud.
3. Switch on the supply and allow ten minutes for the circuits to stabilize.
4. Select **ELECTRICAL CAL** page and proceed as in Section 8.6.3, following.

8.6.3 Electrical Calibration Page

In this section the actual values denoted by '**xxxxx**' are unimportant and are used only to determine display reading stability when carrying out the electrical calibration procedure.



Electrical Calibration

Press ↵ to advance to next page

or

Press ↵ to return to the **Operating** page – see Section 6.2.1, page 19.

Calibrate

Select **YES** to access the electrical calibration sequence.

Select **NO** to advance to **Adjust RTX Zero**.

mV Zero1 (0mV)

Set the millivolt source to 0 mV and allow the analyzer display to stabilize.

mV Span1 (3000mV)

Set the millivolt source to 3000 mV and allow the analyzer display to stabilize.

Adjust Retransmission Zero

Set the milliammeter reading to 4 mA.

Adjust Retransmission Span

Set the milliammeter reading to 20 mA.

Note. The retransmission range selected in the **Set Up Outputs** page does not affect the reading.

Return to the **Operating** page – see Section 6.2.1, page 19.

9 Maintenance

The servicing schedule in Table 9.1 is a guide only. Because the turbidity systems are designed for a wide range of applications, where the nature of the sample can vary considerably, it may be necessary to amend the schedule to suit the particular installation and sample conditions.

Task	Recommended Frequency
Wiper blade replacement	Quarterly
LED light source (ISO 7027) replacement kit	Every 5 years

Table 9.1 Suggested Maintenance Schedule

9.1 Sensor Cleaning

9.1.1 Sensors Without Wiper Unit

These sensors are normally used on clean water samples and, under normal conditions, may require only manual monthly cleaning of the flow chamber. However, if a high turbidity breakthrough occurs, clean the flow chamber immediately to ensure accurate readings.

9.1.2 Sensors With Wiper Unit

The required automatic cleaning frequency of the flow chamber and optical windows of the sensors can be determined only by plant experience. It is recommended that checks are made at appropriate intervals.

10 Fault Finding

10.1 Error Messages

If erroneous or unexpected results are obtained, the fault may be indicated by an error message – see Table 10.1. The majority of problems are overcome by thorough cleaning of the flowcell optical windows and / or a sensor calibration.

Error Message	Description and Remedy
`Cal Fail`	Indicates that the expected step change between a zero and span calibration was not produced by the sensor (zero response from the sensor). 1. Repeat calibration. 2. If using a dry calibration standard, ensure that the optical windows on the dry standard are clean and dry. 3. If using solutions: Check that the flowcell has been thoroughly cleaned and rinse well between solutions Check both zero and formazine solutions 4. Check electrical connections to sensor. 5. Using a suitable voltmeter, check the sensor 12 V supplies, both at the analyzer terminals and sensor junction box – see Table 4.1 on page 14 for details. 6. Check the analyzer's response to an electrical input by injecting 0 and 3 V into the following terminals and noting the reading displayed in **Sensor Voltage** in the **Operating** page (see Section 6.2.1, page 19): Wall- / pipe-mount–ve to terminal 7 +ve to terminal 4 Panel-mount –ve to terminal 6 +ve to terminal 9 Small errors in displayed voltage can be removed by electrical calibration. Large errors indicate an electronic fault.
`Cleaner Fail`	Indicates that the analyzer was unable to detect the correct operation of the wiper unit; either the wiper unit did not rotate or failed to park in the correct position. 1. Check the electrical connections to the sensor. 2. Using a suitable voltmeter, check the sensor 12 V supplies, both at the analyzer terminals and sensor junction box – see Figs 4.4, 4.5 and 4.9 on pages 14, 15 and 17 for connection details. 3. Check operation of the wiper unit by disconnecting the white lead from the analyzer terminal block (Cleaner Initiate signal) and touching it briefly to the 0 V terminal – see Table 4.1 on page 14 for details. This initiates a cleaning cycle, that can be observed when the wiper unit is removed from the flowcell.
`NV Memory Error`	Indicates that the contents of the nonvolatile memory has not been read correctly during power up. To rectify the problem, switch off the power, wait 10 seconds and switch on again. If the problem persists contact the Company.

Table 10.1 Error Messages

10.2 Unstable or Erratic Readings

There are a number of possible causes of unstable or erratic readings. Check for air bubbles in the sample. This may be due to degassing of the sample, caused by either a drop in sample pressure or a rise in temperature. Frequent cleaning of the optical windows helps to prevent the build-up of bubbles. If bubbles are observed it is recommended that the optional de-bubbler unit is installed – see Section 3.4, page 10.

Where the noise level gradually gets worse over a period of time, this usually indicates that solids are building up in the flowcell. Increasing the flowrate through the flowcell may reduce this build up. Ultimately the flowcell needs to be cleaned manually.

10.3 Intermittent Short Term Spikes in Turbidity Readings

This is usually caused by bubbles passing through the light path within the flowcell. The bubbles are a result of degassing. Degassing is not an instantaneous process and it is possible that it is taking place after the sample has gone through the de-bubbler. The bubbles start to form in the sample pipework and the flowcell. As they grow gradually, the bubbles finally release and flow through the light path, causing a spike in the turbidity reading.

The analyzer can be programmed for Bubble Rejection to remove short-term spikes from the readings – see page 28. For optimum operation, operate the wiper unit frequently to prevent bubbles building up on the windows.

11 Specification

Sensor

Range

Low range 0 to 40 NTU
High range 0 to 400 NTU

Measurement principle

90 ° scattered light measurement.
Compliant to ISO 7027

Maximum linearity

Typically <1.0 %

Accuracy[1, 2]

Low range version ±2 % of reading

High range version ±5 % of reading or 0.3 NTU

Repeatability[3]

0 to 200 NTU <1 %

200 to 400 NTU 2 %

Limit of Detection[4]

Low range version: 0.003 NTU

High range version: 0.3 NTU

Response time

T90 < 1 min at 1 l/min^{-1}

Flow rate

0.5 to 1.5 l/min (0.13 to 0.39 gall [US]/min)

Integral wiper cleaning system

Programmable operational frequency every 0.25 hour, 0.5 hour, 0.75 hour or multiples of 1 hour up to 24 hours

Sample operating temperature

0 to 50 °C (32 to 122 °F)

Sample pressure

Up to 3 bar (43.5 psi)

Ambient operating temperature

0 to 50 °C (32 to 122 °F)

Ambient operating humidity

Up to 95 % RH

[1]Maximum measured error across full measurement range (limited by uncertainty in Formazine standards).

[2]Tested in accordance with IEC 61298 Parts 1-4: Edition 2.0 2008-10.

[3]Tested in accordance with MCERTS: Performance Standards and Test Procedures for Continuous Water Monitoring Equipment. Version 3.1: Environment Agency 2010.

[4]Tested in accordance with BS ISO 15839: 2003.

Wetted parts – materials used

Cell body unit

- Black POM (Polyoxymethylene) Copolymer
- Spectrosil 2000 fused silica
- Nitrile (O-ring)
- Epoxy preform (cured) – Uni-forms 5034-00
- Polyamide 6
- Nickel plated brass
- PTFE

Wiper unit

- Black Polycarbonate, 10% Glass Fibre filled – Lexan 500R
- Stainless Steel (SS 316 S13/S11) w/ Chemical Black – MIL-C13924 class 4
- Silicone grease (WRC Approved) – Unisilkon L 250 L
- 2-part Epoxy Adhesive (cured) – Robnor PX800F/NC
- EPDM (ethylene propylene diene Monomer) black

Analyzer

Measured value
5-digit x 7-segment backlit LCD

Information
16-character, single line, dot matrix, backlit LCD

Units of measurement
All models: NTU and FNU
mg/l and ppm for models high range models

Accuracy
±0.2 % of reading, ±1 digit

Linearity
±0.1 % FSD

Auto-clean timing (7998011, 7998012)
Programmable 15 min, 30 min, 45 min or 1 hour up to 24 hours in 1 hour increments

Environmental Data

Operating temperature limits
–20...55 °C (–4...131 °F)

Storage temperature limits
–25...55 °C (–13...131 °F)

Operating humidity limits
Up to 95 % RH non-condensing

Power Supply

Voltage requirements
100 to 130 V, 200 to 260 V, 50 / 60 Hz*

Power consumption
< 12 VA

Error due to power supply variation
Less than 0.1 % for +6 % –20 % variation from nominal supply

Insulation
Mains to earth (line to ground) 2 kV RMS

*See *Selecting the Mains Voltage*, Section 4.4, page 16

Relay Outputs and Set Points

No. of relays
2

Relay contacts
Single pole changeover
Rating 250 V AC 250 V DC max.
3 A AC, 3 A DC max.
Loading (non-inductive) 750 VA 30 W max.
(inductive) 750 VA 3 W max.

Insulation
2 kV RMS contacts to earth (ground)

No. of set points
2

Set point adjustment
Programmable

Set point hysteresis
±1 % fixed

Local set point annunciation
Red LED

Retransmission

No. of retransmission signals
One fully isolated programmable 0 to 10 mA, 0 to 20 mA or 4 to 20 mA Optional second current output

Accuracy
±0.25 % FSD ±0.5 % reading

Resolution
0.1 % at 10 mA, 0.05 % at 20 mA

Max. load resistance
750 Ω (20 A max.)

Mechanical Data

Model 4690/500

Wall-mounting	
Protection	IPx6/NEMA4X
Dimensions	160 mm (6.30 in.) wide x 214 mm (8.43 in.) high x 68 mm (2.68 in.) deep
Weight	2 kg (4½ lb)

Model 4695/500

Panel-mounting	(¼ DIN)
Protection	IP66/NEMA4X front
Dimensions	96 mm (3.78 in.) wide x 96 mm (3.78 in.) high x 191 mm (7.52 in.) deep
Weight	1.5 kg (3¼ lb)
Panel cut-out:	$92^{+0.8}_{-0}$ mm x $92^{+0.8}_{-0}$ mm ($3.62^{+0.03}_{-0}$ in. x $3.62^{+0.03}_{-0}$ in.)

Approvals, Certification and Safety

CE Mark
Covers EMC & LV Directives (including latest version EN 61010)

General safety
EN61010-1
Pollution Degree 2
Insulation Category II

EMC

Emissions and Immunity
Meets requirements of IEC 61326 for an industrial environment and domestic emissions

DS/4690–EN Rev. C

12 Spares and Consumables

12.1 Maintenance Kits

Part Number	Description	Kit Contents
7998023	Wiper blade pack	4 x 7997203
7998044	Replacement LED kit (ISO infrared LED version)	1 x 7998126, 1 x 7998021

12.2 Accessories

Part Number	Description	Kit Contents
7998047	Dry standard LOW for use with ISO infrared LED version	7998181 dry standard + calibration certificate
7998048	Dry standard HIGH for use with ISO infrared LED version	7998183 dry standard + calibration certificate

12.3 Upgrade Kits

Part Number	Description	Kit Contents
7998022	Wiper unit upgrade kit	1 each of: 7998140 0216580 – cable gland and locknut 7998023 – wiper blade pack 7998317 – wiper cap

12.4 Strategic Spares

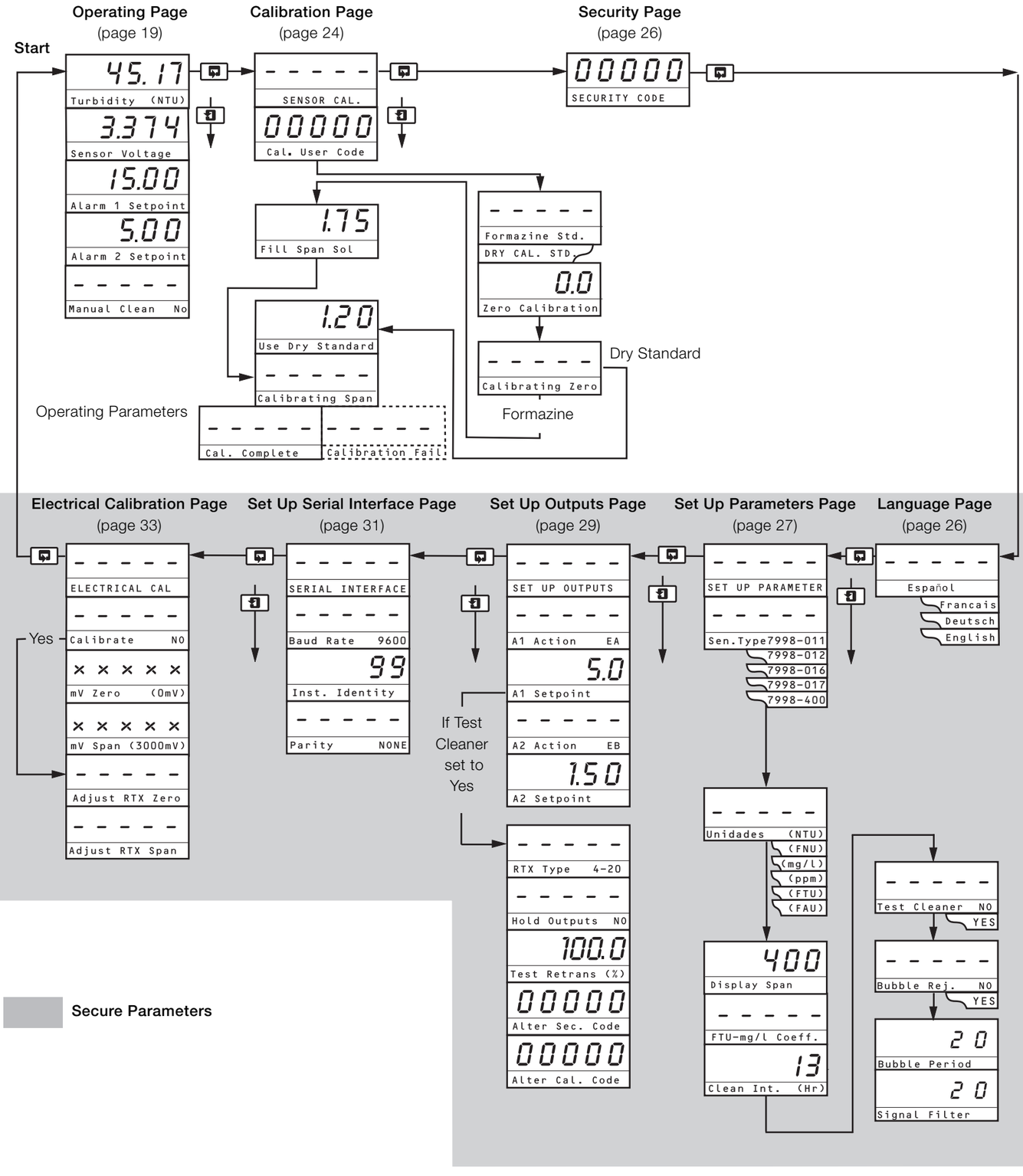
Part Number	Description	Kit Contents
7998024	Feed/drain kit	1 x 7998149, 2 x 0216509, 2 x 0216510
7998026	Emitter unit (ISO infrared LED version)	1 x 7998101
7998029	Receiver unit (infrared LED 0 to 40 NTU)	1 x 7998107
7998030	Receiver unit (infrared LED 0 to 400 NTU)	1 x 7998108
7998037	Replacement ball valves	2 x 0216509
7998038	Replacement hose connectors	2 x 0216510
7998039	Replacement wiper O-ring	2 x 0211346
7998031	O-ring spares kit	1 each of: 0211051, 0211317, 0211346 2 each of: 0211223, 0211314,
7998021	Replacement endcaps	2 x 7998130
7998020	Wiper plug assembly	1 x 7998148
7998190	Cal record card kit	3 x 7998385 – cal record card kit 1 x 0219319 – Vispass bespoke 1 x STT3367 – 250 mm (10 in.) cable tie
7998049	Wiper unit replacement	1 x 7998140 – wiper unit 1 x 7998023 – wiper blade pack

12.5 Software

Part Number	Description	Kit Contents
7998040	7998 Turbidity EPROM (basic)	1 x 46803000 BASIC
7998041	7998 Turbidity EPROM (second retransmission)	1 x 46803001 2ND RETRANS
7998042	7998 Turbidity EPROM (Modbus)	1 x 46803002 MODBUS
7998043	7998 Turbidity EPROM (PROFIBUS)	1 x 46803003 PROFIBUS

12.6 De-bubbler

Item	Description	Part Number
1	O-ring large (3 off)	0211 322
2	O-ring small (2 off)	0211 138
3	Quick-fit connector (2 off)	7997 511


Start
Operating Page
(page 19)
45.17
Turbidity (NTU)
3.374
Sensor Voltage
15.00
Alarm 1 Setpoint
5.00
Alarm 2 Setpoint
- - - - -
Manual Clean No
Calibration Page
(page 24)
- - - - -
SENSOR CAL.
00000
Cal. User Code
Security Page
(page 26)
00000
SECURITY CODE
1.75
Fill Span Sol
1.20
Use Dry Standard
- - - - -
Calibrating Span
- - - - -
Formazine Std.
DRY CAL. STD
0.0
Zero Calibration
- - - - -
Calibrating Zero
Dry Standard
Formazine
Operating Parameters
- - - - -
Cal. Complete
- - - - -
Calibration Fail
Electrical Calibration Page
(page 33)
Set Up Serial Interface Page
(page 31)
Set Up Outputs Page
(page 29)
Set Up Parameters Page
(page 27)
Language Page
(page 26)
ELECTRICAL CAL
Calibrate NO
Yes
mV Zero (0mV)
mV Span (3000mV)
Adjust RTX Zero
Adjust RTX Span
SERIAL INTERFACE
Baud Rate 9600
99
Inst. Identity
Parity NONE
SET UP OUTPUTS
A1 Action EA
5.0
A1 Setpoint
A2 Action EB
1.50
A2 Setpoint
If Test Cleaner set to Yes
RTX Type 4-20
Hold Outputs NO
100.0
Test Retrans (%)
00000
Alter Sec. Code
00000
Alter Cal. Code
SET UP PARAMETER
Sen.Type 7998-011
7998-012
7998-016
7998-017
7998-400
Unidades (NTU)
(FNU)
(mg/l)
(ppm)
(FTU)
(FAU)
400
Display Span
FTU-mg/l Coeff.
13
Clean Int. (Hr)
Español
Francais
Deutsch
English
Test Cleaner NO
YES
Bubble Rej. NO
YES
20
Bubble Period
20
Signal Filter
Secure Parameters

Products and customer support

Automation Systems
For the following industries:
- Chemical & Pharmaceutical
- Food & Beverage
- Manufacturing
- Metals and Minerals
- Oil, Gas & Petrochemical
- Pulp and Paper

Drives and Motors
- AC and DC Drives, AC and DC Machines, AC Motors to 1kV
- Drive Systems
- Force Measurement
- Servo Drives

Controllers & Recorders
- Single and Multi-loop Controllers
- Circular Chart and Strip Chart Recorders
- Paperless Recorders
- Process Indicators

Flexible Automation
- Industrial Robots and Robot Systems

Flow Measurement
- Electromagnetic Flowmeters
- Mass Flowmeters
- Turbine Flowmeters
- Wedge Flow Elements

Marine Systems & Turbochargers
- Electrical Systems
- Marine Equipment
- Offshore Retrofit and Refurbishment

Process Analytics
- Process Gas Analysis
- Systems Integration

Transmitters
- Pressure
- Temperature
- Level
- Interface Modules

Valves, Actuators and Positioners
- Control Valves
- Actuators
- Positioners

Water, Gas & Industrial Analytics Instrumentation
- pH, Conductivity and Dissolved Oxygen Transmitters and Sensors
- Ammonia, Nitrate, Phosphate, Silica, Sodium, Chloride, Fluoride, Dissolved Oxygen and Hydrazine Analyzers
- Zirconia Oxygen Analyzers, Katharometers, Hydrogen Purity and Purge-gas Monitors, Thermal Conductivity

Customer support
We provide a comprehensive after sales service via a Worldwide Service Organization. Contact one of the following offices for details on your nearest Service and Repair Centre.

UK
ABB Limited
Tel: +44 (0)1453 826661
Fax: +44 (0)1453 829671

USA
ABB Inc.
Tel: +1 215 674 6000
Fax: +1 215 674 7183

Client Warranty
Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification. Periodic checks must be made on the equipment's condition. In the event of a failure under warranty, the following documentation must be provided as substantiation:
- A listing evidencing process operation and alarm logs at time of failure.
- Copies of all storage, installation, operating and maintenance records relating to the alleged faulty unit.

ABB Limited
Measurement & Analytics
Oldends Lane, Stonehouse
Gloucestershire, GL10 3TA
UK
Tel: +44 (0)1453 826661
Fax: +44 (0)1453 829671
Mail: instrumentation@gb.abb.com

ABB Inc.
Measurement & Analytics
125 E. County Line Road
Warminster, PA 18974
USA
Tel: +1 215 674 6000
Fax: +1 215 674 7183

abb.com/measurement

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