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FIGURES

1.0 Description

The model 4300 Flow Control Drawer is designed to operate in conjunction with Perma Pure's RATAmation® software to perform RATA (relative accuracy test audit), testing and data gathering for stack gases in order to meet government requirements for continuous emissions monitoring (CEM) of industrial and utility stack gases.

1.1 Features

Control of the flow drawer is via the user's computer running Perma Pure's RATAmation software.

- A stack gas sample can be routed to any of 6 analyzer channels.
- There are inlets for up to 14 calibration gases, which can be routed directly to the analyzers to check their calibrations.
- Calibration gas can be routed to the sampling probe for system calibration.
- Up to 12 channels of analog data can be read from the analyzers.
- An Ethernet connection is provided for interfacing with the computer running the RATAmation software.
- There are 8 front panel flow meters.
  Six meters measure and control the flow of gas to each analyzer.
  One meter measures and controls the flow of cal gas to the sampling probe for system calibration.
  One meter measures total gas flow to the analyzers.
- Front panel pressure gauges sample/cal gas pressure and pump vacuum.
- A Cal gas regulator controls the pressure of calibration gases.
- An operator interface screen displays basic information about the operational status of the system and allows selection of analog input type
- A built-in system controller executes commands and interfaces data with the user's computer.

Optional features

- An auxiliary analyzer panel can be used to connect 6 additional analyzers, raising the total to 12.

2.0 Installation

The model 4300 Flow Control Drawer comes in a standard enclosed 19″ rack-mountable cabinet. Mechanical and electrical connections are all made at the rear panel.

2.1 Dimensions

19″ W x 23″ D x 8 ¾″ H rack mount cabinet; drawer slides optional.

(a) Optional analyzer Expansion Panel:
19″ W x 4″ D x 5 ¼″ H rack mount

2.2 Electrical Connections

(a) Input power rating

90 – 264 VAC, single phase, 50/60 Hz, 300W

(b) Rear panel input power connection

Three-wire, grounded AC power receptacle with On/Off switch and fuseholder; included 3 wire, six-foot, plug-in power cord.
Fuse type and rating: 4 Amp 2AG, 5 x 20 mm, fast blow

<u>WARNING:</u> It is important for safety to connect the power cord to a properly grounded 3 terminal outlet.

(c) Analog Inputs

Three pluggable terminal boards are provided for analog input signals from the analyzers: Channels 1– 4; 5 – 8; 9 – 12.
Each channel has four terminals; + and − are for: 0 – 10V, 0 – 5V, and 0 – 1V;
Two more terminals are provided for installing jumpers for 4 – 20 mA signals.

<u>IMPORTANT:</u> The provided jumpers must be installed for an analog input of 4 – 20 mA.

(d) Digital Outputs

Four pairs of terminals are provided for connection to internal SPST-NO dry type relay contacts.
Contact rating: 5 amps @ 250 VAC
5 amps @ 24 VDC, resistive load

Channel 1: BB — activate probe blow-back solenoid;
Channel 2: R1 — user defined (See RATAmation software);
Channel 3: R2 — user defined (See RATAmation software);
Channel 4: R3 — user defined (See RATAmation software).

(e) Ethernet Connection

An RJ45 connector is provided for connecting a standard Ethernet Patch cable from the computer running the RATAmation software.

2.3 Mechanical Connections

(a) Calibration Gas Inlet Connections

Press-in type ¼″ tubing connectors — tubing ends must be cut square (non-metallic tubing only).

(b) Sample Gas Outputs to Analyzers

Channels 1 – 6: compression fittings for ¼″ hose to connect sample gas to analyzers.

> Tightening procedure: When tightening the compression nut, hold the bulkhead fitting with a 5/8″ wrench and tighten the nut with a 9/16″ wrench. Go 1 ¼ turns past finger tight.

(c) Vent Hose

Compression fitting for ¼″ hose:

> Tightening procedure: When tightening the compression nut, hold the bulkhead fitting with a 5/8″ wrench and tighten the nut with a 9/16″ wrench. Go 1 ¼ turns past finger tight.

(d) Calibration Gas Outlet to Probe — System Calibration

Compression fitting for ¼″ hose:

> Tightening procedure: When tightening the compression nut, hold the bulkhead fitting with a 5/8″ wrench and tighten the nut with a 9/16″ wrench. Go 1 ¼ turns past finger tight.

(e) Sample Pump Vacuum

The sample pump vacuum compression fitting for ¼″ hose allows the sample pump upstream vacuum pressure to be displayed on the front panel “Pump Vacuum” pressure gauge.

> Tightening procedure: When tightening the compression nut, hold the bulkhead fitting with a 5/8″ wrench and tighten the nut with a 9/16″ wrench. Go 1 ¼ turns past finger tight.

(f) Sample Gas Inlet

Compression fitting for ¼″ hose:

> Tightening procedure: When tightening the compression nut, hold the bulkhead fitting with a 5/8″ wrench and tighten the nut with a 9/16″ wrench. Go 1 ¼ turns past finger tight.

3.0 Operating Instructions

3.1 Install Connections.
Install all electrical and mechanical connections as described in Section 2.0.

3.2 Install RATAmation Software.
Install RATAmation software v.2.0 or above in the computer that will be used to run the tests.

3.3 Calibration and Test Sequence.
The calibration and test sequences are controlled through the RATAmation software — **Refer to the RATAmation v2.0 User Manual.**

(a) Typical Test Sequence

- Direct calibration of analyzer instruments.
- System calibration.
- Readings of sample gases.
- After a selected time interval, repeat sample gas readings.
- Repeat this cycle for the desired time, ending with direct calibration of the analyzers to be sure they have remained within the required accuracy limits.
- Print test report.

4.0 Detailed Description of System Operation

The use of the Model 4300 Flow Drawer can best be understood by referring to the system flow diagram (Figure 1), which shows how the control drawer interacts with the rest of the CEM or RATA system.

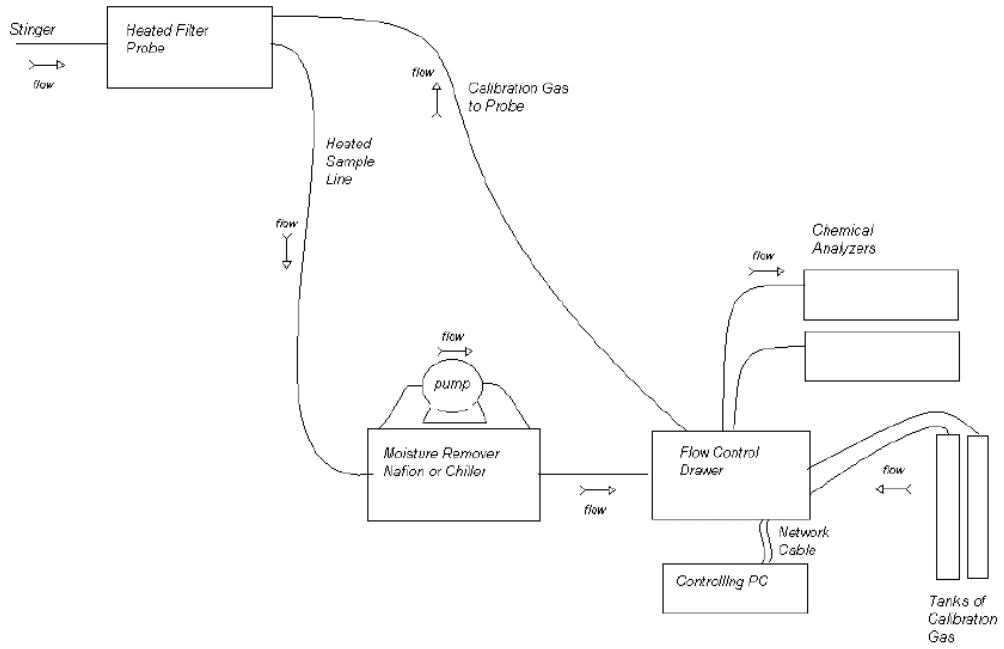


Figure 1. System Flow

The control drawer serves as the switching center for running the system.

4.1 System Functions:

(a) Continuous Measurement

Continuously measure and report the amounts of specified gases in the stack emissions to ensure that they do not exceed the government's mandated limits.

(b) Calibration

Direct calibration —
Certified calibration gas is directly routed to the analyzers to confirm that the analyzers are within their required limits of accuracy.

System calibration —
Certified calibration gas is pumped up to the sampling point in the stack and then drawn back through the sampling probe and sample conditioning system into the Flow Drawer, where it is routed to the analyzers. This confirms that the sampling system has not introduced an error into the measurement.

4.2 Control Drawer Functions

Reference to the System Flow diagram (Figure 1) and the Piping and Instrumentation diagram (Figure 2) illustrates how the control drawer functions are accomplished.

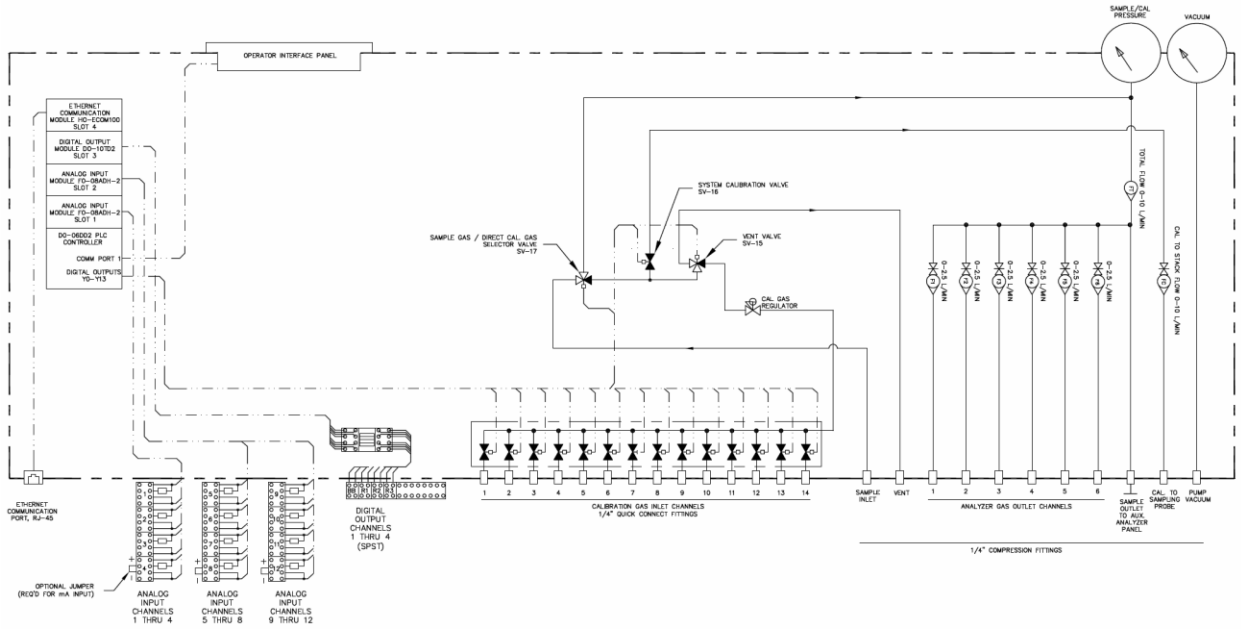


Figure 2. Piping and Instrumentation

All solenoid valves are energized/de-energized by the built-in system controller. The system controller executes the control functions called for by the user's computer via the Ethernet connection and sends data back to the computer in the same way.

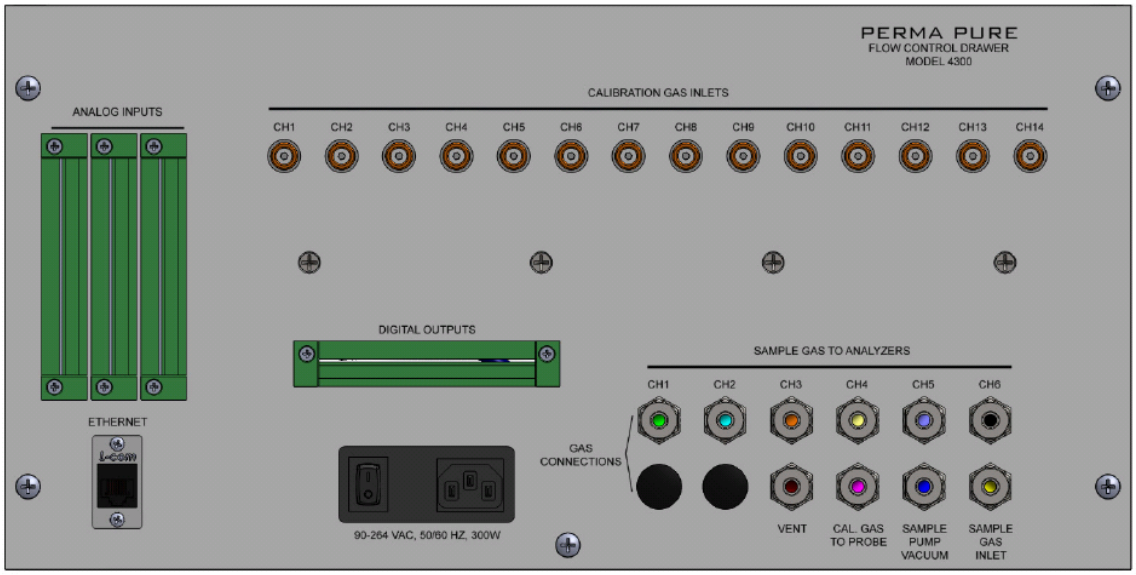


Figure 3. Rear Panel

4.3 Gas Sampling

Solenoid Valves

Cal Gas Inlet channels 1 – 14	Energize to select cal gas
Sample Gas/Cal Gas selector valve	De-energized
System Calibration valve	De-energized
Vent valve	Energized

Sample gas from the stack flows into the drawer by means of the “sample gas inlet” fitting on the back panel (Figure 3). Inside the drawer it connects to the three-way solenoid-controlled “sample gas/cal gas selector valve.” In sampling mode this valve is de-energized, so the sample gas is routed via the front panel flow meters to the six “sample gas to analyzers” fittings that are used to flow the gas to the analyzers (and to the optional auxiliary analyzer panel).

4.4 Calibration

(a) Direct Calibration

Solenoid Valves

Cal Gas Inlet channels 1 – 14	Energize to select cal gas
Sample Gas/Cal Gas selector valve	Energized
System Calibration valve	De-energized
Vent valve	Energized

Calibration gases are connected by ¼-inch tubing from the calibration gas cylinders to the 14 available "Calibration Gas Inlet" fittings on the rear panel of the drawer (Figure 3). There is a solenoid-controlled valve in each cal gas input line that blocks the flow until it is energized to allow the use of that particular cal gas. When a cal gas is selected in this way, the vent valve is also energized to block the escape of the cal gas. The gas flows through the front panel "cal gas regulator," past the blocked "system calibration valve" to the three-way "sample gas/cal gas selector valve." This valve is energized to permit flow of the cal gas to the analyzer ports and to block flow from the "sample inlet."

(b) System Calibration

Solenoid Valves

Cal Gas Inlet channels 1 – 14	Energize to select cal gas
Sample Gas/Cal Gas selector valve	De-energized
System Calibration valve	Energized
Vent valve	Energized

The selected calibration gas flows through the front panel "Cal Gas Regulator." The "sample gas/cal gas selector valve" remains de-energized: to block the cal gas from reaching the analyzer ports. The "system calibration valve" is energized, to direct the flow of cal gas to the "Cal Gas to Probe" ¼-inch compression type connector on the rear panel. The cal gas is carried by means of an umbilical tube up to the sampling probe. The flow rate should be set by means of the "Cal Gas to Probe" flow meter to roughly one and a half times the normal sample gas rate so it floods the sample gas out of the probe. The cal gas is then drawn back through the sampling line by the sampling pump, through the gas filtering and conditioning equipment and back to the "Sample Gas Inlet" connector. The cal gas is then routed to the analyzers, just as in continuous monitoring mode.

4.5 Vent

The vent line solenoid valve is normally de-energized (open): to allow any cal gases that might flow through a leaky input valve to vent to the atmosphere so as not to contaminate the sample.

The vent solenoid valve is energized whenever a cal gas solenoid valve is selected (energized) to prevent the cal gases from escaping.

4.6 Sample Pump Vacuum

The sample pump vacuum connector allows the sample pump upstream vacuum pressure to be displayed on the front panel ”Pump Vacuum” pressure gauge (Figure 4). The vacuum level can be used as an indication of the probe filter condition. By checking and recording the baseline vacuum reading when installing a new filter and comparing the current reading to the baseline reading, a dirty/clogged filter can be detected without physical inspection of the filter.

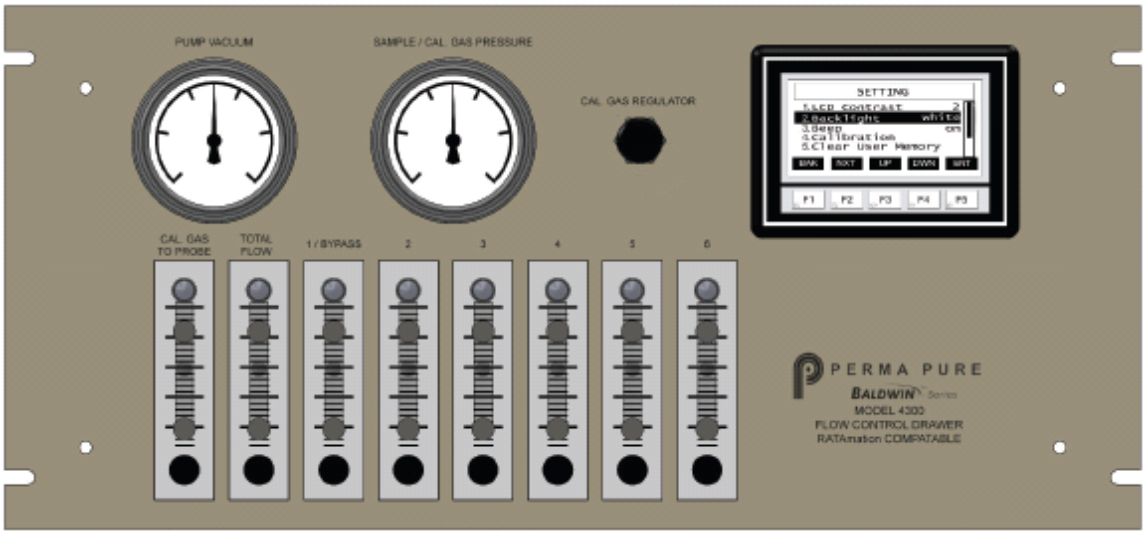


Figure 4. Front Panel

4.7 Sample/Cal Gas Pressure Gauge and Regulator

The front panel “Sample/Cal Gas Pressure” gauge displays the pressure in the line feeding the analyzers. Sample pressure is controlled externally. This is normally accomplished by a 10 psi check valve across the pump head (outlet to inlet). The check valve will crack open at 10 psi and bleed excess sample gas back to the pump inlet thereby limiting pump outlet pressure to 10 psi. Cal. gas pressure is controlled by the regulator on the front panel and should be adjusted to provide a pressure close to that of the sample gas.

4.8 Analog Inputs

There are three terminal strips for connecting up to 12 analog inputs from up to 8 analyzers: Channels 1 – 4, 5 – 8, and 9 – 12.

The analog signals are fed to the system controller, which communicates the information to the user’s computer by means of the Ethernet connection. The system controller processes these as 0 – 1, 0 – 5, and 0 – 10 volt signals. When the analyzer analog output signal is 4 – 20 mA, a jumper must be installed on that

terminal to connect the internal 250 ohm resistor that converts the signal to 1 – 5 volts.

4.9 Digital Outputs

There are four single pole single throw (SPST) normally open dry type relay contacts available at the “Digital Output” terminal strip. The Channel 1 Blow-Back relay activates the solenoid in the probe assembly that directs a stream of compressed air at the probe filter for 30 seconds.

The functions of the three other channels can be programmed using the RATAmation software. (See RATAmation v2.0 User Manual.)

4.10 Ethernet

The computer running the RATAmation software communicates with the drawer by means of an Ethernet patch cable through the RJ-45 connector on the rear panel.

4.11 Flow Meters

There is a flow meter with an adjustable needle valve in the gas lines feeding each of the six analyzers.

A flow meter without an adjustment indicates the total flow to all six analyzers.

A flow meter with a needle valve measures the “Cal Gas to Probe” during system calibration.

(a) Flow meter adjustments.

The Flow meters (except for the Total Flow meter) have needle valves to adjust the desired flow rate based on the requirements of the analyzer model.

Counterclockwise increases flow; clockwise decreases flow.

Cal Gas to Probe Valve —

For system calibration (see Paragraph 2.4(b)), set to approximately one and a half times the sample flow rate.

Bypass function of first flow meter —

If the user connects a backpressure regulator to the channel 1 analyzer gas outlet, it would exhaust excess sample gas in order to control the pressure in the manifold that feeds the analyzers. In “Bypass” mode, that meter indicates the flow rate of the sample gas being exhausted. The needle valve should be left fully open when using bypass mode.

4.12 System Status Display

The touch screen on the front panel provides a local display of the system status.

a) Main status screen

When the control drawer is initially energized, the default display on the touch screen is the system operating mode. (Figures 5 – 7)

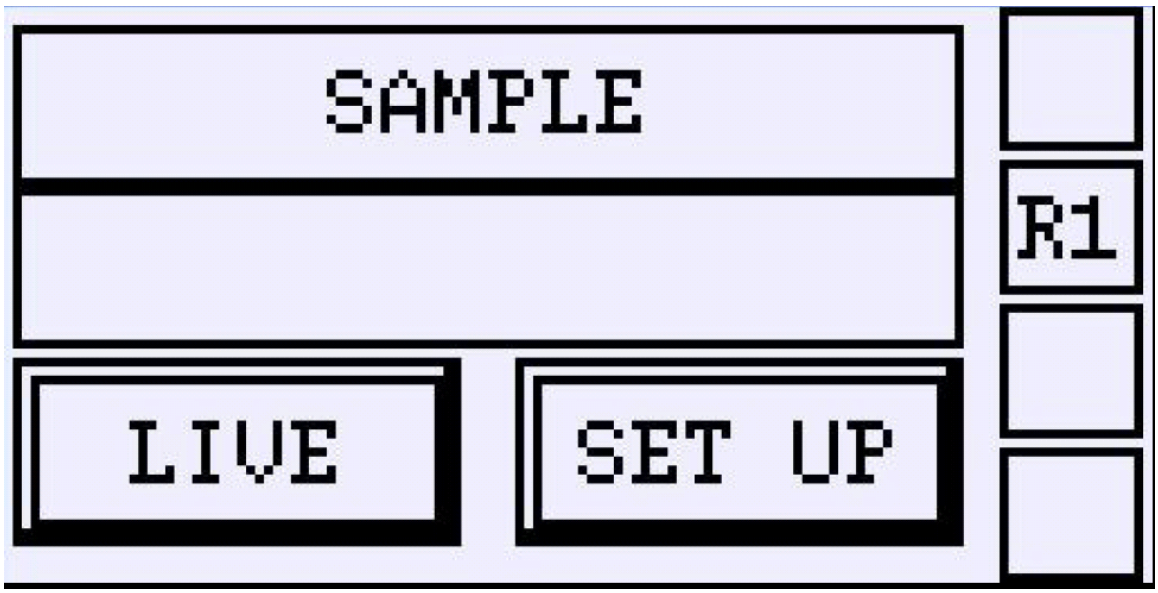


Figure 5. Main Screen — Sampling Mode

Figure 5 illustrates the display as it appears when the system is set for sampling the stack gas. “Sample” is displayed.

In this example, “R1” is indicated on the right-hand side of the screen. This means that user-defined relay R1 is energized. There is one box to indicate each of the four relays: Blow Back (BB) and R1– R3.

The two rectangles at the bottom of the screen, “Live” and “Set Up,” are pushbuttons for changing the screen that is displayed.

- Pressing “Live” will display the analog input readings for each channel. (Figure 8)
- Pressing “Set Up” will display and allow one of the four standard analog input signal types to be selected for each channel. (Figure 9).

Figure 6. Main Screen — Direct Calibration Mode

Figure 6 illustrates the main status display as it appears when the system is set for direct calibration mode. “Direct” and the cal gas being used in this example, “cal gas 9,” are displayed. All of the boxes on the right are empty, which means that none of the four relays are energized.

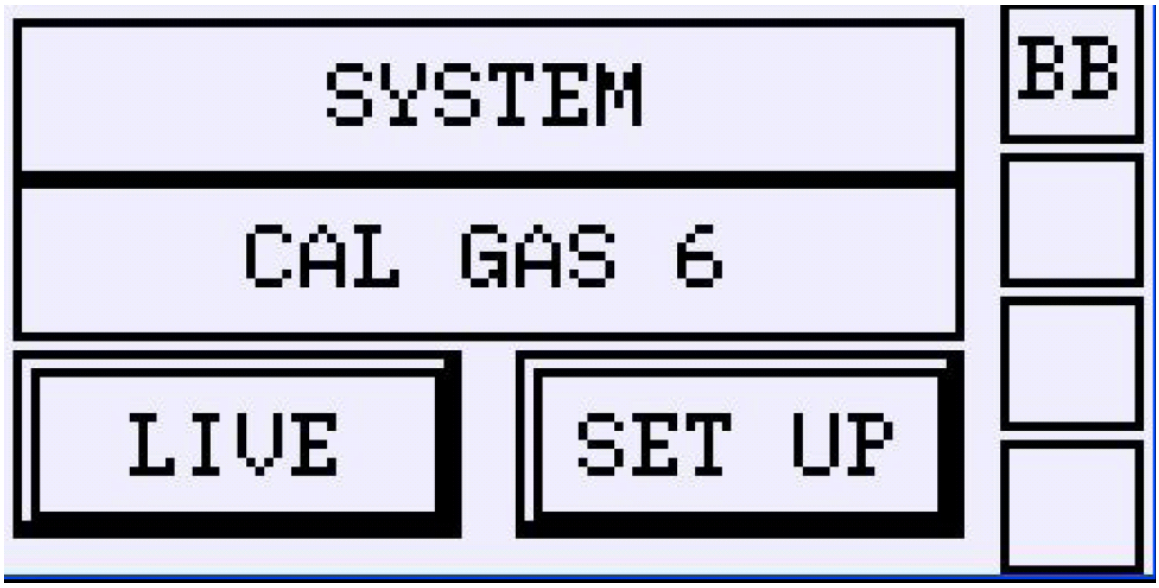


Figure 7. Main Screen — System Calibration Mode

Figure 7 illustrates the main status display as it appears when the system is set for system calibration mode. “System” and the cal gas being used in this example, “cal gas 6,” are displayed.
In this example, “BB” is indicated on the right-hand side of the screen. This means that the blow-back relay is energized, but none of the three user-defined relays are energized.

Figure 8. "Live" Screen

(b) “Live” screen

Figure 8 is an example of the screen that comes up when “Live” is pressed on the main status screen. It displays the percentage of full scale output for a particular analog input. Here, the level of channel 1 is 35% of the full scale output of the analyzer.

Pressing “Prev” and “Next” scrolls through all 12 of the analyzer analog input channels. “Exit” returns the default status display.

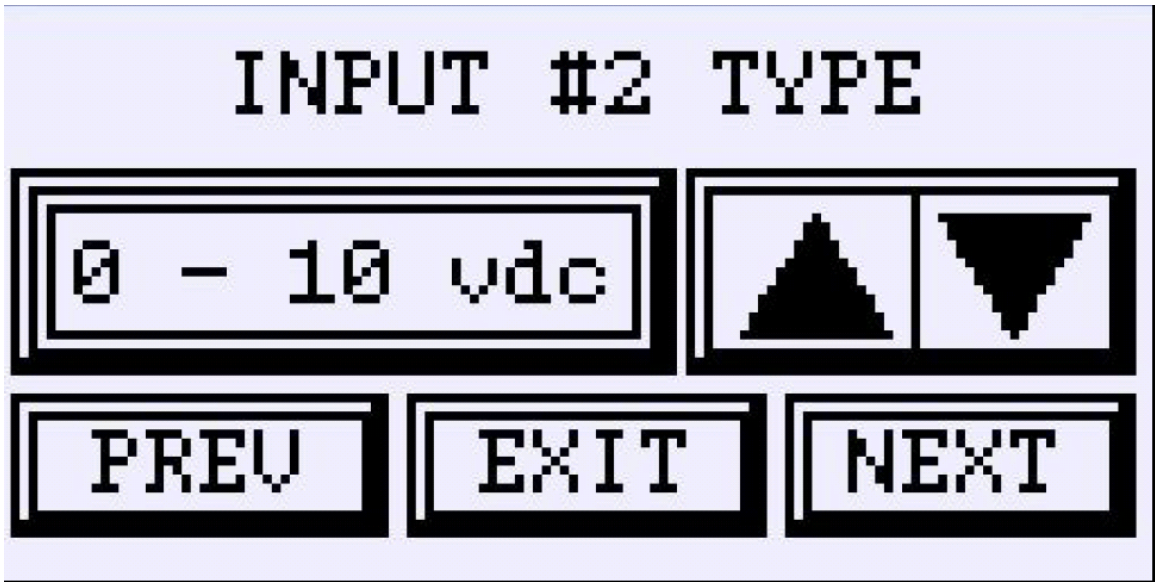


Figure 9. "Set Up" Screen

(c) “Set Up” screen

Figure 9 is an example of the screen that comes up when “Set Up” is pressed on the main status screen. It displays the type of analog signal that is set for each of the 12 analog inputs. Here, 0 to 10 volts dc represents the full range of the analog output of the analyzer connected to the channel 2 analog input terminals.

Pressing the up and down arrows scrolls through all 4 input ranges: 0 to 1 vdc, 0 to 5 vdc, 0 to 10 vdc, and 4 to 20 mA.

Pressing “Prev” and “Next” scrolls through the 12 analog input channels.

Pressing “Exit” displays the “Save Set Up screen.” (Figure 10).

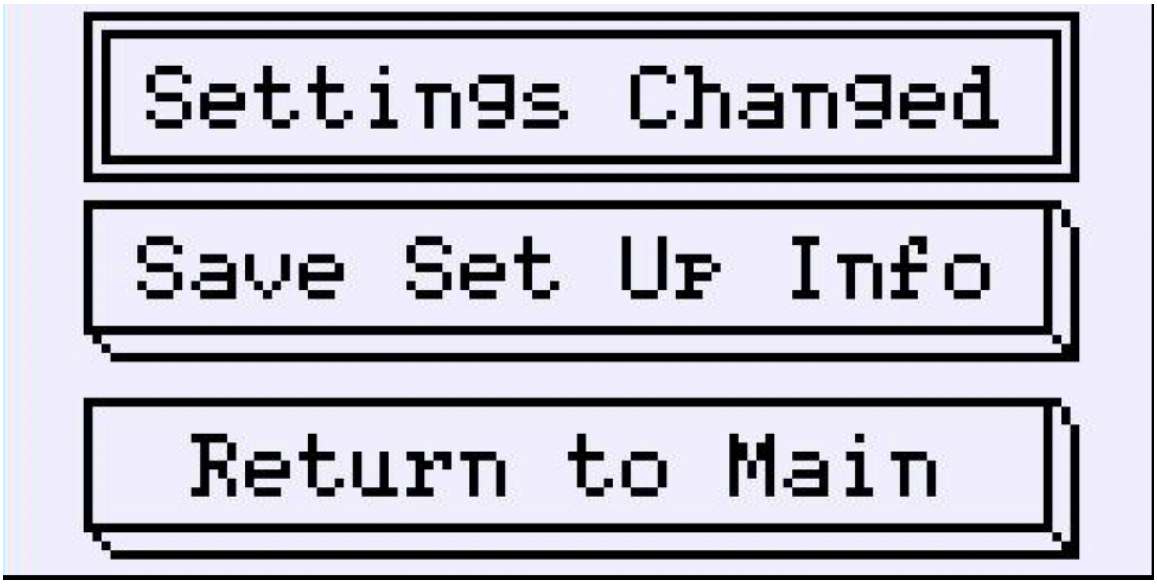


Figure 10. "Save Set Up Info" Screen

(d) "Save Set Up Info" screen

If the analog signal type was changed, this screen will indicate "Settings Changed." In order to accept the new settings it is necessary to press "Save Set Up Info." Pressing "Return to Main" will display the main status screen (Figures 5 – 7). If "Save Set Up" has not been pressed, the changes will be lost when power is removed.

5.0 SPECIFICATIONS

	Notes
System Enclosure w/ optional drawer slides	19" Rack Mount, 5U (8.75")
Analyzer expansion panel	19" Rack Mount, 3U (5.25")
Ambient operating temperature range	1-45°C (34-113°F)
Ambient operating humidity range	0-95%RH (non- condensing)
Number of. of analyzers supported with base unit	6
With optional analyzer expansion panel	12
Total sample gas flow with base unit, Max	10 lpm (21.9 scfh)
With optional analyzer expansion panel	20 lpm (43.8 scfh)
Sample gas flow per analyzer, max.	2.5 lpm (5.5 scfh)
Cal. gas inlet channels, max.	14
Cal. gas inlet pressure, max.	3 Bar (45 psig)
Cal. gas pressure regulation range	0-2 Bar (0-30 psig)
Cal. gas inlet tubing connection size	1/4" "instant" tube fitting
Cal. gas outlet to stack tubing connection size	1/4" compression fitting
Cal. gas vent tubing connection size	1/4" compression fitting
Sample gas inlet pressure range	30 in-Hg to 2 Barg (30 psig)
Sample gas inlet tubing connection size	1/4" compression fitting
Sample gas outlet to analyzer tubing connection size	1/4" compression fitting
Number of analog input channels	12 1
Analog Input ranges	0-1V, 0-5V, 0-10V, 4-20mA
External analog input connection	Removable connector with screw terminals
Probe filter blowback output	Dry contact, AC voltage to 250V/5A, DC voltage 24V/5A resistive load
External digital output connection	Removable connector with screw terminals
Digital Communications	Ethernet
Ethernet connection type	RJ-45, 2
Electrical power	100-250 VAC, 50/60 Hz, 2.5A

Notes:

1. Max. 8 analyzer channels addressable in RATAmation software. Additional 4 channels available for other data.
2. Requires patch cable for connection to computer.

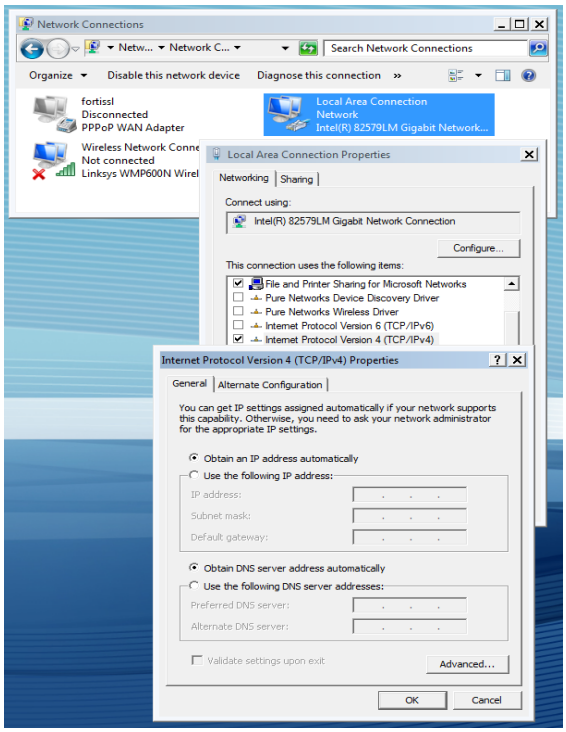
6.0 REPLACEMENT PARTS LIST

7.0 APPENDIX

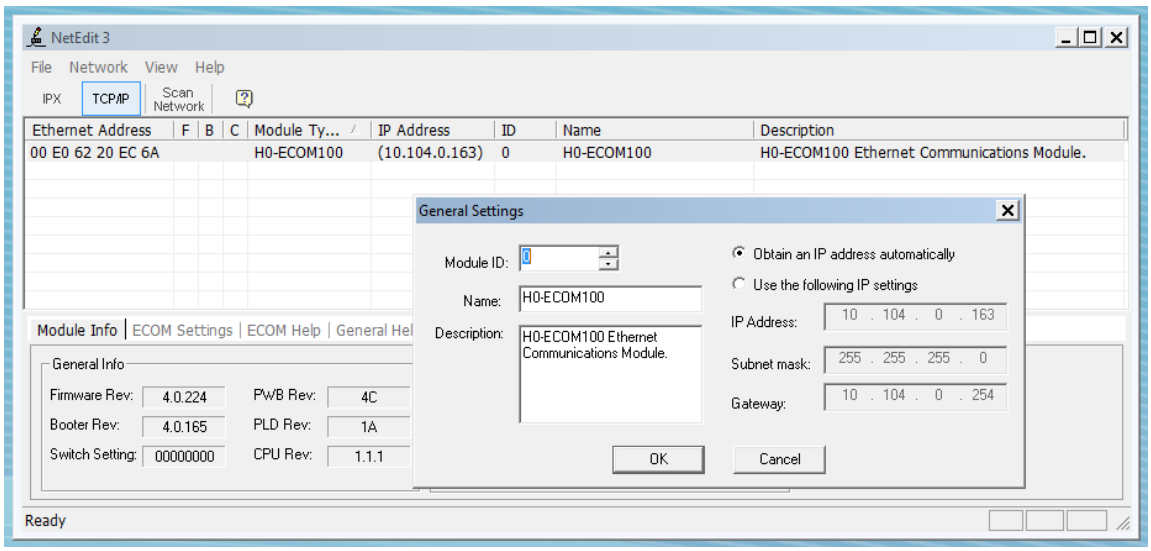
Ethernet Communications Configuration

Install RATAmation software onto the computer. Put the supplied software Crypto-Key in any USB port. Your computer should recognize the key device and show up as ‘CBUSB’ if the computer is seeing it. The software for the key should install automatically. There is nothing else that needs to be done with the key.

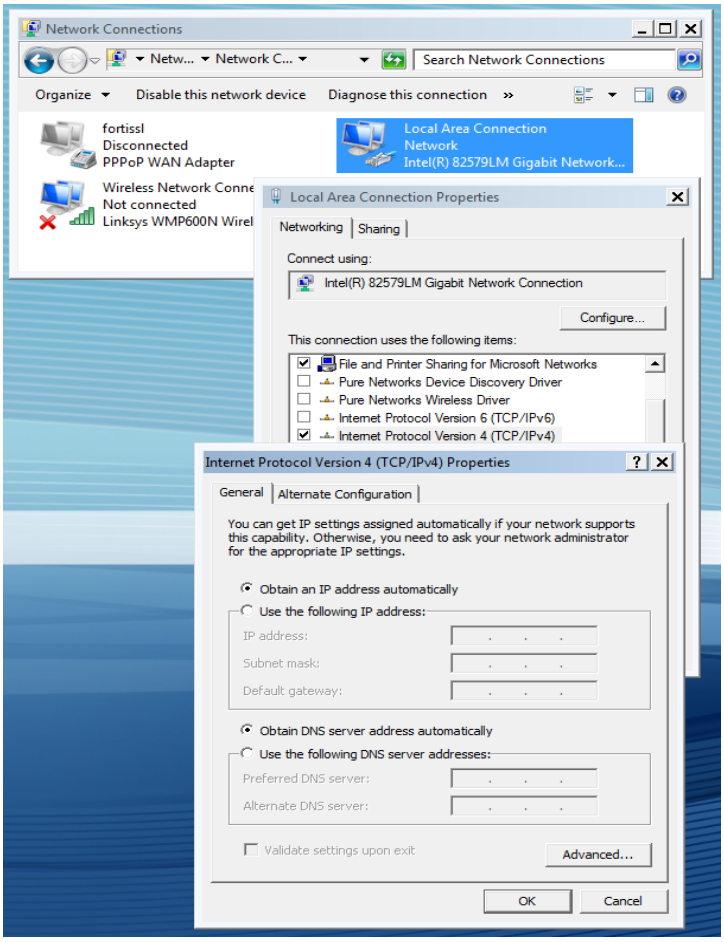
1. If you are connecting a Model 4P-4300 Flow Control Drawer (FCD) to a computer that is on a network with a DHCP server, the TCP/IP settings on the computer AND the flow control drawer must be set so that they are obtained automatically. For direct connection of the computer to the 4300FCD, skip to step 2.
    a. ***Turn off Windows Firewall until communications have been established.***
    b. To set the computer’s TCP/IP settings to automatic, go to **Start,** Select **Control Panel**, select **Network and Sharing Center**, in the upper left corner select **Change Adapter Settings** and a window will open displaying your network connections. Right click on local area connection and select **Properties**. A dialogue box will open. Select **Internet Protocol Version 4 (TCP /IPv4)** and click on the **Properties** button. Another dialogue box window will open.
    c. There are two selection points. Select them both to so that the IP address and the DNS Server are selected automatically as in the screen shot below. Click **OK** and close out of all windows.



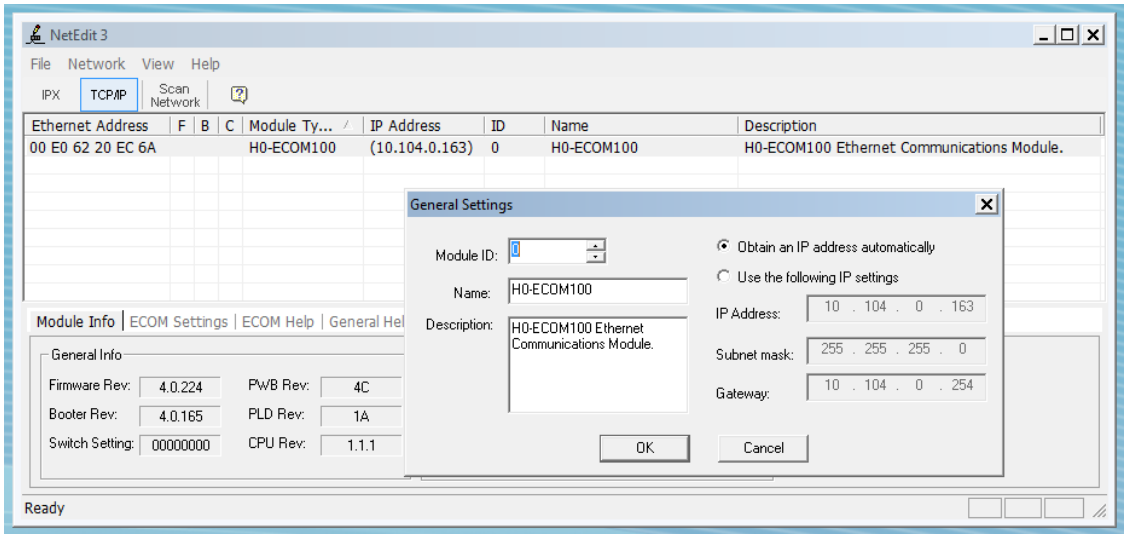
d. On the RATAmation software disc there is a program called **SetupNE3.exe**. Click to install and follow directions to complete installation.
e. Connect an Ethernet cable directly between the FCD and the computer. Power must be on for the FCD.
f. Go to **Start**, select **AutomationDirect Tools**, select **NetEdit 3**.
g. Click on the **Scan Network** button at the top. A line of data will fill the top line indicating connection to the FCD.
h. Right click on the top line. A menu will open. Select **General**. Make sure that **Obtain IP address automatically** is selected. Click **OK**.
i. Turn off power to the FCD. Turn on power to the FCD and restart the computer.
j. Skip to step 3



2. If you are connecting a Model 4P-4300 Flow Control Drawer to a dedicated computer, the TCP/IP settings must be set explicitly. This must be done for the settings on the computer AND the flow control drawer.
    a. ***Turn off Windows Firewall until communications have been established.***
    b. To set the TCP/IP settings to automatic, go to **Start,** Select **Control Panel**, select **Network Sharing Center**, in the upper left corner select **Change Adapter Settings** and a window will open displaying your network connections. Right click on local area connection and select **Properties**. A dialogue box will open. Select **Internet Protocol Version 4 (TCP /IPv4)** and click on the **Properties** button. Another dialogue box window will open.
    c. There are two selection points. Select **Use the following IP address:** The DNS server address can be left blank.
        i. Enter the IP Address as 192.168.135.10
        ii. Enter the Subnet Mask as 255.255.255.0
        iii. Enter the Default Gateway as 192.168.135.9
    d. Click **OK** and close out of all windows.



e. On the RATAmation software disc there is a program called **SetupNE3.exe**. Click to install and follow directions to complete installation.
f. Connect an Ethernet cable directly between the 4300 FCD and the computer. Power must be on for the FCD.
g. Go to **Start**, select **AutomationDirect Tools**, select **NetEdit 3**.
h. Click on the **Scan Network** button at the top. A line of data will fill the top line indicating connection to the FCD.
i. Right click on the top line. A menu will open. Select **General**. There are two selection points. Select **Use the following IP address:** Notice that the IP address and Default Gateway addresses are swapped as compared to the computer settings.
    i. Enter the IP Address as 192.168.135.9
    ii. Enter the Subnet Mask as 255.255.255.0
    iii. Enter the Default Gateway as 192.168.135.10
j. Click **OK** to exit.
k. Turn off power to the FCD. Connect both the computer and the FCD to the network. Turn on power to the FCD and restart the computer.



3. Configure RATAmation program
    a. Open RATAmation.
    b. Open the **Configuration** menu at the top. Select **Communications**. The words **Test Key** should be grayed out indicating that the program is seeing the Crypto-Key. If the lettering is black, click on it and a window should open saying the program is unlocked.
    c. Open **Configuration** again and select **Communications**. Clicking on this will open a window. If necessary click on **Retest and Reload List** and then **Open and Test**. If the configuration was successful, it will say **4300 Communications OK**. Click Exit.
    d. In the lower left of the window you should see **LIVE DATA**. This indicates that the FCD and the computer are communicating properly.