GARMIN

# GDL 88
# TSO Installation Manual



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**RECORD OF REVISIONS**

| Revision | Revision Date | Description |
|---|---|---|
| A | | Initial Release |
| | | |
| | | |

**DOCUMENT PAGINATION**

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## INFORMATION SUBJECT TO EXPORT CONTROL LAWS

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### 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.

### WARNING

Perchlorate Material – special handling may apply, See www.dtsc.ca.gov./hazardouswaste/perchlorate.

### WARNING

The GDL 88 with GPS/SBAS and the GDL 88D with GPS/SBAS contains a lithium battery that must be recycled or disposed of properly. Battery replacement and removal must be performed by professional services.

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## LIST OF TABLES

## GDL 88 MOD LEVEL HISTORY

The following table identifies hardware modification (Mod) Levels for the GDL 88, GDL 88D, GDL 88 with GPS/SBAS and GDL 88D with GPS/SBAS. Mod Levels are listed with the associated service bulletin number, service bulletin date, and the purpose of the modification. The table is current at the time of publication of this manual (see date on front cover) and is subject to change without notice. Authorized Garmin Sales and Service Centers are encouraged to access the most up-to-date bulletin and advisory information on the Garmin Dealer Resource web site at www.garmin.com using their Garmin-provided user name and password.

| Mod Level | Service Bulletin Number | Service Bulletin Date | Purpose Of Modification |
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# 1 GENERAL DESCRIPTION

## 1.1 Introduction

This manual is applicable for GDL 88 units with software version 2.00 or later. This manual describes the physical, mechanical, and electrical characteristics, as well as instructions and other conditions and limitations for installation and approval of the GDL units. Refer to Section 2, Limitations, for additional information and other considerations.

**NOTE**

Except where specifically notes, references made to GDL 88 will equally apply to GDL 88 with GPS/SBAS, GDL 88D, and GDL 88D with GPS/SBAS units.

**Table 1-1. GDL 88 Units**

| Model | Part Number |
|---|---|
| **GDL 88** | 010-00859-00 |
| **GDL 88 with GPS/SBAS** | 010-00860-00 |
| **GDL 88D** | 010-00861-00 |
| **GDL 88D with GPS/SBAS** | 010-00862-00 |

## 1.2 Equipment Description

The GDL 88 is a remote-mounted product that contains a 978 MHz Universal Transceiver (UAT) and a 1090 MHz receiver. The GDL 88 will transmit ownship ADS-B data via the UAT data link. It will receive data from other UAT and 1090ES equipped aircraft, as well as Flight Information Service Broadcast (FIS-B) weather. The received data may be output to an appropriate display.

The GDL 88 Series consist of four variations:

- GDL 88
- GDL 88, with an internal GPS/SBAS receiver
- GDL 88D with dual antenna diversity
- GDL 88D, with dual antenna diversity and an internal GPS/SBAS receiver

## 1.3 Technical Specifications

### 1.3.1 Physical Characteristics

**Table 1-2. Physical Characteristics – GDL 88 Units**

| Characteristics | Specifications |
|---|---|
| **Height** | |
| **Width** | |
| **Depth (Installed with rack and connectors)** | |
| **GDL 88 Weight (Unit only)** | |
| **GDL 88 Weight (Installed with rack)** | |
| **GDL 88 with GPS/SBAS Weight (Installed with rack)** | |
| **GDL 88D Weight (Unit only)** | |
| **GDL 88D Weight (Installed with rack)** | |
| **GDL 88D with GPS/SBAS Weight (Unit Only)** | |
| **GDL 88D with GPS/SBAS Weight (Installed with rack)** | |

### 1.3.2 General Specifications

**Table 1-3. General Specifications - GDL 88 Units**

| Characteristics | Specifications |
|---|---|
| **Operating Temperature Range** | -45°C to +70°C For more details see Environmental Qualification Form on the Dealers Only page on www.garmin.com. See Appendix A for part numbers. |
| **Humidity** | 95% at 65°C |
| **Altitude Range** | 50,000 ft (maximum) |
| **Input Voltage Range** | 9 to 33 VDC |
| **External Cooling** | External fan incorporated into GDL 88 backplate is required. |
| **Environmental Testing** | See Environmental Qualification Form on the Dealers Only page on www.garmin.com. See Appendix A for part numbers. |

### 1.3.3 GPS/SBAS Specifications

**Table 1-4. GPS/SBAS Specifications – GDL 88 and GDL 88D with GPS/SBAS**

| Characteristics | Specifications |
|---|---|
| **Number Of Channels** | 15 (12 GPS and 3 SBAS) |
| **Frequency** | 1575.42 MHz L1, C/A code |
| **Sensitivity (Acquisition, No Interference)** | -134.5 dBm GPS<br>-135.5 dBm WAAS |
| **Sensitivity (Drop Lock)** | -144 dBm |
| **Dynamic Range** | > 20 dB |
| **Lat/Lon Position Accuracy** | <1.25 meter RMS horizontal, <2 meter vertical, with WAAS |
| **Velocity** | 1000 knots maximum (above 60,000 ft) |
| **TTFF (Time To First Fix)** | 1:45 min. typical with current almanac, position, and time |
| **Reacquisition** | 10 seconds typical |
| **Position Update Interval** | 0.2 sec (5 Hz) |
| **1 PPS (Pulse Per Second)** | ±275 Nsec of UTC second |
| **Datum** | WGS-84 |
| **SATCOM Compatibility** | SATCOM compatibility is dependent upon antenna selection. |
| **Antenna Power Supply** | 35 mA typical, 40 mA max at 4.7 VDC |

### 1.3.4 978 MHz UAT Transceiver Specifications

**Table 1-5. UAT Transceiver Specifications**

| Characteristics | Specifications |
|---|---|
| **Frequency** | 978.00 MHz |
| **Transmit Power** | 50 W (+47 dBm) |
| **Frequency Tolerance** | ± 20 PPM |
| **Modulation** | Continuous Phase FSK, h = 0.6, Raised Cosine shaping, a = 0.5 |
| **Data Rate** | 1.04 Mbps |
| **99% Power Bandwidth** | 1.3 MHz |
| **60 dB Bandwidth** | 3.3 MHz (estimated) |
| **Receiver Sensitivity** | -96 dBm for 90% MSR |

### 1.3.5 1030 MHz Transmitter Specifications

**Table 1-6. Transmitter Specifications**

| Characteristics | Specifications |
|---|---|
| **Frequency** | 1030 MHz |
| **Transmit Power** | -29 dBm |
| **Frequency Tolerance** | ± 20 kHz |

### 1.3.6 1090 MHz Receiver Specifications

**Table 1-7. Receiver Specifications**

| Characteristics | Specifications |
|---|---|
| **Frequency** | 1090 MHz |
| **Frequency Tolerance** | ± 1 MHz |
| **Modulation** | Binary Pulse-Position |
| **Data Rate** | 1 Mbps |
| **Sensitivity** | -82 dBm for 90% MSR |

### 1.3.7 UAT/1090 Requirements

The GDL 88 requires UHF antenna(s) meeting the following specifications:

- Vertically polarized
- The VSWR produced by the antenna does not exceed 1.7:1 at 978 MHz and 1.5:1 at 1090 MHz.
- TSO-C66, TSO-C74, or TSO-C112 antennas that also meet the VSWR specification.

**NOTE**

Certain types of transponder antennas that utilize very thin radiator elements are only intended for use at 1030 and 1090 MHz. These types of antennas should be evaluated on a model-by-model basis to determine their suitability as UAT data link antennas.

**CAUTION**

Operating the GDL 88 without RF terminations on the top or bottom UAT antenna ports can result in equipment damage. Always operate the GDL 88 with the top and bottom UAT antenna ports terminated with a VSWR ration of 3.0:1 or less.

### 1.3.8 GPS Antenna Requirements

Antenna performance is critical to the GPS/SBAS operation. The antennas listed in Table 1-8 provide acceptable performance with the GDL 88.

**Table 1-8. Approved GPS/SBAS Antennas**

| Model/Description | Conn Type | Mfr | Part Number | Garmin Order Number |
|---|---|---|---|---|
| GA 35, GPS/WAAS [1] | TNC | Garmin | 013-00235-( ) | 013-00235-( ) |
| | | Aero Antenna | AT575-93G( )-TNCF-000-RG-27-NM | |
| GA 36, GPS/WAAS | TNC | Garmin | 013-00244-( ) | 013-00244-( ) |
| | | Aero Antenna | AT575-126G( )-TNCF-000-RG-27-NM | |
| GA 37, GPS/WAAS/XM | TNC | Garmin | 013-00245-( ) | 013-00245-( ) |
| | | Aero Antenna | AT2300-126G( )-TNCF-000-RG-27-NM | |
| A33W, WAAS Antenna | TNC | Garmin | 013-00261-( ) | 013-00261-( ) |
| | | Aero Antenna | AT575-332G( )- TNCF-000-RG-27-NM | |
| GPS/VHF Antenna | TNC/BNC [2] | Comant | CI-2580-200 | N/A |
| GPS/VHF Antenna | TNC/BNC [2] | Comant | CI-2728-200 | N/A |
| GPS/XM/VHF Antenna | TNC/TNC/BNC [3] | Comant | CI-2580-410 | N/A |
| GPS/XM/VHF Antenna | TNC/TNC/BNC [3] | Comant | CI-2728-410 | N/A |
| GPS/WAAS Antenna | TNC | Comant | CI-428-200 | N/A |
| GPS/XM Antenna | TNC/TNC | Comant | CI-428-410 | N/A |

[1] Same mounting hole pattern as GA 56, but GA 35 antenna has a physically larger footprint.

[2] The antenna connector is a TNC type. The VHF connector is a BNC type.

[3] The antenna connector is a TNC type. The XM connector is a TNC type. The VHF connector is a BNC type.

## 1.4 License Requirements

The Telecommunications Act of 1996, effective February 8, 1996, provides the FCC discretion to eliminate radio station license requirements for aircraft and ships. The GTN 750 installations must comply with current transmitter licensing requirements. In the US, to find out the specific details on whether a particular installation is exempt from licensing, please visit the FCC web site http://wireless.fcc.gov/aviation. If an aircraft license is required, make application for a license on FCC form 404, Application for Aircraft Radio Station License. The FCC also has a fax-on-demand service to provide forms by fax. Outside the US, contact the responsible telecommunication authority. The GTN 750 owner accepts all responsibility for obtaining the proper licensing before using the transceiver. The maximum transmitting power, modulation identification, and frequency band information may be required for licensing and are detailed in Section 1.4.4.

**CAUTION**

The VHF transmitter in this equipment is guaranteed to meet Federal Communications Commission acceptance over the operating temperature range. Modifications not expressly approved by Garmin could invalidate the license and make it unlawful to operate the equipment.

**NOTE**

Canadian installations are required to meet Industry Canada specifications for maximum radiation as documented in Radio Specifications Standard 102 (RSS-102). For more information about RF exposure and related Canadian regulatory compliance, contact:

Manager, Radio Equipment Standards
Industry Canada
365 Laurier Avenue
Ottawa, Ontario
K1A 0C8

In accordance with Canadian Radio Specifications Standard 102 (RSS 102), RF field strength exposure to persons from an antenna connected to this device should be limited to 60V/m for controlled environment and 28 V/m for uncontrolled environment.

## 1.5 Regulatory Compliance

### 1.5.1 TSO Authorization and Advisory Circular References

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 in compliance with 14 CFR part 43 or the applicable airworthiness requirements.

All GTN unit functions are design approved under the TSO. Unauthorized changes or modifications to any GTN unit product may void the compliance to required regulations and authorization for continued equipment usage.

**Table 1-9. TSO Authorization**

**C** – Complete TSO **I** – Incomplete TSO

| GDL 88 | GDL 88D | GDL 88 w/ GPS/SBAS | GDL 88D w/ GPS/SBAS | Function | TSO/ETSO/ SAE/RTCA/ EUROCAE | Class/ Type | Applicable SW P/Ns | Applicable CLD P/Ns |
|---|---|---|---|---|---|---|---|---|
| | | C | C | Airborne Navigation Sensors Using the Global Position System Augmented by the Satellite Based Augmentation System (SBAS) | TSO-C145c DO-229D | B2 | | |
| | C | | C | Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast (ADS-B) Equipment Operating on Frequency of 978 MHz | TSO-C154c DO-282B | A1H | | |
| C | | C | | | | A1S | | |
| I | I | I | I | Aircraft Flight Information Services – Broadcast (FIS-B) Data Link Systems and Equipment | TSO-C157 DO-267A | | | |
| | I | | I | Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Service – Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz) | TSO-C166b DO-260B | A1 | | |
| I | | I | | | | | | |
| I | I | I | I | Avionics Supporting Automatic Dependent Surveillance – Broadcast (ADS-B) Aircraft Surveillance Applications (ASA) | TSO-C195 DO-317 | C1, C2, C3, C4 | | |

### 1.5.2 Non-TSO Functions

**Table 1-10. Non-TSO Functions**

| Function | Applicable SW P/N | Applicable CLD P/Ns |
|---|---|---|
| Transponder Self Interrogations:<br>The GDL 88 has the ability to transmit a low power Mode A all call interrogation on the 1030 MHz frequency for the purposes of receiving the squawk code and IDENT status from a nearby Mode A, A/C, or S transponder on the 1090 MHz frequency. | | |

**Table 1-11. System Functions**

| System Function | DO-178B Level |
|---|---|
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**NOTE**

All GDL 88 unit functions are design approved under the TSO. Unauthorized changes or modifications to any GDL 88 unit product may void the compliance to required regulations and authorization for continued equipment usage.

### 1.5.3 TSO Deviations

**Table 1-12. TSO Deviations**

| TSO | Deviation |
|---|---|
| TSO-C145c | |
| | |
| | |
| TSO-C154c | |
| | |
| | |
| TSO-C157 | |
| | |
| | |
| TSO-166b | |
| | |
| | |
| TSO-C195 | |
| | |
| | |

### 1.5.4 FCC Grant of Equipment Authorization

**Table 1-13. FCC and IC IDs**

| Model | FCC ID | IC ID |
|---|---|---|
| GDL 88 | IPH-01246 | 1312A-01246 |

## 1.6 Aviation Limited Warranty

All Garmin avionics products are warranted to be free from defects in materials or workmanship for: two 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 will 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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**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.

# 2 LIMITATIONS

## 2.1 Installation

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 GDL 88 GPS/SBAS receiver, when installed with an appropriate antenna listed in Section 1.3.8, is compatible with aircraft equipped with SATCOM when installed in accordance to this manual.

# 3 INSTALLATION OVERVIEW

Always follow acceptable avionics installation practices per AC 43.13-1B, AC 43.13-2B, or later FAA approved revisions of these documents. The GPS/SBAS installation instructions have been prepared to meet the guidance material contained in AC 20-138A "Airworthiness Approval of Global Navigation Satellite System (GNSS) Equipment." The communications installation instructions have been prepared to meet the guidance material defined by AC 20-67B, "Airborne VHF Communications Equipment Installations."

## 3.1 Antenna Considerations

This section contains mounting location considerations for the antennas required for the GDL 88 units. For mounting the GPS/SBAS antenna, refer to FAA approved data. For mounting the NAV antennas, refer to the aircraft manufacturer's data.

### 3.1.1 GPS Antenna Location

The GPS/SBAS antenna is a key element in the overall system performance and integrity for a GPS/SBAS navigation system. The mounting location, geometry, and surroundings of the antenna can affect the system performance and/or availability. The following guidance provides information to aid the installer in ensuring that the most optimum location is selected for the installation of the GPS antenna. The installation guidelines presented here meet the intent of AC 20-138A section 16. The greater the variance from these guidelines, the greater the chance of decreased availability. Approach procedures with vertical guidance are the most sensitive to these effects. LNAV only approaches, terminal operations, and en route operations may also be affected. Because meeting all of these installations guidelines may not be possible on all aircraft, these guidelines are listed in order of importance to achieve optimum performance. Items 3 below are of equal importance and their significance may depend on the aircraft installation. The installer should use their best judgment to balance the installation guidelines. Figure 3-1 shows the recommended placement of antennas.

1. Mount the antenna as close to level as possible with respect to the normal cruise flight attitude of the aircraft. If the normal flight attitude is not known, substitute the waterline, which is typically referenced as level while performing a weight and balance check.
2. The GPS antenna should be mounted in a location to minimize the effects of airframe shadowing during typical maneuvers. Typically mounting farther away from the tail section reduces signal blockage seen by the GPS antenna.

3a. The GPS antenna should be mounted no closer than two feet from any VHF COM antenna or any other antenna which may emit harmonic interference at the L1 frequency of 1575.42 MHz. An aircraft EMC check (reference VHF COM interference check in Post Installation Checkout procedures) can verify the degradation of GPS in the presence of interference signals. If an EMC check reveals unacceptable interference, insert a GPS notch filter in line with the offending VHF COM or the (re-radiating) ELT transmitter.

**NOTE**

When mounting a combination antenna (ex. GPS and COM, GPS and XM), the recommended distance of two feet or more is not applicable to the distance between the antenna elements provided the combination antenna is TSO authorized and has been tested to meet Garmin's minimum performance standards.

3b. The GPS antenna should be mounted no closer than two feet from any antennas emitting more than 25 watts of power. An aircraft EMC check can verify the degradation of GPS in the presence of interference signals.

3c. To achieve the best possible low-elevation antenna gain (by minimizing pattern degradation due to shadowing and near-field interaction), the GPS antenna must be mounted with clearance from other antennas, including passive antennas such as another GPS antenna or XM antenna. When practical, installers will use 12 inch center-to-center spacing between antennas. If 12 inch spacing is not practical, installers will use the maximum center-to-center spacing from adjacent antennas, but never less than 9 inch center-to-center spacing. Spacing less than 9 inches center-to-center results in unacceptable GPS/SBAS antenna pattern degradation.

4. To maintain a constant gain pattern and limit degradation by the windscreen, avoid mounting the antenna closer than 3 inches from the windscreen.

5. For multiple GPS installations, the antennas should not be mounted in a straight line from the front to the rear of the fuselage. Also varying the mounting location will help minimize any aircraft shading by the wings or tail section (in a particular azimuth, when one antenna is blocked the other antenna may have a clear view).

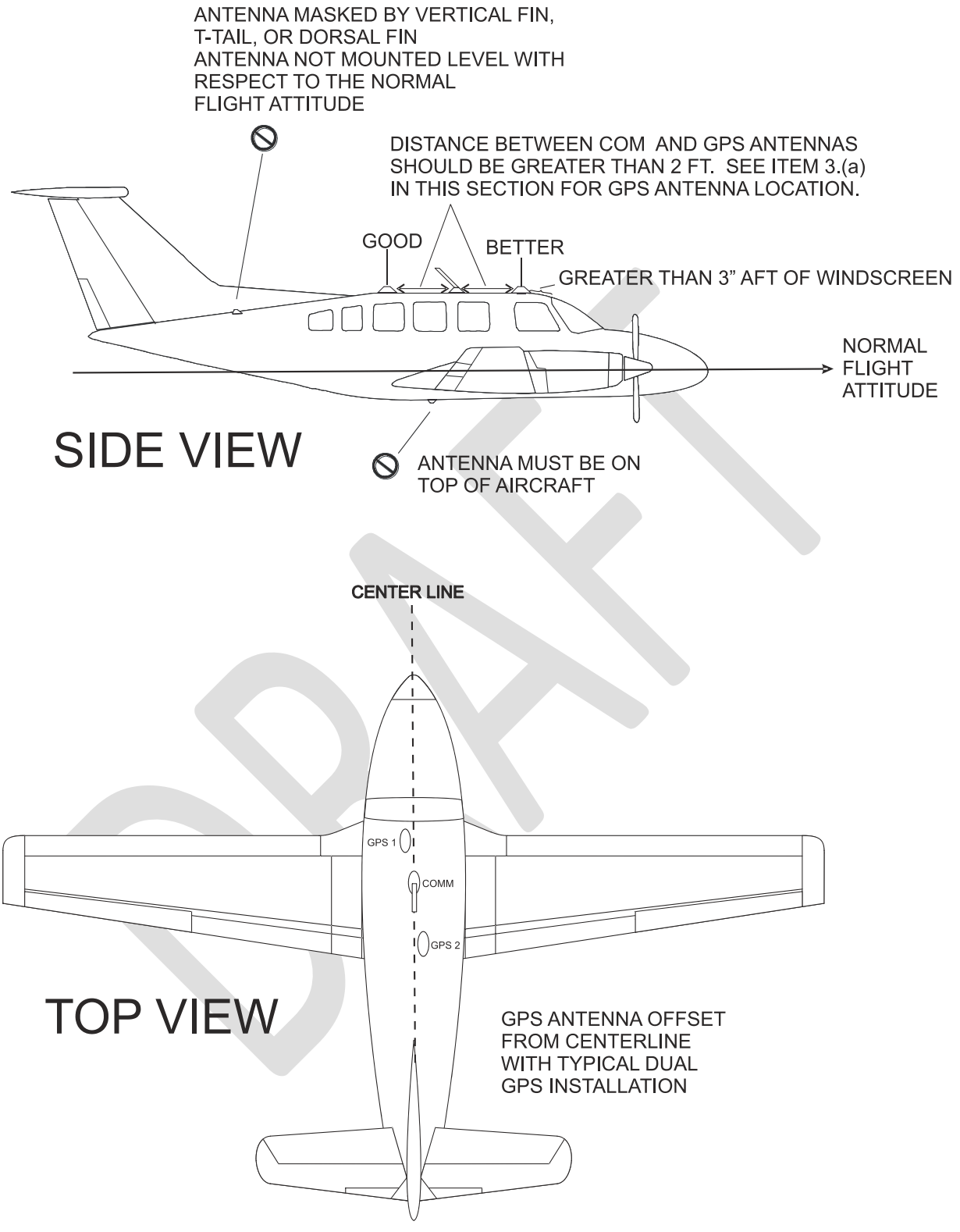


**Figure 3-1. GPS Antenna Installation Considerations**

# 4 INSTALLATION PROCEDURES

## 4.1 Unit and Accessories

For description of units, see Table 1-1.

**Table 4-1. Catalog Part Numbers**

| Model | Unit Only Kit | Standard Kit | Unit P/N |
|---|---|---|---|
| **GDL 88** | 010-00859-00 | 010-00859-30 | 011-02369-00 |
| **GDL 88 with GPS/SBAS** | 010-00860-00 | 010-00860-30 | 011-02370-00 |
| **GDL 88D** | 010-00861-00 | 010-00861-30 | 011-02371-00 |
| **GDL 88D with GPS/SBAS** | 010-00862-00 | 010-00862-30 | 011-02372-00 |

**Table 4-2. Standard Kit Accessories**

| Model | Item | Part Number |
|---|---|---|
| **GDL 88** | Configuration Module Kit | 011-00979-00 |
| | Backplate Assembly | 011-01718-00 |
| | Connector Kit | 011-02375-00 |
| | Remote Rack Assembly | 115-01035-00 |
| | Installation Kit | 011-02621-00 |
| **GDL 88 with GPS/SBAS** | Configuration Module Kit | 011-00979-00 |
| | Backplate Assembly | 011-01718-10 |
| | Connector Kit | 011-02375-00 |
| | Remote Rack Assembly | 115-01035-00 |
| | Installation Kit | 011-02621-00 |
| **GDL 88D** | Configuration Module Kit | 011-00979-00 |
| | Backplate Assembly | 011-01718-20 |
| | Connector Kit | 011-02375-00 |
| | Remote Rack Assembly | 115-01035-00 |
| | Installation Kit | 011-02621-00 |
| **GDL 88D with GPS/SBAS** | Configuration Module Kit | 011-00979-00 |
| | Backplate Assembly | 011-01718-30 |
| | Connector Kit | 011-02375-00 |
| | Remote Rack Assembly | 115-01035-00 |
| | Installation Kit | 011-02621-00 |

## 4.2 Optional Accessories

### 4.2.1 GPS Antenna Options

For details regarding antenna selection, refer to Section 1.3.8. Once the antenna type is decided upon, refer to the information below for detailed parts information for antennas available directly from Garmin. Contact the manufacturer directly for information on other antennas.

**GA 35 Antenna:**

GA 35 Antenna Garmin P/N 013-00235-00 contains the following items:

| Item | Part Number | Qty |
|---|---|---|
| GA 35 GPS/ WAAS Antenna [1] | 013-00235-00 (Garmin) | 1 |
| | AT575-93G (Aero Antenna) | |

[1] Antenna includes 8-32 UNC-2A x 1.00" SS 303 mounting screws (qty 4) and O-ring (qty 1).

An antenna doubler may also be required. Refer to the appropriate antenna installation data.

To secure the antenna #8 washers (qty 4) and #8 (qty 4) self-locking nuts are required in addition to the antenna, or suitable nutplates may be installed on the doubler.

To connect the GPS antenna coaxial cable to the antenna a TNC plug is required.

**GA 36 Antenna:**

GA 36 Antenna Garmin P/N 013-00244-00 contains the following items:

| Item | Part Number | Qty |
|---|---|---|
| GA 36 GPS/WAAS Antenna [1] | 013-00244-00 (Garmin) | 1 |
| | AT575-126G (Aero Antenna) | |

[1] Antenna includes 8-32 UNC-2A x 1.00" SS 303 mounting screws (qty 4) and O-ring (qty 1).

An antenna doubler may also be required. Refer to the appropriate antenna installation data.

To secure the antenna #8 washers (qty 4) and #8 (qty 4) self-locking nuts are required in addition to the antenna, or suitable nutplates may be installed on the doubler.

To connect the GPS antenna coaxial cable to the antenna a TNC plug is required.

**GA 37 Antenna:**

GA 37 Antenna Garmin P/N 013-00245-00 contains the following items:

| Item | Part Number | Qty |
|---|---|---|
| GA 37 GPS/WAAS + XM Antenna [1] | 013-00245-00 (Garmin) | 1 |
| | AT2300-126G (Aero Antenna) | |

[1] Antenna includes 8-32 UNC-2A x 1.00" SS 303 mounting screws (qty 4) and O-ring (qty 1).

An antenna doubler may also be required. Refer to the appropriate antenna installation data.

To secure the antenna #8 washers (qty 4) and #8 (qty 4) self-locking nuts are required in addition to the antenna, or suitable nutplates may be installed on the doubler.

To connect the GPS antenna coaxial cable to the antenna a TNC plug is required.

**A33W Antenna:**

A33W Antenna Garmin P/N 013-00261-00 contains the following items:

| Item | Part Number | Qty |
|---|---|---|
| A33W, WAAS [1] | 013-00261-00 (Garmin) | 1 |

[1] Antenna includes 6-32 UNC-2A x 1.00" SS 303 mounting screws (qty 4) and O-ring (qty 1).

An antenna doubler may also be required. To secure the antenna, #6 washers (qty 4) and #6 (qty 4) self-locking nuts are required in addition to the antenna, or suitable nutplates may be installed on the doubler that is used. To connect the GPS antenna coaxial cable to the antenna a TNC plug is required.

### 4.2.2 UAT Antenna Options

## 4.3 Miscellaneous Options

| Item | Garmin P/N | Mfg P/N |
|---|---|---|
| Connector, BNC, Male, Clamp | 330-00087-00 | N/A |
| GPS 1.57542 GHz Notch Filter | 330-00067-00 | N/A |
| Connector, TNC, Male, Clamp | N/A | 031-4452 [1] |

[1] This part is not available from Garmin.

***Vendor Contact Information (provided for convenience only):***

Amphenol RF, Four Old Newtown Road, Danbury, CT 06810 Phone: 800-627-7100

## 4.4 Installation Materials not Supplied

### 4.4.1 Installation Materials Required but not Supplied

The GDL 88 is intended for use with the standard aviation accessories. The following items are required for installation, but not supplied.

- Wire (MIL-W-22759/16 or equivalent)
- Shielded Wire (MIL-C-27500 or equivalent)
- Mounting Screws (8 minimum – MS24693 Screw, Machine, Flat Countersunk Head 100°, Cross-recessed with .1380-32 UNC-2A Thread, Corrosion Resistant Steel)
- Push/Pull (manually resettable) Circuit Breakers
- Tie Wraps or Lacing Cord
- Ring Terminals (for grounding)
- Coaxial Cable (RG-400, RG-142B or equivalent – Refer to Section 4.11 for additional information).

## 4.5 Special Tools Required

Some of the connectors use crimp contacts. The table below identifies crimp tools required to ensure consistent, reliable crimp contact connections for the rear D-sub connectors.

**Table 4-3. Recommended Crimp Tools (or Equivalent)**

| Manufacturer | Hand Crimping Tool | 22 – 28 AWG (P1001 – P1005) | |
|---|---|---|---|
| | | Positioner | Insertion/ Extraction Tool |
| Military P/N | M22520/2-01 | M22520/2-09 | M81969/14-01<br>M81969/1-04 |
| Positronic | 9507-0-0-0 | 9502-4-0-0 | M81969/1-04 |
| ITT Cannon | 995-0001-584 | 995-0001-739 | 000849490<br>274-7048-000MIL |
| AMP | 601966-1 | 601966-6 | 91067-1<br>2031838-1 |
| Daniels | AFM8 | K42 | M81969/14-01<br>M81969/1-04 |
| Astro | 615717 | 615725 | M81969/14-01<br>M81969/1-04 |

**NOTE**

Insertion/extraction tools from ITT Cannon are all plastic; others are plastic with metal tip.

## 4.6 Coaxial Cable Installation

Follow the steps below for installation of the coaxial cables:

1. Route the coaxial cable to the radio rack location keeping in mind the recommendations of Section 3.1. Secure the cable in accordance with AC 43.13-1B Chapter 11, section 11.
2. Trim the coaxial cable to the desired length and install the TNC and BNC connectors per the cabling instructions on Figure 4-1 below. If the connector is provided by the installer, follow the connector manufacturer's instructions for cable preparation.

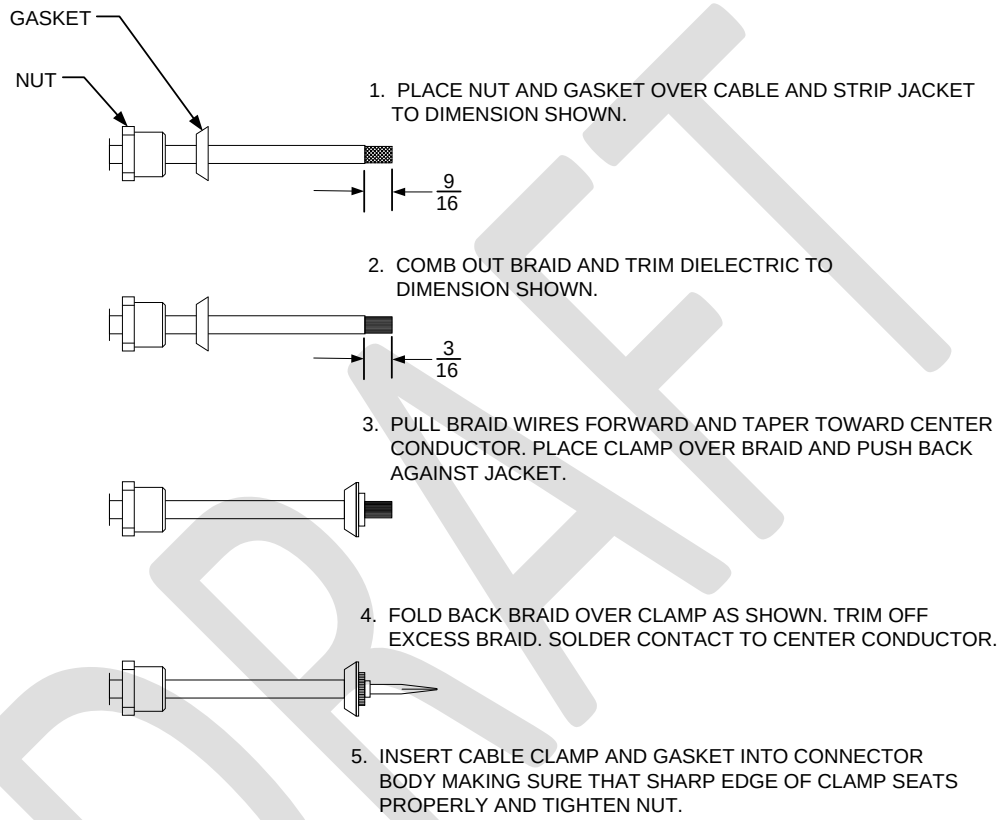


**Figure 4-1. Coaxial Cable Installation**

**Table 4-4. Socket Contact Part Numbers**

| Wire Gauge | Configuration Module 78-pin Connector (P1001) | P1001-P1005 |
|---|---|---|
| | 28 AWG [1] | 22-28 AWG [2] |
| Garmin P/N | 336-00021-00 | 336-00021-00 |
| Military P/N | N/A | M39029/58-360 |
| AMP | N/A | 204370-2 |
| Positronic | N/A | MC8522D |
| ITT Cannon | N/A | 010-2042-000 |

[1] For configuration module pins, ensure that the crimp tool is set to crimp 28 AWG wire (indenter setting of '4').

[2] Contacts listed are not to be used for configuration module wiring. Use the contacts supplied with the configuration module when installing configuration module wires in P1001.

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

## 4.7 Equipment Mounting

### 4.7.1 Unit Replacement

## 4.8 Antenna Installation and Connections

This section provides information on the antenna cable installation. Refer to 3.1 herein for installation location considerations.

**SUGGESTION:** Temporarily locate the GPS/SBAS antenna with coax connected to the GTN unit and check the GPS/SBAS performance as described in Section. Once a suitable location has been verified, then permanently mount the antenna.

Once the antenna mounting position has been prepared, route the coax cable from the antenna to the GTN unit. Proper selection of coax cable and assembly of connectors is critical to GPS signal performance. **Cable loss from the GPS/SBAS antenna must be between 1.5 dB and 6.5 dB in order to maintain proper rejection to interference signals.**

Coaxial connectors and adapters, such as TNC to BNC, add additional loss to the cable and should be considered when computing the cable loss. A typical loss of 0.2 dB can be used for each connection. To maintain integrity of the SBAS signal, the GPS antenna coaxial cable must have a minimum of two shields (e.g. RG-400 or RG-142B).

**NOTE**

If RG-142B or RG-400 is used, 1.5 dB equates to a length of approximately 6.5 feet of cable with a connector on each end. RG-142B or RG-400 cable can be used as long as the length is less than 35 feet. For longer lengths, use low-loss double or triple shielded 50Ω coax.

For very short runs, where the loss is less than 1.5 dB, additional cable should be used to increase the loss to within 1.5 dB to 6.5 dB. This additional cable may be coiled, taking into account the minimum bend radius of the cable.

During the post-installation checkout, susceptibility to harmonics of VHF COM transmitters will be evaluated. If problems arise, then better isolation, or distance, may be required between the GPS and COM antennas, or a 1575.42 MHz notch filter may be installed in series with the antenna coax of the VHF COM transceiver to reduce or eliminate the harmonic interference. A notch filter for this use (P/N 330-00067-00) is available from Garmin.

If a VHF COM transmitter causes problems with the GPS on the selected frequencies as listed in the post-installation checkout, the problem may be due to the ELT. This can be verified by disconnecting the ELT antenna coax at the ELT unit. If the ELT is found to cause the problem, then contact the ELT manufacturer or replace the ELT.

# 5 CONNECTOR PINOUT INFORMATION

## 5.1 Pin Function List

### 5.1.1 P881 Connector

View looking at rear of unit, Pin X is top X

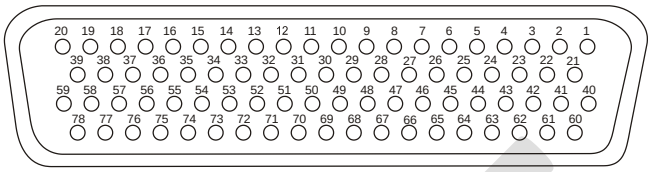


**Table 5-1. P881 Connector**

| Pin | Pin Name | I/O |
|---|---|---|
| 1 | RESERVED | -- |
| 2 | RS-232 OUT 5 | I/O |
| 3 | TIME MARK 1B | I/O |
| 4 | AUDIO OUT HI | Out |
| 5 | RS-232 OUT 4 | Out |
| 6 | RS-232 OUT 3 | Out |
| 7 | RS-232 OUT 2 | Out |
| 8 | RS-232 OUT 1 | Out |
| 9 | TIME MARK 2B | I/O |
| 10 | ARINC 429 OUT 1A | Out |
| 11 | ARINC 429 OUT 2A | Out |
| 12 | FAN SPEED | In |
| 13 | AUDIO ACTIVE OUT* | Out |
| 14 | ADS-B DEVICE FAIL* | Out |
| 15 | ADS-B FUNCTION FAIL | Out |
| 16 | AIR/GROUND* | In |
| 17 | REMOTE POWER ON* | In |
| 18 | GROUND | In |
| 19 | AIRCRAFT POWER | In |
| 20 | AIRCRAFT POWER | In |
| 21 | RS-232 IN 5 | In |
| 22 | TIME MARK 1A | I/O |
| 23 | AUDIO OUT LO | Out |
| 24 | RS-232 IN 4 | In |
| 25 | RS-232 IN 3 | In |
| 26 | RS-232 IN 2 | In |
| 27 | RS-232 IN 1 | In |
| 28 | TIME MARK 2A | I/O |
| 29 | ARINC 429 OUT 1B | Out |
| 30 | ARINC 429 OUT 2B | Out |
| 31 | FAN POWER (5V) | Out |
| 32 | RS-422 IN 2A | In |
| 33 | RS-422 IN 2B | In |
| 34 | RS-422 OUT 2A | Out |
| 35 | RS-422 OUT 2B | Out |
| 36 | IDENT* | In |
| 37 | AUDIO INHIBIT IN* | In |
| 38 | PRESSURE ALT BROADCAST INHIBIT* | In |

| P881 Connector Cont'd | | |
|---|---|---|
| **Pin** | **Pin Name** | **I/O** |
| 39 | SPARE* | In |
| 40 | RS-232 GND 5 | In |
| 41 | USB GROUND | In |
| 42 | USB VBUS POWER | In |
| 43 | RS-232 GND 4 | In |
| 44 | RS-232 GND 3 | In |
| 45 | RS-232 GND 2 | In |
| 46 | RS-232 GND 1 | In |
| 47 | ARINC 429 IN 2A | In |
| 48 | ARINC 429 IN 1A | In |
| 49 | ARINC 429 IN 3A | In |
| 50 | FAN GROUND | In |
| 51 | ETHERNET IN 1A | In |
| 52 | ETHERNET IN 1B | In |
| 53 | ETHERNET OUT 1A | Out |
| 54 | ETHERNET OUT 1B | Out |
| 55 | PRESSURE ALT BROADCAST ANNUN* | Out |
| 56 | RS-422 OUT 1A | Out |
| 57 | RS-422 IN 1A | In |
| 58 | TEST MODE* | In |
| 59 | SUPPRESSION | Out |
| 60 | USB DATA LO | I/O |
| 61 | USB DATA HI | I/O |
| 62 | CONFIG MODULE DATA | I/O |
| 63 | CONFIG MODULE CLOCK | Out |
| 64 | CONFIG MODULE GND | In |
| 65 | CONFIG MODULE POWER | Out |
| 66 | ARINC 429 IN 2B | In |
| 67 | ARINC 429 IN 1B | In |
| 68 | ARINC 429 IN 3B | In |
| 69 | GROUND | In |
| 70 | ETHERNET IN 2A | In |
| 71 | ETHERNET IN 2B | In |
| 72 | ETHERNET OUT 2A | Out |
| 73 | ETHERNET OUT 2B | Out |
| 74 | RESERVED | -- |
| 75 | RS-422 OUT 1B | Out |
| 76 | RS-422 IN 1B | In |
| 77 | AIRCRAFT GND | In |
| 78 | AIRCRAFT GND | In |

An asterisk (*) following a signal name denotes that the signal is an Active-Low, requiring a ground to activate. If there is no asterisk, the signal is an Active-High.

## 5.2 Power and Antennas

This section covers the power input requirements and antenna connections. See Appendix D for interconnect information.

### 5.2.1 Power

| Pin Name | Connector | Pin | I/O |
|---|---|---|---|
| AIRCRAFT POWER | P881 | 19 | In |
| AIRCRAFT POWER | P881 | 20 | In |
| AIRCRAFT GND | P881 | 77 | -- |
| AIRCRAFT GND | P881 | 78 | -- |

### 5.2.2 Antennas

| Pin Name | Connector | I/O |
|---|---|---|
| UAT ANTENNA – BOTTOM BNC | P882 | I/O |
| UAT ANTENNA – TOP | P883 | I/O |
| GPS/SBAS ANTENNA TNC | P884 | In |

UAT antenna(s) use BNC coaxial connectors on the connector backplate. The GPS/SBAS antenna uses a TNC coaxial connector on the connector backplate.

# 6 POST INSTALLATION CONFIGURATION AND CHECKOUT PROCEDURES

# 7 PERIODIC MAINTENANCE

This section contains information on periodic calibration and maintenance required for continued airworthiness.

## 7.1 Equipment Calibration

No scheduled servicing tasks or internal manual adjustments are required on the GDL 88 units.

## 7.2 Cleaning

The GDL 88 units do not require regular cleaning.

## 7.3 Battery Replacement

The GDL 88 with GPS/SBAS and the GDL 88D with GPS/SBAS includes an internal battery that will last about 10 years. The battery is used for internal RAM memory and GPS system information. Regular planned replacement is not necessary. The battery is not user-replaceable. Battery replacement and removal must be performed by professional services.

# Appendix A ENVIRONMENTAL QUALIFICATION FORM

For RTCA/DO-160F Environmental Qualification Forms (EQFs) visit the Dealers Only site on http://www.garmin.com. The GDL 88 units all use the same EQF, part number 005-00358-20.

# Appendix B GDL 88 DATA FORMAT

## B.1 GDL 88 RS-232 Fuel/Air Data Input Format

### B.1.1 Electrical Interface

The input signals are compatible with RS-232C. Data input at 9600 baud (1200 baud for Apollo Altitude Encoder) with a word length of 8 bits, one stop bit, and no parity. One message is received per second.

### B.1.2 Icarus Altitude Sentence

The GDL 88 is capable of receiving the following 10-byte message from the Icarus Altitude Serializer:

**ALT <sp>12345<CR>**

Where:

| | |
|---|---|
| ALT | ASCII characters |
| <sp> | space (0x20) |
| 12345 | altitude in feet |
| <CR> | carriage return (0x0d) |

### B.1.3 Apollo Altitude Sentence

The GDL 88 is capable of receiving the following 17-byte message from an Apollo Altitude Encoder:

**#AL<sp><+/->ddul<CR>**

Where:

| | |
|---|---|
| #AL | ASCII characters |
| <sp> | space (0x20) |
| <+/-> | sign indicator (0x2B[“+”] or 0x2D[“-“]) |
| ddddd | altitude in feet (-1000 feet to 35,000 feet) |
| T | ASCII characters |
| <+/-> | sign indicator |
| dd | sensor temperature |
| ul | checksum of bytes 1 through 14 in hex ASCII (i.e. “FA”) |
| <CR> | carriage return (0x0D) |

### B.1.4 Shadin Altitude Sentence

The GDL 88 is capable of receiving the following 17-byte message from Shadin Altitude Encoders, Altitude Serializers, and Altitude Converters:

**RMS<sp><+/->12345T<+/->12ul<CR>**

Where:

| | |
|---|---|
| RMS | ASCII characters |
| <sp> | space (0x20) |
| <+/-> | sign indicator (0x2b["+"] or 0x2d["-"]) |
| 12345 | altitude in feet |
| T | ASCII character |
| <+/-> | sign indicator |
| 12 | sensor temperature |
| ul | checksum of bytes 1 through 14 in hex ASCII (i.e., "FA") |
| <CR> | carriage return (0x0d) |

**Note**: Checksum is calculated by adding each byte in the message (1 through 14).

### B.1.5 Shadin Fuel/Air Data Computer

The GDL 88 is capable of receiving the following message strings from the Shadin Fuel/Air Data or Air Data Computer:

**SHADIN "z" FORMAT**

<STX>

| | |
|---|---|
| ZA012<CR><LF> | "ZA" (ASCII characters); "012" represents indicated Air Speed (knots) |
| ZB345<CR><LF> | "ZB" (ASCII characters); "345" represents true Air Speed (knots) |
| ZC678<CR><LF> | "ZC" (ASCII characters); "678" represents Mach Speed (thousandths) |
| ZD<+/->9012<CR><LF> | "ZD" (ASCII characters); sign; "9012" represents pressure altitude (tens of feet) |
| ZE<+/->3456<CR><LF> | "ZE" (ASCII characters); sign; "3456" represents density altitude (tens of feet) |
| ZF<+/->78<CR><LF> | "ZF" (ASCII characters); sign; "78" represents outside air temperature (Celsius) |
| ZG<+/->90<CR><LF> | "ZG" (ASCII characters); sign; "90" represents true air temperature (Celsius) |
| ZH123<CR><LF> | "ZH" (ASCII characters); "123" represents wind direction (degrees from north) |
| ZI456<CR><LF> | "ZI" (ASCII characters); "456" represents wind speed (knots) |
| ZJ<+/->78<CR><LF> | "ZJ" (ASCII characters); sign; "78" represents rate of turn (degrees per second) |
| ZK<+/->901<CR><LF> | "ZK" (ASCII characters); sign; "901" represents vertical speed (tens of ft/minute) |
| ZL234<CR><LF> | "ZL" (ASCII characters); "234" represents heading (degrees from north) |
| ZM5678<CR><LF>† | "ZM" (ASCII characters); "5678" represents fuel flow, right (tenths gallons/hour) |
| ZN90123<CR><LF>† | "ZN" (ASCII characters); "90123" represents fuel used, right (tenths gallons) |
| ZO4567<CR><LF>† | "ZO" (ASCII characters); "4567" represents fuel flow, left (tenths gallons/hour) |
| ZP89012<CR><LF>† | "ZP" (ASCII characters); "89012" represents fuel used, left (tenths gallons) |
| ZQ345<CR><LF> | "ZQ" (ASCII characters); "345" represents error log/reason indicator |
| ZR678<CR><LF> | "ZR" (ASCII characters); "678" represents checksum |

<ETX>

Where:

| | |
|---|---|
| <STX> | start-transmit character (0x02) |
| <CR> | carriage-return character (0x0d) |
| <LF> | line-feed character (0x0a) |
| <+/-> | sign indicator (0x2b["+"] or 0x2d["-"]) |
| <ETX> | end-transmit character (0x03) |

† Not available from Air Data Computer

**Note**: Checksum is calculated by adding each byte in the message (including all characters from <STX> up to and including the error log/reason indicator), such that carries are discarded to give a one byte result. The ASCII-coded decimal representation of that byte is given, ranging from 0 (0x30, 0x30, 0x30) to 255 (0x32, 0x35, 0x35).

# Appendix C MECHANICAL DRAWINGS

# Appendix D INTERCONNECT DIAGRAMS


GARMIN