I. Introducing : Proportional Pressure Controller


The MAC Proportional Pressure Controller, (PPC) is an innovative product which converts an electrical signal into a proportional pneumatic output. The PPC is unlike conventional I/P or V/P transducers. It offers much more in terms of performance, features, and reliability.
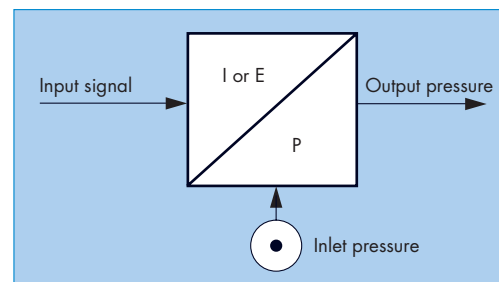
The key to the MAC PPCs are two MAC 34, 45, 400, 47, 92 or 93 Series valves that are used to control the output pressure. The valves are operated by the PPCs closed loop electronic control circuit. Feedback is obtained from one or two transducers. The balanced poppet, fast response, and high flow of these two MAC Valves provide outstanding performance characteristics for the PPC.

The PPC controls output pressure by constantly measuring its down stream pressure and comparing it to the command signal. If a higher pressure is commanded the PPC quickly responds by actuating the MAC fill valve, increasing the output pressure until it is equal to the pressure represented by the command signal. Conversely, if a lower pressure is required, the PPC will energize the MAC exhaust valve, decreasing output pressure until the correct pressure is achieved. All of this happens very quickly to smoothly maintain the correct pressure.
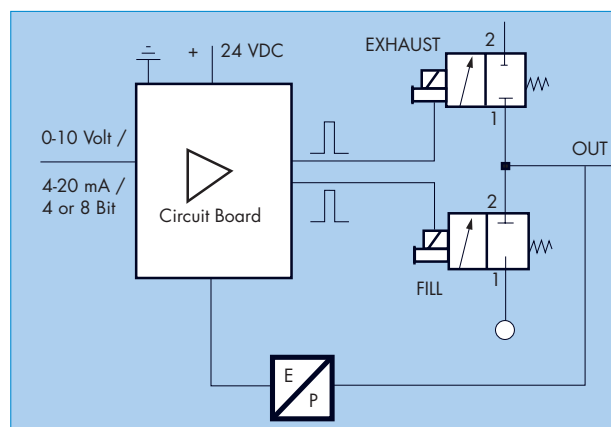
This approach to pressure control provides a small, light, and cost effective unit. Unlike voice coil units, the PPC is not affected by vibration or mounting position. Unlike large direct solenoid proportional units, the PPC is small and light, drawing little power, and producing little heat. Unlike units that utilize unbalanced air valves, the PPCs balanced valves provide high flow and extremely fast and repeatable response times as well as eliminating "undershoot" and "overshoot" problems normally associated with unbalanced valve designed units. Other proportional products often incorporate valves from third party manufactures. All MAC PPCs utilize only fast shifting, repeatable, high flow, long life MAC Valves as fill and exhaust valves.

II. Configuration

The PPC is available in many configurations.
The PPC5C can be ordered with a single or dual transducer, with an analog or digital command signal, for pressure or vacuum service. All other PPCs can be ordered with a single transducer with an analog command signal.
Single transducer PPCs can be configured with internal sensing (stand alone) or with external sensing (e.g. for Proportional Multi-Pressure Pak®). Dual transducer PPCs are available for controlling other devices such as boosters.
PPCs with analog or digital command signal are chosen following the command device available for the application.
Most PPC Series are available as covered or coverless devices. Coverless PPCs are intended for use in cabinets or areas protected from moisture while covered PPCs can be used in unprotected environments (Washdown).
MAC offers a multitude of special modifications designed to meet customers specific application requirements. Please contact your local MAC distributor for consultation if our standard product options do not fulfill your requirements.

III. Specifications

The linearity parameter shows the capability of the unit to follow the input signal according to an ideal straight line curve.
MAC PPCs exhibit excellent linearity throughout the pressure range. The deviation is measured in ± % of full scale.
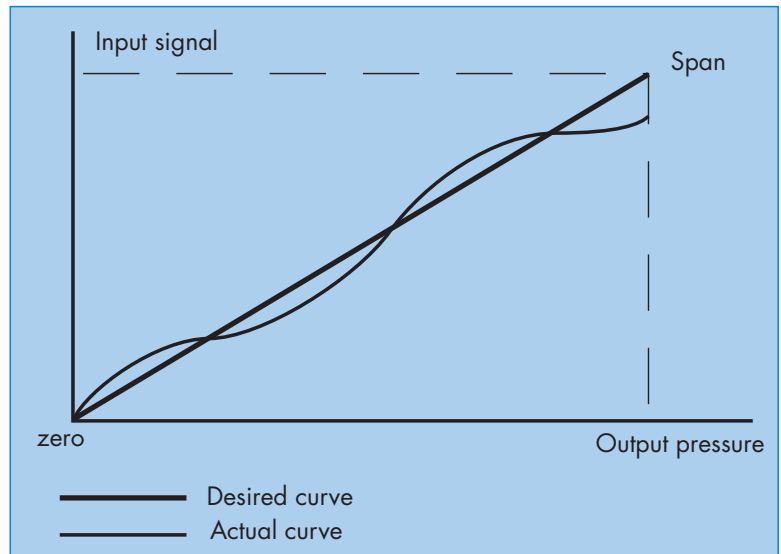
For single transducer models, two parameters can be adjusted. Primarily these should be set by the factory but can be done in the field if absolutely necessary. The first parameter is the ZERO adjust, the second is the SPAN adjust. These parameters provide the possibility of customizing the PPC according to customers needs. However these adjustments are limited due to the tolerances of the transducers. If adjustments are necessary, please consult the factory or your local distributor

Note: Dual transducer models are not field adjustable.

Consult "Precautions" page 94 before use, installation or service of MAC Valves.

MAC

Introduction
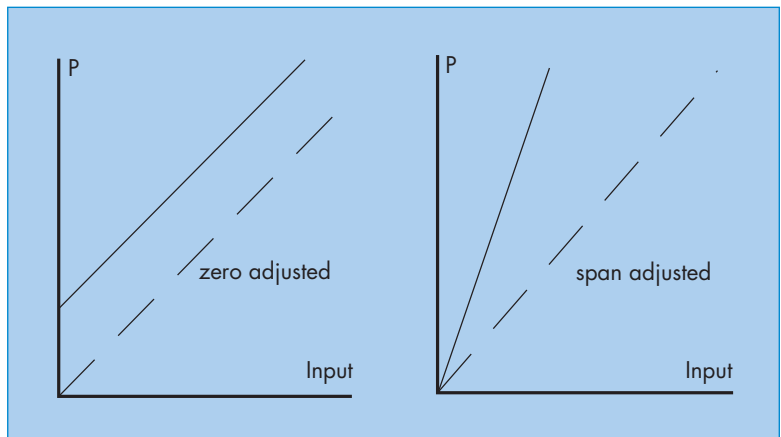
HYSTERESIS

The hysteresis error, sometimes called "deadband", is the amount of output pressure variance required to cause the PPC to react, making a correction to the output pressure. It is given in percent of full scale pressure, all MAC PPC products perform with minimal hysteresis.

120 PSI

60,5 PSI

60 PSI

59,5 PSI

0 PSI
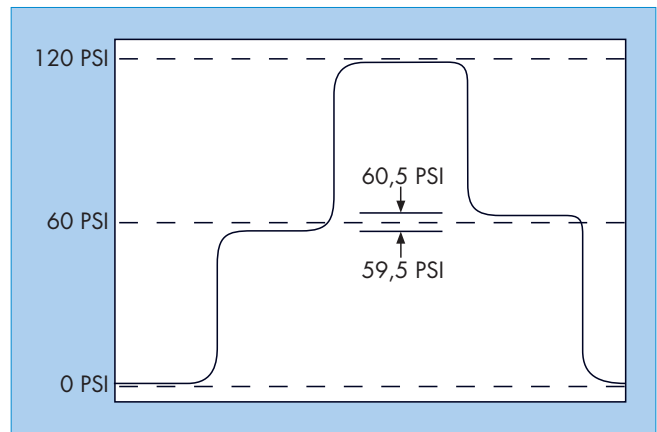
ACCURACY

MAC Valves states accuracy of the MAC PPCs as overall accuracy. Accuracy is expressed in percent of full scale, which includes hysteresis and linearity. Some suppliers give separate parameters in order to give a better impression. In this case hysteresis and linearity are added. MAC PPCs are extremely accurate and maintain excellent control of output pressure well within our stated accuracy.

OVERSHOOT — UNDERSHOOT

Two undesirable characteristics of other proportional control units available on the market are overshoot and undershoot.

Overshoot is a characteristic of the regulator to exceed the desired output pressure when the command signal is given. Undershoot is a characteristic of the regulator to fail to reach the desired output pressure.
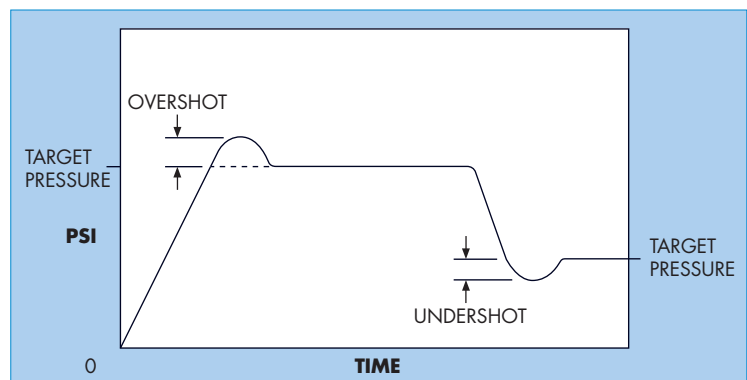
The PPC is based on a closed loop design which combined with MACs fast responding, very repeatable, high flow, balanced 2-way valves, optimizes response and accuracy, practically eliminating overshoot and undershoot.

OVERSHOT

TARGET PRESSURE

PSI

UNDERSHOT

TARGET PRESSURE

0   TIME

CLOSED END VOLUME

The closed end volume is the amount of volume needed to keep the PPC stable. If the closed volume to be filled is not appropriate for a particular PPC model (too small in comparison with the flow of air coming from the PPC), it will be very difficult to control the desired pressure inside this volume. So the PPC will be required to compensate for any small variation of pressure and the device will be unstable. This instability is sometimes referred to as "motorboating" or the continuous energizing and de-energizing of the fill and exhaust valves. Minimum volume requirements to prevent "motorboating" are listed for each PPC in this catalog for your reference.

Consult "Precautions" page 94 before use, installation or service of MAC Valves.

IV. Command Signal Options

The PPC can be controlled with either an analog command signal or a digital command signal.

ANALOG COMMAND SIGNAL

The analog command signal can be either 0 – 10 VDC (voltage) or 4 – 20 mA (current).

Two wires are necessary to accept the command signal. The PPC measures the voltage differences between the two wires to determine the desired pressure output. Along with the command signals, a 24 VDC source must be available to operate the PPC. The return path for the 24VDC source and the return path for the command signal must not be isolated from each other. An example of how to wire the PPC with a differential command signal is shown below.

The major advantages of the command signal for the PPC are :

• Elimination of ground loop noise.
• Operation of multiple PPC's from a single power supply.
• Easy to connect to single-ended equipment.

0 TO 10V

+COMMAND (WHITE)

–COMMAND (BLUE)

24VDC

POWER (BLACK)

COMMON (GREEN)

CABLE TO PPC
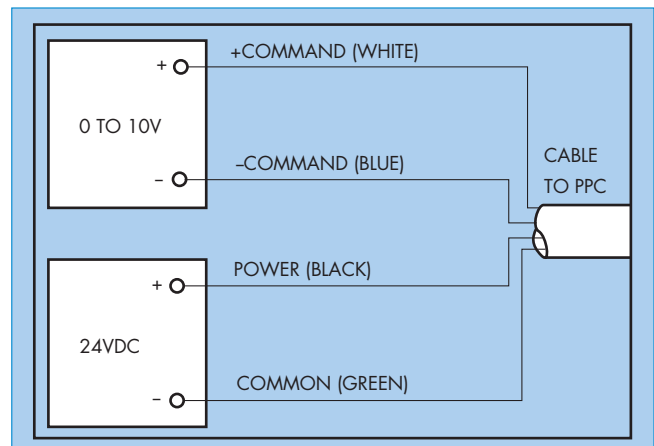
DIGITAL COMMAND SIGNAL

The PPC, through the use of a converter board, accepts a digital command signal for 4-bit or 8-bit binary logic and converts this to an analog signal to produce a proportional pressure.

Using a 4-bit digital input, the maximum number of different pressures available at the output is 16. If an 8-bit digital input is specified, a much finer resolution (256 pressures at the output) can be obtained. For example, in a 100 PSI output system, using 4-bit logic, each bit is equal to 6.67 PSI. With an 8-bit digital, each bit is equal to .392 PSI

There are four different models available for the 4-bit and 8-bit digital PPC based on the type of input signal :

1. Positive Logic/Sourcing Input   **2. Negative Logic/Sourcing Input**
3. Positive Logic/Sinking Input   **4. Negative Logic/Sinking Input**

Positive Logic is defined as a minimum command level (all bits are logic low) controlling a minimum pressure output. For example, in a 4-bit system, a 0000 digital signal would correspond to zero psi and a 1111 digital signal would correspond to the maximum pressure.

Consult "Precautions" page 94 before use, installation or service of MAC Valves.

Negative Logic is defined as a maximum command level (all bits are logic high) controlling a minimum pressure output. For example, in a 4-bit system, a 1111 digital signal would correspond to zero psi and a 0000 digital signal would correspond to the maximum pressure.

Sinking Input requires the digital voltage to be supplied by the controller connected to the input of the PPC. A command signal must be supplied by the external controller to the digital input connections. The PLC "drives" the PPC, by which a digital input (as opposed to analog) will control the output pressure.

Sourcing Input requires the PPC to produce the digital voltage. The controller connected to the input of the PPC is required to "pull the logic level down to zero" or to "maintain the logic level at one". "Zero" is considered that level of the signal which corresponds to the minimum value of the digital input supply (logic low). "One" is considered that level of the signal which corresponds to the maximum positive value of the digital input supply (logic high). In this case, the PPC "drives" the PLC. Again, a digital input will control the output pressure.

V. Monitor Signal Options

The PPC is available with two optional monitor signals. The Analog Monitor Signal (AMS), and the Logic Monitor Signal (LMS). The PPC may be ordered with either one or both of these signals. Monitor Signals provide intelligent feedback to the controlling device.

ANALOG MONITOR SIGNAL -AMS-

The Analog Monitor Signal is a 0 to 10 VDC feedback signal that provides a voltage proportional to the pressure output of the PPC or the output of the device it is controlling. In the case of MACs Proportional Multi-Pressure Pak®, the AMS signal provides a voltage output proportional to the output pressure of the PMPP.

The AMS may be used by the controlling device to verify that the correct pressure has been achieved. Also, the AMS may be connected to a voltage meter to display the pressure output. In some applications, the AMS is fed into the analog input of a controller to provide data for Statistical Process Control. In either case, a high impedance input is required for proper operation.
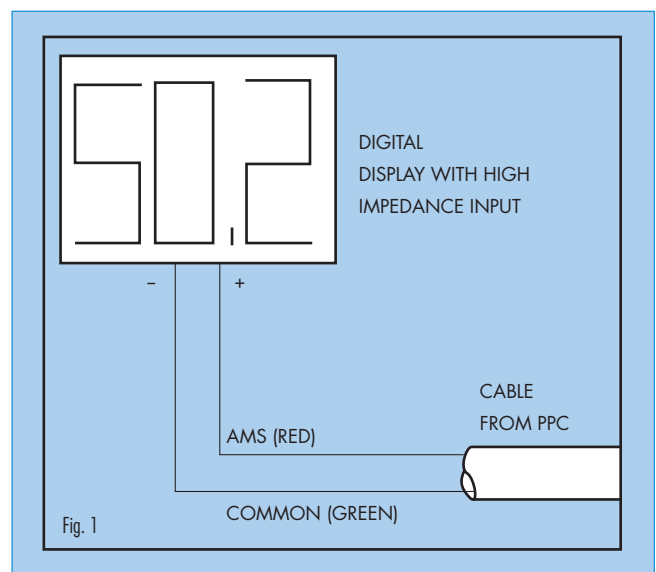

DIGITAL
DISPLAY WITH HIGH
IMPEDANCE INPUT

– +

CABLE
FROM PPC

AMS (RED)

COMMON (GREEN)

Fig. 1

Figure 1, shows how to wire the AMS to a panel meter to display pressure output.

LOGIC MONITOR SIGNAL =LMS=

The Logic Monitor Signal provides digital feedback to confirm that the PPC has achieved the correct pressure. The LMS provides standard logic levels such as TTL (5V) or 24 VDC.

With the TTL option, when correct pressure is achieved, the LMS outputs a logic 1, (5 VDC). When the PPC is working, (Fill or Exhaust valve is in operation) the LMS outputs a logic 0, 0 VDC.

Figure 2 shows how to wire the LMS to a controller's TTL input.

The LMS provides a simple "go/no go" signal back to the controlling device. The LMS may also be used to turn on an L.E.D. for remote indication.

Fig. 2
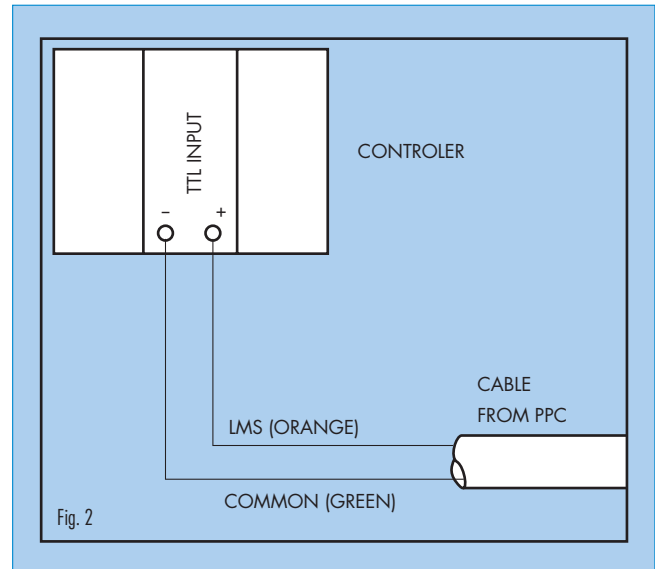
There also is a negative logic version (LMS) available. When the correct pressure is achieved, this option outputs a logic 0. When the PPC is working (fill or exhaust valve is in operation) the output is a logic 1. In either case, the LMS circuit is a sinking type of output. Thus, the PPC supplies the ground to the reading device.

COVERLESS PPC WIRING PIN OUT

AMS – Analog Monitor Signal
   - 0-10 VDC feedback signal that provides a voltage proportional to the output pressure

LMS 1– Logic Monitor Signal
   - 5 VDC (TTL high), 24 VDC (high), 5 VDC (low), or 24 VDC (low) "go/no go" feedback signal (depending on requirements)

LMS 2– Logic Monitor Signal
   - 5VDC (TTL low), 24 VDC (high), or 24 VDC (low) "go/no go" feedback signal (depending on requirements)

CV+ – Positive Command Signal
   - Positive lead for the 0 – 10 VDC or 4-20 MA command signal (depends on requirements)

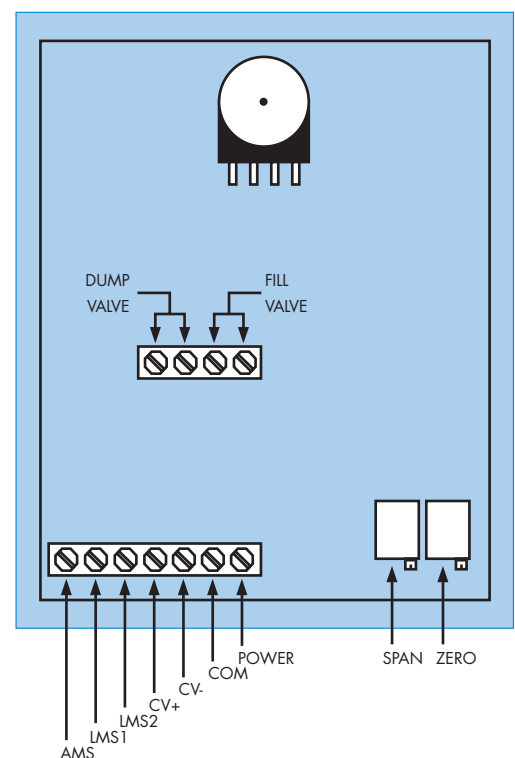**CV- – Negative Command Signal**
   - Negative lead for the 0 – 10 VDC or 4-20 MA command signal (depends on requirements)

COM – Main Power Common
   - Common lead for the 24 VDC power

PWR – Main Power
   - Positive lead for the 24 VDC power

8

Proportional pressure controller

MAC

Series PPC400A

Port size	Flow [Max] [Cv/NI/min]	Individual mounting	Series
1/4"	1.3/1300	coverless analog base mount	

OPERATIONAL BENEFITS

1. Reliable operation, using two MAC 400 Series with balanced pilot.
2. Fast response.
3. Long life.
4. High flow.
5. Low power consumption.
6. Not affected by vibrations.
7. Accuracy : ± 2.5 % full scale.
8. Analog command signal and output.
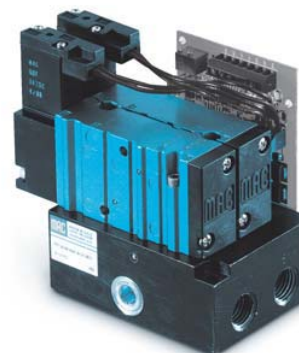
PPC5C

PPC34B

LCP35A

PPC45B

PPC47A

PPC400A

PPC92B

PPC93A

HOW TO ORDER

BASIC MODEL

PPC400A X X X - X X X X - X X X

Type	Type of mounting	Pressure range PSI/BAR	Pressure reference	Accuracy	Command signal	Logic monitor signal	Cover options
A Analog (int. pilot)	**AA** Base side port 1/4" NPTF	**0A** 100/6.7	**G** Gage pressure	**E** ±2.5% F.S.	**B** 0-10v differential	**A** TTL LMS 1,2	**0** No Cover
B Analog (ext. pilot)	**AB** Base side port 1/4" BSPPL	**0B** 60/4	**D** Differential pressure		**D** 4-20mA differential	**B** 24v LMS High on TTL LMS 1 Press. Achieved	
	AC Base side port 1/4" BSPTR	**0C** 30/2				**C** 24v LMS Low on TTL LMS Press. Achieved	
	AD Base side 8mm tube receptacle	**0N** 10/0.66	Caution: differential pressure must not exceed pressure range.				
	BA Base bottom port 1/4" NPTF	**0T** 45/3					
	BB Base bottom port 1/4" BSPPL						
	BC Base bottom port 1/4" BSPTR						
	BD Base bottom 8mm tube receptacle						

EXAMPLE : PPC400A **AAA - 0AGE - BA0**

400 Series flow valves, analog, side port 1/4" NPTF, 100 psi pressure range, gage reference, 2.5% accuracy, 0-10v differential, TTL LMS 1,2, no cover.

Consult "Precautions" page 94 before use, installation or service of MAC Valves.

Series PPC400A

GENERAL DATA

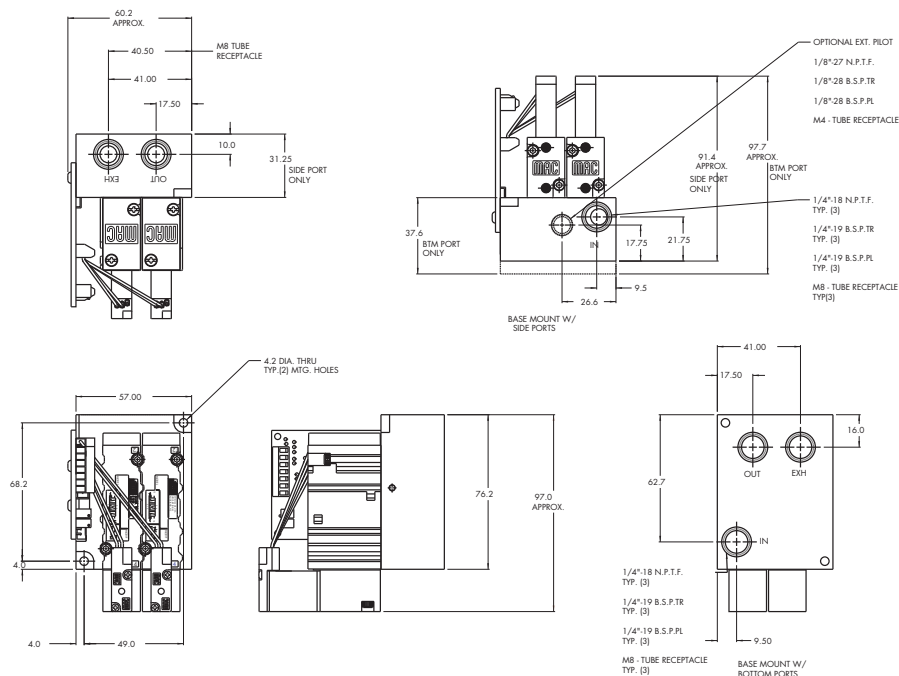|	
Ambient temperature :	32 to 120°F/0 to 50°C
LED indicators :	Red : power on - Green : pressure achieved
Vibration :	Not affected
Port size :	G1/4", 1/4" NPTF - Option : bottom ports
Connector :	7 pin terminal block
Mounting :	Any plane

ELECTRICAL DATA

Supply voltage :	20.4 to 26.4 VDC
Supply current :	50 to 350mA
Command signal :	0 to 10V or 4 to 20mA
Command type :	Single-ended or differential
Input impedance :	4.99 kΩ ± 1.0% (voltage)
	316 Ω ± 0.1% (current)
Analog Monitor Signal (AMS) :	0 to 10 Volt
Logic Monitor Signal (LMS) :	2 types of signals (see How to order) (sinking)
EMI/RFI protection :	Common mode and high frequency noise reduction for electrical inputs

PNEUMATIC DATA

Inlet pressure* :	120 PSI max (for 10-100 PSI output pres.)
	8 BAR max (for 0.66-6.6 BAR output pres.)
Fluids :	Compressed air or inert gases
Lubrication :	Not required. However, if used, a medium aniline point oil is recommended
Output pressure :	0 to 10, 30, 45, 60, 100 PSI
	0 to 0.66, 2, 3, 4, 6.6 BAR
Overall accuracy :	± 2.5% full scale
Flow :	Cv 1.3/1300 Nl/min
Minimum closed end volume :	50.0 cubic inch - 820 cm^3

* 20 PSI maximum inlet for 10 PSI output pressure - 1.3 BAR maximum inlet for 0.66 BAR output pressure.
Minimum inlet pressure for 400 series internal pilot is 20 PSI/1.3 BAR.

DIMENSIONS

Consult "Precautions" page 94 before use, installation or service of MAC Valves.

MAC

Series **PPC400A**

Port size	Flow [Max] [Cv/Nl/min]	Mounting	Series
1/4"	1.3/1300	coverless analog DIN rail mount	

OPERATIONAL BENEFITS

1. Reliable operation, using two MAC 400 Series with balanced pilot.
2. Fast response.
3. Long life.
4. High flow.
5. Low power consumption.
6. Not affected by vibrations.
7. Accuracy : ± 2.5 % full scale.
8. Analog command signal and output.

PPC5C

PPC34B

LCP35A

PPC45B

HOW TO ORDER

BASIC MODEL

PPC400A **X X X - X X X X - X X X**

PPC47A

Type	Type of mounting	Pressure range PSI/BAR	Pressure reference	Accuracy	Command signal	Logic monitor signal	Cover options
A Analog (int. pilot) **B** Analog (ext. pilot)	**DA** Din rail base 1/4" NPTF side port **DB** Din rail base 1/4" BSPPL side port **DC** Din rail base 1/4" BSPTR side port **DD** Din rail base side 8mm tube receptacle	**0A** 100/6.7 **0B** 60/4 **0C** 30/2 **0N** 10/0.66 **0T** 45/3	**G** Gage pressure **D** Differential pressure Caution: differential pressure must not exceed pressure range.	**E** ±2.5% F.S.	**B** 0-10v differential **D** 4-20mA differential	**A** TTL LMS 1,2 **B** 24v LMS High on TTL LMS 1 Press. Achieved **C** 24v LMS Low on TTL LMS Press. Achieved	**0** No Cover

PPC400A

PPC92B

PPC93A

Note: Din rail mount (EN50 022)

EXAMPLE : PPC400A **ADA - 0AGE - BA0**

400 Series flow valves, analog, din rail 1/4" NPTF side port, 100 psi pressure range, gage reference, 2.5% accuracy, 0-10v differential, TTL LMS 1,2, no cover.

Consult "Precautions" page 94 before use, installation or service of MAC Valves.

100% OF PRODUCTION TESTED **100%**

WARRANTY 18 MONTHS

GENERAL DATA

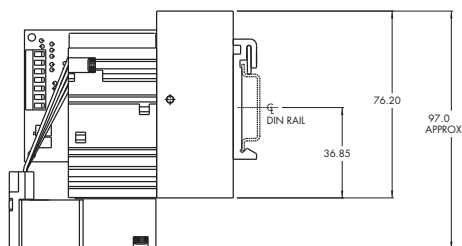|	
Ambient temperature :	32 to 120°F/0 to 50°C
LED indicators :	Red : power on - Green : pressure achieved
Vibration :	Not affected
Port size :	G1/4", 1/4" NPTF - Option : bottom ports
Connector :	7 pin terminal block
Mounting :	Any plane

ELECTRICAL DATA
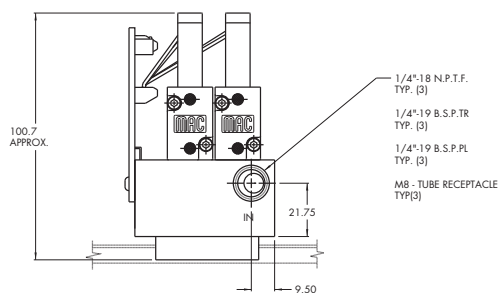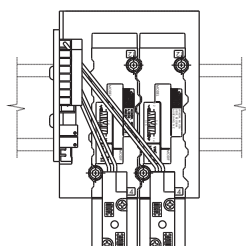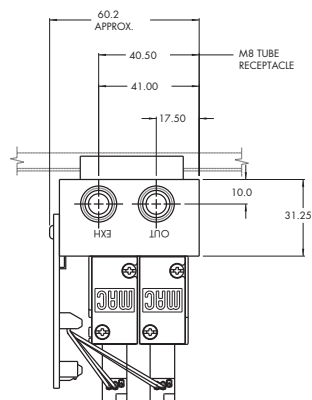
Supply voltage :	20.4 to 26.4 VDC
Supply current :	50 to 350mA
Command signal :	0 to 10V or 4 to 20mA
Command type :	Single-ended or differential
Input impedance :	4.99 kΩ ± 1.0% (voltage)
	316 Ω ± 0.1% (current)
Analog Monitor Signal (AMS) :	0 to 10 Volt
Logic Monitor Signal (LMS) :	2 types of signals (see How to order) (sinking)
EMI/RFI protection :	Common mode and high frequency noise reduction for electrical inputs

PNEUMATIC DATA

Inlet pressure* :	120 PSI max (for 10-100 PSI output pres.)
	8 BAR max (for 0.66-6.6 BAR output pres.)
Fluids :	Compressed air or inert gases
Lubrication :	Not required. However, if used, a medium aniline point oil is recommended
Output pressure :	0 to 10, 30, 45, 60, 100 PSI
	0 to 0.66, 2, 3, 4, 6.6 BAR
Overall accuracy :	± 2.5% full scale
Flow :	Cv 1.3/1300 Nl/min
Minimum closed end volume :	50.0 cubic inch - 820 cm³

* 20 PSI maximum inlet for 10 PSI output pressure - 1.3 BAR maximum inlet for 0.66 BAR output pressure.
Minimum inlet pressure for 400 series internal pilot is 20 PSI/1.3 BAR.

DIMENSIONS

Consult "Precautions" page 94 before use, installation or service of MAC Valves.

Алматы (7273)495-231
Ангарск (3955)60-70-56
Архангельск (8182)63-90-72
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
Белгород (4722)40-23-64
Благовещенск (4162)22-76-07
Брянск (4832)59-03-52
Владивосток (423)249-28-31
Владикавказ (8672)28-90-48
Владимир (4922)49-43-18
Волгоград (844)278-03-48
Вологда (8172)26-41-59
Воронеж (473)204-51-73
Екатеринбург (343)384-55-89

Иваново (4932)77-34-06
Ижевск (3412)26-03-58
Иркутск (395)279-98-46
Казань (843)206-01-48
Калининград (4012)72-03-81
Калуга (4842)92-23-67
Кемерово (3842)65-04-62
Киров (8332)68-02-04
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Курск (4712)77-13-04
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Липецк (4742)52-20-81

Магнитогорск (3519)55-03-13
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Ноябрьск (3496)41-32-12
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Омск (3812)21-46-40
Орел (4862)44-53-42
Оренбург (3532)37-68-04
Пенза (8412)22-31-16
Петрозаводск (8142)55-98-37
Псков (8112)59-10-37
Пермь (342)205-81-47

Ростов-на-Дону (863)308-18-15
Рязань (4912)46-61-64
Самара (846)206-03-16
Санкт-Петербург (812)309-46-40
Саратов (845)249-38-78
Севастополь (8692)22-31-93
Саранск (8342)22-96-24
Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
Сочи (862)225-72-31
Ставрополь (8652)20-65-13
Сургут (3462)77-98-35
Сыктывкар (8212)25-95-17
Тамбов (4752)50-40-97
Тверь (4822)63-31-35

Тольятти (8482)63-91-07
Томск (3822)98-41-53
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Тюмень (3452)66-21-18
Ульяновск (8422)24-23-59
Улан-Удэ (3012)59-97-51
Уфа (347)229-48-12
Хабаровск (4212)92-98-04
Чебоксары (8352)28-53-07
Челябинск (351)202-03-61
Череповец (8202)49-02-64
Чита (3022)38-34-83
Якутск (4112)23-90-97
Ярославль (4852)69-52-93

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