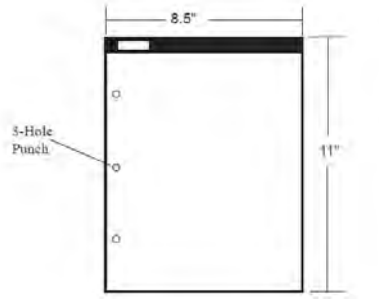
SPECIFICATION CONTROL DRAWING			REVISIONS	
	REV.	DATE	DESCRIPTION	ECO NO.
	A	12/20/12	Initial release	- - -



AVIATION REVIEW REQUIRED

NOTES:

1. DESCRIPTION: Installation Documentation - GRA 5500 Installation Manual
2. PAGE SIZE: Letter: Width = 8.5 inches, Height = 11 inches, Double-sided Tabloid: Height = 17.0 inches, Width = 11 inches, Single-sided Tabloid: Width = 17.0 inches, Height = 11 inches,
3. PAGINATION: 26 double-sided letter sheets, 4 double-sided tabloid sheets, 7 single-sided tabloid sheets.
4. MATERIAL: 24 pound bond. Approved equivalents allowed.
5. COLOR: Black ink on white paper stock.
6. BINDERY: Three-hole punch, shrink-wrap. Digital output preferred.
7. FOLDS: Z-Fold tabloid sheets at end of document.
8. ELECTRONIC ARTWORK: Shall conform to Garmin Archive, Filename: 190-01277-00.pdf
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Filename	File Contents
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Checker:		
Project Engineer:		
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GRA 5500 Installation Manual

SIZE A	Part Number: 190-01277-00	Rev A
Scale: N/A	AVIATION REVIEW REQUIRED	Sheet 1 of 1

GARMIN®

GRA 5500

Radar Altimeter

Installation Manual

190-01277-00 December, 2012 Revision A

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RECORD OF REVISIONS

Revision	Revision Date	Description
A	12/20/12	Production Release

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DEFINITIONS OF WARNINGS, CAUTIONS, AND NOTES

WARNING

Warnings *are used to bring to the installer's immediate attention that not only damage to the equipment but personal injury may occur if the instruction is disregarded.*

CAUTION

Cautions are used to alert the individual that damage to equipment may result if the procedural step is not followed to the letter.

NOTE

Notes *are used to expand and explain the preceding step and provide further understanding of the reason for the particular operation.*

WARNING

This product, its packaging, and its components contain chemicals known to the State of California to cause cancer, birth defects, or reproductive harm. This Notice is being provided in accordance with California's Proposition 65. If you have any questions or would like additional information, please refer to our web site at www.garmin.com/prop65.

CURRENT REVISION DESCRIPTION

Revision	Page Number(s)	Section Number	Description of Change
A	All	All	Initial Release

DOCUMENT PAGINATION

Section	Page Range
Table of Contents	i – viii
Section 1	1-1 – 1-4
Section 2	2-1 – 2-14
Section 3	3-1 – 3-18
Section 4	4-1 – 4-6
Appendix A	A-1 – A-8
Appendix B	B-1 – B-2
Appendix C	C-1 – C-5

Aviation Limited Warranty

All Garmin avionics products are warranted to be free from defects in materials or workmanship for: one years from the date of purchase for new Remote-Mount and Panel-Mount products; one year from the date of purchase for new portable products and any purchased newly-overhauled products; six months for newly-overhauled products exchanged through a Garmin Authorized Service Center; and 90 days for factory repaired or newly-overhauled products exchanged at Garmin in lieu of repair. Within the applicable period, Garmin will, at its sole option, repair or replace any components that fail in normal use. Such repairs or replacement will be made at no charge to the customer for parts or labor, provided that the customer shall be responsible for any transportation cost. This warranty does not apply to: (i) cosmetic damage, such as scratches, nicks and dents; (ii) consumable parts, such as batteries, unless product damage has occurred due to a defect in materials or workmanship; (iii) damage caused by accident, abuse, misuse, water, flood, fire, or other acts of nature or external causes; (iv) damage caused by service performed by anyone who is not an authorized service provider of Garmin; or (v) damage to a product that has been modified or altered without the written permission of Garmin. In addition, Garmin reserves the right to refuse warranty claims against products or services that are obtained and/or used in contravention of the laws of any country.

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Garmin retains the exclusive right to repair or replace (with a new or newly-overhauled replacement product) the product or software or offer a full refund of the purchase price at its sole discretion. SUCH REMEDY SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY BREACH OF WARRANTY.

Online Auction Purchases: Products purchased through online auctions are not eligible for warranty coverage. Online auction confirmations are not accepted for warranty verification. To obtain warranty service, an original or copy of the sales receipt from the original retailer is required. Garmin will not replace missing components from any package purchased through an online auction.

International Purchases: A separate warranty may be provided by international distributors for devices purchased outside the United States depending on the country. If applicable, this warranty is provided by the local in-country distributor and this distributor provides local service for your device. Distributor warranties are only valid in the area of intended distribution. Devices purchased in the United States or Canada must be returned to the Garmin service center in the United Kingdom, the United States, Canada, or Taiwan for service.

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TABLE OF CONTENTS

PARAGRAPH PAGE

PARAGRAPH PAGE

LIST OF FIGURES

FIGURE PAGE

LIST OF TABLES

TABLE **PAGE**

1 GENERAL DESCRIPTION

1.1 Introduction

This manual presents mechanical and electrical installation requirements for installing the GRA 5500 Radar Altimeter as part of a Garmin Integrated Flight Deck and in retrofit/stand-alone applications. The GRA 5500 can be integrated into a variety of airframes under an appropriate TC or STC. Each airframe installation may vary. Use only approved (type or supplemental type) data for specific installation instructions in a particular aircraft.

1.2 Equipment Description

The GRA 5500 is a digitally-based airborne low-range radar altimeter designed to calculate and provide precise Above Ground Level (AGL) altitude information for both Garmin Integrated Flight Deck and retrofit/stand-alone radar altimeter applications. The GRA 5500 features a standard two-antenna architecture utilizing low-power "gated" FMCW operation, digitally-based transmitter operation, advanced digital signal processing (DSP) based receiver altitude detection algorithms, operation from ground to 2500 ft AGL, accuracy of +/- 1.5 ft (0 – 100 ft AGL), +/- 2 % (>100 – 2500 ft AGL), full-featured self-test operation (BITE) and fault logging functionality (including patent-pending automated self-testing and fault detection of the entire internal TX, RX, and processing circuitry), a patent-pending on-ground automated installation calibration procedure to essentially eliminate the traditional requirement for a minimum RF antenna cable length, 14 Volt and 28 Volt operation, two configurable ARINC 429 data outputs, two proprietary Garmin HSDB over RS-422 data interfaces, and a standard USB full-speed interface for convenient unit configuration, calibration, diagnostics, and software updates in retrofit/stand-alone applications.

1.3 Interface Summary

The GRA 5500 provides the following interfaces via circular connector:

- Two "diode ORed" aircraft power inputs (for redundant power systems)
- Two ARINC 429 data outputs (configurable for output data formats and data rates)
- Two Garmin High-Speed Data Bus (HSDB) over RS-422 data interfaces (used in lieu of ARINC 429 data outputs in Garmin Integrated Flight Deck installations)
- Two active-low annunciator outputs used for optional "altitude alert" indications (altitudes are installation configurable)
- Four active-low discrete inputs used as configuration straps in dual and triple installations and for optional manually-initiated self-test and self-test inhibit operation in retrofit/stand-alone applications.
- One standard Universal Serial Bus (USB) full-speed interface for unit configuration, calibration, diagnostics, and software updates in retrofit/stand-alone applications.
- One Garmin configuration module interface (configuration module usage is not required in Garmin Integrated Flight Deck installations and is optional in retrofit/stand-alone applications in order to retain unit configuration parameters external of the installed LRU)

The GRA 5500 also provides RF connections from the transmitter and receiver to the respective radar altimeter antennas via standard TNC (threaded Neill-Concelman) connectors.

See Section 4 for connection details.

1.4 Technical Specifications

1.4.1 Environmental Qualification Form

It is the responsibility of the installing agency to obtain the latest revision of the GRA 5500 Environmental Qualification Form. This form is available directly from Garmin under the following part number:

GRA 5500 Environmental Qualification Form, Garmin part number 005-00616-01

To obtain a copy of this form, see the dealer/OEM portion of the Garmin web site (www.garmin.com).

1.4.2 Physical Characteristics

Table 1-1 lists the physical characteristics for the GRA 5500 unit, rack, and connectors. Refer to Appendix B for additional information.

Table 1-1 Physical Characteristics

Characteristics	Specifications
Unit Height (with mounting rack)	3.99” (101.3 mm)
Unit Width (with or without mounting rack)	3.02” (76.7 mm)
Unit Depth (with mounting rack and connector)	11.62” (295.2 mm)
Unit Depth (with mounting rack, connector, and configuration module)	12.08” (306.9 mm)
Unit Weight (with mounting rack)	3.5 lb (1.6 kg)
Typical Mating Circular Connector Weight	0.13 lb (0.06 kg)
Typical Mating RF Connector Weight (2X)	0.07 lb (0.03 kg) (weight listed is for 2 connectors)

1.4.3 General Specifications

For detailed specifications, see the Environmental Qualification Form (Section 1.4.1).

Table 1-2 General Specifications

Characteristics	Specifications
Operational Temperature Range	-55° C to +85° C
Altitude Range	55,000 ft maximum
Software Compliance	RTCA/DO-178B Level B
Hardware Compliance	Not Applicable - The GRA 5500 does not contain any complex or programmable logic devices.
Environmental Conditions	RTCA/DO-160F

1.4.4 Performance Specifications

Table 1-3 Performance Specifications

Characteristics	Specifications
Altitude Accuracy	± 1.5 ft (3 - 100 ft AGL) ± 2 % (> 100 - 2500 ft AGL)
Altitude Range	-20 - 2550 ft AGL
Altitude Alert Outputs Range	0 - 2500 ft AGL
Altitude Output Time Constant	0.1 second maximum
Transmitter Output	Frequency: 4.25 - 4.35 GHz "Gated" FMCW Power: 1.0 W nominal
Horizontal Velocity	0 - 200 knots maximum
Vertical Velocity	20 ft/sec maximum (up to 100 ft AGL) 25 ft/sec maximum (above 100 ft AGL)
Pitch Angle	± 20° maximum
Roll Angle	± 20° maximum (with published altitude accuracy limits) ± 20° to ± 30° (with ± 20 % altitude accuracy limits throughout entire altitude range)

1.4.5 Power Requirements

Table 1-4 Power Requirements

Characteristics	Specifications
Supply Voltage	14/28 VDC. See the Environmental Qualification Form for details on surge ratings and minimum/maximum operating voltages.
Power Consumption	13.75 W maximum (0.5 A at 27.5 VDC, 1.0 A at 13.75 VDC)

1.5 Certification

The conditions and tests required for TSO approval of this article are minimum performance standards. It is the responsibility of those installing this article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within the TSO standards. TSO articles must have separate approval for installation in an aircraft. The article may be installed only if performed under 14 CFR part 43 or the applicable airworthiness requirements.

The Appliance Project Identifier (API) for the GRA 5500 is GMN-00946. Documents submitted to the FAA and other regulatory agencies on behalf of this project will be filed under and referred to by this number.

1.5.1 TSO Compliance and Limitations

When installed as a system, the GRA 5500, which must include two Garmin approved antennas (see Section 2.2.3) installed per Section 2.3.3 of this Installation Manual and a cockpit display of altitude information, comprise what Garmin considers to be a minimum generic GRA 5500 system installation. The GRA 5500 lacks a display and by itself is an incomplete system and cannot completely meet the requirements of TSO-C87a.

This article meets the minimum performance and quality control standards required by a technical standard order (TSO). Installation of this article requires separate approval.

Table 1-5 provides a list of applicable TSOs for the GRA 5500.

Table 1-5 TSO Compliance

Function	TSO	Applicable LRU System (Main) SW Part Numbers	Applicable Boot Block SW Part Numbers	Applicable LRU System (Sensor) SW Part Numbers	Applicable Region List SW Part Numbers
Airborne Low-Range Radio Altimeter	TSO-C87a Functional Class A	006-B1447-0(_) except 006-B1447-00 006-B1447-01 006-B1447-02 and 006-B1447-03	006-B1448-B(_) except 006-B1448-BA 006-B1448-BB and 006-B1448-BC	006-B1448-0(_) except 006-B1448-00 006-B1448-01 006-B1448-02 and 006-B1448-03	006-D3609-0(_) except 006-D3609-00 and 006-D3609-01

1.5.2 TSO Deviations

No TSO deviations were requested or granted for the GRA 5500.

1.6 Operating Instructions

The GRA 5500 is a remote-mount LRU with no user controls or indicators, and normal operation is completely automated. All user interface is accomplished through a compatible display and/or interface device. For Garmin Integrated Flight Deck installations, refer to the applicable airframe specific Pilot's Guide documentation for operating instructions (available at www.garmin.com). For retrofit installation operating instructions, reference the operating instructions of the compatible display and/or interface device. For operating instructions and characteristics for the automated and manual altitude self-test capability of the appliance, see Section 3.7.4.1 of this document.

1.7 Reference Documents

The following publications are sources of additional information for installing the GRA 5500. Before installing the GRA 5500, the technician should be familiar with all referenced materials, in addition to this manual.

Table 1-6 Reference Documents

Part Number	Document
190-00313-12	Circular Connector (and Configuration Module) Installation Instructions
190-00303-00	G1000 System Installation Manual
190-00903-00	G1000 Integrated Flight Deck (LJ/VLJ) System Maintenance Manual
190-00907-00	G1000 System Maintenance Manual Standard Piston/Turboprop Aircraft

2 INSTALLATION OVERVIEW

2.1 Introduction

This section provides hardware equipment information for installing the GRA 5500, related hardware, and antennas. Installation of the GRA 5500 must follow the aircraft TC or STC requirements. Cabling is fabricated by the installing agency to fit each particular aircraft. The guidance of FAA advisory circulars AC 43.13-1B and AC 43.13-2B, where applicable, may be found useful for making retrofit installations that comply with FAA regulations.

Refer to Appendix B for rack drawings and dimensions.

2.2 Installation Materials

The GRA 5500 is only available as a single unit under the following part number:

Table 2-1 Available Units

Item	Garmin P/N
GRA 5500, Unit Only (011-02537-00)	010-00946-00

2.2.1 Available Equipment

Each of the following accessories are provided separately from the GRA 5500 and are required for installation.

Table 2-2 Available Equipment

Item	Garmin P/N
Sub-Assy, GRA 5500 Mounting Rack	011-02567-00
Sub-Assy, Connector Kit, GRA 5500 (*For Garmin Integrated Flight Deck installations*)*	011-02573-00
Sub-Assy, Connector Kit w/Config Module & USB Pigtail, GRA 5500 *(For retrofit/stand-alone installations)**	011-02573-01

*Each GRA 5500 connector kit provides seal plugs for the circular connector. Refer to the Circular Connector (and Configuration Module) Installation Instructions (GPN: 190-00313-12) for seal plug, config module, and connector installation instructions.

2.2.2 Additional Equipment Required

The installation accessories listed in Table 2-3 are required but not provided:

Table 2-3 Additional Equipment Required

Item	Specification
Radar Altimeter Antennas (2 per installation)	See Section 2.2.3 for more information.
Antenna Coaxial Cables (2 per installation)	See Section 2.5.1 for more information.
TNC connectors (4 per installation)	See Section 2.5.1 for more information.
Circuit Breakers (1 or 2 per installation)	5 amp aircraft circuit breakers are recommended for 28 VDC operation. Larger circuit breakers may be required for 14 VDC operation.

2.2.3 Approved Radar Altimeter Antennas

The antennas listed in Table 2-4 are the only approved antennas for use with the GRA 5500 radar altimeter:

Table 2-4 Approved Radar Altimeter Antennas

Antenna Manufacturer	Manufacturer Part Number	Garmin Part Number*
Sensor Systems Inc.	S67-2002	013-00378-00
Sensor Systems Inc.	S67-2002-4	013-00378-04
Sensor Systems Inc.	S67-2002-12	013-00378-12
Sensor Systems Inc.	S67-2002-13	013-00378-13
Sensor Systems Inc.	S67-2002-14	013-00378-14
Sensor Systems Inc.	S67-2002-18	013-00378-18
Sensor Systems Inc.	S67-2002-19	013-00378-19
Sensor Systems Inc.	S67-2002-29	013-00378-29
Sensor Systems Inc.	S67-2002-45	013-00378-45

*Garmin encourages customers to procure the selected antenna type directly from the antenna manufacturer. For customers who do not have a business relationship with the antenna manufacturer, the selected antenna type may be purchased through Garmin by referencing the corresponding Garmin Part Number.

2.3 Installation Considerations

Fabrication of a wiring harness is required. Sound mechanical and electrical methods and practices are required for installation of the GRA 5500.

The GRA 5500 requires two antennas to be installed for each system installation. One antenna is used to transmit the radar signal, and the other is used to simultaneously receive the reflected signal.

2.3.1 Multiplex Operation (Dual and Triple Unit Installations)

Each GRA 5500 system fulfills all TSO minimum accuracy requirements when installed with either one or two additional GRA 5500 systems on the same aircraft. Mutual interaction is not operationally significant. See Section 2.3.3 for guidance in planning antenna locations for multi-unit installations. The second and/or third unit in a multi-unit installation is selected by strapping the respective discrete input(s) on each unit per Table 2-5.

Table 2-5 System ID Discrete Inputs

RADAR ALT SYSTEM ID PROGRAM* 1	RADAR ALT SYSTEM ID PROGRAM* 2	GRA 5500 UNIT NUMBER
Open	Open	1
Ground	Open	2
Open	Ground	3
Ground	Ground	Not Allowed

2.3.2 Installation Approval Considerations for Pressurized Aircraft

Cable installations (both wiring harness and coaxial antenna cables) on pressurized cabin aircraft require FAA approved installation design and engineering substantiation data whenever such installations incorporate alteration (penetration) of the cabin pressure vessel by connector holes and/or mounting arrangements.

For needed engineering support pertaining to the design and approval of such pressurized aircraft installations, it is recommended that the installer proceed according to any of the following listed alternatives:

1. Obtain approved installation design data from the aircraft manufacturer.
2. Obtain an FAA approved STC, pertaining to and valid for the subject installation.
3. Contact the FAA Aircraft Certification Office in the appropriate Region and request identification of FAA Designated Engineering Representatives (DERs) who are authorized to prepare and approve the required installation engineering data.
4. Locate an appropriate consultant FAA DER from the “FAA Consultant DER Directory” at the FAA “Designee and Delegation” web page.
5. Contact an aviation industry organization such as the Aircraft Electronics Association for assistance.

2.3.3 Antenna Location Planning Guidance

NOTE

*The ability of any radar altimeter system to accurately and reliably detect and process radar altitude signals is **highly** dependent upon correct transmitter (TX) antenna and receiver (RX) antenna placement on the airframe. Stated performance specifications for the GRA 5500 can only be achieved when the system is installed in accordance with all the guidelines stipulated in this section and with all other instructions given in this Installation Manual.*

Careful planning for optimal antenna placement is **extremely critical** in any radar altimeter installation and requires a high level of attention to detail in order to achieve optimal system performance of the GRA 5500. The following guidelines must be followed in order to achieve acceptable performance of the system during all stages of normal operation. Failure to follow any of these guidelines will result in degradation of system performance.

If there is any question as to whether a planned installation will meet all the guidelines given below or may require special consideration, contact Garmin for further support.

1. Location on Aircraft: Antennas must be mounted on a surface of the bottom of the aircraft near the center point of pitch and roll rotation (this reduces the effect of momentary pitch and roll altitude offsets/inaccuracies during approach and landing or while maneuvering the aircraft).
2. Angle of Antennas to Ground: Antennas must be mounted such that the surface of each antenna is within +/- 6° of horizontal during level flight. If adapter plates are manufactured to ensure this angle is met, the adapters must not recess the antenna surfaces within the skin of the aircraft. The adapters must only extrude the antenna surfaces outside the skin of the aircraft.
3. Mounting Surface: The antennas are normally mounted on a continuous metallic surface. Non-metallic surfaces or ones with discontinuities require special consideration. Contact Garmin for more information or clarification if needed.
4. Minimum Height: Due to antenna spacing limits (described in following guideline 8.), the minimum antenna height possible above ground while parked, taxiing, or at aircraft touchdown is 20 inches for any aircraft.
5. Antenna Clearance Cones: The locations chosen for both antennas must be free of aircraft projections (landing gear, flaps, drainage vents, etc…) within a 120° cone from each antenna downward to prevent locking onto false altitude returns. Consider all possible modes of aircraft operation when establishing compliance with this guideline (e.g. – landing gear distances while in transition, flap distances while fully extended, etc.).
6. Distance to Other Antennas: The radar altimeter antennas should be located no closer than 3 feet to any other aircraft antenna.
7. Relative Location (Single System): The two radar altimeter antennas must be mounted either in a straight, nose-to-tail longitudinal line with both antenna arrows pointing forward, or in a straight, side-to-side, lateral line with both arrows pointing to one side of the aircraft or the other (they may alternatively point toward each other or away from each other). The longitudinal installation is preferred over the lateral installation to provide more roll than pitch angle coverage. Additionally, the angle between the antenna surface planes must not exceed 6° and the antennas must not be tipped toward each other at any angle. In a single system, either antenna may be selected as the transmitter (TX) or receiver (RX) antenna.

8. Relative Antenna Spacing (Single System): The two antennas must be spaced apart a minimum distance of 20 inches (center to center). They must be spaced a maximum distance apart of not more than their equivalent distance to the ground while parked, taxiing, or at aircraft touchdown (whichever is less). The absolute maximum spacing is 6 feet (regardless of touchdown, taxiing, or parked height). For example, if the antenna distance to the ground at touchdown is 36 inches and when parked is 30 inches, then the antenna spacing must not be more than 30 inches. Ideally, the antennas would be spaced halfway between the given minimum and maximum constraints for the aircraft.
9. Dual System Additional Guidance: Each individual system within a dual system installation must first conform to the constraints of a single system. In addition, a dual system installation must conform to an end-to-end configuration (as shown in Figure 2-1 or Figure 2-2) or a side-by-side configuration (as shown in Figure 2-3). The end-to-end configuration requires 5 inches (center to center) minimum spacing between systems with no limit on maximum spacing. The side-by-side configuration requires 5 inches (center to center) minimum spacing between systems with maximum spacing limited by the 35° angle as shown. For example, if the spacing between TX1 and RX1 is 30 inches, then the spacing between RX2 and RX1 must not be more than 30 inches multiplied by the tangent of 35° (approximately 21 inches). The angular limit is necessary because unwanted signal leakage between TX to RX increases rapidly as the end-to-end antenna orientation transitions toward a pseudo side-to-side orientation (TX to TX and RX to RX antenna spacings are not vulnerable to this leakage). It is essential that functional antenna numbering assignments (e.g. – TX1, RX2, etc.) are used during planning and installation in order to avoid confusion.
10. Triple System Additional Guidance: Each individual system within a triple system installation must first conform to the constraints of a single system. In addition, a triple system installation must conform to an end-to-end configuration (as shown in Figure 2-1 or Figure 2-2), a side-by-side configuration (as shown in Figure 2-3), or a hybrid configuration (as shown in Figure 2-4). The end-to-end configuration requires 5 inches (center to center) minimum spacing between systems with no limit on maximum spacing. The side-by-side configuration requires 5 inches (center to center) minimum spacing between systems with maximum spacing limited by the overall 35° angle as shown. The hybrid configuration requires the minimum distances and maximum angles shown. It is essential that functional antenna numbering assignments (e.g. – TX1, RX2, etc.) are used during planning and installation in order to avoid confusion.

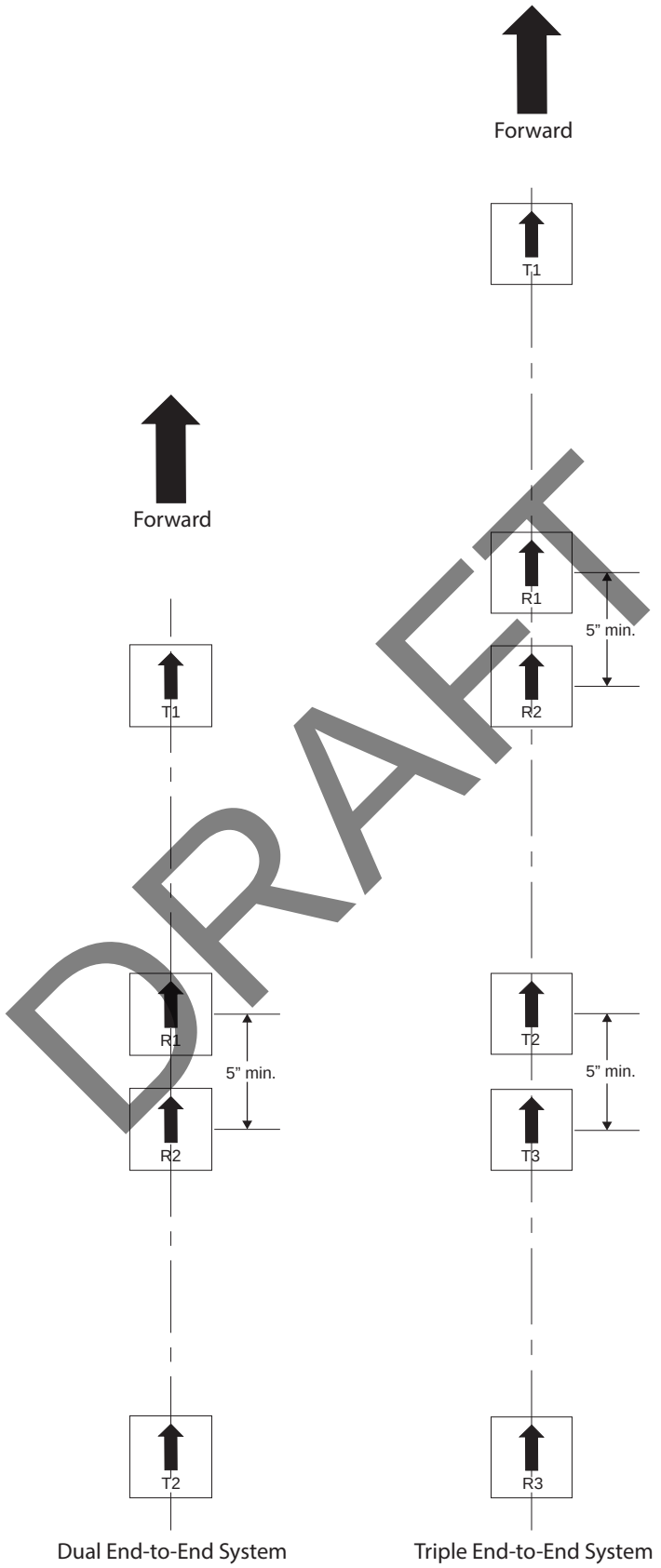

Figure 2-1 Standard Dual and Triple End-to-End System Layouts

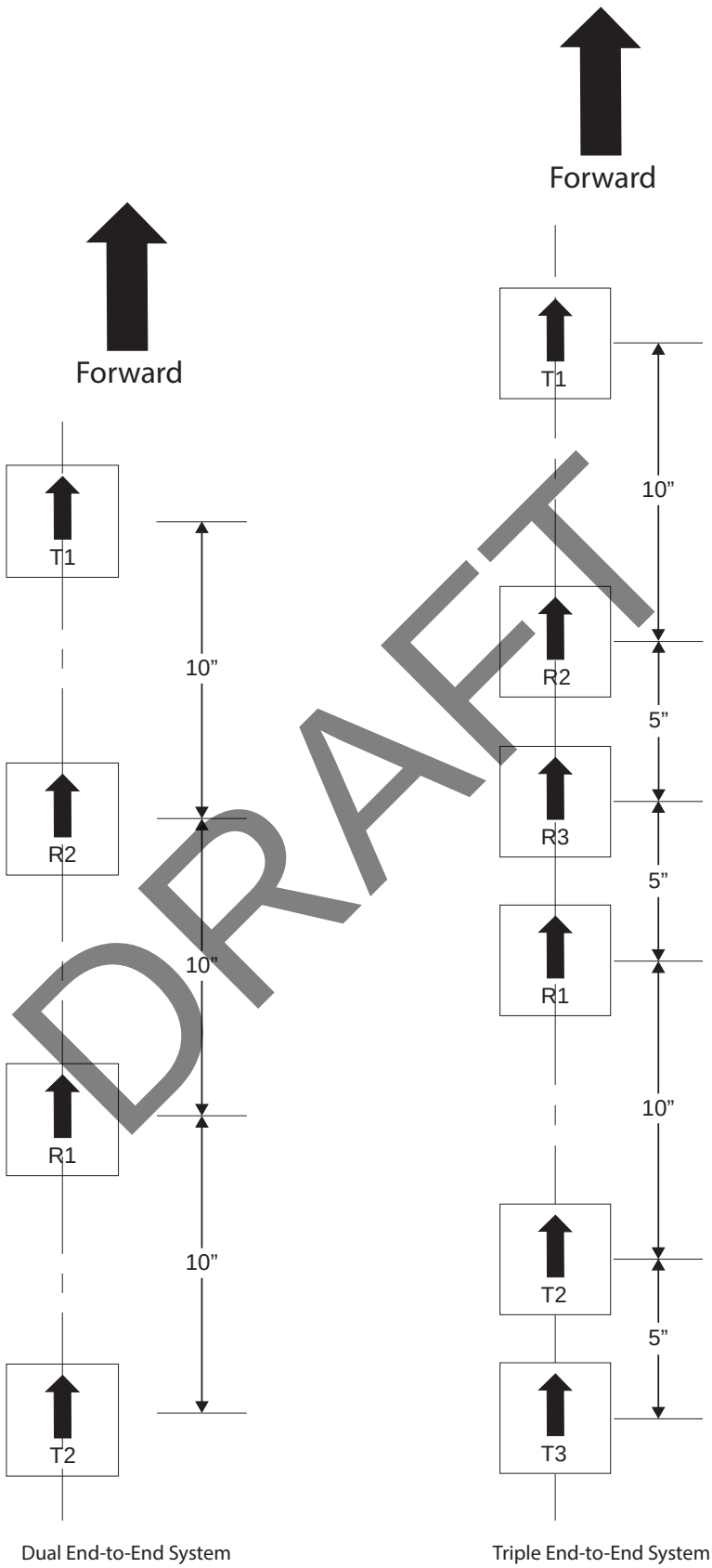

Figure 2-2 Compact Dual and Triple End-to-End System Layouts

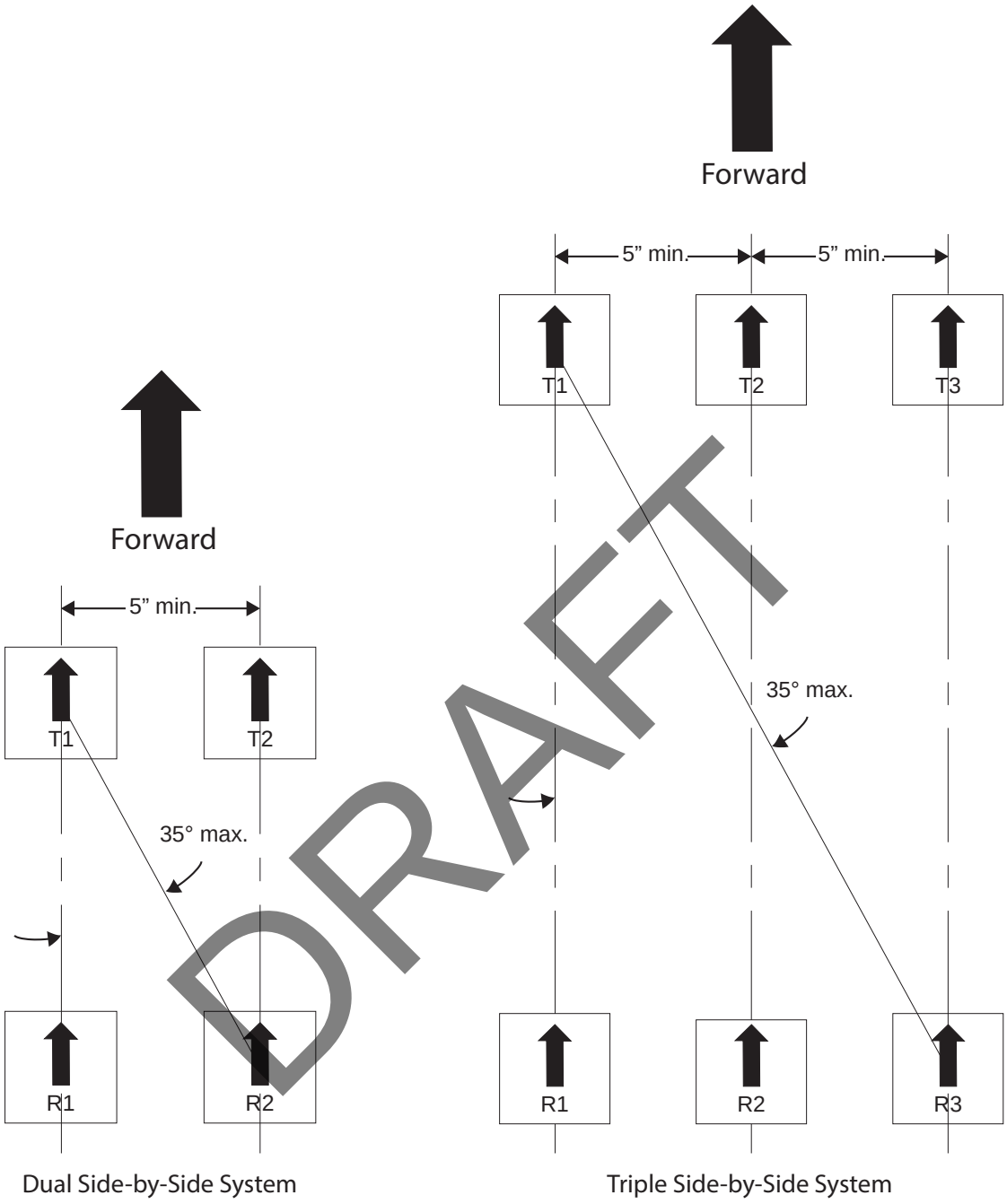

Figure 2-3 Dual and Triple Side-by-Side System Layouts

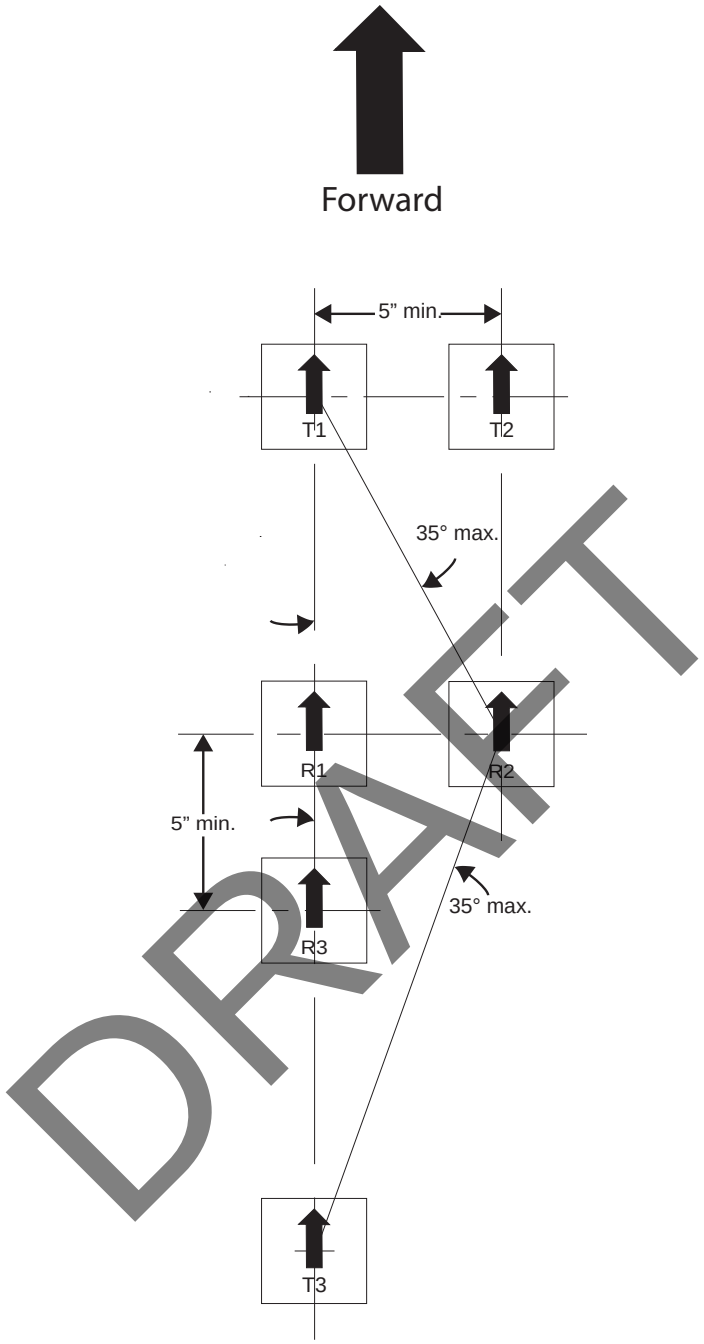

Figure 2-4 Hybrid Triple System Layout

2.3.4 Antenna Installation Considerations

The following guidelines should be observed when implementing the antenna installation:

1. Antenna and airframe surfaces should be prepared and bonded according to guidance given in Section 2.4.
2. A visual inspection should be performed to verify that all coaxial cables are connected properly before attempting to operate the equipment.
3. Always refer to the antenna manufacturer's provided installation material for any additional installation guidance specific to the antenna type being used.

2.4 Electrical Bonding

All electrical equipment, supporting brackets, racks, and antennas should be electrically bonded to the aircraft's main structure. Refer to SAE ARP 1870 Section 5 when surface preparation is required to achieve electrical bond. The electrical bond should achieve direct current (DC) resistance less than or equal to 2.5 milliohms to the local structure to where the equipment is mounted. Compliance should be verified by inspection using a calibrated milliohm meter. An equivalent OEM procedure may also be substituted. There may be OEM specific reasons for electrically isolating equipment or having a higher bond resistance. These reasons should be rationalized upon installation approval. In general, Garmin recommends that all GRA 5500 equipment be electrically bonded.

2.5 Cabling and Wiring

Refer to the interconnect examples in Appendix C for wire gauge guidance. Use only wire, coaxial cable, and installation methods that are compliant with governing aviation regulations and standards.

Any bend radius applied to a cable must not exceed the minimum bend radius specification as prescribed by the cable manufacturer for the specific cable type. It is recommended that the bend radius applied to a coaxial cable is minimized when in close proximity to the connector ferrule or compression housing in order to decrease side loading of the cable at the crimp or compression area. Whenever possible, it is recommended that no clearly visible bending exists within 1/2 inch of each coaxial cable assembly connector ferrule or compression housing. All cables should be secured in a manner that minimizes any potential back and forth side loading of the cable at the connector crimp or compression area. When routing the wire and cable, the installing agency should observe the following important precautions:

- Route all wiring and coaxial cables in a manner that maintains a minimal length of cable needed to complete the required connections, while avoiding, (as much as possible) routing near noisy environments such as power sources and circuits that carry or generate heavy current, 400 Hz generators, trim motors, pulse transmitting equipment, or fluorescent lighting power sources.
- For all wiring and coaxial cables, do not exceed the specified minimum bend radius and eliminate any potential of sharp bends that exceed the minimum bend radius (refer to preceding paragraph for additional cable recommendations).
- Ensure that all wiring and coaxial cables are properly secured while avoiding the potential of deteriorating the integrity of the insulation and jackets because of rubbing against the aircraft structure, other installed equipment, or excessively tight cable ties.
- Prior to connecting the fabricated wiring harness to the GRA 5500, verify correct routing of aircraft power and aircraft power ground to the assigned pins and verify that aircraft power is available at the assigned pins after routing verification.

2.5.1 Antenna Coaxial Cables (Requirements and Fabrication Guidance)

The GRA 5500 requires a minimum of two coaxial cable assemblies (each coaxial cable assembly consists of a coaxial cable and a connector properly terminating each end of the coaxial cable) assembled with the same type of coaxial cable for connection from the radar altimeter antennas to the LRU transmitter (TX) and receiver (RX) ports. If multiple coaxial cable assemblies must be used with adapters in order to connect the unit ports to the antennas, all assemblies must use the same type of coaxial cable. Although the use of adapters (both right angle and straight) may be unavoidable when addressing certain installations, minimal use of adapters in the installation is recommended whenever possible.

NOTE

Any in-line or bulkhead penetrations must be evaluated separately from the coaxial cable assemblies and require special consideration. It is the responsibility of the installing agency to show airworthiness of the installed coaxial cable assemblies (whether fabricated or purchased).

The requirements for the RF transmission lines made of coaxial cable assemblies used to connect the GRA 5500 TX and RX ports to the radar altimeter antennas are as follows (see Figure 2-5):

NOTE

For the purpose of this document, an RF transmission line is defined as either a single coaxial cable assembly used to connect a unit TX or RX port to its respective antenna port, or a number of coaxial cable assemblies and adapters used to connect a unit TX or RX port to its respective antenna port. It is the responsibility of the installing agency to ensure that the RF transmission lines and associated coaxial cable assemblies meet the following requirements in order to comply with the system installation standards.

1. The maximum total RF loss of each RF transmission line (made up of one or more cable assemblies with adapters) must not exceed 5.0 dB at 4.3 GHz.
2. The maximum total length of each RF transmission line (made up of one or more cable assemblies with adapters included in the length total) must not exceed 30 feet.
3. The minimum total length of each RF transmission line (made up of one or more cable assemblies with adapters included in the length total) must not be less than 1 foot.
4. All coaxial cable assemblies making up the RF transmission line must have a Voltage Standing Wave Ratio (VSWR) of less than 1.5:1, at each connector, at a frequency of 4.3 GHz.
5. The RF transmission line used to connect the unit to the antennas must have a total Voltage Standing Wave Ratio (VSWR) of less than 1.5:1, at each of the two end connectors of the assembled RF transmission lines, at a frequency of 4.3 GHz.

The VSWR of any adapter used to complete the assembly of an RF transmission line must be compliant with the adapter's manufacturer specification at 4.3 GHz.

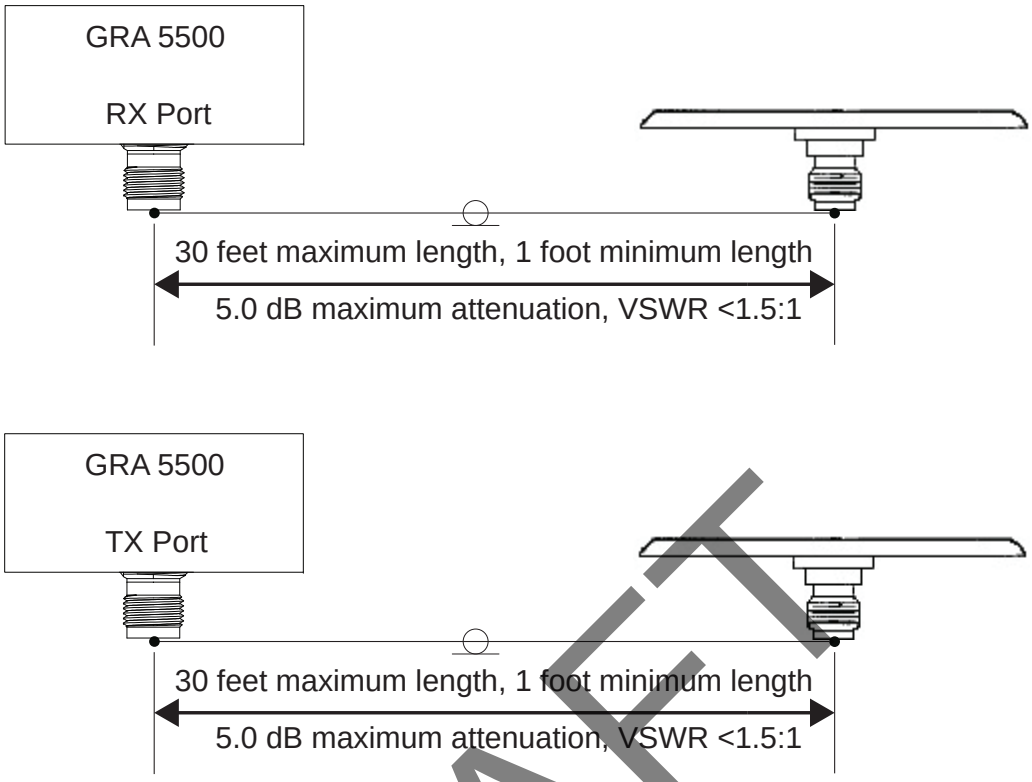

Figure 2-5 Coaxial Cable Requirements

TNC male connectors are required to build the coaxial cable assemblies and are not provided with the GRA 5500 system. Table A-1 provides guidance information concerning cable types, cable type attenuation, and cable type lengths in agreement with the overall requirements for the coaxial cable assemblies. The maximum coaxial cable lengths in Table A-1 are for reference only and are defined as the end-to-end cut cable length (non-terminated cable lengths). Actual cable lengths may vary depending on the manufacturer specifications and recommendations for the specific coaxial cable and connectors (Table A-2) used. Table A-2 references common sources for cable and connector part numbers. Figure 2-6 shows suggested installation instructions for typical TNC connectors.

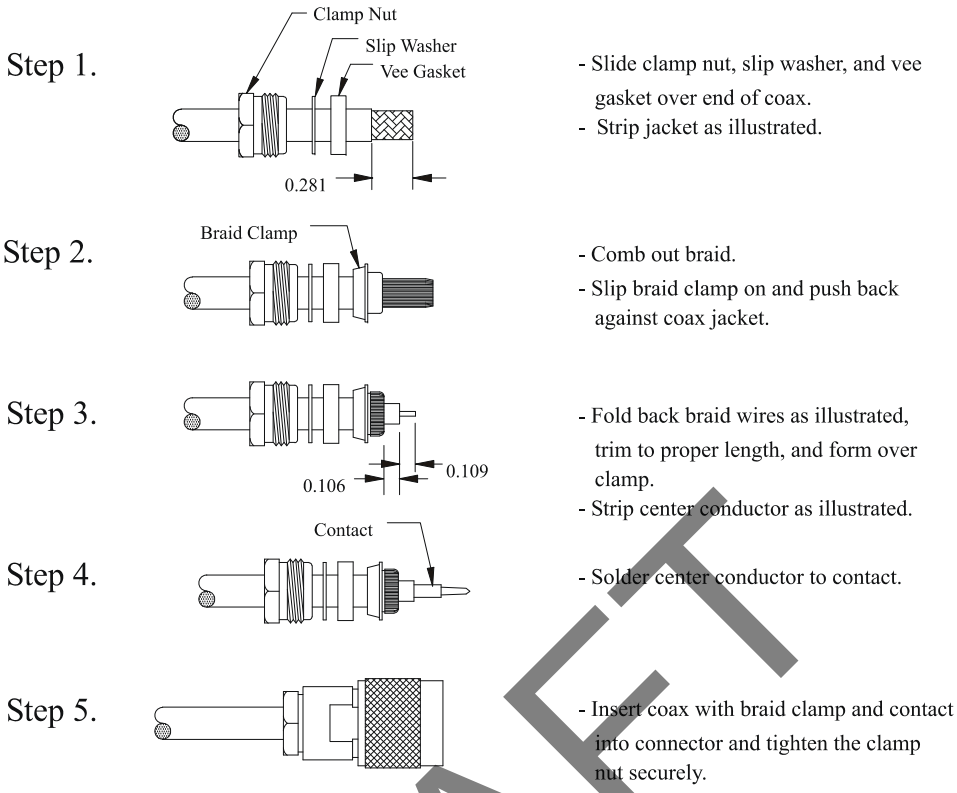

Figure 2-6 TNC Connector Installation

NOTE

It is recommended that a two inch piece of adhesive heat shrink tubing be installed over all coaxial cable interfaces. The heat shrink tubing should overlap the connector body as much as practical without interfering with the coupling nut (see Figure 2-7).

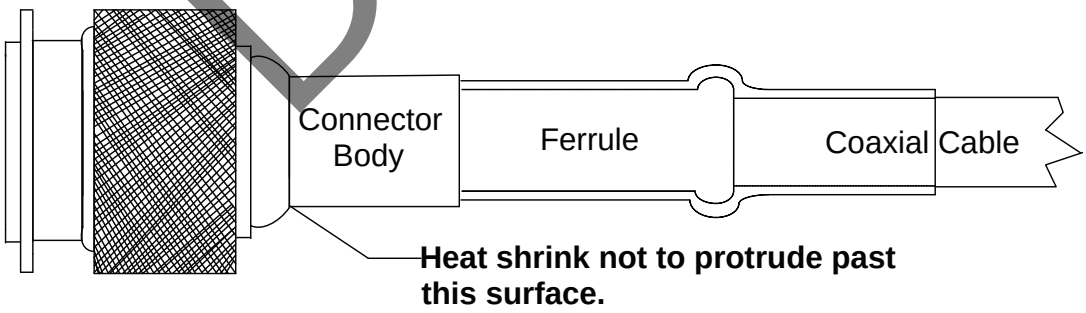

Figure 2-7 Heat Shrink Positioning

NOTE

It is recommended that the nominal end-to-end coaxial cable (non-terminated) length for each assembly be recorded for the specific installation in the event that a particular coaxial cable assembly associated with an installed set should require replacement.

2.6 Cooling Requirements

Dedicated cooling is not required for the GRA 5500 to meet indicated EQF categories. Thermal analysis must be performed to verify that high temperature limits implied by the indicated EQF categories for the GRA 5500 are not exceeded during normal operation of the aircraft. Guidance can be found in the Garmin Integrated Avionics System Thermal Management Plan document (GPN 190-00313-50) and the Garmin Integrated Avionics System Thermal Validation Procedure (GPN 190-00313-51).

Contact Garmin for additional cooling guidance.

2.7 Mounting Requirements

The GRA 5500 mounting surface should be capable of providing a sufficient electrical bond to the aircraft to minimize Electromagnetic Interference (EMI) and provide protection from High-Intensity Radiation Fields (HIRF). Bonding resistance measured between the GRA 5500 mounting rack and the airframe should measure less than 2.5 milliohms. The GRA 5500 must be mounted in the vertical position using the GRA 5500 mounting rack. Refer to Appendix B for outline and installation drawings.

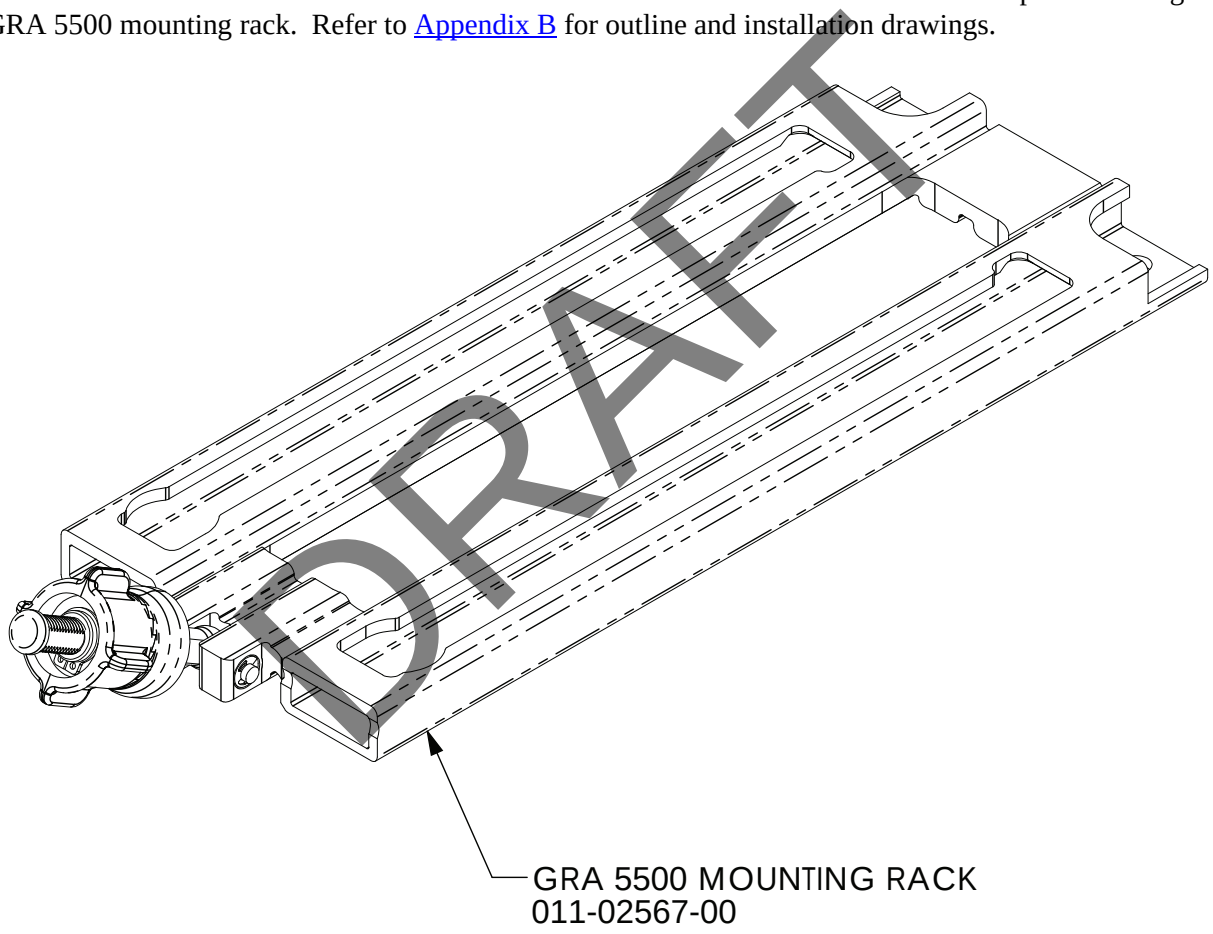

Figure 2-8 GRA 5500 Mounting Rack

3 INSTALLATION PROCEDURE

3.1 Unpacking Unit

Carefully unpack the equipment and make a visual inspection of the unit for evidence of damage incurred during shipment. If the unit is damaged, notify the carrier and file a claim. To justify a claim, save the original shipping container and all packing materials. Do not return the unit to Garmin until the carrier has authorized the claim.

Retain the original shipping containers for storage. If the original containers are not available, a separate cardboard container should be prepared that is large enough to accommodate sufficient packing material to prevent movement.

3.2 Wiring Harness Installation

Allow adequate space for installation of cables and connectors. The installer shall supply and fabricate all of the cables. All electrical connections to the GRA 5500 are made through one 55 pin circular connector (Figure 4-1). Section 4 defines the electrical characteristics of all input and output signals. Required connector and associated hardware are supplied with the connector kit.

See Appendix C for examples of interconnect wiring diagrams. Construct the actual harness in accordance with aircraft manufacturer authorized interconnect standards.

Contacts for the 55 pin connector must be crimped onto the individual wires of the aircraft wiring harness. Table 3-1 through Table 3-4 list contact part numbers (for reference) and recommended tools.

Table 3-1 Pin Contact Part Numbers

Item	Manufacturer	Part Number
Pin Contacts	Military	M39029/56-348

Table 3-2 Recommended Crimp Tools

Manufacturer	Contact Size/Type	Crimping Tool	Turret Die or Positioner
Military P/N	22D Socket	M22520/2-01 M22520/7-01	M22520/2-07 M22520/7-05

Table 3-3 Recommended Insertion Tools

Use with Contact Size	Plastic Tools		Metal Tools			
			Angle Type		Straight Type	
	MS Part Number	Color	MS Part Number	Proprietary Part Number	Proprietary Part Number	Color
22D	M81969/14-01*	Green/(White)	M81969/8-01	11-8674-24	11-8794-24	Black

*Double end insertion/removal tool.

Table 3-4 Recommended Removal Tools

Use with Contact Size	Plastic Tools		Metal Tools				
	MS Part Number	Color	For Unwired Contacts Proprietary Part Number	Angle Type		Straight Type Proprietary Part Number	Color
				MS Part Number	Proprietary Part Number		
22D	M81969/ 14-01*	(Green)/ White	11-10050-07	M81969/8-02	11-8675-24	11/8795-24	Green/ White

*Double end insertion/removal tool.

NOTE

Non-Garmin part numbers shown are not maintained by Garmin and consequently are subject to change without notice.

3.3 Backshell Assembly

The GRA 5500 connector kit includes a circular strain relief assembly. The circular strain relief gives the installer the ability to quickly and easily terminate shields. In non-Garmin Integrated Flight Deck (retrofit) installations, the Garmin circular configuration module may also be attached to the strain relief (see Figure B-2). Refer to the document Circular Connector (and Configuration Module) Installation Instructions (190-00313-12) for circular connector installation.

3.4 Antenna Installation

Refer to Section 2.3.4 for installation instructions.

3.5 Unit Installation

For final installation and assembly, refer to the outline and installation drawings shown in Appendix B of this manual and to the following procedures.

3.5.1 Installation Procedure (see Figure 3-1)

1. Place the unit on the mounting rack, ensuring the GRA 5500 rear feet are aligned in the mounting rack slots.
2. Slide the GRA 5500 back until the feet are fully engaged with the mounting rack.
3. Lift the lockdown mechanism collar in place on the GRA 5500 hook and hand turn the lockdown mechanism knob clockwise until the GRA 5500 is secure and the knob cannot reasonably be ratcheted any tighter by hand.

3.5.2 Removal Procedure (see Figure 3-1)

1. Pull back on the lockdown mechanism and simultaneously turn counterclockwise until free.

2. Disengage the lockdown mechanism collar from the GRA 5500 hook and slide the GRA 5500 forward to remove from the mounting rack.

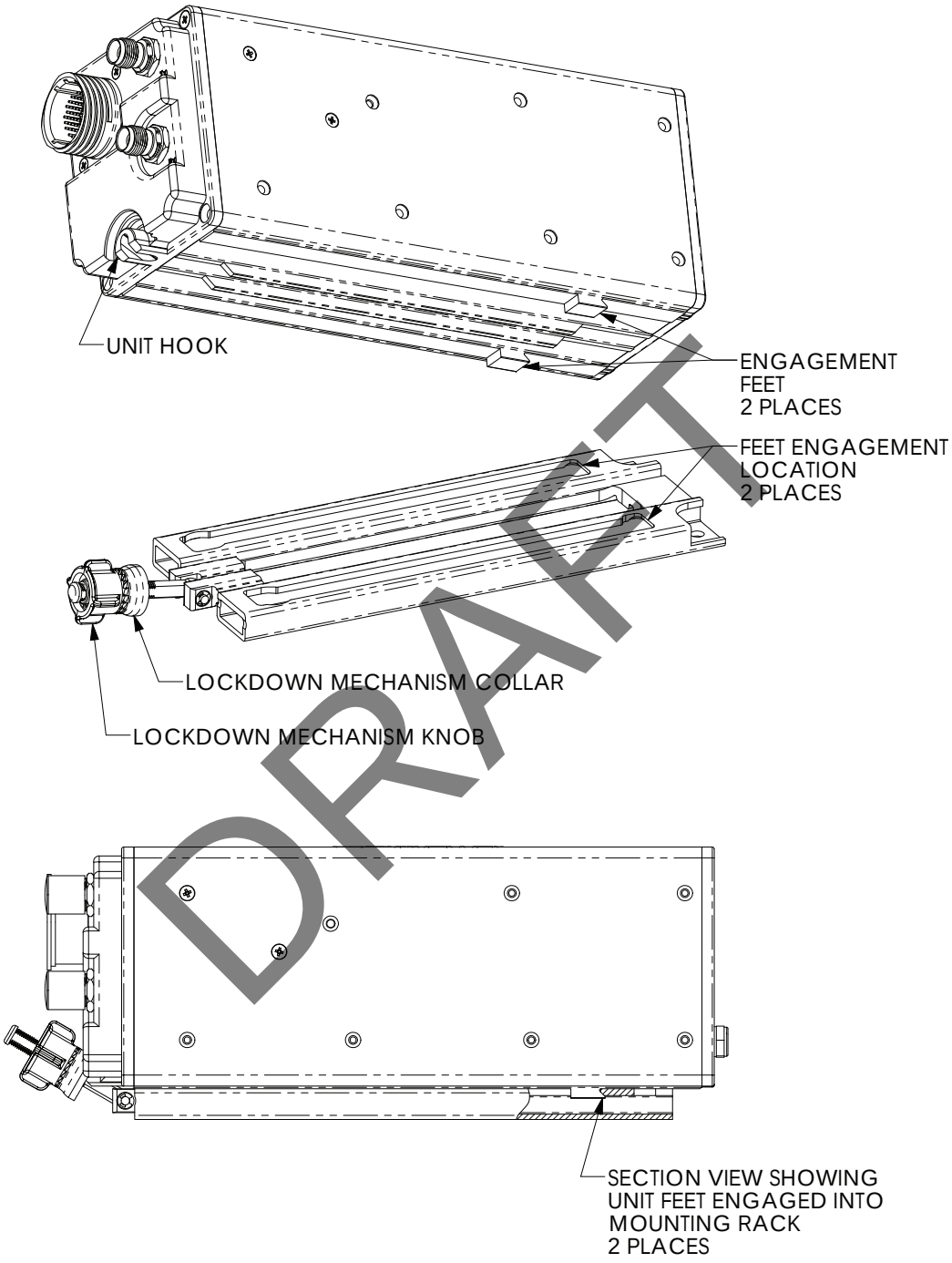

Figure 3-1 GRA 5500 Installation

3.6 Downloading and Installing the GRA 5500 Retrofit Installation Tool

GRA 5500 configuration, calibration, diagnostics, and software upgrades are performed (in retrofit/non-GIFD installations) using a personal computer (installed with Microsoft Windows XP or later) and the GRA 5500 Retrofit Installation Tool, Garmin part number 006-A0451-00. This tool is also used to assist in the diagnosis and resolution of asserts found in the GRA 5500 assert log during the installation process and during post-installation flight operation. The tool is available for download from the Dealer Resource Center portion of the Garmin website (www.garmin.com). See the accompanying "readme" file in the tool's installation directory for the latest instructions.

NOTE

A standard USB-A plug to USB-B plug commercial cable (not provided) is required to interface between a personal computer USB-A receptacle and the GRA 5500 USB-B receptacle installed in the wiring harness (in retrofit/non-GIFD installations). This dongle cable is required to use the GRA 5500 Retrofit Installation Tool. Refer to Figure C-4 for applicable interconnect drawings.

Installation

1. Once downloaded, launch the installation file from the directory in which it is stored (or use the web browser's download shortcuts).
2. The GRA 5500 Retrofit Installation Tool Setup Wizard will begin.
3. Click "Next" as prompted by the setup wizard, and adjust any settings (e.g. installation directory) as needed.
4. The last screen of the setup wizard will show "Installation Complete." Click the "Close" button to close the setup wizard.

NOTE

Depending on the computer's security settings, Windows may prompt the installer to allow the installation software to make changes to the computer. The installer will need access to install hardware drivers, program files, and shortcuts. The application may be uninstalled at any time through the Windows Control Panel.

3.7 Post Installation Configuration and Checkout Procedures

The following actions must be performed after initial installation of the GRA 5500 and any time after the equipment has been removed/disconnected and then reinstalled/reconnected:

1. GRA 5500 Configuration/Checkout for Varying Installation Types (Section 3.7.1)
2. Using the GRA 5500 Retrofit Installation Tool (Section 3.7.2) - *This step is not required for GIFD installations.*
3. Zero-Foot Calibration Procedure and Initial Built-In Self-Test (Section 3.7.3 and Section 3.7.4)

3.7.1 GRA 5500 Configuration/Checkout for Varying Installation Types

Configuration instructions may differ according to the specifics of the installation. Refer to the following subsections for specific instructions applicable to the various installation types.

3.7.1.1 FAA Approved Garmin Integrated Flight Deck GRA 5500 Installation

When installed as part of a Garmin Integrated Flight Deck via the Garmin High Speed Data Bus (HSDB over RS-422), the GRA 5500 must have FAA approved configuration data.

Configuration data is loaded to the GRA 5500 from an aircraft-specific software loader card. For basic configuration information refer to the appropriate maintenance manual. For actual installation/checkout, use only aircraft manufacturer approved or STC checkout procedures.

NOTE

GDU display units with SW versions prior to v15.00 do not support connection of the GRA 5500 to the Garmin Integrated Flight Deck via the Garmin High Speed Data Bus (HSDB over RS-422). In these installations the GRA 5500 must be connected as in a retrofit installation. See Section 3.7.1.2 for more information.

3.7.1.2 Non-Garmin Integrated Flight Deck (Retrofit) GRA 5500 Installation

Configuration, calibration, diagnostics, and software upgrades are accomplished using the GRA 5500 Retrofit Installation Tool (Section 3.7.2).

NOTE

Installations that are unable to electronically display the software part number of the GRA 5500 should affix a label on the GRA 5500 LRU marked with the software part number to meet TSO marking requirements.

3.7.2 Using the GRA 5500 Retrofit Installation Tool

After the GRA 5500 Retrofit Installation Tool has been installed and the PC has been connected to the GRA 5500 (as described in Section 3.6), start the GRA 5500 Retrofit Installation Tool from the provided "Start Menu" shortcut, or launch the application from its program folder. Next, power-up the GRA 5500 by applying aircraft power.

The connection status in the lower, right-hand corner of the GRA 5500 Retrofit Installation Tool will transition from "Not Connected," to "Connecting," and finally to "Connected."

If the GRA 5500 Retrofit Installation Tool does not display "Connected" in the lower-right hand corner, check the installation and make sure the GRA 5500 has been powered-up and that the USB cable is properly connected to the PC.

If the PC displays a "Found New Hardware" wizard, the GRA 5500 Retrofit Installation Tool was not successfully installed. It may be necessary to cancel the "Found New Hardware" wizard and attempt to re-install the GRA 5500 Retrofit Installation Tool. If the "Found New Hardware" wizard continues to launch upon detecting the GRA 5500, it may be necessary to manually load the drivers. Copies of the drivers' ".inf" files are located in the target installation directory selected during installation in Section 3.6. Consult the PC's operating system documentation on manually installing drivers.

When configuring a new GRA 5500 installation, the GRA 5500 Retrofit Installation Tool should look similar to Figure 3-2 (note the annunciated Calibration fault).

NOTE

If any other faults besides a Calibration fault are indicated, it will not be possible to perform the zero-foot calibration procedure. See Table A-3 for resolutions to specific fault conditions before attempting to perform the zero-foot calibration procedure.

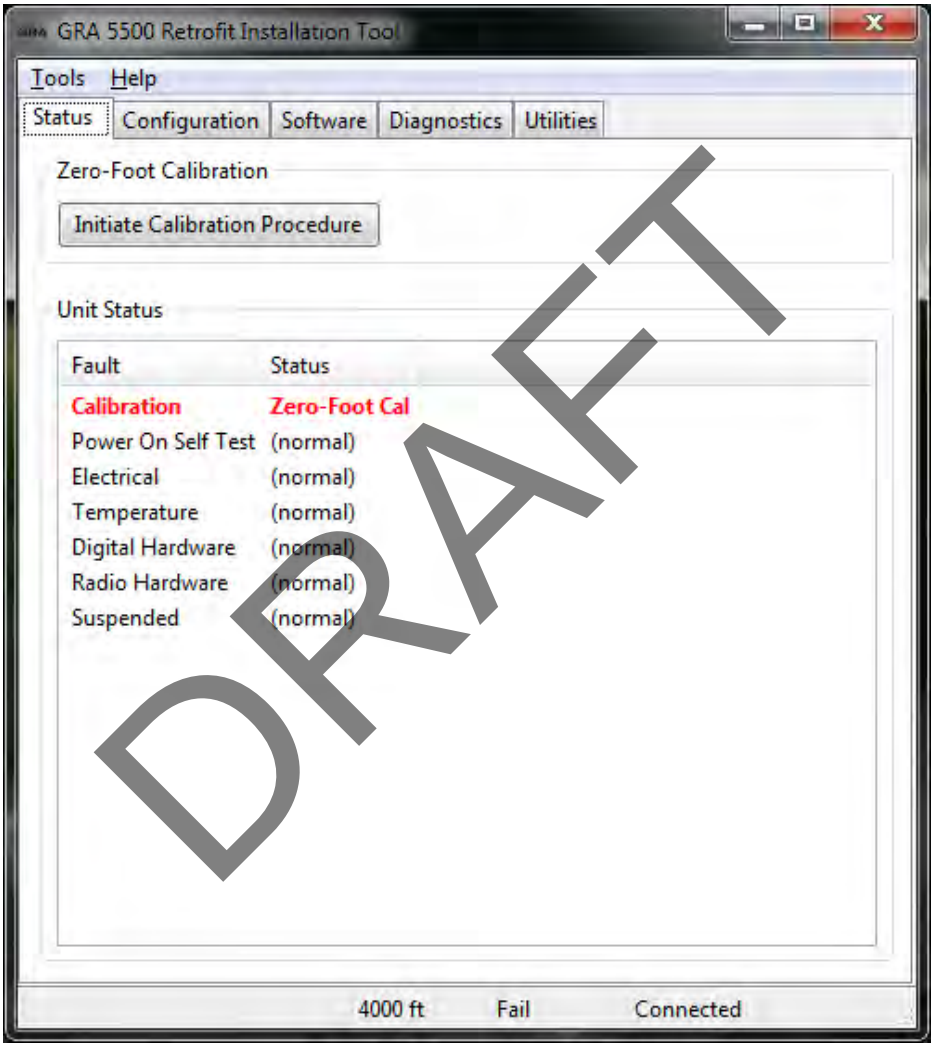

Figure 3-2 GRA 5500 Retrofit Installation Tool (New Installation)

3.7.2.1 Zero-Foot Calibration Procedure

Before the GRA 5500 is ready for normal operation, it is necessary to perform the following zero-foot calibration procedure.

NOTE

Before initiating the zero-foot calibration procedure, see Section 3.7.3 to ensure the GRA 5500 is physically ready to be calibrated.

The GRA 5500 Retrofit Installation Tool provides an interface button to initiate the zero-foot calibration procedure. Clicking this button will make a series of requests to the connected GRA 5500. During the calibration procedure, the GRA 5500 Retrofit Installation Tool will display a progress dialog. Once the calibration procedure has completed, the progress dialog will close, and the status tab will be updated. If the fault list does not annunciate any faults and the information displayed in the status bar area indicates "0 ft" and "Normal," the unit has been successfully calibrated.

If a fault is indicated, see Table A-3 for resolution methods.

The following sections detail the primary functions of the GRA 5500 Retrofit Installation Tool.

Status Tab

The status tab (see Figure 3-3) provides the basic fault status of the unit. During normal operation, the status of each fault should indicate "(normal)." If the unit indicates a fault, the fault's entry on the list will be displayed in a bold, red font. The status will also update to show the specific failure under that fault. See Table A-3 for a comprehensive list of possible failures.

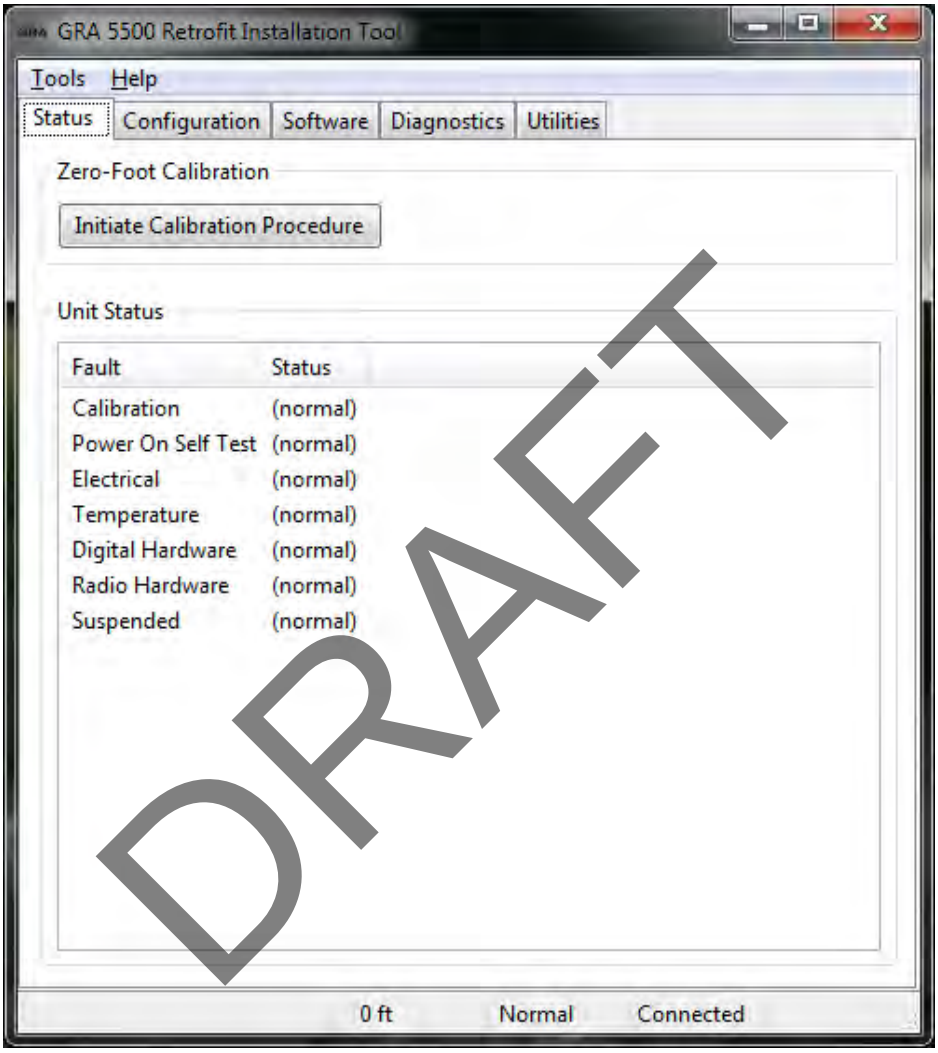

Figure 3-3 GRA 5500 Retrofit Installation Tool Status Tab (Normal Operation)

Configuration Tab

The configuration tab (see Figure 3-4) provides an interface to change the unit's per-airframe configuration. The configuration tab displays the unit's current settings. After adjusting any settings, the "Save Configuration to Unit" button must be clicked to send the configuration values to the GRA 5500. Clicking the button labeled "Restore Defaults to Unit" restores all settings to their default, factory state.

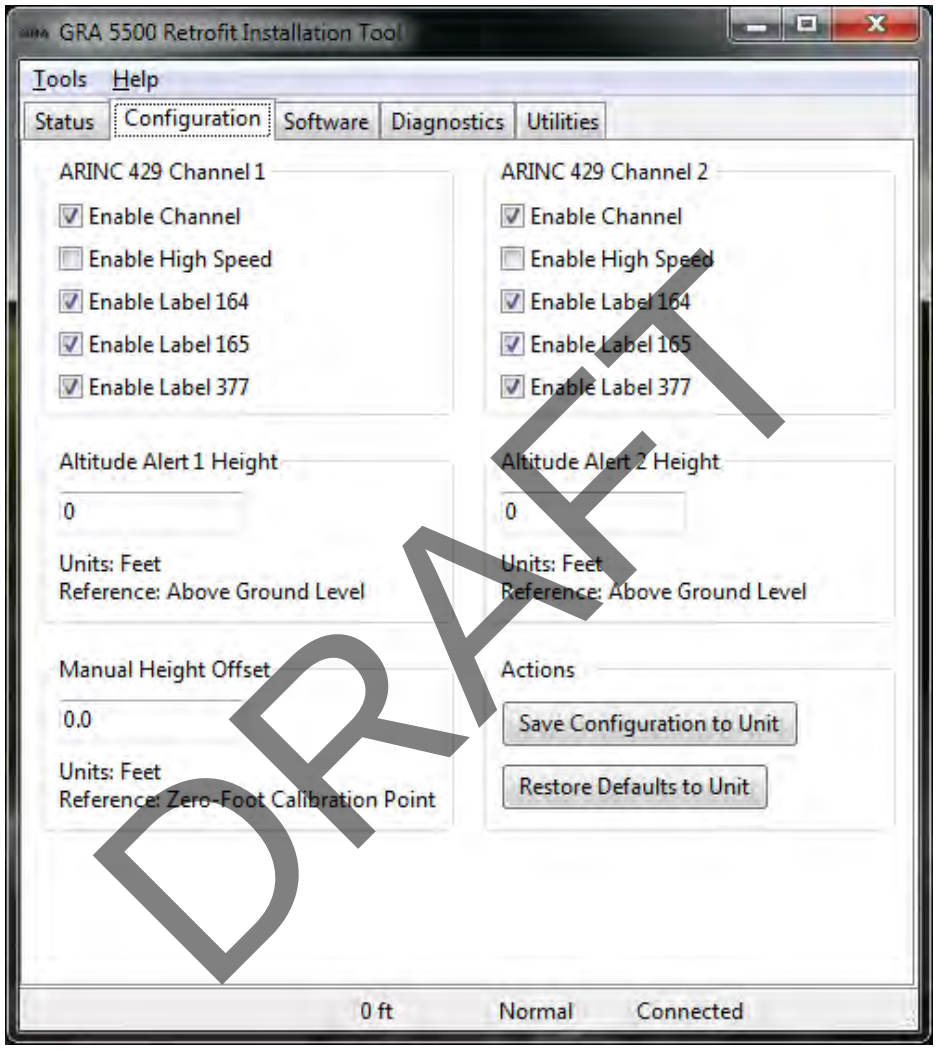

Figure 3-4 GRA 5500 Retrofit Installation Tool Configuration Tab

Configuration Items

- ARINC 429 Channel 1:

  The “ARINC 429 Channel 1” section adjusts the ARINC 429 Channel 1 settings.

Table 3-5 ARINC 429 Channel 1 Settings

Configuration	Description
Enable Channel	Check to enable the channel Uncheck to disable the channel
Enable High Speed	Check to enable high speed (100 kbps) operation Uncheck to enable low speed (12.5 kbps) operation
Enable Label 164	Check to enable sending label 164 (Radio Altitude, BNR format) Uncheck to disable sending label 164
Enable Label 165	Check to enable sending label 165 (Radio Altitude, BCD format) Uncheck to disable sending label 165
Enable Label 377	Check to enable sending label 377 (Equipment Identification) Uncheck to disable sending label 377

- ARINC 429 Channel 2:

  The “ARINC 429 Channel 2” section adjusts the ARINC 429 Channel 2 settings.

Table 3-6 ARINC 429 Channel 2 Settings

Configuration	Description
Enable Channel	Check to enable the channel Uncheck to disable the channel
Enable High Speed	Check to enable high speed (100 kbps) operation Uncheck to enable low speed (12.5 kbps) operation
Enable Label 164	Check to enable sending label 164 (Radio Altitude, BNR format) Uncheck to disable sending label 164
Enable Label 165	Check to enable sending label 165 (Radio Altitude, BCD format) Uncheck to disable sending label 165
Enable Label 377	Check to enable sending label 377 (Equipment Identification) Uncheck to disable sending label 377

- Altitude Alert 1 Height:

  Altitude alert heights between 0 and 2500 ft may be configured for each Altitude Alert annunciator output. See Section 4.4.2 for more information on the functionality of the Altitude Alert annunciator outputs.

- Altitude Alert 2 Height

  Altitude alert heights between 0 and 2500 ft may be configured for each Altitude Alert annunciator output. See Section 4.4.2 for more information on the functionality of the Altitude Alert annunciator outputs.

- Manual Height Offset

  The “Manual Height Offset” section configures a manual offset to all heights reported by the GRA 5500. This setting allows the GRA 5500 to report values other than “0 ft” at the zero-foot calibration point. Setting the manual height offset to a positive value causes the GRA 5500 to report that respective value as a “negative height” at the zero-foot calibration point (hence, negatively offset from the calibrated height). Values are limited between 0 and +20 ft. Setting the manual height offset to a negative value is not allowed by the GRA 5500 Retrofit Installation Tool.

  Configuring a manual height offset for the GRA 5500 may be useful for installations when a “0 ft” reading is desired immediately at aircraft touchdown, instead of when the aircraft is completely at rest on the ground (such as after the landing gear is compressed or in installations where the radar altimeter antennas are mounted substantially forward of the main landing gear).

Software Tab

The software tab (see Figure 3-5) provides a list of currently installed software regions on the GRA 5500 as well as an interface to load new software regions to the GRA 5500.

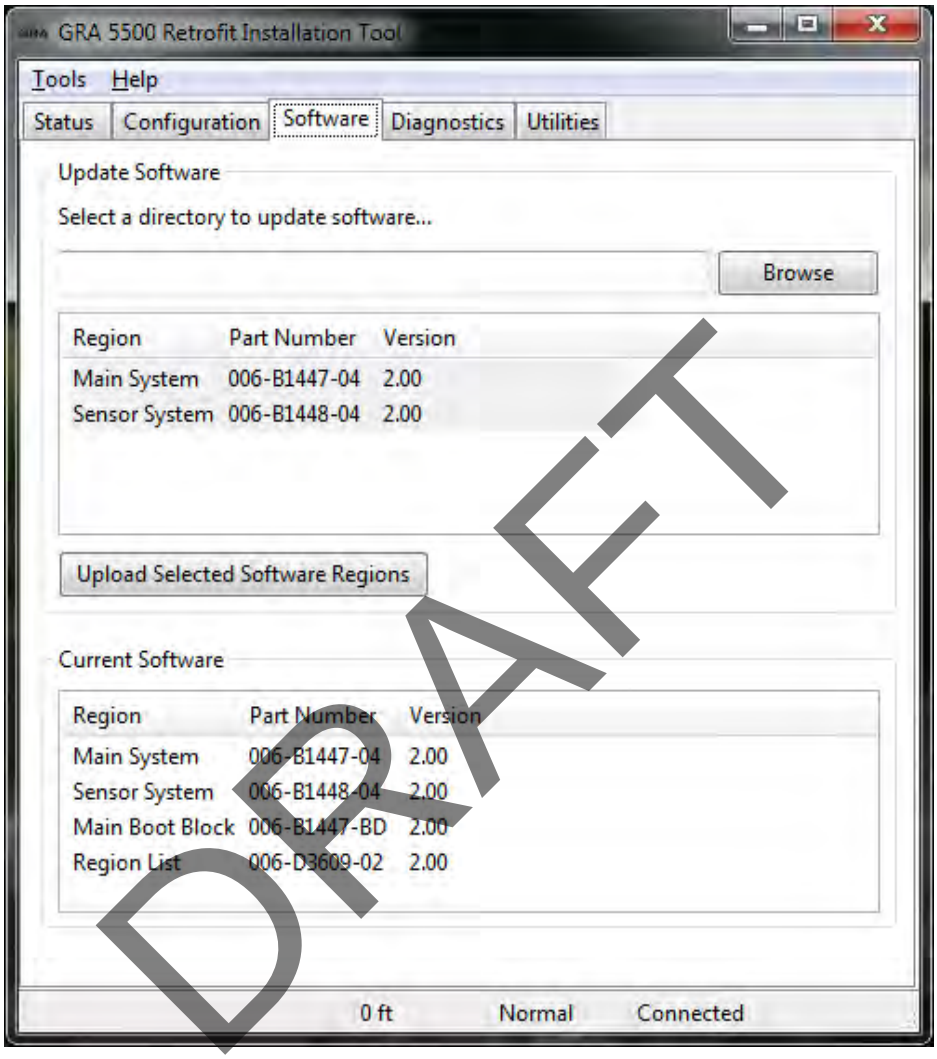

Figure 3-5 GRA 5500 Retrofit Installation Tool Software Tab

NOTE

Care should be taken when updating software in the field. While the process is designed to be very robust and reliable, each step must be followed carefully to ensure correct operation of the GRA 5500. Deviation from these procedures may result in a failure of the GRA 5500 to operate correctly and may require factory servicing.

1. Depending on the method of receiving updated software region files, it may be required to extract the files to a directory on the PC that is/will be connected to the GRA 5500. The GRA 5500 Retrofit Installation Tool will only recognize Garmin Aviation binary region files (.bin).
2. Enter the directory where these files are stored, or click the "Browse" button to locate the directory.
3. Once the directory is selected, the GRA 5500 Retrofit Installation Tool will display a list of all valid software region files in the directory. If no software region information is displayed in the list, the selected directory does not contain valid software region files. Make sure the files have been properly extracted (to .bin files), and have not been corrupted during transfer.

NOTE

Due to the sensitive nature of the "Boot Block" and "Region List" software regions, the installation tool will not list these software region files by default. If these software regions must be updated in the field, click the "Tools" pull-down menu, select "Preferences," click the "Overrides" tab, check the box labeled "Allow Boot Block and Region List updates," and click "OK." The available software list will now display any valid Boot Block and Region List files.

4. Select the region(s) to upload to the unit. By default, the latest versions of all valid software region files are selected. Single-clicking a software region will eliminate all other updates. Group selection (CTRL+click and/or SHIFT+click) permits selecting multiple regions to upload at once.

NOTE

If there are multiple versions of the same software region in the selected directory and more than one are selected, only the newest version will be sent to the unit.

5. Click the “Upload Selected Software Regions” button to initiate the update procedure. This will produce a progress dialog indicating the software update progress. Once the software update has completed the GRA 5500 will be automatically restarted to reload the new software.

CAUTION

While the GRA 5500 provides extensive protection from corrupt and/or invalid updates, it is important to allow the software update process to completely finish before attempting to forcibly close the GRA 5500 Retrofit Installation Tool, shut down Windows, power-down the PC, power-down the GRA 5500, or disconnect the GRA 5500 from the PC. If a “Main System” or “Sensor System” software update is accidentally corrupted in the field, the unit can still be recovered using the GRA 5500 Retrofit Installation Tool (by repeating the software update procedure). If a “Boot Block” or “Region List” update is accidentally corrupted in the field, the unit must be sent to Garmin for servicing.

6. Once the progress dialog has closed, check the “Current Software” section to verify that the previously selected software regions have been successfully updated. The “Current Software” section displays product information for each software region currently loaded on the GRA 5500. Each region is shown with its corresponding Garmin part number and software release version.

NOTE

If the reported versions are not updated, restart the GRA 5500 by cycling aircraft power. If the reported versions are still not updated, the software update has failed. It may be necessary to repeat the software update procedure or return the unit to Garmin for service.

3.7.3 Zero-Foot Calibration

After the GRA 5500 is configured, but before it may be put into normal flight operation, a one-time zero-foot calibration procedure must be performed on the unit in order to "zero" the altitude outputs from the unit for the individual aircraft installation. This procedure removes the altitude offsets associated with antenna cables, antenna height above ground, etc. This procedure is accomplished via GDU display interface in Garmin Integrated Flight Deck installations (see Section 3.7.1.1). In non-Garmin Integrated Flight Deck (retrofit) installations this procedure is accomplished via the GRA 5500 Retrofit Installation Tool (see Section 3.7.1.2 and Section 3.7.2). The following conditions must be met before the zero-foot calibration procedure should be attempted:

1. The entire GRA 5500 must be completely installed and mounted in the final configuration as representative of normal flight conditions.
2. The installer must perform a visual inspection to verify that the antenna installation meets all the guidelines of Section 2.3.3. Also, the visual inspection must verify that the antenna coaxial cables are installed and connected properly.
3. The zero-foot calibration procedure must be performed outdoors on a hard, flat surface and away from hangars, buildings, or other metal structures that may reflect the radar signal.
4. Dual or triple unit installations must be calibrated separately and independently. Thus, the system(s) not presently being calibrated must be powered down (circuit breaker pulled or circular connector wiring harness disconnected) so as to prevent interference with the unit presently being calibrated.

Once the calibration has successfully completed, the GRA 5500 should output "0 feet" from the altitude outputs with no GRA 5500 faults annunciated in the GDU or Retrofit Installation Tool (depending upon installation type). For further details on how to accomplish the zero-foot calibration procedure, see Section 3.7.2.

NOTE

Prior to completing the zero-foot calibration procedure for the first time on an individual GRA 5500 unit, the status of the GRA 5500 should indicate "fail" and a calibration fault should be annunciated. This is normal operation and is used to indicate that a valid zero-foot calibration has not yet occurred.

3.7.4 Built-In Self-Test Functionality

The GRA 5500 contains a full-featured built-in self-test (BIST/BITE) and fault logging functionality (including automated self-testing and fault detection of the entire internal TX and RX circuitry – see Section 3.7.4.1 for more information) that occurs every time the unit is powered up and at periodic and various times during unit operation. The tests in Table A-3 are run on the system and the resulting faults are displayed and stored in the Assert Log.

NOTE

Faults can be viewed by using the GRA 5500 Retrofit Installation Tool as described in Section 3.6 and the corresponding Assert Log may be diagnosed by using the Installation Tool to download and diagnose the unit's Assert Log. Alternatively, the Assert Log file may be downloaded and send to Garmin for diagnosis.

3.7.4.1 Automated and Manually-Initiated Altitude Self-Test and Self-Test Inhibit Functionality

The GRA 5500 includes an advanced altitude self-test functionality which provides the ability to detect and log faults within the entire internal transmitter and receiver circuitry and processing chain at various internally simulated altitudes. The altitude self-test functionality is completely automated (and can be inhibited), but it also may be run manually if desired. See below for more information applicable to both forms of altitude self-test:

Automated Altitude Self-Test

- Functionality is completely transparent to the pilot or any user of radar altitude data from the GRA 5500.
- Runs every time the unit is powered up and subsequently every 1 minute during normal unit operation at calculated altitudes above 250 ft AGL or during "No Computed Data" conditions (such as at actual altitudes above 2550 ft AGL, during excess pitch or roll maneuvering, or anytime the ground reflection is poor enough to cause "No Computed Data" to appear on the altitude outputs).
- Other than during initial unit power up, the automated altitude self-test functionality is never initiated at calculated altitudes of 250 ft AGL or below.
- Other than during initial unit power up, the automated altitude self-test functionality can be completely disabled (inhibited) by grounding the SELF TEST INHIBIT* active-low discrete input (see Section 4.4.1 for more information) or by activating the "self-test inhibit" command in GIFD installations any time (or always) during normal unit operation.

Manually Initiated Altitude Self-Test

- Performs the same physical functionality as the automated altitude self-test, but may be manually initiated at any time during normal unit operation (including at altitudes below 250 ft AGL).
- During manually initiated altitude self-test, the status of all altitude outputs from the GRA 5500 are set to "Test" and an altitude of 40 ft is output. Unlike the automated altitude self-test, this functionality is intentionally not transparent to the pilot or any user of radar altitude data from the GRA 5500 in order to be useful to the pilot or crew and not provide misleading data.
- May be initiated by grounding the SELF TEST SELECT* active-low discrete input (see Section 4.4.1 for more information) or by activating the "self-test" command via GDU in GIFD installations.
- Activation of manually initiated altitude self-test may be disabled (inhibited) by grounding the SELF TEST INHIBIT* active-low discrete input (see Section 4.4.1 for more information) or by activating the "self-test inhibit" command in GIFD installations any time (or always) during normal unit operation.

NOTE

The manually initiated altitude self-test is completely optional for installation and use. It does not provide any additional safety enhancements or fault monitoring capabilities beyond the automated altitude self-test other than allowing the pilot or users of the GRA 5500 data to see feedback (a displayed test altitude) during any stage of GRA 5500 operation.

NOTE

Because the automated altitude self-test functionality is always inhibited during operation at 250 ft AGL or below (except during unit power-up), if extended flying time below 250 ft AGL is expected (such as in certain rotorcraft operations) it is recommended to install provisions to utilize the manually initiated altitude self-test functionality (see Section 4.4.1 for more information). Manual altitude self-test functionality may then be used (and thus altitude sensing and processing integrity may be verified) during extended operations below 250 ft AGL.

3.8 Continued Airworthiness

Maintenance of the GRA 5500 is “on condition” only.

NOTE

It is the installer’s responsibility to properly document any Instructions for Continued Airworthiness as may be required by the local aircraft certification authorities.

4 SYSTEM INTERCONNECTS

4.1 Pin Function List

4.1.1 P55001

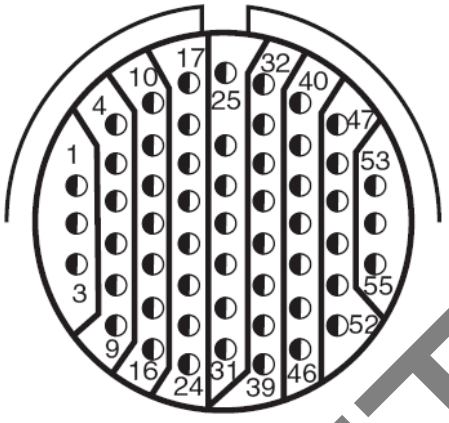

Figure 4-1 View of J55001 connector, from front of unit

Table 4-1 P55001 Connector

Pin	Pin Name	I/O
1	AIRCRAFT POWER 2	In
2	POWER GROUND	--
3	AIRCRAFT POWER 1	In
4	ARINC 429 OUT 2 B	Out
5	RESERVED (DO NOT CONNECT)	--
6	SPARE	--
7	SPARE	--
8	POWER GROUND	--
9	SELF TEST SELECT*	In
10	ARINC 429 OUT 2 A	Out
11	SIGNAL GROUND	--
12	RESERVED (DO NOT CONNECT)	--
13	RADAR ALT SYSTEM ID PROGRAM* 1	In
14	RADAR ALT SYSTEM ID PROGRAM* 2	In
15	RESERVED (DO NOT CONNECT)	--
16	SPARE	Out
17	RADAR ALTITUDE ALERT OUT* 2	Out
18	RS422 IN 2 B	In
19	SELF TEST INHIBIT*	In
20	SIGNAL GROUND	--
21	SIGNAL GROUND	--
22	SIGNAL GROUND	--

*Denotes Active Low (Ground to activate)

Table 4-1 P55001 Connector

Pin	Pin Name	I/O
23	RS422 OUT 1 B	Out
24	RS422 OUT 1 A	Out
25	RS422 IN 2 A	In
26	SIGNAL GROUND	--
27	SIGNAL GROUND	--
28	SIGNAL GROUND	--
29	SIGNAL GROUND	--
30	SIGNAL GROUND	--
31	SIGNAL GROUND	--
32	RADAR ALTITUDE ALERT OUT* 1	Out
33	SIGNAL GROUND	--
34	SIGNAL GROUND	--
35	RS422 IN 1 B	In
36	SIGNAL GROUND	--
37	SIGNAL GROUND	--
38	RS422 OUT 2 A	Out
39	SIGNAL GROUND	--
40	CONFIG MODULE DATA	Out
41	SIGNAL GROUND	--
42	RS422 OUT 2 B	Out
43	SIGNAL GROUND	Out
44	USB VBUS POWER	Out
45	USB GROUND	--
46	RS422 IN 1 A	In
47	CONFIG MODULE CLOCK	Out
48	CONFIG MODULE GROUND	--
49	USB DATA HI	I/O
50	RESERVED (DO NOT CONNECT)	--
51	SIGNAL GROUND	--
52	ARINC 429 OUT 1 A	Out
53	CONFIG MODULE POWER	Out
54	USB DATA LO	I/O
55	ARINC 429 OUT 1 B	Out

*Denotes active low (ground to activate)

4.2 Power Functions

4.2.1 Aircraft Power

The GRA 5500 provides two aircraft power inputs which accept 14/28 VDC. AIRCRAFT POWER 1 and AIRCRAFT POWER 2 are "diode ORed" to provide redundant aircraft power connections, such as on aircraft with two electrical busses. For non-redundant operation, only one input need be connected.

Table 4-2 Aircraft Power

Pin Name	Pin	I/O
AIRCRAFT POWER 1	3	In
AIRCRAFT POWER 2	1	In
POWER GROUND	2	--
POWER GROUND	8	--

4.3 Serial Data Connections

4.3.1 HSDB Over RS-422

The GRA 5500 provides two HSDB (High-Speed Data Bus) over RS-422 interfaces/channels. HSDB is Garmin's proprietary data bus for use in connecting LRUs to the Garmin Integrated Flight Deck (GIFD) in GIFD installations. Each HSDB over RS-422 interface consists of two input lines and two output lines and is physically compatible with EIA/TIA standards for RS-422.

In GIFD installations, GRA 5500 altitude information is outputted from this interface, and all unit configuration (except for dual/triple unit strapping), calibration, diagnostics, and software upgrades of the GRA 5500 occur over the HSDB over RS-422 interface. Both HSDB over RS-422 channels are identical, and only one channel need be connected to the GIFD in order to achieve full unit functionality. However, for redundancy or failure rate analysis reasons, both HSDB over RS-422 channels may be connected to provide redundant information.

Table 4-3 HSDB Over RS-422

Pin Name	Pin	I/O
RS-422 IN 1 A	46	In
RS-422 IN 1 B	35	In
RS-422 OUT 1 A	24	Out
RS-422 OUT 1 B	23	Out
RS-422 IN 2 A	25	In
RS-422 IN 2 B	18	In
RS-422 OUT 2 A	38	Out
RS-422 OUT 2 B	42	Out

4.3.2 ARINC 429

The GRA 5500 provides two independently configurable ARINC 429 output interfaces which conform to ARINC 429 electrical specifications when loaded with up to 5 standard ARINC 429 receivers.

In non-GIFD (retrofit) installations, GRA 5500 altitude information is output from this interface. The ARINC 429 outputs can be configured for low speed (12.5 kbps) or high speed (100 kbps) operation.

Table 4-4 ARINC 429

Pin Name	Pin	I/O
ARINC 429 OUT 1 A	52	Out
ARINC 429 OUT 1 B	55	Out
ARINC 429 OUT 2 A	10	Out
ARINC 429 OUT 2 B	4	Out

The ARINC 429 labels in Table 4-5 can be output from the unit and are configurable via the GRA 5500 Retrofit Installation Tool (see Section 3.7.2):

Table 4-5 ARINC 429 Output Labels

Label	Description	Output Data Rate/Period
164	Radio Altitude (BNR format)	20 Hz/50 msec
165	Radio Altitude (BCD format)	20 Hz/50 msec
377	Equipment Identification	20 Hz/50 msec

During “No Computed Data” conditions (operation above 2550 ft AGL or insufficient return signal conditions below 2550 ft AGL) the sign/status matrix bits of Label 164 and Label 165 are set to indicate “No Computed Data” and the altitude bits of each label are set to indicate 4000 ft. If a unit fault is found during normal operation, the sign/status matrix bits of Label 164 are set to indicate “Fail” and the altitude bits are set to indicate 4000 ft. During a “Fail” state Label 165 is not transmitted.

4.3.3 Configuration Module

Use of a configuration module in Garmin Integrated Flight Deck (GIFD) installations is not required. For non-GIFD (retrofit) installations, use of a configuration module is optional to retain configuration settings outside of the individual LRU.

Table 4-6 Configuration Module

Pin Name	Pin	I/O
CONFIG MODULE DATA**	40	Out
CONFIG MODULE CLOCK**	47	Out
CONFIG MODULE GROUND**	48	--
CONFIG MODULE POWER**	53	Out

**Signals have ESD (Electrostatic Discharge) protection, but no lightning protection.

4.3.4 USB

The GRA 5500 provides a standard Universal Serial Bus (USB) interface for unit configuration (except for dual/triple unit strapping), calibration, diagnostics, and software upgrades in non-GIFD (retrofit) installations. The interface is compatible with the Universal Serial Bus Version 1.1 standard for operation as a "full-speed" device.

Table 4-7 USB Connections

Pin Name	Pin	I/O
USB VBUS POWER**	44	Out
USB GROUND**	45	--
USB DATA HI**	49	I/O
USB DATA LO**	54	I/O

**Signals have ESD (Electrostatic Discharge) protection, but no lightning protection.
USB Type B Receptacle pigtail cable must be wired directly to P55001.

4.4 Discrete I/O

4.4.1 Active Low Discrete Inputs

The GRA 5500 provides four active-low discrete inputs. Two are used as configuration straps in dual and triple installations (in both GIFD and non-GIFD/retrofit installations). Two additional inputs are provided for optional manually-initiated self-test and self-test inhibit operation (discrete inputs used in non-GIFD/ retrofit installations only – manually-initiated self-test and self-test inhibit functionality occurs via HSDB over RS-422 connections in GIFD installations). See Section 3.7.4.1 for more information on automated and manually-initiated self-test capability and operation as well as self-test inhibit functionality. All active-low discrete inputs conform to the following specifications:

ACTIVE: $0\ V \leq Vin \leq 3.5\ V$, or $Rin \leq 375$ ohms

INACTIVE: $8\ V \leq Vin \leq 36\ V$, or $Rin \geq 100k$ ohms

Source current is internally limited to approximately 1 mA max for a grounded input.

Table 4-8 Active Low Discrete Inputs

Pin Name	Pin	I/O
SELF TEST SELECT*	9	In
RADAR ALT SYSTEM ID PROGRAM* 1	13	In
RADAR ALT SYSTEM ID PROGRAM* 2	14	In
SELF TEST INHIBIT*	19	In

*Denotes Active Low (Ground to activate)

4.4.2 Altitude Alert (Annunciator) Outputs

The GRA 5500 provides two active-low annunciator outputs for use as “altitude alerts” or altitude trip points to annunciate when the GRA 5500 indicates a radar altitude below the configured trip point for each altitude alert pin. The altitude value for each altitude alert pin is configurable via the GRA 5500 Retrofit Installation Tool (see Section 3.7.2 for further information on accomplishing configuration).

Each altitude alert pin will annunciate the active state if the altitude value output from the GRA 5500 is less than the configured value for the respective altitude alert pin and the status of the altitude is “Normal”. If the GRA 5500 indicates a “No Computed Data” or a “Fail” condition, both altitude alert pins will revert to the inactive state. Both altitude alert pins will also revert to the inactive state whenever the manually-initiated self-test functionality is active (See Section 3.7.4.1 for more information on self-test functionality).

ACTIVE: 0 V ≤ Vout ≤ 0.5 V, or Rout ≤ 10 ohms, sinking up to 500 mA

INACTIVE: Rout ≥ 100k ohms to ground, withstanding up to +36 VDC

Table 4-9 Alert Outputs

Pin Name	Pin	I/O
RADAR ALTITUDE ALERT OUT* 2	17	Out
RADAR ALTITUDE ALERT OUT* 1	32	Out

*Denotes Active Low

APPENDIX A Referenced Tables

Table A-1 Recommended Coaxial Length

Min. & Max. Lengths (max. loss includes cable and connector loss combined)		Max Cable Attenuation (dB/ 100ft)	Carlisle IT Type[1]	PIC Type[2]	MIL-C-17 Type[3]	RG Type[4]
Minimum	Maximum (loss of 5.0 dB)					
1' 0" [0.30m]	10' 0" [3.05m]	45.7			M17/128-RG400	RG-400
1' 0" [0.30m]	10' 0" [3.05m]	45.6			M17/60-RG142	RG-142
1' 0" [0.30m]	20' 0" [6.09m]	22.8			M17/127-RG393[5]	RG-393[5]
1' 0" [0.30m]	14' 9" [4.49m][7]	27.9		S88207		
1' 0" [0.30m]	15' 3" [4.65m][7]	31.8	3C142B			
1' 0" [0.30m]	15' 4" [4.76m][7]	30.7	432101			
1' 0" [0.30m]	16' 7" [5.05m][7]	27.5		S44191		
1' 0" [0.30m]	17' 8" [5.38m][7]	25.8		S44193		
1' 0" [0.30m]	18' 0" [5.46m][7]	26.4	311901			
1' 0" [0.30m]	18' 2" [5.54m][7]	24.4	352001			
1' 0" [0.30m]	25' 6" [7.77m][7]	18.4	311601			
1' 0" [0.30m]	26' 3" [7.62m][7]	18.3	421601			
1' 0" [0.30m]	27' 3" [8.35m][7]	16.3		S67163		
1' 0" [0.30m]	29' 5" [8.96m][7]	15.5		S33141		
1' 0" [0.30m]	30' 0"[6] [9.14m][7]	14.7	311501			
1' 0" [0.30m]	30' 0"[6] [9.14m]	13.0	421201			
1' 0" [0.30m]	30' 0"[6] [9.14m]	11.8		S55122		
1' 0" [0.30m]	30' 0"[6] [9.14m]	11.8	311201			
1' 0" [0.30m]	30' 0"[6] [9.14m]	8.3		S22089		
1' 0" [0.30m]	30' 0"[6] [9.14m]	7.8	310801			

[1]Vendor: Carlisle IT (Electronic Cable Specialists) 5300 W Franklin Drive, Franklin, WI 53132
Telephone: 800.327.9473 or 414.421.5300, Fax: 414.421.5301 Website: www.carlisleit.com

[2]Vendor: PIC Wire and Cable N53 W24747 S Corporate Circle, Sussex, WI 53089-0330
Telephone 800.742.3191 or 262.246.0500, Fax: 262.246.0450 Website: www.picwire.com

[3]Except for RG393, see current issue of Qualified Products List, QPL-17.

[4]RG types are obsolete and are shown for reference only; replaced by M17 type numbers.

[5]RG393 is listed only for the purpose of re-using existing RG393 cable for retrofits.

[6]Antenna cable length shall not exceed 30 feet per cable.

[7]Calculation provided by cable manufacturer

Table A-2 TNC Connectors

Cable Type	Connector Type	Market	Connector Part Number
Carlisle IT 432101	TNC Right Angle	Helicopter/Fixed Wing	CTR522
	TNC Straight	Helicopter/Fixed Wing	CTS522
Carlisle IT 352001	TNC Right Angle	Helicopter/Fixed Wing	CTR3522
	TNC Straight	Helicopter/Fixed Wing	CTS3522
Carlisle IT 3C142B, 311901	TNC Right Angle	Helicopter/Fixed Wing	CTR722
	TNC Straight	Helicopter/Fixed Wing	CTS722
Carlisle IT 421601, 311601, 311501	TNC Right Angle	Helicopter/Fixed Wing	CTR922
	TNC Right Angle	Helicopter/Fixed Wing	CTS922
Carlisle IT 421201, 311201	TNC Right Angle	Helicopter/Fixed Wing	CTR122
	TNC Right Angle	Helicopter/Fixed Wing	CTS122
Carlisle IT 310801	TNC Right Angle	Helicopter/Fixed Wing	CTR022
	TNC Straight	Helicopter/Fixed Wing	CTS022
PIC S44191, S44193	TNC Straight	Helicopter/Fixed Wing	190108
	TNC Right Angle	Helicopter/Fixed Wing	190109
PIC S67163	TNC Straight	Helicopter/Fixed Wing	190508
	TNC Right Angle	Helicopter/Fixed Wing	190509
PIC S83204, S88207	TNC Straight	Helicopter/Fixed Wing	190808
	TNC Right Angle	Helicopter/Fixed Wing	190809
PIC S33141	TNC Straight	Helicopter/Fixed Wing	190308
	TNC Right Angle	Helicopter/Fixed Wing	190309
PIC S55122	TNC Straight	Helicopter/Fixed Wing	190608
	TNC Right Angle	Helicopter/Fixed Wing	190609
PIC S22089	TNC Straight	Helicopter/Fixed Wing	190408
	TNC Right Angle	Helicopter/Fixed Wing	190409
Tyco Electronics M17/128-RG400, M17/60-RG142	TNC Straight	Helicopter/Fixed Wing	5225555-6
	TNC Right Angle	Helicopter/Fixed Wing	5225554-6
Tyco Electronics M17/127-RG393	TNC Straight	Helicopter/Fixed Wing	1-522550-3
	TNC Right Angle	Helicopter/Fixed Wing	1-5225554-1

Table A-3 identifies the various unit faults that can be encountered during normal operation of the GRA 5500. Use Table A-3 as a reference to determine the proper actions to take after a fault has been identified.

Table A-3 GRA 5500 Fault Descriptions

Fault Type	Fault Name	Description	Cause	Resolution
Configuration	N/A	Unit does not boot	GRA HW Revision ID invalid for SW version	Update software to correct version for hardware
			GRA Unit ID invalid (Both discrete inputs grounded)	Check Unit ID strapping and set to a valid ID
			Hardware failure	Return unit to Garmin for service
Calibration	Zero-Foot Lock	Average frequency of zero-foot signal is larger/smaller than allowable frequencies	Improper antenna connections	Check antenna installation and all cable connections and retry calibration. Note there are no assert log entries for this fault.
			Antenna cables are too long or calibration completed while aircraft is in air	Calibrate unit while on ground. Note there are no assert log entries for this fault.
	Zero-Foot Cal	Zero-foot point not set	Calibration not complete	Calibrate the unit. Note there are no assert log entries for this fault.
POST (Power On Self-Test)	PLL Register	After programming, read-back of the PLL register values does not match what was sent from the CPU	Internal communication error	Cycle power to unit. If fault persists, return unit to Garmin for service.
	RF Self-Test	The self-test signal is not within the acceptable frequency range	Improper antenna connections	Check antenna installation and all cable connections
			Internal failure	Download the assert log and send to Garmin for diagnosis. If fault persists, return unit to Garmin for service.
	Sensor Boot	Sensor processor software not successfully loaded	Internal communication error	Cycle power to unit. If fault persists, return unit to Garmin for service.
	Various (see Table A-4)	Numerous tests identified in this table are run during Power On Self-Test (POST). Failure of these tests is identified as a POST fault during power up and also identified by the fault name in the fault log.	Various (see Table A-4)	Cycle power to unit. If fault persists, return unit to Garmin for service.

(continued on next page)

Table A-3 GRA 5500 Fault Descriptions

Fault Type	Fault Name	Description	Cause	Resolution
Digital HW	Clock Generator I2C	Clock Generator is read to determine correct frequency output.	Internal communication error	Cycle power to unit. If fault persists, return unit to Garmin for service.
	Main Temp Sensor I2C	Temperature Sensor is read to determine correct operation.		
	CRF Temp Sensor I2C			
	ADC (Voltage Monitor)	ADC did not respond to sampling conversion command within 20us	Internal communication error	Cycle power to unit. If fault persists, return unit to Garmin for service.
	ADC Monitor 0	ADC used to monitor internal unit voltages fails self-test	ADC failure	Cycle power to unit. If fault persists, return unit to Garmin for service.
	ADC Monitor 1	ADC used to monitor internal unit voltages fails self-test	ADC failure	Cycle power to unit. If fault persists, return unit to Garmin for service.
	ADC Monitor 2	ADC used to monitor internal unit voltages fails self-test	ADC failure	Cycle power to unit. If fault persists, return unit to Garmin for service.
	Clock Generator Register	Clock generator programming failure	Clock generator failure	Cycle power to unit. If fault persists, return unit to Garmin for service.
	DDR	Memory integrity test	Memory failure	Cycle power to unit. If fault persists, return unit to Garmin for service.
	Flash-to-RAM Code	Failed to validate code sections in memory	Code corrupted in flash memory	Cycle power to unit. If fault persists, return unit to Garmin for service.
			Code corrupted during transfer from flash to RAM	
	Sensor Code CRC	Sensor processor code failed validity check	Code corrupted during transfer from flash to main processor	Cycle power to unit. If fault persists, return unit to Garmin for service.
			Code corrupted during transfer from main to sensor processor	Cycle power to unit. If fault persists, return unit to Garmin for service.
	Sensor Status	Sensor CPU fails to respond to Main CPU or packet information is not correct from sensor	Sensor processor failure	Cycle power to unit. If fault persists, return unit to Garmin for service.
			Internal communication error	
	Sensor Watchdog	Sensor processor reset signal triggered by sensor watchdog	Sensor processor failure	Cycle power to unit. If fault persists, return unit to Garmin for service.
			Internal communication error	

(continued on next page)

Table A-3 GRA 5500 Fault Descriptions

Fault Type	Fault Name	Description	Cause	Resolution
Electrical	+12.5V Monitor	+12.5 V power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
			Internal power supply failure	If fault persists, download the assert log and send to Garmin for diagnosis.
	-12.5V Monitor	-12.5 V power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
			Internal power supply failure	If fault persists, download the assert log and send to Garmin for diagnosis.
	+8V RF Monitor	+8 V RF power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
			Internal power supply failure	If fault persists, download the assert log and send to Garmin for diagnosis.
	-6V RF Monitor	-6 V RF power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
			Internal power supply failure	If fault persists, download the assert log and send to Garmin for diagnosis.
	+5.75V RF Monitor	+5.75 V RF power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
			Internal power supply failure	If fault persists, download the assert log and send to Garmin for diagnosis.
	+5.75V Monitor	+5.75 V power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
			Internal power supply failure	If fault persists, download the assert log and send to Garmin for diagnosis.
	+3.3V Monitor	+3.3 V power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
			Internal power supply failure	If fault persists, download the assert log and send to Garmin for diagnosis.
	+1.9V Monitor	+1.9 V power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
			Internal power supply failure	If fault persists, download the assert log and send to Garmin for diagnosis.
	Current Monitor	Improper current on +8 V power rail	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
			Internal power supply failure	If fault persists, download the assert log and send to Garmin for diagnosis.
	+12.5V RF Monitor	+12.5 V RF power rail outputs improper voltage	Aircraft power input out of range	Check aircraft power supply. Cycle power to unit.
			Internal power supply failure	If fault persists, download the assert log and send to Garmin for diagnosis.
	+80V Backup Monitor	+80 V backup power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
			Internal power supply failure	If fault persists, download the assert log and send to Garmin for diagnosis.
Suspended	Power Fail	Aircraft power lost for greater than 220 ms	Aircraft power failure	Return power to unit. Note there are no assert log entries for this fault.
Radio HW	DDS	Failure to program DDS or read back correct register information from the DDS	Internal communication error	Cycle power to unit. If fault persists, return unit to Garmin for service.
	TX PLL Lock	The TX PLL is not locked while the unit is transmitting.	Internal failure	If fault persists, download the assert log and send to Garmin for diagnosis.
	LO PLL Lock	The LO PLL is not locked while the unit is transmitting	Internal failure	If fault persists, download the assert log and send to Garmin for diagnosis.
	Auto RF Self-Test	The self-test signal is not within the acceptable frequency range	Improper antenna connections	Check antenna installation and all cable connections.
			Internal failure	If fault persists, download the assert log and send to Garmin for diagnosis.
	Main RF Self-Test	The self-test signal is not within the acceptable frequency range	Improper antenna connections	Check antenna installation and all cable connections.
			Internal failure	Download the assert log and send to Garmin for diagnosis. If fault persists, return unit to Garmin for service.

(continued on next page)

Table A-3 GRA 5500 Fault Descriptions

Fault Type	Fault Name	Description	Cause	Resolution
Temperature	Main Temp	Main board temperature greater than 100° C or less than -60° C	Installed unit location is too hot/cold	Return unit to qualified temperature range as specified in Environmental Qualification Form (EQF). If fault persists, return unit to Garmin for service.
			Internal failure	
	RF Temp	RF board temperature greater than 100° C or less than -60° C	Installed unit location is too hot/cold	Return unit to qualified temperature range as specified in Environmental Qualification Form (EQF). If fault persists, return unit to Garmin for service.
			Internal failure	

Table A-4 identifies the various unit faults that can be encountered during the initial Power On Self-Test (POST) of the GRA 5500. Use Table A-4 as a reference to determine the proper actions after a fault has been identified.

Table A-4 "Various" POST (Power On Self-Test) Faults

POST Fault	Description	Cause	Resolution
ADC Monitor 0	ADC used to monitor internal unit voltages fails self-test	Internal voltage monitor failure	Return unit to Garmin for service.
ADC Monitor 1	ADC used to monitor internal unit voltages fails self-test	Internal voltage monitor failure	Return unit to Garmin for service.
ADC Monitor 2	ADC used to monitor internal unit voltages fails self-test	Internal voltage monitor failure	Return unit to Garmin for service.
+12.5V RF Monitor	+12.5 V RF power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
		Internal power supply failure	If fault persists, download the assert log and send to Garmin for diagnosis.
+12.5V Monitor	+12.5 V power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
		Internal power supply failure	Download the assert log and send to Garmin for diagnosis. If fault persists, return unit to Garmin for service.
-12.5V Monitor	-12.5 V power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
		Internal power supply failure	Download the assert log and send to Garmin for diagnosis. If fault persists, return unit to Garmin for service.
+8V RF Monitor	+8 V RF power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
		Internal power supply failure	Download the assert log and send to Garmin for diagnosis. If fault persists, return unit to Garmin for service.
-6V RF Monitor	-6 V RF power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
		Internal power supply failure	Download the assert log and send to Garmin for diagnosis. If fault persists, return unit to Garmin for service.
+5.75V RF Monitor	+5.75 V RF power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
		Internal power supply failure	Download the assert log and send to Garmin for diagnosis. If fault persists, return unit to Garmin for service.
+5.75V Monitor	+5.75 V power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
		Internal power supply failure	Download the assert log and send to Garmin for diagnosis. If fault persists, return unit to Garmin for service.
+3.3V Monitor	+3.3 V power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
		Internal power supply failure	Download the assert log and send to Garmin for diagnosis. If fault persists, return unit to Garmin for service.
+1.9V Monitor	+1.9 V power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
		Internal power supply failure	Download the assert log and send to Garmin for diagnosis. If fault persists, return unit to Garmin for service.
+80V Backup Monitor	+80 V backup power rail outputs improper voltage	Aircraft power input voltage out of range	Check aircraft power supply. Cycle power to unit.
		Internal power supply failure	If fault persists, download the assert log and send to Garmin for diagnosis.
Main Temp	Main board temperature greater than 100° C or less than -60° C	Installed unit location is too hot/cold	Return unit to qualified temperature range as specified in Environmental Qualification Form (EQF). If fault persists, return unit to Garmin for service.
		Internal failure	
RF Temp	RF board temperature greater than 100° C or less than -60° C	Installed unit location is too hot/cold	Return unit to qualified temperature range as specified in Environmental Qualification Form (EQF). If fault persists, return unit to Garmin for service.
		Internal failure	

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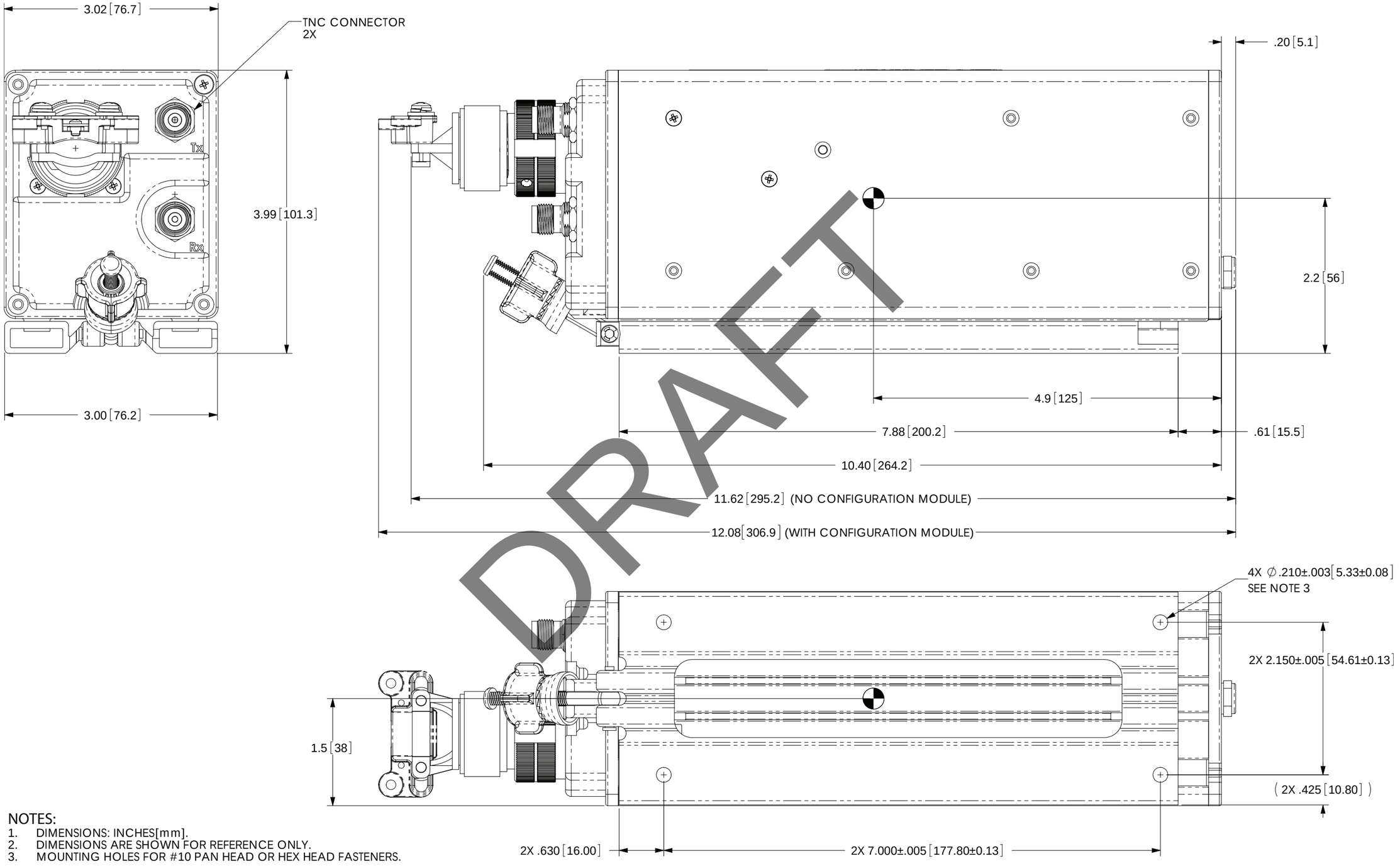
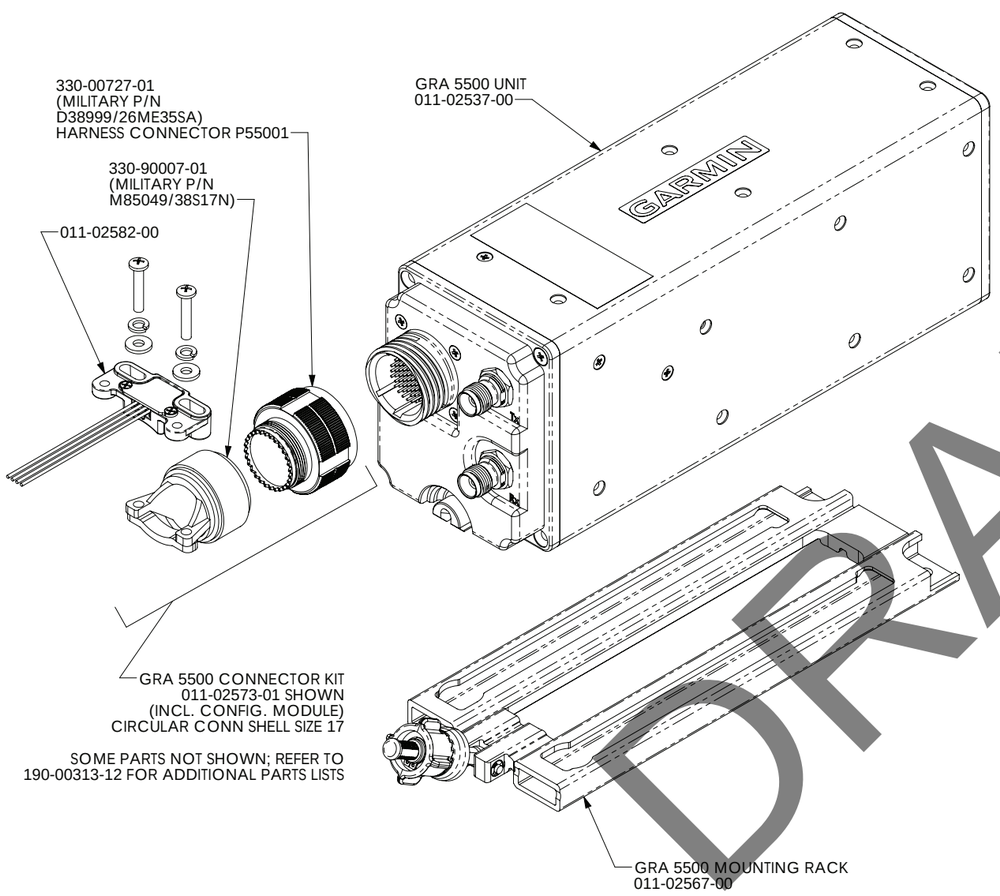
APPENDIX B Outline and Installation Drawings

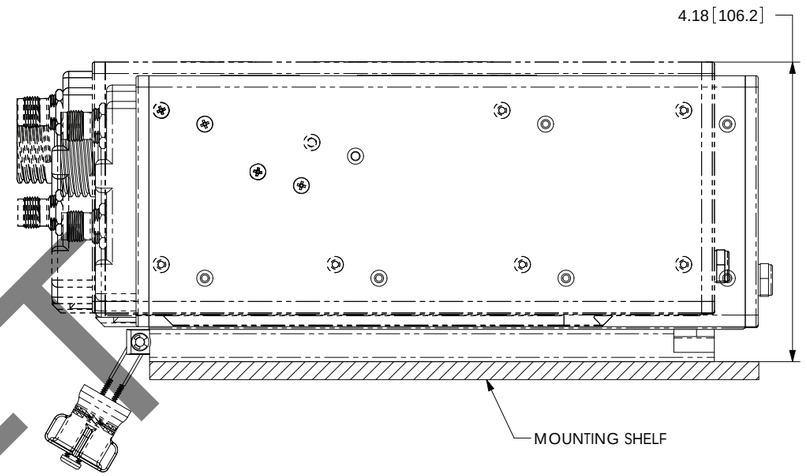


NOTES:
1. DIMENSIONS: INCHES[mm].
2. DIMENSIONS ARE SHOWN FOR REFERENCE ONLY.
3. MOUNTING HOLES FOR #10 PAN HEAD OR HEX HEAD FASTENERS.

Figure B-1 GRA 5500 Outline Drawing



MINIMUM REQUIRED INSTALLATION AND REMOVAL CLEARANCE
WITH LOCKDOWN OVERHANGING MOUNTING SHELF



MINIMUM REQUIRED INSTALLATION AND REMOVAL CLEARANCE
WITH LOCKDOWN NOT OVERHANGING MOUNTING SHELF

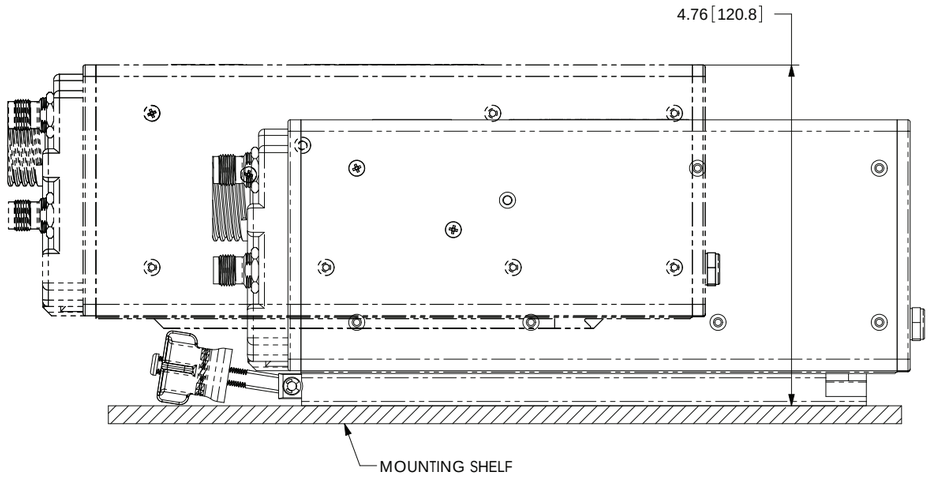
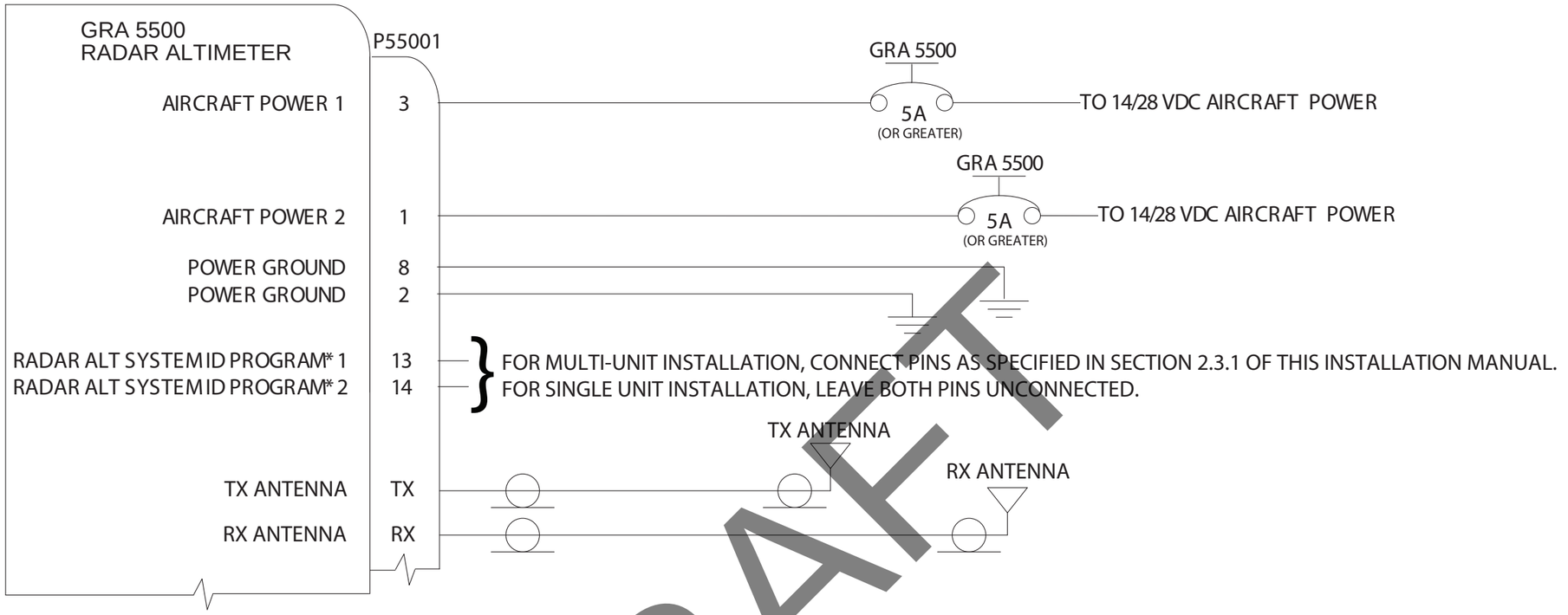


Figure B-2 GRA 5500 Connector/Rack Assembly Drawing



NOTES:

1. THIS INTERCONNECT EXAMPLE DRAWING APPLIES TO BOTH GIFD (GARMIN INTEGRATED FLIGHT DECK) AND NON-GIFD (RETROFIT) INSTALLATIONS.
2. UNLESS OTHERWISE NOTED, ALL STRANDED WIRE MUST CONFORM TO MIL-W-22759/16 OR EQUIVALENT.
3. UNLESS OTHERWISE NOTED, ALL SHIELDED WIRE MUST CONFORM TO MIL-C-27500 OR EQUIVALENT.
4. UNLESS OTHERWISE NOTED, ALL WIRES ARE 22 GAUGE MINIMUM.
5. SYMBOL DESIGNATIONS

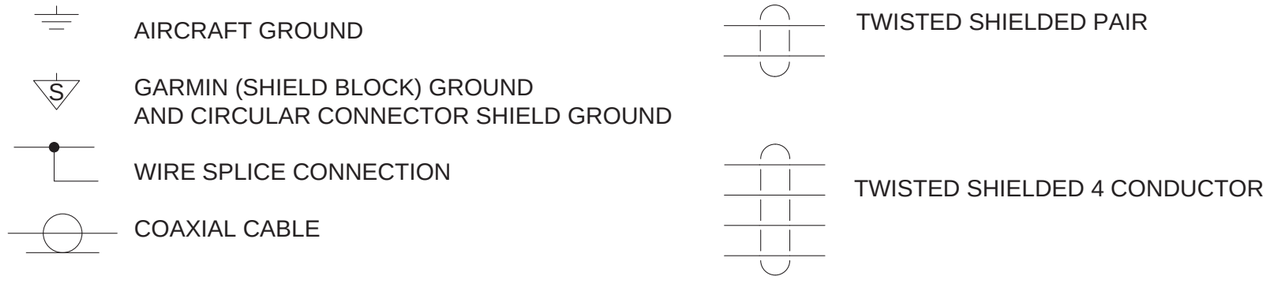


Figure C-1 Garmin Integrated Flight Deck (GIFD) and non-GIFD (retrofit) Interconnect Example

THIS INTERCONNECT EXAMPLE DRAWING APPLIES ONLY TO GARMIN INTEGRATED FLIGHT DECK (GIFD) INSTALLATIONS.

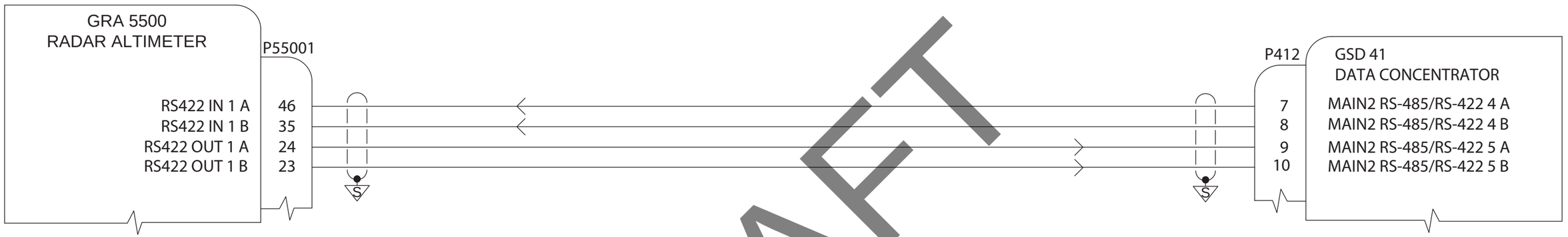
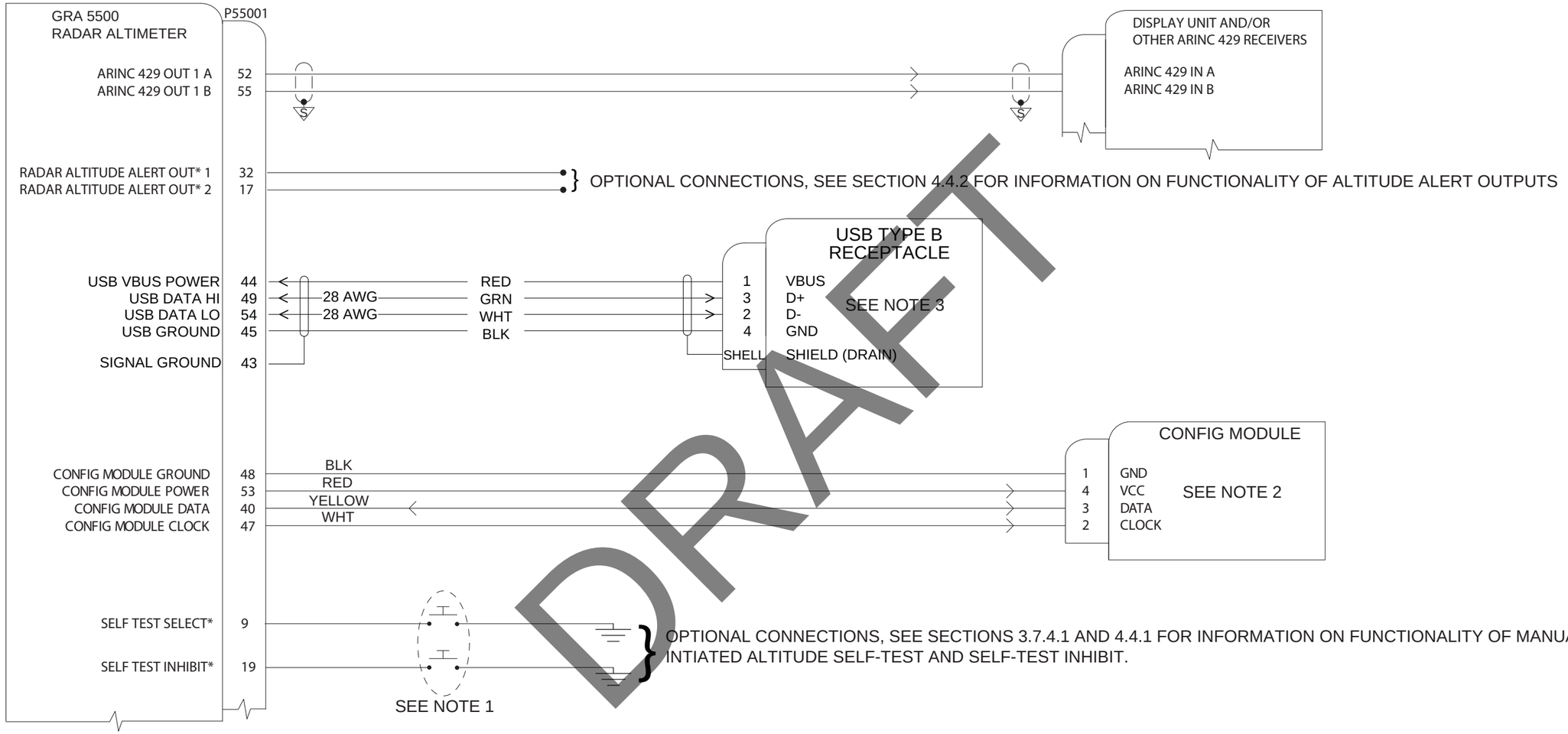


Figure C-2 Garmin Integrated Flight Deck Interconnect Example

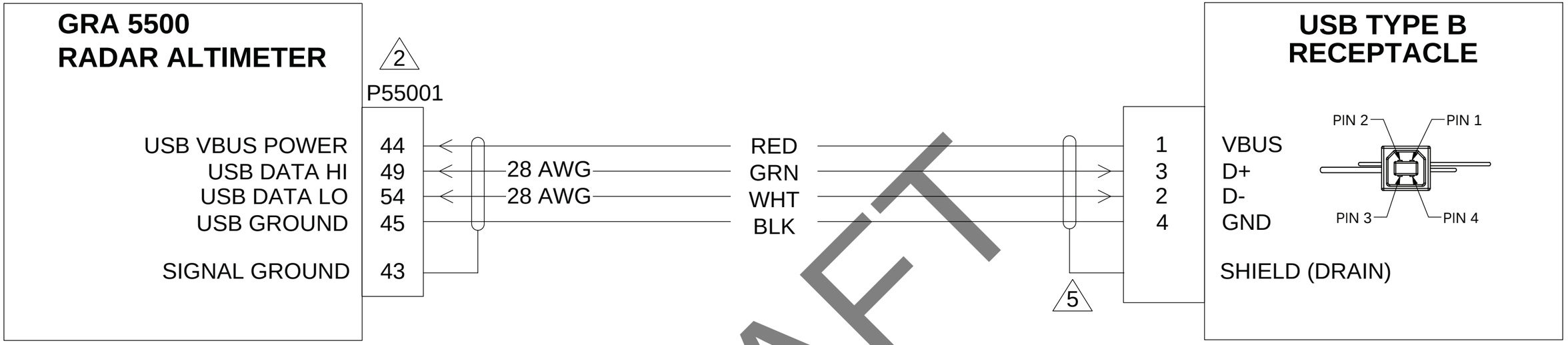
THIS INTERCONNECT EXAMPLE DRAWING APPLIES ONLY TO NON-GARMIN INTEGRATED FLIGHT DECK (RETROFIT) INSTALLATIONS.



NOTES

1. EXTERNAL ACTIVE LOW DISCRETE OUTPUTS/ANNUNCIATORS FROM OTHER APPLIANCES MAY BE USED AS INPUTS FOR PINS 9 AND 19 INSTEAD OF SWITCHES.
2. CONFIGURATION MODULE USE IS OPTONAL. SEE SECTION 4.3.3 FOR MORE INFORMATION.
3. USB TYPE B RECEPTACLE PIGTAIL MUST BE WIRED DIRECTLY TO P55001. USB EXTENSION CABLES MUST BE DISCONNECTED FROM THE PIGTAIL WHILE IN FLIGHT.

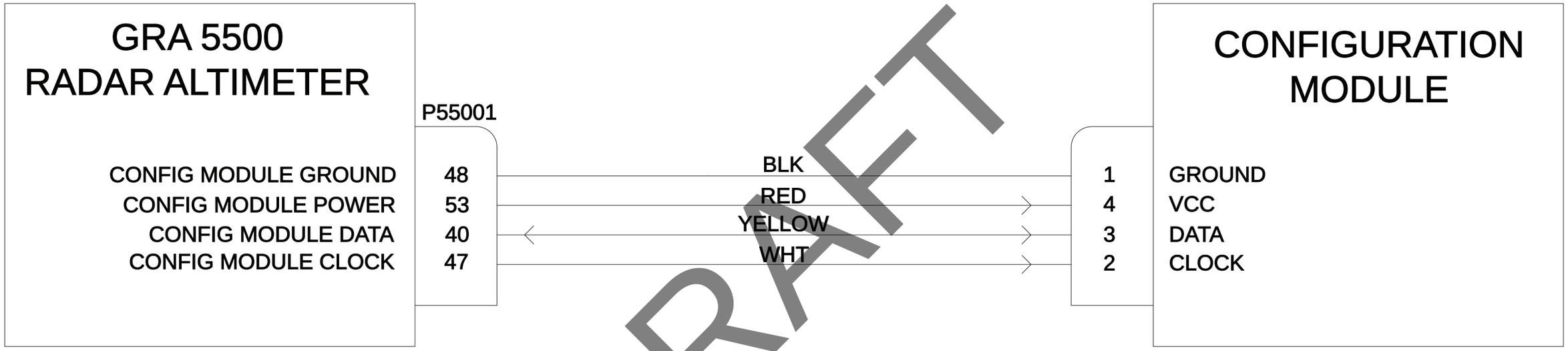
Figure C-3 Non-Garmin Integrated Flight Deck (retrofit) Interconnect Example



NOTES:

1. ALL WIRES 24 AWG OR LARGER UNLESS OTHERWISE SPECIFIED.
2. USB TYPE B RECEPTACLE PIGTAIL (P/N 011-01782-00) MUST BE WIRED DIRECTLY TO P55001. ALL USB EXTENSION CABLES MUST BE DISCONNECTED DURING FLIGHT.
3. TRIM ALL EXPOSED INDIVIDUAL 24 AWG AND 28 AWG WIRES AND THE TINNED 28 AWG DRAIN WIRE BACK TO THE OUTER BLACK INSULATION.
4. REMOVE THE OUTER BLACK INSULATION SO THAT THE INDIVIDUAL WIRES ARE EXPOSED FOR A LENGTH OF 1.25 INCHES.
5. AS THE DRAIN WIRE IS UN-INSULATED, A TEFLON SLEEVE (18 AWG OR HIGHER) IS REQUIRED OVER THE EXPOSED AREA BACK TO THE OUTER INSULATION OF THE CABLE. THE DRAIN WIRE IS CONNECTED TO THE METALLLIC AREA AROUND THE USB RECEPTACLE.
6. CRIMP PINS ON TO THE INDIVIDUAL WIRES AND THE DRAIN WIRE USING BEST SHOP PRACTICES.

Figure C-4 GRA 5500 USB Dongle Cable



NOTE:

USE OF A CONFIGURATION MODULE IN GARMIN INTEGRATED FLIGHT DECK (GIFD) INSTALLATIONS IS NOT REQUIRED. FOR NON-GIFD (RETROFIT) INSTALLATIONS, USE OF A CONFIGURATION MODULE IS OPTIONAL TO RETAIN CONFIGURATION SETTINGS OUTSIDE OF THE INDIVIDUAL LRU.

Figure C-5 GRA 5500 Configuration Module Interconnect Example