

FH100M Multichannel Pump Systems

Operating Manual

Model Numbers

72-320-046, 72-320-048,

72-320-083, 72-320-084,

72-320-126, 72-320-128

A-1299-7141 First Edition



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SAFETY PRECAUTIONS



DANGERS: High voltages exist and are accessible. Use extreme caution when servicing internal components.

Remove power from the pump before any cleaning operation is started.



WARNING: Remove power from the pump before attempting any maintenance.



WARNINGS: Tubing breakage may result in fluid being sprayed from pump. Use appropriate measures to protect operator and equipment.

Turn Pump System off before removing or installing tubing. Fingers or loose clothing could be caught in drive mechanism.

Ensure that the pump drive is disconnected from the power source.

Turn off drive before removing or installing Cartridges. Safety guards are provided to minimize risk of fingers getting caught between the roller mechanism and the base of the module. However, be safe-Keep your fingers away from these areas.



CAUTIONS: Power must be turned off before connecting the external remote control cable to prevent damage to the drive.

Use only tubing/cartridge/pump combinations defined by Recommended Occlusion Settings Table. Use of other combinations could cause malfunction or damage to the pump.

Excessive occlusion can cause high pump temperatures and early tubing and roller failure. Do Not set occlusion tighter than what is recommended in the Recommended Occlusion Settings Table.



CAUTIONS: To avoid electrical shock, the power cord protective grounding conductor must be connected to ground. Not for operation in wet locations as defined by EN61010-1.

Replace the fuse only with one of the same type and rating. The fuse rating and type are stated on the rear panel.

If the product is not used in a manner specified in the instructions, the protection provided by the equipment may be impaired.



CAUTION: Keep fingers away from rotor while pump is in operation. Stop pump before loading or unloading tubing/cartridge.

Explanation of Symbols



CAUTION: Risk of Danger. Consult Operator's manual for nature of hazard and corrective actions.



CAUTION: Risk of crushing. Keep fingers away from rotor while pump is in operation. Stop pump before loading or unloading tubing.



CAUTION: Hot Surface. Do not touch.



CAUTION: Risk of electric shock. Consult Operator's manual for nature of hazard and corrective actions.

WARNING: Product Use Limitation



This product is not designed for, nor intended for use in patient connected applications; including, but not limited to, medical and dental use, and accordingly has not been submitted for FDA approval.

This product is not designed for, nor intended for use in hazardous duty areas as defined by ATEX or the NEC (National Electrical Code); including, but not limited to use with flammable liquids. Consult the factory for products suitable for these types of applications.

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Section 1 Introduction

The FH100M Series of pumps are peristaltic Pump Systems that provide flow rates from 0.002 to 760 mL/min per channel.

Application Solutions

Advantages of the Peristaltic Pumps:

- Handle abrasive slurries and corrosive fluids with minimal wear. Ideal for titanium-dioxide or diatomaceous earth filter aid applications.
- No seals in contact with the medium pumped.
- No valves to clog.
- Inner surfaces are smooth and easy to clean.
- Fluid contacts only the tubing or tube material
- Suction lift and priming up to 8m water column at sea level.
- Low shearing for low handling the most shear sensitive of fluids like latex or fire fighting foam.
- Capable of running dry and pumping fluids with high quantities of entrained air, such as black liquor soap.
- High volumetric efficiency allows operation in metering or dosing applications where high accuracy is required.
- Handle extremely viscous fluids.
- Tubing and tube materials are available that are suitable for food and pharmaceutical use.

General Description

Thermo Scientific FH100M Multichannel Pump Systems provide flow rates from 0.002 to 760 mL/min per channel depending upon tubing size.

The FH100M Multichannel Pumps provide a motor speed repeatability of 0.25 percent to maximize productivity in precision liquid dosing, batch dispensing and filling applications. A turndown ratio up to 100:1, bidirectional flow and self-priming capabilities allow for smooth, seamless operation and an extremely broad flow range within one tubing size.

In addition to high accuracy, precision, repeatability and resolution of speed (or flow rate), the FH100M Multichannel Pumps feature a multi-language, intuitive, man/machine interface with a graphical LCD display providing direct readout of pump speed (rpm), number of dispenses and menu options.

The easy-to-use keypad eliminates setpoint overshoot and provides easy navigation through the menu options that include a number of on-screen programming features. This, combined with its high turndown, superior accuracy and intuitive interface make the FH100M Multichannel Pumps ideally suited where ultraprecise, repeatable flow control is required. The pumps accommodate a variety of product fill rates, fill volumes and batch dispensing profiles. Inherent to peristaltic pump technology, only the fluid contacts the tubing providing for contamination-free pumping.

FH100M Multichannel Pumps are self-priming, can operate dry without damage, are suitable for most chemicals and contain no valves or seals. *See Tubing Chemical Compatibility Guide* within this CD.

Section 2 Installation and Setup

Before Starting Drive

- The drive should be mounted on a flat horizontal surface.
- The ambient air temperature should not exceed 104° F (40° C) and adequate air flow should be provided for.
- Tubing should be clean and routed so that bend radii are at a minimum four (4) times the tube diameter and as short as possible.



WARNING: Turn drive off before removing or installing tubing. Fingers or loose clothing could get caught in drive mechanism.

- Use a tube size of appropriate diameter for the flow rate and viscosity required.
- For tubing selection and compatibility, see *Tubing Selection Guide* within this CD.



DANGERS: Remove power from the pump before any cleaning operation is started.

High voltages exist and are accessible. Use extreme caution when servicing internal components.



WARNING: Remove power from the pump before attempting any maintenance.

Unpack the drive and retain all packing material until proper product operation has been verified. Select the tubing according to the flow desired, while considering chemical compatibility and tubing life.

Tubing Size Selection

Flow rate is determined by the size of the tubing in the Pump Head.

The FH100M Multichannel Pumps accept a variety of tubing sizes that are determined by the cassettes used (MicroBore tubing from 0.19 mm to 2.78 mm and Masterflex tubing sizes 13, 14, 16, 25, 17 and 18).

For best results, select a tubing size with a mid-range at the desired flow rate to be pumped.

Tubing Inspection and Replacement

Tubing should be inspected periodically and checked for tears, cracks, cut marks, abrasions, inability to hold pressure, bubbles in the flow stream and reduction or loss of flow. Tubing life may be extended by periodically moving the worn tubing inside the occlusion bed of the pump to the outside of the occlusion bed to the suction side of the pump. This will avoid excessive tubing wear at any specific point. Always move the worn tubing to the suction side of the pump.

Pump Controls



CAUTION: Excessive occlusion can cause high pump temperatures and early tubing and roller failure. Do Not set occlusion higher than what is recommended.

1. Make sure the speed is set to the minimum setting.
2. Turn the power switch ON. Increase the speed to start the pump action. The higher the rpm, the faster the speed of the pump.
3. The Pump Systems are self-priming. To begin pumping, select a flow direction with the flow direction button, insert the intake and output tubing into a reservoir, and turn the unit ON. Prime the tubing for at least 5 minutes. If accurate flow control is important, allow the pump to prime for approximately 20 minutes for more stable flow conditions.

Tubing Flow Range

MicroBore 2 Stop Tubing Links (Use with Small Cartridges)

		0.19 mm	0.25 mm	0.89 mm	1.42 mm	2.06 mm	2.79 mm
Pump Head	No. of Rollers	mL/min	mL/min	mL/min	mL/min	mL/min	mL/min
72-320-048	8	0.013 to 0.60	0.018 to 0.91	0.18 to 9.1	0.4 to 20.0	0.88 to 44.0	1.38 to 67.0
72-320-084	4	0.02 to 0.04	0.03 to 1.0	0.26 to 13.0	0.53 to 26.0	1.14 to 57.0	2.06 to 100.0
72-320-128	8	0.002 to 0.11	0.004 to 0.20	0.03 to 1.9	0.07 to 4.3	0.14 to 8.6	0.25 to 14.0

Precision Tubing Links (Use with Large Cartridges)

		13	14	16	25	17	18
Pump Head	No. of Rollers	mL/min	mL/min	mL/min	mL/min	mL/min	mL/min
72-320-046	6	0.21 to 10.0	0.60 to 30.0	2.2 to 110.0	4.0 to 200.0	5.6 to 280.0	7.2 to 360.0
72-320-083	3	0.22 to 11.0	0.84 to 42.0	3.2 to 160.0	6.8 to 340.0	10.6 to 530.0	14.8 to 760.0
72-320-126	6	0.033 to 1.9	0.012 to 6.6	0.35 to 20.0	0.70 to 40.0	0.98 to 56.0	1.3 to 128.0

Introduction Pump Heads/Cartridges

Pump Heads

MODEL	TYPE
Model 72-320-046	6-Roller, 2 Large or 4 Small Channel. No Speed Reduction
Model 72-320-048	8-Roller, 2 Large or 4 Small Channel, No Speed Reduction
Model 72-320-126	6-Roller, 6 Large or 12 Small Channel, 5:1 Speed Reduction
Model 72-320-128	8-Roller, 6 Large or 12 Small Channel, 5:1 Speed Reduction
Model 72-320-083	3-Roller, 4 Large or 8 Small Channel, No Speed Reduction
Model 72-320-084	4-Roller, 4 Large or 8 Small Channel, No Speed Reduction

Cartridges

MODEL	TYPE
Model 72-557-100	Large
Model 72-557-000	Small
Model 72-560-100	Large
Model 72-560-000	Small

These Cartridge Pumps are designed to provide up to 12 simultaneously driven pump channels and the ability to provide nearly pulse-free flow. In addition, the pump systems incorporate the following features:

- 5:1 speed reduction on models 72-320-126 and 72-320-128, providing ultra-low flow rates.
- 12 cartridge capacity of models 72-320-126 and 72-320-128 permit dispensing simultaneously into 12 separate containers with one set-up and pump cycle.
- Four, six, and eight roller designs provide reduced pulsation over the standard three roller.
- Elimination of “leakback” and greatly reduced pulsation by pairing cartridges with offset occlusion.
- Low friction rollers for minimum abrasion of tubing.
- Auto-resetting limit clutch built in to protect the Pump and Drive in case of excessive overload on models 72-320-1-26 and 72-320-128.

Application Data

Four, six, or eight-roller Cartridge Pump Systems are designed for multi-channel use where low pulsation and/or close occlusion control of a variety of different flows is required in low-flow applications. See table on page 2-2 for flow rates.

General Description

Each Pump Head System is composed of a multi-roller Pump Head and two sizes of snap-in tubing cartridges, each with individually adjustable occlusion settings. The occlusion "wedge" design provides accurate and more balanced flow control.

Some Pump Head Systems have an off-center occlusion path that allows two oppositely mounted cartridges to be connected together for virtually pulseless flow with no leakback.

Both the six- and the eight-roller Pump Heads are available in two sizes. The short Pump Heads hold up to 2 large or 4 small cartridges and operate at the same speed as the drive. The long Pump Heads hold up to 6 large or 12 small cartridges and operate at one-fifth the speed of the drive.

Models 72-320-126 & 72-320-128 have an auto resetting limit clutch built in to protect the Pump and Drive in the event of an excessive overload. When an overload occurs, the clutch emits an audible clatter indicating the pump rotor is not rotating.

MODELS 72-320-126 & 72-320-128

MODELS 72-320-046, 72-320-048
72-320-083, 72-320-128

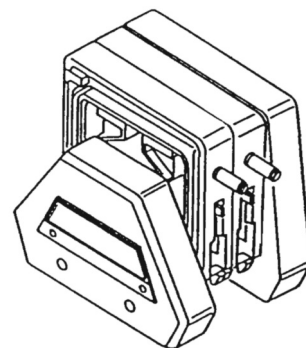
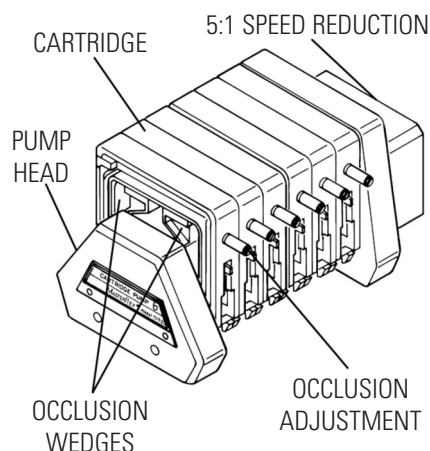


Figure 2-1. Pump Heads with Cartridges

Installation

Tool Required: Long hex key (provided).

Your pump system comes with pump mounted. In the event that you need to mount the Pump Head to the FH100M:

1. Connect the Pump to Drive by aligning the tang on Pump Head (see Figure 2-2) with the slot in the motor Drive shaft.

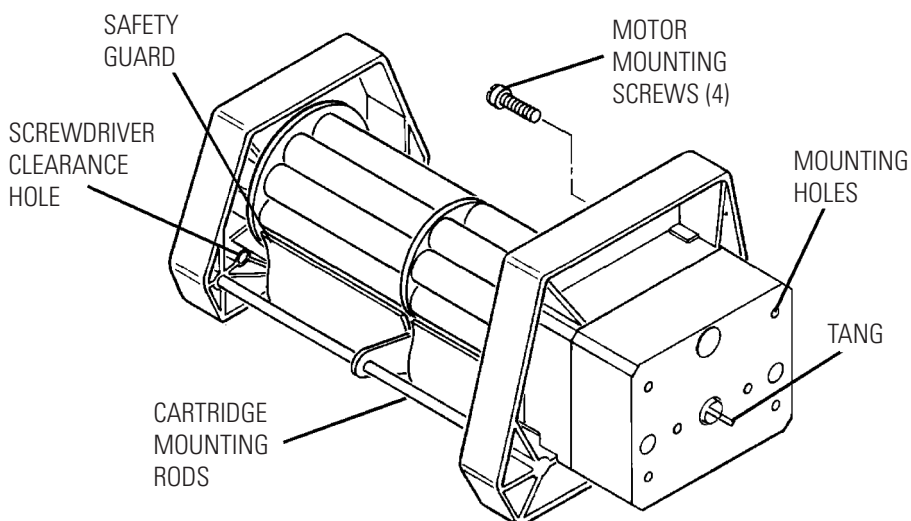


Figure 2-2. Pump Mounting

2. Attach Pump Head to drive unit with four screws (provided) using the long hex key (also provided).
3. If the Pump Head requires support, install the foot provided.

Setup

Two cartridge sizes (0.72 in and 0.36 in thick) (see Figure 2-3) accommodate a broad range of tubing sizes, as noted in Tables 1 and 2.

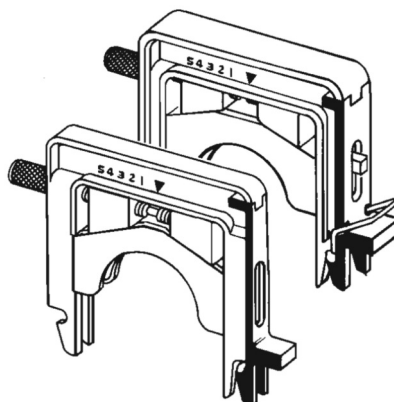


Figure 2-3. Small and Large Cartridges

Select Cartridges

NOTE: These Pump Systems are supplied with Cartridges designed for use with that specific system.

See product literature for what cartridges are available.

Depending on which Pump is selected, , up to six large or twelve small tubing cartridges can be teamed up with the Pump Head. But there is a limit, depending on available drive power and pump load. For full tubing flow rates at 0 psi, See *Recommended Occlusion Settings* Table which shows cartridge capacities according to tubing size and drive type.

Cartridge sizes can be intermixed on the different pumps as long as the total load does not exceed the drive capability.

The small Cartridge is designed to operate with MASTERFLEX® Precision Tubing sizes LS® 13 and LS® 14 in either six-roller pump head and will also accommodate specially designed MicroBore Tubing Sets (0.9 mm wall) when used in one of the four or eight-roller pump heads.

The large Cartridge is designed to operate with MASTERFLEX® Precision Tubing sizes LS® 14, LS® 16, LS® 25 and LS® 17 in either three, four, or six-roller Pump Head.

Load Cartridges

Note on some of the Cartridges; occlusion surfaces are positioned asymmetrically around the pump roller assembly (see Figure 2-3), so orientation on the Pump Head may be important for certain applications.

To achieve parallel, synchronized pulsations and fluid “pillows” through all channels, orient Cartridges in the same direction.

To achieve nearly pulseless flow, install reduced pulsation Cartridges in alternate directions and connect equal lengths of tubing from the discharge side of two alternate cartridges together through a Y connector as shown (see Figure 2-4). The asymmetric design of the cartridges provides overlapping pulses through the two tubings, which act to almost completely cancel pulsation in the combined flow channel.

NOTE: The joined flow rate will be greater than the single channel flow rate for any given tubing size and pump speed.

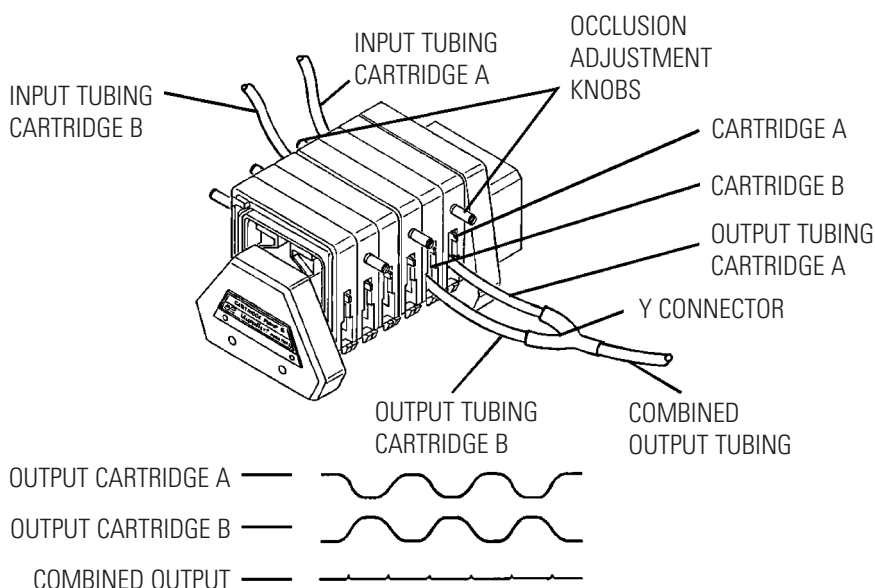


Figure 2-4. Reduced Pulsation Connection 72-560-XXX Cartridges Only!



WARNINGS: *Tubing breakage may result in fluid being sprayed from pump. Use appropriate measures to protect operator and equipment.*

Turn off drive before removing or installing Cartridges. Safety guards are provided to minimize risk of fingers getting caught between the roller mechanism and the base of the module. However, be safe—Keep your fingers away from these areas.



CAUTION: *Use only tubing/cartridge/pump combinations defined by the Recommended Occlusion Settings Table. Use of other combinations could cause malfunction or damage to the pump.*

Load Cartridges (continued)

With the drive stopped, follow this procedure to install Cartridges.

1. Turn the Occlusion Adjustment Knob (see Figure 2-5) counterclockwise to maximum open. This step is not necessary when the occlusion is set at the factory setting or if the occlusion has already been set appropriately during previous pumping.
2. Set the Tubing Retainer according to tubing size (see Figure 2-7 A) when using the large Cartridge. (See *Recommended Occlusion Settings Table*) No retainer adjustment is required when using the small Cartridge. (Note: The retainer button located on the Occlusion Adjustment Knob-side of the large Cartridge is a loose component and may fall out. To reassemble, push it back into place while pressing in the button.)
3. Select tubing and place in Cartridge (see Figure 2-7B). If using a MicroBore Tubing Set (see Figure 2-6), place the Collar up against the Tubing Retainer (see Figure 2-7C) on both sides of the Cartridge.

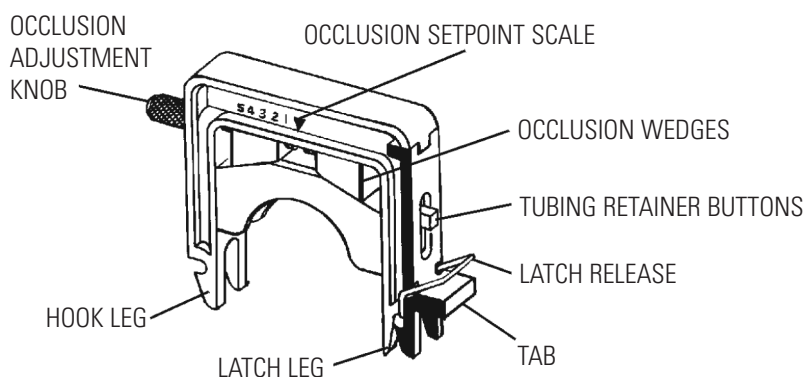


Figure 2-5. Cartridge Assembly

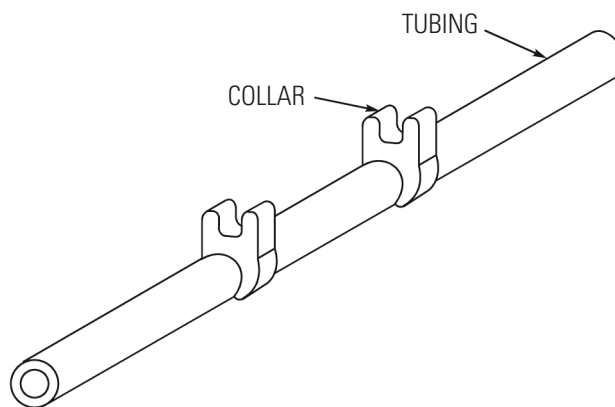


Figure 2-6. MicroBore Tubing Set

Load Cartridges (continued)

4. Attach the Hook leg of the Cartridge onto one of the Support Rods while holding the tubing between the Cartridge legs and against the Tubing Retainer (see Figure 2-7D).
5. Swing the Cartridge with the tubing over the rotor and push down on the Tab (see Figure 2-5) until the latch snaps closed (see Figure 2-7E).
Note: Depress the Cartridge as required in the location indicated in Figure 7E to facilitate latching and unlatching.
6. Lightly pull the tubing at the outlet and inlet to remove the slack when using continuous tubing. No slack removal is required when using a MicroBore Tubing Set.
7. Adjust the occlusion setting (see OPERATION section). For a nominal setting with MASTERFLEX tubing, turn adjustment screw until inside edge of the wedge is aligned midway between #3 and #4 on the label.

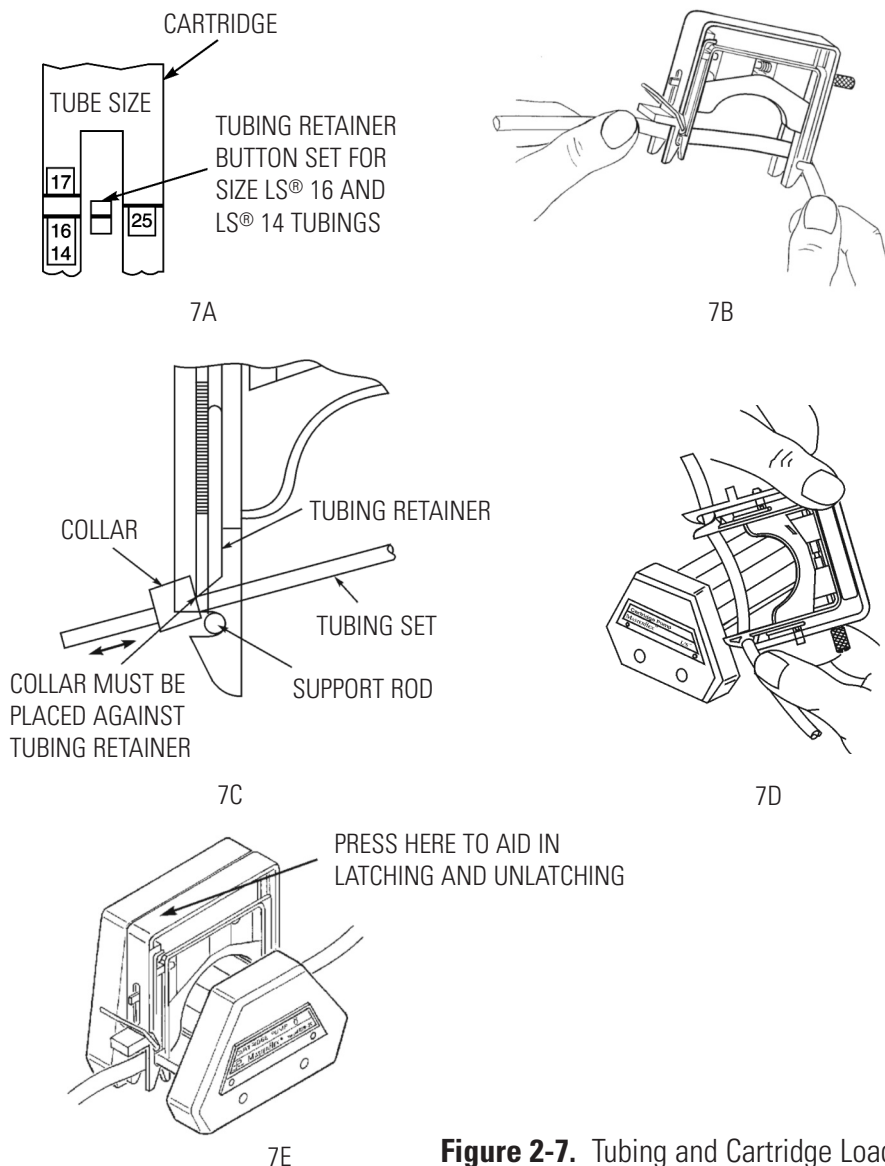


Figure 2-7. Tubing and Cartridge Loading

Cartridge Removal

Follow this procedure to unload the Cartridge.

1. Turn the Drive OFF.
2. Push down on latch side of Cartridge (see Figure 2-7E) and pull latch leg outward to unhook from rod. The latch Release (see Figure 2-5) can be depressed to aid in this process as desired.
3. Pivot Cartridge upwards and unhook Hook leg from rod and remove Cartridge.

Bi-Directional Pumping

Fluids can be pumped into and back out of containers by reversing the drive.

Partial Bank Pumping

The Pump can be operated with either a partial or a full bank of Cartridges. There is an elastic, VITON® fluoroelastomer O-ring on each of the two metal rods of the pump (see Figure 2-8) that holds the Cartridges in place on the pump. These O-rings should be adjusted as follows. If the pump is partially loaded with Cartridges, slide the O-rings along the rods, up against the front of the outermost Cartridge, to keep it in place (note position A, for example, in Figure 2-8). If the pump is fully loaded with Cartridges, slide the O-rings to the front of the pump as far as possible (note position B in Figure 2-8). When using speed-reduced models (72-320-126, -128) and the pump is less than half full of Cartridges, load the Cartridges into the front half of the pump so that the O-rings can be utilized.

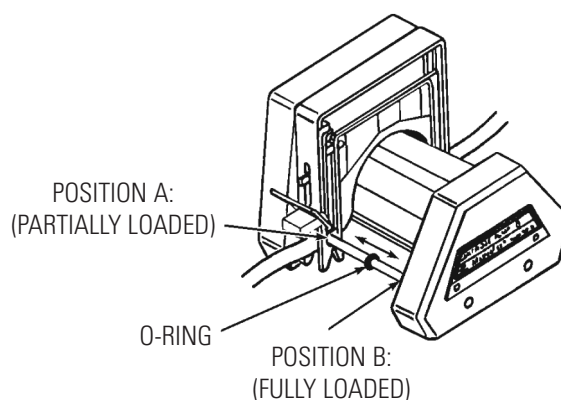


Figure 2-8. O-Ring Position

Operation

This section describes the procedures for obtaining the desired performance.

Relative Pulsation Rates

The relative pulsation rate in the pump output is dependent on several factors, including number of rollers on the pump rotor, cartridge size, and whether cartridges are paired.

Using the range of oscillation observed in a ball type flowmeter as a measure, approximate relative pulsation values for any given tubing size and flow rate are shown in the following chart. The chart is based on using a three-roller 72-320-083 pump as the benchmark with an arbitrary value of 10.

Pump Type	Small Cartridge	Large Cartridge
6-Roller	4	4
8-Roller	3	—
6-Roller Paired Cartridges	1.5	>1
8-Roller Paired Cartridges	<1	—

Select Pump Speed

Select fixed speed drive or adjust speed of variable speed drive to provide desired nominal flow rate within the rotor rpm speed range shown for the pump model selected.

Adjust Occlusion Settings on Cartridges



CAUTION: Excessive occlusion can cause high pump temperatures and early tubing and roller failure. Do not set occlusion tighter than what is recommended in the Recommended Occlusion Settings Table.

NOTE: With large and small cartridges, the scale identified as "Mflex" provides nominal occlusion for MASTERFLEX L/S® precision tubing at the #3 - #4 setting. With small cartridges only, the scale identified as "Micro" provides nominal occlusion for 0.9 mm (0.035 in) wall MicroBore Tubing Sets at the #3 - #4 setting.

With a multi-channel cartridge system, flow rate, pressure sensitivity and tubing life can be fine-tuned-even while the pump is running. No lost time, and with operating speeds up to 400 rpm, you get higher maximum flows with the same size tubing.

Figure 2-9A (large and small cartridge) shows the wedges adjusted at #3 on the occlusion setpoint scale for the MASTERFLEX tubing.

Figure 2-9B (small cartridge only) shows the wedges adjusted at the #3 - #4 setting on the scale for the MicroBore Tubing Sets.

Adjust Occlusion Settings on Cartridges (continued)

The Occlusion Adjustment Knob, (see Figures 2-9A and 2-9B), controls a screw mechanism to move the occlusion wedges. Once a Cartridge is adjusted to a desired setting for a particular application, there is no need to reset. Or, you can record settings and quickly reproduce them at any later time.

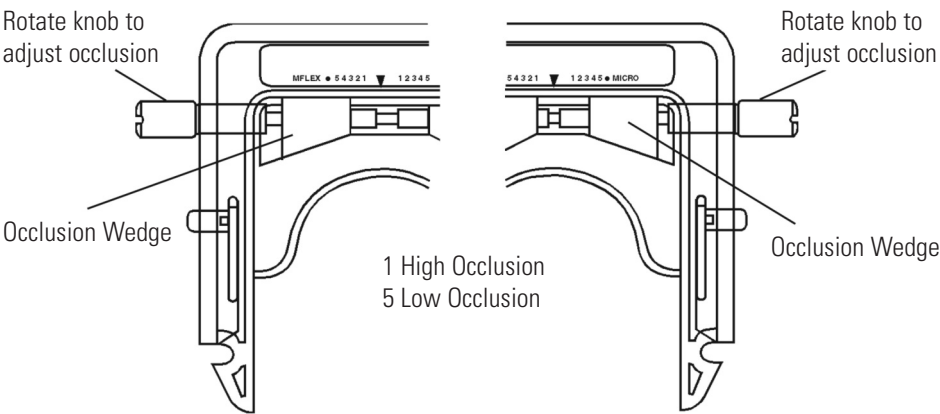


Figure 2-9A. Occlusion Indications for the MASTERFLEX Tubing

Figure 2-9B. Occlusion Indications MicroBore Tubing Sets

Normal Occlusion Settings

The following table shows the appropriate occlusion settings to provide satisfactory performance for various tubing sizes. (For optimum occlusion settings, see following section.)

Recommended Occlusion Settings

Tubing	Large Cartridge Mflex Scale	Small Cartridge	
		Mflex Scale	Micro Scale
MicroBore Tubing Set	N/A	Use Micro Scale	#3 Micro Scale
MASTERFLEX. L/S® Precision	#3 - #4 Mflex scale	#3 - #4 Mflex scale	Use Mflex Scale

Occlusion Setting Procedure

1. Select the recommended occlusion value from the table.
2. Turn the Occlusion Adjustment Knob to align the inside edge of the white Wedge with the scale number. (Clockwise rotation increases the occlusion.)

Optimized Occlusion Settings

Some applications require additional fine-tuning of the occlusion setting to vary the flow rate for a particular tubing to reduce flow variations caused by changes in system pressure, or to increase tubing life.

1. Adjust the Occlusion Wedges as described in the preceding table.
2. Refine this setting, depending on your objectives:

NOTE: To Maximize Tubing Life

While running the pump, simply reduce the adjusted occlusion setting by turning the Occlusion Adjustment Knob counterclockwise to move the wedges to a higher setpoint scale number (toward 5). Continue turning the knob counterclockwise until the flow drop-off or the pressure sensitivity becomes unacceptable, then turn knob slightly clockwise.

NOTE: To Reduce or Eliminate Flow Drop-Off Rate with Pressure Fluctuations

While running the pump, alternate the backpressure between the expected high and low values and increase the adjusted occlusion setting. Turn the Occlusion Adjustment Knob clockwise to move the wedges to a lower setpoint scale number (toward 1) until the flow drop-off is minimized.

NOTE: To Fine-Adjust the Flow Rate

Increase or decrease the occlusion value to vary the flow.

Pump Overloading

Models 72-320-126 and 72-320-128 have an auto-resetting limit clutch built in to protect the Pump and Drive in the event of excessive loading. When an overload occurs, the pump rotor will stop rotating and the clutch will emit an audible clatter.

The clutch capacity is sufficient to drive most combinations of tubing size and material at any pump speed with a full complement of channels operating. Some larger sizes of stiff tubings pumping through tight occlusion settings at higher speeds will cause an overload condition. This will limit the number of channels that can be run.

Permissible Number of Cartridges Per Pump

Tubing		Model Number					
		72-320-046	72-320-048	72-320-083	72-320-084	72-320-126	72-320-128
		Cartridge Size					
Size	Type	Large	Small	Large	Small	Large	Small
0.19 mm	Soft		4		8		12
	Stiff		4		8		12
0.25 mm	Soft		4		8		12
	Stiff		4		8		12
0.89 mm	Soft		4		8		12
	Stiff		4		7		12
1.42 mm	Soft		4		8		12
	Stiff		4		7		12
2.06 mm	Soft		4		8		12
	Stiff		4		7		10
2.79 mm	Soft		4		8		12
	Stiff		3		7		7
13	Soft	4		4	8	6	12
	Stiff	4		4	7	6	12
14	Soft	4		4	8	6	12
	Stiff	4		4	6	6	10
16	Soft	2		4		6	
	Stiff	2		4		6	
25	Soft	2		4		6	
	Stiff	2		2		4	
17	Soft	2		4		4	
	Stiff	CF		2		3	
18	Soft	CF		CF		3	
	Stiff	CF		CF		2	

An example of Soft tubing materials are Silicones.

Examples of Stiff tubing materials include PVC, Santoprene®, VITON, TYGON LFL, and TYGON lab.

CF: Consult Factory

Section 3 Operation

Turning On the Drive

1. Plug the power cord into the IEC Connector, located on the rear of the drive. Plug the opposite end of the power cord into an electrical outlet.
2. Flip the power switch located on the rear of the drive.
3. Upon turning on the drive for the first time you will be prompted to select a language. The selected language will be set as the default but can be changed at any time by selecting “LANGUAGE” on the main menu.
4. After selecting your language, the Main Menu will now appear on the LCD screen. (**NOTE:** Each start-up after the initial will revert to the mode of operation screen previously in use.)
5. If the language is accidentally changed and the user would like to reset it to the default language (English), press and hold the UP/DOWN (▲/▼) keys during power up.
6. To restore drive to default settings, press and hold the LEFT/RIGHT (◀/▶) keys during power up.



CAUTION: To avoid electrical shock, the power cord protective grounding conductor must be connected to ground. Not for operation in wet locations as defined by EN61010-1.



CAUTION: Power must be turned off before connecting the external remote control cable to prevent damage to the drive.



WARNING: Tubing breakage may result in fluid being sprayed from pump. Use appropriate measures to protect operator and equipment.

The Control Panel

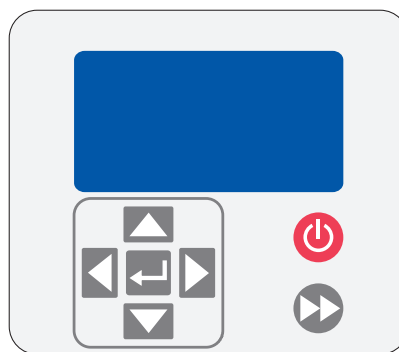







Figure 3-1. Control Panel

- To navigate all menus on the drive use the  directional pad directly below the LCD screen.
- The  (ENTER) key located in the middle of the directional pad is used to enter or select a highlighted field or option. This key is often referred to as the ENTER key in this manual.
- The  (START/STOP) key located at the top right of the control panel is used to start and pause the drive. This key is functional only when in one of the three operating modes: Continuous, Time Dispense or Copy Dispense. This key is often referred to as the START/STOP key in this manual.
- The  (PRIME) key located at the bottom right of the control panel is used to access the prime (fast forward) function. While pressed, this key operates the drive at the maximum allowed speed/flow rate and in the direction shown on the display. When released, the drive returns to its original speed or flow rate.

Priming the Pump

1. Insert appropriate tubing into cassette. Load cassette onto pump body.
2. Insert tube inlet into supply fluid.
3. Insert supply outlet into desired container.
4. Turn on pump using switch located on the back of the drive.
5. Press and hold the PRIME  key on the drive console to prime the pump. Priming will stop when key is released.



CAUTION: Keep fingers away from rotor while pump is in operation. Stop pump before loading or unloading tubing/cartridge.

Main Menu

CONTINUOUS MODE refer to *Continuous Mode* in this manual.

TIME DISPENSE MODE refer to *Time Dispense Mode* in this manual.

COPY DISPENSE MODE refer to *Copy Dispense Mode* section in this manual.

REMOTE CONTROL MODE refer to *Remote Control Mode* section in this manual.

SOUNDS: An audible “beep” can be enabled to indicate a keypad press, the end of a dispense and/or the end of a batch.

AUTOSTART: By default the drive will not restart when power is applied. To enable this feature select AUTOSTART and then ON. The drive will now restart when power is reapplied, if the drive was running when powered off.


DISPLAY CONTRAST: This display can be adjusted using the UP/DOWN (▲/▼) arrows after selecting this menu item.

LANGUAGE: After selecting this menu, the user will be able to select one of seven different languages.

NOTE: If the language is accidentally changed and the user would like to reset it to the default language (English), press and hold the UP/DOWN (▲/▼) keys when power is reapplied.

DEFAULT SETTINGS: Selecting this menu item and pressing the ENTER key will restore default settings. To restore drive to default settings the user may also press and hold the LEFT/RIGHT (◀/▶) keys when power is reapplied.

Setup Menu

All three operation mode screens contain a SETUP icon  in the upper right hand that gives quick access to the SETUP menu. The exact options that can be accessed through the SETUP menu will depend on the operating mode currently in use:

1. **Selecting the SETUP Menu:** In any of the three operating modes, use the directional pad and enter key to select the SETUP icon from the mode operation screen.
2. **Navigating the SETUP Menu:** Use the directional pad and the ENTER key to select desired setting.

A breakdown of the setting features common to all modes follows. Other settings are related to the specific operating mode currently in use and can be accessed through the mode operation screen as well.

Flow Unit: Select desired flow unit to be displayed.

Flow Rate: Set the flow rate in flow unit listed at the top of the screen. (**NOTE:** To change flow unit, see *Flow Unit* above.) When the entire rate field is highlighted, press ENTER. The digits can be navigated individually using the UP/DOWN arrows; switch between digits using the LEFT/RIGHT arrows. After selecting an optimal flow rate, press ENTER again to validate.

Pump Direction: Select the direction of the pump flow.

Sounds: Select a beep for keypad, end of dispenses, and batches.

Remote Control: See *Remote Control*.

Keypad Lockout: Allows for the keypad to be locked and unlocked.

Main Menu: Return to the Main Menu.

Exit: Return to the Mode Operation screen.

Continuous Mode Screen

Display Legend: Below is a screenshot of the screen display for the drive in Continuous Mode. An explanation of the information on the screen follows.

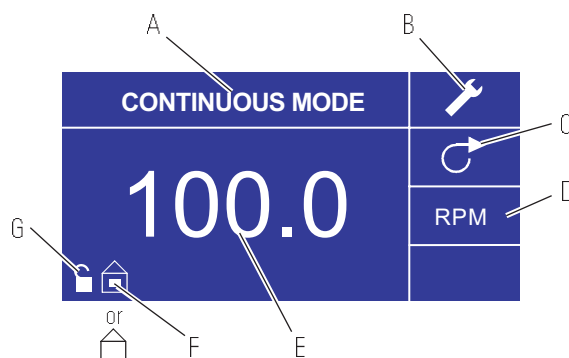







Figure 3-2. Continuous Mode Screen

- A. **Mode Display:** Current operating mode in which the drive will operate. Pressing ENTER key when highlighted will cycle through the different operation modes.
- B. **Setup**  : Pressing the ENTER key on this icon goes to the Setup screen. The Setup screen contains most functions that can be accessed from the Continuous Mode operation screen, including: flow units, tubing size, flow rate, pump direction, remote control, and keypad lockout. The Setup screen also provides access to sounds and the Main Menu.
- C. **Flow Direction:** Pressing the ENTER key on this icon toggles between clockwise and counterclockwise flow direction.
- D. **Flow Units:** Pressing the ENTER key on this icon goes to the Flow Unit selection screen. **NOTE:** % and rpm are available in Continuous Mode only.
- E. **Current Flow Rate:** The center digits show the speed of the drive in % max speed or rpm (see position D, Figure 3-2).
- F. **Local/Remote**  **or**  : Pressing the ENTER key on this icon goes to the Remote Control setup screen. This icon indicates whether your drive is in local or remote control mode. If the solid rectangle appears in the center of the figure the drive is set to be operated locally. If the solid rectangle does not appear in the center of the figure the drive is set to be operated by remote control.
- G. **Key Pad Lock**  : Pressing the ENTER key on this icon goes to the Keypad Lockout screen. Locking the keypad will prevent someone from changing the settings on the drive. When locked this icon changes to .

Continuous Mode Operation

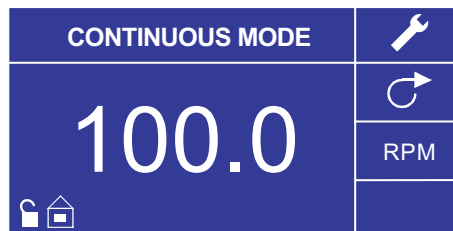


Figure 3-3. Continuous Mode Operation

1. **Getting Started:** From the Main Menu, use the ENTER key to select Continuous Mode to enter the Continuous Mode Operation screen.
2. **Preparing External Supplies:** Insert tube inlet into supply fluid. Next, insert tube outlet into desired container.
3. **Starting the Drive:** From this operation screen, simply pressing the START/STOP key will start the drive at the speed/flow rate and direction shown. In Continuous Mode the drive will operate at the displayed speed/flow rate and direction continuously.
4. **Stopping the Drive:** To pause or stop the drive, press the START/STOP key in the top right hand corner of the console.
5. **Changing Speed/Flow Rate:** To change the speed/flow rate of the drive, use the directional pad to highlight the numeric field in the center of the display and press the ENTER key. This puts you in a position to change the speed/flow rate of the drive at the farthest digit to the right (tenths, hundredths, thousandths, etc depending on flow unit). Pressing the UP arrow on the directional pad will increase the speed/flow rate by one value and pressing the DOWN arrow will decrease the speed/flow rate by one value. Use the LEFT/RIGHT arrows on the directional pad to move between digits and the UP/DOWN arrows to increase or decrease the value, respectively. Once desired speed/flow rate is selected, press ENTER key a final time to set the drive to operate at that speed/flow rate.
6. **Changing Flow Unit:** To change the flow unit of the drive pause the drive using the START/STOP key. Next, use the directional pad to select the Flow Units icon and press the ENTER key. Use the UP/DOWN arrow on the directional pad to select the desired flow unit and press the ENTER key to choose that unit. The drive will now operate in that flow unit. Press the START/STOP key to resume operating the drive.

Time Dispense Mode Screen

Display Legend: Below is a screenshot of the screen display for the drive in Time Dispense Mode. An explanation of the information on the screen follows.

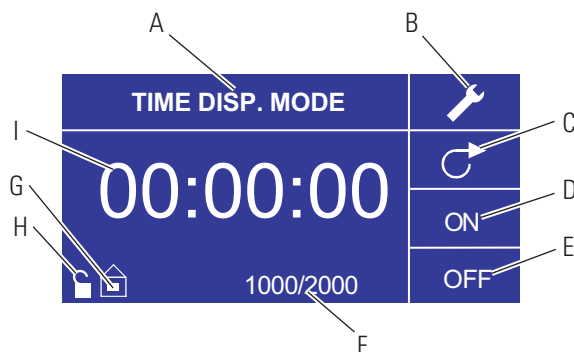







Figure 3-4. Time Dispense Mode Screen

- A. **Mode Display:** Current operating mode.
- B. **Setup** : The Setup screen can be used to select flow rate, sounds, and Main Menu. The Setup screen contains some functions that can be accessed from the Time Dispense Mode operation screen, including: pump direction, on/off time, batch count, remote control, and keypad lockout.
- C. **Flow Direction:** Pressing the ENTER key on this icon toggles between clockwise and counterclockwise flow direction.
- D. **Pump ON Time:** When this field is highlighted the drive is ON.
NOTE: The drive will not show 00:00 when switching from ON to OFF Time.
- E. **Pump OFF Time:** When this field is highlighted the drive is OFF.
- F. **Batch Count:** Displays the number of cycles dispensed in the batch.
- G. **Local/Remote**  or : Pressing the ENTER key on this icon goes to the Remote Control setup screen. This icon indicates whether your drive is in Local or Remote Control mode. If the solid rectangle appears in the center of the figure the drive is set to be operated locally. If the solid rectangle does not appear in the center of the figure the drive is set to be operated by remote control. Selection of Current Input or Voltage Input will force the drive into CONTINUOUS MODE.
- H. **Key Pad Lock** : Pressing the ENTER key on this icon goes to the Keypad Lockout screen. Locking the keypad will prevent someone from changing the settings on the drive. When locked this icon changes to .
- I. **Time Display:** The center digits show the remaining time of the drive in the ON or OFF Time highlighted on the right of the display (position D or E, Figure 3-4).

Time Dispense Mode Operation



Figure 3-5. Time Dispense Mode Operation

1. **Getting Started:** From the Main Menu, use the enter key to select Time Dispense Mode to enter the Time Dispense Mode Operation screen.
2. **Choosing Settings:** Select desired flow unit, flow rate, pump direction, etc. For more information see “*SETUP Menu.*”
3. **Preparing Tubing:** Insert tube inlet into supply fluid. Next, insert tube outlet into desired container.
4. **Selecting Flow Rate:** Use the directional pad and ENTER key to select the Setup icon. Use the UP/DOWN arrows on the directional pad to select Flow Rate. In the Flow Rate selection screen, press the ENTER key and then use the UP/DOWN arrows on the directional pad to select a desired flow rate. For faster entry, use the LEFT/RIGHT arrows on the directional pad to move between digits and the UP/DOWN arrows to increase or decrease the value, respectively. Press ENTER one more time to validate the selected flow rate. Use the directional pad to select EXIT to return to the Time Dispense Mode Setup Screen. Select EXIT again to return to Time Dispense Mode.
5. **Setting ON Time:** To set the ON Time, use the directional pad and ENTER key to select the ON field (see position D, Figure 3-5). Doing so will highlight the timer in the center of the screen (see position I, Figure 3-5). Pressing ENTER again, allows the timer to be set using the UP/DOWN arrows. Switch between digits using the LEFT/RIGHT arrows. Having selected an optimal ON Time, press ENTER again to validate. The drive will now run for the time appearing in the center of the screen.

NOTE: When entering the Time Dispense Mode Screen the ON or OFF Field will be highlighted (see position D or E, Figure 3-5). The highlighted field indicates whether the time displayed is for the ON time or OFF Time.

Time Dispense Mode Operation (continued)

6. **Setting OFF Time:** To set the OFF Time, use the directional pad and ENTER key to select the OFF field (see position E, Figure 3-5). Doing so will highlight the timer in the center of the screen (see position I, Figure 3-5). Pressing ENTER again, allows the timer to be set using the UP/DOWN arrows. Switch between digits using the LEFT/RIGHT arrows. After selecting an optimal OFF Time, press ENTER again to validate. The drive will now rest for the time appearing in the center of the screen. **NOTE:** If the OFF Time is set to 00:00:00, the drive requires a START/STOP Input from the keypad or the remote IO Connector to start the next dispense.
7. **Setting Batch Size:** Before running the drive at the selected ON/ OFF Times, select a batch size for the operation. To do so, use the directional pad and the ENTER key to select the BATCH icon (see position F, Figure 3-5). In the Batch Count screen, press the ENTER key and then use the UP/DOWN arrows on the directional pad to select a batch size. Switch between digits using the LEFT/RIGHT arrows. Press ENTER one more time to validate the selected batch size. When set to zero (0) the drive will run for an infinite number of cycles and the ∞ symbol is displayed. Use the directional pad to select EXIT to return to the Time Dispense Operation Screen.
8. **Starting the Drive:** The drive is now set to operate, press the START/STOP key in the upper right hand corner to start the drive. The drive can be paused at any time throughout the batch to adjust flow direction, flow units, flow rate, etc.
9. **Reset Batch Count:** To reset a batch count to zero, use the directional pad and the ENTER key to select the BATCH icon (see position F, Figure 3-5). In the Batch Count screen, use directional pad to select RESET and press the ENTER key to reset the batch count, select EXIT to return to the main Time Dispense Mode operation screen.

Copy Dispense Mode Screen

Display Legend: Below is a screenshot of the screen display for the drive in Copy Dispense Mode. An explanation of the information on the screen follows.

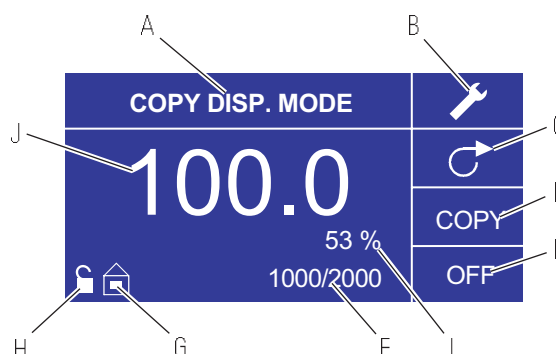







Figure 3-6. Copy Dispense Mode Screen

- A. **Mode Display:** Current operating mode.
- B. **Setup**  : The Setup screen can be used to select flow units, flow rate, sounds, and Main Menu. The Setup screen contains some functions that can be accessed from the Time Dispense Mode operation screen, including: pump direction, on/off time, batch count, remote control, and keypad lockout.
- C. **Flow Direction:** Pressing the ENTER key on this icon toggles between clockwise and counterclockwise flow direction.
- D. **Copy Amount Screen:** See *Copy Setting Screen*, Figure 3-8.
- E. **Pump OFF Time:** Highlighted when the drive is OFF.
- F. **Batch Count:** Displays the number of cycles dispensed in the batch.
- G. **Local/Remote**  or  : Press the ENTER key on this icon to go to the Remote Control setup screen. This icon indicates whether your drive is in local or remote control mode. If the solid rectangle appears in the center of the figure the drive is set to be operated locally. If the solid rectangle does not appear in the center of the figure the drive is set to be operated by remote control. Selection of Current Input or Voltage Input will force the drive into CONTINUOUS MODE.
- H. **Keypad Lock**  : Press the ENTER key on this icon to go to the Keypad Lockout screen. Locking the keypad will prevent someone from changing the settings on the drive. When locked this icon changes to .
- I. **Percentage Completed:** This icon displays the portion of fluid dispensed as a percentage.
- J. **Copy Volume:** Displays the Copy Volume while dispensing or the OFF Time.

Copy Dispense Mode Operation

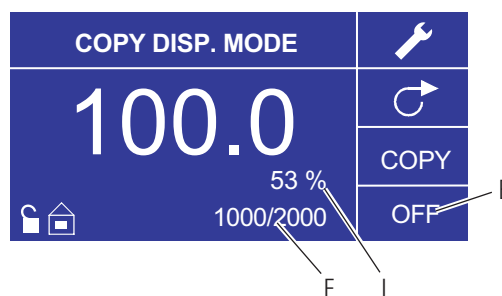


Figure 3-7. Copy Dispense Mode Operation

1. **Getting Started:** From the Main Menu, use the ENTER key to select Copy Dispense Mode to enter the Copy Dispense Mode operation screen.
2. **Choosing Settings:** Select desired flow unit, flow rate, pump direction, etc. For more information see “Using the SETUP Menu.”
3. **Preparing Tubing:** Insert tube inlet into supply fluid. Next, insert tube outlet into desired container.
4. **Setting Copy Amount:** See *Copy Setting Operation*.
5. **Setting OFF Time:** To set the OFF Time, use the directional pad and ENTER key to select the OFF field (see position E, Figure 3-7). Doing so will highlight the timer in the center of the screen (see position I, Figure 3-7). Pressing ENTER again, allows the timer to be set using the UP/DOWN arrows. Switch between digits using the LEFT/RIGHT arrows. After selecting an optimal OFF Time, press ENTER again to validate. The drive will now rest for the time appearing in the center of the screen. **NOTE:** If the OFF Time is set to 00:00:00, the drive requires a START/STOP Input from the keypad or the remote IO Connector to start the next dispense.
6. **Setting Batch Size:** Use the directional pad and ENTER key to select the Batch Count icon from the operation screen (see position F, Figure 3-7). From Batch Count screen use the UP/DOWN arrows to select batch size. Press ENTER to validate batch size. When set to zero (0) the drive will run for an infinite number of cycles and the ∞ symbol is displayed. Select EXIT to return to the Copy Dispense Mode screen.
 - Batch count may be reset to zero from the BATCH COUNT screen by selecting RESET.

Copy Dispense Mode Operation (continued)

7. **Operating Drive:** Press the START/STOP key to operate the drive at the settings selected and displayed on the screen. Press again to pause or stop the drive. Drive will automatically stop once batch is complete.
8. **Reset Batch Count:** To reset a BATCH COUNT to zero, use the directional pad and the ENTER key to select the BATCH COUNT icon (see position F, Figure 3-7). In the BATCH COUNT screen, select RESET and press the ENTER key to reset the batch count. Select EXIT to return to the Copy Mode Operation screen.

NOTE: The drive is limited to a maximum number of revolutions that can be stored accurately in COPY DISPENSE MODE. The maximum number of revolutions safely stored is 5,461. At full speed the maximum time for a copy is approximately 13-1/2 or 27 minutes depending on the model. If a copy dispense exceeding this is created inaccurate dispenses will result. If greater copy volumes are required please change to TIME DISPENSE MODE or increase the tubing size used.

COPY Setting Screen

Display Legend: Below is a screenshot of the screen display for the drive in Copy Setting Mode. An explanation of the information on the screen follows.

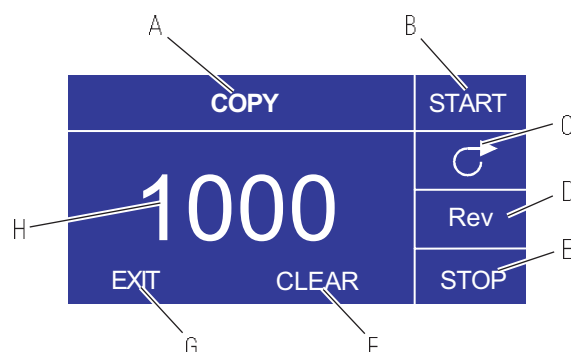


Figure 3-8. Copy Setting Screen

- A. **Mode Display:** Current operating mode.
- B. **START:** This icon will start drive allowing for copy volume to be set.
- C. **Flow Direction:** Pressing the ENTER key on this icon toggles between clockwise and counterclockwise flow direction.
- D. **Volume Unit:** Revolutions is the only available unit.
- E. **STOP:** This stops the Copy and sets the volume to be dispensed. It is displayed in position H.
- F. **CLEAR:** Selecting this will clear the number displayed on the screen and will allow for a new copy volume to be selected.
- G. **EXIT:** Return to Copy Dispense Mode.
- H. **Volume:** This is the amount that was dispensed during the copy.

COPY Setting Operation

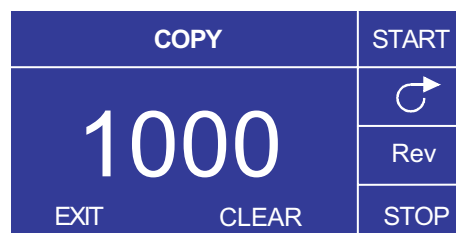


Figure 3-9. Copy Setting Operation

1. Getting Started: From the COPY DISPENSE MODE Screen select COPY and ENTER.
2. Clear Volume: Using the directional Keypad select CLEAR and ENTER.
3. Establish Copy Volume: 3 methods are available to the user.
 - a. Place the desired container at the tubing outlet. Press the START/STOP key to initiate the dispensing of fluid. When you have reached the desired volume press the START/STOP key again. Select EXIT and press ENTER. The drive will store the value of the copy in memory and use that value in the COPY DISPENSE MODE.
 - b. Place the desired container at the tubing outlet. Select the START field on the screen and press the ENTER key to initiate the dispensing of fluid. The drive will now highlight the STOP field on the screen. When you have reached the desired volume press the ENTER key to stop. Select EXIT and press ENTER. The drive will store the value of the copy in memory and use that value in the COPY DISPENSE MODE.
 - c. Place the desired container at the tubing outlet. Close the contacts on the START/STOP input to initiate the dispensing of fluid. When you have reached the desired volume, close and release the contacts on the START/STOP input. Select EXIT and press ENTER. The drive will store the value of the copy in memory and use that value in the COPY DISPENSE MODE.

Remote Control Menu

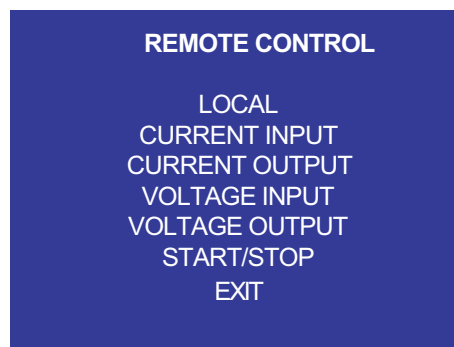


Figure 3-10. Remote Control Menu Screen

NAVIGATION: From the Main Menu or SETUP Menu select REMOTE CONTROL and ENTER.

LOCAL: When this is selected the drive is controlled by the front panel keypad, START/STOP Input, Directional Input or Prime Input. After LOCAL is selected the user is directed to the Remote Control START/STOP Input Selection Screen.

CURRENT INPUT: When this is selected, the drive is in remote control. This allows the user to input a current signal to control the flow. The user has an option to adjust the minimum, maximum and middle set points for current and flow. By default the minimum (MIN) current is set to 4.2 mA and the flow is set to 0. The maximum (MAX) is set to 20 mA and the flow is set to maximum. The middle (MID) is auto calculated for a current and flow that is centered between the MIN and the MAX. The MID can be adjusted if other profiles are needed. The scaling can be inverted if necessary. To confirm CURRENT INPUT MODE is selected, select EXIT after returning to the Remote Control Menu. To deselect Remote Current Input Mode select LOCAL and ENTER. **NOTE:** Selection of Current Input will force the drive into CONTINUOUS MODE. The START/STOP Input **MUST BE** closed or the START/STOP key pressed before the drive will run.

NOTE: When Current Input is selected the drive will not start until the REMOTE CONTROL MODE is exited.

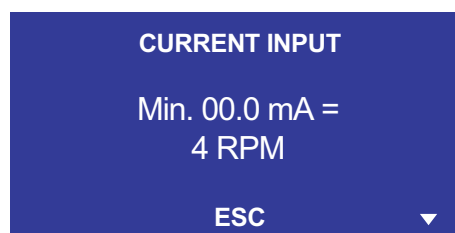


Figure 3-11. Typical ESC (Escape) Field Screen

ESC FIELD: This field allows the user to quickly return to the last RUN MODE screen (CONTINUOUS PUMP MODE or one of the DISPENSE MODE Screens) without changing from LOCAL to REMOTE MODE (or REMOTE to LOCAL MODE).

Remote Control Menu (continued)

CURRENT OUTPUT: This allows the user to adjust the current output for a given flow. The user has an option to adjust the minimum, maximum and middle setpoints for current and flow. By default the minimum (MIN) flow is set to 00.0 and the current is set to 4.0 mA. The maximum (MAX) is set to maximum flow and the current is set to 20.0 mA. The middle (MID) is auto calculated for a current and flow that is centered between the MIN and the MAX. The MID can be adjusted if other profiles are needed. This allows for a three-point calibration of the current output. The flow is linear between these points. The scaling can be inverted if necessary.

NOTE: Selecting Current Output will not put user into REMOTE CONTROL MODE. Only selecting Voltage Input or Current Input will put the user into REMOTE CONTROL MODE, as indicated by the empty house icon (see position G, Figure 3-2).

NOTE: The Current Output indicates the Running Command Speed when the drive is running. Use the Motor Running contacts (normally open/closed) to indicate if pump is running.

ESC FIELD: This field allows the user to quickly return to the last RUN MODE screen (CONTINUOUS PUMP MODE or one of the DISPENSE MODE Screens) without changing from LOCAL to REMOTE MODE (or REMOTE to LOCAL MODE). See *Typical ESC Field Screen*, Figure 3-11.

VOLTAGE INPUT: When this is selected, the drive is in remote control. This allows the user to input a voltage signal to control the flow. The user has an option to adjust the minimum, maximum and middle setpoints for voltage and flow. By default the minimum (MIN) voltage is set to 00.1 V DC and the flow is set to 00.0. The maximum (MAX) is set to 10.0 V DC and the flow is set to maximum. The middle (MID) is auto-calculated for a voltage and flow that is centered between the MIN and the MAX. The MID can be adjusted if other profiles are needed. The scaling can be inverted, if necessary. To confirm VOLTAGE INPUT MODE is selected, select EXIT after returning to the Remote Control Menu. To deselect Remote Voltage Input Mode select Local and ENTER. **NOTE:** Selection of Voltage Input will force the drive into CONTINUOUS MODE. The START/STOP Input **MUST BE** closed or the START/STOP key pressed before the drive will run.

ESC FIELD: This field allows the user to quickly return to the last RUN MODE screen (CONTINUOUS PUMP MODE or one of the DISPENSE MODE) without changing from LOCAL to REMOTE MODE (or REMOTE to LOCAL MODE). See *Typical ESC Field Screen*, Figure 3-11.

NOTE: When Voltage Input is selected the drive will not start until the REMOTE CONTROL MODE is exited.

Remote Control Menu (continued)

VOLTAGE OUTPUT: This allows the user to adjust the voltage output for a given flow. The user has an option to adjust the minimum, maximum and middle set points for voltage and flow. By default the minimum (MIN) flow is set to 00.00 and the voltage is set to 00.0 VDC. The maximum (MAX) is set to maximum flow and the voltage is set to 10.0 VDC. The middle (MID) is auto calculated for a voltage and flow that is centered between the MIN and the MAX. The MID can be adjusted if other profiles are needed. This allows for a three point calibration of the voltage output. The flow is linear between these points. The scaling can be inverted if necessary. **NOTE:** Selecting Voltage Output will not put the user into Remote Control Mode. Only selecting Voltage Input or Current Input will put the user into Remote Control Mode, as indicated by the empty house icon (see position G, Figure 3-2). **NOTE:** The Voltage Output indicates the Running Command Speed when the drive is running. Use the Motor Running contacts (normally open/closed) to indicate if pump is running.

ESC FIELD: This field allows the user to quickly return to the last RUN MODE screen (CONTINUOUS PUMP MODE or one of the DISPENSE MODE Screens) without changing from LOCAL to REMOTE MODE (or REMOTE to LOCAL MODE). See *Typical ESC Field Screen*, Figure 3-11.

START/STOP: The START/STOP input can be configured to be OFF (factory default), or ON for the drive to run.

With the OFF selected (factory default), use of the START/STOP input is optional. When the START/STOP input is open, the drive can still be started using the START/STOP key, PRIME key, or PRIME input. In remote modes the drive will also run if there is sufficient current or voltage at the input.

Closing the START/STOP input will cause the drive to run until the START/STOP input opens or the START/STOP key is pressed. In Time dispense, and Copy dispense, only a momentary START/STOP closure is needed to start the drive. If the drive is already running in one of the dispense modes, a momentary START/STOP closure will stop the drive. In SET COPY MODE, the START/STOP input functions the same as in CONTINUOUS MODE; closing it will cause the drive to run until it opens.

Remote Control Menu (continued)

The function of the START/STOP input is considerably simplified when the ON is selected. The drive will not run under any condition unless the START/STOP input is closed.

Table 3-1. Continuous Mode Operation

MENU SETTINGS SETUP OPTIONS		START/STOP INPUT	INTERNAL MODE		mA or V MODE
AUTO START	START/STOP REQUIRED		Drive State When Powered OFF	Drive Response When Powered ON	Drive Running (sufficient level) When Powered OFF Drive Response when Powered ON (sufficient level present)
OFF	OFF	OPEN	Running	Not running	Not running
OFF	OFF	OPEN	Not running	Not running	Not running
OFF	OFF	CLOSED	Forced run due to S/S CLOSED	Not running	Not running
OFF	ON	OPEN	Forced not running due to S/S OPEN	Not running	Not running
OFF	ON	CLOSED	Forced run due to S/S CLOSED	Not running	Not running
ON	OFF	OPEN	Running	Running	Running
ON	OFF	OPEN	Not running	Not running	Running
ON	OFF	CLOSED	Forced run due to S/S CLOSED	Running	Running
ON	ON	OPEN	Forced not running due to S/S OPEN	Not running	Not running
ON	ON	CLOSED	Forced run due to S/S CLOSED	Running	Running

NOTE: In Continuous Mode when using the START/STOP input the drive is started with a closed contact and stopped when the contacts are opened.

Table 3-2. Dispense Mode Operation

MENU SETTING SETUP OPTIONS		START/STOP INPUT	Drive State When Powered OFF	Drive Response When Powered ON
AUTO START	START/STOP REQUIRED			
OFF	OFF	OPEN	Running	Not running
OFF	OFF	OPEN	Not running	Not running
OFF	OFF	CLOSED*	Forced run due to S/S CLOSED	Not running
OFF	ON	OPEN	Forced not running due to S/S OPEN	Not running
OFF	ON	CLOSED	Forced run due to S/S CLOSED	Not running
ON	OFF	OPEN	Running	Running
ON	OFF	OPEN	Not running	Not running
ON	OFF	CLOSED*	Forced run due to S/S CLOSED	Running
ON	ON	OPEN	Forced not running due to S/S OPEN	Not running
ON	ON	CLOSED	Forced run due to S/S CLOSED	Running

*** NOTE:** In Dispense Modes and START/STOP MENU SETUP Option OFF the drive will start a dispense with a momentary contact closure and stop with a momentary contact closure during both the dispense period and interval period.

DB-25 Pin Configuration with Wiring Scheme

Contact Arrangements

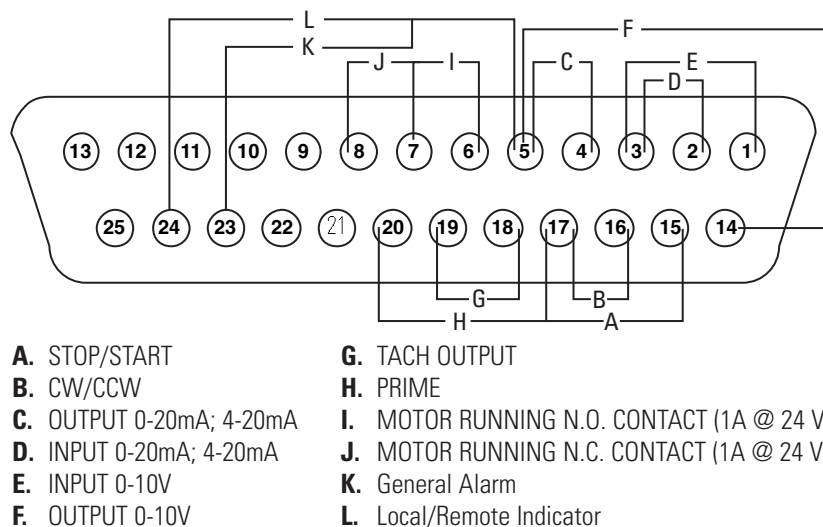


Figure 3-12. DB-25 Pin Configuration

Pin No. DB-25	Description
1	Speed Control Voltage Input (0-10 V)
2	Speed Control Current Input (0-20 mA)
3	Speed Control Input Ground Return
4	Speed Signal Current Output (0-20 mA)
5	Speed Signal Output Ground Reference
6	Motor Running N.O. Default 1A @24 V (Relay)
7	COM (Motor Running)
8	Motor Running N.C. Default 1A @24 V (Relay)
14	Speed Signal Voltage Output (0-10 V)
15	Remote Start/Stop Input
16	Remote CW/CCW Input
17	Remote Start/Stop, CW/CCW, Prime Grnd Ref.
18	Tach Ground Reference
19	Tach Output (open collector)
20	Remote Prime Input
9	Reserved – Not Used
10	Reserved – Not Used
11	Reserved – Not Used
12	Reserved – Not Used
21	Reserved – Not Used
22	Reserved – Not Used
23	General Alarm (Open Collector)
24	Local/Remote Indicator (Open Collector)
25	Reserved – Not Used
13	Reserved – Not Used

NOTE: Pins 5, 13, 17 and 18 are at earth ground, all are suitable for use with START/STOP, PRIME, Direction, Tach, LOCAL/REMOTE, General Alarm Signals and Current and Voltage Outputs.



CAUTION: Power must be turned off before connecting the external remote control cable to prevent damage to the drive.

Remote Control Inputs and Outputs

INPUTS

Remote CW/CCW, Remote Start/Stop and Remote Prime:

The remote control inputs work with current sinking outputs (open-collector NPN transistor outputs without passive pull-up resistors) or contact closures to DC common (earth ground). A continuous active low to the Remote Start/Stop input causes the drive to run, while a continuous active low to the Remote CW/CCW input causes the drive to run CCW. The motor is brought to a controlled stop before reversing direction. A continuous active low to the Remote Prime input causes the drive to run at full rated speed.

	Input Voltage	Input Current
High State	2.0 VDC Typ.	0.65 mA to activate (typical)
Low State	0.8 VDC Max.	1.0 mA typical

Remote Analog Input:

- 4-20 mA Input: 250 ohms typical input impedance ref. to signal ground.
4 mA, Stop; 20 mA, Full Speed (Default Settings)
10 Bit Resolution
Overload Capability: 10 V or 40 mA max.
- 0-10 V Input: 10 K ohms typical input impedance ref. to signal ground.
0 V, Stop; 10 V, Full Speed (Default Settings)
10 Bit Resolution

OUTPUTS

- 4-20 mA Output: 0 to 600 ohms max. load referenced to earth ground.
4 mA, Stop; 20 mA, Full Speed (Default Settings)
10 Bit Resolution
- 0-10 V Output: 1.0 K ohms min. load referenced to earth ground.
0 V, Stop; 10 V, Full Speed (Default Settings)
10 Bit Resolution
- Tach Output: Open Collector, 1.0A @ 28VDC
- Frequency range: 40 to 2000 Hz or 8 to 800 Hz, 50% Duty Cycle.
(10 Hz = 1 pump RPM)
- Logic Outputs: Open Collector, 1.0 A @ 28VDC

Motor Running Normally Open and Normally Closed contacts when drive is running.

General Alarm Output: Closed (Open Collector High Impedance) when an alarm is displayed.

Local/Remote Indicator: Open (Open Collector High Impedance) when in remote control mode (either Voltage Input or Current Input).

Open Collector Outputs

INTRODUCTION

Some remote outputs on this drive (Tachometer, Local/Remote, and General Alarm) are “open collector” type outputs and cannot be wired in the same manner as relay outputs. An open collector output is not isolated and must be configured differently than a relay output. When the open collector output is active, the output is effectively switched to earth ground and if improperly terminated could result in damage to the drive and/or external equipment.

RECOMMENDATION

When connecting to open collector outputs, the output should be connected to a current limiting resistor and then to a positive supply source which is less than 28VDC. Typically this would be connected to a 24V PLC input as shown in the Figure 3-13.

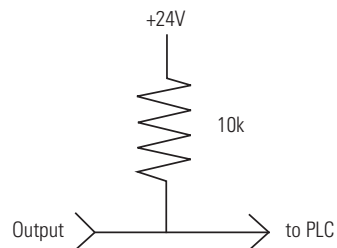


Figure 3-13. Terminating Open Collector Outputs to a PLC

When a relay is preferred, it is recommended to use a 24V relay. This can be powered from an independent 24V supply. See Figure 3-14.

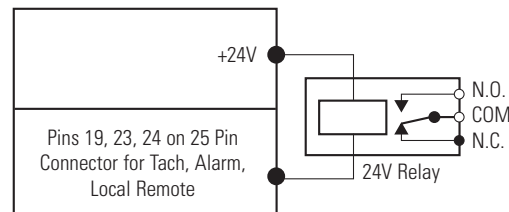


Figure 3-14. Attaching an External 24V Relay

NOTE: It is not recommended to attach 120V supply lines to relay contacts!

Section 4 Maintenance



WARNING: Remove power from the pump before attempting any maintenance.

The speed control circuit has solid-state components that do not require service. An excessive load on the system may, however, cause the fuse to blow. An indication of an excessive load is a display that does not light with power applied to the pump and when the ON-OFF switch is in the ON position. If this condition occurs, remove power from the unit and remove the fuse from the fuse holder located on the rear of the pump. Replace the fuse with a fuse of the same type and rating. This information is printed on the rear of the unit.



CAUTION: Replace the fuse only with one of the same type and rating. The fuse rating and type are stated on the rear panel.

Cleaning



DANGER: Remove power from the pump before any cleaning operation is started.

Keep the pump enclosure clean by using a mild detergent solution. Never immerse nor use excessive fluid when cleaning the pump.

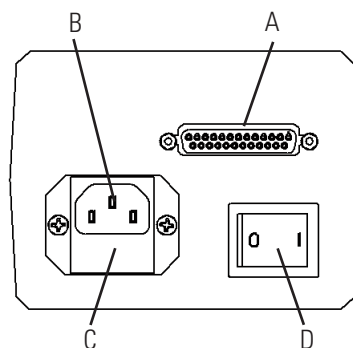
Fuse Replacement



CAUTION: Replace the fuse only with one of the same type and rating. The fuse rating and type are stated on the rear panel.

The fuse rating and type are stated on the rear panel.

1. Place the power switch in the off position.
2. Disconnect the AC power input line cord from the receptacle.
3. Remove and check the fuse and replace if defective.



Item	Description
A	I/O Receptacle DB-25 Pin
B	IEC Power Entry Module / Line Cord
C	T3.15A (5 × 20 mm) Fuse – Do Not Substitute
D	Power Switch – All settings are retained in memory

Figure 4-1. Fuse Replacement

Pump Maintenance

No maintenance required. Wipe Pump with a clean cloth and a mild detergent. Never immerse or use excessive fluid. Service Parts: When Servicing a Pump the following tools/parts are required to remove and replace the pump head.

Hex Key (9/64 in Hex)

Models 72-320-046 and 72-320-048,	A-3502
Models 72-320-126, -128, -083, -084	A-4376

Mtg. Screws (8-32)

Models 72-320-046, -048, -083, 084	110663
Models 72-320-126 and 72-320-128	B-1079-0408

Boot (closed ends)	A-3480
--------------------	--------



1. Install the plastic Boot over the tang at the end of pump shaft. This Boot prevents metal-to-metal contact, and thus reduces noise. This Boot should be inspected and replaced when worn or at 500 hour intervals.



CAUTION: Not using the boot will damage the pump.

Section 5 Troubleshooting

Troubleshooting Chart

Symptom	Cause	Remedy
Motor does not rotate, Display does not light.	No Power.	1. Check fuse and replace, if necessary.
		2. Check that unit is plugged into a live line.
		3. Check connection of power cord.
		4. Check the line cord for continuity and replace if defective.
		5. Return for servicing.
Motor does not rotate. Display lights.	Defective Remote Control or Setting Error.	1. Place power switch in OFF position.
		2. Check that remote cable connector is fully inserted into the receptacle.
		3. Reapply power.
		4. If motor still does not rotate, select remote control in Main Menu or Setup Menu and verify settings.
		5. Return to Mode screen and verify icon shows  for Local Control Mode, or  for Remote Control Mode.
		6. See <i>Remote Control Mode</i> in this manual for further details.
	START/STOP Mode "ON" without an input at I/O Connector.	1. See <i>Remote Control Mode</i> in this manual for further details. 2. Select "OFF" in START/STOP Menu to run without an input at the I/O Connector cable.
	Tubing size and formulation may exceed drive rating before break-in.	1. Start drive at 100 rpm or lower and run for 10-20 minutes.

Error Definitions

Error #2 Motor Overspeed

Description:	The drive has exceeded commanded speed value.
Error Condition(s):	The motor has exceeded the commanded speed value by 20%.
Actions:	Drive will stop immediately. Verify load is correct and power cycle drive. If error persists consult factory.

Error #3: Instantaneous Over-Current

Description:	Motor is drawing too much current for a short duration of time.
Error Condition(s):	The motor current is above 4.0 A peak.
Actions:	Drive will stop immediately. Verify that pump head is not binding and that the load is not above recommended maximum load. If error persists consult factory.

Error #4: Bad Flash Checksum

Description:	Run-time checksum (checked at power-on) contains a bad checksum value.
Error Condition(s):	Checksum is checked at power-on for an invalid value.
Actions:	Power cycle the drive. If error persists consult factory.

Error #7: Bad EEPROM Checksum (Settings)

Description:	Bad EEPROM checksum on parameter values and settings, or its data is out of range.
Error Condition(s):	1) Checksum value in EEPROM does not match calculated value. 2) Data in EEPROM is out of range.
Actions:	Error will be cleared after 10 seconds and parameters will be reset to default values. If error persists consult factory.

Error #8: Bad EEPROM Checksum (Factory Cal)

Description:	Bad EEPROM checksum for Factory Cal
Error Condition(s):	1) Checksum value in EEPROM does not match calculated value. 2) Data in EEPROM is out of range.
Actions:	Error will be cleared after 10 seconds and parameters will be reset to default values. If error persists consult factory.

Error Definitions (continued)

Error #9: EEPROM Write Verification Error

Description:	Data written to EEPROM does not match.
Error Condition(s):	Data values do not match.
Actions:	Error will be cleared after 10 seconds and parameters will be reset. If error persists consult factory.

Error #10: Bus Over Voltage

Description:	The measured AC voltage reported by the drive is too high.
Error Condition(s):	The drive voltage is above 260V AC.
Actions:	The pump will stop immediately, check the supply line voltage. If error persists consult factory.

Error #11: Bus Under Voltage

Description:	The measured AC voltage reported by the drive is too low.
Error Condition(s):	The drive voltage is below 90V AC.
Actions:	The pump will stop immediately, check the supply line voltage.
NOTE:	This error when displayed during power down is considered normal and proper. If error persists consult factory.

Error #12: Motor Stall / Motor Under Speed

Description:	The motor was commanded to run, but has either slowed down significantly or has stopped.
Error Condition(s):	The motor speed is below 95% of the desired speed for too long a period of time.
Actions:	The motor will be commanded to stop. Verify the pump turns freely and is not binding. If error persists consult factory.

Error #14: Ambient Over Temperature

Description:	The motor is overheating.
Error Condition(s):	The temperature value from motor is above given threshold value.
Actions:	The pump will stop immediately. Verify that the ambient air temperature is less than 104° F (40° C). Verify the pump turns freely and that there is no restriction of air flow. If error persists consult factory.

Error Definitions (continued)

Error #15: Motor Feedback Fault

Description: Communications to the motor control board is not correct, has disappeared, or some other communications fault.

Error Condition(s): No data coming back over the serial port from the motor.

Actions: The drive will attempt to stop the pump. Power cycle drive. If error persists consult factory.

Error #16: Invalid Interrupt or Address

Description: Software jumps to an invalid address, invalid interrupt, or other abort/exception (i.e., Data Abort Exception). This may occur due to invalid pointer references, or ram memory corruption, etc.

Error Condition(s): These are handled by an Abort Exception/Interrupt within the CPU and should branch out to their respective exception handler functions.

Actions: Power cycle the drive to reset error. If error persists consult factory.

Error #18: Watchdog Error

Description: Program has stopped running as the watch dog has not been updated, i.e., Software Locked up.

Error Condition(s): Interrupt triggered when the Watchdog has not been updated.

Actions: Power cycle drive to reset error. If error persists consult factory.

Section 6 Replacement Parts and Accessories

Replacement Parts

Description	Part Number	Qty.
Rubber Foot (pkg. of 6)	A-1390-0004-CR	1
Fuse (T3.15A, 250V, 5 x 20 mm)	77500-25	1
Pump Replacement (for model 72-320-046)	72-005-046-CR	1
Pump Replacement (for model 72-320-048)	72-005-048-CR	1
Pump Replacement (for model 72-320-083)	72-005-083-CR	1
Pump Replacement (for model 72-320-084)	72-005-084-CR	1
Pump Replacement (for model 72-320-126)	72-005-126-CR	1
Pump Replacement (for model 72-320-128)	72-005-128-CR	1
Ferrite, Line Cord Snap-on, (CE Required)	B-3689-CR	1
Line Cord, Australia	50001-60	1
Line Cord, Denmark	50001-62	1
Line Cord, India	50001-64	1
Line Cord (115V), United States	50001-68	1
Line Cord, Israel	50001-69	1
Line Cord, Europe	50001-70	1
Line Cord, England	50001-72	1
Line Cord, Switzerland	50001-74	1
Line Cord, Italy	50001-76	1
Line Cord (230V), United States	50001-78	1
Line Cord, China	50001-79	1

Accessories

Description	Part Number
25ft Remote Control Cable w/DB25	980-7590
Footswitch w/DB-25 male	7523-92
Dispenser Wand w/DB-25 male	7523-96
DB-25 External Control Connector	7523-94
PTFE Sinkers – keep intake tube at bottom of reservoir: Small: 1/16 in to 1/8 in (1.6 mm to 3.2 mm) ID tubing; Large: 3/16 in to 5/16 in (4.8 mm to 8.0 mm)	
Sinkers, (1 Small and 1 Large)	75-250-100
Small Sinkers 1/16 in – 1/8 in (1.6 mm – 3.2 mm)	75-250-102
Large Sinkers 3/16 in – 1/4 in (4.8 mm – 6.4 mm) each	75-250-104

MicroBore Tubing Links and Transfer Tubing Ordering Information

Tubing ID (mm) Links	PVC 12/pk	Silicone 6/pk	Santoprene 12/pk	VITON® 12/pk
0.19	72-450-019	—	—	—
0.25	72-450-025	—	72-470-025	—
0.89	72-450-089	72-460-089	72-470-089	72-480-089
1.42	72-450-142	72-460-142	72-470-142	72-480-142
2.06	72-450-206	72-460-206	72-470-206	72-480-206
2.79	72-450-279	72-460-279	72-470-279	72-480-279
Tubing	100 ft	50 ft	100 ft	50 ft
0.19	72-451-019	—	—	—
0.25	72-451-025	—	72-471-025	—
0.89	72-451-089	72-461-089	72-471-089	72-481-089
1.42	72-451-142	72-461-142	72-471-142	72-481-142
2.06	72-451-206	72-461-206	72-471-206	72-481-206
2.79	72-451-279	72-461-279	72-471-279	72-481-279

Precision Pump Tubing Links and Transfer Tubing Ordering Information

Tubing Size Links	Inside Dia.	Hose Barb	TYGON® 12/pk	Silicone 6/pk	PharMed® 12/pk
13	0.03	1/16	72-580-135	72-570-135	72-573-135
14	0.06	1/16	72-580-145	72-570-145	72-573-145
16	0.12	1/8	72-580-165	72-570-165	72-573-165
25	0.19	3/16	72-580-255	72-570-255	72-573-255
17	0.25	1/4	72-580-175	72-570-175	72-573-175
18	0.31	3/8	—	72-570-185	—
Tubing			50 ft/pk	25 ft/pk	50 ft/pk
13	0.03	1/16	—	—	72-303-013
14	0.06	1/16	72-310-014	72-300-014	72-303-014
15	0.12	1/8	72-310-016	72-300-016	72-303-016
16	0.19	3/16	72-310-025	72-300-025	72-303-025
17	0.25	1/4	72-310-017	72-300-017	—
18	0.31	3/8	—	72-300-018	—

Section 7 Specifications

Output:

Speed:	4 - 200 rpm/ 0.8 - 80 rpm
Torque:	168 in-oz (12.1 kg•cm)

Input:

Operating Voltage/Frequency:	90-260Vrms, 50/60 Hz, 1.6A @ 115Vrms, 1.9A @ 230 Vrms
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Remote Inputs:

START/STOP, CW/CCW, Remote/Local Speed Control	Contact closure
Voltage input	0–10V DC @ 10 kohm,
Accuracy:	±0.5% Full Scale
Current input	0–20 mA @ 250 ohm,
Accuracy:	±0.5% Full Scale

Remote Outputs:

Voltage speed output:	0–10V DC @ 1 kΩ min
Current speed output:	0–20 mA @ 0–600Ω
Motor running contacts:	1A @ 28V DC

Environment:

Operating Temperature:	32 to 104°F (0 to 40°C)
Storage Temperature:	-13 to 149°F (-25 to 65°C)
Humidity:	10% to 90% non-condensing
Altitude:	Less than 6562 ft (2000 m)
Pollution Degree:	Pollution degree 2 (indoor use—lab, office)

Construction:

Dimensions (L × W × H):	18 in × 11 in × 6 in (45.7 cm × 27.9 cm × 15.2 cm)
Weight:	6.8 kgs (15lbs)
Color:	Light Grey (5% Black)
Material:	Aluminum, ABS plastic and vinyl
Enclosure Rating:	IP31 per IEC-60529

Compliance:

UL 61010-1, CAN/CSA-C22.2 No. 61010-1

This product has been tested to the requirements of CAN/CSA-C22.2 No. 61010-1, second edition, including Amendment 1, or a later version of the same standard incorporating the same level of testing requirements.

(For CE Mark):

EN61010-1: (EU Low Voltage Directive) and

EN61326: (EU EMC Directive)

Section 8 Warranty, Product Return and Technical Assistance

Warranty

This product is warranted against defects in material or workmanship, and at the option of the manufacturer or distributor, any defective product will be repaired or replaced at no charge, or the purchase price will be refunded to the purchaser, provided that: (a) the warranty claim is made in writing within the period of time specified on the warranty card, (b) proof of purchase by bill of sale or receipted invoice is submitted concurrently with the claim and shows that the product is within the applicable warranty period, and (c) the purchaser complies with procedures for returns set forth in the general terms and conditions contained in the manufacturer's or distributor's most recent catalog.

This warranty shall not apply to: (a) defects or damage resulting from: (i) misuse of the product, (ii) use of the product in other than its normal and customary manner, (iii) accident or neglect, (iv) improper testing, operation, maintenance, service, repair, installation, or storage, (v) unauthorized alteration or modification, or (b) post-expiration dated materials.

THIS WARRANTY IS THE EXCLUSIVE REMEDY OF THE PURCHASER, AND THE MANUFACTURER AND DISTRIBUTOR DISCLAIM ALL OTHER WARRANTIES, WHETHER EXPRESS, IMPLIED, OR STATUTORY, INCLUDING WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. NO EMPLOYEE, AGENT, OR REPRESENTATIVE OF THE MANUFACTURER OR DISTRIBUTOR IS AUTHORIZED TO BIND THE MANUFACTURER OR DISTRIBUTOR TO ANY OTHER WARRANTY. IN NO EVENT SHALL THE MANUFACTURER OR DISTRIBUTOR BE LIABLE FOR INCIDENTAL, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

The warranty period for this product is one (1) year from date of purchase.

Section 8

Warranty, Product Return and
Technical Assistance

Product Return

To limit charges and delays, contact the seller or Manufacturer for authorization and shipping instructions before returning the product, either within or outside of the warranty period. When returning the product, please state the reason for the return. For your protection, pack the product carefully and insure it against possible damage or loss. Any damages resulting from improper packaging are your responsibility.

Technical Assistance

If you have any questions about the use of this product, contact the Manufacturer or authorized seller.

Thermo Fisher Scientific
28W092 Commercial Ave.
Barrington, Illinois U.S.A. 60010-2392
1-800-637-3739 (U.S. and Canada only)
11 (847) 381-7050 (Outside U.S.)
(847) 381-7050 (Local)

www.thermoscientific.com
fluidhandling@thermoscientific.com



Intertek



RoHS

1 year
warranty