Sport/Horizon 10.1 Installation Manual

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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 10.1 and Horizon 10.1 EFIS 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	SW Revision	Description
A	July 2019	All	First Release

1 Contents

2 GENERAL DESCRIPTION

2.1 Introduction

This document provides the physical, mechanical and electrical characteristics and installation requirements for the GRT Sport and Horizon 10.1 Electronic Flight Instrumentation System (EFIS).

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.

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

- **EFIS:** Electronic Flight Information System. This refers to the Sport EX/Horizon EX 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 EX/Horizon EX.”

- **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.

2.2 Certification

This 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.

2.3 System Description and Architecture

The EFIS consists of a panel-mounted Display Unit and an optional remotely-mounted magnetometer.

The display unit provides a graphical display of primary flight data, moving map/HSI and engine data. The Horizon EX requires a connection to an external GPS in order to display flight and navigation data. Both the Horizon EX and the Sport EX require a connection to a GRT Engine Information System (EIS) Engine Monitor in order to display engine data.

The 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 EFIS 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 EFIS does not include an internal GPS, as it is most common to use the GRT Safe-Fly GPS as both the GPS source for the EFIS, and as an FAA accepted position source for ADS-B 2020 compliance. 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 continuously transmit their flight plan, allowing the EFIS to display the flight plan on its Map and Flight Plan pages. This ability is useful for adding IFR GPS capability to the Sport system via an IFR-approved GPS. **Note** that external GPS receivers supply only navigation and flight plan information, such as position, ground track, groundspeed, flight plan, etc… Other data displayed by an external GPS (such as weather) are not displayed on the GRT EFIS screen (unless this data is also provided 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.

2.4 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** of this manual or the Support section of the GRT Avionics website (www.grtavionics.com) for more information on the various GRT system & third-party equipment configurations.

2.5 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 30-mile range; displays terrain, obstacles, airports and more.
- Sunlight-readable 1400-nit LCD displays; dimmable to less than 5 nits for night flying.
- Internal AHRS/Air Data computer; provides critical attitude, altitude and airspeed data.
- Supports rear-mounted GRT GPS Safe-Fly module and third-party GPS receivers. The EFIS supports 1 or 2 GPS inputs.
- High-Integrity AHRS; does not require pitot-static or GPS aiding.
- Internal, world-wide database.
- Compatible with panel mounted and remote nav radios that support the SL-30 serial data format.

- ADS-B transponder/receiver support; Displays weather and traffic (TIS-A).
- Displays Traffic Information Service (TIS-B) traffic (when used with Mode S transponder).
- Can tune any communication and/or navigation radio that provides an SL30/SL40 compatible serial interface, including SL30, SL40, GTR 200, GTR 225, GNC 255, VAL Com and Nav radios.
- Fully-integrated autopilot functionality for GRT and third-party units.
- Flight director for all autopilot modes.
- Customizable split-screen views, PFD-MFD screen swap, Engine Page and Moving Map overlays.
- Up to 12 high-speed serial ports (Three standard; an additional three serial ports may be optionally added).
- Optional ARINC 429 expansion module; allows full integration with Garmin panel-mounted GPS.

2.6 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)

3 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.

3.1 Choosing Your Serial Port Assignments

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. Six of the terminal positions in the connectors 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 connections– 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 mush 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 display unit corresponds to **BOTH** the serial input and output.

- The type of function for a DU serial input does not have to match; the baud rate, however, **MUST** match. For example, Serial Input 1 on the DU could be wired to an EIS engine monitor. It is configured for 9600 baud. Serial Output 1 on the DU 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 DU 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 EX 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.

3.2 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/).

3.2.1 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 data that only a single display unit may be receiving or controlling, such as EIS engine data that is wired to only one display unit, EFIS analog inputs, ARINC 429 data, traffic, and sensed angle-of-attack data.

3.3 Serial and Ethernet

Inter-display unit data can be communicated between any GRT display units using a serial data connection. The ethernet connection can be used for a high-speed inter-display unit link that allows even weather data to be shared between EFIS display units, and does not require the use of a serial port.

3.3.1 AHRS

The EFIS can receive two sets of AHRS data. Typically, one set of AHRS data comes from the DU's internal AHRS while the second comes from a serial port connection to an external AHRS. The external AHRS connection may come from a standalone AHRS unit or from the internal AHRS of a another 10.1 display unit. Providing the EFIS with multiple attitude sources allows for automatic cross-checking of the attitude data. An "AHRS Miscompare" warning will occur if the roll and pitch attitude differ more that the test threshold. Either set of AHRS data can be chosen by the pilot to drive the EFIS. The EFIS will default to "BOTH," a composite of the two AHRS data sets.

3.3.2 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.

3.3.3 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.

An analog input can be configured to provide a panel mounted switch for selecting heading or navigation mode for the lateral autopilot. This can provide a convenient short-cut when switching between these often-used modes.

3.3.4 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.

3.3.5 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.

3.3.6 ADS-B GPS Output

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 (input and output). Additionally, this GPS provides accuracy and integrity data that is used by the EFIS. The integrity validation performed by this GPS is similar to that performed by IFR-certified GPS navigators.

3.3.7 Remote Transponders

The Sport EX supports fully remote transponders, including the Trig TT22, uAvionix ESX, and SL70.

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 are 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.

3.3.8 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 EFIS requires an external adapter for Gray code altitude encoding outputs. Newer transponders may allow either serial output or Grey code.

3.3.9 Communication and Navigation Radio Tuning

The EFIS has the ability to load all com/nav radios compatible with the Garmin SL30 and SL40 serial format with frequency pre-sets, allowing convenient selection of these frequencies from the front panel controls of the 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 compatible radios: The EFIS provides an HSI and other functions that display and use the VOR bearing data. Localizer and glide slope deviation data is also displayed on the DU 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 is communicated to other display units via the inter-display unit link, it is preferable to connect the nav radio’s serial data output to two display units independently. This allows the navigation data to be displayed on either display unit if one fails. The EFIS imposes minimal electrical loading, allowing a single serial output to be connected to multiple display units. Control of the one radio using either to two (or more) display units requires the addition of a switch to select which display unit will control the radio.

3.3.10 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.

3.3.11 IFR GPS Navigator Sources

The Sport EX 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, ground track and flight plan data.

3.3.12 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.

3.4 Gray Code Altitude Encoder Output

Older transponders use an interface called Gray Code to receive data from altitude encoders. Since the Sport EX 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 this adapter is not commonly used.

3.5 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 EX and Horizon EX both have a single 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 DU via USB—simply install the software update files onto a USB thumb drive from the GRT website, then connect the thumb drive to the display unit’s USB port. The DU will upload the files as per the Update instructions found in the **Sport EX Setup Guide**.

3.6 Sport 10.1 Optional Features

There are several optional features that can be added at any time to the Sport 101., allowing you to purchase the EFIS at a lower total-cost and to expand the capabilities of your EFIS as your need dictate. These expanded features can be implemented during the initial build phase or at a later date, usually without having to remove the display unit from your instrument panel. The features are:

- **Synthetic Vision/Terrain Relief Map:** 10-mile range; high-resolution, forward-looking synthetic vision includes terrain, runways, obstacles, waypoints and traffic.
- **Angle-of-Attack Sensing***
- **Touchscreen***
- **Vertical Autopilot Functions**

***NOTE:** These optional features require a hardware upgrade and need to be sent in to GRT in order to add them.

3.7 Analog Inputs

The EFIS includes six analog inputs and a two-channel (stereo) audio output. The analog inputs allow the EFIS to measure voltages in the airplane and to perform a variety of functions. Auxiliary inputs on the EIS engine monitor may also be used for some of these functions.

Function Name	**Description**	**EIS Aux Input Can Perform Also?**
ILS Tuned	Legacy Function – Normally not used	No
GPS Deviations Active	Legacy Function – Normally not used	No
VOR/ILS Deviations Active	Legacy Function – Normally not used	No
Ext A/P HDG Mode Select	Allows a dedicated switch to be mounted on the panel to select lateral autopilot modes of HDG or navigation coupling.	No
Hold/Sequence	Allows a dedicated switch to be mounted on the panel to select suspend or resume waypoint sequencing of the EFIS flight plan.	No
AUX (EIS Compatible)	Emulates the function of EIS aux input for additional engine monitoring or custom functions.	Yes
Flaps	Displaying flap position on the EFIS	Yes
Aileron Trim	Displaying aileron trim position on the EFIS.	Yes
Elevator Trim	Displaying of elevator trim position on the EFIS	Yes
Rudder Trim	Displaying of rudder trim on the EFIS	Yes
Page Flip	Allows a momentary switch, normally located on the control stick, to control EFIS page changes according to user customization.	No
Sync Selected Heading	Allows a momentary switch to synch the airplanes current heading to the selected heading.	No
Dimmer	Allows an external voltage to control EFIS dimming.	No
Screenshot	Allows an external switch to save the displayed EFIS screen to a USB memory stick	No

3.7.1 Multiple Display Unit Considerations

EIS auxiliary inputs can be shared with multiple display units by connecting the EIS serial output to each display unit, or by sharing the EIS data over the inter-display unit link.

Although it is not good practice to connect an analog input to multiple display units, EFIS analog inputs can also be shared with other display units via the inter-display link.

Typically, these inputs are used to display the trim and flap positions, but they can be user-defined for just about any purpose. For example, the inputs may be defined and used to display fuel levels, fuel pressure, water temperature or even ignition advance (if compatible with your ignition system).

3.8 Audio Output

The audio output provides a method of alerting the pilot when limits are exceeded, gives altitude call-outs on approach, traffic alerts and much more. The audio output is wired through the intercom or audio panel. Audio panels or intercoms that are not stereo may use either the left or right audio output.

3.9 Loss of GPS Data Considerations

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.

The EFIS supports two GPS inputs. If the EFIS detects loss of position data from one GPS, it will automatically select the other GPS.

3.10 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.

4 PHYSICAL INSTALLATION

4.1 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, such as those with tip-up canopies, for example, have canopy supports that may interfere with the back of the DU when the canopy is closed. A mounting template for display unit dimensions and clearance requirements for the rear of the unit is included near the end of this manual.

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

4.2 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’ long and designed to reach out to the wingtip, which is the ideal location for most airplanes. 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° nose up or nose down.

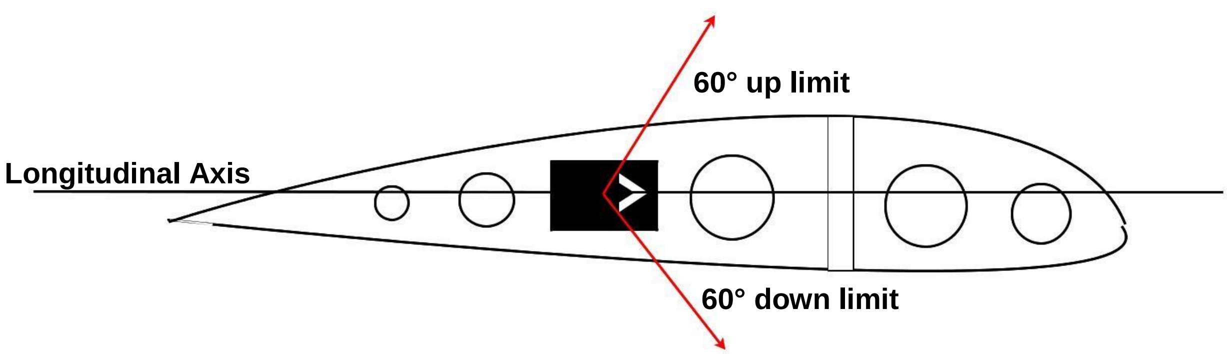


Figure 3-1: Magnetometer Pitch Range

***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 cables 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 EX.

4.3 Cooling Considerations

The EFIS does not require external cooling and generally does not require any special considerations regarding cooling in most installations. In our experience the one exception to this is pressurized airplanes, which do need consideration to avoid directing hot cabin pressurization air toward the EFIS, as well as venting as needed to avoid the accumulation of heat behind the instrument panel.

If the EFIS detects overheating, it will slow its processor to reduce power consumption (and self-generated heating) and will alert the pilot of excessive temperatures before shutting down. This typically occurs above 180 degrees Fahrenheit.

Good practice can be to include a few small openings in the glare shield to promote the flow of air behind the panel. Fans or some other means of moving air around electronic equipment are usually worthwhile for airplanes operating in extreme conditions. Be certain that cooling air does not contain water—a problem often encountered when using external forced-air cooling methods.

4.4 Pitot-Static Connections

Pitot and static air pressure connections are made to the EFIS for the measurement of airspeed, altitude and vertical speed. These connections are made via female 1/8–27 NPT fittings on the rear of the EFIS. To facilitate installation and removal of the display unit, quick disconnect fittings may be helpful, with enough tubing length to allow the EFIS to be pulled 6 inches or more from the panel. 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.

4.5 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. This is illustrated near the end of this manual.

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.

5 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.

5.1 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 pin or socket contacts. 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 taught 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 "For More Information".

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

5.2 Power Connections

The display units each include three isolated power input connections. This allows redundant power sources, such as a main and secondary bus. The display units consume approximately 2 amp maximum, making even a 4 amp-hour gel cell a suitable backup power source.

The configuration of the power system supplying the display unit(s) is left to the builder. Considerations, such as the number of power buses, the addition of redundant power to a single device (allowing the device to potentially affect both buses), the implementation of backup equipment into the electrical system, etc., may dictate the best configuration for a particular airplane.

No provision is included within the display units for a power switch. If a power switch is desired for the DU, 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 DU 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' 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.

5.3 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 5'.

5.4 Digital Magnetometer Wiring

Typically, the magnetometer harness 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 "Digital Magnetometer Installation Diagram". If desired, the crimp-type D-sub connector can be replaced with a solder-type connector.

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

The digital magnetometer serial output may be shared between any number display units with Adaptive AHRS or stand-alone Adaptive AHRS.

5.5 Specific Equipment Interconnect Details

Most equipment shares information with the display unit via a serial port connection. Each serial port in the DU that is wired to another device must be configured so that the DU 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 EX 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.

5.6 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.

6 Initial Checkout, Basic Configuration Settings and Calibration

6.1 Display Unit Checkout

1. Apply power to the display unit. The LCD will become active within 20 seconds, the display should show the "Accept" page if on the ground. (If in-flight, the "Accept" page will not be displayed, and the EFIS will display the last normal (not set page) that it was on.)

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

6.2 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 ports 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.gratavionics.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.

6.3 Trig TT22 (RS-485 Port)

The EFIS provides an RS-485 port for a direct connection to the Trig TT22 Mode S transponder. If this port is wired to the Trig TT22, the following setting should be configured (the setting is accessed from the “General Setup” submenu within the “Set” menu):

TT22 A/B Port: (On/Off) Default is off. Turn this on if a Trig TT22 is wired to the Sport EX. This setting should be off if a Trig TT22 is wired to the DU via a serial port using the GRT Trig Adapter.

6.4 Multiple AHRS Inputs

A user setting is provided to allow for designating if the internal AHRS is to be used, and if so, whether it is identified as AHRS1 or AHRS2. This setting is accessed from the “General Setup” submenu within the “Set” menu.

Internal AHRS: (No/AHRS1/AHRS2) Default and normal configuration is AHRS1. If the display unit is wired to an external AHRS, the serial port for this AHRS would be configured as AHRS2. If two sets of external AHRS data is provided to the DU, this setting must be set to “No.”

The Horizon EX does not include an internal AHRS and must use external AHRS sources.

Future Growth: The EFIS will use “Backup AHRS Data” to perform cross-checking between all of the attitude sources provided to it. “Backup AHRS Data” is data provided to the EFIS via an inter-display unit link. The link may include some latency; because of this, the Backup AHRS Data cannot be relied upon for normal autopilot performance. Backup AHRS Data can be selected to drive the DU screens. When this is selected, the EFIS will continuously display “Backup Attitude” on the PFD screen to alert the pilot that this data is a duplicate of the data provided by the backup source. Backup attitude data allows the EFIS to more reliably choose the best AHRS when the cross-check detects a miscompare.

6.5 Defining Magnetometer Connections

Since the Adaptive AHRS does not require a magnetometer, a setting is provided to specify if one has been connected to the AHRS. This allows the EFIS to detect if an installed magnetometer has stopped providing data. A setting is provided for each of the two possible AHRS connections. This setting is accessed in the “General Setup” submenu, within the “Set” menu.

AHRS(1/2) Has Magnetometer: (Yes/No/Auto) Default is “Auto.” Set to match your installation. If it is unknown, use the “Auto” setting until you determine if one has been connected. The “Auto” setting will not generate a warning if a magnetometer is not connected or is not providing data. The EFIS will generate a warning if “Yes” is set and no magnetometer data is being received.

6.6 External AHRS/Air Data Computer Test

This section applies only in cases where a stand-alone external AHRS is wired to the EFIS to provide redundant attitude/air data information to the EFIS.

1. Apply power to the display unit. Apply power to its external AHRS as well.

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

    a. Select the external AHRS using the PFD AHRS softkey.
    b. The display unit shows altitude and airspeed tapes. Airspeed will be shown as dashes (---). Altitude will be approximately correct and will not be blank.
    c. Attitude and heading data appears on the screen at the completion of the alignment period (typically less than 2 minutes). Attitude data is being displayed when the background of the Primary Flight Display is no longer black.
    d. No "ATTITUDE FAIL" message is shown on the PFD screen.
    e. 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.

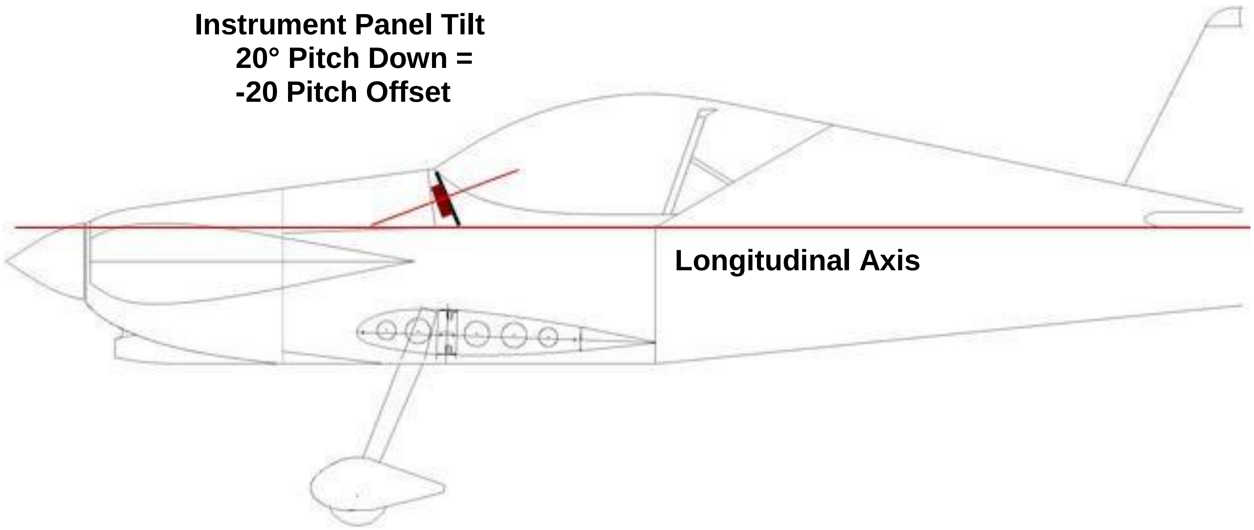
5. If a magnetometer is connected, verify that the PFD screen shows HDG next to the heading box at the top-center of the screen. When no magnetometer is installed, the heading display will be dashes until GPS ground track becomes valid, which requires aircraft motion.

6.7 Setting Internal and External AHRS Orientation

This first adjustment is an approximate setting to account for angled instrument panel (for internal AHRS), and to account for the orientation of an external AHRS relative to the airplane axis. 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):**



AHRS Pitch Orientation Offset

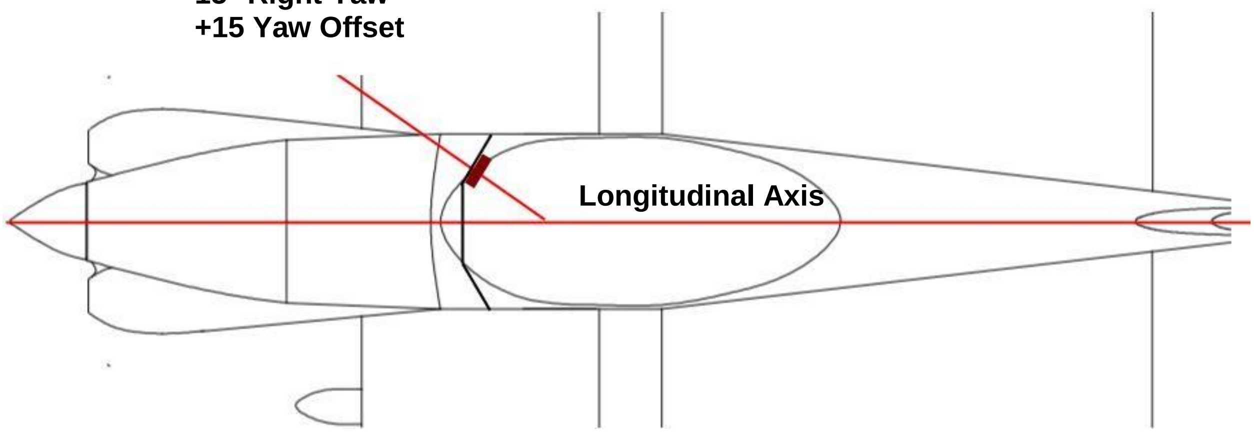


Figure 5-2: AHRS Yaw Orientation Offset

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

6.8 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 the “Magnetic Heading” field on this screen.

   ***NOTE:** Do not use the heading data shown on the normal Primary Flight Display screen; this is gyro data that is slaved to the magnetometer. This data will change slowly when the magnetometer heading changes, making it difficult to detect disturbances to the magnetometer. The “Magnetic Heading” field on the AHRS Maintenance page shows instantaneous magnetometer heading data.

3. Observe the Magnetic Heading and verify that it does not change by more than +/- 2° 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, especially the ailerons.

   c. Observe the magnetic heading while shutting down the engine and note if this causes a significant change in the heading. If so, this may be a result of changes in the electrical currents flowing through the airplane, suggesting that some current-carrying wires are too to the magnetometer.

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° 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.

6.9 Set Magnetometer 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**.

6.10 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.

6.11 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 (the GPS cannot determine your track unless you are moving). Note the precise indication on the backup whiskey compass. Stop the airplane and adjust its heading to the reading observed on the whiskey compass.

2. After the aircraft is positioned correctly, turn ON the GRT Sport EX/Horizon EX (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. The EFIS 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!

6.12 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.

6.13 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.

6.14 Required Settings Before Flying

In addition to the ability to interface with a large variety of third-party equipment, the Sport EX 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 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 this section above.
- All settings described in equipment supplements applicable to other equipment connected to the EFIS.
- All settings in the following table:

Setting	Set Menu	Notes
Speed/Distance Units	General Setup	
Fuel Units	General Setup	If fuel flow 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	
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 leaning.
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 current baroset entered.
EFIS Settings Backup	Display Unit Maintenance	Use to save all settings to a USB memory stick whenever settings are updated to allow easy restoration of all settings.

7 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 EX/Horizon EX.

The **Wiring** and **Pinout Diagrams** included in this **Appendix** show the function of each D-sub connection and its associated wire color. Functions labeled **NC** have no connection. 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.

7.1 Sport/Horizon 10.1 Mounting Template

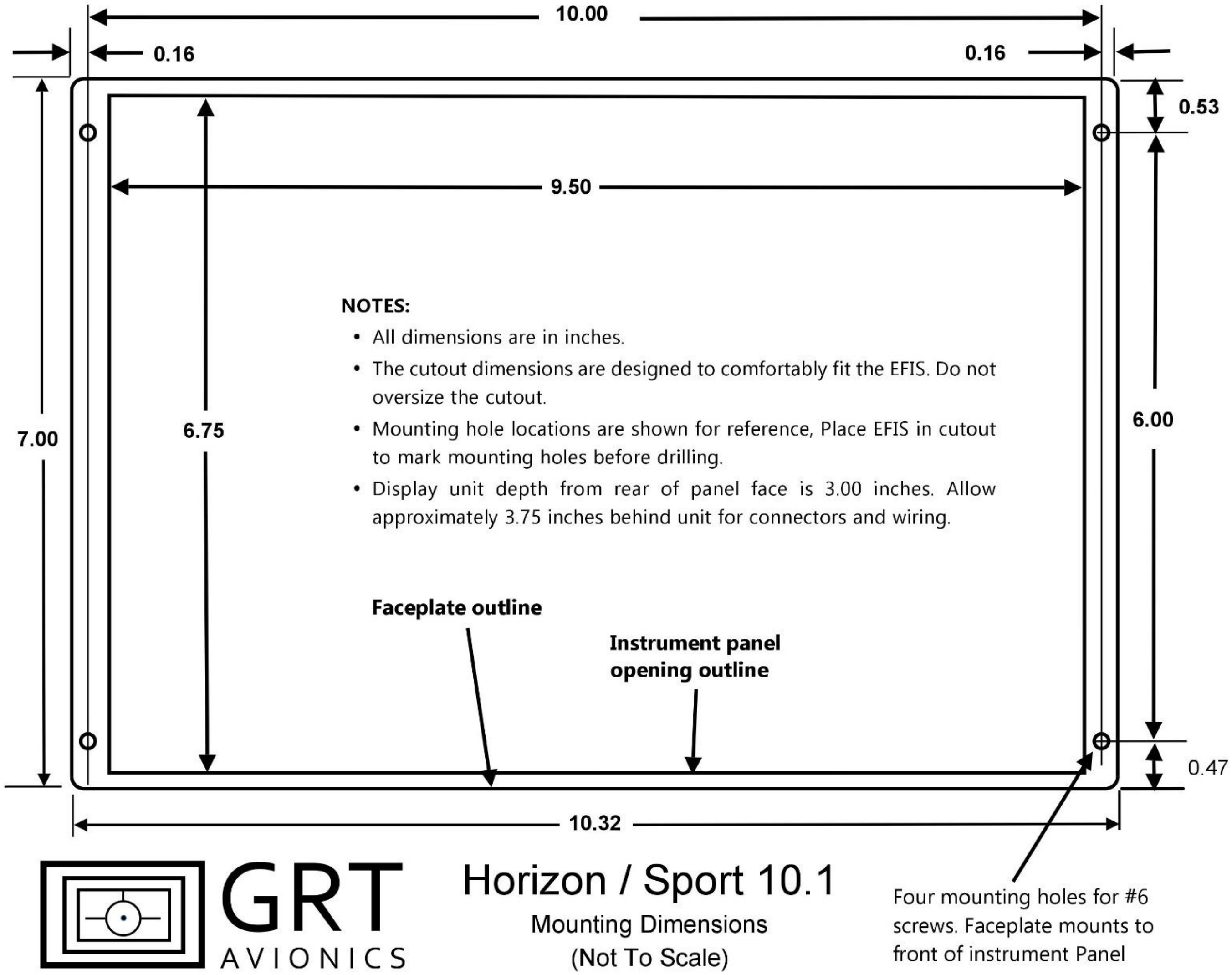


Figure A-1: Sport EX/Horizon EX Mounting Template

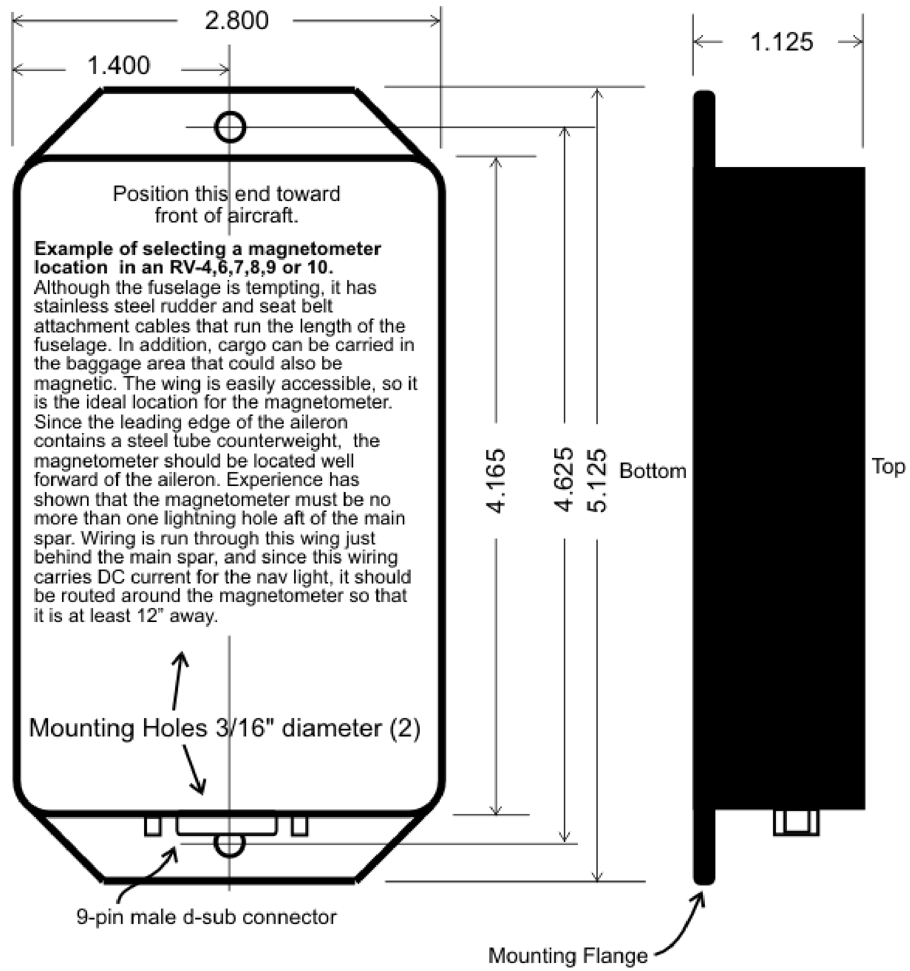
7.2 External Module Diagrams

External modules are used for the following devices.

- Digital Magnetometer
- ARINC 429 Adapter
- Gray Code Adapter
- CAN Bus Adapter

The size of these modules is identical, as described in the following diagram, “Digital Magnetometer Installation Diagram”, except for the location of the electrical connections. In addition, the ARINC 429 modules is 9/16” taller than the other external modules and requires about 3 inches above it for the electrical connections.

7.3 Digital 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 a "magnetometer" app in a smartphone. These apps display the magnetic field strength, and the direction of the magnetic field. Use the app to measure the earth magnetic field strength away from the airplane (and far from any possible sources of magnetic interference) with the phone in the same orientation as the position to be tested. Then place the phone in the location to be tested, 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.

Alternatively, the magnetometer itself can be used by observing the raw magnetometer data.

7. The orientation of the AHRS must be set, followed by setting of the orientation of the magnetometer as described within this manual. Until this is done, the magnetic heading provided by the magnetometer will be incorrect.

8. Mount with brass or nylon hardware only.

Digital Magnetometer Installation

7/21/2019
Digital_Mag_Install.cdr

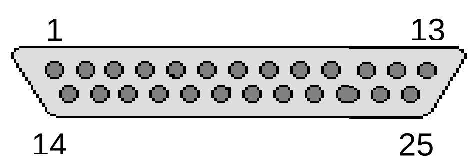
GRT AVIONICS

7.4 Connector A Pinout Diagram

Connector A is a 25-Pin D-Sub female connector that attaches to the male EFIS 25-pin D-sub. Pins for primary power IN and ground are pre-installed in the connector. Commonly used optional wires are supplied as loose wires. Wire colors and devices assigned to serial ports are suggestions only. NC denotes “No Connection”.

Pin		Function	Rec. Wire Color
A1	S	Serial 6 OUT	WHT/BLK
A2	S	Serial 1 OUT	WHT/GRN
A3	S	Serial 5 OUT	ORG
A4	S	Serial 2 OUT	BRN
A5	S	Serial 4 OUT	YEL/WHT
A6		Serial 9 OUT	
A7		Serial 9 IN	
A8		Serial 10 OUT	
A9		Serial 10 IN	
A10		Serial 11 OUT	GRY
A11		Serial 11 IN	BLUE
A12		Serial 12 OUT	WHT/BLU
A13		Serial 12 IN	ORG/BLK
A14	I	Primary Power IN	RED
A15	S	Secondary Power IN	RED/BLUE
A16		Tertiary Power IN	
A17	I	Ground	BLK
A18	S	NC	RED/WHT
A19	S	Serial 2 IN	YEL
A20	S	Serial 1 IN	WHT
A21	S	Serial 4 IN	GRN/BLK
A22	S	Serial 5 IN	YEL/BLU
A23	S	Serial 3 IN	GRY/RED
A24	S	Serial 6 IN	YEL/GRY
A25	S	Serial 3 OUT	GRY/BLK

Note 1: Connector A harness is 4 feet long. Longer harnesses are available by special order.

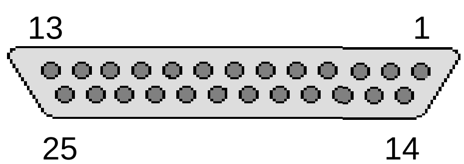


Rear view of connector for the cable that plugs into connector A. Shown from the side the wires are inserted.

7.5 Connector B Pinout Diagram

Connector B is a 25-Pin D-Sub male connector that attaches to the female EFIS 25-pin D-sub. Pins labeled NC denote “no connection”. Connector B wires are 4 feet long. Longer wires are available by special order.

Pin		Function	Wire Color
B25		Audio Output Ground	
B24		Right Audio Output	
B23		Serial 7 IN	
B22		Serial 7 OUT	
B21		Analog 1 Input	
B20		Analog 2 Input	
B19		Analog 3 Input	
B18		Analog 4 Input	
B17		Analog 5 Input	
B16		Analog 6 Input	
B15		Ground	
B14		Aux Power Output (12V 0.5 Amp max)	
B13		Ground	
B12		Magnetometer Power	
B11		Left Audio Output	
B10		Magnetometer Serial Data Input	
B9		Outside Air Temperature Input	
B8		Discrete Output 1	
B7		Serial 8 IN	
B6		Serial 8 OUT	
B5		RS-485 A (Trig TT22 A)	
B4		RS-485 B (Trig TT22 B)	
B3		Discrete Output 3	
B2		Discrete Output 2	
B1		Warning Lamp (Open/Gnd 0.5A max)	



7.5.1.1 Wiring Harness Connector B as viewed from REAR (wired side)

7.6 Digital Magnetometer Pinout Diagram

The digital magnetometer harness has a female 9-pin D-sub connector that attaches to the digital magnetometer's male 9-pin D-sub connector. The harness is provided with the pins installed on the wires, but not in the connector housing, so that they may be routed through smaller openings. After routing the wires to the magnetometer location, the excess wiring may be coiled, or cut off and new female contacts installed. These wires are then inserted into the connector housing as shown in the following table.

Digital Magnetometer Pinout			
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 pin into connector after the wires are pulled through the airframe.**		

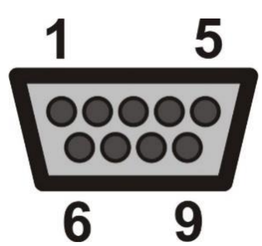
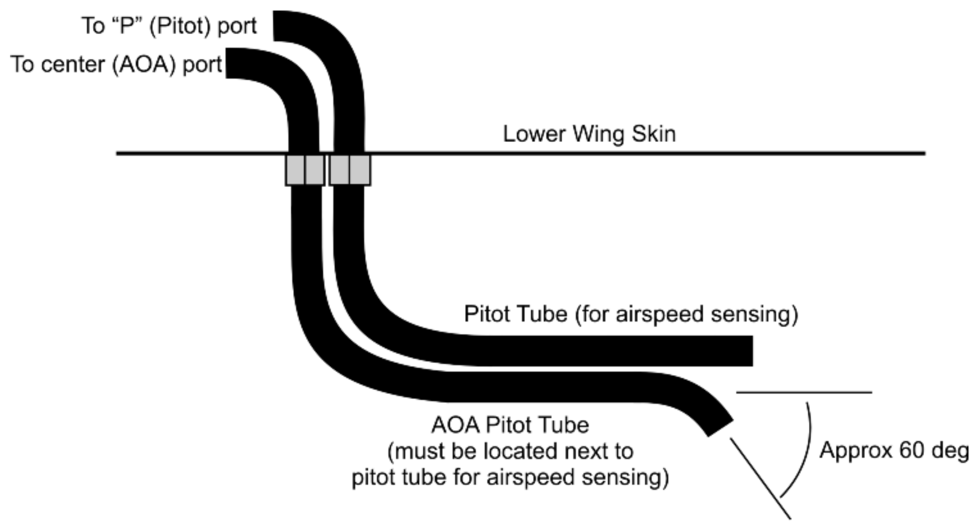


Figure A-7: 9 Position Female D-sub Connector (Insertion View)

7.7 Angle-of-Attack (AOA) Installation and Calibration

7.7.1 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.

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).

7.7.2 Calculated AOA Installation

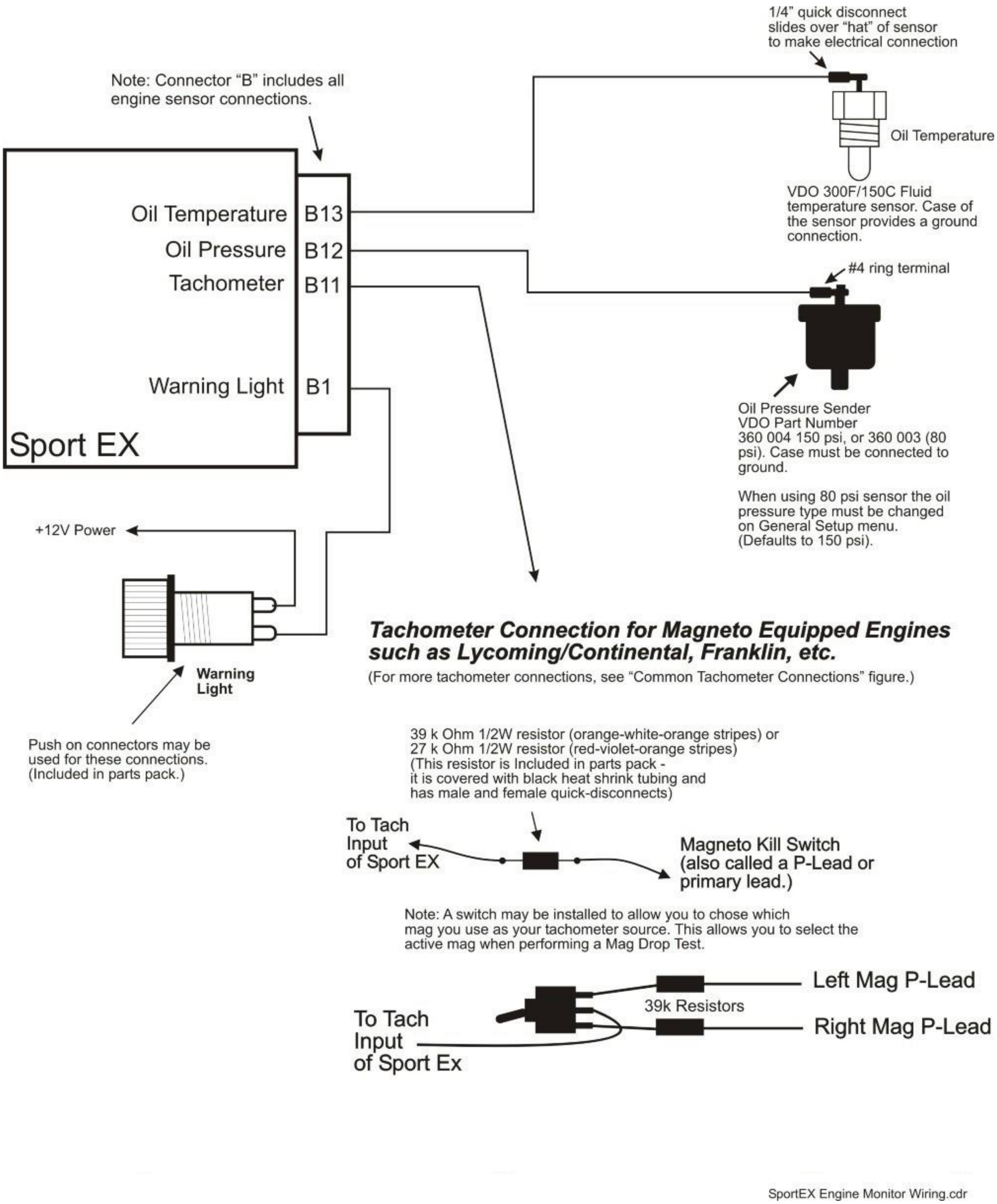
No installation is required, as the angle-of-attack is computed from the AHRS pitch attitude, true airspeed and vertical speed. **Note** that this method, although not requiring any sensors or additional pressure connections, degrades in accuracy while in rising or falling air.

7.7.3 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.

7.8 Basic Engine Monitoring Wiring

(Requires purchase of Basic Engine Monitoring Option)



Sport EX Basic Engine Monitoring Wiring

7.9 Common Tachometer Connections

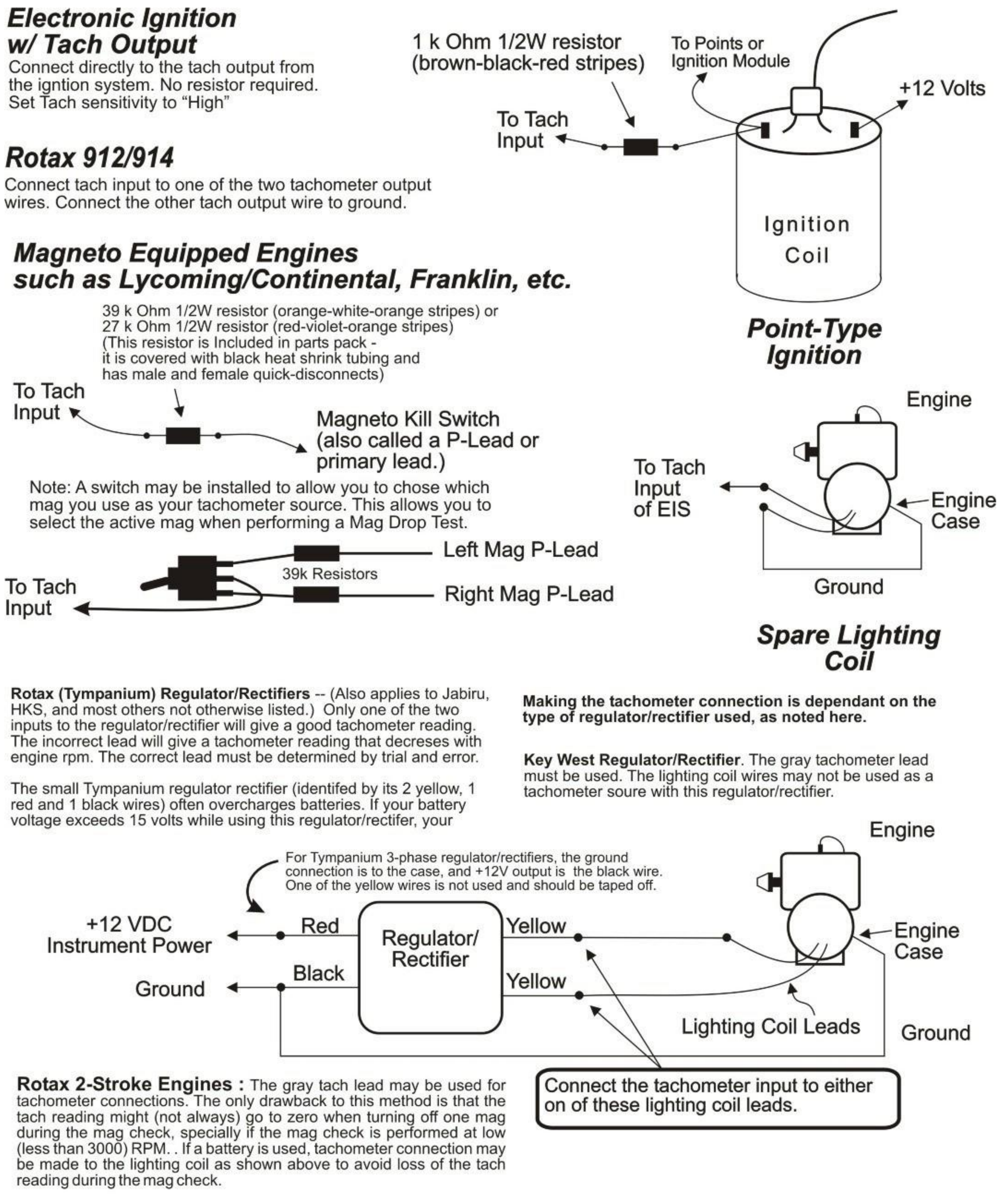
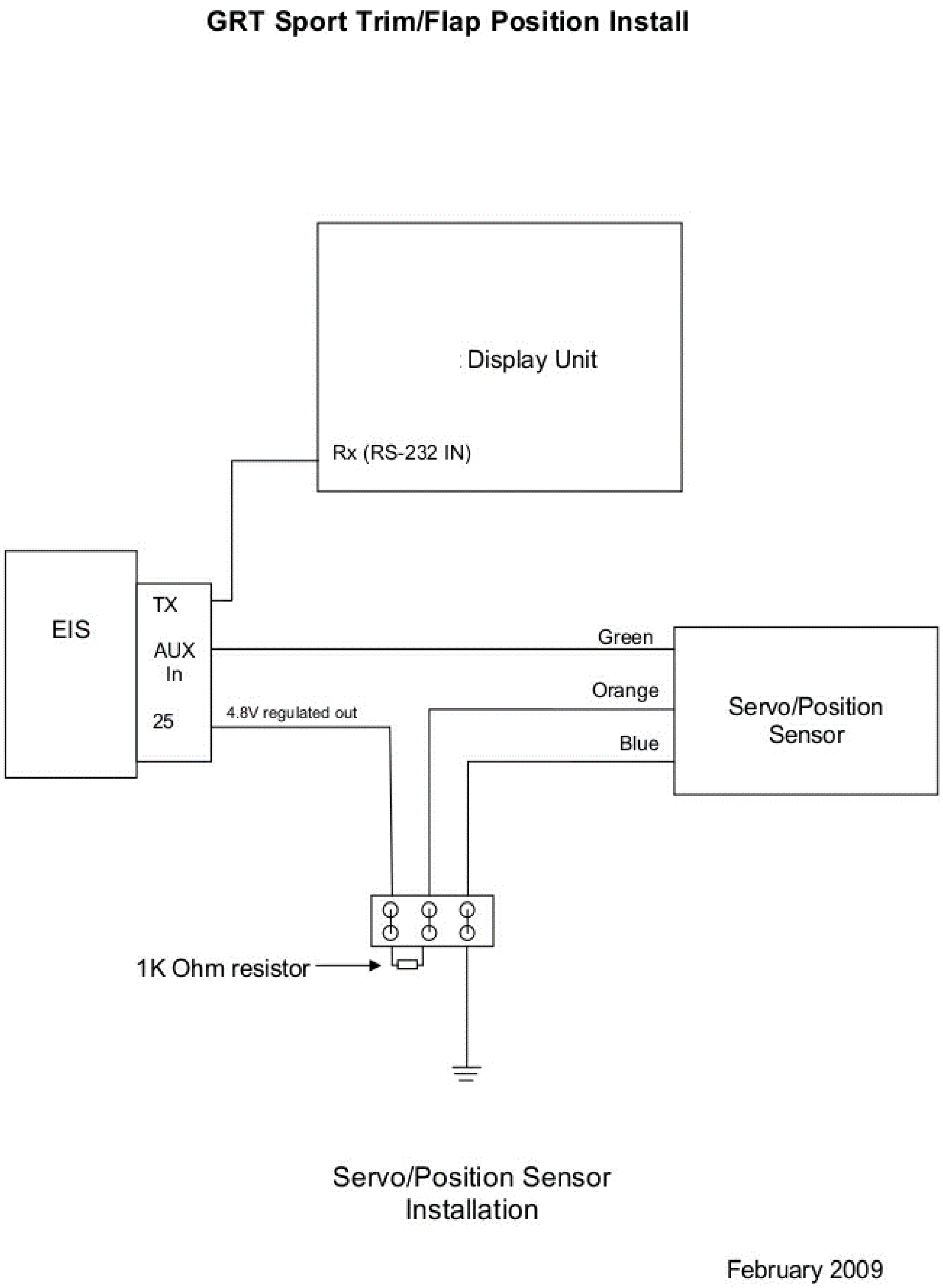


Figure A-10: Common Tachometer Connections ***Basic Engine Monitoring Option Only**

7.10 Trim/Flap Position Sensor Wiring

This diagram illustrates the use of an EIS Engine Monitor auxiliary input for sensing trim or flap position. The EFIS may use this method or one of its optional analog inputs.



7.11 Sport/Horizon 10.1 Display Unit Specifications

Overall Size	
Faceplate	10.32” W x 7.00” H
Depth of Display Unit	3” behind Panel Face (Approx.)
Panel Opening	9.5” W x 6.75” H
Weight	2.5 lbs
Sport EX AHRS/Air Data Computer Specifications	
Max. Angular Rate	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
Display	Sunlight-Readable LED backlit LCD
Backlight Intensity Range	3 to 1400 nits
Airspeed Range (Standard)	25-330 mph IAS
Airspeed Range (High-Speed)	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	< 2 amp

Questions to be answered:

Dual AHRS. Just configure another 10.1 with an AHRS output?