



# Atlas Automated Batch Reactor Systems

## RD10993 – Atlas Pump Communications Protocol

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## 1 Summary

The Atlas Pump communications protocol is an ASCII serial communications protocol transferred through a USB adapter in the pump

Under Linux the FDTI USB serial driver must be attached to the USB device detected by the kernel. Please consult your Linux distributions instructions on how to do this, the USB identifiers for the pump are either VID 0x403 and PID 0xB8C6 or VID 0x403 and PID 0xB28B.

## 2 Information

### 2.1 COM port settings

1. Go to Device Manager -> Universal serial bus controllers -> AGI Custom USB Comms cable
2. Right-click and go to Properties
3. Activate VCP
4. Reload Device Manager
5. Check that AGI Custom USB Comms cable is visible under ports and has been assigned a COM number

### 2.2 Serial settings

57600 Baud,

8 Data Bits,

1 Stop Bit,

No Parity,

No Flow Control

### 2.3 Protocol

Below we document the commands to send to the Atlas Pump and the expected responses and their meanings.

#### 2.3.1 PC Control and Watchdog

The pump can respond to status queries at any time.

Before sending commands that change the pumps state you must first send the "PC Control" command to the pump.

Once in "PC Control", the PC must send a status query at least once every 10 seconds or the pump's safety watchdog will take over and stop all operations and exit PC control.

#### 2.3.2 Symbol Definitions

Symbols used in this protocol are as follows:

Symbol	Meaning
<b>n</b>	the pump axis the command applies to, it is either 0 or 1
<b>s</b>	is the response code 0 for success 1 for pump busy 2 for invalid pump number 3 for failure

	4 for invalid port
	5 for invalid command

### 2.3.3 Commands and Responses

All sent commands and responses are terminated by `\r\n` characters which are the carriage return & line feed ASCII bytes **0x13, 0x0a**.

Note: Unless otherwise stated, all volumes are in  $\mu\text{l}$  and all flow rates are in  $\mu\text{l}/\text{min}$ .

Note: Ports on a valve are labelled A, B, C etc. However, this protocol uses 1,2,3. In other words, refer to port A as 1, B=2, C=3 etc.

Table 1: Atlas Pump Commands

Command	Send Format	Response Format	Comment
PC Control	A1	#A	Enter PC Control Mode
PC Control Exit	A0	#A	Exit PC Control Mode
Empty	En <flow rate> <port>	#E s	Empty to the given "port" at "flow_rate". If "port" is zero, then use the default port as defined in the hardware
Stop	Xn	#X s	Stop the given pump
Pause	Wn	#W s	Pause all pumping on given axis; if pump is continuous pumping, then both pumps will pause regardless of n
Unpause	Un	#U s	Restart all pumping on a given axis; if pump is continuous pumping, then both pumps will restart regardless of n
Fill	Fn <flow rate> <port>	#F s	Fill from the given "port" at "flow_rate". If "port" is zero, then use the default port as defined in the hardware.
Pump	Pn <flow rate> <volume> <fill_port> <empty_port>	#P s	Pump "volume" at "flow_rate" from the given "fill_port" to the "empty_port". If "port" is zero, then use the default port as defined in the hardware.
Pump for fixed time	Dn <duration mins> <volume> <fill port> <empty port>	#P 0 (there was a mistake here) could also be #D 0	Fixed time dose, the response code has 2 possible forms as a mistake was made in some versions of pump firmware
Status	Sn	#Sn "<error_code> <current state> <volume remaining for a pump> <number of syringe movements> <cumulative volume pumped> <current flow rate> <Node Sensor Value 1> <Node Sensor 2> <Total Cumulative Vol Pumped (only after 1.4.26)>"	Error code and current state defined below. If no node attached, node values are '?' to indicate no node
Reset Cumulative Volume	Rn	#R	Reset the cumulative volume for a given pump to zero
Version info command	v1	#v 0 [major].[minor].[misc]	This returns the version of pump firmware
Valve info command	V3	#V 0 [valves1] [valves2]	Returns the number of valves on each syringe pump

Syringe info command	Z3	#Z 0 [syringe_vol1] [syringe_vol2]	Returns the volume of each syringe
Continuous pump command	C <pumpingSpeed> <emptyPort> <fillPort> <doseVolume> <doseDuration (mins)>	#C s	Do some continuous dosing. Below pump version 1.4.23 doseVolume and doseDuration are ignored. Above version 1.4.23 if pumpingSpeed is zero, volume and duration are used to calculate the rate instead and a fixed dose is performed, but if pumpingSpeed is not zero then duration and volume are ignored and the pump will pump indefinitely. This is a bit odd but maintains backward compatibility.
Get Pump Label	l	#l <pump label>	Get the current label of this pump. Only present after 1.4.19
Set Pump Label	L	#L 0	Set the current label of this pump. Only present after 1.4.19
pH Ctrl	pH <Target pH> <pH DeadZone> <Axis 1 Type> <Axis 2 Type> <Max Time> <Max Volume> <source port> <dest port> <flow rate>	#pH 0	Start performing pH Ctrl (requires a pH node attached to pump). See notes below for more explanation

### 2.3.4 pH Control

pH is a measure of acidity or basicity in solution and varies between 0 (acid) and 14 (base), 7 being neutral (water).

The pump can be configured to maintain the pH of a reaction, by using one or more syringes connected to either acid or base solutions.

The parameters are:

- **Target pH** the value we are trying to keep the solution at
- **pH Dead zone** the amount of error around the target value we tolerate.
- **Axis 1 Type** defines if syringe 1 is used and if so whether it is connected to base or acid, see below
- **Axis 2 Type** same as above
- **Max Time** to run control for in minutes
- **Max Volume** to dispense in ul
- **Source port** port to fill from (same for both syringes if using both)
- **Destination port** port to empty to (same for both syringes if using both)
- **Flow rate** how fast to dose the acid / base into the reactor

### 2.3.5 Error Codes

0 for no error

A non-zero number is an error code given above

### 2.3.6 Axis Type for pH Control

#### Axis Type Meaning

- |   |   |
|---|---|
| 0 | Axis is not used, can be used by other control types such as dosing |
| 1 | Axis is used to dispense Acid into the reactor                      |
| 2 | Axis is used to dispense Base into the reactor                      |

### 2.3.7 Current State

The state enumeration consists only of:

- PUMPS BUSY 1
- PUMPS IDLE 6

### 2.3.8 Usage Examples

#### 2.3.8.1 Querying the pump status

Enter 'PC Control': **A1\r\n**

Response: **#A\r\n**

Query the status of pump axis 0: **S0\r\n**

Response: **#S 0 <current state> <volume remaining for a pump> <number of syringe movements> <cumulative volume pumped> <current flow rate> <Node Sensor Value 1> <Node Sensor 2> <Total Cumulative Vol Pumped>**

#### 2.3.8.2 Filling

Enter 'PC Control' as described above.

Start filling from port A on pump axis 1 at a rate of 2ml/min: **F0 2000 1\r\n**

Response: **#F 0\r\n**

If the pump does not receive any command within 10s, it will exit PC Control mode and stop all operations.

#### 2.3.8.3 Continuous pumping

Enter 'PC Control' as described above.

Start continuous pumping at fixed speed 5ml/min from port A to port B: **C 5000 1 2 0 0\r\n**

Response: **#C 0**

Alternatively, to use the *doseVolume* and *doseDuration* arguments, set *pumpingSpeed* to 0:

Start continuous pumping of dose volume 10ml from port A to port B in 2 minutes: **C 0 1 2 10000 2\r\n**

Response: **#C 0**

#### 2.3.8.4 pH Control

Enter 'PC Control' as described above.

Start pH control with target 6, dead zone of 0.5 using axis 2 to dispense acid at a rate of 0.5ml/min from port A to B, Max Time and Max Volume are 20 minutes and 50ml, respectively: **pH 6 0.5 0 1 20 50000 1 2 500\r\n**

Response: **#pH 0\r\n**

*If you require assistance or further explanation, please contact [support@syrris.com](mailto:support@syrris.com).*