

# **Operating Manual for Column Selector**

# Table of Contents

|  |    |
|--|----|
| <b>I. INTRODUCTION</b>                       |    |
| A. Description                               | 3  |
| B. Customer Service                          | 3  |
| <b>II. UNPACKING</b>                         |    |
| A. General                                   | 3  |
| B. Supplied with Column Selector             | 4  |
| C. Terminology Appendix                      | 4  |
| <b>III. IMPORTANT OPERATING NOTICES</b>      |    |
| A. Cautions                                  | 4  |
| B. Warnings                                  | 5  |
| <b>IV. SPECIFICATIONS</b>                    |    |
| A. Unit                                      | 5  |
| B. Valve                                     | 5  |
| C. Electrical Connections                    | 6  |
| D. Control and Communications                | 6  |
| <b>V. INSTALLATION</b>                       |    |
| A. General Description                       | 7  |
| B. Electrical and Communications Connections | 8  |
| C. Installing Columns onto Column Selector   | 11 |
| <b>VI. OPERATION</b>                         |    |
| A. Front Panel                               | 13 |
| B. Manual Operation                          | 13 |
| C. Self Test                                 | 14 |
| D. Remote or Automatic Operation             | 15 |
| E. Serial Communication                      | 16 |
| F. Maintenance and Troubleshooting           | 18 |
| G. Troubleshooting                           | 20 |
| H. Appendix A - Electronic Definitions       | 24 |

## I. INTRODUCTION

### A. Description

1. The Column Selector is available in both a 3-column and a 6-column Selector configuration. The Column Selector is used in-line with an injection and detection system, and is designed to select up to 3 or up to 6 columns depending on the model. The instruments are available in PEEK (polyetheretherketone) and stainless steel versions.

### B. Customer Service

1. If you need assistance in sales, technical information, applications or repair please contact your vendor.

## II. UNPACKING

### A. General

1. The Column Selector is shipped assembled and ready to use. The Column Selector and the accessories are shipped together.
2. After unpacking, inspect for damage and/or shortage.
3. Keep the original packaging in case the unit must be returned.

## B. Supplied With Column Selector

1. The following accessories are shipped with the unit:
  - a) Fitting sets for all the ports
  - b) Hex Key(s)
  - c) Jumper Wire(s)
  - d) 3.7 meters (12 feet) of 1/16-inch O.D. tubing.
  - e) 1/4-5/16" open end wrench
  - f) Universal Power Supply
  - g) Power Line Cord
  - h) Interface Cable
  - i) Operating Manual

## C. Terminology Appendix

1. All terms appearing in *italics* can be found in Appendix A: "Electronic Definitions in Non-Electronic Terms."

## III. IMPORTANT OPERATING NOTICES



### A. Cautions

1. For connections from your instrument to the Column Selector use only a *contact closure* or a *TTL switch*. Do not supply a voltage and current from your instrument to the Column Selector or it will damage the Column Selector circuitry.
2. Rinse the valve after using buffer solutions to prevent the formation of crystals that can scratch the sealing surfaces.
3. Use only the supplied Power Supply for connection to the Column Selector.
4. Operate within temperature range, 4° - 40° C only.
5. When using the PEEK valve use only plastic ferrules in the stator ports. Metal ferrules can cause irreparable damage to the plastic stator.

## **B. Warnings**



1. Do not submerge the Column Selector in liquids.
2. Confirm there is adequate ground between your instrument and the Column Selector. This is especially important for electrospray mass spectroscopy.
3. Plug Power Supply into Column Selector first, then plug Power Supply into AC power source. When disconnecting, unplug at AC power source first.

## **IV. SPECIFICATIONS**

### **A. Unit:**

1. Temperature range: 4° - 40° C, non-condensing.
2. Weight: 7.3 kg (16 lb.).
3. CE Mark represents:
  - a) EMC certification (EN 50082-1) and
  - b) EMI certification (EN 50081-1).

### **B. Valve:**

1. Maximum pressure: 35 MPa, or 345 bar, or 5000 psi
2. Wetted surfaces:
  - a) PEEK valves: PEEK.
  - b) Stainless Steel valves: Stainless Steel and PEEK.
3. Flow passages: 0.38 mm (0.015") and 0.61 mm (0.024").
4. Ports: accept 10-32 male threaded fittings.
5. Not recommended for use with concentrated HNO<sub>3</sub> or concentrated H<sub>2</sub>SO<sub>4</sub>.

### **C. Electrical Connections:**

1. See Figure 3 for an illustration of the electrical connections.
2. Barrel connector for power input to the Column Selector (attached to power supply).
3. *Universal power supply* input is 100-240VAC, 50-60 Hz, output is 24VDC, 1.7A.
4. *Input/output* from the Column Selector is through a 25 pin d-subminiature connector.

### **D. Control and Communication**

1. *Line Control*
  - a) *Input:* 4 Line BCD. (TTL, contact closure)
2. *Serial Communication* (bi-directional, including position number and error codes)
  - a) RS-232 is available.

## V. INSTALLATION

### A. General Description

1. Figure 1 shows a front view of the Column Selector with the Cover (1) mounted.

- The Cover (1) is magnetically secured and is simply pulled off to give access to the columns.
- Positioned on either side of the main unit are five holes (2) designed to allow tubing at the valve IN/OUT ports to pass through while the cover remains on. The multiple positions of the holes, allow the user to minimize tubing connectors to the injector and the detector.
- The Numeric Display (3) is visible with or without the cover on the unit. The number of the column that is in-line is displayed here.
- The Local-Remote button (4) is located in this area. The button controls manual or remote column selection.

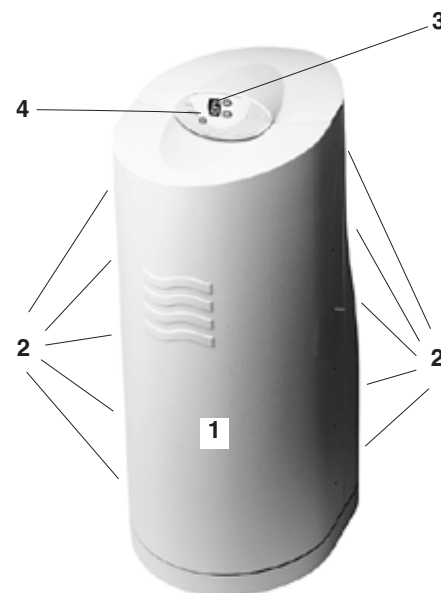


Fig. 1. Column Selector with cover.

2. Figure 2 shows a front view of the 6-column selector with the cover removed.

- The valve (1) is located to provide easy access to the liquid-end should servicing be required. The unit is supplied with fittings and tubing (2).
- The column clips (3) are spring loaded and hold columns from 3.2-25.4 mm (1/8-1") OD firmly in place. The Column Selector can accommodate both long and short columns, 5-35 cm (2-13.8").
- A built-in drip tray (4) safely contains any solvent spills. The drain tube connected to the hole drains solvents to waste. The tube can be adjusted to terminate to waste in any direction.

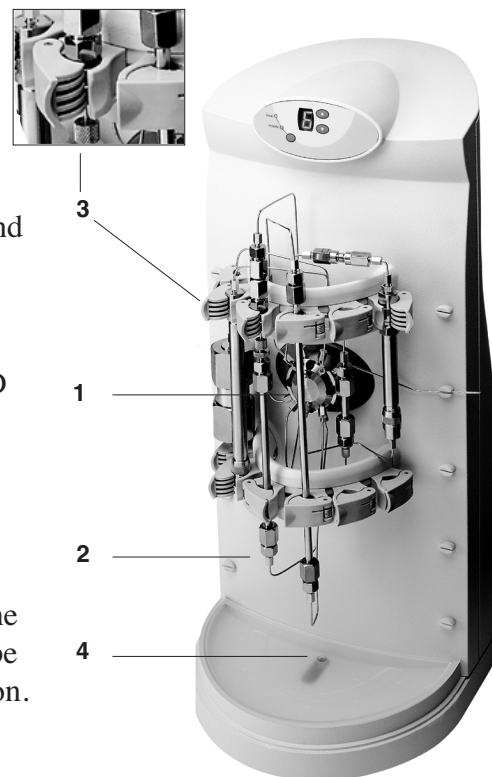


Fig. 2. Column Selector with cover removed.

## B. Electrical and Communications Connections to Column Selector

1. All electrical and communications connections to the Column Selector are made in the rear of the unit (see Fig. 3):
2. Electrical Connections:
  - a) Plug the Power Supply (1) male-barrel terminal (2) into the Column Selector female port (3).
  - b) Plug the IEC 320 connector (4) of the Power Line Cord into the Power Supply box (1).
  - c) Plug the opposite end of the Power Line Cord into a properly grounded power source (5). The *Universal Power Supply* can be operated from *inputs* of 100-240 VAC, 50-60 Hz. The *output* is 24VDC, 1.7A.

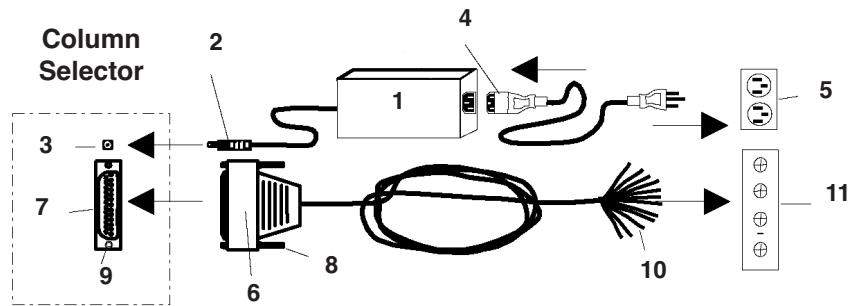


Fig. 3. Electrical and communications connections to Column Selector.

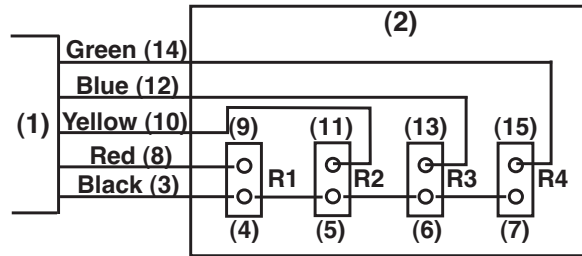
3. Remote Communication Cable Connections:
  - a) There are two ways to accomplish remote control of the Column Selector:
    - (1) *Line control* using the interface cable with *contact closures* or *TTL* relays.
    - (2) *Serial communication* using an RS-232 cable and software.



- b) For *line control* use the supplied 25-pin *Interface Cable*. The Cable is plugged into the 25-pin terminal on the Column Selector. The loose wires on the opposite end of the Cable are wired to an appropriate *output* device on your instrument, such as an *External Event Relay* or a *Time Function Switch*. The *output* must be either *contact closure* or *TTL* in order to connect the Column Selector to your instrument (see **Caution - III. A. 1.**). See Figure 3.
  - (1) Plug the *Interface Cable* connector (6) into the 25-pin terminal (7) located on the rear of the Column Selector. Tighten the connector screws (8) into their mating terminal ports (9).
  - (2) Connect the color coded *Interface Cable* wires (10) to the HPLC controller *contact closures* or *TTL* relay (11), as described in more detail in the next section “Input Line Control.”
- c) For *serial communication* the *interface cable* is replaced with a RS-232 cable. The serial cable is connected between the 25-pin terminal on the Column Selector and the appropriate *output* on your computer. See Figure 3.
  - (1) Plug the RS-232 cable connector (6) into the 25-pin terminal (7) located on the rear of the Column Selector. Tighten the connector screws (8) into their mating terminal ports (9).
  - (2) Connect the opposite end of the RS-232 cable (not shown) into the HPLC controller computer port, as described in more detail in **Section VI.e.**

4. *Input Line Control* (controlling with a *contact closure* or *TTL* relay).

- a) 4-line *BCD* control. The control instrument used must have four (4) *TTL* or *contact closure outputs*. This method of control allows direct access to any chosen column position.
  - (1) 4-Line *BCD* Control (independent selection of any position):
    - (a) Four *event relays* required. The relays must be capable of simultaneous operation. The position of the valve is dictated by the *states* of the four *event relays*.
    - (b) Wiring the *interface cable* (1) to the HPLC (2) with 4-line *BCD* control (see Fig. 4):

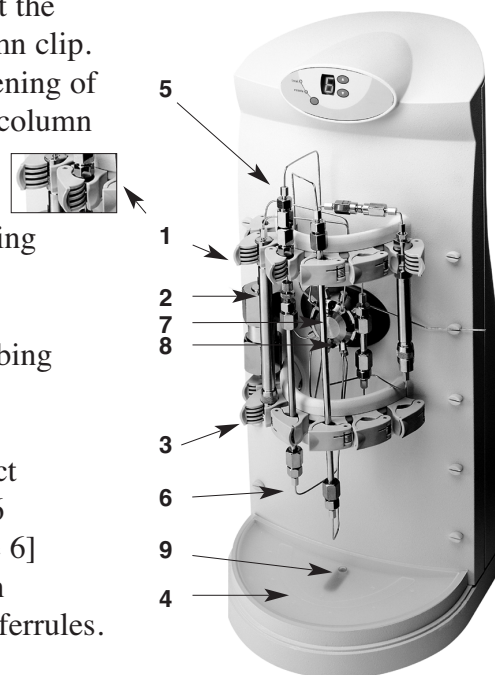


**Fig. 4. Four line control.**

- (i) Connect the black wire (3) to the *ground terminal* (4) of the HPLC event relay R1.
  - (ii) Connect the jumper wires (supplied) from the *ground terminal* (4) of the HPLC event relay R1 to the *ground terminals* (5, 6, and 7) of the HPLC event relays R2, R3, and R4.
  - (iii) Connect the red wire (8) to the control line *terminal* (9) of the HPLC event relay R1.
  - (iv) Connect the yellow wire (10) to the control line *terminal* (11) of the HPLC event relay R2.
  - (v) Connect the blue wire (12) to the control line *terminal* (13) of the HPLC event relay R3.
  - (vi) Connect the green wire (14) to the control line *terminal* (15) of the HPLC event relay R4.
- (c) See the Operation section (VI.) for typical commands and examples of programming with this type of control.

C. Installing Columns onto the Column Selector:

1. Figure 5 shows the general locations for installing columns onto the Column Selector.
2. Open the upper column clip (1), insert the column (2), and close the upper column clip. Slide the column upward to allow opening of the lower column clip (3). Insert the column into and close the lower column clip.
3. Install the inlet nuts, ferrules, and tubing (5).
4. Install the outlet nuts, ferrules, and tubing (6).
5. Connect the column inlet to the correct valve inlet (7) position (numbered 1-6 in the 6-column configuration [Figure 6] and 1-3 in the 3-column configuration [Figure 7]). Install the inlet nuts and ferrules.
6. Connect the column outlet to the correct valve outlet (8) position (numbered 1'-3' in the 3-column configuration and 1'-6' in the 6-column configuration). Install the outlet nuts and ferrules.
7. The correct inlet and outlet plumbing is shown schematically in the inside of the Column Selector Cover. It may be convenient to turn the Cover around and place it next to the Column Selector during plumbing. Connections are also summarized in the following table:

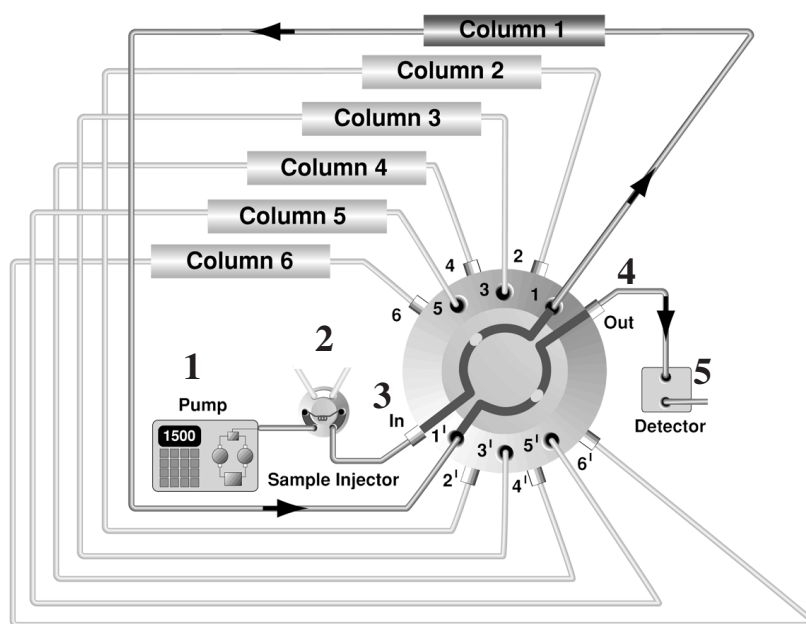


**Fig. 5. Installing columns on Column Selector.**

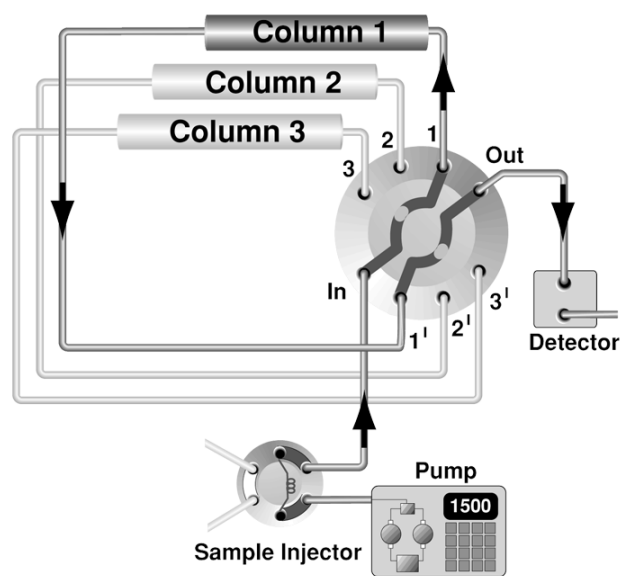
| Column Location in Clips                   | Left | 1  | 2  | 3  | 4  | 5  | 6  | Right |
|--|------|----|----|----|----|----|----|-------|
| Top of Valve - Column Inlet Connection     | Left | 6  | 5  | 4  | 3  | 2  | 1  | Right |
| Bottom of Valve - Column Outlet Connection | Left | 1' | 2' | 3' | 4' | 5' | 6' | Right |

8. The correct inlet and outlet plumbing is also shown schematically in Figure 6 (6-column configuration) and Figure 7 (3-column configuration).
  - (a) The pump (1) and sample injector (2 [usually an autosampler]) are hooked up to the common valve inlet (3), through the columns (labeled 1-3 or 1-6) to the common valve outlet (4) to the detector (5).

9. One pair of ports (e.g., 6 and 6') can be dedicated for a flush-out line. In place of a column, a piece of tubing is connected between the two ports. A flush-out line is especially useful when the various columns and solvents are not compatible.
10. Solvent Spill Containment and Waste Tubing Routing.
  - (a) The plastic solvent drip tray located below the valve (4 in Figure 5) is designed to funnel any spilled liquids through the tray exit hole (9 in Figure 5) to a waste container.
  - (b) The tray exit tubing should be routed into a waste container. Make sure there are no kinks in the tubing and that the end of the tube is secured to the waste container. Make sure that the Column Selector is located higher than the waste container to assure proper draining.



**Fig. 6. 6-Column plumbing schematic with TeleFLO® architecture.**



**Fig. 7. 3-Column plumbing schematic with TeleFLO® architecture.**

## VI. OPERATION

### A. Control Panel Overview

1. The Column Selector control panel is shown in Figure 8. Display and operations are:
  - a) Local-Remote button (1)
  - b) Remote indicator light (2)
  - c) Local indicator light (3)
  - d) Valve/column position [LED] (4)
  - e) Manual forward position selector button (5)
  - f) Manual reverse position selector button (6)

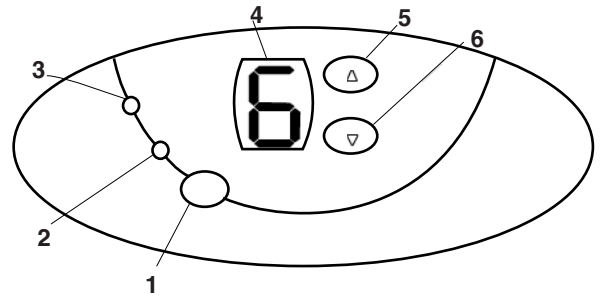


Fig. 8. Column Selector displays and manual selectors.

### B. Manual Operation

1. To operate the Column Selector manually, connect the Power Supply to the Column Selector as described in the Installation section (V.).
2. Pressing the Local-Remote button (1) selects either Local (manual) or Remote (automatic) operation.
  - a) The Column Selector must be in Local (manual) mode to use the manual (forward or backward) position selection buttons. Manual mode can be confirmed by observing that the Local indicator light (3) is illuminated.
  - b) The Column Selector must be in Remote (automatic) mode to use 4 line *BCD* or RS-232. Remote mode can be confirmed by observing that the Remote indicator light (2) is illuminated.

3. The LED display (4) indicates the active valve/column position.
4. Pressing the forward position selector button (5) moves the valve one position in the clockwise (or numerically higher) direction each time that the button is depressed.
  - a) If the valve is in the highest position (six for 6-Column Selector or three for 3-Column Selector) pressing the forward button will not move the valve to position #1. The reverse button must be used to relocate to position #1.
5. Pressing the reverse position selector button (5) moves the valve one position in the counterclockwise (or numerically lower) direction each time that the button is depressed.
  - a) If the valve is in the lowest position, pressing the reverse button will not move the valve to the highest valve position (Six for 6-Column Selector or three for 3-column selector). The forward button must be moved to relocate to higher positions.

### **C. Column Selector Self Test**

1. To confirm proper operation, the Column Selector can be put through a “self test.” This test is a very valuable diagnostic tool to help determine potential problems for remote and automatic operational control.
2. To perform a “self test,” put the Column Selector in Local mode and simultaneously press the two “arrow” buttons located near the numeric display for one second.
3. The Column Selector will move *slowly* to the number 1 (home) position then rapidly cycle through all available positions and *slowly* return to the number 1 position.
4. If an “EE” (ERROR) shows in the numeric display, refer to the Troubleshooting section (G).

## D. Remote or Automatic Operation

### 1. *Input Line Control* (controlling with a *contact closure* or *TTL* relay)

a) 4-line *BCD* control. The instrument must have four (4) *TTL* or *contact closure* outputs. This method of control allows direct access to any chosen column position.

- (1) Four *event relays* are required. The relays must be capable of simultaneous operation. The position of the valve is dictated by the *states* of the four *event relays*.
- (2) *BCD* outputs work using binary logic ( $2^0=1$ ,  $2^1=2$ ,  $2^2=4$ ,  $2^3=8$ ), therefore when activated the relays will produce the following outputs:

|                 | External Event or Relay # |   |   |   |
|-----------------|---------------------------|---|---|---|
|                 | 1                         | 2 | 3 | 4 |
| Number Produced | 1                         | 2 | 4 | 8 |

- (3) When numerous relays are turned on **SIMULTANEOUSLY** these numbers become additive, so they can be programmed, as follows:

| Desired Valve Position # | External Event or Relay # |        |        |        |
|--------------------------|---------------------------|--------|--------|--------|
|                          | 1                         | 2      | 3      | 4      |
| 1                        | Open                      | Closed | Closed | Closed |
| 2                        | Closed                    | Open   | Closed | Closed |
| 3                        | Open                      | Open   | Closed | Closed |
| 4                        | Closed                    | Closed | Open   | Closed |
| 5                        | Open                      | Closed | Open   | Closed |
| 6                        | Closed                    | Open   | Open   | Closed |

- (4) A 4-line *BCD* generic time programming example follows. (Note: the actual programming will vary depending on the manufacturer of the HPLC used):
- (5) Wiring the interface cable (1) to the HPLC (2) with 4-line *BCD* control is shown in Fig. 4.

**Program 1**

| Time    | Relay 1 | Relay 2 | Relay 3 | Relay 4 | Comments                |
|---------|---------|---------|---------|---------|-------------------------|
| Initial | Closed  | Open    | Open    | Closed  | Valve is in position #6 |
| 10      | Open    | Closed  | Closed  | Closed  | Moves to position #1    |
| 20      | Closed  | Open    | Closed  | Closed  | Moves to position #2    |
| 30      | Open    | Open    | Closed  | Closed  | Moves to position #3    |
| 40      | Closed  | Closed  | Open    | Closed  | Moves to position #4    |
| 50      | Open    | Closed  | Open    | Closed  | Moves to position #5    |
| 60      | Closed  | Open    | Open    | Closed  | Moves to position #6    |
| 70      | Open    | Open    | Closed  | Closed  | Moves to position #3    |
| 80      | Open    | Closed  | Closed  | Closed  | Moves to position #1    |
| 90      | Open    | Closed  | Open    | Closed  | Moves to position #5    |

**E. Serial Communication**

1. *Serial communication* (RS-232) allows random access positioning and feedback (position and error messages) through standard communication protocols.
2. A computer equipped with the proper interface (usually COM1 or COM2 or an additional communications board containing more communications ports) is required for serial bi-directional control and feedback.
3. Additionally, communications software is required to run a *serial communications* device.
4. RS-232 serial communication.
  - a) RS-232 is a standard 4-line communication protocol requiring no hardware handshaking. To control the Column Selector with RS-232 communication use a standard 25-pin female to female serial cable with a null modem as described in the Installation section (V.) (see Fig. 3).
  - b) Interface requirements are as follows:
    - (1) Terminal Emulation: VT100
    - (2) BAUD rate: 9600
    - (3) # Data Bits: 8
    - (4) # Stop Bits: 1
    - (5) Parity: None
    - (6) Hardware Handshaking: None
  - c) Using a standard terminal emulator (VT100), the Column Selector will return a menu, which indicates the current status and acceptable commands for control-



ling the valve. An example of the RS-232 menu is shown in Figure 9.

- d) Lines 1 and 2 in Figure 9 show the firmware version and the valve type. Line 3 indicates the valve position or an “EE” for error. Lines 4 through 8 describe the available commands for controlling the valve. Command descriptions follows:

| Valve Control Unit Ver. X |               |
|---------------------------|---------------|
| Valve Type:               | 6Ps 18dg 25:1 |
| Current Port:             | 1             |
| Port #:                   | 1-6           |
| Home:                     | H             |
| BIT:                      | T             |
| CW:                       | >             |
| CCW:                      | <             |
| Enter Selection:          |               |

**Fig. 9. Example RS-232 terminal communications protocol.**

- (1) Sending a number corresponding to any available position will rotate the valve to the designated position.
- (2) Sending “H” or “h” will command the valve to find the “home” position at a reduced speed (this is useful after an error has occurred).
- (3) Sending “T” or “t” will indicate a “self test.” This test cycles through all available positions to confirm proper operation.
- (4) Sending “>” or “.” will rotate the valve one position in the clockwise (CW) direction.
- (5) Sending “<” or “,” will rotate the valve one position in the counter-clockwise (CCW) direction.

## **F. Maintenance and Troubleshooting**

### **1. Electrical Maintenance**

- a) There is no maintenance required for electronic components.

- b) If an electrical problem is encountered, please consult the electrical installation and troubleshooting sections of the manual. If the problem persists contact your vendor for assistance.

## 2. Valve Maintenance

- a) With normal use the valve will give many thousands of actuations without trouble. The main cause of early failure, which is seen as valve leakage, is abrasive particles in the sample and/or mobile phase or crystallization of buffer solutions. Either can cause scratches on the rotor seal and stator face assembly.

- b) Valve Disassembly

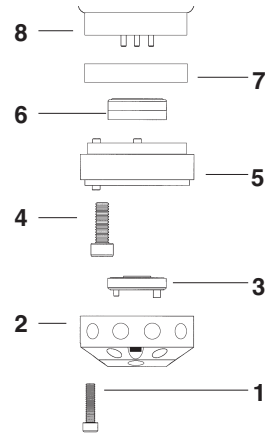
To disassemble the valve, refer to Figures 10 and 11 and proceed as follows:

- (1) With the Hex Key provided, remove the Stator Screws (1) [four in 6-column and five in 3-column version] from the Stator (2).
- (2) Remove the Stator and Stator Face Assembly (3) from the Stator Ring (5). The Stator Face Assembly usually remains on the Stator.
- (3) Using the Hex Key, remove three Stator Ring Screws (4) from the Stator Ring.
- (4) Remove the Stator Ring (5).
- (5) Remove the Rotor Seal (6) from the valve Body (8). The Rotor Seal is mounted on three pins, and can be pulled off. The Gap Ring (7) should stay in place on the Body (8).

c) Valve Reassembly.

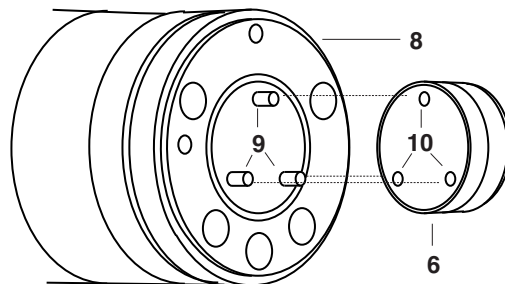
To reassemble the valve, refer to Figures 10 and 11 and proceed as follows:

- (1) Mount the new Rotor Seal (6) with the slots facing the Stator (2). The three pins (9) on the Shaft Assembly fit into the mating holes (10) in the Rotor Seal only one way. Replace the Gap Ring (7), if it was removed.



**Fig. 10. Exploded view of valve.**

- (2) Replace the Stator Ring (5) so the two short pins on the ring enter the mating holes in the Body (8).
- (3) Replace and tighten the three Stator Ring Screws (4). Tighten each an equal amount until the Screws are finger-tight, then turn another half turn.
- (4) Mount the new Stator Face Assembly (3) onto the Stator (2). On the 3-column Column Selectors the assembly is symmetrical and has only two pins and it can be mounted either of two ways. On the 6-column Column Selectors the assembly is not symmetrical. The two pins on the assembly have different diameters, and can only mount on the stator one way.
- (5) Replace the Stator (2) and Stator Face Assembly (3) on the valve so that the pin in the Stator Ring enters the mating hole in the Stator.
- (6) Replace the Stator Screws (1) [four in 6-column and five in 3-column version] into the Stator. Tighten each an equal amount until the screws are finger-tight, then turn another half turn.

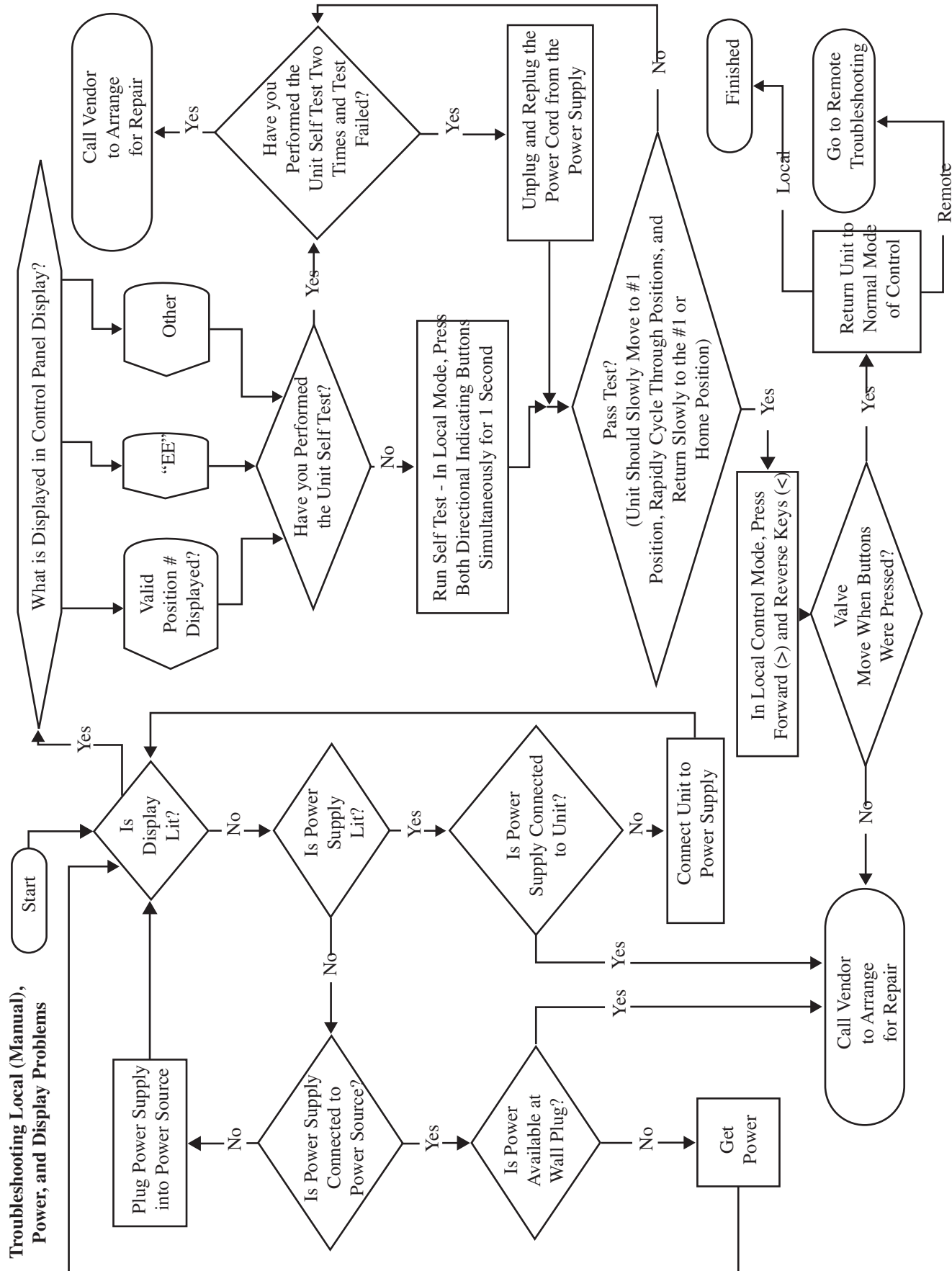


**Fig. 11. Mounting new rotor seal.**

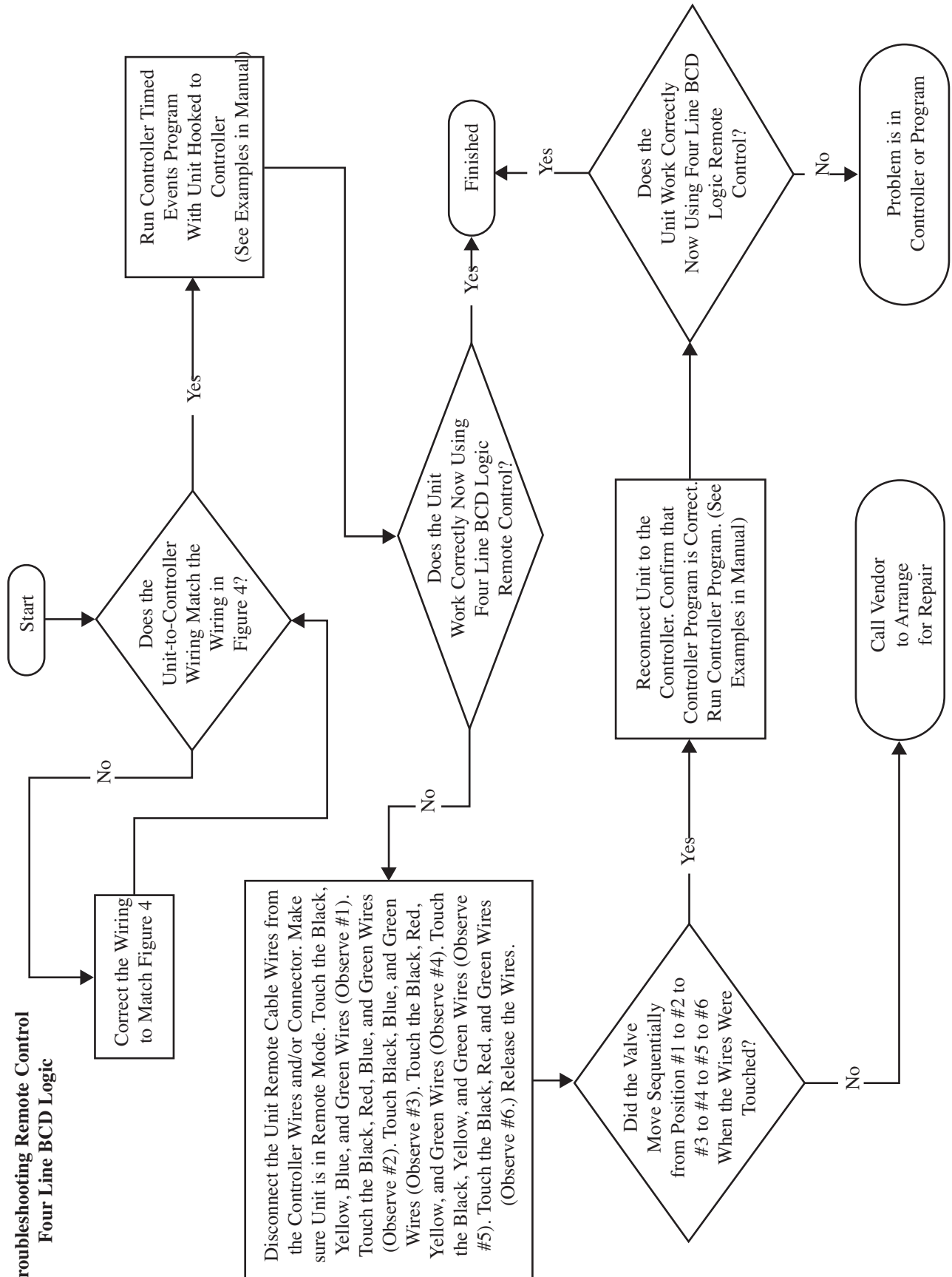
## G. Troubleshooting

| Symptom   | Cause   | Solution   |
|---|---|--|
| <b>1:</b> Valve leaks between the stator and stator ring or from a port.                                | <b>A:</b> The rotor seal and stator face assembly have been damaged by abrasive particles in the sample and/or mobile phase or crystallization of buffer solutions.                             | Replace the rotor seal and stator face assembly. Filter sample and mobile phase. Flush the valve frequently to prevent crystallization of buffer solutions.                |
|   | <b>B:</b> The pressure rating of the valve has been exceeded.   | Confirm that the pressure increase is not caused by a blockage in the flow path. If no blockage, lower the flow rate or change the column to decrease the pressure.        |
|   | <b>C:</b> The port is damaged and a nut and ferrule cannot seal correctly.  | Replace the stator. Consult vendor for part number.  |
| <b>2:</b> Valve is not rotating.  | <b>A:</b> There is no power to the Column Selector.   | Confirm there is power at the source, and all electrical connections are secure.   |
|   | <b>B:</b> The program and/or wiring to control the Column Selector is incorrect.  | Check the program used to control the Column Selector. Review the wiring as detailed in the installation section.  |
|   | <b>C:</b> Attempting to rotate the valve using the control panel positional selector keys - nothing happens.  | Set the control panel control mode to Local (manual) mode and press the appropriate positional selector key.   |
|   | <b>D:</b> Attempt to rotate the valve forward from position 6 to 1 or in reverse from 1 to 6 using the control panel positional selector keys - nothing happens.                                | In Local (manual) mode you cannot rotate forward from 6 to 1 (must rotate in reverse direction) or from 1 to 6 (must rotate in forward direction).                         |
|   | <b>E:</b> Attempting to rotate the valve using the computer control mode (with either TTL, contact closure or RS-232) - nothing happens.  | Verify that the Remote (automatic) mode is selected on control panel.  |
|   | <b>F:</b> Attempting to rotate the valve using the computer control mode (with either TTL, contact closure, RS-232) and remote (automatic) mode is selected on control panel - nothing happens. | Verify that you have programmed the computer or HPLC control software correctly and that the device is outputting a correct output (either TTL contact closure or RS-232). |
|   | <b>G:</b> Additional Problems.  | See <b>Troubleshooting Local (Manual), Power, and Display Problems</b> (page 21) or <b>Troubleshooting Remote Control Problems</b> (page 22, 23).                          |
| <b>3:</b> After running the Self Test (see Section VI. C.) an “EE” is displayed in the numeric display. | <b>A:</b> The electronics are not responding correctly.   | See Troubleshooting flow charts on pages 21-23.  |
| <b>4:</b> Remote Control Problems   | <b>A:</b> Problems arise when attempting to use 4 line BCD Control.   | See Flow Charts on Troubleshooting Remote Control 4 Line BCD Logic (page 22).  |
|   | <b>B:</b> Problems arise when attempting to use RS-232 Control.   | See Flow Charts on Troubleshooting Remote Control RS-232 Logic (page 23).  |

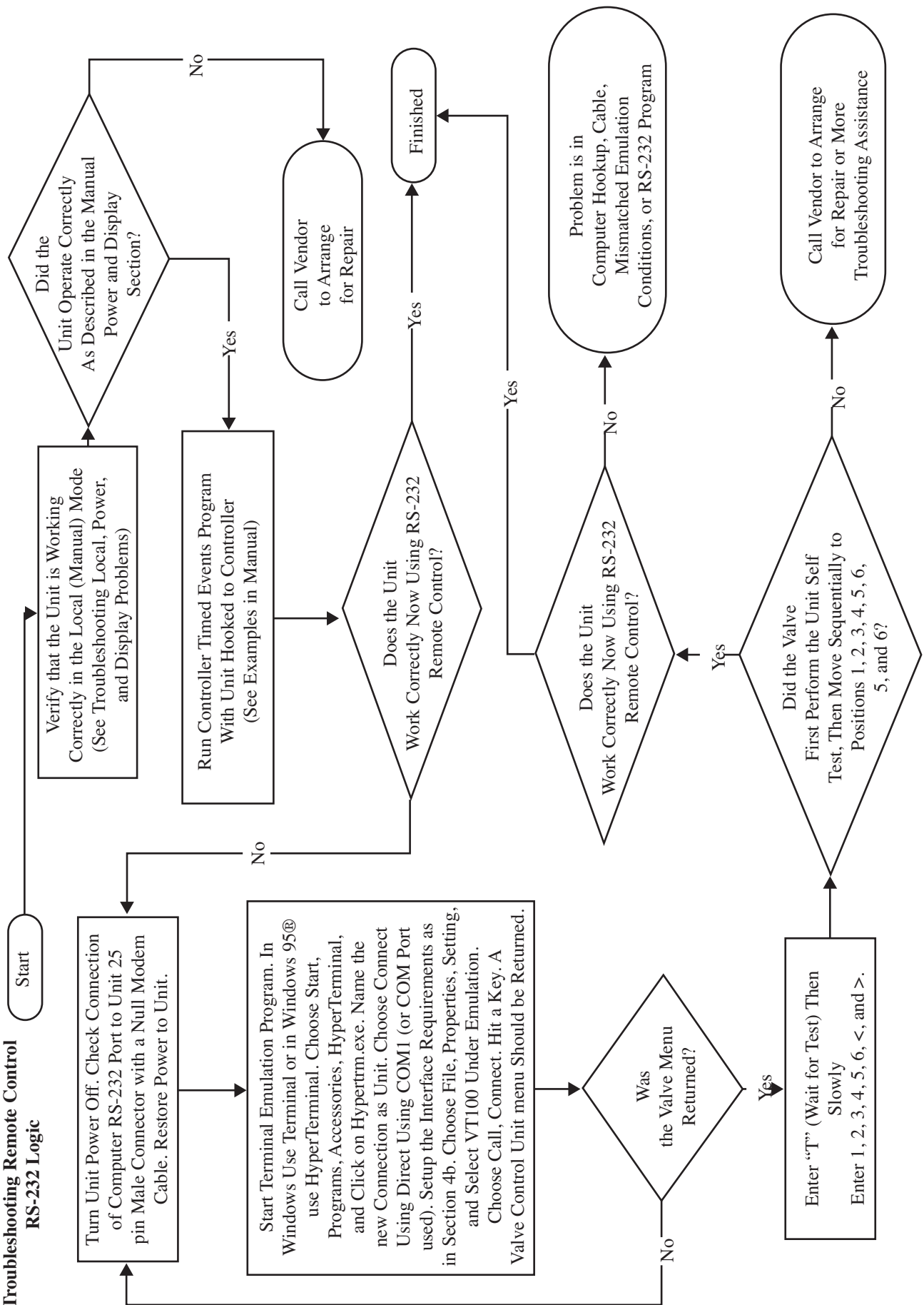
# Troubleshooting Local (Manual), Power, and Display Problems



# **Troubleshooting Remote Control Four Line BCD Logic**



## Troubleshooting Remote Control RS-232 Logic



## I. Appendix A. Electronic Definitions in Non-Electronic Terms

### BCD

Abbreviation for Binary Coded Decimal. A system of representing numbers in a code using 0 and 1. For example, in a 4 bit code, the number 5 would be 0101.

### CCW

Abbreviation for counterclockwise.

### Contact Closure

The correct term is open collector or relay. It simply means there is no connection when the circuit is open. The line is either grounded (GROUND) or not (OPEN).

### Cord Set

The electrical power cord to connect the power supply to an electrical wall outlet.

### CW

Abbreviation for clockwise.

### Event Relay

See External Event Relay.

### External Event Relay

These are the terminals on the instrument where the interface cable is wired. They are also known as Timed Event Terminals, External Event Terminals or Time Functions Switches. Each relay has two terminals. When the relay is a TTL, one is ground, the other is HI/LO (+5 volts/0 volts). When the relay is a contact closure either terminal can be ground, the other is to the control line.

### Ground

Common reference point required between two or more devices.

### Input

The electrical communication coming into a device. For example, the fluid processor requires either a TTL, contact closure or serial communication.

### Interface Cable

The multi-wire cable connecting the fluid processor to the controlling instrument.

### Level Logic

Type of electrical signal. In reference to the fluid processor, any change in the control signal's logic state will cause the valve to move one position.

### Line Control

A remote control scheme employing separate wires. Each wire is used with a common ground to send signals controlling the instrument.

### Logic State

The terminal at the Event Relay is in either one or the other state in the following pairs, HI/LO, OPEN/CLOSE, OFF/ON, OPEN/GROUND. For example, in a contact closure switch the relay is either grounded (GROUND) or not (OPEN).

### Output

The electrical communication coming out of a device. For example, the fluid processor has two outputs available, they are serial communication or five feedback lines. The serial communication is via a special cable. The five feedback lines are via the provided interface cable. Four of the lines on the interface cable are BCD position feedback lines and are represented by the following wire colors:

Grey - Feedback 3  
White - Feedback 2  
Purple - Feedback 1  
Orange - Feedback 0

The fifth line is brown and is the Busy/Done feedback (LO=Busy, HI=Done).

### Random Access

The valve can be programmed to move directly to the designated position. For example, from position 1 to position 4 in one step rather than move sequentially requiring three program steps. This is available with 4 Line BCD and with Serial Communication.

### Serial Communication

A way of communicating with a computer. A special cable is required to connect the fluid processor to your computer if you are using serial communication.

### State

See Logic State

### Terminal

The position at the Event Relay where the wire is connected. Each Event Relay has two terminals.

### TTL

Abbreviation for Transistor-Transistor-Logic, also called digital logic. A control line is either HI (+5 volts) or LO (0 volts). Typical OFF state of an instrument's TTL switch is HI.

### Universal Power Supply

A "black box" or adaptor that converts electrical power from a wall socket to usable power to run the fluid processor. The input required is 100-240 VAC, 50-60 Hz. The output of the power supply to run the fluid processor is 24 VDC.