

202U/AA

Auto control cassette pump
Installation and operating instructions

Publication PB 0117

- 1 Ensure mains electricity supply matches that marked on rear panel.
- 2 If pump is to be operated under manual control, ensure pre-linked Din plug is positioned in side panel Din socket. Pump will not operate correctly unless this is done.
- 3 If pump is to be operated under auto control, follow instructions in Part 2 or Part 3.
- 4 Load tubing into pumphead cassettes.
- 5 Set direction of rotation on top panel switch.
- 6 Press power button to set pump running.
- 7 Hold down max switch to prime pump.
- 8 Set running speed if pump is to be manually controlled.
- 9 To stop pump, press power switch again.
- 10 To set pump to 0.5 percent idle speed, press min switch.

Watson-Marlow Limited warrants, subject to the conditions below, through either Watson-Marlow Limited or its authorised distributors, to repair or replace free of charge, including labour, any part of this product which fails within two years of delivery of the product to the end user. Such failure must have occurred because of defect in material or workmanship and not as a result of operation of the product other than in accordance with the instructions given in this manual.

Conditions of and specific exceptions to the above warranty are:

- 1 Consumable items such as fuses, rollers and tubing are excluded.
- 2 Products must be returned by pre-arrangement carriage paid to Watson-Marlow Limited or its authorised distributor.
- 3 All repairs or modifications must have been made by Watson-Marlow Limited or its authorised distributors or with the express permission of Watson-Marlow Limited or its authorised distributors.
- 4 Products which have been abused, misused, or subjected to malicious or accidental damage or electrical surge are excluded.

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This manual is divided into three parts.

Part 1 should be read by all users and contains essential installation information.

Part 2 is for users who will operate the pump in the control mode in which it has been received.

Part 3 need only be consulted when either the method of control (manual, remote or auto) is to be changed, or when the pump is to be re-calibrated to respond to a different control signal.

Thank you for purchasing this 202U/AA cassette pump. It is a highly versatile unit which can be operated under manual, remote or automatic control to meet your present and future requirements.

The pump can be programmed at any time to respond to a wide range of both voltage and current control signals up to 60V or 32mA, and incorporates full mains isolation allowing earthed or un-earthed signals to be fed to the pump. If the motor is overloaded, the power to the motor will be held to a safe level until the cause of the overload is removed. A digital display of percentage motor speed is incorporated.

The 202U/AA is a sophisticated peristaltic cassette pump designed for auto-control use with in-built signal calibration facilities to provide customer-programme facilities to respond to different signals.

When returning for servicing, in the current situation of heightened concern over the handling of hazardous materials, any equipment which has been contaminated with, or exposed to, body fluids, toxic chemicals or any other substance hazardous to health must be decontaminated. A certificate (a suitable blank form is available from Watson-Marlow), or signed statement that the equipment has been decontaminated must be attached to the shipping carton.

**Contamination by
materials hazardous
to health**

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Please check that you have received one 202U/AA cassette pump, one unwired Din plug, one Din plug, linked for use in manual mode, one pack of spare self-adhesive mode labels, together with any accessories specified in your order. A label on the rear panel of the pump indicates the control mode in which the pump has been set. If not specified on your order, the 202U/AA will be set to manual mode M1.

Ensure that the supply voltage and frequency corresponds with that marked on the nameplate at the rear of the unit. The mains supply cable is coded so that the live lead is coloured brown, the neutral lead is coloured blue, and the earth lead is coloured green and yellow.

Supplies

The 202U/AA can be operated at ambient air temperature from 0C to 37C. Storage temperatures from -20C to 70C are permissible, but allow time for acclimatisation before operating. The pump should be positioned to enable a free passage of air around it. It is recommended that, in accordance with normal practice, signal leads be kept as short as possible. In some cases screening may be required.

If the pump fails to operate correctly, check that mains electricity is available at the unit, that all fuses are intact, that the pump is not stalled by incorrect fitting of tubing, that the pumphead is properly located and securely attached to the drive, and that the correct Din plug is in position (see Part 2 Routine operation).

Please check

A label on the rear panel indicates for which mode of operation your 202U/AA has been set. If the unit is set in a V (voltage) mode or C (current) mode, no attempt should be made to exercise normal control through the top panel potentiometer since this may have been set as part of the auto-control calibration.

Warning

Motor type	Permanent magnet direct current
Nominal maximum gearbox output speed	50rpm
Nominal maximum rotor speed	10rpm
Speed control ratio	100:1
Operating voltage/frequency	200-250V 50/60Hz 90-130V 50/60Hz
Maximum power consumption	35VA
Fuse ratings	0.16A/200-250V 0.315A/90-130V
Operating temperature	0C to 37C
Storage temperature	-20C to 70C
Standards	CEE10, ESCHLE
Height/width	20mm/125mm
Length/weight 202U/AA4	262mm/4.8kg
Length/weight 202U/AA10	337mm/6.0kg
Length/weight 202U/AA16	412mm/7.2kg

Scheduled maintenance of the 202U/AA pump is not required. If the pump needs cleaning, use a cloth dampened with a solution of water and mild detergent. Do not use strong solvents

Standard operating conditions

These flow rates were obtained from a 202U/AA fitted with vinyl tubing pumping water at room temperature. Where flow rate is critical, it should be determined under operating conditions since factors such as suction and delivery pressure, temperature and the viscosity of the fluid will all affect flow rate. The rated flow rates of the colour coded manifold tubes (for instance, one ml/min for grey/grey tubing) will be obtained at approximately forty percent. Minimum flow rates will be one percent of the figures given.

Flow precision demands accurate, consistent tubing. The formulation, manufacture and quality control of all the manifold pump tubing types listed below comply with Watson-Marlow specifications.

Colour code	Bore mm	Flow ml/min	Marprene		
			PVC	Silicone	
Orange/black	0.13	0.02		980.0013.000	
Orange/red	0.19	0.06		980.0019.000	
Orange/blue	0.25	0.14	978.0025.000	980.0025.000	
Orange/green	0.38	0.24	978.0038.000	980.0038.000	
Orange/yellow	0.50	0.39	978.0050.000	980.0050.000	
Orange/white	0.63	0.57	978.0063.000	980.0063.000	982.0063.000
Black/black	0.76	0.77	978.0076.000	980.0076.000	982.0076.000
Orange/orange	0.88	1.09	978.0088.000	980.0088.000	982.0088.000
White/white	1.02	1.44	978.0102.000	980.0102.000	982.0102.000
Red/red	1.14	1.85	978.0114.000	980.0114.000	982.0114.000
Grey/grey	1.29	2.25	978.0129.000	980.0129.000	982.0129.000
Yellow/yellow	1.42	2.89	978.0142.000	980.0142.000	982.0142.000
Translucent	1.47	3.16			982.0147.000
Yellow/blue	1.52	3.42	978.0152.000	980.0152.000	982.0152.000
Blue/blue	1.65	3.76	978.0165.000	980.0165.000	982.0165.000
Green/green	1.85	4.88	978.0185.000	980.0185.000	982.0185.000
Purple/purple	2.05	5.87	978.0205.000	980.0205.000	982.0205.000
Purple/black	2.38	7.12	978.0238.000	980.0238.000	982.0238.000
Purple/orange	2.54	9.12	978.0254.000	980.0254.000	982.0254.000
Purple/white	2.79	10.20	978.0279.000	980.0279.000	982.0279.000

Colour code	Bore mm	Flow ml/min	Marprene	
			Solvent resistant	Acid resistant
Orange/black	0.13	0.02	984.0013.000	
Orange/red	0.19	0.06	984.0019.000	
Orange/blue	0.25	0.14	984.0025.000	
Orange/green	0.38	0.24	984.0038.000	
Orange/yellow	0.50	0.39	984.0050.000	986.0050.000
Orange/white	0.63	0.57	984.0063.000	986.0063.000
Black/black	0.76	0.77	984.0076.000	986.0076.000
Orange/orange	0.88	1.09	984.0088.000	986.0088.000
White/white	1.02	1.44	984.0102.000	986.0102.000
Red/red	1.14	1.85	984.0114.000	986.0114.000
Grey/grey	1.29	2.25	984.0129.000	986.0129.000
Yellow/yellow	1.42	2.89	984.0142.000	986.0142.000
Translucent	1.47	3.16		
Yellow/blue	1.52	3.42	984.0152.000	986.0152.000
Blue/blue	1.65	3.76	984.0165.000	986.0165.000
Green/green	1.85	4.88	984.0185.000	986.0185.000
Purple/purple	2.05	5.87	984.0205.000	986.0205.000
Purple/black	2.38	7.12	984.0238.000	986.0238.000
Purple/orange	2.54	9.12	984.0254.000	986.0254.000
Purple/white	2.79	10.20	984.0279.000	986.0279.000

There are five top panel switches each of which is identified by a colour and shape-coded light emitting diode. Switch (1) controls power on/off, and switch (2) selects direction of rotation, either clockwise or anti-clockwise.

Priming

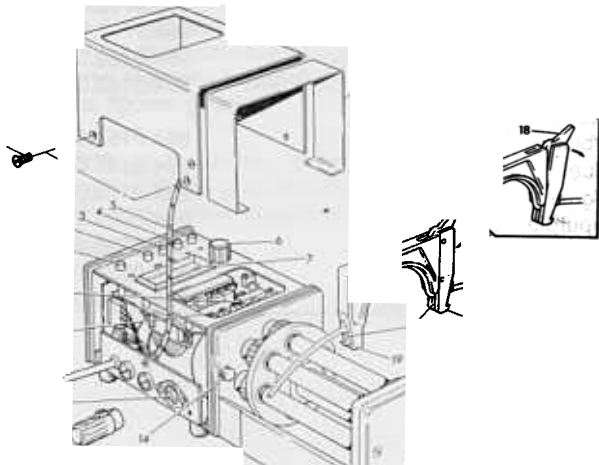
For priming, the max switch (3) will accelerate the pump to between 150 percent and 200 percent of its normal maximum speed depending upon the local mains supply voltage. The max switch is non-latching and must be held down as long as high speed running is required.

Minimum ("crawl") speed

The min switch (4) sets the pump to run at approximately 0.5 percent of its rated maximum speed. This will be found useful as an idle facility since the very low rotor speed is sufficient to prevent the tube walls adhering to each other. The min switch is latching and has a press-to-set, press-to-release action.

The cal switch (5) changes the digital display (7) from its normal function of showing pump speed in percentage terms, to showing the setting of the speed control potentiometer (6). This will be found particularly useful when the min switch is set with the display registering approximately 0.5 percent. If the cal switch is now depressed the setting of the speed control is displayed. This speed setting can be changed, if necessary, so that when the min switch is released the pump will rise to that set speed. The cal switch is non-latching and must be held down for the speed control setting to be displayed. The max switch will override the min switch.

The speed control potentiometer is a ten-turn type enabling the pump to be set to run between one percent and one hundred percent of its normal rated maximum speed in increments of 0.1 percent. Speed stability in this range will be better than plus or minus one percent. (It is possible to set the pump to run below one percent but no assurance is given as to the speed accuracy which will be obtained).



2**Cassette loading**

The cassettes are designed for use with manifold pump tubing. Place the tube, without twisting or stretching it into the retaining slots 17. Depress the cam adjustment lever (18) and push the cassette leg downwards and inwards. Load the cassettes into the pumphead starting at the drive end. Ensure that both retaining lips (19) are properly engaged, then raise the cam adjustment lever to its vertical position to give approximately the right tube occlusion. The final delivery pressure may be varied slightly by adjusting the cam lever position.

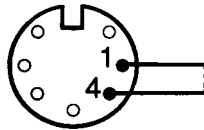
In most cases it will be found that the moving rollers will ease the tube through the cassette until the colour coded wishbone on the inlet side rests against the cassette. Where this does not happen, assist by pulling the tube gently through the cassette.

3**Cassette removal**

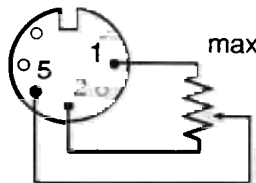
Depress the cam adjustment lever fully and lift out cassette. There is no need to switch off the drive to remove a cassette, and the removal of a cassette will not disturb the pumping action of any other.

4**Manual control**

If the 202U/AA is to be operated manually, first ensure that the mode section of the rear panel is printed Mode M1. The Din plug wired for manual mode must be inserted in the side panel Din socket (10). The pump will not operate if the wrong Din plug is used. If the pre-linked Din plug is mislaid, then a 7 pin Din plug should be linked as follows:

Manual mode M1**5****Remote control**

If the 202U/AA is to be operated remotely, first ensure that the self-adhesive label on the rear panel reads Mode M2. A remote potentiometer can now be connected to the unwired Din plug as shown below:

Remote mode M2

The pump may now be operated remotely over its full speed range. The remote potentiometer should have a value of 4.7 kohm to 10 kohm. A suitable potentiometer is available from Watson-Marlow as Part RV004 and a digital dial as Part DS007.

If the 202U/AA is to be operated under auto-control, first ensure that the self-adhesive label on the rear panel is printed with the value of the signal you propose to use (for example, 4 to 20mA). The signal source should now be connected to the unwired Din plug as shown below. Note that in some modes, pins 1 and 4 must be linked.

Mode	Connection	Mode	Connection
V31 C31 C38		V37 C44	
V32 C32 C39		V38 C45	
V33 C33 C40		V39 C46	
V34 C34 C41		V40 C47	
V35 C35 C42		V41 C48	
V36 C36 C43		V42	
	C37	V46 C54	
V43 C49		V47 C55	
V44 C50		V48 C56	
V45 C51		C57	
C52		C58	
C53			

Warning

CAUTION: Do not adjust the top panel potentiometer. In certain modes it will have been pre-set, calibrating the pump to a specified input signal.

The maximum voltage in to the unit must not exceed 60V. The maximum current permitted when the top panel potentiometer is in circuit is 20mA. When the top panel potentiometer is out of circuit, the maximum permissible current is 32mA.

7

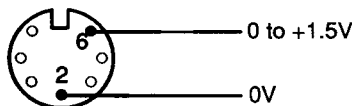
Remote stop

In any of the three control modes (manual, remote or auto), the 202U/AA may be remotely stopped and started. A suitable switch should be wired across pins 2 and 7 of the Din plug. Open contacts to run, closed contacts to stop.

8

Tachometer output

Information from the motor tachometer, which may be used to monitor speed, is present across pins 6 and 2 of the Din socket. When coupled to external instrumentation, the resistance of the instrumentation must be 1 Mohm. The tachometer analogue output signal is dc where plus 1.5V (approximately) equals one hundred percent speed.



The terms used in this section are defined as follows:

Signal range is the change in signal level necessary to produce the required change in pumphead speed (normally zero to maximum rated speed).

Range

Signal offset is the signal level at which the control signal is just about to take effect. Normally the point at which the pumphead is just about to rotate.

Offset

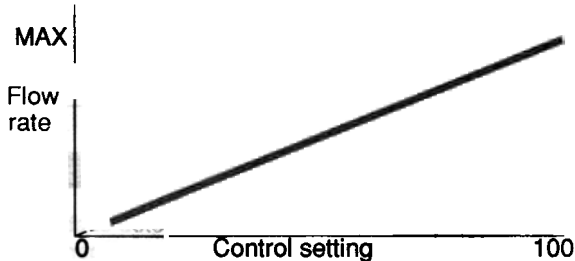
Non-inverted response is obtained when the pump is set to produce an increase in pumphead speed (and thus flow rate) when the signal level increases.

Non-inverted

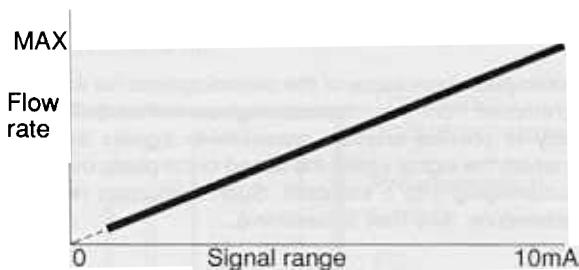
Inverted response is obtained when the pump is set to provide an increase in pumphead speed when the signal level decreases.

Inverted

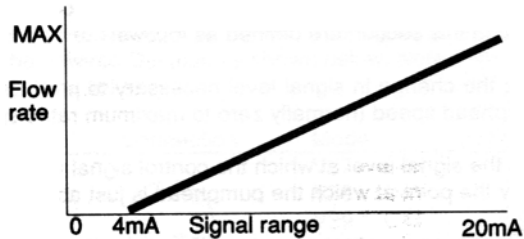
The 202U/AA can be controlled manually from either the top panel mounted potentiometer or by a remotely located potentiometer. The 202U/AA has a control ratio of 100:1, and the relationship between control settings and flow rates can be represented as shown below. Note that accurate control is not normally achieved below one percent of maximum flow.



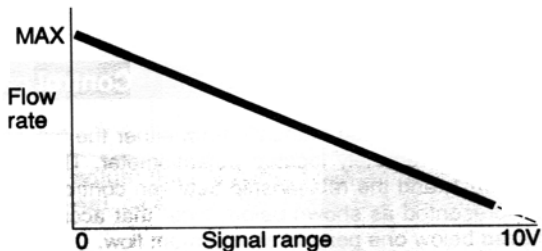
The 202U/AA can also be controlled by virtually any of the process control signals in common use, for instance 0 to 10 mA as shown here.



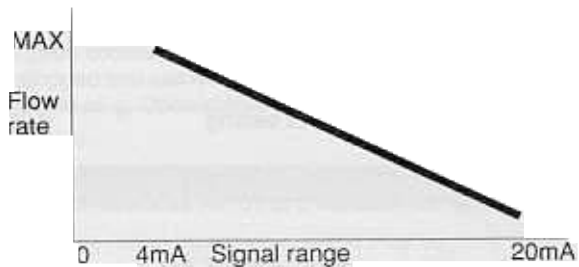
Control through a 4 to 20 mA signal would be as shown below. Here the pump will not respond to the signal until the offset current of 4mA is exceeded. The signal range in this case is 16 mA.



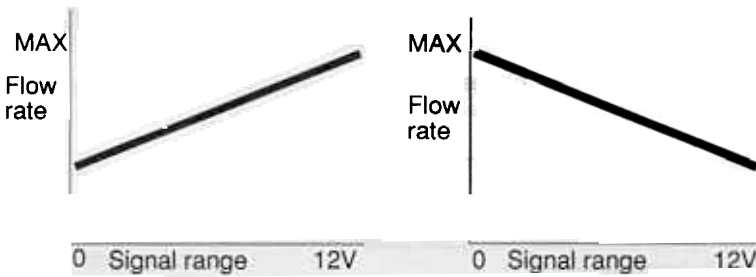
The 202U/AA will meet requirements in which the flow rate is to be inversely proportional to the control signal as shown below in which the input signal varies from 0V, where flow is to be maximal, to 10V where flow is to be minimal.



The pump can also be set to respond to a current signal with a signal offset and in the next illustration the signal ranges from 4mA, where flow is to be at its highest, to 20mA where flow is at its lowest.



The above examples show some of the control options for which the 202U/AA can be programmed from the information given in Part 3. The 202U/AA also has the ability to provide unusual responses to signals as in the following examples in which the signal varies the speed of the pump over a limited speed range without bringing it to a standstill. Such responses require an unusual calibration procedure. See Part 3, Section 8.



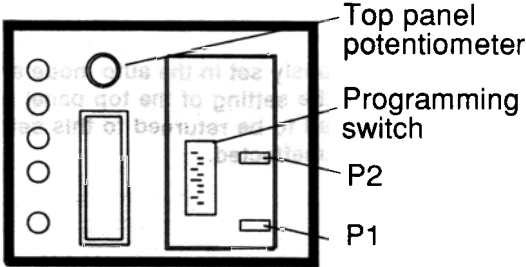
The examples given above refer to some control signals (0 to 10V, 0 to 12V, 0 to 10mA and 4 to 20mA) which are in general use. For those users not already committed to a specific control signal, the following table lists signals in common use. The 202U/AA can be programmed to accept any of them, and the relevant technical data for each signal has been added to aid programming.

	Signal	Sense	Input resistance	Mode
Current signals	0 to 10mA	Non-inverted	0.75k	C34
	0 to 20mA	Non-inverted	1.2k	C35
	4 to 20mA	Non-inverted	0.75k	C43
	0 to 10mA	Inverted	0.75k	C52
	0 to 20mA	Inverted	1.2k	C53
	4 to 20mA	Inverted	1.2k	C53
Voltage signals	0 to 5V	Non-inverted	100k	V31
	0 to 10V	Non-inverted	100k	V32
	0 to 12V	Non-inverted	100K	V32
	0 to 5V	Inverted	100k	V43
	0 to 10V	Inverted	100k	V44
	0 to 12V	Inverted	100k	V44

3 Mode selection

The required mode is determined by selecting the appropriate combination of links and/or connections at the side panel din socket 10, and setting the programming switch 20, which is mounted internally on the printed circuit board.

If an auto-control mode is selected, the unit must be calibrated by adjusting two pcb mounted potentiometers, P1, (8) and P2, (9), and in most cases adjusting the top panel potentiometer (6).



4 Access to programming switch and calibration procedure

Warning

There are dangerous voltages (at mains potential) inside the pump case when it is connected to a mains supply.

- 1 Isolate the pump from the mains supply.
- 2 Remove the five screws 12 securing the cover 11 over the chassis and lift the cover clear, noting that the cover is connected to the chassis by an earth bonding wire.

Warning

Do not disconnect the earth bonding wire.

- 3 The programming switch will now be visible through the access cut-out.
- 4 If manual or remote mode has been selected, resetting of the programming switch may be carried out (see Sections 5 and 6) and the cover replaced.
- 5 If an auto mode has been selected, re-connect the pump to the mains supply before following the procedure detailed in Section 7.

CAUTION: Potentiometers P3, P4, P5, P6, P7 and P8 are factory set and must not be tampered with if the specified performance under manual, remote and auto signals is to be maintained, and the warranty is not to be invalidated.

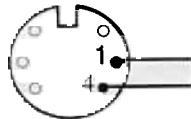
5

Recalibrating for manual speed control

- 1 Set the programming switch as follows:

	Programming switch									
Switch position	1	2	3	4	5	6	7	8	9	10
These switches on	1	2	3	4			7	8		10

- 2 Insert the Din plug linked for manual control into the side panel socket. If the linked plug supplied is mislaid, link a 7 pin Din plug as shown below:



- 3 Remove the now incorrect label to expose screen printed label M1 on the rear panel.

NOTE: If the pump was previously set in the auto mode and is likely to be re-set in that mode, then the setting of the top panel potentiometer should be noted as it will need to be returned to this setting. The pcb mounted potentiometers are unaffected.

A pump can be set to this mode without interfering in any way with any Auto mode calibration which might exist.

1 Wire a suitable potentiometer to the Din plug as outlined in Section II, 5.

2 Set the programming switch as shown below.

Programming switch										
Switch position	1	2	3	4	5	6	7	8	9	10
These switches on	1	2					7	8		10

3 Mark one of the spare self-adhesive labels mode M2 and cover or replace the now incorrect rear panel label.

NOTE: Suitable potentiometers are available from Watson-Marlow (see Part 2, Section 2).

7.1 Mode determination

With a given input signal response requirement for the pump, it is necessary to determine which auto mode will be most suitable. First, the input signal description must be re-stated in a way which provides the information necessary for mode selection and calibration of the pump.

Example 1

Signal 4 to 20mA. Input resistance 0.5 kohm. Flow rate required to rise as signal rises. **4 to 20mA**

Sense	Non-inverted
Signal range	16mA
Input resistance	0.75 kohm
Signal offset	4mA
Maximum speed signal	20mA

From the selection chart for current modes (Section 7.6), this signal can be met by mode C43 or mode C47. The difference between these modes is that in C43 an internal potentiometer is used for the signal offset calibration, and in C47 the top panel potentiometer is used for that calibration. The choice of C43 or C47 will depend on whether you prefer signal offset calibration to be accessible or inaccessible.

Example 2

0 to 10V

Signal 0 to 10V. Input resistance 100 kohm. Flow rate required to fall as signal rises.

Sense	Inverted
Signal range	10V
Input resistance	100 kohm
Signal offset	10V
Maximum speed signal	0V

Signal offset is defined as the point at which the pump is just about to start rotating. In this case, as the signal falls to 10V, rotation will commence and the offset is thus 10V. The signal is best met by mode V44, though V47 could be used. V44 is probably best since the top panel potentiometer is disabled and the calibration cannot be disturbed by adjustment of this control.

Example 3

0 to 5V

Signal 0 to 5V. Input resistance 100 kohm. Flow rate required to rise as signal rises.

Sense	Non-inverted
Signal range	5V
Input resistance	100 kohm
Signal offset	0V
Maximum speed signal	5V

From the selection chart for voltage modes (Section 7.5), it can be seen that this signal can be accommodated by modes V31 and V34. V31 is the recommended mode since no signal offset is required, and the calibration procedure will be simpler than that for V34.

7.2 Equipment required for calibration

7.2.1 Signal source

A process signal (or suitable signal from other source) can be used in the calibration procedure providing that it meets the requirements set out below.

For voltage modes, a stable, variable dc voltage source (for example, laboratory power supply having a source resistance of 5 kohm or less) can be used in conjunction with a dc voltmeter. The maximum voltage into the unit must not exceed 60V. For the current modes, the same dc voltage source may be used, (providing it will supply the current required) in conjunction with a dc milliamp meter. The maximum current permitted when the top panel potentiometer is in circuit is 20mA. When the top panel potentiometer is out of circuit, the maximum permissible current is 32mA.

In all cases, the signal output must be connected to the Din socket in the manner shown in the selection chart.

7.2.2 Setting minimum and maximum rotational speeds

It is best to use the factory calibrated speed display to achieve setting of minimum and maximum rpm. This is carried out by adjusting the signal range potentiometer P2 until the digital display indicates 100.0. Adjust signal offset potentiometer P1 until the digital display indicates 00.0.

7.3 Technical information concerning calibration

- 1 The internal 12V reference has a tolerance of plus or minus five percent, and the figures given in the selection chart for offset are nominal.
- 2 Current modes only: The on-board measuring resistors R15 and R16 have a tolerance of plus or minus two percent and the signal range figures given in the selection chart are nominal. The top panel potentiometer has a tolerance of plus or minus five percent and the current values given in the selection chart are nominal.
- 3 The input resistance referred to on the selection charts determines the loading effect that the pump input circuitry has on the signal source. The signal source must be capable of operating correctly under this loading, which is listed for each mode in the selection charts.

7.4 Before calibrating any unit

- 1 Allow the unit to attain normal working temperature. If practicable, allow it to run for one hour. If a suitable control signal is not available, convert the unit to operate in manual mode (Section 5).
- 2 Set the programming switches for the required mode as specified in the selection chart.
- 3 Connect signal source to the Din socket as indicated in the selection chart.
- 4 Set potentiometers P1 and P2 to approximately mid-position.
- 5 Load cassettes with tubing.

Now proceed to instructions relating to the selected mode as set out in Section 7:5 and 7:6 and record the change of control mode on the rear panel using one of the self-adhesive labels supplied.

7.5 Calibration procedure for voltage signals

V31, V32 and V33 (Top panel potentiometer disabled)

- 1 Set source to the maximum speed signal.
- 2 Adjust P2 for maximum speed.

V34, V35 and V36 (Top panel potentiometer disabled)

- 1 Set source to the maximum offset and adjust P1 for zero speed.
- 2 Set source to maximum speed signal and adjust P2 for maximum speed.
- 3 Repeat 1 and 2 until interaction between adjustments is eliminated.

Tolerances

Settings for Voltage modes

V37, V38 and V39 (Offset adjustment for top panel potentiometer)

- 1 Set source to the signal offset and adjust the top panel potentiometer for zero speed.
- 2 Set source to maximum speed signal and adjust P2 for maximum speed.
- 3 Repeat 1 and 2 until interaction between adjustments is eliminated.

V40, V41 and V42 (Top panel potentiometer extends offset range adjustment)

- 1 Set source to the signal offset
 - and (a) when offset is required to be 11V or less, set top panel potentiometer fully anti-clockwise and adjust P1 for zero speed.
 - or (b) when offset is required to be between 11V and 36V, adjust P1 fully anti-clockwise and then adjust the top panel potentiometer for zero speed.
- 2 Set source to maximum speed signal and adjust P2 for maximum speed.
- 3 Repeat 1 and 2 until interaction between adjustments is eliminated.

V43, V44 and V45 (Top panel potentiometer disabled)

- 1 Set source to the signal offset and adjust P1 for zero speed.
- 2 Set source to maximum speed signal and adjust P2 for maximum speed.
- 3 Repeat 1 and 2 until interaction between adjustments is eliminated.

V46, V47 and V48 (Top panel potentiometer extends offset range adjustment)

- 1 Set signal source to the signal offset
 - and (a) when offset is required to be 11V or less, adjust the top panel potentiometer fully anti-clockwise and adjust P1 for zero speed.
 - or (b) when offset is required to be between 11V and 36V, adjust the top panel potentiometer to fully clockwise position and adjust P1 for zero speed.
- 2 Set the source to maximum speed signal and adjust P2 for maximum speed.
- 3 Repeat 1 and 2 until interaction between adjustments is eliminated.

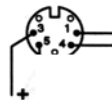
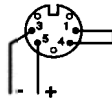
7.6 Selection chart voltage (V) modes

Sense Mode	Input signal Range	Input signal Range		Offset		Input resistance kohm	Programming switch									
		min	max	min	max		1	2	3	4	5	6	7	8	9	10
N	V31	3.8	7	0	0	100	These switches on									
							1	2							9	
o	V32	7	14	0	0	100	1	2							9	10
n	V33	14	24	0	0	200		2							9	10
-	V34	3.8	7	0	12	100	1			5					9	
i	V35	7	14	0	12	100	1			5					9	10
n	V36	14	24	0	2.4	200				5					9	10

v	V37	3.8	7	0	11	100	1	2			6				9	
e	V38	7	14	0	11	100	1	2			6				9	10
r	V39	14	24	0	11	200		2			6				9	10
t	V40	3.8	7	0	22	100	1			5	6				9	
e	V41	7	14	0	22	100	1			5	6				9	10
d	V42	14	24	0	36	200				5	6				9	10

l	V43	3.8	7	3.8	12	100	1			5					9	
v	V44	7	12	7	12	100	1			5					9	10
e	V45	14	24	14	22	200				5					9	10

r	V46	3.8	7	3.8	22	100	1			5	7				9	
t	V47	7	14	7	22	100	1			5	7				9	10
e	V48	14	24	14	36	200				5	7				9	10
d																



7.7 Calibration procedure for current signals

C31, C32, C34 and C35

- 1 Set the top panel potentiometer fully anti-clockwise.
- 2 Set the signal source to maximum speed signal.
- 3 Adjust P2 for maximum speed.

C36, C37, C38, C39 and C40 (Front panel potentiometer extends signal range adjustment)

- 1 Set source to maximum speed signal.
- 2 Set the top panel potentiometer fully anti-clockwise, and then adjust P2 for maximum speed. If required speed cannot be obtained, leave P2 in maximum setting and then adjust the top panel potentiometer.

These modes are similar to C31, C32, C33, C34 and C35, but a wider choice of signal range is achieved by utilising the top panel potentiometer to provide the necessary increase in input resistance.

C41, C42 and C43

- 1 Set the top panel potentiometer fully anti-clockwise.
- 2 Set source to the signal offset and adjust P1 for zero speed.
- 3 Set source to the maximum speed signal and adjust P2 for maximum speed.
- 4 Repeat 2 and 3 until interaction between adjustments is eliminated.

Settings for Voltage modes

C44, C45, C46, C47 and C48 (Offset adjustment from top panel potentiometer)

- 1 Set source to the signal offset and adjust the top panel potentiometer for zero speed.
- 2 Set source to the maximum speed signal and adjust P2 for maximum speed.
- 3 Repeat 1 and 2 until interaction between adjustments is eliminated.

C49, C50, C51, C52 and C53 Set the top panel potentiometer fully anti-clockwise.

- 1 Set source to the signal offset and adjust P1 for zero-speed.
- 2 Set signal source to the maximum speed signal and adjust P2 for maximum speed.
- 3 Repeat 2 and 3 until interaction between adjustments is eliminated.

NOTE: The combination of the signal range and the offset must not be less than zero. For example, 2.7 offset with 10 signal range is minus 7.3. This is not acceptable).

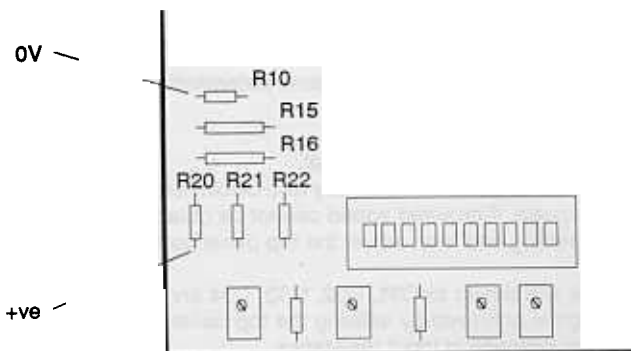
C54, C55, C56, C57 and C58 (Offset adjustment from top panel potentiometer)

For modes C54 and C55 adjust P1 to a voltage of plus 5.7V. For modes C56, C57 and C58 adjust P1 for maximum positive voltage (normally between plus 11.5V to plus 12.5V) (see illustration below for measuring points).

Set source to the signal offset and adjust top panel potentiometer for zero speed.

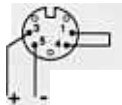
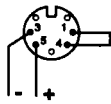
Set source to maximum speed signal and adjust P2 for maximum speed.
Repeat 2 and 3 until interaction between adjustments is eliminated

NOTE Slight re-adjustment of P1 may be necessary to achieve zero speed.



7.8 Selection chart for current (C) modes

Sense Mode	Input signal Range		Offset		Input resistance kohm	Programming switch									
	min	max	min	max		1	2	3	4	5	6	7	8	9	10
Non-inverting	C31	3.2	5.7	0	0	1.2	1	2	3						9
	C32	5	9.5	0	0	0.75	1	2		4					9
	C33	6	11	0	0	1.2	1	2	3						9 10
	C34	9.5	18	0	0	0.75	1	2		4					9 10
	C35	12	22	0	0	1.2			2	3					9 10
	C36	3.2	5.7	0	0	6.2-1.2	1	2	3						9
	C37	5	9.5	0	0	5.75-0.75	1	2		4					9
	C38	6	11	0	0	6.2-1.2	1	2	3						9 10
	C39	9.5	18	0	0	5.75-0.75	1	2		4					9 10
	C40	12	22	0	0	6.2-1.2			2	3					9 10
	C41	3.2	5.7	0	10	1.2	1	3		5					9
	C42	6	11	0	10	1.2	1	3		5					9 10
	C43	9.5	18	0	16	0.75	1			4	5				9 10
Inverting	C44	3.2	5.7	0	9.5	1.2	1	2	3		6			9	
	C45	5	9.5	0	15	0.75	1	2		4	6			9	
	C46	6	11	0	9.5	1.2	1	2	3		6			9 10	
	C47	9.5	18	0	15	0.75	1	2		4	6			9 10	
	C48	12	22	0	9.5	1.2			2	3		6			9 10
Inverting	C49	3.2	5.7	3.2	5.7	1.2	1	3		5				9	
	C50	5	9.5	5	9.5	0.75	1			4	5			9	
	C51	6	11	6	11	1.2	1	3		5				9 10	
	C52	9.5	16	9.5	16	0.75	1			4	5			9 10	
	C53	12	22	12	22	1.2			3	5				9 10	
	C54	3.2	5.7	3.2	14	1.2	1	3		5		7		9	
	C55	5	9.5	5	22	0.75	1			4	5	7		9	
	C56	6	11	6	20	1.2	1	3		5		7		9 10	
	C57	9.5	16	16	32	0.75	1			4	5	7		9 10	
	C58	12	22	20	30	1.2			3	5		7		9 10	



8 For highest accuracy of operation

Improved accuracy will be achieved when calibrating if the pump is fitted with the tubing which it is intended to use. It is not normally necessary for the tubing to contain fluid during calibration.

It is assumed in this manual that signal offset coincides with zero speed (and hence zero flow rate). In practice, the control range of the pump is finite, and no accurate control is available between zero and one percent speed. It may therefore be beneficial to set signal offset to give 1.0 on the digital display. Thus in the second example given in Part 3, Section 2, where 0 to 10mA is shown controlling the flow rate from zero to maximum, adjust the unit so that 0.1mA corresponds to one percent of maximum speed. This may result in the pump stopping before zero or continuing to rotate very slowly at zero.

The final two graphs in Part 2 illustrate the use of speed offset where the pump is set to run at some minimum speed regardless of signal level. Full range deflection of the signal will then vary the speed of the pump over the remainder of the speed range. This is perhaps best illustrated by the following example.

Signal 0 to 10mA. Input resistance 0.75k ohm. Flow rate to rise with signal but output to vary only from fifty percent to one hundred percent.

Sense	Non-inverted
Signal range	10mA
Input resistance	0.75 kohm
Signal offset	0 mA
Maximum speed signal	10mA

Turning to the selection chart for current signals, modes C43 and C47 are suitable because they cater for 0 to 10mA and 0.75 kohm input resistance and have offset adjustment. Modes C34 and C39 are unsuitable because although they will handle the signals they do not have an offset adjustment. Potentiometer P1 can be used to give, in this case, speed offset instead of signal offset. The choice between C43 and C47 is determined by whether external adjustment (through the top panel potentiometer) of the calibration control is required. Calibration is carried out as follows:

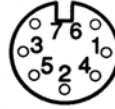
- 1 Follow the access instructions given in Section 4.
- 2 Set the programming switch and connect the signal to the unwired Din plug as shown in the selection chart, mode C43.
- 3 Set the top panel potentiometer to zero.
- 4 Set the signal source to 0mA and adjust P1 for the required minimum speed (50 percent of maximum in this example).
- 5 Set the signal source to 10mA and adjust P2 for the required maximum speed (100 percent in this example).

These spare grids are provided so that control signals which may be used with a 202U/AA may be stated in a way which will provide the information necessary for mode selection and calibration. Finally, the mode number and the Din plug connection can be noted as a permanent record.

Sense
Signal range
Input resistance
Signal offset

Maximum speed signal

Din plug
Connection



Sense
Signal range
Input resistance
Signal offset

Maximum speed signal

Din plug
Connection



Sense
Signal range
Input resistance
Signal offset

Maximum speed signal

Din plug
Connection



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Signal range
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Maximum speed signal

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Connection



