1 Introduction

1.1 Brief Description

The Model 8241 Silica Monitor is a microprocessor-based colorimetric analyzer that monitors the level of silica in de-mineralization and steam generation plants. The instrument is available as a single stream or as a multi-stream version, the latter is able to sequentially sample up to six independent streams.

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 silica in the sample involves the addition of various chemical reagent solutions to the sample in a specific order 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 silica in the original sample, thus making it possible for the measurement to be made optically.

The 8241 Silica Monitor carries out this reagent solution addition as follows:

1. 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.
2. A solenoid valve is then used to select automatically one stream to be sampled sequentially. This allows sample, under controlled pressure conditions, to be
3. presented to one of two multi-channel peristaltic pumps which
4. proportions sample and reagents through a series of mixing and reaction stages. The reaction stages are temperature controlled to remove the effects of sample and ambient variations.
5. The reacted solution is then delivered to a small chamber, called a measuring cuvette, in the optical system where the measurement takes place.
6. The output from the optical system, which is based on how much light is absorbed by the solution, is then processed by the microprocessor-based electronics section to calculate the actual silica concentration in the sample.

Note.

- 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.
- At silica concentrations greater than 2000µg l^{-1} SiO_2 the light absorbed by the solution in the standard length cuvette is sufficient to cause inaccuracies in the measurement. For determination of high silica concentrations, therefore, a shorter path length cuvette is fitted. This allows the upper limit of silica concentration to be increased to 5000µg l^{-1} SiO_2 with a corresponding increase in the minimum current output range from 20 to 50µg l^{-1} SiO_2.

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.

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 2.

To gain access to the liquid handling section follow steps 4 and 5.

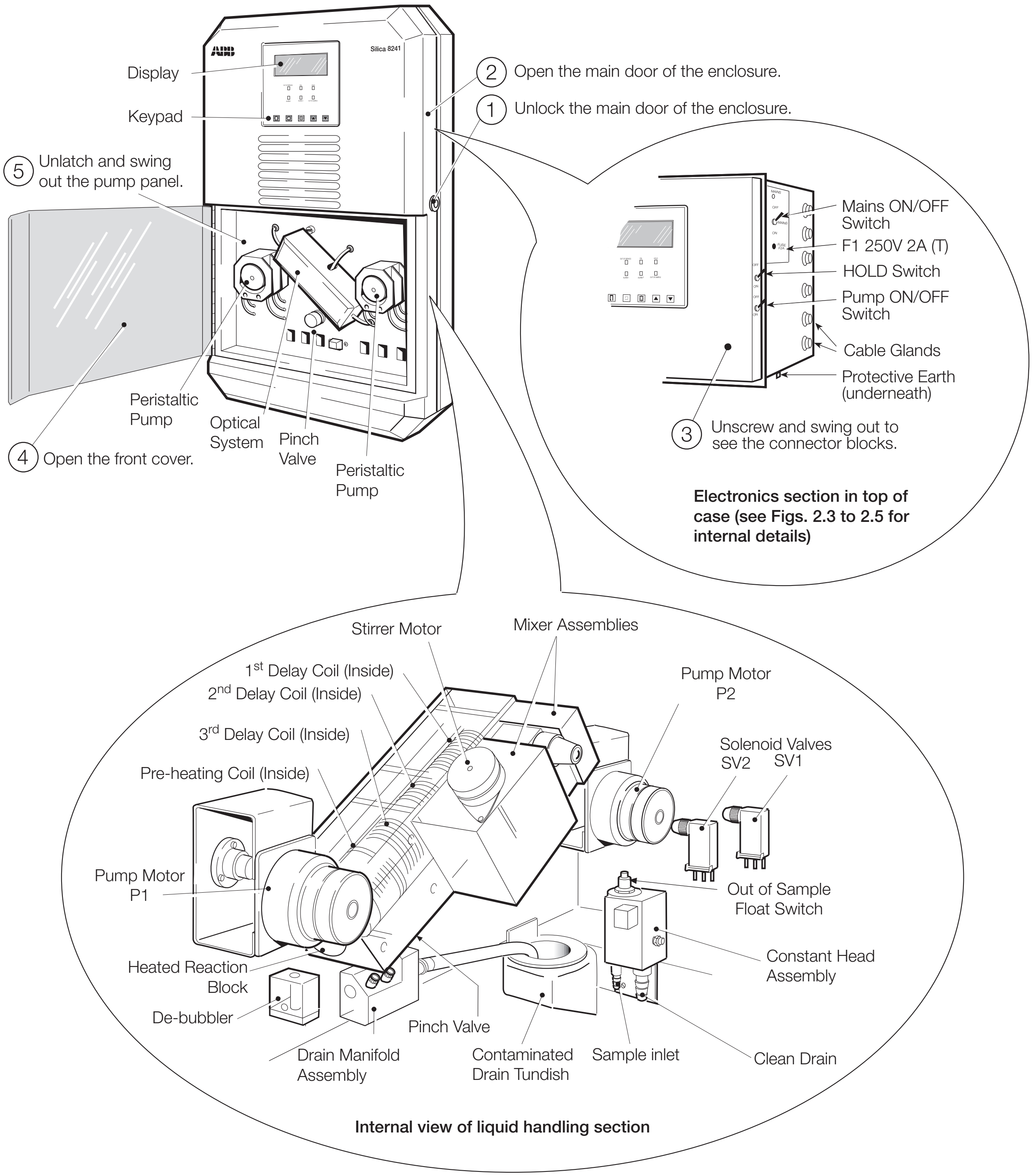


Fig. 1.1 Main Components

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

2 Installation

2.1 Accessories

The accessories supplied are as follows:

- 4 x reagent containers
- 1 x calibration solution container
- 5 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 and enclosure dimensions.

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:

1. Sample flowrates must be greater than 5ml min^{-1}.
2. Sample temperature should be within the range 5°C to 55°C.
3. Particles must be less than 10mg l^{-1} and the size must not exceed 60 microns without the sample filter being fitted. Above these levels it is essential that the filter supplied is fitted in both sample and emergency inlets.

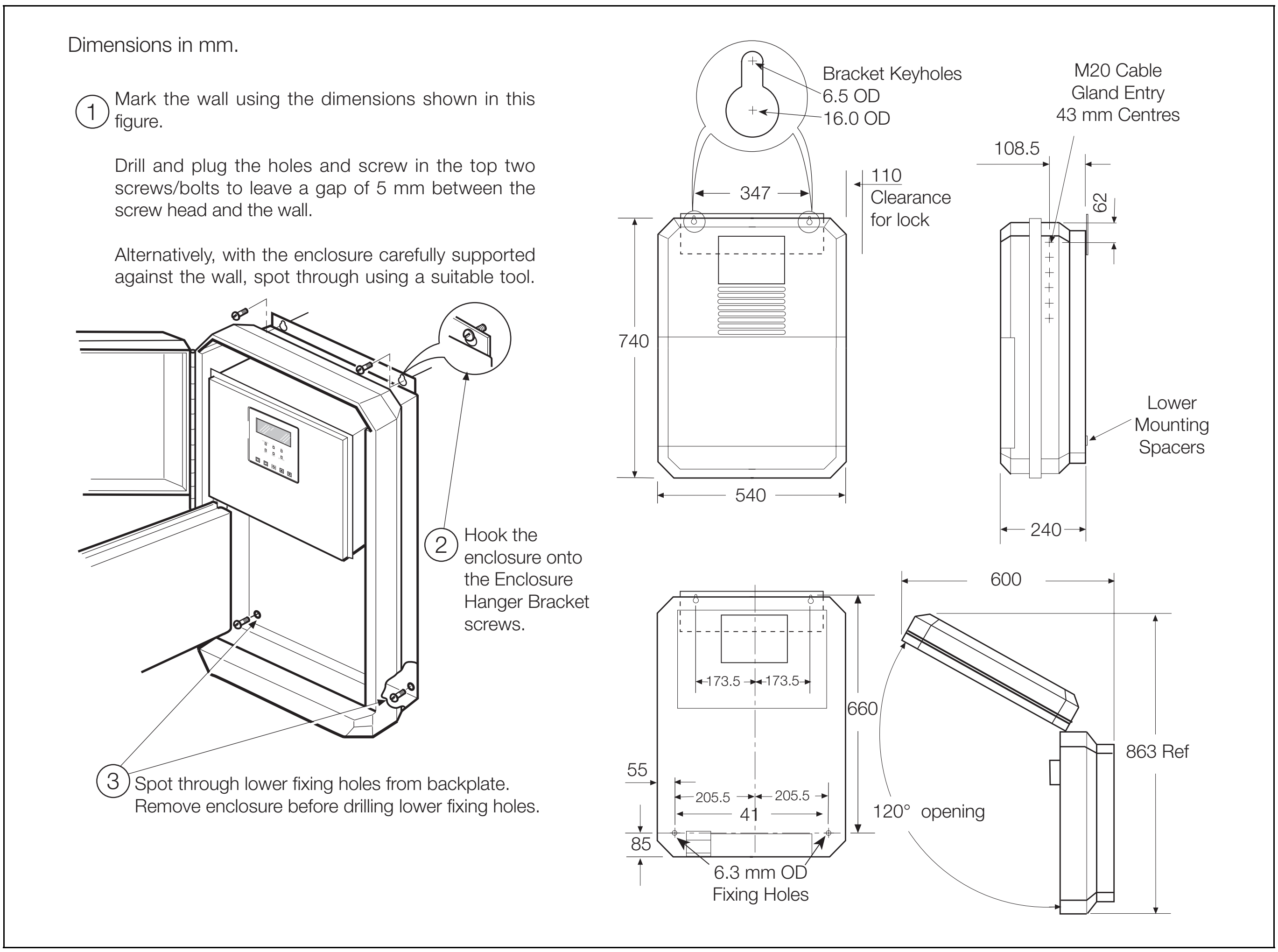


Fig. 2.1 Mounting the Unit

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

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.** 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.

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

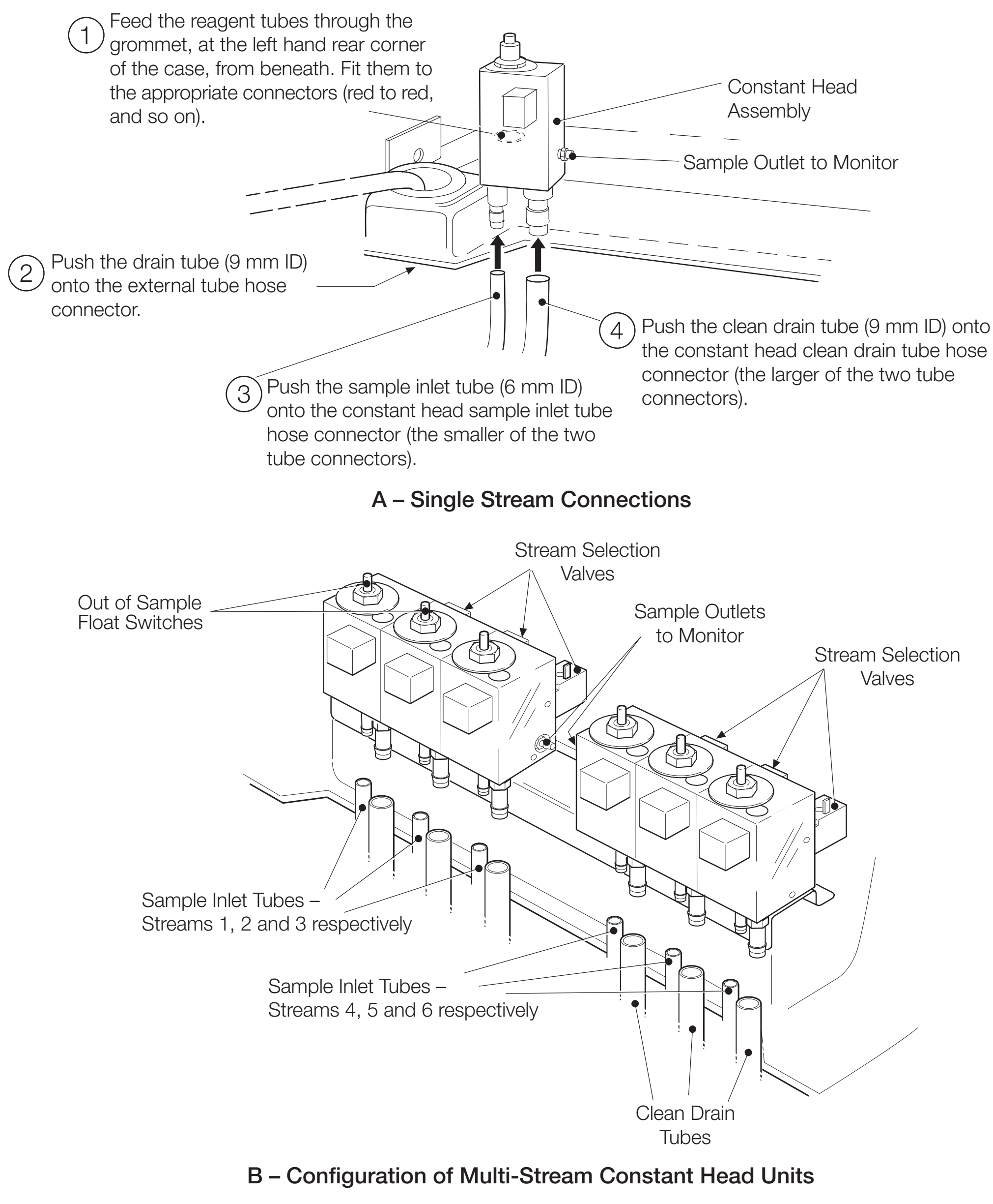


Fig. 2.2 External Tube Connections

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

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 3A fuse or miniature circuit breaker (MCB), must also be fitted by the installer.
- 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.
- The power supply earth (ground) must be connected to ensure safety to personnel, reduction of effects of radio frequency interference (RFI) and correct operation of the power supply interference filter.

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 RFI 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)** – 115V (110 to 120V) or 230V (220 to 240V). The mains voltage is selected using the voltage selector – 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.

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

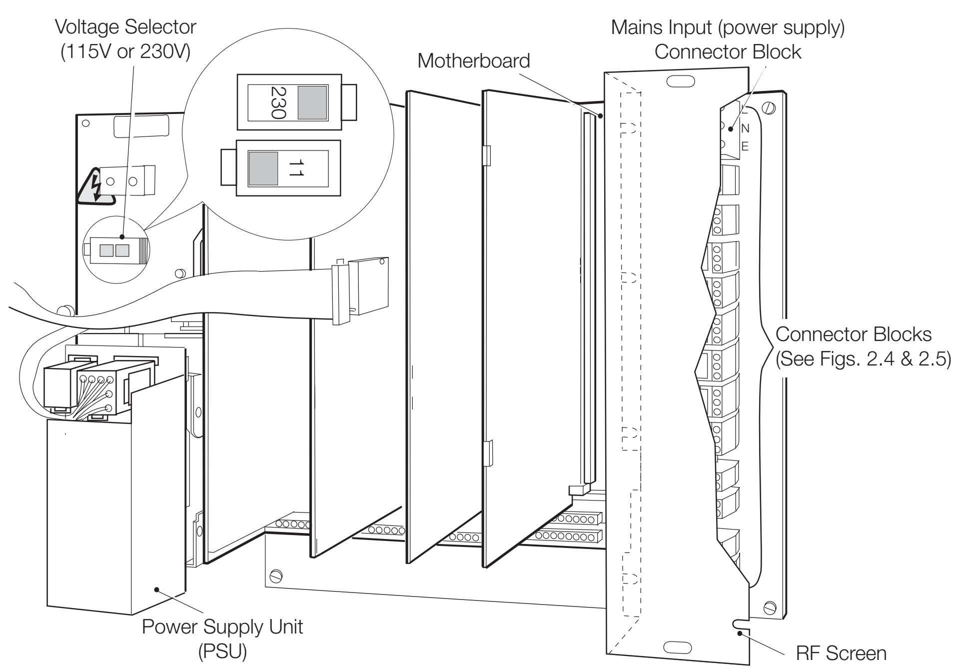
The setting of the range of the current output is covered on Programming Page 4 (see Section 6.5, page 24).

- **Single-Stream:**
  RELAY 1 and 2–two 'Concentration' alarms relays.
  RELAY 3–'Out of Sample' alarm relay.

  Multi-Stream:
  RELAYS 1 to 6–one relay per stream configurable as 'Concentration' or 'Out Of Sample' alarms relays.

  The 'Out of Sample' alarm relay can be used as a remote indication.
- **CALIBRATION** – remote calibration mode indication alarm relay. This indicates when the instrument is off-line during a calibration – see Section 7, page 27.
- **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, page 34.
- **SERIAL** – optional serial interface (see supplementary instruction manual for details).

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

Fig. 2.3 Mains Input Connector Block and Voltage Selector Locations

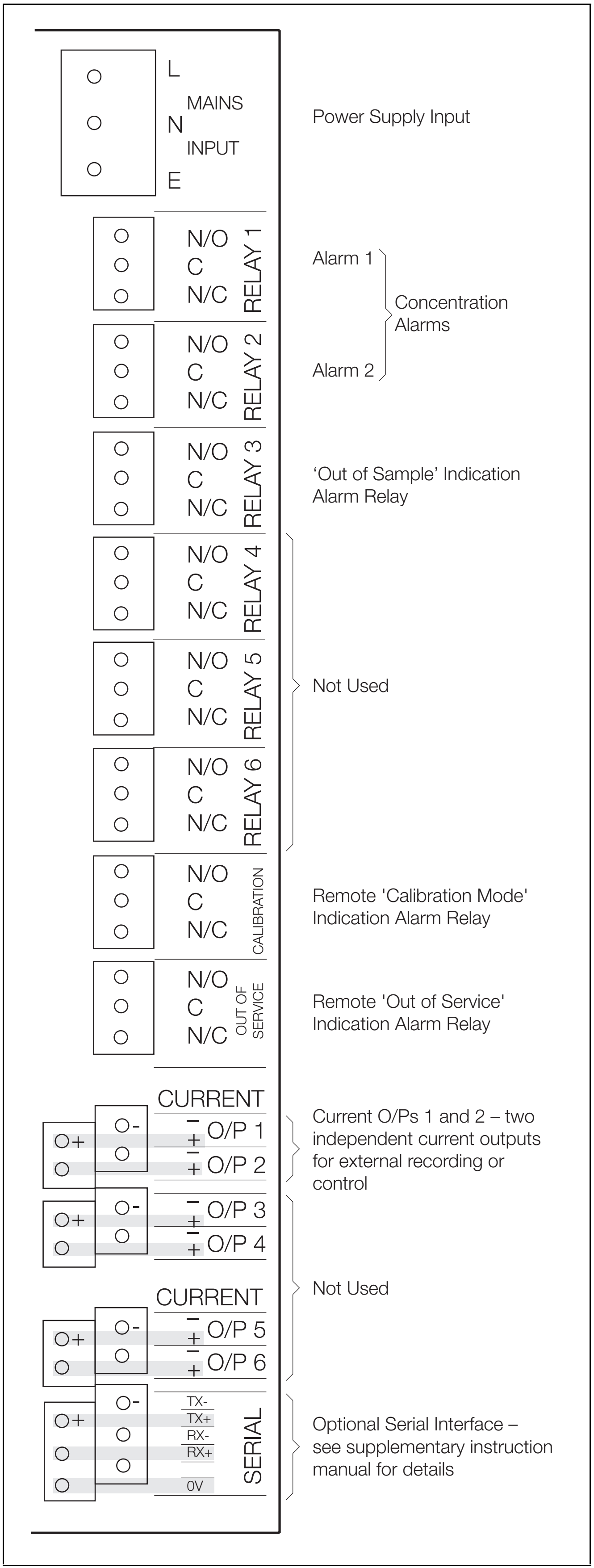


Fig. 2.4 Electrical Connections – Single Stream

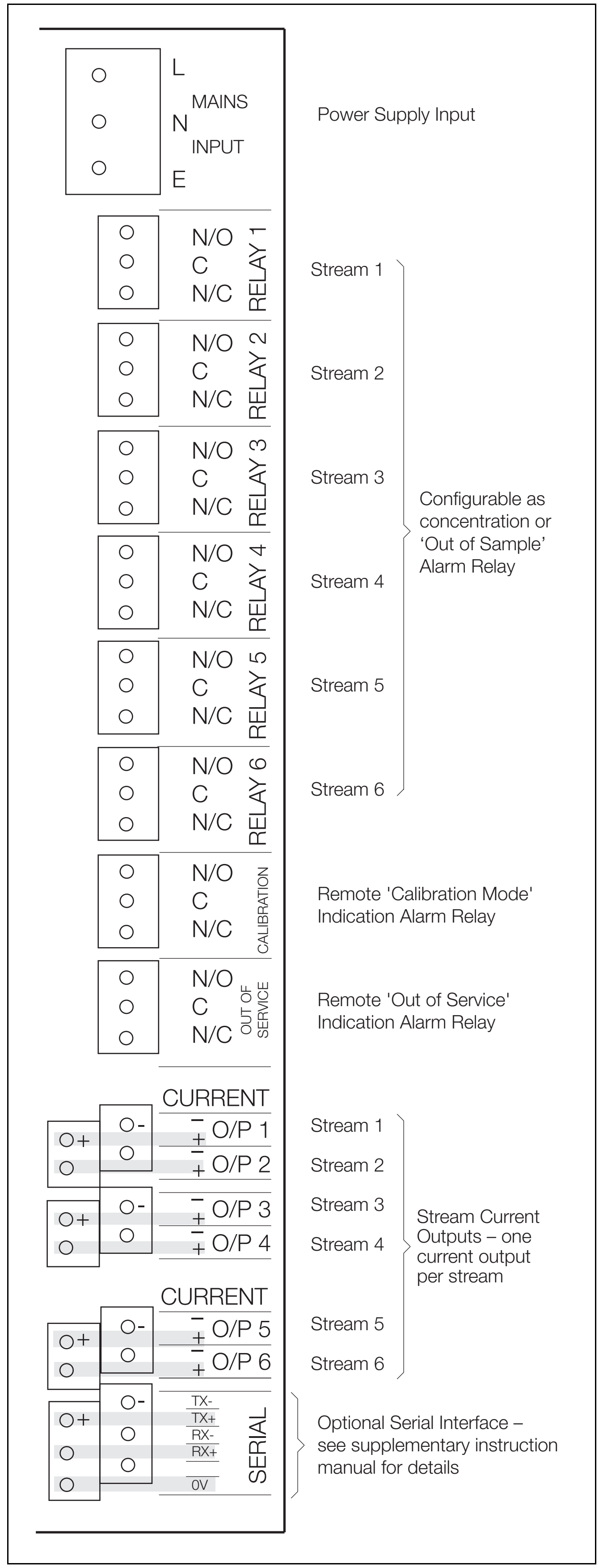


Fig. 2.5 Electrical Connections – Multi-Stream

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 RFI which can cause instrument malfunctions and incorrect readings. To minimize the effects of RFI, arc suppression components are required; these are resistor/capacitor networks for AC applications, or diodes for DC applications. These components can be connected either across the load or directly across the relay contacts.

For **AC applications** the value of the resistor/capacitor network depends on the load current and inductance that is switched. Initially fit a 100R/0.022µF RC suppressor unit (part no. B9303) as shown in Fig. 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 **DC applications** fit a diode as shown in Fig. 2.6B. For general applications use an alternative IN5406 type (600V peak inverse voltage at 3A – part no. B7363).

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

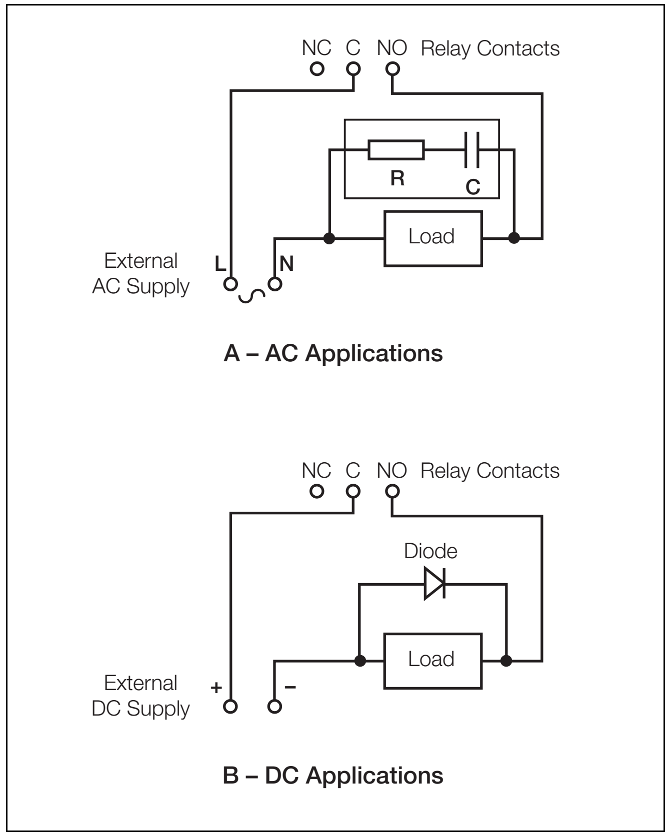


Fig. 2.6 Relay Contact Protection

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.

1. Ensure that all external electrical and plumbing connections have been made correctly.
2. Fill reagent and standard solution bottles (see Section 8.1, page 28 for details of these solutions).
3. 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.
4. 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, page 19 (or Appendix A for multi-stream programming). Any calibrations are prevented by the microprocessor during this time.

5. Verify that there is an adequate supply of sample to the monitor constant head unit.
6. 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.
7. Fit the pressure plate platen on the peristaltic pumps (see Section 8.2.6, page 31) and switch the pumps on with the switch on the side of the monitor. Note that the peristaltic pumps rotate and check that sample and reagents are being drawn into the monitor by observing the progress of any small bubbles present in the inlet tubes.
8. 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.
9. Set the following parameters to YES using Programming Page 2.1:

   Five-Weekly System Flush
   Five-Weekly Solution Replacement
   Default Calibration Parameters.

> **Note.** 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, page 30.

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

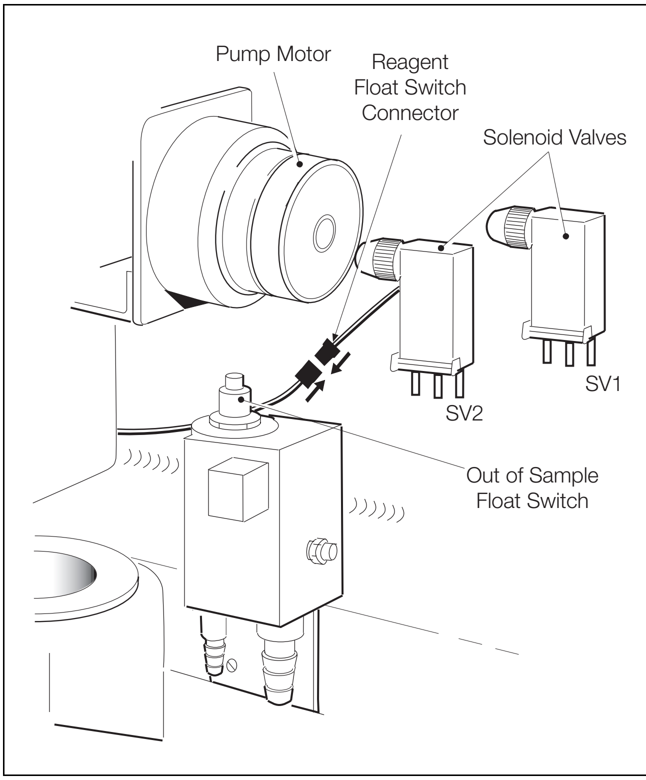


Fig. 3.1 Reagent Float Switch Connector

10. 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 one to two hours to purge the old solution and assess stability.
11. If the monitor exhibits good stability, i.e. ±2% of reading, carry out a two-point BASELINE calibration – see Programming Page 2.3.
12. Check the condition of the sample filters and replace them if necessary. Ensure that new filters are fitted correctly by taking note of the flow directions indicated on the filter bodies.

4 Liquid Handling Section

4.1 Principle of Operation – Fig. 4.1

The chemical method used in the monitor utilizes the reaction between silicate species in the sample, acid and molybdate reagents, to form yellow molybdosilicic acid complex. The acid conditions are chosen so that specifically beta-molybdosilicic acid is produced which excludes interference from other forms of the acid complex. To improve the sensitivity of the method the yellow acid is reduced to the blue form which is measured colorimetrically in the optical system.

The sequence of events is:

1. Sulfuric acid (1st acid reagent) is added to the sample to reduce the pH to a value between 1.4 to 1.8pH.
2. Ammonium molybdate is added to the acidified sample.
3. The solution enters the first reaction coil in the temperature controlled block (providing a two minute delay) where the yellow beta-molybdosilicic acid is developed.
4. Sulfuric acid plus citric acid (2nd acid reagent) is added before the solution enters the second reaction coil in the temperature controlled block (providing a two minute delay) to reduce the pH further to a value between 0.8 to 1.0pH. This is the pH value required to stop further development of the silica and to provide the conditions for the next reaction (reduction) to take place.

   In applications where the sample contains phosphate, the citric acid concentration is increased to destroy any phosphate complexes which would augment the color developed in the next stage.
5. The reduction solution is added before the solution enters the third reaction coil in the temperature controlled block (providing a one minute delay) reducing the yellow complex to the blue form.
6. The fully developed solution passes to the measuring cuvette in the optical system where the intensity of the color, which is proportional to the original silica concentration, is measured.
7. During the automatic zero calibration the monitor generates a zero solution by diverting the sample to a point where the second acid solution is added. The pH at this point is too low to allow the silica-molybdate reaction to take place, so the solution of zero silica concentration is produced. In the zero calibration the system allows silica in the first acid and molybdate solutions to be developed. A secondary upscale calibration is achieved by the automatic introduction of a standard solution of a known value.

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 to energize the emergency sample valve. This 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.

> **Note.** Fitted in the sample lines are disposable sample filters. These are necessary to protect the liquid handling system from blockages due to solids in the sample.

For the multistream 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 (P1) 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 drain by another channel of (P1). This is necessary to reduce the effect of air bubbles in the sample which will give variable reagent mixing resulting in noisy readings on the display.

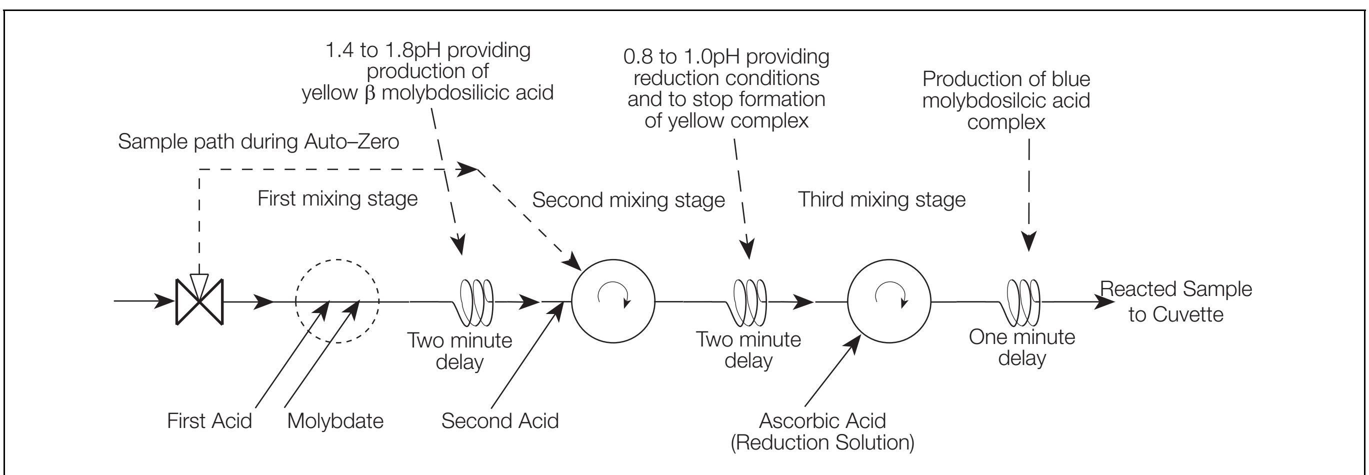


Fig. 4.1 Chemical Schematic

The 1st acid and the ammonium molybdate solutions, delivered via two channels on the peristaltic pump (P2) are then added to the sample in the static mixer block (M1) before passing through the 1st heated delay coil where the first reaction takes place.

The 2nd acid, via P2 is added to the sample before entering the dynamic mixer (M2) and then passes through the 2nd heated delay coil.

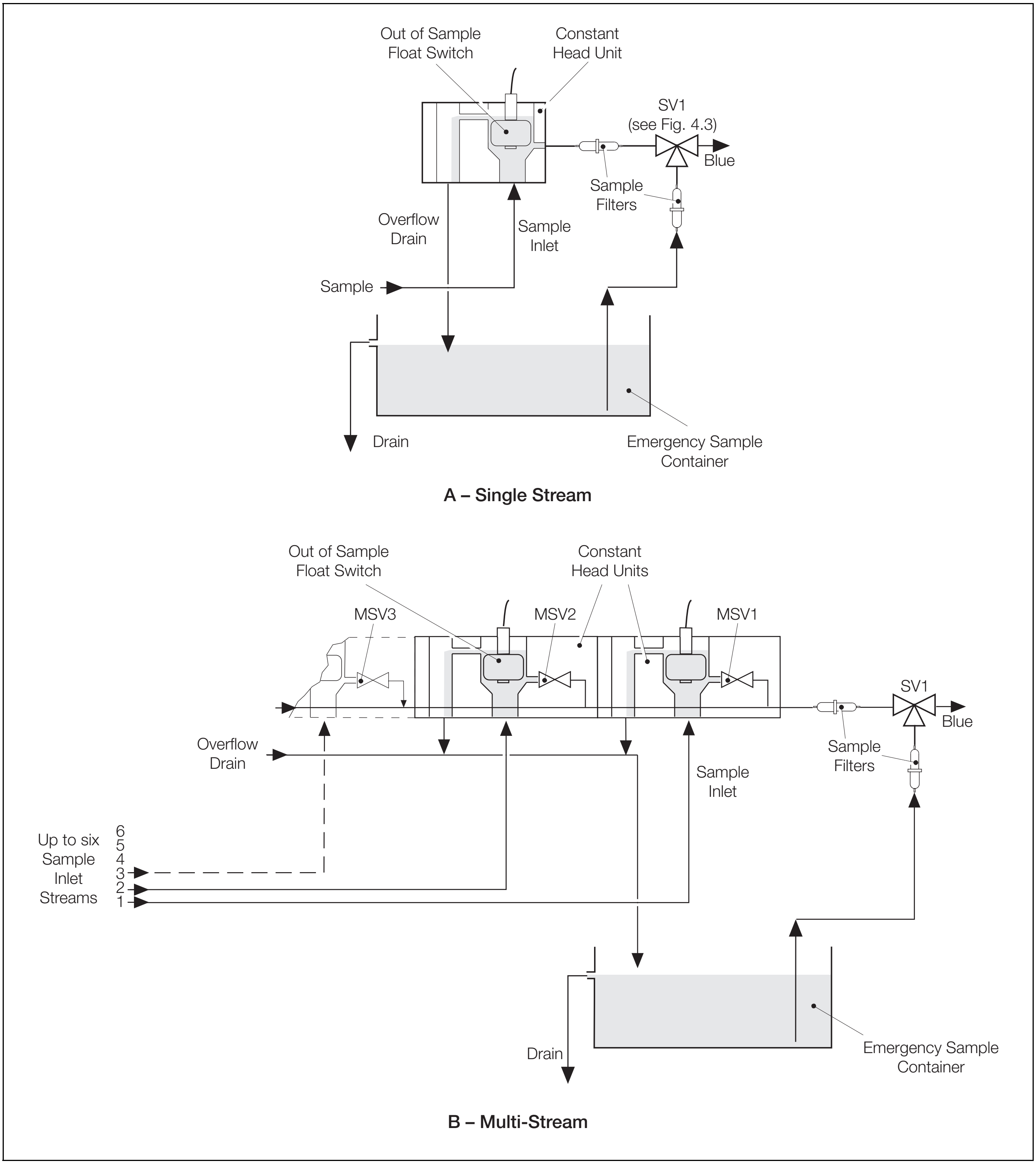


Fig. 4.2 Flow Schematic – Sample Inlet

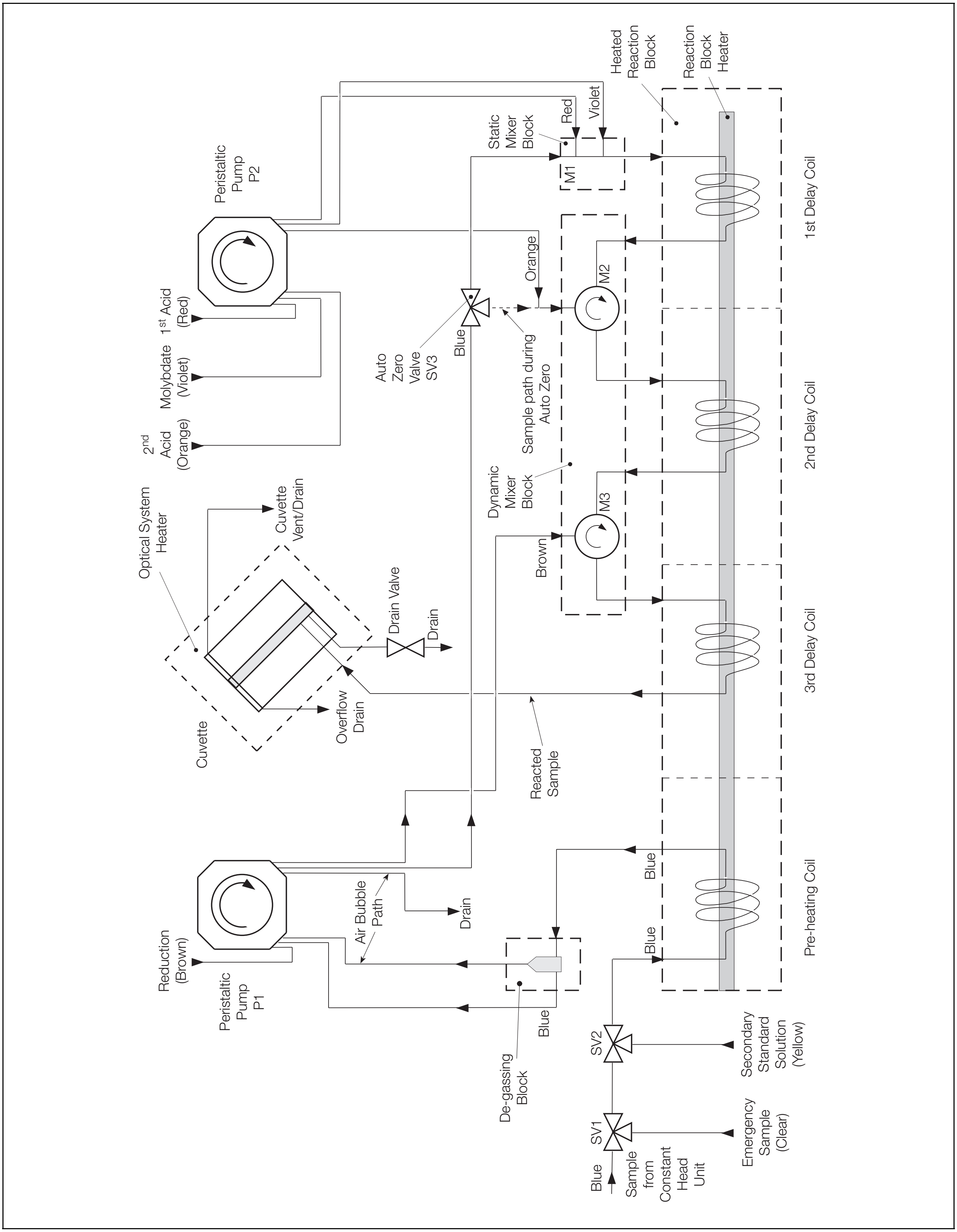


Fig. 4.3 Flow Schematic of Chemical Section

The solution then passes into the dynamic mixer (M3) where the reduction reagent solution is added via P1.

The resultant solution is then passed through the 3rd heated delay coil before being presented to the measuring cuvette.

> **Note.** A dynamic mixer consists of a small stirrer sited in a chamber in the mixer block and is magnetically coupled to a small electric motor.

During an AUTO ZERO, solenoid valve SV3 is used to divert the sample from mixer block M1 to M2. Solenoid valve SV2 is used to introduce the secondary standard solution. In the event of a loss of sample, SV1 is used to introduce an emergency sample to prevent the undiluted reagents fouling in the system plumbing tubing.

The sample pre-heater coil and the three reaction coils are mounted in a single acrylic block. This block is heated using a small 24V 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, page 30.

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 on page 42). The stream sampling period, i.e. the duration the monitor spends on each stream, is normally set to 12 minutes, although the upscale and downscale times can be set independently by the user – see Programming Page 4.1. 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. 4.4.

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 LED 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 on page 42). 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 into multi-stream operation.

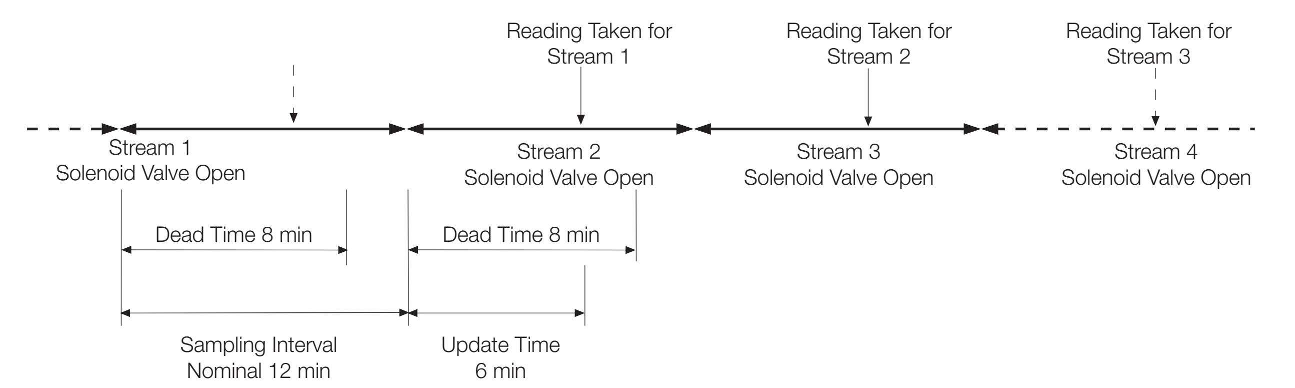


Fig. 4.4 Multi-Stream Timing

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:

1. Put 100ml of sample into a clean, well rinsed container. This will run the monitor for 25 minutes approximately.
2. Remove the secondary calibration container tube. Rinse in high purity water and transfer it to the grab sample container.
3. Energize the secondary calibration valve (see Section 6, page 19, 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, page 13).
4. The display should stabilize on the grab sample value after 16 minutes approximately which can them be noted.
5. Remove the tube from the container, rinse and return it to the secondary calibration container. Run the monitor for a further five minutes.
6. Return the monitor to normal operation by de-energizing the secondary calibration valve.

4.5 Optical System – Figs 4.5 and 4.6

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 810nm). 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 one-minute cycle controlled by the microprocessor.

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.

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

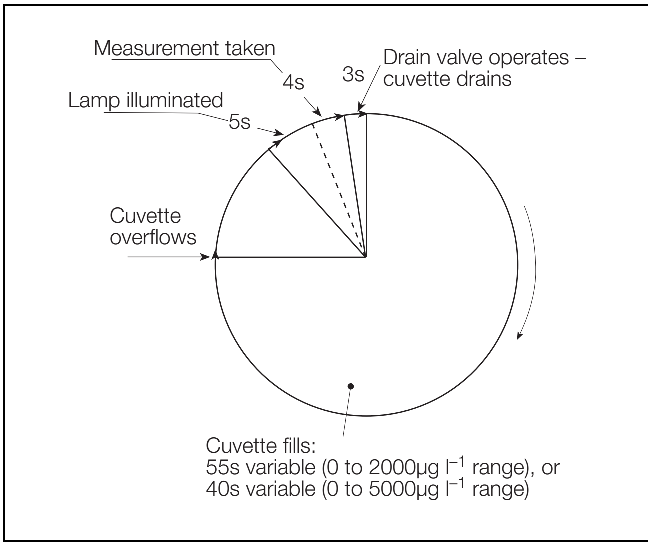


Fig. 4.5 Drain/Fill Sequence

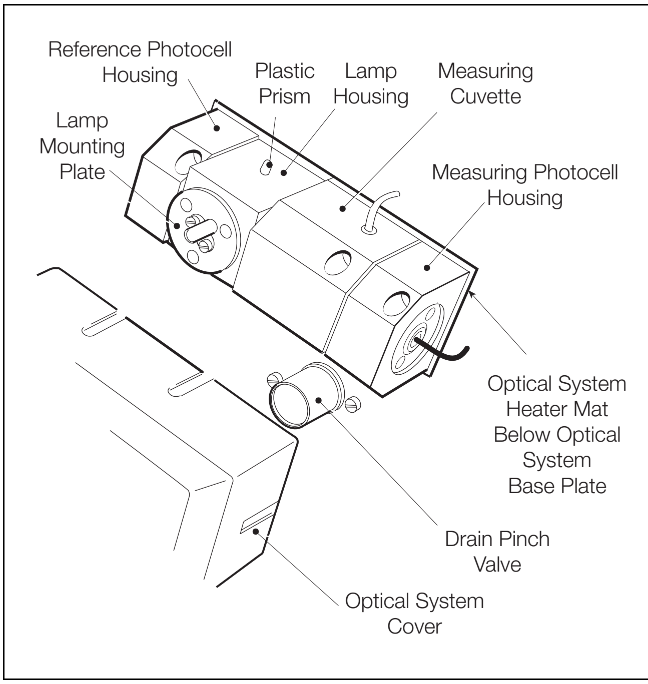


Fig. 4.6 The Optical System

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

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 (Single Stream) or Appendix A (Multi-stream). 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.

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

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

5.2 Display

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

> **Note.** A flashing display indicates that the value is out of range for that particular parameter.

5.3 LED Indicators

Out of Service Indicates that the monitor out of servicealarm is active, the source is indicated on Programming Page 1.0 – see Section 6, page 19.

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 calibration.

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

Streams 1 to 6 These are two color red/green LED 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 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 Fig. 2.5 and Fig. 2.6.

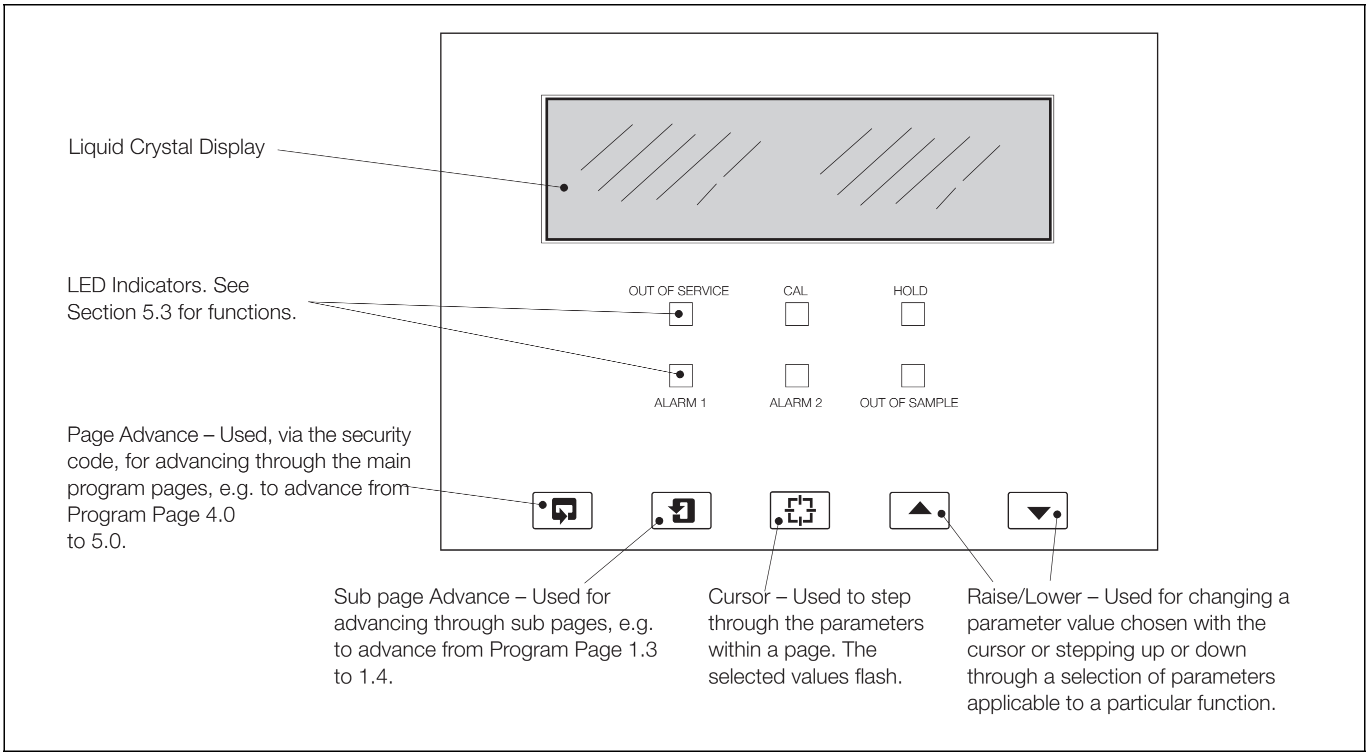


Fig. 5.1 Front Panel Controls – Single Stream

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.

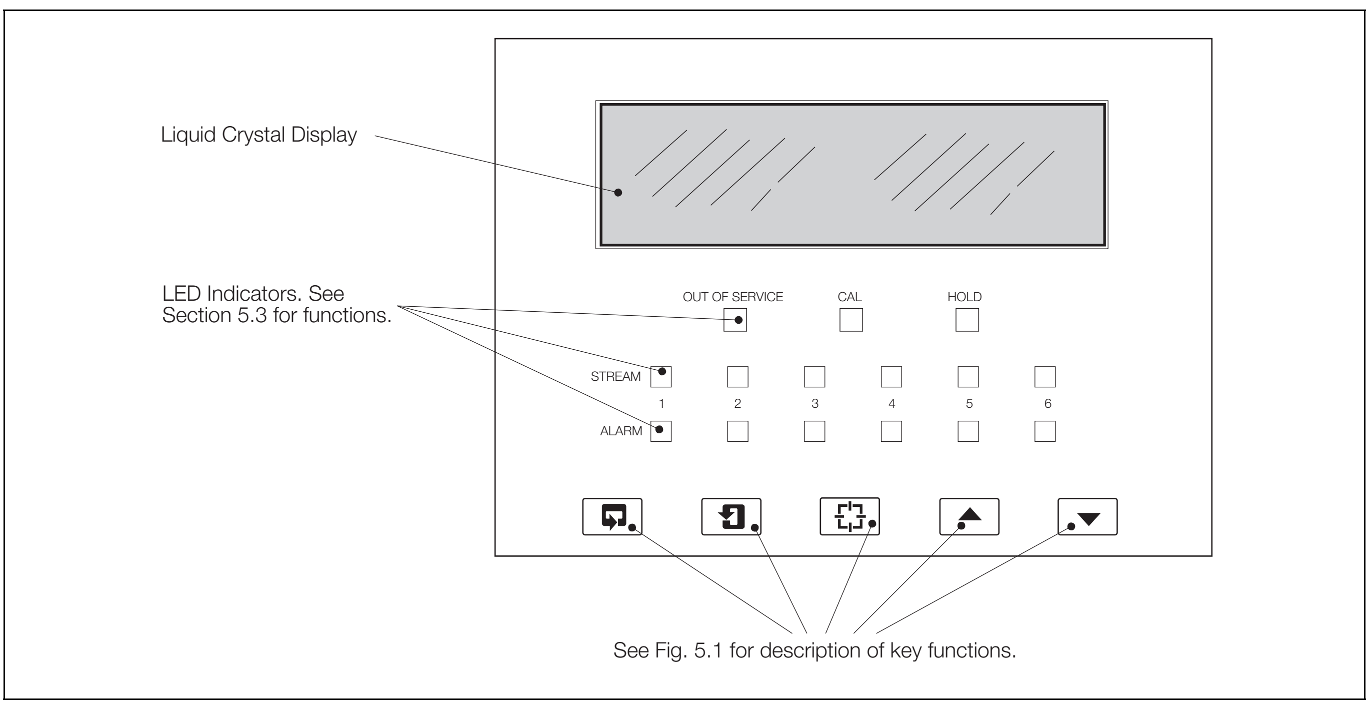


Fig. 5.2 Front Panel Controls – Multi-Stream

5.4 Microprocessor Unit – Figs. 5.3 and 5.4

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

Motherboard 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 selection, calibration value, pump motor and heater control.

Output Board Provides current, 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.

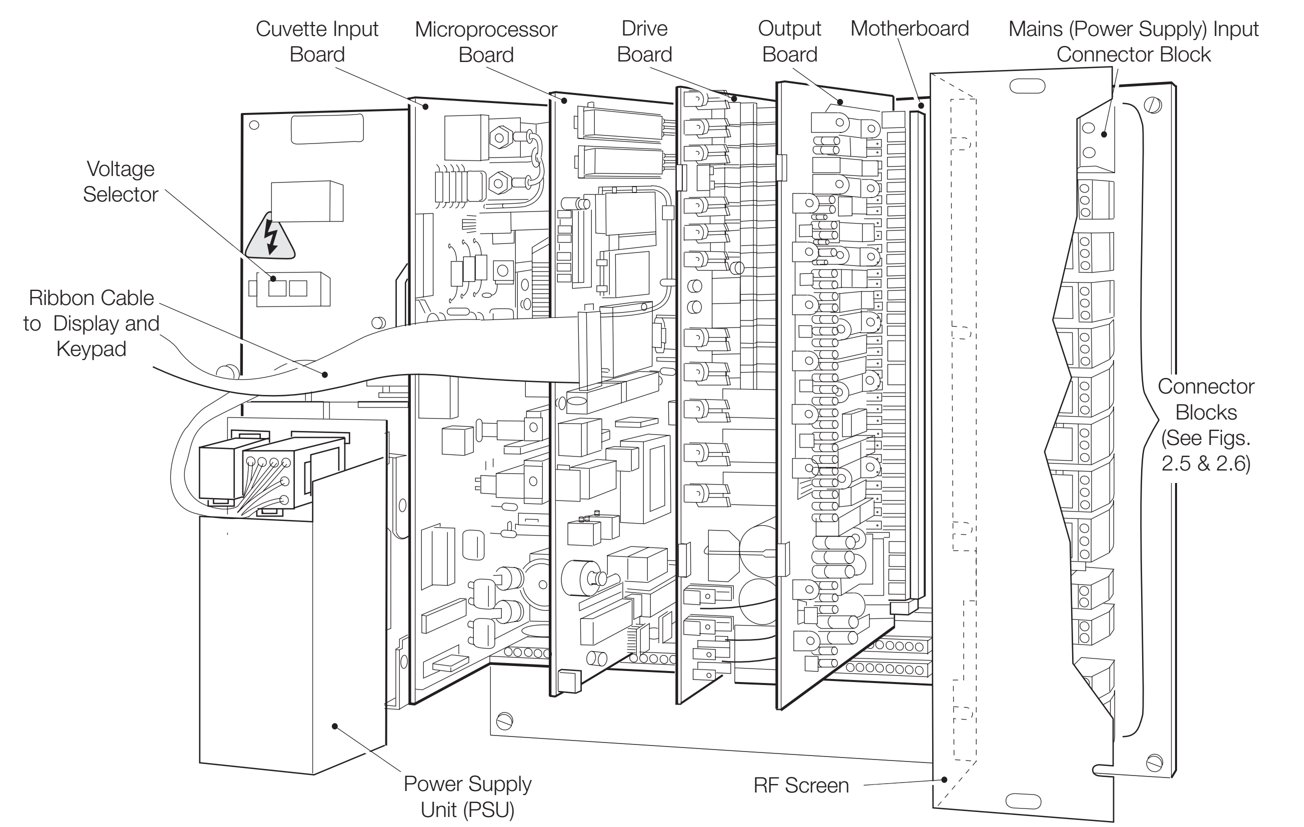


Fig. 5.3 Microprocessor Unit

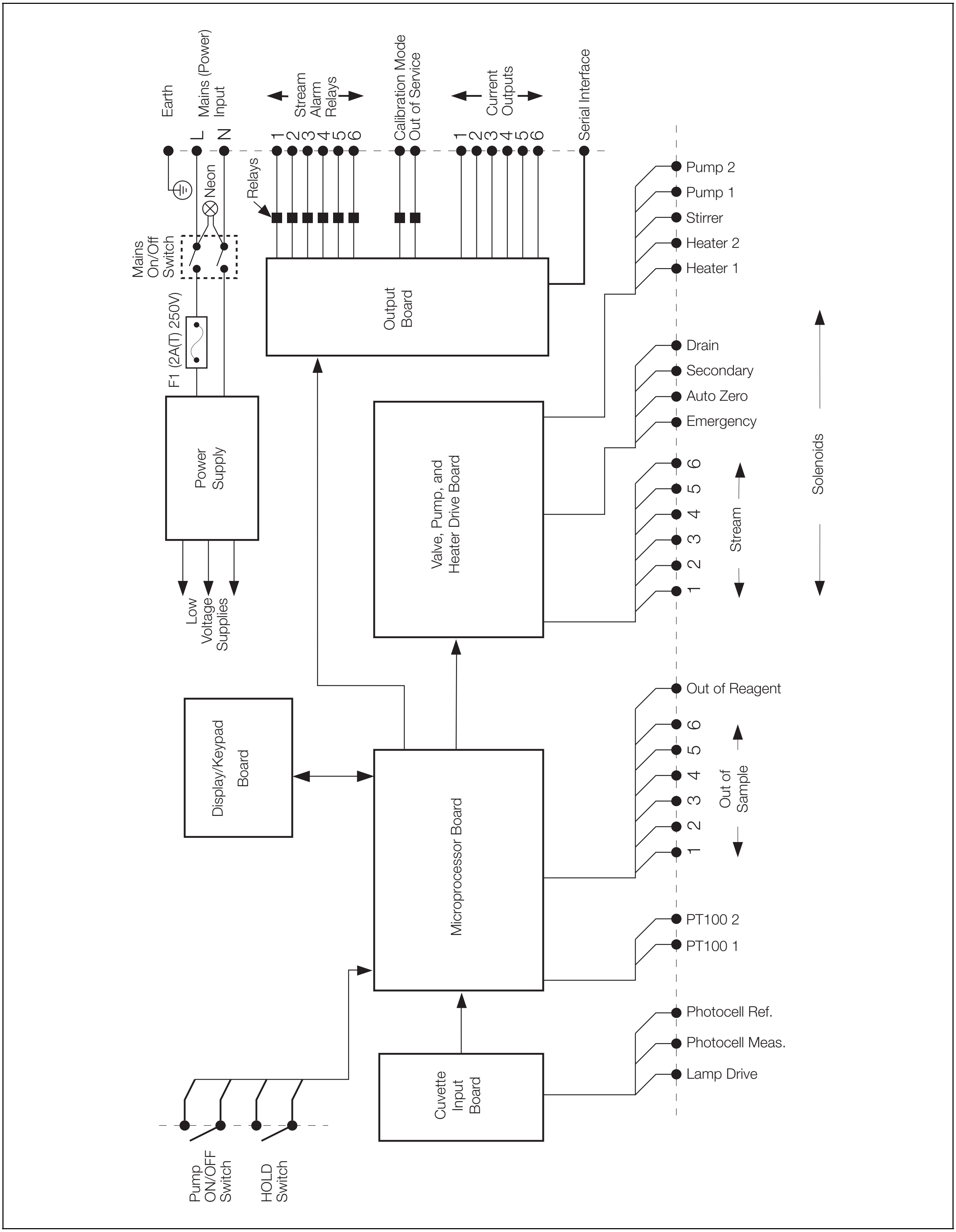


Fig. 5.4 Electronics Section Schematic

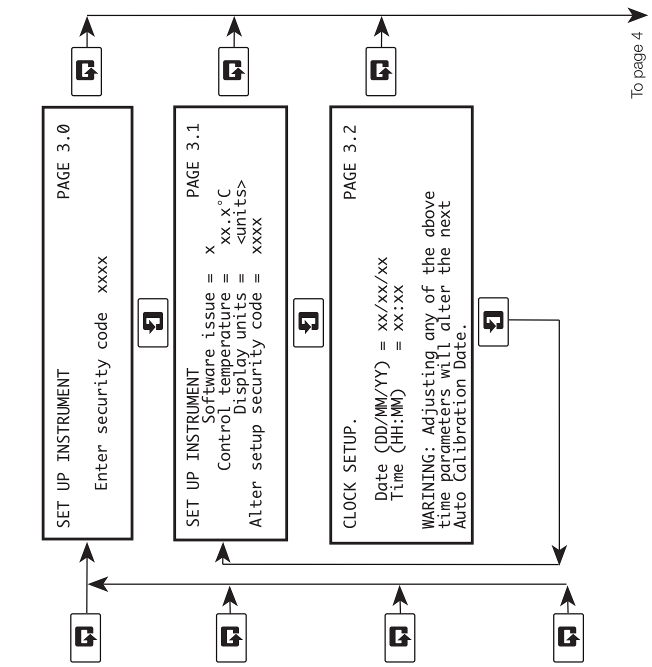
6 Single Stream Programming

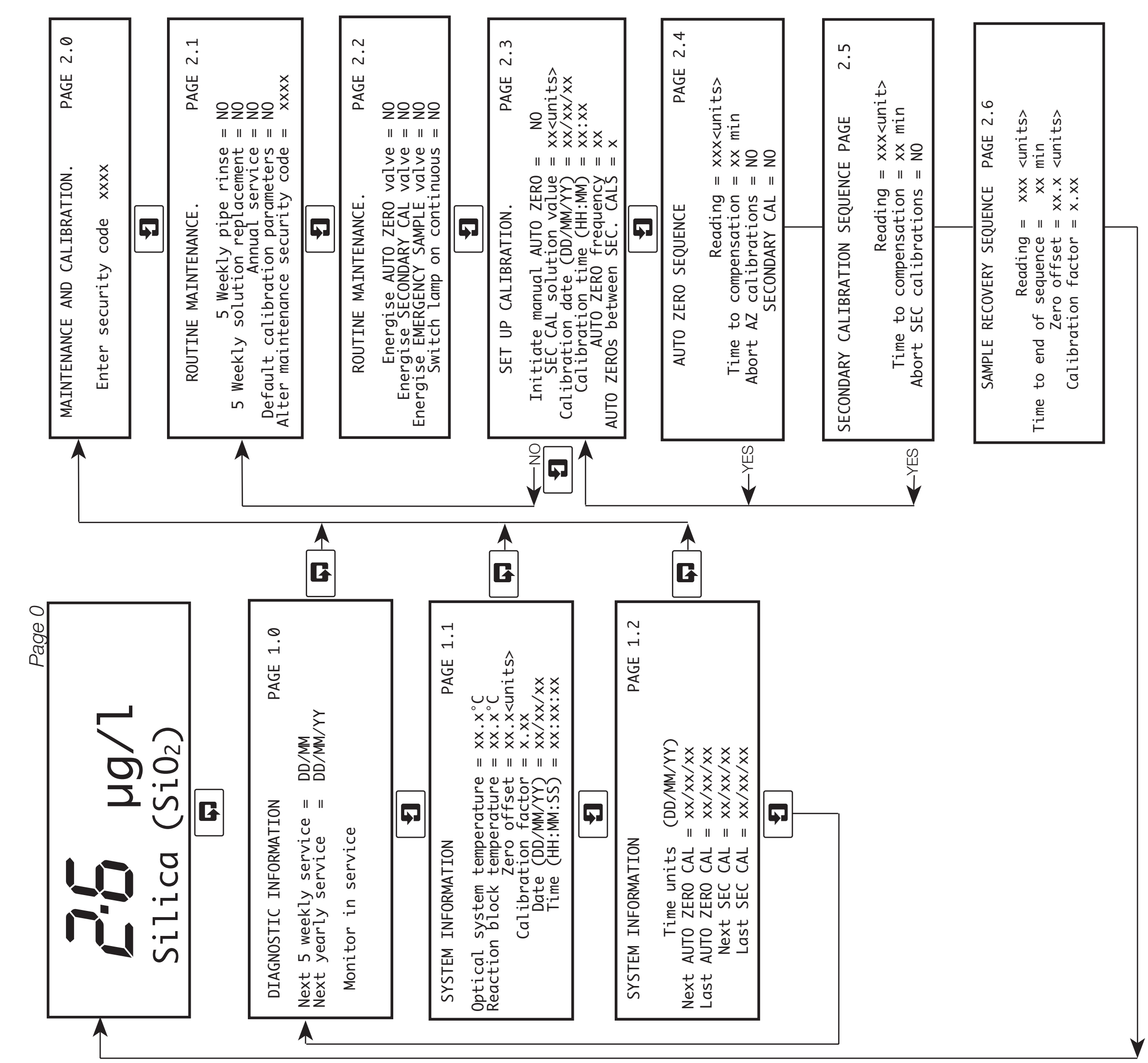
In normal operation (Operating Pages 0 and 1) the display gives indication of the units of measurement, diagnostics, calibration information and time. Selection is made by means of the [page switch] and [menu switch] switches.

Operation of the [page switch] 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.





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
    Maximum output range = 0-xxxx

    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
```

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.
- Pressing advances to the next main page, e.g. 2.2 to 3.0.
  Pressing advances to the next sub-page, e.g. 5.0 to 5.1.
- If an incorrect security code is entered and is pressed, access to the sub-pages is not allowed but the current page level is maintained.

  Pressing displays Page 0.

6.1 Operating Page

```
2·6 µg/l
Silica (SiO2)
```

Page 0. Normal operation display page.

6.2 Page 1 – Diagnostics

```
 DIAGNOSTIC INFORMATION          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 in the case of the 5-weekly service, the 'Out of Service' LED 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, page 34.

```
 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.

6.3 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
```

Set 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.

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 continuous = 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, page 27.

Used to enter the value of the Secondary Calibration solution 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, 12 h, 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.

```
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.

6.4 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>
Alter setup security code =  xxxx
```

Shows the current software issue level.

Set the required control temperature within the range 35 to 45°C in 0.1°C increments. This temperature should be set to 37°C or 5°C above the maximum ambient temperature expected.

Set the required display units for silica concentration (ppb, µg/l or µg/kg).

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.

Set the current (real) time.

6.5 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 of SiO2, 0 to 2000µg/l range instrument – 0 to 20 and 0 to 2000µg/l, or 0 to 50 and 0 to 5000µg/l.

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.

6.6 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 LED 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.

6.7 Page 6 – Factory Settings

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

```
  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.
```

```
  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
```

Used for diagnostic purposes only.

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 20mA range, but values are valid for 0 to 10 and 0 to 20mA 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
     Maximum output range = 0 - xxxx

     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.

Set to 2000μg/l or 5000μg/l to suit the cuvette fitted, i.e. 50mm path cuvette = 2000μg/l and 10 mm path cuvette = 5000μg/l.

Cuvette filling time normally set to 40s (0 to 5000μg/l system) or 55s (0 to 2000μg/l system) to ensure that the cuvette overflows before the lamp is switched on.

35min
20min
20 min

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. 50 to 500, OFF, normally set to 100.

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.