OPERATION MANUAL

E-Sampler V2

Particulate Monitor
E-Sampler V2-9800
Rev. B

Met One Instruments
POWERED BY ACOEM

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Met One Instruments

POWERED BY ACOEM

Met One Instruments, Inc. is now part of the Acoem international group of companies.

Met One Instruments has been designing and manufacturing class-leading meteorological, ambient air sensing, and air quality monitoring instrumentation since its inception in 1989. Its line of robust industrial-grade meteorological equipment, air particulate monitoring equipment, and indoor air quality monitoring systems have set the standard for the industry. Headquartered in Grants Pass, OR, Met One Instruments, Inc. is fueled by a dedicated expert team who is diligently working to advance the technology required to ensure continued improvements in human and environmental health now and for generations to come.

Acoem is committed to helping organizations and public authorities find the right balance between progress and preservation — safeguarding businesses and assets and maximizing opportunities while conserving the planet's resources. Headquartered in Limonest, France, Acoem delivers unrivaled inter-operable AI-powered sensors and ecosystems that empower our customers to make enlightened decisions based on accurate and timely information.

In 2021, Acoem acquired Met One Instruments, marking a pivotal moment when two industry leaders in the air quality monitoring sectors converged — creating a single, stronger and more future-focused provider of holistic environmental monitoring solutions. Now, Met One Instruments Powered by Acoem has opened new possibilities through an extensive offering of class leading, multi-parameter environmental monitoring and industrial reliability solutions. These integrated measurement systems, technologies, and services deliver comprehensive solutions for a range of applications, including environmental research, regulatory compliance, and industrial safety and hygiene.

For more information about Met One Instruments Powered by Acoem, please visit: metone.com

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1. INTRODUCTION

1.1 *About This Manual*

This document is organized with the most important information grouped together for easy reference by the user. All E-Sampler V2 owners and operators should read and understand the sections on assembly, deployment, setup, menu hierarchy and field calibrations. Other sections that provide in-depth information on subjects such as theory, diagnostics, accessories, and alternate settings provide valuable information which should be consulted as needed. An electronic version of this manual is also available at https://metone.com/support-documents/.

1.2 *Technical Service*

This manual is structured by customer feedback to provide the required information for setup, operation, testing, maintaining, and troubleshooting the E-Sampler V2. Should you still require support after consulting the documentation, we encourage you to contact one of our expert Technical Service representatives during normal business hours of 7:00 a.m. to 4:00 p.m. Pacific Time, Monday through Friday. In addition, technical information and service bulletins are often posted on our website.

Contact Information:	Tel:	+ 541 471 7111	Address:	Met One Instruments
	Fax:	+ 541 471 7116		1600 NW Washington Blvd
	Web:	www.metone.com		Grants Pass, Oregon 97526 U.S.A.
	Email:	service.moi@acoem.com		

1.2.1 Return Authorization

Met One Instruments requires that an RA or Return Authorization form be completed and sent to the Met One Service department for approval, before sending instruments back for factory service.

Please contact the Met One Service Department to obtain a Return Authorization (RA) number. This allows us to track and schedule service work and to expedite customer service.

Domestic Customers: Visit the service tab at ***www.metone.com*** or email service.moi@acoem.com for the return authorization form and instructions.

International Customers: Email the Service department (Email listed in **Section 1.2**) for Return Authorization instructions.

1.3 *Unpacking the E-Sampler V2*

When unpacking the E-SAMPLER V2 and accessories, verify and compare them to the packing list to make sure all the required items are included for the type of installation planned.

See **Section 3** for the system check-Off list which includes standard and optional accessories.

NOTE: Please keep all the special shipping materials (box, foam packing, etc.) used to ship the E Sampler V2. They should be re-used when the E Sampler V2 is transported (changing site locations, returning to the factory, etc.). Contact Met One Instruments to purchase replacement packing materials if necessary.

1.3.1 Shipping Damage

If any damage to the shipment is present before unpacking, **a claim must be filed with the commercial carrier immediately**. Follow any special unpacking instructions provided by the carrier when all items are carefully removed from the containers and each component inspected. It is recommended to document and photograph all damaged packages and items before, during, and after unpacking them. Contact Met One Instruments to arrange for any replacement items needed.

1. Carefully unpack items from the box.
2. Inspect all components for damage.
3. Compare all components to the packing list to ensure all items have been shipped.
4. After unpacking all components/sub-assemblies, take photos of each part with labels still attached and confirm they match all components/sub-assemblies listed on the packing list.

From the list provided below, check that all mandatory, standard equipment and optional accessories have been included.

1.3.2 Packing Materials Replacement

Met One Instruments recommends keeping the special shipping box and foam packing material the E-Sampler V2 was shipped in as they could be re-used when the instrument is transported to another site or returned to the factory for any reason.

If the original packing materials are disposed of or lost, replacement packing materials can be purchased through the Met One service department via email.

1.4 *About the E-Sampler V2*

The Met One Instruments, Inc. model *E-Sampler V2* is a type of nephelometer which automatically measures and records real-time airborne PM10, PM2.5, or TSP particulate concentration levels using the principle of forward laser light scatter. In addition, the E-Sampler V2 has a built-in 47 mm filter sampler which can optionally be used to collect the particulate for subsequent gravimetric mass or laboratory evaluation. The E-Sampler V2 combines the excellent real-time response of a nephelometer with the accuracy and traceability of a low flow manual gravimetric sampler. Detailed descriptions of the E-Sampler V2 measurement modes can be found in **Section 5**.

Figure 1-1 E-Sampler V2 System with Optional Tripod

Laser Light Scatter System
Sample air is drawn into the E-Sampler V2 and through the laser optical module, where the particulate in the sample air stream scatters the laser light through reflective and refractive properties. This scattered light is collected onto a photodiode detector at a near-forward angle, and the resulting electronic signal is processed to determine a continuous, real-time measurement of airborne particulate mass concentrations.

Gravimetric Filter Sampler System
After the sample air stream has been measured by the E-Sampler V2 and exits the optical engine, it passes through the built-in 47 mm filter sampler system. This system allows the particulate to optionally be collected on a filter disc as a second method to obtain airborne particulate mass data, or for laboratory analysis of the particulate.

The 47 mm filter system can also be used to determine a gravimetric K-factor (slope multiplier) to correct the E-Sampler V2 real-time signal to match the local particulate type. In this case, a filter disc is weighed on a microbalance before and after being run in the E-Sampler V2 for a period of time. The resulting mass of the dust on the filter is correlated with the concentrations that the E-Sampler V2 recorded over the same time period, and a correction factor is calculated. The E-Sampler V2 can be used with no correction factor in applications where relative particulate trending is appropriate.

1.4.1 Laser Radiation Safety and Conformity

The E-SAMPLER V2, when properly installed and operated, is considered a Class I laser product. Class I products are not considered to be hazardous.

This system contains a diode laser that operates at 5 mW power and 670 nm wavelength. The beam is visible to the naked eye and can cause retinal damage if directly exposed. A protective optical housing fully encapsulates the laser beam and optics system within the E-SAMPLER V2. Do not attempt to disassemble the optical module. Failure to comply with this instruction could cause accidental exposure to laser radiation. The manufacturer certifies that this product operates in compliance with following standards and regulations:

- **FDA / CDRH This product is tested and complies with 21 CFR, Subchapter J, of the health and Safety Act of 1968.**
- **US 21 CFR 1040.10.**

Always power down the system whenever service or repair work is being performed inside the instrument enclosure.

NOTE: The optional internal battery must be disconnected to de-energize the E-Sampler. Only trained technicians should attempt to repair the E-Sampler. Routine maintenance does not require removing the instrument from its weatherproof enclosure.

1.5 *E-Sampler V2 Specifications*

Table 1-1 E-Sampler V2 Specifications Table

PARAMETER	SPECIFICATION
Measurement Principles:	Particulate concentration by forward light scatter laser Nephelometer. 47 mm Filter for Gravimetric sample comparison (Timed Sample).
Available Cut Points:	TSP Inlet Standard. PM_1, $PM_{2.5}$ and PM_{10} sharp-cut cyclone inlets available.
Measurement Range:	0 to 100 mg/m^3 (0 to 100,000 µg/m^3).
Nephelometer Accuracy:	± 10% to gravimetric method typical when K-factored to local particulate type.
Gravimetric Accuracy:	± 8% of NIOSH 0600.
Precision:	Greater of 3 µg/m^3 or 2%.
Sample Cycle Options	Continuous or Timed (for Gravimetric Sampling)
Alarm Contact Closure:	Normally closed contact closure relay output. Contact rating 0.5A @ 100V DC max.
Alarm Reporting	Available through serial port data files, display, and relay output.
Data Storage Resolution:	1 µg/m^3
Data Storage	Maximum of 22,518 user data records. When Storage is full, oldest data will be erased to store new data.
Data Storage Intervals:	User-Selectable 1, 5, 10, 15, 30, or 60 minute averages.
Data Update Interval:	1-second measurements, available on display and analog output.
Particle Size Sensitivity:	0.1 to 100 micron. Optimal sensitivity 0.5 to 10 micron particles.
Laser Type:	Diode Laser, 5 mW, 670nm. Visible red.
Long Term Stability:	5% with clean optics.
Flow Rate:	2.0 liters/minute ± 0.1 lpm. Actual volumetric flow.
Pump Type:	Brushless diaphragm sample pump Secondary purge pump
Automatic Zero and Span:	User-selectable 1 hour, 2 hour, 12 hour, or 24 hour intervals.
Internal Battery:	Optional lead acid battery, 12V, 5 Amp-Hour. DURA12-5F or equivalent.
Internal Battery Run Time:	Up to 12 hours with inlet heater off. Up to 4 hours with inlet heater on.
Power Supply:	Universal 100-240 VAC input, 15 VDC output power supply included. Compatible with solar power kits or external batteries using optional DC power cable.

Table 1.1 E-Sampler V2 Specifications Table - Continued

PARAMETER	SPECIFICATION
Power Consumption:	1.1 amps @ 12 VDC (15 Watts) max continuous draw, running with inlet heater on. 0.35 amps (4.2 Watts) running with inlet heater off.
Operating Temperature:	0 to +50°C . (Ambient Temperature Sensor Range -30 to +50°C).
Barometric Pressure:	60,000 to 104,000 Pascal pressure sensor range.
Ambient Humidity Range:	0 to 90% RH, non-condensing.
Humidity Control:	Automatic 10 Watt inlet heater module controlled to sample RH setpoint. Sample RH sensor standard. 83832 ambient temperature and RH sensor standard.
Approvals:	ISO-9001. Designed to agree with EPA Class I and Class III FRM/FEM particulate samplers and monitors. Not an EPA-designated equivalent method.
User Interface:	Menu-driven interface with graphic color display, selector knob and two-button keypad.
Serial Interface:	RS-232, RS-485, USB C 2-way serial ports for PC, datalogger, or modem communications.
Compatible Software:	Comet™ (included), Air Plus™ and terminal emulators.
Factory Service Interval:	24 Months typical, under continuous use in normal ambient air.
Mounting Options:	Pole or wall mount bracket standard. Optional EX-905 tripod recommended.
Unit Weight:	5 kg (11 lbs) without tripod, battery, or optional accessories.
Unit Dimensions:	65cm high, 27cm wide, 16.5cm deep. (25.5" x 10.5" x 6.5"). With inlet assembly.

Specifications may be subject to change without notice.

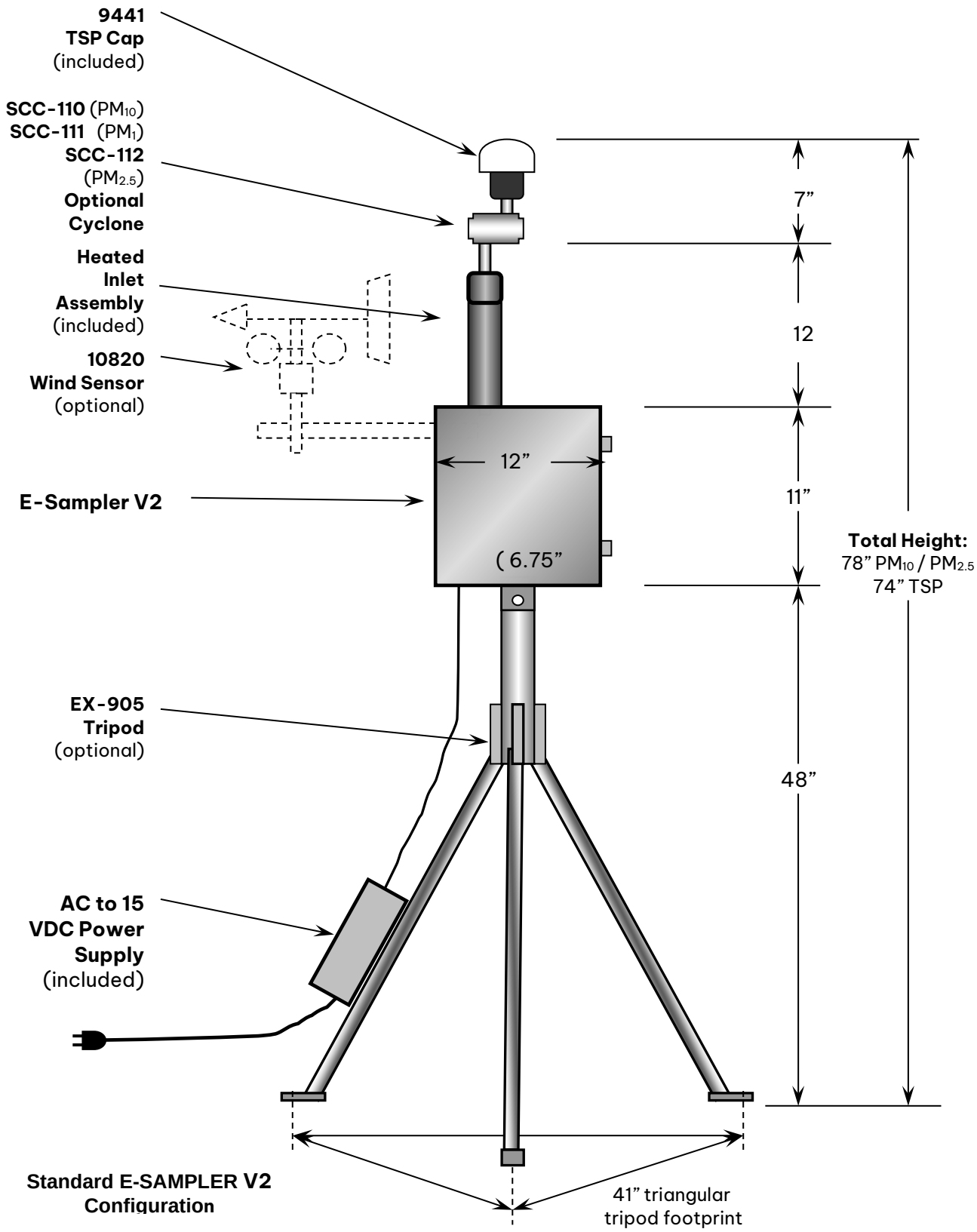


Figure 1-2 E-Sampler V2 Full System Diagram

2. SITE SELECTION and POSITIONING CRITERIA

Use the following criteria when choosing a sampling location for the E-Sampler V2. Always consider safety, security, and the suitability of the sampling environment before deploying the unit.

2.1 *Site Selection Requirements*

Proper site selection for the E-Sampler V2 is critical for accurate measurements. These items must be correctly addressed for the collected data to be acceptable for regulatory requirements, such as ARM or SPM methods. Although the E-Sampler V2 is not an EPA-designated instrument, U.S. EPA Specifications for the site selection are a good reference and can be found in the EPA documents referenced at the end of this sub-section.

U.S. EPA Document references:

- 40 CFR, Part 58 Appendix E.
- Quality Assurance Guidance Document 2.12 "*Monitoring $PM_{2.5}$ in Ambient Air Using Designated Reference or Class I Equivalent Methods*" **Section 5.1.2**.

2.1.1 Mounting Options

The E-Sampler V2 is a versatile, weatherproof particle counter designed to be mounted on the EX-905 tripod, a vertical post or a wall, for outdoor deployment. Take these options into consideration when selecting a sample site. Some sites may limit the mounting solutions available.

See **Section 4.1** for the different mounting options and their assembly procedures.

2.1.2 Electrical Grounding Requirements

To help prevent permanent damage caused by electrostatic discharges, the E-Sampler V2 needs to be wired to an earth ground. A heavy green and yellow ground cable is included in the accessory kit. One end of the grounding cable can be secured to the bottom of the E-Sampler V2 chassis by the grounding lug and its hardware. The other end of the grounding cable can be attached to either a grounding rod or pipe that extends at least three feet into the ground. Grounding the E-Sampler V2 is recommended before supplying any power to the system.

1. Remove the green rubber cap and lock nut.
2. Leave the individual lock washer on the grounding stud.
3. Install the grounding wire lug onto the grounding stud.
4. Thread the lock nut onto the grounding stud to secure the wire lug to the Chassis.

Figure 2-1 Grounding Stud Cap and Nut Removed

Figure 2-2 Grounding Wire Installed and Secured

This ground cable provides an electrical hazard ground, and static discharge path. It also provides some protection for the equipment from induced electrical currents that may occur during nearby lightning strikes. If a ground rod is not available, a cold-water pipe can be used as an alternative. If a water pipe must be used, be sure that a suitable type of compression grounding clamp is attached to the water pipe.

2.2 *Power Options*

This section is an introduction to the different power options available for the E-Sampler V2 and brief descriptions of their applications.

2.2.1 AC Power

The E-Sampler V2 standard power configuration uses a 15 VDC, 120VAC or 220VAC smart power supply that connects to the bottom of the E-Sampler V2, “DC Power” connection. See **Section 4.5.2** for installation instructions.

2.2.2 Stand-Alone Battery Options

1. Internal Battery

The recommended internal battery is an AGM Deep Cycle battery. This option is only intended for short term use. See Table 1-1 E-Sampler V2 Specifications Table for more information.
The internal battery can be almost any 12 VDC lead battery (AGM battery type Battery recommended) with maximum dimensions of 3.9” width (100 mm) 3.85” height (98 mm) and 6” length (150 mm). See **Section 4.5.3** for internal battery installation.

NOTE: The optional internal battery connection must be disconnected to power down the E-Sampler V2.

2. External Battery (Array)

WARNING: External batteries cannot be charged when connected to the E-Sampler V2. Catastrophic damage will occur to the E-Sampler V2's internal electronics.

The E-Sampler V2 can run for extended periods on external batteries. External batteries can be individually connected to the E-Sampler V2 and replaced with a charged battery as needed. Another option is to connect an array of batteries for longer run times. The most common type of battery for this application are 12 volt, 110 amp-hour, gel-cell or AGM, deep cycle batteries. **It is recommended to consult a certified electrician when setting up an external battery array.**

NOTE: The E-Sampler V2 AC power supply or internal battery cannot be connected to the E-Sampler V2 while external batteries or solar kits are connected, since these use the same power input connector.

Assuming a continuous E-Sampler V2 current draw of 1.25 amps, a single fully-charged 110 Ah battery would have the theoretical capacity to run the unit for 88 hours. However, the general rule is that a lead-acid battery should not be discharged by more than 2/3 of its capacity, especially in temperatures below 40 degrees F, so:

((110 Ah / 1.25 A) * .67) = about **59 hours** of run time per battery (worst case).

However, if the inlet heater is not running full time, the battery will last much longer. Additional run time can be achieved by connecting more batteries **in parallel** to the first battery. Additional batteries **must** be of the same type! When the battery voltage discharges below 10.5 volts, the unit will shut itself down until fresh batteries are supplied and the restart voltage threshold is exceeded.

2.2.3 External Batteries with Solar Charging System

Some remote applications require powering the E-Sampler V2 with a solar charging system and battery array. Met One supplies a line of standardized portable solar power kits for use with the E-Sampler V2. Data sheets are available. These are usually drop shipped directly from the manufacturer, and work in most (but not all) areas and applications. However, it is often preferable to contact your local solar shop and have your own array built locally based on your exact needs.

The size of the solar array will vary depending on the Peak Sun-Hour (PSH) rating of the sample location. *PSH ratings are usually based on worst case winter conditions at a particular location.* Summer sun ratings at the same location will be considerably higher, requiring less solar wattage. Sun rating maps can be found on the National Renewable Energy Laboratory website at www.nrel.gov. The table below shows some estimated solar array wattages required to run a 15 Watt DC E-Sampler V2 continuously in various sun ratings:

Table 2-1 External Battery Ratings

Local PSH Sun Rating kWh/m²/day	Minimum Solar Array Wattage	Battery Array for 5 Days Backup
2.0	316	2 x 110Ah
2.5	353	2 x 110Ah
3.0	211	2 x 110Ah
3.5	180	2 x 110Ah
4.0	158	2 x 110Ah
4.5	140	2 x 110Ah
5.0	126	2 x 110Ah
5.5	115	2 x 110Ah
6.0	105	2 x 110Ah
6.5	97	2 x 110Ah
7.0	90	2 x 110Ah

Met One supplies a line of standardized portable solar power kits for use with the E-Sampler V2. Data sheets are available. These are usually drop shipped directly from the manufacturer, and work in most (but not all) areas and applications. However, it is often preferable to contact your local solar shop and have your own array built locally based on your exact needs.

WARNING! Never connect a solar panel directly to the E-Sampler V2 power input! Never connect the E-Sampler V2 to a solar power kit without first connecting the batteries to the solar kit! Immediate over-voltage damage to the E-Sampler V2 circuit boards can result!

Solar panels output a high DC voltage during sunlight hours; beyond their nominal voltage. Even a solar charge controller may output higher voltages if not connected to a battery. A bank of external batteries is always required when using a solar array, to ensure function during the night and cloudy weather. The solar panels must be wired to charge these batteries through an appropriate charge controller. The E-Sampler V2 runs off of the solar system battery array only. The E-Sampler V2 will only tolerate 10 to 16 VDC input.

The solar power setup will require an 83246-1 DC battery power cable which plugs into the main power connector on the bottom of the unit. The internal battery (if used) should be removed from the E-Sampler V2 if a solar power kit is to be used.

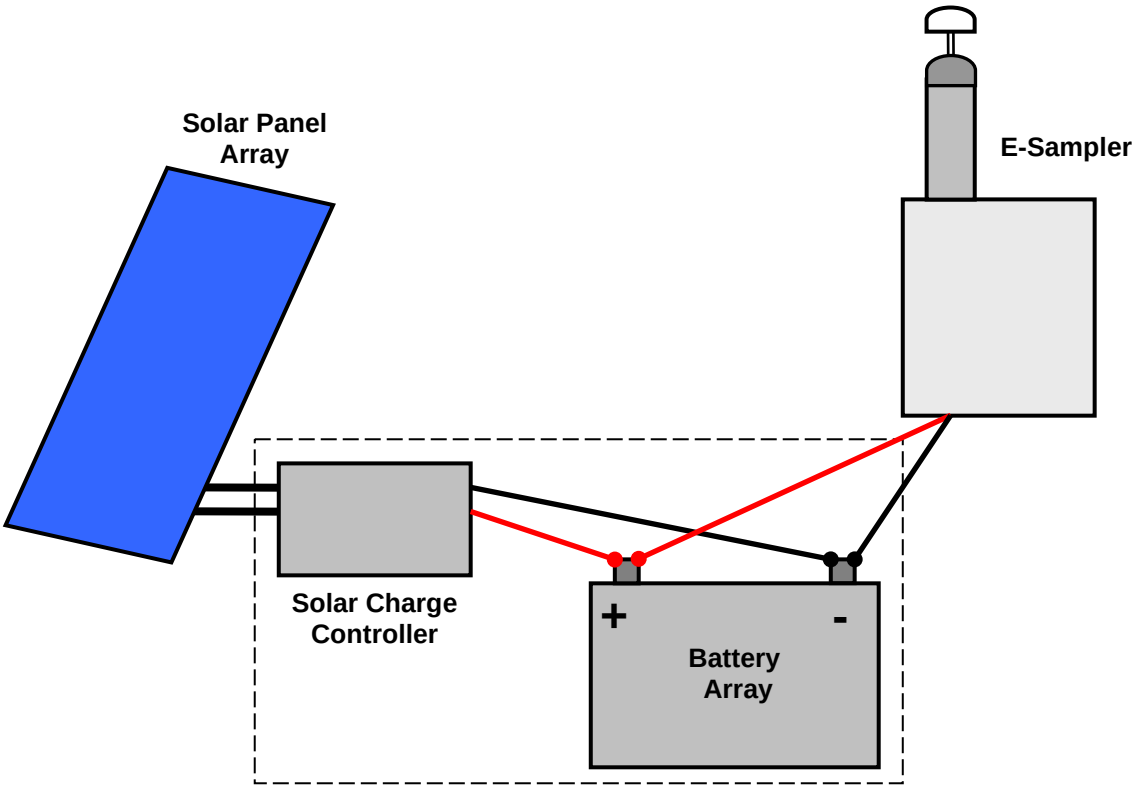


Figure 2-3 Simplified Solar System Diagram

2.3 *Inlet Requirements Height*

The inlet should be located between 2 and 15 meters above ground level for optimum sampling conditions.

- EX-905 Tripod Mounting: E-Sampler V2 Inlet, with a cyclone installed, sits two meters above the tripod base.

WARNING: If the E-Sampler inlet is the highest point on a building, lightning rods must be installed on the roof to protect the instrument from lightning strikes.

2.3.1 Inlet Radius Clearance Requirements

1. **CO-LOCATION**: When the E-Sampler V2 is collocated with other particulate instruments, the sample inlets must be within one meter vertically and two meters apart.
2. **BREATHING ZONE**: The E-Sampler V2 inlet should have a two-meter radius, free of any objects that may influence airflow characteristics.

3. **MAJOR OBSTRUCTIONS**: If located beside a major obstruction (such as a building) then the distance between the E-Sampler V2 and the obstruction should be at least twice the height of the obstruction.
    - There should be at least a 270-degree arc of unrestricted airflow around the inlet unless mounted on a wall.

3. E-SAMPLER V2 COMPONENTS

The E-Sampler V2 is supplied with the following standard accessories listed below. Optional Accessories are also listed below the standard accessories. The standard components for the E-Sampler V2 are shown in **Figure 3-1 E-Sampler V2 Standard Accessories.**

E-Sampler V2 System Check-Off List

- ☐ One Operation Manual (**E-Sampler V2-9800**)
- ☐ One **E-Sampler V2**
- ☐ One Weatherproof Universal AC to 15 VDC Power Supply (**9438-7**)
- ☐ One System Grounding Cable (**9035**)
- ☐ One Ambient Temperature and RH Combo Sensor with Cable (**83832**)
- ☐ One TSP Sampling Inlet (**9441**)
- ☐ 47 MM filter Cassette (**460128**)
- ☐ One Mounting Bracket with Hardware (**9425**)
- ☐ U-Bolt Kit (**9104-1**)
- ☐ One USB A Male to USB C Male Cable (**502116**)
- ☐ Three Cable Ties

Optional Accessories

The following optional accessories may be purchased separately:

- ☐ Tripod Assembly (**EX-905**)
- ☐ $PM_{2.5}$ sharp cut cyclone, 2 LPM (**SCC 112**)
- ☐ PM_{1} Sharp Cut Cyclone (**SCC 111**)
- ☐ PM_{10} Sharp Cut Cyclone (**SCC 110**)
- ☐ Internal Battery, 12V, 5Ah, AGM Deep Cycle (**390037**)
- ☐ Wind Speed and Wind Direction Sensor (**10820**)
- ☐ External DC Power Cable for Batteries and Solar Power Systems (**83246-1**)
- ☐ Filter, 47 MM Teflon, 2 Micron, 50 Pk (**460137**)
- ☐ Filter, 47 MM Glass Fiber, 100 Pk (**460138**)
- ☐ Filter, 47 MM Quartz Fiber, 100 Pk (**460139**)
- ☐ Serial Com Cable with Breakout (Stripped and Tinned) (**83315**)
- ☐ Serial Cable with DB9 Connector (**83849**)
- ☐ External Analog Relay Cable (**83609**)

Figure 3-1 E-Sampler V2 Standard Accessories

4. ASSEMBLY and DEPLOYMENT

The E-Sampler V2 is designed for rapid deployment and easy setup by a single person. The average assembly time can be less than 15 minutes in most applications. This section describes the different configuration options and assembly of the E-Sampler V2 and its standard accessories.

4.1 *System Mounting Options*

Mounting options will vary depending on the sample site location and available resources. The E-Sampler V2 provides versatile mounting solutions for most applications that include the optional EX-905 tripod, mounting on a pole, mast, or wall, using the provided mounting bracket. **Figure 4-1** and **Figure 4-2** are examples of how to hang and secure the E-Sampler V2 using the EX-905 tripod as an example but each mounting option will use the upper moutning tab receiver and bottom mounting support tab.

Figure 4-1 E-Sampler V2 Mounting Bracket Receiver

Figure 4-2 Bottom Mounting Support Tab

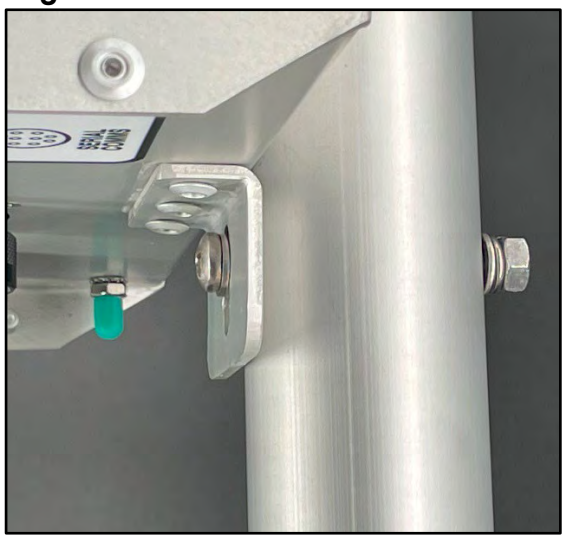


Figure 4-3 Secured Support Tab Example

4.1.1 Hanging and Securing The E-Sampler V2

NOTE: Before installing or mounting any accessories, hang the E-sampler V2 on the chosen mounting option.

To hang the E-Sampler V2, slide the mounting tab receiver over the mounting tab of the tripod or mounting bracket tab.

Secure the bottom mounting tab to the mounting surface with appropriate hardware. Each mounting option requires different hardware to secure the bottom mounting tab. Due to unknown mounting surfaces, hardware for the bottom bracket is not provided.

4.1.2 Optional EX-905 Tripod

The Met One EX-905 aluminum tripod is the recommended mounting for the E-Sampler V2. This optional mounting accessory provides a sturdy and portable platform.

The EX-905 is not included as a standard accessory to lower the overall cost for users who may not require it.

See **Figure 1-1, Figure 4-1, Figure 4-2, Figure 4-3** for examples of how the E-Sampler V2 mounts on an EX-905 Tripod.

4.1.2.1 EX-905 Tripod Assembly

The Met One EX-905 aluminum tripod is a standard accessory and recommended mounting option for the E-Sampler V2 in most outdoor applications. To deploy the tripod, follow the instructions below.

- **Tripod Leg Deployment**

The EX-905 is shipped in the storage/transport configuration shown in **Figure 4-4**. In this configuration the tripod mast is upside down. To deploy and secure the tripod, follow the steps below.

1. Withdraw the three stainless steel detent pins from the tripod mast base by pulling on the rings attached to the three pins (See **Figure 4-4)**.
2. Flip the tripod so the mast is in the upward position, this will allow the legs to pivot down into the leg slots.
3. Line up the holes in the leg supports with the detent pin holes in the mast base slots.
4. Insert each pin into the aligned holes until the detent ball is visible from the other side, securing the legs in the open position (See **Figure 4-5**). Make sure the assembled tripod is rigid and stable.

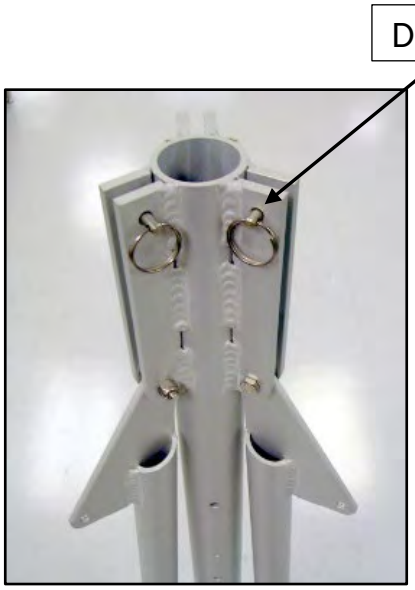


Figure 4-4 Tripod Storage/Transport Configuration (Upside down)

Figure 4-5 Tripod Legs Deployed

- **Securing the EX-905 Tripod**

Stand the tripod on a surface that is level. The tripod feet can be secured to the ground or mounting surface with bolts, screws, or heavy tent pegs, if necessary. Secure the tripod legs to protect the system in windy conditions.

4.1.3 Mounting Bracket

The mounting bracket and hardware (included in the accessory kit) is standard equipment for hanging the E-Sampler V2 on a pole, mast, or wall.

Figure 4-6 Mounting Bracket Front View

Figure 4-7 Mounting Bracket Side View

The bracket must be screwed or bolted to the mounting surface with appropriate hardware.

The hardware provided with the mounting bracket is intended for a pole or mast with a maximum outer diameter of 2-inchs. The hardware may not be suitable for other mounting solutions such as wall mounting.

The pre-drilled bracket holes and bottom support bracket slot can be used as templates for marking the mounting surface in preparation for drilling. (Photo of marking hole points with bracket.)

After the E-Sampler V2 has been hung, align the bottom support tab to the center of the pole mast. Use the support tab slot as a template to drill a hole for desired bottom support tab hardware.

The bracket receiver on the top backside of the E-Sampler V2 slides over the mounting bracket tab (**Figure 4-6**). There is a support tab at the bottom of the E-Sampler V2 that needs be bolted to the mounting surface to ensure the unit is secure (**Figure 4-2**).

4.1.4 Pole or Mast Mounting

Pole or mast mounting solutions provide versatility if the EX-905 tripod is not available, or the sample site does not have adequate space for the tripod. This mounting option, when correctly secured, provides Ideal sampling positioning. See, **Section 2.1** for sampling recommended sample site criteria.

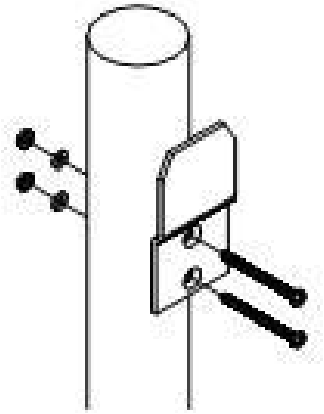


Figure 4-8 Mounting Bracket, Pole

4.1.5 Wall Mounting

If EX-905 or pole mounting is not possible, wall mounting is an option but is not recommended due to airflow and particulate obstructions produced by the wall.

Depending on the wall surface, a professional contractor may need to be employed to secure the mounting bracket to the chosen wall.

NOTE: If mounting the unit to a wall, ensure that there is adequate space around the inlet to allow unrestricted airflow to the Inlet.

4.2 *Sample Inlet Configurations*

Figure 4-9 Inlet Cap

This section explains the various inlet combinations and how to assemble them for specific sampling requirements.

The E-Sampler V2 Ships with a rubber inlet cap. This cap needs to be removed before installing any other inlet devices.

DO NOT DISCARD the rubber inlet cap as it can be used for performing leak tests and storing the E-Sampler V2.

4.2.1 Weatherproof TSP Cap

TSP or Total Suspended Particulate Sampling cap is the standard inlet configuration for the E-Sampler V2. A TSP inlet is included with the accessories that comes with the E-Sampler V2. The TSP Cap is intended to keep water, insects, and debris out of the instrument's sample flow system.

Install the TSP by firmly pressing the opening of the TSP cap onto the inlet until it stops.

Figure 4-10 TSP Inlet Cap

WARNING: Never operate the E-Sampler V2 outdoors without at least the TSP inlet in place, as the resulting water/debris damage is not covered under warranty.

4.2.2 PM Specific Cyclone

NOTE: The E-Sampler V2 is NOT EPA certified as a standard and can only be used as a reference for collocation purposes.

SCC 111 Cyclone (PM_1) Installation:

Remove the black rubber cap from the inlet.

Slide the wide opening of the silver cyclone adapter (installed on the bottom end of the gray SCC body) onto the inlet tube.

There are two O-rings inside the wide opening of the adapter that need to be fully seated on the inlet tube.

The SCC 111 comes with a TSP cap that is secured to the SCC 111 by a screw.

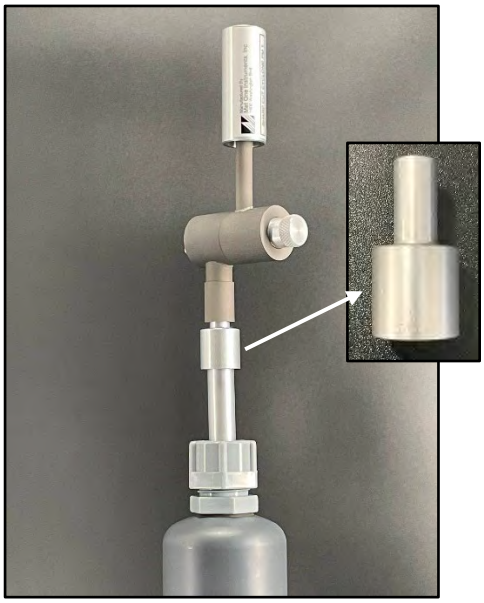


Figure 4-11 SCC 111

For $PM_{2.5}$ or PM_{10} monitoring, the optional sharp-cut cyclone of the desired cut-point must be installed onto the inlet tube, under the TSP inlet.

SCC 112 $PM_{2.5}$ and SCC 110 PM_{10} Specific Cyclone and TSP Cap Installation:

Be sure to remove the black rubber inlet cap before installing the cyclone and TSP Cap (See **Figure 4-10**).

If a TSP cap has previously been installed, remove the cap to install the Cyclone.

Both the cyclone and TSP cap have two O-rings inside the outlet to seal the connection.

Firmly press the wide opening (outlet) of the cyclone onto the inlet tube until both O-rings are engaged.

The TSP cap outlet is then firmly pressed on the smaller opening (inlet) of the cyclone.

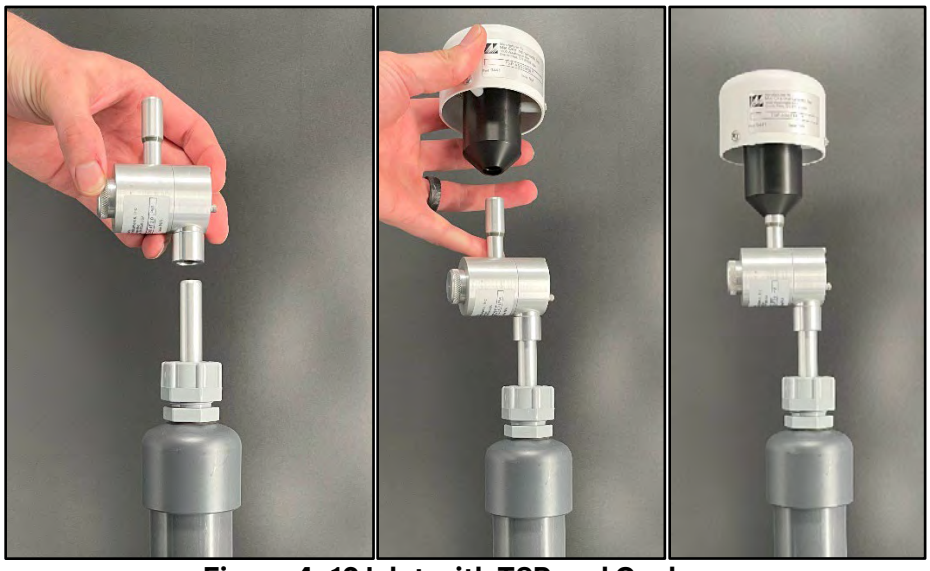


Figure 4-12 Inlet with TSP and Cyclone

4.3 *47 mm Filter Cassette*

The 47mm Filter is not a commonly used system of the E-Sampler V2. See **Sections 8.5.1** and **11.2.3** for more information about the 47mm filter system, its application and operation.

4.4 *Electrical Connections*

The E-Sampler V2 has five keyed plugs with leashed weatherproof caps on the bottom of the unit. Each connector is keyed to assure correct alignment and has different pin configurations to prevent incorrect connections. **Figure 4-13** identifies each connector with their description.

NOTE: The E-Sampler V2 will turn on automatically when a 12V power source is connected to the power input.

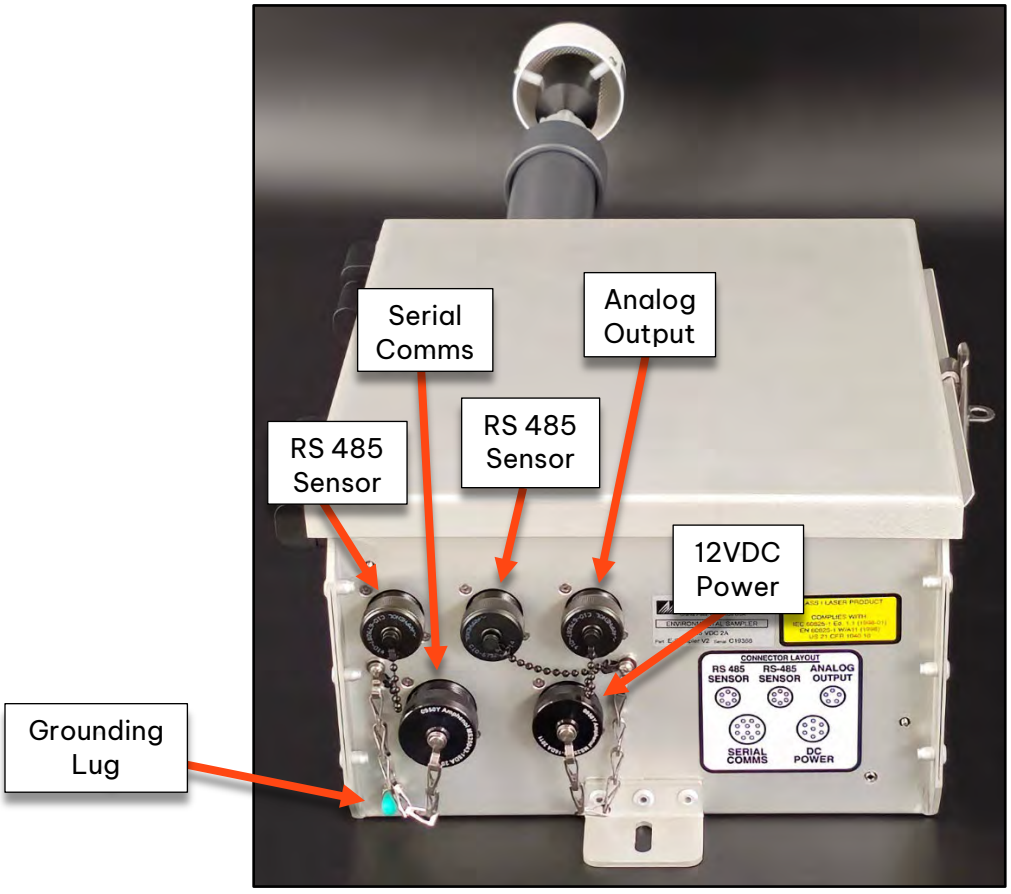


Figure 4-13 Electrical Connections

4.4.1.1 Connector Descriptions

Grounding Point: The grounding lug is where the E-Sampler V2 chassis is grounded. To install the green and yellow grounding cable to the E-Sampler V2, remove the green rubber cap from the grounding point threads. Remove the nut from the grounding pint. Place the blue lug, attached to the grounding cable, over the grounding point and secure with the nut. See **Section 2.1.2** for more information about grounding requirements.

RS 485 Sensor Connector: These connectors are for digital ambient sensors such as the ambient combo sensor (**83832**) and optional wind sensor (**10820**).

Analog Output Connector: This connector is for the optional analog output cable, part 83609**.**

Serial Comms connector: This connector is for the optional Serial Comms cable, part 83315.

DC Power (12V) Connector: This connector is used for the standard DC power supply or the optional external DC power cable for batteries and solar power systems, part 83246-1.

1. Connecting sensor and communication cables to the E-Sampler V2.
    a. Unscrew the waterproof cap from the connector receiver.
    b. Mate the correct cable connector to the connector receiver at the bottom of the E-Sampler V2.
    c. Rotate the cable connector until the connector key slot and receiver key matchup allowing the connector and receiver threads to make contact.
    d. Thread the cable connector collar onto the receiver threads by pressing the connector towards the threads and turning the collar clockwise.
    e. Tighten the collar until it is snug.
2. Power Connection
    a. Follow the same steps above to connect the power cable to the bottom of the E-Sampler V2. Be sure that all other sensors are connected before supplying power to the instrument.

See Section **5.1 Initial Startup Sequence** after system is connected to power.

4.5 *Accessory Mounting and Connections*

This section explains how to mount accessories and connect them to the E-Sampler V2.

4.5.1 MET Sensor Mounting and Connection

83832 Ambient Sensor Mounting The mounting hardware includes one U-bolt, one V-Channel Bracket, two nuts, two locking washers and two flat washers. A 10 mm deep socket or wrench will be needed.

NOTE: It is recommended to assemble the mounting hardware on the Sensor bracket before mounting to the tripod or pole.

1. Put the U-bolt threads through the inner holes of the sensor bracket.
2. Slide the V-channel bracket over the threads, V facing towards the sensor bracket.
3. Put the flat washers over the U-bolt threads, against the V-Channel bracket, followed by the lock washers.
4. Thread the nuts onto the U-bolt threads, about

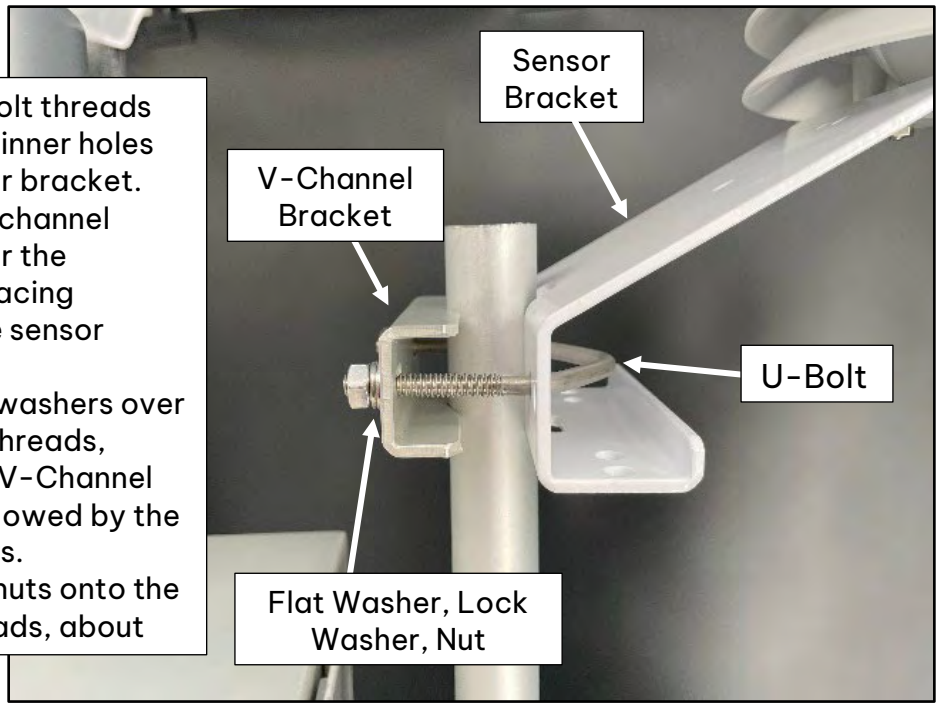


Figure 4-14 Sensor Mounting Diagram

Pull the V-channel bracket away from the sensor bracket to create a gap. Slide the assembly onto the Tripod pole. Tighten the nuts until the lock washer is flat.

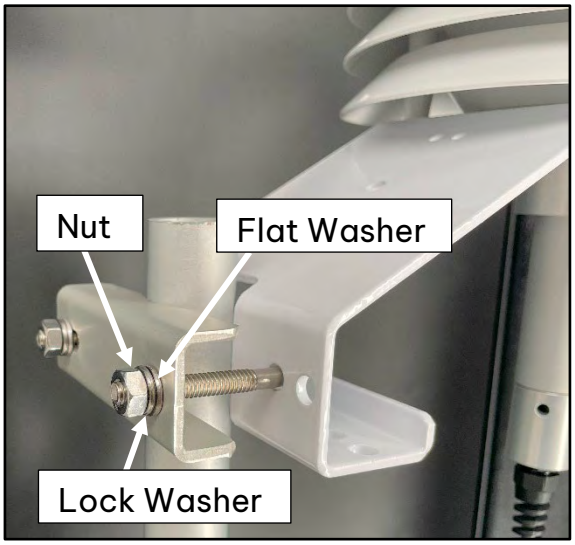


Figure 4-15 Sensor Mounting Example 1

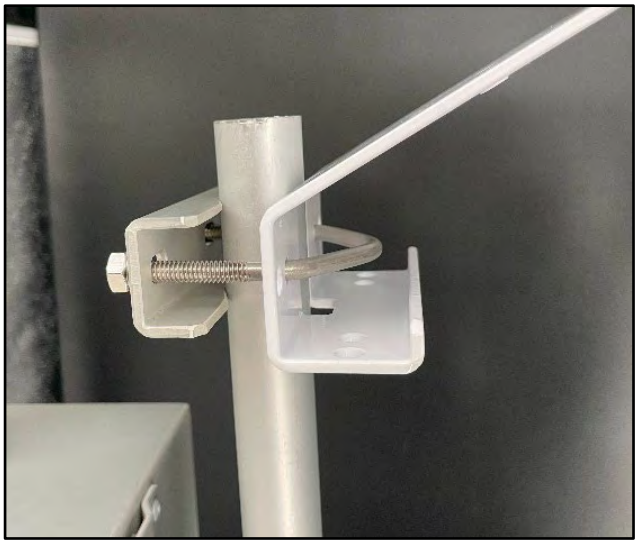


Figure 4-16 Sensor Mounting Example 2

83832 Ambient Sensor Connection

Unscrew and remove the cap from the first RS-485 plug at the bottom of the E-Sampler V2.

NOTE: the connector alignment key is facing towards the front of the unit.

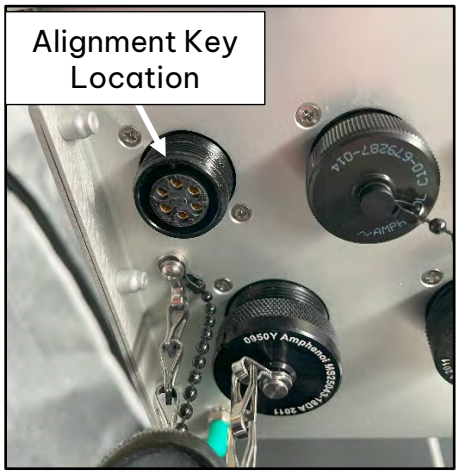


Figure 4-17 Sensor Plug alignment key

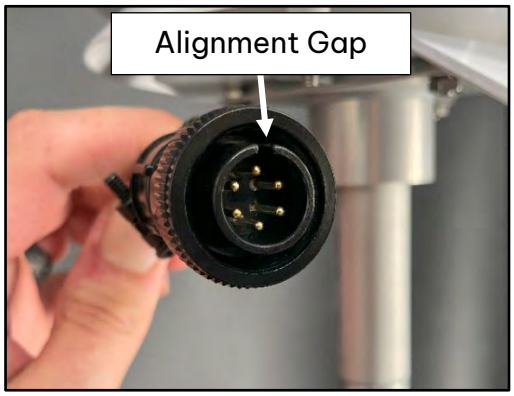


Figure 4-18 Sensor Connector Alignment Gap

Align the six-pin Sensor Connector alignment gap with the plug key.

Push the connector into the plug as far as it will go.

Grip the base of the connector and push upward with one hand while turning the threaded connector collar, clockwise.

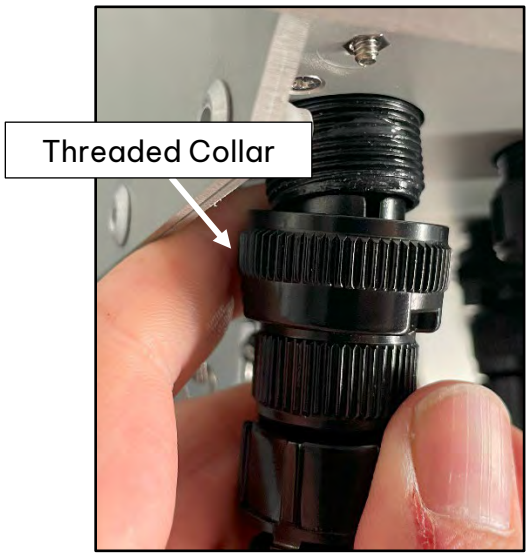


Figure 4-19 Connector Alignment and Threaded Collar

Tighten the threaded collar, finger tight.

Figure 4-20 Sensor Cable Connected

4.5.1.1 Optional Wind speed and direction Sensor

If an optional 10820 or EX-AIO digital wind speed/direction sensor is supplied, then it will come with a cross-arm tube which mounts to the stud on the top of the EX-905 tripod with supplied fittings. Install the wind sensor on the end of the cross-arm. The wind sensor should be as far from the E-Sampler V2 unit as possible without affecting the tripod balance, and (for the 10820) the wind vane must be able to rotate freely.

Connect the wind sensor into the RS-485 SENSOR plug, directly to the right of the temp sensor plug on the bottom of the unit. Consult the separate manual that comes with the optional wind sensor for correct installation and orientation.

The second RS-485 plug is reserved for secondary or optional sensors such as a wind speed and wind direction sensor.

4.5.2 Power Supply Mounting

The instructions below are for mounting the power supply to the leg of an EX-905 Tripod. These instructions are also applicable when securing the system to a pole. Other mounting solutions such as wall mounting, may require different hardware to secure the power supply. The power supply kit includes the power supply with hardwired cables coming out the bottom of the enclosure, two U-bolts and four nuts. A 7/16th deep socket or wrench is required to tighten the nuts.

There are mounting/alignment tabs at the top and base of the power supply enclosure.

Secure the top of the power supply first, then the bottom.

With the cables in the downward position, mate the back of the power supply to a leg of the tripod using the tab cut-outs as an alignment guide.

The U-bolt mates to the tripod leg from the back of the power supply with the threaded portions going through the top mounting tab holes, towards the front of the power supply.
Thread one nut on both of threaded portion of the U-Bolt and tighten the nuts.

Follow the steps above to secure the base of the power supply.

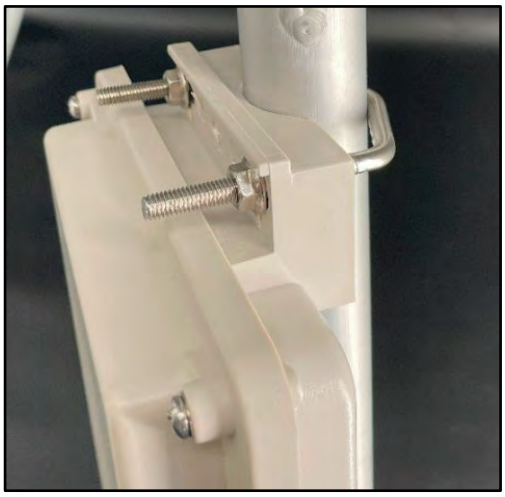


Figure 4-21 Power Supply Mounting Position

Figure 4-22 Power Supply Mounted

Remove the DC Power plug cap by unscrewing it, counterclockwise.

Align the 7-pin connector gap with the DC Power plug

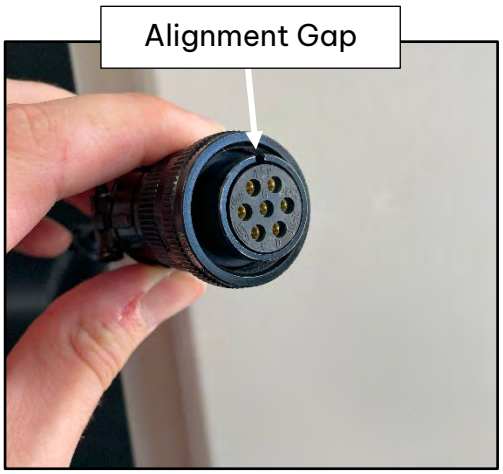


Figure 4-23 Power Supply 7-Pin Connector

Figure 4-24 DC Power Connected

Tighten the threaded collar while applying upward pressuer to the base of the connector.

The collar should be snug.

4.5.3 Internal Battery Connection

If the unit is to be used with the optional internal 12V battery, connect the included two-wire fused battery harness to the battery (red positive, black negative). Slide the battery into the tray and route the Velcro strap around the battery. Do not ship or transport the unit with the battery installed.

Remove the electrical cover from the front of the unit by pulling on the small knob at the top center of the cover.

The cover is held on by a magnet.

NOTE: The internal battery must be disconnected to power down the unit.

Figure 4-25 Electrical Cover Removal

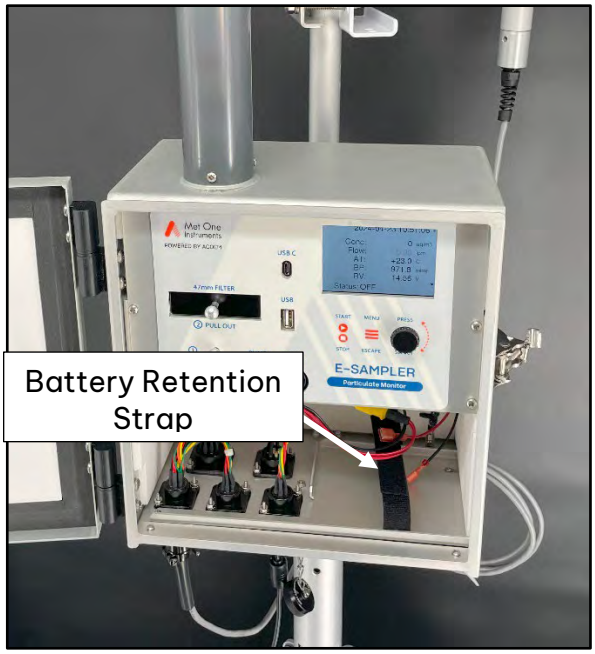


Figure 4-26 Electrical Cover Removed

With the electrical cover removed, Locate the battery retention strap on the right side of the electrical compartment.

The battery retention strap is made from hook and loop material.

Pull the two ends apart and move them out of the way.

Figure 4-27 Battery Retention Strap

Figure 4-28 Battery Terminal Covers

Remove the plastic battery terminal covers by sliding them off the terminal tabs.

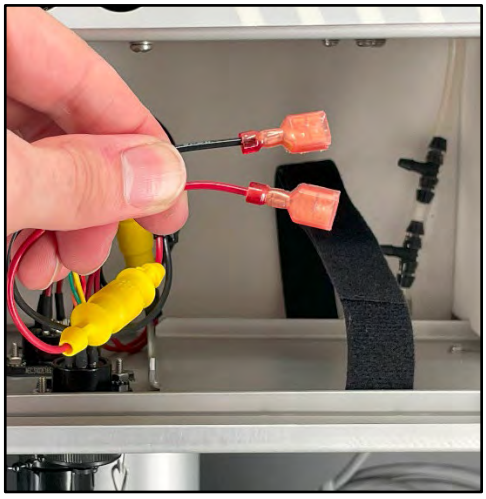


Figure 4-29 Batter Connection Wires

Locate the internal battery connectors with a yellow in-line fuse holder.

Slide the red wire connector onto the terminal with the red square.

Slide the black wire onto the terminal with the back square.

When both wires are connected, the instrument will power on.

Figure 4-30 Battery Terminals

Figure 4-31 Battery Installed

With the terminals facing down and to the left, lay the battery on its side in the battery tray. Secure the battery by re-attaching the straps. Re-install the electrical cover.

5. USER INTERFACE and MENU SYSTEM

This section describes the E-Sampler V2 user startup sequence, user interface system, each menu, its sub menus, and their functions.

5.1 *Initial Startup Sequence*

When the E-Sampler V2 is first powered on, a dark screen will appear for a few moments and change to the white splash screen with the Met One Logo in the top left corner. The logo will disappear and be replaced with the Home screen. The start sequence duration is 5 seconds.

5.2 *User Interface Navigation*

This section describes how to control the user interface, navigate through the menu hierarchy, and edit input fields.

The E-Sampler V2 user interface includes a selector knob, 2-button keypad, and a color LCD display (**Figure 5-1**).
Table 5-1**,** below, describes keypad button and selector knob functions. Note: buttons have more than one function when pressed.

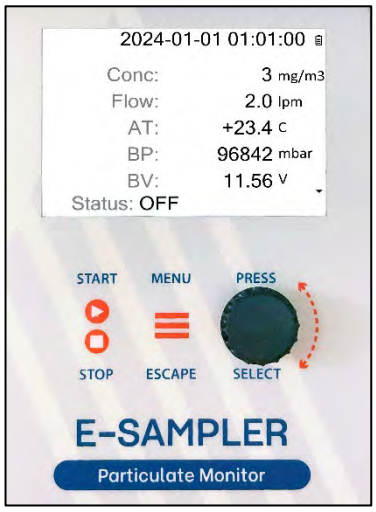
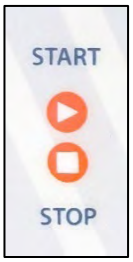
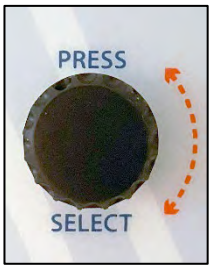


Figure 5-1 E-Sampler V2 Interface

Table 5-1 User Interface Descriptions

Button	Description
	Press between the triangle and square icons to actuate the button. When pressed, the Start/Stop button functions as follows: • **At the Home Screen**: Starts or stops a sample. • **In the Menu system**: Return to Home screen. • **When editing settings**: Cancels edit mode and return to the Home screen.
	Press on the three horizontal lines to actuate the button. When pressed, the Menu/Escape button functions as follows: • **At the Home screen**: Display the Main menu. • **In the Menu system**: Return to previous screen. • **When editing settings**: Cancel edit mode and return to the previous menu.
	**Selector knob Function** • Turn clockwise to scroll down or right. • Turn counterclockwise to scroll up or left. • Turn to move though picklist or numerical parameters in edit mode. **Press Function** • Press to select outlined menu option. • Press to edit outlined input field. • Press to save modified input fields and exit edit mode. • Press to view sample history at Home screen.

5.2.1 Editing Input Fields

To adjust an entry field, turn the selector knob so the green box is around the field to be edited.

Press the selector knob to edit the field within the green box.

When pressed, the box will be replaced by a red line under the first character within the field being edited.

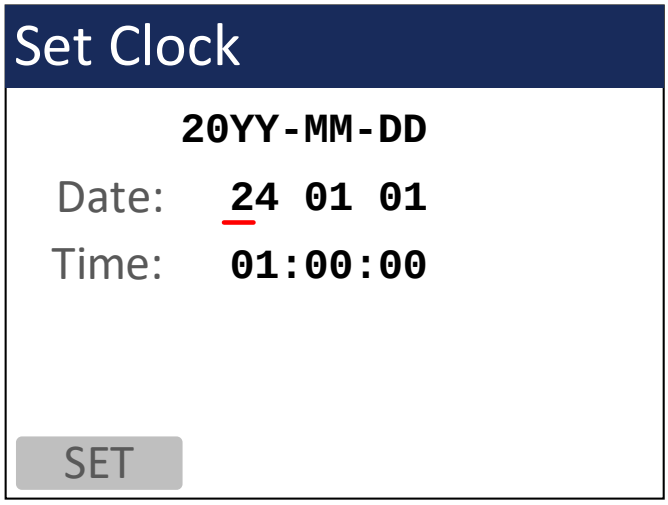


Figure 5-3 Set Year, First Digit

Turn the selector knob to adjust the next character.

Press the selector knob to set the change.

The red underline will be replaced with the green box.

Use the selector knob to move the green box to the next field to be edited.

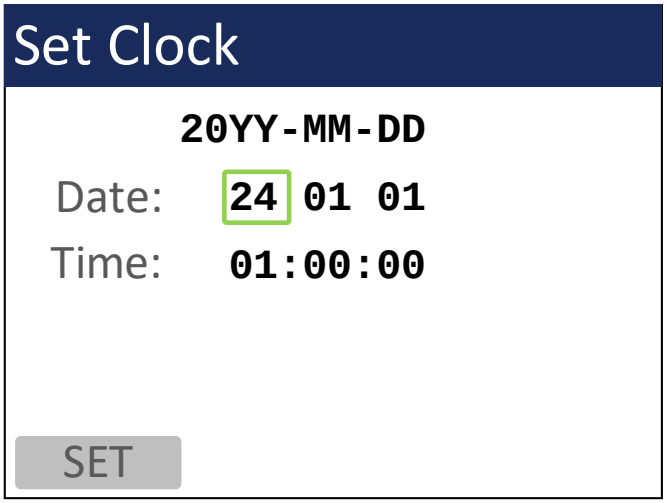


Figure 5-2 Set Clock, Year

Turn the selector knob to adjust the first character. For numerical values, the first number will automatically change the lower decimals when the minimum or maximum range is reached.

Press the selector knob to adjust the next character in the field.

When pressed, the red underline will move to the next character to the right (**Figure 5-4**).

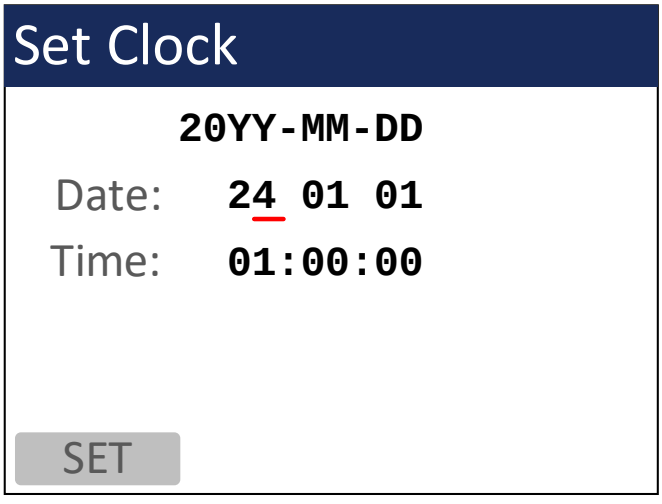


Figure 5-4 Set Year, Second Digit

5.3 *Menu Hierarchy*

Table 5-2 E-Sampler V2 Menu Hierarchy

Main Menu	Sub Menu Options	Overview
Home Screen	**NO SUB MENU**	**Displays the following:** Date and Time, Battery Level (BV), Concentration (Conc), Flow, Ambient Temperature (AT), Barometric Pressure (BP), Sampling Status (Off or ON), External Relative Humidity (RHx), Internal Relative Humidity (RHi), Wind Speed (WS), Wind Direction (WD).
Toolbox	**Sample Setup**	Setup Sample Time, Concentration Units, K-factor, and Sample Mode
	Self Test	Setup span test frequency and Off/On status
	Heater Control	Setup/adjust heater actuation (RH % Setpoint)
	Memory	View memory usage and clear memory
	Alarm Contact	Establish rules for activating the alarm contact closure relay output
	Digital Sensor	Setup digital ambient sensor connections
Calibrate	**Calibrate AT**	Calibrate temp. sensor or restore default settings
	Calibrate RH	Calibrate relative humidity sensors or restore default settings
	Calibrate BP	Calibrate barometric pressure sensor or restore default settings
	Calibrate Flow	Calibrate flow rate or restore default settings
	Calibrate DAC	Calibrate the digital to analog signal converter
	Leak Test	Test flow system for leaks
Alarm Log	**NO SUB MENU**	View/erase stored alarms
Transfer Data	**NO SUB MENU**	Select file type and copy stored data a USB drive (Days)
Initial Setup	**Clock**	Set the date and time
	Communications	Set station ID, baud rate, protocol, and Modbus address
	Engineering Units	Setup concentration, temp, pressure, and wind speed engineering units
	Analog Output	Setup concentration range and voltage range output.
	Display	Adjust back light brightness and display timeout
About	**NO SUB MENU**	Provides model, serial number, firmware version, service email, company phone number, last calibration date, and total run time.

5.4 *Detailed Menu Descriptions*

The following sections describe the seven main menus and the functions of the sub-menus within. The sub-menus have specific functions to change settings for proper configuration, operation, and calibration of E-Sampler V2 systems.
This section is broken up by the main menus and sub-menus with individual descriptions. The 5.X.X level shows the main menu screens, and the 5.X.X.X sections show and explain the submenus and their individual entries.

For first time configuration of this instrument see **Section 5.4.6 Initial Setup Menu**.

5.4.1 Home Screen

The E-Sampler V2 main sampling/operation screen or Home Screen is shown below in **Figure 5-5**. The date and time are always fixed at the top line of the display on this screen. The menus can be accessed by pressing the Menu/ESC button shown in **Table 5-1 User Interface** Descriptions.

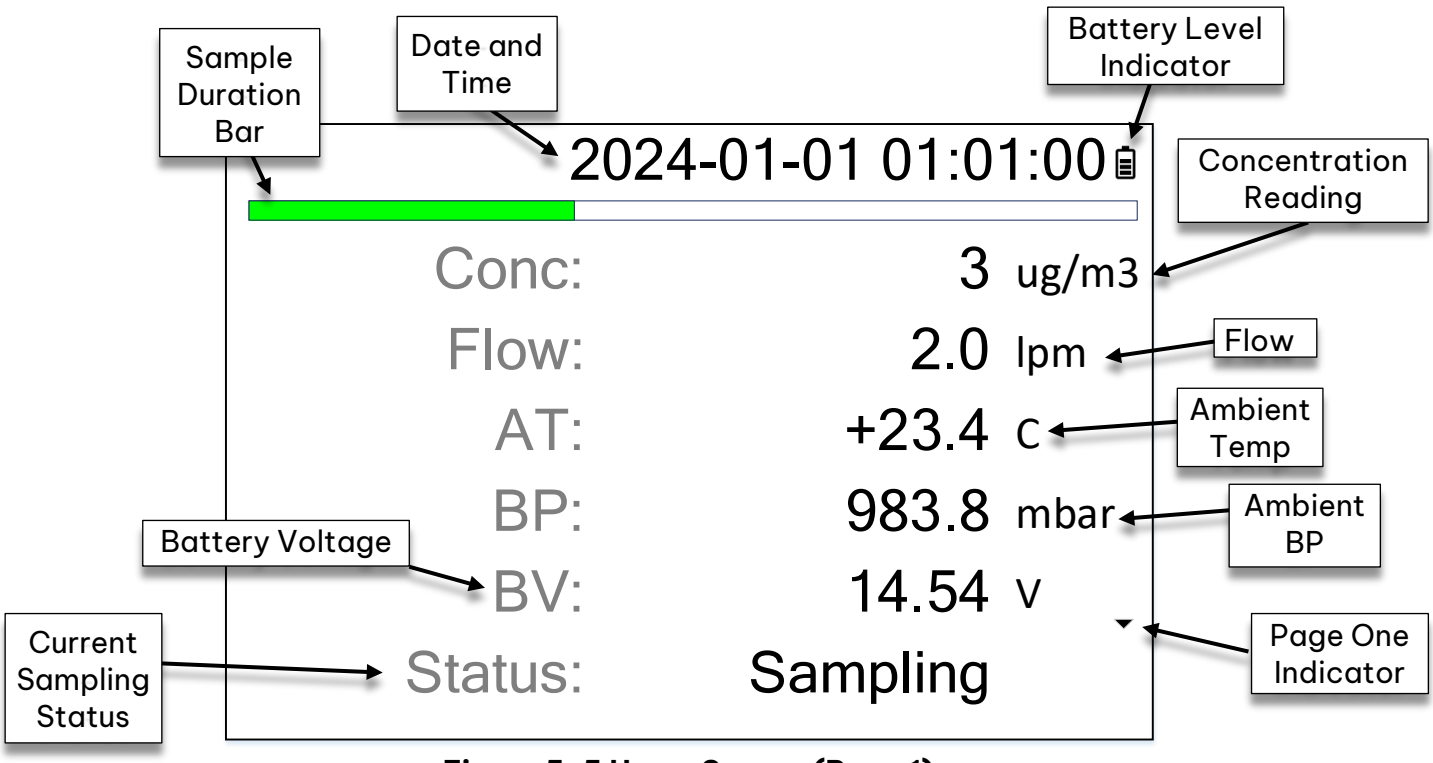


Figure 5-5 Home Screen (Page 1)

There are two pages of live data available from the home screen. The data is refreshed or updated every second. **Figure 5-5** displays the first page of live data and **Figure 5-6** shows the second page of live data. There are page indicators on the right side of the screen. The bottom arrow indicates page one is visible. The top arrow indicates page two is visible. To access the second page of data, turn the selector knob clockwise, from the first page. Move back to the first page by turning the selector knob counterclockwise.

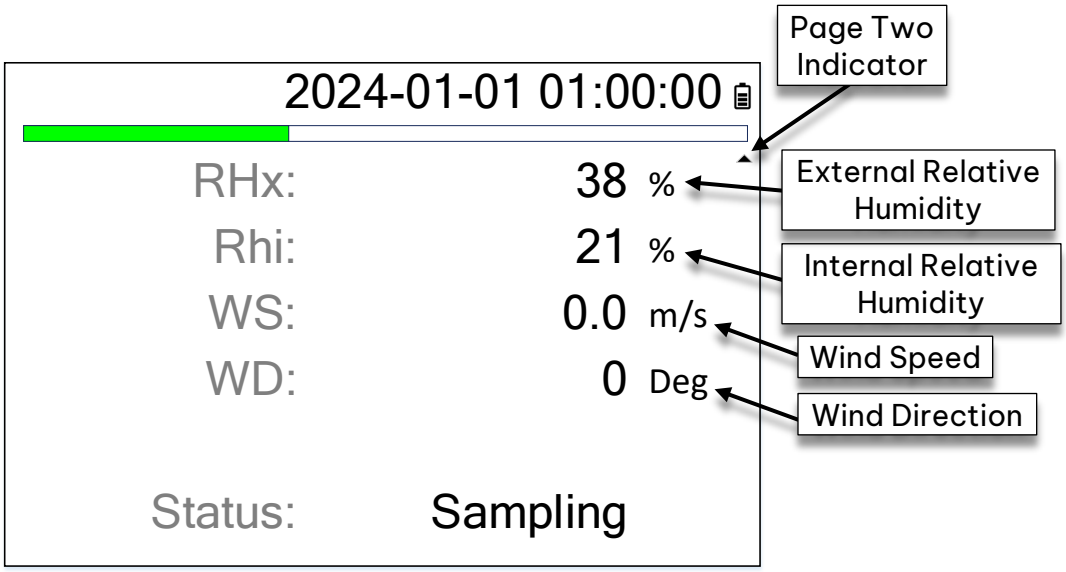


Figure 5-6 Home Screen (Page 2)

Historical data can be viewed at the Home Screen by pressing the selector knob. The viewable data corresponds with the set sample duration.

The data can be viewed from the newest to oldest records.

When in History mode, the date and time, along with the status will turn red and status will say “History”.

Turn the selector knob to scroll through the records.

Press the selector knob and turn the knob clockwise to view the second page of a specific data record.

Press the selector knob to continue navigating though data.

Press the Menu button to go back to the Home Screen.

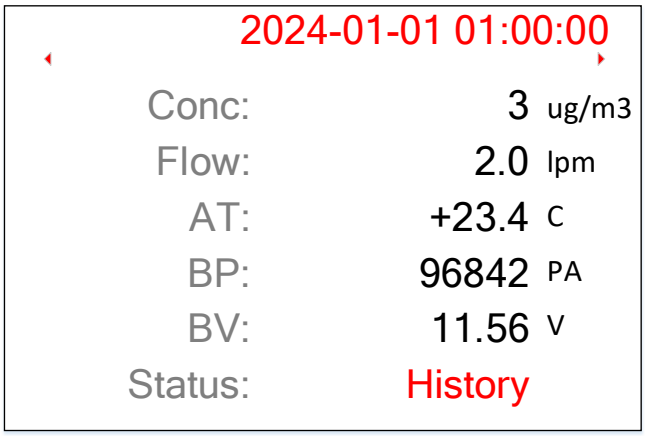


Figure 5-7 Main Screen Sample History

5.4.2 Toolbox Menu

The Toolbox menu provides commonly used configuration options.

Example: If the instrument moves from one location to the next, configurations may need to change to accommodate new sample site requirements.

The subsections below describe each of the configuration options within the Toolbox Menu.

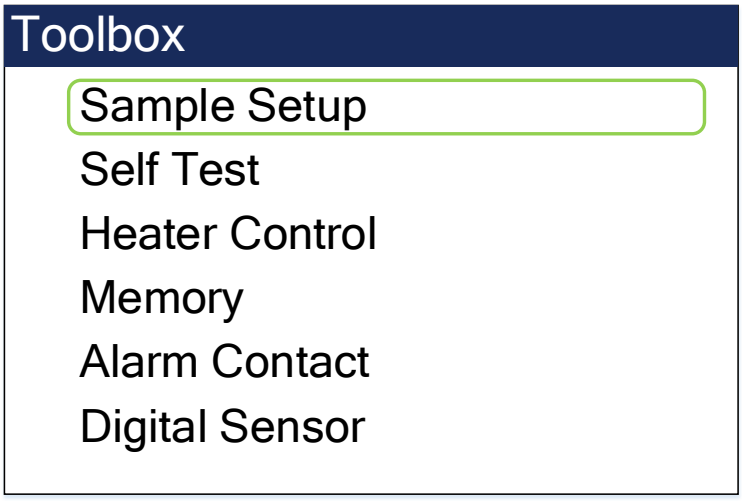


Figure 5-8 Toolbox Menu

5.4.2.1 Sample Setup Screen Description

Sample Setup screen consists of the following configuration options: Sample time, Units, K-factor, and Sample mode.

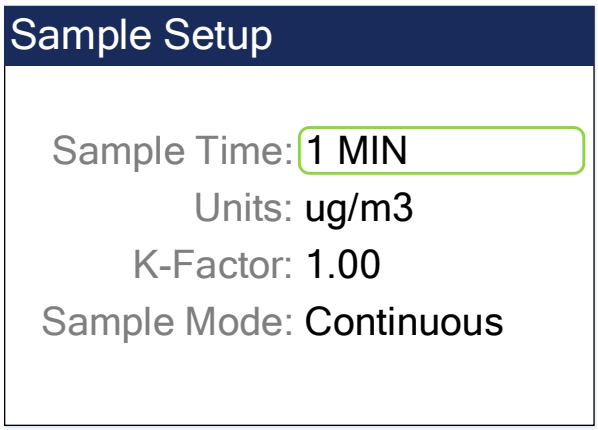


Figure 5-9 Sample Setup Screen

- **Sample Time**: The duration of time for concentration averaging calculations.

  Sample Time averaging options: 1 min, 5 min, 10 min, 15 min, 30 min, 1 hour.

- **Units**: Concentration engineering units.

  Selectable Unit Options: µg/m³ *(micrograms per meter cubed), mg/m³ (milligrams per meter cubed)*

- **K-factor**: Used to correct mass output slope multiplier. Correction values are established by utilizing the 47mm filter options for gravimetric reference or collocating with an FRM or FEM instrument. See **Sections 8.5 and 11.2.3** for more information.
- **Sample Mode**: Selectable run time options, Continuous sampling mode or Timed Sample mode.

  Continuous sample mode: When sampling begins in this mode, the instrument will sample until manually stopped.

  Timed sample mode: Set the sample start date and time along with sample duration or run time. Only one sample time can be programmed at a time.

5.4.2.2 Self Test Screen

To assure stable concentration data, the E-Sampler V2 performs optical system zero and span self-tests.

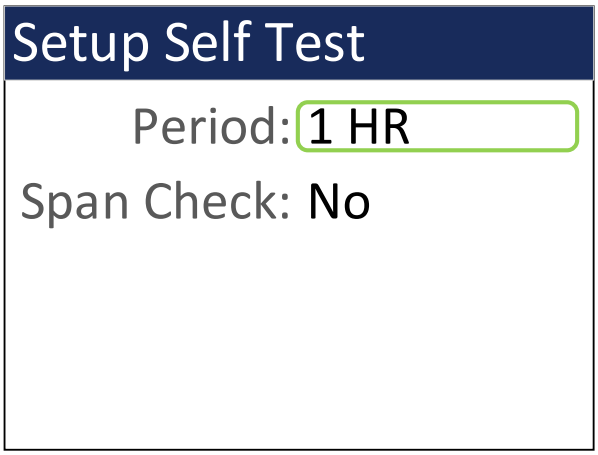


Figure 5-10 Self Test Screen

- **Self Test**: The interval can be configured to run every hour, 2 hours, 12 hours, or 24 hours.
- **Span Test**: The test can be turned off by selecting NO or selecting YES to run during the self test.

NOTE: Setting Span Check to "Off" means more sample time with less interruptions.

5.4.2.3 Heater Control Screen

The heater control screen displays the current E-Sampler V2's internal RH% for reference and RH Setpoint.

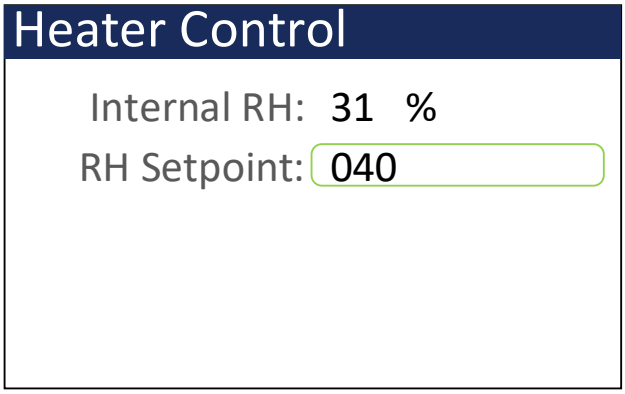


Figure 5-11 Heater Control Screen

- **RH Setpoint**: This is used to control when the inlet heater is automatically turned on or off, based on the internal RH. When the RH is at or above the setpoint, the heater will turn on.

5.4.2.4 Memory Screen

This Screen displays available or free memory and where stored data can be permanently cleared. Settings will remain when data is cleared. Memory capacity is displayed numerically, starting at 100% and counts down to 0%.

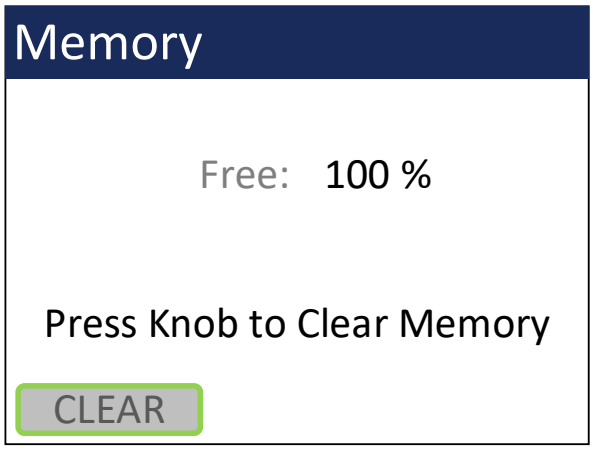


Figure 5-12 Memory Screen

- 100% indicates that the memory is empty.
- 0% indicates that the memory is full.

NOTE: When the memory is full, the oldest data will be overwritten by new data.

5.4.2.5 Alarm Contact Screen

This screen is used to establish the rules for activating the alarm contact closure relay output of the E-Sampler V2.

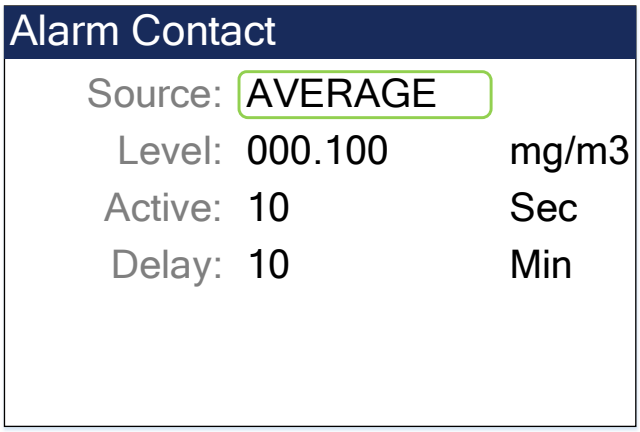


Figure 5-13 Alarm Contact Screen

The contact relay activation sources are Alarms, Average and Real Time.

Alarms will trigger the contact relay when a new alarm event takes place.

Average will trigger the contact relay with the average concentration calculated at the data logger rate averaging period.

Real Time will trigger the contact relay with the selected Real Time concentration.

Active is the time for how long the alarm is active.

Delay is the time between alarm activation if the condition continues or a new event occurs.

NOTE: The Alarm Contact Relay can be utilized using the 83609 External Analog Relay Cable.

5.4.2.6 Digital Sensor Screen

The Digital Sensor screen is used to set up and test the link with one or two digital ambient sensors.

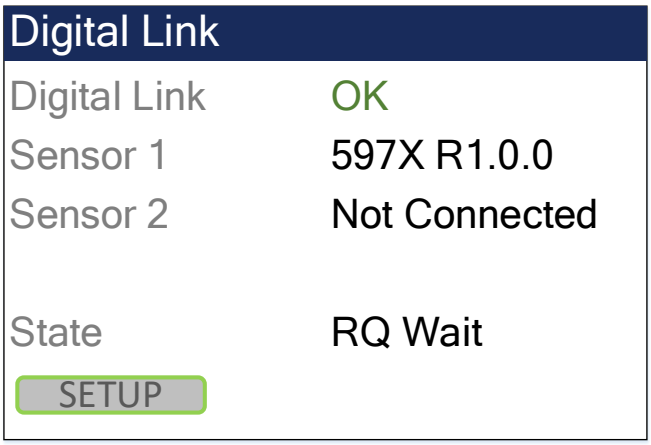


Figure 5-14 Digital Link Screen

5.4.3 Calibrate Menu

This section describes the Calibration menu, its sub-menus, and their functions. The Calibration menu provides the means to audit and calibrate individual measurement sensors that are vital to the operation of the E-Sampler V2.

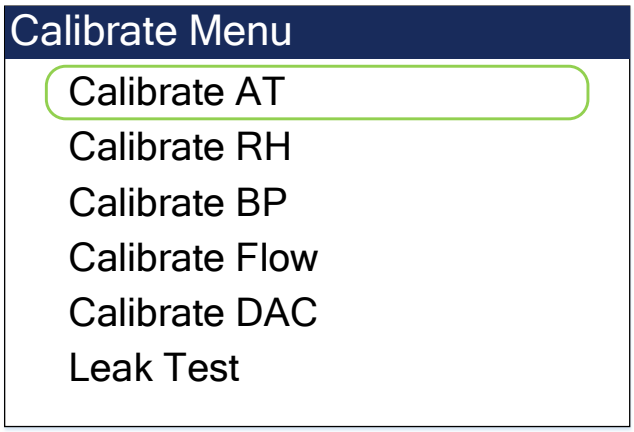


Figure 5-15 Calibrate Menu

5.4.3.1 Calibrate AT Screen

The Calibrate AT screen is used to audit and calibrate the temperature sensor in use.

If an external sensor is not present, the internal sensor will be calibrated.

See **Section 8.4.1** for the AT calibration Procedure.

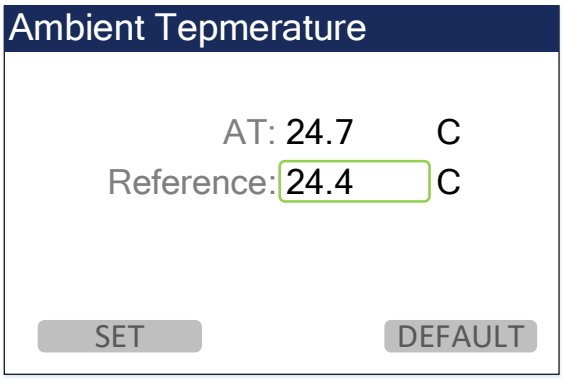


Figure 5-16 Calibrate Temp Screen

5.4.3.2 Calibrate RH Screen

Figure 5-17 Calibrate Relative Humidity Screen

The Calibrate RH screen is used to audit and calibrate the external relative humidity sensor in use.

See **Section 8.4.2** for the RH calibration procedure.

5.4.3.3 Calibrate BP Screen

The Calibrate BP screen is used for field audits and calibrations of the internal barometric pressure sensor. Note that the pressure will be displayed as the selected units for pressure (mbar or mmHg). See **Section 8.4.3** for the BP calibration procedure.

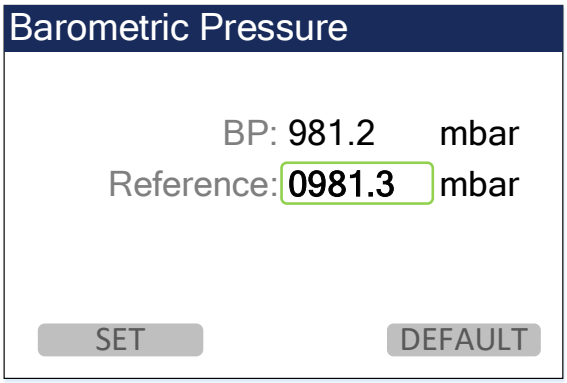


Figure 5-18 Calibrate BP Screen

5.4.3.4 Calibrate Flow Screen

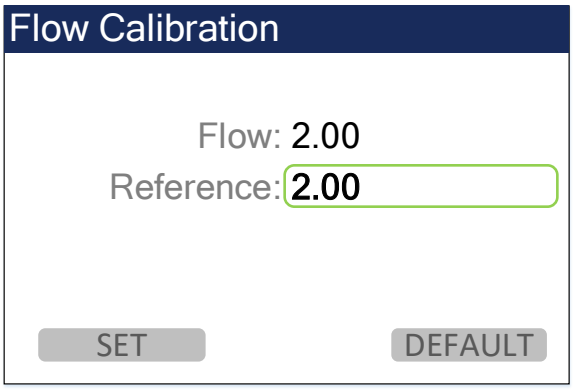


Figure 5-19 Calibrate Flow Screen

The Calibrate Flow screen is used for field audits and calibrations of the sample flow sensor. The AT, BP, and leak test must be confirmed accurate before performing a flow calibration. See **Section 8.4.4** for the Flow calibration procedure.

5.4.3.5 Calibrate DAC Screen

The CALIBRATE DAC screen is used for field audits or calibrations of the E-Sampler V2's digital-to-analog converter (DAC) output. The output voltage is only available on the communications connector using the 83609 cable with the analog output wires split out. This output is rarely used.

See **Section 8.4.5** to Calibrate the DAC output.

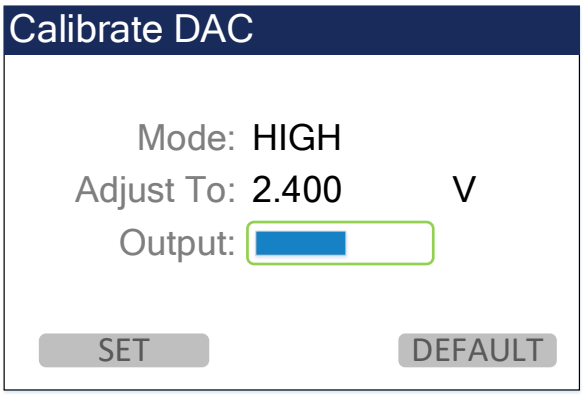
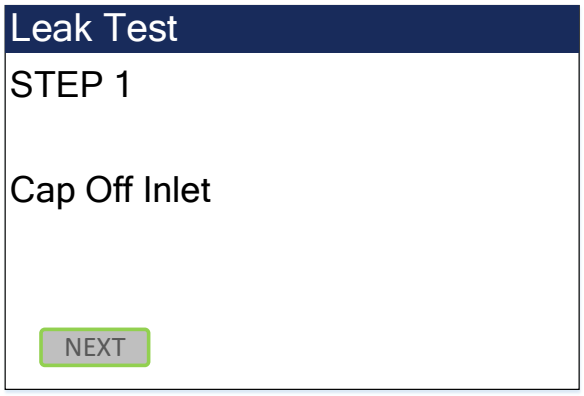


Figure 5-20 Calibrate DAC Screen

5.4.3.6 Leak Test Screen



The Leak Test screen is used to check the flow system for leaks that can affect performance and accuracy. See **Section 8.3.1** for the leak test procedures.

Figure 5-21 Leak Test Screen

5.4.4 Alarm Log Screen

The Alarm Log screen allows operators to quickly view alarms and error log entries. The screen displays the date and time when the error occurred, the alarm type, and alarm details. Alarms can also be cleared from this screen. See **Sections 8.6 Alarms** and **9.6.1 Clear Alarms** for more information.

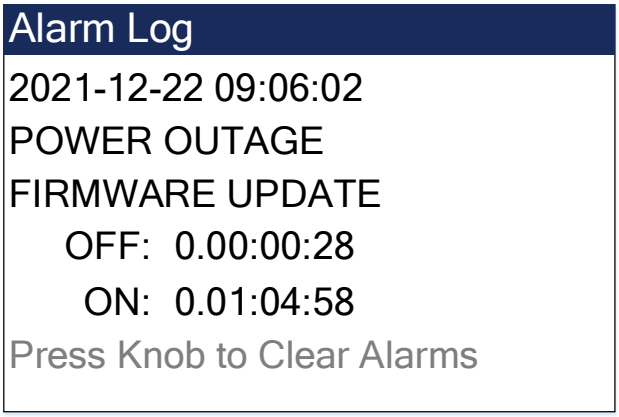


Figure 5-22 Alarm Log Screen

5.4.5 Transfer Data Screen

The Transfer Data screen is a simple and convenient option for retrieving data reports from the E-Sampler V2, locally. There are two file download options (All Data and User Files) and an option to select the number of days of stored data to be downloaded. See **Section 9** for the transfer data procedure.

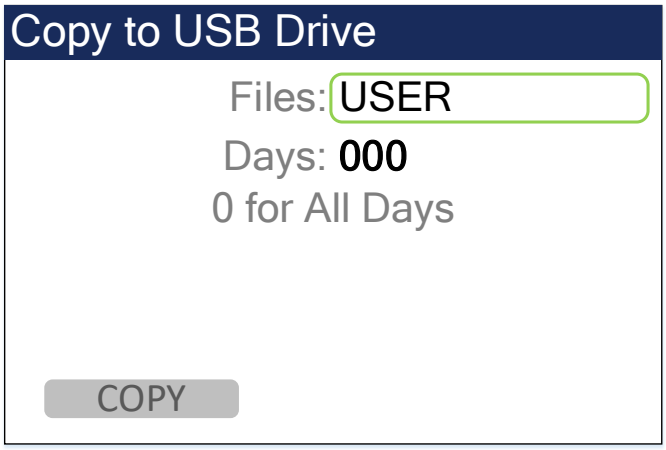


Figure 5-23 Transfer Data Screen

- **All Files** include the User Settings Report, Data Report, Alarm Log and Factory Diagnostics Report.
- **User Files** include the above reports excluding the Diagnostics Report.

5.4.6 Initial Setup Menu

The Initial Setup Menu is used in preparation for first-time deployment, time-zone changes, or loss of memory. The subsections below describe each of the configuration options within the Initial Setup Menu.

The Initial Setup menu consists of the following configuration Screens: Clock, Communications, Engineering Units, Analog Output and Display.

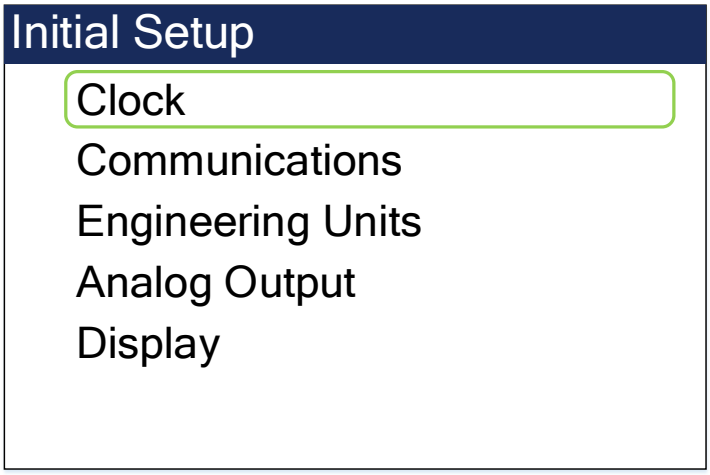


Figure 5-24 Initial Setup Menu

5.4.6.1 Clock

The Clock screen is used to set the date and time. An accurate date and time is vital for tracking data and alarms. See **Section 6.1.1** for the clock setting procedure.

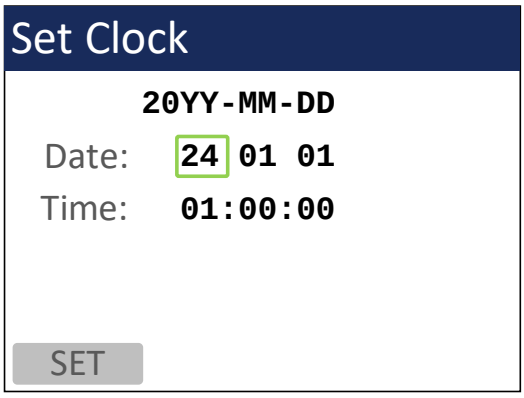
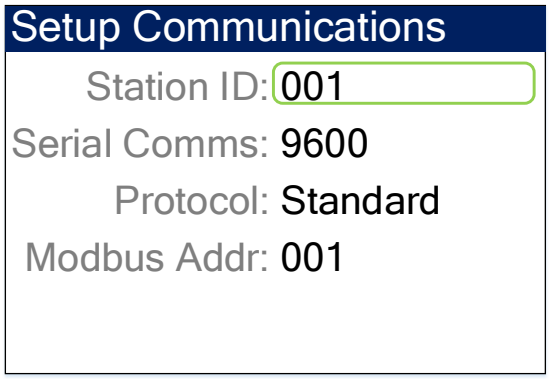


Figure 5-25 Set Clock Screen

5.4.6.2 Communications



The Communication screen provides basic communication settings. The settings options and their descriptions are below.

Figure 5-26 Setup Communications Screen

- **Station ID**: This setting is commonly used Identify individual units incorporated in the same network.
- **Serial Comms (Baud Rate)**: This setting controls the baud rate at which the instrument communicates. This setting needs to match the receiving devices baud rate. See **Section 6.1.2.2** for setting the Serial Comms baud rate.
- **Protocol**: This setting changes the communication protocol and some report data. See **Section 6.1.2.3** to change the protocol setting.

  STANDARD: The factory set 7500 protocol for standard communications.

  LEGACY: Allows the instrument to communicate using the previous generation E-Sampler V2 terminal commands and provides GOES transmitter compatibility.
- **Modbus Addr.**: This setting is used to designate a Modbus Address for Modbus Communications. See **Section 6.1.2.4** to set the Modbus address.

5.4.6.3 Engineering Units

This screen provides customization for units of measurement, displayed and reported. See **Section 6.1.3** to set the different engineering units.

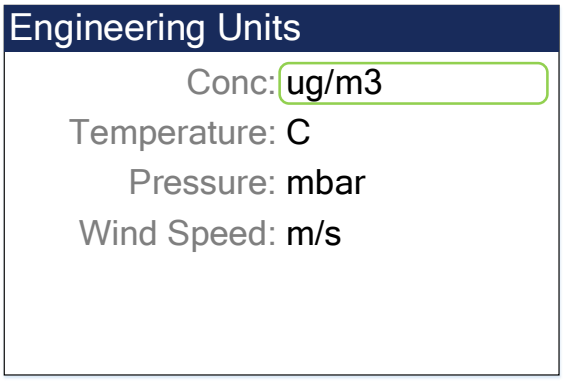
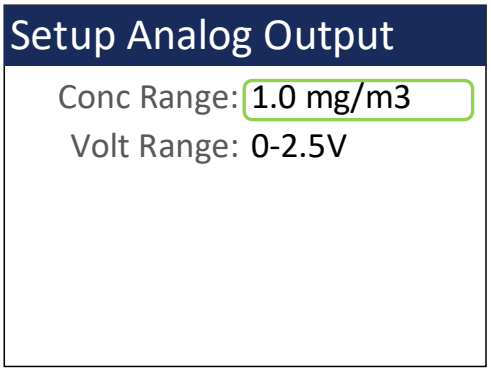


Figure 5-27 Engineering Units Screen

- **Conc**: Concentration Units of measurement per cubic meter options; **ug/m³** (micrograms), **mg/m³** (milligrams).
- **Temperature**: Temperature units of measurement options; **C** (Celsius), **F** (Fahrenheit).
- **Pressure**: Pressure units of measurement options; **mbar** (millibar), **PA** (Pascals), **mmHg** (millimeters of mercury), **inHg** (Inches of mercury).
- **Wind Speed**: Wind speed units of measurement options; **m/s** (meters per second), **mph** (miles per hour).

5.4.6.4 Analog Output



This screen is used to configure the analog output signal when the E-Sampler V2 is connected to an external analog data logger. See S**ection 6.1.4** to view the Conc and Voltage range and to set the analog output values.

Figure 5-28 Setup Analog Output Screen

- **Conc Range**: This is used to set the maximum analog concentration.
- **Volt Range**: This setting needs to match the analog logger voltage input range.

5.4.6.5 Display

This screen is used to adjust the screen backlight and set the backlight timeout. See **Section 6.1.5** to setup or adjust the display settings.

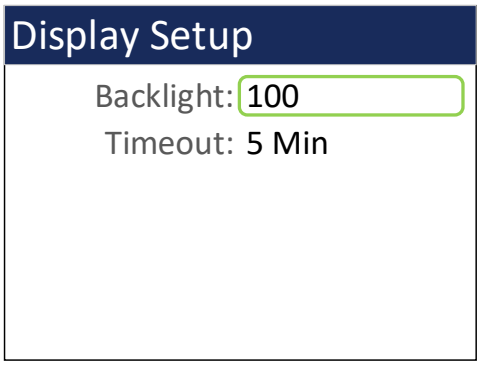


Figure 5-29 Display Setup Screen

- **Backlight**: The settings range is 100 to 10, with 100 being the brightest and 10 being the darkest.
- **Timeout**: This setting is used to designate when the back light will dim.

  Duration Options: None, 1 min, 5 Min, 10 min.

5.4.7 About

The About screen provides the instrument's model number, serial number, firmware version, Met One Instruments Service contact information, last calibration date, and total runtime.

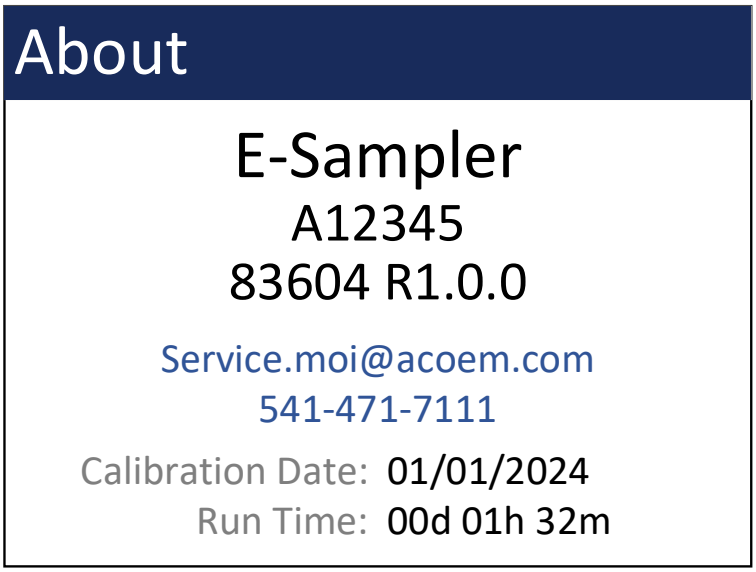


Figure 5-30 About Screen

6. E-SAMPLER V2 CONFIGURATION

This section explains the Initial Setup process, and configuration process for user and regulatory sampling requirements.

6.1 *Initial Setup Menu*

The Initial Setup procedure is intended for first time use, sample site transitions or if the instrument's memory has been cleared.

The settings options in the Initial Setup menu (**Figure 6-1**) are Date and Time, Communication parameters, Engineering Units of measurement, Analog Output and Display Settings.

Initial Setup Menu Location: Main Menu> Initial Setup

6.1.1 Setting Date and Time

Date and Time Location: Main Menu> Initial Setup>Clock

The number structure for both Date and Time consists of three pairs of numbers. Each number within the pair will be adjusted individually. The available number range is 0 to 9.

NOTE: The date and time should be set to accommodate the sample site SOP requirements.

From the Initial Setup Menu:

Move the green box around "Clock" and press the selector knob to enter the Set Clock screen.

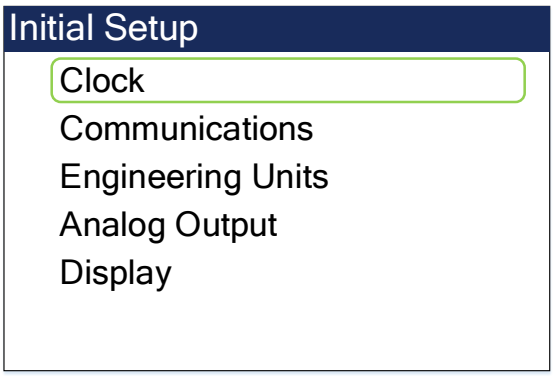


Figure 6-1 Initial Setup Menu

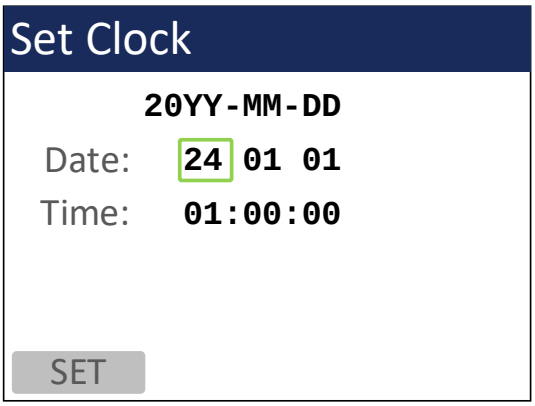


Figure 6-2 Set Clock, Year Config.

Date (From left to right)

Year-Month-Day

24 01 01

Time (From left to right)

Hours: Minutes: Seconds

01 00 00

Select a field using the green box.

Use the selector knob to edit the selected field.

When all fields are adjusted accordingly, move the green box to "SET" and press the selector knob to save the changes.

6.1.2 Communications Menu Settings

This section provides instructions on how to configure the various communication settings within the Initial Setup Menu. The communications settings are Station ID, Serial Comms (Baud Rate), Protocol, and Modbus address (See **Figure 6-4**).

Location: Main Menu> Initial Setup

From the Initial Setup Menu:

Move the green box around "Communications" and press the selector knob to enter the Communications screen.

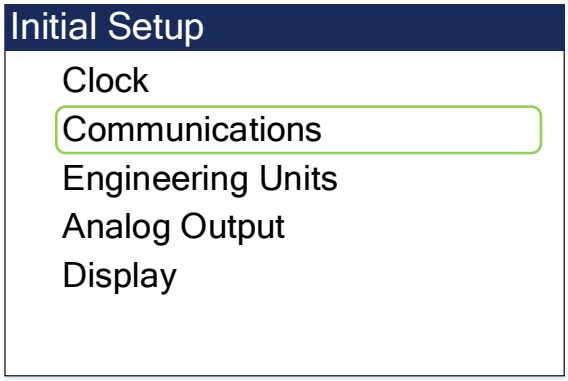


Figure 6-3 Initial Setup, Communications

6.1.2.1 Location ID

Location: Main Menu> Initial Setup>Communications

The Location ID is an editable field with a three-digit value. The range is 001 to 999.

Move the green box around the three numbers next to Location ID (001).

Press the selector knob to enter edit mode and adjust Location ID.

Press the selector knob to save the changes to Location ID.

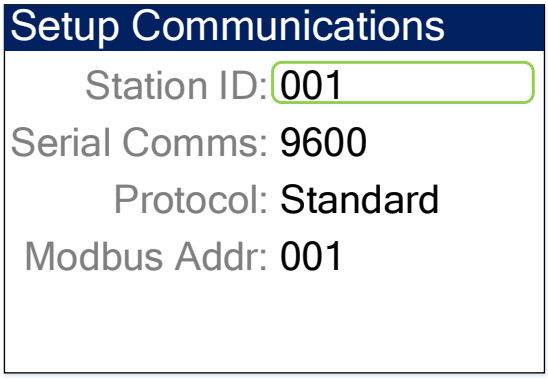


Figure 6-4 Location ID Config.

6.1.2.2 Serial Coms (Baud Rate)

Location: Main Menu> Initial Setup>Communications

Serial Comms is a drop-down list of preprogrammed selectable Baud Rates.

Move the green box around the set of numbers to the right of Serial Comms (9600).

Press the selector knob to expand view the list of Baud Rates (See **Figure 6-6**).

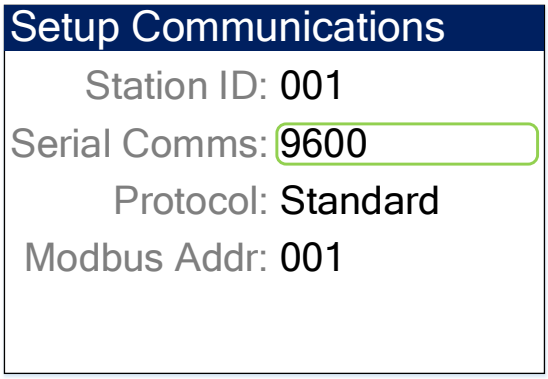


Figure 6-5 Serial Comms Config.

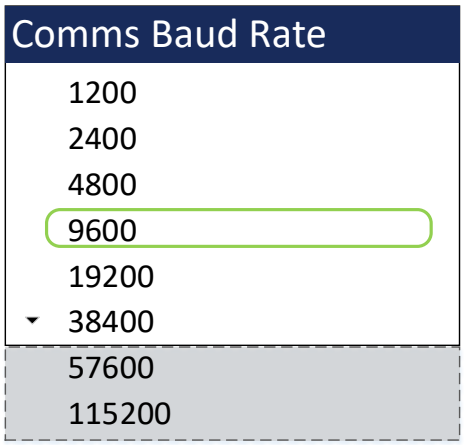


Figure 6-6 Expanded Comms Baud Rate List

Turn the selector knob to move the green box around the required baud rate.

Press the selector knob to set the new baud rate.

6.1.2.3 Protocol

Location: Main Menu> Initial Setup>Setup Communications

See **Section 5.4.6.2** for the different protocol settings descriptions.

Move the green box around the protocol option to the right of "Protocol" shown in **Figure 6-7** (Standard).

Press the selector knob to view the protocol options.

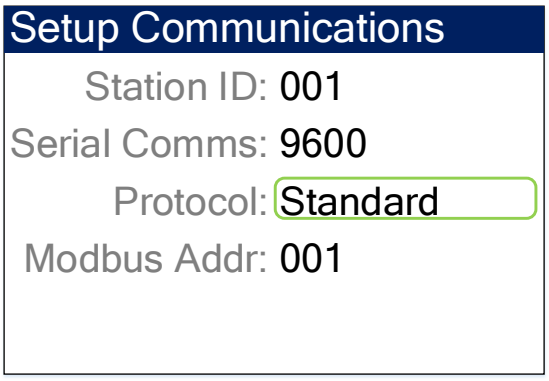


Figure 6-7 Communications Protocol Config.

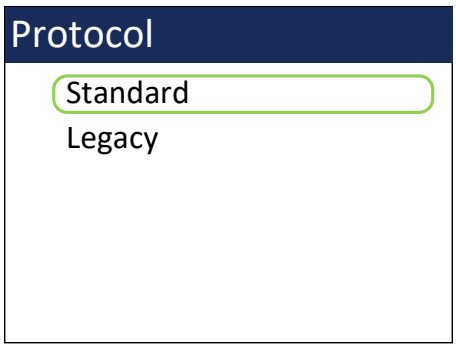


Figure 6-8 Communications Protocol Options

Turn the selector knob to move the green box around the required protocol option.

Press the selector knob to select the required protocol option.

6.1.2.4 Modbus Address

Location: Main Menu> Initial Setup>Communications

The Modbus Address is an editable field with a three-digit numerical value. The range is 001 to 999.

Move the green box around the three numbers next to "Modbus Addr" (001) shown in **Figure 6-9**.

Use the selector knob to edit the Modbus Address.

Press the knob to save the changes.

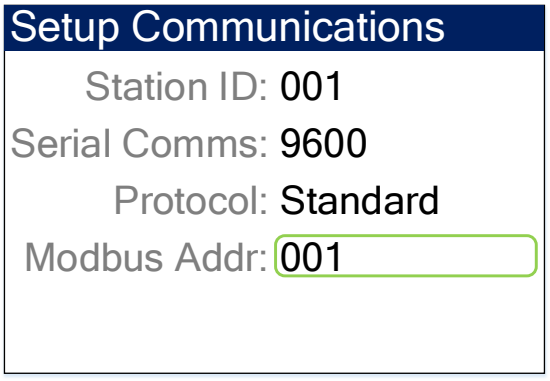


Figure 6-9 Modbus Address Config.

6.1.3 Setup Engineering Units

NOTE: Changing engineering units will affect stored and displayed data.

Location: Main Menu> Initial Setup

From the Initial Setup Menu:

Turn the selector knob to move the green box around "Engineering Units" and press the knob to select.

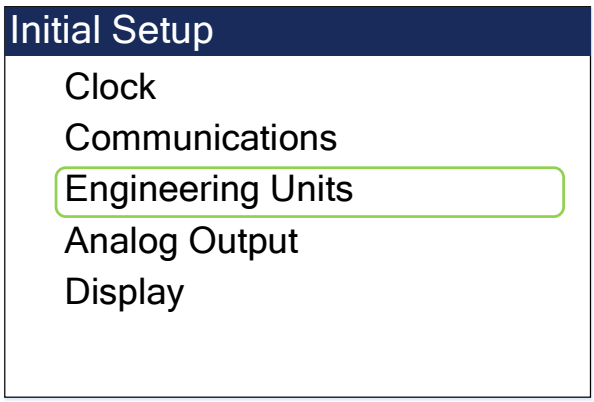


Figure 6-10 Engineering Units Menu

6.1.3.1 Concentration Units (Conc)

Location: Main Menu> Initial Setup>Engineering Units

With the green box around the option to the right of "Conc" (ug/m³), press the selector knob to view the available options (See **Figure 6-12)**.

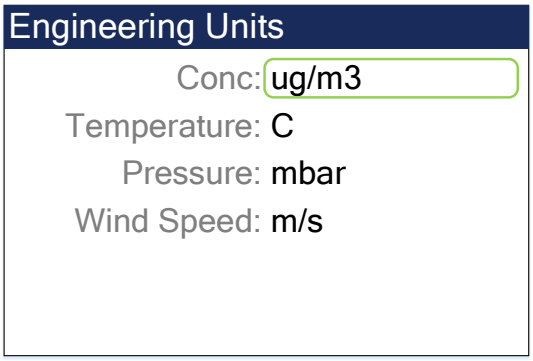


Figure 6-11 Concentration Units Config.

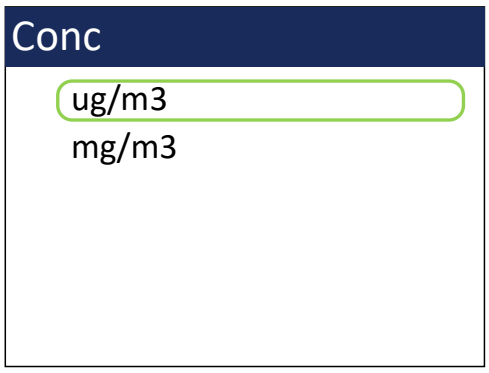


Figure 6-12 Concentration Unit Options

Select an option by moving the green box around the required unit of measurement.

Press the selection knob to set the Conc units.

ug/m³: Micrograms per cubic meter.

mg/m³: Milligrams per cubic meter.

6.1.3.2 Temperature Units

Location: Main Menu> Initial Setup>Engineering Units

With the green box around the option to the right of “Temperature” (C), press the selector knob to view the available options (See **Figure 6-14**).

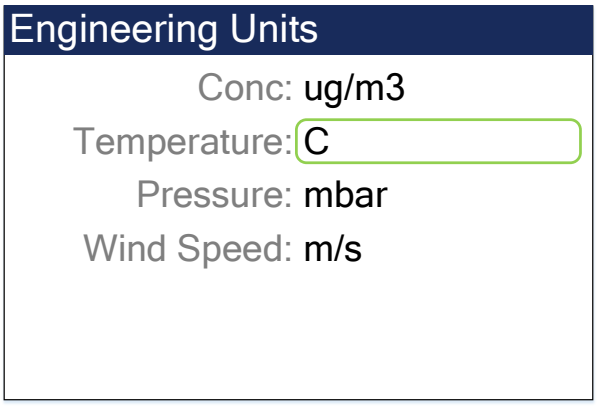


Figure 6-13 Temperature Units Config.

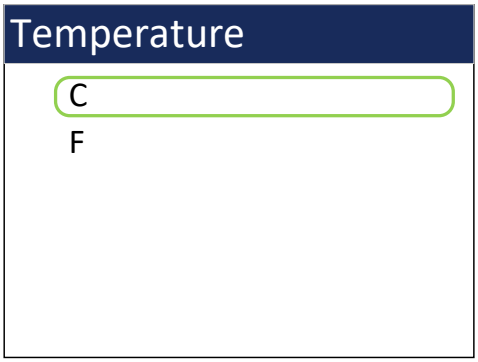


Figure 6-14 Temperature Unit Options

Select an option by moving the green box around the required unit of measurement.

Press the selection knob to save the new temperature unit.

C: Celsius

F: Fahrenheit

6.1.3.3 Pressure Units

Location: Main Menu> Initial Setup>Engineering Units

With the green box around the option to the right of “Pressure” (mbar), press the selector knob to view the available unit options (See **Figure 6-16**)

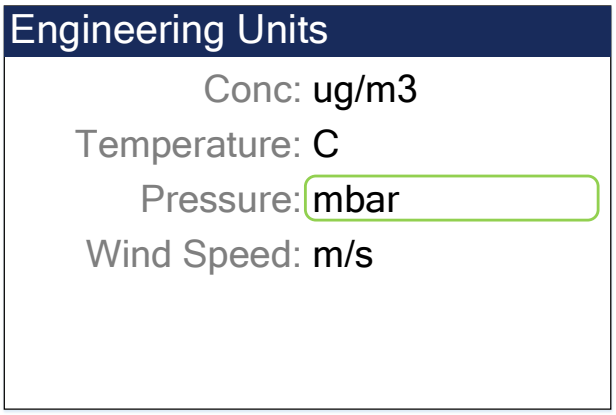


Figure 6-15 Pressure Units Config.

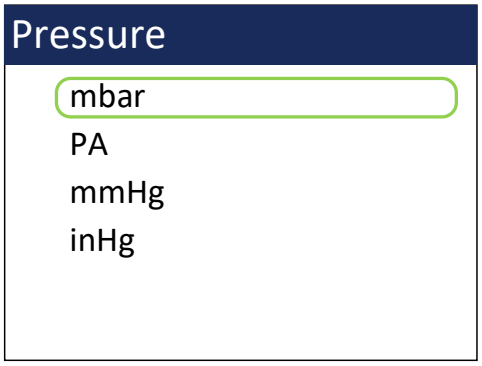


Figure 6-16 Pressure Unit Options

Turn the selector knob to the green box around the required setting.

Press the selection knob to set the pressure unit.

mbar: millibars

PA: Pascal

mmHg: millimeters of mercury

inHg: inches of mercury

6.1.3.4 Wind Speed Units:

Location: Main Menu> Initial Setup>Engineering Units

With the green box around the option to the right of "Wind Speed" (wind speed units), press the selector knob to view the available unit options (See **Figure 6-18**)

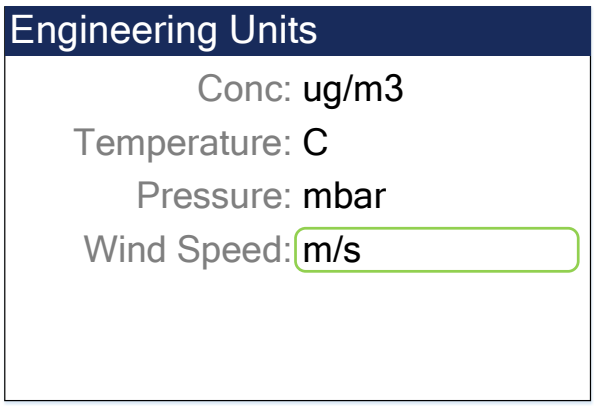


Figure 6-17 Wind Speed Config

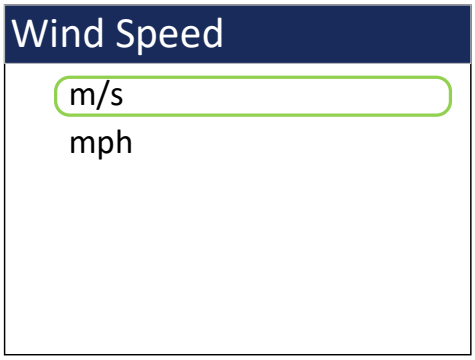


Figure 6-18 Wind Speed Unit Options

Select either option by moving the green box around the required setting.

Press the selection knob to select an option.

m/s: meters per second

mph: miles per hour

6.1.4 Analog Output

Location: Main Menu> Initial Setup>

From the Initial Setup Menu:

Turn the selector knob to move the green box around "Analog Output" and press the knob to select.

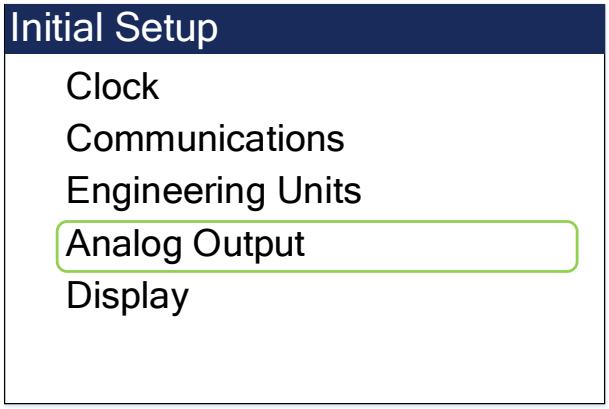


Figure 6-19 Analog Output

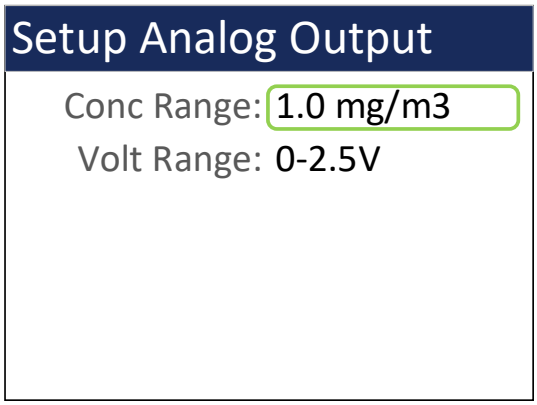


Figure 6-20 Analog Output, Conc Range Config.

With the green box around the option to the right of "Conc Range" (Concentration full scale value), press the selector knob to view the available unit options (See **Figure 6-21**).

Select one of the options by moving the green box around the required setting.

Press the selection knob to select an option from the list shown by

Figure 6-21.

mg/m³: milligrams per cubic meter

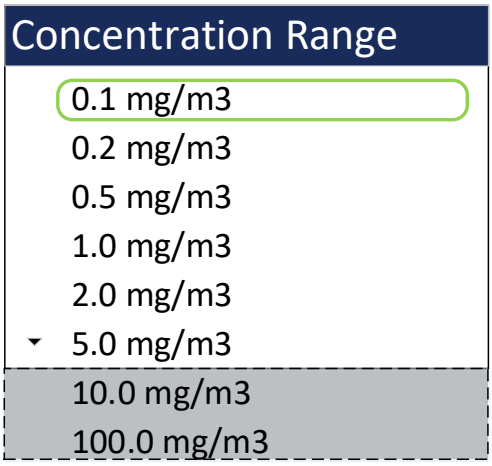


Figure 6-21 Conc Range List

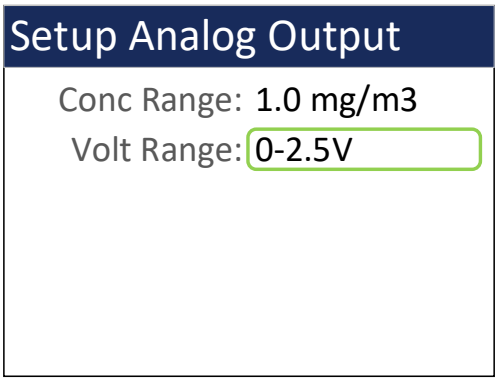


Figure 6-22 Setup Analog Output, Volt Range Config.

With the green box around the option to the right of "Volt Range" (Volt output range), press the selector knob to view the available range options (See **Figure 6-23**).

Select one of the options by moving the green box around the required setting. Press the selection knob to select an option from the list shown by **Figure 6-23.**

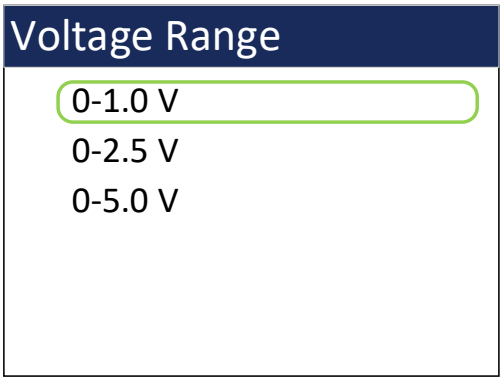


Figure 6-23 Analog Output Volt Range List

6.1.5 Display

Location: Main Menu> Initial Setup

From the Initial Setup Menu:

Turn the selector knob to move the green box around "Display" and press the knob to select.

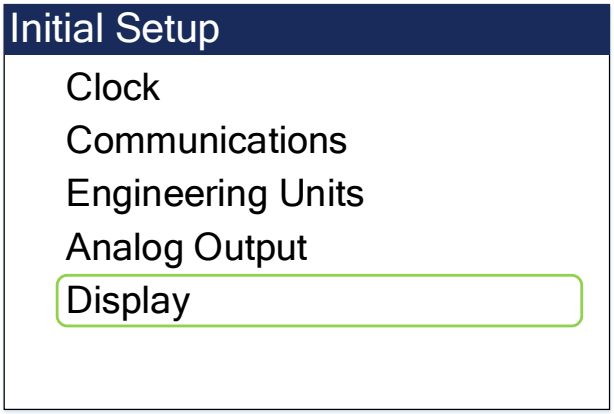


Figure 6-24 Initial Setup, Display

The three digits to the right of "Backlight" are editable when selected. The digits represent the backlight brightness percent. The number range is 100 (brightest) to 10 (darkest).

Move the green box around the three numbers next to "Backlight" (100) shown in **Figure 6-25**.

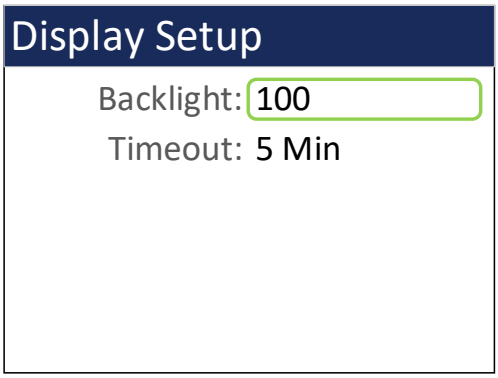


Figure 6-25 Display Setup, Backlight

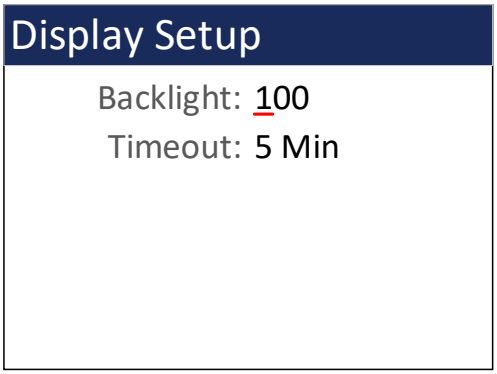


Figure 6-26 Backlight Value Adjustment

Use the selector knob to edit each digit of the Backlight percent value.

Press the knob to save the changes.

With the green box around the option to the right of "Timeout" (Backlight timeout), press the selector knob to view the available timeout options (See **Figure 6-28**).

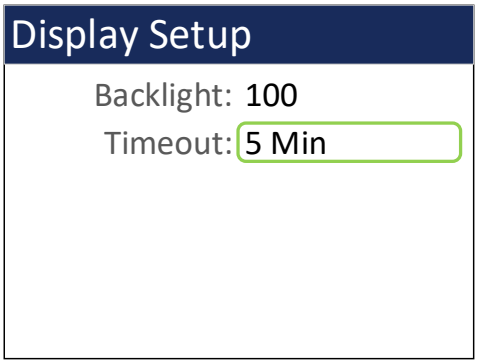


Figure 6-27 Display Setup, Timeout Config.

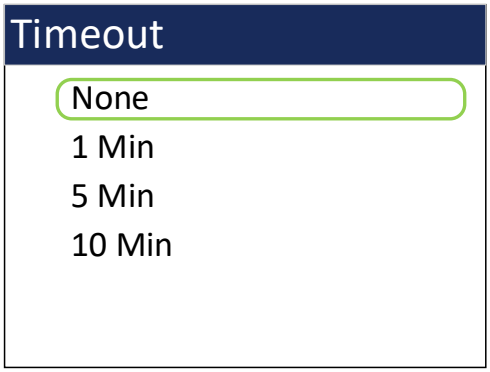


Figure 6-28 Backlight Timeout Options List

Select one of the options by moving the green box around the required setting.

Press the selection knob to select an option from the list shown by **Figure 6-28.**

6.2 *Digital Sensors*

The E-Sampler V2 accepts up to two digital sensors at one time. This section describes the procedure for configuring the E-Sampler V2 digital sensor communication.

An 83832 AT/RH digital smart sensor, used for accurate monitoring and reporting of ambient conditions, is provided with the E-Sampler V2 as standard equipment.

Most Digital sensors provided by Met One Instruments are programmed with a numerical single digit address. The address is used to identify the sensor when two sensors are connected to the E-Sampler V2 and can be configured using the steps below.

NOTE: Most digital sensors from Met One Instruments are programmed as Sensor 1 or Address 1.

Location: Main Menu> Tool Box> Digital Sensor

Descriptions of the main digital link Screen displayed information.

Digital Link: Digital sensor connection Status.

Sensor 1 and 2: The assigned address, name, and revision for connected sensors.

State: Internal communications between digital sensors and the E-Sampler V2.

To change a digital sensor address, press the selection knob in the main digital link screen to go to the Setup Digital Sensors Screen. (**Figure 6-29**).

Figure 6-29 Digital Link Main Screen

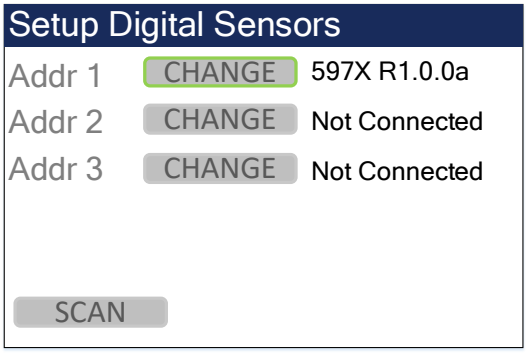


Figure 6-30 Setup Digital Sensor Screen

Chang Addr. 1 to Addr 2 by moving the green selection box around the "CHANGE" option next to Addr. 1.

Press the selection knob.

See **Figure 6-31** for next step.

SCAN: The Scan option in the lower left corner of **Figure 6-30** is used to automatically scan for other digital sensors with an address of 1-99.

NOTE: When address 1 is already assigned, another sensor with address 1 will not register and will cause conflicts.

The current digital address will be displayed to the right of "From" (1).

Digital address options are shown at the bottom of the screen.

Turn the selection knob to move the green box around the new digital address (Set 2).

Press the selection knob to select the new digital address.

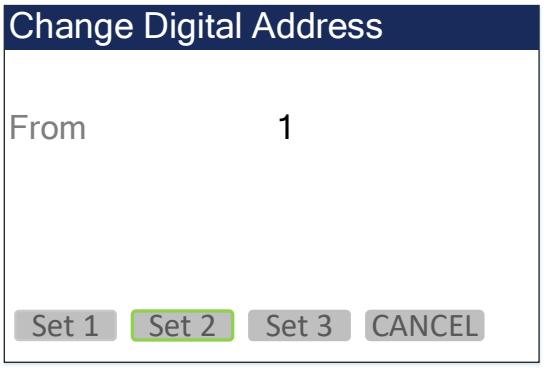


Figure 6-31 Change Digital Address screen

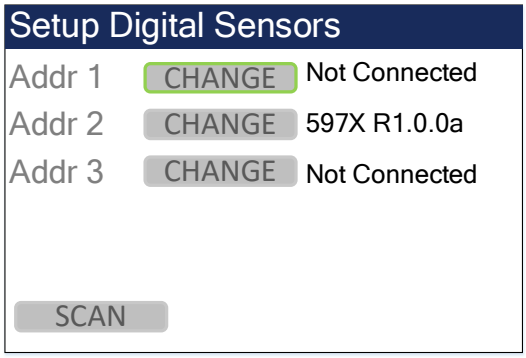


Figure 6-32 Digital Sensor, Addr. 2

Figure 6-32 now shows the sensor as Addr. 2 from Addr. 1.

Digital Link "FAIL" (**Figure 6-33**) indicates no digital sensors are connected or connected digital sensors are not responding.

See **Section 8.7** for troubleshooting solutions.

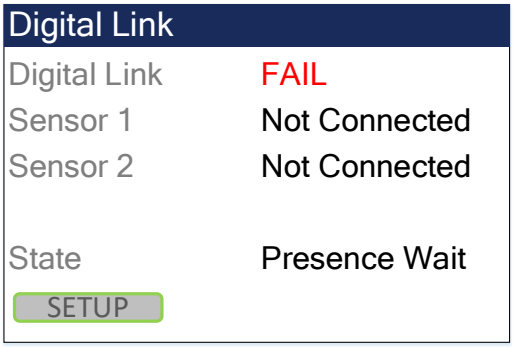


Figure 6-33 Digital Link Screen, Fail

6.3 *Self Test Setup*

Location: Main Menu> Tool Box> Self Test

The Self Test screen is where the Interval of the Self Test cycle can be modified or to enable or disable the Span Check option.

To modify the Self Test cycle period, move the green box around the option next to "Period" (1 HR), shown by **Figure 6-34**. Press the selection knob to display the list of self test period options (**Figure 6-35**).

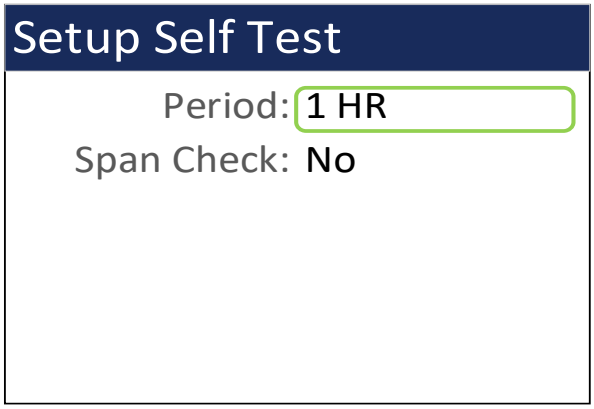


Figure 6-34 Self Test Setup Screen

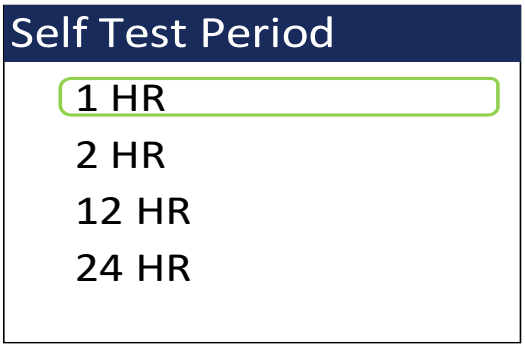


Figure 6-35 Self Test Period Options

Turn the selector knob to move the green box around the required test period.

Press the selector knob to set the new test period.

Turn the selector knob to move the green box around the option next to "Span Check" (No) shown by **Figure 6-36.**

Press the selector knob to select from the Span Check options list.

See **Figure 6-37** for the next step.

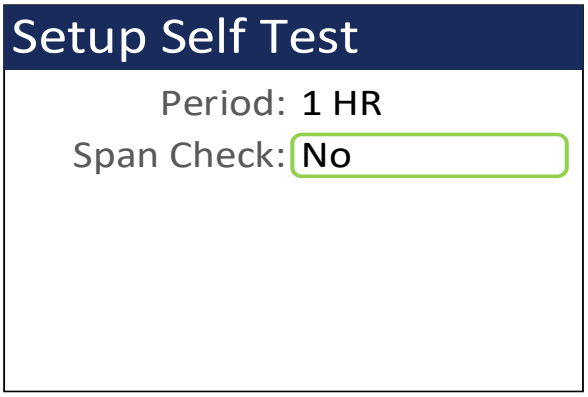


Figure 6-36 Self Test Span Check

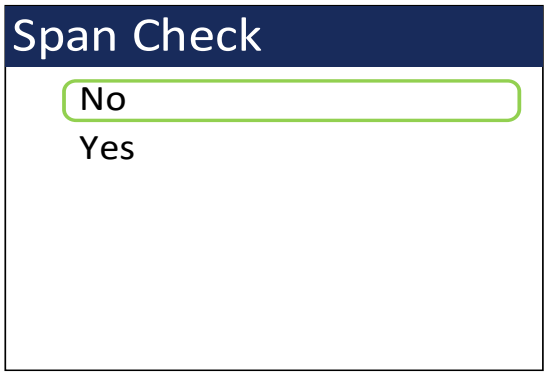


Figure 6-37 Span check

Turn the selector knob to move the green box around the required Span Check setting.

The Span Check period can be set to No (Off) or Yes (On).

No: Span Check will not run until turned on.

Yes: Span Check will run during the self test.

Press the selector knob to set the test period.

6.4 *Sample Setup*

Location: Main Menu> Tool Box> Sample Setup

The Sample Setup Screen provides a way to customize sample run times (averaging period), units of measurement, adjust the K-factor multiplier and set the sample mode. This section provides instructions on how to configure the sample setup options.

See **Section 5.4.2.1** for a detailed description of the Sample Setup Screen.

6.4.1 Adjusting Sample Time

Change the Sample Time by moving the green box around the option (1 Min) to the right of "Sample Time, shown by **Figure 6-38**.

Press the selector knob to view the available Sample Time setting options.

See **Figure 6-39** for next step.

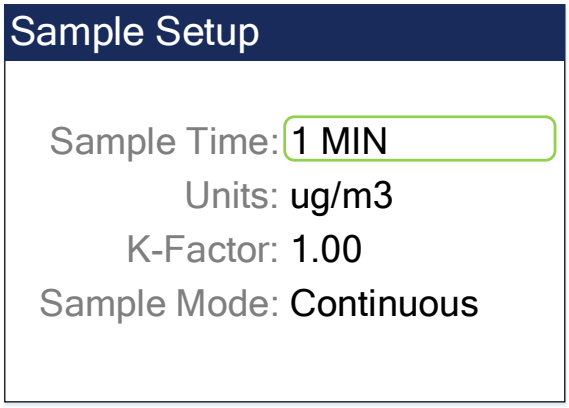


Figure 6-38 Sampel Setup, Sample time Config.

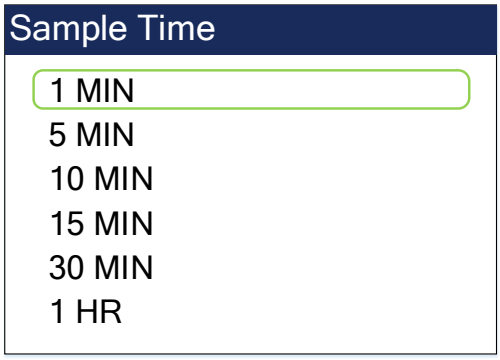


Figure 6-39 Sample Time Options

Turn the selector knob to move the green box around the required Sample Time option.

Press the selector knob to set the new sample time duration.

6.4.2 Engineering Units

Turn the selector knob to move the green box around the option (ug/m^3) to the right of "Units."

Press the selector knob to view available Units options.

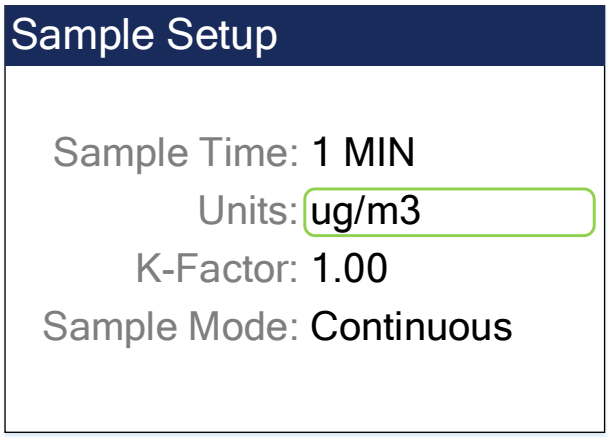


Figure 6-40 Engineering Units Setup

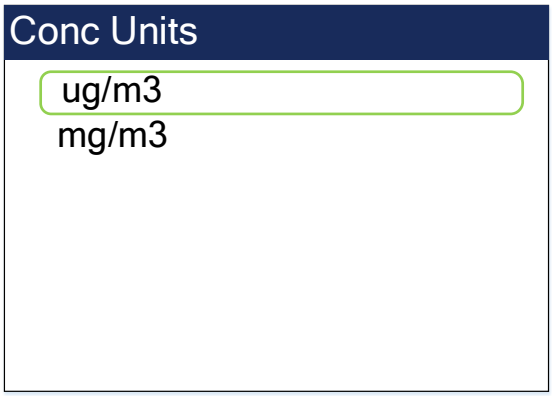


Figure 6-41 Conc Units Options

Turn the selector knob to move the green box around the required Units option.

Press the selector knob to set the new concentration units.

6.4.3 K-factor

Turn the selector knob to move the green box around the editable field (1.00) to the right of "K-Factor."

Press the selector knob to edit the K-Factor numerical field.

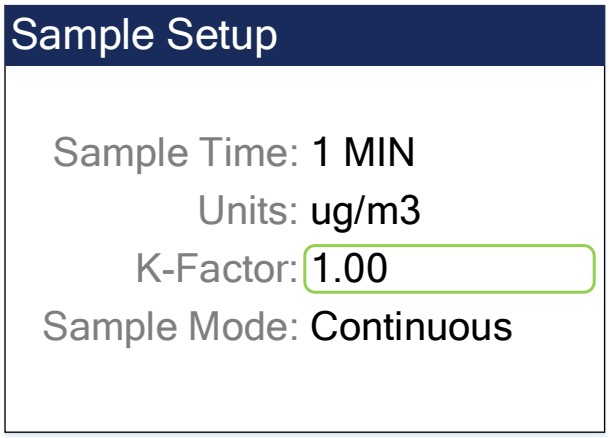


Figure 6-42 K Factor

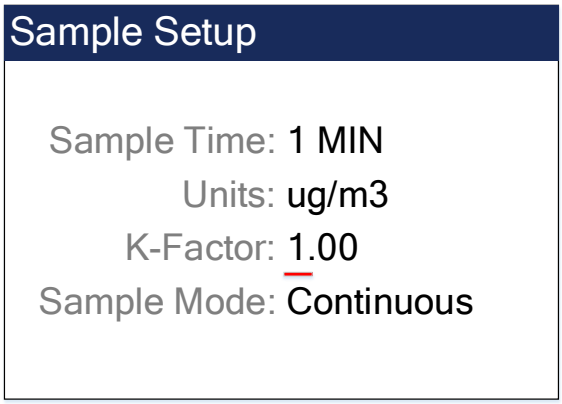


Figure 6-43 Edit K-Factor Field

Turn the selector knob to change the numerical value.

Press the selector knob to change decimal places to the right.

When the knob is pressed three times, the red underline will disappear, and the green box will take its place. This indicates the K-Factor has been set.

NOTE: Previous data will not reflect the newly set K-Factor, new data will show the change.

6.4.4 Sample Mode

Turn the selector knob to move the green box around the option (Continuous) to the right of "Sample Mode."

Press the selector knob to view available Sample Mode options.

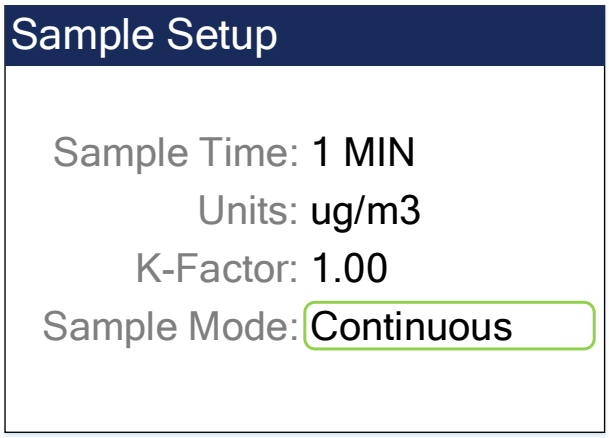


Figure 6-44 Sample Mode

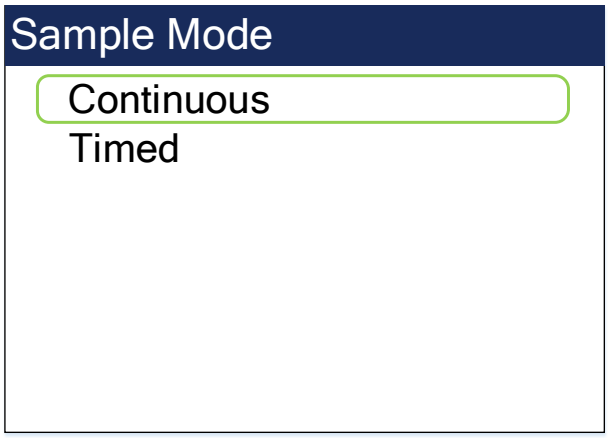


Figure 6-45 Sample Mode Options

Turn the selector knob to move the green box around the required Sample Mode Option.

Press the selector knob to set the new Sample Mode.

When "Timed" sample mode is selected, "Setup Time" Will appear at the bottom right corner of the main Sample Setup Screen (**Figure 6-46**).

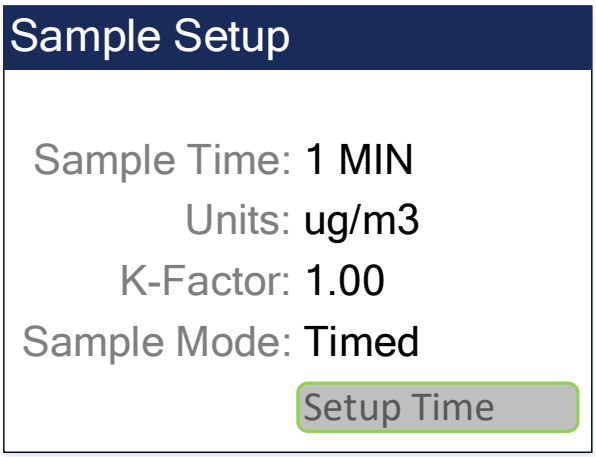


Figure 6-46 Sample Setup, Setup Time

Turn the selector knob to move the green box around "Setup Time."

Press the selector knob to set up the sample start time, date, and duration of the sample.

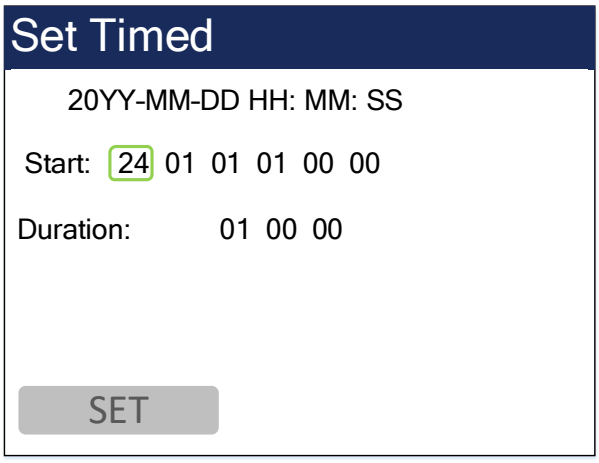


Figure 6-47 Set Timed Screen

Turn the selector knob to set the required start date, time, and sample duration.

Move the green box around "SET" in the lower left corner and press the selector knob to save the changes.

Duration: DD HH MM

6.5 *Heater Control, RH Setpoint*

Location: Main Menu> Tool Box> Heater Control

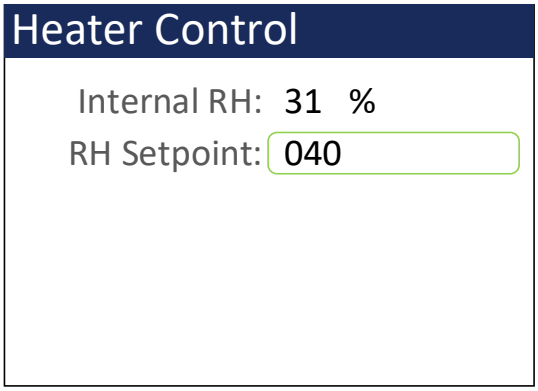


Figure 6-48 Heater Control

Internal RH is for refence only.

Press the selector knob to edit the RH Setpoint used for heater activation.

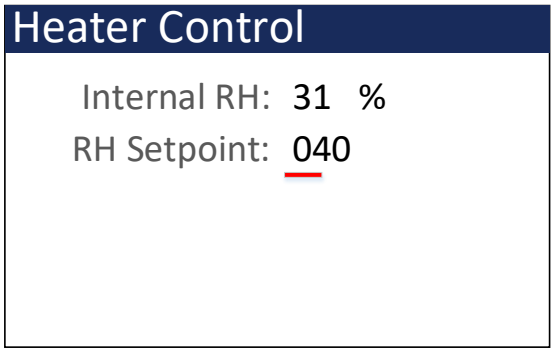


Figure 6-49 Edit RH Setpoint

Use the selector knob to edit the three-digit numerical value that represents the RH Setpoint.

The RH set point value can be set at 100% RH to 000% RH.

The heater will begin operating when the RH reaches or is above the set point.

When the RH is lower than the RH setpoint, the heater operation will stop.

An RH setpoint of 0 will disable the heater indefinitely.

6.6 *Alarm Contact*

Location: Main Menu> Tool Box> Alarm Contact

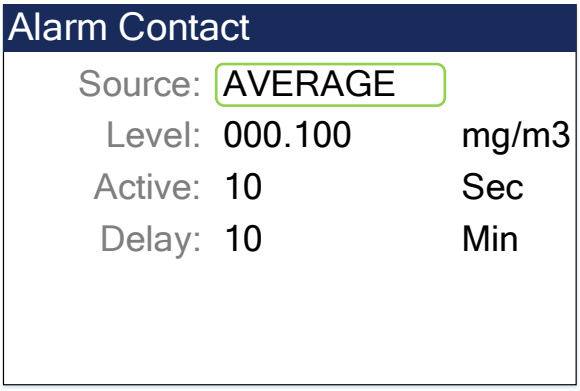


Figure 6-50 Alarm Contact, Main

To change the Alarm Contact Source, turn the selector knob so the green box is around the option next to “Source”.

Press the selector knob to view the available Source options.

See **Figure 6-51** for the next step.

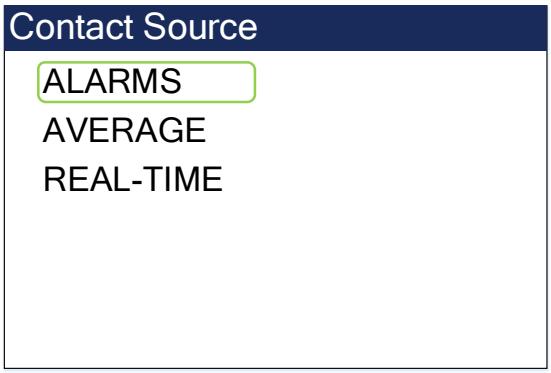


Figure 6-51 Contact Source Options

Turn the selector knob to move the green box around the six-digit numerical value to the right of "Level" (**Figure 6-52**).

This value represents the minimum concentration level to activate the alarm contact.

Press the selector knob to edit the six-digit numerical value.

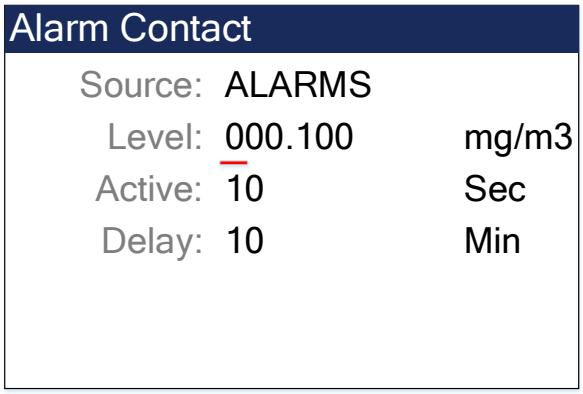


Figure 6-53 Edit Alarm Contact Level

Turn the selector knob to move the green box around the required contact source option.

Press the selector knob to set the source.

See **Section 5.4.2.5** for detailed descriptions for each source option.

The settings below apply for all three Contact Source Options shown by **Figure 6-52.**

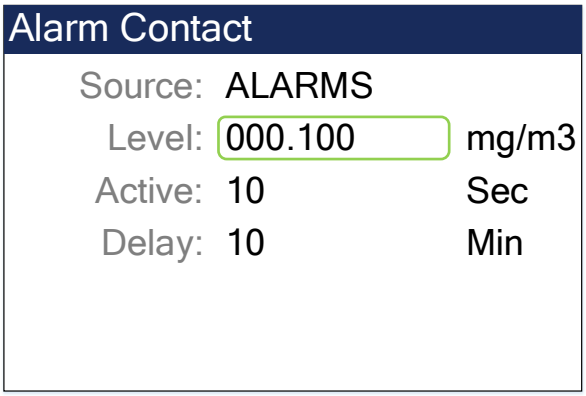


Figure 6-52 Alarm Contact Level

Use the selector knob to edit the six-digit numerical value.

When the required value is shown, press the selector knob until the green box returns.

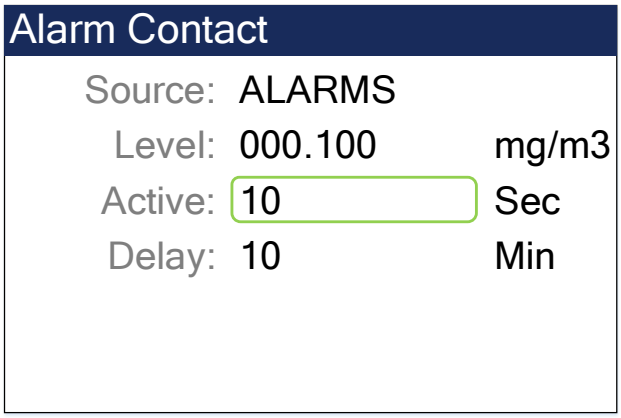


Figure 6-54 Alarm Contact, Active

Use the selector knob to edit the two-digit numerical value.

When the required value is shown, press the selector knob until the green box returns.

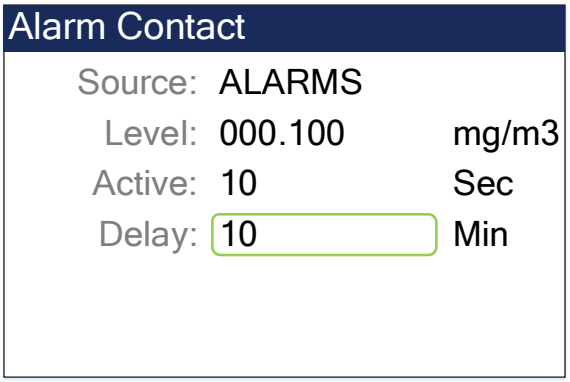


Figure 6-56 Alarm Contact, Delay

Use the selector knob to edit the two-digit numerical value.

When the required value is shown, press the selector knob until the green box returns.

Turn the selector knob to move the green box around the two-digit numerical value to the right of "Active" (Figure 6-54).

Press the selector knob to edit the two-digit numerical value.

The Active time range can be set from one to 60 seconds.

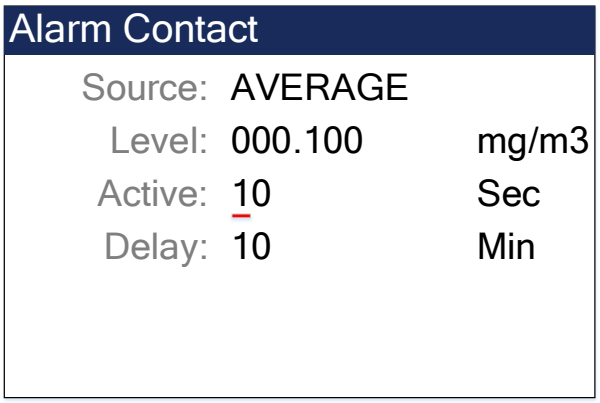


Figure 6-55 Edit Alarm Contact, Active

Turn the selector knob to move the green box around the two-digit numerical value to the right of "Delay" (**Figure 6-56**).

Press the selector knob to edit the two-digit numerical value.

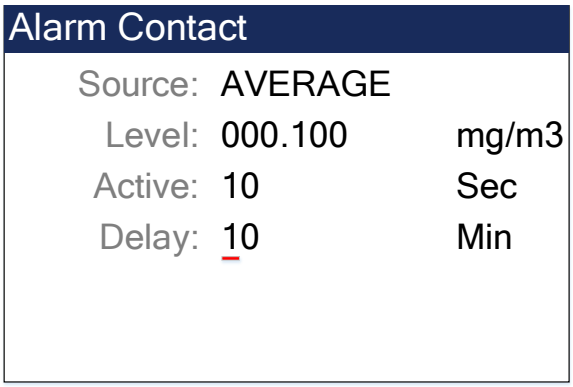


Figure 6-57 Edit Alarm Contact, Delay

7. E-SAMPLER V2 OPERATION

This section explains the initial startup procedures which includes how to start and stop samples in each sampling mode.

7.1 *Initial Startup*

The initial startup procedure begins when power is applied to the E-Sampler V2.

Figure 7-1 E-Sampler V2 Splash Logo

After power is applied, the splash screen will appear for approximately three seconds, leading to the Home Screen.

7.1.1 System Verification

The E-Sampler V2 systems are calibrated to manufacture's specifications in preparation for distribution. It is vital, though, that the instrument sub-systems are verified or calibrated to accommodate the local ambient environment. Those systems include the external combo temperature and relative humidity sensor, internal pressure sensor, and flow sensor. See **Section 8.4** for calibration procedures.

7.2 *Starting and Stopping a Sample*

7.2.1 Continuous Sampling

See **Section 6.4.4** to set the instrument to Continuous Sampling mode.

Starting and stopping a sample in continuous mode is initiated at the press of a button while the Home Screen is displayed.

Press the Start/Stop button on the E-Sampler V2 keypad to initiate the start sample process.

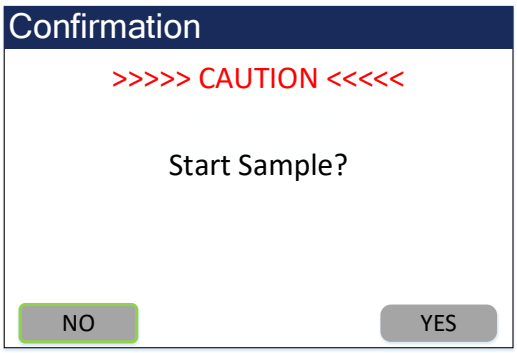


Figure 7-2 Start Sample Confirm. Screen

Press the Start/Stop button to a start sample. The confirmation screen will be displayed (**Figure 7-2**). NO and YES are selectable options at the bottom of the screen. Descriptions below.

NO: Go back to Home Screen.

YES: Begin the sampling process.

When YES is selected, the E-Sampler V2 will begin sampling. The table below outlines the order of processes and their descriptions after a sample has been initiated.

Table 7-1 Start Sample Process

Process	Description
1. Purging	Runs the purge pump to remove any particulates in the detection system.
2. Zeroing	Zeros the detection sensor to assure sampling accuracy.
3. Span Test	**Skip this step if Span Test is set to off.** Span settling and Span sampling tests runs twice. **Test 1:** With Span LED On simulating a high scale for optical system. **Test 2:** With Span LED Off to verify a span-zero value.
4. Settling	Runs the main sampling pump to allow flow equalization.
5. Sampling	Sampling has begun.

See **Section 11.2.1** for a detailed description of the Span Test.

Press the Start/Stop button to end continuous sampling.
The stop sample screen will be displayed.
Select NO to continue sampling.
Select YES to end continuous sampling and go back to the Home screen.

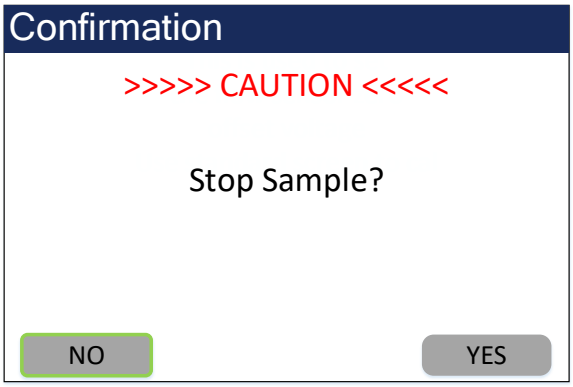


Figure 7-3 Stop Sample Confirm Screen

NOTE: When a Sample has been stopped, the E-Sampler V2 will run the purge pump to clear the detection chamber of residual particulate.

7.2.2 Timed Sampling

See **Section 6.4.4** to set the start time and duration of Timed Sampling mode.

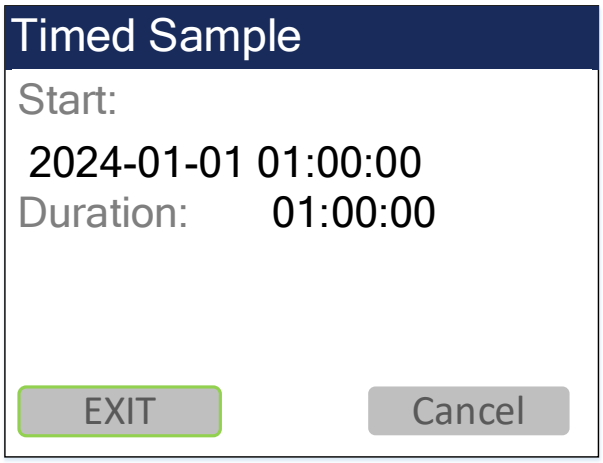


Figure 7-4 Timed Sample Notification

Timed Sampling mode will start sampling at the scheduled time and continue for the set duration, unless manually stopped.

View the scheduled timed sample, press the keypad Start button while the home screen is displayed.

The start date and time along with the sample will be displayed (**Figure 7-4**).

Select EXIT to go back to the Home Screen.

Select Cancel to disable the timed sample before it begins.

When a timed sample is in progress, press the Start button while at the Home screen to view the start date and time along with the remaining sample duration (**Figure 7-5**).

Select EXIT to go back to the Home screen.

Select STOP to cancel the currently running timed sample.

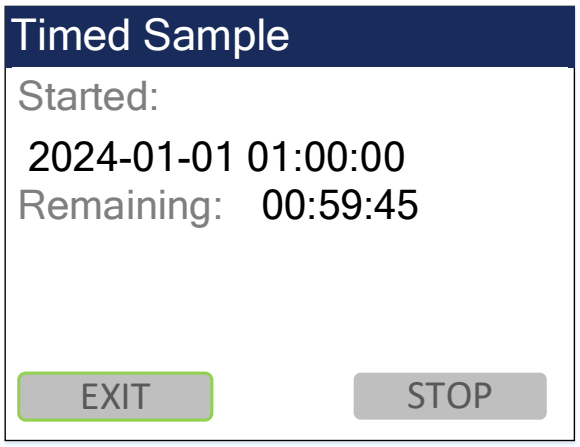


Figure 7-5 Running Timed Sample

8. MAINTENANCE and TROUBLESHOOTING

This section provides information about routine maintenance of the E-Sampler V2, and for performing more detailed diagnostic tests if a problem is encountered. The E-Sampler V2 generates error messages on the display or in the data log if a failure or other problem is detected. Many times, there is a simple solution. Persistent errors often signify a failure which will require investigation.

The E-Sampler V2 is an extremely component-dense assembly! Only skilled and trained electro-mechanical technicians should attempt any disassembly or repairs inside the E-SamplerV2 . Routine maintenance procedures do not involve removing the E-Sampler V2 assembly from the enclosure.

8.1 *Periodic Maintenance Schedule*

The following table shows the Met One recommended periods for routine maintenance items. Some of these items will need to be performed more frequently depending on the severity of sample site conditions. The program administrator should review these items and establish SOPs appropriate for your application.

Table 8-1 Periodic Maintenance Schedule

Maintenance Item	Suggested Period
System leak check	**Monthly**
Audit Temperature, Pressure and Flow (Calibrate if needed)	**Monthly**
Inspect TSP inlet (clean if necessary).	**Monthly**
Clean cyclone particle trap	**Monthly**
Clean 47mm filter holder	**Monthly**
Check alarm log	**Monthly**
Disassemble and clean cyclone	**3 Months**
Check RH sensor (Internal RH and External RH if present)	**6 Months**
Replace PUMP and PURGE filters	**12 Months**
Replace O-Rings	**12 Months**
Factory service - optical system cleaning and recalibration	**24 Months**
Replace Coin cell lithium backup battery, as needed	**5 Years**

Factory Service Details:

The E-Sampler V2 needs to be returned to the factory for service and recalibration. The recommended period is two years. However, some users establish their own interval depending on the harshness of the sampling conditions, particulate levels, and data scrutiny. High-concentration sampling may require more frequent factory service.

Factory service primarily consists of optical system cleaning, laser/detector checks, and recalibration. As-found calibration checks can also be requested. Contact the Met One technical service department to schedule E-Sampler V2 service. A Return Authorization (RA) number must be obtained before the unit is returned. See **Section 1.2.1** Return Authorization for instructions on returning the instrument for factory service.

8.2 *Flow System Cleaning*

The E-Sampler V2 flow system requires cleaning to maintain proper operation. The sections below explain cleaning procedures for the different flow system components. Those components are The TSP Cap, Cyclone and the 47 mm filter holder.

Frequency: Monthly

NOTE: For extreme particulate concentration levels, more frequent flow system inspections and cleaning may be required.

8.2.1 TSP and Cyclone Inlet Devices

All E-Sampler V2 units require a TSP inlet to protect delicate internal components from rain and oversized debris. In addition to the TSP inlet, sharp-cut cyclones can be used to remove particles greater than the rated cut-point. These inlets need to be periodically cleaned. The time interval between cleanings varies depending on the local particulate levels.

The TSP inlet can be blown out with compressed air or canned air, for dusting, in most cases. If needed, the TSP cap can be disassembled for cleaning by removing the three screws in the cap. Soap and water is recommended for cleaning the TSP inlet and debris screen if compressed air is not sufficient. Do not over-tighten the screws during reassembly or the plastic threads will strip out.

8.2.1.1 Cyclone Cleaning

Particle Trap:

Remove the cyclone particle trap by unscrewing the knurled cap from the cyclone body. clean the particle trap by wiping it out with a cloth or use compressed air to blow out debris. Inspect the cap O-ring for any damage and lubricate with silicone grease if necessary.

Frequency: Monthly

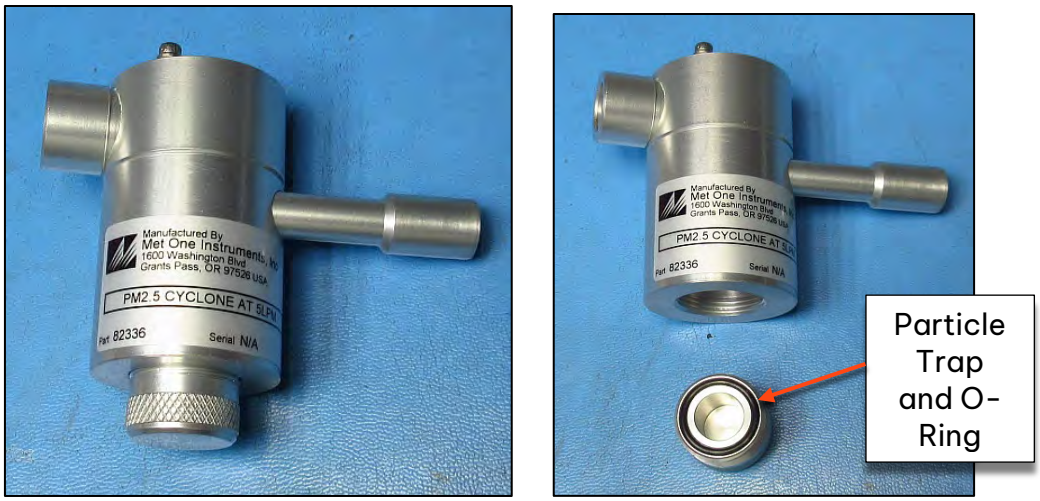


Figure 8-1 Remove and Clean Particle Trap

Cyclone Internals:

Disassemble the cyclone by unscrewing and removing the three socket-head Allen screws (**Figure 8-2**). Separate the two parts of the cyclone to access the conical chamber inside (**Figure 8-3**). All inside surfaces must be cleaned. Isopropyl alcohol and cotton-tipped applicators are recommended for cleaning the areas pointed out by **Figure 8-3.** Inspect and grease O-rings. If O-rings are damaged, 8658-2 replacement O-ring kit can be purchased though the Met One service department.

Frequency: Three months

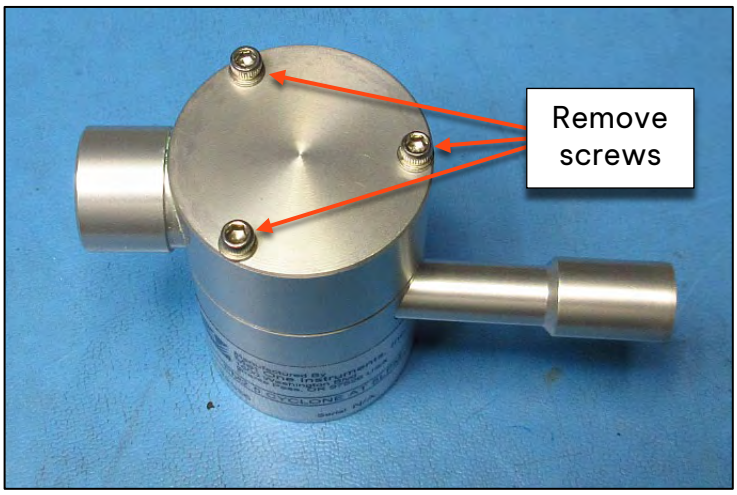


Figure 8-2 Cyclone Disassembly for Full Cleaning

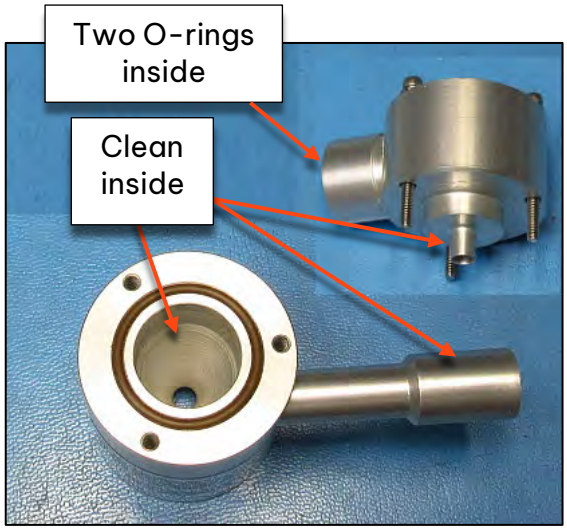


Figure 8-3 Cyclone Internal Cleaning

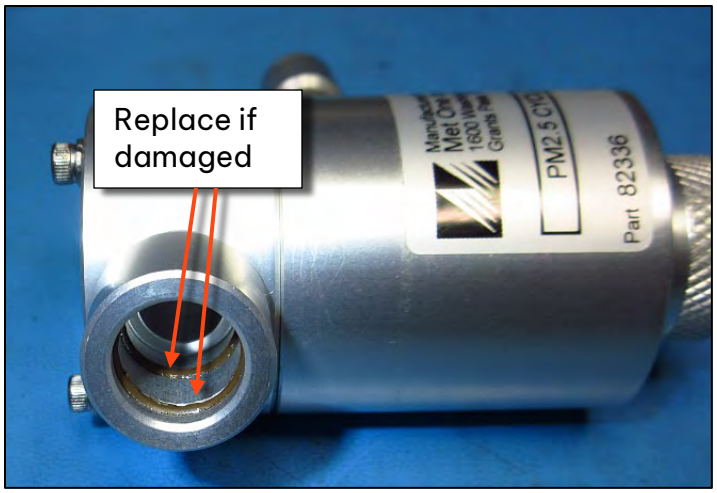


Figure 8-4 Cyclone Inlet Receiver O-rings

8.2.2 47 mm Filter Holder Cleaning

The 47mm Filter holder is directly in line with the flow path and can collect debris over time. Excessive debris buildup can cause flow restrictions leading to early pump failure or sampling data inaccuracies. The following steps should be followed when cleaning the 47mm filter holder and screen.

Frequency: Monthly

Removing Filter Cassette:

Figure 8-5 Filter Cassette Holder Removal

Pull down on the Filter Holder Release lever and hold in the down position to remove the filter holder.

Grip the silver knob protruding from the filter cassette holder and pull outward.

The cassette holder and cassette will slide out of the main assembly.

The top and bottom rims of the filter cassette mate with V-Rings, sealing the flow path. These rims will need to be wiped off.

Filter cassette orientation:

The filter screen is recessed into the cassette from the top side of the filter Cassette. (**Figure 8-7**).

Figure 8-6 Filter Cassette Holder Removed

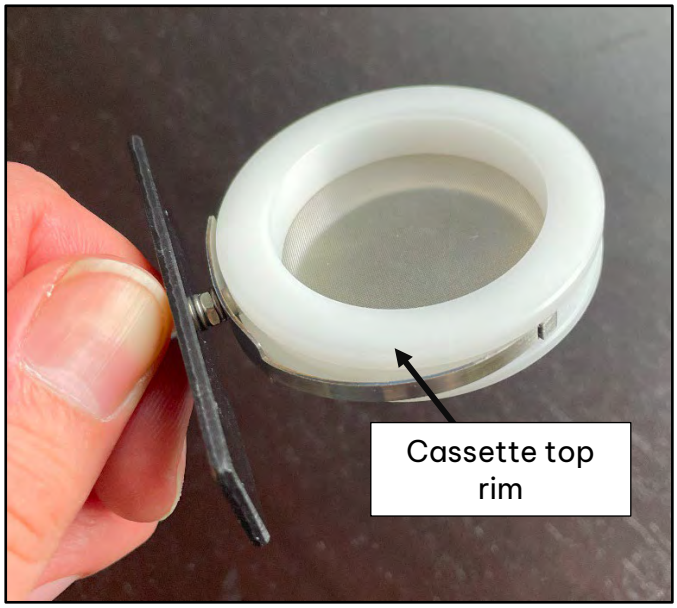


Figure 8-7 47 mm Filter Holder, Top View

Debris will be deposited on the top side of the screen.

Remove the filter Cassette from the cassette holder.

Blow a few short blasts of compressed air on the top side of the screen to loosen any stuck debris.

Wipe off the top rim.

Turn the cassette over, exposing the bottom side of the screen.

With compressed air, blow off the bottom side of the screen.

Wipe off the bottom cassette rim.

Install the cassette back into the cassette holder, and reinstall the assembly, top side up, back in the E-Sampler V2.

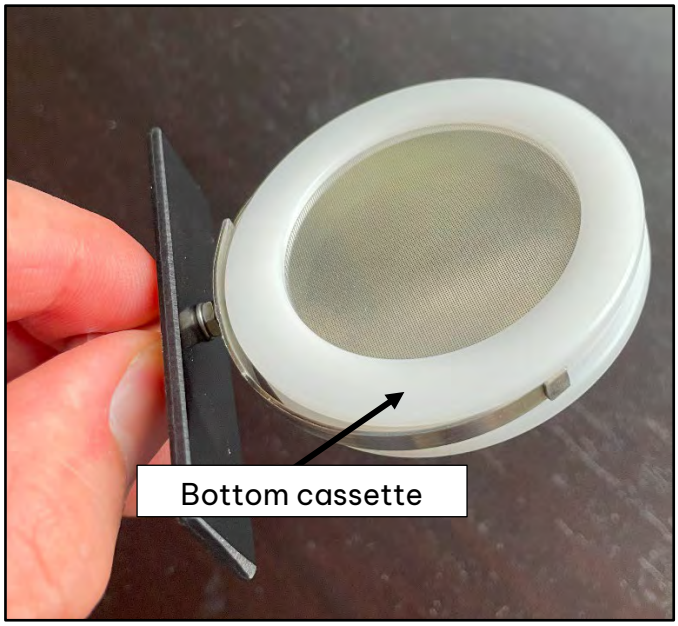


Figure 8-8 47 mm Filter Holder, Bottom View

8.3 *Flow System Audit*

See **Section 8.4.4** for auditing and calibrating the flow sensor**.** Before performing a flow audit or calibration, follow the instructions below to verify that the flow system is in good working order.

WARNING: If there are issues with the flow system, a flow calibration will not be accurate.

See **Section 11.2** for more information about the flow system and its components.

To perform any calibrations, a standard or reference device such as the Met One SWIFT 6.0 (Shown Below) is required.

Figure 8-9 Swift 6.0

8.3.1 Leak Check Procedure

Performing leak checks are vital for maintaining overall sampling performance of the E-Sampler V2. This section describes the necessary equipment and procedures for performing leak checks in the field.

The Leak Test screen is used to check for airflow system leaks which could affect the accuracy of the flow measurements or cause unwanted measurement biases. The Leak Test has a progression of screens to walk the operator through the process.

1. Remove TSP inlet and sharp cut cyclone. Cap off the top of the E-Sampler V2 inlet tube with a vinyl or rubber cap.
2. Open the front door and remove the battery cover plate. Locate the purge cutoff value on the left side. Rotate it to the closed position as shown by **Figure 8-11**.

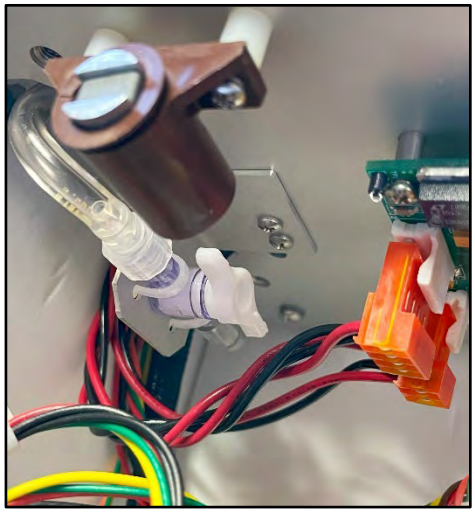


Figure 8-10 Purge Cutoff Open

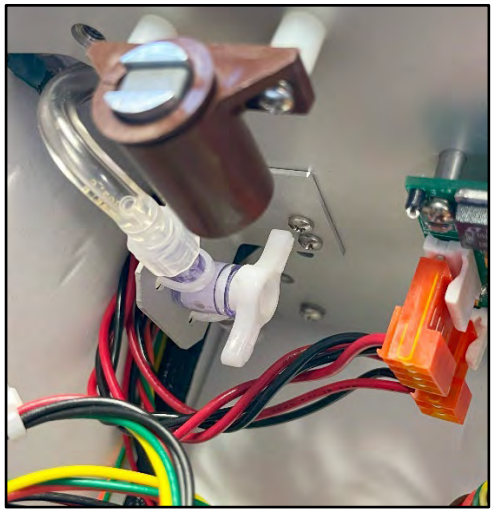


Figure 8-11 Purge Cutoff Closed

3. Wait for the system to zero the flow sensor reading. This step is omitted if steps 1 and 2 take longer than the zero-flow sensor process (~25 seconds). The software will automatically proceed to the step 4 when the zero-flow sensor process has completed.
4. The pump is turned on. Wait for flow reading to stabilize (about 2 minutes). The leak test will pass if the reading is less than 0.3 liters per minute. The leak test will FAIL if the reading is greater than 0.3 liters-per-minute. Do not run this test for more than 5 minutes because it will reduce the lifetime of the pump motor.
5. The pump is turned off. Rotate the purge cutoff valve back to the open position as shown. Remove the vinyl cap from the inlet and re-install the sharp cut cyclone and TSP cap.

8.4 *Field Calibration Procedures*

Menu Location: Main Menu> Calibrate

The E-Sampler V2 has a system of calibration menus which allow the operator to audit or calibrate the airflow control system parameters for optimal performance and sampling accuracy. These parameters should be audited monthly and calibrated quarterly during continuous operation. The exact frequency may vary depending on the harshness of the local conditions and the data validation requirements established by the sampling program administrator and your resulting standard operating procedures (SOP).

NOTE: The E-Sampler V2 temperature, pressure, and leak status should always be checked before any flow calibrations are performed, since the flow calculation is dependent on these parameters.

8.4.1 Ambient Temperature Calibration

Location: Main Menu> Calibrate> Calibrate AT

The Calibrate AT screen is used for field audits or calibrations of the ambient temperature measurement of the E-Sampler V2.

The AT calibration will be conducted in Degrees C regardless of the current setting for engineering units. It will calibrate the primary external temperature sensor if one is connected. If no external temperature sensor is connected, the internal temperature will be calibrated, and its readings will be used for flow calculations. An accuracy of ±2 degrees C is adequate for flow control purposes.

The AT parameter is the current reading from the E-Sampler V2 temperature sensor. The Reference parameter is where you can enter the correct value from your traceable temperature standard. The AT value should change to match the Reference value when you select SET and press the selector knob.

DEFAULT can be selected to clear out all previous field calibrations and restore the factory calibration for the sensor. Use this if difficulty is encountered during the calibration. Press ESCAPE to escape without changes.

NOTE: The internal temp sensor can be three to five degrees above ambient conditions. If the internal sensor is calibrated to actual ambient temp and an external sensor is added later, the external temperature should be re-calibrated to remove the artificial offset from using the internal temperature sensor for ambient readings.

8.4.2 Ambient RH Sensor Calibration

Location: Main Menu> Calibrate> Calibrate RH

The Calibrate RH screen is used for field audits or calibrations of the 83832 AT/RH sensor's relative humidity measurement.

The RH parameter is the current reading from the E-Sampler V2 external RH sensor. The Reference parameter is where you can enter the correct value from your traceable humidity standard. The RH value should change to match the Reference value when you select SET.

DEFAULT can be selected to clear out all previous field calibrations and restore the factory calibration for the sensor. Use this if difficulty is encountered during the calibration. Press ESCAPE to escape without changes.

NOTE: *This calibration screen does not apply to the internal E-Sampler V2 filter RH sensor*, which is located inside the E-Sampler V2. The internal sensor can be audited by checking the RHi value at the bottom page of Home screen. See **Section 5.4.1**. The internal RH sensor cannot be calibrated, only audited.

The Internal RH sensor will almost always read lower than ambient RH due to it's location within the E-Sampler V2. If the E-Sampler V2 has been operating with the inlet heater running, the inside temperature of the unit will be much warmer than ambient, resulting in internal RH readings that will be significantly lower than an ambient RH standard. If the sample RH sensor is to be audited, it is expected that the RH reading will be lower than ambient RH. If the internal RH sensor fails, it will read an impossible value such as 125% or -25%.

8.4.3 Ambient Barometric Pressure Calibration

Screen Location: Main Menu> Calibrate> Calibrate BP

The Calibrate BP screen is used for field audits or calibrations of the internal ambient barometric pressure sensor.

The BP parameter is the current reading from the E-Sampler V2 pressure sensor.
The Reference parameter is where you can enter the correct value from your traceable pressure standard. The Barometric Pressure calibration will allow the Reference value to be entered in the Engineering Units that are selected for the pressure sensor. The BP value should change to match the Reference value when you select SET.
DEFAULT can be selected to clear out all previous field calibrations and restore the factory calibration for the sensor. Use this if difficulty is encountered during the calibration. Press ESCAPE to escape without changes.

8.4.4 Flow Calibration

Screen Location: Main Menu> Calibrate> Calibrate Flow

WARNING: The E-Sampler V2 temperature, pressure, and leak status must be checked before performing any flow calibrations to prevent errors.

The Calibrate Flow screen is used for field audits or calibrations of the sample flow measurement of the E-Sampler V2. Remove the TSP inlet and any cyclones from the E-Sampler V2 inlet tube, and then connect the top of inlet tube to the outlet of your traceable flow meter using a length of appropriate flexible tubing. The E-Sampler V2 flow rate should be maintained to within ±0.1 LPM (1.9 to 2.1 LPM) for proper cut-point performance of inlet cyclones.

The Flow parameter is the current reading from the E-Sampler V2 flow sensor, in actual volumetric liters per minute. The E-Sampler V2 should automatically regulate to the setpoint (2.0 LPM) when the flow calibration screen is entered. This may take a moment. The Reference parameter is where you can enter the correct value from your traceable flow meter, using the scroll wheel. **The flow reading that you enter must be in actual conditions**. The Flow value should change to match the Reference value when set is selected.

The DEFAULT button can be selected to clear out all previous field calibrations and restore the factory calibration for the sensor. Use this if difficulty is encountered during the calibration. Press ESCAPE to escape without changes.

NOTE: To audit the E-Sampler V2 flow rate without changing the calibration, simply compare the Flow value to your traceable standard and record the results. If the SET button is not selected, then no flow calibrations are affected.

8.4.5 DAC Calibration

Location: Main Menu> Calibrate> Calibrate DAC

The CALIBRATE DAC screen is used for field audits or calibrations of the E-Sampler V2 digital-to-analog converter (DAC) output. See **Figure 4-13** for the analog output connector location.

To save any changes, move the green selection box around SET and press the selector knob.

The DEFAULT button can be selected to clear out all previous field calibrations and restore the factory calibration. Use this if difficulty is encountered during the calibration. Press ESCAPE on the keypad to escape without saving changes.

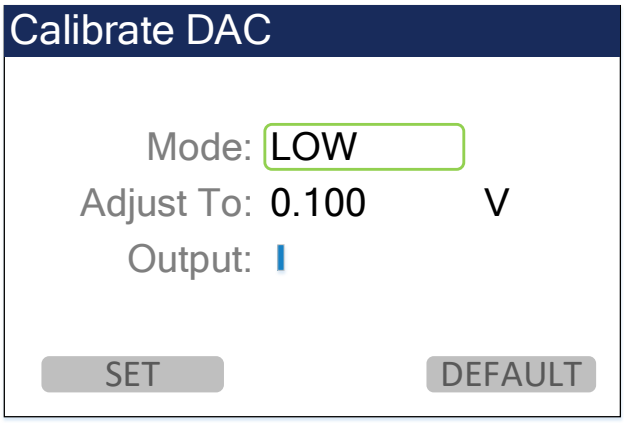


Figure 8-12 Calibrate DAC Main Screen

NOTE: Only a high-quality voltmeter should be used for this test. Low quality voltmeters may not give accurate measurements at millivolt levels. The E-Sampler V2 analog output can be confirmed with the external datalogger connected, to make sure that the logger or cables are not affecting the voltage.

*A high-quality volt meter and the **83609** External Analog output cable are required to calibrate the DAC. Contact the Met One service department to order the **83609** cable.*

Connect the 83609 cable to the Analog output at the bottom of the E-Sampler V2.

Use the table below to connect the volt meter to the correct 83609 analog output cable leads.

Table 8-2 Analog output cable breakout

83609 Cable	Voltmeter Lead
Red - Analog Out	Red Lead
Black - Ground	Black Lead

Set the volt meter to read Volts.

Compare the displayed value to the actual voltage measured on the analog output using a voltmeter and record the results. The voltage measured on the E-Sampler V2 analog output wires must match this setting within ±0.001 volts. If not, the analog output on the E-Sampler V2 will need to be adjusted. Follow the instructions below for adjusting the analog output voltage.

The MODE can be set to LOW, or HIGH using the selector knob.

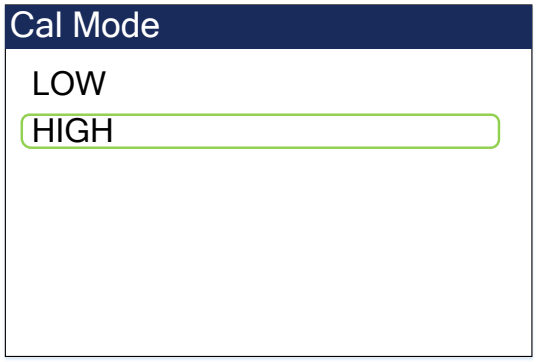


Figure 8-13 Calibration Mode Options

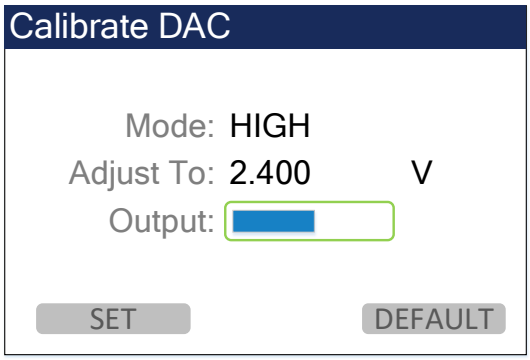


Figure 8-14 Calibrate DAC, High Mode

With the green selection box around the Output bar, press the selection knob.

Turn the selection Knob to increase or decrease the voltage output.

See below for details on calibrating the DAC Output.

In the HIGH mode, the analog output is forced to 100 mV below the full-scale voltage of the unit (0.990 volts if set to 1.000V scale). If the output does not match the voltmeter reading, the Output bar can be selected (using the selector knob) to adjust the output up or down. Be sure to SAVE any changes by selecting SET.

In the LOW mode, the analog output is forced to 0.100 volts. Measure the actual voltage output again and make any adjustments. After the HIGH and LOW modes are adjusted and saved.

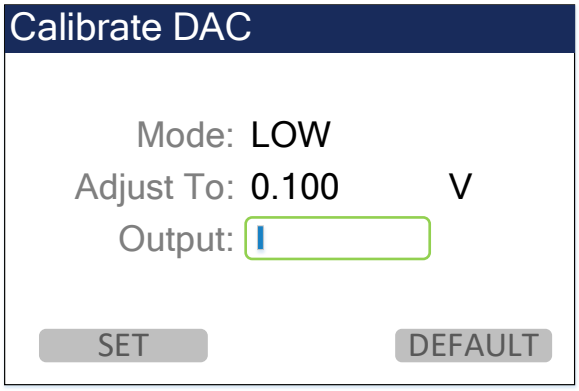


Figure 8-15 Calibrate DAC, Low Mode

8.5 *K Factor*

The main limitation of most nephelometer instruments is that the accuracy of the mass output can be negatively affected by variations in particulate size, color, shape, and index of refraction. One of the most important uses for the 47 mm filter system is determination of a gravimetric K-factor (slope multiplier) to correct the E-Sampler V2 signal to compensate for local particulate characteristics.

8.5.1 Establishing a K-Factor Correction (47mm Filter)

The E-Sampler V2 47mm filter option is a low-flow version of the manual sampler gravimetric method, which is the standard measurement technique against which all continuous methods are compared in the U.S. and most other countries since it is very accurate and yields repeatable data.
The filter material used in the 47 mm system can be selected based upon the desired type of laboratory analysis.

In some applications the appropriate K-Factor will be quite significant, such as a multiplier of three or greater.

WARNING: The K-Factor is only valid at the same site and for the same particulate type. If the local particulate source changes, the K-Factor may no longer be valid.

The E-Sampler V2 can be used with no correction factor (K=1) in applications where relative particulate measurements are appropriate.

NOTE: An empty filter cassette, with a screen, must be installed in the E-Sampler V2 at all times, in order to seal the flow system!

Follow the steps below to properly establish and set a K-factor.

1. Obtain and/or pre-weigh the 47 mm disc filters on a microbalance scale according to standard protocol.
   Pre-weighed filters are often obtained from an outside lab due to the expense of the scale and lab setup. See 40 CFR Part 50 for more information or contact a reputable lab. Many agencies already have appropriate filters for use in reference method filter samplers on hand. Met One recommends using PTFE/Teflon filters.
2. Install and check the E-Sampler V2. Make sure that the sampling site is representative of the local air. Use FRM/FEM siting criteria whenever possible. See **Section 3**. Make sure that the E-Sampler V2 passes all leak checks and flow calibrations.
3. Determine the length of the sampling period. For good gravimetric results, there should be about 0.5 mg (500 µg) of mass deposited on the filter if possible. The time it takes to accumulate this amount of dust will vary greatly depending on how clean or dirty the air is. In normal ambient air at moderate concentrations, you will usually need to run the E-Sampler V2 for about four or five days.

   If the typical average daily concentration levels at the site are known, then you can calculate the required run time based on the known value. You could also make a rough estimate by running the E-Sampler V2 for a day, then download the real-time data and calculate the average in mg/m^3 over the period.

For example, the E-Sampler V2 draws 0.12 cubic meters per hour (at 2.0 LPM). If the average daily concentration at the site is about 0.035 mg/m^3, and you want .5 mg on the filter, then:

0.035 mg/m^3 * 0.12 m^3/hr = **0.0042 mg/hr**

0.500 mg / 0.0042 mg/hr = **119 hours (≈5 days)**

4. Set the E-Sampler V2 to TIMED sampling mode and set the event duration to the estimated amount of time determined in step 3, or a similar convenient interval. Install the 47 mm filter and run the timed sample.
5. After the sample period has ended, remove the 47 mm filter and have it re-weighed in the lab. The filter must be handled carefully, transported carefully, and equilibrated properly.
6. Download the E-Sampler V2 light scatter data and average the E-Sampler V2 concentration data values for the entire sample period.
7. Evaluate the E-Sampler V2 total flow over the sample period. First, check the flow values in the downloaded data for proper 2.0 lpm regulation. The E-Sampler V2 data does not record the sample volume, so you must calculate it. If the E-Sampler V2 ran for five days (120 hours), then the nominal sample volume would be 2.0 lpm, times 60 min/hr, times 120 hours. This equals 14,400 liters or 14.4 cubic meters of nominal sample volume.

   However, you must also compensate for the fact that the sample stops for about 2.8 minutes each time the automatic self-test ran during the timed sample. For example: If the E-Sampler V2 was set to hourly self-test, then 2.8 minutes of each hour would not have flow going through the 47 mm filter. This amounts to 2.0 lpm times 2.8 minutes, or 5.6 liters of air per hour. So if the sample ran for five days (120 hours), then 5.6 liters per hour times 120 hours equals 672 liters. The corrected total sample volume would then be 14,400 – 672 = 13,728 liters, or 13.728 cubic meters. **Note:** 1 cubic meter equals 1000 liters.
8. Use the change in mass results from the gravimetric filter analysis (the difference between the clean and dirty filter weight in mg) and the total sample flow volume (m^3) through the filter to calculate the concentration of particulate on the 47 mm filter in mg/m^3. The concentration is calculated as total mass divided by total sample volume.

For example, if the clean filter weighed 77.643 mg and the dirty filter weighed 78.345 mg, then the total particulate mass on the filter would be 78.345 minus 77.643, or 0.702 mg. If the total sample volume was 13.728 cubic meters, then the filter total concentration would be 0.702 mg divided by 13.728 m^3, or 0.051 mg/m^3.

9. Calculate the K-Factor as the 47 mm filter total concentration divided by the E-Sampler V2 total light scatter concentration. For example, if the filter total concentration was 0.051 mg/m^3 and the E-Sampler V2 total concentration was 0.038 mg/m^3, then the K-Factor would be 0.051 divided by 0.038 or 1.342.

See **Section 6.4.3** on how to set a K-factor. **The K-Factor will only be applied to new data!** The resulting corrected concentrations are stored in memory, shown on the LCD, and scaled on the analog output.

Table 8-3 K-factor Calculation Example

E-Sampler V2 Sample Event Time:	120 Hours (5 days)
E-Sampler V2 Flow Rate:	120 liters per hour (2.0 lpm) (0.12 m^3/hr)
E-Sampler V2 Self Test Interval (no flow):	Hourly (2.8 minutes per hour)
Self Test Flow Correction:	-5.6 Liters per hour (-672 liters over 5 days)
E-Sampler V2 Total Sample Flow Volume:	**13.728 cubic meters**
Clean 47 mm Filter Weight:	77.643 mg
Dirty 47 mm Filter Weight:	78.345 mg
47 mm Total Particulate Mass:	0.702 mg
47 mm Filter Total Concentration:	**0.051 mg/m^3**
E-Sampler V2 Light Scatter Avg Concentration:	**0.038 mg/m^3**
Calculated K-Factor:	**1.342**

8.6 *Alarms*

The E-Sampler V2 contains a comprehensive system of error and alarm codes which are used to alert the operator to any problems with the unit. These error codes may be generated during normal operation or during a self-test routine. The errors appear in the alarm log as a detailed record of the time and type of the error. In addition, errors are stored in the digital data log as a code number in the data array.

The following table describes each of the error and alarm types which can be generated by the E-Sampler V2, along with the conditions which cause the alarms. Many of these alarms indicate critical parameters which must be working correctly for machine operation.

Table 8-4 Alarm Descriptions

Alarm/Error Message	Alarm Description
POWER OUTAGE	This alarm message indicates that the E-Sampler V2 power has been cycled off and then back on. This can mean that there was a power failure or that someone simply unplugged the unit to turn it off. The E-Sampler V2 alarm display will show OFF time indicating how long the power was off, and ON time indicating how long the power was on before the power failure. A second type of power alarm can be shown on the display as a FIRMWARE UPDATE. This will only occur when the E-Sampler V2 firmware is flash updated by the user. This is normal and does not indicate a failure.
INTERNAL COMM DOWN!	This alarm indicates that there was an internal failure, preventing the MD-F Engine from communicating with the processor board for 10 seconds or more. The time and date of the error will be displayed. The E-Sampler V2 will stop operation until internal communication is restored. If these errors persist, please contact Met One.
LASER FAILURE	This alarm occurs when the MD-F engine laser current is out of range. The alarm is cleared when the laser current is within range.
ZERO STABILITY ERROR	This alarm occurs during the Self-Test event when the MD-F engine output stability is out of range. The alarm is cleared when the next event does not fail.
PRESSURE FAILED	This occurs when communication is lost to the digital pressure sensor. A failed pressure sensor is forced to read 101306 Pa or 29.9 inHg.
FLOW FAILED	This alarm indicates that the flow system is more than 5% out of regulation for more than 5 minutes. The alarm display will show the actual flow rate and the time and date of the error.
BATTERY WARNING or BATTERY FAILED	The BATTERY WARNING occurs if the input voltage drops below 11.2 volts and clears when the voltage restores to above 11.7 volts. BATTERY FAILED occurs if the voltage drops below 9.5 volts and clears when the voltage restores to above 10.2 volts. The time and date of the error will be displayed, along with the actual voltage.
DETECTOR ERROR	This alarm occurs during the Self-Test event when the MD-F engine output is out of range. The alarm is cleared when the next event does not fail.
SPAN ERROR	This alarm occurs during the Self-Test event when the MD-F engine output is out of range. The alarm is cleared when the next event does not fail.

The E-Sampler V2 also contains an "alarm" code column, within the retrieved User data report, to indicate if there were any alarm or error flags during that particular sample period. An example of an E-Sampler V2 data record is shown below. The alarm header and alarm code are highlighted below:

```
AutoMet Data Log Report
02-AUG-2011 09:25:10,
ID,1
SN,M4373

Time,Conc(MG/M3),Flow(l/m),AT(C),BP(PA),RHx(%),RHi(%),WS(M/S),WD(Deg),BV(V),Alarm
02-AUG-2011 09:15:00,0.023,2.0,25.2,97302,1,39,0.3,1,14.2,0
```

Figure 8-16 Data Output (Legacy Mode) Alarm Code Example

NOTE: When the instrument communications is set to Standard Output mode, the output code will be labeled "Status" instead of "Alarm" See **Section 5.4.6.2** for more information.

The following table defines the possible error codes that can appear in the "alarm" column of the E-Sampler V2 data records:

Table 8-5 Data Alarm/Error Code

Code	Error/Alarm Type
0	No alarm
1	Self-Test Failure
2	Span Failure
4	Laser Current Failure
8	Pressure Sensor Failure
16	Flow Failure
32	Not Used
64	Internal Hardware (SPI bus) Failure
128	Low Battery

NOTE: If multiple errors or alarms occur in the same data period, the reported alarm code will be the *sum of the two individual code numbers*. This is a rare occurrence.

Example: If an alarm code of 17 is reported, that means that a Self-Test Failure (Code 1) and a Flow Failure (Code 16) occurred during the same sample period.

When the digital error log is retrieved from the E-Sampler V2 using Comet software or ESCAPE commands (Communications: Legacy Mode), the error report will contain the same information about the alarms as described above, only in the following format:

```
E-Sampler Alarm Log Report
02-AUG-2011 14:25:26,
SN,M4373

20-NOV-2008 20:00:00, Power outage: 0.00:20:17 On: 5.02:30:22
20-NOV-2008 20:00:00, Laser Failure: 26.3 mA
20-NOV-2008 20:00:00, Flow failed: Setpt: 2.0 Flow: 1.4
20-NOV-2008 20:00:00, Low battery: 9.46
```

Figure 8-17 Retrieved Alarm Log Report Example

In each case, the alarm log record indicates the time and date of the error, and the specific parameter which generated the alarm. The measured value of the parameter, compared to the acceptable limits, is also recorded where applicable.

8.7 *Problems and Solutions Table*

The following table contains information on some of the more common E-Sampler V2 problems which may be encountered, and some steps to identify and remedy the problems. Met One Instruments, Inc. welcomes customer suggestions for new items to include in this section of future manual revisions. If the solution cannot be found in the following table, then contact one of our expert service technicians for help in resolving your problem.

Problem:	**The E-Sampler V2 won't start a measurement cycle.**
Cause/Solution:	• You must press the START button to start continuous operation. • The E-Sampler V2 may not start a measurement cycle if it detects a hardware failure, such as a pressure sensor failure or a pump failure. • The unit will not start a cycle if the input DC voltage is below the restart threshold of 10.2 volts DC.

Problem:	**Flow failures or low flow.**
Cause/Solution:	• Check the PUMP and PURGE filters. These must be replaced periodically. • Try to DEFAULT the flow sensor calibration. If corrupted flow cal parameters are entered into the flow calibration, it may appear that the flow system is not working. • Verify the AT and BP sensors function. Failed sensors can affect the flow. • The sample pump itself will eventually wear out and need to be replaced. It should last at least a year under normal conditions. Check the other possibilities first.

Problem:	Leak check failures
Cause/Solution:	• Make sure that the inlet is completely blocked with a rubber or vinyl cap during the leak check. Using a finger to block the inlet is not sufficient. • Make sure the inlet tube is fully seated into the top of the optical module, especially if you installed the inlet heater assembly yourself. You may need to temporarily loosen the weatherproof fitting at the top of the inlet tube to get it seated correctly. • Make sure the 47 mm filter cartridge is installed correctly and V-Rings are in good condition for a proper seal. • Make sure the PUMP and PURGE filter holders are tightened fully.

Problem:	Optical system alarms and failures
Cause/Solution:	• The E-Sampler V2 must be periodically returned to the factory for optical system cleaning. The period will depend on your particulate levels. • Check the PURGE filter and replace it as needed. • Make sure the manual purge valve (inside the battery compartment) is OPEN (parallel to the tubing) during normal operation. If closed, the unit will still function normally, but no purge air will circulate around the optics to keep them clean! • The laser diode has a finite lifetime which will be reduced at high temperatures. It may eventually fail and need to be replaced at the factory. • Never disassemble the MD-F laser optical subassembly!

Problem:	The E-Sampler V2 data does not match BAM or FRM data at the same site
Cause/Solution:	• A K-Factor (multiplier) must be established for good accuracy and correlation to collocated instruments. The K-Factor will sometimes be very significant, such as a multiplier of 3 or 5. See **Section 6.4.3**. • The E-Sampler V2 is calibrated on latex 0.6 micron micro-spheres. These provide an extremely consistent calibration, but do not generally match the characteristics of ambient particulate. • The K-Factor is only valid at the same site and for the same particulate type. If the local particulate source changes, the K-Factor may no longer be valid. • The E-Sampler V2 TSP inlet is designed for low winds only. High winds may cause inaccurate sampling. • Make sure the correct cyclone is used on the E-Sampler V2. The PM_{10}, $PM_{2.5}$ and PM_1 cyclones look very similar. The cyclone cut point must match the cut point used on any collocated instruments. • Clean the TSP inlet and any cyclones at least monthly. • Check the sample RH data and filter RH sensor operation. High sample RH will cause E-Sampler V2 over-reading. The sensor itself can occasionally fail. • Check the E-Sampler V2 for flow leaks and flow calibration problems. • Check the alarm log for optical system alarms.

8.8 *Field Replaceable Components*

There are only a few critical parts of the E-Sampler V2 that can be replaced in the field. Those parts include the two pump filters and pump Module. This section provides instructions on how to replace the filters and the pump module.

8.8.1 Pump and Purge Pump Filter Replacement

The E-Sampler V2 PUMP FILTER and PURGE FILTER are the two filter cartridges located in the front panel of the instrument.

They can be removed by unscrewing the black aluminum filter holders with a coin using the slot in the face of the holder (**Figure 8-18**). The expected lifetime of the two filters is one year, but in heavy particulate areas they may need to be replaced more often.

Figure 8-18 Unscrewing Filter Holder

Figure 8-19 Removing Filter and holder

When the filter and holder are removed from the main assembly, the filter can be separated from the holder by pulling the filter over the threads and off the holder. Clean the filter holders by wiping them with a cloth, soap and water may be required. A new filter can then be installed on the filter holder. The filter holder and then be threaded back into place in the main assembly.

The 5 micron PUMP filter keeps any large particles from entering the flow sensor or sample pump. The 0.2 micron PURGE filter cleans the recirculated purge air which is used to keep the optics clean during normal operation and the zero self-test.

Figure 8-20 Pump and Purge Filters Removed

8.8.2 Pump Module Replacement

The E-Sampler V2 brushless diaphragm sample pump has a life span of up to 10,000 hours or one year during continuous operation. The exact lifetime will depend on the harshness of the sampling environment. The E-Sampler V2 has a second smaller diaphragm purge pump which only runs during the self-test zero period. The current

design uses a removable flow system subassembly containing both pumps, the flow sensor, and pulsation chamber.

******Before replacing the pump, check all filters, flow calibration and, leak check.******

WARNING: The E-Sampler V2 is densely assembled, and it can be difficult to service inside. If you are unsure of your technical skills, send the unit in for factory service instead.

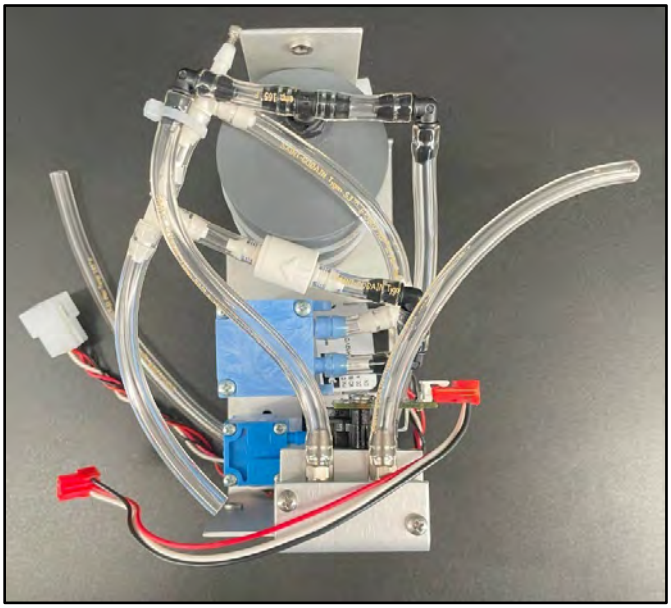


Figure 8-21 Pump Module Top View

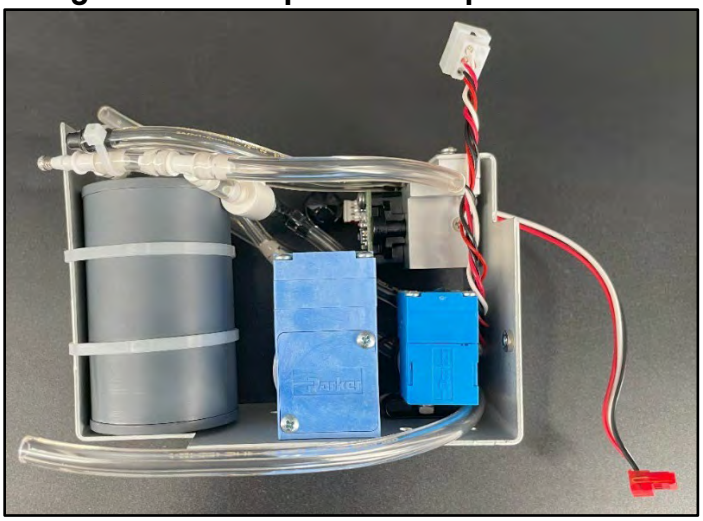


Figure 8-22 Pump Module (Side View)

1. Disconnect all power from the E-Sampler V2. Remove the internal battery if used.
2. Remove the inlet heater assembly from the top of the E-Sampler V2. Remove the three screws from the base of the plastic heater sleeve, then pull the assembly out of the top of the unit. Unplug the heater electrical harness.
3. Unscrew the E-Sampler V2 main assembly from the enclosure. There are four screws in the front display panel.
4. Remove the entire E-Sampler V2 internal assembly from the enclosure. You will have to unplug the exhaust tubing from the exhaust port in the bottom of the enclosure. Note the connector locations on the bottom of the unit, remove these also.

NOTE: Newer versions of the E-Sampler V2 have a connector plate with four screws. This is there so all connectors can be removed together rather than individually. Remove the four screws to release the connector plate from the chassis.

Figure 8-23 Connector Plate Example

5. It will be easier to proceed if you unscrew the back panel of the E-Sampler V2 assembly (2 screws) and unscrew the long stand-off support (one flat head screw). This allows the assembly to be expanded for easier access.
6. Unscrew the pump module assembly from the main E-Sampler V2 assembly. There are two screws on the bottom, and one screw through the plastic clip on the top.
7. Unplug the pump module main electrical harness connector, and the flow sensor connector. Unplug the two clear tubes connecting the pump module to the filter block in the E-Sampler V2. Note which tube goes to which position! You should now be able to remove the pump module. Avoid any further disassembly of the E-Sampler V2 or unplugging any other connectors.
8. Install the new pump module in the reverse order. Be sure to reconnect all electrical and tubing connections into the correct positions.
9. After reassembly, check for leaks and perform a complete AT, BP, and flow calibration.

9. DATA RETRIEVAL

This section describes the methods used to retrieve data files from the E-Sampler V2. The unit has a USB C serial port on the front panel and a SERIAL COMMS port on the bottom for either RS-232 or RS-485 two-way serial port which handles all digital data transfer, and may be used with a local computer, laptop, or digital datalogger. The serial port can also be used for remote communications with various modem kits. Access to the data through the serial port is easy using the supplied Comet software or simple terminal commands.

9.1 *E-Sampler V2 to Computer Communications*

The E-Sampler V2 can be directly connected to a local computer for data retrieval and for changing settings. It also can be connected to a data logger or modem for network use and remote data retrieval. The table below provides information about the different cables and their intended uses.

Table 9-1 Communications Cable Descriptions

Cable Part Number	Description	Notes
502116 USB-C to USB	Temporary connection to a computer for data downloads, clearing memory and serial commands.	USB-C port located at the front of the unit.
83849 Serial Coms to DB-9	Connection to a computer or data logger for data downloads, clearing memory and serial commands.	DB-9 to USB converter (550067) is required for USB connection to a computer if a DB-9 port is not available.
83315 Serial Comms to brake out, strip and tin wires	Connection to data logger or other terminal block devices for data storage, and communications.	Contact Met one for more information.

The E-Sampler V2 fixed settings for the front USB-C port is 115200 Baud, 8 data bits, no parity, one stop bit.

The baud rates for the Serial Comms port can be set at the Initial setup menu under communications. See **Section 6.1.2.2** for instructions on how to set the baud rate.

For long-term network communication solutions Contact Met One for more information.

9.2 *Modem Options for Remote Data Retrieval*

The Met One Instruments CCS Modem is recommended for remote data retrieval with the E-Sampler V2. The required cable for communications between the CCS modem and the E-Sampler V2 is part 83867 (sold separately). Cell modems, radio modems, satellite transmitters, and TCP/IP addressable Ethernet modems are also compatible and available for the E-Sampler V2. These technologies are constantly changing; therefore, they are handled per individual order. Contact Met One for details.

9.3 *Comet™ Data Retrieval Software*

The E-Sampler V2 recommended data retrieval software, Comet™, can be downloaded for free at metone.com. Comet™ software is a simple Windows-based communications terminal program developed by Met One Instruments, Inc. This is the recommended method for local and TCP/IP (with a cellular or network modem) data retrieval, since Comet allows the user to easily download the data logs, error logs, and settings files from the E-Sampler V2, without having to know any of the underlying communications protocols. The Comet software user's manual (Comet-9800) is a general PDF guide for the program setup and operations. The manual can be downloaded from metone.com. Install the program onto computers intended for data retrieval and review the manual for data examples.

Warning: A Silicon Labs CP210x Driver for the USB connection must be installed before connecting to the USB Type C port. Driver download weblink: https://www.silabs.com/products/development-tools/software/usb-touart-bridge-vcp-drivers

Note: Before using the USB Type C port, ensure an existing RS-232 connection is disconnected.

The Comet program is available from the Met One Instruments website: https://metone.com/products/comet/

Install the program on the computer, then run it from the Programs directory. Create a new station for the E-Sampler V2 and then use it to retrieve the data from the E-Sampler V2 monitor.

NOTE: If you use the Comet software for routine E-Sampler V2 data retrieval, you will not need to use or understand any of the terminal program setups or serial commands shown in the rest of this manual subsection.

9.4 *Terminal Program Serial Communications and Data Retrieval*

The E-Sampler V2 can communicate via terminal or escape commands using RS-232, or USB Serial. The monitor only allows one physical communication connection at a time, either the USB-C port or the serial port, but not both. These connection options allow users to download both data and operate the instrument.

The E-Sampler V2 supports a system of ASCII based terminal commands and Escape commands that can be used to manually collect data records or to remotely change some of the settings in the instrument through the serial port. These commands can be sent to the instrument through the terminal window tab in Comet (or through a terminal program). They can also be programmed into a digital data logger or similar automated system. Most of these functions are intended primarily for use with advanced or remote data collection systems and are not usually used for routine data collection purposes. The Met One Instruments 7500 Protocol commands can be used in either Terminal Mode or Escape Command Mode.

This section provides the necessary information for terminal program communication with the E-Sampler V2:

- Connect the SERIAL COMMS port on the bottom of the E-Sampler V2 or the USB C port (A Silicon Labs CP210x Driver for the USB connection must be installed before connecting to the USB Type C port as mentioned in **Section 9.3**, above) on the front panel to your computer or laptop using the option serial cable or a USB-C Cable. Follow the connection prompts for the terminal program in use.
- Required Terminal Program Settings

USB-C Port baud rate:	115200 (Fixed)
Serial Coms baud rate:	9600 (Default) See **Section 6.1.2.2** to customize baud rate.
Data bits:	8
Parity:	None
Stop bits:	1
Flow control:	None

9.4.1 Terminal Mode

The E-Sampler V2 must be placed in Terminal Mode to use the Terminal Mode command set. From any command prompt (such as the terminal window in the Comet software), send three <cr> carriage returns ("Enter" key on a standard keyboard) through the serial port. The instrument will respond with an asterisk (*) indicating that is connected in Terminal Mode. Any terminal command may now be sent to the instrument.

NOTE: After two minutes, the E-Sampler V2 will stop waiting for a command and you will have to send another series of three carriage returns to reestablish the terminal mode connection.

9.4.2 Escape Command Mode

Escape commands do not require the E-Sampler V2 to be in Terminal Mode. The command strings are slightly more complicated, but there are no timeout issues and data integrity is higher. This is better for machine-to-machine programming than Terminal Mode. In this case, the command string consists of an ASCII <Esc> (Escape) character (hex 1B), followed by the desired alphanumeric command, and then completed by a carriage return <cr> (Enter). Escape commands are not echoed back as they are entered. This means that characters that are typed will not be displayed in the software terminal window.

An example of entering an Escape command string to request only the last data record would be entered like this:
<Esc>4<cr>

9.4.3 Terminal Commands

When a serial connection between a computer terminal program and the E-Sampler V2 has been established, the various E-Sampler V2 data files can be viewed and settings changed, by sending the following commands through serial port with keyboard strokes or ASCII characters.

If you send an "h" or "?" character, the E-Sampler V2 will respond with a help menu containing the serial command set descriptions:

Table 9-2 Terminal Commands

Command	Description
?	Help command (used when in a menu to see included options)
1	Report settings
2	Report all the data
3	Report the new data (data from after the last download)
4	Report the last record
C	Clear the data file
E	Stop sample
H	Help Menu
S	Start sample
BL	Back Light (10-100%)
CU	Count units. 0=ug/m^3, 1=mg/m^3
DT	Date / Time (2024-05-30 12:01:17)
ID	Network ID (1-999)
MA	Modbus Address (1-247)
MP	Modbus Port. 0=USB,1=RS-485,2=RS-232
PT	Communication Protocol Type. PT 0= Standard, TP 1=Legacy
PU	Pressure units. 0=mbar,1=PA,2=mmHg,3=inHg
QH	Report data record header
RQ	Report (ReQuest) data record readings
RV	Report Model, Firmware part number and version
SK	Set K-Factor. K Factor range is 0.1-10
SM	Sample Mode. SM 0=Continuous, SM 1=timed (Start date and duration can only be set from the physical E-Sampler V2 User Interface.
SS	Serial Number
ST	Sample Time. ST 0=1-min, ST 1=5-min, ST 2=10-min, ST 3=15-min, ST 4=30-min, ST 5=1-hour.
SU	Wind Speed Units. SU 0=m/s, SU 1=mph
TU	Temperature Units. TU 0=C, TU 1=F
SPAN	Enable / Disable Span Check ("SPAN 0"=disabled, "SPAN 1"=enabled).
DISPTO	Manual Display Timeout. 0=None, 1=1-min, 2=5-min, 3=10-min.

The following is an example of the data response from the E-Sampler V2 after a "2" command (all data records) was sent to the unit. The report starts with a printout of the time and date of the download, and the station ID and serial number of the E-Sampler V2. Then a data header row is printed which defines each of the columns in the data field. The columns are separated by commas to make it easy to import the data into a spreadsheet, or to parse out data fields in an automatic data collection system. Each column is a certain data parameter. Each row is one complete data record consisting of all stored parameters.

In this example (Legacy report type),the average period is set to 15 minutes, so there was a complete record stored to memory every 15 minutes. Data parameters such as wind speed/direction and external RH will always appear in the data array even if no sensors were connected for those channels. In this example, only a small amount of data was stored in the memory:

```
2

AutoMet Data Log Report
02-AUG-2011 09:22:06,
ID,1
SN,M4373

Time,Conc(MG/M3),Flow(l/m),AT(C),BP(PA),RHx(%),RHi(%),WS(M/S),WD(Deg),BV(V),Alarm
01-AUG-2011 18:15:00,0.008,2.0,26.8,96950,1,39,0.3,1,14.2,0
01-AUG-2011 18:30:00,0.007,2.0,27.2,96969,1,37,0.3,1,14.2,0
01-AUG-2011 18:45:00,0.008,2.0,27.5,96969,1,37,0.3,1,14.2,0
01-AUG-2011 19:00:00,0.010,2.0,27.8,96969,1,36,0.3,1,14.2,0
01-AUG-2011 19:15:00,0.008,2.0,28.0,96969,1,36,0.3,1,14.2,0
01-AUG-2011 19:30:00,0.006,2.0,28.1,96989,1,35,0.3,1,14.2,0
01-AUG-2011 19:45:00,0.005,2.0,28.1,96989,1,35,0.3,1,14.2,0
01-AUG-2011 20:00:00,0.007,2.0,28.1,97009,1,35,0.3,1,14.2,0
```

If a “3” command is sent (new data records), the data response from the E-Sampler V2 is formatted the same as shown above, but includes only the data logged since the last time the data was downloaded, based on the position of a data pointer. This command saves time by not retrieving previously downloaded data.

If a “4” command is sent (last data record), then the E-Sampler V2 responds with only the latest (newest) data record in memory as shown below. This is often used by digital data loggers which are programmed to collect data from an array of instruments at frequent intervals:

```
4

AutoMet Data Log Report
02-AUG-2011 09:25:10,
ID,1
SN,M4373

Time,Conc(MG/M3),Flow(lpm),AT(C),BP(PA),RHx(%),RHi(%),WS(M/S),WD(Deg),BV(V),Alarm
02-AUG-2011 09:15:00,0.023,2.0,25.2,97302,1,39,0.3,1,14.2,0
```

The following table defines the E-Sampler V2 data parameters as they appear in the header for data reports:

Table 9-3 Data Report Headings

Field	Description
Time	Date and time stamp of the data record.
Conc (mg/m^3)	Real-time light scatter average concentration in mg/m^3.
Flow (lpm)	Average air flow for the data logging period in actual liters per minute.
AT (C)	Average ambient temperature for the data logging period in °C.
BP (PA)	Average barometric pressure for the data logging period in Pascals.
RHx (%)	Average external RH for the data logging period. (83832 sensor)
RHi (%)	Average sample RH for the data logging period.
WS (m/s)	Average wind speed in meters per second. (Requires 10820 option)
WD (Deg)	Average wind direction in degrees. (Requires 10820 option)
BV (V)	Average battery or input voltage in volts.
Status	Error code (0 = no errors). **Standard Report Mode**
Alarm	Error code (0 = no errors). **Legacy Report Mode**

9.5 *Upgrade Firmware*

The E-Sampler V2 has the capability for flash firmware upgrades. This allows the field operator to reprogram or update the E-Sampler V2 through the serial port using the Firmware Update Utility program. A Met One technician may supply the firmware update files via an e-mail weblink if a bug fix is released, or if additional features are added to the firmware program. The following tasks must be performed whenever the firmware is upgraded:

1. **Download and save the data log and error log from the E-Sampler V2 before proceeding. These will be cleared from memory during the upgrade process!**
2. Firmware Update Utility is a PC-based utility program which is used to update firmware in Met One products equipped with FLASH memory technology. Install the Firmware Update Utility program onto the computer by following the prompts on the weblink.
3. Connect the E-Sampler V2 USB C serial port to the computer USB port with the USB-C to USB cable that is provided with the E-Sampler V2.
4. **Take great effort to ensure that the power source to the E-Sampler V2 and the computer will not be interrupted during the update process!** A power interruption may cause the E-Sampler V2 firmware to become inoperative! If this happens the unit may have to be returned to the factory.
5. Run the Firmware Update Utility.
6. The program will prompt you for the COMM port number. Enter the number and press ENTER to begin the update.

7. A “Done!” message will be displayed at the end of the update process. Execution time is approximately five to fifteen minutes.
8. The E-Sampler V2 can now be operated with the new firmware.

9.6 *Clearing Memory*

9.6.1 Clear Alarms

Location: Main Menu>Alarm Log

The stored alarm log file can be cleared by pressing the scroll wheel.

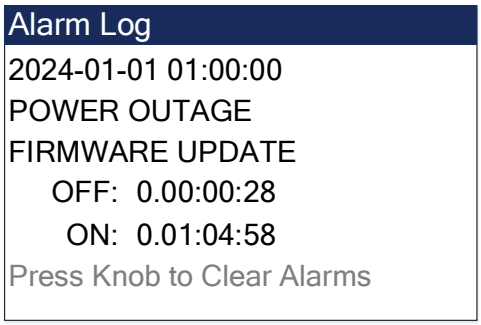


Figure 9-1 Alarm Log, Clear Memory

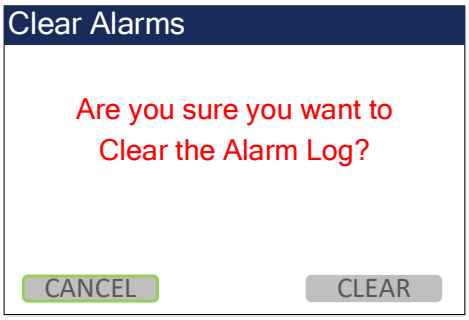


Figure 9-2 Alarm Log, Clear Alarms Warning

A confirmation screen will appear. Select the CLEAR option on the confirmation screen to continue with erasing the data and then returning to the Home Screen. Pressing the ESCAPE at the confirmation screen will return to the Alarm Log screen without erasing the data.

“No Records Available” will be displayed in the alarm log until an alarm or event has been triggered.

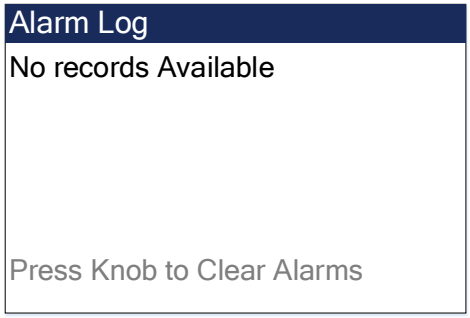


Figure 9-3 Alarm Log, Records Clear

9.6.2 Clear Data Records

Location: Main Menu> Toolbox> Memory

Press down on the selector knob to CLEAR the unit's memory.

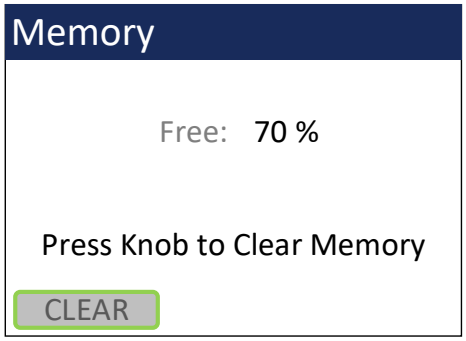


Figure 9-4 Memory, Clear Screen

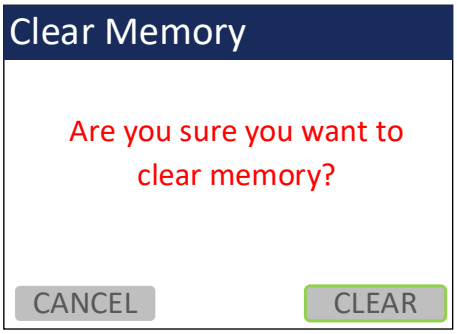


Figure 9-5 Memory, Confirmation Screen

A confirmation screen will appear. Select the CLEAR option on the confirmation screen to continue with erasing.

Select CANCEL on the confirmation screen or press the ESCAPE key to return to the Memory screen without erasing the data.

When the memory is cleared, the free percent will show 100%.

Press the Escape button to return to the menu.

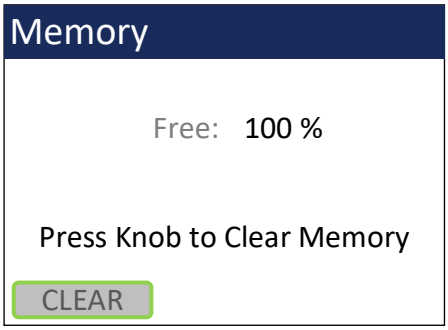
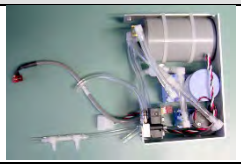


Figure 9-6 Memory, Cleared

10. SPARE PARTS and ACCESSORIES

Consumables, Replacement Parts, and Accessories
The following parts are available from Met One for maintenance, replacement, service, and upgrades. If unsure about a part you need, please contact the technical service department. Some of these parts may require technical skills or special instructions before use or installation.

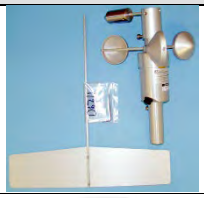
Flow System Components

Description	Part Number	Graphic
Sample Pump Module Assembly	**80160-1**	
Flow Sensor, E-Sampler	**82258**	
Internal Filter RH Sensor	**9359**	
Purge Filter Holder, Black Aluminum	**8912**	
Pump Filter Holder, Black Aluminum	**8913**	
Purge Air Filter, 0.2 micron	**580302**	
Pump Filter, 5 micron	**580345**	
O-Ring, For Purge and Pump Filter Holders	**720063**	
47 mm Filter Cassette, Delrin, With Screen	**460128**	
47 mm Filters, PTFE, 2 micron, 50 Pack	**460137**	
47 mm Filters, Quartz Fiber, 100 Pack	**460139**	
47 mm Filter Cassette Holder and Tray Door	**80398**	

Inlet Components

Description	Part Number	Graphic
$PM_{2.5}$ Sharp Cut Cyclone, 2 LPM	**SCC 112**	
PM_{10} Sharp Cut Cyclone, 2 LPM	**SCC 110**	
PM_{1} Sharp Cut Cyclone, 2 LPM	**SCC 111**	
TSP Sampling Inlet Harsh environment, with insect screen and rain cap	**9441**	
Cross-arm Clamp, ¾" x ¾", Aluminum Mounts cross-arms to the E-Sampler tripod	**1552**	
Cross-arm, ¾", 18" long, Aluminum Tube	**1539-18**	

Meteorological Sensors

Description	Part Number	Graphic
Wind Speed and Wind Direction Combination Sensor	**10820**	
AIO-2 Wind Speed, Wind Direction, Ambient Temperature, RH, and Barometric Pressure Combination Sensor. Includes 6 foot cable (10706) and 3 foot crossarm (7156)	**EX-AIO**	
Ambient Temperature and Relative Humidity Sensor	**83832**	

Miscellaneous Parts and Accessories

Description	Part Number	Graphic
Lithium Battery, Memory Backup	**390068**	
E-Sampler I/O Circuit Board Assembly	**83750-1**	
Pole Mount Bracket for E-Sampler. Mounts the unit enclosure to a mast, post, wall, or other vertical surface.	**9425**	
Battery, 12V, 5Ah, Lead Acid, DURA12-5F	**390037**	
Internal Battery Harness, Fused	**9423-1**	
Fuse, For Internal Battery Harness, 5 Amp	**590807**	
Fuse, 10 Amp	**590869**	
Power Supply, E-Sampler, 100 - 240V AC input 15V DC output, Weatherproof.	**9438-7**	
Modified 7-pin Power Supply, 115V AC input, for use with GOES transmitter, Weatherproof.	**EX-121-1**	
Solar Power Kit, 160W, 3.7 minimum PSH	**730139**	
Solar Power Kit, 240W, 2.5 minimum PSH	**730140**	
Tripod Assembly, E-BAM/E-SAMPLER	**EX-905**	
Cellular Modem Kit (Call Met One for Details on LTE)	**CCS Modem**	

Power Cable, E-Sampler to External Battery	**83246-1**	
Serial Comm Cable, E-Sampler	**83849**	
Strip and tin Serial Cable	**83315**	
USB C Serial Cable	**502116**	
External Analog Relay Cable	**83609**	
CCS Modem Comms Cable	**83867**	

11. E-SAMPLER V2 PRINCIPALS of OPERATION

The Met One Instruments, Inc model E-SAMPLER V2 is a type of nephelometer which automatically measures and records real-time airborne PM_{10}, $PM_{2.5}$, PM_1 or TSP particulate concentration levels using the principle of forward laser light scatter. This section describes the measurement systems.

11.1 *Forward Laser Light Scatter Nephelometer System*

Sample air is drawn into the E-Sampler V2 by an internal diaphragm pump. The flow rate is controlled based on actual conditions for accurate cut-points through sharp-cut cyclones, and to accurately determine the sampled volume.

This sample air is drawn through the MD-F laser optical module or "laser engine", where an internal visible laser diode beam is collimated and directed through the sample air stream. The particulate in the sample air stream scatters the laser light through reflective and refractive properties. This scattered light is collected onto a silicon photodiode detector at a near-forward angle, and the resulting electronic signal is processed to determine a continuous, real-time measurement of airborne particulate mass.

The forward light scatter method allows for a more accurate total mass estimate compared to right-angle light scatter, which is better suited for counting and sizing individual particles. Met One also manufactures a complete line of right angle particle counters.

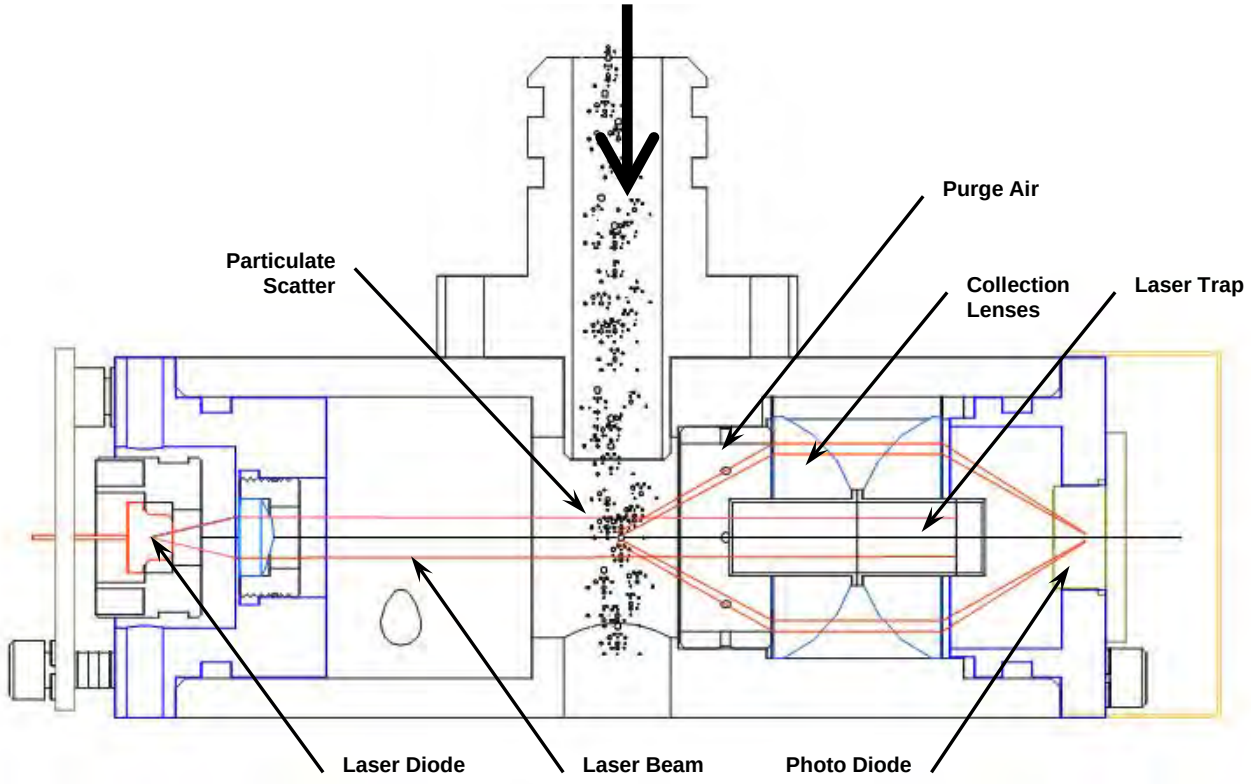


Figure 11-1 MD Forward Light Scatter Laser Optical Engine

1-second values are temperature compensated using a factory-set algorithm, and averaged into the user-selected data storage interval of 1, 5, 10, 15, 30, or 60 minutes. The 1-second values are also displayed on the LCD and available on the analog output.

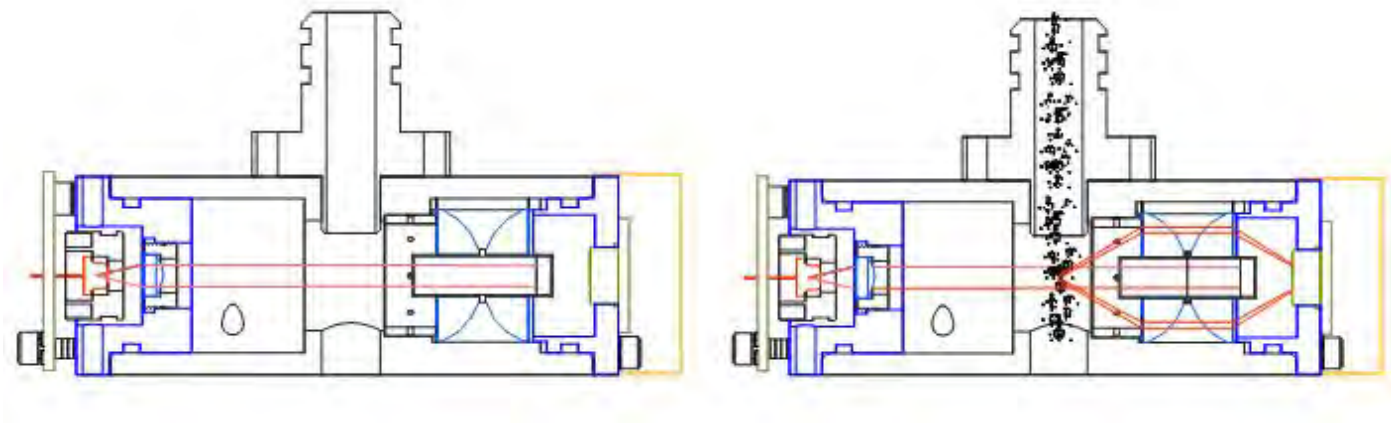


Figure 11-2 Clean Air and Particulate Scatter Conditions In the MD-F Engine

Sample RH Control for Light Scatter Mass

The relative humidity (RH) of the sample air has an influence upon the measurement of particulate mass by nephelometers. At RH values greater than about 50% this effect begins to increase due to particle aggregation and particle size increases as water is absorbed. The E-Sampler V2 mitigates this through a heated inlet tube that uses an internal sample RH sensor. The RH of the incoming air is measured and the inlet heater is turned on whenever the user-set setpoint is exceeded (typically 50% RH). See **Section 6.5**.

A study in *Atmospheric Environment* showed that RH can drastically affect the concentration measurement as shown in the graph below from Volume 34, pp 4829-4838, 2000. The following article references also contain related information:

Volume 35, Issue 30, Oct 2001:

-Aerosol Light Scattering Measurements as a Function of Relative Humidity. (Malm, Day).

-Diurnal and Seasonal Patterns in Light Scattering, Extinction, and Relative Humidity. (Malm, Gebhart, Copeland).

Volume 35, Issue 16, June 2001:

-Estimates of Aerosol Species Scattering Characteristics as a Function of Relative Humidity. (Malm, Day).

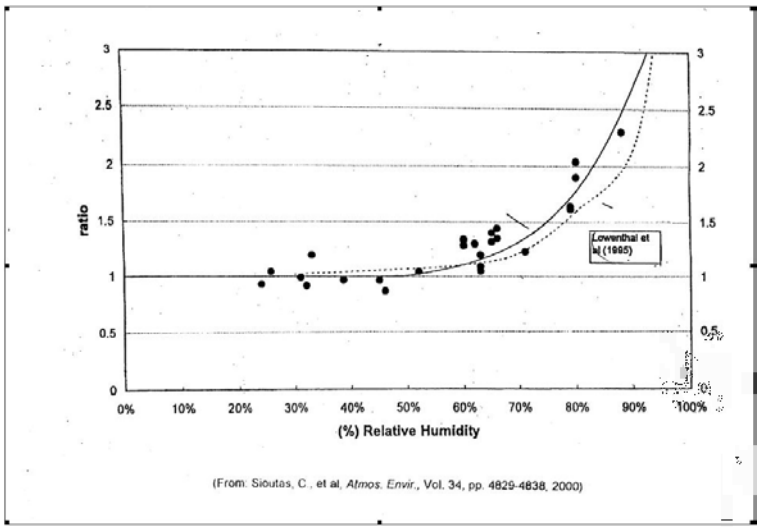


Figure 11-3 Particulate Size Increase verses RH

11.2 *Flow System*

This system allows the particulate to be collected as a second method to obtain airborne particulate mass data, or for laboratory analysis of the particulate.

The main function for the filter collection system is to establish a slope correction multiplier to correct the E-Sampler V2 real-time concentration output. The procedure for generating the K-Factor is described below in **Section 11.2.3.**

This is a low-flow version of the manual sampler gravimetric method, which is the standard measurement technique against which all continuous methods are compared in the U.S. and most other countries since it is very accurate and yields repeatable data.

After the sample air stream has been measured by the E-Sampler V2 and exits the MD-F optical engine, it passes through the built-in 47mm filter sampler system.

11.2.1 Automatic Zero and Span Self-Tests for the Optical System

To assure stable concentration data, the E-Sampler V2 performs optical system zero and span self-tests at a user-selected periodic rate of; 1 hour, 2 hours, 12 hours, or 24 hours. See **Section 6.3**.

A separate zero air pump activates and circulates clean air through the optical system. The E-Sampler V2 filters the air through a 0.2-micron pore size, 99.99% efficient filter element before it enters the sensor. This is the PURGE FILTER located in the front panel of the instrument. The E-Sampler V2 zeros itself based on this clean air condition.

Next, the E-Sampler V2 activates an LED which flood illuminates the chamber to provide a high-level span signal to test the detector and related electronics. Then a second test is activated with the LED off to verify the system is in a zero condition.

11.2.2 The Airflow Control System Diagram and Description

The flow control system is an integral component of the E-Sampler V2. A complete description is included to assist the user in understanding the E-Sampler V2 flow system:

1. Ambient air is drawn in through the TSP inlet and the PM_{10}, $PM_{2.5}$ or PM_1 cyclone (if used) at 2.0 lpm. This flow rate is used because the cut-point of the cyclones is dependent on the velocity of the particles and is only accurate at the rated flow rate.
2. The sample air goes through the vertical inlet tube, which is heated if necessary to keep the sample air humidity below 40% RH to prevent measurement errors caused by moisture.
3. The sample air stream immediately enters the laser optical module where it passes through the laser beam and the particulate is measured.
4. The pump filter removes any particles larger than 5 microns to protect the flow sensor and pump. The air stream then passes through the flow meter which measures the mass flow rate of the sample air as an analog electronic signal which is sent to the CPU where the ambient temperature and pressure are used to calculate the actual flow.
5. Down-stream of the flow meter, a pulsation chamber is used to reduce the pressure pulsations caused by the diaphragm pump, which would otherwise appear as noise in the flow sensor signal. There is nothing inside the pulsation chamber.
6. The air is drawn into the vacuum side of the main sample pump. This is a brushless diaphragm pump which is pulse-width modulated (PWM) by the CPU to control the flow rate.
7. Most of the sample air exhausts through the pump to the exhaust fitting inside the bottom of the E-Sampler V2. A small amount (about 10%) of the pump exhaust is recirculated through a simple purge adjust valve (T-fitting with a screw installed in one of the ports). This purge adjust is factory-set to control the ratio of the purge air and should not be tampered with.
8. The purge air passes through the purge filter which removes any remaining particles larger than 0.2 microns in size, then passes through the open manual purge shutoff valve. The purge air enters the laser optical module in a ring around the detector lenses, and through a port in front of the laser focus lens. The clean air circulating past the lenses greatly reduces the amount of dirty sample air which would otherwise contact and contaminate the optics.

NOTE: The purge shutoff valve must be open during normal operation! If left closed during sampling, the purge-air system will be disabled, and the optics will get dirty much faster. The valve is located in the battery compartment and is closed by the operator during leak checks.

9. During the zero portion of the automatic periodic self-test cycle, the main sample pump is turned off and the purge pump is turned on. The air is filtered by the purge filter and circulated through the laser module at a higher flow rate. The air in the laser module is 100% filtered during this process, and no scattered light should enter the detector. The E-Sampler V2 takes a zero reading and establishes a new signal baseline. A check valve prevents air from back-flowing through the purge pump during normal sampling.

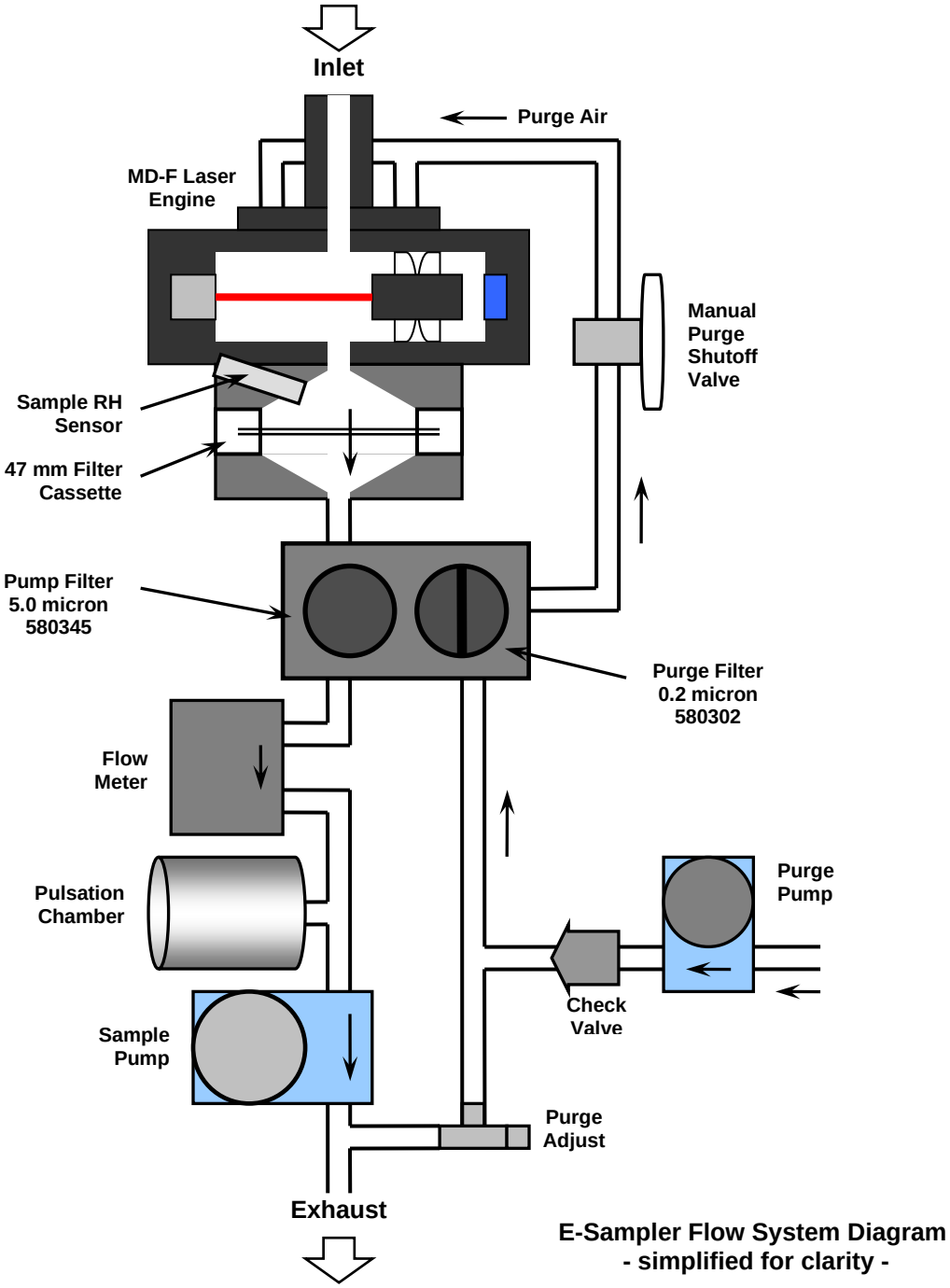


Figure 11-4 E-Sampler V2 Flow System Diagram

11.2.3 47mm Gravimetric Filter Collection System

After the sample air stream has been measured by the E-Sampler V2 and exits the MD-F optical engine, it passes through the built-in 47mm filter sampler system. This system allows the particulate to be collected as a second method to obtain airborne particulate mass data, or for laboratory analysis of the particulate.
This is a low-flow version of the manual sampler gravimetric method, which is the standard measurement technique against which all continuous methods are compared in the U.S. and most other countries since it is very accurate and yields repeatable data.
The filter material used in the 47 mm system can be selected based upon the desired type of laboratory analysis, or an empty filter cartridge can be installed to use the E-Sampler V2 as a real-time instrument only, without collecting any dust samples.

NOTE: At least an empty filter cassette must be installed in the E-Sampler V2 at all times, in order to seal the flow system!

The main use for the filter collection system is to establish a slope correction multiplier to correct the E-Sampler V2 real-time concentration output. The procedure for generating the K-Factor is described in **Section 8.5.1**

Selecting 47 mm Filter Material
47 mm filter discs of various materials and pore sizes can be selected depending on the desired laboratory analysis. Met One generally does not supply the filter discs. The following table gives some basic usage overview for different filter media. Additional research and material considerations will be required depending on your application:

Table 11-1 Filter Media Types

Filter Medium	Applications
Polycarbonate	SEM analysis, epifluorescent microscopy, reflective light microscopy, asbestos monitoring, chemotaxis, parasitology, cytology.
Nylon	bioassays, particle analysis
Medical Grade PVC	silica analysis, black carbon or quartz particulates
Quartz Fiber	gravimetric, heavy metals
Glass Fiber	general purpose PM10 and PM2.5 gravimetric
PTFE	EPA standard for PM2.5 FRM gravimetric samplers