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## ***Thanks for demonstrating the Bimba pneumatic positioning control products!***

Use these instructions to demonstrate PFC operation, adjustment, set-up, and capabilities. The cylinder has a rod lock; instructions are provided to demonstrate its operation. We have also included instructions for integrating the rod lock into an application.

The demo unit has been fully tested, and is performing well. All components are new, made to the latest revision. The PFC has a rod insulator, typical of our latest design.

If on occasion you should find that the demo is not operating as it should, consider the following:

1. Air pressure should be 70-80 PSI. Lower air pressures may produce erratic operation.
2. If there is noise on the AC power applied to the electronics, the noise will be superimposed on the DC power supplied to the PFC. Most of the time this will not be an issue. For the occasions where it is an issue, an AC line filter will solve the problem.
3. High amounts of ambient EMI may also cause erratic operation. Select an environment for your demonstration away from potential sources of EMI, such as fluorescent lights, switching power supplies, power lines, and electric motors.

To ensure top performance in field applications, always ask your customers:

***Is the air clean? Are you using filters and desiccant driers? Are there contaminants in the environment?*** The PFC is designed to operate using clean, dry, non-lubricated air. Enemies of the PFC are moisture, dirt, and lubricants, especially silicon. Conductive inks silk screened onto the probe are eroded quickly when water or contaminants condense onto the probe. In moist or dirty environments, filters and desiccant driers must be used, and failure in these applications is a result of improper air prep, not defects in workmanship or materials.

***Is your PCS control connected properly?*** Fittings should be air tight, not cracked or leaking, sealed with Teflon tape. Avoid small diameter air hoses; they reduce force. Avoid long lengths of hose between the PCS valve ports and the PFC; long lengths slow response. All electrical connections, especially the control voltage to the PCS and the feedback signal from the PFC, must be shielded. Inadequate shielding results in erratic response. ***The simplest way to ensure adequate shielding and circumvent EMI interference problems is to order a PCS control with the Q option and companion shielded cables.*** Power supplied to the PCS should be clean.

***Is your PCS control adjusted properly?*** Erratic operation is often caused by improper adjustment of the PCS control. For smoother operation, increase the deadband and decel settings. If the control is set up under no load and a load is applied, the deadband and decel may need to be increased. Trying to stop the load TOO SUDDENLY will result in overshoot, which will cause a correcting position signal to be applied, which will cause overshoot, and so on. The piston will buzz for a while back and forth before settling into position. The adjustments on the PCS circuit board are via multi-(many)-turn pots. The pots do not have hard stops, so they can be turned dozens of times; users sometimes lose track of what they are doing, and keep turning them. To fix this problem, just follow the adjustment procedure in the enclosed instructions.

***Have you specified the low friction option?*** For accurate positioning, always specify the low friction option. If the customer complains about rough operation and the cylinder being used is not low friction, a low friction option will help a lot.

***What is your air pressure?*** At 70-80 psi, the PCS control and PFC cylinder operate normally. At low pressures, operation will be rough and erratic.

***Are you using flow controls?*** If flow controls are installed in the cylinder ports, erratic operation may result.



# Bimba Model PCS Pneumatic Control System

## Learn how to:

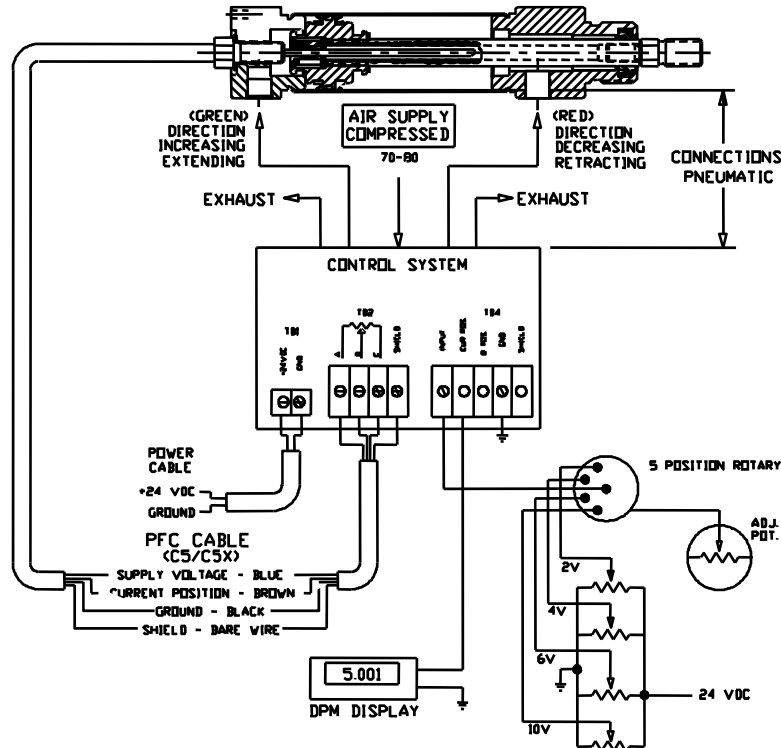
- Recognize the components required for a PCS system.
- Understand how the PCS components are interconnected.
- Be able to adjust Zero, Span, Deadband, Decel.
- Understand basic PCS operation.



## Components required for a complete closed loop system:

- PCS electro-pneumatic controller (includes valves).
- PFC, PFCN, PTF, or PTFN cylinder
- Air supply (70-80 psi required for proper operation).
- Regulated, filtered DC voltages.
- 24 VDC fixed for PCS.
- 0-10 VDC variable control voltage.
- 120 VAC line power for DPM if used.
- DPM panel meter (for direct positioning readout)

## Demo Case Circuit Diagram



# Getting started

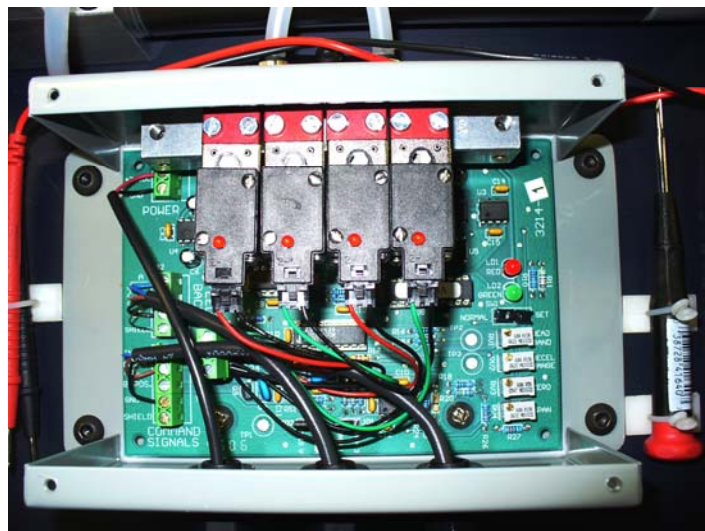
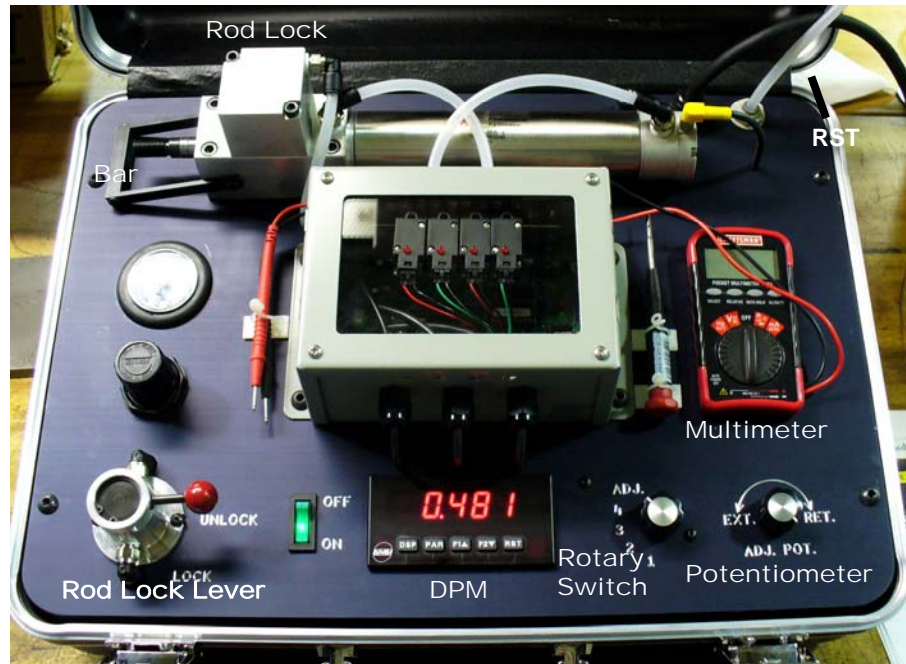
**Power up and connect air supply to demo case.  
Be sure rod lock lever is in “UNLOCK” position.**

Observe the connection of air lines to cylinders and valves (see image to the right). Valves are part of the PCS control. The demo contains a DC power supply, switch, and potentiometer, which would normally be supplied in the application. The multimeter should be in VOLTAGE position. It ranges from volts to millivolts; don't be confused by this: 1000 mV equals 1 V.

Positions 1 through 4 on the rotary switch move the piston in increments of one inch. Position 5 switches to the potentiometer, which moves the piston continuously to any position in its stroke.

The DPM is only used to display displacement in inches.

Remove cover to expose the PCS control. Review all positions in the top three terminal blocks. They are clearly marked. Electrical connection to valves is not required of customer for encased controls. Identify trim pots and LEDs, which are also clearly labeled.



# Set up and adjustments

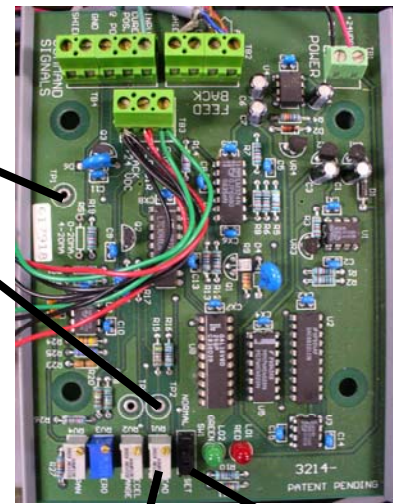
**Set the deadband** (page 15) The deadband adjustment changes the tolerance on the ending position of the PFC rod. Smaller deadbands mean a tight tolerance and higher positioning accuracy. Higher deadbands are required for greater loads.

1. Application sizing chart (PCS manual page 23, below) identifies “Zero Friction Deadband Voltage” for setting deadband. The deadband setting can be varied from 0.005 to 0.500 VDC.
2. Locate TP1, TP2, SW 1, and the deadband adjustment pot.
3. Move SW1 to SET position
4. Set DMM to DC volts and measure between TP1 and TP2.
5. Adjust deadband setscrew to 100 mV initially.
6. Move SW1 to NORMAL position.

## Application Sizing and “Rules of Thumb”

*PFC Cylinder/PCS Valve System Matching and Sizing Recommendations* TP2

Bore Size	PCS Model	Stroke Range	Maximum Payload @ Average Velocity (lbs.)	Maximum Average Velocity without overshoot (in/sec)	Maximum External Friction (lbs.)	Zero Friction Deadband Width per inch of stroke	1/2 Maximum Friction Deadband Width per inch of stroke	Maximum Friction Deadband Width per inch of stroke	Minimum Step (in.)
1-1/16" (PFC-09)	PCS-1	2" to 7"	1	2.75	0	0.005"	N/A	N/A	0.08
1-1/16" (PFC-09)	PCS-1	8" to 24"	30	4.00	5	0.004"	0.008"	0.016"	0.2-0.39
1-1/2" (PFC-17)	PCS-1	1" to 3"	2	2.50	0	0.0025"	N/A	N/A	0.04



### Identify LEDs and Span and Zero adjustments.

#### LED's indicate valve operation

1. Green LED means rod is being extended: Air is exhausted from Valve 1 (front) and pressure is applied at valve 3 (rear)
2. Red LED means rod is being retracted: Air is exhausted from Valve 3 (rear) and pressure is applied at valve 1 (front).

### Set the zero position (page 16)

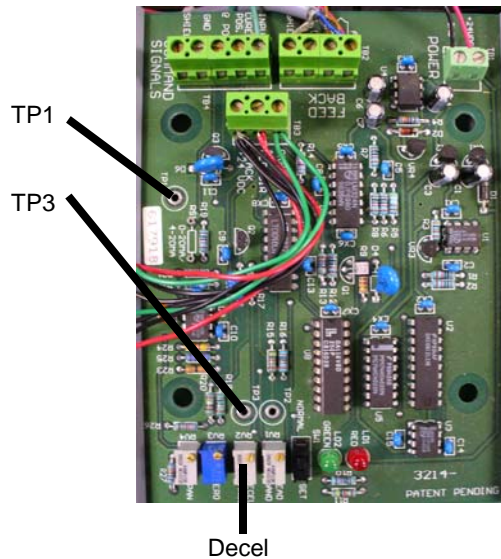
1. Set control voltage to 0.
2. Turn ZERO adjust CW until rod is in the desired retracted position (not necessarily fully retracted).
3. Red LED should not be on continuously.

### Set the Span adjustment or end position (p.18)

1. Set control voltage to maximum (10 VDC)
2. Turn SPAN CCW until rod is in the desired fully extended position.
3. The green LED should not be on continuously.



# Set up and adjustments (cont'd.)



## Decel adjustment (page 19)

The decel adjustment regulates the distance over which the PFC rod slows to a stop. Low Decel settings provide fastest speeds. High Decel settings provide the most stability for high loads. If deadband is set too low for the load, the rod will overshoot and undershoot the target position, oscillating before settling to a stop.

1. Locate TP1, TP3, and Decel adjustment.
2. Turn DECEL adjust and monitor voltage with DMM.
3. Set to 1.5 V for PFC and 3.5 V for PFCN.
4. Step the control voltage up and down using the rotary switch. Actuator moves in steps.
5. Adjust DECEL to half the value; observe results.
6. Adjust DECEL to 6 V and observe results.
7. Reset DECEL to original value.
8. With actuator set in mid-stroke, push on end of actuator and observe results.
9. If decel is too short, cylinder will oscillate around final position. If decel is too long, cylinder will brake gradually. Speed is adjusted through decel and deadband.

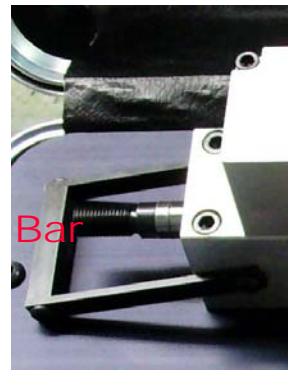
## Rod Lock Demo

1. Lower bar, set rotary switch to position 5.
2. Turn potentiometer so that rod is mid-stroke.
3. Push and pull rod – resistance to movement is provided by the valves controlled by the PCS.
4. Move Rod Lock lever to “LOCK.”
5. Push and pull rod again. “LOCK” position removes air pressure from the rod lock
6. Rod lock is a failsafe for loss of power. A Tech Bulletin is included in this manual.



## Measuring with the DPM

1. Set rotary switch to position 5.
2. Raise bar at end of Rod Lock.
3. Turn pot until rod bottoms out on bar, Back off until PCS valves stop oscillating.
4. Hit Reset <RST> on DPM (zeros display).
5. Retract rod using potentiometer.
6. Place business card between rod and bar; and turn pot until rod bottoms out on bar as in (3).
7. Read thickness of card on DPM.



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# Employing a Rod Lock with a PCS System in a Linear Motion Control System

The Rod Lock is intended to be used as a failsafe to lock the PFC piston rod. It is not intended to be used as a dynamic brake. The PFC's piston rod must be at rest before engaging the Rod Lock.

The Rod Lock allows rod movement when air pressure is applied, and clamps the rod when air pressure is removed. When air pressure is removed, an internal spring engages the Rod Lock mechanism. The spring is overcome when the Rod Lock is pressurized. Use a three-way, normally closed, spring return valve with the Rod Lock. The valve must be energized to release the rod. If power or air pressure is lost, the Rod Lock/3-way valve subsystem will clamp the cylinder's rod.

## Limitation of Using a Rod Lock with a PCS Control System

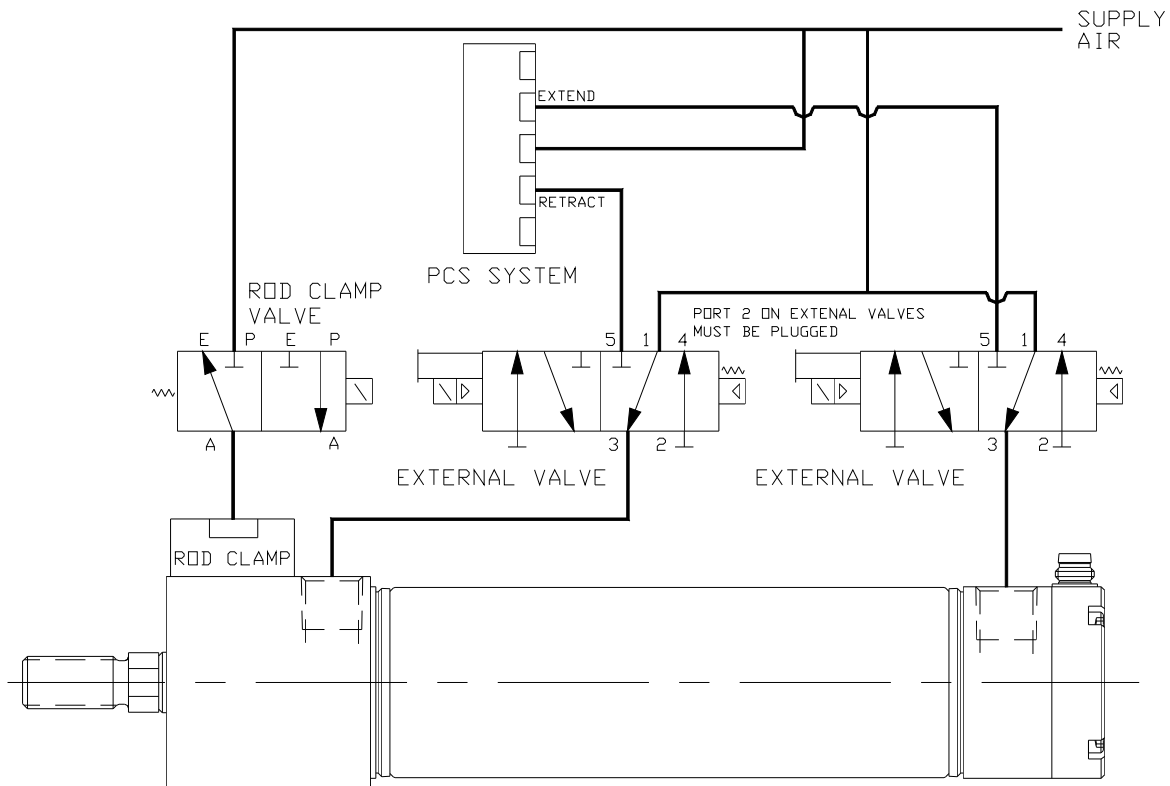
To accurately move the piston rod and hold it in position, the PCS controls the pressure on both sides of piston. When a Rod Lock is added, a leak in the system could engage the Rod Lock, clamping the rod. The PCS control may attempt to overcome the Rod Lock in order to move the rod into position, potentially applying a large pressure to one side of the piston which could wear out the Rod Lock and eventually cause failure or cause violent motion or loss of control.

## Pneumatic Circuit for Using the Rod Lock with a PCS

Refer to the figure on the next page. The valve labeled "Rod Clamp Valve" in the left center of the figure is a three-way, normally open, spring return valve that operates the Rod Lock. The PCS control's valves are shown at the top center of the figure. The extend and retract ports of the PCS are connected to additional valves which are only required when the Rod Lock is employed. These must be 4-way valves with 5 ports. They allow the PCS to operate normally when in motion. The valves are switched after the cylinder comes to its commanded position. This places full line pressure at both the extend and retract ports. As a result, the worst-case loading condition is reduced to the payload plus the area of the cylinder's rod times the line pressure. Spring return valves should be added between the cylinder and the PCS. When power is lost, both the extend and retract ports would be supplied with full line pressure. Port 2 (shown in the figure) must be plugged on both these valves to prevent the normal valve blow by from reducing the effectiveness of this circuit. The 3-way valve recommended for the Rod Lock will clamp the cylinder's rod when power or compressed air is lost.



# Employing a Rod Lock with a PCS System in a Linear Motion Control System



## Programming Requirements for Using the Rod Lock with a PCS Control

The PCS control has a digital (@Position) signal to indicate when the cylinder is at its commanded position (actually within +/- the deadband setting of its commanded position). If the rod is in motion and is about to overshoot the target, one could inadvertently engage the Rod Clamp, causing it to act as a dynamic brake. It is therefore necessary to monitor the @Position signal before engaging the Rod Lock to be certain that the payload is within the deadband zone AND the system is stable. Once this has occurred the 3-way valve should be de-energized allow the Rod Lock to engage. Then the two 4-way valves should be de-energized to divert full-line pressure to both sides of the PFC piston.



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# Employing a Rod Lock with a PCS System in a Linear Motion Control System

In the event of an air leak, if the Rod Lock is released and the rod is commanded to a new position, the rod could jolt and the system could become unstable. To prevent this:

- Switch the two 4-way valves so that the PCS system is connected to the cylinder.
- Command a motion in the direction *opposite* to that of intended travel with the Rod Lock still engaged to ensure that one side of the piston is energized.
- Delay a small amount of time to allow proper pressurization of the cylinder
- Issue the command to new position, with the Rod Clamp still engaged (this command will insure the opposite side of the piston is energized).
- Delay briefly to allow pressurization of the opposite side of the cylinder.
- Disengage the Rod Clamp.

## Programmed Sequence of Events

1. Command the PCS to move to its position.
2. Wait until either the @Position or Output signal indicates that the payload has entered the deadband.
3. Delay for a moment to ensure that the system is stable (this is demonstrated when the payload remains within the deadband zone during the delay).
4. Engage the Rod Clamp.
5. Switch the two 5-port valves so that both of the cylinders ports are at line pressure.
6. Perform whatever operations are required at this position.
7. Switch the two 5-port valves so that both the cylinder's ports are connected to the PCS.
8. Command the PCS to move in the opposite direction (with the Rod Clamp still engaged).
9. Delay for a short period of time.
10. Command the PCS to move to its next position (with the Rod Clamp still engaged).
11. Delay for a short period of time.
12. Disengage the Rod Clamp.

The durations of time delays (Steps 3, 9, & 11) are determined during system set up. Time delays are typically 50 to 100 milliseconds. Steps 8 and 9 may not be necessary. The durations of time delays and the need for steps 8 and 9 depend upon the final system configuration and variables such as payload, payload orientation, supply pressure, valve response time, and valve capacity.



