GRT HORIZON

Models HX, HS & WS

Installation Manual

Rev. D
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FORWARD

Welcome to Grand Rapids Technologies' GRT Horizon! We are pleased that you have chosen our product to meet your flying needs.

Visit the Grand Rapids Technologies (GRT) website (**www.grtavionics.com**) for the latest updates and supplemental information concerning the operation of this and other GRT products.

This manual describes the installation of GRT Horizon 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. GRT is not responsible for unintentional errors or omissions in the manual or their consequences.

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RECORD OF REVISIONS

Rev	Date	SW Rev	Change(s)
A	Feb 2009	32a	Initial Release
C	Nov 2011		Small changes to G430 Installation instructions.
D	Feb 2015		Modified for Adaptive AHRS/Digital Mag

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Chapter 1 GENERAL DESCRIPTION

1.1 Introduction

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

This document, the Horizon Set Up Guide, the Horizon Users Guide, the Horizon Cable Description, the Horizon Interface Diagram, and the Horizon Connector Definitions document, make up the set of installation documents. Be sure to get the latest versions of these documents from www.grtavionics.com. They are located in Support, Documents.

1.2 Description

The GRT Horizon EFIS consists of panel mounted Display Unit(s), separately mounted AHRS and a separately mounted magnetometer. There are several Display Unit options:

Standard Resolution Display (MFD-WS)
High Resolution Display (MFD-HS)
High Resolution 8.7" W x 6.47" H Display (HS-8.4)
High Resolution, Accelerated Processor with Synthetic Vision (MFD-HX)
Panel Mount Width (7.1"), Radio Rack Width (6.25") or 8.4 Display (8.7")

Two AHRS packages are available
Single AHRS (AHRS-1)
Dual AHRS (AHRS-2) (standard with dual display systems)

Please consult www.grtavionics.com Support, Documents for the latest dimensions.

The display faces are coated with a special coating which is very sensitive to skin oils, waxes and abrasive cleaners. It is very import to clean the display with an eyeglass lens cleaner and a clean lint free cloth.

1.3 Certification

The GRT Horizon EFIS is not certified for installation in FAA Type Certificated Aircraft. It is designed and intended for installation in aircraft licensed as Experimental.

Chapter 2 ACCESSORIES AND PACKING LIST

Your EFIS has been carefully inspected and packaged and includes the Display Unit (DU) and associated accessories. Before installing and getting started with your new system, please use the packing list that accompanied the DU 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, Inc. or your GRT, Inc. dealer immediately.

2.1 Two Display Package

The GRT Horizon two- display package includes two DU's identified by the rear panel label, Aircraft Multifunction Display, Part Number MFD-HS, MFD-HX, MFD-WS or MFD-HS-8.4.

Packaged with the two DUs are:

- Two Aircraft Magnetometers
- One Dual Attitude-Heading Reference System (AHRS-2)
- OAT probe
- Wiring Harness, DU to DU, Two DU to AHRS / Magnetometer
- USB Memory Stick
- User's Guide and Reference Manual
- Installation Manual
- Set Up Manual

Optionally, DUs may be equipped with:
GPS, internal (WS, HS) or external (WS, HS, HX)
RAIM GPS, internal (WS, HS) or external (HX)
Engine Monitor / EIS
XM weather module
ARINC 429 interface module (standard in HX)

Packaged with GPS DUs is a GPS antenna.

Packaged with Engine Monitor DUs are:

Engine Information System (EIS-4000 or EIS-6000) Computer
Four (4) or Six (6) Exhaust Gas Temperature (EGT) Probes
Four (4) or Six (6) Cylinder Head Temperature (CHT) Probes
Oil Temperature Sensor
Oil Pressure Sensor
Manifold Pressure Sensor
Fuel Pressure Sensor
Fuel Flow Sensor
Current Sensor
Wiring Harness

Packaged with XM weather DUs is an GRT XM weather processor and WX Worx weather receiver and antenna. HX Horizon perform weather processing internally so only WX Worx receiver and antenna are supplied.

2.2 3 or 4 Display Packages

3 or 4 display packages will contain the same accessories as a Dual Display package and may be equipped with similar options. DU to DU wiring harness supplied will accommodate the number of DUs supplied.

2.3 Single Display Package

The GRT Horizon single display package includes a DU identified by the rear panel label, Aircraft Multifunction Display, Part Number MFD-HS, MFD-HX, MFD-WS or MFD-HS-8.4.

Packaged with the DU is:

- One Aircraft Magnetometer
- One Single Attitude-Heading Reference System (AHRS-1)
- OAT probe
- Wiring Harness, DU to AHRS,/ Magnetometer
- USB Memory Stick
- User's Guide and Reference Manual
- Installation Manual
- Set Up Manual

The same options are available for a single display package as a dual display package,

GPS, internal or external, (with or without RAIM)
Engine Monitor / EIS
XM weather module
ARINC 429 interface module (standard in HX)

NOTE: The current software version comes installed from GRT, Inc. Any product or software updates can be found on the Grand Rapids Technologies, Inc. website at www.grtavionics.com. Be sure you have the current software installed.

Chapter 3 MECHANICAL INSTALLATION

3.1 Display Unit Installation

Mount the display unit(s) in the desired location in the instrument panel. The main consideration in choosing a location is simply the ability to view the display unit. Since the display is fully sunlight-readable, no consideration for shielding the display unit from sunlight is required.

1. For panel mount style display units, the use of nut plates behind the instrument panel greatly simplifies the task of installing and removing the 4 screws used to retain the display unit in the panel. #6 socket cap stainless steel screws are recommended.
2. For radio rack style display units, the #6 screws on the side of the unit (2 per side) should be used to attach the display unit to the radio rack.

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 Display in Part 23 Airplanes
- AC 20-138A Airworthiness Approval of Global Navigation Satellite System Equipment

3.2 GADAHRS 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 GADAHRS 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 GADAHRS ***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 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 in this reversionary state.
- Although there is no need to remove the GADAHRS for maintenance or software updates, it is desirable to chose a location that considers the practical considerations of mounting and removing it.

Setting the GADAHRS 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 - Aft, 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.

3.3 GADAHRS Digital Magnetometer Installation

The digital magnetometer supplied with your GADAHRS 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.

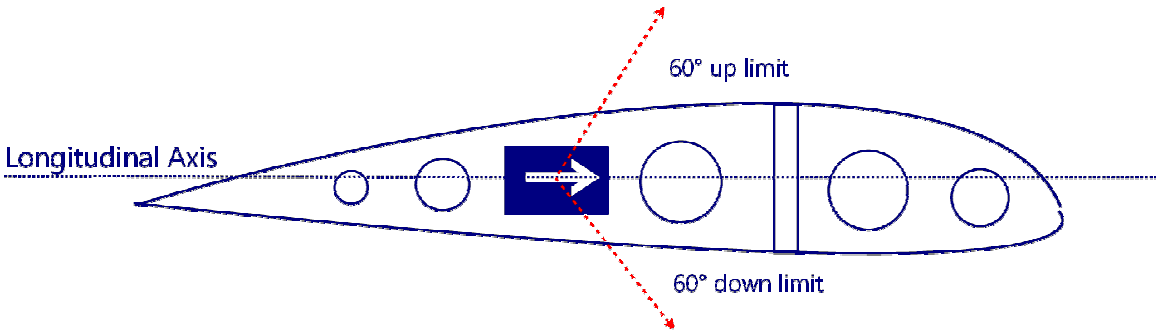
Setup for the Magnetometer

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.



Verifying Magnetometer Operation

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

Magnetometer Location Validation

Verifying a good magnetometer location starts with choosing a good location. We highly recommend mounting the magnetometer in the wingtip of the airplane if possible. Even the wingtip can include sources of magnetic disturbance, such as strobe power supplies, nav light wiring, nutplates, moving ferrous counter-weights in the ailerons, etc. The fuselage typically has more sources of disturbances, including large effects from stainless steel rudder and seatbelt cables, proximity to transmitting antennas, etc., and should not be used unless a wingtip mounting is completely impractical.

Keep the magnetometer at least 12 inches away from any current carrying wires (such as navigation or landing light wires), and more than 18 inches from ferrous metal, such as the steel mass balance tube that is typically used in the leading edge of ailerons. Use non ferrous hardware (or even double sticky tape for testing locations) for mounting the magnetometer. Keep the magnetometer as far as possible from transmitting antennas (transponder and especially comm. radio) and their coaxial cables.

Before starting the verification, make sure that no sources of magnetic interference (such as nearby magnetized tools, steel hangar doors, etc.) exist in the location where the airplane is parked. This can be verified by using a magnetic compass and verifying it shows consistent magnetic headings in the vicinity of the airplane where the magnetometer is to be mounted.

Using a Smartphone App to Validate the Magnetometer Location

A very useful tool to validate a proposed location for the magnetometer can be a magnetic field app that are available for most smart phones. The apps are free, and show a graphical view of the earth's magnetic field direction and strength. If the app shows the direction and/or strength of the field is not consistent in the area proposed for the magnetometer, this probably indicates that magnetic interference exists in this location, and the location is probably not suitable.

Using the EFIS to Validate the Magnetometer Location

- Access Set Menu > AHRS Maintenance. Locate **Magnetometer Heading** field on this screen.

NOTE: Do not use the heading data shown on the heading tape on the PFD, as this is gyro data slaved to magnetic heading.

NOTE: If the magnetometer detects a very sudden change in the magnetic heading (such as might be induced by electrical wiring when currents are turned on), the magnetometer heading will toggle between the last known good heading, and the current, but assumed invalid, heading. This indicates that magnetic interference exists.

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

- Turn on and off any electrical equipment whose wiring passes within 2 feet of the magnetometer.
- Move all flight controls from limit to limit.
- Optional. If practical, start the engine and turn on the alternator.
- 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 observe the heading while operating the landing gear.
- If greater than +/- 2 degree change is noted, either relocate the magnetometer or the offending wiring or metallic materials. Recheck. 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 and repeat the test.

Mapping the Magnetic Disturbances

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 uncorrected heading error:

- Digital Magnetometers Only: Go to Set Menu > AHRS Maintenance > Set Magnetometer Orientation.

- Go to Set Menu > AHRS Maintenance > Magnetometer Calibration. With the Magnetometer Calibration page in view, rotate the airplane 360 degrees (it may be taxied or pulled by hand with the engine off). A red graph will appear on this page showing the calculated errors. If errors of greater than 30 degrees are observed, there may be a wiring error, or the location chosen for the magnetometer has significant magnetic disturbances, and is not desirable.

Fine Magnetometer Calibration

Magnetometer calibration is required to achieve accurate magnetic heading readings. This calibration corrects for minor 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. Ideally, the engine should be running and electronic equipment turned on during calibration to simulate the electromagnetic field in the aircraft during flight conditions.

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

   It is also possible to orient the airplane to magnetic north using the magnetometer itself. This technique is more accurate assuming the magnetic disturbances from the airplane are minimal in the north direction. We recommend using this technique first, performing this calibration, and then validating the accuracy of the magnetic heading by taxiing the airplane and comparing the EFIS heading to the GPS ground track (both are displayed on the PFD.

   Another 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. This technique requires stopping the airplane after it has been established on a heading, without changing the heading. This can be problematic.

2. After the aircraft is positioned accurately, turn ON the AHRS. (If it was already on, then turn it OFF, and then back ON again) and allow at least 1 minute for the AHRS to fully stabilize.
3. Access Set Menu > AHRS Maintenance. Scroll to and select Magnetometer Calibration field on this screen.
4. Press Start soft key. The first question is “Are you sure?” Press YES if you are sure.
5. 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.
6. 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 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.
7. 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.

If calibration is unsuccessful the calibration procedure must be repeated.

If the airplane is rotated too rapidly, the calibration will not end after the airplane has been rotated 380 degrees. 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 validity of the location for the magnetometer calibration can now be verified.

1. Point the airplane toward magnetic north.
2. 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.)
3. Select the Magnetometer Calibration page. (Do not activate the calibration this time.)

4. 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.
5. 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 the orientation was set prior to calibration.
6. 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.

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 groundtrack. 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 the 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 on the PFD also. The difference between them is the magnetic heading error. If it is excessive, the fine magnetometer calibration should be repeated.

How accurate should the magnetic heading be?

Achieving highly accurate magnetic heading requires that the magnetometer be installed in a good location on the airplane, and the AHRS be mounted accurately. Due to the steep angle of the earth’s magnetic fields (only about 20 degrees off vertical), the attitude data from the AHRS must be used to process the magnetic field data from the magnetometer, and for every degree of attitude error, 3 degrees of heading error will be induced.
Heading error of less than 5 degrees are not normally apparent in normal flying, but errors this large will cause the winds calculated by the EFIS to be inaccurate.

For every 1 degree 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 degree heading error, an airplane flying at 100 knots will show a false crosswind of 8.5 knots.

AHRS Internal GPS/GSNS

The Adaptive AHRS can include an optional GPS receiver, or more accurately, a satellite navigation receiver (GSNS). 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 AHRS 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.

3.2 Legacy Equipment - AHRS Installation

The AHRS is not affected by wiring, magnetic, 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 insure it is oriented correctly.

3.3 Legacy Equipment - Magnetometer Installation

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

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

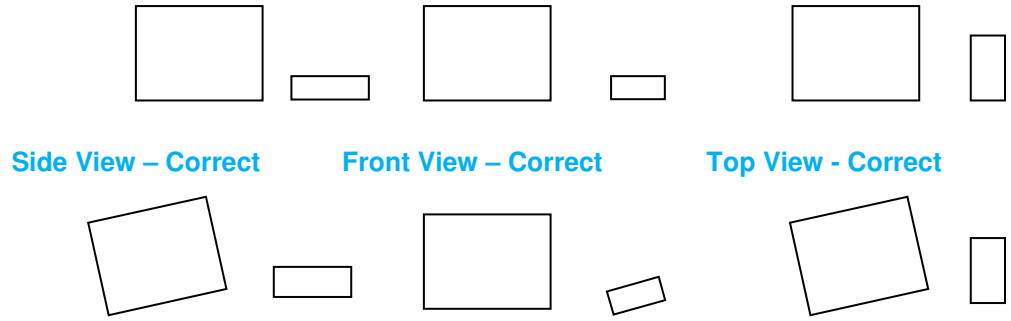
1. Turn on and off any electrical equipment whose wiring passes within 2 feet of the magnetometer.
2. Move the flight controls from limit to limit.
3. If the magnetometer is located within 2 feet of retractable landing gear, operate the landing gear.
4. Operate the comm. radio (transmit) and transponder (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. The following sketch shows this.

NOTE: Magnetometer and AHRS must be mounted in same attitude relative to each other.



Side View – Correct Front View – Correct Top View - Correct

Side View – Incorrect Front View – Incorrect Top View - Incorrect

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 insure it is oriented correctly.

Fine Magnetometer Calibration

Perform the fine magnetometer as described previously in the section , "Fine Magnetometer Calibration".

Chapter 4 COOLING CONSIDERATIONS

The GRT Horizon 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. Fans or some other means of moving air around electronic equipment are usually worthwhile. Be certain that cooling air does not contain water – a problem often encountered when using external forced air cooling air.

The Horizon HX contains in internal cooling fan. Be sure that there is adequate air available so that it can cool the display unit.

Chapter 5 PITOT STATIC CONNECTIONS

The AHRS contains the Air Data Computer. The ADC requires connection to the aircraft pitot static system. Connections on the display unit take a 1/8 – 27 NPT male fitting. To facilitate installation and removal of the display unit, quick disconnect fittings may be helpful. Connections and the entire pitot static system must be leak tight. Refer to AC 43.13.1B for approved methods to achieve this.

Chapter 6 WIRING CONSIDERATIONS

6.1 General

The cable assemblies supplied with the EFIS includes wires that are certain to be used pre-installed in the connectors. Other connections to the EFIS, which may or may not be used, are not installed in the d-sub connectors. Colored tefzel wires with d-sub connector contacts pre-installed are included for these connections. The cable description diagrams include 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. Please refer to FAA AC 43-13-1B, Acceptable Methods, Techniques, and Practices - Aircraft Inspection and Repair.
- 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. This is especially true in composite airframes since, unlike aluminum airframes, composites offer no shielding of electromagnetic energy.
- The checkout procedures should be completed to verify the EFIS is not affected by radio transmissions on any frequency.

6.2 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 less than 2 amps each, making even a small 3 Amp-Hour gel cell a suitable emergency source.

The majority of the current flow into the display unit will occur on the bus with the highest voltage. So if the voltage of the main bus or power source falls below that of the secondary bus or power supply, the secondary bus will power the display units and operation will not be interrupted. Since it is desirable to not have the display units and AHRS connected to the power supply supplying power to the engine starter during the engine start (to maximize the current available for the starter, and possibly extend the life of the CCFL backlight in the display unit),

this feature allows the fitting of a small (3-5AH) auxiliary battery to one of the power input connections provide power to the EFIS during engine start. If an auxiliary battery is fitted, provisions should be made to keep it charged.

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 that device being unaffected by failure of a bus), 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).

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.

6.3 Ground Connections

The cable assembly provided includes 20 or 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.

6.4 AHRS, Magnetometer & OAT Wiring

Typically, the AHRS & magnetometer cable supplied with the EFIS will not have a d-sub connector installed on DU 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 cable description diagram. If desired, the crimp-type d-sub connector can be replaced with a solder-type connector.

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.

Legacy Equipment - AHRS 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.

6.5 Other Wiring Considerations

6.5.1 Switches

Depending on the other equipment installed in the airplane, switches may be necessary or desirable for the following functions:

One may wish to install a switch to allow the autopilot to be controlled by either the EFIS, or directly from the GPS. The benefit of this switch is to allow the GPS to control the autopilot in the event the display unit which normally commands the autopilot is not functioning.

6.5.2 Warning Light Output

A warning output is provided 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, and the other to this output. The maximum current that can be controlled by this output is 0.2 amps.

6.5.3 Clock Power

Horizon installations require the clock to be powered at all times.

6.5.4 Audio Output

An audio output is provided. Future growth is planned to allow this 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.

Chapter 7 CHECK OUT

7.1 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, turn off the display unit, and apply power from each bus individually.
3. For dual or multiple display systems, repeat the above steps for the other display unit(s).

7.2 AHRS/Air Data Computer and Magnetometer Checkout Procedure

1. Apply power to the display unit.
2. Proper operation of the AHRS and magnetometer is indicated as follows:
    a. The display unit shows altitude and airspeed tapes.
    b. Attitude and heading data appears on the screen at the completion of the alignment period (typically less than 2 minutes).
    c. No "ATTITUDE FAIL" message is shown on the PFD screen.
    d. No failure messages are listed in the status page (accessible from the "Status" softkey on the PFD screen).
3. Select the “Set Menu” from the softkeys, and select the “AHRS Maintenance” page.
4. 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.
5. Scroll down this screen to the “Magnetic Heading” field. This is the raw magnetic heading sensed by the magnetometer.
6. To verify the magnetic heading is reasonable, the following conditions must be met.
    a. The roll and pitch attitude data must be accurate.
    b. The magnetometer must be in the same attitude as the AHRS.
    c. The magnetometer must have been electrically connected to the AHRS when the Display Unit was turned on.
    d. The magnetic heading should be accurate within 30 degrees for any direction in which the airplane is pointed. This can be verified by observing the “Magnetic Heading” data while positioning the airplane in different directions. If this accuracy is not achieved, it is likely due to a wiring error of the magnetometer connector, or magnetic disturbances in the vicinity of the magnetometer.
7. The magnetometer location validation should be performed. Complete calibration must also be performed prior to flight. Refer to the GRT Horizon Users Guide for complete magnetometer calibration instructions
8. For dual or multiple display systems, repeat the above steps for the other Display Unit/AHRS pairs.

Chapter 8 Magnetometer Location Validation

Select “Set Menu”, “AHRS Maintenance”, and locate the Magnetic Heading field on this screen. This shows the magnetic heading data provided by the magnetometer. (The heading data shown on the normal display screens is the gyro slaved heading, which responds slowly to magnetic heading changes.) Observe this reading and verify it does not change by more than +/- 2 degrees while doing the following:

- Turn on and off any equipment whose wiring passes within 2 feet of the magnetometer.
- Move the flight controls.
- If the magnetometer is located near retractable landing gear, operate the landing gear.
- Operate the comm. radio (transmit) and transponder (IDENT).

Before performing the magnetometer calibration procedure, the approximate accuracy of the uncorrected magnetic heading data must be checked. While the calibration procedure can remove errors as large as 125 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, select the magnetometer calibration page from the AHRS maintenance page by changing the selection next to "Magnetometer Calibration". While on this page, rotate the airplane 360 degrees. A red graph will appear on this page showing the errors showing the calculated errors.

If errors of greater than 30 degrees are observed, they may be caused by magnetic disturbances near the magnetometer, such a ferrous metal, magnetic fields from electric motors, radiation from transmitting antennas or the magnetometer orientation is not the same as the AHRS. (For every 1 degree of misalignment between the magnetometer and the AHRS, approximately 3 degrees of heading error can be expected.)

Location Problems

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, or transmitting antennas (comm., transponder) 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.

Wiring Problems (Legacy Magnetometer Only)

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

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

Direction	X Raw Data*	Y Raw Data*	Z Raw Data*
Magnetic North	Positive Value above 100	Between -50 and +50	Greater than positive 200**
Magnetic East	Between -50 and +50	Positive Value above 100	Greater than positive 200**
Magnetic South	Negative Value less than -100	Between -50 and +50	Greater than positive 200**
Magnetic West	Between -50 and +50	Negative Value less than -100	Greater than positive 200**

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

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

Fine Magnetometer Calibration

Chapter 9 EQUIPMENT INTERCONNECT DETAILS

9.1 Serial Ports

9.1.1 Number

The GRT Horizon HS & WS have 6 serial ports. Serial Port 1 and Serial Port 2 are High Speed. The GRT Horizon HX has 8 high speed serial ports. The

current pin outs are available in the Support, Documents section of www.grtavionics.com.

9.1.2 Configuring

Each Serial Port is configurable (Settings Menu, General Setup) as to assignment and baud rate, so the EFIS may be configured to the equipment attached to it. Detailed instructions for configuring Serial Ports are in the Horizon SetUp Guide.

9.1.3 Inter-Display Link

Display units communicate between themselves 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 Unit Link is user defined (Settings Menu, General Setup). In general one should try to have data from connected equipment sent directly to each DU so that data is available in case a DU fails. However since a limited number of Serial ports are available, inevitably some data must be shared via the Inter-Display Unit Link. If possible, the GPS data from an installed panel mount GPS is connected to each DU. XM weather cannot be shared over the link. The Inter-Display Unit Communication is accomplished by connecting a serial output port to a serial input port on each display unit (WS and HS Models).

Horizon HX use Ethernet rather than Serial ports for Inter Display Unit communications. If more than two HX are connected, it is necessary to use an Ethernet Hub. An HX will share all inputs with another HX over the Ethernet link, including Weather.

9.1.4 Internal & External ARINC & GPS Modules

Each HS or WS Horizon DU can have at most one internal module installed, ARINC or GPS. The internal module is connected to Serial Port 1. If the internal module is ARINC, the ARINC module will communicate with the Horizon and also provide a Serial port for other uses. This serial port will be degraded to low speed. If the internal module is a GPS, Serial Port 1 is not available for other use.

In a dual DU system, it is common for the PFD DU to have an internal ARINC and the MFD DU to have a GPS. One might consider a second ARINC module in the MFD DU if two GNS430/530/480 receivers are installed.

All Horizon HX have a built in ARINC module whose connection is independent of the eight serial ports and does not affect the operation of Serial port 1

Horizon WS & HS DUs may be equipped with internal or external GPS or RAIM GPS modules. The Horizon HX may be equipped with an external GPS or RAIM

GPS module. In all cases, the GPS module will use one serial port (In & Out). **Please note that even with RAIM GPS, the GRT Horizon EFIS does not meet the certification requirements for stand alone use for IFR flight.**

9.1.5 XM Weather

In HS or WS Horizon DUs, the GRT XM Weather Processor must be connected to a high speed serial port (1 or 2). If a DU has no internal module installed, either serial port may be used. If an internal module is installed, the GRT XM Weather Processor must be connected to Serial Port 2. In a dual display system, if you desire to display weather on both DUs, the output from the XM Weather Module must be connected to a high speed serial port IN on both displays since weather data cannot be transmitted on the Inter-Display Link. A high speed Serial port OUT from only one display is connected to the XM Weather Module and is used to control the XM weather processor.

9.1.6 AHRS to DU

AHRS communicate all data via serial outputs. AHRS data is typically wired to all display units. If multiple AHRS are included in an installation, if practical, all display units are wired to receive data from both AHRS. If this is not practical, the display unit that is most likely to be used to display primary flight data should be wired with both AHRS inputs to allows cross-checking of the data. This preserves automatic data cross-checking.

AHRS data may also be transmitted across the inter-display link. This allows for display and cross-checking of the data, but this benefit will be lost if a display unit becomes non-operational.

9.1.7 Engine Monitoring (EIS)

Engine monitoring (EIS) systems use one serial port IN. However, if possible, provide a serial port OUT connection for future considerations.

9.1.8 EFIS GPS General Information

Many panel mount GPS receivers require altitude and air data information. This is the same information used by transponders. It is usually Fuel/Air Data Z Format and supplied by a Serial Out port on the EFIS.

It is common to provide the EFIS with GPS data from the GPS receiver. The data may be used for GPS position (removes need for GRT GPS module) and to transmit Flight Plans from the GPS receiver to the EFIS. Panel mount GPS (GNS430 etc) are usually in GPS Aviation format while hand held GPS (GPSMAP 396 etc) are in NEMA format. The data is sent to a serial port IN.

9.1.9 HX Serial Port / Inter-Display Link / ARINC / Weather

All Horizon HX serial ports are high speed and all serial inputs, including weather are shared over the Ethernet link. All Horizon HX have a built in ARINC module whose connection is independent of the eight serial ports and does not affect the operation of Serial port 1. The Horizon HX processes XM weather data internally; it does not use the GRT XM Weather processor. The Horizon HX connects to the WX Works receiver by USB interface and cable, rather than one of the eight serial ports.

The connector diagrams 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. A port configured for 9600 baud will receive data at 9600 baud only and will send data only at 9600 baud. Here is a table of common baud rates for commonly connected equipment.

Serial			
Unit	Baud Rate	Display Unit Format(Notes)	Unit Settings
AHRS	19200		
Inter-Display Link	19200		
GRT GPS	4800	NMEA	
GRT Weather	115200	Port 2 Horizon, Port 4 Sport	
EIS	9600		
SL30	9600		
SL40	9600		
GNS430	9600	Aviation/MapCom	Shadin FADC
GNS530	9600	Aviation/MapCom	Shadin FADC
GNS480	9600	Aviation/MapCom	Shadin FADC
GTX327	9600	FAD (Z Format)	Shadin FADC w/ ALT
GTX330	9600	FAD (Z Format)	Shadin FADC w/ ALT
GNC300	9600	Aviation/MapCom	Shadin FADC
GNC250	9600	Aviation/MapCom	Shadin FADC
TruTrak	4800 or 9600	A/P NMEA or A/PAviation	
GPSMap196	Configure?	NMEA	
GPSMap296	Configure?	NMEA	
GPSMap396	Configure?	NMEA	

MX20	Configure?	
Autopilot	Configure	NMEA
Zaon	57600	
Zaon	9600	
CO Guardian	9600	

9.2 Analog Inputs

The GRT Horizon has 8 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 Position, Trim Position etc, although any 0-12 volt signal may be displayed. See www.grtavionics.com Support, Documents for more details.

9.3 USB Port

Each HS & WS display unit has a USB port on the rear. It is used to record flight data to a memory stick (also called a USB drive) and to load software updates from a memory stick. USB extension cables are available so that a receptacle for a USB memory stick can be located at a convenient place in the cockpit.

The GRT Horizon HX has two USB ports. Both are master ports. One may be used to interface to the XM weather receiver (GRT XM Weather processor not used) while the other is used to record flight data or to load software.

9.4 ARINC Interface

9.4.1 General

The optional (Horizon HS & WS) ARINC interface provides additional features to interface with GPS receivers and autopilots. The GRT Horizon HX comes standard with the ARINC interface. The connections are made via 9 pin D Sub connector. Please refer to www.grtavionics.com for up to date details.

The ARINC 429 adapter 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 other equipment installed in the airplane as described below. Each input may be configured for any of the possible functions.

The ARINC 429 output is used by the EFIS to generate data usable by a variety of equipment, such as autopilots and GPS receivers. The ARINC 429 output can be connected to as many ARINC 429 inputs (receivers) as desired, GNS430 and Autopilot for example.

GRT Horizon uses of ARINC include control of an autopilot using GPSS/GPSV mode, to accept TIS information from a GTX 330 transponder, and exchange of information with GPS and Nav receivers.

9.4.2 ARINC Check Out

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

ARINC 429 Inputs

1. Select the "SET MENU", "Display Unit Maintenance" menu. Scroll down near the end of this menu to locate the "ARINC Status" setting. Select the ARINC Status menu by selecting the "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 G430, 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 of 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.

9.5 HX Wiring

The HX Horizon has the same 25 pin d sub connectors as do the HS & WS Horizons and all the pin connections are identical. So if HS or WS displays are being replaced by HX displays, merely copy the configuration data to a memory

stick (Settings Menu, Display Unit Maintenance), change the displays and copy the old configuration to the HX displays.

If HX DUs are being installed in a new install, to take full advantage of the current and planned features of the HX Horizon,

1. Use the provided Ethernet ports for Inter-Display Link.
2. Connect Wx Worx XM Weather receiver (no GRT Processor) to one of the USB ports.

Connect peripheral equipment to Serial Ports and Analog Inputs in accordance with documentation.

9.6 Commonly Connected Equipment

Here is connection information for commonly connected equipment.

9.6.1 Localizer/Glideslope

The localizer/glideslope deviation indicators (scales or needles) provided on the EFIS can be driven from any Garmin ILS/GS receiver or combination Nav/GPS receivers (GNS430/530,480, etc). ARINC interface is not required. Specific wiring recommendations are provided for GNS430/530/480 systems below.

When Nav receivers are connected to the EFIS, the localizer and glideslope deviation and flag connections are made to the EFIS localizer/glideslope deviation and flag inputs. If the Nav receiver includes an “ILS Tuned” output, indicating an ILS frequency is selected on the Nav radio, connect this to an Analog input on the Display unit (Analog 1 recommended) as shown in the following tables.

These inputs require practically no power from the Nav receiver’s outputs, allowing the Nav receiver to be wired to as many display units as desired. Nav heads may also be wired to these connections.

For redundancy purposes, it is desirable to connect these signals to all display units.

Note that the operation of the HSI for VOR and GPS indications is performed within the Horizon, independent of the Nav receiver.

Display Unit Connector A Connections

Mating Connector: 25-pin Female D-sub (Instrument has 25-pin male D-sub)

EFIS Display Unit Pin	Function	Notes
A-6	Localizer Deviation + Left Input	

A-7	Localizer Deviation + Right Input	
A-8	Glideslope Deviation + Down	
A-9	Glideslope Deviation + Up	
A-10	Localizer Valid – Input	
A-11	Localizer Valid + Input	
A-12	Glideslope Valid – Input	
A-13	Glideslope Valid + Input	

Display Unit Connector B Connections

Mating Connector: 25-pin Male D-sub (Instrument has 25-pin Female D-sub)

EFIS Display Unit Pin	Function	Notes
B-21	Analog Input 1 – ILS Tuned Input	Pull-Up Required**

** Pull-Up required indicates a pull-up resistor is required. If this input is also connected to another system, such as a Nav head, the pull-up resistor is not required as long as this other system is installed. If this signal is not shared with other systems, a 10k ohm resistor, connected with one lead to aircraft 12V power, and the other lead “tee-d” into this connection is required.

9.6.2 Garmin GNS430 / GNS530 / GNS430W / GNS530W

Note: In this Chapter (9.6.2), wherever Garmin GNS430 is used, it applies to any of the four receivers, GNS430, GNS430W, GNS530 or GNS530W.

The following guidelines are provided for reference purposes only. They provide suggested methods for connecting this GPS to the EFIS display unit to allow optimal performance of both units.

The interface between this GPS and the EFIS allows for:

- GPS position, groundspeed and ground track to be provided to the EFIS.
- GPS flight plan data to the EFIS (although curved paths such as DME arcs, procedure turns and holding patterns are not displayed)
- Display of Localizer/Glideslope data on the EFIS
- Display of GPS CDI data to the EFIS in the same format as localizer data
- Transmission of air and fuel data to the GPS to allow RAIM integrity monitoring, and other functions within the GPS related to fuel management, etc.
- With the optional ARINC 429 interface, full VOR functionality is provided on the EFIS, and selected course is transmitted to the GNS430 from the EFIS when the OBS selection on the GNS430 is on.

9.6.2.1 GPS Data to EFIS

The Garmin GNS430 must be configured for “AVIATION” output on one its serial output channels. This output is connected to a serial input of the DU(s) (Serial Input 5 is suggested), and the DU input configured as “AVIATION” input at 9600 baud. For redundancy, this input should be provided to each DU. This connection provides GPS position, groundspeed, ground track and flight plan data to the EFIS.

9.6.2.2 EFIS to GPS Data

Configure one DU for Fuel/Air Data Z Format on one of its serial outputs (Serial 6 Out is suggested), and connect this serial output to one of the 4 serial inputs to the Garmin GNS430. Configure the Garmin GNS430 for “Shadin FADC” (9600 baud) on this input. This will allow fuel and air data to be supplied to the GPS, allowing the RAIM integrity monitoring, and other functions to operate in the GPS.

9.6.2.3 Localizer / Glideslope Data

To display VOR data on the EFIS, the optional ARINC 429 interface is required. See Chapter 9.6.2.6 below. However, Localizer/GS information may be displayed without ARINC. See Chapter 9.6.1 above. In multiple Horizon systems, usually DUs other than the PFD are wired and configured to display this data in the event the display unit with the ARINC 429 module, or its inter-display unit communication, fails.

9.6.2.4 Display Unit to GNS430 Analog Connections

Connector A Mating Connector: 25-pin Female D-sub (Instrument has 25-pin male D-sub)

EFIS Display Unit Pin	Function	Garmin 430 Connector-Pin	Notes
A-1	Serial Out 6 – RS232 Out (This is the recommended serial output to be configured as “Fuel/Air Data” output to the GNS-430.)	Any of the RS-232 serial inputs	
A-6	Localizer Deviation + Left Input	P4001-21*	
A-7	Localizer Deviation + Right Input	P4001-22*	
A-8	Glideslope Deviation + Down	P4001-28*	
A-9	Glideslope Deviation + Up	P4001-27*	
A-10	Localizer Valid – Input	P4001-24*	
A-11	Localizer Valid + Input	P4001-23*	
A-12	Glideslope Valid – Input	P4001-30*	
A-13	Glideslope Valid + Input	P4001-29*	
A-22	Serial Input 5 – RS232 GPS Data In (Aviation Format) (Suggested Port)	Any one of the RS-232 serial outputs	

*These connections are not required on a DU with an ARINC 429 Module

installed and the GNS430 VOR/ILS/GS ARINC output connected to the ARINC 429 Module. These connections should be made to all display units which do not include the ARINC 429 Module so that this data is provided to the display unit in the event the display unit with the ARINC429 module, or its inter-display unit communication, fails.

Connector B Mating Connector: 25-pin Male D-sub (Instrument has 25-pin Female D-sub)

EFIS Display Unit Pin	Function	Garmin 430 Connector-Pin	Notes
B-21	Analog Input 1– Reserved for future growth/ILS Tuned Input	P4006-29*	Pull-Up Required**
B-20	Analog Input 2 – GPS Deviations Active (true when low)	P4001-2*	Pull-Up Required**
B-19	Analog Input 3 – VOR/ILS Deviations Active (true when low)	P4001-1*	Pull-Up Required**
B-18	Analog Input 4 - OBS Select (this connection may not be required)	P4001-7*	Pull-Up Required**

*These connections are not required on a DU with an ARINC 429 Module installed and the GNS430 VOR/ILS/GS ARINC output connected to the ARINC 429 Module. These connections should be made to all display units which do not include the ARINC 429 Module so that this data is provided to the display unit in the event the display unit with the ARINC429 module, or its inter-display unit communication, fails.

** Pull-Up required indicates a pull-up resistor is required. If this input is also connected to another system, such as a Nav head, the pull-up resistor is not required as long as this other system is installed. If this signal is not shared with other systems, a 10k ohm resistor, connected with one lead to aircraft 12V power, and the other lead “tee-d” into this connection is required.

9.6.2.5 Configuring the Display Unit for GNS430 Analog Inputs

The display unit must be configured according to the following table to enable it to read the above analog signals.

Set Menu Page	Setting	Value
General Setup	Analog 1 Function	ILS Tuned
General Setup	Discrete 1 Active Voltage	Low
General Setup	Analog 2 Function	GPS Deviation Active
General Setup	Discrete 2 Active Voltage	Low
General Setup	Analog 3 Function	VOR/ILS Deviations Active

General Setup	Discrete 3 Active Voltage	Low
General Setup	Analog VOR/ILS Inputs	Nav1 (or Nav2 if this display unit is wired to Nav receiver 2.)
General Setup	Serial Port 6 Out (Suggested Port)	Fuel/Air Data Z Format
General Setup	Serial Port 6	Rate 9600
General Setup	Serial Port 5 In (Suggested Port)	GPS Aviation
General Setup	Serial Port 5	Rate 9600

Post-Installation checkout for analog VOR/ILS data

Turn the G430 on, and wait until it reaches the self-test page. Verify the VOR/GS deviations shown on the EFIS agree with the settings shown on the G430.

9.6.2.6 Display Unit to GNS430 ARINC 429 Connections for VOR/ILS/GS

The following connections to the GNS430 allow the EFIS to receive VOR/ILS/GS navigation information from the GNS430 via ARINC. The data transmitted to the EFIS also includes ILS data, making it unnecessary to connect the analog localizer and glideslope deviation and validity signals (connections shown in tables above except for Serial 6 Out, Fuel/Air Data and Serial 5 In, GPS Aviation).

ARINC 429 Adapter Pin	Function	GNS430 Pin	GNS430 Function
C-3 (or C-1)*	VOR/ILS Input	J4006-24	ARINC 429 A - VOR/ILS Output
C-4 (or C-2)*	VOR/ILS Input	J4006-23	ARINC 429 B - VOR/ILS Output
C-5	EFIS Output May also connect to other devices, such as an autopilot	J4001-48** ARINC IN 1A (J4001-50 ARINC IN 2A)	ARINC 429 A Channel 1 EFIS Input.
C-9	EFIS Output May also connect to other devices, such as an autopilot	J4001-49** ARINC IN 1B (J4001-51 ARINC IN 2B)	ARINC 429 B - Channel 1EFIS Input.

* C-3, C-4 must be used as a pair, or C-1,C-2 must be used as a pair.
** If this input to the G430 is used by other equipment, the other ARINC 429 input may be used.

If desired, the ARINC output wires from the EFIS may connect to a switch for the autopilot data source as mentioned in Chapter 6.5.1. See Chapter 9.6.10 for more detail.

9.6.2.7 Configuring the Display Unit for ARINC Data Input (VOR/ILS/GS)

The display unit must be configured according to the following table to enable it to read the above ARINC signals:

Set Menu Page	Setting	Value
General Setup	ARINC Module Connected*	Yes
General Setup	ARINC Receive Rate*	Low (A/P Dependent)
General Setup	ARINC Transmit Rate	Low
General Setup	ARINC VOR/ILS Inputs*	Nav1 (or Nav 2 if this display unit is connected to number 2 GNS430/530)
General Setup	Analog Ext1 Nav Mode	Off
General Setup	Nav Mode Source	External
General Setup	Nav Ext1 Label	G430-1
General Setup	Analog 1-8 Function	None set to ILS Tuned, or GPS Deviations, or VOR/ILS Deviations
Primary Flight Display Setup	ILS Type	Needles or Scales (Not OFF)
Primary Flight Display Setup	Show VOR CDI on Loc	Yes (or as desired)
Primary Flight Display Setup	Show GPS on LOC/GS	Yes (required for LPV approach)

9.6.2.8 Configuring the GNS430

Refer to the GNS430 installation manual, and configure the serial input used to receive fuel / air data for FADC w/ALT format, and the serial output used to send GPS data for “Aviation” format.

Setting	Value
RS232 Input - Channel used for fuel/air data input from display unit.	Shadin-FADC
RS232 Output - Channel Used for GPS Output to display unit.	Aviation
VOR/LOC/GS ARINC 429 - TX	Low (Autopilot Requirement)
VOR/LOC/GS ARINC 429 - RX	Low (Autopilot Requirement)
ARINC429 Input - Channel 1 (or the channel connected to ARINC429 Module Output)	**Speed** Low Speed **Data** EFIS/Airdata (Provides selected course and air data.)

Post-Installation checkout for ARINC 429 VOR/ILS data

Select ARINC status on display unit maintenance page. With the G430 on, verify the VOR/ILS frequency is displayed to verify VOR/ILS ARINC data is being received.

9.6.2.9 Display Unit to GNS430 ARINC 429 for GPS

Since the Horizon database does not contain approach information, the Horizon cannot provide lateral steering for procedure turns, DME arcs, holding patterns etc. However, the GNS430 can provide GPS position, flight plan data, lateral deviation, vertical deviation, roll commands and mode selection to the Horizon over an additional ARINC connection (ARINC GPS), just like the VOR/ILS/GS ARINC connection. This information allows the EFIS to provide VNAV functions for an approach and follow roll commands from the GNS430 while still controlling pitch commands. This eliminates the need for analog inputs for deviation and requires less switching of the autopilot output between the EFIS and the GNS430. With this feature, the external switch (see Chapter 6.5.1) can be left in the EFIS position unless there is an EFIS failure. See the Horizon Users Manual, Chapter 5.3.1, GNAV for how to use these features.

9.6.2.10 Display Unit to GNS430 ARINC 429 Connections for GPS

ARINC 429 Adapter Pin	Function	GNS430 Pin	GNS430 Function
C-1	GPS Input	J4001-46	ARINC 429 A - GPS Output May also connect to other devices, such as an autopilot
C-2	GPS Input	J4001-47	ARINC 429 B – GPS Output May also connect to other devices, such as an autopilot

If desired, the ARINC output wires from the GNS430 may connect to a switch for the autopilot data source as mentioned in Chapter 6.5.1. See Chapter 9.6.10 for more detail.

9.6.2.11 Configuring the Display Unit for ARINC Data Input (GPS)

The display unit must be configured according to the following table to enable it to read the above ARINC signals:

Set Menu Page	Setting	Value
General Setup	ARINC Receive Rate*	To match GNS430 rate
General Setup	ARINC GPS Inputs*	GPS1 (or GPS 2 if this display unit is connected to number 2 GNS430/530)

9.6.2.12 Configuring the GNS430 for ARINC (GPS)

Refer to the GNS430 installation manual, and configure the serial input used to receive fuel / air data for FADC w/ALT format, and the serial output used to send GPS data for “Aviation” format.

Setting	Value
RS232 Input - Channel used for fuel/air data input from display unit.	Shadin-Fadc
RS232 Output - Channel Used for GPS Output to display unit.	Aviation
ARINC CONFG OUT DATA	GAMA 429
ARINC CONFG SPEED	Match VOR/LOC/GS output
ARINC CONFG VNAV	**Enable labels**
ARINC CONFG SDI	**LNAV 1**

Post-Installation checkout for ARINC 429 GPS data

Select ARINC status on display unit maintenance page. With the G430 on, verify the NAV Mode is displayed to verify GPS ARINC data is being received. The CDI button on the G430 will toggle the nav mode between VLOC and GPS.

9.6 3 Garmin GNS480

The following guidelines are provided for reference purposes only. They provide suggested methods for connecting this GPS to the EFIS display unit to allow optimal performance of both units.

The interface between this GPS and the EFIS allows for:

- GPS position, groundspeed and ground track to be provided to the EFIS.
- GPS flight plan data to the EFIS (although curved paths such as DME arcs, procedure turns and holding patterns are not displayed)
- Display of Localizer/Glideslope data on the EFIS
- Display of GPS CDI data to the EFIS in the same format as localizer data
- Transmission of air and fuel data to the GPS to allow RAIM integrity monitoring, and other functions within the GPS related to fuel management, etc.
- With the optional ARINC 429 interface, full VOR functionality is provided on the EFIS, and selected course is transmitted to the 480 from the EFIS when the OBS selection on the 480 is in

9.6.3.1 GPS Data to EFIS

The Garmin 480 must be configured for “MAPCOM” output on one its serial output channels. This output is connected to a serial input of the display unit(s) (serial input 5 is recommended), and the input configured as “AVIATION” input at 9600 baud. This connection provides GPS position, groundspeed, ground track and flight plan data to the EFIS.

9.6.3.2 EFIS to GPS Data

Configure the display unit for Fuel/Air Data Z Format on one of its serial outputs,

and connect this serial output to one of the 3 serial inputs to the Garmin 480. Configure the Garmin 480 for "FADC" (9600 baud) on this input. This will allow fuel and air data to be supplied to the GPS, allowing the RAIM integrity monitoring, and other functions to operate in the GPS.

9.6.3.3 Localizer / Glideslope Data

To display VOR data on the EFIS, the optional ARINC 429 interface is required. See Chapter 9.6.4.6 below. However, Localizer/GS information may be displayed without ARINC. See Chapter 9.6.1 above. In multiple Horizon systems, usually DUs other than the PFD are wired and configured to display this data in the event the display unit with the ARINC 429 module, or its inter-display unit communication, fails.

9.6.3.4 Display Unit to GNS480 Analog Connections

Connector A Mating Connector: 25-pin Female D-sub (Instrument has 25-pin male D-sub)

EFIS Display Unit Pin	Function	Garmin 480 Connector-Pin	Notes
A-1	Serial Out 6 – RS232 Out (This is the recommended serial output to be configured as "Fuel/Air Data" output to the GNS-480.)	Any of the RS-232 serial inputs	
A-6	Localizer Deviation + Left Input	P7-14*	
A-7	Localizer Deviation + Right Input	P7-13*	
A-8	Glideslope Deviation + Down	P7-31*	
A-9	Glideslope Deviation + Up	P7-30*	
A-10	Localizer Valid – Input	P7-29*	
A-11	Localizer Valid + Input	P7-10*	
A-12	Glideslope Valid – Input	P7-32*	
A-13	Glideslope Valid + Input	P7-13*	
A-22	Serial Input 5 – RS232 GPS Data In (Aviation Format) (Suggested Port)	Any one of the RS-232 serial outputs	

*These connections are not required on a DU with an ARINC 429 Module installed and the GNS480 VOR/ILS/GS ARINC output connected to the ARINC 429 Module. These connections should be made to all display units which do not include the ARINC 429 Module so that this data is provided to the display unit in the event the display unit with the ARINC429 module, or its inter-display unit communication, fails.

Connector B Mating Connector: 25-pin Male D-sub (Instrument has 25-pin Female D-sub)

EFIS Display Unit Pin	Function	Garmin 430 Connector-Pin	Notes

B-21	Analog Input 1– Reserved for future growth/ILS Tuned Input	P5-68*	Pull-Up Required**
B-20	Analog Input 2 – GPS Deviations Active (true when low)	P7-17*	Pull-Up Required**
B-19	Analog Input 3 – VOR/ILS Deviations Active (true when low)	P7-18*	Pull-Up Required**

*These connections are not required on a DU with an ARINC 429 Module installed and the GNS480 VOR/ILS/GS ARINC output connected to the ARINC 429 Module. These connections should be made to all display units which do not include the ARINC 429 Module so that this data is provided to the display unit in the event the display unit with the ARINC429 module, or its inter-display unit communication, fails.

**Pull-Up required indicates a pull-up resistor is required. If this input is also connected to another system, such as a Nav head, the pull-up resistor is not required as long as this other system is installed. If this signal is not shared with other systems, a 10k ohm resistor, connected with one lead to aircraft 12V power, and the other lead "tee-d" into this connection is required.

9.6.3.5 Configuring the Display Unit for GNS480 Analog Inputs

The display unit must be configured according to the following table to enable it to read the above analog signals.

Set Menu Page	Setting	Value
General Setup	Analog 1 Function	ILS Tuned
General Setup	Discrete 1 Active Voltage	Low
General Setup	Analog 2 Function	GPS Deviation Active
General Setup	Discrete 2 Active Voltage	Low
General Setup	Analog 3 Function	VOR/ILS Deviations Active
General Setup	Discrete 3 Active Voltage	Low
General Setup	Analog VOR/ILS Inputs	Nav1 (or Nav2 if this display unit is wired to Nav receiver 2.)
General Setup	Serial Port 6 Out (Suggested Port)	Fuel/Air Data Z Format
General Setup	Serial Port 6	Rate 9600
General Setup	Serial Port 5 In (Suggested Port)	GPS Aviation
General Setup	Serial Port 5	Rate 9600

9.6.3.6 Display Unit to GNS480 ARINC 429 Connections for VOR/ILS/GS

The following connections to the GNS480 allow the EFIS to receive VOR/ILS/GS navigation information from the GNS480 via ARINC. The data transmitted to the

EFIS also includes ILS data, making it unnecessary to connect the analog localizer and glideslope deviation and validity signals.

ARINC 429 Adapter Pin	Function	GNS480 Pin	GNS480 Function
C-3 (or C-1)*	VOR/ILS Input	P5-4	ARINC 429 A - VOR/ILS Output
C-4 (or C-2)*	VOR/ILS Input	P5-24	ARINC 429 B - VOR/ILS Output
C-5	EFIS Output May also connect to other devices, such as an autopilot	P5-7	ARINC 429 A EFIS Input.
C-9	EFIS Output May also connect to other devices, such as an autopilot	P5-27	ARINC 429 B – EFIS Input.

* C-3, C-4 must be used as a pair, or C-1,C-2 must be used as a pair.

If desired, the ARINC output wires from the EFIS may connect to a switch for the autopilot data source as mentioned in Chapter 6.5.1. See Chapter 9.6.10 for more detail.

9.6.3.7 Configuring the Display Unit for ARINC Data Input (VOR/ILS/GS)

The display unit must be configured according to the following table to enable it to read the above ARINC signals:

Set Menu Page	Setting	Value
General Setup	ARINC Module Connected*	Yes
General Setup	ARINC Receive Rate*	Low (A/P Dependent)
General Setup	ARINC VOR/ILS Inputs*	Nav1 (or Nav 2 if this display unit is connected to number 2 GNS480)

9.6.3.8 Configuring the GNS480

Refer to the GNS480 installation manual, and configure serial input for data from EFIS for the FADC w/ALT format, and serial output for data to EFIS for “GPS Aviation” format.

Setting	Value
RS232 Input - Channel used for fuel/air data input from display unit.	Fadc
RS232 Output - Channel Used for GPS Output to display unit.	MapCom
VOR/LOC/GS ARINC 429 - TX	Low (A/P Dependent)
VOR/LOC/GS ARINC 429 - RX	Low (A/P Dependent)
ARINC429 Input	**Speed** Low Speed **Data** EFIS/Airdata (Provides selected course

	and air data.)

9.6.3.9 Display Unit to GNS480 ARINC 429 for GPS

Since the Horizon database does not contain approach information, the Horizon cannot provide lateral steering for procedure turns, DME arcs, holding patterns etc. However, the GNS480 can provide GPS position, flight plan data, lateral deviation, vertical deviation, roll commands and mode selection to the Horizon over an additional ARINC connection (ARINC GPS), just like the VOR/ILS/GS ARINC connection. This information allows the EFIS to provide VNAV functions for an approach and follow roll commands from the GNS480 while still controlling pitch commands. This eliminates the need for analog inputs for deviation and requires less switching of the autopilot output between the EFIS and the GNS480. With this feature, the external switch (see Chapter 6.5.1) can be left in the EFIS position unless there is an EFIS failure. See the Horizon Users Manual, Chapter 5.3.1, GNAV for how to use these features.

9.6.3.10 Display Unit to GNS480 ARINC 429 Connections for GPS

ARINC 429 Adapter Pin	Function	GNS480 Pin	GNS480 Function
C-1	GPS Input	P5-5	ARINC 429 A - GPS Output May also connect to other devices, such as an autopilot
C-2	GPS Input	P5-25	ARINC 429 B – GPS Output May also connect to other devices, such as an autopilot

If desired, the ARINC output wires from the GNS480 may connect to a switch for the autopilot data source as mentioned in Chapter 6.5.1. See Chapter 9.6.10 for more detail.

9.6.3.11 Configuring the Display Unit for ARINC Data Input (GPS)

The display unit must be configured according to the following table to enable it to read the above ARINC signals:

Set Menu Page	Setting	Value
General Setup	ARINC Receive Rate*	To match GNS480 rate
General Setup	ARINC GPS Inputs*	GPS1 (or GPS 2 if this display unit is connected to number 2 GNS480)

9.6.3.12 Configuring the GNS480

Refer to the GNS480 installation manual, and configure serial input 1 for the FADC w/ALT format, and serial output 2 for “GPS” format.

Setting	Value
RS232 Input - Channel used for fuel/air data input from display unit.	Fadc
RS232 Output - Channel Used for GPS Output to display unit.	MapCom
ARINC CONFG OUT DATA	GAMA 429
ARINC CONFG SPEED	Match VOR/LOC/GS output
ARINC CONFG VNAV	**Enable labels**
ARINC CONFG SDI	**LNAV 1**

9.6.4 GPS 155XL / GNC 300XL

The following guidelines are provided for reference purposes only. They provide suggested methods for connecting this GPS to the EFIS display unit to allow optimal performance of both units.

The interface between this GPS and the EFIS allows for:

- GPS position, groundspeed and ground track to be provided to the EFIS.
- GPS flight plan data to the EFIS, although curved paths (such as DME arcs, procedure turns, holding patterns) are not displayed at this time.
- Display of GPS lateral (cross-track or CDI) deviation data.
- Ability to set course in to a GPS waypoint
- Transmission of air and fuel data to the GPS to allow RAIM integrity monitoring, sequencing of altitude dependent type waypoints, and other functions within the GPS related to fuel management, etc.
- For EFIS installations that include the ARINC 429 interface, selected course and magnetic heading data is sent to the GPS and CDI scaling can be read from the GPS.

Use of GPS 155XL / GNC 300XL with Horizon EFIS will require use of an external annunciator panel such as Garmin / Mid Continent MD41 to indicate GPS mode.

9.6.4.1 GPS Data to EFIS

The Garmin GPS155XL / GNC300XL must be configured for “AVIATION” output on one its serial output channels. This output is connected to a serial input of the DU(s) (serial input 5 is recommended), and the DU input configured as “AVIATION” input at 9600 baud. For redundancy, this input should be provided to each DU. This connection provides GPS position, groundspeed, ground track and flight plan data to the EFIS.

9.6.4.2 EFIS to GPS Data

Configure the display unit for Fuel/Air Data Z Format on one of its serial outputs, and connect this serial output to one of the to the GPS155XL / GNC300XL serial inputs Configure the GPS for “Shadin Fuel” (9600 baud) on this input. This will allow fuel and air data to be supplied to the GPS, allowing the RAIM integrity monitoring, and other functions to operate in the GPS.

Alternative EFIS to GPS Data Connections

Alternatively, RS232 serial altitude encoder data that is transmitted to the transponder can also be wired to the GPS instead of the fuel/aid data output. This may limit the amount of data is provided to the GPS to accommodate the needs of the transponder (resulting in less functionality in the GPS), this does allow the possibility of using 1 less serial output from the display unit. Although not conforming to the RS-232 specification, it is usually acceptable to connect this output to both the GPS, and a transponder.

9.6.4.3 No ARINC Operation

For full control of the GPS receiver, the optional ARINC 429 interface is required. See Chapter 9.6.4.6 below. Limited information may be displayed without ARINC. In multiple Horizon systems, usually DUs other than the PFD are wired and configured to display this data in the event the display unit with the ARINC 429 module, or its inter-display unit communication, fails.

9.6.4.4 Display Unit / GPS155XL / GNC300XL Analog Connections

Connector A Mating Connector: 25-pin Female D-sub (Instrument has 25-pin male D-sub)

EFIS Display Unit Pin	Function	GPS155XL/GNC300XL Connector-Pin
A-1	Serial Out 6 – RS232 Out (This is the recommended serial output to be configured as “Fuel/Air Data” output to the GNS-430.)	Any of the RS-232 serial inputs
A-6	CDI + Left Input	P101-1*
A-7	CDI + Right Input	P101-4*
A-8	TO +	P101-2*
A-9	FROM +	P101-4*
A-10	Flag -	P101-4*
A-11	Flag +	P101-3*
A-22	Serial Input 5 – RS232 GPS Data In (Aviation Format) (Suggested Port)	Any one of the RS-232 serial outputs

These connections are not required on a DU with an ARINC 429 Module installed and the GPS155XL/GNC300XL GPS ARINC output connected to the ARINC 429 Module. These connections should be made to all display units which do not

include the ARINC 429 Module so that this data is provided to the display unit in the event the display unit with the ARINC429 module, or its inter-display unit communication, fails. These signals may also be connected to a conventional Nav head, without the need for any special considerations such as isolation diodes, or the like.

Connector B Mating Connector: 25-pin Male D-sub (Instrument has 25-pin Female D-sub)

EFIS Display Unit Pin	Function	GPS155XL/GNC300XL Connector-Pin	Notes
B-18	Analog 1 ILS Tuned)	J101-10*	Pull-Up Required** Connects also to Garmin MD41 Switch/Annunciator panel, pin 9

* This connection is not required if the ARINC 429 interface is used, and connected to the GPS ARINC 429 Output from the GPS. This signal may also be connected to a conventional Nav head, without the need for any special considerations such as isolation diodes, or the like.

** Pull-Up required indicates a pull-up resistor is required. If this input is also connected to another system, such as a Nav head, the pull-up resistor is not required as long as this other system is installed. If this signal is not shared with other systems, a 10k ohm resistor, connected with one lead to aircraft 12V power, and the other lead “tee-d” into this connection is required.

9.6.4.5 Configuring the Display Unit for GPS155XL/GNC300XL Analog Input

The display unit must be configured according to the following table to enable it to read the above analog signal.

Set Menu Page	Setting	Value
General Setup	Analog 1 Function	ILS Tuned
General Setup	Discrete 1 Active Voltage	Low

9.6.4.6 Display Unit to GPS155XL/GNC300XL ARINC 429 Connections (GPS)

At the time of this writing it is believed that ARINC 429 connections to the GPS are required or GNC300XL will error out. The benefits of using the ARINC 429 interface are as follows:

- CDI scaling information is provided directly by the GPS. Without this scaling information, the EFIS attempts to duplicate the scaling based flight plan data.

- Selected Course Data is provided to the GPS from the EFIS. This allows the CDI analog output of the GPS to operate correctly when waypoint sequencing is in the "HOLD" state.
- Magnetic Heading information is provided to the GPS.

The following connections allow the EFIS and GPS155XL/GNC300XL to share information via the ARINC interface.

ARINC 429 Adapter Pin	Function	GPS155XL/GNC300XL Pin	GPS155XL/GNC300XL Function
C-3 (or C-1)*	GPS Input	J101-16	ARINC 429 A - GPS Output
C-4 (or C-2)*	GPS Input	J101-15	ARINC 429 B - GPS Output
C-5	EFIS Output May also connect to other devices, such as an autopilot	J101-32	ARINC 429 A Channel 1 EFIS Input.
C-9	EFIS Output May also connect to other devices, such as an autopilot	J101-33	ARINC 429 B - Channel 1 EFIS Input.

* C-3, C-4 must be used as a pair, or C-1,C-2 must be used as a pair.

9.6.4.7 Configuring the Display Unit for ARINC Data Input

Set Menu Page	Setting	Value
General Setup	ARINC Module Connected	Yes
General Setup	ARINC Receive Rate*	Low
General Setup	ARINC GPS Inputs*	GPS1 (or GPS 2 if this display unit is connected to number 2 GPS155XL/GNC300XL)

The display unit must be configured for "LOW" speed ARINC data. Note that since both ARINC input channels must be configured for the same rate, and since traffic data provided by the GNX330 is high speed, it is not possible to connect this GPS and the GTX330 transponder into the same ARINC 429 interface.

9.6.4.8 Configuring the GPS155XL/GNC300XL

The GPS must be configured with its ARINC 429 output as "Collins PL2 EFS" or "King EFS 40/50".

9.6.5 Altitude Encoder

Horizon WS & HS DUs have Gray code encoding outputs for transponders that require this format. These outputs are provided on connector B. Each output

(such as A1, A2, A4, etc.) from the display unit connects to the corresponding input (A1, A2, A4, etc.) of the transponder.

Gray code outputs are not available on Horizon HX. Encoding data must be sent using RS232 encoding information as described in the next paragraph. Most transponders accept RS232 serial data as described next.

9.6.6 GTX327 Transponder

The EFIS can provide altitude encoding data to this transponder. The data must be provided via a serial data output, as the gray code input to these transponders is not compatible with the gray code output provided by the EFIS.

9.6.6.1 Display Unit Connector A Connections to the Garmin GTX327

Mating Connector: 25-pin Female D-sub (Instrument has 25-pin male D-sub)

EFIS Display Unit Pin	Function	GTX327 Connector 3271 Pin Number	Notes
A-1	Serial Output 6 (Suggested Port)	19	Provides Altitude Encoding Data to Transponder. This output may also be wired to other devices (GNS430/530) requiring this data.

9.6.6.2 Configuring the GTX327

Refer to the GTX327 installation manual, and configure serial input 1 for the FADC w/ALT format.

Setting	Value
RS232 Input - Channel 1	FADC w/ALT

9.6.6.3 Configuring the Display Unit

Use the "Settings Menu", "General Setup", to select the following:

Setting	Value
Serial Port 6 Output (Suggested Port)	Fuel/Air Data (Z Format)
Serial Port 6 Rate	9600

9.6.7 GTX 330 Transponder

The EFIS can provide altitude encoding data to this transponder. The data must be provided via a serial data output, as the gray code input to these transponders is not compatible with the gray code output provided by the EFIS. This

transponder also provides traffic information to the EFIS. Traffic (TIS) may be sent via RS232 Serial link or ARINC.

9.6.7.1 Display Unit Connector A Connections to the Garmin GTX330

Mating Connector: 25-pin Female D-sub (Instrument has 25-pin male D-sub)

EFIS Display Unit Pin	Function	GTX330 Connector 3301 Pin Number	Notes
A-1	Serial Output6 (Suggested Port)	24	Provides Altitude Encoding Data to Transponder.
A-24	Serial Input 6 (Suggested Port)	25	Receives TIS data from Transponder.

9.6.7.2 Configuring the GTX330

Refer to the GTX330/330D installation manual, and configure it as follows:

Setting	Value
RS232 Input - Channel 2	FADC w/ALT
RS232 Output - Channel 2	Remote + TIS

9.6.7.3 Configuring the Display Unit

Use the "Settings Menu", "General Setup", to select the following:

Setting	Value
Serial Port 6 In (Suggested Port)	Garmin TIS
Serial Port 6 Output (Suggested Port)	Fuel/Air Data (Z Format)
Serial Port 6 Rate	9600

9.6.7.4 ARINC

Alternatively, TIS information may be transmitted via ARINC interface.

9.6.7.4.1 Connections with ARINC

GTX330 Connector P3301 Pin Number	Function	EFIS Pin	Notes
30	Traffic Out	ARINC C1 or (C3)*	ARINC Traffic
28	Traffic Out	ARINC C2 or (C4)*	ARINC Traffic
24	Fuel/Air Data In	A1	EFIS Serial 6 Out (Suggested Port)

25**	Traffic Out	A24	EFIS Serial 6 In (Suggested Port)

* C-3, C-4 must be used as a pair, or C-1, C-2 must be used as a pair
** If no ARINC input available on EFIS, use Serial connection.

9.6.7.4.2 Configuring the Display Unit

Use the "Settings Menu", "General Setup", to select the following:

Setting	Value
Serial Port 6 In**(Suggested Port)	Garmin TIS
Serial Port 6 Output (Suggested Port)	Fuel/Air Data (Z Format)
Serial Port 6 Rate	9600
ARINC Module Connected	Yes
ARINC Receive Rate	High
ARINC In 1 Function	GTX330 Traffic

** If no ARINC input available on EFIS, use Serial connection.

9.6.8 Other GPS (GPSMAP496, Lowrance etc)

The EFIS can accept and display GPS data including flight plans. Most panel mount GPS supply data in GPS Aviation / MapCom format. Most hand held GPS (GPSMAP496 etc) supply data in NMEA 0183 format.

9.6.8.1 Display Unit Connector A Connections to other GPS

EFIS Display Unit Pin	Function	Other GPS Connection	Notes
A-22	Serial Port 5 IN (Suggested Port)	Varies RS232 Serial Data OUT	Use RS232 Serial Out from Other GPS

9.6.8.2 Configuring Other GPS

Configure Other GPS for data out in either Aviation Format or NMEA 0183 format.

9.6.8.3 Configuring the Display Unit

Use the "Settings Menu", "General Setup", to select the following:

Setting	Value
Serial Port 5 Input (Suggested Port)	GPS1 Aviation /MapCom or NMEA 0183
Serial Port 5 Rate	9600
GPS1 Flight Plan Source	External

9.6.9 SL30/SL40 Nav/Com or Com

9.6.9.1 Display of Navigation Data from the SL30

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

While the RS-232 connection is the preferred method for communicating this data to the EFIS, the SL30's analog outputs for glideslope and localizer may also be connected to the EFIS. If both the RS-232 serial data connection and analog connections are made, the EFIS will use the RS-232 data.

9.6.9.2 Radio Tuning and Loading of Pre-Sets in the SL30/SL40

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

9.6.9.3 Multi-Display Unit Considerations

Although the data from the SL30 may be communicated to other display units via the inter-display unit serial data connections, allowing this data to appear on all display units, it is preferable to connect the serial data output from the SL30 to each display unit. Connecting the serial output from the SL30 to each display unit in multiple display unit systems, allows the SL30 data to be displayed in the event one display unit is not functional.

The serial ports within the display unit provide minimal loading of the serial data signals, allowing the one serial data output from the SL30 to be connected to multiple display units.

Only one serial data output to the SL30/SL40 may be provided. If the display unit which provides this (tuning) data to the SL30/SL40 was not operational, the SL30/SL40 would be tuned by its front panel controls.

9.6.9.4 Display Unit Connector A Connections

Mating Connector: 25-pin Female D-sub (Instrument has 25-pin male D-sub)

EFIS Display Unit Pin	Function	SL30/SL40	Notes

A-2	Serial Output 1 from Display Unit to SL30/SL40 (Suggested Port)	Pin 4 of 37-pin connector-SL30 Pin 10 of 15-pin connector-SL40	Only 1 display unit may provide this connection.
A-20	Serial Input 1 from SL30 (Suggested Port)	Pin 5 of 37-pin connector	This output from the SL30 may be connected to multiple display units.

9.6.9.5 Configuring the Display Unit

Using the general setup menu, set the display unit to which the above connections are made to 9600 baud. For the serial data output, select “SL30/SL40 Output”. For the serial input, select “SL30/SL40 Input”.

9.6.10 Autopilot

The Horizon may send steering commands to an autopilot via RS232 Serial communications. These steering commands are GPS Nav format and provide Lateral steering only. Some advanced autopilots can accept GPSS and GPSV steering commands from the Horizon via ARINC and may provide both Lateral and Vertical steering.

9.6.10.1 Serial Interface

Display Unit Connector A Connections

EFIS Display Unit Pin	Function	Autopilot Connection	Notes
A-5	Serial Output 4 - Autopilot NEMA or Aviation (Suggested Port)	GPS Serial Data Input	Output from the EFIS emulates Aviation or NMEA 0813 format data to control the autopilot.

Optional Dual Serial Inputs to the Autopilot

To allow coupling the autopilot to the GPS in the event the display unit that normally controls the autopilot is not functional, a switch may be installed. This switch is wired so that it selects either the EFIS autopilot output, or the GPS serial data output. This switch should remain in the "EFIS" position, unless the display unit that provides the autopilot output is not functional. When the switch is in the "GPS" position, the autopilot will follow the GPS flight plan only, and will not respond to EFIS autopilots mode selections, such as HDG or others.

The switch needs to be a single pole, two position device. The common pin will be wired to the autopilot serial input and the other switch connections are one to the EFIS serial out port and one to the GPS receiver serial out port.

Configuring the Autopilot

Make the following setting on the autopilot. Refer to the autopilot installation manual for additional information.

Setting	Value
RS232 Serial Input Baud Rate	4800 or as necessary to match EFIS autopilot serial port baud rate.

9.6.10.2 ARINC Interface

ARINC Connections

For autopilots that accept ARINC 429 inputs for GPS steering, both the serial port autopilot connection (above), and the ARINC 429 connection are required.

ARINC 429 Adapter Pin	Function	Autopilot Connection	Autopilot Function
C-5	EFIS Output May also connect to other devices, such as an GNS430	ARINC 429 A	ARINC 429 A Channel 1 EFIS Input.
C-9	EFIS Output May also connect to other devices, such as an GNS430	ARINC 429 B	ARINC 429 B - Channel 1 EFIS Input.

Optional Dual ARINC Inputs to the Autopilot

To allow coupling the autopilot to the GPS in the event the display unit that normally controls the autopilot is not functional, a switch may be installed. This switch is wired so that it selects either the EFIS ARINC output, or the GPS ARINC output. This switch should remain in the "EFIS" position, unless the display unit that provides the autopilot output is not functional. When the switch is in the "GPS" position, the autopilot will follow the GPS flight plan only, and will not respond to EFIS autopilots mode selections, such as HDG or others.

The switch needs to be a two pole, two position device. The common pins will be wired to the autopilot ARINC input and the other switch connections are one to the EFIS ARINC out port and one to the GPS receiver ARINC out port.

When using ARINC to interface to an autopilot and a GNS430(W) / 530(W) or GNS480 another function is available, GNAV.

Since the Horizon database does not contain approach information, the Horizon cannot provide lateral steering for procedure turns, DME arcs, holding patterns etc. However, the GNS430 can provide GPS position, flight plan data, lateral deviation, vertical deviation, roll commands and mode selection to the Horizon over an additional ARINC connection (ARINC GPS) just like the VOR/ILS/GS ARINC connection. This information allows the EFIS to provide VNAV functions for an approach and follow roll commands from the GNS430 while still controlling pitch commands. This requires less switching of the autopilot output between the EFIS and the GNS430. With this feature, the external switch (see Chapter 6.5.1) can be left in the EFIS position unless there is an EFIS failure. See the Horizon Users Manual, Chapter 5.3.1, GNAV for how to use these features.

Configuring the Display Unit

Set Menu Page	Setting	Value
General Setup	ARINC Module Connected	Yes
General Setup	ARINC Transmit Rate*	Low
General Setup	Serial Out 4 (Suggested Port)	Serial Output 4 - Autopilot NEMA or Aviation

Configuring the Autopilot

Setting	Setting
ARINC 439 A In	Autopilot
ARINC 429 B In	Autopilot
RS232 Baud Rate	To match Horizon Output

GNAV ARINC Connections

ARINC 429 Adapter Pin	Function	GNS430 Pin	GNS430 Function
C-1	GPS Input	J4001-46	ARINC 429 A - GPS Output May also connect to other devices, such as an autopilot
C-2	GPS Input	J4001-47	ARINC 429 B – GPS Output May also connect to other devices, such as an autopilot
C-5	EFIS Output May also connect to other devices, such as an **autopilot**	J4001-48** ARINC IN 1A (J4001-50 ARINC IN 2A)	ARINC 429 A Channel 1 EFIS Input..
C-9	EFIS Output May also connect to other devices, such as an **autopilot**	J4001-49** ARINC IN 1B (J4001-51 ARINC IN 2B)	ARINC 429 B - Channel 1EFIS Input..

Configuring the Display Unit for GNAV ARINC Data In

The display unit must be configured according to the following table to enable it to read the above ARINC signals:

Set Menu Page	Setting	Value
General Setup	ARINC Receive Rate*	To match GNS430 rate
General Setup	ARINC GPS Inputs*	GPS1 (or GPS 2 if this display unit is connected to number 2 GNS430/530)

Configuring the GNS430(W) / GNS530(W) or GNS480 for GNAV

Refer to the GNS430 installation manual, and configure serial input 1 for the FADC w/ALT format, and serial output 2 for "GPS" format.

Setting	Value
RS232 Input - Channel used for fuel/air data input from display unit.	Shadin-Fadc (Fadc only for GNS480)
RS232 Output - Channel Used for GPS Output to display unit.	Aviation
ARINC CONFG OUT DATA	GAMA 429
ARINC CONFG SPEED	Match VOR/LOC/GS output
ARINC CONFG VNAV	**Enable labels**

9.6.11 Zaon Traffic

Zaon Collision Avoidance System requires only a Serial Port In connection to GRT Horizon. The data may either be Zaon format at 57600 baud or TIS Traffic format at 9600 baud. The later may be preferable since it does not tie up an entire Serial Port. The higher baud rate may deliver better performance since the data transmission rate is higher.

High Speed Connection (57600 baud)

EFIS Display	EFIS Pin	Zaon Pin	Function
Serial Port In	Available Serial Port	See Manual	Profile 2

Configuration

EFIS Display	Function	Zaon	Function
Serial Port In	Zaon Traffic	Serial Out	Profile 2 Traffic
Serial Port Rate		57600	

Low Speed Connection (9600 baud)

EFIS Display	EFIS Pin	Zaon Pin	Function
Serial Port In	Available Serial Port	See Manual	Garmin

Configuration

EFIS Display	Function	Zaon	Function
Serial Port In	Garmin GTX330	Serial Out	Garmin
Serial Port Rate		9600	

9.6.12 CO Guardian

Certain CO Guardian CO detectors have provisions for connection to MFD via RS232 Serial communication. Both a Serial Port In and a Serial Port Out connection to GRT Horizon is required since acknowledging the alarm sends a reset message to the detector.

Connection

EFIS Display	EFIS Pin	CO Guardian Pin	Function
Serial Port In	Available Serial Port	See Manual	
Serial Port Out	Available Serial Port	See Manual	

Configuration

EFIS Display	Function	CO Guardian	Function
Serial Port In	Co Guardian	Serial Out	CO Alarm
Serial Port Rate		9600	

Chapter 10 : MOUNTING DIAGRAMS

Please refer to www.grtavionics.com Support, Documents for up to date mounting information.

Chapter 11 CONNECTOR DESCRIPTIONS

Please refer to www.grtavionics.com Support, Documents for up to date connector descriptions. AHRS connectors descriptions are provided here for the current Adaptive AHRS, and the previously version of the AHRS.

Adaptive AHRS Connector

Mating Connector: 25-pin Male D-sub (AHRS has 25-pin Female D-sub)

Pin	Function
1	Serial Out 1 – AHRS 1 Data Output
2	Serial Out 1 – AHRS 1 Data Output
3	Serial Out 2 – AHRS 1 Data Output
4	Serial Out 2 – AHRS 1 Data Output
5	Serial In 1 - AHRS Control Input
6	Reserved - Do not connect
7	Reserved – Do not connect
8	Magnetometer Serial Input
9	AHRS2 Power In A (9-30Vdc)
10	Outside Air Temperature Input (Ground other OAT probe lead.)
11	Reserved – Do Not Connect
12	Reserved – Do Not Connect
13	Ground
14	Magnetometer Gnd
15	GPS Serial Output
16	GPS Serial Input
17	AHRS2 Power In B (9-30Vdc)
18	Serial Input – AHRS2 Control*
19	Serial Output – AHRS 2 Data Output*
20	Serial Output – AHRS 2 Data Output*
21	Serial Output – AHRS 2 Data Output*
22	Magnetometer Power Out (4.3-5.0 Vdc)
23	AHRS1/GPS(GSNS) Power In A (9-30 Vdc)
24	AHRS1/GPS(GSNS) Power In B (9-30 Vdc)
25	AHRS1/GPS(GSNS) Power In C (9-30 Vdc)

* Power Inputs A,B, and C are identical, diode-isolated inputs. Connect one or more to power sources via a 5 amp or less breaker or fuse.

Digital Magnetometer Connector

Mating Connector: 9-pin female D-sub (Magnetometer has 9-pin male D-sub)

All electrical connections are made only to the AHRS/Air Data Computer.

Pin	Function	Connects to AHRS Pin
1	Ground (Connects to AHRS Magnetometer Ground	14
2	Do not connect	
3	Do not connect	
4	Do not connect	
5	Power In (+4.3V Power to be supplied only by AHRS Magnetometer Power Output)	22
6	Do not connect	
7	Do not connect	
8	Serial Input – (normally unused. Provision for software updating only.)	No connection
9	Serial Output	8

AHRS Connector (Legacy Version - Part No. AAS-01-03001)

Mating Connector: 25-pin Male D-sub (AHRS has 25-pin Female D-sub)

Pin	Function
1	Serial Out 1
2	Serial Out 1
3	Serial Out 2
4	Serial Out 2
5	Serial In 1 - AHRS Control Input
6	Serial In 2 - Spare Serial Input (no connect)
7	Magnetometer X Input
8	Magnetometer Y Input
9	Magnetometer Z Input
10	Outside Air Temperature Input
11	Supply B Status Output -- Power Input B is output on this pin through a 1 k ohm resistor.**
12	Supply C Status Output -- Power Input C is output on this pin through a 1 k ohm resistor.**
13	Ground
14	Magnetometer Gnd
15	Not Used
16	Not Used
17	Built-In-Test Status Output (Open/Ground) Ground state has 1k ohm resistance to ground. Ground = Operation Normal
18	Magnetometer Control Output
19	Reserved – Do Not Connect
20	Not Used
21	Bluetooth +12V regulated power output
22	Magnetometer Power Out
23	Aircraft Power Input A
24	Aircraft Power Input B
25	Aircraft Power Input C

* Power Inputs A,B, and C are identical, diode-isolated inputs.

Magnetometer Connector

(Legacy Version - Part No. ADM-01-03001) (Analog Version for Legacy AHRS)

Mating Connector: 9-pin Male D-sub (Magnetometer has 9-pin female D-sub)

All electrical connections are made only to the AHRS/Air Data Computer.

Pin	Function
1	Magnetometer Y Output
2	Magnetometer X Output
3	Magnetometer Z Output
4	Power (Power to be supplied only by AHRS Magnetometer Power Output)
5	Ground
6	Control
7	No Connection
8	No Connection
9	No Connection

Chapter 12 INTERCONNECT DIAGRAMS

Please refer to www.grtavionics.com, Support, Documents for up to date interconnect diagrams.

Many find it useful to use the Interconnect Diagrams, the Cable Descriptions and Connector Definitions from the website and the information in this document to construct a spreadsheet defining all the interconnections for their particular aircraft and installed equipment. A sample spreadsheet is:

Unit	Pin No	Name	Use	Format	Baud	TO/FROM	Pin No	Name
MFD 1	A-22	Serial 5 In	GPS Data	GPS Aviation	9600	GNS430	P4001-56	Serial 1 Out

Group each the Serial Port together, ie

Unit	Pin No	Name	Use	Format	Baud	TO/FROM	Pin No	Name
		Serial 1 In						
		Serial 1 Out						
		Serial 2 In						
		Etc						

		Serial 6 Out						

Then you can easily assign Serial ports keeping in mind that baud rate must the same for In and Out on each port. **Note that Serial Port assignments shown in GRT documents are suggested only.** Any Serial Port may be assigned any function with exceptions only being those connected to internal ARINC or GPS and the requirement of high speed ports for XM Weather.

Use a similar spreadsheet to assign Analog inputs. **Note that Analog Input assignments shown in GRT documents are suggested only.**

Add other connections to the spreadsheet such as power, OAT etc so that you end up with a comprehensive document that fully describes your aircraft.

Chapter 13 MAGNETOMETER INSTALLATION

Please refer to www.grtavionics.com Support, Documents for up to date magnetometer installation information.