Auburn FilterSense

Particulate Monitor
Model DynaCHARGE™ PM I PRO

INSTALLATION & OPERATING MANUAL

T: (978) 927-4304 | 800 Cummings Center, 355W Beverly, MA 01915 USA | www.auburnfiltersense.com

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1 Notifications

1.1 Technical Support Contact

Auburn FilterSense provides industry-leading Engineering and Technical Support for all product lines. The Technical Support department is staffed with a team of engineering professionals. Areas of assistance provided by the Technical Support department include:

- Pre-Installation Site Analysis
- Product Installation
- General Operation
- Application-Specific Review
- Routine Calibration
- EPA Compliance
- Performance Upgrades and Add-On Features

To assure the best and most efficient technical support, please be prepared with the following information prior to contacting Auburn FilterSense. If it is determined that the component must be returned for evaluation/repair, a Return Material Authorization (RMA) number will be issued. You must include the RMA number on the packing slip and mark the outside of the shipping container.

- Company Name_____
- Product Model Number_____
- Product Serial Number_____
- Date of Installation_____
- Reason for Return_____

Auburn FilterSense Technical Support may be reached by:

Phone: (978) 927-4304
Fax: (978) 927-4329
E-Mail: info@auburnfiltersense.com
Address: AUBURN FILTERSENSE
800 Cummings Center, 355W
Beverly, Ma. 01915, USA

Hours of Operation: 8:00AM – 5:00PM U.S. Eastern Time

- Any control unit or particulate sensor that was exposed to hazardous materials in a process must be properly cleaned in accordance with OSHA standards, and a Material Safety Data Sheet (MSDS) must be completed before it is returned to the factory.
- All shipments returned to the factory must be sent by prepaid transportation.
- All shipments will be returned F.O.B. factory.
- **Returns will not be accepted without an RMA number.**

1.2 Disclaimer

This document contains important information necessary for proper operation of the product. It is strongly urged that all users of the product read this manual in its entirety. All instructions should be followed properly and any questions that arise should be discussed with Auburn FilterSense LLC.

Any use or distribution of this document without the express consent of Auburn FilterSense LLC is strictly prohibited. Any reproduction is prohibited without written permission.

In no event will Auburn FilterSense LLC be liable for any mistake, including lost profits, lost savings, environmental compliance costs, or other incidental or consequential damages or injury arising out of the use or inability to use this manual, even if advised of the possibility of such damages, or any claim by any other party. Terms and conditions supplied with each order contain additional liability limitations related to this product.

1.3 Symbols and Conventions

WARNING 	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Warning statements help you to: • Identify a hazard. • Avoid a hazard. • Recognize the consequences. Identifie les informations sur les pratiques ou les circonstances qui peuvent entraîner des blessures corporelles ou la mort, des dommages matériels ou des pertes économiques. Les avertissements vous aident à: • Identifier un danger • Évitez un danger • Reconnaître les conséquences
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
	Identifies information, sections, or statements in this manual that apply to approved hazardous area systems, regulations, or installation. Identifie les informations, sections ou déclarations de ce manuel qui s'appliquent aux systèmes, réglementations ou installations approuvés pour zones dangereuses.

1.4 Safety

WARNING

AREA CLASSIFICATION (CLASSIFICATION DE ZONE)
Before installing any device, confirm area classification requirements as specified on the product label. Do not install any device that is not tagged as suitable for the required area classification.

Avant d'installer un appareil, confirmez les exigences de classification de zone telles que spécifiées sur l'étiquette du produit. N'installez aucun appareil qui n'est pas étiqueté comme adapté à la classification de zone requise.

ENVIRONMENT (ENVIRONNEMENT)
Before installing any device, confirm ambient temperature, process temperature, and process pressure requirements. Do not install any device that is not tagged as suitable for the required temperatures and pressures.

Avant d'installer un appareil, vérifiez les exigences de température ambiante, de température de processus et de pression de processus. N'installez aucun appareil qui n'est pas étiqueté comme adapté aux températures et pressions requises.

NOT A SAFETY RATED DEVICE (PAS UN DISPOSITIF DE SÉCURITÉ ÉVALUÉ)
This model must not be used independently for safety or as a critical input signal to a safety system. This model is designated for general process control, diagnostics, and environmental monitoring. Safety must be addressed with the detailed engineering, redundancy, and safety certified components where applicable. Consult factory for critical safety applications.

Ce modèle ne doit pas être utilisé indépendamment pour la sécurité ou comme signal d'entrée critique vers un système de sécurité. Ce modèle est conçu pour le contrôle général des processus, les diagnostics et la surveillance environnementale. La sécurité doit être abordée avec l'ingénierie détaillée, la redondance et les composants certifiés de sécurité, le cas échéant. Consultez l'usine pour les applications de sécurité critiques.

WARNING

GROUNDING (MISE À LA TERRE)
Before turning on the instrument, you must connect the protective earth terminal of the instrument to a proper earth ground. Grounding to the neutral conductor of a single-phase circuit is not sufficient protection.

Avant de mettre l'instrument sous tension, vous devez connecter la borne de terre de protection de l'instrument à une prise de terre appropriée. La mise à la terre du conducteur neutre d'un circuit monophasé ne constitue pas une protection suffisante.

INSTALLATION AND SERVICE PERSONNEL (PERSONNEL D'INSTALLATION ET DE SERVICE)
Only appropriately licensed professionals should install this product. Always disconnect power before servicing.
Personnel must be familiar with operational hazards, such as those caused by hot, pressurized, or toxic gases, liquids, or particulates.
Service of individual electronics is limited to replacement of the electronics module. Do not attempt to disassemble electronics. Any components that are not operating properly should be returned to Auburn FilterSense for service.

Seuls les professionnels agréés doivent installer ce produit. Débranchez toujours l'alimentation avant de procéder à l'entretien.
Le personnel doit être familiarisé avec les dangers opérationnels, tels que ceux causés par des gaz, des liquides ou des particules chauds, sous pression ou toxiques.
L'entretien de l'électronique individuelle est limité au remplacement du module électronique. N'essayez pas de démonter l'électronique. Tous les composants qui ne fonctionnent pas correctement doivent être renvoyés à Auburn FilterSense pour réparation.

2 Associated Documentation

This manual is to be referenced in conjunction with the following Auburn FilterSense documentation:

2.1 Product Information

Publication Number	Title
228-1076	Auburn FilterSense Particulate Sensor Model PS 10 Hardware Manual
228-1077	Auburn FilterSense Particulate Monitoring Application and Alarm Guide
225-1084	Control Drawing, PS10 Hazardous Area Wiring Using PM 1
225-1085	Control Drawing, PM 1-T Intrinsically Safety Wiring
EXXXX	Project Specific Drawings if Applicable

Specific Conditions of Use:

1. When the manufacturer of the equipment has not identified the type of protection to be used for installation on the label, the user shall, on installation, mark the label with the type of protection used. Once the type of protection has been marked it shall not be changed.
2. The PM 1 PRO-T shall be used with the EATON MTL5541 when installed in the hazardous area according to 225-1085.
3. NEMA 4X and IP66 ratings only apply to the PS 10 probe assembly when installed per drawing 225-1084.
4. The maximum permitted ambient temperature of the PM 1 Transmitter is 71 °C. To avoid the effects of process temperature and other thermal effects care shall be taken to ensure the surrounding ambient and the ambient inside the transmitter housing does not exceed 71°C
5. To prevent the risk of electrostatic sparking the painted surface of the enclosure should only be cleaned with a damp cloth.

Conditions particulières d'utilisation :

1. Lorsque le fabricant de l'équipement n'a pas identifié le type de protection à utiliser pour l'installation sur l'étiquette, l'utilisateur doit, lors de l'installation, marquer l'étiquette avec le type de protection utilisé. Une fois que le type de protection a été marqué, il ne doit pas être modifié.
2. Le PM 1 PRO-T doit être utilisé avec l'EATON MTL5541 lorsqu'il est installé dans la zone dangereuse conformément à 225-1085.
3. Les indices NEMA 4X et IP66 s'appliquent uniquement à l'ensemble de sonde PS 10 lorsqu'il est installé conformément au schéma 225-1084.
4. La température ambiante maximale autorisée du transmetteur PM 1 est de 71 °C. Pour éviter les effets de la température du processus et d'autres effets thermiques, il faut veiller à ce que la température ambiante et la température ambiante à l'intérieur du boîtier du transmetteur ne dépassent pas 71 °C.
5. Pour éviter le risque d'étincelles électrostatiques, la surface peinte du boîtier ne doit être nettoyée qu'avec un chiffon humide.

3 Introduction

3.1 PM 1 PRO Overview

PM 1 PRO

The DynaCharge™ PM 1 PRO is a single-point, advanced functionality, high performance, and heavy-duty particulate monitor employing charge induction/electrodynamic sensing for reliable monitoring of particulate in stacks, ducts, and pipes. Applications include continuous particulate emissions monitoring, filter performance monitoring, leak detection, cyclone overflow detection, powder flow trending and flow/no flow indication. Advanced functionality and high performance/reliability make the instrument ideally suited for Industry 4.0, IIoT (Industrial Internet of Things) and optimizing plant performance.

Available Features include:

- Advanced communication options
  - HART with DTM, Bluetooth with Android and iOS Apps, USB, and Modbus
- State of the art low power/loop powered design including:
  - High speed DSP for high accuracy and low-level measurement
  - Automatic zero, span, sensor, and device health checks
  - Internal data logging with high accuracy time clock
- Advanced dynamic charge induction sensing.
- Fully insulated sensing probes for reliable operation in moist, corrosive, and conductive applications

EPA Compliance

The PM 1 PRO is a value-added solution for EPA compliance. The instrument can meet different levels of measurement and monitoring including EN 15859, ASTM D7392 and US-EPA MACT including self-testing and quality assurance requirements. The product employs the latest generation of Auburn FilterSense TUV QAL 1 approved technology.
Optional equipment and proper configurations may be required to meet a specific compliance regulation. Consult the factory for an application review.

Versions

The PM 1 PRO is available in three versions:

- PM 1 PRO-T (Transmitter, Loop Powered)
  - 2-Wire Loop Powered Transmitter (4-20mA, HART Optional)
  - Integral or Remote Electronics
  - Graphical Display/Keypad

- PM 1 PRO-AT (Alarm and Transmitter)
  - Alarm Relays and Transmitter (powered 4-20mA, HART Optional) or Serial (Modbus or Profibus)
  - Integral or Remote Electronics
  - Graphical Display/Keypad

- PM 1 PRO-A (Alarm Only)
  - Alarm Relay Outputs
  - Integral or Remote Electronics
  - Graphical Display/Keypad

PM 1

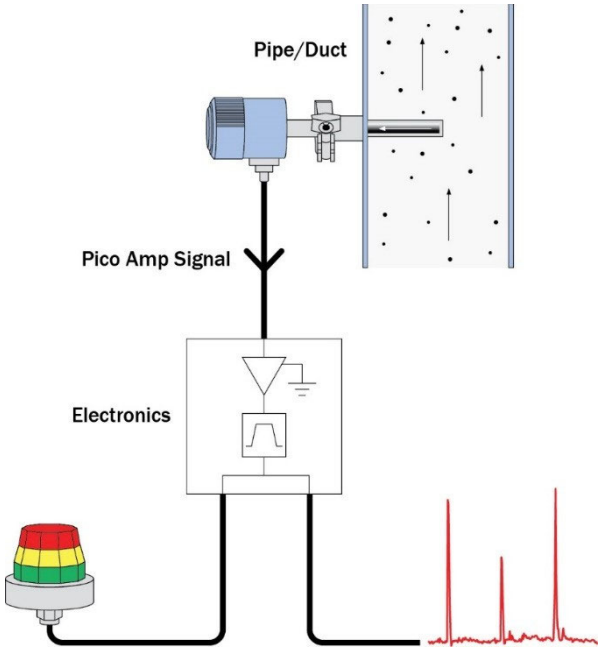
The PM 1 is also available in a lower priced basic version.
Refer to PM 1 basic manual.

- PM 1-A (Alarm Only)
  - Alarm Relay Outputs Only
  - Integral Electronics Only

- PM 1-T (Transmitter, Loop Powered)
  - 2-Wire Loop Powered 4-20mA
  - Integral Electronics Only
- Refer to the PM 1 manual or contact Sales @AuburnFiltersense.com for more information.

Principle of Operation

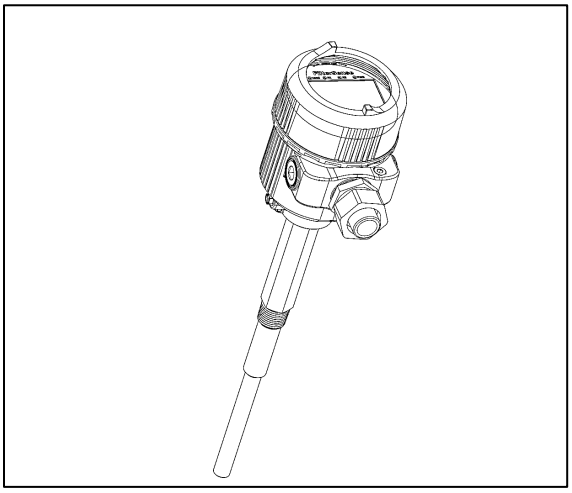
The principle of operation is dynamic charge induction (electrodynamic).
As particles flow near or over the electrically isolated sensing probe, minute charge is dynamically induced and transferred into the probe. The charge flows through a measurement circuit to ground.
The signal is digitally filtered to principally measure the induced charge and is further processed to provide an output that is linear to mass. The unit of measure is picoamperes (pA). For highest accuracy and highest linearity to mass, refer to the model PM 100 PRO.
The device also analyses aspects of the raw signal to provide device and performance diagnostics.
For best understanding of particulate levels, 4-20mA analog outputs should be converted to pA at remote recording devices or remote displays. For output in mg/m3 or gs/cf the PM 100 PRO is recommended.



3.2 Design

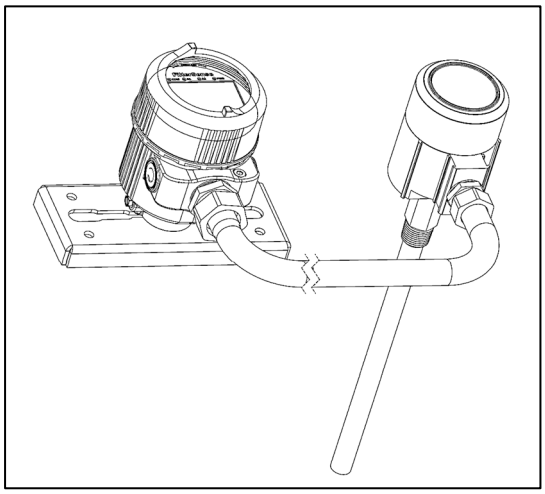
Integral Electronics

- Integral electronics for accessible locations
- Electronics and display are integral to the particulate sensor.



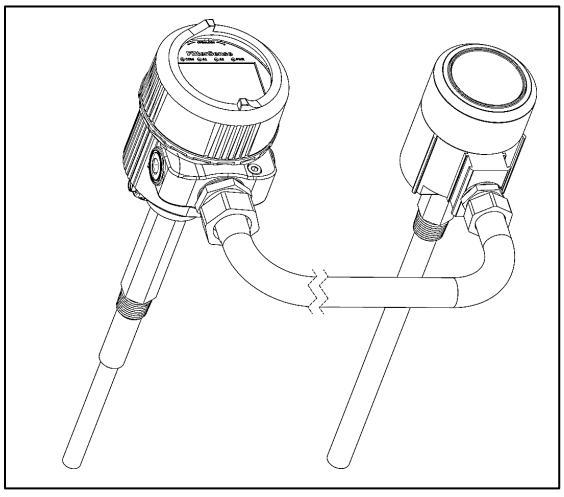
Remote Electronics

- Remote electronics for hard-to-access locations and very high-temperature applications
- Electronics and graphical display are mounted separately from the particulate sensor
- Requires PS 10 particulate sensor and coaxial cable (CCA-SMB-XXX)



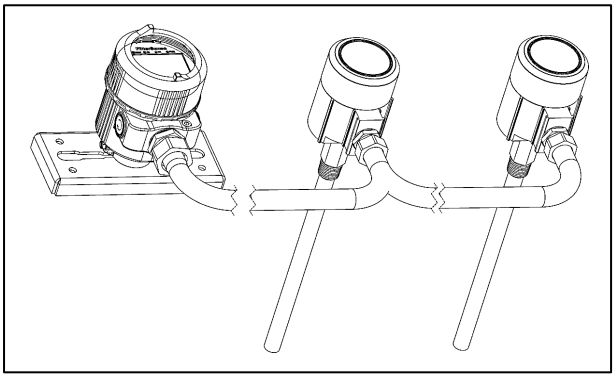
Integral Electronics with Daisy Chain Sensor

- Integral electronics for accessible locations
- Daisy chain design for additional sensing coverage across large ducts
- Requires PS 10 particulate sensor and coaxial cable (CCA-SMB-XXX)



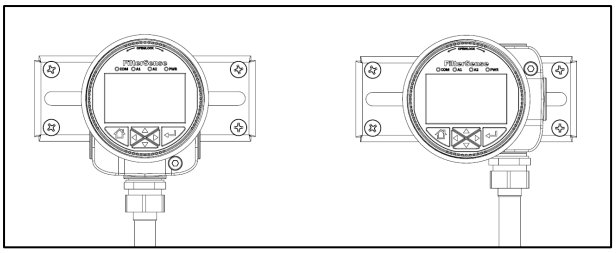
Remote Electronics with Daisy Chain Sensor

- Remote electronics for hard-to-access locations and very high-temperature applications
- Daisy chain design for additional sensing coverage across large ducts
- Requires multiple PS 10 particulate sensors, coaxial cable (CCA-SMB-XXX), and Daisy Chain Type Connector
(CCA-DC-XXX)



Flexible Display/UI Module

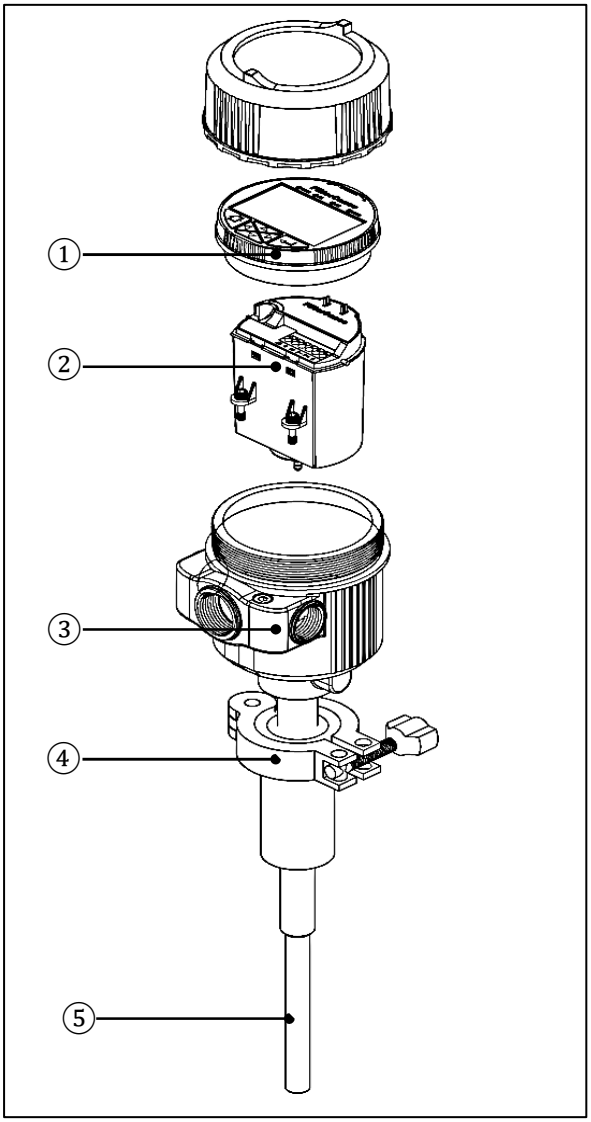
- The PM 1 PRO Display/UI Module can be inserted or removed at any time.
- It is not necessary to disconnect power before removing the Display Module.
- The PM 1 PRO will continue to function and remain powered when the display has been removed.
- Four module positions are possible, each displaced by 90°.
- The enclosure can be rotated 360° to accommodate all installation orientations.
- The rotatable enclosure allows easy removal of threaded sensors without the need to remove wiring and conduit.



3.3 Components

The PM 1 PRO consists of the following main elements:

① Display/UI Module
② Electronics Module
③ Enclosure
④ Sensor Nipple/Process Mount
⑤ Sensing Probe



3.4 Technical Data

Display/UI Module

Parameter	Detail/Code	Specifications	Notes
Display	PRO	Wide temperature, low power 2.7 in High-Resolution Monochrome	Rotatable Design, 4 x Possible Display Orientations
LEDs	-A -AT	4 x LEDs for Power, Alarms 1 & 2, and Communication	
Rotatable Design		4 x Possible Display Orientations	

Electronics Module

Parameter	Detail/Code	Specifications	Notes
Measurement Technology		Charge Induction/electrodynamic	
Measurement Units		Picoamperes (pA)	1 x 10^{-12} A
Input Voltage	-A or -AT -T	Universal 20-250 VAC/VDC, 47-63 Hz Fuse: 1.0A, Slow-Blow 250V, Type 'T' 18-32 VDC Loop Power	
Input Power	-A or -AT	3 Watts Max.	
Electronic Resolution, Range	-R4 -R5 -R6 -R9	Special - Monitoring, Resolution: 0.1 pA, Range: 0 to 5,000 pA, Requires Automatic EPA Self-Checks (N-K Order Code) 0.5pA, Range 0 to 5,000pA 5.0pA, Range 0 to 5,000pA 10.0pA, Range 0 to 100,000pA	 Powder Flow Only
Minimum Detection Level	-R4 -R5 -R6 -R9	~1mg/ m^3 ~1-5 mg/m^3 ~5-10 mg/m^3 ~10 mg/m^3	
Minimum Particle Size		0.3 Micron	
Temperature Ambient		-40 °F to +160 °F (-40 °C to +71 °C) -40 °F to +185 °F (-40 °C to +85 °C)	Operating Storage
Relay Outputs	-A or -AT	Form A (SPST) 250 VAC/1A (Resistive), 1A (Inductive) 30 VDC/1A (Resistive), 1A (Inductive)	Type Max Ratings
4-20mA Output	-T -AT	500Ω Max. Loop Impedance @ 24 VDC Loop Power 500Ω Max. Loop Impedance @ 20 VDC Sourced Current Output Adjustable via Keypad	Rating Rating Span
Electronics Version	-I -R	Integral Remote (Requires coaxial cable & PS 10)	
Enclosure	-N4X -N4XR	Type 4X/IP 66 Aluminum, Powder Coated with Window (Pending) Type 4X/IP 66 Aluminum, Powder Coated with Window, Remote Electronics Version (Pending)	
Area Classification	-G -H0 -H2 -H3	Ordinary/General Purpose, (UL, CSA, CE) Special - Hazardous Location, ATEX Zone 2, 22 self-certification, Groups IIC/IIIC, T4/T135 Hazardous Location, Class II, Division 2 (Zone 1, 2, 21, 22), Groups A-G, T4, (UL, CSA, ATEX, IECEx). Integral or Remote Electronics Hazardous Location, Class I, II, Division 1, 2 (Zone 0, 1, 2, 20, 21, 22), Groups A-G, T4, (UL, CSA, ATEX, IECEx), **Includes External Approved Safety Barrier, Wired According to CONTROL DRAWING: 225-1085.**	**H3 is PM 1 PRO-T Integral Only**

Sensor Probe

Parameter	Detail/Code	Specifications	Notes
Base Sensor	-N05 -N15 -G15 -R15 -Q15 -Q20 -F20 -F50 -FAXXY -FDXXY -AP	Special - NPT Male, 0.5 in., 316L NPT Male, 1.5 in., 316L BSPP (G) Male, 1.5 in., 316L BSPT (R) Male, 1.5 in, 316L Special - Quick Clamp, 1.5 in., 316L Quick Clamp, 2.0 in, 316L Flange, ANSI, 2.0 in, 150#, 316L Flange, DIN 50, PN 10, 316L Special - ANSI Flange, 316L, XX = Flange Size (25 =2.5 in), Y = Class (1 = 150#, 3 = 300#, 6 = 600#) Special - DIN Flange, 316L, XXX = Flange Size (DN) (80, 100 125), YY = Pressure Rating in Bar (PN) (6,10) Advanced Internal Air Purge (Must Select Quick Clamp 2.0 in. or Flange Nipple Assembly Above)	XX – Size (in) Y – Pressure Rating (Bar)
Probe Type	-B -C -T Nipple/Mount	Bare, 316L Stainless Steel (Hastelloy C276 and C22 Available) Special - Fully Insulated, Teflon Coated, 316L Fully Insulated, Teflon Layer, 316L 316L Stainless Steel (Hastelloy C276 and C22 Available)	**Layered only valid for temperatures < 450F, Coated or Layered cannot be used with H2 or H3, Coated Only for PM1, Coated for 100 PSI or 500F, otherwise use Layered**
Process Temperature Operating Range	-T42 -T44	-40 °F to 250 °F (-40 °C to 121 °C) -40 °F to 450 °F (-40 °C to 232 °C)	For Higher Refer to Remote PS 10. **T44 CANNOT be used with H2 or H3**
Process Pressure Operating Range	-P0 -P1	0 to 10 PSI (0.69 Bar) 0 to 100 PSI (6.9 Bar) - Excludes 0.5" Thread and 1.5" QC	For Higher Refer to Remote PS 10

4 Installation

WARNING

- Only trained professionals should install/maintain this product.
- Shutdown processes that include high temperatures, high pressures, toxic gases, hazardous particulate, or explosion risks prior to installing or removing equipment.

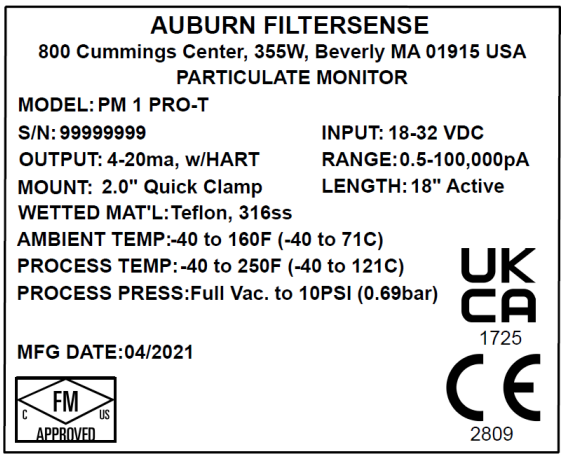
- Seuls des professionnels qualifiés doivent installer / entretenir ce produit.
- Arrêtez les processus qui incluent des températures élevées, des pressions élevées, des gaz toxiques, des particules dangereuses ou des risques d'explosion avant d'installer ou de retirer l'équipement.

4.1 Location

Area Classification

- Do not install any device that is not tagged as suitable for the required area classification.
- Check label for the following:
  - Area classification
  - Certification numbers as required.
  - Certification numbers as required.
    - FM20NUS0012
    - FM20NCA0006
    - FM20ATEX0034X
    - FM22UKEX0094X
    - FM20ATEX0033X
    - FM22UKEX0033X
    - FM20US0127X
    - FM20CA0064X
    - IECEXFMG20.0035X

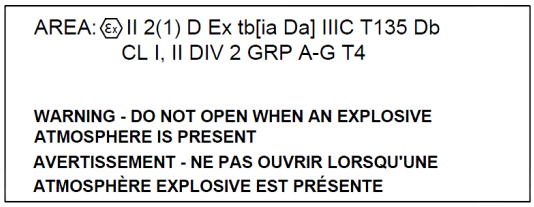
Hazardous Area Label Example

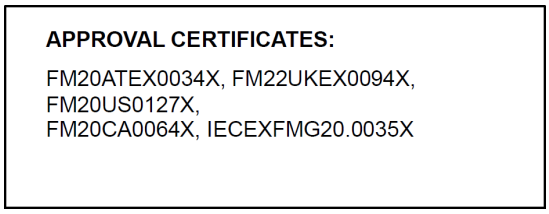


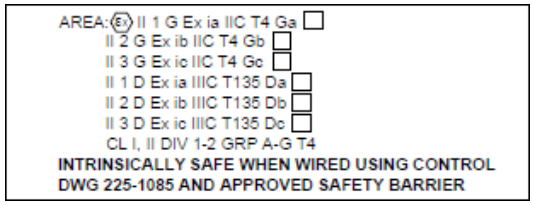
Temperature and Pressure

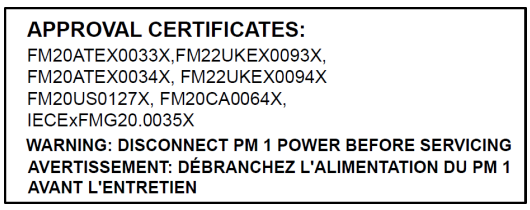
- Confirm compatibility of pressure and temperature ratings with process and installation area.
- Check label for the following:
  - Process temperature rating
  - Process pressure rating

Hazardous Area Side Label Examples







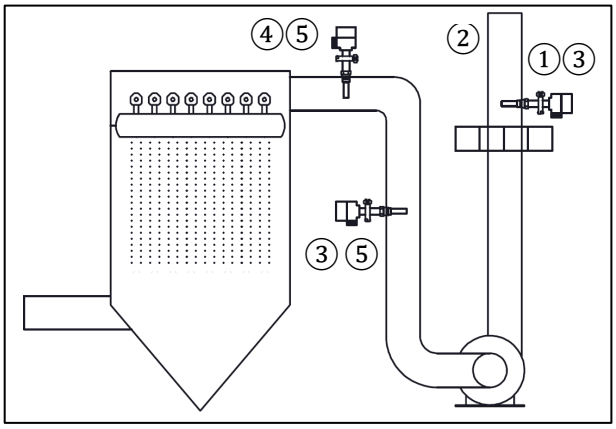


The following factors should be considered:

- Confirm compatibility of all sensor ratings with process and installation area.
- Check label for the following:
  - Wetted materials
  - Enclosure rating
- Installation must be in grounded metal duct/pipe. Consult factory for non-metallic duct/pipe solutions.
- High levels of vibration should be avoided.

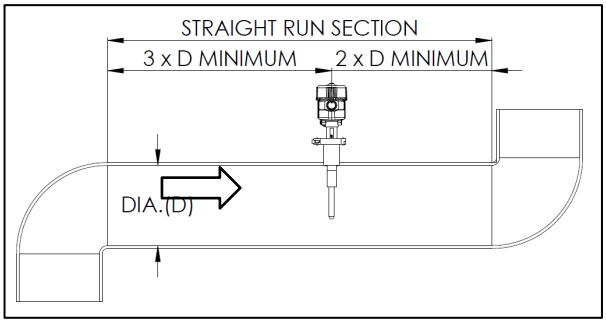
Filter Outlet Locations

① Ensure good access.
② Avoid locating within one pipe diameter or 36 inches of vertical stack exit to protect against weather. Horizontal exits allow for closer placement to open weather.
③ Straight runs and laminar flow best for measurement.
④ Short straight runs are acceptable for basic monitoring.
⑤ Accessible negative pressure locations may be preferred to prevent exposure to toxic gases and particulate.



Straight Run Considerations

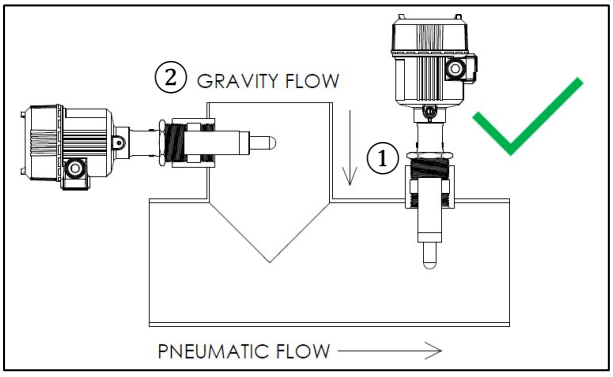
- Straight runs meeting the following criteria are preferred but not required for basic monitoring.
- Three (3) duct diameters upstream.
- Two (2) duct diameters downstream.
- Straight run can be horizontal or vertically downward (as shown in illustration).



Powder Flow Locations

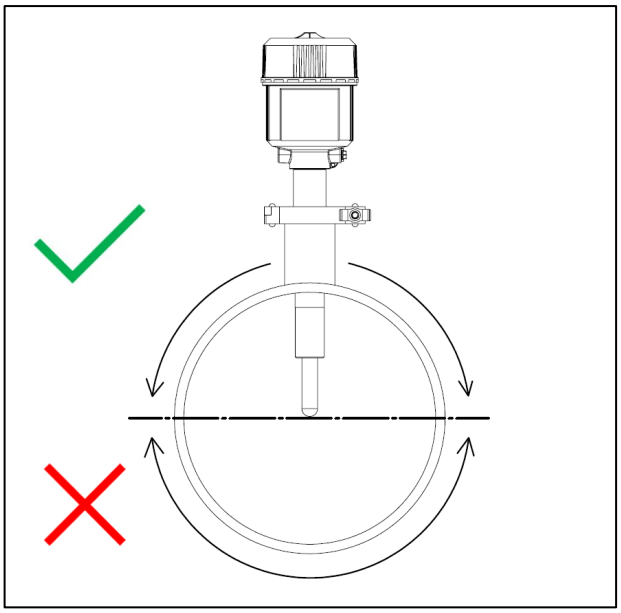
① Best installed in pneumatic section (positive or negative pressure).
② For gravity feed, consult factory.

- Grounded metal duct required.
  - Consult factory for nonmetallic duct/ pipe solutions.
- Follow **straight run considerations**.



Horizontal Pipes/Ducts

- Side or top mount recommended.
- Bottom mount not recommended.
- Proper mount and installation location will prevent buildup.
- For further installation advice please contact sales@AuburnFiltersense.com



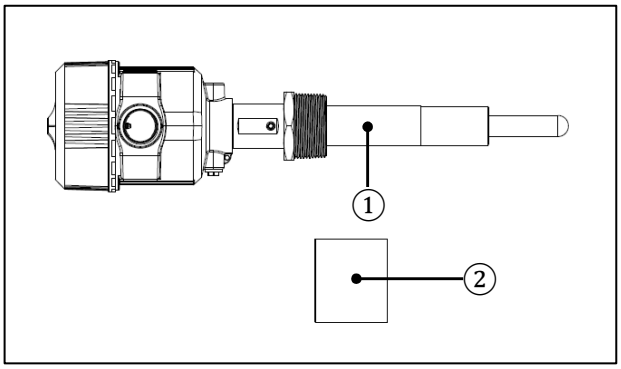
4.2 Process Mounts

The following types of process mounts are available:

Threaded

- NPT Standard
- BSPP (G) and BSPT (R) Optional

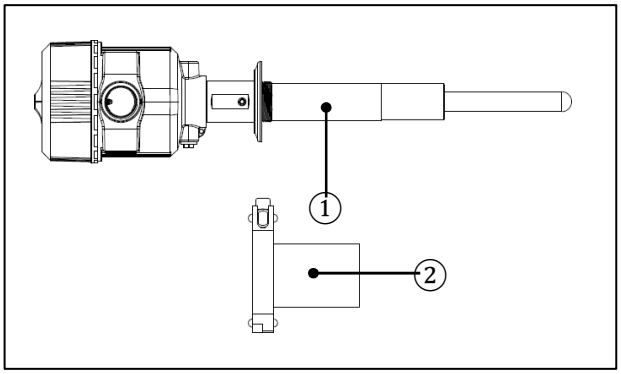
① Threaded Nipple
② Threaded Coupling Process Mount



Quick Clamp

- Quick Clamp Standard
- Allows quick and easy removal from process
- Allows rotation to easily align

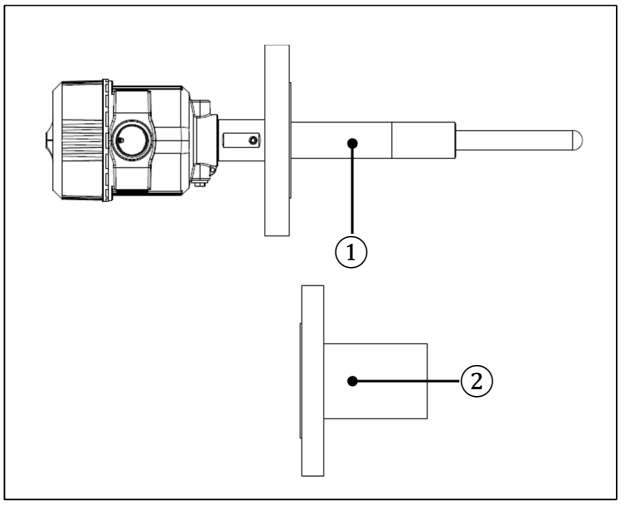
① Quick Clamp Nipple
② Quick Clamp Process Mount Kit
  - Ferrule
  - Gasket
  - Tri-clamp



Flange

- ANSI Standard
- DIN Optional

① Flange Nipple
② Flange Process Mount



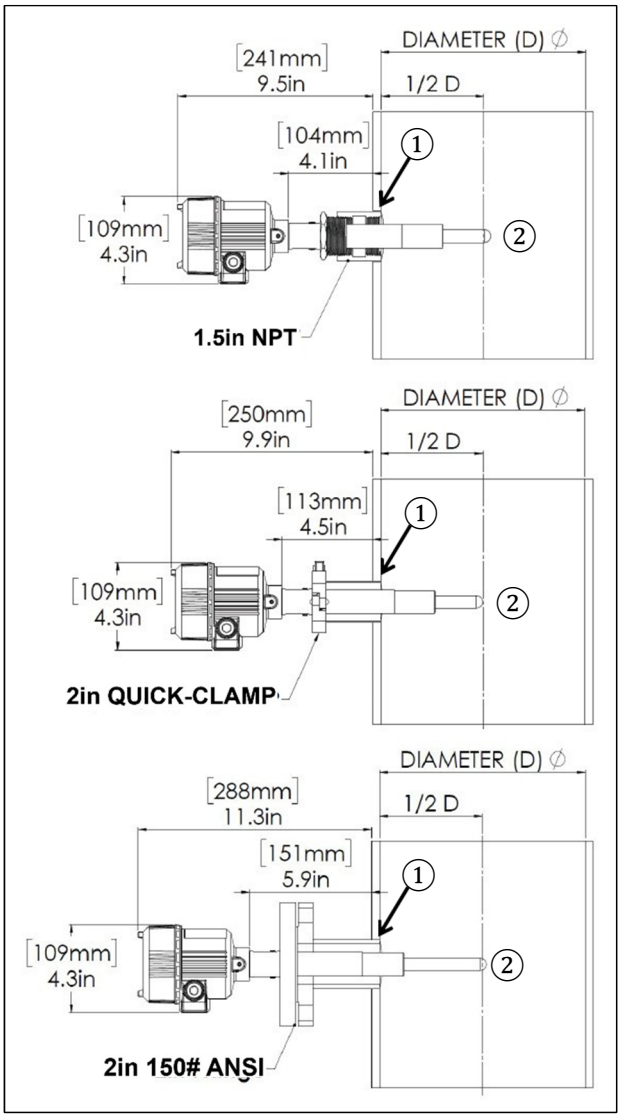
4.3 Sensor Mounting

Sensor Mounting Considerations

① Process mount should protrude into process 0.125 in (3.175 mm) to 0.5 in (12.7 mm).

② Sensor probe should extend approximately 1/2 of the duct diameter for stacks and filter ducts and 1/4 to 1/2 of the pipe diameter for powder flow applications.

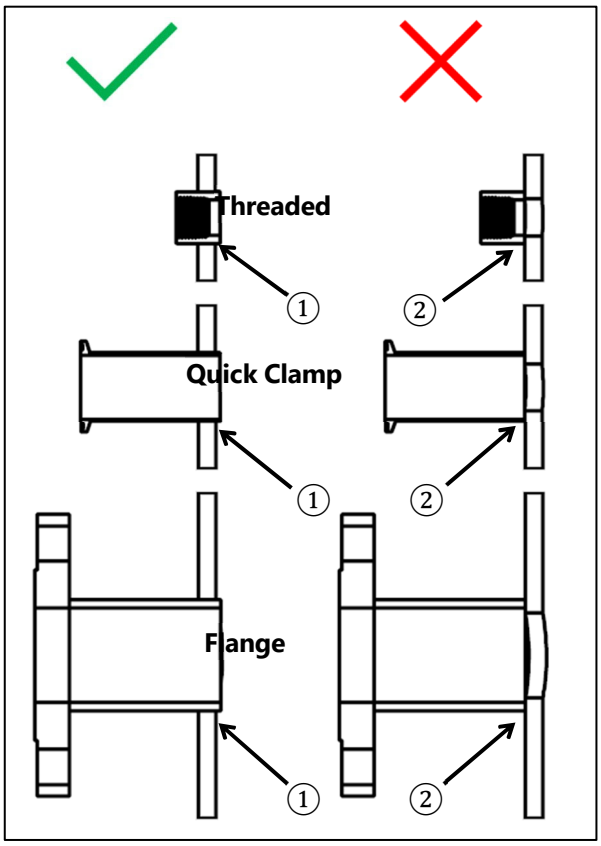
- In very large stacks/ducts, two sensors in a daisy chain configuration can be considered.
- In smaller pipes, the probe should be at least 1 in (25.4 mm) minimum away from the opposite side.
- High levels of vibration should be avoided.



Welding and Clearance

① "Through weld" half coupling, quick clamp mount, or flange mount to ensure proper clearance and to prevent particulate buildup in mount. Process mount should protrude into process 0.125 in (3.175 mm) to 0.5 in (12.7 mm).
② Do not face weld.

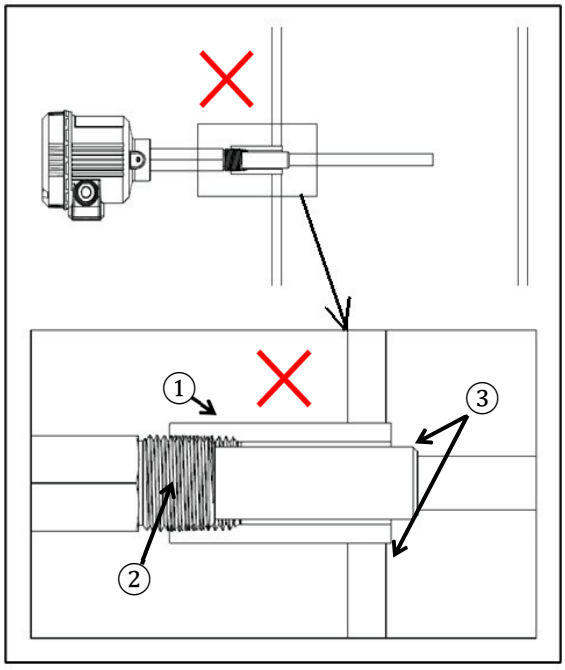
- Weld in center of the duct/pipe, perpendicular to the flow.
- Air and watertight seal.



Improper Extensions

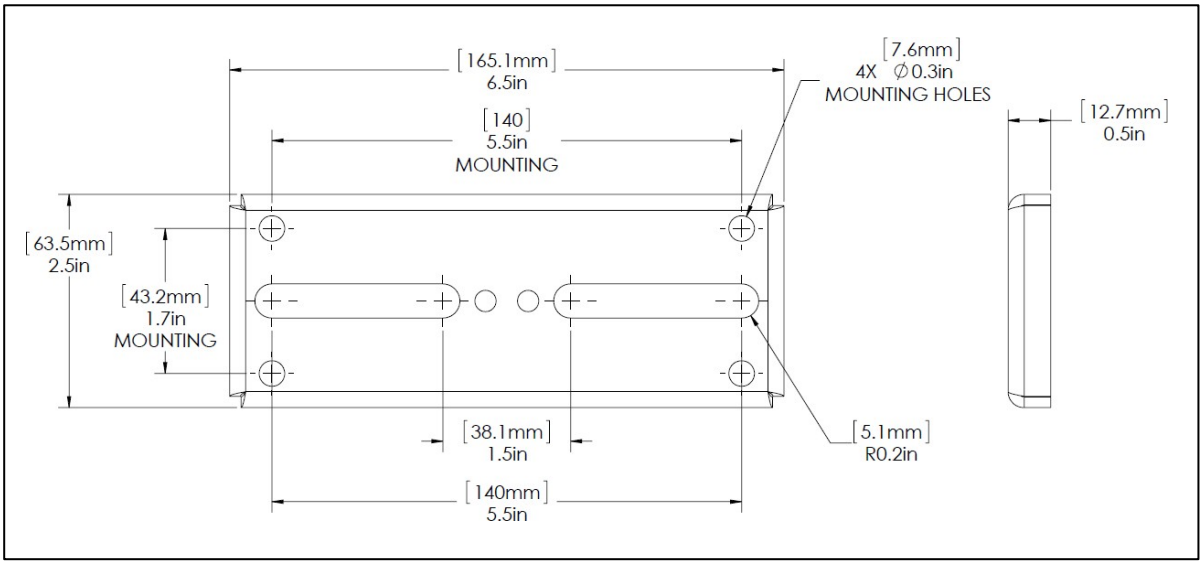
① Do not use an extended or improper mount.
② Longer mounts can cause the nipple not to protrude into the process.
③ Extended mounts can cause particulate buildup on the insulator and sensing probe.

- Contact the factory for custom sensor nipple extensions for proper installation in an existing port.
- Do not use non-stainless steel mounts that may corrode and cause corrosive residue to drip on the sensor.



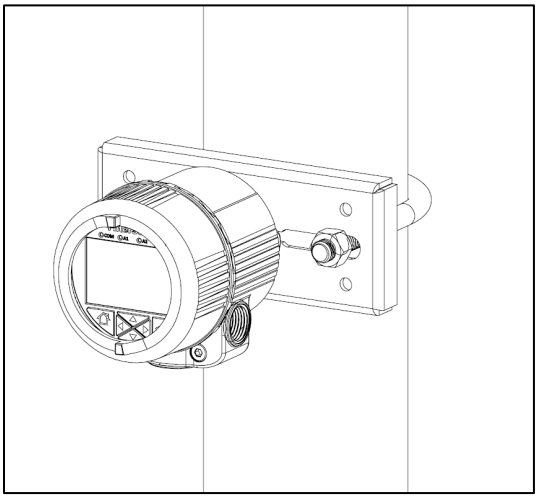
4.4 Remote Electronics Mounting

Mounting Plate Dimensions



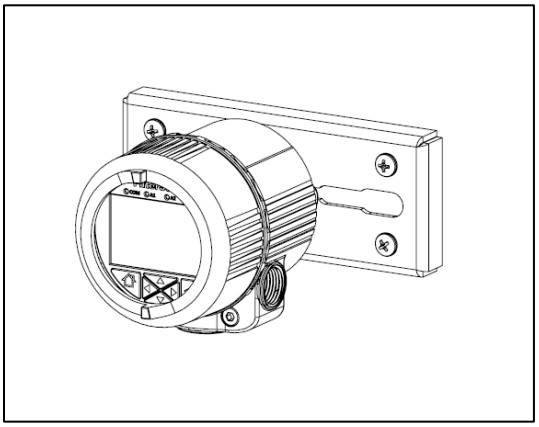
Pipe Mount

- Remote electronics mounted on a pipe/pole.



Wall Mount

- Remote electronics mounted on a wall.

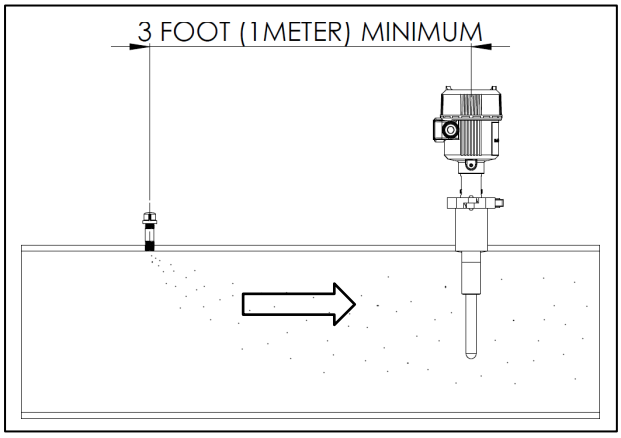


4.5 Test Port

Installation of a sensor test port is for introducing particulate upstream of the sensor as a method for checking the response to an increase in particulate. Some applications are required by EPA regulations to include a sensor test port for **Response Testing**.

Location and Mounting

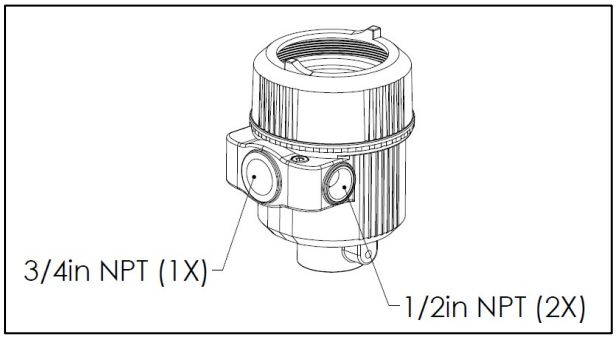
- Non-hazardous areas only.
- Negative pressure location.
- Install at least 3 ft upstream of the particulate sensor.
- In line with sensor on the same side of the pipe/duct.
- If possible, locate the test port at ground level and/or a location with easy access.
- If the test port must be located at an inaccessible location, a length of tubing can be used to improve access.
- Typical test port is a 1/8 in NPT x 3 in long nipple with a cap or shutoff valve.



5 Wiring

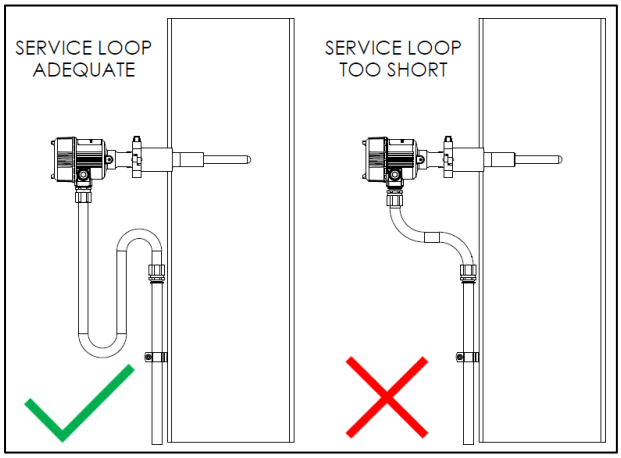
Conduit Entries

- One (1) ¾ in and two (2) ½ in NPT entries provided.
- Conduit fittings should be tight.
- Conduit should be routed downward to prevent moisture from entering enclosure.
- The three plastic shipping thread protectors must be removed and replaced during installation to prevent water entry into the housing.



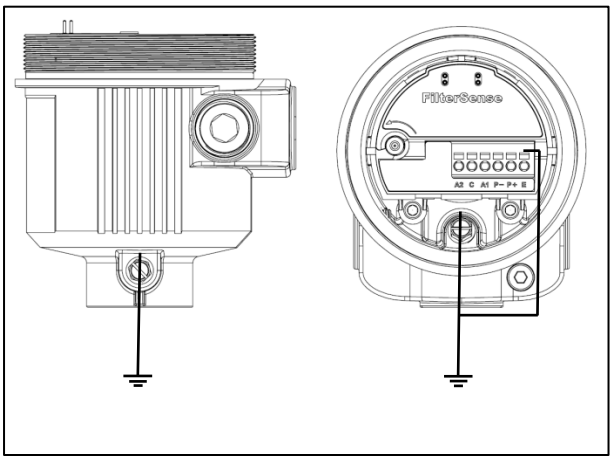
Recommended Service Loop

- Flex conduit and ground cable should have enough length to allow for removal of the sensor.
- Recommended service loop is 1 to 2 times the sensor probe length.
- Service loop should extend downward to prevent moisture from entering enclosure.



Grounding

- Required for reliable operation and safety.
- PM 1 PRO-T: Earth ground connection is made through the process mount (for threaded mounts do not use Teflon tape, use conductive pipe dope or conductive grease). Grounding to the enclosure ground studs is not required.
- PM 1 PRO-A, PM 1 PRO-AT: Earth ground connection must be made to one of the three ground locations:
    - External enclosure ground screw.
    - Internal enclosure ground screw.
    - Electronics module earth ground terminal.
- Analog wiring cable shield should be terminated to earth ground in PLC/DCS cabinet or at panel meter (terminate at one end only).
- Ground wire should not impede service loop.



GROUNDING IN HAZARDOUS AREAS (MISE À LA TERRE DANS LES ZONES DANGEREUSES)

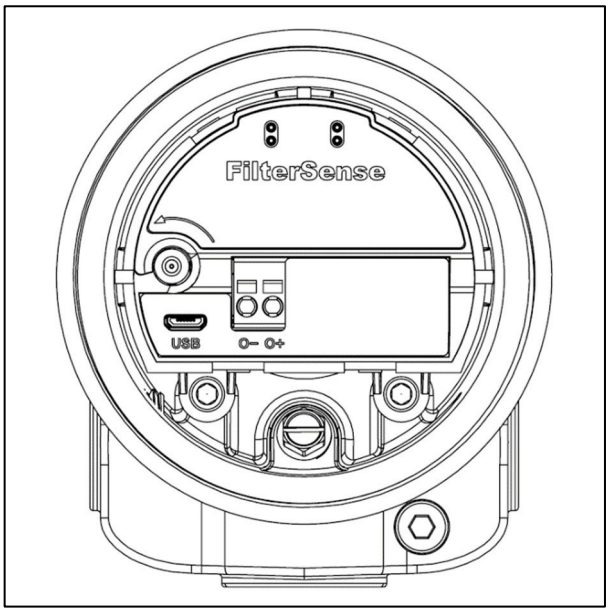
- For hazardous area applications, an external sensor earth ground cable is required to maintain sensor grounding during installation and maintenance.
- The ground cable must remain attached when the sensor is temporarily removed from the process. Do not disconnect the ground cable.
- Hazardous area installation of the PM 1 PRO -T must be performed using drawing 225-1085, “Control Drawing, PM1-T Intrinsically Safety Wiring”. Hazardous area installation of the PM1 PRO using the PS10 remote sensor must be performed using drawing 225-1084, “Control Drawing, PS10 Hazardous Area Wiring Using PM1”. The PM1 PRO unit must be marked for correct hazardous area installation and required ratings.

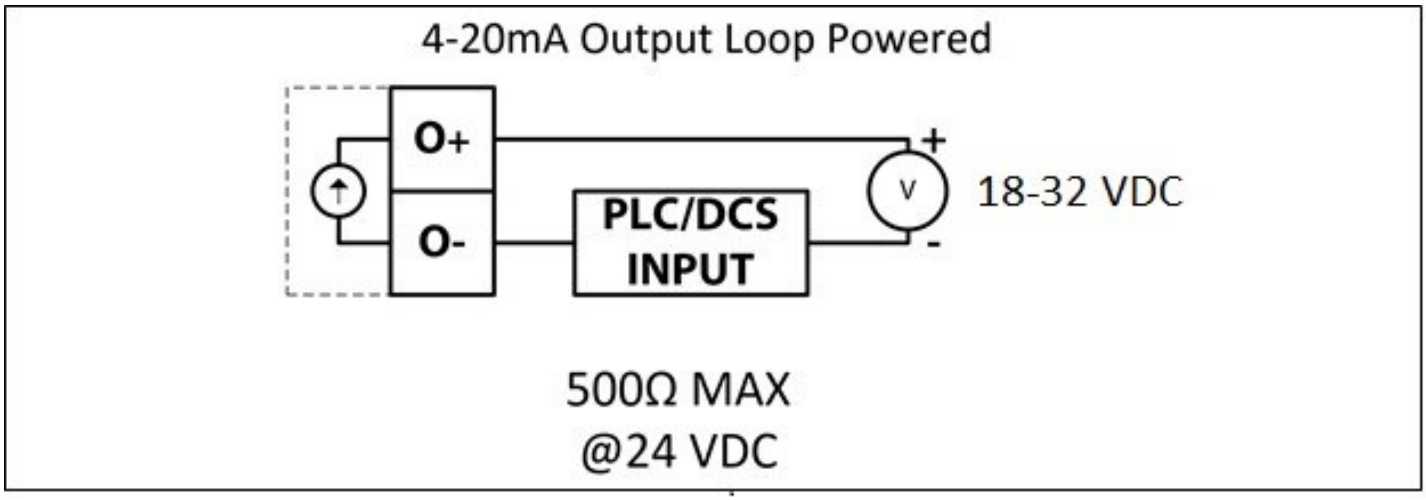
- Pour les applications en zone dangereuse, un câble de mise à la terre du capteur externe est nécessaire pour maintenir la mise à la terre du capteur pendant l'installation et la maintenance.
- Le câble de masse doit rester attaché lorsque le capteur est temporairement retiré du processus. Ne déconnectez pas le câble de masse.
- L'installation en zone dangereuse du PM1 PRO-T doit être effectuée à l'aide du schéma 225-1085, « Control Drawing, PM1-T Intrinsically Safety Wiring ». L'installation en zone dangereuse du PM1 PRO à l'aide du capteur à distance PS10 doit être effectuée en utilisant le schéma 225-1084, "Control Drawing, PS10 Hazardous Area Wiring Using PM1". L'unité PM1 PRO doit être marquée pour une installation correcte en zone dangereuse et les valeurs nominales requises.

5.1 Terminal Connections

PM 1 PRO-T (2-Wire Loop Power Transmitter)

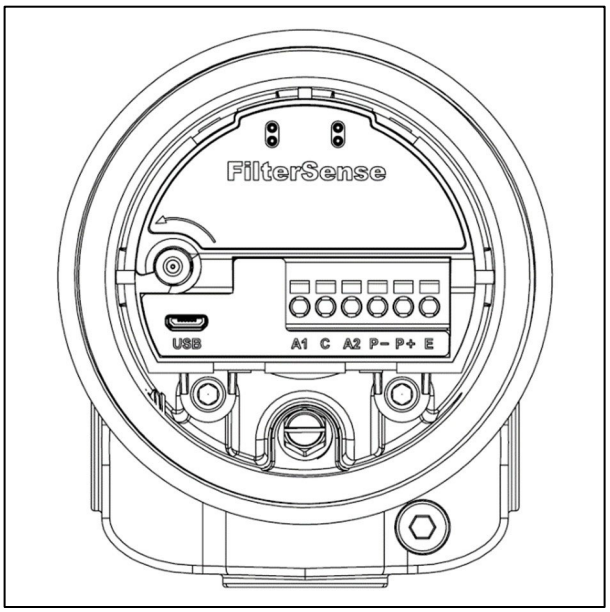
- Terminal connection for loop powered **analog 4-20 mA output**.
- All wiring must be rated for 250V minimum.
- Always disconnect power before connecting/ removing wiring from the terminal connectors.
- Analog 4-20mA wire should be 22 AWG stranded shielded twisted pair, Belden 88761 or equivalent.
- Analog wiring cable shield should be terminated to earth ground in PLC/DCS panel/cabinet (terminate one end only).

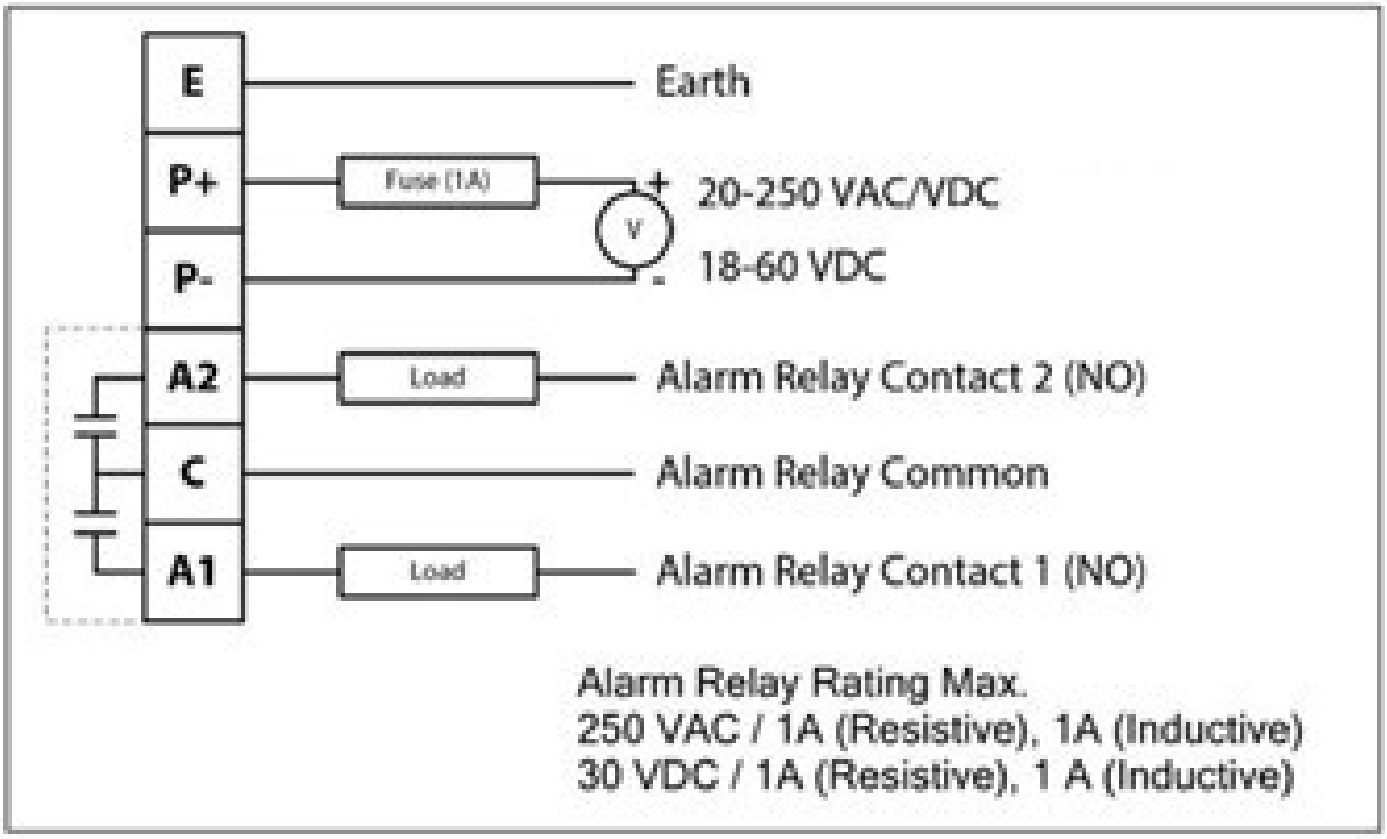




PM 1 PRO-A (Alarm/Relay Output)

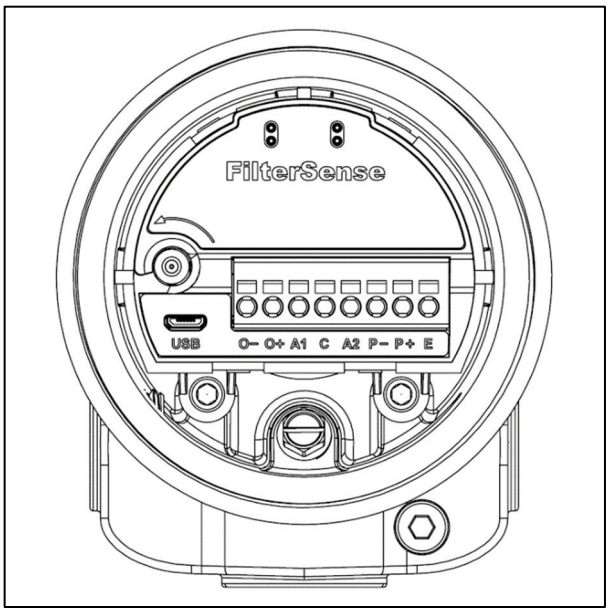
- Terminal connections for power and two **alarm relays**.
- All wiring must be rated for 250V minimum.
- Always disconnect power before connecting or removing wiring from the terminal connectors.

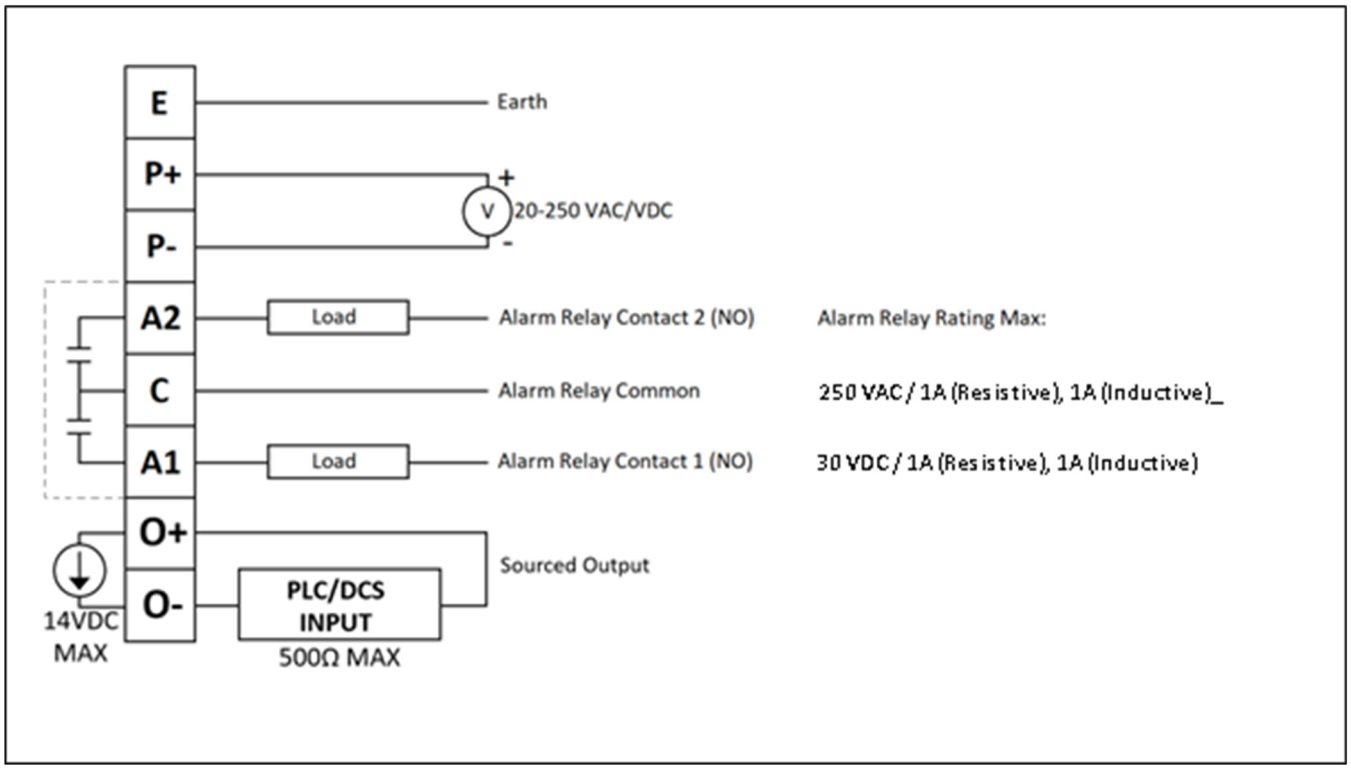




PM 1 PRO-AT (Alarm/Relay Output & Analog Output Transmitter)

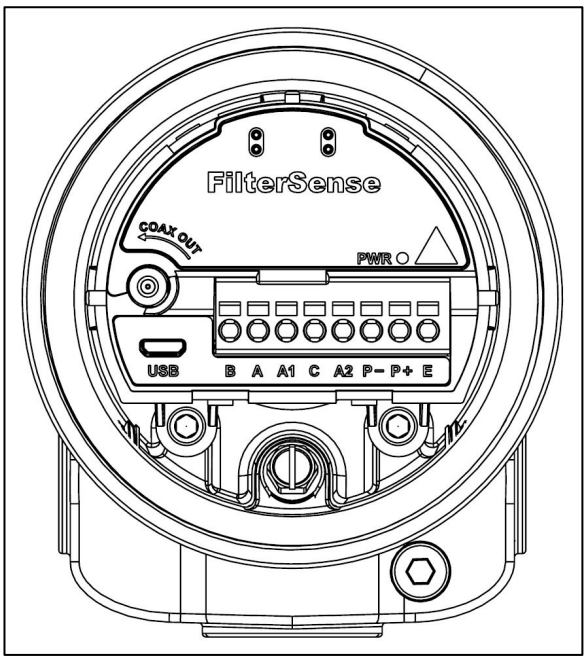
- Terminal connections for power, two **alarm relays**, and an **analog 4-20mA output.**
- All wiring must be rated for 250V minimum.
- Always disconnect power before connecting or removing wiring from the terminal connectors.
- Analog 4-20mA wire should be 22 AWG stranded shielded twisted pair, Belden 88761 or equivalent.
- Analog wiring cable shield should be terminated to earth ground in PLC/DCS panel/cabinet (terminate one end only).

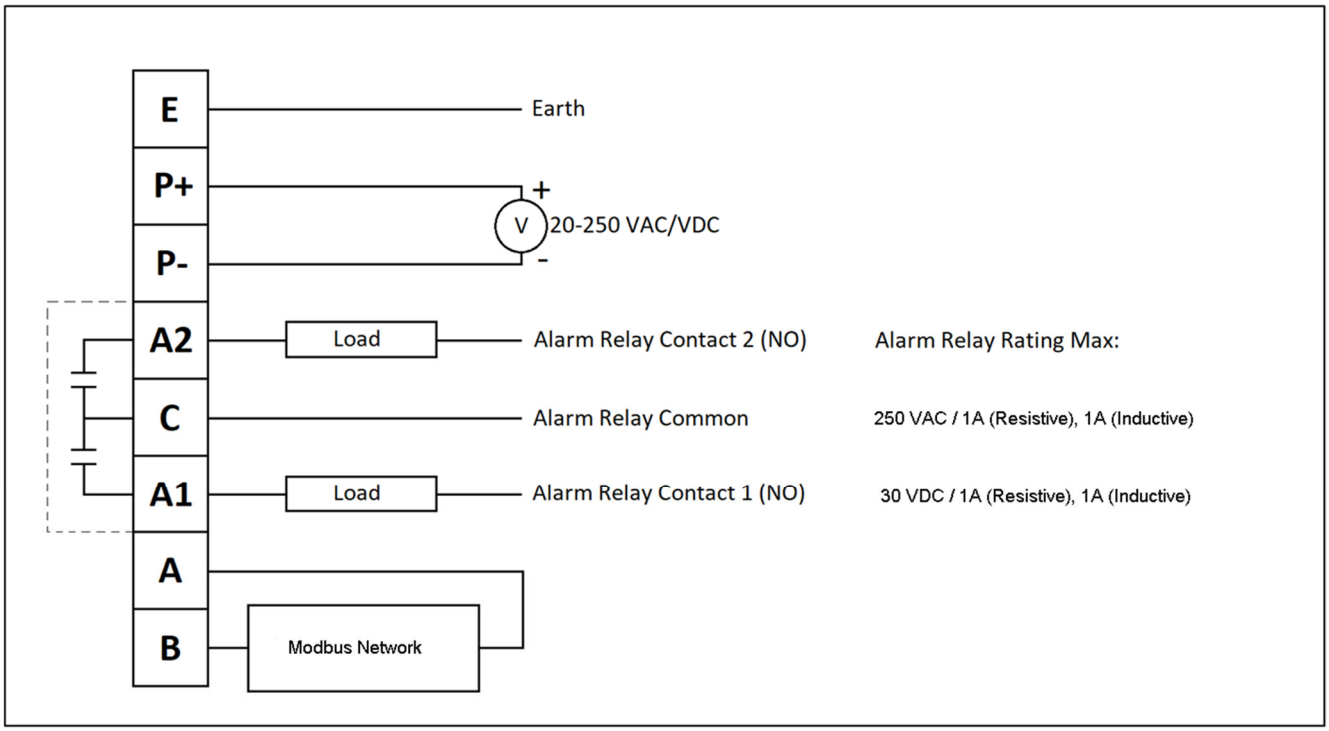




PM 1 PRO-AT-M (Alarm/Relay Output & Modbus RTU)

- Terminal connections for power, two **alarm relays**, and **Modbus RTU**.
- All wiring must be rated for 250V minimum.
- Always disconnect power before connecting or removing wiring from the terminal connectors.
- Follow best practices for terminating Modbus wiring cable shield.



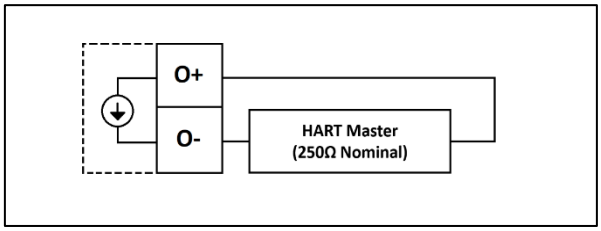


NOTE: The Modbus wiring requires a 120 ohm, 1/4W termination resistor across the last device on the Modbus Network.

5.2 HART Wiring

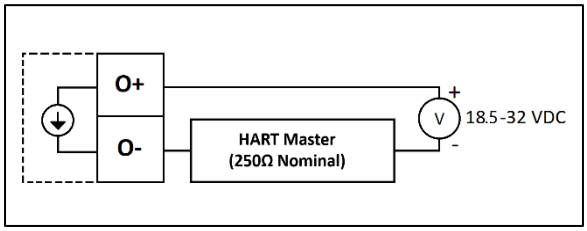
PM 1 PRO-AT

- HART connections in parallel to resistance.
- Analog 4-20mA output internally powered.



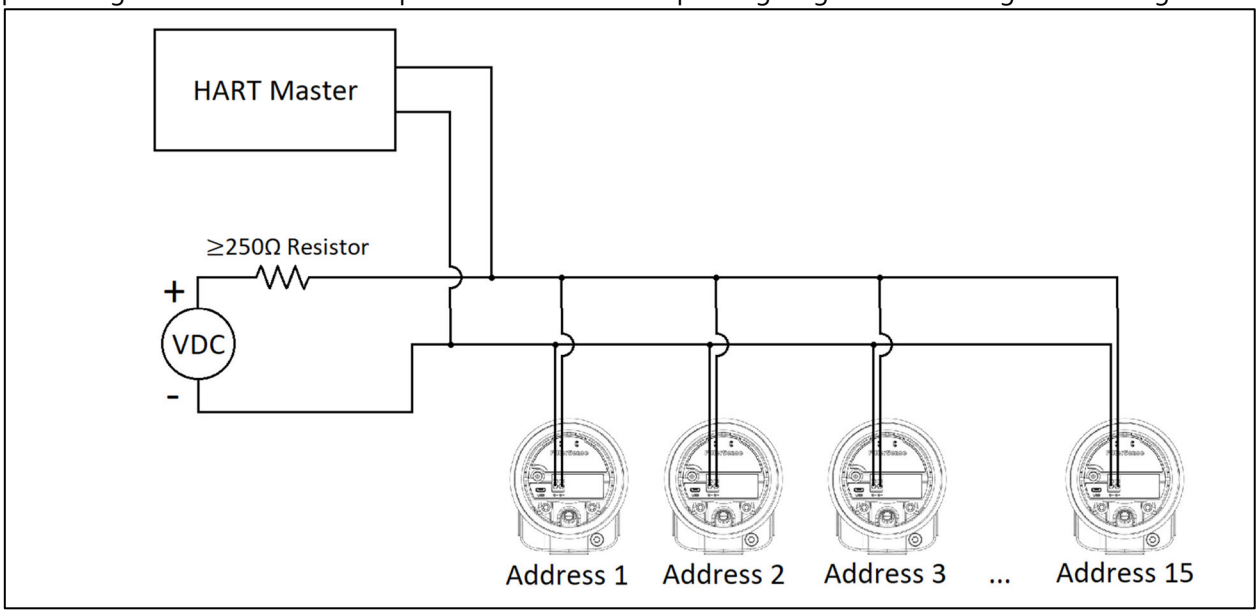
PM 1 PRO-T

- HART connections in parallel to resistance.
- Analog 4-20mA output loop powered.



PM 1 PRO Multi-Drop Topology

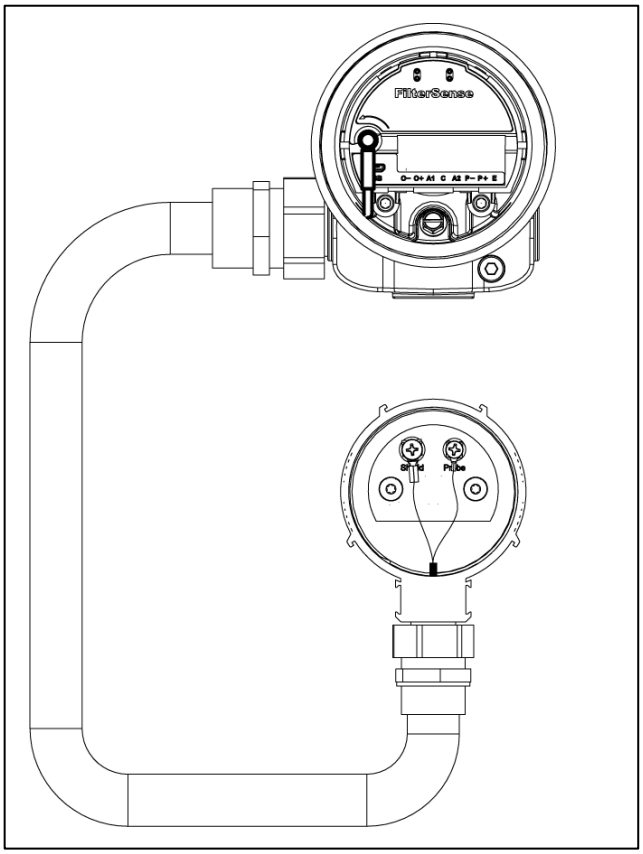
The PM 1 PRO supports multi-drop topology. In multi-drop operation, the devices exchange data and measured values only via the HART protocol/HART Network. In this configuration, the analog current signal serves only to energize the two-wire devices, providing a current of 4 mA per instrument. In multi-drop mode, up to 15 field devices are connected in parallel to a single wire pair or segment. Below is an example of a HART multi-drop wiring diagram for a configuration using PM 1 PRO-T devices.



HART multi-drop topology can also be achieved using PM 1 PRO-AT devices. Refer to the HART Commissioning section for details on how to configure PM 1 PRO devices for multi-drop use.

5.3 Particulate Sensor Wiring (Remote Version Only)

- Display removed to show wiring.
- Install in dedicated conduit.
- Conduit should avoid high vibration, heat over 394 °F (200 °C), and strong magnetic or electrical fields.
- Locate at least 18 in (46 cm) away from sources of electrical interference.
- Use grounded metal conduit.
- Follow **Recommended Service Loop** guide-lines.
- Excess cable should be coiled in nearest junction box. Do not leave any excess cable in the PM 1 PRO electronics enclosure or PS 10 particulate sensor enclosure.
- Twist CCA-SMB coaxial connector counter-clockwise to disconnect.
- Maximum CCA-SMB cable length is 300 ft.

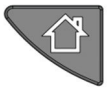
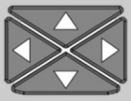
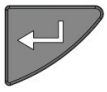


6 Operation

6.1 User Interface

The user interface consists of six navigation keys and a high-resolution graphic display. The PM 1 PRO-A and PM 1 PRO-AT also include status LEDs for power, alarms, and fieldbus communications. Upon power up, the start-up screen appears, showing device information as well as power-on self-test (POST) status. After the POST is complete, one of the user-enabled **Process Screens** is shown.

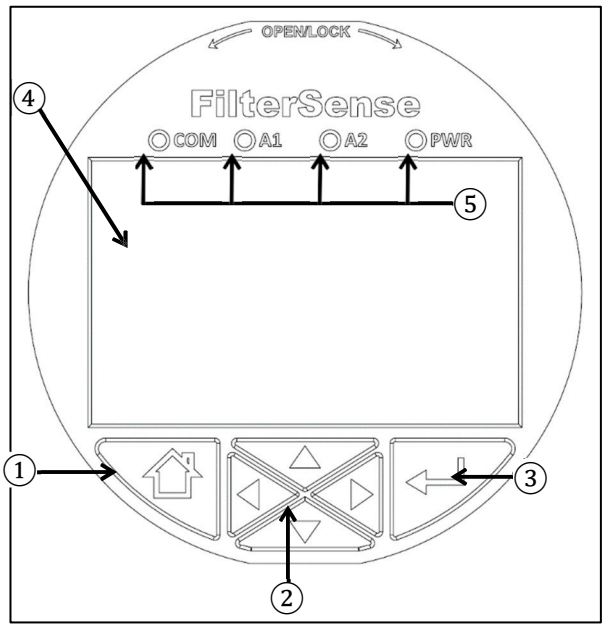
Keypad

Key	Description
① **Home** 	• Press to go back one menu • Hold to go to Home Screen
② **Arrows** 	• Move cursor • Menu navigation
③ **Enter** 	• Enter setting • Accept value

Display and LEDs

Key	Description
④ **LCD Display**	• View process reading, alarms, diagnostic info • View and adjust settings
⑤ **Status LEDs**	• PM 1 PRO-A(T) only • Alarms, power, and fieldbus indications

User Interface

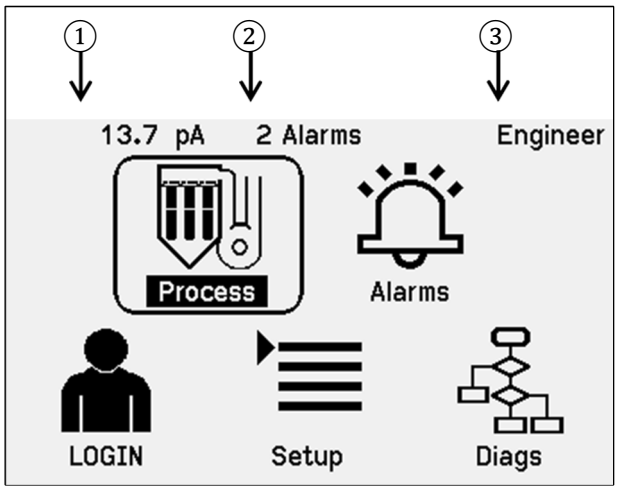


Status LEDs (Alarm Versions Only - PM 1 PRO-A(T))

LED	State	Meaning
COM	Flashing Green Off	• Communicating • Not communicating
A1	Red Off	• Alarm 1 relay closed • Alarm 1 relay open
A2	Red Off	• Alarm 2 relay closed • Alarm 2 relay open
PWR	Green Off	• Power • No power

6.2 Home Screen

- The **Home Screen** provides access to all screens and user settings.
- Use the ARROW keys to move the selection box to any icon.
- Press the ENTER key to select.



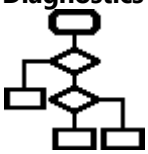
① Current **Primary Process Variable** reading

- User-selectable between Particulate and Average Particulate

② Number of active alarms
③ Current user access level

- Items ①, ②, and ③ are shown as the header on all screens except for **Process Screens**.

Home Screen Icons

Icon	Description
Process Screens 	• Displays particulate, average particulate, and max (peak) particulate readings • Particulate alarm and NAMUR status • Horizontal and vertical bar graphs of live or average particulate readings • User configurable screens
Alarms 	• Active alarms • Alarm acknowledgement • Alarm details and troubleshooting • Access to alarm system setup
Diagnostics 	• Displays particulate self-check status and schedule • User configurable schedule
User Login 	• User login screen
Setup 	• Displays the main setup menu

6.3 Process Screens

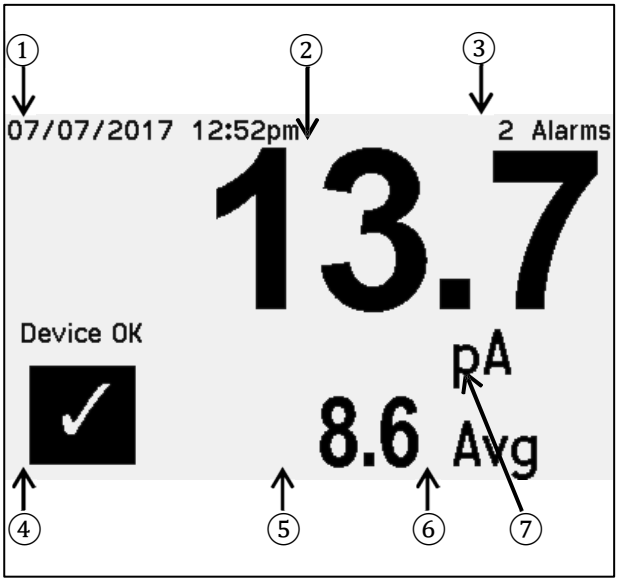
The **Process Screens** display particulate readings from the sensor (real-time, average, and max (peak) values) and alarms. All enabled **Process Screens** are shown in a rotation, each appearing for a user-selectable time. A key press will temporarily stop the cycling for a user-set period after which cycling resumes.
On all **Process Screens**, if a reading is currently in alarm, its associated label will alternate with an alarm bell icon every three seconds.
Process variable selection and other features of the **Process Screens** can be modified. Pressing the ENTER key displays a screen specific menu/options in a popup window. Setup options include adjustment of alarm thresholds, process variable scaling, and screen setup.

Large Value Screen

① Alternating header text

- Alternates between the following:
  - Current date and time
  - "FilterSense" followed by the device model number
  - **Device Tag**, if enabled

② **Primary Process Variable** reading
③ Number of Active Alarms
④ Device Status and Icon
⑤ **Secondary Process Variable** reading
⑥ **Secondary Process Variable** label
⑦ Units



Horizontal Bar Graph Screen

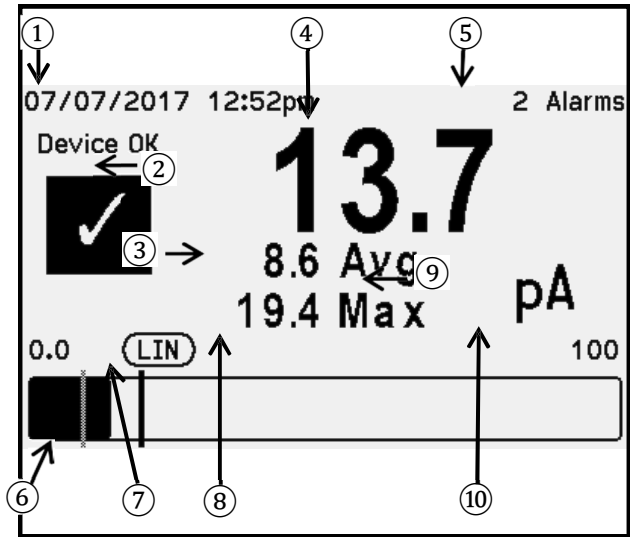
① Alternating header text

- Alternates between the following:
  - Current date and time
  - "FilterSense" followed by the device model number
  - **Device Tag**, if enabled

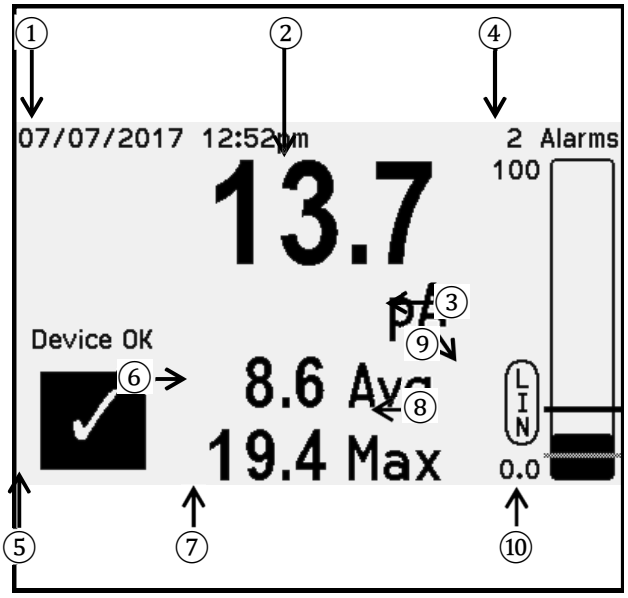
② Device Status and Icon
③ **Secondary Process Variable** reading
④ **Primary Process Variable** reading
⑤ Number of Active Alarms
⑥ Horizontal Bar Graph

- Bar filled according to **Primary Process Variable** reading
- Gray line indicator for **Secondary Process Variable**
- Black line indicator for **Peak Trac** value

⑦ Bar graph type (LIN=linear, LOG=logarithmic)
⑧ **Peak Trac** value (Max Particulate)
⑨ **Secondary Process Variable** label
⑩ Units



Vertical Bar Graph Screen



① Alternating header text

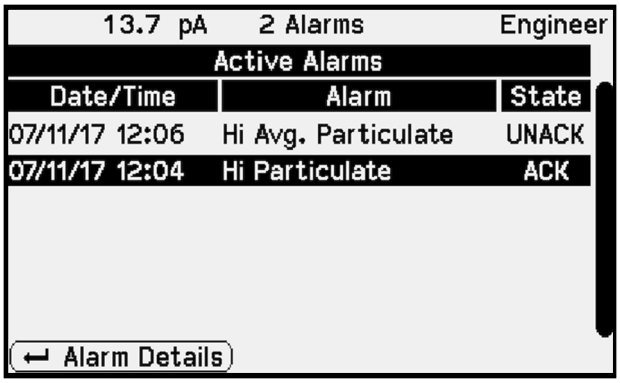
- Alternates between the following:
  - Current date and time
  - "FilterSense" followed by the device model number
  - **Device Tag**, if enabled

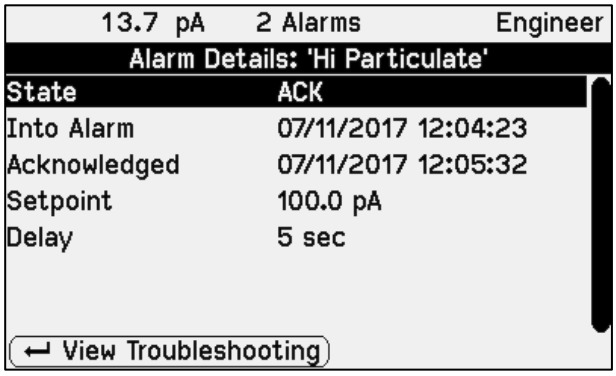
② **Primary Process Variable** reading
③ Units
④ Number of Active Alarms
⑤ Device Status and Icon
⑥ **Secondary Process Variable** reading
⑦ **Peak Trac** value (Max Particulate)
⑧ **Secondary Process Variable** label
⑨ Bar graph type (LIN=linear, LOG=logarithmic)
⑩ Vertical Bar Graph

- Bar filled according to **Primary Process Variable** reading
- Gray line indicator for **Secondary Process Variable**
- Black line indicator for **Peak Trac** value

6.4 Active Alarm Screen

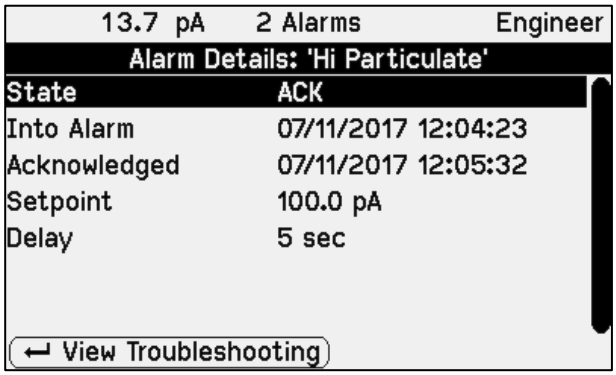
- The **Active Alarm Screen** shows a list of all the currently active alarms.
- The following information is shown for each alarm on this screen:
  - The Date/Time the alarm became active
  - The alarm name
  - The current state of the alarm (ACK or UNACK)
- Use the up and down ARROW keys to change the highlighted alarm.
- Press the ENTER key on a process alarm to view the **Alarm Details Screen** for the currently selected alarm.
- Press the ENTER key on diagnostic alarm to go to the **Diagnostic Screen** for more details on the alarm.





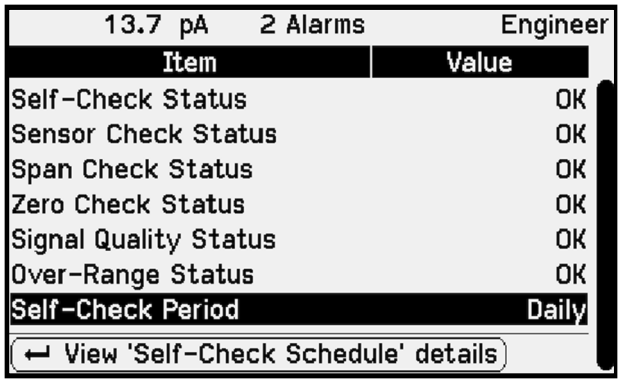
6.5 Alarm Details Screen

- The **Alarm Details Screen** shows the following information about an alarm:
  - Current state (ACK or UNACK)
  - The date/time that the alarm became active
  - The date/time that the alarm was acknowledged
  - The alarm setpoint
  - The alarm delay
- Press the ENTER key to view troubleshooting steps for the alarm.



6.6 Diagnostic Screen

- The **Diagnostic Screen** shows the current status for all **Self-Checks**, as well as the automated **Self-Check Period**.
- Press the ENTER key on a status to view more details for the self-check, or to manually run the self-check.
- Press the ENTER key on **Self-Check Period** to view or modify the **Self-Check Period**.



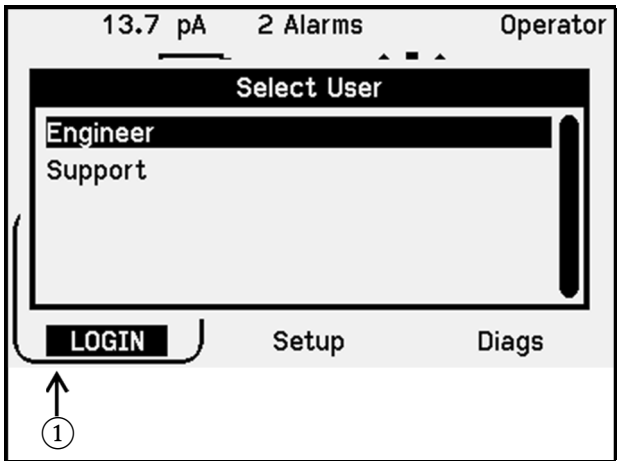
6.7 User Login

Login is required to modify most **Settings** and is valid until power is removed, or after 5 minutes without keypad activity. The password for the Engineer user level can be changed by the user.

User Level	Password	Permissions
Operator	None	View all settings, modify display settings only.
Engineer	55	View and change all settings.

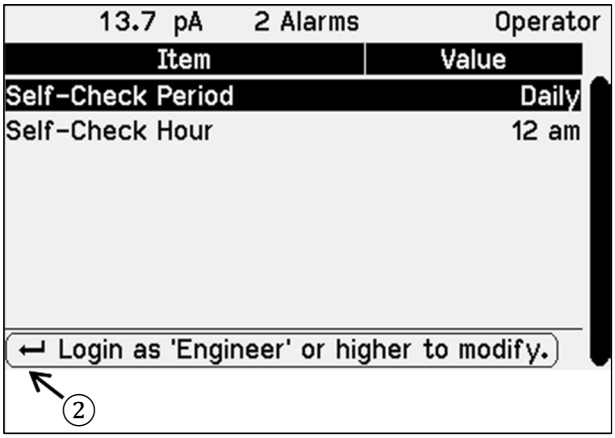
- Some device settings require the user to login before an adjustment can be made.

① Login can be made by pressing the ENTER key while the **Login** icon is selected on the home screen.

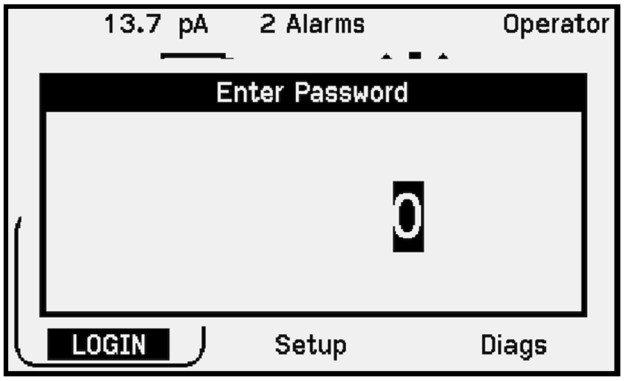


② Login can also be made by pressing ENTER on any setting that requires a higher user level to adjust.

- The help text at the bottom of the screen will indicate that a higher login is required to modify the setting.

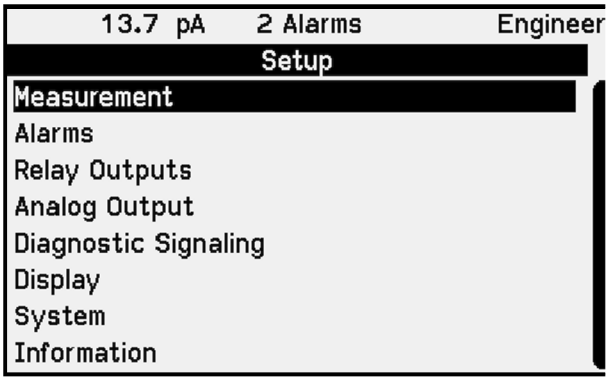


- Select the desired user level in the popup, and then enter the password.
  - Use the LEFT and RIGHT ARROW keys to move the cursor for the current digit to adjust.
  - Use the UP and DOWN ARROW keys to adjust the currently highlighted digit.



6.8 Setup Menu

- The **Setup Menu** provides access to system configuration settings.
- Use the UP and DOWN ARROW keys to highlight the desired menu. Press the ENTER key to view/adjust the settings in that menu.
- Only configuration settings that apply to the current device model are shown.



Setup Menu Categories

Refer to the **Commissioning** section for more details.

Category	Description
Measurement	• Configure the particulate reading
Alarms	• Configure the particulate alarms. • PM 1 PRO-A and PM 1 PRO-AT only
Relay Outputs	• Configure the alarm relays • Force the alarm relays to a known state for testing/commissioning. • PM 1 PRO-A and PM 1 PRO-AT only
Analog Output	• Configure the analog output • Force the output to a known value for testing/commissioning. • PM 1 PRO-AT and PM 1 PRO-T only
Diagnostic Signaling	• Adjust the diagnostic error notification outputs ○ Analog Output level and Relay Output channel
HART	• Configure HART settings. • PM 1 PRO-AT and PM 1 PRO-T only
Bluetooth	• Configure Bluetooth settings. • View Bluetooth information and status.
Display	• Enable, disable, and configure process screens • Adjust keypad timeout delay and screen cycling time
System	• Configure system-level settings • Save/Load/Reset device settings
Information	• View device and support information

7 Commissioning

7.1 Measurement

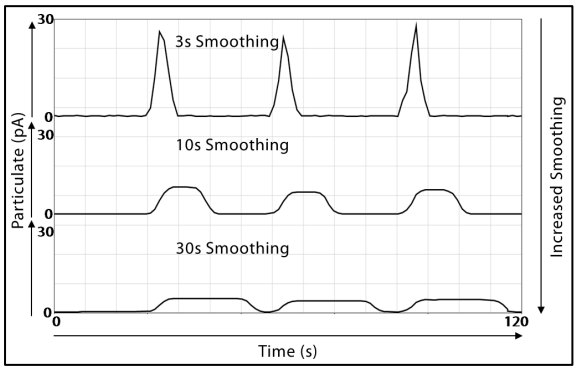
Measurement Settings

Setting	Default	Notes
Real-Time Smoothing	3 seconds	Particulate signal smoothing for short-term averaging (1-60 seconds). Increase for smoother reading, decrease for more dynamic
Peak Trac Time	5 seconds	Buffer time interval for peak particulate reading
Units	pA	The engineering units for the particulate signal (pA, mg/m^3, or gr/ft^3)
Scaling Factor	1.0	Linear scale value used for correlating the particulate signal (units/pA)
Averaging	6 minutes	Long-term average applied to the Average Particulate measurement (1-60 minutes)
Averaging Buffer Clear	No	Clear the averaging buffer

Real-Time Smoothing

IMPORTANT Alarms and ranges should be adjusted **after** changes are made to **Real-Time Smoothing**.

- A signal smoothing adjustment is provided to fine tune the real-time output.
- Adjust for reasonably stable baseline readings, while response to peaks remains dynamic and fast.
- Adjusting too high may limit setting an alarm based on peaks.
- Adjusting too low may result in an output that is too dynamic to easily interpret.



Smoothing Seconds example. Actual response is application dependent.

Peak Trac

In addition to Particulate and Average Particulate readings, the PM 1 PRO will also display the Peak Particulate reading. **Peak Trac** displays the maximum reading over the previous **Peak Trac Time**. In pulse jet baghouses, it is recommended to adjust the **Peak Trac Time** to equal the off time between pulses.

Unit Conversion

The **Units** and **Scaling Factor** can be adjusted to change the particulate reading units and scale.

IMPORTANT

UNIT CONVERSION

Changing **Units** on the PM 1 PRO does not automatically scale the measurement to the new units. Gravimetric correlations must be performed and a **Scaling Factor** must be calculated and adjusted in the PM 1 PRO for output in mass (mg/m^3 or gr/cf).

7.2 Alarms

Two alarms are available in the PM 1 PRO. An alarm will be activated when the **Alarm Source** increases above (**Hi** or **HiHi Alarm Logic**) or decreases below (**Lo** or **LoLo Alarm Logic**) the **Alarm Setpoint** continuously for a period longer than the **Alarm Delay** setting. The LED status will correspond with the associated alarm. The default alarm configuration is listed below:

IMPORTANT

ALARM LEVELS

Appropriate alarm levels will vary by process and user needs. Default alarm levels should not be relied on without careful review of each process.

Alarm Settings

Setting	Default	Notes
A1 Source	Particulate	The particulate signal that is used as the source for alarm 1 (Particulate, Avg. Particulate)
A1 Setpoint	30	Limit for alarm 1 activation
A1 Delay	10	Amount of time (seconds) reading must be in alarm condition to activate alarm 1
A1 Latching	Disabled	Alarm 1 requires user acknowledgement to clear if enabled (Enabled/Disabled)
A1 Logic	HIHI	Activation logic (HI, HIHI, LO, or LOLO)
A2 Source	Particulate	The particulate signal that is used as the source for alarm 2 (Particulate, Avg. Particulate)
A2 Setpoint	100	Limit for alarm 2 activation
A2 Delay	5	Amount of time (seconds) reading must be in alarm condition to activate alarm 2
A2 Latching	Disabled	Alarm 2 requires user acknowledgement to clear if enabled (Enabled/Disabled)
A2 Logic	HIHI	Activation logic (HI, HIHI, LO, or LOLO)
Alarm Ack User Level	Operator	Minimum user level required to acknowledge alarms (Operator or Engineer)

Alarm Latching

Alarm Latching allows alarms to be latched in the active alarm state until cleared and acknowledged. This prevents plant personnel from missing an alarm that may have been active only for a short period of time. If the **Alarm Latching** setting is set to **Disabled**, an active alarm is cleared when the **Alarm Source Process Variable** returns to normal, and no acknowledgement is required. If the **Alarm Latching** setting is set to **Enabled**, an active alarm is cleared by acknowledging the alarm and the **Alarm Source Process Variable** returns to normal.

Action Required to Reset Alarm Relay	Alarm Latching Setting
Alarm source process variable returns to normal	Disabled
Alarm source process variable returns to normal and the active alarm is acknowledged	Enabled

Alarm Logic

Alarm Logic defines how the particulate alarms are activated. When the **Alarm Logic** setting is set to **HI** or **HIHI**, the alarm is activated when the input rises above the **Alarm Setpoint** continuously for a period longer than the **Alarm Delay**. When **Alarm Logic** is set to **LO** or **LOLO**, the alarm is activated when the input falls below the **Alarm Setpoint** continuously for a period longer than the **Alarm Delay**. **LO** or **LOLO Alarm Logic** is used for loss of flow applications.

7.3 Relay Outputs

The PM 1 PRO-A and PM 1 PRO-AT have two relay outputs that are used to output the two alarm statuses. The two relays are normally open.

Relay Settings

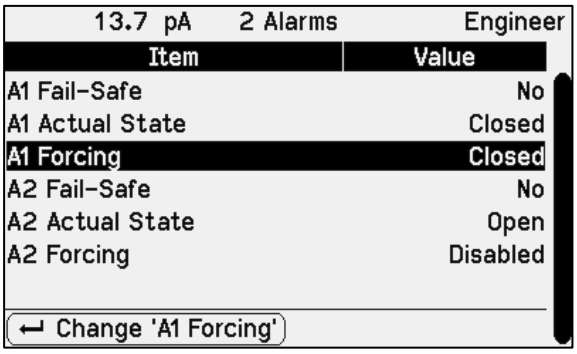
Setting	Default	Notes
A1 Fail-Safe	Disabled	Determines relay state of alarm 1 output (Disabled/Enabled)
A1 Actual State		Displays current state of alarm 1 relay
A1 Forcing	Disabled	Force alarm 1 relay (Disabled, Open, or Closed)
A2 Fail-Safe	Disabled	Determines relay state of alarm 2 output (Disabled/Enabled)
A2 Actual State		Displays current state of alarm 2 relay
A2 Forcing	Disabled	Force alarm 2 relay (Disabled, Open, or Closed)

Fail-Safe Relay State

Fail-Safe Mode	Power Off/Removed	Normal Operation	Active Alarm
Disabled	Open	Open	Closed
Enabled	Open	Closed	Open

Relay Forcing

- Set **Forcing** to **Open** or **Closed** to force the relay state.
- The **Actual State** setting and the alarm LED will match the forced relay state.
- After the relay output is forced, it will stay forced until it is **Disabled** by the user or 5 minutes have elapsed.



7.4 Analog Output

An analog 4-20mA output is available in the PM 1 PRO-AT and PM 1 PRO-T for trending live particulate readings in external devices. The selectable **Range** can be set to a number of linear or logarithmic ranges. After selecting the desired **Range**, the output can be forced to verify proper wiring and scaling in the connected device.

IMPORTANT The **Analog Output** settings listed below are ignored for devices with HART ordered and **Loop Current Control** is set to **HART**.

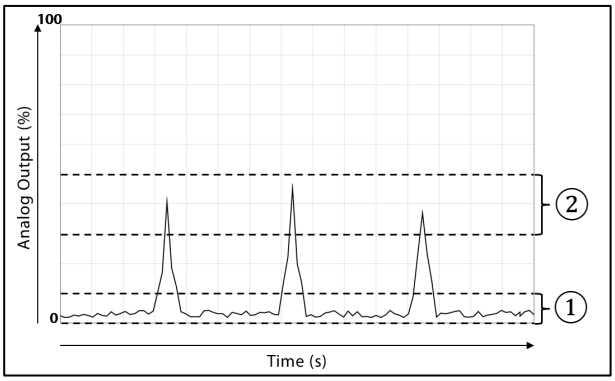
Analog Output Settings

Setting	Default	Notes
Source	Particulate	The particulate signal that is present on the analog output (Particulate or Avg. Particulate)
Range	0-1000 Linear	Range selection for the analog output. Available ranges include both linear and logarithmic scales.
Loop mA		The current mA output
Forcing Enable	Disabled	Force the analog output (Enabled or Disabled)
Forced Value	4.0	The value used while forcing the analog output (3.6-24.0mA)

Analog Output Range Selection

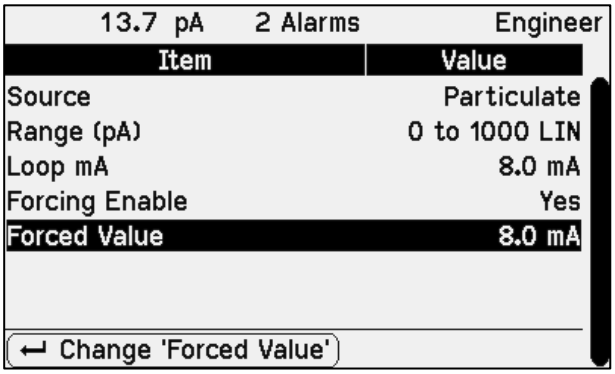
- Range selection recommendations:

① Baseline is 0-10% of range.
② Peaks are 30-50% of range.



Analog Output Forcing

- Set **Forcing Enable** to **Enabled** to force the analog output.
- Set the **Forced Value** to the desired analog output current.
- The **Loop mA** setting will match the analog output current.
- After the analog output is forced, it will stay forced until it is **Disabled** by the user or 5 minutes have elapsed.



7.5 Diagnostic Signaling

Diagnostic errors can be signaled using the analog 4-20mA output and/or a relay output. The analog output current used for diagnostic checks and errors can be selected or disabled using the **NAMUR Check** and **NAMUR Error** settings. The **Alarm Output** setting is used to select the alarm relay that will be triggered when a diagnostic error occurs. Refer to the **Diagnostic mA Output Levels (NE43)** section for more information.

Diagnostic Signaling Settings

Setting	Default	Notes
NAMUR Check	3.8mA	The mA level to drive the analog output to during self-checks (Disabled, 3.8mA, 20.5mA)
NAMUR Error	3.6mA	The mA level to drive the analog output to when an error occurs (Disabled, 3.6mA, 21.0mA)
Alarm Output	A1	The alarm relay to trigger when there is a diagnostic error (A1 or A2)

7.6 HART

HART version 7.6 with universal and common practice commands is implemented. A HART master can be used to acquire real-time particulate, average particulate, and peak (max) particulate readings. It can also be used to run self-checks and acquire self-check and alarm status.

HART Settings

Setting	Default	Notes
HART Device Revision	101	HART firmware revision 1.01 (read only)
HART Polling Address	0	Set to non-zero number to configure device for multi-drop (0-63)
Loop Current Control	HART	Selection for loop current range control (HART or Local)
HART Write Protect	Off	Allows or denies write requests received from HART communication (Off/On)
HART Device Armed	Yes	Allow device to respond to HART messages (Yes/No)
PV LRV	0.0	Primary variable lower range value (read only)
PV URV	10,000	Primary variable upper range value (read only)
HART PV Forcing Enable	Disabled	Force the Primary Variable to the specified value. The 4-20mA output will be scaled accordingly (Enabled/Disabled)
HART PV Forced Value	0.0	Primary Variable forced value
HART Default, Dev Reset	No	"Yes" causes the PM 1 PRO to restore default HART configuration settings, and then to reset the PM 1 PRO device (Yes/No)

HART Dynamic Variables

Dynamic Variable	Default	Description
PV	Particulate	Primary variable (Particulate/Average Particulate/Peak Particulate)
SV	Average Particulate	Secondary variable (Particulate/Average Particulate/Peak Particulate)
TV	Peak Particulate	Tertiary variable (Particulate/Average Particulate/Peak Particulate)
QV	-	Fourth variable (Unused)

HART Multi-Drop Configuration

To configure PM 1 PRO devices for multi-drop topology, all devices must:

- Be connected in parallel to a single wire pair or segment.
- Have a unique address.

The address of each PM 1 PRO device can be set using the **HART Polling Address** setting in the **HART** menu as a value from 1 to 63. Once a PM 1 PRO device has an address other than zero, the device stops driving its 4-20mA signal and starts transmitting data digitally through the wire pair with a fixed minimum current of 4mA.

Up to 15 devices can operate on the same loop in a multi-drop configuration with HART.

Configuration and Monitoring Software (HART DTM)

A Device Type Manager (DTM) is available for use with any HART configured PM 1 PRO device. The PM 1 PRO HART DTM can be used within a frame application to view real-time readings, trend live and historical measurements, and adjust device settings. The DTM supports the following frame applications:

- PACTware 5.0 (Available for download on Auburn FilterSense website or at www.pactware.com)
- Emerson AMS Device Manager
- Endress & Hauser FieldCare 2.09
- FDTContainer 4.2
- Yokogawa FieldMate Lite Edition 3.02

The DTM may also work within additional frame applications.

The DTM is available for download at www.filtersense.com, or by contacting technical support. Follow the instructions included with your frame application to add the PM 1 PRO HART DTM.

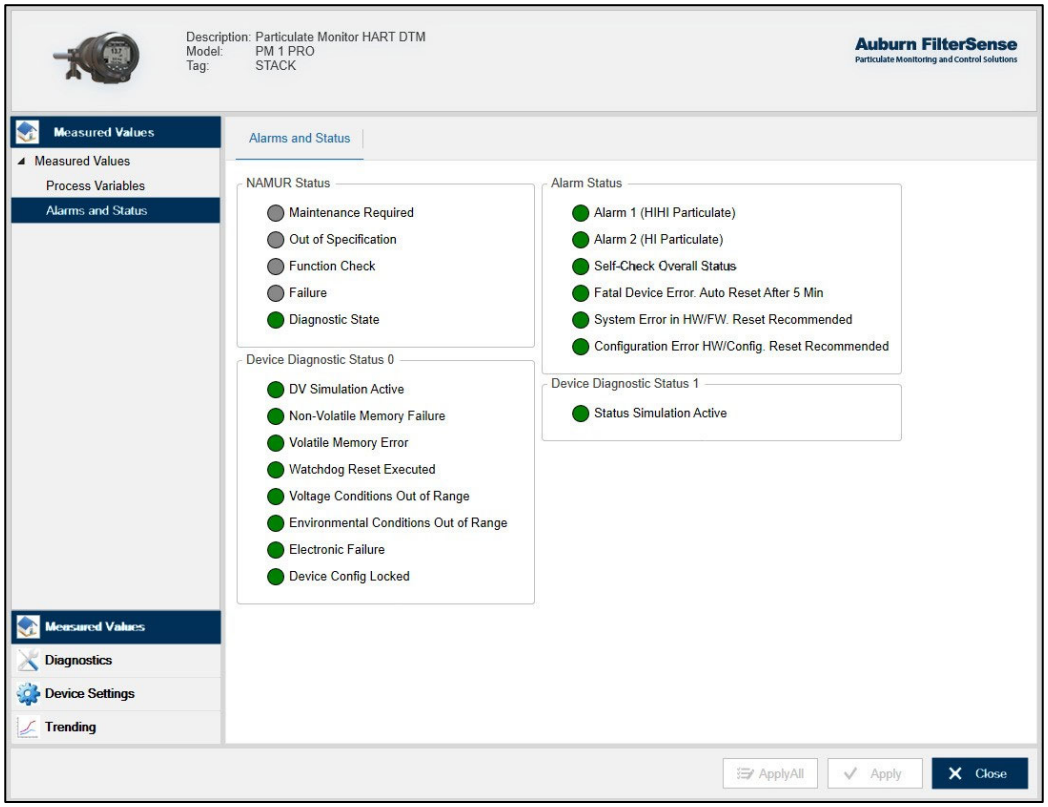
Once the DTM is added and the device is connected, you can view and configure HART-accessible device information. For help with menu navigation, please refer to the DTM menu structure in the following table. Additional information is available in the PM 1 PRO HART DTM User Guide, available at www.filtersense.com or by contacting technical support.

DTM menu structure and example screenshots shown below:

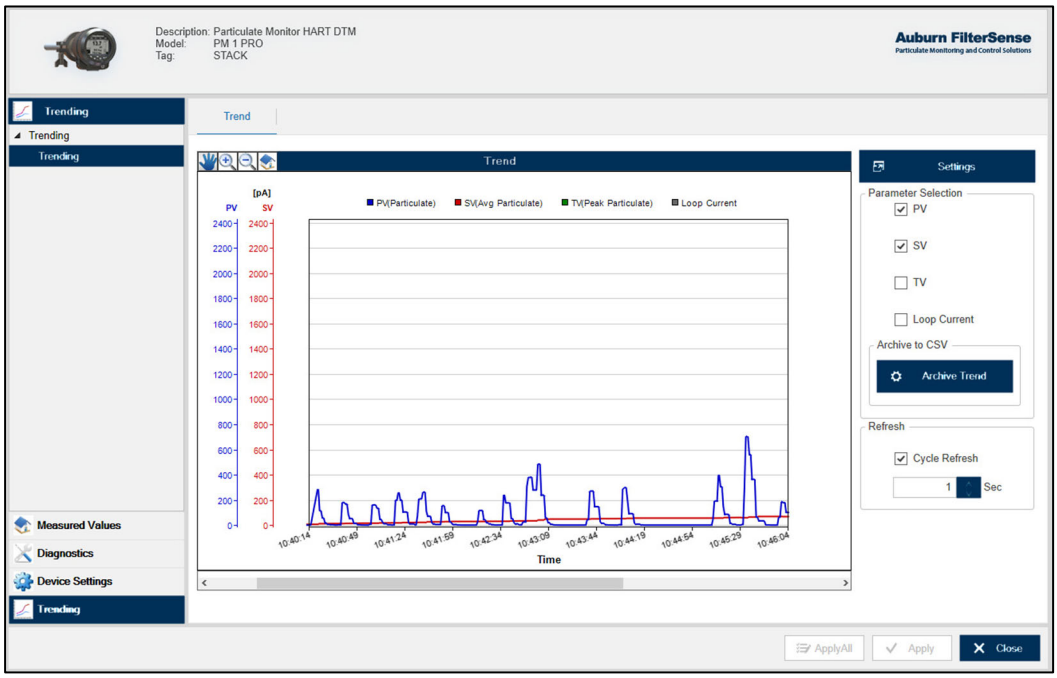
TOP MENU	SUB MENU	TABBED MENU
Operate	Process Variables	**Process Variables:** View real-time readings and trends
	Alarms and Status	**Alarms and Status:** View alarm status information
Diagnostics	Diagnostics	**Device Diagnostics:** View status and run Self-Checks
		Sensor Check: View status and run Sensor Check
		Span Check: View status and run Span Check
		Zero Check: View status and run Zero Check
		Signal Quality: View status and run Signal Quality Check
		Self-Check Schedule: Set automatic Self-Check time
Device Settings	Setup	**Measurement:** Configure how data is displayed
		Alarms: Configure alarm settings
		Relay Outputs (Optional): Configure relay settings
		Analog Output (Local Current Control): Configure analog output settings
		HART: Configure HART settings
		Diagnostic Signaling: Configure diagnostic error signaling settings
		System: Configure system and RTC settings
	Device Info	**Device Info:** View device info
	Calibration	**Calibration:** Calibrate 4-20mA loop
Trending	Trending	**Trend:** View live data and archive logged data to a Comma Separated Values (.csv) file

```

## HART DTM Software




## Alarms and Status Menu




**Real-Time Data Trending**
```

HART Device Description ('DD')

The table below describes the layout of the parameter and configuration data exposed to HART - as defined by the HART Device Description files provided with the product.

HART DD Menu Structure and Settings				
Device Setup	Process variables	PV/SV/TV/Loop current values		
	Diag/Service	Test device	Self test/Device reset/ Squawk	
			Status	HART Device Status Information
		Calibration	Re-range	PV Range values/Apply values
			Analog output	PV Alrm type/Loop test
	Basic setup	PV unit/xfer fnctn		
		Device information	Model/Dev Id/Tag/Clock	
			Revision #'s	Fld dev rev, SW/HW rev
	Detailed setup	PV/SV/TV assignments		
		Sensors	Particulate Sensor	Particulate value
				Sensor Information
		Signal condition	PV range/PV Damp settings	
		Output condition	Analog output	PV Alrm type/Loop test
			HART output	Poll addr
		Device information	Model/Dev Id/Tag/Clock	
			Revision #'s	Fld dev rev, SW/HW rev
	Review	Device info and Revision #'s		

HART Device Status Information

The table below describes the internal device status information available over HART.

Status	Bit	Field	Description
Self-Check Status	0	Self-Check Overall Status	Self-Check: Sensor, Span, Zero, Signal Quality, or Over-Range
	1	Sensor Status	
	2	Span Status	
	3	Zero Status	
	4	Signal Quality Status	
	5	Over Range Status	
	6	Reserved	
	7	Reserved	
NAMUR Status	0	Maintenance Required	(1 = Err, 0 = OK)
	1	Out of Specification	(1 = Err, 0 = OK)
	2	Check Function	(1 = Err, 0 = OK)
	3	Failure	(1 = Err, 0 = OK)
	4	Diagnostic State	(1 = Active, 0 = Passive)
	5	Reserved	
	6	Reserved	
	7	Reserved	
Alarm Status 1	0	Alarm 1 Status	HIHI Particulate
	1	Alarm 2 Status	HI Particulate
	2	Alarm 3 Status	
	3	Alarm 4 Status	
	4	Alarm 5 Status	
	5	Alarm 6 Status	
	6	Alarm 7 Status	
	7	Alarm 8 Status	
Alarm Status 2	0	Alarm 25 Status	
	1	Alarm 26 Status	
	2	Alarm 27 Status	
	3	Alarm 28 Status	
	4	Alarm 29 Status	Supervisor Fatal Error. Auto Reset after 5 min
	5	Alarm 30 Status	System Error in HW/FW. Reset Recommended
	6	Alarm 31 Status	Configuration Error HW/Config. Reset Recommended
	7	Alarm 32 Status	Self-Check: Sensor/Span/Zero/Signal Quality/Over-Range.

Alarm Ack Status 1	0	Alarm 1 Acknowledge State	HIHI Particulate
	1	Alarm 2 Acknowledge State	HI Particulate
	2	Alarm 3 Acknowledge State	
	3	Alarm 4 Acknowledge State	
	4	Alarm 5 Acknowledge State	
	5	Alarm 6 Acknowledge State	
	6	Alarm 7 Acknowledge State	
	7	Alarm 8 Acknowledge State	
Alarm Ack Status 2	0	Alarm 25 Acknowledge State	
	1	Alarm 26 Acknowledge State	
	2	Alarm 27 Acknowledge State	
	3	Alarm 28 Acknowledge State	
	4	Alarm 29 Acknowledge State	Supervisor Fatal Error. Auto Reset after 5 min
	5	Alarm 30 Acknowledge State	System Error in HW/FW. Reset Recommended
	6	Alarm 31 Acknowledge State	Configuration Error HW/Config. Reset Recommended
	7	Alarm 32 Acknowledge State	Self-Check: Sensor/Span/Zero/Signal Quality/Over-Range.
Extended Device Status	0	Maintenance Required	
	1	Device Variable Alert	
	2	Critical Power Failure	
	3	NAMUR Failure	
	4	NAMUR Out of Specification	
	5	NAMUR Function Check	
	6	Reserved	
	7	Reserved	
Device Diagnostic Status 0	0	Simulation Active	
	1	Non-Volatile Memory Failure	
	2	Volatile Memory Error	
	3	Watchdog Reset Executed	
	4	Voltage Conditions Out of Range	
	5	Environmental Conditions Out of Range	
	6	Electronic Failure	
	7	Device Config Locked	
Device Diagnostic Status 1	0	Status Simulation Active	
	1	Reserved	
	2	Reserved	
	3	Reserved	
	4	Reserved	
	5	Reserved	
	6	Reserved	
	7	Reserved	
Status Group 14-17	0-7	Reserved	

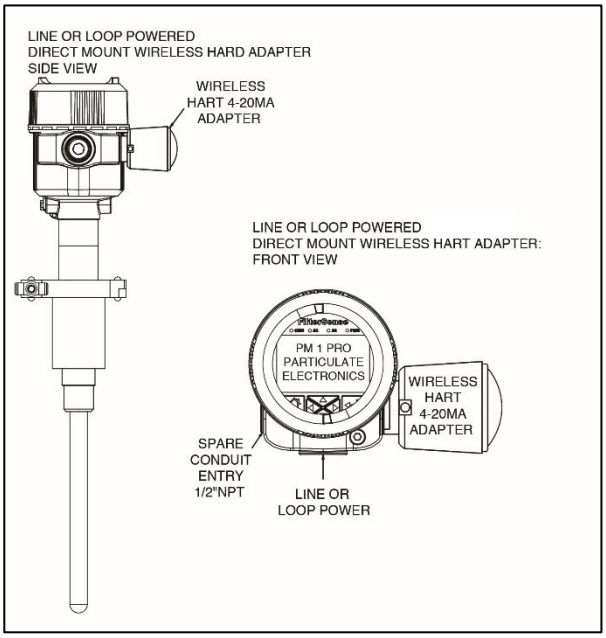
Basic HART Commands Supported

Command	Description	Type
0	Read Device ID	Universal
1	Read Primary Variable	Universal
2	Read Loop Current and Percentage of Range	Universal
3	Read Dynamic Variables and Loop Current	Universal
6	Write Polling Address	Universal
7	Read Loop Configuration	Universal
9	Read Device Variables with Status	Universal
12	Read Message	Universal
13	Read Tag, Descriptor, Date	Universal
14	Read Primary Variable Information	Universal
15	Read Output Information	Universal
16	Read Final Assembly Number	Universal
17	Write Message	Universal
18	Write Tag, Descriptor, Date	Universal
20	Read Long Tag	Universal
22	Write Long Tag	Universal
33	Read Device Variables	Common Practice
34	Write Primary Variable Damping Value	Common Practice
35	Write Primary Variable Range Values	Common Practice
38	Reset Configuration Changed Flag	Common Practice
40	Enter/Exit Fixed Current Mode	Common Practice
41	Perform Self-Checks	Common Practice
48	Read Additional Transmitter Status Bits 0-7: Self-Check Status, Sensor-Check Status, Span-Check Status, Zero-Check Status, Signal Quality Status, Over-Range Status, Alarm 1 Status, Alarm 2 Status Bits 8-31: Unused	Common Practice
50	Read Dynamic Variable Assignments	Common Practice
51	Write Dynamic Variable Assignments	Common Practice
54	Read Device Variable Information	Common Practice
55	Write Device Variable Damping Value	Common Practice
72	Squawk	Common Practice
79	Write Device Variable	Common Practice
89	Set Real-Time Clock	Common Practice
90	Read Real-Time Clock	Common Practice

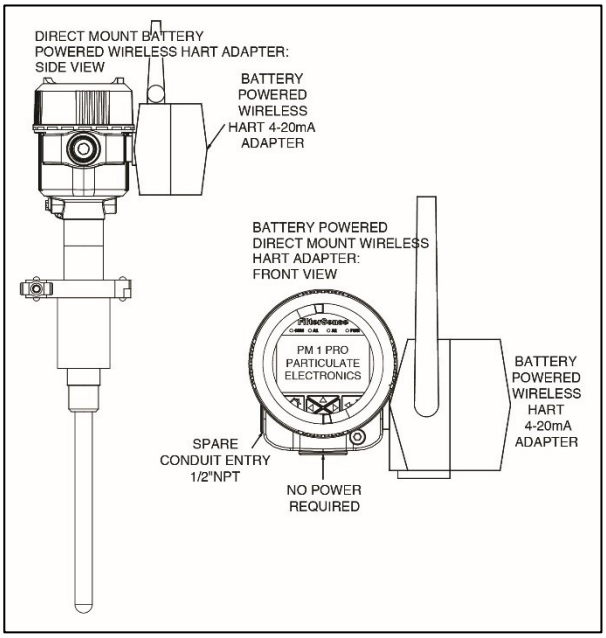
Wireless HART Adapter

PM 1 PRO models are available with wireless HART for transmitting process and diagnostic data wirelessly. The wireless adapters mount directly to the sensor housing or can be mounted remotely for better signal and the wireless adapter can be line or loop powered or battery powered. Both Integral and Remote Electronics are supported.

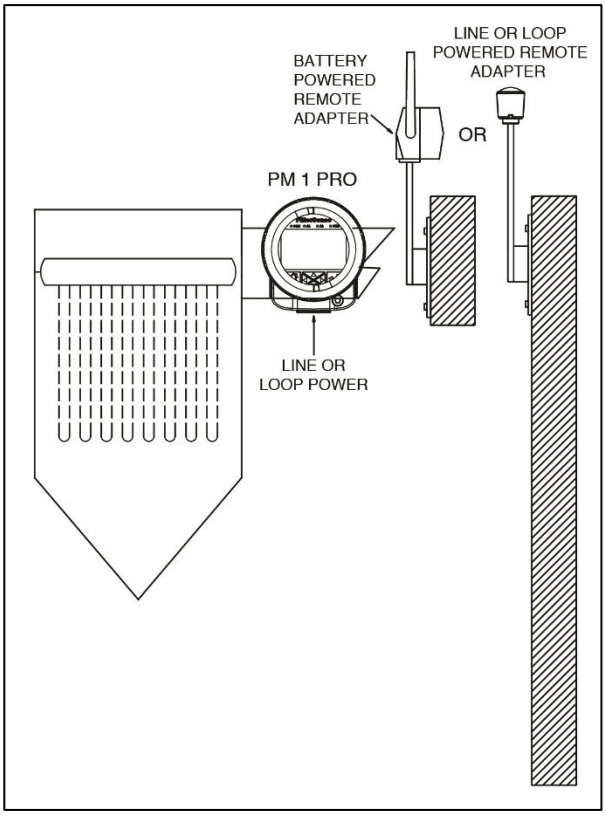
- Integral Electronics
- Line or Loop-Powered Adapter
- Direct Mounting



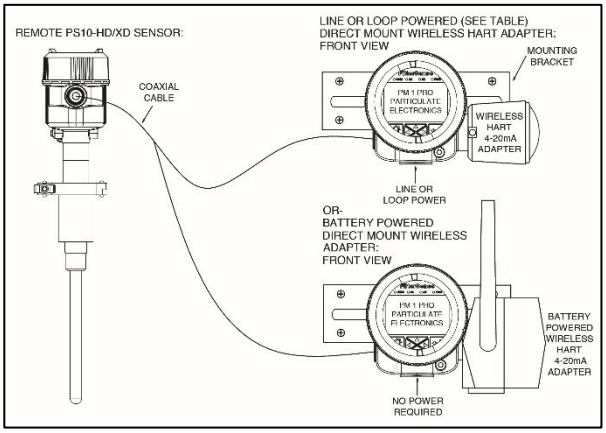
- Integral Electronics
- Battery Powered Adapter
- Direct Mounting



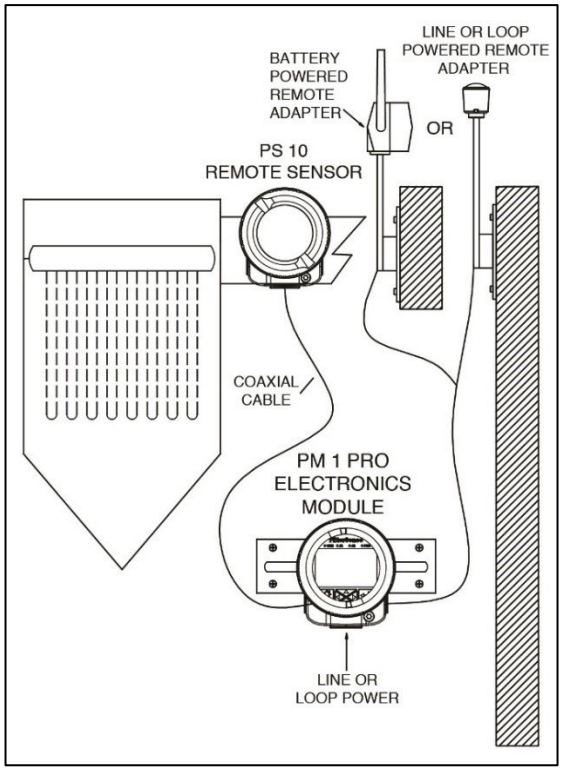
- Integral Electronics
- Remote Mounted Wireless Adapter
  If Necessary, to Avoid Obstruction



- Remote Electronics
- Direct Mounted Wireless Adapter



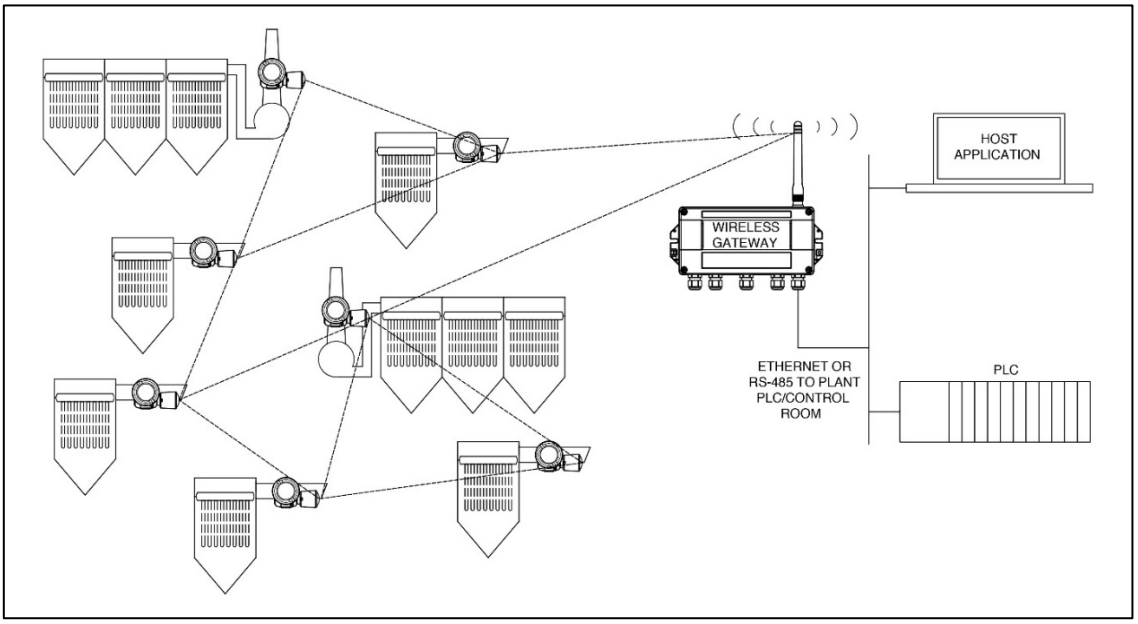
- Remote Electronics
- Remote Mounted Wireless Adapter
  If Necessary, to Avoid Obstruction



Wireless HART Network General Layout

For each wireless network a wireless gateway is required to receive the signal and connect to the plant Ethernet network. The wireless gateway transmits the process data from the wireless sensors to devices on the Ethernet network such as PLC's and applications for a PC. Below is an example of a general wireless network.

- 24VDC Power
- Up to 16 Wireless Devices per Gateway for Reliable 1 Second Data
- Up to 235 Meters (770 Ft) Perfect Line of Sight
- Max 30 Meters (98 Ft) Between Devices for High Speed Data Transfer with Heavy Obstruction
- Ethernet or RS-485 Interface



7.7 Bluetooth and DeviceLINK Mobile App

The **Bluetooth** menu is used to change and view Bluetooth settings.

Setting	Default	Notes
BT Active	Yes	Selection to allow for Bluetooth capability (Yes/No)
BT PIN	001234	User defined Bluetooth PIN to allow for client access to Bluetooth device (0-999999)
BT State		Status of device Bluetooth (read only)

DeviceLINK – Bluetooth Mobile Application

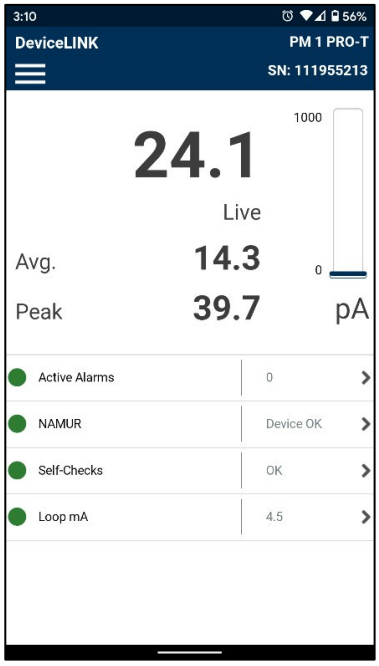
DeviceLINK is a Bluetooth mobile application specifically designed for the PM 1 PRO. It provides safe easy access to the instrument as well user-friendly operation and advanced functions. The software is available in the app store for Android and iOS. Functions include but are not limited to the following:

- Monitoring readings and configuring settings
- Viewing multiple trends (Ex: real-time, average, and peak)
- Guided configuration of critical device settings
- Intelligently generate recommended alarm setpoints based on historical data (requires datalogging)
- Connected product support (easily contact customer support and transfer device information)
- Export process data from the internal device data log
- Generate device health reports that can be distributed by email
- Save/Load device settings

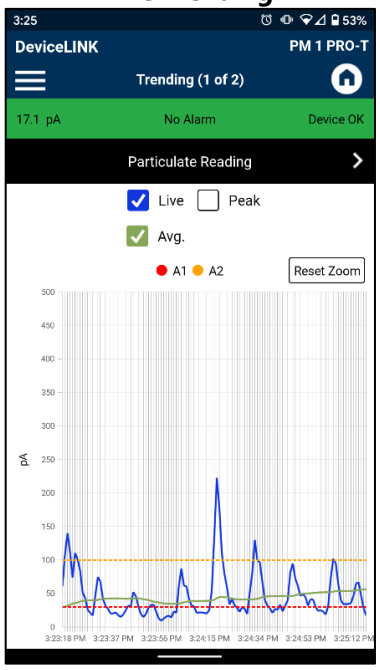
Typical communications distance from the mobile device to the PM 1 PRO devices is 35 to 60 feet (~10.7 to 18 m)

A few example screen shots are displayed below:

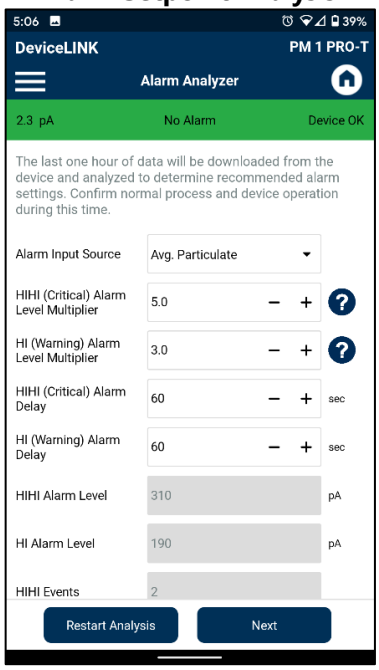
Home



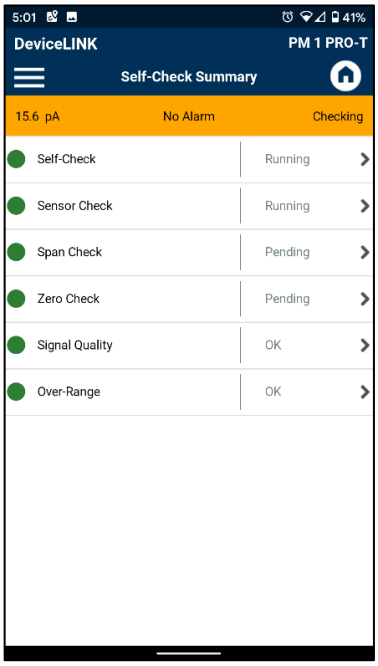
Live Trending



Alarm Setpoint Analysis



Self-Checks



7.8 Display

The **Display** menu contains all settings related to how process information is displayed on the user interface. All screens are enabled by default and can be disabled if desired. The **Bar Graph** Scale can be adjusted based upon normal operating conditions to best display baseline and peak readings.

After the **Keypad Timeout Delay** has been reached with no user interaction, the enabled screens will cycle based upon the **Screen Cycling Period**. **Process Screen Cycling** can be disabled if desired.

Display Settings

Setting	Default	Notes
Bar Graph Scale	0 to 1000 Linear	The range for all bar graphs on the local display. Linear and logarithmic scales are selectable.
Primary Process Variable	Particulate	Select the primary process variable for all screens and bar graphs. The variable that is not selected becomes the secondary measurement (Particulate or Avg. Particulate)
Large Value Screen	Enabled	Enable or Disable the Large Value process screen
Horizontal Bar Screen	Enabled	Enable or Disable the Horizontal Bar Graph process screen
Vertical Bar Screen	Enabled	Enable or Disable the Vertical Bar Graph process screen
Active Alarms Screen	Enabled	Enable or Disable the Active Alarms screen
Process Screen Cycling	Enabled	Enable or Disable automatic process screen cycling
Screen Cycling Period	10 seconds	Number of seconds before cycling to the next process screen
Keypad Timeout Delay	300 seconds	Amount of time with no user interaction before process screens are shown/cycled

7.9 System

The **System** menu allows the user to set the date and time and choose a **Device Tag**. The date, time, and device tag are cycled in the header of the **Process Screens**. The **Device Tag** is useful for large baghouses with particulate sensors in each compartment to distinguish between compartments. The user can also change the **Datalog Sample Rate** and the default **Engineer Password** from the **System** menu.

System Settings

Setting	Default	Notes
Set Date/Time		Set the current Date/Time
Datalog Sample Rate	1.0 second	Set the sample rate for internal process data logging (0.2-60 seconds)
Device Tag Display	Disabled	Enable or Disable the Device Tag Display in the process screen header
Device Tag	Particulate 1	The device tag (Particulate 1-32, or Compartment 1-16)
Engineer Password	55	Change the password for the Engineer login (0-65535)
Save Settings	No	Save settings to Display Module
Load Settings	No	Load settings from Display Module
Reset All Settings	No	Reset all settings to default

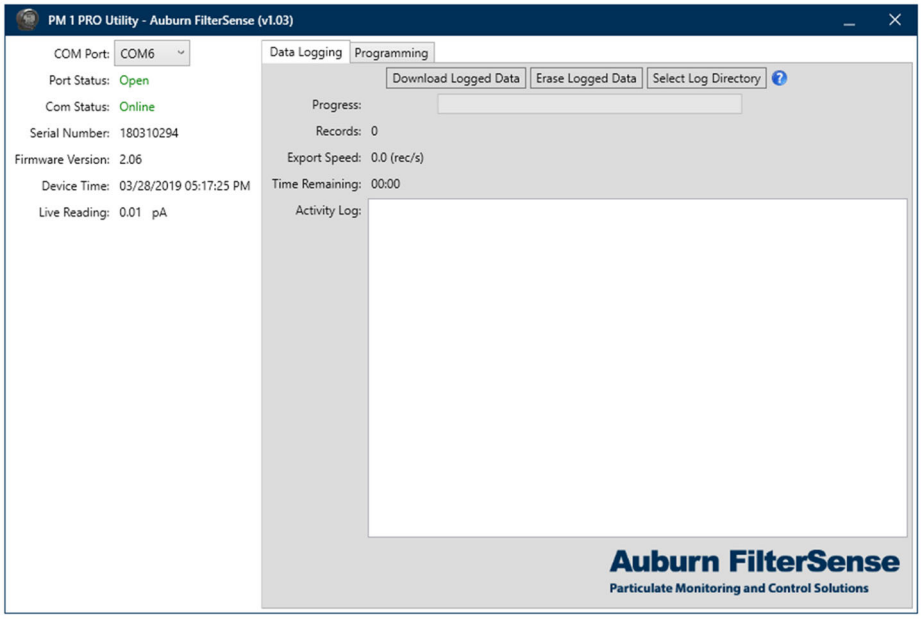
Datalog Sample Rate

Process data can be logged to internal device memory. Once 100K data points have been stored, the oldest data is automatically overwritten by new data. The **Datalog Sample Rate** adjusts the rate at which process data is logged, and affects the total duration of logged data per the table below.

Datalog Sample Rate	Logged Data Duration
0.2 seconds	≈ 5 hours
1.0 seconds	≈ 1 day
30 seconds	≈ 35 days
60 seconds	≈ 70 days

Exporting Data

The **Export Utility** is a software utility for exporting internally stored data from a PM 1 PRO configured for data logging. To utilize the **Export Utility**, a PC with a USB port is required. A connection can be made to the PM 1 PRO using a micro USB connector.



Export Utility Screenshot

Export Utility Function	Description
Download Logged Data	Copy all logged particulate data into a .csv file and save it to a user-defined log directory. The .csv file can be viewed with a spreadsheet software.
Erase Logged Data	Clear internal process data stored to the PM 1 PRO device.
Select Log Directory	Select location to save generated .csv files.

The **Export Utility** is available for download at www.filtersense.com or by contacting technical support.

WARNING

Exporting Data from a Loop Powered Device

- An isolated USB hub (recommended model CM-M4160-ISO by CableMax) or a laptop running only on battery power must be used to prevent high loop current reading and possible damage to the PM 1 electronics.

Exportation de données à partir d'un périphérique alimenté en boucle

- Un concentrateur USB isolé (modèle recommandé CM-M4160-ISO par CableMax) ou un ordinateur portable fonctionnant uniquement sur batterie doit être utilisé pour éviter une lecture de courant de boucle élevée et d'éventuels dommages à l'électronique du PM 1.

Save Settings / Load Settings

User-settings can be transferred between devices using the **Save Settings** and **Load Settings** options. **Save Settings** will copy all user-settings onto the Display Module. Once the copy is complete, the Display Module can be removed and installed onto another device. Once installed onto another device, use the **Load Settings** option to copy the settings from the Display Module onto the device.

7.10 Information

The **Information** menu is read-only and contains product information, the support phone number, and a QR code to download a digital copy of this manual.

Setting	Default	Notes
Serial Number		Displays the serial number
Firmware Version		Displays the firmware version
Hardware Version		Displays the hardware version
System Date/Time		Displays the current date and time
Support Phone Number	978-927-4304	Displays the contact phone number for the factory
User-Manual QR Code		Scan this QR code to be directed to a digital download of this manual

7.11 Alarm Setpoint Guidance

Alarms should be set based on observing the output over the full range of normal operating conditions. For fabric filter applications, monitor the readings when the filter media is in good non-leaking condition and with cleaning both disabled and enabled. For filter applications, baseline and peak particulate readings following cleaning cycles should be noted.
Once a good set of readings is observed, alarms should be set based on the alarming objective. In all cases recall the output of a DynaCharge™ particulate monitor is reasonably linear/proportional to mass. This means that if the readings increase by a factor of 3, for example, the amount of particulate will have increased by a factor of 3. If during normal operation the baseline is always 0pA, contact the factory for a model with lower detection capabilities.
The following are the main approaches to setting the alarms.

Proportional Alarming (focus is on detecting a relative change in the mass concentration)

- Adjust **Smoothing Seconds** for relatively stable particulate readings.
- Set a **HI** (peak) alarm at a desired multiple over the average baseline reading with a 1- to 60-second delay.
- Set a **HIHI** (baseline) alarm at a desired multiple over the average baseline reading with a 30- to 360-second delay.

Leak Alarming (focus is on detecting leaks in filter media)

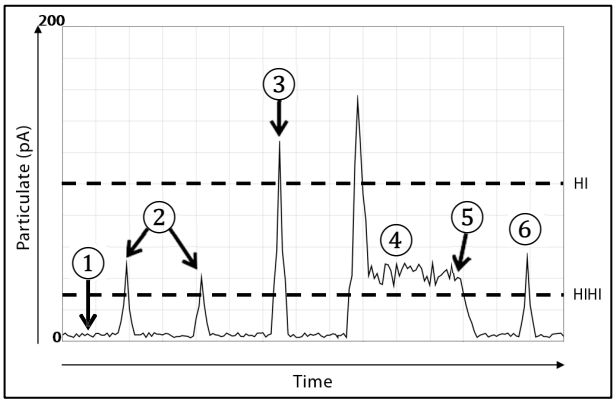
- Adjust **Smoothing Seconds** for good response to cleaning cycles while keeping the baseline fairly stable.
- Set a **HI** (peak) alarm to capture increasing cleaning cycle peak readings at 1.5x to 5x typical peak height with a 1- to 5-second delay. This provides an early warning alarm.
- Set a **HIHI** (baseline) alarm to capture increasing baseline readings at 2x to 10x average baseline reading with a 30- to 180-second delay.

Powder Flow Alarming

- Adjust **Smoothing Seconds** for relatively stable particulate flow readings.
- Set a **HI** (increased powder flow) alarm above the desired powder flow rate.
- Set a **LO** (loss of powder flow) alarm below the desired powder flow rate.

Example of Typical Baghouse/Dust Collector Readings

① Normal baseline.
② Normal peaks from cleaning cycles.
③ Filter wear causes an increase in the cleaning peak. Early warning alarm of filter leak-through (HI alarm).
④ Filter leak increases, causing a baseline shift. HIHI alarm triggered.
⑤ Filter replaced.
⑥ Baseline and cleaning peaks return to normal levels.



Typical Readings for Modern Efficient Fabric Filters

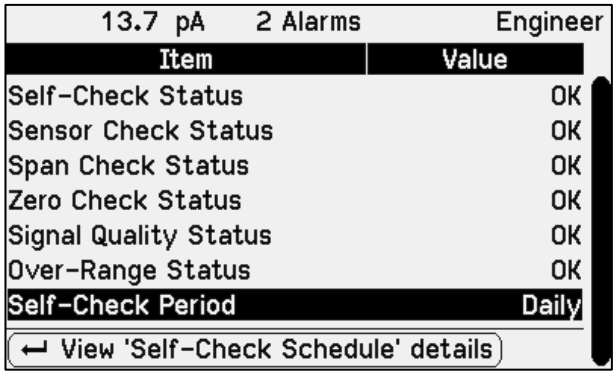
Average Baseline	Peaks (After Cleaning Cycles)	Filter Condition
1 to 10pA	Less than 50pA	No significant leaks
10 to 100pA	50 to 500pA	Onset of leaks
100 to 1000pA	500 to 5000pA	Significant leaks present

8 Diagnostics

8.1 Automatic Self-Checks

DynaCHARGE PM 1 PRO models contain an internal self-check system to automatically (or manually) perform zero and upscale (span) checks of the measurement circuit, and to check the performance of the sensor and cable. Additional self-checks include continuous checks for signal quality and over-range as well as general device health.

- Diagnostic Screen Detail
- Displays all self-check statuses



Diagnostic Screen Entries

Setting	Type	Values	Notes
Self-Check Status	Automatic or Manual	OK Running Error	• OK if all Self-Checks passed • Running if any of the Self-Checks are running • Error if any of the Self-Checks are in error
Sensor-Check Status	Automatic or Manual	OK Pending Running Error	• OK if the Sensor-Check passed • Pending if in the queue to run • Running if the Sensor-Check is running • Error if there is a Sensor-Check error
Span-Check Status	Automatic or Manual	OK Pending Running Error	• OK if the Span-check passed • Pending if in the queue to run • Running if the Span-Check is running • Error if there is a Span-Check error
Zero-Check Status	Automatic or Manual	OK Pending Running Error	• OK if the Zero-Check passed • Pending if in the queue to run • Running if the Zero-Check is running • Error if there is a Zero-Check error
Signal Quality Status	Continuous	OK Error	• OK if the signal quality passes • Error when the particulate reading is not varying within parameters
Over-Range Status	Continuous	OK Error	• OK if the particulate signal is in measurement range • Error when the particulate signal exceeds the range of the advanced particulate electronics
Setting	**Type**	**Values**	**Notes**
Self-Check Period	Setting	Disabled/ Hourly/Daily	• Set periodic Self-Check date and time

Self-Check Status

The general **Self-Check** is a quick way for the user to run an overall check on the sensor, including all self-checks.

Setting	Values	Notes
Self-Check Status	OK Running Error	• OK if all Self-Checks passed • Running if any of the Self-Checks are running • Error if any of the Self-Checks are in error
Run All Self-Checks	Yes No	• Yes to run all Self-Checks • No when not running

Sensor-Check

The **Sensor-Check** tests the sensor condition and the cable for shorts. Consult factory if the error cannot be cleared by checking sensor and cable connection.

Setting	Values	Notes
Sensor-Check Status	OK Pending Running Error	• OK if the Sensor-Check passed • Pending if in the queue to run • Running if the Sensor-Check is running • Error if there is a Sensor-Check error
Run Sensor-Check	Yes No	• Yes to run Sensor-Check • No when not running
Sensor-Check Last Run	Date/Time	• Date/Time of last Sensor-Check
Sensor-Check Result	MΩ	• Result of last Sensor-Check

Span-Check

The **Span-Check** tests the internal amplifier and circuitry by inputting multiple upscale test signals into the measurement circuit. Consult factory if an error occurs.

Setting	Values	Notes
Span-Check Status	OK Pending Running Error	• OK if the Span-Check passed • Pending if in the queue to run • Running if the Span-Check is running • Error if there is a Span-Check error
Run Span-Check	Yes No	• Yes to run Span-Check • No when not running
Span-Check Last Run	Date/Time	• Date/Time of last Span-Check
Result – High-Gain Neg		• Result of last negative high-gain Span-Check
Result – High-Gain Pos		• Result of last positive high-gain Span-Check
Result – Mid-Gain Neg		• Result of last negative mid-gain Span-Check
Result – Mid-Gain Pos		• Result of last positive mid-gain Span-Check
Result – Low-Gain Neg		• Result of last negative low-gain Span-Check
Result – Low-Gain Pos		• Result of last positive low -gain Span-Check

Zero-Check

The **Zero-Check** tests the zero offset of the measurement circuitry. Consult factory if an error occurs.

Setting	Values	Notes
Zero-Check Status	OK Pending Running Error	• OK if the Zero-Check passed • Pending if in the queue to run • Running if the Zero-Check is running • Error if there is a Zero-Check error
Run Zero-Check	Yes No	• Yes to run Span-Check • No when not running
Zero-Check Last Run	Date/Time	• Date/Time of last Sensor-Check
Zero-Check Result		• Result of last Zero-Check

Signal Quality (Continuous Self-Check)

The **Signal Quality** test runs continuously and detects when the measured reading is not responding properly. Check the coaxial cable and sensor for shorts, buildup, and/or damage.

Setting	Values	Notes
Signal Quality Status	OK Error	• OK if the signal quality passes • Error when the particulate reading is not varying within parameters
Average Value		• Averaged particulate signal
Standard Deviation		• Standard deviation of the particulate signal

Over-Range (Continuous Self-Check)

The **Over-Range** test runs continuously and detect when the particulate signal is outside the range of the device. Check the coaxial cable and sensor for shorts, buildup, and/or damage.

Setting	Values	Notes
Over-Range Status	OK Error	• OK if the particulate signal is in measurement range • Error when the particulate signal exceeds the range of the advanced particulate electronics

8.2 Device Diagnostics & NAMUR

NAMUR is the international user association of automation technology industries. NAMUR has identified that the status of devices used in automation, control, and monitoring is important to the plant operators. The PM 1 PRO diagnostics meet the NAMUR 107 and 43 standard (NE107 & NE43).
Device diagnostics are used to meet NE107. A full detail of each diagnostic symbol is listed below in the following table.

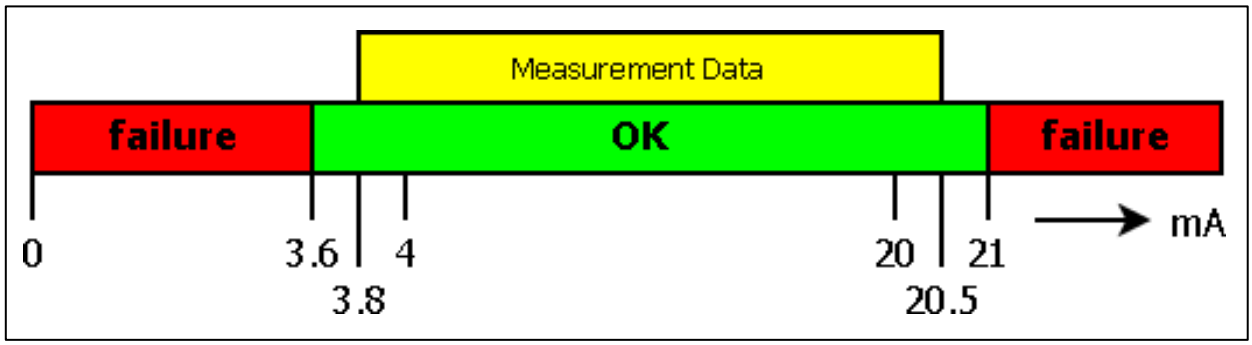
Device Diagnostic Status Icons (NE107)

Icon	Description
Device OK 	• Signal is valid • All self-tests pass
Checking 	• Signal is temporarily not valid (holding last value) • Zero, span, and/or Sensor-Checks are currently running
Service 	• Signal is valid • Possible causes: ○ Particulate buildup on sensor • Clean insulator/probe
Out of Specification 	• Signal cannot be guaranteed valid • Possible causes: ○ Failed electronics temperature check • Check alarms and diagnostics for more information

Device Failure 	• Signal is not valid
	• Possible causes:
	  ○ Failed Sensor-Check
	  ○ Failed Zero-Check
	  ○ Failed Span-Check
	  ○ Failed Over-Range check
	  ○ Failed signal quality check
	  ○ General error
	• Check alarms and diagnostics for more information

Diagnostic mA Output Levels (NE43)

Manipulation of the analog output signal is used to meet NE43. The PM 1 PRO offers a selectable mA output level below or above the standard 3.8-20.5mA range for when diagnostics are running or during diagnostic failures. This differentiates a full scale or zero scale reading from a device diagnostic error.



The settings associated with this are listed in the table below. Engineer User Level is required to adjust these settings.

Diagnostic Signaling

Setting	Default	Notes
NAMUR Check	3.8mA	The mA level to drive the analog output to during self-checks (Disabled, 3.8mA, 20.5mA)
NAMUR Error	3.6mA	The mA level to drive the analog output to when an error occurs (Disabled, 3.6mA, 21.0mA)
Alarm Output	A1	The alarm relay to trigger when there is a diagnostic error (A1 or A2)

8.3 Functional Verification

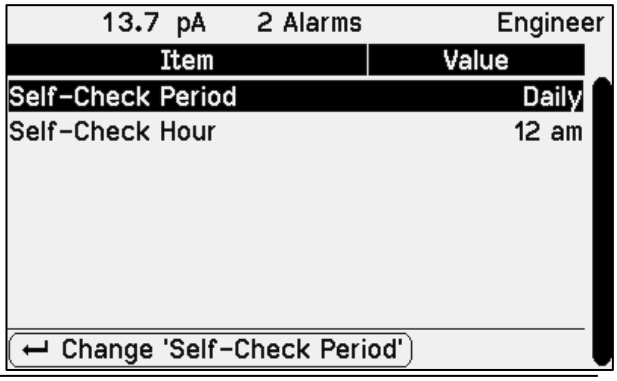
To verify operation after commissioning or otherwise as needed, the following checks should be performed:

1. **Run Self-Checks**
2. **System Zero Check**
3. **Response Testing**
   - As needed the device can be returned to the factory for full electronics testing and mechanical checkout.

8.4 Run Self-Checks

The best way to determine if the PM 1 PRO is operating normally is to run the **Self-Check** from the diagnostic screen. This will check the electronics, the sensor, and cable (remote electronics version). **Self-Checks** can be set to automatically run from the diagnostic screen as well. For more information regarding each **Self-Check**, refer to the **Automatic Self-Check** section.

- Setting the self-checks to periodically run
- Select from **Disabled**, **Daily**, **Hourly**



8.5 System Zero Check

A **System Zero Check** is an in situ (fully installed) test of the entire system when there is no airflow. A **System Zero Check** confirms proper installation and zeroing of the electronics and sensing probe when fully installed.

System Zero Procedure

1. Shut down the process and fan. Ensure process flow has completely stopped; the slightest amount of flowing particles can create a signal.
2. Monitor the particulate reading for a System Zero.

8.6 Response Testing

Response Testing is performed to verify response to an actual increase in particulate.

Response Testing Procedure

1. Introduce particulate upstream of the sensor using one of the following methods:
   a. Pulse filters while process is running and collecting particulate.
   b. Inject particulate using sensor test port (1 tsp of talc powder or actual process dust recommended).
   c. Increase particulate flow by changing process.
2. Monitor the particulate reading for an increase in particulate.

WARNING

RESPONSE TESTING (TEST DE RÉPONSE)

- Particulate injections should only be performed in non-hazardous areas.
- A response test can trigger alarm activation depending on alarm setpoints and the amount and type of particulate injected.

- Les injections de particules ne doivent être effectuées que dans des zones non dangereuses.
- Un test de réponse peut déclencher l'activation d'une alarme en fonction des points de consigne d'alarme et de la quantité et du type de particules injectées.

8.7 Factory Testing

Contact Auburn FilterSense to request an RMA to return the device for full factory testing. NIST traceable calibration certificates are available upon request. The following parts can be returned for calibration:

1. PM 1 PRO (Electronics Module)
2. PM 1 PRO (Electronics Module & Sensor Probe)
3. PS 10 (Particulate Sensor)

9 Troubleshooting

Issue	Action
Zero Reading (with process running)	• Perform a **Response Test**. • If response is confirmed, baseline detection level may not be suitable for the application. Contact **Factory** for PM 1 electronics module with lower detection capabilities. • If response is not confirmed, contact **Technical Support**.
Elevated Flat-Lined Reading (with process running)	• **Run Self-Checks** to verify the electronics module. • Confirm correct **Scaling** between 4-20mA output and PLC. • Inspect the electronics enclosure to check that water has not entered the enclosure. ○ If water is found, contact **Technical Support**. • Perform a **Response Test**. • Perform a **System Zero Check**. • If the issue remains, contact **Technical Support**.
Low Reading (with process running)	• Confirm correct **Scaling** between 4-20mA output and PLC. • Perform a **Response Test**. If the system responds properly, reevaluate the selected **Alarm Setpoints**.
High Dynamic Reading (with process running)	• Check to make sure the particulate has not increased. Leaking filters and filter cleaning cycles can cause high dynamic readings. The particulate sensor detects very low levels of particulate. Small leaks can cause alarms. • Verify PM 1 is grounded to earth with less than 1Ω of impedance per the specifications in the **Grounding** section. • Check the **Signal Smoothing** adjustment. • Confirm correct **Scaling** between 4-20mA output and PLC. • If nothing is found, perform a **System Zero Check**.
Relay Not Responding	• Verify alarm **LED status**. Remove all wiring from the output and connect the output to an ohmmeter. Check continuity across relay output circuit. • Verify relay settings in the alarms menu, checking for forcing and logic to make sure they are set correctly.
Analog Output Not Responding	• Use a multimeter in series to verify that the milliamps match the milliamp measurement on the digital readout. • **Force** the analog output.

10 Maintenance

- Only trained professionals should install/maintain this product.
- Shutdown processes that include high temperatures, high pressures, toxic gases, hazardous particulate, or explosion risks prior to installing or removing equipment.

- Seuls des professionnels qualifiés doivent installer / entretenir ce produit.
- Arrêtez les processus qui incluent des températures élevées, des pressions élevées, des gaz toxiques, des particules dangereuses ou des risques d'explosion avant d'installer ou de retirer l'équipement.

Electronics Module

DynaCHARGE™ electronics are normally drift free and require no periodic maintenance or electronics calibration by the user. Electronics calibration is automatically confirmed with PRO models equipped with device health checks or EPA Automatic Self-Checks. As desired or required for quality programs or regulations, the entire device or the electronics module may be returned to the factory for NIST traceable calibration certification.

Particulate Sensor

DynaCharge™ particulate sensors properly configured for the application generally do not require periodic maintenance other than an annual inspection. This should be verified by conducting functional verification checks of the electronics and manually inspecting the sensor after one and six months of operation. After these two initial checks, if no need for sensor maintenance is observed, an annual inspection is recommended. For EPA compliance and critical measurement applications, PRO models with device health checks and EPA Automatic Self-Checks are recommended to provide added assurance between annual inspections and to automate regulatory inspection requirements.

Particulate Monitor Inspection

Each inspection should consist of the following:

- Visually inspect inside the sensor enclosure.
- Remove the sensor from the process and inspect the probe and insulator for buildup and/or moisture.
  - The sensor probe and insulator may be wiped down with a damp rag.
  - Fully insulated probes are recommended for processes with moisture and most conductive particulates.
- Inspect the inside of the process mount for buildup and/or moisture.
- Check the outputs.
- Perform **Functional Verification** checks.

11 Spare Parts

Spare parts for the PM 1 PRO include the following:

- PM 1 PRO Display Module
- PM 1 PRO Electronics Module
- PM 1 PRO Enclosure and Sensor/Nipple/Probe Assembly
- PS 10 Particulate Sensor
- CCA-SMB-XXX Coaxial Cable
- CCA-DC-XXX Daisy Chain Type Connector

Please see the **Model Configuration** section for spare parts configuration and examples. Add –SP to a part number to specify a spare part.

11.1 Electronics Module Replacement

The PM 1 is designed so that the electronics module can be easily replaced. An electronics module can be replaced by following the steps below:

1. Remove the cover from the PM 1 PRO.
2. Save settings onto the display module. (See section 6.9 for details)
3. Disconnect all power to the PM 1 PRO.
4. Remove all wiring (power, outputs, and remote sensor) from the terminal connections.
5. Remove the entire sensor from the process.
6. Remove the PM 1 PRO display module from the enclosure.
7. Loosen the two 9/64-inch hex screws that connect the electronics module to the enclosure.
8. Remove the electronics module from the enclosure and replace with spare electronics module.
9. Follow the above steps in reverse to complete the replacement.