

WARRANTY

Notwithstanding any provision of any agreement the following warranty is exclusive.

Ohmic Instruments warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1-year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses or any product or parts which have been subjected to misuse, neglect, accident, or abnormal conditions of operation.

In the event of failure of a product covered by this warranty, Ohmic Instruments will repair and recalibrate an instrument returned within 1 year of the original purchase: provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within 1 year of the original purchase, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident, or abnormal conditions of operations, repairs will be billed at a nominal cost. In such case, an estimate will be submitted before work is started, if requested.

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If any failure occurs, the following steps should be taken:

1. Notify Ohmic Instruments giving full details of the difficulty, and include the model, type, and serial numbers (where applicable). On receipt of this information, service data, or shipping instructions will be forwarded to you.
2. On receipt of shipping instructions, forward the instrument, transportation prepaid. Repairs will be made and the instrument returned, transportation prepaid.

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

All shipments of Ohmic Instruments products should be made via United Parcel Service or "Best Way" prepaid. The instrument should be shipped in the original packing carton, or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER

The instrument should be thoroughly inspected immediately upon delivery to purchaser. All material in the shipping container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact Ohmic Instruments.) Final claim and negotiations with the carrier must be completed by the customer.

Ohmic Instruments will be pleased to answer all application or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to:

Ohmic Instruments
3081 Elm Point Industrial Drive
St. Charles, MO 63301 USA
ATTN: Technical Support

Or call Ohmic Technical Support at 410-820-5111.

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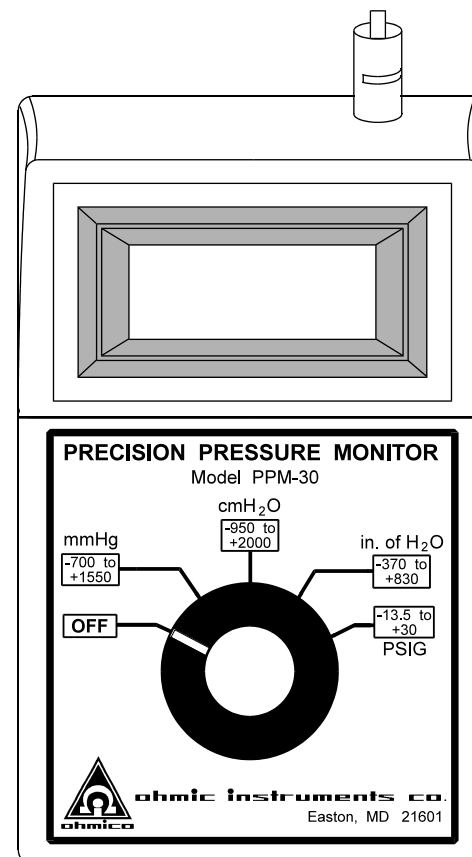
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SF-SLS-560 (A)

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PRESSURE UNIT CONVERSIONS

| To Obtain | Multiply | By |
|---------------------|---------------------|-----------|
| mmHg | cmH ₂ O | 0.7355 |
| mmHg | in.H ₂ O | 1.868 |
| mmHg | psi | 51.715 |
| cmH ₂ O | mmHg | 1.3595 |
| cmH ₂ O | in.H ₂ O | 2.54 |
| cmH ₂ O | psi | 70.308 |
| in.H ₂ O | mmHg | 0.53525 |
| in.H ₂ O | cmH ₂ O | 0.3937 |
| in.H ₂ O | psi | 27.680 |
| psi | mmHg | 0.01934 |
| psi | cmH ₂ O | 0.01422 |
| psi | in.H ₂ O | 0.3613 |

APPLICATION NOTES

PRESSURE MEASUREMENTS

Gage - Differential - Absolute

Gage This pressure measurement uses the sea-level atmospheric pressure as its zero reference. It is the most common method of expressing pressures in the health care field. A reading of one (1) atmosphere at sea level gives the

zero pressure reference. Pressures greater than one atmosphere are positive and pressures less than one atmosphere are negative. The most negative gage pressure is a perfect vacuum. Gage pressure units are generally suffixed with "g" or specified as "gage". The table below shows how vacuum, the one atmosphere reference, and a pressure of two atmospheres are related on the gage scale.

| | psig | mmHg gage | cmH ₂ O gage | in. H ₂ O gage |
|---------------|-------|-----------|-------------------------|---------------------------|
| Vacuum | -14.7 | -760 | -1033.5 | -406.9 |
| 1 Atmosphere | 0 | 0 | 0 | 0 |
| 2 Atmospheres | +14.7 | +760 | +1033.5 | +406.9 |

Differential This method of expressing pressure is used to describe the difference in pressure between two sources, called input ports. One port is connected to the higher pressure and the other port is connected to the lower pressure. The high pressure is expressed as a positive pressure with respect to the low pressure. Differential pressure units are generally suffixed with "d" or specified as "differential". (Example: 2.5 psid = 129 mmHg differential)

Absolute This is a pressure that is measured by using vacuum as the zero reference. A perfect vacuum has a zero absolute pressure and other positive pressures are referenced to it as there is no negative pressure on the absolute pressure scale. Absolute pressure units are generally suffixed with an "a" or specified as "absolute". The table below shows how the vacuum reference and two atmospheres are related on the absolute scale.

| | psia | mmHg absolute | cmH ₂ O absolute | in. H ₂ O absolute |
|---------------|-------|---------------|-----------------------------|-------------------------------|
| Vacuum | 0 | 0 | 0 | 0 |
| 1 Atmosphere | +14.7 | +760 | +1033.5 | +406.9 |
| 2 Atmospheres | +29.4 | +1520 | +2067 | +813.8 |

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SPECIFICATIONS

Electrical

Pressure Sensor: Piezoresistive type
Media Compatibility: Most non-corrosive liquids and gases; must be generally compatible with silicon gel, RTV, plastic, aluminum and glass. Switching between liquids and gases is not recommended.

Pressure Ranges:

| Model | mmHg | cmH ₂ O | in.H ₂ O | PSIG |
|---------|----------------|--------------------|---------------------|------------------|
| PPM-1 | -50.0 to +50.0 | -70.0 to +70.0 | -28.0 to +28.0 | -1.000 to +1.000 |
| PPM-5 | -250 to +250 | -350 to +350 | -135.0 to +135.0 | -5.00 to +5.00 |
| PPM-15 | -700 to +775 | -950 to +1050 | -370 to +415 | -13.50 to +15.00 |
| PPM-30 | -700 to +1500 | -950 to +1999 | -370 to +830 | -13.50 to +19.99 |
| PPM-100 | -700 to +1999 | -950 to +1999 | -370 to +1999 | -13.5 to +100.0 |

Accuracy: $\pm 1.0\%$ of full scale

Display: 3½ Digit Liquid Crystal Display (LCD) with Low Battery Indicator

Operating Temperature: Temp. Compensated over +32°F to +150°F

Pressure Input Fitting: Male Luer Lock (for 5/32" I.D., 9/32" O.D.Tubing)

Maximum Pressure: PPM-1: 1 PSI

PPM-5: 5 PSI

PPM-15: 15 PSI

PPM-30: 30 PSI

PPM-100: 100PSI

Power: 9 Volt Rechargeable Battery

Mechanical

Size: 3.5" wide x 5.6" long x 2" high

Case Description: High Impact ABS Plastic Case

Weight: 12 Ounces

5. If BAT is indicated in the upper left corner of the display, the battery is weak and should be recharged.
6. Always set the range selector switch to the OFF position when the PPM is not in use. This will prolong the charge of the battery which is normally 30 to 40 hours of continuous use.

HOW TO ZERO THE PPM PRECISION PRESSURE MONITOR

1. Remove any connection to the pressure inlet of the pressure monitor. The inlet should be open to the atmosphere.
2. Set the range selector switch on mm Hg.
3. The access hole to the Zero Adjustment is located on the left side of the instrument. Using a small screwdriver, turn this adjustment until the display indicates zero.

IMPORTANT!

The 9 volt rechargeable battery inside the PPM should provide years of service. Should this battery fail, however, we strongly recommend that the PPM be returned to Ohmic Instruments Company for a replacement battery. We do NOT recommend replacing the battery with an alkaline, since an alkaline can explode if the included AC charger is plugged into the unit. Ohmic cannot be held responsible for damage caused by misuse.

SPECIAL NOTICE FOR PPM-100 ONLY

Use caution to avoid excessive pressure over 120 psi since this could damage the sensor or tubing in the PPM. Use the appropriate luer lock fitting and properly rated tubing and clamps when taking measurements.

For high pressure applications, smaller 1/16" or 1/8" I.D. tubing is suggested for safety purposes. Poly-

urethane and teflon tubing have stiff walls and are readily available.

The PPM is not intended to be permanently connected to a pressurized line. An hour or two on the line is acceptable as long as there are no sudden peak pressures above 120 psi.

INTRODUCTION

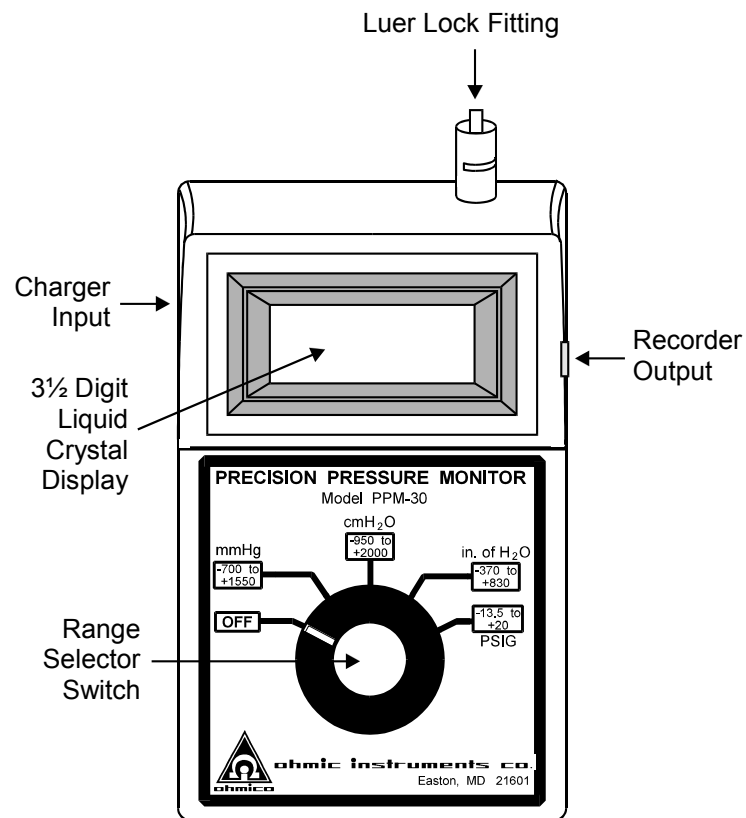
OHMIC Company's Precision Pressure Monitor (PPM) is a precision pressure monitoring instrument capable of measuring in any of four selectable pressure units; mm Hg, cm H₂O, in. of H₂O, and psig. This portable hand-held instrument uses a piezoresistive pressure transducer having a $\pm 1.0\%$ full scale accuracy and was designed for use in the medical environment to check the calibration on a variety of equipment, such as dialysis machines, I.V. pumps, suction devices, and pressure gauges. It can measure positive or negative pressure of gases or liquids in any of the four selectable units of measure (NOTE: Switching between liquids and gases is not recommended, as liquids usually remain in the internal tubing that feeds the transducer. Designating your PPM as gas-only or liquid-only should prevent problems).

The pressure to be measured is connected to the PPM through a male luer lock pressure fitting. A 3½-digit LCD display indicates the measured pressure with a resolution of ± 1 digit or ± 0.1 digit depending on the position of the range selection switch. The range selection

switch also has a position to turn the instrument OFF. A zero adjustment is accessible through the side of the case to null any ambient atmospheric pressures which may cause measurement errors.

The instrument is powered by a 9-volt rechargeable battery which will provide years of service and can be recharged with the included battery charger. When the battery is weak, the LCD display will indicate BAT in the upper left corner of the display window. This indicates the unit should be put on charge for about 8 hours for full operating power. The pressure measurements made with this instrument are fully temperature compensated over an operating temperature range of +32° to +150°F.

The standard PPM Series Precision Pressure Monitors that are available are the PPM-1, PPM-5, PPM-15, PPM-30 and PPM-100, which cover different full scale ranges using the same pressure measuring units. All PPM Series Precision Pressure Monitors are fully guaranteed for 90 days on the pressure sensor and for one year on all other parts.



OPERATING CONTROLS

1. **LCD DISPLAY.** The liquid crystal digital display indicates the measured pressure value either in mm Hg, cm H₂O, in. of H₂O, or psig depending on the position of the RANGE SELECTION SWITCH. The display resolution is ± 1 unit on all ranges except psig which is ± 0.01 unit. If the rechargeable battery is too weak to adequately power the instrument, the display will show "BAT" in the upper left corner and the PPM should be put on charge for about 8 hours. If excessive pressure is applied to the instrument, the display will
2. **RANGE SELECTION SWITCH.** This is a five-position rotary switch used to select measurements in any of four pressure units; millimeters of mercury (mm Hg), centimeters of water (cm H₂O), inches of water (in. of H₂O), or pounds per square inch gage (psig). When the units selection is made, the instrument will also be turned ON. The full counterclockwise position of this switch will turn the unit OFF.

show an overrange indication as "1" in the most significant digit position.

3. **ZERO ADJUSTMENT.** A small hole on the left side of the instrument allows access to a multi-turn trim potentiometer for adjusting the display reading to read zero when no pressure is applied (ambient atmospheric pressure). This allows all pressure measurements to be referenced to the prevailing barometric pressure. If another pressure is to be used as a reference, then this reference pressure must be applied to the instrument before and then nulled out using the ZERO Adjustment.

4. **LUER LOCK PRESSURE FITTING.** The applied pressure must be connected to this pressure fitting using 5/32" I.D. plastic or rubber tubing with an O.D. of about 9/32". This fitting has a central connection port with an outer collar which has internal threads to lock the tubing in place by simply pushing the tubing on the center port connection and twisting clockwise. Slots on the threaded collar allow inspection to assure the tubing is adequately locked into the fitting.

5. **CHARGER INPUT JACK.** On the left side of the PPM is a power jack for connecting the charger unit to recharge the internal battery. The charger supplies +12 vdc to charge up the +9 volt rechargeable battery. **DO NOT USE OTHER CHARGERS WITH THIS INSTRUMENT SINCE INTERNAL DAMAGE MAY OCCUR.** In normal operation, a single charge

should last for about 30 to 40 hours of continuous use.

6. **RECORDER OUTPUT JACK.** This is a 1/8" Mono phono jack provided for connecting a recording device or computer to the PPM for recording pressure readings. The DC output voltage is 0.1 millivolt per pressure unit for all pressure selections except psig which is 1 millivolt per psi.

HOW TO USE THE PPM PRECISION PRESSURE MONITOR

1. Zero Check. With no pressure applied to the Pressure Monitor (i.e., pressure inlet should be open to the atmosphere), set the range switch to mm Hg. The display should indicate zero. All other ranges should also read zero. If the reading is not zero, follow the instructions "How To Zero The PPM Precision Pressure Monitors".
2. Connect a length of 5/32-inch I.D. (9/32-inch O.D.) plastic or rubber tubing from the luer lock pressure fitting to the pressure source to be monitored.
3. Set the range switch to the desired pressure units.
4. If the display indicates "1", then the applied pressure is too high for the unit to measure. Pressures greater than twice the full scale range may cause permanent damage to the piezoresistive pressure sensor.