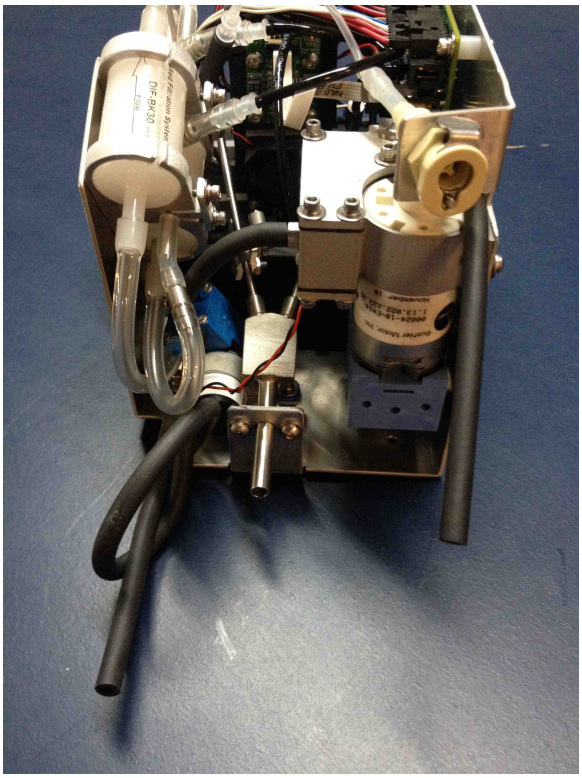
BRECHTEL



MCPC

MIXING CONDENSATION PARTICLE COUNTER

MODEL 9403 aMCPC SYSTEM MANUAL (Supplement to Model 1720 MCPC manual)

BMI PN 83-00027-01 Rev 3

Contents

1 Unpacking

Each MCPC receives thorough testing and inspection at the factory to ensure your instrument is ready for operation when you receive it. Inspect the packaging before opening. If the packaging is damaged and/or the shock watch has been tripped, contact and notify the shipping company immediately.

If the packaging does not show signs of damage, after carefully opening, inspect the instrument for broken parts, scratches, dents or other signs of damage incurred during shipping. **Notify BMI within 2 days of receiving package if ShockWatch has been tripped.**

Verify the contents of the shipment with the unpacking instructions, which are included both with the instrument and as a separate .pdf. **Retain all shipping packaging, foam inserts and cushions to ensure a safe delivery should the instrument need to be returned.**

2 Model 9403 MCPC Overview

Refer to the Model 1720 MCPC manual that was shipped with your unit. Almost all of the features are identical between the Model 1720 MCPC and Model 9403 MCPC. Only key differences are described here.

Unlike the Model 1720 MCPC, the Model 9403 MCPC includes:

1. integrated vacuum pump
2. integrated mounting bracket
3. redesigned main board electronics to reduce size
4. Larger saturator to hold a greater volume of liquid butanol
5. A unique serial command to allow all pumps to be turned off remotely

3 Installation

3.1 Mounting

The MCPC is shipped integrated with a mounting bracket that has holes for mounting bolts (figure 1). Alternatively, the unit can simply be placed on a table top. DC power, serial and USB communications, and other main PC board connectors are shown in the figure. The UAV MCPC ships with an external display that is not necessary for operation but is convenient to monitor instrument operating parameters. The ribbon cable and display may be disconnected from the main board after steady-state operation has started. Do not plug in the display ribbon cable while power is on. Threaded standoffs may also be used to mount the unit to a shelf. Be sure to employ atleast four hard mounting points to properly support the MCPC. Bolts should not extend into the cover so much that they would interfere with the main control board connections. Mount the unit for easy access to the butanol fill connector and main PC board edge connectors.

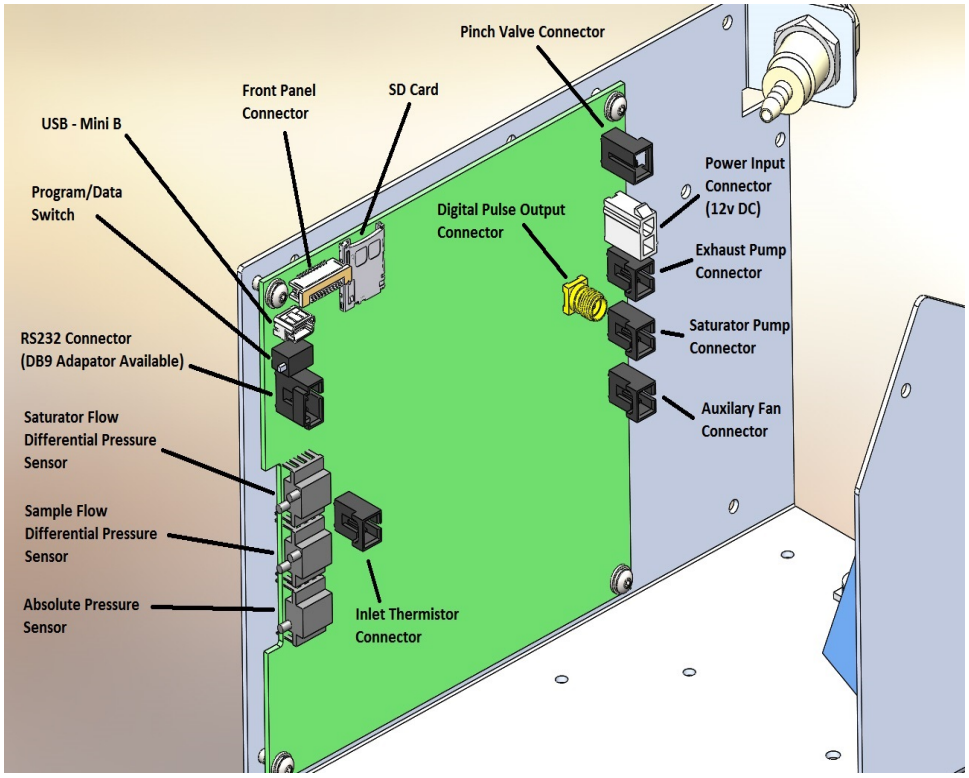


Figure 1: View of UAV MCPC main PC board showing various electrical connections.

3.2 Connecting plumbing

The sample line inlet tube (figure 2) delivering particles to the MCPC should be connected to the 0.25 inch outside diameter stainless steel inlet tube. The sample volumetric flow is accurately measured with an in-line LFE just downstream of the inlet tube. The LFE differential pressure monitoring ports are connected to the small differential pressure sensor

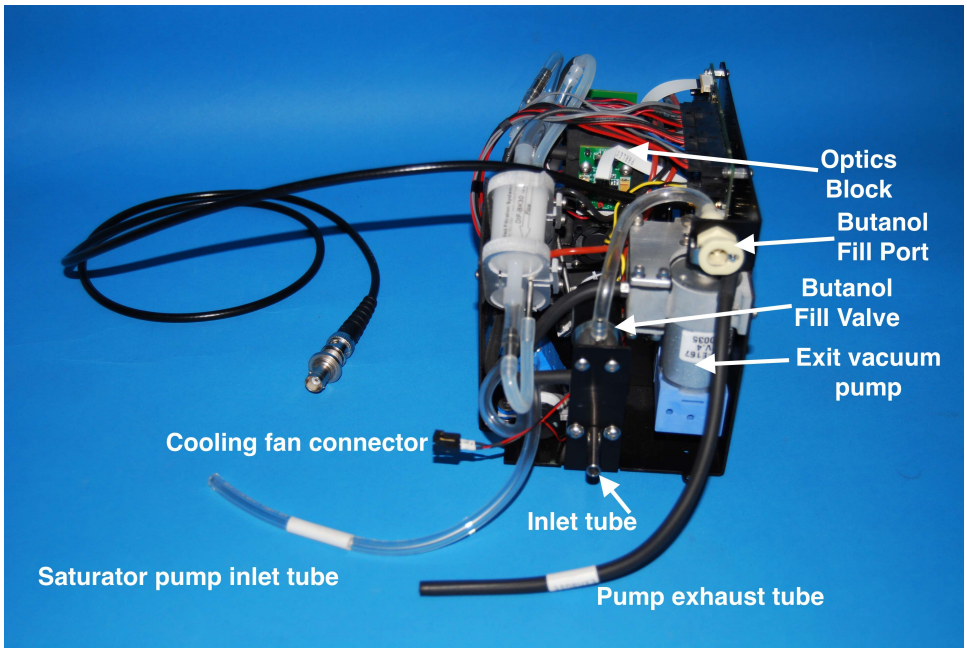


Figure 2: Front view of MCPC showing the liquid butanol fill connector and the metal sample inlet tube connection.

shown in the PC board figure above. The LFE thermistor is attached to the LFE so a proper temperature correction can be applied to the LFE-measured volumetric flow. Absolute pressure is measured using a barbed fitting that taps into one of the LFE pressure tubes. No vacuum pump connections are necessary as the exit vacuum pump is integrated with the MCPC. The various air flow filters and shown in the side view below.

The exhaust from the MCPC (black tubing in figure 2) should be directed away from the inlet. Take care not to install tubing on the exhaust that will create a high pressure drop on the line, as the flow control performance will be degraded and the pump may be damaged. Always route the pump exhaust so it vents at roughly the same pressure conditions as the sample inlet, otherwise the pump may not function properly. Always route the exhaust from the unit to a well vented location as it contains butanol vapor. If you need to operate the unit in a pressurized cabin during research or other flights, contact Brechtel, as non-standard pumps may be required. Connect the cooling fan provided to the cooling fan connector and mount the fan in a location where it will blow cooling air into the middle of the unit, focusing on the condenser area.

3.3 Connecting the power

To facilitate the use of a battery to power the MCPC, DC voltages between 10 and 15 Volts may be used and should be connected to the Molex power in connector provided with the unit. Any AC adapter with an output of 12 Volts DC at 8 AMP (start-up current) can be used to power the MCPC. Be sure to connect the provided display ribbon cable to the main board before applying power if the instrument will be configured using the user interface via the display. Once the unit is warmed up, the current consumption is reduced. The instrument

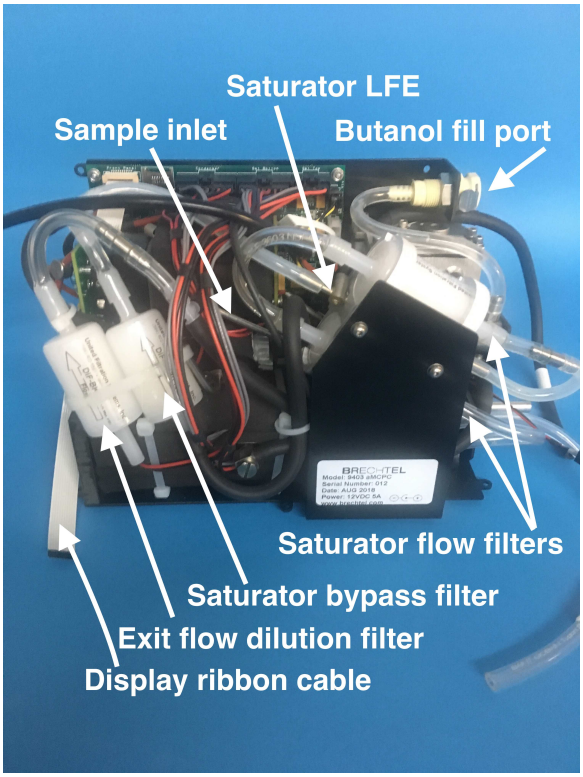


Figure 3: Side view of aMCPC showing various components.

firmware automatically runs when power is connected. **Ensure the power plug is fully seated in the connector before connecting the instrument to a computer. Do not connect the display cable to the main board after power has been applied to the main board.**

3.4 Connecting to a computer

The MCPC may be furnished with an optional tablet, or you may use your own Windows computer to connect to the MCPC. A computer is not necessary to operate the MCPC, however, the Brechtel user interface (UAV Reader) software is an easy way to interact with the instrument, and will record, save, and display data in real time. Raw serial communication is also supported. An RS-232 to USB adapter cable is included with the instrument.

1. Plug the short RS232-to-mainboard connector cable into the mainboard.
2. Connect the serial-to-USB adapter cable into RS232 connector attached to the mainboard and the USB end into the computer (figure 1). **Failure to tighten the thumb screws on the COM cable may result in loss of communication with the PC.**
3. Start the MCPC control software (see instructions below).

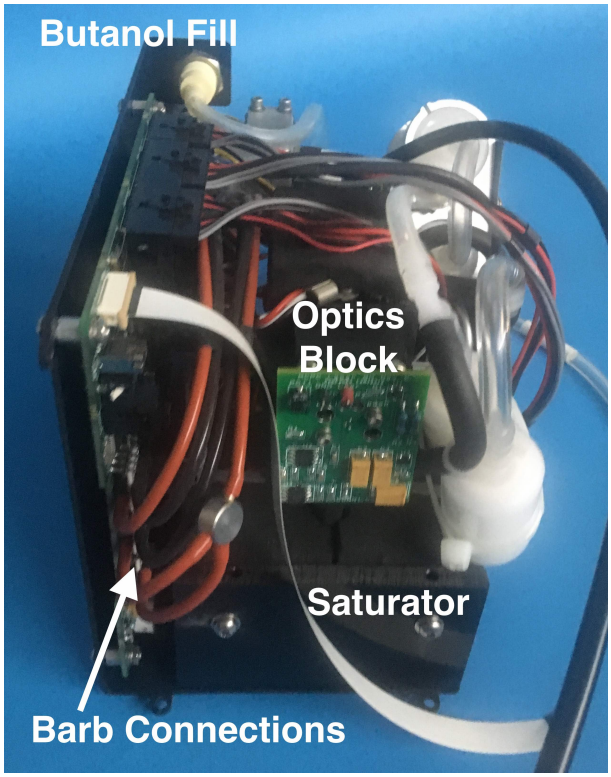


Figure 4: Rear view of aMCPC showing various components.

3.5 Filling Butanol

1. The unit must be powered ON to add liquid butanol and flow rates should be at nominal values.

2. Connect a full butanol bottle to the butanol fill port.

3. Hold the butanol bottle above the level of the fill port to allow butanol to flow into the unit until the FillCnt value stays at zero.

4. Up to three or four filling cycles may be required to fully charge the unit with butanol. Leave the bottle connected. The FillCnt value may drop to zero for a few seconds and then begin increasing again. Leave the bottle connected until the FillCnt value stays at zero for atleast 3 minutes. You should hear the solenoid valve click open and closed during filling.

5. Disconnect the butanol bottle.

6. With a full saturator the unit should count particles for a minimum of 8 hours before requiring more butanol.

4 Operation with MCPC Graphical User Interface Software

The same MCPC Reader program that reads, plots and save data from the Model 1720 MCPC will also function with the Model 9403 MCPC. The Labview-based executable runs in a Windows environment and can be furnished on an optional tablet computer or loaded on a Windows-based computer you already own. Please refer to the Model 1720 manual for details on the software. Alternatively, Brechtel offers a UAV Reader Software that allows control of and interaction with multiple UAV instruments at once.

4.1 Output Data Format

The control software saves collected data locally to the SD Card on the main PC board. The firmware defaults must be set to save data to SD card if desired and a SD card must be installed. A detailed description of the data file contents is provided in the Model 1720 MCPC manual. The .txt files contain both raw data directly from the instrument as well as data with processing applied by the control software. The data files may be opened with any text editor. Please refer to the Model 1720 user manual for a detailed description of the data file format and naming convention.

5 MCPC Model 9403 Specifications

Category	**Value**
D50	8 nm
Maximum Concentration	100,000/cc
Sample flow rate	0.36 or 0.72 LPM
Response Time	180 milliseconds
Background	0.001/cc
Fluid Use	1.9 ml/hour (n-Butanol)
Operating Pressure	0.2-1.0 atm (special pumps may be required for low pressures)
Dimensions (L × W × H)	8.0in × 5.8in × 5.3in
Weight	1.0 kg (2.2 lbs)
Power Consumption	50 W @ 12 VDC
Mounting	Multiple hard mounting points through metal body bracket.
Serial communications	RS232, 9600-115000 baud, no parity, 8 data bits, 1 stop bit.

6 RS-232 Commands

RS-232 communications may be used to communicate with the unit directly. Refer to the Model 1720 MCPC manual for details on the communication protocol and commands. When communicating serially with the unit, be sure to set the communication settings in the unit to the match those used by your communication software.

Commands are issued over-the-wire by transmitting the command as ASCII text, followed by a carriage return and line feed. In most serial communications software, this can be accomplished by simply typing the command and pressing the <Enter> key. The only additional command available for the UAV version of the MCPC allows the user to turn the internal vacuum pump on and off, which can be useful when the instrument is turned off to save battery power during UAV flights. The command syntax is 'mcpc=0' to turn pumps off, and 'mcpc=1' to turn pumps on.

7 Trouble-shooting Tips

7.1 Leaks

The main issue arising during operation is particle leaks. Be sure to use TWO filters in series whenever leak checking the unit as a single filter may allow particles to pass through. The leak could be in many places depending on which tubing might have been disconnected/reconnected, shock during shipping, tipping resulting in flooding of the optics block, etc.

If the unit was not leaking at one time and then started leaking the question to answer is: what was changed or what happened to the unit between those times? For example, if the unit was shipped, then it's important to go through each barbed tube connection and make sure the tubes are properly seated on the barbs. If the unit was flooded, then the optics could be dirty from residues left after drying and this could look like a leak but is in fact just artifact light produced in the optics block that is detected as particles. This "virtual" leak will NOT get worse if you expose the unit to higher outside concentrations.

In some cases, especially during high vibration or shock exposure, the butanol solenoid valve can strike the flexible plastic tube connected to the sample inlet LFE and cause a puncture.

Other areas to check for leaks include:

1. The small pressure sensors along the back edge of the board have small barbs and the tubing sometimes can come loose resulting in a leak. Carefully push the tubing over the barbs to reseat the tubing. It may help to pull one tube off at a time and cut the last 0.5cm of length from the tube and then reseat it on the barb to create a tighter connection.

2. Confirm that the splitter "Y" fitting on the sample LFE flexible tube is not cracked (this splitter allows connection to the total pressure sensor along the back edge of the main control board).

3. Confirm the 4 bolts holding the optics block to the condenser are tight.

4. Check all of the barb tubing connections inside the unit: LFE barb connections on both LFEs, saturator barb connections, saturator flow path barbs.

5. Check the saturator flow filter connections and confirm the flexible tygon tubing is attached tightly to the filters.

7.2 Butanol Flooding

A second issue that can arise is flooding of the optics block whereby liquid butanol passes upward from the saturator, through the condenser, and into the optics block. In general, once this happens the optics block must be removed and cleaned at the factory, as residues from the liquid will dirty the glass lenses causing the unit to detect artifact "virtual" particle counts. Evidence of flooding may be appearance of liquid butanol at the sample flow inlet to the unit, or appearance of liquid butanol in the exit flow from the optics block or the exhaust of the vacuum pump pulling flow from the optics block. Liquid may NOT appear at these locations and the unit could still be flooded.

In some cases, the optics block can be removed and cleamed in the field IMMEDIATELY after butanol exposure before any residues form. To clean a flooded optics block in the field you will need allen wrenches and clean isopropyl alcohol (100 ml). Remove the optics block from the unit by disconnecting the laser board power cable, the detector board ribbon cable, and the thermistor cable. Loosen the four bolts holding the optics block to the condenser assembly and lift the optics block straight up out of the unit after disconnecting any cable assemblies that may be in the way. Turn the optics block over and remove the focusing cone if it came off with the block. Flush the optics block 3 times, each time using about 30 ml of alcohol, swishing for 10 seconds before pouring the alcohol out of the block. After the third rinse, use dry FILTERED air at less than 5 psig to blow the inside of the optics block dry. Replace the block and test for a good zero. This method will NOT always succeed, but it is worth trying if you cannot ship your unit back to the factory. Please be aware that you are liable for damage caused during the removal or installation of the optics block, if you are not comfortable performing the tasks the unit should be returned to the factory.

If the unit becomes flooded with the butanol, the saturator bypass filter MUST be removed and checked for butanol. If liquid butanol has entered the filter it needs to be either replaced or dried out completely before the unit can be operated properly. If the filter is not replaced or dried, the unit will continue flooding until a proper filter is installed.

7.3 Butanol Fill Valve

At times, butanol can cause the fill valve to stick in the closed position so that butanol will not be allowed into the unit. Without butanol the unit will not count particles. If you observe the fill count parameter continually increasing to high values and never returning to zero (denoting properly fillled unit), then the fill valve may be stuck closed. One way to unstick the valve is to gently tap it with a small metal tool on the stainless steel base. If that is unsuccessful, Disconnect the butanol bottle and disconnect the valve electrical connector from the main board. Find the connector for the external fan, unplug it, and plug the valve into the fan connector. Listen for the click. This will keep 12vdc on the valve continuously

and could unstick it if you leave power on for an hour or more. After a couple hours turn power off and switch the connectors back. Test for proper filling.

8 Contact Us

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