Sport SX
Installation Manual

Including Legacy Sport HS/WS Installation

Revision A
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FOREWORD

Congratulations on your purchase of the GRT Avionics EFIS! We are pleased that you have chosen our product to meet your flying needs!

This manual describes the installation of the GRT Sport SX and legacy Sport HS and Sport WS display units using the software version shown in the Record of Revisions. Some differences may be observed when comparing the information in this manual to other software versions. Every effort has been made to ensure that the information in this manual is accurate and complete. Visit the GRT website, www.grtavionics.com, for the latest manuals, software updates and supplemental information concerning the operation of this and other GRT products. GRT is not responsible for unintentional errors or omissions in the manual or their consequences.

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RECORD OF REVISIONS

Revision	Date	Sport SW Revision	Description
A	May 2019	SX 15.00 and prior	Re-issue as a standalone manual for Sport SX/Sport HS/Sport WS

Contents

SECTION 1: GENERAL DESCRIPTION

1-1: Introduction

This document provides the physical, mechanical and electrical characteristics and installation requirements for the GRT Sport SX Electronic Flight Instrumentation System (EFIS). The information and processes in this manual are also applicable to the Legacy Sport models HS and WS.

This manual is set up in order to match the steps you will follow to install this equipment.

- Description of the display unit – What the equipment does.
- Planning your Installation - What this equipment can do for you
- Physical installation – How to install it
- Wiring – How to wire it
- Initial Checkout, Basic Configuration, and Calibration – How to set it up and check it out.

This manual, the **Sport Setup Guide** and the **Sport User's Guide** comprise the entire set of Sport user documentation.

***NOTE:** This manual refers to the EFIS, display unit and screen; although it may seem like these are all interchangeable terms, it is important to note that they all refer to different aspects of the Sport SX stem:

- **EFIS:** Electronic Flight Instrumentation System. This refers to the Sport SX system as a whole; it includes the display unit, peripheral devices and the components that connect them together (such as wiring harnesses). Alternatively referred to as "the system."

- **Display Unit:** This is the centerpiece of the EFIS. It is made up of the electronic components that connect to the peripheral devices and the physical elements that the pilot uses to interact with the system. It takes the data from the peripheral devices, processes it and then displays a human-readable version of that data on its screen for the pilot to use. Abbreviated and referred to as "DU;" may also be referred to by model name, "Sport SX."

- **Screen:** This is the physical screen of the Display Unit; it's what all the data from the system is displayed on for the pilot's use.

1-2: Certification

The GRT Sport EFIS is not certified for installation in FAA Type Certificated Aircraft. It is designed and intended for installation in VFR aircraft licensed as Experimental or Light-Sport.

1-3: System Description and Architecture

The GRT Sport SX EFIS consists of a panel-mounted Display Unit and a remotely-mounted magnetometer. The Sport SX is available in two configurations: one for use as a Primary Flight Display (PFD) and one as a Multifunction Display (MFD). The two models are designated as S200 (PFD) and S100 (MFD).

The display unit provides a graphical display of primary flight data, moving map/HSI and engine data. The display of engine data requires the EFIS to be connected to a GRT Engine Information System (EIS) Engine Monitor. Dimensional drawings for the Sport SX, Sport HS and Sport WS display units along with the magnetometer are provided in the **Appendix** sections **A-1: 6.5" Sport SX Mounting Template**, **A-2: 8.4" Sport SX Mounting Template**, **A-3: Sport HS Mounting Template**, **A-4: Sport WS Mounting Template** and **A-5: External Module Diagrams**.

The GRT Sport EFIS may be operated as a single or multiple screen system. Within each display unit is a processor, power supply and screen that allow it to process and display information independent of another EFIS display unit (except for unique data that may be coming from other display units). This allows multiple screens to provide redundancy. Multiple screens are normally linked together via a serial inter-display link to share pilot entries, such as baroset, dimming, flight plan, etc…

Interfacing to other systems is accomplished via serial ports, and in some cases, the USB port. The Sport SX is also connected to the aircraft pitot/static system for sensing airspeed, altitude and vertical speed. The internal AHRS provides roll and pitch attitude data. When a magnetic heading is provided via the remote magnetometer, the gyro heading data is also provided. Without the magnetic heading data from the magnetometer, gyro-stabilized GPS ground track is provided. The GRT AHRS is unique in the industry in that it can provide attitude data without external aiding from air data or GPS.

The Sport SX EFIS display units have two model numbers. The S200 is used as the primary flight display (PFD) in a multi-display system, or the only display in a single-display system. It contains the AHRS, Air Data Computer and altitude encoder for the transponder. It may also contain the optional Internal GPS, but this is typically installed in the secondary unit in multi-unit systems.

The S100 is used as a multifunction display (MFD) or slave unit. It's never used as the primary unit. It does not contain an AHRS, air data computer or encoder, but may contain the Internal GPS, if optionally ordered. The S100 may be used to display map and

weather data or engine instrumentation. It may also be used as a redundant display of the flight instrumentation through the inter-display link. If a builder prefers dual AHRS systems for redundancy, a second S200 should be used in place of the S100.

An internal GPS is standard in the Sport SX S200. Any external GPS may also be used, as long as its serial data output is in one of the commonly used avionic formats. Most GPS units will always transmit their flight plan, allowing the EFIS to display either the GPS's flight plan or its own internal plan. This ability is useful for adding IFR GPS capability to the Sport system via an IFR-approved GPS navigator. Please note that only the GPS functions will be transmitted via a GPS serial output, such as position, ground track, groundspeed, flight plan, etc… Other data provided to an external GPS (such as weather) are not displayed on the GRT EFIS screen (unless this data is also available to the EFIS, such as weather from an ADS-B receiver). Database information (such as airport frequencies, runway information, etc…) will always come from the EFIS navigation database.

When the GRT Avionics Engine Information System (EIS) unit is connected to the EFIS, its data is displayed on the EFIS screen. The EFIS enhances the usefulness of the engine data by adding such features as an EGT time history, percent power and engine efficiency (specific fuel consumption). The EIS may include its own digital display or may be fully remote. The ENG page on the EFIS is dedicated to engine and environmental parameters. Engine data can also be displayed on a portion of the primary flight display page.

1-4: Integrating Third-Party Equipment

GRT Avionics differentiates itself from other manufacturers by embracing compatibility with third-party equipment. This allows new technologies to be adopted quickly and gives the owner the ability to take full advantage of the advances made in a competitive marketplace. This includes equipment like Comm/Nav radios, transponders, ADS-B transponders/receivers and many other devices. The addition of a second or third display unit doubles or triples the number of available serial and USB ports, allowing for the use of more third-party devices. The inter-display link between display units also allows for data from most devices to be shared amongst the units for redundancy and convenience.

See section **2.2 - Common Equipment Interfaces**, the **Appendix**, or the GRT Avionics website (www.grtavionics.com/home/compatible-equipment/) for more information on the various GRT system & third-party equipment configurations.

1-5: Display Unit Features and Limitations

A partial list of features and limitation includes:

- Complete Primary Flight/Map/Engine display functionality (optional sensors required).

- Optional Synthetic Vision with 10-mile range; displays terrain, obstacles, airports and more.
- Sunlight-readable LCD displays; dimmable to less than 5 nits for night flying.
- Internal AHRS/Air Data computer; provides critical attitude, altitude and airspeed data.
- Supports internal GRT GPS, external GRT GPS Safe-Fly module and third-party GPS.
- High-Integrity AHRS; does not require pitot-static or GPS aiding.
- Internal, world-wide database.
- Receives deviation data from Nav radios (excluding those with composite outputs).
- ADS-B transponder/receiver support; display of weather and traffic.
- Displays Traffic Information Service (TIS) traffic (when used with Mode S transponder).
- Interfaces with Garmin SL30/40 to display VOR/ILS/GS and tune preset radio frequencies.
- Fully-integrated autopilot functionality for GRT and third-party units.
- Flight director.
- Customizable split-screen views, PFD-MFD screen swap, Engine Page and Moving Map overlays.
- Up to 5 serial ports (4-port version standard; 5-port version available with the upgraded processor option).
- Optional ARINC 429 expansion module; allows full integration with Garmin panel-mounted GPS.

1-6: Supported Equipment

The list of serial-port compatible equipment includes:

- ADS-B (Traffic and Weather)
- GRT EIS Engine Monitor (All Versions)
- GRT Autopilot Servos
- External Autopilots (Trio Avionics and TruTrack Flight Systems)

- Single or Dual GPS Receivers (All Types)
- Full Nav Interface with Garmin:
    - GNC Series Nav/Comm (420/420W)
    - GNS Series GPS/Comm (480) and GPS/Nav/Comm (430/430W/530/530W)
    - GTN Series GPS/MFD (625/725), GPS/Comm/MFD (635) and GPS/Nav/Comm/MFD (650/750)
- Single or Dual Interface with Garmin SL30/SL40
- XM Satellite Weather
- Guardian Avionics CO Guardian Series CO Detector
- TIS Traffic Datalink (GTX 330)
- Zaon Flight Systems PCAS XRX and MRX
- BF Goodrich WX-500 Stormscope
- Vertical Power VP-X Series Electronic Circuit Breaker System
- Serial Data Input Transponders
- TCAS (Traffic Collision Avoidance System/Traffic Alert and Collision Avoidance System)

SECTION 2: PLANNING YOUR INSTALLATION

Modern flight instrumentation systems may seem intimidating, but they can be easier to install than their analog counterparts. This section provides some basic information for aircraft builders new to the world of electronic flight display systems.

2-1: Choosing Your Serial Port Assignments—the Key to a Good Installation!

A key element to designing a glass-panel installation is the communication between different components of the system, which occurs primarily through the serial port connections. For systems with multiple display units, it is essential to consider the effect of any single device failure—a power bus, GPS unit, etc… Although less likely to occur, it is also important to consider the effects of multiple device failures on the system. These considerations are pivotal to any airplane that's operated in instrument conditions. Multiple device failures are unlikely; however, they can occur in conditions that effect multiple elements of the plane's avionics. Such conditions include static discharge (not a consideration in aluminum airplanes, but essential to consider with fiberglass airplanes), water leaking into the airplane (when entering the plane during rain, any opening in the canopy during flight, especially the vents), an over-voltage condition that can occur if the battery becomes disconnected, loss of charging, etc…

Electrical connections to the EFIS display unit are made through the D-sub connectors affixed to it and its accompanying wiring harnesses. The connectors are pre-wired for required, dedicated functions, such as power, ground and warning light output connections. Up to five of the terminal positions in the connectors (four standard with an optional fifth) are reserved for use as serial ports.

All serial ports are user-configurable, allowing them to be used with a wide variety of other equipment. Each serial port consists of two contacts– a Transmit (OUT) and a Receive (IN)–that exchange information between the display unit and a connected device, such as a GPS, radio or autopilot. Some devices will only transmit data (such as a GPS), while some will only receive data (such as altitude data to a transponder). Some devices transmit and receive data, such as autopilot servos.

A stream of serial data is like a sentence, with data packets being the words of that sentence. Data packets are transmitted in a predetermined order and frequency. This frequency is known as the **baud rate**. A device that communicates at a baud rate of 9600 delivers 9,600 coded data packets per second in a sequence that the receiving device expects. The baud rate of a serial port in the display unit must be configured to match that of the device connected to it. **Note:** that when two devices share one serial port, they must use the same baud rate.

Some limitations that should be considered when planning your serial port connections:

- The baud rate set for the serial port in the EFIS corresponds to **BOTH** the serial input and output.

- The type of function for an EFIS serial input does not have to match; the baud rate, however, **MUST** match. For example, Serial Input 1 on the EFIS could be wired to an EIS engine monitor. It is configured for 9600 baud. Serial Output 1 on the EFIS could then be used to send altitude data to a transponder, if it accepted data at 9600 baud.

- The hardware design of the serial inputs to the EFIS can't exceed RS-232 standard loads; this ensures that any standard RS-232 output can provide data to multiple EFIS display units with no loss of fidelity. For example, since serial output from an external GPS can be wired to multiple GRT EFIS display units, its signal can be corrupted if the loading from the EFIS exceeds the standard.

- The Sport SX serial ports are all high-speed, meaning that any serial port can be used with any device, regardless of the baud rate the connection may require. The Legacy Sport WS and HS models have a single high-speed port (serial port 4), which is typically used to provide ADS-B weather or XM weather to the EFIS.

2-2: Common Equipment Interfaces

This section is an overview of the typical interconnections that are made to other avionics. It is intended to inform you of the benefits of connecting your GRT EFIS to other equipment. Refer to the latest revisions of the **Equipment Supplements** for each third-party component for the most detailed and up-to-date wiring and setup information (www.grtavionics.com/home/compatible-equipment/).

2-2-1: Other GRT Avionics Display Units—the Inter-Display Unit Link

This connection allows two or more display units to function as one integrated system, so pilot inputs do not need to be duplicated on each display unit. The following pilot entries are always shared over the inter-display unit link:

- Baroset
- Display Dimming Level
- Flight Plan
- Limits (compared between display units at power-up)
- Autopilot/Flight Director Mode and Targets
- EFIS Navigation Mode

The inter-display unit link can also share specified data that only a single display unit may be receiving, including any analog inputs.

2-2-2: Autopilots

An autopilot provides the greatest benefit for the cost of almost any addition to the airplane. It is an essential tool for single pilot IFR and highly beneficial for any VFR pilot that undertakes cross-country flights. The autopilot frees up the pilot to perform other vital tasks, such as looking for traffic, radio tuning, evaluating imminent weather, etc… We highly recommend it for all airplanes, with the exception of those that are not flown cross-country. If you have chosen not to install an autopilot, but may do so in the future, we recommend installing the servo wiring at the very least, and possibly installing the servo mounting kits as well. This will make the addition of the servo easier in the future. This also increases the value of the airplane for any future owner if it is sold without an autopilot installed.

2-2-3: Autopilot Using GRT Avionics Servos

An autopilot using GRT Servos provides excellent performance and is the easiest configuration to implement. The installation will require wiring for the servos, mounting kits to attach the servos to your airplane, a power-switch for the servos and an engage/disengage button. A single serial port is used to control both the roll and pitch servos.

When using multiple GRT EFIS display units, any display unit can function as the autopilot mode controller. Adding an autopilot switch to a second display unit ensures functionality in the event that the primary autopilot-controlling display unit fails.

2-2-4: Trio Avionics and TruTrack Flight Systems External Autopilots

Most of our customers use GRT Servos for their autopilot needs. However, airplanes with existing autopilots can still interface with any GRT EFIS. This is accomplished via a serial output from the EFIS for lateral-only steering. Autopilots that provide vertical steering require an ARINC 429 adapter to receive GPSS and GPSV commands, which requires the use of both a serial input and an output from the EFIS.

External autopilots that include their own source of gyro data provide some degree of redundancy with the AHRS data from the EFIS when the autopilot is coupled. This benefit is offset by slight transients in pitch when the autopilot is initially coupled to the EFIS. It also requires more button presses than when GRT servos are used. Since GRT servos can be mounted in place of TruTrak or Dynon servos, many of our customers choose to sell their autopilot and install GRT servos; in this instance, the existing mounting kits and wiring can be used. The required changes to the electrical connections for this switchover are not difficult to make.

2-2-5: ADS-B Receivers

All ADS-B receivers that provide data in the standard ADS-B format can be wired to the display unit for weather and traffic data. Most ADS-B receivers provide data in this standard format, except for some Garmin units. We find the inclusion of ADS-B weather and traffic to be very beneficial and highly recommend its integration into your airplane's avionics systems. ADS-B receivers can be purchased for as little as a few hundred dollars.

2-2-6: ADS-B GPS Output

The GPS output from the Sport SX's internal GPS is **NOT** FAA 2020 compliant for use with ADS-B or mode S with extended squitter transponders. If this GPS position data is used, the FAA will detect that a noncompliant GPS is being used. However, the GRT Safe-Fly GPS is 2020 ADS-B compliant and is approved by the FAA for this use. This GPS also includes a serial combiner that provides the EFIS with 3 more serial ports. Additionally, this GPS provides accuracy and integrity data that is used by the Sport SX. The integrity validation performed by this GPS is similar to that performed by IFR-certified GPS navigators.

2-2-7: Remote Transponders

The Sport SX supports fully remote transponders, including the Trig TT22 and Uavionix.

These have several advantages over traditional panel mounted transponders:

- No panel space is required.
- The EFIS interface is easy to use.
- More flexibility in the mounting location.
- The EFIS can have automated control over the transponder.
- Multiple display units provide multiple ways to control the transponder.

A serial input and output is required to interface a display unit with a Uavionix remote transponder. If the Trig TT22 is being used, an RS-422 interface (or a serial input and output with a Trig Adapter) is needed to connect it to the display unit. When the remote transponder and display unit are interfaced, the connection provides altitude data and control of the transponder to the display unit.

2-2-8: Panel-Mounted Transponders

The EFIS provides altitude encoding information to all common transponders. Gray code outputs are provided for older transponders that do not have a serial input for altitude

data. The Sport SX requires an external adapter for Gray code altitude encoding outputs. Newer transponders may allow either serial output or Grey code.

2-2-9: Communication and Navigation Radio Tuning

The EFIS has the ability to load the Garmin SL30 and SL40 radios with frequency pre-sets, allowing convenient selection of these frequencies from the front panel controls of the radio. For the SL30, the EFIS can also tune the navigation radio. This data is transmitted to the radio via an RS-232 serial output from the EFIS display unit.

Display of Navigation Data from the SL30: The EFIS provides an HIS and other functions that display and use the VOR bearing data provided by the SL30 Nav/Com. Localizer and glide slope deviation data is also displayed on the EFIS from this radio. This data is transmitted to the radio via an RS-232 output from the EFIS display unit.

Multi-Display Unit Considerations: Although the navigation data from the SL30 is communicated to other display units via the inter-display unit link, it is preferable to connect the serial data output from the SL30 to two display units independently. This allows the SL30 navigation data to be displayed in the event that one of the display units fails. One serial data output from the SL30 may be connected to multiple display units. Only one serial data output **TO** the SL30/SL40 is provided, but in this case, redundancy is not an issue. If the display unit that provides the tuning data to the SL30/SL40 is non-operational, the radio would simply be tuned with its front panel controls.

2-2-10: External GPS Sources

Practically all external GPS receivers provide a serial output that is compatible with the input formats accepted by the EFIS display unit. Position, groundspeed, ground track and the flight plan are normally provided by the GPS. The display unit supports two GPS inputs. The GPS source used by the EFIS is selected on the display unit Navigation Mode softkey.

2-2-11: IFR GPS Navigator Sources

The Sport SX is fully-compatible with IFR GPS navigators from Garmin and Avidyne. The optional ARINC 429 Interface is required to receive VOR/ILS information from these devices, as well as to provide them with EFIS data that the GPS can use for enhanced functionality. A serial connection is enough to receive the GPS position, groundspeed, track and flight plan data.

2-2-12: GPS Data to External Devices

Configuring any serial output to “Autopilot-NMEA 0183” will provide NMEA0183 GPS position, speed and ground track data; the flight plan is not transmitted.

2-3: Gray Code Altitude Encoder Output

Older transponders use an interface called Gray Code to receive data from altitude encoders. Since the Sport SX does not contain an internal altitude encoder, an external adapter is used for interfacing with this type of transponder. All newer transponders have the option to use serial data instead of Gray Code, so use of this adapter is not common.

2-4: USB Port

In some cases, other equipment may communicate with the display unit via a USB connection. A USB port is easy to connect and transmits large amounts of data quickly. USB devices do not require you to program a baud rate. The Sport SX has one USB port that may be used for one USB device. Alternatively, you may attach a USB hub to connect up to three devices. Software updates are also delivered to the EFIS via USB—simply install the software update files onto a USB thumb drive from the GRT website, then connect the thumb drive to the EFIS USB port. The EFIS will upload the files as per the Update instructions found in the Sport Setup Guide.

2-5: Audio Output

The Sport SX feature an audio output; it provides a method of alerting the pilot when limits are exceeded, altitude call-outs on approach, traffic alerts and much more. The audio output is wired through the intercom or audio panel.

2-6: Analog Inputs

The Sport SX does not include analog inputs, however, the EIS engine monitor provides up to six auxiliary inputs that can be used for trim and flap position.

2-7: Optional Features

The Sport SX includes a moving map, ADS-B displays, Bluetooth wireless compatibility, five serial ports and audio alerting as standard features. Synthetic Vision/Terrain relief map and angle-of-attack are available options. Touchscreen, basic engine monitoring and analog inputs are not available at this time.

2-8: Loss of GPS Data

While it is expected that the EFIS will be provided with GPS data for accurate navigation information, it is a possibility that all GPS data could be lost. If this occurs while in flight, the EFIS will dead-reckon from its last known GPS position. Due to varying winds and sensor errors, the EFIS system position will degrade in accuracy over time. The intent of the dead-reckoned system position is to provide approximate position information so that

the pilot has time to implement other means of navigation, such as visual observations, VOR, etc…

2-9: For More Information

Depending on what your "mission" is, you may want a simple VFR system, or an IFR system with many built-in redundancies. The GRT system enables customization for the entire range of possible configurations, from simple to sophisticated, depending on the builder's desire and skill level.

While this manual covers the very basics of EFIS wiring and communication, along with GRT Sport-specific details, there are many very important safety aspects of aircraft wiring that we cannot even begin to discuss in this manual. The techs at GRT recommend the following sources for more information on proper aircraft avionics & electrical system design:

- The "Aeroelectric Connection" by Bob Nuckolls is a great place to start. It covers everything from the very basics of electricity to the proper design and installation of sophisticated IFR-capable systems.

- EAA columnist Tony Bingelis's books have long been a staple of experimental aircraft builder knowledge. In addition to wiring considerations, Mr. Bingelis discusses all aspects of kitplane building, from spinner to tail. The books are: *The Sportplane Builder: Aircraft Construction Methods*, *Sportplane Construction Techniques: A Builder's Handbook*, *Firewall Forward: Engine Installation Methods* and *Tony Bingelis on Engines*.

- FAA Advisory Circular 43.13-2B provides the "certified" reference for safe and durable aircraft wiring techniques, though it is a bit outdated. It is available online as a free download from www.faa.gov.

- The Experimental Aircraft Association has compiled a collection of videos called "Hints for Homebuilders" on its website, www.eaa.org. A quick search through these will give you valuable hints on various wiring topics, including properly crimping D-sub/Molex connector pins.

SECTION 3: PHYSICAL INSTALLATION

3-1: Display Unit Installation

Mount the display unit(s) in the desired location in the instrument panel. The main consideration in choosing a location is the ability to view the display unit and reach its controls. Since the screen is fully sunlight-readable, no consideration for shielding the display unit from sunlight is required. Be mindful of the space behind the instrument panel as well; some aircraft with tip-up canopies, for example, have canopy supports that may interfere with the back of the EFIS when the canopy is closed. See the **Appendix** sections **A-1: 6.5" Sport SX Mounting Template**, **A-2: 8.4" Sport SX Mounting Template**, **A-3: Sport HS Mounting Template** and **A-4: Sport WS Mounting Template** for display unit dimensions and clearance requirements for the rear of the unit.

1. For panel-mount style display units, the use of nut plates behind the instrument panel greatly simplify the task of installing and removing the 4 screws used to retain the display unit in the panel. #6 socket cap stainless steel screws are recommended.

2. For radio rack style display units, the #6 screws on the side of the unit (2 per side) should be used to attach the display unit to the radio rack.

3-2: Remote Digital Magnetometer Installation

The remote magnetometer must be placed in an area of the airplane with little or no electromagnetic interference. The cable is 20 feet long and designed to reach out to the wingtip or tail. The magnetometer is marked with an arrow pointing in the direction of flight. Mount it with the arrow pointing forward, parallel to the centerline of the airplane. There is not a designated "top" of the magnetometer, so it can be turned on its side for easier mounting. The side of a wing tip rib is a simple place to put it. The arrow on the magnetometer should be parallel with the centerline of the airplane for yaw. Pitch attitude is not critical as long as it is within 60 degrees nose up or nose down.

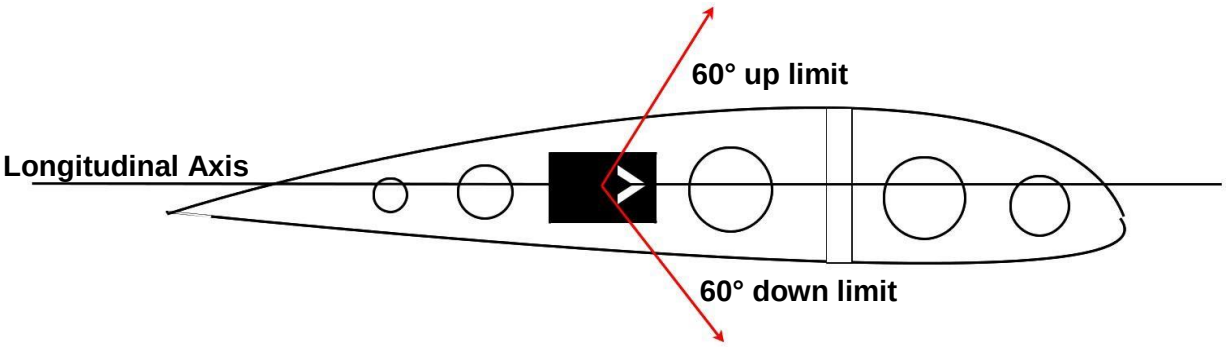


Figure 3-1: Magnetometer Pitch Range

***NOTE:** The most common cause of magnetic sensing error is simply magnetic disturbances near the magnetometer. This can be caused by ferrous metal (any metal that a magnet will stick to), control cables or cable carrying electrical currents, such as navigation or landing lights, being too close to the magnetometer. The magnetometer's location will be tested for interference in **Section 5: Initial Checkout, Basic Configuration Settings and Calibration**, after the initial boot-up checks of the Sport SX.

3-3: Legacy Analog Magnetometer Installation for Sport SX200

Determining the location of the magnetometer requires considerable care because of the magnetometer's sensitivity to magnetic disturbances generated by the airplane. No periodic maintenance is required for the magnetometer, although it is desirable to mount it in a location that allows access to it if necessary. The most important consideration when mounting the magnetometer is choosing a location in the airplane that is away from magnetic disturbances. It is quite amazing how sensitive the magnetometer is to these disturbances and how much error this can cause in the magnetic heading reported by the AHRS.

Keep the magnetometer at least 12 inches away from any current carrying wires (such as navigation or landing light wires) and more than 18 inches from ferrous metal, such as the steel mass balance tube that is typically used in the leading edge of ailerons. Use non-ferrous hardware (or even double-sided sticky tape) for mounting the magnetometer.

You can test your proposed magnetometer location prior to mounting the magnetometer itself by placing an ordinary compass at the spot. Then:

1. Turn on and off any electrical equipment whose wiring passes within 2 feet of the proposed magnetometer location.

2. Move the flight controls from limit to limit.

3. If the proposed magnetometer location is within 2 feet of retractable landing gear, operate the landing gear.

Observe the compass while doing each of the above processes. The goal is for there to be no movement from the compass needle, although movement of less than five degrees is acceptable. If you observe the needle moving greater than five degrees at any time, try another location. After the installation and wiring of the magnetometer and display unit(s) is complete, a more sensitive check for magnetic disturbances will be conducted.

The magnetometer and the AHRS in the Primary Flight Display unit work together. For this reason, they must be oriented in the same direction; that is, the pitch, roll and yaw axes of the magnetometer and the PFD display unit containing the AHRS need to be parallel. A standard level can be used to orient the magnetometer and display unit such that they are equal in roll and pitch. For yaw, the orientation of these devices should be

parallel to the fuselage centerline. In cases where the magnetometer is mounted in the wing, it may be possible to orient the magnetometer parallel to a wing rib, if the ribs are oriented in the wing such that they are parallel to the fuselage centerline. This is quite practical in airplanes such as Van's RV's.

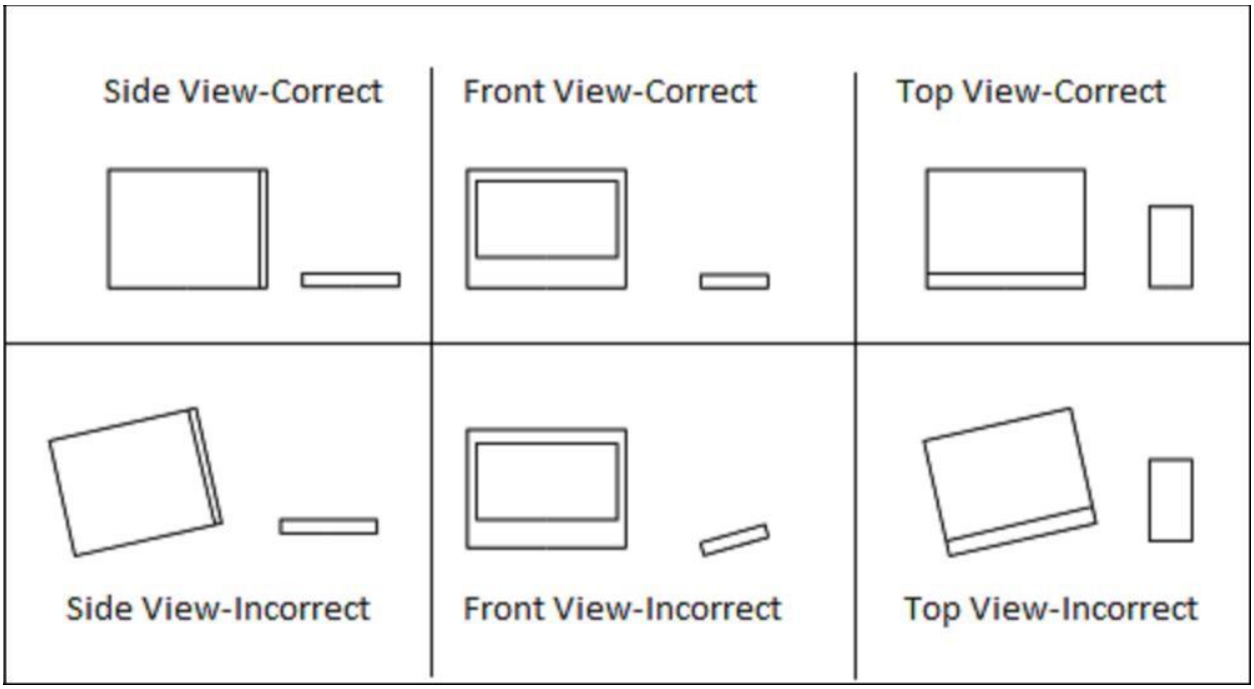


Figure 3-2: Legacy Magnetometer/Display Unit Mounting Alignment

***NOTE:** The magnetometer and the display unit containing the AHRS must be mounted in the same attitude relative to each other.

Be sure to mount the magnetometer with the connector toward the rear of the airplane. Observe the label on the magnetometer to ensure it is oriented correctly. Refer to the **Magnetometer Installation Notes** section of **Appendix A: Mounting, Wiring and Interface Diagrams** for additional installation instructions.

3-4: Cooling Considerations

The GRT Sport SX does not require external cooling. However, as with all electronic equipment, lower operating temperatures may extend equipment life. Units in an avionics stack heat each other through radiation, convection and sometimes by direct conduction. Even a stand-alone unit operates at a higher temperature in still air than in moving air. Fans or some other means of moving air around electronic equipment are usually worthwhile. Be certain that cooling air does not contain water—a problem often encountered when using external forced-air cooling methods. A few small openings in the glare shield are usually enough for adequate natural air circulation.

3-5: Pitot-Static Connections

The PFD display unit also contains the Air Data Computer. The ADC requires connection to the aircraft's pitot-static system. Connections on the display unit take a 1/8 – 27 NPT male fitting. To facilitate installation and removal of the display unit, quick disconnect fittings may be helpful. Connections and the entire pitot-static system must be leak tight. Refer to AC 43.13-2B for approved methods to achieve this.

Consider placing a water trap or drain in the lowest part of the pitot-static system to prevent water from getting into the electronics. Make sure the drain is of a high enough quality that it seals completely airtight when closed.

3-6: Angle-of-Attack Pressure Port Connection

When equipped with the sensed angle-of-attack (AOA) option, the pitot-static block will also include a port for sensing the AOA using a dual port pitot tube. This type of pitot tube provides the pitot pressure for sensing indicated airspeed and a second pitot pressure for sensing AOA. Typically, this AOA pitot is positioned about 60° down from the pitot used to sense indicated airspeed. This probe is available from several third-party sources, or may be fabricated by the builder by adding a second pitot tube, bent to point 60° below the pitot used for airspeed. When constructing your own AOA pitot, it should be mounted as close as practical to the airspeed pitot.

Use the appropriate tubing to make an air-tight connection between the AOA pitot and the AOA port on the EFIS. The AOA port is located between the pitot (marked "P") and the static (marked "S") ports.

SECTION 4: WIRING

Before starting the wiring of your airplane, we highly recommend you create a wiring diagram. This forces you to think through your wiring decisions, provides valuable documentation for the maintenance of your airplane and makes the task of physically wiring your airplane simply a matter of following these diagrams. The diagrams can be simple, but should include the name of the devices you are wiring to, the connector/terminal position and should show all interconnections.

4-1: General Guidelines

The EFIS is supplied with a wiring harness composed of 22 gauge, Tefzel-insulated stranded wire suited for use in any aircraft. All wires are different colors and are crimped with a D-sub connector terminal. Wires that are certain to be used, such as power and ground, are factory installed in the D-sub connector housing. The remaining wires can be inserted into the connector for inputs that are to be used. If a wire is installed in the wrong location in the connector housing, it can be removed using a D-sub terminal extraction tool. The extraction of a terminal can be difficult, but it should be done carefully to avoid breaking it.

When routing the wiring, the following guidelines should be considered:

- Good practices for physical installation of the wiring should be followed, such as grommets where wires pass through sheet metal, PVC/expandable sleeving in areas where the wire is likely to chafe or is in proximity to moving mechanisms, etc…

- Wires should be long enough to allow for the equipment to be serviced. For example, the wires that connect to the display unit should be long enough that they can remain connected to the display unit if it's removed from its position in the instrument panel. Furthermore, wires should **NEVER** be so short that they become taut when they are plugged in.

- In general, the routing of the wiring is not critical, as the EFIS is designed to be tolerant of the electrical noise and other emissions typically found in aircraft. Some consideration should be given to avoid routing wires near antennas or other locations that could impart high levels of electromagnetic interference on the wiring.

- The checkout procedures outlined in **Section 5: Initial Checkout, Basic Configuration Settings and Calibration** must be completed to verify that the EFIS is not affected by radio transmissions on any frequency.

- Consider the effects of individual component failures in the design of the system and create redundancy where necessary.

- If you should need to install you own terminals, information on how to crimp wires is available on the EAA's "Hints for Homebuilders" website, as well as written information in the publications listed in section **2-9: For More Information**.

- A wiring diagram is provided in the **Appendix** as a reference point for designing your own diagrams.

4-2: Power Connections

The display units each include 2 isolated power input connections. This allows redundant power sources, such as a main and secondary bus. The display units consume approximately 1 amp, making even a 2 Amp-hour gel cell a suitable backup power source.

No provision is included within the display units for a power switch. If a power switch is desired for the EFIS, the +12V power should be controlled with the switch, not the ground.

The display units include internal thermally-activated fuses. This protects the equipment from internal electrical faults. Power supplied to the EFIS must pass through a fuse or circuit breaker. It should be sized to allow at least 1.5 amps per display unit, with a maximum rating of 5 amps.

Voltage drop in the power and ground wires will cause the EFIS voltmeter to read lower than actual, by the amount of the voltage drop. For this reason, we recommend limiting the length of these wires to 5 feet each, which will limit the voltmeter error due to this effect to 0.15V.

The display unit monitors all power inputs; alarms are available to annunciate the loss of any power source that was provided and is expected to be working according to the "General Setup" menu.

The majority of the current flow into the display unit will occur on the bus with the highest voltage.

If all the buses that power the display unit(s) and AHRS are also used to supply power to the engine starter, then the display unit(s) and AHRS should be turned off during engine start-up. This maximizes the current available for the starter and prevents undesirable voltage fluctuations being applied to the display unit when it is booting up.

4-3: Ground Connections

The cable assembly provided includes 22 gauge wire for the ground return of the display units. This will result in a voltage drop of about 0.015V/ft, which is acceptable for wire lengths of up to five feet.

4-4: Magnetometer Wiring

Typically, the magnetometer cable supplied with the EFIS will not have its D-sub terminals plugged into the connector housing. This makes it easier to route the cable through the airplane. After the cable has been routed, the wires can be cut to length if desired (new terminals will have to be crimped on the wire ends). If the wires are not cut, inspect the D-sub connector terminals to verify that they have not been damaged. Insert the designated wire into the appropriate D-sub connector housing position according to section **A-10: Magnetometer – Digital and Analog (Legacy)** (indicated by wire color). If desired, the crimp-type D-sub connector can be replaced with a solder-type connector.

All magnetometer connections are made directly to the mating display unit with internal AHRS. This wiring includes the power connections necessary for the magnetometer to operate.

SX200A Only: The digital magnetometer serial output may be shared between any number of the Mini-X, Mini-AP and any Adaptive AHRS.

SX200 Legacy Only: Each AHRS and magnetometer pair is calibrated together at the factory for optimal accuracy, and this pairing should be maintained for the best performance.

4-5: Specific Equipment Interconnect Details

Most equipment shares information with the EFIS via a serial port connection. Each serial port in the EFIS that is wired to another device must be configured so that the EFIS knows what it has been connected to. This is accomplished via the “Set Menu,” within the “General Setup” menu. Each serial port is listed and entries are provided that allow them to be configured for a wide variety of functions. Since all serial ports on the Sport SX are high-speed, they are capable of receiving data at 115,200 baud and can be used for any function.

Detailed instructions and wiring information for connecting to specific other avionics equipment, along with EFIS pinout information, are provided in the **Appendix**, as well as being provided as **Equipment Supplements** on GRT’s website (www.grtavionics.com/home/compatible-equipment/).

Depending on the other equipment installed in the airplane, switches may be necessary or desirable for some functions. For example, a switch to allow the autopilot to be controlled by the EFIS, or directly from the GPS, allows the GPS to control the autopilot in the event that the autopilot-controlling display unit fails.

4-6: Warning Light Output

A warning output is provided on the D-sub connector to drive an external warning light. This output provides a path to ground when active, thus the indicator should be wired with one of its terminals to aircraft power while the other is wired to this output. The maximum current that can be controlled by this output is 0.2 amps.

SECTION 5: INITIAL CHECKOUT, BASIC CONFIGURATION SETTINGS AND CALIBRATION

5-1: Display Unit Checkout

1. Apply power to the display unit. The LCD may flicker, and within 30 seconds, the display should show the “Accept” page if on the ground. (If in-flight, the “Accept” page will not be displayed.)

2. If multiple power buses connect to the display unit, apply power from each bus individually to test.

5-2: Basic Configuration Settings

The basic configuration settings can be made in any order. The default settings will usually allow most basic functions, such as the AHRS and GPS, to operate; this does not apply to the serial ports and they must be manually configured.

5-3: Configuring the Serial Ports

When wiring the airplane, it is likely that serial ports were used to send and receive information with other equipment. Each serial port, input and output, must be configured to allow successful communication with these devices. This configuration includes setting both the function and baud rate. A serial counter is provided to show when data is being detected at a serial input to the display unit to help validate a new installation. **Note** that this counter will advance regardless of whether or not the data being transmitted is at the correct baud rate or even matches the serial port’s configuration.

The configuration data is accessed by finding the “Set Menu” softkey that appears on the PFD, MAP and Engine pages. Pressing this button brings up the Settings Menu. Categories, and the settings within them, are selected by rotating the knob to choose an item. Clicking the knob selects the item and allows a setting to be changed. Clicking the knob again enters the setting and allows another setting to be selected.

The **Equipment Supplements** on the GRT website should be used to configure serial port and other required settings. From the website home page, select the “Support” drop down, followed by the “Compatible Equipment” page to see the list of the most up-to-date equipment supplements. Alternatively, the page can be accessed directly by entering (www.grtavionics.com/home/compatible-equipment/) into your web browser’s address bar. These supplements will also describe a post-installation checkout procedure.

Once all settings are configured, the settings should then be backed up to a USB memory stick, using the “User Setting Backup” function on the “Display Unit Maintenance” set menu. This will allow you to restore these setting if they ever become altered. It also

allows you to review the settings when away from the airplane by viewing the backup file with a text editor.

5-4: Required Setup for the Internal GPS

The internal GPS must be designated as “GPS1,” “GPS2” or “No” (not used) in order to specify which of the two possible GPS sources the EFIS may use. “No” specifies that the internal GPS will not be used. For external GPS inputs, the serial port setup specifies if a particular input is configured as GPS1 or GPS2. The following user setting defines how the internal GPS is to be used.

Internal GPS: None / GPS1 / GPS2: (**Applies to Sport SX only**. Accessed via the Set Menu, General Setup submenu) (Factory default is GPS1). This setting is used to assign the internal GPS to one of the two EFIS GPS inputs. If “None” is selected, up to 2 external GPS inputs may be wired through the serial inputs and/or from data transmitted over the inter-display unit link from another GRT EFIS.

At least one GPS should be connected to the EFIS. Only one GPS source (internal or external) can be assigned to GPS1 or GPS2 at any one time.

5-5: Internal GPS Settings

The internal GPS provides serial data at 9600 baud in the NMEA0183B format. The output from this GPS is wired to pin 32. It may be shared between all GRT EFIS display units as desired, as well as at least two other devices, such as an ELT, transponder, etc…. If these other devices impart too much load on the serial output, the signal level will be reduced. This could result in some, or potentially all, of the devices failing to receive data.

A setting is provided for each of the two possible AHRS connections. This setting is provided via the set menu, general setup submenu.

AHRS(1/2) Has Magnetometer: Yes/No/Auto: Set to match your installation. If it is unknown, use the “Auto” setting until you determine if one has been connected (the default setting is “Auto”). The EFIS will generate a warning if an AHRS, that is specified to have a magnetometer connected to it, fails to receive data from the magnetometer.

5-6: AHRS/Air Data Computer Test

1. Apply power to the display unit with the internal AHRS.

2. Proper operation of the AHRS and magnetometer is indicated as follows:

    a. The display unit shows altitude and airspeed tapes.

b. Attitude and heading data appears on the screen at the completion of the alignment period (typically less than 2 minutes).

c. No "ATTITUDE FAIL" message is shown on the PFD screen.

d. No failure messages are listed in the status page (accessible from the "Status" softkey on the PFD screen).

3. Select “Set Menu” from the softkeys, and then select the “AHRS Maintenance” page.

4. Verify AHRS communications status is valid and that the AHRS status is OK. Verify that the AHRS is receiving serial communications from the display unit by confirming that there are no grayed-out data fields.

5. Verify the PFD screen shows HDG next to the heading box at the top-center of the screen; this indicates that it is receiving valid heading data from the magnetometer.

5-7: Setting AHRS Orientation

This first adjustment is an approximate setting to account for angled instrument panel installations. You will fine-tune the instrument orientation again in-flight, after validating the location of the magnetometer (if installed).

1. Access Set Menu > AHRS Maintenance. Scroll to “Set Instrument Orientation.”

2. Enter the offset, in degrees, for each axis. Positive corrections correspond to right roll, pitch up and right yaw. **See following figures (not to scale):**

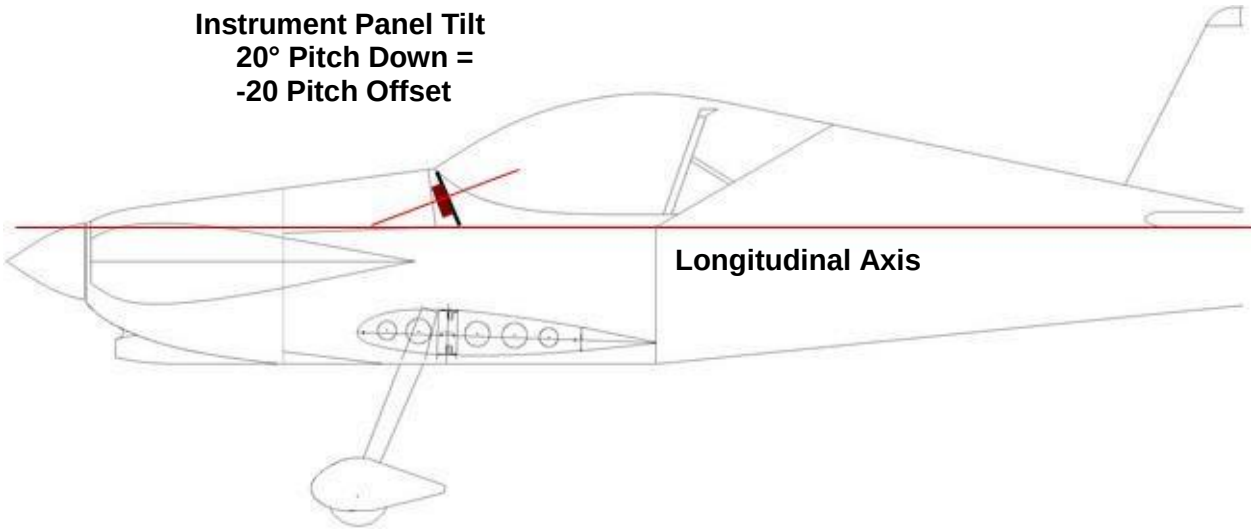


Figure 5-1: AHRS Pitch Orientation Offset

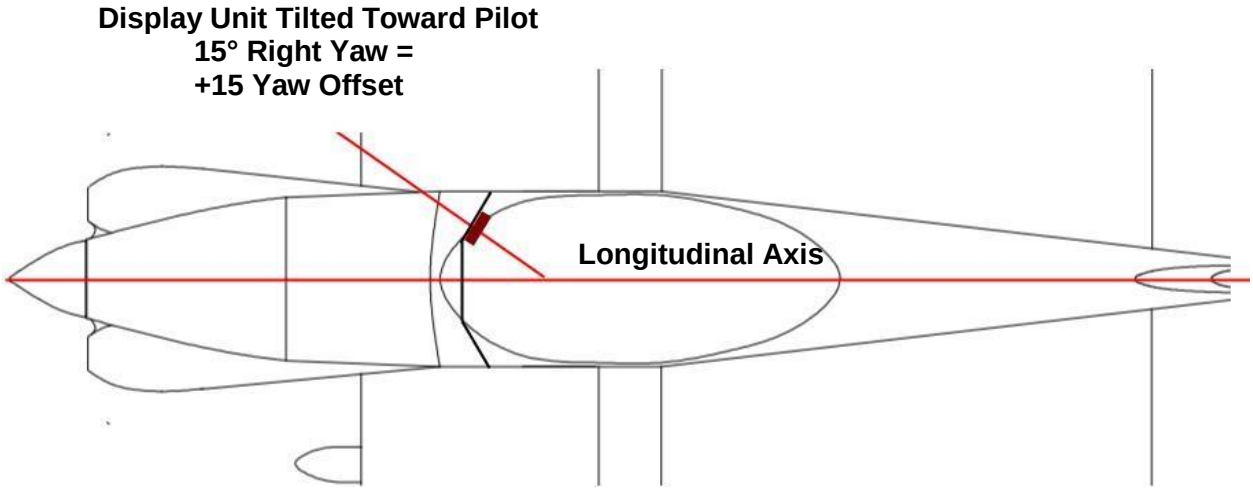


Figure 5-2: AHRS Yaw Orientation Offset

Panther line drawings used with permission from Sport Performance Aviation, LLC.

5-8: Magnetometer Location Validation

1. Park the aircraft on a level surface and start the engine.

2. Press any button on the EFIS display to bring up the soft key labels. Press SET MENU soft key, then scroll to and select AHRS Maintenance. Locate Magnetic Heading field on this screen.

3. **NOTE:** Do not use the heading data shown on the heading tape on the PFD for calibration because this is a composite reading of several other pieces of information. The Magnetic Heading field contains instantaneous data on the magnetic heading only.

4. Observe the Magnetic Heading and verify that it does not change by more than +/- 2 degrees while doing the following:

    a. Turn on and off any electrical equipment whose wiring passes within 2 feet of the magnetometer.

    b. Move all flight controls from limit to limit.

    c. Shut down the engine and observe the heading while the engine is not running, noting any differences.

    d. **For aircraft with retractable landing gear:** If the magnetometer is located within 2 feet of retractable landing gear, support the aircraft using proper jacking equipment, then repeat Step 1 while operating the landing gear.

e. If changes greater than +/- 2 degrees are noted, either relocate the magnetometer or the offending wiring/metallic materials. Recheck.

The most common causes for magnetometer errors are simply magnetic disturbances near the magnetometer. They can be caused by ferrous metal (any metal that a magnet will stick to), control cables or cables carrying electrical currents, such as those for navigation or landing lights, being too close to the magnetometer. If there is any doubt about a location, try moving the magnetometer to another location. Use tape or other temporary means to hold it in place, roughly aligned with the orientation of the AHRS, and repeat the test.

5-9: Analog Magnetometer Wiring Problems – Sport SX200 (Legacy WS and HS Only)

Some wiring problems will be detected by the AHRS's built-in test functions. They will result in an "AHRS Attitude Fail" message and an "AHRS: Magnetometer X, Y or Z-Axis Failed" message on the status page (accessed by the STATUS button from any page). If this message is present, the wiring to the magnetometer should be checked.

It is also possible that no built-in-test failure will be reported, while the wiring is still incorrect. This can occur if the magnetometer X, Y, Z inputs are swapped. To check for this, point the airplane at various directions listed in the table below, with the magnetometer in an approximately level position (it may need to be removed from the airplane and held by hand). Use the AHRS Maintenance page to observe the "Magnetometer X, Y, Z Raw Data." **The following should be observed:**

- The raw data readings will appear to shift left and right on the screen once per second as the signs change for a brief moment. This is normal, and the brief sign changes should be ignored when using this table of the expected readings.

- The Z Raw data will be greatly influenced by where on the earth the test is performed. Positive values will be observed in the northern hemisphere while negative values will appear in the southern hemisphere.

5-10: Set Final Magnetometer and Instrument Orientation

Once the chosen magnetometer location is verified to have acceptable levels of interference, set the orientation of the magnetometer.

1. Go to Set Menu > AHRS Maintenance > Set Magnetometer Orientation. Answer the prompts on the screen to begin automatic orientation of the magnetometer. For maximum accuracy, this procedure should be performed when the ambient temperature is between 50-90°F.

2. When the final instrument and magnetometer orientations are set, check the uncorrected Magnetic Heading and then perform the Fine Magnetometer Calibration, described in sections **5-11: Check the Uncorrected Magnetic Heading** and **5-12: Fine Magnetometer Calibration Procedure**.

5-11: Check the Uncorrected Magnetic Heading

While the calibration procedure can remove errors as large as 127°, accuracy is improved if the location chosen for the magnetometer requires corrections of less than 30°.

To check the accuracy of the uncorrected magnetic heading:

1. Scroll to Magnetometer Calibration on the AHRS Maintenance page and select it.

2. While on this page, rotate the airplane 360°. A red graph will appear on this page showing the calculated errors.

If errors greater than 30° are observed, refer to the previous sections, **5-8: Setting AHRS Orientation** and **5-9: Magnetometer Location Validation**, to ensure that the AHRS is properly oriented and that the magnetometer is mounted in a valid location.

5-12: Fine Magnetometer Calibration Procedure

The magnetometer must be calibrated before the first flight of the aircraft. Magnetometer calibration is required to achieve accurate magnetic heading readings. This calibration corrects for errors induced by magnetic disturbances local to the sensor, such as ferrous metal objects.

***NOTE:** The AHRS will not allow magnetometer calibration to be initiated if the airspeed is greater than 50 mph to prevent inadvertent selection while in flight. If calibration is successful, the existing calibration data (if any) will be replaced with the new corrections.

The Magnetometer Calibration page will help guide you through this procedure with its on-screen menus and prompts.

***NOTE:** Before performing this procedure, be sure that the AHRS orientation and magnetometer orientation have been set. If these are not performed, the magnetometer calibration will produce inaccurate magnetic heading readings.

1. Point the aircraft to magnetic north in an area without magnetic disturbances, such as a compass rose.

   A simple means of pointing the airplane toward magnetic north is to taxi the airplane slowly and use the GPS ground track to determine when you are taxiing in a magnetic north direction. Make small corrections to the direction of travel of the airplane and continue to taxi for several seconds for the GPS to accurately

determine your ground track. The GPS cannot determine your track unless you are moving.

2. After the aircraft is positioned correctly, turn ON the GRT Sport. (If it was already on, then turn it OFF, and then back ON again.)

3. Allow at least 1 minute for the AHRS to fully stabilize.

4. Press any button on the EFIS display to bring up the soft key labels. Press the SET MENU soft key, and then scroll to and select AHRS Maintenance. Scroll to and select the Magnetometer Calibration field on this screen.

5. Press Start soft key.

6. The first question is “Are you sure?” Press YES if you are sure.

7. Verify that the airplane is still pointed to magnetic north. Answer the question “Are the aircraft, AHRS, and magnetometer pointing to magnetic north?” with YES. A message will appear at the bottom of the screen indicating that the system is waiting for the gyros to stabilize.

8. As soon as the message “Calibration in Progress” is displayed (within 15 seconds), rotate the aircraft 360°, plus an additional 20°, in a counter-clockwise manner (initially towards west). The airplane does not need to be rotated in place, but simply pulled or taxied in a circle. The airplane must be rotated completely through the 380° past magnetic north within 3 minutes of initiating the calibration. The airplane should be rotated slowly, such that it takes approximately 60 seconds for the complete rotation.

9. If calibration is successful, the AHRS will re-start itself automatically and begin using the corrections. While re-starting, the AHRS will not provide any data. This will result in the AHRS data disappearing from the display unit for about 10 seconds.

10. If calibration is unsuccessful, one of two things will happen. In either case, the calibration procedure must be repeated.

    a. If the airplane is rotated too rapidly, the calibration will not end after the airplane has been rotated through the 380°.

    b. It will exit calibration mode and will show “Calibration INVALID - Maximum correction exceeded” if a correction of greater than 127° is required (Invalid - OVERLIMIT will be displayed on the AHRS maintenance page next to the Magnetometer Calibration field). A correction of greater than 127° can be caused by incorrect mounting of the magnetometer, the presence of ferrous

metal too close to the magnetometer, the airplane not being pointed towards magnetic north when the calibration begins or magnetometer wiring errors.

The accuracy of the magnetometer calibration can now be verified:

11. Point the airplane towards magnetic north.

12. Turn ON the AHRS (if already ON, turn it OFF, and then back ON).

13. Verify that the AHRS (on the AHRS Maintenance page) shows a heading close to north. (Small errors are likely to be a result of not positioning the airplane to the exact heading used during magnetometer calibration.)

14. Select the Magnetometer Calibration page (Do not activate the calibration this time).

15. Rotate the airplane through 360° and inspect the Calculated Error graph (the red line) drawn on the screen.

The magnetic heading errors should be less than 5° and can typically be reduced to about 2°. An accurate magnetic heading is required for the AHRS to display accurate heading data and to allow accurate wind speed/direction calculations.

The graph will also show the correction stored in the AHRS as a green line. The green line will be within +/-30°, if the magnetometer was mounted in a good location and was mounted accurately with respect to the AHRS.

The status of the magnetometer correction data is indicated by the field next to the Magnetometer Calibration setting on the AHRS Maintenance page. If the field has the message “Change to open page,” then no valid data is stored within the AHRS and it must be recalibrated. If the field says “Valid,” it means that the data is present. Keep in mind that the accuracy of this data is not assured, because it is dependent on how carefully the user performed these steps. The calibration data should be cross-checked with reliable ground references such as a compass rose or runway headings before flight.

Congratulations! Magnetometer calibration is now complete!

5-13: Measuring the Accuracy of the Magnetic Heading

The accuracy of the magnetic heading can be easily observed while taxiing and comparing the magnetic heading displayed on the AHRS maintenance page to the GPS ground track. The difference between them is the heading error in that direction.

This can also be observed on the PFD screen, although the heading data on this screen is slaving the yaw gyro, and thus, will respond slowly to the difference between the displayed heading and that of the magnetometer heading. When using the PFD screen,

the best technique is to point the airplane in the direction to be tested, wait at least 20 seconds (or until the heading is not changing) and then taxi until the ground track is stable. The difference between them is the magnetic heading error. If it is excessive, the fine magnetometer calibration should be repeated.

5-14: How Accurate Should the Magnetic Heading Be?

Achieving a highly-accurate magnetic heading requires that the magnetometer be installed in a good location on the airplane, and that the orientation of the AHRS and magnetometer are accurate. The attitude data from the AHRS is used to process the magnetic field data from the magnetometer, and due to the steep angle of the earth's magnetic fields (only about 20° off vertical), every degree of attitude error will cause 3° of heading error.

Heading errors of less than 5° are not normally apparent in normal flying, but errors this large will cause the cross-wind component of the wind speed to be less accurate. For every 1° of heading error, 1.7% of the forward speed of the airplane will be falsely reported as a cross-wind. Thus, with only a 5° heading error, an airplane flying at 100 knots will show a false crosswind of 8.5 knots.

5-15: Required Settings Before Flying!

In addition to the ability to interface with a large variety of third-party equipment, the Sport SX allows the user to customize many aspects of the EFIS. Some of these settings are to support pilot preferences, such as what data they wish to be displayed in the data boxes on the PFD. Other settings are provided to support redundant inputs, labels used to identify navigation inputs, etc…

Before flying, we recommend setting at least the following items:

- All settings described in the previous subsections of **Section 5: INITIAL CHECKOUT, BASIC CONFIGURATION SETTINGS AND CALIBRATION**.
- All settings described in the **Equipment Supplements** that are applicable to the peripheral devices that are connected to your EFIS. The supplements can be found on the GRT website: (www.grtavionics.com/home/compatible-equipment/).
- All settings in the following table:

Setting	Set Menu	Notes
Speed/Distance Units	General Setup	
Fuel Units	General Setup	If Fuel Flow is installed.
Stall Speed Landing	Primary Flight Display	
Stall Speed Clean	Primary Flight Display	
Max Flap Speed	Primary Flight Display	
Max Struct. Cruise Speed	Primary Flight Display	

Setting	Set Menu	Notes
Never Exceed Speed	Primary Flight Display	
Altitude Alerting	Primary Flight Display	Disable to avoid nuisance alarms unless it will be used.
Climb/Descent Presets	Primary Flight Display	Set if Vertical Autopilot Functions option is included in display unit.
Engine Display	Graphical Engine Monitoring	Configure dials and bar graphs as desired.
Engine Limits	Limits	Review all limits if engine data is provided to the EFIS.
Engine Performance	Limits	Not required, but useful for assuring power is below 75% for learning.
Fuel Scale Data	Limits	As needed if fuel levels are provided to the EFIS.
Load EFIS Software	Display Unit Maintenance	New software may be available since your EFIS was purchased.
Database Maintenance > Load Navigation Database	Display Unit Maintenance	New databases are provided every 28 days on the GRT website.
Altimeter Calibration	Altimeter Calibration	Adjust “BIAS” as necessary so Altimeter is correct with currently-entered baroset.

APPENDIX

This section contains diagrams (mounting, wiring and interface), installation notes for specific components (magnetometer, angle-of-attack, etc…) and physical specifications for the Sport SX.

The **Wiring** and **Pinout Diagrams** included in this **Appendix** show the function of each D-sub connector terminal position and its associated wire color. Functions labeled **NC** have no connection or are terminal positions that should remain empty. Functions with **TX** in them represent a “Transmit” or Serial OUT connection; those with an **RX** represent a “Receive” or Serial IN connection. D-sub connector housing figures are of the Insertion View perspective, or viewed from the rear of the connector, where the wires are inserted.

A-1: 6.5” Sport SX Mounting Template

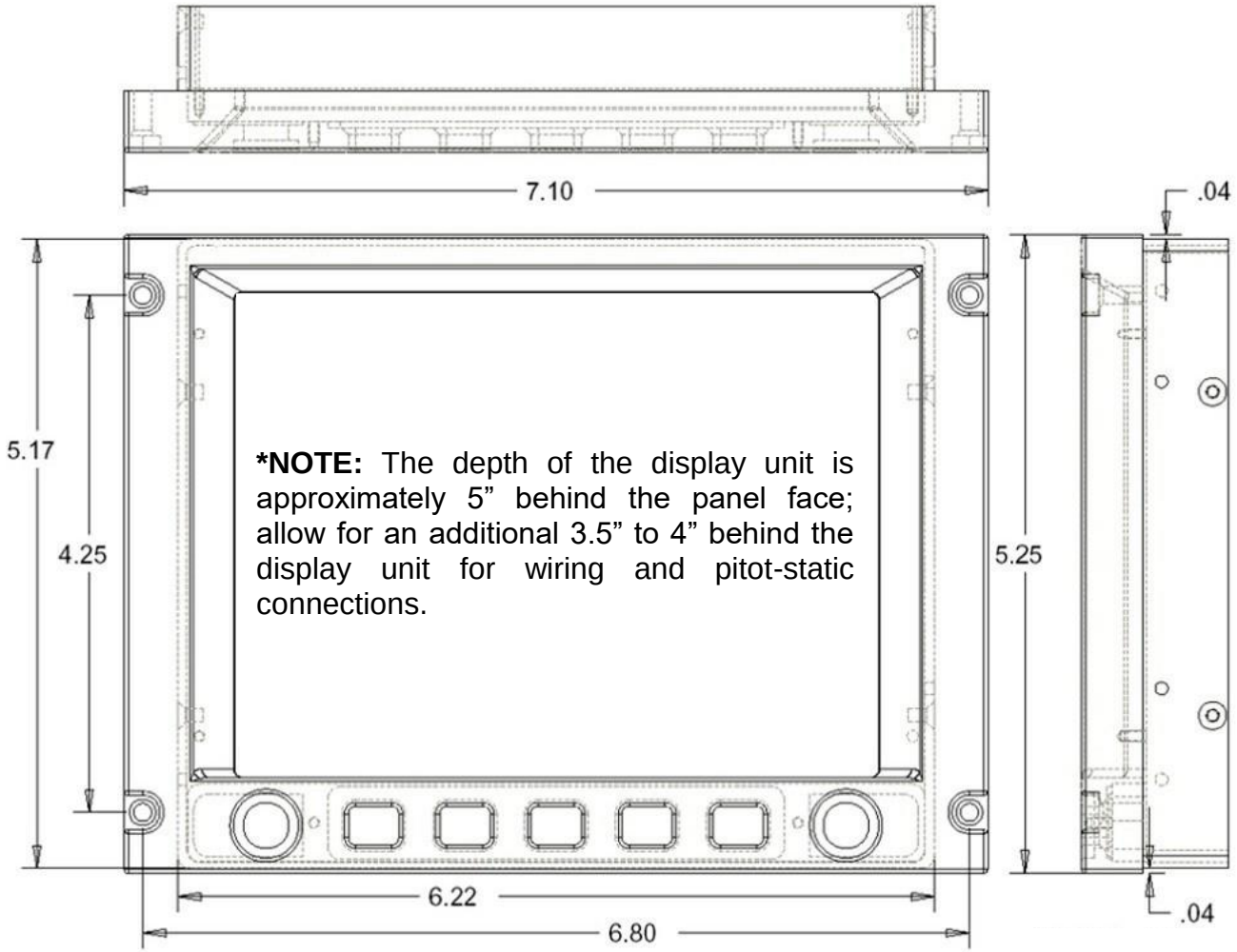


Figure A-1: 6.5” Sport SX Mounting Template All dimensions are in inches (NOT TO SCALE).

Panel Cutout: 6.24” x 5.19” (This allows for clearance on each side). Use No. 6 screws for mounting.

A-2: 8.4” Sport SX Mounting Template

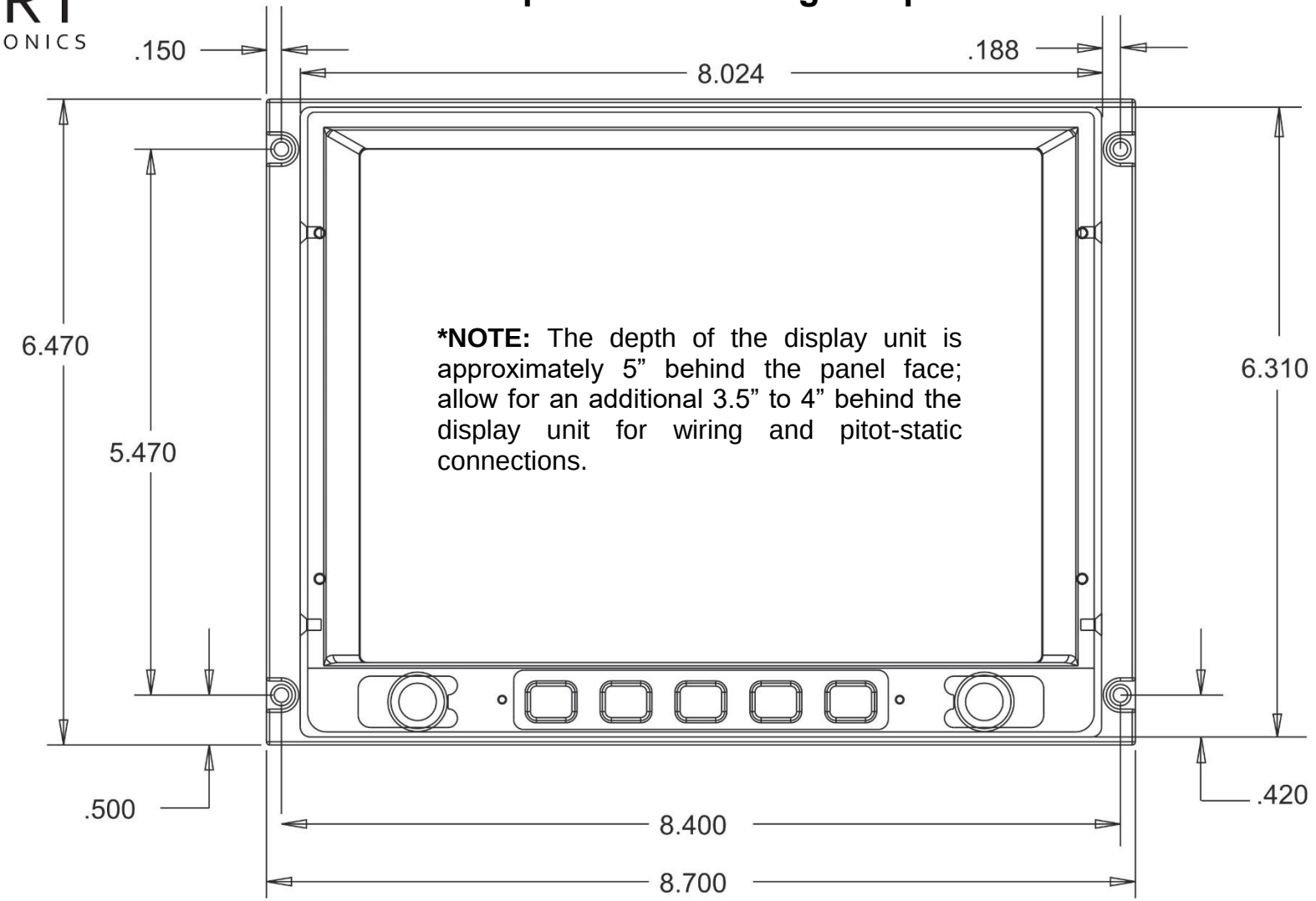


Figure A-2: 8.4” Sport SX Mounting Template All dimensions are in Inches (NOT TO SCALE).

Panel Cutout: 8.064” x 6.33” (This allows for clearance on each side). Use No. 6 screws for mounting.

A-3: Sport HS Mounting Template

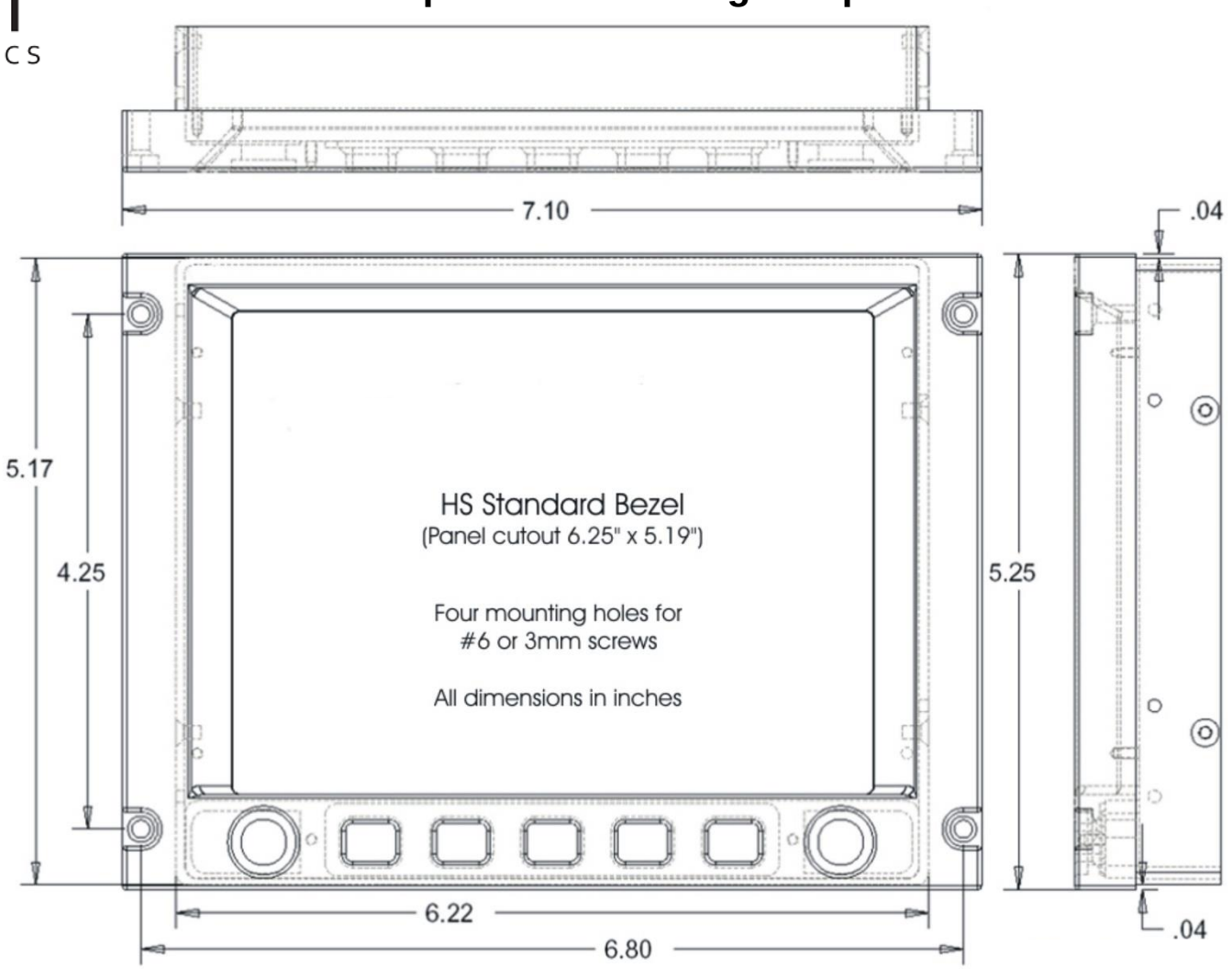


Figure A-3: Sport HS Mounting Template

NOT TO SCALE

A-4: Sport WS Mounting Template

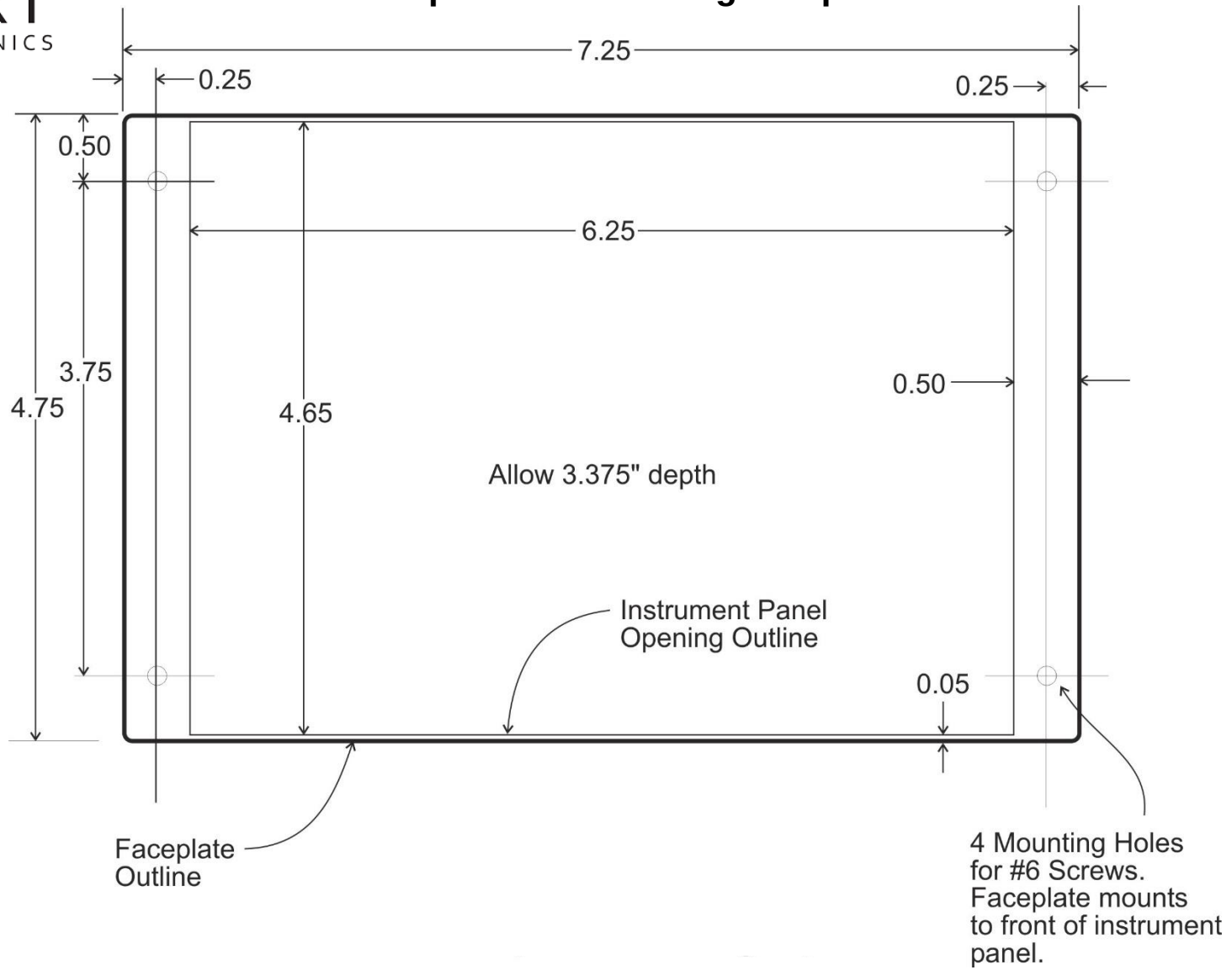


Figure A-4: Sport WS Mounting Template

All dimensions are Inches (NOT TO SCALE).

A-5: External Module Diagrams

- External GPS Module
- RAIM GPS Module
- ARINC Module
- Magnetometer

***NOTE:**

- Drawing shows height of module mounting platform only.
- GPS and ARINC modules are 9/16” taller than mount.
- Allow an extra 3” above ARINC module for D-sub connector.

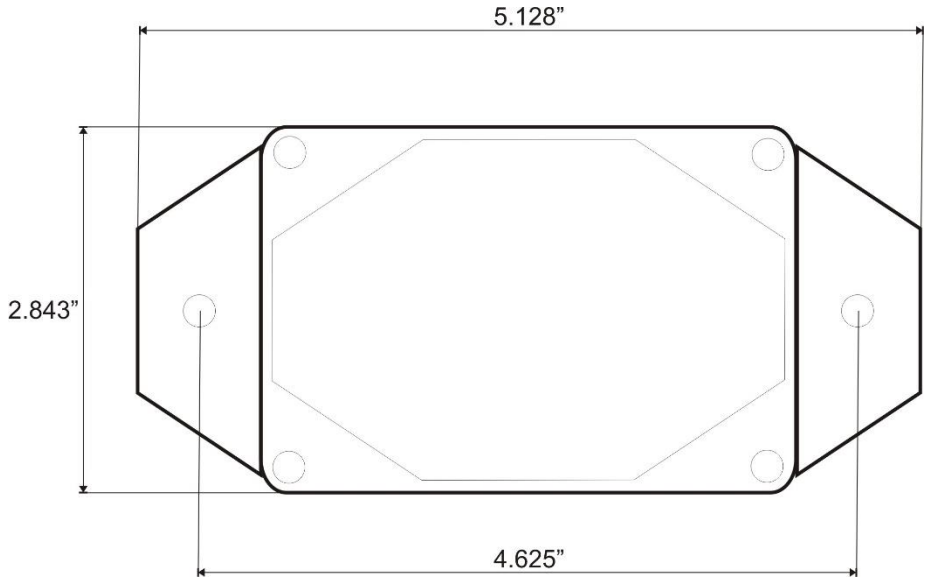


Figure A-5: External Module – Top View

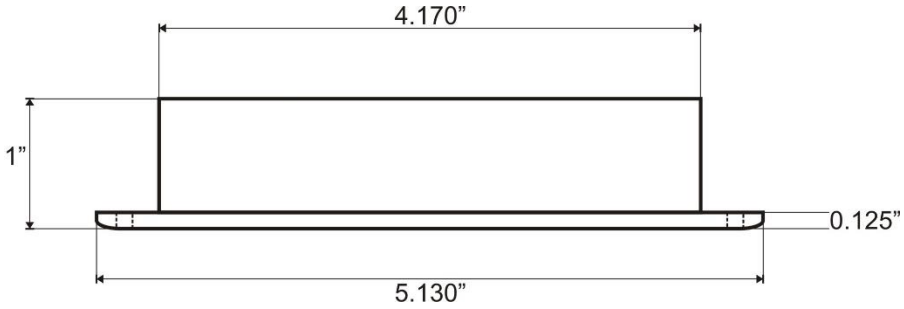
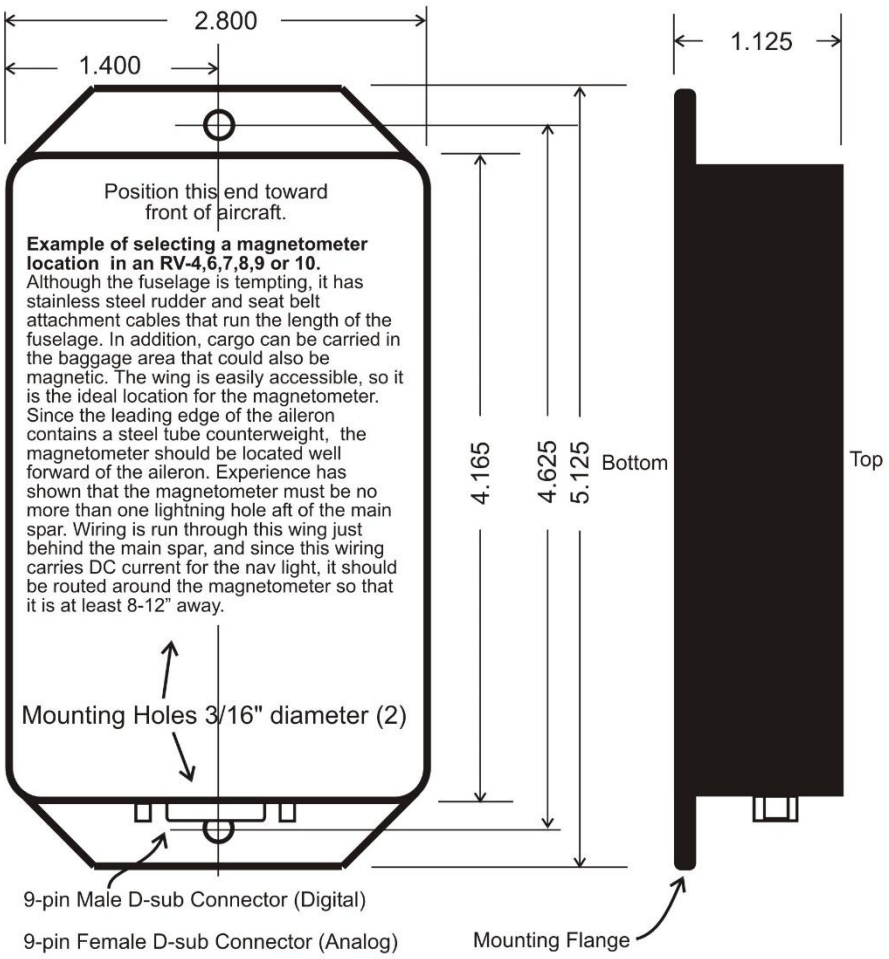


Figure A-6: External Module – Side View

A-6: Magnetometer Installation Diagram



Installation Notes:

1. Orient with the end opposite the d-sub connector toward the front of the aircraft.

2. The recommended location for the magnetometer is in the wingtip. The magnetometer must be as far away as practical from ferrous metal, moving ferrous metal (such as belcranks, landing gear, etc), stainless steel cables, wiring that carries DC currents, strobe power supplies, motors, magnets, steel counterweights, transmitting antennas, or anything else that causes magnetic interference. It may be possible to locate the magnetometer in the fuselage, as far from the engine as possible, but this is not recommended unless necessary.

3. If mounting within 5' of transmitting antennas, or in any location in a composite aircraft, be sure to test the location by observing the raw magnetometer reading on the EFIS while transmitting.

4. Do not locate within 18 inches of a strobe power supply, or electric motors.

5. Route wires carrying heavy currents (such as landing lights) so they do not pass closer than 12 inches to the magnetometer.

6. A location can be tested using an app in a smartphone called "Magnetmeter", or "GPS Status". These apps display the magnetic field strength, and the direction of the magnetic field. Use the app to measure the earth magnetic field strength when far from any possible sources of magnetic interference. Then place the phone in the proposed location of the magnetometer, and verify the **field strength** in this location is unchanged. Next, move the flight controls, turn on power to everything in the airplane, and observe that the **strength and direction** of the field does not change.

7. The magnetometer must be mounted in the same orientation as the AHRS/Air Data Computer to within 0.5 degrees. This is most easily accomplished by observing the "accelerometer roll", and "accelerometer pitch" readings on the display unit "AHRS Maintenance" page, and adjusting the mounting of the magnetometer to match using a protractor or digital level. Be sure to consider which way is left or right roll, and which way is pitch up or down.

8. The magnetometer is not affected by temperature or moisture.

9. Mount with brass or nylon hardware only.

Figure A-7: Magnetometer Installation

A-7: Sport SX Internal GPS Diagram

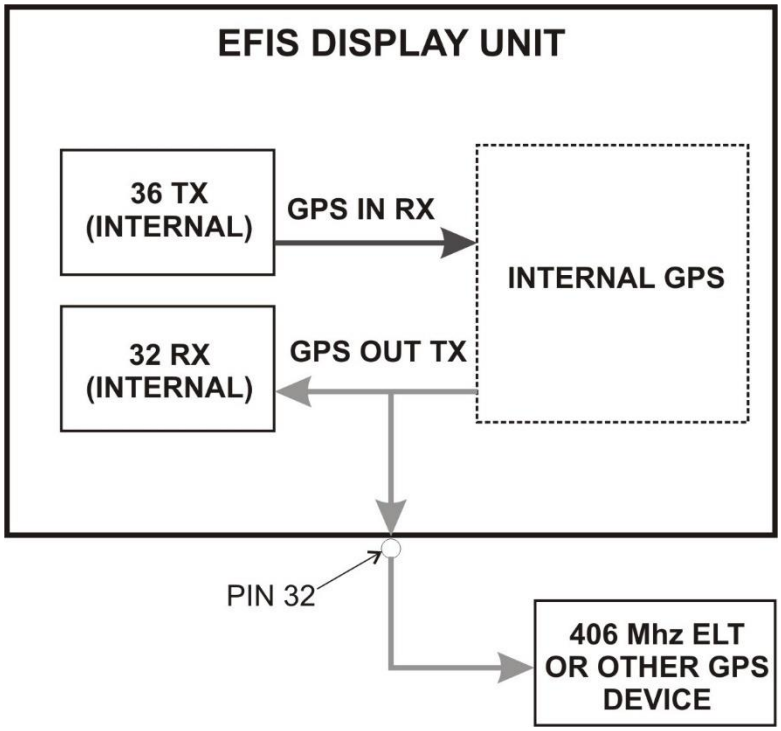


Figure A-8: Sport SX Internal GPS

***NOTE:** Serial Port 3 is used for the Internal GPS, when optionally installed. The receiving port and GPS module are located inside the EFIS display unit. Pin 32 functions as an output to feed GPS information to an external device that requires GPS. Pin 36 is not available when the Internal GPS is installed.

A-8: Sport SX200A (Adaptive AHRS) Connector A Pinout Diagram

CAB-SX200A-01: Connector A is a female 37-position D-sub connector that attaches to the display unit's male 37-position D-sub connector. Wires that are certain to be used, such as the magnetometer connections, are pre-wired at GRT. Commonly used optional wires are supplied loose as pre-terminated wires. Empty terminal positions are optional; for example, Pins 10-19 are reserved for Grey code output, if required.

Pin		Function	Wire Color
1	▶	Primary Power Input	RED
2	▷	Secondary Power Input	RED/BLU
3	▶	GND	BLK
4	▶	MAG GND	BLK
5		Reserved – NC	
6	▶	Magnetometer Serial In	WHT/BRN
7		Reserved – NC	
8		Reserved – NC	
9	▶	MAG PWR	WHT/RED
10	☐	D4 Alt Encoder Output	
11	☐	C4 Alt Encoder Output	
12	☐	C2 Alt Encoder Output	
13	☐	C1 Alt Encoder Output	
14	☐	B4 Alt Encoder Output	
15	☐	B2 Alt Encoder Output	
16	☐	B1 Alt Encoder Output	
17	☐	A4 Alt Encoder Output	
18	☐	A2 Alt Encoder Output	
19	☐	A1 Alt Encoder Output	

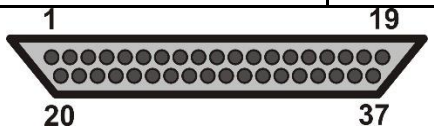


Figure A-9: 37 Position Female D-sub Connector (Insertion View)

***** Legacy SX200 Sport EFIS can be differentiated from the Sport SX200A by noting the AHRS software version on the Set Menu, AHRS Maintenance page. AHRS software versions less than 50 (or 0.50) are legacy type AHRS.

Pin		Function	Wire Color
20		Audio (SW Ver. 11 and up)	
21	▷	GPS Memory	RED/WHT
22		NC	
23		Audio Ground	
24		NC	
25		NC	
26	☐	RX5**	
27	☐	TX5**	
28	☐	Warning Light	
29	▷	OAT Sensor	GRY
30	☐	RX1 *External GPS Input*	
31	▷	RX2 *EIS Serial Input*	GRN/BLK
32		RX3 Internal GPS*	—
33	☐	RX4	
34	▷	TX1 *A/P Serial Output*	BLU
35	☐	TX2 *Encoder Serial Out*	
36		TX3 Internal GPS*	—
37		TX4	
▶	**Connected in Wiring Harness**		
▷	**Supplied as Loose Pinned Wires**		
☐	**Optional Wiring**		

*** NOTE:** See **Figure A-5** for information about optional Internal GPS and Serial Port 3.

****:** Applies to SX with CPU/GPU processor upgrade.

Recommended serial port usage in italics.

A-9: Legacy Model SX200 Connector A Pinout Diagram

CAB-200SX-01: Connector A is a female 37-position D-sub connector that attaches to the display unit's male 37-position D-sub connector. Wires that are certain to be used, such as the magnetometer connections, are pre-wired at GRT. Commonly used optional wires are supplied loose as pre-terminated wires. Empty terminal positions are optional; for example, Pins 10-19 are reserved for Grey code output, if your transponder requires it.

Pin		Function	Wire Color
1	▶	Primary Power Input	RED
2	▷	Secondary Power Input	RED/BLU
3	▶	GND	BLK
4	▶	MAG GND	BLK
5	▶	MAG X	WHT/GRN
6	▶	MAG Y	WHT/BRN
7	▶	MAG Z	WHT
8	▶	MAG CNTRL	WHT/BLU
9	▶	MAG PWR	WHT/RED
10	☐	D4 Alt Encoder Output	
11	☐	C4 Alt Encoder Output	
12	☐	C2 Alt Encoder Output	
13	☐	C1 Alt Encoder Output	
14	☐	B4 Alt Encoder Output	
15	☐	B2 Alt Encoder Output	
16	☐	B1 Alt Encoder Output	
17	☐	A4 Alt Encoder Output	
18	☐	A2 Alt Encoder Output	
19	☐	A1 Alt Encoder Output	

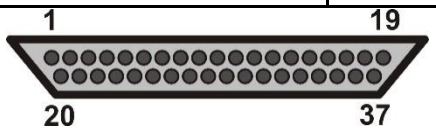


Figure A-9: 37 Position Female D-sub Connector (Insertion View)

* Legacy SX200 Sport EFIS can be differentiated from the Sport SX200A by noting the AHRS software version on the Set Menu, AHRS Maintenance page. AHRS software versions less than 50 (or 0.50) are legacy type AHRS.

Pin		Function	Wire Color
20		Audio (SW Ver. 11 and up)	
21	▷	GPS Memory	RED/WHT
22		NC	
23		Audio Ground	
24		NC	
25		NC	
26	☐	RX5**	
27	☐	TX5**	
28	☐	Warning Light	
29	▷	OAT Sensor	GRY
30	☐	RX1 *External GPS Input*	
31	▷	RX2 *EIS Serial Input*	GRN/BLK
32		RX3 Internal GPS*	—
33	☐	RX4	
34	▷	TX1 *A/P Serial Output*	BLU
35	☐	TX2 *Encoder Serial Out*	
36		TX3 Internal GPS*	—
37		TX4	
▶	**Connected in Wiring Harness**		
▷	**Supplied as Loose Pinned Wires**		
☐	**Optional Wiring**		

*** NOTE:** See **Figure A-5** for information about optional Internal GPS and Serial Port 3.

****:** Applies to SX with CPU/GPU processor upgrade.

Recommended serial port usage in italics.

A-10: Magnetometer – Digital and Analog (Legacy)

CAB-SX200A-01/CAB-200SX-01: The Connector A harness comes with the magnetometer wires installed in its connector housing; a mating 9-position D-sub connector and set of D-sub terminals are also included for installation after the wires have been run through the airframe (Female/sockets to attach to the Digital Magnetometer's male connector and male/pins to attach to the Analog Magnetometer's female connector). Use the following diagram to plug the wires into the connector housing. Be sure to inspect the terminals before inserting them into the connector, as damage may occur while pulling them through the airframe. The magnetometer wires' connector attaches to the magnetometer's mating D-sub connector (A male connector for the Digital Magnetometer and a female connector for the Analog Magnetometer).

NC denotes "No Connection."

CAB-SPORT-MAG Digital Magnetometer			
Pin		**Function**	**Wire Color**
1	I	Ground	BLK
2		NC	
3		NC	
4		NC	
5	I	Power In (+4.3V)	WHT/RED
6		NC	
7		NC	
8		NC	
9	I	Serial Output	WHT/BRN
I	**Insert terminal into connector after the wire is pulled through the airframe.**		

Legacy Analog Magnetometer			
Pin		**Function**	**Wire Color**
1	I	MAG Y	WHT/BRN
2	I	MAG Z	WHT
3	I	MAG X	WHT/GRN
4	I	MAG PWR	WHT/RED
5	I	MAG GND	BLK
6	I	MAG CNTRL	WHT/BLU
7		NC	
8		NC	
9		NC	
I	**Insert terminal into connector after the wire is pulled through the airframe.**		

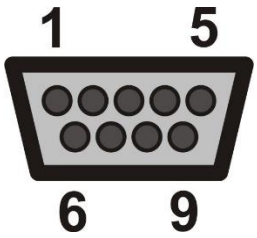


Figure A-10: 9 Position Female D-sub Connector

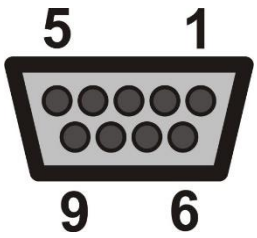


Figure A-11: 9 Position Male D-sub Connector

A-11: Sport SX200A Suggested Connector A Pinout Diagram (Dual-Screen System)

CAB-SX200A-01: Connector A is a female 37-position D-sub connector that attaches to the display unit's male 37-position D-sub connector. Wires that are certain to be used, such as the magnetometer connections, are pre-wired at GRT. Commonly used optional wires are supplied loose as pre-terminated wires. Empty terminal positions are optional; for example, Pins 10-19 are reserved for Grey code output, if required.

Pin		Function	Wire Color
1	▶	Primary Power Input	RED
2	▷	Secondary Power Input	RED/BLU
3	▶	GND	BLK
4	▶	MAG GND	BLK
5		Reserved – NC	
6	▶	Magnetometer Serial In	WHT/BRN
7		Reserved – NC	
8		Reserved – NC	
9	▶	MAG PWR	WHT/RED
10	☐	D4 Alt Encoder Output	
11	☐	C4 Alt Encoder Output	
12	☐	C2 Alt Encoder Output	
13	☐	C1 Alt Encoder Output	
14	☐	B4 Alt Encoder Output	
15	☐	B2 Alt Encoder Output	
16	☐	B1 Alt Encoder Output	
17	☐	A4 Alt Encoder Output	
18	☐	A2 Alt Encoder Output	
19	☐	A1 Alt Encoder Output	

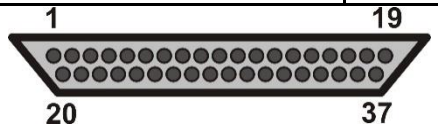


Figure A-9: 37 Position Female D-sub Connector (Insertion View)

* Legacy SX200 Sport EFIS can be differentiated from the Sport SX200A by noting the AHRS software version on the Set Menu, AHRS Maintenance page. AHRS software versions less than 50 (or 0.50) are legacy type AHRS.

Pin		Function	Wire Color
20		Audio (SW Ver. 11 and up)	
21	▷	GPS Memory	RED/WHT
22		NC	
23		Audio Ground	
24		NC	
25		NC	
26	☐	RX5**	
27	☐	TX5**	
28	☐	Warning Light	
29	▷	OAT Sensor	GRY
30	☐	RX1 *External GPS Input*	
31	▷	RX2 *EIS Serial Input*	GRN/BLK
32		RX3 Internal GPS*	—
33	☐	RX4 *Inter-Display Link*	ORG
34	▷	TX1 *A/P Serial Output*	BLU
35	☐	TX2 *Encoder Serial Out*	
36		TX3 Internal GPS*	—
37	☐	TX4 *Inter-Display Link*	VLT
▶	**Connected in Wiring Harness**		
▷	**Supplied as Loose Pinned Wires**		
☐	**Optional Wiring**		

*** NOTE:** See **Figure A-5** for information about optional Internal GPS and Serial Port 3.

****:** Applies to SX with CPU/GPU processor upgrade.

Recommended serial port usage in italics.

A-12: Legacy Model SX200 Suggested Connector A Pinout Diagram (Dual-Screen System)

CAB-200SX-01: Connector A is a female 37-position D-sub connector that attaches to the display unit's male 37-position D-sub connector. Wires that are certain to be used, such as the magnetometer connections, are pre-wired at GRT. Commonly used optional wires are supplied loose as pre-terminated wires. Empty terminal positions are optional; for example, Pins 10-19 are reserved for Grey code output, if your transponder requires it.

Pin		Function	Wire Color
1	▶	Primary Power Input	RED
2	▷	Secondary Power Input	RED/BLU
3	▶	GND	BLK
4	▶	MAG GND	BLK
5	▶	MAG X	WHT/GRN
6	▶	MAG Y	WHT/BRN
7	▶	MAG Z	WHT
8	▶	MAG CNTRL	WHT/BLU
9	▶	MAG PWR	WHT/RED
10	☐	D4 Alt Encoder Output	
11	☐	C4 Alt Encoder Output	
12	☐	C2 Alt Encoder Output	
13	☐	C1 Alt Encoder Output	
14	☐	B4 Alt Encoder Output	
15	☐	B2 Alt Encoder Output	
16	☐	B1 Alt Encoder Output	
17	☐	A4 Alt Encoder Output	
18	☐	A2 Alt Encoder Output	
19	☐	A1 Alt Encoder Output	

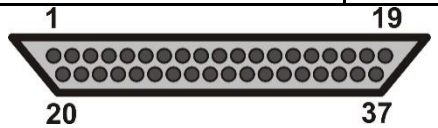


Figure A-9: 37 Position Female D-sub Connector (Insertion View)

* Legacy SX200 Sport EFIS can be differentiated from the Sport SX200A by noting the AHRS software version on the Set Menu, AHRS Maintenance page. AHRS software versions less than 50 (or 0.50) are legacy type AHRS.

Pin		Function	Wire Color
20		Audio (SW Ver. 11 and up)	
21	▷	GPS Memory	RED/WHT
22		NC	
23		Audio Ground	
24		NC	
25		NC	
26	☐	RX5**	
27	☐	TX5**	
28	☐	Warning Light	
29	▷	OAT Sensor	GRY
30	☐	RX1 *External GPS Input*	
31	▷	RX2 *EIS Serial Input*	GRN/BLK
32		RX3 Internal GPS*	—
33	☐	RX4 *Inter-Display Link*	ORG
34	▷	TX1 *A/P Serial Output*	BLU
35	☐	TX2 *Encoder Serial Out*	
36		TX3 Internal GPS*	—
37	☐	TX4 *Inter-Display Link*	VLT
▶	**Connected in Wiring Harness**		
▷	**Supplied as Loose Pinned Wires**		
☐	**Optional Wiring**		

*** NOTE:** See **Figure A-5** for information about optional Internal GPS and Serial Port 3.

****:** Applies to SX with CPU/GPU processor upgrade.

Recommended serial port usage in italics.

A-13: Sport SX100 Suggested Connector A Pinout Diagram (Multi-Screen System)

CAB-100SX-01: Connector A is a female 37-position D-sub connector that attaches to the display unit's male 37-position D-sub connector. Wires that are certain to be used, such as the power and ground connections, are pre-wired at GRT. Commonly used optional wires are supplied loose as pre-terminated wires.

Pin		Function	Wire Color
1	▶	Primary Power Input	RED
2	▷	Secondary Power Input	RED/BLU
3	▶	GND	BLK
4		NC	
5		NC	
6		NC	
7		NC	
8		NC	
9		NC	
10		NC	
11		NC	
12		NC	
13		NC	
14		NC	
15		NC	
16		NC	
17		NC	
18		NC	
19		NC	
20		Audio (SW Ver. 11 and up)	
21	▷	GPS Memory	RED/WHT
22		NC	
23		Audio Ground	
24		NC	
25		NC	
26		RX5***	
27		TX5***	
28		Warning Light	
29		OAT Sensor	
30	▶	RX1 Inter-Display Link	VLT
31	▶	RX2 EIS Serial Input	GRN/BLK
32		RX3 Internal GPS**	—
33		RX4*	
34	▶	TX1 Inter-Display Link	ORG
35		TX2	
36		TX3 Internal GPS**	—
37		TX4	
▶	**Connected in Wiring Harness**		
▷	**Supplied as Loose Pinned Wires**		
☐	**Optional Wiring**		

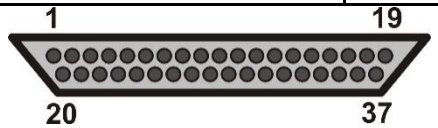


Figure A-9: 37 Position Female D-sub Connector (Insertion View)

***NOTE:** Serial Port 4 is the only high-speed port in HS and WS Sport EFIS models, making it the only port suitable for XM Weather in these units. All five SX serial ports are high-speed.

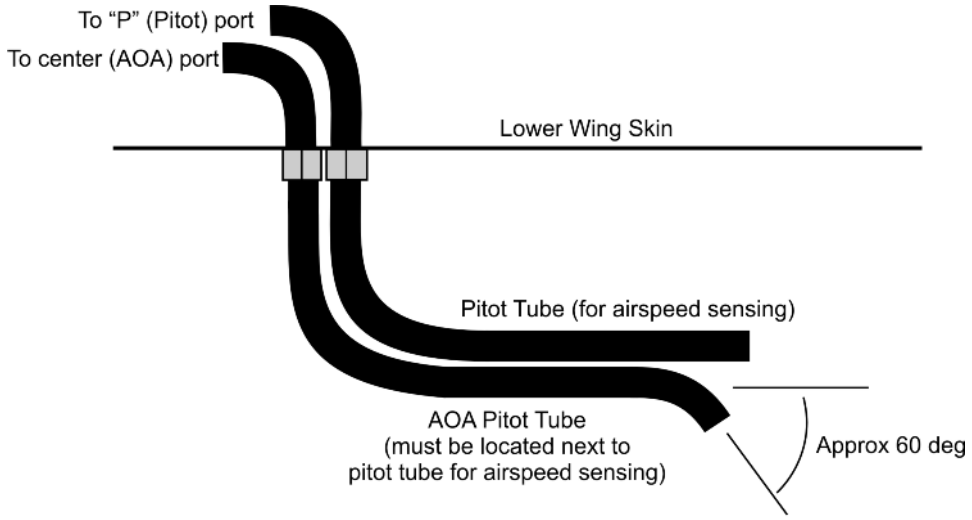
****NOTE:** See **Figure A-5** for information about optional Internal GPS and Serial Port 3.

*****NOTE:** Applies to SX with CPU/GPU processor upgrade.

A-14: Angle-of-Attack (AOA) Installation and Calibration

A-14-1: Sensed AOA Installation

The sensed version of the angle-of-attack option uses a two-port pitot tube, such as the Garmin GAP-26. If a heated probe is not required, a two-port pitot probe may be fabricated by mounting a second pitot tube, bent downward at approximately a 60° angle, as shown here:



Fabricating a dual port pitot tube for airspeed and angle of attack sensing.

Figure A-12: Sensed AOA Fabrication and Installation

When using a two-port pitot tube, a pressure connection (typically using the same tubing and hardware that's used for the pitot connection) is made from the AOA port on the pitot tube to the AOA port on the pitot-static block. The AOA port on the pitot-static block is the center port, between the Pitot and Static ports (for instruments equipped with this option).

A-14-2: Calculated AOA Installation

No installation is required, as the angle-of-attack is computed from the AHRS pitch attitude, true airspeed and vertical speed. **Note** that this method, although not requiring any sensors or additional pressure connections, degrades in accuracy while in rising or falling air.

A-14-3: Calibration of the AOA (Calculated and Sensed)

When in flight, in smooth air and at a sufficient altitude to safely stall the airplane, select "Set Menu – Primary Flight Display." Near the end of this menu, set "Angle of Attack (AOA)" to "ON." New settings will appear below this setting when set to "ON." We

recommend setting “Pitch Limit Indicator” to “ON,” following this setting is “AOA Pitch Offset.” Change this setting to activate the calibration process. Follow the on-screen prompts. The prompts will include a step where you fly the airplane near stall speed. When performing this step, minimal power should be used while the flaps should be in their retracted position.

A-15: Sport SX Display Unit Specifications

Overall Size: 6.5” Sport SX	
Faceplate	7.1” W x 5.25” H
Depth of Display Unit	4.75” Behind Panel Face (Approx.)
Panel Opening	6.25” W x 5.19” H
Weight	3.5 lbs
Overall Size: 8.4” Sport SX	
Faceplate	8.7” W x 6.47” H
Depth of Display Unit	4.75” Behind Panel Face (Approx.)
Panel Opening	8.064” W x 6.33” H
Weight	4.2 lbs
Sport EFIS Specifications	
Max. Angular Rate	**SX200:** 200°/s, All Axis Simultaneous **SX200A:** 250°/s, All Axis Simultaneous
Pitch/Roll Angles Range	Unlimited
Operating Temperature Range	-15° to 160° F (-25° to 70° C)
Storage Temperature Range	-25° to 185° F (-30° to 85° C)
Max. Rate of Change of Temperature	Unlimited
Long Term Reference	Accelerometer and Magnetometer (Independent of GPS)
Display	Direct Sunlight-Readable
Backlight Intensity Range	3 to 800 nits
Airspeed Range (Standard)	**SX200:** 35-285 mph IAS **SX200A:** 20-330 mph IAS
Airspeed Range (High-Speed)	**SX200:** 50-600 mph Indicated
Altimeter Range	-1,000 to 35,000 ft; Meets US IFR Accuracy Requirements
Magnetic Heading	Gyro-Stabilized; < 5° Error
Current Draw	< 1 amp

A-16: Table of Figures