FCD WCAIM2048-01
(Part 18736)

Worcester Controls Electri-SAFE DataFlo Digital Electronic Positioner

Technical Reference Manual

Models

15 DP 72 – DataFlo Positioner
Mounted On 15-72 Electri-SAFE Actuator

20 DP 72 – DataFlo Positioner
Mounted On 20-72 Electri-SAFE Actuator

Inputs

DP – 1K (120A)	1000 ohm Resistance Input
DP – 10 (120A)	10 to 50 milliamp Input
DP – 13 (120A)	135 ohm Resistance Input
DP – 5V (120A)	0 to 5 VDC Input
DP – 1 (120A)	1 to 5 milliamp Input
DP – XV (120A)	0 to 10 VDC Input
DP – 4 (120A)	4 to 20 milliamp Input

Voltages

120 A – 120 VAC Power Circuits

Contents

continued

1.0 Description of Positioner

The Worcester/McCANNA Electri-SAFE DataFlo Digital Electronic Positioner was designed for use with the Worcester/McCANNA Series 72 Electri-SAFE Hydraulic Actuators only.

This Electri-SAFE DataFlo Digital Electronic Positioner provides positioning of the Series 72 electro-hydraulic actuator for partial opening of the valve. The positioner operates by receiving a signal from a remote source to open the actuator to a particular position. A feedback loop is designed into the electronic board to keep the actuator at the required position. A resistance potentiometer and gear are attached to the output shaft to provide accurate position feedback. A change in the remote input signal will cause the actuator to open or close to meet the new desired position.

Three switches (keys) are located on the positioner circuit board to allow for manual operation of the positioner, calibration, function programming of the microchip, and troubleshooting.

CAUTION: The Electri-SAFE DataFlo Digital Electronic Positioner is sensitive to electrical noise on signal or supply lines and in the environment. For maximum positioner sensitivity, the electrical noise level should be as low as possible. Follow installation, calibration and adjustment guidelines carefully and use shielded wire for all low-voltage signals.

The Digital Positioner board is designed to receive a floating current input signal. This allows several pieces of equipment to be operated from the same current loop while at the same time remaining electrically independent of each other. A floating input signal means that the current input signal should not be referenced to the circuit board ground. The board power source must have a ground independent from that of the signal source.

The Digital Positioner board standard setup is 4 mA for full clockwise rotation (0°) and 20 mA for full counterclockwise rotation (90°).

The 4-20 mA signal input circuit for the Digital Positioner boards is protected with a 62 mA fuse (F1). The fuse is used to protect the input circuit from an excessively high voltage. The fuse used in the input circuit is a Littlefuse PICO II very fast-acting fuse rated at 62 mA.

Quite often when we receive an actuator for repair at Flowserve, we find that the only thing wrong with the unit is that the feedback potentiometer is out of calibration. It is very important that the feedback potentiometer be properly calibrated for correct operation of the positioner board. Whenever you have a problem with the positioner calibration, always check the feedback potentiometer calibration first. This must be done with no power applied to the circuit board. If the actuator is in the full clockwise position, check the resistance between the purple and white/black potentiometer leads. The reading should be 80-90 ohms. If it is not, rotate the face gear until the proper reading is achieved. If the actuator happens to be in the full counterclockwise position then check the resistance between the green and white/black potentiometer leads. If necessary adjust the face gear for an 80-90 ohm reading.

***NOTE**: It is not necessary to loosen or remove face gear snap ring to rotate gear—it is a friction fit. If for any reason the snap ring is to be removed, do not over-stretch it; use the minimum opening to allow it to slip over the gear.*

2.0 Features of the Electri-SAFE Electronic Positioner Circuit Board

2.1 General

Figure 7 in the appendix defines the location of major electrical components in the positioner housing. The Digital Positioner Board is factory wired to the terminal strips per Figure 4 and Figure 5 in the appendix.

The feedback potentiometer leads are factory connected to the terminal block (TB2) on the Digital Positioner Board.

If a dual potentiometer option is installed, the "B" potentiometer leads will have to be wired directly to external device. The "A" potentiometer leads are factory connected to the terminal block (TB2) on the Digital Positioner Board. Also, note that the "B" potentiometer has a voltage limit of 30 volts maximum.

2.2 Circuit Board Configurations

The positioner board is factory supplied for one of the seven input signal options plus a two-wire RS-485 interface.

***NOTE**: Field changes to the positioner board are not advised. Consult Flowserve before attempting any modification.*

2.3 LED Indicators

Light emitting diodes (LED) marked LD1 (CW) (see Figure 2 in the appendix) and LD2 (CCW) mounted on the power supply (are in the output circuits) and when lit indicate which direction the actuator is trying to drive to. A third LED, LD3 (see Figure 1 in the appendix), is used to indicate when an alarm condition exists. If LD3 is lit, the alarm that caused it to light must be determined by looking at the LCD on the circuit board and finding the alarm parameter with the UP or DN switch.

2.4 Controls (Override)

There are no adjustable controls provided on the circuit board, because none are necessary. All parameters are set through the programming switches (keys) or the RS485 interface. Local push-button control is provided at the controller by simultaneously pressing the SEL and UP switches (keys) for three seconds. At this point the UP and the DN switches (keys) can be used to manually rotate the actuator shaft. Pressing the SEL switch for three seconds will return the positioner to the run mode.

2.5 AC Power Control

The AC output circuits are controlled by solid state switches (triacs Q3, Q4), which will provide trouble-free operation for the life of the equipment they are used with, AS LONG AS THEY ARE OPERATED WITHIN THEIR RATINGS.

3.0 Wiring of Electri-SAFE Digital Positioner and Actuator

See wiring diagrams located under positioner and actuator covers and in figures 4, 5 and 6 in the appendix for customer connections.

CAUTION: Wiring should be inserted only to midpoint of terminal strip.

3.1 Actuator Wiring

An Actuator Electrical System is made up of two major components involved in user connections:

1) Actuator housing

2) Positioner housing

Incoming power is brought to the Electri-SAFE unit via the Actuator Housing.

Signal wiring is brought to the Electri-SAFE unit via the Positioner Housing.

The positioner input power, pump motor and solenoid control signals (and wires for optional indicating switches) are factory-wired to the actuator housing terminals (figure 6 in the appendix) and wired to meet Class-1, Div-1 requirements.

1) The actuator housing contains the CCW over-travel limit switch, and wiring for the motor, control and fail-safe solenoid valves. All of the high-voltage input wiring is connected here.

2) The positioner housing contains the Digital Positioner Board, power supply, position potentiometer, terminal strips, and optional indicating switches. Figure 7 in the appendix defines the location of major electronic components in the positioner housing. The power supply is factory wired to terminal strip 1-10 (see Figure 4 in the appendix). Wiring from the positioner terminal strip 1-10 to the actuator terminal strip 1-8 is factory-wired. Signal wiring is brought from the positioner board to terminal strip A-H in the positioner housing (see Figure 5 in the appendix).

   All field signal connections are at terminal strip A-H in the positioner housing (see Figure 5 in the appendix).

   ***NOTE**: IT SHOULD BE NOTED THAT INSTALLING THIS ACTUATOR IN A HAZARDOUS AREA REQUIRES THE USE OF CONDUIT AND SEALS AND OTHER REQUIREMENTS AS SPECIFIED IN THE NATIONAL ELECTRICAL CODE, CHAPTER 5.*

3.1.1 Minimum Fuse Ratings

See table on this page for minimum fuse rating when over-current protection is used in motor power circuit.

***NOTE**: This table shows the minimum rating to prevent inrush current from blowing the fuse.*

Actuator Size	Voltage	Fuse Rating
15-72	120 VAC	10 A
20-72	120 VAC	10 A

3.1.2 Wiring and Installation of Accessories

Refer to installation and wiring instructions, contained in Part 6.0 of this manual and/or respective accessory kit.

4.0 Positioner – General Description and Modes of Operation

When properly adjusted, the actuator will stop at the full CCW and full CW positions as a result of having reached one of the respective limits of the input signal span. The full CCW over-travel limit switch will be used only as a backup to stop the actuator pump motor should a failure of an electronic component occur.

4.1 Programming Switches (Key Functions)

There are three switches (keys) on the positioner circuit board which are labeled SEL (black) for select, DN (white) for down, and UP (white) for up. These are the keys that are used to calibrate, program and position the Digital Positioner Board locally.

The UP and the DN switches can be used to advance through the menu until the desired parameter is reached. At this time, the display will be flashing between the parameter name and its current setting. Momentarily pressing the SEL switch will lock in that parameter's current setting and allow the user to change it. If the display is alphabetic such as riSE or FALL for setpoint direction, momentarily pressing the UP switch will cycle through the setting options for that parameter. When the desired setting option is reached, momentarily pressing the SEL switch will set the parameter to that option and store it in nonvolatile memory. If the display is numeric, momentarily pressing the SEL switch will lock in the value with the left most digit flashing. Pressing the UP switch will increment this digit. Pressing the DN switch will advance the flashing digit to the next digit to the right. Therefore, the UP switch is used to set the flashing digit to the desired value while the DN switch is used to select the flashing digit. Once the overall value is entered, momentarily press the SEL switch to store the value in nonvolatile memory.

4.2 Limit Switch Adjustment and Calibration Procedures

4.2.1 Adjustment of Over-Travel Limit Switch

The Positioner has been shipped with a limit switch factory-calibrated to stop the actuator in the full CCW position (approximately 92°). It is located in the actuator housing, behind the flat cover. If it has been determined that the limit switch requires adjustment, perform the adjustment as follows:

***NOTE**: Be very careful when adjusting the switch. It can be damaged by the actuator switch probe if the switch is adjusted (tightened) too far in toward the probe. If in doubt of switch position, loosen (back out) the switch adjustment screw to its loose limit before performing the following steps.*

If not already done, remove the actuator and positioner housing covers.

When power is first applied, the unit will be in the Run Mode. The positioner display should be flashing between POS and a number between 0 and 100.

On the positioner board, simultaneously press the SEL and UP keys for three seconds to enter the Manual Mode. The display should alternate between POS and 0.0.

Press and hold the UP key until the actuator goes full CCW and stops moving. The actuator should be full CCW, and there should be no motor noise.

If the motor continues to run, turn the limit switch adjustment screw clockwise until the motor stops running. Turn the adjustment screw clockwise an additional ¼ turn to set the switch. Verify the switch setting as follows:

Press the DN key to rotate the actuator shaft about 20 degrees CW.

Turn the limit switch adjusting screw counterclockwise ½ turn.

Press and hold the UP key until the actuator shaft rotates to full CCW and stops moving.

If the actuator is not at full-open:

Press the DN key to rotate the actuator shaft about 20 degrees CW.

Turn the limit switch adjusting screw counterclockwise ½ turn.

Press and hold the UP key until the actuator shaft rotates to full CCW and stops moving.

Repeat until the actuator is full-open and there is no motor noise.

The actuator shaft must travel a couple of degrees beyond the 90 degree full CCW position for the positioner to control the full range of operation. Place a straight edge along the flats on the positioner shaft to verify that the actuator has gone past the 90 degree position when stopped by the limit switch.

To return to the RUN mode, press and hold the SEL key for three to five seconds.

4.2.2 Calibration Procedures for Positioner

***NOTE**: Also refer to section 4.6 for step-by-step procedures.*

When power is first applied, the unit will be in the Run Mode. The display should be flashing between POS and a number between 0 and 100.

Simultaneously press and hold the SEL and DN switches (keys) for three seconds to enter the calibration mode. When first entering the Calibration Mode, CAL will be displayed for two seconds and the security code will be checked. If the required security code is not zero (“0000”), the display will begin alternating between codE and 0000. Enter the security code as described in paragraph 4.4.1 and per paragraph 4.3.6. If the required security code is zero, it will not need to be entered by the user, i.e., it will be bypassed and the display will automatically flash SEtL, and you can skip to paragraph b. Note: If the security code is forgotten, the special number 4800 can be used to gain entry. However, this number will now be the new security code and if another code number is still desired, it will have to be reprogrammed.

If and after a security code has been entered, press and release SEL to accept code. The display will now flash SEtL and a value.

Simultaneously press and release the SEL and UP keys, then adjust input signal to lower input value, e.g., 4 mA. Press and release SEL to lock in value.

Press and release the DN key, the display will now flash SEtU and a value. Simultaneously press and release SEL and UP, then adjust input signal to higher input value, e.g., 20 mA . Press and release SEL to lock in value.

Press and release DN, the display will now flash PoC and a number between 0.0 and 5.0. Simultaneously press and release SEL and UP. Rotate the actuator to the full CW position by pressing and holding the DN key. Release the DN key when full rotation has been achieved.

***Important**: Be careful not to go past the CW “0” degree position. (Position a straight edge along the flats on the positioner shaft to verify the shaft position). The display should read between .200 and .400. If not: rotate the face gear located on the positioner shaft (that drives the potentiometer) until you read between .200 and .400. The gear is held in place by means of a friction lock and a snap ring. No tools are needed nor is it necessary to loosen or remove the snap ring to move the gear. Steady gentle finger pressure will move the gear to allow you to adjust the feedback potentiometer. Press and release SEL to lock in the value.*

Press and release the DN key, the display will now flash PoCC and the feedback voltage value. Simultaneously press and release SEL and UP. Adjust so shaft is full CCW using the UP key (do not go past 90 degrees). Press and release SEL to lock in value.

Press and release the DN key, the display will now flash Cyt and a cycle time reading. Simultaneously press and release the SEL and UP keys. At this time the actuator will perform one cycle to measure its cycle time displaying PoC as the actuator travels to the full CW position and PoCC for the CCW position.

To return to the RUN mode, press and hold the SEL key for three to five seconds.

4.3 General Description of Digital Positioner

The Digital Positioner is used for intelligent control and operation of the Electri-SAFE Electro-Hydraulic Actuator.

4.3.1 Valve Position Setpoint Input

The valve position setpoint input signal is derived from either an analog input signal or from a digital RS485 serial input.

4.3.2 Valve Position Feedback

Valve position feedback to the digital positioner board is from the 1,000 ohm potentiometer geared to the actuator shaft.

4.3.3 Key Features of The Digital Positioner

Easy push-button calibration of the positioner

Programmable set point direction

Microprocessor-based positioner

Programmable split range

High resolution

Programmable deadband as well as auto adjust

Cycle count

Programmable operating parameters

Hi, Low, and Deviation alarms

Four programmable position response curves

Loss of signal position and time delay

Local and remote positioner operation

Loss-of-power position and time delay

Electronic travel limits

ASCII text area in EEPROM (420 + bytes)

4.3.4 Operating Modes

The four modes of operation are:

CALIBRATION (see part 4.2 and part 4.6)

PROGRAM (see part 4.4)

LOCAL (see part 4.5)

RUN (This is also the default mode, see part 4.7.)

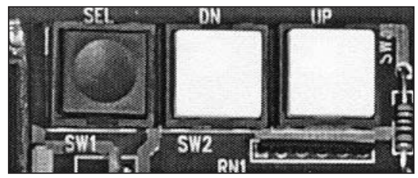
4.3.5 Data Readout

A four-digit LCD mounted on the positioner board provides local data readout. Each LCD segment is controllable, which allows display of some letters in addition to all digits. Parameters will be identified by names, not numbers. Provisions for numerical values with decimal points will be made.

4.3.6 Local Data Entry

Key combination while in run mode	New mode	New mode entry display
SEL	Program Mode	Prog
SEL + UP	Manual Setpoint Mode	Loc
SEL + DN	Calibration Mode	CAL

Three push-button switches (as shown below) on the positioner board are used for local data entry:



SEL Selects a parameter for editing or changes modes of operation.

UP Increases selected value or selects next parameter. Hereafter this switch will be called UP.

DN Decreases selected value or selects previous parameter. Hereafter this switch will be called DOWN.

In the Program Mode of operation, data is edited by pressing the SEL switch while the parameter name is alternating with its value. The display will then be in the Fixed Mode where one or more digits will flash.

With a single digit flashing, pressing the UP switch will increase the digit value by 1, wrapping from 9 to 0. Pressing the DOWN switch will cause the next digit to blink and allow it to be edited. Pressing the SEL switch will store the value in non-volatile memory, discontinue editing, and return the display to the Toggle Mode.

***Note**: Displayed data cannot be edited in the Run Mode. Pressing the SEL switch in that mode causes the display to stop alternating and only the parameter value is displayed.*

4.3.7 Display Modes

The display has two modes of operation: Toggle Mode and Fixed Mode.

In Toggle Mode (default), the display will alternate between a parameter name and its value. In Fixed Mode (press SEL switch), only the value appears on the display. If a parameter is being edited, one or more digits are blinking as the value of the parameter is being displayed.

4.4 Program Mode (Data Entry Parameters)

The table below shows all programmable parameters, their display name and data range.

Parameter Name Display	Minimum Numeric Value	Maximum Numeric Value	Pick List Values	Description	Notes
CodE	0000	9999		Security code	
Addr	1	255		Communications address	
Ocur			4-20, 0-20	Optional current output module range	
Sdir			riSE, FALL	Setpoint direction	
SPrS	0.0 %	99.9 %		Split range start point.	
SPrE	0.1 %	100.0 %		Split range end point.	
OPEn	0 sec	200 sec		Ramp open (CCW) time.	1
CLOS	0 sec	200 sec		Ramp close (CW) time.	1
SFc			Lin, FrE1, FrE2, FrE3, FrE4	Setpoint function (linear or curve select)	
dEbA	0.3 %	10.0 %	Auto	Positioning deadband	2
SPOS	0.0 %	100.0 %	HOLd	Loss of setpoint signal position	
SPt	0 sec	9999 sec		Loss of setpoint dwell time	
PPOS	0.0 %	100.0 %	HOLd	Power-on position	
PPt	0 sec	9999 sec		Power-on position dwell time	
yA	0.0 %	100.0 %		Positioner lower (CW) rotational limit	3
yE	0.0 %	100.0 %		Positioner upper (CCW) rotational limit	3
yCLS			yES, no	Tight valve shutoff operation.	4
yOPn			yES, no	Full open valve operation.	5
bAUd			1200, 2400, 4800, 9600, 19200, 38400	Communications rate.	
CyS				Valve total travel time (from full CW to full CCW and back).	6
CyCn				Total number of valve cycles.	
AdE				Deviation alarm time.	6
AHi	0.0 %	100.0 %		Valve high (CCW) position alarm.	
ALo	0.0 %	100.0 %		Valve low (CW) position alarm.	
SLxx	0.0 %	100.0 %		Free curve vertices (see section 4.4.10)	
PrSt			yES, no	Option to set all parameters to their default values (see section 4.4.17).	

Notes	Description
1	If a time of "0" is used or a time is entered that is less than the travel time, the rate of response to a step change in the input signal we be as fast as the actuator can operate.
2	The deadband is used to prevent oscillations about a setpoint because of small fluctuations in either the setpoint signal or the position feedback signal. The deadband represents a plus and minus percentage of the full range of either the input signal or the feedback signal. Deadband can be set to a fixed value or it can be set to Auto. See paragraph 4.4.11 for a discussion of deadband.
3	In normal operation, the valve will operate in the yA to yE limits. yA must be less than yE. The yA value is the most CW position and the yE value is the most CCW position the valve will be able to travel.
4	Tight valve shutoff specifies if the valve should be closed completely when the signal is between 4.1 and 4.2 mA, regardless of the yA setting. So if yCLS is yES and yA is at 20.0 % the valve will close completely (full CW) when the setpoint is between 4.1 mA and 4.2 mA even though 20% was the lower limit.
5	Full-open valve operation specifies if the valve should be opened completely when the signal is between 19.8 and 19.9 mA, regardless of the yE setting. So if yOPn is yES and yE is at 70.0% the valve will open completely (full CCW) when the setpoint is between 19.8 mA and 19.9 mA even though 70% was the upper limit.
6	This parameter is read-only and cannot be modified by editing.

The Program Mode is entered from the Run Mode by pressing the on-board SEL switch for three seconds.

When first entering the Program Mode, Prog will be displayed for two seconds and the security code will be checked. If the required security code is not zero, the display will begin alternating between CodE and 0000. Enter the security code as described in paragraph 4.4.1. If the required security code is zero ("0000") it will not need to be entered by the user, i.e., it will be bypassed.

After any required security code is correctly entered, a menu allows the user to select individual parameters they wish to program.

For all parameters in the table on previous page, the display will be in Toggle Mode alternating between showing the parameter name for one second then its value for one second. Pressing the UP or DOWN switches in the Toggle Mode will display the next or previous parameter (respectively). Pressing the SEL switch while in the Toggle Mode will enter the Fixed Mode of display where the value can be altered.

As explained in paragraph 4.3.6, values are edited by pressing the UP or DOWN switches (UP to increment digit and DOWN to advance to the next digit) until the desired value is obtained. Pressing the SEL switch while editing will record the new value and return the display to the Toggle Mode.

If an invalid value is entered for a parameter, the display will flash an error message until acknowledged by the user. The user can acknowledge an error by pressing the SEL switch.

4.4.1 Security Code Screens

The display will alternately display CodE and 0000

The correct security code number must be entered to gain access to Program and Calibration Modes. Once in the Program Mode, the security code can be reprogrammed.

Legal security code values are 0000 to 9999. Note that when the security code of 0000 is used, the security option will be bypassed. With a code of 0000 the user is not required to enter the code to gain access to modes that use the security code.

If the security code is forgotten, the special number 4800 can be used to gain entry to modes that require a security code. However, this number will now be the new security code and if another code number is still desired, it will have to be reprogrammed.

4.4.2 Unit Address Screen

The display will alternately display Addr and the communications address, which is factory set at 1 on new units.

CAUTION: Do not install two units with the same address on the same RS485 bus.

To edit the value, use the UP or DOWN switches to select a value from 1 through 255.

4.4.3 Output Current Range

The display will alternately display Ocur and either 4-20 or 0-20.

Edit the value and use the UP or DOWN switches to select 0-20 or 4-20.

4-20 selects a 4-20 mA output current range.

0-20 selects a 0-20 mA output current range.

A voltage output can be achieved by connecting a resistor across the current output.

The output current feedback is linear.

4.4.4 Analog Setpoint (Input) Range

The analog setpoint (input) signal range is fixed.

4.4.5 Setpoint Direction (Rise/Fall)

The display will alternately display Sdir and either riSE or FALL.

Use the UP or DOWN switches to select riSE or FALL.

riSE selects direct acting positioner control where the actuator rotates in the CCW direction as the setpoint signal increases. The valve is full CW at the minimum setpoint signal value.

FALL selects reverse acting positioner control where the actuator rotates in the CCW direction as the setpoint signal decreases. The valve is full CCW at the minimum setpoint signal value and full CW at the maximum setpoint signal value.

4.4.6 Setpoint Split Range START Selection

The display will alternately display SPrS and its value.

For a direct-acting positioner, SPrS specifies the START of the split range input signal for the full CW actuator position, and must be less than SPrE. For a reverse-acting positioner, SPrS specifies the START of the split range input signal for the full CCW actuator position, and must be less than SPrE.

The setting can be anywhere from 0.0 to 99.9% of the input signal range in 0.1% increments.

Split ranging is useful when more than one valve is used in a control system. As an example, one actuator can be calibrated to open for an input signal between 4-12 mA and another to open for an input signal between 12 and 20 mA.

4.4.7 Setpoint Split Range END Selection

The display will alternately display SPrE and its value.

For a direct-acting positioner, SPrE specifies the END of the split range input signal for the full CCW actuator position, and must be greater than SPrS. For a reverse-acting positioner, SPrE specifies the END of the split range input signal for the full CW actuator position, and must be less than SPrS.

The setting can be anywhere from 0.1 to 100.0% of the input signal range in 0.1% increments.

4.4.8 Setpoint Ramp-Time to Open

The display alternately displays OPEn and the selected time to open.

Times from 0 to 200 seconds can be selected as the time for the actuator to travel from the full-closed (CW) to the full-open (CCW) position.

If “0” (or a time less than the CCW travel time) is selected, the rate of response to a step change in the input signal will be as fast as the valve actuator can operate. The slowest time to open is 200 seconds.

4.4.9 Setpoint Ramp-Time to Close

The display alternately displays CLOS and the selected time to close.

Times from 0 to 200 seconds can be selected as the time for the actuator to travel from the full-open (CCW) to the full-closed (CW) position.

If “0” (or a time less than the CW travel time) is selected, the rate of response to a step change in the input signal will be as fast as the valve actuator can operate. The slowest time to close that can be selected is 200 seconds.

4.4.10 Setpoint Curve Function

The positioner translates the setpoint input using a table of values. The positioner contains a linear table and four 21-point curves called free curves. By default, the linear translation table is used (SFn is set to Lin). The four free curve tables can be edited to allow different translation curves to be used. By default, free curve #1 (FrE1) is preset to a 1:25 equal percentage response curve, free curve #2 (FrE2) is preset to 1:50 equal percentage response curve, and free curves #3 and #4 (FrE3 and FrE4) are each preset to a linear response curve. All four free curves can be modified. The table on the next page shows all the tables and the default free curve values. These values are loaded any time the parameters are defaulted with the PrSt parameter.

NOTE*: Definition of equal percentage: for equal increments of valve rotation, the C_V increases by a given percentage over what it was at the previous setpoint.*

The display will alternately display SFc and either Lin or FrE1, FrE2, FrE3, or FrE4.

This function tells the positioner the desired shaft positioning characteristic with respect to input signal.

Lin causes the shaft position to vary in a linear fashion as the input signal changes (i.e., if the signal is at 50 percent, the shaft position will be at 50 percent of the selected operating range).

The FrE1-FrE4 curves allow 21 setpoint vertices to be set. In this way, a custom shaft positioning characteristic can be entered. There is a vertices set (data point) at 4 mA and then every 0.8 mA up to and including 20 mA. The vertices are displayed as SL 0 to SL 20 and will only be displayed when one of the FrE1-FrE4 curves is chosen as the setting. The SL parameters can be found in the menu between the PrSt parameter and the CodE parameter. Use the UP and DOWN switches to select and change the vertices settings.

Parameter	Linear Curve (Lin)	Free Curve #1 1:25 (FrE1)	Free Curve #2 1:50 (FrE2)	Free Curve #3 (FrE3)	Free Curve #4 (FrE4)
SL 0	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
SL 1	5.0 %	0.8 %	0.3 %	5.0 %	5.0 %
SL 2	10.0 %	2.1 %	0.8 %	10.0 %	10.0 %
SL 3	15.0 %	3.2 %	1.5 %	15.0 %	15.0 %
SL 4	20.0 %	4.9 %	2.6 %	20.0 %	20.0 %
SL 5	25.0 %	6.5 %	3.7 %	25.0 %	25.0 %
SL 6	30.0 %	8.4 %	5.0 %	30.0 %	30.0 %
SL 7	35.0 %	10.7 %	6.6 %	35.0 %	35.0 %
SL 8	40.0 %	13.2 %	8.4 %	40.0 %	40.0 %
SL 9	45.0 %	15.7 %	10.9 %	45.0 %	45.0 %
SL10	50.0 %	18.7 %	13.5 %	50.0 %	50.0 %
SL11	55.0 %	22.6 %	16.5 %	55.0 %	55.0 %
SL12	60.0 %	27.2 %	20.3 %	60.0 %	60.0 %
SL13	65.0 %	33.4 %	25.0 %	65.0 %	65.0 %
SL14	70.0 %	40.0 %	31.1 %	70.0 %	70.0 %
SL15	75.0 %	46.0 %	36.8 %	75.0 %	75.0 %
SL16	80.0 %	53.8 %	45.4 %	80.0 %	80.0 %
SL17	85.0 %	63.2 %	54.4 %	85.0 %	85.0 %
SL18	90.0 %	73.7 %	67.5 %	90.0 %	90.0 %
SL19	95.0 %	86.2 %	85.0 %	95.0 %	95.0 %
SL20	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

4.4.11 Positioner Deadband

The display will alternately display dEbA and the deadband value.

The deadband is used to prevent oscillations about a setpoint because of small fluctuations in either the setpoint signal or the position feedback signal. The deadband represents a plus and minus percentage of the full range of either the input signal or the feedback signal. Fixed deadband values can be selected from 0.1 to 10.0 (percent) of range. When the DOWN switch is pressed when the right most digit is selected, the display will show Auto. Pressing SEL while on that screen will select Auto deadband.

A deadband setting of Auto will allow constant automatic adjustment of the deadband in an adaptive fashion as required for best performance. This is the recommended setting. The lower Auto default value is .5 but this can be changed with the manual setting. Whatever value has been set for the manual deadband setting, becomes the lower limit for the Auto deadband mode.

4.4.12 Loss-of-Signal Position and Delay Time

The display will alternately display SPOS and the position the valve will move to if there is a loss of signal. A loss-of-signal condition occurs in either of two situations: 1) When the positioner is in analog position control and the input signal is less than 2 mA; or 2) When the positioner is controlled by the serial data link (digital control) and no signal has been received within the SPt time period.

When a loss of signal occurs in the analog control mode, the positioner will immediately go to the SPOS position. A HOld option specifies the positioner is to hold its current position. The positioner will hold the SPOS position until a valid analog input signal is present for the SPt delay period. If the SPt parameter is set to 0 seconds, restoration of the signal will cause the positioner to work as normal with no time delay.

A loss of signal in PC CMD control mode means the positioner has not received a valid command within the SPt time period. In that case, the positioner will immediately go to the SPOS position. A HOld option specifies the positioner is to hold its current position. The positioner will hold the SPOS position until a valid digital position command is received.

The display will alternately display SPt and the delay time (in seconds). The time range is 0 to 9999 seconds. A time of 0 in analog control mode disables the loss-of-signal option. A time of 0 in digital control mode effectively disables the loss-of-signal option by allowing an infinite time between received commands. In digital-control mode, non-zero SPt time values less than three seconds will use three seconds as the delay.

4.4.13 Power-On Position and Delay Time

When power is first applied to the positioner and the unit is in analog signal control mode, it will go to the position specified by the PPOS parameter for a time specified by the PPt parameter. During that time, any input signal is ignored.

If the unit is in PC Cmd control mode and there is a valid PC signal, the unit will respond to the signal immediately, otherwise, it will go to the power on position for the PPt time and then go to the SPOS position for the SPt time.

The display will alternately display PPOS and the position (in percent) the valve will move to when power is first applied or when power is restored. The actuator will hold that position for the time specified in the next step. The position range is 0.0 to 100.0% and HOLd. A HOLd option specifies the positioner is to hold the last position (i.e., the actuator will not move).

The display will alternately display PPt and the time (in seconds) that the PPOS position will be held. During that time, the positioner will ignore any input signal and will hold the PPOS position. The time range is 0 to 9999 seconds. A time of 0 disables this option such that the positioner will immediately respond to the input signal when power is first applied or restored.

4.4.14 Electronic Positioner Rotation Limits (Electronic travel stops)

The display will alternately display yA and its position value.

yA is the electronic lower rotation limit for shaft position at the start of the signal range. It can be set to a value from 0.0 to 100.0 in increments of 0.1 percent.

Press the UP switch to advance to the yE parameter screen.

The display will alternately display yE and its position value.

yE is the electronic upper rotation limit for shaft position at the end of the signal range. It can be set to a value from 0.0 to 100.0 in increments of 0.1 percent.

If yA were set at 20.0 then the actuator shaft would never rotate further CW than 20 percent open. If yE is set to 70 percent then the actuator shaft would never rotate further CCW than 70 percent open. These electronic limits restrict the range of actuator shaft rotation.

yA must always be less than or equal to yE. yE must always be greater than or equal to yA.

4.4.15 Tight Valve Shutoff

The display will alternately display yCLS and its setting.

yCLS is how we specify whether tight valve shutoff is desired when the input signal reaches the low end of its range. It is significant when the yA function is set to a value other than 0.0 percent. The two choices are yES and no. As an example, if the actuator/valve is controlling fuel flow to a burner, yA might be set to 30 percent as a low-fire position, but between 4.1 and 4.2 mA the valve would fully close if yCLS is set to yES to allow maintenance to be performed on the burner.

4.4.16 Full-Open Operation of Valve with Open Travel Limit Set

The display will alternately display yOPn and its setting.

yOPn is how we specify whether the valve will fully open when the input signal reaches the upper end of its range. It is significant when the yE function is set to a value other than 100.0 percent. The two choices are yES and no. As an example, if yE is set at 70 percent and yOPn is set to yES, then the actuator/valve would be 70 percent open at 19.8 mA, but would open fully when the signal is increased to 19.9 mA.

4.4.17 Restore Factory Default Values

The display will alternately display PrSt and no.

If yES is selected instead of no then the factory default values for all parameters will be selected. This flag is not a parameter but must be edited the same way to select yES. This is a momentary function and values can be altered after the default values have been selected. After the factory default values have been reloaded, the display will once again display no.

See Part 4.8 for a list of the default values.

4.4.18 Run Time Cycles for Maintenance

The display will alternately display CyS and the total number of seconds for the valve to travel from full counterclockwise to full clockwise then back to full counterclockwise. This cycle time is measured in the cycle time calibration routine which is performed after the feedback potentiometer calibration routine.

The microprocessor converts run time into cycles.

The next screen displays accumulated cycles CyCn. The number shown represents thousands of cycles. The display can show up to 9.999 million cycles. Obviously at higher resolutions, less resolution is available on the display. Only whole cycles are displayed.

With CyCn displayed, the user can press the SEL switch and the total will begin flashing. At that point, holding down the DOWN switch for four seconds will clear the total.

Because the life of EEPROM is based on the number of write operations, only every 100 cycles will cause the total to be written to the non-volatile memory.

4.4.19 Alarm Functions

The DEVIATION alarm becomes active if the valve does not move to the desired position within a certain time period. The time period is 10 seconds plus either the ramp time for the direction in which the actuator is moving, or the open/close time from calibration, whichever is greater.

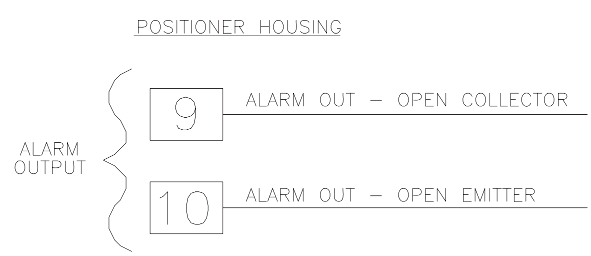
A means to set UPPER and LOWER rotation alarm limits on the actuator/valve shaft position is provided. An alarm shall occur if the positioner rotates beyond either the upper or lower set limit. The range of rotation limits is from 0 to 100%. An example of typical alarm limits would be 20% for LOWER and 80% for UPPER.

An opto isolated open collector/open emitter alarm output will be on whenever any alarm condition exists.

***NOTE**: For wiring of alarm outputs refer to diagram at right.*

Two alarm parameters will be programmable:

Ahi: 0.0 to 100.0% For the upper rotation alarm.



Alo: 0.0 to 100.0% For the lower rotation alarm.

Load Specs. for Alarm Output:

Maximum Collector/Emitter Voltage is 50 Volts DC

Maximum Collector/Emitter Current is 100 mA

The AdE value is also shown with the programmable parameters to show the deviation alarm time. This value cannot be edited.

4.5 Local Mode

Local Mode is provided to allow manual control of the positioner. Local Mode is entered from the Run Mode by holding down the SEL and UP switches simultaneously for three seconds. From the Local Mode, pressing and holding the SEL switch for two seconds will return to the Run Mode.

In the Local Mode, the display will show POS alternating with the position. Pressing the SEL switch will stop the alternating.

Press either the UP switch to travel CCW or the DOWN switch to travel CW.

4.6 Feedback Calibration Routine and Cycle Time Measurement

The Calibration Mode provides a way to properly calibrate signals used by the positioner. Periodic calibration is recommended to maintain accurate positioning. This mode is entered from the Run Mode by simultaneously holding down the SEL and DOWN switches for three seconds. From the Calibration Mode, pressing and holding the SEL switch for two seconds will return to the Run Mode.

When first entering the Calibration Mode, CAL, will be displayed for two seconds and the security code will be checked. If the required security code is not zero (“0000”) the display will begin alternating between CodE and 0000. Enter the security code as described earlier in paragraph 4.4.1 and 4.3.6. If the required security code is zero, it will not be required to be entered by the user (i.e., it will be bypassed).

After any required security code is correctly entered, a menu allows the user to select individual calibration procedures they wish to perform.

The user is presented with the first of several calibration parameters. Calibration is performed in a manner similar to parameter editing in the Program Mode. A parameter is shown alternating with its current value. Pressing the DOWN switch will select the next calibration parameter. To perform the calibration procedure for a displayed parameter, simultaneously press the SEL and UP switches. When calibration of the selected item is completed, press the SEL switch to return to the menu.

In the table below, calibration names are shown as they appear on the display with their definition. The table also shows the order of the procedures.

Parameter Name	Description
SEtL	Set point range lower limit signal value.
SEtU	Set point range upper limit signal value.
PoC	Shaft position feedback value in clockwise position.
PoCC	Shaft position feedback value in counterclockwise position.
Cyt	Cycle time measurement

A. Input (setpoint) Signal Calibration

1. Use the DOWN switch to go to SEtL.
2. The display will alternate between SEtL and the voltage resulting from the input current signal.
3. To edit, simultaneously Press and release SEL and UP switches and then: Adjust the signal source to produce the lower input reading, e.g., a 4 mA signal. The voltage reading should be less than 1.0 volts. Press the SEL switch to lock in the full CW reading. Control returns to the Calibration Menu.
4. Use the DOWN switch to go to SEtU.
5. The display will alternate between SEtU and the voltage resulting from the current signal.
6. To edit, simultaneously press and release SEL and UP switches and then: Adjust the signal source to produce the higher input reading, e.g., a 20 mA signal. Press the SEL switch to lock in the full CCW input reading. Control returns to the Calibration Menu.

B. Position Endpoint Calibration

1. Use the DOWN switch to go to PoC.
2. The display will alternate between PoC and the feedback voltage value.
3. To edit, simultaneously Press and release SEL and UP switches and then: Use either the UP or DOWN switches to manually rotate the actuator to its full CW position.

   ***Important**: Be careful not to go past the CW “0” degree position. (Position a straight edge along the flats on the positioner shaft to verify the shaft position). The display should read between .200 and .400. If not: rotate the face gear located on the positioner shaft (that drives the potentiometer) until you read between .200 and .400. The gear is held in place by means of a friction fit and snap ring. No tools are needed nor is it necessary to loosen or remove the snap ring to move the gear. Steady gentle finger pressure will move the gear to allow you to adjust the feedback potentiometer. Press and release SEL to lock in value.*
4. Use the DOWN switch to go to PoCC.
5. The display will alternate between PoCC and the feedback voltage value.
6. To edit, simultaneously press and release SEL and UP switches and then: Use the UP switch to manually rotate the actuator to the CCW 90° position. (Do not go past 90°. Place a ruler on the positioner shaft flat for indication.) If the shaft rotates past 90°, use the DOWN switch to bring the shaft back to the 90° position. Press the SEL switch to lock in the 90° feedback reading. Control returns to the Calibration menu.

C. Cycle Time Calibration

__NOTE__: THIS PROCEDURE SHOULD ONLY BE PERFORMED AFTER A VALID POSITION ENDPOINT CALIBRATION PROCEDURE HAS BEEN COMPLETED.

1. Use the DOWN switch to go to Cyt.
2. The display will alternate between Cyt and a cycle time reading.
3. Simultaneously press and release SEL and UP switches.

If this is selected, the actuator will first go to the full CCW position (if is not already there).

The display will than show PoC and the actuator will travel to the full CW (closed) position and record the travel time. At that point, the CW time measurement will begin.

The display will then show PoCC and the actuator will travel the full CCW (open) position and record the travel time. At that point, the cycle time calibration is complete and control returns to the calibration menu.

4.7 Run Mode

The valve actuator run mode display depends upon how the digital positioner board has been programmed.

There are seven Run Mode display screens: POS, SEt, CyCn, dbnd, CyC, CyCC, and ALr. The UP and DOWN switches are used to sequence to the next or previous screen when the parameter name screen is displayed.

For all screens described below, the display will alternate between the name and its value. Pressing the SEL switch will lock the value on the screen.

Run Mode Display Item	Definition	Units of Data
POS	Valve Position	Percent
SEt	Setpoint Position	Percent
CyCn	Count of completed cycles	Cycles
dband	Operating Deadband	Percent
CyC	Clockwise valve travel time from Calibration	Seconds
CyCC	Counterclockwise travel time from Calibration	Seconds
ALr	Alarm conditions that are active as shown below: **De** Deviation (excessive valve travel time) alarm. **Hi** Valve position greater than high alarm point. **Lo** Valve position less than low alarm point. **NoNe** No alarms active.	

4.7.1 Valve Position Screen

The display alternately displays POS and xx.x, the valve position in percent.

4.7.2 Input Setpoint

The display alternately displays SEt and xx.x in percent.

4.7.3 Cycle Count

The display alternately displays CyCn and the total run mode cycles.

4.7.4 Deadband Readout

The display alternates between dbnd and the current deadband value (even when Auto dbnd is selected).

4.7.5 CW and CCW Travel Time Readout

The display alternates between CyC and the calibrated time it took (in seconds) to go from the full CCW position to the full CW position.

Pressing the SEL key then shows the CCW time. The display alternates between CyCC and the calibrated time it took (in seconds) to go from the full CW position to the full CCW position. This is useful for comparing calibrated times with current times.

4.7.6 Alarm Status Readout

The display alternates between Alr and the current alarm condition. A high limit alarm condition will display Hi; a low alarm condition will display Lo; a deviation alarm condition will display dE. Since only one alarm condition can be shown on the display, the deviation alarm takes priority over the other alarms. When the deviation alarm is no longer active, the other alarms will be shown as described above.

4.7.7 Changing Operating Modes

In the Run Mode, holding down the SEL switch alone for three seconds will switch to the Program Mode. In the Run Mode, holding down the SEL and DOWN switches simultaneously for three seconds will enter the Calibration Mode. Holding down the SEL and UP switches simultaneously for three seconds will enter the Local Mode.

When the Program Mode is entered, Prog will briefly be displayed before the sequence described in part 4.4 begins. Pressing and holding the SEL switch in the Program Mode will exit and return to the Run Mode.

When the Local Mode is entered, Loc will briefly be displayed before the sequence described in part 4.5 begins. Pressing and holding the SEL switch in the Local Mode will exit and return to the Run Mode.

When the Calibration Mode is entered, CAL will briefly be displayed before the sequence described in part 4.6 begins. Pressing and holding the SEL switch in the Calibration Mode will exit and return to the Run Mode.

When the Run Mode is reentered, run will be displayed briefly.

Parameter	Parameter Name Display	Factory Default
Security code	CodE	unaffected
Communications address	Addr	unaffected
Optional current output module range	Ocur	4-20 mA
Setpoint direction	Sdir	RISE
Split range start point	SPrS	0.0 %
Split range end point	SPrE	100.0 %
Ramp open (CCW) time	OPEn	0 sec (ASAP)
Ramp close (CW) time	CLOS	0 sec (ASAP)
Setpoint function	SFc	LINEAR
Positioning deadband	dEbA	0.5 %
Loss of setpoint signal position	SPOS	0.0 %
Loss of setpoint dwell time	SPt	0 sec
Power-on position	PPOS	0.0 %
Power-on position dwell time	PPt	0 sec
Positioner lower rotational limit	yA	0.0 %
Positioner upper rotational limit	yE	100.0 %
Tight valve shut off operation	yCLS	NO
Full open valve operation	yOPn	NO
Communications rate	bAUd	38400
Valve total travel time	CyS	Unaffected
Total number of valve cycles	CyCn	Unaffected
Deviation alarm time	AdE	Unaffected
Valve high (CCW) position alarm.	AHi	100.0 %
Valve low (CW) position alarm.	ALo	0.0 %

4.8 Default Values (factory installed)

When default parameters are loaded in Program Mode, they are set as follows: See paragraph 4.4.17 for the procedure to set default values.

To restore all the parameters to the factory default settings as listed here, advance to the PrSt parameter, momentarily press the SEL switch, and then momentarily press the UP switch. The display will show yES for several seconds and then again begin flashing between PrSt and no. The factory defaults are now installed.

4.9 RS-485 Communications

NOTE*: The positioner must be in the RUN MODE for communication between the positioner and computer.*

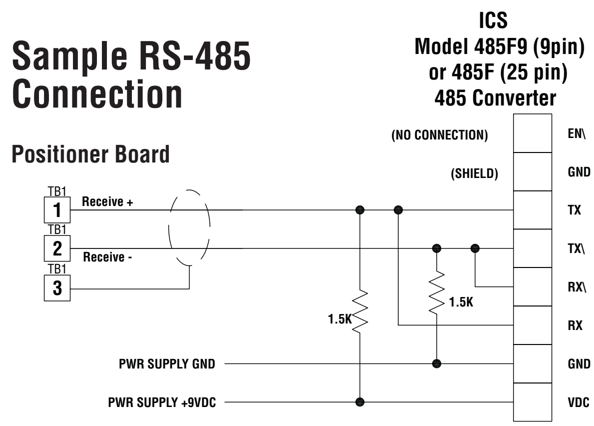
The Digital Positioner Board may be connected to a computer or PLC via an RS-485 two-wire serial bus. Unless the computer has an RS-485 port built in, it will be necessary to use an RS-232 to RS-485 converter on one of the computers serial ports. If there is more than one positioner on the serial bus, all positioner boards except for the last one on the bus must have the 120 ohm terminator resistor removed (see figure 1 in appendix for resistor location). The terminator resistor is in socket pins. The positioners should be connected to the RS-485 bus in a daisy chain fashion. CAUTION: Do not connect two units with the same address to the same RS-485 bus.

4.9.1 See the Worcester/McCANNA Packet Communications specification for the communications protocol information. It is on the software floppy diskette in the form of a txt file in the commspec directory and is called commspec.txt.

4.9.2 The RS-485 Converter must be connected directly to terminal strip TB1 of positioner board: terminals (1) positive; (2) negative and the shield connected to terminal (3).

4.9.3 A floppy disk is provided with the software that is to be installed on a computer which will allow communication with the positioner. There is one executable program on the floppy, ICP1.EXE, as well as several support files. The program may be run from the floppy. Flowserve strongly recommends that one or two backups be made of the software diskette before using it. Write protect the disks, or copy the software to the computer's hard drive (create an ICP directory and then copy all the files to that directory).

Sample RS-485 Connection



4.9.4 Setting Up The Communication Serial Port

NOTE*: THE POSITIONER HAS BEEN FACTORY-SET AT A BAUD RATE OF 38,400 bps.*

The baud rate range is 1,200 bps to 38,400 bps. The baud rate can be reset by reprogramming the positioner using the manual keys on the positioner board (see Part 4.5) but then will require resetting the baud rate in the communication software. (Baud rate as shown on the positioner board display must be the same as set up in the communication software.)

The communication software has been factory-set to default to communication port-1 “com-1” but can be reset to communication ports 2, 3, or 4 if required, as shown using Windows 98 in the following steps. The software baud rate has been factory set to 38,400 bps to agree with the positioner factory setting and can also be changed as follows.

After creating a directory and installing the software in your computer, perform the following:

a) In Explorer, select the Electri-Safe communications software folder and open it.

b) Select the “ICP.EXE” file, right mouse click and select “create shortcut” and drag the shortcut to your desktop.

c) Right mouse click on the communication Icon shortcut on your desktop and select properties.

d) On the properties screen select program and the “command line” should show the path ending in “EXE”.

e) To change the default baud rate and communication path—as an example—enter the following.

   Change baud rate to 19,200 bps.

   Change communication port to port-2.

   After “EXE” in the command line, insert a space and enter 19200, insert another space and enter 2.

   The command line path should look like the following, using your directory name.

   C:\ directory \ ICP.EXE 19200 2

   ***Note**: The baud rate in the positioner has to match the baud rate set in the software command line.*

4.9.5 Monitor Display

Once the program has been started, the following screen will appear (see Figure 1 on following page):

The program will start up looking for address 1. If that unit exists, communications are established. Otherwise, to establish communications with the positioner, tap the space bar. The cursor to the right of the arrow next to the address parameter will begin flashing. Type in the positioner address and then hit the enter key (factory default is 1). The words Reading data… will appear to the right of the arrow. In about two seconds the screen will fill with the positioner data. The arrow just to the left of the Status area indicates whether the positioner is under control of the analog signal or under the control of the computer (PC). The F4 key toggles between computer and analog control of the positioner.

The PC Cmd value in the Status area is the position output of the computer. This value can be changed with the left and right cursor keys but will only control position when the F4 key toggles to PC Cmd. Position can also be changed by pressing F12, entering the desired position on the numeric keypad and then pressing the enter key.

Input is the value of the analog signal being received by the positioner board and controls position only when the F4 key toggles to Input.

Output is the value of the 4-20 mA output signal for shaft position feedback (when this option is installed). Shaft Pos is the actual readout of the actuator shaft position in percent of shaft travel.

DB Run is the current setting for positioner deadband. When shaft motion stops, shaft position should always be within the deadband of the position command signal.

The Alarms are Over, Under, and Dev (Deviate). The area immediately under one of these alarms will light up if that alarm condition exists. The alarms are defined as follows:

Over – Shaft position is greater than the value set in the Over-travel Alarm.

Under – Shaft position is less than the value set in the Under-travel Alarm.

Dev – Shaft has not reached position called for by signal within the time specified by Deviation Alarm.

The **Calibration** Data is a listing of the stroke times measured during calibration.

The listings under **Ver x.xx** are the keys required to control the screen and the positioner.

F2 – Load a file of all parameters including curve data from the hard drive and download it to the positioner (about 40 seconds).

F3 – Save the data in the positioner to a file on the hard drive (about 20 seconds).

F4 – Toggle control of the positioner between the analog signal and the computer.

F9 – Enter the positioner response curve edit screen.

F10 – Enter the positioner ASCII EEPROM edit screen. (Customer information for this unit)

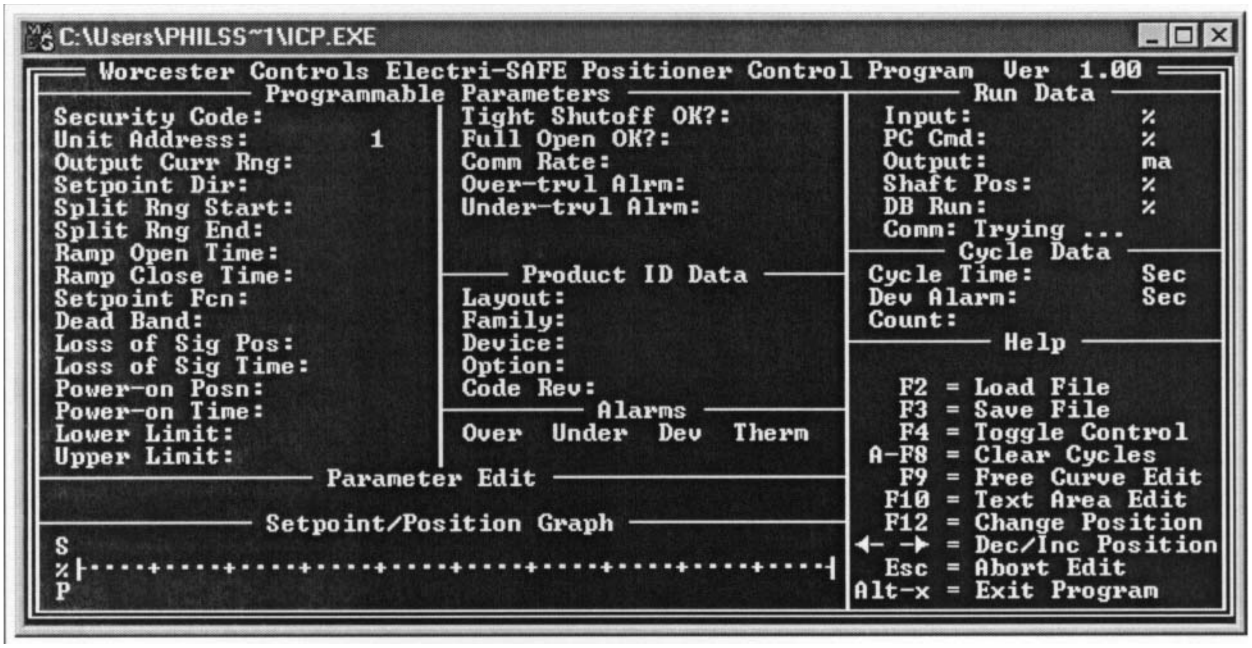
F12 – Enter desired position on numeric keypad then press enter.

[Right Arrow] – Increment the PC Cmd position output signal.

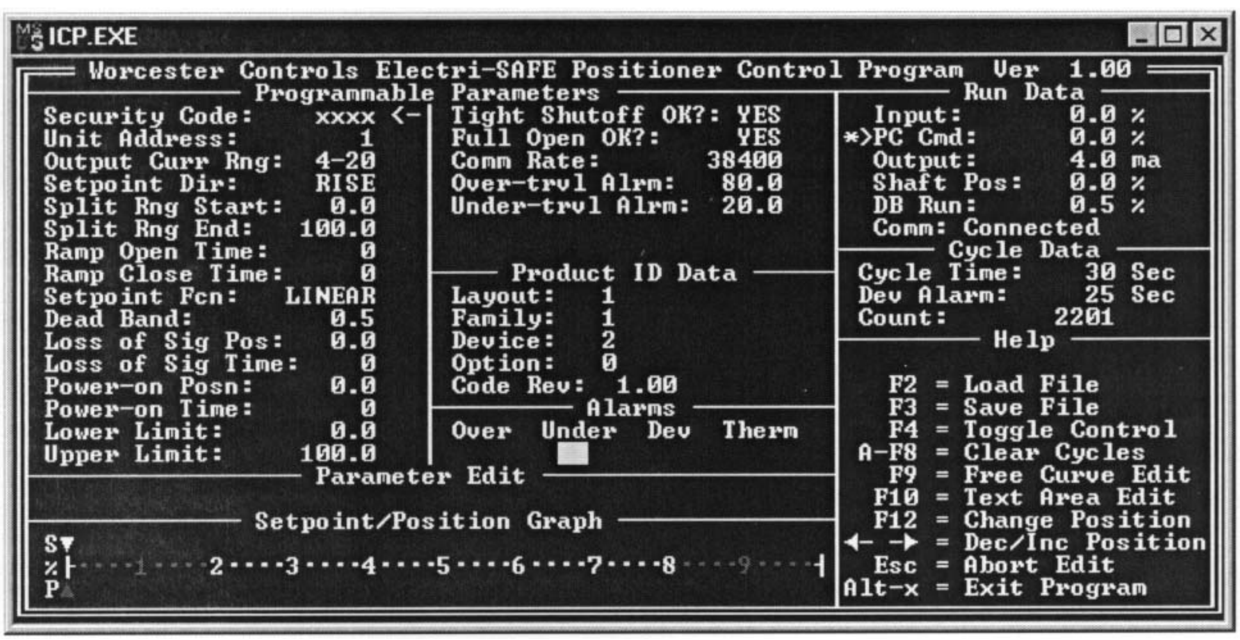
[Left Arrow] – Decrement the PC Cmd position output signal.

Alt-x – Exit the ICP program and return to DOS or Windows.

Figure 1: The following screen appears when the ICP program is first started:



The following screen appears after the Positioner Default Data is Loaded: (Some values may vary)



NOTE*: If you are not using the RS-485 converter that is shown above, then refer to the documentation that came with your converter for proper connections.*

5.0 Technical Data

5.1 Allowable Supply Voltage Range

120 VAC ±10% 50/60 Hz

Power Consumption

3 Watts

5.2 Input Circuit Specifications

Maximum Tolerated Noise Level at Maximum Positioner Resolution/Sensitivity: Approx. 3.5 mV (16 microamps)

Resistance Input

DP72-1K	Nominal 1000 Ohms
DP72-13	Nominal 135 Ohms

Current Input

DP72-1	1 to 5 milliamps
DP72-4	4 to 20 milliamps
DP72-10	10 to 50 milliamps

Voltage Input

DP72-5V	0 to 5 VDC
DP72-XV	0 to 10 VDC

5.3 Output Circuits Specifications

5.3.1 Motor Driver Circuitry Specifications

Maximum Normal Starting or In-Rush Current

10 amps for 1 second

Maximum Stall Current

8 amps for 1 minute

Maximum Running Current

5 amps (resistive load, 90% duty cycle)

Maximum Running Current

3 amps (inductive load, 90% duty cycle)

Maximum Peak Voltage at Load Circuit

800 VAC

5.3.2 Position Feedback – Current Output

4-20 mA output – will drive 20 mA into a maximum load of 350 ohms.

Maximum Voltage Output: 8 volts

Maximum Load Impedance: 350 ohms

5.3.3 Alarm Output

100 mA maximum at 50 volts DC maximum

5.4 Input Circuit Load Resistances

1 to 5 mA Models	Approx. 1000 Ohms
4 to 20 mA Models	Approx. 220 Ohms
10 to 50 mA Models	Approx. 100 Ohms
0 to 5 VDC Models	Approx. 800 Ohms
0 to 10 VDC Models	Approx. 1100 Ohms

6.0 Switch Option

A mechanical switch option is available in the Electri-SAFE Positioner. The switches can be used to provide actuator position indication or to control other equipment.

The option always available (regardless of other options) is:

M2 – Two Single-Pole, Double-Throw Mechanical Switches

The standard switches provided will be standard contact types suitable for low-power applications (120/240 VAC, 1A). Switches capable of handling higher currents are available through Flowserve.

An “Adjustment Plate” is used to mount the single-pole mechanical switches to the base plate. Mechanical switches are mounted to the adjustment plate and set to a middle position — not rotated towards or away from the shaft. There are two sets of mounting holes in the adjustment plate, use the appropriate set as shown below. Their use will be detailed later.

The cams used to actuate the switches offer unlimited positioning without the use of tools. These cams are essentially “wrap-springs” and grip the shaft tightly enough to prevent accidental rotation.

Figure 2

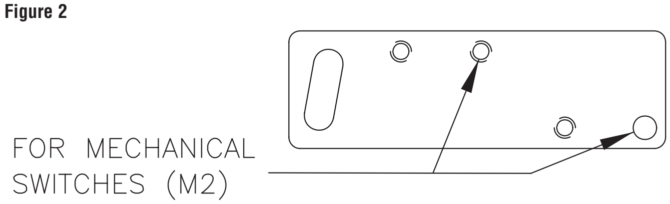
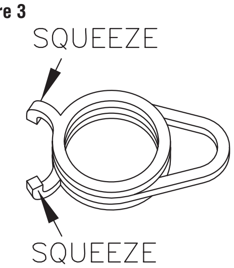


Figure 3



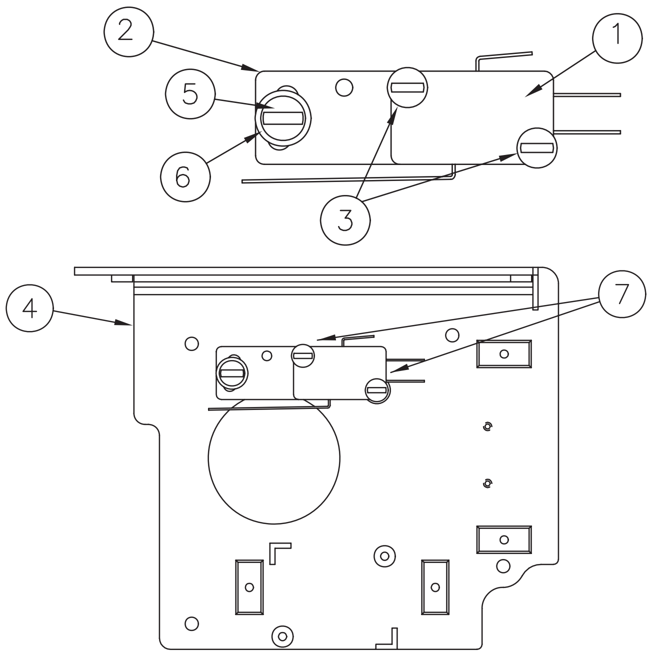
Squeezing together the two small protrusions from the cam, as shown above, loosens the spring and allows adjustment. Needle nose pliers may prove to be helpful when installing the cams, but are not required.

6.1 Assembly

a. M2 – TWO SPDT MECHANICAL SWITCHES

1. Stack two switches (item 1) and attach to the adjustment plate (item 2), as shown in Figure 4, using two #4-40 x 1" screws (item 3) provided. Note: One of the screws will thread into a tapped hole in the adjustment plate while the other engages a clearance hole without threads.
2. Assemble the switches and adjustment plate to the base plate (item 4) as shown below, using the “loose” #4-40 x 1" screw and the #4-40 x 3/8" screw (item 5) and #4 washer (item 6). Move the adjustment plate to a middle position and tighten the screws.

Figure 4



6.2 Cams

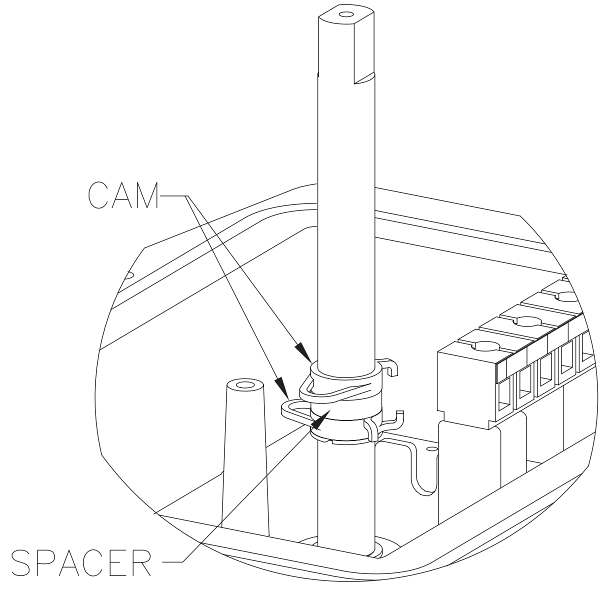
Assemble the first spring cam, the spacer and second spring cam. To work the spring cam down the shaft, squeeze the two protrusions and turn. See Figure 5.

6.3 Wiring

***NOTE**: All wiring is to be run neatly and away from any rotating parts, using wire ties, if necessary. Use caution to avoid pinching wires between the base and cover flanges. All wiring to terminal strip should be inserted only to midpoint of terminal strip.*

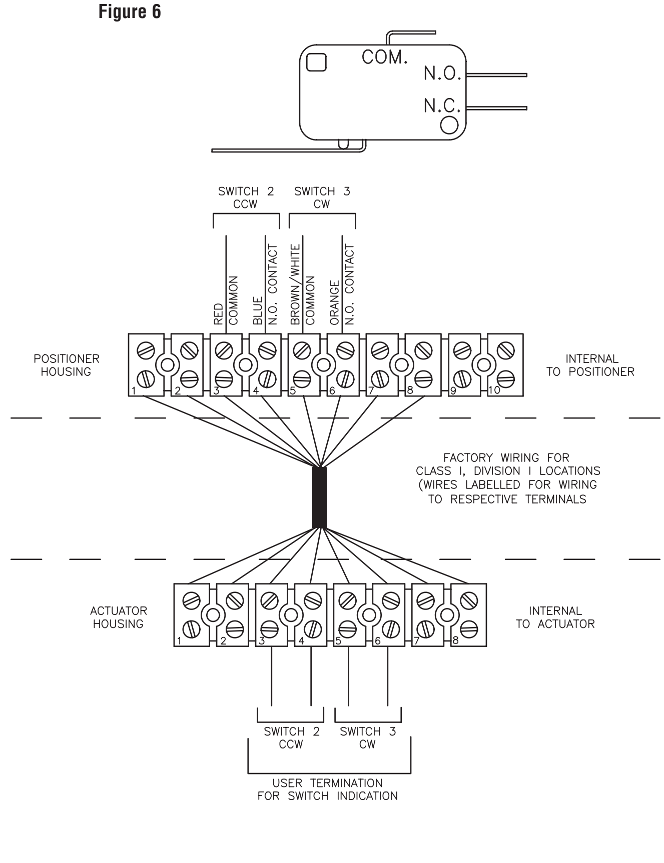
a. The wire leads will be connected to the switches as provided. Pay close attention to the switch labels, schematics, wire colors, etc. when wiring the switches. Switches are to be wired to the terminal strip as shown in wiring diagram to the right.

Figure 5



Switch	Common	N.O.
2	Red	Blue
3	Brown/White	Orange

Figure 6



b. Route the wires neatly and use wire ties if necessary. Be certain that the wires will not get fouled on the shaft when it rotates.

6.4 Operation

a. Once the positioner unit has been assembled and connected to the actuator, the switch cams can be set per user's requirements. Normally switch 2 indicates closed and switch 3 indicates open.

b. The unit should be operated to ensure that switch actuation occurs at the end of rotation (or in whatever position is desired by the customer) repeatably.

6.5 Troubleshooting

Problem	Possible Causes	Solution
Switches do not indicate at proper positions	Improper cam settings	Reset cams.
Switch does not actuate (never trips)	Switch too far from cam	Loosen the adjustment plate screws and rotate switches toward shaft until actuation is correct. Retighten screws.
Switch does not reset (always tripped)	Switch too close to cam	Loosen the adjustment plate screws and rotate switches toward shaft until actuation is correct. Retighten screws.
No indication at terminal strip	Broken, defective, or misplaced wire	Check wiring with appropriate wiring diagram in Appendix.
Cams not aligned with switch arms	Cams/spacers in wrong order	Check and reassemble cams per Part 6.2.
	Cams not pushed into place	Push cams into proper locations. Align with switch arms.

7.0 Troubleshooting

If the Electri-SAFE unit does not operate, the first thing to do is to determine if the problem is with the actuator or the positioner per flow chart on the next page.

7.1 General

7.1.1 Check the Input Signal Fuse F1. Location of the fuse is shown on the circuit board (see figure 1 in the appendix).

Check fuse F1 to see if it is blown. If it is, replace it with Littlefuse PICO II very fast-acting fuse rated at 62 mA. (Newark part number 94F2146).

IMPORTANT*: To check fuse F1, remove it from circuit and test with ohmmeter. Resistance should be about 6 ohms.*

NOTE*: If fuse F1 is blown, excessive voltage (possibly 120 VAC) was applied to the signal input circuit. If so, correct this condition before changing fuse.*

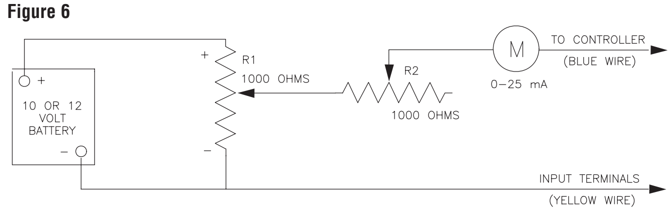
7.1.2 Signal Noise

If the circuit board's LEDs blink or seem to continuously glow, electrical noise is interfering with the positioner's input process signal. Always use shielded cable for the process signal coming to the digital positioner terminal strip. Ground the shield at one end only.

7.1.3 Signal Generator

To facilitate troubleshooting a positioner, it would be advantageous on resistive input units to connect a potentiometer directly to the signal input terminals in place of the standard process input. Use a 135 ohm or 1000 ohm potentiometer depending on which model is used. Figure 6 below shows a schematic of a simple test unit that can be connected to the input terminals to simulate the process signal for a milliamp input positioner.

Figure 6



Test Unit for milliamp Input Positioner – Set R1 all the way toward the plus end. Adjust R2 for a 20 mA reading. Varying R1 will now provide input signals between 4 and 20 milliamps.

7.2 Power Supply

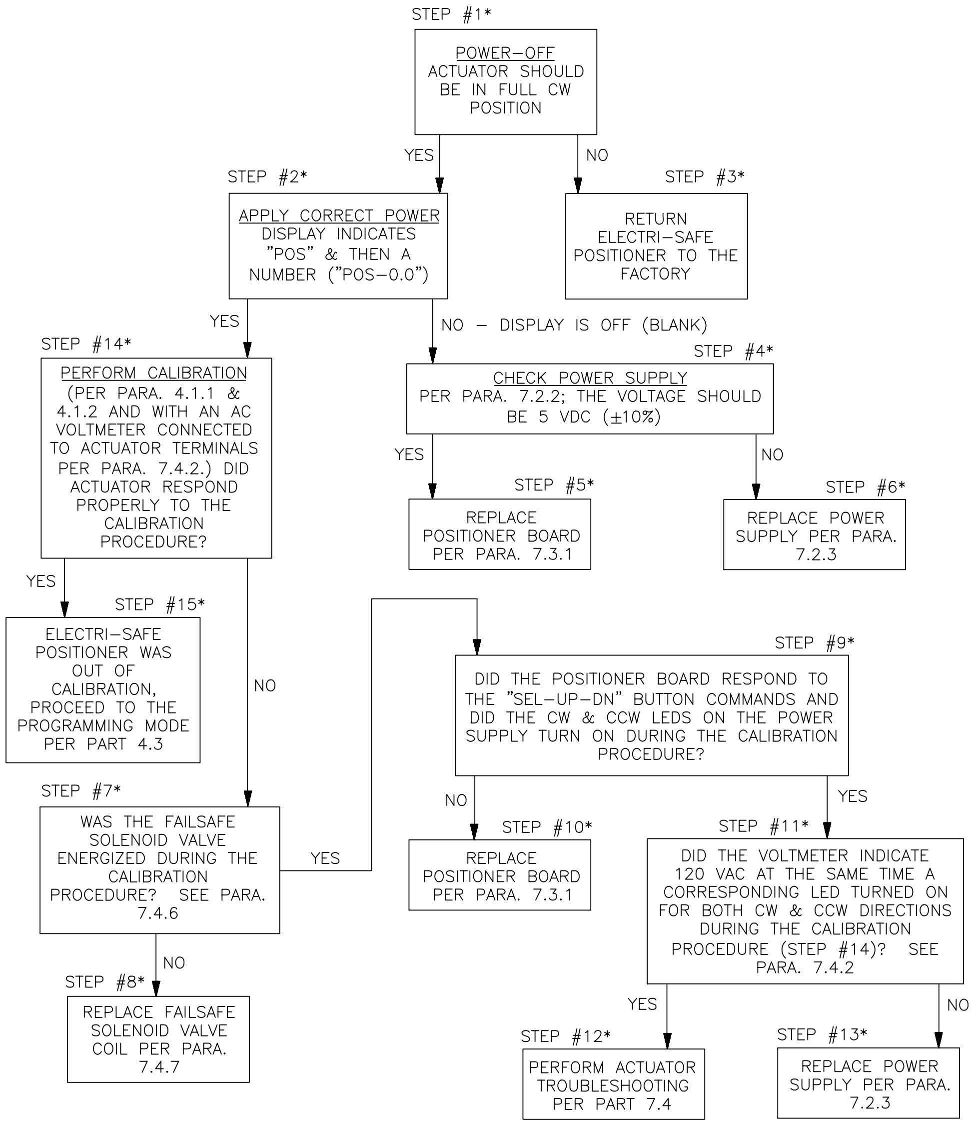
7.2.1 General

The power supply is a separately enclosed metal housing that contains the electronic components that supply the 5 volt logic for the positioner board. It also houses the triacs that operate the pump motor and positioning solenoid and CW/CCW indicating LEDs. There are no fuses in the power supply.

7.2.2 Power Supply Output Voltage (5 VDC)

Check: (troubleshooting chart step 4)

Electri-Safe Troubleshooting Chart**



* – CHART STEP #X – FOR REFERENCE ONLY – NOT THE ORDER OF PROCEDURE.

** – AFTER REPLACING ANY COMPONENTS, RETURN TO STEP #1.

On the back side of the power supply (opposite LEDs) is a five-pin connector that wires to the positioner board (see Figure 3 in the appendix). The pins are numbered 1 through 5 from left to right. Apply 120 VAC power to the actuator. With a digital voltmeter, pin 1 is positive and pin 2 is negative, check to see that 5 volts DC (±10%) is available at these pins. Be careful not to short meter leads to the positioner housing. If no DC voltage is measured, replace power supply per paragraph 7.2.3.

7.2.3 Power Supply Replacement

(Troubleshooting chart steps 6 and 13)

a) Remove AC Power from the actuator.

b) Unplug five-pin connector from back of the power supply housing.

c) Disconnect the white, brown, red and black wires from terminals 1, 2, 7 and 8 coming from the power supply.

d) Remove three mounting screws and remove power supply housing.

e) Install and wire new power supply as per d, c, b above.

f) Apply 120 VAC power and check for 5 VDC voltage as per paragraph 7.2.2.

7.3 Positioner Board

7.3.1 Positioner Board Replacement

(Troubleshooting chart steps 5 and 10)

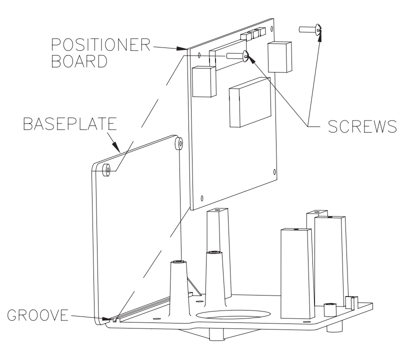
Refer to figure below.

a) Remove AC power.

b) Unplug 5-pin connector from back of power supply housing. Disconnect the white/brown, white/violet, orange, blue, yellow, red and black wires from board to terminal strip points 9, 10, A, B, C, D, and E respectively. Disconnect the potentiometer wires from terminal strip TB2 on board. Disconnect RS-485 wires (if any) from terminal strip TB1 on board.

c) Remove the two #4 screws and lift out the circuit board.

NOTE*: It may be preferable to wire the new circuit board to the terminal strip before mounting the circuit board to the baseplate.*



d) Locate the new positioner circuit board to the baseplate. The bottom edge of the circuit board fits into a groove in the baseplate as shown.

e) Secure the circuit board with two #4 x ¼" self-tapping screws through the top two holes in the board.

f) Make electrical connections per step b and refer to Figures 4 and 5 in the appendix.

g) Calibrate new board per part 4.6.

NOTE*: All wiring is to be run smoothly, neatly and away from any rotating parts, using wire ties if necessary. Use caution to avoid pinching the wires between the base and cover flanges.*

All wiring to terminal strips shall be inserted only to midpoint of terminal strips.

7.4 Actuator Troubleshooting

7.4.1 General

Note*: With no power applied to the actuator, it should be in the full CW position. If not, remove the actuator from service and return it to the factory. There are no field serviceable components associated with the hydraulic pump/motor. The solenoid coils can be replaced in the field per paragraphs 7.4.5 and 7.4.7.*

7.4.2 Command Functions (CW & CCW) Voltage Check

(Troubleshooting chart steps 11 and 14)

This voltage test is done in conjunction with the calibration procedure in order to determine initially if the problem resides with the positioner or the actuator. Perform calibration procedures 4.2.1 and 4.2.2 and at the same time connect a voltmeter to measure the 120 VAC command signals at the actuator terminal strip. When checking for CCW rotation connect the voltmeter to terminals 1 and 7. When checking for CW rotation connect the voltmeter to terminals 2 and 7.

7.4.3 Pump/Motor and Positioner Solenoid Valve Functions

(Troubleshooting chart step 12)

(Perform test in the actuator housing.)

Check For CCW Rotation: Operation of the hydraulic pump/motor.

(Both the CCW and CW tests should be performed with jumper wires that have insulated probe tips.)

Remove the red wire marked 1 and black wire marked 2 from terminals 1 and 2 in the actuator housing and tape these leads separately.

Note: *These wires are part of the bundle that goes to the positioner housing and the two wires are removed from the right side of the terminal strip.*

Using a test cable, connect 120 volt leads (power off) to actuator terminals 7 (neutral) and 8 (hot). Apply power to the actuator and place and hold the jumper probes across terminals 8 and 1. The actuator should rotate CCW until it is stopped by the CCW limit switch 1 in the actuator housing. If the actuator pump/motor does not start, place a jumper across the two wired terminals on switch 1. If the pump/motor starts, quickly remove the jumper and determine if the switch is out of calibration or defective. Replace defective switch and/or calibrate switch operation per paragraph 4.2.1. If the motor still does not start, check for an open motor winding, and check for a shorted capacitor. If the problem with the pump/motor still cannot be determined, return the unit to the factory. If the pump/motor functions properly in the CCW direction, remove jumper probes from terminals 8 and 1 (keep power applied to terminals 7 and 8) and proceed to check the CW rotation function.

Check For CW Rotation: Operation of the positioner/control solenoid.

Be careful, power has to be continuously applied to terminals 7 and 8 for this step.

With the actuator in the full CCW position, remove jumper probes from 8 to 1 and place and hold the jumper probes from 8 to 2. The positioner/control solenoid should energize and the actuator should turn in the CW direction and stop in the full-closed position. If the actuator does not rotate in the CW direction, the positioner solenoid coil may be defective and requires a continuity test per paragraph 7.4.4.

7.4.4 Positioner/Control Solenoid Valve Coil Continuity Test

With power off, disconnect the lead going to the positioner/control solenoid coil at terminal 2 and measure resistance with an ohmmeter connected to this lead and terminal 7. The meter should indicate between 125–150 ohms. If the meter reads infinite (open) the coil is defective and needs replacing per paragraph 7.4.5.

7.4.5 Positioner/Control Solenoid Valve Coil Replacement

Refer to figure 8 in the appendix.

CAUTION: Electrical power must be removed from the unit before working on replacement of the solenoid coil. There is a risk of electrical shock.

a) Remove the pump end cover and gasket.

b) Remove the nut holding the solenoid coil onto the valve.

c) On the limit switch end, disconnect the two black solenoid wires from terminal strip locations 2 and 7.

NOTE*: When removing the solenoid, attach a chase string or wire to the coil wires as you pull the coil wires through the actuator. You can cut the solenoid coil wires from the coil end and use them as a pull through as well. This will allow feeding the new coil wires along the side of the pump motor subassembly.*

d) Remove the solenoid coil from the valve subassembly.

e) Pull the new solenoid coil wires through the enclosure tube using the chase string or wire.

f) Install the new coil onto the valve subassembly.

g) Install the nut to hold the coil onto the valve subassembly.

h) Reconnect the two new black solenoid coil wires to the terminal strip at locations 2 and 7. Refer to figure 6 in the appendix.

i) Install the cover gasket and cover. Tighten the cover screws to make a weather-tight seal between the cover and the pump end casting.

7.4.6 Fail-safe Solenoid Valve – Function and Continuity Test

(Troubleshooting chart step 7)

The fail-safe normally closed solenoid valve is continuously energized (an open) as long as power is applied to the actuator. Check the operation of the fail-safe valve while calibrating per paragraph 4.2.1. When a command is given to the actuator to go in the CCW direction and the CCW LED on and the power supply is on and the motor/pump can be heard running and the actuator does not move, the fail-safe valve coil has probably failed and de-energized. With power off, disconnect the lead going to the fail-safe solenoid coil at terminal 8 and measure resistance with an ohmmeter connected to this lead and terminal 7. The meter should indicate between 100–175 ohms. If the meter reads infinite (open) the coil is defective and needs replacing per paragraph 7.4.7.

7.4.7 Fail-safe Solenoid Valve Coil Replacement

(Troubleshooting chart step 8)

Refer to figure 8 in the appendix.

CAUTION: Electrical power must be removed from the unit before working on replacement of the solenoid coil. There is a risk of electrical shock.

a) Remove the pump end cover and gasket.

b) Remove the ⅝" nut and spring washer holding the solenoid coil onto the valve.

c) On the limit switch end, disconnect the two black solenoid wires from terminal strip locations 7 and 8.

NOTE*: When removing the solenoid, attach a chase string or wire to the coil wires as you pull the coil wires through the actuator. You can cut the solenoid coil wires from the coil end and use them as a pull through as well. This will allow feeding the new coil wires along the side of the pump motor subassembly.*

d) Remove the solenoid coil from the valve subassembly.

e) Pull the new solenoid coil wires through the enclosure tube using the chase string or wire.

f) Install the new coil onto the valve subassembly.

g) Install the spring washer and the ⅝" nut to hold the coil onto the valve subassembly.

h) Reconnect the two new black solenoid coil wires to the terminal strip at locations 7 and 8. Refer to figure 6 in the appendix.

i) Install the cover gasket and cover. Tighten the cover screws to make a weather tight seal between the cover and the pump end casting.

8.0 APPENDIX: Illustrations and Wiring Diagrams

Figure 1 – Positioner Board

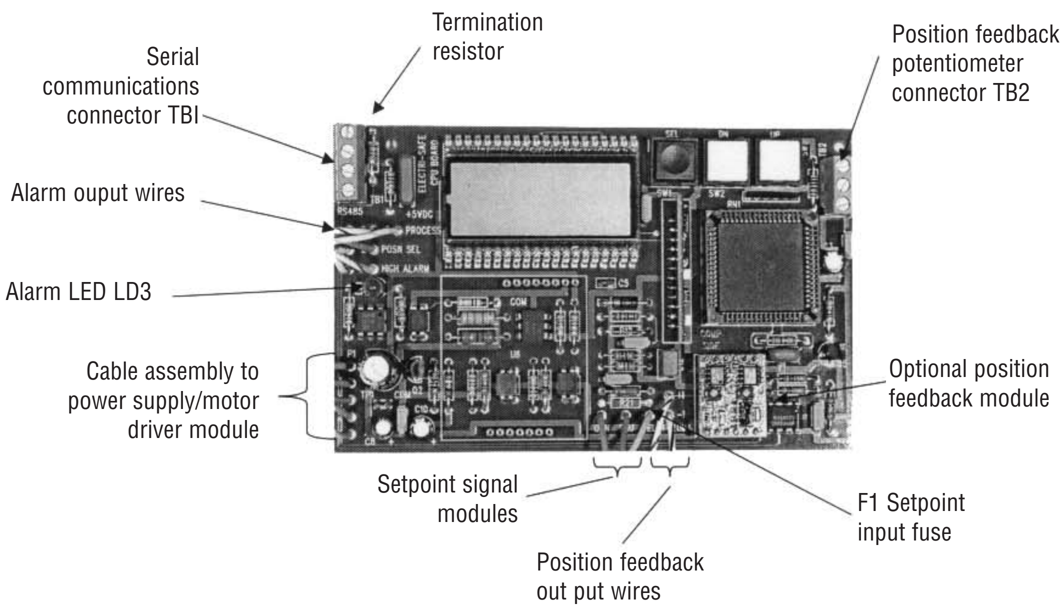


Figure 2 – Front Side

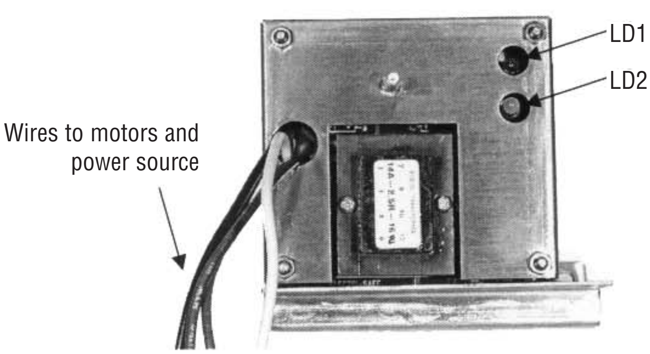


Figure 3 – Back Side

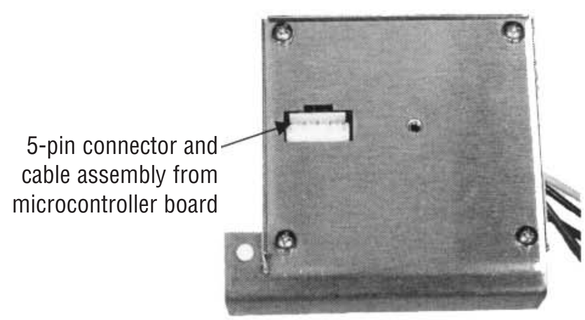


Figure 4
Positioner Housing
Side Terminal

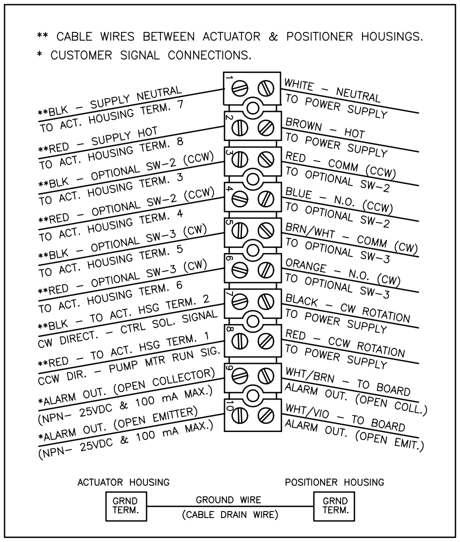


Figure 5
Positioner Housing
End Terminal

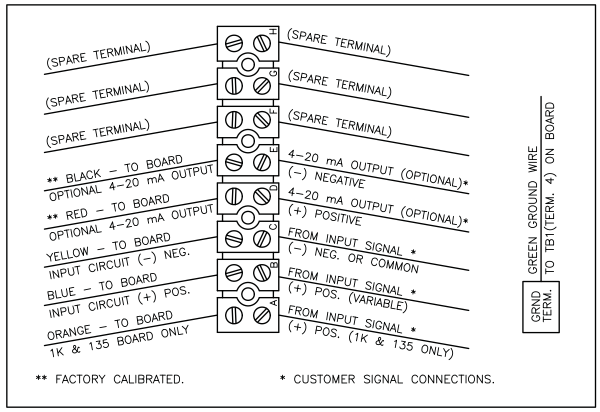


Figure 6
Actuator Housing

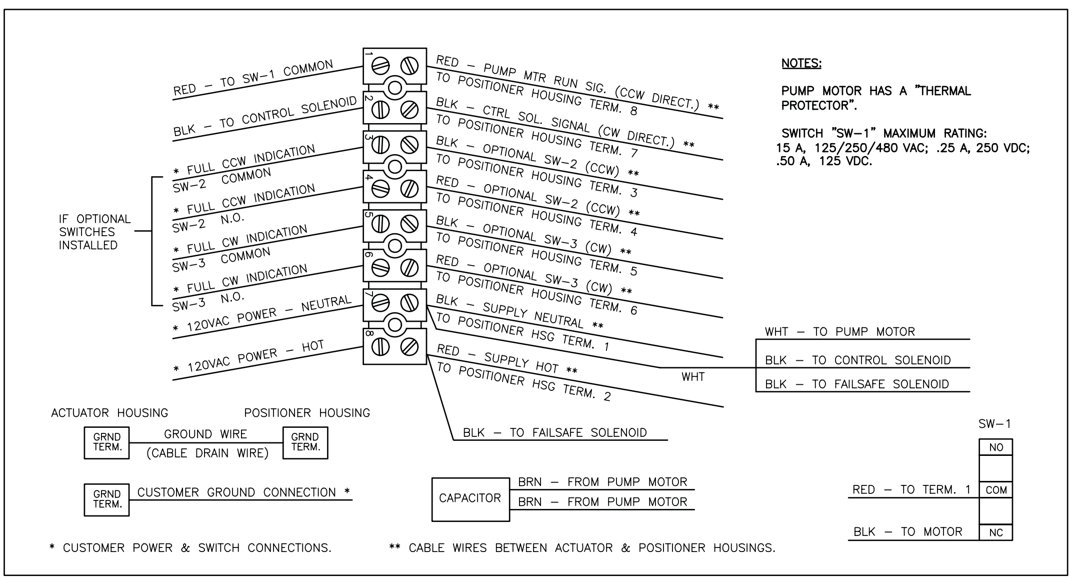


Figure 7
Positioner Housing – Major Components

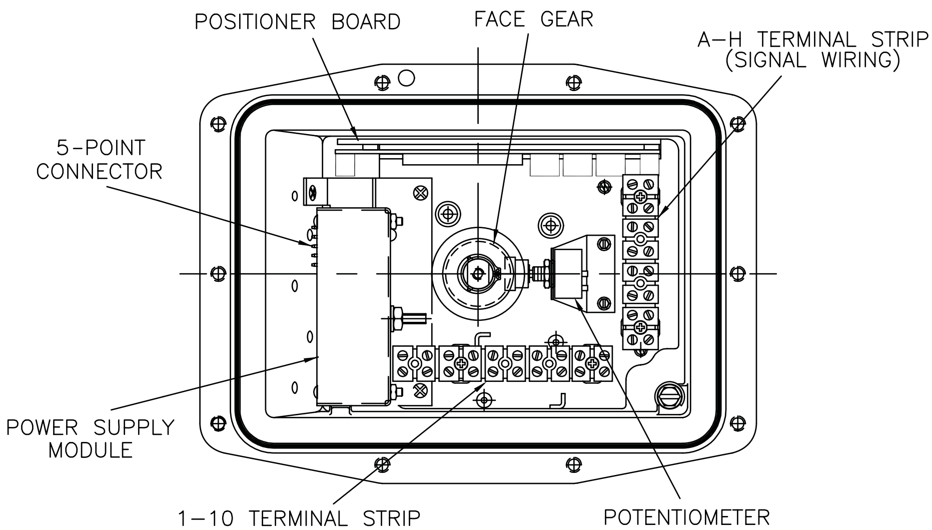


Figure 8
Actuator Pump End Housing

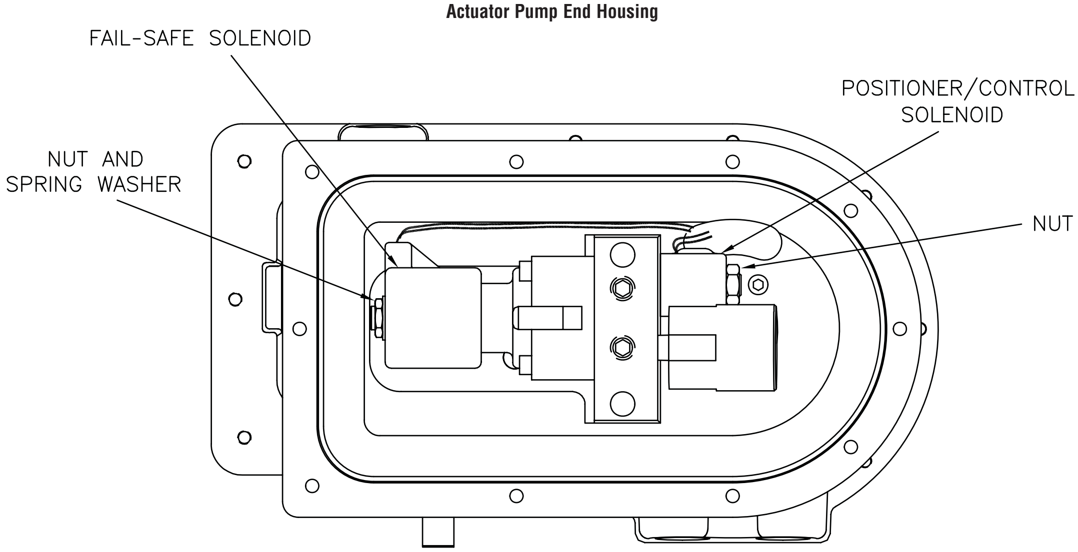
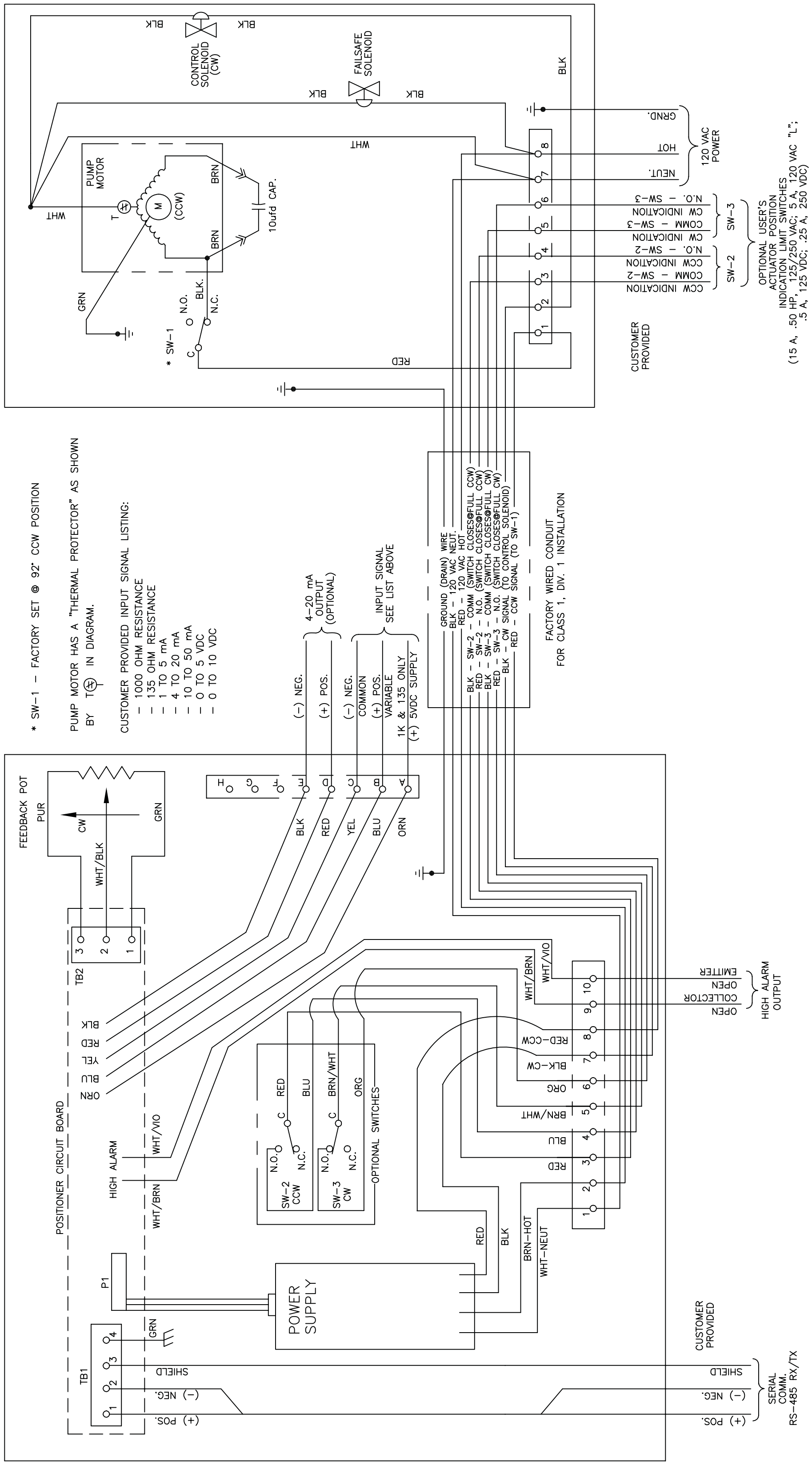


Figure 9
DP72 Interconnection Wiring Diagram



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