GRT AVIONICS

HXr

Installation Manual

Revision A5
7-May-2015

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FOREWORD

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

This manual describes installation of the GRT Hxr Electronic Flight Information System 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 manual updates, 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 Rev	Change Description
A	1-Dec-2012	1b	Initial Release
A1	19-Dec-2012	1b	Added notes about audio output- Section 3.9 and Connector B Pinout Diagram Replaced HXr Interconnect Diagram with high-res image
A2	09-Jan-2013	1d	Updated wiring harness packages and part numbers in packing list– Section 1.5 Updated & clarified wiring harness Connector Pinout Diagrams for Connector A, Connector B, and AHRS– Appendix
A3	31-Jan-2013	1d	Corrected pin assignment described in Section 3.7 from B1 to A18. Simplified trim/flap sensor wiring diagram, A14
A4	03-Apr-2013	1e	Added note about internal pull-up resistors for trim/flap sensors to trim/flap sensor wiring diagram, A14, and Section 3.10. Fixed backwards connector diagram on AHRS connector pinout, A11.
A5	20-Feb-2015	1f	Updated to include mounting for Adaptive AHRS and digital magnetometer..

LIST OF EFFECTIVE SECTIONS

Section	Date	Revision	Notes
Foreword	05-Mar-2015		
1	05-Mar-2015		
2	05-Mar-2015		
3	05-Mar-2015		
4	05-Mar-2015		
5	05-Mar-2015		
Appendix	20-Feb-2015	A4	HXr systems shipped after 1/08/13 include updated wiring harnesses as described in the Appendix of Revision A2. Installers of all units shipped prior to this date should refer to the Horizon Cable Description documents, available from www.grtavionics.com/documents, for Connector A, B and AHRS pinning instructions.

Contents

SECTION 1: GENERAL DESCRIPTION

1.1 Introduction

This document provides the physical, mechanical and electrical characteristics and installation requirements for the GRT HXr EFIS.

This document, the HXr Set Up Guide and the HXr Users Guide make up the set of HXr user documentation. These documents, along with periodic software updates and other notices, are available at www.grtavionics.com under the Support menu.

1.2 Certification

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

1.3 System Description & Architecture

The GRT HXr EFIS (Electronic Flight Information System) consists of one or more panel mounted Display Units, one or more remotely mounted attitude-heading reference system (AHRS), and one or two remotely mounted magnetometers. The Display Unit is available with either a 10.4" or 12.1" screen. Dimensional drawings for both sizes, as well as the AHRS and magnetometer, are provided in the Appendix of this manual. The HXr is available as either a 12 or 28-volt system; the voltage is specified on the data tag of the display unit.

Two AHRS packages are available. The Dual AHRS package (AHRS-2) is standard with the dual-display system, while the single AHRS (AHRS-1) is standard with a single display. The Dual AHRS is two identical AHRS units inside one module; this assures that both AHRS units are aligned with each other at all times. Dual AHRS is available with a single screen system as an option.

The most basic configuration for HXr is a single EFIS screen to display the primary flight instruments of airspeed, altitude, heading, attitude, vertical speed, and rate of turn. To do this, the EFIS display unit works with a remotely-mounted attitude-heading reference system, or AHRS, and a magnetometer unit to determine aircraft attitude and heading information. The air data computer, located inside the AHRS box, is connected to the aircraft pitot/static system to determine airspeed and altitude. The GRT AHRS is unique in the industry in that it provides attitude data without gyros, GPS or pitot/static input to compute aircraft attitude, making it more reliable than systems that require external data.

When GPS is added to the system, GPS track and a moving map are displayed on the map page of the primary display or the secondary display if equipped. GRT offers several different GPS modules for the HXr. A third-party GPS unit may also be used, such as a Garmin 430/530 or Garmin 650/750. This feature is useful for adding IFR GPS approach capability to the HXr system. (IFR approach sequencing is currently in development at GRT.) Note that the only GPS functions that

import from a third-party GPS to the EFIS are track and position. Flight plan sequencing from such a GPS can be imported if the GPS is wired to the EFIS through the ARINC 429 port.

When the Grand Rapids Technologies Engine Information System (EIS) unit is installed in the aircraft, every engine parameter imaginable is able to be monitored through the EFIS system. The EIS module senses the desired engine or environmental data, such as exhaust gas temperature, cylinder head temperature, oil temperature/pressure, and outside air temperature, and displays it on both the EIS screen and the EFIS screen. While the EIS displays it in numerical data only, the EFIS can display data in graphical format, which is useful and easy to read during flight. One notable feature is the EGT line graph, which tracks EGT data for each cylinder over time and allows easy and instantaneous rough-engine troubleshooting. 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, fully customizable in-flight according to the pilot's taste and situation.

GRT strives to maintain open compatibility with third-party equipment vendors. This allows aircraft builders and pilots the freedom to choose whatever brands fit their mission and budget, as well as the flexibility for easy upgrades as technology evolves. Radios, transponders, ADS-B modules, and many other third-party units interface with the GRT HXr through RS-232 serial, ARINC 429, RS-422, and USB ports. VOR/localizer data, traffic alerts, and in-flight weather are very common additions that are easily displayed on the EFIS screen. The HXr features the capability to mount the radio, transponder and engine monitor in a remote location to simplify the design of the instrument panel. The addition of a second or third display unit doubles or triples the number of available serial and USB ports available, allowing use of more third-party devices. The Ethernet inter-display link between EFIS screens allows data from most devices to be shared among screens for redundancy and convenience.

See Section 5, the Appendix of this manual, and the Support section of grtavionics.com for information on various GRT system & third party equipment configurations.

1.4 Light Aircraft Avionics Primer

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

D-Sub Connectors

A key element to designing a glass-panel installation is the communication between different components of the system. The internal circuits of each unit are wired to use D-sub connectors for easy external wiring of required and optional components. The main connectors of the Horizon system are two 25-pin D-Subs, referred to in this manual as Connectors A and B. Each pin of the connector is wired to an internal component of the display unit circuitry. Some pins are hard wired to required elements, such as the AHRS input. Others are designated as serial ports or other communication ports described below.

Analog Input

Some pins on the GRT EFIS connectors are designated as Analog input. These inputs use variations in voltage levels to perform simple tasks. The most common use for analog data in GRT EFIS systems today is for position indicators such as trim, flaps, and squat switches. VOR/Localizer data can be in analog format, but has overwhelmingly been replaced by serial data or ARINC 429 for simplicity and better performance.

Grey Code

Grey code is an analog language used by most transponders, especially older ones, to decipher altitude encoder information. A range of pins on older GRT EFIS systems is designated as Grey code input. Newer transponders can use serial data instead of Grey code, which vastly simplifies the wiring process. Because Grey code is rapidly becoming phased out in favor of serial data, the HXr does not support it.

Serial Ports

Serial ports are user defined, meaning that the aircraft builder can choose which devices use each port. Each serial port consists of two pins– a Transmit (OUT or Tx) and a Receive (IN or Rx)–that exchange information between the display unit and a connected device such as a GPS, radio or autopilot. Devices that receive and transmit information use one "whole" serial port. Some components only require an IN or OUT. For example, the EIS connects to an IN port because it sends information to the EFIS, but the EFIS does not respond back. The other half of the port, the OUT, may be used for a device that only requires data FROM the EFIS, such as a transponder that uses encoder data from the EFIS. During the display unit Setup Procedure, you will use the system Setup Guide or Equipment Supplement to program the display unit and "tell" it which device uses each serial port and which **baud rate** it requires.

Data is transported through the serial ports to make the devices work. A stream of serial data is like a sentence, and data packets are like the words. 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 9600 coded data packets per second in a sequence that the receiving device expects. The baud rate of the serial port in the EFIS must be configured to match that of the device; otherwise, the "sentences" of data packets will be scrambled. Note that only one baud rate may be programmed per serial port, so if two devices share a port, they must use the same baud rate.

ARINC 429

ARINC 429 is a data transfer method designed specifically for use in aircraft avionics systems. It was originally intended for use in airliners and other commercial aircraft where large amounts of data are transferred. It can be more confusing for a beginner to wire than a serial port because it's like a four-lane highway; each data stream IN and OUT requires two wires, referred to as A and B. ARINC 429 data rates are either 12.5 or 100 kilobits per second; therefore, each ARINC port is set to either LOW (12 kbps) or HIGH (100 kbps) depending on the requirements of the device it runs. An ARINC device commonly used with GRT systems is the Garmin GNS430/530 IFR-certified GPS, which uses the ARINC connection for better performance over the old analog VOR/Localizer data..

USB

The preferred method of data transmission for newer devices is USB. Just like the USB port on your computer, an EFIS 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 HXr has two USB ports that may be used for two USB devices, or you may attach a USB hub to run up to three devices. Some ADS-B units, such as the Radenna Skyradar, offer USB data transmission. 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 install the thumb drive to the EFIS USB port. The EFIS will upload the files when you follow the Update instructions in the system Setup Guide. Most people choose to leave a USB extension cable plugged into the USB port for easy software updating. Flight and engine data may be recorded to a USB thumb drive as a "demo file" for later examination– a useful feature for collecting flight test data.

Bluetooth

The HXr features a new method of EFIS data communication: Bluetooth wireless. With this feature, the EFIS can communicate with an Android-based tablet or smartphone that has the GRT App. This is particularly useful in tandem aircraft, where the back seat passenger can have their own PFD on a kneeboard. They can even change radio frequencies and adjust flight plans without getting near the EFIS or the rest of the instrument panel. (Note: The Android app is still in development at GRT; the beta version will be available for free download by the end of 2012.) The Bluetooth transmitter dongle is a tiny device about the size of a thumbnail that plugs into one of the USB ports in the back of the display unit.

Physical Wiring

All the wires supplied with the EFIS system are 22-gauge. Many wires are included in the wiring harness for the EFIS, and some are pre-pinned. GRT pre-connects wires that are guaranteed to be used by the builder. The wires are different colors so they may be traced throughout the airframe and avionics compartment. Labeling the ends of the wires is a good practice, especially in complex installations where there may be dozens of wires.

It will take some effort to figure out exactly how long each wire must be to reach remotely-mounted devices, but too long is always preferable to a wire that barely reaches. Always allow several inches of extra "service loop" in your wiring installations to allow easy removal of connected components from the mount locations and prevent wires from vibrating loose under tension.

Most wires already have connector ends on them, but some do not because each airplane requires different lengths of wire for different applications. Each EFIS comes with pin connectors that will need to be crimped to the ends of wires after they are trimmed to length. For information on how to crimp wires, there are some good videos on EAA's Hints for Homebuilders website, as well as written information in the publications listed at the end of this section.

The **pinout diagrams** included in this manual are designed to give you the pre-wired pin locations for required components, as well as the pin locations of the serial ports and optional items. **NC** means "no connection," or a pin that leads to nothing inside the EFIS. **TX,** or transmit, designates a Serial OUT, and **RX,** or receive, designates a Serial IN connection.

The **graphic interface diagrams** are provided as an example of how different devices can be wired to the EFIS display units. These diagrams offer an efficient way to use the serial ports based on many years of experience of our techs. Of course, this is just an example, and different third-party equipment and serial port configurations are left up to the builder and panel designer.

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 whole range of possibilities, from simple to sophisticated, depending on the builder's desire and skill level.

While this manual covers the very basics of EFIS wiring & communication and the GRT HXr-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. This manual covers everything from the very basics of electricity to the proper design and installation of sophisticated IFR-capable systems.

Longtime EAA columnist Tony Bingelis's books, the *Sportplane Builder* series, 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.

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 for free download from www.faa.gov.

All of the above publications are available at Amazon.com.

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.

1.5 HXr Accessories and Packing List

Your HXr system has been carefully inspected and packaged. It includes the EFIS display unit and associated accessories. Before installing and getting started with your new system, please use the packing list that accompanied the EFIS and the following paragraphs to ensure that no items are

missing and that there is no visible damage. If any parts are missing or damaged, please contact GRT Avionics or your GRT dealer immediately.

There are a number of options for remotely mounted radios, transponders, ADS-B and XM Weather receivers that work with HXr. Because this list is constantly growing, please refer to the GRT website, www.grtavioncs.com, for the most current details about Compatible Equipment options. Some of them are available for purchase from GRT as part of your EFIS package.

Three- or four-display packages contain the same accessories as a Dual Display package and may be equipped with similar options. The EFIS to EFIS wiring harness supplied will accommodate the number of display units supplied.

Single Display Package

Qty	Part Number	Description
1	MFD-HXr-10.4	Multi-Function Display, HXr EFIS (optional 12.1)
1	AHRS-1	Attitude-Heading Reference System w/Magnetometer (single)
1	OAT-03	Outside Air Temperature Probe
1	CAB-HX-KIT-01	Display Unit Wiring Harness Kit
1	CAB-AHRS-01	AHRS Wiring Harness
1		USB Memory Stick

Dual Display Package

Qty	Part Number	Description
2	MFD-HXr-10.4	Multi-Function Display, HXr EFIS (optional 12.1)
1	AHRS-2	Attitude-Heading Reference System w/Magnetometers (dual)
1	OAT-03	Outside Air Temperature Probe
2	CAB-HX-KIT-01	Display Unit Wiring Harness Kit
2	CAB-AHRS-01	AHRS Wiring Harness
1		Inter-Display Ethernet Cable
2		USB Memory Stick

HXr EFIS Options

Qty	Part Number	Description
	GPS-H/E	GRT External GPS Module
	GPS-RAIM-H/E	RAIM GPS Module
	GPS-LPV	TSO-C145c IFR GPS
	(Varies)	Engine Monitor Package (EIS)
	XM-WEATHER	XM Weather Receiver
	USB-EXT	USB Extension Cable

SECTION 2: MECHANICAL INSTALLATION

2.1 Display Unit Installation Considerations

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 display 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 of this manual for HXr component mounting templates.

The use of nut plates behind the instrument panel greatly simplifies the task of installing and removing the 6 screws used to retain the display unit in the panel. #6 socket cap stainless steel screws are recommended.

These two FAA Advisory Circulars provide suggestions for positioning display units with respect to visual field and control location: While they are intended for Part 23 (Certified) Airplanes, the information is useful and applicable to experimental airplanes also:

- AC23.1311-1B Installation of Electronic Displays in Part 23 Airplanes
- AC 20-138A Airworthiness Approval of Global Navigation Satellite System Equipment

2.2 AHRS Installation

The Adaptive GPS/AHRS/Air data computer provides airplane with GPS navigation data, one or two attitude-heading reference systems, and an air data computer. It accepts an input from a GPS antenna, and an external digital magnetometer.

The AHRS has the ability to be mounted in 8 different orientations. This gives the installer more flexibility in where it may be mounted. In addition, the GADARHS includes user settings that allow for +/-30 degree variation in the mounting orientation, eliminating the requirement for a precision mounting surface. These settings are made through a display unit, but are stored within the AHRS.

Selecting a Location

The location of the AHRS ***must*** meet these requirements:

- The location should allow for a solid mounting, such that the GADAHRS will not vibrate.
- Must not be exposed to strong airflow from cabin heat, or cabin vent air such that it could cause rapid changes in the internal temperature of the unit. The accuracy of the attitude data could be reduced when its temperature is changing rapidly.
- Must allow the AHRS to be mounted in any one of the 8 mounting orientations, with a variation from this orientation of no more than +/- 30 degrees in roll, pitch, and yaw.

- Must not be exposed to water.

The location ***should account for:***

- The routing of pitot/static lines to the ports on the unit.
- The GADAHRS will revert to its internal magnetometer when neither the external magnetometer data nor GPS groound track data is available to it. While magnetic fields near the GADAHRS are not critical, mounting the GADAHRS away from strong magnets (motors, wires that carry heavy currents, magnetic compasses, etc.) may allow for more accurate attitude data and faster startup in this reversionary state.
- Although there is no need to remove the AHRS for maintenance or software updates, it is desirable to chose a location that considers the practical considerations of mounting and removing it.

Setting the AHRS Orientation

The mounting orientation of the AHRS is accessed this menu. This menu also includes the roll, pitch being sensed by the AHRS. The settings are accessed via SET MENU > AHRS Maintenance > Set AHRS orientation. This setting screen provides the following settings:

AHRS Orientation Lock:

After setting the orientation of the AHRS, the display unit locks access to this setting, requiring that it be unlocked before the user can alter the AHRS orientation setting. The lock feature prevents inadvertent altering of the selected AHRS orientation, as this could result in reversed roll and pitch attitude displays.

To unlock the AHRS orientation, the serial number of the AHRS (located on the label of the AHRS), must be entered into unlock code. This requires the AHRS be inspected to note its mounted orientation. The unlock code will need to be re-entered after the display unit is turned off.

AHRS Orientation Options

This entry must be set to match the installed orientation of the GADAHRS. This setting will be grayed out when the AHRS orientation is locked. It cannot be altered until the unlock code has been set with the previous setting. The available mounting orientations are defined by the direction top and connector sides of the unit, as follows:

Note: After making the appropriate selection, the AHRS must be restarted for this selection to take effect.

Top - Forward, Connector - Right
Top - Up, Connector - Aft
Top - Up, Connector - Forward
Top - Aft, Connector - Right
Top - Left, Connector - Aft
Top - Left, Connector – Forward
Top - Right, Connector - Aft
Top - Down, Connector – Aft

Orientation Settings - Adjust Roll / Adjust Pitch / Adjust Yaw

These entries allow for correcting for mounting orientation by up to 30 degrees. Adjust the roll and pitch setting as required to make the adjustment. When the knob is pressed after making the adjustment, the roll and pitch displayed on this page will reflect the effect of the new setting. It is possible that some interaction between the settings may be observed if the settings are large.

Roll and pitch can be adjusted to zero the roll and pitch data displayed (assuming the airplane is resting in a wing level/nose level position).

The yaw entry must be made by measuring the orientation of the AHRS box with respect to the longitudinal axis (centerline) of the airplane from a top-down perspective. Note that a right entry indicates the AHRS is mounted with its axis pointing to the right of the airplane longitudinal axis in the direction of the nose.

CAUTION: Adjusting the roll, pitch or yaw orientation of the AHRS requires will reduce the accuracy of the magnetometer data. A fine magnetometer calibration should be performed after these settings are changed.

2.3 Adaptive AHRS Digital Magnetometer Installation

The digital magnetometer supplied with your adaptive AHRS includes internal accelerometers to sense the orientation of the magnetometer automatically. This allows great flexibility in the mounting of the magnetometer, but determining the location of the magnetometer requires considerable care due to 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 where it is not exposed to water, and allows access to it if necessary. Keep in mind **that *the most important consideration when mounting the magnetometer is choosing a location in the airplane that is away from magnetic disturbances***.

Sharing the Magnetometer

The digital magnetometer serial data output may be shared with other GRT Avionics GADAHRS, and with the Mini-EFIS that may also be a part of your panel. To share the data, simply tee the serial output from the magnetometer with other devices. Only one source of power should be provided to the magnetometer. If your panel includes a GRT Avionics Mini-EFIS with a battery backup, we recommend using the Mini-EFIS to power the magnetometer.

Setup for the Magnetometer

Refer to the section "Validating the Magnetometer Location" to find the best location. Before validating a magnetometer location, temporarily mount the magnetometer (such as by using masking tape), Go to Set Menu > AHRS Maintenance > Set Magnetometer Orientation. Answer the prompts on the screen to begin automatic orientation of the magnetometer. Upon completion, the heading data displayed on the PFD screen should be approximately correct.

Magnetometer Mounting Requirements

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 following requirements must be met.

- The magnetometer is marked with an arrow pointing in the direction of flight. This will position the d-sub connector on the aft side.
- Mount it such that the centerline of the magnetometer is parallel to the centerline of the airplane from a top view.
- The "pitch" attitude of the magnetometer should be within the range of +/- 60 degrees.

2.2 Legacy Equipment - AHRS (Part No. AAS-) Installation

The AHRS is not affected by wiring, magnetic field, heat, temperature or vibration influences. However, good practices suggest that it should be located where these influences are minimized. The pitot and static connections are made to the AHRS, so its location should consider this.

It is important that the AHRS is mounted so that the roll, pitch and yaw axes of the AHRS are parallel to the roll, pitch and yaw axes of the aircraft. The precision that this is achieved influences the final performance of the EFIS.

There is no requirement that the AHRS roll, pitch or yaw axes be parallel to those of its associated display unit.

Be sure to mount the AHRS with the connector toward the rear of the airplane. Observe the label on the AHRS to ensure it is oriented correctly.

2.3 Legacy Equipment - Magnetometer Installation (for AHRS Part No. AAS-)

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 for mounting the magnetometer. Keep the magnetometer as far as possible from transmitting antennas (transponder and especially comm. radio) and their coaxial cables.

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 magnetometer.
2. Move the flight controls from limit to limit.
3. If the magnetometer is located within 2 feet of retractable landing gear, operate the landing gear.
4. Operate the comm. radio (transmit) and transponder (IDENT).

Observe the compass while doing each of the above. The goal is no movement, or compass movement of less than 5 degrees. If you observe greater movement, 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.

Each magnetometer and its associated AHRS work together. For this reason, they must be oriented in the same directions, that is, the pitch, roll and yaw axes of the magnetometer and the AHRS need to be parallel. A standard level can be used to orient the magnetometer and AHRS such that they are equal in roll, and in 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 these 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 2-1 shows this.

There is no requirement that the Magnetometer roll, pitch or yaw axes be parallel to those of its associated display unit.

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.

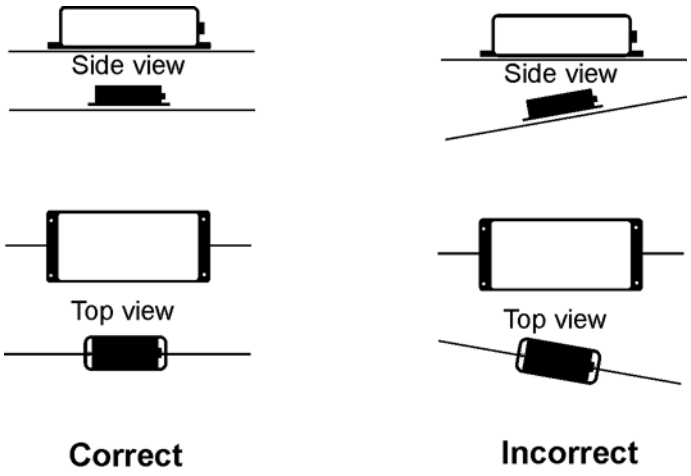


Fig 2-1. AHRS to Mag Orientation
(Applies to Legacy AHRS (Does not apply to adaptive AHRS).

2.3 GSNS (GPS) from the Adaptive AHRS

The GADAHRS can include an optional GPS receiver, or more accurately, a satellite navigation receiver. This receiver can be configured to receive multiple constellations of navigation data, such as the data from the US GPS system, the Russian Glonass, as well as Japanese and European systems that are being developed.

Configuring the Serial Port for GPS Data Input

The GPS data provided by the GADAHRS is transmitted via its serial data output. The serial input used to receive this data must be configured for GPS NMEA0183, 9600 baud.

The output from this GPS may be shared with 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 and some or all of these device will receive no data.

Configuring the Serial Port for data to the GPS

An optional serial output from the display unit, to the GPS may also be made. If this connection is not made, the GSNS will default to using all satellite constellations (not just the American GPS system), and will be set to 1 position update per second. By making this connection, the satellites used can be limited to the American GPS system only. We recommend allowing all satellite types,

and our EFIS is equally happy with once per second update rates as it is with five per second, so the default settings are acceptable.

To configure the GPS, set the serial output to 9600 baud, and use the "GPS NMEA Configuration" serial output selection.

2.4 Cooling Considerations

The GRT Horizon HXr EFIS does not require external cooling. However, as with all electronic equipment, lower operating temperatures 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. The Horizon HXr contains an internal cooling fan. Be sure that there is adequate air available so that it can cool the display unit. A few openings in the glare shield are usually more than adequate to allow natural air flow. If external forced air is used, be certain that the cooling air does not contain water – a problem often encountered when using external air.

2.5 Pitot/Static Connections

The AHRS contains the Air Data Computer. The ADC requires connection to the aircraft pitot static system. Connections on the AHRS unit take a 1/8 – 27 NPT male fitting. Connections and the entire pitot static system must be leak tight. Refer to AC 43.13.1B for approved methods to achieve this.

SECTION 3: WIRING CONSIDERATIONS

3.1 General Guidelines

Wires that are certain to be used are pre-installed in the EFIS cable assembly connectors. Optional connections to the EFIS are not installed in the D-sub connectors at the factory, however, colored aviation-grade wires with pre-installed D-sub connector contacts are included for these connections. The cable description diagram includes recommended wire colors for each connection to the EFIS components.

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, considering for chaffing and interference with moving mechanisms, etc.
- Cable lengths should include enough extra length to allow for servicing the equipment. For example, the cables which plug into the display unit should be long enough to allow them to be connected to display unit with the display unit not installed in the instrument panel.
- In general, 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 signals on the wiring.
- The checkout procedures outlined in Section must be completed to verify the EFIS is not affected by radio transmissions on any frequency.
- Consider the effects of individual component failures in the design of the system as a whole to create redundancy where necessary.

3.2 Power Connections

The display units each include 3 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 small 3 Amp-Hour gel cell a suitable emergency source.

The configuration of the power supplied to the display unit(s) is left to the installer. Considerations such as the number of power buses, the desire or not to supply one piece of equipment with power from redundant buses (which in theory allows the possibility of one device affecting both buses), the configuration of the electrical system with respect to backup equipment, and so on, 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 EFIS, the +12V power should be controlled with the switch (not ground). It is desirable to have the display units and AHRS off during the engine start if all of the buses which power them

are used for supplying power to the engine starter. This maximizes the current available for the starter, and may extend the life of the CCFL backlight in the display unit.

The display units include internal thermally-activated fuses. This protects the equipment from internal electrical faults. Power supplied to the EFIS must pass through an external fuse or circuit breaker. It should be sized to allow at least 2 amps per display unit, with a maximum rating of 5 amps.

The AHRS and display units monitor all of their power inputs, and 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.

3.3 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 0.015 V/foot, which is acceptable for wire lengths up to 10 feet.

3.4 AHRS & OAT Wiring

The AHRS & magnetometer cable supplied with the EFIS does not have a D-sub connector installed on the display unit or magnetometer cable end. This makes it easier to route this cable through the airplane. After the cable has been routed, the wires can be cut to length if desired, although new D-sub pins would need to be installed. If the wires are not cut, inspect the D-sub connector pins to verify they have not been damaged. Insert the indicated wire color into the appropriate D-sub connector housing hole according to the appropriate pinout diagram, located in the Appendix of this manual. 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 AHRS. This wiring includes the power connections necessary for the magnetometer to operate. Each AHRS and magnetometer pair is calibrated together for optimal accuracy, and thus this paring should be maintained.

An OAT sensor may be connected to the AHRS package to provide OAT for true airspeed calculations. More commonly, the OAT is connected to EIS.

3.4.1 Magnetometer Wiring

The digital magnetometer may be wired to an unlimited number of Adaptive AHRS and/or Mini-X/Mini-AP EFIS systems. This is accomplished by connecting the serial output from the magnetometer to as many devices a desired. If a battery-backup is included in a Mini that is using a magnetometer, we recommend wiring to it for the magnetometer power and ground, so that it remains powered in the event the airplane is flown on this backup. Similarly, if no Mini- EFIS systems are in the airplane, but one AHRS is provided with a battery backup, this AHRS should be used for the magnetometer power and ground.

3.4.1 Legacy Equipment - Magnetometer (for AHRS part No AAS-) Wiring

All magnetometer connections are made directly to the mating AHRS. This wiring includes the power connections necessary for the magnetometer to operate. Each AHRS and magnetometer pair is calibrated together for optimal accuracy, and thus this paring should be maintained.

3.5 Specific Equipment Interconnect Details

Detailed wiring information and setup instructions for specific GRT and third-party avionics equipment are provided in Equipment Supplements. These supplements can be downloaded from the GRT website in the Support section.

Examples of wiring diagrams and EFIS pinout diagrams can be found in the Appendix of this manual.

3.6 Autopilot Source Switch

Depending on the other equipment installed in the airplane, switches may be necessary or desirable for some functions. 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 the display unit which normally commands the autopilot is not functioning.

3.7 GPS Wiring from the Adaptive AHRS

The GADAHRS can include an optional GPS receiver, or more accurately, a satellite navigation receiver. This receiver can be configured to receive multiple constellations of navigation data, such as the data from the US GPS system, the Russian Glonass, as well as Japanese and European systems that are being developed.

The output from this GPS may be shared with 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 and some or all of these device will receive no data.

An optional serial output from the display unit, to the GPS may also be made. If this connection is not made, the GSNS will default to using all satellite constellations (not just the American GPS system), and will be set to 1 position update per second. By making this connection, the satellites used can be limited to the American GPS system only. We recommend allowing all satellite types, and our EFIS is equally happy with once per second update rates as it is with five per second, so the default settings are acceptable.

3.8 Inter-Display Communication

Display units communicate between themselves via Ethernet cable so that most entries made during flight can be made from any display unit, and will be applied to all. The ethernet connection is fast enough to transport large amounts of data, such as weather information, from one screen to the other.

3.9 Audio Tone Output

Future growth is planned to allow audio output to provide a warning tone, or possibly other type of audio output. This output may be connected to a spare input on the aircraft's intercom system.

Volume level will be controlled by menu settings within the display unit. (NOTE: This option is not yet available, but Pin B24 has been reserved for it.)

3.10 Trim and Flap Servos and Sensors

Flap & trim position indicators may be displayed on the EFIS screen using the analog inputs. Pull-up resistors for these sensors are provided internally in the HX and HXr systems; if used, they must be turned on in the Setup Menu. Use Trim/Flap Sensor Installation wiring diagram & notes in the Appendix of this manual for wiring and setup guidance.

SECTION 4: CHECK OUT & CALIBRATION

4.1 Display Unit Check Out

1. Apply power to the display unit. The LCD may flicker, and within 10 seconds, the display should show the first page.

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

4.2 AHRS/Air Data Computer Test

1. Verify that the serial ports to all AHRS units have been programmed into the EFIS. (Refer to the HXr Setup Guide for instructions to program serial ports.)

2. Apply power to display unit with internal AHRS.

3. 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 on the EFIS screen (check lower left corner for MSG box).

4. Press “MORE” softkey, then “SET MENU.” Select the “AHRS Maintenance” page.

5. Verify AHRS communications status is valid, and AHRS status is OK. Verify the AHRS is receiving serial communications from the display unit by observing that no data fields are grayed out.

Verifying Magnetometer Wiring

The magnetometer can be verified to be wired correctly and operating when the PFD screen indicates the heading reference is valid (not dashes) and is identified as “HDG”.

Troubleshooting

Since the EFIS will automatically detect and configure the serial port for the magnetometer, this Setting page can be reveiwed to see if the EFIS detected serial data from the magnetometer at some point. If it did, one of the serial ports will be configured as a magnetometer, and if serial data is being received, the serial data counter will be incrementing rapidly.

4.3 Magnetometer Location Validation

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

2. Press the MORE soft key on the EFIS display, then press the SET MENU soft key. Scroll to and select AHRS Maintenance. Locate Magnetic Heading field on this screen.

   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 magnetic heading only.

3. Observe the Magnetic Heading and verify 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 difference.

   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 greater than +/- 2 degree change is noted, either relocate the magnetometer or the offending wiring or metallic materials. Recheck.

The most common cause 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. 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.

4.4 Check Uncorrected Magnetic Heading

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

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 degrees. A red graph will appear on this page showing the calculated errors.

If errors of greater than 30 degrees are observed, see section 4.3 to troubleshoot.

4.5 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.

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 accurately, turn ON the EFIS. (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 the MORE soft key, then the SET MENU soft key. Scroll to and select AHRS Maintenance. Scroll to and select 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 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 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 degrees plus 20 degrees 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 360 degrees, plus an additional 20 degrees past magnetic north, within 3 minutes after 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 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 380 degrees.

    b. It will exit calibration mode, and will show "Calibration INVALID - Maximum correction exceeded" if a correction of greater than 127 degrees is required. (Invalid - OVERLIMIT will be displayed on the AHRS maintenance page next to the Magnetometer Calibration field.) A correction of greater than 127 degrees can be caused by incorrect mounting of the magnetometer, or location of the magnetometer too close to ferrous metal in the aircraft, or starting with the airplane not pointed toward magnetic north or magnetometer wiring errors.

The accuracy of the magnetometer calibration can now be verified.

11. Point the airplane toward magnetic north.

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

13. Verify the AHRS (on 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 degrees, and inspect the Calculated Error graph (the red line) drawn on the screen.

The magnetic heading errors should be less than 5 degrees, and can typically be reduced to about 2 degrees. 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 the +/- 30 degree range 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.

4.6 ARINC Checkout Procedure

If the ARINC 429 input and/or outputs are wired, these interfaces must be verified.

ARINC 429 Inputs

Press the MORE soft key, then the SET MENU soft key and go to the "Display Unit Maintenance" page. Scroll down near the end of this page to locate the "ARINC Status" setting. Select the ARINC Status menu by selecting "Change to activate menu," and pushing the knob. This menu will show if data is being received, and if it is valid. If the ARINC Counter is changing for each input that has been wired to equipment in the airplane, and this equipment is transmitting ARINC data, the counter will be increasing. The counter can increase even if the input is wired backwards, so the data must also be verified.

Verifying Valid Data

The status menu will show labels for data it expects to receive. For each device that sends ARINC data to the EFIS, if any data can be confirmed, the interface can be assumed 100% functional. For example, if a Garmin 430 is wired to the EFIS, it will send the VOR/ILS frequency tuned on the radio. If the ARINC status page shows the same frequency displayed on the GNS430, the interface is functional.

Troubleshooting

If the counter is not changing, the device that transmits the data is not sending data, or the electrical connection is open circuit for one or both of the 429 electrical connections.

If the counter is counting, but no valid data is observed, the two 429 electrical connections are reversed, or are not from the same ARINC output.

Section 5: Equipment Interconnect Details

5.1 Serial Ports

The GRT Horizon HXr has 8 high speed serial ports. Pinout diagrams are available in the Appendix of this manual. Check the website, www.grtavionics.com, for periodic updates as capabilities are added to the system.

Each serial port has a user-definable assignment and baud rate so the EFIS may be configured to the equipment attached to it. The connector diagrams in the Appendix of this manual and on the website provide general suggestions for serial port assignment. You may use any serial port with baud rates compatible with the equipment connected to it. Note that the baud rate for a port is the rate for both input and output. Detailed instructions for configuring serial ports are in the HXr Set-Up Guide and Equipment Supplements.

5.2 Inter-Display Link

Display units communicate via ethernet cable so that most entries made during flight can be made from any display unit, and will be applied to all. The data that is transmitted on the Inter-Display Link is user-defined (Set Menu, General Setup, Inter-Display Link). It is best to design the system to allow devices to communicate directly to multiple screens for redundancy, but the number of serial ports available may limit this. Data may also be shared via the Inter-Display Unit Link, which allows the serial ports to be used for more devices. If more than two HXr displays are connected, it is necessary to use an ethernet hub.

5.3 ARINC 429

All Horizon HXr units have a built-in ARINC module independent of the eight serial ports. GRT Horizon uses of ARINC include control of an autopilot using GPSS/GPSV mode, accepting TIS information from a GTX 330 transponder, and exchange of information with GPS and Nav receivers The connections are made via 9-pin D-Sub, designated Connector C.

The ARINC 429 connection provides 2 serial inputs and 1 serial output that conform to the ARINC 429 serial communication standard. The inputs may be configured for various uses according to the equipment installed in the airplane.

5.4 Analog Input

The GRT HXr has eight user-configurable analog inputs. Similar to the serial ports, the analog inputs may be configured to fit the attached equipment. Common uses include such items as flap and trim position indicators, although any 0-12 volt signal may be displayed.

5.5 USB Ports

Each HXr display unit has 2 USB ports. Their primary function is to upload software updates using a USB thumb drive memory stick. The USB stick may also be used to record flight data. USB

extension cables are available so that a receptacle for a USB memory stick can be located at a convenient place in the cockpit.

Many new devices, such as ADS-B receivers, use USB as the primary means of communication with the EFIS. A USB hub may be used to connect up to three devices to one of the EFIS USB ports.

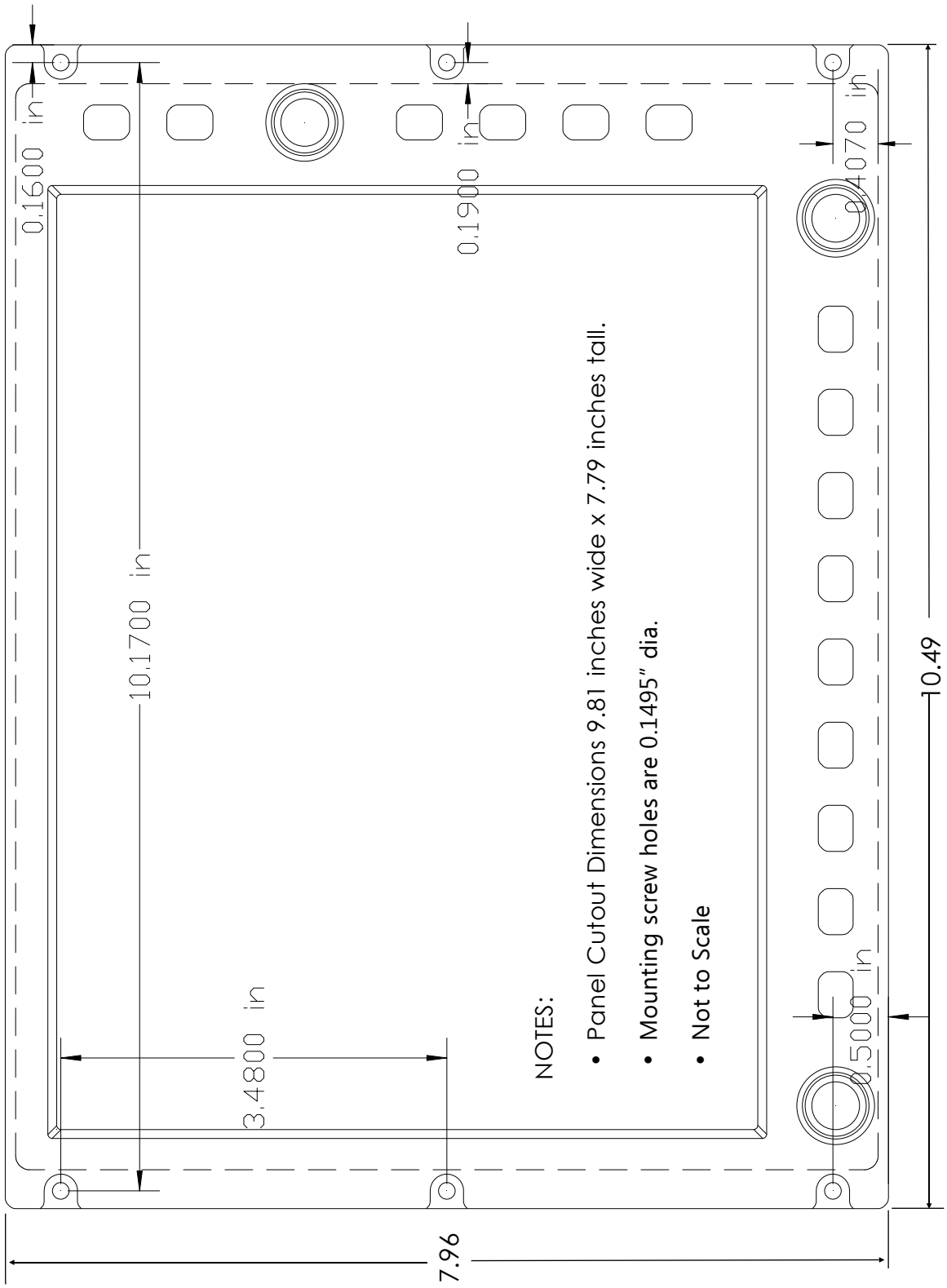
5.6 GRT GPS Modules

The HXr may be wired to an external panel-mount GPS, and/or a GRT Avionics GPS receiver. GRT offers two GPS receiver options. The Adaptive AHRS may include an optional WAAS GPS/GSNS receiver within it, or the GRT Avionics RAIM GPS module may be used. Please note that the GRT RAIM and WAAS GPS/GSNS receivers do not meet the certification requirements for stand alone use for IFR flight at this time. However, the RAIM function does provide integrity monitoring, such that it can detect inaccurate data from a GPS satellite, thus providing more assurance that the GPS position is accurate. A certified IFR GPS such as a GNS430/530 must be coupled to the HXr for GPS approaches at this time.

5.7 Specific Equipment Interconnect Details

Please refer to the Appendix of this manual for sample interconnect diagrams. Several diagrams are provided as examples of simple and more complex systems, but the final configuration of the system is completely up to the panel designer. Radios, GPS units, transponders, and other devices compatible with HXr each have a Compatible Equipment Supplement that contains information on wiring, setup programming, and user interface. Refer to these supplements together with the manuals from the device manufacturers for proper installation, setup and use. Supplements are downloadable from the Support page of the GRT website, www.grtavionics.com.

Appendix: Mounting, Wiring & Interface Diagrams

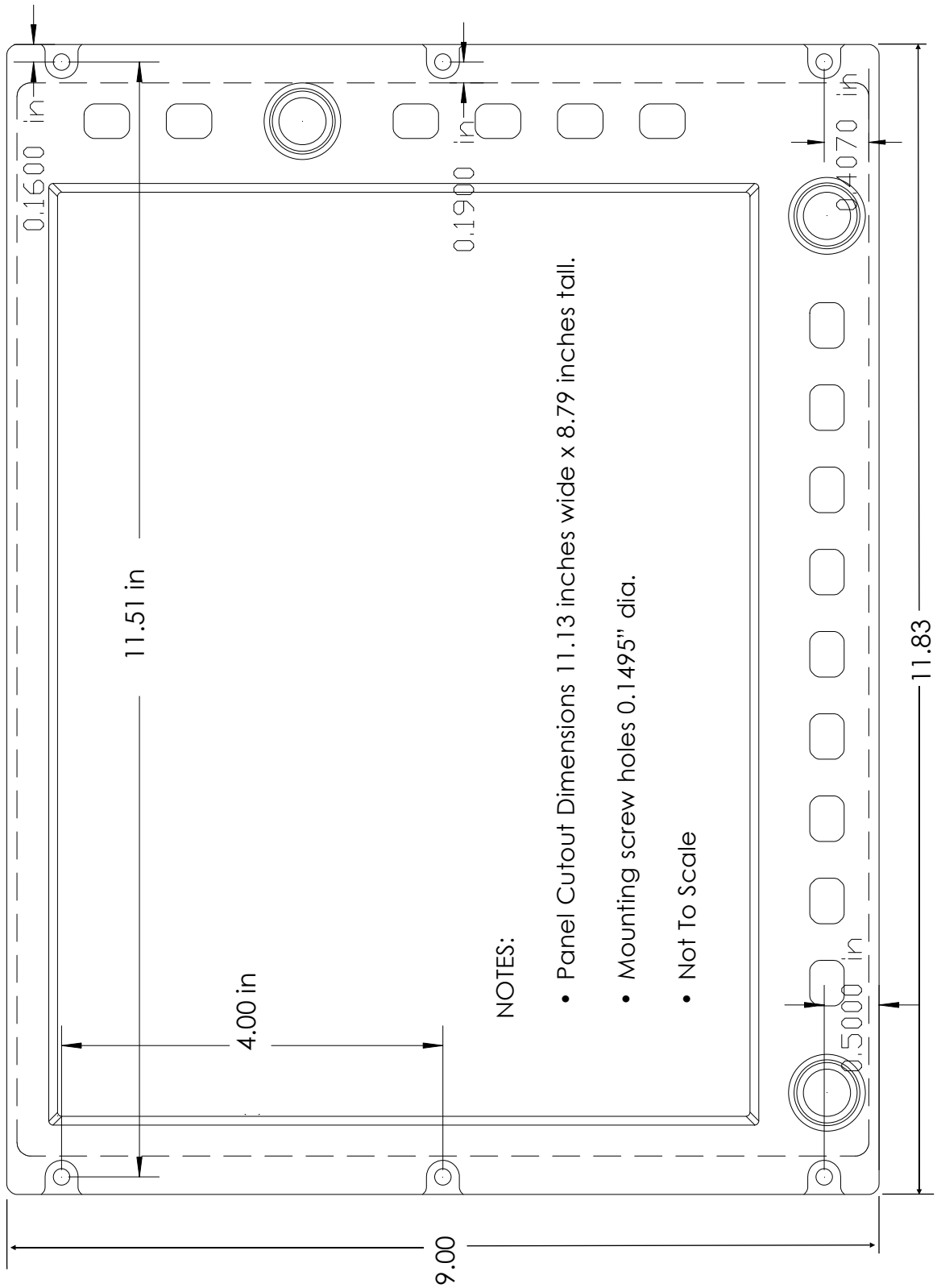


10.4" HXr

Mounting Template

Rev B, 11-16-12

GRT AVIONICS



12.1" HXr

Mounting Template

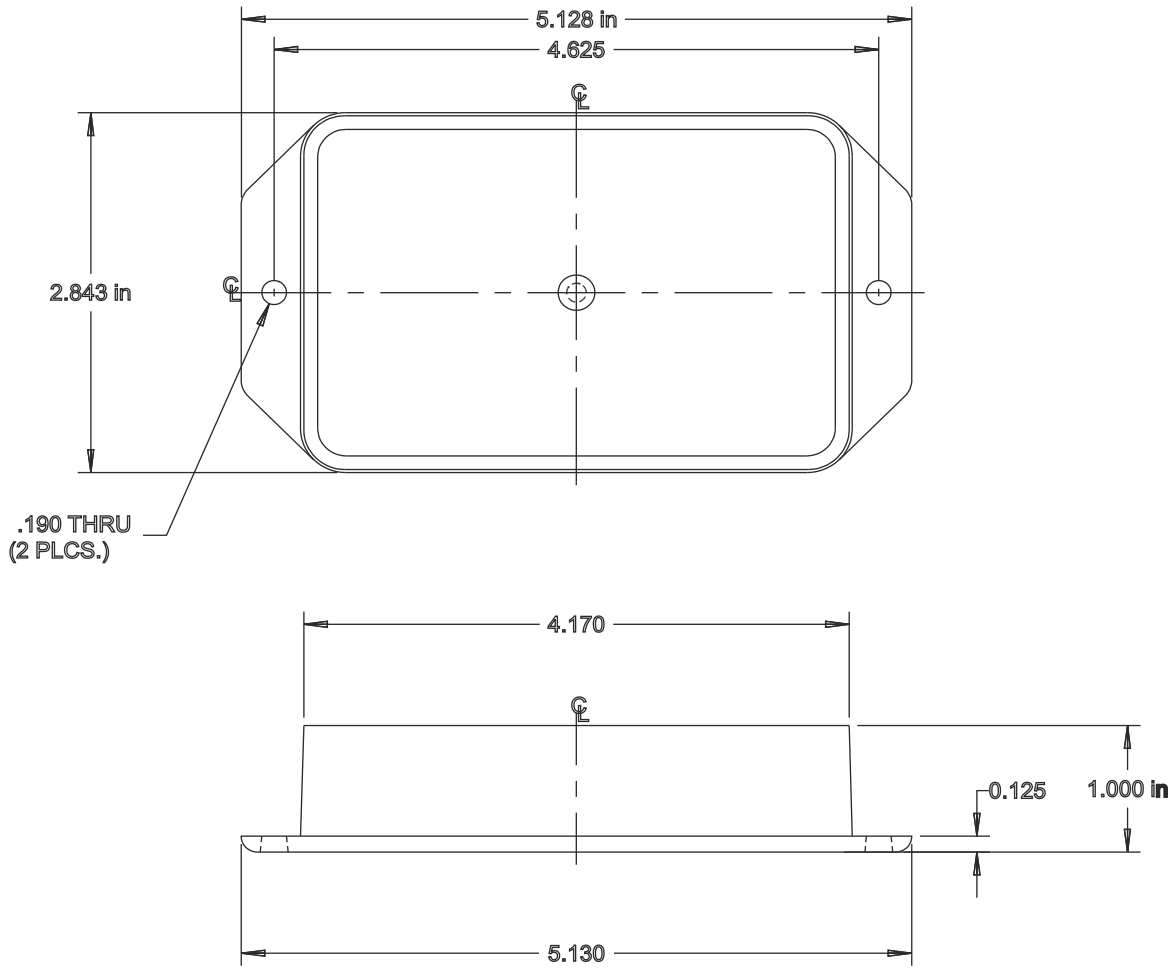
Rev B 11-16-12

GRT AVIONICS

- External GPS module
- RAIM GPS module
- ARINC module
- Magnetometer

Notes:

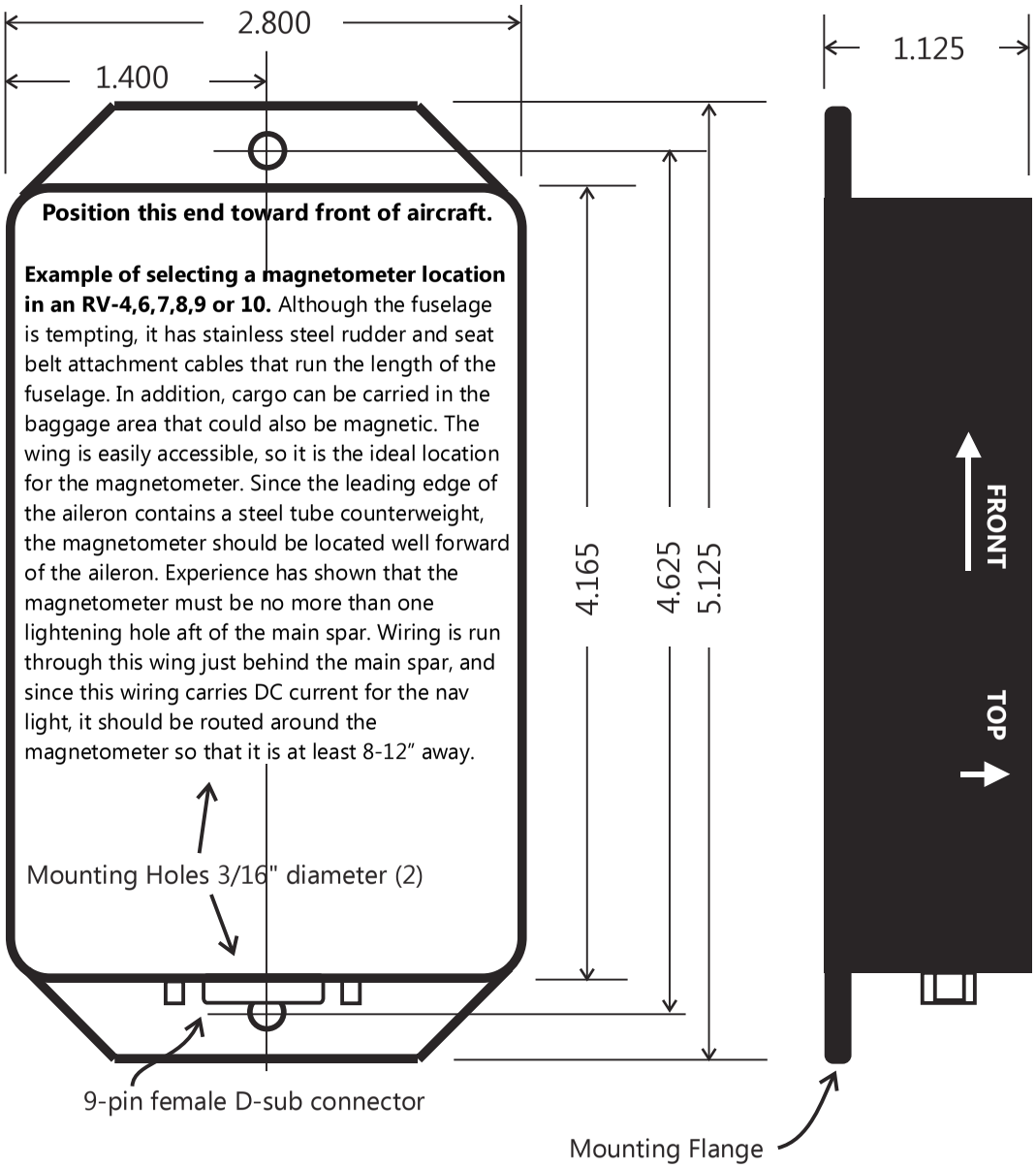
- Drawing shows height of module mounting platform only.
- GPS and ARINC modules are 9/16" taller than mount.
- Allow an extra 3" above ARINC module for D-sub connector.



GRT AVIONICS

External Module Footprint and Mounting Holes

Module Dimensions Rev A.cdr

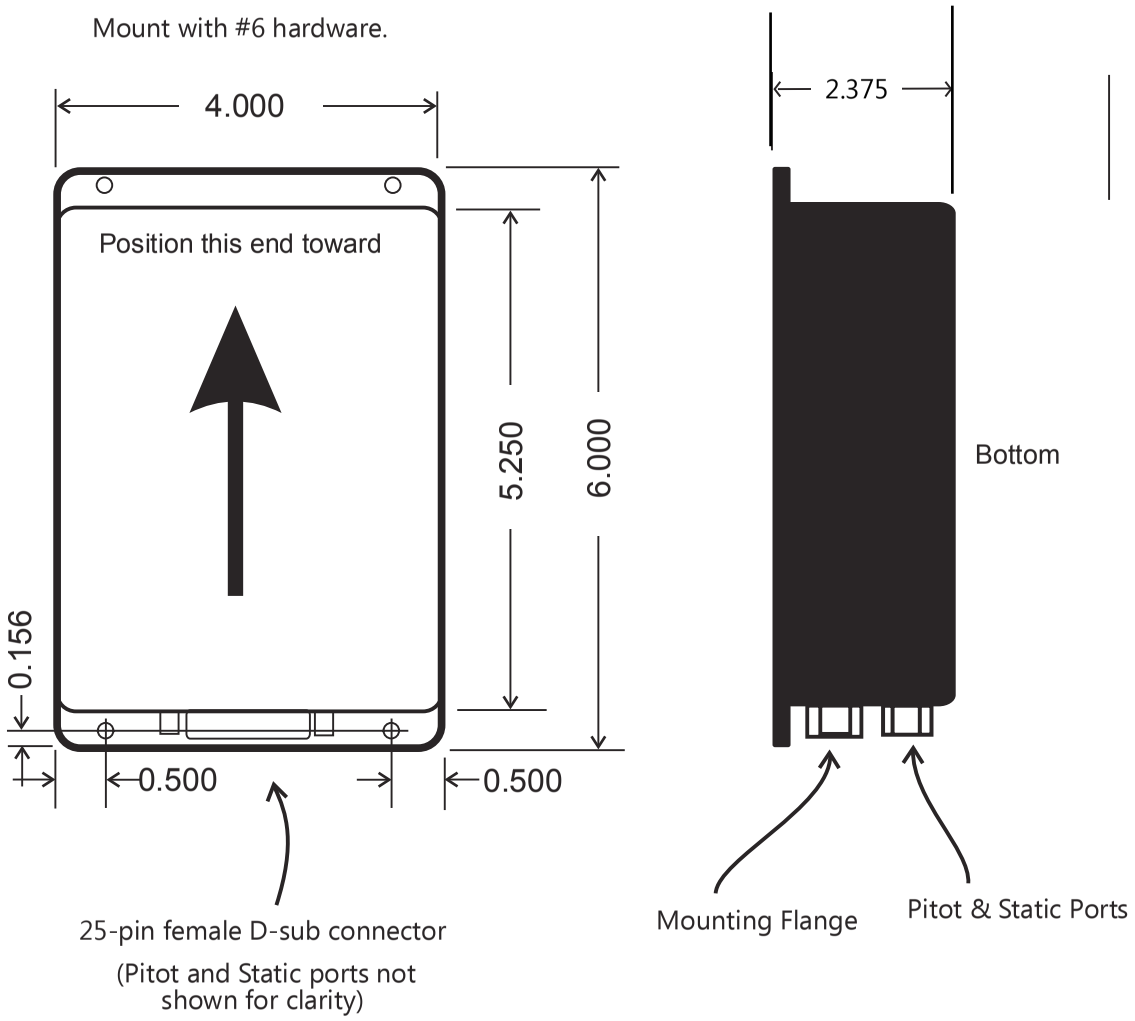


1. Orient with the end opposite the D-sub connector toward the front of the aircraft.
2. The recommended location for the magnetometer is in the wingtip. The magnetometer must be as far away as practical from ferrous metal, moving ferrous metal (such as bellcranks, landing gear, etc), stainless steel 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. See section 3 for mounting orientation.
8. The magnetometer is not affected by temperature or moisture.
9. Mount with brass or nylon hardware only.

GRT AVIONICS

Digital Magnetometer Installation

5/15/12 Mag_D.cdr



Installation Notes:

1. The unit should be mounted in the cabin to minimize the possibility of the formation of condensation.
2. See section 3 for mounting orientation options.
3. The mounting location should not expose the AHRS/Air Data computer to direct airflow from cabin heat or fresh air vents.
4. The structure to which the unit is mounted to must be rigid.

GRT AVIONICS

Adaptive AHRS/GPS Installation Notes

2/24/04 Ahrs_B.cdr

Display Unit 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 that are most likely to be used are pre-installed in the connector at GRT. Commonly used optional wires are supplied as loose wires. Wire colors and devices assigned to serial ports are suggestions only. See HXr Interconnect Diagram for suggested system connections. NC denotes No Connection inside display unit.

Pin		Function	Wire Color
A1		Serial 6 OUT	
A2		Serial 1 OUT	
A3	▽	Serial 5 OUT	BLU
A4		Serial 2 OUT- AHRS 1 OUT (Note 2)	BRN
A5	▽	Serial 4 OUT	YEL/WHT
A6		NC	
A7		NC	
A8		NC	
A9		NC	
A10		NC	
A11		NC	
A12		NC	
A13		NC	
A14	⇨	Primary Power IN	RED
A15		Secondary Power IN	
A16		Third Power IN	
A17	⇨	Ground	BLK
A18	▽	GPS Memory (Note 1)	RED/WHT
A19		Serial 2 IN- AHRS 1 IN (Note 2)	YEL
A20		Serial 1 IN	
A21	⇨	Serial 4 IN - EIS IN (Note 3)	GRN/BLK
A22	▽	Serial 5 IN - GPS	YEL/BLU
A23	▽	Serial 3 IN	GRY/RED
A24		Serial 6 IN- Redundant AHRS (Note 2)	YEL/GRY
A25	▽	Serial 3 OUT	GRY/BLK

⇨ Connected to wiring harness

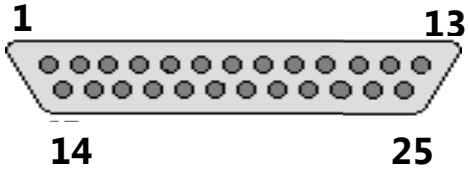
▽ Supplied as loose pinned wires

Note 1: See Section 3.7 of HXr Installation Manual for important information about aircraft battery depletion.

Note 2: Suggested AHRS connections. Wires provided with each AHRS wiring harness. A24/Serial 6 IN Redundant AHRS connection does not apply in Single AHRS/Single Display systems. See AHRS Interconnect Diagram for details.

Note 3: Connector A harness is 4 feet long with the exception of the EIS wire, which is 2 feet. Longer harnesses are available by special order.

Wiring Harness Connector A as viewed from REAR (wired side)



Display Unit Connector B Pinout Diagram

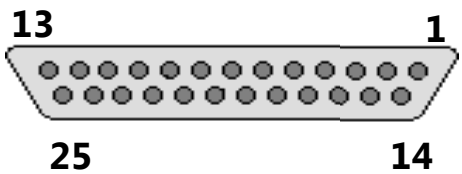
Connector B is a 25-Pin D-Sub male connector that attaches to the female EFIS 25-pin D-sub. Pins that are most likely to be used are pre-installed at GRT. Commonly used optional wires are supplied as loose wires. Wire colors assigned to serial ports are suggestions only. Pins labeled NC have no internal connection. Connector B wires are 4 feet long. Longer wires are available by special order.

Pin		Function	Wire Color
B25		NC	
B24		Reserved for Audio output (future use)	
B23	▽	Serial 7 IN	ORG/BLK
B22	▽	Serial 7 OUT	ORG
B21		Analog 1 IN	
B20		Analog 2 IN	
B19		Analog 3 IN	
B18		Analog 4 IN	
B17		Analog 5 IN	
B16		Analog 6 IN	
B15		Analog 7 IN	
B14		Analog 8 IN	
B13		NC	
B12		NC	
B11		NC	
B10		NC	
B9		NC	
B8		NC	
B7	▽	Serial 8 IN	WHT/GRN
B6	▽	Serial 8 OUT	GRN
B5		RS422 Serial 1 OUT B	
B4		RS422 Serial 1 OUT A	
B3		RS422 Serial 1 IN B	
B2		RS422 Serial 1 IN A	
B1		NC	

⇨ Connected to wiring harness

▽ Supplied as loose pinned wires

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

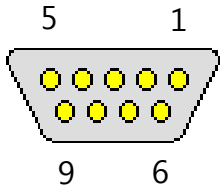


Connector C: ARINC 429 Pinout Diagram

The ARINC 429 connector, or Connector C, plugs into a 9-pin female D-sub receptacle located on the back of the HXr display unit underneath Connector A and Connector B.

A male 9-pin D-sub connector, along with eight male pins and a backshell, are included with the display unit. No wires are included because most devices use ARINC 429 already have a wiring harness.

Pin		Function
C1		ARINC 429 IN 1- A
C2		ARINC 429 IN 1- B
C3		ARINC 429 IN 2- A
C4		ARINC 429 IN 2- B
C5		ARINC 429 OUT- A
C6		Spare Ground*
C7		Spare Ground*
C8		Spare Ground*
C9		ARINC 429 OUT- B
* May be used for shield ground		

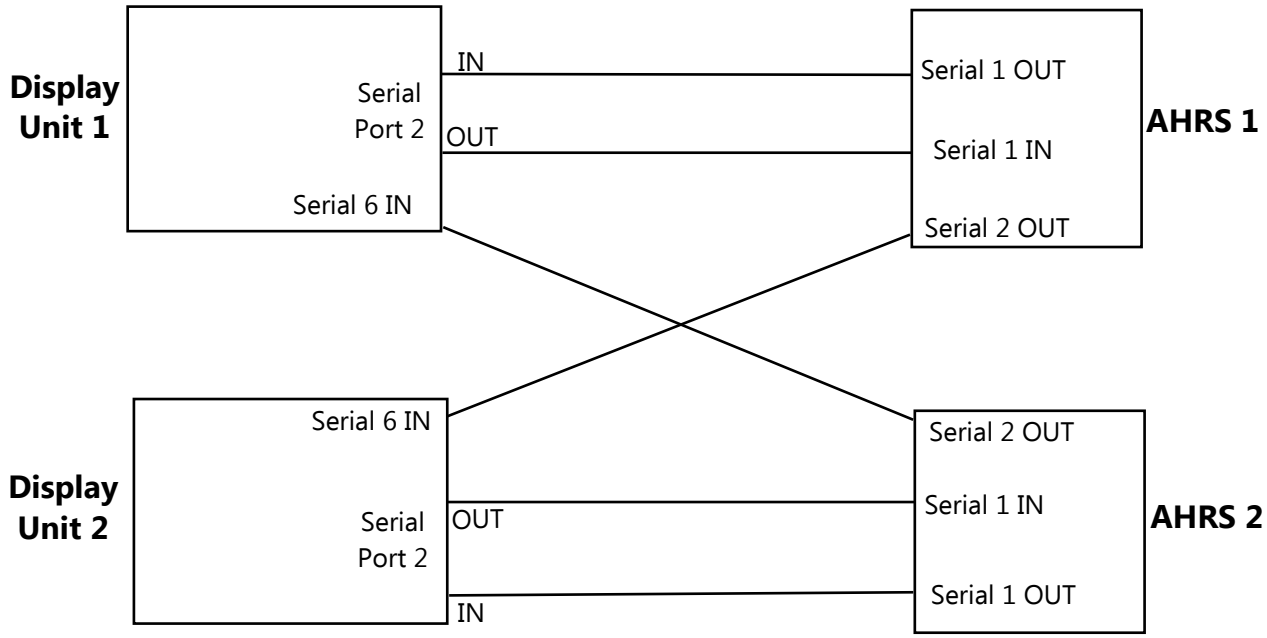


ARINC 429 Wiring Harness Connector as viewed from REAR (wired side)

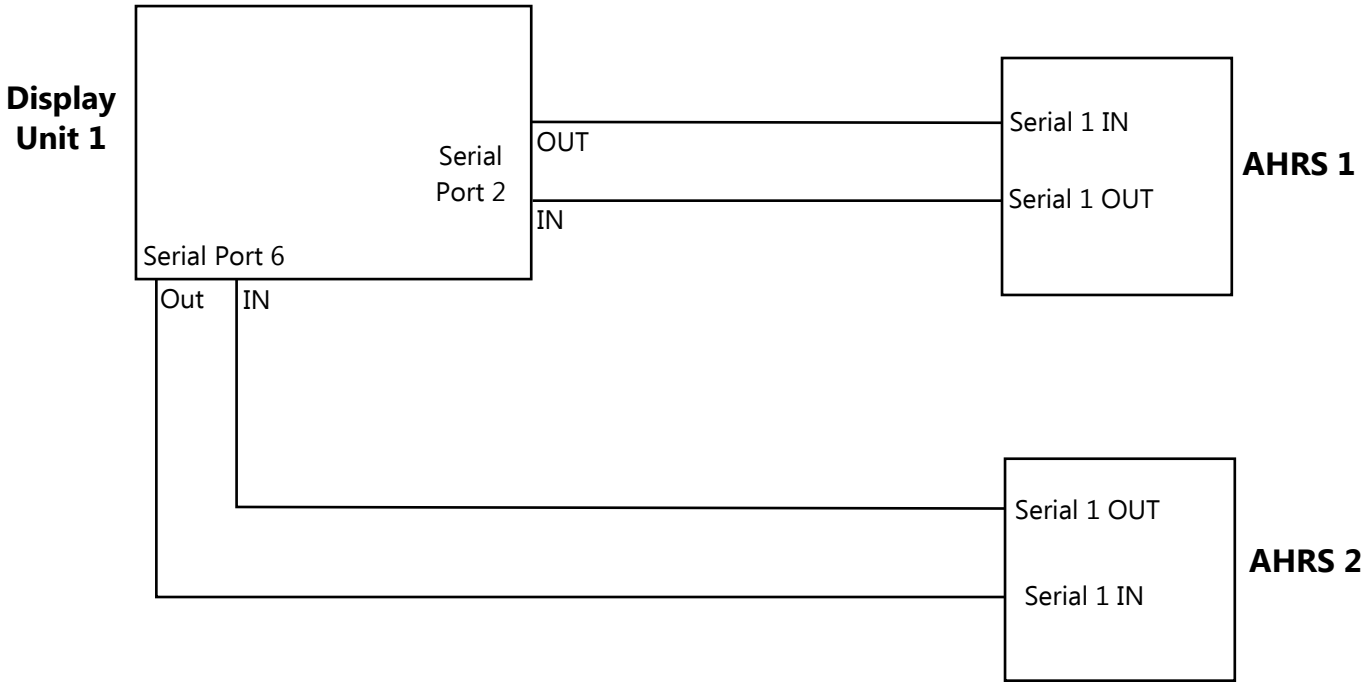
AHRS Interconnect Diagram

Each AHRS unit can be controlled only by one Display Unit. However, each AHRS can feed information to multiple display units.

Dual Display Units - Dual AHRS



Single Display Unit - Dual AHRS



Adaptive AHRS / GSNS (GPS) / Air Data Computer Connector Pinout Diagram

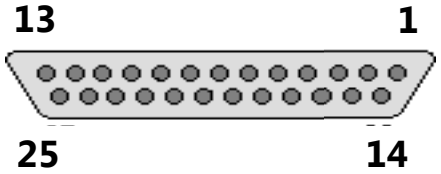
Each AHRS can only receive input from one Display Unit, however, it can send information to multiple display units. Most dual display unit systems have a dual AHRS (one box containing two AHRS units). In dual display/dual AHRS systems, each AHRS uses two serial outputs and one input from its controlling Display Unit. AHRS 1 is controlled by Display Unit 1 and AHRS 2 is controlled by Display Unit 2. See AHRS Interconnect Diagram on page A10 for more information. The AHRS harness is 4 feet long except for the magnetometer wires, which are 20 feet long.

Pin		Function	Wire Color
1	⇨	AHRS1 Serial Out 1	YEL
2		AHRS1 Serial Out 1 (Note 1)	
3	⇨	AHRS1 Serial Out 2 (dual display only)	YEL/GRY
4		AHRS1 Serial Out 2 (Note 1)	
5	⇨	AHRS1 Serial In	BRN
6		Reserved - Do Not Connect	
7		Reserved - Do Not Connect	
8	⇨	Magnetometer Serial In	WHT/BRN
9		AHRS2 Power In A (9-30 Vdc, 0.1A)	RED/BRN
10		Outside Air Temperature IN	Gray
11		Reserved - Do Not Connect	
12		Reserved - Do Not Connect	
13	⇨	Ground (Interchangable with pin 14)	BLK
14		Magnetometer Ground	BLK
15		GPS Serial Out	ORANGE
16		GPS Serial In (Optional)	BLUE
17		AHRS2 Power In B (9-30 Vdc 0.1A)	
18		AHRS2 - Serial Input	WHT/BLU
19		AHRS2 - Serial Output	
20		AHRS2 - Serial Output	
21		AHRS2 - Serial Output	
22		Magnetometer Power OUT (4.3-5.0Vdc)	WHT/RED
23	⇨	AHRS1/GPS Power In A 9-30Vdc 0.15 A	RED
24		AHRS1/GPS Power In B 9-30Vdc 0.15 A	RED/BLU
25		AHRS1/GPS Power In C 9-30Vdc 0.15 A	RED/GRN

⇨ Wire pre-installed in connector

Note 1: Extra serial port; use only in systems with more than two display units.

AHRS connector as viewed from REAR (wired side)



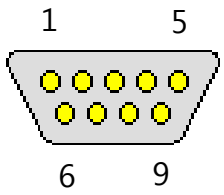
Digital Magnetometer Connector Pinout Diagram

The AHRS connector may have these wires pre-installed, but the magnetometer cable is provided without the connector attached for easier routing through the airframe. Use the following diagram to attach the connector to the cable after running the wires. Be sure to inspect the pins before inserting them into the D-sub, as damage can occur from pulling them through holes in the airframe.

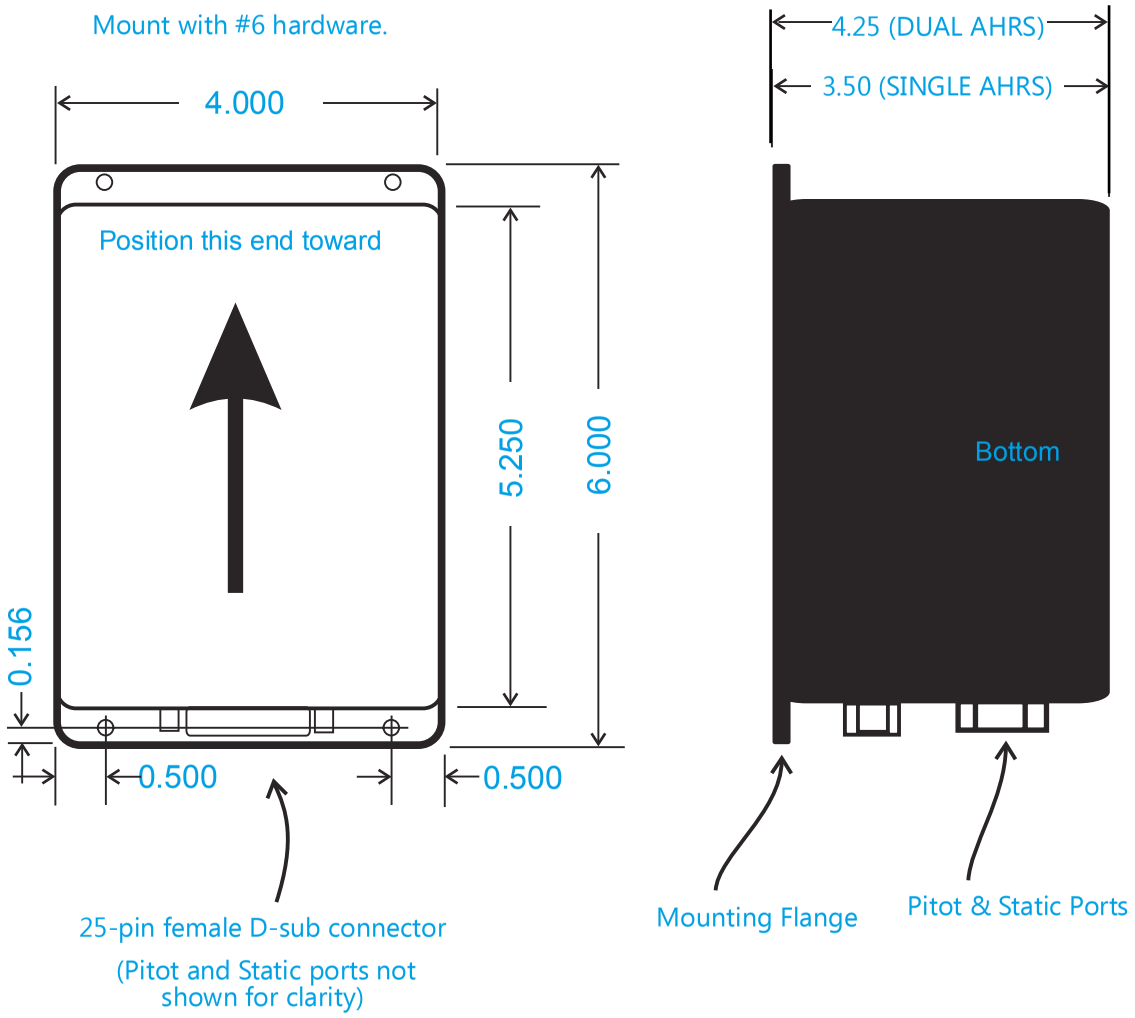
The digital magnetometer may be wired to an unlimited number of Adaptive AHRS and/or Mini-X/Mini-AP EFIS systems. This is accomplished by connecting the serial output from the magnetometer to as many devices a desired. If a battery-backup is included in a Mini that is using a magnetometer, we recommend wiring to it for the magnetometer power and ground, so that it remains powered in the event the airplane is flown on this backup. Similarly, if no Mini- EFIS systems are in the airplane, but one AHRS is provided with a battery backup, this AHRS should be used for the magnetometer power and ground.

The digital magnetometer has a 9-pin male d-sub connector.

Pin		**Function**	**Wire Color**	Connects to AHRS Pin
1		Ground	Black	14
2		NC		
3		NC		
4		NC		
5		Mag Power	WHT/RED	22
6		NC		
7		NC		
8		Mag Serial In (NC)		No Connect
9		Mag Serial Out	WHT/BRN	8



Wiring Harness Connector as viewed from REAR (the side the wires are inserted into).



Installation Notes:

1. The unit should be mounted in the cabin to minimize the possibility of the formation of condensation.
2. Orient with the end opposite the d-sub connector toward the front of the aircraft. The long edge of the mounting plate must be aligned with the centerline of the aircraft.
3. The AHRS/Air Data Computer must be oriented such that it is level in roll. This can be verified using a level placed on top of the case of the AHRS.
4. The pitch orientation of the AHRS/Air Data Computer is not critical, but should match the longitudinal fuselage reference line, or, if this is not available, be oriented so that it is level in pitch when the airplane is in a 0 degree angle-of-attack attitude.
5. The magnetometer must be mounted in the same orientation as the AHRS/Air Data Computer. The alignment between the magnetometer and the AHRS/Air Data Computer should agree within 0.5 degrees or less in all directions.
6. The mounting location should not expose the AHRS/Air Data computer to direct airflow from cabin heat or fresh air vents.
7. The structure to which the unit is mounted to must be rigid.

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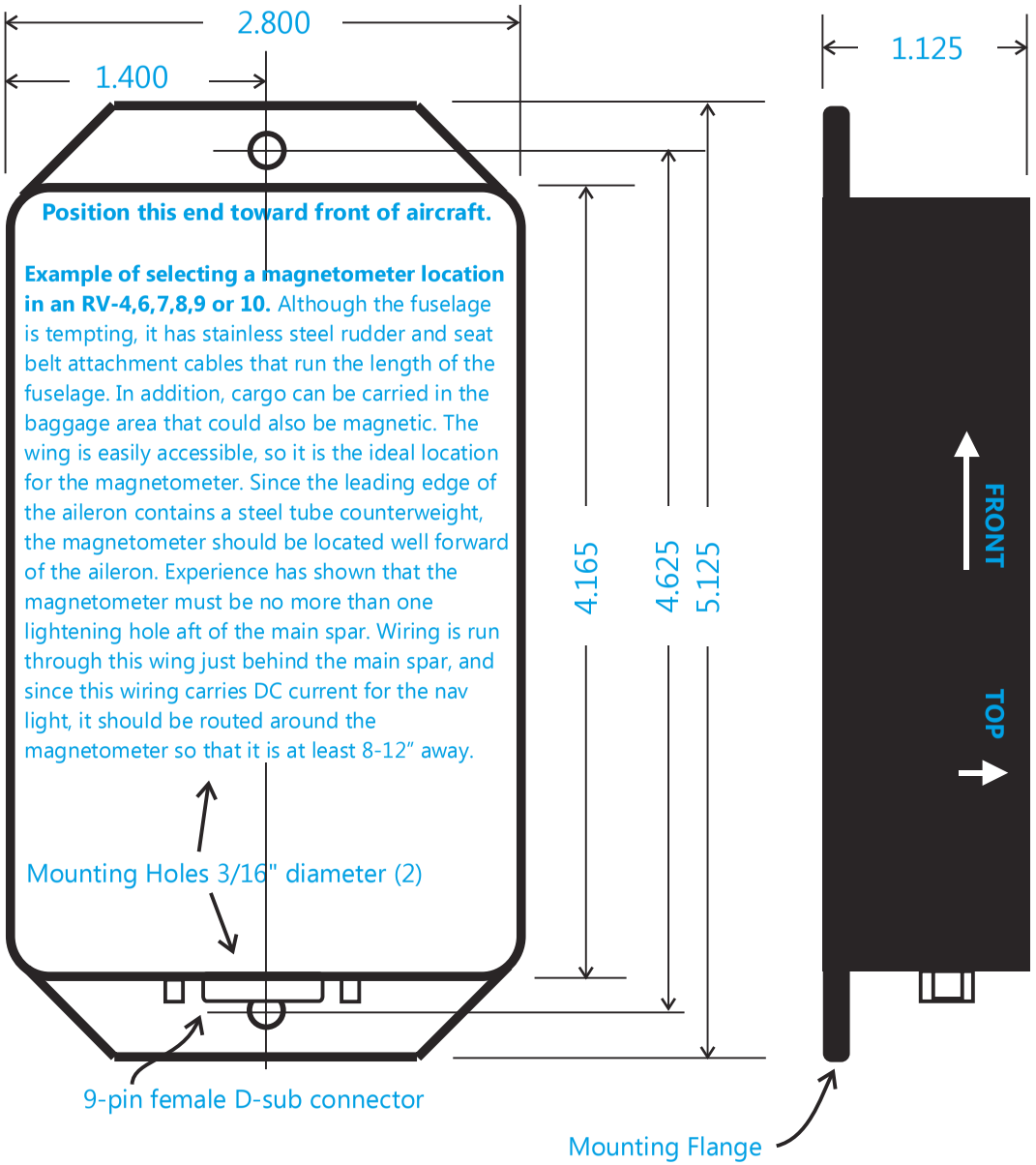
Legacy External AHRS Installation Notes

2/24/04 Ahrs_B.cdr



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 bellcranks, 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.

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Legacy Magnetometer Installation

Legacy AHRS (Part No AAS-) Connector Pinout Diagram

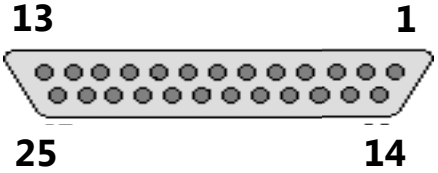
The AHRS can only receive input from one Display Unit, however, it can send information to multiple display units for redundancy. Most dual display unit systems have a dual AHRS (one box containing two AHRS units). In dual display/dual AHRS systems, each AHRS uses two serial outputs and one input from its controlling Display Unit. AHRS 1 is controlled by Display Unit 1 and AHRS 2 is controlled by Display Unit 2. See AHRS Interconnect Diagram on page A10 for more information. The AHRS harness is 4 feet long except for the magnetometer wires, which are 20 feet long.

Pin		Function	Wire Color
1	⇨	Serial Out 1	YEL
2		Serial Out 1 (Note 1)	
3	⇨	Serial Out 2 (dual display only)	YEL/GRY
4		Serial Out 2 (Note 1)	
5	⇨	Serial In 1	BRN
6		Serial In 2 (do not use)	
7	⇨	Magnetometer Z IN	WHT
8	⇨	Magnetometer Y IN	WHT/BRN
9	⇨	Magnetometer X IN	WHT/GRN
10	⇨	Outside Air Temperature IN	Gray
11		NC	
12		NC	
13	⇨	Ground	BLK
14	⇨	Magnetometer Ground	BLK
15		NC	
16		NC	
17		NC	
18	⇨	Magnetometer Control OUT	WHT/BLU
19		NC	
20		NC	
21		NC	
22	⇨	Magnetometer Power OUT	WHT/RED
23	⇨	Aircraft Power Input A	RED
24	⇨	Aircraft Power Input B	RED/BLU
25	⇨	Aircraft Power Input C	RED/GRN

⇨ Connected to wiring harness

Note 1: Extra serial port; use only in systems with more than two display units.

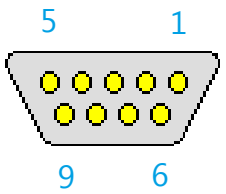
AHRS connector as viewed from REAR (wired side)



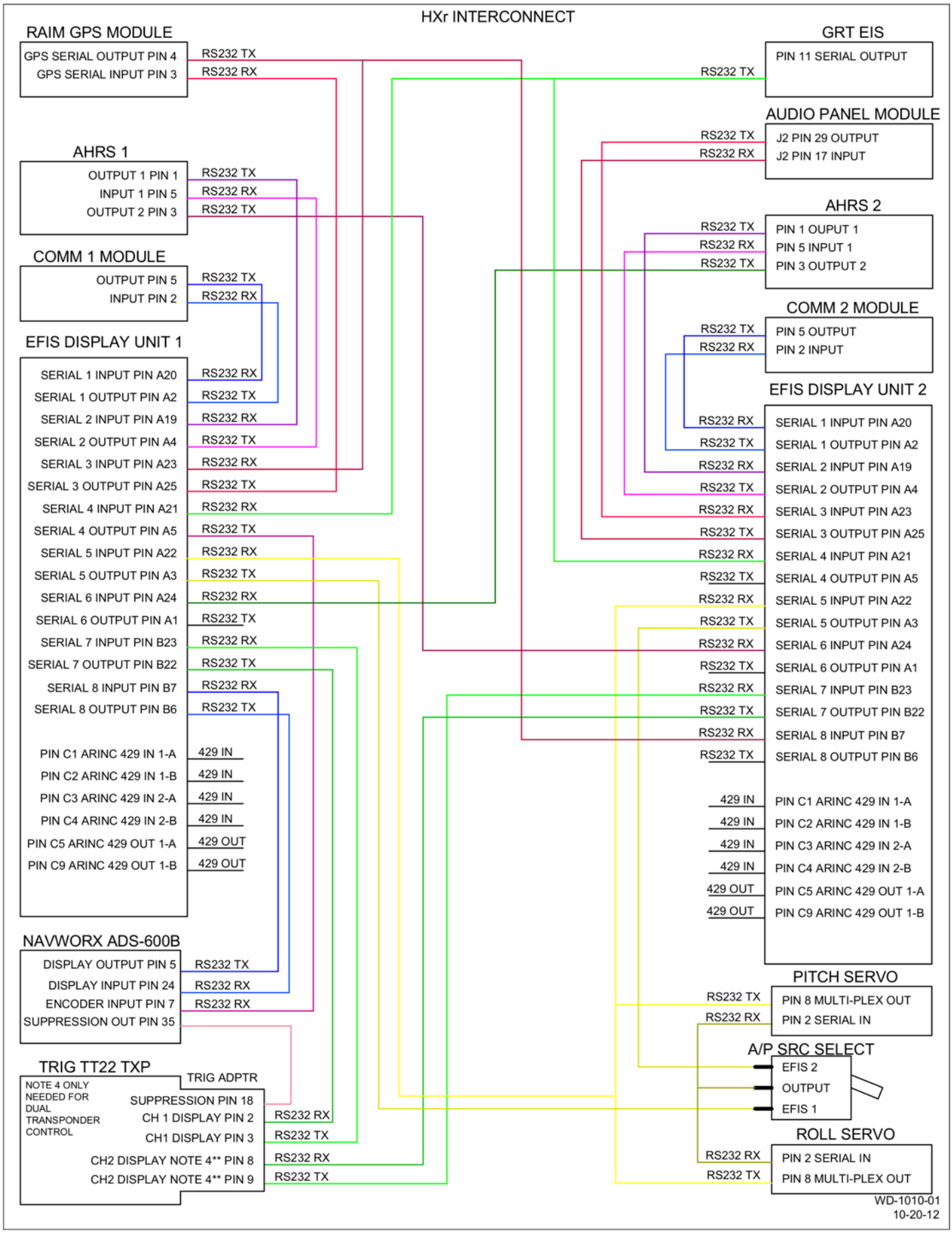
Legacy Magnetometer (For AHRS Part No. AAS-) Connector Pinout Diagram

All electrical connections for the magnetometer are made to the AHRS/Air Data Computer via 9-pin D-sub connectors. The AHRS connector has these wires pre-installed, but the magnetometer cable is provided without the connector attached for easier routing through the airframe. Use the following diagram to attach the connector to the cable after running the wires. Be sure to inspect the pins before inserting them into the D-sub, as damage can occur from pulling them through holes in the airframe.

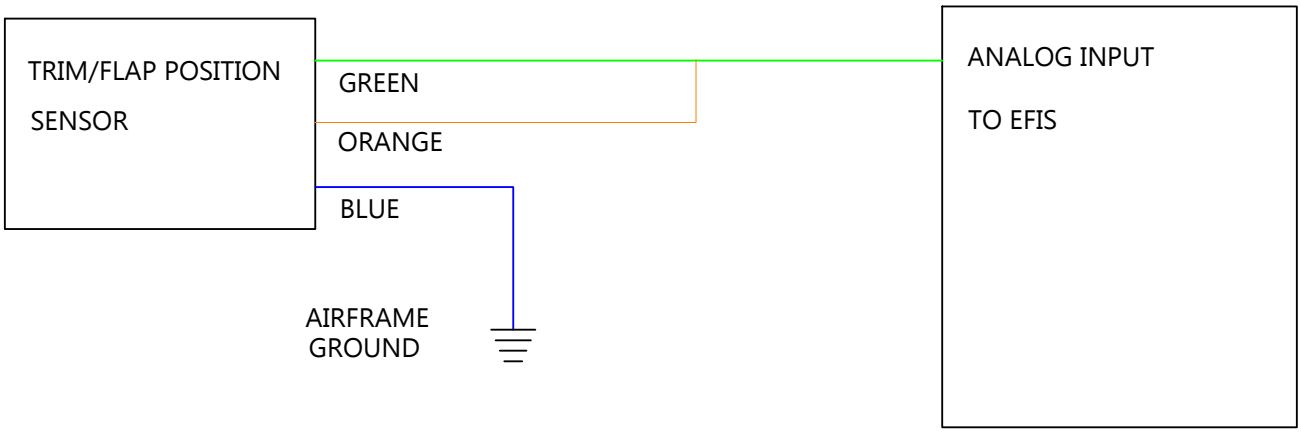
Pin		Function	Wire Color
1		MAG Y	WHT/BRN
2		MAG Z	WHT
3		MAG X	WHT/GRN
4		MAG PWR	WHT/RED
5		MAG GND	BLK
6		MAG CNTRL	WHT/BLU
7		NC	
8		NC	
9		NC	



Male 9-pin D-sub Magnetometer Connector as viewed from REAR (wired side)


HXr INTERCONNECT
RAIM GPS MODULE
GPS SERIAL OUTPUT PIN 4
GPS SERIAL INPUT PIN 3
RS232 TX
RS232 RX
AHRS 1
OUTPUT 1 PIN 1
INPUT 1 PIN 5
OUTPUT 2 PIN 3
COMM 1 MODULE
OUTPUT PIN 5
INPUT PIN 2
EFIS DISPLAY UNIT 1
SERIAL 1 INPUT PIN A20
SERIAL 1 OUTPUT PIN A2
SERIAL 2 INPUT PIN A19
SERIAL 2 OUTPUT PIN A4
SERIAL 3 INPUT PIN A23
SERIAL 3 OUTPUT PIN A25
SERIAL 4 INPUT PIN A21
SERIAL 4 OUTPUT PIN A5
SERIAL 5 INPUT PIN A22
SERIAL 5 OUTPUT PIN A3
SERIAL 6 INPUT PIN A24
SERIAL 6 OUTPUT PIN A1
SERIAL 7 INPUT PIN B23
SERIAL 7 OUTPUT PIN B22
SERIAL 8 INPUT PIN B7
SERIAL 8 OUTPUT PIN B6
PIN C1 ARINC 429 IN 1-A
PIN C2 ARINC 429 IN 1-B
PIN C3 ARINC 429 IN 2-A
PIN C4 ARINC 429 IN 2-B
PIN C5 ARINC 429 OUT 1-A
PIN C9 ARINC 429 OUT 1-B
429 IN
429 OUT
NAVWORX ADS-600B
DISPLAY OUTPUT PIN 5
DISPLAY INPUT PIN 24
ENCODER INPUT PIN 7
SUPPRESSION OUT PIN 35
TRIG TT22 TXP
NOTE 4 ONLY NEEDED FOR DUAL TRANSPONDER CONTROL
TRIG ADPTR
SUPPRESSION PIN 18
CH 1 DISPLAY PIN 2
CH1 DISPLAY PIN 3
CH2 DISPLAY NOTE 4** PIN 8
CH2 DISPLAY NOTE 4** PIN 9
GRT EIS
PIN 11 SERIAL OUTPUT
AUDIO PANEL MODULE
J2 PIN 29 OUTPUT
J2 PIN 17 INPUT
AHRS 2
PIN 1 OUPUT 1
PIN 5 INPUT 1
PIN 3 OUTPUT 2
COMM 2 MODULE
PIN 5 OUTPUT
PIN 2 INPUT
EFIS DISPLAY UNIT 2
PITCH SERVO
PIN 8 MULTI-PLEX OUT
PIN 2 SERIAL IN
A/P SRC SELECT
EFIS 2
OUTPUT
EFIS 1
ROLL SERVO
PIN 2 SERIAL IN
PIN 8 MULTI-PLEX OUT
WD-1010-01
10-20-12

GRT HORIZON HX & HXr
TRIM/FLAP POSITION



Note 1: Wire colors noted in drawing are for a RAY ALLEN COMPANY trim motor or position sensor.

Note 2: EFIS setup, SET MENU; GENERAL SETUP; ANALOG 1-8 (whichever is wired). Selections are: FLAPS, AILERON TRIM, ELEVATOR TRIM, OR RUDDER TRIM.

Note 3: EFIS setup, SET MENU; GENERAL SETUP; ANALOG 1-8 (whichever is wired). Turn Pull-Up Resistor ON.

Note 4: SET MENU; GENERAL SETUP. Set Elevator Trim Orientation DOWN trim at TOP or UP trim at TOP.

Note 5: Complete the flap and/or trim calibration in GENERAL SETUP MENU.