AV450 and AV455
Single and dual input UV nitrate monitor

Measurement made easy

For more information
Further publications are available for free download from:
www.abb.com/analytical

or by scanning this code:
**Electrical safety**

This equipment complies with the requirements of CE/IEC 61010-1:2001-2 ‘Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use’. If the equipment is used in a manner NOT specified by the Company, the protection provided by the equipment may be impaired.

**Symbols**

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

- ![Warning symbol] Warning – refer to the manual for instructions
- ![Caution symbol] Caution – risk of electric shock
- ![Protective earth terminal] Protective earth (ground) terminal
- ![Earth terminal] Earth (ground) terminal
- ![Direct current supply] Direct current supply only
- ![Alternating current supply] Alternating current supply
- ![Both current supply] Both direct and alternating current supply
- ![Double insulation] The equipment is protected through double insulation

**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 only be carried out 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.
- Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
- When disposing of chemicals ensure that no two chemicals are mixed.

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 on the back cover, together with servicing and spares information.

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.
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Table 1.1 AV400 Series Analyzer Options

<table>
<thead>
<tr>
<th>Analyzer Model Number</th>
<th>Description of Analyzer</th>
<th>Sensor A</th>
<th>Sensor B</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV450</td>
<td>Single Input Nitrate</td>
<td>7330 100</td>
<td>–</td>
</tr>
<tr>
<td>AV455</td>
<td>Dual Input Nitrate</td>
<td>7330 100</td>
<td>7330 100</td>
</tr>
</tbody>
</table>

1
1 INTRODUCTION

1.1 Principle of Operation

⚠️ **Warning.** The sensor emitter module contains a high intensity xenon strobe lamp that emits ultraviolet (UV) radiation. **This must NOT be viewed with the naked eye and must NEVER be operated while outside the sensor.** Under normal operating conditions, it is not possible to see the light source but, if the sensor is dismantled with electrical power applied, it may be possible to expose the eyes to the strobe flash.

The broad-spectrum, high intensity xenon strobe lamp, housed in the emitter module, generates pulses of light that pass through the sample water in the flowcell to a filtering and detection system, contained in the receiver module. The received light pulses are analyzed at two wavelengths; the measurement wavelength of 215nm and the reference wavelength of 275nm (at which the sample constituents of interest do not absorb). This dual light path system provides information that enables the measured value to be corrected for any turbidity due to suspended matter in the sample. The monitor is calibrated with a pure solution of a known nitrate content.

An automatic, microprocessor-controlled, dual-wiper system, housed in the cleaner module, cleans the flowcell optical windows periodically to ensure that the sensor remains functional. Samples containing large solids and/or very high concentrations of solids must be pre-filtered.

1.2 AV400 Series Systems – Fig. 1.1

**Note.** An AV400 System is supplied factory-configured as a matched system with each component bearing the same serial number. If any part of a system is replaced (analyzer or sensor[s]), a complete factory re-calibration must be carried out – see Section 7.
2 OPERATION

2.1 Powering Up the Analyzer

Warning. Ensure all connections are made correctly, especially to the earth studs – see Section 6.5.

1) Ensure the input sensor(s) is (are) connected correctly.
2) Switch on the power supply to the analyzer. A start-up screen is displayed while internal checks are performed; then the Operating Page (Section 2.3) is displayed as the nitrates measuring operation starts.

2.2 Displays and Controls – Fig 2.1
The upper and center display lines each comprise a 4½ digit, 7-segment digital display that shows the actual value of the measured parameter and alarm set points, followed by a 6-character dot matrix display showing the associated units. The lower line is a 16-character dot matrix display showing operating and programming information.

Fig. 2.1 Location of Controls and Displays

2.2.1 Membrane Key Functions – Fig. 2.2

A – Moving Between Menus

B – Advancing to Next Page

C – Moving Between Frames

D – Adjusting and Storing a Parameter Value

E – Selecting and Storing a Parameter Choice

Fig. 2.2 Membrane Key Functions
Use the Menu Key
to scroll through
the Menus

Section 5.5, Page 24

CONFIG.OUTPUTS

Use the Downscroll
Key to scroll through
the Parameters
within each Page

Section 5.5, Page 24

CONFIG.OUTPUTS

<table>
<thead>
<tr>
<th>Config. Output 1</th>
<th>Config. Output 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>AO1: Assign</td>
<td>AO2: Assign</td>
</tr>
<tr>
<td>AO1: Range</td>
<td>AO2: Range</td>
</tr>
<tr>
<td>AO1: Span Value</td>
<td>AO2: Span Value</td>
</tr>
<tr>
<td>AO1: Default Val</td>
<td>AO2: Default Val</td>
</tr>
<tr>
<td>AO1: Default</td>
<td>AO2: Default</td>
</tr>
</tbody>
</table>

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CONFIG. CLOCK

Set Clock?
Format dd/mm/yy
Date 17:03:04
Time 12:00

Press ▲ To Set  Press ▼ To Abort

Section 5.7, Page 26

CONFIG. LOGBOOK

Logbook

Section 5.8, Page 26

CONFIG. SERIAL

Display only if digital communications option board fitted and PROFIBUS-DP digital communications
feature enabled (Section 7.1) – see Supplementary Manual PROFIBUS Datalink Description (IM/PROBUS)

Section 5.9, Page 27

TEST/MAINTENANCE

Test Outputs
Test Output 1
Test Output 2

Maintenance
Hold Outputs
Automatic Time

Sensor A Outputs
Nit & Ref Signals
Sensor A Reading

Sensor B Outputs
Nit & Ref Signals
Sensor B Reading

A Cal.Coefficients
Nit. Totals
Ref. Totals
Nit. Peak
Ref. Peak

B Cal.Coefficients
Nit. Totals
Ref. Totals
Nit. Peak

Load/Save Config
Factory Config.
User Config.

Press ▲ To Set  Press ▼ To Abort

To FACTORY SETTINGS
(see Section 7.1, Page 41)

Fig. 2.3B Overall Programming Chart
2.3 Operating Page

2.3.1 Single Input Nitrate

**Measured Values**

Concentration of nitrate in mg/l.

A: set to Disp. as NO3 - see Section 5.3.

A: Set to N Display as N – See Section 5.3.

**Note.** If Lamp Disabled (see below) is set to Yes, Lamp Disabled is shown in the lower display line and no values are displayed.

**Disabling the Lamp**

⚠️ **Warning.** Disable the lamp before performing any maintenance on the flowcell – see also Warning on page 2.

If Yes is selected, Lamp Disabled is shown in the lower display line.

**Manual Cleaning**

Select Yes to initiate the sensor cleaning system.

See Section 3.1.

See Section 4.2.

A3: Type set to Wash (Section 5.4) – See Section 2.3.3.

A3: Type not set to Wash (Section 5.4) – Return to the top of the page.
2.3.2  Dual Input Nitrate

Measured Values in Inferred Units
Sensor A reading (A: set to Disp. as NO3– – see Section 5.3).
Sensor B reading (B: set to Display as N – see Section 5.3).

Note. If Lamp Disabled (see below) is set to Yes, Lamp Disabled is shown in the lower
display line and no values are displayed.

Disabling the Lamp (Sensor A)

⚠️ Warning. Disable the lamp before performing any maintenance on the flowcell –
see also Warning on page 2.

If Yes is selected, Lamp Disabled is shown in the lower display line.

Disabling the Lamp (Sensor B)

⚠️ Warning. Disable the lamp before performing any maintenance on the flowcell –
see also Warning on page 2.

If Yes is selected, Lamp Disabled is shown in the lower display line.

Manual Cleaning (Sensor A)
Select Yes to initiate the Sensor A cleaning system.

Manual Cleaning (Sensor B)
Select Yes to initiate the Sensor B cleaning system.

See Section 3.1.
See Section 4.2.

A3: Type set to Wash (Section 5.4) – See Section 2.3.3
A3: Type not set to Wash (Section 5.4) – Return to the top of the page.
2.3 Operating Page

2.3.3 Wash Function

Note. The Wash function is available only if A3: Type is set to Wash – see Section 5.4.

Wash Function

Off – Wash function off. Lower display line of Operating Page shows WASH INHIBITED.

On – Wash function controlled automatically. Lower display line of Operating Page shows WASH IN PROGRESS.

Manual – Enables wash function to be initiated manually – see below.

Note. Set Wash Function to Off before removing the sensor from the process.

See Section 3.1.

See Section 4.1.

Press To Wash

Press To Abort

Press To Wash

Diss. Organics

Press the ▲ key to initiate the wash cycle. The display returns to the top of the Operating Page and the lower display line shows WASH IN PROGRESS until the wash cycle is completed. The Wash Function selection reverts to the one that was set before Manual was selected.

Press the ▼ key to abort the wash cycle. The display returns to the top of the Operating Page.
3 OPERATOR VIEWS

3.1 View Set Points

View Set Points
This page shows alarm set points. The value of each of the set points is shown, together with the name of the parameter it's assigned to.

Alarm assignments, set point values and relay/LED actions are programmable – see Section 5.4. Those shown in the following frames are examples only.

Alarm 1 Set Point
Sen. A (or Sen. B – dual input analyzers only) displayed to indicate the alarm assignment – see Section 5.4.
Alarm set point.

Alarm 2 Set Point

Alarm 3 Set Point
See Section 3.2.
See Section 4.2.
3.2 View Outputs

**Theoretical Analog Output**
There are two analog outputs, both of which are assigned automatically depending on the analyzer configuration. On a single input analyzer, both are assigned to Sensor A. On a dual input analyzer, Output 1 is assigned to Sensor A and Output 2 is assigned to Sensor B.

Live current output value being retransmitted.

Current output shown as a percentage of full scale for the output range set in **CONFIG. OUTPUTS** – see Section 5.5.

See Section 3.3.

See Section 4.2.

Advance to analog output 2.

---

3.3 View Hardware

**Sensor A Type**
Shows the sensor type selected for the Sensor A input in the **Factory Settings** page – see Section 7.1.

7330 100 – Range 0 to 100mg/l NO₃

**Sensor B Type** – Dual input analyzers only
Shows the sensor type selected for the Sensor B input in the **Factory Settings** page – see Section 7.1.

**Digital Communications Option Board**
*Note.* Displayed only if the digital communications option board is fitted.

Displays the communications type enabled in the **Factory Settings** page – see Section 7.1.

See Section 3.4.

See Section 4.2.
3.4 View Software

**Issue**
Shows the version number of the software.

See Section 3.5.

See Section 4.2.

3.5 View Clock

**Date**
Shows the current date.

Logbook set to On (Section 5.7) – see Section 3.6.
Logbook set to Off (Section 5.7) – see Section 2.3.

See Section 4.2.
3.6 View Logbook

Note. The View Logbook function is available only if Logbook is set to On – see Section 5.7.

The logbook stores data entries for alarm events, sensor errors, power failures and sensor calibrations.

View Logbook
Use the ↑ and ↓ keys to access the Alarms logbook.

Note. If no entries are stored in the Alarms logbook, the display shows No More Entries.

Alarms
The Alarms logbook contains up to 10 entries (entry 1 is the most recent), each comprising an alarm number, alarm state (On or Off), and the date/time of the occurrence.

Note. If no more entries are stored, the display shows No More Entries.

View Logbook
Use the ↑ and ↓ keys to access the Errors logbook.

Note. If no entries are stored in the Errors logbook, the display shows No More Entries.

Errors
The Errors logbook contains up to 5 entries (entry 1 is the most recent), each comprising the sensor letter, error number, and the date/time of the occurrence.

Note. If no more entries are stored, the display shows No More Entries.
3 OPERATOR VIEWS

...3.5 Logbook

**View Logbook**

Use the [▲] and [▼] keys to access the Power logbook.

**Note.** If no entries are stored in the Power logbook, the display shows No More Entries.

**Power**

The Power logbook contains up to 2 entries (entry 1 is the most recent), each comprising the power state (On or Off), and the date/time of the occurrence.

**Note.** If no more entries are stored, the display shows No More Entries.

**View Logbook**

Use the [▲] and [▼] keys to access the Cals logbook.

**Note.** If no entries are stored in the Cals logbook, the display shows No More Entries.

**Calibration**

The Cals logbook contains up to 5 entries (entry 1 is the most recent), each comprising 3 frames. Frame 1 contains the entry number, sensor letter, calibration type (Z = Zero, S = Span, ZS = Zero and Span) and the date/time of the occurrence.

Frames 2 and 3 contain the raw outputs from the sensor for both the Zero and Span solutions. These values equate to the percentage light transmission through the standard solutions.

See Section 2.3.

**Advance to entries 1 to 6 for single input analyzers.**

**Advance to entries 2 to 3 for sensor A on dual input analyzers.**

**Advance to entries 4 to 6 for sensor B on dual input analyzers.**

**Note.** If no more entries are stored, the display shows No More Entries.
4 SETUP

4.1 Sensor Calibration Standard Solutions

Note. Clean the flowcell internally (see Section 8) before calibration to ensure that the standard solutions, particularly the zero standard, are not contaminated with organic material that may be present inside the flowcell.

4.1.1 Zero Standard Solution
High purity water is used for the zero standard solution and must be as fresh as possible. If storage is unavoidable, use a glass container to prevent contamination. Some plastics, for example polythene and polypropylene, may be acceptable, but regardless of material, the container must be meticulously clean and kept solely for the purpose of storing the zero standard solution.

Note. The high purity water used for the zero solution and for diluting the span standard solution must contain less than 50μg/l TOC. It is recommended that the water is obtained from purification systems comprising reverse osmosis and de-ionization units but freshly distilled water can also be used. De-ionized water is not recommended as it often contains significant levels of organics.

4.1.2 Span Standard Solution
Two span standard solutions of known nitrate concentration appropriate to the measuring range (NO₃⁻ or N) are required for sensor calibration:

For Nitrate displayed as NO₃⁻:

a) Prepare a stock solution of 1000mg/l⁻¹ concentration by dissolving 1.371±0.001g analytical reagent grade sodium nitrate in 500ml high purity water. Make up to 1 litre with more high-purity water.

b) Dilute 50ml of the stock solution to 1 litre high purity water to make a 50mg/l⁻¹ concentration span standard solution. Store in a plastic bottle.

Note. A 50mg/l⁻¹ span standard solution gives the best overall calibration accuracy for Nitrate displayed as NO₃⁻. However, a span standard solution of between 40 and 60mg/l⁻¹ concentration may be used if required, prepared by adjusting the amount of stock solution diluted to 1 litre of high purity water accordingly.

For Nitrate displayed as N:

a) Prepare a stock solution of 1000mg/l⁻¹ concentration by dissolving 6.070±0.001g analytical reagent grade sodium nitrate in 500ml high purity water. Make up to 1 litre with more high-purity water.

b) Dilute 10ml of the stock solution to 1 litre high purity water to make a 10mg/l⁻¹ concentration span standard solution. Store in a plastic bottle.

Note. A 10mg/l⁻¹ span standard solution gives the best overall calibration accuracy for Nitrate displayed as NO₃⁻. However, a span standard solution of between 8 and 12mg/l⁻¹ concentration may be used if required, prepared by adjusting the amount of stock solution diluted to 1 litre of high purity water accordingly.

Note. The mass relationship of nitrate (NO₃⁻) to nitrogen (N) is 62/14.

4.1.3 Calibration Checks
The sensor’s emitter module contains an optical system with very stable electronics that eliminate electronic drift, therefore, routine calibration is normally unnecessary. However, it may be necessary to check system accuracy, particularly after cleaning the flowcell.

A calibration check is carried out by filling the flowcell with the Zero and Span standard solutions and observing the readings in the Operating Page – see Section 2.3.

The solutions are poured in from the top of the flowcell.

7330 100 Sensor:

Remove the filler plug on top of the flowcell and use the funnel provided.
4.2 Sensor Calibration

Sensor Calibration

Sensor Calibration Security Code

Note. This frame is displayed only if Alter Cal. Code is not set to zero – see Section 5.8.

Enter the required code number (between 0000 and 19999) to gain access to the sensor calibration pages. If an incorrect value is entered, access to the calibration pages is prevented and the display reverts to the SENSOR CAL. frame.

Calibrate Sensor A

Note. A full calibration comprises a zero and a span calibration. However, it is possible to carry out zero and span calibrations independently by aborting the one that is not required (press the [ ] key to initiate the calibration and press it again before the calibration is complete). If either calibration is aborted, A: Cal Incomplete is shown on the lower display line (see next page). The Cals logbook records the calibration type as zero (Z), span (S) or both (ZS) – see Section 3.5, page 12.

Sensor B calibration (dual input analyzers only) is identical to Sensor A calibration.

Single input analyzer and A: Comp. Type set to Org. (Section 5.3) – continued on page 16.

Alter Sec. Code not set to zero (Section 5.8) – see Section 5.1.

Alter Sec. Code set to zero (Section 5.8) – see Section 5.2.

Zero Calibration

Fill the flowcell with high purity water – see Section 4.1.1.

Press the [ ] key to initiate calibration.

Note. If the [ ] key is pressed again at any time before zero calibration is complete, the display advances automatically to the A: Fill Span Sol. frame.

Raw Output from Sensor

Nitrate total signal

Reference total signal

These values equate to the percentage light transmission through the sample.

As calibration proceeds, a progress indicator appears in the lower display line. After 3 minutes, the lower display line shows ·············100%············, the display then advances automatically to the next frame.

Continued on next page.
**4 SETUP**

### 4.2 Sensor Calibration

**Span Calibration**

Fill the flowcell with the required span standard calibration solution – see Section 4.1.2.

Use the ▲ and ▼ keys to adjust the calibration solution value.

Range – 40 to 60 NO₃, 9 to 13 N

Press the [ ] key to initiate calibration.

**Note.** If the [ ] key is pressed again at any time before span calibration is complete, A:Cal Incomplete is shown on the lower display line (see below).

**Raw Output from Sensor**

Nitrate total signal

Reference total signal

These values equate to the percentage light transmission through the sample.

As calibration proceeds, a progress indicator appears in the lower display line. After 3 minutes, the lower display line shows 100%, the display then advances automatically to the next frame.

**Calibration Completed**

A message is displayed at the end of calibration:

A:Cal Complete – calibration successful

A:Cal Incomplete – zero and/or span calibration aborted

Sensor B calibration (dual input analyzers only) is identical to Sensor A calibration.

Single input analyzer **and** A: Comp. Type set to Org. (Section 5.3) – continued on page 16.

**Alter Sec. Code** not set to zero (Section 5.8) – see Section 5.1.

**Alter Sec. Code** set to zero (Section 5.8) – see Section 5.2.
...4.2 Sensor Calibration

Organic Compensation

Note. These frames are displayed only if A: Comp. Type is set to Org. – see Section 5.3.

This is used to compensate for interference from organics in the sample. The factor is adjusted to give a Nitrate value which is in agreement with laboratory results.

Compensation Factor

Use the \[\uparrow\] and \[\downarrow\] keys to set the compensation factor, between 0.000 and 9.000 in 0.001 increments.

B: Comp. Type set to Org. (Section 5.3) – Sensor B organic compensation (dual input analyzers only) is identical to Sensor A organic compensation.

B: Comp. Type set to Turb. (Section 5.3) or single input analyzers – return to main menu.

Alter Sec. Code not set to zero (Section 5.8) – see Section 5.1.

Alter Sec. Code set to zero (Section 5.8) – see Section 5.2.
5 PROGRAMMING

5.1 Security Code

Note. This frame is displayed only if Alter Sec. Code is not set to zero – see Section 5.8.

Enter the required code number (between 0000 and 19999) to gain access to the configuration pages. If an incorrect value is entered, access to the configuration pages is prevented and the display reverts to the Operating Page – see Section 2.3.

See Section 5.2.
5.2 Configure Display

Set Language
Sets the language to be used on all displays.

Language Page
Select the required language.

Set Up Display Backlight

Backlight
Select the required backlight option:
- **On** – Backlight is always on.
- **Auto.** – Backlight comes on at each button press and switches off one minute after the last button press.

Return to main menu.
See Section 5.3.
5.3 Configure Sensors

Configure Sensor A

Sensor B configuration (dual input analyzers only) is identical to Sensor A configuration.

Single input analyzers only – return to main menu.

Display Type
Select the display type:

- N03–  Nitrate
- N    Nitrogen

Displayed Units
Select the units required for display:

- mg/l  milligrammes per litre
- mg/kg milligrammes per kilogramme
- ppm  parts per million

Filter Time
To prevent short term variations in reading, typically due to air bubbles in the sample, the sensor signal can be configured to provide an average reading over a set period of time. Set the required filter time, between 1 and 10 minutes in 1 minute increments.

Note. Use the lowest value that provides an acceptably stable reading. The default value is 3 minutes.

Compensation Type
To compensate for for organics or turbidity in the sample, select the type of compensation required:

- Org.  Organics compensation. The compensation factor applied to the measured value is set during sensor calibration – see Section 4.2.
- Turb.  Turbidity compensation. The compensation factor applied to the measured value is fixed.

Continued on next page.
...5.3 Configure Sensors

Cleaning Interval
Select the required interval between automatic cleaning operations:
15, 30 or 45 minutes or 1, 2, 4, 6, 12 or 24 hours.

Note. The cleaning interval setting is determined by plant experience. Check the condition of the flowcell and optical windows at appropriate intervals to determine the optimum setting.

Flow Alarm
Set the input switch contact condition required during normal operations:
Off – Input switch contact disabled
N/O – Normally open
N/C – Normally closed

Sensor B configuration (dual input analyzers only) is identical to Sensor A configuration.

Single input analyzers only – return to main menu.

See Section 5.4.
5.4 Configure Alarms

Configure Alarm 1

Alarms 2 and 3 configuration is identical to Alarm 1.

Alarm 1 Type
Select the type of alarm required:

- **Off** – The alarm is disabled, the alarm LED is off and the relay is de-energized at all times.
- **Alarm** – The monitor is configured to generate an alarm in response to a specified sensor reading.
- **Status** – An alarm is generated if either a power failure or a condition occurs that causes any of the error messages in Table 9.1 (page 54) to be displayed.
- **Wash** – Alarm 3 is configured to control the wash sequence.

Note. The wash alarm type can be assigned only to alarm 3 and is displayed only when the lower display shows A3: Type.

Alarm 1 Assign
Select the alarm assignment required:

- **Sen. A** – The monitor activates an alarm if the dissolved organics content of the process fluid measured by the selected sensor exceeds or drops below the value set in the Alarm 1 Set Point parameter, depending on the type of Alarm 1 Action selected – see next page.
- **Sen. B** –

A1: Type set to Off or Status – return to top of page.
A1: Type set to Alarm – continued on next page.
...5 PROGRAMMING

...5.4 Configure Alarms

**Alarm 1 Failsafe**
Select Yes to enable failsafe action, otherwise select No.
Refer to Figs. 5.1 to 5.5 (page 23).

**Alarm 1 Action**
Select the alarm action required, High or Low.
Refer to Figs. 5.1 to 5.5 (page 23).

**Alarm 1 Set Point**
Set the alarm set point to the required value:
- **Display Type** set to A:Disp. as NO3- (Section 5.3) – between 0.0 and 100.0 in 0.1 increments
- **Display Type** set to A:Display as N (Section 5.3) – between 0.00 and 25.00 in 0.01 increments

**Alarm 1 Hysteresis**
A differential set point can be defined between 0 and 5% of the alarm set point value. Set the required hysteresis in 0.1% increments.
Refer to Figs. 5.1 to 5.5 (page 23).

**Alarm 1 Delay**
If an alarm condition occurs, activation of the relays and LEDs can be delayed for a specified time period. If the alarm clears within the period, the alarm is not activated.
Set the required delay, in the range 0 to 100 minutes in 1 minute increments.
Refer to Figs. 5.1 to 5.5 (page 23).

Alarms 2 and 3 configuration is identical to Alarm 1.

See Section 5.5.
5.5 Configure Alarms

### 5.5.1 Wash Cycle Configuration (applicable only to Alarm 3)

**Wash Mode**
Select the wash mode required.

- **Cont.** – (continuous) the relay remains energized for the wash duration
- **Pulsed** – the relay is switched on and off every second for the duration of the wash,
  - see Fig. 5.1

**Wash Frequency**
Set the wash frequency required.

Wash frequency is set in 15 minute increments between 15 and 45 minutes, then in 1 hour increments between 1 and 24 hours.

**Wash Duration**
Set the wash duration required.

Wash duration is set in 15 second increments between 15 and 45 seconds, then in 1 minute increments between 1 and 10 minutes.

**Recovery Period**
Set the recovery period required, between 0.5 and 5.0 minutes in 0.5 minute increments.

---

**Fig. 5.1 Pulsed and Continuous Wash Cycles**
...5.4 Configure Alarms

**Note.** The following examples illustrate **High Alarm Actions**, i.e. the alarm is activated when the process variable exceeds the defined set point. **Low Alarm Actions** are the same except the alarm is activated when the process variable drops below the defined set point.

![Fig. 5.1 High Failsafe Alarm without Hysteresis and Delay](image1)

![Fig. 5.2 High Failsafe Alarm with Hysteresis but no Delay](image2)

![Fig. 5.3 High Failsafe Alarm with Hysteresis and Delay](image3)

![Fig. 5.4 High Non-Failsafe Alarm without Delay and Hysteresis](image4)

![Fig. 5.5 High Failsafe Alarm with Delay but no Hysteresis](image5)

...5.4 Configure Alarms

**Note.** The following examples illustrate **High Alarm Actions**, i.e. the alarm is activated when the process variable exceeds the defined set point. **Low Alarm Actions** are the same except the alarm is activated when the process variable drops below the defined set point.
5.5 Configure Outputs

Assign
Select either Sensor A (Sen. A) or Sensor B (Sen. B).

Range
Select the analog output current range for the selected output.

Span Value
Set the required span value:
- **Display Type** set to A:Disp. as NO3- (Section 5.3) – between 20.0 and 100.0 in 0.1 increments
- **Display Type** set to A:Display as N (Section 5.3) – between 5.00 and 25.00 in 0.01 increments

Default Output
Select the system reaction to failure:
- **Off** – Ignore failure and continue operation.
- **On** – Stop on failure. This drives the analog output to the level set in the **Default Val** frame below.
- **Hold** – Hold the analog output at the value prior to the failure.

Default Value
The level to which the analog output is driven if a failure occurs.
Set the value, between 0.00 and 22.00mA.

Output 2 configuration is identical to Output 1 configuration.

See Section 5.6.
5.6 Configure Clock

Set Clock
Set the system clock.

Date Format
Select the required date format.

Date
Set the date in the format selected above.
Press \[\uparrow\] to move between the day, month and year fields.
Use the \[\uparrow\] and \[\downarrow\] keys to adjust each field.

Time
Set the time in the form hh:mm.
Press \[\uparrow\] to move between the hours and minutes fields.
Use the \[\uparrow\] and \[\downarrow\] keys to adjust each field.

Press \[\uparrow\] to Set and Press \[\downarrow\] to Abort are shown alternately on the lower display line.
Press the appropriate key to set the clock or abort the changes.
5.7 Configure Logbook

Configure Logbook
Set the logbook to On or Off.
If Off is selected, all data entries in the logbook are cleared.

Option board fitted and Serial Communications feature enabled (Section 7.1) – see Supplementary Manual PROFIBUS Datalink Description (IM/PROBUS).
Option board not fitted or option board fitted but Serial Communications feature not enabled (Section 7.1) – see Section 5.8.

5.8 Configure Security

Alter Security Code
Set the security code to a value between 0000 and 19999.

Alter Calibration Code
Set the sensor calibration access code to a value between 0000 and 19999.

Return to main menu.
See Section 5.9.
5.9 Test Outputs and Maintenance

Test Outputs
Displays the output test details for the analog outputs.

Test Output 1 frame only is shown. The format of Test Output 2 frame is identical.

Test Output 1
The theoretical output current value.

Output current as a percentage of the full range current.

Use the [▲] and [▼] keys to adjust the displayed theoretical output current value to give the output required.

Continued below.
See Section 7.1.

Hold Outputs
Enables the relay action and analog outputs to be maintained.

Auto. – Changes in relay action and analog outputs are disabled during sensor calibration.
On – Changes in relay action and analog outputs are disabled.
Off – Changes in relay action and analog outputs are not disabled.

Note. The LEDs flash while the analyzer is on ‘Hold’ mode.

Continued on next page.
See Section 7.1.

Sensor A Outputs
Hold Outputs set to Off or On – return to main menu.
Hold Outputs set to Auto. – continued on next page.
...5 PROGRAMMING

...5.9 Test Outputs and Maintenance

**Automatic Time**

If required, set a time period between 1 and 6 hours, in 30 minute increments, for which the outputs are held when **Hold Outputs** is set to **Auto**.

At the default setting of **Off**, changes in relay action and analog outputs are disabled during sensor calibration and enabled automatically at the end of the procedure.

If a time is set, changes in relay action and analog outputs are disabled during sensor calibration but, if the calibration is not completed within the set time, the calibration is aborted, the display returns to the **Operating Page** and **CAL. ABORTED** is displayed.

---

**Sensor A Outputs**

**Nitrate and Reference Signals**

Nitrate total signal

Reference total signal

These values equate to the percentage light transmission through the sample.

The peak values of the light pulse generated by the strobe lamp.

**Instantaneous Reading**

Internal damping function disabled – display shows instantaneous reading from sensor.

---

**Sensor B outputs** (dual input analyzers only) are identical to **Sensor A outputs**.

Single input analyzer – continued on next page.

See Section 7.1
5.9 Test Outputs and Maintenance

Calibration Coefficients (Sensor A)
The values for signal/reference totals and signal/reference peaks displayed below equate to the percentage light transmission through the sample. They are stored during a sensor calibration and are shown for diagnostic purposes only.

Nitrate Signal Totals
- Calibration Zero
- Calibration Span

Reference Signal Totals
- Calibration Zero
- Calibration Span

Nitrate Signal Peak
- Calibration Zero
- Calibration Span

Reference Signal Peak
- Calibration Zero
- Calibration Span

Sensor B calibration coefficients (dual input analyzers only) are identical to Sensor A calibration coefficients.

Single input analyzer – continued on next page.

See Section 7.1.
5 PROGRAMMING

...5.9 Test Outputs and Maintenance

Load/Save Configuration
Select whether a configuration is to be loaded or saved.

*Note.* If No is selected, pressing the [Enter] key has no effect.

Load User/Factory Configuration

*Note.* Applicable only if Load/Save Config is set to Yes.

- **Factory Config.** resets all the parameters in the Configuration Pages to the Company Standard.
- **Save User Config.** saves the current configuration into memory.
- **Load User Config.** reads the saved user configuration into memory.

User Config. and Factory Config. are displayed alternately if a User Configuration has been saved previously. Select the configuration required.

Press [Up] to Set and Press [Down] to Abort are displayed alternately on the lower display line.

Press the appropriate key to load/save the configuration or abort the changes.
6 INSTALLATION

6.1 Siting Requirements – Fig. 6.1

6.1.1 Analyzer

Notes.

- Mount in a location free from excessive vibration, and where the temperature and humidity specification will not be exceeded.
- Mount away from harmful vapours and/or dripping fluids and ensure that it is suitably protected from direct sunlight, rain, snow and hail.
- Where possible, mount the analyzer at eye level to allow an unrestricted view of the front panel displays and controls.

6.1.2 Sensor

Notes.

- The sensor is supplied fitted with mounting brackets.
- Secure the sensor to a suitable vertical surface in a location that enables easy access for maintenance and calibration.

![Diagram of Siting Requirements]

A – Distance Between Analyzer and Sensor

B – Within Temperature Limits

IP65*

C – Within Environmental Limits

* Refer to Specification on page 57.

Fig. 6.1 Siting Requirements
6.2 Mounting the Analyzer – Figs. 6.2 and 6.3

Fig. 6.2 Overall Dimensions

Fig. 6.3 Wall-/Pipe-mounting
Notes.
- Use flexible plastic or rigid PVC, polypropylene or metal connecting pipework, depending on the installation.
- Fit isolating valves to enable removal of the sensor.

Notes.
- The emitter end mounting bracket is in two parts to facilitate emitter module removal during maintenance – see Section 8.
- For maintenance purposes, allow the following minimum clearances around the sensor:
  - Left (for receiver module removal) – 150mm (5.9 in.)
  - Right (for emitter module removal) – 100mm (3.94 in.)
  - Top (for cleaner module removal) – 200mm (7.87 in.)
6.4 Installing the Optional De-bubbler – Figs. 6.5 and 6.6

**De-bubbler**

**Part Number**
7997 500

**Dimensions in mm (in.)**

- **Drain Outlet**: 91 (3.58)
- **Sample Outlet**: 88 (3.47)
- **Sample Inlet**: ø6.5 (0.26)
- **Quick-release Fittings**: 540 (21.26)
- **Removable Fitting**: 150 (5.9) between centers

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

---

**Fig. 6.5 De-bubbler Overall Dimensions**
...6.4 Installing the Optional De-bubbler – Figs. 6.6 and 6.7

Adjust flow regulator valve (A) until the overflow from the de-bubbler is at a minimum.

Adjust the sample flow through the system to between 0.5 and 5 l/min using flow regulator valve (B) – see Note 3 below.

---

**Notes.**

1. The de-bubbler **MUST** be mounted vertically with the flow upwards.
2. Degassing of the sample causes very erratic readings. To prevent degassing, do not exceed stated distance.
3. Adjust the flowrate as required to prevent blockages in the pipework and/or sediment build-up in the flowcell.
4. Install flow regulating valves and a flow indicator to simplify maintenance and ensure consistent performance. These items are not supplied with the AV400 Series UV Nitrates Analyzer system.

---

**Fig. 6.6 Typical De-bubbler Installation**
6.5 Electrical Connections

**Warnings.**

- The transmitter is not fitted with a switch therefore a disconnecting 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 transmitter within easy reach of the operator and must be marked clearly as the disconnection device for the transmitter.
- Remove all power from supply, relay and any powered control circuits and high common mode voltages before accessing or making any connections.
- The power supply earth (ground) **must** be connected to reduce the effects of RFI interference and ensure the correct operation of the power supply interference filter.
- The power supply earth (ground) must be connected to the earth (ground) stud on the analyzer case – see Fig. 6.9.
- Use cable appropriate for the load currents. The terminals accept cables from 20 to 14 AWG (0.5 to 2.5 mm²) UL Category AVLV2.
- The monitor conforms to Mains Power Input Insulation Category III. All other inputs and outputs conform to Category II.
- All connections to secondary circuits must have basic insulation.
- After installation, there must be no access to live parts e.g. terminals.
- Terminals for external circuits are for use only with equipment with no accessible live parts.
- The relay contacts are voltage-free and must be appropriately connected in series with the power supply and the alarm/control device which they are to actuate. Ensure that the contact rating is not exceeded. Refer also to Section 6.5.1 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 analog output range. The analog output is isolated, therefore the –ve terminal must be connected to earth (ground) if connecting to the isolated input of another device.
- If the monitor is used in a manner not specified by the Company, the protection provided by the equipment may be impaired.
- All equipment connected to the transmitter’s terminals must comply with local safety standards (IEC 60950, EN61010-1).

**USA and Canada Only**

- The supplied cable glands are provided for the connection of signal input and ethernet communication wiring 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 (mains input and relay contact outputs), use only suitably rated field wiring insulated copper conductors rated min. 300 V, 14 AWG 90°C. Route wires through suitably flexible conduits and fittings.

**Notes.**

- Four earth (ground) – studs are fitted to the transmitter case for bus-bar earth (ground) connection – see Fig. 6.9.
- Always route sensor signal cables and mains-carrying/relay cables separately, ideally in earthed (grounded) metal conduit.
- The screens of the sensor’s emitter, receiver and cleaner cables **must** be enclosed in yellow/green sleeving and connected to the earth (ground) stud fitted to the analyzer case closest to the cable’s entry point – see Fig. 6.9.
- Ensure that cables enter the transmitter through the glands nearest the appropriate screw terminals and are short and direct. Do not tuck excess cable into the terminal compartment.
- Ensure that the IP65 rating is not compromised when using cable glands, conduit fittings and blanking plugs/bungs (M20 holes). The M20 glands accept cable of between 5 and 9mm (0.2 and 0.35 in.) diameter.
6 INSTALLATION...

...6.5 Electrical Connections

6.5.1 Relay Contact Protection and Interference Suppression – Fig. 6.7

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) which can result in analyzer malfunctions 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. The RFI components must be fitted to the relay terminal block along with the supply and load wires – see Fig 6.7.

For **AC applications** the value of the resistor/capacitor network depends on the load current and inductance that is switched. Initially, fit a 100R/0.022μF RC suppressor unit (part no. B9303) as shown in Fig. 6.7A. If the analyzer malfunctions (locks up, display goes blank, resets etc.) the value of the RC network is too low for suppression and an alternative value must be used. 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. 6.7B. For general applications use an IN5406 type (600V peak inverse voltage at 3A).

---

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

---

![Fig. 6.7 Relay Contact Protection](image)
6.5.2 Cable Entry Knockouts – Fig. 6.8
The analyzer is supplied with 7 cable glands, one fitted and six to be fitted, as required, by the user – see Fig. 6.8.

Caution. When removing knockouts, take great care not to damage wiring and components within the analyzer.

Note. The cable glands must be tightened to a torque of 3.75 Nm (33 lbf. in.)
...6.5 Electrical Connections

6.5.3 Access to Terminals – Fig. 6.9

Note. When refitting the terminal cover plate, tighten the captive screws to a torque of 0.40 Nm (3.5 lbf. in.)

Fig. 6.9 Access to Terminals
6 INSTALLATION

6.5 Electrical Connections

6.5.4 Connections – Fig. 6.10

Notes.
- The screens of the sensor’s emitter, receiver and cleaner cables must be enclosed in yellow/green sleeving and connected to the earth (ground) stud fitted to the analyzer case closest to the cable’s entry point – see Fig. 6.9.
- Dual input versions – connect each sensor to the correct input terminals (A or B) as indicated on the sensor’s cables.
- Use the three-hole cable gland provided with the sensor for the sensor cables.
- Note. Tighten the terminal screws to a torque of 0.60 Nm (5.3 lbf. in.).

Fig. 6.10 Connections
Note. An AV400 System is supplied factory-configured as a matched system with each component bearing the same serial number. If any part of a system is replaced (analyzer or sensor[s]), a complete factory re-calibration must be carried out.

7.1 Factory Settings

Fig. 7.1 Overall Factory Settings Chart
### Factory Settings

**Factory Settings Access Code**

Enter the required code number, between 0000 and 19999, to gain access to the factory settings. If an incorrect value is entered, access to subsequent frames is prevented and the display reverts to the top of the page.

**Set Up Sensor A**

*Note.* The values in the display lines for sensor calibration are shown as examples only – the actual values obtained will differ.

Continued on next page.

**Operating Page** – see Section 2.3.

#### Select Sensor Type

Select the sensor type connected to sensor input A.

- **7330 100** – Nitrate

*Note.* DO NOT select options **7320 100** and **7320 200**. The hardware is incompatible.

#### Reference Signal Lower Limit

Set the reference signal level at which the Low Signal status message is displayed (default = 25%), between 0 and 25% in 1% increments – see Table 9.1 on page 53.
...7.1 Factory Settings

Set Up Sensor B

Factory Cal. A

Nitrate as NO₃-

Continued on next page.

Operating Page – see Section 2.3.

Select Sensor Model

For single input analyzers, the display appears as shown.

For dual input analyzers, Sensor B type selection is identical to Sensor A.
...7 CALIBRATION

...7.1 Factory Settings

Calibrate Sensor A

**Note.** The Factory Calibration matches the specific linearity characteristics of the sensor to the analyzer.

Sensor B calibration (dual input analyzers only) is identical to Sensor A calibration.

Single input analyzers only – continued on page 46.

**Operating Page** – see Section 2.3.

Zero Calibration

Ensure **Display Type** is set to **A:Disp. as NO3** – see Section 5.3.

Fill the flowcell with de-ionized water.

Press the key to initiate calibration.

**Note.** If the [ ] key is pressed again at any time before calibration is complete, the calibration is aborted and the display advances automatically to the next step.

**Raw Output from Sensor**

Nitrate signal

As calibration proceeds, a progress indicator appears in the lower display line. After 3 minutes, the lower display line shows , the display then advances automatically to the next step.

Calibrate with Solution 1

Fill the flowcell with a 25mg/l NO3 span standard solution prepared from the stock standard solution – see Section 4.1.2.

Press the [ ] key to initiate calibration.

**Note.** If the [ ] key is pressed again at any time before calibration is complete, the calibration is aborted and the display advances automatically to the next step.

**Raw Output from Sensor**

Nitrate signal

As calibration proceeds, a progress indicator appears in the lower display line. After 3 minutes, the lower display line shows , the display then advances automatically to the next step.

Continued on next page.
...7.1 Factory Settings

Calibrate with Solution 2
Fill the flowcell with a 50mg/l NO₃⁻ span standard solution prepared from the stock standard solution – see Section 4.1.2.

Press the key to initiate calibration.

Note. If the key is pressed again at any time before calibration is complete, the calibration is aborted and the display advances automatically to the next step.

Raw Output from Sensor
Nitrate signal
Reference signal
As calibration proceeds, a progress indicator appears in the lower display line. After 3 minutes, the lower display line shows 100%, the display then advances automatically to the next step.

Calibrate with Solution 3
Fill the flowcell with a 80mg/l NO₃⁻ span standard solution prepared from the stock standard solution – see Section 4.1.2.

Press the key to initiate calibration.

Note. If the key is pressed again at any time before calibration is complete, the calibration is aborted, the display advances automatically to the next frame and A:Cal Incomplete is shown on the lower display line.

Raw Output from Sensor
Nitrate signal
Reference signal
As calibration proceeds, a progress indicator appears in the lower display line. After 3 minutes, the lower display line shows 100%, the display then advances automatically to the next step.

Calibration Completed
Cal Complete is displayed to indicate a successful calibration.

Note. Cal Incomplete is displayed if any part of the is calibration is aborted.

Sensor B calibration (dual input analyzers only) is identical to Sensor A calibration.

Single input analyzers only – continued on page 46.

Operating Page – see Section 2.3.
...7 CALIBRATION

...7.1 Factory Settings

Calibrate Output 1

**Note.** When adjusting the 4 and 20mA output values, the display reading is unimportant and is used only to indicate that the output is changing when the [△] and [▽] keys are pressed.

Adjust 4mA
Set the milliammeter reading to 4mA.

**Note.** The analog output range selected in Configure Outputs (see Section 5.5) does not affect the reading.

Refer to Fig. 6.10 for connection details.

Adjust 20mA
Set the milliammeter reading to 20mA.

**Note.** The analog output range selected in Configure Outputs (see Section 5.5) does not affect the reading.

Refer to Fig. 6.10 for connection details.

Calibrate Output 2

**Note.** Output 2 calibration is identical to Output 1 calibration.

Operating Page – see Section 2.3.

Cal. Output 1

Cal. Output 2

16000
01: Adjust 4mA

7200
01: Adjust 20mA

Nitrate as NO3-

Operating Page – see Section 2.3.
...7.1 Factory Settings

Configure Digital Communications Option Board
Select the communications mode required:

- **Pb Dp** – PROFIBUS-DP digital communications enabled
- **None** – Digital communications disabled

Alter Factory Code
Set the factory settings access code to a value between 0000 and 19999.

Return to main menu.

*Operating Page* – see Section 2.3.
8 SENSOR MAINTENANCE

8.1 Scheduled Maintenance

⚠️ **Warning.** DO NOT open the emitter module. It uses high voltages that can cause serious injury or death.

**Note.** The emitter and receiver modules contain no user-serviceable parts and are sealed in clean and dry conditions at the factory. Opening them will lead to degraded performance. See also the **Warning** above.

The following maintenance schedule is a general guide only. The systems are designed for a wide range of applications where the nature of the sample can vary considerably, therefore it is necessary to amend the schedule to suit the particular installation and sample conditions.

8.2 Cleaning the Sensor

Routine maintenance is limited to cleaning out the flowcell manually to remove accumulated fouling or sediment. The flowcell **must** be cleaned prior to calibration (see Section 4) to ensure that the Zero and Span standards are not contaminated by organic matter that may be present inside.

8.2.1 Dismantling and Cleaning – Figs 8.1 to 8.3

⚠️ **Warning.** Isolate the analyzer and sensor from the power supply before dismantling the sensor.

⚠️ **Warning.** The sensor emitter module contains a high intensity xenon strobe lamp that emits ultraviolet (UV) radiation. **This must NOT be viewed with the naked eye and must NEVER be operated while outside the sensor.** Under normal operating conditions, it is not possible to see the light source but, if the sensor is dismantled with electrical power applied, it may be possible to expose the eyes to the strobe flash.

**Notes.**
- The emitter and receiver modules contain precision optical components and must be handled accordingly.
- The emitter module contains the power supply, voltage control and lamp components. As a result, it is heavy and requires extra support.
- Do not support the modules by the cable(s) entering their enclosures.
- Ensure that the O-rings are removed with the screw collars securing the cleaner, emitter and receiver modules; it is possible for these seals to be left inside the flowcell.
...8.2.1 Dismantling and Cleaning – Figs 8.1 to 8.3

1. Unscrew the collar and carefully withdraw the receiver module.

2. Unscrew the collar and carefully withdraw the emitter module.

3. Split the flowcell – see Fig. 8.3.

4. Clean the inside of the flowcell and other assemblies using mild detergent. Rinse thoroughly with de-ionized water.

5. Inspect the wiper blades for wear or damage. Replace as necessary – see Fig. 8.4.

6. Reassemble the flowcell using new seals – see Fig. 8.3.

7. Refit the emitter and receiver modules using new seals, ensuring that the module locating pins are seated correctly in their keyways before tightening the collars.

Fig. 8.1 7330 100 Sensor – Dismantling and Cleaning
Remove the two screws securing the mounting plate to the angle bracket.

Remove the four stainless steel screws holding the flowcell halves together.

Insert two of the stainless steel screws into the holes indicated and screw them in slowly and evenly to push the cell halves apart. When the O-ring seal is clear of the body, the cell halves should separate easily.

Note. Reassembly is the reverse of dismantling.

Fig. 8.2 7330 100 Sensor – Splitting the Flowcell
8 SENSOR MAINTENANCE…

...8.2.1 Dismantling and Cleaning – Figs 8.1 to 8.3

**Notes.**
- The proper functioning of the cleaner system depends on the correct assembly of the washers and orientation of the wiper blade.
- Do not use the wiper blade arm to rotate the wiper drive shaft.

1. Remove the wiper blade securing nut.
2. Remove the blade and washers from the drive shaft.
3. Ensure the blade drive shaft is correctly positioned by performing a manual clean (see Section 2.3) to ‘park’ the blade.
4. Reassemble the components on the drive shaft in the order shown, ensuring the wiper blade is in the parked position, i.e. vertical.
5. Using suitable spanners, prevent the wiper drive shaft from turning and tighten the wiper blade securing nut.
6. Perform a manual clean (see Section 2.3) to check system operation. Ensure blade ‘parks’ correctly.

---

**Fig. 8.3 7330 100 Sensor – Replacing the Wiper Blades**
8.3 Replacing the Emitter and Receiver Modules

Notes.
- The emitter and receiver modules are matched during manufacture. If either module fails, return both to the Company for repair/replacement.
- Refer to the Warnings and Notes in Sections 8.1 and 8.2.1 before removing the modules from the flowcell.
- Under NO circumstances dismantle the modules.

1) Isolate the system from the power supply.
2) Disconnect the cables from the emitter and receiver modules.
3) Refer to Fig. 8.1 and remove the emitter and receiver modules.
4) Refer to Fig. 8.1 and fit the new modules.
5) Refer to Fig. 6.10 and reconnect the emitter and receiver cables.
6) Restore the power supply to the system and allow to warm up for five minutes.
7) Adjust the emitter brightness – see Section 8.4.

8.4 Adjusting the Emitter Brightness
1) Fill the flowcell with high purity water.
2) Select the TEST/MAINTENANCE Page (see Section 5.9).
3) Scroll to the Nit. Totals frame (page 29) for the relevant sensor.
4) Remove the small plug on the left hand side of the emitter module.
5) Using a long, small-bladed screwdriver, adjust the multi-turn potentiometer until Span A (or Span B) value reads 100 ±10.

Note. If this value cannot be obtained, contact the Company.

6) Check that the Span A (or Span B) values in the Nit. Peak and Ref. Peak frames are between 200 and 250.

Note. If these values are outside the limits, contact the Company.

7) Refit the plug removed at step 4.
8) Calibrate the sensor – see Section 4.2.
9) Return the system to normal operation.
9 DIAGNOSTICS

9.1 Status Messages
The diagnostic facilities incorporated in the software displays the appropriate system status message (see Table 9.1) in the Operating Page (see Section 2.3) if a fault is detected.

<table>
<thead>
<tr>
<th>Status Message</th>
<th>Cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Lamp Disabled B: Lamp Disabled</td>
<td>The sensor lamp has been disabled manually in the Operating Page.</td>
<td>See Section 2.3.</td>
</tr>
<tr>
<td>A: Out of Sample B: Out of Sample</td>
<td>Loss of sample/flow pressure detected by the external sample switch contact.</td>
<td>Restore sample/flow pressure.</td>
</tr>
<tr>
<td>A: Low Signal B: Low Signal</td>
<td>No signal received from the sensor. Possible causes are:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Sensor requires cleaning.</td>
<td>Clean sensor – see Section 8.2.</td>
</tr>
<tr>
<td></td>
<td>b) Failure of the cleaner module.</td>
<td>Dismantle sensor to reveal wiper blades (see Section 8.2) and check operation of cleaner module by performing a manual clean – see Section 2.3.</td>
</tr>
<tr>
<td></td>
<td>c) Faulty connections between monitor/sensor.</td>
<td>Check monitor/sensor connections – see Section 6.5.</td>
</tr>
<tr>
<td></td>
<td>d) Failure of lamp power supply.</td>
<td>Return the emitter and receiver modules to the Company for repair.</td>
</tr>
<tr>
<td></td>
<td>e) Failure of the emitter and/or receiver module.</td>
<td>Return the emitter and receiver modules to the Company for repair.</td>
</tr>
<tr>
<td>A: Cleaner Fail B: Cleaner Fail</td>
<td>Failed or jammed cleaner module.</td>
<td>Contact the Company.</td>
</tr>
</tbody>
</table>

Table 9.1 Status Messages

9.2 Unstable or Erratic Readings
This is usually caused by air bubbles in the sample and is more pronounced on the low level sensor due to its greater sensitivity. These bubbles are usually as a result of degassing of the sample caused by either a drop in sample pressure or a rise in sample temperature. Cleaning the optical windows and increasing the flow through the flowcell usually overcomes the problem but if it is severe, install a de-bubbler unit – see Section 6.4.

If erroneous or unexpected results are obtained the fault may be indicated by an error message – see Table 9.1. However, some faults may cause problems with analyzer calibration or give discrepancies when compared with independent laboratory
**Emitter and Receiver Modules** (matched pair) – 7330 181

**Wiper Module**

**Valve**

**Connector**

**O-Ring Kit:** 7997 011

Comprising: 0211 323 x 1 (Optional) 0211 319 x 2

**Wiper Blade Spares Kit**

**Large Rear Spacer**

7330 113

**Small Nylon Washer**

0225 586

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**Description** | **Part Number**
--- | ---
AV400 Monitor | Contact the Company
Processor and Main PSU/P Board (85 to 260V AC) | AX400/0249
Processor and Main PSU/P Board (12 to 30V DC) | AX400/0259
AV400 EPROM | AX400/2000
Display Module | AX400/0295
Multifunction Board (85 to 260V AC) | AX400/0425
Multifunction Board (12 to 30V DC) | AX400/0426
UV Scanning Input Board | AX400/0415
Seal – Terminal Cover | AX400/0119
Seal – Main Case | AX400/0118
Pipe Mounting Kit | AX400/0090

**Table 10.1 AV400 Monitor Spares**
### Specification

#### General

**Sensor range**
- **As NO₃**: 0 to 100mg/l⁻¹
- **As N**: 0 to 20mg/l⁻¹

**Accuracy**
- **As NO₃**: ±2% of reading or 0.5mg/l⁻¹, whichever is the greater
- **As N**: ±2% of reading or 0.15mg/l⁻¹, whichever is the greater

**Reproducibility**
- **As NO₃**: ±0.5mg/l⁻¹
- **As N**: ±0.15mg/l⁻¹

**Interference compensation**
- Turbidity <100NTU
- Dissolved Organics as Humic Acid <20mg/l⁻¹

**Maximum current output scale expansion**
- **As NO₃**: minimum range 0 to 20mg/l⁻¹
- **As N**: minimum range 0 to 4mg/l⁻¹

**Response time**
- Normally three minutes for 90% step change depending on damping factor

**Lamp life**
- Rated by the manufacturer at 1.2 x 10⁹ flashes
- (10 years continuous operation at the rate of one flash at 2s intervals [typical] equates to 13% of the rated lamp life)

**Internal wiper cleaning system**
- Programmable, operation frequency 15, 30, 45 and 60 minutes, 2, 4, 6, 12 and 24 hours

**Maximum distance between transmitter and sensor**
- 750mm (29.5 in.)

#### Sample

**Flow rate**
- 0.5 to 5l min⁻¹ (free of air bubbles)
- A higher minimum flow rate is required at high turbidity levels

**Temperature**
- 0 to 40°C (32 to 104°F)

**Pressure**
- The sensor should be operated at atmospheric pressure but can withstand 3bar (43.5 psi) max.

#### Display

**Type**
- Dual 4½-digit, 7-segment backlit LCD

**Information**
- 16-character, single line dot matrix

**Resolution**
- **As NO₃**: 0.1mg/l⁻¹
- **As N**: 0.01mg/l⁻¹

**Energy saving function**
- Backlit LCD configurable as ON or Auto Off after 60s

**Logbook**
- Electronic record of major events and calibration data

**Real-time clock**
- Records time for logbook and auto cleaning

**Diagnostics**
- Out of sample
- Lamp disabled
- Loss of signal
- Electronic failure

**Languages**
- English
- French
- German
- Italian
- Spanish

#### Outputs

**Current Outputs**

**Number of signals**
- 2 fully isolated current outputs supplied as standard, configurable to one or both sensor outputs
- Current outputs also programmable to any value between 0 and 22mA to indicate system failure

**Output current**
- 0 to 10mA, 0 to 20mA or 4 to 20mA

**Maximum load resistance**
- 750Ω at 20mA

**Accuracy**
- ±0.25% FSD ±5% of reading

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

**Serial communication**
- PROFIBUS DP
Relay outputs
Number of relays
Three supplied as standard, configurable to one or both sensor inputs or status

Set point adjustment
Fully programmable as normal or failsafe, high/low or status

Hysteresis
Programmable 0 to 5% in 0.1% increments

Delay
Programmable 0 to 100 minutes in 1 minute intervals

Relay contacts
Single-pole changeover
Rating 5A 250V max. non-inductive

Insulation
2kV RMS contacts to earth (ground)

Mechanical Data
Transmitter
IP65 (not evaluated under UL certification)
Dimensions 192mm (7.56 in.) high x 230mm (9.06 in.) wide x 94mm (3.7 in.) deep
Weight 1kg (2.2 lb)

Sensor
Low Range Dimensions 327mm (12.87 in.) wide x 410mm (16.14 in.) high x 162mm (6.38 in) deep
High Range Dimensions 405mm (15.94 in.) wide x 373mm (14.68 in.) high x 136mm (5.35 in) deep
Weight 6kg (13.2 lb)

Cable entry types
Standard 5 or 7 x M20 cable glands
N. American 7 x knockouts suitable for ½ in. Hubble gland

Environmental Data
Operating temperature limits
0 to 50°C (32 to 122°F)

Storage temperature limits
-25 to 75°C (-13 to 167°F)

Operating humidity limits
Up to 95%RH non-condensing

EMC emissions and immunity
Meets requirements of:
EN61326 (for an industrial environment)
EN50081-2
EN50082-2

Approvals, Certification and Safety
Safety approval
UL

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

General safety
EN61010-1
Overvoltage Class II on inputs and outputs
Pollution Category 2

DS/AV4NIT–EN Rev. F
Before making any electrical connections, refer to the Warnings on page 37.

Factory-fitted links. DO NOT REMOVE.

* 500mA Type T fuse (AC) or 4A Type T fuse (DC)

Notes.
1) The screens of the sensor’s emitter, receiver and cleaner cables must be enclosed in yellow/green sleeving and connected to the earth (ground) stud fitted to the transmitter case closest to the cable’s entry point – see Fig A.1.

2) Dual input versions – connect each sensor to the correct input terminals (A or B) as indicated on the sensor’s cables.

3) Use the three-hole cable gland provided with the sensor for the sensor cables.

4) Fit a link between C3 and C5. This stops a false Cleaner Fail messages occurring, as the 7320 system cleaner module does not generate the Cleaner Acknowledge signal used in the AV400 for the Cleaner Fail Diagnostic.

5) Remove the existing tag from the green wire and fit an eyelet tag. Connect the green wire (Cable 2) to the AV400 Transmitter earth (ground) stud.

6) Tighten the terminal screws to a torque of 0.60 Nm (5.3 lbf. in.).

Fig. A.1 Connections
Acknowledgments

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