Water Quality Monitor

Instruction Manual

Models 7976
with Automatic Cleaning

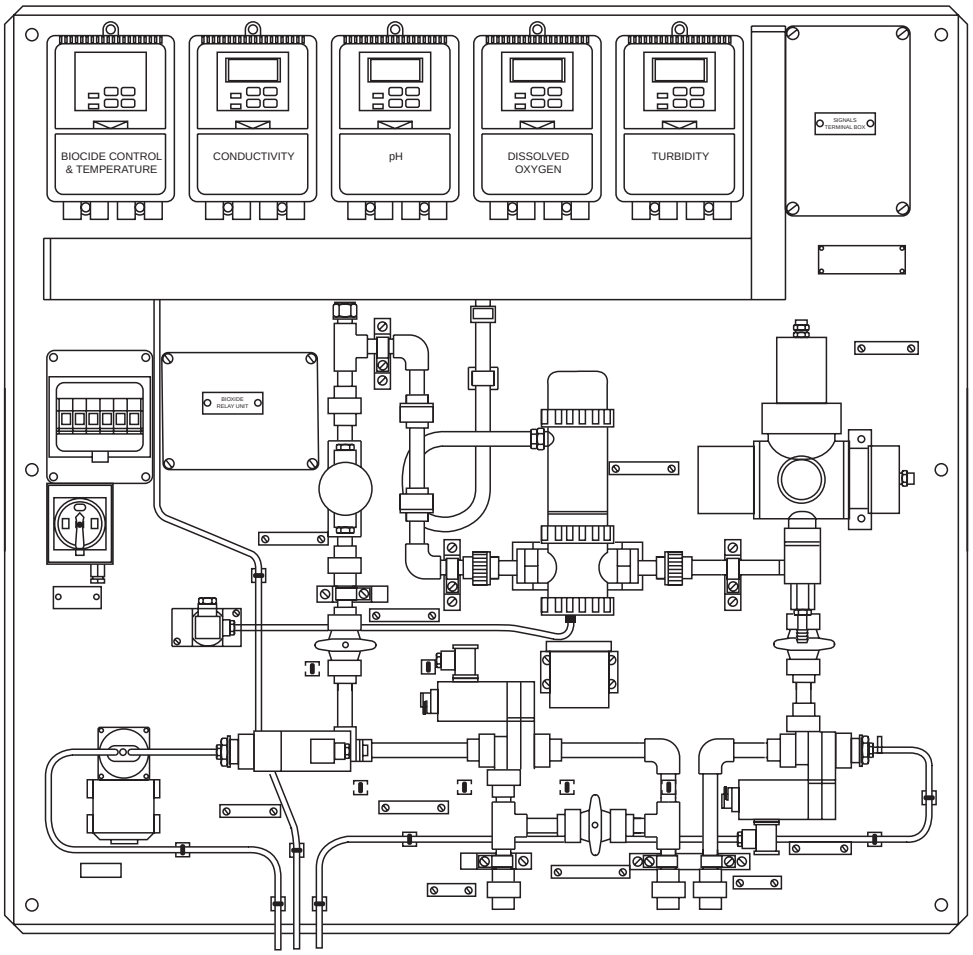


ABB Instrumentation

ABB INSTRUMENTATION

The Company

ABB Instrumentation is an established world force in the design and manufacture of instrumentation 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.

The NAMAS Calibration Laboratory No. 0255(B) is just one of the ten flow calibration plants operated by the Company, and is indicative of ABB Instrumentation's dedication to quality and accuracy.

BS EN ISO 9001

St Neots, U.K. – Cert. No. Q5907
Stonehouse, U.K. – Cert. No. FM 21106

EN 29001 (ISO 9001)

Lenno, Italy – Cert. No. 9/90A

Stonehouse, U.K. – Cert. No. 0255

Use of Instructions

Warning.
An instruction that draws attention to the risk of injury or death.

Note.
Clarification of an instruction or additional information.

Caution.
An instruction that draws attention to the risk of damage to the product, process or surroundings.

Information.
Further reference for more detailed information or technical details.

Although **Warning** hazards are related to personal injury, and **Caution** hazards are associated with equipment or property damage, it must be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process system performance leading to personal injury or death. Therefore, comply fully with all **Warning** and **Caution** notices.

Health and Safety

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

1. The relevant sections of these instructions must be read carefully before proceeding.
2. Warning labels on containers and packages must be observed.
3. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
4. Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
5. Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
6. 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.

CONTENTS

1 INTRODUCTION

1.1 Application

The EIL Model 7976 Multiparameter Water Quality Monitor measures turbidity, pH, conductivity, dissolved oxygen and temperature simultaneously in a flowing sample.

The entire system is on a panel measuring 1.22m (48in) wide and 1.18m (46$^1/_2$in) high, designed for mounting on any convenient vertical surface sheltered from precipitation.

Installation requires only the connection of the sample inlet, drain, compressed air line (if air cleaning is required), a single electrical supply and the outgoing signal and relay lines.

All measured values are presented on local displays and are available as analogue outputs for retransmission to remote data acquisition systems or recorders.

Alarm signals for measurements, at levels preset by the user, are available from sets of isolated relay contacts.

Terminals for all lines are accessible in the signals terminals enclosure.

All routine maintenance may be carried out in situ; full service and spares support is available from ABB Kent-Taylor Limited or its appointed agent or distributor.

Biocide cleaning is available for applications where the sample may be contaminated with algal or similar growths. This provides automatic flushing of the water quality monitor with an appropriate biocide solution, manually or at intervals programmable by the user.

Air cleaning is available for cleaning of the pH electrode when a compressed air line is connected to the panel.

Both biocide and air cleaning can be initiated remotely.

2 SYSTEM DESCRIPTION

2.1 Physical Features (Fig. 2.1)

The equipment is mounted on a single steel panel for fixing to any vertical surface or frame. Six resilient mounting bushes are fitted on the panel.

2.2 Sample Flow Sequence

Sample enters at the bottom edge of the panel by means of a screwed connector accepting a solvent-welded uPVC $^1/_2$in nominal bore pipe. This has an external diameter of 21.4mm. The flow is directed from this inlet, via a series of valves to the sensors, or during maintenance, direct to drain. A bypass allows continuous running of pumps during maintenance and also may be used to drain down the main pipework prior to dismantling for maintenance.

Sample reaches the conductivity cell, which also contains a temperature sensor. The top of the conductivity cell is connected to a ‘T’ fitting with a blanking plug in the opposite arm, allowing cleaning of the cell without removal.

Sample flows from the conductivity cell to an electrode system. This houses the combined pH glass/reference electrode with its temperature compensator, and the dissolved oxygen sensor with integral temperature compensator. In addition to these sensors, there is a temperature sensor for indication of the sample temperature.

Air cleaning of the electrodes is provided, when the panel is fed from a suitable compressed air supply.

Biocide cleaning is provided, with programmable sequencing and timing.
Signals from level switches in the remote biocide tank sequence solenoid valves on the panel to introduce the biocide cleaning solution.

2.3 Electrical System

The single-phase electrical supply enters at the mains isolator. This is a three pole unit but using two poles only. The functional earth (ground) connection is made to an internal stud and both line and neutral are switched by linked sets of contacts. Welded studs are provided at the lower corners of the panel to allow bonding to adjacent exposed metalwork and, in the case of mobile equipment, to an earthing (grounding) spike as may be required by local regulations.

The switched supply is routed via separate miniature circuit breakers (m.c.b.), one for each transmitter on the panel, and one for the biocide relay unit. Terminal rails are provided in the m.c.b. unit for individual neutral and earth connections.

Mains power switches are not generally fitted on instruments; each may be switched off by manual operation of its associated m.c.b., but it should be noted that this does not break the neutral connection.

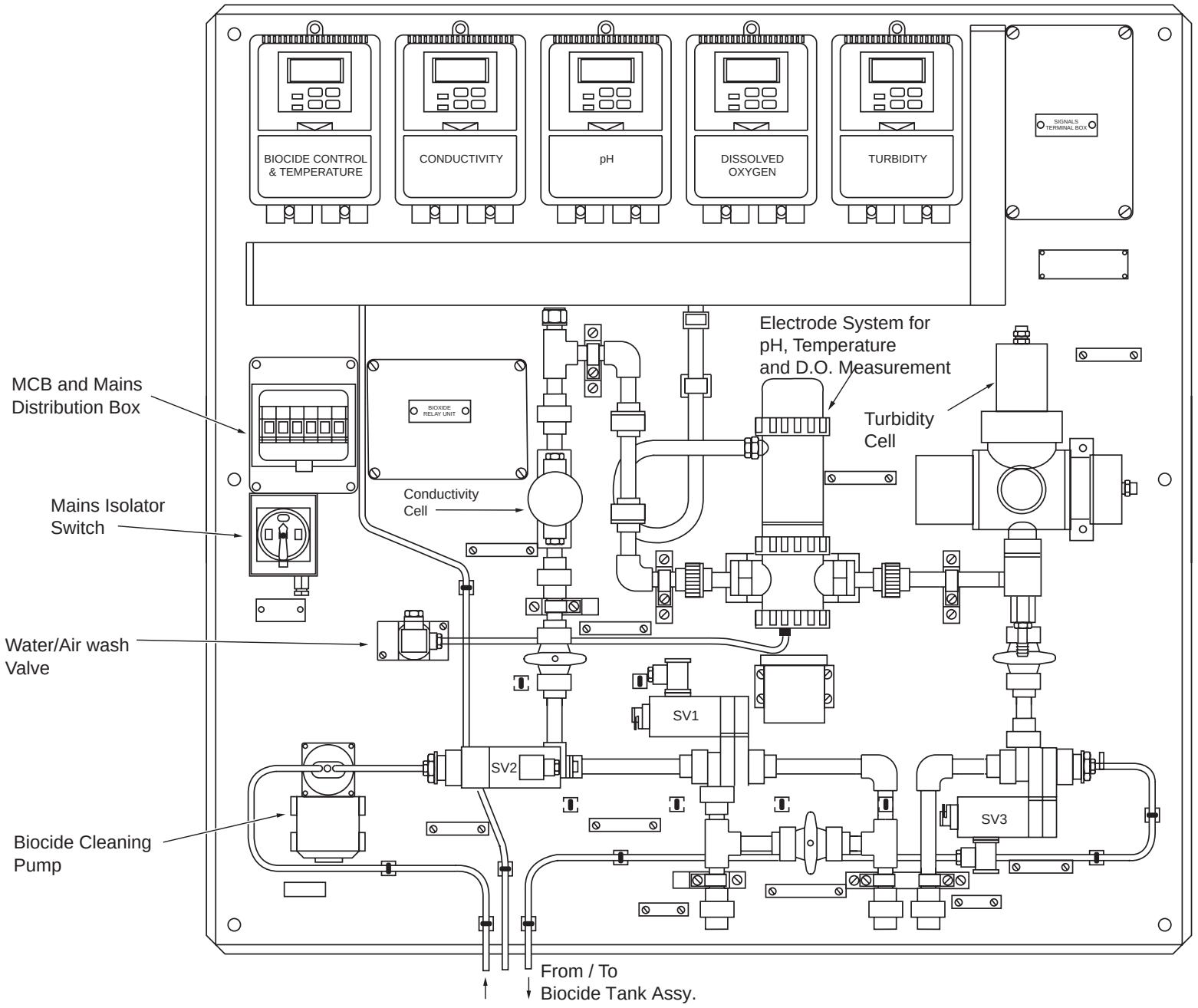


Fig. 2.1 Physical layout

2.4 Transmitters

The Water Quality Monitor includes individual transmitters for monitoring and display of temperature, conductivity, pH, dissolved oxygen and turbidity in the water sample.

Calibration of each of the above functions is available and transmitter parameters are programmable including alarm setpoints, zero and span values and retransmission outputs. Associated ranges and units are selectable, and a security code function is supplied for access to secure parameters.

2.4.1 Model 4691 Biocide Control and Temperature Transmitter

This transmitter provides biocide cleaning control and produces the sample temperature display. It also provides associated external alarms, retransmission signal and serial data output associated with these functions.

2.4.2 Model 4620 Conductivity Transmitter

The Conductivity transmitter displays the conductivity of the sample. It also provides associated external alarm, retransmission signal and serial data output associated with these functions.
Refer to the provided instruction manual for information on the Model 4620.

2.4.3 Model 4630/4631 pH Transmitter

The pH of the sample is displayed by this transmitter. It also provides external alarms, retransmission signal and serial data output associated with this function. Air cleaning, when provided, is also controlled by this transmitter.
Refer to the provided instruction manual for information on the Model 4630 Series.

2.4.4 Model 4640 Dissolved Oxygen Transmitter

Dissolved Oxygen content of the sample is displayed by this transmitter. It also provides associated external alarm, retransmission signal and serial data output associated with this function.
Refer to the enclosed instruction manual for information on the Model 4640.

2.4.5 Model 4670 Turbidity Transmitter

This transmitter displays the turbidity of the sample. It also provides associated external alarm, retransmission signal and serial data output associated with this function.
Refer to the enclosed instruction manual for information on the Model 4670.

3 MECHANICAL INSTALLATION

3.1 Panel Location

A location should be chosen for the panel, where there is a vertical surface with adequate access all around and where ambient conditions will be within the limits given in the specification.

Environmental protection of the instruments mounted on the panel in operating condition is IP65, but for ease of maintenance the panel should be sheltered from precipitation. It should also be shielded from direct sunlight and other intense radiation.

3.2 Panel Mounting

Refer to Fig. 3.1 for mounting dimensions. The instrument displays should be near eye level, the top of the panel being approximately 1700mm (70in) above floor level.

Fixings must be adequate to support the weight of the system and to resist stresses liable to be imposed during operation and maintenance. Soft wall plugs (e.g. plastics or fibre) should not be used.

3.3 Sample Requirements

Sample must be supplied at a flow rate between 5 and 50 l min^{-1}. with a static pressure not exceeding 3 bar gauge (45psi), at a temperature between 0° and 35°C.

3.4 Sample Line Connections

Use 21.4mm (0.84in) o.d. ($^1/_2$in N.B). uPVC pipe for the incoming and outgoing lines. A proprietary solvent cement is required to make these connections; the manufacturer's instructions should be followed at all times.

3.5 Electrode Installation

3.5.1 Description

The combination pH electrode, temperature compensator, and the dissolved oxygen sensor capsule are supplied in separate packing with all necessary accessories for fitting. The probe into which the dissolved oxygen sensor capsule is to be fitted, and the temperature sensor for temperature display by the 4691 transmitter, are both installed at the factory prior to despatch.

The lower part of the electrode system comprises a flow chamber provided with two 1 inch BSP parallel threaded ports, and fitted with adaptors.

A large clamping nut at the bottom of the flowcell allows removal of the bottom plate for flushing out accumulated solids, etc., without disturbing the rest of the system.

The central part of the assembly is a tubular body provided with connections to flexible conduit carrying the cables from the electrodes to the respective transmitters. A sensor holder located in the lower recess carries the clamp bushes, compression washers and O-rings for the pH/reference electrode and the dissolved oxygen/temperature sensor. This sensor holder is a push fit in the body with an O-ring seal. A second O-ring seals this assembly into the flow cell; this being secured with a loose clamping ring to an external thread on the flow cell.

An upper plate located in the tubular body carries compression glands, identified by moulded-in legends, for the leads from the electrodes in the sensor holder assembly, and for the Model 4630 Series instrument cable. On its upper surface there is a labelled terminal block for interconnections. A desiccator capsule, supplied separately in sealed packing, must be fitted on top of the terminal block.

The plate is fitted with two O-rings providing moisture proof seals inside the grey top cap and the body. The cap incorporates an electrostatic screen which, when the cap is screwed on to the top of the body, is connected by a spring loaded earth pin at the top of the terminal block.

Prior to fitting the following compensator/sensors:

a) Unscrew and remove the grey top cap;

b) Remove the upper plate;

c) Unscrew the clamping ring anchoring the tubular body to the flow cell body;

d) Carefully prise the sensor holder out of the body;

3.5.2 Fitting the Temperature compensator

a) Remove the compensator from its box and carefully withdraw the bobbin assembly from the plastic packing tube.

b) Using the small bottle of paraffin oil supplied with the compensator, partially fill the compensator pocket on the sensor holder with sufficient oil so that on carefully inserting the compensator into the tube, the space around the compensator is filled with oil to the top of the tube.

c) Push down the press-fit cap of the compensator over the top of the tube and wipe off any excess oil from the sensor holder. (About 1ml of oil should be sufficient).

d) Feed the compensator cable through the tubular body;

e) On the upper plate, remove the nut and the clamping bush from the gland marked COMP, and slip it over the lead from the compensator;

f) Feed a short length of cable up through the gland and refit the clamping bush and the nut loosely;

g) Carefully tuck the surplus length of cable inside the tubular body;

h) Place the upper plate on top of the tubular body, ensuring that the keys on the plate locate in the keyways in the body.

3.5.3 Fitting the pH sensor

a) Taking care to retain the compression washer and O-ring, unscrew the clamping bush for the pH electrodes and remove the blanking disc;

b) Without touching the electrode membrane, slip the compression washer and then the O-ring on to the electrode stem and slide them up to the shoulder. If the membrane of the electrode is accidentally touched, it should be cleaned with a laboratory grade detergent and rinsed in high purity water;

c) Thread the lead through the bush, seat the electrode in the recess and screw the bush down firmly;

d) Refer to paragraphs d) to h) in **Section 3.5.2** to connect the electrode cable, using the gland marked 'pH'.

3.5 4 Fitting the Dissolved Oxygen Sensor

Caution. Ensure the following steps are done carefully to avoid damaging the membrane covering the silver cathode.

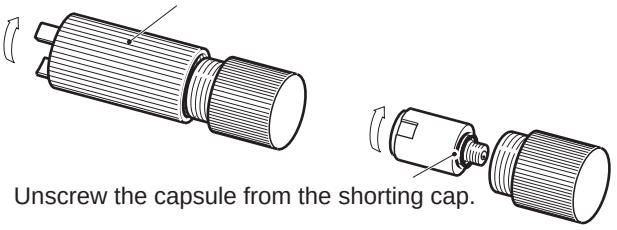
Caution. Clean and dry the area around the sensor capsule before removal, as indicated below.

a) Unscrew the old or dummy capsule from the sensor body and discard the capsule.

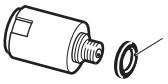
b) Dry the sensor body with a paper tissue; ensure that the gold-coloured electrical contacts, and the recess into which the capsule screws, are clean and completely dry.

Caution. Do not leave the new capsule exposed to air for more than 30 minutes as the membrane will dry out.

c) Access the new capsule by unscrewing the capsule housing



d) Unscrew the capsule from the shorting cap.



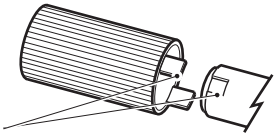
e) Remove and discard the rubber sealing ring from the new capsule.

f) Dry the capsule with a paper tissue taking care not to damage the delicate, transparent membrane covering the silver cathode. Ensure that the gold-coloured contacts, and the threaded portion of the capsule are clean and completely dry.

g) Fit the new sealing ring supplied - see e) above.

h) Screw the capsule into the sensor holder by hand, firmly.

i) Reverse the capsule housing and locate the lugs into the keyways on top of the capsule.



j) Using the capsule housing tighten the the sensor as much as possible using finger pressure only to ensure a good seal.

k) Looking down through the tubular body, locate the keyway over the key on the sensor holder, and press the sensor holder into the body recess;

l) Press the assembly into the aperture in the top of the flow cell and screw down the large clamping ring until the tubular body is firmly held in the flow cell.

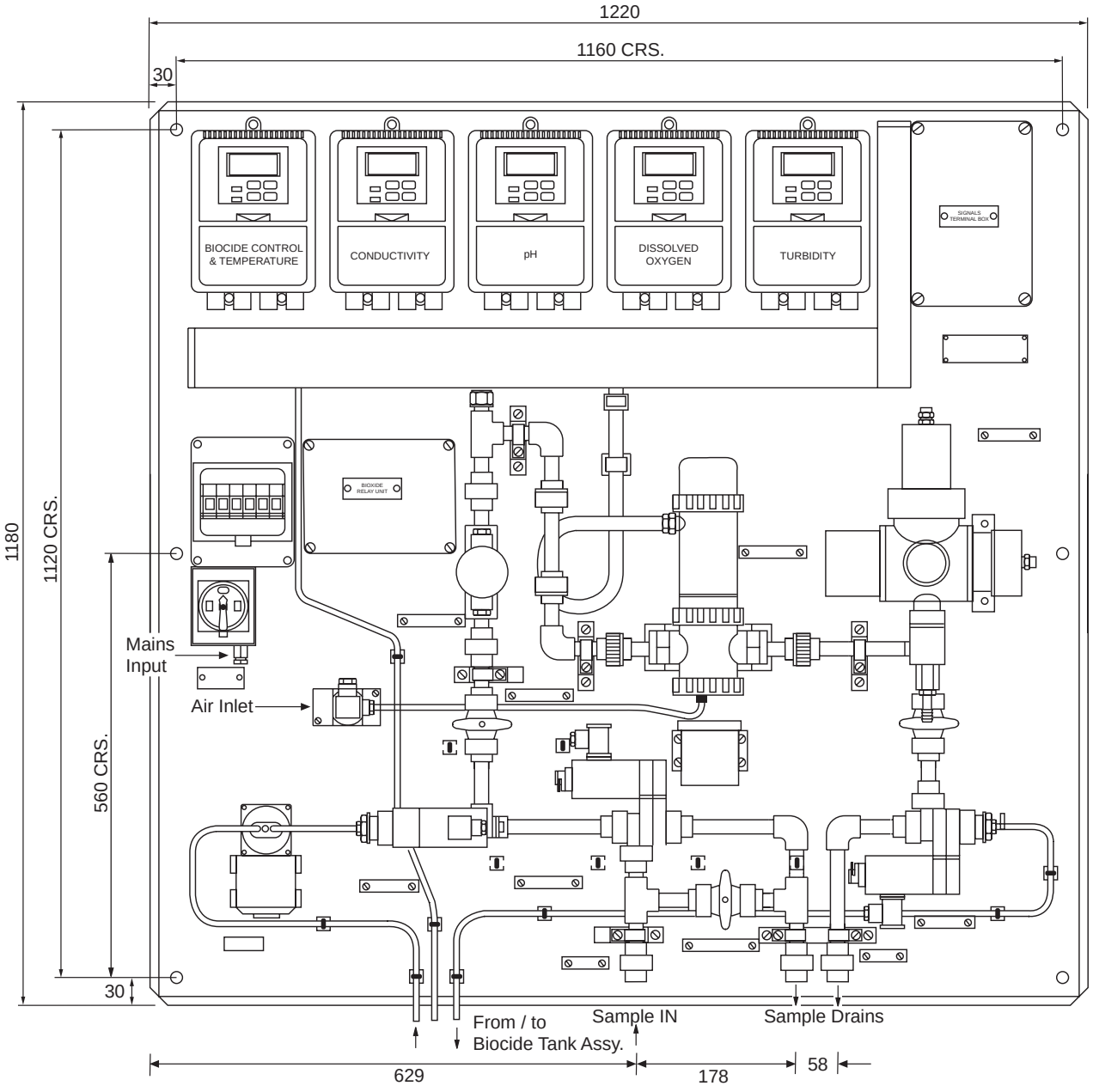


Fig. 3.1 Installation Diagram

Warning. Before starting the electrical installation ensure that the a.c. mains supply is disconnected from any cables being connected to the panel.

Note. All electrical installation must conform to the appropriate local code of practice.

Refer to Fig. 4.1 to connect the mains isolator to the electrical supply.

Refer to Fig. 4.2 when the Serial Communications version is supplied, to connect the alarm circuits and analogue retransmission signals from the signal terminals enclosure.

Refer to Fig. 4.3 when the Non-Serial Communications (remote air and biocide cleaning) version is supplied, to connect the alarm circuits and analogue retransmission signals from the signal terminals enclosure.

4.1 Electrode Connections

Notes.

- The dissolved oxygen sensor and temperature compensator (7976 535) are not connected via the terminal block; the cables are routed through the side entry port and connected directly to the Model 4640 and 4691 transmitters respectively.
- Ignore the colour codes shown in the Operating Instructions Manuals for the Models 4630, 4620 and 4640 Transmitters. They do not apply when used in the Model 7976 configuration.

The terminal block in the top of the tubular body is marked with numbers, identifying terminals to which pH and temperature compensator (7609 500) cables are connected. Letters identify terminals to which the Model 4631 Transmitter cable is connected.

Caution. Ensure in all cases that the black graphite conductivity coating on the inner insulation of coaxial cables is removed. Use a cloth moistened with methylated spirit to clean the last 10mm (0.4in) of insulation.

a) Connect the inner conductor of the screened core in the lead from the pH electrode to terminal 5;

b) Connect the outer screen of the core to terminal 6;

c) Adjust the cables in the top plate glands so that the outer insulation will be gripped and a little slack is left between the glands and the terminal block;

d) Ease the top plate out of the tubular body, tighten all glands in the top plate and refit it;

e) Fit a fresh desiccator on top of the terminal block;

f) Screw the top cap on firmly.

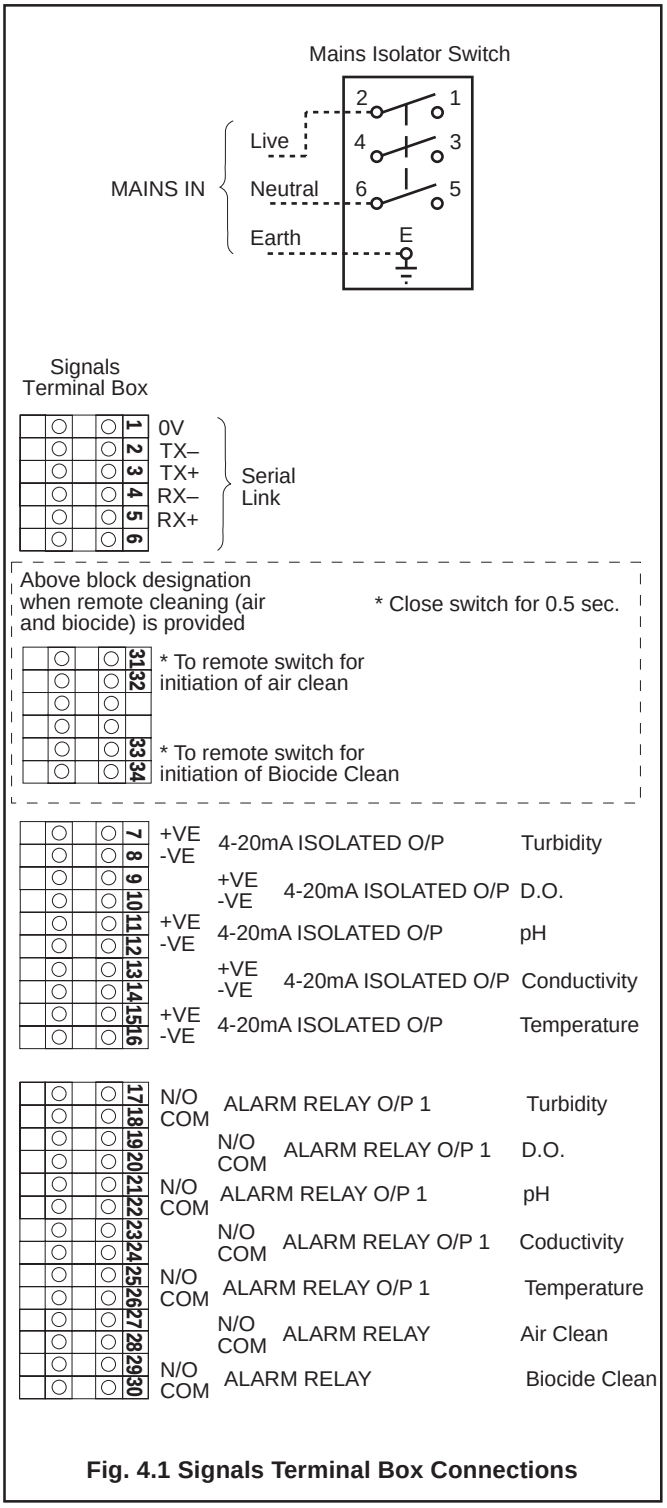


Fig. 4.1 Signals Terminal Box Connections

5 CONTROLS AND DISPLAYS

5.1 Displays – Fig. 5.1

The displays comprise 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 Switch Familiarisation

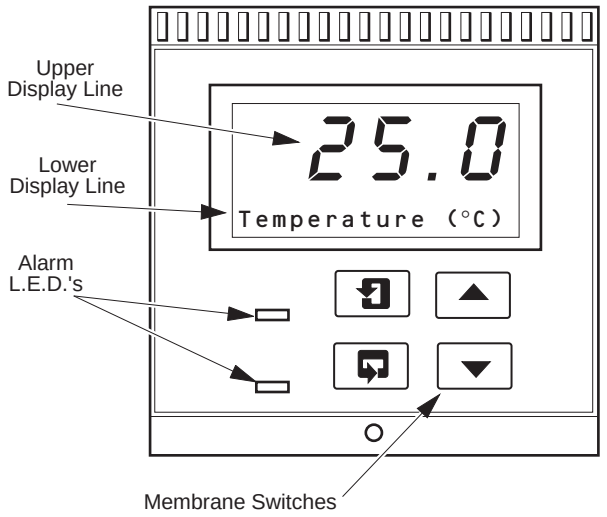
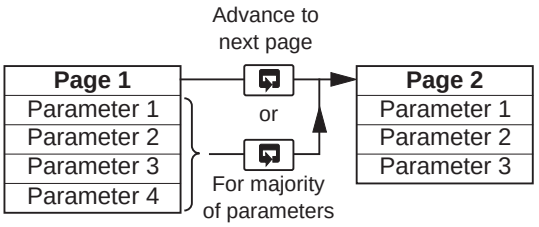
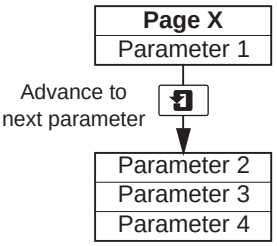


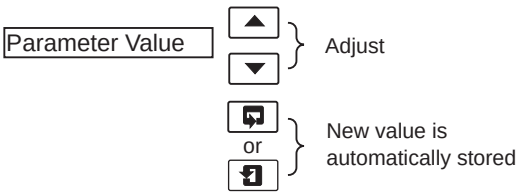
Fig. 5.1 Location of Controls and Displays



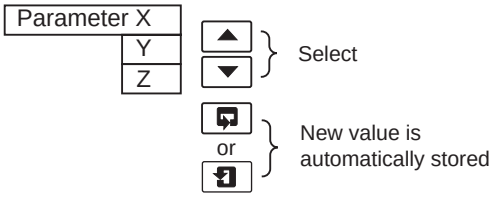
A – Advancing to Next Page



B – Moving Between Parameters



C – Adjusting and Storing a Parameter Value



D – Selecting and Storing a Parameter Choice

Fig. 5.2 Membrane Switch Functions

FIG. 4.2

FIG. 4.3

6.1 Filling the Biocide Tank

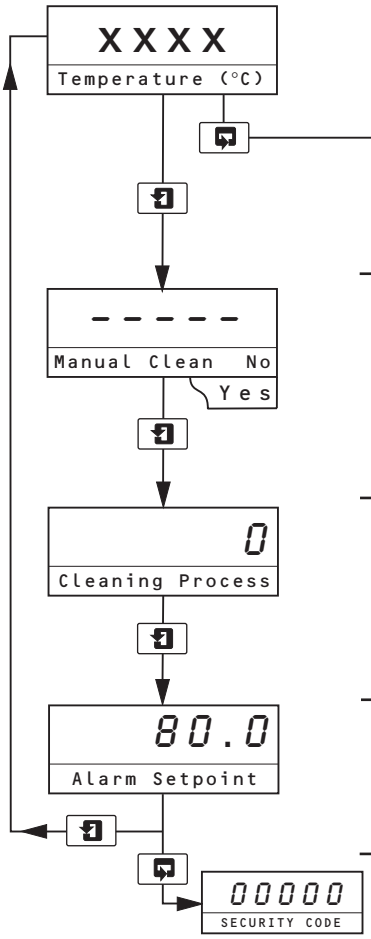
Before switching on the Water Quality Monitor, ensure that the biocide tank is filled with 18.5 litres of biocide solution.
This amount brings the level of solution to the 'step' in the moulding of the tank and corresponds to the upper travel limit of the 'high' level float switch.
Fit the cover, and insert the biocide delivery and return tubes through the holes in the cover and into the tank, routing them away from the float switches. Insert the tubes so that the ends are approximately 50mm above the bottom of the tank.

6.2 Instrument Start-up

Ensure electrical connection has been made correctly to the main switch and with the required individual unit miniature circuit breakers operated, switch on the power supply. If the system is being commissioned for the first time, Biocide Cleaning parameters must be programmed as described in Section 7 of this manual, and other transmitter units as detailed in the appropriate programming sections in the relative transmitter manuals.

6.3 Operating Page for Biocide Cleaning

The **Operating Page** is a general use page in which parameters are viewed, and biocide cleaning can be both initiated and/or reset. To alter or program the Temperature and Alarm Setpoint parameters, refer to the programming pages in Section 7.



Sample temperature is displayed in either °C or °F

Note. Once the sequence has been initiated, it can not be aborted except by switching off the mains supply to the transmitter at the m.c.b. (No.1).

Use the ▲ and ▼ buttons to select 'Yes', which initiates a manual Biocide Cleaning sequence.

Display of the total number of Biocide Cleaning processes performed with the present biocide solution.

Note. When a new biocode solution is used, this value must be reset to zero by using the ▼ button.

Alarm Set Point
The set point value and relay/l.e.d. action are programmable – see Section 7.4,

Advance to **Access to Secure Parameters** Pages**.**

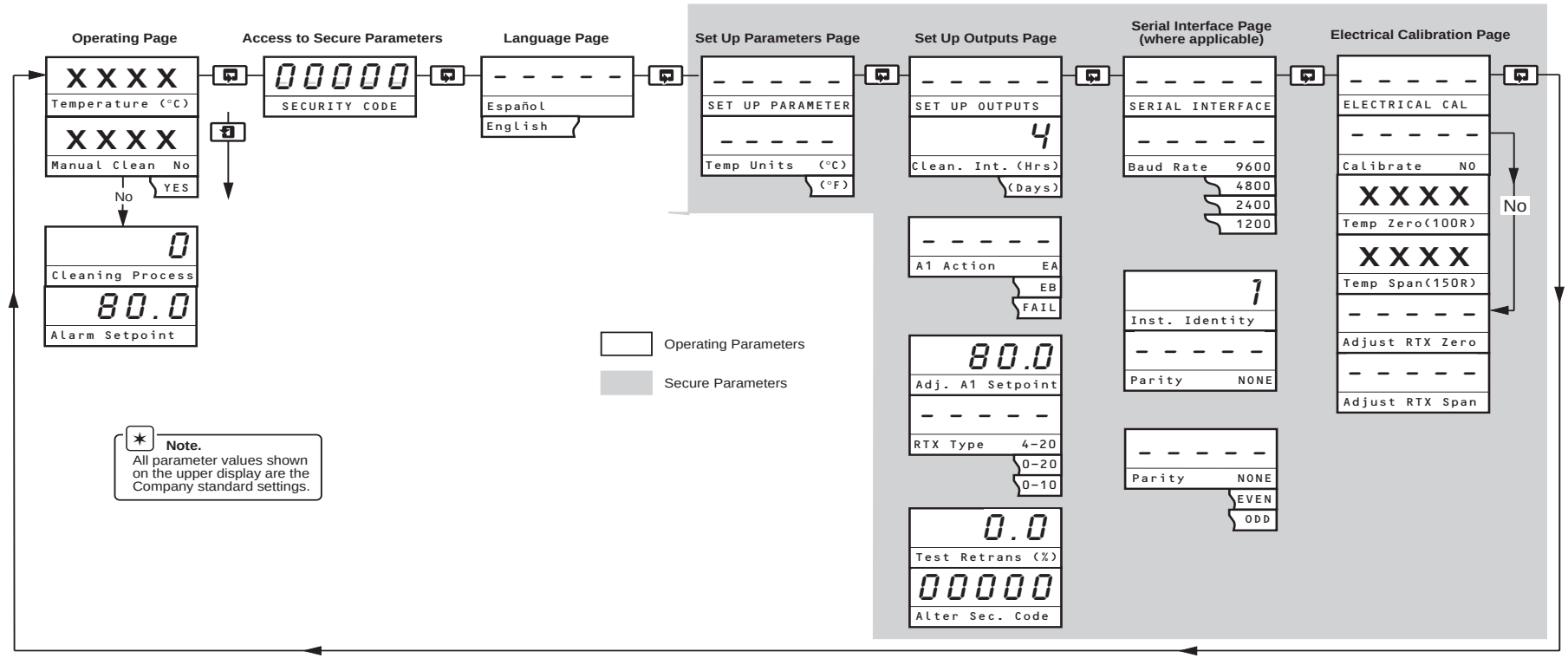
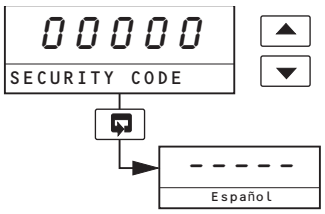


Fig. 6.1 Overall Programming Chart – Biocide Cleaning

7.1 Access to Secure Parameters

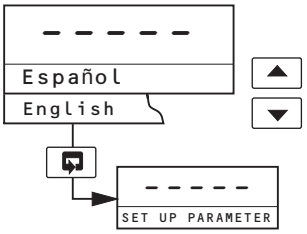
A 5-digit security code is used to prevent unauthorised access to the secure parameters.



Security Code
Enter the required code number, between 00000 and19999, to gain access to the secure parameters. If an incorrect value is entered, access to subsequent programming pages is prevented and **Operating Page** is displayed**.**

Advance to **Select Language** Page

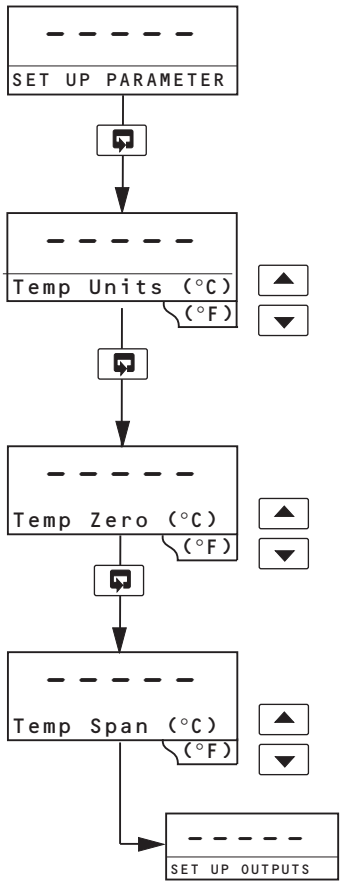
7.2 Select Language Page



Use the buttons to select either Spanish or English language.

Advance to **Set Up Parameters** Page

7.3 Set Up Parameters Page



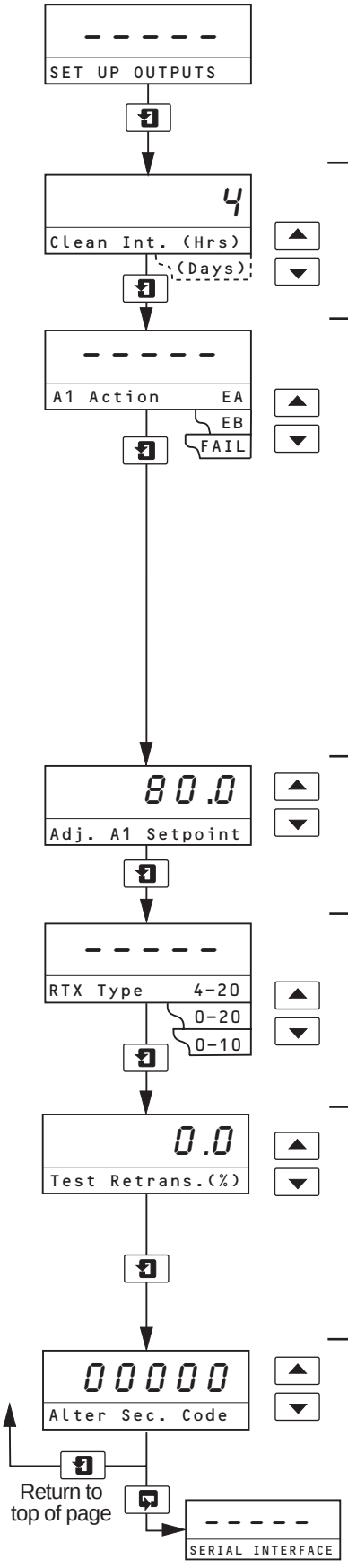
Temperature Units can be displayed as either degrees Celcius or Fahrenheit.
Use buttons to select required units

Temperature Zero
Enter the required value within the range -10°C (+14°F) to +90°C (+194°F)

Temperature Span
Enter the required value within the range +10°C (+50°F) to +110°C (+230°F)
Minimum temperature range of 20°C (36°F)

Advance to **Set Up Parameters** Page

7.4 Set Up Outputs Page



Set the duration between Biocide Cleaning intervals – from 2Hrs to 14 Days

Alarm 1 Action
For '**Fail-safe**' alarm operation the relay's alarm state must be the same as the power-down state, i.e. the relay is de-energised.
For **high alarm** operation the relay must be **E**nergised **B**elow the alarm set point (EB).
For **low alarm** operation the relay must be **E**nergised **A**bove the alarm set point (EA).
The alarm l.e.d.s are illuminated in the alarm condition.

Select the required alarm 1 action from the following table:

Alarm Action	L.E.D. Action for Input Above Set Point	L.E.D. Action for Input Below Set Point	Relay Action for Input Above Set Point	Relay Action for Input Below Set Point
EB	ON	OFF	De-energised	Energised
EA	OFF	ON	Energised	De-energised

If 'FAIL' is selected, an alarm is activated when the biocide clean cycle fails. This may be due to pump failure, float switch failure or low biocide level.

Alarm Setpoint
The alarm setpoint can be set to any value within the temperature range.

Retransmission Output Assignment
Select the retransmission output current range required.

Test Retransmission Output
The instrument automatically transmits a test signal of 0, 25,50, 75 or 100% of the retransmission range selected above. The % test signal selected is shown on the upper display.
Example – for a selected range of 0 to 20mA and 50% retransmission test signal, 10mA is transmitted.

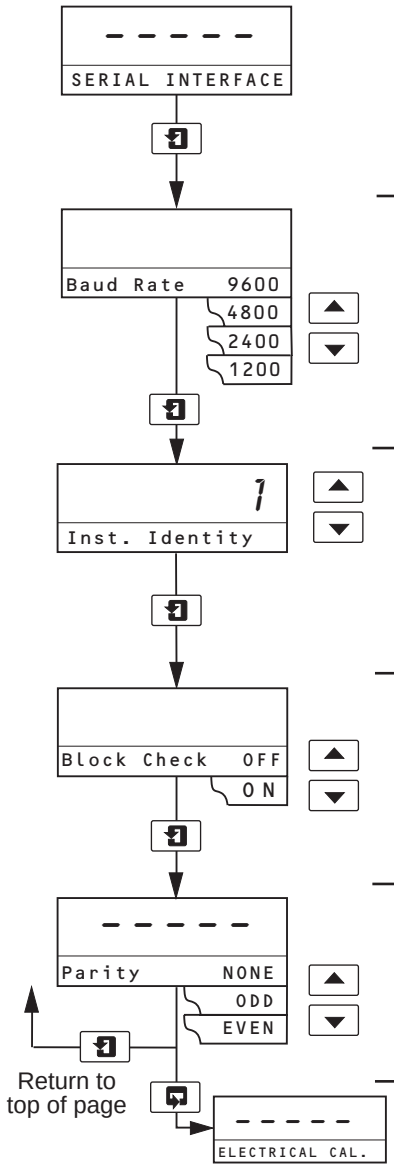
Select the required retransmission level.

Alter Security Code
Set the security code to a value between 00000 and 19999. This value is then entered as detailed in **Section 7.1**, to gain access to the secure parameters.

Important Note. Do **NOT** forget this SECURITY CODE.

Advance to **SERIAL INTERFACE** Page (if applicable).

7.5 Serial Interface Page (where applicable).



See also **Section 8 COMMUNICATION.**

Baud Rate Selection
Select the retransmission rate required.

Instrument Identity
Assign the transmitter an identification number between 1 and 99.
Factory defaults are set as:

1	Biocide Control & Temperature
2	Conductivity
3	pH
4	Dissolved Oxygen
5	Turbidity

Block Check Character
Select ON or OFF as required – see **Section A1**

Parity Selection
Select relative parity.

Advance to **ELECTRICAL CALIBRATION** Page.

7.6 Electrical Calibration Page

Note. The instrument is calibrated by the company prior to despatch and an electrical calibration should only be carried out if its accuracy is suspect.

7.6.1 Equipment Required

a) Millivolt source (pH or Redox input simulator, if required) -1000 to +1000mV.

b) Decade resistance box (temperature input simulator): 0 to 1kΩ (in increments of 0.01Ω).

c) Digital milliammeter (current output measurement): 0 to 20mA.

Note. Resistance boxes have an inherent residual resistance which may range from a few milliohms up to 1 ohm. This value must be taken into account when simulating input levels, as should the overall tolerance of the resistors within the boxes.

7.6.2 Preparation

a) Switch off the supply and disconnect the electrode system, temperature compensator and current output from the instrument's terminal blocks – see Fig. 4.4 (page 9) or Fig. 4.5 (page 11).

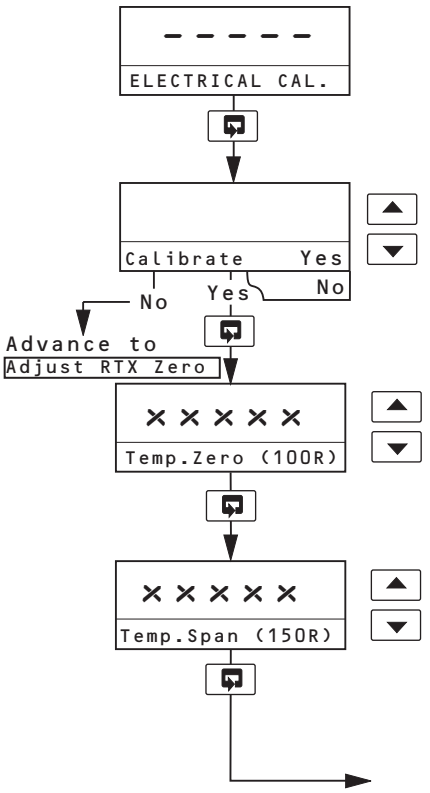
b) Connect the millivolt source, decade box and milliammeter to the appropriate terminals. Ensure the earth on the millivolt source is connected to the earth stud.

c) Switch on the supply and allow ten minutes for the circuits to stabilize.

d) Select the 'ELECTRICAL CAL' page and proceed as in Section 8.3, following.

7.6.3 Electrical Calibration Page

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



Electrical Calibration
Select YES to access the electrical calibration sequence. Select NO to advance to **Adjust Retransmission Zero**.

Advance to next parameter

Calibrate Temperature Zero
Set the temperature simulator resistance box to 100 ohms and allow the instrument display to stabilize.

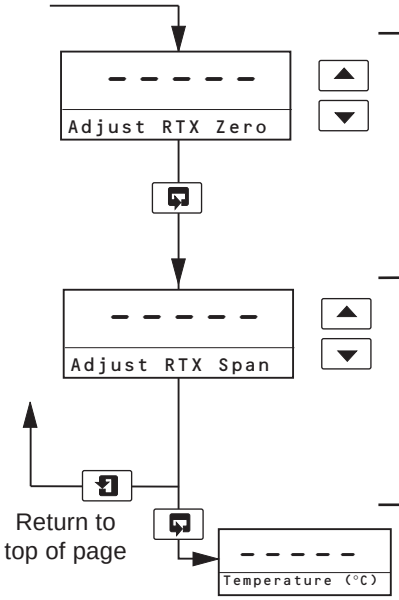
Advance to next parameter

Calibrate Temperature Span
Set the temperature simulator resistance box to 150 ohms and allow the instrument display to stabilize.

Advance to next parameter

Continued on next page.

…7.6 Electrical Calibration Page



Adjust Retransmission Zero
Connect a miiliamp meter to the current output and adjust the output to 4.00mA using the buttons.
Allow the output to stabilise.

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

Adjust Retransmission Span
Adjust the current output to 20.00mA using the buttons.
Allow the output to stabilise.

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

Return to **OPERATING** Page.

8 COMMUNICATION

Note. The details in this section should be read in conjunction with the 4600 Series Serial Data Communications Supplement.

8.1 Communication Transmission

When communicating with the 'BIocide Control and Temperature' and 'pH SP18' Transmitters, the instrument Status details are as shown in Fig. 8.1 and 8.2 respectively.

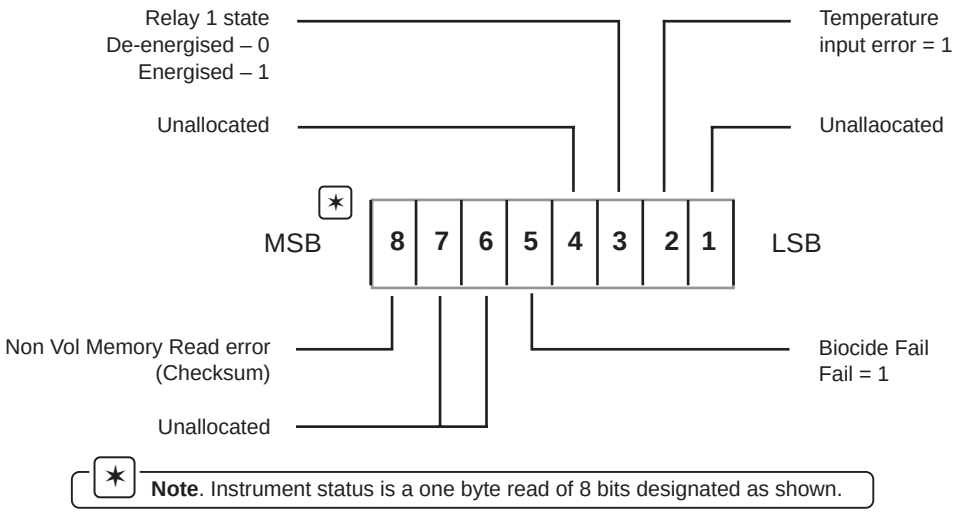


Fig. 8.1 Biocide Control and Temperature Instrument Status

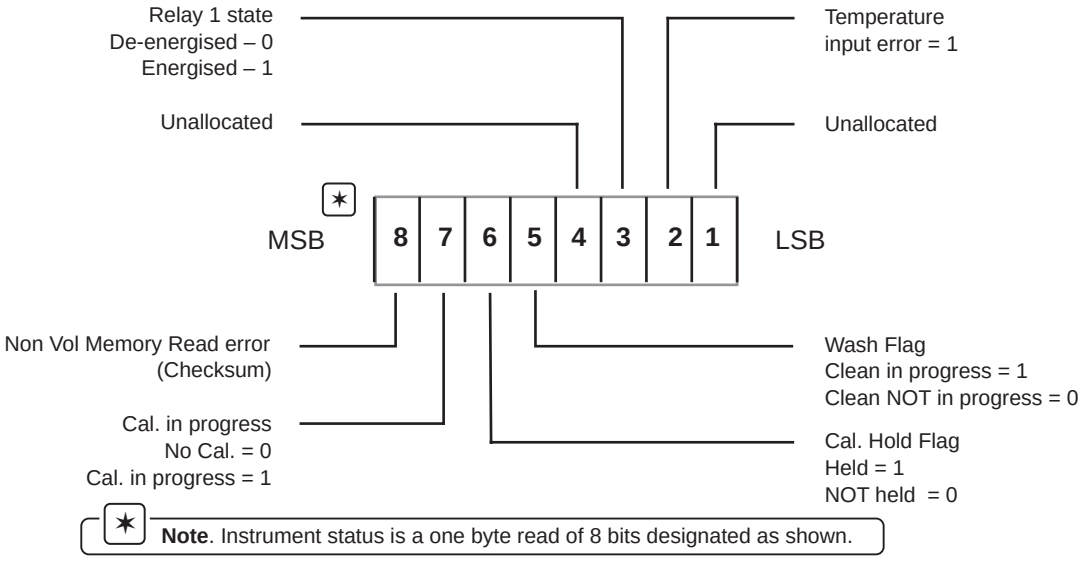


Fig. 8.1 pH SP18 Instrument Status

8.2 Error Codes

Error Codes are as shown in the 4600 Serial Data Communications Supplement.

8.3 Command Mnemonics

i **Information.** In the following sections:
- All parameters can be 'Read'.
- Some parameters can be written to ('Write Command).

8.3.1 Biocide Mnemonics

Parameter	Mnemonic	Write	Interpretation
Measured Temperature	MT	No	-10 to 110°C (14 to 230°F)
Temperature Units	TD	No	0 °C 1 °F
Alarm 1 Action	R1	No	0 EA 1 EB
Retransmission Type	RT	No	0 0 to 10mA 1 0 to 20mA 2 4 to 20mA
Alarm 1 Set Point	A1	Yes	Within temperature range
Biocide Cleaning	BC	Yes	1 Initiate biocide cleaning (1 In progress if in READ mode)
Non-Volatile Memory (Enable/Disable)	NV	Yes	0 Disable 1 Enable
Instrument Status	IS	No	See Fig. 8.1

8.3.2 pH SP18 Mnemonics

Parameter	Mnemonic	Write	Interpretation
Measured Variable	MV	No	Within programmed display range
Preset Temperature	PT	No	-10 to +110°C (14 to 230°F)
Measured Temperature	MT	No	–10 to +110°C (14 to 230 °F)
Alarm 1 Set Point	A1	Yes	Within programmed display range
Alarm 2 Set Point	A2	Yes	Within programmed display range
Display Span	DS	Yes	Refer to IM/4600–CON for maximum and minimum ranges which must not be exceeded
Display Zero	DZ	No	Zero (for UM 0 to 5) or 2MΩ–cm (for UM 6)
Instrument Type	IT	No	0 Redox (ORP) 1 pH Glass 2 pH Antimony
Temperature Unitrs	TD	No	0 °C 1 °F
Alarm 1 Action	R1	No	0 EA 1 EB
Alarm 2 Action	R2	No	0 EA 1 EB
Retransmission Type	RT	No	0 0 to 10 mA 1 0 to 20 mA 2 4 to 20 mA
Temperature Compensation	TK	No	0 No 1 Yes
Sample Compensation	SK	No	0 No This Mnemonic is not used with the 1 Yes Antimony Electrode
Sample Coefficient	SK	No	This Mnemonic is not used with the Antimony Electrode
Hold Outputs	HO	No	0 No 1 Yes
pH Slope Value	PS	No	80 to 105% typical.
pH Check Value	PC	No	6 to 8pH typical (glass) or 0 to 2 pH typical (antimony)
Non-Vol Memory (Enable/Disable)	NV	Yes	0 – Disable 1 – Enable
Instrument Status	IS	No	See Fig. 8.2
Clean enable	CE	Yes	1 Enable

8.3.3 Multiple Read Mnemonics

Parameter Group	Mnemonic	Parameters
General Parameters	M1	Measured Value (MV) Measured Temperature (MT or PT) Instrument Status (IS) Alarm 1 Set Point (A1) Alarm 2 Set Point (A2)
Display Parameters	M2	Display Span (DS) Display Zero (DZ) Display Units Conductivity – Units Measurment (UM) pH/DO – Instrument Type (IT)

9.1 Electrode Calibration

9.1.1 Removing the pH Electrode & D.O. Sensor

Caution. Do not allow the electrodes to dry out; prepare the necessary solutions first.

a) Switch off the Biocide Relay Unit at the appropriate m.c.b. (No. 6). This prevents biocide and/or air cleaning.

b) Open fully the Bypass Isolation Valve and close the Sample Inlet Isolating Valve (see Fig. 2.1).

c) Unscrew the clamping ring anchoring the tubular body to the electrode flowcell.

d) Carefully turn and pull the body, complete with sensor holder, free of the flow cell.

Note. The 'Buffering Pot' provided in the bracket below the flowcell, can be used for calibration. Great care should be taken not to damage the electrode/sensor.

9.1.2 pH Calibration

Refer to the 4630 Transmitter Operating Instructions for the pH calibration procedure.

a) When calibration is complete, inspect the O-ring on the larger diameter of the sensor holder; if it is damaged in any way, discard it and fit a new one lubricated with a trace of silicone grease, taking care to keep the grease away from the electrodes.

b) Replace the system in the flowcell and tighten the clamping ring.

c) Open the Sample Inlet Isolating valve and close the Bypass Isolation Valve to introduce the sample.

d) Switch on the Biocide Relay Unit m.c.b.

9.1.3 Dissolved Oxygen Calibration

The zero calibration requires a 5% w/w solution of analytical grade sodium sulphite in high purity water.

Refer to the 4640 Transmitter Operating Instructions for the Dissolved Oxygen calibration procedure.

a) When calibration is complete, inspect the O-ring on the larger diameter of the sensor holder; if it is damaged in any way, discard it and fit a new one lubricated with a trace of silicone grease, taking care to keep the grease away from the electrodes.

b) Replace the system in the flowcell and tighten the clamping ring.

c) Open the Sample Inlet Isolating valve and close the Bypass Isolation Valve to introduce the sample.

d) Switch on the Biocide Relay Unit m.c.b.

9.2 Sensor Maintenance

9.2.1 pH System Electrode Unit

Very little maintenance of the components of the electrode system carrying sample is necessary unless the conditions of operation are unusually harsh, where experience may dictate regular replacement of O-rings.

Whenever the electrode system is opened at any point, all O-rings (especially the lower sensor holder O-ring), seals, washers, etc. should be checked for damage, wear and flexibility, and unserviceable rings replaced. Very much depends on the particular application, but regular checking will soon determine an average ring life. A spare set of O-rings is supplied with each system, and they should be lightly lubricated with mineral grease before use. Spare O-rings, etc., are listed in Section 11.

Replace the desiccator capsule in the electrode system annually or if the top compartment has been opened in very damp conditions. Used capsules may be reactivated by placing in an oven for a few hours at a temperature of about 130°C.

9.2.2 pH Electrode Cleaning

When the performance of the electrodes begins to deteriorate, cleaning may help to restore their original condition. If the cleaning actions described below do not eliminate the deterioration, either the glass electrode or the sealed reference electrode or both should be replaced. These steps are described in the next sections.

During cleaning, avoid rough handling of the pH glass electrode membrane. Wiping with a soft cloth or tissue soaked in an appropriate solvent for the deposit, or washing with a strong jet of water are preferred methods; this can be carried out simply by removing the electrode holder unit from the flowcell—it would not be necessary to remove the electrodes from the sensor holder. However, where the cleaning operation stipulated below requires an extended period, it is advisable to replace the electrode during cleaning with a new one so that there is a minimum interruption to the on-line process measurement.

Removing sludge and loosely adhering matter

For general sludge and loosely adhering matter the glass membrane can be cleaned with air directed at the membrane. For applications where an integral air cleaning system is fitted, consult the 4600 Series pH Transmitter Operating Instructions. Recalibrate using buffer solutions.

Removing greasy organic deposits

For greasy organic deposits, wipe the glass membrane with cotton wool soaked in a detergent and rinse thoroughly. (Alternatively, a solvent such as isopropanol may be used.) If a sluggish response to pH changes still occurs soak the electrode for a few hours in 0.1M hydrochloric acid and then wash in water. Recalibrate using buffer solutions.

9.2.3 pH Electrode Replacement

If the pH electrode is no longer serviceable (see Section 9) it must be replaced by a new electrode. The procedure is as follows:

a) Switch off the Biocide Relay Unit at the m.c.b. (No. 6).

b) Drain the Water Quality Monitor system.

Note. A 'Buffering Pot' is provided below the flowcell which can be used to temporarily store the tubular body during electrode replacement.

c) Remove the electrode holder unit from the flowcell and take out the sensor holder from the bottom end of the electrode holder unit.

d) Remove the electrode in the reverse manner to fitting, as outlined in **Sections 3 and 4**, and fit the replacement as shown in **Sections 3 and 4**.

e) Carry out calibration of the pH meter/electrode system, as outlined in the pH transmitter instruction manual, and install them into the flowcell.

9.3 Turbidity Transmitter

Check the operation of the integral wiper cleaning system of the turbidity sensor by the procedure in the relevant operating instructions manual, and at intervals dictated by the level of contaminants in the sample.

9.4 Dissolved Oxygen System

No maintenance is possible on the dissolved oxygen sensor capsule, but check the tightness of the capsule and visibly inspect the condition of the membrane. Should the oxygen sensor then fail to calibrate correctly, the sensor capsule must be replaced.

9.5 Conductivity System

The only maintenance necessary with the conductivity cell is occasional cleaning. The electrode bore should be thoroughly cleaned with a nylon bristle brush (supplied), or a warm detergent solution. Access to the cell for this purpose is through the blanking plug at the top of the arm in which the cell is mounted.

For more tenacious deposits a 2% hydrochloric acid solution may be used. The cell should be thoroughly rinsed with distilled water after cleaning. If the cell is removed from the panel for this purpose, the bore should be viewed against a bright light after cleaning to ensure that the interior surfaces are evenly wetted, i.e. free from any grease deposits. Avoid wetting the electrode connection terminals.

9.6 Biocide Clean Operation

A biocide clean operation starts when either a manual or automatic sequence is initiated from the transmitter.

The biocide clean operation is indicated by the messages MANUAL CLEAN or CLEANING PROCESS on the Biocide Control Transmitter display, and the operation of the remote BIOCIDE customer relay contacts.

The sequence during the biocide clean is:

a) The sample divert valve, SV1, is energized.

b) The sample/biocide solenoid valve, SV2, is energized and the biocide pump started. This enables the biocide to be introduced into the Water Quality Monitor. Sample in the Water Quality Monitor is purged to drain.

c) The biocide pump runs until the biocide low level float switch trips or 6 minutes has elapsed, whichever occurs first.

Note. If the pump has run for 6 minutes without the low level float switch operating, the pump is considered to have failed and a plant failure alarm is indicated.

d) When the low level float switch operates within the 6 minute pumping period, SV3 is energized and the biocide pump runs on for a further 5 seconds before stopping.

Note. The biocide is now allowed to be in contact with the wetted parts of the Water Quality Monitor for three minutes.

e) The sample divert solenoid valve SV1 and sample/biocide solenoid valve SV2 are de-energized, allowing sample back into the system. This returns the biocide from the system into the tank.

f) The high level float in the biocide tank operates to indicate that the biocide has returned to the tank. This de-energizes SV3 and the BIOCIDE relay. Normal operation of the Water Quality Monitor then resumes.

Note. If the high level float switch does not signal within 90 seconds of the release of SV1, the plant is shut down and a plant failure occurs.

9.6.1 Chemicals Required

Biocide solution

This consists of an aqueous solution containing:

100mgl^{-1} Bronopol Boots
0.01% by volume Decon 90

The concentration of Bronopol (a broad spectrum biocide) can be increased up to 500mgl^{-1} if the above solution is found to be ineffective.

Caution. Chlorine based biocides, e.g. Sodium Hypochlorite, **MUST NOT BE USED** because of the danger of possible damage to the dissolved oxygen sensor.

'Bronopol' Boots is available from the following U.K. supplier:

Hays Colours Ltd.
Pellon Industrial Estate
HALIFAX HX1 4PF

and Boots worldwide agents.

9.7 Air Clean Operation

Control and programming for the Air Clean Option is via the pH transmitter.

a) An air clean valve is operated allowing compressed air (NOT exceeding 1.4 bar above sample line pressure), from an external source, to be directed at the combination pH electrode in the flow cell.
   A pulsating air cleaning cycle is used for optimum effectiveness.

b) During this period the AIR CLEANING output is active, and the 4-20mA output is held for thirty seconds at the end of the air clean cycle to allow the electrode system to stabilise.

c) The system returns to normal operation.

10 FAULT FINDING

Table 10.1 shows a brief list of faults and their possible causes. It is important to establish at the outset whether the observed fault can be traced to the electrode system (usually a chemical or mechanical malfunction), or to the pH meter (an electrical malfunction). If the former, consult Table 10.1; if the latter, consult the transmitter instruction manual.

11 SPARE PARTS LIST

11.1 Electrodes

7976 195 Combined pH/reference electrode.
8012 170 Dissolved oxygen capsule.
2045 405 Flow-line conductivity cell.
7976 190 D.O. Sensor Body assembly

11.2 Consumables

0214 244 Desiccator capsule
0400 110 50 x 4pH buffer sachets to make 100ml each.
0400 120 25 x 7pH buffer sachets to make 200ml each.
0400 130 50 x 9pH buffer sachets to make 100ml each.

11.3 7600 040 Maintenance spares kit including:

0211 161 O-ring for glass pH electrode. Quantity 2.
0211 171 O-ring for temperature compensator.
0211 190 O-ring for reference electrode location (not used).
0211 251 O-ring for lower plate/flow cell. Quantity 2.
0211 252 O-ring for lower plate/tubular body.
0211 253 O-ring for upper plate.
0211 254 O-ring for top of tubular body.
7600 820 Gland bush for transmitter cable glands. Quantity 2.
7600 910 Slip washer for electrode lead glands in upper plate.
7600 920 Slip washer for transmitter cable glands. Quantity 2.

11.4 Strategic Spares

7600 240 Gland nut for upper plate glands.
7600 430 Gland nut for body side glands.
7600 510 Top cap.
7600 620 Clamp bush for pH electrode.
7600 630 Compression washer for pH electrode.
7600 800 Gland bush.
7600 810 Gland bush for unused gland in body side.
7600 900 Blanking disc for unused gland in body side.
7600 300 Sensor Holder.
7600 570 Blanking plug.
7600 490 Terminal block.
7600 410 Upper plate.

Symptoms	Possible Cause
pH display drifts aimlessly and possibly settles upscale.	a) Electrode leads open circuit - check junction box connections inside the electrode housing. b) Ceramic junction dried out - replace the reference electrode.
Display settles at or near the check reading.	a) Electrode leads short circuited - check junction box connections inside the electrode housing. b) Glass electrode membrane cracked - fit a new electrode.
Display reading drifts.	a) Reference electrode lead earthed - check electrical resistance to earth with an ohmeter: try a new electrode if unsuccessful. b) Ceramic junction blocked or dirty - replace the reference electrode.
Display reading is sluggish in responding to pH changes.	a) Glass electrode membrane dirty or coated - clean and reactivate (if necessary) in 0.1 M HCl for several hours. b) Damp in junction box inside the electrode housing affecting the insulation - check the condition of the O-rings in the system. Carefully dry out the interior of the junction box with a warm air blower. Reactivate the desiccator.
Indicated pH grossly inaccurate. Gives only a small change of indicated pH for a large actual change (check by standardisation).	a) Temperature compensator faulty - try a new compensator. b) Glass electrode faulty - try a new glass electrode.
Incorrect operation and temperature compensation.	Temperature compensator faulty - try a new compensator.

Table 10.1 Fault Finding

12 SPECIFICATION

System

Outputs:
All six parameters programmable for 0-10, 0-20 or 4 to 20mA.

pH, redox, conductivity, dissolved oxygen, turbidity and temperature isolated retransmission outputs.

Power requirements: 220/240V or 110/120V, 50/60Hz.

Caution. Solenoid valves are not voltage interchangeable and are supplied to match the ordered mains voltage system.

Miniature Contact Breakers (m.c.b.):
Numbers 1 to 6 (inc.) 0.2 Amps
Number 7 2 Amps

Overall Dimensions: 1180mm (46 1/2 in) high
1220mm (48 in) wide.

Weight: Approximately 140kg.

Sample Conditions:
Sample temperature: 0° to 35°C.

Flow rate: 10 to 25 $lmin^{-1}$ dependent on the suspended solids in the water.

Inlet Pressure 1.5 bar g maximum.

Ambient Conditions:
Temperature: 0° to 55°C. All electronic components protected to IP66.

Relative humidity: 0 to 95% non-condensing.

Materials of Construction:
Valve bodies: uPVC with EPDM seals.
Piping: uPVC.

Flow cells for pH, dissolved oxygen and temperature: Glass coupled polypropylene.

Flow cells for conductivity: Epoxy resin.

Flow cells for turbidity: Delrin.

Air Cleaning Valve Stainless Steel 316.

Air Pipe Nylon.

Displays

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 temperatures, alarm set points and programmable parameters. The lower display line shows the associated programming units or programming information.

Alarms

Alarms available for pH, conductivity, dissolved oxygen temperature and turbidity. Configuration programmable – see the separate transmitter operation manuals..

Transmitters

For specification details of the transmitter units, see the separate transmitter operation manuals.

a) pH
Range: 0 to 14pH (programmable)
Accuracy: ±0.02pH.

b) Conductivity
Range: Any range within 0 to 10000µS cm^{-1} (maximum).
0 to 0.5µS cm^{-1} minimum.

Accuracy: +1% F.S.D.

c) Dissolved Oxygen
Ranges: 0 to 10ppm, 0 to 20ppm and 0 to 100% saturation and 0 to 200% saturation

Accuracy: ±1% saturation ±0.1ppm.

d) Temperature
Display Range: -10° to + 110°C (14° to 230°F).

Accuracy: ±0.5°C

e) Turbidity (Depends on the 7997 Series Turbidity Unit Model supplied as detailed below):

7997-201

Range: Programmable 0 to 30 NTU (FNU);
(0 to 1 is the minimum usable range).

7997-200

Range Programmable 0 to 500 NTU (FNU);
(0 to 25 is the minimum usable range).

7997-300

Range Programmable 0 to 500 FTU (FAU);
(0 to 100 is the minimum usable range).

A1 Block Check Characters

The block check character (BCC) transmitted, is determined by the seven least significant bits in the binary arithmetic sum of a complete message (excluding parity bits). All characters transmitted before the BCC must be included in the arithmetic sum. Refer to Appendix A1 in the Serial Data Communication Supplement for ASCII characters.

A1.1 BCC Example

Message – STXR01A1ETX

Find the ASCII decimal equivalent of each character in the message, calculate the decimal arithmetic sum and hence obtain the binary arithmetic sum.

STX	=	2
R	=	82
0	=	48
1	=	49
A	=	65
1	=	49
ETX	=	3

Arithmetic sum =
298 decimal
100101010 binary

Only the seven least significant bits (LSB) of the binary arithmetic sum are required to determine the BCC:

MSB LSB
10 0101010

'*****' is the BCC transmitted – see ASCII code list

NOTES

PRODUCTS & CUSTOMER SUPPORT

A Comprehensive Instrumentation Range

Analytical Instrumentation

- ***Transmitters***
  On-line pH, conductivity, and dissolved oxygen transmitters and associated sensing systems.
- ***Sensors***
  pH, redox, selective ion, conductivity and dissolved oxygen.
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  pH and dissolved oxygen meters and associated sensors.
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  For water quality monitoring in environmental, power generation and general industrial applications including: pH, conductivity, ammonia, nitrate, phosphate, silica, sodium, chloride, fluoride, dissolved oxygen and hydrazine.
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- ***Controllers***
  Digital display, electronic, pneumatic. Discrete single-loop and multi-loop controllers which can be linked to a common display station, process computer or personal computer.
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- ***Transmitters***
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Customer Support

ABB Instrumentation provides 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.

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ABB Kent-Taylor Limited
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United States of America

ABB Instrumentation Inc.
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Fax: +1 716 273 6207

Italy

ABB Kent-Taylor SpA
Tel: +39 (0) 344 58111
Fax: +39 (0) 344 58278

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:

1. A listing evidencing process operation and alarm logs at time of failure.
2. Copies of operating and maintenance records relating to the alleged faulty unit.

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