TEOM® Series 1400a

Ambient Particulate (PM-10) Monitor

Operating Manual

(AB Serial Numbers)

42-003347 Revision B 06Sep2008

Thermo SCIENTIFIC

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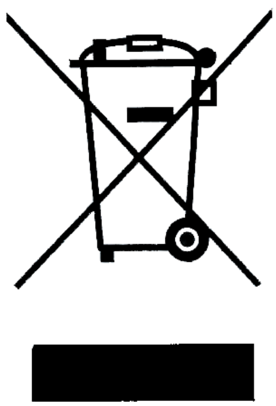
WEEE Compliance

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:



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U.S. EPA Designation

Thermo Scientific TEOM® 1400 and 1400a PM-10 Monitors
EPA Designation No. EQPM-1090-079

The United States Environmental Protection Agency (U.S. EPA) has designated the Thermo Scientific's TEOM® 1400 and 1400a PM-10 Monitors as an equivalent method for the determination of 24-hour average PM-10 concentrations in ambient air. For use as a designated equivalent method, the TEOM® 1400 and 1400a PM-10 Monitors must be operated with a Thermo Scientific PM-10 Inlet (00506-0000), a modified Thermo Scientific PM-10 Inlet (57-004742) or a Sierra-Andersen Model 246b PM-10 inlet, a flow rate of 16.7 liters per minute, teflon-coated glass fiber filter cartridges, the total mass averaging time set at 300 seconds, and the mass rate/mass concentration averaging time set at 300 seconds.

The use of the Thermo Scientific PM-10 inlet was approved by U.S. EPA on December 9, 1990.

On September 1, 1993 the U.S. EPA approved the operation of the TEOM 1400 and 1400a monitors on a case-by-case basis at lower temperature settings under wintertime conditions. Requests to the U.S. EPA will be considered on a case-by-case basis under the provisions contained in Section 2.8 (Modifications of Methods by Users) of Appendix C to 40 CFR Part 58. When granted, such approvals will limit use of the low temperature operation to periods during the wintertime months, when outdoor temperatures exceed 25° C no more than 5 percent of the time, and to monitoring locations where the prevailing ambient PM-10 aerosol has, or is expected to have, a significant contribution from volatile or semi-volatile components. The recommended set points for operation of the TEOM 1400 and 1400a PM-10 monitors at the lower temperature are as follows:

Enclosure Temperature (if applicable):	25° C
Case Temperature:	30° C
Air Temperature:	30° C
Cap Temperature:	0° C (off)

A packet is available from Thermo Fisher Scientific to assist agencies in applying for this user modification.

U.S. EPA Designation (continued)

On March 3, 1994 the U.S. EPA approved the operation of the TEOM 1400 and 1400a monitors at alternate main flow rates of 1 and 2 l/min in addition to the standard setting of 3 l/min. The following main and auxiliary flow rates apply to the approved flow rate settings:

3 l/min Main Flow	13.67 l/min Aux Flow	No change to Flow Splitter
2 l/min Main Flow	14.67 l/min Aux Flow	Use 2 l/min Adapter (36-001664)
1 l/min Main Flow	15.67 l/min Aux Flow	Use 1 l/min Adapter (57-001297)

When operating the instrument at the lower alternate flow settings, replace references to the 3 l/min main flow and 13.67 l/min auxiliary flow with the actual flow rates used.

On October 24, 1995 the U.S. EPA approved the modification of the TEOM 1400a monitor to include new features in units with serial numbers containing the “AB” designation. These changes include, but are not limited to, the redesign of the mass transducer, new layout of the control unit, inclusion of sensors for ambient temperature and pressure, and the use of mass flow controllers designed by Thermo Fisher Scientific.

Patents, Copyrights and Trademarks

This instrumentation from Thermo Fisher Scientific is covered by one or more of the following patents: U.S. Patent Office 3,926,271, 4,391,338, 4,696,181, 4,836,314; other European and Asian patents; also other U.S. and foreign patents pending.

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Mention of specific product names (other than Thermo Fisher Scientific products) in this manual does not constitute an endorsement or recommendation by Thermo Fisher Scientific of that equipment.

Safety Notice

Repair of instrumentation manufactured by Thermo Fisher Scientific should be attempted only by properly trained service personnel, and should be conducted in accordance with the Thermo Fisher Scientific system documentation. Do not tamper with this hardware. High voltages may be present in all instrument enclosures. Use established safety precautions when working with this instrument.

The seller cannot foresee all possible modes of operation in which the user may attempt to use this instrumentation. The user assumes all liability associated with the use of this instrumentation. The seller further disclaims any responsibility for consequential damages. Use of this product in any manner not intended by the manufacturer will void the safety protection provided by the equipment, and may damage the equipment and subject the user to injury.

Warranty (U.S.)

Seller warrants that the Products will operate or perform substantially in conformance with Seller's published specifications and be free from defects in material and workmanship, when subjected to normal, proper and intended usage by properly trained personnel, for the period of time set forth in the product documentation, published specifications or package inserts. If a period of time is not specified in Seller's product documentation, published specifications or package inserts, the warranty period shall be one (1) year from the date of shipment to Buyer for equipment and ninety (90) days for all other products (the "Warranty Period"). Seller agrees during the Warranty Period, to repair or replace, at Seller's option, defective Products so as to cause the same to operate in substantial conformance with said published specifications; provided that (a) Buyer shall promptly notify Seller in writing upon the discovery of any defect, which notice shall include the product model and serial number (if applicable) and details of the warranty claim; (b) after Seller's review, Seller will provide Buyer with service data and/or a Return Material Authorization ("RMA"), which may include biohazard decontamination procedures and other product-specific handling instructions; and (c) then, if applicable, Buyer may return the defective Products to Seller with all costs prepaid by Buyer. Replacement parts may be new or refurbished, at the election of Seller. All replaced parts shall become the property of Seller. Shipment to Buyer of repaired or replacement Products shall be made in accordance with the Delivery provisions of the Seller's Terms and Conditions of Sale. Consumables, including but not limited to lamps, fuses, batteries, bulbs and other such expendable items, are expressly excluded from the warranty under this warranty.

Notwithstanding the foregoing, Products supplied by Seller that are obtained by Seller from an original manufacturer or third party supplier are not warranted by Seller, but Seller agrees to assign to Buyer any warranty rights in such Product that Seller may have from the original manufacturer or third party supplier, to the extent such assignment is allowed by such original manufacturer or third party supplier.

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Equipment Ratings

The following information can be used to determine the power service requirements for the TEOM 1400/1400a Monitors (not including the sampling pump).

Line Voltage
115 V ~ 60 Hz 1.0 Amp
230 V ~ 50 Hz 0.5 Amp

IMPORTANT: Disconnect the power cord from the power source (output) while servicing the instrument to prevent electrical hazard.

Environmental Ranges — The instrument and its sample pump must be installed in a weather-sheltered location that is heated in the winter and air conditioned in the summer.

NOTE: There may be hazardous line (wire) accessible inside the enclosure.

Installation Category — 11

Electrical and Safety Conformity

The product has been tested by ETL Testing Laboratories, and has been documented to be in compliance with the following U.S. and Canadian safety standards:

UL Standard 3101-1
CAN/CSA C22.2 NO. 1010.1

Thermo Fisher Scientific certifies that this product operates in compliance with the EC Directive 89/336/EEC in reference to electrical emissions and immunity. Specifically, the equipment meets the requirements of EN55011:1991 Group 1, Class B (Emissions) and EN50082-1:1992 (Immunity).

In addition, the hardware has been tested for personal or fire safety hazards, and meets the requirements of EN61010-1:1995 (Safety) in fulfillment of EC Directive 73/23/EEC.

Section Revision List

As Thermo Scientific instrumentation changes, so do our operating and service manuals. However, these changes may affect only one aspect of an instrument, while leaving the instrument as a whole unchanged. To explain these individual changes to our customers, the company may update only those sections of its operating and service manuals that are affected by the instrument updates or improvements. As each manual section changes, so does its revision number, which is located at the top right corner of each page of each section.

To help our customers keep track of the changes to the Series 1400a Monitor and its operating manual, following is a list of the manual sections with their respective revision numbers:

Section Number and Description	*Revision Number*
Section 1: Introduction	B.001
Section 2: Hardware Installation	B.002
Section 3: Sample Preparation	B.002
Section 4: Software Overview	B.002
Section 5: Basic Operation	B.002
Section 6: Software Setup	B.002
Section 7: Status Codes	B.002
Section 8: Viewing Stored Data	B.003
Section 9: Data Input and Output	B.002
Section 10: RPComm Software	B.002
Section 11: Password Protection	B.001
Section 12: Routine Maintenance and Verification Procedures	B.000
Section 13: Resetting the Monitor	B.000
Section 14: ACCU System	B.000

Section Revision List (continued)

Section Number and Description	*Revision Number*
Appendix A: Overview of Software Screens	B.001
Appendix B: Program Register Codes	B.001
Appendix C: Two-Way Serial Communication	B.001
Appendix D: Installing New Software	B.003
Appendix E: Consumables and Parts	B.003
Appendix F: Filter Log	B.001
Appendix G: Inlet Maintenance	B.001
Appendix H: Modem Communications	B.001
Appendix I: ASCII Codes	B.000
Appendix J: Original Design Mass Flow Controllers	B.000
Appendix K: Complete Outdoor Enclosure	B.000
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Section 1: Introduction

The TEOM Series 1400a Ambient Particulate Monitor has received the following major regulatory recognitions:

- U.S. EPA PM-10 equivalency approval EQPM-1090-079
- PM 2.5 measurements within the context of a U.S. EPA correlated acceptable continuous monitor (40 CFR 58)
- European Union PM-10 recognition within the context of European Norm EN 12341
- German EPA approval as an equivalent TSP monitor.

The Series 1400a Monitor (Figure 1-1) incorporates the patented Tapered Element Oscillating Microbalance (TEOM) technology developed by Rupprecht & Patashnick Co., Inc. to measure particulate matter mass concentrations continuously. The Series 1400a Monitor can be configured with a variety of sample inlets to measure PM-10, PM-2.5, PM-1 or TSP concentrations. The microprocessor-based unit accommodates all siting requirements and provides internal data storage and analog and serial data input/output capabilities.

Filter-based, direct mass measurements are considered the standard technique for determining particulate matter mass concentration. TEOM instruments from R&P are the only filter-based systems with real-time data output and real-time mass measurement capability. The exchangeable filter in the Series 1400a Monitor also can be used to determine heavy metal concentrations using standard analytical laboratory methods.

Figure 1-1. TEOM Series 1400a Ambient Particulate Monitor: sensor unit (left) and control unit (right).

1.1. Advanced Features

On October 24, 1995 the U.S. EPA approved the modification of the Series 1400a Monitor to include new features in units with serial numbers containing the “AB” designation. These changes include, but are not limited to, the redesign of the mass transducer, new layout of the control unit, inclusion of sensors for ambient temperature and pressure, and the use of mass flow controllers designed by R&P.

The Series 1400a Monitor contains the following features:

- New mass transducer design provides improved mass resolution for short-term measurements.
- Instrument operation at 1, 2 or 3 l/min to provide time-resolved mass measurements in locations ranging from clean-background monitoring stations to highly polluted urban areas.
- Incorporates R&P’s “AB” technology for enhanced measurement stability for mobile installations
- Filter-based, direct mass monitoring using R&P’s patented TEOM technology that never requires mass recalibration. The instrumentation contains no radioactive components and has a 2-year warranty.
- Continuous dust monitor with U.S. EPA approval (EQPM-1090-079) that complies with the California ARB 1-hour acceptance criteria for mass concentration precision. TEOM instrumentation has German TÜV approval for TSP measurements.
- Mass and time resolution (mass transducer minimum detection limit of 0.01 µg). The instrument has a precision of ±5.0 µg/m^3 for 10-minute averaged data and ±1.5 µg/m^3 for 1-hour averages.
- The active volumetric flow control system maintains a constant volumetric flow at the flow rate specified by the user by incorporating ambient pressure and temperature sensors.
- Available with a choice of sample inlets for PM-10, PM-2.5, PM-1 or TSP measurements
- Sample filters can be analyzed after exposure for heavy metals using standard laboratory techniques such as AA or ICAP.

- Viewing and entry of instrument parameters are made possible by a menu-driven user interface. Keypads are available in English, Spanish and German.

- Internal data logging of up to 40 weeks with one data record stored every hour. Each record may contain up to eight user-selectable variables.

- Two levels of password protection – low and high lock. These can be used to restrict access to instrument functions.

- Advanced RS232 support. This allows users to retrieve real-time and stored information and change instrument parameters, both remotely and at the sampling location.

- Seven built-in, averaged analog inputs (scalable as 2 or 10 VDC) with user-defined conversions to engineering units. The averaging time is equal to the user-defined data storage interval. Averaged values may be logged internally.

- Three real-time analog outputs allow straightforward connections to data loggers or chart recorders. These outputs can be configured as 0-1, 0-2, 0-5 or 0-10 VDC. The monitor also contains two user-definable, contact closure circuits.

- Analog inputs from a wind vane/anemometer are used to calculate averaged wind speed, vector-averaged wind velocity and wind direction.

- Built-in support for the optional ACCU™ System. The ACCU System is a sampler that offers flexibility in the sampling of particulate matter and/or gases through filters, gas collection tubes or polyurethane (PUF) sampling modules.

- Optional outdoor enclosure provides a heated and air-conditioned environment for the control unit, sensor unit and pump of the Series 1400a monitor. It also contains additional space to install data logging equipment.

1.2. Overview of Manual

This manual describes the installation and operation of the Series 1400a Monitor. Follow the setup instructions contained in Sections 2 and 3 before applying power to the unit in the manner described in Section 5.

This manual is divided into 14 sections and 13 appendices that discuss different topics. Sections 1 and 2 explain the system's hardware, while later sections describe the system's software and the setup and operation of the monitor. The following list provides an overview of the topics handled in each section of the manual:

Section 1: Introduction
This section provides an overview of the Series 1400a Monitor, as well as the theory of operation of the instrument's patented mass transducer.

Section 2: Hardware Installation
This section describes how to set up the system hardware and optimize operating performance.

Section 3: Sample Preparation
A TEOM filter cartridge must be installed in the system before the unit is turned on. This section explains the steps required to install and exchange filter cartridges.

Section 4: Software Overview
This section describes the operation of the Series 1400a Monitor, including such topics as viewing system data on the four-line display and changing instrument operating parameters. The monitor gives the user full control over its operations directly from its keypad.

Section 5: Basic Operation
This section gives brief, step-by-step instructions on how to turn on the instrument and initiate a sampling run. It also explains how to download data and how to perform a audit of the instrument.

Section 6: Software Setup
This section explains how to set up the instrument's software to run a sample.

Section 7: Status Codes
This section explains all of the status code information and screens.

Section 8: Viewing Stored Data
This section explains how to view the data stored in the Series 1400a Monitor.

Section 9: Data Input and Output
This section explains how to use the monitor's seven user-definable analog inputs, two user-definable contact closure circuits and three analog outputs. This section also explains how to download data through the RS232 port to a serial printer, personal computer (PC) and other data capture devices, such as a data logger.

Section 10: RPComm Software
RPComm is a communications software package for Windows operating systems that provides interactive remote communications with R&P instrumentation. This section describes how to set up a Series 1400a Monitor for direct communications with a PC, and how to use RPComm.

Section 11: Password Protection
This section explains how to set and remove the Series 1400a Monitor's password protection.

Section 12: Routine Maintenance and Verification Procedures
This section describes the routine maintenance and verification procedures for the Series 1400a Monitor.

Section 13: Resetting The Unit
This section explains how to reset the Series 1400a Monitor.

Section 14: ACCU™ System
This section describes the installation and operation of the Automatic Cartridge Collection Unit (ACCU) System.

Appendix A: Overview of Software Screens
This appendix provides an overview of the screens that appear on the Series 1400a Monitor, and the RPComm, TEOMCOMM and TEOMPLUS software programs.

Appendix B: Program Register Codes
This appendix lists the code assignments for system variables (program register codes (PRCs)) used to define the operation of the instrument.

Appendix C: Two-Way Serial Communication
This appendix describes the two-way RS232 Protocols used for the exchange of information between the Series 1400a Monitor and a computer or data logger.

Appendix D: Installing New Software
This appendix explains how to install new system software into the Series 1400a Monitor. This appendix also explains how to obtain and load RPComm onto your personal computer.

Appendix E: Consumables and Parts
This appendix lists the consumables and spare parts used in the Series 1400a Monitor.

Appendix F: Filter Log
This appendix contains a filter log to track all readings associated with each exposed filter.

Appendix G: Inlet Maintenance
This appendix contains maintenance procedures for the PM-10 inlet, modified PM-10 inlet, sharp cut cyclone (SCC) PM-1 and PM-2.5 inlets, old style PM-1 and PM-2.5 cyclone inlets, and the in-line PM-2.5 ACCU inlet.

Appendix H: Modem Communications
This appendix describes how to connect the Series 1400a Monitor to a modem for offsite communications and how to set up a serial switching device for use with multiple instruments.

Appendix I: ASCII Codes
This appendix contains a list of the principal ASCII codes that may be used for setting up the instrument's RS232 communications protocol.

Appendix J: Original Design Mass Flow Controllers
This appendix describes the maintenance and verification procedures for the Original Design Mass Flow Controllers of the Series 1400a Monitor.

Appendix K: Complete Outdoor Enclosure
This appendix describes the set up and operation of the Complete Outdoor Enclosure, an air-conditioned and heated instrument enclosure that houses the Series 1400a Monitor and optional data logging hardware.

Appendix L: TEOMCOMM Software
This appendix describes the screens and operation of the TEOMCOMM software program.

Appendix M: TEOMPLUS Software
This appendix describes the screens and operation of the TEOMPLUS software program.

1.3. Application Range of the Series 1400a Monitor

The Series 1400a Monitor is a real-time device used for measuring the particulate matter mass concentration of particulate matter smaller than 10 µm diameter in outdoor and indoor ambient air, as well as for other particle size cut-points.

TEOM instruments are the only filter-based mass monitors that measure the mass of particulate matter suspended in gas streams in real time. This is made possible through the use of an inertial mass transducer patented in the U.S. and internationally by Rupprecht & Patashnick Co., Inc.

The monitor is ideally suited for applications demanding real-time ambient air particulate matter monitoring in outdoor, indoor or industrial settings. In its most common configuration, it calculates mass concentration, mass rate and the total mass accumulation on the TEOM filter cartridge under the following conditions:

Flow rate through sample inlet	16.7 l/min (1 m^3/hr)
Main flow rate	3 l/min
Temperature of sample stream	50º C
Particulate matter concentration	less than 5 µg/m^3 to several g/m^3

> NOTE: The temperature of the sampled air may vary between -40 and 60 C. The sensor and control units must be weather-protected within the range of 2 to 40 C. The user may purchase a Complete Outdoor Enclosure (Appendix K) that will hold the sensor unit, control unit and pump. The enclosure also has room in its rack for a data logger, modem or other appropriately sized equipment.

The ambient temperature sensor can measure temperatures ranging from -25º to 105º C, with an accuracy of ±2º C. The ambient pressure sensor is rated from 0.68 to 1.09 atm, and is specified to have a maximum eroor of 1.5% in the temperature range of 0º to 85º C. The Series 1400a Monitor smooths both the average temperature and average pressure over a period of approximately 15 seconds.

The Series 1400a Monitor uses the PM-10 inlet to perform a 10 µm particle size cutoff. When fitted with a total suspended particulate (TSP) inlet deigned for 1 m^3/h operation instead of the PM-10 inlet, the instrument functions as a TSP monitor. Other size-selective inlets are available from R&P for PM-2.5 and PM-1 monitoring (Section 2).

1.4. General System Configuration

The Series 1400a Monitor is composed of two major components: the TEOM sensor unit and TEOM control unit (Figure 1-1). The system's sample inlet and flow splitting hardware are not shown in this figure. The user enters the system parameters into the control unit with the keypad located on the front of the unit. Additionally, the system is furnished with software for personal computers (PCs) to allow the user to view the operation of the instrument in real time, and to allow the user to enter system values directly from the PC. The instrument does not require a dedicated computer to function in the field.

The sensor unit contains the mass measurement hardware that continuously monitors the accumulated mass on the system's exchangeable filter cartridge. By maintaining a flow rate of 3 l/min through the instrument and measuring the total mass accumulated on the filter cartridge, the device can calculate the mass concentration of the sample stream in real time.

The control unit houses an industrially hardened microprocessor system, flow control hardware, a gauge to determine filter lifetime, transformers and power supplies. This part of the monitor can be mounted on a 19-inch rack for convenient installation.

1.5. Theory of Operation

The Series 1400a Monitor is a true "gravimetric" instrument that draws ambient air through a filter at a constant flow rate, continuously weighing the filter and calculating near real-time (10 minute) mass concentrations. In addition, the instrument computes the total mass accumulation on the collection filter, as well as 30-minute, 1-hour, 8-hour and 24-hour averages of the mass concentration. The use of a hydrophobic filter material, along with sample collection at above-ambient temperature (50° C), reduces the necessity for humidity equilibration. Both analog and RS232 outputs are available to transmit the measurements to a user's data acquisition system. The instrument's internal storage buffer can store a large amount of data for later viewing on the instrument's display or downloading over the RS232 output.

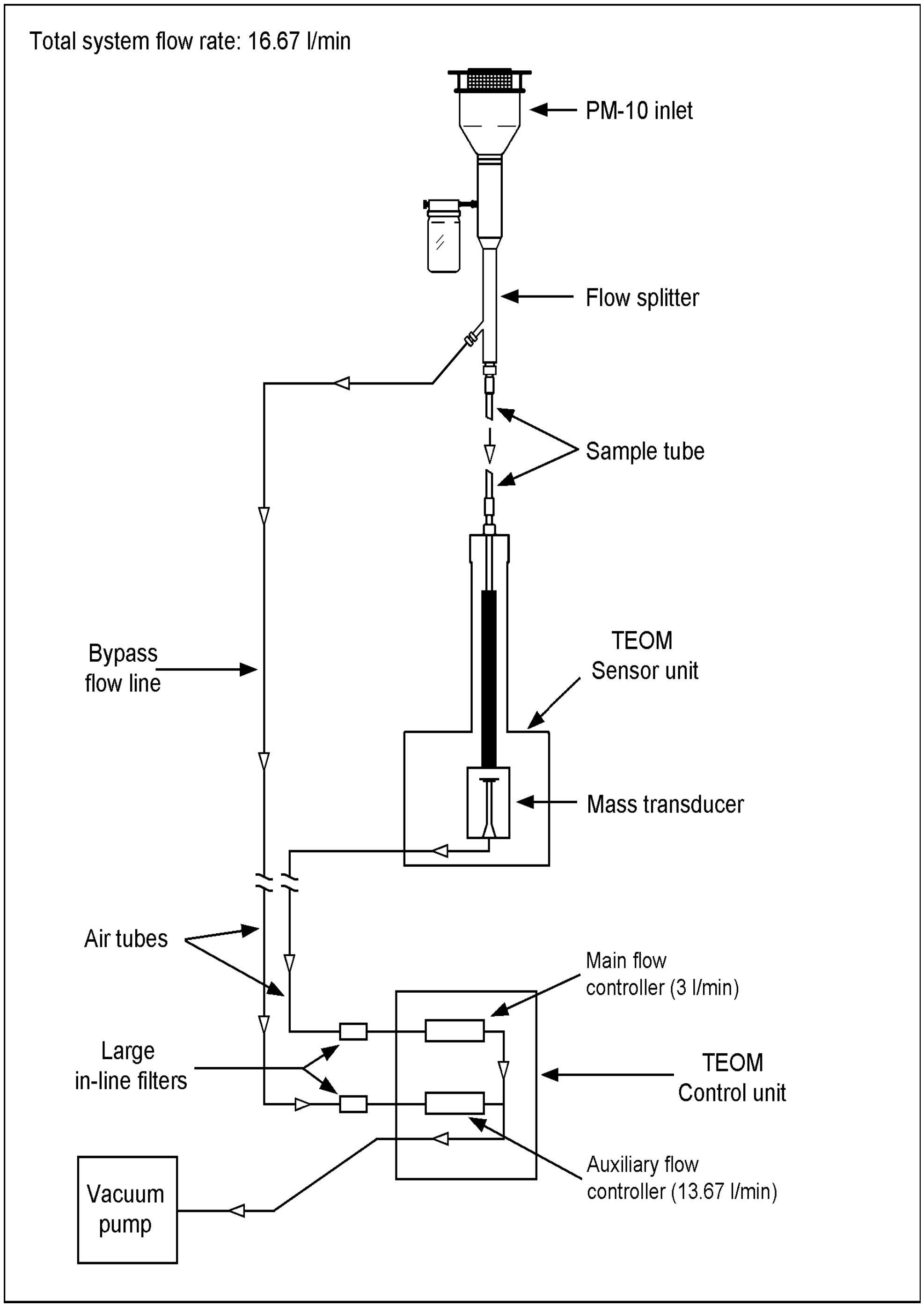
When the instrument samples, the ambient sample stream first passes through the PM-10 inlet (Figure 1-2). At its design flow rate of 16.7 l/min, this inlet allows particles smaller than 10 µm diameter to pass through. At the exit of the PM-10 inlet, the 16.7 l/min flow is isokinetically split into a 3 l/min sample stream that is sent to the instrument's mass transducer and a 13.7 l/min exhaust stream.

Inside the mass transducer, this sample air stream passes through a filter made of Teflon-coated borosilicate glass fiber. This filter is weighed every two seconds. The difference between the filter's current weight and the filter's initial weight (as automatically measured by the instrument after the installation of the filter) gives the total mass of the collected particulate matter. These instantaneous readings of total mass are then smoothed exponentially (using a selectable time constant) to reduce noise.

Next, the mass rate is calculated by taking the change in the smoothed total mass between the current reading and the immediately preceding one and expressing this as a mass rate in g/sec. This mass rate is also smoothed exponentially to reduce noise. Finally, the mass concentration in $\mu g/m^3$ is computed by dividing the mass rate by the flow rate (corrected to EPA standard temperature and pressure and expressed in m^3/sec), and then multiplying the result by 10^6 to convert from g/m^3 to $\mu g/m^3$.

Internal temperatures in the instrument are controlled to minimize the effects of changing ambient conditions. The sample stream is preheated to 50° C before entering the mass transducer so that the sample filter always collects under conditions of very low (and therefore, relatively constant) humidity. All measurement and temperature functions of the instrument are controlled by a dedicated microcontroller. This computer has both digital and analog capability for multipurpose interfacing with external data collection systems. The instrument's rack-mountable control unit has a scrollable four-line display that shows the current values of computed data.

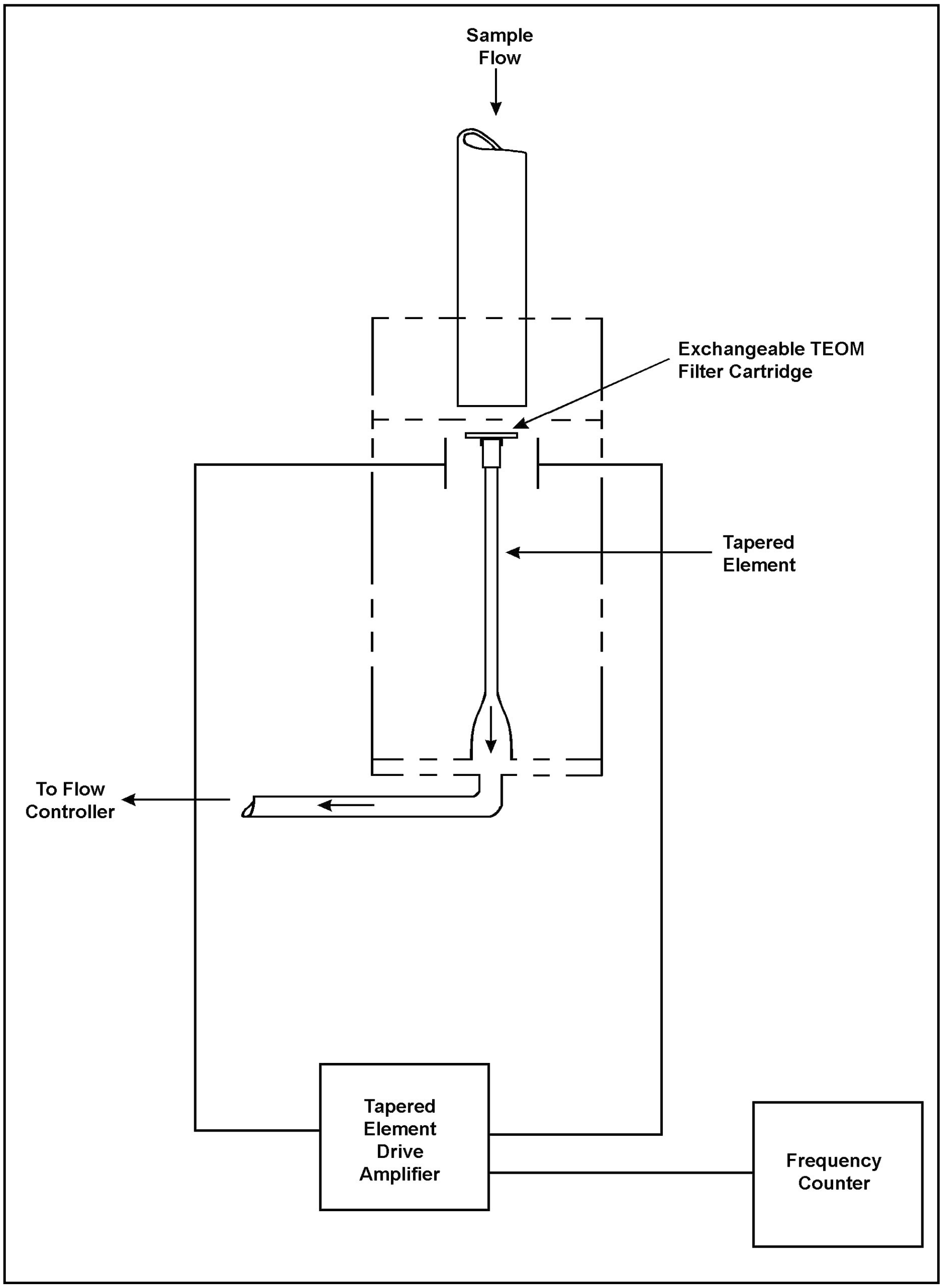
Figure 1-2. Schematic diagram of flow system.



1.5.1. The Flow System

Figure 1-2 shows the flow of the sample stream through the Series 1400a Monitor. The particle size separation at 10 µm diameter takes place as the sample proceeds through the PM-10 inlet. The flow splitter separates the total flow (16.7 l/min) into two parts: a main flow of 3 l/min that enters the sensor unit through the sample tube, and the auxiliary (bypass) flow of 13.7 l/min. The main flow passes through the exchangeable filter in the mass transducer (Figure 1-3), and then proceeds through an air tube and in-line filter to a mass flow controller. The bypass flow is filtered in the large bypass in-line filter before it enters a second mass flow controller. A single pump provides the vacuum necessary to draw the sample stream through the system.

Figure 1-3. Schematic diagram of mass transducer.



1.5.2. Mass Transducer Operation

The weighing principle used in the TEOM mass transducer is similar to that of a laboratory microbalance in that the mass detected by the sensor is the result of the measurement of a change in a parameter (in this case, frequency) that is directly coupled via a physical law (or from first principles).

The tapered element at the heart of the mass detection system (Figure 1-3) is a hollow tube, clamped on one end and free to oscillate at the other. An exchangeable filter cartridge is placed over the tip of the free end. The sample stream is drawn through this filter, and then down the tapered element. This flow is maintained at a constant volume by a mass flow controller that is corrected for local temperature and barometric pressure.

The tapered element oscillates precisely at its natural frequency, much like the tine of a tuning fork. An electronic control circuit senses this oscillation and, through positive feedback, adds sufficient energy to the system to overcome losses. An automatic gain control circuit maintains the oscillation at a constant amplitude. A precision electronic counter measures the oscillation frequency with a 2-second sampling period.

The tapered element is, in essence, a hollow cantilever beam with an associated spring rate and mass. As in any spring-mass system, if additional mass is added, the frequency of the oscillation decreases. This can be seen by observing the frequency on the four-line display of the TEOM control unit (Section 8), and operating the Series 1400a Monitor both with and without a filter in place.

In a spring-mass system the frequency follows the equation:

$$f = (K / M)^{0.5} \tag{1}$$

where:

f = frequency (radians/sec)
K = spring rate
M = mass

K and M are in consistent units. The relationship between mass and change in frequency can be expressed as:

$$dm = K_0 \left(\frac{1}{f_1^2} - \frac{1}{f_0^2} \right) \tag{2}$$

where:

dm = change in mass
K_0 = spring constant (including mass conversions)
f_0 = initial frequency (Hz)
f_1 = final frequency (Hz)

When this equation is rearranged, you can solve for the spring constant, K_0:

✔ The instrument computes a baseline frequency before computing mass concentration results.

$$K_0 = \frac{dm}{\left(\frac{1}{f_1^2} - \frac{1}{f_0^2}\right)} \qquad (3)$$

Thus, K_0 (the calibration constant for the instrument) can be easily determined by measuring the frequencies with and without a known mass (pre-weighed filter cartridge).

In actual operation, the Series 1400a Monitor always measures the entire mass of the system using the equation:

$$M = K_0 / f^2 \qquad (4)$$

At the end of the instrument's 30 minute flow and temperature equilibration period, the monitor averages the frequency for a short period and uses this frequency to compute the baseline mass. Until the next time the unit is reset or taken out of its data collection mode, the frequency is sampled every two seconds and the system mass is calculated.

The difference between this mass and the baseline mass is the mass change of particulate matter collected on the filter cartridge.

1.5.3. Mass Computation Methodology

The calculation of the total mass accumulation on the filter, mass rate and mass concentration are discussed in this section. All of the formulas assume consistent units. In the operating software, unit conversions are made as required.

Several variables are used by the system software to compute mass data:

Gate_Time = 2 — The sampling period (seconds) for each individual frequency measurement.

TM Ave = 300 — The effective time (seconds) over which frequency data points are smoothed to compute total mass. Smoothing is done exponentially, and this value represents the time required for 86% of a step change in the raw total mass to be reflected in the smoothed total mass output; i.e., 2 time constants.

✔ Each TEOM instrument has a unique calibration constant, K_0.

Even if the TM Ave is changed by the user to an averaging time that is different from 300 seconds, the 30-minute, 1-hour, 8-hour and 24-hour mass concentration averages are all computed based upon a TM Ave of 300 seconds that is calculated internally by the instrument.

MR_MC Ave = 300 — The effective time (seconds) over which the differentials between successive total mass data points are smoothed to compute mass rate and mass concentration. The exponential smoothing function used to compute smoothed mass rate_mass concentration is identical to that of the total mass.

K_0 = calibration constant — The calibration constant of the system's mass transducer is determined by R&P before the instrument is shipped to the user. This constant is unique for every TEOM system and is based upon the physical characteristics of the tapered element.

$$\text{TMAlpha} = \frac{2 \times \text{Gate\_Time}}{\text{TM Ave}}$$

A constant used in the total mass exponential smoothing routine.

$$MR\_MCAlpha = \frac{2 \times Gate\_Time}{MR\_MC\ Ave}$$

A constant used in the mass rate_mass concentration smoothing routine.

After the Series 1400a Monitor is turned on or reset by pressing the <F1> or <Run> key on the control unit, the system software determines whether set point temperatures are within acceptable tolerance ranges (Section 6). If the temperatures and flow rates are not within these ranges, the instrument waits until all temperatures and flow rates have remained within these limits for 30 minutes before starting data collection. The monitor is in Operating Mode 1 during this stabilization period.

Once this stabilization period ends, the Series 1400a Monitor enters Operating Mode 2, and computes the system mass of the mass transducer ($Mass_o$). This is equal to the summation of the effective mass of the tapered element, the mass of the filter, and the mass of any particulate matter collected on the filter. This computation is performed by averaging the tapered element frequency over ten 2-second periods (Gate_Time), and then employing the following formula derived in equation 4:

$$Mass_o = K_0 / f_0^{\,2} \qquad (5)$$

where:

$Mass_o$ = the baseline mass of the mass transducer (tare weight of filter and tapered element)

K_0 = the calibration constant of the mass transducer

f_0 = the average tapered element frequency during the initial ten 2-second periods

After the instrument has sampled the tapered element frequency for these ten 2-second periods, it begins computing a new system total mass value ($Mass_i$) every 2 seconds using equation 4. With these $Mass_o$ and $Mass_i$ values, the system then computes a new particulate matter total mass value (TM_i) every 2 seconds.

$$TM_i = Mass_i - Mass_o \qquad (6)$$

To provide data smoothing, an exponential smoothing routine is applied to these TM_i values to compute a new smoothed total mass value every 2 seconds.

$$SmoothTM_i = TMAlpha \times TM_i + (1 - TMAlpha) \times SmoothTM_{i-1} \qquad (7)$$

At the same time that the instrument computes these $SmoothTM_i$ values, it also calculates the incremental change in sample mass between successive smoothed readings according to the following formula:

$$Delta\_Mass_i = SmoothTM_i - SmoothTM_{i-1} \qquad (8)$$

These incremental mass changes are smoothed according to the following formula, where MR stands for mass rate:

$$SmoothMR_i = MR\_MCAlpha \times Delta\_Mass_i + (1 - MR\_MCAlpha) \times SmoothMR_{i-1} \qquad (9)$$

These smoothed mass rate readings are converted to mass concentration data using the following formula:

$$SmoothMC_i = \frac{SmoothMR_i}{Flow\_Rate_{EPA}} \times 10^6 \qquad (10)$$

where:

$Flow\_Rate_{EPA}$ = 3.0 l/min volumetric flow rate set point, converted to EPA standard temperature and pressure

Once the $SmoothTM_i$ values have been computed for 150 seconds (TM Ave / 2), the instrument enters Operating Mode 3. At this point, the smoothed total mass data ($SmoothTM_i$) are shown on the monitor's four-line display and are transmitted to the monitor's analog and RS232 connectors. Prior to this time, the total mass indicated by the instrument is equal to 0.

After the $SmoothMC_i$ values have been calculated for 300 seconds (TM Ave / 2 + MR_MC Ave / 2), the monitor enters Operating Mode 4. At this point, the smoothed mass concentration data ($SmoothMC_i$) are shown on the monitor's four-line display and are transmitted to the monitor's analog and RS232 connectors. Previous to this time, the mass concentration indicated by the instrument is equal to 0.

The 30-minute, 1-hour, 8-hour and 24-hour mass concentration averages are computed differently from the "instantaneous" mass concentrations. This notwithstanding, the averaged results of the instantaneous readings are identical to these longer-term averages except for a very slight time offset caused by the additional exponential smoothing performed on the short-term data. Because the longer-term averages are all computed in the same manner, only one example is given below.

The 1-hour mass concentration average (01-Hr MC) is computed by recording the smoothed total mass ($SmoothTM_i$, internal TM Ave = 300 sec) every hour on the hour, and performing the following calculation:

$$01MC = \frac{SmoothTM_{hour} - SmoothTM_{hour-1}}{Total\_Flow_{EPA}} \times 10^6 \qquad (11)$$

where:

$SmoothTM_{hour-1}$	=	Smoothed total mass at the beginning of the averaging period, internal TM Ave = 300 sec
$SmoothTM_{hour}$	=	Smoothed total mass at the end of the averaging period, internal TM Ave = 300 sec
$Total\_Flow_{EPA}$	=	Total volumetric flow in m^3 for the averaging period (based upon flow rate setpoint), converted to EPA standard temperature and pressure

The instrument updates the longer-term mass concentration averages at the following times:

30-minute average (30MC)	every half hour on the half hour
1-hour average (01MC)	every hour on the hour
8-hour average (08MC)	every hour on the hour
24-hour average (24MC)	every hour on the hour

After the instrument has been turned on or reset, these longer-term averages are equal to 0 until a complete period's data has been collected.

Sampling is performed by the Series 1400a Monitor using a variable mass flow rate that maintains a constant volumetric flow rate appropriate to the PM-10 sampling inlet. Because this flow rate is controlled by mass flow controllers (MFCs), the mass flow rate must be adjusted for temperature and pressure to maintain the appropriate volumetric flow rates within acceptable limits.

The mass flow controllers (MFCs) in the Series 1400a Monitor are internally calibrated for a standard temperature and pressure of 0° C and 1 Atmosphere (1013.2 millibars or 760 mm Hg). The user must enter the seasonal average temperature (Ave. Temp.) and average barometric pressure (Ave. Pres.) at the measurement site to allow the instrument to sample at the correct volumetric flow rate (Section 6).

Alternately, the user can set up the instrument to automatically measure the ambient temperature and pressure using hardware supplied with the unit. The microprocessor calculates the correct mass flow set point ($Flow\_Rate_{STP}$) with this information using the following formula:

$$Flow\_Rate_{STP} = Flow\_Rate_{Vol} \times \frac{273.15}{Ave.\ Temp. + 273.15} \times \frac{Ave.\ Pres.}{1.0} \qquad (12)$$

where:

$Flow\_Rate_{STP}$	=	Control set point to mass flow controller (equivalent flow at 0° C and 1 Atmosphere)
$Flow\_Rate_{Vol}$	=	Volumetric flow rate set point (l/min) to be 3.0 l/min for the sample (main) flow and 13.67 l/min for the auxiliary flow (Section 6)
Ave. Temp.	=	Seasonal average temperature entered by the user (°C)
Ave. Pres.	=	Seasonal average barometric pressure entered by the user (Atmospheres, where 1 Atmosphere = 1013.2 millibars or 760 mm Hg)

NOTE: When using actual conditions for active volumetric flow control, substitute the actual (local) temperature and pressure for the average temperature and pressure variables in equation 12.

PM-10 mass concentration data reported to the U.S. EPA must be referenced to standard cubic meters of air based on a standard temperature and pressure of 25° C and 1 Atmosphere (atm), respectively. For the instrument to report mass concentrations according to this EPA standard, the user must ensure that the standard temperature (Std. Temp.) and standard pressure (Std. Pres.) entered in the instrument equal 25° C and 1 Atmosphere (Section 6). These are the default values for the instrument.

The flow rates referenced internally by the instrument to 0° C are converted to EPA standard conditions using the following computation:

$$Flow\_Rate_{EPA} = Flow\_Rate_{STP} \times \frac{Std.\ Temp. + 273.15}{273.15} \times \frac{1\ atm}{Std.\ Pres.} \qquad (13)$$

This $Flow\_Rate_{EPA}$ is used to determine the mass concentration reported by the instrument, as shown in equation 10.

The $Total\_Flow_{EPA}$ referenced in equation 11 for computing longer-term mass concentration averages is obtained by summing the $Flow\_Rate_{EPA}$ over the period of the longer-term average. For example, the 1-hour $Total\_Flow_{EPA}$ is obtained by:

$$Total\_Flow_{EPA}\ (m^3) = Flow\_Rate_{EPA}\ (l/min) \times \text{period (minutes)} \times 1/1000\ (l/m^3) \quad (14)$$

NOTE: When reporting concentrations to actual conditions, the values for standard and average temperatures must be set to “99,” and the standard and average pressures must be set to “9,” when in the Set Temps/Flows screen (Section 6). This will ensure that the monitor uses the current actual values for temperature and pressure in equation 13.

Section 2: Hardware Setup

To install the Series 1400a Monitor and set up the system, you must check the voltage setting of the control unit (Section 2.3.1); assemble the sensor flow connections (Section 2.3.2.1), bypass flow connections (Section 2.3.2.2), pump connections (Section 2.3.2.3), sensor unit connections (Section 2.3.4), flow splitter (Section 2.4.1), tripod (Section 2.4.2), sampling system components (Section 2.4.3) and the sample tube (Section 2.4.4); and install a sample inlet onto the flow splitter (Section 2.4.5.1). After you have set up the system, you must perform a leak check on the monitor (Section 3.4) and install a TEOM filter (Section 3.1.1) in the mass transducer before starting a sample run.

If you want to mount the control unit in a rack (Section 2.3.3), you must install the control unit into the rack directly after you assemble the pump connections (Section 2.3.2.3). If you want to install the monitor in an outdoor location, refer to Appendix K for further instructions. Consult R&P for specific site recommendations.

2.1. Installation Considerations

The Series 1400a Monitor consists of two basic components: the sensor unit (containing the sample inlet and mass transducer) and the control unit (containing the operator terminal and control electronics). The two units are connected by a 10-meter (optionally 2 or 20 m) cable/tube assembly.

The control unit is suitable for standard rack mounting and may be located in any convenient indoor location which is maintained between 2° and 40° C (35° to 104° F).

✔ The instrument must be located in a weather-protected environment.

R&P strongly recommends that the sensor unit of the Series 1400a Monitor also be installed in an indoor or weather-protected location. If the sensor unit is installed in an indoor location, the user must run a sampling tube through the roof of the monitoring site (Section 2.4).

Although the TEOM monitor is inherently rugged, it is a precision instrument. The user will obtain the best operating conditions and longest instrument life when the unit is not exposed to extremes of weather. Filter exchange, in particular, may be best accomplished by a technician operating in an indoor environment where there is no possibility of rain or snow contaminating the filter.

✘ Be sure to install the ambient temperature sensor.

Be sure to install the ambient temperature sensor (Section 2.4.3). If you do not install the ambient temperature sensor, and then you set the average temperature to “99” and the average pressure to “9” (Section 6), the mass flow controller will attempt to control the sample flow as if the ambient temperature is absolute zero.

✔ The sample tubing must be vertical.

The sample line should proceed in a straight, vertical line from the PM-10 inlet to the inlet of the sensor unit through a 4 cm (1 1/2-inch) diameter hole in the roof of the monitoring site. If you want to install the monitor in an outdoor location, refer to Appendix K for further instructions. Consult R&P for specific site recommendations.

To achieve the best results, locate the TEOM sensor unit in an environment with relatively slow temperature fluctuations. Avoid sampling locations with direct exposure to sunlight or that are in close proximity to a heating or air-conditioning outlet. To avoid condensation in the sample tubing, R&P strongly recommends that the user insulate the sample tube extensions with pipe insulation when operating the instrument in areas of high humidity.

2.2. STANDARD SYSTEM HARDWARE

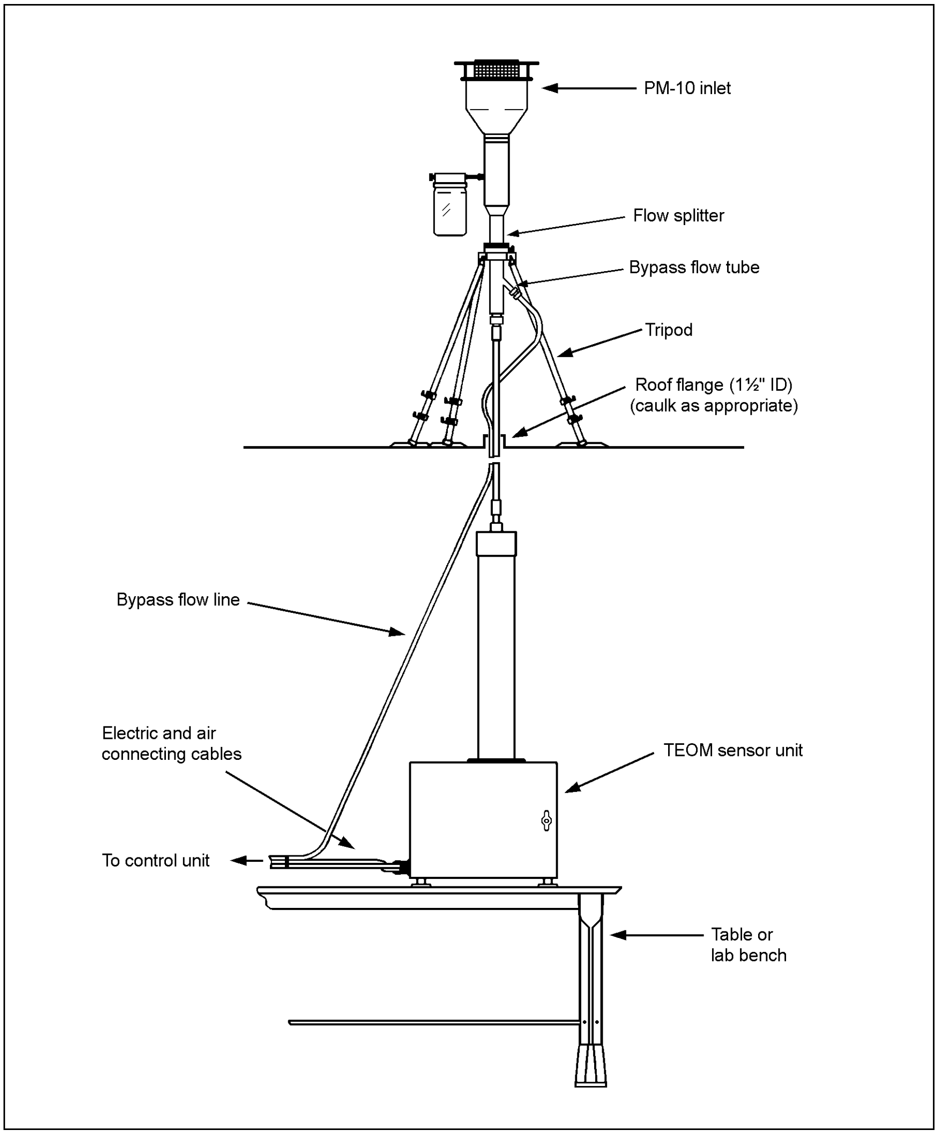
In its most basic U.S. EPA-approved, PM-10 configuration, the Series 1400a Monitor is supplied with the following components:

TEOM control unit (with auxiliary flow controller)
TEOM sensor unit
2 Rack mounting brackets (for the control unit)
Temperature sensor and cable, 10 m
TEOMCOMM software
Electric- and air-connecting cable
3/8"-to-1/4" Reducer fitting
3/8" green tubing for bypass flow, 0.9 m (3 ft)
3/8" nylon tubing to pump, 5 m (16.5 ft)
Conductive rubber tubing with coupling
2 Sample tubing extensions, 1 m (40")
9-to-9 pin computer cable
9-to-25 pin computer adapter
9-to-25 pin modem cable
Box of 20 TEOM filter cartridges (Pallflex TX40)
4 Large in-line filters
Filter exchange tool
Pre-filter assembly (for baseline testing)
Flow splitter
R&P PM-10 inlet
Flow audit adapter kit
Vacuum pump
2 15-pin subminiature D-connectors
4 Mass flow controller orifices
4 Hose barbs
2 Operating Manuals
Quick Start Guide
2 Service Manuals

2.3. Installing the Control and Sensor Units

The TEOM control unit can be located at any convenient location such as a laboratory bench or rack mount cabinet that is within 20 meters of the sensor unit (the default cable length is 10 m). R&P recommends that the sample line be as short as possible for best results. Consult R&P when the distance between these units is longer than 20 meters. The TEOM sensor unit should be located directly below the inlet point of the sample stream on a sturdy surface (Section 2.3.4).

Figure 2-1. Schematic diagram of a typical PM-10 installation.



2.3.1. Voltage Setting

Follow these steps to set the proper voltage for your installation:

1) Locate the voltage setting indicator on the power line filter on the back panel of the control unit (Figures 2-2 and 2-3).

Figure 2-2. Power line filter with voltage setting indicator (A) highlighted.

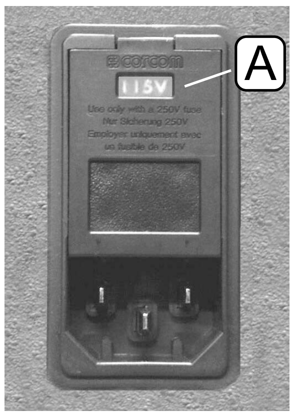
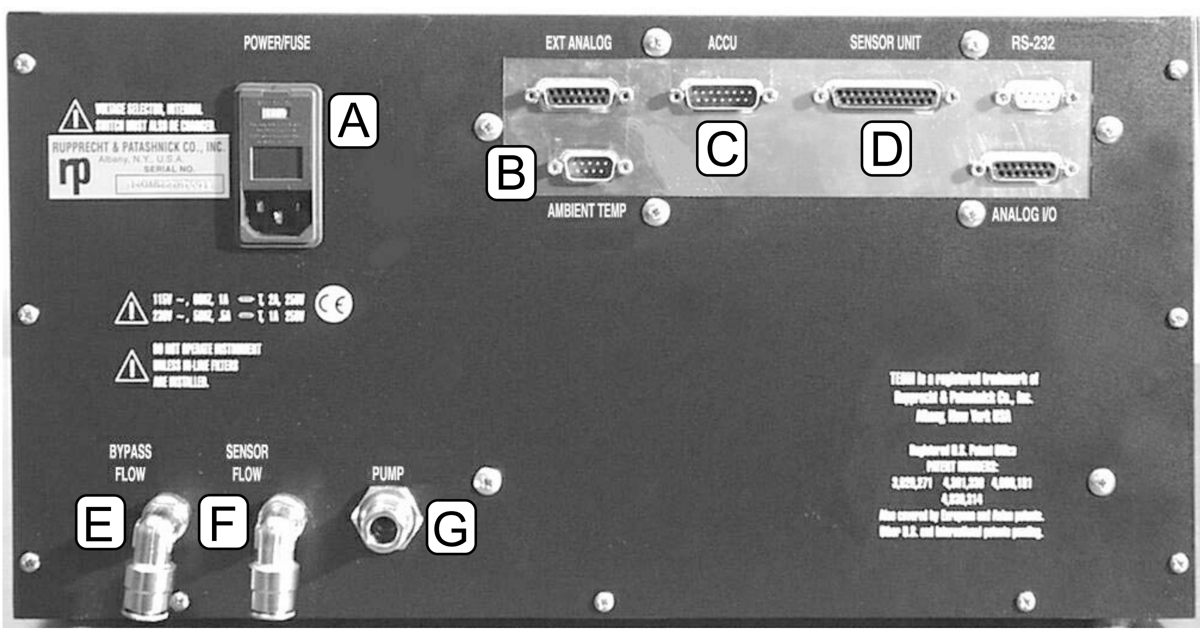


Figure 2-3. Back panel of TEOM control unit with the fuse/power cord socket and power line filter (A), ambient temperature sensor connector (B), ACCU connector (C), 25-pin electrical connection to sensor unit (D), bypass flow connection (E), sensor flow connection (F) and pump connection (G) highlighted.

2) Consult a licensed electrician if you are uncertain of the electrical requirements in your area. If the voltage setting is appropriate for your installation, go to step 8. If the voltage setting is not appropriate for your installation, go to step 3.



3) Place the blade of a small slotted screwdriver in the slot on top of the fuse/power cord socket and power line filter (Figure 2-4) and open the cover.

Figure 2-4. Opening the cover of the fuse/power cord socket and power line filter with a screwdriver.

4) Place the blade of a small slotted screwdriver in the top of the fuse holder insert. Remove the insert by sliding it out of the power line filter (Figure 2-5).

Figure 2-5. Removing the fuse insert with the screwdriver.

5) Remove the two fuses from the insert (Figures 2-6 and 2-7).

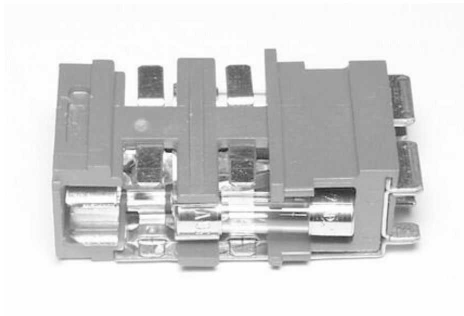


Figure 2-6. Close up of the fuse holder insert with a fuse installed.

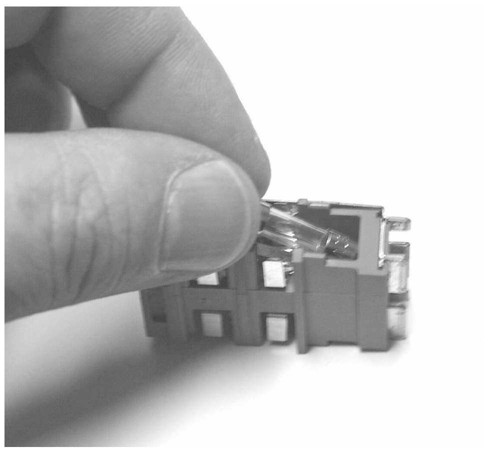


Figure 2-7. Placing the fuses into the fuse holder insert.

6) Install the proper fuses into the insert. Use 2A fuses for 115 VAC operation, or 1A fuses for 230 VAC operation.

7) Install the insert into the power line filter (Figure 2-8) and close the cover (Figure 2-9) so that you can read the correct voltage in the window (Figure 2-10).

Figure 2-8 (left). Installing the fuse insert into the fuse/ power cord socket and power line filter.

Figure 2-9 (right). Closing the cover on the power line filter.

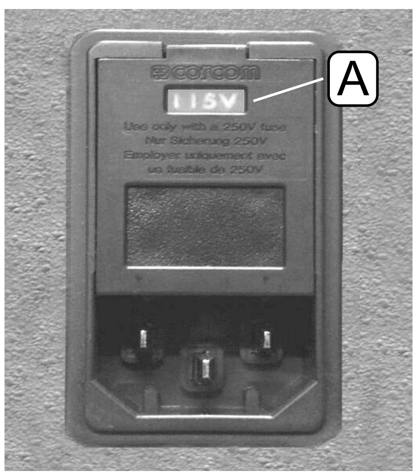


Figure 2-10. The power line filter with the correct voltage (A) highlighted.

8) Remove the top cover of the control unit by unscrewing the screws holding the top cover plate in place (Figure 2-11).

9) Attach an antistatic wrist strap to your wrist. Attach the other end of the antistatic wrist strap to the unit's enclosure.

✘ Always wear appropriate anti-static devices when working with the system electronics.

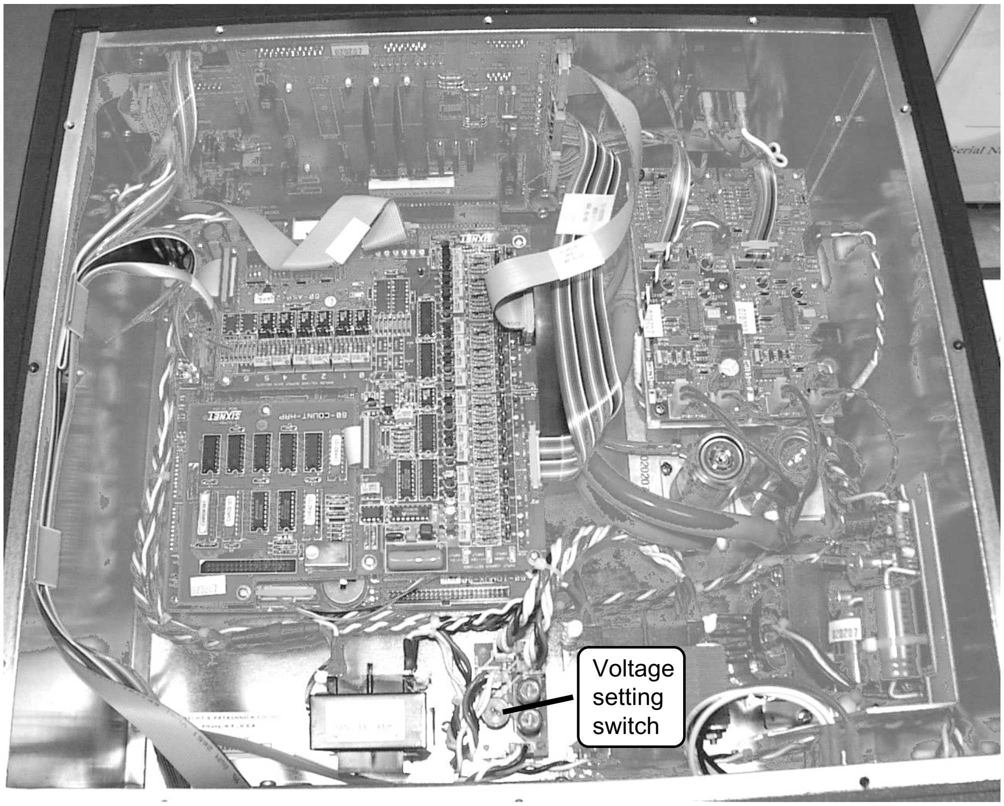


Figure 2-11. Top cover of the control unit removed with voltage setting switch highlighted.

10) Locate the voltage setting switch (Figure 2-12) near the front center of the control unit (Figure 2-11).

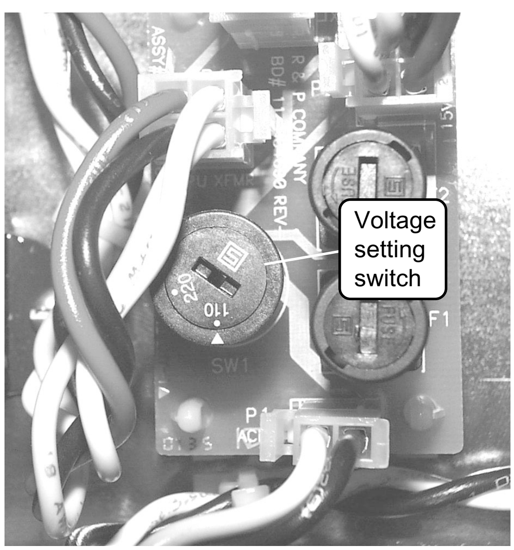


Figure 2-12. Voltage setting switch.

11) Insert a slotted screwdriver into the slot on the top of the voltage setting switch and turn the switch to the correct voltage setting.

12) Replace the cover of the control unit.

13) Insert the power cord into the fuse/power cord socket (Figure 2-2).

14) You must now assemble the sensor flow connections (Section 2.3.2.1).

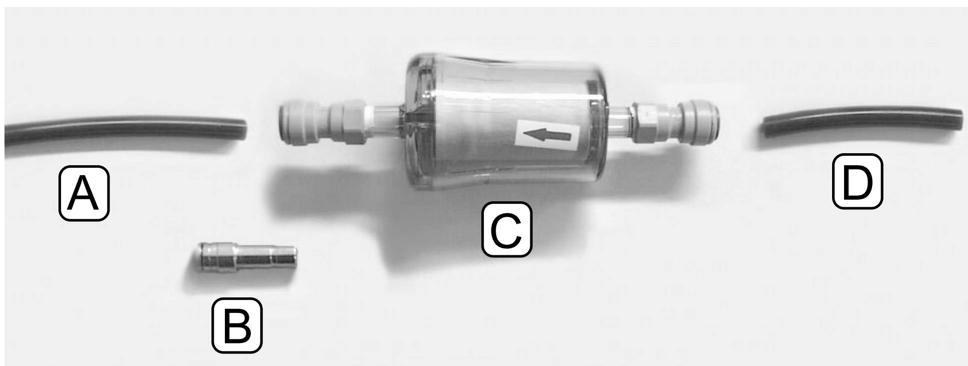
2.3.2. Control Unit Connections

2.3.2.1. Sensor Flow Connections

Follow these steps to assemble the sensor flow connections:

1) Locate the small piece of 3/8" flow line tubing (Section 2.2) (Figure 2-13).

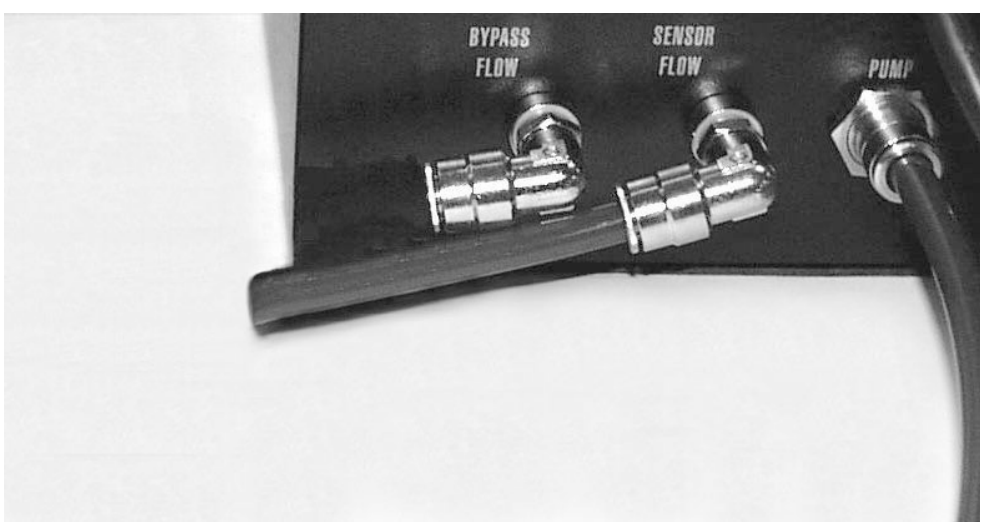
Figure 2-13. Sensor flow components with parts disassembled: 1/4" black sensor flow flow tubing of the electric- and air-connecting cable (A), 3/8"-to-1/4" reducer fitting (B), large in-line filter (C) and 3/8" flow line tubing (D).



2) Cut a 13 cm (5") length of tubing with a clean, perpendicular cut.

3) Push one end of the cut piece of the 3/8" flow line tubing into the "SENSOR FLOW" fitting at the rear of the control unit (Figure 2-14).

Figure 2-14. 3/8" flow line tubing inserted into the "SENSOR FLOW" fitting.



NOTE: The Series 1400a Monitor uses push-to-connect fittings for all air flow lines. To engage these connections, the air tube must be pushed completely into the fitting so that the tube is fully inserted and cannot be pulled out. While pushing the tubing into the fitting, there is an intermediate stop at an O-ring. You must push the tubing past the O-ring to completely engage the tubing inside the fitting and prevent air leaks. To disengage the connection, push the small collar (located at the end of the fitting) toward the fitting and pull the tube out.

4) Locate one of the large in-line filters (Figure 2-15).

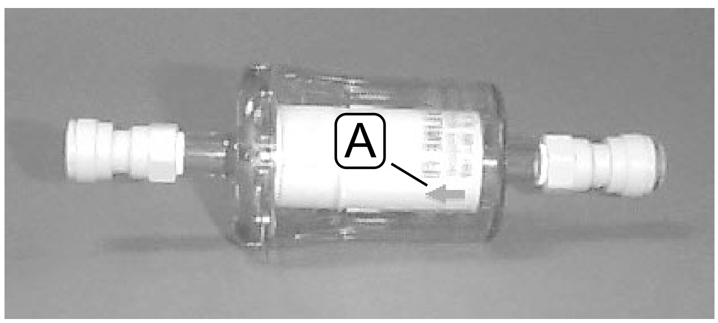


Figure 2-15. Large in-line filter with the flow arrow (A) highlighted.

5) Push the filter onto the open end of the 3/8" flow line tubing so that the flow arrow on the filter points *away* from the control unit (Figure 2-16).

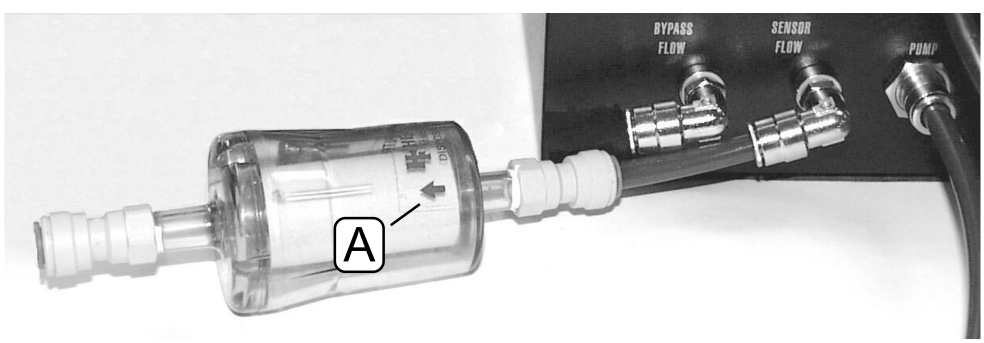
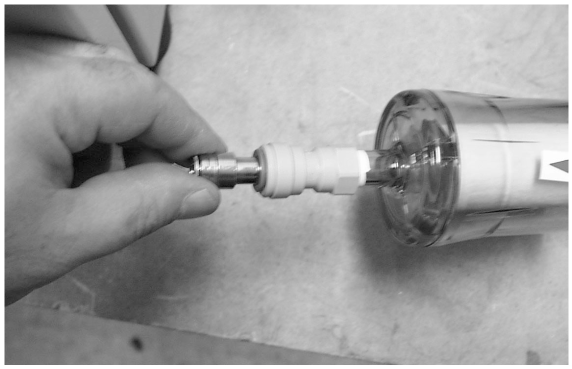


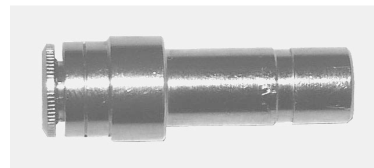
Figure 2-16. In-line filter connected to the 3/8" flow line tubing on the sensor flow fitting. Note that the flow arrow (A) on the filter points *away* from the control unit.

6) Locate the 3/8"-to-1/4" reducer fitting (Figure 2-18) and push it into the open end of the filter (Figure 2-17).

Figure 2-17 (left). Installing the 3/8"-to-1/4" reducer fitting into the sensor in-line filter.

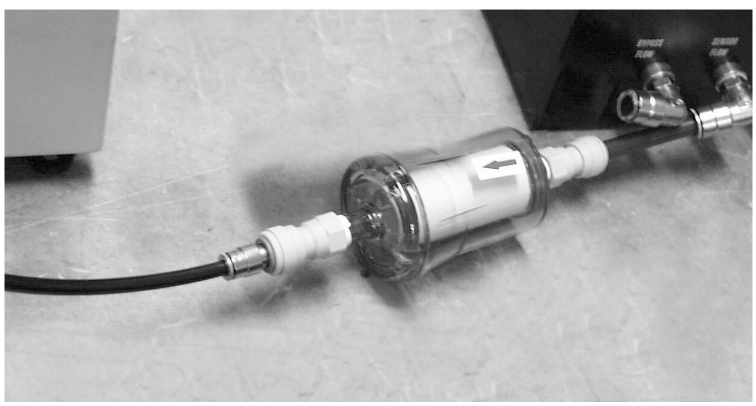
Figure 2-18 (right). Close up of the 3/8"-to-1/4" reducer fitting.





7) Install the 1/4" black sensor flow tubing of the electric- and air-connecting cable into the reducer fitting (Figure 2-19).

Figure 2-19. 1/4" black sensor flow tubing of the electric- and air-connecting cable connected to the reducer fitting.



8) Install the electrical connector of the electric- and air-connecting cable (Figure 2-20) into the "SENSOR UNIT" connection (Figure 2-21) on the back of the control unit.

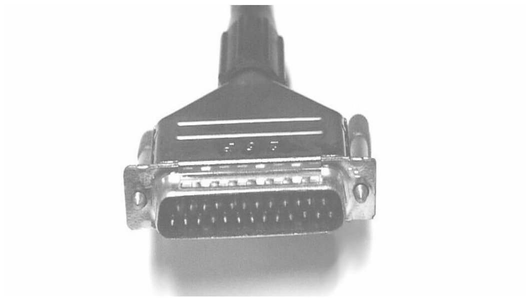


Figure 2-20. The electrical connector of the electric- and air-connecting cable that fits into the control unit.

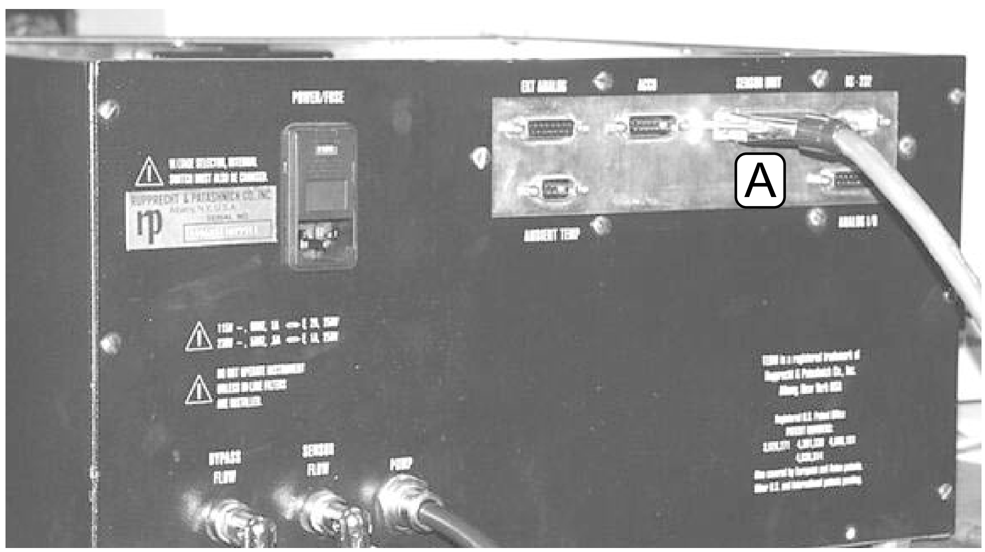


Figure 2-21. Back of control unit with the electric- and air-connecting cable attached to the "SENSOR UNIT" connection (A).

9) You must now assemble the bypass flow connections (Section 2.3.2.2).

2.3.2.2. Bypass Flow Connections

Follow these steps to assemble the bypass flow connections:

1) **Locate the 3/8" green tubing.**
2) **Cut a length of the 3/8" green tubing approximately 13 cm (5") long (Figure 2-22). Ensure that the cut in the tubing is clean and perpendicular.**

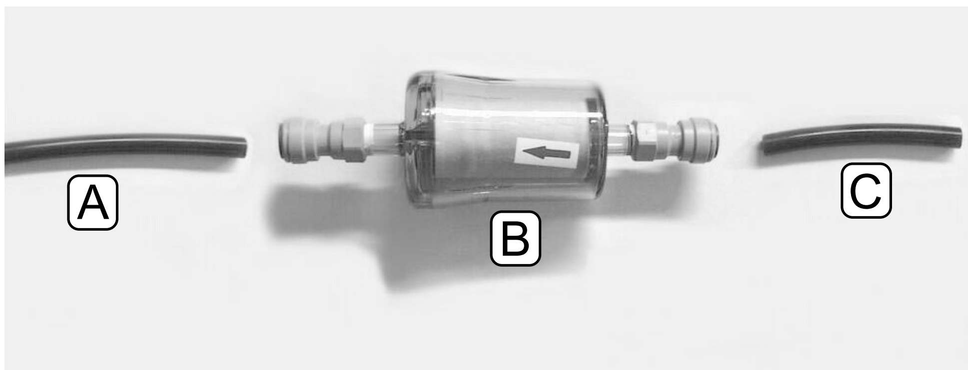


Figure 2-22. Bypass flow components with parts disassembled: 3/8" flow line tubing (A), large bypass in-line filter (B), and 3/8" flow line tubing (C).

3) **Push the 13 cm (5") length of tubing into the fitting on the back of the control unit labeled "BYPASS FLOW" (Figure 2-23).**

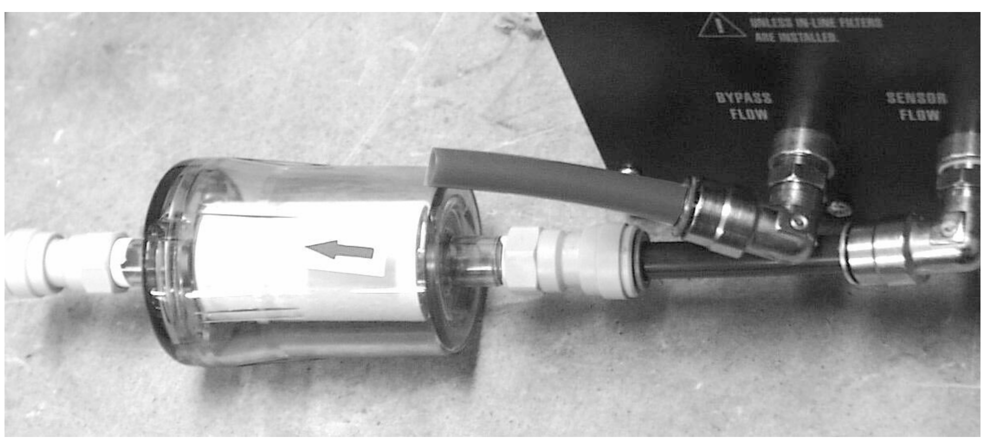
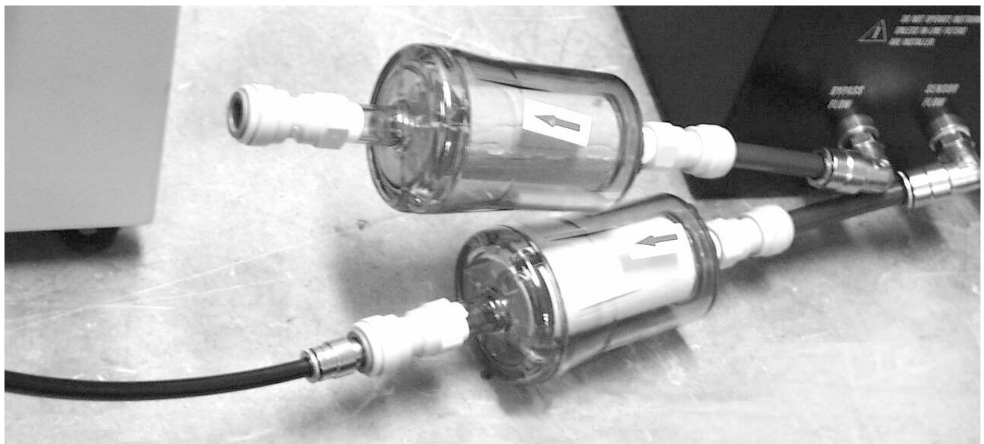


Figure 2-23. 3/8" green tubing inserted into the "BYPASS FLOW" fitting.

4) **Locate another large in-line filter (Figure 2-15).**

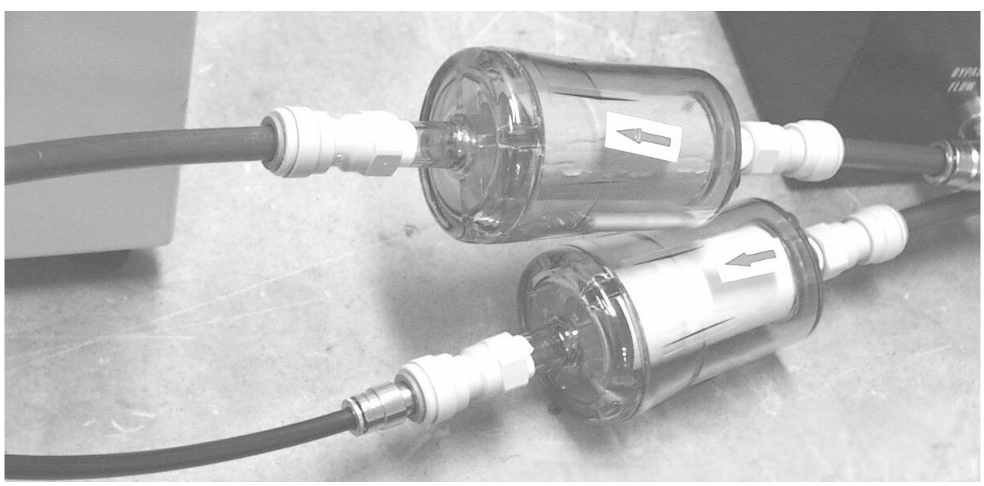
5) Push the filter onto the open end of the length of 3/8" green tubing so that the flow arrow on the filter points *away* from the control unit (Figure 2-24).

Figure 2-24. Large in-line filter inserted into the 3/8" green tubing.



6) Push the other length of the cut 3/8" green tubing into the open end of the filter (Figure 2-25) for later connection to the bypass flow outlet (Section 2.3.3), or the optional ACCU System outlet (Section 14), if used.

Figure 2-25. 3/8" green tubing inserted into the bypass in-line filter.



7) You must now assemble the pump connections (Section 2.3.2.3).

2.3.2.3. Pump Connections

Follow these steps to assemble the pump connections:

1) **Locate the 5 m (15.5') length of 3/8" nylon tubing (Section 2.2). Do not cut or otherwise shorten the pump tubing that connects the control unit to the vacuum pump.**

2) **Push one end of the tubing into the "PUMP" connection on the back of the control unit (Figure 2-26).**

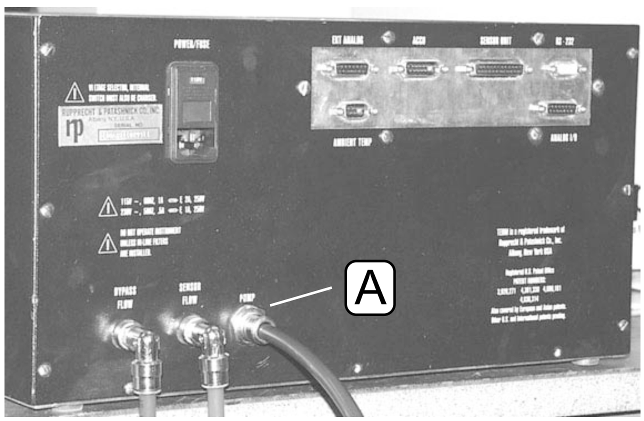


Figure 2-26. 3/8" nylon tubing installed in the "PUMP" connection (A) on the back of the control unit.

3) **Push the other end of the tubing into the fitting on the vacuum pump (Figure 2-27).**

NOTE: R&P strongly recommends that you use the vacuum pump provided with the unit. If you choose to install a different pump, it must be oil-free and able to maintain a 20" Hg vacuum at a flow of 16.67 l/min.

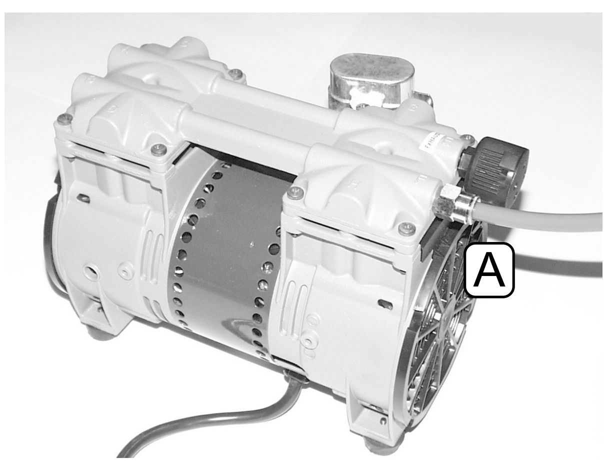


Figure 2-27. 3/8" nylon tubing installed in the pump fitting (A).

4) If you want to mount the control unit in a rack, refer to Section 2.3.3. If you do not want to mount the control unit in a rack, you must now assemble the sensor unit connections (Section 2.3.4).

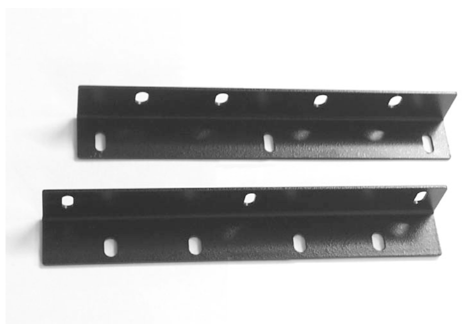
2.3.3. Control Unit Rack Mounts

The TEOM control unit can be rack-mounted when several control units are located at one site.

Follow these steps to install a control unit in a rack:

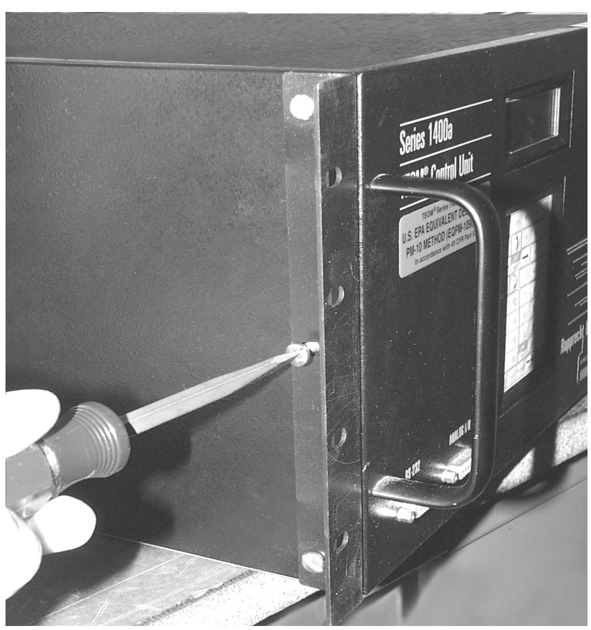
1) Locate the two rack mounts (Figure 2-28).

Figure 2-28. Rack mounts.



2) Fasten the rack mounts to the control unit (Figures 2-29 and 2-30) by screwing them to the sides of the unit near the front panel with the six 10-32×3/8 screws provided with the rack mounting kit.

Figure 2-29. Screwing the rack mount onto a TEOM control unit.



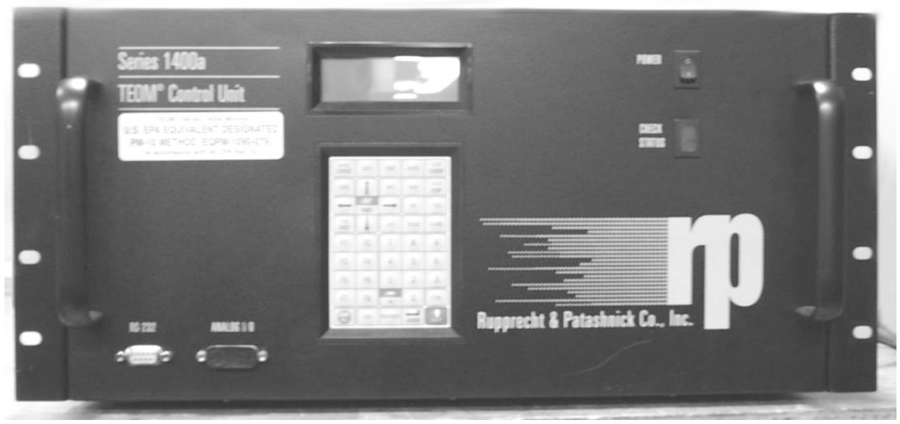


Figure 2-30. Front of TEOM control unit with rack mounts installed.

3) Install the TEOM control unit onto the rack by screwing the rack mounts to the front of the rack supports (Figure 2-35).

NOTE: If the back of the rack is not accessible, you must install the air flow and electric connections on the back of the control unit (Section 2.3) before attaching the control unit to the rack.

Figure 2-31. Three TEOM control units installed in a rack.

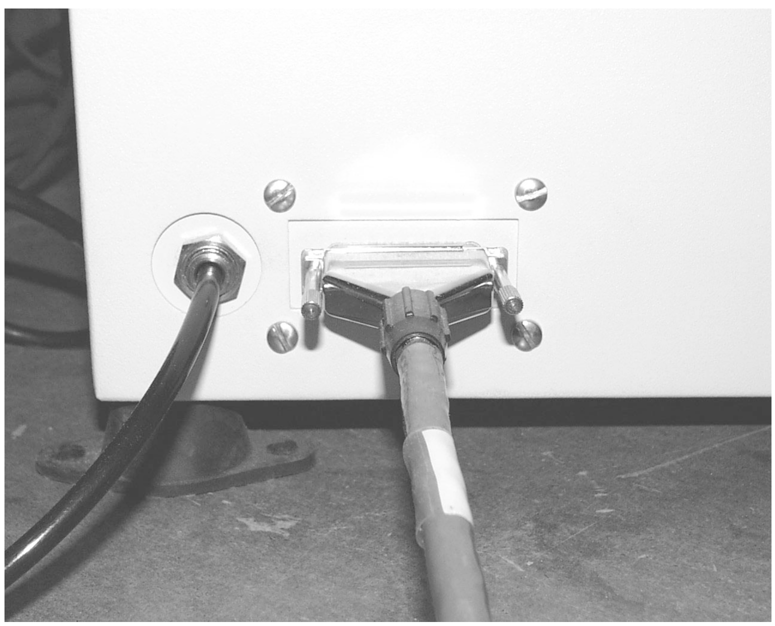
4) You must now assemble the sensor unit connections (Section 2.3.4).

2.3.4. Sensor Unit Connections

Follow these steps to assemble the sensor unit connections:

1) **Install the sensor unit on a sturdy surface directly below the 4 cm (1 1/2") diameter hole in the roof.**
2) **Install the electric connector of the electric- and air-connecting cable (Section 2.2) into the 25-pin connection port on the TEOM sensor unit (Figure 2-32). The other end of the electric- and air-connecting cable should be connected to the control unit (Section 2.3.2).**

Figure 2-32. Electric- and air-connecting cable installed on the sensor unit.



3) **Install the other end of the 1/4" black sensor flow tubing of the electric- and air-connecting cable into the air inlet on the side of the sensor unit (Figure 2-32).**

   NOTE: Ensure that the electric and air connection cable is protected and that the flow lines are not bent sharply or kinked.

4) **If you can install the electric- and air-connecting cable on the sensor unit without kinking or causing a right-angle bend to the cable, go to step 5. If your sensor unit is mounted in a position where the electric- and air-connecting cable would be kinked or bent at a right angle, go to Section 2.3.5.**

5) Remove the end cap from the air inlet on top of the sensor unit (Figure 2-33).

Figure 2-33. Close-up of the top of the sensor unit air inlet with end cap removed.

6) You must now assemble the flow splitter (Section 2.4.1).

2.3.5. Moving the Sensor Unit Connectors

The electric and air connectors on the side of the sensor unit may be moved to the back of the unit to facilitate installation, or to avoid right-angle bends or kinks in the tubing.

Follow these steps to move the sensor unit connectors:

1) Remove the 8 screws that hold the electric- and air-connector assembly in place (Figure 2-34).

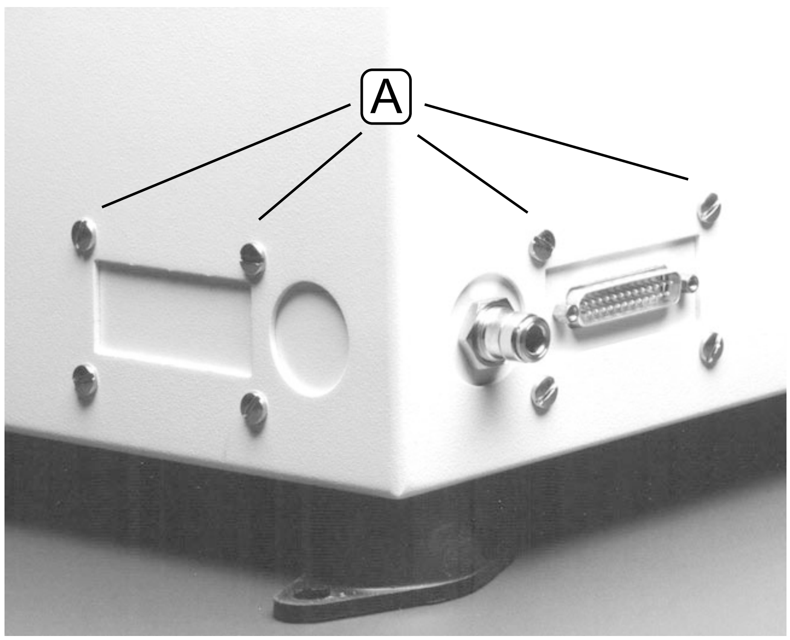


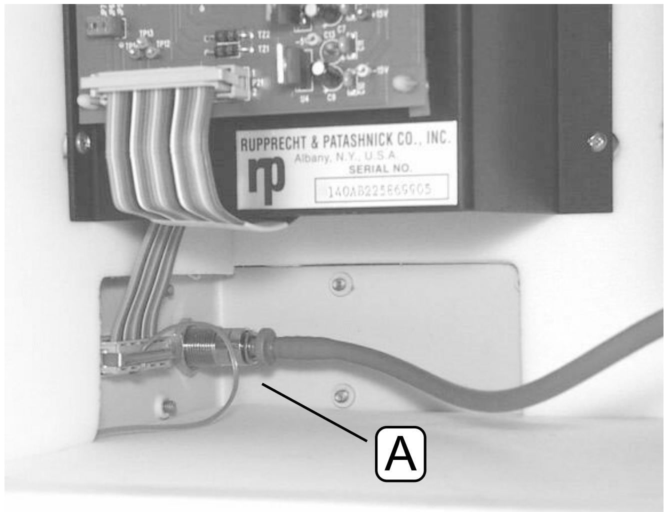
Figure 2-34. Close-up of electric and air connections on the side of the sensor unit with the holding screws (A) highlighted.

2) Open the sensor unit.

3) Remove the electric- and air-connector assembly from the opening in the back of the sensor unit by pulling on the electric cable and air hose (Figure 2-35).

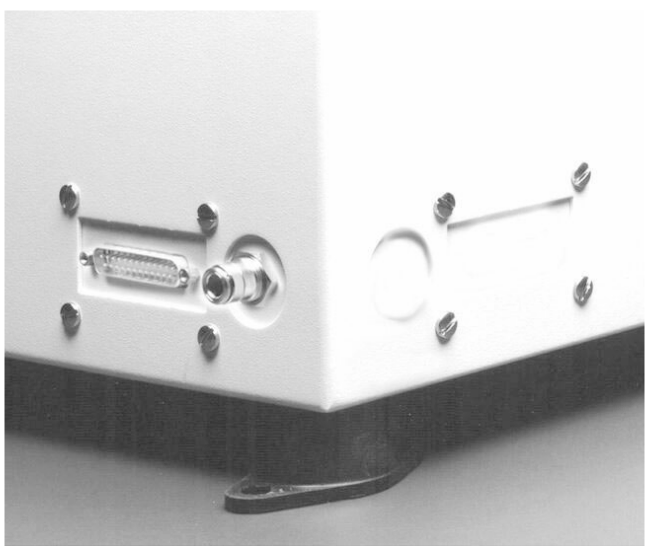
NOTE: Do not disconnect the electric cable and air hose connections from the electric- and air-connector assembly.

Figure 2-35. The inside of the sensor unit showing the electric and air connections with the electric- and air-connector assembly (A) highlighted.



4) Turn the electric- and air-connector assembly over and reinsert the assembly into the openings at the back of the sensor unit (Figure 2-36).

Figure 2-36. Close-up of the electric and air connections on the back of the sensor unit.



5) Replace the 8 screws that secure the electric- and air-connector assembly in place.

6) You must now assemble the flow splitter (Section 2.4.1).

2.4. Installing the Sampling System

There are two possible sampling system configurations: rooftop assembly and outdoor enclosure assembly. Refer to Appendix K to install your Series 1400a Monitor in an outdoor enclosure.

To install the sampling system on a roof top, you must set up the flow splitter assembly (Section 2.4.1), tripod assembly (Section 2.4.2), sampling system assembly (Section 2.4.3) and sample tube assembly (Section 2.4.4), and then choose an appropriate inlet (Section 2.4.5).

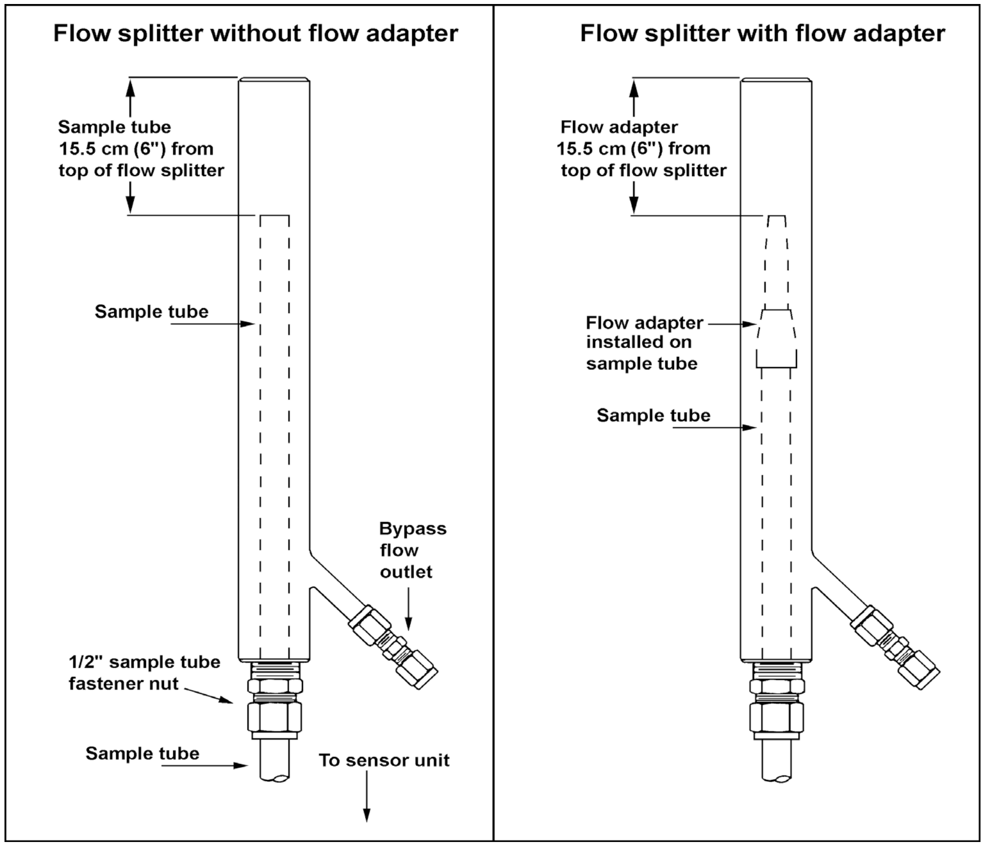
2.4.1. Flow Splitter Assembly

An isokinetic flow splitter (Figures 2-37 and 2-38) is used in combination with a second automatic flow controller to divide the sample flow into two components after the air stream passes through the size-selective inlet. The two sample flow components are the main flow (3 l/min) that flows to the TEOM mass transducer, and the auxiliary (or bypass) flow (13.67 l/min) that is maintained by the second flow controller. The flow splitter should be located directly below the sample inlet (Figure 2-1). Optional flow adapters allow system operation at a 1 or 2 l/min main flow rate in areas with elevated particulate matter concentration. Units equipped with a 1 or 2 l/min flow adapter operate at main flow rate of 1 or 2 l/min and auxiliary flow rate of 15.67 or 14.67 l/min, respectively.

If a 2 l/min flow adapter is installed in the Series 1400a system, replace all references in this manual to a 3 l/min main flow with 2 l/min, and all references to a 13.67 l/min auxiliary flow with 14.67 l/min. Likewise, for monitors equipped with the 1 l/min flow adapter, replace all references in this manual to a 3 l/min main flow with 1 l/min, and all references to a 13.67 l/min flow with 15.67 l/min.

Figure 2-37. Flow splitter.

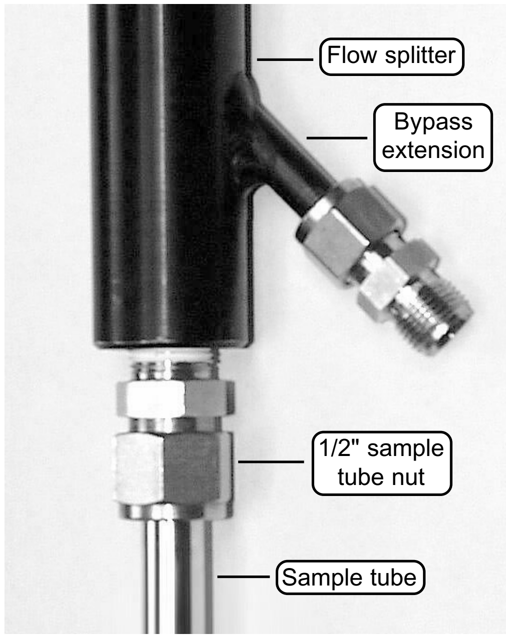
Figure 2-38. Flow splitter with and without a flow adapter installed.



Follow these steps to set up a flow splitter assembly:

1) **Locate the flow splitter (Figure 2-37).**
2) **If you will be installing a flow adapter onto the flow splitter, go to step 3. If you will not be installing a flow adapter onto the flow splitter, go to step 10.**
3) **Loosen the 1/2" sample tube nut at the base of the flow splitter (Figure 2-39).**

Figure 2-39. Close-up view of bottom of flow splitter.

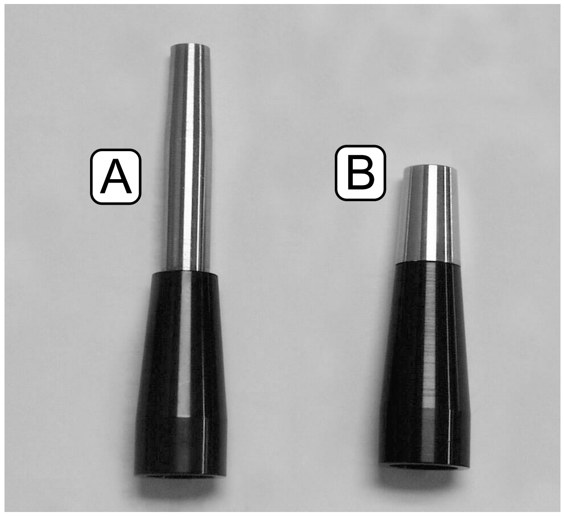


4) Slide the sample tube that is located inside the flow splitter up until it protrudes above the top of the flow splitter (Figure 2-40).

Figure 2-40. Sample tube positioned above the top of the flow splitter.

5) Locate the appropriate size flow adapter (1 or 2 l/min) (Figure 2-41).

Figure 2-41. 1 l/min (A) and 2 l/min (B) flow adapters.



6) **Install the flow adapter onto the protruding end of the sample tube (Figure 2-42).**

Figure 2-42. 1 l/min flow adapter installed on the sample tube.

7) **Push the flow adapter firmly onto the sample tube until it hits a stop. Ensure that you push it past the O-ring that is located inside of the flow adapter.**

8) **Slide the sample tube down into the flow splitter so that the top of the installed flow adapter is 15.5 cm (6") from the top of the flow splitter (Figure 2-43).**

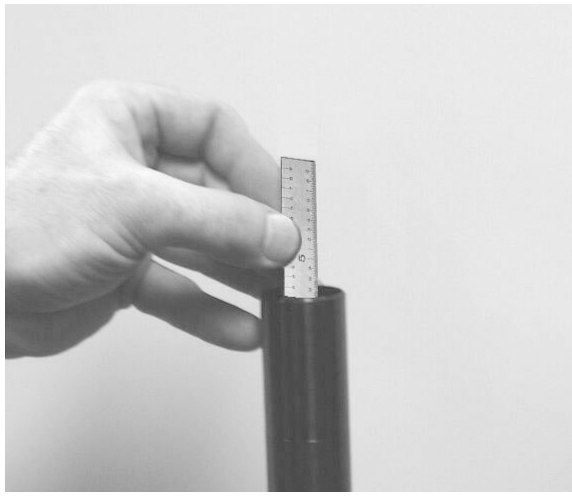


Figure 2-43. Measuring the distance from the top of the flow adapter or sample tube to the top of the flow splitter.

9) Tighten the 1/2" sample tube nut. Ensure that the top of the flow adapter remains 15.5 cm (6") from the top of the flow splitter (Figure 2-43). You have now completed this procedure.

10) Ensure that the top of the sample tube (inside of the flow splitter) is 15.5 cm (6") from the top of the flow splitter (Figure 2-43). If the top of the sample tube is 15.5 cm (6") from the top of the flow splitter, you have completed this procedure. If the top of the sample tube is not 15.5 cm (6") from the top of the flow splitter, go to step 11.

11) Loosen the 1/2" sample tube nut at the base of the flow splitter (Figure 2-39).

12) Slide the sample tube that is located inside the flow splitter up or down until it is 15.5 cm (6") from the top of the flow splitter (Figure 2-43).

13) Tighten the 1/2" sample tube nut at the base of the flow splitter. You have now completed this procedure.

14) You must now assemble the tripod (Section 2.4.2).

2.4.2. Tripod Assembly

Follow these steps to install the tripod assembly onto the roof:

1) Locate a tripod foot (Figure 2-44).

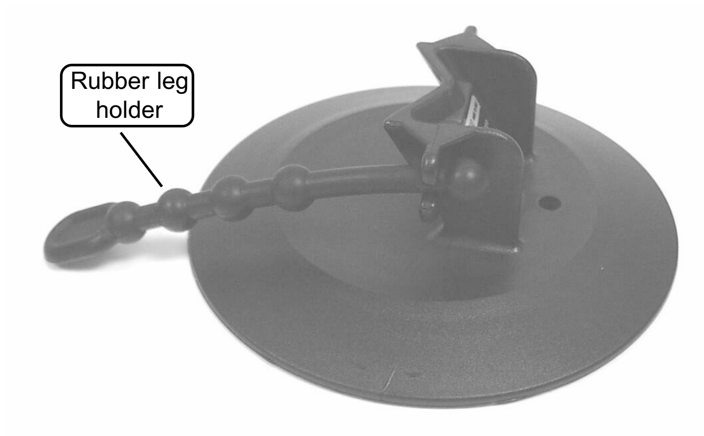


Figure 2-44. Tripod foot with rubber leg holder highlighted.

2) Pull off the rubber leg holder, if one is attached (Figure 2-45).

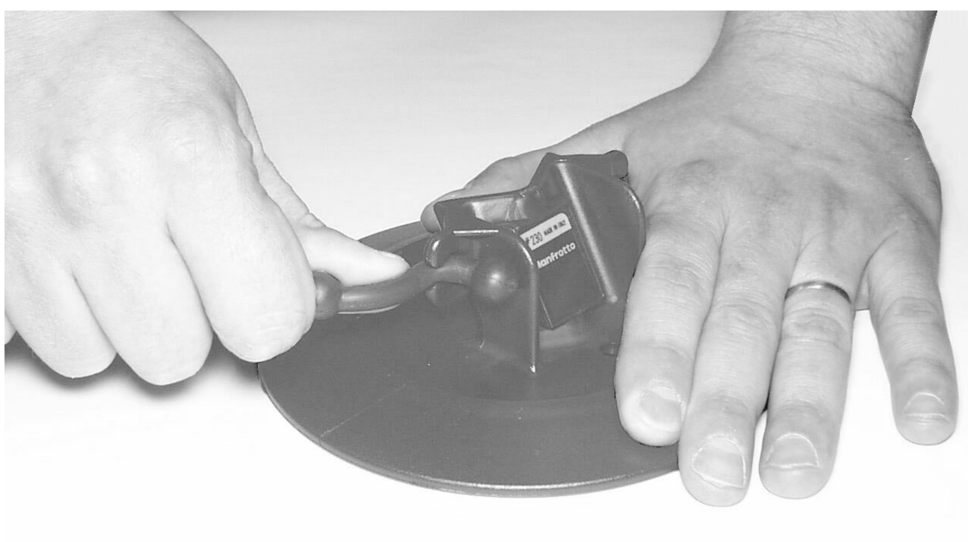


Figure 2-45. Removing the rubber leg holder.

3) Place one leg of the tripod onto the tripod foot.

4) Place a metal bracket over the rubber base of the tripod leg and into the 2 slots on the tripod foot (Figure 2-46).

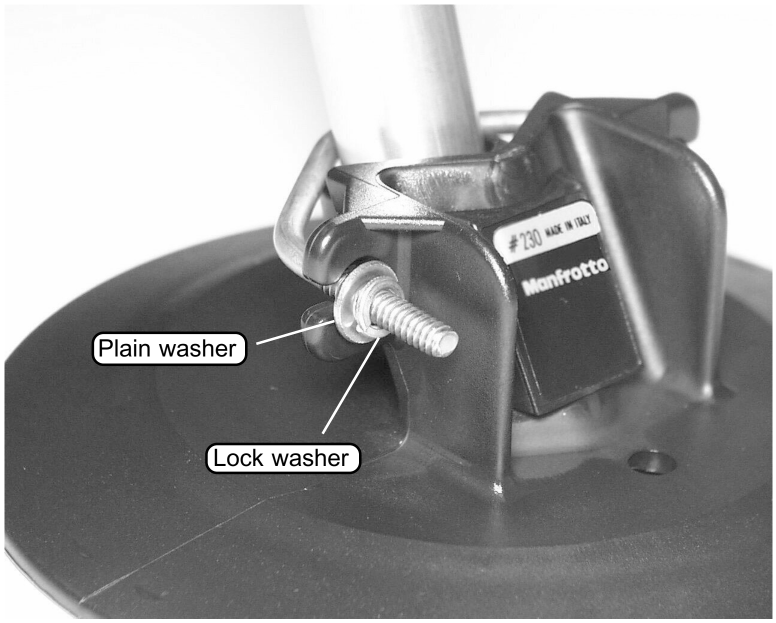
Figure 2-46. Placing the metal bracket on the tripod foot.

5) Ensure that the bracket is placed over the rubber base on the end of the tripod leg (Figure 2-47).

Figure 2-47. Proper placement of the metal bracket.

6) Insert a plain washer then a lock washer onto each threaded end of the bracket (Figure 2-48).

Figure 2-48. Washers placed on the metal bracket.



7) Install the nuts on the threaded ends of the bracket and tighten them with a 3/8" crescent wrench (Figure 2-49).

NOTE: Hand-tighten both nuts on the bracket before tightening them with the crescent wrench to ensure that the bracket is positioned properly on the tripod leg and tripod foot.

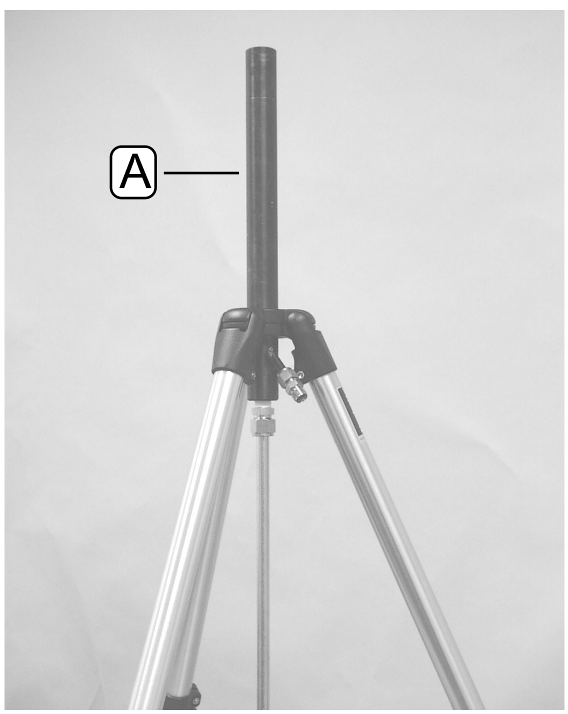
Figure 2-49. Tightening the metal bracket onto the tripod foot.

8) Repeat steps 1 through 7 for each leg of the tripod.

9) Slide the flow splitter up through the center hole of the tripod (Figures 2-50 and 2-51).

Figure 2-50. Center hole of the tripod with the holding ring (A) and the tightening knob (B) highlighted.

Figure 2-51. Tripod with an installed flow splitter (A) highlighted.



10) Tighten the tripod's holding ring onto the flow splitter with the tightening knob (Figure 2-50).

11) Adjust the legs of the tripod (Figure 2-52) to position the open end of the flow splitter at a height of 1.5 m to 1.8 m above the roof.

Figure 2-52. Adjusting the legs on the optional support tripod.

12) Center the tripod over the roof opening.

13) Fasten the tripod feet to the roof with wood screws (Figure 2-53). The length and type of screws required to fasten the tripod feet to the roof depends upon the type of roof surface. The tripod feet also may be attached to a pallet or 3/4" marine plywood, with the pallet or plywood secured by concrete blocks or sand bags.

Figure 2-53. Screwing the tripod foot onto the roof surface.

14) You must now assemble the sampling system components (Section 2.4.3).

2.4.3. Sampling System Setup

Follow these steps to install the sampling system components onto the flow splitter:

1) **Cut a 4 cm (1 1/2") diameter hole in the roof of your monitoring site. If you will be installing your Series 1400a Monitor in an outdoor enclosure, refer to Appendix K for further instructions.**

2) **Place the ambient temperature sensor (Figure 2-54) on the roof of your monitoring site near the 4 cm diameter hole.**

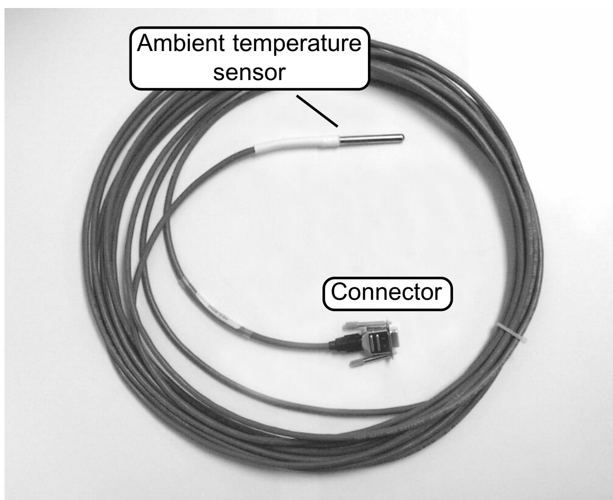


Figure 2-54. Ambient temperature sensor cable with ambient temperature sensor and connector highlighted.

3) **Run the temperature sensor's cable through the 4 cm diameter hole and attach the cable's connector to the "AMBIENT TEMP" connection on the back of the control unit (Figure 2-55).**

   IMPORTANT: Be sure to connect the ambient temperature sensor's cable to the connector on the back of the control unit.

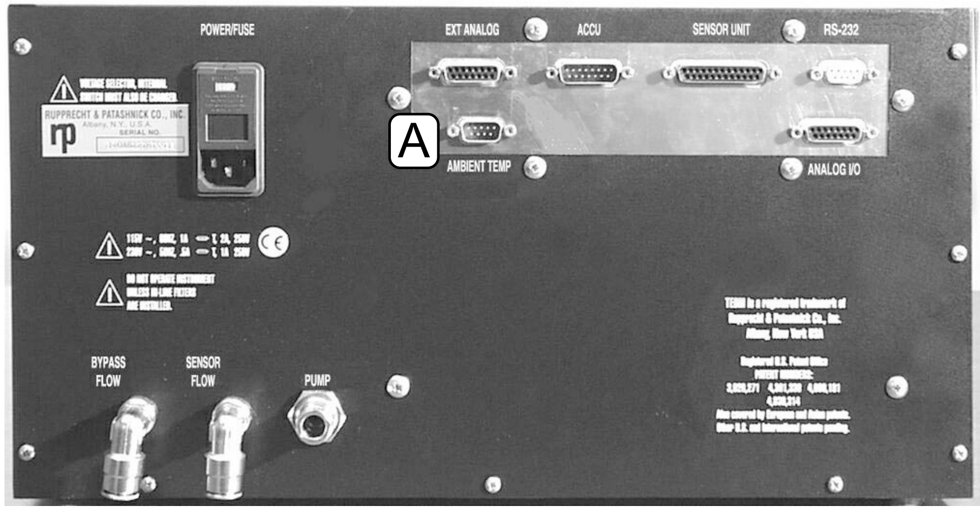


Figure 2-55. Back panel of TEOM control unit with the ambient temperature sensor connector (A) highlighted.

4) Run the green bypass flow tubing, that is connected to the BY-PASS FLOW connector on the back of the control unit, up through the 4 cm diameter hole in the roof.

5) Remove the fastening nut from the bypass extension (Figure 2-56) of the flow splitter.

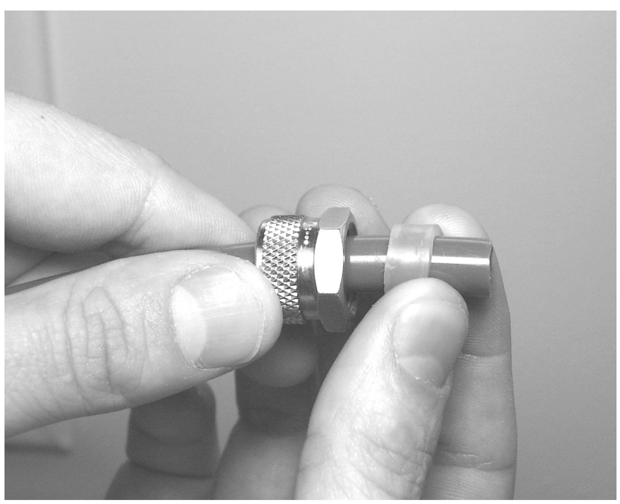
Figure 2-56. Removing the fastening nut from the bypass extension.

6) Remove the rubber ring from the bypass extension fastening nut (Figure 2-57).

Figure 2-57. Bypass extension fastening nut and rubber ring.

7) Install the bypass extension fastening nut onto the end of the green bypass tubing (Figure 2-58). Ensure that the knurled or bumpy side of the bypass extension fastening nut is directed down the green bypass tubing, toward the control unit.

Figure 2-58. Installing the bypass extension and rubber ring onto the green bypass tubing.



8) Install the rubber ring onto the end of the green bypass tubing (Figure 2-58). Ensure that the rubber ring is approximately 1/4-inch from the end of the green bypass tubing.

9) Insert the green bypass tubing into the bypass extension (Figure 2-59).

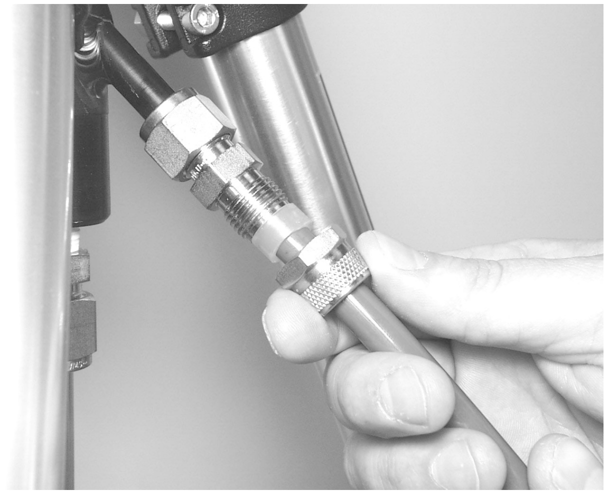


Figure 2-59. Installing the green bypass tubing onto the bypass extension.

10) Tighten the bypass extension fastening nut onto the bypass extension (Figure 2-60).

NOTE: If you are using an ACCU System with the monitor, refer to Section 14.

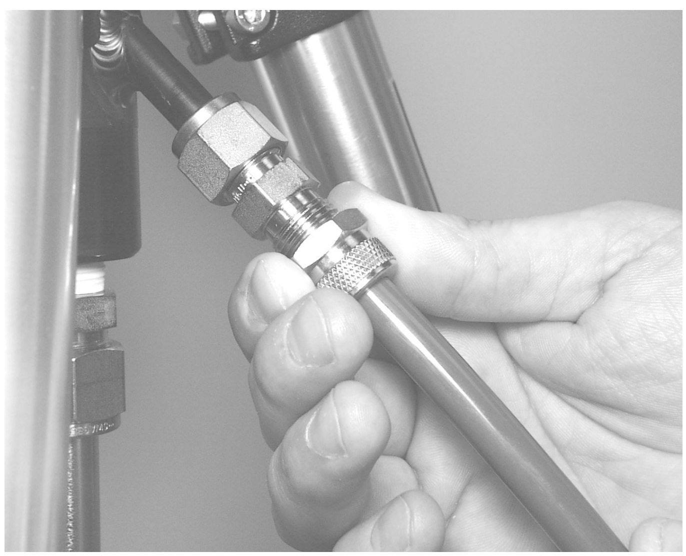


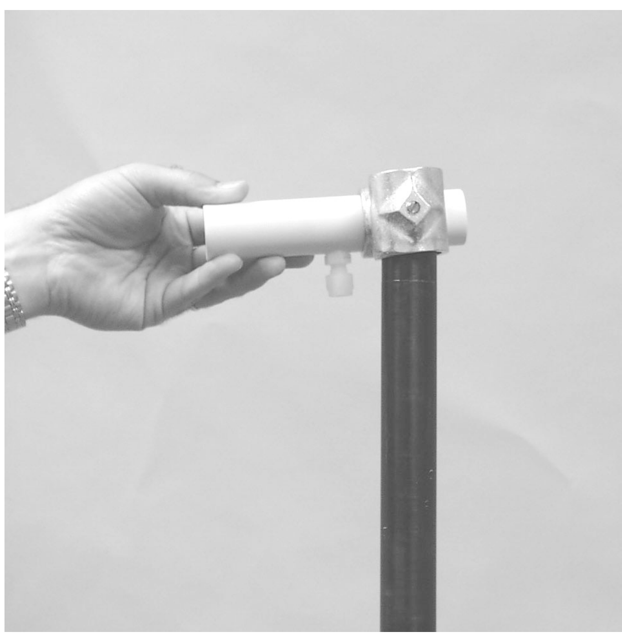
Figure 2-60. Tightening the fastening nut onto the bypass extension.

11) Locate the ambient temperature sensor mount (Figure 2-61).

Figure 2-61. Ambient temperature sensor mount.

12) Slide the ambient temperature sensor mount over the top of the flow splitter (Figure 2-62), or mount it to another suitable outdoor location.

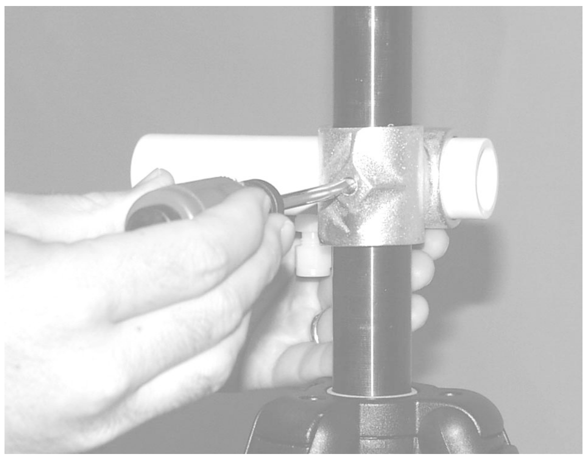
Figure 2-62. Ambient temperature sensor mount being installed onto the flow splitter.



13) Tighten the screw on the side of the ambient temperature sensor mount (Figure 2-63) with a flat-head screwdriver.

IMPORTANT: To avoid damaging the flow splitter, do not overtighten the ambient temperature sensor mount.

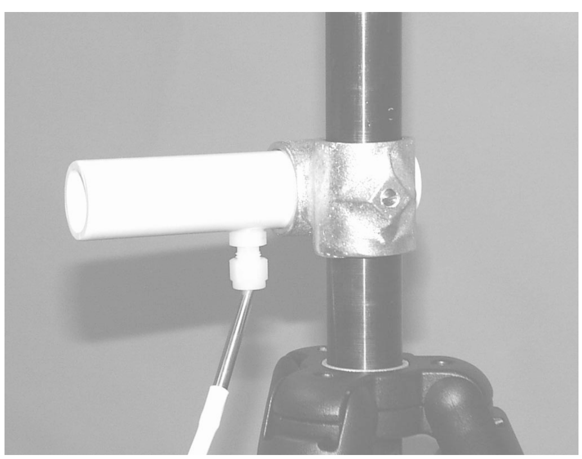
Figure 2-63. Fastening the ambient temperature sensor mount to the flow splitter.



14) Insert the ambient temperature sensor into the ambient temperature sensor mount (Figure 2-64).

IMPORTANT: Be sure to install the ambient temperature sensor when installing the Series 1400a Monitor.

Figure 2-64. Installing the ambient temperature sensor into the ambient temperature sensor mount.



15) Tighten the ambient temperature sensor holding nut to secure the ambient temperature sensor (Figure 2-65) inside the mount.

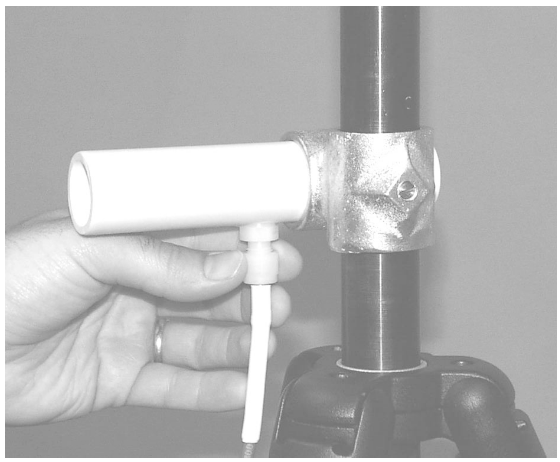


Figure 2-65. Tightening the ambient temperature sensor holding nut.

16) Weather seal the opening in the roof.

17) You must now assemble the sample tube (Section 2.4.4).

2.4.4. Sample Tube Assembly

Figure 2-66 displays the sample tube assembly section.

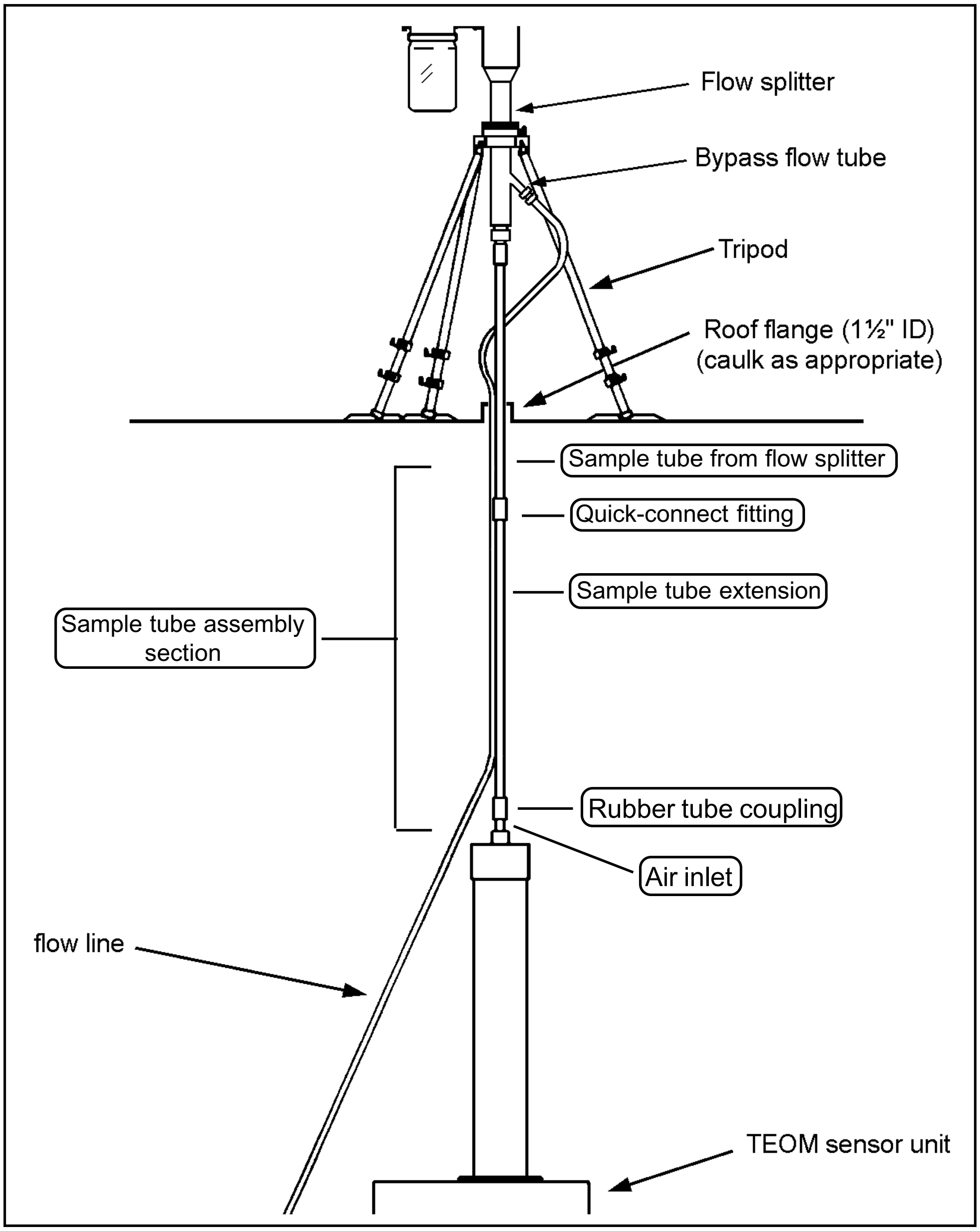


Figure 2-66. Schematic diagram of a typical PM-10 installation with the sample tube assembly section highlighted.

Follow these steps to connect the sample tube to the sensor unit:

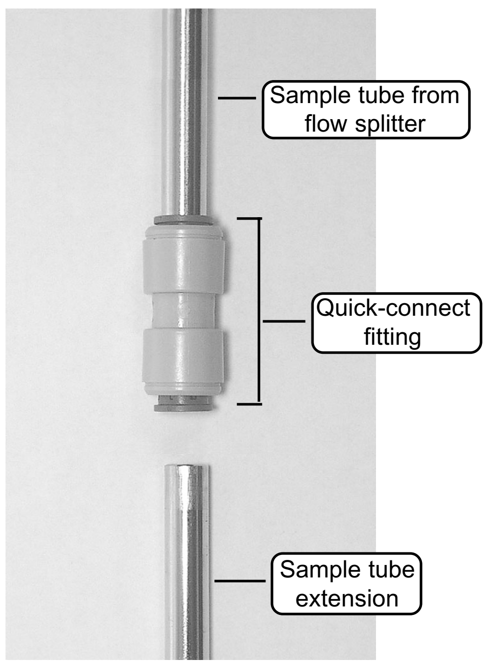
1) Locate a sample tube extension (Section 2.2).

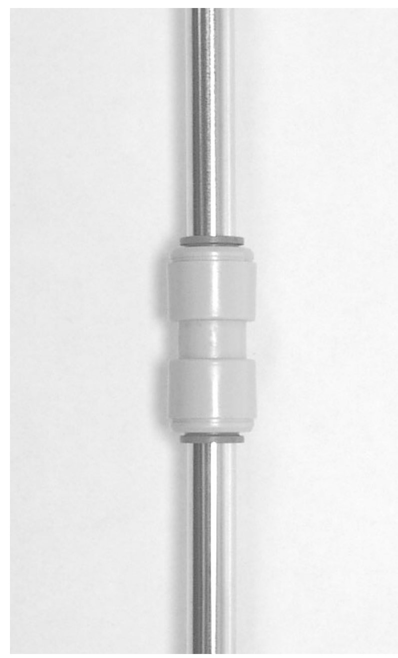
NOTE: Two 1-meter sample tube extensions are provided with the unit, but additional lengths can be purchased from R&P, if needed.

2) Locate the quick-connect fitting on the bottom of the sample tube of the flow splitter (Figure 2-67).

Figure 2-67 (left). Sample tube from flow splitter with the quick-connect fitting and sample tube extension highlighted.

Figure 2-68 (right). Sample tube from flow splitter with sample tube extension inserted into the quick-connect fitting.





3) Insert the sample tube extension into the quick-connect fitting on the bottom sample tube of the flow splitter (Figure 2-68). Use enough sample tube extensions to reach from the flow splitter to the air inlet on the top of the sensor unit (Figure 2-66). Use the shortest possible length of sample tube extension for best results. You may cut the sample tube extension as necessary; however, you must ensure that the cut ends of the sample tube extension are beveled and free of any sharp edges or burrs.

4) Position the end of the sample tube extension so that it is 2.5 cm (1") from the top of the sensor unit's air inlet. You may need to slide the flow splitter up or down inside the tripod to position the end of the sample tube extension so that it is 2.5 cm (1") above the air inlet.

5) Locate the rubber tube coupling (Figure 2-69).

6) Install the rubber tube coupling onto the end of the sample tube extension (Figure 2-69).

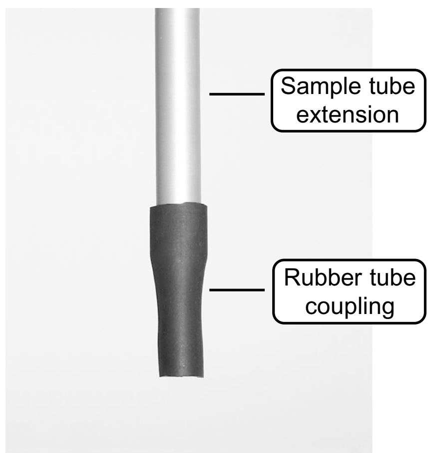


Figure 2-69. Installation of the tube coupling on the sample tube extension.

7) Install the other end of the rubber tube coupling onto the air inlet of the sensor unit (Figure 2-70).

IMPORTANT: The weight of the sampling system must not rest on the sensor unit.

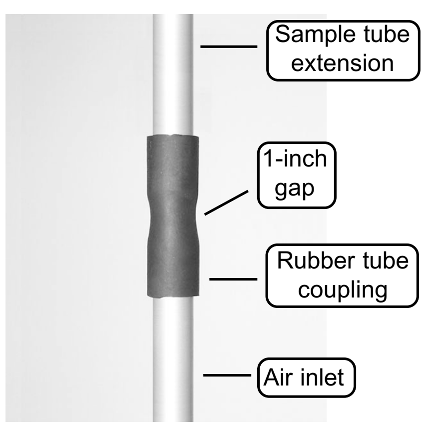


Figure 2-70. Proper installation of the rubber tube coupling between the air inlet of the sensor unit and the sample tube extension.

8) You must now install a sample inlet onto the flow splitter (Section 2.4.5.1).

2.4.5. Inlet Selection

The Series 1400a Monitor can be configured with a variety of inlet systems. This appendix describes the procedures for installing a sample inlet onto the sampling system setup (Section 2.4.5.1), and converting the Series 1400a Monitor from a PM-10 to a PM-1 monitor (Section 2.4.5.2), a PM-2.5 monitor (Section 2.4.5.3), or a total suspended particulate (TSP) monitor (Section 2.4.5.4). It also includes a statement regarding the TEOM monitor adjustment factor (Section 2.4.5.5).

NOTE: If your Series 1400a Monitor is configured for use as a PM-10 or PM-2.5 monitor with the original PM-10 inlet (Figure 2-71) and you are experiencing difficulties with rain intrusion, you can purchase the modified PM-10 inlet (Figure 2-72) from R&P (57-004742). This inlet substantially reduces the possibility of rain intrusion, and is installed in the same manner as the PM-10 inlet. Also, you can convert the original PM-10 inlet to a modified PM-10 inlet by using the PM-10 Inlet Conversion Kit (55-004747). Conversion instructions are included with the kit.

2.4.5.1. Installing a Sample Inlet

Follow these steps to install a sample inlet onto the sampling system setup:

1) Choose an appropriate sample inlet for your sampling needs (Figures 2-71, 2-72, 2-73, 2-74, 2-75 and 2-76).

Figure 2-71 (left). Original PM-10 inlet: 16.7 l/min.

Figure 2-72 (right). Modified PM-10 inlet: 16.7 l/min.

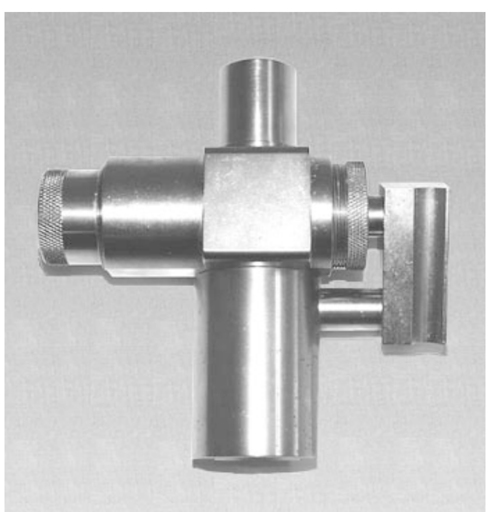


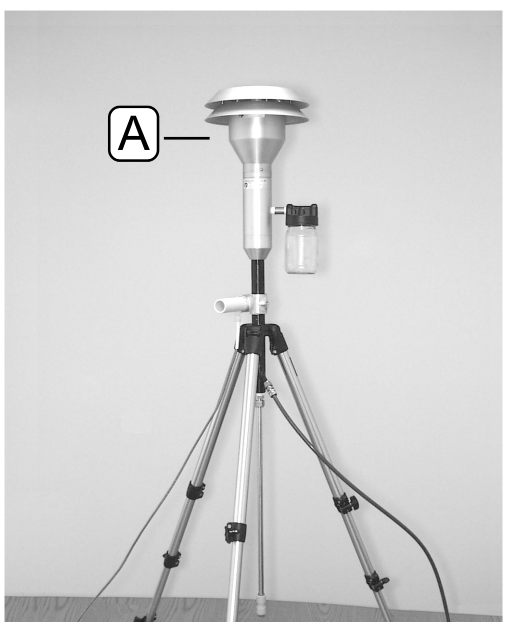
Figure 2-73 (left). Sharp cut cyclone (SCC) PM-2.5 second stage inlet: 16.7 l/min.

Figure 2-74 (right). Sharp cut cyclone (SCC) PM-1 second stage inlet: 16.7 l/min.

Figure 2-75 (left). Old style PM-1 inlet: 16.7 l/min.

Figure 2-76 (right). U.S. TSP inlet (16.7 l/min) installed onto a flow splitter.

2) Slide the sample inlet onto the top of the flow splitter until it stops (Figure 2-77). Ensure that the entrance to the sample inlet (Figure 2-78) is 1.8 to 2.1 m above the roof.



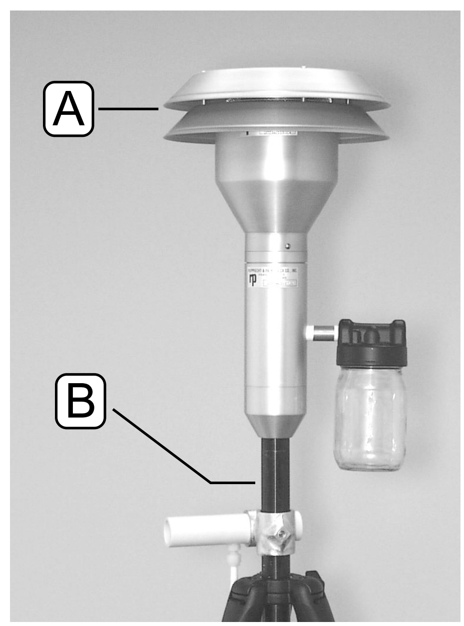


Figure 2-77 (left). Flow splitter with an installed modified PM-10 air inlet (A) highlighted.

Figure 2-78 (right). Modified PM-10 sample inlet installed onto a flow splitter (B) with the entrance to the sample inlet (A) highlighted.

3) Perform a leak check on the system (Section 3.4)

2.4.5.2. Converting from a PM-10 to a PM-1 Monitor

Follow these steps to convert the PM-10 Monitor to a PM-2.5 Monitor using the sharp cut cyclone (SCC) PM-1 second stage inlet:

1) Remove the PM-10 inlet from the top of the flow splitter by pulling it straight upward (Figure 2-79).

Figure 2-79. Removing the PM-10 inlet from the flow splitter.

2) Apply a small amount of silicone grease to the 2 O-rings inside of the base of the SCC PM-1 inlet (Figure 2-74).

3) Install the SCC PM-1 inlet onto the top of the flow splitter by pushing it straight down until it hits a stop.

4) Apply a small amount of silicone grease to the two O-rings inside of the base of the PM-10 inlet (Figure 2-71 or 2-72).

5) Install the PM-10 inlet onto the top of the SCC PM-1 inlet by pushing it straight down until it hits a stop.

6) The Series 1400a Monitor is now configured as a PM-1 monitor. There is no difference in monitor programming or operation with the SCC PM-1 second stage inlet installed.

2.4.5.3. Converting from a PM-10 to a PM 2.5 Monitor

Follow these steps to convert the PM-10 Monitor to a PM-2.5 Monitor using the sharp cut cyclone (SCC) second stage inlet:

1) **Remove the PM-10 inlet from the top of the flow splitter by pulling it straight upward (Figure 2-78).**
2) **Apply a small amount of silicone grease to the 2 O-rings inside of the base of the SCC PM-2.5 inlet (Figure 2-73).**
3) **Install the SCC PM-2.5 inlet onto the top of the flow splitter by pushing it straight down until it hits a stop.**
4) **Apply a small amount of silicone grease to the two O-rings inside of the base of the PM-10 inlet (Figure 2-71 or 2-72).**
5) **Install the PM-10 inlet onto the top of the SCC PM-2.5 inlet by pushing it straight down until it hits a stop (Figure 2-80).**

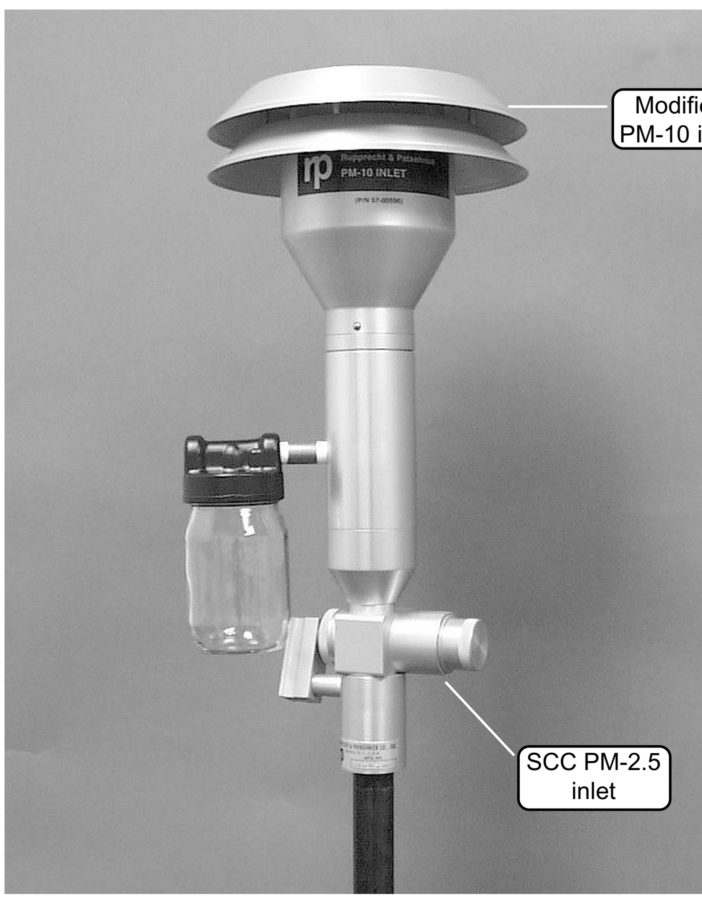


Figure 2-80. Modified PM-10 inlet installed onto a sharp cut cyclone (SCC) PM-2.5 inlet.

6) The Series 1400a Monitor is now configured as a PM-2.5 monitor. There is no difference in monitor programming or operation with the SCC PM-2.5 second stage inlet installed.

2.4.5.4. Converting from a PM-10 to a U.S. TSP Monitor

Follow these steps to convert the Series 1400a PM-10 monitor to a Series 1400a TSP monitor:

1) **Remove the PM-10 inlet from the top of the flow splitter by pulling it straight upward (Figure 2-79).**
2) **Apply a small amount of silicone grease to the two O-rings inside the base of the TSP inlet (Figure 2-76).**
3) **Install the TSP inlet onto the top of the flow splitter by pushing it straight down until it hits a stop (Figure 2-76).**
4) **The Series 1400a Monitor is now configured as a TSP monitor. There is no difference in monitor programming or operation with the TSP inlet installed.**

2.4.5.5. TEOM Monitor Adjustment Factors

The following statement refers to the variables designated “Const A” and “Const B” on the Set Hardware screen (Figure 2-81) of the Series 1400a Monitor.

Figure 2-81. Set Hardware screen.

```
      SET HARDWARE
Const A>          3.000
Const B           1.030
Soft Rate      0.000000
```

This statement also can be found on R&P’s website (www.rpco.com) under the Frequently Asked Questions (FAQ) area for the Series 1400a Monitor. Any new information regarding this issue also will be included in this area of the website.

To make an informed decision as to the choice of the TEOM monitor adjustment factors, it is important to understand the origin of the adjustment factors. The TEOM monitor makes a minor, empirically established adjustment to the mass concentration. This accounts for moisture equilibration differences reflected in the choice of filter media and equilibration thermodynamics used in manual and automated methodologies. This is done using the formula Y=A+Bx, where Y is the adjusted mass concentration, x is the unadjusted mass concentration, A (Const A) is the intercept factor and B (Const B) is the slope factor. The values of A and B must be set to their default values of 3.000 and 1.030, respectively, for the Series 1400a Monitor to be used as a U.S. EPA equivalent method for PM-10 measurements. These adjustment factors were determined at sites where nonvolatile particulate matter dominated and, therefore, the adjustment factors reflect the filter character more than they reflect the particulate matter.

For PM-2.5 measurements, it is justifiable to use the original constants (3.000 and 1.030), because the technical rationale may still apply. The other option is to use no adjustment for PM-2.5, by setting the constants to values of 0.000 (Const A) and 1.000 (Const B). In either case, the adjustment factors used may be revisited later as more information becomes available on the best approach. Because the adjustment is attained by a simple linear transformation, it is possible to recalculate the mass concentration values later based upon new information.

2.5. Housing the Instrument Outdoors

The instrument can be located outside of an air monitoring station if sufficient protection is provided from adverse weather conditions and enough ventilation is supplied to ensure cooling in the summer. An optional heated and air-conditioned Complete Outdoor Enclosure is available for housing the sensor unit, control unit and pump (Figure 2-82). The enclosure has room in its rack for a data logger, modem or other appropriately sized equipment.

The foundation for the outdoor enclosure should be sturdy. If the user wants to mount it on a roof, the support structure of the enclosure must be attached directly to the roof, rather than to auxiliary walkways or platforms. Contact R&P to purchase an enclosure and refer to Appendix K for instructions on setting up the Complete Outdoor Enclosure.

Figure 2-82. Complete Outdoor Enclosure with instrument installed.

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Section 3: Sample Preparation

This section explains how to install and replace sample filters, and discusses the length of the sample filter lifetime. The Series 1400a Monitor always must be operated with a filter installed in the mass transducer. Be sure to install a filter before applying power to the instrument. Also, this section explains how to turn on the instrument and perform a leak check.

3.1. Filter Replacement

✘ Do not handle TEOM filters with your fingers.

Do not handle new TEOM filters with your fingers. Use the filter exchange tool (Figure 3-1) provided with the instrument to replace filters.

3.1.1. First-Time Filter Installation

Follow these steps to install a TEOM filter before the first sampling run:

1) Ensure that the filter exchange tool (Figure 3-1) is clean and free of any contamination that might be transferred to the TEOM filter.

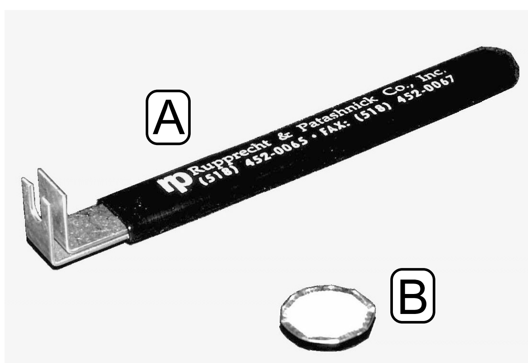


Figure 3-1. Close-up of the filter exchange tool (A) and a TEOM filter (B).

2) Open the door of the sensor unit (Figures 3-2 and 3-3).

Figure 3-2. TEOM sensor unit.

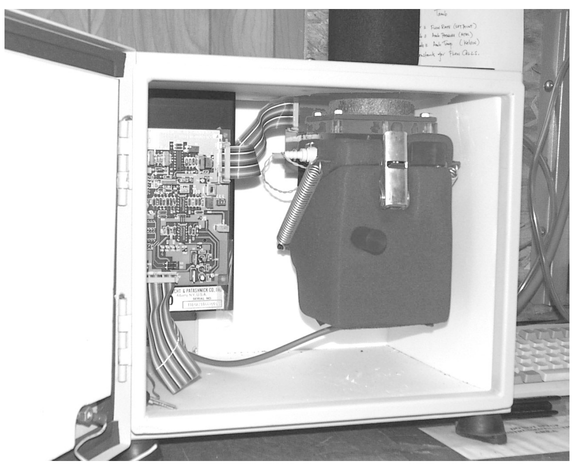


Figure 3-3. TEOM sensor unit with door open.

3) Locate the silver handle on the front of the mass transducer (Figure 3-4). Note that there is a shipping latch in the middle of this handle.

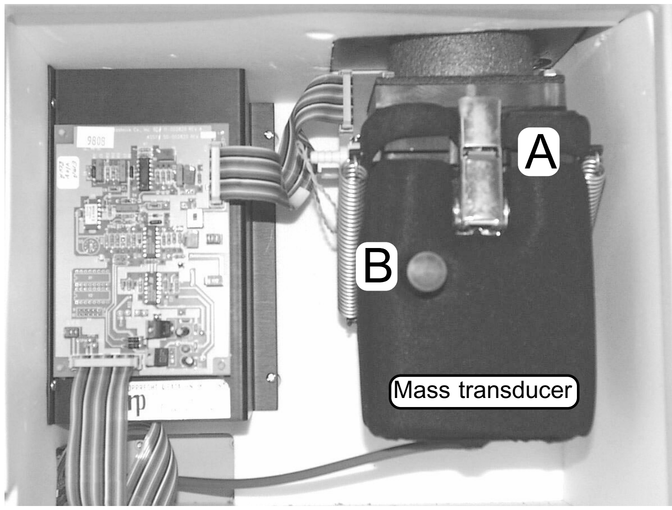


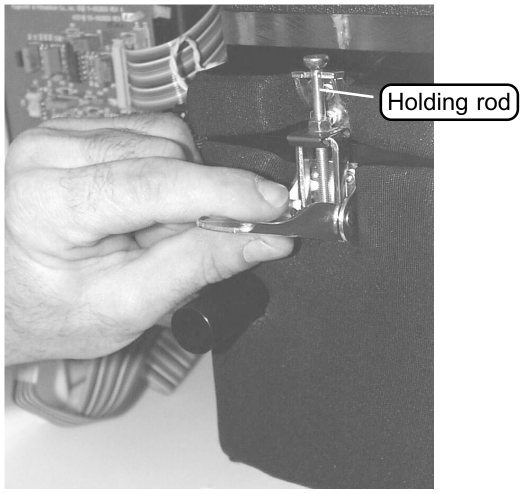
Figure 3-4. Mass transducer in the closed position with the silver handle (A) and black knob (B) highlighted.

4) Grasp the silver handle and move the shipping latch upward with your thumb (Figure 3-5).

Figure 3-5. Lifting the shipping latch on the silver handle.

5) Pull down on the silver handle (Figure 3-6).

Figure 3-6. Pulling the silver handle down.



6) Pull the holding rod off the latch plate (Figure 3-7).

Figure 3-7. Releasing the holding rod on the mass transducer.

7) With the mass transducer unlatched, grasp the black knob (Figure 3-4) and swing the bottom of the mass transducer downward, exposing the tapered element (TE) (Figure 3-8). An old TEOM filter may be already installed on the TE. Refer to Section 3.1.4 to remove this filter.

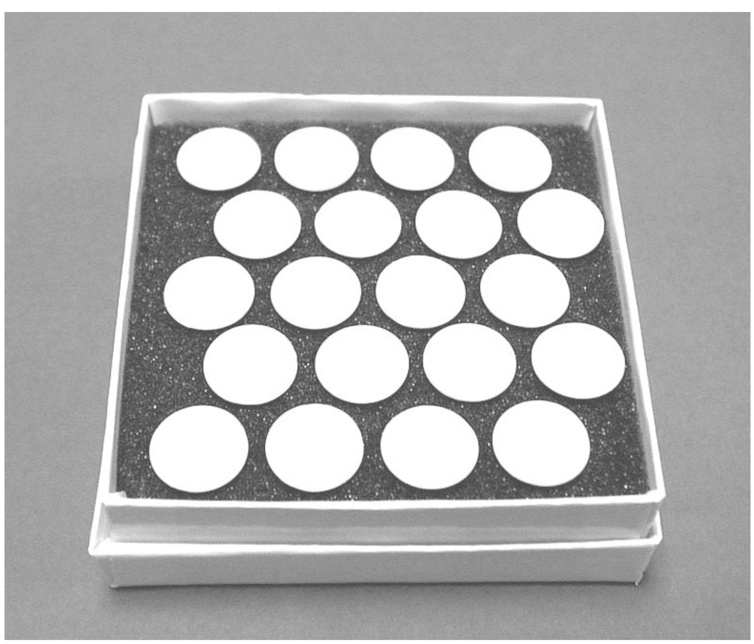
NOTE: If the control unit is operating (power is applied to the control unit) when you open the mass transducer, the tapered element (TE) will automatically stop oscillating.

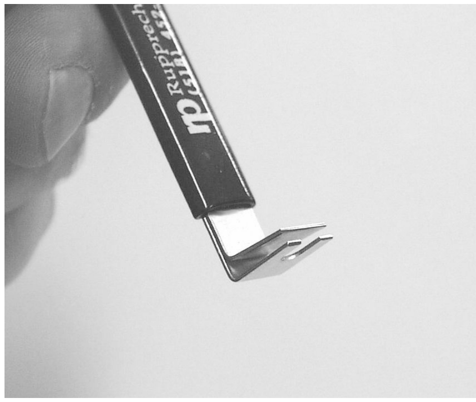
Figure 3-8. Opening the mass transducer.

✘ Do not handle TEOM filters with your fingers.

8) Pick up a new TEOM filter from the box of filters (Figure 3-9) with the filter exchange tool (Figure 3-1) so that the filter disk lies between the fork and the upper tab of the tool and the hub of the filter lies between the tines of the fork (Figures 3-10 and 3-11). Do not touch the filter with your fingers while picking it up with the filter exchange tool.

Figure 3-9. TEOM filters.





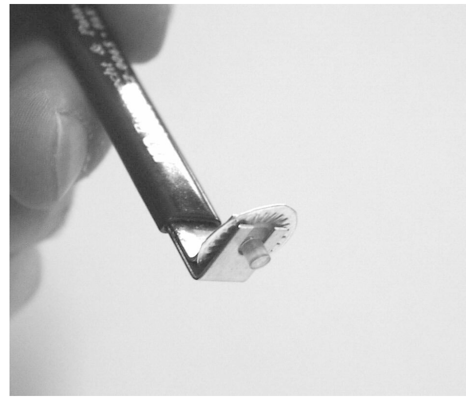


Figure 3-10 (left). Close-up of the filter exchange tool.

Figure 3-11 (right). Close-up of the filter exchange tool holding a TEOM filter.

9) Hold the filter exchange tool in line with the tapered element (Figures 3-12 and 3-13) and lightly place the hub of the filter onto the tip of the tapered element.

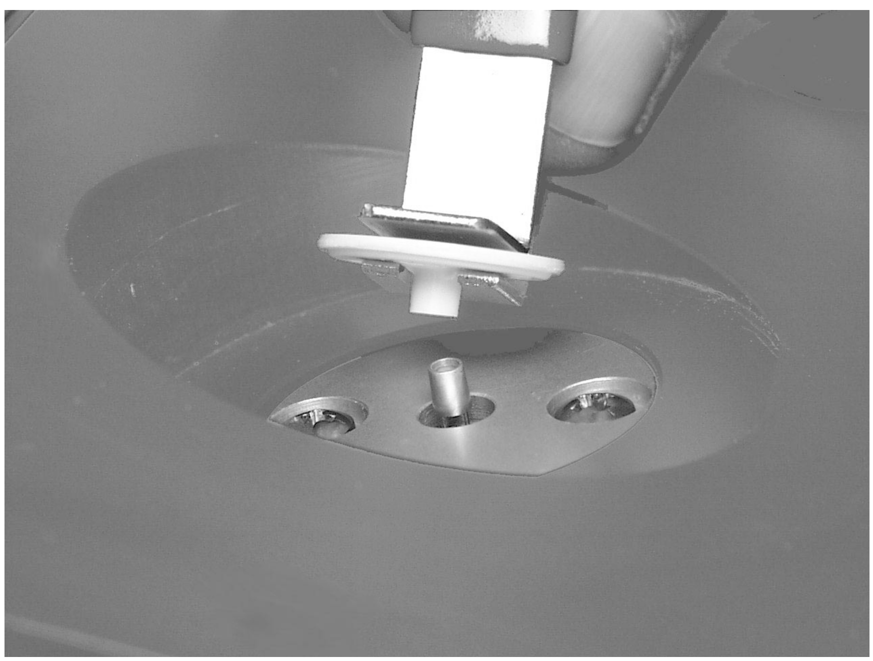
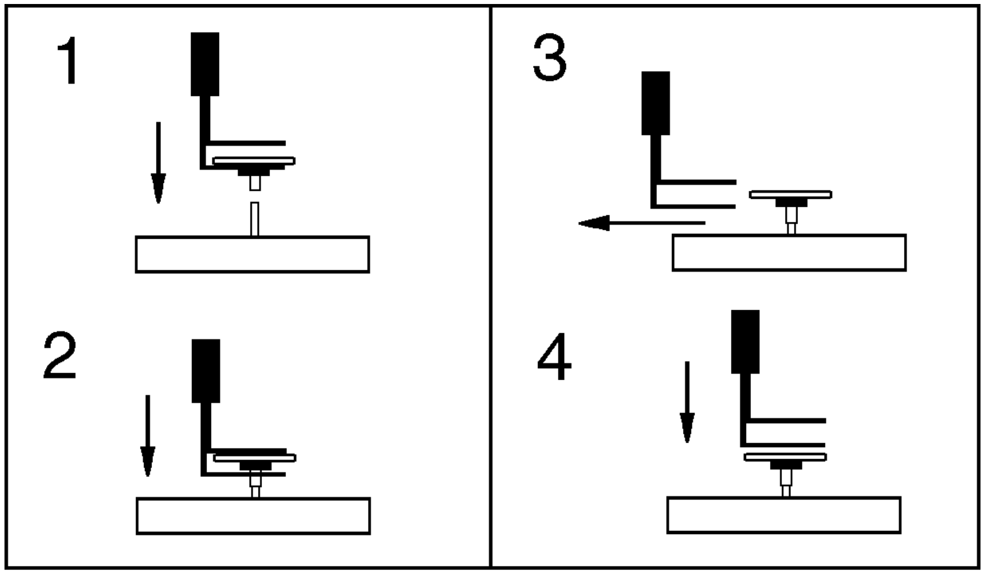


Figure 3-12. Holding the filter exchange tool in line with the tapered element.

Figure 3-13. Filter installation.



10) Gently press down on the filter to ensure that it is seated properly (Figure 3-13).

11) Remove the filter exchange tool by slowly retracting it sideways until it clears the filter (Figure 3-13). Do not disturb the filter.

12) Place the bottom of the filter exchange tool on top of the filter (Figures 3-13) and apply downward pressure (approximately 0.5 kg or 1 lb) to seat the filter firmly in place.

13) Raise the mass transducer to the closed position using the black knob.

14) Fasten the holding rod onto the latch plate.

15) Push the silver handle up until the shipping latch snaps into place.

16) Close and latch the door to the sensor unit. Keep the door open for as short a time as possible to minimize the temperature change in the system.

17) Supply power to the instrument at the appropriate voltage (Section 2.3.1).

18) Press the "POWER" switch on the front panel of the control unit (Figure 3-14). The Title screen will appear on the control unit's four-line display (Figure 3-15). After a moment, the Main screen (Figure 3-16) will display.

Figure 3-14. Control unit with the “POWER” button (A) highlighted.

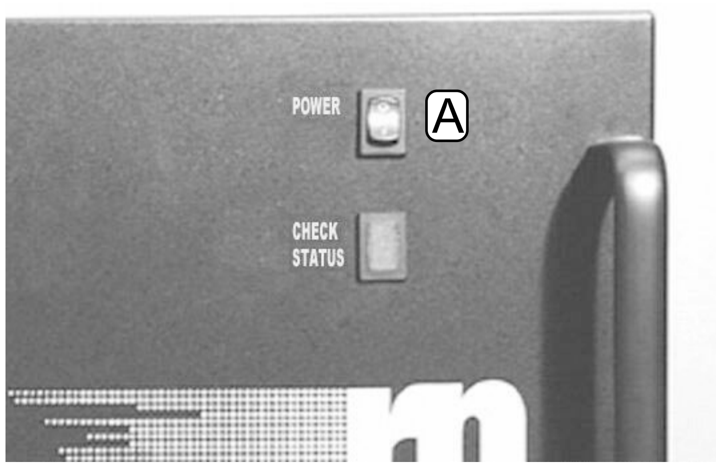


Figure 3-15. Title screen.

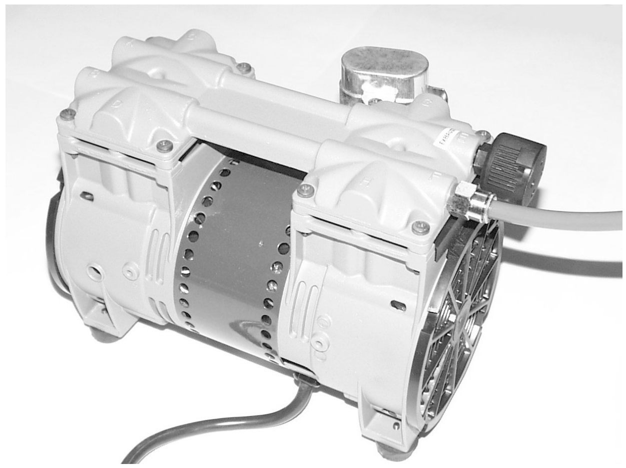
```
   Series 1400a Monitor

      Copyright 2001
  Rupprecht + Patashnick
```

Figure 3-16. Main screen.

```
OK     4+  11%  NU     09:39
Mass Conc>              33.6
30-Min MC               26.8
01-Hr MC                12.5
```

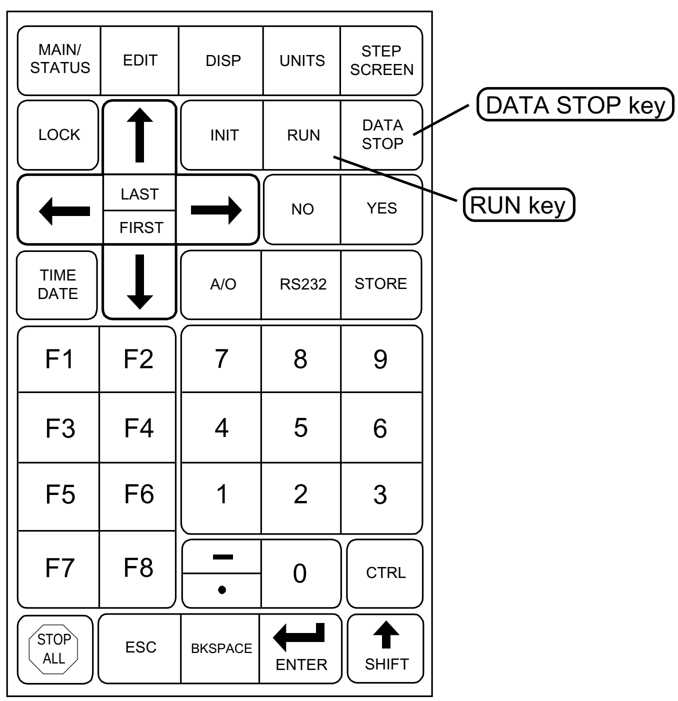
19) Plug the pump (Figure 3-17) into an appropriate power source to draw a sample stream through the system.

Figure 3-17. Sample air pump.



20) Press the <DATA STOP> key on the control unit's keypad (Figure 3-18).

Figure 3-18. TEOM control unit keypad.



21) Reset the unit by pressing <F1> or <RUN> on the control unit's keypad.

22) Wait 5 minutes to allow the temperatures to stabilize inside the transducer and sensor unit.

23) Press the <DATA STOP> key on the control unit's keypad.

24) Open the door of the sensor unit.

25) Open the mass transducer.

26) Press straight down on the filter with the bottom of the filter exchange tool (Figure 3-13). This ensures that the filter is properly seated after it has experienced an increase in temperature.

27) Close the mass transducer and sensor unit door.

28) Reset the unit by pressing <F1> or <RUN> on the control unit's keypad.

29) Wait 5 minutes.

30) Look at the change in the TE's oscillating frequency on the Main screen of the control unit (Figure 3-19). The last two digits of the reading will fluctuate (due to noise) and the rest will remain steady. If more than the last two digits fluctuate in this reading, this indicates that the TEOM filter is loose. Repeat steps 23-30 to re-seat the filter.

Figure 3-19. Main screen with the TEOM tapered element (TE) oscillating frequency highlighted.

```
OK     4+    15%   NU   09:39
Aux Flow                13.66
Noise                   0.034
Frequency           187.05705
```

Oscillating frequency

3.1.2. Routine Filter Installation

Follow these steps to install a filter:

1) **Ensure that the filter exchange tool (Figure 3-1) is clean and free of any contamination that might be transferred to the TEOM filter.**
2) **Press the "POWER" switch to turn on the control unit (Figure 3-14).**
3) **Press the <DATA STOP> key on the control unit's keypad (Figure 3-18).**
4) **Open the door of the sensor unit (Figures 3-2 and 3-3).**
5) **Locate the silver handle on the front of the mass transducer (Figure 3-4). Note that there is a shipping latch in the middle of this handle.**
6) **Grasp the silver handle and move the shipping latch upward with your thumb (Figure 3-5).**
7) **Pull down on the silver handle (Figure 3-6).**
8) **Pull the holding rod off the latch plate (Figure 3-7).**

✔ Keep the door to the TEOM sensor unit open for as short a time as possible to minimize the temperature change in the system.

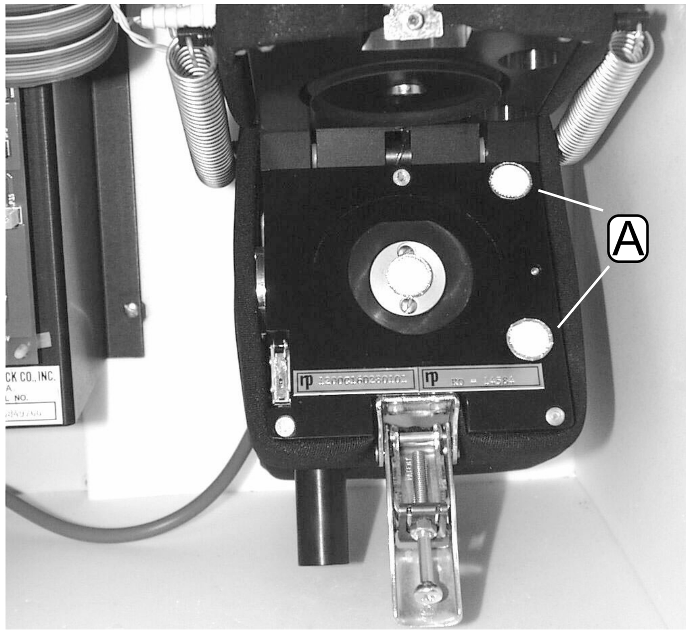
9) **With the mass transducer unlatched, grasp the black knob (Figure 3-4) and swing the bottom of the mass transducer downward, exposing the tapered element (TE) (Figure 3-8). An old TEOM filter may be already installed on the TE. Refer to Section 3.1.4 to remove this filter.**

   NOTE: If the control unit is operating (power is applied to the control unit) when you open the mass transducer, the tapered element (TE) will automatically stop oscillating.

✘ Do not handle TEOM filters with your fingers.

10) **Pick up a new, conditioned filter (Section 3.1.3) from one of the filter holders (Figure 3-20) with the filter exchange tool (Figure 3-1) so that the filter disk lies between the fork and the upper tab of the tool and the hub of the filter lies between the tines of the fork (Figures 3-10 and 3-11). Do not touch the filter with your fingers while picking it up with the filter exchange tool.**

Figure 3-20. Open mass transducer with extra filters in the filter holders (A) highlighted.



11) Hold the filter exchange tool in line with the tapered element (Figures 3-12 and 3-13) and lightly place the hub of the filter onto the tip of the tapered element.

12) Gently press down on the filter to ensure that it is seated properly (Figure 3-13).

13) Remove the filter exchange tool by slowly retracting it sideways until it clears the filter (Figure 3-13). Do not disturb the filter.

✔ Keep the door to the TEOM sensor unit open for as short a time as possible to minimize the temperature change in the system.

14) Place the bottom of the filter exchange tool on top of the filter (Figures 3-13) and apply downward pressure (approximately 0.5 kg or 1 lb) to seat the filter firmly in place.

15) Raise the mass transducer to the closed position using the black knob.

16) Fasten the holding rod onto the latch plate.

17) Push the silver handle up until the shipping latch snaps into place.

18) Close and latch the door to the sensor unit. Keep the door open for as short a time as possible to minimize the temperature change in the system.

19) Reset the unit by pressing <F1> or <RUN> on the control unit's keypad.

20) Wait 5 minutes to allow the temperatures to stabilize inside the transducer and sensor unit.

21) Press the <DATA STOP> key on the control unit's keypad.

22) Open the door of the sensor unit.

23) Open the mass transducer.

24) Press straight down on the filter with the bottom of the filter exchange tool (Figure 3-13). This ensures that the filter is properly seated after it has experienced an increase in temperature.

25) Close the mass transducer and sensor unit door.

26) Reset the unit by pressing <F1> or <RUN> on the control unit's keypad.

27) Wait 5 minutes.

28) Look at the change in the TE's oscillating frequency on the Main screen of the control unit (Figure 3-19). The last two digits of the reading will fluctuate (due to noise) and the rest will remain steady. If more than the last two digits fluctuate in this reading, this indicates that the TEOM filter is loose. Repeat steps 21-28 to re-seat the filter.

3.1.3. Filter Pre-Conditioning

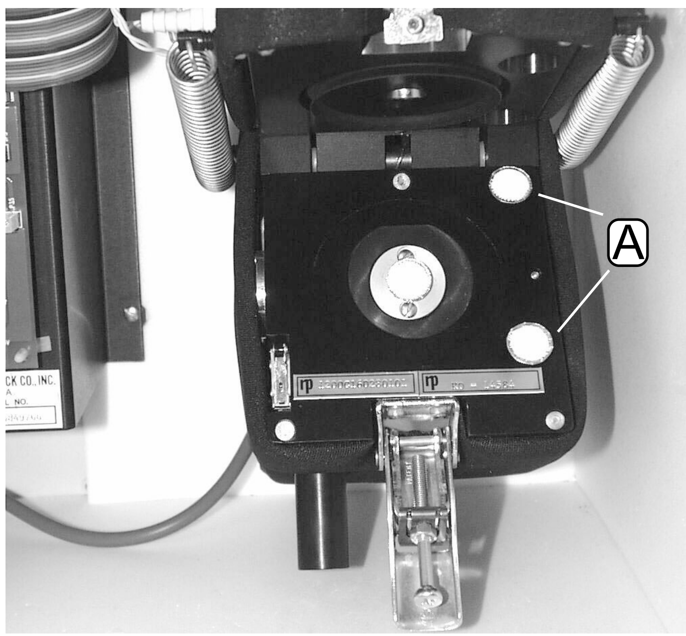
TEOM filters must be preconditioned to avoid excessive moisture buildup prior to their use in the system.

✔ Use the two holders on the right side of the mass transducer (inside) to store the next two TEOM filters to be used.

Follow these steps to precondition the TEOM filters:

1) Place two filters on the filter holders of the mass transducer (Figure 3-21) to condition the filters.

Figure 3-21. Open mass transducer with extra filters in the filter holders (A) highlighted.



✘ Do not handle TEOM filters with your fingers.

2) When it is time to install a new filter, use a conditioned filter from one of the filter holders.

3) Replace the conditioned filter that was on the filter holder with a new filter.

3.1.4. Filter Removal

Follow these steps to remove a filter:

✔ Keep the door to the TEOM sensor unit open for as short a time as possible to minimize the temperature change in the system.

✘ Do not handle TEOM filters with your fingers.

1) **Turn on the sample pump by plugging it into an appropriate power source (Figure 3-17).**
2) **Press the “POWER” switch to turn on the control unit (Figure 3-14).**
3) **Press the <DATA STOP> key on the control unit’s keypad (Figure 3-18).**
4) **Open the door of the sensor unit (Figures 3-2 and 3-3).**
5) **Locate the silver handle on the front of the mass transducer (Figure 3-4). Note that there is a shipping latch in the middle of this handle.**
6) **Grasp the silver handle and move the shipping latch upward with your thumb (Figure 3-5).**
7) **Pull down on the silver handle (Figure 3-6).**
8) **Pull the holding rod off of the latch plate (Figure 3-7).**
9) **With the mass transducer unlatched, hold the black knob (Figure 3-4) and swing the bottom of the mass transducer downward, exposing the filter (Figure 3-8). When the mass transducer is in the open position, the tapered element (TE) will automatically stop oscillating.**
10) **Carefully insert the lower fork of the filter exchange tool (Figures 3-22 and 3-23) under the filter so that the filter disk is between the fork and the upper tab of the filter exchange tool (Figures 3-23 and 3-24). The tines of the fork should straddle the hub of the filter base.**

    NOTE: TEOM filters must be preconditioned to avoid excessive moisture buildup prior to their use in the system (Section 3.1.3).

Figure 3-22. Removing a TEOM filter.

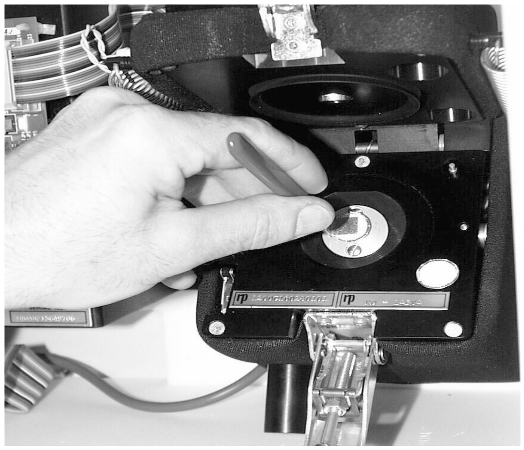


Figure 3-23. Filter removal.

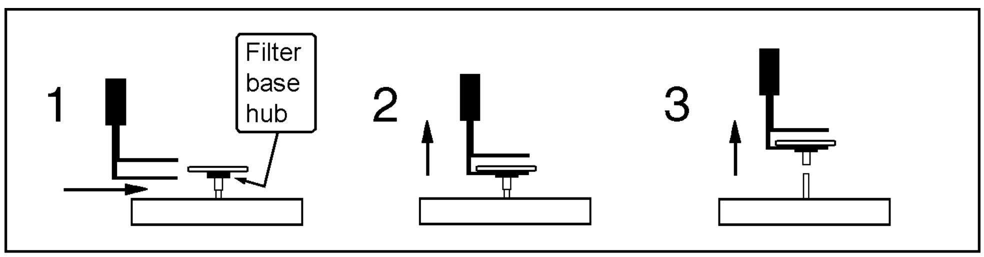
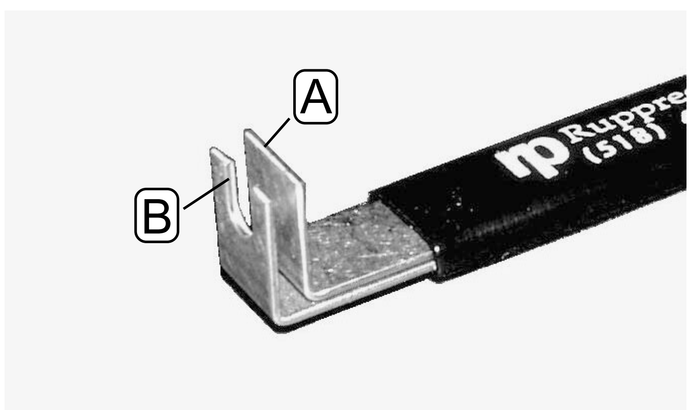


Figure 3-24. Close-up of the filter exchange tool with the upper tab (A) and the fork (B) highlighted.



11) Gently pull straight up, lifting the filter from the tapered element (TE) (Figure 3-23). Do not twist or tilt the filter exchange tool from side-to-side while removing the filter from the TE. This will damage the TE.

3.2. Filter Loading

The filter loading percentage value indicates the fraction of the TEOM filter's total capacity that has been used. You can check the filter loading percentage on the monitor's Main screen (Figure 3-25). Because this value is determined by the pressure drop of the main sample flow line, the instrument always shows a non-zero value even if no filter is mounted in the mass transducer. New filters generally exhibit filter loading percentages of 15% to 30% at a main flow rate of 3 l/min, and less at lower flow rates.

Filter loading percentage

```
OK     4+  11%  NU     09:39
Mass Conc>              33.6
30-Min MC               26.8
01-Hr MC                12.5
```

Figure 3-25. Main screen with filter loading percentage highlighted.

TEOM filters must be replaced before the filter loading percentage reaches 100% to ensure the validity of the data generated by the instrument (Figure 3-26). At some point above 100%, the main flow drops below its setpoint.

Status condition — Filter loading percentage

```
X      4+  91%  NU   09:39
Mass Conc>            33.6
30-Min MC             26.8
01-Hr MC              12.5
```

Figure 3-26. Main screen showing that filter replacement is required.

If the filter loading percentage is higher than 30% (at a main flow rate of 3 l/min) when a new TEOM filter is placed on the mass transducer, or if the lifetime of consecutive TEOM filters becomes noticeably shorter, you may need to replace the in-line filter in the main flow line (Section 12).

Testing performed for official U.S. EPA PM-10 measurements must be conducted with TEOM filters (Section 2.2) made of Teflon-coated, glass-fiber filter paper. Filters should be stored inside the sensor unit for easy access and to keep them dry and warm (Section 3.1.3).

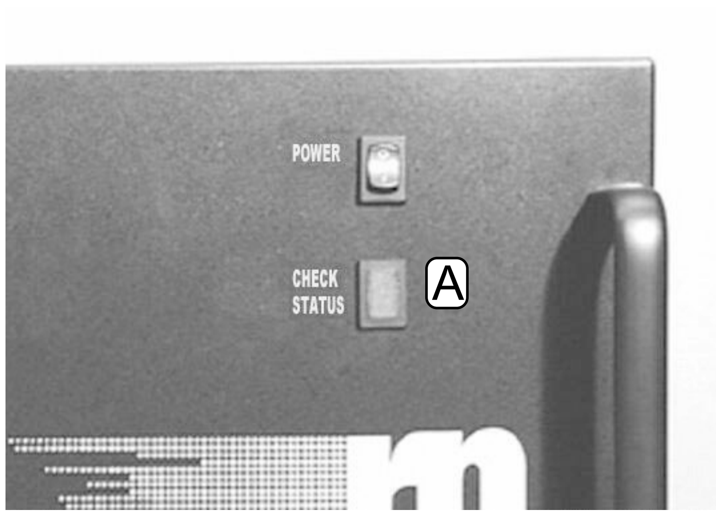
3.2.1. Filter Life

Filter life depends upon the nature and concentration of the particulate matter sampled, as well as the main flow rate setting. TEOM filters must be replaced when the filter loading value approaches 100%. This generally corresponds to a total mass accumulation on the filter of approximately 3-5 mg. Filter life at a main flow rate of 3 l/min is generally 21 days at an average PM-10 concentration of 50 µg/m^3. Filter life is longer at lower flow rates because the particulate matter accumulation on the filter is slower. Flow splitter adapters (Section 2) for 1 l/min and 2 l/min operation can be used in areas with elevated particulate matter concentrations or where a longer filter life is required.

3.2.2. When to Replace TEOM Filters

TEOM filters must be replaced before the filter loading percentage on the status line of the Main screen reaches 100%. When the filter loading percentage is greater than 90%, the "CHECK STATUS" light (located below the "POWER" button on the front of the TEOM control unit) (Figure 3-27) lights up and the status condition code (Section 7) on the status line of the Main screen changes from "OK" to "X" (Figure 3-26).

Figure 3-27. Control unit with the "CHECK STATUS" light (A) highlighted.



If you operate your unit at a main flow rate of less than 3 l/min, your instrument's filter loading percentage may not reach 90% on the Main screen even though the filter is loaded beyond 90%. In this case, the user should replace the TEOM filter every 14-21 days to avoid exceeding the filter's maximum capacity.

3.3. Turning On the Series 1400a Monitor

Follow these steps to turn on the monitor:

1) **Supply power to the instrument at the appropriate voltage (Section 2.3.1).**
2) **Press the "POWER" switch on the front panel of the control unit (Figure 3-28). The Title screen will appear on the control unit's display (Figure 3-29). After a moment, the Main screen (Figure 3-30) will display.**

Figure 3-28. Control unit with the "POWER" button (A) highlighted.

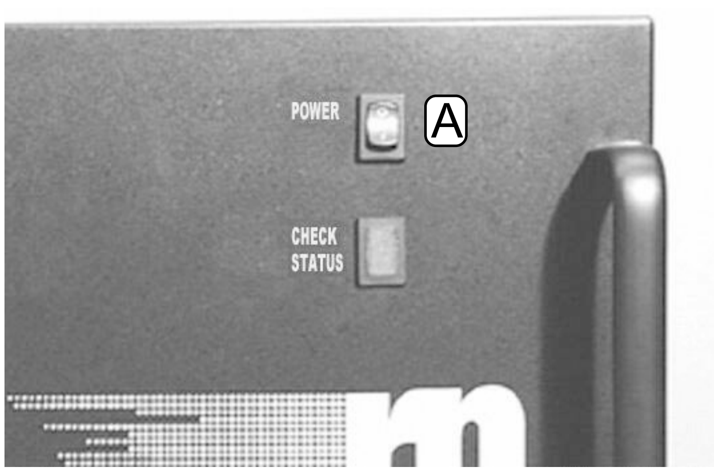


Figure 3-29. Title screen.

```
Series 1400a Monitor

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```

Figure 3-30. Main screen.

```
OK    4+  11%  NU    09:39
Mass Conc>            33.6
30-Min MC             26.8
01-Hr MC              12.5
```

3) Plug the pump (Figure 3-17) into an appropriate power source to draw a sample stream through the system.

Once the power switch is pressed, the “CHECK STATUS” light (Figure 3-27) will light because the flow rates and temperatures are outside of tolerance ranges. The “CHECK STATUS” light will remain lit during the first 30 minutes after the power switch is pressed while the monitor warms up. The status light automatically turns off after all flow rates and temperatures reach tolerance ranges (Section 4.3.1.2).

The flow controllers inside the control unit make a slight “clicking” sound when the instrument is turned on. The instrument automatically resets itself when it is turned on. As part of this initialization procedure, the monitor waits until the flow rates and temperatures stabilize within a narrow range (Section 6) for 30 minutes before starting data collection. This ensures the validity of all data points computed by the system.

3.4. Leak Check

If you have installed the ACCU System (Section 14) on the monitor, be sure to include the ACCU System hardware in the leak check.

Follow these steps to perform a leak check:

1) **Plug the pump (Figure 3-17) into an appropriate power source to draw a sample stream through the system.**
2) **Remove the TEOM filter from the mass transducer according to the instructions in Section 3.1.4.**
3) **Press the "POWER" switch to turn on the control unit (Figure 3-14).**
4) **When in the Main screen (Figure 3-30), press the up (<↑>) and down (<↓>) arrow keys to display the main flow and auxiliary flow values on the four-line display (Figure 3-31).**

Figure 3-31. Main screen with main and auxiliary flow rates displayed.

```
OK     4+  11%  NU      09:44
Main Flow                3.00
Aux Flow                13.66
---------<
```

5) **Locate the flow audit adapter (Figure 3-32), which is contained in the flow audit adapter kit.**

Figure 3-32. Flow audit adapter with valve open.

6) Ensure that the valve of the flow audit adapter is in its open position (Figure 3-32).

7) Remove the sample inlet from the flow splitter (Section 2) and replace it with the flow audit adapter (Figure 3-33).

Figure 3-33. Flow audit adapter installed on flow splitter with valve open.

8) Close the valve of the flow audit adapter (Figure 3-34).

Figure 3-34. Flow audit adapter installed on flow splitter with valve closed.

9) When in the Main screen, the main flow reading should read less than 0.15 l/min and the auxiliary flow reading should read less than 0.60 l/min. If the main flow reading is less than 0.15 l/min and the auxiliary flow reading is less than 0.65 l/min, go to step 18. If the main flow reading is greater than 0.15 l/min and the auxiliary flow reading is greater than 0.65 l/min, check the hose fittings and other critical connections in the flow system for leaks and repeat steps 7-8, and then go to step 10.

10) After you check the hose fittings and other critical connections in the flow system for leaks and repeat steps 7-8, check the main flow reading and the auxiliary flow reading on the Main screen. Go to step 11.

11) When in the Main screen, the main flow reading should read less than 0.15 l/min and the auxiliary flow reading should read less than 0.60 l/min. If the main flow reading is less than 0.15 l/min and the auxiliary flow reading is less than 0.65 l/min, go to step

18. If the main flow reading is greater than 0.15 l/min and the auxiliary flow reading is greater than 0.65 l/min, you must repeat the leak check procedure using an offset value to account for the characteristic non-linearity of the mass flow sensor for flow values near 0 l/min. Go to step 12.

12) To determine the non-linearity offset value (NOV), *slowly* open the valve located on the flow audit adapter (Figure 3-33) and disconnect or unplug the vacuum pump.

IMPORTANT: Be sure to open the valve on the adapter *slowly* to gradually release the vacuum in the system.

13) Wait 1 minute and observe the main flow and auxiliary flow readings. These are the NOVs for both the main flow and auxiliary flow. Record these values.

14) Plug in or reconnect the vacuum pump, and wait 3-5 minutes to allow the main flow and auxiliary flow to stabilize.

15) When both flow rates have stabilized, close the valve on the flow audit adapter (Figure 3-34).

16) When in the Main screen, the main flow reading should read less than 0.15 l/min plus the main flow NOV, and the auxiliary flow reading should read less than 0.60 l/min plus the auxiliary flow NOV. For example, if the NOV for the main flow was recorded as 0.08 l/min, add 0.08 to 0.15 for a total of 0.23 (0.08 + 0.15 = 0.23). The main flow reading should be less than 0.23 l/min. If the NOV for the auxiliary flow was recorded as 0.12 l/min, add 0.12 to 0.65 for a total of 0.77 (0.12 + 0.60 = 0.77). The auxiliary flow reading should be less than 0.77 l/min.

17) If the flow readings exceed these calculated values (the NOVs plus 0.15 l/min for the main flow and 0.65 for the auxiliary flow), perform an analog board calibration and mass flow controller calibration (refer to service manual). This also may indicate that there is a faulty connection or component (such as the mass flow controller or the vacuum pump) in the system. If the flow readings do not exceed these calculated values, go to step 18.

18) Slowly open the valve located on the flow audit adapter.

IMPORTANT: Before removing the flow audit adapter, open the valve on the adapter slowly to gradually release the vacuum in the system.

19) Remove the flow audit adapter from the flow splitter.

20) Install the sample inlet onto the flow splitter (Section 2).

21) Replace the TEOM filter in the mass transducer (Sections 3.1.4 and 3.1.2).

22) Close the mass transducer and the sensor unit door.

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Section 4: Software Overview

This section describes the steps involved in navigating through the basic screens of the Series 1400a Monitor and interacting with the unit. Follow the procedures outlined in Sections 2 and 3 before attempting to operate the monitor.

4.1. Title Screen

When the power switch (Figure 4-1) of the monitor is pressed, the Title screen (Figure 4-2) momentarily appears on the instrument's display to identify the model number of the unit and copyright date (Figure 4-2).

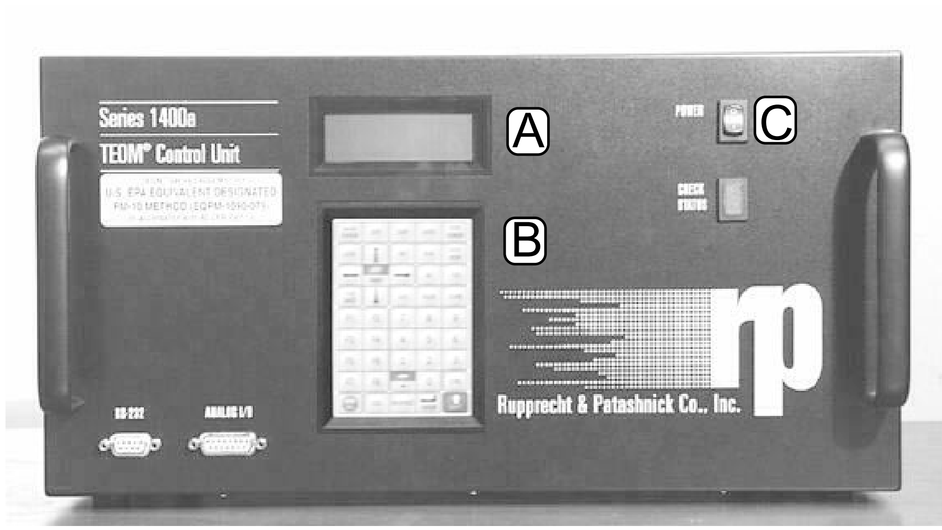

Figure 4-1. Front panel of TEOM control unit with the four-line display (A), keypad (B), and POWER button (C) highlighted.

Figure 4-2. Title screen.

```
    Series 1400a Monitor

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   Rupprecht + Patashnick
```

4.2. Main Screen

The Main screen (Figure 4-3) shows information regarding the existence of any status conditions, the current operating mode and certain operational information. This screen is divided into two sections: the status line at the top of the screen and three information lines below the status line (Figures 4-3 and 4-4).

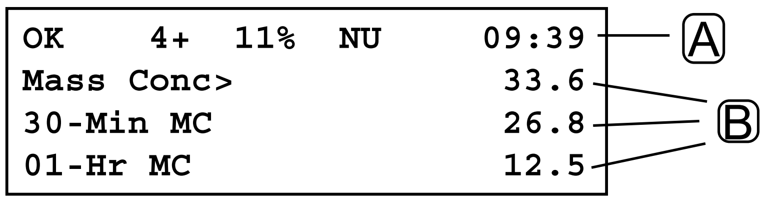


Figure 4-3. Main screen with the status line (A), and information lines (B) highlighted.

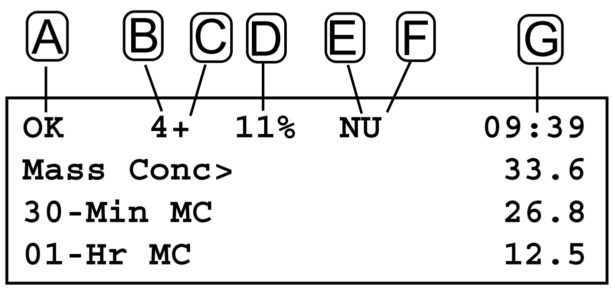


Figure 4-4. Main screen with the current status condition (A), current operating mode (B), status watch (A/I 1 Mode) (C), filter loading percentage (D), current RS232 mode (E), protection level (F) and current time (G) highlighted.

If the Main screen is not currently displayed on the control unit's four-line display, you can display the Main screen in two different ways:

1. Press the <MAIN/STATUS> key on the control unit's keypad.
2. Press the <1> key, the <8> key, and then press the <ENTER> key (Section 4.3.1).

4.2.1. Status Line

The status line (Figures 4-3 and 4-4) of the Main screen provides a summary of the current operational conditions of the instrument.

The status line contains the following information:

OK — This field contains the current status condition. It is an alphanumeric code that summarizes the operational status of the instrument, indicating whether any status condition exists. Refer to Section 7 for an explanation of the unit's status codes.

4 — This field contains the unit's current operating mode. It indicates the instrument's current operational setting and the type of data being computed by the monitor. The operating modes are:

- 1 — Operating Mode 1: Mass values are not currently being computed because temperatures and flow rates are stabilizing. The temperatures and flow rates must remain within a very narrow range of values (Section 5) for 30 minutes before the instrument enters Operating Mode 2. The monitor always starts in Operating Mode 1 when it is turned on or reset. Press the <F1> or <RUN> key to reset the instrument from any operating mode. This action always causes the instrument to enter Operating Mode 1.
- 2 — Operating Mode 2: Data collection has begun, but the first total mass value has not yet been computed.
- 3 — Operating Mode 3: The first total mass value has been computed, but mass concentration and mass rate are not yet available.
- 4 — Operating Mode 4: The unit is fully operational in Operating Mode 4 and normally resides in this mode. All mass values are being computed.

• S Setup Mode: When the unit is in this operating mode, it continues to draw a sample flow and maintain operational temperatures but it does not collect any data. Certain operating parameters such as temperatures and flow rates can only be changed in this mode, because doing so during data collection (Operating Modes 1-4) would affect the data. Press the <DATA STOP> key to enter the Setup Mode while in any operating mode. When the unit is in the Setup Mode (S), the user can change all of the system's parameters. To leave the Setup Mode and start data collection, press either the <F1> or <RUN> key to return the monitor to Operating Mode 1. If the instrument remains in the Setup Mode for 5 minutes without the user pressing any key on the keypad, the monitor will automatically return to Operating Mode 1.

• X Stop All Mode: When the unit is in this operating mode, it suspends operation of the instrument. In this mode, data collection ceases, flow rates in the system drop to zero, and the output to the temperature circuits is turned off. This is an "emergency state" that is activated by pressing the <STOP ALL> key on the instrument's keypad. To leave this mode, press either the <F1> or <RUN> key to enter Operating Mode 1, or the <DATA STOP> key to enter the Setup Mode.

\+ This field contains the status of analog output channel 1 (A/O 1). If the "A/O 1" field of the Main screen status line is blank, analog output 1 is operating in its usual fashion (Section 9). If the A/O 1 field contains a "+", analog output 1 is being used as a status watch indicator. When defined in this fashion, analog output 1 transmits a full scale signal (for example, 10 VDC if the channel is configured for 10 VDC operation) if a status condition exists in the temperatures, flows or oscillation of the mass transducer. If no such status condition exists, analog output channel 1 operates in its usual fashion (Section 10). When in the Main screen, press the <F5> key to display the "+" in the A/O 1 field and use the analog output channel 1 as a status watch indictor.

38% — This field contains the filter loading percentage (Section 3). It indicates the portion of the TEOM filter's total capacity that has been used. Because this value is determined by the pressure drop of the main (sample) flow line, the instrument will always show a nonzero value even if no filter is mounted in the mass transducer. New filters generally exhibit filter loading percentages of 15% to 30% at a main flow rate of 3 l/min, and less at lower flow rates.TEOM filter cartridges must be exchanged before this value reaches 100% to ensure the validity of the data generated by the instrument. At some point above 100%, the main flow drops below its set point.If the filter loading percentage is higher than 30% (at a main flow rate of 3 l/min) when a new TEOM filter is placed on the mass transducer, or if the lifetime of consecutive TEOM filter cartridges becomes noticeably shorter, inspect the in-line filter in the main flow line (Section 12) and replace it, if necessary.

N — This field contains the RS232 mode. It defines the current function of the 9-pin RS232 connectors on the front and back panels of the TEOM control unit. You can select the RS232 mode when in the Set RS-232 Mode screen (Section 9).

IMPORTANT: Never connect serial devices to the front and back RS232 ports of the instrument at the same time. This can cause the RS232 features of the monitor to malfunction.

U — This field contains the protection indicator (Section 11) of the Series 1400a Monitor. It incorporates three states of password protection:

- Unlocked (U) Mode — The user has access to all capabilities of the instrument.

- Low lock (L) Mode — The user is prevented from editing any of the system parameters, but may view all screens and change the operating mode of the instrument to perform maintenance or calibration functions, such as filter exchanges.

- High lock (H) Mode — The user cannot make any changes from the keypad except for turning off the high lock mode with the proper password.

09:39 — This field contains the current time (hh:mm). Refer to Section 6 for instructions on changing the time and date stored by the instrument.

4.2.2. Information Lines

The Main screen contains more information lines than can be viewed at one time. Press the down (<↓>) arrow key on the control unit's keypad (Figure 4-1) to view the additional information lines (Figure 4-5).

Figure 4-5. Main screen with additional information lines displayed.

```
OK    4+  11%  NU     09:39
Mass Conc>             76.4
30-Min MC              72.3
01-Hr MC               78.4
---------------------------
08-Hr MC               85.8
24-Hr MC               69.3
Tot Mass             974.38
Case Temp             50.00
Air Temp              50.01
Cap Temp              49.98
Main Flow              3.00
Aux Flow              13.66
---------<
Noise                 0.524
Frequency         245.55603
```

When you press the down arrow key to view additional information lines, the status line remains visible at the top of the screen. Because the Main screen displays data computed by the instrument, none of the data values on this screen can be edited or changed by the user.

The information lines contain the following information:

Mass Conc	This field contains the 10-minute mass concentration average (μg/m^3). This is a sliding average that is updated every two seconds. This value cannot be changed by the user.
30-Min MC	This field contains the 30-minute mass concentration average (μg/m^3). This is a sliding average that is updated every 30 minutes on the half hour. This value cannot be changed by the user.

01-Hr MC	This field contains the 1-hour mass concentration average (µg/m^3). This is a sliding average that is updated every 60 minutes on the hour. This value cannot be changed by the user.
08-Hr MC	This field contains the mass concentration average with a user-definable period (2-23 hours) (µg/m^3). This is a sliding average that is updated every 60 minutes on the hour. The default period is 8 hours. The period can be changed (Section 6), but the average that this variable generates cannot be changed by the user.

NOTE: Mass concentration averages of less than 24 hours can be averaged using data logging equipment to compute sliding 24-hour averages and 24-hour averages that do not necessarily start and end at midnight, as well as averages on other user-defined time scales.

24-Hr MC	This field contains the 24-hour mass concentration average (µg/m^3). This is a sliding average that is updated every 60 minutes on the hour. This value cannot be changed by the user.
Tot Mass	This field contains the amount of mass that has accumulated on the TEOM filter since the last instrument reset which is done by turning on the instrument or pressing the <F1> or <RUN> key. This value cannot be changed by the user.
Case Temp	This field contains the temperature of the TEOM mass transducer case (set point=50° C, ±0.1° C). This value cannot be changed by the user.
Air Temp	This field contains the temperature of the sample stream at the base of the heated air inlet (set point=50° C, ±0.5° C). This value cannot be changed by the user.
Cap Temp	This field contains the temperature of the upper part of the TEOM mass transducer (set point=50° C, ±0.1° C). This value cannot be changed by the user.

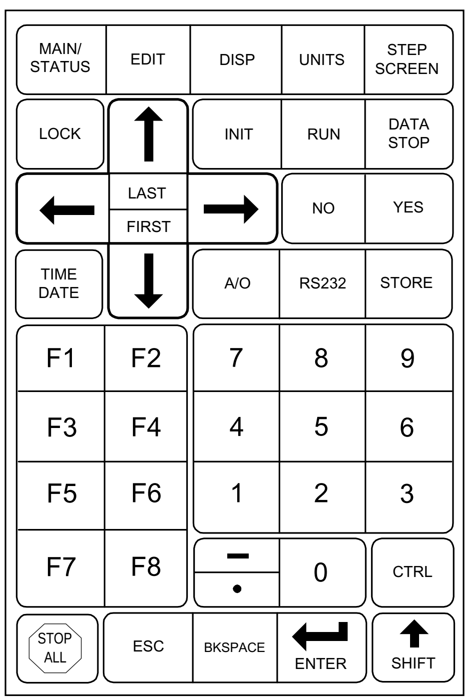
Main Flow	This field contains the actual volumetric flow rate measured by the main flow controller (set point=3 l/min). This value cannot be changed by the user.
Aux Flow	This field contains the actual volumetric flow rate measured by the auxiliary flow controller (set point=13.67 l/min). This value cannot be changed by the user.
Noise	This field contains the mass transducer's performance. This value should be less than "0.10" after the system has been in Operating Mode 4 for at least 30 minutes. This value cannot be changed by the user.
Frequency	This field contains the oscillating frequency of the tapered element (TE) in the mass transducer. This value varies from one Series 1400a Monitor to another, but generally ranges between 150 and 400 Hz. This value cannot be changed by the user.

4.3. Navigating Among Screens

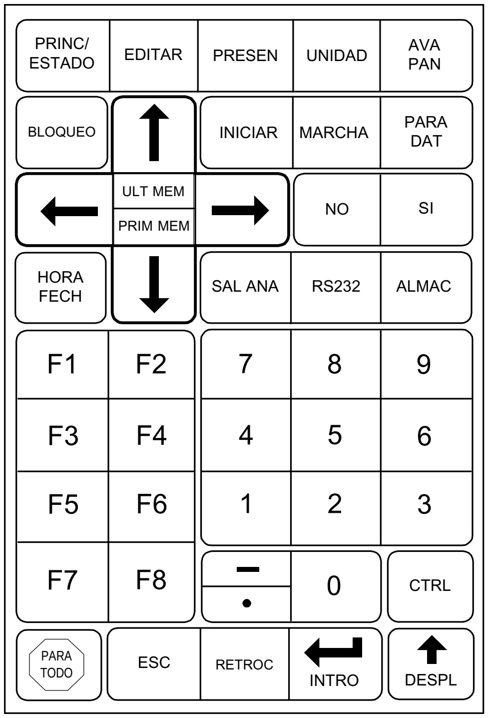
The Series 1400a Monitor incorporates menu-driven software that provides the user with direct instrument control from the keypad of the control unit. This section explains how to interact with the instrument, view information and change the values of system parameters.

4.3.1. Keypads

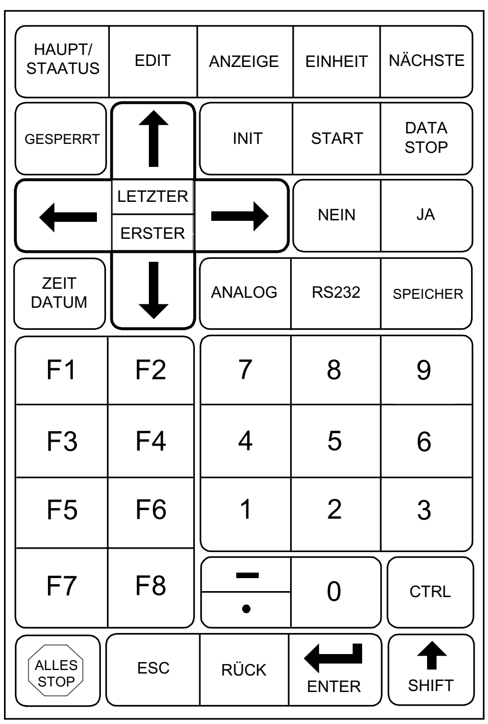
The user can access the monitor's software screens by pressing keys on the keypad. R&P supplies the Series 1400a Monitor with a choice of keypad languages. The languages available at the present time are English (Figure 4-6), Spanish (Figure 4-7) and German (Figure 4-8).



Figures 4-6. English language Series 1400a Monitor keypad.



Figures 4-7. Spanish language Series 1400a Monitor keypad.



Figures 4-8. German language Series 1400a Monitor keypad.

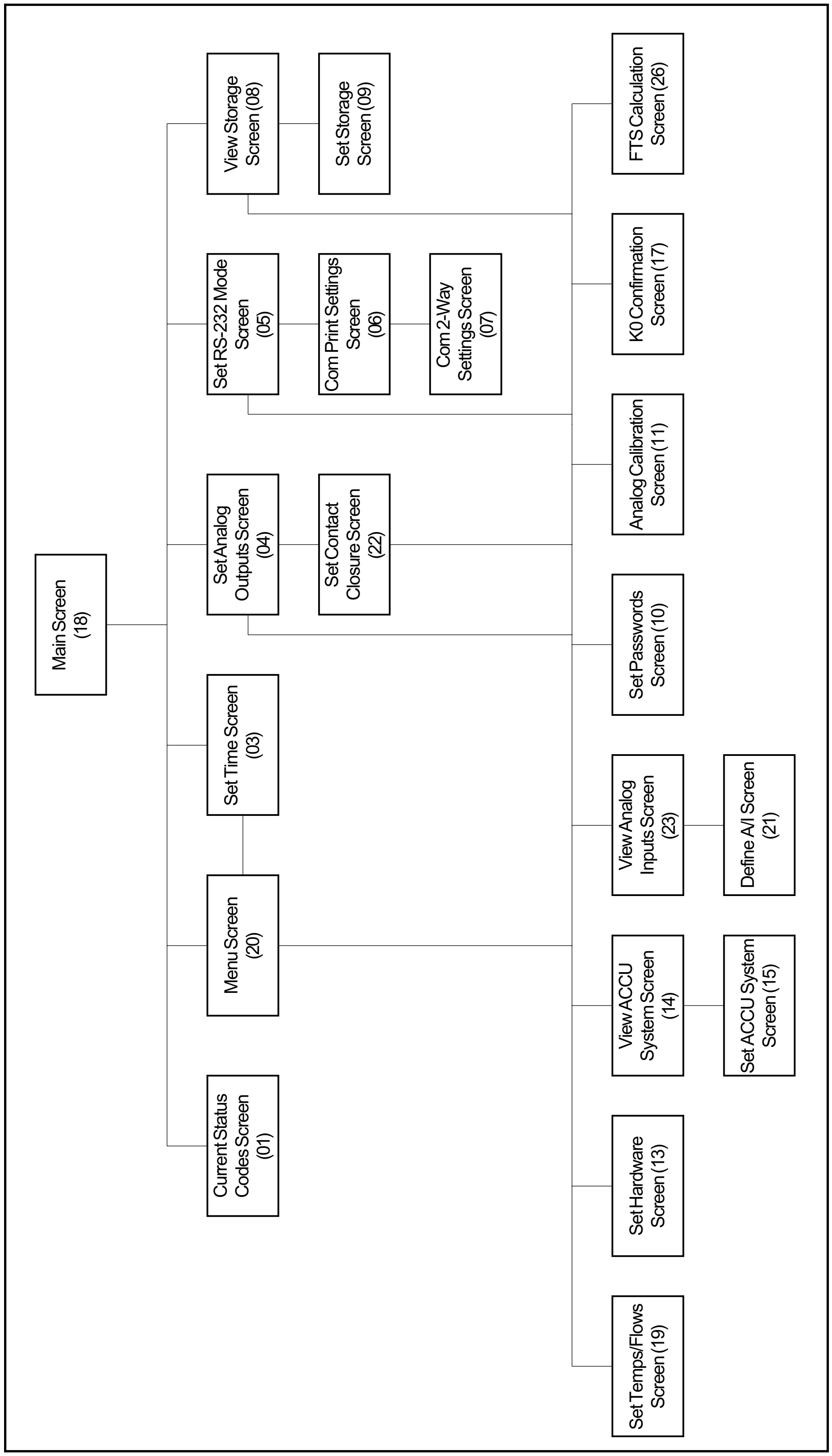
Some of the screens on the Series 1400a Monitor can be displayed by pressing different keys on the keypad, depending on which screen is currently shown on the unit's four-line display (Figure 4-1).

When in the Main screen (Figure 4-3), the following screens can be accessed directly by pressing a key on the unit's keypad:

<MAIN/STATUS> key	Current Status Codes screen (Section 7)
<STEP SCREEN> key	Menu screen (Section 4.3.3)
<TIME/DATE> key	Set Time screen (Section 6)
<A/O> key	Set Analog Outputs screen (Section 9)
<RS232> key	Set RS-232 Mode screen (Section 9)
<STORE> key	View Storage screen (Section 8)

Additionally, any screen can be displayed by entering its "screen number" from the keypad and pressing the <ENTER> key. The two-digit screen number for each screen is shown in Figure 4-9. For example, the screen number of the Main screen is "18." You can display the Main screen by pressing the <1> key, the <8> key and then the <ENTER> key.

Figures 4-9. Hierarchy of software screens.

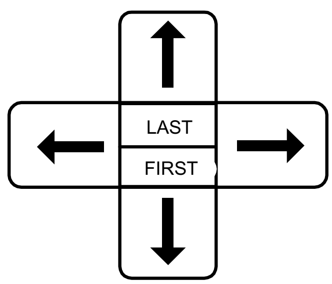


4.3.2. Positioning the Cursor

Many of the monitor’s screens have several lines of information that cannot be seen when the screen is displayed on the four-line display.

Press the up (<↑>) and down (<↓>) arrow keys (Figure 4-6) to move the cursor on the screen up or down one line at a time. To move the cursor up six lines, press the <SHIFT> key and hold it down while pressing the up (<↑>) arrow key. To move the cursor down six lines, press the <SHIFT> key and hold it down while pressing the down (<↓>) arrow key. To move the cursor to the first line of the screen, press the <CTRL> key and hold it down while pressing the up (<↑>) arrow key. To move the cursor to the last line of the screen, press the <CTRL> key and hold it down while pressing the down (<↓>) arrow key.

Figure 4-10. Keypad arrows.



4.3.3. Menu Screen

The user can access all of the monitor's screens directly or indirectly through the Menu screen (Figure 4-11).

Figure 4-11. Menu screen.

```
  LISTING OF SCREENS
> Set Temps/Flows
  Set Hardware
  View ACCU System
```

You can display the Menu screen on the four-line display of the control unit in two different ways:

1. When in the Main screen (Figure 4-3), press the <STEP SCREEN> key on the control unit's keypad.
2. Press the <2> and <0> keys, and then press the <ENTER> key.

The Menu screen contains more information lines than can be viewed at one time. Press the down (<↓>) arrow key on the control unit's keypad (Figure 4-1) to view the additional information lines (Figure 4-12).

Figure 4-12. Menu screen with additional information lines displayed.

```
  LISTING OF SCREENS
> Set Temps/Flows
  Set Hardware
  View ACCU System
  ----------------------
  View Analog Inputs
  Set Time
  Set Analog Outputs
  Set Contact Closure
  Set RS-232 Mode
  View Storage
  Set Passwords
  Analog Calibration
  K0 Calibration
  FTS Calculation
```

The following screens can be accessed through the Menu screen (Figure 4-12):

Set Temps/Flows screen (Section 6)
Set Hardware screen (Section 6)
View ACCU System screen (Section 14)
View Analog Inputs screen (Section 9)
Set Time screen (Section 6)
Set Analog Outputs screen (Section 9)
Set Contact Closure screen (Section 9)
Set RS-232 Mode screen (Section 9)
View Storage screen (Section 8)
Set Passwords screen (Section 11)
Analog Calibration screen (Section 12)
K0 Confirmation screen (Section 12)
FTS Calculation screen (Section 12)

Follow these steps to view an instrument screen through the Menu screen:

1) **When in the Main screen (Figure 4-3), press the <STEP SCREEN> key to display the Menu screen (Figure 4-11). You also can press the <2> and <0> keys, and then press the <ENTER> key to display the Menu screen.**
2) **When in the Menu screen, press the up (<↑>) or down (<↓>) arrow keys to move the cursor to the name of the screen that you want to view.**
3) **Press the <STEP SCREEN> key, or the <ENTER> key, to display the desired screen.**
4) **Press the <MAIN/STATUS> key, or the <ESC> key, to return to the Main screen.**

When the monitor is displaying certain screens, additional related screens can be displayed by pressing the <STEP SCREEN> key. For example, if the monitor is displaying the Set Analog Ouputs screen (Section 9), and the user presses the <STEP SCREEN> key, the unit will now display the Set Contact Closure screen (Section 9). However, when the unit is displaying a screen that does not have an additional related screen and the user presses the <STEP SCREEN> key, the unit will display the Main screen.

If the monitor is displaying any screen except the Main screen, and the user presses the <MAIN/STATUS> key, the monitor will display the Main screen.

4.3.4. EDIT Key

The monitor is normally in the “Display” or “Browse” Mode, which allows the user to move from screen to screen to view the system’s operating parameters. However, in a number of screens, the user may change the unit’s operating parameters. To change the unit’s operating paramaters, the user must enter the “Edit” Mode.

When you are in a screen that has values that can be changed or edited, press the up (<↑>) and down (<↓>) arrow keys to select the field to be edited. Then press the <EDIT> key on the monitor’s keypad to enter the Edit Mode. A “?” will appear on the screen in place of the “>” cursor. Edit the system parameter and then press the <ENTER> key to save the change. Press the <ESC> key to exit the Edit Mode while in any screen.

In certain cases, the instrument will beep when the <EDIT> key is pressed. The monitor will beep for three different reasons: the selected variable cannot be changed or edited, the selected variable can be edited only when the monitor is in the Setup Mode, the monitor is in the low lock or high lock mode (Section 12).

If the monitor is displaying a screen that can be edited, and the monitor beeps when the user presses <EDIT> key, the user must press the <DATA STOP> key to enter Setup Mode before attempting to edit a variable.

If the monitor is in the low lock or high lock mode (Section 12), and the user attempts to edit a variable by pressing the <EDIT> key, the cursor will not change to a “?” and the monitor will not beep.

New values can be entered in one of two ways:

Direct keypad entry	Display the screen that has the operating parameters that you want to change or edit. Press the <EDIT> key. Enter a new value directly by pressing the number keys, including the minus sign and decimal point keys, if necessary, (Figure 4-5). Then press the <ENTER> key to save the change. If you make a mistake while entering the changes on the monitor’s keypad, press the <BKSPACE> key to erase individual characters or the <ESC> key to leave the edit command. You also can use direct keypad entry to enter program register codes (PRCs) (Appendix B). For example, to set the value for “AO1 Var” to the 24-hour mass concentration average in the Set Analog Outputs screen, press the <EDIT> key, <0>, <6>, <0>, and then the <ENTER> key to save the change.

Arrow keys

Display the screen that has the operating parameters that you want to change or edit, and press the <EDIT> key. Press the up (<↑>) and down (<↓>) arrow keys to increase or decrease the value of the variable being edited. To increase the value of the variable by 10 steps at a time, press the <SHIFT> key and hold it down while pressing the up (<↑>) arrow key. To decrease value of the variable by 10 steps at a time, press the <SHIFT> key and hold it down while pressing the down (<↓>) arrow key. To increase the value of the variable by 100 steps at a time, press the <CTRL> key and hold it down while pressing the up (<↑>) arrow key. To decrease the value of the variable by 100 steps at a time, press the <CTRL> key and hold it down while pressing the down (<↓>) arrow key. Press the <ENTER> key to save the change. Using the up and down arrow keys to change a variable is very convenient when changing a variable that is not entirely numeric. For example, when in the Set Analog Outputs screen (Section 9), you can press the <EDIT> key, the up (<↑>) arrow key and then the <ENTER> key to change the value of “AO2 Var” from “01-Hr MC” to “08-Hr MC.” It is generally a good practice to use the up (<↑>) and down (<↓>) arrow keys to change the value of alphanumeric variables, such as the “Month” value in the Set Time screen, and “Max Volt” and “Jumpers” values in the Set Analog Outputs screen.

In certain cases, two editable variables may appear on the same line. For example, in the Set Temps/Flows screen (Section 6), the average and standard temperature variables (“T-A/S”) are on the same line. If you want to change the value of these variables, make sure the Set Temps/Flows screen is displayed on the control unit’s four-line display. When in the Set Temps/Flows screen, press the press up (<↑>) and down (<↓>) arrow keys to move the cursor to the T-A/S field, and press the <EDIT> key. A “?” will appear next to both editable variables on the current display line. Press the left (<←>) or right (<→>) arrow keys to choose which variable to change. This causes one of the two “?” indicators to disappear, leaving only one “?” next to the selected variable. Enter the new value by pressing the appropriate numbers on the control unit’s keypad.

If the “?” edit indicator is shown on the screen and there is no keypad activity for 10 seconds, the cursor will automatically return to the “>” cursor.

4.3.5. Display Key

The display (<DISP>) key (Figure 4-6) allows the user to change the variables that are displayed on the Main screen. When in the Main screen, press the up (<↑>) and down (<↓>) arrow keys to move the cursor to the line on which you want the new variable to appear, and press the <DISP> key. After you press the <DISP> key, a "#" will appear in place of the ">" cursor to indicate that the instrument is waiting for the input of a program register code (PRC) (Appendix B) (Figure 4-13). Enter the three-digit PRC for the new variable that you want to be displayed and press the <ENTER> key.

Figure 4-13. Main screen with the "#" cursor displayed.

```
OK     4+  11%  NU      09:51
Mass Conc#               33.7
30-Min MC                26.8
01-Hr MC                 12.5
```

For example, to bring the current value for the instrument calibration constant to the current line, press the <DISP> key, <0>, <4>, <2> and then the <ENTER> key. If you make a mistake while entering this sequence, press the <ESC> key.

Also, the arrow keys can be used to select a PRC after you press the <DISP> key. Press the up (<↑>) and down (<↓>) arrow keys to increase or decrease the value of the PRC by 1. To increase the PRC variable by 10 steps at a time, press the <SHIFT> key and hold it down while pressing the up (<↑>) arrow key. To decrease the PRC variable by 10 steps at a time, press the <SHIFT> key and hold it down while pressing the down (<↓>) arrow key. To increase the PRC variable to the highest numerical PRC possible, press the <CTRL> key and hold it down while pressing the up (<↑>) arrow key. To decrease the PRC variable to the lowest numerical PRC possible, press the <CTRL> key and hold it down while pressing the down (<↓>) arrow key. Press the <ENTER> key to save the change.

If the "#" cursor is shown on the screen and there is no keypad activity for 10 seconds, the cursor will automatically return to the ">" cursor.

4.3.6. UNITS KEY

The <UNITS> key (Figure 4-6) switches the monitor's four-line display between displaying numbers and units of measure. If numeric values are shown on the display, press the <UNITS> key to display units of measure in place of the numbers (Figure 4-14). Conversely, select the <UNITS> key when units of measure are shown on the instrument to display numeric values.

Figure 4-14. Main screen with units of measure displayed.

```
OK     4+  11%  NU     09:45
Mass Conc>            ug/m^3
30-Min MC             ug/m^3
01-Hr MC              ug/m^3
```

The instrument always returns the display to numeric values whenever the user changes to a new screen on the four-line display.

4.3.7. NO AND YES KEYS

The <NO> and <YES> keys (Figure 4-6) can serve two functions: changing a YES/NO value, or eliminating unwanted negative concentration values.

4.3.7.1. CHANGING A NO OR YES VALUE

Follow these steps to change the value of a NO or YES variable:

1) Ensure that the appropriate screen is displayed on the control unit's four-line display.

2) Press the up (<↑>) or down (<↓>) arrows to move the cursor to the line that you want to edit or change.

3) Press the <EDIT> key.

4) Press the <NO> or <YES> key, or press <0> for "NO" or <1> for "YES." If you pressed the <NO> or <YES> key to change the value, you do not need to press the <ENTER> key after pressing the <NO> or <YES> key to save the change. However, if you pressed <0> for "NO" or <1> for "YES" to change the value, you must press the <ENTER> key to save the change.

4.3.7.2. CHANGING A NEGATIVE CONCENTRATION VALUE

Follow these steps to eliminate or display a negative concentration value:

1) Ensure that the appropriate screen is displayed on the control unit's four-line display.

2) Press the up (<↑>) or down (<↓>) arrows to move the cursor to the line that you want to edit or change.

3) Press the <CTRL> key. If you want to eliminate an unwanted negative concentration value, go to step 4. If you want to display a negative concentration value, go to step 5.

4) Press the <NO> key. You do not need to press the <ENTER> key after pressing the <NO> key to save the change.

5) Press the <YES> key. You do not need to press the <ENTER> key after pressing the <YES> key to save the change.

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Section 5: Basic Operation

This section explains how to program a sampling run, retrieve data after a sampling run in the field and verify your monitor's performance characteristics.

5.1. Programming the Monitor

This section describes the procedures for programming the Series 1400a Monitor for a sampling run. Refer to Section 4 for more detailed information on navigating through the monitor's software screens.

Follow these steps to program the monitor for a sampling run:

1) **Install a TEOM filter (Section 3).**
2) **Press the <DATA STOP> key to ensure that your monitor is in the Setup Mode (Section 4).**
3) **Perform a leak check (Section 3).**
4) **When in the Main screen (Figure 5-1), press the <TIME DATE> key on the monitor's keypad (Figure 5-2) to display the Set Time screen (Figure 5-3).**

Figure 5-1. Main screen.

```
OK    4+  11%  NU     09:39
Mass Conc>             33.6
30-Min MC              26.8
01-Hr MC               12.5
```

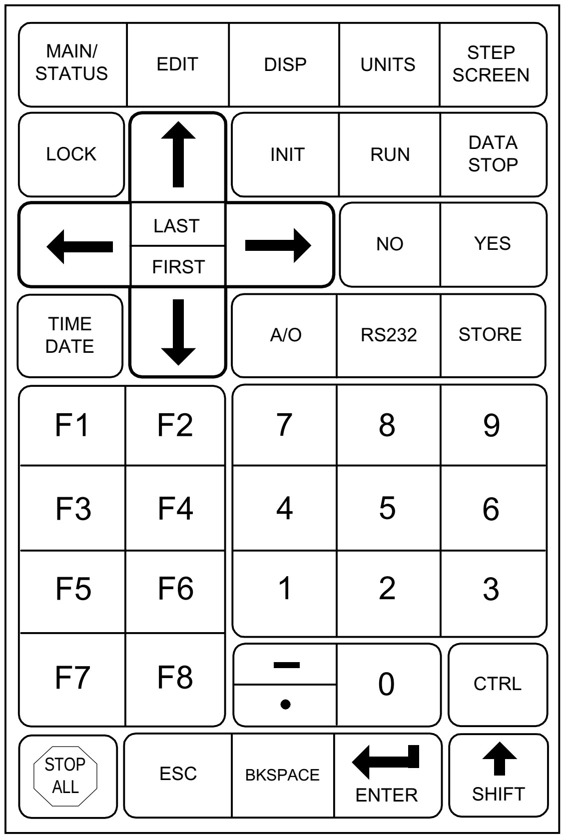


Figure 5-2. Control unit keypad.

Figure 5-3. Set Time screen.

```
         SET TIME
16:20:03          15-Jan-01
Second  >                 0
Minute                   20
```

5) **When in the Set Time screen, enter the current time and date in the appropriate fields (Section 6), and press the <ENTER> key. Press the <ESC> key to display the Main screen.**

6) **When in the Main screen, press the <STEP SCREEN> key on the monitor's keypad to display the Menu screen (Figure 5-4).**

Figure 5-4. Menu screen.

```
 LISTING OF SCREENS
>Set Temps/Flows
 Set Hardware
 View ACCU System
```

7) When in the Menu screen, ensure that the cursor is on "Set Temps/Flows" and press the <ENTER> key. The "Set Temps/ Flows" screen (Figure 5-5) will now display.

Figure 5-5. Set Temps/ Flows screen.

```
     SET TEMPS/FLOWS
T-Case>    50.00    50.00
T-Air      50.00    50.01
T-Cap      50.00    49.98
```

8) When in the Set Temps/Flows screen, determine how you want the monitor to report the mass concentration values: actual, seasonal or standard and enter the necessary parameters (Section 6). Enter the appropriate values for the main (SAMPLE) and auxiliary (BYPASS) flow adjustment factors, if necessary (Section 6). Press the <ENTER> key to save your changes.

9) Press the <STEP SCREEN> key to display the Set Hardware screen (Figure 5-6).

Figure 5-6. Set Hardware screen.

```
       SET HARDWARE
Cal Const>           9605
Ser Num             22822
Inst Type              AB
```

10) When in the Set Hardware screen, check the unit's serial number and calibration constant (Section 12) to ensure that they are correct. If these values are correct, go to step 11. If these values are not correct, press the <EDIT> key and enter the correct parameters. Then press the <ENTER> key to save your changes, and go to step 11.

11) Press the <STORE> key to display the Set Storage screen (Figure 5-7).

Figure 5-7. Set Storage screen.

```
        SET STORAGE
Stor Var1      > Mass Conc
Stor Var2        30-Min MC
Stor Var3         01-Hr MC
```

12) When in the Set Storage screen, select which variables will be stored in the monitor's internal data logger, how many data fields exist per record, and the interval at which records are stored (Section 6). Press the <ENTER> key to save your changes.

13) Press the <RS232> key to display the Set RS-232 Mode screen (Figure 5-8).

Figure 5-8. Set RS-232 Mode screen.

```
       SET RS-232 MODE
  Mode: None
> None
  Print On Line
```

14) When in the Set RS-232 Mode screen, select the appropriate protocol for controlling the unit remotely or downloading the stored data records (Section 9). Press the <ENTER> key to save your changes.

15) If you will be operating the instrument remotely using the RPComm software program, refer to Section 10. If you will be operating the instrument remotely using the AK Protocol or the German Ambient Network Protocol, refer to Section 9.4.5. If you will be downloading data records using the Fast Store Out RS232 Mode, refer to Section 9.4.4.1. If you will be downloading data records using the Print On Line RS232 Mode, refer to Section 9.4.4.2. If you will be downloading data records using the Store to Print RS232 Mode, refer to Section 9.4.4.3. After you have set up the unit for downloading data, go to step 16.

16) If you will be setting up the unit to receive analog inputs, refer to Section 9. If you will be setting up the unit to transmit analog outputs, refer to Section 9.2. If you will be setting up the unit's contact closure circuits, refer to Section 9.3. If you will not be setting up the unit to receive analog inputs, transmit analog outputs or to use the unit's contact closure circuits, go to step 17.

17) If you will be using the password function to control access to the unit's operation, refer to Section 11. If you will not be using the unit's password function, go to step 18.

18) If you will be setting up the ACCU System with the Series 1400a Monitor, refer to Section 14. If you will not be setting up the ACCU System, go to step 19.

19) Press the <ESC> key to display the Main screen.

20) Press the <F1> or <RUN> key to start data collection.

5.2. Post-Sampling Verification and Data Retrieval

This section explains how to verify the sampling run status and retrieve the sampling run data.

Follow these steps to verify the sampling run status and retrieve the sampling run data:

1) **Check the sampling run status on the Main screen, and note any status code other than "OK." If there were any status codes other than "OK," press the <MAIN/STATUS> key to display the Current Status Codes screen (Section 7). When in the Current Status Codes screen, verify the validity of the sampling run.**
2) **Connect the monitor to the personal computer (PC) with the 9-to-9 pin RS232 cable (Section 9).**
3) **If you want to set the storage pointer to the first data record to be downloaded, go to step 4. If you do not want to move the storage pointer, go to step 7.**
4) **Press the <STORE> key on your monitor's keypad to display the View Storage screen (Figure 5-9).**

Figure 5-9. View Storage screen.

```
VIEW STORAGE              2056
16:20:03             15-Jan-01
>Mass Conc                74.9
 30-Min MC                72.3
```

5) **When in the View Storage screen, press the right (←) and left (→) arrow keys to move the storage pointer to the data record where you want the data download to begin (Section 8).**
6) **Press the <CTRL> key and hold it down, then press the <LAST/FIRST> key. This will move the storage pointer to the data record just before your "beginning" data record.**
7) **Initiate the data capture software (such as TEOMCOMM or RPComm) on your PC or other serial data recording device (such as a data logger).**

8) Set your data capture software to the "data capture" or "data download" function.

9) If the monitor has been previously set up for data transfer to a PC, go to step 14. If the monitor has not been previously set up for data transfer to a personal computer (PC), go to step 10.

10) Press the <RS232> key to display the Set RS-232 Mode screen (Figure 5-8).

11) When in the Set RS-232 Mode screen, select the appropriate protocol for controlling the unit remotely or downloading the stored data records (Section 9). Press the <ENTER> key to save your changes.

12) Press the <ESC> key to return to the Main screen. Go to step 13.

13) If you will be operating the instrument remotely using the RPComm software program, refer to Section 10. If you will be operating the instrument remotely using the AK Protocol or the German Ambient Network Protocol, refer to Section 9.4.5. If you will be downloading data records using the Fast Store Out RS232 Mode, refer to Section 9.4.4.1. If you will be downloading data records using the Print On Line RS232 Mode, refer to Section 9.4.4.2. If you will be downloading data records using the Store to Print RS232 Mode, refer to Section 9.4.4.3. After you have set up the unit for downloading data, go to step 14.

14) When the data download is complete, set the RS232 protocol to "None" (Section 9).

15) Disconnect the RS232 cable from the monitor and the PC or other serial data recording device.

16) If any status code conditions occurred during the data download procedure, press the <MAIN/STATUS> key to display the Current Status Codes screen (Section 7).

17) When in the Current Status Codes screen, check the status codes that are displayed.

18) Press <F1> or <RUN> key to reset the unit's status codes and start data collection.

5.3. Verification/Audit Procedures

Perform the ambient air temperature verification (Section 5.3.1), pressure verification (Section 5.3.2) and leak check (Section 3) before executing the flow verification procedure (Section 5.3.3).

5.3.1. Verifying the Ambient Air Temperature

Follow these steps to verify the ambient air temperature:

1) **Press the <1> and <9> keys, and then press the <ENTER> key to display the Set Temps/Flows screen (Figure 5-10).**
2) **When in the Set Temps/Flows screen, locate the current ambient temperature reading (Section 6).**
3) **Determine the current temperature (°C) at the ambient temperature sensor using an external thermometer, [°C = 5/9 x (°F - 32)].**
4) **Verify that the value of the "Amb Temp" field is within ± 2° C of the measured temperature. If this is not the case, perform the ambient temperature calibration procedure (Service Manual).**

Figure 5-10. Set Temps/Flows screen with additional lines displayed.

```
      SET TEMPS/FLOWS
T-Case>    50.00    50.00
T-Air      50.00    50.01
T-Cap      50.00    49.98
F-Main      3.00     3.00
F-Aux      10.00     9.98
T-A/S      25.00    25.00
P-A/S      1.000    1.000
Amb Temp             23.4
Amb Pres            0.988
FAdj Main           1.000
FAdj Aux            1.000
```

5.3.2. Verifying the Ambient Pressure

Follow these steps to verify the ambient pressure:

1) **Press the <1> and <9> keys, and then press the <ENTER> key to display the Set Temps/Flows screen (Figure 5-10).**
2) **When in the Set Temps/Flows screen, locate the current ambient pressure reading (Section 6).**
3) **Determine the current ambient pressure in mm Hg (absolute pressure, not corrected to sea level). Verify the monitor's ambient pressure by measuring the current ambient station pressure in mm Hg with an external measurement device.**
   - To convert from Atmospheres @ 0° C to mm Hg, multiply by 760.
   - To convert from millibars to mm Hg, multiply by 0.75012.
   - To convert from inches Hg @ 32° F to mm Hg, multiply by 25.4.
4) **Verify that the value of the for "Amb Pres" field is within ±10 mm Hg of the measured ambient pressure. If this is not the case, perform the ambient pressure calibration procedure (Service Manual).**

5.3.3. Flow Audit Procedure

✔ Do not run a flow audit procedure during a valid sampling run.

R&P recommends that the flow audit procedure be performed before initiating your first sample run. The flow audit procedure checks the flow rates in the Series 1400a Monitor and can be done with minimal disturbance of the instrument's normal operating configuration. The tolerances in this audit procedure should not be confused with the tighter specifications outlined in the calibration procedures of the Service Manual.

Perform the ambient air temperature verification (Section 5.3.1), pressure verification (Section 5.3.2) and leak check (Section 3) before executing the flow verification procedure (Section 5.3.3).

Tools Needed: Flow audit adapter kit (57-001243)

Materials: None

Follow these steps to perform a flow audit:

1) Press the <F1> or <RUN> key on the control unit's keypad.

NOTE: Any data generated by the instrument during this audit procedure are invalid. Therefore, do not run a flow audit procedure during a valid sampling run.

2) Remove the sample inlet from the flow splitter (Figure 5-11).

Figure 5-11. Removing the PM-10 inlet.

3) Locate the flow audit adapter (Figure 5-12).

Figure 5-12. Flow audit adapter with valve open.

4) Ensure that the valve of the flow audit adapter is in its open position (Figure 5-12).

5) Install the flow audit adapter onto the flow splitter (Figure 5-13).

Figure 5-13. Flow audit adapter installed on flow splitter with valve open.

6) When in the Main screen, press the up (<↑>) and down (<↓>) arrow keys until the “Main Flow” (SAMPLE FLOW) and “Aux Flow” (BYPASS FLOW) lines display on the screen (Figure 5-14). These values represent the actual volumetric flows as measured by the monitor’s flow controllers.

Figure 5-14. Main screen with “Main Flow” and “Aux Flow” lines displayed.

```
OK     4+  11%  NU      09:44
Main Flow                3.00
Aux Flow                13.66
---------<
```

7) Confirm that these flows are within ±2% of their set points (3.0 l/min for the “Main Flow” and 13.67 l/min for the “Aux Flow”). Any greater deviation may indicate that the in-line filters are plugged or other blockages exist in the system.

8) Attach a reference flow meter such as a bubble meter, dry gas meter, or mass flow meter to the top of the flow audit adapter. This reference flow meter should have been recently calibrated to a primary standard, have an accuracy of ±1% at 3 l/min and 16.67 l/min, and a pressure drop of less than 0.07 bar (1 psi).

9) Read the total flow (approximately 16.67 l/min) on the reference flow meter. If you are using a mass flow meter, you must make any necessary corrections to translate this reading to volumetric l/min at the current ambient temperature and barometric pressure. No adjustment is necessary in the case of a volumetric flow meter. The total volumetric flow measured by the reference flow meter must be 16.67 ±1.0 l/min to be acceptable.

10) Disconnect the bypass flow line from the bypass extension on the bottom of the flow splitter (Figure 5-15).

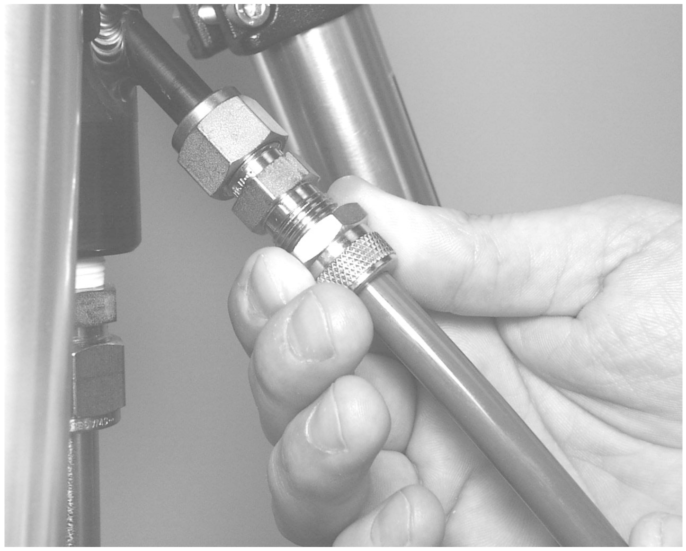


Figure 5-15. Disconnecting the bypass flow line from the bypass extension.

11) Cap the exit of the flow splitter bypass extension with the 3/8-inch Swagelok cap (Figure 5-16).

Figure 5-16. Bypass flow extension with 3/8-inch Swagelok cap.

12) Read the main flow (approximately 3.0 l/min) on the reference flow meter. If you are using a mass flow meter, you must make any necessary corrections to translate this reading to volumetric l/min at the current ambient temperature and barometric pressure. No adjustment is necessary in the case of a volumetric flow meter. The volumetric flow measured by the reference flow meter must be 3.0 ±0.2 l/min to be acceptable. If the main flow reading is within acceptable limits, go to step 14. If the main flow reading is not within acceptable limits, go to step 13.

13) Perform the software and hardware calibrations for the mass flow controller (Service Manual).

14) Remove the 3/8" Swagelok cap from the flow splitter bypass extension.

15) Install the bypass flow line onto the flow splitter bypass extension.

16) Perform a leak check (Section 3.4).

17) Remove the flow audit adapter from the top of the flow splitter.

18) Install the sample inlet onto the flow splitter.

19) Install a new TEOM filter into the mass transducer.

20) Press the <F1> or <RUN> key.

Section 6: Software Setup

This section describes the parameter settings in the software screens that affect the monitor's basic operation and sample programming. It also describes the unit's operational modes. Do not attempt the procedures described in this section until you have read Sections 2-5. Appendix A contains all of the instrument's screens, and Appendix B contains a complete list of the monitor's program register codes (PRCs).

6.1. Modes of Operation

The Series 1400a Monitor displays its current operating mode in the upper left-hand corner of the Main screen (Figure 6-1).

A

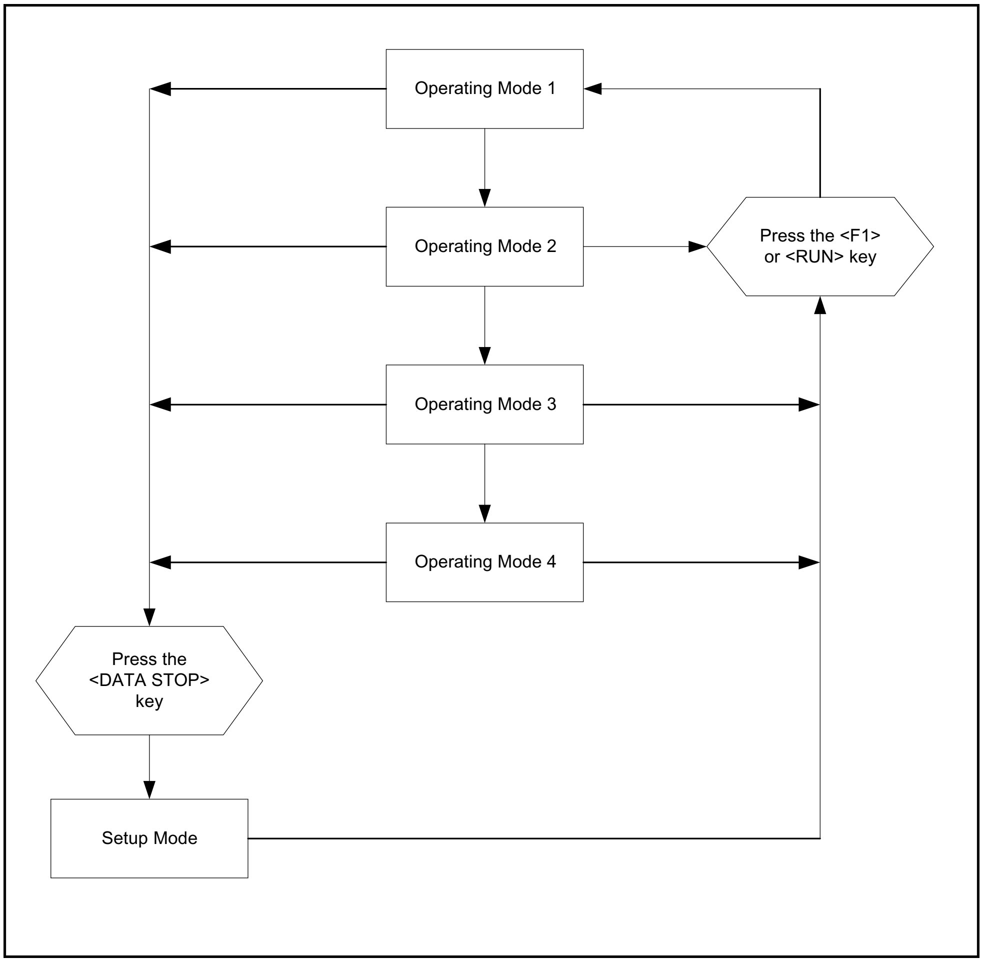
```
OK    4+  11%  NU     09:39
Mass Conc>             33.6
30-Min MC              26.8
01-Hr MC               12.5
```

Figure 6-1. Main screen with operating mode field (A) highlighted.

The unit's operating modes (Figure 6-2) are defined as follows:

Operating Mode 1	This operating mode indicates that the unit has not begun to compute mass values, because the monitor's temperatures and flow rates are stabilizing. The temperatures and flow rates must remain within a very narrow range of values (Section 6.3) for 30 minutes before the instrument enters Operating Mode 2. The monitor always starts in Operating Mode 1 when it is turned on or reset. Press the <F1> or <RUN> key to reset the instrument from any operating mode. This action always causes the instrument to enter Operating Mode 1.
Operating Mode 2	This operating mode indicates that the unit has begun to collect data records, but the monitor has not yet computed its first total mass value.

Figure 6-2. Overview of operating modes.



Operating Mode 3 — This operating mode indicates that the unit has computed the first total mass value, but mass concentration and mass rate values are not yet available.

Operating Mode 4 — This operating mode indicates that unit is fully operational. The monitor normally resides in this mode. All mass values are being computed by the instrument.

Setup Mode — When the unit is in this operating mode, it continues to draw a sample flow and maintain operational temperatures but it does not collect any data. Certain operating parameters such as temperatures and flow rates can only be changed in this mode, because doing so during data collection (Operating Modes 1-4) would affect the data. Press the <DATA STOP> key to enter the Setup Mode while in any operating mode. When the unit is in the Setup Mode (S), the user can change all of the system's parameters. To leave the Setup Mode and start data collection, press either the <F1> or <RUN> key to return the monitor to Operating Mode 1. If the instrument remains in the Setup Mode for 5 minutes without the user pressing any key on the keypad, the monitor will automatically return to Operating Mode 1.

6.2. Set Time Screen

The user can set the system time and date when in the Set Time screen (Figure 6-3).

Figure 6-3. Set Time screen.

```
         SET TIME
16:20:03        15-Jan-01
Second  >               0
Minute                 20
```

You can display the Set Time screen on the four-line display of the control unit in three different ways:

1. Press the <TIME DATE> key on the control unit's keypad.
2. When in the Main screen (Figure 6-1), press the <STEP SCREEN> key to display the Menu screen (Figure 6-4). When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select "Set Time," and then press the <ENTER> key.
3. Press the <0> and <3> keys, and then press the <ENTER> key.

Figure 6-4. Menu screen.

```
  LISTING OF SCREENS
> Set Temps/Flows
  Set Hardware
  View ACCU System
```

The Set Time screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 6-5). Press the up (<↑>) and down (<↓>) arrow keys to view the additional lines of the Set Time screen.

Figure 6-5. Set Time screen with additional lines displayed.

```
         SET TIME
16:20:03          15-Jan-01
Second  >                 0
Minute                   20
---------------------------
Hour                     16
Day                      15
Month                     0
Year                   2001
```

The time and date can only be changed when the instrument is in the Setup Mode. Press the <DATA STOP> key on the monitor's keypad to enter the Setup Mode. The second line of the Set Time screen displays the current time and date generated by the monitor's built-in clock/calendar. To reset the system time, change any of the time variables shown on this screen.

> NOTE: Every time you make a new entry, the instrument resets the "second" counter to "00."

The Set Time screen contains the following information:

Second	This field contains the second (ss) parameter of the clock.
Minute	This field contains the minute (mm) parameter of the clock.
Hour	This field contains the hour (hh) parameter of the clock.
Day	This field contains the day of the month (dd) parameter of the date.
Month	This field contains the numerical month (mm) parameter of the date. January is month "0" and December is month "11." When editing the month, it is simpler to use the up (<↑>) and down (<↓>) arrow keys, instead of entering the number of the month on the control unit's keypad.
Year	This field contains the year (yyyy) parameter of the date.

6.3. Set Temps/Flows Screen

The user can view and set the temperatures and flow rates when in the Set Temps/ Flows screen (Figure 6-6).

Figure 6-6. Set Temps/ Flows screen.

```
     SET TEMPS/FLOWS
T-Case>    50.00    50.00
T-Air      50.00    50.01
T-Cap      50.00    49.98
```

You can display the Set Temps/Flows screen on the four-line display of the control unit in three different ways:

1. When in the Main screen (Figure 6-1), press the <STEP SCREEN> key on the control unit's keypad to display the Menu screen (Figure 6-4). When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select "Set Temps/Flows," and then press the <ENTER> key.
2. When in the Set Hardware screen (Section 6.4), press the <STEP SCREEN> key.
3. Press the <1> and <9> keys, and then press the <ENTER> key.

Each temperature and flow rate has two numbers associated with it. The left-hand value is the parameter setting, and can be changed. The right-hand number is the current value, and cannot be changed.

The Set Temps/Flows screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 6-7). Press the up (<↑>) and down (<↓>) arrow keys to view the additional lines of the Set Temps/Flows screen.

Figure 6-7. Set Temps/ Flows screen with additional lines displayed.

```
       SET TEMPS/FLOWS
T-Case>    50.00    50.00
T-Air      50.00    50.01
T-Cap      50.00    49.98
-------------------------
F-Main      3.00     3.00
F-Aux      10.00     9.98
T-A/S      25.00    25.00
P-A/S      1.000    1.000
Amb Temp             23.4
Amb Pres            0.988
FAdj Main           1.000
FAdj Aux            1.000
```

The Set Temps/Flows screen contains the following information:

T-Case	This field contains the setting and current value of the temperature (°C) inside the control unit. The default setting is 50° C and can be adjusted when the monitor is in the Setup Mode. The current value can not be edited.
T-Air	This field contains the setting and current value of the temperature (°C) of the air stream as it enters the mass transducer. The default setting is 50° C and can be adjusted when the monitor in the Setup Mode. The current value can not be edited.
T-Cap	This field contains the setting and current value of the temperature (°C) inside the mass transducer. The default setting is 50° C and can be adjusted when the monitor is in the Setup Mode. The current value can not be edited.
F-Main	This field contains the setting and current value of the main (SENSOR FLOW) flow rate (l/min). The default setting is 3 l/min and can be adjusted when the monitor is in the Setup Mode. The current value can not be edited.

F-Aux	This field contains the setting and current value of the auxiliary (BYPASS FLOW) flow rate (l/min). The default setting is 13.67 l/min and can be adjusted when the monitor is in the Setup Mode. The current value can not be edited.
T-A/S	This field contains the average and standard temperature (°C) settings. The default setting for both parameters is 25° C and can be adjusted when the monitor is in the Setup Mode. The user can use these values to set the unit's volumetric flow control (Sections 6.3.1 and 6.3.2) and to determine how the unit reports the mass concentration levels (Sections 6.3.3 and 6.3.4). If the instrument has been used before and the user wants to return it to its original settings, the user should first re-initialize the unit (Section 13) before setting the unit's reporting standards.
P-A/S	This field contains the average and standard atmospheric pressure (atm) settings. The default setting for both parameters is 1 atm and can be adjusted when the monitor is in the Setup Mode. The user can use these values to set the unit's volumetric flow control (Sections 6.3.1 and 6.3.2) and to determine how the unit reports the mass concentration levels (Sections 6.3.3 and 6.3.4). If the instrument has been used before and the user wants to return it to its original settings, the user should first re-initialize the unit (Section 13) before setting the unit's reporting standards.
Amb Temp	This field contains the current ambient temperature (°C) at the site. This value can not be edited and will be correct only when the ambient temperature sensor is properly installed (Section 2).
Amb Pres	This field contains the current ambient pressure (atm) at the site. This value can not be edited.
FAdj Main	This field contains the main flow adjustment factor. This value is used during the software calibration of the mass flow controller (Service Manual). The

	default setting for this parameter is “1.000” and this value can be adjusted when the monitor is in the Setup Mode.
FAdj Aux	This field contains the auxiliary flow adjustment factor. This value used during the software calibration of the mass flow controller (Service Manual). The default setting for this parameter is “1.000” and this value can be adjusted when the monitor is in the Setup Mode.

The Series 1400a Monitor uses mass flow controllers to ensure a constant and precise flow through the instrument. The mass flow controllers use the actual (active volumetric flow control setting) or average (passive volumetric flow control setting) temperature and pressure values to regulate the volumetric flow through the system. The active volumetric flow control setting (Section 6.3.1) directs the unit to use the actual ambient temperature and pressure to regulate the volumetric flow through the system. The passive volumentric flow control setting (Section 6.3.2) directs the unit to use the average temperature and pressure values to regulate the volumetric flow through the system. The instrument is delivered with the following temperatures and pressures settings:

Standard temperature .... 25° C	Standard pressure .. 1 atmosphere (atm)
Average temperature .... 25° C	Average pressure ... 1 atmosphere (atm)

If the user receives the Series 1400a Monitor directly from R&P, the only change that the user must make, before using the instrument for U.S. EPA-equivalent PM-10 measurements, is to choose how they want the monitor to control the volumetric flow: actively (Section 6.3.1) or passively (Section 6.3.2). If the user wants to use the instrument for U.S. EPA-equivalent PM-10 measurements, they must ensure that the standard temperature is set to 25° C, and the standard pressure is set to 1 atm, regardless of the values that they entered for the average temperature and average pressure settings. Also, if the monitor has been used before and the user wants to return it to its original settings, the user should first re-initialize the unit (Section 13) before selecting the active or passive volumetric flow control setting.

The unit also uses the parameters in the Set Temps/Flows screen to determine how to report the measured mass concentration levels. The user can choose to report the mass concentration levels to actual (Section 6.3.3) or standard conditions (Section 6.3.4).

If the user chooses to set the unit to report the mass concentration levels to actual conditions, they must they should set the average and standard temperatures to “99,” and the average and standard pressures to “9” when in the Set Temps/Flows screen

(Figure 6-6). This will cause the monitor to use the actual ambient temperature and ambient pressure in its flow rate calculations.

If the user chooses to set the unit to report the mass concentration levels to standard conditions, they must set the standard temperatures and pressures to the appropriate standard regulatory values when in the Set Temps/Flows screen (Figure 6-6). This will cause the monitor to use the standard temperature and pressure values in its sample volume calculations (Section 1).

> NOTE: If the user wants to use the instrument for U.S. EPA-equivalent PM-10 measurements, they must ensure that the standard temperature is set to 25° C, and the standard pressure is set to 1 atm (Section 6.3.4), regardless of the values that they entered for the average temperature and average pressure settings.

6.3.1. Active Volumetric Flow Control

The Series 1400a Monitor uses mass flow controllers to ensure a constant and precise volumetric flow through the instrument. The mass flow controllers use the actual (active volumetric flow control setting) or average (passive volumetric flow control setting) temperature and pressure values to regulate the volumetric flow through the system. The active volumetric flow control setting directs the unit to use the actual ambient temperature and pressure to regulate the volumetric flow through the system. The passive volumentric flow control setting directs the unit to use the average temperature and pressure values to regulate the volumetric flow through the system. If the user wants the unit to use the actual temperature and pressure to control the volumetric flow, they should set the average temperature to “99,” and the average pressure to “9” when in the Set Temps/Flows screen (Figure 6-6).

> NOTE: If the user wants to use the instrument for U.S. EPA-equivalent PM-10 measurements, they must ensure that the standard temperature is set to 25° C, and the standard pressure is set to 1 atm (Section 6.3.4), regardless of the values that they entered for the average temperature and average pressure settings.

If the user chooses to use the actual temperature and pressure to control the volumetric flow, they must install the ambient temperature sensor (Section 2). The instrument’s mass flow controllers measure flow on a mass basis. All of the size-selective inlets (Section 2), including the PM-10 inlet, operate on a constant volumetric flow basis. To measure accurate mass concentration levels when using a size-selective inlet, the user must make a density adjustment to the mass flow controllers using the temperature and pressure values.

Follow these steps to use the actual temperature and pressure values to control the volumetric flow:

IMPORTANT: Ensure that the ambient temperature sensor is installed on the monitor (Section 2).

1) **Press the <DATA STOP> key.**
2) **When in the Main screen (Figure 6-1), press the <STEP SCREEN> key to display the Menu screen (Figure 6-4).**
3) **When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select “Set Temps/Flows,” and then press the <ENTER> key to display the Set Temps/Flows screen (Figure 6-6). You also can press the <1> and <9> keys, and then press the <ENTER> key to display the Set Temps/Flows screen.**

4) Press the <EDIT> key.

5) When in the Set Temps/Flows screen, press the arrow keys to select the left-hand column in the "T-A/S" line.

6) Use the monitor's keypad to enter "99" as the average temperature.

7) Press the arrow keys to select the left-hand column in the "P-A/S" line.

8) Use the monitor's keypad to enter "9" as the average pressure at the site.

9) Press the <ENTER> key.

10) Press the <F1> or <RUN> key to restart data collection.

6.3.2. Passive Volumetric Flow Control

The Series 1400a Monitor uses mass flow controllers to ensure a constant and precise flow through the instrument. The mass flow controllers use the actual (active volumetric flow control setting) or average (passive volumetric flow control setting) temperature and pressure values to regulate the volumetric flow through the system. The active volumetric flow control setting directs the unit to use the actual ambient temperature and pressure to regulate the volumetric flow through the system. The passive volumentric flow control setting directs the unit to use the average temperature and pressure values to regulate the volumetric flow through the system.

The average temperature and average pressure, used by the instrument, may vary with season and altitude. If the user wants the unit to use the average temperature and pressure to control the volumetric flow, they should manually adjust the average temperature and average pressure settings as climatic conditions change. The user usually has to adjust the average pressure only once for the average barometric pressure at the sampling site (i.e., station pressure — not adjusted to sea level). However, the user generally must adjust the average temperature periodically (often 4 times per year) in accordance with changing average ambient temperatures.

> **IMPORTANT:** If you have installed the ambient temperature sensor on the monitor, you must enter “99” in the average temperature field and “9” in the average pressure field.

If the user installs the instrument at an altitude that is different from sea level, the user must set the average pressure to a value other than 1 atm, so that the instrument can maintain its proper volumetric flow within acceptable limits. When the user enters an average pressure of less than 1 atm, it reduces the instrument’s mass flow rate, but ultimately maintains the appropriate volumetric flow for the altitude.

Similarly, average daily temperatures may not always be 25° C. In such cases, the user must adjust the average temperature seasonally to account for changes in mean temperatures. If the user enters an average temperature of less than 25° C in the system, the mass flow through the sampling head increases so that the proper volumetric flow remains within acceptable limits.

> NOTE: If the user wants to use the instrument for U.S. EPA-equivalent PM-10 measurements, they must ensure that the standard temperature is set to 25° C, and the standard pressure is set to 1 atm (Section 6.3.4), regardless of the values that they entered for the average temperature and average pressure settings.

The instrument's mass flow controllers measure flow on a mass basis. All of the size-selective inlets (Section 2), including the PM-10 inlet, operate on a volumetric flow basis. To measure accurate mass concentration levels when using a size-selective inlet, the user must make a density adjustment to the mass flow controllers using the temperature and pressure values.

Follow these steps to use the average temperature and pressure values to control the volumetric flow:

1) **Press the <DATA STOP> key.**
2) **When in the Main screen (Figure 6-1), press the <STEP SCREEN> key to display the Menu screen (Figure 6-4).**
3) **When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select "Set Temps/Flows," and then press the <ENTER> key to display the Set Temps/Flows screen (Figure 6-6). You also can press the <1> and <9> keys, and then press the <ENTER> key to display the Set Temps/Flows screen.**
4) **Press the <EDIT> key.**
5) **When in the Set Temps/Flows screen, press the arrow keys to select the left-hand column in the "T-A/S" line.**
6) **Use the monitor's keypad to enter the average temperature at the site. For example, press the <2> and <0> keys to change the average temperature to 20° C.**
7) **Press the arrow keys to select the left-hand column in the "P-A/S" line.**
8) **Use the monitor's keypad to enter the average pressure at the site. For example, press the <0>, <.>, <9> and <3> keys to change the average pressure to 0.93 atm.**
9) **Press the <ENTER> key.**
10) **Press the <F1> or <RUN> key to restart data collection.**

6.3.3. Reporting to Actual Conditions

The unit uses the parameters in the Set Temps/Flows screen to determine how to report the measured mass concentration levels. If the user chooses to set the unit to report the mass concentration levels to actual conditions, they must set the average and standard temperatures to "99," and the average and standard pressures to "9" when in the Set Temps/Flows screen (Figure 6-6). This will cause the monitor to use the actual ambient temperature and ambient pressure in its flow rate calculations.

NOTE: If the user wants to use the instrument for U.S. EPA-equivalent PM-10 measurements, they must ensure that the standard temperature is set to 25° C, and the standard pressure is set to 1 atm (Section 6.3.4), regardless of the values that they entered for the average temperature and average pressure settings.

IMPORTANT: You MUST install the ambient temperature sensor on your Series 1400a (AB) Monitor, or install the upgrade kit on your Series 1400a (AA) Monitor, to set your unit to report the mass concentration levels to actual conditions.

Follow these steps to set the monitor to use the actual temperature and pressure values in flow rate calculations:

IMPORTANT: Ensure that the ambient temperature sensor is installed on the monitor (Section 2).

1) **Press the <DATA STOP> key.**
2) **When in the Main screen (Figure 6-1), press the <STEP SCREEN> key to display the Menu screen (Figure 6-4).**
3) **When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select "Set Temps/Flows," and then press the <ENTER> key to display the Set Temps/Flows screen (Figure 6-6). You also can press the <1> and <9> keys, and then press the <ENTER> key to display the Set Temps/Flows screen.**
4) **Press the <EDIT> key.**
5) **When in the Set Temps/Flows screen, press the arrow keys to select the left-hand column in the "T-A/S" line.**
6) **Use the monitor's keypad to enter "99" as the average temperature.**

7) Press the right (<→>) arrow key to select the right-hand column in the “T-A/S” line.

8) Use the monitor’s keypad to enter “99” as the standard temperature.

9) Press the arrow keys to select the left-hand column in the “P-A/S” line.

10) Use the monitor’s keypad to enter “9” as the average pressure at the site.

11) Press the right (<→>) arrow key to select the right-hand column in the “P-A/S” line.

12) Use the monitor’s keypad to enter “9” as the standard pressure.

13) Press the <ENTER> key.

14) Press the <F1> or <RUN> key to restart data collection.

6.3.4. Reporting to Standard Conditions

The unit uses the parameters in the Set Temps/Flows screen to determine how to report the measured mass concentration levels. If the user chooses to set the unit to report the mass concentration levels to standard conditions, they must set the standard temperatures and pressures to the appropriate standard regulatory values when in the Set Temps/Flows screen (Figure 6-6). This will cause the monitor to use the standard temperature and pressure values in its flow rate calculations.

NOTE: If the user wants to use the instrument for U.S. EPA-equivalent PM-10 measurements, they must ensure that the standard temperature is set to 25° C, and the standard pressure is set to 1 atm (Section 6.3.3), regardless of the values that they entered for the average temperature and average pressure settings.

IMPORTANT: If your standard regulatory settings are different from the U.S. EPA-equivalent PM-10 measurements, be sure to set the standard temperature and pressure settings as required.

Follow these steps to use the standard temperature and pressure values in flow rate calculations:

1) **Press the <DATA STOP> key.**
2) **When in the Main screen (Figure 6-1), press the <STEP SCREEN> key to display the Menu screen (Figure 6-4).**
3) **When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select “Set Temps/Flows,” and then press the <ENTER> key to display the Set Temps/Flows screen (Figure 6-6). You also can press the <1> and <9> keys, and then press the <ENTER> key to display the Set Temps/Flows screen.**
4) **Press the <EDIT> key.**
5) **When in the Set Temps/Flows screen, set the unit’s volumetric flow control setting (Section 6.3.1 or Section 6.3.2).**
6) **Press the arrow keys to select the right-hand column in the “T-A/S” field.**
7) **Enter the standard temperature value in this field. If you are setting the unit to report to the U.S. EPA-equivalent PM-10 measurements, press the <2> and <5> keys (“25”) on the monitor’s keypad. This sets the standard temperature to “25,”**

which causes the monitor to use the standard temperature in flow rate calculations.

8) **Press the arrow keys to select the right-hand column in the "P-A/S" field.**

9) **Enter the standard pressure value in this field. If you are setting the unit to report to the U.S. EPA-equivalent PM-10 measurements, press the <1> key on the monitor's keypad. This sets the standard pressure to "1," which causes the monitor to use the standard pressure in flow rate calculations.**

10) **Press the <ENTER> key.**

11) **Press the <F1> or <RUN> key to restart data collection.**

6.4. Set Hardware Screen

The Set Hardware screen (Figure 6-8) allows the user to view and change selected hardware parameters.

Figure 6-8. Set Hardware screen.

```
         SET HARDWARE
Cal Const>              9605
Ser Num                22822
Inst Type                 AB
```

You can display the Set Hardware screen on the four-line display of the control unit in three different ways:

1. When in the Main screen (Figure 6-1), press the <STEP SCREEN> key on the control unit's keypad to display the Menu screen (Figure 6-4). When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select "Set Hardware," and then press the <ENTER> key.
2. When in the Set Temps/Flows screen (Section 6.3), press the <STEP SCREEN> key.
3. Press the <1> and <3> keys, and then press the <ENTER> key.

The Set Hardware screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 6-9). Press the up (<↑>) and down (<↓>) arrow keys to view the additional lines of the Set Hardware screen.

Figure 6-9. Set Hardware screen with additional lines displayed.

```
         SET HARDWARE
Cal Const>              9605
Ser Num                22822
Inst Type                 AB
----------------------------
Wait Time                  0
MR/MC Ave                300
TM Ave                   300
XX-Hr MC                   8
Const A                3.000
Const B                1.030
Soft Rate           0.000000
Hard Rate           0.000000
Version                3.016
```

The Set Hardware screen contains the following information:

Cal Const	This field contains the calibration constant, K_o (K0) (Section 1). You can find your monitor's K_o on the label located inside the mass transducer, which is located inside the sensor unit. Each monitor has a unique K_o. The "Cal Const" value must match the value shown on the label inside the mass transducer, or the mass concentration data will be incorrect. This parameter can be edited when the monitor is in the Setup Mode.
Ser Num	This field contains the monitor's serial number. You can find your monitor's serial number on the back panel of the sensor and control units. The "Ser Num" value must match the number found on the hardware. This parameter can be edited when the monitor in any operating mode.
Inst type	This field contains the monitor's instrument type. This two-letter instrument type is incorporated into the serial number prefix of the instrument. The possible variants of the serial number prefix are: "AA" (140A, 140AA, 14UP), "AB" (140AB) and "AT" (140AT). This parameter cannot be edited.
Wait Time	This field contains the length of time (sec) in which the temperatures and flow rates must remain (within a range around their setpoints) before the instrument changes from Operating Mode 1 to 2. The default setting is "1800" seconds. This parameter can be edited when the monitor in any operating mode.

NOTE: R&P recommends that the user set the "Wait Time" to "1000" or higher to avoid damaging the instrument, and to maintain accurate data reporting.

MR/MC Ave	This field contains the monitor's MR/MC averaging time (sec). This value is the length of time over which total mass values are averaged to compute real-time mass rate and mass concentration values (Section 1). The default setting for this value is "300" seconds. This parameter can be edited when the monitor is in any operating mode.

TM Ave	This field contains the monitor's TM averaging time (sec). This value is the length of time over which frequency values from the mass transducer are averaged to compute real-time total mass readings (Section 1). The default setting for this value is "300" seconds. This parameter can be edited when the monitor is in any operating mode.
XX-Hr MC	This field contains the XX-Hr MC parameter. This value gives the user a choice of averaging times (hours) shown on the Main screen, following the 1-hour mass concentration average. The default value for this parameter is "8," which causes the monitor to compute 8-hour averages. The user can select any averaging time between 2 and 23 hours for this parameter. This parameter can be edited when the monitor is in the Setup or Stop All Mode.
Const A	The 1400a monitor makes a minor empirically established adjustment to the mass concentration data to achieve results comparable to the PM-10 reference methods. This is done using the formula Y = A + BX. The "Const A" value must be set its default value of "3.0" to allow the Series 1400a Monitor to be used as an equivalent method for PM-10 measurements. This parameter can be edited when the monitor is in the Setup Mode.
Const B	The 1400a monitor makes a minor empirically established adjustment to the mass concentration data to achieve results comparable to the PM-10 reference methods. This is done using the formula Y = A + BX. The "Const B" value must be set to its default value of "1.03" to allow the Series 1400a Monitor to be used as an equivalent method for PM-10 measurements. This parameter can be edited when the monitor is in the Setup Mode.
Soft Rate	The Series 1400a monitor makes "Soft Rate" software and hardware adjustments for internal clock drift correction. This value is set before the instrument leaves R&P and should not be changed, unless the user loads new software into the instrument. If

the user loads new software into the instrument, the Soft Rate value will return to its default setting (“0”). The user must then follow the procedure for setting the internal clock (Service Manual) to set the Soft Rate to its appropriate value.

Hard Rate	The Series 1400a monitor makes “Hard Rate” software and hardware adjustments for internal clock drift correction. This value is set before the instrument leaves R&P and should not be changed, unless the user loads new software into the instrument. If the user loads new software into the instrument, the Hard Rate value will return to its default setting (“0”). The user must then follow the procedure for setting the internal clock (Service Manual) to set the Hard Rate to its appropriate value.
Version	This field contains the monitor’s software revision number. This parameter can not be edited.

6.5. Set Storage Screen

The Set Storage screen (Figure 6-10) determines which variables are stored in the monitor's internal data logger, how many data fields exist per record, and the interval at which records are stored. The capacity of the data logger, as measured by the number of records, depends upon the number of data fields (system variables) stored in each record. The instrument always stores the time, date and station number in each record in addition to any data fields selected by the user.

Figure 6-10. Set Storage screen.

```
         SET STORAGE
Stor Var1      > Mass Conc
Stor Var2        30-Min MC
Stor Var3         01-Hr MC
```

Figure 6-11 shows the capacity of the monitor's internal storage. Because header information is stored in each record, the capacity of the data logger does not decrease proportionately with an increase in the number of data fields per record.

Figure 6-11. Approximate internal data storage capacity for the Series 1400a Monitor.

Internal Data Storage Capacity*		
Data Fields per Record	**Capacity in Records**	**Capacity in Time****
1	7,017	20.8 weeks
2	4,911	14.6 weeks
3	3,777	11.2 weeks
4	3,069	9.1 weeks
5	2,584	7.6 weeks
6	2,231	6.6 weeks
7	1,964	5.8 weeks
8	1,753	5.2 weeks

* Minumum storage capacity. Most configurations store more data.
** Computed using a storage interval of 30 minutes.

You can display the Set Storage screen on the four-line display of the control unit in two different ways:

1. When in the View Storage screen (Section 8), press the <STEP SCREEN> key on the control unit's keypad.
2. Press the <0> and <9> keys, and then press the <ENTER> key.

The Set Storage screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 6-12). Press the up (<↑>) and down (<↓>) arrow keys to view the additional lines of the Set Storage screen.

Figure 6-12. Set Storage screen with additional lines displayed.

```
        SET STORAGE
Stor Var1      > Mass Conc
Stor Var2        30-Min MC
Stor Var3         01-Hr MC
--------------------------
Stor Var4        Frequency
Stor Var5            A/I 5
Stor Var6         Amb Temp
Stor Var7            A/I 3
Stor Var8             Null
Interval             60.00
Stor Vars                4
Station           48048048
```

The Set Storage screen contains the following information:

Stor Var 1-8 — These fields contain the names of the variables that are currently being stored in the internal data logger. The monitor will store maximum of eight variables in a record. This parameter can be edited when the monitor is in any operating mode.

Interval — This field contains the time (sec) interval between successive writings of data to the circular buffer. For example, if the user sets this field to "3600," the monitor will record data to the internal data logger every hour. The averaged analog input values (average wind speed (PRC 147), average wind velocity (PRC 148) and average wind direction (PRC 149)) are zeroed immediately after that data is stored in the monitor's internal data logger. The averaging time of analog inputs and meteorological data is equal to the data storage interval. The default setting for this value is 1,800 seconds. This parameter can be edited when the monitor is in any operating mode.

Stor Vars — This field contains the number of data fields that the monitor will store per record. The default setting for this parameter is 8 variables. This parameter can be edited when the monitor is in any operating mode.

✘ Changing the value for "Stor Vars" erases the storage buffer.

IMPORTANT: All data stored in the internal data logger are lost when you change the value of the "Stor Vars" parameter.

Station — This field contains the station location variable. This parameter contains an ASCII string (which is a representation of a numeric field) (Appendix I) that can be up to three-digits long. The ASCII string is stored with every record in the internal data logger, and is transmitted every time data are sent to a serial device. The default setting for this parameter is "48048048," which is the ASCII code for "000." This parameter can be edited when the monitor is in any operating mode.

Follow these steps to change the Stor Var(1-8) variables:

1) **Press the <DATA STOP> key.**
2) **When in the Main screen (Figure 6-1), press the <STORE> key to display the View Storage screen (Section 8).**
3) **When in the View Storage screen, press the <STEP SCREEN> key to display the Set Storage screen (Figure 6-9). You also can press the <0> and <9> keys, and then press the <ENTER> key to display the Set Storage screen.**
4) **Press the <EDIT> key. The ">" cursor will now change to the "?" cursor.**
5) **When in the Set Storage screen, press the up (<↑>) and down (<↓>) arrow keys to select the Stor Var(1-8) fields that you want to edit. You can change the variable in each Stor Var field in one of two ways:**

1. Enter the number of the appropriate program register code (PRC) (Appendix B) using the control unit's keypad.

2. Press the up (<↑>) and down (<↓>) arrow keys to increase or decrease the PRC number. To increase the PRC number by one, press the up (<↑>) arrow key. For example, if the mass concentration (PRC 008) is displayed in Stor Var1, and the user wants to change the PRC to total mass (PRC 009), the user would press the up (<↑>) arrow key. To decrease the PRC number by one, press the down (<↓>) arrow key. To increase the PRC number by 10 steps at a time, press the <SHIFT> key and hold it down while pressing the up (<↑>) arrow key. To decrease the PRC number by 10 steps at a time, press the <SHIFT> key and hold it down while pressing the down (<↓>) arrow key. To increase the PRC number by 20 steps at a time, press the <CTRL> key and hold it down while pressing the up (<↑>) arrow key. To decrease the PRC number by 20 steps at a time, press the <CTRL> key and hold it down while pressing the down (<↓>) arrow key.

6) Press the up (<↑>) and down (<↓>) arrow keys to select the "Interval" field.

7) Enter the time interval using the control unit's keypad.

8) Press the up (<↑>) and down (<↓>) arrow keys to select the "Stor Vars" field.

✘ Changing the value for "Stor Vars" erases the storage buffer.

IMPORTANT: All data presently stored in the internal data logger will be lost when you change the value of the "Stor Vars" parameter.

9) Enter the number of storage variables (Stor Var(1-8)) that you want the monitor to store. For example, if you set Stor Var1 to record mass concentration (PRC 008), Stor Var 2 to record mass rate/mass concentration averaging time (PRC 010), Stor Var 3 to record total mass (PRC 009), and Stor Var4 to record total mass averaging time (PRC 011), you would set the "Stor Vars" field to "4."

10) Press the up (<↑>) and down (<↓>) arrow keys to select the "Station" field.

11) Enter the station number using the control unit's keypad.

12) Press the <ENTER> key. The "?" cursor will now change to the ">" cursor.

13) Press the <F1> or <RUN> key to restart data collection.

To erase the contents of the circular storage buffer (internal data logger), change the value of the "Stor Vars" variable. For example, if the "Stor Vars" variable has a value of "8," change the value to "0" and then back to "8," to clear the buffer and resume storing eight data fields per record.

6.6. Extended Function Key Commands

Users can automatically set up the 1400a monitor for different operating configurations by pressing the following key combinations on the control unit's keypad when in the Setup Mode:

Key Combination	Main/Aux flow	Temps
Shift <F1>	1/15.67 l/min	50-50-50° C*
Shift <F2>	2/14.67 l/min	50-50-50° C*
Shift <F3>	3/13.67 l/min	50-50-50° C*
Shift <F4>	1/15.67 l/min	30-30-0° C*
Shift <F5>	2/14.67 l/min	30-30-0° C*
Shift <F6>	3/13.67 l/min	30-30-0° C*
Shift <F8>	Turns flows and temperatures off, sets K_0 to "99999"	

*The temperatures listed in the "Temps" columns are the air, case and cap temperatures, respectively.

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Section 7: Status Codes

This section explains the status codes that display on the Main screen and the Status Codes screen.

The current status condition (Figure 7-1) is located on the upper left-hand corner of the Main screen. It is an alphanumeric code that indicates the operational status of the instrument, indicating any status condition that exists.

A

```
OK    4+  11%  NU     09:39
Mass Conc>             33.6
30-Min MC              26.8
01-Hr MC               12.5
```

Figure 7-1. Main screen with the current status condition (A) highlighted.

Whenever a status code (other than “OK”) is displayed on the Main screen, the instrument automatically turns on the “CHECK STATUS” light (Figure 7-2) on the front panel of the control unit.

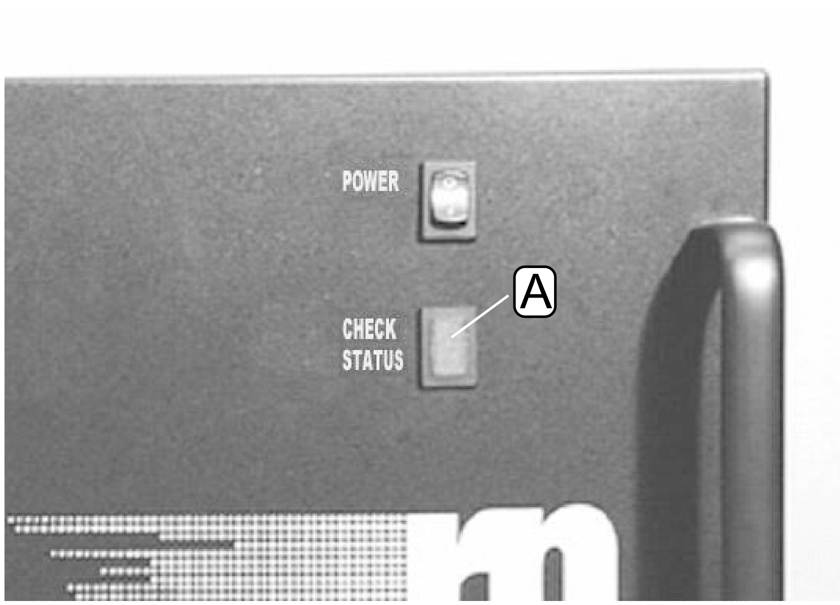

Figure 7-2. Control unit with the “CHECK STATUS” light (A) highlighted.

The status condition can consist of one or more of the following codes:

OK	Normal operation. No current status conditions.
M	Frequency signal failure. Control unit is not receiving a frequency signal.
T	Temperature(s) outside of operational bounds. The range is ±0.5° C for the air temperature, and ±0.1° C for the cap and case temperatures.
F	Flow(s) outside of operational bounds. The range is ±0.1 l/min.
X	Exchange filter. This status code becomes active when the filter loading percentage reaches 90% capacity.
V	Voltage low. This status code becomes active when the AC voltage reading drops below 15 volts.

NOTE: A frequency signal failure ("M") status condition automatically triggers the temperature outside of operational bounds ("T") status code, because the monitor turns off the air and case temperature controls when the mass transducer does not output a frequency.

When in the Main screen, press the <MAIN/STATUS> key on the control unit's keypad to display the Status Codes screen (Figure 7-3). The Status Codes screen provides an explanation of the current status conditions.

Figure 7-3 Status Codes screen with status conditions and additional lines displayed.

```
 CURRENT STATUS CODES
>M        Mass Transducer
 T            Temperature
 F             Flow Rates
-------------------------
 X        Exchange Filter
 V            Voltage Low
```

If the instrument status condition is “OK,” the Status Codes screen will display “No Curr Conditions” (Figure 7-4).

Figure 7-4. Status Codes screen with “OK” status code displayed.

```
  CURRENT STATUS CODES
> No Curr Conditions
```

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Section 8: Viewing Stored Data

The Series 1400a Monitor contains a battery-backed circular buffer (internal data logger) for the storage of historical instrument results (data records). This section describes how to view data records currently stored in the monitor's internal data logger (circular storage buffer). The capacity of the data logger, as measured by the number of records, depends on the number of data fields (system variables) stored in each record. The instrument always stores the time, date and station number in each record, and eight other system variables can be defined by the user in the Set Storage screen (Section 6).

Figure 8-1 displays the capacity of the monitor's internal data storage. Because header information is stored in each record, the capacity of the data logger does not decrease proportionately with an increase in the number of data fields per record. Data records can be viewed on the screen of the monitor (Section 8.1) and/or downloaded through the RS232 port (Section 9). When this buffer is filled, the oldest data points are replaced with the most recent information ("first in, first out").

Figure 8-1. Approximate internal data storage capacity.

Internal Data Storage Capacity*		
Data Fields per Record	**Capacity in Records**	**Capacity in Time****
1	7,017	20.8 weeks
2	4,911	14.6 weeks
3	3,777	11.2 weeks
4	3,069	9.1 weeks
5	2,584	7.6 weeks
6	2,231	6.6 weeks
7	1,964	5.8 weeks
8	1,753	5.2 weeks

* Minumum storage capacity. Most configurations store more data.
** Computed using a storage interval of 30 minutes.

8.1. View Storage Screen

The View Storage screen (Figure 8-2) allows users to view the data records stored in the monitor's internal data logger (circular storage buffer). The fields in this screen cannot be edited.

Figure 8-2. View Storage screen.

```
VIEW STORAGE             2056
16:20:03            15-Jan-01
>Mass Conc               74.9
 30-Min MC               72.3
```

You can display the View Storage screen on the four-line display of the control unit in three different ways:

1. Press the <STORE> key on the control unit's keypad.
2. When in the Main screen (Figure 8-3), press the <STEP SCREEN> key to display the Menu screen (Figure 8-4). When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select "View Storage," and then press the <ENTER> key.
3. Press the <0> and <8> keys, and then press the <ENTER> key.

Figure 8-3. Main screen.

```
OK    4+  11%  NU    09:39
Mass Conc>            33.6
30-Min MC             26.8
01-Hr MC              12.5
```

Figure 8-4. Menu screen.

```
 LISTING OF SCREENS
>Set Temps/Flows
 Set Hardware
 View ACCU System
```

The View Storage screen contains additional lines that cannot be seen when the screen first displays on the control unit’s four-line display (Figure 8-5). Press the up (<↑>) and down (<↓>) arrow keys to move the “>” cursor on the screen up or down one line at a time. To move the cursor up six lines, press the <SHIFT> key and hold it down while pressing the up (<↑>) arrow key. To move the cursor down six lines, press the <SHIFT> key and hold it down while pressing the down (<↓>) arrow key. To move the cursor to the first line of the screen, press the <CTRL> key and hold it down while pressing the up (<↑>) arrow key. To move the cursor to the last line of the screen, press the <CTRL> key and hold it down while pressing the down (<↓>) arrow key.

Figure 8-5. View Storage screen with additional lines displayed.

VIEW STORAGE	2056
16:20:03	15-Jan-01
>Mass Conc	74.9
30-Min MC	72.3
Main Flow	3.0
Frequency	248.3217
Noise	5.438
Null	0
Null	0
Null	0

The View Storage screen contains the following information:

2056	This field contains the record number of the current physical data record displayed. The instrument uses a circular storage buffer, which means that when the monitor reaches the end of the data storage buffer (fills up its internal data logger with data records), it replaces the very first physical data record that was stored with a new data record.
16:20:03	This field contains the beginning sample time (hh:mm:ss) of the current data record displayed.
15-Jan-01	This field contains the date (dd-mmm-yy) of the current data record displayed.

Mass Conc	This field contains the value of a user-defined storage variable that was stored in the internal data logger. If this field displays “Null” this means that the user did not define a variable to be stored in this field.
30-Min MC	This field contains the value of a user-defined storage variable that was stored in the internal data logger. If this field displays “Null” this means that the user did not define a variable to be stored in this field.
Main Flow	This field contains the value of a user-defined storage variable that was stored in the internal data logger. If this field displays “Null” this means that the user did not define a variable to be stored in this field.
Freqency	This field contains the value of a user-defined storage variable that was stored in the internal data logger. If this field displays “Null” this means that the user did not define a variable to be stored in this field.
Noise	This field contains the value of a user-defined storage variable that was stored in the internal data logger. If this field displays “Null” this means that the user did not define a variable to be stored in this field.
Null	This field contains the value of a user-defined storage variable that was stored in the internal data logger. If this field displays “Null” this means that the user did not define a variable to be stored in this field.

When the user displays the View Storage screen, the monitor displays the latest data record that was saved to the internal data logger. The “storage pointer” also will be located at the latest data record that was saved to the internal data logger. Press the right (<→>) and left (<←>) arrow keys to move the storage pointer and to display other data records stored in the monitor’s internal data logger. To move the storage pointer to (and view) the next highest data record, press the right (<→>) arrow key. For example, if the user was viewing data record number 78 and wanted to move the storage pointer to data record number 79, they would press the right (<→>) arrow key. To move the storage pointer to the next lowest data record, press the left (<←>) arrow key. To move the storage pointer forward by 10 data records at a time, press the <SHIFT> key and hold it down while pressing the right (<→>) arrow key. To move the storage pointer backward by 10 data records at a time, press the <SHIFT> key and hold it down while pressing the left (<←>) arrow key. To move the storage pointer forward by 100 data records at a time, press the <CTRL> key and hold it down while pressing the right (<→>) arrow key. To move the storage pointer backward by 100 data records at a time, press the <CTRL> key and hold it down while pressing the left (<←>) arrow key. To move the storage pointer to the beginning of the storage buffer (to the very first data record stored), press the <FIRST/LAST> key. To move the storage pointer to the end of the storage buffer (to the very last data record stored), press the <SHIFT> key and hold it down while pressing the FIRST/LAST> key.

To view data after they have been downloaded from the monitor, refer to Section 9.

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Section 9: Data Input and Output

This section describes how to use the 3 user-definable analog outputs, 2 user-definable contact closure circuits, and 7 analog inputs. This section also explains how to download data through the RS232 port to a serial printer, personal computer (PC) and other data capture devices, such as a data logger.

9.1. Analog Inputs

The standard configuration of the Series 1400a Monitor contains six inputs on the external analog connector (EXT ANALOG) located on the back of the control unit (Figure 9-1), and one analog input on the two identical 15-pin analog I/O (ANALOG I/O) connectors located on the front and back of the control unit (Figures 9-1 and 9-2). These inputs can be configured as ±2 VDC, ±10 VDC full scale (-100% to 100%) or 4-20 mA. The specification for all analog inputs is an input impedance of 24 K ohms.

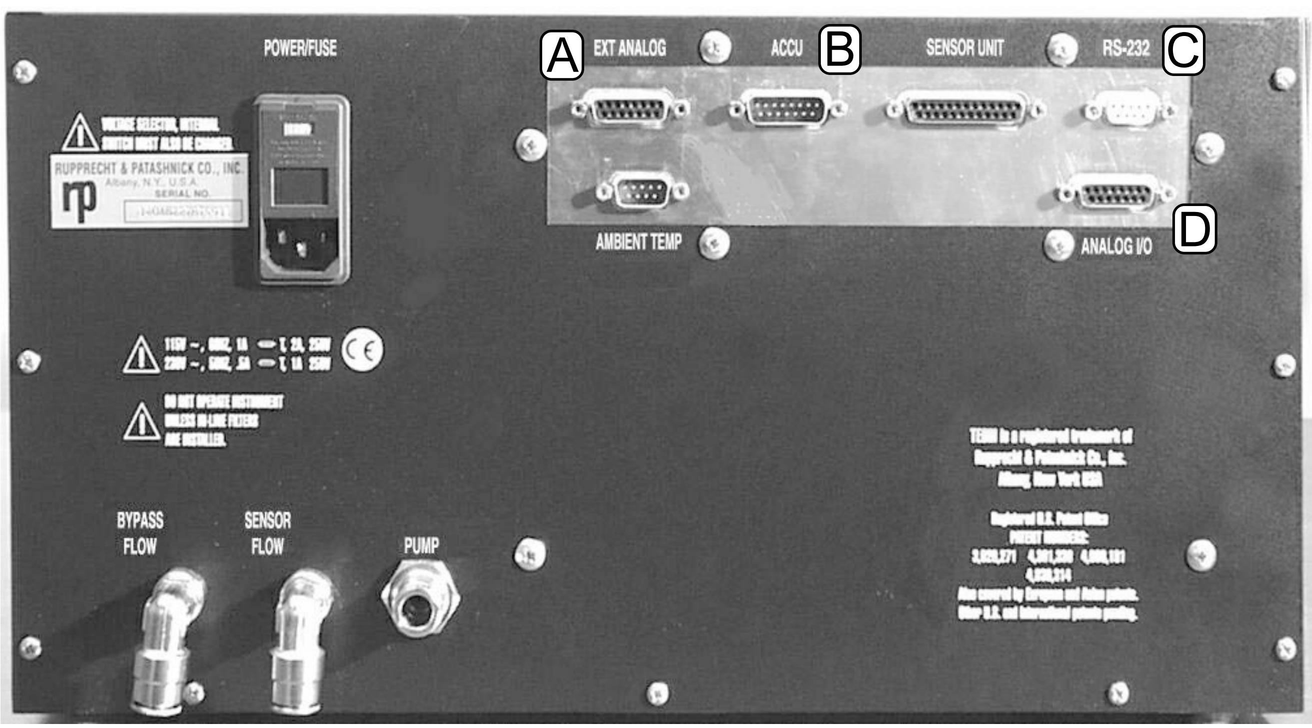
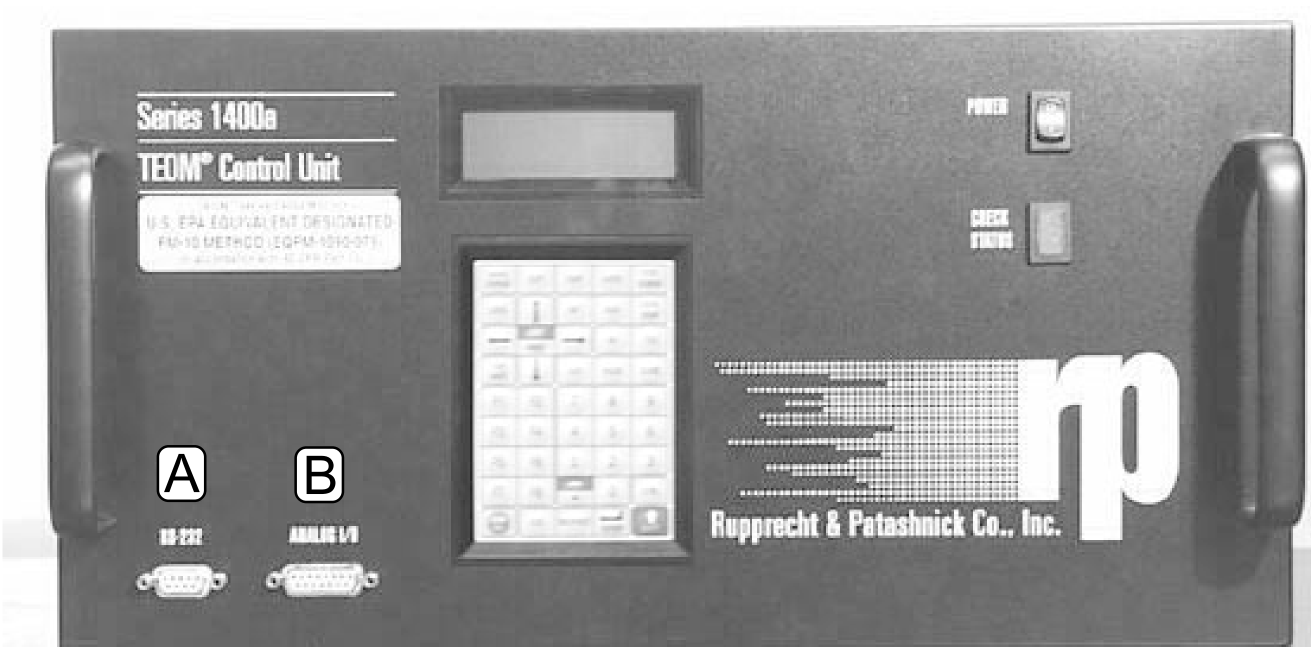


Figure 9-1. Back view of the control unit with the 15-pin external analog input connector (A), auxiliary connector for ACCU System (B), 9-pin serial connector (C) and the 15-pin analog I/O connector (D) highlighted.

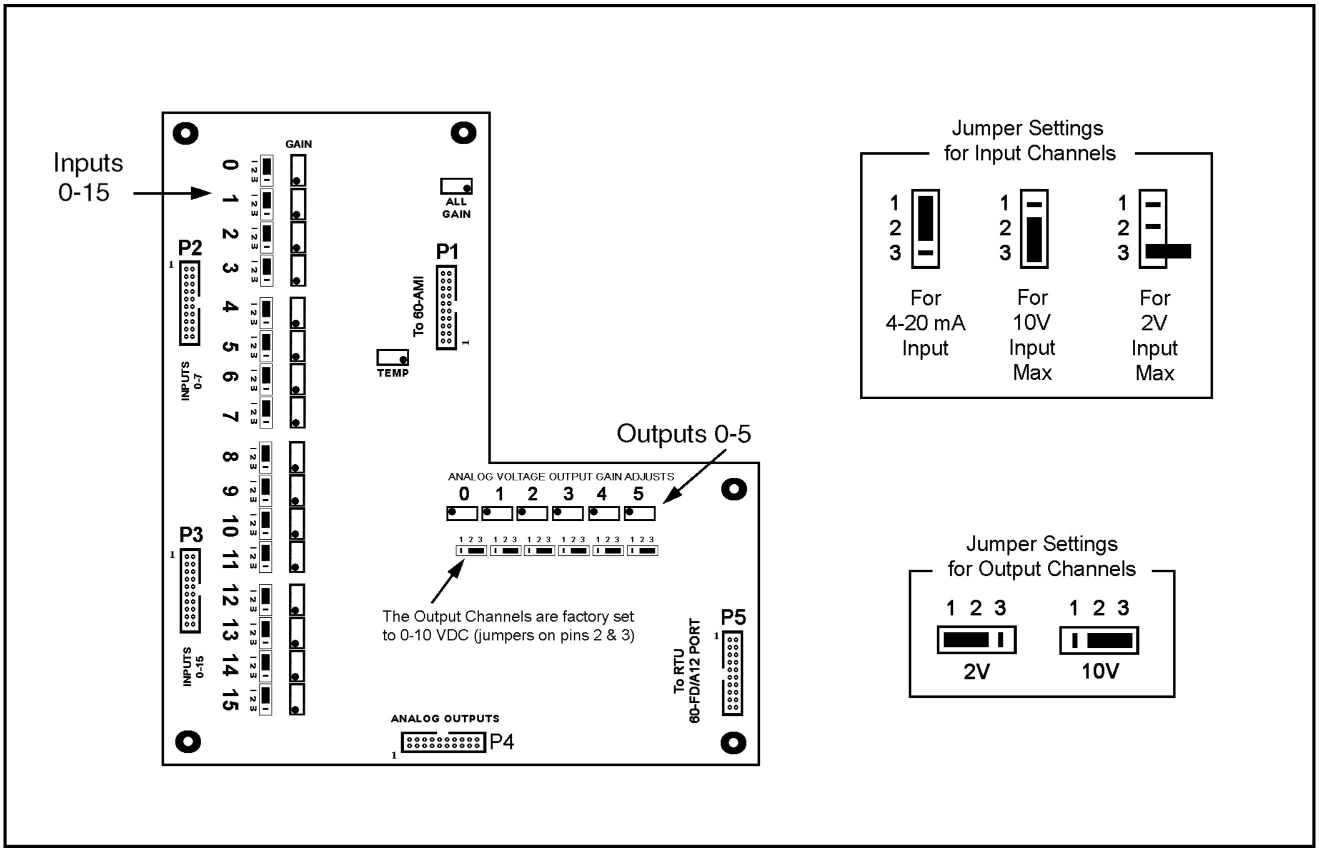
Figure 9-2. Front view of the control unit with the 9-pin RS232 serial connector (A) and the 15-pin analog connector (B) highlighted.



✔ The value for the jumpers variable should be set to 10 VDC for most conditions.

Analog input channel “0” is transmitted to the monitor through the ANALOG I/O connector located on the front and back of the control unit. Pin 7 is designated as the signal line, and pin 8 is designated as the ground line. The jumper setting of analog input “4” on the L-shaped analog input/output board (Figure 9-3) (that is located inside the control unit) determines whether this input is configured for 2 VDC, 10 VDC or 4-20 mA. The default setting for analog input channel “0” and for analog input channels 1-6, is 10 VDC.

Figure 9-3. Analog input/ output jumper settings.



The following values define the location of analog input channel “0” on the two identical 15-pin analog I/O (ANALOG I/O) connectors on the front and back of the control unit:

Input Channel	Signal	Ground	Location on L-shaped board
0	Signal pin 7	Ground pin 8	Analog board channel 4

Each of the six analog inputs available on the external analog (EXT ANALOG) connector on the back of the control unit may be configured in the same manner.

The pin assignments on the 15-pin external analog (ANALOG I/O) connector for analog input channels 1-6 are shown below, along with the location of the jumpers on the L-shaped analog input/output board (Figures 9-3, 9-4 and 9-5):

Input Channel	Signal	Ground	Location on L-shaped board
1	Signal pin 1	Ground pin 2	Analog board channel 10
2	Signal pin 3	Ground pin 4	Analog board channel 11
3	Signal pin 5	Ground pin 6	Analog board channel 12
4	Signal pin 7	Ground pin 8	Analog board channel 13
5	Signal pin 9	Ground pin 10	Analog board channel 14
6	Signal pin 11	Ground pin 12	Analog board channel 15

✔ The value for the jumpers variable should be set to 10 VDC for most conditions.

Analog input channels 1-6 can be jumpered on the L-shaped analog input/output board as 2 VDC, 10 VDC or 4-20 mA (channels 10-15 on the board).

Figure 9-4. Analog input jumpers.

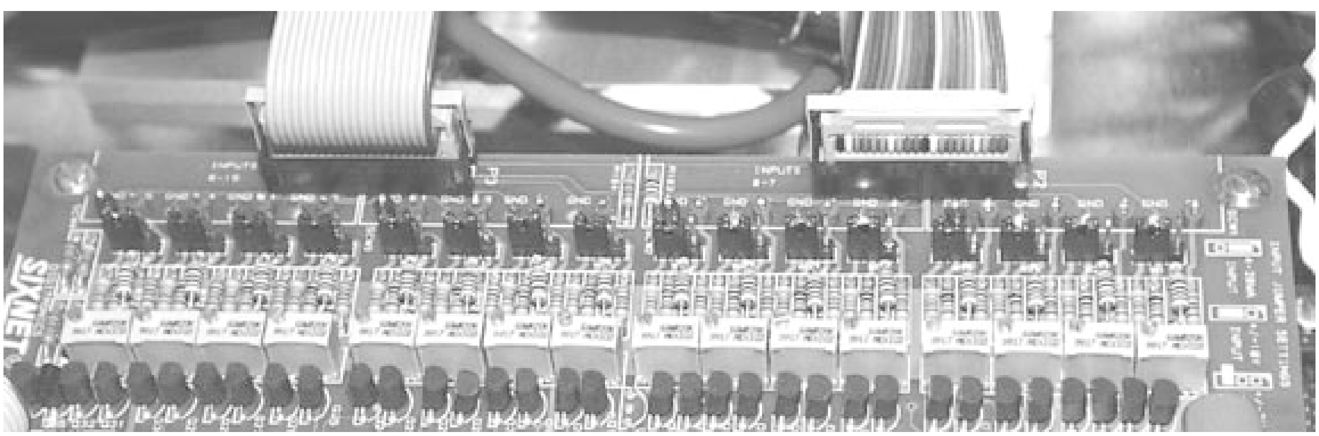
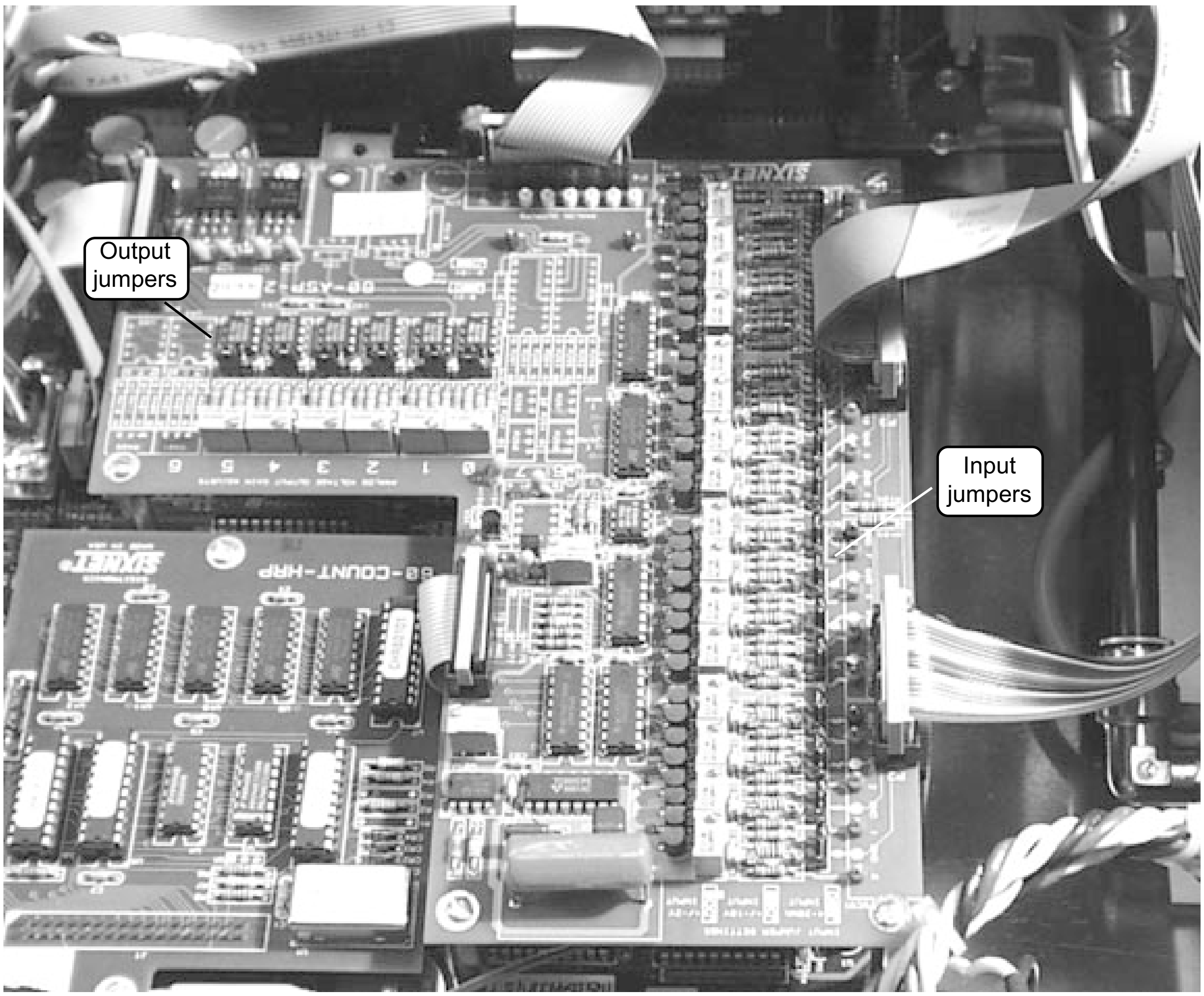


Figure 9-5. L-shaped analog input/output board located inside the control unit.



9.1.1. View Analog Inputs Screen

The View Analog Inputs screen (Figure 9-6) displays the current values of the monitor's analog and meteorological inputs.

Figure 9-6. View Analog Inputs screen.

```
    VIEW ANALOG INPUTS
A/I 0       >       0.000
A/I 1              17.363
A/I 2              27.463
```

You can display the View Analog Inputs screen on the four-line display of the control unit in two different ways:

1. When in the Main screen (Figure 9-7), press the <STEP SCREEN> key to display the Menu screen (Figure 9-8). When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select "View Analog Inputs," and then press the <ENTER> key.
2. Press the <2> and <3> keys, and then press the <ENTER> key.

Figure 9-7. Main screen.

```
OK    4+  11%  NU    09:39
Mass Conc>            33.6
30-Min MC             26.8
01-Hr MC              12.5
```

Figure 9-8. Menu screen.

```
 LISTING OF SCREENS
>Set Temps/Flows
 Set Hardware
 View ACCU System
```

The View Analog Inputs screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 9-9). Press the up (<↑>) and down (<↓>) arrow keys to view the additional lines of the View Analog Inputs screen.

Figure 9-9. View Analog Inputs screen with additional lines displayed.

```
    VIEW ANALOG INPUTS
A/I 0       >       0.000
A/I 1              17.363
A/I 2              27.463
-------------------------
A/I 3              15.957
A/I 4               1.640
A/I 5               2.983
A/I 6              41.885
Wind Spd              0.0
Wind Vel              0.0
Wind Dir              0.0
```

The View Analog Inputs screen contains the following information:

A/I 0 — This field contains the average analog input “0” (engineering units) value. The averaging time is determined by the interval parameter set on the Set Storage screen (Section 6). The average input value for analog input channel 0 is assigned program register code (PRC) 114 (Appendix B).

A/I 1 — This field contains the average analog input “1” (engineering units) value. The averaging time is determined by the interval parameter set on the Set Storage screen (Section 6). The average input value for analog input channel 1 is assigned program register code (PRC) 115 (Appendix B).

A/I 2 — This field contains the average analog input “2” (engineering units) value. The averaging time is determined by the interval parameter set on the Set Storage screen (Section 6). The average input value for analog input channel 2 is assigned program register code (PRC) 116 (Appendix B).

A/I 3 — This field contains the average analog input “3” (engineering units) value. The averaging time is determined by the interval parameter set on the Set Storage screen (Section 6). The average input value

	for analog input channel 3 is assigned program register code (PRC) 117 (Appendix B).
A/I 4	This field contains the average analog input "4" (engineering units) value. The averaging time is determined by the interval parameter set on the Set Storage screen (Section 6). The average input value for analog input channel 4 is assigned program register code (PRC) 118 (Appendix B).
A/I 5	This field contains the average analog input "5" (engineering units) value. The averaging time is determined by the interval parameter set on the Set Storage screen (Section 6). The average input value for analog input channel 5 is assigned program register code (PRC) 119 (Appendix B).
A/I 6	This field contains the average analog input "6" (engineering units) value. The averaging time is determined by the interval parameter set on the Set Storage screen (Section 6). The average input value for analog input channel 6 is assigned program register code (PRC) 120 (Appendix B).
Wind Spd	This field contains the latest averaged value of the wind speed (engineering units). A 5 VDC output represents a 0-180 km/h wind speed. The averaging time is determined by the interval parameter set on the Set Storage screen (Section 6). This value only has meaning if an optional wind vane/anemometer is attached to the monitor (Section 2). The average input value for wind speed is assigned program register code (PRC) 147 (Appendix B).
Wind Vel	This field contains the latest vector-based average of the wind velocity (engineering units). The averaging time is determined by the interval parameter set on the Set Storage screen (Section 6). This value only has meaning if an optional wind vane/anemometer is attached to the monitor (Section 2). The average input value for wind velocity is assigned program register code (PRC) 148 (Appendix B).

Wind Dir	This field contains the latests vector-based averaged value of the wind direction (degrees). The averaging time is determined by the interval parameter set on the Set Storage screen (Section 6). This value only has meaning if an optional wind vane/ anemometer is attached to the monitor (Section 2). The average input value for wind direction is assigned program register code (PRC) 149 (Appendix B).

The program register codes (PRC) that are assigned for analog input channels 0-6 (PRCs 114-120), wind speed (PRC 147), wind velocity (PRC 148) and wind direction (PRC 149) can be stored in the monitor's internal data logger, queried over the RS232 connector, and used to direct the actions of the ACCU System (Section 14).

9.1.2. Define Analog Inputs (A/I) Screen

The user can define the data conversion from analog voltages to engineering units when in the Define Analog Inputs (A/I) screen (Figure 9-10).

Figure 9-10. Define Analog Inputs (A/I) screen.

```
DEFINE A/I              1
A/I %FS  >           4.83
A/I Type         WndSpeed
Const A             0.000
```

You can display the Define Analog Inputs screen on the four-line display of the control unit in two different ways:

1. When in the View Analog Inputs screen (Section 9.1.1), press the <STEP SCREEN> key on the control unit's keypad.
2. Press the <2> and <1> keys, and then press the <ENTER> key.

The Define Analog Inputs screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 9-11). Press the up (<↑>) and down (<↓>) arrow keys to view the additional lines of the Define Analog Inputs screen.

Figure 9-11. Define Analog Inputs (A/I) screen with additional lines displayed.

```
DEFINE A/I              1
A/I %FS  >           4.83
A/I Type         WndSpeed
Const A             0.000
-------------------------
Const B             1.000
Const C             0.000
A/I Ave             0.000
```

The Define Analog Inputs screen contains the following information:

1	This field contains the current analog input channel that is being defined. Press the left (<←>) or right (<→>) arrow keys to move backward or forward by one channel. To view the first channel, press and hold the <CTRL> key while pressing the left arrow key. To view the last channel, press and hold the <CTRL> key while pressing the right arrow key.
A/I %FS	This field contains the current percentage of the analog input's full scale.
A/I Type	This field contains the type of analog input to which the user sets the current analog input channel. This parameter is usually set to "Equation," indicating a regular conversion, using the conversion formula. This value also can be defined as "WndSpeed" (wind speed, engineering units) or "WndDir" (wind direction, 0° to 360°). If the user wants the monitor to compute wind speed , wind velocity and wind direction, they must install an optional wind vane/ anemometer on the monitor (Section 2), and then set one analog input channel to "WndSpd," and another to "WndDir."
Const A	This field contains conversion factor "A" that is used in the conversion formula to convert the analog input value to engineering units.
Const B	This field contains conversion factor "B" that is used in the conversion formula to convert the analog input value to engineering units.
Const C	This field contains conversion factor "C" that is used in the conversion formula to convert the analog input value to engineering units.
A/I Ave	This field displays the average input (engineering units) for the current analog input channel (Section 9.1.1).

✔ If the user wants to set the monitor to measure wind speed, velocity and direction, they must define one analog input channel as "WndSpd" (wind speed) and another channel as "WndDir" (wind direction).

✔ The <LAST/FIRST> key resets the analog input channels.

Press the <LAST/FIRST> key to reset the averaging of all seven analog input channels.

For each analog input channel (0-6), the monitor can convert the incoming voltage signal of 10 VDC, 2 VDC or 4-20 mA into engineering units. Because the instrument cannot tell whether the jumper for a particular analog input channel is set to 10 VDC (default), 2 VDC or 4-20 mA, the incoming signal is expressed as a percentage of full scale (-100% to 100%). For example, if an analog input channel is configured as 10 VDC, -100% represents a voltage of -10 VDC, and 100% represents a voltage of 10 VDC. The location of the analog input jumpers is shown in Figures 9-3, 9-4 and 9-5.

The conversion formula used by the monitor to convert the analog input value to engineering units is:

$$\text{Result} = \text{Const A} + \text{Const B(A/I \%FS)} + \text{Const C (\%A/I FS)}^2$$

"Const A," "Const B" and "Const C" may be defined differently for each channel, and "A/I %FS" is an analog input's percentage of full scale.

In the instrument's default configuration, the Const A and Const C values are set to "0," and the value of Const B is set to "1." In Figure 9-6, the average analog inputs displayed are the percentage of full scale.

If the user has installed an optional wind vane/anemometer on the monitor in which a 5 VDC output represents a 0-180 km/h wind speed, and the input channel is configured in hardware as 10 VDC, the values of Const A, Const B and Const C should be entered as:

A = 0 B = 3.6 C = 0

If the user has installed an optional wind vane/anemometer on the monitor in which a 5 VDC output represents a 0-360° wind direction, and the input channel is configured in hardware as 10 VDC, the values of Const A, Const B and Const C should be entered as:

A = 0 B = 7.2 C = 0

9.2. Analog Outputs

The user can access the instrument's three analog output channels from the two identical 15-pin connectors on the front and back panels of the control unit (Figures 9-1 and 9-2).

The pin assignments of the three analog outputs are:

Channel 1	Positive Pin 10	Ground Pin 3
Channel 2	Positive Pin 1	Ground Pin 5
Channel 3	Positive Pin 9	Ground Pin 6

These analog outputs have an output impedance less than 1 ohm and a maximum output current of 10 mA. They can be scaled to 1, 2, 5 or 10 VDC by means of a combination of hardware and software settings.

9.2.1. Set Analog Outputs Screen

The Set Analog Outputs screen (Figure 9-12) allows the user to define the analog outputs transmitted by the monitor.

Figure 9-12. Set Analog Outputs screen.

```
   SET ANALOG OUTPUTS
Max Volt >           10-VDC
A01 Var          30-Min MC
A01 Min               0.00
```

You can display the Set Analog Outputs screen on the four-line display of the control unit in three different ways:

1. Press the <A/O> key on the monitor's keypad.
2. When in the Main screen (Figure 9-7), press the <STEP SCREEN> key to display the Menu screen (Figure 9-8). When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select "Set Analog Outputs," and then press the <ENTER> key.
3. Press the <0> and <4> keys, and then press the <ENTER> key.

The Set Analog Outputs screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 9-13). Press the up (<↑>) and down (<↓>) arrow keys to view the additional lines of the Set Analog Outputs screen.

Figure 9-13. Set Analog Outputs screen with additional lines displayed.

```
   SET ANALOG OUTPUTS
Max Volt >           10-VDC
A01 Var          30-Min MC
A01 Min               0.00
---------------------------
A01 Max             500.00
A02 Var           01-Hr MC
A02 Min               0.00
A02 Max             500.00
A03 Var           Tot Mass
A03 Min               0.00
A03 Max            5000.00
Jumpers             10-VDC
```

The Set Analog Outputs screen contains the following information:

Max Volt	This field contains the full scale voltage setting. The range for this variable is 1, 2, 5, or 10 VDC. If you are unable to select 5 or 10 VDC while setting this variable, then you must change the setting for the Jumpers variable to 10 VDC.
AO1 Var	This field contains the PRC value of analog output 1, that will be output. Whenever a variable is assigned to one of the analog output channels, the program register codes (PRCs) for the variable's name, minimum value, and maximum value are all assigned to that channel. In the case of a 10 VDC output, the minimum value for the selected output variable is set to 0 VDC and the maximum value is set to 10 VDC. The behavior of analog output channel 1 can be modified if the user chooses to use the channel as a status indicator. Refer to Section 4.3.1.3 for information concerning the Analog Output 1 mode.
AO1 Min	This field contains the minimum value setting of the output PRC for analog output 1.
AO2 Max	This field contains the maximum value setting of the output PRC for analog output 1.
AO2 Var	This field contains the PRC value of analog output 2, that will be output. Whenever a variable is assigned to one of the analog output channels, the program register codes (PRCs) for the variable's name, minimum value, and maximum value are all assigned to that channel. In the case of a 10 VDC output, the minimum value for the selected output variable is set to 0 VDC and the maximum value is set to 10 VDC.
AO2 Min	This field contains the minimum value setting of the output PRC for analog output 2.
AO2 Max	This field contains the maximum value setting of the output PRC for analog output 2.

AO3 Var	This field contains the PRC value of analog output 3, that will be output. Whenever a variable is assigned to one of the analog output channels, the program register codes (PRCs) for the variable's name, minimum value, and maximum value are all assigned to that channel. In the case of a 10 VDC output, the minimum value for the selected output variable is set to 0 VDC and the maximum value is set to 10 VDC.
AO3 Min	This field contains the minimum value setting of the output PRC for analog output 3.
AO3 Max	This field contains the maximum value setting of the output PRC for analog output 3.
Jumpers	This field contains the jumper settings of the three analog output channels in the analog output hardware. In the default configuration, the analog output jumpers are set to 10 VDC. In most cases, the value for the jumpers variable should remain at 10 VDC, and no change must be made to the hardware.

In a typical installation, one of the monitor's three analog outputs will be defined as the instantaneous mass concentration average (PRC 8), and this output will be scaled for output over a range of -100 to +900. This output is transmitted to a data logger that is set for a 1-hour averaging time.

The instrument has an analog output resolution of 12 bits including the sign. If the user wants the monitor to produce 1 or 2 VDC analog outputs, the user can change the jumpers in the monitor to their alternate setting of 2 VDC to receive the best voltage resolution.

An appropriate analog output voltage setting depends on the input characteristics of the instrument receiving the signal (for example, the data logger) from the monitor. Consult the operating instructions that came with that instrument to determine what range of voltages it will accept, and adjust the Series 1400a Monitor's analog output voltage levels from their factory settings (10 VDC) to correspond with it, if necessary.

9.2.2. Changing Analog Input and Output Jumpers

Follow these steps to make hardware and software changes for 10 VDC or 2 VDC analog outputs:

1) Unplug the monitor from its power source.

✓ Always wear appropriate anti-static devices when working with the system electronics.

2) Attach an antistatic wrist strap to your wrist. Attach the other end of the wrist strap to the chassis of the control unit to discharge any static electricity while working on the unit.

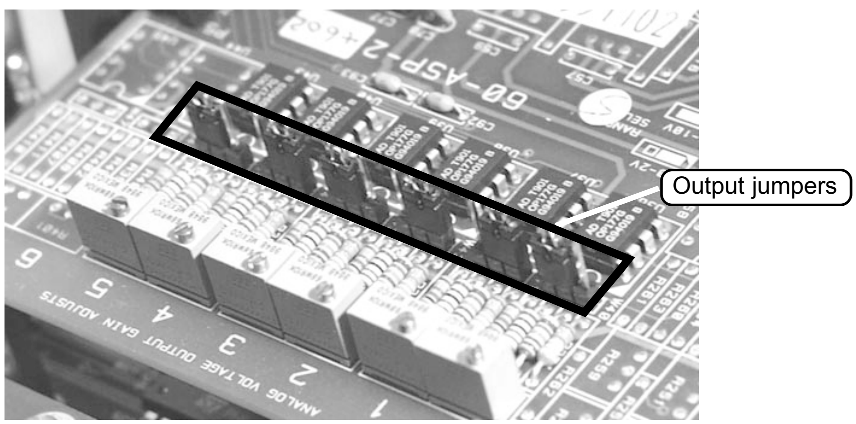
NOTE: Always wear appropriate anti-static devices when working with the system electronics.

3) Remove the cover of the control unit (Section 2).

4) Locate the L-shaped analog input/output board (Figures 9-3 and 9-4).

5) Locate the analog output jumpers (Figure 9-14) on the analog input/output board. The jumpers are black plastic sleeves that cover 2 of the 3 pins corresponding to each output channel.

Figure 9-14. Analog output jumpers.



6) Locate the jumper for output channel 1. Lift the jumper off of the two pins that it covers (pins 2 and 3), and replace it over the middle pin and the other pin that was not previously covered (pins 1 and 2).

7) To change the jumper settings for output channels 2 and 4, repeat step 6.

NOTE: To change the analog output jumpers hardware settings back to 10 VDC, replace the jumpers to pins 2 and 3. Ensure that the software settings are changed accordingly.

8) Replace the cover of the control unit.

9) Plug the monitor into its power source.

10) Turn the monitor on.

11) Press the <A/O> key on the monitor's keypad. This will display the Set Analog Outputs screen (Figure 9-12).

12) Press the <EDIT> key.

13) Change the value for the Jumpers variable(s) in the appropriate fields (Section 9.2.1).

IMPORTANT: The three analog outputs, 1, 2 and 4, must always be set to the same voltage scale.

14) Check the calibration of the analog board (Service Manual).

9.3. Contact Closure Circuits

The user can monitor the unit's operation and filter life by using two user-definable reed relay contacts that open or close when certain status conditions occur. In their default settings, the monitor's contact closure circuits respond to status conditions and the filter loading percentage (Figure 9-15).

Figure 9-15. Default configuration of contact closures.

	Reed Relay Closed	Reed Relay Open
Contact Closure Circuit 1	DATA VALID Status codes M, T or F are not active.	DATA INVALID Status codes M, T or F are active.
Contact Closure Circuit 2	FILTER LOAD PERCENTAGE OK Percent of filter remaining is less than 90%.	FILTER NEEDS EXCHANGE Percent of filter remaining is greater than 90%.

The pin assignments to the contact closure relays (Figure 9-16) can be found on the 15-pin analog connectors on the front and back panels of the control unit. The contact closure relay can be used for voltages up to 200 VAC or 200 VDC, and currents as high as 10 mA.

Figure 9-16. Pin Assignments of contact closures 1 and 2 on 15-pin analog output connector.

	Voltage In	Voltage Out
Circuit 1	Pin 11	Pin 2
Circuit 2	Pin 12	Pin 4

9.3.1. Set Contact Closure Screen

The user can define the operation of the contact closure circuits in the Set Contact Closure screen (Figure 9-17). This programmability allows the user to tailor the channels to a variety of alarm conditions that may exist at different sites.

Figure 9-17. Set Contact Closure screen.

```
    SET CONTACT CLOSURE
Cont 1 Prc >       Status
   NAND              7.00
Cont 2 Prc      Pres Drop
```

You can display the Set Contact Closure screen on the four-line display of the control unit in three different ways:

1. Press the <A/O> key on the monitor's keypad. This will display the Set Analog Outputs screen (Figure 9-12). When in the Set Analog Outputs screen, press the <STEP SCREEN> key.
2. When in the Main screen (Figure 9-7), press the <STEP SCREEN> key to display the Menu screen (Figure 9-8). When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select "Set Contact Closure," and then press the <ENTER> key.
3. Press the <2> key twice, and then press the <ENTER> key.

The Set Contact Closure screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 9-18). Press the up (<↑>) and down (<↓>) arrow keys to view the additional lines of the Set Contact Closure screen.

Figure 9-18. Set Contact Closure screen with additional lines displayed.

```
    SET CONTACT CLOSURE
Cont1 PRC >        Status
   NAND              7.00
Cont2 PRC       Pres Drop
-------------------------
       <            90.00
```

The Set Contact Closure screen contains the following information:

Cont1 PRC	This field contains the program register code (PRC) (Appendix B) of the variable whose current value is to be tested. When in the Edit Mode, use the up <↑> and down <↓> arrow keys to select the appropriate PRC from a list of predefined settings.
NAND	This field contains the comparison or logical operator (<=, <, =, >, >=, <>, AND or NAND) used to compare Cont1 PRC and the constant value. When in the Edit Mode, use the up <↑> and down <↓> arrow keys to select the appropriate operator from a list of predefined settings.
7.00	This field contains the constant value against which Cont1 PRC is compared.
Cont2 PRC	This field contains the program register code (PRC) (Appendix B) of the variable whose current value is to be tested. When in the Edit Mode, use the up <↑> and down <↓> arrow keys to select the appropriate PRC from a list of predefined settings.
<	This field contains the comparison operator (<=, <, =, >, >=, <>) or logical operator (AND or NAND) used to compare Cont2 PRC and the constant value. When in the Edit Mode, use the up <↑> and down <↓> arrow keys to select the appropriate operator from a list of predefined settings.
90.00	This field contains the constant value against which Cont2 PRC is compared.

The monitor performs an evaluation of the designated PRC's current value for each contact closure channel. This test includes a comparison operator (<=, <, =, >, >=, <>) or a logical operator (AND or NAND), and a constant value with which the PRC is compared. If the result of the comparison for an output channel is "true," the monitor closes the circuit (makes contact); otherwise, the channel remains open.

In the monitor's default configuration, contact closure channels 1 and 2 are defined as follows:

Channel 1:	Current Status Code	NAND	7
Channel 2:	Current Filter Pressure Drop	<	90

9.4. Downloading Data

The Series 1400a Monitor can transmit information to other devices through a number of different means, including analog output, RS232 output, a parallel printer output, user-defined logic level outputs and contact closure. In addition to providing on-line printing capabilities, the instrument directly supports a number of RS232 communication protocols, such as the AK Protocol and the German Ambient Network Protocol (Appendix C). When using the AK Protocol, the user can change the value of system variables and download stored data from a remote location. Also, the instrument can download its stored data records directly to a serial printer or other serial device such as a personal computer (PC). This section explains how to download data through the RS232 port to a serial printer, personal computer (PC) and other data capture devices, such as a data logger.

Users also can download data files from the Series 1400a Monitor using PalmOS-based handheld personal computers. Refer to the Palm Pilot PC Operating Manual for instructions on using the PalmOS-based handheld computer to download data from the Series 1400a Monitor.

9.4.1. Set RS-232 Mode Screen

The Set RS232 Mode screen (Figure 9-19) allows the user to select an RS232 mode to download the unit's stored data records.

Figure 9-19. Set RS-232 Mode screen.

```
      SET RS-232 MODE
  Mode: None
 >None
  Print On Line
```

You can display the Set RS232 Mode screen on the four-line display of the control unit in three different ways:

1. Press the <RS232> key on the monitor's keypad.
2. When in the Main screen (Figure 9-7), press the <STEP SCREEN> key to display the Menu screen (Figure 9-8). When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select "Set RS-232 Mode," and then press the <ENTER> key.
3. Press the <0> and <5> keys, and then press the <ENTER> key.

The Set RS232 Mode screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 9-20). Press the up (<↑>) and down (<↓>) arrow keys to view the additional lines of the Set RS232 Mode screen.

Figure 9-20. Set RS-232 Mode screen with additional lines displayed.

```
      SET RS-232 MODE
  Mode: None
 >None
  Print On Line
-----------------------
  AK Protocol
  German Prot
  Store to Print
```

The Set RS232 Mode screen contains the following information:

Mode	This field contains the current RS232 mode.
None	This field contains the None RS232 Mode. When the monitor is in the None Mode, the user can view and change instrument operating parameters using the RPComm software application (Section 10) or the TEOMPLUS software application, and upload new system software to the control unit (Appendix D). When the instrument is shipped from R&P, the RS232 ports are configured for the None Mode.
Print On Line	This field contains the Print On Line RS232 Mode. When the monitor is in the Print On Line Mode, the unit transmits a user-specified line of information, at a user-specified interval. The user sets the information that will be transmitted and the interval at which the information is transmitted in the Com Print Settings screen (Section 9.4.2).
AK Protocol	This field contains the AK Protocol RS232 Mode (Appendix C). When the monitor is in the AK Protocol Mode, the user can retrieve the current value of all system variables over the RS232 connection, change the value of system parameters, and download values stored in the monitor's internal data buffer. The AK Protocol is used in combination with the RPComm software program (Section 10) and the TEOMCOMM software program (Appendix L). The user must set up the unit for transmitting data via the AK Protocol when in the Com 2-Way Settings screen (Section 9.4.3). Refer to Appendix H for further information on modem communications.
German Prot	This field contains the German Ambient Network Protocol RS232 Mode (Appendix C). When the monitor is in the German Ambient Network Protocol Mode, the user can define the Series 1400a Monitor as a station with up to three predetermined system variables in each response transmission. The user must set up the unit for transmitting data via the German Ambient Network Protocol when in the

Com 2-Way Settings screen (Section 9.4.3). Refer to Appendix H for further information on modem communications.

Store to Print — This field contains the Store to Print RS232 Mode. When the monitor is in the Store to Print Mode, the unit downloads all data records (from the storage pointer to the end of the data storage buffer) to a serial printer. The monitor sends one new data record to the serial printer every 2 seconds. If the user leaves the monitor in the Store to Print Mode after the monitor has transmitted the last data record in its data storage buffer, the monitor will continue to transmit stored data records to the serial printer as data records are stored in its data storage buffer. The user sets the rate at which data records are stored in the data storage buffer, and the stored variables that will be downloaded to the serial printer, when in the Set Storage screen (Section 6).

IMPORTANT: The instrument will begin download data to the serial printer immediately after the user changes the RS232 Mode to “Store to Print.” If you want to use this RS232 Mode, be sure to turn on your serial printer and connect it to the monitor BEFORE setting the RS232 Mode to “Store to Print.”

Fast Store Out — This field contains the Fast Store Out RS232 Mode. When the monitor is in the Fast Store Out Mode, the unit downloads all data records (from the storage pointer to the end of the data storage buffer) to a personal computer (PC) or other serial data recording device (such as a data logger). If the user leaves the monitor in the Fast Store Out Mode after the monitor has transmitted the last data record in its data storage buffer, the monitor will continue to transmit stored data records to the PC or other serial data recording device as data records are stored in its data storage buffer. The user sets the rate at which data records are stored in the data storage buffer, and the stored variables that will be downloaded to the PC or other serial data recording device, when in the Set Storage screen (Section 6).

IMPORTANT: The instrument will begin download data to the PC or other serial data recording device (such as a data logger) immediately after the user changes the RS232 Mode to “Fast Store Out.” If you want to use this RS232 Mode, be sure to turn on your PC or other serial data recording device, connect it to the monitor and set it to retrieve data BEFORE setting the RS232 Mode to “Fast Store Out.”

When the user selects an RS232 Mode, the abbreviation for the selected RS232 Mode displays on the status line of the Main screen (Figure 9-21). The abbreviation for the current RS232 Mode is the first letter of the RS232 Mode’s full name.

Figure 9-21. Main screen with RS232 Mode field (A) highlighted.

```
                     A
OK     4+  11%  NU      09:39
Mass Conc>               33.6
30-Min MC                26.8
01-Hr MC                 12.5
```

9.4.2. Com Print Settings Screen

The Com Print Settings screen (Figure 9-22) allows the user to determine the format of the data download when the monitor is in the Print On Line RS232 Mode (Section 9.4.1). Although the name of the Print On Line Mode implies that the user would only use this RS232 mode when connecting to a serial printer, this is not the case. The user can set the monitor to download data to any type of serial data capture device using the Print On Line Mode.

Figure 9-22. Com Print Settings screen.

```
     COM PRINT SETTINGS
Interval >            1800
Columns                  6
Prnt Var 1       Mass Conc
```

You can display the Com Print Settings screen on the four-line display of the control unit in two different ways:

1. When in the Main screen (Figure 9-7), press the <STEP SCREEN> key to display the Menu screen (Figure 9-8). When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select "Set RS-232 Mode," and then press the <ENTER> key to display the Set RS-232 Mode screen (Figure 9-19). When in the Set RS-232 Mode screen, press the <STEP SCREEN> key.
2. Press the <0> and <6> keys, and then press the <ENTER> key.

The Com Print Settings screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 9-23). Press the up (<↑>) and down (<↓>) arrow keys to view the additional lines of the Com Print Settings screen.

Figure 9-23. Com Print Settings screen with additional lines displayed.

```
     COM PRINT SETTINGS
Interval >            1800
Columns                  6
Prnt Var1        Mass Conc
--------------------------
Prnt Var2       30-Min MC
Prnt Var3        01-Hr MC
Prnt Var4        24-Hr MC
Prnt Var5        Tot Mass
Prnt Var6            Null
Station          48048048
```

The Com Print Settings screen contains the following information:

Interval	This field contains the time interval (ssss) between data output transmissions. The default setting is 1,800 seconds.
Columns	This field contains the number of data columns (1-6) that the instrument will transmit in each data output transmission. The default setting is 6 columns of data.
Prnt Var1	This field contains the data variable (PRC) that will be transmitted in Column 1 during each data output transmission.
Prnt Var2	This field contains the data variable (PRC) that will be transmitted in Column 2 during each data output transmission.
Prnt Var3	This field contains the data variable (PRC) that will be transmitted in Column 3 during each data output transmission.
Prnt Var4	This field contains the data variable (PRC) that will be transmitted in Column 4 during each data output transmission.

Prnt Var5	This field contains the data variable (PRC) that will be transmitted in Column 5 during each data output transmission.
Prnt Var6	This field contains the data variable (PRC) that will be transmitted in Column 6 during each data output transmission.
Station	This field contains the station number (ASCII character string), which is a representation of a numeric field that can be up to three digits long. The station variable is transmitted during each data transmission and is stored with every data record in the monitor's internal data storage buffer. Refer to Appendix I for a list of ASCII codes. The default setting for the station number is "48048048," which is the ASCII code for "000."

The monitor always outputs the current date and time, and the station identifier, at the beginning of each data output transmission.

9.4.3. Com 2-Way Settings Screen

The Com 2-Way Settings screen (Figure 9-24) allows the user to set up information exchange between the Series 1400a Monitor and a personal computer (PC) or other serial data recording device, using the AK Protocol or the German Ambient Network Protocol (Appendix C). The AK Protocol is used in combination with the RPComm software program (Section 10) and the TEOMCOMM software program (Appendix L). Refer to Appendix H for further information on modem communications.

Figure 9-24. Com 2-Way Settings screen.

```
     COM 2-WAY SETTINGS
RS-Para 1 >            52
RS-Para 2           75048
RS-Para 3           13010
```

You can display the Com 2-Way Settings screen on the four-line display of the control unit in two different ways:

1. When in the Main screen (Figure 9-7), press the <STEP SCREEN> key to display the Menu screen (Figure 9-8). When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select “Set RS-232 Mode,” and then press the <ENTER> key to display the Set RS-232 Mode screen (Figure 9-19). When in the Set RS-232 Mode screen, press the <STEP SCREEN> key to display the Com Print Settings screen (Figure 9-22). When in the Com Print Settings screen, press the <STEP SCREEN> key.
2. Press the <0> and <7> keys, and then press the <ENTER> key.

The Com 2-Way Settings screen contains additional lines that cannot be seen when the screen first displays on the control unit’s four-line display (Figure 9-25). Press the up (<↑>) and down (<↓>) arrow keys to view the additional lines of the Com 2-Way Settings screen.

Figure 9-25. Com 2-Way Settings screen with an additional line displayed.

```
     COM 2-WAY SETTINGS
RS-Para 1 >            52
RS-Para 2           75048
RS-Para 3           13010
-------------------------
RS-Para 4               0
```

The Com 2-Way Settings screen contains the following information:

RS-Para 1 — This field contains an ASCII code. The definition of this parameter depends on whether the user selects the AK Protocol or the German Ambient Network Protocol. This variable must be set to use either the AK Protocol or the German Ambient Network Protocol to transmit data to and from the Series 1400a monitor.

RS-Para 2 — This field contains an ASCII code. The definition of this parameter depends on whether the user selects the AK Protocol or the German Ambient Network Protocol. This variable must be set to use either the AK Protocol or the German Ambient Network Protocol to transmit data to and from the Series 1400a monitor.

RS-Para 3 — This field contains an ASCII code. The definition of this parameter depends on whether the user selects the AK Protocol or the German Ambient Network Protocol. This variable must be set to use the German Ambient Network Protocol to transmit data to and from the Series 1400a monitor.

RS-Para 4 — This field contains an ASCII code. The definition of this parameter depends on whether the user selects the AK Protocol or the German Ambient Network Protocol.

9.4.4. Downloading Data — One-Way Communication

The user can download data directly from the unit to a serial printer, personal computer (PC), or other serial data recording device. The instructions in this section explain a one-way data tranmission, which is transmitting data only from the unit to another data capture device.

9.4.4.1. Fast Store Out Mode

The user can set up the monitor to download data records using the Fast Store Out Mode before they have been recorded, while they are being recorded, or after they have been recorded. Data transmitted through the Fast Store Out mode are delimited by commas for simplified use in spreadsheet programs. Keypad response to user inputs is diminished when the instrument is in the Fast Store Out Mode due to the high rate at which the RS232 port is accessed. This does not have any effect on the collection, calculation or storage of data in the instrument.

Follow these steps to download data using the Fast Store Out Mode:

1) **Connect one end of the 9-to-9 pin computer cable to one of the RS232 ports on the control unit.**
2) **Ensure that nothing is connected to the other RS232 port of the control unit.**
3) **If your personal computer (PC) or other serial data recording device is equipped with a 9-pin RS232 connector, go to step 4. If your PC or other serial data recording device is equipped with a 25-pin connector, go to step 5.**
4) **Plug the other end of the 9-to-9 pin computer cable into the 9-pin RS232 port of your PC or other serial data recording device. Go to step 8.**
5) **Locate the 9-to-25 pin computer cable adapter.**
6) **Plug the 9-to-25 pin computer cable adapter into the 25-pin port on your PC or other serial data recording device.**
7) **Plug the other end of the 9-to-9 pin computer cable into the 9-to-25 pin computer cable adapter. Go to step 8.**

   NOTE: Do not use the 9-to-25 pin modem cable to connect the control unit with the PC or other serial data recording device. The 9-to-25 pin modem cable is configured for use only with a modem.

8) If you want to set the storage pointer to the first data record to be downloaded, go to step 9. If you do not want to move the storage pointer, go to step 12.

9) Press the <STORE> key on your monitor's keypad to display the View Storage screen (Figure 9-26).

Figure 9-26. View Storage screen.

```
VIEW STORAGE             2056
16:20:03            15-Jan-01
>Mass Conc               74.9
 30-Min MC               72.3
```

10) Press the right (<→>) and left (<←>) arrow keys to move the storage pointer to the data record where you want the data download to begin (Section 8).

11) Press the <CTRL> key and hold it down, then press the <LAST/FIRST> key. This will move the storage pointer to the data record just before your "beginning" data record.

12) Initiate the data capture software (such as TEOMCOMM or RPComm) on your PC or other serial data recording device (such as a data logger).

13) Ensure that the data capture software is set for the same communication parameters as the instrument. The default settings of the monitor are:

Baud rate	9600
Data bits	8
Parity	None
Stop bits	1

14) Set the data capture software to the "data capture" or "data download" mode.

15) Press the <RS232> key on the monitor's keypad to display the Set RS-232 Mode screen (Figure 9-19).

16) When in the Set RS-232 Mode screen, press the <EDIT> key.

17) Press the up (<↑>) and down (<↓>) arrow keys to select "Fast Store Out."

18) Press the <ENTER> key. The instrument will begin downloading data to the PC or other serial data recording device (such as a data logger) immediately after you press the <ENTER> key.

NOTE: If you leave the monitor in the Fast Store Out Mode after the monitor has transmitted the last data record in its data storage buffer, the monitor will continue to transmit stored data records to the PC or other serial data recording device as data records are stored in its data storage buffer. The user sets the rate at which data records are stored in the data storage buffer, and the stored variables that will be downloaded to the PC or other serial data recording device, when in the Set Storage screen (Section 6).

19) When the data download is complete, set the RS232 protocol to "None."

20) Disconnect the RS232 cable from the monitor and the PC or other serial data recording device.

9.4.4.2. Print On Line Mode

The user must set up the monitor to download data records using the Print On Line Mode before they have been recorded. This RS232 protocol will download data to a PC or other serial recording device while the unit is recording data records.

Follow these steps to download data using the Print On Line Mode:

1) **Connect one end of the 9-to-9 pin computer cable to one of the RS232 ports on the control unit.**
2) **Ensure that nothing is connected to the other RS232 port of the control unit.**
3) **If your personal computer (PC) or other serial data recording device is equipped with a 9-pin RS232 connector, go to step 4. If your PC or other serial data recording device is equipped with a 25-pin connector, go to step 5.**
4) **Plug the other end of the 9-to-9 pin computer cable into the 9-pin RS232 port of your PC or other serial data recording device. Go to step 8.**
5) **Locate the 9-to-25 pin computer cable adapter.**
6) **Plug the 9-to-25 pin computer cable adapter into the 25-pin port on your PC or other serial data recording device.**
7) **Plug the other end of the 9-to-9 pin computer cable into the 9-to-25 pin computer cable adapter. Go to step 8.**

   NOTE: Do not use the 9-to-25 pin modem cable to connect the control unit with the PC or other serial data recording device. The 9-to-25 pin modem cable is configured for use only with a modem.

8) **Press the <0> and <6> keys, and then press the <ENTER> key to display the Com Print Settings screen (Figure 9-22).**
9) **When in the Com Print Settings screen, determine the format of the data download (Section 9.4.2).**
10) **Initiate the data capture software (such as TEOMCOMM or RPComm) on your PC or other serial data recording device (such as a data logger).**

11) Ensure that the data capture software is set for the same communication parameters as the instrument. The default settings of the monitor are:

Baud rate	9600
Data bits	8
Parity	None
Stop bits	1

12) Set the data capture software to the “data capture” or “data download” mode.

13) Press the <RS232> key on the monitor’s keypad to display the Set RS-232 Mode screen (Figure 9-19).

14) When in the Set RS-232 Mode screen, press the <EDIT> key.

15) Press the up (<↑>) and down (<↓>) arrow keys to select “Print On Line.”

16) Press the <ENTER> key. The instrument will begin downloading data to the PC or other serial data recording device (such as a data logger) immediately after you press the <ENTER> key.

17) When the data download is complete, set the RS232 protocol to “None.”

18) Disconnect the RS232 cable from the monitor and the PC or other serial data recording device.

9.4.4.3. Store to Print Mode

The user can set up the monitor to download data records using the Store to Print Mode before they have been recorded, while they are being recorded, or after they have been recorded. The Store To Print mode is designed to transmit information to a serial printer by sending one new record every 2 seconds.

Follow these steps to download data using the Store to Print Mode:

1) Connect one end of the 9-to-9 pin computer cable to one of the RS232 ports on the control unit.

2) Ensure that nothing is connected to the other RS232 port of the control unit.

3) If your serial printer is equipped with a 9-pin RS232 connector, go to step 4. If your serial printer is equipped with a 25-pin connector, go to step 5.

4) Plug the other end of the 9-to-9 pin computer cable into the 9-pin RS232 port of your serial printer. Go to step 8.

5) Locate the 9-to-25 pin computer cable adapter.

6) Plug the 9-to-25 pin computer cable adapter into the 25-pin port on your serial printer.

7) Plug the other end of the 9-to-9 pin computer cable into the 9-to-25 pin computer cable adapter. Go to step 8.

NOTE: Do not use the 9-to-25 pin modem cable to connect the control unit with the serial printer. The 9-to-25 pin modem cable is configured for use only with a modem.

8) If you want to set the storage pointer to the first data record to be downloaded, go to step 9. If you do not want to move the storage pointer, go to step 12.

9) Press the <STORE> key on your monitor's keypad to display the View Storage screen (Figure 9-24).

10) Press the right (<→>) and left (<←>) arrow keys to move the storage pointer to the data record where you want the data download to begin (Section 8).

11) Press the <CTRL> key and hold it down, then press the <LAST/FIRST> key. This will move the storage pointer to the data record just before your "beginning" data record.

12) Ensure that your serial printer is turned on and is ready to begin printing.

13) Press the <RS232> key on the monitor's keypad to display the Set RS-232 Mode screen (Figure 9-19).

14) When in the Set RS-232 Mode screen, press the <EDIT> key.

15) Press the up (<↑>) and down (<↓>) arrow keys to select "Store to Print."

16) Press the <ENTER> key. The instrument will begin downloading data to the serial printer immediately after you press the <ENTER> key.

NOTE: If you leave the monitor in the Store to Print Mode after the monitor has transmitted the last data record in its data storage buffer, the monitor will continue to transmit stored data records to the serial printer as data records are stored in its data storage buffer. The user sets the rate at which data records are stored in the data storage buffer, and the stored variables that will be downloaded to the serial printer, when in the Set Storage screen (Section 6).

17) When the data download is complete, set the RS232 protocol to "None."

18) Disconnect the RS232 cable from the monitor and the serial printer.

9.4.5. Data Downloading — Two-Way Communication

The user can retrieve the current value of all system variables over the RS232 connection, change the value of system parameters, and download values stored in the monitor's internal data buffer using a personal computer (PC), or other serial data recording device. The monitor must be in the AK Protocol or German Ambient Network Protocol RS232 Mode to perform two-way data tranmission (Section 9.4.3). The AK Protocol is used in combination with the RPComm software program (Section 10) and the TEOMCOMM software program (Appendix L). The instructions in this section explain a two-way data tranmission, which is transmitting data to and from the unit using a PC or other serial data recording device.

Follow these steps to transmit data to and from the monitor:

1) **Connect one end of the 9-to-9 pin computer cable to one of the RS232 ports on the control unit.**
2) **Ensure that nothing is connected to the other RS232 port of the control unit.**
3) **If your serial printer is equipped with a 9-pin RS232 connector, go to step 4. If your serial printer is equipped with a 25-pin connector, go to step 5.**
4) **Plug the other end of the 9-to-9 pin computer cable into the 9-pin RS232 port of your serial printer. Go to step 8.**
5) **Locate the 9-to-25 pin computer cable adapter.**
6) **Plug the 9-to-25 pin computer cable adapter into the 25-pin port on your serial printer.**
7) **Plug the other end of the 9-to-9 pin computer cable into the 9-to-25 pin computer cable adapter. Go to step 8.**

   NOTE: Do not use the 9-to-25 pin modem cable to connect the control unit with the serial printer. The 9-to-25 pin modem cable is configured for use only with a modem.

8) **Initiate the data capture software (such as TEOMCOMM or RPComm) on your personal computer (PC).**

9) Ensure that the data capture software is set for the same communication parameters as the instrument. The default settings of the monitor are:

Baud rate	9600
Data bits	8
Parity	None
Stop bits	1

10) Set the data capture software to the “data capture” or “data download” mode.

11) Press the <RS232> key on the monitor’s keypad to display the Set RS-232 Mode screen (Figure 9-19).

12) When in the Set RS-232 Mode screen, press the <EDIT> key.

13) Press the up (<↑>) and down (<↓>) arrow keys to select “AK Protocol” or “German Prot” (German Ambient Network Protocol) (Section 9.4.1).

14) Press the <ENTER> key.

15) Press the <0> and <7> keys, and then press the <ENTER> key to display the Com 2-Way Settings screen (Figure 9-24).

16) When in the Com 2-Way Settings screen, enter the appropriate parameters for the AK Protocol or German Ambient Network Protocol (Section 9.4.3).

NOTE: If you are using the TEOMCOMM software, select “AK Protocol” in the Set RS-232 Mode screen (step 13), and enter the following default values on the four lines of the Com 2-Way Settings screen:

RS-Para 1	52
RS-Para 2	75048
RS-Para 3	13010
RS-Para 4	0

17) Test the connection by checking to ensure that data can be sent and received using the commands appropriate to the selected RS232 protocol.

18) When the data transmission is complete, set the RS232 protocol to “None.”

19) Disconnect the RS232 cable from the monitor and the PC.

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Section 10: RPComm Software

RPComm is a communications software package developed for Windows 9x/NT/2000/Me to provide interactive remote communications with R&P instrumentation. RPComm also comes in a version for handheld computers/Windows CE. Refer to the Palm Pilot PC Operating Manual for instructions on using the PalmOS-based handheld computer to download data from the Series 1400a Monitor. Refer to Appendix A for a complete list of RPComm software screens.

RPComm enables the user to:

- Download data stored in the instrument's data storage buffer
- Schedule automatic data downloads
- View and graph downloaded data
- View a real-time graph of selected variables
- Remotely operate the unit using a virtual keypad
- Make multiple connections.

System requirements for running RPComm software are:

- Pentium processor
- 64 megabytes (MB) of random access memory (RAM)
- 40 MB of hard drive space.

RPComm has two communication modes — direct and modem. Direct communication is accomplished when the unit has a direct cable connection with a personal computer (PC). Modem communication is accomplished when the unit has a connection with a PC through the use of a modem and phone line (Appendix H). Before modem communication is attempted, direct communication must be successfully completed. This will ensure that the PC and unit have been set up properly for communications.

10.1. Instrument Setup for Direct Communication

Your personal computer (PC) must be connected to the monitor's control unit.

Follow these steps to connect the PC to the monitor:

1) **Connect one end of the 9-to-9 pin computer cable to one of the RS232 ports on the control unit.**
2) **Ensure that nothing is connected to the other RS232 port of the control unit.**
3) **If your PC is equipped with a 9-pin RS232 connector, go to step 4. If your personal computer is equipped with a 25-pin connector, go to step 5.**
4) **Plug the other end of the 9-to-9 pin computer cable into the 9-pin RS232 port of your PC. Go to step 8.**
5) **Locate the 9-to-25 pin computer cable adapter.**
6) **Plug the 9-to-25 pin computer cable adapter into the 25-pin port on your PC.**
7) **Plug the other end of the 9-to-9 pin computer cable into the 9-to-25 pin computer cable adapter. Go to step 8.**

   NOTE: Do not use the 9-to-25 pin modem cable to connect the control unit with the PC. The 9-to-25 pin modem cable is configured for use only with a modem.

8) **Ensure that the Main screen is displayed on the control unit's four-line display.**
9) **Press the <F2> key on the control unit's keypad until an "N" (None Mode) displays in the RS232 Mode field of the Main screen's status line (Figure 10-1). The instrument must remain in the None Mode while executing the computer routines described in this section.**

RS232 Mode field

```
OK    4+  11%  NU     09:39
Mass Conc>             33.6
30-Min MC              26.8
01-Hr MC               12.5
```

Figure 10-1. Main screen with the RS232 Mode field highlighted.

10.2. Using RPComm

NOTE: This section assumes that RPComm was installed in the default locations when the installation program was executed (Appendix D).

10.2.1. Starting RPComm

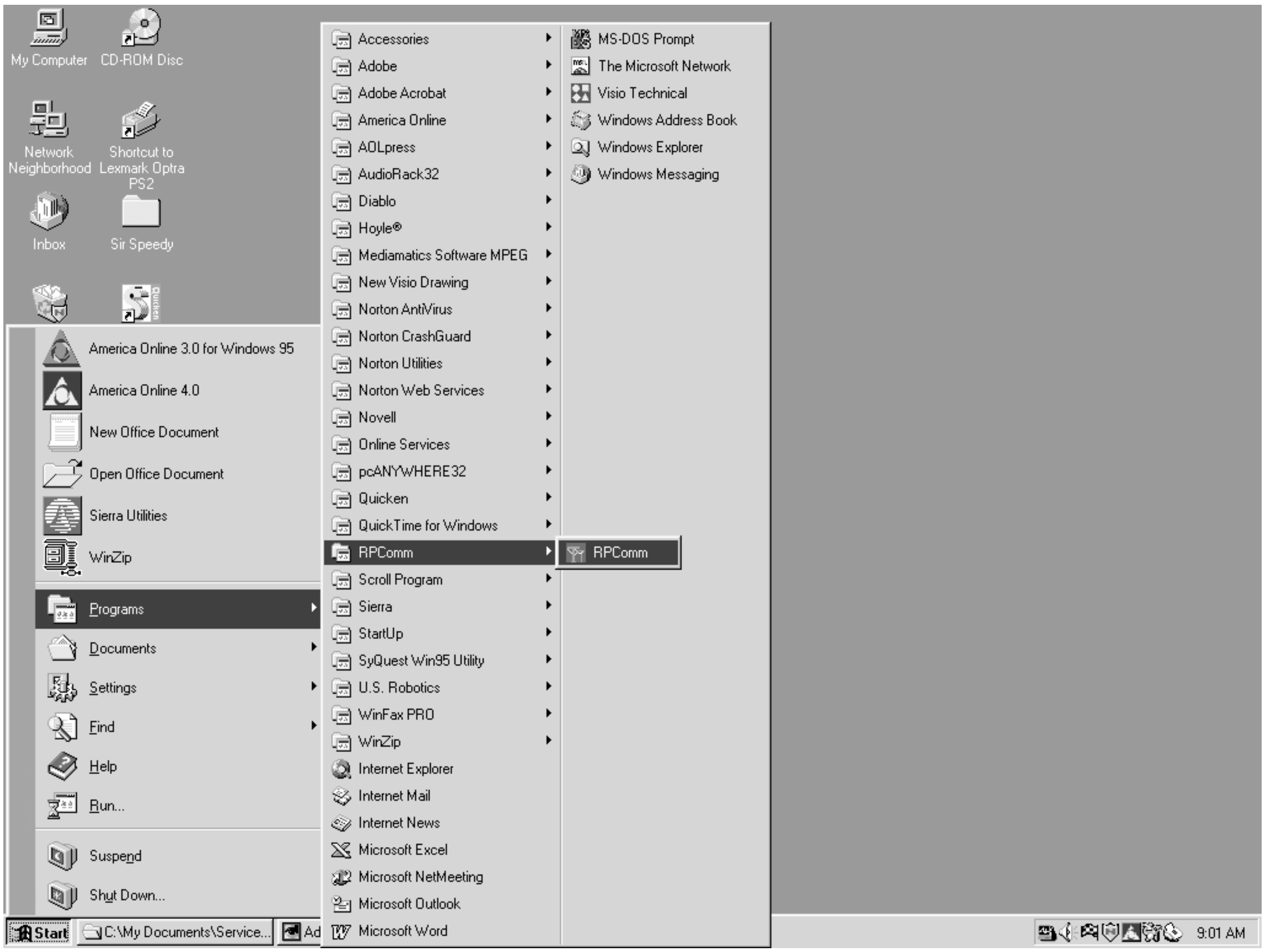
NOTE: The Windows operating system screens shown in this section are from the Windows 98 operating system. These screens may vary slightly from your computer's screens if you are operating RPComm under other Windows operating systems.

The newest version of RPComm available from the R&P Web site (www.rpco.com) is equipped with "Autorun." This means that every time you turn on your personal computer (PC), the RPComm software application will automatically begin running. If you close the RPComm software application to use other software, you may start it manually from the "Start" menu.

Follow these steps to run RPComm:

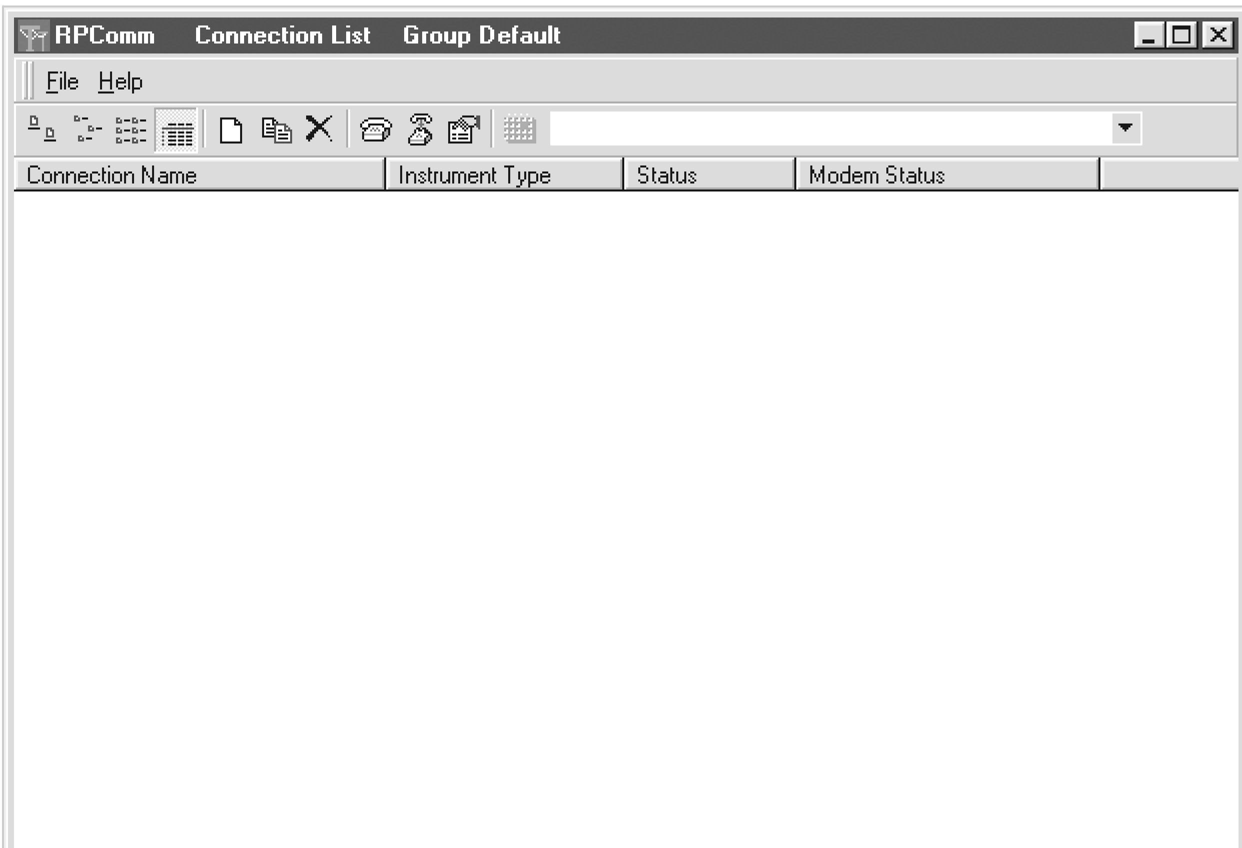
1) **Select the "Start" button on your PC's screen.**
2) **When the Start menu displays, select "Programs," the "RPComm" folder and then "RPComm" (Figure 10-2).**

Figure 10-2. Selecting Programs from the Start menu, then the RPComm folder and RPComm.



3) When RPComm starts running, the RPComm Connection List screen will display (Figure 10-3).

Figure 10-3. Connection List screen.

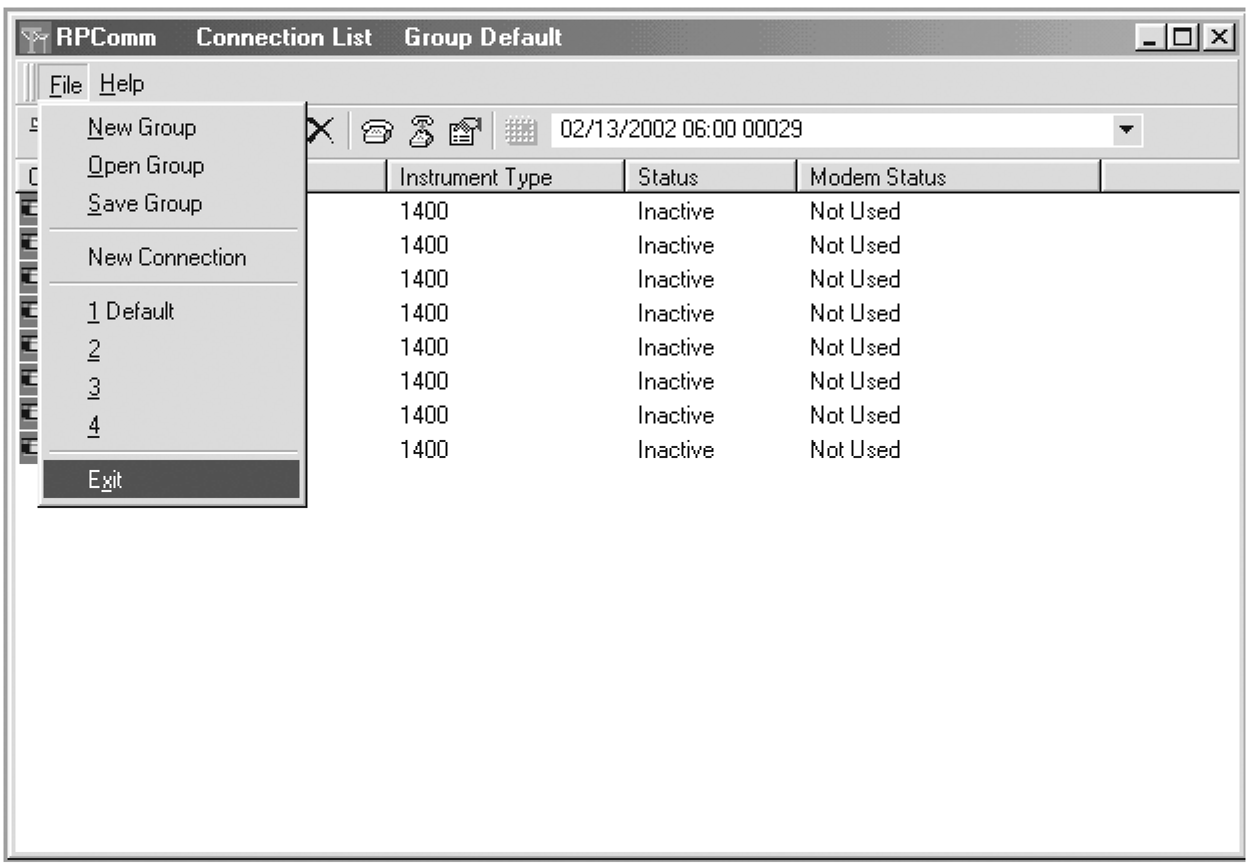


10.2.1.1. EXITING RPCOMM

Follow these steps to stop running RPComm:

1) When in the Connection List screen (Figure 10-3), select "File" and then "Exit" (Figure 10-4).

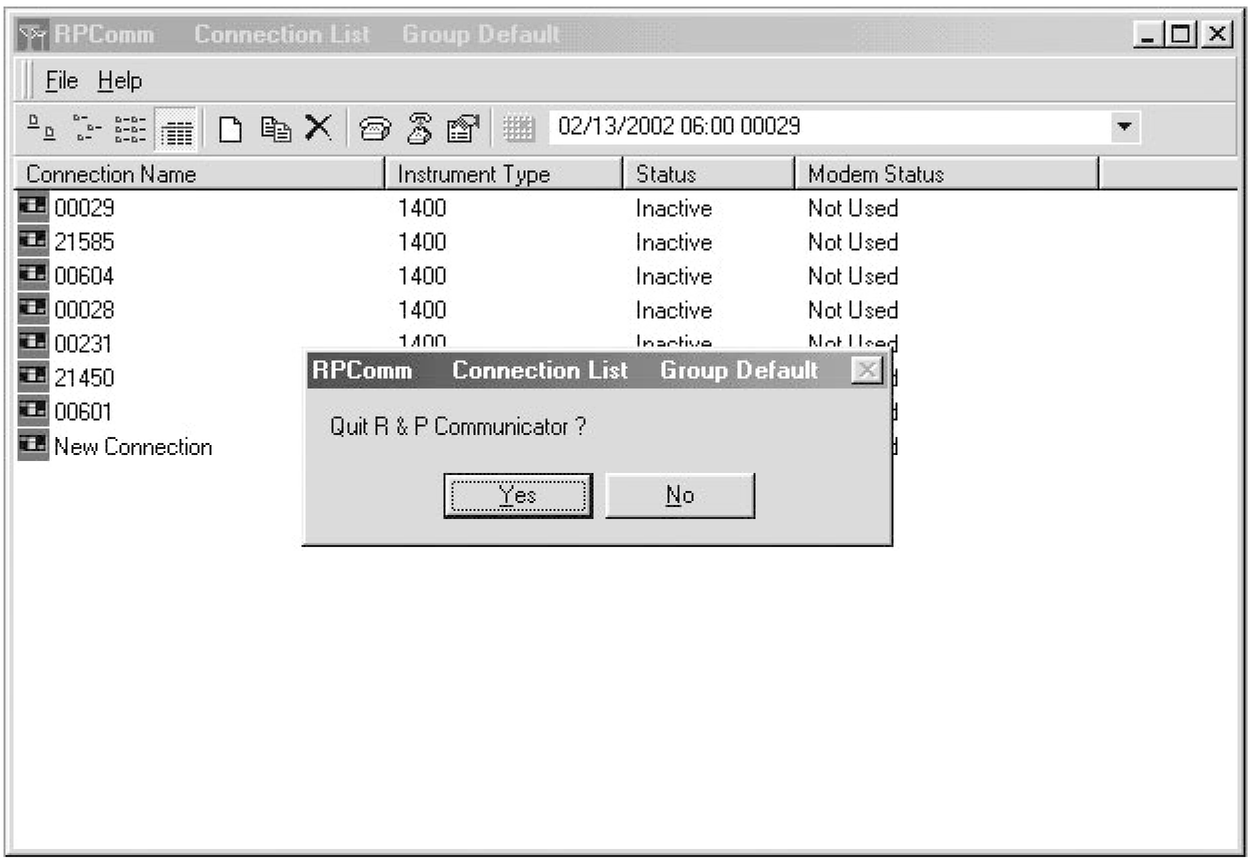
Figure 10-4. Connection List screen with the File menu displayed.



2) The RPComm Connection List screen will display with a "Quit R & P Communicator?" message (Figure 10-5).

3) Select "Yes."

Figure 10-5. Connection List screen with "Quit R & P Communicator?" message.



10.2.2. Creating a New Connection

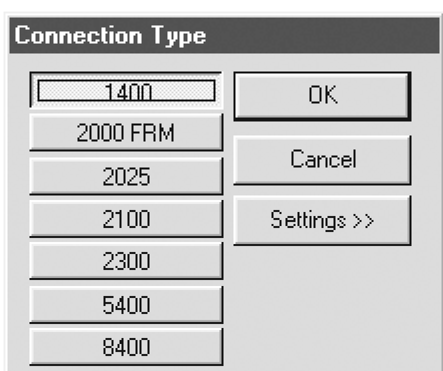
A connection is the hardware, software and proper settings that enable information to travel between your personal computer (PC) and unit. The hardware part of the connection is established by using a 9-to-9 pin cable (Section 6). The software connection is established when RPComm is started. The proper settings must be set up within RPComm to complete the connection.

NOTE: The Windows operating system screens shown in this section are from the Windows 98 operating system. These screens may vary slightly from your computer's screens if you are operating RPComm under other Windows operating systems.

Follow these steps to create a new connection:

1) When in the Connection List screen (Figure 10-3), select the New Connection icon  on the toolbar. The Connection Type screen will be displayed (Figure 10-6).

Figure 10-6. Connection Type screen.



2) When in the Connection Type screen, select the "1400" button and then the "Settings >>" button to display the AK Protocol Setup screen (Figure 10-7).

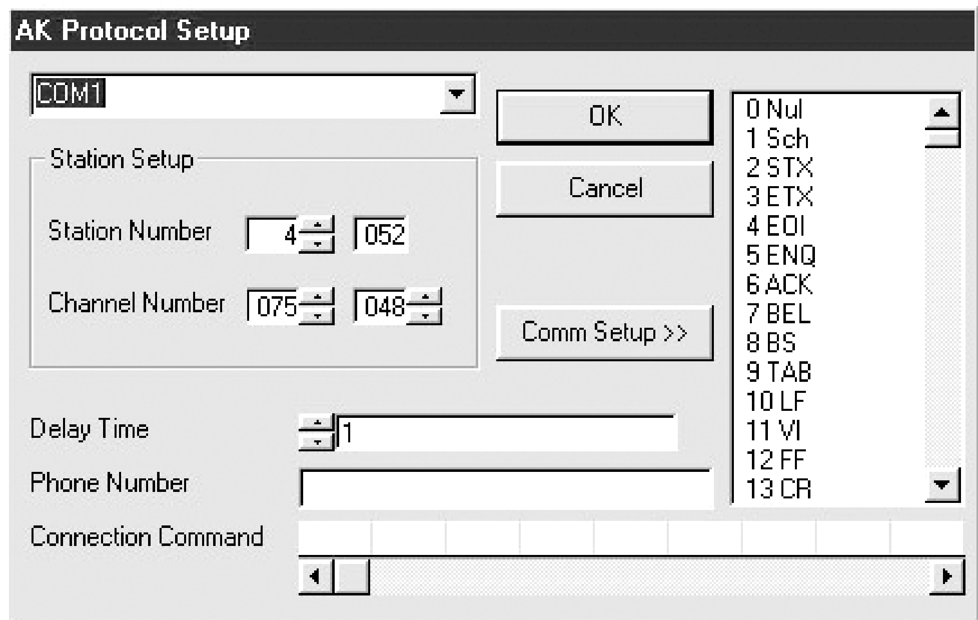


Figure 10-7. AK Protocol Setup screen.

3) For a direct connection, the connection description box should read "COMX," where "X" is the serial (COM) port on your PC that the monitor is connected to (Section 10.1).

4) The Station Setup portion of the screen lists a Station Number (default = 4, 052) and Channel Number (default = 075, 048). These values must match those entered into the unit on its COM 2-Way Settings screen. R&P recommends that these be left at their default values.

5) The description boxes for Delay Time, Phone Number and Connection Command are not used for a direct connection.

6) Select the "OK" button when the proper settings have been confirmed. The Connection Type screen will become the active screen on your PC's display.

7) When in the Connection Type screen (Figure 10-6), select the "OK" button to finish the connection setup. "New Connection" will now be displayed in the Connection List screen. This name can be edited by highlighting the words "New Connection" and then selecting the words again. When the blinking cursor appears, the user can use the PC's keyboard to enter the desired name for the new connection. To save this new file name, press the "Enter" key on your PC's keyboard.

8) The connection should now be ready for use. However, because different instruments require different RS232 port settings, these values must sometimes be changed. Refer to Section 10.2.2.1 for information on confirming or changing these settings. If you want to define additional new connections, go to step 9. If you do not want to define additional new connections, go to step 11.

9) Repeating steps 1-8 to define each new connection. These new connections can connect various instrument types. When you have completed defining your new connections, you can save them in a "connection group." If you want to save your new connections in a "connection group," go to step 10. If you do not want to save your new connections in a "connection group," go to step 11.

10) Ensure that all of your new connections are displayed in the Connection List screen. Ensure that the monitor's RS232 mode is set to "AK Protocol" (Section 9). When in the Connection List screen, select the "File" pull down menu and highlight "Save Group" (Figure 10-8). The next time that you start RPComm, you can restore the connection group by selecting the "File" pull down menu and then highlighting "Open Group." A list of saved connection groups will be displayed in the Save Connection Group screen (Figure 10-9). Highlight the desired group in the Save Connection Group screen and select the "OK" button.

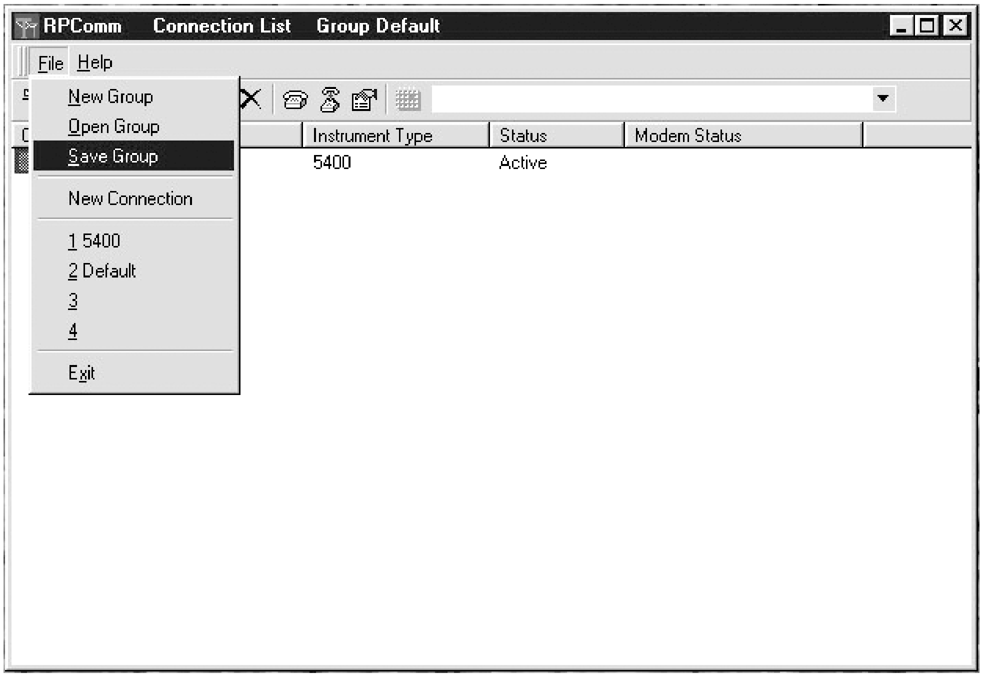


Figure 10-8. RPComm Connection List screen with File pull down menu.

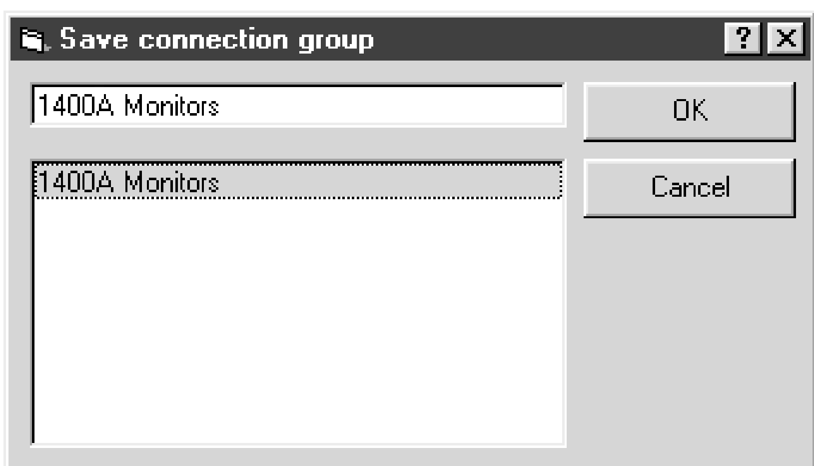


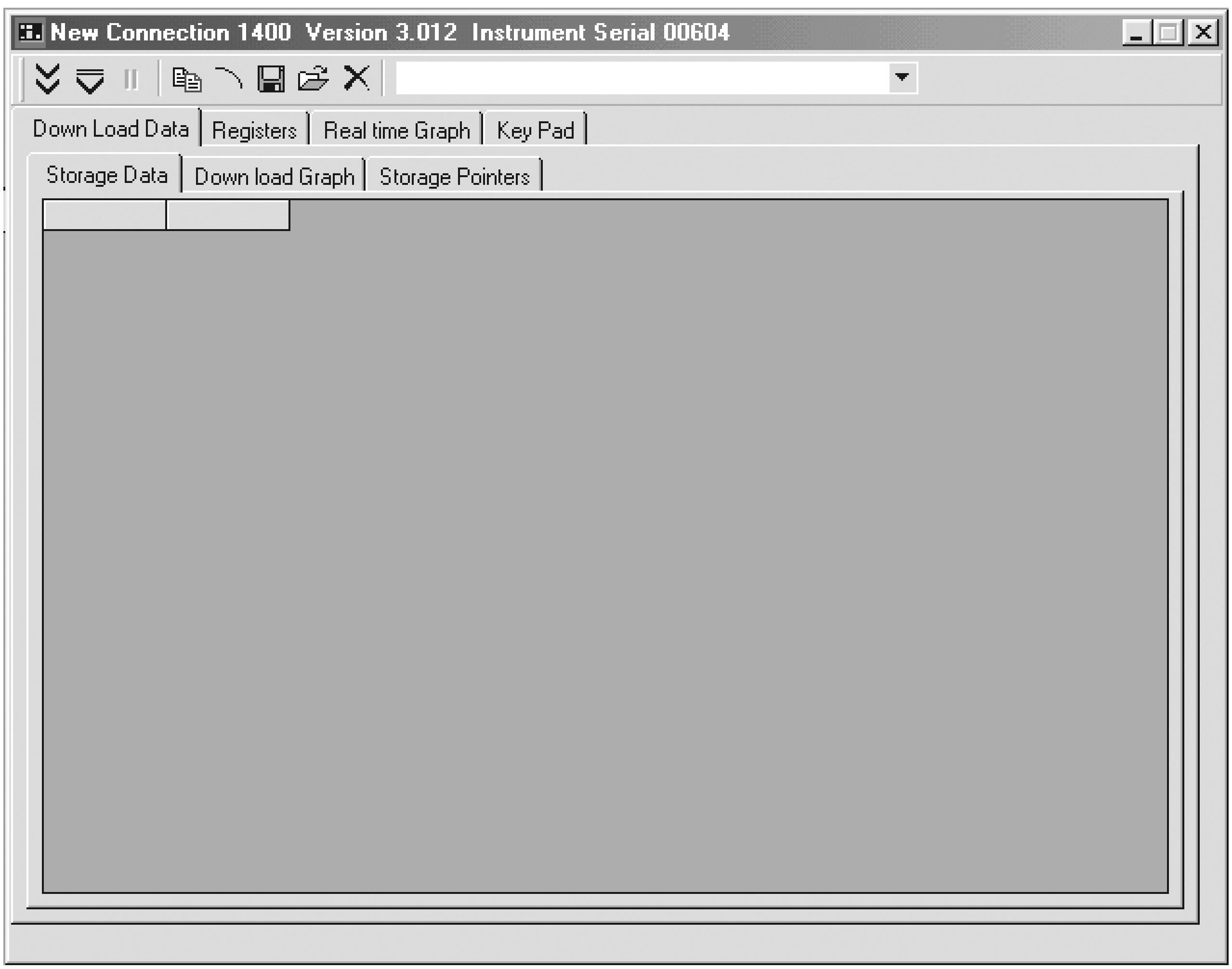
Figure 10-9. Save Connection Group screen.

11) To connect to an instrument, highlight the desired connection in the Connection List screen, and then select the Connection icon.

 **This will display the RPComm Download Data screen (Figure 10-10).**

NOTE: If the connection is successful, the instrument's serial number will be displayed at the top of the screen. If the connection is not successful, or if there is no instrument attached, then the serial number area will be blank or will display "99999."

Figure 10-10. RPComm Download Data screen.



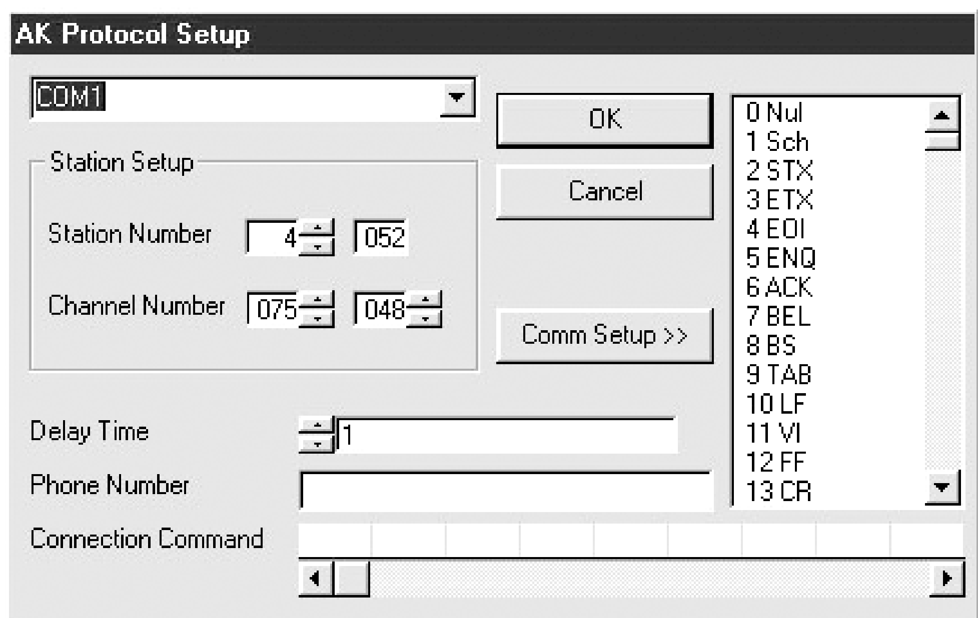
10.2.2.1 Checking Connection Settings

Because different instruments require different RS232 port settings, these values must sometimes be changed. You may also want to confirm the settings before beginning to download data from the Series 1400a Monitor.

Follow these steps to check (or change) the RS232 port settings in RPComm:

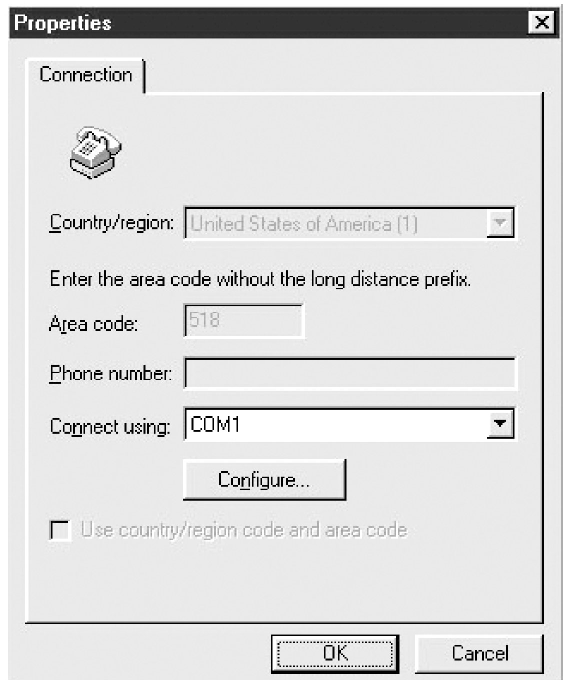
1) **When in the Connection List screen (Figure 10-3), select the "Display Connection Properties" button. The AK Protocol Setup screen will display (Figure 10-11).**

Figure 10-11. AK Protocol Setup screen.



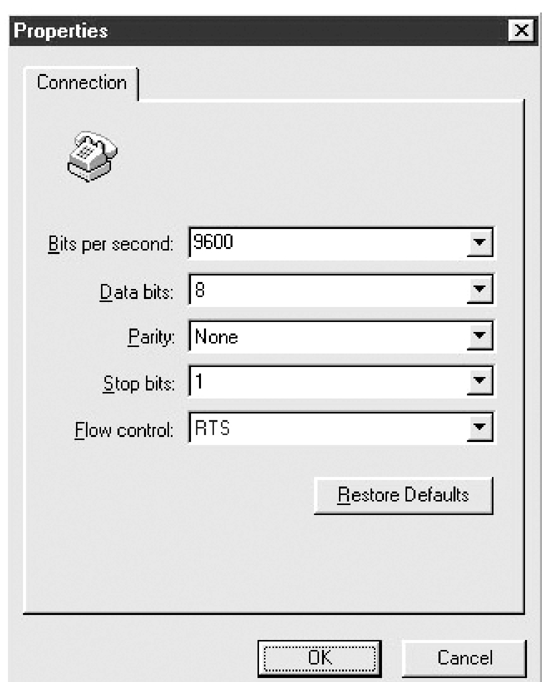
2) **When in the AK Protocols Setup screen, select the "Comm Setup" button. The "Properties" screen with the telephone setup information will display (Figure 10-12) in front of the AK Protocols Setup screen.**

Figure 10-12. Properties screen with telephone setup information.



3) Select the "Configure..." button. The Properties screen with COM connection information (Figure 10-13) will display.

Figure 10-13. Properties screen with COM connection information.



4) When in the Properties screen with COM connection information, check the settings. For the Series 1400a Monitor, the settings should be:

baud rate = 9600
data bits = 8
parity = None
stop bits = 1
flow control = RTS

5) Change the values to match your instrument, if necessary.

NOTE: To return the settings to their default values, select the “Restore Defaults” button (Figure 10-13).

6) When the settings are accurate, select the “OK” button in the Properties screen with COM connection information.

7) When in the Properties screen with telephone setup information, select the “OK” button.

8) When in the AK Protocol Setup screen, select the“OK” button. The Connection List screen will now display.

10.2.3. Downloading Data With RPComm

R&P instruments keep track of which records have been downloaded by using “storage pointers.” These storage pointers indicate the most recently retrieved data record, and serve as the starting point for future downloads. Every time RPComm downloads data records from the Series 1400a Monitor, the unit’s storage pointer is moved to the last data record that was downloaded.

The user can download all the data that are stored in the unit’s internal data logger beginning at the storage pointer. The storage pointer is a “place marker” in the unit’s data logger. It indicates to the RPComm program where the data download should begin. After the data have been downloaded, the unit sets the storage pointer to the end of the internal data storage buffer, so that the next time data are downloaded, only new data records are transmitted. However, if the user wants to download specific records (for example, from a particular date), they can change the position of the storage pointer within the data storage buffer (Section 10.2.3.1). Also, you can move the storage pointer to re-download data that has been lost from your personal computer (PC), or to skip forward to download more recent data records.

NOTE: The Windows operating system screens shown in this section are from the Windows 98 operating system. These screens may vary slightly from your computer’s screens if you are operating RPComm under other Windows operating systems.

10.2.3.1. Setting the Storage Pointer Position

Follow these steps to set the storage pointer position:

1) **When in the Connection List screen (Figure 10-3), highlight the desired connection in the Connection List screen, and then select the Connection icon.**  **This will display the Download Data screen (Figure 10-10).**
2) **When in the Download Data screen, select the Storage Pointers tab. The Storage Pointer screen (Figure 10-14) will display.**

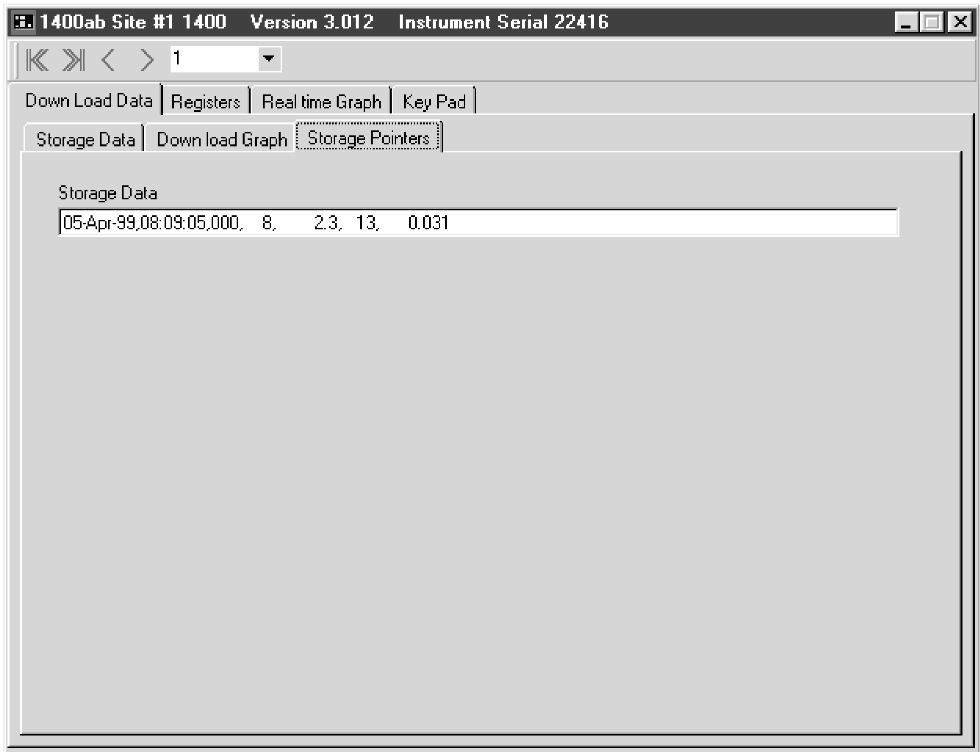
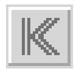
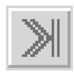
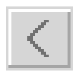
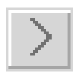


Figure 10-14. Storage Pointer screen.

3) When in the Storage Pointer screen, select the appropriate control button to move the storage pointer. Refer to Figure 10-15 for a complete description of the control buttons on the Storage Pointer screen.

Figure 10-15. Control buttons on the Storage Pointer screen.

	Moves the storage pointer to the first record in the buffer. The displayed position of the storage pointer will change, unless the storage pointer was already at the beginning of the buffer.
	Moves the storage pointer to the last record in the buffer. The displayed position of the storage pointer will change, unless the storage pointer was already at the end of the buffer.
	Moves the storage pointer back “x” number of records, where “x” is defined in the Change Record Step box
	Moves the storage pointer forward “x” number of records, where “x” is defined in the Change Record Step box.
	Change Record Step box. The step size can be 1, 5, 10, 100 or 1000.

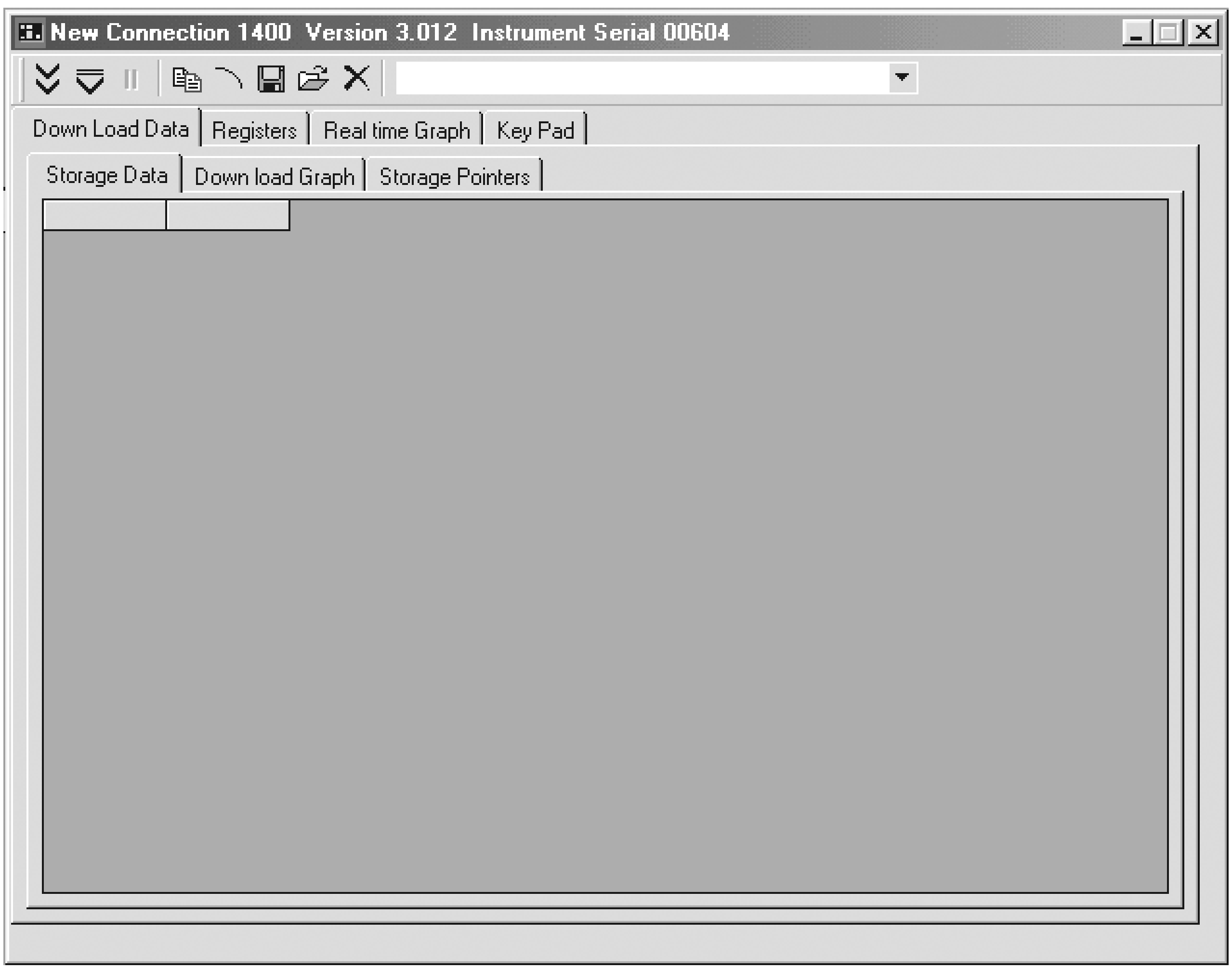
4) After you have set the storage pointer position, go to Section 10.2.3.2 for information on downloading the data records.

10.2.3.2. Downloading Data

Follow these steps to download data with RPComm:

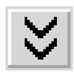
1) **Ensure that the storage pointer is in the correct position (Section 10.2.3.1).**
2) **When in the Connection List screen (Figure 10-3), select the Connection icon  on the tool bar. The Download Data screen will display (Figure 10-16).**

Figure 10-16. RPComm Download Data screen.

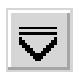


3) When in the Download Data screen, select the appropriate control button to initiate the data downloading process. Refer to Figure 10-17 for a complete description of the control buttons on the Download Data screen. After the data downloading procedure is complete, the Download Data screen will display with the data records that were downloaded (Figure 10-18).

Figure 10-17. Control buttons on the Download Data screen.



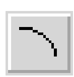
Downloads all stored data in the data buffer, starting at the first data record. After the data are downloaded, the storage pointer will move to the end of the data storage buffer. When the data have been downloaded, the data will be displayed in the Download Data screen.



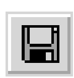
Downloads data from the current storage pointer position to the end of the data buffer. After the data are downloaded, the storage pointer will move to the end of the data storage buffer.

Aborts the download. This action will set the storage pointer to the record location where the download was aborted.

Copies the selected data to the Windows clipboard. The data can then be imported and used in other programs.

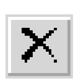


Sends the selected data to the Download Graph screen.



Stores the data to a file. The file is saved in a comma-delimited ASCII format.

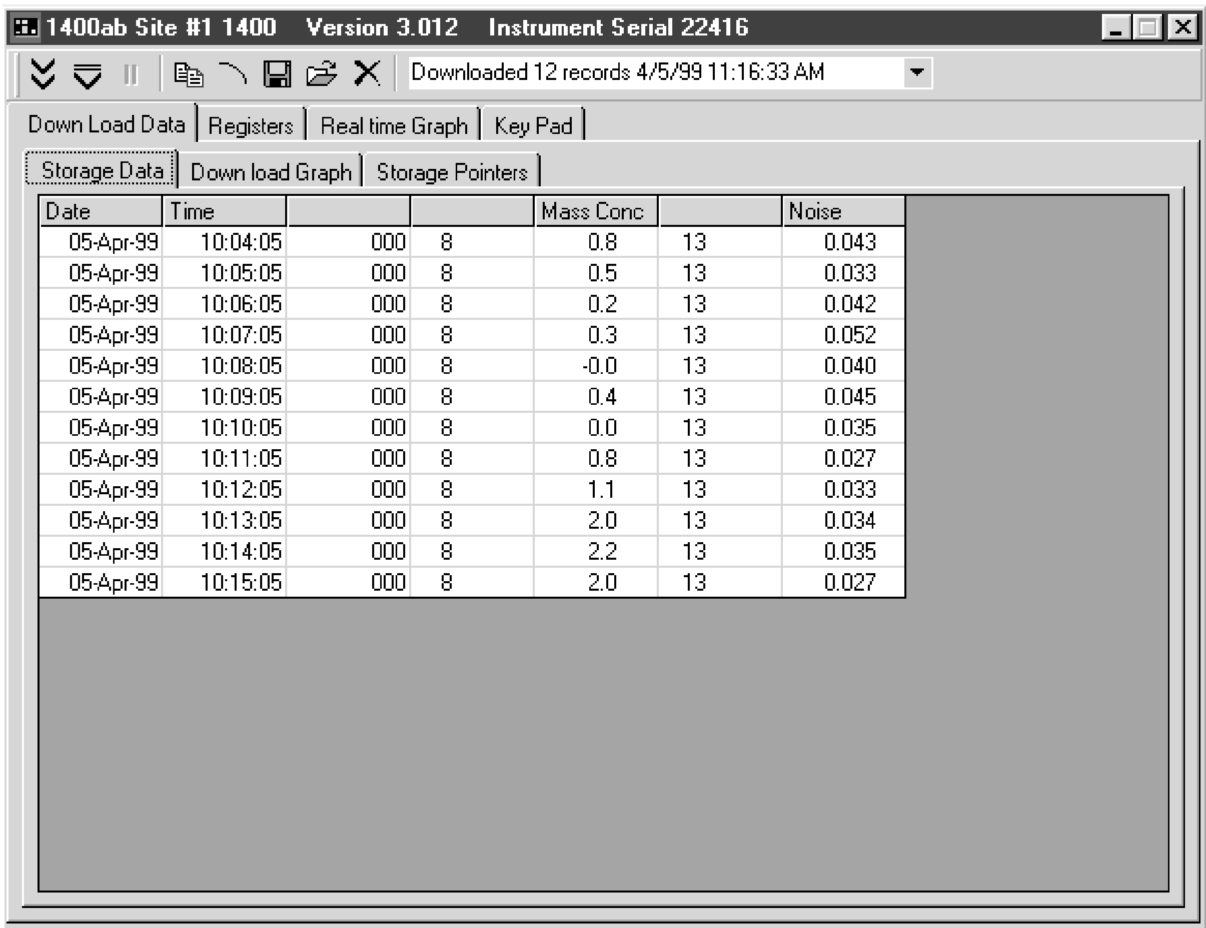
Opens a data file that has been previously saved to disk for display or graphing.



Clears the data currently being displayed.

When the download has been successfully completed, a message will appear in the Dialog box indicating how many records were downloaded.

Figure 10-18. Downloaded storage data.



Date	Time			Mass Conc		Noise
05-Apr-99	10:04:05	000	8	0.8	13	0.043
05-Apr-99	10:05:05	000	8	0.5	13	0.033
05-Apr-99	10:06:05	000	8	0.2	13	0.042
05-Apr-99	10:07:05	000	8	0.3	13	0.052
05-Apr-99	10:08:05	000	8	-0.0	13	0.040
05-Apr-99	10:09:05	000	8	0.4	13	0.045
05-Apr-99	10:10:05	000	8	0.0	13	0.035
05-Apr-99	10:11:05	000	8	0.8	13	0.027
05-Apr-99	10:12:05	000	8	1.1	13	0.033
05-Apr-99	10:13:05	000	8	2.0	13	0.034
05-Apr-99	10:14:05	000	8	2.2	13	0.035
05-Apr-99	10:15:05	000	8	2.0	13	0.027

10.2.4. Manipulating Downloaded Data

After the data have been downloaded, they can be manipulated for different uses. All data manipulation procedures listed in this section can be performed in RPComm without being connected to the monitor.

> NOTE: The Windows operating system screens shown in this section are from the Windows 98 operating system. These screens may vary slightly from your computer's screens if you are operating RPComm under other Windows operating systems.

10.2.4.1. Copying Data to the Clipboard

After the data have been downloaded and displayed in RPComm, a selection of data can be copied to the Windows clipboard for use in other applications.

Follow these steps to copy data to the Windows clipboard:

1) **When in the Download Data screen (Figure 10-16), ensure that the the Storage Data tab is selected.**

2) **Place your cursor on the data cell where you wish to begin the selection. Press and hold down the left mouse button and drag the cursor until all the desired data are selected.**

3) **An alternate way to select data is to place the cursor on the column heading where you wish to begin the selection. Press and hold down the left mouse button and drag the cursor across the columns until all the desired data are selected. This will choose all the data in the selected columns.**

4) **When the proper selection has been made, press the Copy icon.**

 **This will copy the selected data to the Windows clipboard. The data can then be pasted into another application.**

NOTE: Column heading information will be included with these data, even if the entire column was not selected.

10.2.4.2. Graphing Downloaded Data

Follow these steps to graph the downloaded data:

1) **When in the Download Data screen (Figure 10-16), ensure that the the Storage Data tab is selected.**
2) **To select data, place the cursor on the data cell where you wish to begin the selection. Press and hold down the left mouse button and drag the cursor until all the desired data are selected.**
3) **An alternate way to select data is to place the cursor on the column heading where you wish to begin the selection. Press and hold down the left mouse button and drag the cursor across the columns until all the desired data is selected. This will choose all the data in the selected columns.**
4) **When the desired selection has been made, select the Graph icon.**

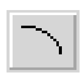
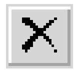
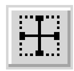
    **This will send the selected data to the Download Graph tab.**
5) **When in the Download Data screen, select the Download Graph tab. The data that were selected should now be graphed and will appear in the Download Graph screen (Figure 10-19). The color key on the right portion of the Download Graph screen shows the variables being graphed and their corresponding colors.**
6) **To display only one of the selected sets of data, choose the desired data set from the color key. To display all selected sets of data again, choose each data set from the color key while holding down the Shift key on your PC's keyboard.**
7) **Refer to Figure 10-20 for a complete description of the control buttons on the Download Graph screen.**

Figure 10-19. Download Graph screen.

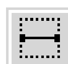
Figure 10-20. Control buttons on the Download Graph screen.



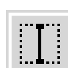
Clears all data listed on the right-hand side of the Download Graph screen. This includes the data being displayed.



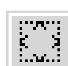
Decreases the scale of the x- and y-axes concurrently. With this icon selected, press and hold the left mouse button and make a box around an area (inside the graph) that you want to zoom into. Once the box is finished, release the mouse button. The graph will be resized according to the box dimensions.



Decreases the scale of the x-axis. With this icon selected, press and hold the left mouse button at the beginning of the area that you want to zoom into. Drag the cursor horizontally to the end of the zoom area and release the mouse button. The graph will be resized according to the new x-axis dimensions.



Decreases the scale of the y-axis. With this icon selected, press and hold the left mouse button at the beginning of the area that you want to zoom into. Drag the cursor vertically to the end of the zoom area and release the mouse button. The graph will be resized according to the new y-axis dimensions.



Enables panning. Panning allows the user to move the graph area so that a different section of the x- or y-axis will be displayed without affecting the scale of either axis. With this icon selected, place the mouse cursor somewhere within the graph area and hold down the left mouse button. Move the mouse to display the desired section of the graph.

Selecting this icon will undo the last zoom or panning step.

Rescales the x- and y-axes so that all the graphs for the selected data are displayed.

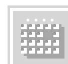
Toggles between the two possible x-axis scales: date and time, and time only. This does not affect the way the data are displayed on the graph.

These two boxes define the number of axis divisions on the graph. The left box refers to the x axis and the right box refers to the y axis. The number of divisions on the axis can be set to 5, 10, 15 or 20. Increasing the number of divisions results in a finer axis grid. Decreasing the number of divisions results in a courser axis grid. This does not affect the way the data are displayed on the graph.

10.2.4.3. Storing Data to a File

Follow these steps to save data to a file:

1) **When in the Download Data screen (Figure 10-16), ensure that the the Storage Data tab is selected.**

2) **Select the Save icon.**  **The Save Dialog box will appear and prompt you for a filename. The default file name format is:**

   nnnnnxyy.txt

   where: nnnnnn = the unit's serial number

   x = data type (s = storage data)

   yy = file number (01, 02, etc.)

3) **Once you have chosen a filename, select the "Save" button.**

4) **The file will be saved in a comma-delimited ASCII format which can be imported into any spreadsheet program. The data include all column heading information.**

10.2.5. Scheduling Data Downloads

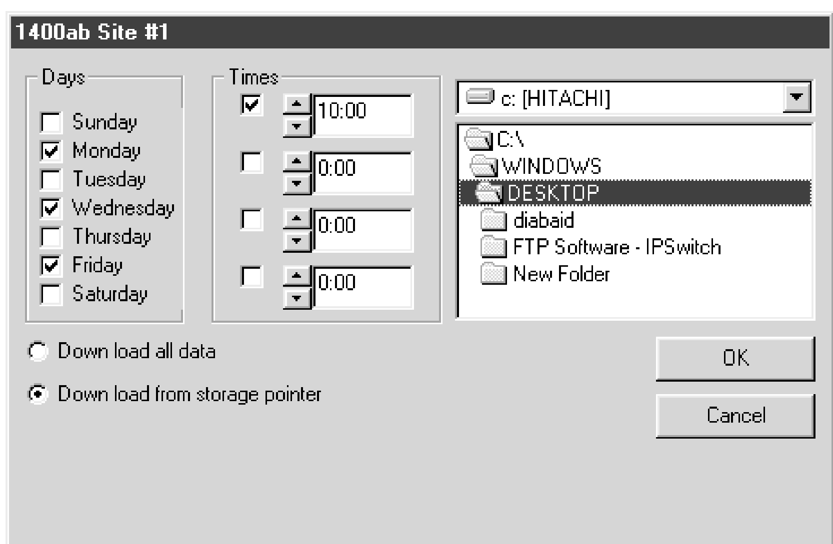
RPComm's automatic download capability allows the user to schedule automatic data downloads from a unit up to four times a day.

> NOTE: The Windows operating system screens shown in this section are from the Windows 98 operating system. These screens may vary slightly from your computer's screens if you are operating RPComm under other Windows operating systems.

Follow these steps to schedule an automatic data download:

1) When in the Connection List screen (Figure 10-3), select the Schedule Download icon. The Schedule Downloads screen (Figure 10-21) will now display.

Figure 10-21. Schedule Downloads screen.



2) Select the box next to the day(s) of the week that you want the data to be downloaded. You may choose a single day each week or any other combination of days.

3) Select the time(s) on the chosen day(s) that the data are to be downloaded. The data can be downloaded up to 4 times a day.

4) Select the directory location where you want the downloaded data to be stored. R&P recommends that you create a separate directory for data downloads, and that you remove these files from this directory on a regular basis because the file serial number can track only 100 files. The data file will be saved under a file name according to the following convention:

nnnnnxyy.txt

where: nnnnn = the unit's serial number
x = data type (s = storage data)
yy = file number (01, 02, etc.)

5) If you want all the data that is stored in the data storage buffer to be downloaded at each scheduled download time, go to step 6. If you want the data download to begin at the storage pointer position, go to step 7.

6) Place your mouse cursor on the white box located to the left of "Download all data," and click once with your mouse. A black checkmark will appear inside the box to confirm your choice. Go to step 8.

7) Place your mouse cursor on the white box located to the left of "Download from storage pointer," and click once with your mouse. A black checkmark will appear inside the box to confirm your choice. Go to step 8.

8) When the schedule has been completed, select "OK" to save your changes. The scheduled downloads for the next 24 hours are listed in the scheduled download list on the Connection List screen. For example, Figure 10-22 shows a scheduled download for 04/05/2001 at 12:00 pm for unit 1400ab, site #1.

Figure 10-22. Example of a scheduled download in the Connection List screen.

9) Data downloads can be scheduled for each connection listed in the connection list. If more than one download is scheduled for the same time, the downloads will occur in the order that they are listed in the Scheduled Download box.

NOTE: R&P recommends that you schedule data downloads to occur 5 minutes apart to ensure smooth data transmission.

During a scheduled download, RPComm assigns file numbers or names to the downloaded data according to the file numbers that already exist in the download directory. RPComm increments the file numbers by a value of one more than the largest file number that already exists in the download directory.

For example, if the download directory has one file in it with the number 20114s01.txt, at the next scheduled setpoint data download RPComm will assign the file name 20114s02.txt to the new downloaded data. The number “02” was the next available file number.

10.2.6. Viewing Instrument Operation

10.2.6.1. Viewing System Registers

A system register is a value entered into, calculated by, or measured by the unit. Examples of system registers are the unit's serial number (entered), the calibration constants (calculated), and the ambient temperature (measured). Every system register can be displayed by RPComm.

Follow these steps to view system registers:

1) When in the Download Data screen (Figure 10-23), select the Registers tab to display the Registers screen (Figure 10-24).

Figure 10-23. Download Data screen.

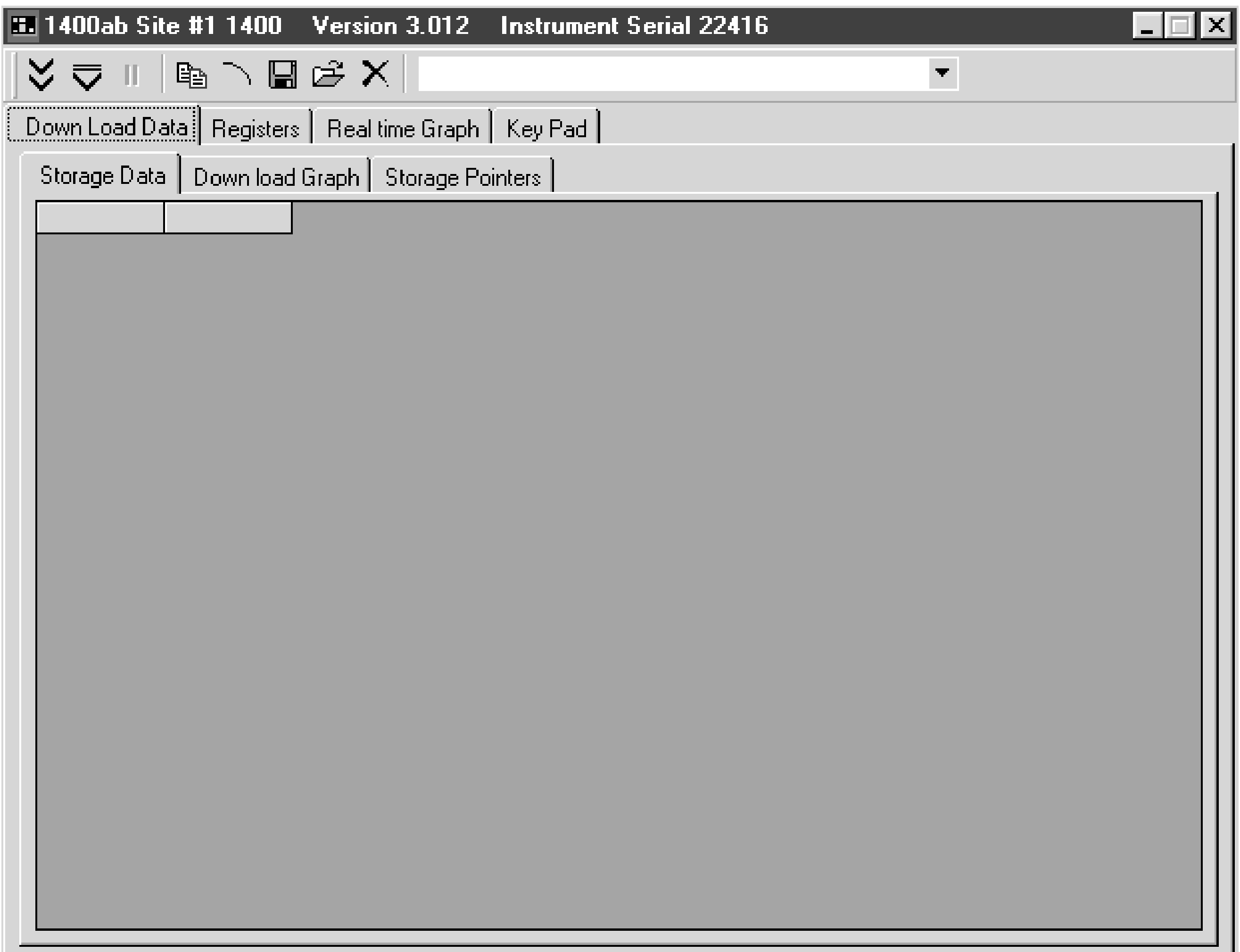
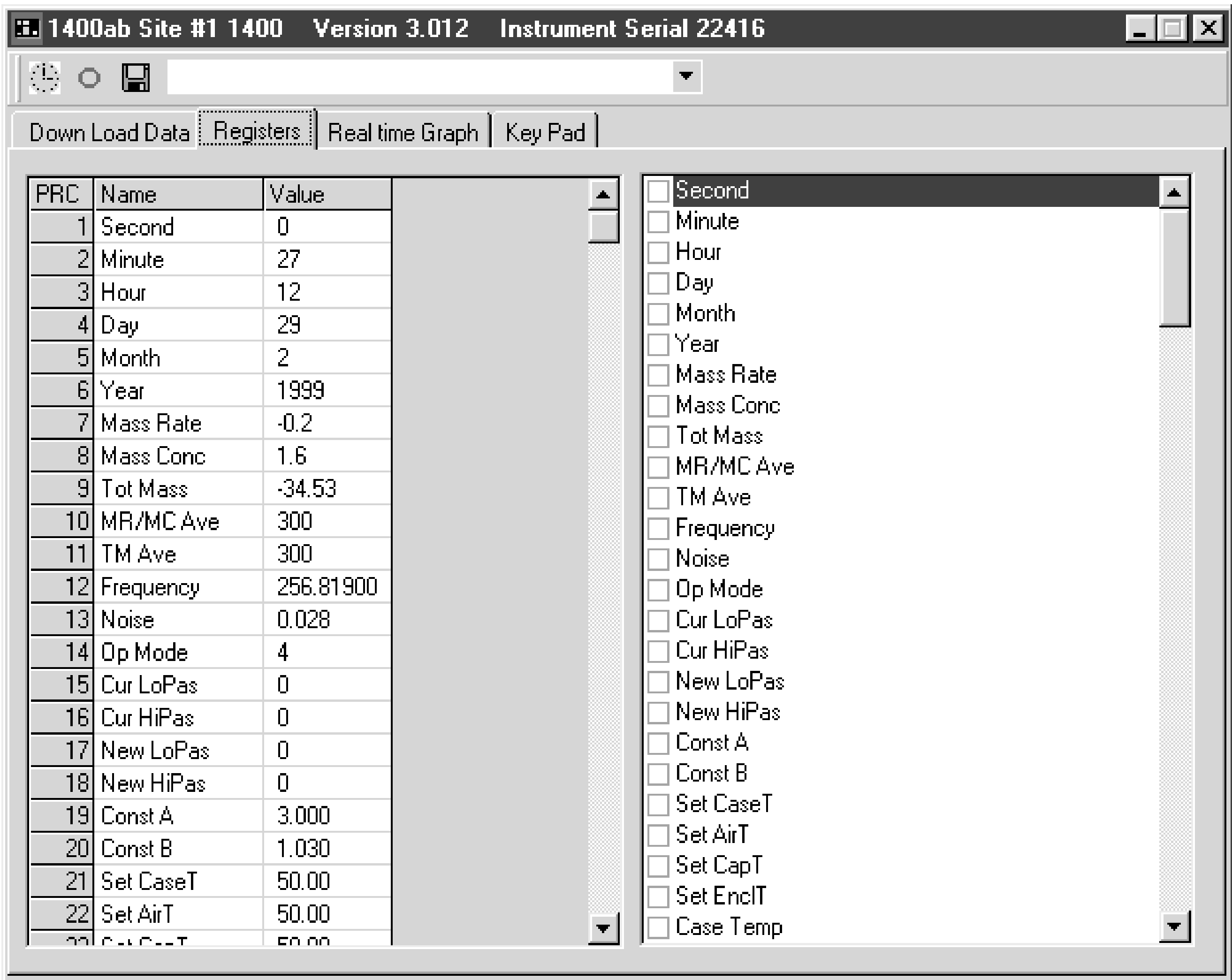
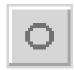
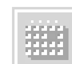


Figure 10-24. Registers screen.



2) On the right-hand side of the Registers screen is a list of all the system registers. Using the scroll bar, examine the list of registers with the scrollbar and place a checkmark next the registers that you wish to view. You also can select the Select All Registers icon  to choose all of the registers. As registers are selected, they will appear on the left-hand side of the screen.

3) Select the Read Registers icon  to read the selected registers from the unit. All the current values will appear in the list on the left-hand side of the screen next to their corresponding label.

4) To save the register list to a file, select the Save icon.  The user will then be prompted to select a location and file name. This list can be useful for troubleshooting.

10.2.6.2. Viewing the Instrument Virtual Keypad

A virtual keypad is available for use in RPComm versions 3.012 and higher. This keypad looks exactly like the keypad on the unit and shows the same current information as on the unit's four-line display.

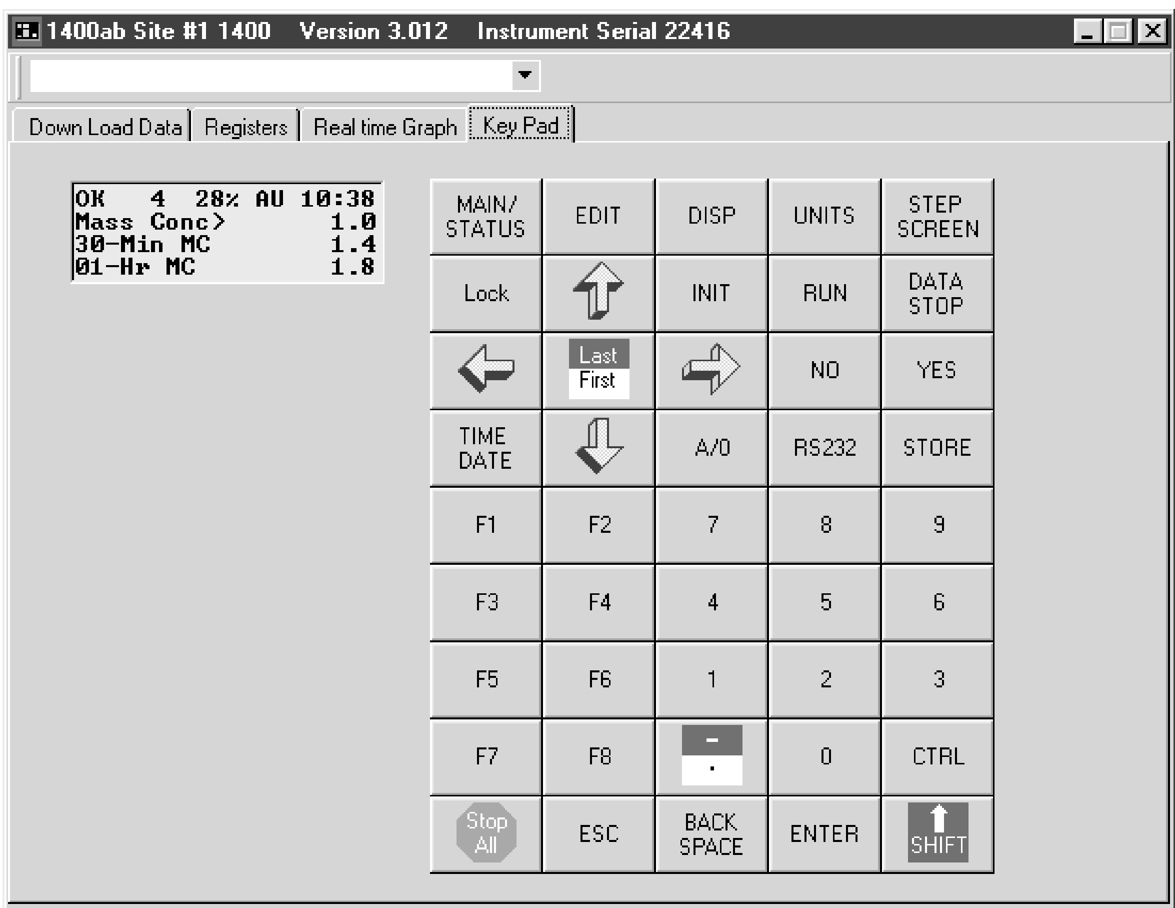
Follow these steps to view the virtual keypad:

1) When in the Download Data screen (Figure 10-23), select the Key Pad tab to display the virtual keypad (Figure 10-25).

NOTE: If the virtual display's status line shows a number line as the top line and does not show the proper display, RPComm is not communicating with the unit properly.

2) Operate the virtual keypad as you would the keypad on the unit.

Figure 10-25. Virtual keypad.



10.3. Creating a Real-Time Graph

RPComm can display any system register(s) in a real-time graph. Each register value is updated and graphed every second.

NOTE: The Windows operating system screens shown in this section are from the Windows 98 operating system. These screens may vary slightly from your computer's screens if you are operating RPComm under other Windows operating systems.

Follow these steps to create a real time graph:

1) **When in the Download Data screen (Figure 10-23), select the Real-Time Graph tab to display the Real-Time Graph screen (Figure 10-26).**
2) **In the lower right-hand corner of the screen is a list of system registers. Using the scroll bar, examine the list of registers and place a checkmark next to the registers that you want to graph. As registers are chosen, the values will appear on the graph. The color key on the upper right-hand portion of the screen shows the variables being graphed and their corresponding colors.**
3) **Refer to Figure 10-27 for a complete description of the control buttons on the Real-Time Graph screen.**

Figure 10-26. Real-Time Graph screen.

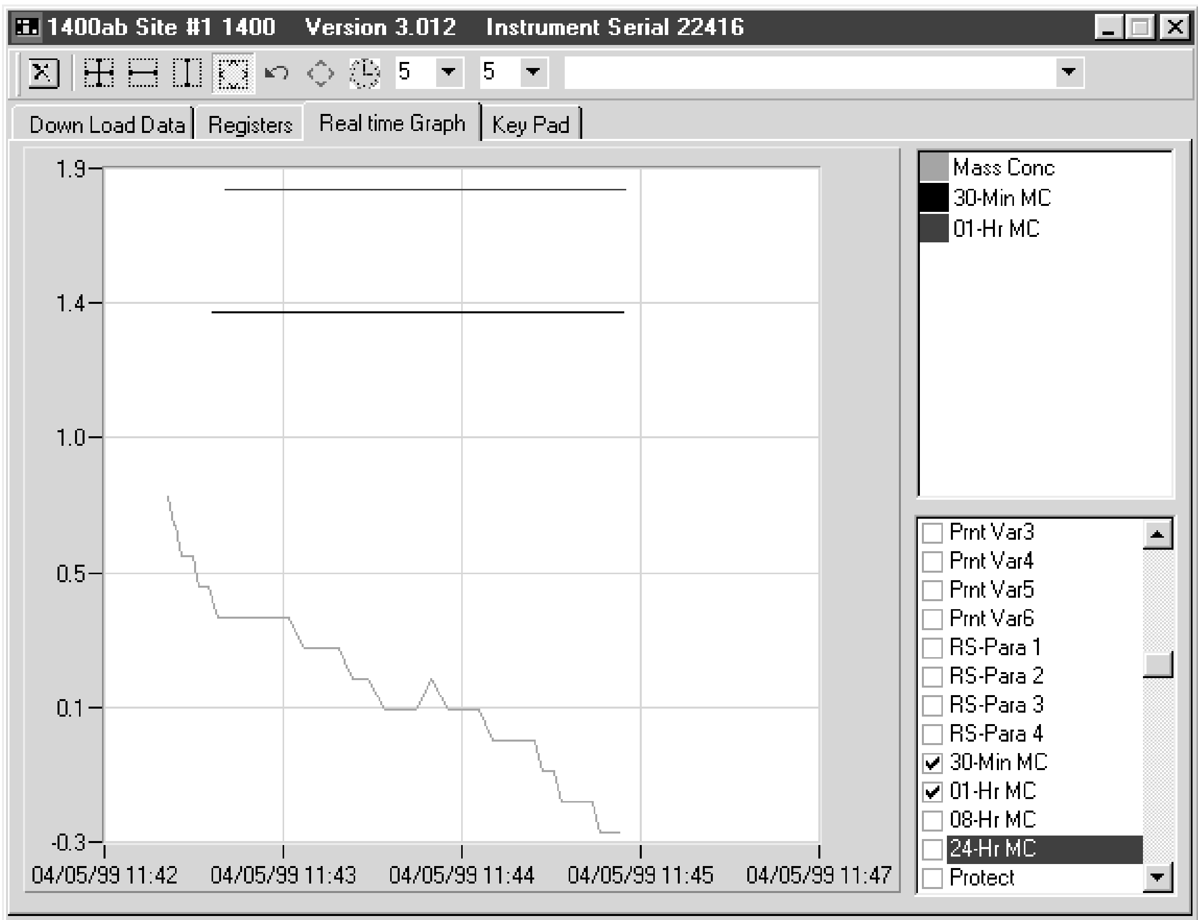
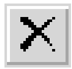
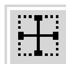
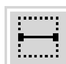
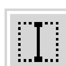


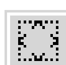
Figure 10-27. Control buttons on the Real-Time Graph screen.


Clears all data listed on the right-hand side of the Real-Time Graph screen. This includes the data being displayed.


Decreases the scale of the x- and y-axes concurrently. With this icon selected, press and hold the left mouse button and make a box around an area (inside the graph) that you want to zoom into. Once the box is finished, release the mouse button. The graph will be resized according to the box dimensions.


Decreases the scale of the x-axis. With this icon selected, press and hold the left mouse button at the beginning of the area that you want to zoom into. Drag the cursor horizontally to the end of the zoom area and release the mouse button. The graph will be resized according to the new x-axis dimensions.


Decrease the scale of the y-axis. With this icon selected, press and hold the left mouse button at the beginning of the area that you want to zoom into. Drag the cursor vertically to the end of the zoom area and release the mouse button. The graph will be resized according to the new y-axis dimensions.


Enables panning. Panning allows the user to move the graph so that a different section of the x- or y-axis will be displayed without affecting the scale of either axis. With this icon selected, place the mouse cursor somewhere within the graph area and hold down the left mouse button. Move the mouse to display the desired section of the graph.


Selecting this icon will undo the last zoom or panning step.


Rescales the x- and y-axes so that all the graphs for the selected data are displayed.


Toggles between the two possible x-axis scales: date and time, and time only. This does not affect the way the data are displayed on the graph.

These two boxes define the number of axis divisions on the graph. The left-hand box refers to the x-axis and the right-hand box refers to the y-axis. The number of divisions on the axis can be set to 5, 10, 15 or 20. Increasing the number of divisions results in a finer axis grid. Decreasing the number of divisions results in a courser axis grid. This does not affect the way the data are displayed on the graph.

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Section 11: Password Protection

The Series 1400a Monitor offers three levels of keypad locking: unlock mode, low lock mode, and high lock mode. The Main screen displays the current keypad locking level on its status line (Figure 11-1). The instrument is always in the unlock mode when it is first shipped from R&P, allowing the user full access to all of the functions of the monitor.

Figure 11-1. Main screen with keypad locking level (A) highlighted.

```
                   A
OK    4+  11%  NU     09:39
Mass Conc>             33.6
30-Min MC              26.8
01-Hr MC               12.5
```

The three states of password protection are defined as:

Unlock (U) mode — The user has access to all capabilities of the instrument.

Low lock (L) mode — The user can view all of the instrument screens or restart data collection by pressing the <F1> or <RUN> key, but cannot edit any of the system variables. Also, the user can change the operating mode of the instrument while in the low lock mode to perform functions such as a filter exchange.

High lock (H) mode — The user cannot make any changes from the keypad except for turning off the high lock mode with the proper password. Also, the user can only view the operation of the instrument through the current screen on the four-line display. The keys for moving the cursor and switching to different screens are disabled when the monitor is in the high lock mode.

11.1. Initiating the Low Lock Mode

✔ In low lock protection mode, the user can not edit any of the parameters in the system.

Follow these steps to enter and exit the low lock mode:

1) **Press the <LOCK> key on the monitor's keypad. The monitor will display an "x" in place of the usual ">" cursor on the four-line display.**

2) **Enter the six-digit numeric low lock password, and press the <ENTER> key.**

   NOTE: When the instrument is shipped from R&P, the low lock password is "100000."

3) **To return to the unlock mode, repeat steps 1-2.**

If you misplace or forget the low or high lock password, refer to Appendix L for further instructions.

11.2. Initiating the High Lock Mode

Follow these steps to enter and exit the high lock mode:

✔ In high lock protection mode, the user can not edit any of the parameters in the system or view different display screens.

1) **Press and hold down the <SHIFT> key on the monitor's keypad.**
2) **Press the <LOCK> key. The monitor will display an "x" in place of the usual ">" cursor on the four-line display.**
3) **Stop holding down the <SHIFT> key.**
4) **Enter the six-digit numeric high lock password, and press the <ENTER> key.**

   NOTE: When the instrument is shipped from R&P, the high lock password is "100000."

5) **To return to the unlock mode, repeat steps 1-4 and then follow the instructions in Section 11.1.**

If you misplace or forget the low or high lock password, refer to ApLendix C for further instructions.

11.3. Set Passwords Screen

The Set Passwords screen (Figure 11-2) allows the user to change the low and high lock passwords. The low and high passwords can be changed while in any operating mode.

Figure 11-2. Set Passwords screen.

```
        SET PASSWORD
Cur Lo Pass>            *
New Lo Pass             *
Cur Hi Pass             *
```

11.3.1. Changing the Low Password

Follow these steps to change the low password:

1) **When in the Main screen, press the <STEP SCREEN> key to display the Menu screen.**
2) **When in the Menu screen, press the up or down arrow keys to select “Set Passwords.”**
3) **Press the <ENTER> key to display the Set Passwords screen. Also, to display the Set Passwords screen, press <1>, <0> and then the <ENTER> key when in any screen.**
4) **Press the up or down arrow keys to place the cursor on the “Cur Lo Pass” line.**
5) **Enter the current password on the “Cur Lo Pass” line. If you enter the current password incorrectly, the instrument will beep and erase the entry.**
6) **Press the up or down arrow keys to place the cursor on the “New Lo Pass” line.**
7) **Enter the new six-digit numeric password on the “New Lo Pass” line. This six-digit code will now become the new low lock password.**

If you misplace or forget the low or high lock password, refer to Appendix L for further instructions.

11.3.2. Changing the High Password

Follow these steps to change the high password:

1) **When in the Main screen, press the <STEP SCREEN> key to display the Menu screen.**
2) **When in the Menu screen, press the up or down arrow keys to select "Set Passwords."**
3) **Press the <ENTER> key to display the Set Passwords screen. Also, to display the Set Passwords screen, press <1>, <0> and then the <ENTER> key when in any screen.**
4) **Press the up or down arrow keys to place the cursor on the "Cur Hi Pass" line.**
5) **Enter the current password on the "Cur Hi Pass" line. If you enter the current password incorrectly, the instrument will beep and erase the entry.**
6) **Press the up or down arrow keys to place the cursor on the "New Hi Pass" line.**
7) **Enter the new six-digit numeric password on the "New Hi Pass" line. This six-digit code will now become the new high lock password.**

If you misplace or forget the low or high lock password, refer to Appendix L for further instructions.

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Section 12: Routine Maintenance and Verification Procedures

This section describes the routine maintenance and verification procedures for the Series 1400a Monitor.

12.1. Routine Maintenance Procedures

Maintenance Procedures	Interval
Sample inlet	Clean the sample inlet each time that you exchange a TEOM filter (Appendix G).
Large in-line filters	Replace the large in-line filters every 6 months, or as necessary (Section 12.1.1).
Air inlet system	Clean the air inlet system once a year, or as necessary (Section 12.1.2).
Sample pump	Rebuild the sample pump once every 18 months, or as necessary. The pump rebuild kit (59-008630) contains instructions for rebuilding the pump that was shipped with the Series 1400a Monitor.

These maintenance intervals are guidelines. Requirements for routine maintenance are site-specific, and may vary from one location to another.

12.1.1. Exchanging the Large In-Line Filters

The large in-line filters (57-002758) are located on the main (SENSOR FLOW) and auxiliary (BYPASS FLOW) lines on the back of the control unit. These filters prevent contamination from reaching the flow controllers. You should replace the large in-line filters immediately following a TEOM filter cartridge exchange. This allows you to exchange the large in-line filters during the 30-minute flow and temperature stabilization period (Section 4).

✔ The instrument must be operated with both large in-line filters installed to avoid contamination of the flow controllers.

Tools Needed: None
Materials: 2 large in-line filters (57-002758)

Follow these steps to exchange the large in-line filters:

1) Remove the existing large in-line filters from their quick-connect fittings.

2) Install new large in-line filters onto the quick-connect fittings (Figure 12-1). Ensure that the arrows on the filters point away from the control unit (against the flow). This will allow the user to see the contamination as it is collected in the filter.

Figure 12-1. Replacing the large in-line filters.

12.1.2. Cleaning the Air Inlet System

You must clean the heated air inlet in the Series 1400a Monitor once a year to remove the buildup of particulate matter on its inner walls. You can order a tapered bristle brush (30-002227) that is appropriate for cleaning the air inlet system from R&P.

Tools Needed: Piece of plastic or another protective material
Soapy water, alcohol or freon solution
Soft brush
Materials: None

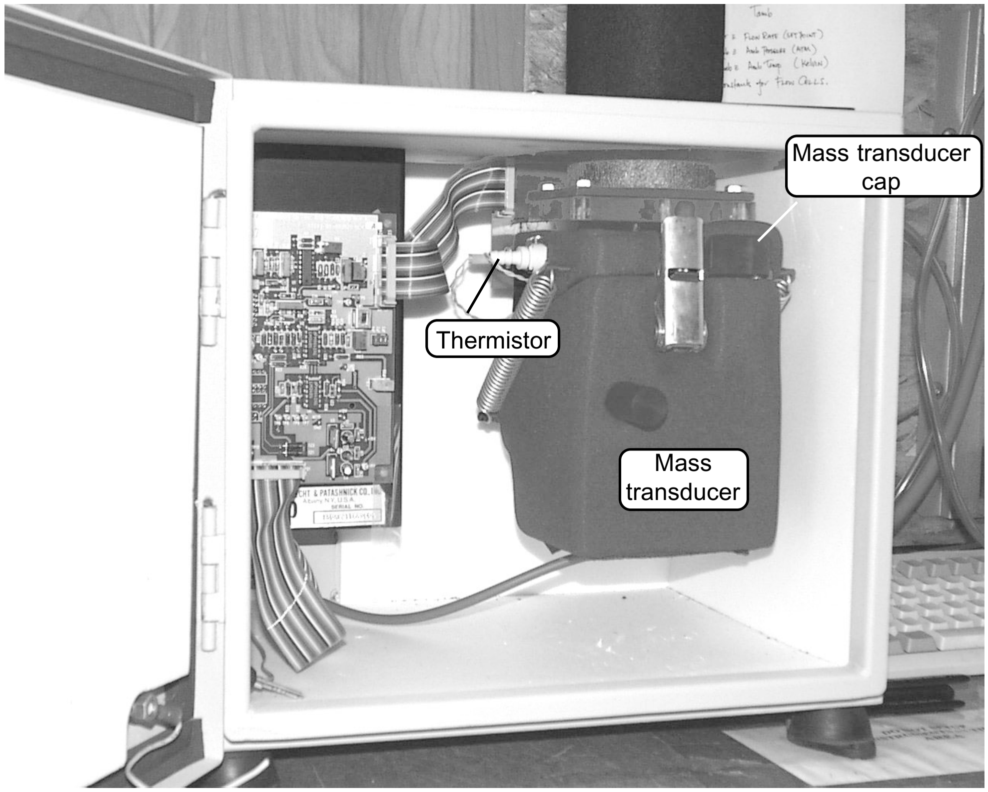
Follow these steps to clean the air inlet system:

1) **Turn off the control unit.**

2) **Open the door of the sensor unit (Figures 12-2 and 12-3).**

Figure 12-2. Sensor unit.

Figure 12-3. Sensor unit with door open.



3) With the mass transducer in its closed, upright position, locate the thermistor in the cap of the mass transducer (Figure 12-3).

4) Press on the metal locking-clip of the thermistor and pull it out of the cap.

5) Locate the silver handle on the front of the mass transducer (Figure 12-4). Note that there is a shipping latch in the middle of this handle.

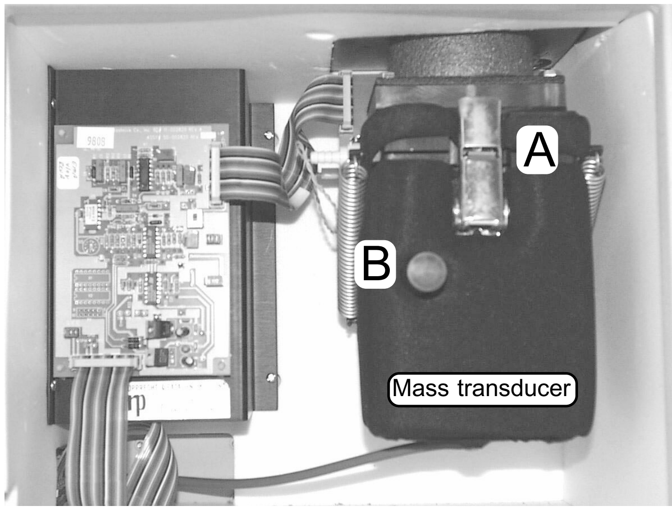


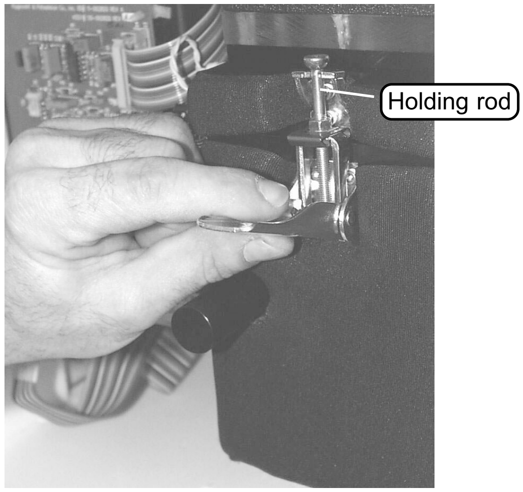
Figure 12-4. Mass transducer in the closed position with the silver handle (A) and black knob (B) highlighted.

6) Grasp the silver handle and move the shipping latch upward with your thumb (Figure 12-5).

Figure 12-5. Lifting the shipping latch on the silver handle.

7) Pull down on the silver handle (Figure 12-6).

Figure 12-6. Pulling the silver handle down.



8) Pull the holding rod off the latch plate (Figure 12-7).

Figure 12-7. Releasing the holding rod on the mass transducer.

9) With the mass transducer unlatched, grasp the black knob (Figure 12-4) and swing the bottom of the mass transducer downward, exposing the tapered element (TE) (Figures 12-8 and 12-9).

Figure 12-8. Opening the mass transducer.

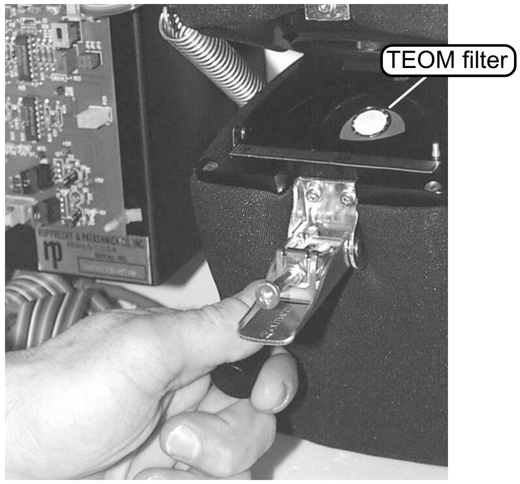
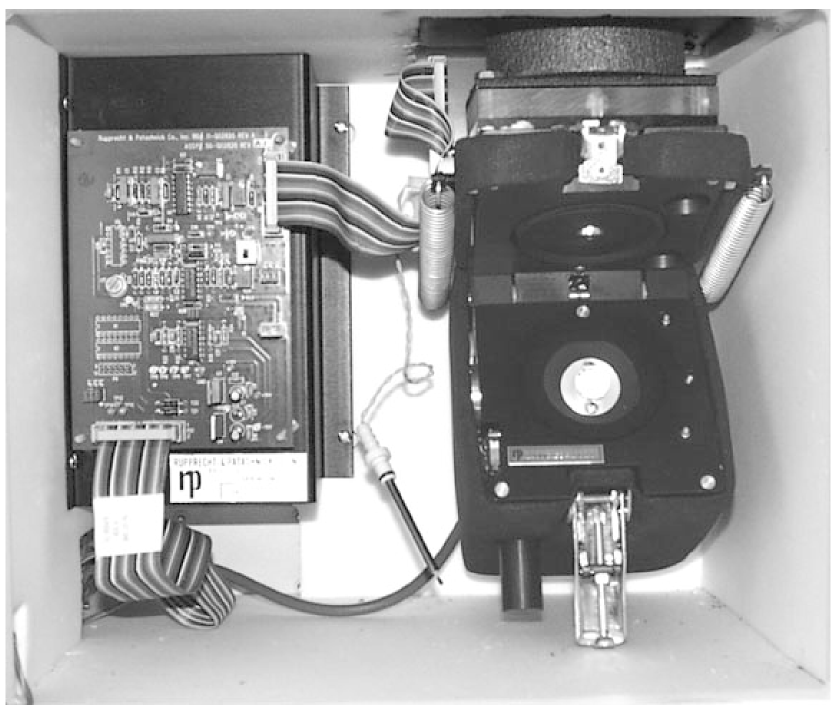


Figure 12-9. The mass transducer in its open position with thermistor removed.



10) **Place a piece of plastic or another protective material over the exposed TEOM filter.**

11) **Using a soapy water, alcohol or freon solution, clean the entire air inlet (Figure 12-10). A soft brush may be used to remove particulate matter on the insides of the walls.**

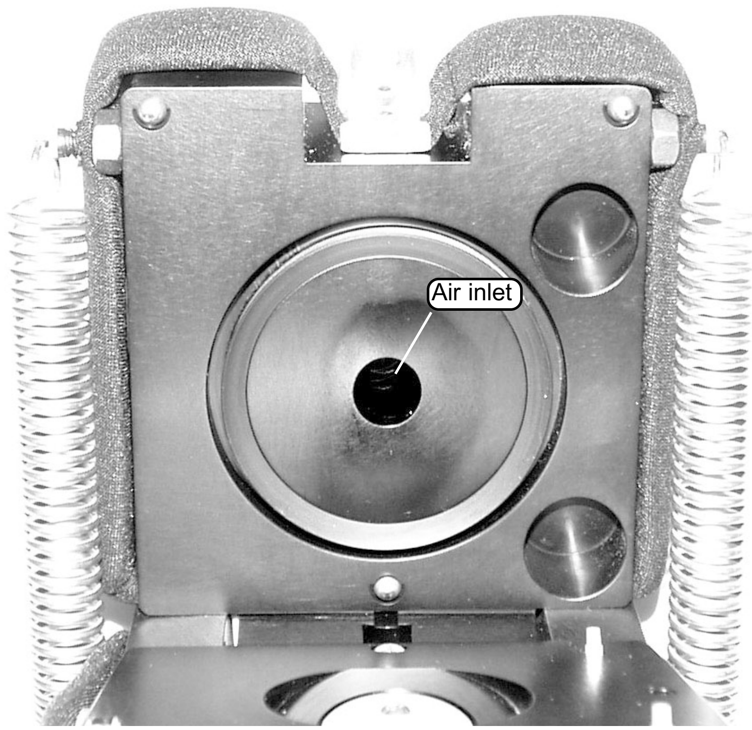


Figure 12-10. Air inlet inside the mass transducer.

12) Allow the air inlet to dry.

13) Remove the protective material from the exposed TEOM filter.

14) Raise the mass transducer to the closed position using the black knob.

15) Fasten the holding rod onto the latch plate.

16) Push the silver handle up until the shipping latch snaps into place.

17) Reinsert the air thermistor into the cap of the mass transducer assembly.

18) Close and latch the door to the sensor unit. Keep the door open for as short a time as possible to minimize the temperature change in the system.

19) Turn on the control unit.

12.2. Verification Procedures

Verification Procedures	Interval
Batteries	Test the batteries once every 6 months, and exchange them as necessary (Service Manual).
Pump	Test the pump once every 6 months (Service Manual).
Mass flow controller:	
Software	Calibrate the mass flow controller's software once every 6 months (Service Manual).
Hardware	Calibrate the mass flow controller's hardware once a year (Service Manual).
Analog I/O	Perfom an analog input/output calibration once every 1 to 2 years (Service Manual).
Leak check	Perform a leak check once a year, or as necessary (Section 3.4).
Mass transducer	Verify the calibration of the mass transducer once a year (Section 12.2.1).
Ambient air temperature	Verify the ambient air temperature measurement once a year (Section 12.2.2).
Ambient pressure	Verify the ambient pressure measurement once a year (Section 12.2.3).
Flow audit	Perform a flow audit once a year (Section 12.2.4).
Ambient temperature sensor	Calibrate the ambient temperature sensor once a year (Service Manual).
Ambient pressure sensor	Calibrate the ambient pressure sensor once a year (Service Manual).

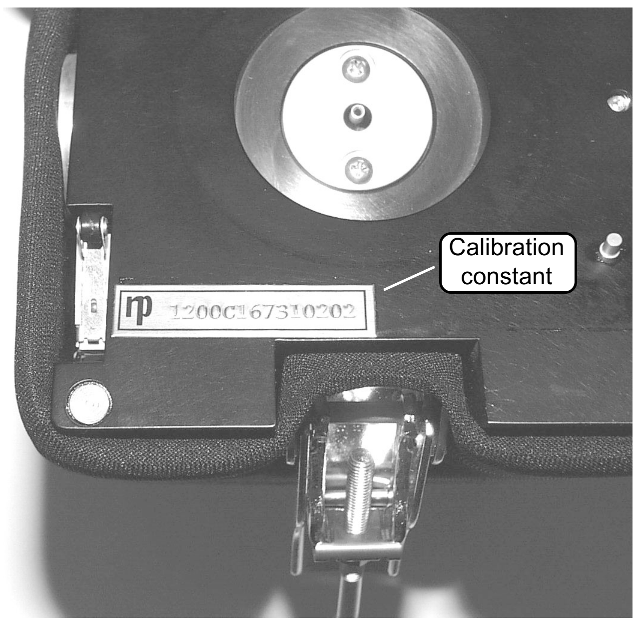
As of February 2001, R&P began manufacturing the Series 1400a Monitor with newly designed mass flow controllers (the “Second-Generation Flow Controller Design”) in the control unit. If you purchased your Series 1400a Monitor before February 2001, or if the serial number on your monitor is 140AB234170011 or below, your control unit has the original version mass flow controllers. If you purchased a monitor with the original mass flow controller design, follow the instructions in Appendix J. If your monitor has the “Second-Generation” mass flow controllers installed, refer to the Service Manual for the mass flow controller software and hardware calibration procedures. Also, if you purchased the Flow Controller Upgrade Kit (55-7758) and installed the Second-Generation mass flow controllers in your Series 1400a Monitor, refer to the Service Manual for the mass flow controller software and hardware calibration procedures.

The verification intervals provided above are guidelines. Requirements for verifications are site-specific, and may vary from one location to another.

12.2.1. Mass Transducer Calibration Verification

The calibration of the mass transducer in the Series 1400a monitor is determined by the mass transducer's physical mechanical properties. Under normal circumstances, the calibration does not change materially over the life of the instrument. Contact R&P if the results of the verification procedure indicate that the a calibration constant has changed by more than 2.5% from the original R&P calibration constant. You can locate the original R&P calibration constant inside the mass transducer (Figure 12-11).

Figure 12-11. Calibration constant (K_0) inside the mass transducer.



Before the Series 1400a Monitor is shipped to the customer, it is calibrated with a new, pre-weighed TEOM filter installed in its mass transducer as a calibration weight. Because the mass of the filter cartridge with particulate matter differs from the mass of a new filter cartridge by only a small fraction, calibrating the system with a calibration mass equivalent to the filter mass allows all measurements to be made at essentially the same operating point as the original calibration. Refer to Section 1 for a detailed explanation of how the calibration constant, K_0, is derived.

12.2.1.1. K0 Confirmation Screen

The K0 Confirmation screen (Figure 12-12) allows the user to verify the monitor's K_0 calibration.

Figure 12-11. K0 Confirmation screen.

```
K0 Confirm       209.44188
>Filt Wght         0.07903
 287.53182       209.44186
 Audit K0             9683
```

Oscillating frequency without a filter

Oscillating frequency with a filter

You can display the K0 Confirmation screen on the four-line display of the control unit in two different ways:

1. When in the Main screen (Figure 12-13), press the <STEP SCREEN> key to display the Menu screen (Figure 12-14). When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select "K0 Confirmation," and then press the <ENTER> key.
2. Press the <1> and <7> keys, and then press the <ENTER> key.

Figure 12-13. Main screen.

```
OK    4+  11%  NU    09:39
Mass Conc>            33.6
30-Min MC             26.8
01-Hr MC              12.5
```

Figure 12-14. Menu screen.

```
  LISTING OF SCREENS
> Set Temps/Flows
  Set Hardware
  View ACCU System
```

The K0 Confirmation screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 12-15). Press the up (<↑>) and down (<↓>) arrow keys to view the additional lines of the K0 Confirmation screen.

Figure 12-15. K0 Confirmation screen with additional lines displayed.

```
K0 Confirm      209.44188
>Filt Wght        0.07903
 287.53182      209.44186
 Audit K0            9683
-------------------------
 Actual K0           9627
 % Diff              0.58
```

The K0 Confirmation screen contains the following information:

209.44188	This field contains the current value of the calibration constant (K0).
Filt Wght	This field contains the weight (units?) of the pre-weighed calibration verification filter.
287.53182	This field contains the oscillating frequency (units?) of the tapered element oscillating microbalance (TEOM) with a TEOM filter installed.
209.44186	This field contains the oscillating frequency (units?) of the tapered element oscillating microbalance (TEOM) without a TEOM filter installed.
Audit K0	This field contains the audit value of the calibration constant (K_0).
Actual K0	This field contains the current calibration constant (K0) value that was entered into the monitor (by R&P or the user).
% Diff	This field contains the percentage difference between the audit value and the currently entered K_0 value.

12.2.1.2. Verifying the Calibration Constant

Tools Needed: Mass calibration verification kit (59-002107)
Pre-weighed calibration filter
Filter exchange tool
Dessicant (for humidity protection)
Humidity indicator

Materials: None

NOTE: Refill kits for the mass calibration verification kit are available from R&P (59-002019).

Follow these steps to confirm the system's K_0 calibration:

1) **When in the Main screen (Figure 12-13), press the <DATA STOP> key on the monitor's keypad.**
2) **Press the <STEP SCREEN> key. The Menu screen will display on the four-line display (12-14).**
3) **When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select "K0 Confirmation."**
4) **Press the <ENTER> key. The "K0 Confirmation" screen will display (Figure 12-12). You also can display the K0 Confirmation screen by pressing <1>, <7> and then the <ENTER> key.**
5) **Press the <EDIT> key.**
6) **Press the up and down arrow keys to select the "Filt Wght" field.**
7) **Using the monitor's keypad, enter the weight of the pre-weighed calibration verification filter in the Filt Wght field.**
8) **Press the <F1> or the <RUN> key.**
9) **Wait for the oscillating frequency value on the "K0 Confirm" line to stabilize.**
10) **When the frequency stabilizes, press the <FIRST/LAST> key to record the frequency, (f_0).**
11) **Install the pre-weighed calibration filter in the instrument (Section 3) and wait for the frequency to stabilize again.**
12) **When the frequency stabilizes, press the <FIRST/LAST> key to record the frequency (f_1). The instrument will now automatically**

compute and display the audit value of the calibration constant (K_0) in the "Audit K0" field.

NOTE: If you make any mistakes while performing any of these steps, exit from the K0 Confirmation screen and re-enter it. The unit will reset all values to zero when the user re-enters the screen.

12.2.2. Verifying the Ambient Air Temperature

Perform the ambient air temperature verification (Section 12.2.2), pressure verification (Section 12.2.3) and leak check (Section 3) before executing the flow verification procedure (Section 12.2.4).

Follow these steps to verify the ambient air temperature:

1) Press the <1> and <9> keys, and then press the <ENTER> key to display the Set Temps/Flows screen (Figure 12-16).

Figure 12-16. Set Temps/ Flows screen.

```
     SET TEMPS/FLOWS
T-Case>    50.00    50.00
T-Air      50.00    50.01
T-Cap      50.00    49.98
```

2) When in the Set Temps/Flows screen, locate the current ambient temperature reading in the “Amb Temp” field (Figure 12-17).

Figure 12-17. Set Temps/ Flows screen with additional lines displayed.

```
     SET TEMPS/FLOWS
T-Case>    50.00    50.00
T-Air      50.00    50.01
T-Cap      50.00    49.98
-------------------------
F-Main      3.00     3.00
F-Aux      10.00     9.98
T-A/S      25.00    25.00
P-A/S      1.000    1.000
Amb Temp             23.4
Amb Pres            0.988
FAdj Main           1.000
FAdj Aux            1.000
```

3) Determine the current temperature (°C) at the ambient temperature sensor using an external thermometer, [°C = 5/9 x (°F - 32)].

4) Verify that the value of the "Amb Temp" field is within ± 2° C of the measured temperature. If this is not the case, perform the ambient temperature calibration procedure (Service Manual).

12.2.3. Verifying the Ambient Pressure

Perform the ambient air temperature verification (Section 12.2.2), pressure verification (Section 12.2.3) and leak check (Section 3) before executing the flow verification procedure (Section 12.2.4).

Follow these steps to verify the ambient pressure:

1) **Press the <1> and <9> keys, and then press the <ENTER> key to display the Set Temps/Flows screen (Figure 12-16).**
2) **When in the Set Temps/Flows screen, locate the current ambient pressure reading in the “Amb Pres” field (Figure 12-17).**
3) **Determine the current ambient pressure in mm Hg (absolute pressure, not corrected to sea level). Verify the monitor’s ambient pressure by measuring the current ambient station pressure in mm Hg with an external measurement device.**
   - To convert from Atmospheres @ 0° C to mm Hg, multiply by 760.
   - To convert from millibars to mm Hg, multiply by 0.75012.
   - To convert from inches Hg @ 32° F to mm Hg, multiply by 25.4.
4) **Verify that the value of the for “Amb Pres” field is within ±10 mm Hg of the measured ambient pressure. If this is not the case, perform the ambient pressure calibration procedure (Service Manual).**

12.2.4. Flow Audit Procedure

The flow audit procedure checks the flow rates in the Series 1400a Monitor. The tolerances in this audit procedure should not be confused with the tighter specifications outlined in the calibration procedures of the Service Manual.

Perform the ambient air temperature verification (Section 12.2.2), pressure verification (Section 12.2.3) and leak check (Section 3) before executing the flow verification procedure (Section 12.2.4).

Tools Needed: Flow audit adapter kit (57-001243)
Flow audit adapter
3/8-inch Swagelok cap
Materials: None

Follow these steps to perform a flow audit:

1) Press the <F1> or <RUN> key on the control unit's keypad.

NOTE: Any data generated by the instrument during this audit procedure are invalid. Therefore, do not run a flow audit procedure during a valid sampling run.

2) Remove the sample inlet from the flow splitter (Figure 12-18).

Figure 12-18. Removing the PM-10 inlet.

3) Locate the flow audit adapter (Figure 12-19).

Figure 12-19. Flow audit adapter with valve open.

4) Ensure that the valve of the flow audit adapter is in its open position (Figure 12-20).

Figure 12-20. Flow audit adapter installed on flow splitter with valve open.

5) Install the flow audit adapter onto the flow splitter (Figure 12-20).

6) When in the Main screen, press the up (<↑>) and down (<↓>) arrow keys until the "Main Flow" (SAMPLE FLOW) and "Aux Flow" (BYPASS FLOW) lines display on the screen (Figure 12-21). These values represent the actual volumetric flows as measured by the monitor's flow controllers.

Figure 12-21. Main screen with "Main Flow" and "Aux Flow" lines displayed.

```
OK     4+  11%  NU     09:44
Main Flow               3.00
Aux Flow               13.66
---------<
```

7) Confirm that these flows are within ±2% of their set points (3.0 l/min for the "Main Flow" and 13.67 l/min for the "Aux Flow"). Any greater deviation may indicate that the in-line filters are plugged or other blockages exist in the system.

8) Attach a reference flow meter such as a bubble meter, dry gas meter, or mass flow meter to the top of the flow audit adapter. This reference flow meter should have been recently calibrated to a primary standard, have an accuracy of ±1% at 3 l/min and 16.67 l/min, and a pressure drop of less than 0.07 bar (1 psi).

9) Read the total flow (approximately 16.67 l/min) on the reference flow meter. If you are using a mass flow meter, you must make any necessary corrections to translate this reading to volumetric l/min at the current ambient temperature and barometric pressure. No adjustment is necessary in the case of a volumetric flow meter. The total volumetric flow measured by the reference flow meter must be 16.67 ±1.0 l/min to be acceptable.

10) Disconnect the bypass flow line from the bypass extension on the bottom of the flow splitter (Figure 12-22).

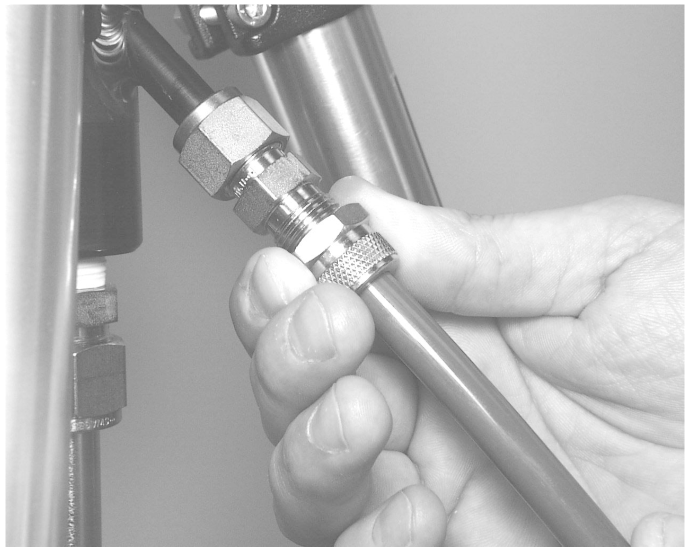


Figure 12-22. Disconnecting the bypass flow line from the bypass extension.

11) Cap the exit of the flow splitter bypass extension with the 3/8-inch Swagelok cap (Figure 12-23).

Figure 12-23. Bypass flow extension with 3/8-inch Swagelok cap.

12) Read the main flow (approximately 3.0 l/min) on the reference flow meter. If you are using a mass flow meter, you must make any necessary corrections to translate this reading to volumetric l/ min at the current ambient temperature and barometric pressure. No adjustment is necessary in the case of a volumetric flow meter. The volumetric flow measured by the reference flow meter must be 3.0 ±0.2 l/min to be acceptable. If the main flow reading is within acceptable limits, go to step 14. If the main flow reading is not within acceptable limits, go to step 13.

13) Perform the software and hardware calibrations for the mass flow controller (Service Manual).

14) Remove the 3/8" Swagelok cap from the flow splitter bypass extension.

15) Install the bypass flow line onto the flow splitter bypass extension.

16) Perform a leak check (Section 3.4).

17) Remove the flow audit adapter from the top of the flow splitter.

18) Install the sample inlet onto the flow splitter.

19) Install a new TEOM filter into the mass transducer.

20) Press the <F1> or <RUN> key.

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Section 13: Resetting the Monitor

This section explains how to initiate an emergency shut-off and reset the instrument to its original settings, and describes what happens to the monitor after a power failure occurs.

13.1. Stop All Command

✔ Press the <STOP ALL> key to shut down all temperature and flow instrumentation.

Certain situations may arise in which the user may want to turn off all temperatures and flows in the instrument. To initiate this procedure, press the <STOP ALL> key on the control unit's keypad to enter the Stop All Mode and cease data collection. When the instrument is in the Stop All Mode, an "X" will appear in the operating mode field of the Main screen's status line (Section 5).

Also, the monitor will reset its system variables to the original values that were set by the user. When the user presses the <STOP ALL> key, this does not set the unit to its default parameters.

The instrument will remain in the Stop All Mode until you press the <F1> or <RUN> key to begin data collection, or press the <DATA STOP> key to enter the Setup Mode, or turn off the control unit.

13.2. Re-initializing the Instrument

Follow these steps to reset the monitor to its original settings:

1) **Press the <DATA STOP> key on the control unit's keypad to enter the Setup Mode.**
2) **When in the Main screen (Figure 13-1), press the <SHIFT> key and hold it down.**

Figure 13-1. Main screen.

```
OK    4+  11%  NU     09:39
Mass Conc>             33.6
30-Min MC              26.8
01-Hr MC               12.5
```

3) **Then press the <STOP ALL> key. This will reset the system variables to their original values.**
4) **Release the <SHIFT> key.**
5) **Follow the procedures in Section 5 (Basic Operation) to enter the appropriate average temperature and pressure for the sampling location, or to select automatic measurement.**

Refer to the program register codes (PRCs) (Appendix B) for a list of the original settings.

13.3. System Operation after a Power Failure

When a power failure occurs and then power is returned to the instrument, the Series 1400a Monitor automatically resets itself. It will enters the same RS232 mode that it was set at before the power failure occured. Upon starting up again, the instrument waits until temperatures and flow rates have stabilized for 30 minutes before automatically resuming data evaluation and collection. Operating parameters, such as temperature and flow settings, are maintained in the system’s battery-backed CMOS memory. The system also contains a battery-backed clock/calendar.

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Section 14: ACCU System

The Automatic Cartridge Collection Unit (ACCU) (Figure 14-1) measures particulate mass concentrations in real time and collects particulate matter on various filter media under microprocessor control.

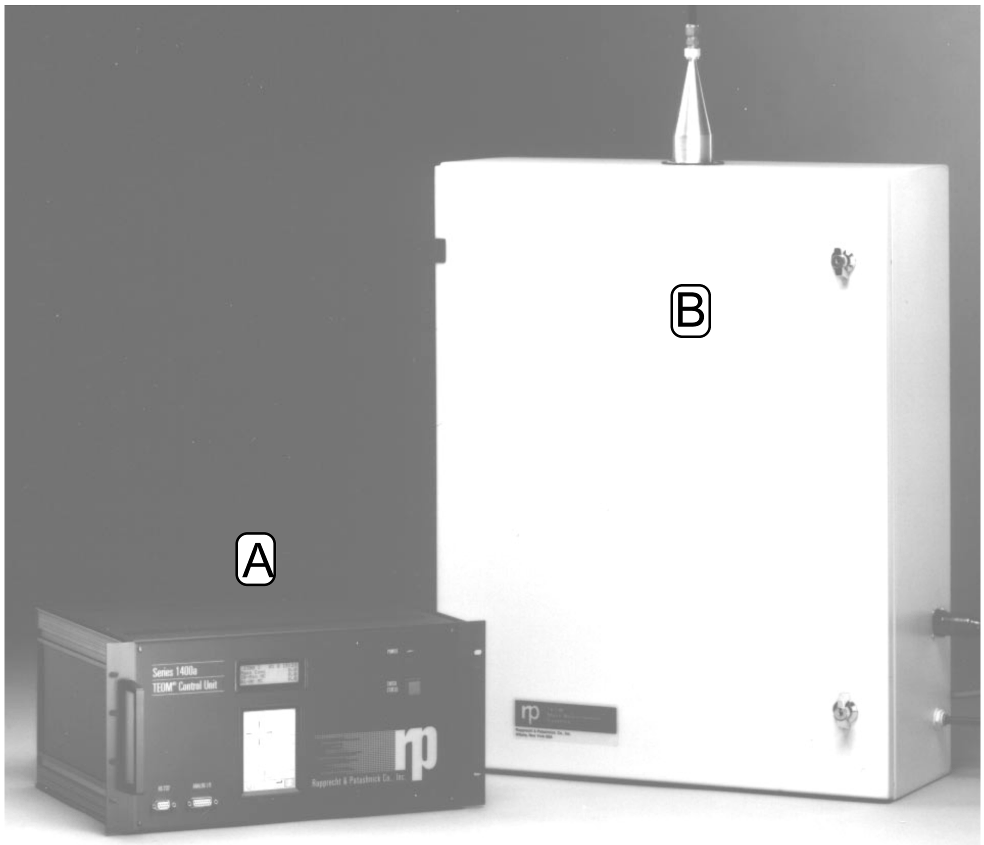


Figure 14-1. Control unit (A) and the ACCU System (B).

The ACCU System also samples ambient particulate matter independently for selected chemical analysis by using the auxiliary (bypass) flow of flow splitter-equipped systems and the microprocessor in the Series 1400a Monitor. The 13.67 (or optional 14.67, or 15.67) l/min bypass flow from the flow splitter is carried through the ACCU System to the auxiliary flow controller in the control unit (Figure 14-2).

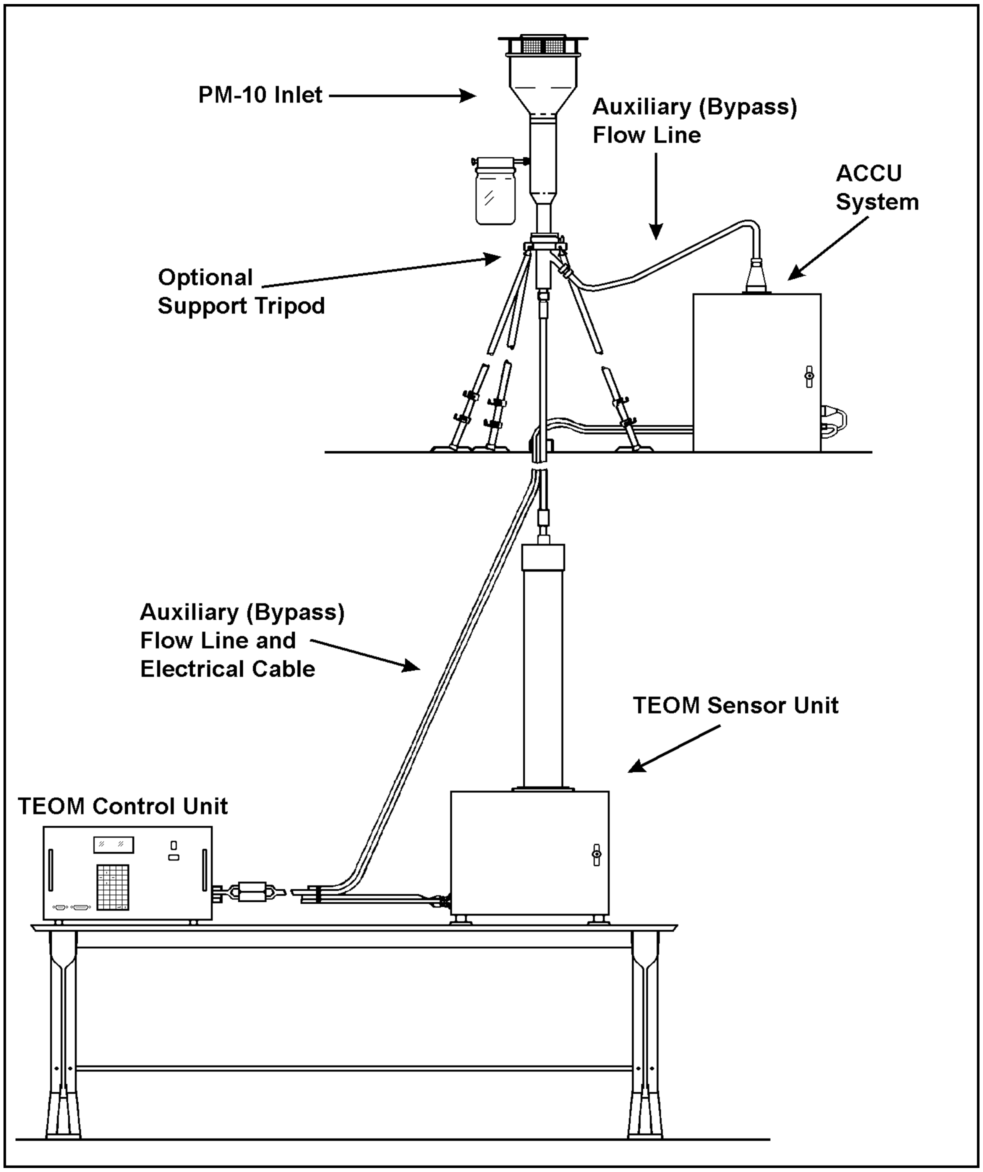


Figure 14-2. PM-10 system configuration with ACCU System installed.

Inside the ACCU System, a bank of solenoid valves redirects the bypass sample stream through one of eight sampling devices mounted inside the unit (not included with the system). These sampling devices can include 25, 37 or 47 mm filter holders with the user's choice of filter media, polyurethane foam (PUF) samplers, or other filter pack/tube combinations suitable for the 13.67, 14.67 or 15.67 l/min flow rate.

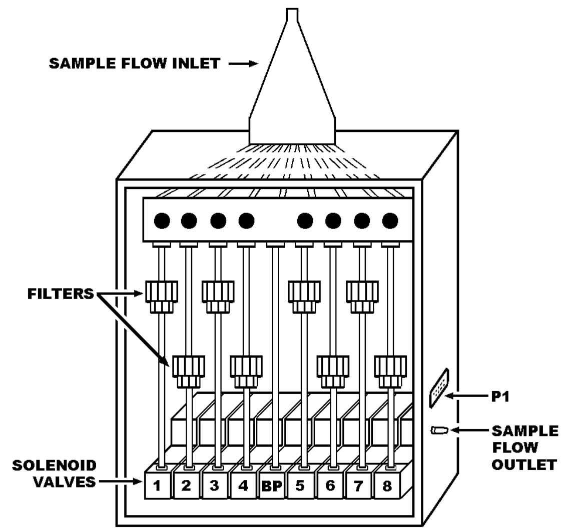
The ACCU System is connected to the Series 1400a Monitor electronically by a 10-meter cable that connects to the ACCU connector on the back panel of the monitor's control unit (Section 2). The cable carries the signals that activate the valves in the ACCU System. The user can specify the conditions under which each of the ACCU System's eight flow channels is opened using the monitor's software (Section 14.4). The flow through the ACCU System can be governed by such factors as the real-time mass concentration, time of day, day of the week, or analog signals generated by other devices such as wind speed or wind direction anemometers.

14.1. Principle of Operation

The ACCU System contains one internal bypass flow line and eight user-definable flow lines that normally contain one collection cartridge each. The ACCU System directs the auxiliary (bypass) flow from the flow splitter of the monitor through one of the eight collection cartridges, or the internal bypass line. Within the unit, conductive tubing is used to minimize the static attraction effects of particulate matter to the tubing walls (Figures 14-3 and 14-4).

Figure 14-3 (left). ACCU System with enclosure door open.

Figure 14-4 (right). Schematic drawing of the ACCU System.



The control unit closely monitors the bypass flow rate through the ACCU System to ensure the integrity of a total flow volume of 16.67 l/min through the sample inlet. If a cartridge installed in the ACCU enclosure causes the bypass flow to deviate from the standard 13.67 l/min by ± 0.40 l/min, this cartridge is not used again until the user exchanges the cartridge and resets the channel. To indicate that a cartridge has caused a high pressure drop, the monitor places a negative sign in front of the value for that channel's total flow volume.

Using the monitor's software, the user defines the conditions under which each of the eight ACCU channels operates. *Only one channel is active at any one time.* Every 10 seconds, the instrument determines which of the ACCU System's eight channels should currently be active. The unit systematically checks the collection criteria for each channel (starting at channel 1) and determines whether that criteria are met. If the criteria are met, the system activates the channel for the next 10 seconds. If the criteria for channel are not met, the instrument performs the same evaluation for the next channel. This process continues through the successive channels in the ACCU System until the monitor finds a channel whose operating conditions are currently met. If none of the channels meet the conditions for operation, the monitor diverts the flow is diverted through the internal bypass flow line for that 10-second period.

If the monitor has disqualified a channel because the pressure drop of the installed cartridge causes the bypass flow to fall outside of the acceptable limits, the instrument skips over this channel when evaluating the cartridges for operation. For example, if channels 1, 2 and 3 fail to meet the criteria for activation and channel 4 has been disqualified because of a high pressure drop, the monitor evaluates channel 5 after it evaluates channel 3.

Because channel 1 is always evaluated first, this cartridge can be used to override the settings of the remaining channels. For example, if channels 2 through 8 are defined by time of day (e.g., midnight to 3:00 a.m.), channel 1 could be used to capture all episodes in which the particulate matter concentration exceeds 200 $\mu g/m^3$. In this case, the bypass sample stream would pass through cartridges 2 through 8 according to the time of day, except when the particulate matter concentration measured by the monitor exceeds 200 $\mu g/m^3$.

If the user anticipates that a particular set of qualification criteria will result in a cartridge overload, R&P recommends that the user define two or more neighboring cartridges with the same criteria. For example, if channels 5 and 6 are both defined with the same criteria and channel 5 later becomes disqualified because its pressure drop is too high, the bypass flow would jump over channel 5 to channel 6 which would continue testing with the same criteria as channel 5.

R&P recommends that the user exchange cartridges and define ACCU channels only when the monitor is in Setup mode, so that the collection of mass concentration data is not affected by such changes.

The ACCU System is active only when the instrument is collecting data in Operating Modes 1, 2, 3, or 4. The monitor always passes the sample stream through the internal bypass of the ACCU System when the instrument is in the Setup Mode or the Stop Mode. After the user leaves the Setup Mode or the Stop Mode by pressing the <F1> or <RUN> key, the ACCU System will become active after one minute. The monitor also waits one minute to activate the ACCU System after the monitor is turned on.

14.2. ACCU System Installation

14.2.1. ACCU System Compilation Package

Depending on your setup requirements, the ACCU System is supplied with the following components:

ACCU System enclosure
Sample distributor cone
Sample distributor gasket
Electrical cable
4 #8-32 screws
8 filter holders
Filters (Pallflex TX40, quartz, Teflon, or nylon)
Backer filters
Anti-stick rings
Four-stage filter pack
PUF sampling system
PUF sampling tube
PUF plug
Impactor plage oil
ACCU inlet
ACCU stand

14.2.2. ACCU Installation

The ACCU System is designed to operate outdoors, and is generally placed in the vicinity of the flow splitter.

Follow these steps to install and set up the ACCU System:

1) If you have purchased the optional ACCU stand, refer to Section 14.2.3. If you did not purchase the optional ACCU stand, go to step 2.

2) Locate the sample distributor gasket and place it around the sample distributor (Figures 14-5 and 14-6). The sample distributor is located on top of the ACCU enclosure. Make sure that the holes in the sample distributor gasket line up with the mounting holes on the top of the enclosure.

Figure 14-5. Sample distributor gasket installed around the sample distributor.

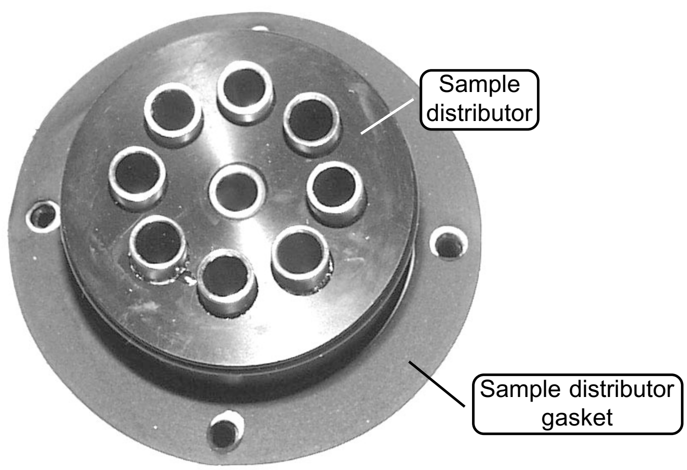
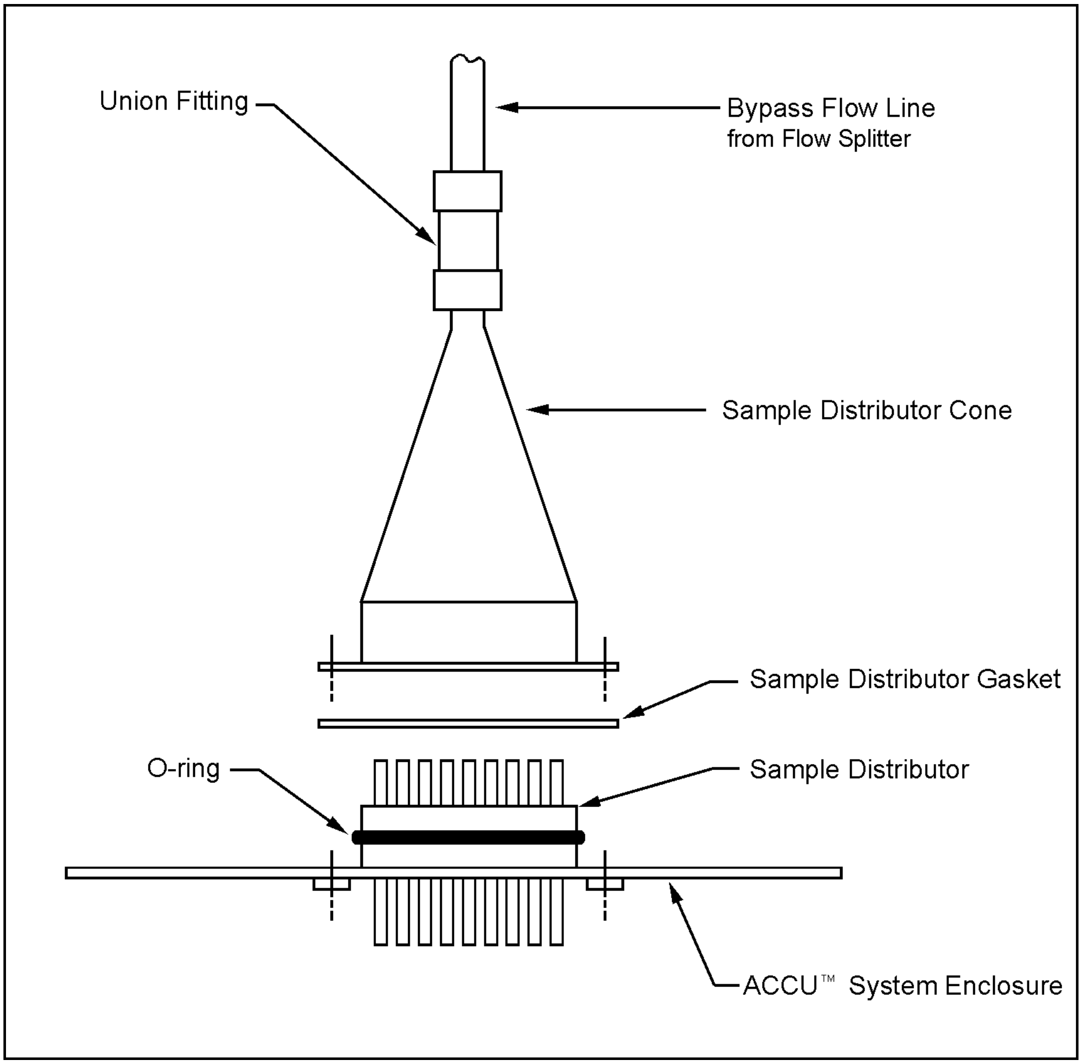
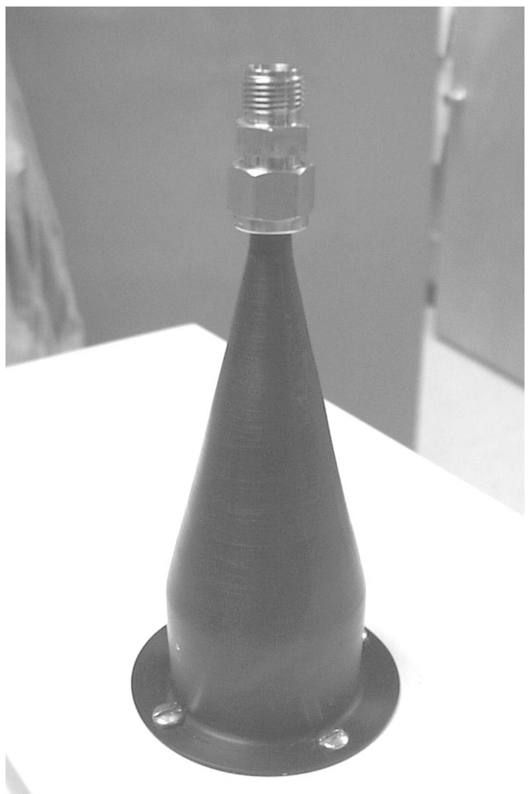


Figure 14-6. Sample distributor cone assembly.



3) Locate the sample distributor cone and slide it over the top of the sample distributor (Figures 14-6 and 14-7). Ensure that the sample distributor gasket is properly seated and that the mounting holes line up.

Figure 14-7. Sample distributor cone installed on top of the ACCU System enclosure.



4) Secure the cone to the ACCU enclosure using the four #8-32 screws (Figure 14-6).

5) Run the 3/8" green nylon tubing from the bypass flow tube of the flow splitter to the union fitting located on the top of the sample distributor cone (Figure 14-6). Ensure that the fitting is properly tightened to avoid leaks.

6) Insert the 3/8" bypass flow line from the electric- and air-connecting cable into the sample flow outlet located on the side of the ACCU System enclosure (Figure 14-7). Ensure that the fitting is properly tightened.

7) Turn the control unit off.

8) Install one end of the electrical cable to the electrical connector on the ACCU enclosure (Figure 14-8).

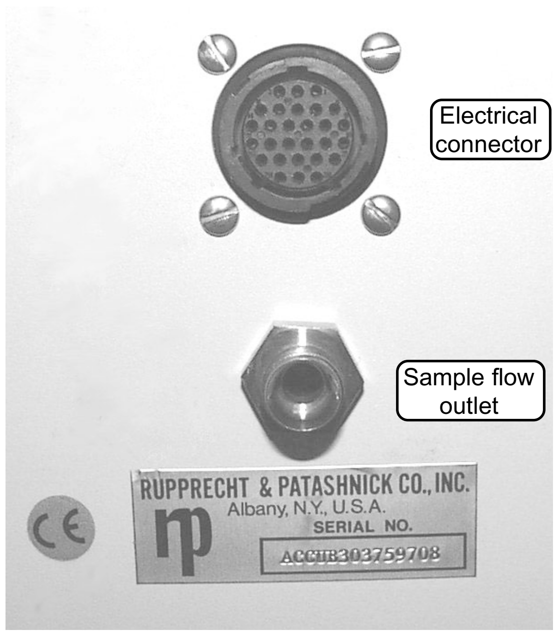


Figure 14-8. Electrical connector and sample flow outlet located on the right-hand panel of the ACCU System enclosure.

9) Install the other end of the electrical cable to the connector labelled "ACCU" on the back panel of the control unit (Section 2).

10) Install the filter cartridge(s) into the ACCU System channels (Section 14.3).

11) Turn the control unit on.

12) Perform a leak check (Section 3).

14.2.3. Installing the Optional ACCU Stand

14.2.3.1 Optional ACCU Stand Compilation Package

The optional ACCU stand package contains the following items (Figure 14-9):

Right vertical support (A)
Left vertical support (B)
Cross support (C)
Right gusset (D)
Left gusset (E)
Gusset support (F)
Right horizontal support (G)
Left horizontal support (H)
2 gusset spacers (I)
10 1/4-inch split washers (J)
10 1/4-inch flat washers (K)
10 1/4-20 x 5/8" long hex bolts (L)
10 1/4-20 hex nuts (M)
4 3/8-inch sealing washers (N)
4 3/8-16 x 3/4-inch long hex bolts (O)

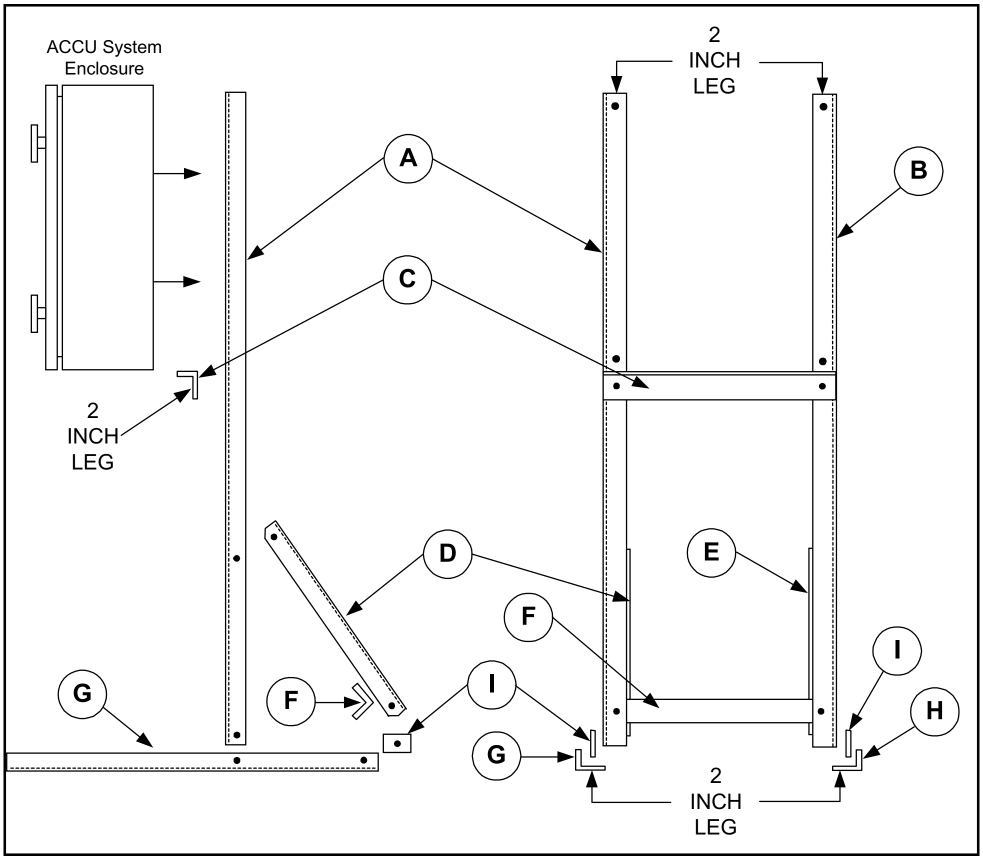


Figure14-9. Optional ACCU stand hardware.

14.2.3.2. Assembling the Optional ACCU Stand

Follow these steps to assemble the optional ACCU stand (Figure 14-9):

1) **Place the right and left horizontal supports (G and H) on the floor so that the legs containing the holes are pointing upward. The angles should be positioned on the floor so that the longer (2 inch) legs are pointing toward each other.**

2) **Attach the right vertical support (A) to the right horizontal support (G) using the J, K, L and M hardware. The longer (2 inch) leg of item A should be pointing inward.**

3) **Attach the left vertical support (B) to the left horizontal support (H) using the J, K, L and M hardware. The longer (2 inch) leg of item B should be pointing inward.**

4) Attach the cross support (C) to the vertical supports using the J, K, L and M hardware. The cross support should be oriented as shown in Figure 14-9, and be attached to the ACCU enclosure side of the stand.

5) Attach the right gusset (D) and left gussets (E) to the gusset support (F) using items the J, K, L and M hardware. The gusset support should be oriented as shown in Figure 14-9.

6) Align the gusset assembly on the horizontal supports (G and H), and secure the horizontal supports using the J, K, L and M hardware.

7) Place the gusset spacers (I) between the gusset assembly and the horizontal supports (G and H). Secure the gusset spacers using the J, K, L and M hardware. If one (or more) of the gussets does not seem to line up properly, loosen the bolts that secure the horizontal and vertical supports and adjust them until the gusset fits properly.

14.2.3.3. Mounting the ACCU Enclosure Onto the Optional Stand

Follow these steps to mount the ACCU enclosure onto the optional stand (Figure 14-9):

1) Place a 3/8" sealing washer (N) onto each 3/8" bolt (O) with the rubber side facing away from the head of the bolt.

2) Push the sealing washer/bolt assembly through the mounting holes in the stand.

3) Place a piece of tape across the head of the bolt so that it stays in place while you install the ACCU enclosure onto the stand.

4) Lift the ACCU enclosure onto the stand and secure it to the stand using with the sealing washer/bolt assemblies.

14.3. Filter Cartridge Installation and Exchange

✘ Never cut any of the tubing inside of the ACCU enclosure.

The ACCU System has been designed to accept any filter cartridge that will physically fit into the ACCU enclosure. This is accomplished through the use of universal filter cartridge fittings. The maximum filter cartridge size that can be accommodated by the system is approximately 5 cm (2 inch) in diameter and 38 cm (15 inch) in length. Although the procedures for the installation and exchange of different cartridges may vary, they all will still be installed by following the same general procedure described below.

✔ The tubing in the ACCU System should not be disconnected, except during filter cartridge exchange.

R&P recommends installing and exchanging filter cartridges only when the instrument is in the Setup Mode so that mass concentration measurements are not affected. Press the <DATA STOP> key to enter the Setup Mode.

14.3.1. Filter Cartridge Installation

A length of conductive tubing is provided for each of the ACCU System's eight channels. This conductive tubing should always be installed in the corresponding fitting whenever a filter cartridge is not installed in the channel.

Follow these steps to install an ACCU filter holder:

1) Ensure that the filter cartridge has the proper fittings installed on its inlet (Figures 14-10 and 14-12) and outlet (Figures 14-11 and 14-12).

Figure 14-10. Inlet fitting properly installed on a filter cartridge.

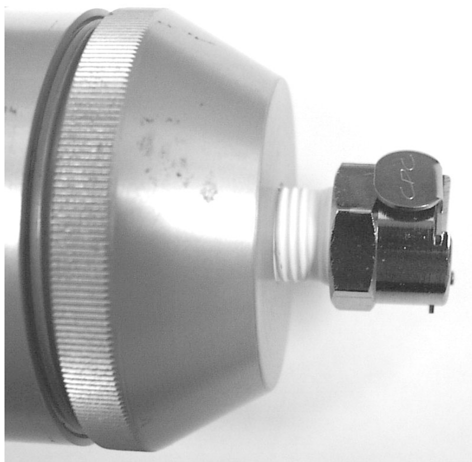


Figure 14-11. Outlet fitting properly installed on a filter cartridge.

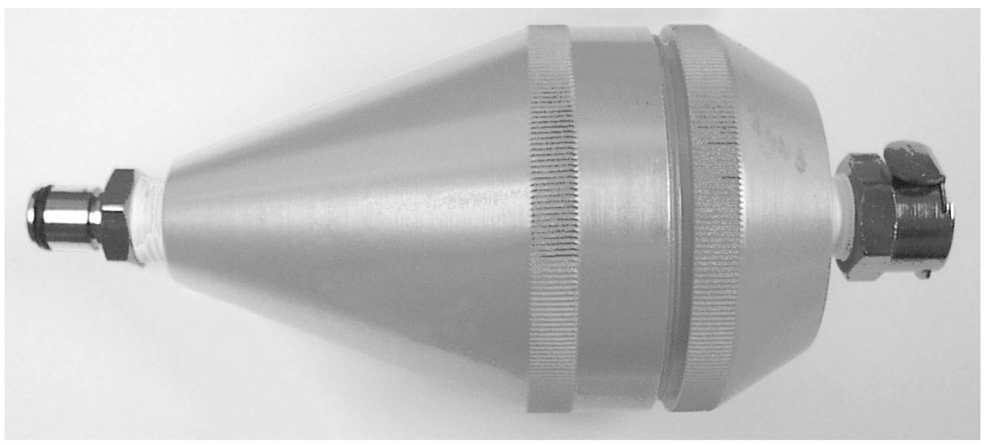


Figure 14-12. Filter cartridge with inlet and outlet fittings properly installed.

2) Press the <DATA STOP> key on the monitor's keypad to enter the Setup Mode.

3) Open the ACCU enclosure door.

✔ The tubing in the ACCU System should not be disconnected, except during filter cartridge exchange.

4) Disconnect the top of the conductive tubing on the first ACCU channel by pressing the fitting and pulling it downward.

✘ Never cut any of the tubing inside of the ACCU enclosure.

5) Install the conductive tubing onto the outlet of the filter cartridge and install the cartridge into the top stationary fitting (Figures 14-13 and 14-14). DO NOT cut the conductive tubing.

IMPORTANT: DO NOT cut, modify or disconnect the tubing that runs down the center of the ACCU System. It is used for the bypass flow.

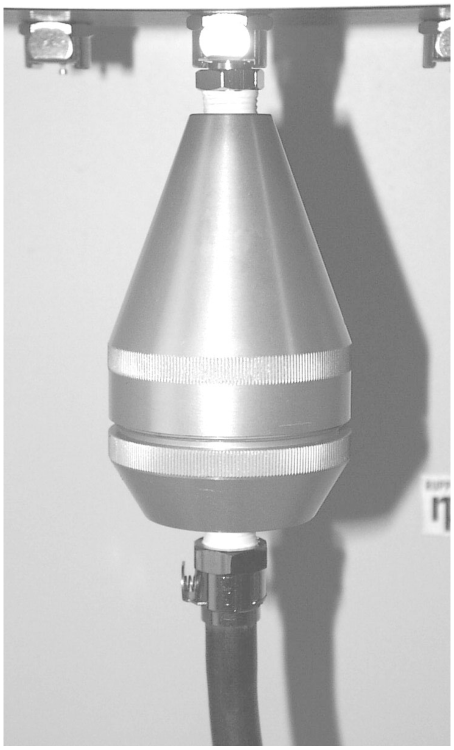


Figure 14-13. Filter cartridge installed inside the ACCU System.

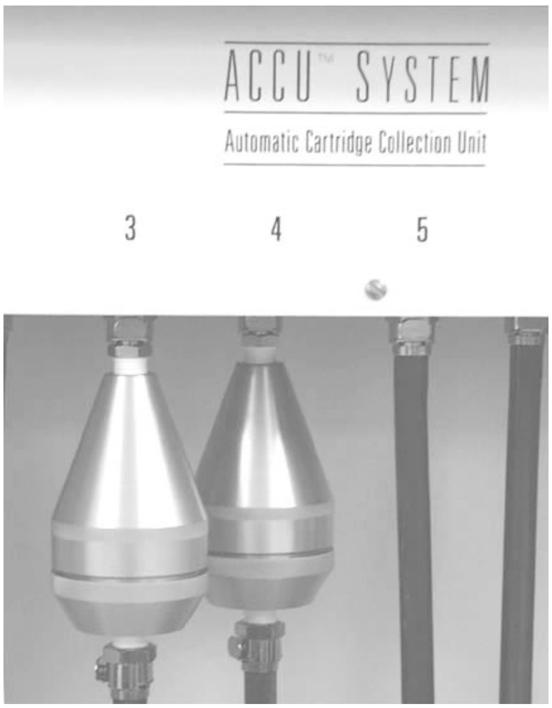


Figure 14-14. Two filter cartridges installed inside the ACCU System.

6) Close the ACCU enclosure door.

7) After you install the filter cartridges in the ACCU System, you must define each ACCU channel (Section 14.4).

8) Press <F1> or <RUN> keys to begin data collection.

14.3.2. Filter Cartridge Exchange

Follow these steps to exchange an ACCU filter cartridge:

✔ The tubing in the ACCU System should not be disconnected, except during filter cartridge exchange.

1) Press the <DATA STOP> key to enter the Setup Mode.

2) Open the ACCU enclosure door.

3) Remove the filter cartridge from the stationary fitting pressing the fitting and pulling downward on the filter cartridge.

4) Disconnect the conductive tubing from the bottom of the filter cartridge by pressing the fitting on the conductive tubing and pulling downward on the fitting. If you will be installing a new filter cartridge, go to step 5. If you will not be installing a new filter cartridge, go to step 6.

✘ Never cut any of the tubing inside of the ACCU enclosure.

5) Install the conductive tubing onto the outlet of the filter cartridge and install the cartridge into the top stationary fitting (Figures 14-13 and 14-14). DO NOT cut the conductive tubing. Go to step 7.

IMPORTANT: DO NOT cut, modify or disconnect the tubing that runs down the center of the ACCU System. It is used for the bypass flow.

6) Install the conductive tubing directly into the top stationary fitting. Go to step 8.

7) Repeat steps 3 to 5 for each filter cartridge that you want to replace. When you have finished installing filter cartridges, go to step 8.

8) Close the ACCU enclosure door.

✘ When the user resets an ACCU channel, the accumulators for that channel are reset to 0.

9) Update the criteria for each channel that you removed or exchanged filter cartridges and reset the channels (Section 14.6).

10) Press <F1> or <RUN> keys to begin data collection.

14.4. Set ACCU System Screen

Each ACCU channel can be defined individually to receive the bypass flow once its specific criteria are met. The user sets the conditions under which a channel is exposed to the bypass flow when in the Set ACCU System screen (Figure 14-15).

Figure 14-15. Set ACCU System screen.

```
 SET ACCU SYSTEM          3
1>Mass Conc           100.0
                     1000.0
2 Curr Ti/Da            600
```

Each channel can contain up to four conditions that must be met in order for the bypass flow to pass through it. The conditions entered are logically “anded” together, meaning that all of the user-specified criteria must be met for the channel to become active. The monitor determines that a condition is met if the current value of the selected PRC is greater than or equal to the minimum value and less than the maximum value.

You can display the Set ACCU System screen on the four-line display of the control unit in two different ways:

1. When in the Main screen (Figure 14-16), press the <STEP SCREEN> key on the control unit’s keypad to display the Menu screen (Figure 14-17). When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select “View ACCU System screen.” Press the <ENTER> key to display the View ACCU System screen (Section 14.5). When in the View ACCU System screen, press the <STEP SCREEN> key.
2. Press the <1> and <5> keys, and then press the <ENTER> key.

Figure 14-16. Main screen.

```
OK    4+  11%  NU    09:39
Mass Conc>            33.6
30-Min MC             26.8
01-Hr MC              12.5
```

Figure 14-17. Menu screen.

```
  LISTING OF SCREENS
> Set Temps/Flows
  Set Hardware
  View ACCU System
```

The Set ACCU System screen contains additional lines that cannot be seen when the screen first displays on the control unit's four-line display (Figure 14-18). Press the up (<↑>) and down (<↓>) arrow keys to view the additional lines of the Set ACCU System screen.

Figure 14-18. Set ACCU System screen with additional lines displayed.

```
 SET ACCU SYSTEM          1
1>Mass Conc           100.0
                     1000.0
2 Curr Ti/Da            600
------------------------------
                        600
3      Null               0
                          0
4      Null               0
                          0
```

The Set ACCU System screen contains the following information:

1	This field contains the number of the ACCU channel that is currently being viewed. Press the right (<→>) arrow key to increase the channel by one. Press the left <←> arrow key to decrease the channel by one. To increase the channel by four, press the <SHIFT> key and hold it down while pressing the right (<→>) arrow key. To decrease the channel by four, press the <SHIFT> key and hold it down while pressing the left <←> arrow key. To display ACCU channel 8, press the <CTRL> key and hold it down while pressing the right (<→>) arrow key. To display ACCU channel 1, press the <CTRL> key and hold it down while pressing the left <←> arrow key.

1>Mass Conc	This field contains the program register code (PRC) (Appendix B) of the first variable whose value is to be tested in ACCU channel 1. If the user specifies fewer than four conditions for a given channel, the user should enter a "0" in the PRC variable field(s) that is not being used.
100.0	This field contains the minimum permissible value of the first PRC variable in ACCU channel 1.
1000.0	This field contains the maximum permissible value of the first PRC variable in ACCU channel 1.
2 Curr Ti/Da	This field contains the program register code (PRC) (Appendix B) of the second variable whose value is to be tested in ACCU channel 2. If the user specifies fewer than four conditions for a given channel, the user should enter a "0" in the PRC variable field(s) that is not being used.
600.0	This field contains the minimum permissible value of the second PRC variable in ACCU channel 1.
600.0	This field contains the maximum permissible value of the second PRC variable in ACCU channel 1.
3 Null	This field contains the program register code (PRC) (Appendix B) of the third variable whose value is to be tested in ACCU channel 2. If the user specifies fewer than four conditions for a given channel, the user should enter a "0" in the PRC variable field(s) that is not being used. In this case, the user is not using this PRC variable field and has entered a "0" for the third PRC variable. "Null" displays in the PRC variable field where the name of the variable is ordinarily shown.
0	This field contains the minimum permissible value of the third PRC variable in ACCU channel 1.
0	This field contains the maximum permissible value of the third PRC variable in ACCU channel 1.

4 Null	This field contains the program register code (PRC) (Appendix B) of the fourth variable whose value is to be tested in ACCU channel 2. If the user specifies fewer than four conditions for a given channel, the user should enter a “0” in the PRC variable field(s) that is not being used. In this case, the user is not using this PRC variable field and has entered a “0” for the third PRC variable. “Null” displays in the PRC variable field where the name of the variable is ordinarily shown.
0	This field contains the minimum permissible value of the fourth PRC variable in ACCU channel 1.
0	This field contains the maximum permissible value of the fourth PRC variable in ACCU channel 1.

14.4.1. Defining an ACCU Channel

Follow these steps to define an ACCU channel:

✔ Each channel may contain up to four collection criteria that are “anded” together.

1) **Press the <DATA STOP> key to enter the Setup Mode.**
2) **Press the <1> and <5> keys, and then press the <ENTER> key to display the Set ACCU System screen (Figure 14-15).**
3) **Press the <EDIT> key.**
4) **Enter the appropriate information for each ACCU channel, depending on the type of sampling that you want the ACCU System to perform (Sections 14.4.1.1-14.4.1.6).**
5) **Press the <ENTER> key.**
6) **Press the <F1> or <RUN> key to reset the instrument and resume data collection.**

14.4.1.1. ACCU Sampling by Time of Day

✔ Once an event triggers the system, the ACCU hardware samples for predefined lengths of time on channels 1 through 8.

To set up an ACCU channel to sample at a specific period of time during the day, enter PRC 62 (“Curr Ti/Da”) in one of the PRC variable fields of the channel (Section 14.4). The monitor computes time in a 24-hour format. Be sure to enter a beginning sampling time in the minimum permissible value field, and an ending sampling time in the maximum permissible value field. For example, if you wanted the channel to begin sampling at 9:00 a.m., you would enter “900” in the minimum permissible value field. If you wanted the channel to end sampling at 2:00 p.m., you would enter “1400” in the maximum permissible value field (Figure 14-19).

Figure 14-19. Set ACCU System screen with channel 1 set for time of day sampling.

```
 SET ACCU SYSTEM          1
1>Curr Ti/Da            900
                       1400
2       Null              0
```

To set the channel to sample for an entire day (from midnight of one day to the following midnight of the next day), you would enter “0” (12:00 a.m.) in the minimum permissible value field, and “2359” (11:59 p.m.) in the maximum permissible value field.

14.4.1.2. ACCU Sampling by Specific Time/Date

To set up the ACCU channel to sample for specific time periods during specific days, you would first enter PRC 62 (“Curr Ti/Da”) in one of the PRC variable fields of the channel (Section 14.4). Then you would enter the date and time as one value for the beginning and ending sample times in the “minimum” and “maximum” parameters. For example, if you wanted to sample from 6:00 a.m. to 6:00 p.m. on June 3, you would enter “6030600” (month, day, hour, minute) in the minimum permissible value field, and “6031800” in the maximum permissible value field (Figure 14-20).

Figure 14-20. Set ACCU System screen with channel 1 set for specific time/date sampling.

```
SET ACCU SYSTEM          1
1>Curr Ti/Da       6030600
                   6031800
2       Null             0
```

If you wanted to sample from 10:00 p.m. on March 17 to 10:00 a.m. on March 18, you would enter “3172200” in the minimum permissible value field, and “3181000” in the maximum permissible value field.

If you wanted to sample for a complete 24-hour period such as midnight to midnight on December 31, you would enter “12310000” in the minimum permissible value field, and “1010000” in the maximum permissible value field.

14.4.1.3. ACCU Sampling by Concentration Level

To define an ACCU channel to be active only when the short-term mass concentration is higher than 100, you would first enter PRC 8 ("Mass Conc") in one of the PRC variable fields of the channel (Section 14.4). Then you would enter "100" in the minimum permissible value field, and an arbitrarily large value that is not expected to be exceeded, such as "10000," in the maximum permissible value field (Figure 14-21).

Figure 14-21. Set ACCU System screen with channel 1 set for sampling triggered by a specific mass concentration level.

```
SET ACCU SYSTEM           1
1>Mass Conc           100.0
                    10000.0
2       Null              0
```

14.4.1.4. Episodic Sampling

The ACCU System can be configured to capture user-defined episodes through the use of a special code. When operated in this manner, each episode is sampled on one user-defined ACCU channel. Once a channel has been activated and used, the monitor will not sample on the channel again until the user resets that channel (Section 14.6).

✔ Episodic sampling collects each user-defined episode on a different ACCU channel.

To capture a user-defined episode, you must define two or more consecutive ACCU channels in an identical manner. For example, you would first enter PRC 98 (“Curr Chan”) in one of the PRC variable fields of two or more consecutive ACCU channels (Section 14.4), such as ACCU channel 1 and 2. Then you would define the minimum and maximum permissible values for the episode that you would like to capture.

In Figures 14-22, 14-23 and 14-24, ACCU channels 1, 2 or 3 are activated whenever the current average of “A/I 0” ranges between “50” and “100.” ACCU channel 1 is used for the first episode that meets this criterion, followed by channels 2 and 3.

Figure 14-22. Set ACCU System screen (additional lines displayed) with channel 1 set for episodic sampling.

```
  SET ACCU SYSTEM       1
1>Curr Chan             0
                        0
2 A/I 0             50.00
---------------------------
                   100.00
3       Null            0
                        0
4       Null            0
                        0
```

Figure 14-23. Set ACCU System screen (additional lines displayed) with channel 2 set for episodic sampling.

```
  SET ACCU SYSTEM       2
1>Curr Chan             0
                        0
2 A/I 0             50.00
---------------------------
                   100.00
3       Null            0
                        0
4       Null            0
                        0
```

Figure 14-24. Set ACCU System screen (additional lines displayed) with channel 3 set for episodic sampling.

```
  SET ACCU SYSTEM          3
1>Curr Chan                0
                           0
2 A/I 0                50.00
----------------------------
                      100.00
3       Null               0
                           0
4       Null               0
                           0
```

Be sure to use great caution when defining episodes. Variables with broad fluctuations, such as 10-minute mass concentrations, should not be used because they may vary greatly around the trigger point and cause undesired cycling through the ACCU channels. For this reason, you should set the ACCU channel to measure 30-minute mass concentration averages, instead of 10-minute mass concentrations.

14.4.1.5. Time Sampling

The ACCU System can be configured to sample each ACCU channel for predefined periods of time after a specific set of conditions is met on channel 1. The sampling criteria assigned to channel 1 are used to begin a sampling sequence that starts with channel 1 and ends with channel 8. The user assigns the length of time that each channel is active.

To set up the ACCU System for triggered sampling by time, the user must enter PRC 100 (“Time”) as the first variable of each flow channel definition. Set the minimum permissible value field to “0.” Then set the maximum permissible value field to the length of time (seconds) that you want the flow channel to be active.

You must enter the conditions to be tested in ACCU channel 1 to trigger the beginning of sampling. No additional conditions besides PRC 100 (“Time”) should be entered into the remaining flow channels (ACCU channels 2-8).

For example, to set the ACCU System to begin sampling on channel 1 when the 30-minute mass concentration average exceeds 100 µg/m^3, with a sampling period of 60 minutes (3600 sec) on all flow channels, you would display ACCU channel 1 and set the first PRC variable field to PRC 100 (“Time”), with a minimum permissible value of “0” and a maximum permissible value of “3600.” Then you would set the second PRC variable field of ACCU channel 1 to PRC 57 (“30-Min MC”), with a minimum permissible value of “100.00” and a maximum permissible value of “9999.00” (Figure 14-25).

Figure 14-25. Set ACCU System screen (additional lines displayed) with channel 1 set for time sampling.

```
  SET ACCU SYSTEM          1
1>Time                     0
                        3600
2 30-Min MC           100.00
----------------------------
                     9999.00
3 Null                     0
                           0
4 Null                     0
                           0
```

After you entered the proper PRC variables and values in channel 1, then you would display the rest of the ACCU channels and set the first PRC variable field to PRC 100 (“Time”), with a minimum permissible value of “0” and a maximum permissible value of “3600” (Figures 14-26 and 14-27).

Figure 14-26. Set ACCU System screen (additional lines displayed) with channel 2 set for time sampling.

```
  SET ACCU SYSTEM        2
1>Time                   0
                      3600
2 Null                   0
--------------------------
                         0
3 Null                   0
                         0
4 Null                   0
                         0
```

Figure 14-27. Set ACCU System screen (additional lines displayed) with channel 3 set for time sampling.

```
  SET ACCU SYSTEM        3
1>Time                   0
                      3600
2 Null                   0
--------------------------
                         0
3 Null                   0
                         0
4 Null                   0
                         0
```

After the ACCU System has exposed all of the flow channels for their predefined lengths of time, the instrument will not use these channels again until the user resets them.

14.4.1.6. Sequential Sampling

The ACCU System can be configured to sample on a certain number of channels for a predetermined amount of time, and then later return to those channels and sample on them again for the same amount of time. The user assigns the length of time during which each channel is active.

To set up the ACCU System for sequential sampling, the user must enter PRC 100 ("Time") as the first variable of each flow channel in the sequence. Set the minimum permissible value field to the length of time (seconds) that you want each flow channel to be active. Then set the maximum permissible value field to "0."

You also may enter additional conditions to define each channel, in conjunction with the "Time" variable. For example, you could set ACCU channel 1 to sample for 1 hour without any additional conditions (Figure 14-28). Then you could set channel 2 to sample for 1 hour only if the 30 minute mass concentration average exceeds 100 µg/m^3 (Figure 14-29).

Figure 14-28. Set ACCU System screen (additional lines displayed) with channel 1 set for sequential sampling.

```
  SET ACCU SYSTEM        1
1>Time                3600
                         0
2 Null                   0
--------------------------
                         0
3 Null                   0
                         0
4 Null                   0
                         0
```

Figure 14-29. Set ACCU System screen (additional lines displayed) with channel 2 set for sequential sampling.

```
  SET ACCU SYSTEM        2
1>Time                3600
                         0
2 30-Min MC         100.00
--------------------------
                   9999.00
3 Null                   0
                         0
4 Null                   0
                         0
```

If the 30-minute mass concentration average does not meet this minimum value, the ACCU System will skip channel 2 and cycle to channel 3 (Figure 14-30), where it will sample for 60 minutes, again without additional conditions. After the ACCU System has exposed all of the flow channels for their predefined lengths of time, the instrument will return to channel 1 and begin the sampling sequence again.

Figure 14-30. Set ACCU System screen (additional lines displayed) with channel 3 set for sequential sampling.

```
  SET ACCU SYSTEM        3
1>Time                3600
                         0
2 Null                   0
--------------------------
                         0
3 Null                   0
                         0
4 Null                   0
                         0
```

The ACCU System will continue sequential sampling in this manner until the user stops the sampling routine, or until the monitor disqualifies a channel because the pressure drop of the installed filter cartridge causes the bypass flow to fall outside of the acceptable limits (Section 7).

14.5. View ACCU System Screen

The user can view the operating statistics of the ACCU System when in the View ACCU System screen (Figure 14-31).

Figure 14-31. View ACCU System screen.

```
 VIEW ACCU SYSTEM        3
Time     >           89400
Volume              20.368
Curr Chan                1
```

You can display the View ACCU System screen on the four-line display of the control unit in two different ways:

1. When in the Main screen (Figure 14-16), press the <STEP SCREEN> key on the control unit's keypad to display the Menu screen (Figure 14-17). When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select "View ACCU System," and then press the <ENTER> key.
2. Press the <1> and <4> keys, and then press the <ENTER> key.

The View ACCU System screen contains the following information:

3	This field contains the number of the ACCU channel that is currently being viewed. Press the right (<→>) arrow key to increase the channel by one. Press the left (<←>) arrow key to decrease the channel by one. To increase the channel by four, press the <SHIFT> key and hold it down while pressing the right (<→>) arrow key. To decrease the channel by four, press the <SHIFT> key and hold it down while pressing the left (<←>) arrow key. To display ACCU channel 8, press the <CTRL> key and hold it down while pressing the right (<→>) arrow key. To display ACCU channel 1, press the <CTRL> key and hold it down while pressing the left (<←>) arrow key.
Time	This field contains the time (sec) during which the ACCU channel has been exposed to the sample stream.

Volume	This field contains the total volume of air (m^3, at standard temperature and pressure) that has been drawn through the ACCU channel.
Curr Chan	This field contains the number of the currently active ACCU channel. “Channel 0” is the designation for the internal bypass line, which is active only when the sampling conditions for channels 1 to 8 are not met.

✔ A negative value for volume indicates that the ACCU sample flow dropped below acceptable limits.

If the pressure drop across the installed filter cartridge causes the flow rate to fall below 13.67 l/min by ± 0.40 l/min, the system will stop using the channel. If this happens, the unit will display a negative number in the Volume field of the View ACCU System screen. To use this channel again, replace the filter and reset the channel.

The ACCU System is only operational if the monitor is in Operating Modes 1-4. If the monitor is not in Operating Modes 1-4, only the internal bypass flow channel (Channel 0) of the ACCU hardware is active. After the user presses the <F1> or <RUN> key on the monitor’s keypad, the ACCU System will begin operation 1 minute after the monitor enters Operating Mode 1.

14.6. Resetting ACCU Channels

✘ When the user resets an ACCU channel, the accumulators for that channel are reset to “0.”

The user would generally reset an ACCU channel after installing a new filter cartridge in that channel (Section 14.3.2). When the user resets an ACCU channel, the Time and Volume fields for that channel (Section 14.5) are reset to “0.” Therefore, you should reset a channel only after you have recorded the values that are displayed in the Time and Volume fields of the View ACCU System screen (Figure 14-31), because this information will be lost after the channel is reset.

Follow these steps to reset an ACCU channel:

1) **Press the <DATA STOP> key on the monitor’s keypad to enter Setup Mode.**
2) **Press the <1> and <4> keys, and then press the <ENTER> key to display the View ACCU System screen (Section 14.5).**
3) **Press the left (<←>) and right (<→>) arrow keys to display the channel that you want to reset.**
4) **Press the <CTRL> key and hold it down.**
5) **Press the <LAST/FIRST> key to reset the channel that is currently being displayed. If you want to view or change the criteria of a channel after you have reset it, go to step 5. If you do not want to view or change the criteria of a channel after you have reset it, go to step 8.**
6) **Press the <STEP SCREEN> key to display the Set ACCU System screen (Section 14.4). When in the Set ACCU System screen, you can change or view or change the criteria of a channel.**
7) **Press the <ENTER> key. Go to step 8.**
8) **Press the <F1> or <RUN> key to reset the instrument and resume data collection.**

NOTE: If the Set ACCU System screen for the current channel contains a PRC 62 (“Curr Ti/Da”) condition that specifies both a time and date, press the <F7> key to decrease the date/time value by one day, or press the <F8> key to increase the date/time value by one day. This procedure also works for adjusting both the minimum and maximum values.

14.7. ACCU System Maintenance

The sample distributor cone and sample distributor of the ACCU System require periodic maintenance. Requirements for routine cleaning are site-specific. Generally, the cone should be removed and examined at least once a year. Clean the interior of the cone periodically to keep it free from contamination.

Follow these steps to clean the sample distributor and cone:

1) Turn the monitor off.

2) Remove the bypass flow line from the sample distributor cone.

3) Remove the four screws that secure the cone to the top of the ACCU enclosure (Figure 14-32).

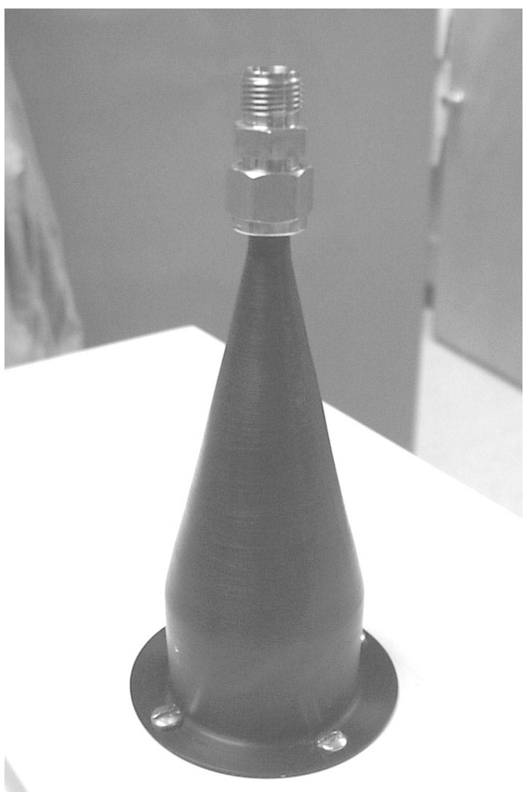


Figure 14-32. Sample distributor cone installed on top of the ACCU System enclosure.

4) Hold the cone by its base and pull it upward to remove it from the enclosure.

5) Inspect the O-ring (22-000485) (Figure 14-33) on the sample distributor for damage or wear. Replace it as necessary.

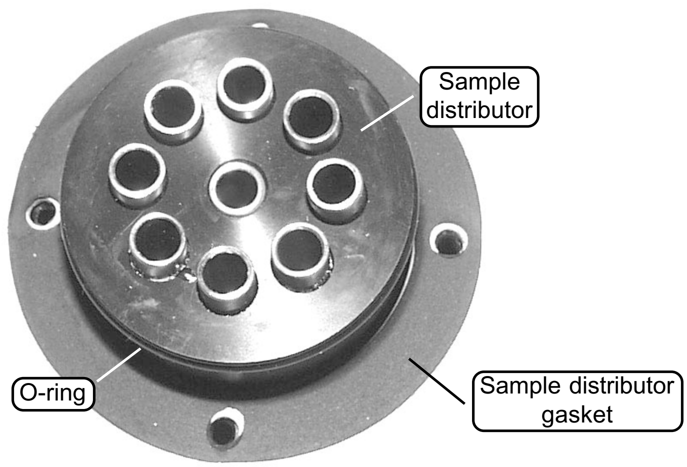


Figure 14-33. Sample distributor gasket installed around the sample distributor.

6) Inspect the sample distributor gasket (30-001617) (Figure 14-33) for damage or wear. Replace it as necessary.

7) Clean the inside of the cone with a lint-free cloth.

8) Clean the surface of the sample distributor with a lint-free cloth.

9) Install the cone onto the top of the enclosure.

10) Install the bypass flow line onto the fitting on the top of the cone.

11) Turn the monitor on.

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Appendix A: Overview of Software Screens

This appendix provides an overview of the screens that appear on the Series 1400a monitor (Section A.1), and the RPComm (Section A.2), TEOMCOMM (Section A.3) and TEOMPLUS (Section A.4) software programs.

A.1. Series 1400a Monitor Software Screens

Figure A-1. Hierarchy of Series 1400a monitor software screens.

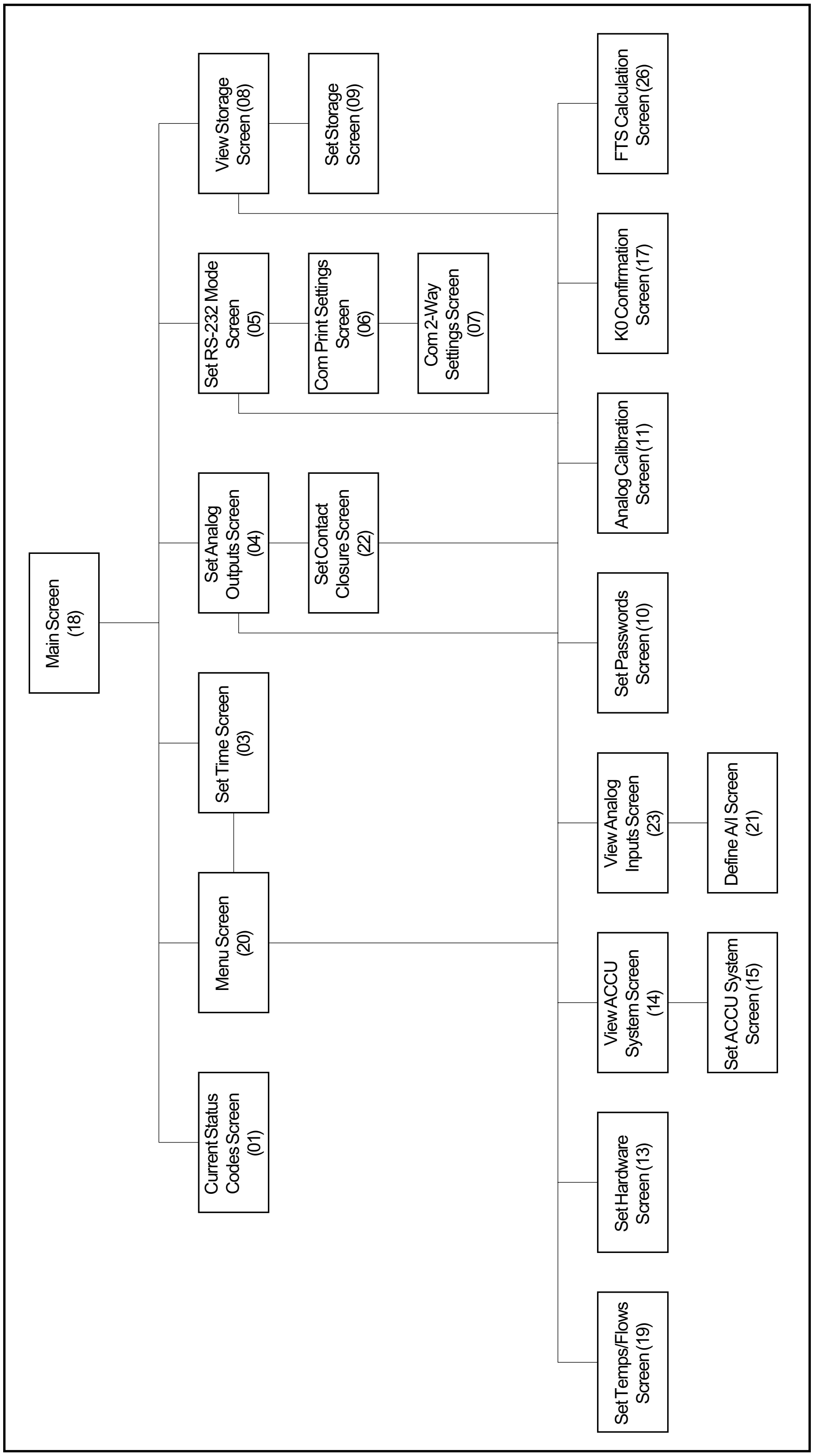


Figure A-2. Title screen.

```
     Series 1400a Monitor

       Copyright 2001
   Rupprecht + Patashnick
```

Figure A-3. Main screen.

```
OK    4+  11%  NU     09:39
Mass Conc>             33.6
30-Min MC              26.8
01-Hr MC               12.5
```

Figure A-4. Main screen with additional lines displayed.

```
OK    4+  11%  NU     09:39
Mass Conc>             76.4
30-Min MC              72.3
01-Hr MC               78.4
---------------------------
08-Hr MC               85.8
24-Hr MC               69.3
Tot Mass             974.38
Case Temp             50.00
Air Temp              50.01
Cap Temp              49.98
Main Flow              3.00
Aux Flow              13.66
---------<
Noise                 0.524
Frequency         245.55603
```

Figure A-5. Current Status Codes screen.

```
 CURRENT STATUS CODES
>M        Mass Transducer
 T            Temperature
 F             Flow Rates
```

Figure A-6. Current Status Codes screen with additional lines displayed.

```
 CURRENT STATUS CODES
>M        Mass Transducer
 T            Temperature
 F             Flow Rates
-------------------------
 X        Exchange Filter
 V            Voltage Low
```

Figure A-7. Menu screen.

```
 LISTING OF SCREENS
>Set Temps/Flows
 Set Hardware
 View ACCU System
```

Figure A-8. Menu screen with additional lines displayed.

```
 LISTING OF SCREENS
>Set Temps/Flows
 Set Hardware
 View ACCU System
-------------------------
 View Analog Inputs
 Set Time
 Set Analog Outputs
 Set Contact Closure
 Set RS-232 Mode
 View Storage
 Set Passwords
 Analog Calibration
 K0 Calibration
 FTS Calculation
```

Figure A-9. Set Time screen.

```
         SET TIME
16:20:03        15-Jan-01
Second  >               0
Minute                 20
```

Figure A-10. Set Time screen with additional lines displayed.

```
         SET TIME
16:20:03        15-Jan-01
Second  >               0
Minute                 20
-------------------------
Hour                   16
Day                    15
Month                   0
Year                 2001
```

Figure A-11. Set Analog Outputs screen.

```
    SET ANALOG OUTPUTS
Max Volt >          10-VDC
A01 Var         30-Min MC
A01 Min               0.00
```

Figure A-12. Set Analog Outputs screen with additional lines displayed.

```
    SET ANALOG OUTPUTS
Max Volt >          10-VDC
A01 Var         30-Min MC
A01 Min               0.00
--------------------------
A01 Max             500.00
A02 Var          01-Hr MC
A02 Min               0.00
A02 Max             500.00
A03 Var          Tot Mass
A03 Min               0.00
A03 Max            5000.00
Jumpers             10-VDC
```

Figure A-13. Set Contact Closure screen.

```
    SET CONTACT CLOSURE
Cont 1 Prc >        Status
   NAND               7.00
Cont 2 Prc       Pres Drop
```

Figure A-14. Set Contact Closure screen with additional lines displayed.

```
    SET CONTACT CLOSURE
Cont1 PRC >         Status
   NAND               7.00
Cont2 PRC        Pres Drop
-------------------------
       <             90.00
```

Figure A-15. Set RS-232 Mode screen.

```
        SET RS-232 MODE
  Mode: None
 >None
  Print On Line
```

Figure A-16. Set RS-232 Mode screen with additional lines displayed.

```
       SET RS-232 MODE
  Mode: None
 >None
  Print On Line
-------------------------
  AK Protocol
  German Prot
  Store to Print
```

Figure A-17. Com Print Settings screen.

```
      COM PRINT SETTINGS
Interval >              1800
Columns                    6
Prnt Var 1         Mass Conc
```

Figure A-18. Com Print Settings screen with additional lines displayed.

```
      COM PRINT SETTINGS
Interval >              1800
Columns                    6
Prnt Var1          Mass Conc
----------------------------
Prnt Var2          30-Min MC
Prnt Var3           01-Hr MC
Prnt Var4           24-Hr MC
Prnt Var5           Tot Mass
Prnt Var6               Null
Station             48048048
```

Figure A-19. Com 2-Way Settings screen.

```
      COM 2-WAY SETTINGS
RS-Para 1 >             52
RS-Para 2            75048
RS-Para 3            13010
```

Figure A-20. Com 2-Way Settings screen with additional lines displayed.

```
      COM 2-WAY SETTINGS
RS-Para 1 >             52
RS-Para 2            75048
RS-Para 3            13010
--------------------------
RS-Para 4                0
```

Figure A-21. View Storage screen.

```
VIEW STORAGE            2056
16:20:03           15-Jan-01
>Mass Conc              74.9
 30-Min MC              72.3
```

Figure A-22. View Storage screen with additional lines displayed.

```
VIEW STORAGE            2056
16:20:03           15-Jan-01
>Mass Conc              74.9
 30-Min MC              72.3
----------------------------
 Main Flow               3.0
 Frequency          248.3217
     Noise             5.438
      Null                 0
      Null                 0
      Null                 0
```

Figure A-23. Set Storage screen.

```
        SET STORAGE
Stor Var1      > Mass Conc
Stor Var2        30-Min MC
Stor Var3         01-Hr MC
```

Figure A-24. Set Storage screen with additional lines displayed.

```
        SET STORAGE
Stor Var1      > Mass Conc
Stor Var2        30-Min MC
Stor Var3         01-Hr MC
--------------------------
Stor Var4        Frequency
Stor Var5            A/I 5
Stor Var6         Amb Temp
Stor Var7            A/I 3
Stor Var8             Null
Interval             60.00
Stor Vars                4
Station           48048048
```

Figure A-25. Set Temps/ Flows screen.

SET TEMPS/FLOWS		
T-Case>	50.00	50.00
T-Air	50.00	50.01
T-Cap	50.00	49.98

Figure A-26. Set Temps/ Flows screen with additional lines displayed.

SET TEMPS/FLOWS		
T-Case>	50.00	50.00
T-Air	50.00	50.01
T-Cap	50.00	49.98
F-Main	3.00	3.00
F-Aux	10.00	9.98
T-A/S	25.00	25.00
P-A/S	1.000	1.000
Amb Temp		23.4
Amb Pres		0.988
FAdj Main		1.000
FAdj Aux		1.000

Figure A-27. Set Hardware screen.

```
        SET HARDWARE
Cal Const>             9605
Ser Num               22822
Inst Type                AB
```

Figure A-28. Set Hardware screen with additional lines displayed.

```
        SET HARDWARE
Cal Const>             9605
Ser Num               22822
Inst Type                AB
---------------------------
Wait Time                 0
MR/MC Ave               300
TM Ave                  300
XX-Hr MC                  8
Const A               3.000
Const B               1.030
Soft Rate          0.000000
Hard Rate          0.000000
Version               3.016
```

Figure A-29. View ACCU System screen.

```
 VIEW ACCU SYSTEM         3
Time     >            89400
Volume               20.368
Curr Chan                 1
```

Figure A-30. Set ACCU System screen.

```
SET ACCU SYSTEM          3
1>Mass Conc          100.0
                    1000.0
2 Curr Ti/Da           600
```

Figure A-31. Set ACCU System screen with additional lines displayed.

```
SET ACCU SYSTEM          1
1>Mass Conc          100.0
                    1000.0
2 Curr Ti/Da           600
---------------------------
                       600
3       Null             0
                         0
4       Null             0
                         0
```

Figure A-32. View Analog Inputs screen.

```
    VIEW ANALOG INPUTS
A/I 0       >      0.000
A/I 1             17.363
A/I 2             27.463
```

Figure A-33. View Analog Inputs screen with additional lines displayed.

```
    VIEW ANALOG INPUTS
A/I 0       >      0.000
A/I 1             17.363
A/I 2             27.463
------------------------
A/I 3             15.957
A/I 4              1.640
A/I 5              2.983
A/I 6             41.885
Wind Spd             0.0
Wind Vel             0.0
Wind Dir             0.0
```

Figure A-34. Define Analog Inputs screen.

```
DEFINE A/I             1
A/I %FS  >          4.83
A/I Type        WndSpeed
Const A            0.000
```

Figure A-35. Define Analog Inputs screen with additional lines displayed.

```
DEFINE A/I             1
A/I %FS  >          4.83
A/I Type        WndSpeed
Const A            0.000
------------------------
Const B            1.000
Const C            0.000
A/I Ave            0.000
```

Figure A-36. Set Password screen.

```
        SET PASSWORD
Cur Lo Pass>            *
New Lo Pass             *
Cur Hi Pass             *
```

Figure A-37. Set Password screen with additional lines displayed.

```
        SET PASSWORD
Cur Lo Pass>            *
New Lo Pass             *
Cur Hi Pass             *
------------------------
New Hi Pass             *
```

Figure A-38. Analog Calibration screen.

```
   ANALOG CALIBRATION
Calibrate       >    YES
A/O Value          50.00
A/I Channel     6  50.00
```

Figure A-39. K0 Confirmation screen.

```
K0 Confirm     209.44188
>Filt Wght       0.07903
 287.53182     209.44186
 Audit K0           9683
```

Figure A-40. K0 Confirmation screen with additional lines displayed.

```
K0 Confirm     209.44188
>Filt Wght       0.07903
 287.53182     209.44186
 Audit K0           9683
------------------------
 Actual K0          9627
 % Diff             0.58
```

Figure A-41. FTS Calculation screen.

```
FTS Calculation
Manometer      > 5.009788
Mano B            -0.1724
Mano M             0.3570
```

Figure A-42. FTS Calculation screen with additional lines displayed.

```
FTS Calculation
Manometer      > 5.009788
Mano B            -0.1724
Mano M             0.3570
---------------------------
FTS Flow            0.000
Amb Temp             23.4
Amb Pres            0.987
```

A.2. RPComm Software Screens

This appendix contains all of the software screens displayed by the RPComm software program.

Figure A-43. Connection List screen.

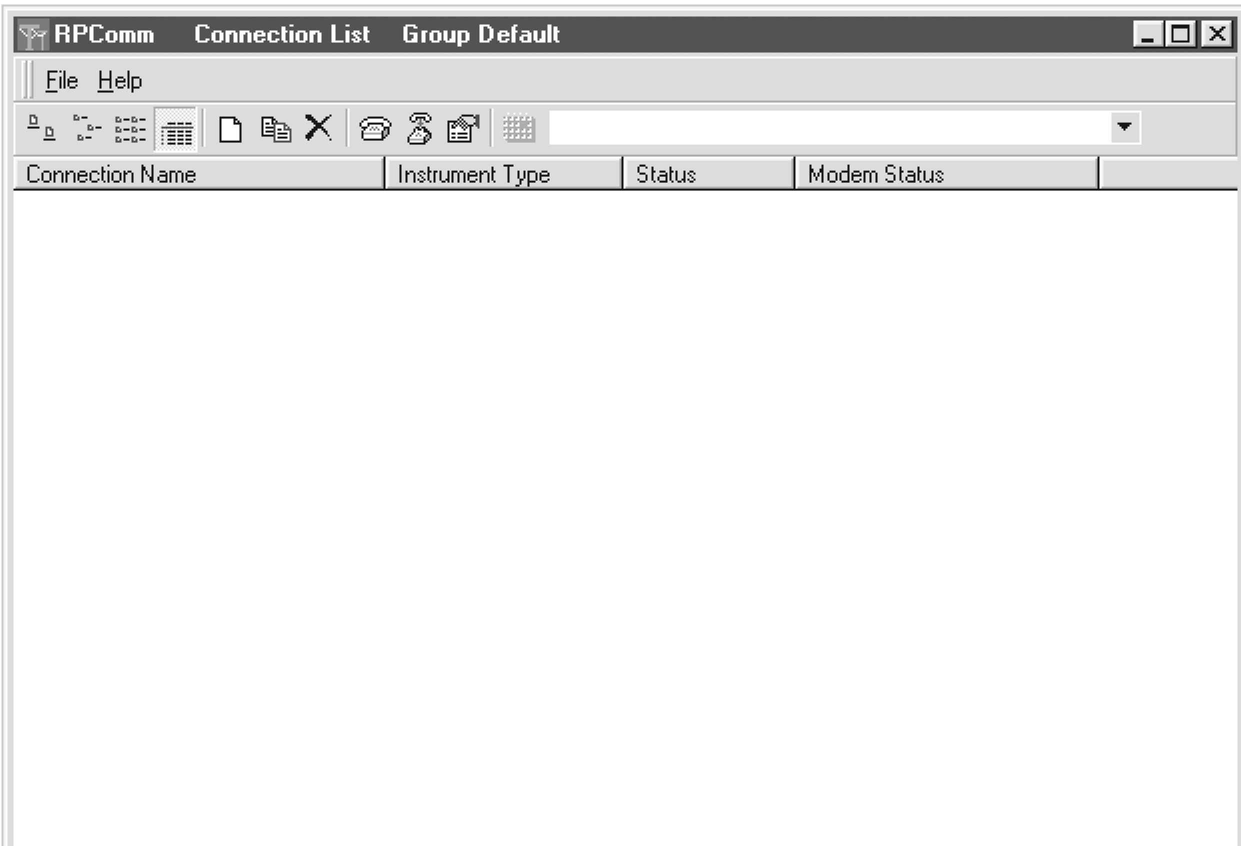
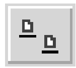
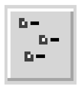
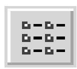
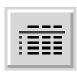
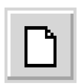
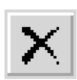
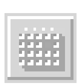
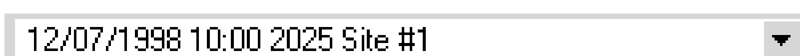


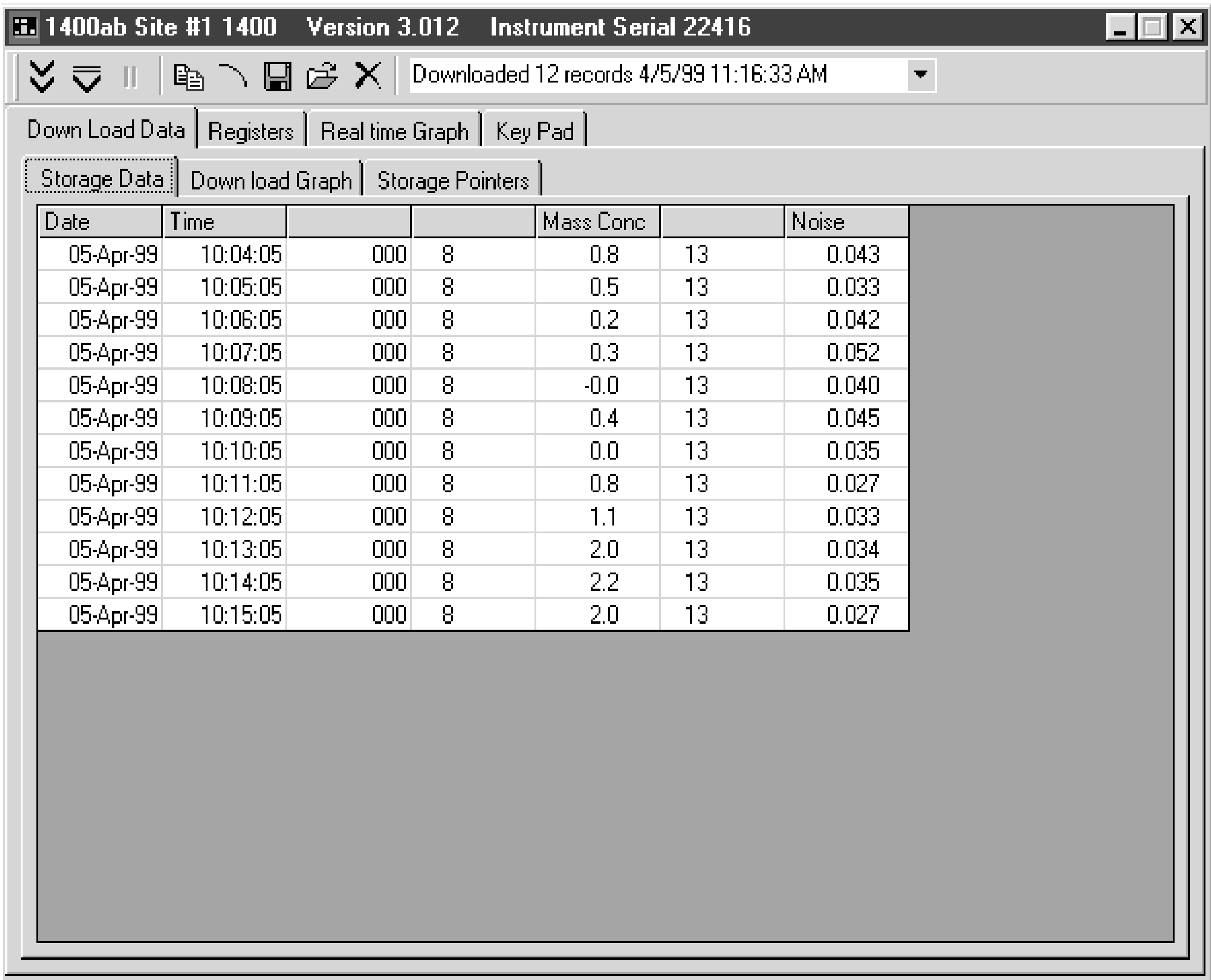
Figure A-44. Control buttons on the Connection List screen.

	Displays the instrument connections on the screen as large icons.
	Displays the instrument connections on the screen as small icons.
	Displays the instrument connections on the screen as a list.
	Displays the instrument connections on the screen as a list with details such as instrument type and status.
	Creates a new instrument connection.
	Edits the settings of the instrument connection currently selected.
	Deletes the instrument connection currently selected.
	Establishes a connection to the selected instrument.
	Disconnects the instrument connection.
	Displays the Properties screen showing the connection properties for the selected instrument.
	Displays the Schedule Download screen which allows the user to schedule automatic data downloads from the selected instrument.



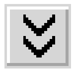
Contains a list of the data downloads currently scheduled.

Figure A-45. Download Data screen.

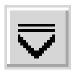


Date	Time			Mass Conc		Noise
05-Apr-99	10:04:05	000	8	0.8	13	0.043
05-Apr-99	10:05:05	000	8	0.5	13	0.033
05-Apr-99	10:06:05	000	8	0.2	13	0.042
05-Apr-99	10:07:05	000	8	0.3	13	0.052
05-Apr-99	10:08:05	000	8	-0.0	13	0.040
05-Apr-99	10:09:05	000	8	0.4	13	0.045
05-Apr-99	10:10:05	000	8	0.0	13	0.035
05-Apr-99	10:11:05	000	8	0.8	13	0.027
05-Apr-99	10:12:05	000	8	1.1	13	0.033
05-Apr-99	10:13:05	000	8	2.0	13	0.034
05-Apr-99	10:14:05	000	8	2.2	13	0.035
05-Apr-99	10:15:05	000	8	2.0	13	0.027

Figure A-46. Control buttons on the Download Data screen.



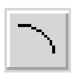
Downloads all stored data in the data buffer, starting at the first data record. After the data are downloaded, the storage pointer will move to the end of the data storage buffer. When the data have been downloaded, the data will be displayed in the Download Data screen.



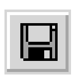
Downloads data from the current storage pointer position to the end of the data buffer. After the data are downloaded, the storage pointer will move to the end of the data storage buffer.

Aborts the download. This action will set the storage pointer to the record location where the download was aborted.

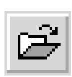
Copies the selected data to the Windows clipboard. The data can then be imported and used in other programs.



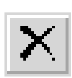
Sends the selected data to the Download Graph screen.



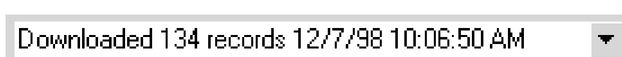
Stores the data to a file. The file is saved in a comma-delimited ASCII format.



Opens a data file that has been previously saved to disk for display or graphing.



Clears the data currently being displayed.



When the download has been successfully completed, a message will appear in the Dialog box indicating how many records were downloaded.

Figure A-47. Download Graph screen.

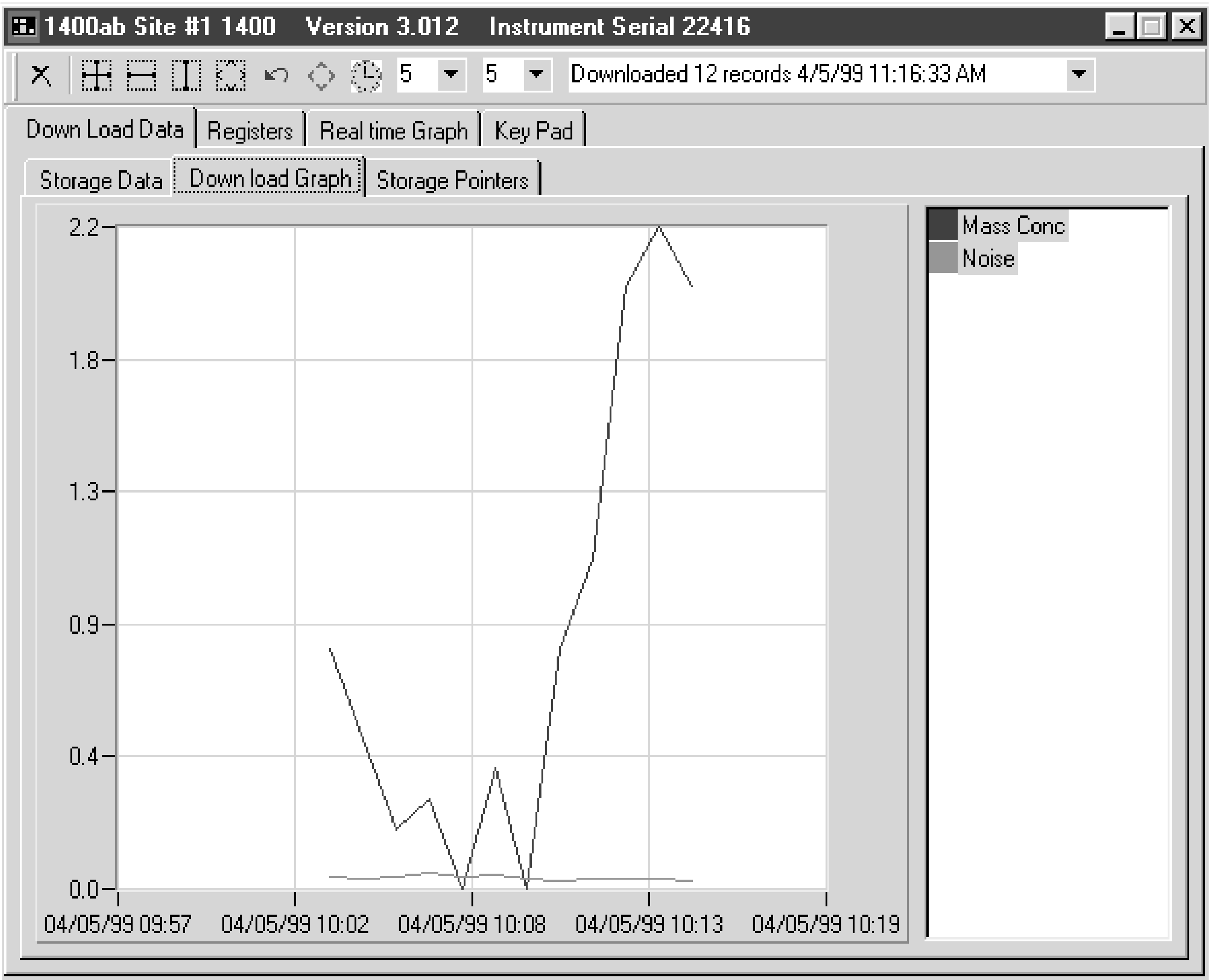
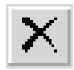
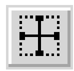


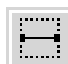
Figure A-48. Control buttons on the Download Graph screen.



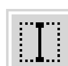
Clears all data listed on the right-hand side of the Download Graph screen. This includes the data being displayed.



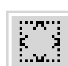
Decreases the scale of the x- and y-axes concurrently. With this icon selected, press and hold the left mouse button and make a box around an area (inside the graph) that you want to zoom into. Once the box is finished, release the mouse button. The graph will be resized according to the box dimensions.



Decreases the scale of the x-axis. With this icon selected, press and hold the left mouse button at the beginning of the area that you want to zoom into. Drag the cursor horizontally to the end of the zoom area and release the mouse button. The graph will be resized according to the new x-axis dimensions.



Decreases the scale of the y-axis. With this icon selected, press and hold the left mouse button at the beginning of the area that you want to zoom into. Drag the cursor vertically to the end of the zoom area and release the mouse button. The graph will be resized according to the new y-axis dimensions.



Enables panning. Panning allows the user to move the graph area so that a different section of the x- or y-axis will be displayed without affecting the scale of either axis. With this icon selected, place the mouse cursor somewhere within the graph area and hold down the left mouse button. Move the mouse to display the desired section of the graph.

Selecting this icon will undo the last zoom or panning step.

Rescales the x- and y-axes so that all the graphs for the selected data are displayed.

Toggles between the two possible x-axis scales: date and time, and time only. This does not affect the way the data are displayed on the graph.

These two boxes define the number of axis divisions on the graph. The left box refers to the x axis and the right box refers to the y axis. The number of divisions on the axis can be set to 5, 10, 15 or 20. Increasing the number of divisions results in a finer axis grid. Decreasing the number of divisions results in a courser axis grid. This does not affect the way the data are displayed on the graph.

Figure A-49. Storage Pointer screen.

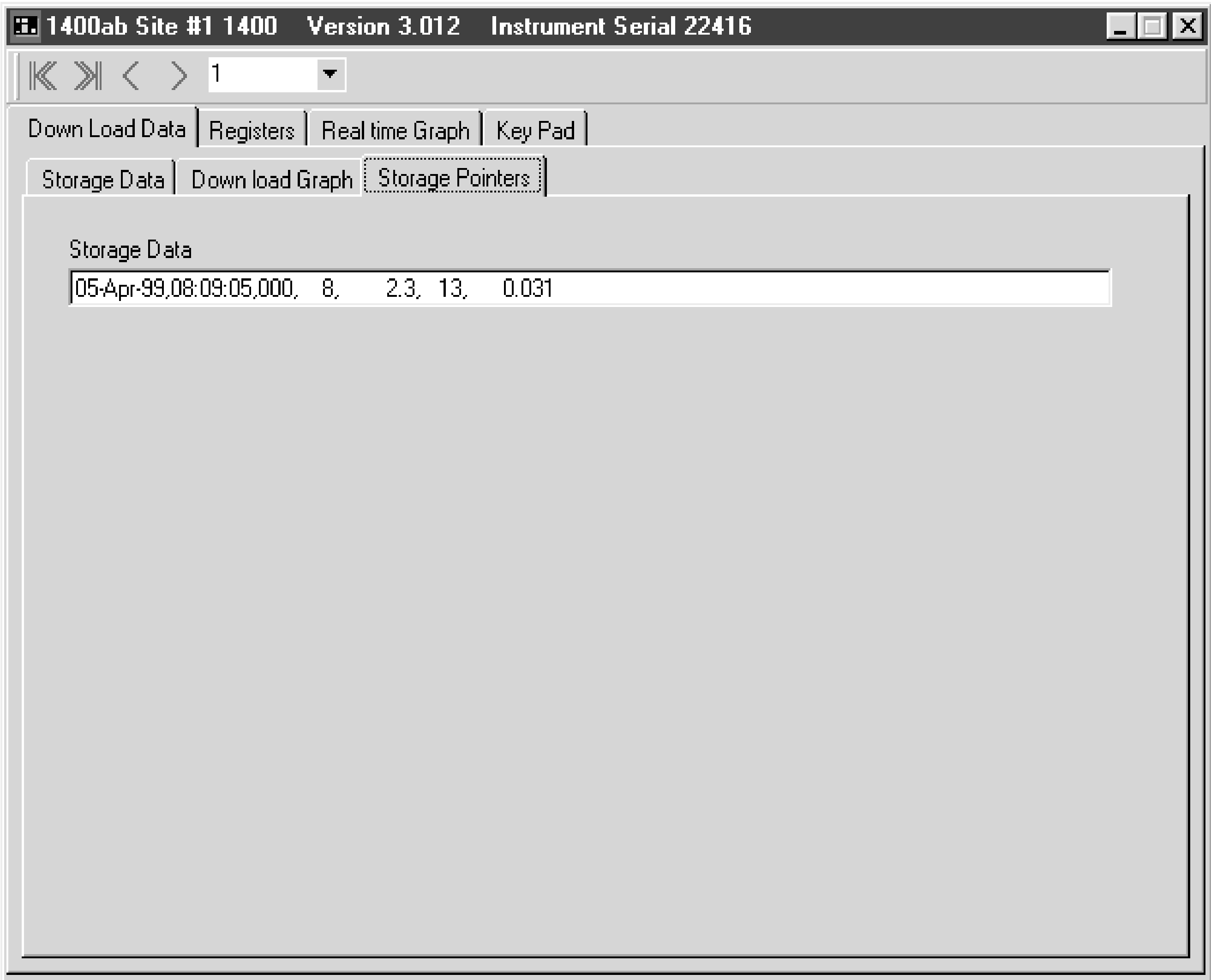
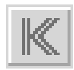
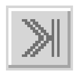


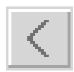
Figure A-50. Control buttons on the Storage Pointer screen.



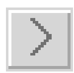
Moves the storage pointer to the first record in the buffer. The displayed position of the storage pointer will change, unless the storage pointer was already at the beginning of the buffer.



Moves the storage pointer to the last record in the buffer. The displayed position of the storage pointer will change, unless the storage pointer was already at the end of the buffer.



Moves the storage pointer back “x” number of records, where “x” is defined in the Change Record Step box



Moves the storage pointer forward “x” number of records, where “x” is defined in the Change Record Step box.

Change Record Step box. The step size can be 1, 5, 10, 100 or 1000.

Figure A-51. Registers screen.

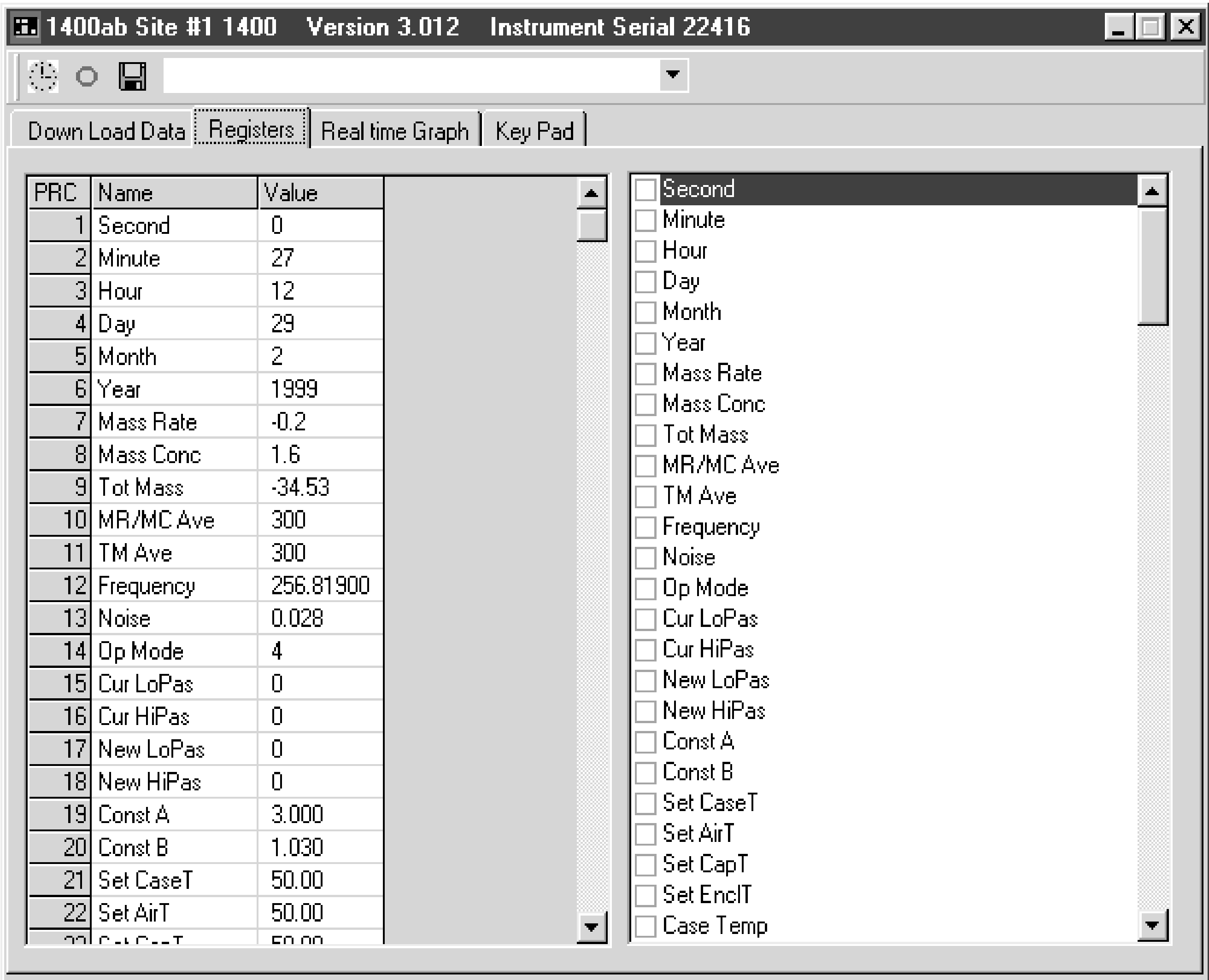
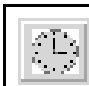
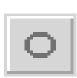


Figure A-52. Control buttons on the Registers screen.

 Reads selected register values from the unit.

 Selects all registers.

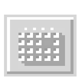
 Saves register data to a file.

Figure A-53. Real-Time Graph screen.

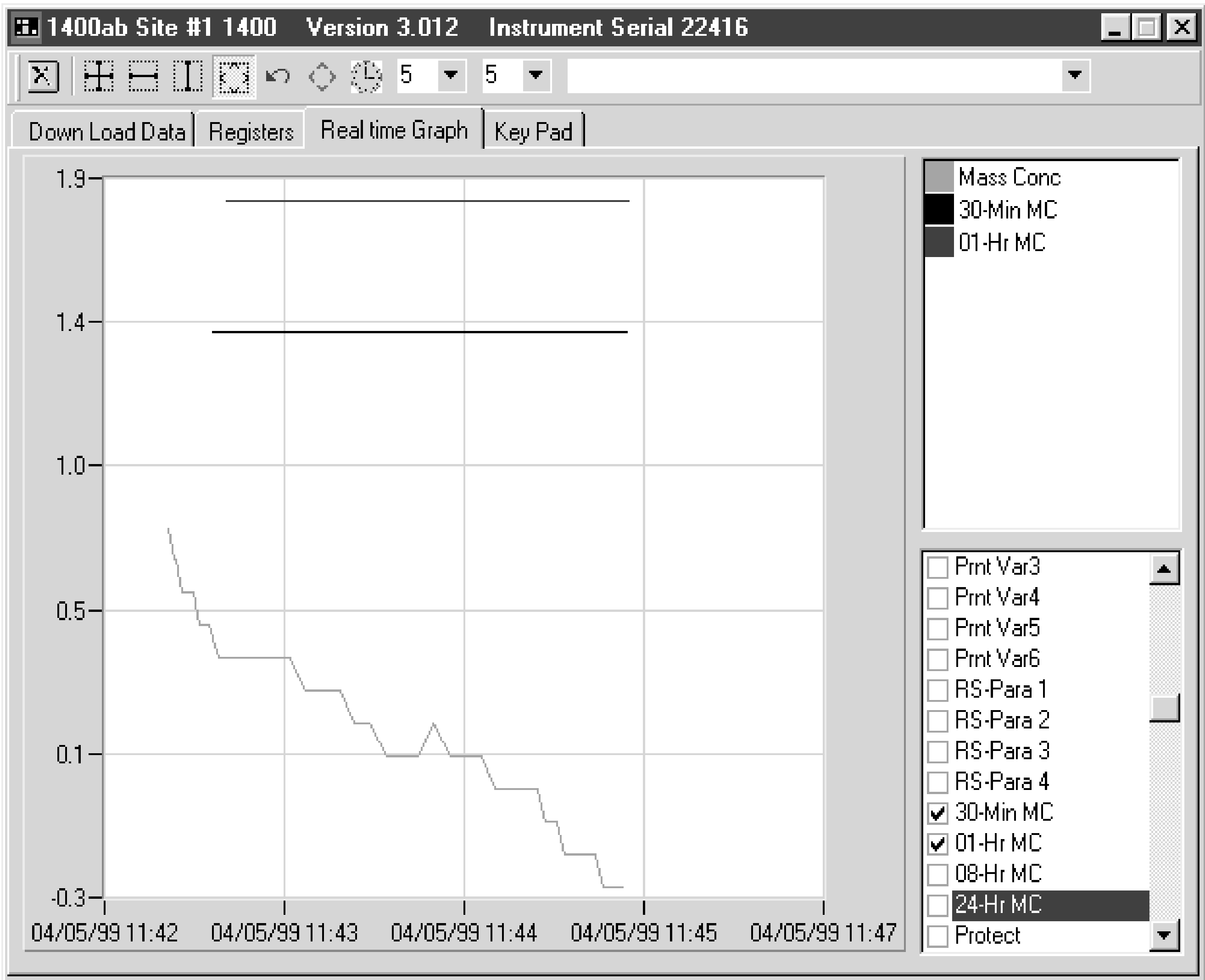
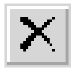
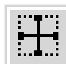


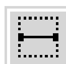
Figure A-54. Control buttons on the Real-Time Graph screen.



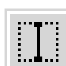
Clears all data listed on the right-hand side of the Real-Time Graph screen. This includes the data being displayed.



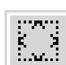
Decreases the scale of the x- and y-axes concurrently. With this icon selected, press and hold the left mouse button and make a box around an area (inside the graph) that you want to zoom into. Once the box is finished, release the mouse button. The graph will be resized according to the box dimensions.



Decreases the scale of the x-axis. With this icon selected, press and hold the left mouse button at the beginning of the area that you want to zoom into. Drag the cursor horizontally to the end of the zoom area and release the mouse button. The graph will be resized according to the new x-axis dimensions.



Decrease the scale of the y-axis. With this icon selected, press and hold the left mouse button at the beginning of the area that you want to zoom into. Drag the cursor vertically to the end of the zoom area and release the mouse button. The graph will be resized according to the new y-axis dimensions.



Enables panning. Panning allows the user to move the graph so that a different section of the x- or y-axis will be displayed without affecting the scale of either axis. With this icon selected, place the mouse cursor somewhere within the graph area and hold down the left mouse button. Move the mouse to display the desired section of the graph.

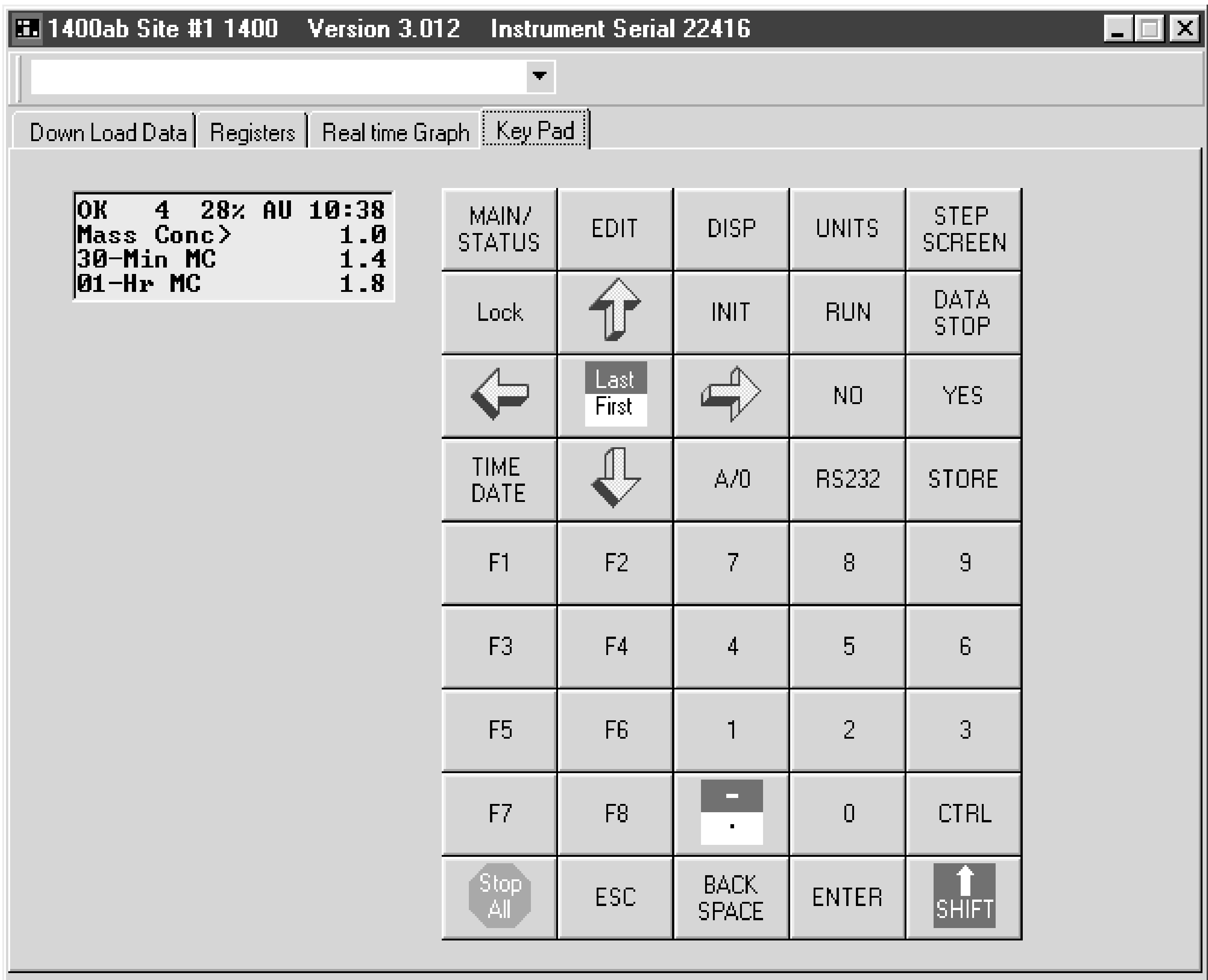
Selecting this icon will undo the last zoom or panning step.

Rescales the x- and y-axes so that all the graphs for the selected data are displayed.

Toggles between the two possible x-axis scales: date and time, and time only. This does not affect the way the data are displayed on the graph.

These two boxes define the number of axis divisions on the graph. The left-hand box refers to the x-axis and the right-hand box refers to the y-axis. The number of divisions on the axis can be set to 5, 10, 15 or 20. Increasing the number of divisions results in a finer axis grid. Decreasing the number of divisions results in a courser axis grid. This does not affect the way the data are displayed on the graph.

Figure A-55. Virtual keypad.



A.3. TEOMCOMM Software Screens

This appendix contains all of the software screens displayed by the TEOMCOMM software program.

Figure A-56. Main screen.

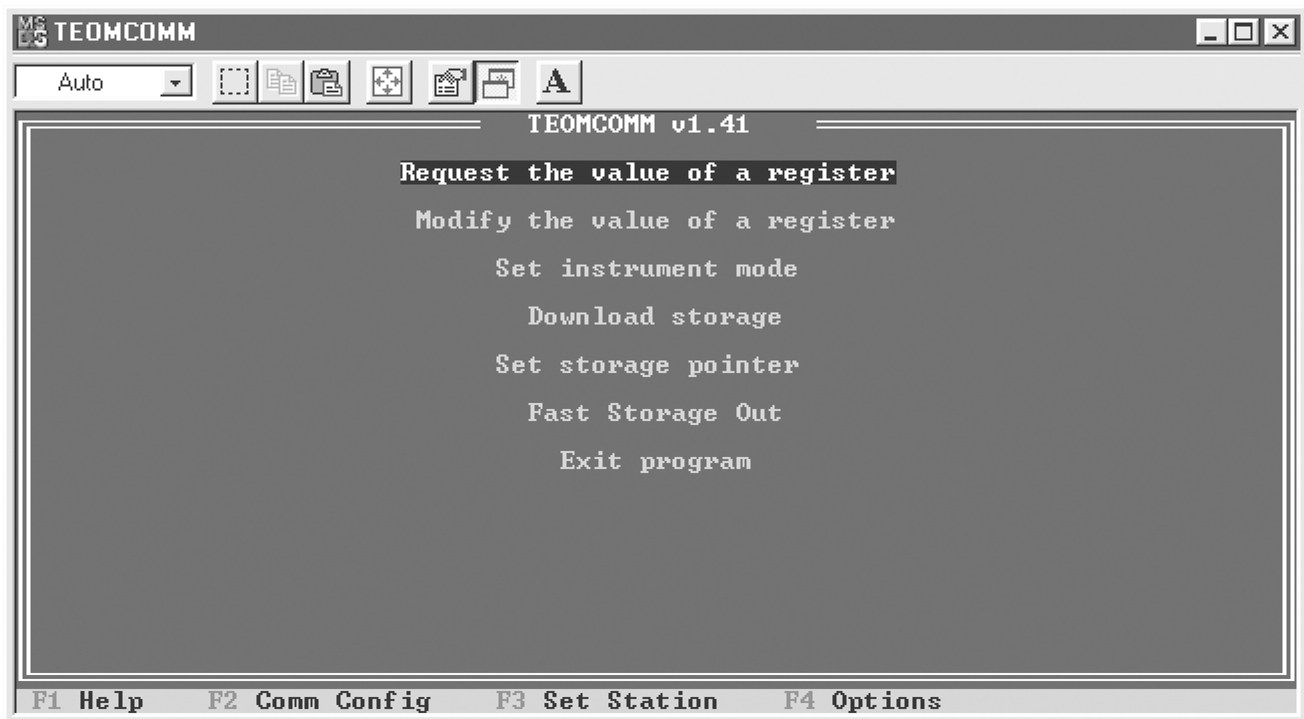
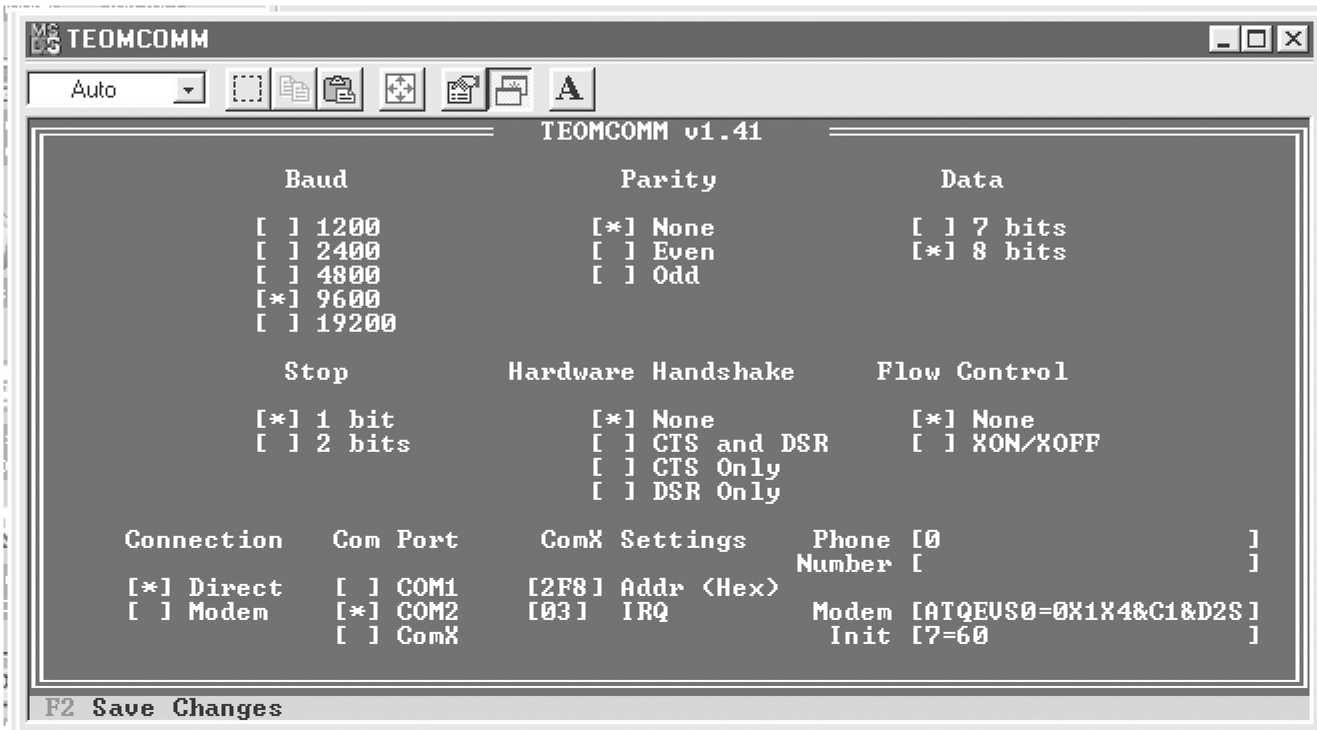


Figure A-57. Communications Setup screen.



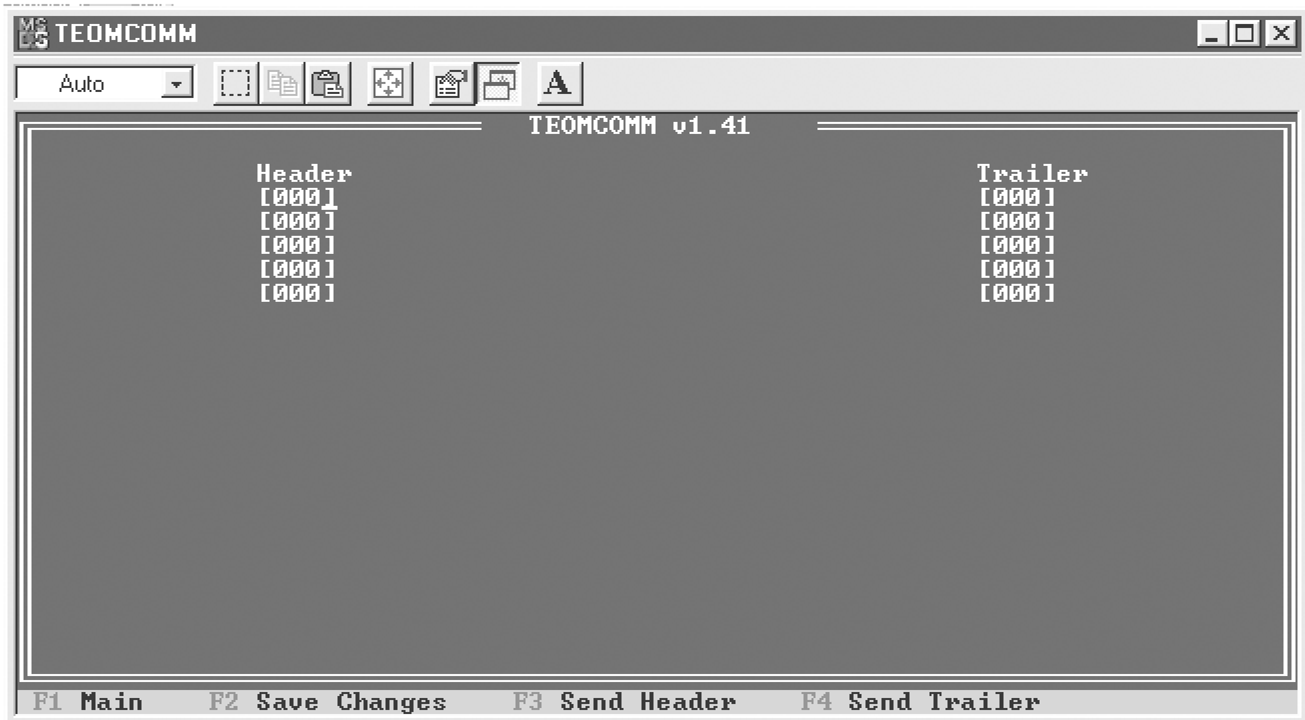


Figure A-58. Send String screen.

A.4. TEOMPLUS Software Screens

This appendix contains all of the software screens displayed by the TEOMPLUS software program.

Figure A-59. TEOMPLUS VIEW screen.

```
Top Window: VIEW                                                   Muxviewr v5.1
 TEOM* Series 1400a Monitor / Page 1                           12:41:16 27-Dec-99
                                Ave Time
  Mass Rate          14.3  ug/h    [ 300.0]    Mode     1
  Mass Conc          79.4  ug/m^3              Status   OK
  Total Mass       974.56  ug      [ 300.0]             No Curr Conditions

  30-Min Mass Conc          72.3 ug/m^3
  01-Hr Mass Conc           78.4 ug/m^3
  08-Hr Mass Conc           85.8 ug/m^3        Noise          0.037
  24-Hr Mass Conc           69.3 ug/m^3        Freq        187.05684  hz

  Filt Load                  38%  Volts: 18.60     Wait Time      [ 1800] sec
  Case Temp       [50.00]  50.00  °C       0.04    Ave Temp       [25.00] °C
  Air Temp        [50.00]  49.99  °C       0.22    Std Temp       [25.00] °C
  Cap Temp        [50.00]  50.00  °C       0.06    Ave Pres       [1.000] atm
  Enclosure Temp  [40.00]  40.02  °C       0.14    Std Pres       [1.000] atm
  Main Flow       [ 3.00]   3.00  l/min    9005    Adj Main Flow  [1.000]
  Auxiliary Flow  [13.67]  13.67  l/min   10259    Adj Aux Flow   [1.000]

  Serial Number  [    2374] Amb Temp:   49.00         OK  4 38%   NU 12:41
  Cal Constant   [9605.000] Amb Pres:    1.005        Mass Conc>     79.4
                                                      30-Min MC      72.3
  Press <F2> to toggle command mode.                  01-Hr MC       78.4
                                                                v. 3.013
```

Figure A-60. TEOMPLUS VIEW screen with additional lines displayed.

```
Top Window: VIEW                                                Muxviewr v5.1
 TEOM* Series 1400a Monitor / Page 2                    14:14:20 27-Dec-99

   ANALOG OUTPUT SETTINGS                                 DATA STORAGE SETTINGS
    Chan        Var       Min           Max                Var 1             8
     1           57       0.00        500.00               Var 2            57
     2           58       0.00        500.00               Var 3            58
     3            9       0.00       5000.00               Var 4            60
    Max Volt      3   (0:1V, 1:2V, 2:5V, 3:10V)            Var 5             9
    Jumper        1   (0:2V, 1:10V)                        Var 6             0
                                                           Var 7             0
   COM PRINT SETTINGS        COMM 2-WAY SETTINGS           Var 8             0
   Interval       1800       Para 1          52            Interval     1800.0
   Columns           6       Para 2       75048            Stor Vars (change 8
   Var 1             8       Para 3       13010            deletes storage)
   Var 2            57       Para 4           0            Station    48048048
   Var 3            58
   Var 4            60                                    Constant A     3.000
   Var 5             9                                    Constant B     1.030
   Var 6             0       ANALOG CALIBRATION
   Station    48048048          Cal Mode (0:Off, 1:On)                0
                                Analog Out Value (%)               0.00
   Low Pass    100000           Analog In Chan/Value       0       0.00
   High Pass   100000
                                                                  v. 3.013
```

Figure A-61. TEOMPLUS ACCU screen.

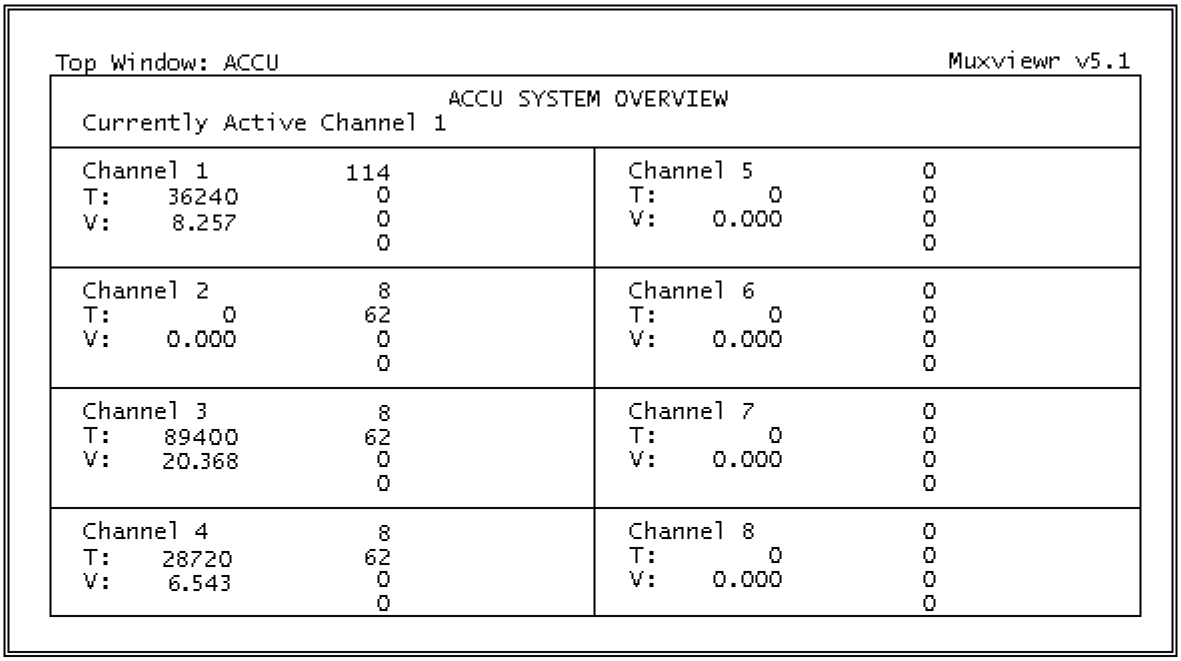
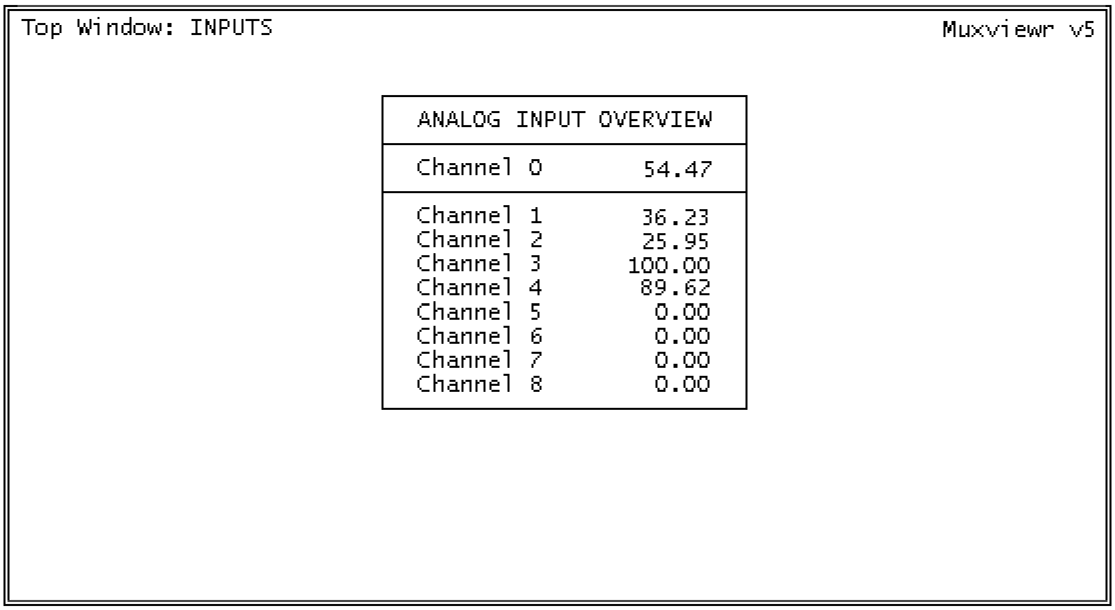


Figure A-62. TEOMPLUS INPUTS screen.



Appendix B: Program Register Codes

This appendix contains a list of the program regiser codes (PRCs) used by the instrument. These codes are numbers that represent variables used by the monitor.

MAIN PROGRAM REGISTER CODES						
Code	**Description**	**Units**	**Range**	**Default**	**Re-Init**	**Edit Modes**
***007**	Mass Rate	µg/hour	N/A	N/A	N/A	not editable
***008**	Mass Concentration	$\mu g/m^3$	N/A	N/A	N/A	not editable
***009**	Total Mass	µg	N/A	N/A	N/A	not editable
***012**	Frequency	hz	N/A	N/A	N/A	not editable
***013**	Noise	µg	N/A	N/A	N/A	not editable
***014**	Operating Mode, 0(S), 1, 2, 3, 4, 5(X)	code	0-5	N/A	N/A	not editable
***025**	Current Case Temperature	°C	N/A	N/A	N/A	not editable
***026**	Current Air Temperature	°C	N/A	N/A	N/A	not editable
***027**	Current Cap Temperature	°C	N/A	N/A	N/A	not editable
***028**	Current Enclosure Temp (AA only)	°C	N/A	N/A	N/A	not editable
***035**	Filter Loading, percent of filter lifetime used	%	0-100	N/A	N/A	not editable
***039**	Current Main Flow	l/min	N/A	N/A	N/A	not editable
***040**	Current Auxiliary Flow	l/min	N/A	N/A	N/A	not editable
***041**	Status Condition	code	N/A	N/A	N/A	not editable
***057**	30-Min Average Mass Concentration	$\mu g/m^3$	N/A	N/A	N/A	not editable
***058**	1-Hour Average Mass Concentration	$\mu g/m^3$	N/A	N/A	N/A	not editable
***059**	XX-Hour Average Mass Concentration	$\mu g/m^3$	N/A	N/A	N/A	not editable
***060**	24-Hour Average Mass Concentration	$\mu g/m^3$	N/A	N/A	N/A	not editable
***063**	Serial Number	N/A	N/A	N/A	N/A	not editable
114-119	Analog Input 0-5	engr	N/A	N/A	N/A	not editable
120	Analog Input 6 (AA: 121=7, 122=8)	engr	N/A	N/A	N/A	not editable
130	Current Ambient Temperature	°C	N/A	N/A	N/A	not editable
131	Current Ambient Pressure	atm	N/A	N/A	N/A	not editable
*** Program Register Code is the same as in version 1 software for compatibility.**						

PROGRAM REGISTER CODES (000-024)						
Code	**Description**	**Units**	**Range**	**Default**	**Re-Init**	**Edit Modes**
000	Null	N/A	N/A	N/A	N/A	not editable
001	Second, used for setting time/date	sec	0-59	N/A	N/A	S
002	Minute, used for setting time/date	min	0-59	N/A	N/A	S
003	Hour, used for setting time/date	hour	0-23	N/A	N/A	S
004	Day, used for setting time/date	day	1-31	N/A	N/A	S
005	Month, used for setting time/date (0=Jan)	month	0-11	N/A	N/A	S
006	Year, used for setting time/date	year	1,970-2,106	N/A	N/A	S
***007**	Mass Rate, averaging time set by PRC 010	µg/hr	N/A	N/A	N/A	not editable
***008**	Mass Conc., averaging time set by PRC 010	$\mu g/m^3$	N/A	N/A	N/A	not editable
***009**	Total Mass, averaging time set by PRC 011	µg	N/A	N/A	N/A	not editable
***010**	Mass Rate/Mass Conc. Averaging Time	sec	2-14,400	300	300	1, 2, 3, 4, S, X
***011**	Total Mass Averaging Time	sec	2-14,400	300	300	1, 2, 3, 4, S, X
***012**	Frequency, current oscillating frequency	hz	N/A	N/A	N/A	not editable
***013**	Noise, diagnostic measurement	µg	N/A	N/A	N/A	not editable
***014**	Operating Mode, 0(S), 1, 2, 3, 4, 5(X)	code	0-5	N/A	N/A	not editable
015	Cur Low Pass, used to set new password	code	6 digits	100,000	N/A	1, 2, 3, 4, S, X
016	Cur High Pass, used to set new password	code	6 digits	100,000	N/A	1, 2, 3, 4, S, X
017	New Low Pass, used to set new password	code	6 digits	N/A	N/A	1, 2, 3, 4, S, X
018	New High Pass, used to set new password	code	6 digits	N/A	N/A	1, 2, 3, 4, S, X
019	Const A, used in MC conversion formula	N/A	-100 - 100	3	3	S
020	Const B, used in MC conversion formula	N/A	0.25-4	1.03	1.03	S
021	Case Temperature Set Point	°C	Ambient-80	50	50	S
022	Air Temperature Set Point	°C	Ambient-80	50	50	S
023	Cap Temperature Set Point	°C	Ambient-80	50	50	S
024	Enclosure Temperature Set Point (only AA serial numbers)	°C	Ambient-80	40	40	S
*** Program Register Code is the same as in version 1 software for compatibility.**						

PROGRAM REGISTER CODES (025-049)						
Code	**Description**	**Units**	**Range**	**Default**	**Re-Init**	**Edit Modes**
***025**	Current Case Temperature	°C	N/A	N/A	N/A	not editable
***026**	Current Air Temperature	°C	N/A	N/A	N/A	not editable
***027**	Current Cap Temperature	°C	N/A	N/A	N/A	not editable
***028**	Current Enclosure Temperature (AA only)	°C	N/A	N/A	N/A	not editable
029	Average Temperature, used in flow calculations	°C	-40 - 75	25	25	S
030	Standard Temperature, used in flow calculations	°C	-40 - 75	25	25	S
031	Average Pressure, used in flow calculations	atm	0.5-3	1	1	S
032	Standard Pressure, used in flow calculations	atm	0.5-3	1	1	S
033	Main Flow Adjustment, software flow calibration	factor	0.8-1.2	1	1	S
034	Aux Flow Adjustment, software flow calibration	factor	0.8-1.2	1	1	S
035	Filter Loading, percentage of filter used	%	0-100	N/A	N/A	not editable
036	Wait Time, temp/flow stabilization period	sec	0-99999	1800	1800	1, 2, 3, 4, S, X
***037**	Main Flow Set Point	l/min	0.5-5	3	3	S
***038**	Auxiliary Flow Set Point	l/min	2-20	13.67	13.67	S
***039**	Current Main Flow	l/min	N/A	N/A	N/A	not editable
***040**	Current Auxiliary Flow	l/min	N/A	N/A	N/A	not editable
***041**	Status Condition, 0:OK, 1:M, 2:T, 4:F, 8:X, 16:V	code	N/A	N/A	N/A	not editable
042	Calibration Constant, K0 - unique for each monitor	N/A	N/A	N/A	N/A	not editable
043	Current RS-232 Mode	code	N/A	0	N/A	1, 2, 3, 4, S, X
044	Instrument Station Code	code	3 char ASCII	"000"	"000"	1, 2, 3, 4, S, X
045	Print Interval	sec	5-32767	1800	1800	1, 2, 3, 4, S, X
046	Print Columns	N/A	1-6	6	6	1, 2, 3, 4, S, X
047	Print Variable 1	PRC	PRC Range	8	8	1, 2, 3, 4, S, X
048	Print Variable 2	PRC	PRC Range	57	57	1, 2, 3, 4, S, X
049	Print Variable 3	PRC	PRC Range	58	58	1, 2, 3, 4, S, X
*** Program Register Code is the same as in version 1 software for compatibility.**						

PROGRAM REGISTER CODES (050-074)						
Code	**Description**	**Units**	**Range**	**Default**	**Re-Init**	**Edit Modes**
050	Print Variable 4	PRC	PRC Range	60	60	1, 2, 3, 4, S, X
051	Print Variable 5	PRC	PRC Range	9	9	1, 2, 3, 4, S, X
052	Print Variable 6	PRC	PRC Range	0	0	1, 2, 3, 4, S, X
053	RS-232 Parameter 1	code	3 char ASCII	52	N/A	1, 2, 3, 4, S, X
054	RS-232 Parameter 2	code	3 char ASCII	75048	N/A	1, 2, 3, 4, S, X
055	RS-232 Parameter 3	code	3 char ASCII	13010	N/A	1, 2, 3, 4, S, X
056	RS-232 Parameter 4	code	3 char ASCII	0	N/A	1, 2, 3, 4, S, X
***057**	30-Min Average MC, updated every 30 min	$\mu g/m^3$	N/A	N/A	N/A	not editable
***058**	1-Hour Average MC, updated every hour	$\mu g/m^3$	N/A	N/A	N/A	not editable
***059**	XX-Hour Average MC, updated every hour	$\mu g/m^3$	N/A	N/A	N/A	not editable
***060**	24-Hour Average MC, updated every hour	$\mu g/m^3$	N/A	N/A	N/A	not editable
061	Protection Level, 0:Unlock, 1:low, 2:high	code	N/A	N/A	N/A	not editable
062	Current Time/Date, seconds since 01-01-70	sec	N/A	N/A	N/A	not editable
***063**	Serial Number	N/A	N/A	N/A	N/A	1, 2, 3, 4, S, X
064	Software Version	N/A	N/A	N/A	N/A	not editable
065	Max Analog Voltage, 0:1V, 1:2V, 2:5V, 3:10V	code	0-3	3	N/A	1, 2, 3, 4, S, X
066	Analog Output 1 Variable	PRC	PRC Range	57	57	1, 2, 3, 4, S, X
067	Analog Output 1 Minimum	N/A	N/A	0	0	1, 2, 3, 4, S, X
068	Analog Output 1 Maximum	N/A	N/A	500	500	1, 2, 3, 4, S, X
069	Analog Output 2 Variable	PRC	PRC Range	58	58	1, 2, 3, 4, S, X
070	Analog Output 2 Minimum	N/A	N/A	0	0	1, 2, 3, 4, S, X
071	Analog Output 2 Maximum	N/A	N/A	500	500	1, 2, 3, 4, S, X
072	Analog Output 3 Variable	PRC	PRC Range	9	9	1, 2, 3, 4, S, X
073	Analog Output 3 Minimum	N/A	N/A	0	0	1, 2, 3, 4, S, X
074	Analog Output 3 Maximum	N/A	N/A	5000	5000	1, 2, 3, 4, S, X
*** Program Register Code is the same as in version 1 software for compatibility.**						

PROGRAM REGISTER CODES (075-099)						
Code	**Description**	**Units**	**Range**	**Default**	**Re-Init**	**Edit Modes**
075	Analog Output Jumper Setting	code	0-1	1	N/A	1, 2, 3, 4, S, X
076	Storage Interval	sec	0.1-86400	1800	1800	1, 2, 3, 4, S, X
077	Storage Variable 1	PRC	PRC Range	8	8	1, 2, 3, 4, S, X
078	Storage Variable 2	PRC	PRC Range	57	57	1, 2, 3, 4, S, X
079	Storage Variable 3	PRC	PRC Range	58	58	1, 2, 3, 4, S, X
080	Storage Variable 4	PRC	PRC Range	60	60	1, 2, 3, 4, S, X
081	Storage Variable 5	PRC	PRC Range	9	9	1, 2, 3, 4, S, X
082	Storage Variable 6	PRC	PRC Range	0	0	1, 2, 3, 4, S, X
083	Storage Variable 7	PRC	PRC Range	0	0	1, 2, 3, 4, S, X
084	Storage Variable 8	PRC	PRC Range	0	0	1, 2, 3, 4, S, X
085	Storage Variables (change erases storage!)	N/A	0-8	8	0	1, 2, 3, 4, S, X
086	Storage Value 1	N/A	N/A	N/A	N/A	not editable
087	Storage Value 2	N/A	N/A	N/A	N/A	not editable
088	Storage Value 3	N/A	N/A	N/A	N/A	not editable
089	Storage Value 4	N/A	N/A	N/A	N/A	not editable
090	Storage Value 5	N/A	N/A	N/A	N/A	not editable
091	Storage Value 6	N/A	N/A	N/A	N/A	not editable
092	Storage Value 7	N/A	N/A	N/A	N/A	not editable
093	Storage Value 8	N/A	N/A	N/A	N/A	not editable
094	Analog Calibration Mode, 0:Off, 1:On	code	0-1	0	0	S
095	Analog Calibration Input Channel	chan	0-15	0	0	S
096	Analog Calibration Input, % of full scale	% scale	0-100	0	0	not editable
097	Analog Calibration Output, % of full scale	% scale	0-100	0	0	S
098	Currently Active ACCU Channel	chan	0-8	N/A	N/A	not editable
099	ACCU Channel Currently Being Viewed	chan	1-8	N/A	N/A	1, 2, 3, 4, S, X
*** Program Register Code is the same as in version 1 software for compatibility.**						

PROGRAM REGISTER CODES (100-124)						
Code	**Description**	**Units**	**Range**	**Default**	**Re-Init**	**Edit Modes**
100	Cumulative Time of Viewed ACCU Channel	sec	N/A	N/A	N/A	not editable
101	Cumulative Volume of Viewed ACCU Channel	m^3 STP	N/A	N/A	N/A	not editable
102	Viewed ACCU Variable 1	PRC	PRC Range	0	N/A	S
103	Viewed ACCU Minimum 1	N/A	N/A	0	N/A	S
104	Viewed ACCU Maximum 1	N/A	N/A	0	N/A	S
105	Viewed ACCU Variable 2	PRC	PRC Range	0	N/A	S
106	Viewed ACCU Minimum 2	N/A	N/A	0	N/A	S
107	Viewed ACCU Maximum 2	N/A	N/A	0	N/A	S
108	Viewed ACCU Variable 3	PRC	PRC Range	0	N/A	S
109	Viewed ACCU Minimum 3	N/A	N/A	0	N/A	S
110	Viewed ACCU Maximum 3	N/A	N/A	0	N/A	S
111	Viewed ACCU Variable 4	PRC	PRC Range	0	N/A	S
112	Viewed ACCU Minimum 4	N/A	N/A	0	N/A	S
113	Viewed ACCU Maximum 4	N/A	N/A	0	N/A	S
114	Analog Input 0	engr	N/A	N/A	N/A	not editable
115	Analog Input 1	engr	N/A	N/A	N/A	not editable
116	Analog Input 2	engr	N/A	N/A	N/A	not editable
117	Analog Input 3	engr	N/A	N/A	N/A	not editable
118	Analog Input 4	engr	N/A	N/A	N/A	not editable
119	Analog Input 5	engr	N/A	N/A	N/A	not editable
120	Analog Input 6	engr	N/A	N/A	N/A	not editable
121	Analog Input 7 (only AA serial numbers)	engr	N/A	N/A	N/A	not editable
122	Analog Input 8 (only AA serial numbers)	engr	N/A	N/A	N/A	not editable
123	Calibration Filter Weight	g	0-100	N/A	0	1, 2, 3, 4, S, X
124	Frequency 0 (Mass Calibration Verification)	hz	N/A	N/A	N/A	not editable
*** Program Register Code is the same as in version 1 software for compatibility.**						

PROGRAM REGISTER CODES (125-153)						
Code	**Description**	**Units**	**Range**	**Default**	**Re-Init**	**Edit Modes**
125	Frequency 1 (Mass Calibration Verification)	hz	N/A	N/A	N/A	not editable
126	Audit K0 Calibration Constant	N/A	N/A	N/A	N/A	not editable
127	Control	N/A	N/A	0	0	1, 2, 3, 4, S, X
128	User-Defined Averaging Time	hour	2-23	8	8	S, X
129	Current Input Voltage	VAC	N/A	N/A	N/A	not editable
130	Current Ambient Temperature	°C	N/A	N/A	N/A	not editable
131	Current Ambient Pressure	atm	N/A	N/A	N/A	not editable
132	Instrument Type, 0:AA, 1:AT, 2:AB	code	0-2	N/A	N/A	not editable
133	Percent Difference of K0 Audit	%	-100 - 100	N/A	N/A	not editable
134	A/I Channel Currently Being Viewed	chan	0-8	N/A	N/A	1, 2, 3, 4, S, X
135	Current A/I Type, 0:Equat, 1:WSpd, 2:WDir	code	0-2	0	0	1, 2, 3, 4, S, X
136	Current A/I Constant A	N/A	N/A	0	0	1, 2, 3, 4, S, X
137	Current A/I Constant B	N/A	N/A	1	1	1, 2, 3, 4, S, X
138	Current A/I Constant C	N/A	N/A	0	0	1, 2, 3, 4, S, X
139	Current A/I % of Full Scale	% FS	0-100	N/A	N/A	not editable
140	Current A/I Average	engr	N/A	N/A	N/A	not editable
141	Contact Closure 1 PRC	PRC	PRC Range	41	41	1, 2, 3, 4, S, X
142	Contact Closure 2 PRC	PRC	PRC Range	35	35	1, 2, 3, 4, S, X
143	Contact Closure 1 Operator*	code	0-7	7	7	1, 2, 3, 4, S, X
144	Contact Closure 2 Operator*	code	0-7	0	0	1, 2, 3, 4, S, X
145	Contact Closure 1 Value	N/A	N/A	7	7	1, 2, 3, 4, S, X
146	Contact Closure 2 Value	N/A	N/A	90	90	1, 2, 3, 4, S, X
147	Average Wind Speed	engr	N/A	N/A	N/A	not editable
148	Average Wind Velocity	engr	N/A	N/A	N/A	not editable
149	Average Wind Direction	degrees	0-360	N/A	N/A	not editable
150	Manometer, differential pressure between FTS and ambient	inches H_20	-100 - 100	N/A	N/A	1, 2, 3, 4, S, X
151	Manometer M, calibration constant M from FTS	N/A	-1 - 1	N/A	N/A	1, 2, 3, 4, S, X
152	Manometer B, calibration constant B from FTS	N/A	-1 - 1	N/A	N/A	1, 2, 3, 4, S, X
153	FTS Flow, calculated volumetric flow	l/min	N/A	N/A	N/A	not editable
*** Code for Contact Closure Operators: 0:<, 1:≤, 2:=, 3:≥, 4:>, 5:<>, 6:AND, 7:NAND.**						

Appendix C: Two-Way Serial Communication

The Series 1400a Monitor supports two serial communication protocols: the AK Protocol and the German Ambient Network Protocol. These protocols permit a locally or remotely located computer to obtain information electronically from the unit. These protocols are described in this appendix.

C.1. AK Protocol

The AK Protocol allows the user to query the present value of any system variable remotely, and allows the user to change those system variable values. The user also can download information from the internal data logger. The RPComm software program uses this protocol for two-way communication directly to a personal computer or through a modem. The following AK Protocol commands are presented in detail on the following pages:

AREG Ask Register Command. The user can query the Series 1400a Monitor for the current value of any system variable (Appendix B).

EREG Enter Register Command. The user can assign a new value to any system variable. Great care must be taken when using this command, as the value of variables should only be changed when the monitor is in the appropriate operating mode.

SFxx Set Function xx Command. The user can send commands using the <RUN> key and the <DATA STOP> key to the instrument. Each command is designated by a two-digit code, xx.

ASTO Ask Storage Command. The user can download a specified number of records from the internal data logger from the current position of the data storage pointer. The location of this storage pointer may be defined by the SSTO command. The values on each line of output are delimited by commas.

SSTO Set Storage Command. The user can change the location of the data storage pointer in the internal data logger, and is used in conjunction with the ASTO command described above. The data storage pointer is always located immediately after the last record transmitted through the RS232 port via the AK Protocol. If the circular buffer overwrites this location or if the ASTO or SSTO commands have not been used, the data storage pointer is positioned at the oldest record in the internal data logger.

The following pages show how RS-Para 1 through RS-Para 4 are defined in the AK Protocol, and also detail the format of the transmission and response messages of the commands listed above.

AK Protocol

Ask Register Command (AREG)

COM 2-WAY SETTINGS

RS-Para 1	52	ASCII code for the 1-digit Station Number (for example "4": 052). The Station Number is always 1 digit in length.
RS-Para 2	75048	ASCII code representation of the 2-digit Channel Number (for example: "K0": 075, 048). The Channel Number is always 2 digits in length.
RS-Para 3	13010	Optional: Up to 3 ASCII codes can be added to response from the instrument. In this case, <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.
RS-Para 4	0	Not used.

Transmission to Instrument			Response from Instrument			
Byte	**Example**	**Description**	**B**	**No Err**	**Error**	**Description**
1	<STX>	ASCII code 002.	1	<STX>	<STX>	ASCII code 002.
2	4	1-digit Station Number, RS-Para 1.	2	4	4	1-digit Station Number, RS-Para 1.
3	A	Ask Register command.	3	A	A	4-digit Ask Register command.
4	R		4	R	R	
5	E		5	E	E	
6	G		6	G	G	
7	<space>	Space.	7	<space>	<space>	Space.
8	K	2-digit Channel Number as defined by RS Para 2.	8	0	0	Number of current status conditions.
9	0		9	<space>	<space>	Space.
10	<space>	Space.	10	9	S	Program Register Code of the variable whose value is being requested. The PRC may be up to 3 digits long and is not right-filled in the response.
11	9	Program Register Code of the variable whose value is being requested. The PRC may be up to 3 digits long. Do not right-fill if the PRC is less than 3 characters long.	11		E	
12			12		<ETX>	
13			13	<space>	<CR>	Space.
14	<ETX>	ASCII code 003.	14	9	<LF>	Current value of the variable referenced by the Ask Register command. NOTE: This value can be of varying length.
15			15	7		
16			16	4		
17			17	.		
18			18	3		
19			19	8		

AK Protocol

Ask Register Command (AREG) (continued)

Transmission to Instrument			Response from Instrument			
Byte	**Example**	**Description**	**B**	**No Err**	**Error**	**Description**
20			20	<ETX>		ASCII code 003.
21			21	<CR>		Up to 3 digits appended to the end of the response transmission, according to the entry for RS-Para 3.
22			22	<LF>		
23	Description of Status Codes (PRC 041) 1 Mass Transducer 2 Temperature 4 Flow Rate 8 Filter Exchange 16 Voltage		23			
24			24			
25			25			
26			26			
27			27			
28			28			
29			29			
30			30			
31			31			
32			32			
33			33			
34			34			
35			35			
36			36			
37			37			
38			38			
39			39			
40			40			
41			41			
42			42			
43			43			
44			44			
45			45			
46			46			

AK Protocol

Enter Register Command (EREG)

COM 2-WAY SETTINGS		
RS-Para 1	52	ASCII code for the 1-digit Station Number (for example "4": 052). The Station Number is always 1 digit in length.
RS-Para 2	75048	ASCII code representation of the 2-digit Channel Number (for example: "K0": 075, 048). The Channel Number is always 2 digits in length.
RS-Para 3	13010	Optional: Up to 3 ASCII codes can be added to response from the instrument. In this case, <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.
RS-Para 4	0	Not used.

Transmission to Instrument			Response from Instrument			
Byte	**Example**	**Description**	**B**	**No Err**	**Error**	**Description**
1	<STX>	ASCII code 002.	1	<STX>	<STX>	ASCII code 002.
2	4	1-digit Station Number, RS-Para 1.	2	4	4	1-digit Station Number, RS-Para 1.
3	E	Enter Register command.	3	E	E	4-digit Enter Register command.
4	R		4	R	R	
5	E		5	E	E	
6	G		6	G	G	
7	<space>	Space.	7	<space>	<space>	Space.
8	K	2-digit Channel Number, as defined by RS Para 2.	8	0	0	Number of current status conditions.
9	0		9	<space>	<space>	Space.
10	<space>	Space.	10	6	S	Program Register Code of the variable whose value was entered. The PRC may be 1 to 3 digits long and is not right-filled in the response.
11	6	Program Register Code of the variable whose value is being requested. The PRC may be up to 3 digits long. Do not right-fill if the PRC is less than 3 characters long.	11	3	E	
12	3		12		<ETX>	
13			13	<ETX>	<CR>	ASCII code 003.
14	<space>	Space.	14	<CR>	<LF>	Up to 3 digits appended to the end of the response transmission, according to the entry for RS-Para 3.
15	2	New value to be entered for variable referenced by Program Register Code in bytes 11 to 13 above. NOTE: The value entered may be of varying length, and is not restricted to 4 bytes.	15	<LF>		
16	3		16			
17	8		17			
18	0		18			
19	<ETX>	ASCII code 003.	19			

AK Protocol

Set Function Command (SFxx)

RS-Para 1	52	ASCII code for the 1-digit Station Number (for example "4": 052). The Station Number is always 1 digit in length.
RS-Para 2	75048	ASCII code representation of the 2-digit Channel Number (for example: "K0": 075, 048). The Channel Number is always 2 digits in length.
RS-Para 3	13010	Optional: Up to 3 ASCII codes can be added to response from the instrument. In this case, <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.
RS-Para 4	0	Not used.

Transmission to Instrument			Response from Instrument			
Byte	**Example**	**Description**	**B**	**No Err**	**Error**	**Description**
1	<STX>	ASCII code 002.	1	<STX>	<STX>	ASCII code 002.
2	4	1-digit Station Number, RS-Para 1.	2	4	4	1-digit Station Number, RS-Para 1.
3	S	Set Function command, where xx represents a 2-digit code between 00 and 32. These codes are defined below.	3	S	S	4-digit Set Function command, with the 2-digit xx code corresponding to the function that was set.
4	F		4	F	F	
5	x		5	x	x	
6	x		6	x	x	
7	<space>	Space.	7	<space>	<space>	Space.
8	K	2-digit Channel Number, as defined by RS Para 2.	8	0	0	Number of current status conditions.
9	0		9	<ETX>	<space>	Space.
10	<ETX>	ASCII code 003.	10	<CR>	S	Upto 3 digits appended to the end of the response transmission, according to the entry for RS-Para 3.
			11	<LF>	E	
			12		<ETX>	
			13		<CR>	
			14		<LF>	
			15	To Set Time Remotely: 1) Ensure that the instrument is in the Stop Mode. 2) Transmit the proper values in PRCs 2 through 6. 3) Execute the SF26 command.		
			16			
			17			
			18			
			19			

LISTING OF FUNCTION CODES (xx):

03 <Run>
06 <Data Stop>
09 <F1>
17 <F5>
25 <Stop All>
26 Set Time

AK Protocol

Ask Storage Command (ASTO)

COM 2-WAY SETTINGS

RS-Para 1	52	ASCII code for the 1-digit Station Number (for example "4": 052). The Station Number is always 1 digit in length.
RS-Para 2	75048	ASCII code representation of the 2-digit Channel Number (for example: "K0": 075, 048). The Channel Number is always 2 digits in length.
RS-Para 3	13010	Optional: Up to 3 ASCII codes can be added to response from the instrument. In this case, <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.
RS-Para 4	0	Not used.

<table>
<tr><th colspan="3">Transmission to Instrument</th><th colspan="4">Response from Instrument</th></tr>
<tr><th>Byte</th><th>Example</th><th>Description</th><th>B</th><th>No Err</th><th>Error</th><th>Description</th></tr>
<tr><td>1</td><td><STX></td><td>ASCII code 002.</td><td>1</td><td><STX></td><td><STX></td><td>ASCII code 002.</td></tr>
<tr><td>2</td><td>4</td><td>1-digit Station Number, RS-Para 1.</td><td>2</td><td>4</td><td>4</td><td>1-digit Station Number, RS-Para 1.</td></tr>
<tr><td>3</td><td>A</td><td rowspan="4">Ask Storage command.</td><td>3</td><td>A</td><td>A</td><td rowspan="4">4-digit Ask Storage command.</td></tr>
<tr><td>4</td><td>S</td><td>4</td><td>S</td><td>S</td></tr>
<tr><td>5</td><td>T</td><td>5</td><td>T</td><td>T</td></tr>
<tr><td>6</td><td>O</td><td>6</td><td>O</td><td>O</td></tr>
<tr><td>7</td><td><space></td><td>Space.</td><td>7</td><td><space></td><td><space></td><td>Space.</td></tr>
<tr><td>8</td><td>K</td><td rowspan="2">2-digit Channel Number, as defined by RS Para 2.</td><td>8</td><td>0</td><td>0</td><td>Number of current status conditions.</td></tr>
<tr><td>9</td><td>0</td><td>9</td><td><space></td><td><space></td><td>Space.</td></tr>
<tr><td>10</td><td><space></td><td>Space.</td><td>10</td><td>3</td><td>S</td><td rowspan="3">Records to be downloaded from storage. This can be smaller than requested number due to end of file. Storage Marker moved to after last record transmitted. Not right-filled.</td></tr>
<tr><td>11</td><td>5</td><td rowspan="3">The number of records to be downloaded from the instrument's storage. Downloading begins at the storage marker, which can be set using the SSTO command.</td><td>11</td><td>1</td><td>E</td></tr>
<tr><td>12</td><td>0</td><td>12</td><td></td><td><ETX></td></tr>
<tr><td>13</td><td></td><td>13</td><td><ETX></td><td><CR></td><td>ASCII code 003.</td></tr>
<tr><td>14</td><td><ETX></td><td>ASCII code 003.</td><td>14</td><td><CR></td><td><LF></td><td rowspan="3">Up to 3 digits appended to the end of the response transmission, according to the entry for RS-Para 3.</td></tr>
<tr><td>15</td><td></td><td></td><td>15</td><td><LF></td><td></td></tr>
<tr><td>16</td><td></td><td></td><td>16</td><td></td><td></td></tr>
<tr><td>17</td><td></td><td></td><td>17</td><td colspan="3" rowspan="3">The instrument then transmits the number of storage records shown in response bytes10 through 12 above. Each record is followed by <CR><LF>.</td></tr>
<tr><td>18</td><td></td><td></td><td>18</td></tr>
<tr><td>19</td><td></td><td></td><td>19</td></tr>
</table>

AK Protocol

Set Storage Marker Command (SSTO)

COM 2-WAY SETTINGS

RS-Para 1	52	ASCII code for the 1-digit Station Number (for example "4": 052). The Station Number is always 1 digit in length.
RS-Para 2	75048	ASCII code representation of the 2-digit Channel Number (for example: "K0": 075, 048). The Channel Number is always 2 digits in length.
RS-Para 3	13010	Optional: Up to 3 ASCII codes can be added to response from the instrument. In this case, <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.
RS-Para 4	0	Not used.

Transmission to Instrument			Response from Instrument			
Byte	**Example**	**Description**	**B**	**No Err**	**Error**	**Description**
1	<STX>	ASCII code 002.	1	<STX>	<STX>	ASCII code 002.
2	4	1-digit Station Number, RS-Para 1.	2	4	4	1-digit Station Number, RS-Para 1.
3	S	Set Storage Marker command.	3	S	S	4-digit Set Storage Marker command.
4	S		4	S	S	
5	T		5	T	T	
6	O		6	O	O	
7	<space>	Space.	7	<space>	<space>	Space.
8	K	2-digit Channel Number, as defined by RS Para 2.	8	0	0	Number of current status conditions.
9	0		9	<ETX>	<space>	ASCII code 003.
10	<space>	Space.	10	<CR>	S	Up to 3 digits appended to the end of the response transmission, according to the entry for RS-Para 3.
11	B	New location of the Storage Marker. B:move to beginning of storage buffer. E: move to end of storage buffer. Enter positive numbers, such as 250, to move forward by 250 records, and negative numbers, such as -1000, to move backwards by 1000 records. Do not right fill.	11	<LF>	E	
12			12		<ETX>	
13			13		<CR>	
14			14		<LF>	
15			15			
16	<ETX>	ASCII code 003.	16			
17			17			
18			18			
19			19			

AK Protocol

Response if Command Addressed to Instrument is Unrecognizable

COM 2-WAY SETTINGS

RS-Para 1	52	ASCII code for the 1-digit Station Number (for example "4": 052). The Station Number is always 1 digit in length.
RS-Para 2	75048	ASCII code representation of the 2-digit Channel Number (for example: "K0": 075, 048). The Channel Number is always 2 digits in length.
RS-Para 3	13010	Optional: Up to 3 ASCII codes can be added to response from the instrument. In this case, <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.
RS-Para 4	0	Not used.

Transmission to Instrument			Response from Instrument			
Byte	**Example**	**Description**	**B**	**No Err**	**Error**	**Description**
1			1		<STX>	ASCII code 002.
2			2		4	1-digit Station Number, RS-Para 1.
3			3		?	Question marks inserted in place of unrecognizable command.
4			4		?	
5			5		?	
6			6		?	
7			7		<space>	Space.
8			8		0	Number of current status conditions.
9			9		<space>	Space.
10			10		S	Syntax error.
11			11		E	
12			12		<ETX>	ASCII code 003.
13			13		<CR>	Up to 3 digits appended to the end of the response transmission, according to the entry for RS-Para 3.
14			14		<LF>	
15			15			
16			16			
17			17			
18			18			
19			19			

C.2. German Ambient Network Protocol

R&P's implementation of the German Ambient Network Protocol allows the user to request the value of 1, 2 or 3 predetermined system variables. Due to the definition of this protocol, it is not possible to remotely select a system variable (Appendix B) to be queried.

The following pages show how RS-Para 1 through RS-Para 4 are defined in the German Ambient Network Protocol, and also detail the format of the transmission and response messages.

German Network Protocol

COM 2-WAY SETTINGS

RS-Para 1	56052053	ASCII codes for 3-digit Instrument Identifier (for example "845": 056, 052, 053). The Instrument Identifier must be 3 bytes in length.
RS-Para 2	48048049	ASCII codes for 3-digit Location ID (for example "001": 048, 048, 049). The Location ID must be 3 bytes in length.
RS-Para 3	8	PRC of the variable to be transmitted by the instrument. Up to 3 PRCs may be designated for transmission by the instrument (for example MC, 30-Min MC and TM: 008, 057, 009).
RS-Para 4	13010	Optional: Up to 3 ASCII codes can be added to response from the instrument. In this case <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.

Transmission to Instrument

Byte	Example	Description
1	<STX>	ASCII code 002.
2	D	The DA command signifies a request for data from the instrument.
3	A	
4	8	3-digit Instrument Identifier, as defined by RS-Para 1. These three bytes are optional.
5	4	
6	5	
7	<ETX>	ASCII code 003.
8	<CRC>	High byte followed by low byte of CRC. The CRCs may be replaced by a single <CR> character.
9	<CRC>	

DEFINITION OF CRC BYTES

The CRC bytes above (bytes 8 and 9) are the hexadecimal representation of the "exclusive or" of bytes 1 through 7. The high byte of the CRC is transmitted as byte 8 and the low byte is sent as byte 9.

Response from Instrument

B	No Err	Error	Description
1	<STX>	<STX>	ASCII code 002.
2	M	M	Response identifier to the DA command.
3	D	D	
4	0	0	Number of variables transmitted by the instrument, as specified by RS-Para 3. May be 01, 02 or 03.
5	1	1	
6	<space>	<space>	Space.
7	8	8	3-digit Instrument Identifier, as defined by RS-Para 1.
8	4	4	
9	5	5	
10	<space>	<space>	Space.
11	+ or -	+	Value of variable being transmitted, in the format +NNNN+EE. For example, a value of 63.7 is represented as +0637-01. If a syntax error exists or the value of the variable is 0, the instrument returns +0000+00.
12	n	0	
13	n	0	
14	n	0	
15	n	0	
16	+ or -	+	
17	e	0	
18	e	0	
19	<space>	<space>	Space.

German Network Protocol (continued)

Transmission to Instrument

Byte	Example	Description

CURRENT OPERATING MODE (Bytes 20, 21)

The two-digit hexadecimal representation of the current operating mode is determined as follows:

Mode 1	2
Mode 2	4
Mode 3	8
Mode 4	10 (decimal 16)
Mode S	0
Mode X	20 (decimal 32)

CURRENT STATUS CONDITION (Bytes 23, 24)

The 2-digit hexadecimal representation of the current status condition is computed by summing the numeric values for all current status conditions. Bytes 23 and 24 are both equal to 0 if if no current status condition exists.

0	OK	No current status conditions.
1	M	Mass Transducer.
2	T	Temperatures.
4	F	Flow Rates.
8	X	Exchange Filter.
16	V	Voltage Low.

DEFINITION OF CRC BYTES

The CRC information in bytes 38 and 39 is the hexadecimal representation of the "exclusive or" of all response bytes. The high byte of the CRC is transmitted as byte 38 and the low byte is sent as byte 39.

Response from Instrument

B	No Err	Error	Description
20	1	1	2-digit hexadecimal representation of current instrument operating mode (see description at left).
21	0	0	
22	<space>	<space>	Space.
23	0	0	2-digit hexadecimal representation of current instrument status condition (see description at left).
24	0	0	
25	<space>	<space>	Space.
26	0	0	3-digit Location ID, as defined by RS-Para 2.
27	0	0	
28	1	1	
29	<space>	<space>	Space.
30	0	9	3-digit PRC of the variable being transmitted, zero-filled from the left. These bytes are not defined in the German Protocol, but are included for informational purposes.
31	0	9	
32	8	9	
33	<space>	<space>	These bytes are not defined in the German Protocol, and are reserved for future definition.
34	<space>	<space>	
35	<space>	<space>	
36	<space>	<space>	Space.
37	<ETX>	<ETX>	ASCII code 003.
38	<CRC>	<CRC>	High byte and low byte of CRC. The CRCs are replaced by a single <CR> if transmit byte 8 was <CR>.
39	<CRC>	<CRC>	
40	<CR>	<CR>	Up to 3 digits appended to the end of the response transmission, according to the entry for RS-Para 4.
41	<LF>	<LF>	
42			

NOTE ABOUT MULTIPLE PRC CODES

If more than one Program Register Code is specified in RS-Para 3, byte 5 of the response transmission is either 2 or 3, and bytes 7 to 36 are repeated for each Program Register Code.

Appendix D: Installing New Software

The TEOM 1400a Monitor's instrument software is stored in battery-backed random access memory (RAM). New revisions of the system software can be loaded directly into the instrument with a personal computer (PC). This appendix explains how to install new system software into the TEOM 1400a Monitor (Section D.1). This appendix also explains how to obtain and load RPComm onto your personal computer (Section D.2).

NOTE: Be sure to check Thermo Scientific's website before uploading new software to ensure that you have the latest software version for either the unit's operating software or RPComm. Users must log in and obtain a password to download new software. Go to:

http://www.tagteam.com/TagTeam/Client/login.asp?

NOTE: The RPComm software for the TEOM 1400a Monitor is a Microsoft Windows-based program. Users should have a general understanding of their personal computer (PC) and of the Windows operating system, including entering and editing text, and opening, closing and saving files.

System requirements for running RPComm software are:

- Pentium processor
- 64 megabytes (MB) of random access memory (RAM)
- 40 MB of hard drive space.

D.1. Installing New System Software

D.1.1. Connecting the Monitor to a Personal Computer

Your personal computer must be connected to the monitor's control unit.

Follow these steps to connect the personal computer to the monitor:

1) **Connect one end of the 9-to-9 pin computer cable to one of the RS232 ports on the control unit.**
2) **Ensure that nothing is connected to the other RS232 port of the control unit.**
3) **If your personal computer (PC) is equipped with a 9-pin RS232 connector, go to step 4. If your personal computer is equipped with a 25-pin connector, go to step 5.**
4) **Plug the other end of the 9-to-9 pin computer cable into the 9-pin RS232 port of your PC. Go to step 8.**
5) **Locate the 9-to-25 pin computer cable adapter.**
6) **Plug the 9-to-25 pin computer cable adapter into the 25-pin port on your PC.**
7) **Plug the other end of the 9-to-9 pin computer cable into the 9-to-25 pin computer cable adapter. Go to step 8.**

   NOTE: Do not use the 9-to-25 pin modem cable to connect the control unit with the PC. The 9-to-25 pin modem cable is configured for use only with a modem.
8) **Ensure that the Main screen is displayed on the control unit's four-line display.**
9) **Press the <F2> key on the control unit's keypad until an "N" (None Mode) displays in the RS232 Mode field of the Main screen's status line (Figure D-1). The instrument must remain in the None Mode while executing the computer routines described in this section.**

RS232 Mode field

```
OK     4+   11%   NU     09:39
Mass Conc>                33.6
30-Min MC                 26.8
01-Hr MC                  12.5
```

Figure D-1. Main screen with the RS232 Mode field highlighted.

D.1.2. Loading New System Software Into the Monitor

Follow these steps to install new system software into the monitor:

1) **Ensure that your PC is in MS-DOS mode.**
2) **If your monitor is a TEOM 1400a Monitor, go to step 3. If your monitor is a TEOM 1400 Monitor that was converted to a Series 1400a Monitor, go to step 5.**
3) **Using the PC's keyboard, type the following command after the MS-DOS command prompt:**

   LOADALL [i] [p] [bbbbb]

   where:

   [i] An optional parameter specifying the revision level of the monitor. The default value, "B", represents the AB version of the instrument. Enter "A" for this parameter if the instrument is an AA revision of the monitor.

   [p] An optional parameter specifying the serial port (COM1 or COM2) used on the personal computer (PC) connected to the control unit. This parameter does not need to be entered if COM1 is being used on the personal computer. If you are using COM2, enter a "2" for this parameter.

   [bbbbb] An optional parameter for the baud rate at which the RS232 port of the control unit is configured. Examples of baud rates that can be entered are 1200, 2400, 4800, 9600, or 19200. The default value is 9600 bps.

   NOTE: If an MS-DOS "environment error" occurs while following one of the above commands, add the following statement to the CONFIG.SYS file of your computer:

   SHELL = C:\DOS\COMMAND.COM /P /E:768

4) **Press the "Enter" key on your PC's keyboard. Go to step 7.**
5) **Using the PC's keyboard, type the following command after the MS-DOS command prompt: LOADMOD [i] [p] [bbbbb]**
6) **Press the "Enter" key on your PC's keyboard. Go to step 7.**
7) **The "STATUS" light will begin to blink. Press any key on the PC's keyboard.**
8) **The Title screen and then the Main screen will display on the control unit's four-line display. Press the <DATA STOP> key on the monitor's keypad to enter the Setup Mode.**

9) When in the Main screen, press the <STEP SCREEN> key to display the Menu screen.

10) When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to select "Set Hardware." Press the <ENTER> key to display the Set Hardware screen (Figure D-2).

Figure D-2. Set Hardware screen.

```
        SET HARDWARE
Cal Const>              9605
Ser Num                22822
Inst Type                 AB
```

11) Verify all operating parameters in the Set Hardware screen. If you have a TEOM 1400a Monitor, go to step 15. If you have a TEOM 1400 Monitor that was converted to a TEOM 1400a Monitor, go to step 12.

12) Locate the calibration constant value on the nameplate located on the left-hand side of the mass transducer, which is inside the sensor unit.

13) When in the Set Hardware screen, press the <EDIT> key.

14) Using the control unit's keypad, enter the calibration constant value in the "Cal Const" line of the Set Hardware screen. Press the <ENTER> key. Go to step 15.

15) When in the Set Hardware screen, press the <STEP SCREEN> key. This will display the Set Temps/Flows screen (Figure D-3).

Figure D-3. Set Temps/ Flows screen.

```
      SET TEMPS/FLOWS
T-Case>     50.00     50.00
T-Air       50.00     50.01
T-Cap       50.00     49.98
```

16) When in the Set Temps/Flows screen, verify all operating parameters and press the <EDIT> key.

17) Enter the appropriate temperature and pressure values for your sampling setup (Section 6) using the control unit's keypad. Press the <ENTER> key.

18) Press the <MAIN/STATUS> key to display the Main screen.

19) Verify and change (if necessary) any other optional system parameters for your sampling setup, such as the time (Section 6), analog output settings (Section 9), contact closure settings (Section 9), analog input conversions (Section 9) and RS232 settings (Section 9).

20) Press the <F1> or <RUN> key to enter Operating Mode 1 and begin data collection.

D.2. Installing RPComm

D.2.1. Uninstalling Previous Versions of RPComm Software

If a previous version of RPComm has been loaded onto your personal computer (PC), you must remove it before uploading a new or updated version of software. Use the Add/Remove Control Panel function on your PC to remove the old program.

D.2.2. Obtaining RPComm Installation Files

The RPComm installation files can be downloaded from Thermo Scientific's Web site. Users must log in and obtain a password to download new software. Go to:

http://www.tagteam.com/TagTeam/Client/login.asp?

D.2.3. Installing RPComm Onto a Personal Computer (PC)

Follow these steps to install RPComm onto a PC:

1) **Exit all Windows programs that you currently have running on your PC.**
2) **The software program "rpcomm.exe," as downloaded from the company website, is a self-executable file and will install itself onto the computer when executed. Double-click on the file name to start the installation process.**
3) **Follow the instructions in the RPComm InstallShield Wizard screen to complete the installaton.**

   NOTE: If your PC displays an "Overwrite Protection" screen that asks you to choose whether you would like overwrite any installation files that may already be on your computer, select the "Yes" button.

4) **The RPComm InstallShield Wizard screen with an "InstallShield Wizard Completed" message will display. You do not need to restart your computer to use RPComm. It is now available in your PC's "Program" menu.**

   NOTE: The RPComm program is equipped with an "Auto Start" ("Autorun") function. This means that every time that you turn on your PC, the RPComm software application will automatically begin running. If you close the RPComm software application to use other software, you may start it manually from the "Start" menu.

D.2.4. Updating the List of Program Register Codes in RPComm

NOTE: Refer to Section 10 for further information on using the RPComm software program.

All TEOM 1400 instruments have a list of system variables that is specific to that type of unit. A system variable is any value that is entered into, calculated by, or measured by the instrument. This list of system variables is called the “program register code” (“PRC”) list.

When the monitor’s software is modified, the PRC list often is affected; usually, new PRCs must be added for software enhancement. If there are new PRCs, then the PRC list must be updated within the RPComm software program. This can be accomplished by:

1) The entire RPComm program can be downloaded from the Thermo Scientific website and installed on the computer, as described in Section D.2. However, this is necessary only if the revision number of the RPComm software program has changed. Changes to the unit’s operating software do not always require that you download the new RPComm program.

2) A new PRC list can be downloaded from the website and installed on your computer. This will update the PRC list within RPComm without requiring the user to reinstall the entire program.

Follow these steps to update the PRC list within RPComm:

1) Go to the RPComm directory on your computer’s hard drive and look at the files. The PRC lists are located in this directory. Determine which PRC list revision you have in your RPComm directory. The file name for the PRC lists have the following format:

Rp{instrument}n.nnn

where: {instrument} = instrument model (2000FRM, 2025, 1400 or 5400)

n.nnn = PRC list revision

2) Go to the Software to Download area of the website. If there is a new PRC list available for the TEOM 1400a Monitor, it will be listed on this web page.

3) There may be multiple PRC lists on this page, one for each instrument that RPComm supports. Determine if there is an updated PRC list for the TEOM 1400a Monitor. Select the appropriate PRC list and save it to a file.

NOTE: Be sure to remember what folder the PRC list file is saved in.

4) Disconnect from the World Wide Web.

5) If RPComm is running, exit the program.

6) Copy the downloaded PRC list to the RPComm directory on your computer's hard drive. The next time you execute RPComm, the program will automatically use the new PRC list in its operations.

Appendix E: Consumables and Parts

This appendix lists the consumables and parts available for the Series 1400a Monitor.

E.1. Consumables

The operation of the Series 1400a Monitor requires the following consumable items. Replacement intervals will vary depending upon sampling location and particle loading.

Average annual consumables pack	59-008158
(AB with new style flow controller)	
includes:	
TX40 filters (box of 20)	57-007225-0020
4 large bypass in-line filters	57-002758

Average annual consumables pack	59-003578
(AB with old style flow controller)	
includes:	
TX40 filters (box of 20)	57-007225-0020
4 large bypass in-line filters	57-002758
2 flow controller filters	30-003097
4 flow controller orifices	32-003339

Average annual consumables pack	59-003058
(00, AA with old style flow controller)	
includes:	
TX40 filters (box of 20)	57-007225-0020
2 large bypass in-line filters	57-002758
4 in-line filters	32-000380

TX40 filters (box of 10)	57-007225-0010
TX40 filters (box of 20)	57-007225-0020
In-line filter (00, AA)	32-000380
Bypass flow splitter filter (early 1400)	32-000393
Large bypass in-line filter (all models)	57-002758
Flow controller filter (AB)	30-003097
Flow controller orifice (AB)	32-003339
Mass calibration verification kit (all models)	59-008298
Refill for mass calibration verification kit (all models)	59-008299
5-filter mass calibration verification kit	59-008298-0005
Refill for 5-filter mass calibration verification kit	59-008299-0005
Bypass line water trap filter	32-005933

E.2. Parts

The following is a list of major parts in the Series 1400a Monitor, along with their R&P part numbers:

Flow Controllers and Flow Accessories

Main flow controller, 5 l/min (00, AA)	10-000354
Auxiliary flow controller, 20 l/min (00, AA)	10-000355
Flow splitter (all models)	57-001667
Bypass fine-particle filter assembly kit (00, AA)	57-001007
Nylon tubing, 3/8" OD (all models)	24-000483
Flow controller upgrade kit (AA)	59-002496
Brooks flow controller service tool (AA)	10-003443
Dual flow controller (AB with old style flow controller)	55-003326
Dual flow controller (AB with old style flow controller) (exchange)	55-003326
Single flow controller (AB with old style flow controller)	55-003603
Single flow controller (AB with old style flow controller) (exchange)	55-003603
Old style flow controller maintenance package (AB)	55-003603
Flow sensor, 20 l/min	10-002415
Flow sensor, 5 l/min	10-003312
New style flow controller, (AB)	55-007675
New style flow controller, (AB) (exchange)	55-007675
1400AB flow controller upgrade package	55-007758

Digital Output Components

Output relay P.C.B. (00, AA)	10-000382
Input solid state relay (early 1400)	04-000387
Output solid state relay (00, AA)	04-000392
Low energy output relay (00, AA)	04-000396
Output solid state relay, 240 VAC (00, AA)	04-000404

Miscellaneous Components (early 1400, AA, AB)

15 VDC power supply (all models)	10-000233
Amplifier P.C.B. (00, AA)	50-000356
Amplifier P.C.B. (exchange) (00, AA)	50-000356
Mass transducer assembly (exchange) (00, AA)	56-002441
Pressure transducer (00, AA)	14-000381
Relay board (00, AA)	10-000382
Fan, 15 VDC (00, AA)	10-000385

Heater power transformer, 24 VAC (00, AA)	03-000386
Probe air thermistor (00, AA)	56-000389
Frequency counter P.C.B. (all models)	10-000394
Frequency counter P.C.B. (exchange) (all models)	10-000394
Computer power transformer (00, AA)	03-000395
Sensor unit heat, 120/240 VAC (00, AA)	56-000493-0004
Replacement shoes (3) for tripod (all models)	10-000447
Filter exchange tool (all models)	55-002013-0001
Display/keypad with English overlay (AA, AB)	10-001589-0USA
Display/keypad with Spanish overlay (AA, AB)	10-001589-0SPN
Display/keypad with German overlay (AA, AB)	10-001589-0GER
Key for instrument enclosure (all models)	20-005922
Early Series 1400 — Specific Components	
Analog I/O P.C.B.	10-000383
Analog I/O P.C.B. (exchange)	10-000383
Main computer P.C.B.	10-000390
Main computer P.C.B. (exchange)	10-000390
Bypass flow splitter filter assembly	32-000403
Operator display/keypad	10-000388
Series 1400a (AA) — Specific Components	
Analog I/O P.C.B.	10-001595-0008
Analog I/O P.C.B. (exchange)	10-001595-0008
Analog I/O P.C.B.–external	10-001595-0016
Analog I/O P.C.B.–external (exchange)	10-001595-0016
Upgrade to analog I/O-external (exchange)	59-002268-0001
Main computer P.C.B.	10-001594-0006
Main computer P.C.B. (exchange)	10-001594-0006
Series 1400a (AB) — Specific Components	
Main computer P.C.B.	10-001594-0006
Main computer P.C.B. (exchange)	10-001594-0006
Analog I/O P.C.B.	10-001595-0016
Analog I/O P.C.B. (exchange)	10-001595-0016
LED status light	05-001794
Probe air thermistor	56-002744
Amplifier P.C.B.	50-002820
Amplifier P.C.B. (exchange)	50-002820
Mass transducer assembly (exchange)	54-003582
Interface P.C.B.	50-003232
Interface P.C.B. (exchange)	50-003232
Temperature sensor cable, 10 m	51-003355

Transformer, ±15 V	03-003407
Transformer, ±12 V	03-003408
Connecting Cables	
Electric & air cable, 2 m, 1 air flow line (AB)	51-003613-0002
Electric & air cable, 10 m, 1 air flow line (AB)	51-003613-0010
Electric & air cable, 20 m, 1 air flow line (AB)	51-003613-0020
Electric & air cable, 2 m, 2 air flow line (AB)	51-003336-0002
Electric & air cable, 10 m, 2 air flow lines (AB)	51-003336-0010
Electric & air cable, 20 m, 2 air flow lines (AB)	51-003336-0020
Electric & air cable, 2 m, 1 air flow line (00, AA)	51-000476-0002
Electric & air cable, 10 m, 1 air flow line (00, AA)	51-000476-0010
Electric & air cable, 20 m, 1 air flow line (00, AA)	51-000476-0020
Electric & air cable, 2 m, 2 air flow lines (00, AA)	51-000399-0002
Electric & air cable, 10 m, 2 air flow lines (00, AA)	51-000399-0010
Electric & air cable, 20 m, 2 air flow lines (00, AA)	51-000399-0020
Upgrades	
Series 1400 to 1400AB upgrade	59-004685-0002
Series 1400UP to 1400AB upgrade	59-004589-0002
Series 1400AA to 1400AB upgrade	59-004590-0002
Pumps	
Piston pump, 120 V, 60 Hz, 1/4 hp	10-001403
Piston pump, 240 V, 50 Hz, 1/4 hp	10-001404
Piston pump rebuild kit	59-008630
Push-to-Connect Fittings and Collets	
Straight 1/4" fitting	32-001017
Straight 3/8" fitting	32-001531
Straight 1/2" fitting	36-001039
Elbow 1/4" fitting	32-001023
Elbow 1/4" to 3/8" fitting	32-001041
3/8" tube x 1/4" FNPT straight	32-002756
Reducer, 3/8" tube to 1/4" tube	32-003271
1/4" collet	32-001852-0004
3/8" collet	32-001852-0006
1/2" collet	32-001852-0008
Batteries	
Battery/clock for U32 (00)	06-002229
Battery/clock for U32 (UP)	06-002229
Battery for U1 and U2 (UP)	06-001628

Battery/clock for U39 (revision B board)	06-001629
Battery for U33 (revision B board)	06-001628
Battery (round) (revision B board)	12-002049
Parts for Inlets	
O-rings used in PM-10 inlet:	
O-ring, 1 1/4" ID, Viton	22-002853-3026
O-ring, 2 3/8" ID, BUNA	22-000485-1036
Jar for PM-10 inlet	55-010841
PM-10 screw, #6-32 x 1/4"	21-003721-0004
PM-10 standoff	12-000620-0020
O-rings used in 1/2" TSP adapter:	
1/2" O-ring, BUNA	22-000485-1014
O-rings used in 1 1/4" TSP adapter:	
1 1/4" O-ring, BUNA	22-000485-1026
Fuses	
Main fuse, 120 VAC units, 3A (00, AA)	04-002140
Main fuse, 240 VAC units, 1.5 A (00, AA)	04-002073
Relay board fuse, 3A (00, AA)	04-002916
0.5 A @ 250 V (voltage set fuse)	04-003417
2 A @ 250 V (in-line fuse)	04-003419
5 A @ 250 V (F301 on inteface board)	04-003576
2 A @ 230 V (F302 on interface board)	04-004628
1 A @ 230 V (slow blow in Corcom)	04-003267
2 A @ 115 V (slow blow in Corcom)	04-003268
Power Cords	
Power cord (U.S.), 120 VAC	07-000593
Power cord (U.S.), 240 VAC	07-002675
Power cord (German), 240 VAC	07-002674
Manuals	
Series 1400a Operating Manual (AB)	42-003347
Series 1400a Service Manual (AB)	42-003348
Series 1400a Quick Start Guide (AB)	42-003579

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Appendix F: Filter Log

This appendix contains a filter log to keep track of readings associated with each exposed filter. R&P encourages users to make photocopies of the form or use a similar form.

R&P Series 1400a Ambient Particulate (PM-10) Monitor
Filter Log

Filter Number	Initial Conditioning	Initial Weighing	Filter Exposure	Post-Collection Conditioning	Post-Collection Weighing	DW W(F) - W(I)	Concentration DWx10^6/Volume
		Weights: W1: W2: W3: W(I):	**Exposure Time:**		**Weights:** W1: W2: W3: W(F):		
	Conditions: RH: Temp: Date: Time:	**Conditions:** RH: Temp: Date: Time:	**Exposure Stats:** Val Time: Tot Time: Volume:	**Conditions:** RH: Temp: Date: Time:	**Conditions:** RH: Temp: Date: Time:		
		Weights: W1: W2: W3: W(I):	**Exposure Time:**		**Weights:** W1: W2: W3: W(F):		
	Conditions: RH: Temp: Date: Time:	**Conditions:** RH: Temp: Date: Time:	**Exposure Stats:** Val Time: Tot Time: Volume:	**Conditions:** RH: Temp: Date: Time:	**Conditions:** RH: Temp: Date: Time:		
		Weights: W1: W2: W3: W(I):	**Exposure Time:**		**Weights:** W1: W2: W3: W(F):		
	Conditions: RH: Temp: Date: Time:	**Conditions:** RH: Temp: Date: Time:	**Exposure Stats:** Val Time: Tot Time: Volume:	**Conditions:** RH: Temp: Date: Time:	**Conditions:** RH: Temp: Date: Time:		
		Weights: W1: W2: W3: W(I):	**Exposure Time:**		**Weights:** W1: W2: W3: W(F):		
	Conditions: RH: Temp: Date: Time:	**Conditions:** RH: Temp: Date: Time:	**Exposure Stats:** Val Time: Tot Time: Volume:	**Conditions:** RH: Temp: Date: Time:	**Conditions:** RH: Temp: Date: Time:		

Appendix G: Inlet Maintenance

This appendix contains maintenance procedures for the PM-10 inlet, modified PM-10 inlet, sharp cut cyclone (SCC) PM-1 and PM-2.5 inlets, old style PM-1 and PM-2.5 cyclone inlets, and the in-line PM-2.5 ACCU inlet.

G.1. Cleaning the PM-10 and Modified PM-10 Inlets

Supplies and tools recommended for maintenance:

Ammonia-based, general-purpose cleaner
Cotton swabs
Small soft-bristle brush
Paper towels
Distilled water
Silicone-based stopcock grease
Small screwdriver
Small crescent wrench
Pocket knife

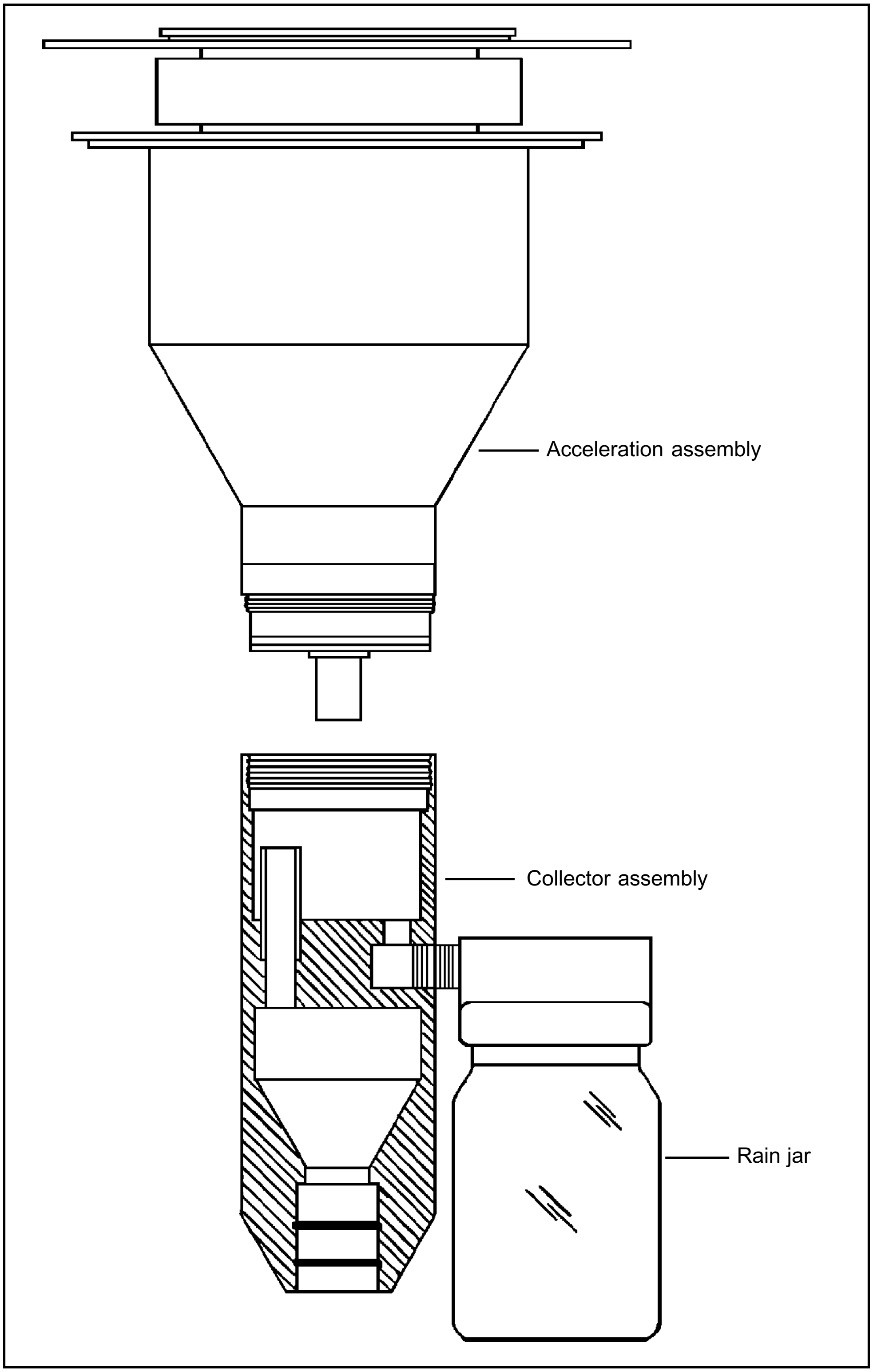
R&P recommends cleaning and maintaining the PM-10 inlet every 1 to 3 months of continuous operation. This includes removing the inlet from the unit, cleaning it and checking its O-ring for signs of damage or wear. Because the PM-10 inlet is similar in construction to the modified PM-10 inlet, the maintenance procedures are the same for both inlets.

G.1.1. Removing the inlet

Follow these steps to remove and disassemble the inlets:

1) **To remove the inlet, lift the entire inlet assembly upward off the flow splitter.**
2) **Remove the rain jar and set it aside.**
3) **Disassemble the upper and lower inlet halves by unscrewing, counterclockwise, the top acceleration assembly from the lower collector assembly (Figure G-1).**

Figure G-1. Schematic drawing of the PM-10 inlet.

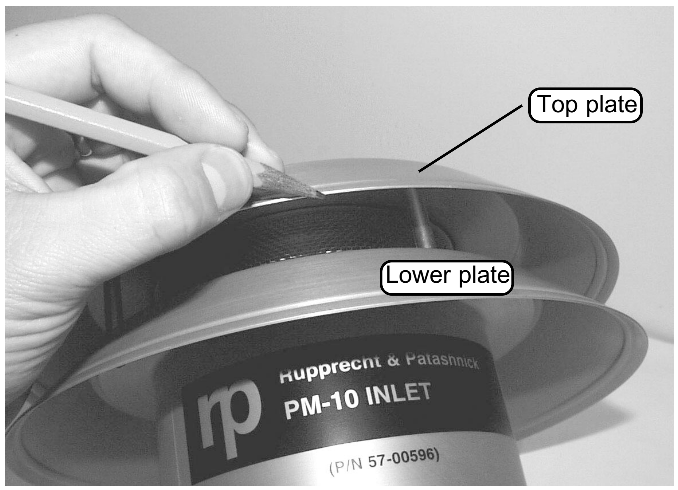


G.1.2. Cleaning the Top Acceleration Assembly

Follow these steps to clean and maintain the top acceleration assembly:

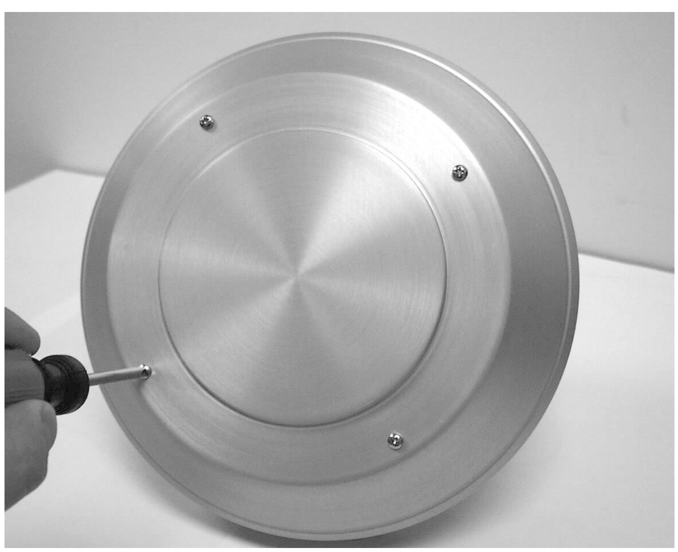
1) **Mark the top plate deflector cone and lower plate with a pencil to facilitate proper orientation when reassembling the assembly after cleaning and maintenance (Figure G-2).**

Figure G-2. Marking the top plate deflector and lower plate.



2) **Using a Phillips screwdriver, remove the four pan head screws from the top of the top plate (Figure G-3). Lift the top plate off the four threaded, spacer standoffs and set aside.**

Figure G-3. Removing the four pan head screws.



3) Remove and inspect the insect screen for contamination (Figure G-4). Clean the screen by lifting it off the lower plate rain deflector and brushing or rinsing it with water until it is clean. Then allow the screen to dry.

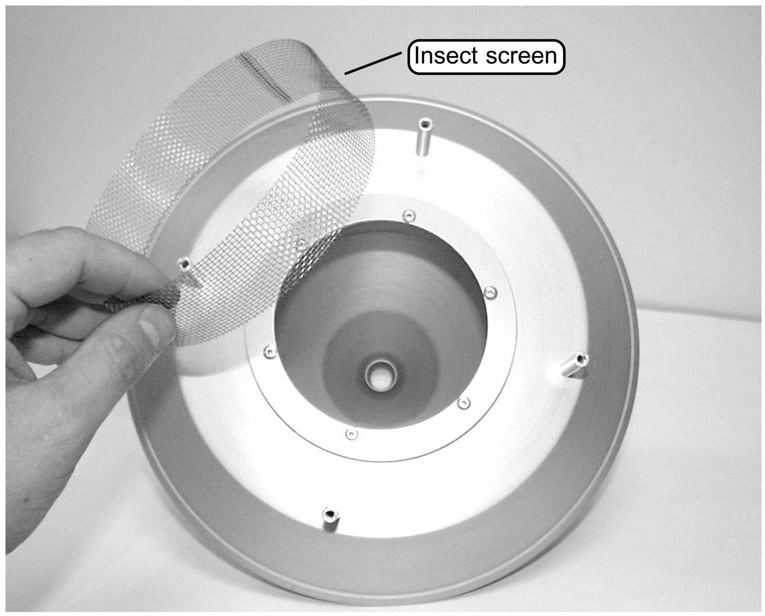


Figure G-4. Removing the insect screen.

4) Using a general-purpose cleaner and paper towel, clean the top plate deflector cone (Figure G-5).

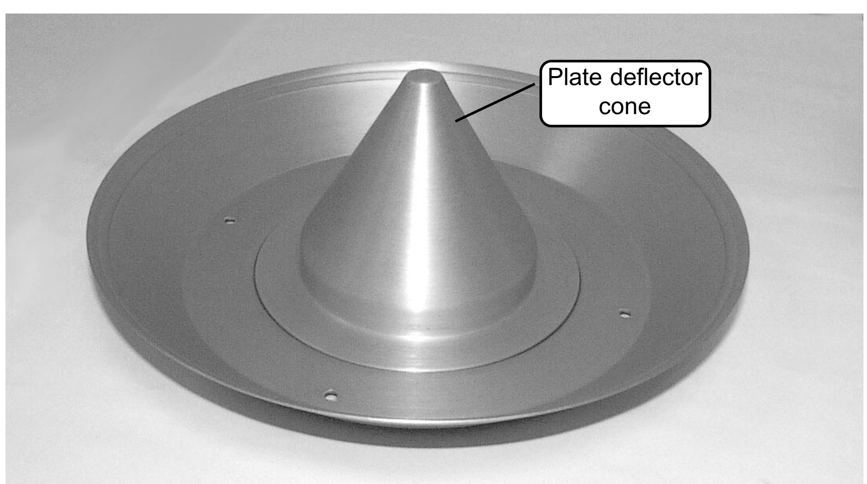


Figure G-5. Top plate with plate deflector cone highlighted.

5) Clean the internal wall surface of the acceleration assembly (Figure G-6).

NOTE: Be sure that after cleaning the assembly the acceleration nozzle is clean. If not, use a cotton swab and cleaner to remove any contamination (Figure G-7).

Figure G-6. Acceleration assembly with internal wall highlighted.

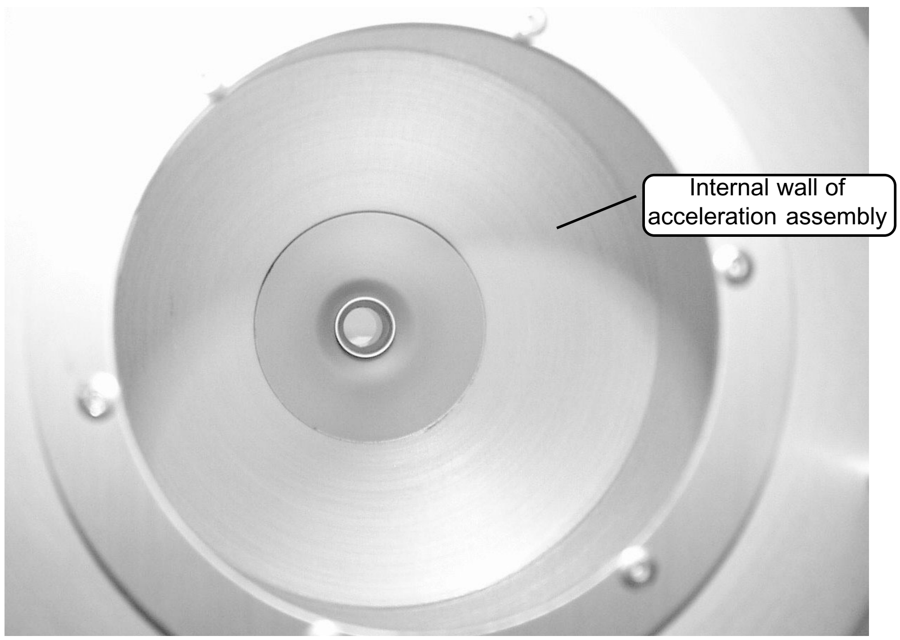
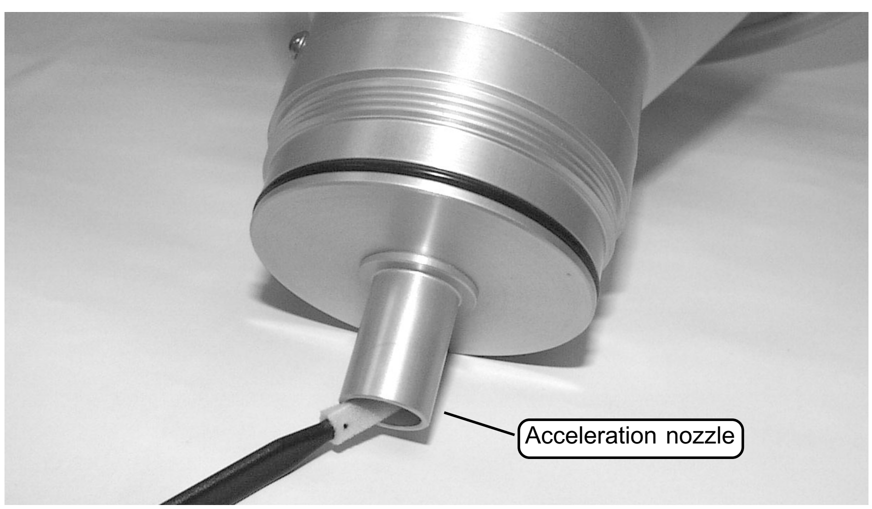
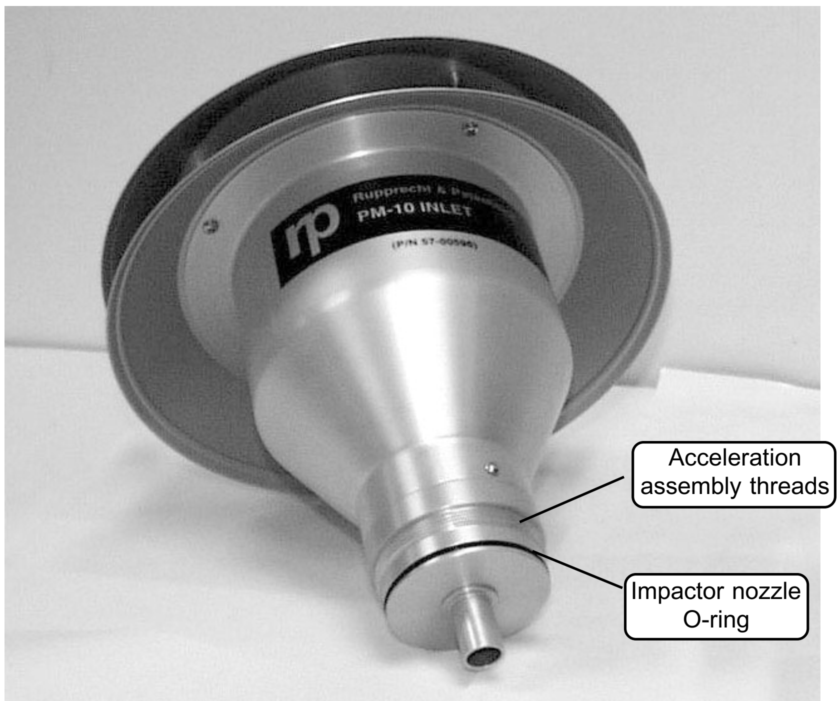


Figure G-7. Acceleration assembly with acceleration nozzle highlighted.



6) Inspect the large diameter, impactor nozzle O-ring for damage or wear. Replace it, if necessary. If the O-ring is still in good condition, apply a thin film of silicone grease to the O-ring. Also, apply a light coating of silicone grease to the aluminum threads of the acceleration assembly (Figure G-8).

Figure G-8. Acceleration assembly with O-ring and threads highlighted.



7) Reinstall the insect screen and align the top plate markings with the lower plate markings. The four holes in the top plate should align with the four spacer standoffs. Install the top plate onto the lower plate and tighten the four pan-head screws.

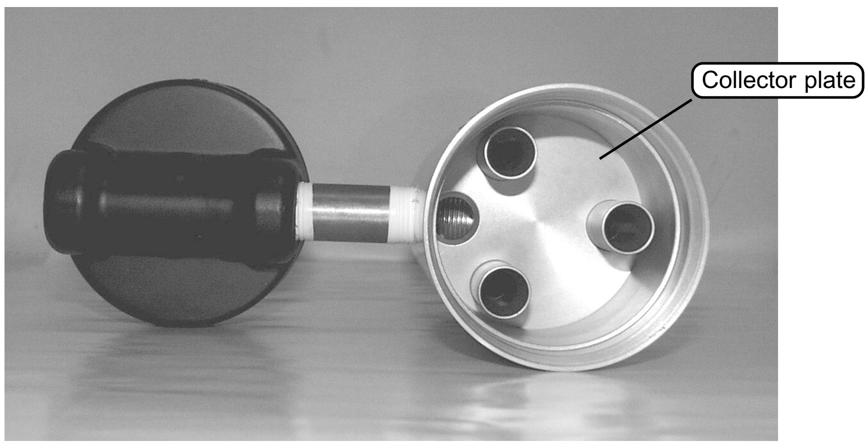
G.1.3. Cleaning the Lower Collector Assembly

Follow these steps to clean and maintain the lower collector assembly:

NOTE: Most of the contamination in the inlet is usually found on the collector plate.

1) Using a general-purpose cleaner with a paper towel, clean the collector assembly walls and plate (Figure G-9).

Figure G-9. Inside of bottom of inlet assembly with collector plate high-lighted.



2) Clean the three vent tubes. You may need to use a cotton swab to clean these vent tubes (Figure G-10).

Figure G-10. Cleaning the vent tubes of the lower inlet assembly.

3) Clean the bottom side of the collector assembly (Figure G-11).

Figure G-11. Bottom of the collector assembly.

4) Using a cotton swab, clean the weep hole in the collector plate where the moisture runs out to the moisture trap (Figure G-12).

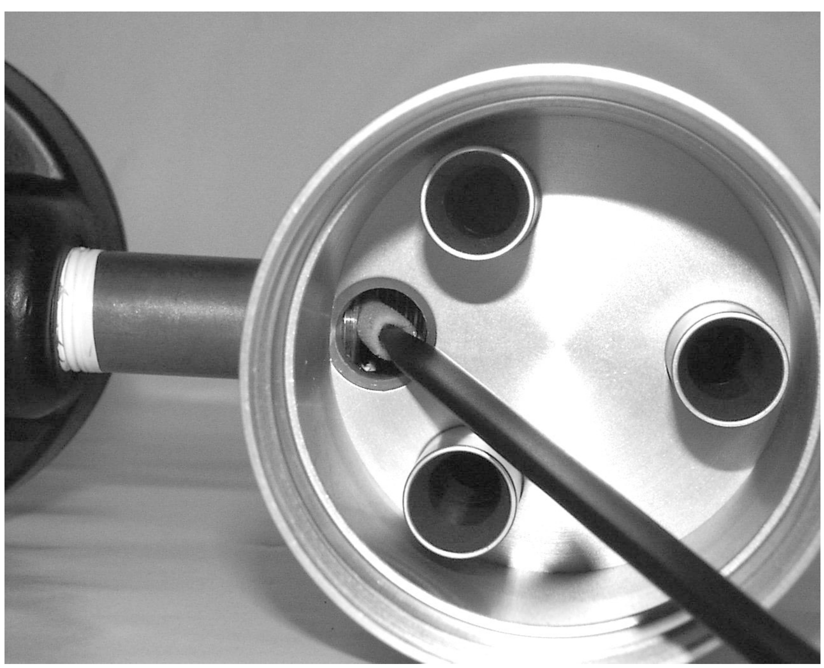
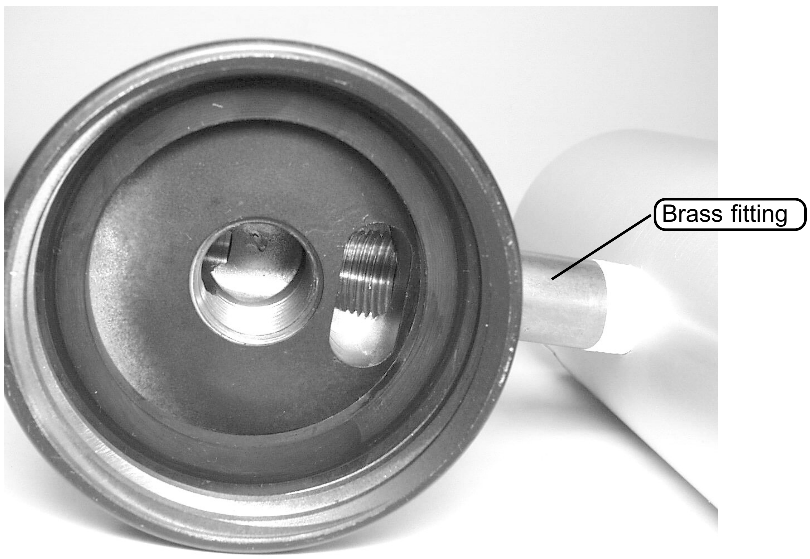


Figure G-12. Cleaning the weep hole in the collector plate.

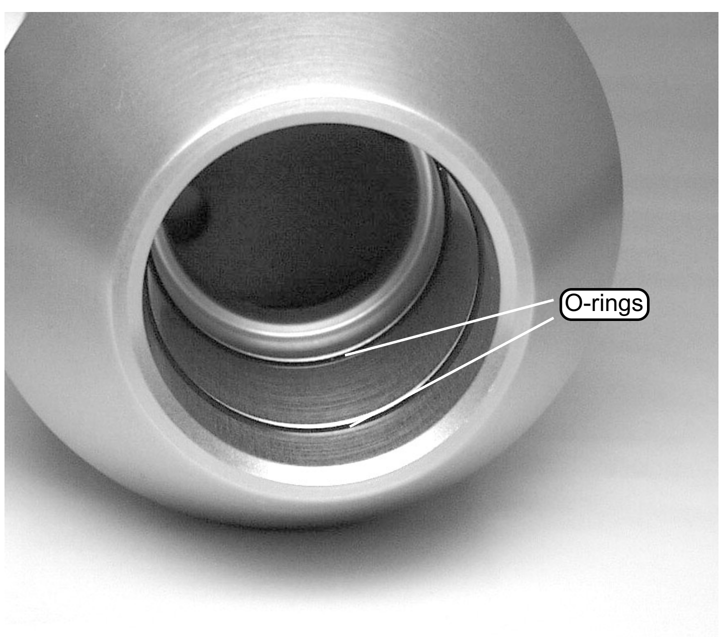
5) Locate the rain jar (Figure G-1) and clean it. Inspect the rain jar cover's brass nipple fitting to ensure that it is secure and free from blockages (Figure G-13).

Figure G-13. Rain jar cover with brass fitting highlighted.



6) Inspect the two inlet tube-sealing O-rings for damage or wear. Replace, if necessary (Figure G-14).

Figure G-14. Bottom of inlet with O-rings highlighted.



7) Apply a light coating of silicone grease to these O-rings to ensure that a seal is made when they are reinstalled on the flow splitter.

8) Clean the lower collector assembly's threads to ensure a tight seal when the two halves are reassembled.

9) Reinstall the rain jar. Place a light coating of silicone grease on the gasket inside the cap of the rain jar. This will ensure a leak-free fit.

G.1.4. Reinstalling the Inlet

Follow these steps to reassemble and reinstall the PM-10 inlet:

1) **Reassemble the top and bottom inlet assemblies until the threads tighten. Hand-tighten only.**
2) **Place a light coating of silicone grease on the gasket inside the cap of the rain jar. This will ensure a leak-free fit. Reinstall the rain jar.**
3) **Place the inlet on the flow splitter. Take care not to damage the internal O-rings.**

G.2. Maintenance of Sharp Cut Cyclone (SCC) Inlets

The sharp cut cyclone (SCC) is a second stage inlet and is available in PM-1 (Figure G-15) and PM-2.5 (Figure G-16) configurations. In Series 1400a Monitor applications, it is used in conjunction with a PM-10 or modified PM-10 inlet (Figure G-17).

Figure G-15. SCC PM-1 inlet.

Figure G-16. SCC PM-2.5 inlet.

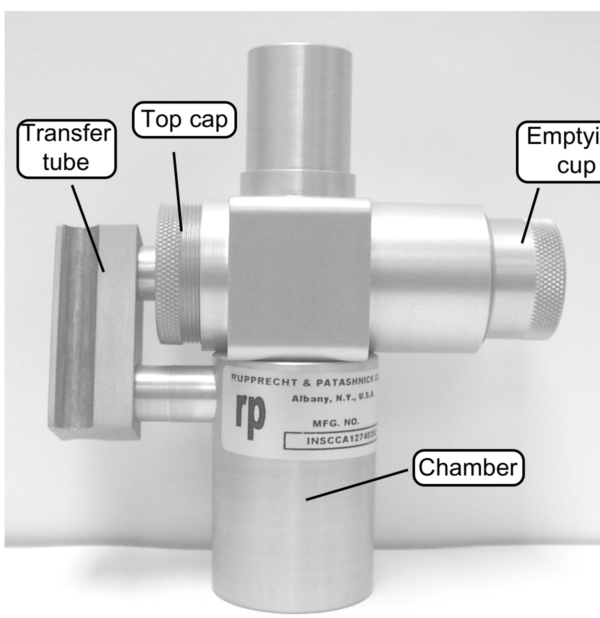


Figure G-17. Modified PM-10 inlet installed onto a sharp cut cyclone (SCC) PM-2.5 inlet.

The exact maintenance interval between cleanings of the SCC depends on the particulate matter mass concentration and composition in the ambient air. Field and laboratory experience indicate a required cleaning interval of three to four weeks, or more. R&P suggests that the user clean the SCC inlet more frequently until operational experience allows better determination of proper cleaning intervals based on your local conditions.

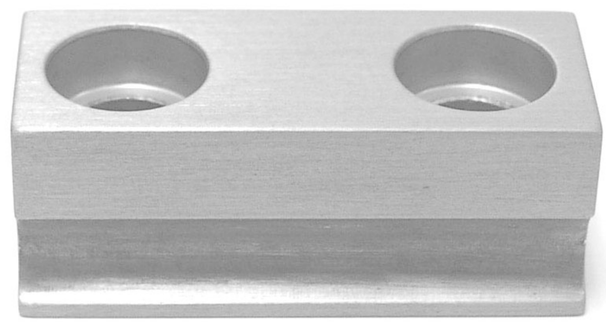
Because the sharp cut cyclone (SCC) PM-1 inlet is similar in construction to the SCC PM-2.5 inlet, the maintenance procedures are the same for both inlets.

Follow these steps to maintain the SCC inlet:

1) Pull the SCC up and off the flow splitter.

2) Pull off the transfer tube (Figures G-16 and G-18). If it is too tight to remove it by hand, pry it off with a rigid plastic lever.

Figure G-18. SCC transfer tube.



3) Remove the top cap (Figures G-16 and G-19) and emptying cup (Figures G-16 and G-20) from the chamber (Figures G-16 and G-21).

Figure G-19. SCC top cap.

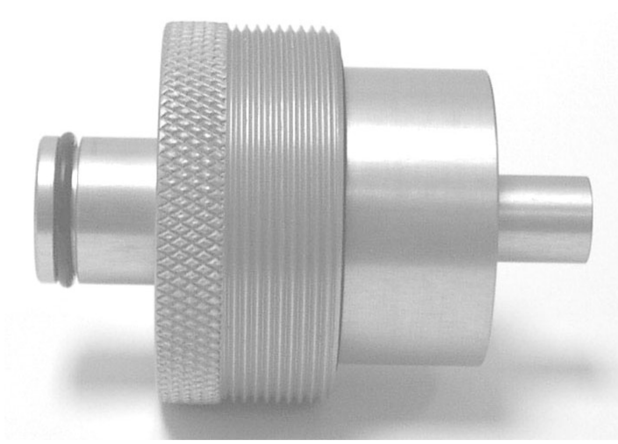


Figure G-20. SCC emptying cup.

Figure G-21. SCC chamber with emptying cup, transfer tube and top cap removed.

4) Wet a lint-free wipe with deionized water and remove all visible deposits. Deposits are most likely to be found in the cone (inside the top cap) and inside the emptying cup.

5) Inspect all O-rings for shape and integrity and replace if necessary. Lubricate all O-rings with light grease. There are 6 O-rings in the SCC, located as follows: 3 on the chamber (2 are located inside the chamber), 2 on the top cap and 1 in the emptying cup.

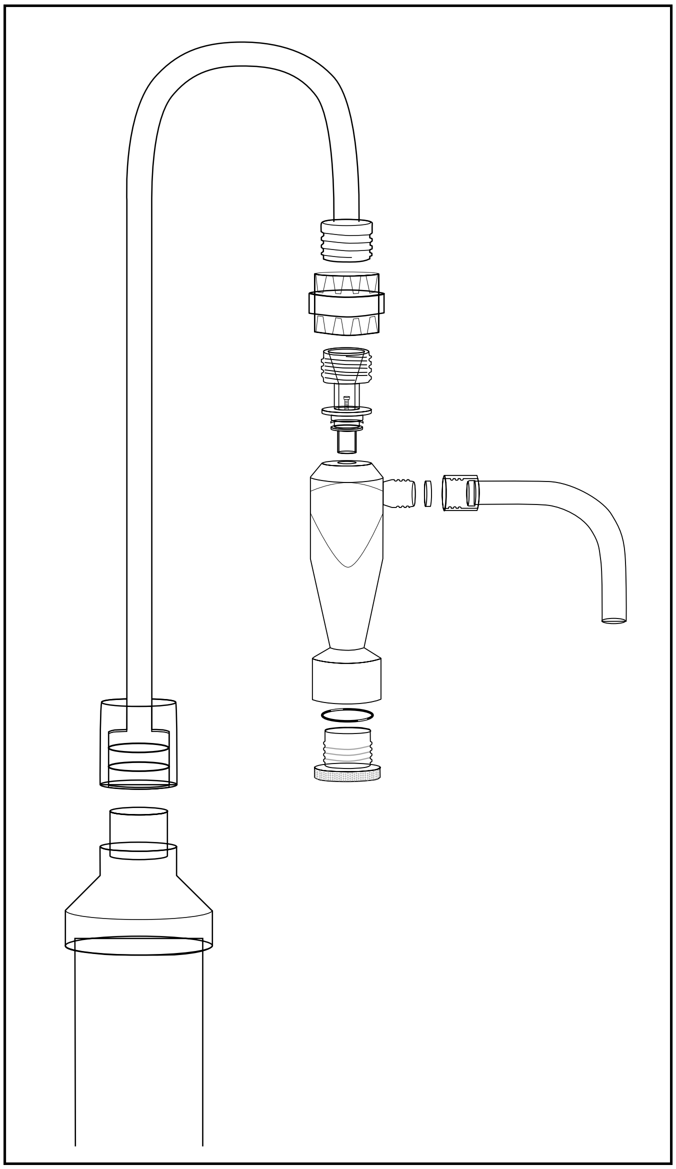
6) Reassemble and reinstall the SCC onto the flow splitter. Lubricate the transfer tube to aid in reassembly.

NOTE: Refer to the Series 1400a Monitor Service Manual for further information on maintaining inlets.

G.3. Maintenance of Old Style PM-2.5 and PM-1 Cyclone Inlets

Because the old style PM-1 and PM-2.5 cyclone inlets (Figure G-22) are of similar construction, the procedure for maintaining them is identical. The cyclone must be cleaned periodically to prevent buildup of particulate matter and contaminants. R&P recommends a cleaning rate of once every one to three months. The frequency for routine maintenance may depend upon the average concentration of the particulate matter and/or the species being sampled.

Figure G-22. Construction of old style PM-1 and PM-2.5 inlets.



Follow these steps to maintain the old style PM-2.5 and PM-1 inlets:

✔ Do not scrub the interior of the inlet. You may damage the Teflon coating.

1) **Remove the cyclone inlet from the flow splitter.**
2) **Disassemble the inlet.**
3) **Soak the inlet in soapy water (any non-organic laboratory detergent is appropriate). Do not scrub the interior of the inlet. Scrubbing may damage the Teflon coating.**

   IMPORTANT: Do not scrub the interior of the inlet. Scrubbing may damage the Teflon coating.
4) **Rinse the inlet several times with deionized water. The last rinse may be with acetone to facilitate drying. The inlet also can be dried with air.**
5) **Reassemble the inlet and cap it until you are ready to use it, or install the inlet onto the flow splitter.**

G.4. Maintenance of ACCU Inlet

The in-line PM-2.5 ACCU inlet (Figures G-23 and G-24) must be cleaned periodically to prevent the buildup of particulate matter and contaminants. R&P recommends cleaning this part every time a TEOM filter is exchanged in the sensor unit of the instrument.

Figure G-23. Schematic drawing of the In-line PM-2.5 ACCU inlet.

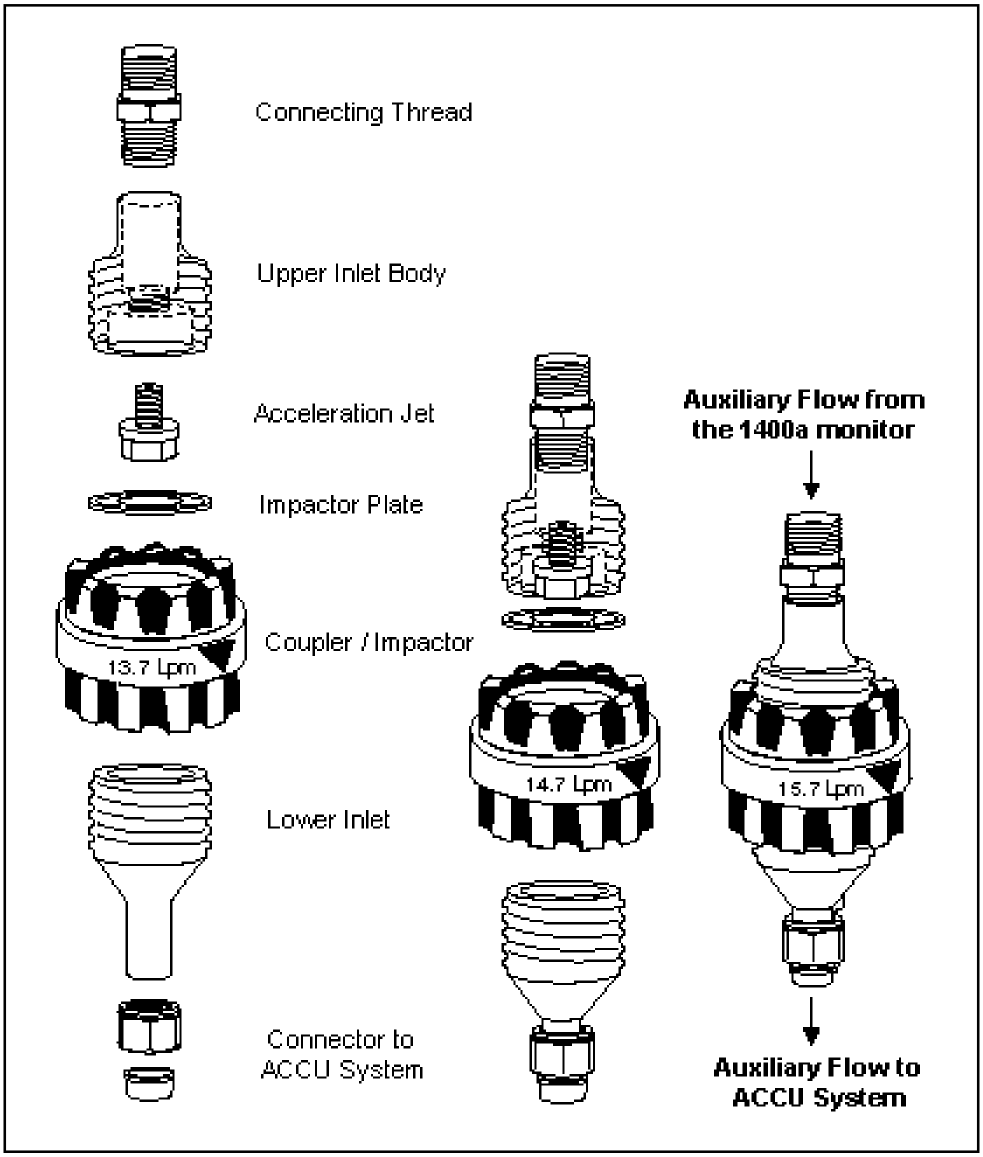


Figure G-24. In-line PM-2.5 ACCU inlet installed on the sample distributor cone.

Follow these steps to maintain the ACCU inlet:

1) **Disassemble the inlet (Figures G-23).**
2) **Soak the inlet in soapy water (any non-organic laboratory detergent is appropriate). Do not scrub the interior of the inlet. Scrubbing may damage the Teflon coating.**

✔ Do not scrub the interior of the inlet. You may damage the Teflon coating.

IMPORTANT: Do not scrub the interior of the inlet. Scrubbing may damage the Teflon coating.

3) **Rinse the inlet several times with deionized water. The last rinse may be with acetone to facilitate drying. The inlet also can be dried with air.**
4) **Reassemble the inlet.**
5) **Place a small drop of impactor plate oil (22-002666) onto the center of the impactor plate. If it is not completely absorbed in 30 seconds, wipe off any remaining oil.**
6) **Install the inlet onto the sample distributor cone, or cap it until it is ready for use.**

Appendix H: Modem Communications

This appendix describes how to connect the Series 1400a Monitor to a modem for off-site communications and how to set up a serial switching device for use with multiple instruments.

H.1. Setting up a Standard Commercial External Modem

Depending on the configuration of your modem, you may need the following parts:

- Commercial external modem
- 9-to-9 pin RS232 cable
- Null modem adapter (10-005671)
- If your modem has a 25-pin connector — 9-to-25 pin serial adapter (06-005895-0925).

Follow these steps to set up an external commercial modem:

1) **Connect your computer directly to the modem. Follow the instructions that came with the modem.**
2) **Begin executing any communication software that will allow direct communications with the modem. Communication software is included with most modems. If no software program was included, Hyper Terminal (which is included with the Windows operating system) can be used.**
3) **Set the modem's communication parameters to work with the Series 1400a Monitor. The following list contains the commands that should be set and the corresponding command codes. Various commercial (especially older) modems may have different command codes for the functions listed. The commands should be replaced with the appropriate codes for your particular modem (consult the modem's instruction manual).**

Communication Parameter	Command Code
Software reset; restore default parameters	&F0
Force DCD (Data Carrier Detect) "ON" at all times	&C0
Ignore DTR (Data Terminal Ready) from instrument	&D0
Set auto answer to 1 ring	S0=1
Set local flow control to "RTS/CTS"	Code varies
Store settings in profile "0"	&W0
Use stored settings in profile "0" on power up	&Y0

4) **Disconnect your computer from the modem.**
5) **Attach the 9-to-9 pin cable to the RS232 connector on the front or back of the monitor.**

6) Attach the null modem adapter to the other end of the 9-to-9 pin cable.

NOTE: Not all null modem adapters can be used in this application because pin connections are not standard. The null modem adapter (10-005671) that is available from R&P is acceptable for use with the Series 1400a Monitor.

7) If your modem is equipped with a 9-pin connector, go to step 8. If your modem is equipped with a 25-pin connector, go to step 9.

8) Install the null modem adapter onto the 9-pin connector on your modem. Go to step 11.

9) Attach a 9-to-25 pin serial adapter (06-005895-0925) to the null modem adapter.

NOTE: Not all 9-to-25 pin serial adapters can be used in this application because pin connections are not standard. The 9-to-25 pin serial adapter (06-005895-0925) available from R&P is acceptable for use with the Series 1400a Monitor.

10) Install the 9-to-25 pin serial adapter onto the 25-pin connector on your modem. Go to step 11.

11) Attach a phone line to the modem. The modem is now ready to communicate with the monitor.

H.2. Setting up RPComm for use with a Modem

NOTE: The Windows operating system screens shown in this appendix are from the Windows 95 operating system. The screens may vary slightly if you are operating RPComm under other Windows operating systems.

The first two steps of this procedure describe how to set up the unit for direct communication. Direct communication must be successfully completed (Section 10.1) before modem communication is attempted. This will verify that RPComm and the Series 1400a Monitor have been configured properly. Refer to Section 10 for instructions on obtaining, installing and using RPComm.

Follow these steps to set up the unit for modem communications:

1) **Set up the Series 1400a Monitor for direct communications (Section 10.1).**

2) **Create a new direct connection (Section 10.2.2) and verify that the unit is communicating properly.**

   NOTE: If the connection is successful, the unit's serial number will be displayed at the top of the screen. If the connection is not successful or if there is no unit attached, then the serial number field will be blank or will display "99999."

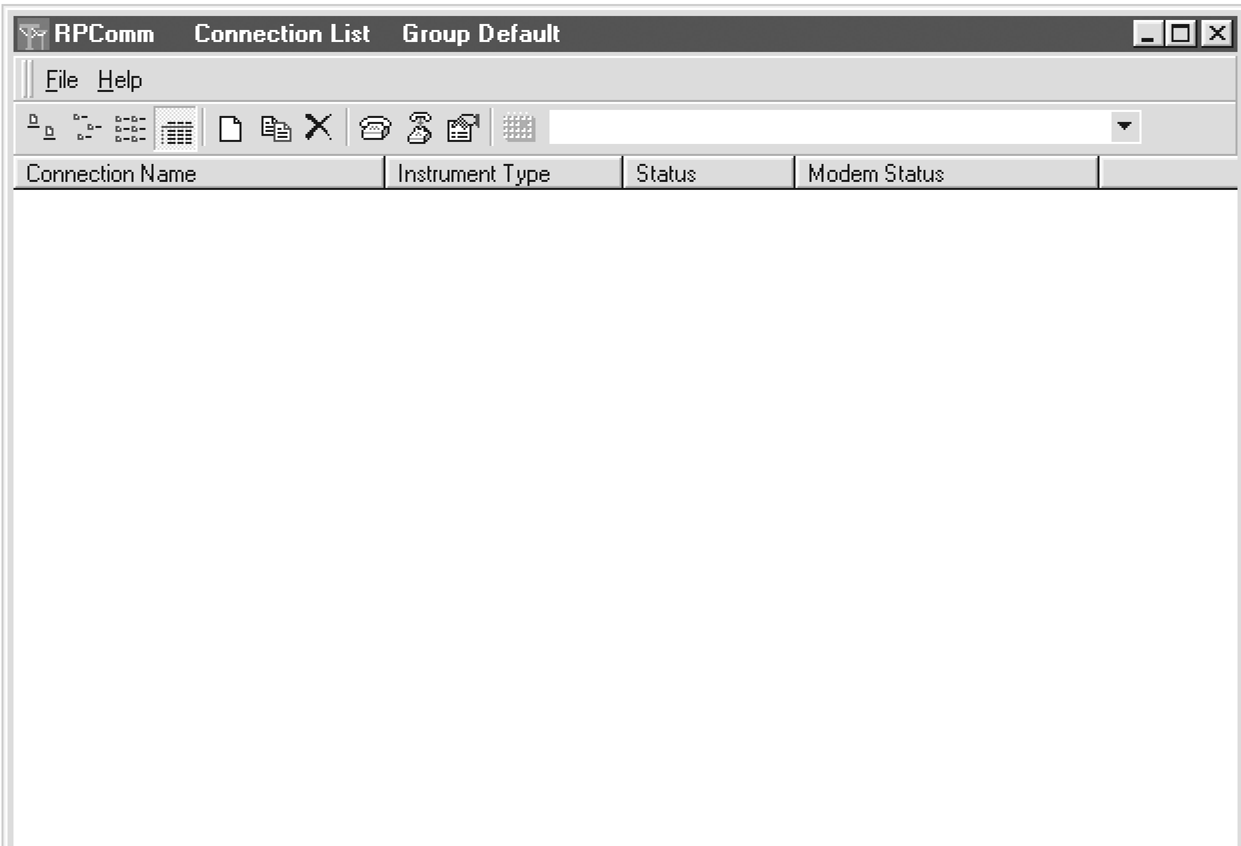
3) **When the RPComm and instrument configurations have been verified, disconnect the direct connection.**

4) **Set up the unit for modem communications (Section H.1).**

   NOTE: R&P recommends that the modem connections be tested before the unit is placed in the field. The test will require the use of two phone lines.

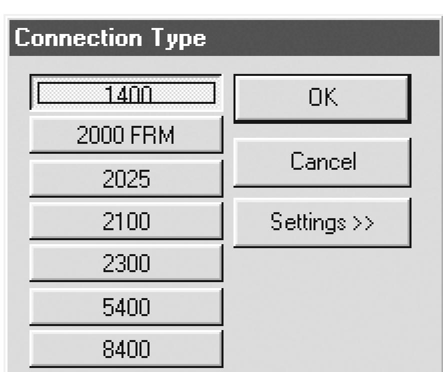
5) **When in the Connection List screen (Figure H-1), select the name of the connection used to verify the direct connection.**

Figure H-1. Connection List screen.



6) Select the Edit Selected Connection icon.  **The Connection Type screen will display (Figure H-2).**

Figure H-2. Connection Type screen.



7) When in the Connection Type screen, ensure that "1400" and select the "Settings" button to display the AK Protocol Setup screen (Figure H-3).

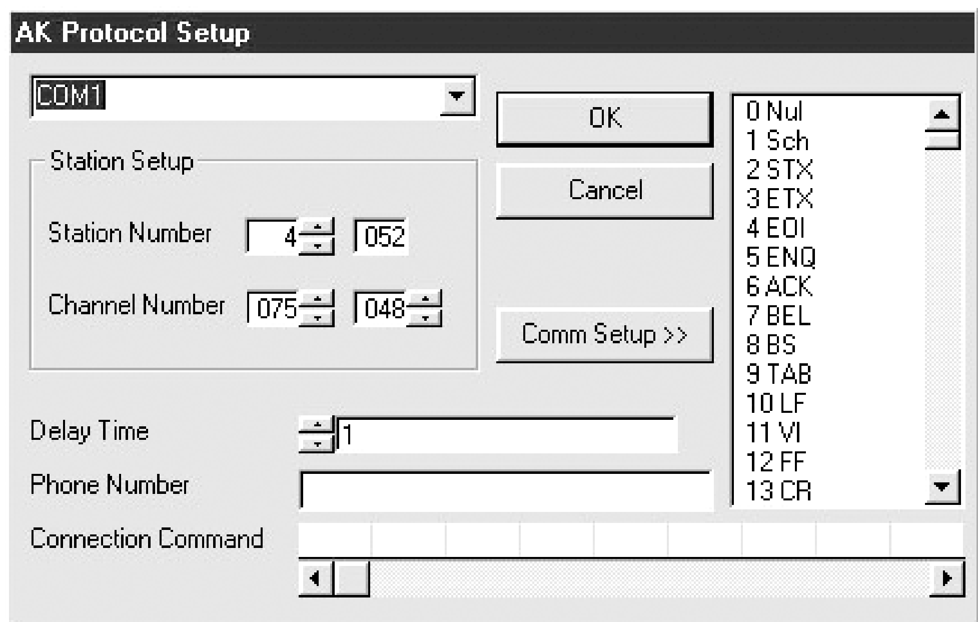
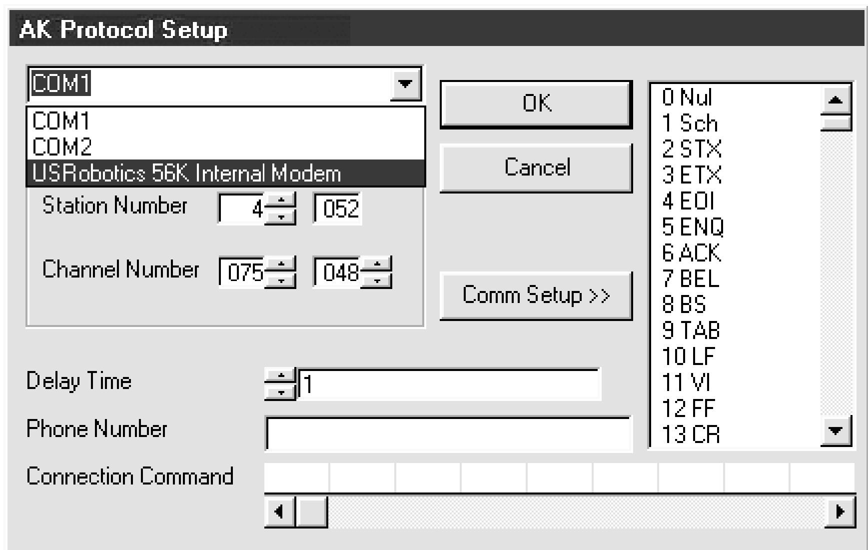


Figure H-3. AK Protocol Setup screen.

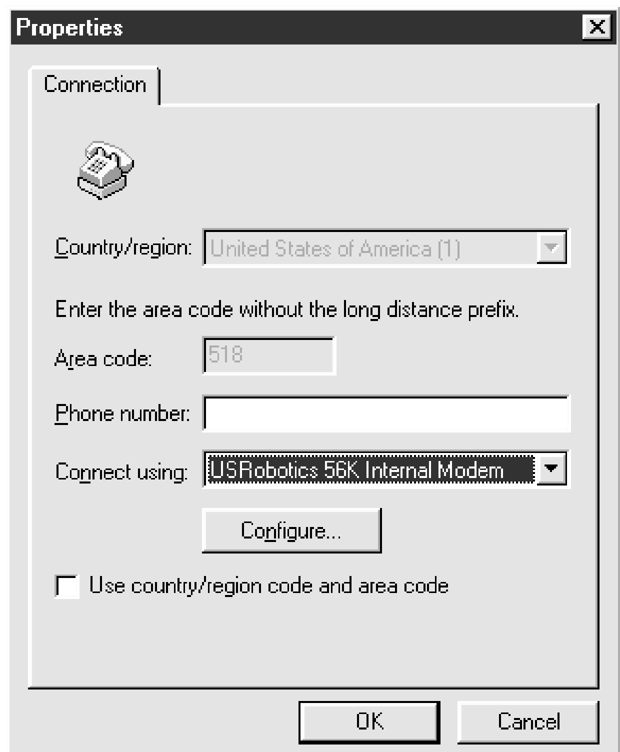
8) When in the AK Protocol Setup screen, place your cursor on the small black "down" arrow located to the right of the white box in the top left-hand of the screen. A menu will display (Figure H-4). Select the appropriate modem connection listed.

Figure H-4. AK Protocol Setup screen with menu displayed.



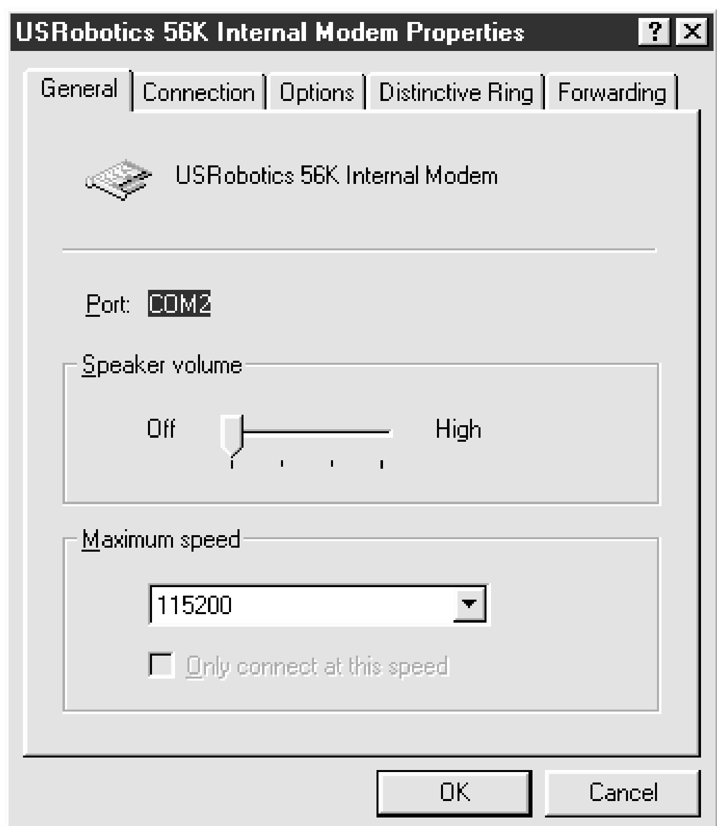
9) Select the “Comm Setup>” button (Figure H-4). The Properties screen (Figure H-5) will display.

Figure H-5. Properties screen.



10) Select the "Configure...." button. The Modem Properties screen will now display with the modem type displayed in the blue bar at the top of the screen (Figure H-6). Generally, the values that your system chooses for variables on this screen are appropriate for a proper connection. However, if your unit and modem experience communication difficulties, these settings may need to be altered. Setting the "Maximum speed" variable to the baud rate of the Series 1400a Monitor generally solves any communications problems. Contact your modem's manufacturer for more information, if necessary.

Figure H-6. Modem Properties screen.



11) Select the "OK" button to exit the Modem Properties screen. The Properties screen (Figure H-5) will now appear as the active screen on your computer.

12) Select the "OK" button to exit the Properties screen. The AK Protocol Setup screen (Figure H-4) will now appear as the active screen on your computer.

13) When in the AK Protocol Setup screen, enter the phone number to be called in the "Phone Number" box at the bottom of the screen. Enter the phone number as you would write it (i.e., (XXX) XXX-XXXX).

NOTE: Phone numbers should be entered with country codes, city or area codes and then the phone number. For the U.S. +1 (518) 555-5555.

14) Select the "OK" button. The Connection Type screen will now appear as the active screen on your computer

15) When in the Connection Type screen, select the "OK" button.

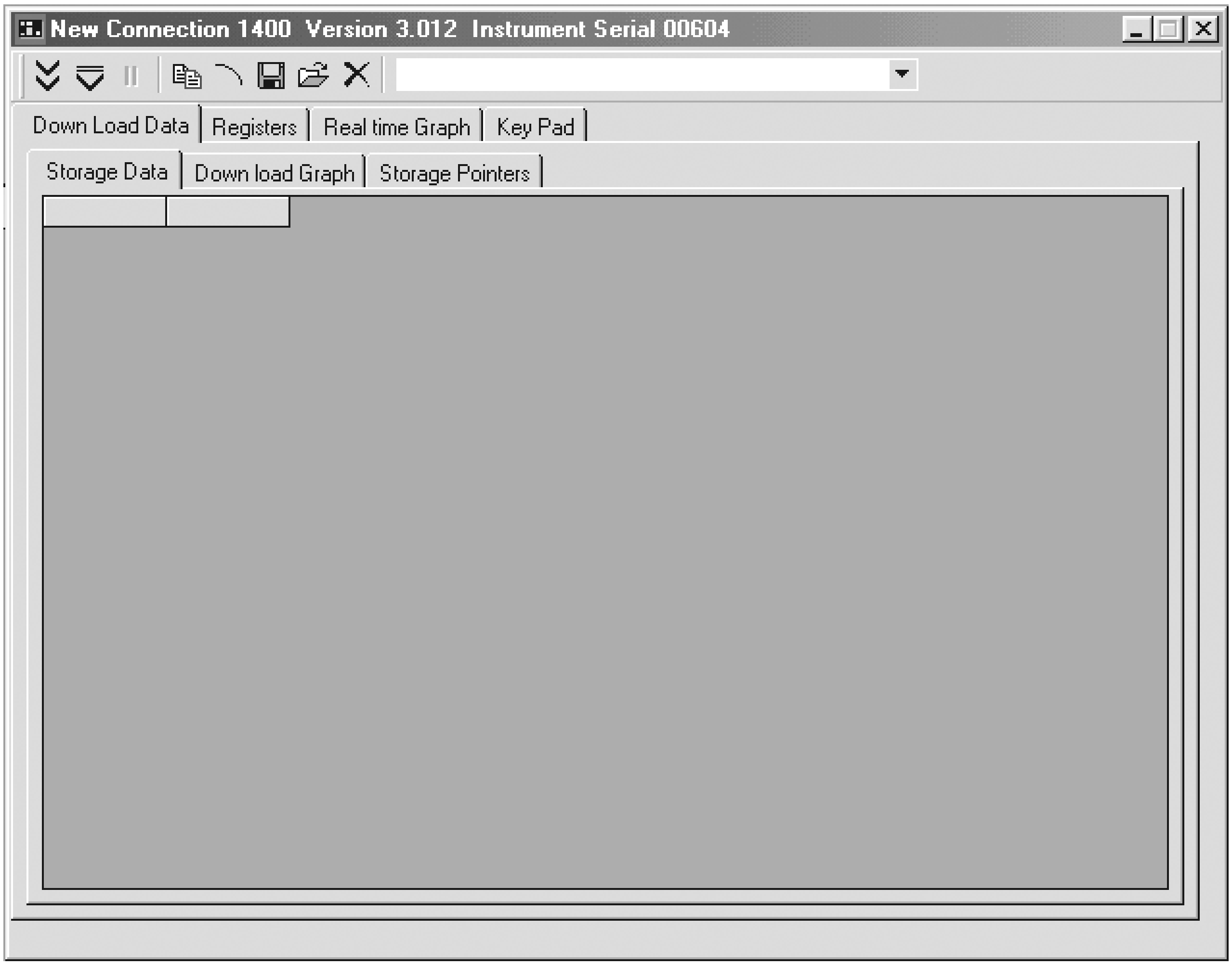
16) To connect to your Series 1400a Monitor through the modem, highlight the connection name on the Connection List screen (Figure H-1) and then select the Connection icon on the tool bar.

 **The modem connection will now be initiated. When communication is established, the Download Data screen will be displayed (Figure H-7).**

NOTE: If the connection is successful, the unit's serial number will be displayed at the top of the screen. If the connection is not successful or if there is no instrument attached, then the serial number will be blank or will display "99999." If the modem loses its connection, wait at least 1 minute before trying to establish another connection. This allows the modem to reset itself.

17) RPComm can now be used as described in Section 10.

Figure H-7. Download Data screen.



H.3. Setting up the Serial Switching Device

For applications where two or more R&P instruments are installed at the same site, a serial switching device can be installed to allow communications with each instrument (including non-R&P serial devices) using one phone line. The serial switching device enables communication to occur with multiple instruments (including non-R&P serial devices) with the use of only one phone line. Command codes can be sent over the phone line to trigger a particular serial port and, therefore, allow communication with the connected instrument. RPComm can be configured to operate with these devices and send the required command codes.

H.3.1. Multiple R&P Instruments of the Same Model

Refer to this section if you are connecting two or more R&P instruments of the same model to a serial switching device.

Follow these steps to set up a serial switching device:

1) **Set up the unit for modem communications (Section H.1). Verify that modem communications to each instrument are successful before adding the serial switching device.**
2) **Obtain a serial switching device from a commercial manufacturer. R&P has found that devices manufactured by Black Box Corp. work well with its instrumentation, although other devices also should function properly. The part number and cost of the device will vary depending on how many serial devices the user wishes to connect to it.**
3) **From the serial switching device's documentation, determine the command codes required to activate each serial port being used.**
4) **Unplug the serial cable, and its adapter(s), from the modem and plug the cable assembly into the serial switching device. Follow the instructions provided with the serial switching device and connect it to the modem.**

   NOTE: R&P recommends that the serial switching device's connections be tested before the unit is placed in the field. This test requires the use of two phone lines.
5) **When in the Connection List screen (Figure H-1), select the name of the connection used to verify the modem connection above and then select the Edit Selected Connection icon.**  **The Connection Type screen will display (Figure H-2).**

6) **When in the Connection Type screen, ensure that the correct instrument type is selected and select the "Settings" button to display the AK Protocol Setup screen (Figure H-3).**

7) **Examine the list of command codes on the right-hand side of the AK Protocol Setup screen. Select the correct series of command codes needed to trigger the desired instrument. As codes are chosen, they will appear on the bottom of the screen in the Connection Command box. If a code is entered incorrectly, the user can delete the incorrect code by selecting the code in the Connection Command box and pressing the "Delete" key on your computer's keyboard.**

8) **The remaining portions of the screen should have been set while establishing the modem connection (step 1). Do not modify these settings.**

9) **Select the "OK" button to exit the AK Protocol Setup screen. The Connection Type screen will display.**

10) **When in the Connection Type screen, select the "OK" button to finish the connection setup.**

11) **To initiate a modem connection to a selected instrument, highlight the connection name on the Connection List screen (Figure H-1) and select the Connection icon  on the tool bar. The connection to the instrument will be initiated and the proper command codes will be sent to the serial switching device. When communication is established, the Download Data screen will display (Figure H-7).**

    NOTE: If the connection is successful, the unit's serial number will be displayed at the top of the screen. Ensure that the correct serial number is displayed to verify that the proper command codes were sent and that the serial port trigger is functioning properly. If the connection is not successful or if there is no instrument attached, then the serial number will be blank or will display "99999." If the modem loses its connection, wait at least 1 minute before trying to establish another connection. This allows the modem to reset itself.

12) **RPComm can now be used as described in Section 10.**

13) **To connect to a different instrument through the serial switching device, the current connection must be terminated. Select the Disconnect icon  on the tool bar to terminate the current connection.**

14) Enter the proper command codes for the desired instrument as described in step 7 and initiate the modem connection as explained in step 11. If the modem loses its connection, wait at least 1 minute before trying to establish another connection. This allows the modem to reset itself.

H.3.2. Multiple R&P Instruments of Different Models

Refer to this subsection if two or more R&P instruments of different models are being connected to a serial switching device. The following combinations involving the Series 1400a Monitor can be supported at this time:

Series 1400a and a Model 2025
Series 1400a and a Series 5400 Monitor

Although RPComm supports both the Series 1400a and the Model 2000-FRM monitors, it is not possible to connect these instruments to a single serial switching device. This is because the Series 1400a Monitor requires the local communication flow control to be set to "RTS/CTS" and the Model 2000-FRM sampler does not support any local communication flow control.

If a Series 1400a and a Model 2000-FRM are located at the same site, two modems and phone lines are necessary for communication with the two instruments.

H.3.2.1. Connecting a Series 1400a Monitor and Other R&P Instruments of Different Models

Follow these steps to connect a Series 1400a Monitor and another R&P instrument via a serial switching device:

1) **Set up the Series 1400a Monitor and the other instrument for direct communications (Section 10).**

2) **Create a new connection to each instrument according to Section 10.2.2 and verify that the units are communicating properly.**

   NOTE: If the connection is successful, the unit's serial number will be displayed at the top of the screen. If the connection is not successful or if there is no unit attached, then the serial number will be blank or will display "99999."

3) **Once the RPComm software and instrument configurations have been verified, disconnect the direct connection.**

4) **Connect your computer directly to the modem that will be connected to the serial switching device (follow the modem's instruction manual).**

5) Begin executing any communication software that will allow direct communications with the modem. Communication software is usually included with most standard commercial modems. If no software program was included, Hyper Terminal (which is included with the Windows operating system) can be used.

6) Set the modem's communication parameters to work with the Series 1400a Monitor. The following list contains the commands that should be set and the corresponding command codes. Various commercial (especially older) modems may have different command codes for the functions listed. Consult your modem's instruction manual for proper commands.

Communication Parameter	**Command Code**
Software reset; restore default parameters	&F0
Force DCD (Data Carrier Detect) "ON" at all times	&C0
Ignore DTR (Data Terminal Ready) from instrument	&D0
Set auto answer to 1 ring	S0=1
Set local flow control to "RTS/CTS"	Code varies
Store settings in profile "0"	&W0
Use stored settings in profile "0" on power up	&Y0

7) Once the connection has been verified, disconnect your computer from the modem.

8) Attach the 9-to-9 pin cable to the RS232 connector on the front or back of the monitor.

9) Attach the null modem adapter to the other end of the 9-to-9 pin cable.

NOTE: Not all null modem adapters can be used in this application because pin connections are not standard. The null modem adapter (10-005671) that is available from R&P is acceptable for use with the Series 1400a Monitor.

10) If your modem is equipped with a 9-pin connector, go to step 11. If your modem is equipped with a 25-pin connector, go to step 12.

11) Install the null modem adapter onto the 9-pin connector on your modem. Go to step 14.

12) Attach a 9-to-25 pin serial adapter (06-005895-0925) to the null modem adapter.

NOTE: Not all 9-to-25 pin serial adapters can be used in this application because pin connections are not standard. The 9-to-25 pin serial adapter (06-005895-0925) available from R&P is acceptable for use with the Series 1400a Monitor.

13) Install the 9-to-25 pin serial adapter onto the 25-pin connector on your modem. Go to step 14.

14) Attach a phone line to the modem. The modem is now ready to communicate with the monitor.

15) When in the Connection List screen (Figure H-1), select the name of one of the connections used to verify the direct connection above and choose the Edit Selected Connection icon.  **The Connection Type screen will then display (Figure H-2).**

16) When in the Connection Type screen, ensure that the correct instrument type is selected and select the "Settings" button to display the AK Protocol Setup screen (Figure H-3).

17) Place your cursor on the small black "down" arrow located to the right of the white box in the top left-hand corner of the AK Protocol Setup screen. A menu will display (Figure H-4). Select the appropriate modem connection from the list.

NOTE: The Station Setup portion of the screen should have been set when you established your direct connection (Section 10). Do not modify these settings.

18) Select the "Comm Setup>" button. The Properties screen (Figure H-5) will display.

19) When in the Properties screen, select the "Configure...." button. The Modem Properties screen will now display with the modem type displayed in the blue bar at the top of the screen (Figure H-6). Generally, the values that your system chooses for variables on this screen are appropriate for a proper connection. However, if your unit and modem experience communication difficulties, these settings may need to be altered. Setting the "Maximum speed" variable to the baud rate of the Series 1400a Monitor generally solves any communications problems. Contact your modem's manufacturer for more information, if necessary.

20) Select the "OK" button to exit the Modem Properties screen. The Properties screen (Figure H-5) will now appear as the active screen on your computer.

21) Select the "OK" button to exit the Properties screen. The AK Protocol Setup screen (Figure H-4) will now appear as the active screen on your computer.

22) When in the AK Protocol Setup screen, enter the phone number to be called in the "Phone Number" box at the bottom of the screen. Enter the phone number as you would write it (i.e., (XXX) XXX-XXXX).

NOTE: Phone numbers should be entered with country codes, city or area codes and then the phone number. For the U.S. +1 (518) 555-5555.

23) Select the "OK" button. The Connection Type screen will now appear as the active screen on your computer

24) When in the Connection Type screen, select the "OK" button.

25) To connect to one of the instruments through the modem, highlight the connection name on the Connection List screen (Figure H-1) and then select the Connection icon on the tool bar. 

The modem connection will now be initiated. When communication is established, the Download Data screen will be displayed (Figure H-7).

NOTE: If the connection is successful, the unit's serial number will be displayed at the top of the screen. If the connection is not successful or if there is no instrument attached, then the serial number will be blank or will display "99999." If the modem loses its connection, wait at least 1 minute before trying to establish another connection. This allows the modem to reset itself.

26) After the connection has been verified, disconnect the modem connection to the instrument.

27) Attach the male end of the 9-to-9 pin cable to the RS232 connector on the other instrument.

28) Repeat steps 15 through 26 (using appropriate values for the required parameters — refer to your instrument's Operating Manual) for the other instrument.

29) After the connection has been verified, disconnect the modem connection to the instrument.

30) Obtain a serial switching device from a commercial manufacturer. R&P has found that devices manufactured by Black Box Corp. work properly with its instrumentation, although other devices should function properly. The part number and cost of the device will vary depending on how many serial devices the user wishes to connect to it.

31) From the serial switching device's instruction manual, determine the command codes required to trigger activation of each serial port being used.

32) Unplug the serial cable, and its adapter(s), from the modem and plug the cable assembly into the serial switching device. Follow the instructions provided with the serial switching device and connect it to the modem.

33) **When in the Connection List screen (Figure H-1), select the name of one of the connections used to verify the modem connection above and then choose the Edit Selected Connection icon.**  **The Connection Type screen will then display (Figure H-2).**

34) **When in the Connection Type screen, ensure that the correct instrument type is selected and select the “Settings” button to display the AK Protocol Setup screen (Figure H-3).**

35) **Examine the list of command codes on the right-hand side of the AK Protocol Setup screen, and select the correct series of command codes needed to trigger the desired instrument. As the codes are chosen, they will appear on the bottom of the screen in the Connection Command box. If the user enters an incorrect code, they can delete it by selecting the code in the Connection Command box and pressing the “Delete” key on your computer’s keyboard.**

36) **The remaining portions of the screen should have been set while establishing the modem connection. Do not modify these settings.**

37) **Select the “OK” button to exit the AK Protocol Setup screen. The Connection Type screen will display.**

38) **When in the Connection Type screen, select the “OK” button to finish the connection setup.**

39) **When in the Connection List screen, highlight one of the instruments and select the Connection icon on the tool bar.**  **The connection to the instrument will be initiated and the proper command codes sent. When communication is established, the Download Data screen will be displayed.**

NOTE: If the connection is successful, the unit’s serial number will be displayed at the top of the screen. Ensure that the correct serial number is displayed to verify that the proper command codes were sent and that the serial port trigger is functioning properly. If the connection is not successful or if there is no instrument attached, then the serial number will be blank or will display “99999.” If the modem loses its connection, wait at least 1 minute before trying to establish another connection. This allows the modem to reset itself.

40) **RPComm can now be used as described in Section 10.**

41) To connect to a different instrument through the serial switching device, the current connection must be terminated. Select the Disconnect icon  **on the tool bar to terminate the current connection.**

42) Enter the proper command codes for the desired instrument as described in step 35 and initiate the modem connection as explained in step 39. If the modem loses its connection, wait at least 1 minute before trying to establish another connection. This allows the modem to reset itself.

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Appendix I: ASCII Codes

The following is a list of ASCII codes that are used in the TEOMCOMM software:

Code	Character
048	0
049	1
050	2
051	3
052	4
053	5
054	6
055	7
056	8
057	9
065	A
066	B
067	C
068	D
069	E
070	F
071	G
072	H
073	I
074	J
075	K
076	L
077	M
078	N
079	O
080	P
081	Q
082	R
083	S
084	T
085	U
086	V
087	W
088	X
089	Y
090	Z

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Appendix J: Original Design Mass Flow Controllers

This appendix describes the maintenance and verification procedures for the Original Design Mass Flow Controllers of the Series 1400a Monitor.

As of February 2001, R&P began manufacturing the Series 1400a Monitor with newly designed mass flow controllers ("Second-Generation Flow Controller Design") in the control unit. If you purchased your Series 1400a Monitor before February 2001, or if the serial number on your monitor is 140AB234170011 or below, your control unit has the original version mass flow controllers. If you purchased a monitor with the original mass flow controller design, follow the instructions in this section. If your monitor has the "Second-Generation" mass flow controllers installed, refer to the Service Manual. Also, if you purchased the Flow Controller Upgrade Kit (55-7758) and installed the Second-Generation mass flow controllers in your Series 1400a Monitor, refer to the Service Manual.

R&P recommends that the user perform the analog calibration (Service Manual) before performing the mass flow controller (MFC) calibrations. Note that the procedures set forth in this section specify the use of a volumetric flow meter. If a non-volumetric flow meter (such as a mass flow meter) is used, you must convert the flow meter's indicated flow rate to a volumetric flow rate using the local temperature and pressure conditions at the flow meter.

J.1. Overview of Calibration Procedures

Calibration Procedures	Interval	Reference
Mass flow controller calibration (software)	6 months	Section J.2
Mass flow controller calibration (hardware)	1 year	Section J.3

The calibration intervals provided above are guidelines. Requirements for routine calibration are site-specific, and may be better defined by the user as necessary.

J.2. Flow Controller Calibration — Software

The software procedure allows the user to calibrate the sample and bypass flow rates without having to adjust any hardware.

Items Needed:
Reference flow meter such as a bubble meter, dry gas meter, or mass flow meter.
NOTE: This reference flow meter should have been recently calibrated to a primary standard, and should have an accuracy of 1% at 3 l/min.

Follow the steps below to perform a software calibration of the original design mass flow controllers:

1) **Turn off the control unit.**
2) **Disconnect the electric cable that links the control unit with the sensor unit.**
3) **Remove the main and bypass flow lines from their connections on the back panel of the control unit.**
4) **Turn on the control unit, and make sure that the pump is on.**
5) **When in the Main screen (Figure J-1), press the <STEP SCREEN> key to display the Menu screen (Figure J-2).**

Figure J-1. Main screen.

```
OK     4+  11%  NU      09:39
Mass Conc>               33.6
30-Min MC                26.8
01-Hr MC                 12.5
```

Figure J-2. Menu screen.

```
  LISTING OF SCREENS
> Set Temps/Flows
  Set Hardware
  View ACCU System
```

6) When in the Menu screen, press the up (<↑>) and down (<↓>) arrow keys to position the cursor on "Set Temps/Flows." Then press the <ENTER> key. The Set Temps/Flows screen will now display (Figure J-3). Also, the user can press <1>, <9> and then the <ENTER> key on the monitor's display/keypad to display the Set Temps/Flows screen.

Figure J-3. Set Temps/ Flows screen.

```
     SET TEMPS/FLOWS
T-Case>     50.00     50.00
T-Air       50.00     50.01
T-Cap       50.00     49.98
```

7) When in the Set Temps/Flows screen, press the up and down arrow keys to position the screen so that "F-Main" (main flow) and "F-Aux" (auxiliary flow) display on the screen. Record the "F-Main" and "F-Aux" readings.

8) Press the up and down arrow keys to position the screen so that "T-A/S" (average/standard temperature) and "P-A/S" (average/ standard pressure) display on the screen. Record the set points for the average temperature (located on the left-hand side of this field), and the average pressure (located on the left-hand side of this field).

9) Ensure that the monitor is in the Setup Mode (Section 6).

10) On the monitor, set the average temperature and average pressure parameters to the current local conditions.

NOTE: The average pressure reading should be actual pressure NOT corrected to sea level.

IMPORTANT: The average temperature and pressure settings should not read 99° C and 9 atm (respectively) during a mass flow controller calibration.

11) On the flow meter, set the average temperature and average pressure parameters to the current local conditions.

NOTE: The average pressure reading should be actual pressure NOT corrected to sea level.

IMPORTANT: The average temperature and pressure settings should not read 99° C and 9 atm (respectively) during a mass flow controller calibration.

12) Press the up and down arrow keys to position the screen so that "FAdj Main" and "FAdj Aux" display on the screen.

13) Connect a reference flow meter such as a bubble meter, dry gas meter, or mass flow meter to the port labelled "SENSOR FLOW" on the back panel of the control unit. This reference flow meter should have been recently calibrated to a primary standard, and should have an accuracy of 1% at 3 l/min.

14) Compare the monitor's "F-Main" set point (step 10) above with the flow rate indicated by the flow meter. The "F-Main" reading is in volumetric liters per minute. If you are using a mass flow meter, you must adjust its reading for temperature and pressure to obtain volumetric flow under the test conditions. If you are using a volumetric flow meter, you do not need to adjust your flow meter for temperature and pressure. If the "F-Main" set point (step 10) matches the flow rate indicated by the flow meter, go to step 16. If the "F-Main" set point (step 10) does not match the flow rate indicated by the flow meter, go to step 15.

15) Edit the "FAdj Main" field on the monitor so that the volumetric flow rate indicated by the flow meter matches the "F-Main" set point (step 10). The value for "FAdj Main" can be increased and decreased by pressing the up and down keys when in the Edit Mode (Section 4). If you must enter a step adjustment greater than ±10% to calibrate the mass flow controller, you must perform a hardware calibration (Section J.3).

16) If your system has an auxiliary flow controller, repeat steps 8 to 14, replacing the references to "F-Main" and "FAdj Main" with "F-Aux" and "FAdj Aux." Connect the reference flow meter to the "BYPASS FLOW" port located on the back panel of the control unit.

17) Change the average temperature (located on the left-hand side of this field) and the average pressure (located on the left-hand side of this field) readings back to their original values (step 8).

18) Turn off the control unit.

19) Install the main and bypass flow lines onto the back panel of the control unit (Section 2).

20) Connect the electric cable that links the control unit with the sensor unit.

21) Turn on the control unit, and make sure that the pump is on.

22) Perform a system leak check (Section 3).

J.3. Flow Controller Calibration — Hardware

NOTE: Always wear appropriate anti-static devices when working with the system electronics.

Items Needed:

Reference flow meter such as a bubble meter, dry gas meter, or mass flow meter.

NOTE: This reference flow meter should have been recently calibrated to a primary standard, and should have an accuracy of 1% at 3 l/min.

Potentiometer adjustment tool

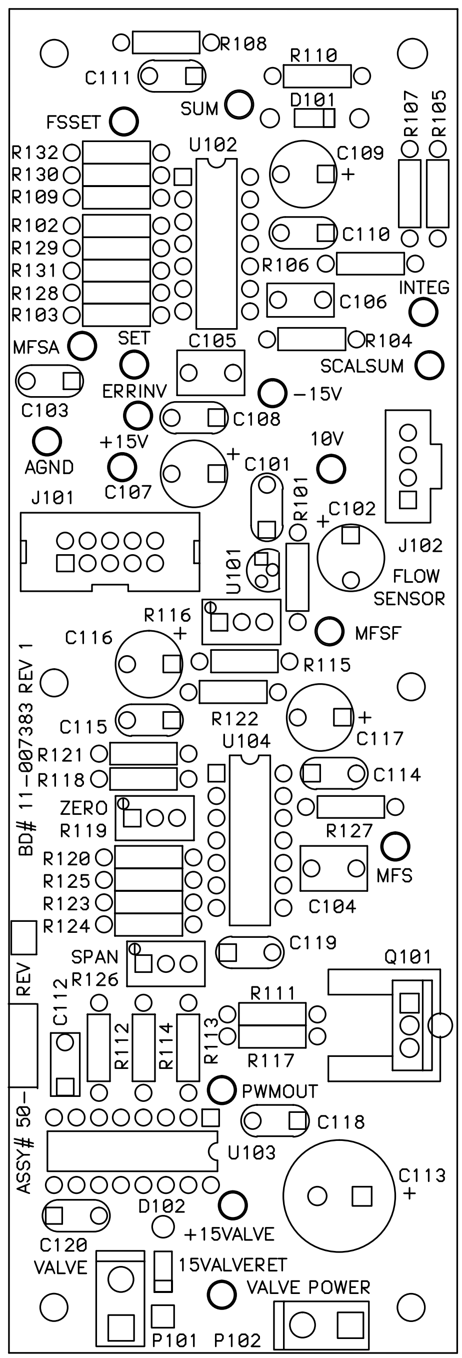
Follow these steps to perform a hardware calibrate of the original design mass flow controllers:

1) **Perform an analog board calibration (Service Manual).**
2) **Turn off the control unit.**
3) **Disconnect the cable that connects the control unit and the sensor unit.**
4) **Remove the top cover of the control unit (Section 2).**

   NOTE: Always wear appropriate anti-static devices when working with the system electronics.
5) **Locate the mass flow controller board (Figure J-4) and ensure that all connectors are fully seated on the mass flow controller board.**

Figure J-4. Mass flow controller board.

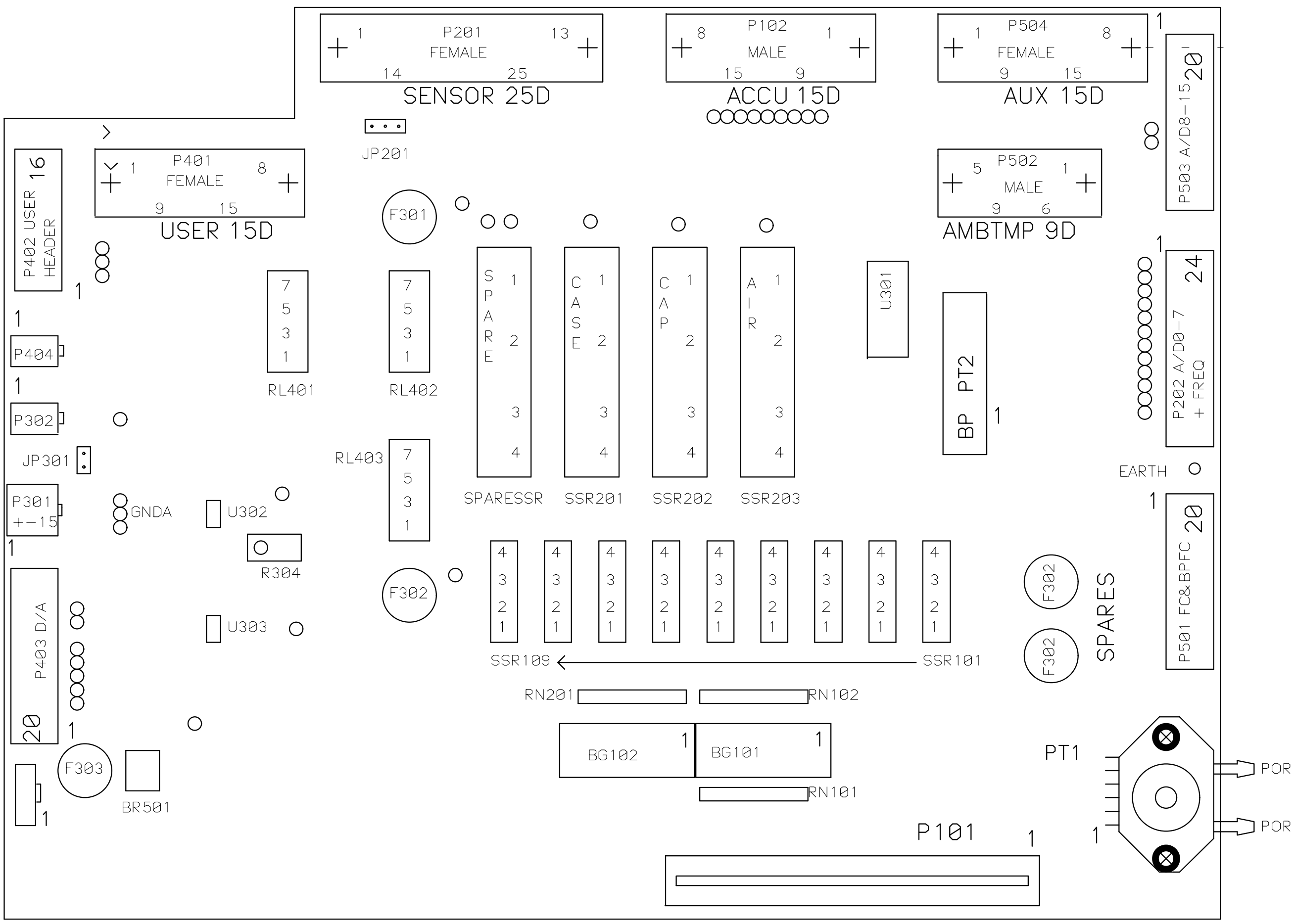
TOPSILK



6) **Turn on the control unit, and make sure that the pump is on. Allow the instrument to warm up for 30 minutes from a cold start, or 5 minutes if it has just been operated.**

7) **Locate the interface board (Figure J-5).**

Figure J-5. Interface board.



8) **Place the positive lead of the digital multimeter on the test point labeled “+10 V” (red) and the negative lead on test point GND (black) (Figure J-5).**

9) **Locate potentiometer R304 (Figure J-5), and adjust it until the reading is 10.000 VDC ± 0.001 V.**

10) When in the Main screen (Figure J-1), press the <STEP SCREEN> key to display the Menu screen (Figure J-2).

11) When in the Menu screen, press the up (<↑>) and down (<↓>) to position the cursor on “Set Temps/Flows.” Then press the <ENTER> key. The Set Temps/Flows screen will now display (Figure J-3). Also, the user can press <1>, <9> and then the <ENTER> key on the monitor’s display/keypad to display the Set Temps/Flows screen.

12) When in the Set Temps/Flows screen, press the up and down arrow keys to position the screen so that “F-Main” (main flow) and “F-Aux” (auxiliary flow) display on the screen. Record the “F-Main” and “F-Aux” readings.

13) Press the up and down arrow keys to position the screen so that “T-A/S” (average/standard temperature) and “P-A/S” (average/ standard pressure) display on the screen. Record the set points for the average temperature (located on the left-hand side of this field), and the average pressure (located on the left-hand side of this field).

14) Ensure that the monitor is in the Setup Mode (Section 6).

15) On the monitor, set the average temperature and average pressure parameters to the current local conditions.

NOTE: The average pressure reading should be actual pressure NOT corrected to sea level.

IMPORTANT: The average temperature and pressure settings should not read 99**°** C and 9 atm (respectively) during a mass flow controller calibration.

16) On the flow meter, set the average temperature and average pressure parameters to the current local conditions.

NOTE: The average pressure reading should be actual pressure NOT corrected to sea level.

IMPORTANT: The average temperature and pressure settings should not read 99**°** C and 9 atm (respectively) during a mass flow controller calibration.

17) Press the up and down arrow keys to position the screen so that “FAdj Main” and “FAdj Aux” display on the screen.

18) Set the adjustment factors for both mass flow controller’s by changing the settings for “FAdj Main” and “FAdj Aux” to “1.000.”

19) **Connect a reference flow meter such as a bubble meter, dry gas meter, or mass flow meter to the port labelled "SENSOR FLOW" on the back panel of the control unit. Do not attach the flow meter to the large bypass in-line filter, and do not attach any system components to the air input side of the flow meter. This reference flow meter should have been recently calibrated to a primary standard, and should have an accuracy of 1% at 3 l/min.**

NOTE: If you are using a mass flow meter, you must adjust its reading for temperature and pressure to obtain volumetric flow under the test conditions. You do not need to adjust your flow meter for temperature and pressure if you are using a volumetric flow meter.

20) **Set the "F-Main" field to 0.5 l/min and observe the actual reading on the flow meter. After approximately 10 seconds, adjust potentiometer R101 (Figure J-5) on the mass flow controller board until the flow is correct within ±0.03 l/min.**

21) **Set the "F-Main" field to 4.5 l/min and observe the actual reading on the flow meter. After approximately 10 seconds, adjust potentiometer R105 (Figure J-5) on the mass flow controller board until the flow is correct within ±0.03 l/min.**

22) **Repeat steps 20-21 until both conditions are met.**

23) **Set the "F-Main" field to its operational rate (step 12) and observe the actual reading on the flow meter. After approximately 10 seconds, adjust potentiometer R101 on the mass flow controller board until the flow is correct within ±0.03 l/min.**

24) **Connect the reference flow meter to the "BYPASS FLOW" port located on the back panel of the control unit. Do not attach the flow meter to the large bypass in-line filter, and do not attach any system components to the air input side of the flow meter.**

NOTE: If a mass flow meter is being used, its reading must be adjusted for temperature and pressure to obtain volumetric flow under the test conditions. No adjustment is necessary in the case of a volumetric flow meter.

25) **Set the "F-Aux" field to 2.0 l/min and observe the actual reading on the flow meter. After approximately 10 seconds, adjust potentiometer R201 (Figure J-5) on the mass flow controller board until the flow is correct within ±0.2 l/min.**

26) **Set the "F-Aux" field to 18.0 l/min and observe the actual reading on the flow meter. After approximately 10 seconds, adjust potentiometer R205 (Figure J-5) on the mass flow controller board until the flow is correct within ±0.2 l/min.**

27) Repeat steps 25 and 26 until both conditions are met.

28) Set the "F-Aux" field to its operational rate (step 12) and observe the actual reading on the flow meter. After approximately 10 seconds, adjust potentiometer R201 on the mass flow controller board until the flow is correct within ±0.2 l/min.

29) Change the average temperature (located on the left-hand side of this field), and the average pressure (located on the left-hand side of this field) back to their original values (step 13).

30) Turn off the control unit.

31) Install the main and bypass flow lines onto the back panel of the control unit (Section 2).

32) Connect the electric cable that links the control unit with the sensor unit.

33) Replace the top cover of the control unit.

34) Turn on the control unit, and make sure that the pump is on.

35) Perform a system leak check (Section 3).

Appendix K: Complete Outdoor Enclosure

The Complete Outdoor Enclosure (99-002332-0120 for 120 VAC and 99-002332-240 for 240 VAC) provides a heated and air-conditioned environment for the control unit, sensor unit and pump of the Series 1400a Monitor. It also contains enough space in its 19-inch mounting rack for the installation of data logging equipment. This appendix describes the installation and maintenance of the outdoor enclosure.

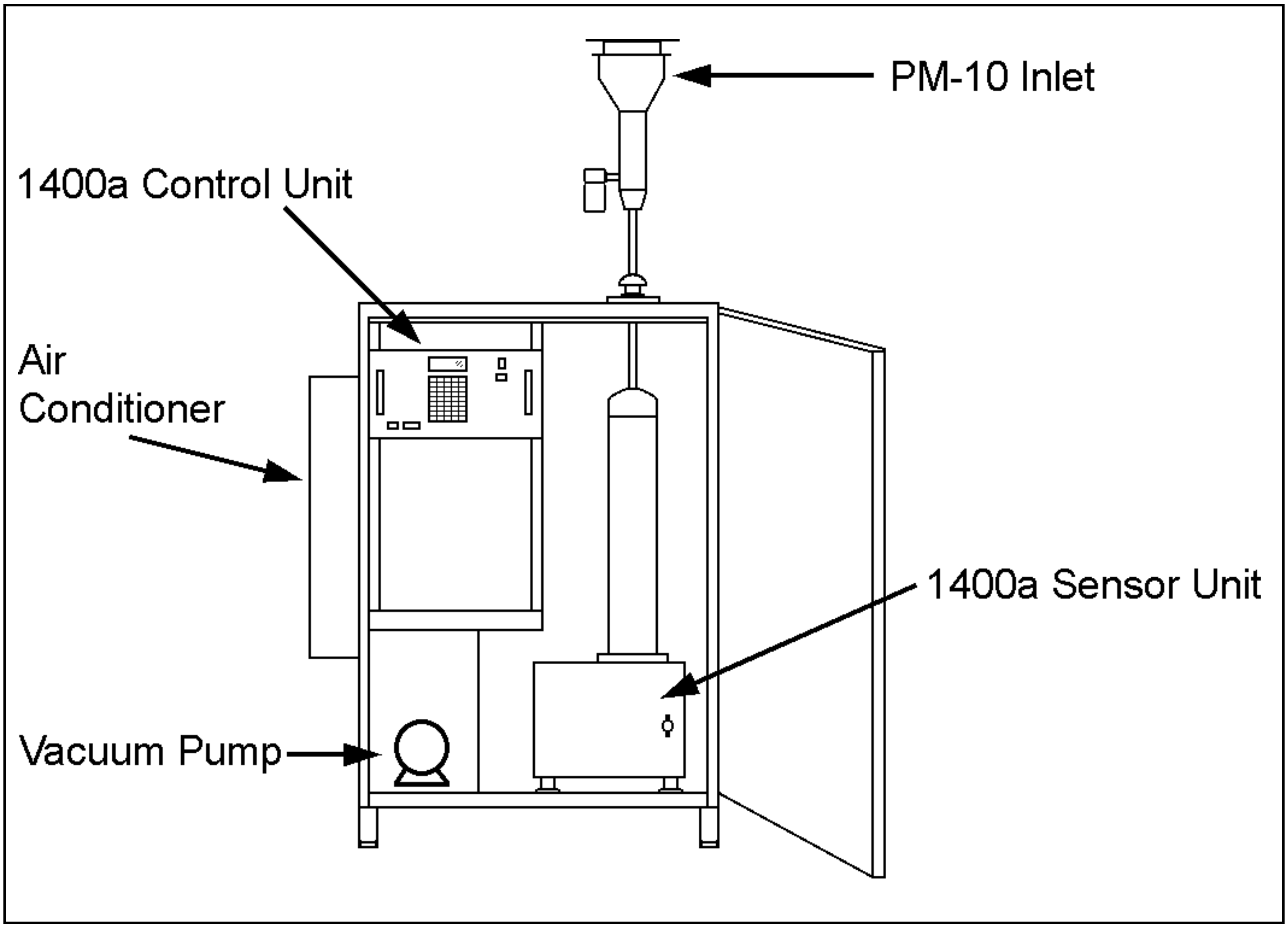
K.1. Installing the Control and Sensor Units

Refer to Section 2 for the setup instructions for the control unit, sensor unit and pump.

Follow these steps to install the monitor in the enclosure:

1) **Set up the air and electrical connections between the sensor unit and the control unit (Section 2).**
2) **Place the control unit on the two angle mounting brackets located in the upper left-hand corner of the enclosure (Figure K-1).**
3) **Secure the control unit to the rack angle uprights.**
4) **Place the sensor unit on the floor on the right-hand side of the enclosure (Figure K-1).**
5) **Refer to Appendix K.3 for instructions on setting up the flow splitter and sample tube inside the enclosure.**

Figure K-1. Instrument placement inside the outdoor enclosure.



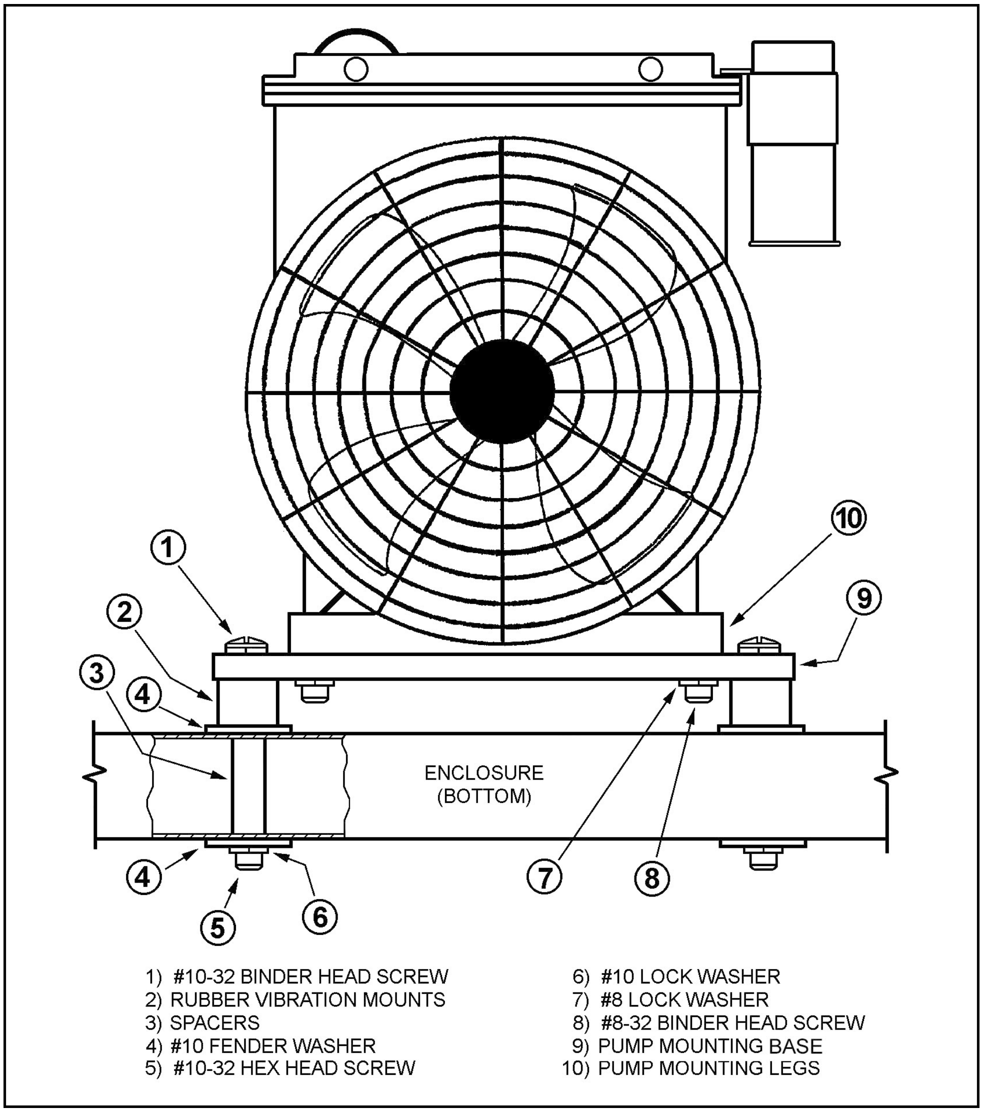
K.2. Installing the Sample Pump

The outdoor enclosure includes a package containing the necessary hardware to install the sample pump.

Follow these steps to install the pump in the outdoor enclosure:

1) Attach the mounting base of the sample pump to the pump mounting legs (Figure K-2) using the #8-32 binder head screws and #8 lock washers.

Figure K-2. Sample pump installation.



2) Fasten the spacers onto the male end of the rubber vibration mounts (Figure K-2). Be sure to place a #10 fender washer between the spacers and the rubber vibration mounts.

3) Fasten the vibration mount assemblies to the pump mounting legs using the #10-32 binder head screws and #10 lock washers (Figure K-2).

4) Insert the entire pump assembly into the enclosure's pump compartment.

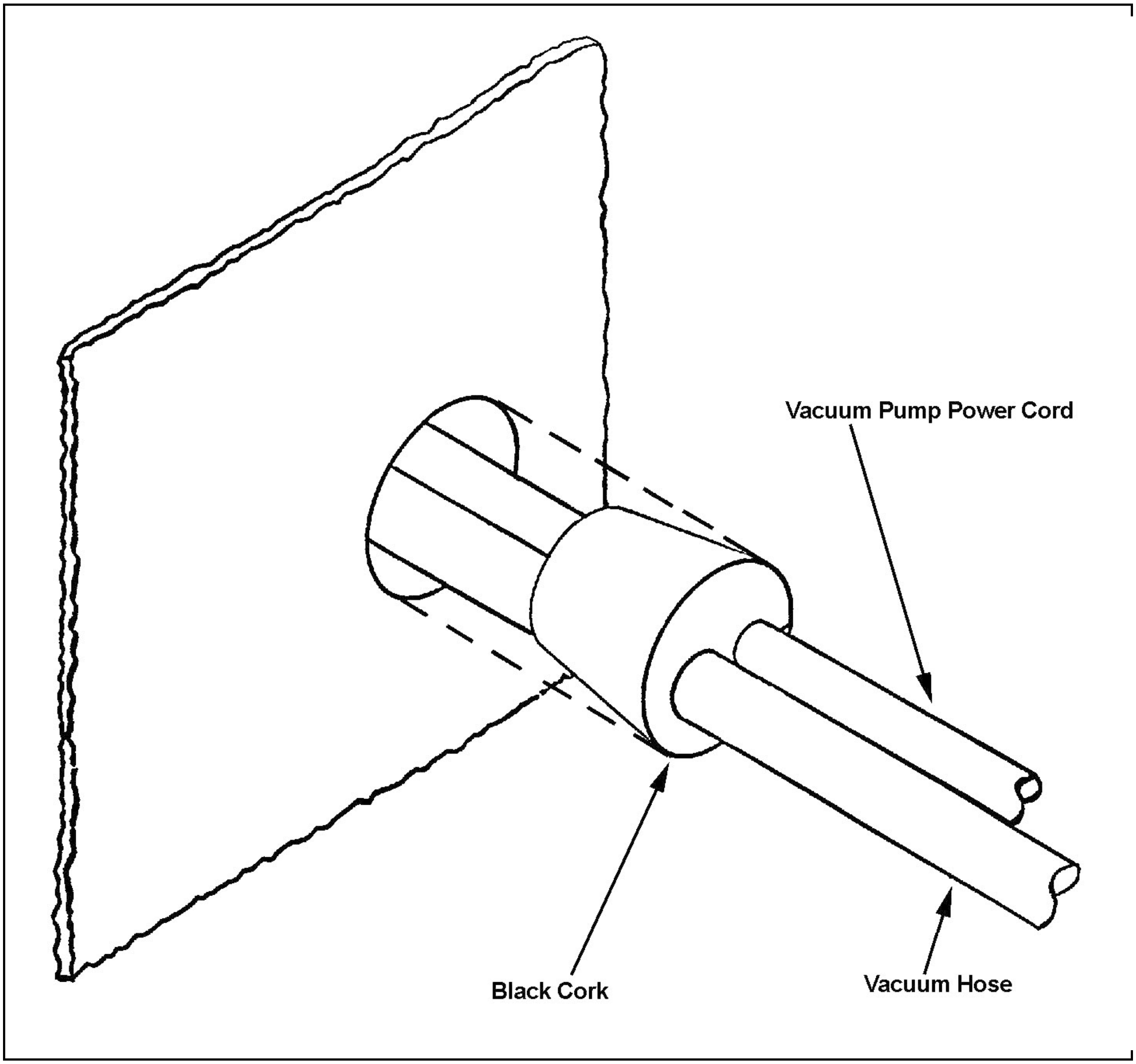
5) Ensure that the four spacers are in their proper positions.

6) Secure the pump assembly to the bottom of the enclosure with the #10-32 hex head screws, #10 lock washers and #10 fender washers (Figure K-2).

7) Place the power cord and vacuum tubing into the appropriate holes in the black rubber cork and close the cork around them (Figure K-3). Push the black cork into the access hole located between the pump compartment and the enclosure.

NOTE: The access hole must be tightly sealed to allow the air conditioner to work properly.

Figure K-3. Black cork installation.



K.3. Installing the Seal Plate

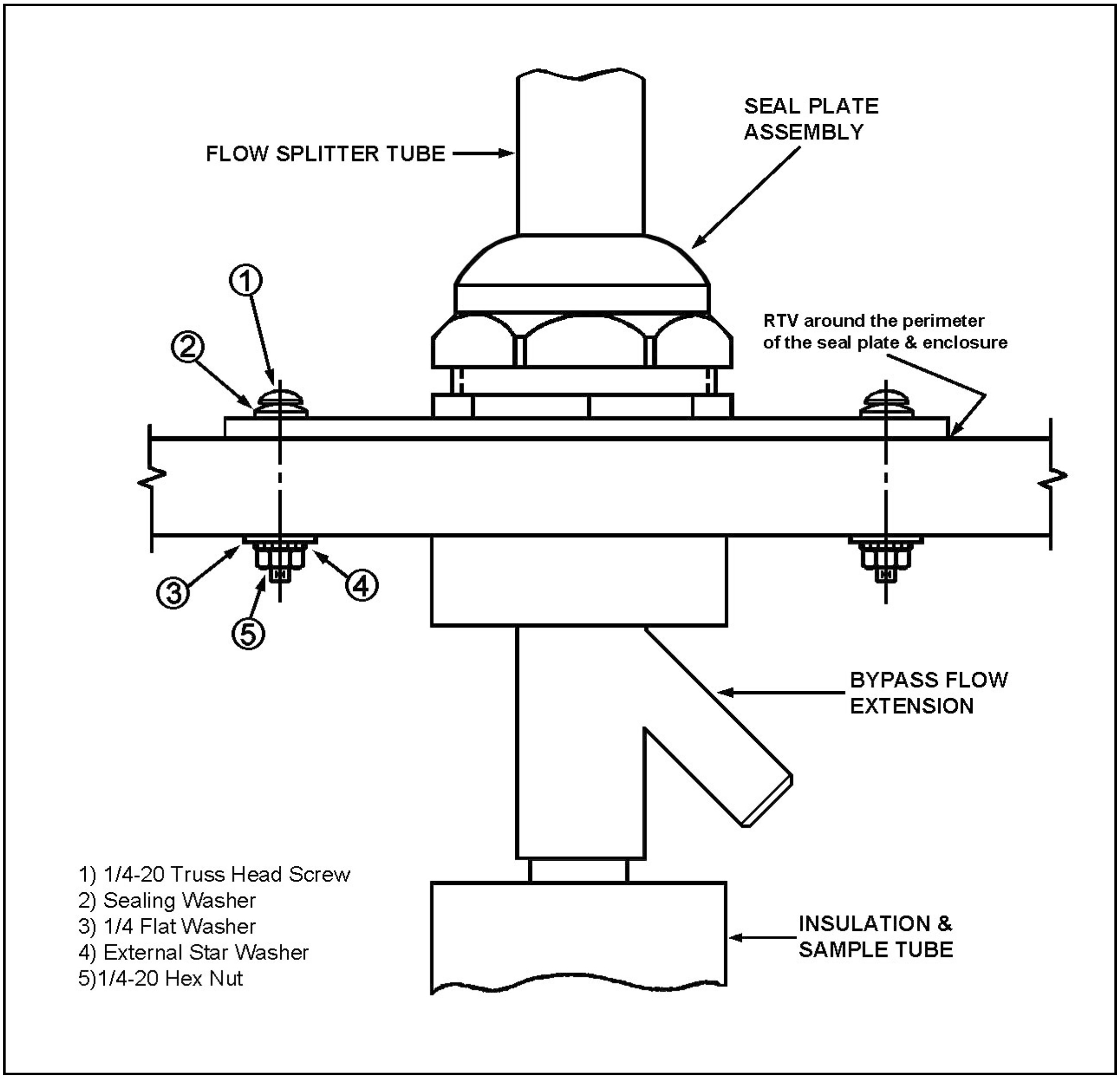
Follow these steps to install the seal plate:

1) **Install the sensor unit inside the enclosure (Section K.1).**
2) **Insert the seal plate assembly (Figure K-4) into the mounting hole located on the top of the enclosure.**

Figure K-4. Seal plate.

3) **Place the sealing washers on the 1/4-20 truss head screws (Figure K-5).**

Figure K-5. Seal plate installation — standard instrument configuration.



4) On top of the seal plate, insert the 1/4-20 truss head screws (with sealing washers) into the seal plate mounting holes (Figure K-5).

5) Place the 1/4-inch flat washers onto the 1/4-20 hex nuts (Figure K-5).

6) Place the 1/4-inch external star washers onto the 1/4-inch flat washers (Figure K-5).

7) On the inside ceiling of the enclosure, insert the 1/4-20 hex nuts (with 1/4-inch flat washers and 1/4-inch external star washers) into the seal plate mounting holes (Figure K-5).

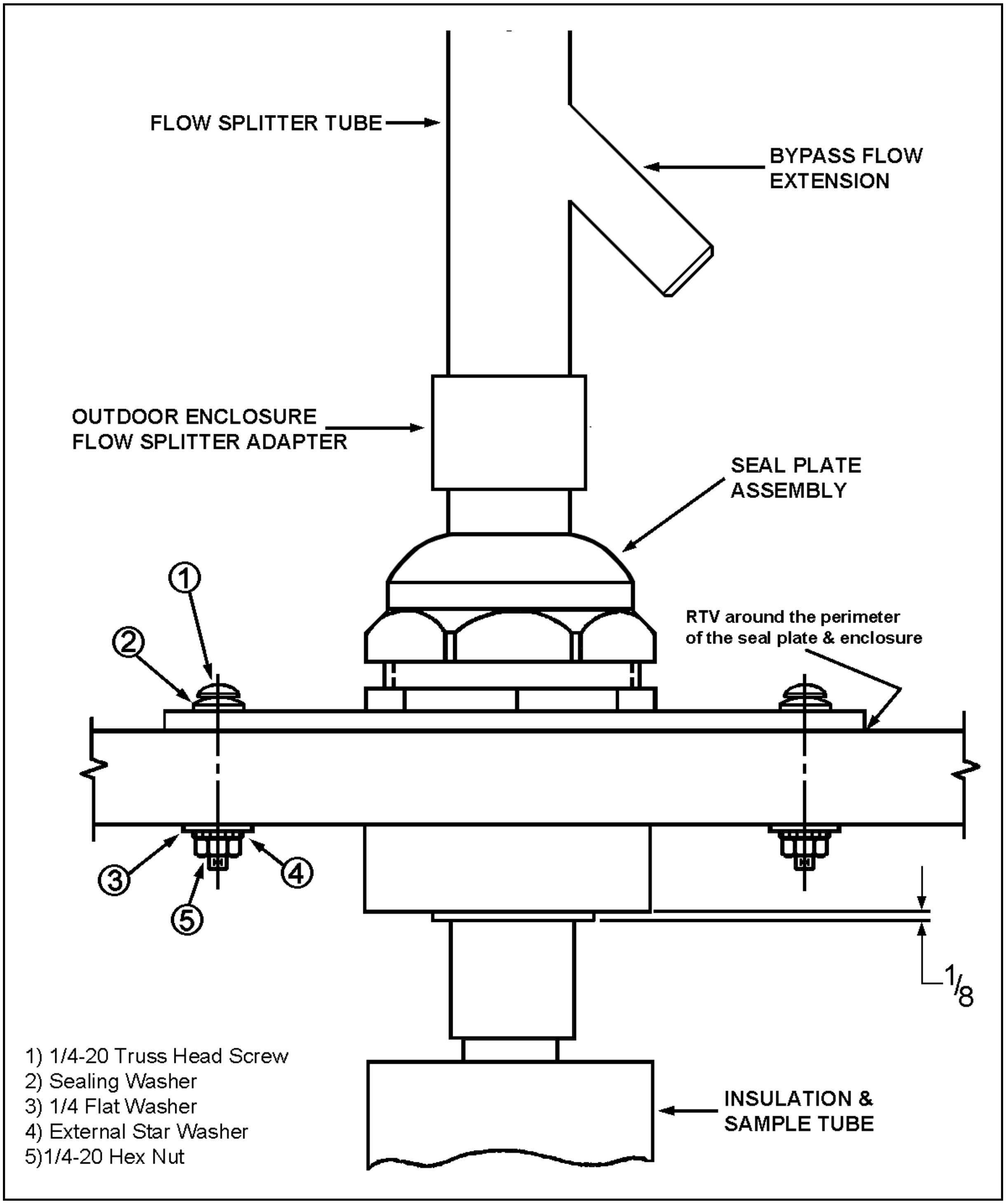
8) Apply room temperature vulcanizing (RTV) sealer around the perimeter of the seal plate to prevent leakage (Figure K-5). If you are setting up a standard installation (Figure K-5), go to step 9. If you are setting up an ACCU System installation (Figure K-6), go to step 10.

9) Insert the flow splitter up through the bottom of the seal plate nut so that the bypass flow extension is inside the enclosure (Figure K-5). Go to step 11.

10) Insert the flow splitter down into the seal plate nut from the top so that the bypass flow extension is outside the enclosure (Figure K-6). Go to step 11.

NOTE: If you will be using the outdoor enclosure with an ACCU System, you must leave the bypass extension outside the enclosure. To leave the bypass extension outside the enclosure, you must use an adapter which is provided as part of the Complete Enclosure Kit for the ACCU System (59-001680). You must purchase this kit separately. All other setup instructions remain the same.

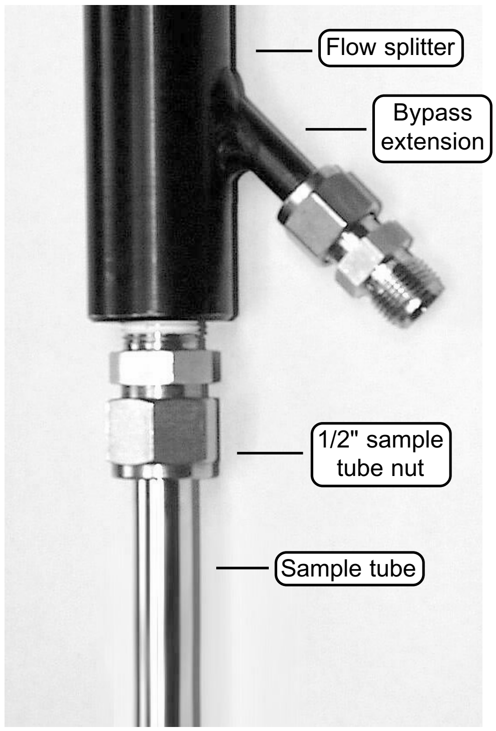
Figure K-6. Seal plate installation — ACCU system configuration.



11) Secure the seal plate nut around the flow splitter.

12) Loosen the 1/2" sample tube nut at the base of the flow splitter (Figure K-7).

Figure K-7. Close-up view of bottom of flow splitter.



13) Slide the sample tube that is located inside the flow splitter up or down until it is 15.5 cm (6") from the top of the flow splitter (Figure K-8). If you have installed a flow adapter (Section 2) onto the end of the sample tube inside the flow splitter, then the top of the flow adapter must be 15.5 cm (6") from the top of the flow splitter (Figure K-9).

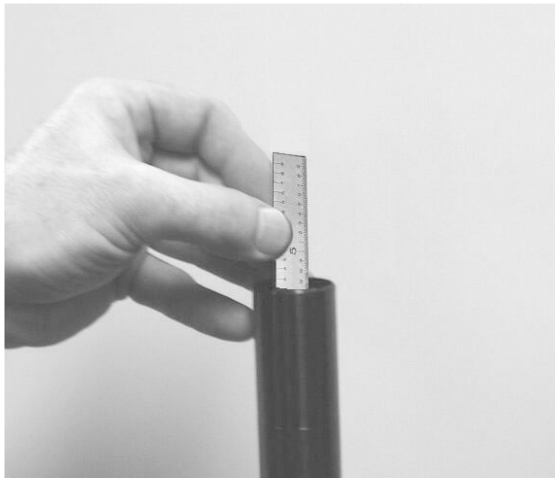


Figure K-8. Measuring the distance from the top of the flow adapter or sample tube to the top of the flow splitter.

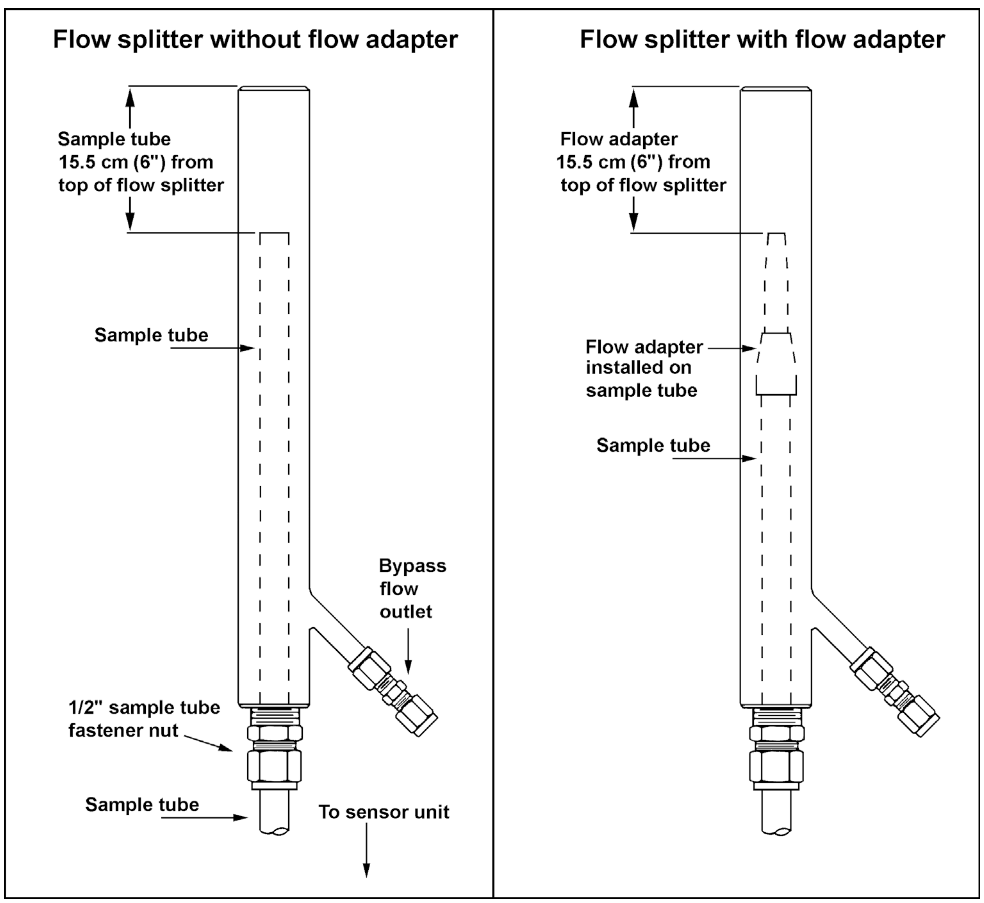


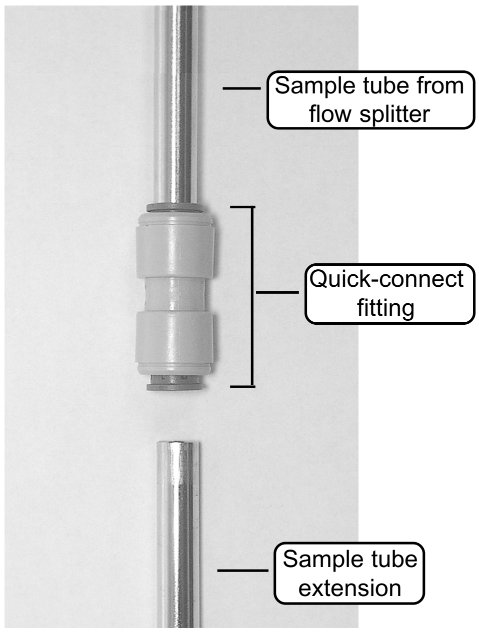
Figure K-9. Flow splitter with and without a flow adapter installed.

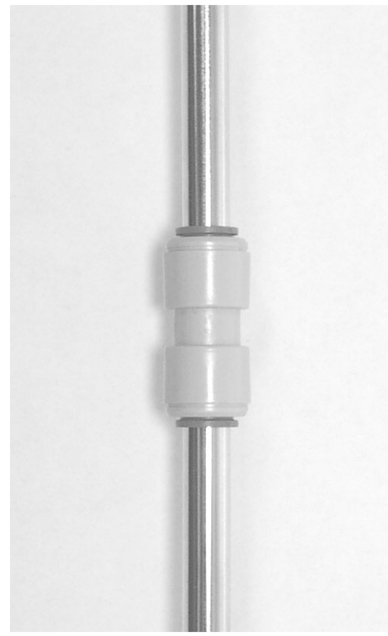
14) Tighten the 1/2" sample tube nut at the base of the flow splitter.

15) Locate the quick-connect fitting on the bottom of the sample tube of the flow splitter (Figure K-10).

Figure K-10 (left). Sample tube from flow splitter with the quick-connect fitting and sample tube extension highlighted.

Figure K-11 (right). Sample tube from flow splitter with sample tube extension inserted into the quick-connect fitting.





16) Insert the sample inlet (located on the top of the sensor unit) into the quick-connect fitting on the bottom sample tube of the flow splitter (Figure K-11). You may cut the sample tube of the flow splitter as necessary; however, you must ensure that the cut ends of the sample tube are beveled and free of any sharp edges or burrs.

K.4. Adjusting the Air Conditioner

The outdoor enclosure is delivered with a McLean Midwest CR29 air conditioner installed. The temperature setting of this unit must be adjusted before operating the enclosure.

✔ Unplug the air conditioner during the winter months at locations where the ambient temperature drops below 10° C.

Follow these steps to adjust the air conditioner:

1) **Ensure that the air conditioner is not operating. Unplug the air conditioner from its power source.**
2) **Loosen the three fasteners located on the outer cover of the air conditioner.**
3) **The user can adjust the temperature control by turning the knob clockwise to increase the temperature setting, and counter-clockwise to decrease the temperature setting. Set the temperature to 27° C (80° F).**
4) **After you have adjusted the temperature setting, close the air conditioner cover and tighten the three fasteners on the cover.**
5) **Restore power to the air conditioner.**

Unplug the air conditioner from its power source during winter months in areas where ambient temperatures regularly drop below 10° C (50° F). When you unplug the air conditioner from its power source, the blower will turn off. Otherwise, the blower will constantly operate when the air conditioner is plugged into its power source.

K.5. Adjusting the Heater

Set the heater to 10° C (50° F) using the thermostat installed in the enclosure.

✔ The temperature in the outdoor enclosure must remain between 2° and 40° C.

NOTE: The temperature requirements for the Series 1400a Monitor range from 2° to 40° C (35° to 104° F). Therefore, the temperature inside the outdoor enclosure must be maintained between 2° and 40° C at all times during instrument operation.

K.6. Installing the Optional Sliding Shelf

The user must install the control unit onto the sliding shelf.

Locate the following parts to install the sliding shelf:

1	Sliding shelf
4	#10-32 screws
4	#10 star lock washer

Follow these steps to mount the sliding shelf :

1) **Unpack the shelf and place it on a flat surface. Note that the shelf is mounted upside down, so that the front and rear lip of each shelf points upward.**
2) **Completely extend one of the shelf slides.**
3) **Locate the black lever at the end of the shelf slide, near the shelf. Pull the lever and pull the shelf slide off the shelf.**
4) **Repeat steps 2 and 3 for the other shelf slide.**
5) **Examine the mounting rails in the outdoor enclosure. Remove the existing mounting shelf, if necessary.**
6) **Place the left shelf slide in the correct position on the mounting rails.**
7) **Secure the back of the slide using a #10-32 screw and lock washer. The slide mounting hole used in the back is centered on the slide and lies in the middle of a U-shaped slot. The position of the slide can be adjusted to get access to the mounting hole.**
8) **Secure the front of the shelf slide to the mounting rail using a #10-32 screw and lock washer. The slide mounting hole used in the front is slotted. The position of the slide can be adjusted to gain access to the mounting hole.**
9) **Repeat steps 6, 7 and 8 to install the other shelf slide.**
10) **Align the shelf on the shelf slides and push it into the enclosure. The shelf will snap into place. Ensure that the shelf is mounted upside down, so that the front and rear lip of each shelf points upward.**

K.7. Maintenance

The outdoor enclosure requires little maintenance. The only item that requires periodic attention is the air conditioner's condenser air inlet, which is located inside the top-right corner of the air-conditioner housing. Clean the air inlet filter by flushing it with warm water and allowing it to dry thoroughly. Recoat the filter with McLean Midwest RP Super Filter Coat adhesive (22-002678), or an equivalent adhesive. If the air-conditioner filter is damaged, you can purchase new filters (32-003022) from R&P.

Clean the screen on the back of the pump box periodically to keep it free of contamination.

Appendix L: TEOMCOMM Software

TEOMCOMM is a communications software package developed by R&P to provide interactive remote communication with the Series 1400a Monitor. The user can use this software application to download data stored in the instrument, and retrieve and set instrument operating parameters remotely.

TEOMCOMM has two communication modes — direct and modem. Direct communication is accomplished when the unit has a direct cable connection with a personal computer (PC). Modem communication is accomplished when the unit has a connection with a PC through the use of a modem and phone line (Appendix H). Before modem communication is attempted, direct communication must be successfully completed. This will ensure that the PC and unit have been set up properly for communications.

L.1. Installing TEOMCOMM onto a Personal Computer (PC)

Follow these steps to install TEOMCOMM onto a PC:

1) **Ensure that your PC is in MS-DOS mode.**
2) **When the MS-DOS prompt displays, enter the following command after the prompt:**

   MD C:\TEOMCOMM

3) **Press the <Enter> key on your PC's keyboard.**
4) **Insert the TEOMCOMM 3 1/2" floppy disk into a 3 1/2" disk drive in the computer.**
5) **Enter the following command after the MS-DOS prompt:**

   COPY X:TEOMCOMM.* C:\TEOMCOMM

   NOTE: The "X" represents the letter of your PC's 3 1/2" disk drive.

6) **Press the <Enter> key on your PC's keyboard. The PC will now copy the files named "TEOMCOMM.EXE" and "TEOMCOMM.CFG" onto its hard drive.**

L.2. TEOMCOMM SETUP

Before you connect your monitor to your personal computer (PC), you must start the TEOMCOMM software program (Section L.2.1) and set TEOMCOMM's communication parameters (Section L.2.2).

L.2.1. STARTING TEOMCOMM

Follow these steps to begin running the TEOMCOMM software program:

1) **Ensure that your PC is in MS-DOS mode.**
2) **When the MS-DOS prompt displays, press the <Enter> key on your PC's keyboard.**
3) **When the MS-DOS prompt displays again, enter the following command after the prompt:**

   CD \TEOMCOMM
4) **Press the <Enter> key on your PC's keyboard.**
5) **If you want to run TEOMCOMM with a monochrome monitor, go to step 6. If you want to allow a time delay while running TEOMCOMM, go to step 8. If you want to create a "SESSION.LOG" file for debugging purposes, go to step 10. If you simply want to begin running the TEOMCOMM software program, go to step 12.**
6) **When the MS-DOS prompt displays, enter the following command after the prompt:**

   TEOMCOMM /M
7) **Press the <Enter> key on your PC's keyboard.**
8) **When the MS-DOS prompt displays, enter the following command after the prompt:**

   TEOMCOMM /T #

   NOTE: The "#" is the number of seconds that you want to allow for the time delay. The default setting for the monitor is 0.5 seconds.
9) **Press the <Enter> key on your PC's keyboard.**
10) **When the MS-DOS prompt displays, enter the following command after the prompt:**

    TEOMCOMM /D

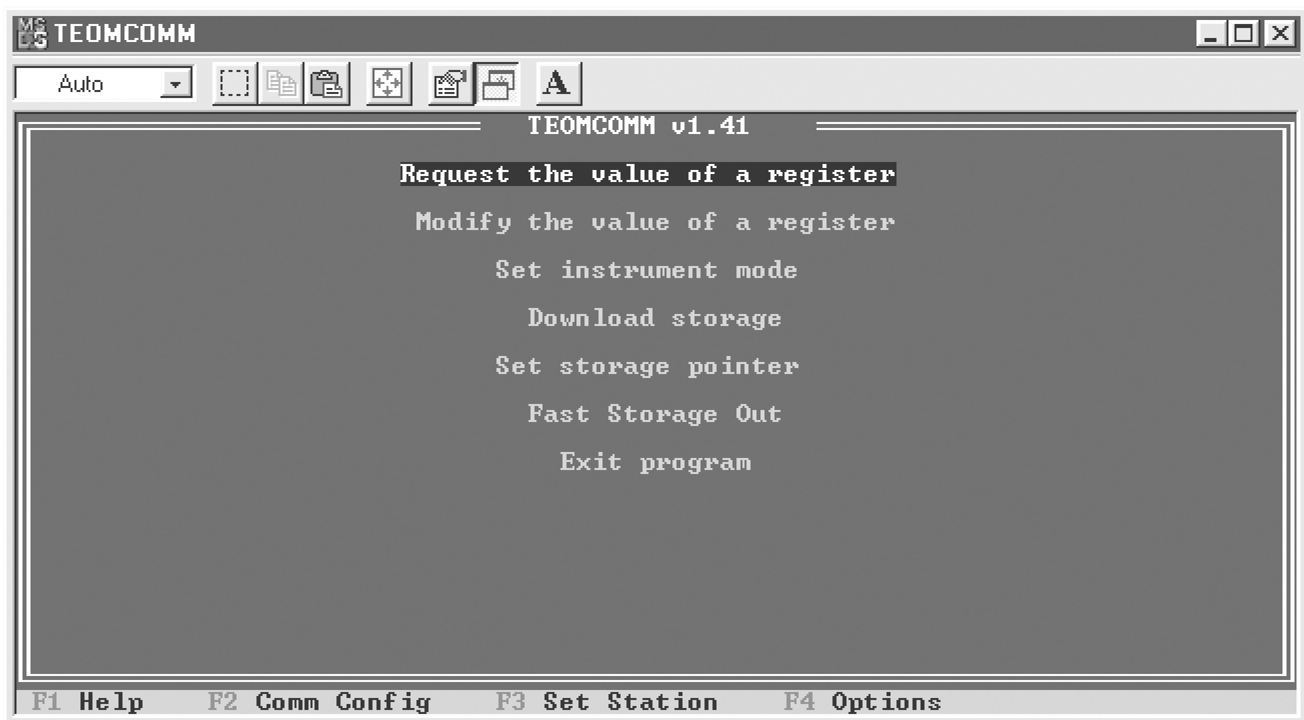
11) Press the <Enter> key on your PC's keyboard.

12) When the MS-DOS prompt displays, enter the following command after the prompt:

TEOMCOMM

13) Press the <Enter> key on your PC's keyboard. The TEOMCOMM Main screen (Figure L-1) (Section L.3) will now display.

Figure L-1. TEOMCOMM Main screen.

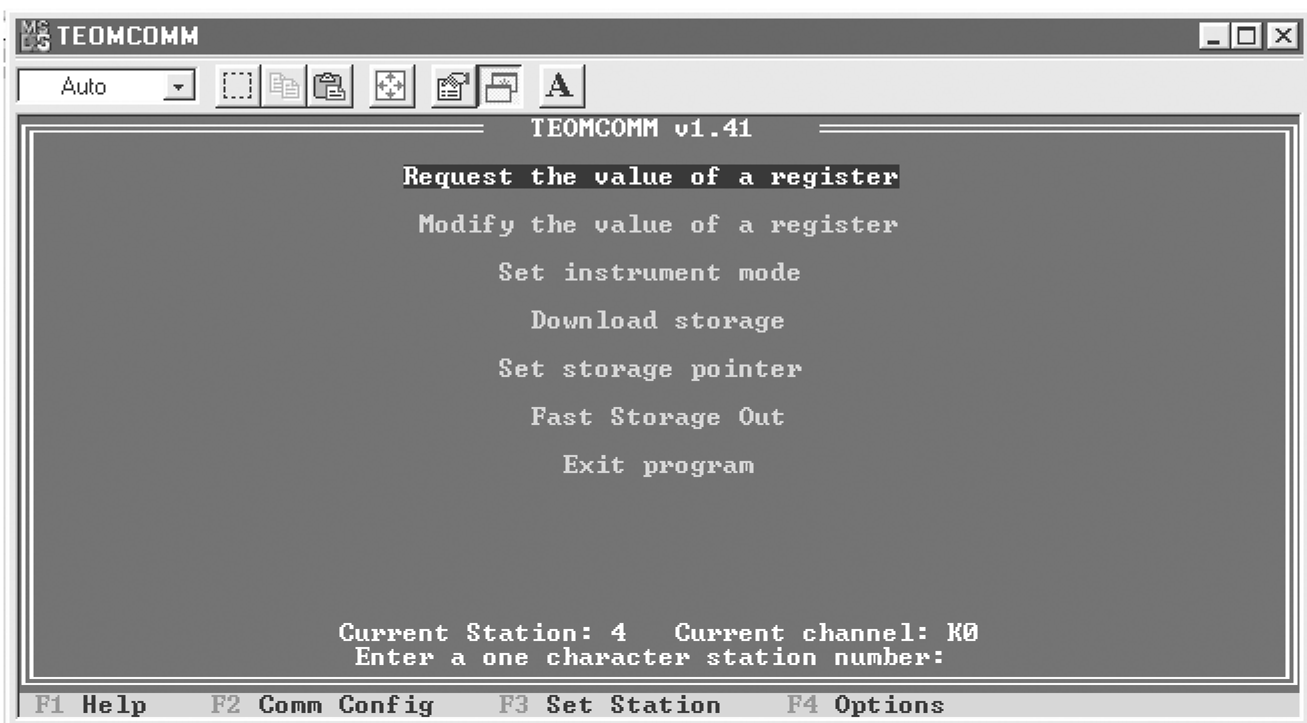


L.2.2. Setting the Communication Parameters

Follow these steps to set TEOMCOMM's communication parameters:

1) **Ensure that your personal computer (PC) is in MS-DOS mode.**
2) **Begin running the TEOMCOMM software program (Section L.2.1).**
3) **When in the TEOMCOMM Main screen (Figure L-1), press the <F3> key on the PC's keyboard to view the "Set Station" parameters currently stored in the program. The PC will display the alphanumeric settings for the station number (RS-Para 1) and channel number (RS-Para 2) (Figure L-2).**

Figure L-2. TEOMCOMM Main screen with Set Station parameters displayed.



4) The TEOMCOMM program will prompt the user to enter a new station number and channel number. Enter “4” for the station number and “K0” for the channel number.

NOTE: All alphabetic letters must be capitalized. Ensure that the letter “K” is followed by a zero (“0”), not the letter “O”.

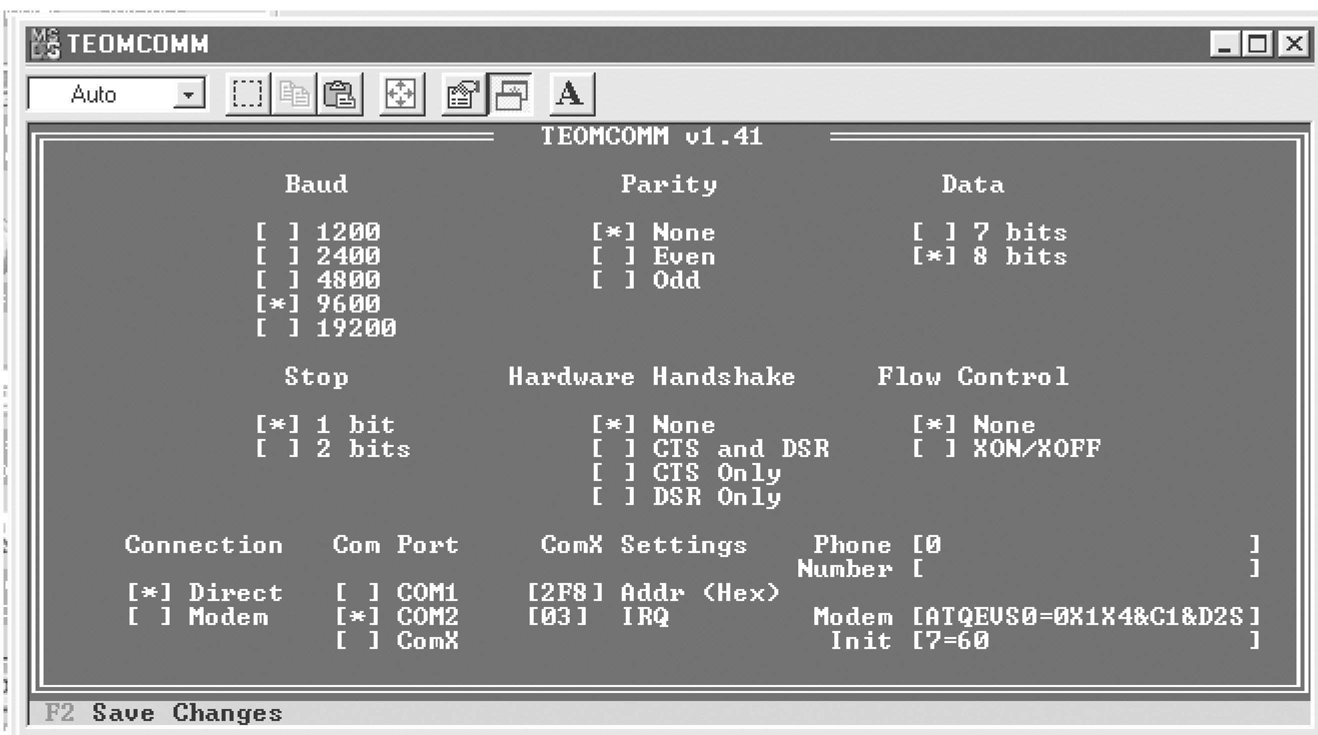
5) Press the <Enter> key on your PC’s keyboard.

6) Press the <F2> key on the PC’s keyboard to display the TEOMCOMM Communications Setup screen (Figure L-3).

✔ The communication parameters of the Series 1400a monitor and the TEOMCOMM software must match in order for the computer to communicate properly with the monitor.

NOTE: The original configuration of the TEOMCOMM software should match the default settings of the monitor. If you want to connect the monitor to a PC through a modem, you may need to change the settings of the “Baud,” “Connection,” “Com Port,” and “Phone” fields.

Figure L-3. TEOMCOMM Communications Setup screen.



7) Ensure that the communication parameters are set properly for direct or modem communications (Section L.4) depending on your setup. If you want to change the communication parameters, go to step 8. If you do not want to change the communication parameters, go to step 11.

8) Press the right (<→>) and left (<←>) arrow keys on the PC's keyboard to move the cursor to the desired parameter field.

9) Press the up (<↑>) and down (<↓>) arrow keys on the PC's keyboard to select the appropriate communication parameter.

10) Press the spacebar on the PC's keyboard to select the new value for the communication parameter. An asterisk "*" will appear next to the newly selected communication parameter.

11) Press the <F2> key on the PC's keyboard. The TEOMCOMM Main screen (Figure L-1) will now display.

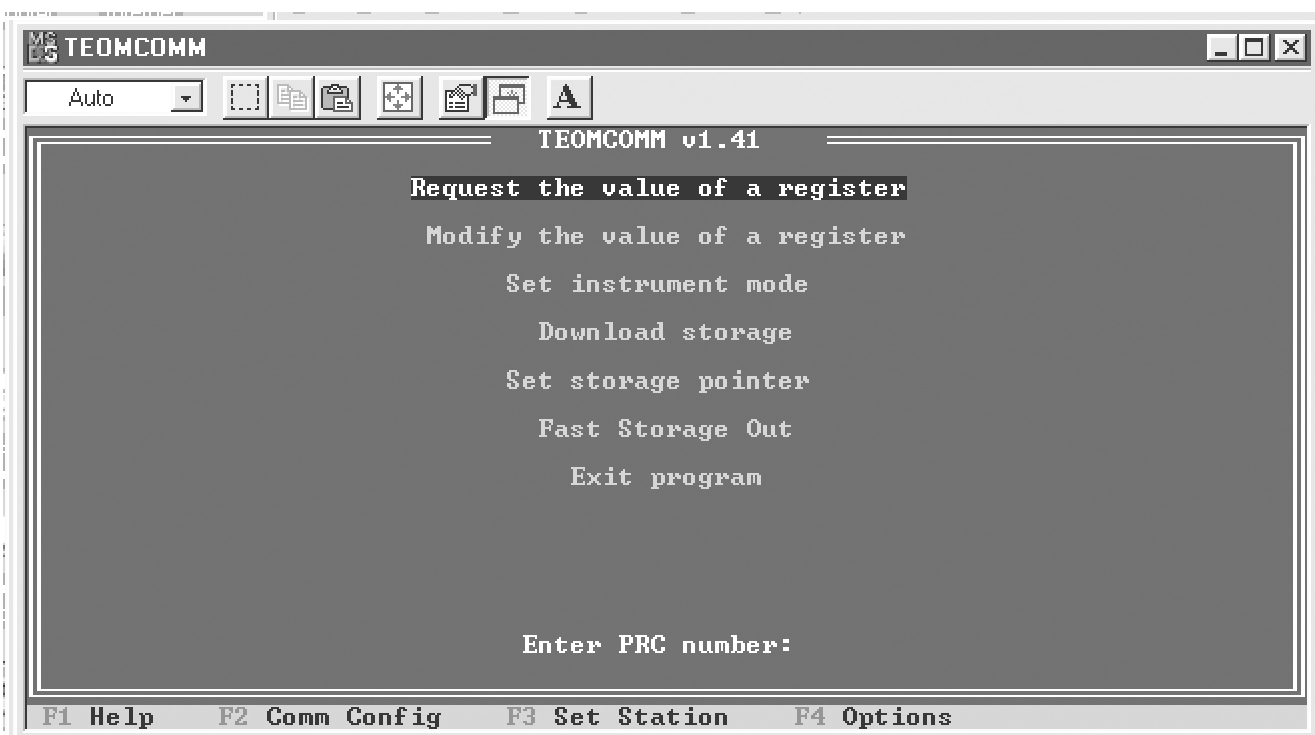
L.3. TEOMCOMM Main Screen

The TEOMCOMM Main screen (Figure L-1) contains a list of commands that are available in the TEOMCOMM software. Press the up (<↑>) and down (<↓>) arrow keys on your personal computer's (PC's) keyboard to select the appropriate command, and then press the <Enter> key. After you press the <Enter> key, the computer will prompt you for any additional information that may be required for the selected command.

L.3.1. Request the Value of a Register

This command returns the value of a requested system variable. When the user selects this command, the computer will request the variable's program register code (PRC) (Appendix B) (Figure L-4). After the user enters the appropriate PRC, the personal computer (PC) will display the current value of the variable.

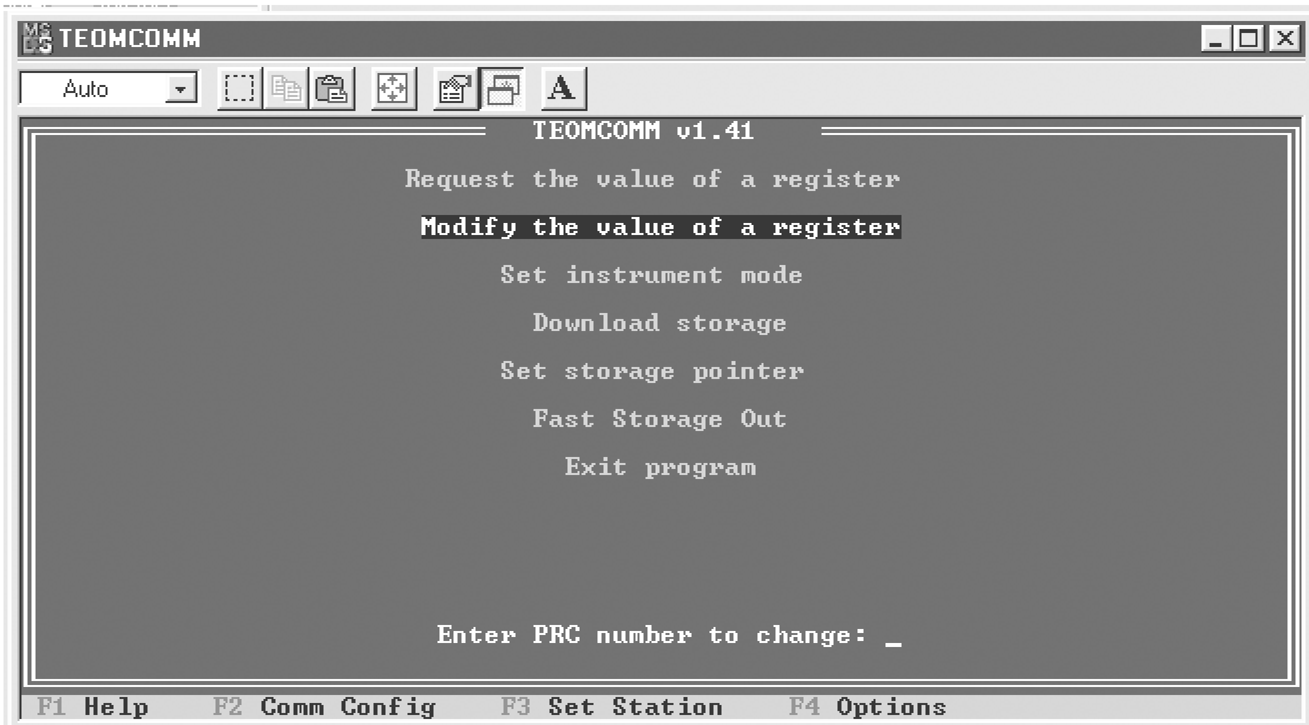
Figure L-4. TEOMCOMM Main screen with request for PRC number displayed.



L.3.2. Modify the Value of a Register

This command modifies the value of a system variable. When the user selects this command, the computer will request the program register code (PRC) (Appendix B) of the variable to be changed (Figure L-5).

Figure L-5. TEOMCOMM Main screen with request for PRC number displayed.



After the user enters the appropriate PRC, the computer will request the new value (Figure L-6). After the user enters the new value, the personal computer (PC) will display a confirmation message showing the PRC and the new value that will be stored in the monitor. Some parameters can be changed only when the monitor is in Setup Mode (Section L.3.3).

Figure L-6. TEOMCOMM Main screen with request for value of PRC number displayed.

L.3.3. SET INSTRUMENT MODE

This command allows the user to change the Operating Mode of the monitor. When the user selects this command, the personal computer (PC) will request the new Operating Mode (Figure L-7).

Figure L-7. TEOMCOMM Main screen with request for new operating mode displayed.

After the user enters the appropriate value for the new Operating Mode, the PC will display a confirmation message that states that the instrument's Operating Mode has been successfully changed.

The user may choose between the following Operating Modes:

Operating Mode 1	This selection puts the monitor into the Run Mode (Section 6)
Operating Mode 2	This selection puts the instrument into the Setup Mode (Section 6).
Operating Mode 3	This selection puts the instrument into the Stop Mode (Section 6).
Operating Mode 4	This selection toggles the Analog Output 1 field between its normal operating mode and its use as a Status Watch indicator (Section 4).
Operating Mode 5	This selection allows the user to exercise the SFxx command (Set Function xx) defined in the AK Protocol (Appendix C). For example, the user can set the monitor's time parameter by using command code "26" while in Operating Mode 5 (Appendix C).

L.3.4. DOWNLOAD STORAGE

This command allows the user to download data records that are stored in the monitor's internal data buffer. The data download will begin at the current location of the storage pointer and end at the most recently recorded data record. When the user selects this command, the personal computer (PC) will request the number of datarecords that they want to download (Figure L-8).

Figure L-8. TEOMCOMM Main screen with request for number of data records to be downloaded displayed.

If the user wants to download all available data records from the current position of the storage pointer to the end of the storage buffer, the user should enter an "A." If the user wants to download a specific number of records starting at the storage pointer, they should enter a specific number. If the number that the user enters is greater than the number of data records that are present between the current storage pointer location and the end of the data buffer, the PC will download all data records from the current position of the storage pointer to the end of the storage buffer.

✔ Set the storage pointer to the desired location before executing the Download Storage command.

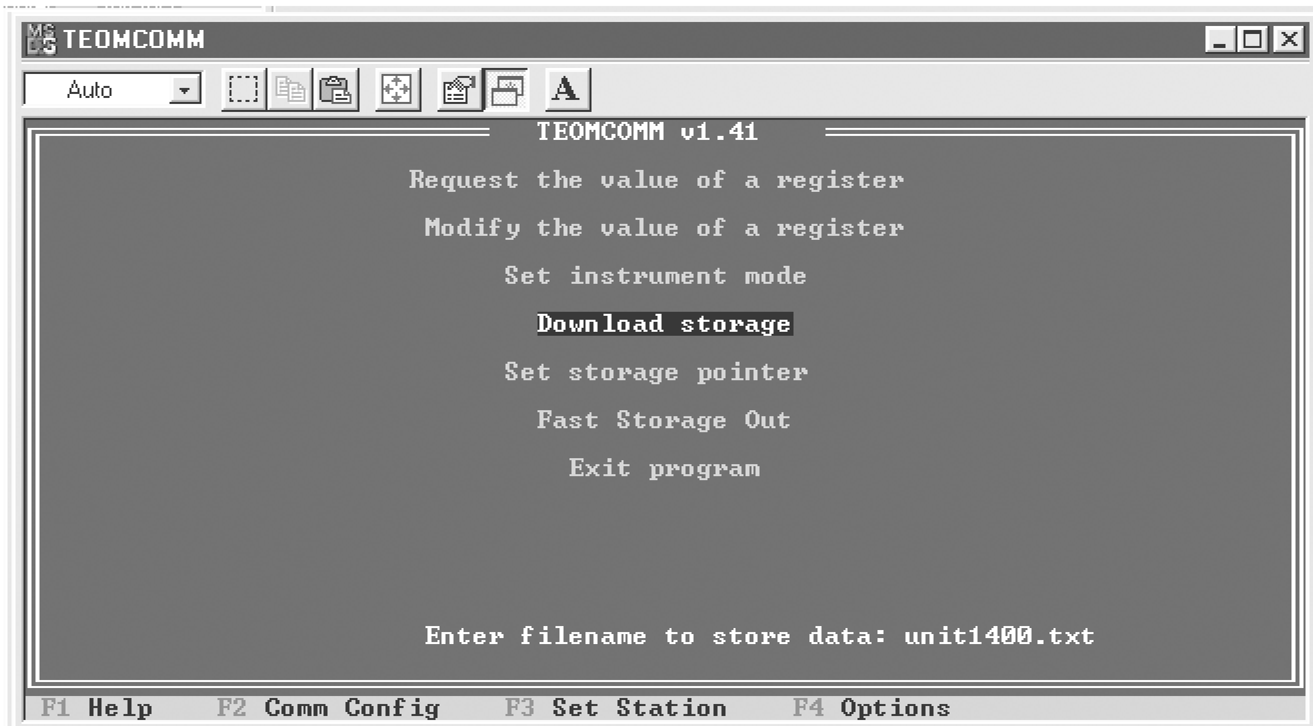
After the user enters an "A" or a specific number, the computer will request a filename which the TEOMCOMM software program will use to save the data (Figure L-9).

Figure L-9. TEOMCOMM Main screen with request for file name to store data displayed.

✔ The location of the storage pointer may be changed remotely.

The user must enter an MS-DOS compliant file name to save the data file name (Figure L-10). An MS-DOS compliant file name is an 8-character file name, a period or dot ("."), and then a 3-character file extension (such as, "txt"). For example, "site256.txt" would be an acceptable file name. When the user enters an MS-DOS compliant file name, the PC will download the appropriate number of records and save them on its hard drive. Also, the PC will display a confirmation message that will show the number of data records that were saved to the appropriate file name.

Figure L-10. TEOMCOMM Main screen with data file name entered.



NOTE: After TEOMCOMM downloads the data records, it will position the storage pointer after the last data record that was transmitted. This will ensure that the previously transmitted data records will not be transmitted again at the next data download. If the user wishes to transmit the data records a second time, they must change the position of the storage pointer by using the Set Storage Pointer command (Section L.3.5.).

L.3.5. Set Storage Pointer

This command allows the user to change the location of the storage pointer in the monitor's internal data storage buffer. When the user selects this command, the personal computer (PC) will display the current location of the storage pointer and request the new storage pointer position.

✔ Set the storage pointer to the desired location before executing the Download Storage command.

The user may enter the following values to move the storage pointer's position:

B	This value will move the storage pointer to the beginning of the data storage buffer. The beginning of the data storage buffer contains the oldest record in the buffer.
E	This value will move the storage pointer to the end of the data storage buffer. The end of the data storage buffer contains the most recent data record that was recorded.
Positive number	The entry of a positive number causes the storage pointer to move from its current position forward through the data records by the number entered. This command moves the storage pointer toward the end of the data storage buffer (i.e., toward the most data record that was recorded).
Negative number	The entry of a negative number causes the storage pointer to move from its current position backward through the data records by the number entered. This command moves the storage pointer toward the beginning of the data storage buffer (i.e., toward the oldest record in the buffer).

✔ The location of the storage pointer may be changed remotely.

After the user entered a value, the PC will display the contents of the data record at the new location of the storage pointer.

L.3.6. Fast Storage Out

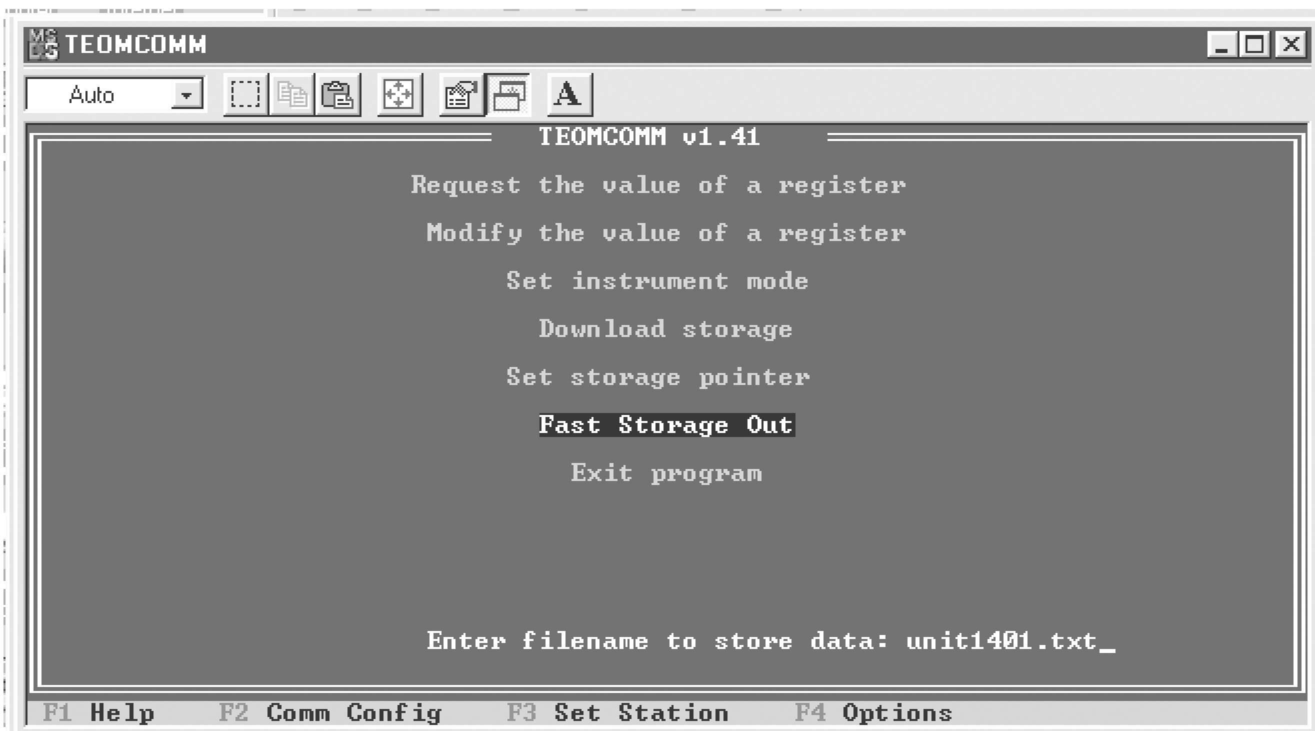
This command allows the user to download records stored in the data storage buffer using the “Fast Store Out” RS232 Mode (Section 9). This command can be used only when the personal computer (PC) is connected directly to the monitor. It can not be used when the PC is connected to a modem.

The Fast Storage Out command is similar to the Download Storage command. The Fast Storage Out command allows the user to download data records that are stored in the monitor’s internal data buffer. The data download will begin at the current location of the storage pointer and end at the most recently recorded data record. When the user selects this command, the computer will request a filename which the TEOMCOMM software program will use to save the data (Figure L-11).

Figure L-11. TEOMCOMM Main screen with request for file name to store data displayed.

The user must enter an MS-DOS compliant file name to save the data file name (Figure L-12).

Figure L-12. TEOMCOMM Main screen with data file name entered.



An MS-DOS compliant file name is an 8-character file name, a period or dot ("."), and then a 3-character file extension (such as, "txt"). For example, "site256.txt" would be an acceptable file name. When the user enters an MS-DOS compliant file name, the computer will request that the user change the monitor's RS232 Mode to "Fast Storage Out" (Figure L-13).

Figure L-13. TEOMCOMM Main screen with request to change monitor's RS232 mode to Fast Store Out displayed.

When the user changes the monitor's RS232 Mode to "Fast Storage Out," the PC will download the appropriate number of records and save them on its hard drive. Also, the PC will display a confirmation message that will show the number of data records that were saved to the appropriate file name.

NOTE: After TEOMCOMM downloads the data records, user should immediately change the monitor's RS232 Mode to "None" or "AK Protocol."

L.3.7. Exit Program

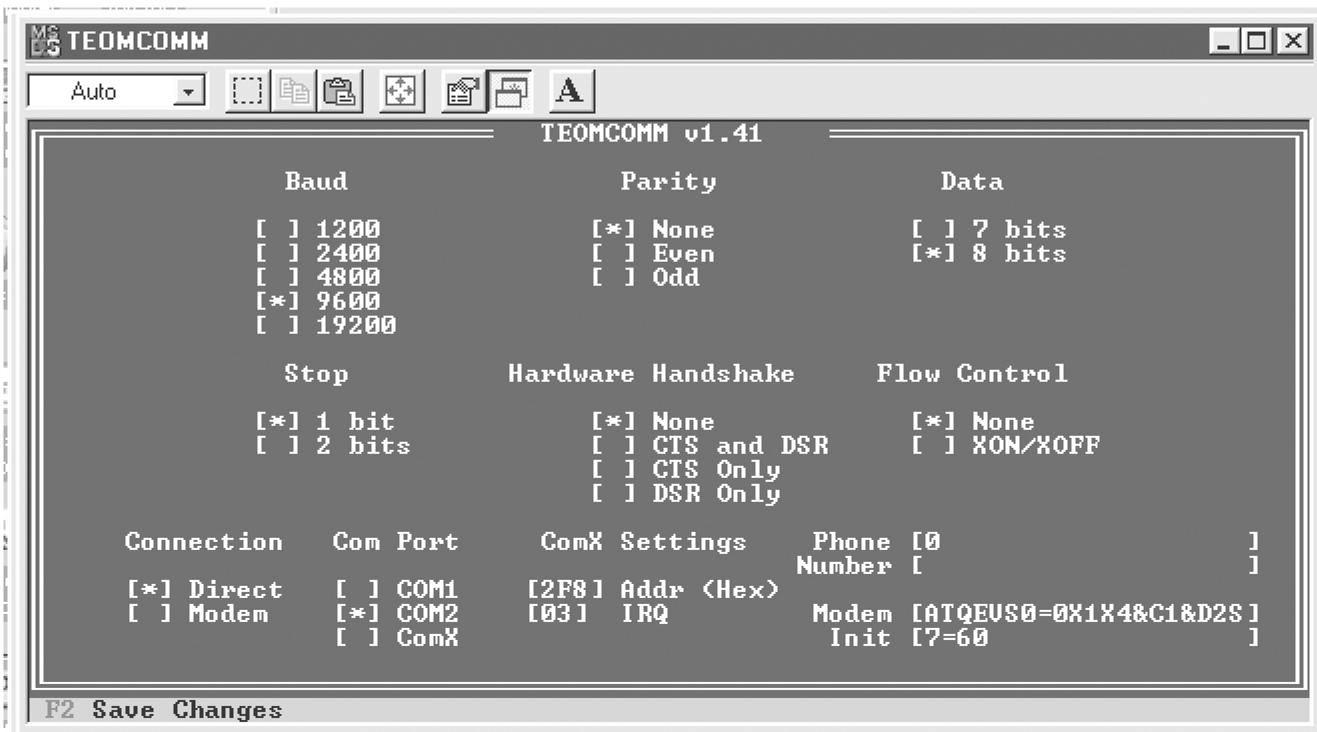
✔ The TEOMCOMM program disconnects any existing communication links when the user exits the program.

This command stops the TEOMCOMM software program from running and returns the personal computer (PC) to an MS-DOS prompt. If the user established modem communication when running TEOMCOMM, the modem connection will be automatically disconnected when the user selects the Exit Program command.

L.4. TEOMCOMM Communications Setup Screen

The user can change the communication parameters of the TEOMCOMM software program when in the TEOMCOMM Communications Setup screen (Figure L-14). When in the TEOMCOMM Main screen (Figure L-1), press the <F2> key on the personal computer's (PC's) keyboard to display the TEOMCOMM Communications Setup screen.

Figure L-14. TEOMCOMM Communications Setup screen.



The TEOMCOMM Communications Setup screen contains the following information:

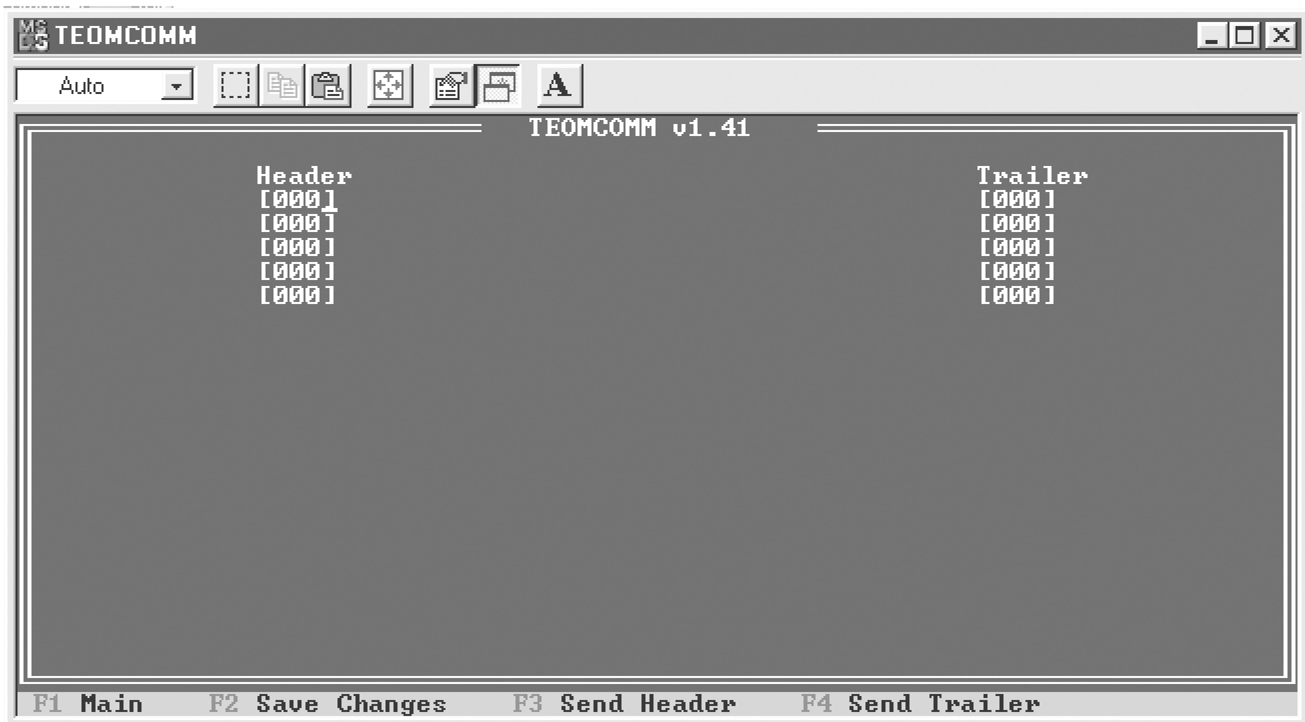
Baud Rate	This field contains the data transmission rate (baud), which may be set to 1200, 2400, 4800, 9600, or 19200 baud. The default setting for the monitor is "9600." Refer to the Service Manual if you suspect that the monitor's baud rate has been changed. If you want to connect the monitor to a PC through a modem, the Baud Rate value must be set to the lowest of the following three values: (1) the maximum baud rate of the modem used with the instrument, (2) the maximum baud rate of the modem used with the computer, or (3) the baud rate setting of the instrument (default = 9600). The maximum baud rate supported by the TEOMCOMM software is 19200.
Parity	This field contains the parity of data transmission, which can be defined to be either "None," "Even," or "Odd." The default setting for the monitor is "None." Refer to the Service Manual to change the monitor's parity setting.
Data	This field contains the word length (data bits), which may be either 7 or 8 bits. The default setting for the monitor is "8." Refer to the Service Manual to change the monitor's data bits setting.
Stop	This field contains the number of stop bits for each character transmitted, which may be either 1 or 2. The default setting for the monitor is "1." Refer to the Service Manual to change the monitor's stop bits setting.
Hardware Handshake	This field contains the monitor's hardware handshaking, which manages the flow control of data at the hardware level. The default setting for the monitor is "None." Refer to the Service Manual to change the monitor's hardware handshake setting.
Flow Control	This field contains the type of communication flow control, which may be either "None" or "Xon/Xoff." The default setting for the monitor is "None." Refer to the Service Manual to change the monitor's flow control setting.

Connection	This field contains the monitor's communication mode: Direct or Modem). The Direct Mode is used to connect the instrument directly to an on-site computer. The Modem Mode is used to connect the instrument to a remote computer using a modem.
Communication Port	This field contains the PC's communication (COM) port that the control unit is connected to (Direct Mode), or that the modem is connected to (Modem Mode). The range for this paramater is 1, 2, 3, or 4.
ComX Settings	This field contains the settings for the PC's communication (COM) port that the control unit is connected to (Direct Mode), or that the modem is connected to (Modem Mode).
Phone Number	This field contains the phone number that the modem will dial to establish a connection with the off-site computer.
Modem Init	This field contains the modem's initialization settings.

L.5. Sending Header and Trailer Codes

The TEOMCOMM Send String screen (Figure L-15) allows the user to send a string of characters through the personal computer's (PC's) RS232 port. The user may define and send both a header and trailer string when in this screen. Press the <F4> key on the PC's keyboard to display the TEOMCOMM Send String screen.

Figure L-15. TEOMCOMM Send String screen.



L.6. Instrument Setup for Direct Communication

Your personal computer (PC) must be connected to the monitor's control unit.

Follow these steps to connect the PC to the monitor:

1) Connect one end of the 9-to-9 pin computer cable to one of the RS232 ports on the control unit.

2) Ensure that nothing is connected to the other RS232 port of the control unit.

3) If your PC is equipped with a 9-pin RS232 connector, go to step 4. If your personal computer is equipped with a 25-pin connector, go to step 5.

4) Plug the other end of the 9-to-9 pin computer cable into the 9-pin RS232 port of your PC. Go to step 8.

5) Locate the 9-to-25 pin computer cable adapter.

6) Plug the 9-to-25 pin computer cable adapter into the 25-pin port on your PC.

7) Plug the other end of the 9-to-9 pin computer cable into the 9-to-25 pin computer cable adapter. Go to step 8.

NOTE: Do not use the 9-to-25 pin modem cable to connect the control unit with the PC. The 9-to-25 pin modem cable is configured for use only with a modem.

✔ Set the instrument to the AK Protocol when operating the TEOMCOMM software.

8) Press the <RS232> key on the monitor's keypad to display the Set RS-232 Mode screen (Figure L-16).

Figure L-16. Set RS-232 Mode screen.

```
     SET RS-232 MODE
 Mode: AK Protocol
>AK Protocol
 German Prot
```

9) When in the Set RS-232 Mode screen, press the <EDIT> key.

10) Press the up (<↑>) and down (<↓>) arrow keys to select "AK Protocol," and then press the <ENTER> key.

NOTE: When using the TEOMCOMM software to operate the instrument, set the RS232 protocol to "AK Protocol" to perform all of the commands on the TEOMCOMM Main screen (Figure L-1). However, if you want to download data with TEOMCOMM using the "Fast Storage Out" RS232 Mode (Sections 9 and L.3.6), set the RS232 protocol to "Fast Store Out."

11) Press the <0> and <7> keys, and then press the <ENTER> key to display the Com 2-Way Settings screen (Figure L-17).

Figure L-17. Com 2-Way Settings screen.

```
    COM 2-WAY SETTINGS
RS-Para 1 >            52
RS-Para 2           75048
RS-Para 3           13010
```

12) When in the Com 2-Way Settings screen, enter the following parameters in these fields:

RS-Para 1	52
RS-Para 2	75048
RS-Para 3	13010
RS-Para 4	0

13) Press the <ENTER> key.

14) Press the <ESC> key to display the Series 1400a Main screen (Figure L-18).

Figure L-18. Series 1400a Main screen.

```
OK    4+  11%  NU    09:39
Mass Conc>            33.6
30-Min MC             26.8
01-Hr MC              12.5
```

15) Ensure that the PC is communicating with the monitor through TEOMCOMM by selecting one of the commands from the TEOMCOMM Main screen (Section L.3).

Appendix M: TEOMPLUS Software

The TEOMPLUS software supplied with the Series 1400a Monitor allows the user to view the operation of the instrument and change many instrument variables from a personal computer (PC). When running TEOMPLUS, the user can view a quick overview of all major settings of the monitor without having to use the four-line display on the instrument's front panel.

A PC is not required for the normal operation of the Series 1400a Monitor or to set any of the program variables. All functions performed from the PC also can be performed from the control unit's keypad, with the exception of loading new system software, which can only take place using a PC.

To use TEOMPLUS, you must load it onto a PC (Section M.1), connect the PC to the control unit (Section M.2), and then initiate the TEOMPLUS software program (Section M.3).

M.1. Loading TEOMPLUS Onto a Personal Computer (PC)

Follow these steps to load TEOMPLUS onto your PC:

1) **Create a folder named "TEOMPLUS" on your "C:\" drive.**
2) **Locate the 3 1/2-inch floppy software disc that has the following files:**

   Accu.bat

   Accu.cfv

   imgflag.set

   Inputs.bat

   Inputs.cfv

   Iomux.cf1

   Iomux_sp.cf1

   License.mxr

   Loadall.bat

   Loadmod.bat

   Main.mux

   Muxinitl.doc

   Muxinitl.exe

   Muxload.doc

   Muxload.exe

   Muxviewr.doc

   Muxviewr.exe

   Muxviewr.hlp

   Muxviews.hlp

   Screen.mux

   Teomcomm.cfg

   Teomcomm.exe

   View.bat

   View.cfv

   NOTE: You also can download these files from the R&P website (Appendix D).

3) Copy these files into the "TEOMPLUS" folder.

M.2. Connecting the Personal Computer (PC) to the Control Unit

The TEOMPLUS software supports the use of either COM 1 or COM 2 on the PC.

Follow these steps to connect the PC to the control unit:

1) **Connect one end of the 9-to-9 pin computer cable to one of the RS232 ports on the control unit.**
2) **Ensure that nothing is connected to the other RS232 port of the control unit.**
3) **If your personal computer (PC) is equipped with a 9-pin RS232 connector, go to step 4. If your personal computer is equipped with a 25-pin connector, go to step 5.**
4) **Plug the other end of the 9-to-9 pin computer cable into the 9-pin RS232 port of your PC. Go to step 8.**
5) **Locate the 9-to-25 pin computer cable adapter.**
6) **Plug the 9-to-25 pin computer cable adapter into the 25-pin port on your PC.**
7) **Plug the other end of the 9-to-9 pin computer cable into the 9-to-25 pin computer cable adapter. Go to step 8.**

   NOTE: Do not use the 9-to-25 pin modem cable to connect the control unit with the PC. The 9-to-25 pin modem cable is configured for use only with a modem.

8) **Ensure that the Main screen (Figure M-1) is displayed on the control unit's four-line display.**

Figure M-1. Main screen.

```
OK     4+  11%  NU     09:39
Mass Conc>              33.6
30-Min MC               26.8
01-Hr MC                12.5
```

9) Press the <F2> key on the control unit's keypad until an "N" (None Mode) displays in the RS232 Mode field of the Main screen's status line (Figure M-2). The instrument must remain in the None Mode while executing the computer routines described in this section.

Figure M-2. Main screen with the RS232 Mode field highlighted.

RS232 Mode field

```
OK     4+  11%  NU      09:39
Mass Conc>               33.6
30-Min MC                26.8
01-Hr MC                 12.5
```

M.3. Running the TEOMPLUS Software

Follow these steps to begin running, and stop running, the TEOMPLUS software program:

1) **Connect the personal computer (PC) to the control unit (Section M.2).**
2) **Press the <RS232> key on the monitor's keypad to display the Set RS232 Mode screen (Figure M-3).**

Figure M-3. Set RS-232 Mode screen.

```
     SET RS-232 MODE
 Mode: None
>None
 Print On Line
```

3) **When in the Set RS232 Mode screen, ensure that the RS232 protocol is set to "None" (Section 9).**
4) **Display the contents of the TEOMPLUS folder (that you created in Section M.1) on your PC's screen. If you want to display the monitor's current set points and values for all operation parameters, go to step 5. If you want to display the cumulative time and volume for each channel of the ACCU system, go to step 6. If you want to display an overview of the analog inputs received by the instrument, go to step 7.**

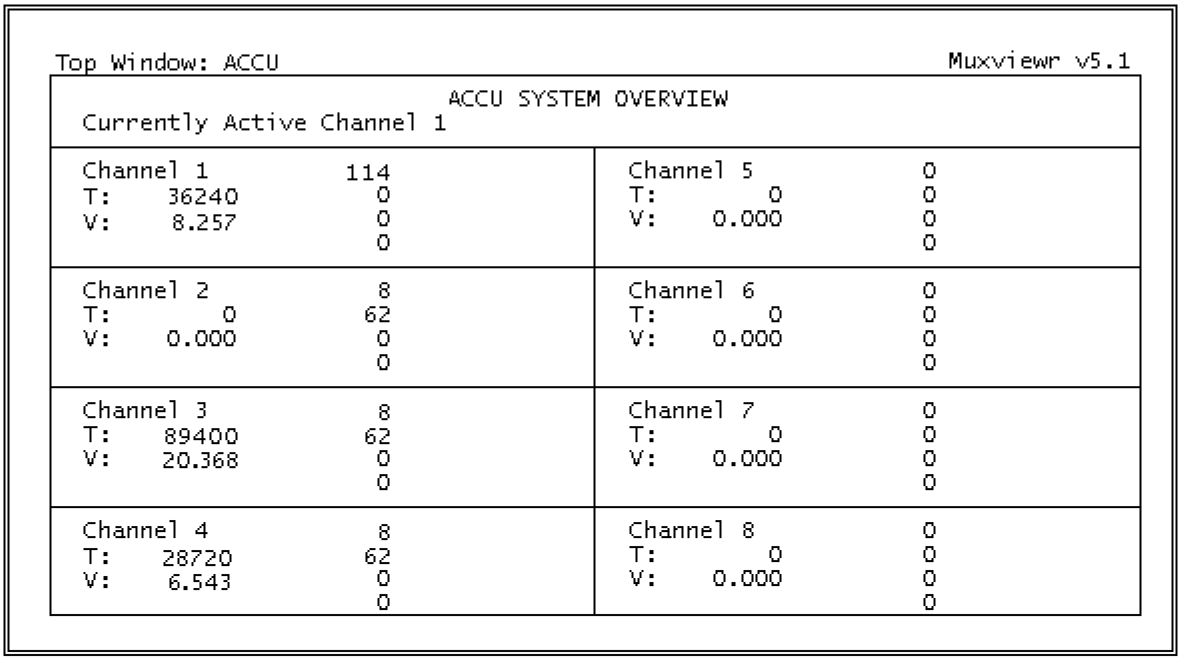
5) Place your cursor on the "View.bat" file and click twice with your mouse. The TEOMPLUS VIEW screen (Figure M-4) will display. Refer to Section M.4 for further information on the TEOMPLUS VIEW screen. Go to step 8.

Figure M-4. TEOMPLUS VIEW screen.

```
Top Window: VIEW                                                   Muxviewr v5.1
 TEOM* Series 1400a Monitor / Page 1                         12:41:16 27-Dec-99
                                         Ave Time
  Mass Rate            14.3  ug/h        300.0       Mode      1
  Mass Conc            79.4  ug/m^3                  Status    OK
  Total Mass         974.56  ug          300.0                 No Curr Conditions

  30-Min Mass Conc          72.3 ug/m^3
  01-Hr Mass Conc           78.4 ug/m^3
  08-Hr Mass Conc           85.8 ug/m^3              Noise          0.037
  24-Hr Mass Conc           69.3 ug/m^3              Freq       187.05684  hz

  Filt Load                  38%   Volts: 18.60        Wait Time        1800  sec
  Case Temp          50.00  50.00  °C      0.04        Ave Temp        25.00  °C
  Air Temp           50.00  49.99  °C      0.22        Std Temp        25.00  °C
  Cap Temp           50.00  50.00  °C      0.06        Ave Pres        1.000  atm
  Enclosure Temp     40.00  40.02  °C      0.14        Std Pres        1.000  atm
  Main Flow           3.00   3.00  l/min   9005        Adj Main Flow   1.000
  Auxiliary Flow     13.67  13.67  l/min  10259        Adj Aux Flow    1.000

  Serial Number       2374  Amb Temp:   49.00            OK  4 38%   NU 12:41
  Cal Constant    9605.000  Amb Pres:    1.005           Mass Conc>     79.4
                                                         30-Min MC      72.3
  Press <F2> to toggle command mode.                     01-Hr MC       78.4
                                                                    v. 3.013
```

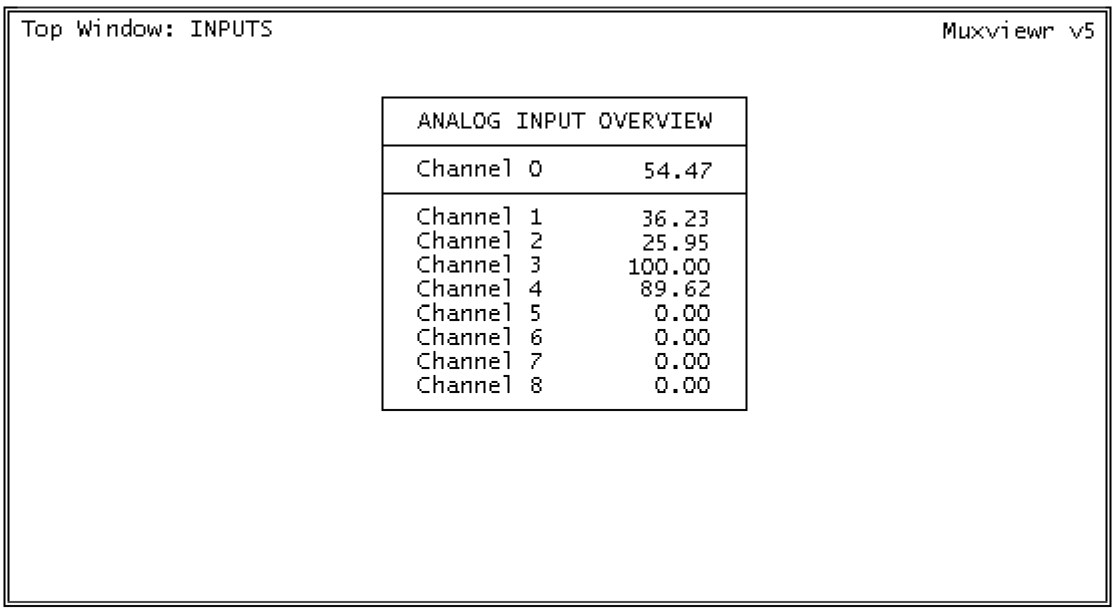
6) Place your cursor on the “Accu.bat” file and click twice with your mouse. The TEOMPLUS ACCU screen (Figure M-5) will display. Refer to Section M.5 for further information on the TEOMPLUS ACCU screen. Go to step 8.

Figure M-5. TEOMPLUS ACCU screen.



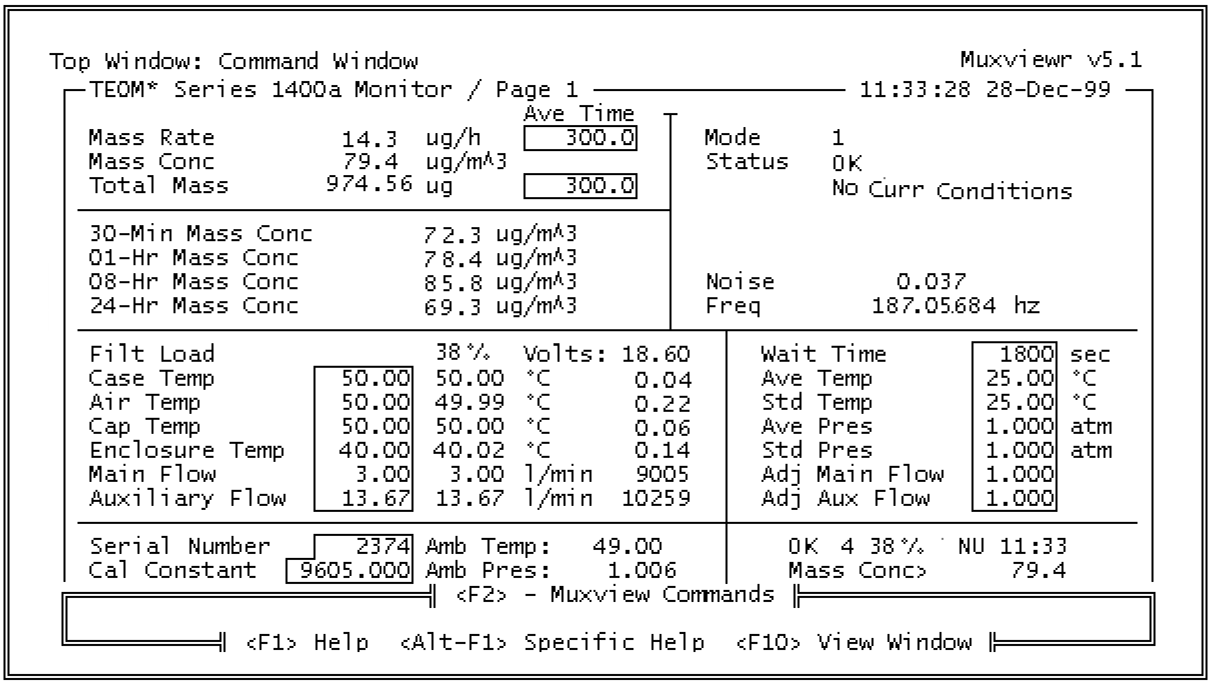
7) Place your cursor on the “Inputs.bat” file and click twice with your mouse. The TEOMPLUS INPUTS screen (Figure M-6) will display. Refer to Section M.6 for further information on the TEOMPLUS INPUTS screen. Go to step 8.

Figure M-6. TEOMPLUS INPUTS screen.



8) When in the TEOMPLUS VIEW screen, TEOMPLUS ACCU screen, or the TEOMPLUS INPUTS screen, press the <F2> key on your PC's keyboard. This will display the "Muxview Commands" dialog box on the bottom of the screen (Figure M-7).

Figure M-7. TEOMPLUS VIEW screen with Muxview Commands dialog box.



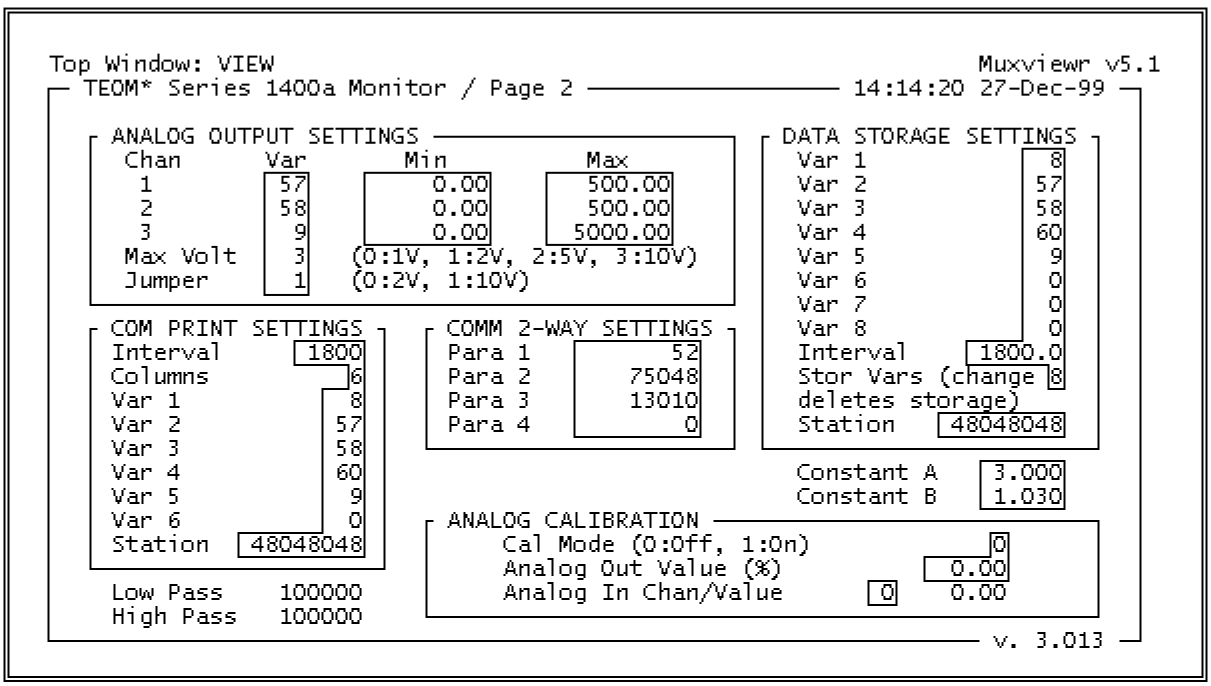
9) Press the <Q>, <U>, <I> and <T> keys ("QUIT"), and then press the <Enter> key on your PC's keyboard. The TEOMPLUS software program will now stop running.

M.4. TEOMPLUS VIEW SCREEN

The TEOMPLUS VIEW screen (Figure M-4) displays the current set points and values for many operational parameters, including mass concentration averages, temperatures, and flow rates.

The TEOMPLUS VIEW screen contains additional lines that cannot be seen when the screen first displays on the personal computer's (PC's) display (Figure M-8). Press the <PgDn> and <PgUp> keys on your PC's keyboard to view the additional lines of the TEOMPLUS VIEW screen.

Figure M-8. TEOMPLUS VIEW screen with additional lines displayed.



The user can enter new values for selected system variables in the highlighted fields of these screens. Press the up (<↑>), down (<↓>), left (<←>) and right (<→>) arrow keys to select a highlighted field. Enter a new value in the highlighted field, and then press the <Enter> key on your PC's keyboard.

M.5. TEOMPLUS ACCU Screen

The TEOMPLUS ACCU screen (Figure M-5) displays the cumulative time and volume for each channel of the ACCU system. Also, this screen displays the program register codes (PRCs) (Appendix B) of the four conditional variables selected for each ACCU channel. You can not change or edit any values on this screen. Refer to Section 14 for further information about the ACCU system.

M.6. TEOMPLUS INPUTS Screen

The TEOMPLUS INPUTS screen (Figure M-6) displays an overview of the analog inputs 0 to 8 received by the instrument. The input values are displayed as a percentage of each analog input channel's full scale. You can not change or edit any values on this screen. Refer to Section 9 further information about the monitor's analog input capabilities.

M.7. Basic TEOMPLUS Commands

The TEOMPLUS software program has two basic operational modes: Edit Mode and Command Mode. The Edit Mode allows the user to change the values of any highlighted fields. Press the up (<↑>), down (<↓>), left (<←>) and right (<→>) arrow keys to select a highlighted field. Enter a new value in the highlighted field, and then press the <Enter> key on your PC's keyboard. The Command Mode allows the user to enter instructions that affect the operation of the TEOMPLUS program, such as exiting from the software, turning communication between the control unit and the computer on and off, and determining the parameters for storing data on the disk of the personal computer.

Press the <F2> key on your PC's keyboard to display the "Muxview Commands" dialog box on the bottom of the screen (Figure M-7). This also will switch the TEOMPLUS software program between the Command Mode and Edit Mode. Press the <End> key on your PC's keyboard to exit from any window.

When the TEOMPLUS program is in the Command Mode, the user can execute the following commands:

<F2> key	To switch the TEOMPLUS program to the Edit Mode, press the <F2> key on your PC's keyboard.
QUIT	To stop the TEOMPLUS program from running, enter "QUIT" after the cursor and then press the <Enter> key on your PC's keyboard.
LOAD	To load one of the other software routines (VIEW, ACCU or INPUTS), enter "LOAD" after the cursor and then press the <Enter> key on your PC's keyboard. The "Muxview Load Selection" dialog box (Figure M-9) will now display as the active screen. Select ".cfv Files" and press the <Enter> key. The "Load Configuration from File" dialog box (Figure M-10) will now display as the active screen. Select the appropriate software routine and press the <Enter> key. The "Muxview Load Program (.mux) File Window" dialog box (Figure M-11) will now display as the active screen. Select "Yes" and press the <Enter> key. The "Muxview Load Communications Window" dialog box (Figure M-12) will now display as the active screen. Select "Yes" and press the <Enter> key. Press the <End> key to exit from the LOAD command.

Figure M-9. TEOMPLUS VIEW screen with Muxview Load Selection dialog box displayed.

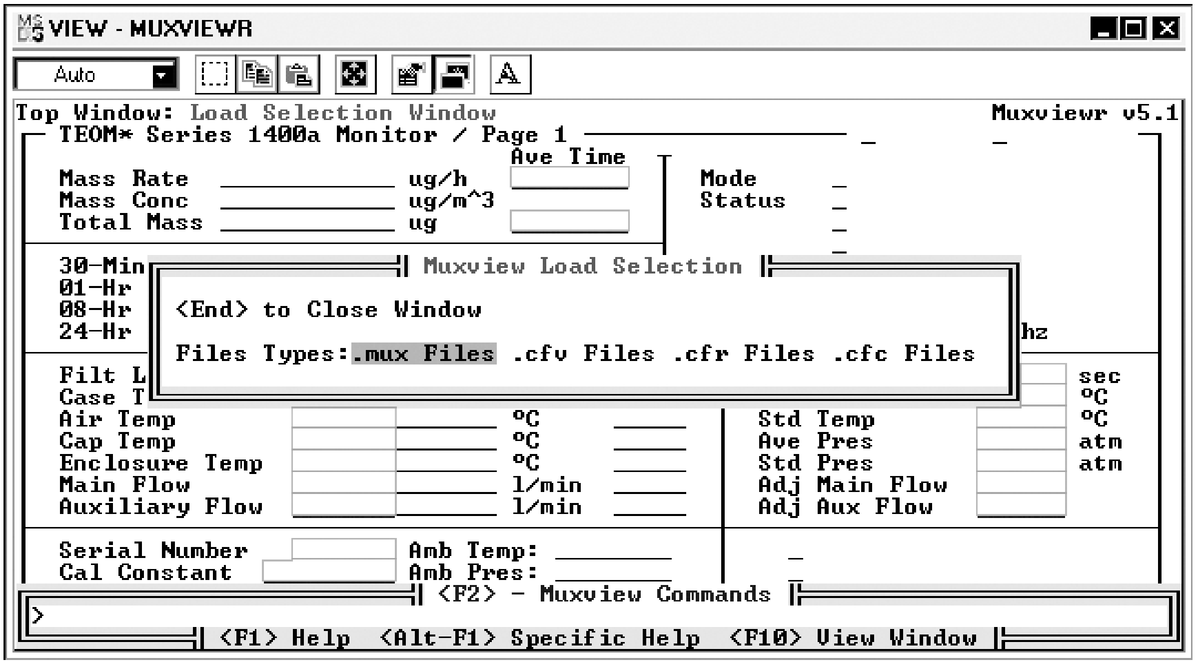


Figure M-10. TEOMPLUS VIEW screen with Load Configuration from File dialog box displayed.

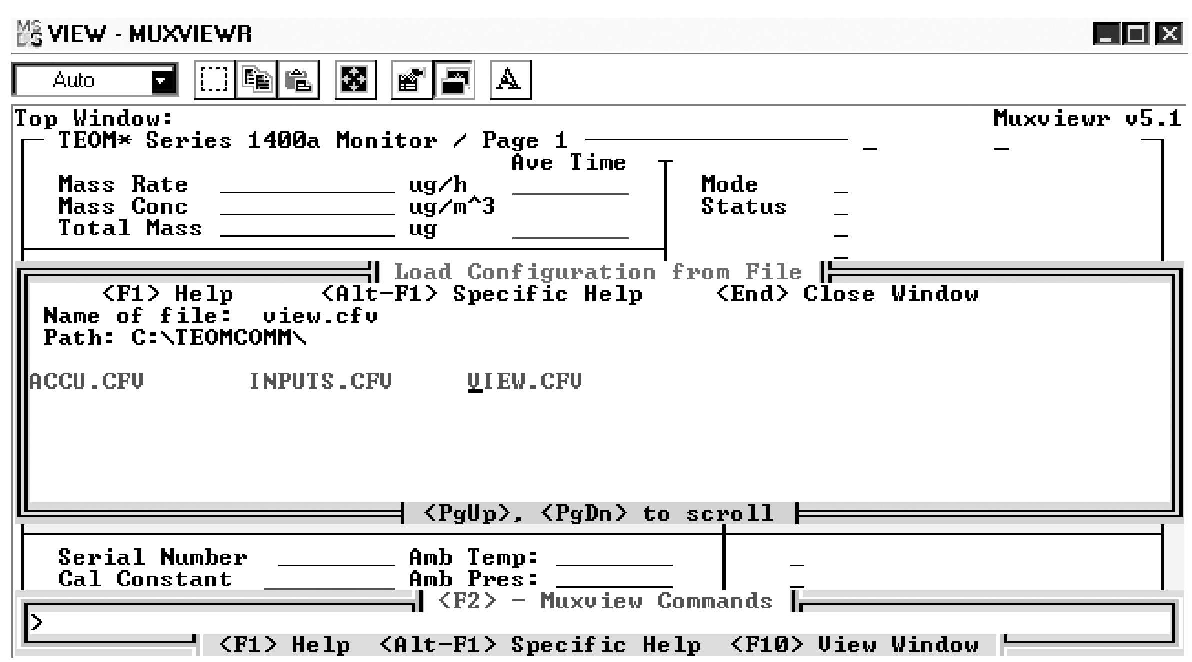


Figure M-11. TEOMPLUS VIEW screen with Muxview Load Program (.mux) File Window dialog box displayed.

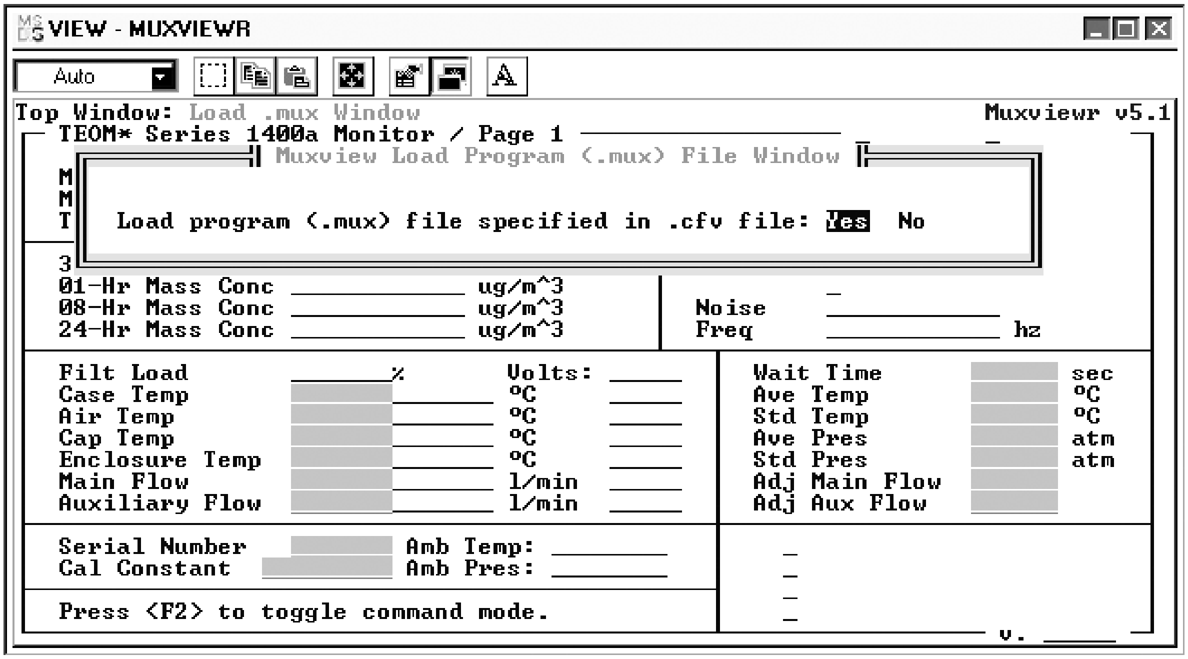
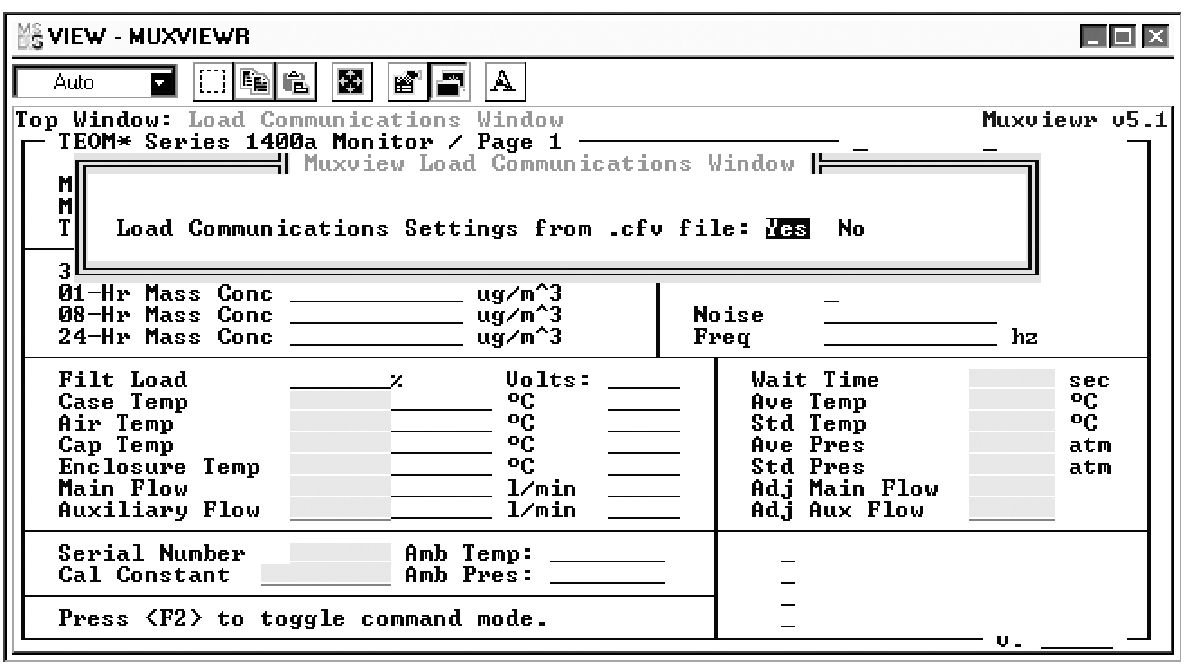


Figure M-12. TEOMPLUS VIEW screen with Muxview Load Communications Window dialog box displayed.

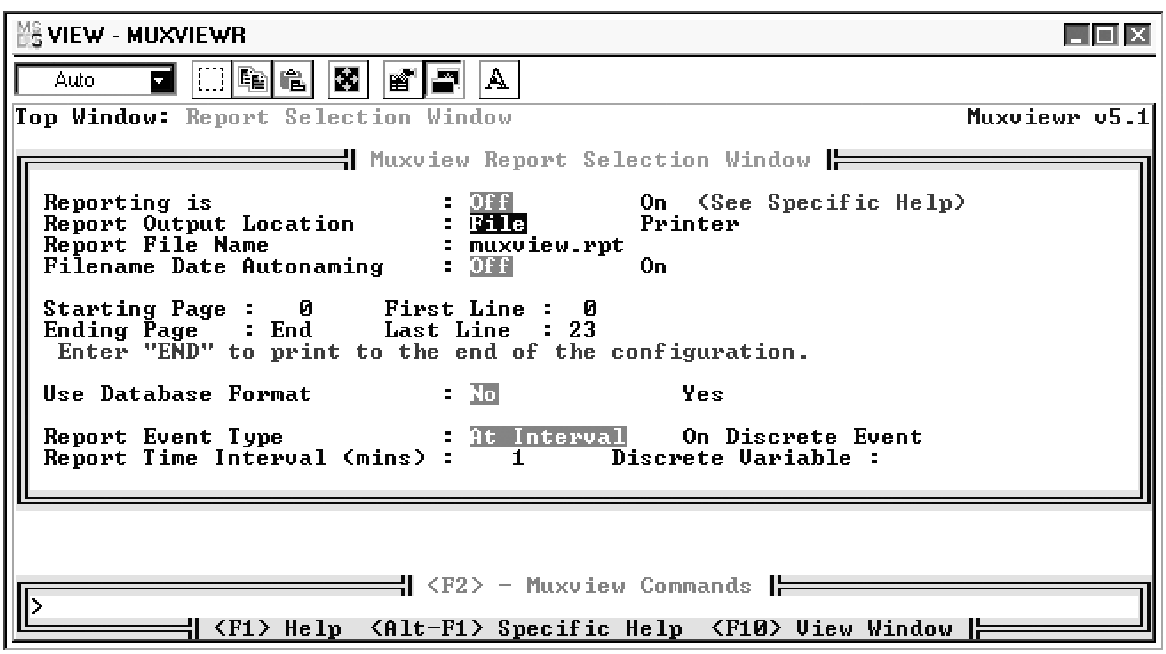


SCAN OFF — To stop the PC from automatically scanning instrument values, enter “SCAN OFF” after the cursor and then press the <Enter> key on your PC’s keyboard. You should always perform this command before disconnecting the cable connection between the PC and the control unit.

SCAN ON — To enable the PC to automatically scan instrument values, enter “SCAN ON” after the cursor and then press the <Enter> key on your PC’s keyboard. You should perform this command to allow the PC to resume its automatic scanning feature.

REPORT — To save selected variables to a file or to send these values to a serial printer to be printed, enter “REPORT” after the cursor and then press the <Enter> key on your PC’s keyboard. The “Muxview Report Selection Window” dialog box (Figure M-13) will now display as the active screen. Select the appropriate parameters and press the <Enter> key. Press the <End> key to exit from the REPORT command.

Figure M-13. TEOMPLUS VIEW screen with Muxview Report Selection Window dialog box displayed.



When the REPORT function is turned on, the PC saves the following columns of values to a file or sends the values to a serial printer to be printed:

Date	The date (dd-mmm-yy) is expressed in ASCII characters.
Time	The time (hh:mm:ss) is expressed in ASCII characters.
MC	Sliding 10-minute average mass concentration.
30-Min MC	30-minute average mass concentration.
01-Hr MC	1-hour average mass concentration.
08-Hr MC	8-hour average mass concentration, or other user-defined averaging time.
24-Hr MC	24-hour average mass concentration.
TM	Total mass accumulation on the TEOM filter since entering Operating Mode 2.
Status	The status is expressed as a summation of the currently active codes, where 0:no status conditions, 1:M, 2:T, 4:F, and 8:X.

REPORT ON

To turn the REPORT function on, enter “REPORT ON” after the cursor and then press the <Enter> key on your PC’s keyboard. If you turn on the REPORT function more than once per day, the latest data are appended to the end of the “TEOMmmdd.RPT” file.

REPORT OFF

To turn the REPORT function off, enter “REPORT OFF” after the cursor and then press the <Enter> key on your PC’s keyboard.

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