

KrosFlo[®] DIGITAL PRESSURE MONITOR



KrosFlo[®] Digital Pressure Monitor Product Information and Operating Instructions

Table of Contents

Section A. KrosFlo® Pressure Monitor

- 1. Introduction 3
- 2. Pressure Monitor Contents 3
- 3. Panel Controls and Features 3
 - 3.1 Front Panel 3
 - 3.2 Back Panel 4
- 4. Pressure Monitor Connections 5
- 5. Pressure Monitor Setup 5
 - 5.1 Setting Pressure Units 5
 - 5.2 Setting High Pressure Stop 5
 - 5.3 Setting High Pressure Alarm 6
 - 5.4 Setting Low Pressure Alarm 6
 - 5.5 Setting Low Pressure Stop 6
 - 5.6 Setting Low Permeate Alarm 7
 - 5.7 Setting the Auto Tare 7
- 6. Serial Communications 8
 - 6.1 KF Comm Software 8
 - 6.2 Monitor - Computer Communications 8
 - 6.3 List of Error Messages 10
- 7. Pressure Calibration 10

Section B. KF Comm Software

- 1. KF Comm License 12
- 2. Installation 12
- 3. KF Comm Software Suite 12
- 4. Instructions for Use 13
 - 4.1 Opening and Configuring the KF Comm Workbook Template 13
 - 4.2 Data Collection Tools 13
 - 4.3 Worksheets Overview 14

SpectrumLab.com's KrosFlo® Digital Pressure Monitor meets strict quality control standards and is warranted against defects in material and workmanship for a period of two (2) years from date of purchase.

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Section A. KrosFlo® Pressure Monitor

1. Introduction

During tangential flow filtration, the KrosFlo® Digital Pressure Monitor performs several important functions that greatly enhance process control, facilitate scale-up and optimize product recovery. These functions include High and Low Pressure Alarms. The user-defined pressure alarms are a safety feature that helps ensure maximum sample recovery and help protect membrane integrity.

2. Pressure Monitor Contents

Verify that all components listed below are included.

KrosFlo® Pressure Monitor	Rubber Feet (4)
Double-sided Foam Tape	Pressure Transducers (3)
110/220V Power Cables	Operating Instructions
F/F Straight-Thru Cable	Serial to USB Adapter

3. Panel Controls and Features

3.1 Front Panel

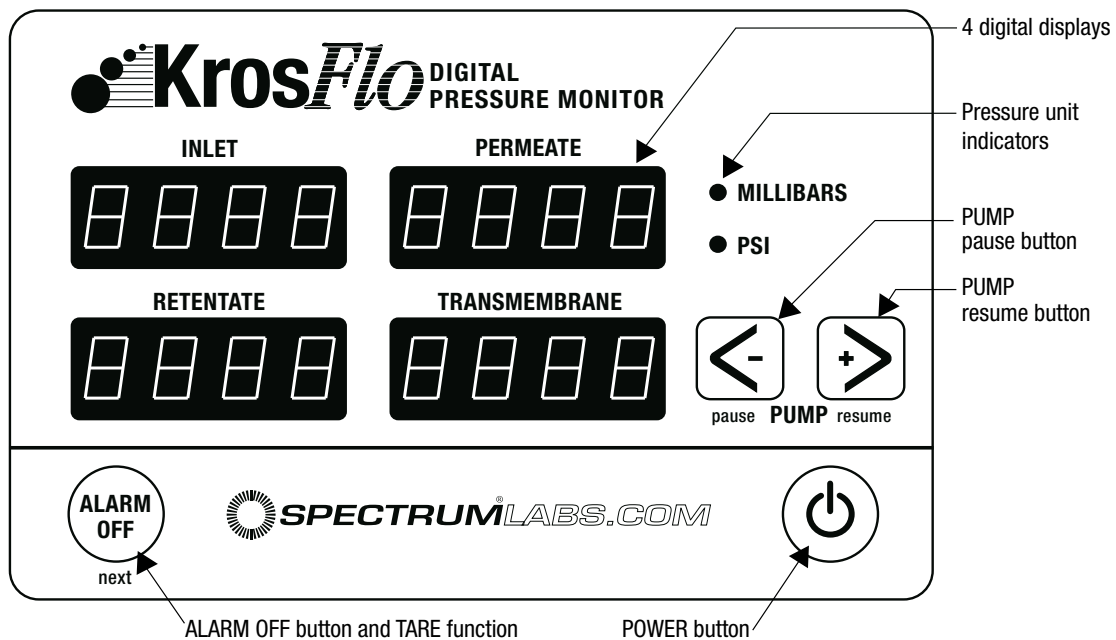


Figure 1 Front panel

Power Button: Turns the pressure monitor on (first press) and off (second press). When the monitor first comes on, the digital displays should come on as well as the 'MILLIBARS' and 'PSI' indicator.

Pressure Unit Indicators: One of the two indicators will be lit to indicate the units of pressure, "PSI" or "MILLIBARS" for the displayed measurements. The pressure units may be changed during the Pressure Monitor Setup.

ALARM OFF Button: The monitor is equipped with both high and low inlet pressure alarms. The trigger points for the alarms can be set from 0 to 75 PSI. The trigger points are set during the Pressure Monitor Setup. When an alarm is triggered by either a high or low pressure set-point, an audible alarm will sound. You can silence the alarm by pressing the ALARM OFF button. Once an alarm is triggered, it will continue to sound until the ALARM OFF button is pressed or the monitor is turned off or unplugged.

Tare Function: The monitor can be manually tared by holding the ALARM OFF button down for about 8 seconds until the word “tare” appears on the displays. It is recommended to tare (or zero) the monitor occasionally to ensure that the transducers have a good zero point. There is an option that can be set during the monitor setup to force the monitor to tare every time it is turned on.

Caution: You should only tare the unit when all of the pressure transducers are either disconnected from the liquid line or are not exposed to any pressure. Taring the unit while non-zero pressure conditions exist will give the monitor a false zero and result in inaccurate pressure displays. To correct this condition, simply disconnect all the transducers from the liquid lines and then hold the ALARM OFF button down until the word “tare” appears on both displays.

3.2 Back Panel

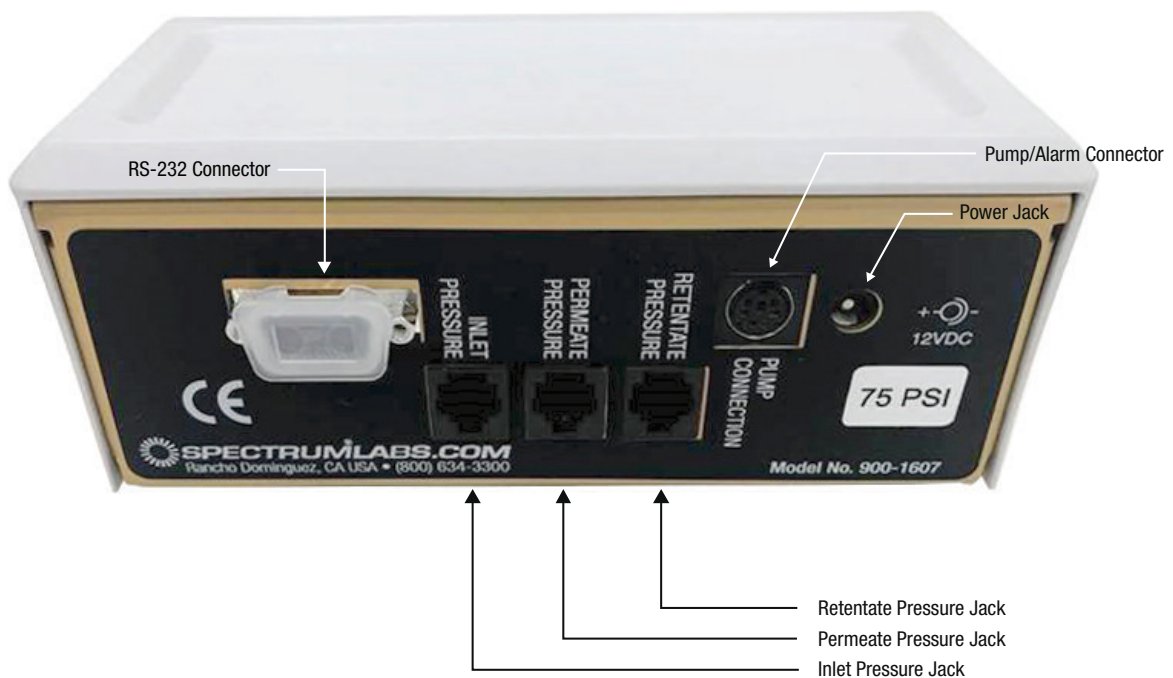


Figure 2 Back panel

Power Jack: The power jack is located on the back of the monitor. It accepts the plug from the included AC/DC adapter. The adapter should supply 12 VDC and be a positive center 2.5 mm style of plug.

Pressure Transducer Connectors: The back panel has 3 jacks for connecting pressure transducers

to the monitor. The jacks are labeled “Inlet Pressure,” “Permeate Pressure,” and “Retentate Pressure.”

Serial Communications: The monitor can communicate with the serial port on a computer. The communication settings normally used by the monitor are:

Data Rate: 19200, Data Bits: 8, Parity: None, Stop Bits: 1, Flow Control: None

No special software is required to access the RS232 output. SpectrumLabs.com recommends using either HyperTerminal or PuTTY.

When the monitor is first turned on, it will periodically output the pressure readings. These can be recorded and saved with your manufacturing or research documents. Each line sent will record and display the inlet pressure, retentate pressure, permeate pressure, transmembrane pressure, pump speed in RPM, high pressure alarm setting, low pressure alarm setting, and current time and date. If an alarm is triggered, “**ALARM**” will follow. The units are not indicated in the RS232 output; they are the same as those shown on the front panel. Additional information about the RS232 communications is in the Serial Communications and Calibration sections.

4. Pressure Monitor Connections

1. Connect the transformer to the Power jack on the back of the monitor and a suitable power source.

5. Pressure Monitor Setup

The monitor ships from the factory with all of the alarms disabled, pressure units displayed in PSI and set to automatically tare when powered on. The following procedure can be used to change any of these default settings.

5.1 Setting Pressure Units

1. If the monitor is on, press the Power button to turn it off. Press the Power button again to turn the monitor back on.
2. While the software version is being displayed and before the pressures are displayed, press and hold down the ALARM OFF key until the top line of the display shows the prompt “Pres Unit”. To change between PSI and MILLIBARS press either the (<-) or (+>) keys. When you are satisfied with your selection, press the ALARM OFF key to move to the next step.

5.2 Setting High Pressure Stop

1. After selecting the appropriate pressure units, you will be able to either enable or disable the High Pressure Stop alarm. Press either the (<-) or (+>) button to change between On and Off. The High Pressure Stop is intended to stop the pump and sound an alarm if the inlet pressure becomes high enough to potentially damage the filter or adversely affect the process. When the High Pressure Stop is enabled and the inlet pressure exceeds its set point, the pump will stop and the alarm will sound continuously until the ALARM OFF button is pressed or the monitor is turned off. When you are satisfied with your choice, press the ALARM OFF button to move to the next step.

2. If the High Pressure Stop is On, you can now set the pressure Stop Point. Press the (<-) or (+>) button to decrease or increase the Stop Point. A typical value might be 12 psi (827 millibars). Once the desired value is displayed, press the ALARM OFF button to save the value and move to the next step.

5.3 Setting High Pressure Alarm

1. After the High Pressure Stop is set, you can either enable or disable the High Pressure Alarm. You can press either the (<-) or (+>) button to change between On and Off. The High Pressure Alarm is intended to warn the operator that the inlet pressure is approaching the High Pressure Stop. When the High Pressure Alarm is enabled and the inlet pressure exceeds its set point, an intermittent alarm will sound until the ALARM OFF button is pressed or the monitor is turned off. The pump, however, will be allowed to continue running. When you are satisfied with your choice, press the ALARM OFF button to move to the next step.
2. If the High Pressure Alarm is On, you can now set the pressure High Alarm Point. Press the (<-) or (+>) button to decrease or increase the High Alarm Point. A typical value might be 10 psi (689 millibars). Once the desired value is displayed, press the ALARM OFF button to save the value and move to the next step.

5.4 Setting Low Pressure Alarm

1. After the High Pressure Alarm is set, you can either enable or disable the Low Pressure Alarm. Press either the (<-) or (+>) button to change between On and Off. The Low Pressure Alarm is intended to warn the operator that the inlet pressure is falling below what might be expected during the process run. This could be caused by a vacuum, a leak or a restricted feed line to the pump. When the Low Pressure Alarm is enabled and the inlet pressure falls below its set point, the pump will stop and the alarm will sound continuously until the ALARM OFF button is pressed or the monitor is turned off. When you are satisfied with your choice, press the ALARM OFF button to move to the next step.
2. If the Low Pressure Alarm is On, you can now set the pressure Low Alarm Point. Press the (<-) or (+>) button to decrease or increase the Low Alarm Point. A typical value might be 1 psi (69 millibars). Once the desired value is displayed, press the ALARM OFF button to save the value and move to the next step.

5.5 Setting Low Permeate Stop

1. After selecting the low inlet pressure alarm, you will be able to either enable or disable the Low Permeate Pressure Stop. Press either the (<-) or (+>) button to change between On and Off. This control is intended to stop the pump and sound an alarm if the permeate pressure becomes too low and pulls a vacuum on the fibers. This happens when a vacuum pump is placed on the permeate line to increase the TMP. When the Low Permeate Stop is enabled and the permeate pressure goes below the set point, the pump will stop and the alarm will sound continuously until the ALARM OFF button is pressed or the monitor is turned off. When you are satisfied with your choice, press the ALARM OFF button to move to the next step.
2. If the Low Permeate Stop is On, you can now set the pressure Stop Point. Press the (<-) or (+>) button to decrease or increase the Stop Point. A typical value might be -3 psi (-206 mil-

libars). Once the desired value is displayed, press the ALARM OFF button to save the value and move to the next step.

5.6 Setting Low Permeate Alarm

1. After the Low Permeate Stop is set, you can either enable or disable the Low Permeate Alarm. You can press either the (<-) or (+>) button to change between On and Off. The Low Permeate Alarm is intended to warn the operator that the inlet pressure is approaching the Low Permeate Stop. When the Low Permeate Alarm is enabled and the inlet pressure exceeds its set point, an intermittent alarm will sound until the ALARM OFF button is pressed or the monitor is turned off. The pump, however, will be allowed to continue running. When you are satisfied with your choice, press the ALARM OFF button to move to the next step.
2. If the Low Permeate Alarm is On, you can now set the pressure Low Permeate Alarm Point. Press the (<-) or (+>) button to decrease or increase the Low Permeate Alarm Point. A typical value might be -1 psi (-69 millibars). Once the desired value is displayed, press the ALARM OFF button to save the value and move to the next step.

5.7 Setting the Auto Tare

1. Setting the Auto Tare using the (<-) or (+>) button is the final step. If this is set to On, the pressure monitor will automatically tare (reset the readings to 0) every time it is turned on. If this is set to Off, it will not automatically tare but will instead use the most recent tare. When you have made your choice, press the ALARM OFF button to complete the setup. If you have set Auto Tare to On, the monitor will now automatically tare when turned on.
2. If the Auto Tare is set to Off, you can manually tare the monitor when you need to by holding the ALARM OFF button down for about 8 seconds until the word “tare” appears on the displays.

NOTE: To update the pressure monitor, please contact SpectrumLabs.com to get the latest firmware. The pressure monitor can only be updated using a null RS-232 cable, not the included straight-thru RS-232 cable.

6. Serial Communications

6.1 KF Comm Software

The KrosFlo® Digital Pressure Monitor is provided with a software program that collects data from the monitor and displays it in a Microsoft® Excel® workbook. For more information on how to use the software refer to Section B KF Comm Software.

6.2 Monitor - Computer Communications

1. To connect the pressure monitor to a computer for data logging or control, use the supplied RS232 cable to connect the RS232 connector on the back of the monitor to a serial port on your computer.
 2. Open the HyperTerminal or PuTTY program. Pick a name and an icon so that you can save the settings you make below.
 3. On the Connect To dialog, go down to the Connect Using item and select the Com port you used for the connection and click OK. On the Port Settings dialog select "19200" for the Bits per second, "8" for the Data bits, "None" for the Parity, "1" for the Stop bits and "None" for the Flow control; then click OK. You can use File/Save to save the settings for easy use later.
 4. When you have connected the monitor to your computer, you should see it periodically print a line of the current pressure readings on the screen. The periodic output records and displays the inlet pressure, retentate pressure, permeate pressure, transmembrane pressure, pump RPM, high pressure alarm setting, low pressure alarm setting, and current time and date. If there is no periodic output, make sure that the cable connecting the pressure monitor to the PC is good. It should be a null modem cable. Also check that the correct COM port on the computer is selected. Use File/New Connection on the menu to select a different COM port.
 5. The RS232 communication is used as a data output for monitoring a log of the process readings as well as to control and calibrate the pressure monitor. In order to better serve the dual purpose, the RS232 port has two different modes or states. When the monitor is first turned on the RS232 port is in the locked state. In this locked state, it periodically outputs the current pressure readings and ignores most input. The only way to change from the locked to unlocked state is by pressing the computer's ENTER key, type "Unlock" and press the ENTER key again. The pressure monitor does not echo the keystrokes mixed in with the pressure readings. Make sure to type a capital "U" and lower case "nlock". The periodic output will continue while you are typing.
 6. While the monitor is unlocked, it will respond to a small set of commands. When it is ready for another command it will display a prompt of ">" and wait for the next command. In all cases the commands are case sensitive. Each command line is ended by pressing the ENTER key.
 - ? : Typing "?" will provide a list of the available commands.
- Lock:** Typing "Lock" returns the RS232 port to the locked state. It will then periodically output the current pressure readings.
- Ver:** Typing "Ver" will cause the pressure monitor to display the version identifier of its

software.

Show: Typing “Show” will cause the pressure monitor to display the values of many of the variables that can be set with the RS232 port.

Reset: Typing “Reset” will cause the pressure monitor to reset itself as if it had just been turned on.

Default 171: Typing “Default 171” will reset all of the pressure monitor parameters to those set by the factory. This includes resetting the Baud Rate to 19200 as well as the calibration and zero points of all of the transducers since it does not reset the monitor. Some changes will not take place until the monitor is turned off and then on (or the “Reset” command is given).

Rate #: While the RS232 port is locked it periodically outputs the current pressure readings. The rate is the number of seconds per reading output. Typing the word “Rate” by itself will cause the current rate number to be displayed. Typing the word “Rate” followed by a space and a number will cause the rate to be set to your new value.

Sep C: The Sep command is used to set the character displayed between the pressure readings in the periodic output. Normally this is a space. You may, however, want to set it to a tab or a pipe (|) character. Typing the word “Sep” by itself displays the current separator character. To set a different separator character type the word “Sep” followed by a space and the new character to use. The separator cannot be set to a null, line feed, or return character; any other character can be used. When displaying the current separator character, characters that might not print visibly are mangled to make them display legibly. For example, a space is shown as “[]” while a tab is shown as “[/]”. The mangled form should not be used to specify the separator, simply type “Sep”, a space, and then the character to use.

Cal S ##.##: The Cal command is used to calibrate one or more of the pressure channels. To calibrate the monitor to a transducer, plug the transducer in to the monitor and connect it to a known pressure source. Then type “Cal” followed by a space, the appropriate pressure channel (either “retentate”, “permeate” or “inlet”) and finally the respective pressure value in the format of ##.##, e.g. “5.3”. When calibrated to a particular transducer, the calibration is only for that transducer on that jack. See the section on Calibration for more information.

Date ##/##/##: Typing the word “Date” by itself displays the current date in the real time clock. To set the date, type the word “Date” followed by a space and the current date in mm/dd/yy format. (mm should be a number from 1 to 12 indicating the current month, dd should be a number from 1 to 31 indicating the current day of the month and yy should be a number from 0 to 99 indicating the last 2 digits of the year.)

Time ##:##:##: Typing the word “Time” by itself displays the current time in the real time clock. To set the time, type the word “Time” followed by a space and the current time in hh:mm:ss format. (hh should be a number from 0 to 23 indicating the current hour, mm should be a number from 0 to 59 indicating the current minute and ss should be a number from 0 to 59 indicating the current second.)

RTC #: The RTC command is used to control whether the date and time are shown. Type “RTC 1” to have the date and time shown, “RTC 0” to prevent the date and time from appearing.

6.3 List of Error Messages

- a. That didn't look like a command to me. Returned whenever the monitor cannot parse your input usefully. If you provide a number out of range or negative, this is usually returned. If you format the date or time wrong (when setting the date or time), this is usually returned. The monitor does not understand backspace or rubout. If you try to backspace, you will almost without fail see this message when you press ENTER. If use the wrong case (upper or lower) for a command, you will also see this message when you press ENTER.
- b. Bye. Returned after the Lock command is accepted. It lets you know that the console is now locked and you should only see the periodic output.
- c. Bad combination. The Default command must be followed by a space and the number 171 to take affect. If you do not include the 171 you will see this message.
- d. I don't like the separator you've picked, please try again. There are some characters that should not be used as the separator character (see the Sep command). Currently these characters are ENTER and rubout. Trying to use these characters returns the "That didn't look like a command to me message".
- e. I'm sorry I can't update the clock right now. The real time clock is connected to a shared bus. It is possible (although not likely if the monitor is operating properly) that the shared bus could be busy when you try to update the clock. If this occurs you will see this message and the clock will not be updated.

7. Pressure Calibration

NOTE: Spectrum does not recommend field calibration of the pressure monitor. We recommend that it is returned to Spectrum for calibration or certification (if required). You can contact Spectrum by phone at (800) 634-3300, fax at (310) 885-4666, or email at customerservice@spectrumlabs.com to make arrangements for the calibration. If you experience an error in a pressure measurement, the cause is most likely the transducer and not the monitor. Please check pressure readings with a new transducer prior to recalibrating the monitor.

To calibrate one or more pressure channels you will need a computer with an available serial port, one or more pressure transducers and a source of known pressure. If you have all of these items available, the following procedure may be used:

1. Disconnect all pressure transducers and pumps from the pressure monitor.
2. Connect power to the monitor and turn it on. The digital displays should light up as well as the Pressure Unit indicators.
3. After the power-on sequence has completed and pressure values are being displayed, press and hold down the ALARM OFF button until the word "tare" appears on the digital displays. After the tare is complete, all displays should show "0" readings.
4. Use the supplied RS232 cable to connect the monitor to a free serial port on a computer and establish communication.
 - i. Open your HyperTerminal program (installed under Accessories/Communications on most Windows installations). Pick a name and an icon so that you can save the settings you make in the following steps.
 - ii. On the Connect To dialog, go down to the Connect Using item and select the Com port

you used for the connection and click OK.

- iii. On the Port Settings dialog select "19200" for the Bits per second, "8" for the Data bits, "None" for the Parity, "1" for the Stop bits and "None" for the Flow control; then click OK. You can use File/Save to save the settings for easy use later. When you have connected the monitor to your computer, you should see it periodically print a line of the current pressure readings on the screen. If you do not see this periodic output, check that you are using a good cable to connect the monitor to the PC. You might also want to check that you've selected the correct COM port on your computer. You will need to use File/New Connection on the menu to select a different COM port.
5. Plug a new pressure transducer into each pressure jack on the back of the monitor. All pressure readings should change and no longer be "0". The following steps should be performed for each transducer (inlet, retentate and permeate), one at a time.
 - i. With no pressure applied to the transducer, press and hold down the ALARM OFF button until the word "tare" appears on the digital displays.
 - ii. Using a calibrated pressure gauge and pressure source, apply about 6 psi to the inlet pressure transducer.
 - iii. Unlock the monitor by pressing the ENTER key on the computer, typing "Unlock", and then pressing the ENTER key again. Be sure to type a capital "U" followed by a lower case "nlock".
 - iv. Type "Cal inlet" ##.## (where ##.## is the pressure on the transducer) and press ENTER. The inlet pressure reading on the front of the monitor should change to the value you have entered. If the calibration value is a magnitude that indicates a hardware problem then an error message will be displayed and the calibration will not be performed.
 - v. Type "Lock" and press ENTER to have the monitor return to periodically sending the current pressure readings.
 - vi. Repeat steps i through v to calibrate both the retentate and permeate transducers. The pressure monitor is now calibrated. You may turn it off and disconnect it from the pressure transducers and computer.

Section B. KF Comm Software

1. KF Comm License

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2. Installation

The pressure monitor is accompanied with the KFComm Software Suite that can be used on Windows® PCs. The software requires Microsoft® Windows XP (32-bit or 64-bit) or newer and Microsoft® Excel® 2007 (32-bit or 64-bit) or newer. The software also does not run on any version of Windows CE and RT.

3. KF Comm Software Suite

1. Launch "Installer.exe" file from KF Comm folder contents
2. The Spectrum KF Comm Installer will check the system settings-- press Proceed to continue
3. Check "Install KF Comm software and workbooks" and "Install USB drivers for pump drive connection (recommended)."
4. Proceed through the default installation steps. When at KF Comm Data Collection Setup's Custom Setup screen, enable the installer to install workbooks that interface with SpectrumLabs.com's Pressure Monitor by clicking on the red X icon and selecting "Will be installed on local hard drive."

5. Complete and confirm installation of all selected components from software suite.

4. Instructions for Use

4.1 Opening and Configuring the KF Comm Workbook Template

1. Before opening the proper TFF system template, ensure that the user has Administrator or similar access to both the computer and Excel
2. To open the Pressure Monitor template, the user may:
 - a. Open the Spectrum Labs folder with shortcuts on the desktop, then select the Pressure Monitor Data Collection shortcut link
 - b. Click on the Start Menu and type in "Pressure Monitor Data Collection" then click on the retrieved file
 - c. Hit the Windows key on the keyboard and type in "Pressure Monitor Data Collection," then click on the retrieved file
3. If asked, enable macros in KF Comm workbook
4. After opening the template, an expected com port selection error may appear-- this is normal, as the default COM port that KF Comm will use is usually not the actual COM port the Pressure Monitor was read as by the computer
5. The About Control dialog will appear-- press OK to confirm
6. Navigate to Add-ins tab and open Configure Collection menu
7. Use the "Find Comm" tool to automatically detect and select the Pressure Monitor's port
8. Set Data Collection intervals ("Period: ## Seconds per line")
9. Press "OK" to save configurations
10. After selecting the proper Pressure Monitor port and applying the changes, the workbook template will start to blink and show live data retrieved from the Pressure Monitor

4.2. Data Collection Tools

Data Collection Tools may be found in the "Add-ins" tab on the Excel ribbon. Different versions of Excel may also display graphical icons to represent the tools.

- a. **End Control:** Used to end data collection. Certain functions in Excel need to be disabled for the data in the workbook to be accessible. Clicking this will stop the spreadsheet from receiving live data, stop collection, and disable other controls. The data can then be saved and accessed for analysis like a normal Excel workbook. If the End Collection button is clicked once, the saved data can still be used for further data collection. If the End Collection button is clicked twice, the saved data cannot be used for further data collection.
- b. **Configure Collection:** Allows the user to open the Setup menu to configure basic KF Comm settings.
- c. **Stop Collection:** After starting collection, the user may use the Stop Collection function to suspend data collection.

- d. **One More Data Point:** Allows the user to take a data point that was not part of the data collection intervals.
- e. **Start Collection:** Starts collecting data. Please note that during data collection, KF Comm is unable to record data if the user is actively navigating through the Add-ins tab and its menus (other than the Pump Control) or if the user is inside a cell in Excel. SpectrumLabs.com recommends that the data collection computer be designated for data collection only when running a process. Concurrent activities on the computer may interrupt or disable KF Comm's ability to collect data properly.
- f. **About Me:** Displays information on Pressure Monitor
- g. **Workbook License:** Calls up a dialog with licensing information.
- h. **About KF Comm:** Calls up a dialog with basic KF Comm information.

4.3 Worksheets Overview

- a. Pressure Data: Collect data with this worksheet when running application
- b. Graph Worksheets: There are a number of other worksheets in the workbook template that are automatically populated with information from the Pressure Data worksheet.

These graphs are:

- i. **Pressures vs Time**
- ii. **Inlet Pressure vs Time**
- iii. **Retentate Pressure vs Time**
- iv. **Permeate Pressure vs Time**
- v. **DP vs Time**

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