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INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTIONS TYPE EPC ELECTRO-PNEUMATIC CONTROLLER

PRINTED IN USA

SIOI145A/9106

SPECIFICATIONS

SUPPLY VOLTAGE:	120 VOLTS 50/60 HZ OR 240 VOLTS 50/60 HZ 24V DC
OPERATING VOLTAGE RANGE:	90 TO 110% OF RATED VOLTAGE
POWER CONSUMPTION:	10 WATTS
INPUT:	(STD) 4 - 20 mA (OPTIONAL) TRANSMITTERLESS RTD SIGNAL CONDITIONING CARD
CONTROL ACTION:	DIRECT OR REVERSE (SWITCH SELECTABLE)
LOCAL SET POINT ADJUSTMENT:	MULTI-TURN POTENTIOMETER WITH DIGITAL DISPLAY
REMOTE SET POINT ADJUSTMENT:	4 - 20 mA STANDARD INPUT
DISPLAY MODES:	CALIBRATION (HIGH/LOW), SET POINT, PROCESS VALUE, DEVIATION
AIR SUPPLY:	100 PSIG MAX
OUTPUT:	0 TO MAXIMUM SUPPLY PRESSURE
AIR CONSUMPTION:	NO STEADY STATE AIR CONSUMPTION
DISPLAY:	3-1/2 DIGIT LCD BACKLIT DISPLAY (GREEN BACKGROUND)
ACCURACY:	±0.5% OF FULL SPAN
SETTING ACCURACY:	ACTUAL SET VALUE COINCIDES WITH INDICATED SET VALUE
RESPONSE SPEED RANGE:	200:1
DEAD BAND:	ADJUSTABLE FROM ± 0% TO 6% OF FULL SPAN
INPUT RESISTANCE OF CURRENT LOOP:	100 OHMS
AMBIENT TEMPERATURE:	32°F - 122°F (0° TO 50°C)
WEIGHT:	8 LBS. (3.6 KG)
DIMENSIONS:	9" WIDE X 11" HIGH X 6.25" DEEP (23cm X 28cm X 16cm)
APPROVALS:	CSA
ENCLOSURE:	NEMA 1-2-3-3S-4-4X-12-13
ENCLOSURE MATERIALS:	ENCLOSURE: NORYL COVER: POLYCARBONATE
PNEUMATIC FITTINGS:	1/8 NPT (FEMALE)
AIR DELIVERY:	SOLENOID FULLY OPEN 0.55 SCFM AT 60 PSI

EPC CONTROLLER MOUNTING DIMENSIONS

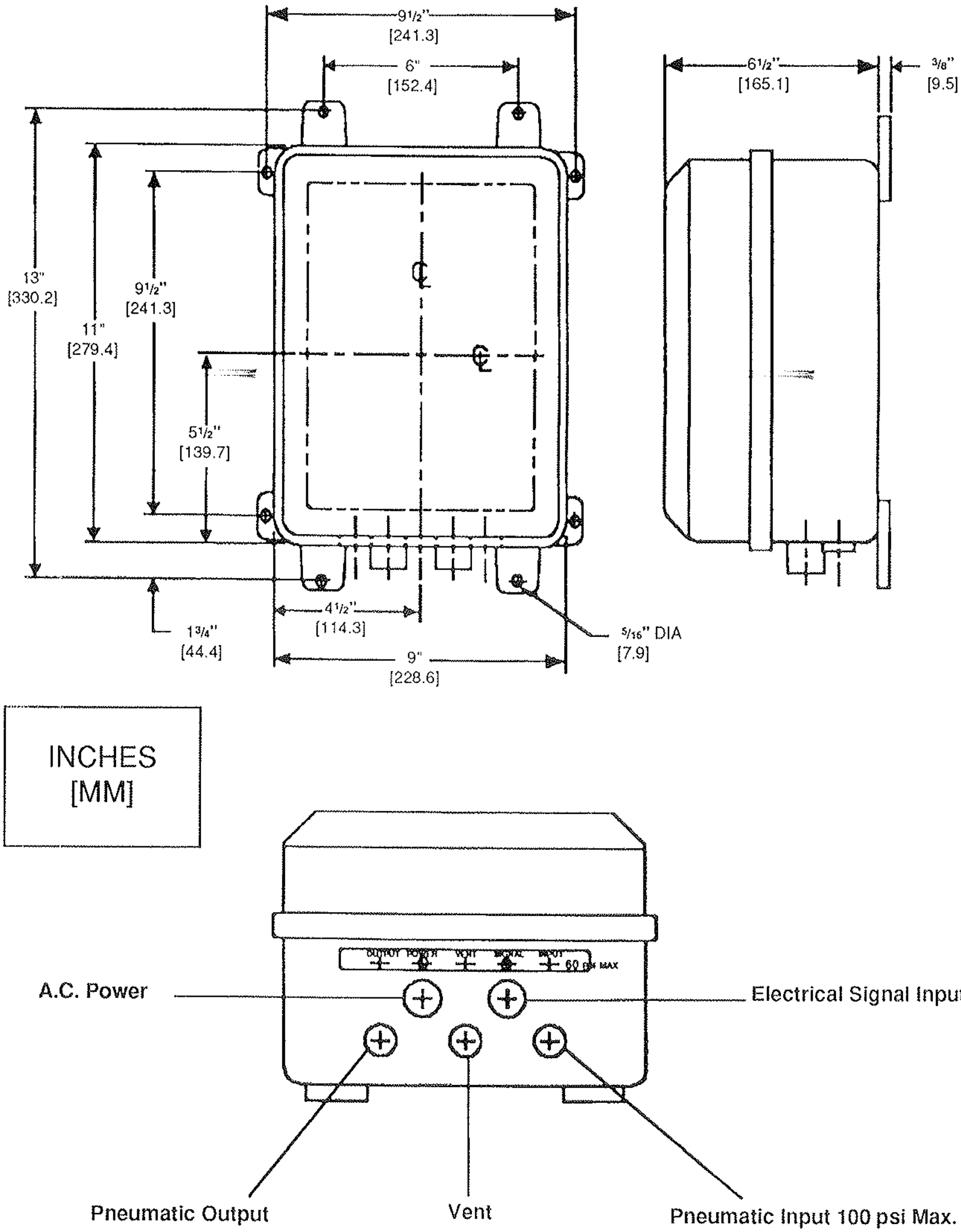


FIGURE 1

A. INTENDED PURPOSE

The Spence EPC electro-pneumatic controller can be used to control pressure, temperature, liquid level and other process variables. It accepts signals from any standard 4-20 mA transmitter and provides a pneumatic output to operate a diaphragm control valve, etc. It provides the following features:

1. The controller supplies 24 volt D.C. power for the transmitter, eliminating the need for a separate D.C. power supply.
2. It provides high volume air output at pressures up to 100 psig to directly operate a diaphragm control valve. I/P transducers and valve positioners are not required or recommended.
3. There are no small air orifices to plug or foul.
4. There is no air consumption except when air is being loaded onto the control valve diaphragm.

B. OPERATING PRINCIPLE

1. The electronic circuit of the controller compares the signal from the transmitter to the desired set point.
2. If the error is greater than the dead band, electrical pulses are sent to one of the two internal air solenoid valves. One valve increases output air pressure and the other bleeds it.
3. Each time a pulse is received, the resulting pressure on the diaphragm of the control valve increases or decreases slightly. If the error is large, the solenoid valves are held open longer to increase the speed of output changes. For small errors, the pulse width is decreased to prevent overshoot.
4. The response speed adjustment can be used to control how quickly the output changes for a given error.
5. Adjusting the dead band will allow the controller to ignore small changes or "noise" in the system. The overall result is more accurate and stable control.

C. INSTALLATION

1. Mount the controller in a location that will allow access to the internal adjustments. See Figure 1 for mounting dimensions.
2. It should be mounted in a location where the temperature will be between 32 - 122°F. Temperatures above or below these limits will affect the LCD although the controller would continue to function.
3. A location within 50 feet of the control valve is recommended to reduce time lags in the pneumatic signal. Where the distance to the control valve is large, an optional external solenoid valve package (EPC local control module model RCS-90) can be used.

   WARNING: Electrical power must be supplied through a circuit with external circuit breaker or fuse protection. An external switch must be provided to turn off power. Always turn off power before removing the internal field wiring panel.
4. Connect air supply and output lines to the 1/8" NPT connections on the bottom of the controller. The center connection is for exhaust air and is supplied with a porous metal filter/silencer which should not be removed.
5. Corrosion resistant 3/8" O.D. tubing or 1/4" pipe is recommended for the air lines. Connect air supply to the right hand connection labeled "Input" and output to left hand connection labeled "Output". See Figure 1.
6. The supply line should be fitted with a pressure gauge and 50 micron filter/regulator to remove any floating particles. If the supply air is mixed with traces of oil, a filter capable of removing oil should be used. **CAUTION:** Some lubricating oils permanently damage solenoid valves.
7. After mounting the EPC at the desired location, remove the cover by removing 6 screws. Then remove field wiring panel by loosening two captive screws. The terminal block wiring diagram shown in Figure 2 appears on the back of the panel. Power and signal lines should be routed through separate conduits to avoid interference.

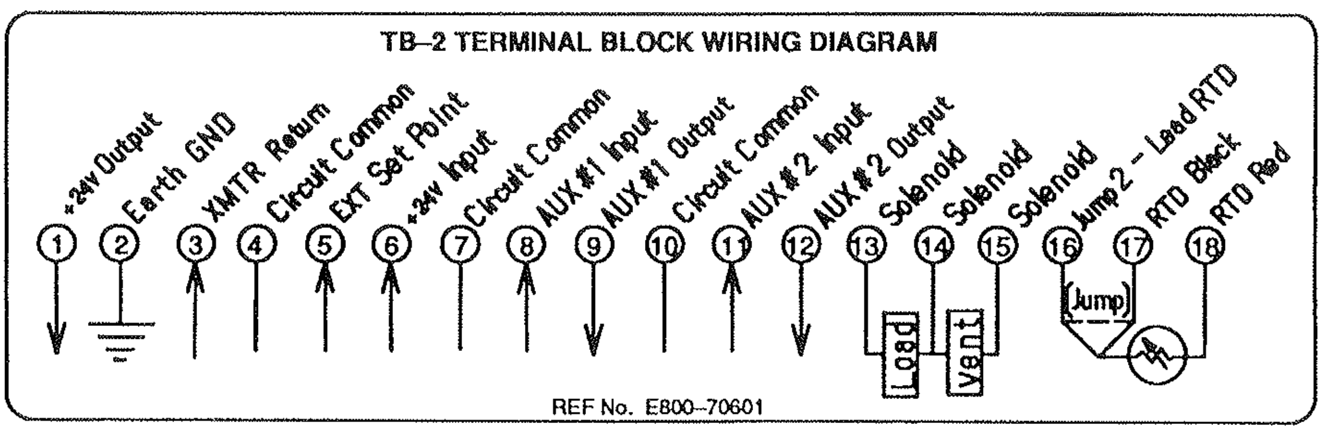


FIGURE 2

8. Connect the transmitter wires as shown in Figure 3. A two wire transmitter should be powered with the 24V DC supply from the EPC by connecting the positive wire to terminal number 1 and the other transmitter wire to terminal 3 of TB-2. Twisted pair wires can be used for connecting the transmitter to the EPC. If a shielded pair of wires is used, connect the shield to terminal 2 of TB-2.

9. For external set point connection (4-20mA), connect two wires to terminals 5 and 4 of TB-2. Terminal 5 is positive (current flows into terminal 5) and terminal 4 is negative. (See Figure 4.)

10. Terminals 8 and 9 are used to engage the "slow loop" control format for slower reacting processes such as temperature or level control. This is accomplished by moving the jumper from terminals 7 and 8 to terminals 8 and 9. (See Figure 5.)

11. Terminals 11 (Aux #2 input) and 12 (Aux #2 output) have been reserved for adding future options to the controller.

12. Terminals 13, 14 and 15 are used to connect the optional local control module model RCS-90. This module can be used if the EPC is mounted at a remote location from a control valve.

13. When the EPC is being used as a temperature controller with an RTD, an optional signal conditioning card calibrated for a temperature range suitable for the process must be installed in TB-5. For a 3 wire RTD, connect the two RTD wires that are internally connected together (zero resistance between them) to terminals 16 and 17 and the remaining connection to terminal 18 of TB-2. (See Figure 6.) For a 2 wire RTD, jump terminals 16 and 17. (See Figure 7.) See appendix C for guidelines on practical distance limitations.

14. Power and signal lines should be routed through separate conduits to avoid interference. Set the 120/240 voltage switch (SW1) to match the supply voltage. Do not turn on A.C. power yet. With AC power circuit breaker OFF, connect power leads (unpowered) to TB-1 (Figure 8). Connect the black wire to terminal 1, the white wire to terminal 2 and the green or green/yellow earth ground wire to terminal 3 of TB-1. If the EPC is powered by 24V DC, connect the positive connection to terminal 6 and the negative connection to terminal 7 of TB-2 and DO NOT connect any wires to TB-1. (See Figure 9.)

F. INITIAL START UP AND SETTING

1. Close stop valves upstream and downstream of the diaphragm control valve.

   CAUTION: All the Pneumatic connections must be tight enough to be leak proof for proper operation.

   WARNING: Keep stop valves closed until all adjustment and checks in steps 2 - 10 are completed.

   WARNING: Turn off electrical power before removing the internal field wiring panel.

2. Take off the field wiring panel by loosening screws..

3. Set the direct/reverse switch (SW3) to the proper position. (See Figure 8). When set on direct, the air output will increase when the signal from the transmitter increases and vice versa.

   EXAMPLE: If the system is being used to control pressure downstream of a normally closed control valve, reverse action would be required (increasing system pressure will increase the signal from the transmitter and this must produce a decrease of output signal air pressure to close the control valve).

4. If a remote set point signal (4-20 mA) is being used, move the remote/local switch (SW2) to the remote position. (See Figure 8). Otherwise, put it in the local position. (At local position of SW2, set point is controlled by the set point control knob located on the panel.

5. If the EPC is being used for controlling slow reacting processes like temperature and level, select the control format for slow-acting control loops by moving the jumper from terminals 7 and 8 to terminal 8 (AUX#1 Input) and terminal 9 (AUX#1 Output) on the Field Wiring Terminal Block, as shown in Figure 5. For control loops other than pressure, temperature or level, install the EPC with the control format that will be most suited to the control system's reaction to control valve change.

6. For initial adjustment, turn the response speed knob to mid position and dead band to position 1.

7. Connect the appropriate jumper, as shown in Figure 8 to locate the decimal point for maximum resolution of the display in relation to the input transmitter. (The EPC is shipped with jumper at J9). Following table shows the range of the display at each jumper position. Replace the field wiring cover.

J7	= 0.000 to ±1.999
J8	= 00.00 to ±19.99
J9	= 000.0 to ±199.9
J10	= 0000 to ±1999

   EXAMPLE: If the EPC controller is being used to control pressure and the pressure transmitter is calibrated for a range of 0 -100 psig, then the maximum resolution will be achieved by placing the decimal point between the third and fourth digits (J9), so that the display will read "100.0" at full scale.

8. Turn on the external electrical power.

9. Display calibration. The display can be calibrated in a range from -250 to +1999 units. A decimal point can be placed after the first, second, third or fourth digit. If a change is required, turn off the external power, then see step 7, above.

WIRING DIAGRAMS FOR TYPICAL INSTALLATIONS

Wiring Connections for 4—20 mA Transmitter (e.g. pressure or level)

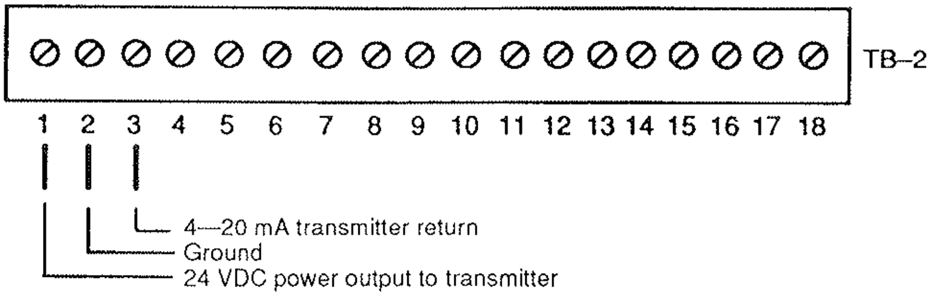
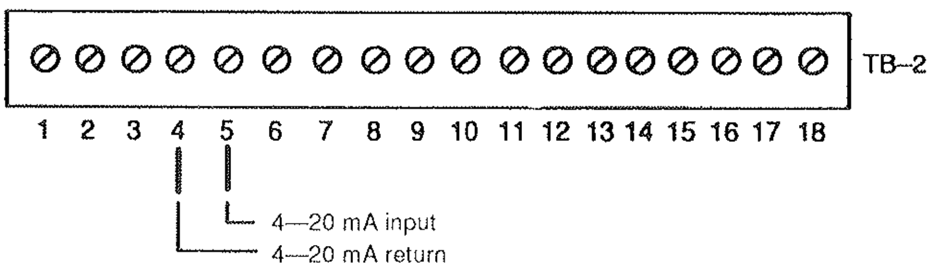


FIGURE 3

Wiring Connections for External Set Point



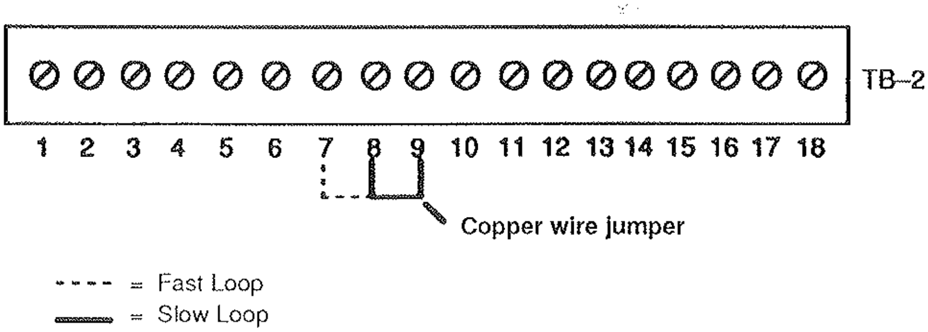
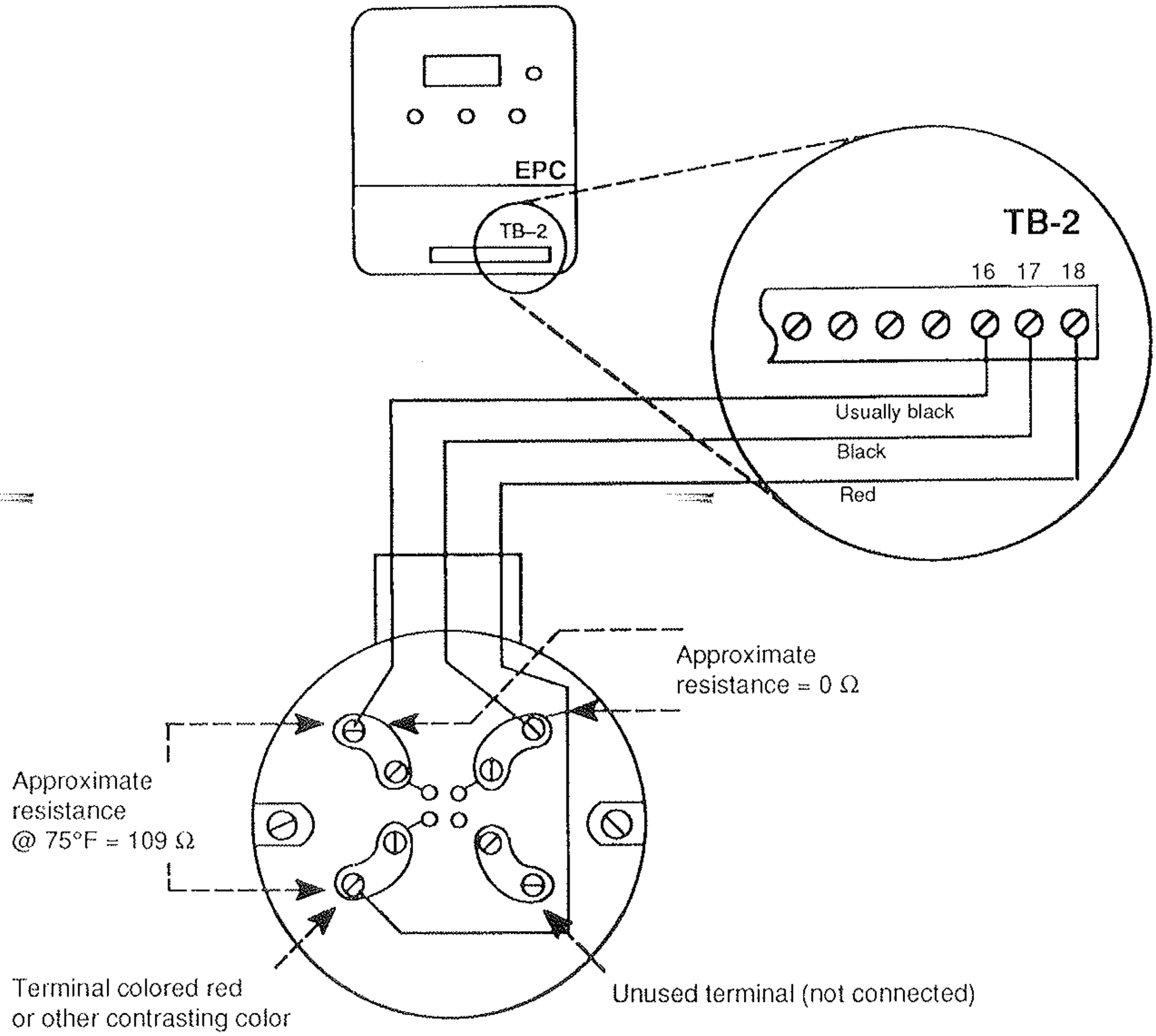


FIGURE 5

CONNECTING AN RTD TO THE EPC



3 Wire RTD Head

FIGURE 6

Wiring Connections for Two—Wire RTD (temperature)

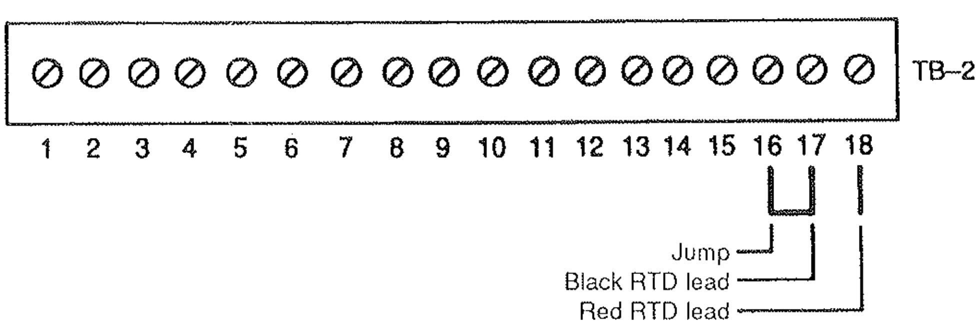


FIGURE 7

a. Set the DISPLAY MODE switch to "CALIBRATE LO". Using a small screwdriver supplied with the unit, adjust the "LO" potentiometer on the front of the panel so that the display indicates the bottom range of the transmitter.

b. Set the DISPLAY MODE switch to "CALIBRATE HI". Adjust the "HI" potentiometer on the front of the panel so that the display indicates the top range of the transmitter.

EXAMPLE: If the EPC controller is being used to control temperature and the RTD with optional signal conditioning card is calibrated for -25 deg. C to +175 deg. C, then the display must be calibrated to read "-.25.0" when the DISPLAY MODE switch is in the "CALIBRATE LO" position and "175.0" when the DISPLAY MODE switch is in the "CALIBRATE HI" position.

10. Using one of the pressure sensitive labels supplied, label the display to indicate the unit of measurement.

11. Adjust the air supply pressure to the controller by adjusting the filter/regulator. The pressure should be set 5 - 10 psig higher than required to operate the diaphragm control valve. Do not exceed 100 psig.

12. Set the display mode switch to "SP" and turn the set point adjusting knob, observing the operation of the diaphragm control valve. If it does not move in the proper direction, the action can be reversed with the direct/reverse switch.

13. Adjust the set point to move the control valve to the closed position.

14. The system can now be started.

WARNING: This instruction can not cover the safety precautions and procedures required for safe start-up of every system. Make sure you understand the system and its safe operation before start-up.

15. Keeping the DISPLAY MODE switch in the "SP" position, turn the set point adjusting knob until the display reads the desired set point.

16. Set the DISPLAY MODE switch to "PV", which will indicate the actual status of the process being controlled.

17. Adjust response speed and dead band to provide stable control. Maximum speed and minimum dead band will provide the highest accuracy but the system may cycle. It's best to adjust the speed and dead band at minimum system flow. With the dead band control at mid position, turn the response speed toward maximum until the system starts to cycle, then turn it back approximately 1/8 turn. Now turn the dead band toward minimum until cycling occurs, then back 1/8 turn. Check the operation at other system loads to assure stability. When the system is stable, the solenoid valves inside the controller should be silent. Change the speed and dead band adjustments as required to make the system stable at all flows.

G. TROUBLE SHOOTING

1. System Cycles
   a. Adjust dead band and response speed. (See step 17 of start-up instructions).
   b. Check that the diaphragm control valve is operating within its rated flow rangeability.
2. Control valve operates in the opposite direction required to satisfy the system.
   a. Check position of direct-reverse switch.
   b. Check that solenoid valves under the printed circuit board are wired properly. Connectors and valve are marked.
3. Controller does not operate at all (LCD display off).
   a. Check A.C. power connection.
   b. Check fuse (F) in Figure 2).
4. Controller does not respond to changes in set point adjustment.
   a. Check that the set point switch is in the local position.
5. Controller does not respond to changes in the controlled variable.
   a. Check connections and signal from transmitter.
6. The displayed process value does not match the actual.
   a. Check display calibration (step 6 of start-up instructions).
   b. Check calibration of transmitter. (See instructions supplied with transmitter).
7. Control valve does not respond to controller output.
   a. Check filter/regulator supplying air to controller to make sure that the output pressure is 5 - 10 psig higher than the pressure required to fully stroke the valve.
   b. Check actuator operation.
8. Process never quite makes the set point.
   a. Check pneumatic connections for leaks.

CAUTION

Improper installation or maintenance of this equipment can cause damage or personal injury.

1. When installing new equipment, check that it is suitable for the fluid, pressures and temperatures in your system.
2. Make sure that all pressure has been vented from the system before loosening or disassembling any part of the piping system or valve.
3. Before pressurizing the system, make sure that all bolts and gasket joints are tight.
4. When starting up the system, open inlet and outlet stop valves slowly to prevent fluid hammer and thermal shock.
5. Use genuine Spence replacement parts. Other parts may look the same but may have lower strength or temperature limits.

If you have any questions about the installation, repair or operation of your Spence equipment, please call Spence Engineering or your local representative.

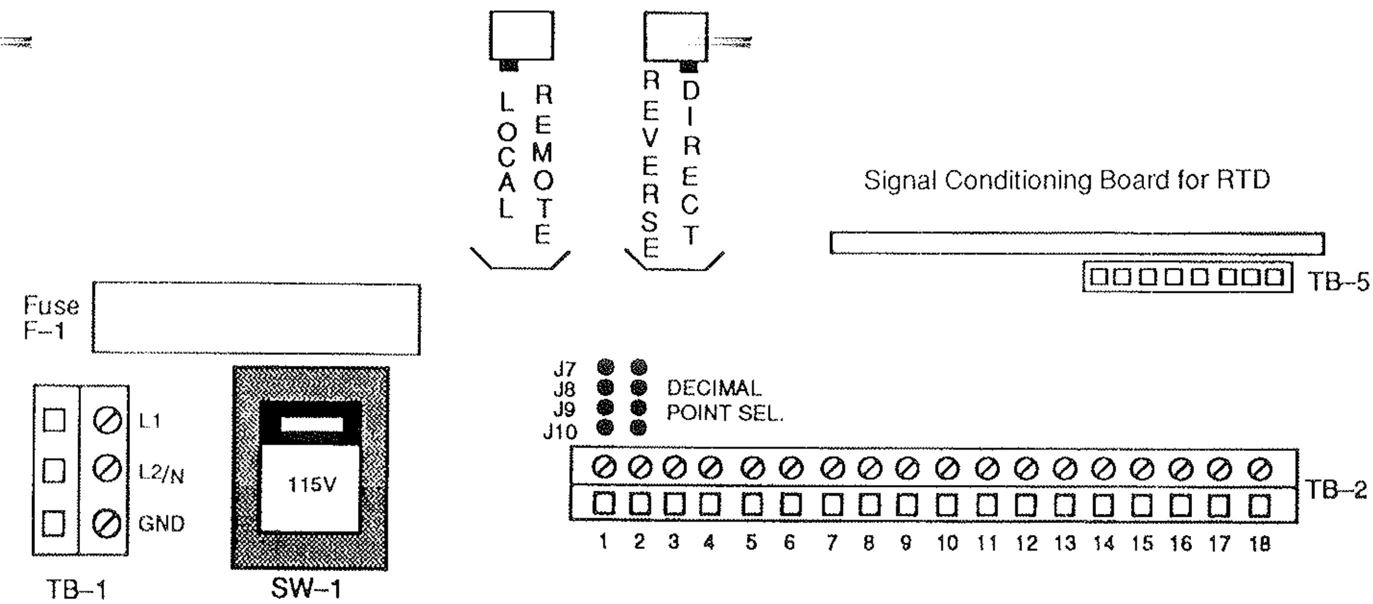


FIGURE 8

Wiring Connections for 24VDC Power

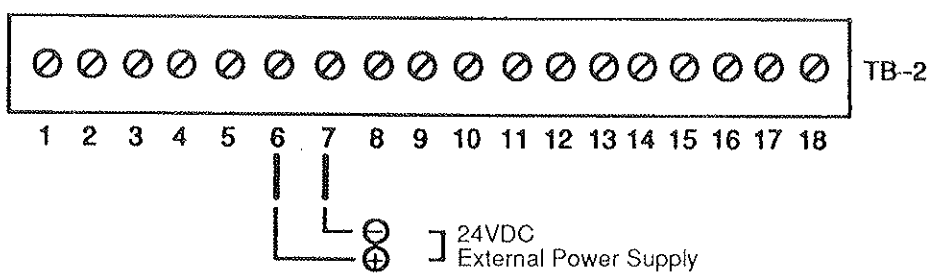
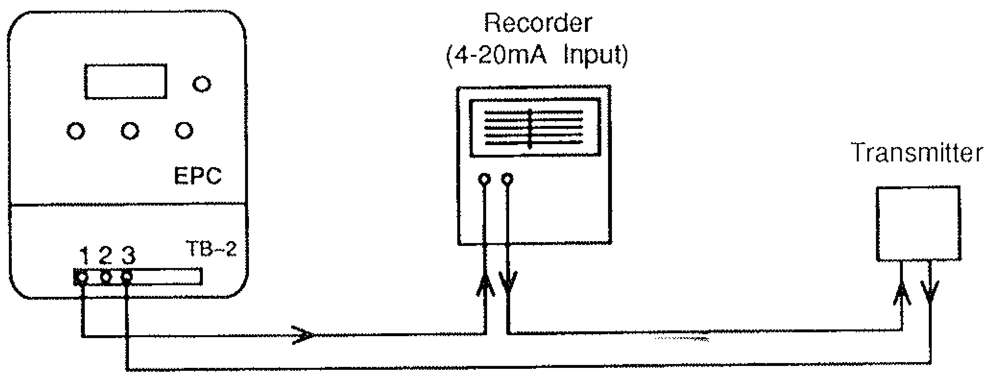


FIGURE 9

APPENDIX A

WIRING MULTIPLE DEVICES IN SERIES WITH THE EPC



The purpose of this Appendix is to provide guidelines for wiring another device, such as a chart recorder, in series with the EPC and a transmitter.

The acceptability of such a practice is based on the following rule: The total voltage drop of all devices In the circuit must be less than the output voltage of the power supply.

The EPC's power supply puts out a total of 24 VDC to the transmitter circuit. As stated in the specifications, the input resistance of the PMC's transmitter circuit is 100Ω. Using Ohm's law, the voltage drop at 20mA (.020 Amps) can be calculated as follows:

$$\frac{\textbf{Voltage (V)}}{\textbf{Current (I)}} = \textbf{Resistance (R)}$$

Voltage = Resistance x Current

Voltage = 100 x .020

Voltage = 2

Thus, at 20mA, the voltage drop of the PMC's transmitter loop is 2 volts.

EXAMPLE:

The EPC is being used in a level control application. The differential pressure transmitter used to measure the level has a minimum power requirement of 12 volts. A chart recorder with an impedance (resistance) of 450Ω is being considered for use with the level control system. Can the chart recorder be wired in series with the EPC and dp transmitter?

Voltage (Chart Recorder) = 450Ω x .020 = 9 V

Total Voltage = 2(EPC) + 12(dp Transmitter) + 9(Chart Recorder)

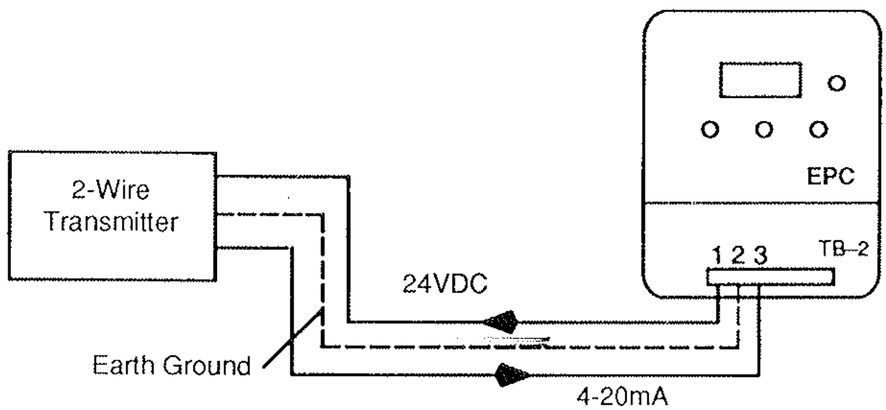
Total voltage = 23 V

Since the total voltage is less than the 24 volt output of the power supply, the chart recorder can be wired in series with the EPC and dp transmitter.

Note: Long lengths of wire can result in additional resistance in the loop and must be considered when the total voltage drop from all devices in the loop approaches the voltage of the power supply output. When in doubt, consult Spence for assistance.

APPENDIX B

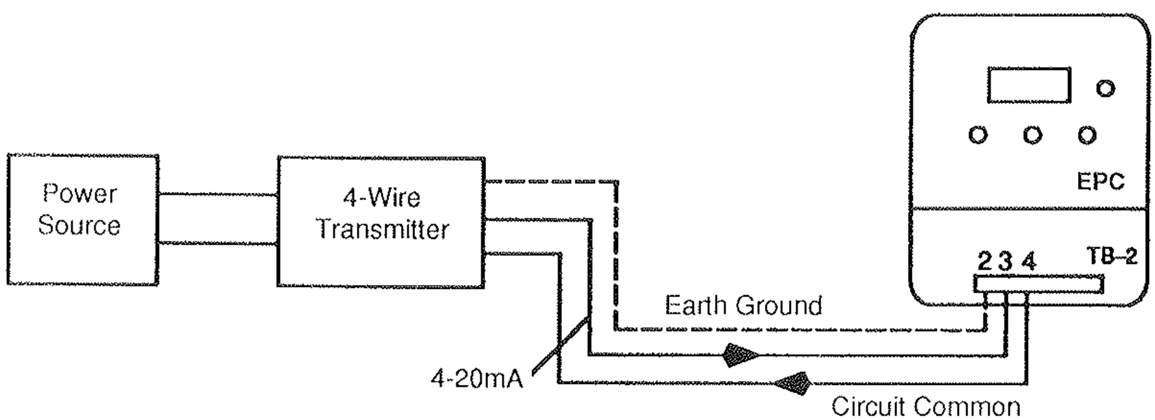
CONNECTING 2-WIRE AND 4-WIRE TRANSMITTERS TO THE EPC



Electronic transmitters used to measure pressure, level, and other variables are classified as 2-wire or 4-wire, depending on how they are powered. The EPC can be used with either type of transmitter.

The most common transmitter type is the 2-wire transmitter, which has one power input wire (24VDC nominal) and one signal output wire (4-20 mA). In most cases, there is actually a third wire leading from the transmitter, but it is still referred to as 2-wire.

The 2-wire transmitter is connected to the EPC as shown in Figure 8. Terminal 1 supplies 24VDC power to the transmitter, and terminal 3 receives the 4-20mA signal back. Terminal 2 is an earth ground.



A 4-wire transmitter needs two additional wires, because it receives its power from a separate power source. This type of transmitter can also be used with the EPC, and it is connected as shown in Figure 9. Since it receives its power from a separate source, terminal 1, the EPC's power is not used. The 4-20mA signal from the transmitter is connected to terminal 3, as in the case of the 2-wire transmitter, but the circuit is completed by connecting the other wire from the transmitter to terminal 4, circuit common. If the transmitter is equipped with an earth ground, it should be connected to terminal 2.

APPENDIX C

RTD DISTANCE LIMITATIONS WITH THE EPC ELECTRO-PNEUMATIC CONTROLLER

When using the EPC electro-pneumatic controller to control temperature with an RTD and optional built-in signal conditioning card, consideration must be given to the distance of the RTD from the EPC controller.

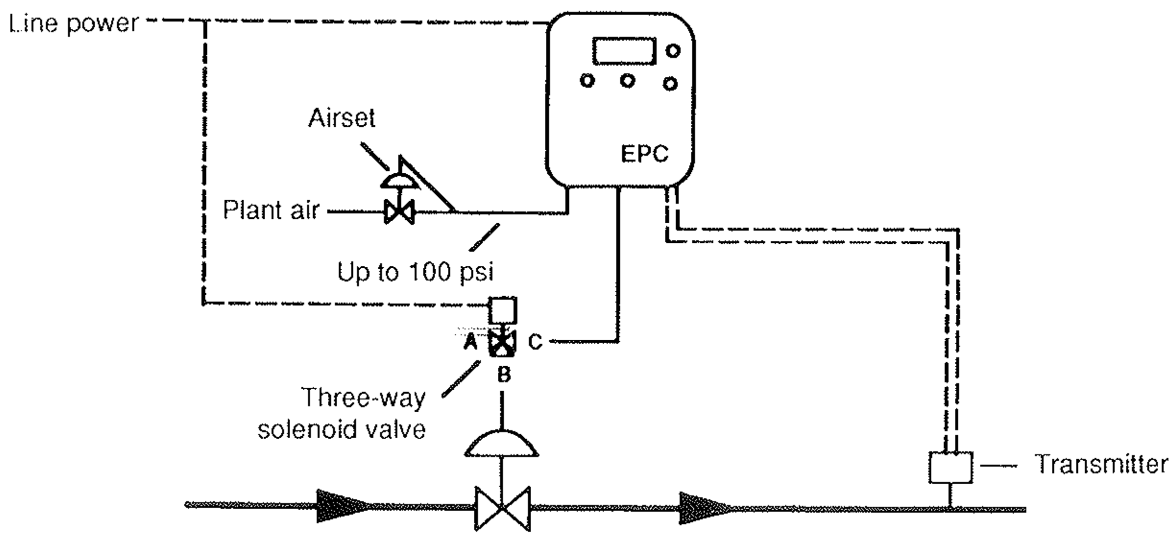
Since the RTD changes resistance in proportion to temperature change, the signal received by the signal conditioning card installed in the EPC is a variable voltage signal. The signal conditioning card converts the voltage signal into a 4-20mA signal, which can be used by the EPC.

The wire connecting the RTD to the EPC provides additional resistance, which varies according to the gauge and length of the wire Although the additional resistance of the wire is insignificant over short distances, it can affect accuracy over long distances. The following guideline can be used to insure that any error induced by wire length will be less than 1%:

WIRE GAUGE		MAX. LENGTH FOR 3-WIRE RTD	
AWG	mm2	Feet	Meters
20	.50	90	27.4
22	.25	55	16.8
24	.22	30	9.1

APPENDIX D

CONTROL OF AIR SIGNAL ON POWER LOSS FOR EPC ELECTRO-PNEUMATIC CONTROLLER



The EPC electro-pneumatic controller modulates a control valve by loading or unloading air to the control valve's pneumatic actuator in a series of pulses. These pulses are controlled inside the EPC by two normally closed solenoid valves.

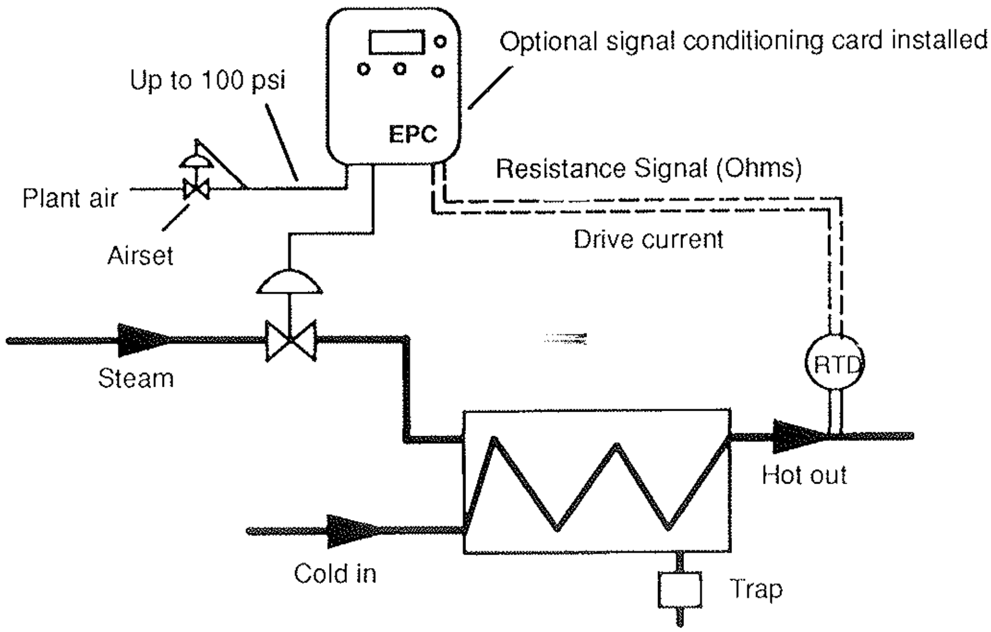
If the AC power to the EPC should fail for any reason, both internal solenoid valves will remain closed, and the control valve will be locked in its last position. If the avoidance of sudden process changes on power loss is important, this lock-up action is a desirable feature.

In certain situations, however, safety considerations may dictate the use of a normally closed control valve that should shut down the system on loss of power to the controller. In such cases, the arrangement shown above is recommended.

A standard three-way solenoid valve is installed in the air line between the EPC and the control valve. The solenoid is energized from the same power source used by the EPC. When the solenoid is energized, ports B and C are connected, and the pneumatic circuit between the EPC and control valve is complete. On loss of power, the solenoid is no longer energized, and ports A and B are connected, allowing the pressure on the actuator diaphragm to vent to atmosphere. If a normally closed actuator has been selected, the control valve will close, and the system will shut down.

APPENDIX E

TYPICAL TEMPERATURE CONTROL APPLICATION FOR EPC ELECTRO-PNEUMATIC CONTROLLER

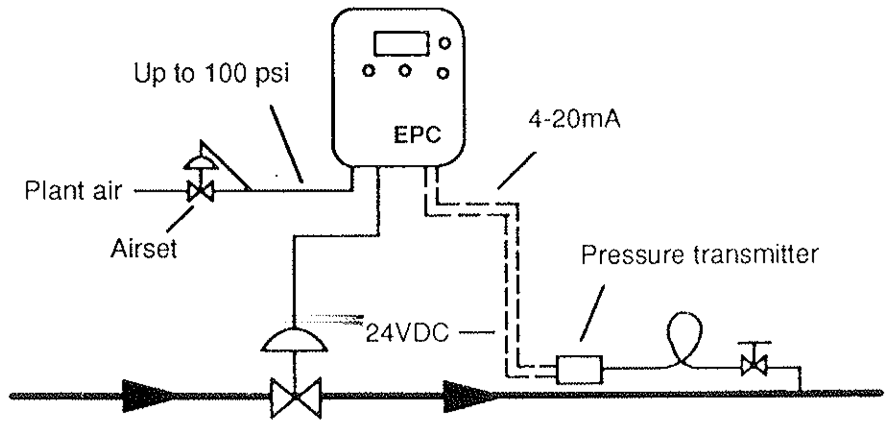


The Spence EPC electro-pneumatic controller provides an accurate, economical alternative to conventional pneumatic or electronic controllers. A standard RTD (resistance temperature device) is connected to the EPC at the dedicated RTD input terminals. An optional signal conditioning card installed in the EPC converts the resistance signal from the RTD into a 20mA signal. The EPC compares the input from the signal conditioning card to the set point, and, using a series of short pneumatic pulses, modulates the control valve as required to maintain the set point. The EPC's "slow loop" control mode can be selected for enhanced control in systems that respond slowly to control valve changes.

During installation, the EPC is calibrated by dialing in the upper and lower limits of the signal conditioning card. The set point and process status can then be read directly from the backlit LCD display. The EPC can be calibrated to display the temperature in either Fahrenheit or Celsius degrees.

APPENDIX F

TYPICAL PRESSURE CONTROL APPLICATION FOR EPC ELECTRO-PNEUMATIC CONTROLLER



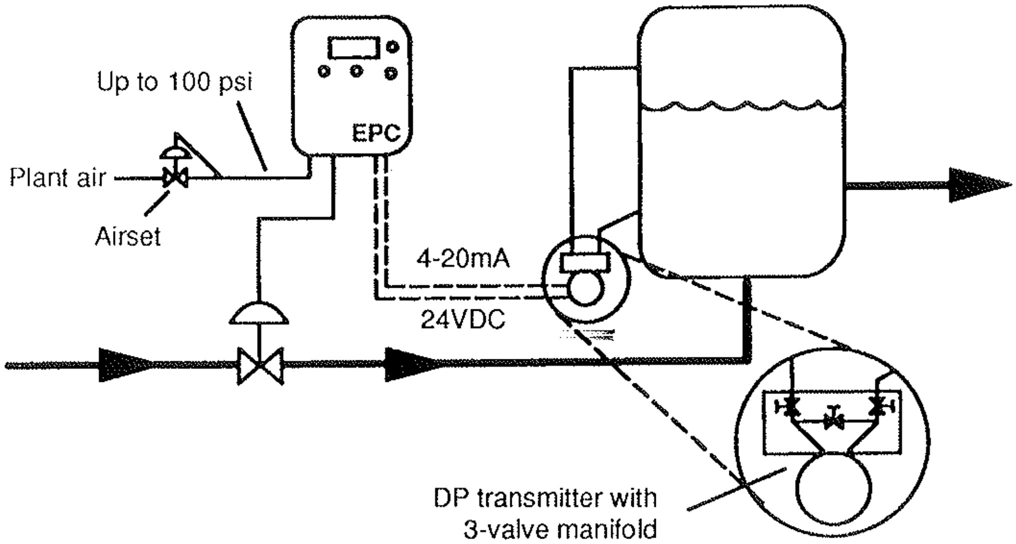
A standard pressure transmitter is connected to the EPC at the transmitter input terminals. The EPC provides 24VDC power to the pressure transmitter, compares the 4-20mA signal returned to the set point and, using a series of short pneumatic pulses, modulates the control valve as required to maintain the desired pressure.

The pressure transmitter is connected to the process pipe by means of a pig tail and isolating valve. The isolating valve provides the ability to change or calibrate the pressure transmitter without otherwise disturbing the system. The pig tail is important in steam applications to avoid overheating the pressure transmitter. The loop in the pig tail maintains a condensate buffer between the steam and the sensing diaphragm of the pressure transmitter.

During installation, the EPC is calibrated by dialing in the upper and lower limits of the pressure transmitter. The set point and process status can then be read directly from the backlit LCD display in the units of measurement preferred by the user.

APPENDIX G

TYPICAL LEVEL CONTROL APPLICATION FOR EPC ELECTRO-PNEUMATIC CONTROLLER



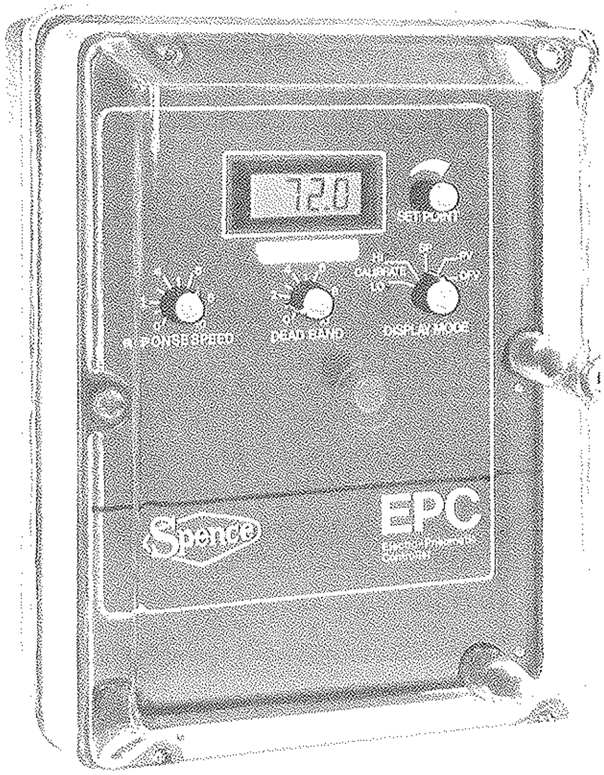
The Spence EPC electro-pneumatic controller provides an accurate, economical alternative to conventional pneumatic or electronic controllers. A standard differential pressure transmitter is connected to the EPC at the transmitter is connected to the EPC at the transmitter input terminals. The EPC provides 24VDC power to the dp transmitter, compares the 4-20mA signal returned to the set point and, using a series of short pneumatic pulses, modulates the control valve as required to maintain the desired level. The EPC's slow loop control mode can be selected for enhanced control in systems that respond slowly to control valve changes.

In a closed system, the differential pressure transmitter is piped as shown above. The upper sensing line measures the static pressure in the system and acts as a reference point. the difference between the upper and lower sensing lines is the head pressure of the liquid. In an open system, the reference line is vented to atmosphere. A three-valve manifold is recommended for use with the dp transmitter to facilitate isolation of the transmitter for replacement or in-line calibration.

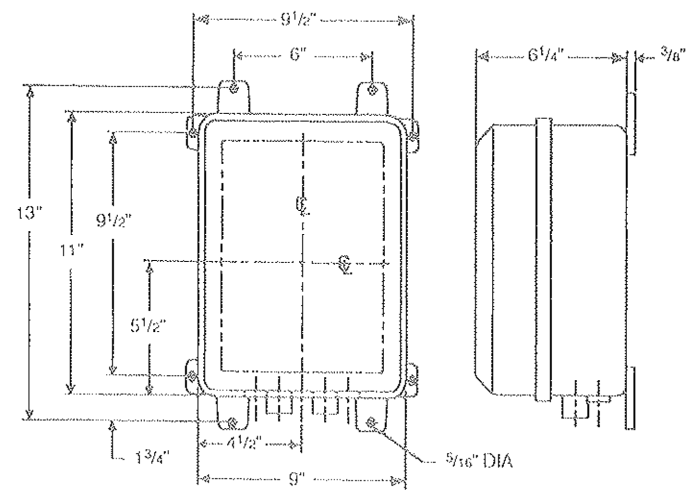
During installation, the EPC is calibrated by dialing in the upper and lower limits of the differential pressure transmitter. The set point and process status can then be read directly from the backlit LCD display in the units of measurement preferred by the user.

SPENCE ENGINEERING COMPANY, INC.
Walden, NY 12586-2035

TYPE EPC ELECTRO-PNEUMATIC CONTROLLER



Type EPC Electro-Pneumatic Controller



Enclosure: NEMA 1, 2, 3, 3S, 4, 4X, 12, 13

The SPENCE Type EPC Controller utilizes standard plant air supply, up to 100 psig, 120/240 VAC electrical power and accepts a standard transmitter signal of 4-20 mA. An optional Signal Conditioning Card is available when a transmitterless RTD is used.

The Controller compares the process variable to the desired indicated set point and produces pulsed air output signals up to 100 psig to directly operate a diaphragm control valve without the need of an I/P transducer or a positioner. It is switch selectable for either direct or reverse action. It is accurate within ±0.5% of full span and can withstand ambient temperatures from 32°F to 160°F. It is 9" wide by 11" high by 6¼" deep and weighs 8 pounds.

Tuning the control loop is a simple procedure requiring only three adjustments: the desired set point, the speed of response and the width of the dead band.

The backlit LCD display utilizes a five-position switch that enables the operator to view and easily set:

- The set point
- The process variable
- The deviation from set point
- The input transmiter's low range limit
- The input transmitters high range limit

The SPENCE Type EPC Controller is the perfect choice for independent, single-loop control applications. The instrument provides a simplified, cost-effective solution over conventional electronic control systems for accurate, reliable control valve operation in all types of institutional and industrial installations.