# PNEUMATIC CONTROL SYSTEM (MODEL PCS)
## "HOW IT WORKS"


The TRD Pneumatic Control System (Model PCS) is designed to control any 1½" thru 4" bore pneumatic TRD position feedback actuator. The system is a closed-loop electronic controller with pneumatic valves that can accurately position the actuator rod and hold it in position with a high degree of accuracy and force. The system accomplishes the long term goal of using pneumatic technology to accurately stop and hold the rod at any desired position.

The standard PCS accepts a 0 to 10 VDC analog command signal. The command signal is used as a reference to move to and hold a specific position. Order Option C if a 0 to 20 mA or a 4 to 20 mA analog command signal is required. For example, if the application has a stroke of 10 inches (i.e., the electrical zero and span is set for a 10 inch stroke), then a 1 volt change in the command voltage is equal to a 1 inch movement. Similarly, a change in command signal of 0.005 of a volt equals a position change of 0.005 of an inch for the same 10 inch stroke application. If the application has a stroke of 5 inches, a change of 1 volt in the command signal represents a ½" movement.

The system utilizes the feedback from the actuator to close the control loop. The control loop compares the system's command signal (the 0-10 VDC, 0-20 mA, or 4-20 mA input command signal) to the feedback signal from the actuator. The difference between the command and feedback is referred to as the error term. When the error term is zero, all valves close, trapping air on both sides of the actuator piston. (The error term is considered to be zero when it is within the deadband range. The deadband range is an adjustable range that determines the final repeatability of the system. The Application Sizing chart located later in this section shows recommended deadband ranges for given application parameters.) This holds the rod at its commanded position. If some force or weight attempts to move the rod out of the commanded position, the system will react by increasing the restoring force eventually to full supply pressure, if necessary. Likewise, if the command signal changes, the system will respond to make the feedback equal the command signal.

There are four adjustments on the PCS system, adjustable via four trim pots. They include the Zero, Span, Decel, and Deadband adjustment. The Zero and Span adjustments allow you to set the zero and full scale position of the actuator to match the input (command) signal. The Decel and Deadband adjustments are used to optimize the performance of the system based on application parameters. These adjustments are described in detail in the Operating Manual, which is included with each system.

The actual accuracy/repeatability of the movements will depend on many factors, including signal noise, load, velocity, supply pressure, supply voltage, and application friction. Refer to the Application Sizing charts found later in this section for detailed information regarding sizing and suggestions for your application.

# PNEUMATIC CONTROL SYSTEM (PCS)

## "HOW TO ORDER"

PCS - 5 - Q

| PNEUMATIC CONTROL SYSTEM |
|---|

| FLOW/TYPE* | |
|---|---|
| 1 | Cv = .02 |
| 2 | Cv = .04 |
| 3 | Cv = .08 |
| 4 | Cv = .09 |
| 5 | Cv = .10 |
| 6 | Cv = .105 |
| 7 | Cv = .11 |
| 8 | Cv = .25 |

| OPTIONS | |
|---|---|
| BLANK | NO CABLES OR CONNECTIONS (0 - 10 VDC COMMAND INPUT) |
| C | 0 - 20 mA OR 4 - 20 mA COMMAND INPUT |
| I | METRIC DIMENSIONS |
| N | NO ENCLOSURE** |
| Q | QUICK CONNECT RECEPTACLES (CABLES SOLD SEPARATELY) |

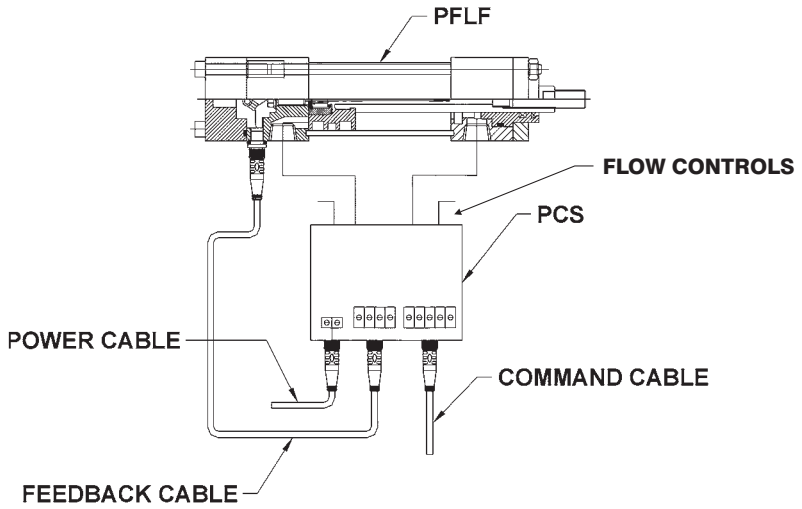
* The Cv values are approximated. The velocities for the different systems are shown in the sizing recommendations chart.

** Allows mounting of control valves close to the actuator and the electronics/PC board in a remote location. This would be beneficial in applications that would otherwise require long air lines which could reduce system accuracy or in applications that would place the electronics/PC board in an area that exceeds the **100°F** operational temperature range.

## *Accessory Cables**

| PART NUMBER | DESCRIPTION |
|---|---|
| PCS-CBL-PWR | 2 meter Power Cable for Quick Connect Option |
| PCS-CBL-PWR-X | 5 meter Power Cable for Quick Connect Option |
| PCS-CBL-CMD | 2 meter Command Signal Cable for Quick Connect Option |
| PCS-CBL-CMD-X | 5 meter Command Signal Cable for Quick Connect Option |
| PCS-CBL-FBK | 2 meter Feedback Cable for Quick Connect Option |
| PCS-CBL-FBK-X | 5 meter Feedback Cable for Quick Connect Option |

***One Power, Command and Feedback cable required if Option Q is purchased. (3 CABLES TOTAL REQ'D).**




System Block Diagram, shown with Option Q

# PNEUMATIC CONTROL SYSTEM (PCS)

## "SPECIFICATIONS"

| DESCRIPTION | SPECIFICATION |
|---|---|
| Zero Adjustment | 50% of Total Full Scale Output between both adjustments |
| Span Adjustment | |
| DECEL Adjustment | Approximately 0.5 to 13.5 volts |
| Deadband Adjustment | Approximately 0.005 to 0.500 volts |
| @ Position | Discrete signal that Sinks to Ground when Within Deadband zone. 20mA Maximum |
| Current Position | 0 to 10 VDC signal, 1M ohm input impedance required for input device |
| Operation at Power Loss | All valves close at power loss |
| Input Supply Voltage | 23.5 to 24.5 VDC, 1 amp |
| Operating Pressure | 70 to 80 max. psig |
| Air Requirement | Regulated and Filtered to 5 microns |
| Operational Temperature Range | 0 to **100°F** (Electronics/PC Board) |
| Reverse Polarity Protected | |
| Overvoltage Protected | |

## APPLICATION SIZING AND "RULES OF THUMB"

*PFLF CYLINDER/PCS VALVE SYSTEM MATCHING AND SIZING RECOMMENDATIONS*

| BORE SIZE | PCS MODEL | STROKE RANGE | MAXIMUM PAYLOAD | AVERAGE VELOCITY | MAXIMUM EXTERNAL FRICTION | ZERO FRICTION DEADBAND** | ½ MAXIMUM FRICTION DEADBAND | MAXIMUM FRICTION DEADBAND | MINIMUM STEP*** |
|---|---|---|---|---|---|---|---|---|---|
| PFLF-1½" | PCS-1 | 2" TO 3" | 2 lbs. | 2.50 in/sec | zero | ±25mV | N/A | N/A | 0.040" |
| PFLF-1½" | PCS-2 | 4" TO 24" | 50 lbs. | 5.50 in/sec | 10 lbs. | ±20mV | ±40mV | ±80mV | 2 x Deadband |
| PFLF-2" | PCS-2 | 2" TO 3" | 4 lbs. | 2.75 in/sec | zero | ±50mV | N/A | N/A | 0.020" |
| PFLF-2" | PCS-3 | 4" TO 24" | 90 lbs. | 6.50 in/sec | 20 lbs. | ±15mV | ±30mV | ±60mV | 2 x Deadband |
| PFLF-2½" | PCS-4 | 3" TO 4" | 120 lbs. | 2.00 in/sec | 35 lbs. | ±90mV | N/A | N/A | 2 x Deadband |
| PFLF-2½" | PCS-5 | 5" TO 24" | 150 lbs. | 2.50 in/sec | 35 lbs. | ±40mV | ±60mV | ±60mV | 2 x Deadband |
| PFLF-3¼" | PCS-6 | 3" TO 4" | 235 lbs. | 2.00 in/sec | 60 lbs. | ±80mV | N/A | N/A | 2 x Deadband |
| PFLF-3¼" | PCS-7 | 5" TO 24" | 235 lbs. | 2.00 in/sec | 60 lbs. | ±40mV | ±40mV | ±60mV | 2 x Deadband |
| PFLF-4" | PCS-7 | 3" TO 4" | 360 lbs. | 2.00 in/sec | 90 lbs. | ±80mV | N/A | N/A | 2 x Deadband |
| PFLF-4" | PCS-8 | 5" TO 24" | 360 lbs. | 2.00 in/sec | 90 lbs. | ±40mV | ±40mV | ±60mV | 2 x Deadband |

1) If your application requires lower velocities or payloads, you may be able to reduce the minimum recommended deadband setting, or if your deadband requirements can accommodate a large range, you may be able to increase your payload higher than the recommended values.
2) **Note: the following formula can be used to convert the deadband voltage to displacement: w=0.1(V) x t, where w is the deadband width, V is deadband voltage listed above and t is full scale travel of the actuator. For example: if the deadband is set for 20mv (0.02 of a volt) for a 6 inch stroke cylinder, w=0.1 (0.02) x 6=±0.012 of an inch.
3) ***Minimum step is stroke dependent.

## *Recommended Tubing Sizes*

| BORE | I.D. | O.D. |
|---|---|---|
| 1½" Bore | .125 | ¼" |
| 2" Bore | .187 | ¼" |
| 2½" Bore | .187 | ¼" |
| 3¼" Bore | .312 | 3/8" |
| 4" Bore | .312 | 3/8" |

# PNEUMATIC CONTROL SYSTEM (PCS)

## APPLICATION SIZING AND "RULES OF THUMB" (CONTINUED)

### Assumptions used for Sizing Values recommendations:

- Values shown in sizing table are with no overshoot. If overshoot is acceptable for your application, the deadband may be less than specified. However, be sure your system cannot go unstable.
- The PFLF cylinder is a very low friction cylinder with a standard rod diameter and NO rod wiper. The use of a rod wiper or oversized rod diameters will have adverse effects on positioning capabilities.
- 80 psi air supply.
- Minimum of 23.5 VDC provided to the PCS.
- Clean Command Signal for Main Control (<5mV noise/ripple).
- Leak free system (The system will actually perform well with some system leakage, however, the best performance is with no leakage).
- Short (<18 inches), hard air lines (nylon) between the valves and the actuator.
- No backlash in the system.
- Horizontally guided load. The system can handle vertical or inclined loads and still meet the minimum deadband specified above, however, the velocity may be effected by up to 40%.

### Typical "Rules of Thumb":

- Deviation from the recommended parameters, such as air pressure, power supply voltage, external friction, etc., will negatively effect system performance. However, the system may still perform adequately for your application.
- Applications with loads less than 10% of actuator capacity and strokes greater than 4 inches will yield better repeatability than the minimum deadband shown in the sizing table.
- Reducing actuator velocity by use of Flow Controls may enable the deadband to be adjusted tighter for a given application. The Flow Controls must be inserted into the exhaust ports of the valve manifold, NOT in the actuator.
- Oversizing the actuator for a given application typically yields better repeatability.
- Generically, following are relative influences on velocity:
  – As Mass increases, Velocity decreases (up to 20%)
  – As Friction increases, Velocity decreases (up to 20%)
  – As Pressure decreases, Velocity decreases (up to 20%)
- Increased Friction decreases repeatability. Maximum external friction should not exceed 20% of the maximum rated payload. Any external friction in the application will degrade system performance. Ensure the system is aligned properly to any guiding systems. Misalignment will cause external application friction.
- A borderline solution can be effective through any/all of the following:
  – sacrificing performance in one area for another,
  – limiting velocity with external flow controls,
  – employing a small central portion of a longer probe,
  – using a larger bore cylinder.
- The PCS system is not suited for applications where accurate velocity control is needed by controlling the rate of command signal change. Flow controls can be used if lower velocities are required.

***Do not allow the PCS valves to stay on for prolonged time periods unless the valves are well ventilated, as they may overheat potentially causing damage to the valves.***

# PNEUMATIC CONTROL SYSTEM (PCS)
## "APPLICATION EXAMPLE"

### PFLF Example

Let's say we have just finished the installation procedure for a PFLF Cylinder with 10 inches of stroke, and are using a 0-10 VDC input command signal. There is a retracted hard stop at 1.5 inches of cylinder stroke and an extended hard stop at the 9.0 inches of cylinder stroke.

Therefore:

- After adjusting the Span setting, 10 volts is equivalent to 9.0 inches of cylinder rod extension.
- After adjusting the Zero setting, 1.5 inches of cylinder rod extension will equal 0 volts.

Therefore, 0 to 10 volts covers the 7.5 inches (9.0" - 1.5") range of motion.

Using the following formula:

The command signal can be translated into actuator displacement with the following formula:

$$CS = d * R / t + Z$$

where:

**CS** = the command signal required to achieve a desired position

**d** = the displacement the desired position is from the zero position

**R** = the full range of the command signal

**t** = full scale travel of the actuator

**z** = the command signal for the zero position

To command the PFLF to go to a position that is 2.0 inches extended from the retracted hard stop, the command signal would be calculated as follows:

**CS = 2 X 10/7.5 + 0 = 2.667 VDC Command Input Signal**

If a 4-20 mA signal is used, the command input signal would be calculated as follows:

**CS = 2 X 16/7.5 + 4 = 8.267 mA Command Input Signal**

*Note: The positional repeatability of the system will be determined by the Deadband adjustment. If the deadband was adjusted to ± 20mV in this example, the system would position to the 2 inch position within ± 0.015" (w=0.1 (V) * t).*

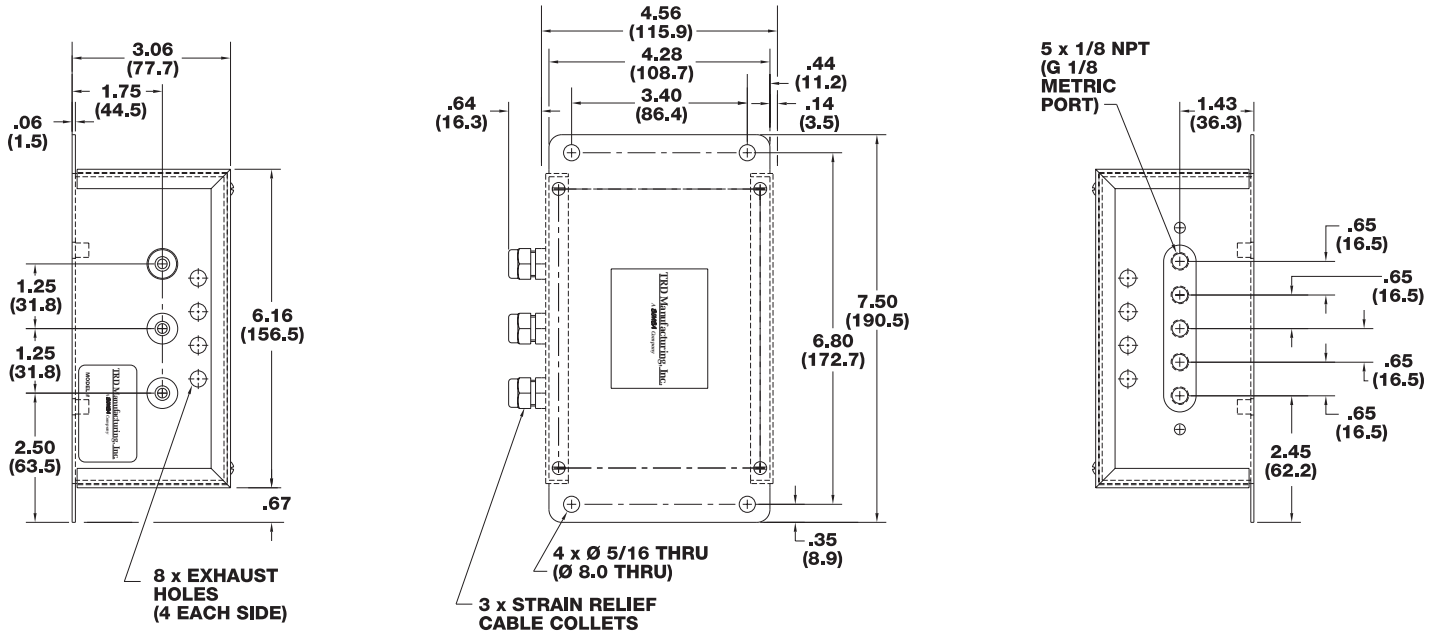
# PNEUMATIC CONTROL SYSTEM (PCS)

## "DIMENSIONS"

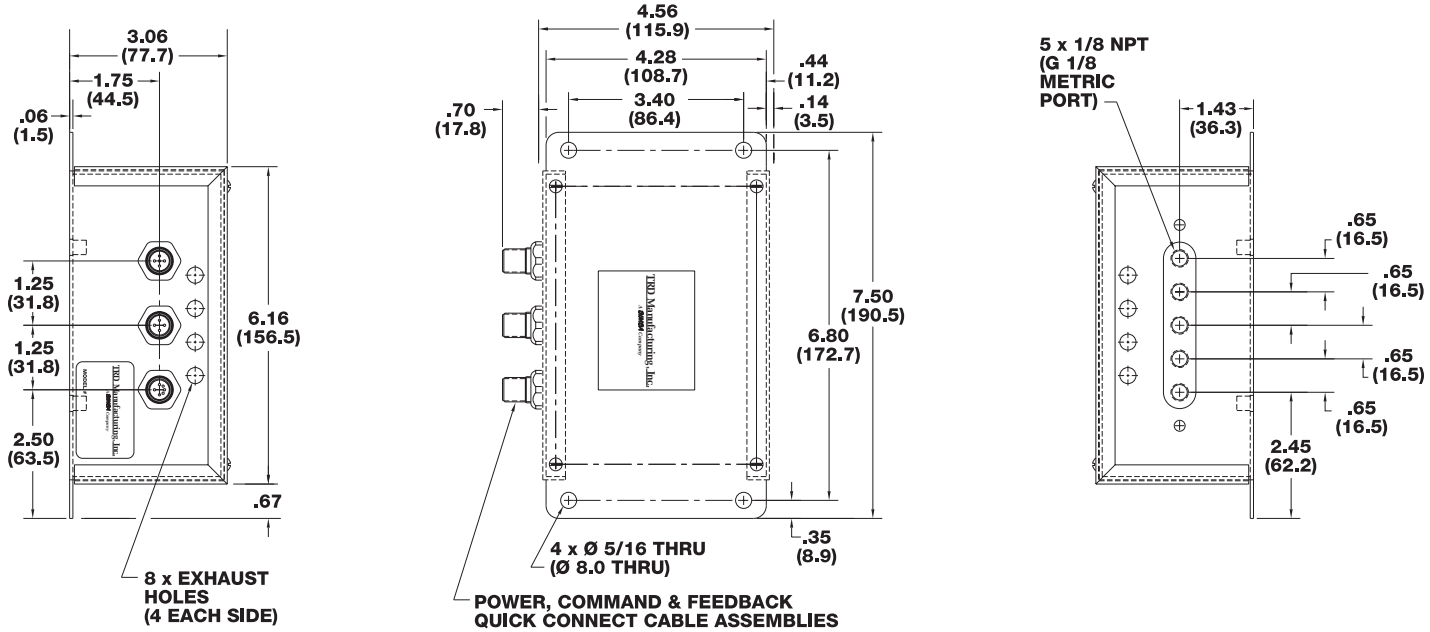
### PCS1 thru PCS3

*Shown in inches (millimeters)*

*Enclosure*




*Option Q*
*(Quick Connect Receptacle)*



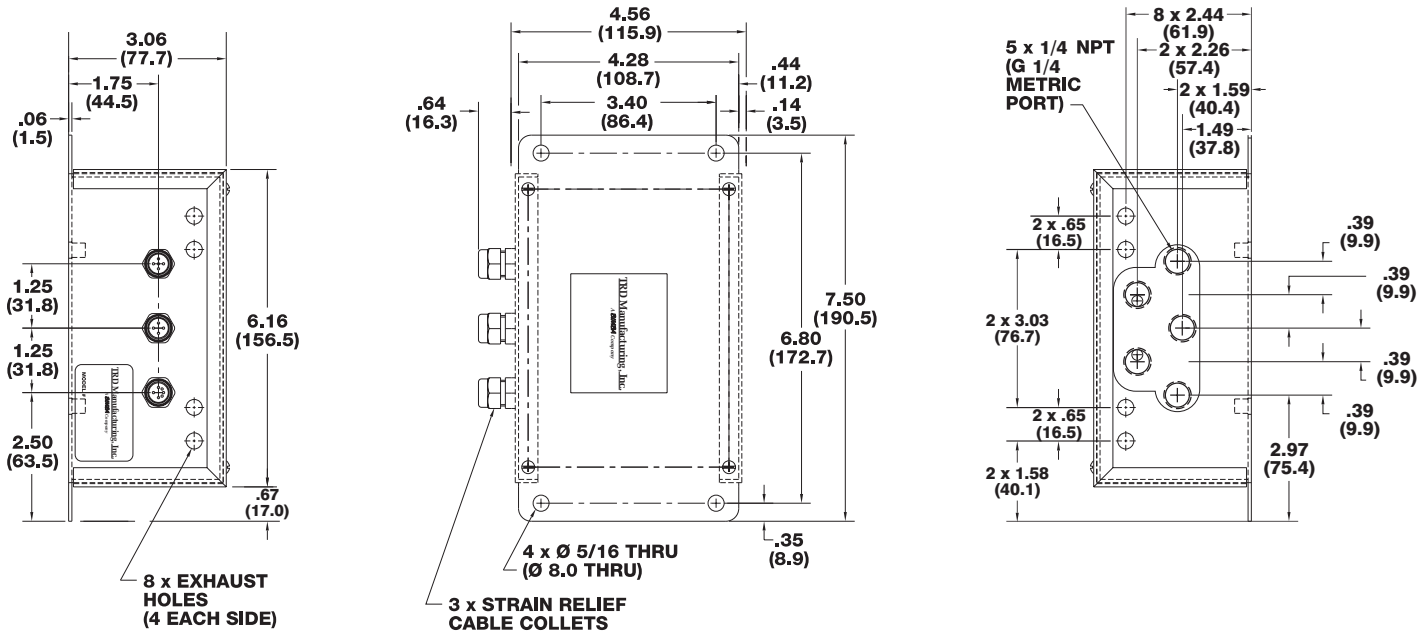
# PNEUMATIC CONTROL SYSTEM (PCS)

## "DIMENSIONS"

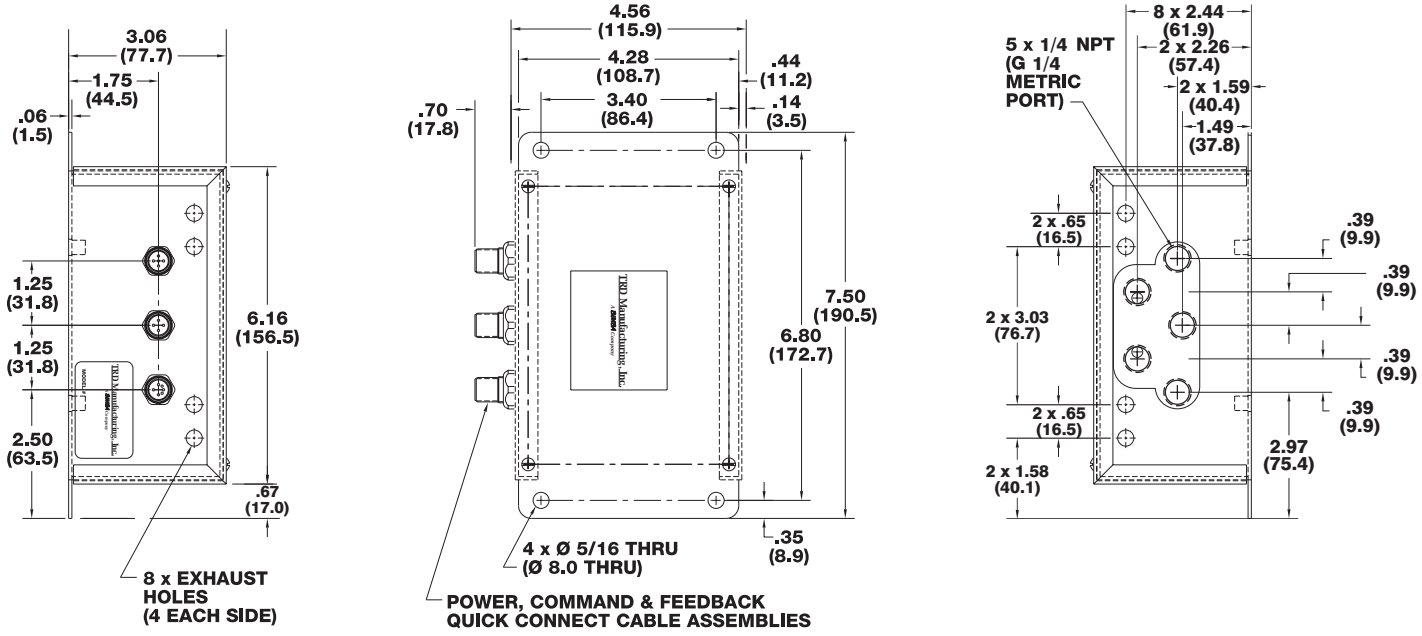
### PCS4 thru PCS8

*Shown in inches (millimeters)*

*Enclosure*




*Option Q*
*(Quick Connect Receptacle)*

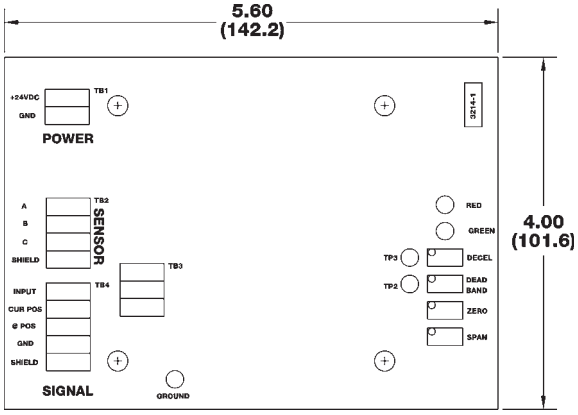


# PNEUMATIC CONTROL SYSTEM (PCS)
## "DIMENSIONS"

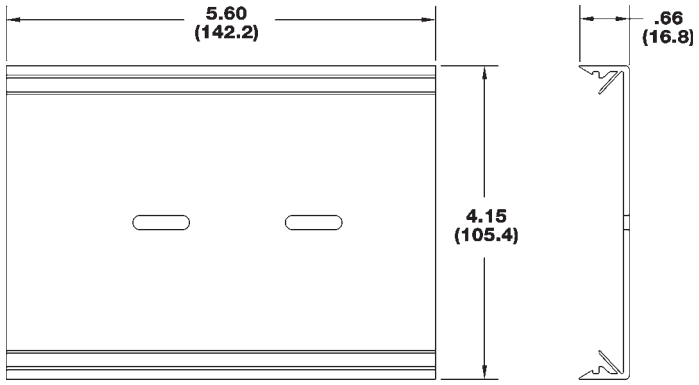
*Shown in inches (millimeters)*

*Option N (No Enclosure)*

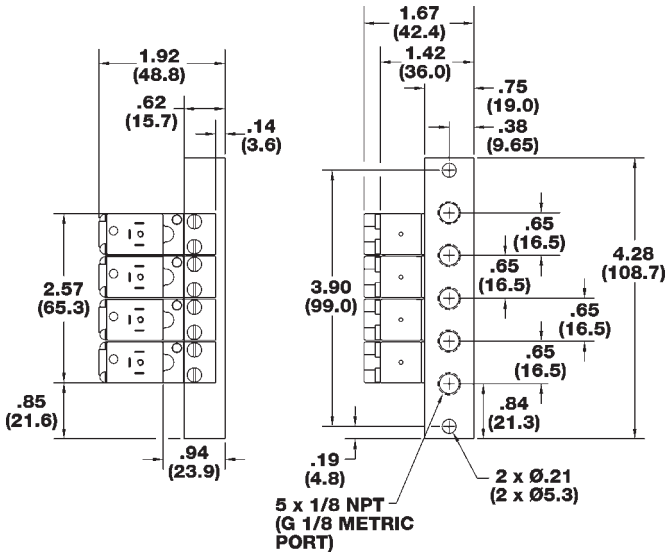
### PC Board



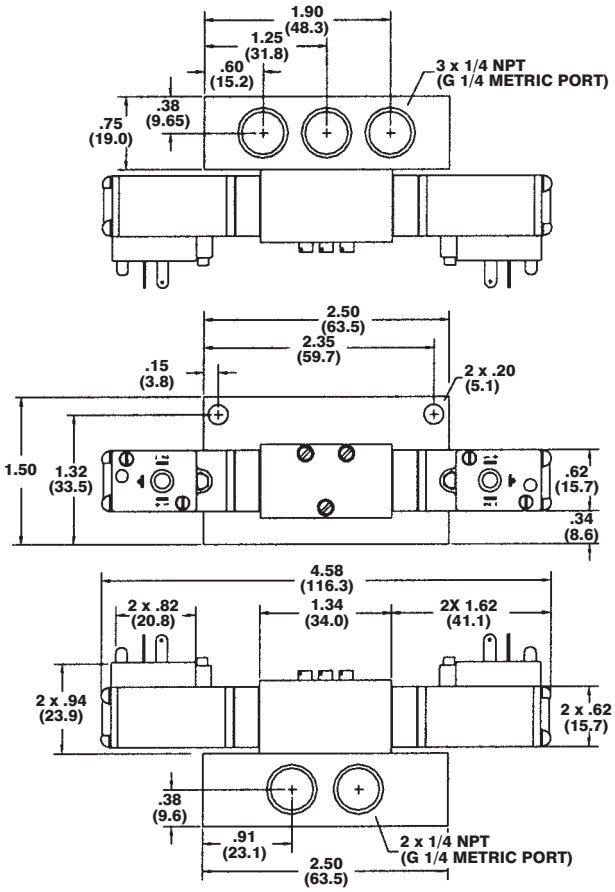

### Snap Track



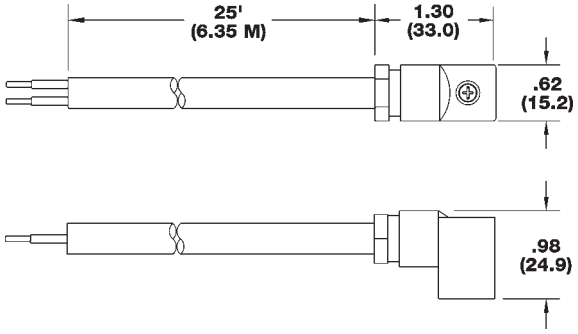

### Valve / Manifold
### PCS1 thru PCS 3




### Valve / Manifold
### PCS4 thru PCS8




### Valve Cable



# PNEUMATIC CONTROL SYSTEM (PCS)

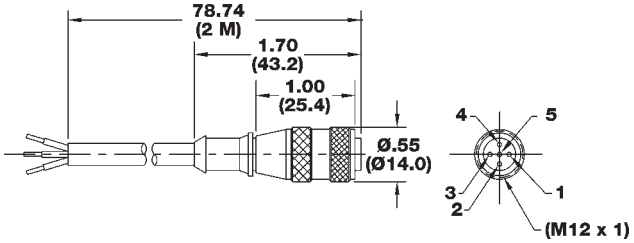
## "ACCESSORIES"

*Shown in inches (millimeters)*

## Quick Connect Cables

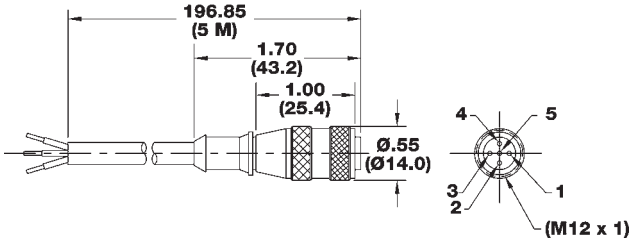
### PCS-CBL-PWR

**SPECIFICATIONS**
**5 CONDUCTORS OF 22 AWG LEADS RATED**
**TO 250 V AT 4 AMPS**
**SHIELDED**




### PCS-CBL-PWR-X

**SPECIFICATIONS**
**5 CONDUCTORS OF 22 AWG LEADS RATED**
**TO 250 V AT 4 AMPS**
**SHIELDED**




### PCS-CBL-PWR Wire Color Codes

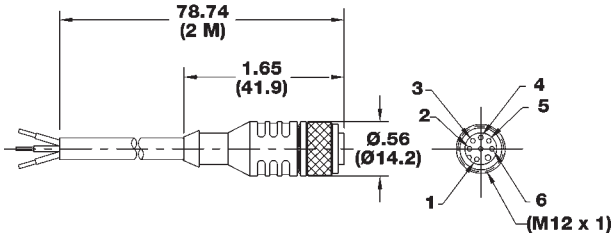
| Color | Pin | Description |
|---|---|---|
| Brown | 1 | Positive |
| White | 2 | N/C |
| Blue | 3 | Negative |
| Black | 4 | N/C |

### PCS-CBL-CMD Wire Color Codes

| Color | Pin | Description |
|---|---|---|
| Brown | 1 | Input |
| White | 2 | @ Position |
| Blue | 3 | Ground |
| Black | 4 | Current Position |
| Green/Yellow | 5 | N/C |
| Pink | 6 | N/C |

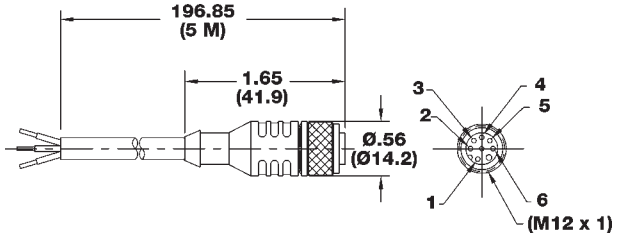
### PCS-CBL-CMD

**SPECIFICATIONS**
**6 CONDUCTORS OF 24 AWG LEADS RATED**
**TO EITHER 30 VAC OR 36 VDC AT 4 AMPS**
**SHIELDED**



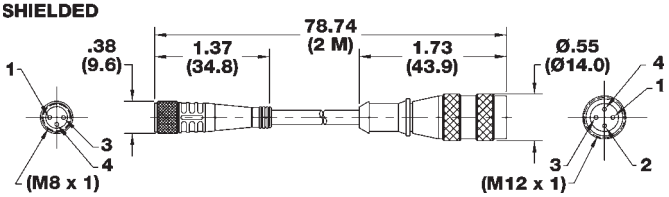

### PCS-CBL-CMD-X

**SPECIFICATIONS**
**6 CONDUCTORS OF 24 AWG LEADS RATED**
**TO EITHER 30 VAC OR 36 VDC AT 4 AMPS**
**SHIELDED**



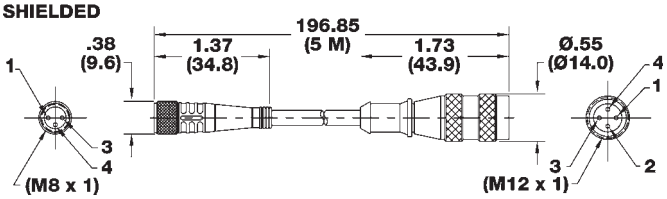

### PCS-CBL-FBK

**SPECIFICATIONS**
**3 CONDUCTORS OF 24 AWG LEADS RATED**
**TO 120 V AT 4 AMPS**
**SHIELDED**




### PCS-CBL-FBK-X

**SPECIFICATIONS**
**3 CONDUCTORS OF 24 AWG LEADS RATED**
**TO 120 V AT 4 AMPS**
**SHIELDED**



# DIGITAL PANEL METER (DPM)

## DPM Series Application

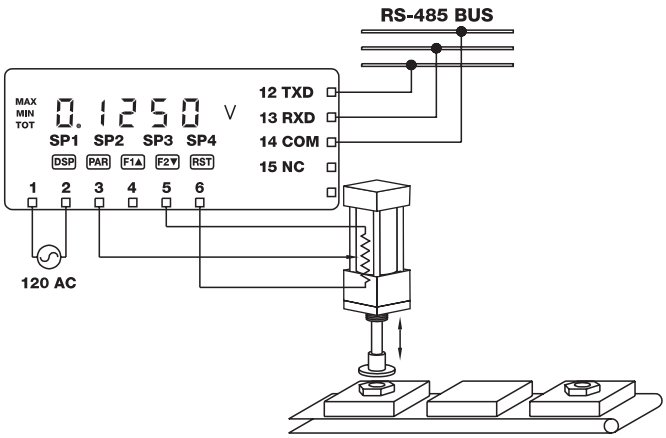
### Digital Panel Meter Model DPM
### Application Example


The DPM controller is ideal for measuring and gauging applications. The measurement repeatability, when combined with the PFLF, is 0.001 inch per inch of stroke. The DPM supplies the PFLF with a very accurate excitation voltage and has a 16 bit A/D converter. The DPM/PFLF combination can be used as a Go/No Go gauge for in process quality control, among other things. A typical application follows:

**Desired Result:** In line process control verification to determine if parts meet required specifications.

### Example One

The DPM is used in conjunction with a PFLF cylinder to verify part specifications during an assembly process, ensuring quality of parts. RS-485 communications are used to monitor the PFLF displacement remotely from the DPM. (The RS-485 protocol allows up to 32 devices to be connected to one port, and is less susceptible to signal noise since the analog to digital conversion is done in the DPM controller, utilizing the same power supply and ground planes as the PFLF.) This information will be read by a PLC. The PLC determines what should be done to the part based on the displacement values read. (i.e., Send part on to the next process, or divert to rework station.) Use the DPM/PFLF combination to verify if nuts are present and tightened correctly by checking the height of the nut. Calibrate the DPM using four calibration points- zero, LCL (lower control limit), UCL (upper control limit), and full scale. Refer to the Quick Start Guide, or the DPM manual shipped with each control unit for instructions.




Configure the PLC with an RS-485 communication port. Program the PLC ladder logic according to your particular application. The ladder logic can be written to accommodate different sets of specifications for different product lines, making set up for the different products much easier and less time consuming.

### Example Two

Read the programmable alarm outputs of the DPM from a PLC input card. The DPM outputs can be used to determine if a part measures to the proper tolerance or not. Alarm output one can be programmed to turn on at the upper control limit (UCL) of the part specification, and alarm output two can be programmed to turn on at the lower control limit (LCL) of the part specification. When the PFLF is extended to measure the part, the PLC can read the DPM setpoint alarm outputs to determine if the part conforms to the proper specifications. After the PFLF is extended against the part, the PLC reads the DPM outputs. If no setpoint alarm turns on, this means that the PFLF displacement is above the UCL, and the part is too big. If setpoint alarm one is on, this means that the part is in the good tolerance zone. If both setpoint alarms are on, this means that the part is either too small, or the part is not present.

# DIGITAL PANEL METER (DPM)

## Model DPM - 1/8 DIN Universal DC Input Panel Meter

### Model DPM Digital Set Point Controller

*The DPM may be used with the Position Feedback Cylinder. The controller provides a digital LED readout that may be calibrated to indicate the position of the cylinder in desired units. The PFLF/DPM combination is ideal for measuring and gauging applications. The controller includes the following features:*

- *PFLF Compatible Excitation and Input Impedance*
- *120 VAC Input Voltage*
- *16 Point Calibration Feature for Increased PFLF Linearity*
- *Max and Min Reading Memory*
- *5 Digit Display*
- *Programmable Function Keys*
- *Optional Serial Communication, Includes RS-232, RS-485 and DeviceNet®*
- *Optional Analog Card with 16 bit Resolution*
- *NEMA 4X/IP65 Sealed Front Bezel*
- *CE Compliant*
- *Fast Input and Output Rates-Programmable*

### General Description

The DPM embodies many features and performance capabilities to suit a wide range of indication requirements. The meter employs advanced technology for stable, drift free readout, while incorporating features that provide flexibility now and in the future with Plug-in option cards. The option cards afford the opportunity to easily configure the meter for the needs of the present while providing an upward migration path as control and indication needs evolve.

The DPM provides a precision excitation compatible for TRD's PFLF. 16-point input scaling feature improves PFLF linearity if necessary. The meter provides a Max and Min reading memory with programmable capture time. The capture time is used to prevent detection of false max and min readings which may occur during start-up or unusual process events.

The signal totalizer (integrator) can be used to compute a time-input product. This can be used to provide a readout of totalized flow, calculate service intervals of motors and pumps, etc. The totalizer can also accumulate batch weighing operations.

The DPM comes standard with four sourcing setpoint outputs. The setpoint alarms can be configured in modes to suit a variety of control and alarm requirements.

- High and low absolute, high and low deviation and band acting
- Balanced or unbalanced hysteresis
- On and off delay timers
- Auto reset or latching modes
- Reverse phase output and/or panel indicator
- Selection of alternate list of setpoint values

Optional accessory cards also facilitate bus communications. These include RS232, RS485 and DeviceNet. Readout values and setpoint alarm values can be controlled through the bus. Additionally, the meter has features that allow a remote computer to directly control the outputs of the meter. This is useful during commissioning phases and diagnostic use. With a communication card installed, set-up software allows configuration from a PC. The configuration data can be saved to a file for later recall. Contact TRD for information if required.

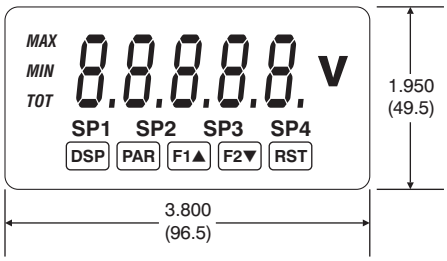
Once the meter has been initially configured, the parameter list may be locked out from further modification in it's entirety or only the setpoint values can be made accessible.

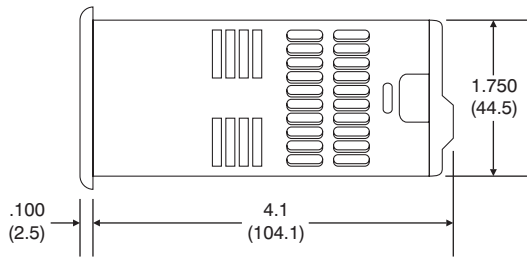
The meter has been specifically designed for harsh industrial environments. With NEMA/IP65 sealed bezel and extensive testing of noise effects to CE requirements, the meter provides a tough and reliable local readout.

***CAUTION: Read complete instructions prior to installation and operation of the unit.***

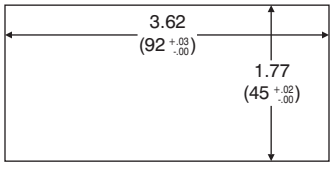
***CAUTION: Risk of electric shock.***

### Dimensions "In Inches (mm)"




**PANEL CUT-OUT**




***Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.5" (140) W.***

# DIGITAL PANEL METER (DPM)
## "SPECIFICATIONS"

1. **DISPLAY:** 5 digit, 0.56" red LED, (-19999 to 99999)
2. **POWER:** 85 to 250 VAC, 50/60 Hz, 15 VA
   **Isolation:** 2300 Vrms for 1 min. to all inputs and outputs
3. **ANNUNCIATORS:**
   **MAX** - max readout selected
   **MIN** - min. readout selected
   **TOT** - totalizer readout selected, flashes when total overflows
   **SP1** - setpoint alarm 1 is active
   **SP2** - setpoint alarm 2 is active
   **SP3** - setpoint alarm 3 is active
   **SP4** - setpoint alarm 4 is active
   **Unit Label** - software controlled units label backlight
4. **KEYPAD:** 3 programmable function keys, 5 keys total
5. **A/D CONVERTER:** 16 bit resolution
6. **UPDATE RATES:**
   **A/D conversion rate:** 20 readings sec.
   **Step response:** 200 msec. max. to within 99% of final readout value (digital filter and internal zero correction disabled) 700 msec. max. (digital filter disabled, internal zero correction enabled).
   The meter periodically (every 12 seconds) imposes a 500 msec. delay to compensate for internal zero drift. If the delay affects applications where step response is critical, it can be defeated. Set the display update to 20/sec. to disable. In this case, add a zero error of 0.1% FS over the 0 to 50°C range.
   **Display update rate:** 1 to 20 updates/sec.
   **Setpoint output on/off delay time:** 0 to 3275 sec.
   **Analog output update rate:** 0 to 10 sec.
   **Max./Min. capture delay time:** 0 to 3275 sec.
7. **RANGE OVERLOAD RESPONSE:**
   Display flashes [OLOL] at approximately 105% above range
   Display flashes [ULUL] at approximately -5% below range
8. **DPM PFLF INPUT:**

| Accuracy* (18 to 28°C) | Accuracy* (18 to 50°C) | Impedance/ Compliance | Max Continuous Overload | Resolution |
|---|---|---|---|---|
| 0.03% of reading +3 mV | 0.12% of reading + 4 mV | 1.066 Mohm | 300 V | 1 mV |

*After 20 minute warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28°C and 10 to 75% RH environment; and accuracy over a 0 to 50°C and 0 to 85% RH (non-condensing environment). Accuracy over the 0 to 50°C range includes the temperature coefficient effect of the meter.

9. **EXCITATION POWER:**
   9V ± 4% initial value regulated, 130 mA max.
10. **LOW FREQUENCY NOISE REJECTION:**
    **Normal Mode:** > 60 dB @ 50 or 60 Hz ± 1%, digital filter off
    **Common Mode:** > 100 dB, DC to 120 Hz
11. **USER INPUTS (Logic Level):** Three software defined user inputs, jumper selectable for sink/source logic
    **Max. Continuous Input:** 30 VDC

| INPUT STATE | SINKING INPUTS (DEFAULT) 22 KΩ pull-up to +5 V | SOURCING INPUTS 22 KΩ pull-down |
|---|---|---|
| Active | $V_{IN}$ < 0.7 VDC | $V_{IN}$ > 2.5 VDC |
| Inactive | $V_{IN}$ > 2.5 VDC | $V_{IN}$ < 0.7 VDC |

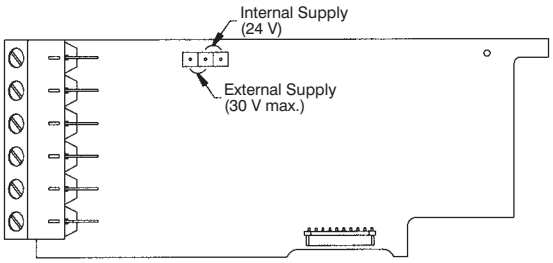
**Isolation To Sensor Input Common:** Not isolated

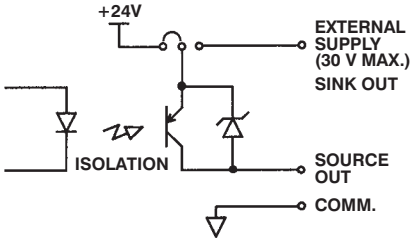
12. **TOTALIZER:**
    **Time Base:** second, minute, hour or day
    **Time Accuracy:** 0.01% typical
    **Decimal Point:** 0 to 0.0000
    **Scale Factor:** 0.001 to 65.000
    **Low Signal Cut-out:** -19,999 to 99,999
    **Total:** 9 digits, display alternates between high order and low order readouts
13. **CUSTOM LINEARIZATION:**
    **Data Point Pairs:** Selectable from 2 to 16
    **Display Range:** -19,999 to 99,999
    **Decimal Point:** 0 to 0.0000
14. **SERIAL COMMUNICATIONS:** (RS232 or RS485)
    **Isolation To Sensor & User Input Commons:**
    500 Vrms for 1 min.
    Working Voltage: 50 V
    Not Isolated from all other commons.
    **Data:** 7/8 bits
    **Baud:** 300 to 19200
    **Parity:** no, odd or even
    **Bus Address:** selectable 0 to 99, Max. 32 meters per line (RS485)
    **Transmit Delay:** Selectable for 2 to 50 msec. or 50 to 100 msec. (RS485)
15. **ANALOG OUTPUT:**
    **Types:** 0 to 20 mA, 4 to 20 mA or 0 to 10 VDC
    **Isolation To Sensor & User Input Commons:** 500 Vrms for 1 min.
    Working Voltage: 50 V
    Not Isolated from all other commons.
    **Accuracy:** 0.17% of FS (18 to 28°C); 0.4% of FS (0 to 50°C)
    **Resolution:** 1/3500
    **Compliance:** 10 VDC: 10KΩ load min.
    20 mA: 500 W load max.
16. ***Quad Sourcing Open Collector:***
    **(Standard with DPM):**

**QUAD SOURCING OUTPUT FIELD TERMINALS**

- 20 – EXTERNAL SUPPLY
- 21 – 01 SRC.
- 22 – O2 SRC.
- 23 – 03 SRC.
- 24 – 04 SRC.
- 25 – COMMON

**Type:** Four Isolated sourcing PNP transistors.
**Isolation To Sensor & User Input Commons:** 500 Vrms for 1 min.
Working Voltage: 50 V
Not Isolated from all other commons.
**Rating:** Internal supply: 24 VDC ± 10%, 30 mA max. total all four outputs.
External supply: 30 VDC max., 100 MA max. each output.

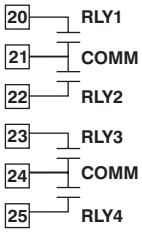


# DIGITAL PANEL METER (DPM)
## "SPECIFICATIONS" (Continued)

*Optional Quad Relay Card:*
**(Optional Accessory Card DPM-R):**

**QUAD RELAY OUTPUT FIELD TERMINALS**




**Type:** Four FORM-A relays
**Isolation To Sensor & User Input Commons:** 2300 Vrms for 1 min.
**Contact Rating:** One Relay Energized: 3 amps @ 250 VAC or 30 VDC (resistive load, 1/10 HP @ 120 VAC, inductive load. Total current with all four relays energized not to exceed 4 amps.
**Life Expectancy:** 100K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads.

17. **ENVIRONMENTAL CONDITIONS:**
**Operating Temperature Range:** 0 to 50°C (0 to 45°C with all three plug-in cards installed)
**Storage Temperature Range:** -40 to 60°C
**Operating and Storage Humidity:** 0 to 85% max. Non-condensing
**Altitude:** Up to 2000 meters

18. **CERTIFICATIONS AND COMPLIANCES:**
**ELECTROMAGNETIC COMPATIBILITY**

*Notes:*
*1. Self-recoverable loss of performance during EMI distribance at 10 V/m: Measurement error less than 2% of full scale.*

*For operation without loss of performance:*
*Mount unit in a metal enclosure (Buckeye SM7013-0 or equivalent)*
*Route power and I/O cables in metal conduit connected to earth ground.*

*Refer to the Application Guide for additional EMC information.*

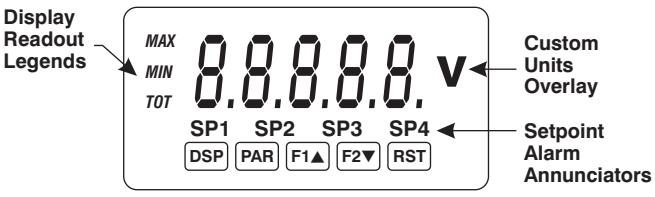
**Immunity to EN 50082-2**

| | | |
|---|---|---|
| electrostatic discharge | EN 61000-4-2 | level 3; 8 Kv air |
| electromagnetic RF fields | EN 61000-4-3 | level 3; 10 V/m1 80 Mhz - 1 GHz |
| fast transients (burst) | EN 61000-4-4 | level 4; 2 Kv I/O level 3; 2 Kv power |
| RF conducted interference | EN 61000-4-6 | level 3; 10 V/rms 150 KHz - 80 MHz |
| simulation of cordless telephones | ENV 50204 | level 3; 10 V/m 900 MHz ± 5 MHz 200 Hz, 50% duty cycle |

**Emissions to EN 50081-2**

| | | |
|---|---|---|
| RF interference | EN 55011 | enclosure class A power mains class A |

## Front Panel




19. **CONNECTIONS:** High compression cage-clamp terminal block
Wire Strip Length: 0.35" (9 mm)
Wire Gauge Capacity: One 14 AWG solid or Two 18 AWG

20. **CONSTRUCTION:** This unit is rated for NEMA 4X/IP65 indoor use. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.

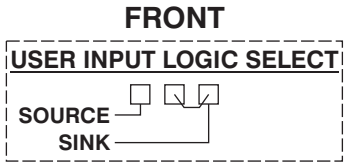
21. **WEIGHT:** 10.4 oz. (295 g)

### *Safety Summary*

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the unit.

## *Jumper Link Functions*



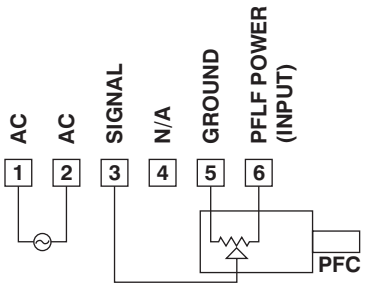

*User Input or Sink Select*

| KEY | DISPLAY MODE OPERATION |
|---|---|
| **DSP** | Index display through max/min/total/input readouts |
| **PAR** | Access parameter list |
| **F1▲** | Function key #1; hold for 3 seconds for Second Function #1 |
| **F2▼** | Function key #2; hold for 3 seconds for Second Function #2 |
| **RST** | Reset (function key) |

**PROGRAMMING MODE OPERATION**

Quit programming and return to display mode
Store selected parameter and index to next parameter
Increment selected parameter value
Decrement selected parameter value
Hold with F1▲, F2▼ to scroll value by x1000

# DIGITAL PANEL METER (DPM)
## "BASIC CONNECTIONS"




***Note: Option card field connections are supplied with the card.***

### *Wire Colors*

| WIRES | 6" LEADS | PLUG |
|---|---|---|
| Input | Red | Blue |
| Ground | Black | Black |
| Output | White | Brown |

### *Custom Units Overlay*

The meter has a backlighted units indicator that can be customized to the application. The backlight is turned on by programming the "b-L it" parameter. Overlays are available in the Units Label Kit. To install an overlay, remove the unit from the case. Select the label and apply it to the label frame, noting that the label must be aligned accurately. Install the label frame to the display board in the alignment holes located on the right side of the display.

### *Plug-In Cards*

The meter has three plug-in card slots. Each slot is dedicated to a specific function. These functions are:

- ***Setpoint Outputs***
- ***Analog Outputs***
- ***Communication Option***

The plug-in cards can be used in any combination, however, it is only possible to use one type of card from each category. Cards can be installed initially, or at a later date as system needs arise.

### *Devicenet Plug-In Card*

A DeviceNet communication port can be added to the meter. DeviceNet is a high level bus protocol based upon the CAN specification. The protocol allows the integration of devices of different types and manufacturers within a common communication framework.

### *Analog Output Plug-In Card*

The analog output is available as a Plug-in card. Either the 20 mA or the 10 V output can be used. The output can be scaled independent of the input range. Reverse acting output is possible by reversing the scaling point positions. Other features are selectable update rate and output source selection.

### *RS485 Plug-In Card*

An RS485 communication port can be added with a Plug-in card. RS485 offers multi-drop bus communications. All devices connect in parallel on a 485 bus. Only one device is permitted to transmit at any one time, while all other devices are in receive mode.The meter controls the bus when it transmits data, otherwise the meter is in the receive mode.

### *RS232 Plug-In Card*

An RS232 communication port can be installed with a Plug-in card. RS232 is intended to allow only 2 devices to communicate to each other (i.e., printer or computer). For more information, See DPM Serial Application Guide.

### *Inputs*

#### Voltage Inputs

The PFLF uses the ±20V range (default).

### *Scaling*

The meter has been factory calibrated on all ranges as a basic multimeter (voltmeter/ammeter/ohmmeter). The basic meter readout can then be post scaled to read out in the process units (level, flow, temperature, etc.). The meter provides two ways in which to scale the display:

**Key-in:** Key in the input and display scaling points using known data.

**Apply:** Apply the actual input value and key in the corresponding display value. The meter records the input value applied.

For processes that require linearity compensation, up to 16 scaling points can be used for correction. The scaling range is extended up to five digits of resolution with selectable display rounding factors.

### *Input Features*

A unique adaptive input filter is used. Whenever the difference between one reading and the next is less than the filter band value, the input is filtered. When the difference exceeds the filter band value, the input is not filtered. This avoids the usual compromise between using a relative high time constant for good noise rejection and using a low time constant filter for quick step response.

The readout can be corrected for process zero errors with an offset value. A tare function zeros the readout via a function operation.

### *Function Keys and User Inputs*

The Function Keys and User inputs can be programmed to perform specific meter control operations. Function Keys #1 and #2 each have two types of functions, primary and secondary. The primary function is executed the instant the key is pressed. Holding the key for three seconds executes the second function. If the key is not held for 3 seconds, the second function is not executed. To implement a hidden key, program no function for the primary and program the desired function for the second. The three user inputs can be selected for sinking or sourcing logic.

### *Max and Min Reading Detection*

The meter records the maximum (max) and minimum (min) process inputs. Conditions such as valve activation, sudden change in material flow rate, etc., can result in false peaks which are not reflective of the true maximum and minimum of the process. In this case, Max and Min capture delay times can be used to prevent the detection of false maximums and minimums.

### Parameter Lock Mode

A user input can be used to lock the parameter list. When the user input is active, the meter is in the protected parameter mode, where it is only possible to access the setpoint values and the security code.

It is possible to lock the parameter list without using a user input as a program lock function. In this case, set the security code to a non-zero value. With a non-zero security value set, press the PAR Key to view the programmed setpoint values. The security code requires a "key" value to gain access to the full parameter list.

## Installation

The DPM meets NEMA 4X/IP65 requirements for indoor use when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown in the Dimensions drawing. Remove the panel latch and cardboard sleeve from the unit and discard the cardboard sleeve. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout. While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

## Ordering Information

| PART NUMBER | DESCRIPTION |
|---|---|
| DPM | Base Unit - Includes Excitation, Quad Solid State Outputs |
| DPMA | Base Unit with Analog Card |
| DPMS | Base Unit with RS-485 Serial Output |
| DPM-485 | RS-485 Plug-In Accessory Card |
| DPM-232 | RS-232 Plug-In Accessory Card |
| DPM-DNET | DeviceNet Plug-In Accessory Card |
| DPM-A | Analog Plug-In Accessory Card |
| DPM-R | Quad Form A 120 VAC Relay Plug-In Accessory Card |

# ELECTRONIC CONTROLLER

The Electronic Controllers provide 10 VDC regulated power to the Position Feedback Cylinder. Four models are available for AC or DC input and voltage or current output. Each controller offers both dual set point and scaled analog output functions. The controllers are strictly analog in nature and are **not** closed loop motion controllers.

## *The Electronic Controller is ideal for applications where:*

- The main system controller being used to interface with the PFLF does not have the required 1 Mohm input impedance.
- The application requires a fast responding scaleable analog output signal.
- Accuracy is not a key consideration (±0.030″ or higher).
- The customer desires to cycle between two variable set points without needing to stop and hold a position.

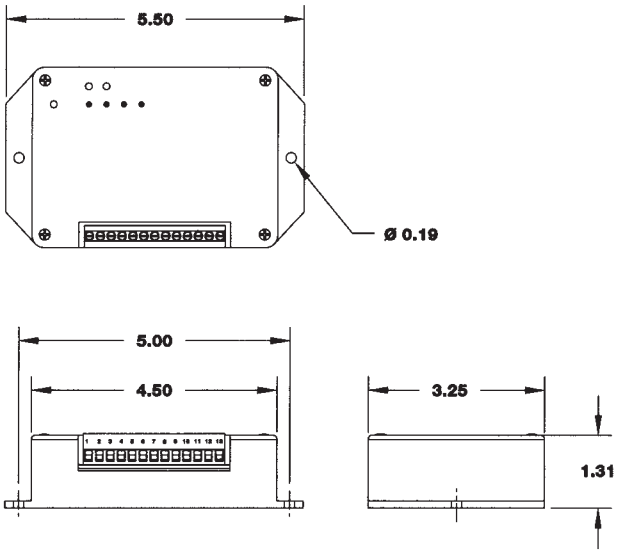
Typically applications include web tensioning or dancer arm control. The Electronic Controller would be used as an interface between the PFLF cylinder and the customers web tensioning or dancer arm controller.

## *"HOW TO ORDER"*

ELECTRONIC CONTROLLER - (MODEL NO.)

| MODEL NO. | INPUT POWER | SCALABLE OUTPUT |
|---|---|---|
| 120AC4-20mA | 120 VAC | 4-20mA |
| 120AC0-10DC | 120 VAC | 0-10 VDC |
| 12/24DC4-20mA | 12-24 DC | 4-20mA |
| 12/24DC0-10DC | 12-24 DC | 0-10 VDC |

## *"DIMENSIONS"*



# ELECTRONIC CONTROLLER
## "SPECIFICATIONS"

Auxiliary Power Requirements:
- AC Models . . . . . 100 to 135 VAC (115 VAC Input)
  200 to 270 VAC (230 VAC Input)
- DC Models . . . . . 11.8 to 26 VDC (12/24 VDC Input)

Power Requirement:
- AC Models . . . . . 5 VA maximum (120 to 230 VAC)
- DC Models . . . . . 1.2 VA maximum (12 VDC)
  2.4 VA Max. (24 VDC)

Frequency Range . . . . . 50/60 HZ
Transducer Excitation Voltage . . . . . 10 VDC (Nominal)
Electrical Connections . . . . . 13 position Euro Style terminal block
Dielectric Strength:
- AC Models . . . . . 2000 VAC (All Inputs to all Outputs)
  2000 VAC (Terminals to case)
- DC Models . . . . . 2000 VAC (All Inputs to relay Outputs)
  2000 VAC (Terminals to case)

Note: The Negative power supply connection is common to the analog signal output.

Transient Protection . . . . . All inputs and outputs are designed to withstand transient energy levels normally associated with Category III service locations as defined by IEC 644. Industrial installations that are typical of this environment would include most distribution, feeder or branch circuit connections that are not located at the immediate service entrance.

Shipping Weight . . . . . Approx. 12 oz.
Operating Temperature Range . . . . . (-30°C to +70°C) -22°F to 160°F
(0°C to +70°C) 32°F to 160°F for 12 VDC Operation
Storage Temperature Range . . . . . (-40°C to +85°C) -40°F to 185°F
Enclosure Dimensions . . . . . 1.31″ H x 5.50″ W x 3.25″ D

### Position Feedback Control Module

Unless noted otherwise:
- Ambient Temperature = (25°C) 77°F Nominal
- Aux Power (AC Models) = 120 VAC, 60 HZ
- Aux Power (DC Models) = 24 VDC

### Relay Outputs

Control Limit Set Point Range . . . . . 2 independent adjustments settable from 0 to 100% of cylinder stroke
Temperature Influence on Control Limits . . . . . ± 0.01% stroke/°C (-30°C to +70°C)
Output Contact Ratings . . . . . 5 A, 250 VAC, 0.8 power factor (general use)
5 A, 30 VDC (resistive)
360 VA, 240V, 0.4 power factor (Pilot Duty)
Output Contact Configuration . . . . . 2 independent form C (SPDT) relays
Each relay has a corresponding control limit set point adjustment

Response Time (Excluding Bounce)
- Operate Time = 8 mS TYP/12 mS maximum
- Release Time = 4 mS TYP/6 mS maximum

Mechanical Life . . . . . 20,000,000 operations minimum

### Analog Ouputs

Output Load Specifications . . . . . 0 t o10 VDC @ 10 mA maximum
4 to 20 mA @ 500 Ω maximum loop resistance
350 Ω for 12 VDC input
Zero Offset Adjustment Range . . . . . ± 5V (10 VDC output)
± 8 mA (4 to 20 mA output)
Gain Adjustment Range . . . . . From 0.5 to 2.0 times input signal
Output Limits . . . . . 13v typical (10 VDC output)
25 mA typical (10 VDC output)
Temperature Influence on Analog Output . . . . . <±0.02% Full Scale Output/°C (-30°C to +70°C)
Output Ripple . . . . . <0.2% of Full Scale Output

Response Time (0 to 90% of final value)
- 0 to 10 VDC = 2 mS TYP/3 mS maximum
- 4 to 20 mA = 2 mS TYP/3 mS maximum