

User Manual

UPAS v2

Ultrasonic Personal Air Sampler



Notices

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Safety Notices

Do not use this product in any manner not specified by the manufacturer. The protective features of this product must not be impaired if it is used in a manner not specified in the operation instructions.

Do Not Remove Instrument Cover

There are no operator serviceable parts inside. Refer servicing to Access Sensor Technologies.

In Case of Damage

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel

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1 Introduction

Access Sensor Technologies' Ultrasonic Personal Air Sampler (UPAS) provides a new paradigm of streamlined, low-cost exposure assessment to indoor air pollution. The UPAS is a self-contained filter-integrated sampler featuring valve-less ultrasonic pumping technology. This technology provides substantial reductions in size, weight, noise, and cost along with increased durability over traditional sampling equipment. The UPAS is silent and light enough to be worn in the subject's breathing zone, but can also be deployed in fixed site sampling scenarios.

The UPAS system consists of two components:

- A hardware component which can be worn in the subject's breathing zone or mounted on a tripod (not included) for general environmental testing.
- A software component with a *Bluetooth*[®] interface allows programming, control and data download via a mobile Android or Apple iOS application.

This User Guide describes both the hardware and the software components. It explains how to prepare and program the UPAS and then retrieve the UPAS sampled data.



CAUTION: The Access Sensor Technologies UPAS Sampler is designed for indoor use only. Shield the UPAS from water, water spray, precipitation, etc.

There are no operator serviceable parts inside. Refer servicing to Access Sensor Technologies.

What comes with my UPAS

Your UPAS comes complete with a kit containing the following items. If you are missing any items, contact Access Sensor Technologies.

Description	Qty
O-Ring replacement kit	1
Filter cartridges	2
PM _{2.5} Cyclone Inlet assembly	1
microSD Card	1

Optional Accessories

Contact Access Sensor Technologies to purchase these accessories.

Description
Flow Measurement Adapter (for flow verification),
Additional Filter cartridges
Additional size selective Cyclone Inlet assemblies

What is not provided

Description	Comments
USB Cable	Optional USB Type A connector to Micro USB connector
Flow Meter/ Primary	Required only for flow verification.
Lanyard, tripod, chest harness, armband, etc.	

UPAS at a Glance

The following photos show the UPAS and identify several key components,

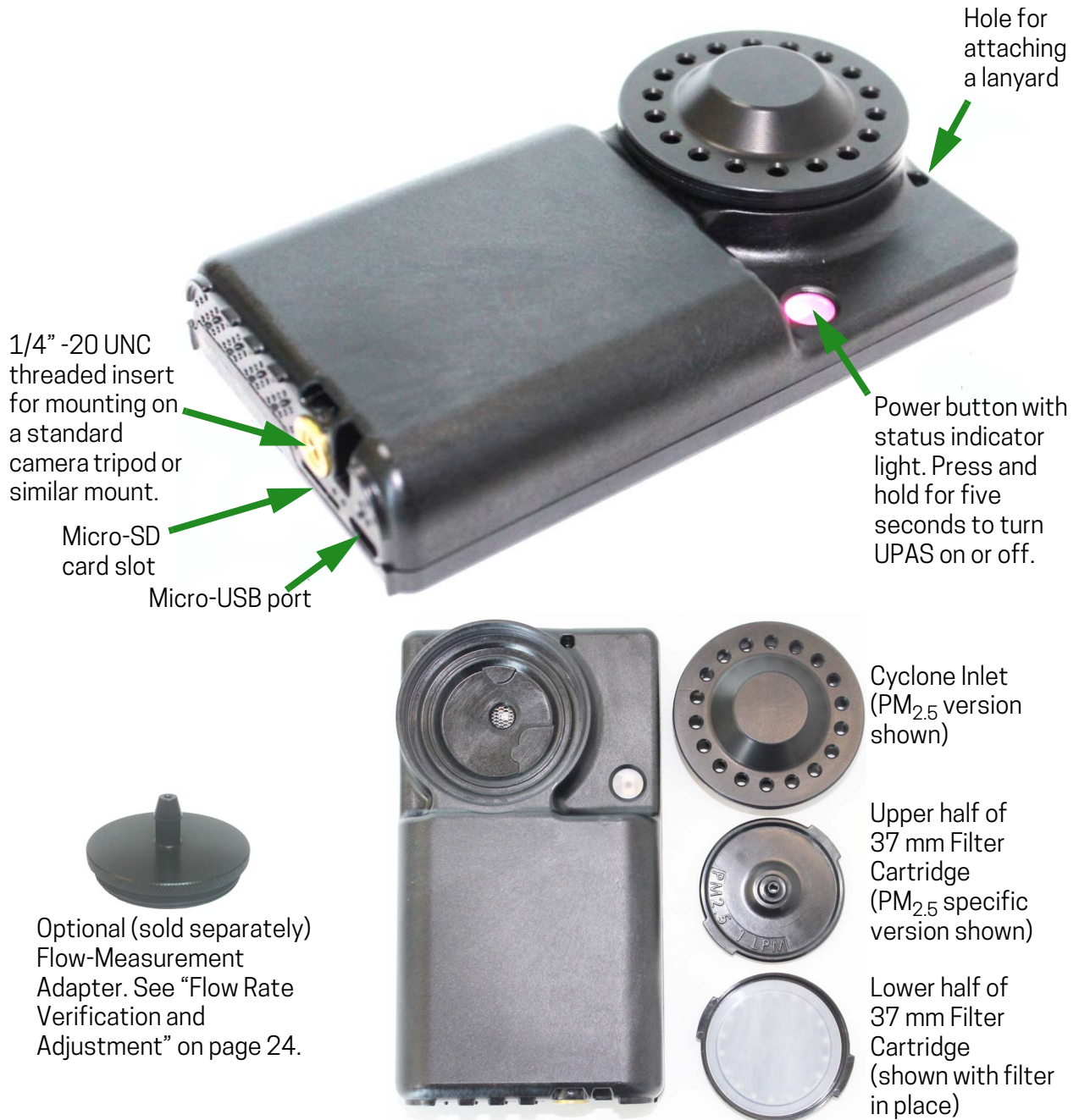


Figure 1 UPAS with Cyclone Inlet Cap Removed

NOTE: There are no user-serviceable components inside. Do not attempt to open the UPAS case. Return the UPAS to Access Sensor Technologies for repair.

Recommended UPAS Filter Membranes

Table 1 Filter Membranes

General Gravimetric analysis		Disolvable (for chemical Analysis)		Scannable via XREF EDS, etc.		Microscopy Analysis		Biological Sampling		Relative Flow Resistance (lower means longer UPAS battery life)		Manufacturer		Product Family		Product ID		Filter Media Material Type		Filter Media Pore Size (µm)		Support Ring Material	
+	+	-	+	+	+	+	+	+	1.0	Tisch Scientific	PTFE	SF17382	PTFE (Teflon) membrane	5.0	none								
+	+	-	+	+	+	+	+	1.2	GE Lifesciences Whatman	TE 38	10411108	PTFE (Teflon) membrane	5.0	none									
+	+	-	+	+	+	+	+	1.3	Pall Laboratory	Teflo	R2PJ037	PTFE (Teflon) membrane	2.0	PMP Ring									
+	+	-	+	+	+	+	+	1.7	Measurement Technology Laboratories (MTL)	PTFE	PT37P-PF03	PTFE (Teflon) membrane	2.0	FEP Ring									
+	+	±	+	+	+	+	+	4.2	SKC	PVC	225-5-37	PVC membrane	5.0	none									
+	+	-	+	+	-	-	-	5.0	Pall Laboratory	Tissuquartz	2500QAT-UP	Quartz fiber (unbonded)	-	none									
+	+	-	+	+	-	-	-	5.1	Pall Laboratory	EMFAB	TX40HI20WW-37 mm	Borosilicate microfiber w/ woven glass, PTFE bonded	-	none									
+	+	-	+	+	+	+	+	6.6	Pall Laboratory	Zefluor	P5PJ037	PTFE (Teflon) membrane	2.0	PTFE Ring									
±	+	+	+	+	+	+	+	10.0	SKC	MCE	225-1988	Mixed cellulose ester (MCE) membrane	5.0	none									
±	+	+	+	+	+	+	+	16.2	SKC	MCE	225-1989	Mixed cellulose ester (MCE) membrane	0.8	none									
±	+	+	+	+	+	+	+	16.2	SKC	MCE	225-334	Mixed cellulose ester (MCE) membrane	0.8	none									
±	+	+	+	+	+	+	+	17.7	EMD Millipore	MF	AAWP03700	Mixed cellulose ester (MCE) membrane	0.8	none									
±	+	+	+	+	+	+	+	19.0	GE Lifesciences Whatman	ME27	10400909	Mixed cellulose ester (MCE) membrane	0.8	none									

± means typical use, ± means optional use, ■ means not typically used.

2 UPAS Physical Setup

General Setup

The UPAS Sampler monitors air pollution by passing ambient air at a regulated flow rate through a size-selective inlet and then a 37 mm filter inside of a cartridge.

An iOS (Apple) or Android mobile device application (the “App”) programs parameters into the UPAS and initializes sampling runs. You can assign a unique sample name and “filter cartridge ID” for each sample, and transfer log files to a computer for data analysis, and more.

Your UPAS Sampler is identified by the serial number ID on the back of the UPAS. You will need this serial number ID when connecting the UPAS to the mobile device App.



Power On/Off Sequence

Turning the UPAS On

Prior to powering up the UPAS, ensure that you have installed the microSD card and that you have properly installed a filter cartridge and Cyclone Inlet cap.

Press the power button firmly until it clicks. Continue holding until the LED light turns on (about five seconds). Release the button. Note that the pushbutton requires an uninterrupted hold down of at least five seconds. If pressing the pushbutton is interrupted, the UPAS does not power on; repeat the process.

The button light should briefly be a blue/cyan color indicating that the unit is powering up. Watch the power button for the power-on status indicator sequence. Refer to Figure 2 on page 9 and Table 2 on page 10 for the power-on sequence.



CAUTION: Never run the UPAS without a 37 mm filter cartridge with filter in place. It is possible to get contaminants in the unit. Dust and other particulates may damage the pumping elements.



Turning the UPAS Off

Press the power button firmly until you feel a click. Continue to hold it in this state for at least five seconds, until the LED light turns off. Release the button. If the unit has been successfully powered down the LED status light is off. If the UPAS fails to shut down, try again with a fresh five second button hold.

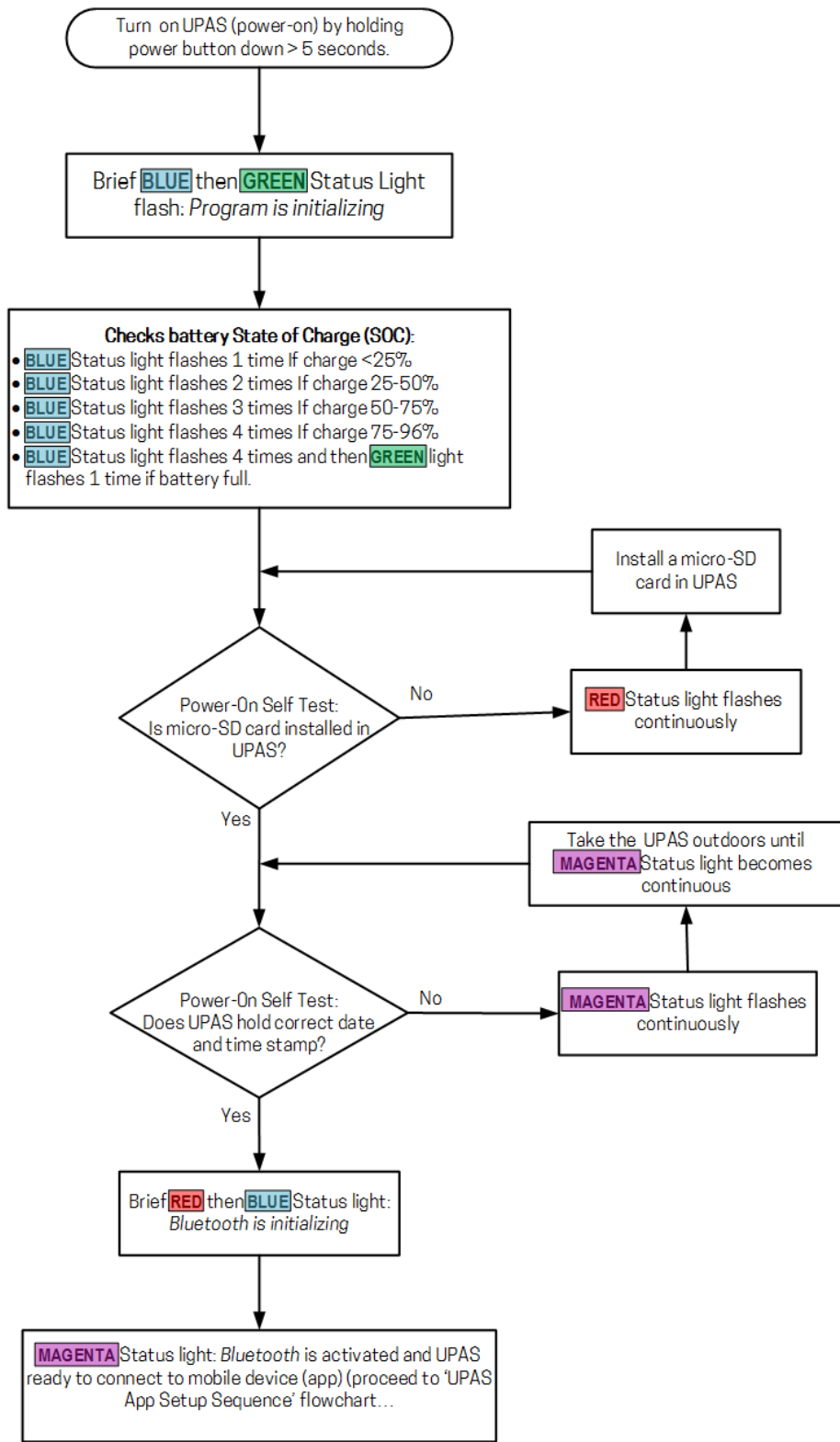


Figure 2 UPAS Power-On sequence

Table 2 Power-on Sequence Status Light Indication. (UPAS Firmware Version 102)

	Sequence / Test	LED Status Indicator	Meaning / Definition	
Start-up Sequence	1	Power-on the UPAS by pressing the power button >5 seconds	Cyan light flashes once then Green light flashes once UPAS is powered on, start-up sequence beginning.	
	2	Battery State of Charge (SOC) ^{1,2} Indication (UPAS flashes one of these codes)	Blue (cyan) light flashes once	SOC is < 25%
			Blue (cyan) light flashes twice	SOC is 25 to 50%
			Blue (cyan) light flashes 3 times	SOC is 50 to 75%
			Blue (cyan) light flashes 4 times	SOC is 75 to 96%
			Blue (cyan) light flashes 4 times then Green flashes once	SOC is > 96%
	3	Test for microSD Card ³	Red light flashes indefinitely	No microSD card is installed in the UPAS.
	4	Test for GPS Date/Time ⁴	Pink light flashes indefinitely	GPS Date/Time stamp is lost. UPAS start-up start-up sequence stops if it needs GPS synchronization.
	5	Bluetooth [®] Low Energy (BLE) Initialization	Blue (cyan) light on	BLE is starting.
			Pink light on	BLE ready and waiting for App connection for programming. Do not connect App until pink light appears.

- 1 If the UPAS is plugged into a computer or charger and powered on, the LED displays a repeating charge-status light sequence until the UPAS is unplugged and Bluetooth will not be available for connection.
- 2 If the UPAS is already powered-on when connected to a computer or charger, the normal LED indicators continues, and Bluetooth connection will be available.
- 3 A microSD card must be installed to use the UPAS. All data is logged to the microSD card. If missing, start-up sequence stops here until microSD card is in place
- 4 Set the GPS Date/Time by placing UPAS outdoors to capture the GPS signal. The process should take five minutes or less. If missing, start-up sequence stops here until GPS date/time is synchronized

Installing / Removing Inlet, Filter Cartridge, and Sampling Filter

Removing / Installing the Cyclone Inlet

- 1 Place the UPAS Sampler on a flat surface.
- 2 Remove the Cyclone Inlet by firmly holding the UPAS on the flat surface while unscrewing the Cyclone Inlet (turn counter-clockwise).

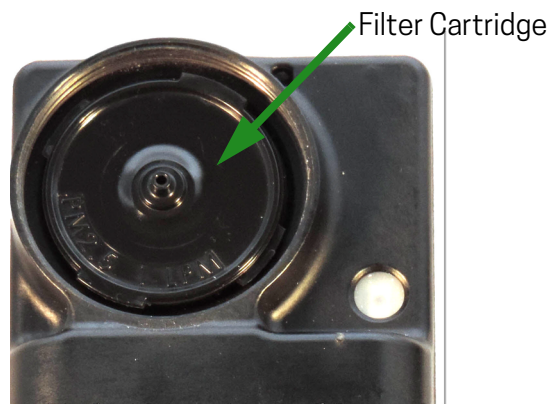


CAUTION: Never run the UPAS without a 37 mm filter cartridge with filter in place. It is possible to get contaminants in the unit. Dust and other particulates may damage the pumping elements.

Install the Cyclone Inlet by carefully screwing the Inlet back onto the UPAS body. Be careful not to cross-thread the Inlet.

Removing / Installing the Filter Cartridge

- 1 Place the UPAS Sampler on a flat surface.
- 2 Remove the Cyclone Inlet. (See above).
- 3 Place the filter cartridge, label down, into the inlet socket of the UPAS. See the following photos. Make certain the cartridge is centered in the UPAS inlet socket.



Filter cartridge properly installed in UPAS



Filter cartridge is installed upside down in UPAS

- 4 Firmly screw Cyclone Inlet cap down, just beyond finger tight.

Removing / Installing the Sampling Filters and Chain of Custody

The following instructions describe removing and installing aerosol sampling filters (user supplied) in a UPAS Filter Cartridge. Handling and processing aerosol sampling filters should be done per sampling protocol defined by the organizational standard being followed. “Recommended UPAS Filter Membranes” on page 6 lists all recommended sampling filters.

NOTE: The filter membranes are fragile; handle with care. Do not handle the filter membranes with your bare hands. Always use clean tweezers.

For most air sampling applications, it is vital to maintain the integrity of collected samples and track the history of samples. Used filter cartridges need to be removed from each UPAS Sampler and returned to their original packages.

NOTE: Do not open filter cartridges unless the sampling protocol instructs you to do so.

- 1 Wash and dry your hands thoroughly.
- 2 Unscrew the black Cyclone Inlet Cap from the front of the UPAS device.
- 3 Remove the filter cartridge from the UPAS. Hold the filter cartridge only by the edges.
- 4 Return the filter cartridge to its original package.
- 5 Seal the package.
- 6 Return the package to the agency / organization sponsoring the test.

Cleaning the UPAS

Cleaning the Outer Housing

Clean the outside of the UPAS Sampler with a soft, slightly dampened lint-free cloth. It is safe to use either a detergent or soap solution or ethanol or isopropyl alcohol on the cloth. Do not use any other chemical solvents.

Cleaning the Cyclone Inlet

Wash and rinse the individual inlet pieces under clean running water. If clean running water is not available, use bottled water from a spray bottle. Use a detergent such as dish soap. Alternately, use ethanol or isopropyl alcohol. Do not use any other chemical solvents.

Select one or more different small, soft-bristled brushes that can reach all the internal surfaces of the inlet. Specifically, one which can reach the end of the pointed conical chamber cavity of the cyclone cap. See the following photos.

Most particulates can be easily observed, they have a light brown or gray coloration and show up well against the black UPAS components.

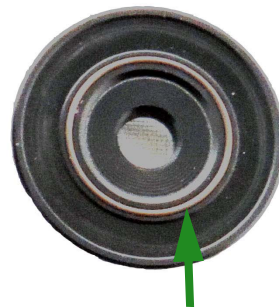
Clean all internal and external surfaces of the outer Cyclone Inlet cap and inner Cyclone Insert before every use of the UPAS.

- 1 Unscrew and remove the Cyclone Inlet Cap from the body of the UPAS Sampler.
- 2 With a small flat screwdriver, key, coin, etc., gently pry the inner Cyclone Insert from the outer Cyclone Inlet.

Cyclone Inlet Cap
(bottom side)



Cyclone Insert
(bottom)



Inspect and clean the Cyclone Insert O-Rings (top and bottom)



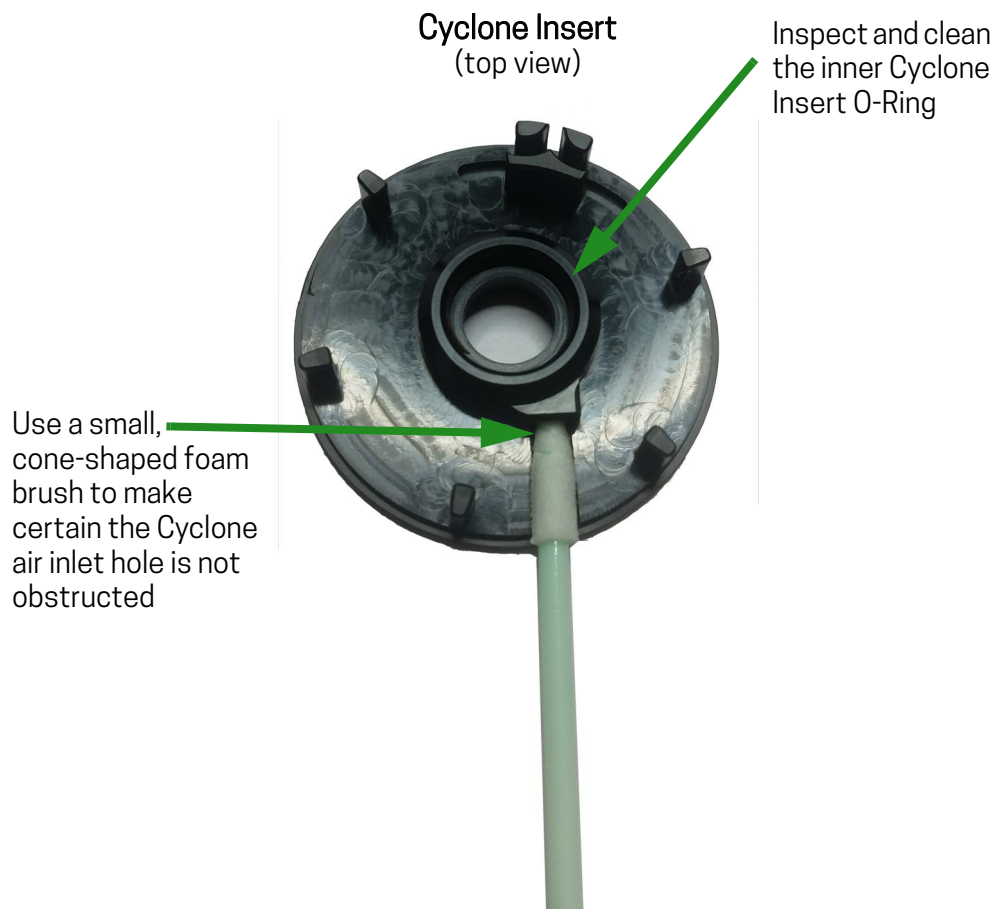
Foam tipped brush

- 3 Carefully inspect and clean the inside of the cone in the Cyclone Inlet Cap with a small soft-bristled brush or pointed foam applicator. Do not use round-tip cotton swabs or any other brush/swab that is not capable of reaching the bottom of the pointed conical chamber cavity of the cyclone cap. Any brush/swab that is too blunt or round may force particulates into the bottom point. Any particulates remaining at the bottom point of the cyclone cap chamber can become dislodged during subsequent sampling runs and contaminate the filter.



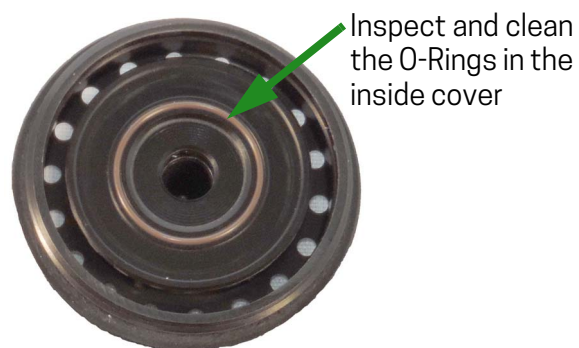
- 4 Clean all surfaces of the Cyclone Insert part. With a small soft brush or a pointed foam applicator, Make certain the Cyclone Air Inlet hole is not obstructed, and free of any debris. Use a small, soft bottle brush or pipe cleaner to clean the Cyclone Air Inlet hole.

NOTE: If grease was previously used, use isopropyl alcohol or ethanol to remove any remaining grease residue. Do not use any other chemical solvents.

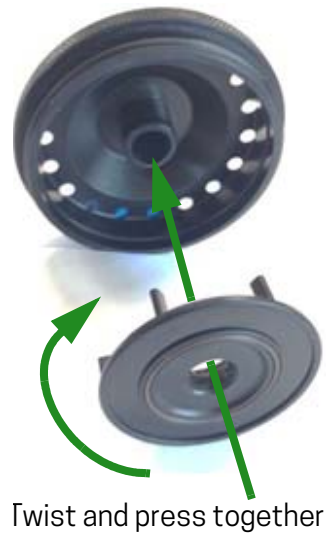


NOTE: Do not use any sharp or metallic tool on this part; it is plastic and can become scratched or otherwise damaged.

- 5 After cleaning, verify that both the small, upper and large, lower O-ring seals are in place (not missing), and free of damage. These are sundry spare components included with each new UPAS. Replace them if they are missing or damaged.



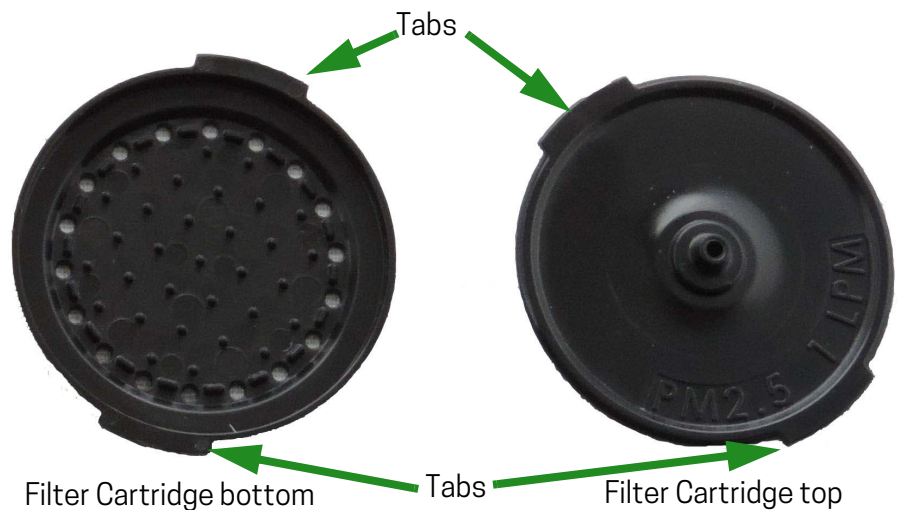
- 6 Allow the Cyclone Inlet components to air dry.
- 7 Reinstall the Cyclone Insert into the Cyclone Inlet Cap with a twisting and pressing motion. There is no specific angular or indexing orientation. If the Inside Cover does not fully snap onto the Inlet Cap, it indicates that the O-ring is not moving into position and may be damaged. When the cap is re-attached to the UPAS body, the two pieces will press together.



Cleaning the 37 mm Filter Cartridge

NOTE: Remove and transfer any exposed air sample filters per the chain-of-custody protocol referenced in “Removing / Installing the Sampling Filters and Chain of Custody” on page 12.

- 1 Both the top half and the bottom half of the filter cartridge have two small tabs. Use these tabs to separate the two halves of the filter cartridge. The top piece has a nozzle; the bottom piece has protrusions to support the filter.



- 2 Place a new filter membrane into a clean cartridge. Do not use a backing pad! For a list of recommended filter membranes, see “Recommended UPAS Filter Membranes” on page 6.
- 3 Press the two halves back together with tabs slightly misaligned. If they don’t easily snap together, check for the presence of the black O-ring on the top (nozzle) piece.

Note the three-character code on top of each filter cartridge. The three-character code is an identifier used to track the filter cartridge. Enter this code into the App as the **Cartridge ID**. This code is saved as part of the Log file and keeps the filter associated with the data.



Cleaning the Filter Cartridges

If you reuse a filter cartridge, it must be thoroughly cleaned between uses.

- 1 Separate the two halves of the filter cartridge as explained above. Remove the filter membrane for analysis. See "Removing / Installing the Filter Cartridge" on page 11.
- 2 Use soapy water and a soft-bristled brush to carefully clean all surfaces of the cartridge.
- 3 Thoroughly rinse the cartridge under clean running water. If running water is not available, use bottled water from a spray bottle. Alternately, use alcohol.



Make sure that both halves of the cartridge are clean and dry before re-loading the cartridge with a clean filter membrane.

Optional – Greasing the Cyclone Input

Carefully inspect and clean the inside of the cone in the Cyclone Inlet Cap with a small soft-bristled brush or pointed foam applicator. Do not use round-tip cotton swabs or any other brush/swab that is not capable of reaching the bottom of the pointed conical chamber cavity of the cyclone cap. Any brush/swab that is too blunt or round may force particulates into the bottom point. Any particulates remaining at the bottom point of the cyclone cap chamber can become dislodged during subsequent sampling runs and contaminate the filter.



NOTE: If grease was previously used, use isopropyl alcohol or ethanol to remove any remaining grease residue. Do not use any other chemical solvents.

After cleaning, apply a very thin layer of Dow Corning 976 or 976V High Vacuum grease to the inside of the small cone in the Cyclone Inlet Cap. (Note: If the UPAS Sampler is used in environments of very high PM concentration, the cyclone can become overloaded to the point that severe vibration can dislodge rejected PM trapped on cyclone wall surfaces.) The grease can re-trap any rejected PM which becomes dislodged in these events and help prevent them from falling into the filter cartridge. This grease must be removed and replaced between sampling runs.

Charging the UPAS Internal Battery

Use a USB cable (USB type A to micro-USB) to connect the UPAS to a computer or standard USB charger. After charging, and before powering it on, remove the UPAS from the charger/computer (otherwise the UPAS keeps its *Bluetooth* communication inactive). A USB charger and cable capable of providing at least 2 Amps charges a fully depleted battery in less than four hours; a charger capable of less than 2 Amps takes longer to charge the batteries. The UPAS manages the battery charging rate, including trickle and maintenance charging. It can be connected to a charger whenever not in use.

NOTE: Before using the UPAS for the first time, fully charge the internal Li Ion battery.

Charging the Battery when UPAS powered ON and Idle

At power-on, the UPAS status light indicates the relative level of battery charge. If already powered on, indicates the UPAS is charging.

Table 3 UPAS Status Light: UPAS ON and Idle

	UPAS Status Indicator	Definition
Battery State of Charge (SOC) ^{1,2} Indication (UPAS flashes one of these codes)	Blue (cyan) light flashes once	SOC is < 25%
	Blue (cyan) light flashes twice	SOC is 25 to 50%
	Blue (cyan) light flashes 3 times	SOC is 50 to 75%
	Blue (cyan) light flashes 4 times	SOC is 75 to 96%
	Blue (cyan) light flashes 4 times then Green flashes once	SOC is > 96%

- 1 If the UPAS is plugged into a computer or charger before it is powered on, the LED displays a repeating charge-status light sequence and Bluetooth will not be available (connection to the mobile device App is not possible) until the UPAS is unplugged.
- 2 If the UPAS is already powered-on when connected to a computer or charger does not provide the relative charge indicators. The UPAS proceeds through its normal power-on sequence and Bluetooth connection is possible.

Charging the Battery while UPAS Actively Sampling

The UPAS status light indicates the status of the UPAS charging:

Table 4 UPAS Status Light: UPAS ON and Sampling

UPAS Status Indicator	Definition
Blue (cyan) light on	UPAS plugged in and charging the internal battery.
Orange light flashes repeatedly	UPAS battery low, recharge immediately.

Using an External Battery to Extend Available Runtime

If the added weight and complexity are acceptable, connecting an external battery pack to the UPAS micro-USB port via cable adds the capacity of the external pack to the UPAS internal battery capacity. The Voltaic model V15 (<https://www.voltaicsystems.com/v15>) and model V44 (<https://www.voltaicsystems.com/v44>) battery packs in **Always-on** mode are the only known packs that reliably provide appropriate extension to the UPAS. Other packs without the Always-on mode may fall asleep due to the nature of the UPAS charging circuit.

Installing / Removing the microSD Card

Before powering-on the UPAS Sampler, ensure a microSD card is installed in the slot in the bottom of the UPAS. microSD cards of any speed class and memory capacity may be used in the UPAS. You do not need to format the microSD card.

Installing a microSD card in the UPAS

- 1 Insert the microSD card into the slot on the bottom of the UPAS (under the threaded mounting hole). The gold metal tabs on the microSD card face the back of the UPAS.
- 2 Gently push the card in with a small coin, paper clip, ball point pen tip, or finger nail until you feel it *click* at its stop position.
- 3 Release the card. It rebounds slightly and then stops in the installed position (set in from the UPAS bottom ~1 to 2 mm). Verify that the card is in this position and not protruding from the housing face. If it is protruding, attempt to push it back in (Step 2).



Removing the microSD Card

To remove the microSD card, simply press and release the microSD card with a small coin, paper clip, ball point pen tip or fingernail. The microSD card pops out and can be removed with your fingers or tweezers, etc.

Mounting the UPAS

The UPAS may be used as either a personal breathing zone sampler or it may be mounted for stationary site sampling.

Mounting the UPAS for Personal Breathing Zone Sampling

In order to collect a good personal air sample, the participant should wear the UPAS as near as possible to the participant's personal breathing zone. By placing the UPAS Sampler in the participant's breathing zone, it samples the same air as the participant is breathing.

Personal Breathing Zone is defined as the area immediately surrounding a person's nose and mouth where the majority of air is drawn into their lungs. This zone is the area monitored by the UPAS to aid in determining the presence of airborne contaminants.

Several possible solutions exist to fit the UPAS to participants:

- A lanyard suspending the UPAS from the participants neck. See Figure 1 on page 5 for the location of the lanyard hole.
- An adjustable harness which holds the UPAS firmly against the participant's body over the collar bone.
- An industry safety vest with attachment points for proper breathing zone mounting.

When fitting the UPAS to a participant, adhere to the following guidelines:

- Always follow the protocol of the agency or organization sponsoring the air test.
- The UPAS must always be worn outside of clothing.
- Make sure the front of the UPAS device faces outward and does not get covered or blocked by clothing or other items during the personal sampling period.
- Participants should remove the sampler when they sleep, bathe, smoke, etc.
- The UPAS Sampler must be shielded from rain and all moisture at all times.

Mounting the UPAS for Fixed Site Sampling

The UPAS provides a 1/4" -20 UNC threaded insert for mounting on a standard camera tripod or similar mount. See Figure 1 on page 5 for the location of the insert.



Figure 3 Mounting the UPAS on a Camera Tripod

- Always ensure that the UPAS is protected from damage by contact/collision from any objects, vehicles, etc.
- The UPAS Sampler must be shielded from rain and all moisture.

Flow Rate Verification and Adjustment

Verify UPAS Flow Rate as prescribed by the method or protocol for each test session. Ensure that the calibration equipment is within its prescribed calibration interval, and record the serial number of the calibration equipment.

Place the same type of sampling filter in-line during sampling pump calibration that will be used to sample in the field. Do not use the actual filter intended for field sampling use to perform calibration.

Required Apparatus

Any flow meter primary with acceptable accuracy that does not pose significant flow restriction (i.e. low pressure drop models are recommended), and doesn't use a moving piston in its measurement may be used. Flow meters that work well are:

- Alicat Scientific MWB low-pressure-drop series (<https://www.alicat.com/models/mw-low-pressure-drop-gas-mass-flow-meters/>).
- Alicat Scientific FP-25 Field Flow Standard (<https://www.alicat.com/models/mw-low-pressure-drop-gas-mass-flow-meters/>).
- BGI Trical (<https://bgi.mesalabs.com/tetracal-air-flow-calibrator/>).
- A. P. Buck Bubble Flow Meter (simple liquid bubble type), M-30 or M-30B (www.apbuck.com/shop/item.aspx?itemid=80).

Measuring Flow Rate

- 1 Prepare the flow measurement apparatus for making a measurement. Connect a suitable flow meter primary (see list of suitable flow meters above) to the UPAS Flow Measurement Adapter using a length of Tygon, Silicone, rubber/EPDM or similar flexible tubing of approximately ¼" inner diameter. Ensure that there are no leaks in this tubing connection.
- 2 Remove the standard threaded cyclone inlet cap from the UPAS.
- 3 Place a filter cartridge containing a typical filter in place in the normal position (the flow-measurement adapter does not seal properly without a filter cartridge in place; measurement errors may result).
- 4 Install the flow-measurement adapter in its place in the same way you would the cyclone inlet cap, threading it in until it becomes tight (you should see a slight gap between the underside of the flow-measurement adapter flange and the lip of the UPAS housing).

NOTE: The UPAS Flow Measurement Adapter is not supplied with the UPAS. It must be ordered separately from Access Sensor Technologies.

- 5 Power-on the UPAS, connect to the App in the standard manner, and set up a sample run of arbitrary length of time at the desired flow rate you wish to check (100% duty-cycle is recommended for ease of measurement).
- 6 Start the sample run via the **Start** button in the App.
- 7 Give the UPAS at least three minutes for flow variation to fully settle before taking a reading with the flow meter primary (ensure you are reading in True Volumetric Flow vs. Standard Volumetric Flow, and convert units to Liters/minute as needed for comparison to the UPAS specification).



The complete flow measurement apparatus (flow-measurement adapter, tubing, flow meter primary) must be connected to the UPAS before initializing the sample run to make a flow measurement. The UPAS adjusts flow slowly thereby adding the flow-measurement apparatus during a sample run that is already underway causes a situation where the UPAS takes several minutes to normalize flow.

1/4 inch Tygon tubing connecting the UPAS to the Flow Rate meter.

Access Sensor Technologies Flow Rate Adapter installed on the UPAS.

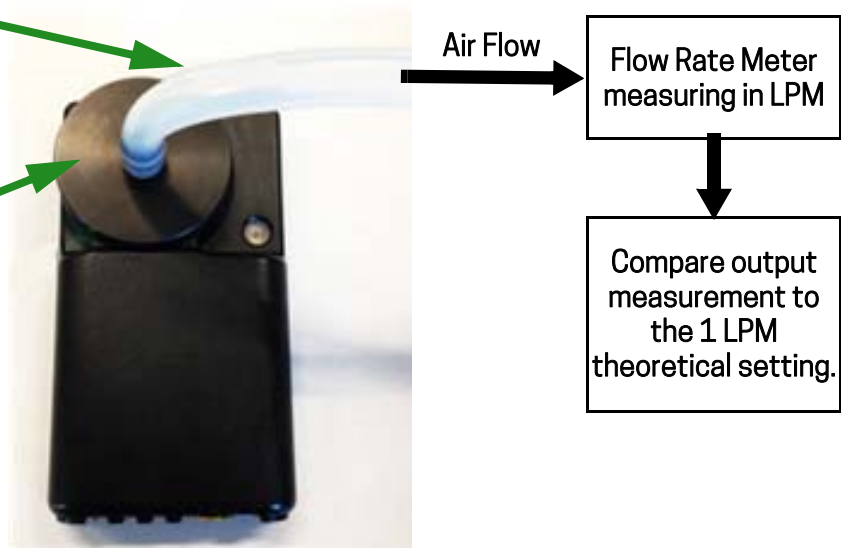


Figure 4 Flow Rate Verification Calibration Train

- 8 After testing, disconnect the flow meter and flexible tubing from the UPAS.

Updating / Flashing the UPAS Firmware

- 1 Connect the UPAS to any computer (Mac or PC) via a USB cable (standard USB A connector on the PC end and a micro USB connector on the UPAS end). Leave the UPAS connected to the computer. A folder should appear in your computer's explorer tree named **DAPLINK**.

NOTE: Ensure that the USB cable supports data transfer. If the cable doesn't work, try a different cable.

- 2 Drag the firmware file into the 'DAPLINK' folder, approve all security pop up messages, and watch the progress bar complete in 10 to 15 seconds showing the UPAS received the code. The folder should disappear out of the tree as the UPAS shuts down, and reappear as it restarts.
- 3 Disconnect the UPAS from the computer by removing the USB cable.
- 4 Turn the UPAS off, and back on to activate the new firmware.

Optionally, you may initiate a short, arbitrary test sample run to verify the firmware version is on the Sampler and that there are no other problems. Note the firmware version in the log file header.

Firmware Release Notes, Installation Procedure for UPAS v2 Sampler

The current UPAS firmware release is known as '**rev102**', and is available in the file: **UPAS_v2_0-rev102-L152RE_20180510_mbed116.bin**.

The following instructions are comprehensive and guides you in updating the UPAS v2 firmware from any prior version to **rev102**. Note that the instructions may guide you to skip some steps depending on how your UPAS is responding. Note also that this update procedure includes 'one-time-only' steps not needed in subsequent (future) firmware updates beyond **rev102**.

Preparation for the firmware Update

Prepare files and devices for the firmware update.

- 1 Before updating the UPAS firmware, ensure that all mobile devices involved have version 2.1.5 of the App installed. If not, update the App on each mobile device via Google Play for an Android device, or Apple Store for an Apple device.
- 2 **Important:** If you are using an Android mobile device (ignore this step if using an Apple/iOS mobile device), ensure that your mobile device is paired with each UPAS (or, simply pair to any unpaired device as you go).
- 3 Access any Windows or Mac computer or tablet with one or more USB ports (mobile devices are not presently compatible to the actual firmware transfer).

- 4 Download the **rev102** firmware file (*UPAS_v2_0-rev102-L152RE_20180510_mbed116.bin*) from the [Access Sensor Technology](#) website (or from this [Dropbox](#) location), and save it to an easily-accessible location on the computer or tablet.
- 5 Insert a USB-to-microUSB cable to the computer/tablet, which allows you to connect to your UPAS Sampler(s).

You may simultaneously connect as many UPAS Samplers as you have USB ports. Alternately, use a USB port expander for multiple USB ports. Multiple cables accelerate the firmware update process as updates take up to one minute per UPAS.

Normal Firmware Update Process

Update the firmware on all UPAS Samplers regardless of what generation of firmware is present.

- 1 Power-On each UPAS to be updated.
- 2 Connect each UPAS to your computer via a USB-to-microUSB cable(s).
- 3 Look for each UPAS to appear as **DAPLINK** in *This PC* if on a PC, or in *finder/devices* if on an iOS/Mac.
- 4 Drag or copy/paste the **rev102** firmware file (*UPAS_v2_0-rev102-L152RE_20180510_mbed116.bin*) into the DAPLINK folder of each UPAS.
- 5 If any security question pops up, simply approve the process. If simultaneously updating multiple UPAS, you may either copy the file and then approve on one UPAS at a time or copy to all and then approve all. A status bar appears for each UPAS being updated and takes ~15 seconds to show completion. Upon completion, the **DAPLINK** device connection and the associated file transfer window for each UPAS disappears. The **DAPLINK** connection reappears a few seconds later in 'my computer' tree or Finder - meaning that the process has completed.

NOTE: If updating firmware on multiple UPAS Samplers at one time, and especially if going through a large number of Samplers, there may be a higher risk of accidentally missing one or more UPAS. You may repeat the previous steps a second time to be absolutely sure you copied the firmware file to each UPAS. This adds approximately 30 seconds of work per UPAS.

-
- 6 Disconnect the UPAS from the computer.
 - 7 Power all UPAS Samplers OFF (Status light may or may not be visible as it was frozen the moment the firmware flash started). Make sure to hold the pushbutton for > 5 seconds to ensure UPAS is off. At this point the new firmware has been installed and is active the next time you power-On the UPAS.

NOTE: *Proceed to update the firmware on any/all UPAS Samplers you have. Then power Off all UIPAS Samplers. At this point you are done using the computer. The following steps use your mobile device only.*

Special One-Time Update Process

The following extra steps should be done ONE time only. Do not perform the following steps on future firmware updates (beyond **rev102** firmware).

- 1 Power-On *one* UPAS Sampler at a time, leaving all other UPAS Samplers Powered-Off. This helps avoid confusion.
- 2 Use the mobile App to connect to the UPAS in the normal fashion.
- 3 If you cannot find the serial ID of your UPAS in the App list, the firmware update has scrambled the UPAS Bluetooth ID as you updated from firmware older than **rev95**. In this case, do the following one-time steps. Otherwise proceed to step 4 below.
 - a Use the mobile App to connect to the one incorrect serial number that shows up as a high 4-digit number (such as **PS4489**), all zeros (**PS0000**), or something odd like **MS0+**), etc.

NOTE: *If using an Android mobile device that has never connected to the UPAS, use the Bluetooth menu to pair to the device first, again via the strange ID - and then connect to it from within the mobile App.*

- b Once connected to the UPAS with the invalid Bluetooth ID (verify the LED on your UPAS is cyan/light blue), enter the actual/correct 4-digit numerical ID (i.e. the ID on the back of the UPAS) into the **Sample Name** field in the App, followed by the tilde (~) symbol. For example, for UPAS **PS0123**, enter **0123~** in the **SAMPLE NAME** field and then **SET** it.
 - c Start a brief sample run by selecting **START**, and okay/approve.
 - d Power-Off the UPAS any time after the light turns red and pumping begins.
 - e Power-On the UPAS and wait for the boot-up sequence to complete (UPAS status light displays solid pink).
 - f Use the mobile App to connect to the same, invalid Serial ID one more time; as soon as you connect to the invalid ID, it should change to the updated ID. This verifies that the prior steps were successful. If the correct Serial ID does not display, repeat steps a through e above, or contact Access Sensor Technology (support@accsensors.com). Otherwise proceed to the following step.
 - 4 Assuming that you are now connected via the mobile App to the correct serial ID, enter **RESET#** (all-caps) into the **SAMPLE NAME** field, and **SET** it. It should return to the main screen showing **RESET** (without the # character) in the **SAMPLE NAME** field. You should now see the refreshed **BATTERY CHARGE** and **BATTERY VOLTAGE** displayed (look for changed values vs.

the previous UPAS values). Note that sample setting parameters were changed by this **RESET#** command to:

FLOW RATE = 1 LPM
DUTY CYCLE = 50%
SAMPLE DURATION = 48 hrs

You can change those values, they are only defaults in this re-flash.

Again, the **Special One-time Process** is a one-time-only process required for some behind-the-scenes changes to occur. Do NOT use these steps in future firmware updates. Typically, the process takes about 30 seconds per UPAS.

3 Sample Run Setup / Initialization on the Mobile Device App

Installing and Updating the Mobile Device Application

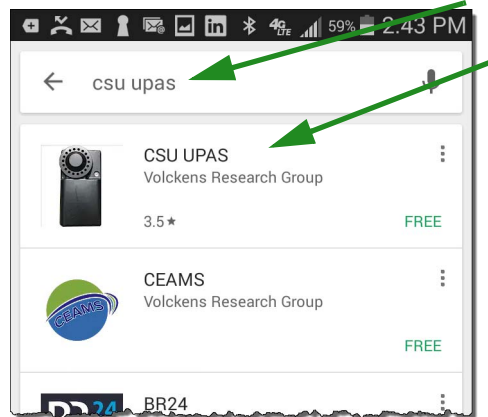
A free-ware mobile device application (the “App”) is required to set up and program the UPAS for sampling. The mobile device (cell phone, tablet, etc.) is needed only for programming the UPAS; it is not needed *during* the sample run and becomes disconnected from the UPAS. The App is available in two operating system versions: iOS (Apple) and Android.

Internet access is required for the device to download the App.

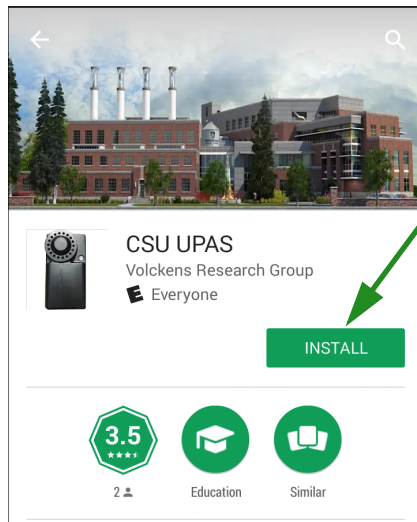
Install and Run the App on an Android Operating System

Users with mobile devices running the Android operating system (OS) can download the current UPAS App from the Google Play Store via the following steps. The current revision of the App (version 2.1.5) is backwards compatible with all firmware revisions of the UPAS.

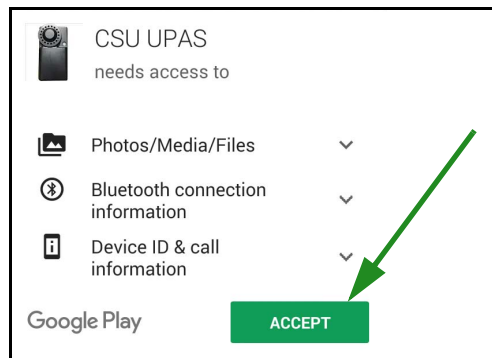
- 1 Find the Google Play Store icon on your mobile device desktop
- 2 Search for **CSU UPAS** to find the application. This is a free App.



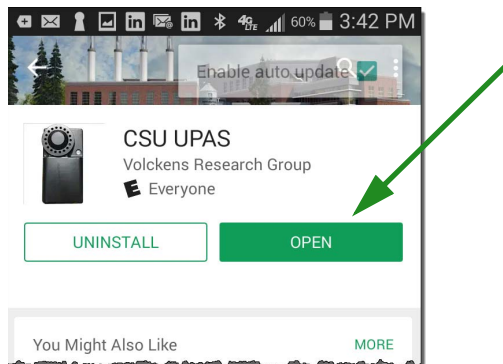
3 Tap **Install** to install the application on your mobile device.



4 Tap **Accept** for all defaults and access requirements.

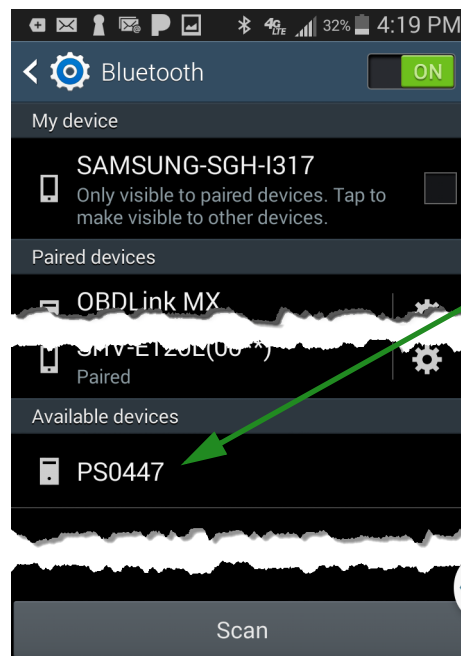


5 Tap **Open** to run the App.



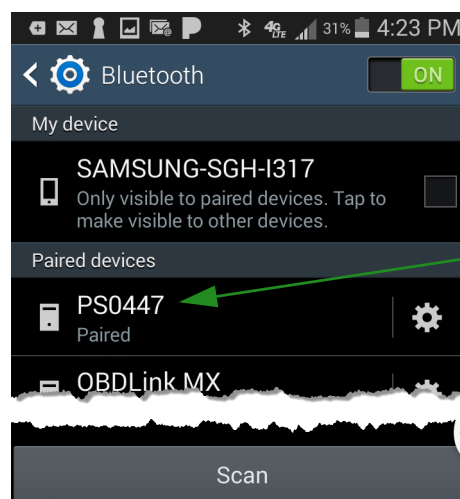
Pairing the UPAS Android App

- 1 Ensure your mobile device has *Bluetooth* enabled. If necessary, click the device Settings menu on your device, then enable *Bluetooth*.
- 2 Use the *Bluetooth* utility on your device to scan for available devices. Your device should locate the UPAS and display it's serial number.





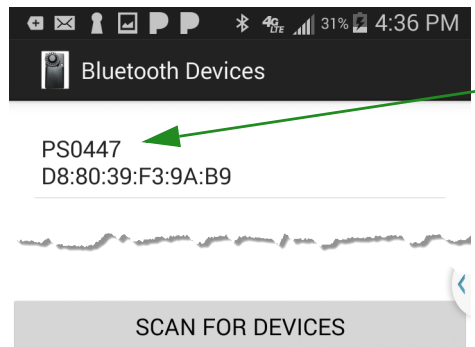
Serial Number
on back of the
UPAS

- 3 Once the UPAS is paired with your mobile device, start the App on your device.

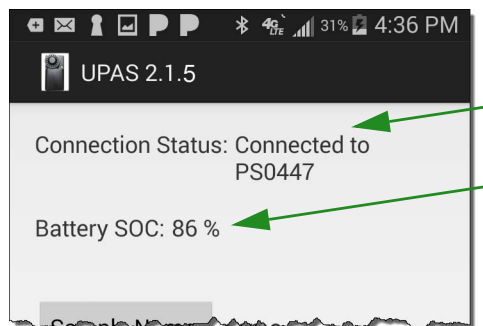


Running the UPAS Android App

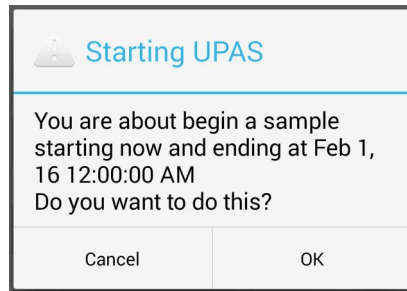
- 1 The first time you run the App, the Connection Status is **Disconnected**. On some Android devices, touch or tap the three dots at the top right of the screen . On other Android devices, tap the Menu Key . This opens the prompt, **Connect to an Air Sampler**.
- 2 The mobile device App searches for *Bluetooth* devices and lists all devices that it finds.



- 3 Tap the device matching the serial number on the back of your UPAS.
- 4 The Connection Status on the App changes to **“Connected to <UPAS serial number>”**. The UPAS Status light should turn from pink to blue.
- 5 The Battery SOC indicates the current charge capacity of the UPAS internal battery.




When you tap the **Start** button, the App prompts you and indicates that you are about to start the UPAS data collection. Tap **OK**.

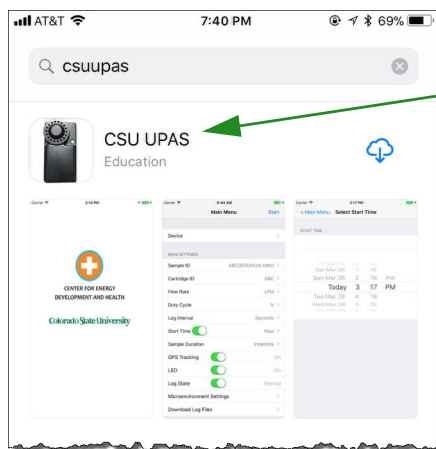



After a few moments, the UPAS Status indicator light turns red and the UPAS pump starts. As soon as the light turns green, it begins sampling. The green light indicates normal operation.

Install and Run the App on an Apple iOS Operating System

The UPAS mobile device App is available on the App Store for iOS devices. The current revision of the App (version 2.1.5) is backwards compatible with all firmware revisions of the UPAS. It requires iOS 9.0 or later and is compatible with iPhone, iPad, and iPod touch devices.

- 1 Find the App Store icon on your mobile iOS device desktop 
- 2 Search for **CSU UPAS** to find the application. This is a free App.



- 3 Tap the cloud icon  to download and install the application on your mobile device.
- 4 Tap **Open** to run the App.

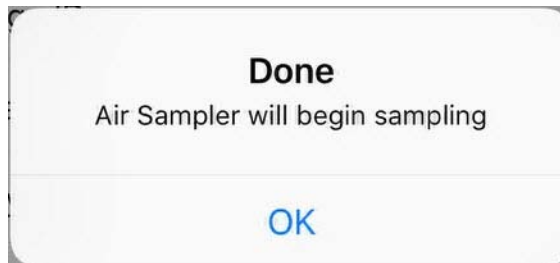
Running the UPAS iOS App

Users with mobile devices running the Apple iOS operating system can download the current UPAS App from the App Store via the following steps.

- 1 Tap **Device** button to scan for available UPAS Samplers. This provides a list of UPAS devices available via *Bluetooth*.
- 2 Tap the UPAS device with the serial number of the Sampler you want to use. This pairs the UPAS Sampler with your App.

When you tap the **Start** button in the upper right corner of the App, it prompts you and indicates that you are about to start the UPAS sample run. Tap **OK**.

Initiates the sampling and data logging process. Note the UPAS power button light changes, red light means pumps are on but not up to speed (not ready). Green means pumps are up to speed (ready).



After a few moments, the UPAS Status light turns red and the UPAS pump starts. As soon as the light turns green, it begins sampling. The green light indicates normal operation.

Sample Run Setup and Programming in the App (Android and iOS)

The following flow chart and table illustrate the sample run setup and run sequence.

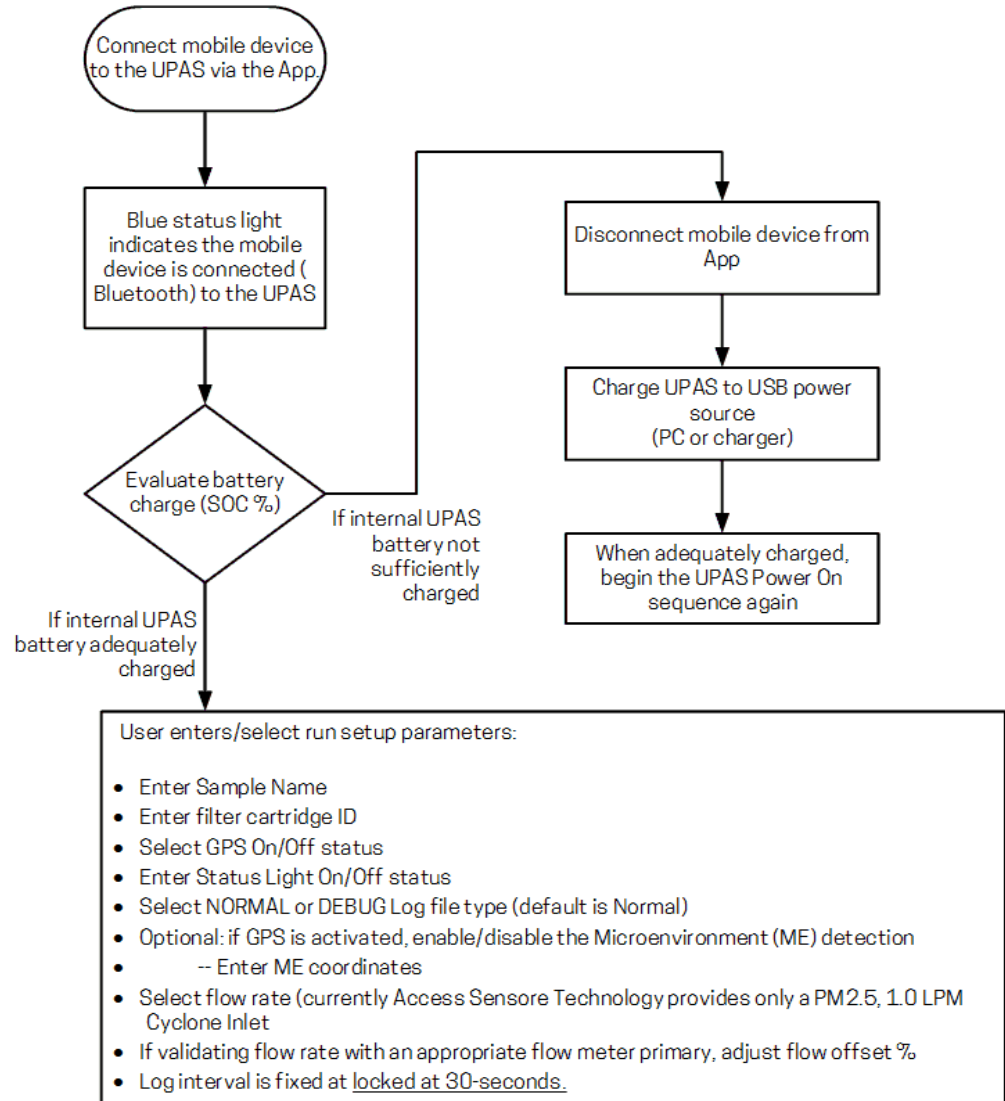


Table 5 Sample Run Sequence

Sequence Item	UPAS Status Indicator	Definition
Connect to UPAS using App for setup	Blue (cyan) light on	UPAS successfully connected to the mobile App.
Setup App parameters	Blue (cyan) light on	Setup all sample configuration parameters in the App
Delayed Start Time	Orange light flashes repeatedly	GPS is off or no GPS date/time is set.
	Blue (cyan) light flashes once	GPS Date/Time set and satellite signal is available.
	Magenta light flashes once	GPS Date/Time set but signal not currently available.
Start at Next Power-on	UPAS Indicator light turns off after starting UPAS sample.	UPAS is sleeping; it starts sampling at next Power-On.
Wake Up for delayed start sampling	UPAS Indicator light turns on.	UPAS is about to start sampling using the pre-sleep App programmed settings. All Start-up Sequence lights apply except Pink light (waiting for App to connect).
GPS Options	Pink light on	GPS is turned on (see App instructions. See Chapter 2).
	Orange light on	GPS is turned off (see App instructions. See Chapter 2).
Optional. Download logged data from previous sample	Red light on	Log file download is initializing.
	Orange light on	Log file download in progress.
	Blue (cyan) light on	Log file download is complete.

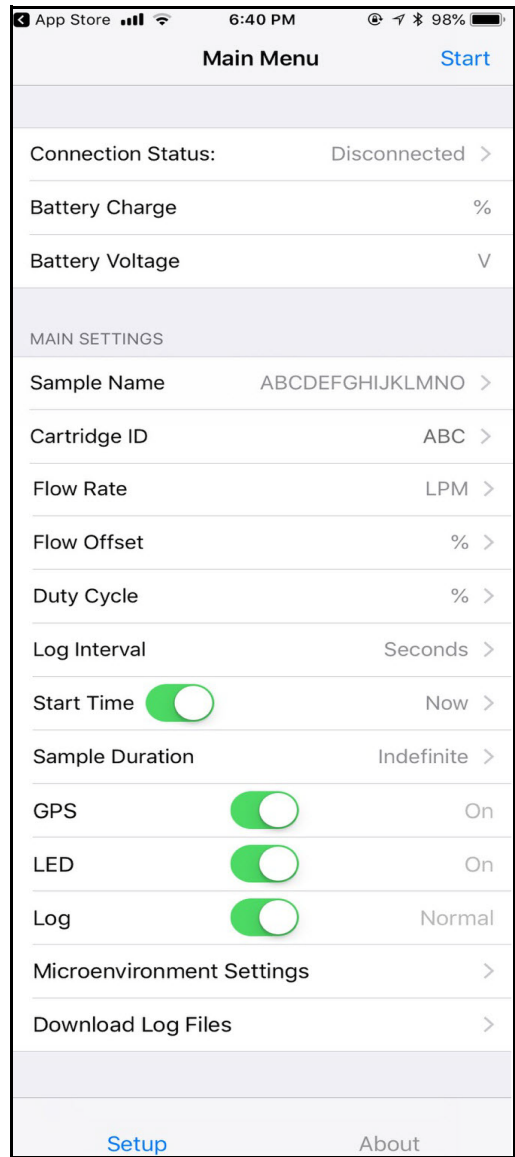
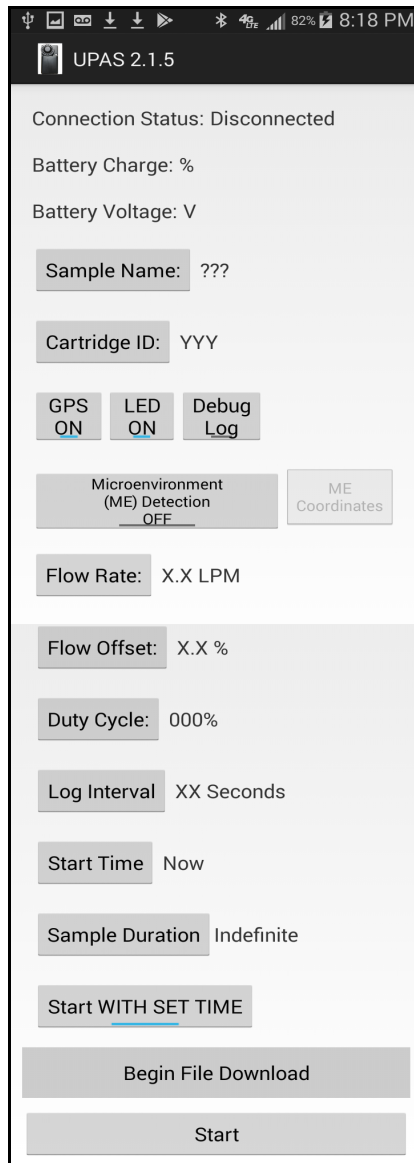


Figure 5 Example Android App Screen (left) and the iOS App Screen (right)

Table 6 below defines each parameter in the App.

Table 6 App Settings

App Button	Description
Connection Status	Indicates either Disconnected or the serial number of the UPAS device that is the mobile device is connected to via the App.
Battery Charge	State of internal Li ION battery charge (as a percentage).
Battery Voltage	Internal battery voltage, in volts.
Sample Name	An optional label you may define which is intended to refer to the human subject ID, or perhaps the designation you decide for this specific sample. The Sample Name becomes part of the log file name and is also recorded within the log file.
Cartridge ID	Filter Cartridge three character alphanumeric label. The Cartridge ID becomes part of the log file name and is also recorded within the log file.
GPS On / GPS Off	Toggles the GPS receiver in the UPAS On or Off. When On, the UPAS writes GPS location data into the log file at each log entry. When Off, the UPAS does not log GPS location data. The GPS uses a considerable amount of electrical energy when enabled – more so if sampling exclusively indoors.
LED On / LED Off	Turns the UPAS indicator light On or Off. There may be instances where you decide to turn the light off, for example at the request of a sample subject, etc. This option defaults to On at each App reconnection. If the indicator light is turned Off you may miss status indications during sampling
Normal Log Debug Log	In Normal Log mode, the logging takes place every 30 seconds. In the Debug Log mode, additional data is logged every one second.
Microenvironment Detection On / Off	Toggles ME Detection in the UPAS On or Off. When On, the UPAS can determine if it is within a set radius distance of up to four user-defined locational coordinates, and record flags within the log file (see ME Coordinates , below). This feature is generally used by expert users.
ME Coordinates	Available only when Microenvironment (ME) Detection is set to On. Allows user to assign latitude/longitude coordinates of four different ME locations which are flagged in the log file data when the subject is in proximity to them; labeled: <i>Home Coordinates</i> , <i>Home Coordinates 2</i> , <i>School Coordinates</i> , <i>School Coordinates 2</i> .
Flow Rate ¹	Target volumetric flow rate in units of liters per minute (LPM, L/min, or L*min ⁻¹), at actual local atmospheric condition density. Options of 1.0, 1.5 and 2.0 L.
Flow Offset ²	Allows user to offset the volumetric flow rate (as a percentage). This user-selected flow offset is persistent and does not change/reset by itself.
Duty Cycle	This is the percent of time that the UPAS Sampler is pulling air. 100% means continuous sampling. Any other value simply applies as the fraction of a succession of 30-second time frames which pumping occurs (e.g., 50% has pump operating for 15-seconds, then off for 15-seconds, repeating indefinitely). The proper flow rate is maintained during the on-period (so that the size-selective inlet continues to function properly). The total integrated sample volume in the log file already reflects the effect of the duty cycle (and is thus used, without further calculation, as the actual sampled volume). Applying duty cycle <100% variously extends the battery endurance, at the cost of a lower effective (time averaged) sampling rate, and thus PM sample acquisition rate.

Table 6 App Settings (continued)

App Button	Description
Log Interval	Log interval is a legacy setting made for outdated firmware. Any firmware newer than revision 84b has the Log Interval locked at 30-seconds.
Start Time	Allows user to set the sampling to either start immediately (START NOW), or at a future date and time (which the Sampler waits in idle mode until, and then start automatically).
Sample Duration	Sets the duration that the sample will run for before automatically shutting down. Possible times are: Indefinite (default), and then 0-8760 hours plus 0-59 minutes.
Start with SET TIME Start ON NEXT Power-ON (in iOS, this is set with Start Time)	Specifies whether the UPAS begins sampling with the specified Start Time (including now/immediately) or the next time the UPAS is powered on. Set date and time to begin sampling. Default is NOW.
Start (in iOS, this is set with Start Time)	Initiates the sampling and data logging process. Note the UPAS power button / Status indicator light changes (see "" on page 10)
Begin File Download Downloading (Download Log Files)	This initiates a download of the data to your <i>Bluetooth</i> -connected device. It changes to the orange "Downloading" while the transfer takes place.

- 1 The present PM_{2.5} inlet is strictly limited to a 1.0 L/min flow rate – future inlets may use different flow values.
- 2 User must connect the UPAS to a primary flow meter and enter a Flow Offset value to reduce any error. Refer to "Flow Rate Verification and Adjustment" on page 24 for detailed information.

Setting a Start Time for the Next Sample Run

Using the Start With Set Time = Now Option

If starting a sampling run immediately is desired, follow the steps:

- 1 Verify that **Select START WITH SET TIME** is displayed (or toggle **START ON NEXT POWER-UP** to turn it back to **START WITH SET TIME**).
- 2 Verify that **START TIME = NOW**.
- 3 Then when ready to begin sampling, click the **START** button and **OK** on the resulting Pop-up.

The following table explains the Status Indicator Lights as the UPAS initializes:

Active Sampling Sequence if START WITH SET TIME = NOW Option Is Used			
Step	Sequence Item	UPAS Status Indicator	Definition
1	Click START to initialize sampling sequence.	Status light is cyan	After clicking START, the UPAS disconnects from the mobile device/APP.
2	Active sampling/pumping begins. UPAS flow control not yet set.	Status light turns red	Pumping starts, UPAS adjusts flow rate.
3	Active sampling/pumping within flow control parameters.	Status Light turns green (or is off if toggled off in App sample window).	UPAS now sampling normally, with flow control within parameters.

Using the Start With Set Time = (Future Date/Time) Option

If you want to start a sample run at some future date and time, follow these steps:

- 1 Verify that **Select START WITH SET TIME** is displayed (or toggle **START ON NEXT POWER-ON** to turn it back to **START WITH SET TIME**).
- 2 Click **START TIME** button to bring up the calendar for date
- 3 Select the intended start date from the calendar, and click **OK**
- 4 A clock appears. Similarly, select the time of day for the programmed start in hours, and then minutes, and then click **OK**.
- 5 Then when the future start date/time have been correctly entered, click the **START** button and **OK** on the resulting Pop-up. This puts the UPAS into a sleep – the UPAS automatically begins sampling when the programmed start date/time are reached.

Active Sampling Sequence if START WITH SET TIME = FUTURE DATE/TIME Option Is Used			
Step	Sequence Item	UPAS Status Indicator	Definition
1	Click START to initialize sampling sequence.	Status light is cyan	After clicking START, the UPAS disconnects from the mobile device/APP.
2	Pre-sampling waiting time (the UPAS displays one of these three status codes)	Blue (cyan) light blinks once	GPS Date/Time is set and the signal is available.
		Orange light blinks repeatedly	GPS is off or no GPS Date/Time set (or GPS has been intentionally turned OFF).
		Magenta light blinks once	GPS Date/Time is set but GPS signal is not currently available.
3	Active sampling/pumping begins. UPAS flow control not yet set.	Status light turns red	Pumping starts, UPAS adjusts flow rate.
4	Active sampling/pumping within flow control parameters.	Status Light turns green (or is off if toggled off in App sample window).	UPAS now sampling normally, with flow control within parameters.

Using the Start On Next Power On Option

Use the **START ON NEXT POWER ON** option If it is desired for the UPAS to begin sampling immediately the next time it is powered on, without any interaction needed from the App – via the following steps:

- 1 Click **START WITH SET TIME** to toggle it to **START ON NEXT POWER-ON**.
- 2 Click the **START** button and **OK** on the resulting Pop-up. This puts the UPAS into a hibernation (from which it begins sampling automatically the next time it is powered-on).
- 3 When you are ready to begin sampling with the previously set sample parameters (i.e. the Sampler is mounted on the subject, etc), simply power the UPAS on – it immediately steps through its normal power-on self-test cycle and then immediately begins sampling.”

Active Sampling Sequence if START ON NEXT POWER ON Option Is Used			
Step	Sequence Item	UPAS Status Indicator	Definition
1	Click START to initialize sampling sequence.	Status light is cyan	After clicking START, the UPAS disconnects from the mobile device/App and turn itself off. It is programmed to begin sampling immediately (without any connection to the mobile App, etc) on next power-on.
2	UPAS is 'hibernating', awaiting power-on to start sampling	Status light is off	The UPAS is now 'hibernating' (not using any power), and programmed to automatically and immediately start sampling on next Power-on (at any point in the future).
	When ready to begin sampling (i.e. have UPAS mounted on subject, etc), power on the UPAS with a >5 second hold-down of power button	(multiple lights - see POWER-ON SEQUENCE steps 2-4)	The UPAS powers on and automatically follows POWER-ON SEQUENCE steps 2-4 before beginning sampling per the previously-programmed setup parameters.
3	Active sampling/pumping begins. UPAS flow control not yet set.	Status light turns red	Pumping starts, UPAS adjusts flow rate.
4	Active sampling/pumping within flow control parameters.	Status Light turns green (or is off if toggled off in App sample window).	UPAS now sampling normally, with flow control within parameters.

Updating the Mobile Device App

Set your mobile device (Android or iOS device) to Auto-Update. When a revised App becomes available, your device automatically updates.

Alternately, when available, simply download the latest App software from either the Google Play Store (see “Install and Run the App on an Android Operating System” on page 30) or the App Store for iOS devices (see “Install and Run the App on an Apple iOS Operating System” on page 35).

Adjusting the Flow Rate using the Flow Offset in the App

If, after testing the flow rate (see “Flow Rate Verification and Adjustment” on page 24), you determine that a substantial error exists, you may adjust the UPAS flow rate to compensate for the error. You must decide if the error is real and significant enough to justify setting a flow offset. This means verifying that the flow meter has sufficient accuracy, is within its normal calibration cycle, etc.



CAUTION: The UPAS was calibrated at the factory and should not be changed unless a substantial error is found during the flow measurement. Do not arbitrarily set a Flow Offset in the App.

The basic process follows:

- 1 Verify the flow control accuracy of the UPAS via a sampling run to check flow (see “Flow Rate Verification and Adjustment” on page 24).
- 2 If the verification reveals an error that is not acceptable and you want to try to reduce the error:
 - a End the measurement run by pressing and holding the UPAS power button for five seconds.
 - b Power the UPAS back on.
 - c Reconnect the UPAS to the App and enter a flow offset percentage to attempt to correct the error.
- 3 Re-run a flow rate verification (using the flow adapter and a flow meter primary as described above) and check the UPAS flow.
- 4 Repeat steps 1 through 3 as many times as necessary until the controlled flow rate of the UPAS matches the flow set point as measured on the qualified flow meter primary.
- 5 Leave that offset in place for future sample runs. The flow offset volume is persistent until it is manually changed again.

NOTE: If measured flow rate error is unacceptable even with Flow Offset dialed to the maximum of +/-9%, the UPAS should be factory-recalibrated. Contact Access Sensor Technologies (support@accsensors.com).

UPAS App Lock to Hold Setup Parameters (Optional)

App LOCK prevents users from changing the programmed sample run parameters without a special command. First, set all App parameters as appropriate. To activate the lock, enter “**APPLOCK#**” into the sample name field. In a few seconds the locked fields become gray, indicating they cannot be changed until the settings are unlocked. To unlock the settings, connect to the locked UPAS and enter “**APPOPEN#**” into the sample name field. The status of the lock is eternally persistent, until changed using the App. The locked parameter fields are listed below:

- Microenvironment zone recording on/off
- Flow Rate
- Flow Offset
- Duty Cycle
- Log interval (normally fixed at 30 seconds)
- Sample duration
- Start type
- LED on/off
- Log mode normal/debug

NOTE: The log mode and LED status are considered one way lock fields. The fields are grayed out, but when the UPAS is power cycled, the LED defaults to ON and the log mode defaults to NORMAL.

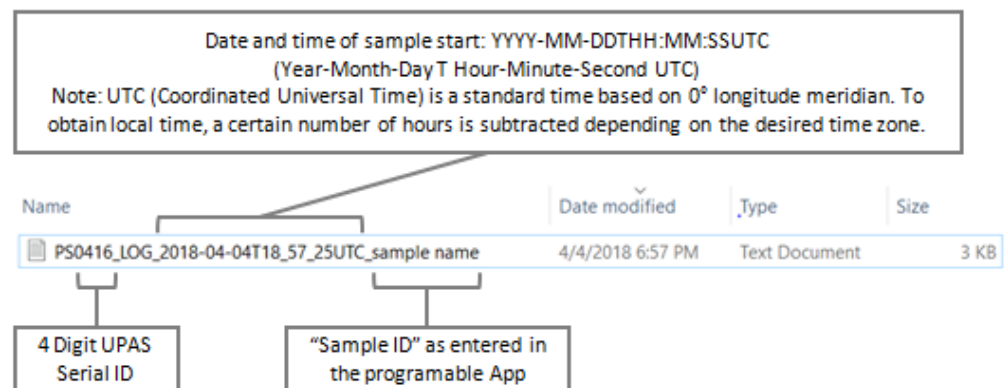
The parameters which remain unlocked are:

- GPS logging on/off
- Start time setting

4 Accessing and Interpreting Sample Log Files

Various sample run data is stored in an individual log file for each sample run on the removable microSD card installed in the UPAS.

NOTE: The file name contains identifiers specific to each sample run as shown below.



Transfer the Log File to a PC from the microSD Card

- 1 Eject the microSD card from the UPAS.
- 2 Insert the microSD card into the computer using an adapter.
- 3 Locate and transfer the .txt file from the microSD card to the computer.
- 4 The .txt file is a comma-separated (CSV) format. Import the file into your spreadsheet for analysis.

Download App Log File via Bluetooth from Android Devices

- 1 On your mobile device, locate the **Download** folder. Create a folder named, **UPAS** in the Download folder. Note: you may need to install a File Manager application on your mobile device to perform this step.

Alternately, connect your mobile device to a computer which allows you to navigate and create the new UPAS folder.

- 2 With the App connected to the UPAS, click the **Begin File Download** button (on an Android device) or the **Download Log Files** button (on an iOS device).

- 3 The UPAS automatically saves the data file in that folder.

Download App Log Files via Bluetooth from iOS Devices

Downloading the Log file from an iOS device to a computer depends on whether the computer is a Apple/Mac computer or a PC. Follow this procedure carefully.

- 1 Connect the UPAS to the iOS mobile device.
 - a Complete the UPAS sample run(s) and cycle power on the UPAS.
 - b Re-connect the UPAS to the IOS UPAS App.
- 2 Download the Log File.
 - a Select **Download Log File** from the main menu in the App.
 - b Select the **Download** button to confirm. The UPAS LED indicates when the log file download is complete – the indicator LED turns from Orange to Blue.
- 3 Identify Computer Type:

Mac Users: Proceed to “Download Log Files from IOS Device to Mac Computer” below.

PC Users: Proceed to “For PC computers, connect IOS device to PC Computer” on page 49.

Download Log Files from IOS Device to Mac Computer

- 1 Connect IOS device to Mac Computer via a USB cable.

NOTE: iTunes must be installed on the Mac computer before connecting the IOS device (iPhone, iPad, iTouch, etc.).

-
- 2 Open iTunes and select the IOS device recognized by iTunes to show details and contents.
 - 3 Select **File Sharing** in the iTunes device navigation tree.
 - 4 Select the UPAS from the Apps list to view the internal UPAS Documents.
 - 5 Select the folder(s) to save to the computer.
 - 6 Select **Save...?**.
 - 7 A small folder browsing window appears. Select a destination folder to export the UPAS files to, then select **Okay?**.
 - 8 Open the previously selected destination. The exported folders, organized by date, contain the individual sample log files.
 - 9 The exported UPAS sample log files are now saved to the Mac computer and can be accessed readily.

For PC computers, connect IOS device to PC Computer

NOTE: iTunes must be installed on the PC computer before connecting the IOS device (iPhone, iPad, iTouch, etc.).

An extension application, such as iExplorer, is required to navigate the internal folders stored on the IOS device. iExplorer offers a free trial download available via this link: <https://macroplant.com/iexplorer>.

NOTE: iExplorer is used as an example in this user manual. Alternative software options, with similar functionality, may also be used.

- 1 Connect the IOS device to the computer via USB cable.
- 2 Check that iTunes recognizes the IOS device before proceeding. Follow iTunes set up procedures for first time device connection.
- 3 Open iExplorer and navigate to the connected IOS device.
- 4 Select the App from the navigation tree.
- 5 Select the UPAS App to view details and contents.
- 6 The **Contains** field of the UPAS App details shows the folders are stored within the App.
- 7 Select the **Export to PC** icon to download the log files to the computer.
- 8 A small browsing window opens. Select a destination folder to export the UPAS files to, then select **Okay**. iExplorer begins exporting the UPAS log file folders.
- 9 Upon completion, iExplorer opens the previously selected destination folder. The exported folders, organized by date, contain the individual sample log files.
- 10 The exported UPAS sample log files are saved to the PC computer and can be accessed.

Interpreting Log File Data

The Log File Setup Summary (rows 1 through 5), Sample Identification (rows 10 through 14), Setup Summary (rows 19 through 33) and the Sample Summary (rows 38 through 52) are where all pre-programmed settings and general information can be verified. Column A is the setting name. Column B contains the parameter value. Column C contains any units or notes pertaining to the parameter value. Refer to the following figure.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	PARAMETER	VALUE	UNITS/NOTES										
2	UPASserial	545	(UPAS serial identification-numerical)										
3	UPASfirmware	UPAS_v2_0-rev0101-L152	(installed firmware version)										
4	LifetimeSampleCount	1	(count-total lifetime sample runs)										
5	LifetimeSampleRuntime	0	(hrs-total lifetime cumulative sample runtime)										
6													
7													
8													
9													
10	SAMPLE IDENTIFICATION												
11													
12	UPASlogFilename	/sd/PS0545_LOG_2018-05	(log file filename-automatically defined)										
13	SampleName	Test	(Sample Name-user entered into app)										
14	CartridgeID	ABC	(Cartridge Identification-user entered into app)										
15													
16													
17													
18													
19	SETUP SUMMARY												
20													
21	GPSUTCOffset	-6	(hours offset from UTC date time)										
22	StartOnNextPowerUp	0	(0=no 1=yes)										
23	ProgrammedStartDelay	0	(s)										
24	ProgrammedRuntime	172800	(s) (360000000 means 'indefinite')										
25	VolumetricFlowRate	1	(L*min^-1)										
26	FlowOffset	0	(%)										
27	DutyCycle	50	(%)										
28	DutyCycleWindow	30	(s)										
29	GPSEnabled	1	(0=no 1=yes)										
30	LogFileMode	0	(0=normal 1=debug)										
31	LogInterval	30	(s)										
32	AppLock	0	(0=unlocked 1=locked -1=not set)										
33	AppVersion	i2.1.2	(i=iOS A=Android)										
34													
35													
36													
37													
38	SAMPLE SUMMARY												
39													
40	StartDateTimeUTC	2018-05-04T21:07:58	(YYYY-MM-DDTHH:MM:SS) (UTC date time format)										
41	StartDateTimeLocal	2018-05-04T15:07:58	(YYYY-MM-DDTHH:MM:SS) (Local date time format)										
42	StartBatteryCharge	52	(%)										
43	StartBatteryVoltage	3.33	(V)										
44	EndDateTimeUTC	2018-05-04T21:18:30	(YYYY-MM-DDTHH:MM:SS) (UTC date time format)										
45	EndDateTimeLocal	2018-05-04T15:18:30	(YYYY-MM-DDTHH:MM:SS) (Local date time format)										
46	EndBatteryCharge	51	(%)										
47	EndBatteryVoltage	3.3	(V)										
48	ShutdownMode	1	(0=unknown error 1=user pushbutton stop 2=depleted battery [<2.8v] 3=completed preset sample duration 4=thermal)										
49	SampledVolume	5.29	(L)										
50	SampledRuntime	0.088	(Hr)										
51	LoggedRuntime	0.172	(Hr)										
52	AverageVolumetricFlow	1.005	(L*min^-1)										
53													

Table 7 A Description of Log File Setup Summary Parameters

Parameter	Description
UPASserial	UPAS serial identification-numerical
UPASfirmware	Current version of firmware running on the UPAS
LifetimeSampleCount	Number of samples started in the lifetime of the UPAS
LifetimeSampleRuntime	Number of cumulative sample hours in the lifetime of the UPAS
Sample Identification	
UPASlogFilename	Name of the file as saved on the SD card
SampleName	Sample name as entered in the App
CartridgeID	Cartridge ID as entered in the App
Setup Summary	
GPSUTCOffset	UTC offset for local time zone
StartOnNextPowerUp	Programming the UPAS to start on next power-on (0=no 1=yes)
ProgrammedStartDelay	Programmed delay between App start and UPAS program run (in seconds)
ProgrammedRuntime	Programmed run time (in seconds) (360000000 means 'indefinite')
VolumetricFlowRate	Programmed volumetric flow rate (L*min ⁻¹)
FlowOffset	Flow offset as entered in the App (as a %)
DutyCycle	Programmed duty cycle (as a %)
DutyCycleWindow	Period of duty cycle (in seconds)
GPSEnabled	GPS status during the programmed run is indicated by the listed outputs 0 = the GPS was disabled during the sample 1 = the GPS was enabled during the sample
LogFileMode	Type of log being recorded is indicated by the listed outputs. 0 = data was logged normally every 30 seconds 1 = data was logged every second in debug mode
LogInterval	Interval between logged data points during sampling (in seconds)
AppLock	Status of App Lock 0 = the settings are unlocked and can be modified in the App 1 = the settings are locked and cannot be changed until unlocked -1 = The App Lock is not set
AppVersion	Current App version used to program the UPAS (i=iOS, A=Android)
Sample Summary	
StartDateTimeUTC	UTC Date/Time when sample started (YYYY-MM-DDTHH:MM:SS) (UTC date time format)
StartDateTimeLocal	Local Date/Time when sample started (YYYY-MM-DDTHH:MM:SS) (Local date time format)
StartBatteryCharge	Battery SOC % when sample started (%)

Table 7 A Description of Log File Setup Summary Parameters (continued)

Parameter	Description
StartBatteryVoltage	Battery Voltage when sample started (V)
EndDateTimeUTC	UTC Date/Time when sample ended (YYYY-MM-DDTHH:MM:SS) (UTC date time format)
EndDateTimeLocal	Local Date/Time when sample ended (YYYY-MM-DDTHH:MM:SS) (Local date time format)
EndBatteryCharge	Battery SOC % when sample ended (%)
EndBatteryVoltage	Battery Voltage when sample ended (V)
ShutdownMode	The fault events that force the UPAS to power-off: 0 = an unknown fault occurred 1 = the user stopped the program run with the push button 2 = the battery depleted (<2.8 V) 3 = the program run finished successfully at duration 4 = the device heated to 60°C or more for more than 30 seconds 5 = The pumps reached maximum power while initializing sampling 6 = The pumps reached maximum power during a controlled sampling 7 = The flow was blocked during the program run
SampledVolume	Sample volume through filter during sample runtime (L)
SampledRuntime	Total sample runtime (Hr)
LoggedRuntime	Total logged sample runtime (Hr)
AverageVolumetricFlowRate	Average volumetric flow rate during sample runtime (L*min ⁻¹)

Sample Log Data

Rows 57 and greater, Columns A-Y of the data file contains recorded sample data values from the programmed sample run. The format of the columns is described below.

57	SAMPLE LOG																												
58	(HH-MM-SS)	(s)	(YYYY-MM-[YYYY-MM-(L*min ⁻¹)] (L)	(C)	(C)	(C)	(hPa)	(hPa)	(Pa)	(%)	(g ^L -1)	(Integer)	(Integer)	(V)	(g ³ min ⁻¹ [V])	(Integer)	(decimalC)	(decimalC (m))	(Integer)	(Integer)	(Integer)	(Integer)	(Integer)	(Integer)	(Integer)	(Integer)			
60	SampleTime	UnixTime	DateTime	Volume	SampledV	PumpT	PCBT	FdpT	PumpP	PCBP	FdPdP	PumpRH	AtmoRho	PumpPow	PumpPow	PumpV	MassFlow	BFGvolt	BFGener	GPSlat	GPSlon	GPSalt	GPSat	GPSpoop					
61	0:00:19	1525468110	2018-05-04 2018-05-04	1.022	0.27	36.05	32.01	36.21	850.81	858.98	137.317	8.95	0.9655	685	0	9.083	0.9868	3.3	32381	0	0	0	0	0	100				
62	0:00:49	1525468140	2018-05-04 2018-05-04	1.02	0.53	35.77	31.83	35.97	850.78	858.9	136.917	8.81	0.9664	689	0	9.06	0.9868	3.3	32375	0	0	0	0	0	100				
63	0:01:19	1525468170	2018-05-04 2018-05-04	1.015	0.78	35.51	31.7	35.69	850.82	858.65	136.733	8.99	0.9669	692	0	9.036	0.98194	3.3	32368	0	0	0	0	0	100				
64	0:01:49	1525468200	2018-05-04 2018-05-04	1.012	1.03	35.26	31.52	35.48	850.81	858.62	136.733	8.9	0.9677	693	0	9.018	0.97765	3.3	32362	0	0	0	0	0	100				
65	0:02:19	1525468230	2018-05-04 2018-05-04	1.01	1.29	35.03	31.41	35.24	850.9	858.44	134.667	9.31	0.9681	694	0	9.01	0.97672	3.3	32355	0	0	0	0	0	100				
66	0:02:49	1525468260	2018-05-04 2018-05-04	1.008	1.54	34.8	31.3	35.03	850.91	858.28	134.233	9.9	0.9686	695	0	9.002	0.9756	3.3	32349	0	0	0	0	0	100				
67	0:03:19	1525468290	2018-05-04 2018-05-04	1.006	1.79	34.58	31.19	34.87	850.86	857.97	133.417	9.67	0.969	696	0	8.996	0.9769	3.3	32342	0	0	0	0	0	100				
68	0:03:49	1525468320	2018-05-04 2018-05-04	1.004	2.04	34.37	31.09	34.66	850.9	857.98	133.233	9.72	0.9697	696	0	8.989	0.97392	3.3	32336	0	0	0	0	0	100				
69	0:04:19	1525468350	2018-05-04 2018-05-04	1.004	2.29	34.19	30.99	34.49	850.8	857.8	133	9.99	0.97	696	0	8.988	0.9743	3.3	32329	0	0	0	0	0	100				
70	0:04:49	1525468380	2018-05-04 2018-05-04	1.003	2.54	34.01	30.89	34.33	850.82	857.62	132.117	11.63	0.97	696	0	8.987	0.97541	3.3	32323	0	0	0	0	0	100				
71	0:05:19	1525468410	2018-05-04 2018-05-04	1.002	2.79	33.83	30.8	34.19	850.8	857.45	132.8	9.9	0.9708	696	0	8.986	0.9743	3.3	32316	0	0	0	0	0	100				
72	0:05:49	1525468440	2018-05-04 2018-05-04	1.002	3.04	33.67	30.73	33.99	850.86	857.48	132.067	9.9	0.9714	696	0	8.984	0.9743	3.3	32309	0	0	0	0	0	100				
73	0:06:19	1525468470	2018-05-04 2018-05-04	1.001	3.3	33.52	30.63	33.86	850.8	857.29	132.283	10	0.9716	696	0	8.984	0.97392	3.3	32303	0	0	0	0	0	100				
74	0:06:49	1525468500	2018-05-04 2018-05-04	1	3.55	33.36	30.55	33.72	850.8	857.26	132.2	10.03	0.9721	696	0	8.981	0.97206	3.3	32296	0	0	0	0	0	100				
75	0:07:19	1525468530	2018-05-04 2018-05-04	1	3.8	33.21	30.46	33.58	850.9	857.24	131.963	10.51	0.9725	696	0	8.981	0.97355	3.3	32290	0	0	0	0	0	100				
76	0:07:49	1525468560	2018-05-04 2018-05-04	1	4.05	33.07	30.41	33.44	850.82	857.04	132.95	10.61	0.9727	696	0	8.98	0.97634	3.3	32283	0	0	0	0	0	100				
77	0:08:19	1525468590	2018-05-04 2018-05-04	0.999	4.29	32.93	30.35	33.31	850.73	856.94	132.15	10.97	0.973	696	0	8.978	0.97355	3.3	32277	0	0	0	0	0	100				
78	0:08:49	1525468620	2018-05-04 2018-05-04	0.999	4.54	32.81	30.26	33.25	850.78	856.91	131.833	10.74	0.9734	696	0	8.977	0.97132	3.3	32270	0	0	0	0	0	100				
79	0:09:19	1525468650	2018-05-04 2018-05-04	0.998	4.79	32.67	30.2	33.06	850.78	856.76	131.567	10.96	0.9736	696	0	8.977	0.97411	3.3	32264	0	0	0	0	0	100				
80	0:09:49	1525468680	2018-05-04 2018-05-04	0.998	5.04	32.56	30.12	33	850.72	856.66	131.383	10.81	0.9739	696	0	8.975	0.97206	3.3	32257	0	0	0	0	0	100				
81	0:10:19	1525468710	2018-05-04 2018-05-04	0.998	5.29	32.46	30.06	32.85	850.89	856.77	131.85	12.57	0.974	696	0	8.974	0.97467	3.3	32251	0	0	0	0	0	100				

A description of the logged variables in Sample Log are listed below.

Table 8 Sample Log Data Descriptions

Column Name (Row 60)	Description
SampleTime	Relative time stamp of the logged data point. Note, if the value reads 99:99:99, the UPAS was not yet operating in the control window. When the UPAS is operating in the control window, it records incremental time stamps. (HH:MM:SS format).
UnixTime	Unix time stamp
DateTimeUTC	UTC Date/Time (YYYY-MM-DDTHH:MM:SS) (UTC date time format)
DateTimeLocal	Local Date/Time (YYYY-MM-DDTHH:MM:SS) (Local date time format)
VolumetricFlowRate	Volumetric flow rate (L*min ⁻¹)
SampledVolume	Cumulative sample volume (in Liters)
PumpT	Temperature near pump (in °C)
PCBT	Temperature near circuit board (in °C)
FdpT	Temperature near filter (in °C)
PumpP	Pressure near the pump (in hPa)
PCBP	Pressure near circuit board (in hPa)
FdPdP	Differential pressure across filter (in Pa)
PumpRH	Relative humidity (as a %)
AtmoRho	Density of air (g*L ⁻¹)
PumpPow1	Relative pump power setting
PumpPow2	PumpPow2
PumpV	Pump drive voltage (in Volts)
MassFlow	Mass flow rate (g*min ⁻¹)
BFGvolt	Battery output voltage (in Volts)
BFGenergy	Relative battery energy
GPSlat	GPS latitude coordinate (decimalDegree)
GPSlon	GPS longitude coordinate (decimalDegree)
GPSalt	GPS altitude (in meters)
GPSsat	Number of GPS satellites being received
GPSpdop	GPS position dilution of precision

5 Diagnostics and Troubleshooting

Ensuring Adequate Battery Endurance

The UPAS needs to be configured such that it has enough battery endurance to sustain it through the desired preset sampling duration. Put another way, the *maximum sampling duration / battery endurance* must be longer than the *preset sampling duration* so that the battery is not depleted to the point of shutdown during the sampling run. Gaining experience using the UPAS helps you determine this. Additionally, visit www.accsensors.com for a *UPAS battery energy management calculator*.

The log file that the UPAS writes on each sample run lists both the battery charge (%) and voltage at both the beginning and the end of the sample run. This is very useful information.

Generally speaking, the following parameters make a significant impact on UPAS power requirements (and therefore battery endurance):

- **Battery Charge (%) at the beginning of the sample period:** Make certain the battery is fully charged (100%) before each use (see status indicator light codes and Battery Charge reported by the App when connected to a UPAS)
- **Flow rate:** Required pumping power for a 2.0 L/min flow rate is higher than for 1.5 L/min, which is higher than 1.0 L/min flow rate.

NOTE: Access Sensor Technologies presently offers only a PM2.5 1 L/min cyclone inlet, however Access Sensor Technologies expects to release additional inlets and flows in the future.

-
- **Sampling filter type / media choice:** Note the relative resistance of filter presented in “Recommended UPAS Filter Membranes” on page 6.
 - **Particulate matter loading of the sampling filter:** This can add resistance and thus pumping power requirement. The more PM loading of the filter the shorter the maximum run time / battery endurance. As PM concentration (and therefore power requirements) are not known before sampling is conducted, it may make sense to be conservative in estimating maximum run time.
 - **GPS function:** GPS requires substantial electrical power, especially when the UPAS is used indoors (where it cannot easily receive GPS satellite signals). Disabling UPAS GPS tracking can extend battery life substantially. When off, the GPS data is not available to be logged.

- **Duty Cycle:** The preset duty cycle (%) is essentially the input / control you can adjust to extend the battery endurance. Use the *UPAS battery energy management calculator* available at www.accsensors.com to help determine a duty cycle percentage.
- **External Battery:** If the added weight/complexity are allowable, connecting an external battery pack to the UPAS micro-USB port via cable adds the capacity of the external pack to the UPAS internal battery capacity. The Voltaic V15 (<https://www.voltaicsystems.com/v15>) and V44 (<https://www.voltaicsystems.com/v44>) models in Always-on mode are the only known packs that reliably provide such extension to the UPAS (other packs without the Always-on mode may fall asleep due to the nature of the UPAS charging circuit).
- **Charging:** Connecting the UPAS via USB cable to an AC USB charger ensures the UPAS can sample indefinitely. This may be an option for some fixed-location sampling deployments.

Interpreting UPAS Status / Shutdown Mode Codes

The UPAS monitors its status continuously during actively sampling, from initialization to shutdown. Unless user-disabled via the App, the status indicator light reports the status in real time, and alerts you if there is a problem before shutting the UPAS down.

- Solid Green indicator light indicates normal sampler function within nominal parameters.
 - UPAS interprets its volumetric flow rate to be within the $\pm 4\%$ of set point error band (Note that the flow-rate of the UPAS must be periodically checked vs. a qualified flow rate primary (see “Flow Rate Verification and Adjustment” on page 24; if necessary to adjust flow rate, see “Adjusting the Flow Rate using the Flow Offset in the App” on page 45).
 - Internal battery has more than 15% charge capacity.
 - UPAS has not exceeded the maximum allowable drive power level.
 - The internal circuit board is at a temperature of $<60\text{ }^{\circ}\text{C}$.
- Flashing Yellow indicator light means the internal battery has been depleted to below 15%, and the sampler is at risk of shutting down soon.
 - If it is desired to continue the sample run for much longer the internal battery will need to be charged soon (see “Charging the UPAS Internal Battery” on page 20).

- Flashing Red indicator light means that a critical fault is occurring.
 - The UPAS shuts itself down if the fault continues longer than 30 seconds.
 - If the UPAS does shut down, it will have altered the **ShutDownMode** code recorded in the SAMPLE SUMMARY section of the log file (see “Interpreting Log File Data” on page 50).

The **ShutDownMode** parameter in the SAMPLE SUMMARY header section in any log file will always hold one of the following codes. Note that code 3 is associated with a successful sample run completion, and code 1 may be so if the sampler was intentionally shut down via pushbutton action:

- **0** = The microSD card was removed during use or has no remaining storage space - or some other undefined error.

The sampler continues to operate if the microSD card is removed. The summary data that is found on the microSD card represents the sample up until the time that the card was removed.

- **1** = The UPAS was shut down via a pushbutton hold down.

This may or may not be an intentional sample run shut down consider if it is expected that the sampler should have been shut down via the pushbutton or not. Undesired pushbutton shut down can come from a sample subject or bystander depressing the pushbutton.

- **2** = Preemptive shutdown because the battery voltage dropped below 2.8 V.

The UPAS would have been operating under a flashing yellow light before this happened.

Charge the internal battery of the UPAS per “Charging the UPAS Internal Battery” on page 20.

- **3** = The pre-programmed sample run finished successfully by running until the pre-programmed end time / duration.

This code is always associated with a successful sample run (for any run that had a pre-programmed sample duration).

- **4** = Preemptive shut down for thermal protection reasons after reaching a temperature of 60 °C.

Contact AST technical assistance If this condition and **ShutDownMode** occurs repeatedly.

- **5** = Preemptive shutdown after pumps were driven to maximum power during initialization (without reaching flow control).

This **ShutDownMode** can be associated with damaged pumps or mass flow sensor contact AST for technical assistance.

- **6** = Preemptive shutdown after pumps exceeded maximum drive power during a controlled sampling.

This **ShutDownMode** can be associated with a highly-restricted flow path (such as from an extremely high PM-load on a sampling filter).

- **7** = Preemptive shutdown after sample air flow was blocked for >30 seconds.

This **ShutDownMode** is associated with a blocked inlet or outlet.

Acquiring / Sending Debug Files

- 1 Connect the mobile device to the UPAS via the App as usual.
- 2 Toggle the **Normal Log** button so it becomes **Debug Log**.
- 3 Start a run at a relevant flow rate (presently only 1 L/min inlets are available).
- 4 Let the UPAS sample and log data for approximately five minutes and then shut down.
- 5 Transfer the resulting log file via file transfer (through App) or by removing the microSD card and transferring to computer.
- 6 Send the resulting log file to Access Sensor Technologies.
Email to: Support@accsensors.com.

Conducting a Diagnostic Test (DIAG#)

The UPAS **Diagnostics Mode (also known as DIAG#)** runs the UPAS through diagnostic tests. It is a special diagnostic mode to gather data which Access Sensors Technologies evaluates for troubleshooting purposes.

NOTE: Diagnostic Mode is only for self-testing the UPAS. It is not appropriate for any intentional air sampling as it shifts flow levels repeatedly. Do not use this mode for air sampling!

Understanding DIAG# mode

- **Diagnostic Mode** is a special self-test mode in which the UPAS automatically runs through a comprehensive battery of tests that demonstrates the performance range and provides data for the diagnosis of UPAS internal problems.
- There is only an initial user interaction with the UPAS needed in a **Diagnostic Mode** test, after which the UPAS runs the **Diagnostic Mode** sequence until intentionally powered off by the user.

- If **Diagnostic Mode** is used for troubleshooting a UPAS, we request that you email the resultant log file to Access Sensor Technologies for evaluation (support@accsensors.com).

Steps for Activating Diagnostic Mode

- 1 Remove the inlet cap and filter cartridge from the UPAS.
- 2 Place a sacrificial sampling filter in a cartridge (i.e. a filter that will not be used for actual sampling - the filter will be contaminated during the Diagnostic Mode test). For greatest relevance, use the same filter type commonly used in your sampling.
- 3 Power up the UPAS via the normal > 5-second push button hold.
- 4 Open the mobile application (i.e. 'App') on your mobile device.
- 5 Connect to the UPAS with the App.
- 6 Once connected, enter **DIAG#** (all capital letters plus # character) in the **Sample Name** field. None of the other parameters or settings matter; **DIAG#** overrides all other settings. Your previous parameter settings are recovered on next App connection, after the diagnostic test.
- 7 Start the diagnostic test run by touching the **Start** button in the App.
- 8 As soon as you click **Okay** to start the sample run, block the inlet hole in the UPAS Sampler with your finger - keep it covered through the first pumping step until the pumping stops (approximately five seconds - easy to hear) and the Status indicator light begins flashing yellow.



- 9 While yellow light is flashing (about 15 seconds), unblock flow by removing finger. Install the filter cartridge and the inlet cap as usual.
- 10 The Sampler goes through a number of tests automatically from that point on. Allow the test to run for at least 15 minutes.
- 11 Shut Sampler down via >5-second button hold.
- 12 Download or transfer the resulting log file, which contains the word **diagnostic** in the filename - and send to Access Sensor Technologies via email (support@accsensors.com).

Correcting an Incorrect UPAS Serial ID

There is a known issue where the UPAS may forget its serial ID, and rename itself with a wrong ID. This error is recognized by the UPAS presenting the wrong ID to the mobile device, as seen in both the device *Bluetooth* menu and within the UPAS App.

The wrong ID is typically either all zeros (e.g., **PS0000**) or a high, four-digit value (e.g. **PS4299**, etc). It can also appear as something like **MS(+0**, etc. If the UPAS in question has been previously paired to the mobile device, the pairing remains – but the serial ID changed (i.e. there is no need to re-pair). The ID can be easily reset via the following procedure:

- 1 Connect to that UPAS with the incorrect ID via the App.
- 2 Enter the actual correct ID numerical value only in the sample name field followed by '~'. (For example, enter **PS0166** as **0166~**, without quotes).
- 3 Power the unit down, and then back up again.
- 4 Close and re-open the App on the mobile device.
- 5 Use the App to see if the serial ID was actually corrected (i.e. look for the correct Device ID). If the correct ID is now listed in the App, the serial ID correction is complete. If it is not correct, continue to step 6.
- 6 Through the App, connect to the wrong ID UPAS one more time. Upon connection you should see the serial ID change immediately to the correct value. At that point the change is completed. The UPAS shows up in both the device *Bluetooth* menu and App correctly in the future (the wrong ID has now finally been changed to the correct value).

UPAS shuts down immediately after starting a new sample run

If the UPAS never proceeds past a red light after a sample run has been started, it shuts down after 2 minutes. This means that the UPAS is failing to reach flow control. If a normal log was selected during setup via the App, the log file written to the microSD card only contains header information and no lines of sequential log data. If a Debug log was selected, the log file contains some lines of log data before the shutdown occurred. This data can be useful in determining the reason for the fault. Please contact Access Sensor Technologies technical support via Email to: support@accsenors.com.

UPAS Not Writing Log Files to the microSD Card

If the UPAS fails to write any log file to the microSD card, the microSD card is likely damaged and needs to be replaced. Replace the card with a new one of any Speed Class designation and memory capacity/size. There is no special formatting required – the new card can be immediately installed.

6 Frequently-Asked Questions

Can I use the UPAS with an External Battery Pack?

An external battery pack may be connected to the UPAS to extend battery life. See **External Battery** under “5 Diagnostics and Troubleshooting” on page 54. Also, refer to the UPAS web page for detailed information:
<https://accsensors.com/technologies/#UPAS>

How do I Calculate Run time / Battery Life?

See “5 Diagnostics and Troubleshooting” on page 54 and the helpful UPAS battery management calculator available at:
<https://accsensors.com/technologies/#UPAS>.

Can the UPAS be used outdoors?

The UPAS is intended for indoor use only. Shield the UPAS from water, water spray, precipitation, etc. at all times.

How do I adjust the UPAS flow rate?

Refer to “Flow Rate Verification and Adjustment” on page 24 for detailed information.

How often should I check the Flow Rate and Perform Maintenance

Under normal conditions, verifying the UPAS flow rate is not required. However, if you choose to verify the flow rate, refer to “Flow Rate Verification and Adjustment” on page 24.

If the verified flow rate is outside of the $\pm 4\%$ range, contact Access Sensor Technologies Technical Support: <https://accsensors.com>.

Analyzing data for PM_{2.5} particulates collected during the Sample?

After each sampling session, collect all filter cartridges and relevant sampling information and send them to the program’s laboratory for analysis.

Does altitude affect my UPAS?

Your UPAS has fully altitude/density-corrected volumetric flow control between 2,500 ft (~760 m) below sea level and 20,000 ft (~6,100 m) above sea level without problems.

Can I use Filter Membranes with different ratings?

Access Sensor Technologies has tested the filter membranes listed in Table 1, "Recommended UPAS Filter Membranes" on page 6. Use of other filter membranes can restrict air flow, shorten battery life, and not collect the necessary particulates.

7 UPAS Specifications

Operating Conditions

	Operating	Storage
Temperature	0 °C to 50 °C	-20 °C to 50 °C
Relative Humidity	Type tested at 95%, +40 °C (non-condensing)	
Altitude	Fully altitude/density-corrected volumetric flow control between 2,500 ft (~760 m) below sea level and 20,000 ft (~6,100 m) above sea level	

Flow Performance

Flow Rate Range	1.0, 1.5, 2.0 Liter/minute (presently only 1.0 Liter/min is supported; 1.5 and 2.0 Liter/minute available soon)
Flow Rate Accuracy	±4% of Set point
Back Pressure	9" H ₂ O at 1 Liter/minute
Pulsation	None
Fault Code Detection	Yes. See "4 Accessing and Interpreting Sample Log Files" on page 47 for specific fault mode failures that result in the UPAS power off.
Flow Performance	Sampling Duty Cycle Range = 13-100% active sampling time, on 30 second time frame

Operational

Exterior Size	128 x 70 x 33 mm (5.0 in x 2.8 in x 1.3 in)
Weight	230 g
Status Indicator Light	The Status Indicator is in the UPAS Power Button.
Body Mounting	Armband, clothing clip, lanyard, safety vest, etc.
Fixed Mounting	Standard tripod mount
Data Logging Frequency	Fixed at 30 seconds intervals
Noise	< 45 dB at 10" distance
Filter Cartridge	Quick interchangeable design for 37 mm filters

Electrical

Internal Battery Type	Li Ion
Battery Life	> 35 hours at 1 Liter/minute Several days with duty cycle sampling Extendable using an external battery source
Battery Level Indicator	Yes. See “” on page 10 for specific battery level indication sequences.
Charge Time	~ 3.5 hours via USB cable (micro USB Connector)
Connectivity	Micro USB, microSD card, and <i>Bluetooth</i> wireless via a free App
On-board Sensors	Mass-flow sensor, atmospheric temperature, pressure and relative humidity, GPS PM concentration proxy (in development)

8 Warranty and Repair Service

Limited Product Warranty

Access Sensor Technologies (known hereafter as 'AST') provides a one-year limited warranty on the UPAS Ultrasonic Personal Air Sampler (known hereafter as 'this product'). This limited warranty extends only to the original purchaser, for a period of one-year after product is received.

Please note that any warranty services or questions must be accompanied by the order number from the transaction through which the warranted product was purchased. The original transaction will include a list of serial number(s) of the products included in the sale, which are covered by this warranty. The order number serves as your warranty number and must be retained. AST will not offer warranty coverage to products with serial numbers not included in the original sale.

AST warrants this product and its parts against defects in materials, workmanship or function for a period of one year from the original ship date. During this period, AST will repair or replace defective parts with new or reconditioned parts at AST's option, without charge for this repair to you.

Shipping fees incurred from returns for under-warranty service will be split between the customer and AST as follows. The customer will pay all shipping, import and duty fees to ship defective product back to AST, who will then service or replace the products. AST will then pay all shipping, import and duty fees to return the repaired or replaced product to the customer at the original, previously agreed upon customer location.

All original parts (parts installed by AST at the original system build) removed by AST or its authorized service center during the process of any warranty service become the property of AST. Any after-market additions or modifications will not be warranted.

AST makes no other warranty, either express or implied, including but not limited to implied warranties of merchantability, fitness for a particular purpose, or conformity to any representation or description, with respect to this product other than as set forth below. AST makes no warranty or representation, either express or implied, with respect to any other manufacturer's product or documentation, its quality, performance, merchantability, fitness for a particular purpose, or conformity to any representation or description.

Except as provided below, AST is not liable for any loss, cost, expense, inconvenience or damage that may result from use or inability to use the product. Under no circumstances shall AST be liable for any loss, cost, expense, inconvenience or damage exceeding the purchase price of the product.

The warranty and remedies set forth below are exclusive and in lieu of all others, oral or written, expressed or implied. No reseller, agent or employee is authorized to make any modification, extension or addition to this warranty.

Warranty Conditions

The above Limited Warranty is subject to the following conditions:

- This warranty extends only to product distributed and/or sold by AST.
- This warranty covers only normal use of the product. AST shall not be liable under this warranty if any damage or defect results from (i) misuse, abuse, neglect, improper shipping or installation; (ii) disasters such as fire, flood, lightning or improper electric current; or (iii) service or alteration by anyone other than an authorized AST representative; (iv) damages incurred through irresponsible use, including those resulting from non-recommended practices.

- No warranty extension will be granted for any replacement part(s) furnished to the purchaser in fulfillment of this warranty.
- This warranty does not cover any third party software or virus related problems.
- AST makes no warranty either expressed or implied regarding third-party (non-AST) firmware.

Return of Non-Defective Products

A non-defective product may be returned to AST within thirty (30) days of the invoice date for a refund of the original purchase price with the following amendments/fees:

AST will refund neither the original shipping cost nor the shipping and handling fees incurred from the products return. No refund will be granted for product which has been opened, used, or tampered with in any way which jeopardized AST's ability to remarket or resell the product. AST maintains full discretion in decisions regarding a products fitness for return.

Procedures for Obtaining Warranty Service

To return a defective product, please contact our Customer Service Department for a Return Merchandise Authorization (RMA) number and follow the Return of Products Instructions below.

If the product must be repaired, an RMA number will be issued for shipment to our repair department. Please follow the instructions given by AST technical support staff to ship your product. AST will not accept any shipments without a RMA number.

Pack the product in its original box or a well-protected box, as outlined in the Return Shipping Instructions. AST will not be responsible for shipping damage/loss of any product outside the 1-year AST-paid service period. Ship the product with a copy of your bill of sale or other proof of purchase, your name, address, phone number, description of the problem(s), and the RMA number you have obtained to Access Sensor Technologies.

Upon receiving the product, AST will repair or replace your product (at AST's discretion) and will ship it back to you within two weeks (dependent on parts availability) via common carrier of AST's choice for normal delivery.

AST will pay for shipping back to the customer only within the one-year of the original product ship date. The customer assumes full liability for losses or damages resulting from shipping as well as all responsibility to pursue remuneration for such issues with their selected carrier.

After One-Year Warranty – Post Warranty Repair

Post warranty repair is possible if both customer and AST can agree to terms before initiating such repair. In the case of such agreement, the procedure is the same as outlined above for RMA and shipping. However, the customer is responsible for shipping charges both ways, current labor (at a rate to-be-determined before repair initiation) and the current price of part(s) used in repair.

Warranty Exclusions

AST does not offer technical support for any aftermarket firmware/software including installed OS or other programs. AST does not offer service or coverage of any external connective software such as mobile device or personal computer applications, etc. Technical support should be pursued through technical support channels offered by the makers of such software. AST accepts no liability for problems caused by after-market software or hardware modifications or additions. AST is not responsible for giving any technical support concerning the installation or integration of any software or component the customer did not pay AST to install. AST is not responsible for loss of data or time, even with hardware failure. Customers are responsible for backing up any data for their own protection. AST is not responsible for any loss of work (“down time”) caused by a product requiring service. This warranty is null and void if the defect or malfunction was due to damage resulting from operation not within manufacturer specifications including but not limited to accidental dropping, collisions with other objects, water immersion or submersion, overheating (over 130F), application of unapproved solvents/liquids/solids, use of a non-approved battery charger, or any other treatment not associated with typical use. The warranty will be null and void if there are indications of misuse and/or abuse. AST has the option of voiding the warranty if anyone other than an AST technician attempts to open or service the product without AST’s express permission being granted. AST will not warrant any problems arising from an act of God (lighting, flooding, tornado, etc.), electrical spikes or surges, or problems arising out of hardware, software, or additional devices added to complement any system/component bought at AST, including battery chargers, charging and data transfer cords, etc. Under no circumstances will AST be responsible for any refund or remuneration exceeding the original purchase price of the product less any shipping fees. AST will not be held responsible for typographical errors on sales receipts, repair tickets, or on our website. AST makes every effort to make sure all information on our website and in literature pertaining to the product is correct.



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