



AV-20 / AV-20-S

Installation Manual



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Document Revisions

Revision	Date	Description of Change
A	09/20/2017	Initial Release as AeroVonics D-0011-0
B	10/03/2018	Updated for initial NORSEE certification, latest UI for Software Release 1.0. Updates from FAA Review.
C	11/24/2019	Release as uAvionix UAV-1003613-001 with updated device part numbers
D	11/18/2020	Remove pressurized aircraft limitation. Add guidance for OAT installation and AV-20 mounting. Update mechanical drawing.
E	1/21/2021	Update Certification Basis to recognize the clock function.
F	1/23/2023	Update battery runtime and AoA calibration guidance.
G	8/9/2024	Add battery replacement information Update expanded DALT range in Table 2 Modified Angle of Attack range Identified pins 3 and 4 as Software Update instead of Reserved Add section for Speed Assist Add section for Pitot-Zero Add section for Airspeed Trim Add section for Altitude Trim Update wiring diagram with wire type specifications Add troubleshooting table

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1 System Description

The uAvionix AV-20 and AV-20-S Multi-Function Displays provide a wide array of supplemental flight information.

Features Include:

- AoA Display (Voice Alerting & Peaks)
- G-Meter Display (Voice Alerting & Peaks)
- Attitude (Roll / Pitch)
- Slip / Skid
- Clock (GMT / Local)
- Outside Air Temperature (C / F)
- Bus Voltage Display
- Dual User Timers (Count Up / Down)
- Engine Run Timer
- Flight Timer
- Density Altitude Display
- True Airspeed Display (Kts / Mph)
- Internal Battery Operation

The unit incorporates a full color sunlight readable display, bezel-mounted light sensor for automatic display brightness, and an internal battery for operation in the event of power loss. The unit is designed to fit a standard 2¼" mounting hole and is approximately 2 inches deep. Dual ¼" quick-connect fittings are provided for pitot and static connections on the rear of the unit.



The AV-20-S model incorporates internal inertial sensors (gyroscopes and accelerometers), and precision pressure sensors (pitot and static). This allows expanded functionality over the base AV-20 model.

See the detailed functionality matrix to determine which features are available in each model.



Unless explicitly noted, references in this manual to the AV-20 are applicable to both configurations.

2 Model Variants & Required Interfaces

The AV-20 is available in two configurations:

- AV-20 (Part Number UAV-1003591-001 or U-1001-0): The base model does not include internal inertial sensors or pitot-static sensors. Functions are limited to those indicated below.
- AV-20-S (Part Number UAV-1003310-001 or U-1002-0): The enhanced (S)ensor model includes the base model functions plus the inertial sensors and pitot-static sensors. Full functionality is available in this configuration.

Feature / Model	AV-20	AV-20-S	Related Interfaces
Clock	✓	✓	
OAT	✓	✓	OAT Probe ⁽¹⁾
Bus Voltage	✓	✓	
Dual User Timers	✓	✓	
Engine Run Timer	✓	✓	
Flight Timer	✗	✓	Pitot and Static Required
AoA	✗	✓	Pitot and Static Required
Attitude	✗	✓	Pitot and Static Required
Density Alt	✗	✓	Pitot and Static Required OAT Probe ⁽¹⁾
True Airspeed	✗	✓	Pitot and Static Required OAT Probe ⁽¹⁾
Slip / Skid	✗	✓	
G-Meter	✗	✓	
Battery Operation	✗	✓	
Audio Alerts			
Timer Alert	✓	✓	Audio Panel Connection ⁽²⁾
AoA Alert	✗	✓	Audio Panel Connection ⁽²⁾
G Limit Alert	✗	✓	Audio Panel Connection ⁽²⁾
Notes:			
(1) The OAT probe is optional. The unit will automatically detect the presence of the sensor and enable functionality related to its use.			
(2) The audio panel connection is optional. Visual alerts will be functional in all modes of operation.			

Table 1 – Functional Dependencies



The model and part number are shown on the splash screen on power-up, and on the system setup info page.



Note that the base AV-20 incorporates both pitot and static ports on the rear of unit but are not utilized. This is provided for upgrade purposes and are plugged from the factory. Do not remove the plugs.



Do not connect Pitot and Static in the AV-20 Base model units. Pitot and Static connections ARE required in the AV-20-S Model for proper functionality.

2.1 Equipment Connections

All connections are provided on the single 9-Pin D-sub connector and the two pneumatic fittings.

The unit connects to aircraft power via a normal power circuit with a dedicated 1 Amp breaker.

2.2 Outside Air Temp Input

The outside air temperature interface requires an external analog probe. This port connection is compatible with the Davtron probe analog probe P/N C307PS (not supplied). This is a simple two-wire current source based on the Analog Devices AD590KH component.

The sensor reading may be trimmed in the setup pages.



Do not tap into an existing OAT system that is in use (the probes may not be put in parallel or series).



OAT functionality requires separate approval for installation of the OAT probe.

2.3 Audio Output

The audio panel connection is a low-voltage analog output that is designed to connect directly to an audio panel (typically a non-switched input). High power outputs capable of directly driving a cockpit speaker are not provided.

2.4 Manufacturing Port

A dedicated RS-232 bi-directional serial port is provided for manufacturing test and calibration purposes. These lines are not connected in the aircraft installation. One spare RS-232 input is also unconnected.

2.5 Pitot and Static Inputs

Internal pressure sensors measure both pitot and static pressure and are required for air data base functionality, including AOA and Attitude. Industry standard ¼" quick connect fittings are utilized. Reference the wiring diagram for details on how to release the tubing from the fitting.

3 Certification Basis

The AV-20 and AV-20-S are both FAA approved designs, are suitable for certificated aircraft and are FAA approved under NORSEE policy PS-AIR-21.8-1602.

The AV-20-S complies with ASTM F3011 Standard Specification for Performance of Angle of Attack System.

When installed in accordance with AC 20-94A, the AV-20 and AV-20-S meet the requirements for an installed clock as specified in 14 CFR § 91.205(d)(6).



The AV-20 and AV-20-S are supplemental and may not be used as a substitution for a certificated aircraft system. Except where otherwise recognized, no operational credit may be taken for installation of this equipment.



The AV-20 and AV-20-S are limited to installation in Part 23, Class I and II aircraft. Installation in other categories of aircraft may require additional certification activities.



Installations requiring penetration of a pressurized aircraft's pressure vessel may require additional certification activities or FAA approved data.

4 Operating Limits

The following operational limitations are applicable:

Operating Limits	
Angle of Attack Range	-10° to +30°
Angle of Attack Resolution	1°
Angle of Attack Operation	+35 to +300 Knots
Angle of Attack Accuracy	2.5°
Density Alt Range (Accuracy)	-5,400 to +35,700 Feet (\pm 500ft)
TAS Range (Accuracy)	+35 to +400 Knots (\pm 20 kts)
Attitude Angle	No Limits
Attitude Rate Limit	\pm 250 Degrees / Second
Attitude Accuracy	1° Static, 2.5° Dynamic
G Alert Limits	\pm 8 g
OAT Range	-40°C to +70°C
OAT Accuracy	\pm 4°C
Slip Range (Accuracy)	\pm 7° (\pm 2°)
Bus Voltage Range	7 to 35 Volts
Bus Voltage Accuracy	\pm 1.0 Volt
Clock Accuracy	\pm 1 Second/Day
Timer Accuracy	\pm 1 Second/Hour

Table 2 – Operating Limits

5 System Specifications

Electrical Attributes	
Input Voltage Nominal	+10 to +32 VDC
Input Voltage Max	+60 VDC
Input Power Nominal	3 Watts (0.25Amps @ 12VDC)
Input Power Max	6 Watts (0.50 Amps @ 12VDC)
Required Circuit Breaker	1 Amp
Operation on Battery (AV-20-S)	Up to 30 Minutes depending on conditions
Audio output	1.5V RMS, load 16 Ohm – 10 kOhm
Physical Attributes	
Mounting Configuration	2 ¼" Round Instrument Hole
Dimensions wo/Connector	2.4 x 2.4 x 1.2 Inches
Weight	0.25 Lbs.
Electrical Connector	9 Pin Male D-Sub
Pneumatic Connectors	¼" OD Quick Connect
Mounting	(4X) #6-32 Machine Screws
Case Material	High Impact ABS Plastic
Environmental	
Operating Temp	-20°C to +55°C
Storage Temp (48 Hrs)	-30°C to +80°C (Via Analysis)
Humidity (48 Hrs)	90% RH (Via Analysis)
Optical Characteristics	
Diagonal Size	1.8"
Resolution	128 x 160
Contrast Ratio (Typical)	500
Brightness (Typical)	1000 cd/m ²
Viewing Angle Left/Right	60°
Viewing Angle Up	45°
Viewing Angle Down	10°

Table 3 – System Specifications

6 Intended Function

Reference the “AV-20 Pilot’s Guide” UAV-1003614-001 Section 2 for intended functionality.

7 Installation

7.1 Overview

Installation consists of the following steps:

- Remove / relocate any old instrumentation
- Add or locate an appropriate power source / breaker
- Wire power and interfaces as needed
- Mount the unit to the instrument panel with supplied screws
- Apply power and perform setup



Proper mounting orientation is important to ensure performance of the AV-20. Confirm the unit is oriented level in the roll-axis when installed in the panel. To do so, ensure the aircraft is level and loosen the mounting screws. Visually align the slid / skid indicator in the middle by rotating the unit, then tighten the screws.

7.2 Mechanical Drawing

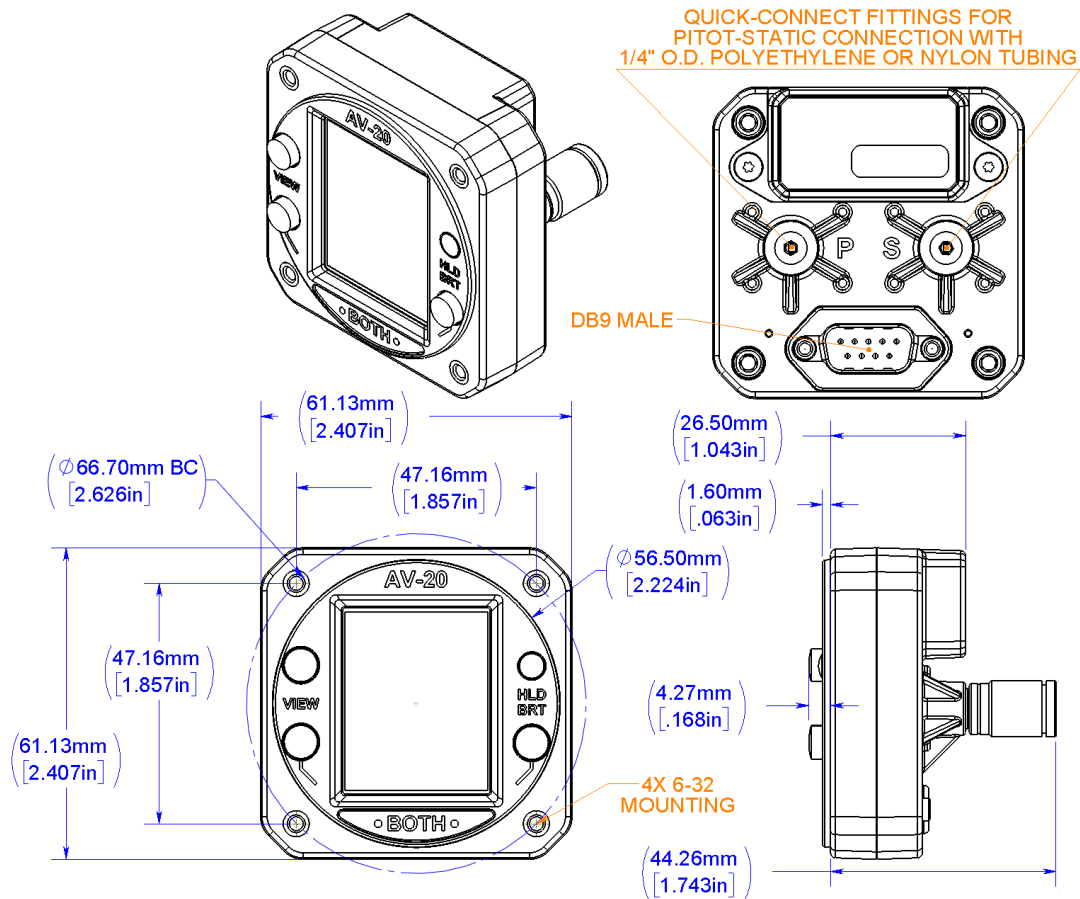


Figure 1 – Mechanical Drawing

7.3 Wiring Diagram

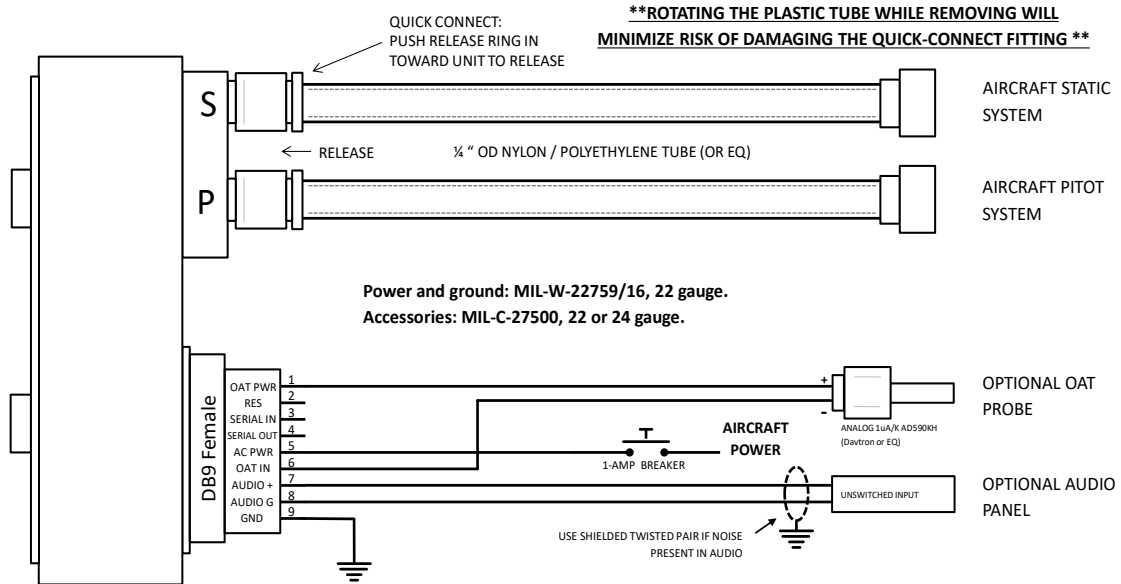


Figure 2 – Wiring Diagram

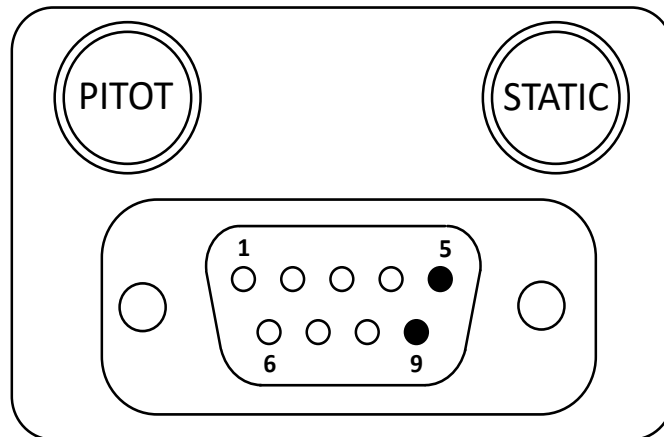


Figure 3 – Unit Connections – DB-9, Male Connector – Rear View

All connections are provided on the single 9-Pin D-sub connector and the two pneumatic fittings.

Pin	Function	Type	Comment
1	OAT Supply	Output	OAT Sensor Supply Line
2	RS-232 Serial	Input	Reserved
3	RS-232 Rx Data	Input	Software Update
4	RS-232 Tx Data	Output	Software Update
5	Power	Power	+12 to +28 VDC
6	OAT Sensor	Input	OAT Sensor Input
7	Audio H	Output	Altitude Alerts / Other
8	Audio L	Output	To Audio Panel Ground
9	Ground	Power	To Aircraft Ground

Table 4 – Connector Pinout

7.4 Setup

Refer to *AV-20 Pilot's Guide UAV-1003614-001* for detailed setup options and procedures. All options are available to the pilot to configure as desired. Some options are disabled when airspeed > 40 kts is detected and some calibration options are disabled if vibration is detected indicating a running engine. A summary of the options are as follows:

- Which pages are enabled
- Which voice alerts are provided
- Audio alert volume
- AoA alerting thresholds
- G-Limit alerting thresholds
- Miscellaneous Settings
 - o Background color
 - o Temperature units
 - o Time format
 - o Speed units
 - o Screen Popup behavior
- OAT Trim
- Hard Calibration
- Airspeed assisted attitude algorithm (Speed Assist)
- Pitot Zero
- Airspeed trim (1-point or 2-point options)
- Altitude trim (1-point or 2-point options)
- Demonstration Modes

8 Calibration & Limits

All calibration and limit settings are available to the pilot. but some are prohibited under flight conditions. These consist of:

Setting	Exclusion Condition
Upper and Lower AoA alerting Thresholds	None
Upper and Lower G-Alerting Thresholds	None
OAT Temperature Trim	None
Hard Calibration	Vibration
Indicated Airspeed 2-point trim	Vibration
Altitude 2-point trim	Airspeed > 40 kts
Pitot-Zero	None

Pitot Zero must be performed on a new installation. AoA thresholds must be configured for proper AoA alerting. See §9 Instructions for Continued Maintenance & Operation below for more information on Hard Calibration.

9 Instructions for Continued Maintenance & Operation

9.1 Limitations

- The AV-20 system may be used for supplemental information but may not replace any equipment required under 14 CFR 91.205.
- The AV-20 system is not a required system and may not be used as a substitution for the certificated aircraft system.
- No operational credit may be taken for installation of the AV-20 system.

9.2 Internal Battery

The AV-20 incorporates a small Li-Po battery that may require replacement on an as-desired basis. It is suggested to return the unit to the manufacturer for battery replacement if any of the conditions are present:

AV-20 Models:

- The clock does not correctly maintain time while the aircraft is not operated.

AV-20-S Models:

- The on-battery operation time drops below 10 minutes when operated at nominal temperatures (10°C to 30°C).
- The clock does not correctly maintain time while the aircraft is not operated.

9.3 Hard Calibration

The AV-20-S utilizes internal inertial sensors for multiple purposes. These sensors can drift out of calibration over time. The setup menu provides for a Hard Calibration procedure that re-calibrates these sensors. Perform the Hard Calibration procedure if erroneous attitude greater than the specified accuracy is observed.

AV-20 Models: Hard Calibration does not apply.



Note the Hard Calibration must be performed while not in flight, and with as little aircraft motion present. Preferred location is inside a hanger with doors closed. The aircraft does not need to be leveled prior to calibration. The Hard Calibration is not accessible while airspeed is above 40 kts.

9.4 Speed Assist

This setting directs software to use pitot-static data to improve Attitude Indicator accuracy.

This setting should be set to Enabled unless this installation cannot meet required pitot-static connections and performance.

9.5 Pitot-Zero

The Pitot Zero procedure must be performed on a new installation and every 24 calendar months thereafter.

The purpose of the Pitot Zero procedure measures small variations seen by the pitot and static pressure sensors due to installation variations and uneven aging of the sensors. The Pitot Zero procedure helps prevent false airspeed indications while on the ground.

To execute the PITOT ZERO function, go to setup menu and select PITOT ZERO. Your pitot tube must be uncovered and the aircraft must be in a still air environment. Read and acknowledge the warnings then press and release the right button. If the measurement was successful a message stating "P-S Difference Success 0.x" will appear. Press and release OK to exit. If the measurement failed a message stating "Measurement Failed" will appear. Check the measurement conditions and try again. If the function still fails, please contact product support.

9.6 Airspeed Trim

As the AV-20-S ages or is exposed to unusual conditions, the pressure sensors may require field adjustment to maintain accuracy. If the True Airspeed appears to be accurate at some airspeeds and increasingly inaccurate as airspeed increases or decreases, a trim adjustment may be beneficial. This function requires a calibrated air data test set connected to the AV-20-S to simulate multiple airspeeds.

To execute this function, select the SETUP page on the AV-20-S. Scroll down to the IAS TRIM submenu and press SEL. Now select LOW TRIM and press SEL. Note that the AV-20-S detects large vibrations to prevent this operation occurring during flight. Make sure the AV-20-S is placed on a vibration-free surface.

Set the air data test set to 45 knots or the stall speed of the aircraft, whichever is greater. Scroll up or down using the left buttons until the airspeed displayed on the AV-20-S is equal to the airspeed indicated on the test set. Press OK to save this value. You have now saved the 1 point trim.

If you wish to set the HIGH point (2 point trim), increase the airspeed on the air data test set to a value at least 70 knots higher than the airspeed used to set the LO trim point.

Using your aircraft's high-speed cruise airspeed is recommended. Select the HIGH TRIM

menu item. If the AV-20-S measures the airspeed difference to be less than 70 knots more than the speed used to set the LOW trim, HIGH TRIM will be grayed out and un-selectable. If that is the case, keep increasing the IAS on the test set until TRIM HIGH turns from gray to blue. Scroll up or down using the left buttons until the airspeed displayed on the AV-20-S is equal to the airspeed indicated on the test set. Press OK to save the value.

Note that if the HIGH TRIM has never been set, the trim value will be “---” which means it is operating in 1 point trim mode. If HIGH TRIM and LOW TRIM values are equal, it will behave the same as 1 point trim mode.

If you make a mistake like setting the LOW TRIM at a high airspeed, start over by lowering the airspeed on the test set and repeat the entire operation in the specified order.

Record the LOW TRIM and HIGH TRIM values in the aircraft records.

9.7 Altitude Trim

As the AV-20-S ages or is exposed to unusual conditions, the pressure sensors may require field adjustment to maintain accuracy. If the Altitude appears to be accurate at some altitudes and increasingly inaccurate as you increase or decrease altitude, a trim adjustment may be beneficial. This function requires a calibrated air data test set connected to the AV-20-S to simulate multiple altitudes.

To execute this function, go to the SETUP menu and select ALT TRIM, then select LOW TRIM and press SEL. Note that the AV-20-S detects airspeed > 40 knots to prevent this operation occurring during flight. Make sure the air data test set has airspeed set below 40 knots.

Set the air data test set at a low altitude point somewhere between -1,000' and 14,900'. Use the left up and down buttons to adjust the trim value until the displayed altitude is equal to the altitude on the air data test set. Press and release OK to save the value. You have now set the 1 point trim.

If you wish to set the HIGH point (2 point trim), increase the altitude on the air data test set to a value at least 10,000' higher than the altitude used to set the LOW TRIM point. Go to the IAS TRIM menu, then the HIGH TRIM menu. If the AV-20-S detects the altitude difference to be less than 10,000' more than the altitude used to set the LOW trim, HIGH TRIM will be grayed out and un-selectable. If that is the case, keep increasing the altitude on the test set until HIGH TRIM turns from gray to blue. Once blue, press the right button to enter the adjustment screen then use the left buttons to adjust the trim until the displayed altitude is equal to the altitude on the air data test set. Press OK to save the value.

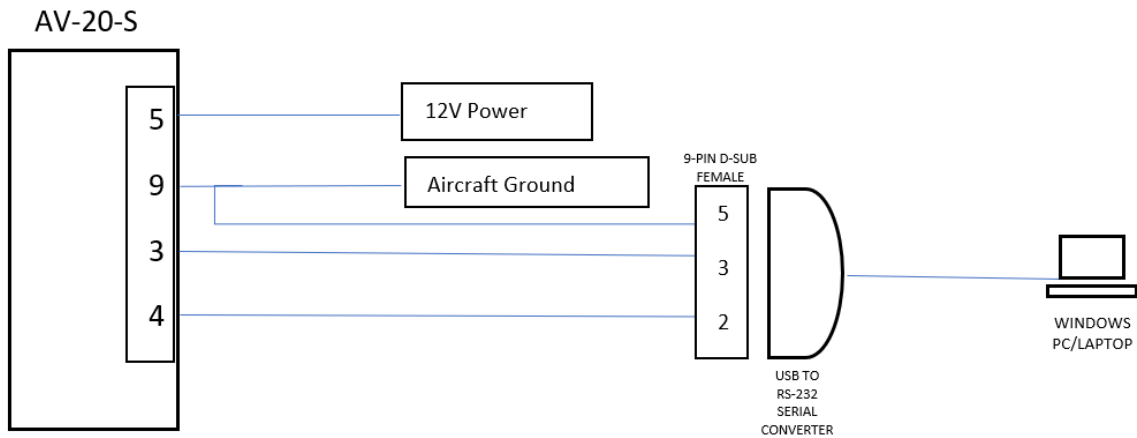
Note that if the HIGH TRIM has never been set, the trim value will be “---” which means it is operating in 1 point trim mode. If HIGH TRIM and LOW TRIM values are equal, it will behave the same as 1 point trim mode.

In the event of a mistake in calibration, such as a LOW POINT set to a high altitude, lower the altitude on the test set and repeat the entire operation in the specified order.

Record the LOW TRIM and HIGH TRIM values in the aircraft records.

9.8 Software Update

Please refer to the service bulletin that accompanies any new software for the AV-20-S. RS-232 serial is used for updating software. The wiring diagram is as shown below.



9.9 Battery Replacement

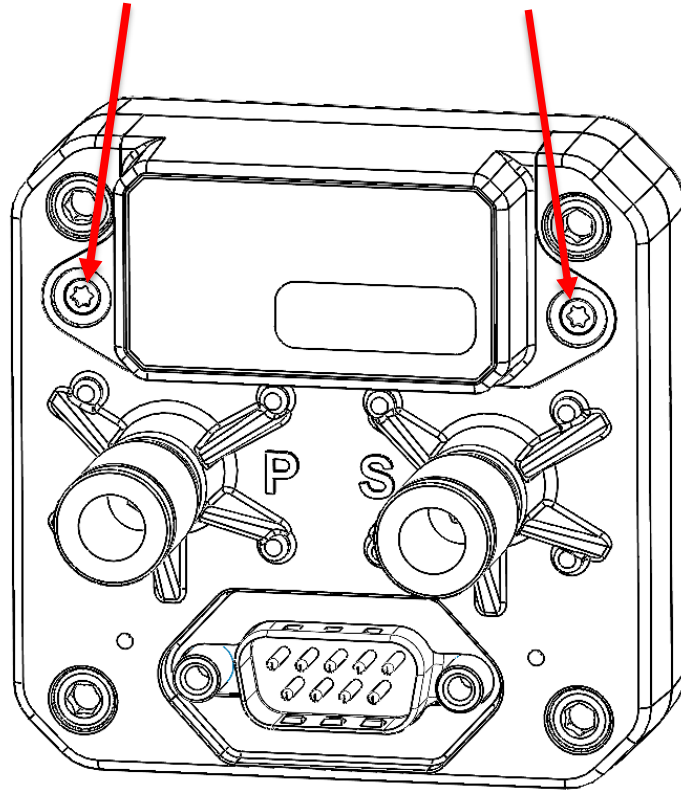
The battery pack is located on the rear of the unit and housed in a removable battery cover assembly. If the unit does not have a removable battery cover, it must be returned to the factory for replacement. Mod D units have the removable battery cover.

Battery replacement consists of removing the battery cover, removing the old battery pack and double-sided tape then re-assembling with new battery pack and new double-sided tape.

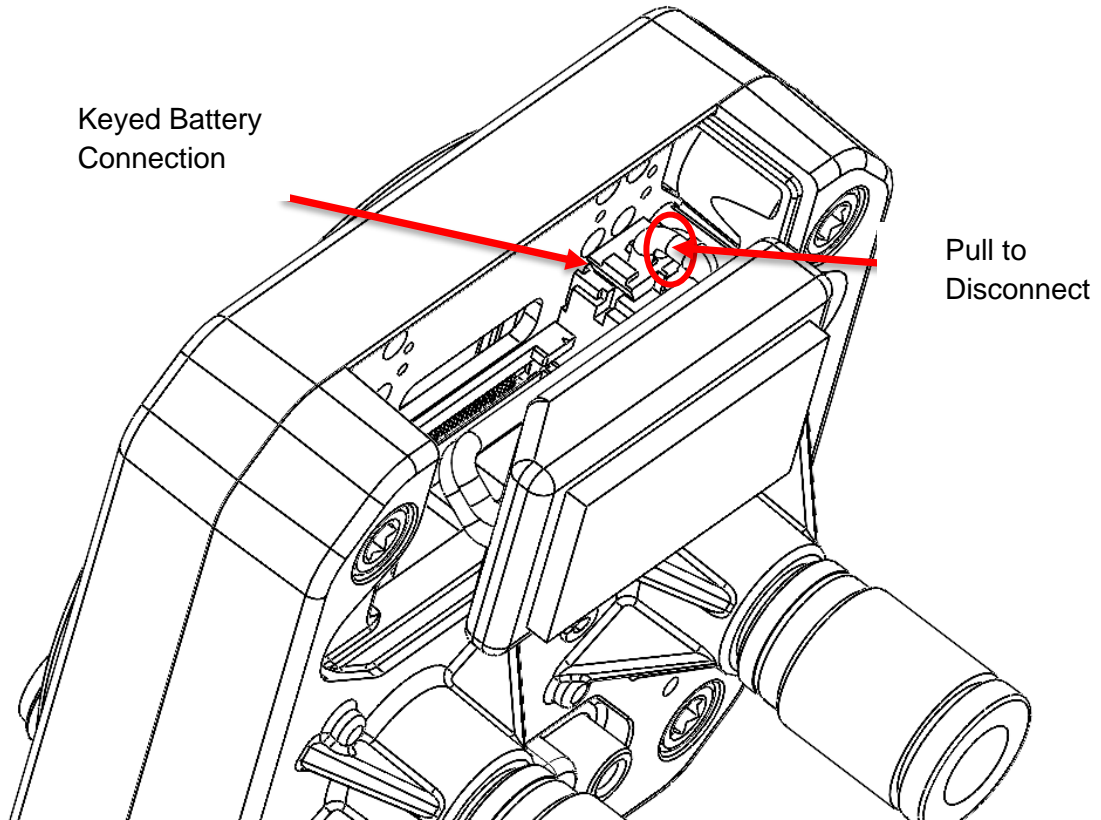
Ensure unit power is removed and unit is not operating under battery power for this procedure.

Detailed steps as follows:

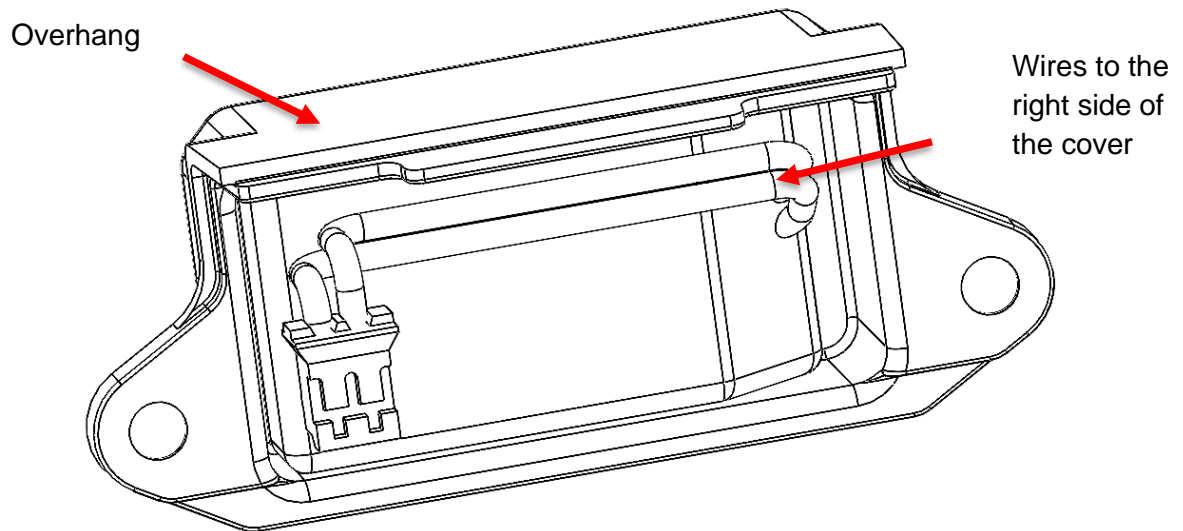
1. Remove the two battery cover hold-down screws (T8).



2. Remove the battery pack and tape from the battery cover and pull gently on the battery wires close to the connector to disconnect the battery from the unit.



3. On the new battery assembly, peel the protective paper from the double-sided tape. Affix the new battery pack to the battery cover, leaving the connection wires from the battery toward the right side of the cover (orientated overhang at the top).



4. Locate the keyed side of the battery connector and press firmly into the mating connector on the unit.
5. Tuck the battery wire into the battery cover while aligning the battery cover to the rear of the unit – ensure the battery wires are not caught or compressed between the battery cover and the unit.
6. Replace the two battery cover hold-down screws and tighten until snug.
7. Dispose of the old battery pack in accordance with local regulatory requirements regarding Li-ion battery disposal or recycling.

10 Troubleshooting

The following steps are to aid in identifying installation or unit performance related issues:

Table 10-1 – Troubleshooting

Issue	Possible Reason and Remedy
Power	
Unit does not power-on	Check associated breakers
	Ensure aircraft battery is greater than 10 VDC
	Check wiring and pinouts
Unit will not shut off, even if power is removed	Ensure no pitot or static blockage or line kinks are present (locking pressure and airspeed indication over 40 knots)
	Pitot and Static sensors need to be zeroed as described in Section 13.2.8
Stabilization	
Unit will not stabilize and aligning annunciator remains on	Return to factory for service if unit does not align within 3 minutes of power-on
Battery	
Battery indicator shows FAIL	Contact uAvionix support to procure a replacement battery. Replacement instructions are in section 9.9 of this manual
Trim	
Pitch shows small but constant error	Set trim adjustment by pressing *BOTH* when on the AI page.
Airspeed or Altitude in error	Set airspeed or altitude trim adjustment in Setup page
Alerts	
Audio alerts not heard over the audio system	Check wiring and ensure alerts are enabled in the Setup menu
	Ensure unswitched input is available on the audio panel
	Verify volume setting is sufficiently high in the Setup menu
Nuisance alerts are generated	Ensure alerting limits are configured as desired in the Setup menu