WATSON MARLOW PUMPS

505Du

Contents

Declarations

Declaration of conformity

CE

When the 505Du/RL pump is used as a stand alone pump it complies with:

Machinery Directive 98/37/EC EN60204-1

Low Voltage Directive 73/23/EEC EN61010-1,

EMC Directive 89/336/EEC EN50081-1/EN50082-1.

Declaration of incorporation

When the 505Du/RL is to be installed into a machine or is to be assembled with other machines for installations, it must not be put into service until the relevant machinery has been declared in conformity with the provisions of the Machinery Directive 98/37/EC EN60204-1.

R. Woods

Responsible person: Dr R Woods, Managing Director, Watson-Marlow Limited, Falmouth, Cornwall TR11 4RU, England.

Telephone 01326 370370 Fax 01326 376009

Three year warranty

Watson-Marlow Limited warrants, subject to the conditions below, through either Watson-Marlow Limited, its subsidiaries, or its authorised distributors, to repair or replace free of charge, including labour, any part of this product which fails within three 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:

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

Warranties purporting to be on behalf of Watson-Marlow Limited made by any person, including representatives of Watson-Marlow Limited, its subsidiaries, or its distributors, which do not accord with the terms of this warranty shall not be binding upon Watson-Marlow Limited unless expressly approved in writing by a Director or Manager of Watson-Marlow Limited.

Safety

In the interests of safety, this pump and the tubing selected should only be used by competent, suitably trained personnel after they have read and understood this manual, and considered any hazard involved.

Any person who is involved in the installation or maintenance of this equipment should be fully competent to carry out the work. In the UK this person should also be familiar with the Health and Safety at Work Act 1974.

There are dangerous voltages (at mains potential) inside the unit. If access is required, isolate the pump from the mains before removing the cover.

Information for returning pumps

Any equipment which has been contaminated with, or exposed to, body fluids, toxic chemicals or any other substance hazardous to health must be decontaminated before it is returned to Watson-Marlow or its distributor.

A certificate (a suitable blank form is included at the rear of these operating instructions), or signed statement, must be attached to the outside of the shipping carton.

This certificate is required even if the pump is unused. If the pump has been used, the fluids that have been in contact with the pump and the cleaning procedure must be specified along with a statement that the equipment has been decontaminated.

Recommended operating procedures

DO keep delivery and suction lines as short as possible.

DO use the minimum number of bends in rigid pipe runs. If there must be a bend, use a swept bend and not a tight elbow.

DO use suction and delivery pipelines with a bore equal to or larger than the bore of the tube fitted in the pumphead. When pumping **viscous** fluids, the losses caused by increased friction can be overcome by using pipe runs with a cross sectional area several times greater than the pumping element.

DO run at a slow speed when pumping viscous fluids. When using the 501RL pumphead, a 4.8 or 6.4mm bore tube with a 1.6mm wall will give the best results. Tube smaller than this will generate a high friction pressure loss, so reducing the flow. Tube with a larger bore will not have sufficient strength to restitute. Flooded suction will enhance pumping performance in all cases, particularly for materials of a viscous nature. Silicone and Marprene tubing is available with a 2.4mm wall thickness for speeds up to 200rpm. (The rotor will require re-setting to a roller/track gap of 3.8mm.)

DO use the largest possible bore tube running at slow speed for the longest tube life.

DO fit an extra length of pump tube in the system so that you can move the tube through the pumphead occasionally, without needing to break the pumping circuit. This is particularly useful for extending tube life in long running sterile applications.

DO keep the track and rollers clean, and ensure that the rollers are free.

DO NOT fit valves in the suction or delivery line without considering that peristaltic pumps are self priming and will hold their prime up to several metres, so there may be no need for non-return or foot valves, nor for the loading valves required on many other kinds of pumps.

Any valves fitted must cause no restriction. If electrically actuated valves are fitted, they should be interlocked so that the pump will only run when the valves are open. Fit an automatic by-pass if manual valves are installed.

When using Marprene or Bioprene tubing, after the first 30 minutes of running, re-tension the tube in the pumphead by releasing the tube clamp on the delivery side a little and pulling the tube tight. This is to counteract the normal stretching that occurs with Marprene and Bioprene, which can go unnoticed and result in reduced tube life.

Tube selection The chemical compatibility list published in the Watson-Marlow catalogue is only a guide. If in doubt about the compatibility of a tube material and the duty fluid, request a tube sample card for immersion trials. Remember the sample will be fully immersed, but the fluid when in use will only be in contact with the inside of the tube. If the material swells but does not lose its strength it could be worth considering.

Viscous dispensing To overcome the common problems of reduced accuracy and dripping delivery pipes, the suction and delivery lines should be kept as short as possible. Use larger bore transmission tubing than that in the pumphead to keep the friction losses to a minimum. Improvement will be noticed if rigid or semi-rigid pipe is used on the delivery side. The rigid tube is effective in reducing over-run because it does not expand during pumping.

Part 1: 505Du drive

Siting

To ensure correct lubrication of the gearbox it is important to run the pump only while its feet are standing on a horizontal surface.

It should be situated where there is free air to circulate around the pump and where the tubing is allowed to enter the tube clamps without kinking.

The 505Du can be operated at ambient temperatures from 5C to 40C. Storage temperatures from -40C to 70C are permissible, but allow time for acclimatisation before use.

Electrical connection

The 505Du operates on single phase mains electricity supplies only. It is fitted with a mains voltage selector which must be set to either 120V for 100-120V 50/60Hz supplies or 240V for 220-240V~50/60Hz supplies. For sites where the local voltage is below this specification and the pumphead loading is high, refer to **Part 4: Reduced voltage operation**.

To comply fully with the requirements of the EMC directive, all auto-control connections should be made using screened cable with the screening taken to earth.

A mains cable fitted with a moulded plug is supplied with the pump, but if another plug is to be fitted, the colour coding of the mains lead must be observed. The mains cable for 220-240V supplies 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. The mains cable for 100-120V supplies is coded so that the live lead is coloured black, the neutral lead is coloured white, and the earth lead is coloured green.

Failure to operate

Should the pump fail to operate, check that mains electricity is available at the unit, that the voltage selector switch is in the correct position, that the fuse is intact and that the pump is not stalled by incorrect fitting of tubing. If the pump is to be used under manual control and fails to operate, check that the manual mode has been selected. If the pump is under auto control check that there is a signal, the connections are correct and that the pump is correctly set up.

There are dangerous voltages (at mains potential) inside the unit. If access is required, isolate the pump from the mains before removing the cover.

Flow rates

The 505Du can be fitted with any of six different pumpheads. For more information about the 501RL and 505L see Parts 3 and 4 of this manual. For details of other pumpheads, please refer to the relevant operating instructions.

The flow rates given below were obtained using silicone tubing (except for the 505AA where vinyl tubing was used), with the pumphead rotating clockwise, pumping water at 20C with zero suction and delivery pressures (unless otherwise stated). Where an application is critical, the flow rate should be determined under operating conditions. The important factors are suction and delivery pressures, temperature, and fluid viscosity. Tube life will be reduced when pumping against pressure. Maximum numbers of pumpheads/channels permissible and the maximum rotor speeds are also given.

501RL flow rates (ml/min)							
Tube #	112	13	14	16	25	17	18
Tube bore	0.5mm	0.8mm	1.6mm	3.2mm	4.8mm	6.4mm	8.0mm
	1/50"	1/32"	1/16"	1/8"	3/16"	1/4"	5/16"
55 rpm	**2.3**	**6.7**	**24**	**100**	**220**	**350**	**550**
220 rpm	**9.2**	**27**	**94**	**410**	**890**	**1400**	**2200**

505L (fitted with double-Y tubing element) flow rates (ml/min)							
Tube #	14	16	25	17	18	122	
Tube bore	1.6mm	3.2mm	4.8mm	6.4mm	8.0mm	9.6mm	
	1/16"	1/8"	3/16"	1/4"	5/16"	3/8"	
55 rpm	**40**	**125**	**230**	**385**	**495**	**685**	
220 rpm	**155**	**500**	**925**	**1540**	**1980**	***2750**	

* 9.6mm bore through pumphead and to delivery; 12.7mm bore to source. An MNA0345A twin tube clamp, available from Watson-Marlow or its distributors, must be purchased to enable the 9.6mm high-flow double-Y tubing element to be used.

303/313 flow rates (ml/min)							
Tube #	112	13	14	16	25	17	18
Tube bore	0.5mm	0.8mm	1.6mm	3.2mm	4.8mm	6.4mm	8.0mm
	1/50"	1/32"	1/16"	1/8"	3/16"	1/4"	5/16"
55 rpm	**1.7**	**3.9**	**15**	**55**	**121**	**198**	**275**
220 rpm	**6.6**	**15.4**	**60**	**220**	**484**	**792**	**1100**

304/314 flow rates (ml/min)							
Tube #	112	13	14	16	25	17	18
Tube bore	0.5mm	0.8mm	1.6mm	3.2mm	4.8mm	6.4mm	8.0mm
	1/50"	1/32"	1/16"	1/8"	3/16"	1/4"	5/16"
55 rpm	**1.65**	**3.3**	**14**	**47**	**105**	**165**	**220**
220 rpm	**6.5**	**13.2**	**55**	**187**	**418**	**660**	**880**

Maximum number of 303/313 pumpheads							
Silicone tubing							
Tube #	112	13	14	16	25	17	18
Tube bore	0.5mm	0.8mm	1.6mm	3.2mm	4.8mm	6.4mm	8.0mm
	1/50"	1/32"	1/16"	1/8"	3/16"	1/4"	5/16"
55 rpm	**6**	**6**	**6**	**6**	**6**	**6**	**5**
220 rpm	**6**	**6**	**6**	**6**	**6**	**6**	**5**
Marprene, Tygon, Neoprene and Fluorel tubing							
Tube #	112	13	14	16	25	17	18
Tube bore	0.5mm	0.8mm	1.6mm	3.2mm	4.8mm	6.4mm	8.0mm
	1/50"	1/32"	1/16"	1/8"	3/16"	1/4"	5/16"
55 rpm	**6**	**6**	**6**	**6**	**4**	**3**	**3**
220 rpm	**6**	**6**	**6**	**6**	**4**	**3**	**3**

505BA flow rates (ml/min)								
Tube bore								max channels
mm	0.13	0.19	0.25	0.38	0.50	0.63	0.76	
"	0.005	0.007	0.01	0.015	0.02	0.025	0.03	
55 rpm	**0.03**	**0.07**	**0.17**	**0.27**	**0.44**	**0.79**	**1.16**	
170 rpm	**0.09**	**0.22**	**0.50**	**0.83**	**1.36**	**2.45**	**3.57**	48
Tube bore								max channels
mm	0.88	1.02	1.14	1.29	1.42	1.47	1.52	
"	0.035	0.04	0.045	0.05	0.055	0.058	0.06	
55 rpm	**1.54**	**2.04**	**2.51**	**3.22**	**3.81**	**4.14**	**4.37**	
170 rpm	**4.76**	**6.29**	**7.75**	**9.96**	**11.8**	**12.8**	**13.5**	48
Tube bore								max channels
mm	1.65	1.85	2.05	2.38	2.54	2.79		
"	0.065	0.07	0.08	0.09	0.1	0.11		
55 rpm	**5.05**	**6.31**	**7.6**	**9.84**	**11.0**	**12.84**		
170 rpm	**15.6**	**19.5**	**23.5**	**30.4**	**34.0**	**39.7**		48
Note: *505BA pumpheads must not be run at speeds greater than 170rpm*								

304MC and 304MCX flow rates (ml/min)								
Tube bore								max channels
mm	0.13	0.19	0.25	0.38	0.50	0.63	0.76	
"	0.005	0.007	0.01	0.015	0.02	0.025	0.03	
55 rpm	**0.04**	**0.15**	**0.26**	**0.46**	**0.83**	**1.50**	**2.30**	
110 rpm	**0.09**	**0.30**	**0.52**	**0.92**	**1.70**	**3.10**	**4.60**	15
Tube bore								max channels
mm	0.88	1.02	1.14	1.29	1.42	1.47	1.52	
"	0.035	0.04	0.045	0.05	0.055	0.058	0.06	
55 rpm	**3.20**	**4.10**	**5.00**	**6.50**	**8.30**	**8.80**	**9.40**	
110 rpm	**6.40**	**8.10**	**9.90**	**13.0**	**17.0**	**18.0**	**19.0**	15
Tube bore								max channels
mm	1.65	1.85	2.05	2.38	2.54	2.79		
"	0.065	0.07	0.08	0.09	0.1	0.11		
55 rpm	**11.0**	**14.0**	**17.0**	**20.0**	**24.0**	**26.0**		
110 rpm	**22.0**	**28.0**	**33.0**	**40.0**	**47.0**	**53.0**		15
Note: *304MC & 304MCX pumpheads must not be run at speeds greater than 110rpm*								

308MC and 308MCX flow rates (ml/min)								
Tube bore								max channels
mm	0.13	0.19	0.25	0.38	0.50	0.63	0.76	
"	0.005	0.007	0.01	0.015	0.02	0.025	0.03	
55 rpm	**0.04**	**0.14**	**0.23**	**0.41**	**0.70**	**1.30**	**1.90**	
110 rpm	**0.09**	**0.28**	**0.47**	**0.83**	**1.40**	**2.60**	**3.90**	15
Tube bore								max channels
mm	0.88	1.02	1.14	1.29	1.42	1.47	1.52	
"	0.035	0.04	0.045	0.05	0.055	0.058	0.06	
55 rpm	**2.60**	**3.30**	**4.40**	**5.0**	**6.0**	**6.50**	**7.0**	
110 rpm	**5.30**	**6.60**	**8.80**	**10.0**	**12.0**	**13.0**	**14.0**	15
Tube bore								max channels
mm	1.65	1.85	2.05	2.38	2.54	2.79		
"	0.065	0.07	0.08	0.09	0.1	0.11		
55 rpm	**8.50**	**10.0**	**12.0**	**14.50**	**16.50**	**18.0**		
110 rpm	**17.0**	**20.0**	**24.0**	**29.0**	**33.0**	**36.0**		15

Note: *308MC and 308MCX pumpheads must not be run at speeds greater than 110rpm*

Tubing range

Flow precision depends upon the accuracy and consistency of the tubing. All Watson-Marlow tubing is formulated, manufactured and quality controlled to rigorous specifications. Peristaltic pumping performance and tube life will be affected unless tubing specifically designed for the task is used.

Tubing for 501RL and 303 pumpheads

Bore mm	Bore "	Tube #	Marprene	Bioprene	Peroxide Silicone	Platinum Silicone
0.5	1/50	112	**902.0005.016**	**903.0005.016**	**910.0005.016**	**913.0005.016**
0.8	1/32	13	**902.0008.016**	**903.0008.016**	**910.0008.016**	**913.0008.016**
1.6	1/16	14	**902.0016.016**	**903.0016.016**	**910.0016.016**	**913.0016.016**
3.2	1/8	16	**902.0032.016**	**903.0032.016**	**910.0032.016**	**913.0032.016**
4.8	3/16	25	**902.0048.016**	**903.0048.016**	**910.0048.016**	**913.0048.016**
6.4	1/4	17	**902.0064.016**	**903.0064.016**	**910.0064.016**	**913.0064.016**
8.0	5/16	18	**902.0080.016**	**903.0080.016**	**910.0080.016**	**913.0080.016**
Bore mm	Bore "	Tube #	Butyl *	Tygon	Fluorel	Neoprene
0.8	1/32	13			**970.0008.016**	**920.0008.016**
1.6	1/16	14	**930.0016.016**	**950.0016.016**	**970.0016.016**	**920.0016.016**
3.2	1/8	16	**930.0032.016**	**950.0032.016**	**970.0032.016**	**920.0032.016**
4.8	3/16	25	**930.0048.016**	**950.0048.016**	**970.0048.016**	**920.0048.016**
6.4	1/4	17	**930.0064.016**	**950.0064.016**	**970.0064.016**	**920.0064.016**
8.0	5/16	18	**930.0080.016**	**950.0080.016**	**970.0080.016**	**920.0080.016**

* Butyl tubing is not suitable for use in 303 or 313 pumpheads.

Double-Y tubing elements for 505L

Tube bore mm	Tube bore "	Silicone	Marprene
1.6	1/16	**910.E016.024**	**902.E016.024**
3.2	1/8	**910.E032.024**	**902.E032.024**
4.8	3/16	**910.E048.024**	**902.E048.024**
6.4	1/4	**910.E064.024**	**902.E064.024**
8.0	5/16	**910.E080.024**	**902.E080.024**
9.6	3/8	**910.E096.024**	**902.E096.024**
9.6*	3/8	**910.H096.024**	

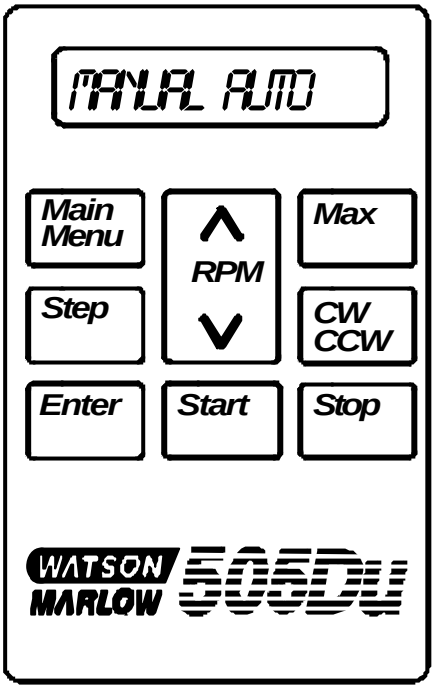
* 9.6mm bore through pumphead and to delivery; 12.7mm bore to source. An MNA0345A twin tube clamp, available from Watson-Marlow or its distributors, must be purchased to enable the 9.6mm high-flow double-Y tubing element to be used.

2.4mm wall tubing for 505L transfer use				
Tube Bore		Tube		
mm	"	#	Silicone	Marprene
0.5	1/50	105	**910.0005.024**	
0.8	1/32	108	**910.0008.024**	
1.6	1/16	119	**910.0016.024**	**902.0016.024**
3.2	1/8	120	**910.0032.024**	**902.0032.024**
4.8	3/16	15	**910.0048.024**	**902.0048.024**
6.4	1/4	24	**910.0064.024**	**902.0064.024**
8.0	5/16	121	**910.0080.024**	**902.0080.024**
9.6	3/8	122	**910.0096.024**	**902.0096.024**

Part 2: Operation

Overview

Overview



The 505Du can be operated under manual control, analogue or digital RS232 auto-control, with remote or TTL control of direction and stop/start.

Under manual control, you can select the speed or direction either when the pump is stopped or when it is running.

There are rapid methods to select the maximum or minimum speeds.

You can quickly select whether after a power interruption the pump should start again automatically, or go to the main menu and await operator input.

You can choose whether to display the drive rpm or flow rate calibrated in ml/min. The flow rate can be calibrated by setting pumphead and tube size or with a calibration dose.

Start up

Turn the power switch (on the rear panel of the drive) ***On*** (**I**).

Main menu

Provided auto-restart has not been selected, the main menu will be displayed Press ***Step*** to move to the required mode**.**

```
MANUAL  AUTO          >
```

Step, Step *calls second screen*

```
CALIB  SETUP          <
```

Step, Step *recalls first screen*

Manual

```
MANUAL  AUTO          >
```

Press ***Enter*** *to select required mode*

Initially the factory default will show on the display and the pump will be stationary. Once the pump has been used it will display the setting last used.

Direction

Change direction by pressing ***CW***/***CCW***

While the pump is running a cursor at the bottom of the display will move from left to right to indicate that the pump is running clockwise and it will move from right to left to indicate that the pump is running anti-clockwise.

Speed

Change speed by pressing Ù or Ú

The speed control ratio of the 505Du is 220:1 giving a minimum speed of 1rpm on the 220rpm drive and 0.2 rpm on the 55 rpm drive. When pressing the Ù or Ú key the speed will change initially on the 220rpm model from 0rpm to 1rpm,

whilst on the 55rpm model the speed will change from 0rpm to 0.2rpm. Speed can then be increased of decreased on both models by an increment of 0.1rpm.

Maximum speed

Select the maximum speed by pressing Ù *and* ***Max*** *together.*

Minimum speed

Select the minimum speed by pressing Ú *and* ***Max*** *together.*

Maximum and minimum speed can be selected with the above commands when the pump is stopped or running.

Keypad lock

The keypad can be locked to avoid accidental resetting or tampering.

To lock the keypad when the pump is stopped, hold down the ***Stop*** key until the padlock symbol on the left hand side of the keypad illuminates. If the pump is running, hold down the ***Start*** key until the padlock symbol illuminates. In the locked state all keys are disabled except the ***Stop*** and ***Start*** keys.

To unlock the keypad, hold down the ***Start*** key if the pump is running, or the ***Stop*** key if the pump is stopped, until the padlock symbol is extinguished.

These commands can be used whether the pump is stopped or started.

Start

To start press ***Start***.

Prime

To prime press **Max**.

Max can only be used while the pump is running.

Stop

To stop press ***Stop***.

RPM or ml/min

The display can either show RPM or ml/min. To change, press ***Step*** at any time that RPM or ml/min is displayed. The ml/min shown will be for the factory default which is for a 501RL pumphead fitted with 8.0mm bore tube, unless another pumphead and tubing has been selected in the CALIB mode.

Until you have run a calibration dose, the flow indicated will be as shown in the published flow rate tables. For applications requiring accurate flow rate indication it is recommended that the calibration dose procedure in CALIB is followed.

Auto-restart

The pump can be set so that, when the mains supply is restored after an interruption, the pump automatically restarts in the same state as before the interruption, or so that, after the power is restored, the pump will remain stopped and require an operator to restart it. To invoke auto-restart, turn the mains supply off, either by using the mains switch on the rear panel or any other convenient power switch controlling the supply to the pump. Hold down the ***Start*** key when you turn the mains supply on until the ***!*** symbol illuminates. You will have to press ***Start*** again to start the pump.

To cancel auto-restart, turn the mains supply off and then hold down the ***Stop*** key while turning the mains supply on. Note that the ***!*** symbol is not illuminated.

For a high repetition of pump stop/starts, the power supply to the pump should not be controlled directly from the mains switch. The auto-control facility of the pump should be used to control power to the drive. This will ensure a fast re-energisation of the pump drive.

Auto-control

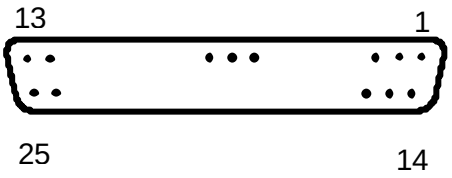
Never apply mains voltage across any pins on the 25D socket as permanent damage, not covered by warranty, will result. Up to 30V may be applied across pins 4 and 17, and 5V TTL on pins 7 and 5, but no voltage should be applied across other pins as permanent damage, not covered by warranty, may result.

Several methods or control can be used with the 505Du. For simple applications the pump can be stopped/started and reversed by using a make/break switch or by TTL compatible logic. These can be used either in the manual or auto mode. Remote speed control can be obtained by using an analogue signal or a potentiometer with the pump in the auto mode set for a 0-12V signal.

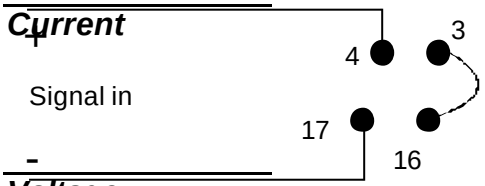
Analogue

The 505Du is shipped from Watson-Marlow with the auto-control circuit set for a 0-10V input signal. Under analogue control the pump displays rpm to the nearest rpm. The actual motor control accuracy of the 55rpm drive is 0.1rpm, whilst the accuracy of the 220rpm drive is 0.25rpm. For more accurate speed measurement apply a digital tachometer to the drive shaft of the pump whilst operating under ambient conditions.

To use the pump under analogue control, identify the 25 pin "D" connector on the rear of the pump. All wiring diagrams refer to the pin-outs shown below:



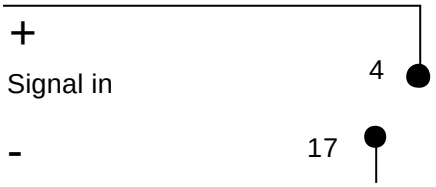
Current



Connections for current control

Circuit impedance 250 ohms. Maximum current signal 32mA. Fit a link between pins 3 and 16 and connect the signal wires to pin 4(+) and pin 17(-) of the 25D plug.

Voltage

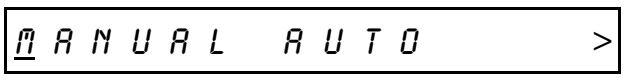


Connections for voltage control

Circuit impedance 100K ohms. Maximum voltage signal 30V. Polarity shown for non-inverted response. Reverse polarity for inverted response.

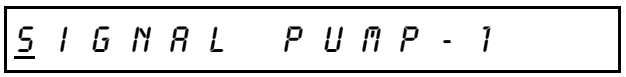
Signal setup

Assume 4-20mA analogue control is required For a speed control of 0-220rpm and that you accept the factory calibration of the signal conditioner on the control circuit. Start from the main menu:

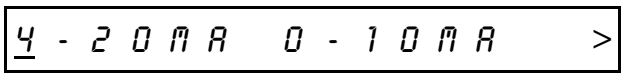


Step, Step *to second screen*

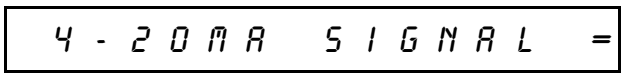
Step *to SETUP and press* ***Enter***



*Press **Enter** at SIGNAL*



*Press **Enter** at 4-20mA*

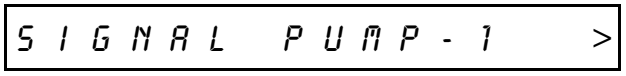


Confirmation screens

If no signal has been chosen or programmed in SETUP, the first time AUTO is selected, screens will prompt for signal information.

Note!

The pump will respond immediately to the process signal and the display will initially show the parameters that have been set up, then it will display the direction, rpm and a prompt that you are in the auto mode. If your requirement is for a signal range or offset that is not shown, or that you require the speed to decrease as the signal increases you must ***Step*** to **SETUP** on the main menu, then ***Enter*** and ***Step*** to:

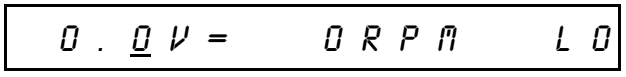


Enter, Step, Step, Step, Step, Step

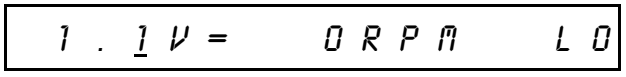
*Press **Enter** at PROGRAM*

Assume that you require the drive to run at 24rpm at 1.1V and 195rpm at 8.0V. For a voltage signal, use the connections as shown.

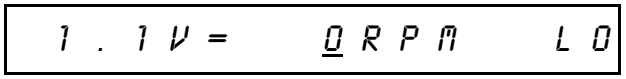
*Press **Enter** at* Ú



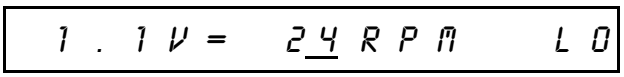
Press Ù *until 1.1V is displayed. If you over-shoot, press* Ú



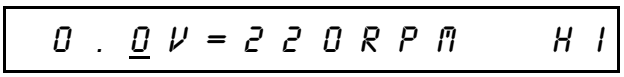
***Step** to RPM*



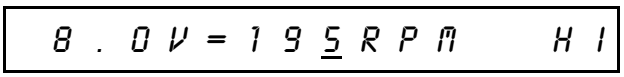
Press Ù *until 24RPM is displayed. If you over-shoot, press* Ú*. Press **Enter.***



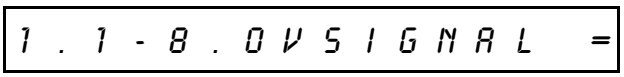
*Press **Enter** when 24RPM is displayed*



*Press Ù until 8.0V is displayed, then **Step***



*Press Ú until 195rpm is displayed, **Enter***



Confirmation screens

Return to **Auto** on the display using ***Main Menu*.**

NETWORK

RS232 is the mode provided to allow the pump to be controlled by computers and process controllers. It can not only control every function of the pump, but data can be passed back to the controller by the pump for closed loop operation. Although the pump display indicates speed to the nearest rpm, the motor control accuracy of the 505Du under RS232 control is 0.1rpm (55rpm) and 0.25rpm (220rpm). For more accurate speed measurement apply a digital tachometer to the drive shaft of the pump when operating under ambient conditions.

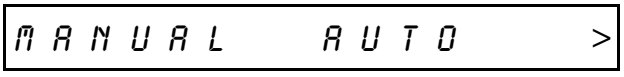
RS232

The 505Du is fitted with a 9D (9 pin D shaped) RS232 data port to allow digital control of all drive functions. Up to 16 pumps may be "daisy-changed" together but individually controlled (use lead PR 0024). All function control codes are listed below for users who wish to construct their own control programs. Additionally, a Networking Kit, which includes a DOS compatible control program, is available from Watson-Marlow to allow digital auto-control from a PC.

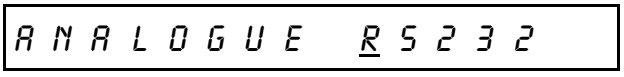
Note!

Watson-Marlow **PumpNet 2** is required for operation with the second-generation 505Du since the older PumpNet 1 does not recognise the 505BA pumphead.

To allow the drive to be controlled by an RS232 process signal, starting from the main menu.



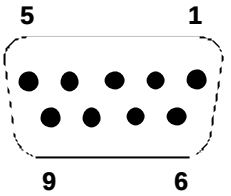
*Press **Enter** at AUTO*



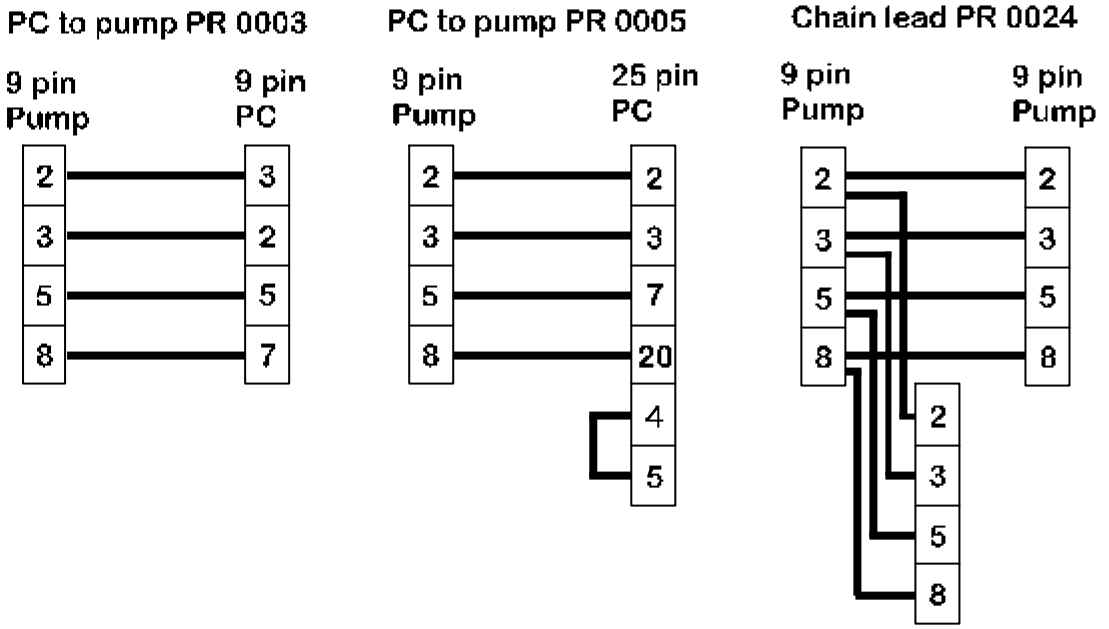
Step** to RS232 and press **Enter

The drive will now be under the exclusive control of the RS232 signal. The front panel ***Stop*** key acts as an emergency stop, and will disable RS232 auto-control signals if pressed. Shown left are the connections for RS232 signals (viewed from inside the plug).

Connections for RS232 signals (viewed from inside the plug).



RS232 cabling shown for CTR handshake



Use only twin shielded RS232 cables.

RS232 settings

Baud	Set in SETUP, BAUD (factory default is 9600)
Stop bits	2
Data bits	8
Parity	None
Handshake	CTR or None
Auto echo	On

Pin	Function	Pin	Function
1	-	6	-
2	RX (Receive data)	7	
3	TX (Transmit data)	8	DTR (Data terminal ready)
4	-	9	-
5	GND (Ground)		

The following codes may be used to operate the 505Du under RS232 control. They must be directed to the pump from a computer serial port (or equivalent). Always terminate each command with a RETURN (ASCII CHR13).

nSP*xxx*	Load speed setting *xxx* to pump number n
nSI	Increment speed by 1rpm for pump n
nSD	Decrement speed by 1rpm for pump n
nGO	Start pump number n
nST	Stop pump number n

nRC	Change rotation direction for pump n
nRR	Set clockwise direction for pump n
nRL	Set anti-clockwise direction for pump n
nDOxxxxx,yyy	Set dose for pump number n in tachometer pulses (note 3)
nRS	Show status for pump number n (note 4)
nZY	Show status if pump n STARTed **1** or STOPped **0**
nTC	Clear tachometer counter
nRT	Read tachometer counter

For writing to pump number n display

nCA	Clear existing display; followed by:
nCH	"Home" cursor; followed by;

nW{text line 1}~{text line 2}@ (@ = terminator)

Notes on control codes

1 n = pump number set in **Setup**. For the command to operate on all networked pumps simultaneously, use # before the command.

2 1284 tacho pulses per revolution of pumphead rotor on 220rpm version.

3200 tacho pulses per revolution of pumphead rotor on 55rpm version

3 nDOxxxxxxxx where xxxxxxxx is any integer and is the target dose in tacho pulses. This can be extended to nDOxxxxxxxx,yyy where yyy is a "kick back" in tacho pulses with a limit of 255 (about 1/5 of a revolution on a 220rpm drive).

4 A show status command will prompt the 505Du to return a text string of the following layout:

[pump type] [ml/rev] [pumphead] [tube size] [speed] [cw/ccw] [P/N] [pump number] [tacho count as a single integer] [stopped/running, 0 /1] [! = delimiter]

eg 505Du 0.7 505l 1.6mm 53.5 CW P/N 1 157810 1 !

5 All networked pumps with the same n will respond to the same command.

6 There should be at least 10mS between consecutive commands

7 When using the # to address all pumps, ensure that it will not generate a *reply*, eg nSS, the result will be unpredictable.

This is a typical short program for pump number 2:

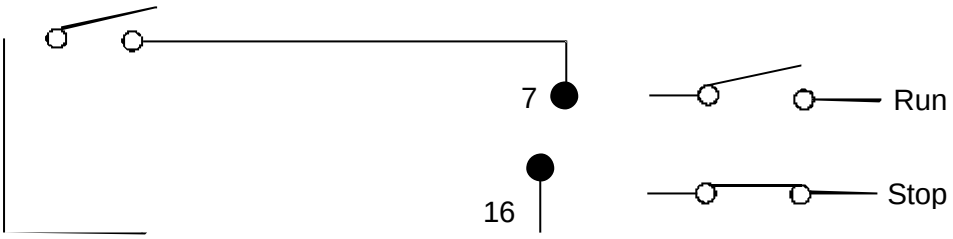
```
OPEN "COM1:9600,N,8,2,CDO,CSO,DSO,OP10000" FOR RANDOM AS #1
PRINT #1, "2SP220" + CHR$(13)
DELAY (command depends on language being used)
PRINT #1, "2GO" + CHR$(13)
DELAY 5000
PRINT #1, "2ST" + CHR$(13)
CLOSE #1
```

Remote control

Never apply mains voltage across any pins on the 25D socket as permanent damage, not covered by warranty, will result. Up to 30V may be applied across pins 4 and 17, and 5v TTL on pins 7 and 5, but no voltage should be applied across other pins because permanent damage, not covered by warranty, may result.

Stop/start

Connect remote switch between pins 7 and 16 of the 25D connector. Open switch to run, close to stop pump. Alternatively a TTL compatible logic input (Low 0v , High 5V) may be applied to pin 7. Low input will stop the pump, High input will allow the pump to run. With no connection the pump will default to running.

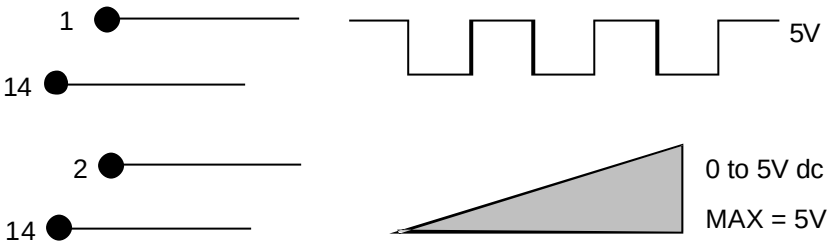


Tachometer

This facility can be used to indicate motor speed or total the number of motor revolutions. When using the square wave, the output is:

1280 cycles per output shaft revolution on the 220rpm drive

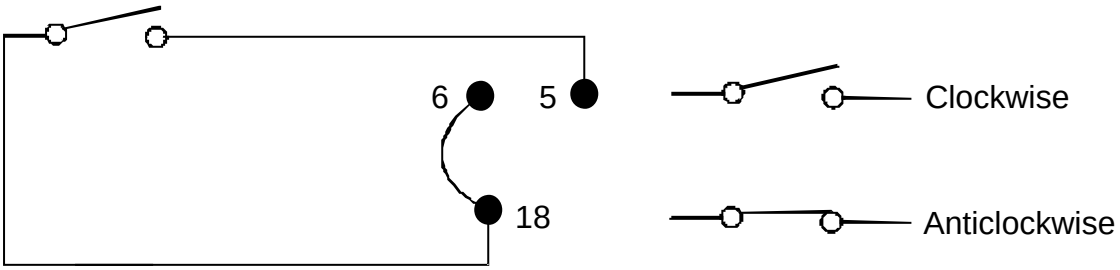
3200 cycles per output shaft revolution on the 55rpm drive



55 rpm 1.47 kHz 220 rpm 2.36 kHz

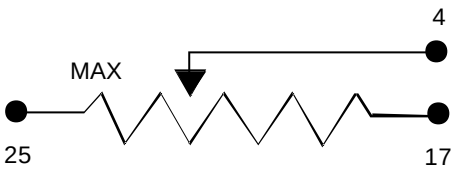
Direction

Connect remote switch between pins 5 and 18 and disable the front panel reversing control by linking pins 6 and 18 of the 25D connector. Open switch for clockwise rotation, close for counter-clockwise. Alternatively a TTL compatible logic input (Low 0, High 5V) may be applied to pin 5. Low input will run pump in a counter-clockwise direction, High input will run the pump in a clockwise rotation. With no connection, the pump will default to clockwise rotation.



Speed

A remote potentiometer with a nominal value of between 1k and 5k with a minimum of 0.25W should be wired as shown. When using a remote potentiometer, do not apply a voltage/current control input signal at the same time. The drive must be calibrated for 0-12V control as described in the auto analogue section. Alternatively, the potentiometer may be used for the calibration procedure, instead of using the minimum and maximum signals, if it is set to its minimum and maximum positions.



Calibration

If it is required to display the flow rate in ml/min the processor must be informed which pumphead and tubing is being used. If your application requires accurate indication of flow rate you should then proceed to a calibration dose.

In the main menu, ***Step*** to:

```
CALIB  SETUP          <
```

*Press **Enter** at CALIB*

```
CURRENT  RE-CALIB
```

*Press **Enter** to view **current** calibration*

The display will show for a three seconds the pumphead, ml per revolution, tube size and the speed at which the pump is set to run. The screen will then display:

```
CURRENT  RE-CALIB
```

***Step**, **Enter** to recalibrate*

If you have selected to enter a new head or tube, the display will now show:

```
HEAD          CAL-DOSE
```

*Press **Enter** at HEAD*

The first three pumpheads from the range are shown:

```
S01RL  505L  303  >
```

*Step to the pumphead fitted and press **Enter***

All the tube sizes which can be used in the pumphead selected are shown.

```
0.5  0.8  1.6  3.2>
```

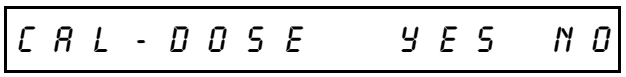
*Step to the tubing fitted and press **Enter***

The display will now confirm your selection of pumphead and tubing:

```
S01RL  3.2MM
```

Confirmation screen

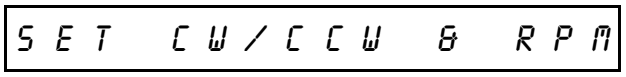
Then the display will move on to request if a calibration dose is required.



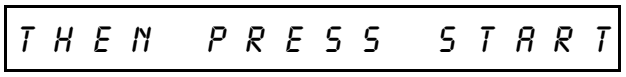
***Step**, **Enter** to accept the published flow rate*

Enter** if you want to run a **calibration dose

If a calibration dose is selected to provide the most accurate flow rate display, the screen will show:

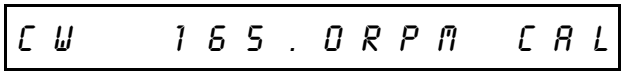


Set correct direction of rotation and speed

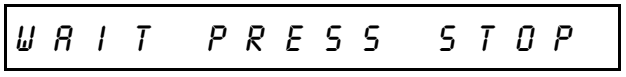


*then press **Start***

For the highest accuracy the calibration dose should be run with the system connected and with the speed and direction set as it will be for the application. The calibration sample which can be entered as **g** or **ml** should be as large as practicable and should not be less than 15 seconds.

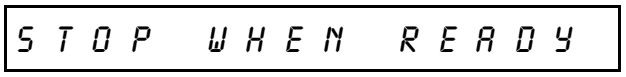


*Press **Start***



Appears for 15 seconds

After 15 seconds, if ***Stop*** has not been pressed, this screen will appear:



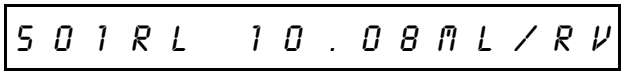
The pump will run for four minutes or until you press ***Stop.***

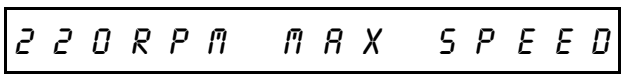
The display will show a volume and a weight that it calculates has been delivered. The weight is calculated assuming that the SG of the fluid is 1.

If you have measured your sample in ml, change the indicated volume by pressing Ù or Ú, ***Enter.***

If you have weighed your sample, ***Step*** and change the indicated weight by pressing Ù or Ú, ***Enter.*** You will then be asked to indicate the SG of the fluid. Press ***Enter***

The display will then show the pumphead fitted, volume per revolution and the maximum speed the particular pumphead can be run.





Confirmation message

Calibration is now complete, and the display will return to the main menu.

Setup

At the Main menu, ***Step*** to SETUP, press ***Enter*** and a choice will be offered. ***Step*** to the required menu item and press ***Enter***.

ROM This menu item will identify the version of the internal software. This information may be requested if you call for technical support.

Beep You are able to turn the audible signal off using this menu item. The default condition is on.

Lang This selects the language used throughout the menu system. The choice is English, German or French.

Signal This feature allows you to select an analogue control signal that is not listed. It has been explained fully in the **AUTO-CONTROL** section.

Pump When you are using a number of pumps under RS232 control, each individual pump will require unique identification. To change the number, press ***Enter*** then Ù or Ú to select a new number, then press ***Enter.***

Baud This is the speed of signal transmission. Its setting will have to match the rest of the system. The factory default is 9600.

Trim This function allows the pump's signal conditioner to be matched to the control signal if they do not coincide. The reason for this may be line losses or mis-calibration of either the pump or the signal source.

The process signal (or suitable signal from another source) can be used in the calibration procedure providing that it meets these requirements: For voltage modes, a stable, variable direct current voltage source (for example a laboratory power supply having a source resistance of 5kohm or less) can be used.

You will be asked to apply zero, 20% and the maximum voltage or current that has been selected for the control signal.

When using a current signal, ensure that the link is connected between pins 3 and 16. For voltage signals, ensure there is no link.

Step to **TRIM**, then press ***Enter***

```
TRIMS  ANALOGUE
```

```
CONTROL  CIRCUIT
```

Explanatory message

```
APPLY  0MA  SIGNAL
```

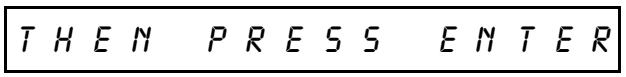
Apply 0mA across pins 4 to 7 or short the

```
THEN  PRESS  ENTER
```

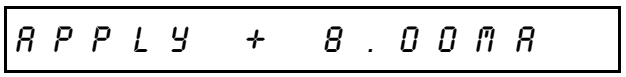
wires from pin 4 to pin 17, then ***Enter***

```
APPLY  +20.00MA
```

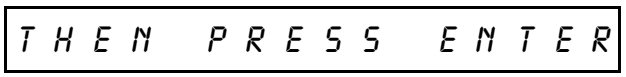
Apply 20mA across pin 14+ and pin 17-



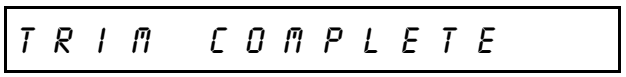
*then press **Enter***



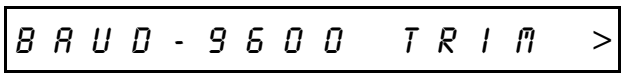
Apply 8mA across pin 14+ and pin 17-



*then press **Enter***



Confirmation message



The SETUP menu returns

Signal calibration is now complete.

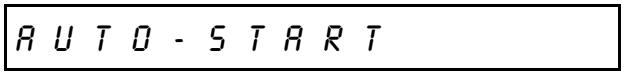
Autostart

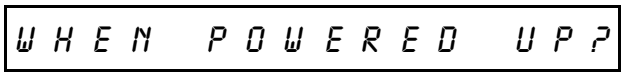
The pump can be set so that after the mains supply is interrupted the pump automatically restarts in the same state as before the interruption or, that after the power is reconnected the pump will remain stopped.

If you press ***Enter*** with the cursor at ***OFF***, following a power interruption the pump will return to the main menu, and await instructions. If you ***Step*** to ***ON,*** then press ***Enter,*** the pump will automatically re-start following a power interruption. The factory default is Auto-restart OFF - the pump returns to the main menu.

To change the Auto-restart state:

*Current state displayed. Press **Enter***





Explanatory message

Step**, and press **Enter

*Confirmation. **Step** or press **Main menu***

Strobe

The state of the pump may be monitored by a system of two 5V Hi Lo signals by connecting to the 25D remote socket on the pump rear panel. This feature can

indicate if the pump is running or stopped and the motor direction. Its use could be to signal to start the next sequence of say a filling machine such as controlling selector gates on the exit side.

Line 1 will change state as soon as the motor starts or stops. The signal can be selected to be either high or low to show running.

```
#1-RUN    HIGH  LOW
```

Enter**, or **Step**, **Enter

Line 2 will change state as soon as the pump direction is changed. The selection is made relative to the output shaft rotating clockwise. You can select if this direction is too high or low.

```
#2-CW     HIGH  LOW
```

Enter**, or **Step**, **Enter

After the selection has been made the screen will confirm.

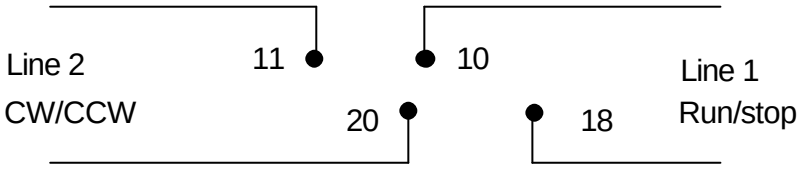
```
STROBE-1  RUN=HI
```

```
STROBE-2  CW=LOW
```

Confirmation messages

```
STROBE  DEFAULT >
```

The **SETUP** menu returns



Default

By following the prompts, all settings can be restored to the factory defaults.

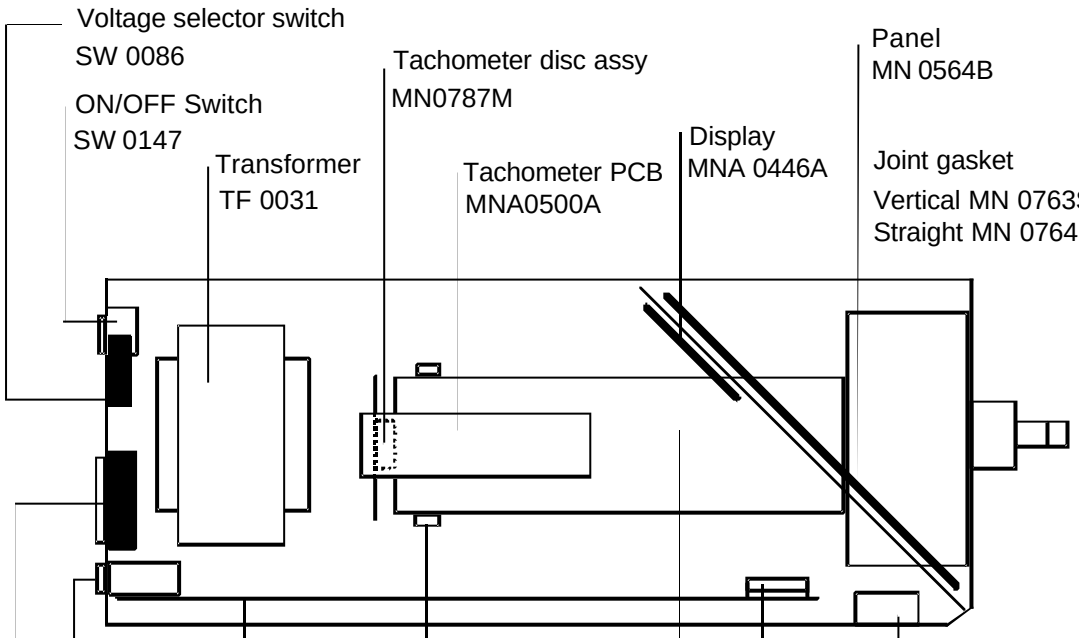
Care and maintenance

The only scheduled maintenance required for the 505Du/RL is inspection of the motor brushes and their replacement before their length is less than 6mm (1/4"). The life of the brushes will depend on the duty of the pump, but is expected to be at least 10,000 hours at maximum speed.

When the pump needs cleaning, remove the pumphead and use a mild solution of detergent in water. Do not use strong solvents.

If the gearbox is rebuilt you must use the 15ml of the recommended lubricant, which is Rocol MP, which is a SAE 30 mineral oil loaded with molybdenum disulphide to form a soft fluid grease.

Spares



Complete drive

220rpm 056.4841.000

55rpm 056.4821.000

Part 3: 501RL Pumphead

Description

The 501RL pumphead has two spring-loaded working rollers, which automatically compensate for minor variations in tubing wall thickness, giving extended tube life.

The 501RL is set during manufacture to accept tubing with wall thicknesses of between 1.6mm and 2.0mm, and internal diameters of up to 8.0mm. The 501RL pumphead is equipped with a "tool lockable" guard for increased safety. This should be locked shut whilst the pump is in use.

A major feature of the 501RL pumphead is the ability to run the pumphead clockwise for extended tube life, or anti-clockwise to operate against higher pressures.

The tube clamps of the 501RL are adjustable to four positions to allow varying tube diameters to be securely held without occluding the tube.

Installation

Any one of three tubing input/output positions can be selected on cased drives. Select the required position then fit the track over the drive shaft and locating boss. Tighten the track retaining screw.

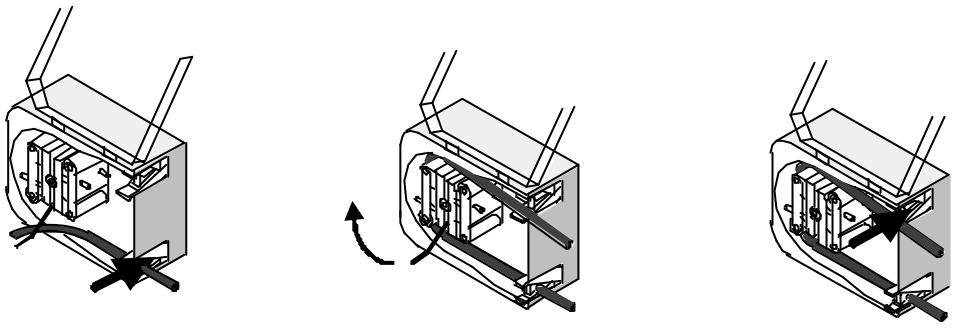
After checking that the shaft is clean and degreased slide the rotor on to it. The rotor is attached to the shaft by a split collet, and it is important that the rotor retaining screw is fully tightened to a torque of 3Nm using the largest screw driver that will fit the screw head. This will prevent the collet slipping when the pump is being used.

To reposition the track, remove any tubing from the pumphead, and swing out the crank handle to expose the rotor retaining screw. Turn the screw anticlockwise one turn to release the collet, and withdraw the rotor from the shaft. Loosen the track locating screw, and pull the track clear. Rotate the track to its new position and tighten the track locating screw.

Tube loading

Switch off the drive before loading the tube. Unlock and open the hinged guard and swing out the rotor crank handle until it locks into position.

Select the length of tubing required, noting that approximately 240mm is required for the track system (measured from the outside faces of the tube clamps).



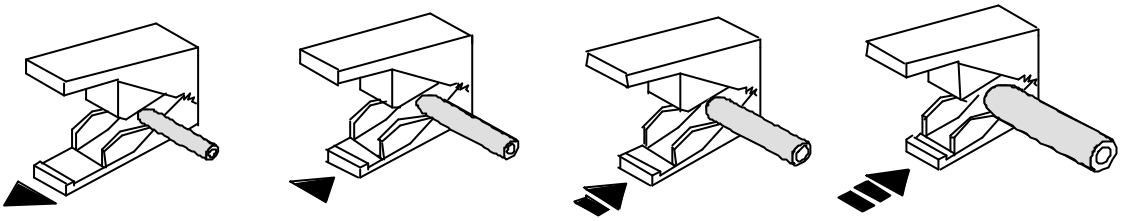
Fit one end of the tubing into one of the spring loaded clamps, and then, whilst rotating the rotor with the crank handle, feed the tubing between the rollers and the track, aligning it within the rotor tube guides. The tubing must lie naturally against the track and must not be twisted or stretched.

Fit the other end of the tubing into the second spring loaded clamp, ensuring that the tubing is not slack in the pumphead, since this can reduce tube life.

Close the crank handle and shut and lock the guard.

After the pump has been started, open the downstream clamp for a short time, so that the tube can find its natural length.

The 501RL pumphead is fitted with four-position tube clamps, to accommodate various tube diameters, which can be adjusted by pushing in or pulling out the bars at the top of the upper clamp and the bottom of the lower clamp. Set the clamps so that the minimum necessary pressure is applied to the tubing.



Roller adjustment

The 501RL has a factory set gap of 2.6mm between the rollers and the track and is suitable for tubing having wall thicknesses of between 1.6 and 2.0mm. Adjustment of the gap will be required if tubing having a wall thickness of less than 1.6mm is required. There is an adjusting screw on each of the two roller arms, and each of these screws will require adjustment. The correct gap is twice the wall thickness less twenty percent. Correct adjustment is important: over occlusion will reduce tube life; under occlusion will reduce pumping efficiency.

To change the gap setting, turn each adjusting screw clockwise to increase the gap, or anticlockwise to decrease the gap. A full turn changes the gap by 0.8mm.

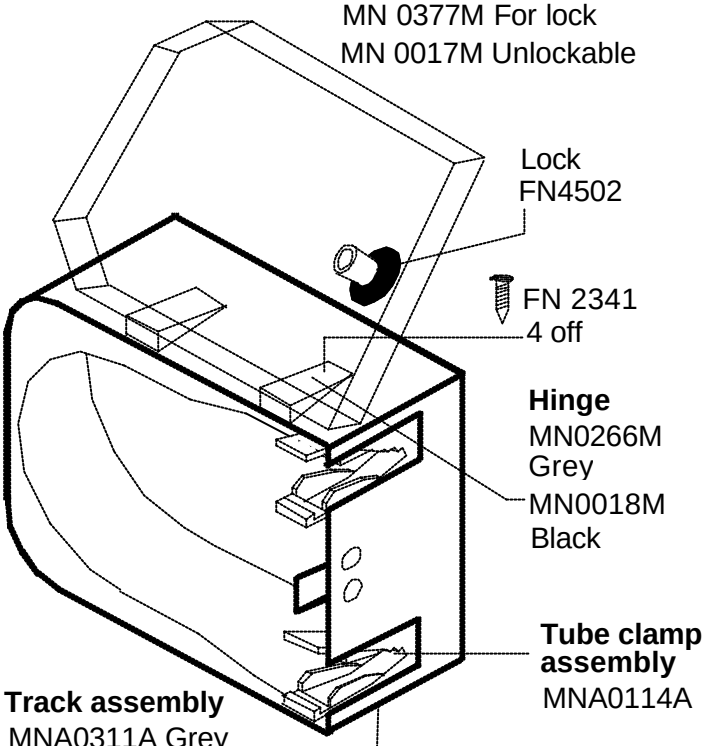
To restore the original settings of 2.6mm, turn the adjusting screws until both rollers are just touching the track, then tighten each screw by three and a quarter turns.

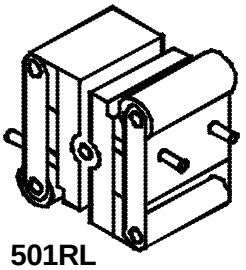
Care and maintenance

If aggressive liquids are spilled on to the pumphead, the head should be removed and cleaned using a mild solution of detergent and water. Remove any tubing from the pumphead, and swing out the crank handle to expose the rotor retaining screw. Turn the screw anticlockwise one turn to release the collet, and withdraw the rotor from the shaft. Unscrew the track retaining screw and detach the track from its spigot.

Check moving parts of the rotor from time to time for freedom of movement. Lubricate pivot points and rollers occasionally with a light lubricating oil. To obtain effective lubrication of the roller spindles, remove the rotor from the pumphead and clean thoroughly prior to applying a light machine oil.

Spares



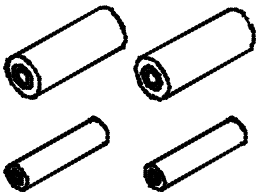


501RL
Rotor assembly
MNA0143A

Springs

SG 0001, 4 off Standard
SG 0002, 4 off Hard

Main rollers
MN 0011T, 2 off



Follower rollers
MN 0012T 2 off

If in doubt when considering spares for order, do not hesitate to contact Watson-Marlow Technical Support for further information.

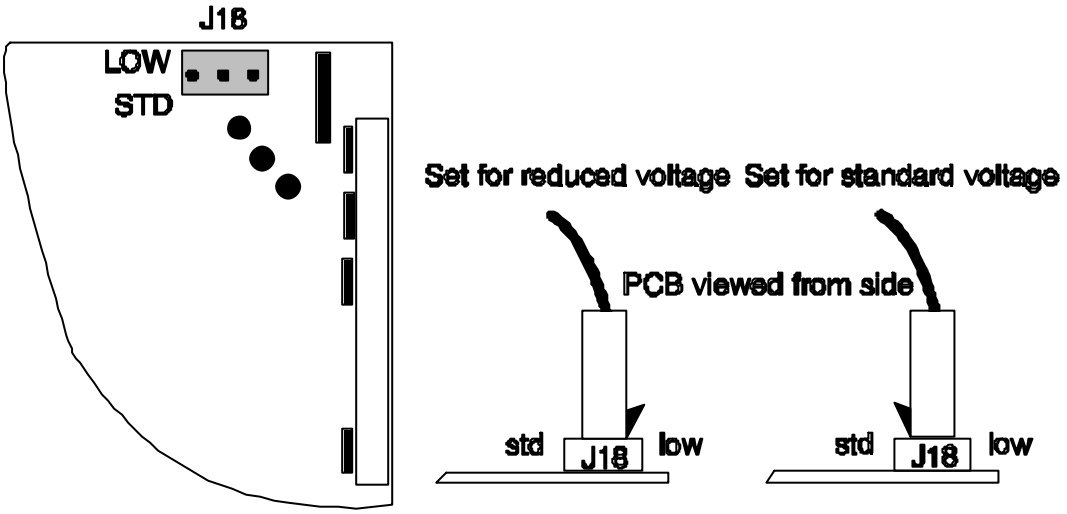
Part 4: Appendices

Reduced voltage operation

If the local voltage is below that specified on page 6, and there is a high pumphead loading, provision has been made in the design of the drive for a simple modification to be carried out. This will make the drive suitable for use with voltages as low as 180 volts when the 220-240V setting is selected, and as low as 90V when the 100-120V setting is selected.

Please note that the work should be carried out only by qualified personnel and that there are components at mains voltage inside the drive. If the drive is found to be damaged after this modification is incorporated and the damage is considered to have been caused by connecting it to a "normal " voltage, the warranty will be considered to have been voided.

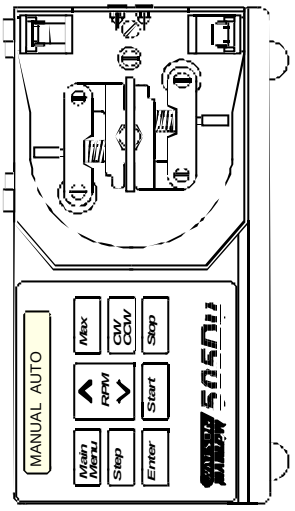
The modification requires the connector J18 on the control PCB to be reversed. To locate the terminal, isolate the mains supply then remove the pump cover which is secured by 4 screws located on the underside of the pump. Lift the cover to one side

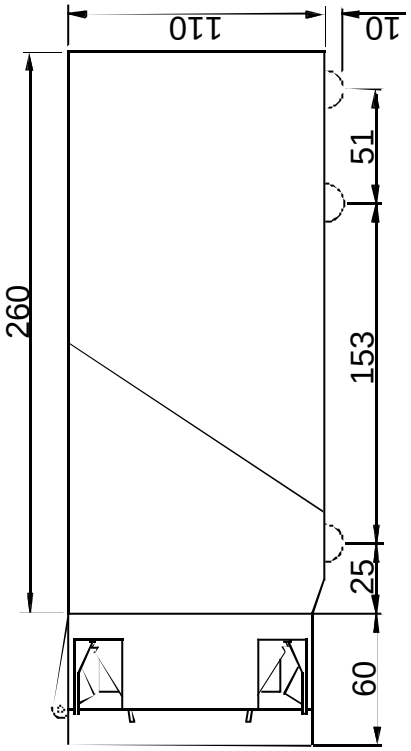


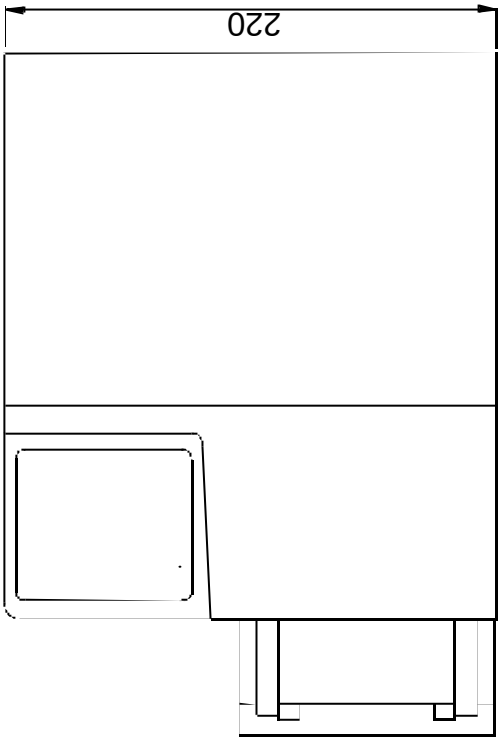
Specification

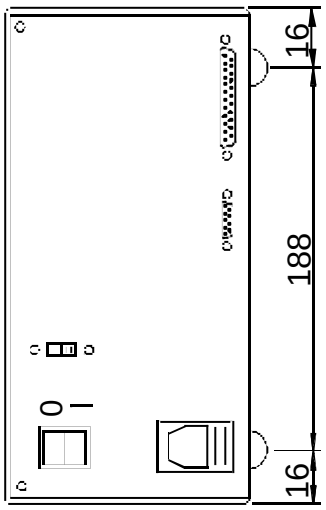
Supply	100-120/220-240V~50/60Hz
(For 80/180V operation see Part 4: Reduced voltage operation)	
Speed control range	220:1
Nominal maximum rotor speeds	55rpm or 220rpm
Power consumption	100VA
Shaft torque	2.2Nm
Operating temperature range	5C to 40C
Storage temperature range	-40C to 70C
Weight (including 501RL pumphead)	7.7kg (17lbs)
Noise	<70dBA at 1m
Standards	IEC 335-1, EN60529 (IP31)
Machinery directive	98/37/EC EN60204-1
Low voltage directive	73/23/EEC EN61010-1
EMC directive	89/336/EEC EN50081-1/EN50082-1

Outline drawing









Product Use and Decontamination Declaration

In compliance with the **UK Health & Safety at Work Act** and the **Control of Substances Hazardous to Health Regulations** you, the user are required to declare the substances which have been in contact with the product(s) you are returning to Watson-Marlow or any of its subsidiaries or distributors. Failure to do so will cause delays in servicing the product. Therefore, **please complete this form** to ensure that we have the information **before** receipt of the product(s) being returned. **A FURTHER COPY *MUST* BE ATTACHED TO THE OUTSIDE OF THE PACKAGING CONTAINING THE PRODUCT(S)**. **You, the user, are responsible for cleaning and decontaminating the product(s) before returning them.**

Please complete a separate Decontamination Certificate for each pump returned. **RGA No:** ……..

1 Company
Address
……. Postcode

Telephone ……. Fax Number

2 Product ……

2.1 Serial Number ……

2.2 Has the Product been used?

YES		NO	

If yes, please complete all the following Sections

If no, please complete Section 5 only

3 Details of substances pumped

3.1 Chemical names:

(a)……

(b)……

(c)……

(d)……

3.2 Precautions to be taken in handling these substances:

(a)……

(b)……

(c) ……

(d)……

3.3 Action to be taken in the event of human contact:

(a)……

(b)……

(c)……

(d)……

3.4 Cleaning fluid to be used if residue of chemical is found during servicing;

(a) ……

(b) ……

(c) ……

(d) ……

4 I hereby confirm that the only substances(s) that the equipment specified has pumped or come into contact with are those named, that the information given is correct, and the carrier has been informed if the consignment is of a hazardous nature.

5 Signed ……..

Name ……

Position ……

Date ……..

Note: To assist us in our servicing please describe any fault condition you have witnessed.