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1 INTRODUCTION

1.1 Applications

The Thermo Scientific Sarasota 2000 is a velocity x area open channel flowmeter which uses
the ultrasonic “time of flight”, also known as the “transit time” method.

Unlike traditional methods of open channel flow measurement which use weirs or flumes, the
transit time method creates no obstruction and assumes no relation between level and flow. It
will correctly determine flow throughout its designed range by measuring water velocity and
cross section area (see Section 1.2).

The method is tolerant of backwater effects caused by tides, downstream confluence or
blockages. Unlike a weir or flume it does not drown out at high flow conditions.

The method employs the transmission of ultrasonic “beams” which can be affected by factors
which impede or deflect them. For this reason the method should not be used in situations of:

- Aerated water
- Weed growth between the transducers (unless it is regularly cut)
- High levels of suspended solids (greater than 2000 mg/l) *
- Gradients of salinity (the actual value of salinity is, however, unimportant)
- Gradients of temperature (the actual temperature is, however, unimportant)

* In relatively small channels (up to 5 metres) the method is more tolerant of suspended solids
and therefore is often used in sewage applications.

Though described as an open channel method, the flowmeter may be used in closed
conduits, including those which run full. In the latter case, the cross section area is defined by
the conduit geometry without the need to measure water level.

Suitable applications include water flow measurement of:

- Rivers
- Canals
- Aqueducts
- Irrigation conduits
- Sewage discharges
- Sewage works
- Industrial discharges
- Power generation

Note that although the flowmeter is most often used for open channels or part filled conduits,
it is often used for conduits which always run full. Under these circumstances it is not
necessary to have a depth input but steps need to be taken to ensure that the flowmeter
always takes the conduit as full. This is done via the encoder depth input. The conduit shape
must still be entered.
1.2 Principle of operation

1.2.1 The Standard

The Sarasota USMP is a velocity x area open channel flowmeter which uses the ultrasonic “time of flight” method. This is also known as the “transit time” method. It complies with the International Standard ISO 6416. The UK version BS 3680 part 3E is identical. The transit time method belongs to the general category of velocity x area methods. A full description of the method and its applications is to be found in the Standard. A brief summary is given below.

1.2.2 Velocity x area method

Velocity x area methods require a means of determining the water velocity and the cross section area. The product of the two produces the flow rate in a manner which is not dependent on factors influencing the level, for example downstream constrictions, tidally influenced water level etc.

Assuming the shape of the channel cross section is stable, determination of the area becomes a matter of measuring water level. This may be done by a variety of methods.

1.2.3 Water level

Water level is required in order to determine the cross section area in an open channel. Though a single level measurement may be used, it is common to use more than one and to average them. This has the advantage of a more representative level, particularly if the measurements are made at different positions, for example on either side of the channel. Another advantage is that flow may still be computed even if a level sensor fails.

Level may be determined by using one or more ultrasonic transducers in the water facing upwards. The time taken for a pulse of sound to return to the transducer after being reflected from the surface is converted into level using the velocity of sound in water as measured on the water velocity paths (see Section 1.2.4). There is a minimum depth of water required above the transducer for it to carry out a measurement. This is given in Appendix 3: Specification.

Water level may also be provided by external auxiliary depth gauges, for example pressure transmitters, downward facing ultrasonic devices and float systems with shaft encoders.

1.2.4 Water velocity

In the transit time method, water velocity is determined at a number of heights within the body of water by measurement of time taken for pulses of ultrasound to travel across the channel at an angle to the flow direction.

Transducers are mounted in the water at or near the sides of the channel with each pair usually at the same height and aligned so as each one can transmit a “beam” of ultrasound towards its partner. The ultrasonic “path” between the transducer pairs must be at an angle (usually about 45°) to the flow direction.

Each transducer acts as a transmitter and receiver and is connected to a processing unit, which measures the transit time and the time difference.
The mean water velocity at the height of each path is determined from these timing measurements, based on pre-determined geometrical measurements (length of the path and the angle to the flow direction).

It may be shown that the water velocity at the height of the path AB is:

\[ v = \frac{L \times (T_{AB} - T_{BA})}{(T_{AB} \times T_{BA} \times 2 \cos \theta)} \]

Where

- \( T_{AB} \) = Transit time from transducer A to B
- \( T_{BA} \) = Transit time from transducer B to A
- \( L \) = Path length (distance between transducer A and transducer B)
- \( \theta \) = the angle between the "path" and the direction of flow.

### 1.2.5 Flow determination

The flow is determined by combining the water velocity measurements at the height of each path with the cross section area defined by the water level and the shape of the channel. The channel shape need not be the same as the projected width between the transducers. For example if the transducers are mounted on piles inset from the channel sides. For the purposes of flow determination the cross section area is divided into horizontal slices determined by the channel bed, the heights of the paths themselves and the water surface level.

The channel flow is the sum of the flows in each slice determined by the path velocity or velocities and the area of the slice. The bottom slice is defined by the bed (which is assumed not to move) and the top slice by the water level (which is measured). The slice widths may be determined by the projected width between the transducers or by a separate table defining the cross section shape.

There are 2 methods, mid section and mean section.
1.2.5.1 Mid section method

In the mid section method, the slice boundaries are defined by lines mid way between the paths. The slice velocity is taken as that determined by the path within the slice and the slice area as the product of the slice height and the (average) width. The upper boundary of the top slice is the water surface. At the bottom, an additional slice is defined between the bed and a line half way between the bed and the bottom path. This bottom slice has a weighting factor, K, normally between 0.4 and 0.8 to allow for the slow moving water near the bed. To reduce the uncertainty of this factor, the bottom path should be positioned as close to the bed as practical.

Illustration of the mid section method for 4 paths
1.2.5.2 Mean section method

In the mean section method, the slice boundaries are defined by the path heights themselves. The slice velocity is taken as the mean of the upper and lower paths which define the slice boundaries. The upper boundary of the top slice is the water surface.

The velocity of the water surface, $V_s$, is given by:

$$Vs = V_4 + (V_4-V_3) \times K_s(H_s-H_4)/(H_4-H_3)$$

Where $K_s$ is a multiplying factor normally between 0 and 1 to allow for the projection of velocity to the water surface.

$V_s$ is limited to a value of $V_4 + (V_4-V_3)$ in the event of $(H_s-H_4)$ being greater than $(H_4-H_3)$.

The lower boundary of the bottom slice is the bed. This bottom slice has a weighting factor, $K_B$, normally between 0.4 and 0.8 to allow for the slow moving water near the bed.

The mean section method is superior in cases where the paths are not near the slice centres, but the mid section method handles the top slice better. The more paths that are deployed, the less the differences matter.

The mean section method is illustrated in the following diagram:

Illustration of the mean section method for 4 paths
1.2.6 Path configurations

The simplest arrangement is to have a number of paths “in line” above each other. This would be suitable for a channel of regular cross section shape, which is straight for a long distance compared with its width (5 to 10 times).

Other configurations are often used in other circumstances. For example:

• Crossed paths where there is uncertainty about the flow direction
• Sloping paths where the depth is greater on one side compared with the other
• Transducers inset from the banks
• Multiple sets of paths for compound channel shapes
• V configuration used to divide the width because of size or uneven profile
• Multiple channels
• Reflected paths where transducers are on one side only and reflectors “bounce” the sound pulses back from the far side. This method saves cable but increases path lengths and is very sensitive to misalignment.

The Sarasota 2000 flowmeter is capable of being configured for these and many other situations. Please consult Thermo Fisher Scientific for examples and advice.

1.2.7 Transducer frequency

Transducers are manufactured with characteristic frequencies. These will be in the range 1 MHz to 100 kHz. For propagation reasons, the greater the path lengths the lower the frequency and the larger the transducer. As a guide, path lengths below 10 metres would use 1MHz transducers, 10 to 80 metres 500 kHz, 80 to 150 metres 250 kHz. These figures are for guidance and the selection may be influenced by other factors relating to the application. For example, lower frequency transducers may be used to improve penetration in conditions of high suspended solids provided there is sufficient depth and velocity.

Please consult Thermo Fisher Scientific for advice.

1.2.8 Minimum depth of water

In order to avoid reflections from the bed or surface causing distortion of the ultrasonic signals, a minimum height of water is necessary above each path. This depends on the transducer frequency and the path length.

\[ H_{\text{min}} = 27 \sqrt{\frac{L}{f}} \]

Where:

- \( H_{\text{min}} \) is the minimum height of water above the path, in metres
- \( L \) is the path length, in metres
- \( f \) is the transducer frequency, in hertz

A similar restriction applies to the channel bed, particularly if it is smooth and reflects rather than absorbs an acoustic signal. The minimum depth of water is therefore usually \( 2 \times H_{\text{min}} \).
1.2.9 Performance estimates

ISO 6416 describes how to estimate the uncertainty of measurement in any particular installation. Please consult Thermo Fisher Scientific for advice on this.

1.3 Implementation of the principles of operation in the Sarasota 2000

The principles described in Section 1.2 are used by the Sarasota 2000 subject to certain rules as listed below. See also Appendix 1: LCD Screens and Appendix 2: GAFA Screens that describe in detail how the flowmeter is programmed via the LCD screen or PC. Note that the Sarasota 2000 is a multi-channel device and so paths and levels may be allocated to up to 4 different channels. Overall “station” information (“S” screens) should be entered before individual channel data (“C” screens). The comments below are how the flowmeter treats each channel. There are some exceptions, for example, measurement units and flow method which are common to the station.

Flow
- There is a choice of mean or mid section method of flow calculation.
- The channel cross section shape is entered as a height/width table independent from the path lengths and angles. (For rectangular or trapezoidal channels it is only necessary to enter 2 points to define the channels.) The separate table allows the path velocities to be applied to more accurate slice areas since the defined shape is used rather than a fixed width for each slice as specified in the Standard.
- Where no path velocity is available, for example at low water height, flow may be inferred from water level. This is done via a flow estimation table, which may be derived empirically or by calculation.

Velocity
- The upstream velocity transducers are connected to the upper row of connectors, downstream to the lower row.
- Path numbering is from the bottom.
- Paths are automatically brought into operation according to the water level and the programmed minimum water cover.
- Paths entered as being at the same height are taken as crossed, otherwise they are separate.
- Separate paths may be “normal” with transducers on each side or “reflected” with transducers on one side only. The latter method saves cable but is not recommended because of the increased path lengths and sensitivity to alignment.
- The velocities calculated by a pair of paths comprising a crossed path are averaged and the average velocity used for the slice. The velocity calculated by a separate path is used alone for the slice.
- When a velocity path fails, the slice boundaries automatically adjust to use only the working paths.
- A failed path will show on the status indicated on screen C11: Instantaneous Flow & Level. The path status is a percentage of the “instantaneous” transducer firings which result in successful reception. If this figure drops below 12% the path is considered to have failed during the corresponding instantaneous cycle time and is discarded for that cycle. This could be the result of a fault, misalignment or obstruction.
- Only valid velocity paths which are in the water and covered by sufficient water to be operating are used for the status indication.
- Each path may have a multiplying factor (“X Factor”) assigned to it. This will normally be 1 but may be different in exceptional circumstances for calibration purposes. An example of when this might be is when the transducers are not exactly at the channel edges.
- Transducers in each velocity path may be set to operate simultaneously (the norm) or sequentially. Simultaneous operation allows more measurements in a given time but
there is a small possibility of confusing a signal reflected back to the firing transducer with one received from the opposite transducer.

**Water level**
- Levels are combined in the following algorithm:
  - Only non-faulty measurements are used.
  - Highest and/or lowest are discarded until 3 remain.
  - The one furthest from the others is discarded leaving 2.
  - The remaining 2 measurements are averaged for arbitrated level if within an acceptable band defined on screen C20: Channel Configuration.
  - If not, level determination fails and flow cannot be calculated.
  - If only 1 level measurement is installed or only 1 is not discarded, it is used as the arbitrated level.
  - If not OK, level fails and flow cannot be calculated.
- Levels defined as valid but rejected by the algorithm will be indicated on the level status, screen C10: Instantaneous Flow & Level.
- Where the flowmeter is installed in a closed conduit which always runs full, the channel shape is entered in the usual way but there is no need for a level measurement. The flowmeter is programmed as though it had an encoder level input (section 2.3.3.2.3) with a reference level at the top of the conduit and a cal. factor of zero.

**Transducer and bed levels**
All heights may be set to a fixed datum (local or national) or relative to mean bed level. The former requires a height for the bed and avoids re-entering all path and level transducer heights in the event of a change to the bed.

**General**
- “Instantaneous” means the average over the cycle time scale. This defaults to 10 seconds but may be set to 1 minute for large numbers of paths or long path lengths via screen S22: Station Configuration.
- The average period is the time over which measurements are averaged for the purpose of output or logged data. If the cycle time is set to 1 minute, the average period cannot be shorter.
- At the data logging intervals, the averaged values of the selected data are stored.
- Analogue inputs will normally be linear. However, screen C212: Analogue Input allows non linear characteristics to be entered.
- When operating on an external 12 volt source, for example from a solar panel, power saving is possible by using intermittent operation. Power consumption in normal and intermittent modes is quoted in the Appendix 3: Specification
- The LCD display will turn off 15 minutes after the last keyboard operation. This is to reduce power and prolong LCD life. Pressing any key will turn it on again.
2 SYSTEM COMPONENTS

2.1 Flowmeter system overview

- The Thermo Scientific Sarasota 2000 is an ultrasonic multi-path flowmeter, which complies with ISO6416.

- It employs state of the art technology to achieve excellent performance in conditions which have previously been outside the scope of this type of instrument.

- Smart transducer technology incorporating drive and receiver circuits optimises signal to noise ratio and minimises losses. The smart circuits are located inside the transducer housings except for the 1 MHz transducers. In that case they are in sealed in-line housings known as Tboxes.

- Automatic adjustment of receiver gain and transducer drive voltage (HT).

- Low power consumption and intermittent modes make mains free operation feasible.

- Multi-path operation, (up to 32 via multi-drop facility made possible by smart transducer addressing.)

- Multiple depth inputs,
  - up to 16 ultrasonic depth transducers
  - up to 4 auxiliary depth gauges (via 4-20 mA inputs.)
  - up to 2 auxiliary depth gauges via BCD inputs
  - up to 2 depth inputs via pulses direct from shaft encoder.

- Multiple flow channels – up to 4 separate channels measured by a single instrument. The velocity paths and depths are allocated to the channels during set up.

- Up to 4 analogue 4-20 mA outputs and two 16 bit binary coded decimal (BCD) I/Os

- Overall system alarm relay

- Four relays (volt free contact) option. Programmable, for example for alarms, status, totaliser pulses.

- Three serial ports. RS232 for PC, RS232 for modem and RS485 for site multi-drop instrument communications

- IR communication link alternative for PC

- Internal data logger, 1 Mbyte capacity, programmable.

- Water temperature measurement at each smart transducer (except 1 MHz transducers)
2.2 Family tree

The schematic diagram below is an illustration of a four path system.

![Diagram of a four path system](image-url)
2.3 Flowmeter contents and options

2.3.1 Flowmeter layout

Fig 1 Sarasota 2000 Flowmeter

Fig 1 shows the front panel view with keyboard, LCD display and status indicator. Also shown are the IR link and RS232 port, which are alternative methods of connection to a PC, see Section 2.6.

The contents are described in Sections 2.3.2 (the “core” items which are always present) and Section 2.3.3 (the items which are optional depending on the number of paths and I/O requirements).

The keyboard allows access to the flowmeter firmware for setting up and interrogation purposes, using the display. This is described in Section 2.5

Fig 2 is the same view with the front panel removed to show the layout of the electronic cards, fuses and power switches.
Fig 2 Sarasota 2000 Flowmeter internal components

**Main rack**, from left to right:-
- Power supply with fuses and power switches (see 2.3.2.1)
- Card position 1 - Status/power management card
- Card position 2 - I/O card 1 (if fitted) (see 2.3.3.2)
- Card position 3 - I/O card 2 (if fitted)
- Card position 4 – Reserved for future enhancements
- Card position 5 – Reserved for future enhancements
- Card position 6 - TIF 4 (Transducer interface card 4) (if fitted)
  - For connection to up to 8 velocity paths (16 transducers) via rear panel connectors G and H, upstream (u/s) and downstream (d/s) and up to 4 ultrasonic depth transducers via connector Z (see Fig 4 and 2.3.3.1)
- Card position 7 - TIF 3 (if fitted)
  - Rear panel connectors E,F for up to 8 velocity paths and Y for up to 4 depths.
- Card position 8 - TIF 2 (if fitted)
  - Rear panel connectors C,D for up to 8 velocity paths and X for up to 4 depths.
- Card position 9 - TIF 1 (always fitted)
  - Rear panel connectors A,B for up to 8 velocity paths and W for up to 4 depths.
- Card position 10 - Central Processor (CPU) (see 2.3.2.2)

The plinth, beneath the main rack, houses the internal battery (see Section 2.3.2.1), the connectors (see Fig 5) and the relay card.

**Note** Power should be switched off and the isolate switch turned off before any cards are removed or plugged in.
2.3.2 Core items

The enclosure houses the following core items as well as the optional items listed in Section 2.3.3:

- power supply and status/power management.
- internal battery
- central processor
- display and keyboard
- connectors for transducers and peripheral devices.

2.3.2.1 Power supply

The standard power supply requires a mains input between 85 and 264 volts AC, 47 to 64 Hz, backed by an internal 12 V battery for operation in the event of AC power failure.

The fuses shown above are 3.15AT (slow blow) for the mains electricity input and 5AF (quick blow) for the low voltage from the power supply module.

The “POWER” switch isolates the flowmeter and its internal battery from the external (AC) power source. When switched off, the flowmeter will continue to operate from the internal battery unless the “ISOLATE” switch is also off. The “ISOLATE” switch disconnects all power from the flowmeter.

The internal battery is automatically charged by the power supply when external power is being supplied and the “POWER” switch is on, regardless of the position of the ISOLATE switch. When the external supply is off the battery is capable of operating the flowmeter for a minimum of 24 hours. This period will be longer in cases when INTERMITTENT OPERATION is being used.

Alternatives of 12 V dc and 24 V dc power sources are available as described in Appendix 3: Specification.

See Appendix 3: Specification for details of power saving through intermittent operation.

2.3.2.2 Central processor (CPU)

The central processor carries out the control and timing functions, stores and runs the operating program and stores the data logs. It controls the status indicator, see “controls and displays”, Section 2.5.

It also controls the three serial i/o ports. See section 2.3.2.4

2.3.2.3 Keyboard and display

The keyboard allows the operator to program the flowmeter and to display measurements, computed results and diagnostic information via the display (see Section 2.5). These functions may alternatively be performed via the PC based GAFA software (see Appendix 2: GAFA Screens).
2.3.2.4 Serial connections

There are 3 serial ports:

- RS232 via 9 way D connector (female) on the front of the plinth. See Figs 1 & 2. This port is used for connection to a PC.
- RS232 via 9 way D connector (male) on the side of the plinth. See Fig 3. This port is used for connection to a modem.
- RS485 via 9 way D connector (female) on the side of the plinth. See Fig 3. This port is used for multi-drop instrument connection networks using Modbus protocol in full or half duplex as set up via the front panel (Appendix 1: LCD Screens). Jumper links on the CPU board may need to be altered depending on the load conditions. Please consult Thermo Fisher Scientific for instructions on setting these links.

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2.3.3 Optional items

The flowmeter enclosure also houses an optional number of the following cards:

- Transducer interface cards (TIFs) (up to 4 may be fitted).
- I/O card (none, 1 or 2 may be fitted)
- Relay (VFC) card (none or 1 may be fitted)

Details are given in Appendix 3: Specification section, but in summary:

2.3.3.1 Transducer interface card (TIF)

Fig 4 Transducer Interface Card (TIF)

The flowmeter has capacity for up to four TIFs as standard. Each one is capable of being connected to 2 velocity paths (4 transducers) directly or 8 paths (16 transducers) by multi-drop, and 1 ultrasonic depth transducer directly or 4 by multi-drop. Each TIF must have its address set via the jumper links PL7 shown in the diagram above. The addresses are in the form of a binary code with the least significant digit at the top of PL7. No link for 0; link present for 1.

TIF1, card position 9, address 4, PL7 Links 0100
TIF2, card position 8, address 5, PL7 Links 0101
TIF3, card position 7, address 6, PL7 Links 0110
TIF4, card position 6, address 7, PL7 Links 0111

When setting up the flowmeter, the cards and their addresses are programmed via the keyboard and screens as described in Appendix 1: LCD Screens or via GAFA as described in Appendix 2: GAFA Screens. When a TIF is changed during service, the replacement must have the same address set.
Each TIF plugs into the main rack and is wired to the back panel co-axial connector pairs A to H for onward connection to the velocity path transducers and W to Z for connection to ultrasonic depth transducers at the time of installation. Fig 5 shows the rear panel connectors. TIF 1 in card position 7 is connected to A and B and to W. TIF 2 in card position 6 is connected to to C and D and X etc. Note that the upstream velocity transducers must be connected to the upper row of A to H and the downstream ones to the lower row.

The standard rear panel allows connections to 32 velocity paths (64 transducers) and 16 ultrasonic depths via “multi-drop” wiring of the smart transducers.

The velocity transducers may be allocated to up to 4 water channels without any restriction other than the total number and cable lengths. Ultrasonic depth transducers are limited to 4 per channel via multi-drop. See Section 2.4.

**Fig 5 Rear panel connections**

The top row of coaxial connectors are for the upstream transducers, the bottom row for the downstream ones.

Paths may be connected individually, for example, path 1 to A, 2 to B etc, or multi-dropped via star junction boxes. For example, paths 1 to 4 connected to A etc.

Ultrasonic depths may be connected individually to W,X,Y,Z or multi-dropped via star boxes. For BCD and analogue connections, see Section 2.3.3.2
2.3.3.2 Input/Output card.

2.3.3.2.1 I/O card layout

Most flowmeters will require this facility. Up to two I/O cards may be fitted. The cards have an address which is set on the links PL1 as shown in Fig 6. This is similar to the TIF addressing, with least significant digit at the top.

I/O 1, card position 2, address 2, PL1 Links 0010
I/O 2, card position 3, address 3, PL1 Links 0011

Each I/O card has:
- Two analogue outputs (normally 4-20 mA)
- Two analogue inputs (normally 4-20 mA)
- 16 bit digital I/O (4 x 4 bit binary coded decimal digits (BCD)). Input or output, selected by jumper on I/O card.
- Phased encoder depth i/p

Fig 5 shows the positions of the connectors. The phased encoder depth inputs share the BCD connectors.
2.3.3.2.2 Analogue I/O

Analogue connections are normally 4-20 mA and are made to the screw terminal blocks at the right of the rear panel. The upper block connects to I/O board 1 and the lower to I/O board 2. Connections 1 to 6 (upper) and 15 to 20 (lower) are the analogue inputs. Connections 7 to 14 (upper) and 21 to 28 (lower) are the 4-20 mA outputs. The table which follows shows the connections.

**Analogue inputs, 4-20 mA (0-20mA) or 0-5V**

The total input range is 0-20mA though analogue inputs are normally set up as 4-20 mA. On board links LK2 and LK4 may be removed to accept 0 to 5 volts instead (Fig 6). Each i/p has 3 connections, 18 V excitation, input and 0V. If the external signal source supplies the power, connections are made to input (4-20 mA +) and to 0V (4-20 mA-).

If the Sarasota 2000 flowmeter is to power the loop, connections are made to 18V (4-20 mA+) and to Input (4-20 mA-)

**Analogue outputs, 4-20 mA**

Analogue outputs are always 4-20 mA. Each o/p has 4 connections, 18V excitation, +V, -V and 0V. If the Sarasota 2000 flowmeter is to power the loop, the output will not be isolated. A link is made between 18V and +V and the 4-20 mA loop is between –V and 0V.

If the external device powers the loop, the output is isolated. The 4-20 mA loop is between +V and -V

**Note** For compliance with EMC emissions control, analogue i/o cables should be screened and the screen connected to one of the 0V pins for each i/o card.

See the following table for connection details.
## 4-20 mA CONNECTIONS (Refer to Fig 5)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Connect for Internal loop power</th>
<th>Connect for external loop power</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0V</td>
<td>N/C</td>
<td>4-20 mA -</td>
<td>I/O card 1, Input 1</td>
</tr>
<tr>
<td>2</td>
<td>Input</td>
<td>4-20 mA -</td>
<td>4-20 mA +</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>18V excitation</td>
<td>4-20 mA +</td>
<td>N/C</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0V</td>
<td>N/C</td>
<td>4-20 mA -</td>
<td>I/O card 1, Input 2</td>
</tr>
<tr>
<td>5</td>
<td>Input</td>
<td>4-20 mA -</td>
<td>4-20 mA +</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>18V excitation</td>
<td>4-20 mA +</td>
<td>N/C</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>0V</td>
<td>-V</td>
<td>4-20 mA +</td>
<td>I/O card 1, Output 1</td>
</tr>
<tr>
<td>8</td>
<td>-V</td>
<td>4-20 mA +</td>
<td>4-20 mA -</td>
<td>Int powered, not isolated</td>
</tr>
<tr>
<td>9</td>
<td>+V</td>
<td>Link 9-10</td>
<td>4-20 mA +</td>
<td>Ext powered, isolated</td>
</tr>
<tr>
<td>10</td>
<td>18V</td>
<td>N/C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>0V</td>
<td>4-20 mA -</td>
<td>N/C</td>
<td>I/O card 1, Output 2</td>
</tr>
<tr>
<td>12</td>
<td>-V</td>
<td>4-20 mA +</td>
<td>4-20 mA -</td>
<td>Int powered, not isolated</td>
</tr>
<tr>
<td>13</td>
<td>+V</td>
<td>Link 13-14</td>
<td>4-20 mA +</td>
<td>Ext powered, isolated</td>
</tr>
<tr>
<td>14</td>
<td>18V</td>
<td>N/C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>0V</td>
<td>N/C</td>
<td>4-20 mA -</td>
<td>I/O card 2, Input 1</td>
</tr>
<tr>
<td>16</td>
<td>Input</td>
<td>4-20 mA -</td>
<td>4-20 mA +</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>18V excitation</td>
<td>4-20 mA +</td>
<td>N/C</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>0V</td>
<td>N/C</td>
<td>4-20 mA -</td>
<td>I/O card 2, Input 2</td>
</tr>
<tr>
<td>19</td>
<td>Input</td>
<td>4-20 mA -</td>
<td>4-20 mA +</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>18V excitation</td>
<td>4-20 mA +</td>
<td>N/C</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>0V</td>
<td>N/C</td>
<td>4-20 mA -</td>
<td>I/O card 2, Output 1</td>
</tr>
<tr>
<td>22</td>
<td>-V</td>
<td>4-20 mA +</td>
<td>4-20 mA -</td>
<td>Int powered, not isolated</td>
</tr>
<tr>
<td>23</td>
<td>+V</td>
<td>Link 23-24</td>
<td>4-20 mA +</td>
<td>Ext powered, isolated</td>
</tr>
<tr>
<td>24</td>
<td>18V</td>
<td>N/C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>0V</td>
<td>N/C</td>
<td>4-20 mA -</td>
<td>I/O card 2, Output 2</td>
</tr>
<tr>
<td>26</td>
<td>-V</td>
<td>4-20 mA +</td>
<td>4-20 mA -</td>
<td>Int powered, not isolated</td>
</tr>
<tr>
<td>27</td>
<td>+V</td>
<td>Link 27-28</td>
<td>4-20 mA +</td>
<td>Ext powered, isolated</td>
</tr>
<tr>
<td>28</td>
<td>18V</td>
<td>N/C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 0 – 5 V CONNECTIONS (Refer to Fig 5)

Alternative connections require links LK2 and LK4 to be removed (Fig 6).

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Connection</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0V</td>
<td>0-5 V –ve</td>
<td>I/O card 1, input 1</td>
</tr>
<tr>
<td>2</td>
<td>Input</td>
<td>0-5 V +ve</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0V</td>
<td>0-5 V –ve</td>
<td>I/O card 1, input 2</td>
</tr>
<tr>
<td>5</td>
<td>Input</td>
<td>0-5 V +ve</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>0V</td>
<td>0-5 V –ve</td>
<td>I/O card 2, input 1</td>
</tr>
<tr>
<td>16</td>
<td>Input</td>
<td>0-5 V +ve</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>0V</td>
<td>0-5 V –ve</td>
<td>I/O card 2, input 2</td>
</tr>
<tr>
<td>19</td>
<td>Input</td>
<td>0-5 V +ve</td>
<td></td>
</tr>
</tbody>
</table>
2.3.3.2.3 16 bit BCD I/O and encoder input

The 16 bit parallel BCD signal may act as either input or output according to the jumper links LK1 and 3 on the board. See Fig 6. The default condition is for BCD INPUT – no links, for example from a shaft encoder counter.

The format is 5 Volt positive logic, though the input can accept inverted logic if specified via the screens (Appendix 1: LCD Screens).

Handshaking is via strobes STRB1 and STRB2. STRB1 relates to bits 1 to 8 and STRB2 to bits 9 to 16.

There are two 25 way female D connectors labelled BCD1 and BCD2. BCD1 is connected to I/O option card 1 if fitted and BCD2 to I/O option card 2 if fitted.

BCD input

- When used as an input, the 4 digit BCD number is normally used as an auxiliary level.
- Operating units are selected via the screens (Appendix 1: LCD Screens) or GAFA (Appendix 2: GAFA Screens).
- The BCD number may have an offset applied – “level above datum” if BCD zero does not correspond to the flowmeter zero level.
- The BCD number may also have a scaling factor applied, for example if a BCD incremental value of 10 corresponds to 5 mm, the scaling factor is 0.5.
- If the scaling factor is given a negative sign, the BCD input will be taken as negative logic (low is “1”)
- For BCD input, the STRB is pulled low for 0.2 ms by the Sarasota 2000 when it wants data.

BCD Output

- When used as an output, the function of the 4 digit BCD number and operating units are selected via the screens (Appendix 1) or GAFA (Appendix 2). Typically the function will be flow or water level.
- For BCD output, the STRB is pulled low for 0.2 ms whilst valid data is being presented.
- BCD output may be uncoded, in which case the BCD number is taken as it appears, or coded in which case the first digit indicates a range/sign and the remaining 3 digits the value.

Coding for flow

The data is represented as a 4 digit number where the most significant digit is the code:

- 0 = multiply by 10^0 (i.e. x 1)
- 1 = multiply by 10^1 (i.e. x 10)
- 2 = multiply by 10^2 (i.e. x 100)
- 3 = fault condition, no data
- 4 = negative flow multiply by 10^0 (i.e. x -1)
- 5 = negative flow multiply by 10^1 (i.e. x -10)
- 6 = negative flow multiply by 10^2 (i.e. x -100)

The three remaining digits are the three most significant digits of the reading;

e.g. Flow + 4.28 m³/s Output 0428
     Flow +34.28 m³/s Output 1342
     Flow - 0.15 m³/s Output 4015

Coding for level

The level data is presented as a 4-digit number, representing the last 4 digits of the displayed value.

e.g. Flow + 4.123 m Output 4123
     Flow +52.678 m Output 2678
Encoder input

The BCD connector also provides the means of connection to the two-phase outputs direct from a shaft encoder as an optional means of depth input. The Sarasota 2000 flowmeter will count the pulses up and down to track the depth changes. It is necessary to set the pulse scale, i.e. the distance corresponding to each pulse, and the counter value at a known depth. See Appendix 1: LCD Screens (screen C213: Encoder Input Configuration) for the method of setting up.

BCD/ENCODER CONNECTIONS (Refer to Fig 5)

<table>
<thead>
<tr>
<th>25 D Pin</th>
<th>Signal</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0V</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>D1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>D3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>D5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>D7</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0V</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>D9</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>D11</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>D13</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>D15</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>0V</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>INT</td>
<td>Encoder phase 2</td>
</tr>
<tr>
<td>13</td>
<td>+5V</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>D0</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>D2</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>D4</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>D6</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>STRB1</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>D8</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>D10</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>D12</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>D14</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>STRB2</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>TC0</td>
<td>Encoder phase 1</td>
</tr>
<tr>
<td>25</td>
<td>0V</td>
<td></td>
</tr>
</tbody>
</table>

Note: For compliance with EMC emissions control, BCD/Encoder i/o cables should be screened and the screen connected to one of the 0V pins for each i/o card.
2.3.3.3 Relay (Volt free contact) card

The relay card consists of 4 programmable relays and a fault relay with both normally open and normally closed contacts. The connections are accessible by removing the cover plate on the side of the plinth.

Fig 7  Relay connections

The function of each relay is specified by the operator. See Section 2.5.2 and Appendix 1: LCD Screens.
For example, relay 2 could be programmed as a high flow alarm to switch on at a high flow and off again at a lower value (hysteresis).

Note that if pulses are required for an external totaliser, the selection is limited to relay 1 on the relay card. However, the standard relay may not be suitable for this if the pulse rate is high. For this reason the relay card is being changed so that a solid state relay will replace relay 1. The switching capacity will be lower but the pulse rate will be higher and there will be no specified limit on the number of operations. Relay 1 will then only have “normally open” connections. See Appendix 3: Specification.

Please consult Thermo Fisher Scientific if in doubt about which type is fitted.


2.4 Ultrasonic transducers

Each velocity path requires two transducers and each ultrasonic depth requires one. The transducers are available in a number of frequencies. See Section 1.2.6 for frequency selection. The frequency of the ultrasonic depth transducer, if used, is not normally critical. 1 MHz is usually used if the velocity transducer frequency is 1 MHz or 500 kHz otherwise.

The diameter of the transducer is different for different frequencies. This is to maintain the angular spread of the beam which is a function of frequency and diameter.

The transducers for the Sarasota 2000 are “smart”, with local circuits for the drive voltage (HT) generation and the receiver amplifier built in to minimise losses and optimise signal-to-noise ratio. In the case of the 1 MHz transducers the size of the transducer is limited and the local circuit is separated from the transducer in a potted in-line housing called a “Tbox”,

Transducers may be wired individually to the flowmeter (rear panel connections A to H for velocity and W to Z for depths) or, using the multi-drop method, via “star” junction boxes in each transducer array. In the latter case up to 4 transducers may be joined to each rear panel connector. A mixture of multi-drop and direct connections may be used. For example, if there are 5 transducers in an array, 4 may be wired via a star box and the fifth wired directly.

The maximum capacity with direct connections is 8 paths and 4 ultrasonic depths. The maximum capacity with multi-drop is 32 paths and 16 depths.

The transducers have programmable addresses. Addresses 1 to 4 are normally used. When using multi-drop, the transducers connected to each star box must be pre-programmed with different addresses to enable each one to be operated separately by the flowmeter. Specialist equipment is necessary to programme the transducers and it is usual to supply them with specified addresses.

2.4.1 1 MHz transducers

For use with path lengths up to 10 metres. In cases where serious attenuation is anticipated (for example, sewage) it is recommended that the use be restricted to 5 metres and a lower frequency be used above that. Of course the lower frequency requires a greater depth of water in which to operate and this must be taken into account (see Section 1).

An in-line Tbox is fitted in line with each transducer. The co-axial cable from the T box must be connected to a star box or extended to run directly to the flowmeter. Coaxial cables to the flowmeter enclosure are usually made up on site. Cables may be supplied to length with made up ends if specified with the order but this often makes the installation more difficult where there is the need to pull cables through ducts.

2.4.2 500 kHz Transducers

For use with path lengths above 10 metres. In cases where serious attenuation is anticipated (for example, sewage) it is recommended that 500 kHz transducer be used above 5 metres. At the upper end, they may normally be used up to 80 metres. For cases where serious attenuation is anticipated, lower frequency transducers should be used for paths above 50 metres.
2.4.3 Lower frequency transducers

Consult Thermo Fisher Scientific about low frequency transducers for path lengths above 80 metres or where conditions might attenuate higher frequency signals.

If ultrasonic depth transducer(s) are being used, it is usual to use 500 kHz frequency when lower frequency transducers are being used for water velocity measurement.

2.4.4 Maximum cable lengths

<table>
<thead>
<tr>
<th>Item</th>
<th>From</th>
<th>To</th>
<th>Max length</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>500 kHz transducer</td>
<td>Flowmeter</td>
<td>300 m</td>
<td>Direct connection</td>
</tr>
<tr>
<td></td>
<td>(velocity or depth)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1 MHz TBox</td>
<td>Flowmeter</td>
<td>300 m</td>
<td>Direct connection</td>
</tr>
<tr>
<td></td>
<td>(velocity or depth)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Star box</td>
<td>Flowmeter</td>
<td>300 m</td>
<td>Multi-drop (but see depth options items 6 &amp; 7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>500 kHz transducer</td>
<td>Star box</td>
<td>5 m</td>
<td>Multi-drop (but see depth option item 6)</td>
</tr>
<tr>
<td></td>
<td>(velocity or depth)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1 MHz Tbox</td>
<td>Star box</td>
<td>5 m</td>
<td>Multi-drop (but see depth option item 7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>500 kHz depth transducer</td>
<td>Star box</td>
<td>50 m</td>
<td>Multi-drop depth option (star box max 5 m from flowmeter)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1 MHz depth TBox</td>
<td>Star box</td>
<td>50 m</td>
<td>Multi-drop depth option (star box max 5 m from flowmeter)</td>
</tr>
</tbody>
</table>
2.5 Controls and displays

2.5.1 Panel layout

Fig. 1 shows the layout of the front panel. It contains the keyboard and liquid crystal display (LCD). The keyboard is used to access the LCD and to:

- programme the flowmeter with site data, for example, path lengths, angles, heights
- set up the inputs and outputs (including simulation for test purposes)
- set up the relay functions and values on which to switch
- display ultrasonic waveforms
- display measurements and results
- display diagnostic data

2.5.2 Screen organisation

The LCD screens are all numbered as listed in Appendix 1: LCD Screens.

The screens are arranged in levels, the lower levels being selected and accessed from the one above.
When a lower level is displayed, it overlays the one above so that each is visible.
The ARROW keys move a highlighted area around each screen.
The ENTER key actions the highlighted instruction, for example to select a lower level screen.
The ESCAPE key reverts to the previous screen.
When the highlighted box requires data, the NUMBER keys are used.
The ENTER key stores that data in memory.
There are 4 FUNCTION keys at the bottom of the screen. Their function changes according to what is displayed above them on the screen.
The display goes blank to save power 15 minutes after the last key stroke. Pushing any key powers it up.

2.5.3 The status indicator

The status indicator operates as follows:

- Continuous green – contentment
- Continuous red – alarm condition exists or has occurred earlier and has not been acknowledged. The meaning of this is defined by the user via screen S30: Fault Relay Configuration, and details of the fault can be identified in screen S10: Fault Status (for example, all faulty ultrasonic paths or depth paths).
- Either light flashing evenly – running on battery.
- Either light “blipping” on intermittently – running in power save intermittent mode.
- No light at all – power off and battery run down.

With the alarm reset key the operator acknowledges the alarm and resets it.

The operation and setting up are described in Section 4: Installation, Appendix 1: LCD Screens and Appendix 2: GAFA Screens.

Note that the GAFA PC software provides similar facilities either locally via the front RS232 connector or the IR link, or remotely via a modem.
2.6 Software & firmware

There are 2 types of software:

- The internal pre-loaded operating software, normally called “firmware”
- The PC software for communicating with the flowmeter, called “GAFA”

2.6.1 Operating firmware

The flowmeter is supplied with the operating firmware already loaded. It would not normally be necessary to re-load the firmware. In the event that new firmware is to be loaded, Thermo Fisher Scientific will provide the procedure or carry out the operation.

2.6.2 “GAFA” PC software

An optional facility is the GAFA software, which runs on a PC under Windows. This allows communication with the flowmeter:-

- Via the RS232 port on the front of the plinth
- Via the IrDA link on the front panel
- Remotely via a modem connected to the RS232 port on the rear of the plinth

The functions possible via GAFA are:-

- Setting up the flowmeter in the same way as via the flowmeter controls and display as described in 2.5 but with the benefit of superior PC display
- Interrogating the flowmeter for measured parameters and calculated results as 2.5 with the same benefit
- Downloading logged data.

Appendix 2: GAFA Screens describes the GAFA.

2.7 Documentation

In addition to the hardware described in 2.3 and 2.4, and possible peripheral equipment, the following documentation may also be supplied:

- A copy of this manual (additional copies may be supplied)
- Site specific data (Appendix A5: Site Data). Configuration and program data completed by installation and commissioning engineers.
- Site specific drawings – transducer mounts, site layout, civil details (if part of contract)
- Certificate of conformity (specific test sheets available on request)
- Certificate of approval for Quality Management System
- On site calibration certificate (if included in the installation contract)
3 PERIPHERAL EQUIPMENT

3.1 Additional items

A number of additional items will be required to complete a flowmeter system. These may include:

- Hardware to be installed in the channel on which to mount the transducers.
- Auxiliary depth gauge(s)
- Kiosk to house the flowmeter
- Communications equipment – for example modems, telemetry outstations, GSM modems.
- Power supplies, for example solar power systems.

plus, often, some civil work for cable ducts, supporting piles etc.

The additional items are often supplied and installed by Thermo Fisher Scientific as part of the contract, in which case details will be included in Appendix 5: Site Data Book.

3.2 Transducer mounting hardware

Thermo Fisher Scientific has extensive experience of transducer mounting system design and maintains a comprehensive computerised library. Please consult Thermo Fisher Scientific for a quotation to design and supply a suitable system.
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4 INSTALLATION

4.1 Safety

<table>
<thead>
<tr>
<th>SAFETY NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>The installation of the Thermo Scientific Sarasota 2000 flowmeter may involve a number of steps which require special skills, training and special equipment. Examples include:</td>
</tr>
<tr>
<td><strong>•</strong> Electrical installation</td>
</tr>
<tr>
<td><strong>•</strong> Working on construction sites</td>
</tr>
<tr>
<td><strong>•</strong> Working near water (may be deep or fast flowing)</td>
</tr>
<tr>
<td><strong>•</strong> Lifting equipment</td>
</tr>
<tr>
<td><strong>•</strong> Working at height</td>
</tr>
<tr>
<td><strong>•</strong> Working from boats</td>
</tr>
<tr>
<td><strong>•</strong> Confined space working</td>
</tr>
</tbody>
</table>

It is recommended that prior to the installation the installer should write a method statement detailing:

- The scope and purpose of the work,
- The steps in the operation,
- Interaction with others,
- The personnel to be involved,
- Their qualifications for the work,
- Protective clothing and equipment,
- Machinery, tools etc.
- Emergency contacts and procedures.

A risk assessment should be carried out and both the method statement and risk assessment should be approved by the person responsible for Health and Safety on the site.

Thermo Fisher Scientific accepts no responsibility for the safety of personnel other than its own employees in the installation and commissioning of the Sarasota 2000 flowmeter and accessories supplied.
4.2 General

It is usually necessary for some preparatory work to be carried out prior to installation of the flowmeter system. This work is often performed under a separate contract and typically includes:

- Installation of supporting structures for transducer mounts, for example, piles in a river, brackets on concrete channel walls.
- Installation of ducts or cable tray for the interconnecting cables.
- Installation of a suitable housing for the flowmeter and peripheral equipment. This could be an existing building or a kiosk.
- Provision of a power supply.
- Provision of a PSTN connection.

The installation of the equipment on site follows the above. It is normal practice to carry out a risk assessment and to write a method statement to be agreed by the client before starting work. The installation work is often restricted to times when suitable site conditions apply.

It is recommended that the installer of the flowmeter should inspect the preparatory work prior to mobilising resources for the installation.

4.3 Unpacking and laying out

If site and general assembly drawings were specified as part of the supply contract they will normally have been supplied and accepted prior to delivery of the equipment. The drawings will be a useful guide to checking the inventory of equipment delivered.

The equipment supplied should be carefully unpacked and checked for content and damage.

The transducers may have been supplied in rack assemblies ready to be installed to the supporting structure. There will normally be two or four racks (for in-line or crossed paths). In large channels or those with complex shapes, there may be more than two racks, for example, in a stepped channel with a low level channel and a wider high one.

If the racks have not been assembled, this may be carried out on site according to the assembly drawings.

It is important to check that sufficient cable has been supplied for connecting transducers and that suitable fixings for all the items have been supplied or separately procured.

4.4 Installing transducer assemblies

**WARNING** – Installing transducer racks may involve working near deep or contaminated water and/or in confined spaces. Appropriate precautions and suitably qualified personnel should be used.

The transducer rack assemblies should be installed in their prepared positions according to the drawings and method statements.

Care must be taken not to damage the coaxial cables during this operation.

See Section 2.4 for transducer and junction box configuration.

Depth gauge transducers or transmitters may be fitted to one or more of the transducer racks or have a separate fitting.
4.5 Connecting transducers to flowmeter

Cables for the ultrasonic transducers should be labelled for identification, cut and pulled through the ducts or laid in trays back to the flowmeter. Connectors should be fitted to each end according to the instructions supplied with the connectors.

Where 1 MHz transducers are being installed, the connections are via the transducer boxes (see Section 2.4.1) which are fitted at the rack assemblies.

Cables for depth gauges other than Sarasota ultrasonic transducers should also be pulled back to the flowmeter. Generally, if the depth gauge is a pressure transmitter, the attached cable will be supplied long enough for this purpose without joining.

The transducer cables are to be terminated at the flowmeter end and plugged in to the flowmeter back panel as shown in Section 2.3.3.1.

Ultrasonic path numbers are as shown, numbered from the lowest path. If 2 paths are at the same height the firmware will take them as crossed for the purposes of slice allocation and flow calculation (see 1.2.5). Upstream transducers should be plugged into the upper row on the back panel and downstream ones to the lower.

4.6 Transducer alignment

At this stage it is usual practice to align the transducers. Each transducer should point at its partner to within ±1°. The method used will vary according to the conditions.

- Pre-set alignment derived from construction drawings.
- Visual methods involving pointers and sighting arrangements.
- Low power laser methods.

If the transducers are in the water, only the first of these may be possible and final adjustment should then be carried out by adjustments to maximise signals during commissioning.

4.7 Output connections

Output signals should be wired to the peripheral devices according to the connection tables given in section 2.3. In some cases standard cables will have been provided, eg RS232, or pre-made cables will have been ordered as part of the contract.

Note For compliance with EMC emissions control, analogue, BCD and serial i/o cables should be screened and the screen connected to a 0V pin. Where the connector is a ‘D’ type connector, the screen may alternatively be connected to the connector body if metal.

4.8 Power Connection

Connection should be made to the external power source according to local or national regulations. The flowmeter is supplied with a standard 230 volt mains cable for connection to an AC source in the range 85 to 264 volt AC; 47 to 64 Hertz. This may be connected to the power outlet via a plug or, more usually via a switched spur. This work should be carried out by a person with the appropriate qualifications.

See the site data book for details of flowmeters supplied for DC operation.
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5 COMMISSIONING

5.1 Site dimensions

If this information is not already available, it will be necessary to carry out a dimensional survey of the installed transducers and the channel in order to programme the flowmeter. It will be necessary to determine the following:

- length, angle and the heights of each path,
- average cross section profile, if different from that defined by the paths,
- mean bed level (MBL),
- height offset of the level transducers and,
- relationship between the local heights and a fixed datum if not working with respect to MBL.

This manual does not cover surveying techniques. However, for small sites physical measurements are easily carried out by measurement with a tape. Angles may be determined by triangulation.

5.2 Powering up

Check that the flowmeter contains the specified modules and the cards are plugged in to the correct rack positions, see Section 2. Also, Appendix 5: Site Data may already have been partially filled in prior to shipping to indicate the card positions.

Switch on the power source and ensure that the internal power switch is on (Section 2.3).

The main STATION HOME screen will be displayed (Appendix 1: LCD Screens).

5.3 Programming

The flowmeter should be programmed as described in Appendix 1: LCD Screens. Alternatively a PC may be used rather than the built-in screen and keyboard as shown in Appendix 2: GAFA Screens. The programme details should be recorded to become part of Appendix 5: Site Data.

Appendix 5: Site Data is a useful checklist covering all programmed data, some of which may not be required for any particular site.

5.4 Setting up

5.4.1 Ultrasonic levels

Select “Manual” and set the gain and voltage for each level (screen C216: Level Transducer Setup) to obtain a clean waveform and detection point (screen C218: Level Waveform Display).

5.4.2 Auxiliary levels – analogue input

Set the input range via screen C212: Analogue Input Configuration. This allows the input to be linearised, but most level devices will be sufficiently linear and only need 2 points to define the input. On the table, define 4 mA as the minimum, 20 mA as the maximum and enter the depth offset (level above datum).
5.4.3 Auxiliary level – encoder input

Screen C213: Encoder Input Configuration allows the details of a direct input from a shaft encoder to be programmed. This involves setting a point of reference from which to count up and down (the current level) and the scaling factor of pulses per unit of depth.

5.4.4 Auxiliary levels – BCD input

Screen C214: BCD Input Configuration is used to define the relationship between the BCD input and actual depth. The level of the counter zero above datum is entered and the conversion factor relating counter value to the depth units.

5.5 Outputs

The outputs are selected from analogue, BCD and relays. (Set up via screens S25: Output Configuration, screen S250: Analogue Output Configuration, screen S251: BCD Output Configuration and screen S252: Test Output Configuration).

Correspondence between the displayed selected parameter value and the output should be checked. It is possible to force the outputs by temporarily changing the set-up, for example changing the level datum will affect not only the apparent level measurement but also the flow. Alarm thresholds may be altered to check relay operation.

Analogue outputs may be checked by a calibrated multi-meter and verified as being received by the destination device.

BCD outputs are more difficult to check with a multi-meter and are usually verified by reading the destination device. A BCD test box with a display is available through Thermo Fisher Scientific.

Alarm outputs may be checked by a calibrated multi-meter and verified as being received by the destination device.
6 CALIBRATION/VERIFICATION

Flowmeters of this type do not normally require calibration. Exceptions are where there are significant unmeasured areas, for example, behind transducers, or where local conditions might create atypical velocity profiles and a small number of velocity paths are deployed. See Section 1: Introduction and Appendix 4: References.

However, it is normal to carry out periodic checks to verify the overall performance of the flow determination.

Whether for calibration or verification purposes, the comparison method to be used will be the same and will depend on the site.

Reference is made to ISO 748 for details of methods. See Appendix 4: References.

The most common method used is by current metering using a calibrated rotating element or electromagnetic current meter.

Care should be taken to use repeated checks and to minimise the experimental uncertainties which could otherwise be greater than the uncertainty of the ultrasonic flowmeter.
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7 MAINTENANCE

There is little maintenance as such relating to the flowmeter itself. However, the river or channel must be kept free of weed, silt and other obstructions to avoid interruption of the ultrasonic paths or changing the cross section area which would affect the accuracy of flow determination.

Periodic checks on the functioning of the flowmeter and verification of the flow as calculated are recommended.

7.1 Channel maintenance

7.1.1 Weed

- If weed tends to grow in the channel, it must be kept cut.
- Weed must be kept clear from between the transducer arrays where it may stop the passage of sound between the transducers.
- Weed should also be controlled on the approach to the gauged section and immediately downstream of it where its presence could distort the velocity profile.

The user must decide on the seasonal cutting regime to suit the channel.

7.1.2 Profile

Periodically the channel shape should be checked to determine whether it has changed since the flowmeter was programmed. It is particularly important to check the bed where silt might have been deposited or scouring could have occurred.

Changes may be required to the programmed channel shape or mean bed level.

In serious cases, it may be necessary to dredge the channel, taking care not to damage the transducers.

The user must decide on the checking regime to suit the channel.

7.1.3 Debris

Under high flow conditions it is not uncommon for debris to be washed along the channel. Whilst the design of the transducer supports should be such as to minimise the risk of snagging this debris, separate deflectors or devices intended to capture it may be employed.

If the channel is prone to this phenomenon, the user must instigate an appropriate debris-clearing regime.

7.2 Flowmeter maintenance

There are no parts requiring maintenance except that the transducers should be checked occasionally for a build-up of surface coating, for example by grease, and for misalignment caused by physical shocks. These checks may be carried out along with the channel maintenance.

Normally it is possible to obtain advance warning of problems by checking the signal quality. This may be done on site or remotely via GAFA (Appendix 2: GAFA Screens).
7.3 Routine checks

7.3.1 Remote

Remote checks of operation of all velocity paths and depths are easily carried out via GAFA. It is recommended that a monthly routine should be set up to handle this.

If the flowmeter is fitted with the relay option, one of the relays may be programmed to initiate an early warning call via a telemetry outstation.

7.3.2 On site

It is recommended that an annual check be made on site. This should include:

• A visual observation of the equipment in the channel and the flowmeter.
• A functional check of the operation of the paths, levels and outputs.
• A check on the operation of the internal battery.
• A verification of calculated flow by a comparison method, see Section 6: Calibration

Any corrective work should be taken at the time if possible or reported for subsequent action.
APPENDIX 1. LCD SCREENS

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<tr>
<td>C11: Instantaneous Path Velocities</td>
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<td></td>
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<td></td>
</tr>
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<td></td>
</tr>
<tr>
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APPENDIX 1. LCD SCREENS

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Screen organisation chart (page 2 of 3)
Screen organisation chart (page 3 of 3)

- S2(M) STATION SETUP
  - S20(E) MEASUREMENT UNITS
  - S22(E) STATION CONFIGURATION
  - S24(E) FLOW CALCULATION
- S21(E) REAL TIME CLOCK
  - S23(M) CARD ADDRESS MAP
  - S230(E) PATH ALLOCATIONS
- S25(E) OUTPUT CONFIGURATION
  - S250(E) ANALOGUE OUTPUT CONFIGURATION
  - S251(E) BCD OUTPUT CONFIGURATION
  - S252(E) TEST OUTPUT CONFIGURATION
- S26(M) AUXILIARY INPUT CONFIGURATION
  - S260(E) AUXILIARY INPUT ALLOCATION
- S27(E) TRANSDUCER CONFIGURATION
A1.2 Screen types and identities

A1.2.1 Screen type

Screens are classified according to their function as follows:

- **MENU** Offers selection of lower order screens
- **GATEWAY** Access screens for station or channel setup
- **ENTRY/EDIT** Data is entered or edited via these screens
- **RESULTS** Displays status or results measured or calculated by flowmeter
- **WAVEFORM** Displays ultrasonic waveforms

The screen type is indicated for each display screen and is shown on the Screen Organisation Chart above.

A1.2.2 Screen identities

- The flowmeter start up screen has no number and is the STATION HOME screen
- Each configured channel (minimum 1, maximum 4) has a CHANNEL HOME screen
- All menu, entry/edit, results and waveform screen numbers associated with the station setup are prefixed ‘S’ and those associated with the channel setup are prefixed ‘C’.
- All screens associated with the station setup can return directly to the STATION HOME screen via the Station soft key
- All screens associated with each channel setup can return directly to the appropriate CHANNEL HOME screen via the appropriate Channel soft key
- Screens below the HOME screens have a unique identification number in the top left corner that corresponds to the Screen Organisation Chart and Index.
- Sample screens for each display are presented in numerical order. Note: 2 digit screen numbers are a sub-set of single digit screen numbers. Similarly, 3 digit screen numbers are a sub-set of 2 digit screen numbers (eg C2; C21; C211)
- Station setup should precede channel setup

A1.2.3 Soft key function

The 4 keys immediately beneath the screen display have a function which varies according to the screen. The active ‘soft key’ function is indicated on the screen immediately above the corresponding key.

Soft key functions include:

- **Station** returns user to STATION HOME screen
- **Channel1** returns user to CHANNEL 1 HOME screen
- **Channel2** (if configured) returns user to CHANNEL 2 HOME screen. Similarly for Channel 3 and 4
- **Text On** and **Text Off** (only available for alphanumeric data entry/edit) turns alphanumeric mode on and off
- **Clone** function available as a short cut when path configurations are similar
- **Rebuild** to confirm entry/modification of path configurations
A1.3  Screen selection and data entry/edit methods

A1.3.1 MENU screens (including GATEWAY setup menu)

The selection of items from a MENU screen is made as follows:
(a) highlight selection using the UP and DOWN arrow keys
(b) confirm selection by pressing the ENTER key
(c) the selected screen will open and overlay the previous screen
(d) to return to menu screen press ESCAPE or, on completion of data modification, press ENTER to confirm and return to previous screen

A1.3.2 ENTRY/EDIT screens (including GATEWAY password)

ENTRY/EDIT screens are used to enter or edit data to configure the flowmeter as required.

Data is either entered in alphanumeric format, or chosen from a predefined selection.

Numeric format

Data entry/modification required in numeric format is indicated throughout the following screen examples by square brackets, [.....]. The value is modified by:

a) highlighting data entry point [...] using UP and DOWN arrow keys
b) position the cursor within the data entry point using LEFT and RIGHT arrow keys
c) enter values using the numeric keypad
d) save new values for entire screen by pressing the ENTER key

Alphanumeric format

Data entry/modification may be in alphanumeric format where indicated by square brackets and alphanumeric characters, [abc123]. An alphanumeric character is modified by:

a) highlighting data entry point [abc123] using UP and DOWN arrow keys
b) select Text On mode using soft key 3
c) move the cursor into position within the data entry point using LEFT and RIGHT arrow keys
d) use UP and DOWN arrow keys to scroll through available alphanumeric characters
e) when alphanumeric modification is complete, select Text Off mode using soft key 3
f) modified text/values are saved for entire screen by pressing the ENTER key
g) available characters include: ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz

Parameter selection

The selection of configuration parameters from a predefined list is indicated on the screen examples by xxxxxxxx. The parameters available for selection are listed beneath each screen. The parameter is selected by:

a) highlighting the parameter selection point using UP and DOWN arrow keys
b) scrolling through available parameters using LEFT and RIGHT arrow keys
c) selected parameters are saved for the entire screen by pressing the ENTER key

A1.3.3 RESULTS screens

RESULTS screens display the results of calculations, the status of operation, selected configuration options and flowmeter setup. Values or configuration parameters selected in associated configuration screens may be shown. However, modifications cannot be made directly to results screens.

A1.3.4 WAVEFORMS screens

WAVEFORMS screens display waveforms in the format selected in associated configure screens.

A1.4 Power-off mode

The display will power off after 15 minutes of inactivity. Press ENTER to reactivate display. As a system security measure the display reverts back to the STATION HOME screen.
A1.5 Sample screens

**STATION DATA HOME SCREEN**
(Screen accessed via flowmeter power up; **STATION** soft key; ESC from S0:Station Menu)

<table>
<thead>
<tr>
<th>Time</th>
<th>23:13  21 June 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FLOW</strong></td>
<td>CUMECS</td>
</tr>
<tr>
<td></td>
<td>******** Ch1</td>
</tr>
<tr>
<td></td>
<td>******** Ch2</td>
</tr>
<tr>
<td></td>
<td>******** Ch3</td>
</tr>
<tr>
<td></td>
<td>******** Ch4</td>
</tr>
<tr>
<td><strong>LEVEL</strong></td>
<td>metres</td>
</tr>
<tr>
<td></td>
<td>******** Ch1</td>
</tr>
<tr>
<td></td>
<td>******** Ch2</td>
</tr>
<tr>
<td></td>
<td>******** Ch3</td>
</tr>
<tr>
<td></td>
<td>******** Ch4</td>
</tr>
<tr>
<td><strong>Status OK</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Station Data
- Channel values for flow and level and Channel1, 2, 3, 4 soft keys are only displayed for the number of channels selected in S22:Station Configuration
- When **summation of channel** is set to ‘combined’ in screen S22:Station Configuration, a single value for flow is displayed (sum of all channel flows)
- Status conditions can be ‘Status OK’ or ‘Channel Fault’. The soft key relating to the channel in fault will be highlighted. Details about the fault are given on the appropriate CHANNEL HOME screen
- To proceed to screen S0:Station Menu, press ENTER
CHANNEL DATA HOME SCREENS

(Screen accessed via CHANNEL soft key, ESC C1:Channel Diagnostics)

**CHANNEL 1**

- Flow: ******** CUMECS
- Velocity: ******** metre/sec
- Level Above Datum: ******** metres

Cumulative Flow: 234819226 CUMECS from 12:20 21 June 2002

Path 1
Path 12
Path 24

Status OK

Channel Data

- For each configured channel (1-4), there is a channel home screen and soft key
- Fault status messages (flow) can be: status OK; initialising; no flow – low level; no paths & no estimation table; no interface cards; no profile table; level above profile table; flow estimate – low level; flow estimate – paths faulty
- Fault status messages (depth) can be: no level inputs; level arbitration failed; all level inputs faulty
- To return to STATION DATA HOME screen use Station soft key
- To proceed to screen C1:Channel Diagnostics, press ENTER.

SCREEN C1: CHANNEL DIAGNOSTICS (MENU)

(Screen accessed via CHANNEL HOME screen; ESC C10:Instantaneous Flow & Level; ESC C11:Ultrasonic Path Velocities; ESC C12:Path Temperatures)

- C1 Channel Diagnostics

  - Instantaneous Flow and Level
  - Ultrasonic Path Velocities
  - Path Temperatures

  Channel 1
SCREEN C10: INSTANTANEOUS FLOW & LEVEL (RESULTS)
(Screen accessed via C1:Channel Diagnostics)

<table>
<thead>
<tr>
<th></th>
<th>Flow : 1.60 litres/sec</th>
<th>DMD : 0.631 litres/sec</th>
<th>Arbitrated Level: 9.72 metre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1L USW1 ok</td>
<td>Flow : 1.60 litres/sec</td>
<td>DMD : 0.631 litres/sec</td>
<td>Arbitrated Level: 9.72 metre</td>
</tr>
<tr>
<td>2L BCD1 ok</td>
<td>Flow : 1.60 litres/sec</td>
<td>DMD : 0.631 litres/sec</td>
<td>Arbitrated Level: 9.72 metre</td>
</tr>
<tr>
<td>3L ENC1 ok</td>
<td>Flow : 1.60 litres/sec</td>
<td>DMD : 0.631 litres/sec</td>
<td>Arbitrated Level: 9.72 metre</td>
</tr>
</tbody>
</table>

INSTANTANEOUS FLOW AND LEVEL
- Screen available for each configured channel
- For ultrasonic depths (USW): **status** can be ‘OK’, ‘no signal’, ‘no transducer’, ‘too low’ and ‘no vos’
- For 4-20mA analogue (AIN): **status** can be ‘OK’ or ‘no signal’
- For binary coded decimal (BCD): **status** can be ‘OK’ or ‘no signal’
- For encoder (ENC) auxiliary depths: **status** can be ‘OK’ or ‘no signal’
- For arbitration rules see section 1.3:
- Auxiliary levels (1-4) are displayed for all channels. Auxiliary levels are not used to calculate the channel level and are not affected by arbitration rules.
- These results are instantaneous – see Section 1.3

SCREEN C11: INSTANTANEOUS PATH VELOCITIES (RESULTS)
(Screen accessed via C1:Channel Diagnostics)

<table>
<thead>
<tr>
<th></th>
<th>Velocity Units: metres/sec</th>
<th>mS</th>
<th>uS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Path</td>
<td>Status</td>
<td>Vos</td>
<td>Vel</td>
</tr>
<tr>
<td>1</td>
<td>100%</td>
<td>1507</td>
<td>0.027</td>
</tr>
<tr>
<td>2</td>
<td>100%</td>
<td>1496</td>
<td>0.002</td>
</tr>
</tbody>
</table>

INSTANTANEOUS PATH VELOCITIES
- These results are instantaneous - see Section 1.3 for definition
- See Section 1.3 for details about **Status** percentage reading
SCREEN C12: PATH TEMPERATURES (RESULTS)
(Screen accessed via C1:Channel Diagnostics)

<table>
<thead>
<tr>
<th>Path</th>
<th>Upstream Temperature</th>
<th>Downstream Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22.0 °C</td>
<td>21.2 °C</td>
</tr>
<tr>
<td>2</td>
<td>22.3 °C</td>
<td>22.0 °C</td>
</tr>
</tbody>
</table>

PATH TEMPERATURES
- See Section 2.1

SCREEN S0: STATION MENU (MENU)
(Screen accessed via STATION HOME; ESC S1:Station Diagnostics; ESC G1:Password; ESC S2:Relay Configuration; ESC S4:Serial Port A Configuration; ESC S5:Serial Port B Configuration; ESC S6:Serial Port C Configuration; ESC S7:Power Management; ESC S8:Data Logging)
SCREEN S1: STATION DIAGNOSTICS (MENU)
(Screen accessed via S0:Station Menu; ESC S10:Fault Status; ESC S11:Power Rails; ESC S12:Software Version)

<table>
<thead>
<tr>
<th>S1</th>
<th>Station Diagnostics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fault Status</td>
</tr>
<tr>
<td></td>
<td>Power Rails</td>
</tr>
<tr>
<td></td>
<td>Software Version</td>
</tr>
</tbody>
</table>

SCREEN S10: FAULT STATUS (RESULTS)
(Screen accessed via S1:Station Diagnostics)

<table>
<thead>
<tr>
<th>S10</th>
<th>FAULT STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level Fail Ch1</td>
<td>ok</td>
</tr>
<tr>
<td>Level Fail Ch2</td>
<td>ok</td>
</tr>
<tr>
<td>Level Fail Ch3</td>
<td>unused</td>
</tr>
<tr>
<td>Level Fail Ch4</td>
<td>unused</td>
</tr>
<tr>
<td>Path Fail Ch1</td>
<td>ok</td>
</tr>
<tr>
<td>Path Fail Ch2</td>
<td>ok</td>
</tr>
<tr>
<td>Path Fail Ch3</td>
<td>unused</td>
</tr>
<tr>
<td>Path Fail Ch4</td>
<td>unused</td>
</tr>
<tr>
<td>CPU Power</td>
<td>ok</td>
</tr>
<tr>
<td>Main Power</td>
<td>ok</td>
</tr>
<tr>
<td>Backup Power</td>
<td>ok</td>
</tr>
<tr>
<td>Clock Battery</td>
<td>ok</td>
</tr>
<tr>
<td>CPU Fault</td>
<td>ok</td>
</tr>
<tr>
<td>Interface Card</td>
<td>ok</td>
</tr>
</tbody>
</table>

FAULT STATUS

- Fault Status can be ‘ok’, ‘unused’ or ‘fault’
- On this screen ‘fault’ indicates a fatal fault ie. that all paths and levels on the channel have failed. Non-fatal faults are not indicated on this screen. Refer to screen C10:Instantaneous Flow & Level
SCREEN S11: POWER RAILS (RESULTS)
(Screen accessed via S1:Station Diagnostics)

<table>
<thead>
<tr>
<th>S11 POWER RAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU Power: 5.05 Volts</td>
</tr>
<tr>
<td>Main Power: 15.24 Volts</td>
</tr>
<tr>
<td>Backup Power: 11.85 Volts</td>
</tr>
<tr>
<td>Clock Battery: ok</td>
</tr>
</tbody>
</table>

POWER RAILS
- Typical value - CPU: 5 Volts +/- 0.2
- Typical value - Main: AC powered 14 to 16 Volts. DC powered as back-up
- Typical value - Back up: 11.5 to 14 Volts
- Clock battery can be ‘ok’ or ‘replace’

SCREEN S12: SOFTWARE VERSION (RESULTS)
(Screen accessed via S1:Station Diagnostics)

<table>
<thead>
<tr>
<th>S12 Software Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boot Rom : 2.1</td>
</tr>
<tr>
<td>CPU Card : 2.1</td>
</tr>
<tr>
<td>Card 2 : 2.0</td>
</tr>
<tr>
<td>Card 3 : 2.0</td>
</tr>
<tr>
<td>Card 4 : 2.0</td>
</tr>
<tr>
<td>Card 5 : 2.0</td>
</tr>
<tr>
<td>Card 6 : 2.0</td>
</tr>
<tr>
<td>Card 7 : 2.0</td>
</tr>
</tbody>
</table>

SOFTWARE VERSION
- The card numbers are addresses, not positions in the rack.
- Addresses are set by jumper links on the cards, see Section 2.3
- See Appendix 5: Site Data for relation between card type/address/position as supplied.
SCREEN G1: PASSWORD (GATEWAY)
(Screen accessed via S0:Station Menu)

<table>
<thead>
<tr>
<th>G1 Enter Password</th>
</tr>
</thead>
<tbody>
<tr>
<td>Password: [.........]</td>
</tr>
</tbody>
</table>

PASSWORD
- This is a number (up to 6 digits) which must be entered to progress beyond this point.
- The unit is supplied with a default number 999999.
- Password may be changed via screen S22:Station Configuration.

SCREEN G2: SETUP MENU (GATEWAY MENU)
(Screen accessed via G1:Password; ESC S2:Station Setup; ESC C2:Channel Setup)

<table>
<thead>
<tr>
<th>G2 Setup Menu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Station</td>
</tr>
<tr>
<td>Channel 1</td>
</tr>
<tr>
<td>Channel 2</td>
</tr>
<tr>
<td>Channel 3</td>
</tr>
<tr>
<td>Channel 4</td>
</tr>
</tbody>
</table>
SCREEN S2: STATION SETUP (MENU)
(Screen accessed via G2: Setup Menu; ESC S20: Measurement Units; ESC S21: Real Time Clock; ESC S22: Station Configuration; ESC S23: Card Address Map; ESC S24: Flow Calculation; ESC S25: Output Configuration; ESC S26: Auxiliary Output Configuration; ESC S27: Transducer Configuration)

Station

- Station Setup
- Measurement Units
- Real Time Clock
- Station Configuration
- Card Address Map
- Flow Calculation
- Output Configuration
- Aux Input Configuration
- Transducer Configuration
**SCREEN S20: MEASUREMENT UNITS (ENTRY/EDIT)**
(Screen accessed via S2:Station Setup)

<table>
<thead>
<tr>
<th>Measurement Units</th>
<th>Selection</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEVEL</td>
<td>Level:</td>
<td>metres</td>
</tr>
<tr>
<td></td>
<td></td>
<td>cm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ft</td>
</tr>
<tr>
<td></td>
<td>inches</td>
<td></td>
</tr>
<tr>
<td>FLOW</td>
<td>Flow:</td>
<td>litre/sec</td>
</tr>
<tr>
<td></td>
<td></td>
<td>litre/min</td>
</tr>
<tr>
<td></td>
<td></td>
<td>litre/hour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MLH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MLD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TCMD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>m3/sec</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CUMECS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>m3/min</td>
</tr>
<tr>
<td></td>
<td></td>
<td>m3/hour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ft3/sec</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ft3/min</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CFM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ft3/hour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>USgalls/sec</td>
</tr>
<tr>
<td></td>
<td></td>
<td>USgalls/min</td>
</tr>
<tr>
<td></td>
<td></td>
<td>USgalls/hour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MGD</td>
</tr>
<tr>
<td>Cumulative Flow</td>
<td></td>
<td>litres</td>
</tr>
<tr>
<td>Totaliser Relay</td>
<td></td>
<td>litres</td>
</tr>
</tbody>
</table>

Station
SCREEN S21: REAL TIME CLOCK (ENTRY/EDIT)
(Screen accessed via S2:Station Setup)

<table>
<thead>
<tr>
<th>S21 Real Time Clock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours: [10]</td>
</tr>
<tr>
<td>Minutes: [58]</td>
</tr>
<tr>
<td>Day: [16]</td>
</tr>
<tr>
<td>Month: June</td>
</tr>
<tr>
<td>Year: [2001]</td>
</tr>
<tr>
<td>Date Format: dd mm yyyy</td>
</tr>
</tbody>
</table>

REAL TIME CLOCK
Selection: Month:
January – December
Selection: Date Format:
dd month yyyy
month dd yyyy
yyyy month dd
SCREEN S22: STATION CONFIGURATION (ENTRY/EDIT)
(Screen accessed via S2:Station Setup)

<table>
<thead>
<tr>
<th>S22 Station Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Station Name: [abc123]</td>
</tr>
<tr>
<td>Number of Channels: [1]</td>
</tr>
<tr>
<td>Summation of Channels: Separate</td>
</tr>
<tr>
<td>Cycle Time: 10 seconds</td>
</tr>
<tr>
<td>Password: [...........]</td>
</tr>
</tbody>
</table>

STATION CONFIGURATION:
Selection: Station name:
Alphanumeric name of up to 17 characters

Selection: Number of Channels:
1, 2, 3 or 4.

Selection: Summation of Channels:
Separate
Combined

Selection: Cycle Time: (See Section 1.3)
1 minute
10 seconds

Selection: Password:
Default password 999999. Can be changed to other numerical password of up to 6 digits
SCREEN S23: CARD ADDRESS MAP (MENU)
(Screen accessed via S2:Station Setup)

- The card numbers are addresses, not positions in the rack.
- Addresses are set by jumper links on the cards, see Section 2.3
- See Appendix 5: site data for relation between card type/address/position as supplied
- By pressing ENTER on selected card (paths 4-7), screen S230: PATH ALLOCATION is accessed. Part 1 lists paths A1-4 and B1-4, part 2 lists paths C1-4 and D1-4, part 3 lists paths E1-4 and F1-4 and part 4 lists paths G1-4 and H1-4

SCREEN S230: PATH ALLOCATION (ENTRY/EDIT)
(Screen accessed via S23:Card Address Map)

- A1, A2 etc are Hardware Identifiers (HWIDs), where A, B, C, D are rear panel BNC connections and 1, 2, 3, 4 are multi-drop transducer addresses.
- See Fig 5, Section 2.3.3
SCREEN S24: FLOW CALCULATION (ENTRY/EDIT)
(Screen accessed via S2:Station Setup)

<table>
<thead>
<tr>
<th>S24 Flow Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method: Mean Section</td>
</tr>
<tr>
<td>Averaging Period: 10 seconds</td>
</tr>
<tr>
<td>Reset Cumulative Flow: No</td>
</tr>
</tbody>
</table>

FLOW CALCULATIONS:
- See section 1.2.5

Selection:
- Method: (See section 1.2.5)
  - Mean Section
  - Mid Section
- Averaging Period:
  - 10 seconds
  - 30 seconds
  - 1 minute
  - 5 minute
  - 10 minute
  - 15 minute
  - 30 minute
- Reset Cumulative Flow: (Use this to reset totaliser)
  - No
  - Yes
SCREEN S25: OUTPUT CONFIGURATION (ENTRY/EDIT)
(Screen accessed via S2:Station Setup; ESC S250:Analogue Output Configuration; ESC S251:BCD Output Configuration)

<table>
<thead>
<tr>
<th>Analogue 1</th>
<th>Analogue 2</th>
<th>BCD 1</th>
<th>Analogue 3</th>
<th>Analogue 4</th>
<th>BCD 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow</td>
<td>Test O/P</td>
<td>Level</td>
<td>Velocity</td>
<td>DMD</td>
<td>None</td>
</tr>
</tbody>
</table>

OUTPUT CONFIGURATION
- Analogue 1 to 4 (2 available per I/O card; BCD 1 to 2 (1 available per I/O module)
- Selection of analogue output type accesses screen S250:Analogue Output Configuration
- Selection of BCD output type accesses screen S251:BCD Output Configuration

Selection : Outputs:
- None (disabled)
- Flow
- Level
- Velocity
- Daily mean discharge (DMD)
- Test O/P (Note: not selectable for BCD outputs)
SCREEN S250: ANALOGUE OUTPUT CONFIGURATION (ENTRY/EDIT)
(Screen accessed via selection of analogue output type on screen S25:Output Configuration)

<table>
<thead>
<tr>
<th>S250 Analogue Output 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Variable : Flow</td>
</tr>
<tr>
<td>Source: Channel1</td>
</tr>
<tr>
<td>Units: CUMECS</td>
</tr>
<tr>
<td>Zero Scale [0.00]</td>
</tr>
<tr>
<td>Full Scale [0.00]</td>
</tr>
</tbody>
</table>

ANALOGUE OUTPUT CONFIGURATION
- Available for each analogue output (up to 4)
- Output variable determined by input on screen S25:Output Configuration

Selection:
Output Source:
Station
Channel1-4
SCREEN S251: BCD OUTPUT CONFIGURATION (ENTRY/EDIT)
(Screen accessed via selection of BCD output type on screen S25:Output Configuration)

<table>
<thead>
<tr>
<th>S251 BCD Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Variable : DMD</td>
</tr>
<tr>
<td>Source: Channel1</td>
</tr>
<tr>
<td>Decimal Places: 0</td>
</tr>
<tr>
<td>Units: CUMECS</td>
</tr>
</tbody>
</table>

BCD OUTPUT CONFIGURATION
- Screen available for each BCD output (max 2, if BCD is not allocated as an input)
- Output variable determined by selection on screen S25:Output Configuration except ‘none’ and ‘test o/p’
- See Section 2.3.3.2.3

Selection: Source:
- Station
- Channel1-4

Selection: Decimal Places:
- 0, 1, 2, 3 or Coded

SCREEN S252: TEST OUTPUT CONFIGURATION (ENTRY/EDIT)
(Screen accessed via selection of test o/p type on S25:Output Configuration)

<table>
<thead>
<tr>
<th>S252 ANALOGUE OUTPUT 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Variable : Test O/P</td>
</tr>
<tr>
<td>Test Value: [0.000] mA</td>
</tr>
</tbody>
</table>

TEST OUPUT CONFIGURATION
- Screen S252:Test Output only available for each analogue output where ‘test O/P’ output variable is selected
SCREEN S26: AUXILIARY INPUT CONFIGURATION (MENU)
(Screen accessed via S2:Station Setup; ESC C211:Ultrasonic Level; ESC C212:Analogue Input; ESC C213:ENC Input; ESC C214:BCD Input)

<table>
<thead>
<tr>
<th>Aux</th>
<th>USW-1</th>
<th>IF Card 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aux</td>
<td>USW-2</td>
<td>IF Card 1</td>
</tr>
<tr>
<td>Aux</td>
<td>USW-3</td>
<td>IF Card 1</td>
</tr>
<tr>
<td>Aux</td>
<td>USW-4</td>
<td>IF Card 1</td>
</tr>
<tr>
<td>Aux</td>
<td>AIN-1</td>
<td>I/O Card 1</td>
</tr>
<tr>
<td>Aux</td>
<td>AIN-1</td>
<td>I/O Card 1</td>
</tr>
<tr>
<td>Aux</td>
<td>ENC-1</td>
<td>I/O Card 1</td>
</tr>
</tbody>
</table>

AUXILIARY INPUT CONFIGURATION
• By selecting auxiliary input and pressing LEFT or RIGHT arrow key, screen S26:Auxiliary Input Configuration is accessed
• By pressing ENTER on US, screen C211:Ultrasonic Level US is accessed
• By pressing ENTER on AIN, screen C212:Analogue Input AIN is accessed
• By pressing ENTER on ENC, screen C213:Encoder Input ENC is accessed
• By pressing ENTER on BCD, screen C214:BCD Input BCD is accessed

SCREEN S260: AUXILIARY INPUT ALLOCATION (ENTRY/EDIT)
(Screen accessed via S26:Auxiliary Input Configuration)

<table>
<thead>
<tr>
<th>Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disabled</td>
</tr>
<tr>
<td>Level USN-1</td>
</tr>
<tr>
<td>Level USN-2</td>
</tr>
<tr>
<td>Level USN-3</td>
</tr>
<tr>
<td>Level USN-4</td>
</tr>
<tr>
<td>Level AIN-1</td>
</tr>
<tr>
<td>Level AIN-1</td>
</tr>
<tr>
<td>Level ENC-1</td>
</tr>
</tbody>
</table>
SCREEN S27: TRANSDUCER CONFIGURATION (ENTRY/EDIT)
(Screen accessed via S2:Station Setup)

<table>
<thead>
<tr>
<th>S27 Transducer Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Input: W</td>
</tr>
<tr>
<td>Up/Dn: level</td>
</tr>
</tbody>
</table>

**SELECTED TRANSDUCER CONFIGURATION**

- **Selection:** US Input:
  - W, X, Y, Z, A, B, C, D, E, F, G, H,
- **Selection:** Up/Dn:
  - Level, upstream, downstream

**WARNING:** THIS SCREEN SHOULD ONLY BE ACCESSED BY AUTHORISED THERMO FISHER SCIENTIFIC
SCREEN S3: RELAY CONFIGURATION (ENTRY/EDIT)
(Screen accessed via S0: Station Menu; ESC S30: Fault Relay Configuration; ESC S31: Relay Configuration)

<table>
<thead>
<tr>
<th>S3 Relay Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault Relay</td>
</tr>
<tr>
<td>Relay 1</td>
</tr>
<tr>
<td>Relay 2</td>
</tr>
<tr>
<td>Relay 3</td>
</tr>
<tr>
<td>Relay 4</td>
</tr>
</tbody>
</table>

FAULT RELAY CONFIGURATION
Selection: Fault Relay:
Enabled
Disabled

Selection: Relays 1-4:
Disabled
Totaliser
Flow estimate alarm
Path fail
Level fail
Level low alarm
Level high alarm
Flow low alarm
Flow high alarm

- When fault relay selection is ENTERED, screen S30: Relay Configuration is accessed
- When relay 1, 2, 3 or 4 selection is ENTERED, screen S31: Relay 1, 2, 3 or 4 is accessed
### SCREEN S30: FAULT RELAY CONFIGURATION (ENTRY/EDIT)
(Screen accessed via selection on 'Fault Relay' on screen S3: Relay Configuration)

<table>
<thead>
<tr>
<th>Conditions To Activate Relay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level Fail Ch1 Enabled</td>
</tr>
<tr>
<td>Level Fail Ch2 Disabled</td>
</tr>
<tr>
<td>Level Fail Ch3 Disabled</td>
</tr>
<tr>
<td>Level Fail Ch4 Disabled</td>
</tr>
<tr>
<td>Path Fail Ch1 Enabled</td>
</tr>
<tr>
<td>Path Fail Ch2 Enabled</td>
</tr>
<tr>
<td>Path Fail Ch3 Disabled</td>
</tr>
<tr>
<td>Path Fail Ch4 Disabled</td>
</tr>
<tr>
<td>CPU Power Enabled</td>
</tr>
<tr>
<td>Main Power Enabled</td>
</tr>
<tr>
<td>Backup Power Enabled</td>
</tr>
<tr>
<td>Clock Battery Enabled</td>
</tr>
<tr>
<td>CPU Fault Enabled</td>
</tr>
<tr>
<td>Interface Card Enabled</td>
</tr>
</tbody>
</table>

**FAULT RELAY CONFIGURATION**
- Any one or more of the enabled conditions would activate the fault relay. Note that for this relay, path fail alarm requires all paths to have failed see Section 1.3
SCREEN S31: OTHER RELAY CONFIGURATION (ENTRY/EDIT)
(Screen accessed via selection of Relay on screen S3: Relay Configuration; ESC S311: Ultrasonic Paths)

<table>
<thead>
<tr>
<th>Source: Paths</th>
<th>Action: Level High Alarm</th>
<th>Polarity: Normally Energised</th>
<th>Delay: [ ] seconds</th>
<th>Latch: Enabled</th>
<th>Setpoint: [ ] metre</th>
</tr>
</thead>
</table>

RELAY CONFIGURATION (FOR RELAY 1, 2, 3 and 4)

Selection: Source:
- Station
- Channel 1-4

Paths <> (only available for path:relay allocation)
(use LEFT and RIGHT arrow key to toggle allocation on/off)

Selection: Polarity:
- Normally Energised
- Normally De-energised

Selection: Latch:
- Enabled
- Disabled

Selection: Scaler (totaliser only):
- x1, x2, x5, x10, x20, x50, x100, x200, x500

Selection: Setpoint:
(low level alarm, level high alarm, flow low alarm, flow high alarm only)
Numeric input
**SCREEN S311: RELAY ULTRASONIC PATHS ALLOCATION**
(ENTRY/EDIT)
(Screen accessed via S31: Relay 1-4)

<table>
<thead>
<tr>
<th>S311 Ultrasonic Paths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Path 1 [A1] Relay 1</td>
</tr>
<tr>
<td>Path 2 [A2] Disabled</td>
</tr>
</tbody>
</table>

**RELAY CONFIGURATION (FOR RELAY 1, 2, 3 and 4)**

- All configured channels and paths shown on scrollable list
- If path is unallocated, highlight selected path, press ENTER to allocate relay to path
- If path already allocated, press ENTER to disable allocation

**Selection:**

<table>
<thead>
<tr>
<th>Source:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relay 1-4</td>
</tr>
<tr>
<td>Disabled</td>
</tr>
</tbody>
</table>
SCREEN S4: SERIAL PORT A CONFIGURATION (ENTRY/EDIT)
(Screen accessed via S0:Station Menu)

S4 Serial Port Configuration
Port A RS232 (modem)
Protocol: ModBus ASCII
Baud Rate: 9600

SERIAL PORT A CONFIGURATION
Selection: Protocols:
ASCII
RTU
Selection: Baud Rates:
1200
2400
4800
9600
19200
### SCREEN S5: SERIAL PORT B CONFIGURATION (ENTRY/EDIT)
(Screen accessed via S0:Station Menu)

**S5 Serial Port Configuration**

<table>
<thead>
<tr>
<th>Port B RS485</th>
<th>Full Duplex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol: ModBus</td>
<td>RTU</td>
</tr>
<tr>
<td>Baud Rate:</td>
<td>19200</td>
</tr>
<tr>
<td>Parity:</td>
<td>ODD</td>
</tr>
</tbody>
</table>

**SERIAL PORT B CONFIGURATION**

Selection: Port B RS 485:
- Full duplex
- Half duplex

Selection: Protocol, Baud Rate
- As for Serial Port A

Selection: Parity:
- None
- Even
- Odd

### SCREEN S6: SERIAL PORT C CONFIGURATION (ENTRY/EDIT)
(Screen accessed via S0:Station Menu)

**S6 Serial Port Configuration**

<table>
<thead>
<tr>
<th>Port C RS232</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol: ModBus</td>
</tr>
<tr>
<td>Baud Rate:</td>
</tr>
<tr>
<td>Parity:</td>
</tr>
</tbody>
</table>

**SERIAL PORT C CONFIGURATION**
Selection: As Port B but additional Baud Rate of 38400

SCREEN S7: POWER MANAGEMENT (ENTRY/EDIT)
(Screen accessed via S0:Station Menu)

<table>
<thead>
<tr>
<th>S7 Power Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display: Off after 15 minutes</td>
</tr>
<tr>
<td>Power source: AC</td>
</tr>
<tr>
<td>Low Power Control: Disabled</td>
</tr>
<tr>
<td>On Time (HHMMSS): 00:00:45</td>
</tr>
<tr>
<td>Off Time (HHMMSS): 00:00:45</td>
</tr>
</tbody>
</table>

POWER MANAGEMENT

- this affects test threshold for alarm
- See Appendix 3: Specification

Selection:

- Power source:
  - AC
  - DC 12V

- Low Power Control:
  - Disabled
  - External
  - Timer
SCREEN S8: DATA LOGGING (ENTRY/EDIT)
(Screen accessed via S0:Station Menu)

<table>
<thead>
<tr>
<th>S8 Data Logging</th>
<th>Source Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Id : [abc123]</td>
<td></td>
</tr>
<tr>
<td>Logging Interval: 30 seconds</td>
<td></td>
</tr>
<tr>
<td>Log Wrap : yes</td>
<td></td>
</tr>
</tbody>
</table>

Var 1 : Flow Channel 1 [ ]
Var 2 : Cumulative Channel 1 [ ]
Var 3 : Velocity Channel 1 [ ]
Var 4 : Level Channel 1 [ ]
Var 5 : DMD Channel 1 [ ]
Var 6 : Temperature Channel 1 [ ]
Var 7 : Path Velocity Channel 1 [ ]
Var 8 : Path Vos Channel 1 [ ]
Var 9 : Path tof Channel 1 [ ]
Var 10: Path % good Channel 1 [ ]
Var 11: Diff Time Channel 1 [ ]
Var 12: Level Channel 1 [ ]

DATA LOGGING
Selection : Logging Interval:
- 30 seconds
- 1 minute
- 5 minutes
- 10 minutes
- 15 minutes
- 30 minutes
- off

Selection : Log Wrap:
- Yes
- No

Selection : Log Variable:
- None
- Flow*
- Cumulative*
- Velocity*
- Level
- DMD*
- Temperature*
- Path velocity
- Path vos
- Path tof
- Path % good
- Diff time
- iLevel

(those marked * have an index of '0', all other indices relate to individual paths or depths)

Selection : Source:
- Station
- Channel 1-4
SCREEN C2: CHANNEL SETUP (MENU)
(Screen accessed via C2:Setup Menu; ESC/ENTER C20:Channel Configuration; ESC C21:Level Measurement; ESC C22:Ultrasonic Paths; ESC C23:Channel Profile; ESC C24:Flow Estimate Table)

<table>
<thead>
<tr>
<th>Channel Setup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel Configuration</td>
</tr>
<tr>
<td>Level Measurement</td>
</tr>
<tr>
<td>Ultrasonic Paths</td>
</tr>
<tr>
<td>Channel Profile</td>
</tr>
<tr>
<td>Flow Estimate Table</td>
</tr>
</tbody>
</table>

CHANNEL SETUP
- Screen available for each configured channel

SCREEN C20: CHANNEL CONFIGURATION (ENTRY/EDIT)
(Screen accessed via C2:Channel Setup)

<table>
<thead>
<tr>
<th>CHANNEL CONFIGURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection : Level Datum: Fixed Datum</td>
</tr>
<tr>
<td>Bed Level: [0.12]metre</td>
</tr>
<tr>
<td>Level Arbitration:[0.05]metre</td>
</tr>
<tr>
<td>Xdr Fire Sequence:Simultaneous</td>
</tr>
<tr>
<td>Bottom Slice Factor: [0.80]</td>
</tr>
<tr>
<td>Top Slice Factor: [0.5]</td>
</tr>
</tbody>
</table>

CHANNEL CONFIGURATION
- See Section 1.3
- Screen available for each configured channel

Selection : Level Datum:
- Fixed datum
- Mean bed level

Selection : Xdr Fire Sequence:
- Simultaneous
- Alternate (use alternate if there is risk of reflections from submerged objects)
SCREEN C21: LEVEL MEASUREMENT (MENU/RESULTS)
(Screen accessed via C2:Channel Setup; selection or ESC C210:Level Allocation; ESC C211:Ultrasonic Level US Menu; selection or ESC C212:Analogue Input Configuration; ESC C213:Encoder Input Configuration; ESC C214:BCD Input Configuration)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C21</td>
<td>Level Measurement</td>
</tr>
<tr>
<td>1L USW</td>
<td>1</td>
</tr>
<tr>
<td>2L AIN</td>
<td>2</td>
</tr>
<tr>
<td>3L ENC</td>
<td>1</td>
</tr>
<tr>
<td>4L BCD</td>
<td>1</td>
</tr>
</tbody>
</table>

LEVEL MEASUREMENT
- Screen available for each configured channel
- Use of LEFT and RIGHT arrow keys on selected path accesses screen C210:Level Allocation for selection
- Pressing ENTER on selected US (ultrasonic level input) links to screen C211:Ultrasonic Level US
- Pressing ENTER on selected AIN (analogue input) links to screen C212:Analogue Input AIN
- Pressing ENTER on selected ENC (encoder input) links to screen C213:Encoder Input ENC
- Pressing ENTER on selected BCD (binary coded decimal input) links to screen C214:BCD Input BCD
SCREEN C210: LEVEL ALLOCATION (ENTRY/EDIT)
(Screen accessed via C21:Level Measurement)

- Station

<table>
<thead>
<tr>
<th>C210 Level Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disabled</td>
</tr>
<tr>
<td>Level USW-1 IF Card 1</td>
</tr>
<tr>
<td>Level USW-2 IF Card 1</td>
</tr>
<tr>
<td>Level USW-3 IF Card 1</td>
</tr>
<tr>
<td>Level USW-4 IF Card 1</td>
</tr>
<tr>
<td>Level AIN-1 IO Card 1</td>
</tr>
<tr>
<td>Level AIN-1 IO Card 1</td>
</tr>
<tr>
<td>Level ENC-1 IO Card 1</td>
</tr>
<tr>
<td>Level BCD-1 IO Card 1</td>
</tr>
</tbody>
</table>

- Screen available for each configured channel
- Complete selection on scrollable screen using UP and DOWN arrow keys.
- The sample screen shown above shows one interface card (level USW, paths 1-4). Additional cards will be shown as USX, USY and USZ as appropriate, each with path number 1-4.
- Refer to Fig 5, Section 2.3.3.

Selection: Level Inputs:

- Disabled
- USW 1-4
- USX 1-4
- USY 1-4
- USZ 1-4
- AIN 1-4
- ENC 1-2
- BCD 1-2
SCREEN C211: ULTRASONIC LEVEL INPUT MENU (MENU)
(Screen accessed via US selection on C21:Level Measurement and US selection on S26:Auxiliary Input Configuration)

- Screen available for each configured ultrasonic level input

ULTRASONIC LEVEL MENU

SCREEN C212: ANALOGUE INPUT CONFIGURATION (ENTRY/EDIT)
(Screen accessed via AIN selection on C21:Level Measurement and AIN selection on S26:Auxiliary Input Configuration)

ANALOGUE LEVEL CONFIGURATION
- Screen available for each configured analogue input

Selection: Input Range:
0-20mA
0-5V
SCREEN C213: ENCODER INPUT CONFIGURATION (ENTRY/EDIT)
(Screen accessed via ENC selection on C21:Level Measurement and ENC selection on S26:Auxiliary Input Configuration)

ENCODER LEVEL CONFIGURATION
- Screen available for each configured encoder input
- See Section 2.3.3.2.3

C213 Encoder Input ENC

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Level</td>
<td>[0.00]metre</td>
</tr>
<tr>
<td>Scaling Factor</td>
<td>[0.00]metre</td>
</tr>
</tbody>
</table>

Station
SCREEN C214: BCD INPUT CONFIGURATION (ENTRY/EDIT)
(Screen accessed via BCD selection on C21:Level Measurement and selection of BCD on S26:Auxiliary Input Configuration)

<table>
<thead>
<tr>
<th>C214 BCD Input</th>
<th>BCD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level Above Datum: [0.00] metre</td>
<td></td>
</tr>
<tr>
<td>Conversion Factor (+/-): [0.00]</td>
<td></td>
</tr>
</tbody>
</table>

BCD LEVEL CONFIGURATION
- Screen available for each configured BCD input
- See Section 2.3.3.2.3
- The conversion factor is a factor which determines the scaling (including decimal place) and polarity

SCREEN C215: (ULTRASONIC) LEVEL CONFIGURATION (ENTRY/EDIT)
(Screen accessed via C211:Ultrasonic Level Input Menu)

<table>
<thead>
<tr>
<th>C215 Level Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transducer Id: USW-1 Type: 500kHz</td>
</tr>
<tr>
<td>Transducer Siting: Channel1</td>
</tr>
<tr>
<td>Transducer Level: [3.9] metres</td>
</tr>
<tr>
<td>Min Submersion: [0.03] metres</td>
</tr>
</tbody>
</table>

(ULTRASONIC) LEVEL CONFIGURATION
- Screen available for each configured ultrasonic level input
- See Section 2.3.3

Selection: Transducer siting:
- Disabled
- Channel1-4
C216 Transducer Setup

| Setup:      | Manual          |
| Gain:       | 1              |
| Drive:      | 11 volts       |
| Charge Mode:| Continuous      |
| Shape Recognition: | No |

LEVEL TRANSDUCER SETUP

- See Appendix 5: Site Data
- Screen available for each configured ultrasonic level input

Selection: Setup:
- Manual
- Auto

Selection: Gain:
- 1
- 2
- 5
- 10

Selection: Drive:
- 1 (11 volts)
- 2 (23 volts)
- 3 (36 volts)
- 4 (62 volts)
- 5 (100 volts)
- 6 (144 volts)
- 7 (185 volts)
- 0 (0 volts)

Selection: Charge Mode:
- Continuous
- Single shot

Selection: Shape Recognition:
- Yes
- No
SCREEN C217: LEVEL WAVEFORM CAPTURE SETUP (ENTRY/EDIT)
(Screen accessed via C211:Ultrasonic Level Menu; ESC C218:Waveform Display)

<table>
<thead>
<tr>
<th>C217 Waveform Capture Setup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capture: Off</td>
</tr>
<tr>
<td>Sample Period: 1 mS</td>
</tr>
<tr>
<td>Trigger Delay: [0.00]mS</td>
</tr>
</tbody>
</table>

WAVEFORM CAPTURE SETUP
- Screen available for each configured channel
- Trigger delay value is typically equal to the time of flight (tof) value displayed on screen C218:Waveform Display

Selection: Capture:
- Auto
- Single shot

Selection: Sample Period:
- 256 uS
- 512 uS
- 1 mS
- 4 mS
- 8 mS
- 16 mS
- 32 mS
- 64 mS
- 128 mS
- 256 mS
- 409 mS
SCREEN C218: WAVEFORM DISPLAY (WAVEFORM)
(Screen accessed via C217:Waveform Capture Setup)

WAVEFORM DISPLAY
- Screen available for each configured ultrasonic level input
- Time of flight (tof) value typically taken as trigger value input for screen C217:Waveform Capture Setup
- Detection levels shown as horizontal dotted lines.
- Initial number shown at bottom left of screen is trigger delay. Initial number shown at bottom right of screen is duration (trigger delay + sample period)
- On access to C218:Waveform Display - Level from C217:Waveform Capture Setup, the initial waveform relates to sample period input in C217:Waveform Capture Setup
- UP and DOWN arrow keys can be used to zoom in and out and LEFT and RIGHT arrow keys can be used to shift the display window
SCREEN C22: ULTRASONIC VELOCITY PATHS (MENU)
(Screen accessed via C2:Channel Setup; ESC C220:Path Menu)

<table>
<thead>
<tr>
<th>C22 Ultra sonic Paths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Path 1 [A1] IF Card 1</td>
</tr>
<tr>
<td>Path 2 [A2] IF Card 1</td>
</tr>
<tr>
<td>Path 3 [B1] IF Card 1</td>
</tr>
<tr>
<td>Path 4 [B2] IF Card 1</td>
</tr>
</tbody>
</table>

ULTRASONIC PATH ALLOCATION

- Screen available for each configured channel
- See Section 2.3.3
- Paths shown have been selected via screen S230:Path Allocation
- In the example above, the transducer for paths 1 and 2 are multi-dropped and connected to rear terminal A. Similarly, paths 3 and 4 are multi-dropped and connected to rear terminal B.
- Highlighting the selected path and pressing ENTER accesses C220:Path Menu to enable configuration of each path
- Alternatively, a ‘cloning’ function is available via the Clone soft key as a short cut for applications where path configuration is similar (eg. a vertical sided channel). The configuration of the highlighted path is applied to all paths below in the list, however path height will still need to be entered via screen C221:Path Configuration Edit.
- On completion of configuration, press Rebuild soft key
SCREEN C220: PATH MENU (MENU)
(Screen accessed via C22:Ultrasonic Paths; ESC C:221:Path Configuration Edit; ESC C222:Transducer Setup; ESC C223:Waveform Capture Setup; ESC C224:Path Constants)

PATH MENU
• Screen available for each configured path

SCREEN C221: ULTRASONIC PATH CONFIGURATION (ENTRY/EDIT)
(Screen accessed via C220:Ultrasonic Velocity Path Menu)

ULTRASONIC PATH CONFIGURATION
• Screen available for each configured path
• See Section 1
• Path X Factor is normally 1. This value may be adjusted for calibration purposes in exceptional circumstances. Consult Thermo Fisher Scientific.

Selection : Path Status:
Disabled
Enabled
SCREEN C222: VELOCITY TRANSDUCER SETUP (ENTRY/EDIT)
(Screen accessed via C220: Ultrasonic Velocity Path Menu)

C222 Transducer Setup

Setup: Manual
Seed Current
Gain: 10
Drive: 3 (36 V) 1 (11 V)
Charge Mode: Continuous
Shape Recognition: No

VELOCITY TRANSDUCER SETUP
• Screen available for each configured path

Selection: Setup:
  Manual
  Auto

Selection: Gain:
  1
  2
  5
  10

Selection: Drive:
  1 (11 volts)
  2 (23 volts)
  3 (36 volts)
  4 (62 volts)
  5 (100 volts)
  6 (144 volts)
  7 (185 volts)
  0 (0 volts)

Selection: Charge Mode:
  Continuous
  Single shot

Selection: Shape Recognition:
  No
  Yes
SCREEN C223: VELOCITY WAVEFORM CAPTURE SETUP (ENTRY/EDIT)
(Screen accessed via C220:Ultrasonic Velocity Path Menu; ESC C225:Waveform Display-Velocity)

<table>
<thead>
<tr>
<th>C223 Waveform Capture Setup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capture:</td>
</tr>
<tr>
<td>Source:</td>
</tr>
<tr>
<td>Sample Period:</td>
</tr>
<tr>
<td>Trigger Delay:</td>
</tr>
</tbody>
</table>

**WAVEFORM CAPTURE SETUP - VELOCITY**

- Screen available for each configured path
- Trigger delay value is typically equal to the time of flight (tof) value displayed on screen C225:Waveform Display-Velocity

**Selection:**

- **Capture:**
  - Off
  - Single shot
  - Auto

- **Source:**
  - Downstream
  - Upstream
  - Both

- **Sample Period:**
  - 256 uS
  - 512 uS
  - 1 mS
  - 4 mS
  - 8 mS
  - 16 mS
  - 32 mS
  - 64 mS
  - 128 mS
  - 256 mS
  - 409 mS
SCREEN C224: PATH CONSTANTS (ENTRY/EDIT)
(Accessed via screen C220: Ultrasonic Path Velocity Menu)

<table>
<thead>
<tr>
<th>C224 Path Constants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hi-Limit A: [114]</td>
</tr>
<tr>
<td>Low-Limit B: [108]</td>
</tr>
<tr>
<td>Cable Offset: [0.00] ns</td>
</tr>
</tbody>
</table>

**PATH CONSTANTS**
- Screen available for each configured path
- Selection of upstream or downstream transducers allows re-allocation of a different transducer from a different path.
- LEFT or RIGHT arrow key on US Txdr or DS Txdr accesses screen C226: Transducer Re-allocation for selection.

**WARNING:** CONSULT THERMO FISHER SCIENTIFIC BEFORE MAKING CHANGES TO THIS SCREEN
SCREEN C225: WAVEFORM DISPLAY – VELOCITY (WAVEFORM)
(Screen accessed via C223:Waveform Capture Setup)

WAVEFORM DISPLAY – DUAL TRACE (VELOCITY)
- Screen available for each configured path
- Detection levels shown as horizontal dotted lines.
- Initial number shown at bottom left of screen is trigger delay. Initial number shown at bottom right of screen is duration (trigger delay + sample period)
- On access to C225:Waveform Display – Velocity from C223:Waveform Capture Setup, the initial waveform relates to sample period input in C223:Waveform Capture Setup
- UP and DOWN arrow keys can be used to zoom in and out, and LEFT and RIGHT arrow keys can be used to shift the display window
SCREEN C226: TRANSDUCER RE-ALLOCATION (ENTRY/EDIT)
(Screen accessed via C224:Path Constants)

C226  Transducer Re-Allocation

Path 1  [A1] IF Card 1
Path 2  [B1] IF Card 1
Path 3  [C1] IF Card 2
Path 4  [D1] IF Card 2

TRANSDUCER RE-ALLOCATION
- Screen available for each configured path
- Path velocity transducers may be re-allocated in exceptional circumstances, for example where a low level transducer is obscured. Therefore, path 1 upstream transducer may fire to path 2 downstream transducer

SCREEN C23: CHANNEL PROFILE (MENU)
(Screen accessed via C2:Channel Setup)

C23  Channel Profile

Edit Channel Profile page 1
Edit Channel Profile page 2
Edit Channel Profile page 3
SCREEN C230: CHANNEL PROFILE EDIT (ENTRY/EDIT)
(Screen accessed via C23:Channel Profile)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel Height</td>
<td>Channel Width</td>
</tr>
<tr>
<td>metres</td>
<td>metres</td>
</tr>
<tr>
<td>Bed[</td>
<td>]</td>
</tr>
<tr>
<td>1 [</td>
<td>]</td>
</tr>
<tr>
<td>2 [</td>
<td>]</td>
</tr>
<tr>
<td>3 [</td>
<td>]</td>
</tr>
<tr>
<td>4 [</td>
<td>]</td>
</tr>
<tr>
<td>5 [</td>
<td>]</td>
</tr>
<tr>
<td>6 [</td>
<td>]</td>
</tr>
<tr>
<td>7 [</td>
<td>]</td>
</tr>
<tr>
<td>8 [</td>
<td>]</td>
</tr>
<tr>
<td>9 [</td>
<td>]</td>
</tr>
</tbody>
</table>

CHANNEL PROFILE
• Defined independently from the path dimensions
• See Section 1.3
• Edit pages 2 and 3 are available for table entries in excess of 9 ie. for table entries 10-19 and 20-29 respectively.

SCREEN C24: FLOW ESTIMATE TABLE (MENU)
(Screen accessed via C2: Channel Setup)

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C24 Flow Estimate Table</td>
</tr>
<tr>
<td>Edit Flow Table page 1</td>
</tr>
<tr>
<td>Edit Flow Table page 2</td>
</tr>
<tr>
<td>Edit Flow Table page 3</td>
</tr>
</tbody>
</table>

FLOW ESTIMATE TABLE
• Level to flow conversion table may be used when velocity is not calculable, e.g. at low water level
• See Section 1.3
SCREEN C240: FLOW TABLE EDIT (ENTRY/EDIT)
(Screen accessed via C24: Flow Estimation Table)

C240 Flow Table Edit

<table>
<thead>
<tr>
<th>River Level metre</th>
<th>Flow Estimate CUMECS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 [......]</td>
<td>[........]</td>
</tr>
<tr>
<td>1 [......]</td>
<td>[........]</td>
</tr>
<tr>
<td>2 [......]</td>
<td>[........]</td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

Flow Table Edit
- Edit pages 2 and 3 are same, levels from 10 to 19 and 20 to 29 respectively
- See Section 1.3
The flowmeter may be programmed and interrogated and the logged data downloaded via a PC.

The PC minimum specification is any PC with a modem and capable of running Windows 95, 98 or 2000.

The communication is either via the serial port on the front of the flowmeter or via a modem. The modem would be connected to the rear panel RS232 connector.

The PC screens follow.
### APPENDIX 2 GAFA PC SOFTWARE

#### Sarasota 2000 Ultrasonic Multipath Flowmeter

**Thermo Measurement**

**STATION**

<table>
<thead>
<tr>
<th>Data &amp; Time</th>
<th>Flow</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>08/10/02 21:49</td>
<td>40.738</td>
<td>1616 m³</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Channel</th>
<th>Flow</th>
<th>Level Above Datum</th>
<th>Avg Vel</th>
<th>Avg Temp</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
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**Flow Meter Status**

- Channel 1 - Level Measurement OK
- Channel 1 - Flow OK

**Exit**
Sarasota 2000 Ultrasonic Multipath Flowmeter

APPENDIX 2 GAFA PC SOFTWARE
Station Configuration

- **System**
- **U/S Path Allocation**
- **Level Allocation**
- **Aux Inputs**
- **Outputs**
- **Relays**

**Configuration**

- **Level**
- **Elevation Above Datum**

**Ultrasound**

- **Type**
- **Minimum Depth**

- **Charge Mode**
  - Continuous
  - Single Shot

- **HT Drive**
  - Drive Voltage
  - Gain

**BCD & Encoder**

- **Reference Level**
- **Correction Factor**

**Analogue**

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**Depth**

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- **Write to Gauge**
- **Cancel**
### Channel #1 Configuration

<table>
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<tr>
<th>Channel</th>
<th>Velocity Path</th>
<th>Level</th>
<th>Profile</th>
<th>Flow Est</th>
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</thead>
</table>

#### Level Measurement
- **Fixed Dotum**
- **Mean Bed Level**

**Bed Level**: 0.0000 metre

#### Level Arbitration

**Level Arbitration**: 0.0500 metre

#### Fire Sequence
- **Alternate**
- **Simultaneous**

**Bottom Slice Factor**: 0.8000

**Top Slice Factor**: 0.5000

---

Write To Gauge

Cancel
Sarasota 2000 Ultrasonic Multipath Flowmeter

APPENDIX 2, GAFA PC SOFTWARE

Thermo Fisher Scientific
### Channel #1 Configuration

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**Thermo Fisher Scientific**
## Channel #1 Configuration

### River Flow Table

| Level | Height (m) | Flow (CUMECS) | | Level | Height (m) | Flow (CUMECS) | | Level | Height (m) | Flow (CUMECS) |
|-------|------------|---------------|---|-------|------------|---------------|---|-------|------------|
| Bed   | 0          | 0             |   | 10    | 0          | 0             |   | 20    | 0          | 0           |
| 1     | 0          | 0             |   | 11    | 0          | 0             |   | 21    | 0          | 0           |
| 2     | 0          | 0             |   | 12    | 0          | 0             |   | 22    | 0          | 0           |
| 3     | 0          | 0             |   | 13    | 0          | 0             |   | 23    | 0          | 0           |
| 4     | 0          | 0             |   | 14    | 0          | 0             |   | 24    | 0          | 0           |
| 5     | 0          | 0             |   | 15    | 0          | 0             |   | 25    | 0          | 0           |
| 6     | 0          | 0             |   | 16    | 0          | 0             |   | 26    | 0          | 0           |
| 7     | 0          | 0             |   | 17    | 0          | 0             |   | 27    | 0          | 0           |
| 8     | 0          | 0             |   | 18    | 0          | 0             |   | 28    | 0          | 0           |
| 9     | 0          | 0             |   | 19    | 0          | 0             |   | 29    | 0          | 0           |

[Write To Gauge] [Cancel]
## Velocity Paths

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<tr>
<th>Path</th>
<th>Success %</th>
<th>YDS (m/s)</th>
<th>Velocity (m/s)</th>
<th>TDF (mS)</th>
<th>Diff (μS)</th>
<th>Temp Upstream (°C)</th>
<th>Temp Downstream (°C)</th>
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### View Aux Inputs

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<td>Aux 4</td>
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</table>

[Image of the View Aux Inputs window]
Sarasota 2000 Ultrasonic Multipath Flowmeter

APPENDIX 2 GAFA PC SOFTWARE

Thermo Fisher Scientific
Save As

Save in: Gauge Logs

File name: LogName

Save as type: Text File (*.txt)

Collecting log
APPENDIX 3 SPECIFICATION

A3.1 Enclosure

Size
- Height 300 mm
- Width 450 mm
- Depth 400 mm

Weight
- 19 kg Includes batteries.
  Weight will vary slightly depending on cards fitted.

Environment

- IP rating 55
- Operating temperature* -10 to +50 °C
- Storage temperature -10 to +70 °C
- Humidity 85% condensing
* LCD backlight will not turn on below 0 °C

A3.2 Power supply

A3.2.1 AC supply

- Voltage 85 to 264 Volts
- Frequency 47 to 64 Hz
- Power consumption 50 W max
- Internal battery 12 V, 13 AH
- Internal fuses 20 mm, 3.15AT, input
  20 mm, 5AF, secondary.

A3.2.2 12 Volt DC Supply

- Voltage 10.5 to 16 Volts
- Fuse 20 mm 5AT

Power consumption for 8 path flowmeter typically 0.4 A @12 V when on continuously, 0.02 A in sleep mode.

Intermittent modes may be set up by defining on and off times or by an external switch input. Average consumption is then defined by the on/off ratio.

For example, for an 8 path flowmeter, “On” time 2 minutes, “off” time 13 minutes in a 15 minute cycle, average current = 0.071 A.

A3.2.3 24 Volt DC supply

- Voltage 18 to 36 volts
- Power consumption 50 W max
- Internal battery 12 V, 13 AH
- Internal fuses 20 mm, 5AT, input
  20 mm, 5AF, secondary.
A3.3 Electronics

Timer resolution

\[ 10^{-9} \text{ s} \]

Logging capacity

1 Mbyte

4-20 mA outputs

Resolution 12 bits
Maximum load when loop power internally sourced 600 ohms
Minimum voltage when loop power externally sourced 3.5 volts

4-20 mA inputs

Resolution 12 bits
Input impedance 200 ohms

BCD as output

High level 5 volts, +/- 5%, o/p impedance 1 k ohm
Low level 0 volts, o/p impedance 1 k ohm

BCD as input

High level 4 to 5 volts i/p impedance 100 k ohm
Low level 0 to 1 volt, i/p impedance 100 k ohm

Relays

Fault relay
Type – change over (NO & NC)
Contact rating 0.3 A at 125 V AC or 1 A @ 30 V DC
Guaranteed operations greater than \( 10^5 \)

Standard Relay (relays 2-4 on new boards or 1-4 on early boards)
Type – change over (NO & NC)
Contact rating 5 A at 250 V AC or 30 V DC
Guaranteed operations greater than \( 10^5 \)
(depending on load and voltage)

Solid State Relay (Relay 1 on new style boards)
Type NO
Rating 0.21 A @ 400 V peak
On resistance 27 ohm max ac load, 7 ohm dc load
Off resistance 7000 G ohm
Consult Thermo Fisher Scientific for solid state option for high switching rates.

Serial

RS232 Baud rates
1200, 2400, 4800, 9600, 19200 (modem)
1200, 2400, 4800, 9600, 19200, 38400 (PC)

RS485 Baud rates
1200, 2400, 4800, 9600, 19200
A3.4 Transducers

A3.4.1 1 MHz

- Frequency tolerance: 2%
  (matched pairs available for close tolerance requirements)
- Immersion pressure: max 5 bar. Standard.
  (Consult Thermo Fisher Scientific for higher pressure ratings)
- Operating temperature range: -5°C to +50°C
- Safe area use: standard.
- Hazardous area use: consult Thermo Fisher Scientific

A3.4.2 500 kHz

- Frequency tolerance: 2%
- Immersion pressure: max 5 bar.
- Operating temperature range: -5°C to +50°C
- Safe area use: standard.

A3.4.3 Other frequencies

Consult Thermo Fisher Scientific

A3.4.4 Transducer cable

URM76 with additional outer polypropylene sheath for continuous immersion.
Overall diameter 8mm.

A3.5 GAFA software

PC requirement

Minimum 486 with 8Mbyte RAM free
Operating under Windows 95, 98, 2000
This page is blank
BS 3680: Part 3E: 1993
Measurement of liquid flow in open channels – measurement of discharge by the ultrasonic (acoustic) method.

This is identical to


In the near future a revised, dual numbered version will be published as

BS ISO 6416

BS ISO 748: 1997
Measurement of liquid flow in open channels – velocity area methods.

This includes check gauging by current metering. The standard was formerly numbered as

BS 3680 part 3A.
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APPENDIX 5 SITE DATA BOOK

A5.1 Model and serial number

Sarasota 2000
Serial Number……………

A5.2 Site and customer

Site name:
River or channel:
Customer name:
Customer reference:
Sales Order reference number:
Thermo Fisher Scientific site reference number:

A5.3 General description

Number of paths:
Configuration:
Number and frequency of transducers:
Number and type of levels:
Number and type of outputs:
Power source:
Other comments:

A5.4 Software issue

Software issue:
Date:
Special features:

A5.5 Card layout in rack

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## A5.6 Programmed data

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A5.7 Schedule of drawings

(Drawings to be enclosed)

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A5.8 Test certificates

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</tr>
</tbody>
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