BAM-1020 PM-COARSE
MANUAL ADDENDUM
FOR BX-COARSE SAMPLING KIT

BX-COARSE-9805 REV A

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About this Document:

This manual addendum describes the hardware and software configurations used on the BAM-1020 particulate monitor when operated for PM-Coarse measurements in a dual-unit system. This information is meant to supplement the main BAM-1020 Operation Manual. In this document, the designator **$PM_{10-2.5}$** is used to represent "PM-Coarse". Coarse particulate includes the mass of all airborne particulate smaller than 10 microns in size, but not counting particles smaller than 2.5 microns. PM_{10} - $PM_{2.5}$ = $PM_{10-2.5}$.

Technical Support

Should you still require support after consulting your printed 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. Please contact us and obtain a Return Authorization (RA) tracking number before sending any equipment back to the factory. This allows us to track and schedule service work and expedite customer service.

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Model BAM-1020 $PM_{10-2.5}$ U.S. EPA Equivalent Method

The Met One Instruments, Inc. Model BAM-1020 $PM_{10-2.5}$ Measurement System is designated as an equivalent method for $PM_{10-2.5}$ (PM-Coarse) monitoring in accordance with 40 CFR Part 53 by the United States Environmental Protection Agency as of June 15, 2009.

Designation Number: **EQPM-0709-185**

The following conditions must be observed when a pair of BAM-1020 units are operated as a $PM_{10-2.5}$ FEM continuous measurement system:

- One of the BAM-1020 units is configured as a $PM_{2.5}$ FEM (EQPM-0308-170).
- The other unit is configurable as a $PM_{2.5}$ FEM, but set to measure PM_{10} by excluding the $PM_{2.5}$ cyclone.
- The two monitors are collocated to within 1 and 4 meters apart.
- The units are equipped with the BX-COARSE sampling kit, which allows the two units to be directly connected to provide concurrent sampling and reporting of the $PM_{10-2.5}$ concentrations.
- Both units are operated in accordance with the PM-Coarse manual addendum (this document).

1 The PM-Coarse Measurement Solution

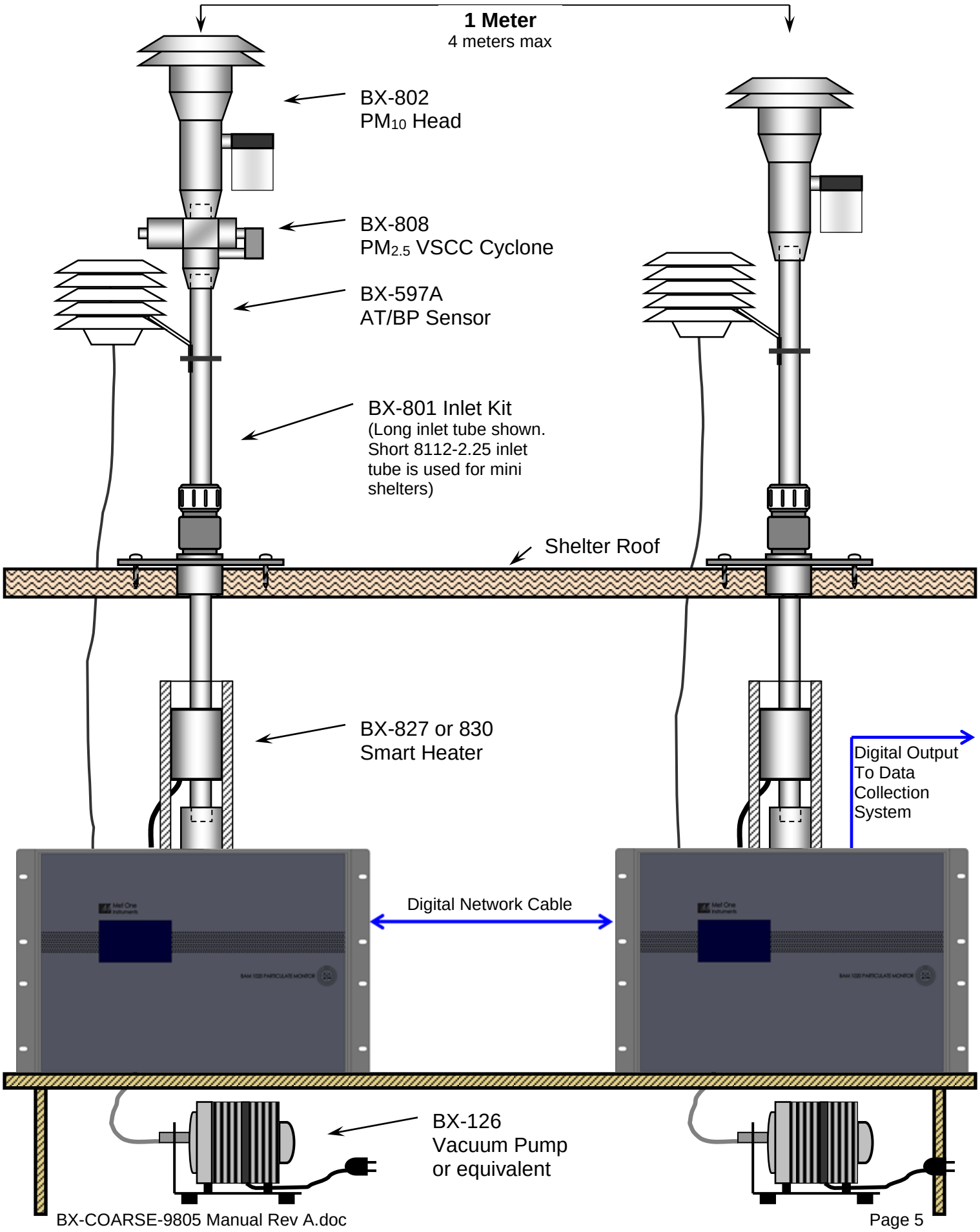
Met One Instruments, Inc. has developed a $PM_{10-2.5}$ (coarse) measurement solution based on BAM-1020 technology. The system allows the collection of EPA equivalent continuous measurements for PM_{10}, $PM_{2.5}$, and $PM_{10-2.5}$ without the need for manual data calculations and correlation.

The coarse system is based on a pair of the latest revision BAM-1020 beta gauge particulate monitors which have been modified to operate in a Master/Slave configuration. One instrument measures, stores, and displays $PM_{2.5}$ levels as if it were a stand-alone unit. This unit provides the concentrations to the Master unit through a dedicated serial network port. The Master unit measures PM_{10} concentrations while collecting $PM_{2.5}$ data from the Slave. The Master unit also calculates the $PM_{10-2.5}$ concentrations and stores and displays all three concentration values for each hour. The Master unit also synchronizes the clock timing between the two units and monitors both units for errors and alarms.

Data collection is accomplished by simply retrieving the digital data array from the Master unit, which contains all of the $PM_{2.5}$, PM_{10}, and $PM_{10-2.5}$ data in a single file. Each unit has its normal analog output available as well, although there is no analog output for the $PM_{10-2.5}$ values.

- Each unit has its own vacuum pump and performs its own actual (volumetric) flow control at 16.7 lpm just like a normal BAM-1020 configuration. Each unit has a BX-597A combination sensor for the measurement of ambient temperature, barometric pressure, and relative humidity.
- The coarse PM_{10}, $PM_{2.5}$, and $PM_{10-2.5}$ values are all reported in actual conditions as required by the EPA. The PM_{10} unit also reports the PM_{10} concentration in standard conditions to meet the requirements for normal PM_{10} reporting.
- The PM_{10} unit uses a standard BX-802 EPA PM_{10} inlet head only. The $PM_{2.5}$ unit uses both a BX-802 PM_{10} head and a BX-808 $PM_{2.5}$ cyclone (BGI Inc. VSCC-A™).
- The inlets of the two units must be spaced no closer than one meter apart and no more than four meters apart. One meter spacing should be used when possible. The inlets must be the same height within one meter but should be within 6 inches whenever possible. See Section 2 of the BAM-1020 manual for other BAM-1020 siting criteria.
- A weatherproof shelter or environmental enclosure is required for the BAMs and is not included in the BX-COARSE kit. Met One can supply the optional BX-906 air conditioned dual-unit shelter if needed. Most users provide their own shelter arrangement.
- The serial network between the two units is connected by means of a single cable between the correct back panel ports of the two units. The cable connection is identified in the next section of this manual. The cable is included.

A major advantage of the Met One coarse solution is that *the two units can be separated and operated as stand-alone $PM_{2.5}$ FEM or PM_{10} FEM units at any time*! Only an additional VSCC cyclone would need to be procured to operate the coarse PM_{10} unit as a $PM_{2.5}$ FEM. All other required sampling accessories for both units are already included in the BX-COARSE kit. This makes the BAM-1020 coarse measurement system extremely flexible.


1 Meter
4 meters max
BX-802
PM10 Head
BX-808
PM2.5 VSCC Cyclone
BX-597A
AT/BP Sensor
BX-801 Inlet Kit
(Long inlet tube shown.
Short 8112-2.25 inlet
tube is used for mini
shelters)
Shelter Roof
BX-827 or 830
Smart Heater
Digital Output
To Data
Collection
System
Digital Network Cable
BX-126
Vacuum Pump
or equivalent

2 Coarse System Hardware Setup

The two BAM-1020 units used for the $PM_{10-2.5}$ configuration must be set up and connected as follows. Consult the BAM-1020 manual as needed. The BX-COARSE kit comes with the following items needed for the setup:

Part	Qty	Description
80327-1	1	BX-Coarse Network Cable, 10’
80860	1	Coarse Firmware for BAM-1020 (Factory Installed into the master PM_{10} BAM)
83347	1	Standard Firmware for BAM-1020 (Factory Installed into the slave $PM_{2.5}$ BAM)
BX-COARSE-9805	1	PM-Coarse Manual Addendum

In addition, the BX-COARSE kit includes all the standard BAM-1020 $PM_{2.5}$ FEM accessories for both units, with the exception of only including one VSCC $PM_{2.5}$ cyclone:

Part	Qty	Description
BX-802	2	PM10 Inlets, EPA Style
BX-808	1	PM2.5 Very Sharp Cut Cyclone, BGI Inc. VSCC-A (one per BX-COARSE kit)
BX-597A	2	Ambient Temperature and Barometric Pressure Combo Sensors (one per BAM)
BX-302	2	Zero Filter Calibration Kits.
BX-827	2	Smart Inlet Heater Kits (BX-830 used for 230V applications)
BX-801	2	BAM-1020 Inlet Kits, with roof flange, 8’ inlet tube standard, custom length available.

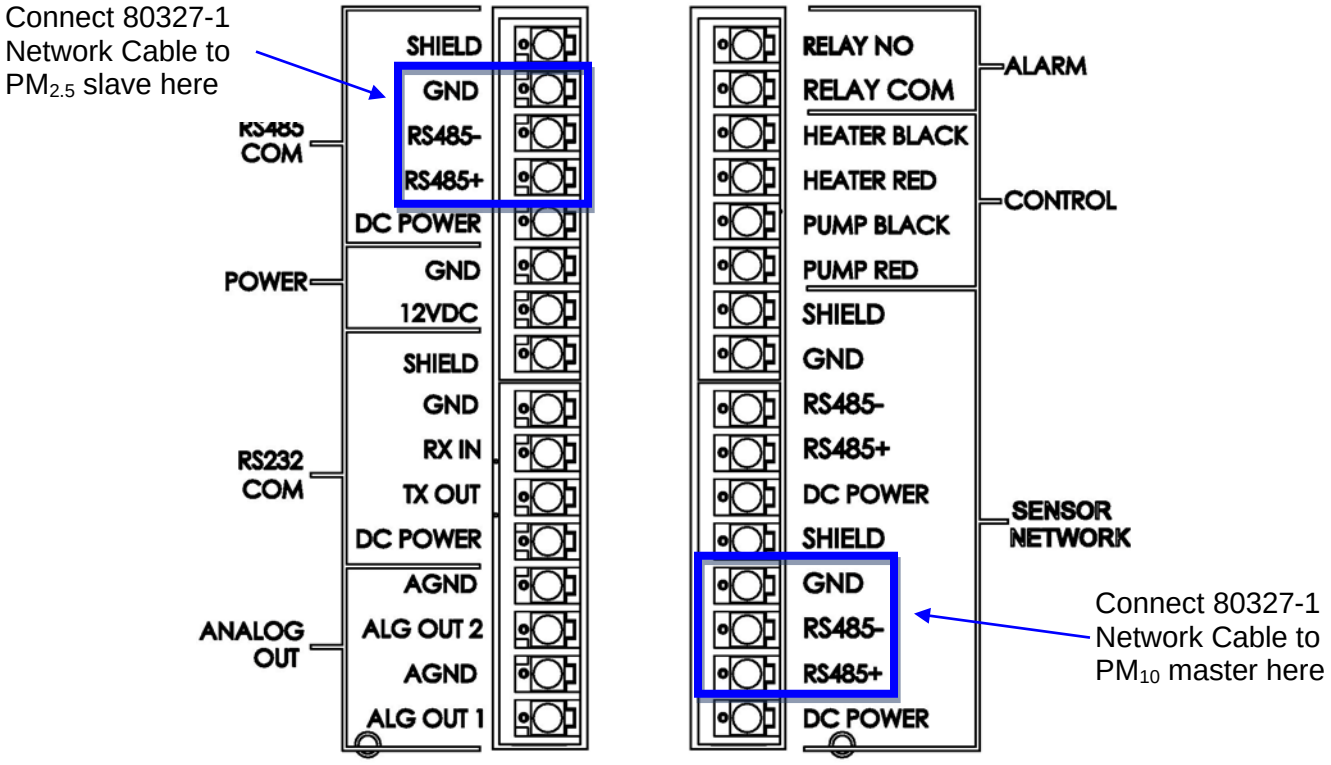
Note: The two Medo or Gast vacuum pumps for the BAM-1020s are handled as a separate line item on Met One sales orders, not as part of the coarse sampling kit.

1. Configure your shelter or weatherproof enclosure for the two BAMs as described in the BAM-1020 manual. The inlet tubes of the two BAM-1020 units should be spaced one meter apart when possible. The optional Met One BX-906 dual-unit mini shelter is available if needed, and only requires two short inlet tubes (part 8112-2.25) for setup. The mini shelters do not use the standard 8-foot inlets that come with the coarse kit.
2. Install the BAM units and their sampling accessories as described in the BAM-1020 manual. Both units must be configured as a $PM_{2.5}$ FEM units, with the exception that the PM_{10} master unit will not have a BX-808 VSCC cyclone in the inlet stack. Each unit will have different firmware. Refer to Section 3.

3. Connect the 80327-1 Network Cable between the two BAM units as shown in the table below. The terminals are located on the back panel of each BAM. The cable is a simple three-conductor pair which may be extended if needed:

80327-1 Network Cable Connection		
BAM Master PM10	**Wire Color**	**BAM Master PM10**
RS485 COM GND	White/Black	SENSOR NETWORK GND
RS485 COM RS485-	Black	SENSOR NETWORK RS485-
RS485 COM RS485+	Red	SENSOR NETWORK RS485+

BAM 1020 Back Panel Connections



Note: Never connect any other clock synch signal (such as from a separate datalogger) to either unit while it is configured as part of a coarse system! The master BAM and the datalogger will fight over the slave clock reset functions, causing improper function and alarms. However, the PM_{10} master BAM may be connected to an external clock synch signal from a datalogger. Timing is very critical in the coarse configuration.

4. Use a length of green/yellow grounding wire (supplied with the BAMs) and connect the CHASSIS terminals of each BAM unit to a common earth ground point, such as a copper ground rod if possible. This is important to minimize potential measurement discrepancies between the two units. The BAMs are also chassis grounded through the power cord safety ground.

3 Coarse Setup

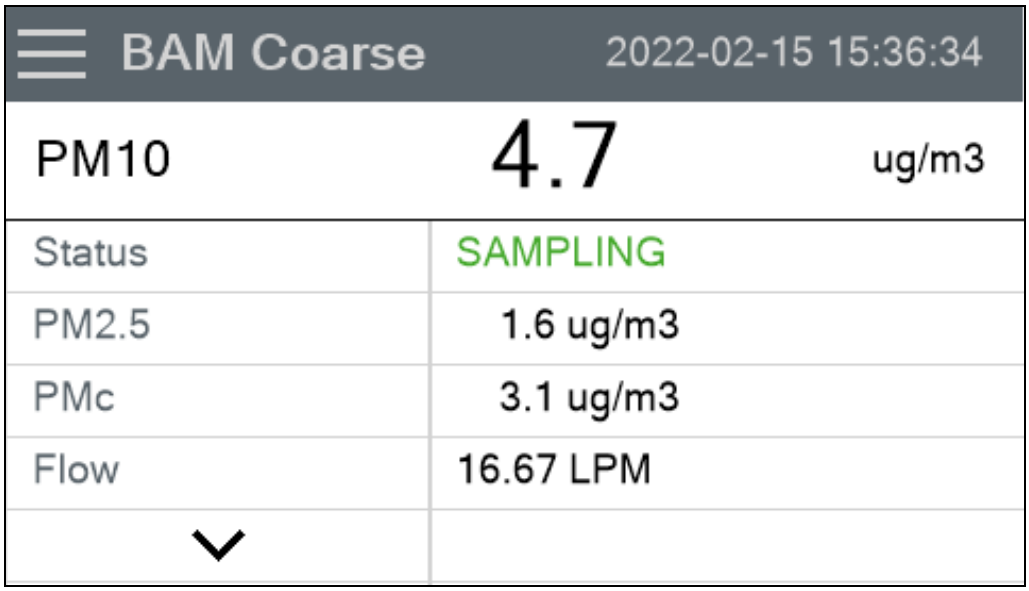
The BAM-1020 monitor used as the PM_{10} master unit for the $PM_{10-2.5}$ configuration must have special firmware installed. The special coarse firmware is part number is **80860**. The BAM-1020 monitor used as the $PM_{2.5}$ slave unit for the $PM_{10-2.5}$ configuration must have the normal firmware installed, part number **83347,** R9.4.0 or greater. Firmware part number and revision can be checked in the About screen of each unit.

Most of the user interface screens and menus are the same as the normal $PM_{2.5}$ FEM series of firmware and are described in detail in the BAM-1020 manual. Only the new and different menu items and test functions unique to the coarse system are described below.

Master PM_{10} Configuration

The PM_{10} master firmware will force the Inlet Type setting to PM10 on the Setup>Sample menu screen. There are no changes required by the operator.

The main operate screen of the PM_{10} master is changed to display the $PM_{2.5}$ and $PM_{10-2.5}$ (displayed as PMc) concentrations. It also reports PM_{10} in actual and standard conditions.



Main PM_{10} Master Screen

Slave $PM_{2.5}$ Configuration

The $PM_{2.5}$ slave unit connects to the master as a digital sensor. The Station ID must be set to 3 by the operator. This is changed in the Setup>Station ID screen. The RS-485 baud rate must be set to 9600 by the operator. This is changed in the Setup>Serial Port screen.

Once the Master establishes communication with the Slave, the Station ID, RS-485 baud rate, and Inlet Type cannot be edited. The Inlet Type is forced to PM2.5.

Set the clock of the Slave unit to match the clock of the Master unit as close as possible. This is changed in the Setup>Clock screen. This is very important for clock synchronization.

Clock Synchronization

Timing is very critical in the coarse configuration. At minute-30 of each hour the PM_{10} master unit sends a time synchronization command to the $PM_{2.5}$ slave unit. The $PM_{2.5}$ slave unit time will change if the difference is greater than 3 seconds. If the difference is greater than 1 minute (Slave minute is less than 29 or greater than 31 when Master minute is 30), the clock synchronization will not occur, and a 2048 error code will be logged in the Slave data log. If this occurs clock synchronization will not occur until the clocks of each unit are manually changed to match each other within 1 minute.

Never connect any other clock synch signal (such as from a separate datalogger) to either unit while it is configured as part of a coarse system.

4 Data Storage and Retrieval

Serial data retrieval from the BAM-1020 $PM_{10-2.5}$ configuration is virtually unchanged from other versions of the unit. See the BAM-1020 manual. The data reports that are different in the PM_{10} Master unit are CSV files **2** (All Data file), **3** (New Data file), and **4** (Last Data file). These have been modified to include the PM_{10}, PM_{10s}, $PM_{2.5}$ and $PM_{10-2.5}$ concentration values into the array. Note: The $PM_{10-2.5}$ (coarse) values are labeled "**PM_c**" in the data headers to save space.

The following table defines the data values that appear in the comma-separated digital data array:

Value	Description
TIME	Measurement timestamp
PM10	PM_{10} Concentration at Actual conditions
PM2.5	$PM_{2.5}$ Concentration at Actual conditions
PMC	$PM_{10-2.5}$ Coarse Concentration at Actual conditions
PM10S	PM_{10} Concentration at Standard conditions
QTOT	Sample volume at Actual conditions
QTOTS	Sample volume at Standard conditions
FLOW	Flow rate
WS	Wind Speed
WD	Wind Direction
AT	Ambient Temperature
RH	Relative Humidity
BP	Barometric Pressure
FT	Internal Filter Temperature
FRH	Internal Filter RH
MEMB	Hourly span membrane
STATUS	Alarm events

Alarms and Errors in the Coarse System:

The PM_{10} master BAM-1020 unit must wait until the end of the sample hour before it can collect the $PM_{2.5}$ concentration from the slave unit and calculate the $PM_{10-2.5}$ coarse value. Each unit maintains its own separate digital error log which can only be downloaded from that unit.

The Master will send two alarms related to the coarse system when an error occurs. The master unit will generate an "Internal, Course" alarm in its error log if the PM_{10} and/or $PM_{2.5}$ measurement(s) is not valid or an "Internal, Coarse Link Down" alarm in its error log if the Master to Slave serial communication fails. The Master will also log a "256" error code in its data log status for that hour.

The Slave will send an "External Reset, Not Allowed" alarm in its error log and "2048" error code in its data log status for that hour if the time difference between the 2 units is greater than 1 minute during the clock synchronization event.

None of the $PM_{2.5}$ slave unit's flow statistics files, data log, or settings files can be downloaded or viewed through the PM_{10} master unit, so a separate direct download from the slave unit would be required if these files are needed.