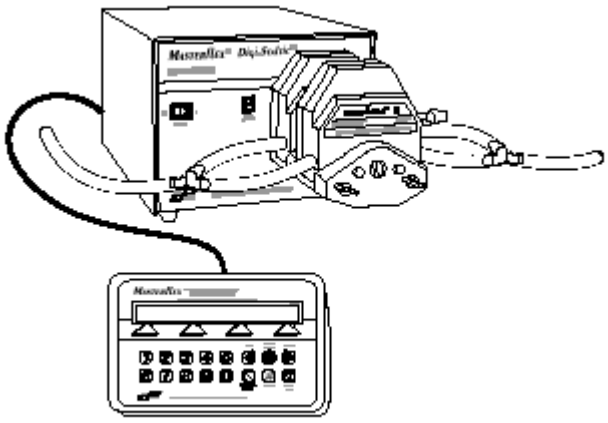
SERVICE MANUAL

MODELS:

77310-00 L/S Digi-Staltic Pump System for high performance precision tubing 115/230 VAC
77310-50 L/S Digi-Staltic Satellite Drive for high performance precision tubing 115/230 VAC
77340-00 L/S Digi-Staltic Pump System for precision tubing 115/230 VAC
77340-50 L/S Digi-Staltic Satellite Drive for precision tubing 115/230 VAC
77310-02 L/S Digi-Staltic Pump System Controller
77310-01 L/S Digi-Staltic Satellite Drive with no pump heads
77310-00 and 50 are supplied with two each 77200-62 pump heads
77340-00 and 50 are supplied with two each 77200-60 pump heads



PROPRIETARY

Barnant Company
Division of Cole-Parmer Instrument Company, Inc.
625 East Bunker Court
Vernon Hills, Illinois 60061-1844

(847) 549-7600
(847) 247-2929 (Fax)
800-323-4340
A-1299-0802
EDITION 02

TABLE OF CONTENTS

INTRODUCTION 2
SAFETY CONSIDERATIONS 4
FUNCTIONAL DESCRIPTION 5
DRIVE BOARD 6
CONTROLLER BOARD 8
TROUBLESHOOTING 10
REPAIR PROCEDURES 11
REPLACEMENT PARTS LISTING 19
CHECK-OUT PROCEDURE 21
SPECIFICATIONS 24
ACCESSORIES 25

INTRODUCTION

Service for this product is performed at three levels: the customer, distributor/COLE-PARMER and factory/depot repair. This manual describes distributor/COLE-PARMER service procedures.

Customer service procedures are described in the operator's manual. Customers are encouraged to perform service as described in the operator's manual as well as in special circumstances where special skills and safety are not considerations.

To use this manual, begin with the troubleshooting section to isolate the fault to a replaceable part. The functional description and check-out procedure sections are also helpful in determining the faulty part. Distributor/COLE-PARMER repair is limited to replacement of modules as detailed in the replacement parts list section. The repair procedures section details disassembly and assembly procedures. After repair, the product should be calibrated and checked for proper performance.

Please refer to the operator's manual (A-1299-0780) for:

A) Applications Data

B) Product Description

C) Installation

D) Setup

E) Operation

F) User Calibration

G) User Troubleshooting & Maintenance

H) Accessories

I) Specifications

SAFETY CONSIDERATIONS

Servicing must be performed only by personnel trained and skilled in the methods of troubleshooting and repair of electromechanical products. Use of procedures other than those described in this manual may result in a safety hazard to service personnel and/or customers.

When servicing any component of this unit make absolutely sure that all power to circuitry is removed. If any functional checks are to be performed while power is applied and chassis is disassembled, care must be exercised for the following:

CAUTION: Do not inadvertently short any part of the printed circuit card to ground, as severe damage will result.

CAUTION: Almost all circuits are referenced to the AC line. Powering the unit from a isolation transformer is strongly recommended.

DANGER: Never remove the cover from the pump drive when power is present.

AC and DC power in the pump drive can cause serious injury or death. Ensure that the pump drive is disconnected from the power source before removing the cover for maintenance. Allow ten minutes for the capacitors in the power supply to discharge before proceeding.

FUNCTIONAL DESCRIPTION

The Masterflex® dispenser, pump, and diluter system has two major components. A tabletop control console provides means for operator programming and control. As many as four satellite drives with two L/S® Easy-Load® II pump heads with tubing sets provide the actual pumping action.

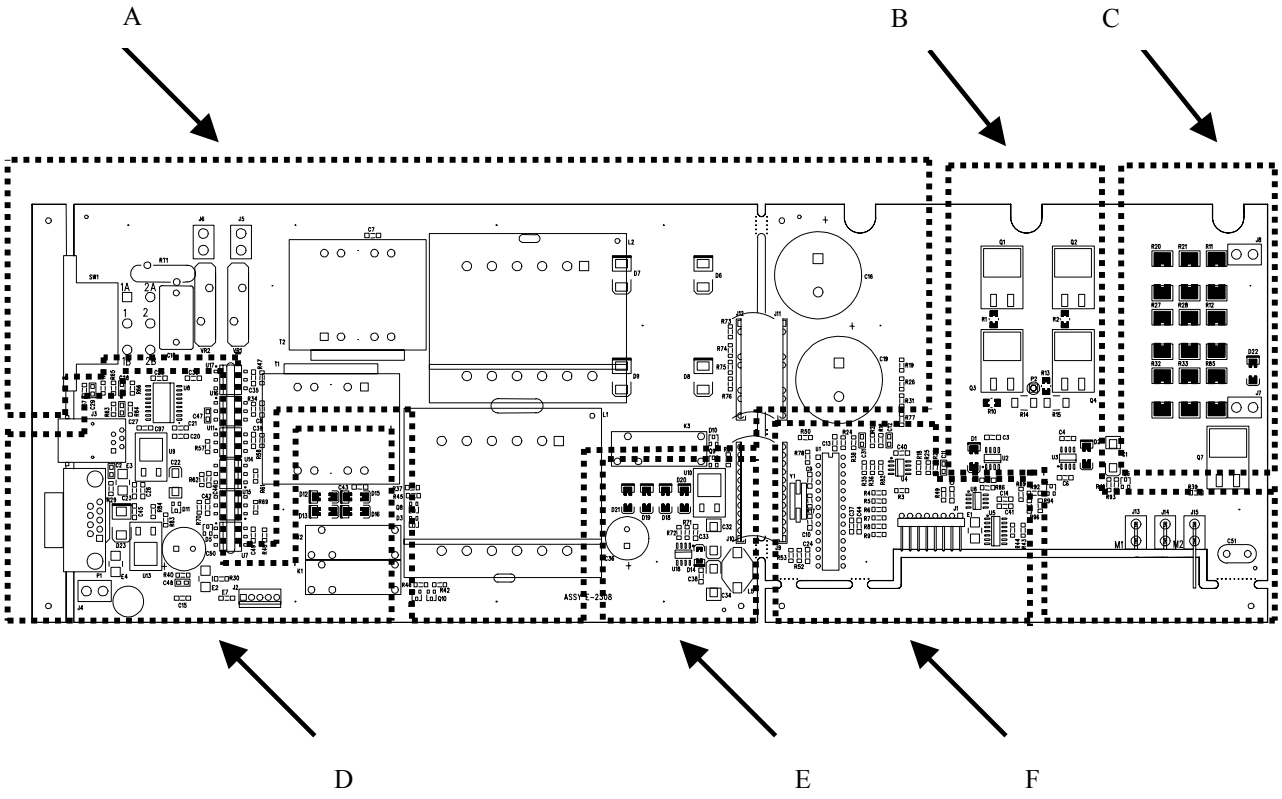
The control console is a basic I/O computer for operator interface and pump coordination. The operator is guided through a series of menus to operate and to program the unit. The LED backlit, two-row by-forty character, alphanumeric display and four soft keys help the user through all the necessary control steps. A total of 20 membrane keys, including the numbers zero through nine, also facilitate the operator's actions. An HC11-based microcontroller scans the keypad, communicates to the LCD display module, and communicates with the attached satellite drives. The user's program information is stored indefinitely in an EEPROM. The pump powers the control.

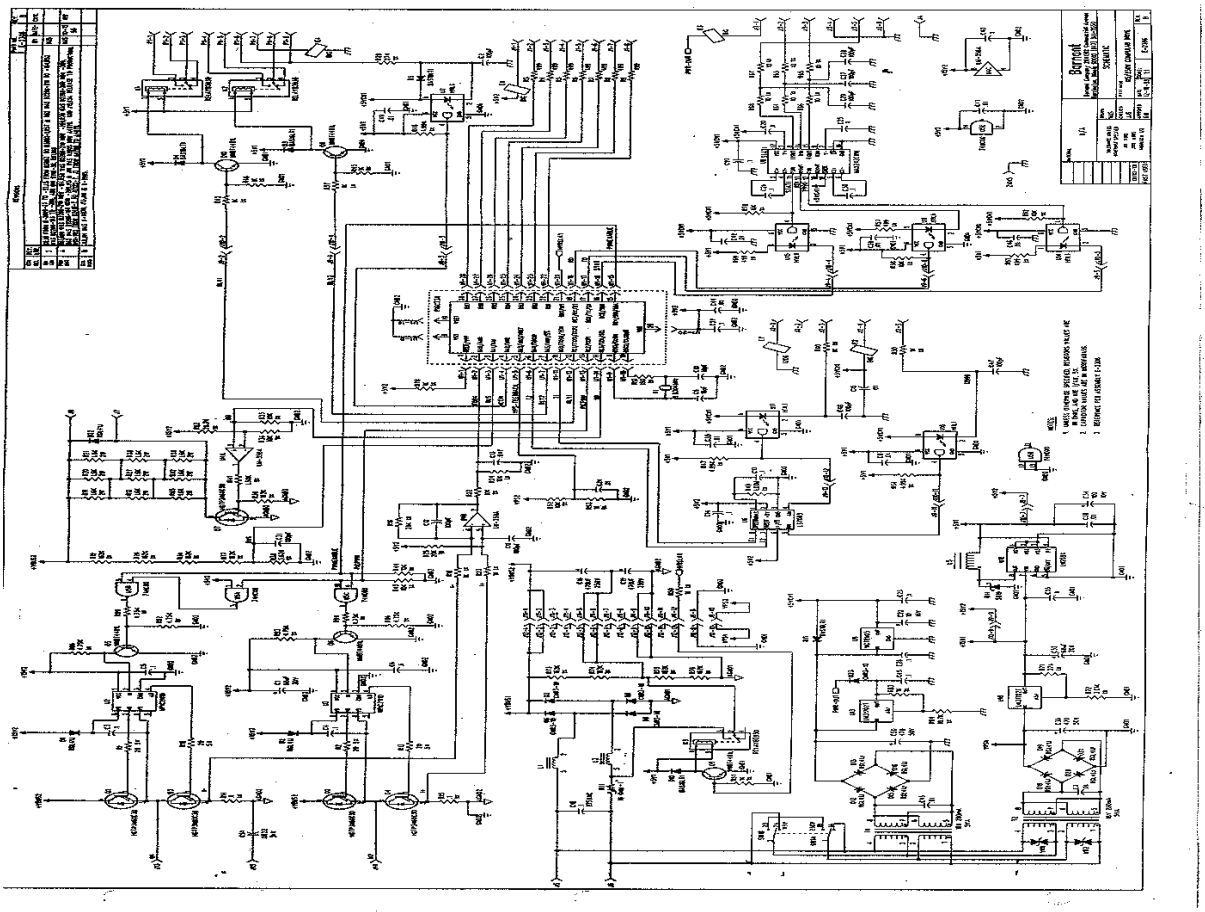
The controller communicates with the satellite drives via an RS232 port. The controller is the master and hub of a star-configured system. The on-chip asynchronous serial interface of the microcontroller is multiplexed to four RJ-12 phone jack ports on the controller. TD (Transmit Data), RD (Receive Data), plus the control signal RTS (Request To Send) are implemented in the controller and satellite drives. The controller can broadcast system commands (for example, "go" and "stop") to all the drives for synchronization. The drives can request to be heard by the hub with RTS hand-shaking. A baud rate of 19200 is used.

The drives have an on/off switch and a seven-segment display. The seven segment display indicates, when lit, power and numerically indicates the port from which its plug into the controller. This RJ-12 port supplies power to, and RS-232 communication with, the controller. The drives also have a DB-9 connector for remote start/stop input, and two contact closure outputs. The pump systems are supplied with two L/S Easy Load II pump heads. No operator controls other than the on/off switch and contact closure switch are provided. The drives are driven by permanent magnet DC brush motors using optical tachometer feedback for accurate speed control. The unit is dual (115/230 VAC) voltage. 115V line cord is supplied.

DRIVE BOARD

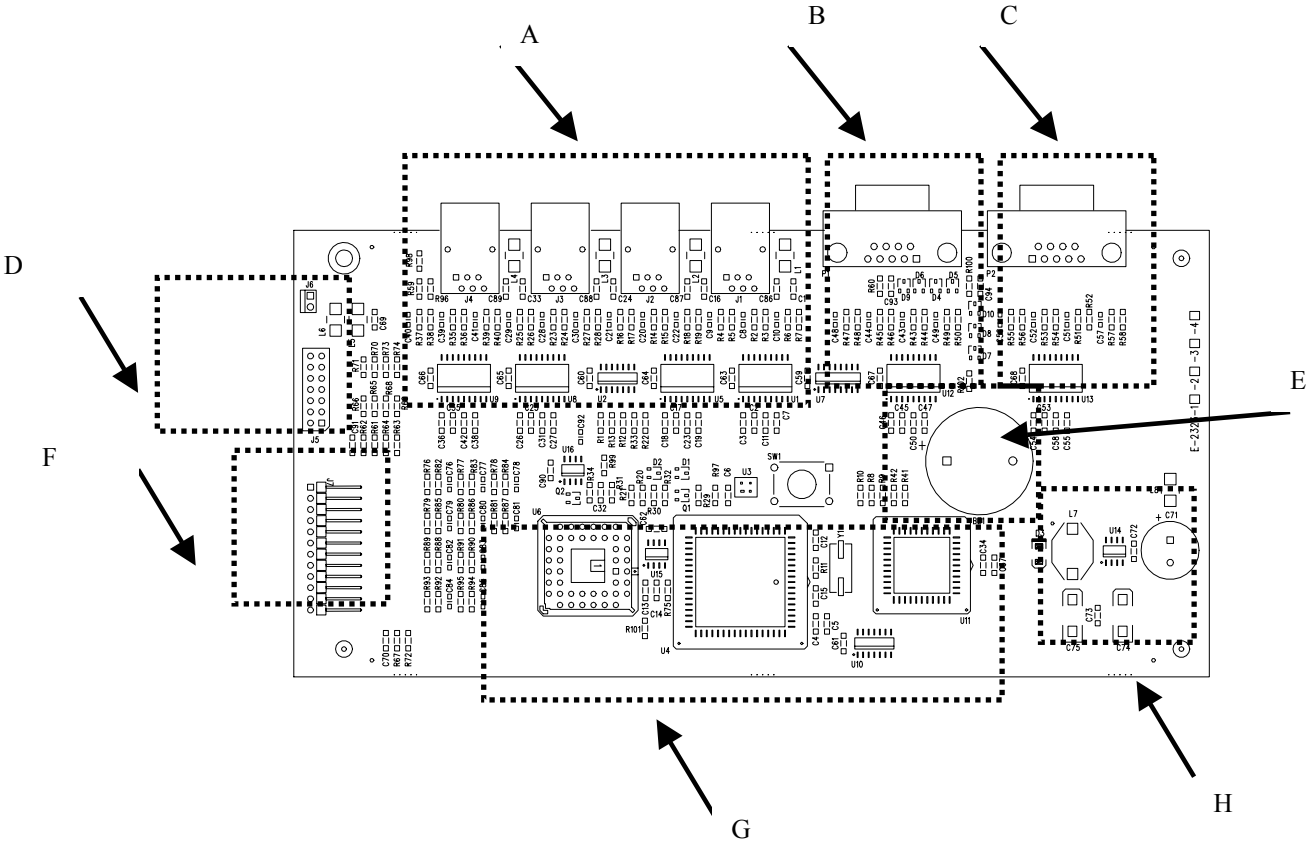
A. Input and Bus Voltage
B. PWM Motor Control Bridge
C. Dynamic Break Resistors
D. I/O and Earth Grounded Power Supply
E. 5V Switching Power Supply
F. Microprocessor and Encode/Decode Circuitry

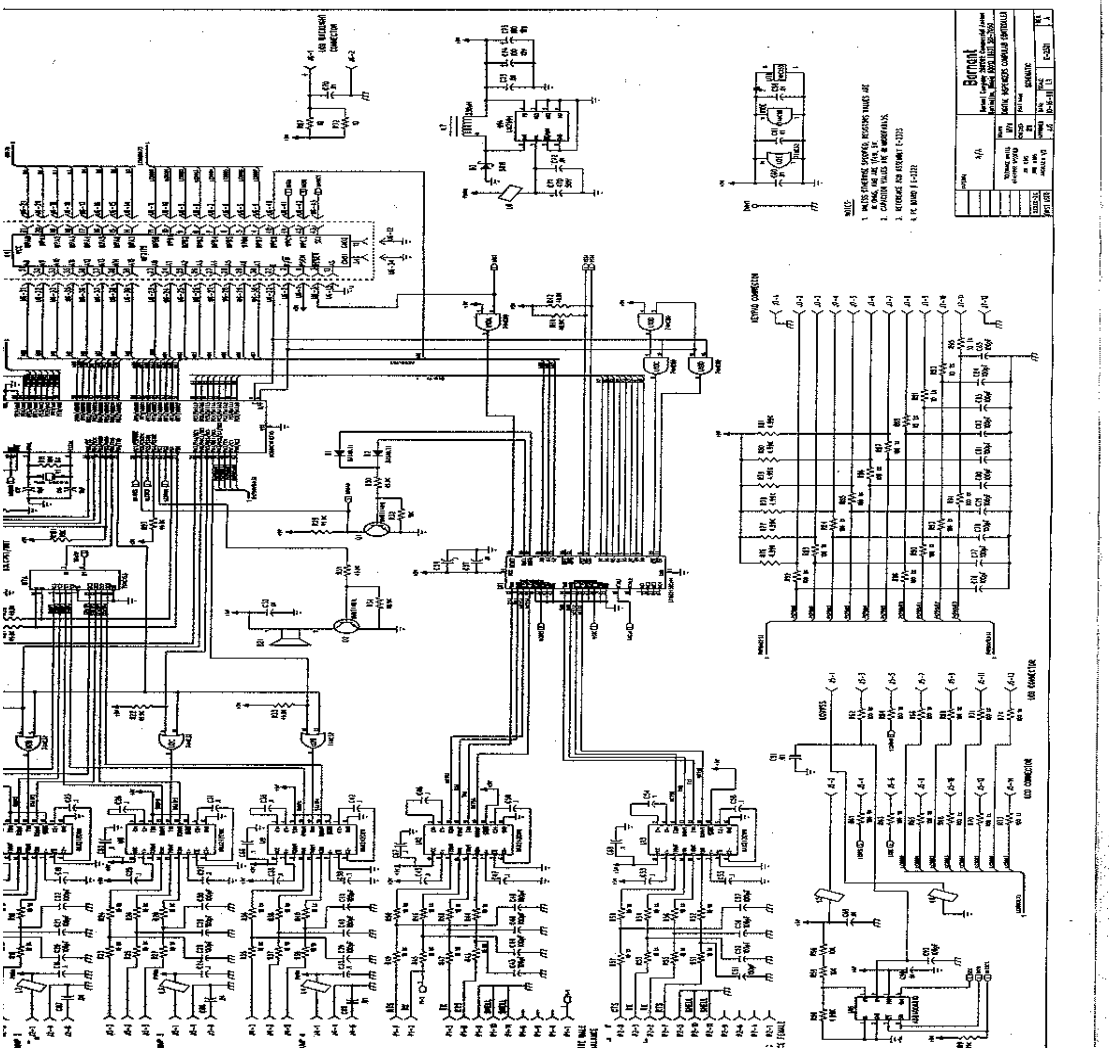




CONTROLLER BOARD

A. RS-232 Motor Drive Interface
B. RS-232 Balance Interface
C. RS-232 Computer Interface
D. Display Interface and power
E. Buzzer
F. Keypad connector
G. Microprocessor, Memory, and DUART for computer & balance interface
H. 5V Switching Power Supply





TROUBLESHOOTING

Repairs on this unit are confined to the unit's drive and controller PC Board, and/or drive motor assembly.

Where possible, swap known good parts to localize and isolate the problem. The following is a list of possible problems and remedies:

VERIFY AC POWER IS OPERATIVE.

UNIT DOES NOT TURN ON; NO SEVEN SEGMENT DISPLAY:

1. fuse blown	-replace fuse
2. power cord not connected properly	-check & replace
3. A/C power switch failure	-replace switch assembly
4. unit connected to dead outlet	-verify supply is HOT

UNIT BLOWS FUSES:

1. wrong voltage selection	-check proper voltage switch position
2. motor drive failure	-check using known good motor
3. defective drive board	-return/replace drive board
4. wrong fuse installed	-check fuse type and rating

DRIVE UNIT DISPLAY "0"

1. RJ12 cable not connected properly	-check/replace cable
2. controller RJ12 port is defective	-try another pump #/ replace controller board

MOTOR WILL NOT RUN, DRIVE UNIT DISPLAYS A PUMP #:

1. defective keypad	-return/replace keypad
2 defective drive board	-return/replace drive board
3. defective encoder	-return/replace motor assembly

NO REMOTE OPERATION:

1. defective controller board	-return/replace controller board
2. external cable not connected properly	-check/replace cable

FOR ADDITIONAL INFORMATION REGARDING YOUR UNIT PLEASE REFER TO THE FOLLOWING: A-1299-0780 Operator's Manual

REPAIR PROCEDURES

DISPLAYED ERROR CODES

COMMUNICATIONS ERRORS

ERROR! ENTER CONTINUES
COMMUNICATION ERROR #?

? = 1,2,3...
1 = checksum error
2 = framing error
3 = overrun error
4 = invalid command
5 = invalid data
6 = incomplete command string
10 = no reply from pump drive
11 = reply command didn't match request command
12 = calculated checksum didn't match rx checksum

DRIVE ERRORS

1). ERROR! ENTER CONTINUES
DRIVE STOPPED BY TIMEOUT

1.) drive cable to controller disconnected/bad	-replace/reattach cable
2.) defective drive board	-replace drive board
3.) defective controller board	-replace controller board

2) ERROR! ENTER CONTINUES
NO ENCODER PULSES

1.) encoder cable disconnected/bad	-replace/reattach cable
2.) defective drive board	-replace drive board
3.) defective motor encoder assembly	-replace motor assembly

3) ERROR! ENTER CONTINUES
MOTOR OVER SPEED

1.) defective drive board	-replace drive board

4) ERROR! ENTER CONTINUES
MOTOR CONTROL FAULT

	1.) Voltage selection switch set to improper voltage	-Check voltage selection switch for proper voltage.
5)	ERROR! ENTER CONTINUES MOTOR OVER CURRENT LIMIT	
	1.) Current limit is being exceeded.	-Check pump and/or motor drive system for binding. Check with a known good motor.
6)	ERROR! ENTER CONTINUES BUS VOLTAGE LIMIT	
	1.) Voltage limit is being exceeded.	-Check AC supply voltage.
7)	ERROR! ENTER CONTINUES CANNOT COMMUNICATE WITH BALANCE	
	1.) Wrong balance	-use approved balances
	2.) Port isn't working	-replace controller board
	3.) Balance isn't setup and wired correctly.	-check balance owners manual
	4.) External cable not connected properly.	-check/replace cable
8)	ERROR! ENTER CONTINUES BAD EEPROM WRITE, DATA NOT SAVE	
	1.) The controller couldn't write to the EEPROM.	-replace controller board
9)	ERROR! ENTER CONTINUES UNKOWN ERROR CODE	
	An error unknown to the controller has occurred.	-return unit

DANGER: Never remove the cover from the pump drive when power is present. AC and DC power in the pump drive can cause serious injury or death. Ensure that the pump drive is disconnected from the power source before removing the cover for maintenance. Allow ten minutes for the capacitors in the power supply to discharge before proceeding.

TO DISASSEMBLE DRIVE UNIT, PROCEED AS FOLLOWS:

A) Disconnect AC power.
B) Remove and retain the four screws from each side of the pump drive cover.
C) Remove the cover by sliding it straight up.

TO REASSEMBLE DRIVE UNIT, PROCEED AS FOLLOWS:

A) Slide on cover.
B) Install the four pan head screws on each side of the unit's cover.

TO REMOVE PCB STACK ASSEMBLY:

A) Remove fuse.
B) Remove the two pan head screws on the I/O panel at the rear of the chassis.
C) Remove the four screws from the lower printed circuit board.
D) Remove PCB Stack Assembly.
E) To remove PCB slide it forward and lift up.
F) Remove all cables and wires from PCB.

TO REPLACE PCB STACK ASSEMBLY:

A) Follow the steps outlined in "DISASSEMBLE DRIVE UNIT".
B) Replace PCB Stack assembly.
C) Note wiring of chassis as follows:
    1) WHITE of AC power switch to: J6
    2) BLACK of AC power switch to: J5
    3) RED of drive motor to: M1
    4) BLACK of drive motor to: M2
    5) GREEN/YELLOW of chassis ground to: J4
    6) Ribbon cable from Display PCB J1
    7) Cable from Motor Encoder J2
D) Follow the steps outlined in "ASSEMBLE DRIVE UNIT".

TO REMOVE SEVEN SEGMENT DISPLAY PCB:

A) Follow the steps outlined in "DISASSEMBLE DRIVE UNIT".
B) Remove the two nuts/washers holding the PCB to the chassis.
C) Remove ribbon cable.

TO REPLACE SEVEN SEGMENT DISPLAY PCB:

A) Follow the steps outlined in "DISASSEMBLE DRIVE UNIT".
B) Replace cables.
   1) Cable from PCB Stack assembly J1.
C) Secure Display PCB with two nuts/washers.
D) Follow the steps outlined in "ASSEMBLE DRIVE UNIT".

TO REMOVE BELT:

A). Follow the steps outlined in "DISASSEMBLE DRIVE UNIT".
B). Refer to Figure 7 and loosen, but do not remove, the two nuts that secure the motor to the top of the motor mounting brackets.

NOTE: Be careful when working near the fan end of the motor. The fan blades are sharp.

C) Pivot the motor toward the pump, and remove the belt from around the motor pulley.
D) Remove the belt from around the pump pulley.

TO REPLACE BELT:

A). Install the replacement belt around the pump pulley and around the motor pulley.
B). Pivot the motor so the belt is taut, and secure the motor in position by tightening the loosened nuts, loosened just enough to hold the motor.
C). Test belt tension by pressing on the belt midway between the pulley. The belt should flex approximately 1/8 in. (3 mm).
D). If belt tension is correct, tighten the nuts securely. If tension is not correct, loosen the nuts and repeat.
E). Follow the steps outlined in "ASSEMBLE DRIVE UNIT".

TO REPLACE BELT:

NOTE: Inspect the belt to see if it is broken or has missing teeth. If it is broken or worn, it needs to be replaced.

A) Refer to Figure 7 and loosen, but do not remove, the two nuts that secure the motor to the top of the motor mounting brackets.

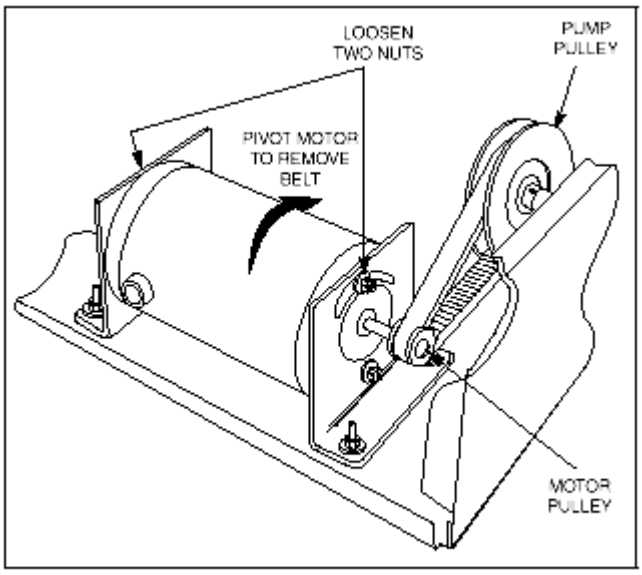


Figure 7. Replacing the Belt

Brush Replacement

Exact motor brush and commutator life will depend on duty cycle and motor operating speed. Inspect the brushes every six months or after 2000 hours of operation, whichever occurs first. Replace brushes if they are less than 0.30 in (7.6 mm) long. Inspect the commutator when the brushes are replaced, and clean if necessary.

DANGER: Never remove the cover from the pump drive when power is present. AC and DC power in the pump drive can cause serious injury or death. Ensure that the pump drive is disconnected from the power source before removing the cover for maintenance. Allow ten minutes for the capacitors in the power supply to discharge before proceeding.

A) Refer to Belt Replacement, remove the cover, and remove the belt from the pulley on the drive motor.
B) Pivot the motor away from the pump to gain access to the brush on the pump side of the motor.
C) Refer to Figure 8 and remove the brush caps.
D) Rotate each brush retainer so it lines up with the groove in the brush holder. Remove the brushes.
E) Measure the length of the brushes. If either brush is less than 0.30 in (7.6 mm) long, they both need to be replaced. Always replace them in pairs.

CAUTION: Excessive commutator wear or "bridging" between commutator segments can cause excessive current through the controller circuit and damage to the dispenser.

F) Inspect the commutator for wear and dirt. If the commutator segments are worn, replace the motor. If there are dark tracks where the brushes contact the commutator, clean with isopropyl alcohol.
G) Install the brushes into the brush holders and rotate the retainer to secure the brushes. Reinstall the brush caps.
H) When the motor has been reassembled, refer to Belt Replacement to reassemble the pump drive.

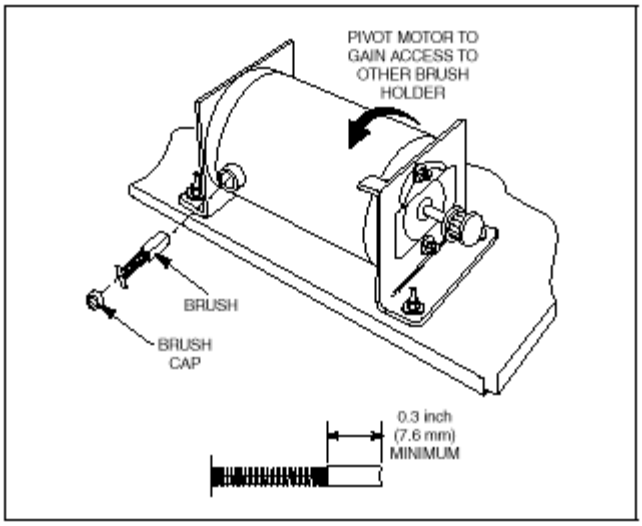


Figure 8. Inspecting and Replacing Brushes

TO DISASSEMBLE CONTROLLER UNIT, PROCEED AS FOLLOWS:

A) Disconnect AC power.
B) Remove and retain the four screws from the under side of the controller.
C) Remove the cover by sliding it straight up.

TO REMOVE DISPLAY PCB:

A) Follow the steps outlined in "DISASSEMBLE CONTROLLER UNIT".
B) Remove the four screws holding the PCB to the cover.
C) Remove cables.

TO REPLACE DISPLAY PCB:

A) Follow the steps outlined in "DISASSEMBLE CONTROLLER UNIT".
B) Replace the cable.
    1) Cable from PCB J5.
    2) Cable to PCB J6.
C) Secure Display PCB with four screws.
D) Follow the steps outlined in "ASSEMBLE CONTROLLER UNIT".

TO REMOVE KEYPAD:

A) Follow the steps outlined in "DISASSEMBLE CONTROLLER UNIT".
B) Remove cable from PCB J7.
C) Peel keypad from enclosure.
D) Affix new keypad to enclosure.

TO REMOVE PCB ASSEMBLY:

A) Remove the four screws from the printed circuit board.
B) Remove PCB Assembly.
C) Remove all cables and wires from PCB.

TO REPLACE PCB ASSEMBLY:

A) Follow the steps outlined in "DISASSEMBLE CONTROLLER UNIT".
B) Replace PCB assembly.
C) Note wiring of chassis as follows:
    1) RED and BLACK of Display PCB to: J6
    2) Ribbon cable of Display PCB to J5
    3) Cable of keypad to J7
D) Follow the steps outlined in "ASSEMBLE CONTROLLER UNIT".

REPLACEMENT PARTS LISTING

The following is a list of stockable main control PCB assemblies and their reference schematic diagrams for all indicated models:

MODELS

MODEL #	PCB #	REFERENCE SCHEMATIC
77310-00	E-2429-0003 E-2323-0001	E-2306 E-2321
77310-50	E-2429-0003 E-2323-0001	E-2306 E-2321
77340-00	E-2429-0003 E-2323-0001	E-2306 E-2321
77340-50	E-2429-0003 E-2323-0001	E-2306 E-2321
77310-02	E-2323-0001	E-2321
77310-01	E-2429-0003	E-2306

OTHER REPLACEABLE PARTS

Description	Part Number

Line cord 115V	B-3115
Line cord 230V	B-2938
AC Receptacle	B-4016
3-1/2 ft (1.1 m) RJ-12 cable	77095-02
Seven Segment Display Assembly	B-3889-CR
Keypad (Controller)	E-2534
Bearing Block Assembly	D-3115-CR
ON/OFF Switch	B-1084-0121
Belt	A-1341-0006
Small Belt Pulley	A-3166
Large Belt Pulley	B-2317
Motor Assembly	D-3106-0001
Motor brushes (2)	B-1238-0056
Fuse	B-1115-0043
Rubber feet (each)	A-1390-0004

CHECK-OUT PROCEDURE

0.00 Test equipment required:

0.01 Hand-Tach
0.02 Line leakage tester
0.03 Hi-pot tester
0.04 DB9 Communication Jumper cable
0.05 RJ12 Cable
0.06 Dispensing Wand (77310-05) or Foot switch (07595-40)
0.06 Voltmeter
0.08 Test Unit:
77310-02 Only: 77310-01 Test Drive
77310-01 Only: 77310-02 Test Controller

2.00 Performance:

CAUTION:

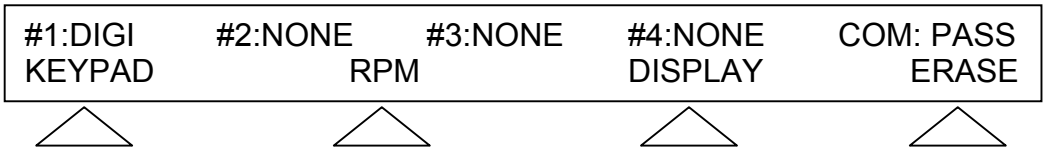
HIGH VOLTAGE IS PRESENT ON CONNECTORS AND PCB!

A. OPERATION

1. a. Switch the voltage selector switch to the proper voltage and plug in the drive.
   b. Plug the RJ-12 cable into the rear of the controller (77310-02) labeled Pump 1 (2,3,4) and the other end into the rear of the drive (77310-01).
   c. Plug a jumper cable into the Balance (DB9) to the PC (DB9) ports of the controller (77310-02) linking them together.

B.

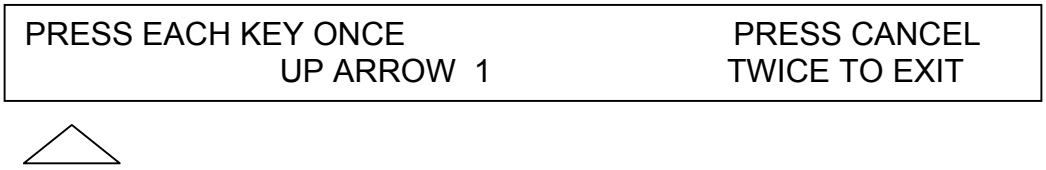
While holding the upper left arrow key on the controller switch the main power on one of the connected drives. Release the arrow key and turn on any remaining drives. Verify that the display number displays “0” for 3 seconds then “8” for 3 seconds, then the drive should display the appropriate pump number. The controller display should display the appropriate drive type **DIGI** . For Example, if there was only 1 pump (77310-01 plugged into the controller “Pump **#1** location”, the display on the controller should display the following:



CONTROLLER (Drive Only: Proceed to Step 7)

2. 77310-02 only: If only one drive is being used, leave the drive on and remove RJ12 cable from the Pump1 location and repeat on RJ12 ports Pump 2, Pump 3, and Pump 4. Verify the drive's seven-segment display shows “8” then the correct number for each RJ12 pump port and that the controller reports the proper drive. COM should have a “PASS” indicating the Balance and PC COM ports are operating correctly. If there is a failure “FAIL” will be displayed.

3. 77310-02 only: Activate the **KEYPAD** test by pressing the arrow just below “KEYPAD”. Then press each key and verify the key was pressed by observing the controllers display. Press the cancel/stop button twice to exit keypad test.



4. 77310-02 only: Activate the **DISPLAY** test by pressing the arrow just below “DISPLAY”. All segments should fill in.

5. 77310-02 only: Activate the **ERASE** by pressing the arrow just below “ERASE”. This will erase any programs in memory.

DRIVE

6. 77310-01 only: Activate the **RPM** test by pressing the arrow just below “RPM”. The controller display should show 600 for each of the drives connected. Attach a dispensing wand to the drive unit DB9 port. Then activate the auxiliary switch on the dispensing wand and the drive should start. If a drive isn’t connected or there is a problem with the drive an error code will be displayed.

CODES:

NONE = No response from drive (Drive not connected or not communicating)

ER5 = Timeout
ER6 = No encoder pulses
ER7 = Excessive encoder pulses
ER8 = Incorrect motor response
ER9 = Motor current error
ERA = Bus voltage error

7. Using a hand-tach verify that the connected drives are running at 600 +/- 1 RPM. Release the dispense wand switch and motor should stop.

8. Enter exits the RPM mode. (Drive Only: Proceed to Step 12)

9. Turn **OFF** drive/drives.

10. Turn drive/drives **ON** and verify that there are no error messages.

11. Turn drive/drives **OFF** and unplug and disconnect controller.

3.0 Safety:

A. HI-POT TEST
With a sensitivity setting of 5 mA, apply 1900 VDC (77310-01 only), Hot lead Black to Ground, for 60 sec.

B. LINE LEAKAGE TEST (.5mA MAX.)

C. GROUND RESISTANCE TEST (.5 ohms MAX.)

SPECIFICATIONS

Output:	
Speed:	6 to 600 rpm
Maximum torque output:	12.9 kg•cm (180 oz-in)
Speed regulation (all conditions):	±0.3% of full speed
Remote contact closures:	28 VDC, 1 A 28 VAC, 1 A
Dispense volume:	0.1 mL to 8000 L
Dilute volume:	Sample: 0.1 mL to 100.0 mL Delivery: 0.1 mL to 8000 L
Input:	
Supply voltage limits:	
115 VAC	90 VAC to 130 VAC, 48 Hz to 63 Hz
230 VAC	180 VAC to 260 VAC, 48 Hz to 63 Hz
Nominal current:	
115 VAC	1.7 A
230 VAC	0.8 A
Installation category:	Category II per IEC 664 (Local level — appliances, portable equipment, etc.)
Remote input:	START/STOP +5 VDC, 5 mA
Display:	40-character x 2-line backlit LCD
Construction:	
Control console dimensions:	22.6 cm (8.9 in) wide 16.5 cm (6.5 in) deep 2.3 cm (0.9 in) front, 6.9 cm (2.7 in) back in height
Control console weight:	1.4 kg (3.0 lbs)
Pump drive dimensions:	23.4 cm (9.2 in) wide 32.3 cm (12.7 in) deep 18.8 cm (7.4 in) high
Pump drive weight:	9.1 kg (20 lbs)
Two EASY-LOAD II pump heads:	14.6 cm (5.75 in) deep
Environment:	
Operating temperature:	0° to 40°C (32° to 104°F)
Storage temperature:	–25° to 65°C (–13° to 149°F)
Humidity (non-condensing):	10% to 90%
Altitude:	Less than 2000 m (6500 ft)
Pollution degree:	Pollution degree 2 per IEC 664 (Indoor use — lab, office)
Chemical resistance:	All materials withstand standard cleaning solvents. Materials used in the construction are: a polyester label, a combined aluminum motor and paint-loc steel controller enclosure, and an epoxy-based, non-chip paint finish.
Environmental protection:	Withstands general spills and light sprays (IEC-529 IP22).
Compliance:	Meets UL 508; CSA C22.2 No. 14-M91; and

CE	EN61010-1/A2: 1995 (Safety), EN50081-1: 1992 (EMC Emissions), and EN50082-1: 1992 (EMC Immunity)

ACCESSORIES

Description	Part Number
10 ft (3 m) RJ-12 cable	77095-03
15 ft (4.6 m) RJ-12 cable	77095-04
Footswitch	07595-40
Dispenser handle for 1 to 4 pumps	77310-05
Dispenser handle holder, small V-base	08024-55
Dispenser handle holder, large V-base	08024-56
PTFE tubing weights	77310-03
Glass dispensing tip w/Luer lock for 3/16 in. and 1/4 in. ID tubing	77310-04
EASY-LOAD II pump head for high performance precision tubing	77200-62
EASY-LOAD II pump head for precision tubing	77200-60
Mounting hardware (2) pump heads	77200-02
"Y" connectors for use with L/S tubing size:	
L/S ® 13, L/S ® 14 10/pk (KYNAR ®)	30703-90
L/S ® 16 20/pk (Polypropylene)	06295-10
L/S ® 15, L/S ® 25 20/pk (Polypropylene)	06295-20
L/S ® 17, L/S ® 24 20/pk (Polypropylene)	06295-30
L/S ® 18, L/S ® 35, L/S ® 36 20/pk (Polypropylene)	06295-40
Stands	
Frame rods (small)	08024-22
Frame rods (large)	08024-23
Equipment clamp (small)	08024-40
Equipment clamp (large)	08024-41
Frame clamp	08024-28
V-Base (small)	08024-55
V-Base (large)	08024-56