

## Chapter 5: RECEIVING AND DISPLAYING DATA

WRPAS data may be monitored in real time over Wi-Fi or via a USB cable. Data can also be stored on internal memory and downloaded later over a USB connection. The most reliable approach is to use a terminal program such as HyperTerminal or TeraTerm to communicate with the WRPAS Unit.

The prototype instrument can be configured for cloud connectivity through a 3<sup>rd</sup> party cloud service. In the prototype instrument this is a very limited capability though a recommended provider (Adafruit), primarily for demonstration purposes, but it does allow logging and visualization of concentrations and concentration ratio values.

### 5.1 Using a Terminal Program to configure WRPAS for a given Wi-Fi Network

WRPAS needs to be configured when first connected to a wi-fi router. It only stores one configuration so it needs to be re-configured every time the network is changed. This must be done using the USB port on WRPAS and sending the wi-fi network name and password. If WRPAS has been set up to connect to a network, skip to section 5.2

Any terminal program such as *HyperTerminal* or *TeraTerm* can be configured to connect with the WRPAS USB port. The instructions here are for TeraTerm but other terminal programs will be similar.

1. Connect WRPAS to a computer with a USB mini-B cable.
2. Open the TeraTerm. Connect to the appropriate COM port, which may take some experimenting. (Figure 9)

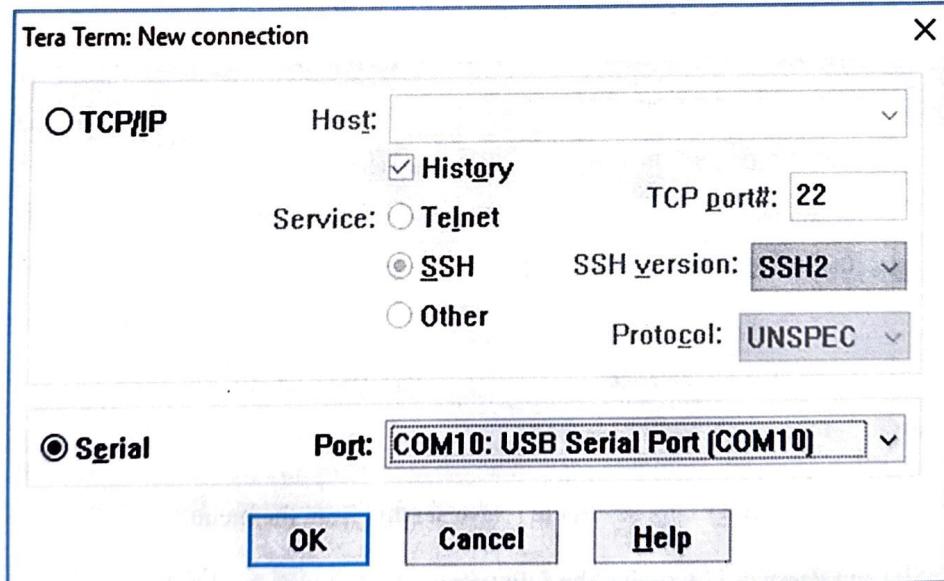


Figure 9

3. Choose "Setup | Serial port..." from the *TeraTerm* menu and use the serial port settings as shown in *Figure 10* (Port: may have a number if connected). The settings for a serial connection are 115,200 baud, No parity, 1 stop=bit, Xon Xoff flow control.

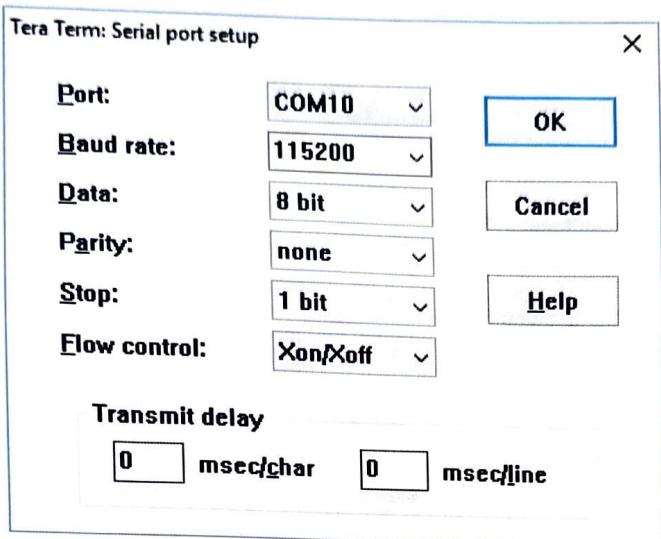


Figure 10

- Choose “Setup | Terminal” from the menu and select Local echo and Transmit CR/LF (Figure 11). It is recommended to also change the window size to full screen width. You also change the font under “setup | font”.

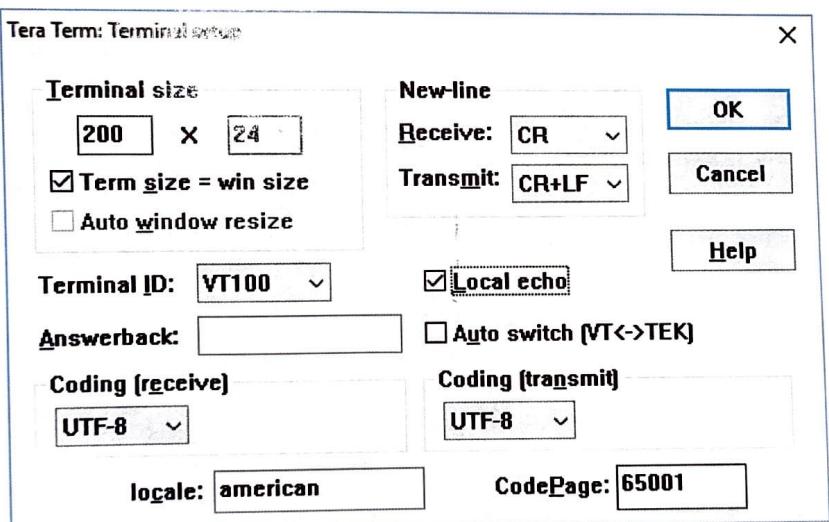


Figure 11

- To save the terminal settings choose “Setup | Save set up” from the menu.
- Set the SSID and Password by typing the following:

WSWIFISSID = “network name”  
WSWIFIPSK = “password”

where the strings in quotes are replaced with the appropriate names for the given router.

7. On the WPRAS unit, check that the WRPAS is connected by navigating to the WiFi menu (under Status) and confirm that:

WiFi is enabled

Socket 3602 is **enabled**

MQTT is **disabled** (which is required if Socket Host 3602 is used)

Status SSID matches what was set in step 6

PSK matches what was set in step 6

NOTE:

You may continue using the serial port to transfer data or you can transfer data using Wi-Fi as described in sections 5.2, 5.3 or 5.4.

## 5.2 Using a Terminal Program for Wi-Fi Communication.

1. In your terminal program open a TCP/IP connection setting the Host to the IP Address of the WRPAS unit, set the port to 3602, the service is “other” and the protocol to unspecified. These last two may be different or not necessary on some terminal programs. In TeraTerm it will look like the following (Figure 12):

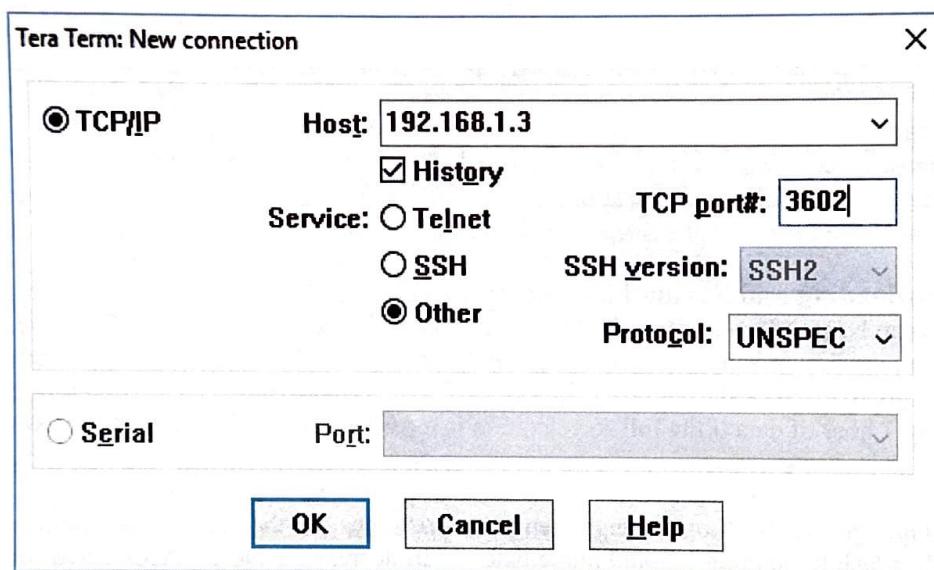


Figure 12

2. Data transmission can be initiated from the WRPAS unit (Status-WiFi enable) or via serial commands sent from the terminal program. The command CDTW 1 and CDTW 0 turns on and off wi-fi transmission of the complete data (including the complete acceleration record). CCT 1 (CCT 0) turns on (off) transmission of concentration only. See Table 5.1 for commands more commands.
3. Save transmitted data to a log file. In Teraterm  
select “File – Log”,  
ensure that the “timestamp” is UNCHECKED\*\*  
navigate to where you want data stored and enter file name, then save

(\*\*you want the time stamp from the WRPAS unit, not the one from the computer).

### 5.3 Using a Terminal Program for Serial Communication.

The settings for using a Terminal Program with USB communication are the same as described in Section 5.1. Table 5.1 shows useful commands.

**Table 5.1: WRPAS Commands**

WSWIFISSID = "NETGEAR71"	Network ID. Space before and after '=' and quotes are necessary.
WSWIFIPSK = "smoothspider"	Password must be less than 13 letters. Space before and after '=' and quotes are necessary.
CDT 1 CDT 0	For USB communication only. Turns on and off continuous Data Transmission., Use with CAT 1 if full accelerometer data is desired.
CCT 1 CCT 0	Turns on and off Continuous Concentrations Transmission.
CDTW 1 CDTW 0	Enable Wi-Fi continuous data transmission. This is the same as enabling "ContinuData" on the WRPAS unit. Transmits complete data record, including full Accelerometer data.
CAT 1 CAT 0	Continuous Acceleration transmission On/Off Use for USB Communication only.
DOMDUMP	Do Memory Dump. Reads Flash Data. Turn off all other data transmission first. Record data using a USB connection: Received Data may be corrupted on a Wi-Fi network.

### 5.4 Downloading and Saving Flash Memory Data

Data records can be saved every second. There are two types of data Records. The first saves only x, y & z, minimum, maximum and average acceleration for three axes. The second type saves three axes 50 hertz acceleration data. The flash holds approximately four hours of data with the first type and approximately 1 hour of data if the full Acceleration is recorded. Recording of data stops when the flash is full.

To save data navigate to the “Log Settings Menu” under “Status” on the WRPAS unit; and enable “Data Save”. “Flash Remaining” should immediately start decreasing. Note: “Accel Save” only determines what type of record is save, it does not start or stop data recording.

To Download the recorded data. Disable “Data Save”. Connect the WRPAS unit to a USB cable and open a terminal as described in sections 5.1. Set the terminal program to save to a file (in TeraTerm, select “File | Log”). Do not timestamp data since WRPAS records its own time stamp. Type DOMDUMP. Close the log file when data transmission is complete.

Note, DOMDUMP may be issued over wi-fi but the data may be corrupted on some networks.

WRPAS will not accept any commands or button press while the flash is being cleared.

## 5.5 Connecting to the Cloud

The prototype instrument can be configured for cloud connectivity through a 3<sup>rd</sup> party cloud service. In the prototype instrument this is a very limited capability though a recommended provider (Adafruit), primarily for demonstration purposes, but it does allow real-time logging and visualization of concentrations and concentration ratio values. In order to connect to the recommended cloud you will need to sign up for Adafruit's open beta for their IO Dashboard system at <https://io.adafruit.com/>. Useful links on using the Adafruit service include an overview of the Dashboard System at <https://learn.adafruit.com/adafruit-io-basics=dashboards/overview>, and an overview of Feeds at <https://learn.adafruit.com/adafruit-io-basics=feeds>.

Before connecting to the cloud, the WRPAS unit needs to be configured for communicating to the cloud through a wireless access point. The wireless access point can be a cellphone hotspot or any other wireless network connected to the WRPAS using the instructions in section 5.1.

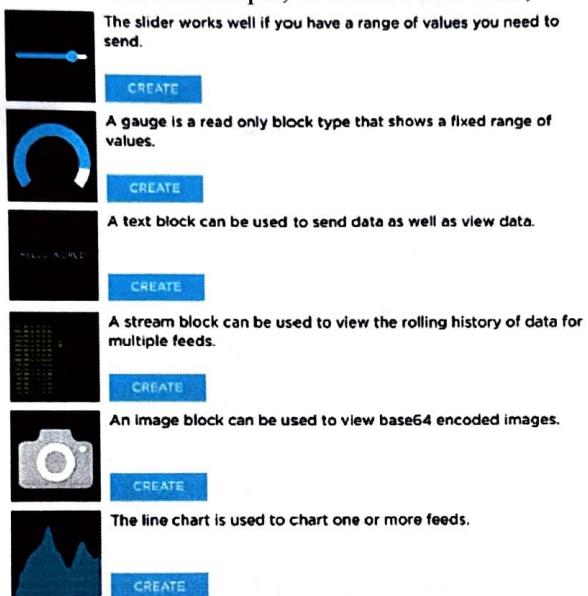
1. Using the instructions in section 5.1 set the SSID and Password by typing the following:  
WSWIFISSID = "network name"  
WSWIFIPSK = "password"  
where the strings in quotes are replaced with the appropriate names for the given router.
2. While still connected to a Terminal program, set the cloud account Broker as well as the broker account User Name and Password by typing the following:  
WSMQQTBROKER = "cloud broker name" (e.g., io.adafruit.com, <39 characters)  
WSMQTTUSER = "cloud user name" (e.g., your adafruit user name, <39 characters)  
WSMQTTPW = "cloud password" (e.g., your adafruit password, <39 characters, this is your "Secret AIO Key viewable on your adafruit dashboard---see section 5.6)  
where the strings in quotes are replaced with the appropriate names for the cloud service.
3. On the WRPAS unit, check that it is connected by navigating to the WiFi menu (under Status) and confirm that:  
WiFi is enabled,  
Socket 3602 is disabled (which is required if MQQT is used)  
MQQT is enabled  
Status SSID matches what was set in step 1  
PSK matches what was set in step 1  
Broker matches what was set in step 2  
User matches what was set in step 2  
PW matches what was set in step 2

## 5.6 Cloud Dashboard Setup and Example

1. At the [io.adafruit.com](https://io.adafruit.com) site, log in to your account. View "all dashboards" and select Actions>Create Dashboard.
2. Give the dashboard a name and click "Create Dashboard"
3. You will be brought to your main dashboard page. In the top right corner, there are useful buttons for adding dashboard elements or viewing your Secret AIO Key. The Secret AIO Key was used in section 5.5 when configuring the WRPAS for cloud communication. Click "My Dashboard" to go back to the menu page.
4. Click "Your Feeds" to go to the page that shows all of the Feeds that are already created.
5. The next step is to click "Create Feed" to add a new feed. The feeds collect and store data that are sent from the WRPAS, and the dashboard uses these feeds to generate charts and gauges.
6. Currently the WRPAS is configured to send only 3 different feeds named Sensor1, Sensor2 and FF. These correspond to the concentrations reported in Channel 1 and Channel 2 as well as the ratio Channel1/Channel 2, respectively. Data are sent to the cloud at the rate of one point per second (the maximum rate allowed by Adafruit), so even though the WRPAS unit is

updating each of these values every second, it is only uploading every third complete measurement to the cloud. Name the first feed “Sensor1”. Then create two additional feeds named “Sensor2” and “FF”.

7. Click Your Dashboards, and select the dashboard that was just made. This will bring you back to your dashboard. Click the blue plus symbol button to create a dashboard block element to display one or more of the feeds you created. A variety of block components will be shown as illustrated below. Line charts display the feed data as a function of time. Gauges display instantaneous feed values. As an example, to create a line chart, click the line chart icon.



8. To continue the line chart example, select one or more feeds to plot, then click “Next Step.” Fill out the desired axis labels and values, then click “Create Block.” Once the block has been created, it should appear in your dashboard. The block will begin to display data once the feed has been updated with data from the WRPAS.

## 5.7 Cloud Dashboard Data Retrieval

1. At the [io.adafruit.com](http://io.adafruit.com) site, log in to your account. Under “Your Feeds” select the feed with the data that you wish to download. Each feed holds only one data set (data values and adafruit time stamp.)
2. Select the grey download button in the bottom right corner and select the file type that you would like to download. Attention: If you wish to analyze the data using Microsoft Excel, please choose CSV instead of Excel file format. The Excel format saves data as text so it is more difficult to import and handle in a way that it does not appear as 0 in Excel calculations and charts.

## Chapter 6: TROUBLESHOOTING

This chapter lists a series of symptoms, their possible causes and recommended solutions for problems with the WRPAS. If your symptom is not listed, or if none of the solutions solves your problem, please contact ADI.

**Always** perform the System Check as the first troubleshooting step. Passing the System Check usually indicates that the WRPAS unit is working properly.

<b>System Check Errors</b>	Low Flow	Check flows at inlet with an external flow meter. If flows are lower than recommended (100cc/min $\pm$ 10) increase the pump voltage slowly until the external flow meter reads the recommended value. If only one of the channels is reading low, a leak at the inlet can be causing this problem and flow should be measured at body inlet. Proceed to open the unit, remove the top case and disconnect the naftion tubes from inlet. Measure flow. If flow reading is still low, check that the pump is working.
	High Flow	Check flows at inlet with an external flow meter. If flows are higher than recommended (100cc/min $\pm$ 10) decrease the pump voltage slowly until the external flow meter reads the recommended value.
	Flow in one channel high, flow in the other channel low.	If one channel is low, usually the other one is high. In this case one of the filters or orifices controlling the flow are clogged and should be changed. Proceed to open the unit, disconnect the blue filter from the sampling line and measure flows again. If flow is in range, replace the filter with a new one.
	Counts low	If counts are low check sampling flow on the corresponding channel. If the flow is in the acceptable range, determine if the growth tube wick has been wetted recently. Wet the wick and perform System Check again. If problem persists, go check Detection Parameters menu and check laser power. This should read near 100% (80-120%). If not, unit should be sent to ADI for service
<b>Counts</b>	Counts irregular with spikes	Probable cause of the irregular and spikes in counts is due to water in the sampling line or the optics head. Attached the HEPA filter to the inlet and run the instrument for several hours with it. Test counts again; if problem persist run the instrument until unit dries out and channels counts read 0. Wet the wicks and turn on the unit. Wait few minutes and check counts again.
	Channel counts are zero	Growth tube wicks are dry. Turn OFF the unit, wet the wick and turn ON the unit again. If the problem persist check sampling flows. If flows are not in the acceptable range, please check solution above (Low-High Flow readings). If flows are fine, then check the detector.

## Appendix: WRPAS SELECTED SERIAL COMMANDS

The commands below can either be delivered to WRPAS over the USB virtual COM port or over Wi-Fi. To use the commands, the use of a terminal emulator program such as HyperTerminal is suggested. The USB connection on WRPAS is an FTDI FT232 chip which requires the correct Windows driver to be installed on the PC. Connection parameters are 115200 baud, no parity, 8 data bits, 1 stop bit.

For the continuous data transmission commands, if the command is delivered over USB, WRPAS will send the resulting transmissions over USB. If the command is delivered over Wi-Fi WRPAS will send the resulting transmissions over Wi-Fi. The exception is the CDTW command which can be sent over USB but will always cause Wi-Fi transmissions.

Commands which change the Wi-Fi setup will work more predictably if used over USB.

For the commands below, if a '\*' appears in the command, enter '1' to enable or '0' to disable.

### **CONTINUOUS TRANSMISSION COMMANDS:**

"CAT *"	Continuous Accelerometer Transmission.
"CBFT *"	Continuous Data Transmission for Beau Farmer's display program.
"CDT *"	Continuous ADI Data Transmission for ADI's laptop display program.
"CDTW *"	Continuous ADI Data Transmission to WIFI. This is a setting which is sticky. The state of this setting can also be viewed or changed on the "Wi-Fi" status screen on the instrument.
"CCT *"	Continuous Count Transmission.
"CPT *"	Continuous Pressure Transmission.
"CST *"	Continuous Status Transmission.
"CTT *"	Continuous Temperature Transmission.

### **LOGGING (SAVE TO INTERNAL MEMORY) COMMANDS:**

"DOMCLEAR"	Clear saved measurements from the dataflash chip.
"DOMDUMP"	Dump saved measurements from the dataflash chip. Xon/Xoff flow control can be used if transferring logged data over USB and the PC can't keep up.
"RMMPCPT"	Read Measurement percent of dataflash memory left.
"WSUCACCSAVE *"	Activate/deactivate saving of full accelerometer measurements to the dataflash chip. If deactivated, only partial accelerometer measurements will be saved. Logging ("WSUCMSAVE *" below) must be turned on for anything to be saved. This setting is sticky.
"WSUCMSAVE *"	Activate/deactivate saving of measurements to the dataflash chip. This setting is sticky.

### **WI-FI SETUP COMMANDS:**

"DOWIFIRESET"	Reset Wi-Fi and go. This command is necessary to make WRPAS use any new Wi-Fi or MQTT settings below after updating them.
"WSWIFIDISABLE *"	Enable or disable Wi-Fi module from connecting to Wi-Fi network.
"WSWIFISOCKHOST *"	Enable or disable Wi-Fi module from hosting a TCP connection over port 3602. Other network-connected devices can establish a TCP connection over port 3602 and exchange ASCII data and commands, if they know WRPAS' IP Address. WRPAS' IP Address can be learned by using the "RSWIFI" command or by looking on the Wi-Fi menu on WRPAS'

"WSMQTENABLE \*" display, after WRPAS connects to the Wi-Fi network.  
Enable or disable Wi-Fi module from connecting as an MQTT client  
to the broker specified with the WSMQTTBROKER command below.  
(NOTE: The Wi-Fi TCP socket host on port 3602 and the MQTT client cannot be used at the  
same time)

"WSWIFIPARAMS" Send DEFAULT Wi-Fi parameters and Wi-Fi configuration to Wi-Fi module.  
This will change SSID to "NETGEAR77" and PSK to "smoothspider".  
This will also update to the correct Wi-Fi mode to use the Wi-Fi  
chip. This command should only be needed if the Wi-Fi chip loses its  
settings.

"WSWIFIPSK = "?????????????????" Reset the PSK (network password) to the value sent.  
The new PSK value must be 13 chars or less.  
The new PSK value must be letters or numbers only.  
e.g. type this, the <CR> is carriage return and means hit ENTER:

WSWIFIPSK = "smoothspider"<CR>

"WSWIFISSID = "?????????????????????????????" Reset the SSID (network/router ID) to the value sent.  
The new SSID value must be 32 chars or less.  
The new SSID value must be letters or numbers only.  
e.g. type this, the <CR> is carriage return and means hit ENTER:

WSWIFISSID = "NETGEAR77"<CR>

"RSWIFI" This is a query of the current Wi-Fi state. An example follows.  
Note that "MQTT ClientID" is not a user setting and is created  
automatically from the instrument serial number when connecting  
to the MQTT broker. It shows "not initialized" until the broker  
connection is made.  
IP Address is assigned to WRPAS by the network when connecting.  
DHCP is turned on to assign WRPAS' IP Address automatically.  
IP Address usually stays the same for the same network but could  
change if the WRPAS is disconnected from the network for some length  
of time.

RSWIFI<CR>  
SSID = TSI Guest  
PSK = gu3stus3r  
IP Address = 10.1.62.76  
IP Gateway = 10.1.62.254  
Sock host 3602 enabled = 0  
MQTT enabled = 0  
MQTT Broker = io.adafruit.com  
MQTT ClientID = not initialized  
MQTT User = myadafruitusername  
MQTT PW = mypassword  
WiFi Connect status = Network connected

**MQTT SETTING COMMANDS:**

"WSMQTTBROKER = "?????????????????????????????????????????"  
Reset the MQTT broker DNS resolvable name or IP address to the value sent.  
The value must be 38 chars or less.  
e.g. type this, the <CR> is carriage return and means hit ENTER:  
  
WSMQTTBROKER = "io.adafruit.com"<CR>  
or  
WSMQTTBROKER = "52.5.238.97"<CR>  
  
"WSMQTTUSER = "?????????????????????????????????????"  
Reset the MQTT User Name address to the value sent.  
The value must be 38 chars or less.  
e.g. type this, the <CR> is carriage return and means hit ENTER:  
  
WSMQTTUSER = "myadafruitusername"<CR>  
  
"WSMQTTPW = "?????????????????????????????????"  
Reset the MQTT Password to the value sent.  
The value must be 38 chars or less.  
e.g. type this, the <CR> is carriage return and means hit ENTER:  
  
WSMQTTPW = "mypassword"<CR>

**GENERAL COMMANDS:**

"FWVER" Read Firmware version. Returns:  
"FWVER m.nn.h\r\n", where:  
"m" = major rev,  
"nn" = minor rev,  
"h" = hardware rev.  
"IDENTIFY" Returns "WRPAS-USBVCOM" if command sent thru USB serial port.  
Returns "WRPAS-Wi-Fi" if command sent thru Wi-Fi.  
"RMULTI" Read Multiple Measurements.  
"RMCONC1" Read Measurement Concentration, channel 1:  
The instrument will wait for the concentration to be updated  
(could take up to 1 second) and then transmit the concentration.  
"RMCONC2" Read Measurement Concentration, channel 2:  
The instrument will wait for the concentration to be updated  
(could take up to 1 second) and then transmit the concentration.  
"RADIDATA" Read Data for ADI's laptop display program.