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Bios Met Lab® Series Bi-Directional Communications Protocol

To enable Bios customers to integrate their Met Lab® Series primary piston provers with their unique applications, our Met Lab systems come standard with a bi-directional communication protocol.

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

Commands

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

$STOP DC	
Purpose	Stops Met Lab flow measurements
Syntax	$STOP DC<cr>
Parameters	None
Query Reply	$ACK 1
Remarks	Stops the current Met Lab flow measurement
Example	$STOP DC<cr>
Reply	None

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$GET DS DC	
Purpose	Initiates a Met Lab flow measurement and acquires the Met Lab data stream (up to four)
Syntax	$GET DS DC<cr>
Parameters	None
Query Reply	
Remarks	Reads Met Lab flow data, including: Flow; flow average; flow units; measurement number; number in the series; temperature; temperature units; barometric pressure; barometric units; standardized (Std.) temperature; Std. temperature units; gas constant, piston tear value (LCF); time; date; product; model; serial number; revision level;<cr><lf>
Example	$GET DS DC<cr>
Reply (Std.)	760.11,760.11,sccm, 01,10, 23.1, C, 760.6, mmHg, .00,C,1.000,1.000,12:35 PM,06/15/00,ML-500, Base, 123456, 2.00, ML-500, Cell:24, 100501, 1.05,,,,,,,,,<cr><lf>
Reply (Vol)	825.87,825.90, ccm, 02, 10,23.1 ,C ,760.6 ,mmHg,,,,,12:36 PM,06/15/00, ML-500, Base, 123456, 2.04, ML-500, Cell:24, 100501, 1.05,,,,,,,,,<cr><lf>

$GET PI DC	
Purpose	Reads the Met Lab product information
Syntax	$GET PI DC<cr>
Parameters	None
Query Reply	
Remarks	Reads Met Lab product information, including: Product; model; serial number; revision level; position; calibration constant; stroke counter, <cr><lf>
Example	$GET PI DC<cr>
Reply	ML-500, Base, 123456, Base,,,,ML-500, Cell:10,100500, 1.05 , 1, 16902111210, 00000028222 , ML-500, Cell:24, 100501, 1.05 , 2, 06902111210, 00000008222, ML-500, Cell:44, 100503, 2.04 , 3, 04902111210, 00000508222, ,,,,,,,<cr><lf>

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$GET DQ DC	
Purpose	Initiates a Met Lab flow measurement and acquires the Met Lab data query stream
Syntax	$GET DQ DC<cr>
Parameters	None
Query Reply	
Remarks	Reads Met Lab data, including: Vflow; temperature (C); barometric pressure (mmHg); pressure 1; pressure 2; LTV; product model; serial number; revision level, <cr><lf>
Example	$GET DQ DC<cr>
Reply	842.34 ,25.4,756.4, 756.5, 756.6, .145, ML-500, Base, 123456, 1.23, ML-500, Cell:24, 654321, 1.07,ML-500, Cell:44, 554321, 1.07,,,,,,,,,<cr><lf>

$GET WAI DC	
Purpose	Determines the position of the Met Lab's piston during a flow measurement cycle
Syntax	$GET WAI DC<cr>
Parameters	None
Query Reply	
Remarks	Returns a number (0-3) as to where the Met Lab's piston is during flow measurement cycle<cr><lf>
Example	$GET WAI DC<cr>
Reply	0, 1, 2 or 3

$GET TEMP DC	
Purpose	Reads Met Lab temperature in degrees C
Syntax	$GET TEMP DC<cr>
Parameters	None
Query Reply	
Remarks	Returns Met Lab temperature, <cr><lf>
Example	$GET TEMP DC<cr>
Reply	23.56, cr><lf>

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$GET PRES DC	
Purpose	Reads Met Lab Barometric pressure in mmHg
Syntax	$GET PRES DC<cr>
Parameters	None
Query Reply	
Remarks	Returns Met Lab's barometric pressure,<cr><lf>
Example	$GET PRES DC<cr>
Reply	756.23, <cr><lf>

$GET PTVM DC	
Purpose	Reads Met Lab Piston Tare Value Multiplier (PTVM)
Syntax	$GET PTVM DC<cr>
Parameters	None
Query Reply	
Remarks	Returns Met Lab's c PTVM <cr><lf> (Range .200 -3.000)
Example	$GET PTVM DC<cr>
Reply	1.000,<cr><lf>

$SET PTVM DC	
Purpose	Sets the Met Lab Piston Tare Value Multiplier (PTVM)
Syntax	$SET PTVM DC<cr> #XXXX<cr>
Parameters	#XXXX (where XXXX is 200 to 3000) The range is .200 to 3.000 and no decimal point required.
Query Reply	$ACK 9
Remarks	Sets the Met Lab's PTVM <cr><lf>
Example	$SET PTVM DC<cr> #1234
Reply	None

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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 Met Lab piston prover 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

Examples

To reset your Met Lab:
Type into the HyperTerminal: **$RESET DC<cr>**
This will clear the display of the Met Lab, as well as all readings, averages, and counts.

To read your Met Lab product information:
Type into the HyperTerminal: **$GET PI DC<cr>**
This will show relevant Met Lab product information.

To initiate a flow measurement:
Type into the HyperTerminal: **$GET DS DC<cr>**
This will initiate a read cycle and display the information in the HyperTerminal window.

Using Windows HyperTerminal

The Windows HyperTerminal program is an excellent tool for checking and troubleshooting your Bios bi-directional communication interface. With HyperTerminal, commands can be sent to and data received from your Met Lab. HyperTerminal is included with the Microsoft Windows operating system and is usually located under **Accessories**.

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For assistance with HyperTerminal, please contact Microsoft.

Step One
Be sure you are disconnected before entering the Properties menu. To disconnect, click on the raised "Phone" icon, then click on the Properties icon located to the right.

Step Two
Under the **Connect To** tab, set up HyperTerminal for a direct connection to Com1 (as your PC's communication port may vary, attempt using other ports if Com1 does not work).

Step Three
Press **Configure** and set the settings to the serial interface above. After set, click **OK** to return.

Step Four
Click on the **Settings** tab. Emulation should be set to Auto Detect; Telnet Terminal ID should be set to ANSI; and Back scroll buffer lines should be set to 500.

Step Five
Press the **ASCII Setup** button. Then, check that the "Send" line ends with line feed, and check the Echo type characters locally. Both Line delay and Character delay should be set to 100 milliseconds.

Step Six
Check that the Append line feeds to incoming line ends, and check the Wrap lines that exceed the terminal width. However, do not check the Force incoming to 7-bit ASCII.

Step Seven
Click **OK** to return to Properties; click **OK** to return to the Communications window; then, click the "Phone" icon to start the process.

Calculations

Several calculations are performed within your Met Lab base unit. When using the **$GET DS DC** command, all the calculations are performed internally. When using the **$GET DQ DC** command, the data is output in raw format, and calculations must then be performed manually in order for the data to be valid.

The first calculation is to adjust the flow for leakage (where PTV is the piston tare value, and PTVM is the piston tare value multiplier):

Adjusted Leakage = PTV*PTVM

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Next, there is a cell constant, called **Vk**. This is the volume ratio constant. This value varies by flow cell model, as follows:

Model	ML-500	ML-800	Definer 1020
3	---	12.0	
10	2.49	1.31	1.70
24	2.00	1.28	
44	2.52	1.76	

There is another formula used called **Pv**. This is the pressure/volume calculation.

For the ML500 and Definer 1020:
Pv = P2/Pa + ((P2-P1)/Pa)*Vk

For the ML-800:
Pv = (P2+Pa)/Pa + ((P2-P1)/Pa)*Vk

Calculations (continued)

Volumetric flow = (Flow from DQ + Adjusted Leakage)*Pv
Standardized flow = Volumetric Flow (Pa[mmHg]/760)*((273.15+K)/(273.15+Tc[°C]))

(where K is the standardizing temperature in °C, typically 0°C or 21.1°C)

In order to compensate your Met Lab's flow measurements to account for the additional error in the mass flow controller (MFC) created when the MFC uses a different gas species than it was originally calibrated to, the software will apply a gas correction algorithm, as follows:

Gas Corrected Flow = Standardized Flow*Gas Correction Factor

Troubleshooting

There appears to be no communication.

1. Check cable for connections
2. If user designed interface, check using HyperTerminal
3. If using HyperTerminal, make sure the correct port is selected

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When using HyperTerminal, the data appears strange.

1. Check communication setup
2. Check cable

I can hear the valve click, but the piston does not move.

1. Is the gas supply connected and turned on?
2. Are the fittings tight?
3. Is the flow source or vacuum source connected to the correct fitting?

Flow appears different than expected or different than what's on the display.

1. Make sure of the settings of the Met Lab (ex. Standard flow vs. Volumetric)
2. The DQ command gives an output of raw data. Further calculations are required to be done to this raw data

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