



ML-One™

User Manual

Bios

Driving a Higher Standard
in Flow MeasurementSM





- ▶ Accurate
- ▶ Reliable
- ▶ Easy to Operate

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About Your ML-One

Like all Bios primary standards, the ML-One is a positive displacement primary piston prover for gas flow measurements. Using patented Proven DryCal® Technology, it combines the accuracy of a primary calibrator with unequalled speed and convenience, providing gas flow measurements with the touch of the screen. By nature, your ML-One performs a primary measurement of volumetric flow. However, since pressure variations within any measurement system can cause ambiguous results, the ML-One is generally used in a standardized mode, automatically converting its volumetric flow measurements to the flow that would exist under standard temperature and pressure conditions. An excellent tool for the

calibration of instruments that read in mass flow, your ML-One measures flow from 5 ccm (Cubic Centimeters Per Minute) to 50,000 ccm within an accuracy of $\pm 0.15\%$ of reading standardized. Flow measurements can be taken manually (one reading at a time), or automatically in the continuous mode, with up to 100 measurements in an averaging sequence. The ML-One is controlled through an LCD touch screen or through the RS-232 or USB data port. For information regarding the metrology behind your ML-One, referred to as Proven DryCal® Technology, please visit our web site, at www.biosint.com

Precautions:

- The ML-One internal components are designed to handle corrosive gases compatible with borosilicate glass, 304 – 316 stainless steel and AFLAS® fluoroelastomer. When measuring corrosive gases the user must take appropriate laboratory safety procedures to contain and prevent inadvertent gas leakage from the ML-One and connecting plumbing.
- The ML-One is not designed to measure gas pressure above 16 psia (1103 mbar) or for gas flows above 50,000 ccm. If pressurization reaches 15.9psia (1096mbar), the following warning will appear on the display on the main control panel: OVERPRESSURE! If this occurs, remove the overpressure situation, then touch “Stop” on the LCD display to clear this warning.
- The ML-One does not contain user-serviceable parts and must be returned to the Bios factory in New Jersey, USA for maintenance.

Unpacking Your ML-One

Your ML-One is a high accuracy primary standard, and has been shipped in Bios’ rugged, reusable shipping container. The ML-One weighs 62 lbs / 28 kilograms; unpacking by two people is recommended. The ML-One can be lifted from the shipping container by grasping the back or bottom of the unit. Your ML-One comes with the following:

- AC Power Adapter
- Bios Optimizer™ Software CD
- PC Serial Cable (RS-232)
- Calibration Certificate
- Manual
- Reusable shipping container

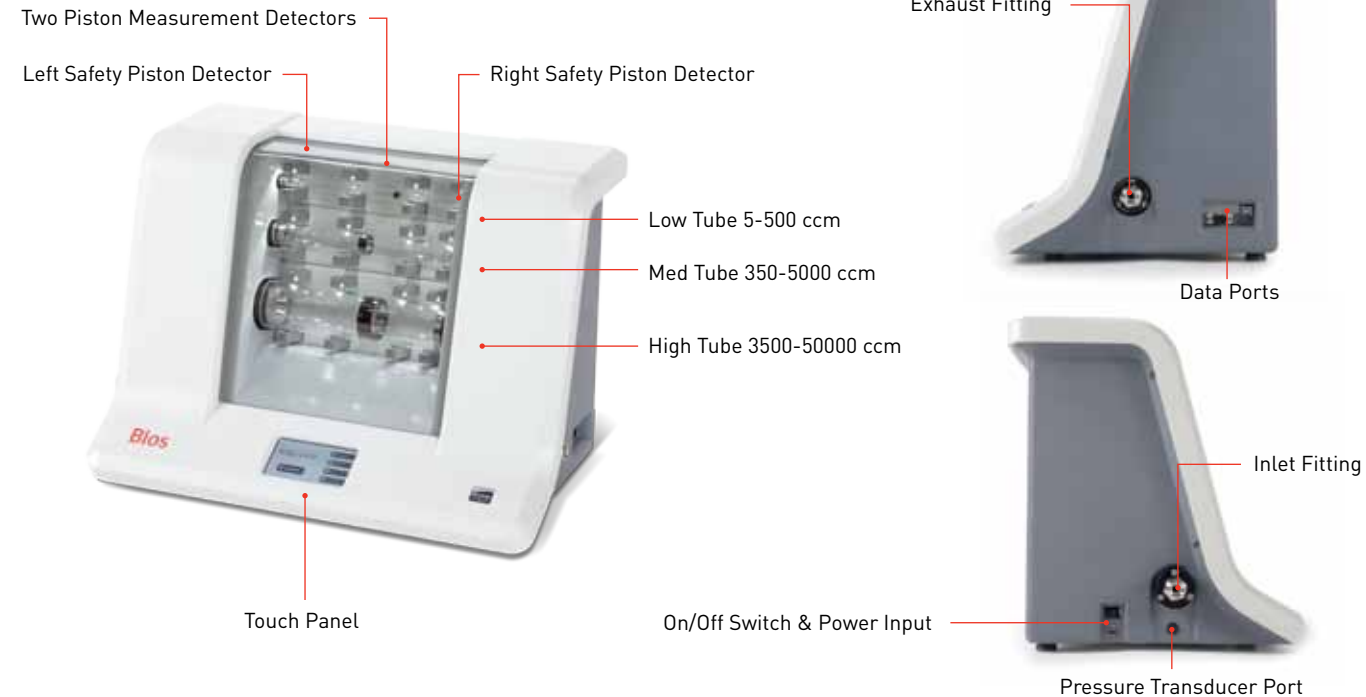
ML-One Introduction

The ML-One contains three measurement tubes for measuring gas flow rates from 5 to 50,000 ccm across a pressure range of 14 to 15.9 psia. The “High Flow” tube, located at the bottom, measures flow rates of 3,500 to 50,000 ccm, the middle “Medium Flow” tube measures flow rates from 350 to 5,000 ccm and the “Low Flow” tube, located at the top, measures flow rates from 5 to 500 ccm. The ML-One will select the correct measurement tube as flow readings are taken. Standardized flow rate corrections are made using the internal temperature and pressure transducers and the application of a compressibility factor correction.

Four piston detectors are used for each tube. The two inner piston detectors measure the time required to displace the piston a known volume/distance. From this time interval the volumetric flow rate is calculated. The two outer most piston detectors are used to initialize the piston position and as a safety in case of measurement piston detector failure. The piston

detector assemblies also contain white LEDs that illuminate the active measurement tube. Small green LEDs located on the bottom arm of the piston detectors indicate internal valves activity.

When a gas flow measurement is initiated two normally closed valves for the selected tube open and four flow control valves operate directing the gas flow. The piston oscillates between two piston measurement detectors and the time interval required for the piston to sweep the calibrated tube volume provides the volumetric flow rate. A temperature transducer located at the gas stream entrance to the tube measures gas temperature. A precision pressure sensor measures gas pressure in the measurement tube. From the gas temperature, gas pressure and a compressibility factor the volumetric gas flow rate is converted to a standardized gas flow rate. The ML-One is controlled by the front panel touch screen or through commands sent through the Data Port.



Locating the ML-One

Your ML-One can be placed on a steady, secure work surface or mounted on a work cart for portable use. The ML-One has self adjusting feet on its base. The inlet gas fitting (1/2" VCR® fitting) is located on the left side, the outlet gas fitting (1/2" VCR® fitting) is located on the right side. Remove the protective caps and connect to the gas source. The outlet port can be connected to an exhaust line or left open if inert safe gases are being measured. When measuring hazardous gases the ML-One should be placed in a vent hood as a safety precaution. The ML-One can also be operated at sub atmospheric pressures as a safety precaution against accidental gas leakage.

Power

Plug your AC power adapter (supplied) into an AC wall outlet, and insert the DC output cord into the input power connection on the left side of the ML-One. Turn on the ML-One with the ON-Off switch located on the right side of the unit.

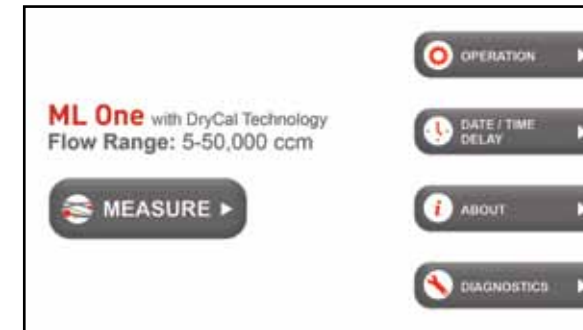
Pressure Transducer Port

Located below the Gas In fitting is a test port for connecting to the internal pressure transducer. This is used for verifying the accuracy of the pressure transducer see DIAGNOSTICS screen.

Data Ports

A USB and a RS-232 interface are located on the right side of the ML-One. The data ports allow for control of the ML-One and for recording flow readings. See appendix A for details on ML-One data port commands. The USB to serial driver has to be loaded to enable the USB in your ML-One to communicate to a PC. Use the included CD or visit <http://www.ftdichip.com/Drivers/VCP.htm>, download and run the driver suitable to your operating system.

Home Screen



Touch to go to MEASURE, OPERATION, DATE/TIME DELAY, ABOUT or DIAGNOSTICS screen.

Getting Started

The power switch is located on the left side of the unit. When powered up an introduction screen appears followed by the home screen.

Operation Screen



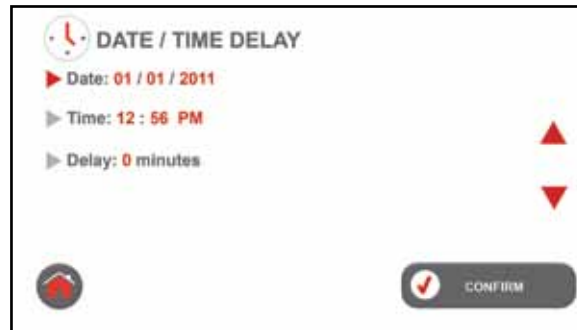
Touch CONFIRM to save changes or Home to return to the home page without saving the changes

Operation Screen:

- Select the Language to be displayed on the touch screen. Touch the arrows to scroll through the available languages.

- Select the default measurement mode: (Single) take a single reading, (Burst) take a series of consecutive readings equal to the number of readings selected in the average, or (Continuous) take continuous readings.
- Select REMOTE to set the ML-One control from the Data Port. Note: Once in remote mode the touch panel is inactive until a command is sent to the data port to return control to the touch screen interface or the ML-One is power cycled.

Date/Time Delay Screen



Touch **CONFIRM** to save changes or the home button to return to the home page without saving the changes

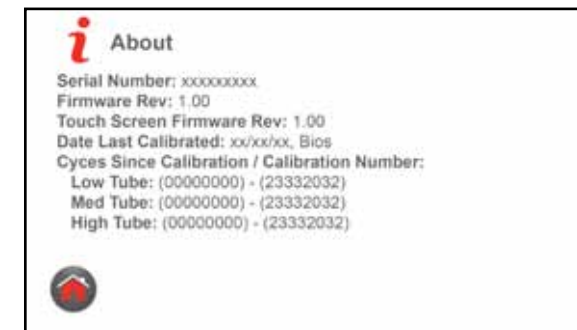
Date/Time Delay Screen:

- Set the Date, touch Date to highlight Day/Month/Year. Use the up and down arrows to set the highlighted segment.
- Set the Time, touch Time to highlight hour/minute/ AM-PM. Use the up and down arrows to set the highlighted segment.
- Delay: When taking continuous or burst readings the ML-One will wait the entered delay interval between readings.

About Screen:

- Displays the serial number of the ML-One.
- Displays the firmware revision.
- Displays the revision of the touch screen firmware.
- Displays the date when the ML-One was last calibrated and the authorized calibration laboratory that performed the calibration.
- For each tube the number of measurements taking since the last calibration is displayed followed by a calibration number associated with the tube. The calibration number represents the volume swept by the piston during a measurement.

About Screen



Touch Home to return

Diagnostics Screen:

- Observe the reading of the pressure transducer
- Observe the temperature sensor readings for each tube; the temperature transducers are located at the center of the incoming gas flow stream for each tube.
- Observe the readings from the twelve optical piston detectors. Each tube has four detectors two center measurement detectors are used for timing the piston displacement during a flow measurement. The right and left most detectors are used to initialize the piston location and as a safety in case a measurement detector fails. Readings for the detectors should be between 300 and 1026 unless a piston is located under a sensor in which case the reading should be less than 50.
- Touch (OPEN EXTERNAL PRESSURE TAP) connects the internal pressure transducer to the pressure port on the left side of the ML-One under the inlet fitting. This allows the user to connect a reference pressure indicator to the internal pressure transducer for verification.

Diagnostic Screen




Touch [Home](#) to return

- Touch (OPEN ALL FLOW VALVES) will set all of the internal valves to an open condition. This can be used to perform leak verification testing. After opening all of the internal valves the user would:
 - Cap the outlet port
 - Pressurized the ML-One to a maximum of 20 PSIA or have a vacuum applied.

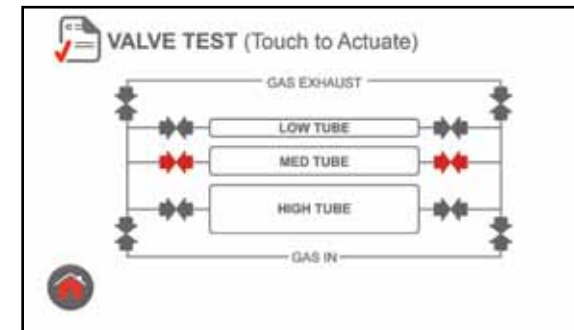
- Close the pressure source or vacuum source to the ML-One.
- Observe that the vacuum or pressure in the ML-One is stable after allowing time for thermal stabilization of the captured gas.
- Touch (VALVE TEST) to be taken to a schematic diagram of the internal ML-One valves.

VALVE TEST Screen:

The valve test screen provides a schematic representation of the ML-One. Each valve is shown as 

A valve symbol in red indicates the valve is open and a valve in gray indicates a valve is closed. Touching a valve will change the state of the valve. Manual activation of individual valves can be used as a diagnostic tool to identify valve operation issues.

Valve Test Screen



Touch [Home](#) to return

Measure screen:

The measure screen is the screen from which measurements are taken and the user can select units of measure and change measurement settings.

If the ML-One is being operated remotely the touch screen functions are inactive and the screen only displays measurement results.

Measure Screen:

The flow reading is displayed. Touching the box allows the user to select Flow Units, Volumetric or Standardized Flow, Standardization Temperature and Number in Average

Shows Gas Pressure and Temperature, touch the box to change units

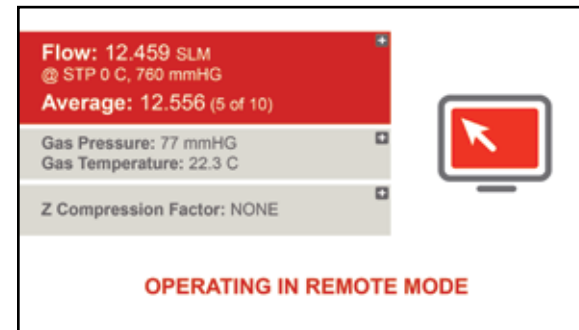
Touch to select a gas compressibility factor correction

Press to start a reading

Touching selects the measurement tube. High Tube is default. The ML-One will auto change to a different tube if the flow is outside the tube's flow range.

Press to toggle through measurement modes (Single, Burst, Continuous)

Measure Remote Mode Screen:



Notes

Out of Range!

If your Device Under Test is generating more flow than your ML-One's rated flow range of 50,0000 ccm, the "Out of Range!" warning appears when you attempt to take a flow measurement. Immediately lower or disconnect the flow source.

Over Pressure!

If your ML-One has an internal pressure that is greater than 14.9 psiA the "Over Pressure !" warning appears. This can occur before or during a flow measurement. You will need to determine the source of the over pressure. This is most likely caused by a restriction in the exhaust flow path.

Program

The recessed Program button, located on the rear of your ML-One, enables firmware updates. Please contact Bios if you need a firmware update.

Reset Function

If your ML-One fails to respond to commands, try resetting the unit by pressing the reset button on the back. This can be done easily with a bent paper clip. Please note that resetting your ML-One will not affect your user settings. However, if you are in the middle of a calibration, your ML-One will return to the home screen and you'll need to initiate a new flow measurement.

Storage

To store your ML-One for an extended period, please follow these guidelines:

- Always store it in a clean, dry place
- Cap Inlet and Outlet fittings

Annual Maintenance and Calibration

Your ML-One is engineered to provide years of reliable service, with appropriate care and maintenance. Bios recommends annual calibration by an ISO17025-accredited laboratory, such as Bios, to help ensure the best possible flow measurements, meet regulatory requirements and provide a bulletproof audit trail in the event of litigation. Should you encounter any problems with your ML-One, immediately contact Bios Customer Service.

Recertification

Your ML-One is a precision measuring standard with moving parts machined to extremely close tolerances. Various environmental factors, product wear, drift of the temperature sensors and pressure transducers or inadvertent damage may adversely affect your ML-One's measurement accuracy or general performance. For these reasons, we highly recommend having your ML-One annually verified and serviced by our experienced Bios personnel in our accredited ISO

17025 metrology laboratory, located in New Jersey, USA. For those applications subject to regulatory or ISO requirements, verification by our accredited laboratory provides you with assurance of measurement integrity. Please note that while many accredited gas flow measurement laboratories may be capable of properly verifying the accuracy of your ML-One, Bios is the only authorized service center in the USA for Bios products. Outside the USA, please check with Bios to determine if a local authorized Bios service center is available. Our elective Recertification program is a complete product service package that provides pre-validation at significant flow points; sensor calibration, full product testing, and available firmware upgrades; post-validation at significant flow points; and NIST-traceable Bios calibration certificates backed by our accreditation to ISO 17025, ANSI Z-540, and NIST Handbook 150 quality standards. Recertification includes a 90-day service warranty should any related labor or parts replacements prove

faulty. Turnaround time is generally one to two weeks within Bios' facility from the date we received your ML-One. To obtain current Recertification pricing, please contact Bios at **973.492.8400**, or visit our web site at **www.biosint.com**. Please contact Bios to see if expedited service is available for an additional charge.

Sending Your ML-One to Bios

Please contact Bios for an RMA (return merchandise authorization) number before sending your Definer 1020 to our factory for elective Recertification or other service. You can get an RMA number through our automated web-based system at **http://www.biosint.com/ContactUs/rmaform.php** by email to **service@biosint.com**, or by telephone at **973.492.8400**. Our web site address is **www.biosint.com**. Sending your ML-One to Bios without an RMA number may result in return of the instrument without inspection or a substantial delay in service turnaround time. When requesting an RMA number, provide your ML-One serial number

and revision level. Also describe any product issues you may be experiencing. Please keep in mind that Bios will not begin evaluation and service of your ML-One until you have approved our formal RMA quote. If sending your ML-One for repair or evaluation (rather than elective Recertification), please contact Bios for technical support or troubleshooting assistance prior to shipping the unit. We will first attempt to resolve the situation over the phone or via email. If you've provided us with a detailed description of your ML-One's issue and application details and we're unable to resolve the situation by phone or email, we'll issue you an RMA number for prompt return of your ML-One for evaluation. Please note that Bios will make every attempt to verify your issue, as we want you to get the most out of your ML-One. However, if we are unable to detect a product issue or if we determine that the issue is application-related rather than product-related, we reserve the right to charge an evaluation fee.

Shipping

When shipping your ML-One, please use the reusable shipping container that was supplied with your unit. We highly recommend insuring the product against damage in transit, and using a standard freight carrier (e.g., FedEx, UPS) that provides tracking numbers and offers door-to-door delivery directly to Bios. Please note that Bios does not arrange, or pay for, shipment transfers from local airports to our facility, so we are not responsible for additional expense and transit time incurred through airport deliveries. Bios is generally not responsible for freight costs associated with shipments to and from Bios, except in certain instances; please contact Bios for information before initiating a shipment. Bios isn't responsible for damage that may occur during shipment.

Appendix A: Specifications

Flow Range: 5–50,000 sccm*

Low Tube: 5–500 sccm*

Medium Tube: 350–5,000 sccm*

High Tube: 3,500–50,000 sccm*

Accuracy Standardized Flow: 0.15% of reading and +/- 0.01 sccm

Measurement Gas Pressure:
Atmospheric Pressure +/- .5 PSIA

Temperature Range Operating: 15 to 30°C

Temperature Range Storage: 0 to 70°C

Gas Compatibility: Gases compatible with (316/304 SS, borosilicate glass, Teflon, AFLAS elastomeric)

Compressibility Factor Correction: User selection of gases to apply compressibility factor correction for non-ideal gas behavior

Interface: Touch screen or via Commands through data port

Data Port Connections: RS-232 and USB

Inlet and Outlet Fitting: 1/2 inch VCR fitting

Approximate Measurement Interval: Flow dependent (.5 - 60 seconds) typical 2 seconds

Dimensions: 22" wide x 15" high x 13" deep

Weight: 62 lbs

Warranty: 1 year

* At a gas pressure of 760 mmHg, and a gas temperature of 25° centigrade with standardization temperature set to 21.1° centigrade.

Appendix B: Data Port Commands

ML-One Bi-Directional Communications Protocol

To enable Bios customers to integrate their ML-One primary piston prover with their unique applications, our ML-One come standard with a bi-directional communication protocol.

Using ASCII commands sent through your ML-One's RS-232 serial port or USB port, this protocol enables you to control and customize your ML-One system's operation (serial cable supplied by Bios). For your convenience, the ASCII commands are referenced in the following tables.

Commands

\$SET COMM DC	
Purpose	Transfers the control of ML-One back to touchscreen
Syntax	\$SET COMM DC<cr>
Parameters	None
Query reply	
Remarks	Stops flow measurements; Transfers the control of ML-One back to touchscreen
Example	\$SET COMM DC<cr>
Reply	None

\$RESET DC	
Purpose	Resets all flow measurements and flow averages
Syntax	\$RESET DC<cr>
Parameters	None
Query reply	\$ACK 0
Remarks	Stops flow measurements; clears the current flow measurement; resets the flow average and measurement number
Example	\$RESET DC<cr>
Reply	None

\$STOP DC	
Purpose	Stops flow measurements
Syntax	\$STOP DC<cr>
Parameters	None
Query reply	\$ACK 1
Remarks	Stops flow measurements
Example	\$STOP DC<cr>
Reply	None

\$GET DS DC	
Purpose	Initiates a single flow measurement and acquires the data stream
Syntax	\$GET DS DC<cr>
Parameters	None
Query reply	
Remarks	Reads flow data, including: Flow; flow average; flow units; measurement number; number in the series, temperature; temperature units; pressure; pressure units; standardized (Std.) temperature; Std. temperature units; Gas compression factor; time; date; cell id;<cr><lf>
Example	\$GET DS DC<cr>
Reply(Std.)	760.11,760.11,scc/m, 01,10, 23.1, C, 760.6, mmHg, 21.1, C,1.0005,12:35 PM,06/15/00,H<cr><lf>
Reply(Vol.)	760.11,760.11,cc/m, 01,10, 23.1, C, 760.6, mmHg, ,,12:35 PM,06/15/00,H<cr><lf>

\$GET PI DC	
Purpose	Reads the product information
Syntax	\$GET PI DC<cr>
Parameters	None
Query reply	
Remarks	Reads product information, including: Product; model; serial number; revision level; calibration constant; stroke counter, <cr><lf>
Example	\$GET PI DC<cr>
Reply	ML-One,H,100503,1.07,4902111210,00000 508222<cr><lf>

\$SET CELL DC	
Purpose	Sets the flow tube the measurement takes place
Syntax	\$SET CELL DC X<cr>
Parameters	0-2, 0-Medium, 1-Low, 2-High
Query reply	None
Remarks	Determines the flow tube the measurement takes place
Example	\$SET CELL DC 1<cr>
Reply	None

\$SET GAS DC	
Purpose	Sets the type of gas being measured
Syntax	\$SET GAS DC X<cr>
Parameters	0-21, 0-Air,1-NH3,2-Ar,3-CO2,4-CO,5-C2H6,6-C2H4,7-He,8-H2,9-CH4,10-N2,11-N2O,12-O2,13-C3H8,14-C3H6,15-R14,16-R23,17-R116,18-RC318,19-SF6,20-SO2,21-Xe
Query reply	None
Remarks	Sets the type of gas being measured
Example	\$SET GAS DC 1<cr>
Reply	None

\$GET GAS DC	
Purpose	Reads the type of gas being measured
Syntax	\$GET GAS DC<cr>
Parameters	None
Query reply	None
Remarks	Reads the type of gas being measured
Example	\$GET GAS DC<cr>
Reply	1 { 0-21, 0-Air,1-NH3,2-Ar,3-CO2,4-CO, 5-C2H6,6-C2H4,7-He,8-H2,9-CH4,10-N2,11-N2O,12-O2,13-C3H8,14-C3H6,15-R14,16-R23,17-R116,18-RC318,19-SF6, 20-SO2,21-Xe }

\$GET PRES DC	
Purpose	Reads the gas pressure in the flow tube
Syntax	\$GET PRES DC<cr>
Parameters	None
Query reply	None
Remarks	Reads the gas pressure
Example	\$GET PRES DC<cr>
Reply	759.9

\$GET TEMP DC	
Purpose	Reads the gas temperature in the flow tube
Syntax	\$GET TEMP DC<cr>
Parameters	None
Query reply	None
Remarks	Reads the gas temperature in the flow tube
Example	\$GET TEMP DC<cr>
Reply	23.25, 23.23, 23.26

Command Not Recognized

If a command is not recognized, you'll receive the following return: !NAK 12.

Cable

The RS-232 serial cable connecting your ML-One to the PC should be a 1 to 1 connection, 9-pin d-sub female. A Null Modem cable should not be used.

Serial Interface

Baud Rate 9600
 Data Bits 8
 Parity None
 Stop Bits 1
 Flow Control None

Bios

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