RT-2087/ZPX-A

User and Installation Guide

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1 Revision History

Revision	Date	Comments
A	30 Jun 2021	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 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 two years from the installation of ZPX-A in or on the platform. For the duration of the warranty period, uAvionix, at its sole discretion, will repair or replace any product which fails in normal use. Such repairs or replacement will be made at no charge to the customer for parts and labor, provided that the customer shall be responsible for any transportation cost.

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

Disclaimer of Warranty: 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. Proof of purchase for the product from uAvionix or authorized reseller is required to obtain and better expedite warranty service.

Please contact uAvionix support with a description of the problem you are experiencing. Also, please provide the model, serial number, shipping address and a daytime contact number.

You will be promptly contacted with further troubleshooting steps or return instructions. It is recommended to use a shipping method with tracking and insurance.

4 Contents

5 System Information

5.1 Certification Applicability

This installation manual provides mechanical and electrical information necessary to install the RT-2087/ZPX-A (ZPX-A). It is not equivalent to an approved, airframe-specific maintenance manual, installation design drawing, or installation data package. The content of this manual assumes use by competent and qualified personnel using standard maintenance procedures in accordance with Title 14 of the Code of Federal Regulations and other related accepted procedures. The conditions and tests required for approval of this article are minimum performance standards.

Those installing this AIMS-certified article either on or within a specific type or class of aircraft must determine that the aircraft installation conditions are within the standards, which include any accepted integrated functions not specified by the standards.

5.2 AIMS-Certified Performance

ZPX-A is based on the uAvionix TSO-certified ping200X, with the addition of an enable/disable control for the Mode A X-bit. ZPX-A is designed to meet the performance requirements of the applicable FAA Technical Standard Orders (TSOs), RTCA Minimum Operational Performance Standards (MOPS), and DoD AIMS performance and test standards outlined below.

Function	Document	Class
AIR TRAFFIC CONTROL RADAR BEACON SYSTEM/MODE SELECT (ATCRBS / MODE S) AIRBORNE EQUIPMENT	TSO-C112e (INCOMPLETE) RTCA/DO-181E	Level 2els Class 1 *[1]*
1090 MHz EXTENDED SQUITTER AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B)	TSO-C166b RTCA/DO-260B	Class B1S
AUTOMATIC PRESSURE ALTITUDE CODE-GENERATING EQUIPMENT	TSO-C88b	Pressure altitude sensor compliant to 35,000 ft MSL (Internal).

Function	Document	Class
AIMS “Civil-Only Capability” Transponder Requirements	AIMS 17-1000, App. G, §1.1	Modes 3/A, C, S ELS, and ADS-B Out
AIMS Test Standard for UAS X-Bit Control	AIMS 1101 §1.8.1	AIMS 1101 Test §5.21 is required

[1] Anticipating RTCA/DO-181F Level 2 Transponder requirements, ZPX-A does not support the UM protocol, does not support the Comm-A protocol, and does not have the capability to process and transmit air-initiated Comm-B messages. See Section 5.5 for additional details.

5.3 Applicable P/Ns

Description	P/Ns
RT-2087/ZPX-A Module	UAV-1005423-001
ZPX-A Software (AIMS-certified)	UAV-1002393-005
ZPX-A Firmware (AIMS-certified)	UAV-1002391-001

5.4 System Functions (derived from ping200X)

System Function	DO-178C DAL	DO-254 DAL
Mode S Transponder	C	C
1090 MHz ADS-B Out	C	C
Internal BaroAlt Sensing/Encoding	C	C

5.5 Deviations

Deviations from TSO and AIMS 17-1000 requirements are noted below.

Doc.	Deviation
C112e	From TSO-C112e paragraphs 3.e and 6.f to use DO-178C instead of DO-178B
C112e	Anticipating DO-181F for a Level 2 “Basic Transponder”, UM field support is not implemented
C112e	Anticipating DO-181F for a Level 2 “Basic Transponder”, Comm-A is not supported
C112e	Anticipating DO-181F for a Level 2 “Basic Transponder”, broadcast interrogations are not supported
C112e	Anticipating DO-181F for a Level 2 “Basic Transponder”, multisite message protocols, as they apply to Comm-B and Level 2 transponders, are not supported
C112e	Anticipating DO-181F for a Level 2 “Basic Transponder”, Air-Initiated Comm-B is not supported
C112e	Anticipating DO-181F, and in compliance with ICAO Annex 10 Volume IV requirements for equipment certified after January 1, 2020, ATCRBS/Mode S All-Calls interrogations (Long P4) are not replied to
C166b	From TSO-C166b paragraph 3.e and 6.h to use DO-178C instead of DO-178B.
C166b	Anticipating DO-260C, Airborne Velocity subtypes 3 and 4 are not supported
C88b	From TSO-C88b paragraph 3.e and 6.h to use DO-178C instead of DO-178B.
C88b	From TSO-C88b paragraph 3.d to use DO-160G instead of DO-160E.

Doc.	Deviation
17-1000	Barometric pressure altitude is limited to 101,350 ft rather than 126,750 ft [ref: AIMS 17-1000, §4.9.8 (Altitude Transmission)].
17-1000	ZPX-A is a non-diversity, single channel transponder and should be installed only on platforms that can meet antenna radiation requirements using a single antenna [ref: AIMS 1101, Appendix G, §3.3 (Diversity)].

5.6 FCC ID

Model	FCC ID
RT-2087/ZPX-A	2AFFTP200S

5.7 Environmental Qualification Form

Test Description	DO-160G	Category / Value
Temperature and Altitude	4.0	Equipment tested to Categories B2, C4
Low temperature ground survival	4.5.1	-55°C
Low Temperature Short-Time Operating	4.5.1	-35°C
Low Temperature Operating	4.5.2	-35°C (see Note 1)
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 not required. (+70°C operating without cooling)
Altitude	4.6.1	35,000 feet (see Note 2)
Decompression	4.6.2	Category B2, C4
Overpressure	4.6.3	Category B2, C4
Temperature Variation	5.0	Category B
Humidity	6.0	Category A
Operation Shock	7.0	Category B
Crash Safety	7.0	Category B Type 5
Vibration	8.0	Aircraft Zone 2, Type 5 - Category S(M)
Explosion	9.0	Category X (see Note 3)
Waterproofness	10.0	Category X
Fluids Susceptibility	11.0	Category X
Sand and Dust	12.0	Category X
Fungus	13.0	Category X
Salt Spray	14.0	Category X
Magnetic Field	15.0	Category Y
Power Input	16.0	Category BX
Voltage Spike	17.0	Category B
AF Conducted Susceptibility	18.0	Category B
Induced Signal Susceptibility	19.0	Category AC
RF Susceptibility	20.0	Category TT
RF Emissions	21.0	Category B
Lightening Induced Transient Susceptibility	22.0	Category A2XXXX
Lightening Direct Effects	23.0	Category X
Icing	24.0	Category X
Electrostatic Discharge	25.0	Category A
Fire, Flammability	26.0	Category X

Notes:

1. Tested to operating low of -45 ^{O}C when used with an external altitude encoder.
2. Tested to 50,000 ft.
3. Category X => Untested; Unspecified

5.8 Continued Airworthiness

Maintenance of the ZPX-A is "on condition" only.

Periodic regulatory function checks of the transponder and altitude encoder must be performed. Every 24 months, or after any maintenance is performed where data correspondence error could be introduced:

1. The transponder must be tested, inspected, and found to comply with the requirements of 14 CFR Part 91.413, as described in 14 CFR 43 Appendix F.
2. The internal altitude source must be tested to ensure correspondence to the primary flight altimeter (if used and applicable), as described in AC 43-6D and 14 CFR 43 Appendix E, to meet the maintenance requirements of 14 CFR Part 91.411. If the altitude encoder demonstrates correspondence errors in excess of ±125 feet, then calibration as described in Section 10.5 must be performed. If the error cannot be corrected using the calibration procedure, the unit must be repaired or replaced.

Annually, confirm the ADS-B software version is current per Service Bulletins available at the uAvionix website.

The aircraft must be returned to service in a means acceptable to the appropriate aviation authority.

Note: *Transponders certified after January 1, 2020 must not respond to ATCRBS/Mode S All-Calls (Long P4 interrogation). This may lead to unexpected results with some transponder test sets.*

Note: *Mode S transponders must respond to Mode S Only All-Calls only when airborne. ZPX-A can be placed in an airborne state for test purposes by entering "Ground Test Mode" using the "ping200X Control & Config" Windows application, or by using certain compatible control heads. For more detail see Section 10.3.*

5.9 System Limitations

Installation

This article meets the minimum performance and quality control standards required by DoD AIMS 17-1000. If installing this article on or in a specific type or class of aircraft, separate approval for installation is required. As an example, for a military UAS to gain platform approval requires verification of functionality and performance in accordance with AIMS 1102 and 1103.

5.10 Regulatory Compliance

Aircraft using ZPX-A must evaluate their needs to be compliant with 14 CFR 91.215, 91.225 and 91.227. While in transponder airspace specified in 14 CFR 91.215, ZPX-A must be maintained to 14 CFR Part 91.413.

While in ADS-B OUT airspace specified in 14 CFR 91.225, ZPX-A must be configured and equipped to meet the requirements of 14 CFR 91.225 and 91.227.

For ZPX-A to meet the ADS-B OUT requirements of 14 CFR 91.225 and 91.227, a compliant position source must be connected. See Section 9 and Appendix B for details on the position interface, and Appendix C for representative compatible equipment.

To meet 14 CFR 91.225 and 91.227 with no operational limitations, dynamic (in-flight) control is necessary. See Section 8 and Appendix A for details on the control interface, and Appendix C for compatible equipment.

For additional guidance on ADS-B OUT installation and approval, refer to AC 20-165B (“Airworthiness Approval of ADS-B OUT Systems” dated 7 Dec 2015).

6 System Specifications

6.1 System Functionality

ZPX-A is a Mode S, Level 2els, Class 1 transponder with support for ADS-B extended squitter, elementary surveillance, and SI code. A control that provides for enabling X-bit for Mode 3/A replies is provided. The nominal conducted power output is about 54 dBm, meaning AIMS 17-1000 App. G, §3.1 transmit power of 52 dBm (158 W) is met when the antenna cable has < 2 dB attenuation. ADS-B OUT meets DO-260B Class B1S.

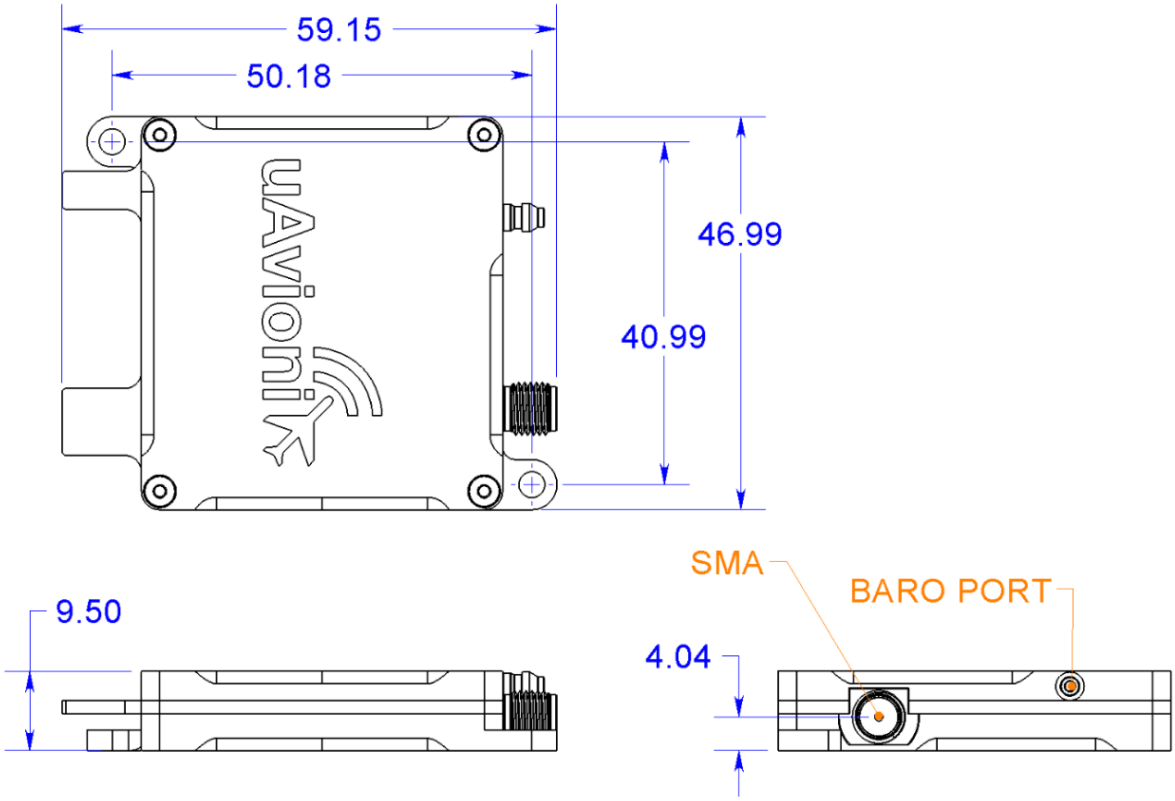
This transponder replies to both legacy Modes A and C interrogations and to Mode S interrogations from both ground radar and airborne collision avoidance systems. In all cases, the interrogations are received by the transponder on 1030 MHz, and replies are transmitted on 1090 MHz.

6.2 ZPX-A AIMS-Certified Specification

General Specifications

Characteristic	Specification
Width	46.99 mm
Height	9.50 mm
Depth	59.15 mm
Weight	45 g
Operating temperature range	-35°C to +70°C (internal barometer) -45°C to +70°C (external barometer)
Maximum pressure altitude [1]	35,000 ft (internal barometer) 101,350 ft (external barometer)
Input voltage range	9 to 30.3 VDC
Power Consumption	0.4 W – STBY 1.7 W – ON / ALT
14V current	0.16A idle 0.25A maximum
28V current	0.13A idle 0.20A maximum
Inrush Current Limit [2]	1A
Export Compliance	ECCN 7A994
FCC ID	2AFFTP200S

[1] Maximum altitude of 101,350 ft is a dynamic range limitation of altitude encoding.
[2] Inrush and internal short-circuit protection is internally current-limited to 1A.



Mode S Transponder Specification

Characteristic	Specification
Transmit frequency	1090 MHz
Transmit power	~54 dBm – Class 1
Transponder Level	2els
Receive frequency	1030 MHz
AIMS Certified Modes	3/A, C, S ELM, ES ADS-B OUT
ATCRBS sensitivity	-74 dBm
Mode S sensitivity	-74 dBm
RF Impedance	50 Ω
RF Connector	SMA

ADS-B OUT Specification

Characteristic	Specification
Transmit frequency	1090 MHz
Class	B1S
Downlink Format	DF=17

Internal Altitude Sensor/Encoder Specification

Characteristic	Specification
TSO-C88b Operating Range	-1,000 ft to 35,000 ft (for TSO compliance)
Maximum Differential Pressure Altitude (static port to installation environment)	36,000 ft
Maximum Rate of Altitude Change	20,000 fpm
Static Pressure Port	M3 barb fitting

Control Interface Specification

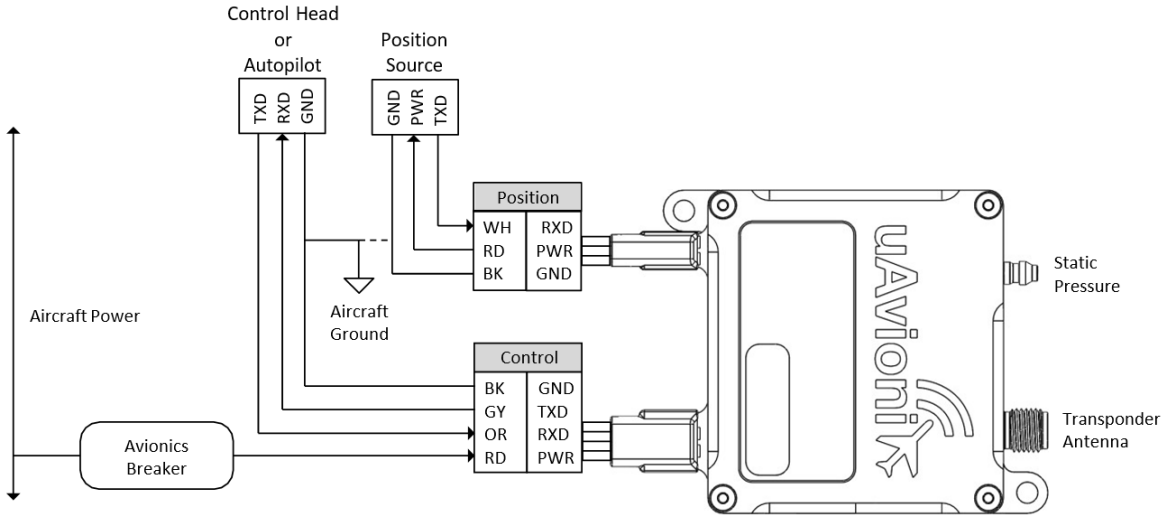
Characteristic	Specification
Physical	RS-232
Rate and properties	57,600 bps 8N1
Protocols	UCP, UCP-HD and Apollo

Position Interface Specification

Characteristic	Specification
Physical	RS-232
Rate and properties	115,200 bps 8N1
Protocols	MAVLink

Note: For more position interface details, see Appendix B.

System Interfaces



Serial Data Interfaces

Function	Protocol	Message Type
CONTROL and CONFIGURATION 2400 – 115200 bps	UCP RX	[0x2B] Transponder Configuration [0x2C] Message Request [0x2D] Transponder Control [0x2E] GNSS Data
	UCP TX	[0x00] Heartbeat [0x0A] Ownship [0x25] Identification [0x0B] Geo Alt Ownship [0x28] Sensor, Barometer [0x2B] Transponder Configuration [0x2F] Transponder Status
POSITION 115200 bps	MavLink RX	[0xCA, Length 51] Navigation Data

Note:

- Details of the UCP packets can be found in UAV-1002375-001 *uAvionix UCP Transponder Interface Control Document* (Rev. T or later).
- Details of the Navigation Data Message can be found in UAV-1001912-001 *uAvionix MavLink OEM Protocol ICD.*

7 Installation

7.1 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 and file a claim for the damage. To justify your claim, save the original shipping container and all packing materials.

7.2 Applicable Part Numbers

Part	Part Number	Rev
RT-2087/ZPX-A Micro Transponder	UAV-1005423-001	
ZPX-A Certified Software	UAV-1002393-005	
ZPX-A Certified Firmware	UAV-1002391-001	
ping200X USB Configuration Adapter	UAV-1004050-001	
Ping200X Control & Config PC Application	UAV-1004567-001	V3.27
RT-2087/ZPX-A User and Installation Guide	UAV-1005667-001	A

7.3 Installation Material and Tools

ZPX-A requires configuration, either using the available uAvionix Windows-based application, or dynamically using the described configuration protocol. Typical installations will be configured using:

- Ping200X Control & Config" Windows application
- ping200X USB configuration adapter

ZPX-A may require standard aviation parts for installation, such as:

- Screws or appropriate hardware
- Wire
- Shielded wire (2 or 3 conductor)
- Circuit breakers

- Environmental splices
- Ring terminals for grounding
- Static pressure lines and fittings
- Thread locking compound. (We recommend Loctite® 242 or 243 which works well with stainless steel hardware.)

Minimally, ZPX-A installation requires access to the following tools:

- Screwdriver or another appropriate driver
- Appropriate crimping tool(s) or soldering equipment

7.4 Additional Required Equipment

ZPX-A is a “remote” transponder. To fully function it requires connection to a controlling device, often referred to as a control head in a manned platform or Ground Control Station (GCS) – via a flight computer – for an unmanned platform. It is possible to provide ZPX-A a with static configuration for autonomous operation, but capabilities such as changing squawk code and responding to annunciations will not be possible without an interactive control device.

For transmission of complete ADS-B data elements, and 14 CFR §91.225 compliance, ZPX-A requires connection to a compliant position source – typically a GPS with TSO-C145e or equivalent.

The following table details the functions provided directly by ZPX-A.

Transponder	ADS-B Transmitter	Baro Altitude Source	GPS Receiver	Transponder Antenna	Control Head or GCS with Annunciation
X	X	X			

7.5 Mounting

ZPX-A is designed to be mounted in any convenient location: cockpit, cabin, avionics bay, or affixed in some other way to the airborne platform.

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

- Select a position in the aircraft not too close to any high external heat source. ZPX-A is not a significant heat source itself and does not need to be kept away from other devices for this reason.
- Avoid sharp cable bends and placing the cables too close to aircraft control cables.

Secure the transponder to the aircraft via the two (2) integrated mounting lugs. The lugs are designed to accept screws up to size M3 or 4-40. Thread locking compound should be used as appropriate. ZPX-A should be mounted on a flat surface.

Note: A civil installation of ZPX-A must accord with AC43.13-2B,Chapter 1.

7.6 Wiring

ZPX-A requires connections to power, ground, an RS-232 control interface, and an RS-232 position interface.

4-wire Control Interface			
Color	Type	Function	Rate
Red	Power Input	Aircraft Power	Selectable
Black	Power Input	Aircraft Ground	-
Gray	Data Output	Control RS-232 Transmit	Programmable
Orange	Data Input	Control RS-232 Receive	Programmable

3-wire Position Interface		
Color	Type	Function
Red	Power Output	Position Power (also can be directly tied to 4-wire I/F power input without additional protection)
Black	Power Output	Position Ground (also can be directly tied to 4-wire I/F power input without additional protection)
White	Data Input	Position RS-232 Receive @ 115200 bps

If new power wiring is required, refer to AC 43.13-1B Chapter 11 for guidance. The wiring should present an impedance of less than 0.5 Ω. The following table provides guidance for typical aircraft hook-up wire.

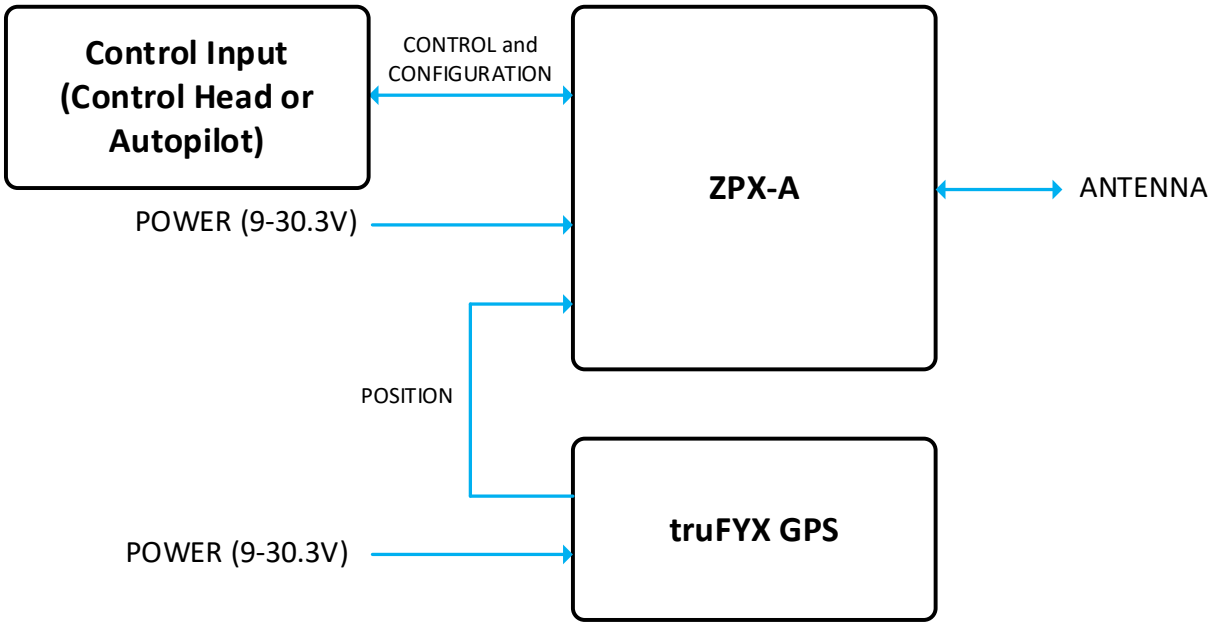
Gauge	Ohm/km	Maximum Length for 0.5 Ω
20 AWG	35	14.2 m
22 AWG	64	7.8 m

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

Powering the transponder without an attached load will result in damage to the device not covered under warranty.

Wiring Diagram

Refer to Appendix C for more detail regarding wiring diagrams and installations.



7.7 Transponder Antenna

An appropriate L-band antenna, designed to receive and transmit vertically polarized signals at 1030 and 1090 MHz, must be installed.

Prior to powering ZPX-A, ensure an appropriate antenna or commercially available 50 Ω load is connected to the SMA port. Powering ZPX-A without an attached load will result in damage to the device not covered under warranty.

The following antennas may be used:

- Standard 50Ω vertically polarized antenna with VSWR ≤ 1.5:1 over the 1030 to 1090 MHz frequency band
- TSO-C74( ) or TSO-C112( ) antennas that meet the above specification
- uAvionix non-TSO SMA dipole: P/N UAV-1004675-001

Take into consideration the antenna manufacturer's installation instructions. General guidance is provided below.

- The antenna should be mounted external to the airframe, and typically on the bottom of the aircraft.

The antenna should be mounted in a vertical orientation when the aircraft is in level flight. For uAvionix UAV-1004675-001, see below for proper orientation.

- Keep the cable lengths as short as possible and avoid sharp bends in the cable to minimize the Voltage Standing Wave Ratio (VSWR) (i.e., Return Loss).
- Ensure that cable and connector losses do not reduce power output below allowed levels for your aircraft operation.
- Conventional monopole antennas require an appropriate ground plane. For metallic aircraft, ensure good ground connection to the antenna. For composite aircraft, a ground plane must be installed.
- The antenna connections should be protected from the elements, and antenna cabling should be installed to minimize RF energy radiated inside the aircraft.

The antenna used must be installed to provide a separation distance of at least 20 cm from all persons.

7.8 Static Pressure Port

ZPX-A contains a TSO-C88b altitude encoder. If used, the barb fitting (size M3) located on the unit's enclosure should be securely attached to the aircraft's static pressure system. Minimize static pressure line lengths as much as possible. Press-plastic tubing (PVC, soft nylon, or polyurethane) with a nominal ID of 1/8" (3.175 mm) can be used and secured with a small tie-wrap. Adapters may be used to convert the barb to match the aircraft's current static plumbing. Ensure any fittings are free from leaks.

Upon completion of installation, a case leak test should be performed per 14 CFR Part 43 Appendix E.

If an external altitude encoding source is configured (see §10.1.9), the internal altitude encoder is unused, and the static pressure system does not need to be connected to the ZPX-A static pressure port. The Maximum Operating Altitude listed on the ZPX-A nameplate is not applicable when used with an external altitude encoding source – instead reference the Environmental Qualification Form in Section 5.7.

7.9 Cooling Requirements

ZPX-A is designed to meet all applicable performance requirements without forced-air cooling.

Attention should be given, however, to the incorporation of cooling provisions to limit the maximum operating temperature if ZPX-A is installed in close proximity to other avionics which would otherwise cause operational temperature limits to be exceeded [see §5.7 (Environmental Qualification Form)]. The reliability of equipment operating in close proximity in an avionics bay can be degraded in the absence of adequate cooling.

8 Control and Configuration Interface

ZPX-A has a control and configuration serial interface. It is used to configure the equipment at installation time and to control the device while operating. Typically, a control head or unmanned aircraft flight control computer is connected to the device during operation.

Transponder control provides the ZPX-A with data such as operating mode, emergency status, squawk code, and IDENT. Optionally it provides external pressure altitude. Status and annunciation information is provided by ZPX-A over the control interface.

For 14 CFR 91.225 compliance with no operational limitations, dynamic (in-flight) control is necessary.

For details on the ZPX-A control interface, refer to Appendix A.

For typical installations, refer to Appendix C.

9 Position Interface

For 14 CFR 91.225 (i.e., ADS-B) compliance, a serial connection to an appropriate position source is required. For additional details reference §5.10 and §7.4.

ZPX-A receives compliant position information from a GPS or similar position source. Only one position source can be configured to ZPX-A at a time. If multiple position sources are detected, ZPX-A will indicate a

"Maintenance Required" failure. If no position data is provided, certain ADS-B messages will be incomplete.

Care must be taken to ensure the position source is qualified to meet ADS-B regulations for your operation, and that the ZPX-A is appropriately configured (SIL/SDA value). Amongst other considerations, position source and system latency must be considered.

For details on potential position sources and how to connect them, refer to Appendix C.

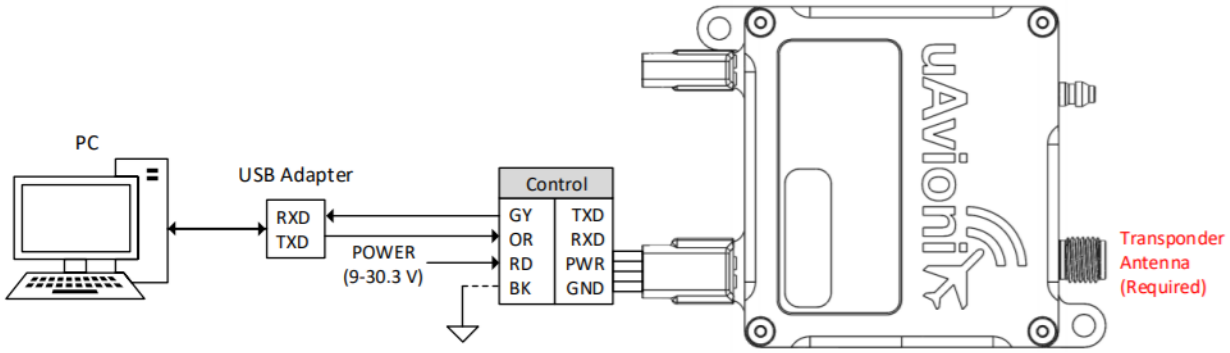
For details on the ZPX-A position interface, refer to Appendix B.

10 Configuration and Calibration

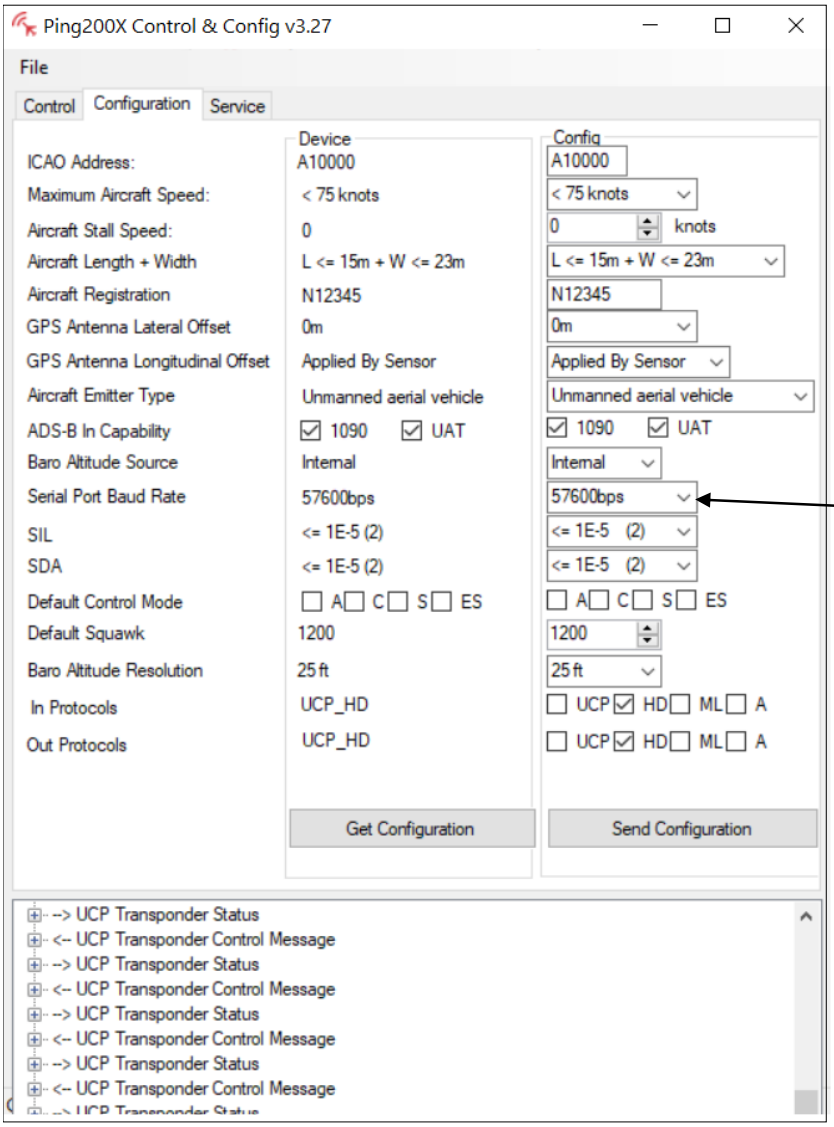
The transponder system must be configured during initial system installation. This can take place on the bench or in the aircraft, but device power and connection to a PC must be available.

Prior to powering ZPX-A, ensure an appropriate antenna or commercially available 50 Ω load is connected to the SMA port. Powering ZPX-A without an attached load will result in damage to the device not covered under warranty.

Connect ZPX-A to a PC running the Configuration and Control application via the USB COM port adapter.



Set 'Conn Type' to 'Serial', 'Port' to the USB or serial port connected to ZPX-A, 'App Baud' to '57600' and 'Protocol' to 'UCP'.



Make sure that the COM settings on the control tab match the serial port assigned to the USB adapter

Click ‘Start’.

10.1 Configuration

The Configuration Items List below should be used to document the system installation for future reference. For example, the following parameters – until changed - would be permanently stored in ZPX-A.

Configuration Item		Default	Configured
ICAO Address		0x000000	
Aircraft Maximum Speed (kts)		< 75	
Aircraft Stall Speed		0	
Aircraft Length + Width (m)		L ≤ 15 + W ≤ 23	
Aircraft Registration		“ “	
GPS Antenna Lateral Offset (m)		0	
GPS Antenna Longitudinal Offset (m)		Applied by sensor	
Aircraft Emitter Type		No Information Available	
ADS-B In Capability	UAT RX	NO	
	1090ES RX	NO	
Baro Altitude Source		Internal	
Serial Port Baud Rate (bps)		57600	
SIL		3	
SDA		2	
Default Control Mode		None	
Default Squawk		1200	
Baro Altitude Resolution (ft)		25	
In Protocols		UCP	
Out Protocols		UCP	

10.1.1 ICAO Address

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 ZPX-A understands the hexadecimal format. An octal number must be converted to hexadecimal format 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. Applies to U.S. registered civilian aircraft only.

10.1.2 Aircraft Maximum Speed

Mode S transponders can transmit their maximum airspeed characteristics to aircraft equipped with TCAS. This information is used to identify threats and to plan avoidance actions by the TCAS-equipped aircraft. The airspeeds are grouped in ranges.

10.1.3 Aircraft Stall Speed

The default aircraft stall speed is 0. Set as appropriate for your aircraft to allow automatic air/ground state determination. Set to 0 to lock in airborne state, or to allow switching by the control head. See Appendix A for more details.

10.1.4 Aircraft Length / Width

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 in Meters
L ≤ 15	W ≤ 23
15 < L ≤ 25	28.5 < W ≤ 34
25 < L ≤ 35	33 < W ≤ 38
35 < L ≤ 45	39.5 < W ≤ 45
45 < L ≤ 55	45 < W ≤ 52
55 < L ≤ 65	59.5 < W ≤ 67
65 < L ≤ 75	72.5 < W ≤ 80
75 < L ≤ 85	W > 80
L > 85	Any

10.1.5 Aircraft Registration

The Aircraft Registration can be up to an 8 alpha-numeric code that corresponds to the tail number of the aircraft.

Note: This is typically the civilian aircraft N-number or military equivalent, unless otherwise advised by the FAA or ATC.

10.1.6 GPS Antenna Lateral / Longitudinal 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 and some UAS 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	
Left 6	
Right 2	
Right 4	
Right 6	

10.1.7 Aircraft Emitter Type

The aircraft emitter type default is ‘No Information Available’. This must be configured as appropriate for the host aircraft.

10.1.8 ADS-B In Capability

The ADS-B transmissions include an indication to the ground stations of whether the aircraft includes a 1090 MHz ADS-B receiver, a UAT ADS-B receiver, or both. This data is used to determine if ADS-R or TIS-B is worth broadcasting to your aircraft if conditions allow it. ZPX-A does not include an ADS-B receiver. Only select these items if you have a separate ADS-B receiver on-board.

10.1.9 Baro Altitude Source

By default, ZPX-A utilizes pressure altitude measurements from an internal TSO-C88b pressure altitude source for Mode C, S, and ADS-B messages. If desired, an existing or external altitude source can be used in lieu of the internal altitude source. To do so, change the ZPX-A “Baro Altitude Source” from “Internal” to “External”. If set to “External”, ZPX-A will use the barometric pressure altitude reported in the Control Message in all Mode C, S, and ADS-B messages.

10.1.10 Serial Port Baud Rate

This setting configures the speed of the control interface serial baud rate in bps.

10.1.11 SIL / SDA

Set SIL according to the advertised integrity level of the GPS source.

Per AC 20-165B, ZPX-A’s System Design Assurance (SDA) must report the lowest SDA value of the ADS-B system. The ADS-B system includes both the SDA of ZPX-A and the paired GPS position source. If the paired GPS SDA is less than 2, configure the ZPX-A SDA value to the SDA of the GPS. For GPS SDA values ≥ 2, configure the ZPX-A SDA to 2.

10.1.12 Default Control Mode

Select the default operating mode, to be used prior to arrival of control messages. This setting configures the ZPX-A for Mode A, Mode C, Mode S and ADS-B Extended Squitter transmissions.

- “None” selected – Disables all modes.
- Mode A - Squawk
- Mode C – Altitude
- Mode S – Addressed Identification and Altitude
- Mode ES – ADS-B Identification and Position reporting

10.1.13 Default Squawk

The default squawk is 1200. To assist ATC tracking of aircraft, an aircraft squawk is transmitted. The configured value is the squawk code that will be transmitted in lieu of available control data.

10.1.14 Baro Altitude Resolution

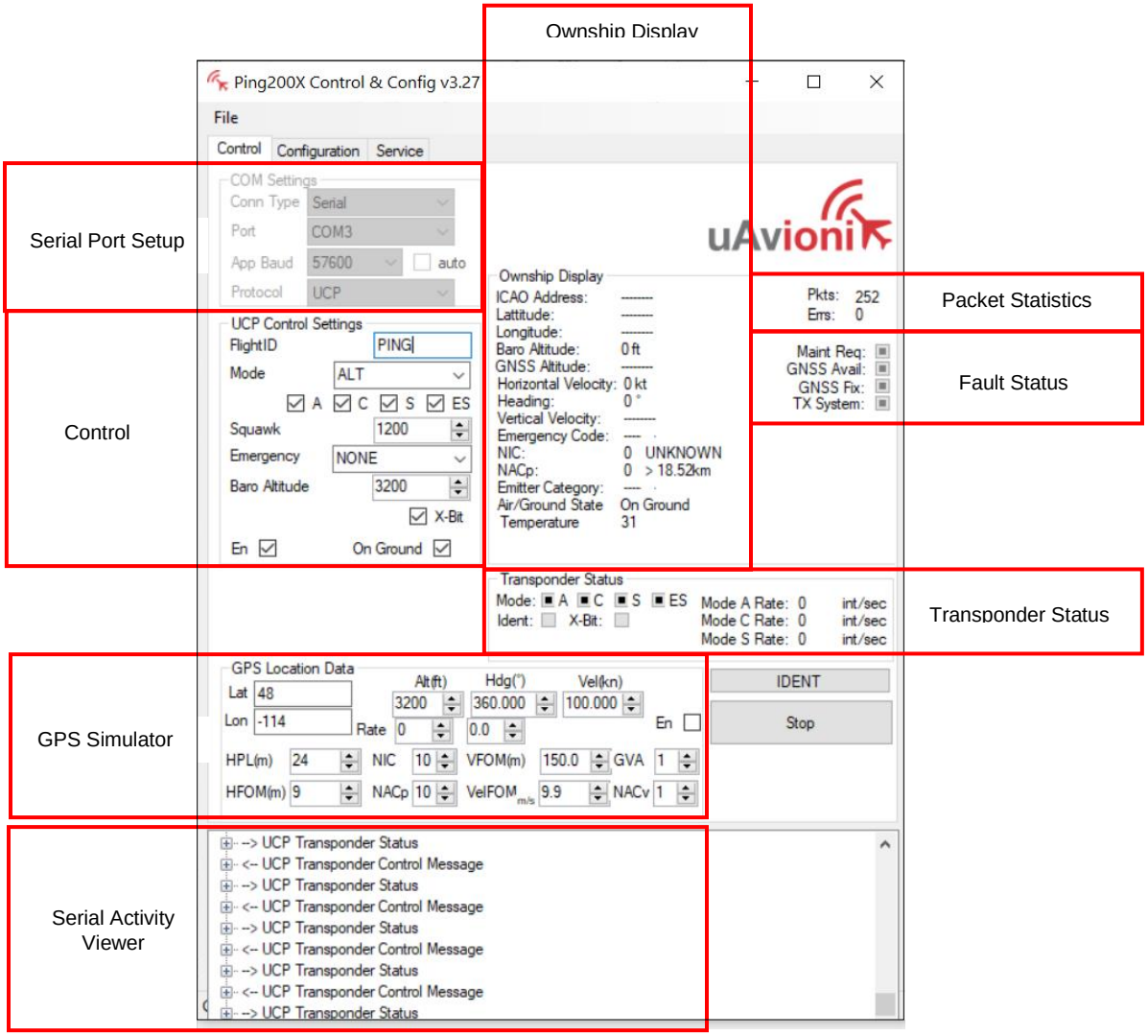
The default source resolution of barometric pressure altitude is 25 (ft).

10.1.15 In / Out Protocols

The default In/Out protocols are UCP (Universal Computer Protocol).

10.2 Control

The Control tab allows the installer to exercise and verify the transponder's operation. This simulates a control head, control panel of a GCS, or similar equipment.



Note: Enabling X-bit produces a Mode A reply having X-bit = 1. In Mode S replies, X-bit = 0 (i.e., X-bit cannot be enabled for Mode S replies).

10.3 Post-Installation Checks

Post-installation checks must be performed by the installer, after configuration, as appropriate for the aircraft and type of installation.

To ensure compliance with civil regulations in the United States, verify functionality identified in 14 CFR Part 43 Appendix F (ATC Transponder Tests and Inspections) and 14 CFR Part 43 Appendix E (Altimeter System Test and Inspection).

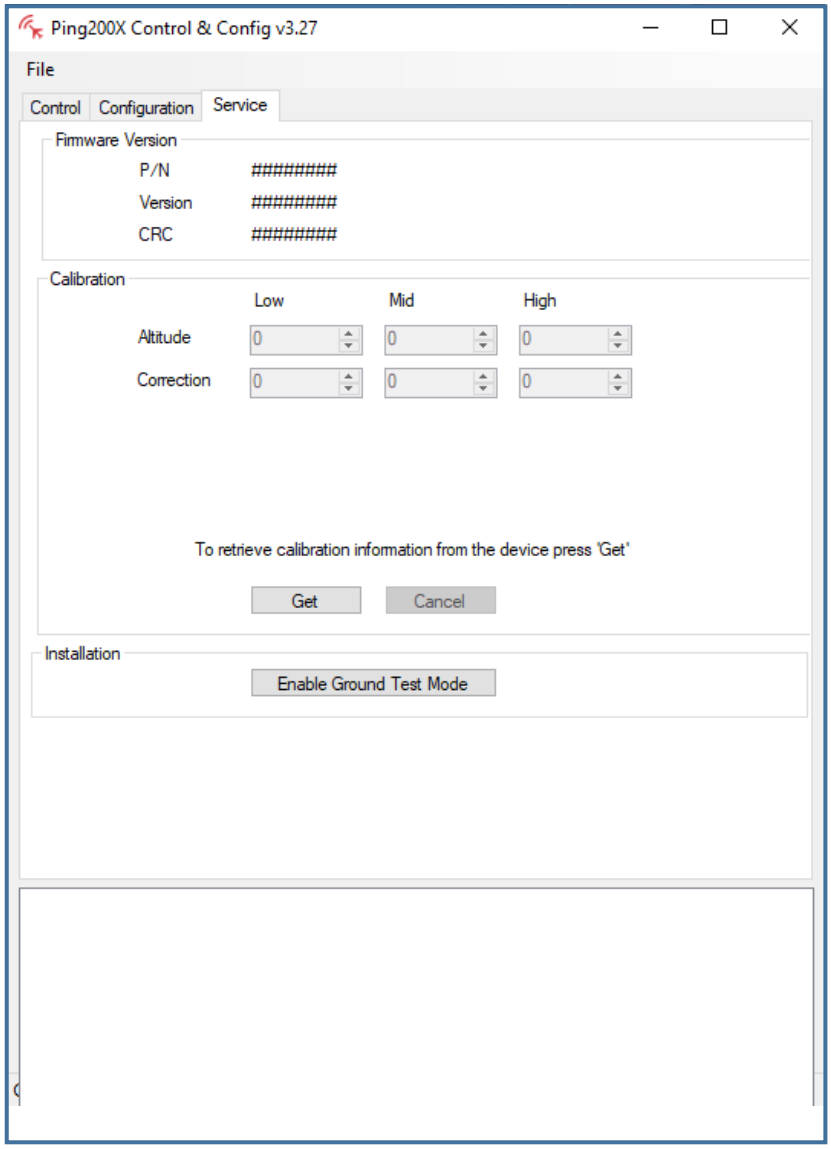
Aircraft with ZPX-A installed may be subject to requirements in 14 CFR 91.215, 91.225 and 91.227. For additional details reference §5.10.

A complete post-installation check may be performed by using a ramp tester such as a VIAVI IFR6000. A simplified post-installation check procedure follows.

STEP	CHECK
Launch the *Ping200X Control & Config* Windows Application (v3.27 or later)	
Set Port to the USB or serial port connected to the ZPX-A	
Set the ‘App Baud’ to ‘57600’	
Set ‘Protocol’ to ‘UCP’ • If the ZPX-A has been reconfigured for a protocol other than UCP, this procedure may not apply	
Connect the Antenna PRIOR TO APPLYING POWER	
Apply power from a minimum of an 11V, 1A power source	
Press ‘Start’ in ‘*Ping200X Control & Config’* Windows application	
Confirm activity in ‘Serial Activity Viewer’ and incrementing ‘Pkts’ in ‘Packet Statistics’ of ‘Control’ tab	
Verify ‘ICAO Address’ in ‘Ownship Display’ is correct for your aircraft, and not ‘000000’	

STEP	CHECK
Confirm ‘Baro Altitude’ in ‘Ownship Display’ shows the current pressure altitude; i.e., the current altitude as displayed on an altimeter set to 29.92	
If a GPS is connected and the GPS antenna has a clear view of the sky, allow the GPS time to obtain a position fix; confirm that ‘Latitude’ and ‘Longitude’ are correct in ‘Ownship Display’	
Select ‘ALT’ from the ‘Mode’ selection box in ‘Control’	
Verify ‘TX System’ fault annunciation LED turns green in ‘Fault Status’	
If you are in range of Radar or connected to an interrogating test set, ‘Transponder Status’ will indicate interrogations	
If not already in airborne state, access the ‘Service’ tab and select ‘Enable Ground Test Mode’ • This enables airborne state until ZPX-A power is cycled	
Return to ‘Control’ tab and verify ‘Air/Ground State’ displays ‘Airborne’ in ‘Ownship Display’	
Perform ramp test procedures, as necessary, for required aircraft operations	
An EFB application such as ForeFlight Mobile, when connected to an ADS-B receiver such as Sentry, can be used to verify ADS-B transmissions. • Using ForeFlight Mobile, in the ADS-B Device screen, select ‘Ownship’ when detected, and verify transmitted parameters.	

10.4 Altitude Encoder Calibration

STEP	CHECK
Launch the ‘ping200X Control & Config’ Windows Application 	
Set Port to the USB or serial port connected to the ZPX-A	
Set the ‘App Baud’ to value noted in Section 10.1	
Set ‘Protocol’ to value noted in Section 10.1	
Apply power from a minimum of a 11V, 1A power source	

STEP	CHECK
Press ‘Start’ in ‘ping200X Control & Config’ Windows application	
With a Pitot Static Test Set connected, select the ‘Service’ tab	
Press ‘Get’ to retrieve the calibration information	
Adjust Pitot Static Test Set to the Low calibration altitude	
Wait for Pitot Static Test Set to reach the Low calibration altitude, then click 'Start'	
Wait for calibration to complete	
Adjust Pitot Static Test Set to Mid calibration altitude	
Wait for Pitot Static Test Set to reach the Mid calibration altitude, then click 'Start'	
Wait for calibration to complete	
Adjust Pitot Static Test Set to the High calibration altitude	
Wait for Pitot Static Test Set to reach the High calibration altitude, then click 'Start'	
Wait for calibration to complete	
Click ‘Send’ to send updated calibration to the device	

11 Normal Operation

ZPX-A should be enabled, typically in ALT mode, during all phases of flight, including surface movement operations.

12 Maintenance

ZPX-A is not a user serviceable product. All service must be performed either by uAvionix or an authorized uAvionix repair center.

13 Support

For additional questions or support please visit:

https://www.uavionix.com/support/

Appendix A Control Interface

ZPX-A is controlled and configured using the data interface specified below.

Characteristics	Specifications
Physical	RS-232
Data rate	57,600 bps (default)
Parity	None
Data bits	8
Stop bits	1
Protocol	UCP (RX/TX enabled by default) UCP-HD (disabled by default) Apollo (disabled by default)

UCP is enabled by default for use as the input protocol. Apollo input can optionally be enabled simultaneous with UCP, and messages are processed based on the received data format.

UCP is enabled for use as the output protocol. Additionally, Apollo output is enabled automatically upon receipt of an Apollo input message.

The data rate and protocols can be configured by the UCP/UCP-HD Transponder Configuration message. UCP or UCP-HD input is required to be enabled to allow device configuration.

A.1 UCP

uAvionix Control Protocol (UCP) is documented in *uAvionix UCP Transponder Interface Control Document* UAV-1002375-001 (Rev. T or later). This document is available to authorized parties and may be obtained by contacting uAvionix.

UCP can be used to configure, control, and monitor status of ZPX-A.

A.1.1 Control Message

The Control message must be supplied to ZPX-A as documented in the UCP ICD. Minimally, Mode A (squawk) code, IDENT, emergency state, and transponder mode are provided in this message.

Mode

To set the transponder operating mode, appropriate enable bits must be set in the Control message. The mapping of traditional transponder modes to their corresponding Control enablement bits follows.

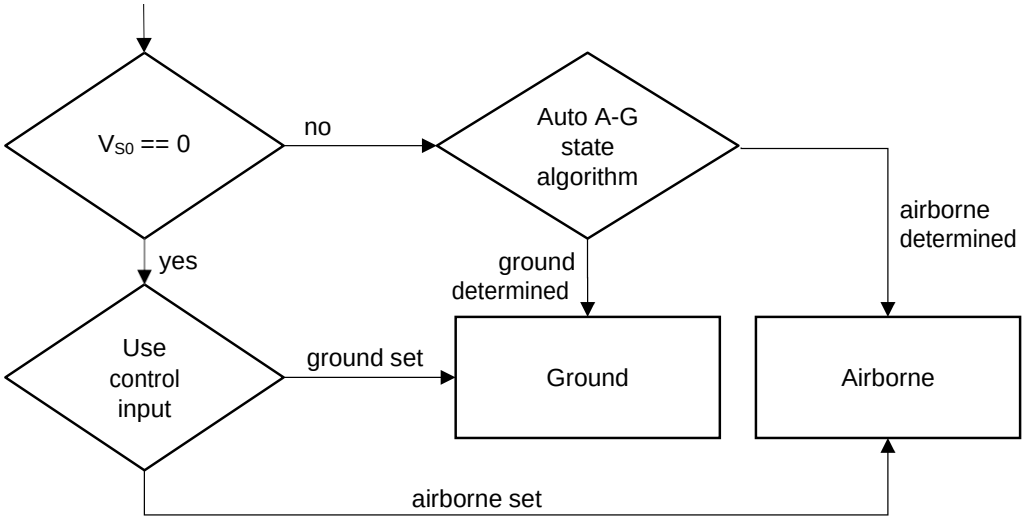
Operating Mode	Mode A	Mode C	Mode S	1090ES
STBY				
ON (altitude suppressed)	X		X	X
ALT	X	X	X	X

Flight Identification

If Flight Identification is provided in the Control message, that value is transmitted as Flight ID. If none (all spaces) is provided, the Call Sign/Aircraft Registration value configured in the device is transmitted.

Air-Ground State

Optionally, air-ground state may be provided in the Control message. To use air-ground state from the control message, the device must be configured with a V_{S0} of zero. Air-ground logic is described by the following chart.



Airborne subsonic and supersonic state is automatically determined by ZPX-A.

A.1.2 Heartbeat Message

With UCP enabled, the Heartbeat message is sent once per second. The following specific fault indications are available in the Heartbeat message, and should be mapped to annunciations compliant with applicable regulations. TSO-C166b requires annunciations of ADS-B transmission device and function failures (see RTCA/DO-260B §2.2.11.5)

Fault	Description
Maintenance Required	ICAO address not set (RTCA/DO-181E §2.2.10.3) ICAO address not set (RTCA/DO-260B §2.2.11.3.1) Multiple position sources available – check configuration (RTCA/DO-260B §2.2.5.3)
Failure TX System	Transponder replies not enabled or acquisition squitter rate failure (RTCA/DO-181E §2.2.10.4) Transmit not enabled or extended squitter rate failure (RTCA/DO-260B §2.2.11.2.1 and §2.2.11.5.1)
Failure GNSS No 3D Fix	No valid 3D position from GNSS (RTCA/DO-229E §2.1.2.6)
Failure GNSS Unavailable	Unable to communicate with GNSS subsystem (RTCA/DO-260B §2.2.11.6)

A.2 UCP-HD

uAvionix Control Protocol – Half Duplex (UCP-HD) is documented in *uAvionix UCP Transponder Interface Control Document* UAV-1002375-001 (Rev. T or later). This document is available to authorized parties and may be obtained by contacting uAvionix.

UCP-HD can be used to configure, control, and monitor status of ZPX-A.

A.2.1 Control Message

See A.1.1 for a description of the Control message.

A.2.2 Transponder Status

With UCP-HD enabled, the Transponder Status is sent in response to each Control message, as documented in the ICD.

The presence of a fault to annunciate is delivered by the “Fault or Failure Indicated” bit being set. To determine the specific fault, query the Heartbeat message using a Message Request. See A.1.2 for a description of the fault indications available in the Heartbeat message.

A.3 Apollo

Apollo can be used to control and monitor status of ZPX-A. To use,ensure Apollo is enabled as an input protocol. Once an Apollo message is received, Apollo message output is enabled until device reset.

A.3.1 Supported Input Messages

The following input messages are supported:

Mode (#MD)

The Mode message configures the operating mode, Mode A code (squawk), and IDENT.

Setting	Description	Mode A	Mode C	Mode S	1090ES
'O'	STBY				
'A'	ON (Suppressed Altitude)	X		X	X
'C'	ALT	X	X	X	X

Altitude (#AL)

The altitude message provides pressure altitude information.

Appendix B Position Interface

Position data may be provided through the control interface using UCP or UCP-HD GNSS Data Messages. Typical configurations, however, will use the dedicated position interface to supply position data.

The position interface communicates using the MAVLink protocol format and accepts custom uAvionix “Navigation Data Messages”. This message is documented in the *uAvionix OEM Protocol Specification* UAV-1001912-001. This document is available to authorized parties and may be obtained by contacting uAvionix.

Appendix C Equipment Compatibility and Interconnect Drawings

ZPX-A can be programmed with a static configuration, or be dynamically controlled in-flight by a control head, GCS, or by an autonomous unmanned aircraft flight control computer. To meet installation or operational requirements, dynamic control may be required (e.g., to provide in-flight updates to the squawk code).

For 14 CFR 91.225 compliance with no operational limitations, dynamic control is necessary.

For 14 CFR 91.225 compliance, a position source is necessary.

The installation information below serves as a supplement to any manuals describing controlling devices, and concerns basic wiring of the transponder control and position functionalities only. For further installation and operating instructions, please reference the appropriate installation manual and pilot's guide. The installer should become fully familiar with the installation process for the controlling device. These descriptions are informational, and in no way grant an installation approval.

C.1 Compatible Control Protocols

ZPX-A can be controlled using equipment compatible with UCP, UCP-HD and Apollo protocols, as documented in Appendix A.

C.2 Compatible Position Protocols

ZPX-A can be provided position data using equipment compatible with custom MAVLink, UCP and UCP-HD protocols, as documented in Appendix B.

C.3 Compatible Equipment

The following equipment has been shown to be compatible with ZPX-A and can serve as a position source.

Manufacturer	Model	P/N	ZPX-A Protocol	ZPX-A Configuration
uAvionix	truFYX	UAV-1002809-001	MAVLink OEM	SIL = 3 SDA = 2

The following equipment has been shown to be compatible with ZPX-A and can serve as a controlling device *[1].*

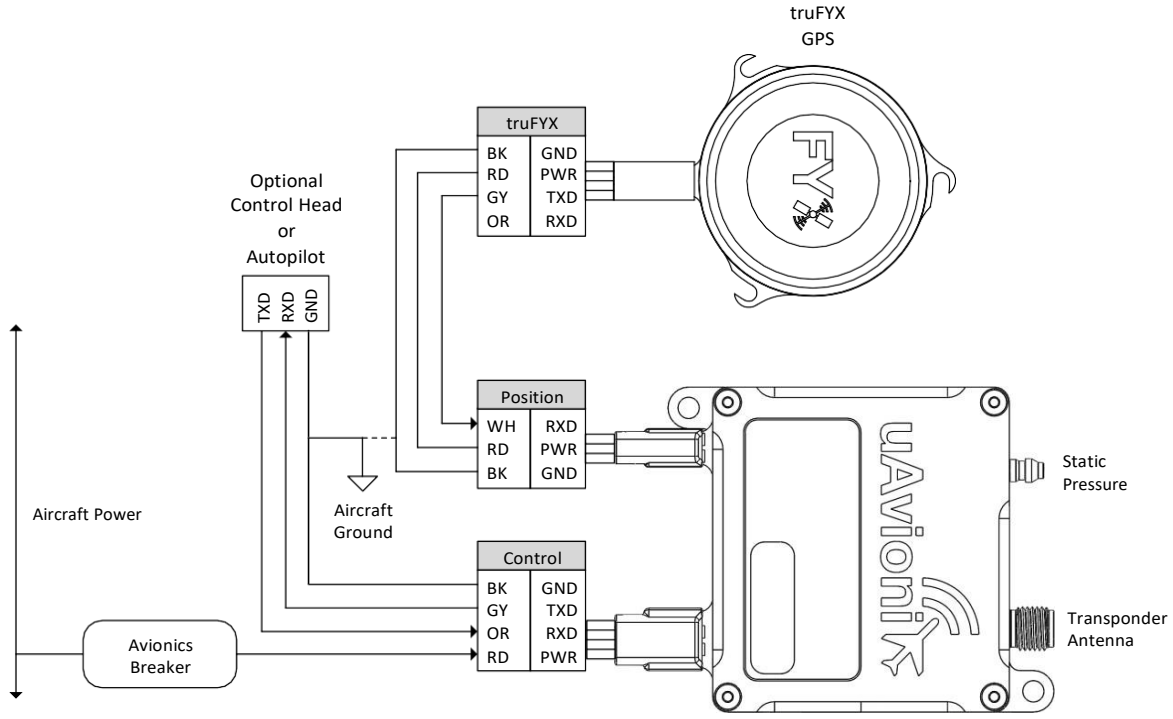
Manufacturer	Model	ZPX-A Protocol	Controller Configuration
uAvionix	AV-20-E	UCP-HD *[2]*	Enable “XPDR CTRL” page
	AV-30-E	UCP-HD *[2]*	SERIAL 2: “BEACON X” GPS NAV SRC: “BEACON X” (optional, enable if GPS track and velocity information desired)
	AV-30-C		

[1] X-bit control may not be available.
[2] Protocol must be enabled on ZPX-A

See below for drawings showing examples of interconnected components.

C.3.1 Standalone (control optional) with truFYX GPS

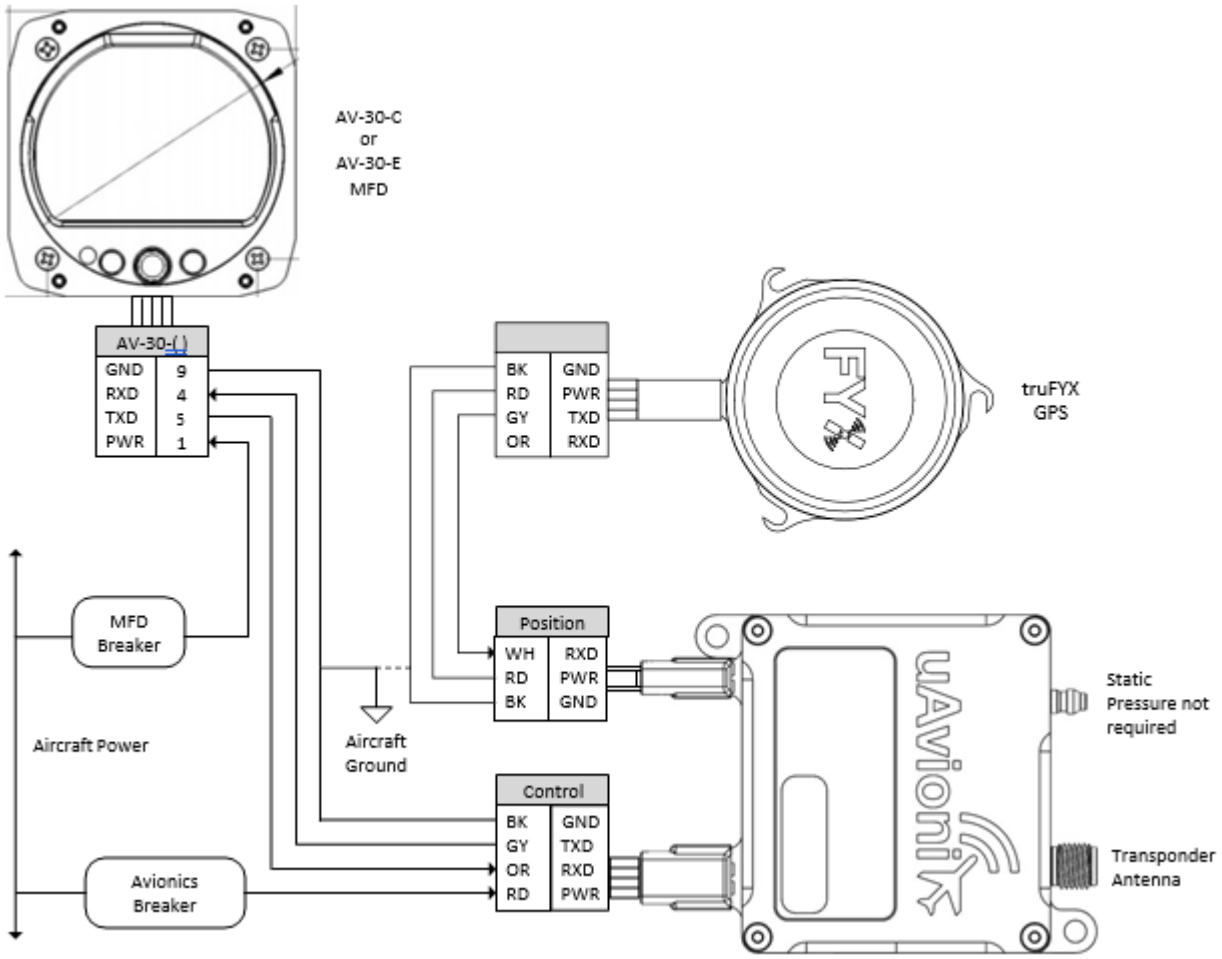
This installation uses the truFYX GPS for position data. An optional control head or flight control computer, configured for UCP (default) or UCP-HD protocol, may be connected to provide other dynamic or configuration data.



Configure the ZPX-A as appropriate.

C.3.2 AV-30-C or AV-30-E Control Head with truFYX GPS

This installation uses the uAvionix truFYX GPS for position data. The uAvionix AV-30-C or AV-30-E provides control, status, and altitude encoder data.



Configure the ZPX-A as appropriate, ensuring the following values have been updated from defaults:

Parameter	Value
In Protocols	UCP-HD
Out Protocols	UCP-HD
Serial Port Baud Rate	2400
Baro Altitude Source	External

C.4 Third-party Equipment

The following devices are reported to be compatible with supported ZPX-A control protocols. These EFIS displays have the capability to send barometric pressure altitude data and control the mode and squawk functions of ZPX-A through any available RS-232 serial output. ZPX-A configuration must still take place through the “ping200X Control & Config” Windows application.

Note – These devices may not support X-bit control.

Manufacturer	Model	ZPX-A Protocol	Configuration	Function Provided
GRT	MINI-B	Apollo	Serial Output: SL70/STX175 Serial Rate: 57600	Control
	MINI-AP			
	MINI-X			
	Sport EX			
	HorizonEX			
MGL	iEFIS	Apollo	Type: STX165(R) Serial Rate: 57600	Control
	Xtreme EFIS			

For complete functionality, ensure both a position source and controller are connected.

Proper operation of the interface and system, with the specific equipment configuration, must be demonstrated at installation time.

C.4.1 ZPX-A Configuration

Configure the ZPX-A as appropriate, ensuring the following values have been updated from defaults:

Parameter	Value
In Protocols	UCP and Apollo
Out Protocols	Apollo
Serial Port Baud Rate	57600 or as appropriate
Baro Altitude Source	External

C.4.2 Controller Configuration

Only the EFIS serial OUTPUT is required. If no configuration information is provided in the compatible equipment table above, the parameters should be set as follows.

Characteristic	Specification
Physical	RS-232
Rate and properties	57,600 bps 8N1 (or as configured on ZPX-A)
Protocol	SL70, STX 165R, or UCP

C.4.3 Interconnect

Connect the ZPX-A control port Orange (RXD) wire to the appropriate EFIS serial port transmit (TXD) line.

Example pinout options for certain compatible EFIS displays are shown below. Please consult the EFIS installation manuals for additional options and information.

GRT Mini-X / Mini-AP	Serial 1	Serial 2
TXD Pin	5	1

GRT Mini-B	Serial 1	Serial 2	Serial 3
TXD Pin	5	1	9

GRT Sport EX / Horizon EX	Serial 1	Serial 2	Serial 3	Serial 4	Serial 5	Serial 6
TXD Pin	A2	A4	A25	A5	A3	A1