

5003U

5003U Micropump drive
Publication PB 0111

Manual control

- 1 The 5003U operates on single-phase mains electricity supplies only. It has a voltage selector switch on the rear panel which must be set for the local mains supply voltage. Set voltage selector switch to 120V for 100-120V 50/60Hz supplies, or 240V for 220-240V 50/60Hz supplies.
- 2 Set switch on front panel for manual or auto-control. If drive is to be controlled from a process signal, make proper connections to 7pin Din socket and set range and offset potentiometers on rear panel (see section 5). Input signal in Volts or milli-Amperes is shown on digital display when front panel switch is held in V/mA position.
- 3 Set running speed between 100rpm and 5000rpm if drive is to be manually controlled.
- 4 Turn power switch to ON (I) position to start drive. Never run a Micropump dry.
- 5 Prime pump with max switch on front panel.
- 6 Turn power switch to OFF (O) position to stop drive.

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 the 5003U drive 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 and exceptions

Conditions of and specific exceptions to the above warranty are:

- 1 Consumable items such as fuses are excluded.
- 2 Products must be returned by prearrangement 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.

Warranties purporting to be on behalf of Watson-Marlow Limited made by any person, including representatives of Watson-Marlow Limited 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 .

Thank you for choosing the Watson-Marlow 5003U Micropump drive. The 5003U is specially manufactured for the magnet-driven Micropump gear pumps. A precision direct current motor is controlled by Watson-Marlow's exclusive pulse-width-modulated circuitry which has three independent feedback loops for motor current, motor voltage and back-emf to ensure precise speed control regardless of load. This circuit gives a speed control ratio of better than 50:1, and provides black commutation to the motor, making brush wear negligible. True motor speed derived from a tachometer, which can be continuously varied between 100rpm and 5000rpm, is displayed digitally, and a rapid priming switch is fitted.

A sophisticated signal conditioner is built in to the 5003U, which allows the drive to be customer-programmed for automatic control from any process signal up to 60V or 32mA. A front panel switch allows instant switching between auto and manual control. Signal overload is indicated by an over-range reading and motor shutdown. The 5003U can be stopped, started or speed controlled from a remote switch or potentiometer. Measuring circuitry built into the 5003U allows the input signal to be displayed in Volts or milliAmperes on the front panel digital display.

The 5003U accepts a wide range of Micropumps, giving flow rates up to 4600 millilitre per minute, system pressures up to 20 bar (300 psi) and differential pressures up to 8 bar (120 psi).

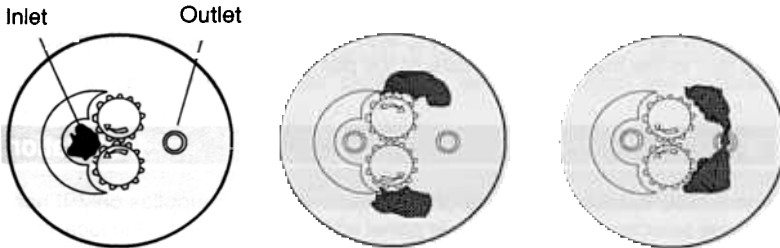
**Auto control
signal conditioner**

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 before it is returned for service. A certificate, or signed statement, that the equipment has been decontaminated must be attached to the shipping carton.

**Contamination by
hazardous
materials**

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Two or more rotating gears mesh together. One of the gears is driven (via the magnetic coupling) and drives the other gear or gears. The gaps between the gear teeth transfer the fluid from the inlet to the outlet. The meshing of the gears prevents the fluid from returning to the inlet, making the gear pump a positive displacement pump.



Micropumps have the advantage of being self priming from between 150mm (6") and 600mm (24") of water depending on the pump type and system configuration. A major advantage is their ability to operate against high pressures, with total system pressures up to 20 bar (300 psi) and differential pressures up to 8 bar (120 psi).

Watson-Marlow is the world's peristaltic pump specialist. Many of the advantages of peristaltic pumps (which are self-priming, dry-running, non-contaminating and have a positive displacement action) are shared by Micropumps, but Micropumps become the preferred pump type when pressures higher than a continuous 1.5 bar (22 psi) are required at flow rates up to 4600 ml/min, or when chemical compatibility or temperature makes the use of a peristaltic pump impossible.

Conventional pumps require seals around the drive shaft which are a common focus of leaks and contamination. Micropumps use a magnetic coupling to drive the pump gears which eliminates these problems, making them leak-free and non-contaminating.

When the pump load exceeds the coupling torque between the driven and driving magnets, the pump decouples from the motor, acting as a safety device to protect pump and motor. Stopping the motor and eliminating the cause of decoupling allows safe restartig.

All Micropump driven magnets are encapsulated in 316 stainless steel and Ryton or Teflon. This ensures fluids are not contaminated by the magnet material. Within the Micropump range, there is a choice of materials for body, gears and seals. Micropumps have 316 stainless steel bodies, and gears are cut in Teflon, graphite, or Ryton. Seals are made in Teflon, Viton or Buna-N.

How gear pumps work

Working against pressure

Decoupling

Materials of construction

184, 185 and 200 Micropumps feature a new gear pump technology which reduces the number of components required, so enhancing reliability, and creates a pressureloaded pump which means that the higher the pressure, the tighter the gears are sealed.

Service kits

All Micropump gears, magnets and seals can easily be replaced in the field. Service kits come complete with instructions. 120, 122, 180 and 200 Micropumps have externally adjustable bypass valves, which permit internal recirculation of the working fluid when the preset pressure is reached. The pressure level can be useradjusted, with the pump in operation, from 0.7 bar (10 psi) to the maximum pressure of the pump.

3

Installation

Supply

The 5003U operates on single-phase mains electricity supplies only. It has a voltage selector switch on the rear panel which must be set for the local mains supply voltage. Set voltage selector switch to 120V for 100-120V 50/60Hz supplies, or 240V for 220-240V 50/60Hz supplies. A mains cable fitted with a moulded plug is supplied with the drive, 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 white, the neutral lead is coloured black, and the earth lead is coloured green

Manual or auto-control?

If the drive is to be used under manual control, set the switch on the front panel to the manual position. If the drive is to be used under automatic control, set the switch to the auto position, and ensure that the range and offset potentiometers (accessible through the rear panel) are properly set (see section 3) before operating the drive.

The 5003U can be operated at ambient temperatures from 0C to 37C (32F to 99F). Storage temperatures from 40C to 70C (-40F to 150F) are permissible, but allow time for acclimatisation before use. The drive should be positioned to allow a free flow of air around it.

Please check

If the drive does not operate correctly, check that mains electricity is available at the unit, that the voltage selector switch on the rear panel is in the correct position, and that the fuses are intact. If the drive is to be used under manual control and fails to operate, check that the switch on the front panel is in its manual position. If the drive is to be used under automatic control and fails to operate, check that the switch on the front panel is set to its auto position, that the signal range and signal offset potentiometers are properly set, that connections (and link, if a current signal is in use) to the rear panel Din socket are properly made, and that the process signal is available at the unit.

Warning

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

Set the front panel switch to manual. Set the drive speed on the digital display using the ten-turn potentiometer. The speed control range of the 5003U is from 100rpm to 5000rpm. Start the drive by turning the power switch to its on (I) position. Stop the drive by turning the power switch to off (O).

If the drive is running under automatic control from a process signal, and is then required to run under manual control, it is only necessary to turn the front panel auto/manual switch to manual. It is not necessary to disconnect the process signal from the rear panel Din socket or adjust the calibration potentiometers.

Switching from
manual to
auto-control

The 5003U can be controlled by any analogue process signal up to 60V or 32mA, to provide a rising or falling flow rate against a rising signal. When the drive is set to provide rising flow rate against a rising signal, this is defined as a **non-inverted** response. When the drive is set to provide a falling flow rate against a rising signal, this is defined as an **inverted** response. **Signal range** is the difference between that signal which is to produce maximum speed (flow rate) and that which is to cause minimum speed (flow rate). A 0V to 12V signal has a signal range of 12V. A 4mA to 20mA signal has a signal range of 16mA.

Definitions

Never apply mains voltage across any pins on the Din socket as permanent damage, not covered by warranty, will result. Up to 60V may be applied across pins 2 and 3, but no voltage should be applied across other pins because permanent damage, not covered by warranty, may result.

Warning

Signal offset is the signal level at which the Micropump is just about to start pumping. At this point, and until 100rpm is reached, the digital display of speed may be ambiguous. If a 4mA to 20mA signal is to provide a non-inverted response, the signal offset is 4mA. If the same signal is to provide an inverted response, then the signal offset is 20mA, because that is the level at which the Micropump is just about to start pumping. (It will be pumping at maximum rate when the signal is 4mA).

For the drive to be controlled by a process signal, the front panel switch must be in its auto position and the process signal must be connected to the Din plug provided, which should then be inserted into the rear panel Din socket. The diagrams and tables below show the minimum and maximum signal ranges and signal offsets available, and the connections and their polarity for non-inverted or inverted responses.

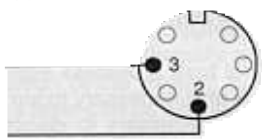
Connections

If the signal rises above its proper maximum, the action of the signal conditioner will be to shut down the motor. If the signal rises above 60V, permanent damage, not covered by warranty, may result.

Warning

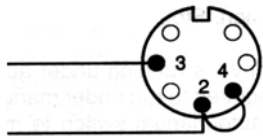
Signal input

Voltage signal (Input resistance 220 kohm)	
Range	5 to 30V
Offset	0 to 30V



Response	Pin 2	Pin 3
Non-inv.	-	+
Inverted	+	-

Current signal (Input resistance 1 kohm)	
Range	5 to 30mA
Offset	0 to 30mA



Response	Pin 2	Pin 3
Non-inv.	-	+
Inverted	+	-

Calibration

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. The maximum voltage across the unit must not exceed 60V. For current modes, the same direct current voltage source may be used, (providing it will supply the current required). The maximum permissible current is 32mA.

When the signal has been connected to the drive through the Din plug and socket, the signal conditioner must be calibrated using the two potentiometers for signal range and signal offset accessible through the rear panel.

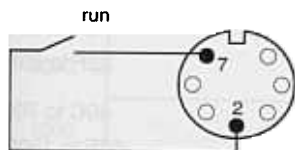
To calibrate the signal conditioner, set the signal source to the maximum offset or, if there is no offset, to zero volts or zero current. Adjust the signal offset potentiometer to the point where the Micropump stops pumping. When this has been done, the signal source should be set to its maximum speed signal, and the signal range potentiometer adjusted to give the maximum required response (usually 5000rpm) on the digital display.

These two calibration steps should be repeated until interaction between the adjustments is eliminated. The drive is now set to operate under process control. Attach a label to the rear panel showing the signal and response for which the drive is set. The front panel potentiometer is not in circuit when the drive is operating under process control and may safely be left at any setting.

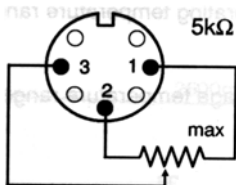
The 5003U can be stopped and started from a remote switch, or speed controlled from a remote potentiometer which should have a value between 4.7 kohm and 5.0 kohm. Connections for each function are shown below. Both functions may be used concurrently. The remote stop/start facility may also be used when drive speed is under process control.

Never apply mains voltage across any pins on the Din socket as permanent damage, not covered by warranty, will result. Up to 60V may be applied across pins 2 and 3, but no voltage should be applied across other pins because permanent damage, not covered by warranty, may result.

Remote stop/start



Remote potentiometer



When a remote potentiometer has been connected, the signal conditioner must be calibrated. Set the front panel switch to its auto position. Set the remote potentiometer to minimum and adjust for zero flow by turning the signal offset potentiometer until the Micropump stops pumping. At this point, and until 100rpm has been reached, the digital display of speed will be ambiguous. Set the remote potentiometer to maximum and then adjust for maximum flow rate by turning the signal range potentiometer until the digital display reads 5000rpm. Start/stop and tachometer output facilities remain available when a remote potentiometer is fitted.

A remote potentiometer must be correctly connected. Incorrect connection may result in permanent damage, not covered by warranty.

A signal is available at the Din socket which is analogue and proportional to motor speed. Pin 2 is negative and pin 6 is positive. There is 0.5V across the pins at maximum speed. High impedance measuring devices must be used to measure the voltage across the pins.

The use of low impedance devices will seriously compromise speed control accuracy. Any digital voltmeter will be satisfactory.

Connections

Warning

Calibration

Warning

Analogue output

Motor type	Permanent magnet direct current
Maximum speed	5000rpm
Operating voltages and frequencies	220-240V 50/60Hz 100-120V 50/60Hz
Fuse rating	Type T (anti-surge) 1.0A
Maximum power consumption	130VA
Control range	100rpm to 5000rpm
Operating temperature range	0C to 37C 32F to 99F
Storage temperature range	40C to 70C -40F to 150F
Dimensions	H110mm x W215mm x L290mm H4 5/16" x W8 7/16" x L11 7/16"
Weight	6kg (13lbs)
Standards	CEE10, IEC 34-5 (IP31)
Port size	1/8 27 NPT

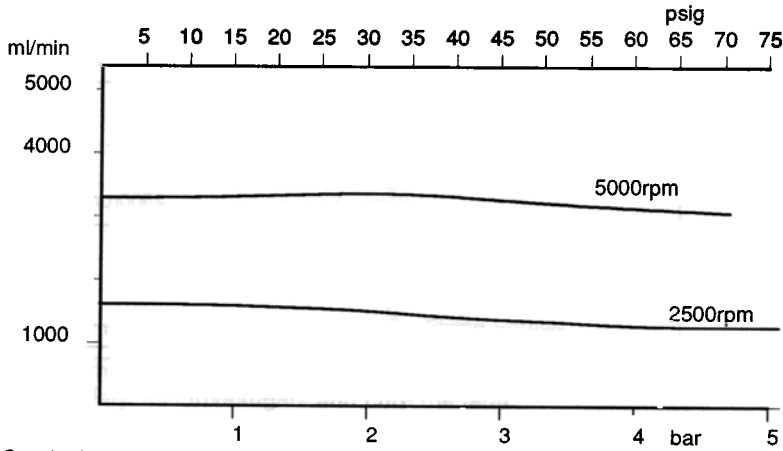
Pump	Max flow (ml/min)	Pressure (bar)		By pass	Temp (°C)	Materials		
		System	Diff			Body	Gears	Seals
120	3250	20	8	Yes	-45/100	SS 316	Teflon	Teflon
122	4600	20	4	Yes	-45/100	SS 316	Teflon	Teflon
130	3250	20	7	Yes	-45/120	SS 316	Ryton	Teflon
184	220	20	5	No	-70/135	SS 316	Graphite	Teflon
185	410	20	4	No	-70/135	SS 316	Graphite	Teflon
187	100	20	4	No	-70/135	SS 316	Graphite	Teflon
200	2750	20	8	Yes	-40/75	SS 316	Ryton	Viton

10 Flow rates of Micropumps against pressure

Micropump 120

Up to 3250ml/min

65 ml/min to 3250 ml/min at 0 bar differential pressure.
Maximum differential pressure 5 bar (75 psig)

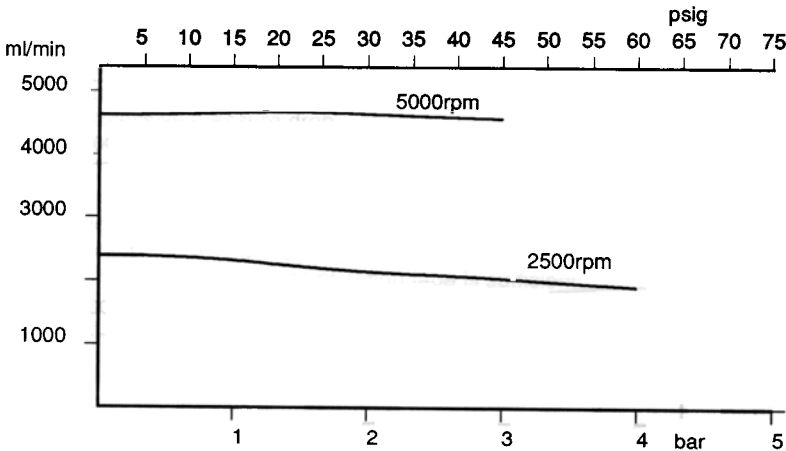


Graph shows flow rates for 120 Micropump with bypass. Flow rate at 5000rpm decreases near maximum pressure due to bypass.

Micropump 122

Up to 4600ml/min

92 ml/min to 4600 ml/min at 0 bar (0 psig) differential pressure.
Maximum differential pressure 4 bar (60 psig)

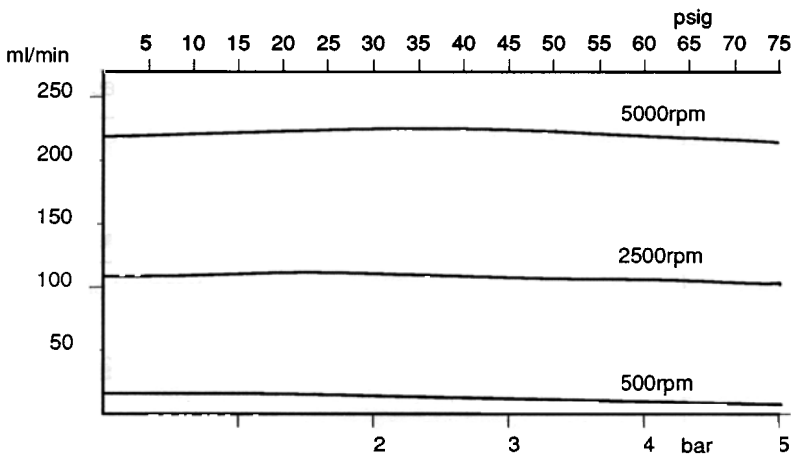


Graph shows flow rates for 122 Micropump with bypass. Flow rate decreases near maximum pressure due to bypass.

Up to 220ml/min

Micropump 184

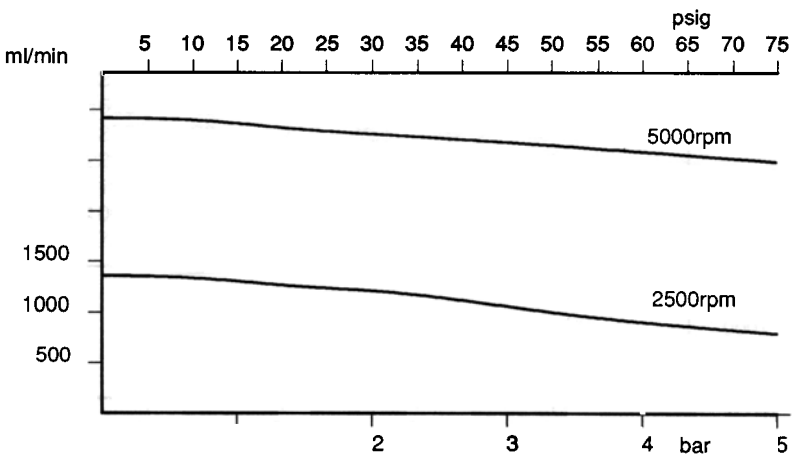
4.4 ml/min to 220 ml/min at 0 bar differential pressure.
Maximum differential pressure 5 bar (75 psig)



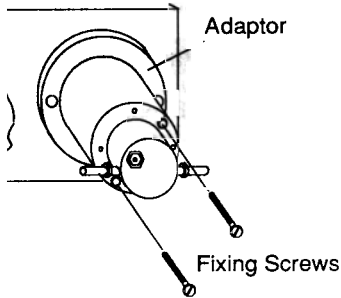
Up to 2900ml/min

Micropump 200

58 ml/min to 2900 ml/min at 0 bar differential pressure.
Maximum differential pressure 8 bar (120 psig)



Fit the Micropump over the black plastic adaptor on the 5003U front panel. The Micropump must be pushed fully on to the adaptor, and it is **vital that the Micropump is absolutely square to the adaptor**. The Micropump should be attached to the adaptor with the two long screws supplied with the Micropump. **The screws must not be overtightened**. It is only necessary to lightly tighten the screws.



If, when the drive is turned on, there is any unusual noise, stop the drive immediately, and investigate and cure the fault.

Restrictions in the inlet and discharge lines may cause a loss of pump performance. A restriction can be a valve (some less restricting than others), small diameter tubing, long lengths of tubing and even elbows or sharp turns in the line can restrict the flow. It is important to avoid or limit these restrictions whenever possible.

Micropump gears will be rapidly and permanently damaged if there are any abrasive particles present in the fluid being pumped. A 5 micron to 20 micron filter should be installed on the inlet side, except in the case of a closed recirculating system, in which case the filter should be on the discharge side. It should be noted that such a filter is a restriction and may affect pump performance. All strainers and filters should have large surface areas to prevent excessive pressure drop.

Before installing fittings to pumps, whether hose or pipe fittings, pipe sealing compound or Teflon tape should be applied to the threads to prevent leakage. Apply sealant or tape sparingly to prevent excess material from dislodging and clogging the pump. Two wraps of Teflon tape is sufficient.

When installing fittings, secure the pump head as shown. Take care to support the motor to prevent housing misalignment.

All Micropumps can operate in any position.

Fitting a
Micropump to the
5003U drive

Warning

Pipework

Filtration

Installing fittings

Pump
position/location

Bypass adjustment

Certain Micropump gear pumps are equipped with an externally adjustable bypass. This bypass is an internal relief valve that permits recirculation of the working fluid when the preset pressure is reached. The pressure level at which the bypass is activated can be adjusted in the field, from 7 bar (10 psig), to the maximum pressure capability of the pump, with no disassembly required. The adjustment is made externally with a hex key, provided with the pump and can be made while the pump is in operation.

Warning

Because the bypass recirculates the fluid within the pump, heat can be produced as a result. The more fluid that is recirculated via the bypass, the more heat is produced. At full bypass the additional heat may result in the fluid temperature exceeding the temperature limit of the particular pump. Consequently, Micropump recommends that these pump not be run at full bypass.

Dry running

Dry running is harmful to all Micropump pumps. Although dry running for short intervals (such as when dry lifting to prime a gear pump) may not effect pump performance, extended periods of dry running may cause permanent damage to the pump.

Dry lifting

Micropump gear pumps can dry lift fluid, however, dry lift capabilities will vary depending on the fluid and the system. Depending on the application, the Micropump 120 can typically dry lift 150mm (6") of water, the Micropump 200 can lift 750mm (30") of water and the Micropump 180 can lift 1500mm (60") of water. When dry lifting, wetting of the gears with the fluid will help lubricate the pump until it is primed. Once primed, Micropumps will lift 725 mmHg (28 "Hg), depending upon barometric pressure.

Mixed phase

Micropump gear pumps can easily handle mixed phase (gas/fluid).

Reverse pressure

Being pressure-loaded pumps, Micropump 200 and Micropumps 184, 185 and 187 cannot operate conventionally under reverse pressure. Reverse pressure occurs when the fluid pressure coming into the pump is greater than the fluid pressure on the discharge side of the pump.

Decoupling

When a pump decouples there is a sudden drop to zero flow and zero pressure with the motor speed increasing to no-load speed. This occurs because the torque of the coupling has been exceeded. Once this slippage occurs, the driving magnet will run free while the driven magnet remains motionless. To re-engage the magnetic coupling, simply stop the drive for a few seconds and the two magnets will re-couple.

Decoupling can occur when the discharge is blocked or when maximum pressure has been reached or when something is preventing the gears from turning (something lodged in between gears or binding gears).

After decoupling, you must find and eliminate the cause of decoupling. Re-priming of the pump may also be necessary.

Scheduled maintenance of the 5003U drive is not required. The 5003U uses a permanent magnet direct current motor but no attention to the brushes is necessary because the pulsewidthmodulated speed controller provides black commutation making brush wear negligible. If harmful liquids are spilled on to the drive, the drive should be washed down thoroughly. The case should be cleaned with detergent and water. Do not use strong solvents.

5003U Micropump drives	
5003U drive 100120V/220-240V 50/60Hz, American plug	506.0001.00A
5003U drive 100-120V/220240V 50/60Hz, European plug	506.0001.00E
5003U drive 100-120V/220240V 50/60Hz, UK plug	506.0001.00U
Stocked Micropumps	
Micropump 120 with SS316 body, Teflon gears and seals	503.0120.00T
Micropump 122 with SS316 body, Teflon gears and seals	503.0122.00T
Micropump 130 with SS316 body, Ryton gears, Teflon seals	503.0130.00T
Micropump 200 with SS316 body, Ryton gears, Viton seals	503.0200.00V
Non-stocked Micropumps	
Micropump 184, SS316 body, graphite gears, Teflon seals	503.0184.00T
Micropump 185, SS316 body, graphite gears, Teflon seals	503.0185.00T
Micropump 187, SS316 body, graphite gears, Teflon seals	503.0187.00T

Drives and
pumpheads

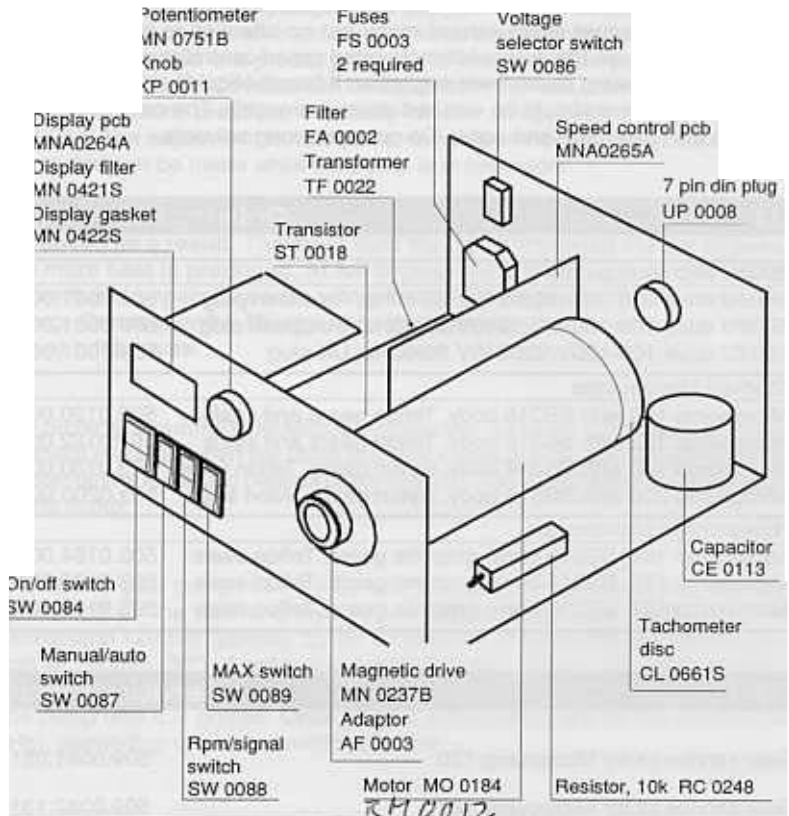
Gear service kit for Micropump 120	509.0081.051
Gear service kit for Micropump 122	509.0082.131
Gear service kit for Micropump 130	509.0081.561
Gear service kit for Micropump 184	509.0082.135
Gear service kit for Micropump 185	509.0082.136
Gear service kit for Micropump 187	509.0082.134
Gear service kit for Micropump 200	509.0081.287

Service kits

Standard service kits contain seal number 1 (Product Code 509.0005.369). If seal number 2 (Product Code 509.0003.613) or seal number 3 (Product Code 509.0004.188) are required, they must be ordered separately.

Seal number 2	509.0003.613
Seal number 3	509.0004.188
Bushing insertion tool	509.0005.465

Seals and
insertion tool



17

Micropump identification

Micropumps available from Watson-Marlow Limited can be identified from the Micropump part numbers (marked on the pumps) and the Watson-Marlow product codes:

Micropump model	Micropump Part number	Watson-Marlow Product code
Micropump 120	81110	503.0120.00T
Micropump 122	81111	503.0122.00T
Micropump 130	81528	503.0130.00T
Micropump 184	81113	503.0184.00T
Micropump 185	81114	503.0185.00T
Micropump 187	81112	503.0187.00T
Micropump 200	81281	503.0200.00V

Trademarks

Micropump is a trademark of Micropump

Ryton is a trademark of Phillips Petroleum Co.

Teflon and Viton are trademarks of E. I. du Pont de Nemours and Co.

Declaration of incorporation

We declare that when any pump or drive unit listed below is used with any suitable Watson-Marlow pumphead (also listed below) and intended for installation into machines or are to be assembled with other machines into machines. It must not be put into service until the machinery into which it has been incorporated has been declared to be in conformity with the provisions of the

Machinery Directive 91/368/EEC EN60204-1

Pumps	Drive units		Pumpheads			
101U/R	701S/R	205S	505S	205AA	501RL	603R
101F/R	701U/R	205U	505U	205BA	505L	605L
	701FB/R		505Du	205LA	505LX	
501/601FB/R	701FBC/R	302S	505Di	205AAX		701RX
501/601FBC/R	701VB/R	302F	505Dz	205BAX	504MC	701REX
501/601VB/R	701DFBC/R			205LAX	508MC	
501/601DFBC/R	701DFB/R	504S	603S			MG204
501/601DFB/R	701DVBC/R	504U	604S	303D/A	505AA	MG209
501/601DVBC/R	701DVB/R	504F	604U	303X	505BA	MG213
501/601DVB/R	701IB/R		604Di	304D/A	505LA	
				304X		
	EL3-N		5004U	306D/A	505AAX	
				306X	505BAX	
					505LAX	

**WATSON
MARLOW**

Responsible person: A S Balding, Managing Director.
Watson-Marlow Limited, Falmouth, Cornwall, TR11 4RU, England.
 Phone 01326 370370 Fax 01326376009

Declaration of conformity

We declare that when any pump or drive unit listed below is used with any suitable Watson-Marlow pumphead (also listed below) to form a stand alone pump it conforms to the requirements of the

Machinery Directive 91/386/EEC EN602C4-1
 Low Voltage Directive 73/23/EEC EN61010-1

Pumps	Drive units		Pumpheads			
101U/R	701S/R	205S	505S	205AA	501RL	603R
101F/R	701U/R	205U	505U	205BA	505L	605L
	701FB/R		505Du	205LA	505LX	
501/601FB/R	701FBC/R	302S	505Di	205AAX		701RX
501/601FBC/R	701VB/R	302F	505Dz	205BAX	504MC	701REX
501/601VB/R	701DFBC/R			205LAX	508MC	
501/601DFBC/R	701DFB/R	504S	603S			MG204
501/601DFB/R	701DVBC/R	504U	604S	303D/A	505AA	MG209
501/601DVBC/R	701DVB/R	504F	604U	303X	505BA	MG213
501/601DVB/R	701IB/R		604Di	304D/A	505LA	
				304X		
	EL3-N		5004U	306D/A	505AAX	
				306X	505BAX	
					505LAX	

**WATSON
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