User Guide

IM/8242 Issue 12

Phosphate Monitor

8242

ABB

ABB

The Company

We are 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 is just one of the ten flow calibration plants operated by the Company, and is indicative of our dedication to quality and accuracy.

EN ISO 9001:1994

Cert. No. Q05907

EN 29001 (ISO 9001)

Lenno, Italy – Cert. No. 9/90A

Stonehouse, U.K.

0255

Electrical Safety

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

Symbols

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

	Warning – Refer to the manual for instructions		Direct current supply only
	Caution – Risk of electric shock		Alternating current supply only
	Protective earth (ground) terminal		Both direct and alternating current supply
	Earth (ground) terminal		The equipment is protected through double insulation

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.

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 Brief Description

The Model 8242 Phosphate Monitor is a microprocessor-based colorimetric analyzer that monitors the level of phosphate in river and potable water supplies and also in sewage/waste water treatment. The instrument is available as a single stream or as a multi-stream version, the latter being able to sequentially sample up to six independent streams. The single stream version also incorporates a facility to compensate for color in samples.

This manual covers both versions of the monitor; aspects specific to the multi-stream version are covered in the text as appropriate, but multi-stream programming is covered in Appendix A.

1.2 Training

Due to the specialized nature of the above instrumentation, it is recommended that, where personnel have had no previous experience of maintaining this type of equipment, training be provided by the Company. Such training is available via a network of local or overseas agents, or may be carried out on the users' premises.

1.3 Location and Function of the Main Components – Fig. 1.1

The monitoring of phosphate involves the addition of a chemical reagent solution to the sample under constant temperature conditions. The result is a chemical complex, in solution, which has a predetermined color. The absorbance of this colored complex is proportional to the concentration of the phosphate in the original sample, thus making it possible for the measurement to be made optically.

Because some samples are naturally colored, the monitor has a feature to compensate for interference from colored samples. This feature is available in single stream monitors only.

The 8242 Phosphate Monitor carries out the measurement as follows:

a) The sample is presented to a constant head unit and any excess is allowed to overflow. On multi-stream versions there is a constant head unit for each stream.

b) A solenoid valve is then used to select automatically one stream to be sampled sequentially. This allows sample, under controlled pressure conditions, to be

c) presented to a multi-channel peristaltic pump which

d) proportions sample and reagent through a series of mixing and reaction stages. The reaction stage is temperature controlled to remove the effects of sample and ambient temperature variations.

e) The reacted solution is then delivered to a small chamber, called a cuvette, in the optical system where the measurement takes place.

f) The output from the optical system, which is based on the amount of light absorbed by the solution, is then processed by the microprocessor-based electronics section to calculate the phosphate concentration in the sample.

Information. A facility is provided to pass a 'grab' sample through the monitor manually which has been taken from another sample point. This facility can also be used to check the calibration of the monitor.

To maintain optimum measurement accuracy it is necessary to carry out a zero and a secondary upscale calibration by introducing standard solutions of known concentration. The monitor utilizes solenoid valves to introduce these solutions automatically, at predetermined intervals, under the control of the microprocessor.

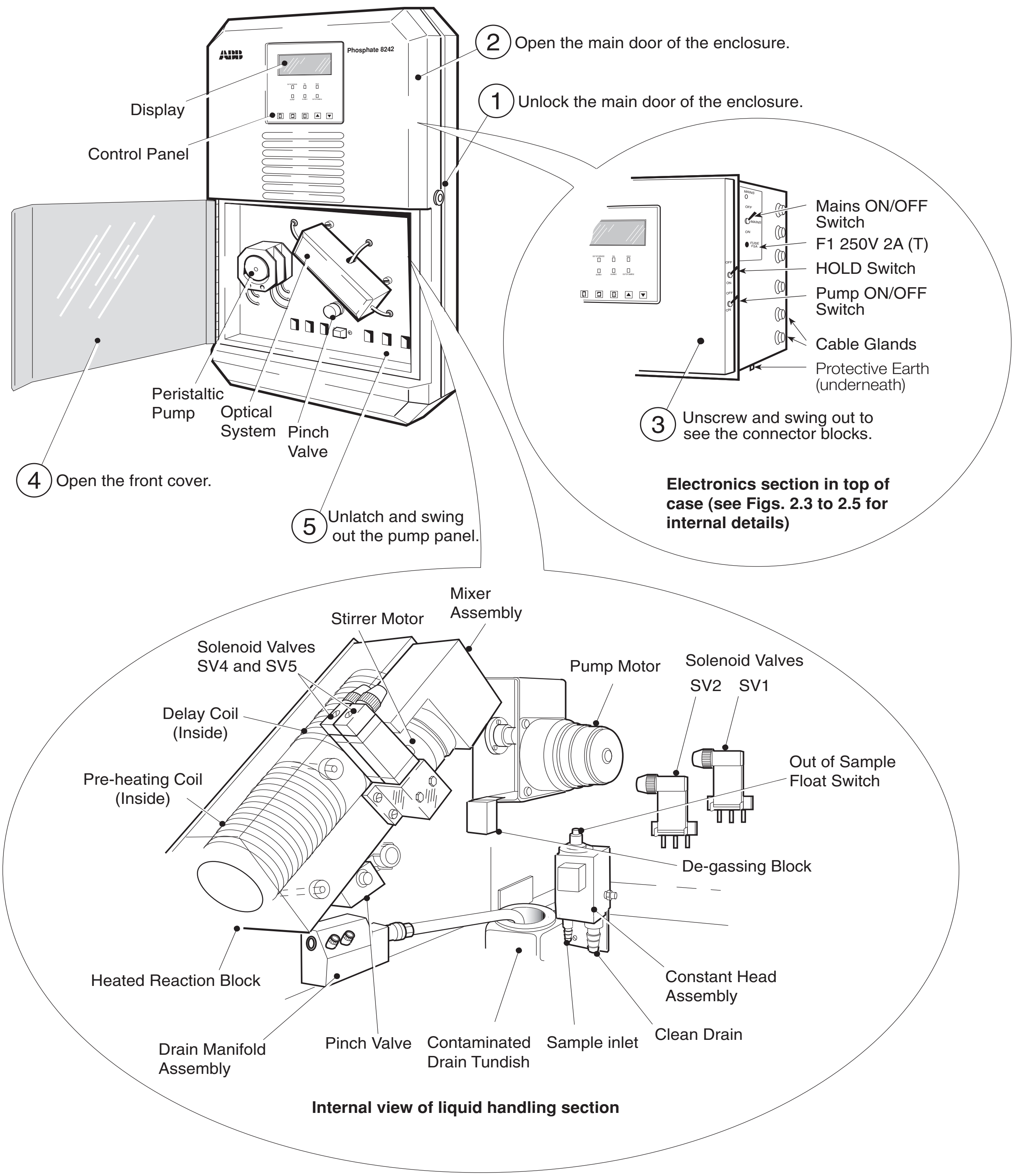
If the color compensation facility has been selected, sample is presented to the optical system without the addition of reagent. The microprocessor then calculates the true phosphate value.

The electronics section consists of a main Microprocessor Unit situated above the liquid handing section, which controls all the instrument functions including the multi-streaming of the different samples, if applicable.

The monitor case is hinged on the left hand side and has one lockable catch on the right hand side.

Access to the optical system, pump and solenoid valves is provided by means of a hinged acrylic door which is held open or closed by use of a push/push latch. The panel holding the liquid handling section is also hinged on the left to allow access to the rear of the panel for maintenance.

To gain access to the electronics section follow steps (1) to (3).
To gain access to the liquid handling section follow steps (4) and (5).



Note. The arrangement of the constant head units for the multi-stream version is shown in Fig. 2.2B.

Fig. 1.1 Main Components

2 INSTALLATION

2.1 Accessories

The accessories supplied are as follows:

1 x reagent container

2 x calibration solution containers

3 x solution container sealing caps

1 x spares kit

2.2 Location

Install in a clean, dry, well ventilated and vibration-free location giving easy access, and where short sample lines can be used. Avoid rooms containing corrosive gases or vapors, e.g. chlorination equipment or chlorine gas cylinders. It is also advisable to have adjacent drains near ground level, so that the waste outlet from the monitor can be as short as possible, together with maximum fall. Power supplies should also be adjacent. Ambient temperature within the range 5 °C to 40 °C.

2.3 Mounting – Fig. 2.1

See Fig. 2.1 for mounting procedure.

2.4 Sampling Requirements

In addition to being as close as possible to the monitor, the sampling point must provide a thoroughly mixed representative sample. The sample must also conform to the following conditions:

a) Sample flowrates must be greater than 5 ml min^{-1}.

b) Sample temperature should be within the range 5 °C to 55 °C.

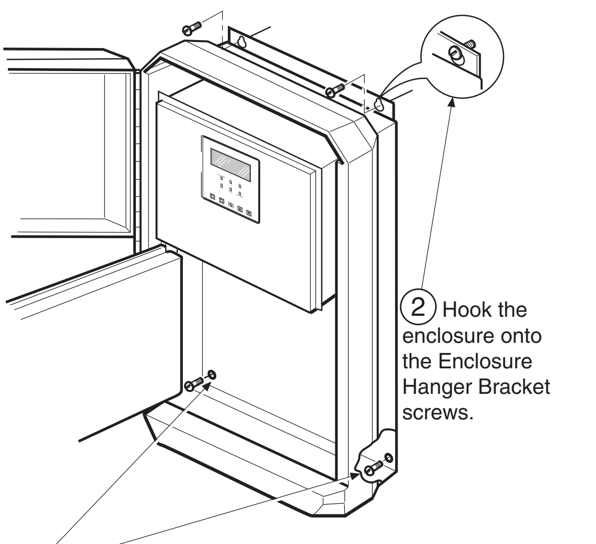
c) Particles must be less than 10 mg l^{-1} and the size must not exceed 60 microns.

Note. To avoid erroneous readings and prevent possible tube blockages the use of a sampling system which provides the appropriate filtration of the sample is recommended. ABB Ultrafiltration Units are the most suitable for the purpose, details of which are available on request. For power applications a 60 micron, in-line filter should be used – part number: 0217 463.

① Mark the wall using the dimensions shown in this figure.

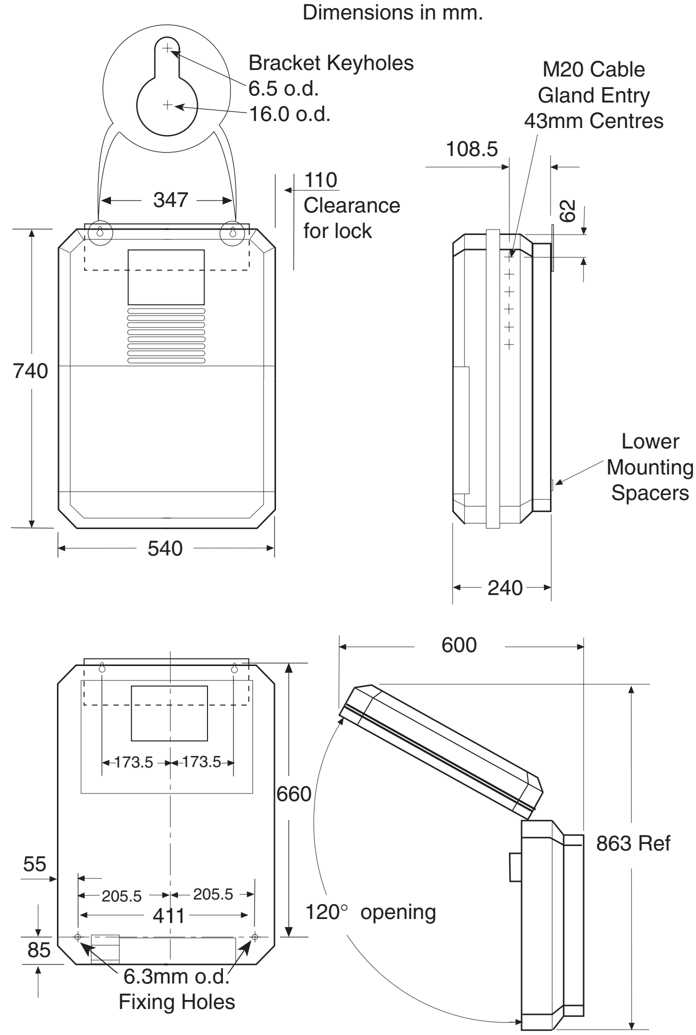
Drill and plug the holes and screw in the top two screws/bolts to leave a gap of 5mm between the screw head and the wall.

Alternatively, with the enclosure carefully supported against the wall, spot through using a suitable tool.



② Hook the enclosure onto the Enclosure Hanger Bracket screws.

③ Spot through lower fixing holes from backplate. Remove enclosure before drilling lower fixing holes.



Note.

- Mains (power supply) and signal cables are connected through cable glands directly into the electronic section.
- Sample and drain pipe work are brought in through the bottom of the case.

Fig. 2.1 Mounting the Unit

2.5 Sample Connections – Fig. 2.2

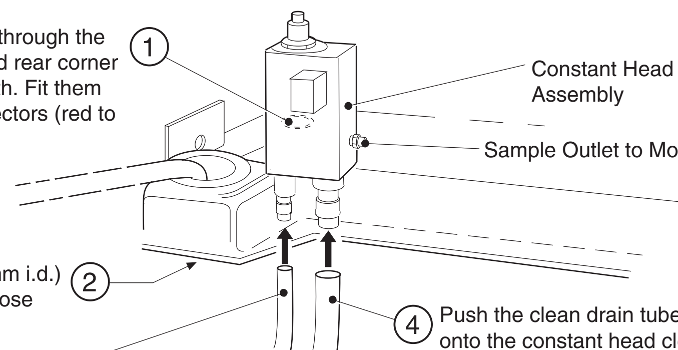
Connect inlet and outlet tubes as shown in Fig. 2.2A (single stream) and Fig. 2.2B (multi-stream).

Note. If the optional emergency sample facility has been requested, a suitable 40 litre emergency sample container must be provided by the user. A suggested arrangement is shown in Fig. 4.2. Alternatively, a constant, independent source may be used.

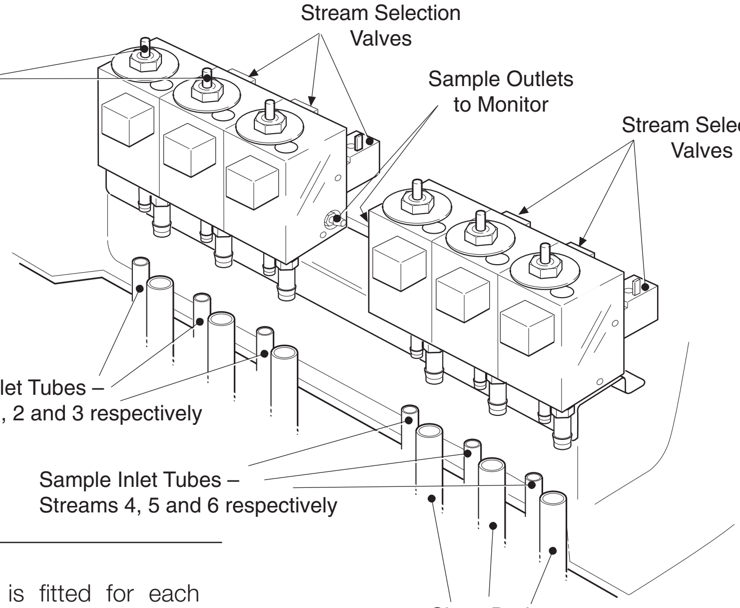
Notes.

- Use tube of inert material, e.g., p.v.c.
- The sample inlet tube must incorporate a shut-off valve at its up-stream end.
- Ensure the drain outlet tube is short, has a free fall and is vented to atmosphere as soon as possible.

Information. To gain access to the constant head assembly follow steps 1, 2, 4 and 5 in Fig. 1.1.



A – Single Stream Connections



Note.

- One constant head assembly is fitted for each sample inlet in multi-stream versions of the monitor.
- Fig. 2.2B shows six sample inlets and six corresponding constant head assemblies.

B – Configuration of Multi-Stream Constant Head Units

Fig. 2.2 External Pipe Connections

2.6 External Electrical Connections – Figs. 2.3 to 2.5

Warning.

- Although certain instruments are fitted with internal fuse protection, a suitably rated external protection device, e.g. a 3 A fuse or miniature circuit breaker (m.c.b.), must also be fitted by the installer.
- The power supply earth (ground) must be connected to ensure safety to personnel, reduction of effects of radio frequency interference (r.f.i.) and correct operation of the power supply interference filter.
- Before making any connections, ensure that the power supply, any high voltage-operated control circuits, high common mode voltages, including externally powered alarm circuits, are switched off.

Caution. Slacken the terminal screws fully before making connections.

The external electrical connections are in the electronic section, behind the hinged cover and beneath the R.F. screen – see Fig. 2.3. The cables are passed through the cable glands on the right hand side on the monitor case and connected as follows:

- Mains input (power supply) – 115 V (110 to 120 V) or 230 V (220 to 240 V). The mains voltage is selected using the voltage selector – see Fig. 2.3.
- Single-Stream – CURRENT OUTPUT 1 and 2 – two independent current outputs for external recording or control.

  Multi-Stream – CURRENT OUTPUT 1 to 6 – one current output per stream.

Information. Because the current output is isolated, the negative terminal MUST be connected to earth (ground) if connecting to the isolated input of another device.

The setting of the range of the current output is covered on Programming Page 4 (see Section 6.4).

- Single-Stream:

  RELAY 1 and 2 – two Concentration alarm relays.

  RELAY 3 – 'Out of Sample' alarm relay.

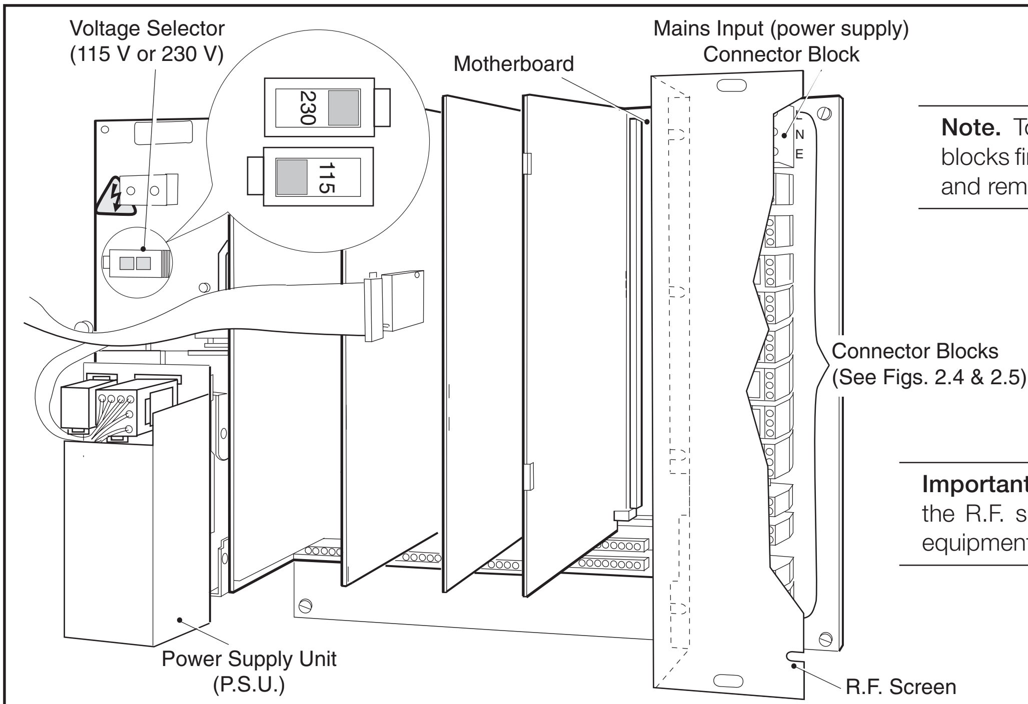
  Multi-Stream:

  RELAYS 1 to 6 – one relay per stream configurable to be concentration or 'Out of Sample' alarm relays.

The 'Out of Sample' alarm relay can be used as a remote indication or to operate a pump or filter change over sequence.

- CALIBRATION – remote calibration mode indication alarm relay. This indicates when the instrument is off-line during a calibration – see Section 7.
- OUT OF SERVICE – remote instrument 'Out of Service' indication alarm relay. This indicates that the monitor readings are suspect and it is in need of attention – see Section 8.4.
- SERIAL – Optional serial interface (see supplementary instruction manual for details).

Information. All relays have voltage-free single pole change over contacts.



Note. To access the connector blocks first undo the 10 fixing screws and remove the R.F. screen.

Important Note. Replace and secure the R.F. screen before operating this equipment.

Fig. 2.3 Mains Input Connector Block and Voltage Selector Locations

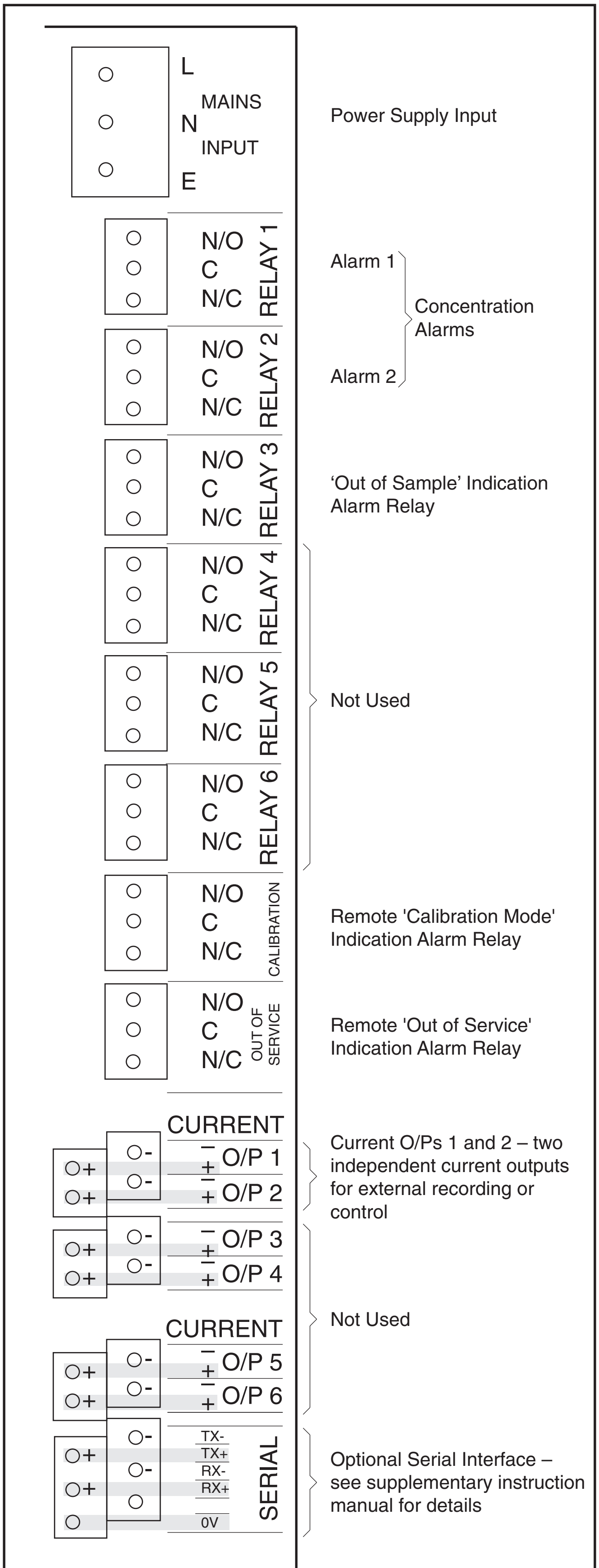


Fig. 2.4 Electrical Connections – Single Stream

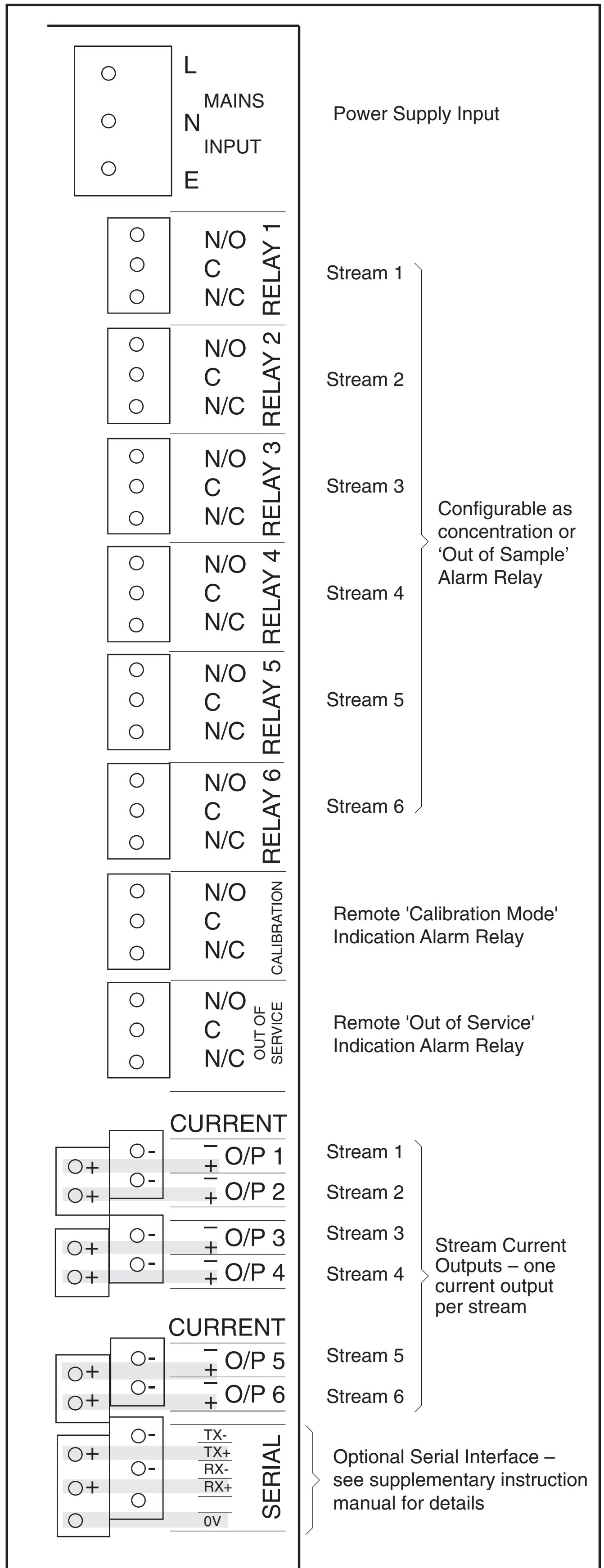


Fig. 2.5 Electrical Connections – Multi-Stream

2.7 Relay Contact Protection and Interference Suppression – Fig. 2.6

If the relays are used to switch loads on or off the relay contacts can become eroded due to arcing. Arcing also produces radio frequency interference (r.f.i.) which can cause instrument malfunctions and incorrect readings. To minimize the effects of r.f.i., arc suppression components are required; these are resistor/capacitor networks for a.c. applications, or diodes for d.c. applications. These components can be connected either across the load or directly across the relay contacts.

For a.c. applications the value of the resistor/capacitor network depends on the load current and inductance that is switched. Initially fit a 100 R/0.022 µF RC suppressor unit (part number. B9303) as shown in Fig. 2.6A. If the instrument malfunctions the value of the RC network is too low for suppression and an alternative value must be used. If the correct RC suppressor unit cannot be obtained, contact the manufacturer of the switched device for details of the RC unit required.

For d.c. applications fit a diode as shown in Fig. 2.6B. For general applications use an IN5406-type (600 V peak inverse voltage at 3 A – part number B7363).

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

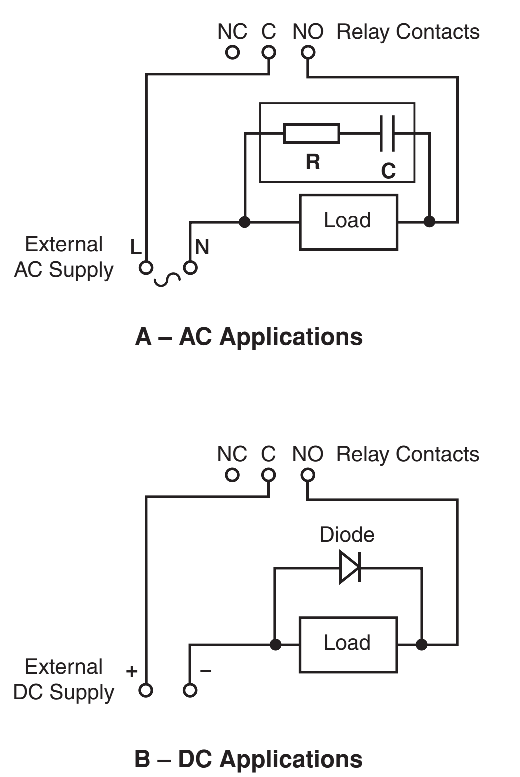


Fig. 2.6 Relay Contact Protection

3 SETTING UP

Note. Before proceeding any further, ensure that the HOLD switch is ON; all other switches are set to OFF on the right hand side of the electronics unit – see Fig. 1.1.

a) Ensure that all external electrical and plumbing connections have been made correctly.

b) Fill reagent and standard solution bottles (see Section 8.1 for details of these solutions).

c) Connect the reagent float switch to the plug (Fig. 3.1) routing the lead through the far left hand grommeted hole in the bottom of the enclosure.

d) Connect the electrical supply and switch on.

Note. The temperature controlled reaction block and optical block require up to one hour to reach the normal control temperature. During this time, 'Temperature Stabilizing' is indicated on Programming Page 1.0 – see Section 6 (or Appendix A for multi-stream programming). Any calibrations are prevented by the microprocessor during this time.

e) Verify that there is an adequate supply of sample to the monitor constant head unit.

f) Fit the cuvette drain tube into the pinch valve. Press in the central plunger and ensure that the tube is fully inserted into the valve. This ensures that no leakage from the cuvette occurs.

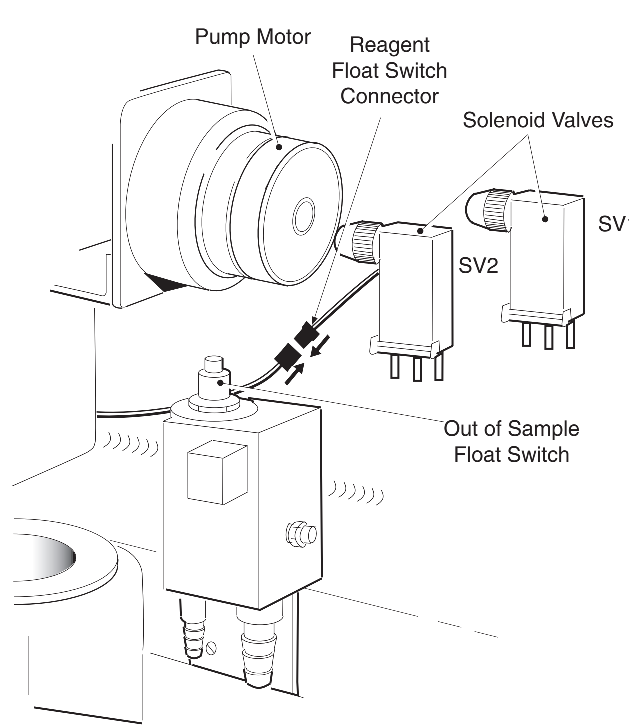


Fig. 3.1 Reagent Float Switch Connector

g) Fit the pressure plate platen on the peristaltic pump (see Section 8.2.6) and switch the pump on with the switch on the side of the monitor. Note that the peristaltic pump rotates, and check that sample and reagent is being drawn into the monitor by observing the progress of any small bubbles present in the inlet tubes.

h) Run the monitor for at least one hour to allow the solutions to be pumped into the system and to purge the air from the pipework. Check for any leaks around the pipe connections and rectify as necessary.

j) Set the following parameters to YES using Programming Page 2.1:

Five-Weekly System Flush

Five-Weekly Solution Replacement

Default Calibration Parameters

For single stream instruments only, set the color compensation frequency to 'OFF' using Programming Page 3.3.

Information. If the monitor has not been in use for a long period, the 're-wetting' process of the system can be speeded up by introducing the chemical rinse solution for a period of 30 to 60 minutes (see Section 8.2.4).

Note. Before proceeding to the next step, multi-stream users must select single stream mode as described in Section 4.3.

k) If having not already done so energize the secondary CAL valve (see Programming Page 2.3) and leave for 15 minutes. Adjust the reading on scale with the ▲ and ▼ switches and run the monitor for 30 to 60 minutes to purge the old solution and assess stability.

l) If the monitor exhibits good stability, i.e. <±5% of reading, carry out a two-point BASELINE calibration – see Programming Page 2.3.

For single stream instruments only:

m) If color compensation is required, switch to 'Enable' for manual compensation only, or to automatic timed compensation by selecting a frequency between 1 to 24 hours using Programming Page 3.3. For general information regarding the setting up of the color compensation see Section 7.2.

4 LIQUID HANDLING SECTION

4.1 Principle of Operation – Fig. 4.1

The chemical method used in the monitor utilizes the reaction between orthophosphate, molybdate and metavanadate which in the presence of acid react to form a yellow phospho-vanado-molybdate complex. The absorbance of the complex, which is directly related to the phosphate concentration in the sample, is measured colorimetrically in the optical system.

The sequence of events is:

a) A combined reagent comprising ammonium molybdate, ammonium metavanadate and nitric acid is added to the sample and mixed.

b) The solution then enters the reaction coil in the temperature-controlled block (providing a three minute delay) where the yellow phospho-vanado-molybdate complex is developed.

c) The fully developed solution passes to the measuring cuvette in the optical system where the absorbance of the complex is measured.

d) Calibration of the monitor is achieved by replacing the sample with de-ionized water (for the ZERO solution) and then a phosphate standard for the secondary upscale calibration solution.

Silica in the sample is prevented from interfering by choosing sufficiently strong acid conditions to inhibit the silica-molybdate reaction.

In the chemical method used, the reactive phosphate species is orthophosphate, PO_4^{3-}. If the sample contains other phosphate species which are converted to orthophosphate under the chemical conditions of the monitor, they will also be measured.

For single stream instruments only:

If the sample is colored, the phosphate reading may show a positive error. Compensation for color is obtained by measuring the absorbance by the sample without addition of reagent. This reading is then automatically subtracted from the phosphate reading to give the color compensated value.

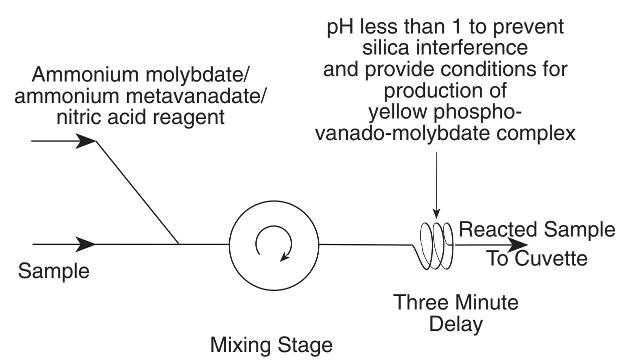
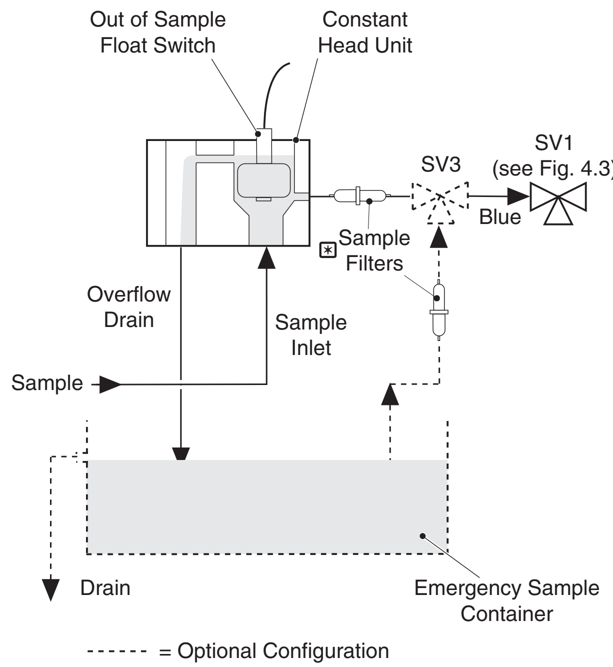
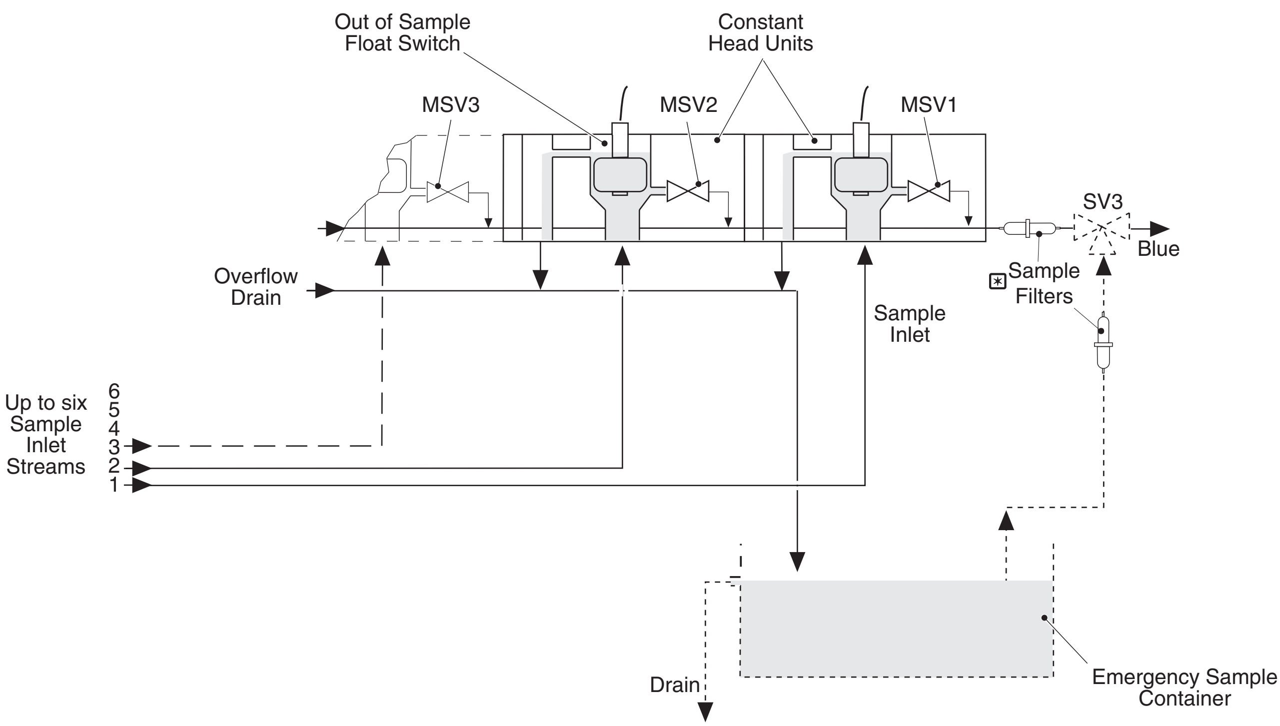


Fig. 4.1 Chemical Schematic



Note. Sample filters are used in power applications only.

A – Single Stream Version



B – Multi-Stream Version

Fig. 4.2 Flow Schematic – Sample Inlet

4.2 General Operation – Figs. 4.2 and 4.3

The sample enters the constant head unit situated at the bottom of the instrument case – see Fig. 4.2A for single stream and Fig. 4.2B for multi-stream. The constant head units are fitted with an 'Out of Sample' switch. This switch is used by the microprocessor, in the appropriate situation, to instigate the 'Out of Service' alarm and energize the emergency sample valve, if fitted. This optional valve introduces sample from an alternative supply to maintain the monitor operation when the sample has been lost. This avoids potential problems caused when the monitor is run without a sample for long periods.

For the multi-stream version, each sample is presented to individual constant head units each of which is fitted with an 'Out of Sample' switch (see Fig. 4.2B). Solenoid valves, MSV 1 to 6, attached to each constant head unit are then used to select each stream to be sampled. The emergency sample valve is energized when all sample streams are lost or de-selected.

The sample is drawn off from the selected stream by one channel of the peristaltic pump via the pre-heating coil – see Fig. 4.2B. The purpose of this coil is to pre-heat the sample prior to the reaction taking place. Any air bubbles which form in the sample are removed by the de-gassing block and pumped to the drain by one channel of the peristaltic pump via valve SV5 (in the multi-stream version the sample is passed directly to drain). This is important because bubbles in the sample will give variable reagent mixing resulting in noisy readings on the display.

The reagent solution, delivered via one channel of the pump is then added to the sample before entering the dynamic mixer block and then passes through the heated delay coil where the reaction takes place. The resultant solution is then presented to the measuring cuvette via a solenoid valve SV4 (in the multi-stream version the solution is passed directly to the cuvette).

Information. The dynamic mixer consists of a small stirrer situated in a chamber in the mixer block and is magnetically coupled to a small electric motor.

During an AUTO ZERO, solenoid valve SV1 is used to introduce the primary standard solution. Solenoid valve SV2 is used to introduce the secondary standard solution.

The sample pre-heater coil and reaction delay coil are mounted in a single acrylic block. This block is heated using a small 24 V cartridge heater and controlled using a PT100 temperature sensor. This optimizes the chemical reaction time and removes the effect of ambient and sample temperature changes.

The coils are made from PTFE and do not normally require any maintenance except for the 5-weekly system flush – see Section 8.2.2.

If the color compensation sequence is initiated, both SV4 and SV5 valves are energized. The developed solution passes to drain and is replaced by undeveloped solution (sample without reagent) which passes to the cuvette via valve SV5.

After a preset number of fill/drain cycles a measurement of absorbance is made. This is converted to a phosphate reading which is then subtracted from the reading on developed solution. The value displayed is then the color compensated phosphate concentration.

Timing for the color compensation sequence is shown in Fig. 4.4.

Note. The color compensation manifold and valves SV4 and SV5 are not fitted in the multi-stream version.

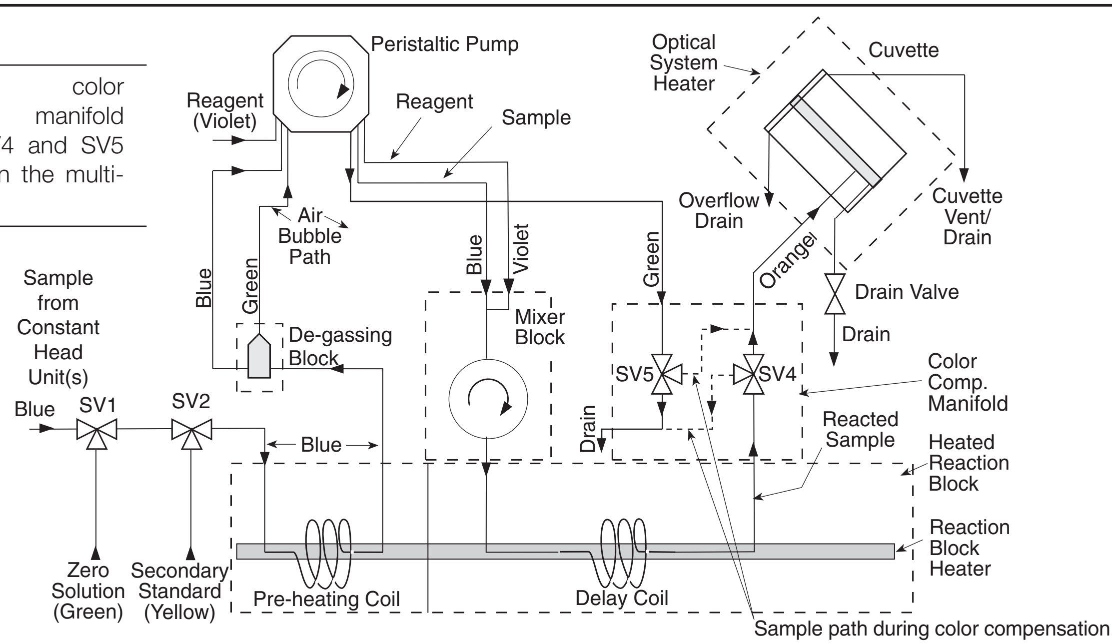


Fig. 4.3 Flow Schematic of Chemical Section

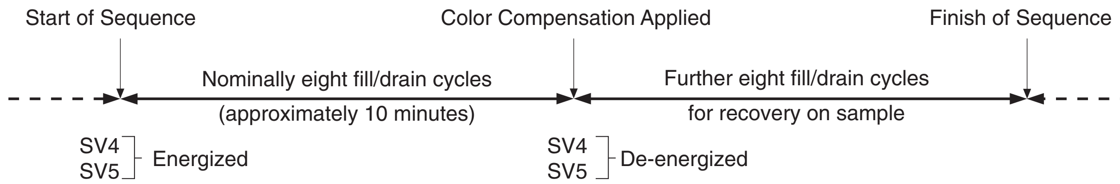


Fig. 4.4 Color Compensation Timing Sequence for Single Stream Instruments

4.3 Multi-Stream Operation

Between two and six streams can be fitted to the multi-stream version of the monitor. The front panel controls remain the same on all versions.

The monitor samples the streams in the sequence specified on Programming Page 3.3 (see appendix A). The stream sampling period, i.e. the duration the monitor spends on each stream, is normally set to 12 minutes. However, the reading, taken after a further six minutes, is used to update the display and current output for that particular stream. This takes advantage of the eight minutes 'dead' time of the monitor in reducing the overall sampling period – see Fig 4.5. The reading for that stream is then held until that stream is again sampled and updated. This includes 'Loss of Sample' and de-selection of the stream.

The stream sequence would be normally set to sample each stream in turn, i.e. on a three stream version this would be set to 1, 2 ,3. However, greater priority could be given to a particular stream (e.g. stream 1) by programming the sequence 1, 2, 1, 3 or 1, 1, 1, 2, 3 etc.

Front panel stream LEDs provide status information on each stream as follows:

Green ....Stream selected.

Flashing green........Sample currently being sampled.

Red ....Sample lost on stream.

Not illuminated ....Stream de-selected or not fitted.

If the stream is unavailable throughout the sampling period the monitor selects the next stream in the sequence. The red stream lamp remains on until the stream is sampled again; if the stream has been reinstated, the l.e.d. changes to green and the display is updated as normal.

Single Stream Mode for Maintenance

To carry out any maintenance it is necessary to switch to a single stream provided that a stream is available. If not, a solution could be introduced via the SECONDARY CAL valve (energized on Programming Page 2.2 – see Appendix A). Single stream mode is initiated by selecting one stream on Programming Page 3.3, Appendix A. This stops the multi-stream sequencing and enables the display and the current output to respond to changes on each drain/fill cycle. This mode is used to check the basic performance of the monitor, such as response or drift, without waiting for the normal stream update.

Selecting more than one stream puts the monitor to multi-stream operation.

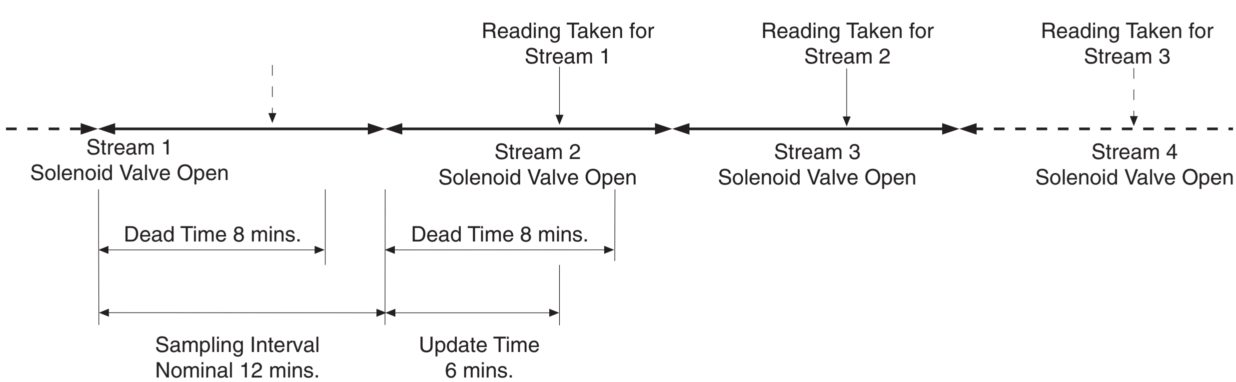


Fig. 4.5 Multi-Stream Timing

4.4 Manual Grab Sample Facility

A facility is provided to pass a grab sample through the monitor manually which has been taken from another sample point. If required, the same procedure can be used to introduce standard solutions to check the monitor calibration. Proceed as follows:

a) Put 100 ml of sample into a clean, well rinsed container. This will run the monitor for 25 minutes approximately.

b) Remove the secondary calibration container tube. Rinse in high purity water and transfer it to the grab sample container.

c) Energize the secondary calibration valve (see Section 6, Programming Page 2.2). This will bring up the 'Out of Service' alarm and prevent an automatic calibration from taking place. Return to the main display page. On multi-stream versions of the monitor it will be necessary to switch to single stream operation (see Section 4.3).

d) The display should stabilize on the grab sample value after 16 minutes approximately which can them be noted.

e) Remove the tube from the container, rinse and return it to the secondary calibration container. Run the monitor for a further five minutes.

f) Return the monitor to normal operation by de-energizing the secondary calibration valve.

4.5 Optical System – Figs. 4.6 and 4.7

The optical system comprises a tungsten halogen exciter lamp mounted between two photocells. The light falling on the measuring photocell first passes through the measuring cuvette containing the reacted sample and then through a colored filter. This filter selects the specific wavelength required for the correct operation of the monitor (approximately 470 nm). The light can be seen via the prism on top of the lamp housing. Its intensity is controlled by the output from the reference photocell.

Although the reaction of the sample is continuous, the actual optical measurement of the reacted sample is based on a nominal 80-second cycle controlled by the microprocessor – see Fig. 4.6.

The temperature of the optical system is controlled using a mat heater and a PT100 temperature sensor. This temperature is kept to the same value as that of the reaction block to avoid convection currents in the measuring cuvette.

Information. The exciter lamp operates well below the specified operating voltage. This design gives a lamp life of many years.

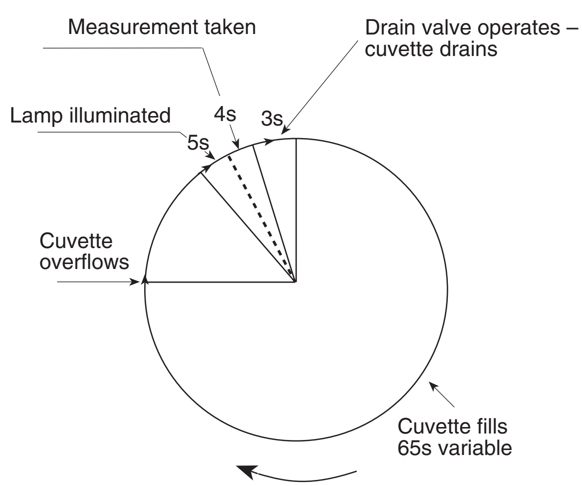
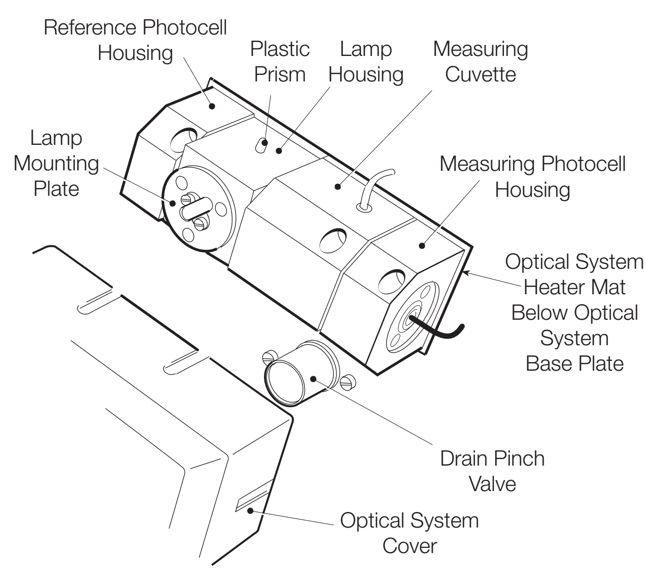


Fig. 4.6 Drain/Fill Sequence



Important Note. The Optical System Cover must be in place when the monitor is running. This cover excludes the effects of ambient temperature and light.

Fig. 4.7 The Optical System

5 ELECTRONICS SECTION

5.1 Front Panel Controls - Figs. 5.1 and 5.2

The program controls comprises five tactile membrane switches. In normal operation the switches are used to view the measured variable, the concentration alarm values, diagnostics and status **information.** Access to the programming and calibration pages are protected by customer programmable security codes.

When programming, the switches are used to sequence through a programming procedure as detailed in Section 6. The procedure is set out in programming pages for Input, Current Output, Alarms, Real Time Clock and Monitor Calibration. Each program page contains the program functions, the values or parameters of which are all programmable.

Switch functions are described in Fig. 5.1.

Three other switches are situated on the side of the electronic section – see Fig. 1.1. Their functions are as follows:

Mains ON/OFF — Used to isolate the mains (power) supply from the instrument.

Warning. Externally powered alarm circuits may still contain high voltages. These circuits must be switched off independently.

Pump ON/OFF — Used to switch the pumps on and off during maintenance.

HOLD-ON/OFF — Used during maintenance to hold the concentration alarms, activate the 'Out of Service' relay, and inhibit any timed automatic calibrations.

5.2 Display

The monitor display panel indicates the solution concentration and provides user information during setting up and in normal operation.

5.3 L.E.D. Indicators

Out of Service — Indicates that the monitor out of service alarm is active, the source is indicated on Programming Page 1.0 – see Section 6.

Cal — Indicates when a calibration sequence is taking place.

Hold — Indicates that the HOLD switch has been switched to 'HOLD' during servicing. This holds the current concentration alarm states and activates the 'Out of Service' alarm relay, and inhibits timed automatic calibrations.

- Single Stream

Alarm 1,2 — Used to indicate a concentration alarm state (either high or low).

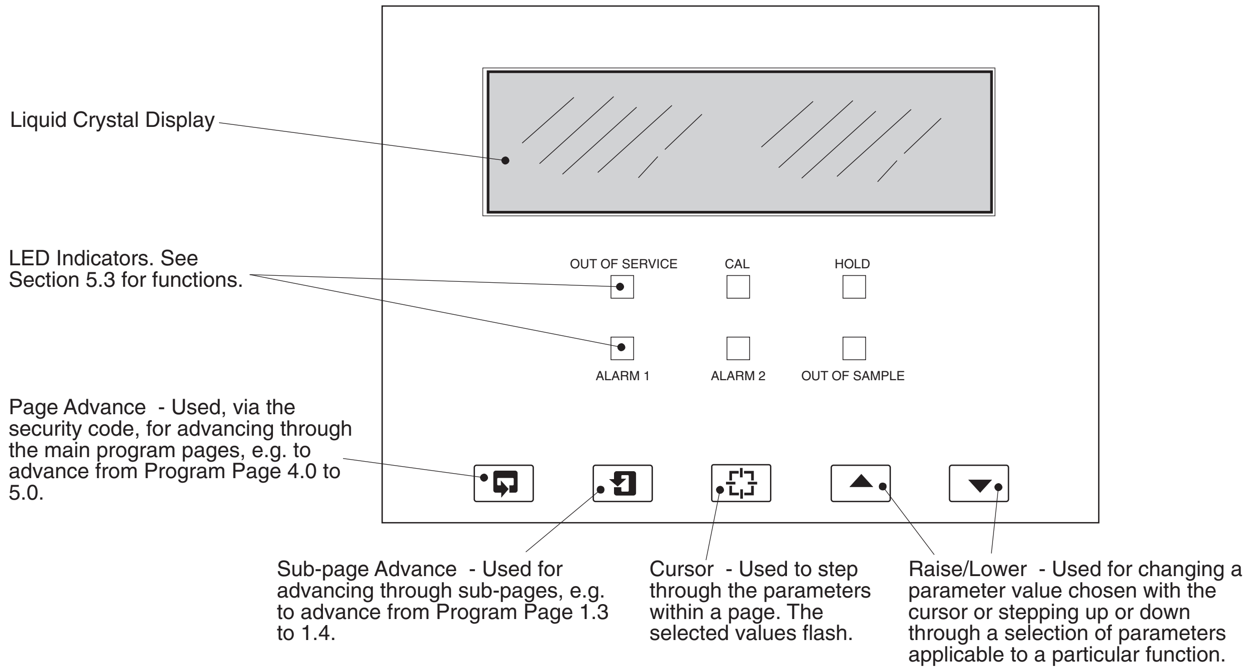
Out of Sample — Indicates that sample has been lost.

- Multi-Stream

Stream 1 to 6 — These are two color red/green l.e.d. indicators. A continuous green indication shows the stream(s) selected, a flashing green indication shows the stream which is currently being sampled, and a red indication signifies an 'Out of Sample' alarm on the stream indicated.

Alarms 1 to 6 — Used to indicate either a concentration alarm state (either high or low).

These indicators are used in association with external alarm relay outputs except for the multi-stream version where the Relays 1 to 6 can be configured as remote stream 'Out of Sample' or concentration alarm indication – see Figs. 2.4 and 2.5.



Note. Continued pressure on the ▲ or ▼ switches causes the rate of change of the displayed value to increase. To make small adjustments, operate the switches momentarily.

Fig. 5.1 Front Panel Controls – Single Stream

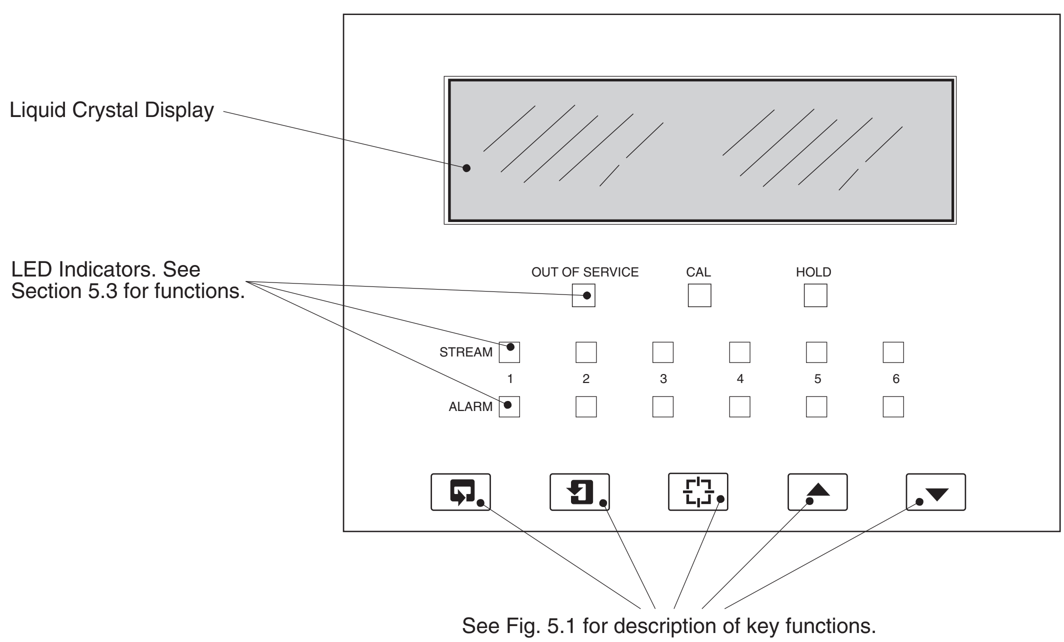


Fig. 5.2 Front Panel Controls – Multi-Stream

5.4 Microprocessor Unit – Figs. 5.3 and 5.4

The electronic section comprises six main circuit boards which carry out the following functions:

Mother Board	Comprises the user terminations, alarm relays, and sockets for the four plug-in boards.
Cuvette Input Board	Processes the signals from the two photocells and controls the lamp brightness.
Microprocessor Board	The heart of the electronics section which controls all aspects of the monitor.
Drive Board	Provides outputs to drive internal functions, i.e. stream section, calibration valves, pump motor, and heater control.
Output Board	Provides current and alarm outputs and, if fitted, the serial interface.
Display Board	Connected to the microprocessor board by a ribbon cable and provides display and keypad functions.

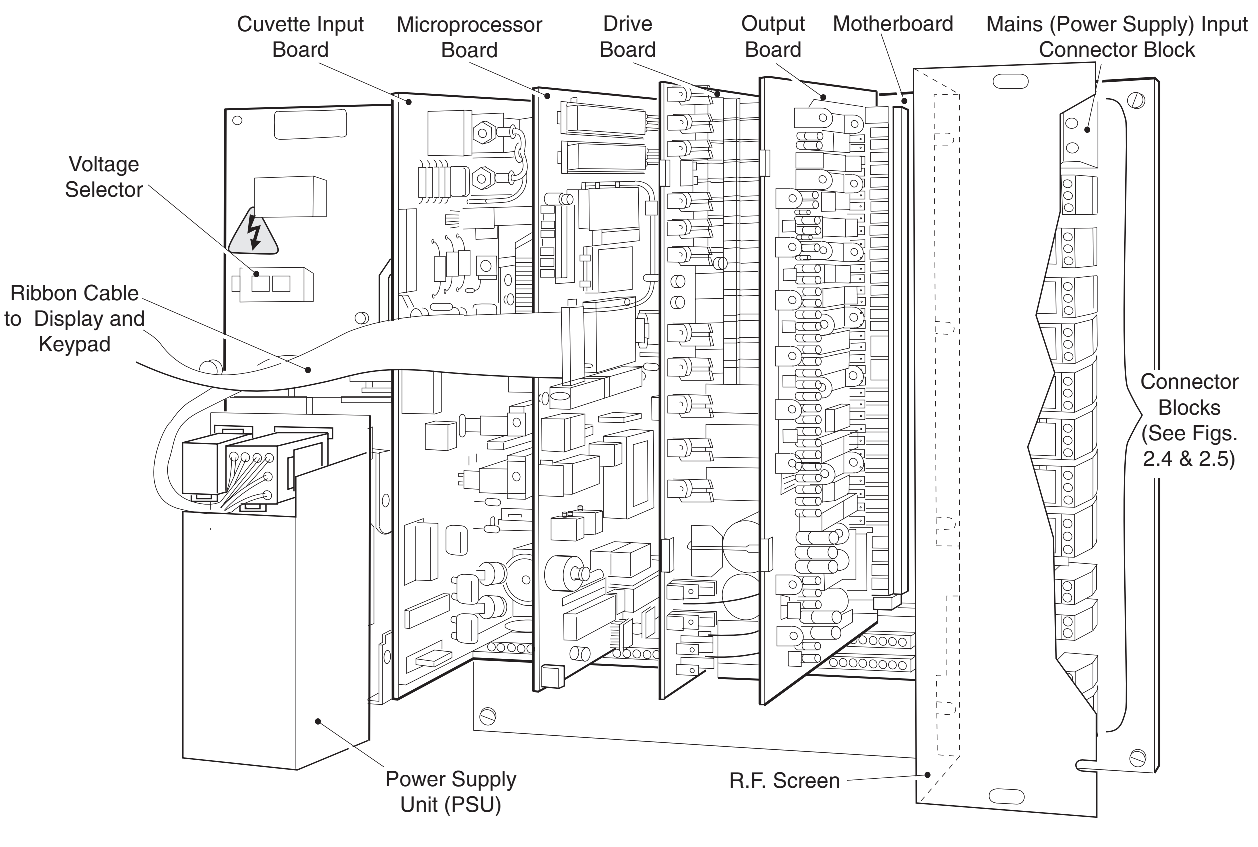


Fig. 5.3 Microprocessor Unit

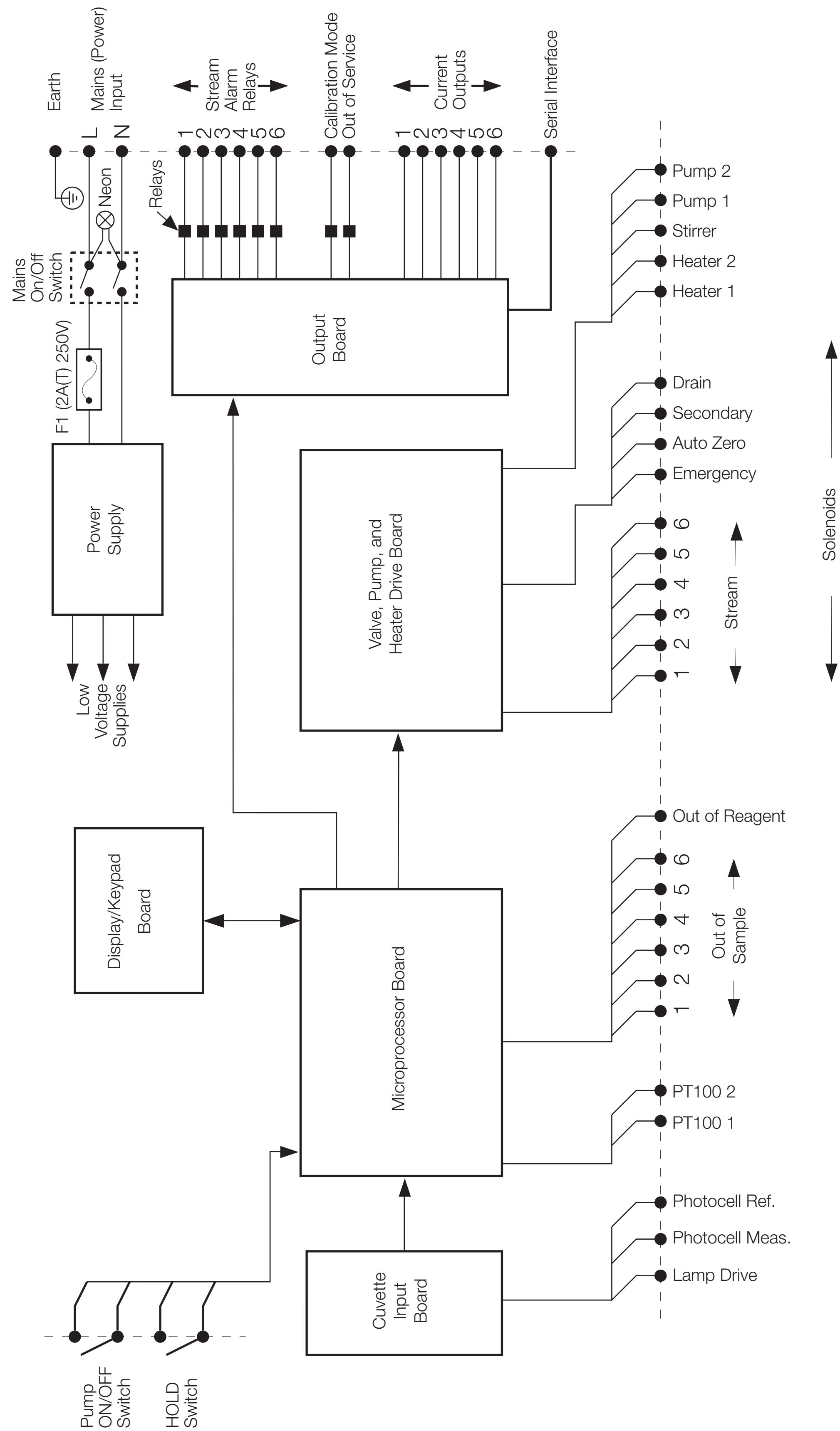


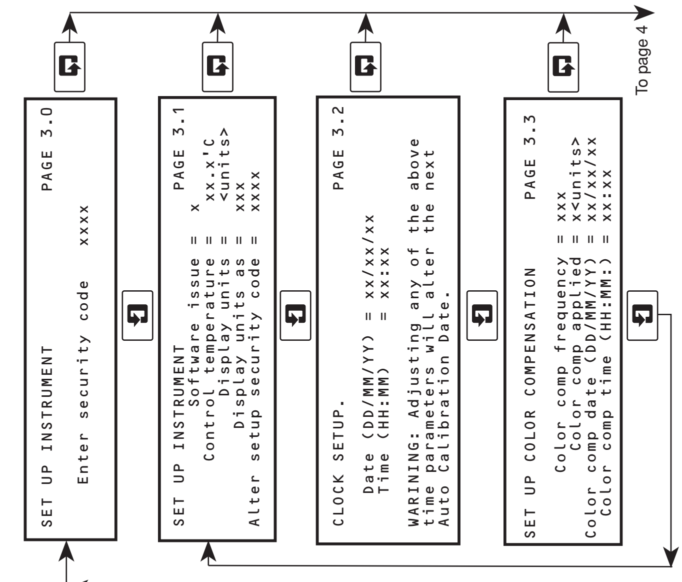
Fig. 5.4 Electronics Schematic

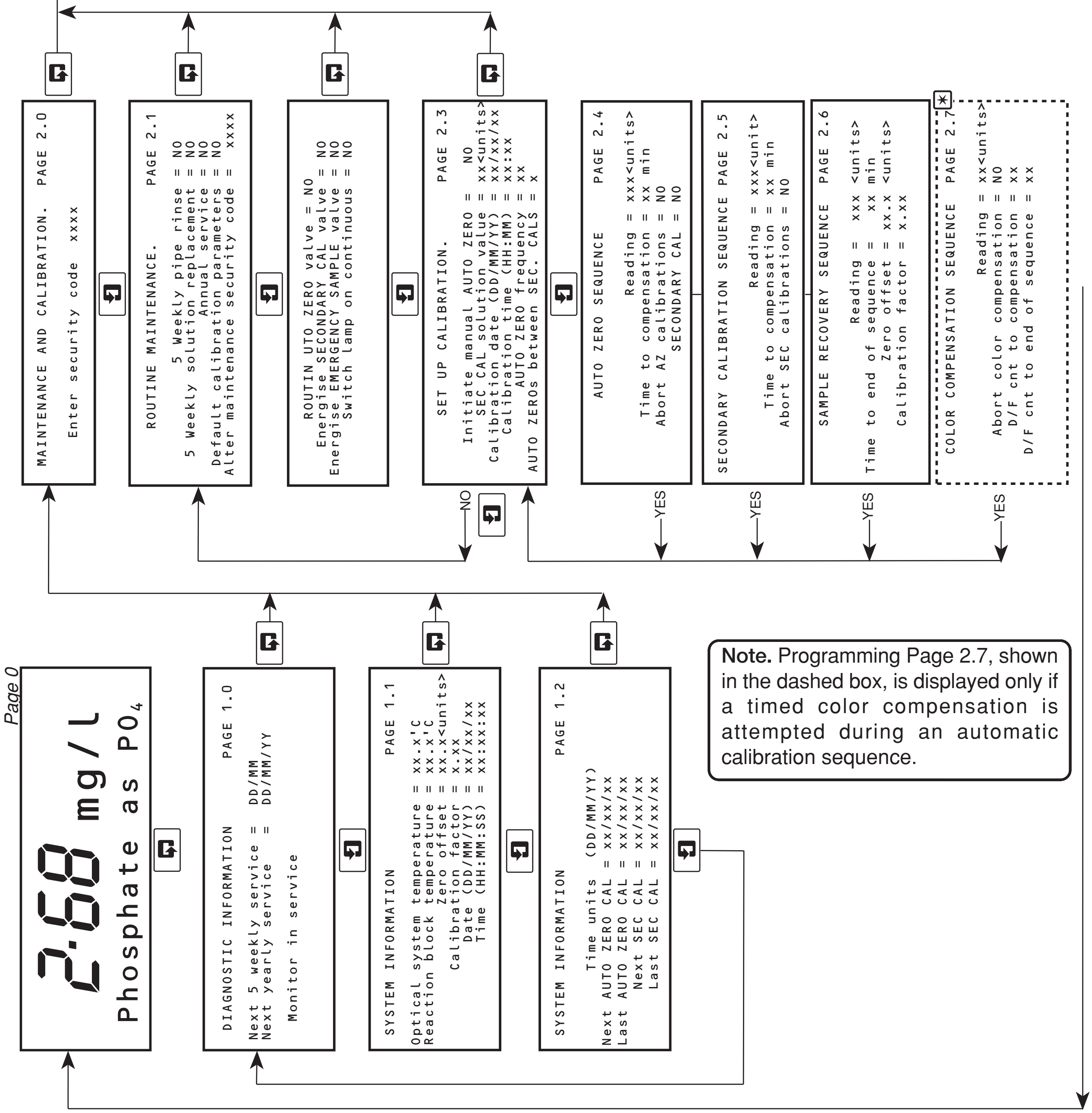
In normal operation (Operating Pages 0 and 1) the display gives indication of the units of measurement, diagnostics, calibration information and time. Selection is made by means of the [key] and [key] switches.

Operation of the [key] switch enables a series of 'programming' pages to be displayed. Unauthorized entries to these pages are inhibited by a four-digit security code which is displayed immediately after the page header.

Values displayed in Operating Pages 0 and 1 are for viewing only and cannot be altered by the operator. Displayed values on subsequent pages indicated by x's can be altered by means of the [▲] and [▼] switches. Options such as Yes/No or High/Low are also selected using these switches. Passing onto the next parameter, or exiting from the page, automatically enters the new value into memory.

Programming information for users of multi-stream monitors is contained in Appendix A.





Note. Programming Page 2.7, shown in the dashed box, is displayed only if a timed color compensation is attempted during an automatic calibration sequence.

From Page 3

```
SET UP CURRENT OUTPUTS          PAGE 4.0

  Output range 1 = 0 to  xxx <units>
Calibration hold = NO
  Output range 2 = 0 to  xxx <units>
Calibration hold = NO
     Output type = xx to xx mA
     Test output = NO
```

```
  ALARM RELAY SETUP             PAGE 5.0

 A1 enabled = NO
A1 setpoint = xxx <units>
  A1 action = LOW
 A2 enabled = NO
A2 setpoint = xxx <units>
  A2 action = LOW
```

```
COMMON RELAY CONFIGURATION     PAGE 5.1

    Alarm failsafe = YES
       Alarm delay = xx min
  Alarm hysteresis = xx %
```

```
  FACTORY SETTINGS             PAGE 6.0

 Enter factory settings
          security code    xxxx
```

```
  FACTORY SETTINGS             PAGE 6.1

WARNING : These parameters are factory
set and should not normally require
adjustment. They can only be set up if
the necessary equipment is available.
DO NOT PROCEED WITHOUT CONSULTING THE
OPERATION MANUAL.
```

```
  ELECTRICAL CALIBRATION.    PAGE 6.2

               Reading = xxx<units>
  Lamp alignment V read =  x.xxx Volts
  Lamp alignment V ref  =  x.xxx Volts
Alter factory settings
          security code     xxxx
```

```
  ELECTRICAL CALIBRATION     PAGE 6.3

  Read I/P zero -2V   xxxxx
  Read I/P span +2V   xxxxx
   Ref I/P zero -2V   xxxxx
   Ref I/P span +2V   xxxxx
```

```
  ELECTRICAL CALIBRATION     PAGE 6.4

Temperature chan1 zero 100Ω     xxx.x
Temperature chan1 span 150Ω     xxx.x
Temperature chan2 zero 100Ω     xxx.x
Temperature chan2 span 150Ω     xxx.x
```

```
  ELECTRICAL CALIBRATION     PAGE 6.5

        Current output 1 4mA
        Current output 1 20mA
        Current output 2 4mA
        Current output 2 20mA
```

```
    INSTRUMENT TIMING         PAGE 6.6
  Measured variable filter = ON
            Optical filter = x
Extra cuvette filling time = x    s
      Cuvette filling time = xxx s
            AUTO ZERO time = xxx min
SECONDARY CALIBRATION time = xxx min
   Recovery on sample time = xxx min
```

```
  CALIBRATION ALARM SETUP     PAGE 6.7

 Zero offset range = 0.0+/- xxx<units>
 Cal factor range  = 1.0+/- x.xx
```

```
  COLOR COMPENSATION SET UP  PAGE 6.8

Color compensation cycles = xx
                Tube type = x
```

To Page 0

Note.
The security code on Programming Page 6.0 is set at the factory to prevent alterations by unqualified personnel. The security code for this page is available on request.

Note.

Pressing [main-page key] advances to the next main page, e.g. 2.2 to 3.0

Pressing [sub-page key] advances to the next sub-page, e.g. 5.0 to 5.1.

Note. If an incorrect security code is entered and [sub-page key] pressed access to the sub-pages is not allowed, but the current page level is maintained.

Pressing [main-page key] displays Page 0.

```
   2·68 mg/l
Phosphate as PO4
```

Page 0. Normal operation display page.

6.1 Page 1 - Diagnostics

```
 DIAGNOSTIC INFORMATION          PAGE 1.0

Next 5 weekly service = DD/MM
Next yearly service   = DD/MM/YY


  Monitor in service
```

- Next 5 weekly service / Next yearly service: Indicates the date when the next relevant routine maintenance is required. When the date is exceeded, 'overdue' is displayed and the 'Out of Service' l.e.d. is illuminated.
- Monitor in service: This message indicates that the monitor is working normally but it is replaced with the relevant information, when necessary, by the monitor diagnostics - see Section 8.4.1.

```
 SYSTEM INFORMATION               PAGE 1.1

Optical system temperature = xx.x'C
Reaction block temperature = xx.x'C
               Zero offset = xx.x<units>
        Calibration factor = x.xx
           Date (DD/MM/YY) = xx/xx/xx
           Time (HH:MM:SS) = xx:xx:xx
```

- The control temperature of the two heaters is displayed in °C.
- Zero Offset indicates the zero drift since the last BASELINE AUTO ZERO CALIBRATION.
- The Calibration Factor is calculated after a SECONDARY CALIBRATION; the nominal value is 1.00 but this differs between individual monitors and the reaction control temperature. It is intended to indicate the condition of the monitor and the chemical solutions.
- Current date and time.

```
 SYSTEM INFORMATION               PAGE 1.2

       Time units  (DD/MM/YY)
Next AUTO ZERO CAL = xx/xx/xx
Last AUTO ZERO CAL = xx/xx/xx
      Next SEC CAL = xx/xx/xx
      Last SEC CAL = xx/xx/xx
```

- The date when the next AUTO ZERO CALIBRATION is to be carried out. If the automatic calibration is disabled, then OFF is displayed in place of the date.
- The date of the last ZERO calibration.
- The date when the next SECONDARY CALIBRATION is to be carried out. If the secondary calibration is disabled, then OFF is displayed in place of the date.
- The date of the last SECONDARY calibration.

6.2 Page 2 – Maintenance and Calibration

```
 MAINTENANCE AND CALIBRATION.  PAGE 2.0

   Enter security code   xxxx
```

- Enter the value of the previously entered security code.

Set the following three parameters to YES when the tasks are carried out. Once set to YES change the display on Page 0 to the required value.

```
     ROUTINE MAINTENANCE.       PAGE 2.1

              5 Weekly pipe rinse = NO
   5 Weekly solution replacement = NO
                  Annual service = NO
  Default calibration parameters = NO
 Alter maintenance security code = xxxx
```

- 5 Weekly pipe rinse / 5 Weekly solution replacement: Sets the date of the next 5-weekly service.
- Annual service: Sets the date of the next yearly service.
- Default calibration parameters: Used during routine maintenance to check the stability of the monitor prior to calibration.
- Alter maintenance security code: Enter a security code (up to four digits) if required.

```
     ROUTINE MAINTENANCE.      PAGE 2.2

      Energise AUTO ZERO valve = NO
   Energise SECONDARY CAL valve = NO
Energise EMERGENCY SAMPLE valve = NO
      Switch lamp on continuous = NO
```

All programming Page 2.2 parameters normally set to NO, set to YES as required (setting is maintained).

Used to energize the appropriate solenoid valve for test purposes and operating the monitor on synthetic solutions.

Used to carry out tests on the electronic and optical sections.

Note. If any of the parameters on Page 2.2 are set to YES, except for the EMERGENCY valve, it will not be possible to proceed to Page 2.3

```
     SET UP CALIBRATION.       PAGE 2.3

   Initiate manual AUTO ZERO = NO
      SEC CAL solution value = xx<units>
 Calibration date (DD/MM/YY) = xx/xx/xx
    Calibration time (HH:MM) = xx:xx
         AUTO ZERO frequency = xx
 AUTO ZEROs between SEC.CALS = x
```

Set to ROUTINE, BASELINE or COLOR depending on the type of Auto Zero required – see Section 7. It is not possible to select COLOR if ‘OFF’ is selected on Programming Page 3.3.

Used to enter the value of the Secondary Calibration prior to calibration.

Sets the date when the first timed automatic calibration is to be carried out.

Sets the time when the first timed automatic calibration is to be carried out.

Sets the frequency at which the AUTO ZERO calibration takes place. Select: OFF, 12h, 1 day, 2 days,……7 days.

Sets the number of AUTO ZERO calibrations that take place between AUTO SECONDARY calibrations. Select 0 to 10 in one unit increments. When 0 is selected a two-point calibration will be carried out whenever a timed calibration takes place. When SEC CAL set to OFF only Auto Zeros will take place.

Note. Programming Pages 2.4 to 2.6 are part of the automatic calibration sequence. These displays cannot be changed from these pages unless the sequence is aborted.

```
     AUTO ZERO SEQUENCE        PAGE 2.4

                 Reading = xxx<units>
     Time to compensation = xx min
    Abort AZ calibrations = NO
            SECONDARY CAL = NO
```

Reading during calibration prior to compensation.

Remaining time to the end of the Auto Zero sequence.

When set to YES the sequence is aborted. The original zero offset value is maintained.

When set to YES a two-point calibration takes place. This option is not available when a BASELINE AUTO ZERO is selected.

```
SECONDARY CALIBRATION SEQUENCE PAGE 2.5

                   Reading = xxx<unit>
      Time to compensation = xx min
    Abort SEC calibrations = NO
```

Reading during calibration prior to compensation.

Remaining time to the end of the Secondary Calibration sequence.

When set to YES the sequence is aborted. The original calibration factor value is maintained.

```
SAMPLE RECOVERY SEQUENCE       PAGE 2.6

                Reading =  xxx <units>
Time to end of sequence =   xx min
            Zero offset = xx.x <units>
     Calibration factor = x.xx
```

Reading during recovery back onto the sample. The display shows the reading which incorporates new calibration values.

Remaining time to end of sequence.

See Programming Page 1.1.

Note. Only during a color compensation sequence is Programming Page 2.7 displayed.

```
 COLOR COMPENSATION SEQUENCE   PAGE 2.7

                      Reading = x<units>
   Abort color compensation = NO
     D/F cnt to compensation = xx
  D/F cnt to end of sequence = xx
```

To abort the sequence set to YES.

Displays number of **D**rain/**F**ill counts before color compensation. See Programming Page 6.8.

Displays number of **D**rain/**F**ill counts before the end of the color compensation sequence.

6.3 Page 3 - Set Up Instrument

```
SET UP INSTRUMENT              PAGE 3.0

    Enter security code   xxxx
```

Enter the value of the previously entered security code.

```
SET UP INSTRUMENT                  PAGE 3.1
           Software issue =  x
      Control temperature =   xx.x'C
            Display units =   <units>
         Display units as =  xx
Alter setup security code =  xxxx
```

Shows the current software issue level.

Set the required control temperature within the range 20 to 45°C in 0.1°C increments. This temperature should be set to 5°C above the maximum ambient temperature expected.

Set the required display units for phosphate concentration (ppm, mg/l or mg/kg).

Set the display type as P (Phosphorus) or PO_4^{3-} (Orthophosphate).

Enter setup security code (up to four digits) if required.

```
CLOCK SETUP.                       PAGE 3.2

       Date (DD/MM/YY)=  xx/xx/xx
       Time (HH:MM)    =  xx:xx

WARNING: Adjusting any of the above
time parameters will alter the next
Auto Calibration Date.
```

Set the current (real) date and time respectively.

```
SET UP COLOR COMPENSATION          PAGE 3.3

       Color comp frequency = xxx
       Color comp applied   = xx<units>
  Color comp date (DD/MMYY) = xx/xx/xx
    Color comp time (HH:MM) = xx:xx
```

Set frequency as either OFF, MANUAL, 24hr, 12hr, 6hr, 3hr or 1hr. If MANUAL is selected the color compensation can only be initiated from Programming Page 2.3.

Value of color compensation applied. If 'Default programming parameters' (Programming Page 2.1) is set to YES, 'Color comp frequency' is set to 0.

Set the date and time respectively.

6.4 Page 4 - Set Up Current Outputs

```
SET UP CURRENT OUTPUTS             PAGE 4.0

  Output range 1 = 0 to  xxx <units>
Calibration hold = NO
  Output range 2 = 0 to  xxx <units>
Calibration hold = NO
     Output type = xx to xx mA
     Test output = NO
```

Set the current output to any range between the following maximum and minimum limits:

PO_4^{3-}	P
0 to 3	0 to 1
and	and
0 to 60	0 to 20

If set to YES the Current Outputs are held during calibration.

Set to one of the following ranges: 0 to 10, 0 to 20 or 4 to 20mA.

If required, the instrument can automatically transmit a percentage of the full scale test signal: 0, 25, 50, 75, 100% of the current output selected.

6.5 Page 5 - Alarm Relay Setup

```
   ALARM RELAY SETUP              PAGE 5.0

  A1 enabled = NO
 A1 setpoint =  xxx <units>
   A1 action = LOW
  A2 enabled = NO
 A2 setpoint =  xxx <units>
   A2 action = LOW
```

Select YES or NO as required.

Set the required setpoint values within the instrument range.

Select the alarm action required - HIGH or LOW.

```
COMMON RELAY CONFIGURATION         PAGE 5.1

    Alarm failsafe = YES
       Alarm delay = xx min
  Alarm hysteresis = xx %
```

If fail-safe action is required select YES.

Relay actuation and alarm l.e.d. indication can be delayed in the event of the alarm condition. If the alarm condition clears within the programmed delay time, the alarm function is not activated and the delay time is reset. Set the required delay time in the range 0 to 99 minutes in 1 minute increments.

A differential set point can be set as a percentage of the set point value. The differential setting operates on the set point. **Example** – a 5% differential setting operates 2.5% above and below the setpoint.
Set the differential required between 0 and 5% in 1% increments.

6.6 Page 6 - Factory Settings

```
   FACTORY SETTINGS               PAGE 6.0

 Enter factory settings
          security code   xxxx
```

Enter the value of the previously entered security code.

```
   FACTORY SETTINGS          PAGE 6.1

WARNING : These parameters are factory
set and should not normally require
adjustment. They can only be set up if
the necessary equipment is available.
DO NOT PROCEED WITHOUT CONSULTING THE
OPERATION MANUAL.
```

Used for diagnostic purposes only.

```
   ELECTRICAL CALIBRATION.    PAGE 6.2

             Reading = xxx<units>
  Lamp alignment V read =  x.xxx Volts
  Lamp alignment V ref  =  x.xxx Volts
 Alter factory settings
          Security code    xxxx
```

Displays the output of the photocell pre-amplifiers. Used only for information and photocell balance adjustment.

Enter a security code (up to four digits) if required.

```
   ELECTRICAL CALIBRATION     PAGE 6.3

   Read I/P zero -2V   xxxxx
   Read I/P span +2V   xxxxx
    Ref I/P zero -2V   xxxxx
    Ref I/P span +2V   xxxxx
```

Used for the calibration of the A and D converter. This is set up during the manufacture of the processor board and must not be changed unless full details of the procedure are known.

```
   ELECTRICAL CALIBRATION     PAGE 6.4

Temperature chan1 zero 100Ω    xxx.x
Temperature chan1 span 150Ω    xxx.x
Temperature chan2 zero 100Ω    xxx.x
Temperature chan2 span 150Ω    xxx.x
```

Connect a 100Ω resistance to the input of the respective temperature input.

Connect a 150Ω resistance to the input of the respective temperature input.
Wait for the display to stabilize before moving on to the next step. The new calibration datum is automatically entered.

```
   ELECTRICAL CALIBRATION     PAGE 6.5

        Current output 1 4mA
        Current output 1 20mA
        Current output 2 4mA
        Current output 2 20mA
```

Calibration is performed on the 4 to 20 mA range, but values are valid for 0 to 10 and 0 to 20 mA ranges.
Connect a digital current meter to the respective output terminals and use the raise and lower buttons to adjust the respective output up or down to within <±0.25% of the maximum current output.

```
     INSTRUMENT TIMING        PAGE 6.6
  Measured variable filter = ON
            Optical filter = x
Extra cuvette filling time = xx  s
      Cuvette filling time = xxx s
            AUTO ZERO time = xxx min
 SECONDARY CALIBRATION time = xxx min
   Recovery on sample time = xxx min
```

For service purposes only. Must normally be set to ON. When set to OFF, the signal processing to remove the effects of chemical noise and air bubbles is bypassed.

This is set to 1 or 2 depending on the type of optical filter fitted in the photocell housing. The 'type 2' is indicated by a red sleeve on the photocell cable.

Used when a color compensation is being performed. Range 0 to 30 seconds in 1 second steps. Default 4 seconds.

Cuvette filling time normally set to 65s to ensure that the cuvette overflows before the lamp is switched on.

20min
20min
20min

These do not require further adjustment except for 'Recover on sample time' which can be increased if the sample value is near zero.

```
  CALIBRATION ALARM SETUP     PAGE 6.7

  Zero offset range = 0.0 +/- xxx <units>
  Cal factor range  = 1.0 +/- x.xx
```

Enables the acceptable range of zero offset to be selected before a calibration fail alarm is initiated. 0.6 to 30 as PO_4^{3-} or 0.2 to 10 as P, OFF, normally set to 6 as PO_4^{3-}, 2 as P.

Enables the acceptable range of calibration factor to be selected before a calibration fail alarm is initiated. 0.15 to 0.5, OFF, normally set to 0.2.

```
  COLOR COMPENSATION SETUP    PAGE 6.8

  Color compensation cycles = xx
                  Tube type = x
```

Set the fill/drain cycles in the range 4 to 15 (normally set to 8) in one step increments.

Set the tube type as 1 or 2.
[Type 1 = larger reagent tube (0.64mm i.d.)
Type 2 = smaller reagent tube (0.51mm i.d.)]

7.1 Method of Calibration

Calibration of the monitor is carried out by replacing the sample solution sequentially with two solutions of known phosphate concentration – see Section 4.1. Initially a zero phosphate solution, and then, if required, a secondary standard solution are passed through the monitor – see Section 8.1.2. This calibration sequence can be initiated automatically at preset times, or manually on demand. Since most of any drift which takes place affects the zero more than the sensitivity, the monitor can be set up to carry out regular AUTO ZERO calibrations and less frequent AUTO SECONDARY calibrations. This reduces the instrument 'down time' to an absolute minimum. Manual one or two point calibration sequences can also be initiated. Calibration programming is covered in Section 6 (single stream) and Appendix A (multi-stream).

On initiation, either manual or timed automatic, the 'Cal' l.e.d. is illuminated and the remote Calibration Mode relay is energized. Two solenoid valves, SV1 and SV2, are energized sequentially to admit the zero solution and then (if selected) to admit the secondary standard solution. At each stage of the sequence, sufficient time is allowed to displace the previous solution and allow the reading to stabilize. The calibration sequence is shown in Table 7.1.

After calibration, the outputs from the optical system corresponding to the two solutions, are used to calculate new zero and calibration factor values, thus compensating for any drift or sensitivity in the reagents or liquid handling performance characteristics.

The new zero and calibration factor can be displayed in Operating Page 1 (a calibration factor of 1.00 is the nominal value). This parameter is intended to indicate the performance of the monitor and in particular the chemical solutions. If the value is outside factory pre-set limits, a calibration fail alarm is initiated and the 'Out of Service' l.e.d. is lit.

The calibration factor can be defaulted to 1.00 (see Programming Page 2.2) following maintenance. The displayed reading can be brought onto scale with the ▲ and ▼ switches to allow the reading to be observed to assess the stability of the monitor prior to carrying out a calibration.

Initially, a BASELINE AUTO ZERO calibration is manually initiated to establish the new baseline zero when a new reagent solution is installed. This sets the zero offset value, displayed on Programming Page 1, to 00.0. Following a BASELINE AUTO ZERO a SECONDARY calibration is initiated. Subsequent timed ROUTINE AUTO ZEROs generate a new zero offset value which can then be assessed to check for zero drift within the life of the reagent (normally five weeks). If the zero offset is outside factory pre-set limits, a calibration fail alarm is initiated and the 'Out of Service' l.e.d. is lit.

Activity	AUTO ZERO	Introduce SECONDARY CALIBRATION Solution (if selected)	Introduce Sample	Normal Operation
Valve Energised	SV1	SV2	None	None
Timing (Default) in minutes	20	20	20	

Table 7.1 Calibration Sequence

7.2 Operation of Color Compensation

The monitor has been designed to compensate for background color in the sample which could produce higher readings than expected. However, the compensation sequence takes 20 minutes during which the instrument is off line.

It is recommended therefore, that color compensation is only used when necessary, and then set to a compensation frequency which is the minimum for the particular application.

For many applications, such as in the power industry and for potable water, color compensation will not be required. For certain environmental applications where a visible examination of the sample shows it to have a yellow-orange coloration, there may be a significant absorbance in the region where normal phosphate development takes place. Phosphate readings will be in error until a color correction (color compensation) has taken place.

Note. If the sample color changes, the monitor readings will be in error until another compensation is carried out.

This can easily be achieved by making a measurement on sample without addition of reagent. If this reading is then subtracted from the developed sample reading, a measurement of true phosphate concentration is obtained.

To decide whether color compensation should be applied, carry out the following test:

a) Ensure that color compensation is OFF (see Programming Page 3.3) and that default calibration parameters on Programming Page 2.1 are set to YES.

b) Carry out a normal BASELINE calibration and make a note of the sample reading.

c) To compensate for color in the sample, select MANUAL on Programming Page 3.3 and manually start a compensation (Programming Page 2.3). Make a note of the new sample reading at the end of the sequence.

d) If it is felt that the difference between the readings is insignificant with respect to the monitor application, then color compensation is unnecessary.

Note. This test should be repeated at intervals to check for periodic variations in sample color.

7.3 Calibration/Color Compensation Conflicts

If color compensation is set to MANUAL on Programming Page 3.3, a color compensation sequence can only be initiated manually. Alternatively, if a frequency is entered, then the compensation can be initiated manually or automatically.

If color compensation is taking place and a timed calibration is due, the timed calibration proceeds immediately after completion of color compensation. Conversely, if a timed calibration is taking place and a color compensation is due, the color compensation proceeds immediately after completion of timed calibration.

8 MAINTENANCE

8.1 Chemical Solutions

The reagent and standard solutions listed below are necessary to maintain the monitor in operation.

Caution. Great care should be taken to prevent contamination of these solutions with phosphates. Reagent and standard solution containers must be emptied and then rinsed with high purity water, not simply topped up. The performance of the monitor relies heavily on the integrity of these solutions, so it is very important that they are prepared, stored and handled with great care.

If solutions are purchased from a proprietary chemical supplier, care should be taken in storing the containers. They should be date stamped, used in strict rotation, and not used after their expiry date.

8.1.1 Reagent Solution

The following single, combined reagent will maintain the monitor in operation for a period of approximately five weeks. The container and associated tubing are color coded for ease of identification.

Warning.

- Concentrated nitric acid must be handled with great care; ensure that when diluting concentrated acid, it is added to the water, not water to the acid. Wear appropriate protective clothing, i.e. rubber gloves and full face protection, and work under a fume hood.
- Care should be taken when mopping up spillages; wear eye protection and rubber gloves and dilute with plenty of water.

Proceed as follows:

a) Place approximately 4 liters high purity water in a plastic beaker and add carefully 2500 ml (±10 ml) analytical reagent grade concentrated nitric acid, HNO_3 (1.42 s.g.). Stir the solution continuously during the addition and allow it to cool to room temperature before proceeding.

For phosphate concentrations up to 10 mg l^{-1} as P, 30 mg l^{-1} as PO_4^{-3}

b1) Transfer 10.0 g (±0.1 g) analytical reagent grade ammonium metavanadate, NH_4VO_3, slowly to the nitric acid, stirring the solution continuously to dissolve the solid. (Use a little high purity water to help transfer the solid.)

c1) Dissolve 200 g (±1 g) analytical reagent grade ammonium molybdate, $(NH_4)_6Mo_7O_{24}.4H_2O$, in approximately 2 liters of high purity water.

Go to step d).

OR

For phosphate concentrations up to 20 mg l^{-1} as P, 60 mg l^{-1} as PO_4^{-3}

b2) Transfer 12.5 g (±0.1 g) analytical reagent grade ammonium metavanadate, NH_4VO_3, slowly to the nitric acid, stirring the solution continuously to dissolve the solid. (Use a little high purity water to help transfer the solid.)

c2) Dissolve 250 g (±1 g) analytical reagent grade ammonium molybdate, $(NH_4)_6Mo_7O_{24}.4H_2O$, in approximately 2 liters of high purity water.

For either concentration

d) Carefully add the acid/metavanadate solution to the molybdate, stirring well to dissolve any precipitate and then make up to 10 liters with more high purity water to give a pale yellow solution.

This reagent has a shelf life of several months if kept in a tightly-stoppered plastic container.

8.1.2 Standard Solutions

The following instructions are for the preparation of stock solutions of 1000 mg l^{-1} either as P or PO_4^{3-}.

a) Phosphate as P

Dissolve 4.393 g (±0.001 g) of analytical reagent grade potassium dihydrogen phosphate, KH_2PO_4, in approximately 500 ml of high purity water.

Phosphate as PO_4^{3-}

Dissolve 1.433 g (±0.001 g) of analytical reagent grade potassium dihydrogen phosphate, KH_2PO_4, in approximately 500 ml of high purity water.

b) Transfer the appropriate solution to a one-liter volumetric flask and make to volume with more high purity water.

Information. The accuracy of the monitor over its total range is governed by the choice of the secondary standard solution value. A monitor calibrated at 2 mg l^{-1}, for example, would not exhibit the best accuracy at 20 mg l^{-1}.

In the case of a multi-stream the concentration of the solution should be chosen to coincide with the point of greatest required accuracy. This could also apply to a single stream version. But in the absence of this, the value should correspond to 80% of the current output range.

c) Dilute the appropriate stock solution with high purity water to make the secondary calibration solution. The dilution should be carried out using polyethylene apparatus wherever possible.

Information. High purity water, i.e. de-ionized, is used for the ZERO solution.

The stock solutions are stable for at least 3 months. Calibration solutions should be replaced at weekly intervals.

8.1.3 Rinse Solution for Internal Pipework

It is important that the internal pipework of the monitor is cleaned every five weeks as part of the routine maintenance. This prevents the gradual build-up of molybdate precipitation in the pipework which can introduce errors. Problems such as noise can also be caused by contaminated pipework. The solution can also be used to clean the chemical panel and neutralize any acid spillages.

Warning. Sodium hydroxide is extremely caustic and must be handled with great care. Wear gloves and eye protection.

One liter of the rinse solution is prepared as follows:

a) Dissolve 100 g of sodium hydroxide pellets, $NaOH$, in approximately 600 ml of high purity water in a plastic container. Allow the solution to cool to ambient temperature.

b) Add to the solution 5 g di-sodium EDTA and stir to dissolve.

c) Transfer the above solution to a 1 liter measuring cylinder and make to the mark with more high purity water. Mix well and store in a tightly stoppered plastic container. Stored in this container the solution is stable for many months.

8.2 Scheduled Servicing

The following servicing schedule has been produced as a general guide only. Because the monitor is designed for a wide range of applications, where the nature of the sample can vary considerably, it may be necessary to amend the schedule to suit the particular installation and sample conditions.

8.2.1 Regular Visual Checks

It is recommended that the monitor and the sampling system is visually inspected on a regular basis to ensure the correct functioning of the system and to check the integrity of the readings.

a) Check for leaks particularly around the sample and drain pipework connections.

b) Confirm sample flow by checking delivery to the constant head unit and effluent from the drain.

c) Check liquid levels in the reagent and standard solution containers.

d) Inspect all tubing and liquid handling components for leaks and deterioration.

e) Check for malfunction indications on the instrument display.

8.2.2 Five-weekly

a) Carry out the normal visual checks covered in Section 8.2.1.

Warning. It is vital that good maintenance in this respect is adhered to and that all leaks of potentially aggressive chemical solutions are attended to as soon as possible and spillages are cleaned up.

b) Discard old reagent and standard solutions, clean containers thoroughly, and refill with fresh solutions – see Section 8.1.

Caution. All unused solutions must be discarded; the containers must be rinsed with high purity water before refilling with the fresh solution.

c) Replace pinch tube between the cuvette and the drain manifold. Release the tube from the pinch valve by pressing the centre plunger and remove. Replace with new silicon rubber tube from the spares kit. Ensure that the tube is fully inserted into the valve to avoid any leakage of solution from the cuvette.

d) Set the following parameters to YES using Programming Page 2.1:

Five-Weekly System Flush

Five-Weekly Solution Replacement

Default Calibration Parameters

For single stream instruments only:

Set the color compensation frequency to OFF using programming Page 3.3.

e) Rinse the internal pipework – see Section 8.2.4. It is important that this procedure is carried out to ensure that the monitor tubing is kept in a good clean condition, essential for correct monitor operation.

Note. Before proceeding to the next step, multi-stream users must select single stream mode as described in Section 4.3.

f) If having not already done so energize the secondary CAL valve (see Programming Page 2.3) and leave for 15 minutes. Adjust the reading on scale with the ▲ and ▼ switches and run the monitor for 30 to 60 minutes to purge the old solution and assess stability.

g) If the monitor exhibits good stability, i.e. $<\pm5\%$ of reading, carry out a two-point BASELINE calibration – see Programming Page 2.3.

For single stream instruments only:

h) If color compensation is required, switch to MANUAL for manual compensation only, or to automatic timed compensation by selecting a frequency between 1 to 24 hours using Programming Page 3.3. For general information regarding the setting up of the color compensation see Section 7.2.

8.2.3 Twelve-monthly

a) Service pump – see Section 8.2.6.

b) Replace all internal plumbing and pump tubing – see Section 8.2.7.

c) Set 'Annual Service' to 'YES' – see Programming Page 2.1.

d) Carry out the normal four-weekly schedule not already covered in steps a) and b).

8.2.4 Rinsing Internal Pipework

Important Note.

- It cannot be stressed strongly enough that the five-weekly chemical rinse with the rinse solution is vitally important. It is also very effective at reducing calibration problems, drift and signal noise. Any evidence of white precipitate in the mixer or reaction coil must be removed with the rinse solution.
- If the routine rinse procedure has not been carried out on a regular basis as scheduled, or the liquid handling section is in poor condition, run the cleaning solution through the monitor for several hours.

Carry out the following procedure on a five-weekly basis:

a) Remove the secondary standard tube from the solution container and immerse in the rinse solution.

b) Energize the secondary cal. valve (see Section 6, Programming Page 2.2) and allow the rinse solution to run through the monitor for about 30 minutes.

c) Remove the secondary solution tube from the rinse solution, wash it well with high purity water and return it to the secondary calibration solution.

d) Carry out a calibration of the monitor as described in Section 8.2.2, starting at step f).

In some applications deposits may accumulate in the pipework which are unaffected by the alkaline rinse solution. In this case an acid cleaner, e.g. the reagent solution, may be more effective and can be introduced in a similar manner to that described in this section.

8.2.5 Consumable Spares Kit – see Section 10

This kit includes all the components which are recommended for annual replacement (refer to the details in the spares kit). This annual refurbishment ensures a high level of reliability from the monitor for many years. The kit should be re-ordered when used so that all the items are available throughout the following years operation.

The kit contains:

- one set of pump tubing,
- one set of pump capstans,
- a syringe for checking free flow though valved and tubing and for clearing blockages,
- a complete set of plumbing tubing, and
- sundry items – 'O' rings, tube connectors, pump tube bungs, and sample filters.

8.2.6 Peristaltic Pump – Fig. 8.1

It is recommended that the pump tubing and pump capstans, supplied in the Consumable Spares Kit, are replaced after one year of operation. Carry out the procedure shown in Fig.8.1.

8.2.7 Replacement of Plumbing Tubing – Fig. 8.2

All the following items are included in the Consumable Spares Kit.

Caution. It is essential that the correct tube, which was chosen with great care, is fitted in each position. Failure to do this could upset the performance of the monitor or result in solution leakages around connections due to chemical attack.

a) Remove each section of the sample and reagent plumbing tubing in turn and replace with new tubing of the same length.

b) Remove drain tubing, and replace with new tubing of the same length.

c) It is recommended that the sample and drain tubing to and from the monitor is inspected and replaced if the condition of the tubing is poor or shows evidence of any build-up of solids.

8.3 Shutdown Procedure

The monitor can be left with the pump switch off for up to 24 hours without any detrimental effects. However, for longer periods it must be shutdown correctly to prevent chemical precipitation in the pipework resulting in extensive maintenance and recommissioning.

Perform the following Shutdown sequence:

a) Close the sample valve up-stream of the monitor.

b) Rinse the internal pipework – see Section 8.2.4. It is important to flush the reagent bottle tube; so these need to be immersed in the rinse solution also.

c) Repeat the process with high purity water to flush out the rinse solution.

d) Switch off the monitor.

e) Remove the platen from the peristaltic pump and release the tube from the pinch valve.

f) Empty reagent and standard containers and rinse with high purity water.

Note.

- The bungs are designed to grip the pump tube when compressed by the platen. Two sizes of tube are used so it is essential that the correct size of bung is fitted.
- It is immaterial which tube passes over which pump roller, but for neatnes the front tube should be de-gassed sample, the centre tube reagent and the raw sample tube to the rear.

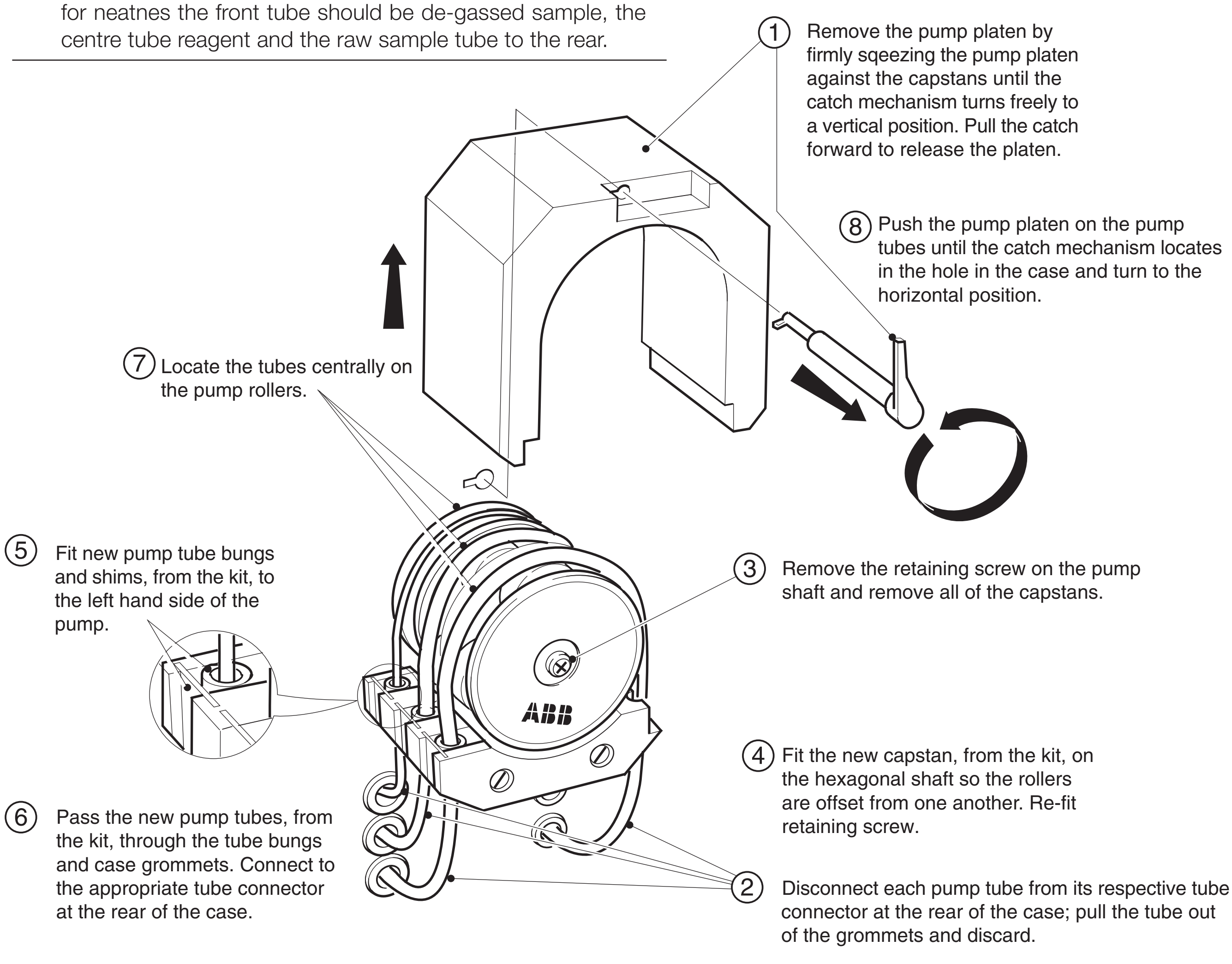
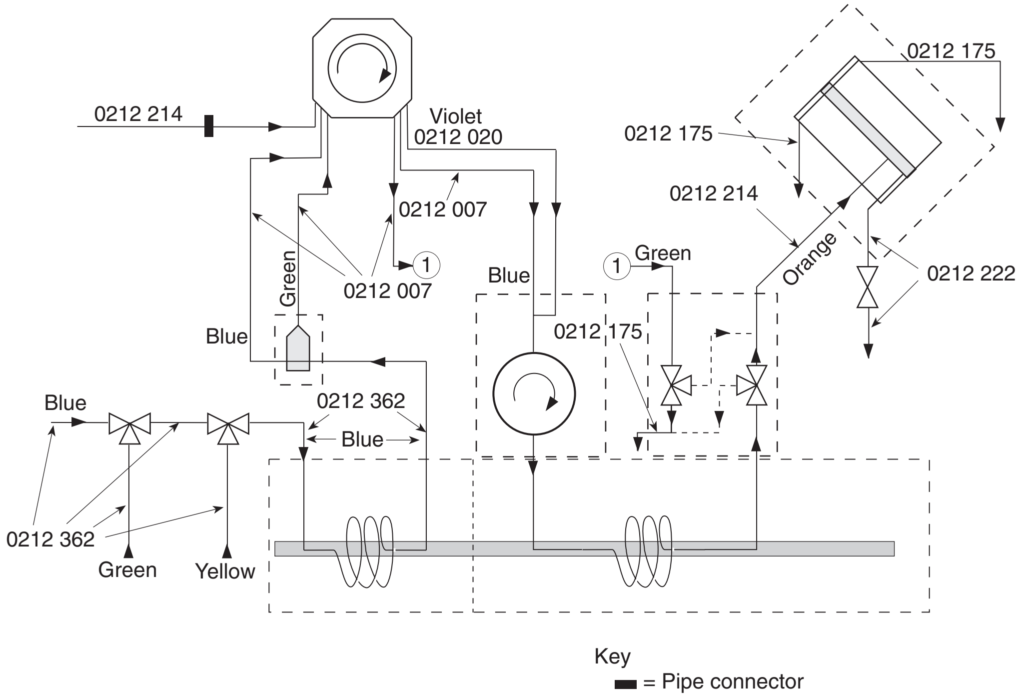
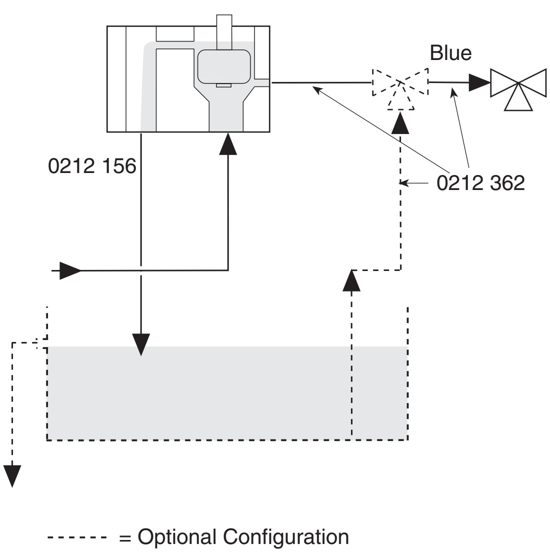


Fig. 8.1 Maintaining the Peristaltic Pump





Part No	Tube Specification
0212 007	2 mm i.d. Santoprene
0212 020	0.51 mm i.d. Santoprene
0212 222	3.2 mm i.d. silicon rubber
0212 156	9.5 mm i.d. pvc
0212 175	4.00 mm i.d. pvc
0212 214	1.6 mm i.d. Tygon
0212 362	2.4 mm i.d. Tygon

Note. Replace the tube between the drain manifold assembly and the contaminated drain tundish (see Fig. 1.1) with the tube provided – part no. 8240 179.

Note. Tube specifications for the multi-stream version are as those in the table, but repeated for each stream.

Fig. 8.2 Replacement of Plumbing Tubing

8.4 Unscheduled Servicing

8.4.1 Monitor Diagnostic Information

The monitor is fitted with extensive diagnostics which provide information on routine servicing and problems that have developed. Any one of these problems illuminate the 'Out of Service' l.e.d. and de-energize the normally energized 'Out of Service' alarm relay. This alarm also goes into an alarm state when the monitor is switched off. Timed calibration is inhibited but could be started manually. Information is displayed on Page 1.0 when an alarm has been raised to indicate the cause of the problem. The diagnostic messages are given in Table 8.1.

8.4.2 Malfunction of the Monitor

A calibration fail for any reason could be caused by almost any part of the liquid handling section of the monitor including the solutions.

Mechanical components which are involved with the liquid handling, e.g.: pumps; valves; tubing and tubing connections, should be systematically checked for correct operation and for leaks or blockages which change the chemical conditions within the monitor.

Caution. Check that there have been no unauthorized modifications, e.g., incorrect tubing fitted.

In the majority of cases any problems experienced are generally found to be associated with the chemistry and the liquid handling section.

Noise may be due to air bubbles sticking in the pipework or to the walls on the cuvette. Degassing of the sample is normal due to pre-heating of the sample on entry into the liquid handling section. However, the monitor is designed so this does not normally affect its performance. If the problem is excessive a chemical rinse should be carried out to clean and re-wet the liquid handling system and cuvette – see Section 8.2.4. Reducing the control temperature also helps – see Section 6, Programming Page 3.1.

The most common problems are associated with the reagent or standard solutions. Any unpredictable problems may be due to the standard or reagent solutions, or their flow through the monitor. If any doubts exist regarding the integrity of these solutions, they should be replaced with freshly prepared solutions in the early stages of the fault finding investigations.

Display	Explanation	Action
Next 5 weekly service /Overdue	Five-weekly service overdue	Carry out a five-weekly service and acknowledge (set to YES) in Programming Page 2.1 (see Section 6.2, or Appendix A for multi-stream version).
Monitor in service	Monitor operating correcly	None.
Control temperature stabilising	The mains power supply has been re-instated and the temperature of the two heaters is stabilizing	Allow i) sufficient time for the heaters to stabilize at their operating temperature, and ii) a further 10 minutes for a full reaction to take place.
Out of reagent	Reagent solution bottle(s) are empty	Replace reagent solution bottles.
Pumps off	Pump switch is in the OFF position	Switch pump(s) on – see Fig. 1.1.
Control temperature high	One or more of the heaters is greater than ±2°C of the control temperature setpoint	Normally this indicates a fault in the heater control unit but, in the case of a high alarm, a high ambient temperature could be the cause – see Programming Page 3.1 in Section 6.3 (or Appendix A for multi-stream version).
Control temperature low		
In test mode see page 2.2	Test mode parameter(s) in Programming Page 2.2 are active (set to YES)	Refer to page indicated; check and correct the setting(s).
Excessive zero offset	Large zero drift has occurred since the last BASELINE calibration	Refer to Section 8.5.1
Calibration factor too high	Indicates higher than normal silica sensitivity	Refer to Section 8.5.2
Calibration factor too low	Indicates lower than normal silica sensitivity	Refer to Section 8.5.2

Table 8.1 Diagnostic Messages

If the monitor fails to produce results as expected, the most likely cause is the standards, either contaminated when handled or (and most likely) made up with poor quality water, possibly containing background phosphate. Incorrectly prepared reagent may give a poor calibration factor. If the solutions are purchased from a proprietary chemical supplier, take care in storing the containers; they should be date stamped, used in strict rotation, and not used after their expiry date.

8.4.3 Effects of Loss of Power to the Monitor

The action taken by the monitor following an unforeseen loss of power is dependant on the length of time the power was off. Table 8.2 shows the alternative actions performed by the monitor.

Status of the Monitor	Period of Loss of Power	
	Less than 5 minutes	Greater than 5 minutes
In Between Calibrations	Normal operation resumed after temperature stabilisation*.	A ZERO calibration is automatically performed one hour after temperature stabilisation* .
During Calibrations	After temperature stabilisation*, the current calibration is re-started.	The current calibration is re-started one hour after temperature stabilisation*.

*This period allows sufficient time for the heaters to stabilise at their operating temperature, plus a further 10 minutes for a full reaction to take place.

Table 8.2 Effects of Loss of Power to The Monitor

8.5 Simple Checks

Note.

- All references to 'Programming Pages' are found in Section 6 for single stream versions of the monitor. Before carrying out tests on the multi-stream version, it is essential that only one stream is selected – see Section 4.3.
- On single stream versions always start any fault finding investigations by disabling the color compensation in Programming Page 3.3. On multi-stream versions always put into single stream mode – see Programming Page 3.3.

8.5.1 Unstable or Erratic Readings

a) Check the flow of sample into the cuvette.

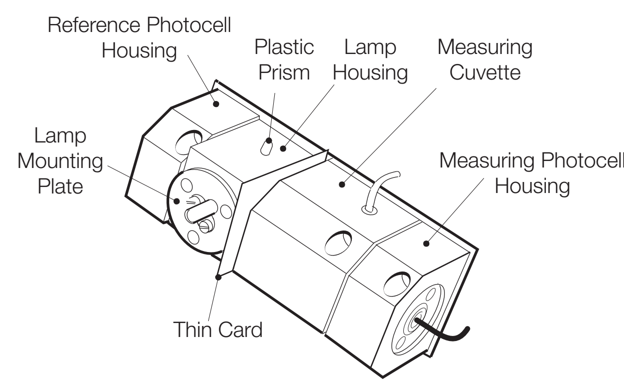
b) Check the flow of the reagent through the pump.

c) Check that the pinch tube is fitted correctly into the pinch valve.

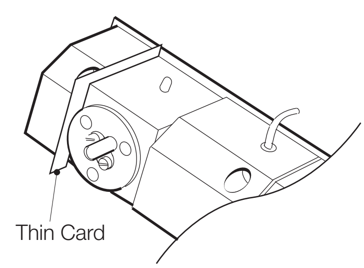
d) Ensure that the drain/fill cycle is taking place normally. Illumination can be seen via the plastic prism on the top of the lamp housing – see Fig. 8.3.

e) Ensure that the cuvette overflows through the bottom left hand outlet tube before the lamp lights during each drain/fill cycle.

Important Note. It cannot be stressed strongly enough that the five-weekly chemical rinse with the rinse solution is vitally important. It is also very effective at reducing calibration problems, drift and signal noise. Any evidence of white or blue precipitate in the mixer or reaction coil must be removed with the rinse solution.



A – Card between Lamp Housing and Measuring Cuvette



B – Card between Lamp Housing and Reference Photocell Housing

Fig. 8.3 Simple Electronic Response Test

f) Rinse the pipework for 30 minutes with cleaning solution (see Section 8.2.4) to remove any build-up of molybdate precipitate.

g) Carry out a monitor response test – see Section 8.4.4.

8.5.2 Low/High Calibration Factor Value

a) Check and, if necessary, replace the standard solutions.

b) Check and, if necessary, replace the reagent solution.

c) Switch 'Energise AUTO ZERO valve' to YES on Programming Page 2.2.

d) Lift the zero calibration solution tube out of the container and ensure that air is being drawn into the tube.

> **Caution.** Clean up any spillages from the second mixer chamber.

e) Switch 'Energise AUTO ZERO valve' to NO and set 'Energise SECONDARY CAL valve' to YES.

f) Lift the secondary calibration solution tube out of the container for a few seconds and ensure that air is being drawn into the tube.

> **Important Note.** It cannot be stressed strongly enough that the five-weekly chemical rinse with the rinse solution is vitally important. It is also very effective at reducing calibration problems, drift and signal noise. Any evidence of white or blue precipitate in the mixer or reaction coil must be removed with the rinse solution.

g) Carry out a monitor response test – see Section 8.5.3.

8.5.3 Monitor Stability/Response Test

a) Check that the temperature on both heaters is under control and stable.

b) Switch 'Default calibration parameters' to YES on Programming Page 2.1.

c) Switch 'Energise AUTO ZERO valve' to YES on Programming Page 2.2.

d) Run the monitor for 30 minutes.

e) Use the ▲ / ▼ buttons to generate a sensible reading of the sample on the display on Programming Page 0. Note the reading over a 30 minute period to ensure a stable reading.

f) Switch 'Energise AUTO ZERO valve' to NO and 'Energise SECONDARY CAL valve' to YES.

g) Run the monitor for 30 minutes. Note that the reading on Programming Page 0 has changed by approximately the value of the secondary solution and is stable over a 30 minute period.

h) If successful, set the monitor to normal operation, i.e. de-energise the SECONDARY CAL valve and carry out a baseline calibration – see Programming Page 2.3.

8.5.4 Simple Electronic Response Test

a) Remove the optical system cover.

b) Switch 'Default calibration parameters' to YES on Programming Page 2.1.

c) Switch 'Lamp on continuous' to YES on Programming Page 2.2. This stops the drain/fill sequence.

d) Place a thin card between the lamp housing and the measuring cuvette (see Fig. 8.3A) to stop the light reaching the measuring photocell.

e) Wait six seconds and note that the reading on the display on Programming Page 0 goes off the scale.

f) Remove the card and place it between the lamp housing and the reference photocell housing to stop the light reaching the measuring photocell (see Fig. 8.3B).

g) Wait six seconds and note that the reading goes to zero. Note also that the intensity of the light, seen through the plastic prism on top of the lamp housing, increases.

h) Remove the card and set the monitor to normal mode via Programming Pages 2.1 and 2.2.

8.6 Setting Up the Optical System

This lamp is pre-set at the factory and normally needs no further adjustment. Also, the lamp is run well below its rated voltage and should have a long life. However, in the unlikely event of exciter lamp or cuvette board failure, the optical system will require resetting. Section 8.6.2 explains how to adjust the lamp alignment to ensure that the maximum amount of light is hitting the photoelectric cell. Section 8.6.3 explains how to set a new cuvette board, i.e. balance the two outputs from the photocells. If only the cuvette board is being replaced, then the lamp alignment requires no adjustment. However, both steps need to be carried out if the lamp position has been disturbed.

8.6.1 Replacing the Exciter Lamp – Fig. 8.4

a) Remove (pull off) the optical system cover (see Fig. 4.6).

b) Switch off the instrument, unscrew the three spring-loaded positioning screws (Fig. 8.4) and lift off the lamp mounting plate.

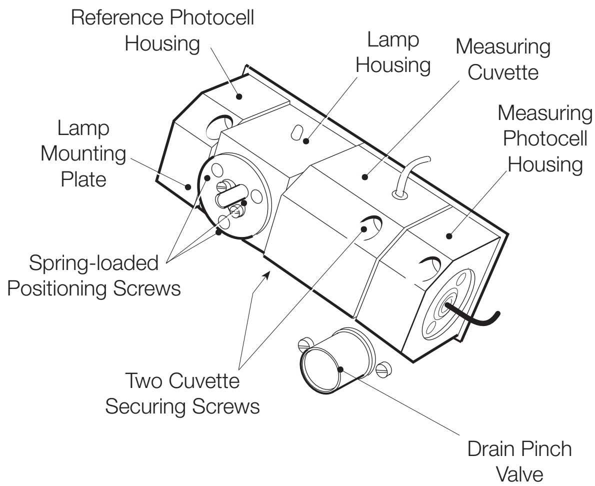
> **Caution.** Do not touch the glass envelope of the new lamp; use a tissue to hold it.

c) Pull out the old lamp and fit a new one.

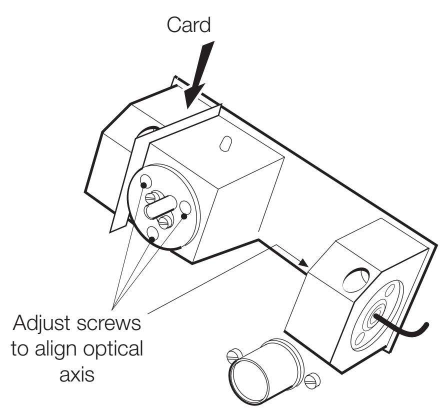
d) Temporarily switch on the instrument and check that the lamp illuminates during each drain/fill cycle.

e) If the lamp is working, switch off the instrument and secure the lamp mounting plate. Ensure that the springs are in place. Switch on the instrument.

Now align the lamp – see Section 8.6.2.



A – Location of Adjusting Screws



B – Setting the Lamp to Full Intensity
Fig. 8.4 Lamp Adjustment

8.6.2 Aligning the Exciter Lamp

a) To avoid spillages in the next step depress the pinch valve plunger for two to three seconds to drain the cuvette.

b) Remove all tubing from the cuvette connectors.

c) Unscrew fully the two screws holding the cuvette in place and remove the cuvette.

d) Scroll to Programming Page 2.2 and use the ▲ switch to select 'YES' for 'Switch lamp on continuous'.

e) Loosen off the three screws on the lamp mounting plate until the light beam falls directly onto the photoelectric cell window. Placing a piece of white card aids this adjustment – see Fig. 8.4B.

f) Fit the cuvette and the associated tubing.

Now set up the cuvette board – see Section 8.6.3.

8.6.3 Setting Up the Cuvette Board

a) Switch off the pump.

b) To avoid spillages in the next step depress the pinch valve plunger for two to three seconds to drain the cuvette.

c) Remove the optical system cover if not already done so. Remove the cuvette inlet tube from the cuvette connector. This is a small diameter tube sited behind the drain tube.

d) Using a length of inlet tube from the spares kit connect a syringe filled with demineralized water to the cuvette inlet connector.

e) Slowly push the demineralized water through the cuvette allowing it to overflow, and occasionally depressing the pinch valve plunger.

   Repeat this step once more before proceeding.

f) Refill the syringe and fill the cuvette until it just overflows.

g) Now scroll to the Programming Page 6.2. (The security code to enter Programming Page 6 is normally set to 42.)

   The voltages at both the Read and Reference photoelectric cells are displayed. The Reference voltage remains constant at approximately 2 V whereas the Read voltage will vary depending on the intensity of the color complex formed with the phosphate in the sample. As demineralized water is present in the cuvette, no color exists and therefore represents a zero phosphate solution.

h) When the voltages are stable make fine adjustments with the potentiometer, which is sited towards the bottom of the cuvette board (see Fig. 8.5) until the Read voltage is between 20 to 50 mV less than the Reference voltage.

i) Connect the cuvette tube to the cuvette inlet connector and fit the optical system cover.

j) Select 'NO' for 'Switch lamp on continuous' on Programming Page 2.2 to turn the lamp off. Switch on the pump.

k) Allow the instrument to settle down for one hour before performing a baseline calibration.

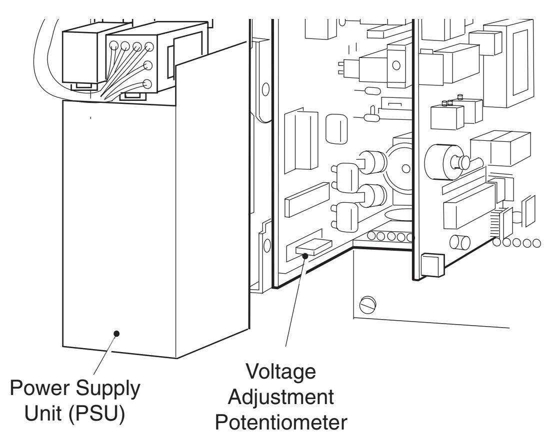


Fig. 8.5 Location of the Potentiometer on the Cuvette Board

8.7 Color Compensation Solenoid Valves

There is no maintenance required for these valves (SV4 and SV5 – see Fig. 1.1). If they have been removed from the base for any reason, please refer to Fig. 8.6 for the correct orientation on reassembly.

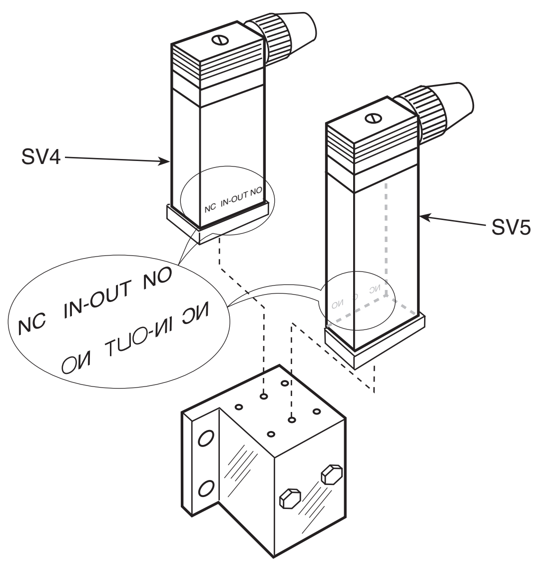


Fig. 8.6 Orientation of Valves SV4 and SV5

General Specification

Range

0 to 60mgl^{-1} as PO_4^{3-}

0 to 20mgl^{-1} as P

Accuracy

< ±0.05mg/l or < ±5% whichever is the greater

Reproducibility

< ±0.05mg//l or < ±5% whichever is the greater

Response time

90% step change in approximately 11 minutes

Chemical drift

Dependent on reagents – typically less than ±5% of reading/month

Control temperature range

20° to 45°C (68° to 113°F)

Displays

Concentration and programming data by backlit l.c.d. graphics display module

Status indication

Single stream:

Two LEDs illuminated when concentration alarms are exceeded
Single LED illuminated when calibration in progress
Single LED illuminated when monitor is 'Out of Service'
Single LED illuminated when HOLD switch operated

Multistream:

Six LEDs illuminated when concentration alarms are exceeded
Six LEDs (one per stream) when stream 'Out of sample'
Single LED illuminated when calibration in progress
Single LED illuminated when monitor is 'Out of Service'
Single LED illuminated when HOLD switch operated

Current outputs

Single stream:

As standard two isolated current outputs 0 to 10, 0 to 20 or 4 to 20mA.
Range independently selectable over the full range of the monitor
Maximum voltage load 15V

Multistream:

As standard one isolated current output per stream 0 to 10, 0 to 20 or 4 to 20mA.
Range independently selectable over the full range of the monitor
Maximum voltage load 15V

Computer interface

Optional second current output or RS485 serial interface

Alarms

Single stream:

Two concentration relay outputs.
Can be configured as high or low concentration.
Remote 'Out of Sample' alarm
Remote calibration-mode indication.
Remote monitor 'Out of Service' alarm

Multistream:

Maximum of six (one per stream) relay outputs.
Can be configured as high or low concentration, or 'Out of sample' alarms
Remote calibration-mode indication.
Remote monitor 'Out of Service' alarm

Concentration alarm adjustment

Programmable over monitor range

Calibration

Frequency and time of day programmable, fully automatic, plus manual initiation on demand

EMC

Conforms to EMC Directive (89/336/EEC)

Classifications	BS EN 500 81-2
	BS EN 500 82-2
Electrical safety	BS EM 61010-1

Installation Information

Install the monitor where the following conditions can be maintained:

Sample flow

5 to 750ml.min^{-1}

Suspended solids

< 10mgl^{-1}, < 60 microns

Sample connections

Inlet 6mm, flexible hose connection

Outlet 9mm, flexible hose connection

Ambient temperature

5° to 40°C (41° to 104°F).

Sample temperature

5° to 55°C (41° to 131°F).

Reagent Solutions

Consumption of the reagent is 10 liters per five weeks

Calibration Solutions

A solution of one liter is required of concentration and formulation suitable for the particular range and application

Enclosure dimensions

Height 740mm (29 in.)

Width 540mm (21 in.)

Depth 240mm (9.5 in.)

Weight

25kg (55lb)

Power supply

110 to 120V or 220 to 240V, 50/60Hz, 100VA

Power supply tolerance

+6% to –20%

Isolation voltage

Input, output and power supply 1.5kV

Degree of protection

Electronics section – IP65

Liquid handling – Case IP31, Critical internal components IP65

SS/8242 Issue 7

10 SPARES

Consumable Spares

Part No.	Description	Qty.
8242 020	Consumable spares kit comprising pump tubes, pump capstans, plumbing tubing, tube connectors, 'O' rings etc.	1

Refurbishment Spares

Part No.	Description	Qty.
0217 321	Magnetic Stirrer Bar – for mixer block	1
8242 131	Reagent Container	1
8242 130	Reagent Container – complete with 'Out of Reagent' probe assy	1
8242 137	Standard Solution Container – zero	1
8240 085	Standard Solution Container – secondary	1
0234 019	Solenoid Valve – calibration	2
0232 004	Solenoid Valve – color compensation	2
8240 054	Drain Pinch Valve	1
0217 220	Solution container sealing cap	3

Strategic Spares

Part No.	Description	Qty.
8240 100	Constant Head Unit – single stream	1
8240 112	Constant Head Unit Module Assembly – multi-stream, one for each stream and complete with solenoid valve	1
0211 132	'O' Ring Seal between each constant head module	1
0234 023	Solenoid Valve – multi-stream	1
8240 114	Float Switch Assy. – 'Out of Sample'	1
8242 134	Float Switch Assy – 'Out of Reagent'	1
8240 090	Sample De-gasser	1
8242 150	Mixer Block Assembly	1
8242 126	Reaction Block Assembly	1
8240 110	Cuvette Assembly	1
8240 117	Optical System Cover	1
8240 106	Drain Manifold Assembly	1
8240 107	Final Drain Assembly	1
8242 129	Color Compensation Manifold	1
8242† 158	P/cell Hsg Assy, filter type 1– measuring	1
8242† 159	P/cell Hsg Assy, filter type 1– ref.	1
8242‡ 167	P/cell Hsg Assy, filter type 2– measuring	1
8242‡ 168	P/cell Hsg Assy, filter type 2– ref.	1

† Fitted to units manufactured before February 1996.

‡ Fitted with red colored identification sleeving.

Part No.	Description	Qty.
0231 462	Tungsten-Halogen Exciter Lamp	1
8242 153	Stirrer Motor Assembly – terminated	1
8240 103	Pump Motor Assembly 50Hz – terminated	1
8240 123	Pump Motor Assembly 60Hz – terminated	1
8035 870	Pump Motor Coupling Assembly	1
8240 105	Heater Mat Assembly – optical system	1
8240 104	Cartridge Heater Assembly – reaction block	1
8240 196	Temperature Sensor Assembly – optical system	1
8240 142	Temperature Sensor Assembly – reaction block	1
0234 712	Heater Thermal Cut-out	2
8240 045	Electrical Connector Kit – Liquid handling section. Contains one set of male and female connectors for pump motor, heater, float switches and lamp	1
8240 046	Electrical Connector Kit – Float switch/solenoid valve. Contains one set of male and female connectors for the 'Out-of-Sample' float switches and a pair of connectors for the stream switching solenoid valve. One kit per stream.	1
0234 726	Toggle Switch – mains, pump, and hold	3
0234 714	Toggle Switch Boot	3
8240 235	Mother Board	1
8240 257	Power Supply Assembly (inc. transformer)	1
8240 205	Cuvette Board	1
8240 215	Microprocessor Board (without EPROM)	1

Fuse

Part No.	Description	Qty.
0231 548	F1 – 2A 20 x 5mm Anti-surge 250V AC	1

EPROMs

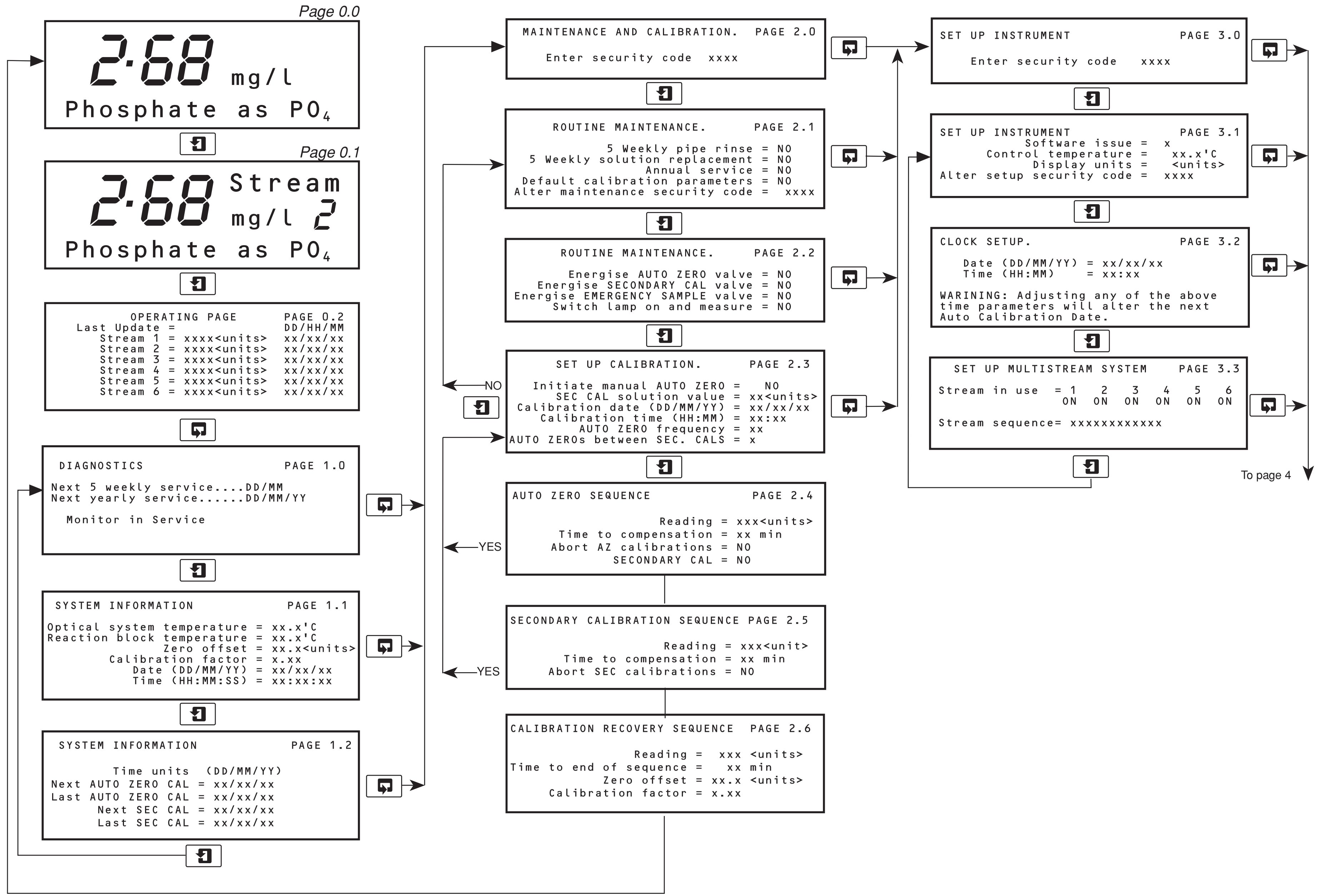
Part No.	Description	Qty.
8242 180	EPROM – single stream (English)	1
8242 181	EPROM – single stream (German)	1
8242 182	EPROM – single stream (French)	1
8242 183	EPROM – single stream (Spanish)	1
8242 190	EPROM – multi-stream (English)	1
8242 191	EPROM – multi-stream (German)	1
8242 192	EPROM – multi-stream (French)	1
8242 193	EPROM – multi-stream (Spanish)	1
8242 185	EPROM – single stream MODBUS serial (English)	1
8242 186	EPROM – single stream MODBUS serial (German)	1
8242 187	EPROM – single stream MODBUS serial (French)	1
8242 188	EPROM – single stream MODBUS serial (Spanish)	1
8242 195	EPROM – multi-stream MODBUS serial (English)	1
8242 196	EPROM – multi-stream MODBUS serial (German)	1
8242 197	EPROM – multi-stream MODBUS serial (French)	1
8242 198	EPROM – multi-stream MODBUS serial (Spanish)	1
8242 200	EPROM – single stream MODBUS/PROFIBUS serial (English)	1
8242 201	EPROM – single stream MODBUS/PROFIBUS serial (German)	1
8242 202	EPROM – single stream MODBUS/PROFIBUS serial (French)	1
8242 203	EPROM – single stream MODBUS/PROFIBUS serial (Spanish)	1
8242 210	EPROM – multi-stream MODBUS/PROFIBUS serial (English)	1
8242 211	EPROM – multi-stream MODBUS/PROFIBUS serial (German)	1
8242 212	EPROM – multi-stream MODBUS/PROFIBUS serial (French)	1
8242 213	EPROM – multi-stream MODBUS/PROFIBUS serial (Spanish)	1

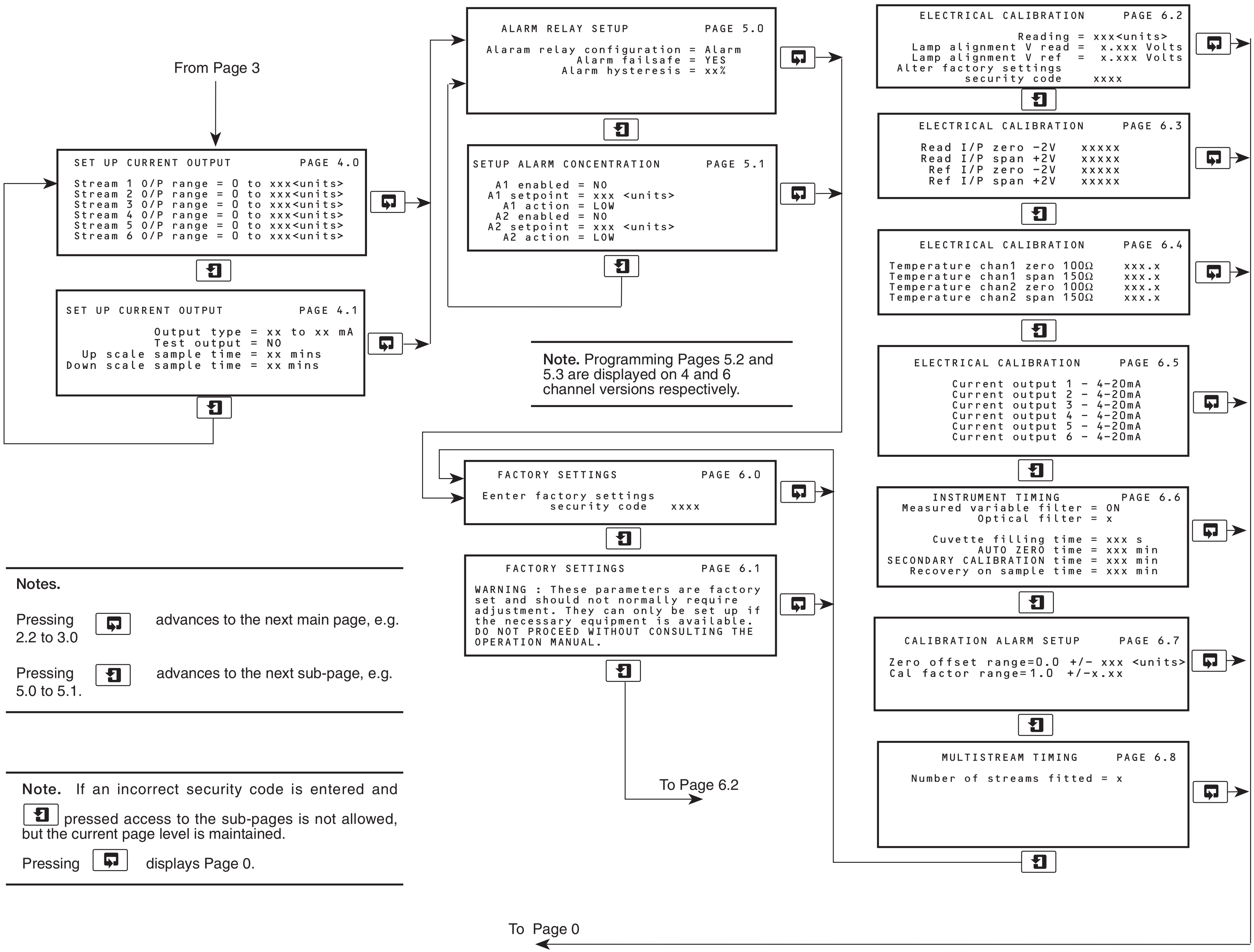
APPENDIX A – MULTI-STREAM PROGRAMMING

In normal operation (Operating Pages 0 and 1) the display gives indication of the units of measurement, diagnostics, calibration information and time. Selection is made by means of the [page] and [parameter] switches.

Operation of the [page] switch enables a series of 'programming' pages to be displayed. Unauthorized entries to these pages are inhibited by a four-digit security code which is displayed immediately after the page header.

Values displayed in Operating Pages 0 and 1 are for viewing only and cannot be altered by the operator. Displayed values on subsequent pages indicated by x's can be altered by means of the ▲ and ▼ switches. Options such as Yes/No or High/Low are also selected using these switches. Passing onto the next parameter, or exiting from the page, automatically enters the new value into memory.


Page 0.0
2.68 mg/l
Phosphate as PO_4
Page 0.1
2.68 Stream
mg/l 2
Phosphate as PO_4
OPERATING PAGE PAGE 0.2
Last Update = DD/HH/MM
Stream 1 = xxxx<units> xx/xx/xx
Stream 2 = xxxx<units> xx/xx/xx
Stream 3 = xxxx<units> xx/xx/xx
Stream 4 = xxxx<units> xx/xx/xx
Stream 5 = xxxx<units> xx/xx/xx
Stream 6 = xxxx<units> xx/xx/xx
DIAGNOSTICS PAGE 1.0
Next 5 weekly service....DD/MM
Next yearly service......DD/MM/YY
Monitor in Service
SYSTEM INFORMATION PAGE 1.1
Optical system temperature = xx.x'C
Reaction block temperature = xx.x'C
Zero offset = xx.x<units>
Calibration factor = x.xx
Date (DD/MM/YY) = xx/xx/xx
Time (HH:MM:SS) = xx:xx:xx
SYSTEM INFORMATION PAGE 1.2
Time units (DD/MM/YY)
Next AUTO ZERO CAL = xx/xx/xx
Last AUTO ZERO CAL = xx/xx/xx
Next SEC CAL = xx/xx/xx
Last SEC CAL = xx/xx/xx
MAINTENANCE AND CALIBRATION. PAGE 2.0
Enter security code xxxx
ROUTINE MAINTENANCE. PAGE 2.1
5 Weekly pipe rinse = NO
5 Weekly solution replacement = NO
Annual service = NO
Default calibration parameters = NO
Alter maintenance security code = xxxx
ROUTINE MAINTENANCE. PAGE 2.2
Energise AUTO ZERO valve = NO
Energise SECONDARY CAL valve = NO
Energise EMERGENCY SAMPLE valve = NO
Switch lamp on and measure = NO
SET UP CALIBRATION. PAGE 2.3
Initiate manual AUTO ZERO = NO
SEC CAL solution value = xx<units>
Calibration date (DD/MM/YY) = xx/xx/xx
Calibration time (HH:MM) = xx:xx
AUTO ZERO frequency = xx
AUTO ZEROs between SEC. CALS = x
NO
AUTO ZERO SEQUENCE PAGE 2.4
Reading = xxx<units>
Time to compensation = xx min
Abort AZ calibrations = NO
SECONDARY CAL = NO
YES
SECONDARY CALIBRATION SEQUENCE PAGE 2.5
Reading = xxx<unit>
Time to compensation = xx min
Abort SEC calibrations = NO
YES
CALIBRATION RECOVERY SEQUENCE PAGE 2.6
Reading = xxx <units>
Time to end of sequence = xx min
Zero offset = xx.x <units>
Calibration factor = x.xx
SET UP INSTRUMENT PAGE 3.0
Enter security code xxxx
SET UP INSTRUMENT PAGE 3.1
Software issue = x
Control temperature = xx.x'C
Display units = <units>
Alter setup security code = xxxx
CLOCK SETUP. PAGE 3.2
Date (DD/MM/YY) = xx/xx/xx
Time (HH:MM) = xx:xx
WARINING: Adjusting any of the above
time parameters will alter the next
Auto Calibration Date.
SET UP MULTISTREAM SYSTEM PAGE 3.3
Stream in use = 1 2 3 4 5 6
ON ON ON ON ON ON
Stream sequence= xxxxxxxxxxxx
To page 4



Note. Programming Pages 5.2 and 5.3 are displayed on 4 and 6 channel versions respectively.

Notes.

Pressing [main page key] advances to the next main page, e.g. 2.2 to 3.0

Pressing [sub-page key] advances to the next sub-page, e.g. 5.0 to 5.1.

Note. If an incorrect security code is entered and [sub-page key] pressed access to the sub-pages is not allowed, but the current page level is maintained.

Pressing [main page key] displays Page 0.

```
2·68      Stream
     mg/l  2
Phosphate as PO4
```

Page 0.0 is a fixed display on the indicated stream. The ▲ and ▼ switches are used to select the stream required.

```
2·68      Stream
     mg/l  2
Phosphate as PO4
```

The display on Page 0.1 continuously scrolls, at two second intervals, all the streams fitted.

```
      OPERATING PAGE      PAGE 0.2
  Last update =           DD/HH/MM
     Stream 1 = xxxx<units>  xx/xx/xx
     Stream 2 = xxxx<units>  xx/xx/xx
     Stream 3 = xxxx<units>  xx/xx/xx
     Stream 4 = xxxx<units>  xx/xx/xx
     Stream 5 = xxxx<units>  xx/xx/xx
     Stream 6 = xxxx<units>  xx/xx/xx
```

Displays all streams together with the latest update day of the month and time in hours and minutes.

A1 Page 1 - Diagnostics

```
 DIAGNOSTICS                PAGE 1.0

Next 5 weekly service....DD/MM
Next yearly service......DD/MM/YY


  Monitor in service
```

Indicates the date when the next relevant routine maintenance is required. When the date is exceeded, 'overdue' is displayed and the 'Out of Service' l.e.d. is illuminated.

This message indicates that the monitor is working normally but it is replaced with the relevant information, when necessary, by the monitor diagnostics - see Section 8.4.1.

```
 SYSTEM INFORMATION         PAGE 1.1

Optical system temperature = xx.x'C
Reaction block temperature = xx.x'C
               Zero offset = xx.x<units>
        Calibration factor = x.xx
           Date (DD/MM/YY) = xx/xx/xx
           Time (HH:MM:SS) = xx:xx:xx
```

The control temperature of the two heaters is displayed in °C.

Zero Offset indicates the zero drift since the last BASELINE AUTO ZERO CALIBRATION.

The Calibration Factor is calculated after a SECONDARY CALIBRATION; the nominal value is 1.00 but this differs between individual monitors and the reaction control temperature. It is intended to indicate the condition of the monitor and the chemical solutions.

Current date and time.

```
 SYSTEM INFORMATION         PAGE 1.2

        Time units  (DD/MM/YY)
Next AUTO ZERO CAL = xx/xx/xx
Last AUTO ZERO CAL = xx/xx/xx
      Next SEC CAL = xx/xx/xx
      Last SEC CAL = xx/xx/xx
```

The date when the next AUTO ZERO CALIBRATION is to be carried out. If the automatic calibration is disabled, then OFF is displayed in place of the date.

The date of the last ZERO calibration.

The date when the next SECONDARY CALIBRATION is to be carried out. If the secondary calibration is disabled, then OFF is displayed in place of the date.

The date of the last SECONDARY calibration.

A2 Page 2 - Maintenance & Calibration

```
MAINTENANCE AND CALIBRATION.  PAGE 2.0

   Enter security code  xxxx
```

Enter the value of the previously entered security code.

Set the following three parameters to YES when the tasks are carried out. Once set to YES change the display on Page 0 to the required value.

```
    ROUTINE MAINTENANCE.      PAGE 2.1

             5 Weekly pipe rinse = NO
  5 Weekly solution replacement = NO
                  Annual service = NO
 Default calibration parameters = NO
Alter maintenance security code = xxxx
```

Sets the date of the next 5-weekly service.

Sets the date of the next yearly service.

Used during routine maintenance to check the stability of the monitor prior to calibration. Used in single stream mode only - see Section 4.3.

Enter a security code (up to four digits) if required.

All programming Page 2.2 parameters normally set to NO, set to YES as required (setting is maintained).

```
     ROUTINE MAINTENANCE.     PAGE 2.2

      Energise AUTO ZERO valve = NO
  Energise SECONDARY CAL valve = NO
Energise EMERGENCY SAMPLE valve = NO
      Switch lamp on and measure = NO
```

Used to energize the appropriate solenoid valve for test purposes and operating the monitor on synthetic solutions.

Used to carry out tests on the electronic and optical sections.

Note. If any of the parameters on Page 2.2 are set to YES, except for the EMERGENCY valve, it will not be possible to proceed to Page 2.3.

```
     SET UP CALIBRATION.      PAGE 2.3

  Initiate Manual AUTO ZERO = NO
      SEC CAL solution value = xx<units>
Calibration Date (DD/MM/YY) = xx/xx/xx
   Calibration time (HH:MM) = xx:xx
        AUTO ZERO frequency = xx
AUTO ZEROs between SEC.CALS = x
```

Set to ROUTINE or BASELINE depending on the type of Auto Zeroing required. See Section 7.

Used to enter the value of the Secondary Calibration prior to calibration.

Sets the date when the first timed automatic calibration is to be carried out.

Sets the time when the first timed automatic calibration is to be carried out.

Sets the frequency at which the AUTO ZERO calibration takes place. Select: OFF, 12h, 1 day, 2 days,……7 days.

Sets the number of AUTO ZERO calibrations that take place between AUTO SECONDARY calibrations. Select 0 to 10 in one unit increments. When 0 is selected a two-point calibration will be carried out whenever a timed calibration takes place. When SEC CAL set to OFF only Auto Zeros will take place.

Note. Programming Pages 2.4 and 2.5 are part of the automatic calibration sequence. These displays cannot be changed from these pages unless the sequence is aborted.

```
AUTO ZERO SEQUENCE            PAGE 2.4

                Reading = xxx<units>
   Time to compensation = xx min
  Abort AZ calibrations = NO
          SECONDARY CAL = NO
```

Reading during calibration prior to compensation.

Remaining time to the end of the Auto Zero sequence.

When set to YES the sequence is aborted. The original zero offset value is maintained.

When set to YES a two-point calibration takes place. This option is not available when a BASELINE AUTO ZERO is selected.

```
SECONDARY CALIBRATION SEQUENCE PAGE 2.5

                  Reading = xxx<unit>
     Time to compensation = xx min
   Abort SEC calibrations = NO
```

Reading during calibration prior to compensation.

Remaining time to the end of the Secondary Calibration sequence.

When set to YES the sequence is aborted. The original calibration factor value is maintained.

```
CALIBRATION RECOVERY SEQUENCE  PAGE 2.6

               Reading =  xxx <units>
Time to end of sequence =   xx min
           Zero offset = xx.x <units>
    Calibration factor = x.xx
```

Reading during recovery back onto the sample. The display shows the reading which incorporates new calibration values.

Remaining time to end of sequence.

See Programming Page 1.1.

A3 Page 3 - Set Up Instrument

```
SET UP INSTRUMENT              PAGE 3.0

   Enter security code  xxxx
```

Enter the value of the previously entered security code.

```
SET UP INSTRUMENT              PAGE 3.1
           Software issue =  x
       Control temperature =   xx.x'C
             Display units =   <units>
          Display units as =  xx
Alter setup security code =  xxxx
```

Shows the current software issue level.

Set the required control temperature within the range 20 to 45°C in 0.1°C increments. This temperature should be set to or 5°C above the maximum ambient temperature expected.

Set the required display units for phosphate concentration (ppm, mg/l or mg/kg).

Set the display type as P (Phosphorus) or PO_4^{3-} (Orthophosphate).

Enter setup security code (up to four digits) if required.

```
CLOCK SETUP.                   PAGE 3.2

       Date (DD/MM/YY)=  xx/xx/xx
       Time (HH:MM)   =  xx:xx

WARNING: Adjusting any of the above
time parameters will alter the next
Auto Calibration Date.
```

Set the current (real) date and time respectively.

```
  SET UP MULTISTREAM SYSTEM    PAGE 3.3

Stream in use   = 1   2   3   4   5   6
                 ON  ON  ON  ON  ON  ON

Stream sequence= xxxxxxxxxxxx
```

Enables streams to be selected/de-selected.

Used to set the stream sampling order.

Note. If one stream only is selected the monitor behaves as a single stream version.

A4 Page 4 - Set Up Output Currents

```
SET UP CURRENT OUTPUT         PAGE 4.0

   Stream 1 O/P range = 0 to xxx<units>
   Stream 2 O/P range = 0 to xxx<units>
   Stream 3 O/P range = 0 to xxx<units>
   Stream 4 O/P range = 0 to xxx<units>
   Stream 5 O/P range = 0 to xxx<units>
   Stream 6 O/P range = 0 to xxx<units>
```

Set the current output to any range between the following maximum and minimum limits:

PO_4^{3-}	P
0 to 3	0 to 1
and	and
0 to 60	0 to 20

```
SET UP CURRENT OUTPUT                PAGE 4.1

           Output type = xx to xx mA
           Test output = NO
   Up scale sample time = xx mins
 Down scale sample time = xx mins
```

Set to one of the following ranges: 0 to 10, 0 to 20 or 4 to 20mA.

If required, the instrument can automatically transmit a percentage of the full scale test signal: 0, 25, 50, 75, 100% of the current output selected.

These set the sample time (see Section 4.3), i.e. the time the monitor samples each stream. Different times can be entered depending on whether the new stream is higher or lower than the previous stream. This is determined by the values entered on Programming Page 4.0. These parameters are normally set to 12 and 15 minutes, but could be increased if required.

A5 Page 5 - Alarm Relay Setup

```
    ALARM RELAY SETUP                PAGE 5.0

  Alaram relay configuration = Alarm
              Alarm failsafe = YES
            Alarm hysteresis = xx%
```

If fail-safe action is required select YES.

A differential set point can be set as a percentage of the set point value. The differential setting operates on the set point. **Example -** a 5% differential setting operates 2.5% above and below the setpoint.

Set the differential required between 0 and 5% in 1% increments.

```
    ALARM RELAY SETUP                PAGE 5.1

   A1 enabled = NO
  A1 setpoint = xxx <units>
    A1 action = LOW
   A2 enabled = NO
  A2 setpoint = xxx <units>
    A2 action = LOW
```

Select YES or NO as required.

Set the required setpoint values within the instrument range.

Select the alarm action required - HIGH or LOW.

```
SETUP ALARM CONCENTRATION            PAGE 5.2

   A3 enabled = NO
  A3 setpoint = xxx <units>
    A3 action = LOW
   A4 enabled = NO
  A4 setpoint = xxx <units>
    A4 action = LOW
```

Select YES or NO as required.

Set the required setpoint values within the instrument range.

Select the alarm action required - HIGH or LOW.

```
SETUP ALARM CONCENTRATION            PAGE 5.3

   A5 enabled = NO
  A5 setpoint = xxx <units>
    A5 action = LOW
   A6 enabled = NO
  A6 setpoint = xxx <units>
    A6 action = LOW
```

Select YES or NO as required.

Set the required setpoint values within the instrument range.

Select the alarm action required - HIGH or LOW.

Note. Programming Pages 5.2 and 5.3 are displayed on 4 and 6 channel versions only.

A6 Page 6 - Factory Settings

```
   FACTORY SETTINGS                 PAGE 6.0

   Enter factory settings
          security code   xxxx
```

Enter the value of the previously entered security code.

Used for diagnostic purposes only.

```
     FACTORY SETTINGS                PAGE 6.1

  WARNING : These parameters are factory
  set and should not normally require
  adjustment. They can only be set up if
  the necessary equipment is available.
  DO NOT PROCEED WITHOUT CONSULTING THE
  OPERATION MANUAL.
```

APPENDIX B – WIRING SCHEMATIC

```
   ELECTRICAL CALIBRATION.    PAGE 6.2

              Reading = xxx<units>
  Lamp alignment V read =  x.xxx Volts
  Lamp alignment V ref  =  x.xxx Volts
Alter factory settings
          security code   xxxx
```

Lamp alignment V read / V ref – Displays the output of the photocell pre-amplifiers. Used only for information and photocell balance adjustment.

Security code – Enter a security code (up to four digits) if required.

```
   ELECTRICAL CALIBRATION     PAGE 6.3

   Read I/P zero -2V    xxxxx
   Read I/P span +2V    xxxxx
    Ref I/P zero -2V    xxxxx
    Ref I/P span +2V    xxxxx
```

Used for the calibration of the A and D converter. This is set up during the manufacture of the processor board and must not be changed unless full details of the procedure are known.

```
   ELECTRICAL CALIBRATION     PAGE 6.4

Temperature chan1 zero 100Ω    xxx.x
Temperature chan1 span 150Ω    xxx.x
Temperature chan2 zero 100Ω    xxx.x
Temperature chan2 span 150Ω    xxx.x
```

Connect a 100Ω resistance to the input of the respective temperature input.

Connect a 150Ω resistance to the input of the respective temperature input.

Wait for the display to stabilize before moving on to the next step. The new calibration datum is automatically entered.

```
   ELECTRICAL CALIBRATION     PAGE 6.5

        Current output 1 - 4-20mA
        Current output 2 - 4-20mA
        Current output 3 - 4-20mA
        Current output 4 - 4-20mA
        Current output 5 - 4-20mA
        Current output 6 - 4-20mA
```

Calibration is performed on the 4 to 20 mA range, but values are valid for 0 to 10 and 0 to 20 mA ranges.
Connect a digital current meter to the respective output terminals and use the raise and lower buttons to adjust the respective output up or down to within <±0.25% of the maximum current output.

```
     INSTRUMENT TIMING         PAGE 6.6
  Measured variable filter = ON
           Optical filter = x

     Cuvette filling time = xxx s
           AUTO ZERO time = xxx min
SECONDARY CALIBRATION time = xxx min
   Recovery on sample time = xxx min
```

Measured variable filter – For service purposes only. Must normally be set to ON. When set to OFF, the signal processing to remove the effects of chemical noise and air bubbles is bypassed.

Optical filter – This is set to 1 or 2 depending on the type of optical filter fitted in the photocell housing. The 'type 2' is indicated by a red sleeve on the photocell cable.

Cuvette filling time normally set to 65s to ensure that the cuvette overflows before the lamp is switched on.

20min
20min
20min

These do not require further adjustment except for Recover On Sample Time which can be increased if the sample value is near zero.

```
  CALIBRATION ALARM SETUP     PAGE 6.7

 Zero offset range = 0.0 +/- xxx <units>
 Cal factor range  = 1.0 +/- x.xx
```

Zero offset range – Enables the acceptable range of zero offset to be selected before a calibration fail alarm is initiated. 0.6 to 30 as PO_4^{3-} or 0.2 to 10 as P, OFF, normally set to 6 as PO_4^{3-}, 2 as P.

Cal factor range – Enables the acceptable range of calibration factor to be selected before a calibration fail alarm is initiated. 0.15 to 0.5, OFF, normally set to 0.2.

```
       MULTISTREAM TIMING     PAGE 6.8

   Number of streams fitted = x
```

Number of streams fitted into the monitor.

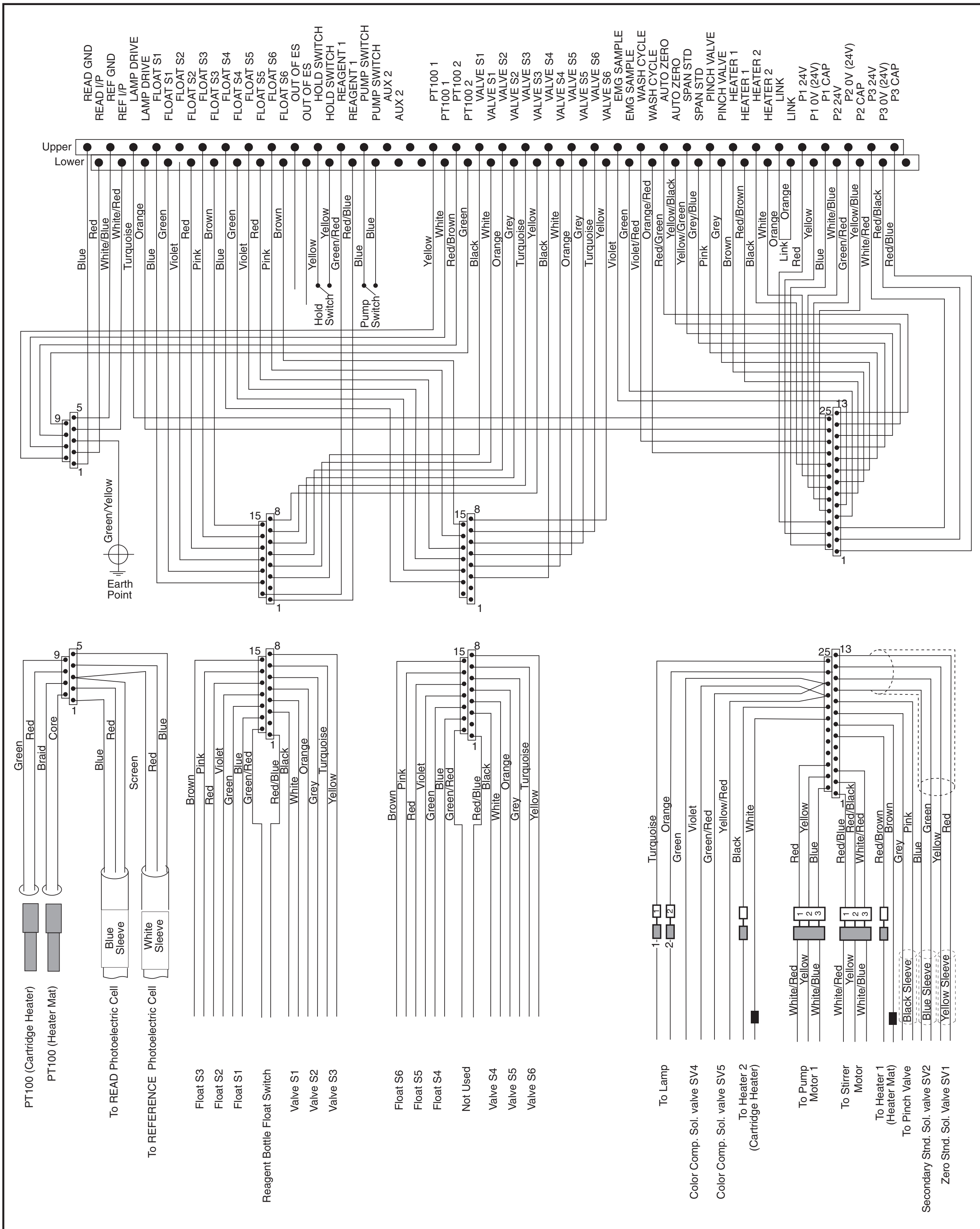


Fig. B1 Wiring Schematic

Warning. Switch off the monitor and electrically isolate it before carrying out the following steps.

Caution. Employ normal antistatic precautions while handling chips and PCBs.

1) Remove the screws from the electronics section front panel and swing it open to reveal the printed circuit boards (PCBs).
2) Remove the four screws that secure the two PCB restrains to stand-off pillars and remove the restrains.
3) Disconnect the ribbon cable – see Fig. C1. Note that the cable feeds in from the front of the board.
4) Carefully ease the processor board (see Fig. C1) from the mother board.
5) Remove the software EPROM chip, preferably using an extractor. This chip is the third from the top (the only labelled chip – see Fig. C1).
6) Fit the replacement chip ensuring correct orientation in its socket.
7) Complete the procedure as follows:
   - Plug the PCB onto the mother board;
   - connect the ribbon cable to the processor board;
   - fit the PCB restraints and secure them using the previously removed screws;
   - close the electronics section front panel and secure it using the previously removed screws.
8) The monitor may now be put into service.
9) Check program parameters – see instruction manual.
10) Carry out a routine 2-point calibration.

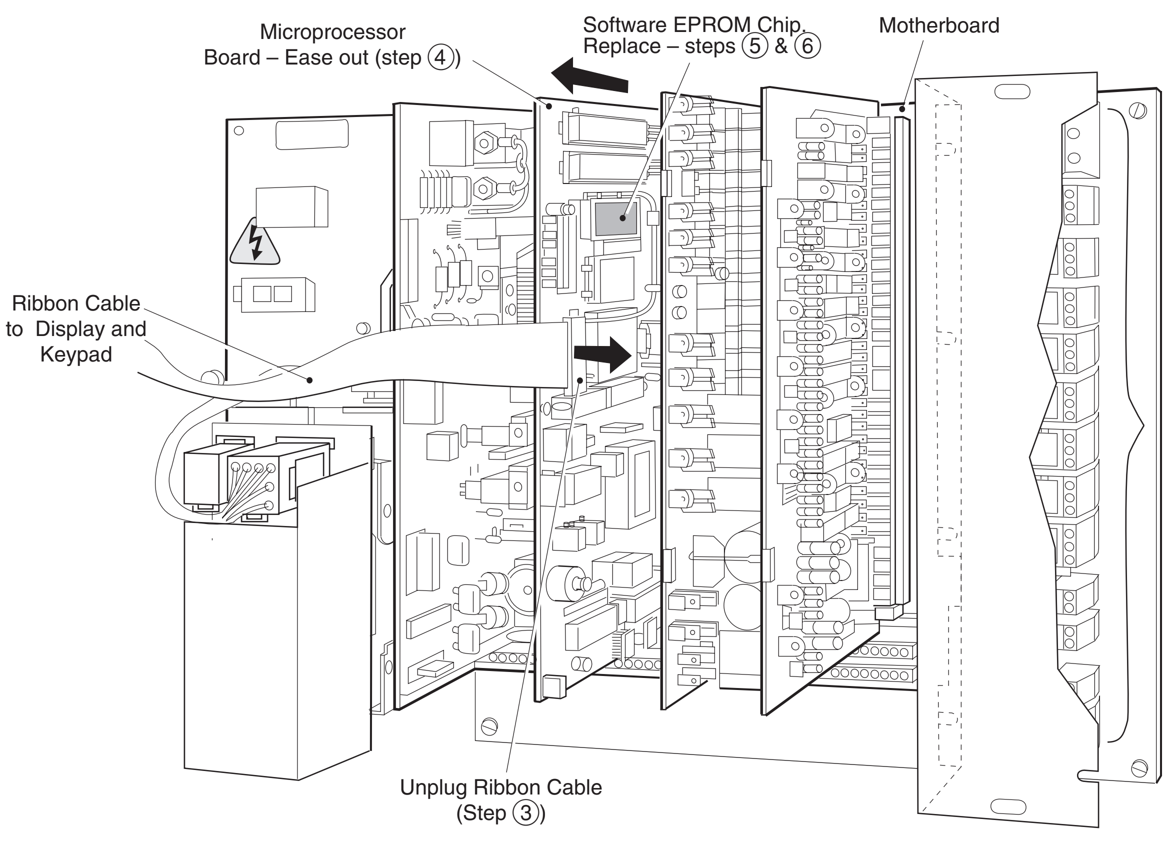


Fig.C1 8240 Electronics Section

PRODUCTS & CUSTOMER SUPPORT

Products

Automation Systems

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

Drives and Motors

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

Controllers & Recorders

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

Flexible Automation

- *Industrial Robots and Robot Systems*

Flow Measurement

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

Marine Systems & Turbochargers

- *Electrical Systems*
- *Marine Equipment*
- *Offshore Retrofit and Refurbishment*

Process Analytics

- *Process Gas Analysis*
- *Systems Integration*

Transmitters

- *Pressure*
- *Temperature*
- *Level*
- *Interface Modules*

Valves, Actuators and Positioners

- *Control Valves*
- *Actuators*
- *Positioners*

Water, Gas & Industrial Analytics Instrumentation

- *pH, Conductivity and Dissolved Oxygen Transmitters and Sensors*
- *Ammonia, Nitrate, Phosphate, Silica, Sodium, Chloride, Fluoride, Dissolved Oxygen and Hydrazine Analyzers*
- *Zirconia Oxygen Analyzers, Katharometers, Hydrogen Purity and Purge-gas Monitors, Thermal Conductivity*

Customer Support

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

United Kingdom

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

United States of America

ABB Inc.
Tel: +1 (0) 775 850 4800
Fax: +1 (0) 775 850 4808

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 all storage, installation, operating and maintenance records relating to the alleged faulty unit.

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