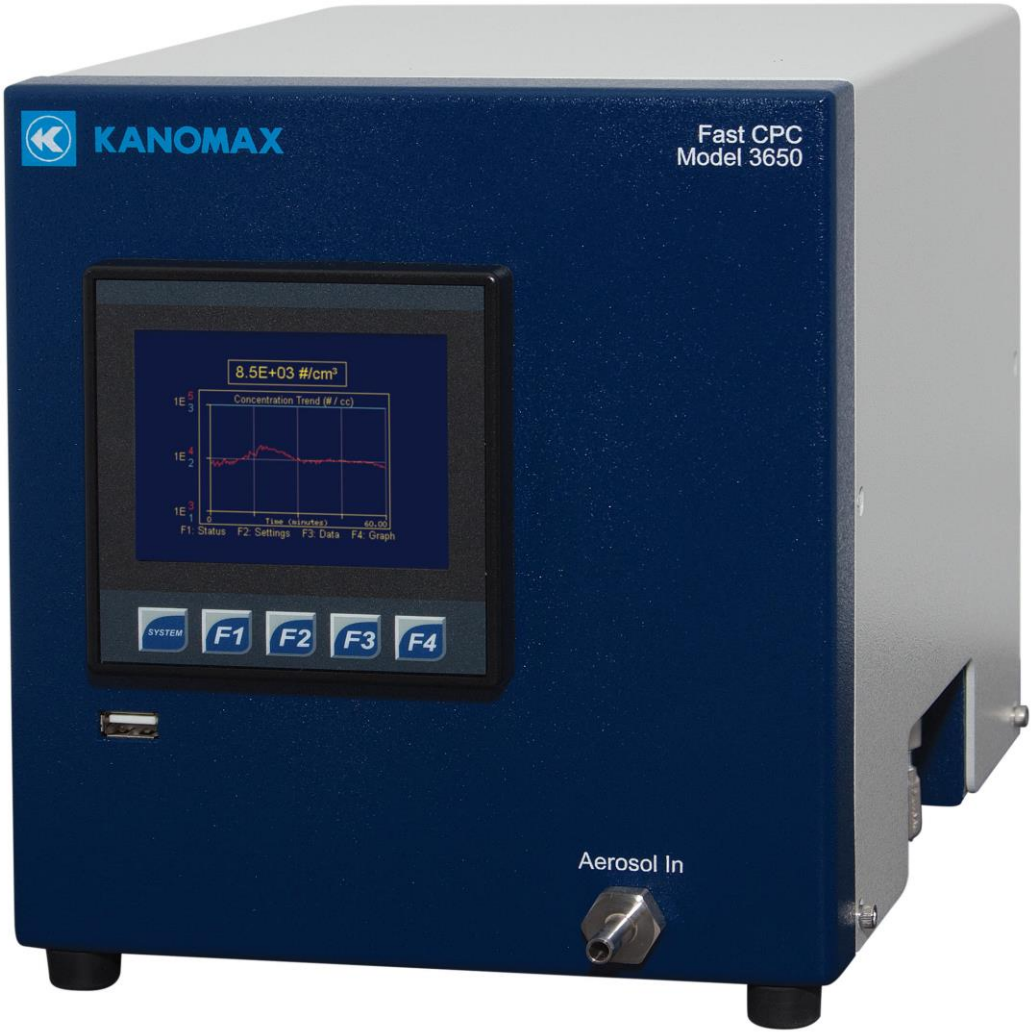
KANOMAX FMT
A Kanomax Company

Fast Condensation Particle Counter

Model 3650: User Manual



Part Number: 1973650 Version 1.2.1

Fast CPC Model 3650: User Manual

Address:	Kanomax FMT, Inc. 4104 Hoffman Road White Bear Lake, MN 55110-3708 USA
Phone Number:	651-762-7762
Fax Number:	651-762-7763
URL:	www.kanomaxfmt.com

The following is a history of the Fast CPC Model 3650 User Manual (part number 2679001):

Version	**Date**	**Change**
Version 1.0	September 2017	User Manual created.
Version 1.1	November 2018	Updated screenshots and instructions.
Version 1.2	April 2019	Updated Data Management screens to show Fast button.
Version 1.2.1	July 2020	Removed Packing List Table

Limitation of Warranty and Liability

Kanomax FMT, Inc. offers a full 12-month repair or replacement warranty on all products sold. Warranty covers defects resulting from design or manufacturing. If any such product proves defective during this warranty period, Kanomax FMT, Inc., at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product. This warranty is offered on a return to factory basis, with return shipping expense expressly at the cost of the customer. Kanomax FMT, Inc. will pay the return shipping on any materials repaired or replaced. Any repaired or replaced item assumes the remainder of the initial warranty period. Kanomax FMT, Inc. warrants only to the extent of replacement or repair of our products, and does not assume any responsibility for consequential damages. No warranty is offered on accounts with past due balances. In order to obtain service under this warranty, Customer must notify Kanomax FMT, Inc., of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. The Customer shall be responsible for packaging and shipping the defective product to the service center designated by Kanomax FMT, Inc. with shipping charges prepaid.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Kanomax FMT, Inc. shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Kanomax FMT, Inc. representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; or c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY KANOMAX FMT, INC. WITH RESPECT TO THE LISTED PRODUCTS IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. KANOMAX FMT, INC. AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. KANOMAX FMT, INC. RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. KANOMAX FMT, INC. AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER KANOMAX FMT, INC. OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

Service Policy

Knowing that inoperative or defective instruments are a detriment to our customers' satisfaction, our service policy is to give prompt attention to any known problems. If you discover any malfunction of the Fast CPC, contact Kanomax FMT, Inc. at 651-762-7762 (USA). If you are outside of the USA, please call your authorized distributor.

Table of Contents

About This Manual

Intended Audience

The Fast CPC Model 3650 User Manual is intended to be used by qualified personnel (such as technicians and engineers) in a laboratory setting.

Scope of User Manual

This user manual contains detailed instructions for the installation and set up of the Fast CPC Model 3650. The manual also contains an explanation of how the aerosol generator works.

Definitions

- EU: European Union
- psi: Pounds per Square Inch
- kPa: Kilo Pascals
- VAC/VDC: Volts Alternating Current/Volts Direct Current
- AC: Alternating Current
- mA: Milliamperes
- PLC: Programmable Logic Controller

Safety and Handling Procedures

Read this section to learn safe handling procedures for the Fast CPC.

There are limited user-serviceable parts inside the Fast CPC: all repair and maintenance must be performed by a qualified service technician.

When working with the Fast CPC:

- Do not remove any parts from the instrument unless this manual tells you to do so.
- Do not remove the instrument housing or covers while power is supplied to the instrument.

Safety Signals

The following warning symbols and labels are used in the documentation and on the Fast CPC. Follow the procedures described in this manual to use the instrument safely.

Warning

Warnings are used for the following purposes:

- To indicate that unsafe use of the instrument could result in serious injury to you or cause irrevocable damage to the instrument.
- To indicate that if you do not follow the procedures described in this manual, you may damage the instrument.
- To draw attention to important information about the operation and maintenance of the Fast CPC.

High Voltage Sticker

A High Voltage warning sticker attached to the Fast CPC warns you that un-insulated voltage within the instrument may be sufficient to give you an electric shock. Do not make contact with any part inside the instrument.

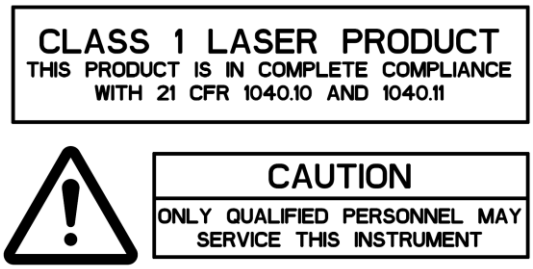
Grounding Connection Sticker

A Grounding Connection sticker attached to the Fast CPC indicates that the nebulizer is connected to earth ground and cabinet ground.

Class I Laser Sticker

When operated according to the manufacturer's instructions, the Fast CPC is a Class I laser product as defined by U.S. Department of Health and Human Services standards under the Radiation Control for Health and Safety Act of

1968. A certification and identification label like the one shown below is positioned on the back panel of the Fast CPC.



Warnings

Please familiarize yourself with the following warnings before operating the Fast CPC:

- The Fast CPC must be used following manufacturer's specifications otherwise safety cannot be guaranteed.
- All service work must be performed by qualified service technicians - only qualified service technicians should remove the cover.
- To prevent electric shocks, ensure that all electrical outlets are grounded.
- Follow the instructions for all inlet and outlet connections. Incorrect connections will cause the CPC to malfunction.
- Do not operate the Fast CPC at angles >15°.
- You must drain the Fast CPC before you move or ship it. Do not ship an undried/undrained device back to Kanomax FMT, Inc.: doing so might damage the device and invalidate the warranty.
- Do not subject an undrained device to freezing temperatures: doing so might damage the device and invalidate the warranty.
- The n-Butanol (n-butyl alcohol) used to operate the Fast CPC is flammable and toxic; follow appropriate chemical handling procedures.

How the Fast CPC Works

The Fast CPC is a thermally diffusive, laminar-flow condensation particle counter. The Fast CPC measures the concentration of particles larger than a known threshold size within a gas sample. The instrument also detects particles that are too small to be detected optically (using light scattering techniques) by condensing a vapor onto the particles so that they grow by several orders of magnitude in size.

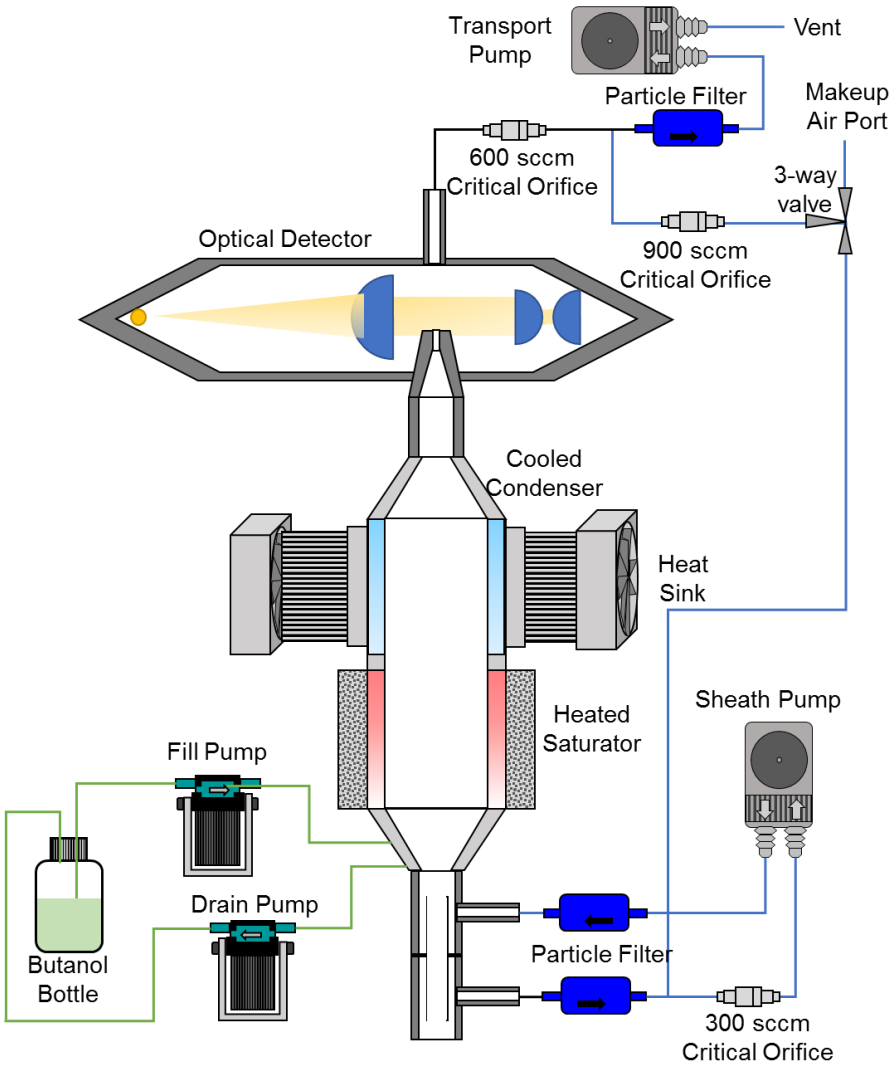
At vapor pressures below the saturation vapor pressure at the sample temperature, condensation is energetically unfavorable because of the significant energy required to increase the liquid surface area upon condensation. Super-saturated vapors are able to overcome the energetic barrier where the super-saturation required to initiate condensation onto a particle is inversely proportional to the particle size.

Super-saturation is achieved by changing the wall conditions of a sample conduit containing an aerosol saturated with the working fluid. In the Fast CPC, which uses n-butyl alcohol as the working fluid, the conduit walls in the super-saturation region are maintained at a temperature below the saturated sample temperature. Transitioning to a conduit where the wall temperature is below that of the saturated sample leads to heat and mass transfer towards the wall. Because the mass diffusivity of n-butyl alcohol vapor is lower than the thermal diffusivity of air, the sample cools (lowering the saturation vapor pressure) at a faster rate than the vapor can diffuse towards the walls. The ratio of the actual vapor pressure (Pv) to the saturation vapor pressure (Psat) is the saturation ratio (S).

The Fast CPC has a short response time to capture time-variant aerosol particle concentrations. The instrument uses short sample path lengths and a patent-pending round flow conduit to shorten the diffusion length and thus facilitates shorter saturation and super-saturation conduits.

Figure 1 is a schematic diagram of the Fast CPC.

Figure 1: Schematic Diagram of the Fast CPC Model 3650.



The Model 3650 Fast Condensation Particle Counter offers the following advantages over existing aerosol generation technology:

- Ultra-fast response time (τ ~ 20 ms)
- Small particle detection (down to 1.9 nm)
- Integrated, compact design
- Robust liquid handling

The Fast CPC pushes aerosol nanoparticle measurement performance to new heights. Using the classic approach of enlarging particle size through condensational growth from a supersaturated alcohol vapor, particles as small as 1.9 nanometers grow into micron-sized droplets that are

individually counted with a laser droplet sensor. Vapor-diffusive, laminar-flow operation provides stable detection efficiency.

The Fast CPC's compact package includes internal sheath and transport pumps with critical orifice flow control. A patent-pending parallel-plate flow geometry shortens the aerosol flow path for faster response time and lower diffusion losses. A robust active working fluid transport system reduces flooding and reliability problems common with competing products. With no internal alcohol reservoir, the instrument is more tolerant to tipping, vibration, and rapid pressure fluctuations at the inlet making it suitable for applications in mobile transportation studies.

With faster response than any competing CPC on the market, the Fast CPC is the ideal detector for rapidly changing aerosol systems and electrical mobility size distribution measurements.

Applications

The Fast CPC offers significant advantages in applications where:

- Fast-response particle detection is needed.
- Rough handling, such as tipping, may occur.

The Fast CPC is protected by pending patents in the US, Japan, Korea and Germany. It is available for purchase from Kanomax FMT, Inc. Licensing is available for customers who wish to incorporate this technology into other applications.

How to Install the Fast CPC Model 3650

Following is an overview of the steps required to install a Fast CPC. Please read the detailed instructions (beginning below) for each step before you set up the instrument.

- Unpacking the Fast CPC.
- Connecting the aerosol supply.
- Connecting the n-Butanol supply.
- Connecting the power.
- Installing/removing the inlet bypass fitting.
- Connecting the bypass outlet.

Unpacking the Fast CPC

To unpack the Fast CPC, follow these instructions:

1. Carefully remove the Fast CPC from its shipping container. Save the original packing materials for use when shipping the Fast CPC back to Kanomax FMT, Inc. for service, or for moving the Fast CPC to a different location.

Warning. If the Fast CPC is returned to Kanomax FMT, Inc. in anything other than the original shipping container, you will be charged for any damage that occurs during shipping. If you do not have the original shipping container, contact Kanomax FMT Inc. at 651-762-7762. (Customers in Asia please call +81 6-6877-0183.)

2. Place the Fast CPC on a level surface.
3. Make sure there is an unrestricted air flow around the device. Kanomax FMT, Inc. recommends at least a 2-inch air gap on both sides and the top of the instrument.
4. Allow the Fast CPC to reach ambient temperature, if necessary.
5. Make sure all the items listed in Table 1, were included in the Fast CPC shipment. If any of the items are missing, or damaged, please call Kanomax FMT, Inc. at 651-762-7762. (Customers in Asia please call +81 6-6877-0183.)

Equipment You Need

To install the Fast CPC, you need the following items:

- Reagent-grade n-Butanol (n-butyl alcohol)
- Phillips screwdriver
- 120-240 VAC power at 50/60 Hz

Installing the Fast CPC

Figures 2 and 3 show the front and back panels of the Fast CPC.

Figure 2: Front Panel of the Fast CPC.

Figure 3: Back Panel of the Fast CPC.

Connecting the Aerosol Supply

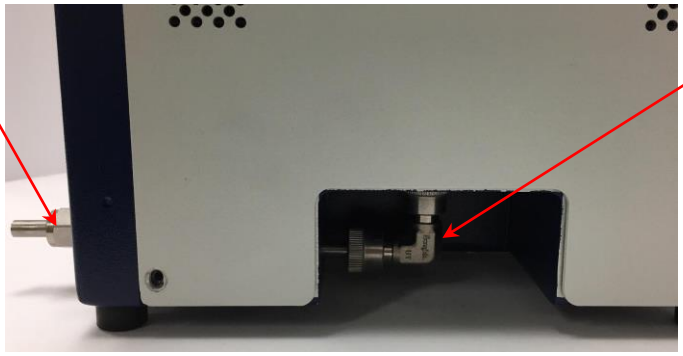
The Fast CPC can be connected to an aerosol supply through the inlet on the front panel. It can also be connected to an Annular Flow Ion Mobility Classifier using an alternative aerosol inlet on the base of the Fast CPC.

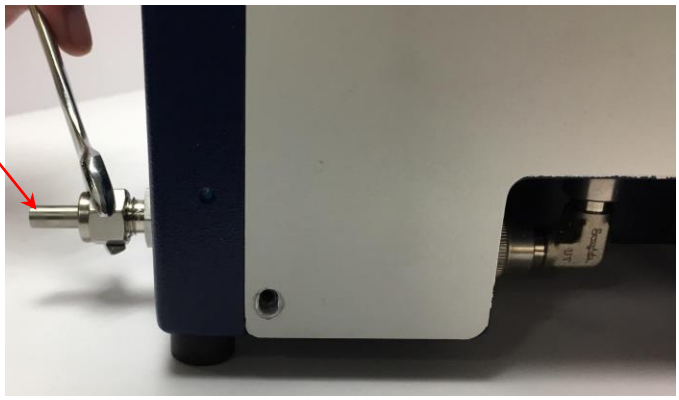
Follow these instructions to connect the Fast CPC to an aerosol supply via the front panel fitting:

1. Remove the protective cap from the **Aerosol In** fitting on the front panel.
2. Push a length of static dissipative silicon tubing onto the **Aerosol In** tube.
3. Connect the other end of the tubing to your aerosol supply.

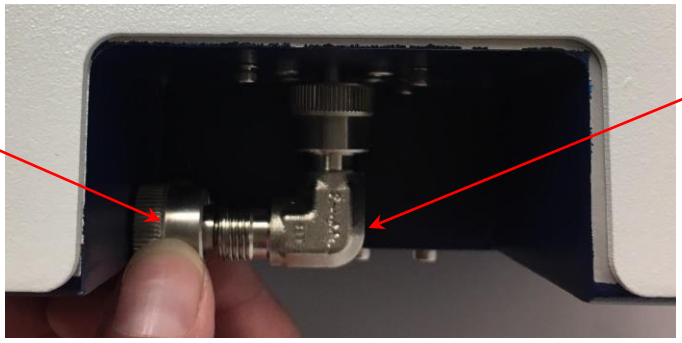
Follow these instructions to connect the Fast CPC to an Annular Flow Ion Mobility Classifier using the high-performance aerosol inlet:

1. Loosen and then remove the stainless steel nut on the **Aerosol In** fitting.





2. Pull the **Aerosol Inlet** tube forward.
3. Loosen the nut on the stainless steel elbow joint on the high-performance aerosol inlet on the base of the Fast CPC.



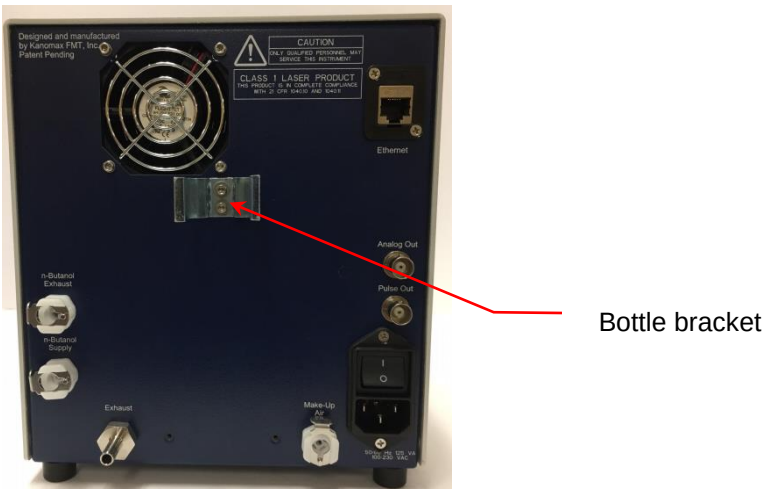
4. Remove the elbow joint fitting. Save the joint and all its component parts for reuse. (Do not lose the O ring.)

5. Connect the bypass inlet to an ion mobility classifier with conditioner or stainless steel tubing.

Connecting the n-Butanol Supply

The fill bottle and bottle bracket are supplied with the Fast CPC. To mount the n-Butanol bracket and fill bottle, follow these instructions:

1. Using a Phillips screwdriver, remove the two screws on the back panel of the Fast CPC (beneath the fan).
2. Using the screws, attach the bottle bracket to the back of the Fast CPC in the position shown below.



3. Snap the provided fill bottle into place in the bracket as shown in the photo below.
4. Insert the fitting on the end of the bottle's lower tube into the **n-Butanol Supply** inlet.
5. Insert the fitting on the end of the bottle's upper tube into the **n-Butanol Exhaust** outlet.

6. Carefully pour n-Butanol into the fill bottle. Do not fill past the n-Butanol exhaust fitting level. The n-Butanol will not flow into the CPC until the connections are made, the instrument is powered on, and the warm-up cycle is complete.
   Warning: n-Butanol (n-butyl alcohol) is flammable and toxic; follow appropriate chemical handling procedures.

Connecting the Exhaust

The air flow containing n-Butanol vapor exits the Fast CPC from the Exhaust port. When operating the Fast CPC in a confined space, vent the exhaust away from the work area using flexible tubing. To vent the exhaust, follow these instructions:

1. Push one end of a length of flexible tubing compatible with n-Butanol onto the **Exhaust** outlet fitting on the back panel.

2. Place the other end of the tubing into a vent hood.

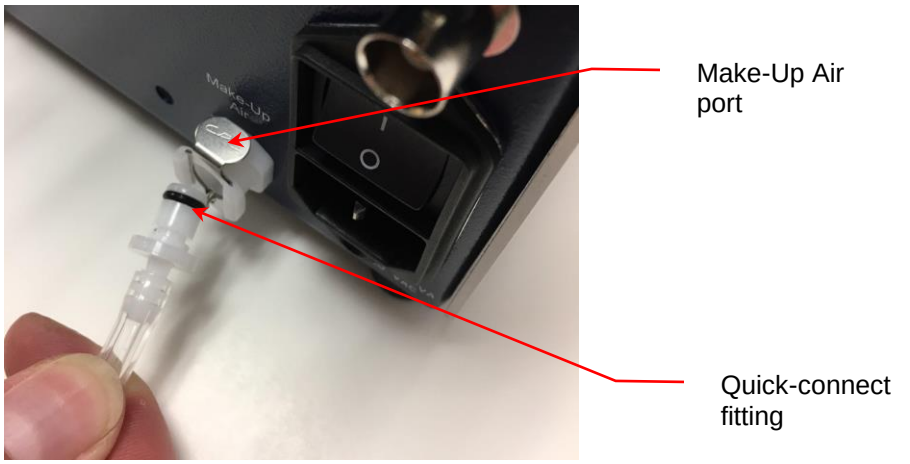
Connecting Make-Up Air

The Fast CPC can be operated in two flow modes. In the high-flow mode the instrument samples at a rate of 1.5 L/min and in the low-flow mode it samples at a rate of 600 ccm. To maintain a consistent flow when operating in low-flow mode, make-up air is drawn in through the Make-up Air inlet at 900 ccm.

Warning: Do not connect the fitting to this port while operating in the high flow mode.

To connect the make-up air supply, follow these instructions:

1. Insert the supplied Quick Disconnect 1/8 in barbed tube to a length of 1/8 inch ID tubing.
2. Push the quick connect fitting into the **Make-Up Air** port.



Connecting the Power

To connect the power supply, follow these instructions:

1. Plug the supplied power cable into the AC plug socket on the back panel of the Fast CPC.

2. Plug the cord into an earth-grounded AC power source (100 to 240 VAC, 50 to 60 Hz, 0.6 A).

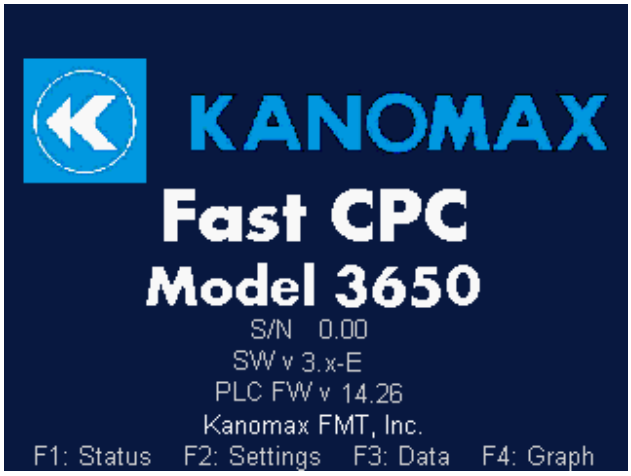
Warning: Ensure that the ground is secure. Connection to an improperly grounded electrical source is a severe shock hazard.

Warming Up the Fast CPC

Using the power switch on the back panel, turn the power on. You see the instrument splash screen (shown below) and the Fast CPC automatically begins its warm-up procedure. Note: The warm-up procedure may take up to 15 minutes. When the warm-up cycle is complete, n-Butanol begins to fill the internal reservoir.

Press **F1** to view the warm-up status on the Device Status screen.

Figure 6: Fast CPC Warm-up Screen.



If you experience any problems installing your Fast CPC, please contact Kanomax FMT, Inc. at 651-762-7762. (Customers in Asia please call +81 6-6877-0183.)

Operation Instructions

Once all installation procedures have been completed, you are ready to begin standard operation of the Fast CPC.

Warning: The n-Butanol (n-butyl alcohol) used to operate the Fast CPC is flammable and toxic; follow appropriate chemical handling procedures.

The Back Panel

Components of the Fast CPC back panel include the following:

- n-Butanol supply and drain ports.
- Power switch.
- Make-Up Air inlet.
- Exhaust port.
- Data Communication ports.

Figure 4: Fast CPC Back Panel.

The Front Panel

Components of the Fast CPC front panel include the following:

- Aerosol inlet.
- Touch-screen display and control buttons.
- USB port

An alternative aerosol inlet is provided on the base of the instrument (to one side) to allow you to connect to an ion mobility classifier.

Figure 5: Fast CPC Front Panel.

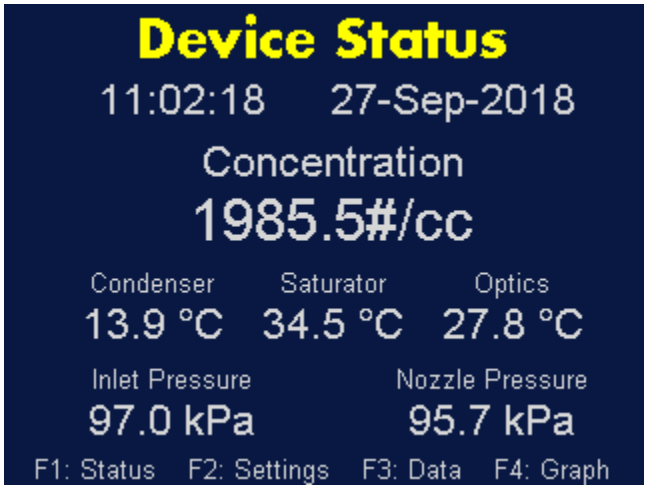
The Fast CPC is operated using the touch-screen display and the F1, F2, F3, and F4 buttons. The F buttons perform the following functions:

- F1: Press **F1** to view instrument status.
- F2: Press **F2** to view/change instrument settings.
- F3: Press **F3** to view/change data collection options.
- F4: Press **F4** to view onscreen graphs.
- System: the **System** button is for factory use only and is non-functional for the customer.

Checking the Status

On the front panel, press **F1** to see the **Device Status** screen. The current time and date (hh:mm:ss, day-month-year) is displayed below the screen heading. Any status readings displayed in red indicate that the status is outside the acceptable range or the set point has not been reached.

Figure 6: Fast CPC Device Status Screen.



The Device Status screen displays the following instrument statuses:

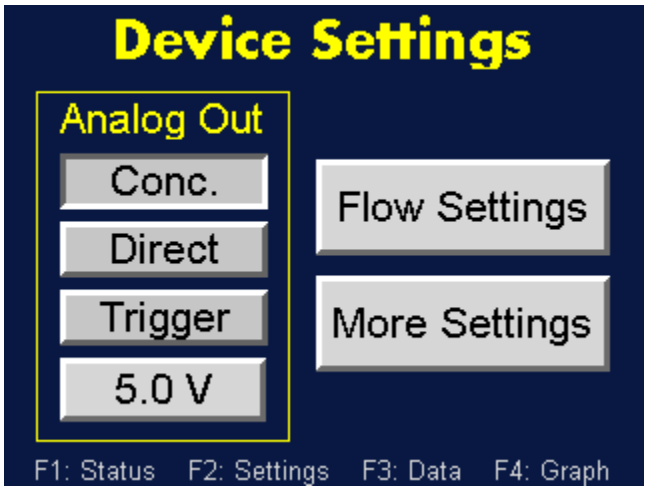
- **Concentration**: Displays particle concentration in particles/cc.
- **Condenser:** Displays the condenser temperature: in °C. The nominal value is 14°C. If the Fast CPC does not reach the operating temperature, place the instrument in a cooler location or a suitable environmental cabinet.
- **Saturator:** Displays the saturator temperature: in °C. 35 °C. If the Fast CPC does not reach the operating temperature, place the instrument in a warmer location or a suitable environmental cabinet.
- **Optics**: Displays the condenser temperature: in °C. The nominal value is 28 °C. If the Fast CPC does not reach the operating temperature, place the instrument in a warmer location or a suitable environmental cabinet.
- **Inlet Pressure**: Displays the inlet pressure in kPa.

- **Nozzle Pressure:** Displays the nozzle pressure in kPa. The nozzle pressure should be approximately 1-3 kPa below the inlet pressure. If the value is outside this range, refer to the troubleshooting section of this manual.

Changing the Instrument Settings

On the front panel, press **F2** to see the **Device Settings** screen.

Figure 7: Fast CPC Device Settings Screen.



The **Device Settings** screen displays the following:

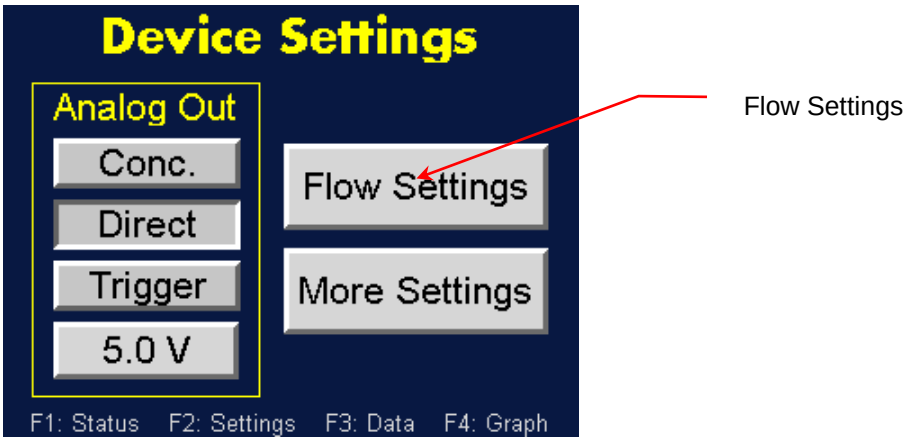
- **Analog Out, Conc:** Sets output voltage as a function of concentration.
- **Analog Out, Direct**: Sets output voltage to the setpoint value.
- **Analog Out, Trigger**: Syncs the analog output with the start of data logging. . When data logging is activated the analog output adjusts to the voltage setpoint.
- **#.#V**: Voltage Setpoint for Direct and Trigger only. Example: 5.0V.
- **Flow Settings**: Allows you to turn off the Butanol, Sample, and Sheath flows On/Off and choose the inlet flow rate.
- **More Settings**: Allows you to set the Date and Time.

Changing the Flow Settings

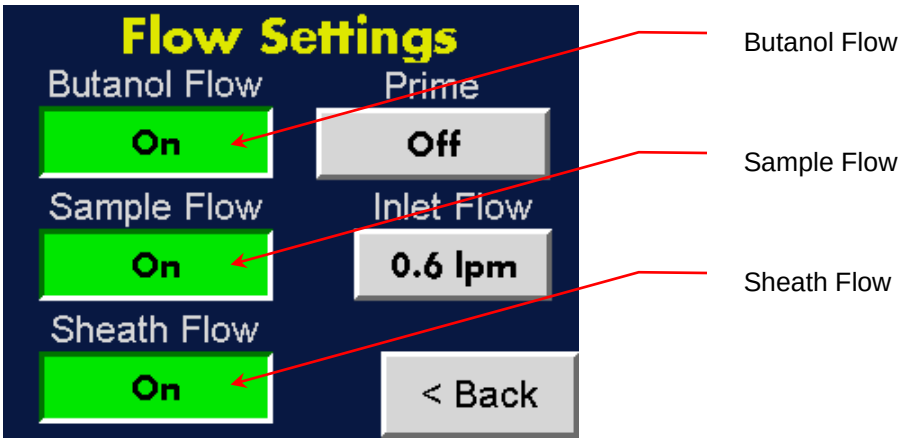
The flow buttons allow you to turn the Butanol, Sample, and Sheath flows On/Off, and to choose the Inlet Flow rate.

To change the flow settings, follow these instructions:

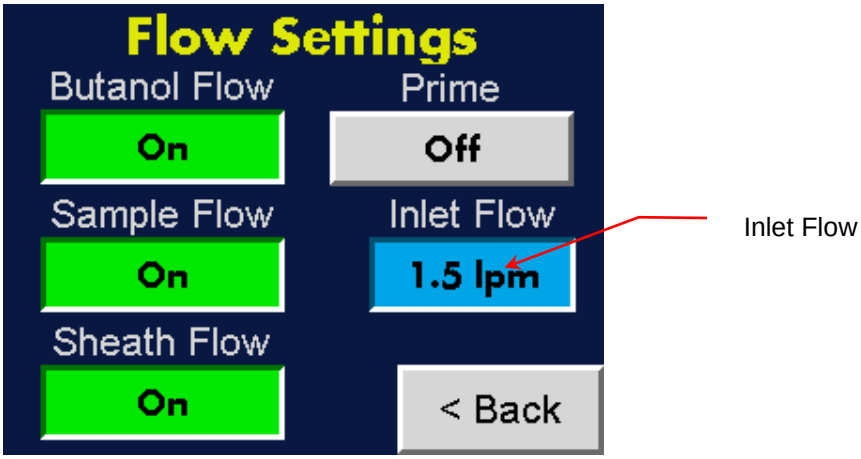
1. Press **F2**.
2. On the Device Settings screen, touch **Flow Settings**.



3. On the **Flow Settings** screen, touch the **Butanol Flow**, **Sample Flow**, and **Sheath Flow** toggle buttons to turn each flow **On/Off**.



4. To switch between high- (1.5 lpm) and low- Inlet Flow mode (0.6 lpm), touch the **Inlet Flow** toggle button. In high-flow mode the button is blue; in low-flow mode the button is gray.

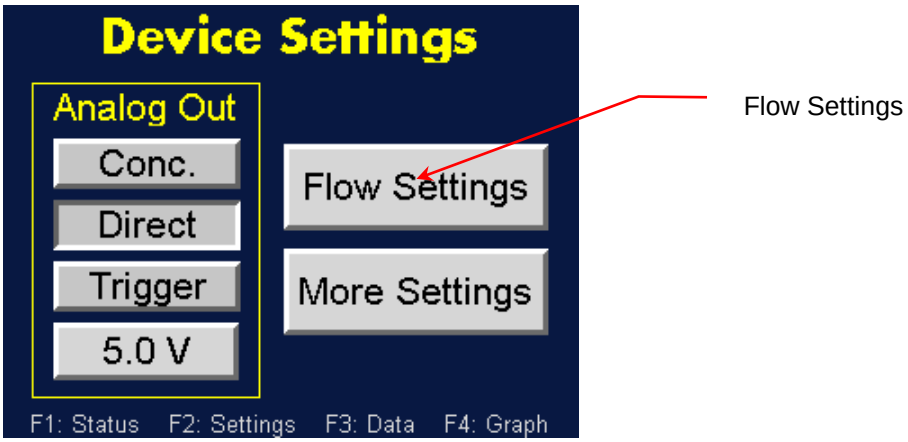


Priming the Flow

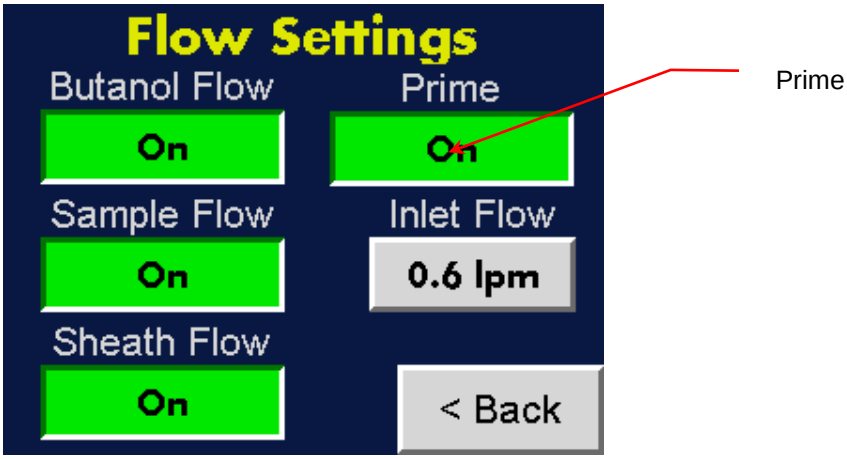
The Prime button allows you to increase the butanol injection rate by 10x to reduce the time needed to fill the butanol pumps and tubing. When Prime is active the injection rate increases by 10x.

To prime the flow, follow these instructions:

1. Press **F2**.
2. On the Device Settings screen, touch **Flow Settings**.



3. On the **Flow Settings** screen, touch the **Prime** toggle buttons to turn the priming function **On**.

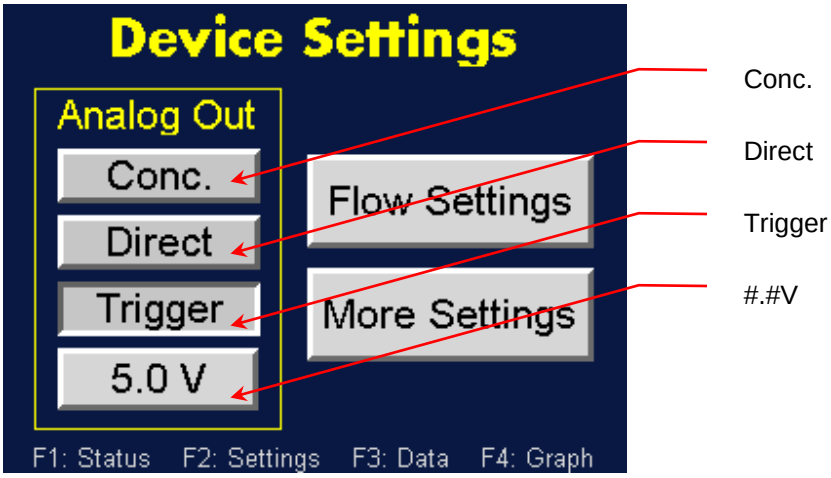


4. When Butanol is consistently exhausted from the instrument, press Prime **On** to turn Off the Prime function. Note: It is normal for bubbles to be present in the Butanol exhaust tubing. Excessive priming may cause flooding in the inlet.

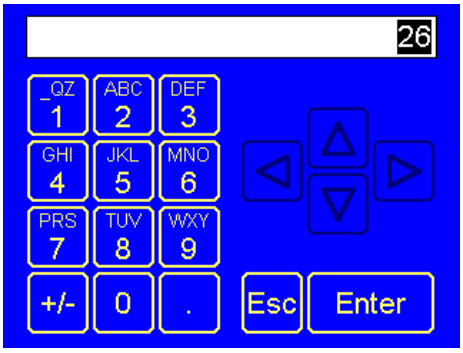
Changing the Analog Out Settings

To change the Analog Out settings, follow these instructions:

1. Press **F2**.
2. On the **Device Settings** screen, to set the Analog Out as a function of concentration touch **Conc**. When **Conc**. is selected the analog output voltage represents the measured particle concentration as Conc = 10^(Volt-3).



3. To set the Analog Out to a user-specified value, touch **Direct**.
4. To sync the analog output with the start of data logging touch **Trigger**. (See Data Collection and Data Plotting on page 27 for more information.)
5. To set the output voltage, touch the #.#V button. Use the on-screen keypad to enter a value for any of the parameters you wish to change, then touch Enter.

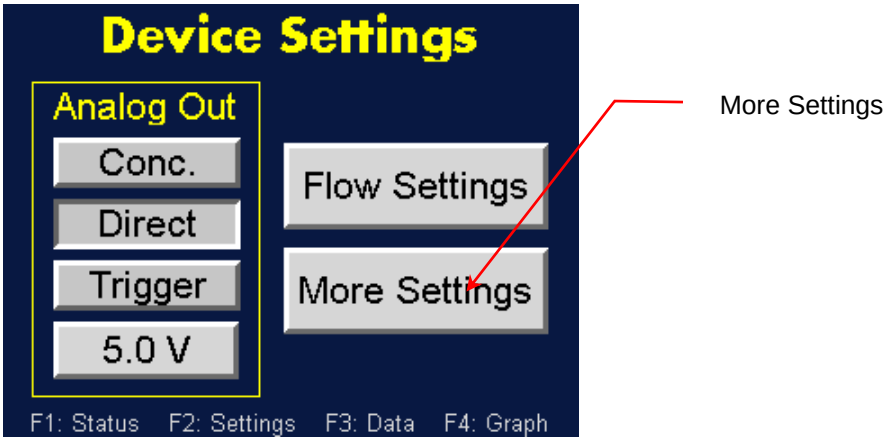


Note: △ ▽ buttons index the temperature. ◁ ▷ buttons set the cursor. ± sets the sign on the number.

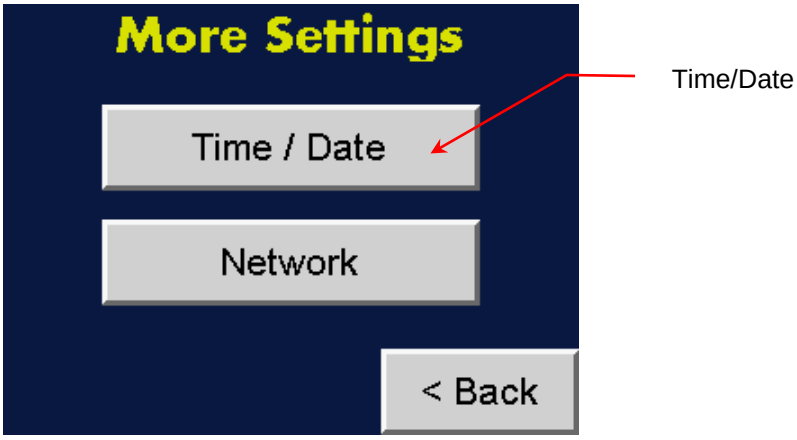
Changing the Date and/or Time

To change the date and time, follow these instructions:

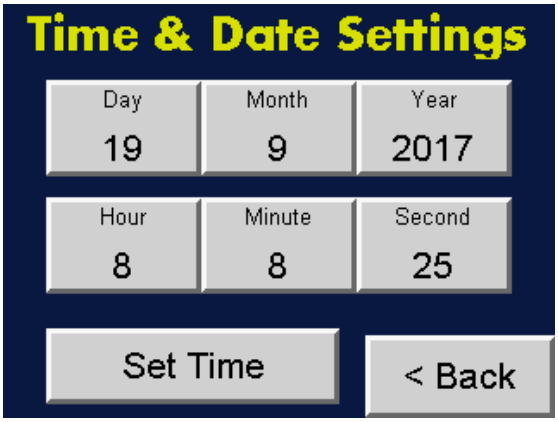
1. Press **F2**.
2. On the **Device Settings** screen touch **More Settings.**

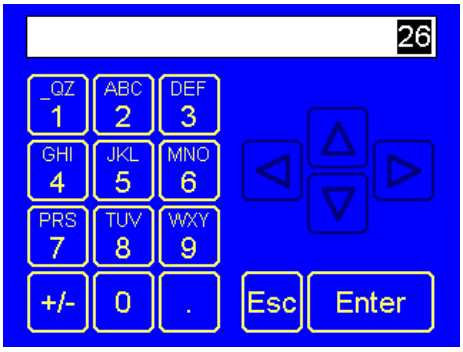


3. On the **More Settings** screen touch **Time/Date**.



4. On the **Time & Date Settings** screen, touch **Day** to change the day, **Month** to change the month, **Year** to change the year, **Hour** to change the hour, **Min** to change the minutes **and Sec** to change the seconds. Use the on-screen keypad to enter a value for any of the parameters you wish to change, then touch **Enter**.





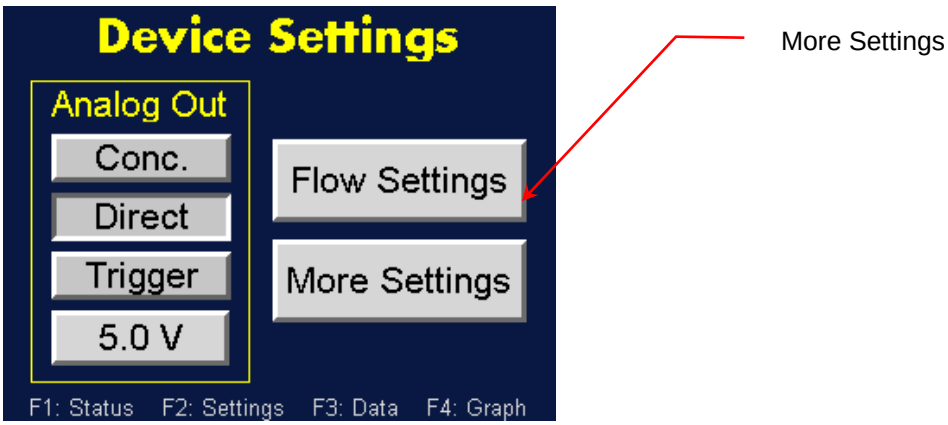
Note: △ ▽ buttons index the temperature. ◁ ▷ buttons set the cursor. ± sets the sign on the number.

5. Press **Set Time**. The date and time appear below the heading on the **Device Status** screen.

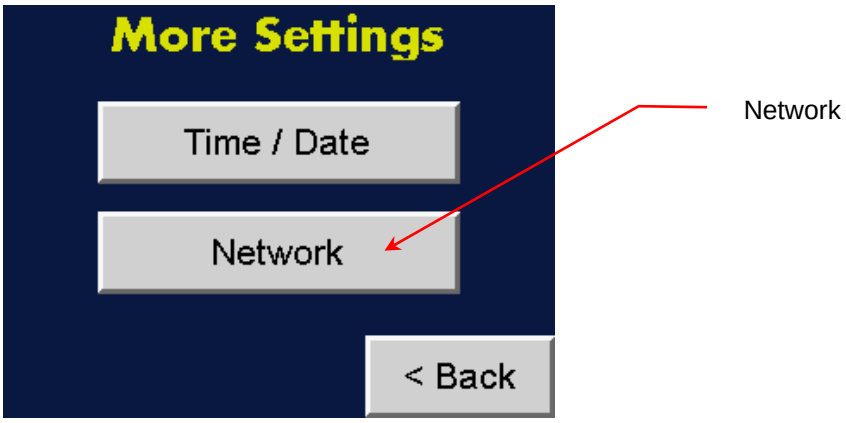
Changing the Network Settings

To change the network settings, follow these instructions:

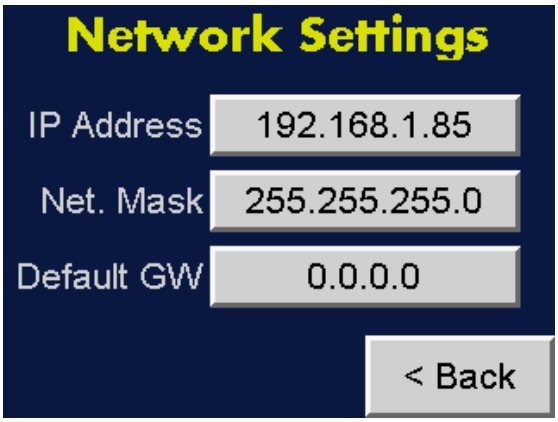
1. Press **F2**.
2. On the Device Settings screen touch **More Settings**.

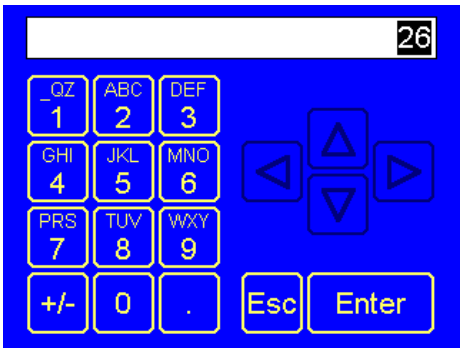


3. On the More Settings screen touch **Network**.



4. On the Network Settings screen use the on-screen keypad to enter a value for any of the parameters you wish to change, then touch **Enter**.



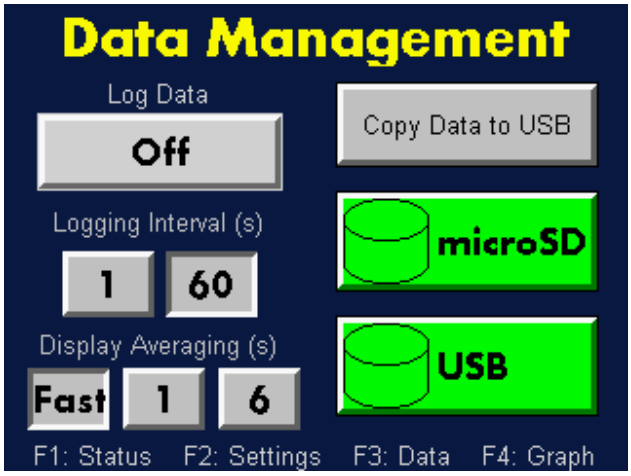


Note: △ ▽ buttons index the temperature. ◁ ▷ buttons set the cursor. ± sets the sign on the number.

Data Collection and Data Plotting

On the front panel, press **F3** to see the **Data Management** screen.

Figure 8: Fast CPC Data Management Screen.



The **Data Management** screen allows you to do the following:

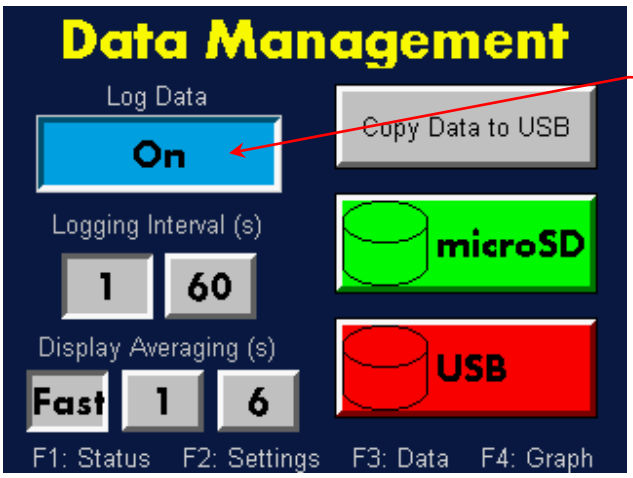
- **Log Data:** Turn data logging on/off.
- **Logging Interval(s)**; Set the data logging intervals.
- **Display Averaging(s)**: Set the averaging time for the display.
- **Fast:** Updates the display at the maximum sampling rate (~20 ms/sample).
- **Copy Data to USB**: Start the process of transferring data to a Flash Drive.
- **microSD**: Manage internal data storage.
- **USB:** Format a USB drive.

When the data logging function is turned on, the Fast CPC stores status data in its internal memory. You can transfer the stored data to an external Flash memory drive.

Turning Data Logging On/Off

To turn data logging on/off, follow these instructions:

1. Press **F3**.
2. On the **Data Management** screen touch the **Logging On/Off** toggle button to turn data logging On or Off.

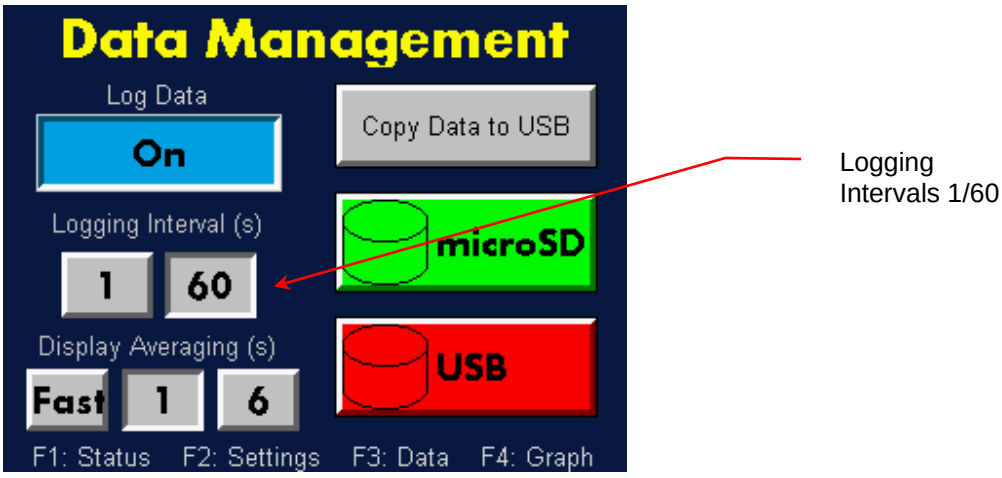


Changing the Data Logging Intervals

You can select either 1 or 60 for the data logging time interval (in seconds). Selecting **1** records a row of data every second with 20 ms concentration readings; selecting **60** records a row of data every second with 1 s concentration readings. Note: the 1 s concentration readings are dead-time corrected but the 20 ms concentration readings are not dead-time corrected. The depressed button indicates the current selected interval.

To change the intervals, follow these instructions:

1. Press **F3**.
2. On the **Data Management** screen, press either **Logging Interval(s) 1** or **Logging Interval(s) 60.**

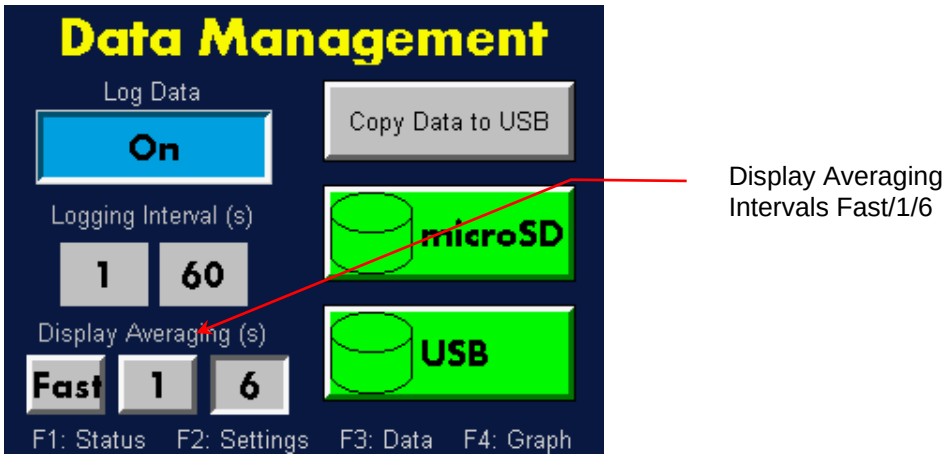


Changing the Display Averaging Intervals

Display averaging selects the number of concentration readings to average for the display. You can select either 1 (concentration is averaged over 1-second intervals) or 6 (concentration is averaged over 6-second intervals). It does not affect the logged values. The depressed button indicates the current selected interval. Selecting Fast updates the display at the maximum sampling rate (~20 ms).

To change the display averaging, follow these instructions

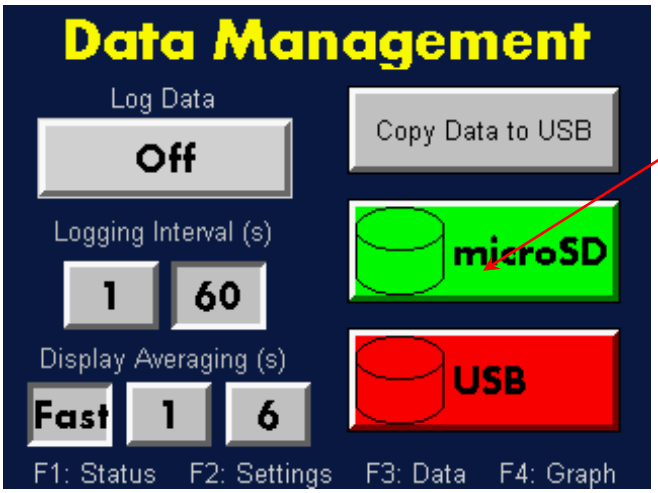
1. Press **F3**.
2. On the **Data Management** screen, press either **Fast**, **Display Averaging (s) 1** or **Display Averaging (s) 6**.



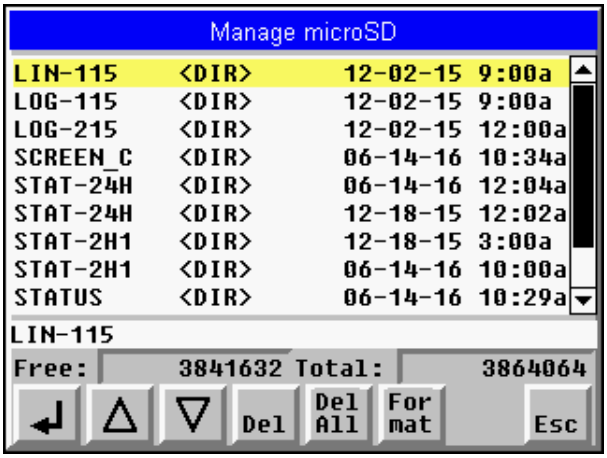
Managing Internal Memory

To manage the internal memory you can view the data record files, check the available memory and the total memory used, format the drive, and delete the stored data. To manage the stored data, follow these instructions:

1. Press **F3.**
2. On the **Data Management** screen touch **microSD**.



3. A list of data folders is displayed on the Manage microSD screen. Use the △▽ arrows to scroll between the folders and then press ↵ (Enter) to see the contents of the folder. Note: The data files for each day that data was collected are displayed in comma delimited records.
   Free: indicates the amount of memory available in kB.
   Total: indicates the memory usage in kB.
   Del deletes the selected folder or data file.
   Del All deletes all folders or data files.

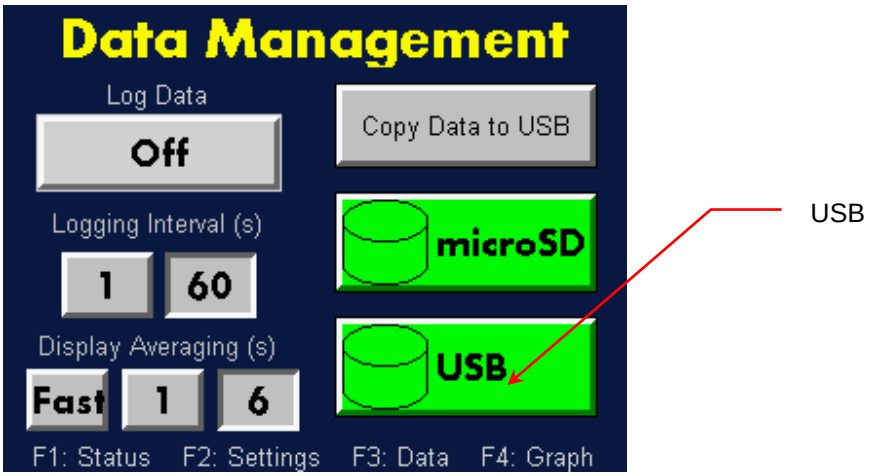


Formatting a USB Drive

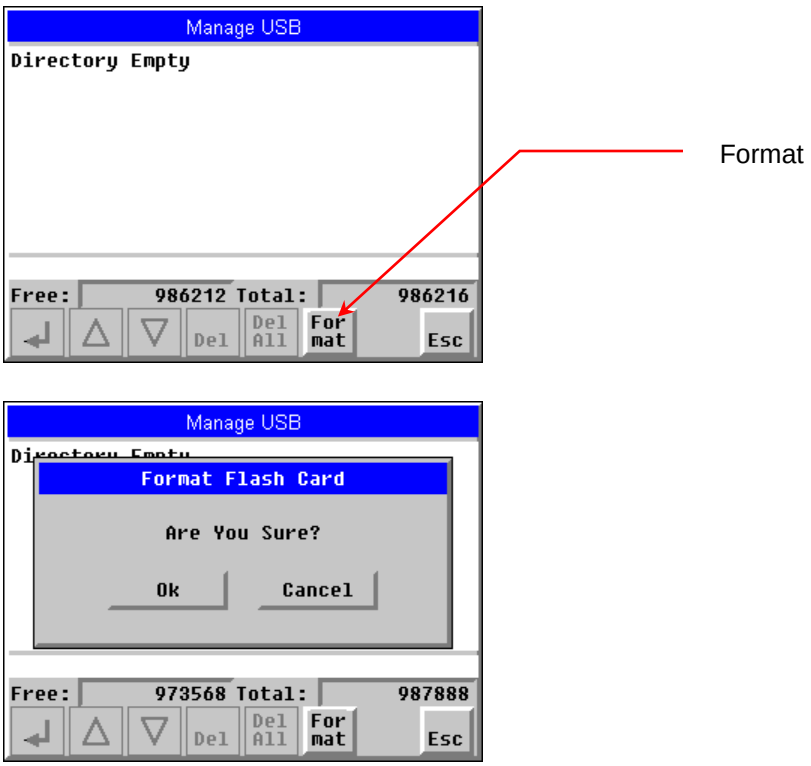
To format a USB drive, follow these instructions:

1. Insert a Flash Memory drive into the USB port on the front panel of the Fast CPC.

2. Press **F3**.
3. On the **Data Management** screen touch **USB**.



4. On the **Manage USB** screen touch **For/mat**, then touch **OK.** Touch **Cancel** to cancel the formatting. Note: Any data stored on the USB drive will be erased.

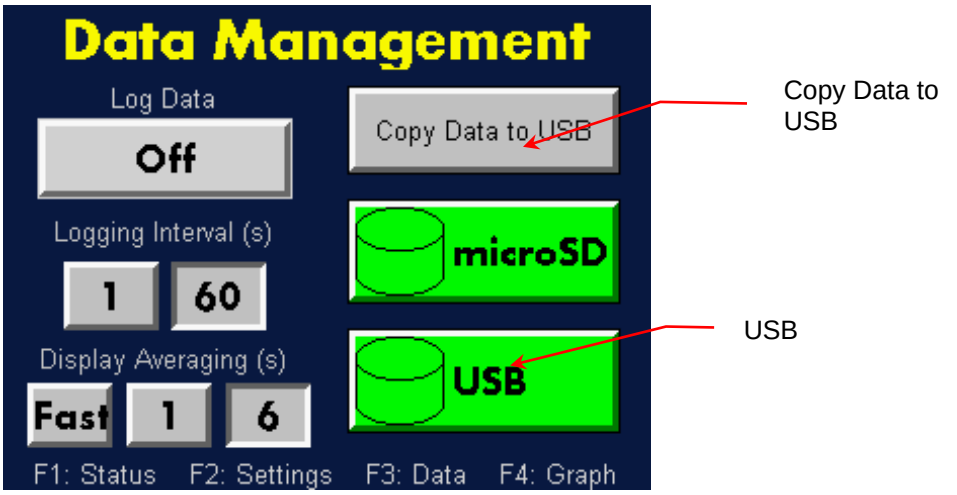


Transferring Data to a USB Drive

The Fast CPC stores status data in its internal memory. You can transfer the stored data to an external Flash memory drive. To complete the transfer, follow these instructions:

1. Insert a Flash Memory drive into the USB port on the front panel of the Fast CPC.

2. Press **F3**.
3. On the **Data Management** screen touch **USB** to see a list of any files stored on the Flash Memory drive. Review the files and delete any you do not need.



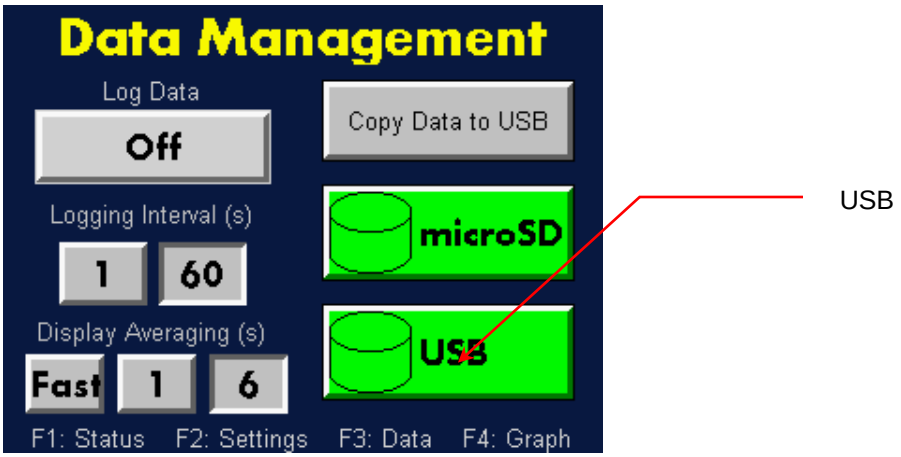
4. Touch **Copy Data to USB** to transfer the data files to the Flash Memory Drive. The button will remain green as long as the data is transferring.
5. After transferring the data the files are contained in a folder named **FCPC** on the Flash drive. The files have the following names (depending on whether 1 or 60 s logging intervals were selected).

   FCPC\FASTCPC000000__20180927_1-SEC.CSV
   FCPC\FASTCPC000000__20180927_1_MIN.CSV

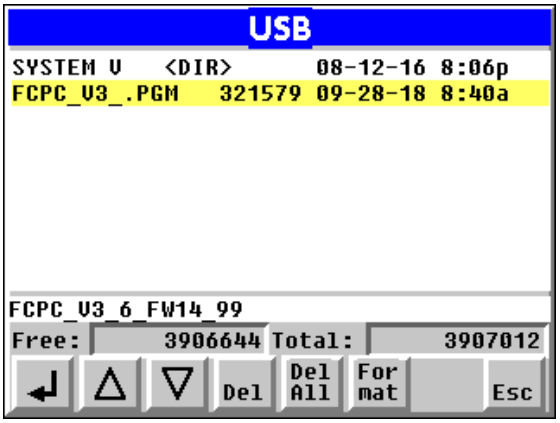
Updating the Firmware

To update the firmware (when instructed by KanomaxFMT), follow these instructions:

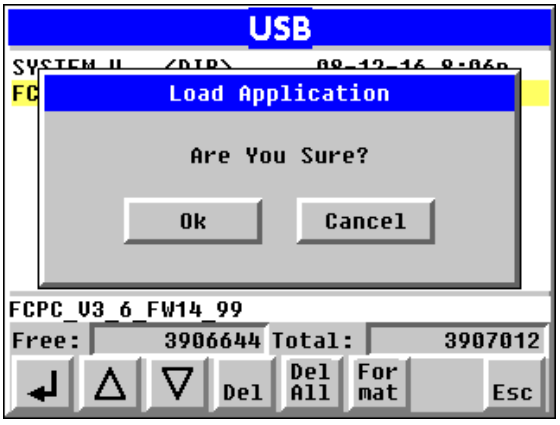
1. Copy the *.pgm file supplied by KanomaxFMT to a Flash memory drive.
2. Insert the Flash drive into the USB port on the front panel of the FastCPC.
3. Press **F3** on the front panel of the FastCPC.
5. On the **Data Management** screen touch **USB**.



4. On the **Manage USB** screen use the up/down arrows to select the *.pgm file.



5. Press the ↵ key.
6. Press **OK** to load the application when prompted.

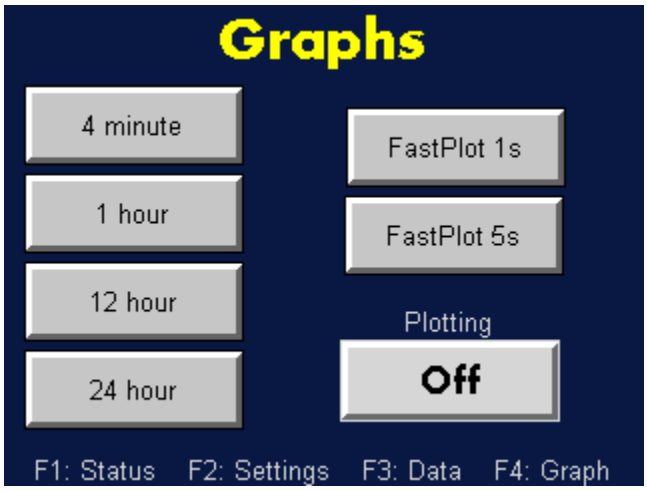


7. Press **OK** to put the FastCPC back into run mode.
8. Power cycle the FastCPC.

Viewing Graphs

On the front panel, press **F4** to see the **Graphs** screen.

Figure 9: Fast CPC Graphs Screen.



The Fast CPC can display the following graphs:

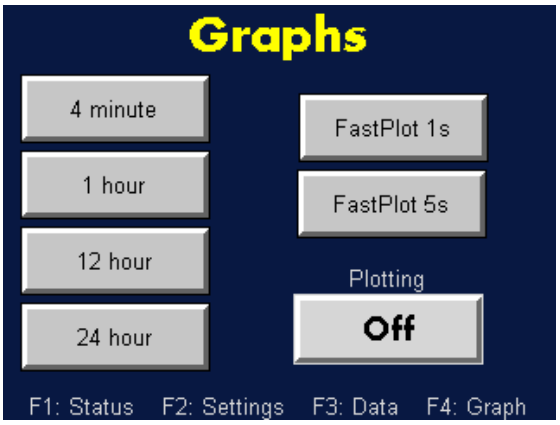
- **4 minute:** Trend graph showing particle concentration over a four-minute period.
- **1 hour**: Trend graph showing particle concentration over a one-hour period.
- **12 hour**: Trend graph showing particle concentration over a 12-hour period.
- **24 hour**: Trend graph showing particle concentration over a 24-hour period.

The following fast plotting functionality is available:

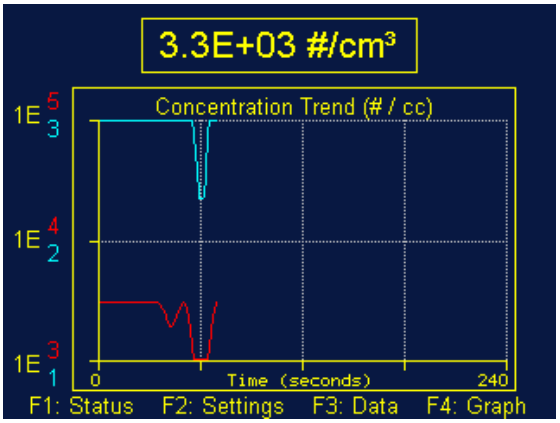
- **Fast Plot 1s**: Plots and logs data at 20 mS intervals for 1 second.
- **Fast Plot 5s**: Plots and logs data at 20 mS intervals for 5 seconds.

To view graphs, follow these instructions:

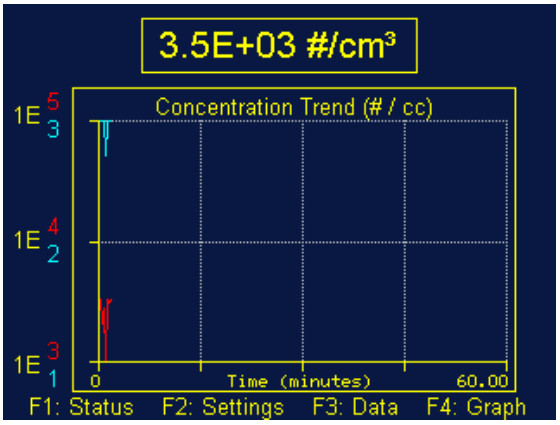
1. Press **F4** to see the **Graphs** screen.



2. Touch any of the buttons on the left to see the relevant trend graph. For example, touch **4 minute** to see a trend of particle concentration over a four-minute period. The y-axis is in a log scaling with the exponent corresponding to each trace by their color.



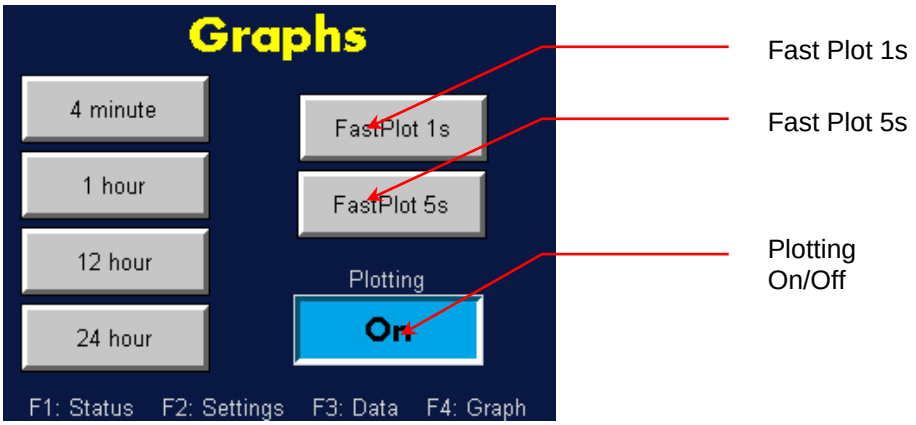
Or touch **1 hour** to see a trend of particle concentration over a one-hour period.



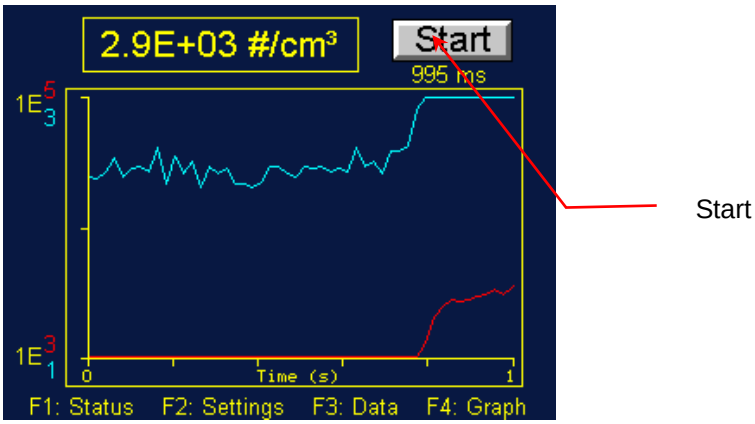
Using the Fast Plot Function

To use the Fast Plot function, follow these instructions:

1. Press **F4**.
2. On the **Graphs** screen, to enable plotting, touch **Plotting On/Off**.
3. On the **Graphs** screen, touch either **Fast Plot 1s** or **Fast Plot 5s**.



4. On the resulting graph screen, press **Start**. This begins data logging but the logging function ends after 1 second or 5 seconds (depending upon which option you selected). If **Trigger** was selected on the Device Settings screen, the analog output is synced with the Start button.



How to Shut Down the Fast CPC for Moving or Shipping

If you need to move the Fast CPC to another lab or facility, or ship it for service, read this section to familiarize yourself with the precautions you should take and the procedures you should follow.

Performing any of the following improper handling techniques may damage the instrument and will invalidate the warranty:

- Do not operate the Fast CPC at angles greater than >15°.
- You must drain the Fast CPC before you ship it. Do not ship an undried/undrained device back to Kanomax FMT, Inc.: doing so might damage the device and invalidate the warranty.
- Do not subject an undrained device to freezing temperatures: doing so might damage the device and invalidate the warranty.

To prepare the Fast CPC for shipping, follow these instructions:

1. Disconnect and remove the n-Butanol fill bottle then empty it into an appropriate container. (Note: To preserve the n-butanol, swap the supply and exhaust connections so that the supply is drawing from the top of the bottle and the exhaust is feeding the bottom.)
2. Set the butanol flow in Prime mode.
3. Place the empty bottle back in the bracket and reconnect.
4. Operate the Fast CPC until the counts on the **Device Status** screen read 0.
5. Disconnect the aerosol supply from either the **Aerosol In** fitting on the front panel or from the high-performance aerosol inlet (beneath the instrument).
6. Disconnect the exhaust and make-up air tubing.
7. Replace the aerosol inlet adapter elbow if not already in place.
8. Turn off the power and unplug the power cable.
9. Place all the caps that you received with the instrument on the inlets and outlets to prevent contaminants from entering the instrument. **Note:** If you did not save the original protective caps, find suitable alternatives.
10. The Fast CPC is now prepared for shipping or moving.
11. Place the instrument in its original packing materials for shipping.

If you have any questions about shipping or moving the Fast CPC, contact Kanomax FMT, Inc. at 651-762-7762. (Customers in Asia please call +81 6-6877-0183.)

Data Acquisition

Analog Out and Pulse Out

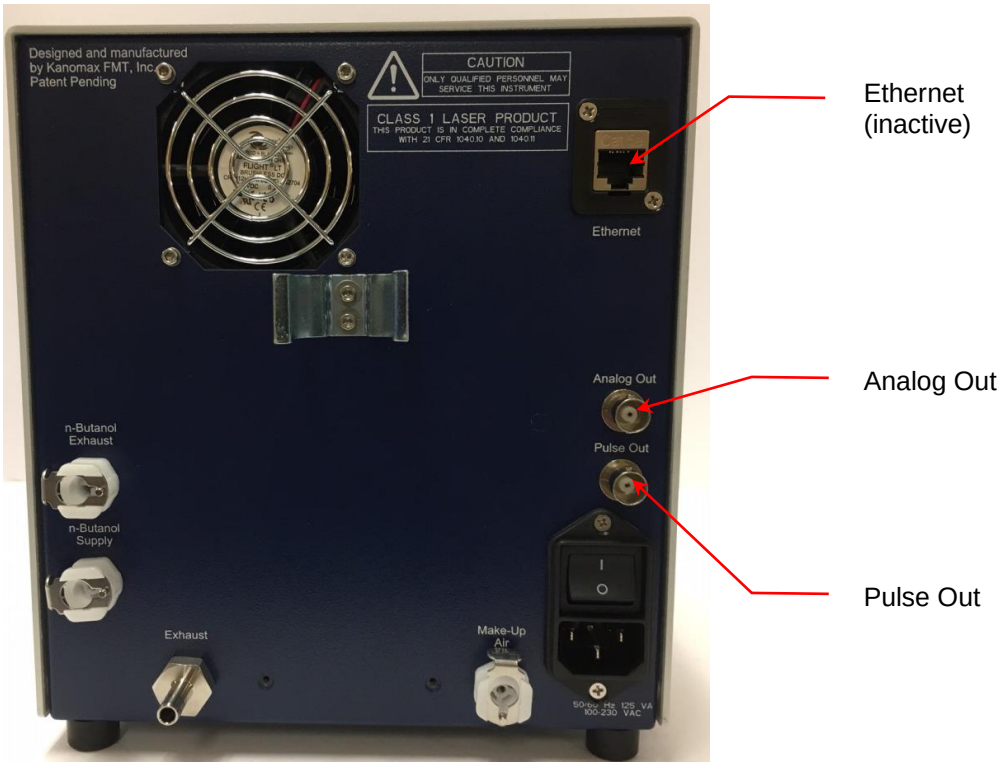
Figure 10 below shows the communication ports on the Fast CPC back panel.

Analog out output (0-10 VDC) is set using the Output button on the **Device Settings** screen. (See information in Changing the Output beginning on page 22.)

Pulse Out provides a 5-volt digital pulse for each particle detected.

Note: Functionality for the Ethernet connection will available through a future firmware update.

Figure 10: Fast CPC Data Communication Ports



USB

The USB port is located on the front panel of the Fast CPC. Status data can be transferred from the Fast CPC to a Flash Memory drive inserted into the USB port. (For detailed instructions see page 30.)

Troubleshooting

All repair and maintenance of the Fast CPC must be performed by a qualified service technician. When working with the Fast CPC:

- Do not remove any parts from the instrument unless this manual tells you to do so.
- Do not remove the instrument housing or covers while power is supplied to the instrument.

Problem	Cause	Action
Fast CPC not counting particles.	Laser diode or fill pump failure.	Contact Kanomax FMT, Inc.
Fast CPC not zeroing.	n-Butanol in the sheath line.	Operate the instrument as normal for several hours to clear the n-Butanol from the line.
Inlet flow out of range.	Make-up air port is leaking or has a fitting connected to the atmosphere	Confirm that the **Make-Up Air** fitting is disconnected.
Inlet flow out of range.	Pump failure or clogged flow orifice	Contact Kanomax FMT, Inc.
Low counts.	Water in n-Butanol.	The n-Butanol contains water. Empty the bottle and refill with new n-Butanol.
Nozzle Pressure >3.	Nozzle may be obstructed.	Contact Kanomax FMT, Inc.
Water collecting in n-Butanol supply bottle.	Bottle not drained before refilling (topping off leads to excess water).	Water and n-Butanol are not miscible; you can see a partition between the liquids when high levels of water are present. Ensure that the bottle is completely empty before refilling.

Appendix A: Fast CPC Model 3650 Specifications

Particle Size detection	1.9 nm to > 3 μm
Concentration range	1 – 100,000 particles/cm^3
Response time	50% response time ~ 80 ms, 10-90% response time ~ 35 ms, time constant (τ) ~ 20 ms
Working condensing fluid	n-butyl alcohol
Flow control	Critical orifices with internal pumps
Aerosol sample flow	300 cm^3/min
Inlet flow	600 or 1500 cm^3/min (user selectable)
Sheath flow	300 cm^3/min
Aerosol inlet	Front panel or vertical from the bottom (user selectable, fitting access on right side of instrument)
Dimensions (WxDxH)	8.5″ × 7.5″ × 8.5″ (21.6 cm × 19 cm × 21.6 cm)
Weight	6.8 kg (15 lb)
Power requirements	50/60 Hz, 100-220 VAC, 75 Watts
I/O	RJ-45 with Ethernet (future), , pulse output and user selectable analog output

Specifications subject to change without notice.

Index