



truFYX™ TSO

User and Installation Guide



© 2019 - 2021 uAvionix Corporation. All rights reserved.

Except as expressly provided herein, no part of this guide may be reproduced, transmitted, disseminated, downloaded or stored in any storage medium, for any purpose without the express written permission of uAvionix. uAvionix grants permissions to download a single copy of this guide onto an electronic storage medium to be viewed for personal use, provided that the complete text of this copyright notice is retained. Unauthorized commercial distribution of this manual or any revision hereto is strictly prohibited.

uAvionix® and Ping® are registered trademarks of uAvionix Corporation, and may not be used without express permission of uAvionix.

truFYX, tailBeaconX, skyBeaconX, ping200X, tailBeacon, skyBeacon, and skyBeacon Installer are trademarks of uAvionix Corporation and may not be used without express permission of uAvionix.

Patent uavionix.com/patents

1 Revision History

Revision	Date	Comments
A	4/23/2019	Initial release
B	7/19/2021	TSO submission updates
C	10/4/2021	Add -002 configuration

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 purchase. 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.

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 email or call 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 Table of Contents

1	Revision History	3
2	Warnings / Disclaimers	4
3	Limited Warranty.....	5
4	Table of Contents	6
5	TSO and System Information.....	8
5.1	Certification.....	8
5.2	TSO Authorization.....	8
5.3	System Functions	8
5.4	TSO Deviations and Incomplete.....	8
5.5	Device Marking	9
5.5.1	truFYX Hardware.....	9
5.5.2	truFYX Software	9
5.6	Environmental Qualification Form	10
5.7	Continued Airworthiness	11
5.8	System Limitations.....	11
5.9	Reference Documents and Tools.....	11
6	System Specifications.....	12
6.1	truFYX Specifications.....	12
6.1.1	Physical Specifications	12
6.1.2	GPS/SBAS Specification	14
6.2	System Interfaces	15
6.2.1	Power Input.....	15
6.2.2	Data Interface (PVT)	15
6.2.3	Time Pulse Output (1PPS)	15
7	Equipment Installation	16
7.1	Unpacking and Inspecting.....	16

7.2	Authorized Part Numbers.....	16
7.3	Mounting.....	16
7.4	Wiring	16
7.4.1	Typical Application	17
7.5	Unit Installation	17
7.6	Software Part Number Identification.....	18
7.7	Software Update	18
8	Post Installation Checks.....	19
9	Maintenance	20
10	Care and Cautions.....	20
11	Normal Operation	20
12	System Configuration	21
12.1	Navigation Output.....	21
12.1.1	NMEA.....	21
12.1.2	MAVLink OEM.....	21
13	Support.....	22
Appendix A	Interface Protocols.....	23
A.1	NMEA	23
A.2	MAVLink OEM	23
Appendix B	Equipment Compatibility and Interconnect Drawings	25
B.1	Compatible Protocols.....	25
B.2	Compatible Equipment.....	25

5 TSO and System Information

5.1 Certification

This installation manual provides mechanical and electrical information necessary to install truFYX. 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 Regulation and other related accepted procedures. The conditions and tests required for approval of this article are minimum performance standards. Those installing this 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. TSO articles, articles approved with 14 CFR Part 21.8(d), and any accepted integrated function(s) not specified in the standard must have separate approval for installation in an aircraft. The article may be installed only according to 14 CFR Part 43 or the applicable airworthiness requirements. This is an incomplete system intended to provide the functions identified in, and when installed according to this installation manual.

5.2 TSO Authorization

Function	TSO/RTCA	Class
Airborne Navigation Sensor Using the Global Position System (GPS) Augmented by the Satellite Based Augmentation System (SBAS)	TSO-C145e INCOMP RTCA/DO-229E	Beta 1

5.3 System Functions

System Function	TSO	DO-178C DAL	DO-254 DAL
GPS/SBAS	TSO-C145e	C	C

5.4 TSO Deviations and Incomplete

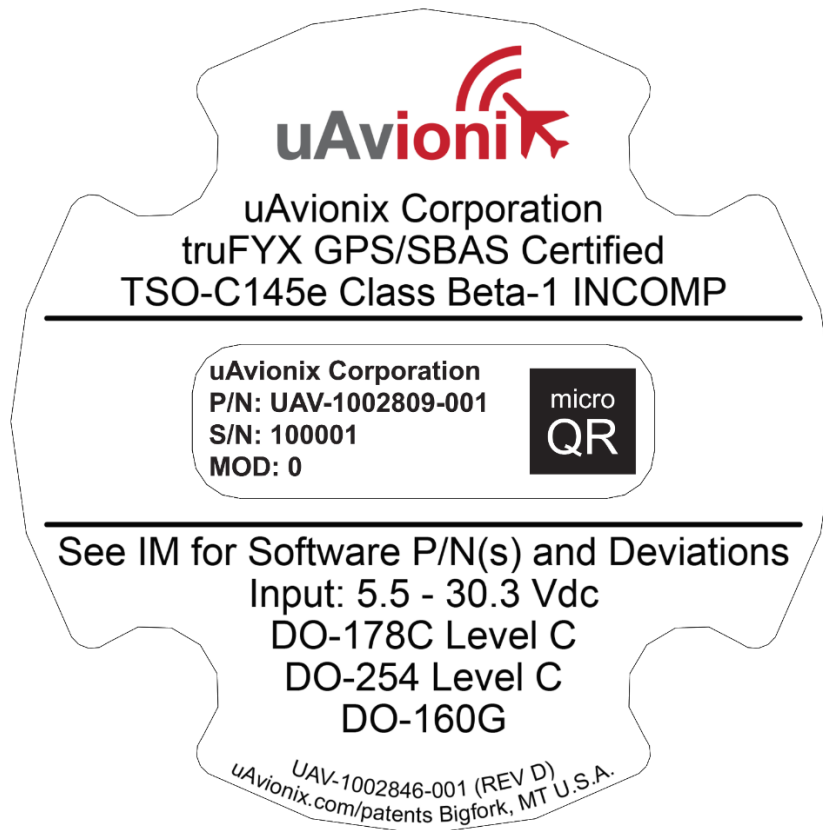
TSO	Deviation
C145e	uAvionix was granted a deviation from TSO-C145e Paragraph 3.g to use RTCA/DO-160G in place of RTCA/DO-160E.

C145e	uAvionix was granted a deviation from TSO-C145e, RTCA/DO-229E section 2.1.1.10 to use a GPS antenna that meets uAvionix minimum performance specifications instead of DO-301 qualified antennas.
C145e	uAvionix was granted a deviation from TSO-145e, RTCA/DO-229E section 2.1.3.2.2.3 to not provide FD prediction capability.

TSO-C145e Class Beta 1 functionality is incomplete. truFYX does not implement LNAV approach mode, instead operating in En Route/Terminal mode only, as appropriate for ADS-B Out applications.

5.5 Device Marking

5.5.1 truFYX Hardware



Example marking for the UAV-1002809-001 configuration is shown.

5.5.2 truFYX Software

The software contained in truFYX is identified by electronic marking. Reference Section 7.6 for information on determining the software part number.

UAV-1002631-001

Rev C

5.6 Environmental Qualification Form

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	25,000 feet
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 A
Humidity	6.0	Equipment tested to Category A
Operation Shock and Crash Safety	7.0	Equipment tested to Category B
Vibration	8.0	Aircraft Zone 2: Type 5 Category S Curve M
Explosion	9.0	Equipment identified as Category X – no test
Waterproofness	10.0	Equipment identified as Category R <i>See Note 1</i>
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 Y
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 A2XXXX
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 A
Fire, Flammability	26.0	Equipment identified as Category X – no test

Notes:

[1] UAV-1002809-002 configuration waterproofness tested only to extents of case. Additional waterproofing of electrical connections may be required.

5.7 Continued Airworthiness

Maintenance of truFYX is "on condition" only. For regulatory periodic functional checks, refer to the approved aircraft maintenance manuals or manual supplements. The aircraft must be returned to service in a means acceptable to the appropriate aviation authority.

Annually, use the procedure in Section 7.6 to confirm the software version is current per Service Bulletins listed at:

<https://uavionix.com/support/trufyx/>

If the software version is not current, ensure necessary approvals are met and apply Service Bulletins as appropriate.

5.8 System Limitations

Installation

This article meets the minimum performance and quality control standards required by a technical standard order (TSO). If you are installing this article on or in a specific type or class of aircraft, you must obtain separate approval for installation.

SatCom

truFYX has not been demonstrated as compatible with SatCom equipment and should not be installed on SatCom equipped aircraft.

Fault Detection Prediction

Cannot be used for navigational guidance where Fault Detection (FD) prediction capability is required, such as during execution of certain approach operations outside of SBAS coverage.

Supported Modes

truFYX does not implement LNAV approach mode. It operates in En Route/Terminal mode only.

5.9 Reference Documents and Tools

Documents listed below provide information required to install, configure, or interface with truFYX.

Description	Part Number
truFYX TSO User and Installation Guide	UAV-1002631-001
uAvionix truFYX NMEA ICD	UAV-1002084-001
uAvionix MAVLink OEM Protocol ICD	UAV-1001912-001

Software tools listed below may be used to help maintain and monitor truFYX.

Description	Part Number
uAvionix PingBootFlasher	UAV-1002813-001
uAvionix GNSS Toolkit	UAV-1005663-001

All reference documents and tools can be obtained from uAvionix.

6 System Specifications

truFYX is a TSO-145e Class Beta 1 certified SBAS GPS position source with integrated antenna. It can be used as a primary position source for domestic en-route and terminal navigation. It provides integrity in the absence of SBAS signal through the use of Fault Detection and Exclusion (FDE).

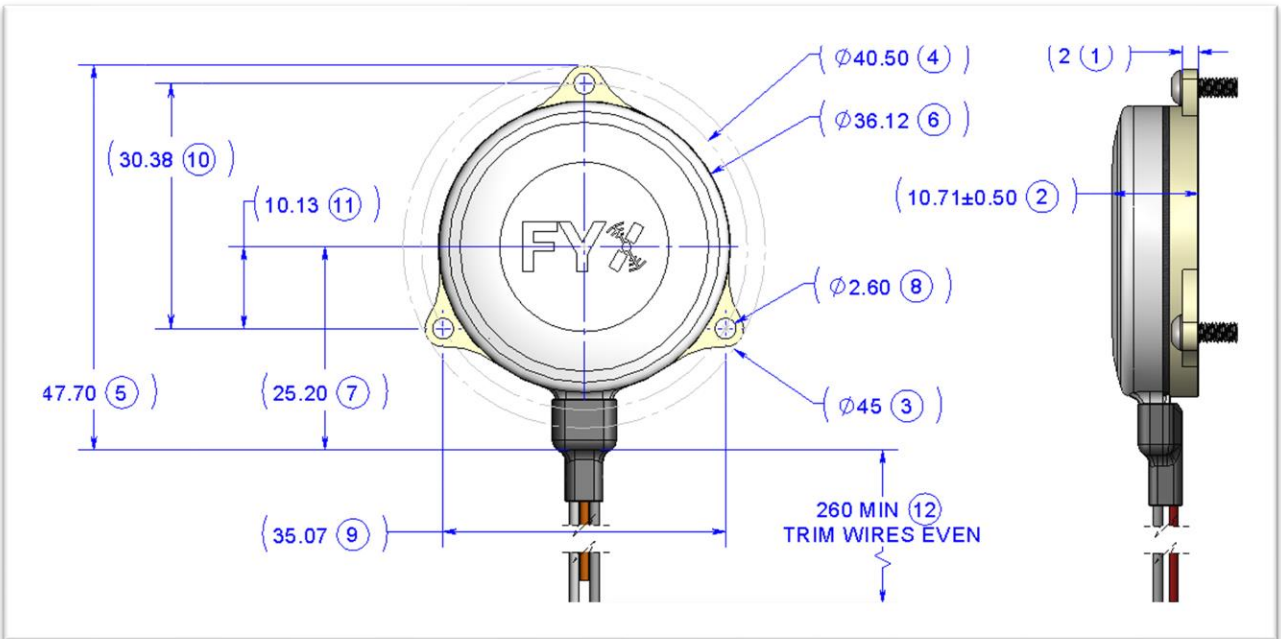
When paired with a compatible and appropriately qualified ADS-B transmitter, truFYX can be used to meet FAA ADS-B requirements, as mandated by 14 CFR 91.225 and 14 CFR 91.227.

6.1 truFYX Specifications

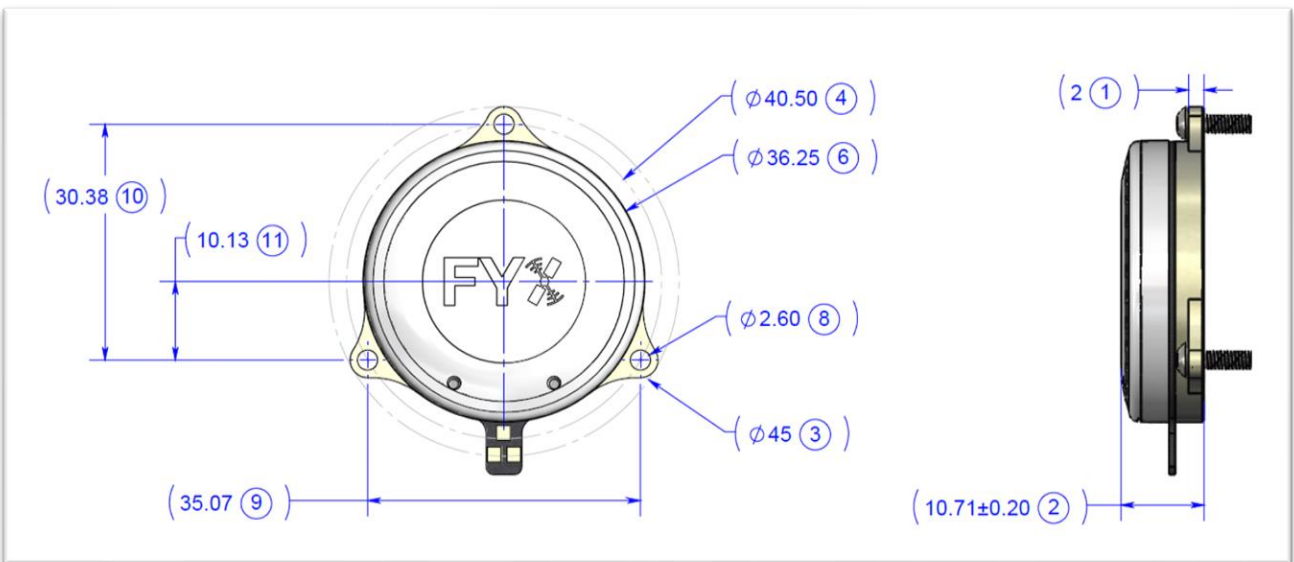
6.1.1 Physical Specifications

Characteristics	Specifications
Width	1.56 in (39.5 mm)
Depth	1.88 in (47.7 mm)
Height	0.42 in (10.7 mm)
Weight	0.7 oz (20 grams)
Operating Temperature Range	-45°C to +70°C
Maximum Pressure Altitude	25,000 ft
Input Voltage Range	5.5 to 30.3 VDC
14V Current	30mA Max
28V Current	15mA Max

UAV-1002809-001



UAV-1002809-002



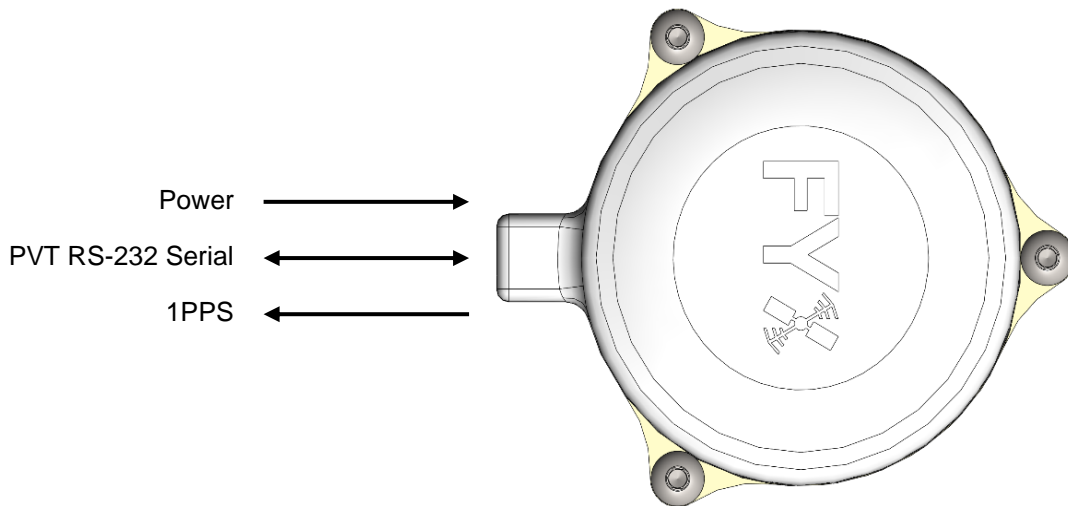
6.1.2 GPS/SBAS Specification

Characteristics	Specifications
Number of Channels	15 (12 GPS and 3 GPS/SBAS)
Frequency	1575.42 MHz L1, C/A code
Sensitivity	
Tracking	-166 dBm
Reacquisition	-160 dBm
Cold Start	-148 dBm
Hot Start	-160 dBm
Horizontal position accuracy	5 m RMS with SBAS
Velocity accuracy	3 m/s
TTF (Time to First Fix)	58 seconds typical with current almanac and position
Reacquisition	1 second typical
Position update interval	0.2 second (5 Hz)
Time Mark	±30 nSec of UTC
Datum	WGS-84
Altitude output	Height Above Ellipsoid (HAE)
SDA (System Design Assurance)	2
SIL (Source Integrity Level)	3

6.2 System Interfaces

truFYX has a 5-wire power and data interface.

- UAV-1002809-001 configuration has color-coded pigtailed wires.
- UAV-1002809-002 configuration is intended for integrated applications where custom wiring is appropriate, and allows wires to be directly soldered to pads on the device.



6.2.1 Power Input

truFYX operates at voltages from 5.5 to 30.3 VDC.

6.2.2 Data Interface (PVT)

The data interface is bidirectional RS-232 serial at 115,200 bps, no parity, 8 data bits, 1 stop bit. Position-Velocity-Time (PVT) and integrity data is output at 5Hz using either NMEA 0183 with custom sentences, or MAVLink OEM protocol. Configuration and control commands use custom NMEA sentences.

Details of the interface protocols can be found in the documents listed in Section 5.9 Reference Documents.

6.2.3 Time Pulse Output (1PPS)

A 1Hz precision pulse output (1PPS) is synchronized to Coordinated Universal Time (UTC), and is available on establishment of GPS fix. It operates at RS-232 voltage levels.

7 Equipment Installation

This section describes the installation of truFYX on the aircraft, including mounting, wiring, and connections.

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

7.2 Authorized Part Numbers

Part	Part Number
truFYX Hardware	UAV-1002809-()
GNSS Operating Program Software	UAV-1002029-()

7.3 Mounting

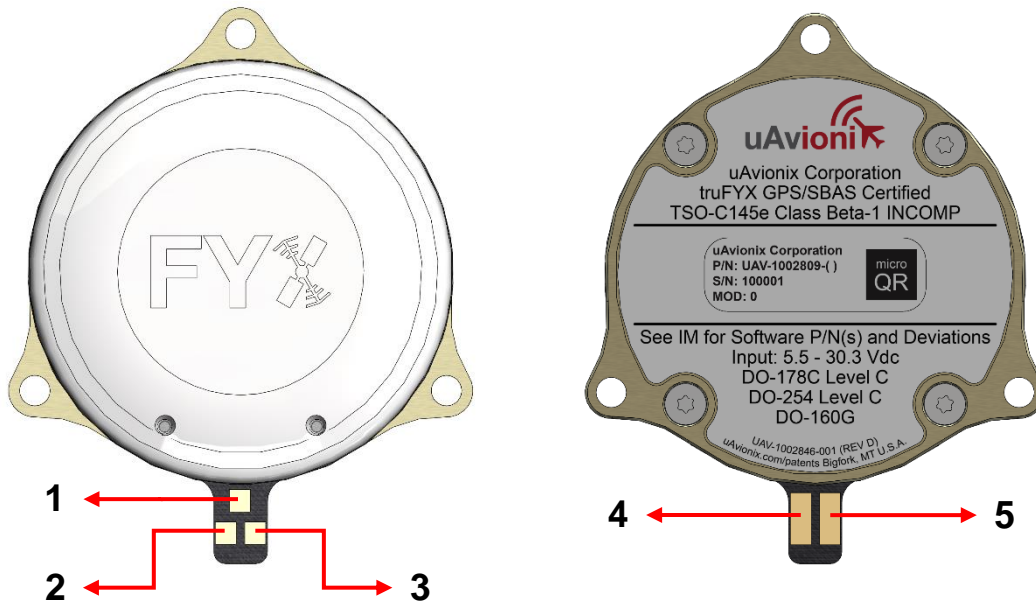
truFYX is designed to be mounted on top of the airframe, with a clear view of the sky. The top (plastic) portion of the enclosure must be facing upward and mounted using M2.5 hardware (not included).

7.4 Wiring

The UAV-1002809-001 configuration has color-coded pigtailed wires. The UAV-1002809-002 configuration eschews the wires and has pads available for direct soldering. Wire colors and pad numbers for the various configurations are shown below.

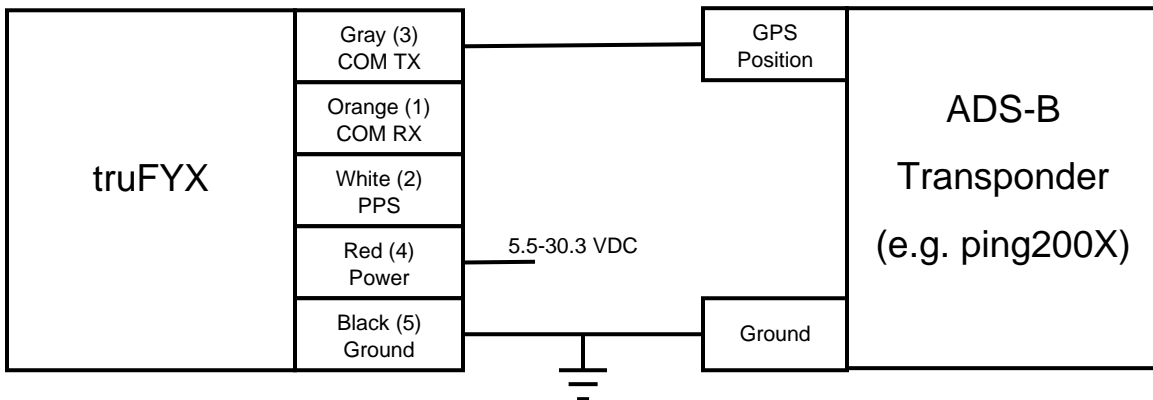
Wire Color UAV-1002809-001	Pad Number UAV-1002809-002	Description	Physical	Rate
Black	5	Ground		
Red	4	Power	5.5-30.3V	
Gray	3	COM TX	RS-232 Out	115,200 bps
Orange	1	COM RX	RS-232 In	115,200 bps
White	2	1PPS Time Pulse	RS-232 Level	1Hz

UAV-1002809-002 Pad Numbering



7.4.1 Typical Application

A typical application of truFYX is as a position source for an ADS-B transponder. An example interconnect diagram is shown below. For more detailed interconnect drawings, please reference Appendix B.



7.5 Unit Installation

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

- Ensure truFYX is configured to output the correct protocol for the interfaced device and application. See Section 12.

- Select a position on the airframe. The location is an important consideration. It should not be mounted close to VHF COM or other high-power transmission antennas, especially those that may emit interference at the GPS L1 frequency of 1575.42 MHz. Select a location with an unobstructed view of the sky.
- Avoid sharp bends and placing the cables too near to the aircraft control cables.
- Secure truFYX to the airframe using three (3) mounting screws and appropriate hardware. It should be mounted on a flat surface.
- Wire truFYX for the desired application. Refer to AC 43.13-1B chapter 11 for wiring guidance.

7.6 Software Part Number Identification

Electronic part marking can be confirmed over the RS-232 serial port and the uAvionix custom NMEA messaging sentence 'PUAVVER'. See Section 12.1 for details on connecting truFYX to a PC. With the device configured to transmit NMEA messages, issue the command:

```
$PUAVVER*53
```

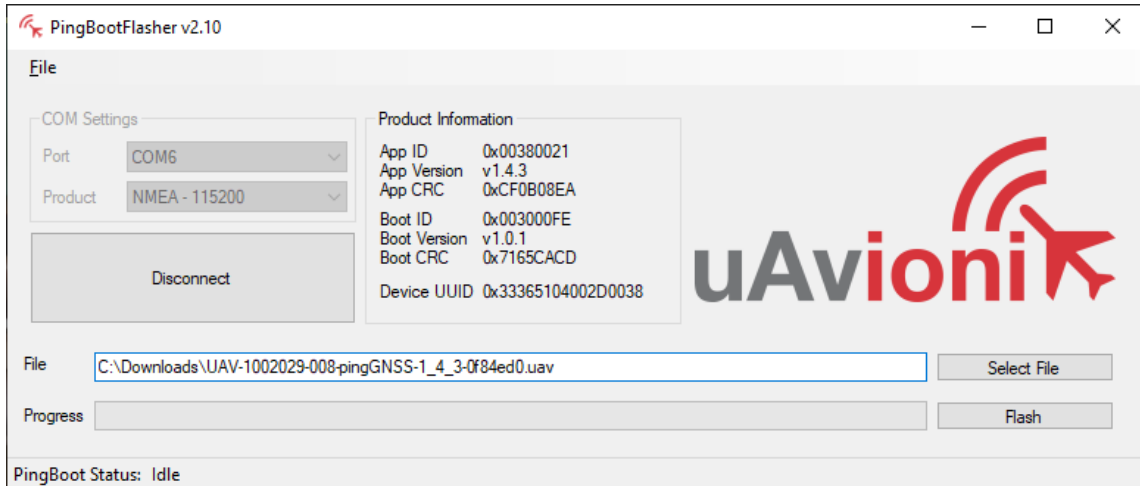
truFYX will respond with its software version.

```
$PUAVVER,01,04,03,0038,0021,CF0B08EA,UAV-1002029-008*48
```

truFYX reports the “GNSS Operating Program Software” as UAV-1002029-(). The software version number can be identified by the first three numbers after the sentence identifier (in the above case, version 1.4.3).

7.7 Software Update

truFYX software is field updatable using the “uAvionix PingBootFlasher” software application (UAV-1002813-001) version 2.10 or higher. To update truFYX, connect it to a Windows PC using a USB to serial adapter or equivalent device. Select the appropriate COM port and set the Product to “NMEA – 115200”. Press “Connect” and verify the existing application version.



To update to newly approved software, select an appropriate file with a “.uav” extension, and press the “Flash” button. Upon successful completion the device will report the newly loaded application version and CRC.

After loading, the full software part number can be verified using the procedure in Section 7.6.

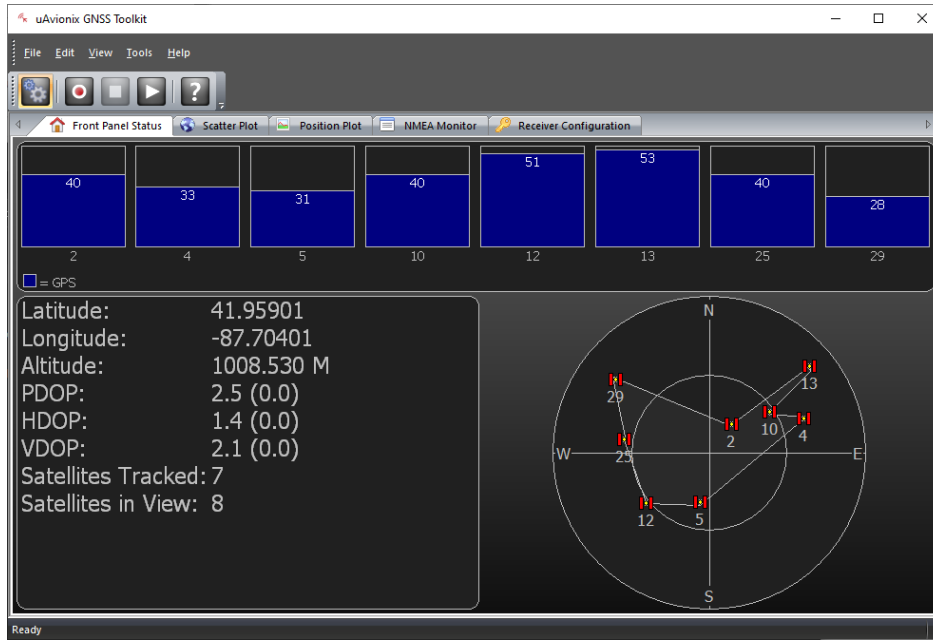
8 Post Installation Checks

Post installation checks should be carried out in accordance with your aircraft, interfaced device, certification, and/or regulatory requirements.

Acquisition of position data can be confirmed using the annunciator LEDs (see Section 11) or the serial navigation data output.

- Place truFYX in a location with a clear view of the sky.
- Apply power to the GPS receiver.
- Wait up to several minutes for a valid position fix.
- Confirm the Green LED is On and the Blue LED is either Flashing (3D fix) or On (Differential fix).

To monitor the serial navigation data output when in NMEA mode, any serial terminal emulator may be used. Alternatively, uAvionix provides a Windows software application, “uAvionix GNSS Toolkit” (UAV-1005663-001) for device monitoring.



9 Maintenance

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

10 Care and Cautions

Use of chemical cleaners and degreasers should be avoided. If truFYX is exposed to cleaning chemicals, promptly wash off all residue.

DO NOT wax, buff, paint or attempt to polish any part of the truFYX assembly. Doing so may damage the housing. Avoid any contact with abrasive materials including scrubbing pads.

11 Normal Operation

truFYX has two annunciator LEDs visible through the plastic top cover. They indicate operating status of truFYX.

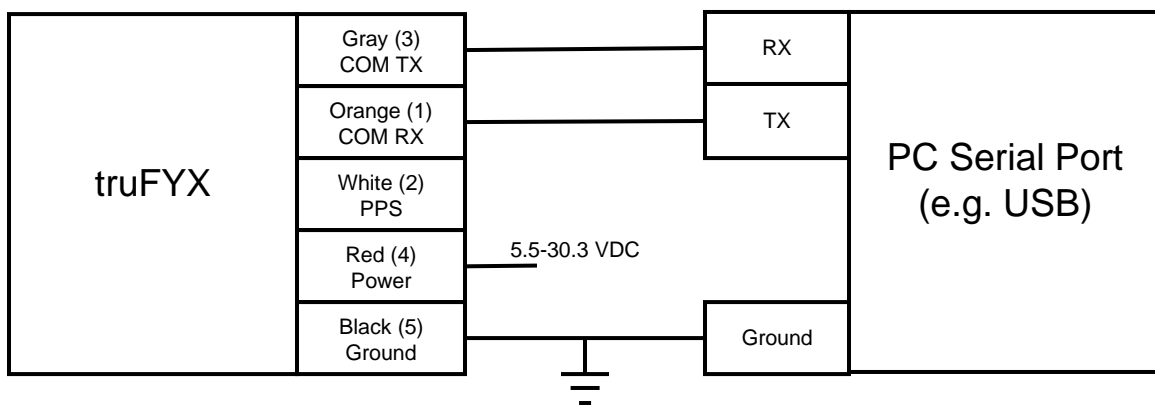
Green LED	Blue LED	Meaning
Flash	Off	Powered and passed self-test
On	Off	Acquired first satellite
On	Flash	3D fix
On	On	Differential (SBAS) fix

Complete status information may be determined by monitoring the serial navigation data output.

12 System Configuration

12.1 Navigation Output

truFYX can be configured to transmit uAvionix custom NMEA or MAVLink OEM messages from its RS-232 port. Connect truFYX to a PC as shown below.



Open a serial terminal emulator on the PC, configured for a speed of 115,200 bps, no parity, 8 data bits, and 1 stop bit. Alternatively, “uAvionix GNSS Toolkit” can send and receive NMEA commands.

When open, either transmission of NMEA sentences (ASCII) or MAVLink OEM packets (binary) will be observed. The receive data port on truFYX remains available to accept NMEA commands, including \$PUAVCFG.

For full information on the NMEA and MAVLink interface definitions, refer to the appropriate Interface Control Document (ICD) specified in Section 5.9.

12.1.1 NMEA

To configure truFYX to transmit NMEA messages, issue the command:

```
$PUAVCFG,N*32
```

12.1.2 MAVLink OEM

To configure truFYX to transmit MAVLink OEM messages, issue the command:

\$PUAVCFG,M*31

13 Support

For additional questions or support please visit:

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

Appendix A Interface Protocols

Position-Velocity-Time (PVT) data is transmitted by truFYX, and configuration commands are processed. truFYX is configured using the data interface specified below.

Characteristics	Specifications
Physical	RS-232
Data rate	115,200 bps
Parity	None
Data bits	8
Stop bits	1
Protocol	NMEA (RX/TX, output enabled by default) MAVLink OEM (TX only, optionally enabled)

NMEA is always enabled as the input protocol. The output protocol can be switched between NMEA and MAVLink OEM, depending on the application. For information on how to change the output protocol, reference Section 12.1.

A.1 NMEA

The NMEA protocol is based on the data specification described in NMEA 0183 version 4.10. It does not adhere to the NMEA 0183 electrical specification, instead communicating over serial as described above.

In addition to NMEA standard sentences, RAIM/FDE data is transmitted in custom sentences.

Contact uAvionix to obtain “uAvionix truFYX NMEA ICD” UAV-1002084-001, for a full description of the interface.

A.2 MAVLink OEM

The MAVLink OEM protocol is based on the public MAVLink specification available here: <https://mavlink.io/>

truFYX outputs two primary messages, both with Message ID 202, but with different sizes and CRC_EXTRA definitions. The standard Dynamic message provides basic PVT data. The enhanced Navigation Data message provides PVT data with enhanced RAIM/FDE information and accuracy metrics.

Additionally, truFYX outputs a custom identification message containing software version and part number information.

Contact uAvionix to obtain “uAvionix MAVLink OEM Protocol ICD” UAV-1001912-001, for a full description of the interface.

Appendix B Equipment Compatibility and Interconnect Drawings

When paired with a compatible and appropriately qualified ADS-B transmitter, truFYX can be used to meet FAA ADS-B requirements, as mandated by 14 CFR 91.225 and 14 CFR 91.227. truFYX meets the requirements to configure ADS-B transmissions with a SIL of 3 and SDA of 2.

The installation information below serves as a supplement to any manuals, describing truFYX configuration and basic wiring only. For further installation and operating instructions, please reference the appropriate installation manuals and pilot’s guides. These descriptions are informational, and in no way grant an installation approval.

B.1 Compatible Protocols

truFYX is compatible with NMEA and MAVLink protocols, as documented in Appendix A.

B.2 Compatible Equipment

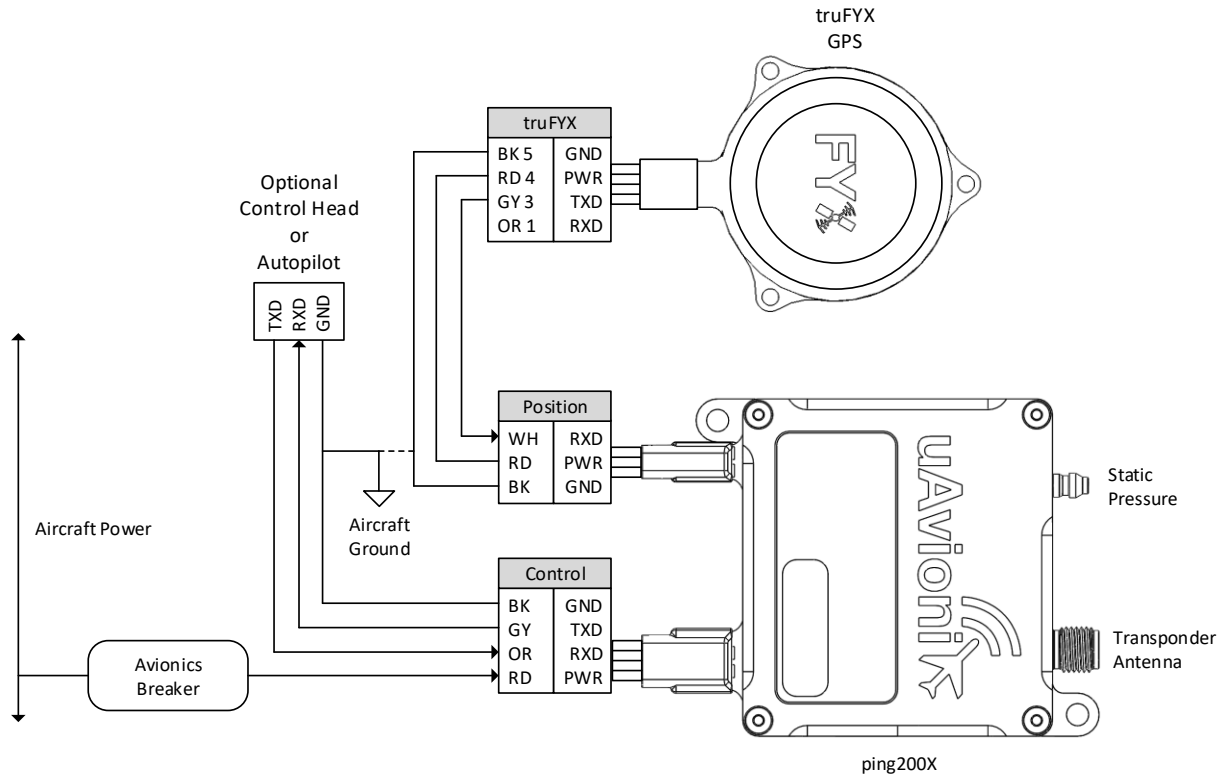
The following equipment has been shown to be compatible with truFYX, and can serve as a position source. truFYX must be configured to output the protocol listed in the “truFYX Protocol” column.

Manufacturer	Model	Device Type	P/N	truFYX Protocol
uAvionix	ping200X	ADS-B Transponder	UAV-1002723-001	MAVLink

See below for example interconnect drawings.

B.2.1 ping200X

In this configuration, truFYX supplies position data to the ping200X ADS-B Transponder. An optional control head or flight control computer may be connected to provide the ping200X with additional dynamic or configuration data. truFYX must be configured to output MAVLink, as described in Section 12.1.



For information on configuration of the ping200X and associated controllers, reference the appropriate installation guides.