



Mesa Metrology Series ML-800 Bi-Directional Communications Protocol



To enable Mesa customers to integrate their Metrology Series primary piston provers with their unique applications, our DryCal systems come standard with a bi-directional communication protocol.

Using ASCII commands sent through your DryCal base unit's USB-B or RS-232 serial port, this protocol enables you to control and customize your DryCal system's operation (serial cable supplied by Mesa). For your convenience, the ASCII commands are referenced in the following tables. The carriage return symbol is denoted by <cr> and the line feed symbol is denoted by <lf>, each of which are ASCII hex values 0x0d and 0x0a respectively.

Commands

\$RESET DC	
Purpose	Resets all DryCal flow measurements and flow averages
Syntax	\$RESET DC<cr>
Parameters	None
Query Reply	\$ACK 00
Remarks	Stops DryCal flow measurements; clears the current flow measurement; resets the flow average and measurement number
Example	\$RESET DC<cr>
Reply	\$ACK
Reply (Hex)	24 41 43 4b 20 00 30 30 0d 0a

\$STOP DC	
Purpose	Stops DryCal flow measurements
Syntax	\$STOP DC<cr>
Parameters	None
Query Reply	\$ACK 01
Remarks	Stops the current DryCal flow measurement
Example	\$STOP DC<cr>
Reply	\$ACK 01
Reply (Hex)	24 41 43 4b 20 00 30 31 0d 0a

\$GET DS DC	
Purpose	Initiates a DryCal flow measurement and acquires the DryCal data stream (up to four)
Syntax	\$GET DS DC<cr>
Parameters	None
Query Reply	
Remarks	Reads DryCal 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 tare 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 DryCal product information
Syntax	\$GET PI DC<cr>
Parameters	None
Query Reply	
Remarks	Reads DryCal 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, 10,100500, 1.05 , 1, 16902111210, 00000028222 , ML-500, 24, 100501, 1.05 , 2, 06902111210, 00000008222, ML-500, 44, 100503, 2.04 , 3, 04902111210, 00000508222, ,,,,,,<cr><lf>

\$GET DQ DC	
Purpose	Initiates a DryCal flow measurement and acquires the DryCal data query stream
Syntax	\$GET DQ DC<cr>
Parameters	None
Query Reply	
Remarks	Reads DryCal 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 DryCal'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 DryCal's piston is during flow measurement cycle<cr><lf>
Example	\$GET WAI DC<cr>
Reply	0, 1, 2 or 3 0<cr><lf>

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

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

\$GET PTVM DC	
Purpose	Reads DryCal Piston Tare Value Multiplier (PTVM)
Syntax	\$GET PTVM DC<cr>
Parameters	None
Query Reply	X.XXX<cr><lf>
Remarks	Returns DryCal's PTVM <cr><lf> (Range .200 -3.000)
Example	\$GET PTVM DC<cr>
Reply	1.234<cr><lf> 0.350<cr><lf>

\$SET PTVM DC	
Purpose	Sets the DryCal Piston Tare Value Multiplier (PTVM)
Syntax	\$SET PTVM DC<cr> #XXXX<cr>
Parameters	#XXXX (where XXXX is 0200 to 3000) The range is .200 to 3.000 and no decimal point is required. Follow by a \$RESET DC command.
Query Reply	
Remarks	Sets the DryCal's PTVM <cr><lf>
Example	\$SET PTVM DC<cr>#1234 This sets PTVM to 1.234 \$SET PTVM DC<cr>#0500 This sets PTVM to 0.500
Reply	None

Command Not Recognized

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

Hex: 21 4e 41 4b 20 00 31 32 0d 0a

Cable

The RS-232 serial cable connecting your DryCal 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. Standard USB-B cable may also be used. FTDI virtual COM port drivers are needed for use with the USB-B cable. These drivers can be obtained from FTDI's website.

Serial Interface

Baud Rate: 9600

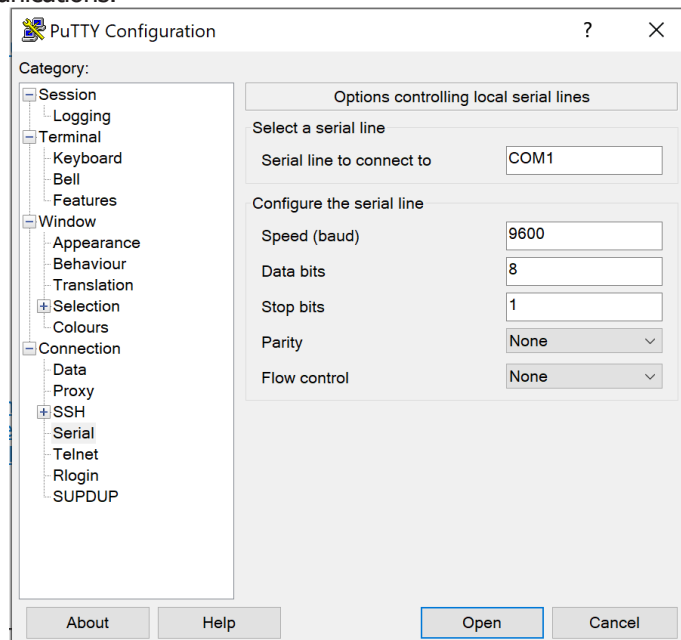
Data Bits: 8

Parity: None

Stop Bits: 1

Flow Control: None

Any generic serial communication terminal program can be used to communicate with your DryCal. PuTTY or Terminate terminals can be used. Make sure to configure your terminal programs to append the carriage return symbol at the end of each message. Custom software can also be created to control your DryCal through serial communications.



Examples

To reset your DryCal: Type into your terminal program: \$RESET DC<cr>

This will clear the display of the DryCal, as well as all readings, averages, and counts. To read your DryCal product information:

Type into the terminal program: \$GET PI DC<cr> This will show relevant DryCal product information.

To initiate a flow measurement: Type into the terminal program: \$GET DS DC<cr>

This will initiate a read cycle and display the information in the terminal program's window.

Calculations

Several calculations are performed within your DryCal 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):

$$\text{Adjusted Leakage} = \text{PTV} * \text{PTVM}$$

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	DryCal 800	DryCal 1020
3	---	12.0	---
10	2.49	1.31	1.70
24	2.00	1.28	---
44	2.52	1.76	---
75	---	12.0	---

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

For the ML500 and DryCal 1020:

$$P_v = P_2/P_a + ((P_2 - P_1)/P_a) * V_k$$

For the DryCal 800:

$$P_v = (P_2 + P_a)/P_a + ((P_2 - P_1)/P_a) * V_k$$

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 DryCal'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 terminal program
3. If using terminal program, make sure the correct port is selected

When using terminal program, 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 DryCal (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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