OPERATIONS MANUAL

PM2500

Particle Monitor

Revised 02/25/13JE

CHEMTRAC

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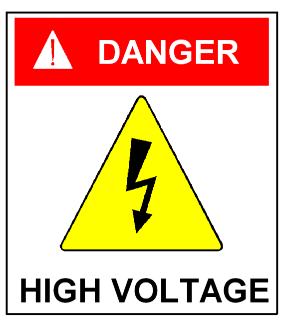
IMPORTANT INSTRUCTIONS

When using this instrument, basic safety precautions shall always be followed to reduce the risk of fire, electrical shocks and injury to persons, including the following:

- ☑ Before attempting to unpack, set up, or operate this instrument, please read this entire manual.
- ☑ Make certain the unit is disconnected from the power source before attempting to service or remove any component.
- ☑ Follow all warnings and marked on the instrument.
- ☑ Failure to follow these precautions could result in personal injury or damage to the equipment.
- ☑ Do not attempt to disassemble the unit.
- ☑ Water must not be allowed to enter the housing of the unit.
- ☑ Close and fasten the covers of the unit prior to any external cleaning to prevent water ingress.
- ☑ Do not drop or jar the unit.
- ☑ Do not modify any internal electrical wiring or electronics.
- ☑ Use a mild non-abrasive cleanser when cleaning the outer cover of the unit.

SAFETY PRECAUTIONS

In order to provide maximum user safety this instrument was designed with all electrical circuitry enclosed within a protective non-conductive housing. The label below will be visible at any location where high voltage is present.



WARRANTY INFORMATION

Chemtrac®, Inc. warrants its equipment to be free from defects in material and workmanship for a period of one (1) year from date of shipment to the original purchaser. Upon receipt of written notice from purchaser, seller shall repair or replace the equipment (at option of Chemtrac®, Inc.).

Chemtrac®, Inc. assumes no responsibility for equipment damage or failure caused by:

1. Improper installation, operation, or maintenance of equipment.
2. Abnormal wear and tear on moving parts caused by some processes.
3. Acts of nature (i.e. lightning, etc.)

This warranty represents the exclusive remedy of damage or failure of equipment. In no event shall Chemtrac®, Inc. be liable for any special, incidental, or consequential damage such as loss of production or profits.

Should you experience trouble with the equipment, please contact:

Chemtrac, Inc
6991 Peachtree Industrial Blvd., Building 600
Norcross, GA 30092

Phone:	1-800-442-8722 (Inside US only), 770-449-6233
Fax:	770-447-0889
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Website:	www.chemtrac.com

SECTION 1.0 GENERAL INFORMATION

1.1 PARTICLE MONITOR OVERVIEW

The Particle Monitor (PM) functions to detect impurities or contaminants in liquids. The detected impurities can be particulate or non-soluble liquids (e.g. oil in water). The PM is especially suitable for particles equal to and greater than 2 micron in size and can be over 100 times more sensitive than conventional nephelometric turbidimeters. The instrument has a wide response range and can be used to monitor the concentration of non-soluble contaminants from the very low part per trillion (ppt) level up to several part per million (ppm).

The Particle Monitor is very useful for routine monitoring of the quality of various “relatively clean” liquids such as filtered water, condensate, beverages, fuels, etc. (any liquid that is transparent and has a turbidity of less than 5 NTU is a potential candidate). The Particle Monitor provides a relative reading referred to as the Particle Index (PI). The PI value is determined by the quantity and size distribution of 2 micron and larger particulate (or non-soluble emulsions) present in the sample. And so, an increase in the Particle Index reading is an indication that the impurities in the sample being measured have increased.

It is not possible to derive quantitative information on actual particle size or concentration from the Particle Index reading. However, for many applications, it is possible to correlate the PI value to other useful measurements of contaminant level. For example, in a boiler application the Particle Index can be correlated to the part per billion (ppb) concentration of particulate Iron present in a condensate sample (determined by gravimetric analysis or various other methods).

An example of how the Particle Monitor is typically used is in the monitoring of a multimedia filter effluent to detect changes in filter performance. An alarm or filter backwashing sequence could be setup to automatically initiate when the Particle Index reaches a high threshold level on the filter. For condensate monitoring applications, a dump valve can be opened when the Particle Index crosses a threshold value that has been correlated to a specific part per billion (ppb) level of metal oxides.

The Particle Monitor system consists of a Monitor / Display unit and at least one Remote Sensor. Up to three additional remote sensors (for a total of four) can be connected to the Monitor / Display unit. There are two models of the Remote Sensor to choose from. The most commonly used model is the Outdoor Rated Remote Sensor Model PMRS-1. The PMRS-1 is the recommended model for outdoor / wet environment use. The second model is the Indoor Rated / Compact Enclosure Model PMRS-2. The PMRS-2 is a compact version of the Remote Sensor and great for installations that are tight on space. However, the PMRS-2 is not rated for outdoor / wet environment use. Both Remote Sensors can be ordered with an optional Constant Head Device (also referred to as a Flow Control Weir).

1.2 OPERATING PRINCIPLE

Essentially, water flows through a transparent tube and is illuminated by a narrow beam of infrared radiation (about 850 nm wavelength). The effective beam width is about 0.3 mm and the optical path length (tube diameter) is 3 mm, giving an illuminated sample volume of the order of 0.2 mm3 (or 2 x 10-4 cm3). Only a small fraction of the total flow through the tube (about 20%) passes through the illuminated volume, so that the majority of particles in the flowing sample are not “seen” by the monitor. However, if the fraction passing through the beam is representative of the whole flow, this does not cause any problems.

The transmitted radiation is monitored by a sensitive detector. The output from the detector is converted to a voltage, which consists of a large, steady component (the DC value) and a much smaller, fluctuating component (the AC value). The DC value is simply a measure of the average transmitted intensity and in the monitor, this is kept constant, by means of feedback control. The AC component arises as a result of random variations in the number and size of particles in the light beam.

The Particle Index value is determined by this AC component. It is important to understand that the RMS value of this AC signal is determined by both the number and size of particle present in the sample. This means that a few large particles can provide the same Particle Index reading as a several smaller particles. So, it is useful to think of the Particle Index as a measurement of the total amount of particulate. This detection method of measurement allows the Particle Index to be fairly accurately correlated to the actual mass of particulate present in a sample if all the particulate is presumed to be made up of the same material (e.g. Iron).

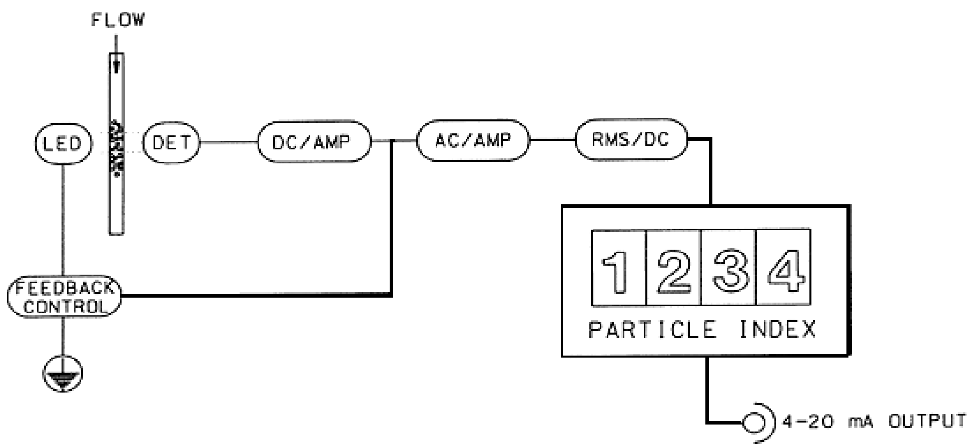


FIGURE 1. Operation Principle

A schematic diagram of the monitor is given in Figure 1. The AC value is separated from the DC value amplified and passed to an RMS-to-DC converter. The output from this device (the RMS value) is a DC voltage equal to the root mean square value of the amplified AC signal. For a given type of particle, the RMS value is proportional to the square root of the concentration. For a given (weight) concentration, the RMS value depends on particle size in a rather complex manner, but, up to about 2 microns, there is a strong increase with increasing particle size. Large aggregates (flocs) can give a very high response, but, in filtered water (for which the monitor is primarily intended), these should not be present in significant amounts.

1.3 ANALOG OUTPUTS

For data logging, the Particle Index values are available as a 4-20 mA outputs on the instrument. There is one 4-20 mA output for each of the four available sensors.

1.4 FEEDBACK CURRENT

Feedback control regulates the current through the light-emitting diode to give a constant intensity of transmitted light, corresponding to a DC value of 5.7 volts DC. The current will depend on the efficiency of the LED, which varies from one unit to another and may decline gradually during extended use. The feedback current is display as percentage on the main screen. For highly transparent tubing and clean water, a high sample's cell percentage value will be display; between 85 to 99% is a typical number. If the tubing becomes coated with adhering particles, a lower sample's cell percentage value will be display (less than 80%).

The sample's cell percentage value provides useful information on the operating conditions. A visual indication is provided on the display. The sample's cell percentage value can also be helpful in positioning a new tube in the slot - the tube should be adjusted to give the maximum sample's cell percentage value.

1.5 AUTOMATIC SAMPLE COLLECTION (OPTIONAL FEATURE)

The PM2500 has an **optional** feature for Automatic Sample Collection. This feature allows the user to establish a particle index threshold at which a sample would be taken if the reading were to cross the threshold. As seen in Figure 2 below, a **Threshold** (❶) is established by the user. The threshold can be any number between 0 and 9999. The user will then establish a **Delta Time** setting (❷) which establishes how long the reading has to remain above that threshold before sample collection would begin. If the reading remains above the threshold value for the full Delta Time period, the sample valve will activate and start filling a sample bottle. The sample valve will remain on for however many seconds the **Sample Time** (❸) is set for.

In the below example, the **Threshold** was set for 500, the **Delta Time** was set for 120 seconds, and the **Sample Time** was set for 300 seconds.

When the unit has finished collecting a sample, the average reading over the sample period is displayed along with the time that has expired since the sample was collected. The average reading allows the user to correlate the level of contaminant (e.g. ppb of Iron) in the sample to the instruments reading. The expired time since the sample was collected allows the user to identify the exact time the sample was taken and then correlate that to a specific process event. See Section 5.5 for more information on this feature.

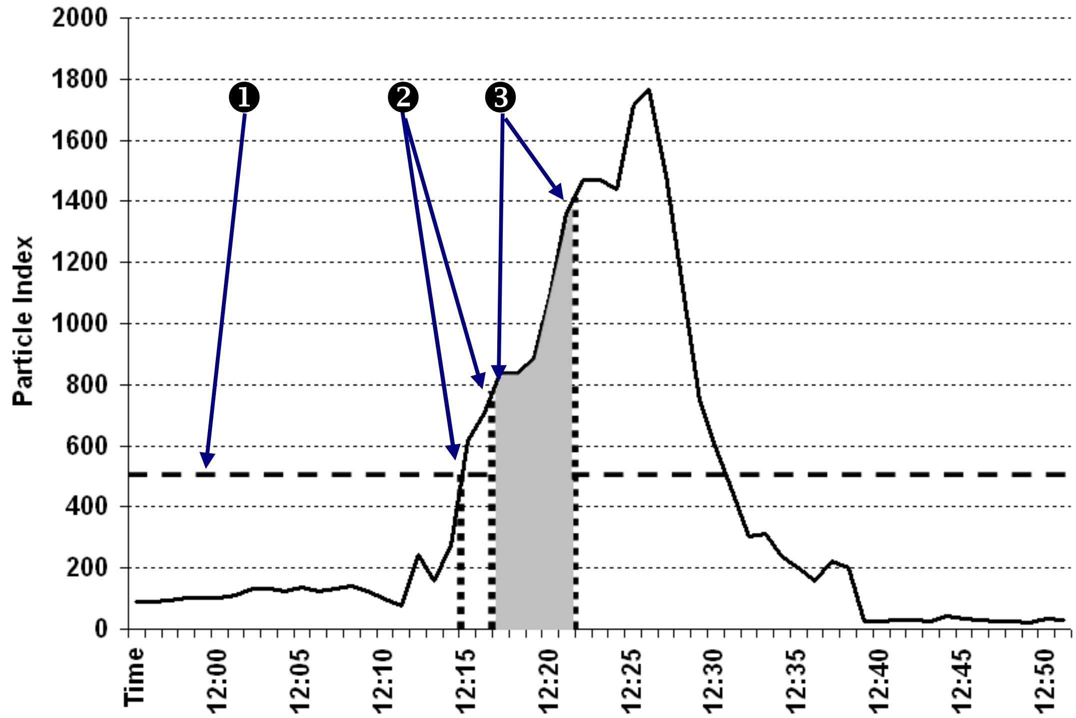


Figure 2 Automatic Sample Collection Operating Principle

1.6 TECHNICAL SPECIFICATIONS

MONITOR

Power	85-264 VAC, 47–63 Hz
Current Load	110 VAC @ 0.5A Max 220 VAC @ 0.25A Max
User Interface	Backlit Liquid Crystal Display, Menu Driven Functions, Keypad Interface
Detection Range:	2 micron and above
Detection Technology:	Light Obstruction
Light Source:	LED, 850 nm
Light Detection:	Photo Diode
Beam Width:	0.3 mm
Optical Path Length:	3 mm
Particle Index:	0-9999
Self Diagnostics:	LED Feedback Current (Cell %)
Sample Cell Type:	Flow Through
Sensor Response Time:	<2 seconds
Sample Tubing:	1/8 in I.D., 3/16 in O.D.
Materials Contacting Sample:	Vinyl or Glass
Sample Flow Rate:	75 – 150 mL/Min
Noise Rejection:	Standard
Output Signal	4-20 mA (300 ohm Load) to Particle Index
Alarm Output	24 VDC
Enclosure Type	NEMA 250 Type 4X, Reinforced Fiberglass
Enclosure Size	9.2"W, 11.2"H, 6.3"D (234mm W, 285mm H, 161mm D)
Mounting Holes	11.25"W, 7.4"H (286mm W, 188mm H)
Weight	6 Pounds (2.72 kg)

PMRS-1 OUTDOOR RATED REMOTE SENSOR

Signal Wiring	4 Conductors Twisted Shielded Pair, 20 AWG
w/ Auto Sampler	5 Conductors Twisted Shielded Paiir, 20 AWG
Enclosure Type	NEMA 250 Type 4X, Reinforced Fiberglass
Enclosure Size	9.2"W, 7.2"H, 5.3"D (234mm W, 183mm H, 135mm D)
Mounting Holes	7.7" W, 8.5" H (196mm W, 215mm H)
Weight	5 Pounds (2.3 kg)
Operating Temperature	32° F to 120° F (0° C to 49° C)

PMRS-2 INDOOR RATED, COMPACT ENCLOSURE REMOTE SENSOR

Signal Wiring	4 Conductors Twisted Shielded Pair, 20 AWG
Enclosure Type	NEMA 4X, Polycarbonate
Enclosure Size	.3.2"W, 6.3"H, 3.7"D (80mm W, 160mm H, 94 mm D)
Mounting Holes	2.0" W, 5.8" H (50 mm W, 148 mm H)
Weight	2 Pounds (.9 kg)
Operating Temperature	32° F to 120° F (0° C to 49° C)

SECTION 2.0 MOUNTING AND INSTALLATION

2.1 UNPACKING

When unpacking the PM2500XRD it is important to follow the following guidelines.

1. Open the box right side up.
2. Carefully remove and examine packing material for any loose items that may have fallen out of containers during shipping.
3. Carefully lift the unit and any accessories from the box.
4. Your PM2500XRD should include the following items.
   - Particle Monitor Module
   - Remote Sensor (1 Standard, Option For Up To 3 Additonal)
   - Sensor Clamping Pin (P/N: 15070)
   - 6 feet of sample tubing
   - Flow Control Weir (optional)

If you are missing any of the following items, please contact Chemtrac for replacement. The PM2500 requires no assembly and is ready to mount out of the box.

2.2 MOUNTING

Refer to figures 12 thru 15 at the back of this manual for mounting dimensions and instructions. The PM2500 or Remote Sensors should not be mounted in a potential flooding zone. If the equipment were to be submerged in water a severe electrical shock hazard would exist, potential personnel injury and the equipment damaged could occur.

The Remote Sensors can be mounted up to 1000 feet away from the PM2500 display unit. It is recommended to mount the sensors as close to the sample point as possible to avoid the necessity of running long sample lines.

The PM2500 and Remote Sensor should be permanently mounted in an upright position using the mounting hardware supplied with the equipment. It is very critical that the Remote Sensor be mounted upright with the tubing running vertically through the sensor. The flow of the sample through the tubing should be from the bottom and out the top of the sensor. If the Remote Sensor is mounted incorrectly or the flow direction is reverse, this could result in air bubbles collecting in the sensing area which would produce incorrect readings

2.3 SAMPLE PLUMBING

The PM2500 Remote Sensor(s) should be mounted as close to the sample point as possible. Avoid long runs of sample tubing, as this increases the buildup of solids that could break loose causing false and erratic readings. If long runs of sample tubing are unavoidable, try to maintain a sufficiently high enough flow rate to help keep sample tubing from forming too much buildup.

It is recommended to employ a constant head device to maintain flow within acceptable limits for installations that rely on gravity feed for the sample, or where pressure and flow rates tend to fluctuate. Under these conditions, it will be necessary to maintain a head pressure greater than or equal to 10 inches above the constant head (or flow control weir) to ensure sufficient sample flow to the sensor. If head pressure drops below 10 inches, then sample flow will be reduced below minimum requirements. The constant head device should be mounted as shown in Figure 3.

In certain applications where the sample is especially clean, under pressure, and the pressure does not tend to fluctuate; it may be possible to forego the constant head device and control flow through the sensor using a rotometer (with the rotometer being upstream of the sensor). The only caution when using a rotometer is to ensure there are not debris in the sample large enough to potentially plug the rotometer, and that the pressure feeding the rotometer is fairly constant.

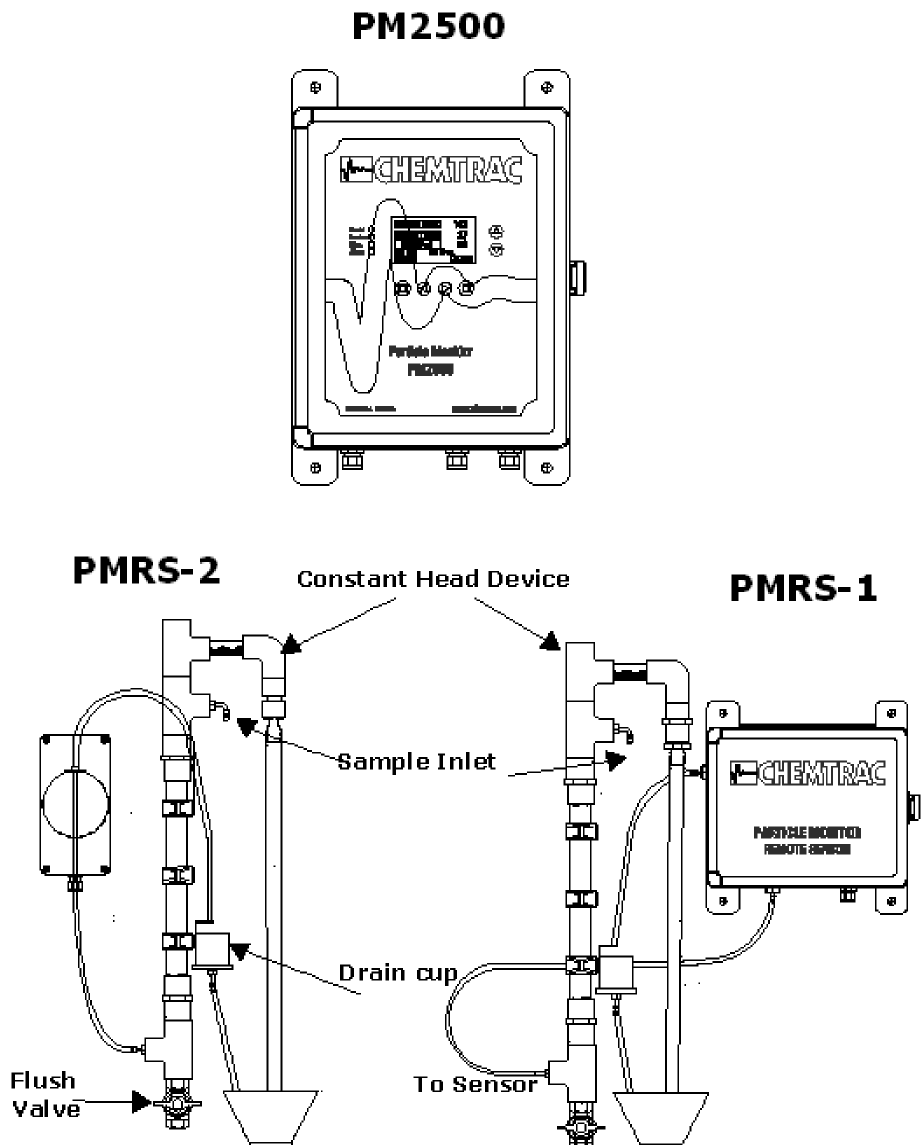


FIGURE 3. PM2500 & Remote Sensor (PMRS-1 Outdoor Rated, PMRS-2 Indoor Rated)

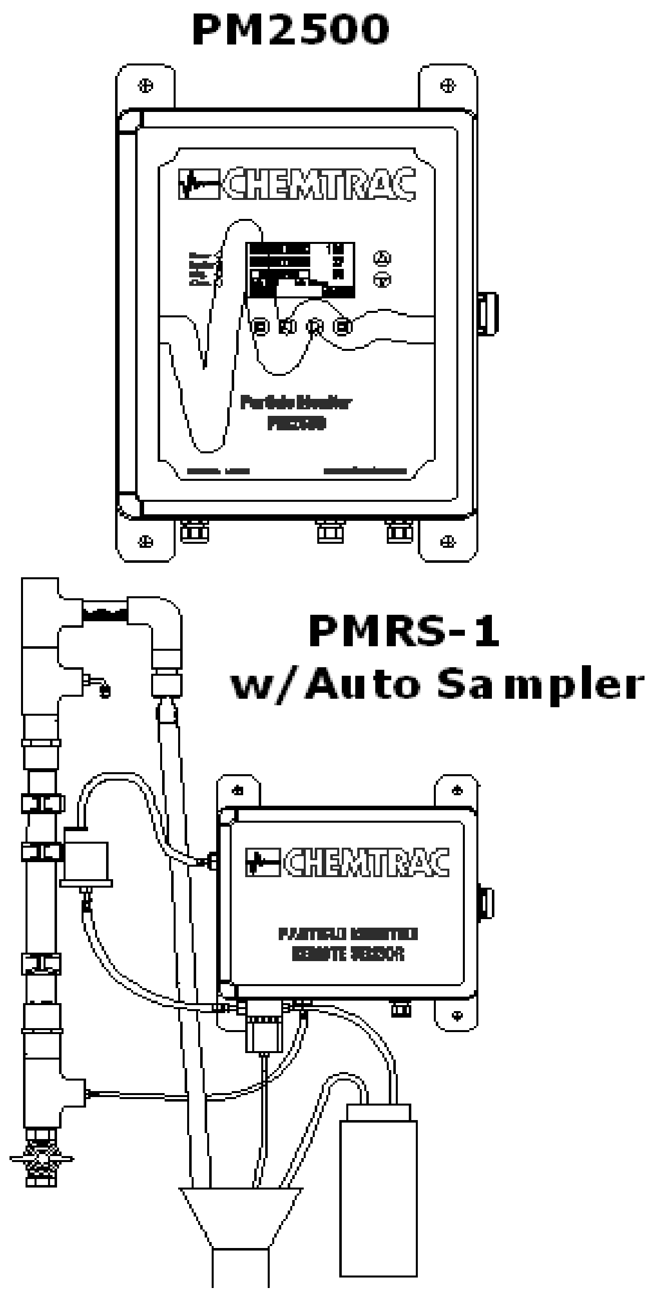


FIGURE 4. PM2500 & PMRS-1 With Auto Sampler Option

2.4 CONSTANT HEAD DEVICE RECOMMENDED FLOW RATE

The flow rate to the constant head device should be adjusted so that the overflow sight glass is half full of water. This requires a flow rate of approximately 500 to 700 mL/min.

2.5 REMOTE SENSOR RECOMMENDED FLOW RATE

The flow rate to the sensor should be adjusted for 100 to 125 mL/min (the flow should not be allowed to fluctuate out of this range by more than +/- 25 mL/min). If using the constant head device, simply slide the Drain Cup up or down the weir to adjust the flow rate through the sensor. Raising the Drain Cup will lower the flow through the sensor and lowering the Drain Cup will increase the flow through the sensor.

2.6 WIRING

The unit comes equipped with a flexible power cord that the customer may choose to replace with a conduit connection. It is important to observe the following safety precautions prior to wiring the unit. Refer to Figures 5 to 10 for wiring diagrams.

- Power must be locally fused or switched prior to entering the unit.
- Disable power circuit prior to hardwiring the unit.
- Observe polarity when connecting the unit to facility power. The unit will not work and can be damaged if polarity is crossed.
- All wiring connections must be tinned prior to connecting to ensure proper contact and to prevent corrosion.
- The unit must be connected to a protective earth conductor.

2.7 POWER REQUIREMENT

Electrical power should be connected in the following order

☑ Insert the ground wire into the middle terminal labeled “G”.

☑ Insert the hot wire into the left terminal labeled “L”.

☑ Insert the neutral wire into the right terminal labeled “N”.

For safety and proper operation, the monitor must be properly grounded through their power cord. In cases where potential noise sources could affect the performance of the equipment, a "surge suppressor" must be installed with the unit. The following drawing shows power terminal connections.

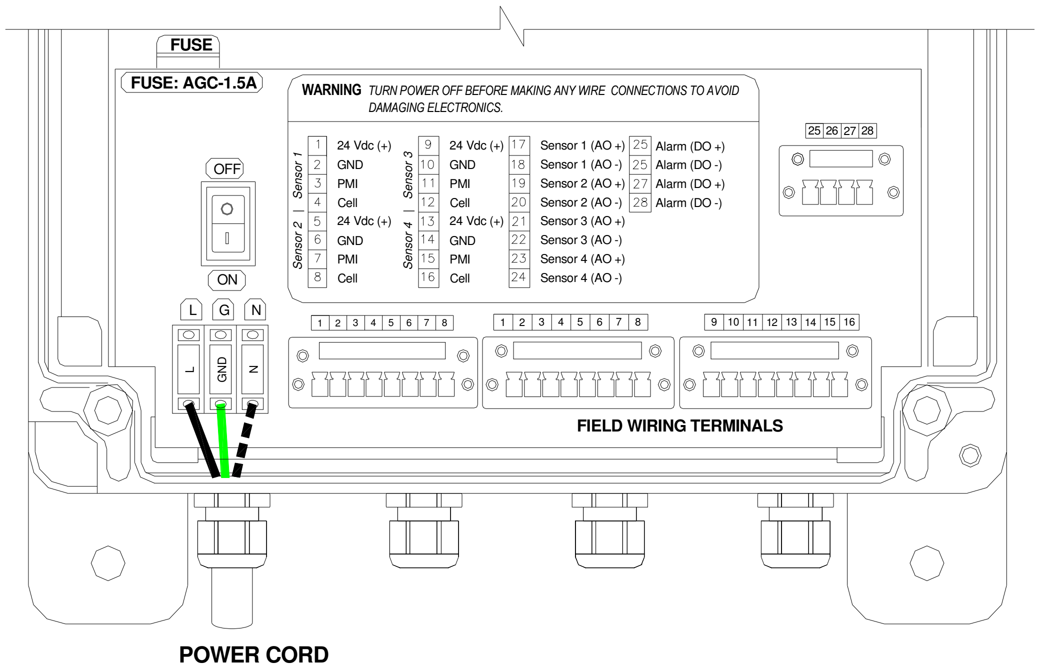


FIGURE 5. Monitor Power Wiring

2.8 SIGNAL WIRING

The Remote Sensors need to connect to the PM2500 Monitor via a multi conductor shielded cable (20 to 22 AWG). See Figure 6 to 10 for signal wires interconnection diagram. The cable should be enclosed in conduit for maximum protection against damage or electrical interference. Do not run cable in same conduit with any other wiring.

CAUTIONS

☑ Make sure the monitor's power switch is turn to off position before making any signal wiring connections.

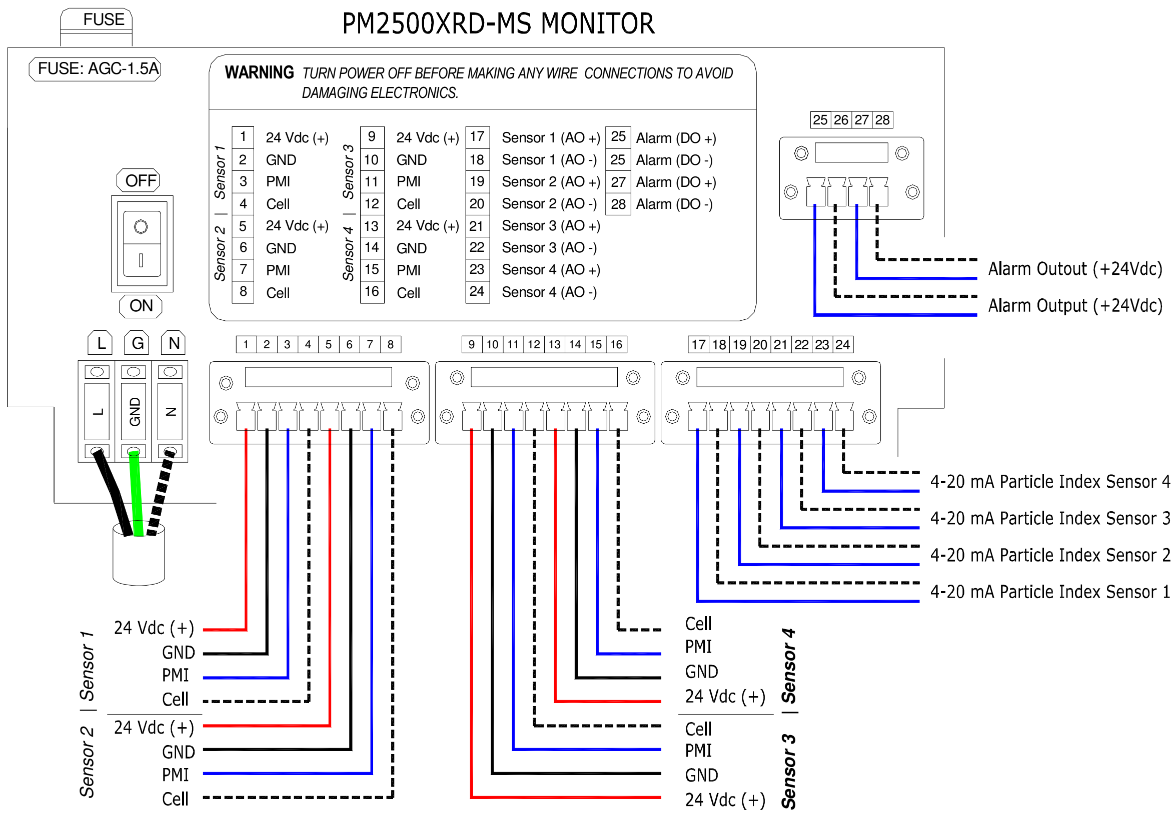


FIGURE 6. Signal Wires Interconnection Diagram

2.8.1 REMOTE SENSOR WIRING INSTRUCTIONS

The Remote Sensors are matched at the factory to a specific input channel on the Monitor. The sensors must be wired to monitor as indicated on the Serial Number label. To determine which of the 4 channels on the Monitor a remote sensor is to be wired to, check the serial number label on the remote sensor. It will appear as follows:

Serial No.: PM25RS08A035 <u>-1 Sensor</u>

"-1 Sensor" shown on the serial number label indicates that sensor needs to be wired to "Sensor 1" terminals on the Monitor. If multiple Monitors have been supplied, the serial number label on the remote sensor will show the Monitor number along with the sensor number (e.g. #1-1 Sensor). If you have received multiple monitors, check the serial number label on the monitor to determine its identification (e.g. #1 Monitor) and be sure to wire the correct sensors to that monitor.

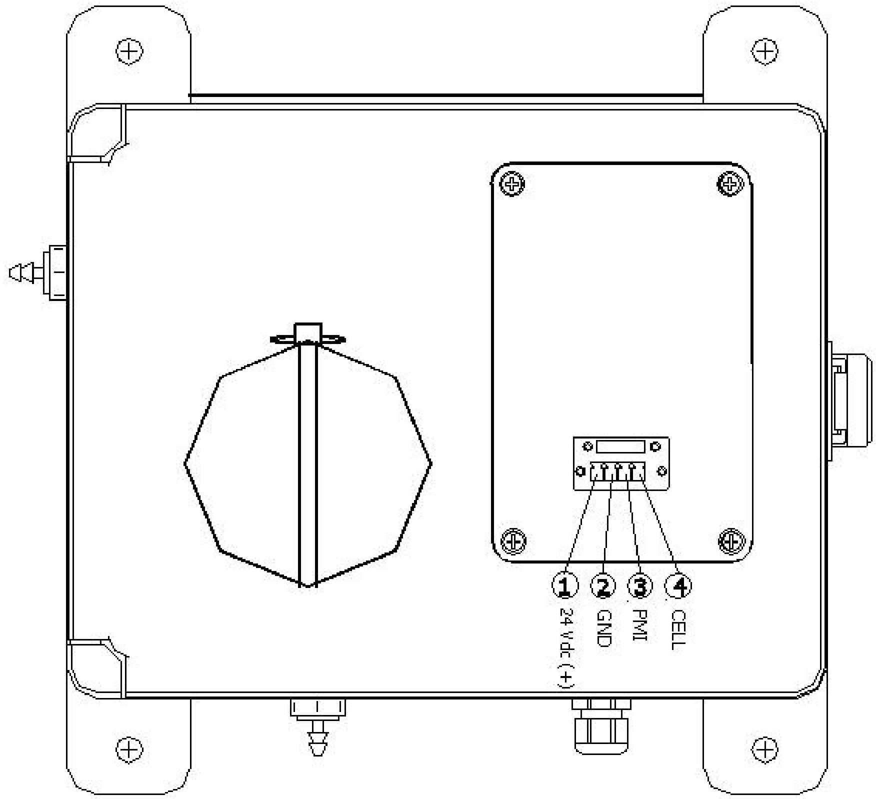


FIGURE 7. PMRS-1 (Outdoor Rated Remote Sensor) Wiring Terminals

Remove Lid To Access Wiring Terminals

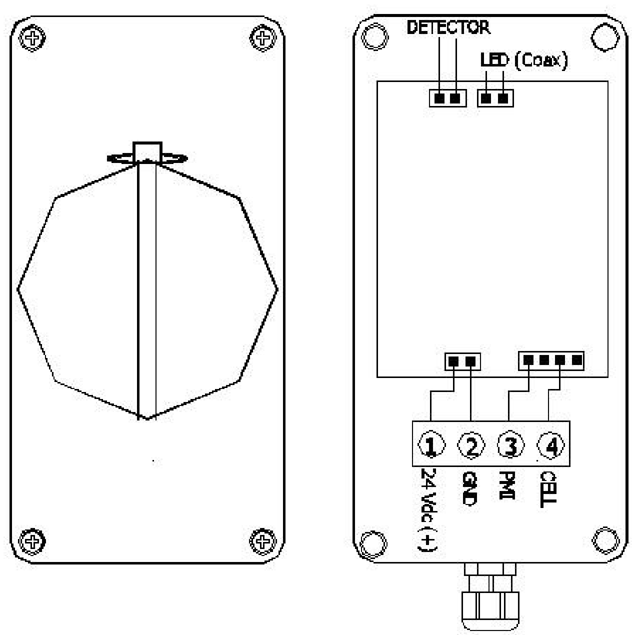


FIGURE 8. PMRS-2 (Indoor Rated Remote Sensor) Wiring Terminals

2.8.2 REMOTE SENSOR WIRING INSTRUCTIONS (WITH AUTO SAMPLER)

The interconnect wiring for the PM2500 to the Remote Sensor with Automatic Sampler option is show below in Figures 9 & 10. **Note**: This section provides wiring diagram info only. Read sections 2.6 to 2.8 of this manual for additional notes on power and signal wiring requirements for the PM2500.

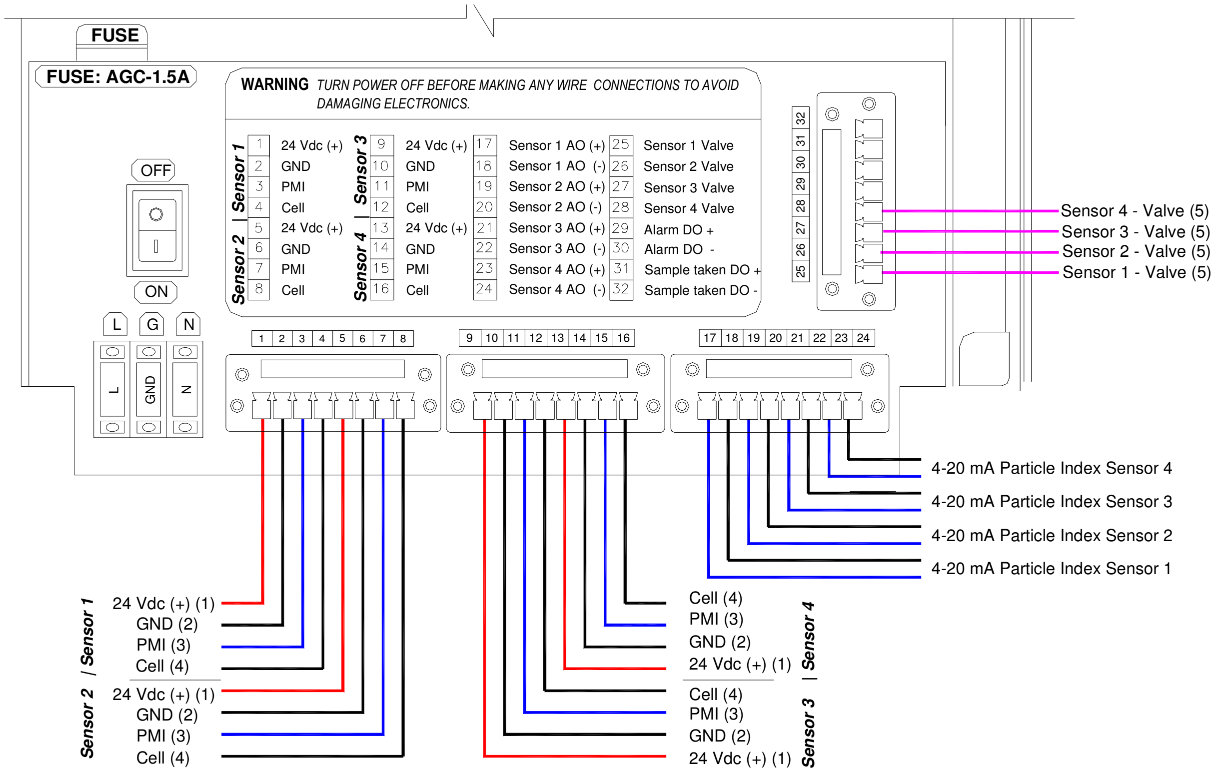


FIGURE 9. Signal Wires Interconnection Diagram

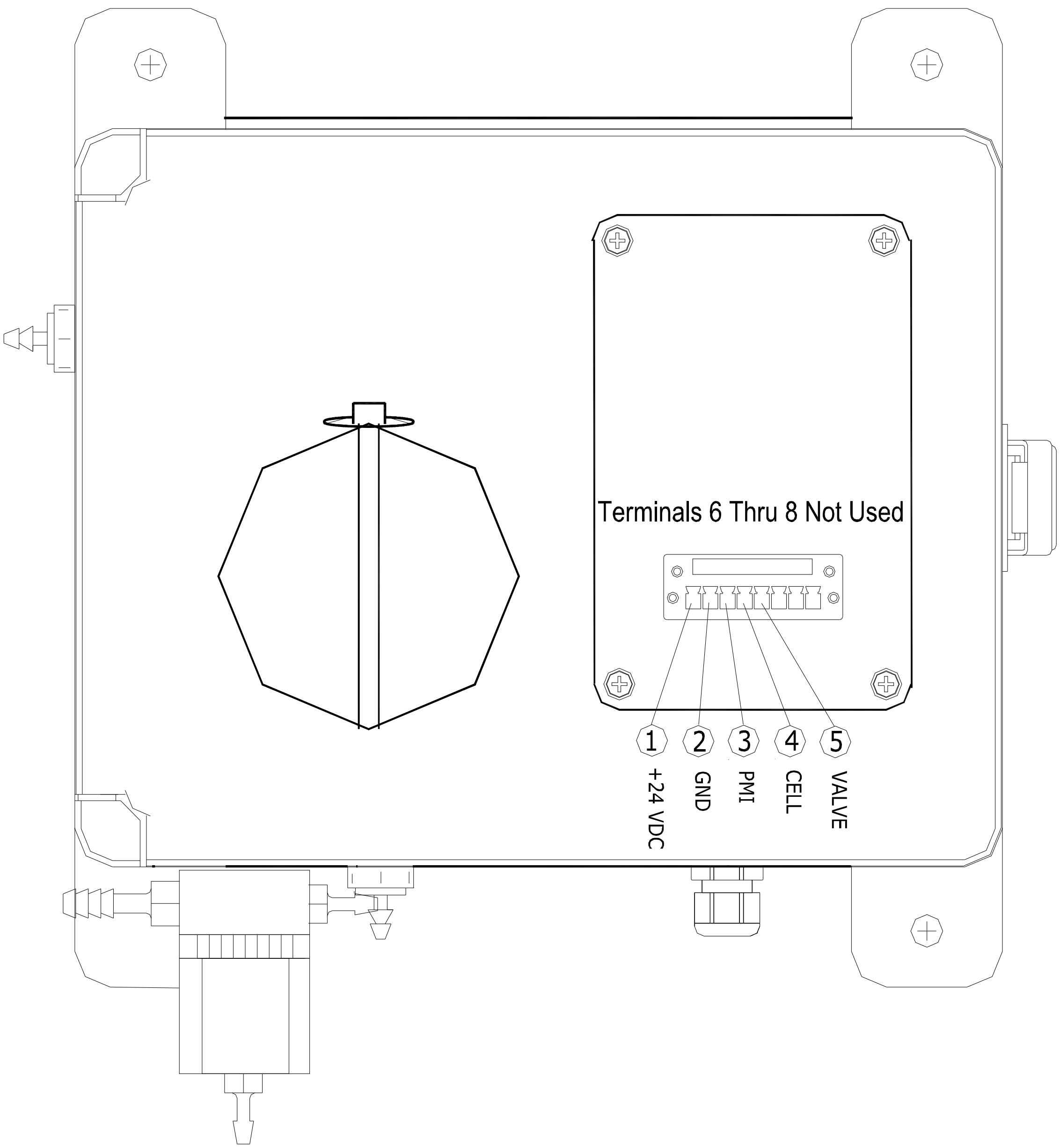


FIGURE 10. PMRS-1 with Auto Sampler – Wiring Terminals

SECTION 3.0 APPLICATIONS

The Particle Monitor has a wide variety of applications dealing in water treatment from monitoring clarifier effluents to micron cartridge filter effluents. There have also been applications in parts washing, beverage quality monitoring, monitoring of solutions used in film making, and many other applications where the contamination of a relatively clean and pure liquid is a concern. The following are a few of the suggested applications just on a typical Industrial Boiler System.

1. Monitor raw water particulates to prevent process/heat exchanger fouling and resultant efficiency loss.
2. Monitor filter influent/effluent particulates to prevent process fouling (such as RO fouling).
3. Monitor resin bed effluent for resin loss to avoid resin replacement costs and downstream fouling potential.
4. Monitor boiler feed water for particulates/iron to prevent boiler fouling and tube failure.
5. Monitor for particulate laden stream leaks (e.g. surface condenser leaks) into condensate lines to prevent boiler fouling.
6. Monitor condensate return lines for particulates/iron to prevent boiler fouling.
7. Monitor microbiological particulates in chilled water to maintain system efficiency and reduce maintenance costs.
8. Monitor for clarifier and lime softener carryover to prevent process fouling and improve filter run lengths.

3.1 HOT / COLD SAMPLE APPLICATIONS

Even though the Particle Monitor may be used for a wide variety of applications, as seen above, they can all be narrowed down to two basic categories: HOT and COLD liquids. For mounting dimensions, and external wiring refer to the diagrams on the following pages.

NOTE: For further information on Constant Head Device, see Section 6, Optional Equipment/Accessories.

Hot Liquid Applications

1. Mount the Particle Monitor securely.
2. Cool sample to a temperature not exceeding 120° F.
3. Establish constant flow to the sensor's sample cell.
4. Reduce sample flow to the 1/8" tubing.
5. Insert tubing into the sensor's sample cell.

Cold Liquid Application

1. Mount the Particle Monitor securely.
2. Establish constant flow to the sensor's sample cell.
3. Reduce sample flow to the 1/8" tubing.
4. Insert tubing into the sensor's sample cell.

SECTION 4.0 OPERATION

4.1 OPERATION

The most noteworthy feature of the Particle Monitor is the center slotted on the sensor housing where the sample tube is inserted. This houses the electro-optic components and associated electronics. It is designed to take standard vinyl tubing of 1/8" bore and 1/32" wall thickness (i.e. 3/16" outside diameter). The tubing fits tightly in the block and must be pushed to the back of the slot, so that the light beam passes centrally through the tube. (Two precisely-aligned pinholes in opposite faces of the slot define the light path). A clamping pin is provided and should be pushed downwards into the block in front of the tube. When this pin is pushed completely into the block, the tubing will be securely held, with the walls flattened against the inner faces of the slot, so that optically, the tubing behaves nearly as a parallel-sided cell.

The water sample should flow through the tube at a rate of at least 75 ml/min (100 to 125 mL/min recommended). At lower flow rates, the RMS value is reduced. Varying the flow rate from 75 to 150 ml/min. should give no change in the RMS value. The most convenient arrangement for controlling flow is gravity flow from a suitable constant head device (optional). This provides a steady flow rate and allows bubbles to escape. Adequate flow to the constant head device (>300 mL/min) must always be maintained to prevent loss of flow to the sensor.

A rotometer can be used as an alternative to the constant head device providing the sample pressure is relatively stable (stable enough to allow the rotometer to maintain flow in the range of 75 to 150 mL/min). The sample also needs to be free of larger particles that could potentially plug the rotometer's flow control valve.

4.2.1 INTERPRETATION OF RESULTS

Because the monitor operates on a novel principle, it is not possible to draw upon previous experience in analyzing the data. The results are given on relative scale, which has no quantitative significance in terms of concentration and size of particles. The same applies to turbidity measurements, but these have been routine for a long time and operators feel comfortable with the standard turbidity scale. A reading of 0.5 NTU indicates reasonable clarity, but gives no idea of the concentration or type of particles in the water. Generally, it is assumed that the lower the turbidity reading, the lower the concentration of suspended particles, and this will usually be a fair assumption.

The monitor has been scaled so that a standard concentration of mono-sized latex particles passed through a remote sensor gives a fixed reading. The response to other suspensions (e.g. tap water) is then found to be closely similar for different sensors. There will be some inevitable variation from one sensor to another, but the difference is usually within 10% for readings greater than 250. Since the RMS value is always referenced to a constant DC level, most of the problems associated with long-term electronics drift are avoided. Changes in the efficiency of the LED or in the transmissivity of the tubing are automatically compensated.

As a guide to the readings that may be expected, a suspension of latex particles, 2 micron diameter, concentration 1000 particles per ml gives a reading around 500 units. The turbidity of the same suspension (Hach Ratio Turbidimeter) is about 0.05 NTU, which is only slightly greater than the reading obtained with pure, particle-free water (0.03 NTU). The monitor's response for such suspensions is proportional to the square root of the concentration. A concentration of about 65 particles per ml is easily detectable, which is very much less than the minimum concentration that can be reliably monitored by a turbidimeter.

A laboratory tap water sample, after standing for about 4 hours, had a turbidity of 0.29 NTU and gave a monitor reading of 275 units. After filtering this sample through No. 1 filter paper, the turbidity was 0.23 NTU and the monitor reading 195 units. Because of the square root dependence of the monitor response, filtration appears to reduce the particle concentration by about 50%, whereas the is reduced by only about 20%.

This is consistent with the response of the two instruments to different particle sizes. Filter paper removes particles a few microns in size, but allows sub-micron particles through. Since turbidity responds mainly to smaller particles, this is little affected by filtration. On the other hand, the particle monitor response depends more on larger particles, which are better removed by filtration. Thus, the Particle Monitor is a more ideal choice for monitoring and optimizing filter operation (e.g. pretreatment system ahead of RO).

With good quality deionized water, there is no measurable turbidity above the 0.03 NTU background level, but the particle monitor may show a reading of 5-20 units (although this is very dependent on stray contamination). After membrane filtration (0.22 micron), the monitor response can be reduced practically to zero.

In practical operation, when the Particle Monitor is used to check the quality of filter water, reading of less than 100 units could probably be taken as indicating good quality water, although even lower readings may be routinely attainable. Readings greater than about 500 units may suggest an unacceptably high particle concentration. Actual thresholds adopted in practice will have to be established after appropriate operating experience has been obtained.

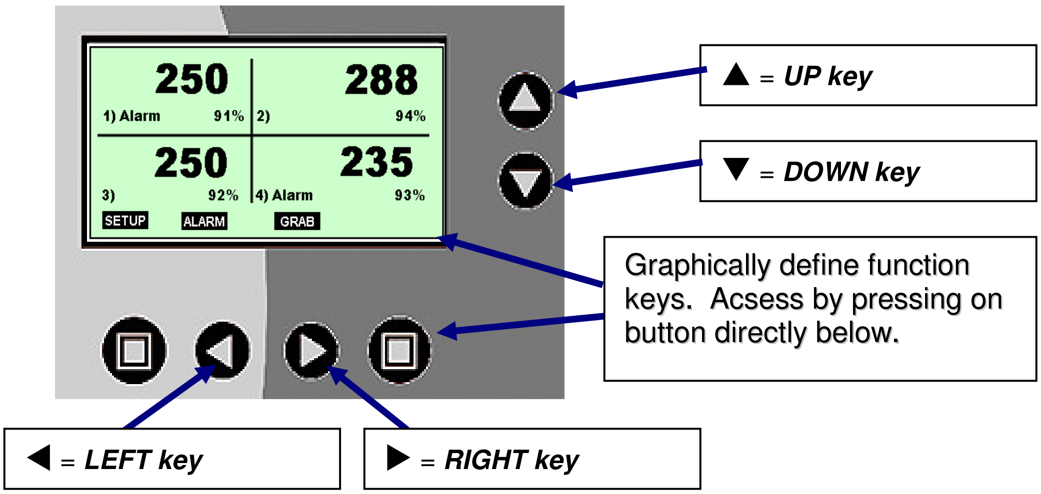
4.3 SUMMARY OF OPERATING PROCEDURE

1. Switch on the monitor and allow about 10 minute warm-up period.
2. Insert clear vinyl tubing (1/8” ID, 3/16” OD) into the block and push into the slot. Insert the clamp pin and push fully downwards.
3. Fill the tube with water. Make sure the sample’s cell percentage display normal cell condition. A low sample’s cell percentage (e.g. <75%) indicates a possibly contaminated or badly-positioned tube. Try adjusting the position of the tube or replace it.
4. Flow the sample at about 75 to 150 ml/min. through the tube, preferably by gravity and without allowing air to be entrained. Readings can then be taken indefinitely, with no further attention needed, except for occasional check on the cell percentage (see Step 3 above). These checks may indicate when the tubing needs to be changed.

SECTION 5.0 USER INTERFACE

5.1 PARTICLE MONITOR USER INTERFACE

The Monitor is equipped with user interface keys, LED indicators, and audible beeps. The interface keys are up (▲), down (▼), left (◀), right (▶), and function keys.



There are four LED lights to the left of the graphical display. These are:

- Power –Green LED that illuminates when there is power to the unit.
- Service - Yellow LED displays the status of the electronics.
- Diag. – Not use.
- Alarm – Red LED that illuminates when the Monitor is in alarm condition.

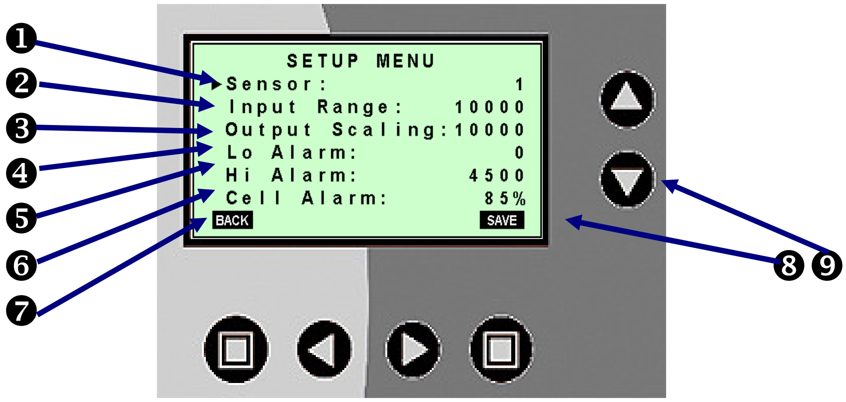
The Monitor/Controller provides the user with an audible beep feedback every time a button is pressed.

The menu navigation of the Monitor/Controller is by using buttons at the front panel. The following steps explain general menu navigations.

1. From the MAIN screen, pressing any function key will gain access to other menu screens.
2. At the menu screen, on the far left hand side of the text there is a text cursor (▸) that indicates the active line on the menu. By pressing the ▲ or ▼ key, the text cursor will move to a different menu text line.
3. To modify the parameter setting on the active menu text, first press the ▶ key to gain access to the parameter and then press the ▲ or ▼ key to scroll through the parameter range. By holding down the ▲ or ▼ key, the number will increase or decrease with larger unit changes.
4. When finished making the parameter change, press ◀ key to store the value. At this point, the new parameter has not been saved. After all parameters modification are completed, press the **SAVE** function key to accept the change or press the **MAIN** function key to discard the changes.

5.2 SETUP MENU

From the MAIN screen, press SETUP function key, the SETUP screen will display. Within the SETUP screen menu, the Input Range, Output Scaling, Lo Alarm, Hi Alarm, and Cell Alarm settings can be modified.



Definitions

❶ **Sensor:** Display the setup for sensor number 1, 2, 3, or 4. To view other sensors setup parameter, press the down ▼ or up ▲ key. Remember to press SAVE function key after changes were made.

❷ **Input Range:** The Input Range of the Particle Index can be set for 10000, 5000, or 2500. This setting allows the Particle Index range to match the sensor board output scaling jumper settings (see Figure 11). NOTE – the Input Range must match the sensor board jumper sensitivity setting.

❸ **Output Scaling:** The analog output's scaling of the Particle Index value can be set for ***10000, 5000, or 2500.*** This setting allows the analog output to change based on different scale settings.

❹ **Lo Alarm:** This is the Particle Index low alarm value setting***.*** The Lo Alarm value can be changed from ***0 to 10000*** at 1 unit increment. For ultra clean water application, this alarm should be set to zero. When Particle Index falls below the Lo Alarm value setting, the alarm will be activated. Once the Particle Index value returns above the alarm threshold, the Alarm will deactivate.

❺ **Hi Alarm:** This is the Particle Index high alarm value setting***.*** The Hi Alarm value can be changed from ***0 to 10000*** at 1 unit increment. When Particle Index rises above the Hi Alarm value setting, the alarm will be activated. Once the Particle Index value returns below the alarm threshold, the Alarm will deactivate.

❻ **Cell Alarm:** This is the Cell Alarm threshold setting. The Cell Alarm value can be changed from ***60 to 100%*** at 1 unit increment. If the tube becomes contaminated or if the LED becomes less efficient, then the cell percentage indication will decrease. When Cell Particle Index falls below the Lo Alarm value setting, the alarm will be activated. Once the Particle Index value returns above the alarm threshold, the Alarm will deactivate

❼ **SAVE Function Key** – Pressing this key will save current setting modifications and brings up the ***MAIN*** screen.

❽ **BACK Function Key** – Pressing this key will ignore any setting modifications on this screen and brings up the ***MAIN*** screen.

❾ Press the down ▼ key six times to view **SET UP MENU (2)**, the current status of all four sensors will be displayed.

1. The sensors can be selected using the down ▼ or the up ▲ keys to move the cursor to the desired sensor
2. Once the cursor is on the desired sensor, use the right ▶ key to select the sensor, blinking text indicates when a sensor has been selected.
3. The sensor status (enabled or disabled) can be changed by pressing the up▲ or down ▼ keys
4. Press the **SAVE** function key to save the current settings and return to the **MAIN** screen

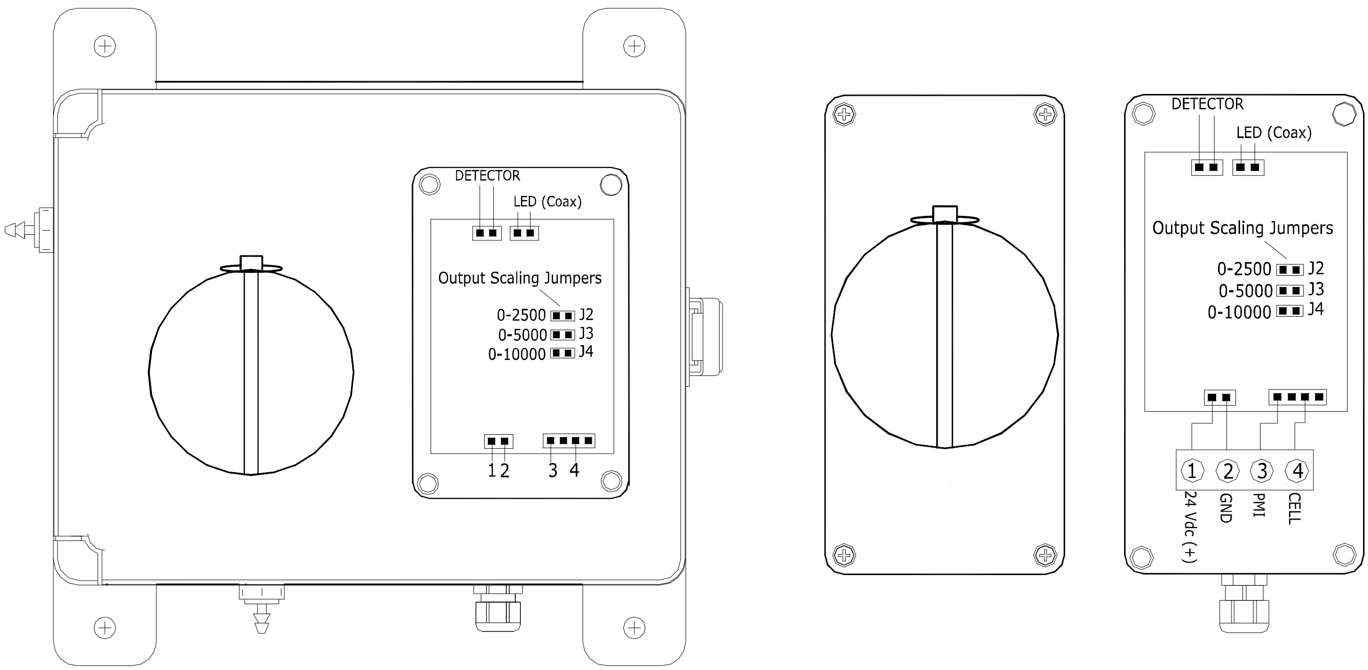
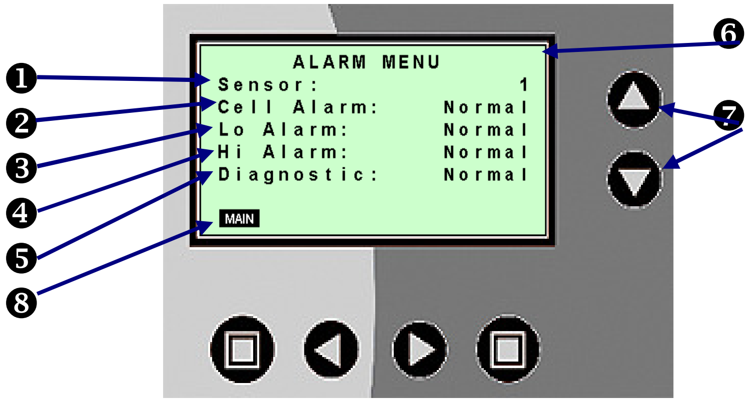


FIGURE 11. Remote Sensor Output Scaling Jumpers

5.3 ALARM MENU

From the MAIN screen, press ALARM function key, the ALARM MENU screen will display. Within the ALARM STATUS menu you can view which Alarm has been triggered, as well as, turn the Monitor's audible alarm feature on and off.



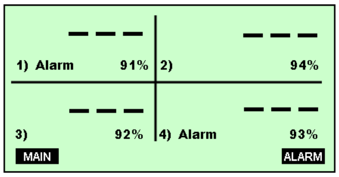
Definitions:

❶ **Sensor:** Display the setup for sensor number 1, 2, 3, or 4. To view other sensors setup parameter, press the down ▼ or up ▲ key.

❷ **Cell Alarm:** The Cell Alarm indicates the alarm condition when sample's cell percentage falls below the Cell Alarm threshold.

❸ **Lo Alarm:** The Lo Alarm indicates the alarm condition when Particle Index falls below the Particle Index low alarm threshold.

❹ **Hi Alarm:** The Hi Alarm indicates the alarm condition when Particle Index rises above the Particle Index high alarm threshold.



❺ **Diagnostic:** Display sensor diagnostic alarm condition. When the self diagnostic test fail, the Particle Index will show "**---**" on the main screen; see Troubleshoot Section of this manual.

❻ **Audible Alarm Indication:** The Monitor is equipped with audible alarm feature. The audible alarm will beep and the red LED light will come on when any alarm condition occurred. The ✱ symbol will appear when the audible alarm is enabled, see Special Function Key's definition below to activate and deactivate the audible alarm. There are two audible alarm sound levels, high and low. When the audible alarm is enabled and alarm condition occurs, high-level beep will be generated. The method of acknowledging the alarm is to press the ALARM function from the MAIN screen, the alarm beep will switch to low level. If any new alarms occur, the high-level beep will be generated to notify the user of the new alarm.

❼ **Special Function Key:** The audible alarm can be toggled ON and OFF by pressing both ▼ and ▲ keys. The ✱ symbol will only appear when the audible alarm is enabled. Once the audible alarm is disabled, the only way to enable is to toggle with this Special Function key.

❽ **MAIN Function Key:** Pressing this key will bring up the MAIN screen.

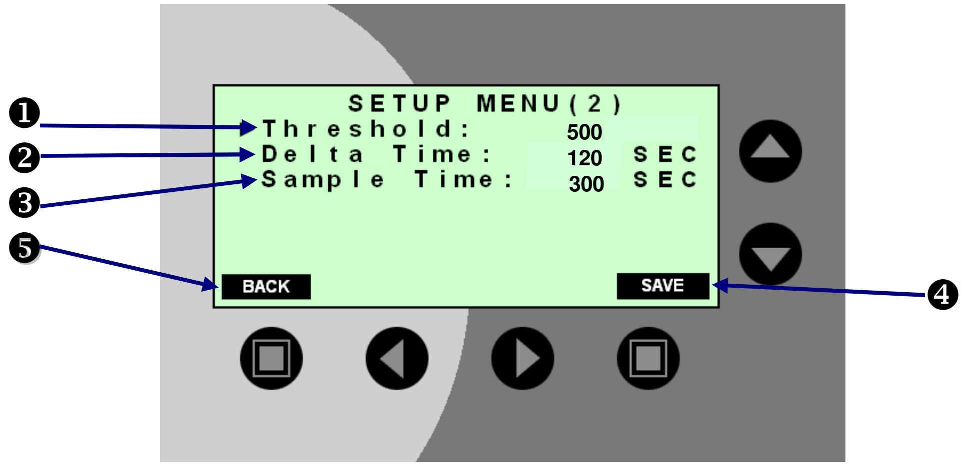
When any alarm is triggered, a +24 Vdc signal will be present on the Monitor's digital alarm output terminals. This signal can be connected to a SCADA/DCS system to alert the operators to an Alarm condition. In lieu of a +24VDC signal, an optional solid state relay output is available (must be specified with order).

5.4 PM2500 Sensor Status (enabled or disabled)

1. From the **MAIN** screen, press **SETUP** function key. **SETUP MENU (1)** screen will display.
2. Press six times **down** (▼) key to reach **SETUP MENU (2)** screen. The current status of all four sensors will display.
3. The desired sensor would be chosen, using **up** (▲) and **down** (▼) keys.
4. Use **right** (▶) key to indicate the active line of sensor status (blinking text).
5. Change Sensor status (enabled or disabled), pressing **up** (▲) and **down** (▼) keys.
6. Press left (◀) key to confirm the change (stop blinking text).
7. Press **SAVE** function key to save the configuration. The MAIN screen will display.

5.5 SAMPLER SETUP MENU

From the Main screen, press the **SAMPLER** button (left arrow) to view the SAMPLER MENU screen. Within the SAMPLER SETUP menu, the GRAB SAMPLE settings, Threshold, Delta Time, and Sample Time can be modified.



Definitions:

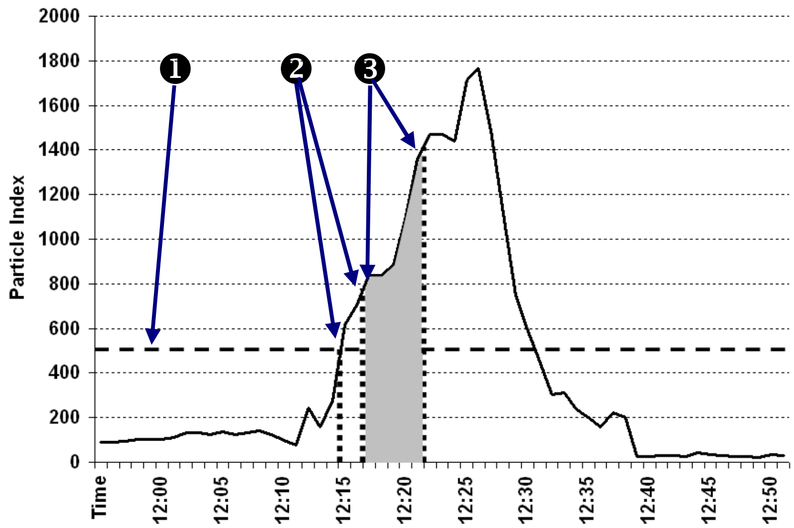
❶ **Threshold:** A predetermined value at which a sample will be taken by the sample module.

❷ **Delta Time:** The length of time required for the Particle Index to remain above the Threshold value before a sample is taken.

❸ **Collect Time:** The length of time the sample valve will remain open. The Collect time needs to be long enough to fill the sample bottle (approx. 10 minutes for a 1 liter bottle).

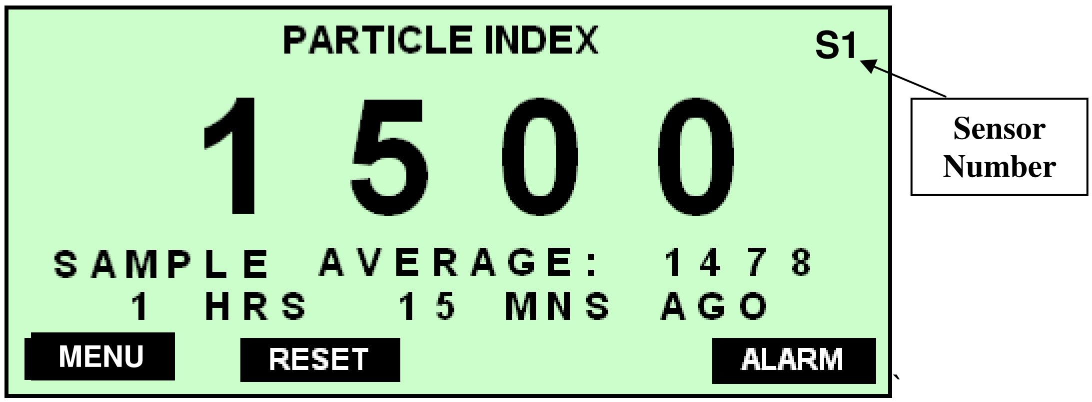
❹ **SAVE Function Key** – Pressing this key will save current setting modifications and brings up the ***MAIN*** screen.

❺ **BACK Function Key** – Pressing this key will ignore any setting modifications on this screen and brings up the ***MAIN*** screen.



5. 6 GRAB SAMPLE INFORMATION

On the main menu, when a sample is being taken, the sensor number will blink with the status message "**TS**". After a sample has been taken, the sensor number and status message "**SMP**" will blink under the particle index. To view the sample average, press the up and down arrow keys. The following menu screen will be displayed for each sensor.



If a sample was taken for the displayed sensor (see upper right corner for sensor number) the display will show how long it's been since the sample was taken.

The **SAMPLE AVERAGE** is an average reading over the whole sample period (determined by the **SAMPLE TIME** setting).

After a sample collection is finished, the display will start updating the time so the user can see how long ago the sample was taken. This time readout is provided so that the user can go back and review a more detailed readout of the Particle Index on their datalogger (e.g. charge recorder, SCADA, DCS, etc.) if desired. This requires that the 4-20mA output signal be connected to the datalogger.

Another sample will not be taken until the **RESET** button is pressed. Once the **RESET** button is pressed, the sample information is cleared from the main screen.

SECTION 6.0 TROUBLESHOOTING GUIDES

PROBLEMS	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
1. No displays	A. Blown fuse B. Power Supply C. Faulty circuit card	A. Replace 1A/125V fuse B. Check for 125VAC at the L and N terminals. If present, check 24 VDC between terminals 22 and 21 at the module. C. Replace circuit card.
2. Particle Index Display “---“	A. Self Diagnostic Test Fail	A. Sensor wiring not connected. B. Fail sensor card at the remote sensor.
3. Low Sample Cell Percentage	B. Dirty sample tube. C. Complete obstruction of light source D. Faulty circuit card	C. Replace tubing, or reposition on cleaner segment. D. Clear obstruction and clean sensor block with alcohol and cotton swab. E. Replace circuit card.
3. No numeric display or frozen numeric display	A. Loose display cable	A. Turn off the power switch. Make sure both ends of the display cable are connected.
4. Display varies rapidly and widely	A. Drastic flow rates change B. Intermittent bubbles in sample line C. Buildup of sedimentation in sample line	A. Check source of sample. Change sample point or introduce debubbler to stabilize flow rate. B. Check sample line connection for air leaks. If OK, install debubbler. C. Replace sample tubing.

SECTION 7.0 OPTIONAL EQUIPMENT / ACCESSORIES

7.1 CONSTANT HEAD DEVICE

The constant head device (Water Weir) is designed to deliver constant flow to the sample cell, despite changes in source pressure. Overflow must be maintained to ensure that full flow is achieved. The device consists of a cylinder mounted on a backplate. There are three fittings: one for the inlet, one for the overflow, and one for the flow to the sample cell. The flow into the device must be controlled so that it does not exceed the overflow capacity.

The flow must be reduced to enter the device through the ¼" ID fitting near the bottom of the cylinder. The sample flow is taken from the ¼" ID fitting in the middle of the cylinder, this flow must be reduced to a 1/8" ID tubing to go to the sample cell. The bigger fitting near the top of the cylinder is for the overflow.

Head adjustment is achieved by moving the sample cell outlet up or down until the desired flow rate is obtained.

7.2 ORDERING INFORMATION

To place an order for spare parts you may call, email, or fax Chemtrac®, Inc. directly or contact your local distributor or representative. The following information should be included in your request: Model number of your monitor, part number(s), qty, description of parts required, and purchase order number. Please contact Chemtrac®, Inc. for up to date pricing.

Parts order normally ship within 24 hours.

Chemtrac, Inc
6991 Peachtree Industrial Blvd., Building 600
Norcross, GA 30092

Phone:	1-800-442-8722 (Inside US only), 770-449-6233
Fax:	770-447-0889
Email:	sales@chemtrac.com
Website:	www.chemtrac.com

SECTION 8.0 MECHANICAL SPECIFICATIONS

Figures 12 thru 15 illustrate enclosure and mounting dimensions for the PM2500 and PMRS-1 & PMRS-2 Remote Sensors

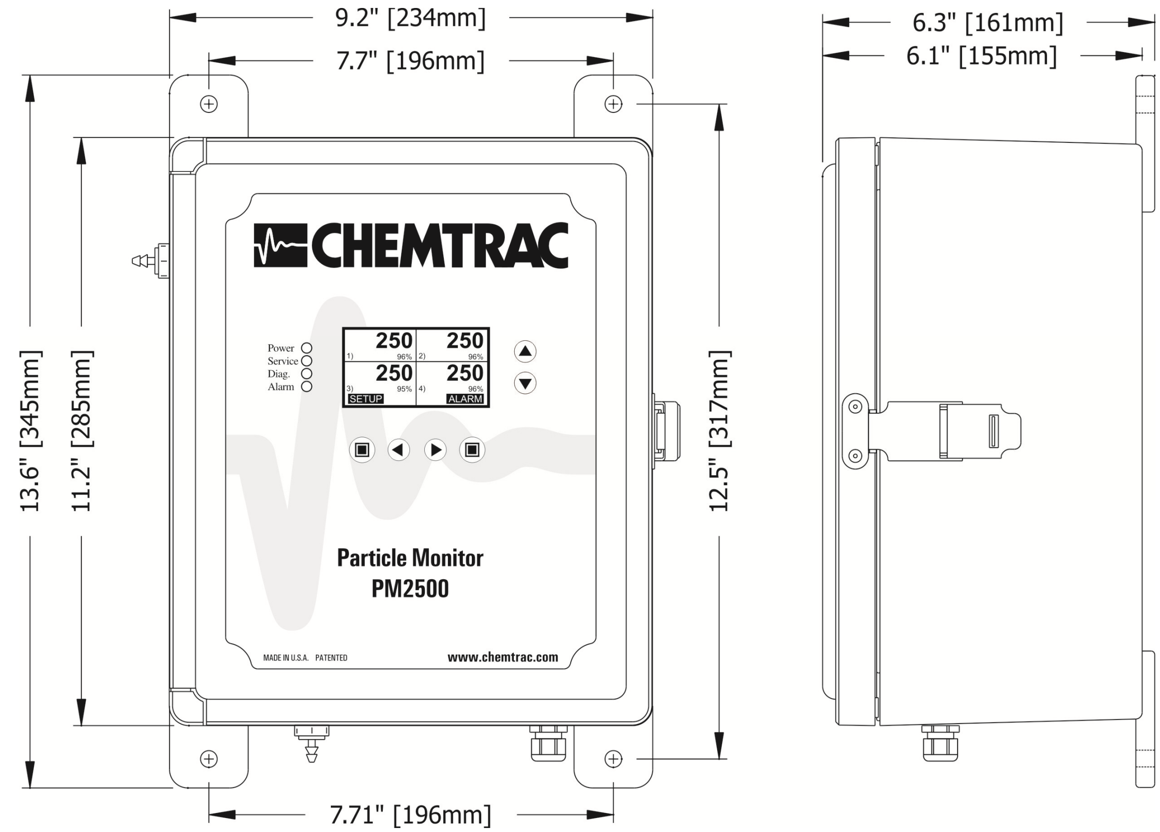
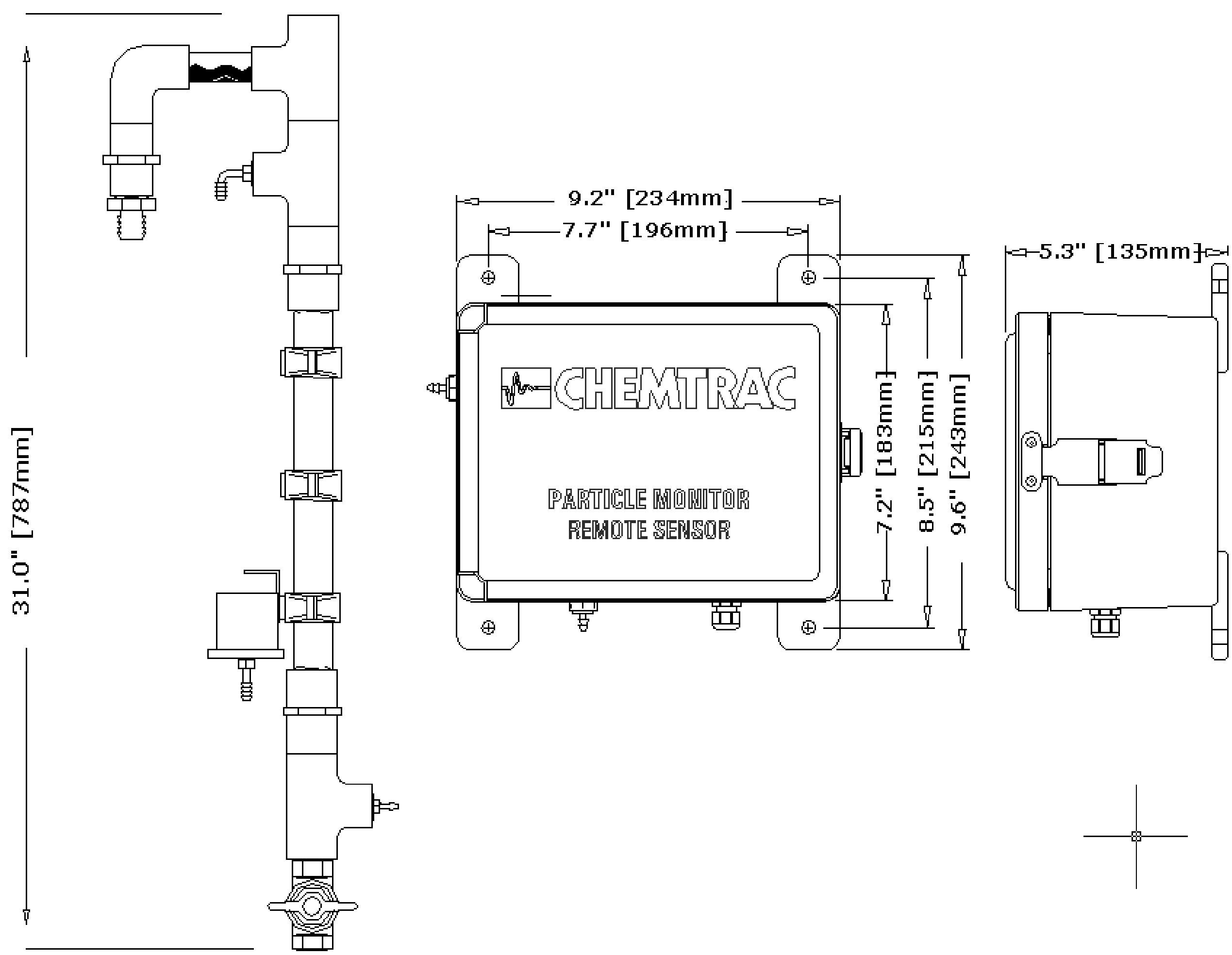


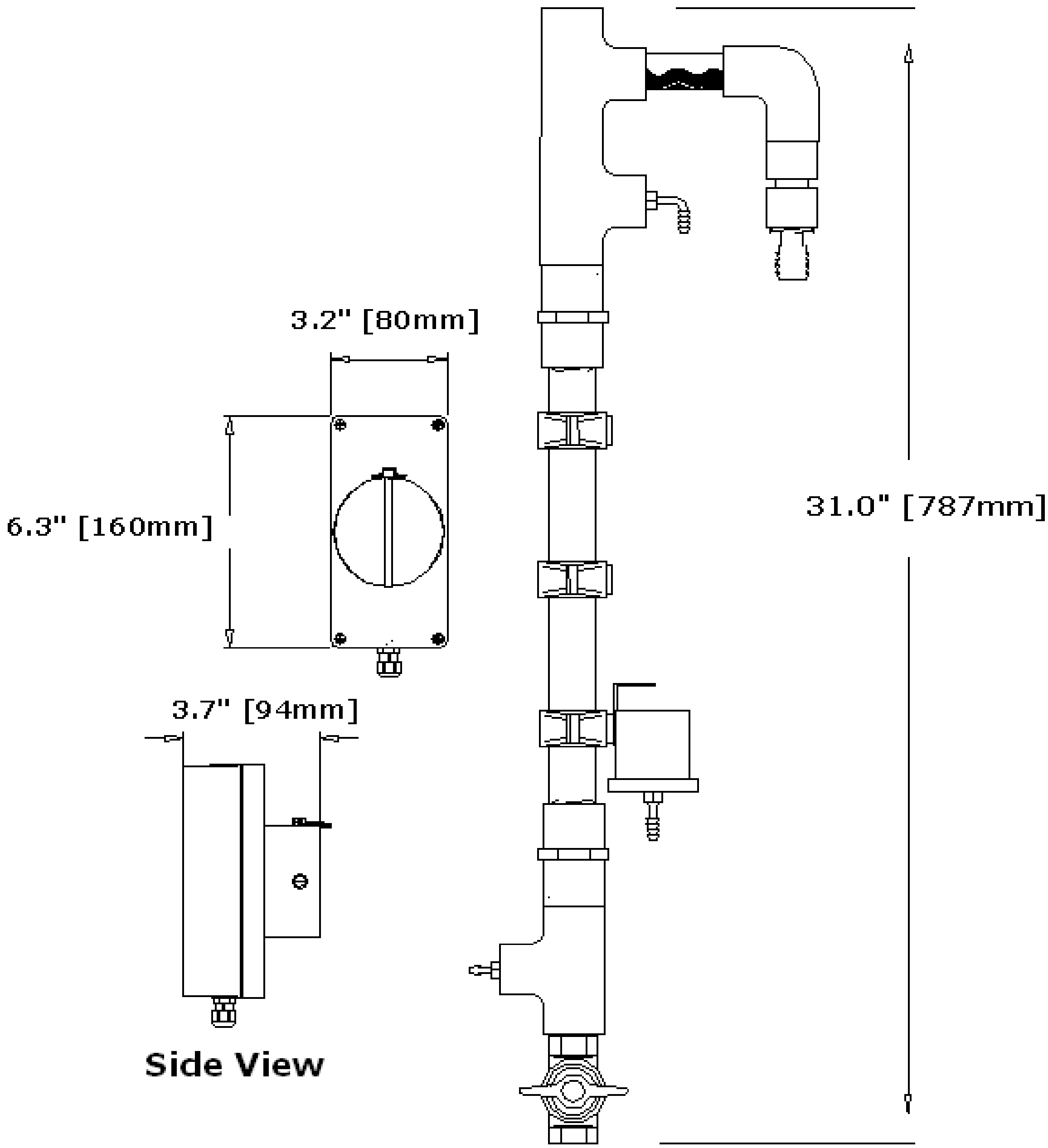
FIGURE 12. PM2500 Monitor Dimensions

FIGURE 13. PMRS-1 Remote Sensor with Optional Weir (Dimensions)



When mounting the constant head device and remote sensor, the placement of the constant head device needs to be similar to what is shown in the above diagram. In order to maintain proper flow to the sensor, it is very important that the overflow sight glass is a few inches higher than the top of the PMRS-1 enclosure as shown in this drawing.

FIGURE 14. PMRS-2 Remote Sensor with Optional Weir (Dimensions)



When mounting the constant head device and remote sensor, the placement of the constant head device needs to be similar to what is shown in the above diagram. In order to maintain proper flow to the sensor, it is very important that the overflow sight glass is a few inches higher than the top of the PMRS-2 enclosure as shown in this drawing.

FIGURE 15. PMRS-2 Enclosure Mounting Dimensions