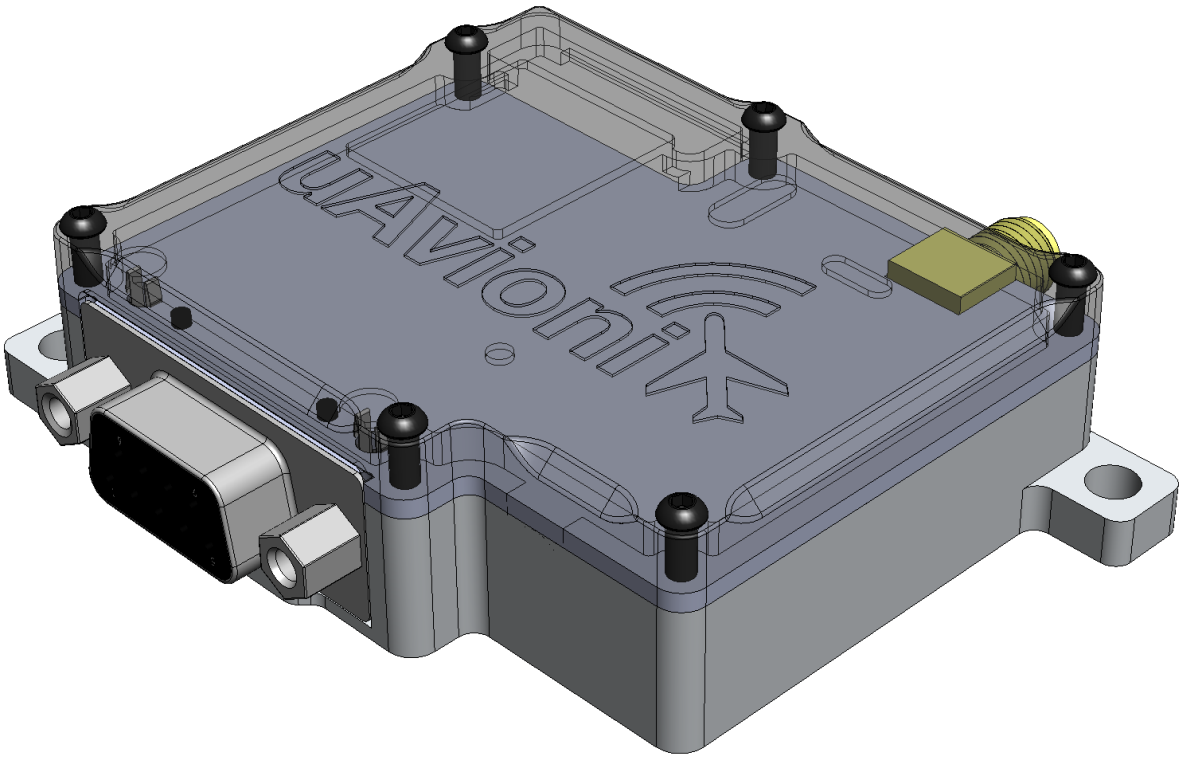
uAvionix

echoESX

User and Installation Guide



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1 Revision History

Revision	Date	Comments
A	1/22/2019	Initial release

2 Warnings / Disclaimers

All device operational procedures must be learned on the ground.

uAvionix is not liable for damages arising from the use or misuse of this product.

This equipment has received a FAA transmit license for manned aircraft and a license for un-manned aircraft operating above 500ft AGL

This equipment is classified by the United States Department of Commerce's Bureau of Industry and Security (BIS) as Export Control Classification Number (ECCN) 7A994.

These items are controlled by the U.S. Government and authorized for export only to the country of ultimate destination for use by the ultimate consignee or end-user(s) herein identified. They may not be resold, transferred, or otherwise disposed of, to any other country or to any person other than the authorized ultimate consignee or end-user(s), either in their original form or after being incorporated into other items, without first obtaining approval from the U.S. government or as otherwise authorized by U.S. law and regulations.

3 Limited Warranty

uAvionix products are warranted to be free from defects in material and workmanship for one year from the installation in the aircraft. For the duration of the warranty period, uAvionix, at its sole option, will repair or replace any product which fails under normal use. Such repairs or replacement will be made at no charge to the customer for parts or labor, provided that the customer shall be responsible for any transportation cost.

This warranty does not apply to cosmetic damage, consumable parts, damage caused by accident, abuse, misuse, water, fire or flood, damage caused by unauthorized servicing, or product that has been modified or altered.

IN NO EVENT, SHALL UAVIONIX BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM THE USE, MISUSE OR INABILITY TO USE THE PRODUCT OR FROM DEFECTS IN THE PRODUCT. SOME STATES DO NOT ALLOW THE EXCLUSION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU.

Warranty Service

Warranty repair service shall be provided directly by uAvionix.

4 Contents

5 Introduction

5.1 Description

5.1.1 Transponder

The EchoESX is a Mode S, Level 2els transponder with support for ADS-B extended squitter. The EchoESX has a nominal power output of 250W and meets the power output requirements for Class 1. The ADS-B function meets DO-260B class B1S.

This transponder replies to both legacy Mode A/C interrogations and to Mode S interrogations from both ground radar and airborne collision avoidance systems. In all cases, the interrogations are received by the transponder on 1030MHz and replies are transmitted on 1090MHz.

5.1.2 ADS-B Capabilities

The echoESX includes ADS-B Out capabilities when installed with an approved external GPS position source.

5.2 Interfaces

The EchoESX has a single SMA antenna connection and a 9-pin Data interface.

Host Interface

Interface	Specification	Devices
COM	Setup Mode, Altitude, Squawk, Ident GPS Position	Dynon, MGL, GRT, AFS, UNPANEL

Software and Airborne Electronic Hardware Configuration.

Part	Part Number	Revision
Software	UAV-1001188-001	A
Airborne Electronic Hardware	UAV-1001189-001	A

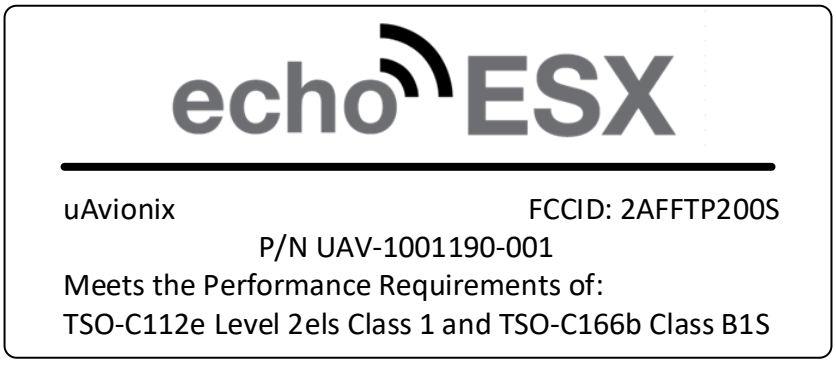
5.3 Supplied Accessories

Part	Part Number
EchoESX	UAV-1001190-001
9p D-Sub connector	Cinch DEUH-9P NorComp 977-009-101R031
RF adapter cable SMA-BNC	UAV-1001011-001
Monopole Antenna 1030/1090	UAV-1001009-002
EchoESX User Manual	UAV-1001191-001

6 Technical Specifications

Specification	Characteristics
Compliance	DO-181E Level 2els Class 1 DO-260B Class B1S
FCC ID	2AFFTP200S
FAA Transmit License	Manned aircraft. Un-manned operating above 500ft AGL.
Software	RTCA DO-178B Level C
Hardware	RTCA DO-254 Level C
Power Requirements	11 – 33VDC. Typical 1W On/Alt, 0.3W Standby.
Altitude	35,000ft
Operating Temperature	-45°C to +70°C
Transmit Frequency	1090MHz ±1MHz
Transmit Power	250W nominal; 125W minimum at antenna after allowing for 0.5dB connector losses and 1.5dB cable losses.
Transmitter Modulation	6M75 V1D
Transponder Receiver Sensitivity	1030 MHz, -74dBm ±3dB
Weight	75grams
Height	20mm
Length	50mm
Width	67mm

6.1 Markings



7 Equipment Limitations

7.1 Installation

7.1.1 Modifications and Use Outside of Intended Scope

This device has been designed and tested to conform to all applicable standards in the original form and when configured with the components shipped with the device. It is not permissible to modify the device, use the device for any use outside of the intended scope, or use the device with any antenna other than the one shipped with the device.

7.1.2 Deviations

There are no deviations from the MPS of TSO-C112e or TSO-C166b.

7.1.3 Configurable Options

Accessing or altering configurable options not intended to be operated may cause pilot distraction.

7.1.4 Approvals

Approvals do not cover adaptations to the aircraft necessary to accommodate ancillary equipment such as power provisions, mounting

devices or external antennas; such items must still be approved under existing minor modification/change processes applicable to the aircraft.

7.1.5 This device meets the minimum performance and quality control standards required by a technical standard order (TSO). Installation of this device requires separate approval.

This device meets the performance requirements for use in transponder rule airspace as defined in 14 CFR § 91.215 and ADS-B rule airspace as defined in 14 CFR § 91.225.

7.1.6 FAA Transmitter License and FCC Grant of Equipment Authorization

This equipment has received a FAA transmit license for manned aircraft, and for un-manned aircraft operating above 500ft AGL.

This equipment has been issued an FCC Grant of Equipment Authorization.

The equipment contains FCC ID 2AFFTP200S and is marked on the equipment nameplate.

8 Equipment Installation

This section describes the installation of EchoESX and related accessories in the aircraft, including mounting, wiring, and connections.

8.1 Unpacking and Inspecting

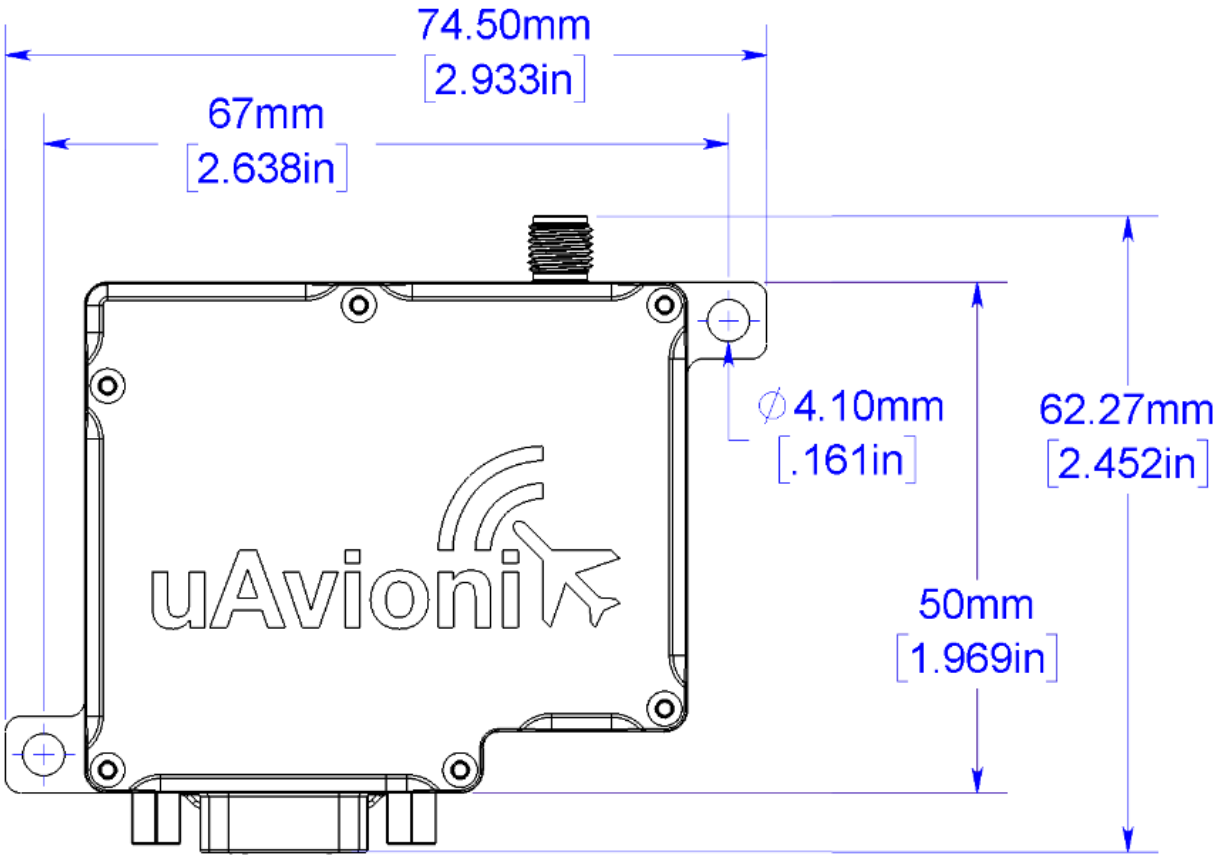
Carefully unpack the device and make a visual inspection of the unit for evidence of any damage incurred during shipment. If the unit is damaged, notify the shipping company to file a claim for the damage. To justify your claim, save the original shipping container and all packing materials.

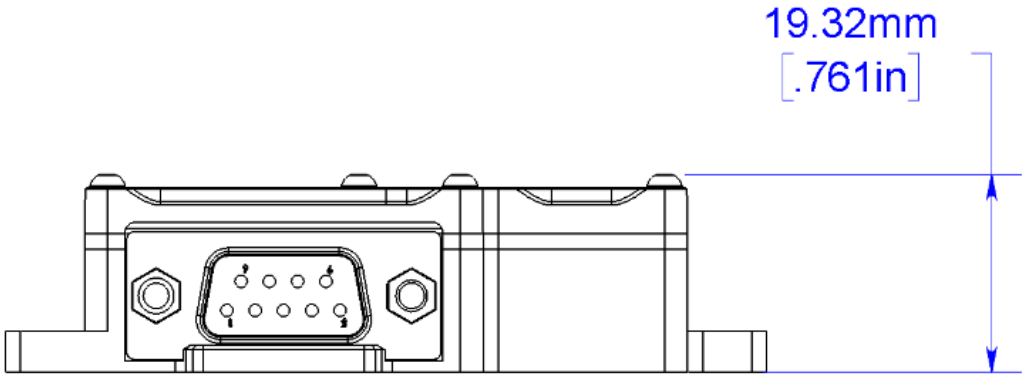
8.2 Mounting

The EchoESX is designed to be mounted in any convenient location in the cockpit, the cabin, or an avionics bay.

The following installation procedure should be followed, remembering to allow adequate space for installation of cables and connectors.

- Select a position in the aircraft that is not too close to any high external heat source. The EchoESX is not a significant heat source itself and does not need to be kept away from other devices for this reason.
- Avoid sharp bends and placing the cables too near to the aircraft control cables.
- Secure the transponder to the aircraft via the two (2) mounting holes. It should be mounted on a flat surface.


74.50mm
[2.933in]
67mm
[2.638in]
∅4.10mm
[.161in]
62.27mm
[2.452in]
50mm
[1.969in]
uAvioni


19.32mm
[.761in]

8.3 Connections

Whenever power is supplied to the transponder, a 50ohm load must be provided to the SMA connection. You can use the supplied antenna or a commercially available 50ohm load.

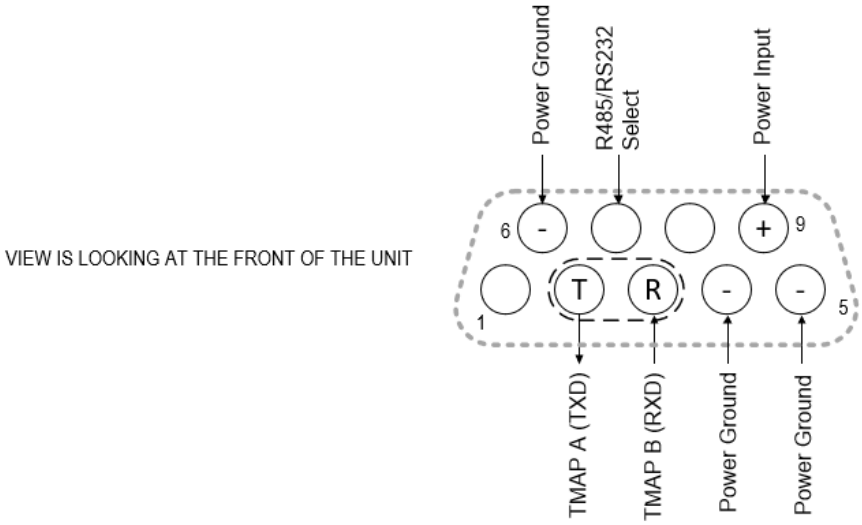
Pin	Type	Physical	Baudrate	Protocol
1	NC			
2	COM TX	RS-232 Out RS-485 A(-)	38400 bps 8 bits, 1 stop ODD parity	TMAP
3	COM RX	RS-232 Out RS-485 B(+)	38400 bps 8 bits, 1 stop ODD parity	TMAP
4	RS232 Ground			
5	Aircraft Ground			
6	Ground			
7	R485/RS232 Select	Input	Connect to Pin 6 to select RS232	
8	NC			
9	Aircraft Power		11-33V	
Mating Connector: Cinch DEUH-9P				

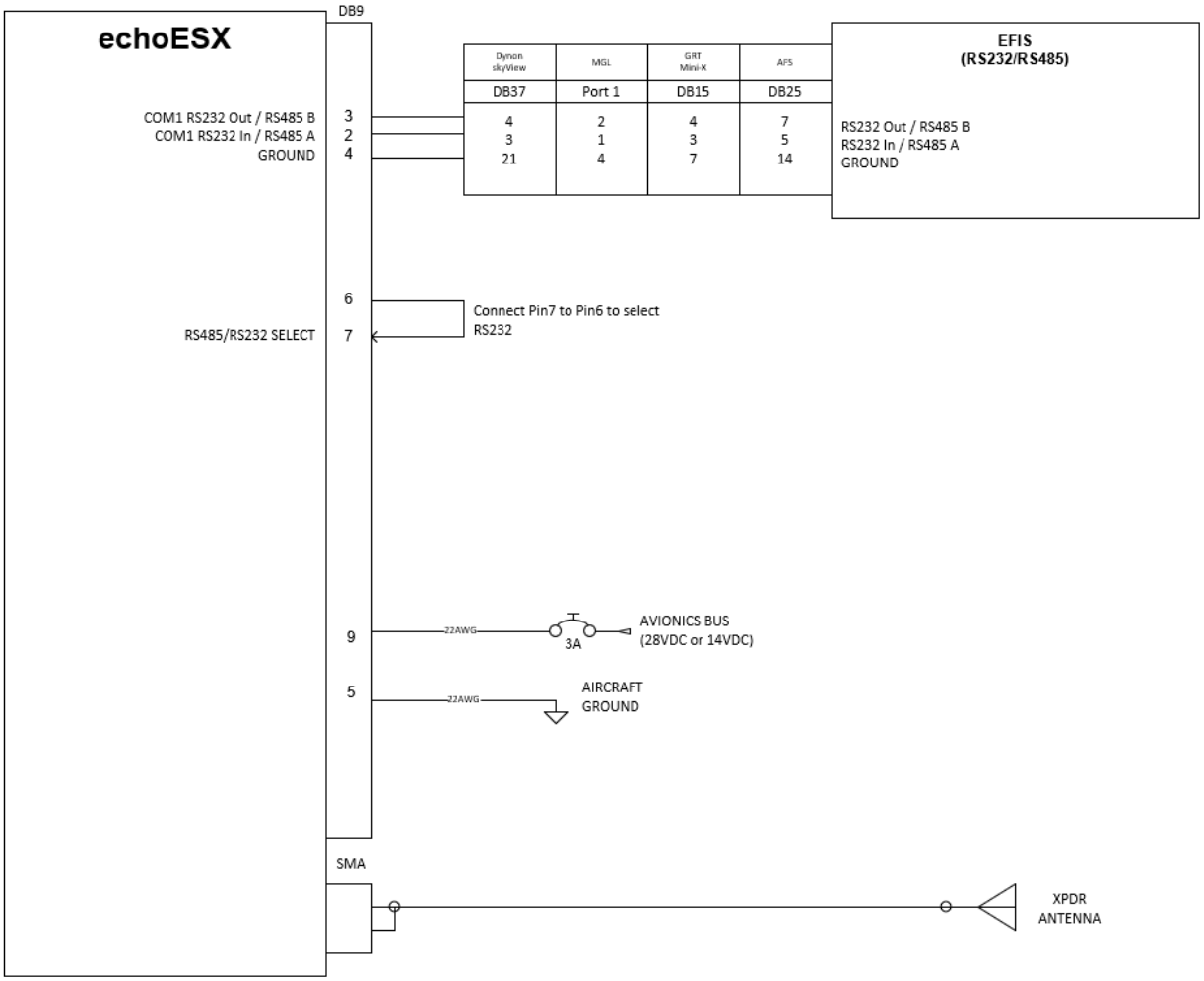
Note: Use a 3A circuit breaker between the power source and echoESX.

LEDs

LED	SOLID	FLASHING
GREEN	Powered	Transmitting

8.4 Wiring Diagrams





8.5 Cooling Requirements

EchoESX is designed to meet all applicable TSO requirements without forced-air cooling.

Attention should, however, be given to the incorporation of cooling provisions to limit the maximum operating temperature if EchoESX is installed in close proximity to other Avionics. The reliability of equipment operating in close proximity in an avionics bay can be degraded if adequate cooling is not provided.

8.6 Wiring Considerations

The EchoESX was designed and tested using unshielded, untwisted wiring. There may, however, be technical benefits of improved electromagnetic emissions and susceptibility to and from the transponder system. Use of twisted wire can reduce interference and break-through on adjacent audio wiring if it is not possible to route them separately.

The distance between the EchoESX and the power source is limited by the impedance of the wire between them. The EchoESX is powered directly from aircraft power, and, therefore, the acceptable voltage drop in the power line is what limits the distance.

The EchoESX needs an impedance of less than 0.5ohm in the power line for satisfactory operation. The following table gives guidance for typical aircraft hook-up wire. Note that different brands may vary – check your supplier for details.

Gauge	ohm/km	Length for 0.5ohm
20 AWG	35	14.2m
22 AWG	64	7.8m
24 AWG	99	5.0m

An alternative to a harness built from individual wires, particularly for a long cable run, is to use a multi-core cable. Aviation grade cables with 6 or more cores are often more expensive than individual wires, and, therefore, are

not generally a good choice. For aircraft where those situations do not apply, an attractive alternative solution may be to use 3 or 4 pair data cable.

Please note that not all data cable is suitable for this application. Cables with solid cores should not be used. Cables should be selected based on the wear characteristics of their insulation material, including temperature rating, resistance to solvents and oils, and flammability. Most inexpensive commercial data cables have poor flammability properties.

8.7 Antenna Installation

8.7.1 Supplied OEM Monopole Antenna

The following considerations should be taken into account when siting the antenna.

- The antenna should be well removed from any projections, the engine(s) and propeller(s). It should also be well removed from landing gear doors, access doors or other openings which will break the ground plane for the antenna.
- The antenna should be mounted on the bottom surface of the aircraft and in a vertical position when the aircraft is in level flight.
- Avoid mounting the antenna within 1 meter of the ADF sense antenna or any COMM antenna and 2 meters from the transponder to the DME antenna.
- Where practical, plan the antenna location to keep the cable lengths as short as possible and avoid sharp bends in the cable to minimize the VSWR.

Electrical connection to the antenna should be protected to avoid loss of efficiency due to exposure to liquids and moisture. All antenna feeders shall be installed in such a way that a minimum of RF energy is radiated inside the aircraft.

When a conventional aircraft monopole antenna is used it relies on a ground plane for correct behavior. For ideal performance, the ground plane should be large relative to the wavelength of the transmission, which is 275mm. In a metal, skinned aircraft this is usually easily accomplish, but is more difficult in a composite or fabric skinned aircraft. In these cases, a metallic ground plane should be fabricated and fitted under the antenna.

The ground plane should be as large as you can sensibly make it. Because it is a function of the wavelength of the transmission, the smallest practical ground plane for a transponder is approx. 120mm per side; as the size increases, the performance improves, until the ground plane is approx. 700mm on each side. Anything much larger than that size is unlikely to result in significant further improvement.

The thickness of the material used to construct the ground plane is not critical, providing it is sufficiently conductive. A variety of proprietary mesh and grid solutions are available.

8.7.2 Antenna Cable

The EchoESX is designed to meet Class 1 requirements with an allowance of 2dB for loss in connectors and cable used to connect it to the antenna. Excessive loss will degrade both transmitter output power and receiver sensitivity.

Allowing for 0.25dB loss for the connector at each end of the antenna cable assembly leaves an allowance of 1.5dB maximum loss for the cable itself.

An acceptable cable:

- has less than 1.5dB loss for the run length needed,
- has a characteristic impedance of 50ohms,
- has double braid screens or has foil and braid screen.

Once the cable run length is known, a cable type with low enough loss per meter that meets the above requirements can be chosen. Longer runs require lower loss cable.

When routing the cable:

- Route the cable away from sources of heat
- Route the cable wiring away from potential interference sources such as ignition wiring, 400Hz generators, fluorescent lighting and electric motors
- Allow a minimum separation of 300mm from an ADF antenna cable
- Keep the cable run as short as possible
- Avoid routing the cable around tight bends
- Avoid kinking the cable, even temporarily, during installation
- Secure the cable so that it cannot interfere with other systems

9 Installation Setup

The transponder system should be configured on the EFIS during initial system installation by a qualified technician. The configuration items list below should be used to document the system installation for future reference.

Configuration Item		Default	Setting
ICAO Number		0x000000	
Callsign		“ “	
Emitter Category		Light Aircraft	
Max Airspeed		Unknown	
ADS-B RX Capability	UAT RX	NO	
	ES1090 RX	NO	
Vso		0	
Aircraft Length		L <= 15	
Aircraft Width		W <= 23	
GPS Antenna Offset Lat		0	
GPS Antenna Offset Lon		0	

Configuration Items List

9.1 Aircraft Address Programming

The ICAO address is a 24-bit number issued to the aircraft by the registration authority of the aircraft. These addresses are usually written as a 6-digit hexadecimal number, although you may also encounter one written as an 8-digit octal number. The echoESX understands the hexadecimal format, so you must first convert an octal number to hexadecimal before entering.

Tip: By using the N-Number Look Up function on https://www.faa.gov, locate and use the “Mode S Code (base 16 / hex)” value.

9.2 Call Sign

The CALL SIGN can be up to an 8 digit code that corresponds to the tail number of the aircraft. (0-9, A-F) e.g. N8644B

9.3 Emitter Category

To assist ATC tracking of aircraft, an aircraft category can be transmitted. Select the aircraft category that most closely matches the aircraft.

Emitter Category	
Light Airplane	Rotorcraft
Small Airplane	Glider / Sailplane
Large Airplane	Lighter Than Air
Large Airplane with High Vortex	Parachute
Heavy Airplane	Ultralight
Highly Maneuverable Airplane	UAV
	Space Craft

9.4 Max Airspeed

Enter the maximum airspeed of the aircraft.

9.5 ADSB-In Capability

Sets the ADS-B in equipment capability reporting.

ADS-B In capability
None
UAT
1090
Both UAT and 1090

9.6 V_{S0} (knots)

This parameter allows the echoESX to automatically switch between airborne and ground modes. Enter the VSO value for your aircraft. Setting V_{S0} to 0 passes control of the Air/Ground state to the EFIS.

Airspeed (in kts) that the aircraft typically flies after take-off.
0 – 999 knots

9.7 Aircraft Length and Width in Meters

When on the ground, ADS-B transmits encoded aircraft size information which is used by ATC to identify taxiing routes and potential conflicts. Enter the length and width (wingspan) fields and the appropriate size codes will be calculated for transmission.

Aircraft Length in Meters	Aircraft Width (wing span) in Meters
L ≤ 15	W ≤ 72.5
15 < L ≤ 25	72.5 < W ≤ 80
25 < L ≤ 35	
35 < L ≤ 45	
45 < L ≤ 55	
55 < L ≤ 65	
65 < L ≤ 75	
75 < L ≤ 85	
L > 85	

9.8 GPS Antenna Offset

The GPS antenna offset is used in conjunction with the length and width to manage taxiway conflicts. A typical GPS does not report the geographic position of the center of the aircraft, or even the tip of the nose of the aircraft; instead, it usually reports the location of the actual GPS antenna (not the GPS receiver). In normal flight operation, this distinction is of no importance at all, but if ADS-B is used to manage taxiway conflicts, a significant offset in antenna position could mean the aircraft footprint is not in the same place as the ADS-B reported position. Although the GPS Antenna Offset is primarily intended for position correction on large transport aircraft, General Aviation aircraft can also have a significant offset. For example, if the aircraft has a long tail boom and the GPS antenna is on top of the tail, the GPS position could be 4 meters or more from the nose of the aircraft.

GPS Antenna Lateral Offset from roll axis (Meters)	GPS Antenna Longitudinal Offset from aircraft nose (Meters)
0	0 to 60 Meters in 2 Meter increments
Left 2	
Left 4	
Right 2	
Right 4	
Right 6	

10 Post Installation Checks

Post installation checks should be carried out in accordance with your certification requirements.

- Mode S interrogations to verify correct address programming.
- Verification of the reported altitude using a static tester.
- Interrogations to verify the receiver sensitivity. A mode S transponder should have a minimum triggering level (MTL) of between -77dBm

and -71dBm. Failure to meet this requirement usually indicates an antenna or coaxial cable problem.

- Interrogations to verify the transmitted power. A Class 1 installation should have no less than 125watts at the antenna (and no more than 500watts). Failure to meet this requirement is also generally due to antenna or wiring issues.
- Verification of the GPS position source and ADS-B outputs. Whenever a valid position is received by the transponder and the transponder is in any mode other than standby, ADS-B Extended Squitter messages should be observed on the transponder test set.

11 Continued Airworthiness

Other than for periodic functional checks required by the regulations, EchoESX has been designed and manufactured to allow “on condition maintenance”. This means that there are no periodic service requirements necessary to maintain continued airworthiness, and no maintenance is required until the equipment does not properly perform its intended function. When service is required, a complete performance test should be accomplished following any repair action. Repairs should only be carried out in accordance with uAvionix service procedures.

12 Environmental Qualification Forms

Nomenclature	EchoESX ADS-B Mode S transponder	
Part Number	UAV-1001190-001	
Manufacturer	uAvionix Inc	
Address	300 Pine Needle Lane, Bigfork, MT 59911	
Conditions	**DO-160G Section**	**Description of Conducted Tests**
Temperature and Altitude	4.0	Equipment tested to Category B2
Low temperature ground survival	4.5.1	-55°C
Low Temperature Short-Time Operating	4.5.1	-45°C
Low Temperature Operating	4.5.2	-45°C
High Temperature Operating	4.5.4	+70°C
High Temperature Short-Time Operating	4.5.3	+70°C
High Temperature Ground Survival	4.5.3	+85°C
Loss of Cooling	4.5.5	Cooling air not required (+55°C operating without cooling)
Altitude	4.6.1	25,000feet
Decompression	4.6.2	Equipment identified as Category B2 – no test
Overpressure	4.6.3	Equipment identified as Category B2 – no test
Temperature Variation	5.0	Equipment tested to Category B
Humidity	6.0	Equipment tested to Category A
Operation Shock and Crash Safety	7.0	Equipment tested to Category X – no test
Vibration	8.0	Aircraft zone 2: type 5 Category S level M
Explosion	9.0	Equipment identified as Category X – no test
Waterproofness	10.0	Equipment identified as Category X – no test
Fluids Susceptibility	11.0	Equipment identified as Category X – no test
Sand and Dust	12.0	Equipment identified as Category X – no test
Fungus	13.0	Equipment identified as Category X – no test
Salt Spray	14.0	Equipment identified as Category X – no test
Magnetic Field	15.0	Equipment identified as Category Z
Power Input	16.0	Equipment identified as Category BX
Voltage Spike	17.0	Equipment identified as Category B
AF Conducted Susceptibility	18.0	Equipment identified as Category B
Induced Signal Susceptibility	19.0	Equipment identified as Category AC
RF Susceptibility	20.0	Equipment identified as Category TT
RF Emissions	21.0	Equipment identified as Category B
Lightening Induced Transient Susceptibility	22.0	Equipment identified as Category XXXX – no test
Lightening Direct Effects	23.0	Equipment identified as Category X – no test
Icing	24.0	Equipment identified as Category X – no test
Electrostatic Discharge	25.0	Equipment identified as Category X – no test
Fire, Flammability	26.0	Equipment identified as Category X – no test
Temperature and Altitude	4.0	Equipment tested to Category B2