

Apollo[®]

Model GX50 GPS

Model GX60 GPS/Comm

Model GX65 GPS/Comm

Installation Manual

II MORROW

VISIONARY THINKING TODAY



February 2002

560-0959-04

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HISTORY OF REVISIONS

Revision	SW Ver	Date	Description
--		Nov 5, 1997	Initial release.
-01		Nov 11, 1997	Corrected altitude input requirements.
-01b		June 10, 1998	Added references about altitude encoders, F/AD, & serial interface
-02		June 26, 1998	Addition of Model GX65 GPS/Comm
-03		Mar 24, 1999	Test Mode additions, Serial data output, Apollo ACU added
-03a		Sept. 23, 1999	Added new connector pins and crimping tools
-03b		5/8/00	Add new extended data and SL30 output messages
-03c	3.3	7/2/01	Add autopilot roll steering data, and changes for GX SW Ver 3.3. Mounting tube changes.
-04		2/18/02	Added helicopter environmental qualification information

IMPORTANT NOTE

“The conditions and tests required for TSO approval of this article are minimum performance standards. It is the responsibility of those desiring to install this article on or within a specific type or class of aircraft to determine that the aircraft operating conditions are within TSO standards. The article may be installed only if further evaluation by the applicant documents an acceptable installation and is approved by the Administrator.”

Source: FAA TSO-C129a, TSO-C37d, TSO-C38d, and TSO-C128

ORDERING INFORMATION

To receive additional copies of this publication, order part # **560-0959-04**, *Apollo GX50 GPS and GX60/GX65 GPS/Comm Installation Manual*.

NOTES

TABLE OF CONTENTS

SECTION 1 - INTRODUCTION	1
ABOUT THIS MANUAL	1
APOLLO GX50/60/65 DESCRIPTION.....	1
FEATURES	3
SYSTEM CONFIGURATIONS.....	4
VFR GPS NAVIGATION INSTALLATION.....	4
IFR GPS NAVIGATION INSTALLATION	5
COMM TRANSCEIVER - GX60/65.....	5
DATABASE UPDATES.....	5
REGULATORY COMPLIANCE.....	5
UNPACKING THE EQUIPMENT	6
PACKAGE CONTENTS	6
OTHER REQUIRED MATERIALS.....	8
SPECIAL TOOLS REQUIRED.....	8
LICENSE REQUIREMENTS	8
SECTION 2 - INSTALLATION.....	9
PRE-INSTALLATION INFORMATION.....	9
INSTALLATION OVERVIEW	9
INSTALLATION CONSIDERATIONS.....	9
MOUNTING CONSIDERATIONS.....	9
MINIMUM SYSTEM CONFIGURATION.....	9
ALTITUDE INPUT.....	9
EQUIPMENT MOUNTING	10
MOUNTING TUBE INSTALLATION.....	11
UNIT INSERTION.....	12
UNIT REMOVAL	12
ELECTRICAL CONNECTIONS	14
POWER	14
AVIONICS OUTPUTS	14
SERIAL INTERFACE	14
SPEAKER AND HEADPHONE OUTPUTS (GX60/65 ONLY).....	15
MICROPHONE INPUTS (GX60/65 ONLY).....	15
TRANSMIT KEY INPUT (GX60/65 ONLY)	15
INTERCOM SELECTOR SWITCH (GX60/65 ONLY).....	15
REMOTE FLIP/FLOP INPUT (GX60/65 ONLY)	15
ANTENNA INSTALLATION AND CONNECTIONS	15
COMM ANTENNA (GX60/65 ONLY).....	15
GPS ANTENNA	16
POST INSTALLATION CHECKOUT.....	25
TEST MODE CHECKOUT AND SETUP.....	25
GPS NAVIGATION CHECKOUT	27
VHF COMM CHECKOUT (GX60/65).....	28
FINAL SYSTEM CHECK	29
INTERFACE CHECKS.....	29
SECTION 3 - SPECIFICATIONS	33
ELECTRICAL.....	33

PHYSICAL	33
ENVIRONMENTAL	34
GPS RECEIVER PERFORMANCE	34
AVIONICS OUTPUTS	35
ALTITUDE INPUT REQUIREMENTS	36
ANNUNCIATOR REQUIREMENTS	36
COMM RECEIVER PERFORMANCE (GX60/65 ONLY)	37
COMM TRANSMITTER PERFORMANCE (GX60/65 ONLY)	37
INTERCOM PERFORMANCE (GX60/65 ONLY)	38
CONTROL INPUTS	38
ANTENNA REQUIREMENTS	38
GPS ANTENNA	38
COMM ANTENNA	38
SERIAL INTERFACE	38
REAR CONNECTOR PINOUT	39
SECTION 4 - LIMITATIONS	41
INSTALLATION	41
OPERATIONAL	41
APPENDIX A - TROUBLESHOOTING	43
CONTACTING THE FACTORY FOR ASSISTANCE	44
APPENDIX B - PERIODIC MAINTENANCE	45
LITHIUM BATTERY REPLACEMENT	45
EQUIPMENT CALIBRATION	45
REFERENCE OSCILLATOR (GX60/65)	45
CLEANING THE FRONT PANEL	45
APPENDIX C - ENVIRONMENTAL QUALIFICATIONS	47
APPENDIX D - ACCESSORIES	49
FROM II MORROW	49
COMMERCIALLY AVAILABLE	52
APPENDIX E - SERIAL INTERFACE SPECIFICATIONS	55
MOVING MAP OUTPUT	56
BINARY NEAREST LIST DATA (WHEN EXTENDED DATA IS ENABLED ONLY)	59
ANNUNCIATOR OUTPUTS (WHEN EXTENDED DATA IS ENABLED ONLY)	60
FLIGHT PLAN WAYPOINT TYPES (WHEN EXTENDED DATA IS ENABLED ONLY)	61
NAVCOMM DATA OUTPUT	62
REMOTE LOCALIZER LIST	64
DISTANCE/SPEED/TIME MESSAGE	66
ALTITUDE ENCODER/CONVERTER INPUT	67
FUEL/AIR DATA COMPUTER INPUT	68
“S” DATA FORMAT	68
“Z” DATA FORMAT	70
GPSS SERIAL OUTPUT	72

LIST OF TABLES

TABLE 1 PACKAGE CONTENTS	7
TABLE 2 COMM INTERFACE CONNECTOR PINOUT	39
TABLE 3 NAVIGATION INTERFACE CONNECTOR PINOUT	40
TABLE 4 TROUBLESHOOTING GUIDE	43
TABLE 5 RS-232 SERIAL INTERFACE SELECTIONS	55
TABLE 6 MOVING MAP ASCII NAVIGATION DATA	57
TABLE 7 MOVING MAP BINARY ROUTE DATA	58
TABLE 8 NEAREST WAYPOINT LIST DATA	59
TABLE 9 ANNUNCIATOR OUTPUT DATA	60
TABLE 10 FLIGHT PLAN WAYPOINT TYPE	61
TABLE 11 ALTITUDE INPUT DATA	67
TABLE 12 FUEL/AIR DATA MESSAGE DATA (S FORMAT)	69
TABLE 13 FUEL/AIR DATA MESSAGE DATA (Z FORMAT)	71
TABLE 14 - ASCII AUTOPILOT DATA	72

LIST OF ILLUSTRATIONS

FIGURE 1 GX50 FRONT PANEL	2
FIGURE 2 GX60/65 FRONT PANEL	2
FIGURE 3 - FULL STACK MOUNTING TUBE SPACING	11
FIGURE 4 MOUNTING FRAME ASSEMBLY	13
FIGURE 5 CABLE ROUTING	13
FIGURE 6 REAR COAX CONNECTOR ASSEMBLY	17
FIGURE 7 TNC COAX CONNECTOR ASSEMBLY	17
FIGURE 8 GX50/60/65 POWER AND AVIONICS CONNECTIONS	18
FIGURE 9 - APOLLO ACU TO APOLLO GX50/60 WIRING DIAGRAM	19
FIGURE 10 - APOLLO ACU TO APOLLO GX65 WIRING DIAGRAM	20
FIGURE 11 APOLLO 50/60 CONNECTIONS WITH MD41 ANNUNCIATOR / RELAY	21
FIGURE 12 RS-232 SERIAL CONNECTIONS	22
FIGURE 13 GX60/65 COMM WIRING DIAGRAM	23
FIGURE 14 GX60/65 TYPICAL AUDIO PANEL CONNECTIONS	24
FIGURE 15 UNIT DIMENSIONS	34
FIGURE 16 - EXAMPLE ANNUNCIATORS	36
FIGURE 17 MOVING MAP DATA OUTPUT (EXTENDED DATA DISABLED)	61
FIGURE 18 MOVING MAP DATA OUTPUT (EXTENDED DATA ENABLED)	62
FIGURE 19 ALTITUDE DATA INPUT	68
FIGURE 20 FUEL / AIRDATA DATA INPUT (S FORMAT)	70
FIGURE 21 - FULL STACK INTERCONNECT DRAWING	73

NOTES

SECTION 1 - INTRODUCTION

ABOUT THIS MANUAL

This manual describes the installation of the Apollo GX50 GPS and GX60/65 GPS/Comm units. It is intended for use by persons certified by the Federal Aviation Administration (FAA) to install aircraft navigation devices. It includes installation and checkout procedures for the GX50, GX60, GX65 and units to standards described in FAA advisory circulars AC 20-138 (for GPS) and AC 20-67B (for comm).

The GX50 and GX60/65 units are equivalent except that the GX50 does not include the VHF Comm. Throughout this manual, references to the GX50/60/65 are for the GX50, GX60, and GX65. The GX65 differs from the GX60 in that it is not certified for IFR approaches.

Section 1 Provides an **introduction** to the Apollo GX50/60/65 units. TSO certification information is also included in this section.

Section 2 Includes **installation** and checkout procedures.

Section 3 Includes complete **specifications**.

Section 4 Includes **limitations** for the equipment and installation.

Appendix A Includes **troubleshooting** information.

Appendix B Includes **periodic maintenance** requirements.

Appendix C Includes the **environmental qualification form**.

Appendix D Includes information on **accessories**.

Appendix E Includes **serial data specifications**.

APOLLO GX50/60/65 DESCRIPTION

The Apollo GX50 GPS is a TSO-C129a, Class A1 GPS supplemental navigation receiver for IFR en route, terminal, and non-precision approach operation. The unit features a moving map display and a database provided by means of a plug-in data card for convenience in changing and updating the database.

The Apollo GX60 GPS/Comm includes the same GPS capabilities as the GX50 and includes a 760 channel VHF Comm transceiver. The Apollo GX65 includes the same GPS and Comm capabilities as the GX 60, except that it is not certified for non-precision approach.

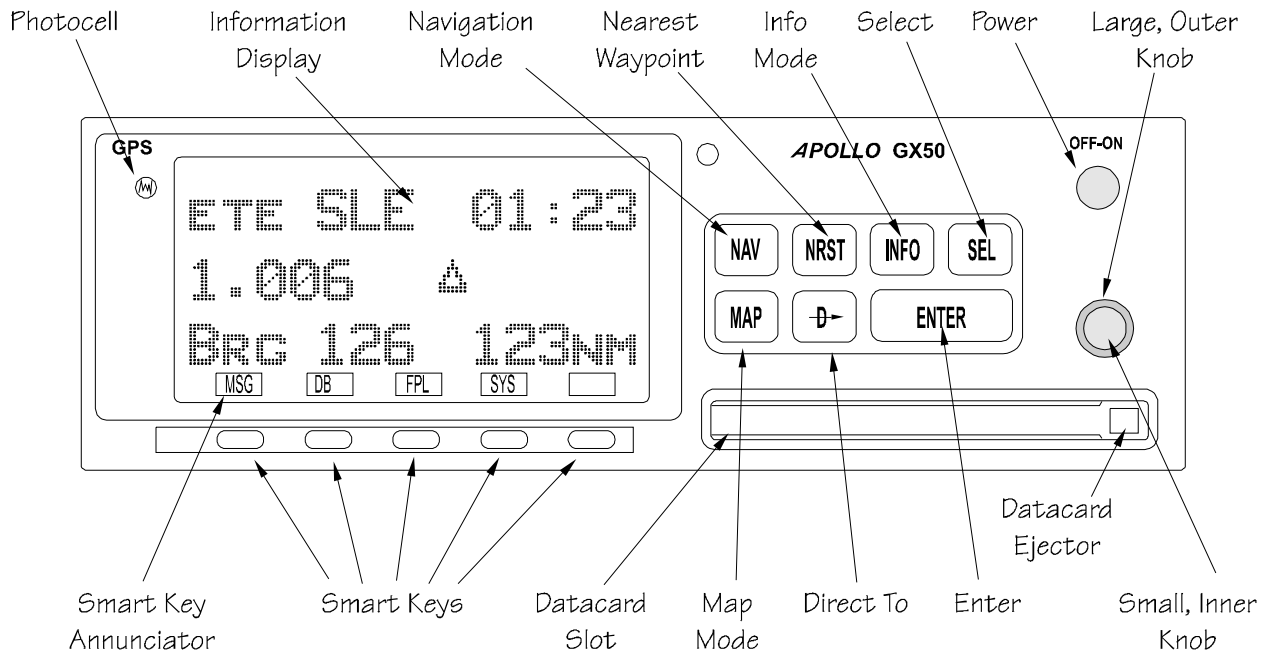


Figure 1 GX50 Front Panel

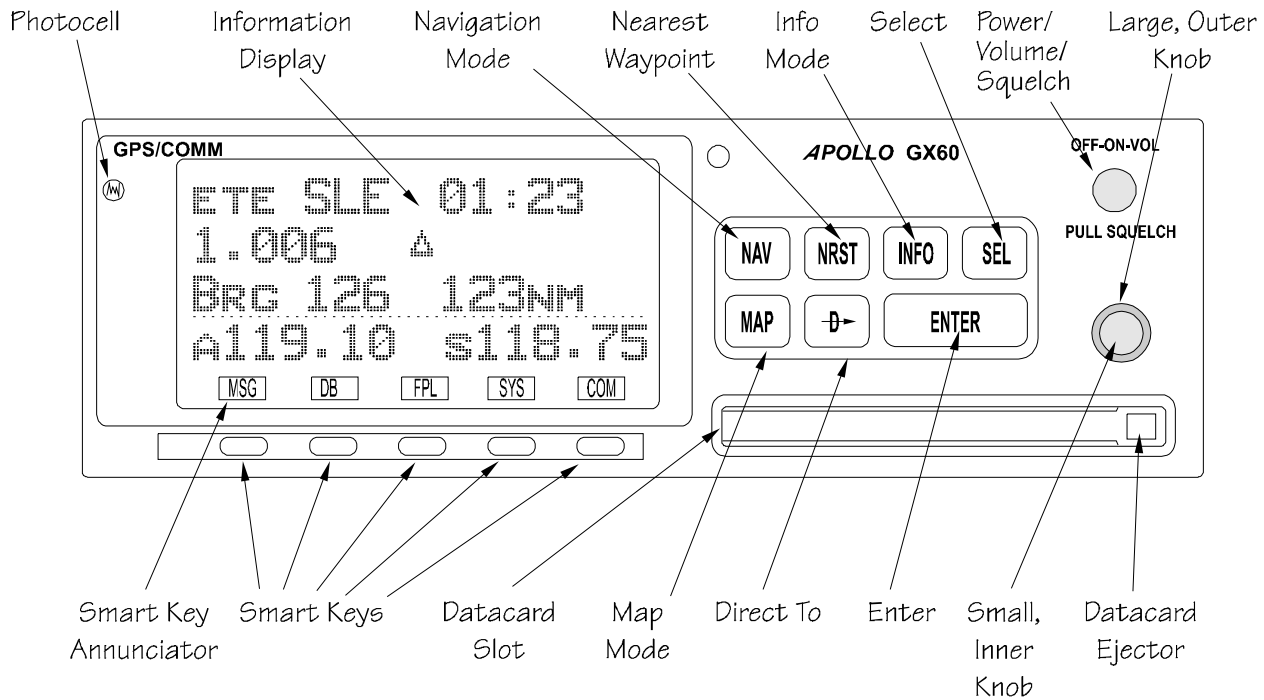


Figure 2 GX60/65 Front Panel

FEATURES

The GPS navigation features for the GX50 GPS and GX60/65 GPS/Comm include:

- High resolution, daylight readable graphics display
- Automatic display intensity
- Back-lit buttons
- Simple “Direct-To” navigation
- Datacard database for easy user update and replacement
- Nearest waypoint and airspace search (includes airports, VORs, LocDMEs, NDBs, intersections, and user waypoints)
- Remote waypoint search
- Navigation displays -
 - Lat/Lon to 0.01 minute
 - Bearing and distance to waypoint
 - Ground speed and track angle
 - Track angle error
 - Desired track and distance between waypoints
 - Cross track error with numeric and graphic CDI
 - Display of the “TO” waypoint ident
 - ETE and ETA to the “TO” and destination waypoints
 - Altitude (from altitude encoder/converter input)
 - Minimum safe altitude and en route safe altitude information
- Map Displays -
 - Full screen map with bearing, distance to waypoint, and zoom level
 - Split screen map with distance, speed, bearing, track, crosstrack error, To waypoint, and zoom level
 - Split screen with nav data and comm frequency display (GX60/65 only)
 - Smart key, 1 button map declutter, Tri-state
 - On map waypoint selection for information, direct-to nomination
 - Track up, desired track up, and magnetic north up options
 - Runway diagrams and runway names displayed
 - 5nm ATC rings around airports with control towers
 - Airspaces displayed by sector or outer boundary
 - Airspace display controllable by type
 - Approach preview page (*GX50/60 only*)
 - Route line displayed
- Automatic waypoint sequencing
- Vectors to final input (*GX50/60 only*)
- DME arc assist
- Built-in simulator for trip planning and training
- User definable navigation pages with auto sequencing
- 30 flight plans of 20 legs each
- 500 user waypoints created by lat/lon or by radial/distance from a reference waypoint
- Real time clock (time and date) in UTC
- Countdown timer

- Flight timer
- Automatic or manual magnetic variation
- Parallel track offset
- Alerts for -
 - Loss of navigation data
 - Arrival at waypoint
 - Special use airspace
- Full range (10VDC to 40VDC) input supply voltage

The VHF Comm features of the GX60/65 GPS/Comm include:

- 760 channels
- Frequency range of 118.000 to 136.975 MHz
- Active and standby frequency display
- Transmit status indicator
- Stuck mic time-out
- Frequency monitor function - listen to Standby frequency while monitoring Active frequency for any activity
- Weather channels - tune in to National Weather Service channels
- Built-in intercom function
- Frequency memory and recall functions
 - from navigation data base
 - 10 last used
 - 10 user stored
- Two microphone inputs
- 12 watt audio amplifier
- Remote flip/flop input

SYSTEM CONFIGURATIONS

The GX50/60/65 can be installed in several configurations based upon individual requirements. This includes VFR or IFR GPS navigation. This section defines the minimum requirements.

VFR GPS NAVIGATION INSTALLATION

When installed for VFR operation, the GX50/60/65 requires only the following minimal connections.

- an A-33 or A-34 GPS antenna
- power input

The GX50/60/65 can also be connected to other external devices such as:

- an external non-numeric indicator, such as a CDI or HSI
- external lamp annunciators including “MSG” and “PTK”
- an “OBS/HLD” external annunciator (with switch)
- an autopilot
- a moving map display connected to an RS-232 serial output
- an altitude encoder/converter

- Fuel/Airdata Computer (e.g. Shadin Model ADC-200)

When the GX50/60/65 is installed for VFR, a placard stating “GPS Limited to VFR Use Only” or an FAA approved equivalent statement must be placed next to the primary indicator.

IFR GPS NAVIGATION INSTALLATION

When installed for IFR operation, the GX50/60/65 requires connections to several external indicators. The minimum connections for IFR operation are as follows.

- an A-33 or A-34 GPS antenna
- power input
- an external non-numeric indicator, such as a CDI or HSI
- external lamp annunciators including “MSG” and “PTK”

For TSO-C129a A1 (non-precision approach) operation the following connections are also required (GX65 not included):

- external lamp annunciators including “APPRCH” and “ACTIVE”
- an “OBS/HLD” external annunciator (with switch)
- altitude input from an altitude encoder/converter or air data computer

The GX50/60/65 can also be connected to other external devices such as:

- an autopilot
- a moving map display connected to an RS-232 serial output
- an SL40 VHF Comm radio connected to an RS-232 serial output (For GX50 units)
- Fuel/Airdata Computer (e.g. Shadin Model ADC-200)

COMM TRANSCEIVER - GX60/65

For standalone installations, the comm requires connections to:

- a standard comm antenna
- a microphone (or microphones)
- a speaker or headphone
- power input

The microphone and speaker or headphones may be installed dedicated to the GX60/65 comm, or by connection to an audio panel.

The comm installation can also include optional connections:

- external remote flip-flop button

DATABASE UPDATES

The GX50/60/65 utilizes a Flybrary database stored on a standard plug-in memory card for easy updating and replacement. Simply plug in the new datacard to update your existing database or change to a new database.

Contact the II Morrow factory for information on databases available for the GX50/60/65.

REGULATORY COMPLIANCE

The Apollo GX60/65 is designed and tested to meet the following TSOs:
FAA TSO-C37d for transmit

FAA TSO-C38d for receive
FAA TSO-C128 for unintentional transmission (stuck mic)
FAA TSO-C129a for GPS navigation

The Apollo GX50 is designed and tested to meet the following TSOs:
FAA TSO-C129a for GPS navigation

The Apollo GX60/65 comm complies with the FCC requirements specified in:
CFR 47, Part 87, Aviation Services, Subpart D, Technical Requirements

The Apollo GX50 and GX60/65 comply with the FCC requirements specified in:
CFR 47, Part 15, Radio Frequency Devices, Subpart B, Unintentional Radiators

The Apollo GX50/60/65 software is designed and tested to RTCA/DO-178B, level C.

Note: Unauthorized changes or modifications to the GX50/60/65 may void the compliance to regulatory agency requirements and authorization for continued equipment usage.

UNPACKING THE EQUIPMENT

Carefully unpack the equipment. Visually inspect the package contents for any evidence of shipping damage. Retain all shipping containers and packaging material in case reshipment is necessary.

PACKAGE CONTENTS

As shipped from the II Morrow factory, the Apollo GX50/60/65 package includes most items necessary for installation other than supplies normally available at the installation shop, such as wire and cable ties, and required input and output equipment. The standard items included in the package are listed in Table 1.

Table 1 Package Contents				
Part #	Description	Qty		
		GX50	GX60	GX65
Units				
430-6050-4xx	GX50 GPS	1		
430-6050-6xx	GX60 GPS / Comm		1	
430-6050-8xx	GX65 GPS / Comm			1
Install kits	Part number: 424-2007-	-4xx	-6xx	-8xx
162-0100	15-pin dsub connector shell		1	1
162-0103	37-pin dsub connector shell	1	1	1
162-1008	Right angle coax plug	1	2	2
162-1060	TNC coax connector	1	1	1
202-0001	Cable tie	2	4	4
204-0037	Edge grommet	6"	6"	6"
204-2100	Shoulder bushing	2	4	4
221-0400	4-40 x 1/4 SS pan head Phillips machine screw with lock washer	4	4	4
224-0404	4-40 x 1/4 SS flat head Phillips machine screw	6	8	8
245-0022	Crimp contact for dsub, 20 to 24 awg wire	37	52	52
310-5184-xx	Mounting frame	1	1	1
310-5188-xx	Connector mounting plate	1	1	1
998-0048	3/32 hex driver	1	1	1
Manual kits	Part number: 564-0064-	-4xx	-6xx	-8xx
560-0961-xx	GX GPS User's Manual	1	1	1
560-0959-xx	GX50 / GX60 Installation Manual	1	1	1
560-0928-xx	GX GPS Approach User's Manual Insert	1	1	
560-0963-xx	GX60 Comm User's Manual Insert		1	1
560-9000	Binder, 5½ x 8½ x 1" 3 ring	1	1	1
561-0236-xx	GX60/65 Quick Reference Guide		1	1
561-0238-xx	GX50 Quick Reference Guide	1		
Accessories				
560-0949-xx	A-33 Installation Guide	1	1	1
590-1104	A-33 GPS Antenna	1	1	1

Note: Package contents may vary depending on how the unit is ordered.

OTHER REQUIRED MATERIALS

The GX50/60/65 is intended for use with standard aviation accessories. External devices required for various installations are listed in the System Configurations section on page 4. Depending upon the installation, this will include items such as:

- annunciators
- a CDI or HSI
- a comm antenna
- a microphone(s)
- a speaker or headphones

SPECIAL TOOLS REQUIRED

Crimp Tool

A crimp tool meeting MIL specification M22520/1-01 and a positioner/locator are required to ensure consistent, reliable crimp contact connections for the rear d-sub connectors. These tools are available from:

For pin p/n 245-0022

Astro Tool Corp.
21615 SW TV Highway
Beaverton, OR 97006

Phone (503) 642-9853
Fax (503) 591-7766

Crimp tool:
Positioner:

Astro Tool part #615708
Astro Tool part #616356

For pin p/n 245-0027

ITT Cannon
1851 E. Deere Ave.
Santa Ana, CA 92705-6500

Phone (714) 261-5300
Fax (714) 575-8324

Insertion tool:	ITT part # 274-7006-000 (Desc. CIET-20HD)
Regular duty Crimp tool:	ITT part #995-0001-585 (Desc. M22520/1-01)
Regular duty Locator tool:	ITT part #995-0001-244 (Desc. TH25)
Heavy duty Crimp tool:	ITT part #995-0001-584 (Desc. M22520/2-01)
Heavy duty Locator tool:	ITT part #995-0001-604 (Desc. M22520/2-08)

LICENSE REQUIREMENTS

An aircraft radio station license is required for operation of the GX60/65 comm transmitter once installed in the aircraft. An application must be submitted on FCC Form 404, which may be obtained from the FCC in Washington, DC, or any of its field offices. Procedures for applications are in CFR 47, Part 87, Aviation Services, Subpart B, Applications and Licenses.

SECTION 2 - INSTALLATION

This section describes the installation of the GX50 and GX60/65 including mounting, wiring, and connections. A post installation check-out procedure is included at the end of this section.

PRE-INSTALLATION INFORMATION

Always follow good avionics installation practices per FAA Advisory Circulars (AC) 43.13-1A, 43.13-2A, AC 20-138, and AC 20-67B, or later FAA approved revisions of these documents.

Follow the installation procedure in this section as it is presented for a successful installation. Read the entire section before beginning the procedure. Perform the post installation check-out before closing the work area in case problems occur.

INSTALLATION OVERVIEW

A successful installation should start with careful planning including determination of mounting location for the GX50/60/65, antenna mounting, cable routing, and other required modifications. Once the mounting location has been determined, prepare the mounting frame for installation. It may be easier to complete the wiring harness and attach the connectors to the mounting frame before installing the mounting frame.

INSTALLATION CONSIDERATIONS

MOUNTING CONSIDERATIONS

The GX50/60/65 is designed to mount in the avionics stack in the aircraft instrument panel within easy view and reach of the pilot. The standard package includes a mounting frame for ease of mounting, connections, and service of the unit. Allow an additional one inch clearance to the rear of the mounting frame for connectors and cables.

For typical installations, the GX50/60/65 does not require external cooling. When mounting the unit, ensure that a clearance of 1/8 to 1/4 inch exists between avionics units to allow for air circulation.

MINIMUM SYSTEM CONFIGURATION

The minimum system configuration and external connection requirements are described in the System Configurations section on page 4.

ALTITUDE INPUT

The GX50/60/65 includes an altitude input, which is used by the GPS RAIM calculations as well as providing for altitude assist functions such as altitude preset and hold and 3D airspace alerts. The altitude input is required for installations approved for non-precision approach operation, optional for other installations.

The GX50/60/65 altitude input can be connected from either an altitude encoder/converter or an air data converter. The minimum requirements for the altitude input are listed in the specifications on page 36.

HELICOPTER REQUIREMENTS

The GX60 and GX65 is qualified for helicopter installation with certain mount tube and GX60/65 configurations (see Section 4 - Limitations).

EQUIPMENT MOUNTING

Once the cable assemblies have been made, attach the 15 and 37 pin d-sub and coaxial cable connectors to the rear connector mounting plate and the mounting frame as illustrated in Figure 4 and Figure 5. Route the wiring bundle as appropriate. The rear connector plate should be attached to the mounting frame before installing the frame in the instrument panel. The rear connector plate can be used to tie down the cable assemblies. Use the supplied edge guard to protect the cable from sharp edges. Connect the shield grounds directly to the connector mounting plate.

Once the cable assemblies, the connector mounting plate, and the mounting frame are assembled, install the mounting frame assembly in the instrument panel as illustrated in Figure 3. Be sure to use low profile head screws so the unit will slide in and out freely. Attach the front of the mounting frame to the instrument panel. Use support brackets to attach the rear of the frame to the aircraft.

MOUNTING TUBE INSTALLATION

Care must be taken when installing the mounting tube to ensure you can properly insert and secure the unit. There must be a minimum vertical spacing of 0.040 inches between units to prevent interference with the cam locking mechanisms. Mounting tubes with clearance dimples help maintain the proper clearance. The mounting tube must be installed with the clearance dimples pointing up.

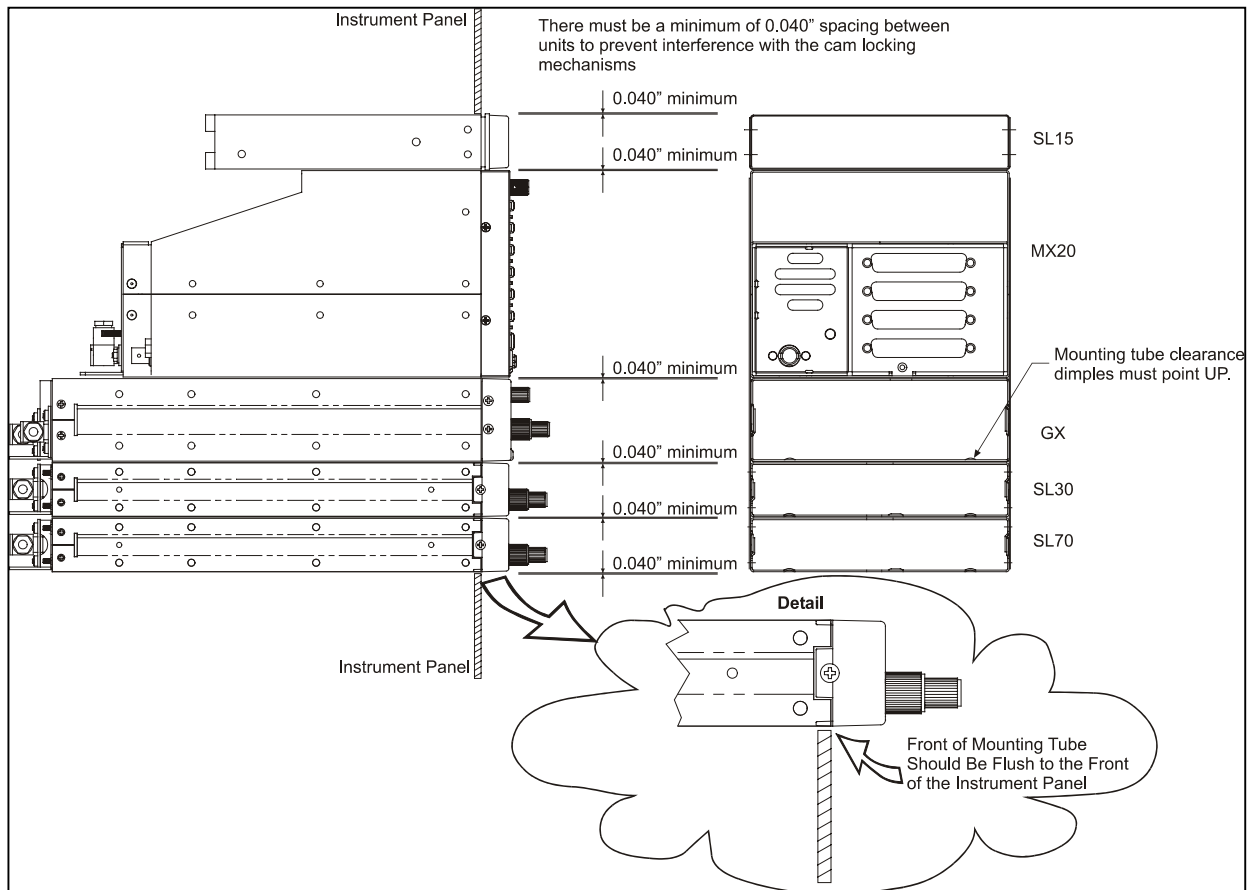


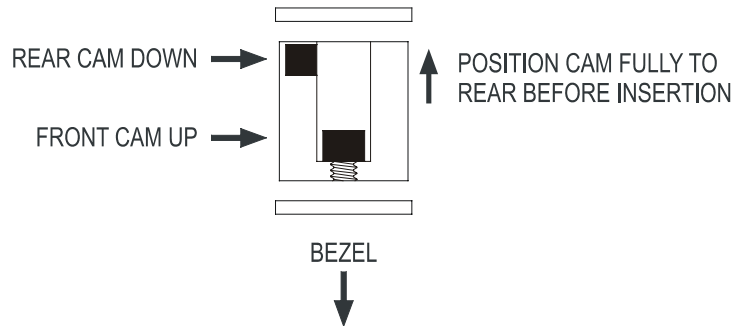
Figure 3 - Full Stack Mounting Tube Spacing

The mounting tube should be flush to the instrument panel and allow sufficient clearance for the back of the bezel of the unit to mount flush to the mounting tube. Sufficient clearance must exist in the instrument panel opening to allow ease of insertion and removal of the unit. **If the back of the unit bezel does not mount flush to the mounting tube, the connector may not engage fully.**

Secure the mounting tube to the instrument panel structure. Mounting screw heads must not protrude into the mounting tube. Be sure to use the appropriate screws so the unit will slide in and out freely. The screws attaching the mounting tube to the instrument panel structure must not interfere with the insertion of the unit. Failure to prevent interference will result in damage to the unit or prevent its insertion. Take care that the mounting tube is not distorted when it is attached to the instrument panel and structural supports. Shims may be necessary to properly install the mounting tube. If the mounting tube is distorted out of square, the unit may either bind when being inserted or the cam lock may not engage.

UNIT INSERTION

Position the cam lock as shown below. The front lobe of the cam should be vertical. The cam lock mechanism should be fully unscrewed (turned counter-clockwise). Slide the unit into the frame. Turn (clockwise) and carefully **hand-tighten** (4 in-lb max.) the cam lock mechanism using **only** the 3/32" hex driver provided in the installation package. Using a larger tool than the one provided makes it easy to exceed the allowable torque on the cam lock resulting in damage to the unit. The unit will be pulled into the frame securing the unit and the connectors will fully engage. **Do NOT overtighten.** The back of the bezel must only be flush to the mounting tube. If the cam lock is hard to turn or the unit does not seat fully, the unit is probably binding and the mounting tube should be checked.



UNIT REMOVAL

To remove the unit from the mounting frame, turn the screw counter-clockwise with the hex driver to unscrew the cam lock mechanism. The unit will begin to pull away from the mounting tube. Turn the screw until slight resistance is felt and then pull the unit from the frame. **Do not exert excessive turning force at the end of the cam lock travel or the unit may be damaged.** With the cam lock fully disengaged, pull the unit straight out holding onto the sides of the bezel. It is not recommended that you pull the unit out by the rotary knobs. No special extraction tools are required, if the mounting tube is properly installed.

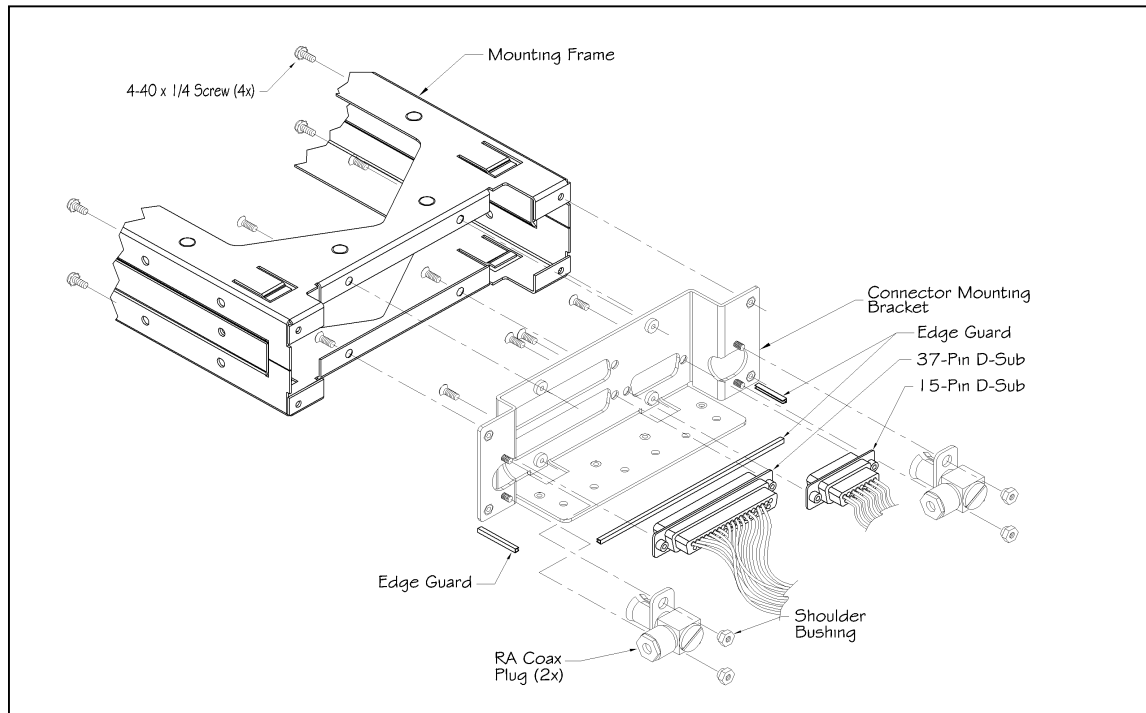


Figure 4 Mounting Frame Assembly

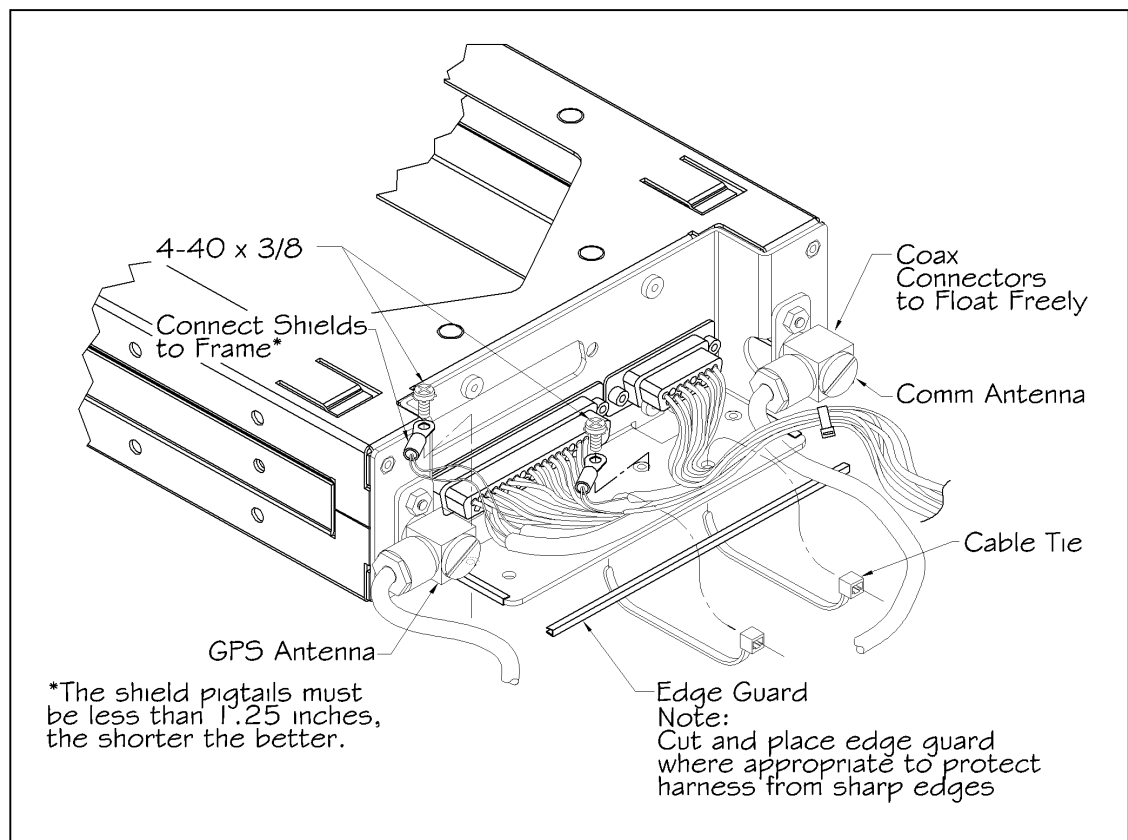


Figure 5 Cable Routing

ELECTRICAL CONNECTIONS

Wiring necessary for installation of the GX50/60/65 includes the rear panel electrical connections and the antenna cable placement. The 15 and 37 pin d-sub connectors and coax connector(s) may be wired before or after being installed in the mounting frame. The recommended connecting wire size for the connectors is 20 to 24 AWG. Wiring diagrams are included on pages 18 through 24.

POWER

The GX60/65 requires two power connections, one for the GPS navigation side of the unit, the other for the comm. Make the power connections to the unit using 20 AWG wire.

The GPS navigation power input is internally fused at 3 amps. A separate 2 amp (maximum) circuit breaker or fuse should be installed for downline overload or short circuit protection.

The comm power input (GX60/65 only) is internally fused at 7 amps. A separate 5 amp (maximum) circuit breaker or fuse should be installed for downline overload or short circuit protection.

Note: Circuits should be protected in accordance with guidelines in AC 43.13-1A, chapter 11, section 2, paragraph 429.

Warning

When connecting power to the GX unit, reversing the polarity of the connection will blow the internal fuse. The internal fuse is soldered onto the circuit board and requires repair at the factory.

AVIONICS OUTPUTS

The GX50/60/65 includes avionics outputs for CDI/HSI indicators, autopilot, and annunciators. These outputs are to be connected as appropriate for the particular installation. The CDI/HSI outputs may be connected to a dedicated CDI or HSI or to a shared indicator using an appropriate switching relay. The avionics outputs available are listed in the Avionics Outputs specification on page 35. Connect the annunciator outputs to lamp indicators as described in the specifications. The minimum connections required for different installations are listed in the System Configurations on page 4.

If a switching relay is used to make connections to a shared CDI/HSI, it should be a minimum of an eight pole relay box with an appropriate selector switch with annunciation. The ILS enable signal (see Figure 8 and Figure 11) from a connected ILS receiver can be connected to automatically switch the indicators back to the nav receiver when an ILS frequency is selected.

SERIAL INTERFACE

The GX50/60/65 includes two RS-232 serial ports for making optional connections. The serial ports can be used for connecting to such devices as the Apollo SL40 comm, a moving map display, multi-function display, autopilot, VHF Nav/Com, Fuel Air/Data computer, or an altitude encoder/converter. Serial output connections should be limited to no more than three external units.

When making connections to the GX50/60, use a three-conductor shielded cable (for two-way serial communication) or a two-conductor shielded cable (for one-way serial communication). Make Rx/D, Tx/D, and signal ground connections to the 37-pin connector. Connect the shield(s) to the rear of the mounting frame. The shield leads must be <1.25 inches. See Figure 5.

Complete serial interface specifications are included in Appendix E.

SPEAKER AND HEADPHONE OUTPUTS (GX60/65 ONLY)

Connect the speaker and headphones to the output pins on the rear connector.

MICROPHONE INPUTS (GX60/65 ONLY)

Microphone input connections should be made using a twisted pair shielded cable. Attach the signal ground to the mic ground pin on the rear connector and connect the shield to the rear connector plate.

TRANSMIT KEY INPUT (GX60/65 ONLY)

The TxKey input on the rear connector must be pulled low to ground to enable the transmitter. This input should be connected to a microphone or yoke mounted momentary push button switch.

INTERCOM SELECTOR SWITCH (GX60/65 ONLY)

The GX60/65 includes a voice activated intercom function that can be enabled by an external control switch. This is an optional connection.

When making connection for the intercom selection, connect the intercom selection input to a remote mounted normally open switch. A momentary toggle or alternate action switch can be used. Connect the other terminal of the switch to ground. The intercom function is enabled when the input is pulled low to ground. The monitor function is inhibited when the intercom function is selected.

REMOTE FLIP/FLOP INPUT (GX60/65 ONLY)

The GX60/65 includes a remote flip/flop input. This is an optional input that can be connected to a remote mounted (such as on the yoke) momentary push button switch which pulls the input low to ground.

ANTENNA INSTALLATION AND CONNECTIONS**COMM ANTENNA (GX60/65 ONLY)**

The GX60/65 requires a standard 50Ω vertically polarized antenna. Follow the antenna manufacturer's installation instructions for mounting the antenna.

The antenna should be mounted on a metal surface or a ground plane with a minimum area of 18 x 18 inches. The antenna should be mounted a minimum of two feet away from GPS antennas.

The comm antenna should also be mounted as far apart as practical from the ELT antenna, preferably one on top and the other on the bottom of the aircraft fuselage. Some ELTs have exhibited re-radiation problems generating harmonics that may interfere with GPS signals. This can happen when the comm (GX60/65 or any other comm) is transmitting on certain frequencies such as 121.15 or 121.175 MHz, which may cause the ELT output circuit to oscillate from the signal coming in on the ELT antenna coax.

The antenna coax cable should be made of RG-142B or a comparable quality 50Ω coax. Assembly instructions for the rear coax connector are included in Figure 6.

GPS ANTENNA

The mounting location and cable connections for the GPS antenna are very important. The antenna should be mounted no closer than two feet from VHF comm transmitter antennas, six inches from other antennas emitting less than 25 watts, and two feet from higher power antennas. Special care should be taken to ensure that the GPS antenna is not mounted in close proximity to antennas that may emit harmonic interference at the L1 frequency of 1575.42 MHz. Refer to the antenna installation manual for installation instructions.

The connectors are included in the installation kit, and are intended for use with RG-142B size coax cable. If using a different diameter coax, alternative connectors may be required. Assembly instructions for the connectors are included in Figure 6 and Figure 7. RG-142B cable can be used as long as the length is less than 20 feet. For longer lengths, use a low loss 50Ω coax.

Suggestion: *Temporarily locate the GPS antenna with coax connected to the GX50/60/65 and check the GPS performance as described in the GPS Operation and Position test in the Post Installation Checkout on page 27. Once a suitable location has been verified, then permanently mount the antenna.*

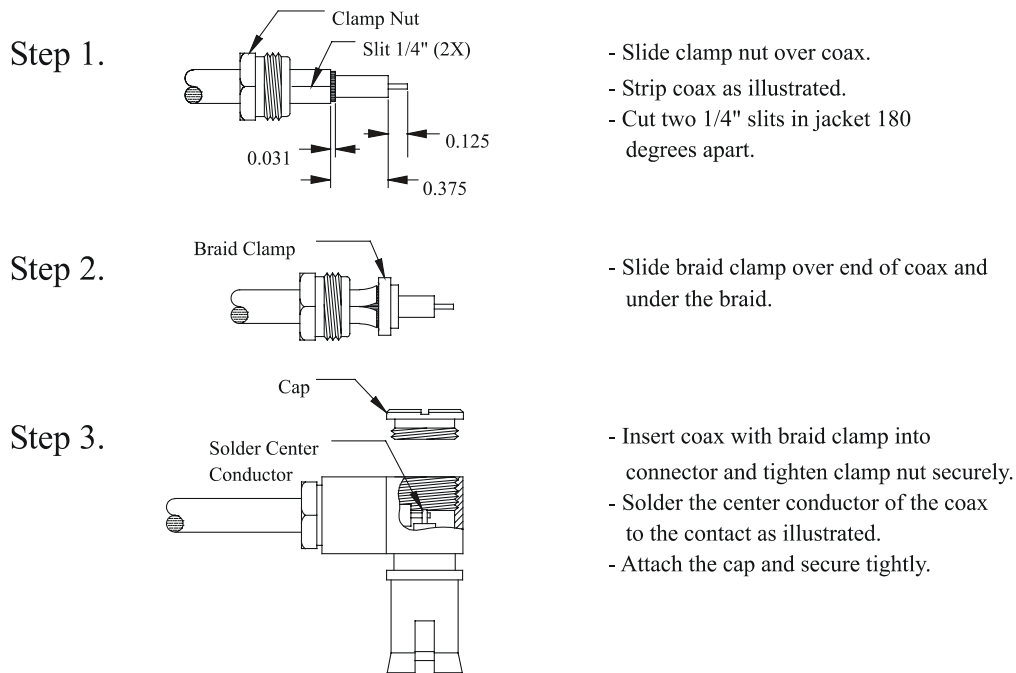
Note: *If using a GPS antenna that was already on the aircraft, or if mounting the antenna closer than two feet from a comm antenna, conduct the GPS Operation and Position test in the Post Installation Checkout on page 27. If the GX50/60/65 passes the test, then moving the antenna is not necessary.*

Once the antenna mounting position has been prepared, route the coax cable from the antenna to the GX50/60/65. Proper selection of coax cable and assembly of connectors is critical to GPS signal performance. The cable loss from the antenna to the GX50/60/65 should be limited to a maximum of 4 dB. Minimize the coax length for optimum performance and **DO NOT** coil excess cable. Leave only enough for service loops. The coaxial connectors and adapters, such as TNC to BNC, add additional loss to the cable and should be considered when computing the maximum 4 dB loss. A typical loss of 0.2 dB can be used for each connection. The typical cable loss for 20 feet of RG-142B coax with a connector on each end is 4 dB.

During the post-installation checkout, susceptibility to harmonics of VHF comm transmitters will be evaluated. If problems arise, then better isolation, or distance, may be required between the GPS and comm antennas, or a notch filter may be installed in series with the antenna coax of the VHF comm transceiver to reduce or eliminate the harmonic interference. A notch filter for this use (part #162-1059) is available from II Morrow.

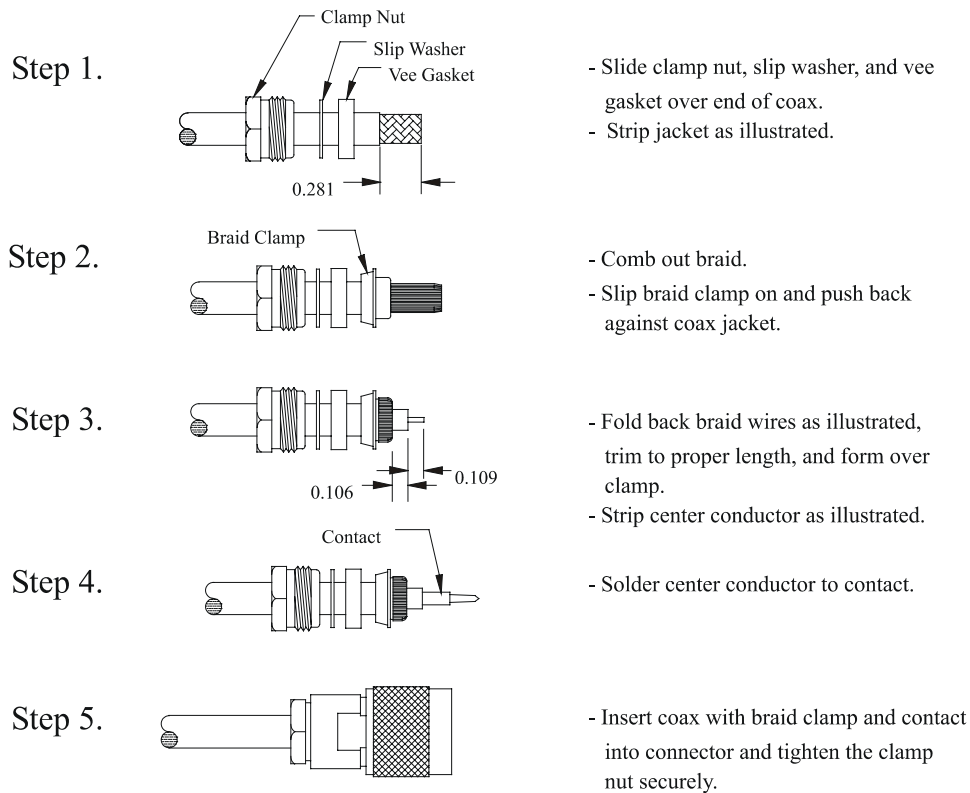
Note: *GX60/65 performance has been verified in typical installations and has not shown problems with the built-in comm interfering with the GPS when installed according to the recommended installation guidelines.*

If a VHF comm 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.



Assembly instructions for right angle connector part #162-1008

Figure 6 Rear Coax Connector Assembly



Assembly instructions for straight TNC connector part #162-1060

Figure 7 TNC Coax Connector Assembly

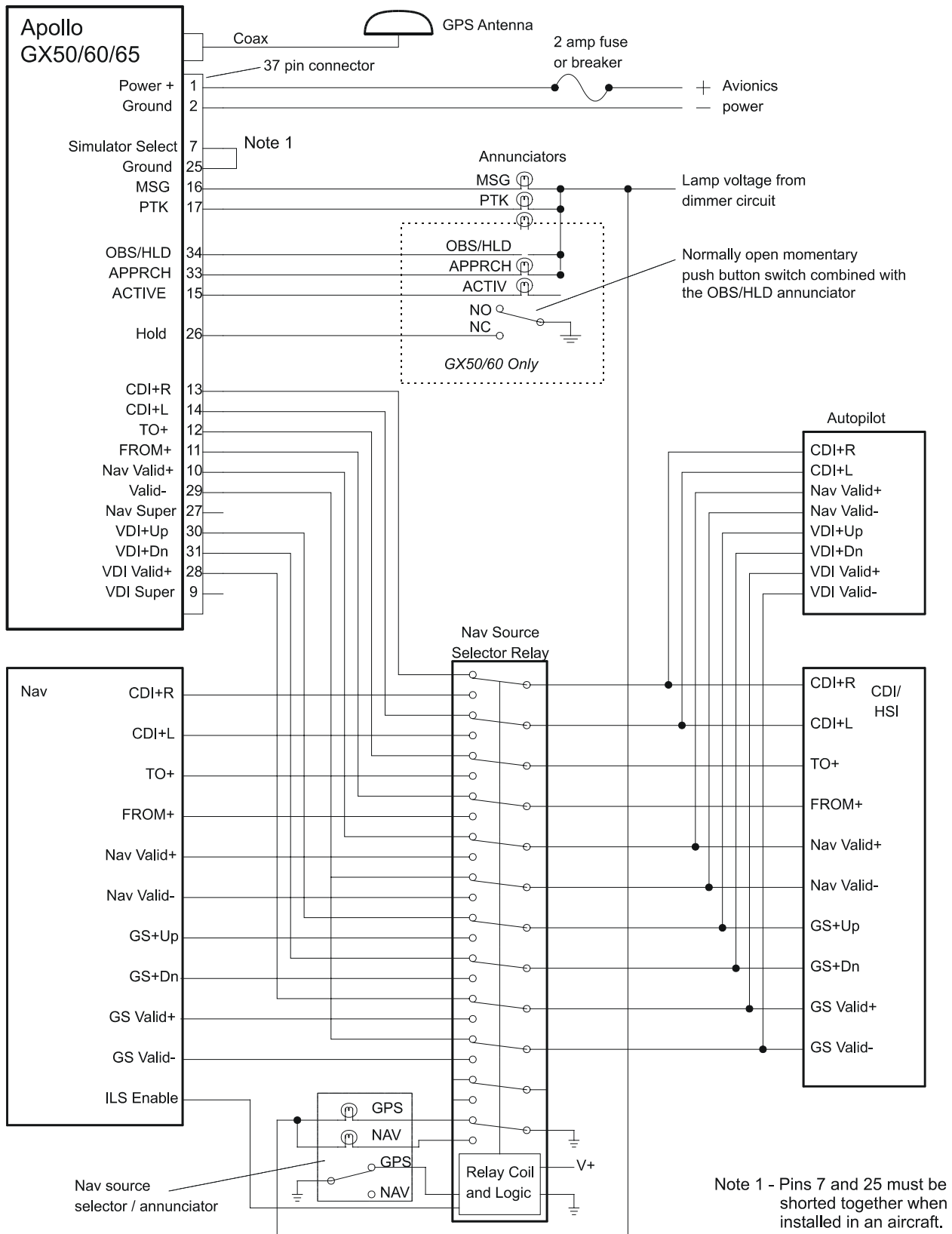


Figure 8 GX50/60/65 Power and Avionics Connections

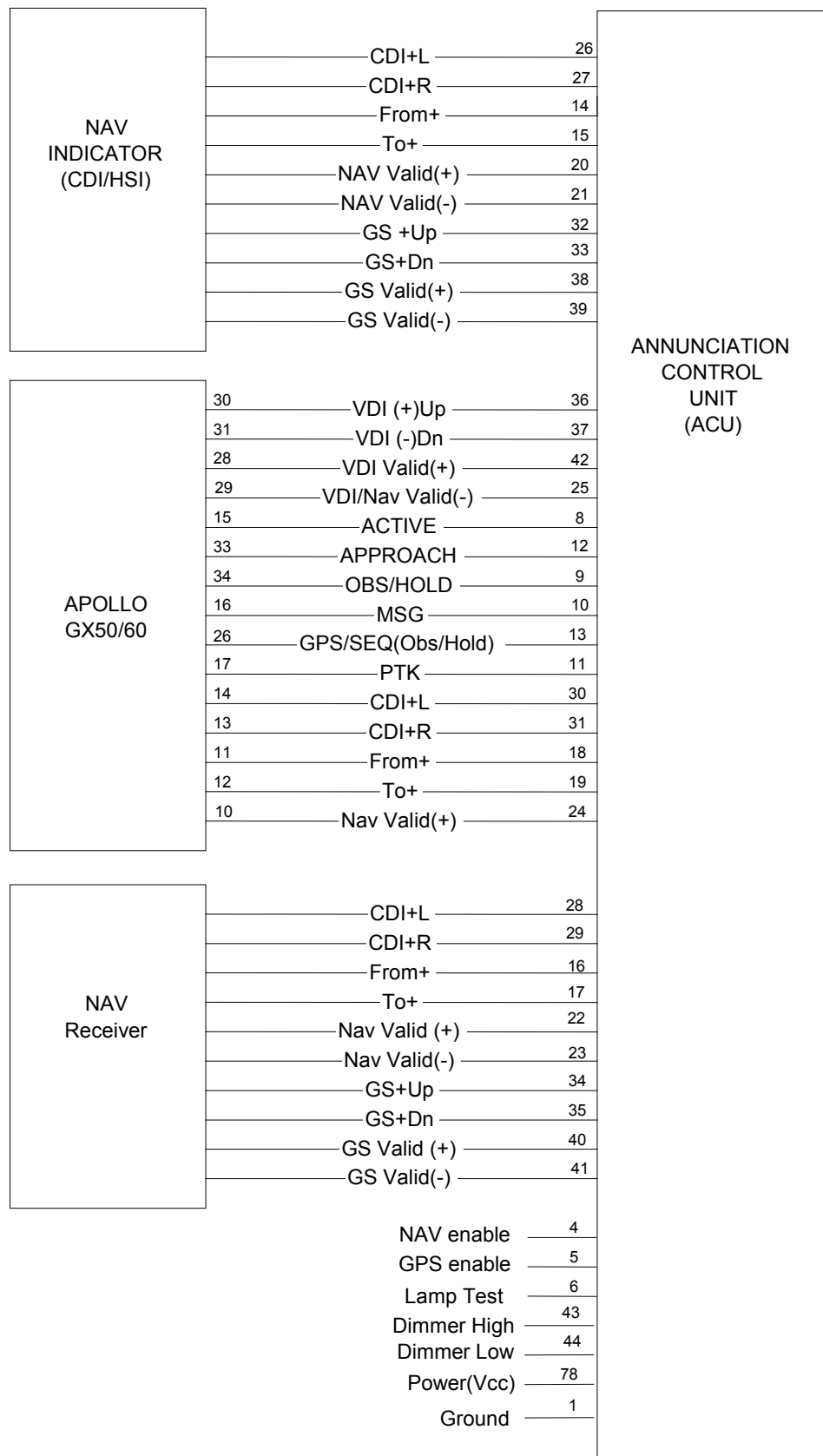


Figure 9 - Apollo ACU to Apollo GX50/60 Wiring Diagram

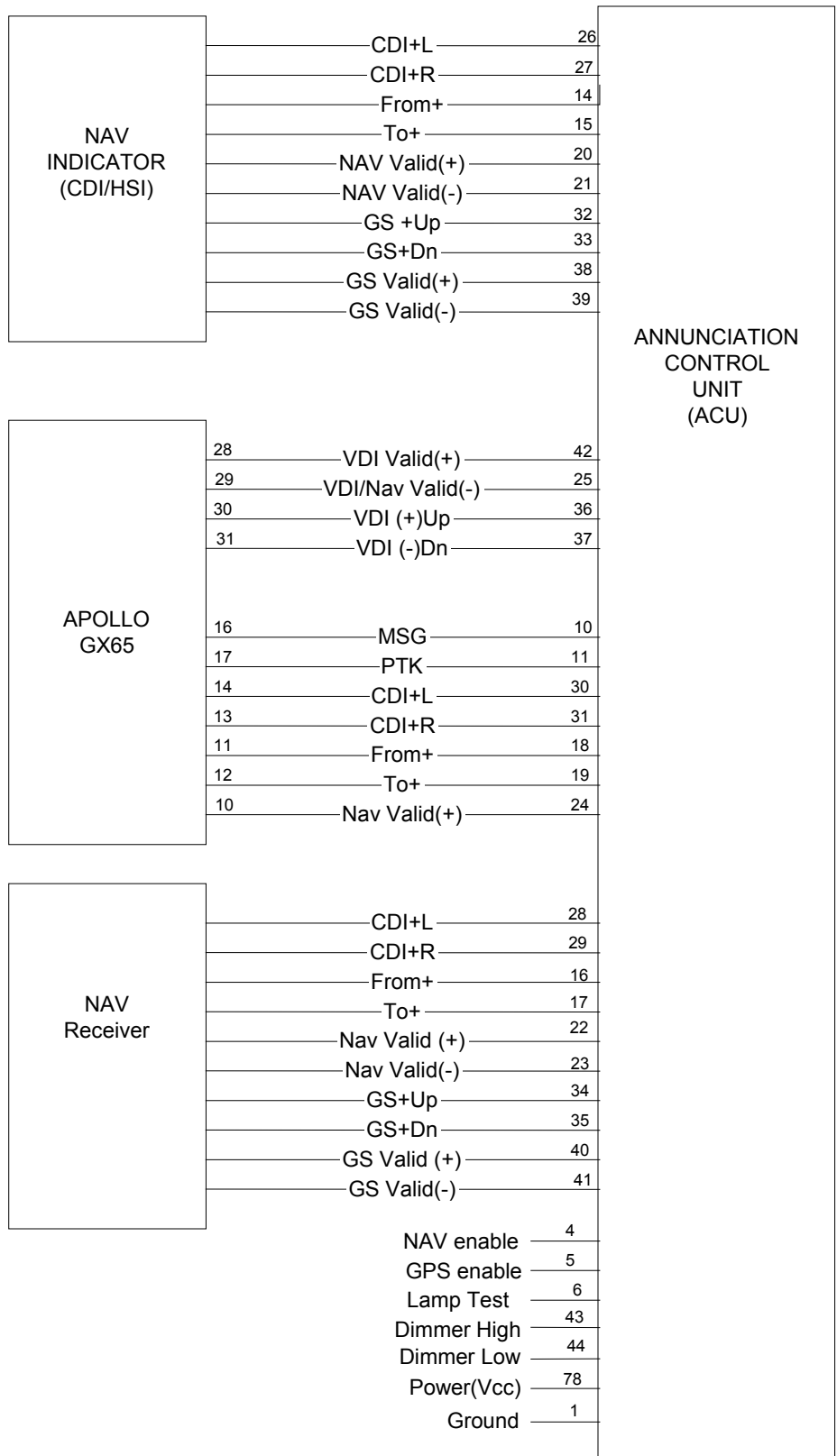


Figure 10 - Apollo ACU to Apollo GX65 Wiring Diagram

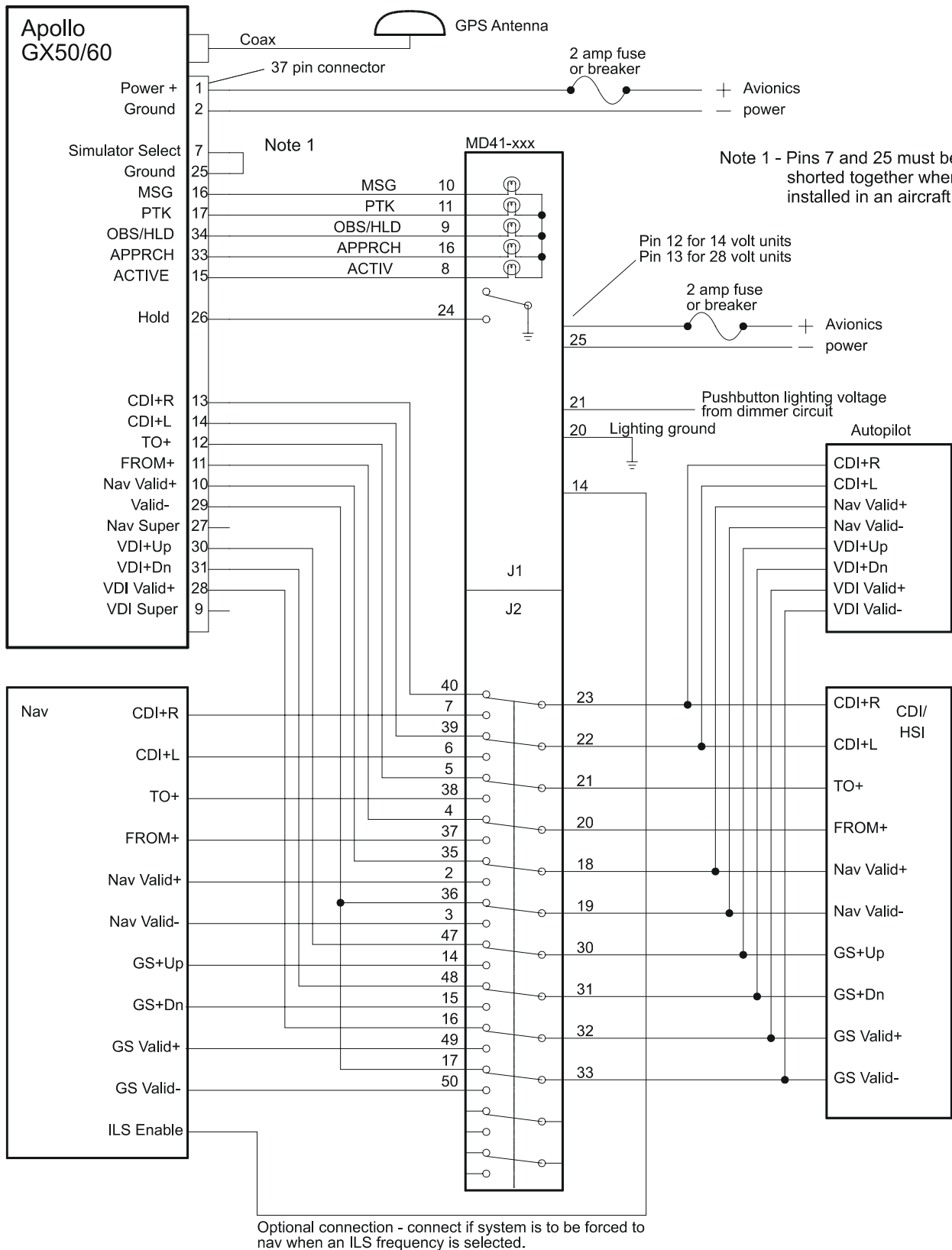
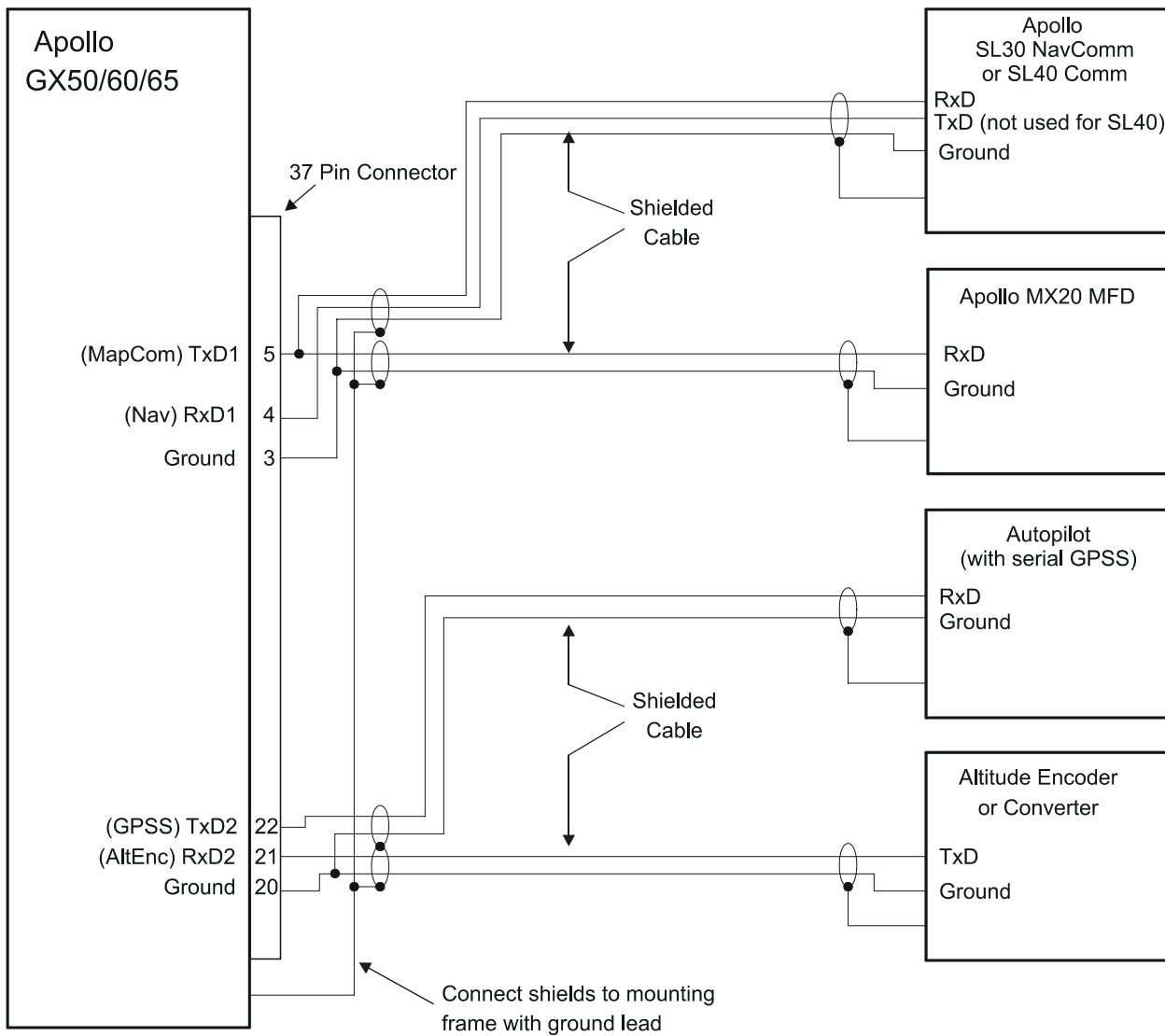


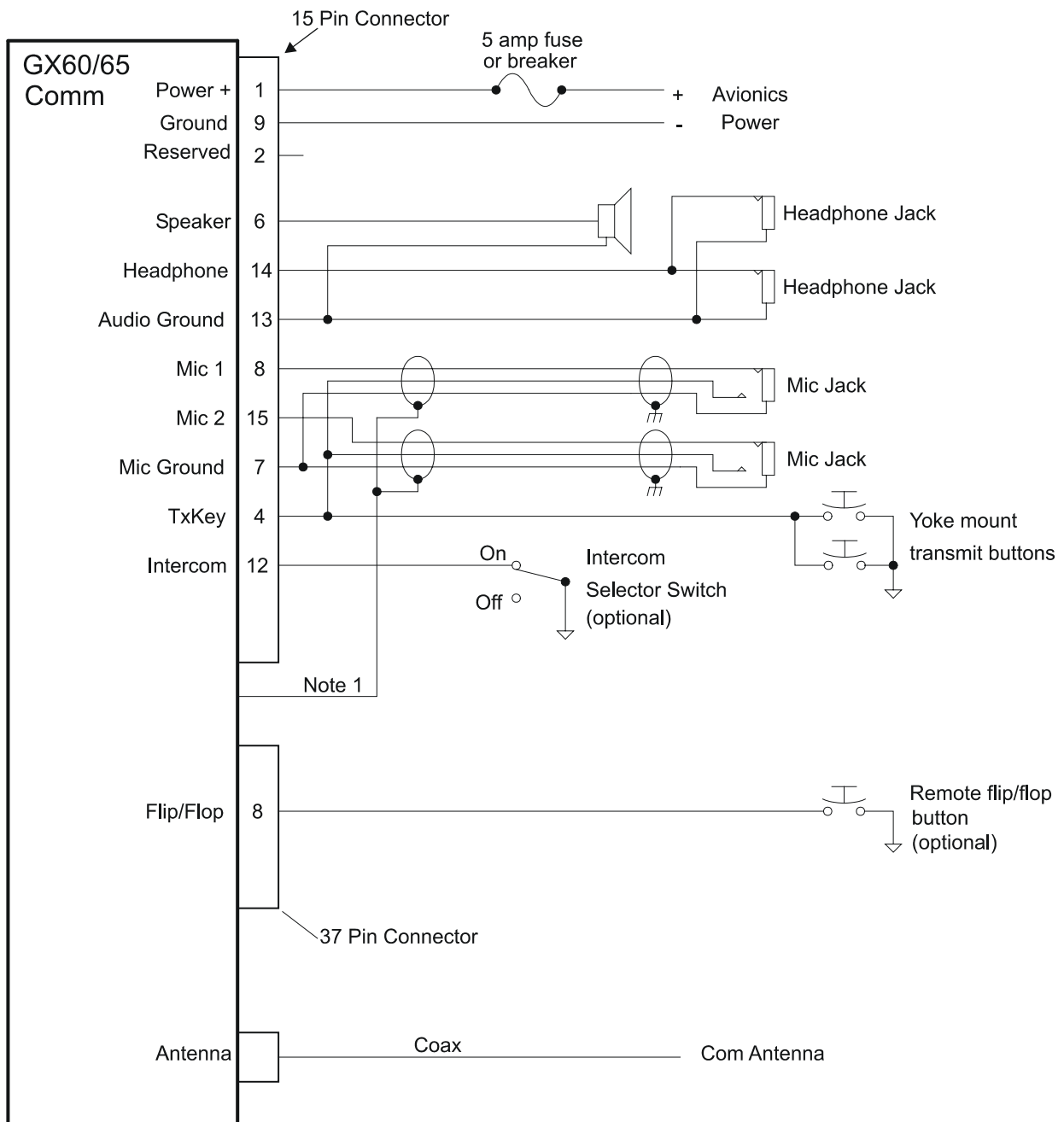
Figure 11 Apollo 50/60 Connections with MD41 Annunciator / Relay



- Notes:
1. Use shielded cable for all RS-232 interface connections.
 2. Serial outputs should be limited to three devices.
 3. Connect cable shields to the rear of the mounting frame with pigtails < 1.25 inches.
 4. Connect shields to chassis ground at both ends of each shielded cable.
 5. Consult the full stack wiring diagrams or individual manuals for device connection and pin numbers.

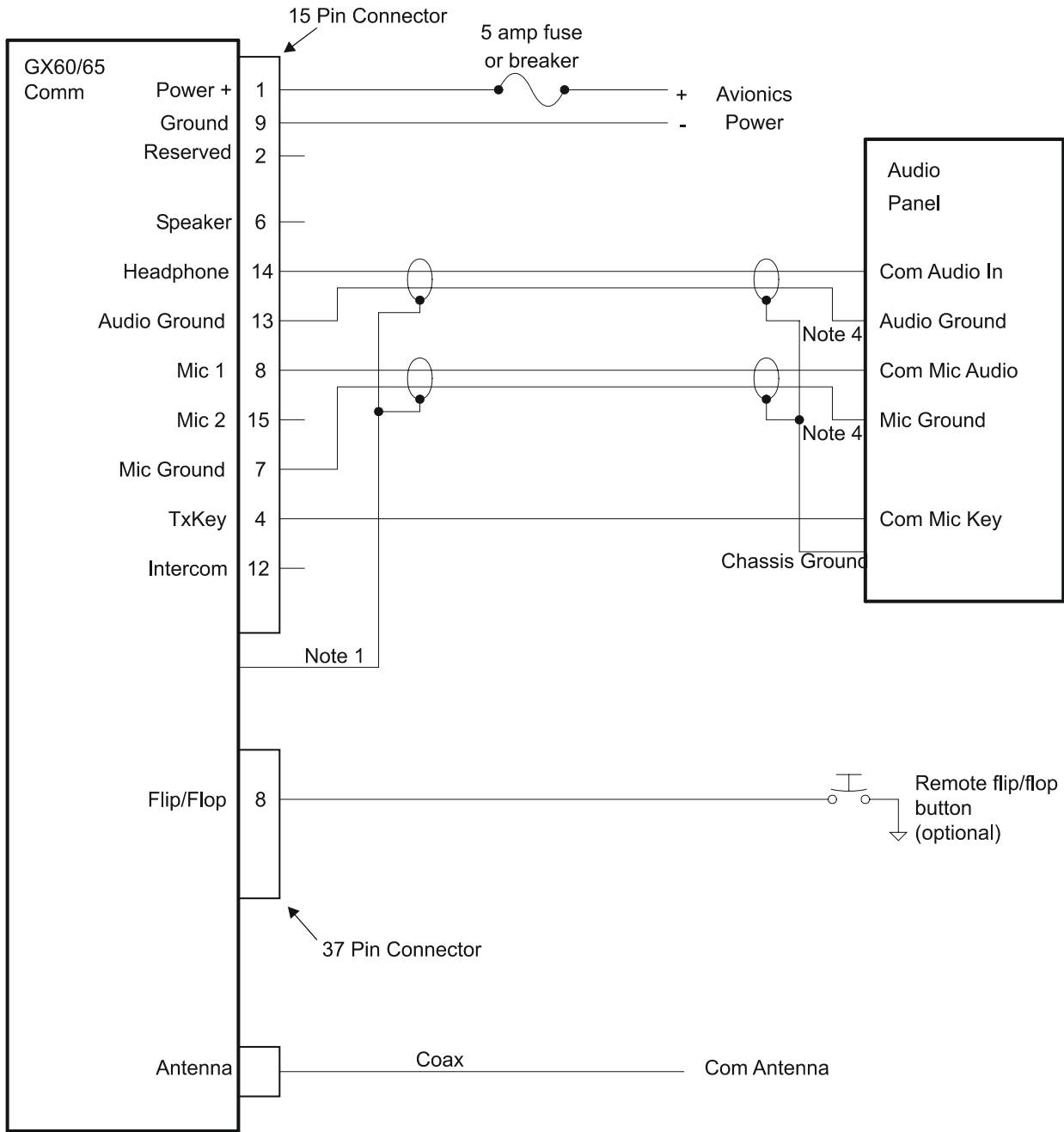
Typical Serial Configuration		
	Rx	Tx
Port 1	Nav	MapCom
Port 2	AltEnc	GPSS

Figure 12 RS-232 Serial Connections



- Notes:
1. Connect cable shields to the rear of the mounting frame, with pigtails < 1.25 inches.
 2. Use shielded cable for the microphone connections.
 3. Connect shields to ground at both ends of cables.

Figure 13 GX60/65 Comm Wiring Diagram



- Notes:
1. Connect cable shields to the rear of the mounting frame, with pigtails < 1.25 inches.
 2. Use shielded cable for the microphone connections.
 3. Connect shields to chassis ground at both ends of cables.
 4. The audio ground and mic ground connections may use a common point at the audio panel.

Figure 14 GX60/65 Typical Audio Panel Connections

POST INSTALLATION CHECKOUT

Once the unit is installed, complete the checkout procedure to verify proper operation. Refer to the User's Guide for operating instructions.

The steps that are not applicable to a particular installation may be skipped. A checkout log sheet is included on page 31 to fill out during the checkout procedure. Make a photocopy of the log sheet for ease of use if desired.

The checkout procedure is broken into several groups. The GPS Navigation Checkout, VHF Comm Checkout (GX60/65), and the Final System Check should be completed with the aircraft moved clear of hangers and other structures.

Mounting / Wiring Check

Verify that all cables are properly secured and shields are connected to the rear of the mounting frame. Check the movement of the aircraft controls to verify that there is no interference.

TEST MODE CHECKOUT AND SETUP

The GX50/60/65 has a built-in test mode to simplify the checkout. To operate the GX50/60/65 in the test mode, hold down the leftmost and rightmost "smart keys" while switching on the power. To return to normal operation, switch the power off, then back on.

Avionics Outputs

Check the avionics output connections by using the test mode as follows. Rotate the LARGE knob to select each test.

1. Using the "CDI TRIANGLE" page, rotate the SMALL knob to check left, mid, and right.
2. Using the "VDI TRIANGLE" page, rotate the SMALL knob to check down, mid, and up.
3. Using the "TO/FROM FLAG" page, rotate the SMALL knob to check the Off, To, and From outputs.
4. Using the "LAMP OUTPUTS" page, rotate the SMALL knob to check all the connected annunciators.
5. Using the "VALID FLAG PAGES" page, rotate the SMALL knob to check all the connected valid flag outputs.

Installation Configuration

The GX50/60/65 must be configured to match the operation supported by the installation. This includes IFR, VFR, approach, and Search and Rescue operation selections.

1. In test mode, rotate the LARGE knob to the "INSTALL OPTIONS" page.
2. Press SEL. Rotate the SMALL knob to select IFR operation (YES or NO). Rotate the LARGE knob for APPR* selection. Rotate the SMALL knob to select approach operation (YES or NO). Rotate the LARGE knob for SAR (Search and Rescue) selection. Rotate the SMALL knob to select SAR operation (YES or NO). Press ENT when complete. (Note: APPR can only be set to YES when IFR is set to YES).

* (GX50/60 only)

Note: Make sure that all installation requirements are complete for the selected operation. Refer to the System Configurations section on page 4 for installation requirements.

Serial Interface Configuration

The GX50/60/65 RS-232 serial ports can be configured for several input and output formats. To select the serial port configurations:

1. In test mode, rotate the LARGE knob to the serial port configuration “CH RX TX” page.
2. Press SEL (the selection fields will start flashing), rotate the LARGE knob to select the port, rotate the SMALL knob to select the desired configurations, then press ENT when complete.

The available serial port configurations are included in Appendix E. Serial output connections should be limited to no more than three external units. An example of the typical settings for the RS-232 selections for most installations would be:

CH	Rx	Tx
1:	NAV	MapCom
2:	AltEnc	GPSS

Comm Radio Setup

The Test Mode settings may also be used to preset the Microphone (Mic) Gain and the Receiver Squelch levels.

Mic Gain

Set the microphone gain for microphones 1 and 2 for values from 0 to 255.

1. In the Test Mode, rotate the LARGE knob to select "Mic Gain."
2. Press SEL to activate selection. The Mic 1 value will flash.
3. Turn the SMALL knob to change the value.
4. Turn the LARGE knob to the Mic 2 value. Turn the SMALL knob to change the value.
5. Press ENTER to accept and save the settings.

Receiver Squelch

Preset the receiver squelch level for values from 25-100.

1. In the Test Mode, rotate the LARGE knob to select "Receiver Squelch."
2. Press SEL to activate selection. The value will flash.
3. Turn the SMALL knob to select a value.
4. Press ENTER to accept and save the settings.

Other Test Mode Pages

The GX50/60/65 test mode includes several other pages that are not necessary for the checkout. They are as follows:

- “TO TEST DISPLAY” Can be used to check the GX50/60/65 front panel displays by pressing ENTER.
- “TEST CONTROLS” Can be used to check the GX50/60/65 front panel controls. Press each button and rotate the SMALL knob to check the controls.
- “OPERATION STATUS:” Factory use only. Should be set to “STANDARD.”

“SYSTEM INITIALIZATION”	Factory use only. Used to reset all internal memory including user waypoints, flight plans, and configuration data.
	<i>Caution: Using the system initialization function will cause all user data to be lost!</i>
“SERIAL PORT TEST”	Factory use only. Used to check the RS-232 serial ports.
"Extended MovMap Data Format"	Enable/Disable extended moving map data. This should be enabled when interfaced with an Apollo MX20 or Sandel HSI. Call Customer Service if you have questions.
“A/D CHANNEL 1”	Factory use only. Used to check internal circuits and display voltages.
“EEPROM BYTE 0000:”	Factory use only. Used to display eeprom setup memory.

GPS NAVIGATION CHECKOUT

Switch on the GX50/60/65 in the normal mode to complete this part of the checkout. The GX50/60/65 will go through a sequence of self tests.

The GX50/60/65 requires a “seed” position, time, and date for the GPS sensor to know which satellites to look for. Once this is entered, it will be saved and updated automatically. If the GX50/60/65 is moved a great distance without being turned on, the seed position may have to be re-entered.

Entering the seed position:

1. During the display startup sequence, press SEL when the position page is displayed.
2. Rotate the LARGE knob to move the cursor to different fields, rotate the SMALL knob to input the correct lat/lon, and then press ENT to save the changes.

The seed position can also be input with reference to a waypoint. Refer to the user’s manual for instructions.

Entering the time and date:

The time and data can be entered after the power up sequence from the nav page display.

1. Press the SYS button, rotate the LARGE knob to display the “SYSTEM INFO” page, and press ENTER.
2. Press SEL, rotate the LARGE knob to move the cursor to different fields, rotate the SMALL knob to input the correct time, and then press ENT to save the changes.

GPS Operation and Position

This checkout is to be completed with the aircraft moved away from hangars and other structures that may obstruct the view of the satellites.

1. Turn on the GX50/60/65 and allow the unit to acquire a position. All other avionics should be turned off for this part of the test.
2. Check the position using the lat/lon navigation page. Press the NAV button and rotate the LARGE knob to the lat/lon page. The lat/lon should agree with a known reference position.

3. Check the signal reception using the GPS sensor displays in the System mode. Press the SYS button, rotate the LARGE knob to the “GPS SENSOR:” page, and press ENT. Then rotate the SMALL knob to display the GPS info. Typical signal levels are 50 or better.
4. Turn on other avionics one at a time and check the GPS signal reception to make sure it is not affected.
5. Check for VHF comm transmitter interference. This must be completed on all IFR installations.
 - a) Verify that 5 to 8 satellites are in DATA and the NAV flag is out of view.
 - b) Tune the comm to 121.150 MHz and transmit for 20 seconds.
 - c) Verify that the position is not lost.
 - d) Repeat for additional frequencies as follows.

121.125 MHz	131.225 MHz
121.175 MHz	131.250 MHz
121.200 MHz	131.275 MHz
121.225 MHz	131.300 MHz
121.250 MHz	131.325 MHz
131.200 MHz	131.350 MHz
 - e) Repeat for each comm transmitter.
 - f) If the GX50/60/65 is susceptible to VHF comm transmitter interference, then better isolation, or distance, may be required between the GPS and VHF antennas. With some comm transmitters, a notch filter may be required in series with the VHF comm antenna coax at the rear of the comm unit.

Note: Older VHF comm transmitters may emit higher levels of harmonic interference causing greater problems and may be more difficult to deal with.

VHF COMM CHECKOUT (GX60/65)

Receiver / Transmitter Operation

Tune the unit to a local frequency and verify the receiver output produces a clear and understandable audio output. Verify the transmitter functions properly by contacting another station and getting a report of reliable communications. Check the remote flip/flop.

Antenna Check

The antenna VSWR can be checked using an inline wattmeter in the antenna coax using frequencies near both ends of the band. The VSWR should be < 2:1, and is not to exceed 3:1. A VSWR of 2:1 will cause a drop in output power of approximately 12%, and 3:1 causes approximately a 26% drop.

Sidetone Level Adjustment

The sidetone volume was preset at the factory to a typical audio level. The level can be adjusted using one of the built-in system functions. To adjust the sidetone level:

1. Press SYS, rotate the LARGE knob to the “COM INFO” page, and press ENT.
2. Rotate the LARGE knob to the “SIDETONE LEVEL” page.
3. Press SEL, rotate the SMALL knob to adjust the sidetone level, then press ENT when complete. The sidetone level is displayed in a range of 000 to 255, with 255 the highest level. The sidetone level can be adjusted during transmit.

Comm Flight Test Check

A flight test is recommended as a final installation verification. The performance may be verified by contacting a ground station at a range of at least 50nm while maintaining an appropriate altitude and over all normal flight attitudes. Performance should be checked using low, high, and mid band frequencies.

FINAL SYSTEM CHECK

The GX50/60/65 GPS navigation functions should be complete at this time. The final check includes checking database, entering a direct to waypoint, and checking the navigation functions. Start with the unit turned on and operating in the normal mode. Refer to the user's manual for operating instructions.

1. Verify a valid position is displayed.
2. Check the database to ensure it is for the right coverage area and check the expiration date. To check the database:
 - a) Press SYS, rotate the LARGE knob to the "SYSTEM INFO" page, and press ENT.
 - b) Rotate the LARGE knob to the Apollo GX "SOFTWARE VERSION" page
 - c) Rotate the SMALL knob to display the database information. The database name, expiration date, and version will be displayed.
3. Enter a direct to waypoint. Press the DIRECT-TO button, use the LARGE and SMALL knobs to select a nearby waypoint, then press ENT. Or use the nearest search function to select a waypoint.
4. Verify the bearing and distance to the selected waypoint.

If the database is expired, or if a different coverage area is needed, contact the II Morrow factory for an update.

INTERFACE CHECKS

The interfaces to other equipment, such as the SL40 or a moving map display, should be checked. Make sure the other equipment is connected and switched on. The Apollo GX must have a seed position and be navigating to a waypoint to check the interfaces.

Apollo SL30

When your Apollo GX is connected to and configured to communicate with an Apollo SL30 Nav/Comm, your Apollo GX will exchange information with the SL30. If the following steps do not perform correctly, check the electrical connections and configuration setup.

1. In the Apollo GX, view Tuned Station page in Nav mode. The tuned station identifier and frequency sent by the Apollo SL30 should be displayed.
2. In the Apollo SL30, Distance, Speed, and Time information for the selected station should be displayed. The Distance, Speed, and Time information for the selected station shown in the SL30 ensures that the GX and SL30 are communicating.

If your Apollo SL30 is only configured to receive, use the following steps for checkout.

1. In the SL30, press **NAV**.
2. Then, press **SEL**.
3. Note that you should see the three to four letter designator for either the Localizer for the destination or the closest VOR to your current position.

Apollo SL40

The Remote function will allow the SL40 to access the airport frequency database in an Apollo GPS receiver. If the following steps do not perform correctly, check the electrical connections and configuration setup.

1. In the SL40, press **RCL** to view the Remote (REM) frequencies.
2. Then, turn the **SMALL**, inner knob to display the available frequencies. The waypoint type and frequency received from the GX are displayed.

Apollo MX20

The Apollo MX20 must be installed and setup according to its installation manual. If the following steps do not perform correctly, check the electrical connections and configuration setup.

1. Check the System Info page on the MX20 to verify that the data is available to each port and that it is being processed properly.
2. The GX Flight plan will be displayed on the MX20 on the FPL page.

Altitude Encoder and Fuel Air/Data Computer

In the System Mode check the Misc Sensors function. If the following steps do not show the correct information, check the electrical connections and configuration setup.

1. Press **SYS**. Turn the **LARGE** knob to Misc Sensors and press **ENTER**.
2. The Encoding Altimeter value will be displayed.
3. Turn the **LARGE** knob to view Air Data Info.
4. Turn the **LARGE** knob to view Fuel Info.

Autopilot

The Apollo GX provides GPSS roll steering information to an appropriate autopilot. When connected properly, the autopilot will show a GPSS valid indication when the aircraft reaches a speed over 5 kts and is navigating to a waypoint.

1. Apply power to the equipment and wait for the GX to acquire a position.
2. In the GX, set a course to a destination waypoint. For instance; press **NRST**, select airport with the **SMALL** knob, and press **DIRECT-TO**.
3. Taxi the aircraft faster than 5 kts.
4. Verify that GPSS is valid via the autopilot annunciation.

Annunciator Control Unit (ACU)

Once the unit is installed, complete the checkout procedure to verify proper operation. Refer to the User's Guide for operating instructions.

APOLLO GX50/60/65 POST-INSTALLATION CHECKOUT LOG		Date: ___/___/___
		By: _____
CONFIGURATION INFORMATION:		
<input type="checkbox"/> GX50 GPS	430-6050-4__ Mod _____	Serial # _____
<input type="checkbox"/> GX60 GPS/Comm	430-6050-6__ Mod _____	GPS Antenna _____
<input type="checkbox"/> GX65 GPS/Comm	430-6050-8__ Mod _____	Comm Antenna: _____
TEST MODE CHECKOUT AND SETUP:		
Avionics Outputs:		Installation Configuration:
<input type="checkbox"/> <input type="checkbox"/> N/A] CDI (left, mid, right)		IFR?: <input type="checkbox"/> Yes <input type="checkbox"/> No
<input type="checkbox"/> <input type="checkbox"/> N/A] VDI (down, mid, up)		APPR? <input type="checkbox"/> Yes <input type="checkbox"/> No
<input type="checkbox"/> <input type="checkbox"/> N/A] TO/FROM flag (OFF, TO, FROM)		SAR?: <input type="checkbox"/> Yes <input type="checkbox"/> No
<input type="checkbox"/> <input type="checkbox"/> N/A] External annunciators		Serial Interface Configuration:
<input type="checkbox"/> <input type="checkbox"/> N/A] Valid flags		_____ / _____ (Port 1)
		_____ / _____ (Port 2)
GPS NAVIGATION CHECKOUT:		
<input type="checkbox"/> Seed position entered		Interface Checks:
<input type="checkbox"/> Time, date entered		<input type="checkbox"/> <input type="checkbox"/> N/A] RS-232 outputs checked
GPS Operation:		<input type="checkbox"/> <input type="checkbox"/> N/A] Map/Mapcom
<input type="checkbox"/> Position check		<input type="checkbox"/> <input type="checkbox"/> N/A] GPSS
<input type="checkbox"/> Signal reception check		<input type="checkbox"/> <input type="checkbox"/> N/A] RS-232 inputs checked
<input type="checkbox"/> Interference from other avionics checked		<input type="checkbox"/> <input type="checkbox"/> N/A] Altitude Encoder
<input type="checkbox"/> VHF comm interference check		<input type="checkbox"/> <input type="checkbox"/> N/A] NAV
		<input type="checkbox"/> <input type="checkbox"/> N/A] F/ADC
VHF COMM CHECKOUT: (GX60/65 ONLY)		
<input type="checkbox"/> Receiver / Transmitter operation		<input type="checkbox"/> Sidetone level set / checked
<input type="checkbox"/> Antenna check		<input type="checkbox"/> Flight test operation
<input type="checkbox"/> <input type="checkbox"/> N/A] Remote flip/flop input		
FINAL SYSTEM CHECK:		
<input type="checkbox"/> Database checked		<input type="checkbox"/> Navigation data checked
<input type="checkbox"/> Direct To waypoint entered		<input type="checkbox"/> DST data acceptable*
* Note: Distance, Time, and speed information sent through the serial port must be displayed in an acceptable manner. See Limitations in Sec. 4.		
COMMENTS:		

NOTES

SECTION 3 - SPECIFICATIONS

This section includes detailed electrical, physical, environmental, and performance specifications for the Apollo GX50 and GX60/65.

ELECTRICAL

Input voltage.....	10VDC to 40VDC, reverse polarity protected
Input current (GPS navigation input)	500 mA typical, 750 mA max. at 13.75 VDC 250 mA typical, 375 mA max. at 27.5 VDC
Input current (comm input)	270 mA typical, 2A max. at 13.75 VDC, receive 130 mA typical, 900 mA max. at 27.5 VDC, receive 2.1 A typical, 3.2 A max. at 13.75 VDC, transmit 1.0 A typical, 1.4 A max. at 27.5 VDC, transmit Note: Receive max. at full receive audio, transmit max. at 90% modulation at 1000 Hz
Input power (GPS navigation input)	7 watts typical
Input power (comm input).....	3.7 watts typical, receive 28 watts typical, transmit
Internal fuses	Nav input: 3 amp fast blow, surface mount on-board Comm input : 7 amp fast blow, soldered in-board Fuses must be replaced with the same or equivalent type (contact the factory).
Memory backup.....	Internal lithium battery with a service life of approximately 4 to 6 years. See Appendix B for battery replacement instructions.

Note: The GX50/60/65 will provide a message on the display when the Lithium battery is running low and needs replacement.

PHYSICAL

Height.....	2.00 inches (5.08 cm)
Width.....	6.25 inches (15.88 cm)
Depth.....	11.45 inches (29.1 cm) behind panel, including mounting frame and connectors
Weight (with mounting frame).....	GX50: 2.6 lb. (1.179 kg) GX60/65: 3.1 lb. (1.409 kg)

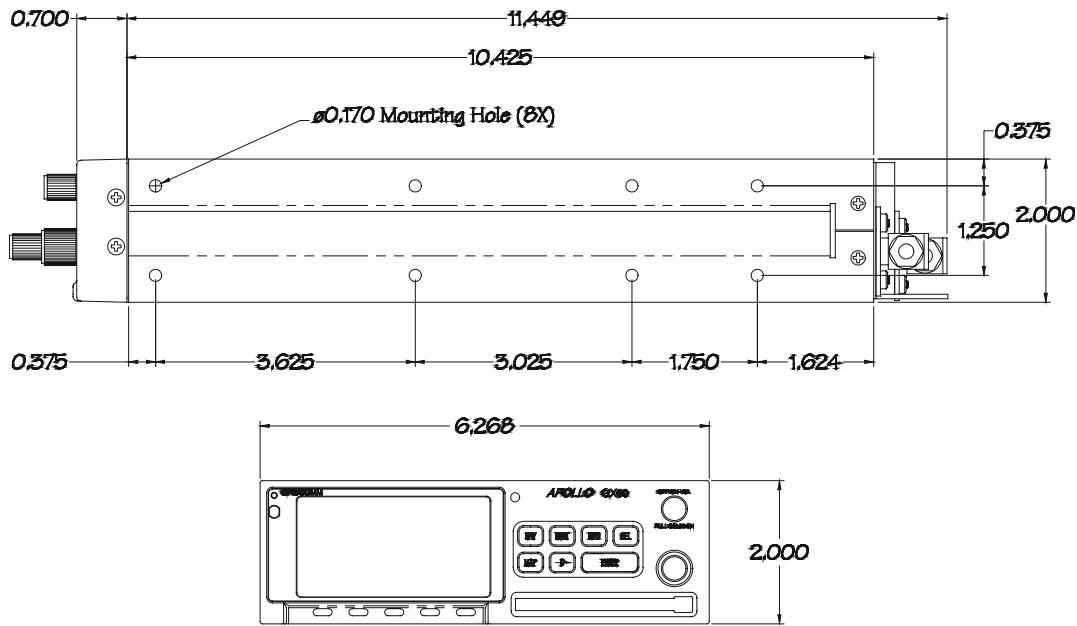


Figure 15 Unit Dimensions

ENVIRONMENTAL

The Apollo GX50 and GX60/65 units are designed and tested to meet appropriate categories of RTCA/DO-160C. The Environmental Qualification Form is included in Appendix C.

- Operating temperature -20°C to +55°C
- Storage temperature -55°C to +85°C
- Temperature variation 2°C per minute
- Humidity 95% at 50°C for 6 hours (2 day cycle)
- Maximum altitude 55,000 feet
- Cooling Not required

GPS RECEIVER PERFORMANCE

- Number of channels 8
- Frequency 1575.42 MHz L1, C/A code
- Sensitivity (acquisition) -135 dBm
- Sensitivity (drop lock) -142 dBm
- Dynamic range > 20 dB

Lat/Lon position accuracy.....	15 meters RMS typical 25 meters, SEP, without SA 100 meters 2DRMS with SA
Velocity.....	1000 knots maximum
Acceleration.....	4G maximum
TTFF (time to first fix).....	25 seconds typical with current almanac, position, time, and ephemeris 55 seconds typical with current almanac, position, and time
Reacquisition.....	2.5 seconds typical
Position update interval.....	1 second typical
Datum.....	WGS-84

AVIONICS OUTPUTS

CDI L/R deviation.....	±150 mv full scale, will drive up to 200 ohm load
TO/OFF/FROM flag.....	±250 mv, TO/FROM indication, will drive up to 200 ohm load
Nav valid flag.....	+300 mv for valid indication, will drive up to 100 ohm load
Nav superflag.....	Vin - 2 volts minimum for valid, source capability of 400 mA
VDI up/down.....	±150 mv full scale, will drive up to 200 ohm load
VDI valid flag.....	+300 mv for valid indication, will drive up to 100 ohm load
VDI superflag.....	Vin - 2 volts minimum for valid, source capability of 400 mA
Annunciators.....	Open collector outputs capable of sinking up to 400 mA for turning ON annunciator lamps <ul style="list-style-type: none"> • MSG (message) ON indicates message(s) active • PTK (parallel track) ON indicates parallel track is enabled • OBS/HLD (waypoint sequencing hold) ON indicates waypoint sequencing is on hold • APPRCH (approach enabled) ON indicates the approach has been enabled • ACTIVE (approach active) ON indicates the approach is active

ALTITUDE INPUT REQUIREMENTS

The altitude data can be input to the GX50/60/65 from either an altitude encoder or serializer, or from an air data computer.

The minimum requirements of the optional altitude data input are as follows:

Input method RS-232

Type pressure altitude

Resolution 100 feet minimum

Accuracy must meet accuracy requirements of TSO-C88a

Note: Installation of altitude input equipment, such as encoders, must be done according to their installation instructions.

Note: Specifications for the RS-232 altitude input are included on pages 67 to 68.

ANNUNCIATOR REQUIREMENTS

The GX50/60 installed for IFR non-precision approach operation requires the following annunciators (upper annunciator pictured below). Each annunciator should include a lamp of the proper voltage for the installation. The lower annunciator is suitable for the GX65.

<u>Legend</u>	<u>Color</u>
MSG	amber
PTK	blue or white
OBS/HLD	blue or white- with included momentary switch
APPRCH	blue or white
ACTIVE	green

Installations that do not include non-precision approach operation may be made with the MSG and PTK annunciators only.

The annunciators should be connected to a suitable dimming circuit for night time operation.

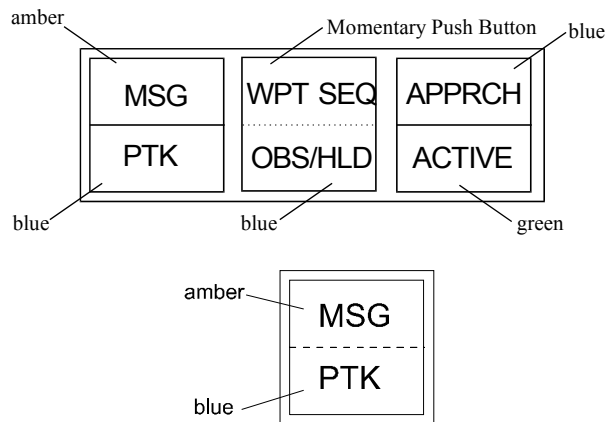


Figure 16 - Example Annunciators

COMM RECEIVER PERFORMANCE (GX60/65 ONLY)

Class	D
Frequency range	118.000 to 136.975 MHz, 760 channels
Sensitivity	1 μ V (2 μ V hard) for 6dB S+N/N with 30% modulation at 1000Hz
Selectivity	< 6dB variation at \pm 7 kHz, > 60dB at \pm 22 kHz
Speaker audio output level	12 watts into 4 Ω , 8 watts into 8 Ω
Headphone audio output level	280 mW into 100 Ω , 120mW into 500 Ω
Distortion	< 5% at rated output at 1000 Hz
AGC characteristics	< 3dB variation in audio output from 5 μ V to 100mV input, 15% to 90% modulation
Squelch control	Automatic squelch with manual override

COMM TRANSMITTER PERFORMANCE (GX60/65 ONLY)

Class	4
Output power	8 watts minimum carrier at >12VDC input, 6 watts minimum at 10VDC input (transmit is locked out below 9 volts input)
Frequency range	118.000 to 136.975 MHz, 760 channels
Frequency tolerance	\pm 15ppm from -20 $^{\circ}$ C to +70 $^{\circ}$ C
Microphone input	Two inputs, standard carbon or dynamic mic with integrated preamp providing minimum 70mV rms into 1000 Ω load
Modulation capability	85% with 100mV to 1000mV rms microphone input at 1000 Hz
Audio frequency distortion	< 10% at 85% modulation at 350 to 2500 Hz
Audio frequency response	< 4 dB variation with 350 to 2500 Hz, 85% modulation
Carrier noise level	> 35 dB down
Sidetone output	up to 280 mW into 100 Ω , 120 mW into 500 Ω
Duty cycle	100%
Stuck mic time-out	35 second time-out, reverts to receive

INTERCOM PERFORMANCE (GX60/65 ONLY)

Microphone input.....	Two inputs, standard carbon or dynamic mic with integrated preamp providing minimum 70 mV rms into 1000Ω load
Headphone audio output level	280 mW into 100Ω, 120mW into 500Ω
AGC characteristics	output varies < 3dB with input of 100mV rms to 1000 mV rms

CONTROL INPUTS

Simulator select.....	Must be connected to ground for normal operation, leave open for built-in simulator operation
Hold select	Waypoint sequencing hold input, connect to momentary button to ground for hold input operation, should be combined with the OBS/HLD annunciator (optional on GX65)
Transmit key (GX60/65).....	Input pulled low to ground to enable the transmitter
Intercom select (GX60/65)	Input pulled low to ground to enable the intercom function
Flip/Flop (GX60/65).....	Remote comm flip/flop input, connect to a momentary button to ground for remote flip/flop operation.

ANTENNA REQUIREMENTS

GPS ANTENNA

The GX50 and GX60/65 are designed to operate properly with the A-33 or A-34 GPS antennas. The GX50/60/65 supplies 5 volts for the antenna.

COMM ANTENNA

The Apollo GX60/65 requires a VHF comm antenna meeting the following specifications.

Standard 50Ω vertically polarized antenna with a VSWR < 2.5:1.

SERIAL INTERFACE

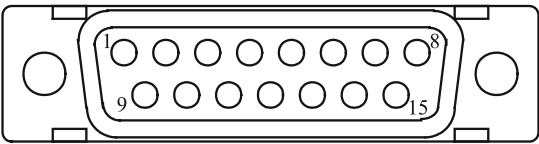
RS-232	Defined in Appendix E - Serial Interface Specifications
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REAR CONNECTOR PINOUT

The GX60/65 includes two rear panel connectors, a 15 pin for the comm interface connections and a 37 pin for the GPS navigation connections. The GX50 uses only the 37 pin connector. The pinout for the connectors is listed in the following tables.

Table 2 Comm Interface Connector Pinout

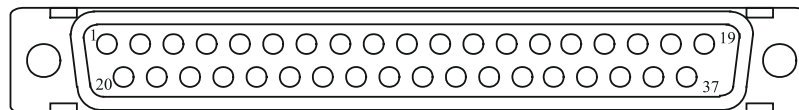
Pin #	I/O	Connection	Function
1	I	Power +	main DC power input
2	I	Reserved	do not connect
3	O	Reserved	do not connect
4	I	TxKey	transmit enable key, pulled low to transmit
5	--	NC	do not connect
6	O	Speaker	speaker terminal output
7	I	Mic ground	microphone input ground connection
8	I	Mic 1	microphone input #1
9	I	Power ground	main power ground input
10	I	Reserved	do not connect
11	O	Reserved	do not connect
12	I	Intercom select	intercom function select, pulled low to turn on the intercom function
13	O	Audio ground	speaker and headphone ground connection
14	O	Headphone	headphone terminal output
15	I	Mic 2	microphone input #2



Viewed from rear of unit

Table 3 Navigation Interface Connector Pinout

Pin #	I/O	Connection	Function
1	I	Power +	main DC power input
2	I	Power ground	main power ground input
3	O	Serial ground	RS-232 signal ground
4	I	RxD1	RS-232 channel 1 serial data input
5	O	TxD1	RS-232 channel 1 serial data output
6	I	Ext in 2	reserved
7	I	Simulator select	simulator mode, connect to ground for normal operation
8	I	Flip/Flop	Remote comm frequency flip/flop input - GX60/65 only
9	O	VDI Superflag	VDI high level superflag output
10	O	Nav + valid	Nav low level valid flag output
11	O	+ FROM	+ From flag output
12	O	+ TO	+ To flag output
13	O	CDI + Right	CDI + Right output
14	O	CDI + Left	CDI + Left output
15	O	ACTIVE	Approach Active annunciator output (<i>GX50/60 only</i>)
16	O	MSG	Message annunciator output
17	O	PTK	Parallel track annunciator output
18	--	reserved	do not connect
19	--	reserved	do not connect
20	O	Serial ground	RS-232 signal ground
21	I	RxD2	RS-232 channel 2 serial data input
22	O	TxD2	RS-232 channel 2 serial data output
23	--	reserved	do not connect
24	O	reserved	do not connect
25	O	Ground	signal ground connection
26	I	Hold select	Hold input (<i>GX65 optional</i>)
27	O	Nav superflag	Nav high level superflag output
28	O	VDI + valid	VDI low level flag output
29	O	Ground	valid flag ground connection
30	O	VDI + Up	VDI + Up output
31	O	VDI + Down	VDI + Down output
32	O	Ground	signal ground connection
33	O	APPRCH	Approach annunciator output (<i>GX50/60 only</i>)
34	O	Hold	Hold annunciator output (<i>GX65 optional</i>)
35	O	reserved	do not connect
36	O	Power control	Power control output
37	O	Ground	reserved



Viewed from rear of unit

SECTION 4 - LIMITATIONS

INSTALLATION

For minimum equipment and connections required for VFR or IFR installations, refer to the System Configurations on page 4.

Installations of the GX50/60/65 GPS navigation functions are to be made in accordance with AC 20-138, or other appropriate FAA approved guidelines.

Installations of the GX60/65 comm functions are to be made in accordance with AC 20-67B or other appropriate FAA approved guidelines.

When the GX50/60/65 is installed for VFR, a placard stating “GPS Limited to VFR Use Only” or an FAA approved equivalent statement must be placed next to the primary indicator.

When Nav tuning is provided to the GX, the GX will output Distance, Speed, and Time (DST) information on the MapCom output. It is the installer’s responsibility to ensure that this information is displayed in an acceptable fashion. For instance, in an installation where two Apollo SL30’s are integrated in the system, it is not appropriate to display DST information on the SL30 that is not providing the tuning information. Apollo SL30 SW version 1.2, or later, provides the means for disabling the display of DST information.

The GX60 and GX65 are qualified for helicopter installation only when the correct mounting hardware and GX configurations are used. Mount Tube p/n 310-5184-01 and Connector Mounting Plate p/n 310-5188-01 (or later FAA-approved revisions) are required for helicopter installations and recommended for all installations. GX60 p/n 430-6050-605 (or later FAA-approved revision) or GX60 units upgraded with Mod AD should be used in helicopter installations. GX65 p/n 430-6050-805 (or later FAA-approved revision) or GX65 units upgraded with Mod AB should be used in helicopter installations.

OPERATIONAL

An approved Aircraft Flight Manual Supplement is required for IFR installations.

Note: A sample AFM supplement is available from II Morrow (UPS Aviation Technologies) listing operational limitations.

An aircraft radio station license is required with the GX60/65 for transmitting.

For approach use with software version 3.3 or greater, a data card with a cycle date of 7/12/01, or later, must be used.

Limitations

NOTES

APPENDIX A - TROUBLESHOOTING

This appendix provides information to assist troubleshooting if problems occur after completing the installation. Use Table 4 to assist in troubleshooting.

Table 4 Troubleshooting Guide		
Problem	Cause	Solution
The GX50/60/65 does not power on.	The unit is not getting power.	Check power connections, breakers, and main avionics switch.
The GX50/60/65 does not compute a position.	Not receiving signals, or incorrect seed position, time, and date.	Make sure a correct position and time/date have been entered. Check the GPS antenna connections. Make sure the aircraft is clear of hangers, buildings, trees, etc.
The GPS signal levels are very low.	Improper antenna installation or coax routing.	Check GPS antenna installation, connections, and cable routing. The GPS antenna must be mounted on the top of the aircraft.
	Antenna shaded from satellites.	Make sure the aircraft is clear of hangers, buildings, trees, etc.
	RF interference at 1575.42 MHz from VHF comm.	Move GPS antenna further from the comm antenna. Add a 1575.42 MHz notch filter in comm coax. Fix or replace the comm. Disconnect the ELT antenna coax to check..
GPS signal levels drop when avionics are turned on.	Noise interference from other avionics.	Turn all avionics off, then turn on each piece one at a time to isolate the source of the interference. Route cable and antenna away from sources of interference.
The GX60/65 does not transmit.	The TxKey input is not being pulled low.	Check the TxKey (mic key) input, pulled low for transmit.
	A weather channel is selected.	Select a different frequency, the unit will not transmit on a weather channel.
	No power to the comm.	Make sure power input is connected to the comm 15-pin connector.
	The input voltage is too low.	Increase input supply voltage to > 9 volts DC.
The sidetone level is too low or too high.	Wrong type of headsets, or level needs adjustment.	See the Sidetone Level Adjustment on page 28.
The intercom doesn't function.	Control input not connected.	The intercom select input must be pulled to ground to turn on the intercom function.
	Active frequency signal present.	Change the active frequency. The active frequency has priority.
	No voice activation, or have to talk too loud.	Change the intercom squelch threshold using the setup function described in the user's manual.

Table 4 Troubleshooting Guide		
Problem	Cause	Solution
Display flashes from power interrupts	Caused by momentary power interruptions in the electrical system, typically due to changing power sources.	This is normal operation of the GX50/60/65, operation recovers in approximately 1 second. If it becomes a problem, check the electrical system.

CONTACTING THE FACTORY FOR ASSISTANCE

If the Apollo GX50/60/65 unit fails to operate despite troubleshooting efforts, contact the II Morrow factory for assistance.

II Morrow Inc.
2345 Turner Rd. SE
Salem, Oregon 97302
USA

Phone (503)581-8101 or 1-800-525-6726

Be prepared with the following information about the installation:

- Installation configuration (accessories, antenna, ...)
- Model number, part number with mod levels, and serial number
- Software versions
- Description of problem
- Efforts made to isolate the problem
- other installed avionics

APPENDIX B - PERIODIC MAINTENANCE

The GX50/60/65 unit is designed to not require any regular general maintenance except as included in this section.

LITHIUM BATTERY REPLACEMENT

The internal keep alive battery will require replacement after 4 to 6 years. Regular planned replacement is not necessary. The GX50/60/65 will display a “low battery” message when replacement is required. Once the low battery message is displayed, the battery should be replaced within 1 to 2 months. If the battery is not replaced, the internal ram memory and the system clock information will be lost.

To replace the battery, remove the GX50/60/65 from the aircraft, remove the top cover, and replace the battery. Make sure to insert the battery in the correct polarity. Replace the top cover, re-install the unit in the aircraft, and verify unit operation.

Battery replacement should be done only by the II Morrow factory or by a trained technician.

Note: The battery is to be replaced only with II Morrow part #148-1702, or a II Morrow approved equivalent.

Caution

The battery may explode if mistreated. Risk of fire, explosion, and burns. Do not recharge, disassemble, heat above 100 °C, or incinerate.

Dispose of batteries promptly. Keep away from children.

Be sure the battery is inserted in the right direction.

EQUIPMENT CALIBRATION

The GX50/60/65 design requires very few adjustments or calibration to be made. In fact, there are **no** internal manual adjustments.

REFERENCE OSCILLATOR (GX60/65)

The comm reference oscillator frequency should be checked approximately every 3 to 5 years to ensure the unit’s transmit frequency is within allowable tolerance.

The oscillator frequency can be checked by connecting the transmitter output through an appropriate load to a calibrated frequency counter. The transmit frequency should be within 15ppm of the selected channel frequency. Contact the II Morrow factory for instructions on adjusting the frequency if required.

CLEANING THE FRONT PANEL

The front bezel, keypad, and display can be cleaned with a soft cotton cloth dampened with clean water. DO NOT use any chemical cleaning agents. Care should be taken to avoid scratching the surface of the display.

NOTES

APPENDIX C - ENVIRONMENTAL QUALIFICATIONS

The Apollo GX50 and GX60/65 have been tested to the following environmental categories per procedures defined in RTCA/DO-160C or DO-160D.

Environmental Qualification Form			
Model:	GX50	GX60	GX65
Part No:	430-6050-4xx	430-6050-6xx	430-6050-8xx
TSO No:	TSO-C129a Class A1	TSO-C129a Class A1, TSO-C37d, TSO-C38d, TSO-C128	TSO-C129a Class A2, TSO- C37d, TSO-C38d, TSO- C128
Manufacturer: II Morrow Inc. 2345 Turner Road SE Salem, Oregon 97302			
Conditions	DO-160C Section	Description of Conducted Tests	
Temperature and Altitude	4.0	Equipment tested to Category F1 with	
In-flight Loss of Cooling	4.5.4	No cooling required	
Altitude	4.6.1	Equipment tested to 55,000 feet	
Decompression	4.6.2	Equipment tested 8K to 55K in < 15 seconds	
Overpressure	4.6.3	Equipment tested for overpressure	
Temperature Variation	5.0	Equipment tested to Category C, 2°C/min	
Humidity	6.0	Equipment tested to Category A, standard humidity environment	
Operational Shocks and Crash Safety	7	Equipment tested for both operational and crash safety shocks. (Equipment operated normally after the crash safety shocks.)	
Vibration	8.0	Equipment tested without shock mounts to Categories B, M, & N	
Explosion Proofness	9.0	Equipment identified as Category X, no test required	
Waterproofness	10.0	Equipment identified as Category X, no test required	
Fluids Susceptibility	11.0	Equipment identified as Category X, no test required	
Sand and Dust	12.0	Equipment identified as Category X, no test required	
Fungus Resistance	13.0	Equipment identified as Category X, no test required	
Salt Spray	14.0	Equipment identified as Category X, no test required	
Magnetic Effect	15.0	Equipment is Class Z	
Power Input	16.0	Equipment tested to Categories A & B	
Voltage Spike	17.0	Equipment tested to Category A	
Audio Frequency Conducted Susceptibility - Power Inputs	18.0	Equipment tested to Categories A & B	
Induced Signal Susceptibility	19.0	Equipment tested to Category Z	
Radio Frequency Susceptibility (Radiated and Conducted)	20	Equipment tested to Category U	
Emission of Radio Frequency Energy	21	Equipment tested to Category Z	
Lightning Induced Transient Susceptibility	22.0	Equipment tested to - Category A3 for the GPS navigation connections (37 pin) Category A1 for the GPS antenna connector Categories A3 and B2 for the comm connections	
Lightning Direct Effects	23.0	Equipment identified as Category X, no test required	
Icing	24.0	Equipment identified as Category X, no test required	
Remarks: Also tested to meet IEC 801-2 / 1984 & 1991 ESD requirements and EN55022 Class B emissions requirements.			

The Apollo GX60 and GX65 have been tested to the following environmental categories per procedures defined in RTCA/DO-160D to support helicopter installations.

Environmental Qualification Form			
Model:	GX60	GX65	Manufacturer: II Morrow Inc. 2345 Turner Road SE Salem, Oregon 97302
Part No:	430-6050-605, or later	430-6050-805, or later	
TSO No:	TSO-C129a Class A1, TSO-C37d, TSO-C38d, TSO-C128	TSO-C129a Class A2, TSO-C37d, TSO- C38d, TSO-C128	
Conditions	DO-160D Section	Description of Conducted Tests	
Temperature and Altitude	4.0	Equipment tested to Category F1 with	
In-flight Loss of Cooling	4.5.4	No cooling required	
Altitude	4.6.1	Equipment tested to 55,000 feet	
Decompression	4.6.2	Equipment tested 8K to 55K in < 15 seconds	
Overpressure	4.6.3	Equipment tested for overpressure	
Temperature Variation	5.0	Equipment tested to Category C, 2°C/min	
Humidity	6.0	Equipment tested to Category A, standard humidity environment	
Shock	7.2	Equipment tested for both operational and crash safety shocks.	
Operational	7.2.1	Equipment operated normally after 20g shocks	
Crash Safety - Impulse	7.3.1	Equipment tested at 20g levels	
- Sustained	7.3.2	Certification based on DO-160C tests. See previous page.	
Vibration	8.0	Equipment tested without shock mounts to Category U Robust Vibration - Helicopter (Curves F and F1) and Category S Standard Vibration (Curves B and M)	
Explosion Proofness	9.0	Equipment identified as Category X, no test required	
Waterproofness	10.0		
Fluids Susceptibility	11.0		
Sand and Dust	12.0		
Fungus Resistance	13.0		
Salt Spray	14.0		
Magnetic Effect	15.0		
Power Input	16.0		
Voltage Spike	17.0		
Audio Frequency Conducted Susceptibility - Power Inputs	18.0		
Induced Signal Susceptibility	19.0		
Radio Frequency Susceptibility (Radiated and Conducted)	20		
Emission of Radio Frequency Energy	21		
Lightning Induced Transient Susceptibility	22.0		
Lightning Direct Effects	23.0	Equipment identified as Category X, no test required	
Icing	24.0	Equipment identified as Category X, no test required	
Remarks:			

APPENDIX D - ACCESSORIES

This appendix includes information on accessory items available for the Apollo GX50/60/65. Refer to the information that is provided with those items for complete specifications and installation instructions.

FROM II MORROW

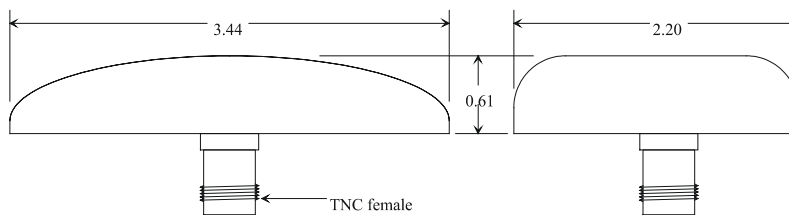
A-33 Antenna

II Morrow Part #:..... 590-1104

Manufacturer: Aero Antenna

Manufacturer #: AT-575-9

The A-33 GPS antenna is a standard accessory item with the GX50/60/65. The A-33 includes a built-in preamp with 26 dB gain and has a low profile, low drag radome mounted on a die cast aluminum base. It has a maximum altitude of 55,000 feet and weighs only 3.9 oz. See the installation manual for the A-33 for complete specifications and installation instructions.



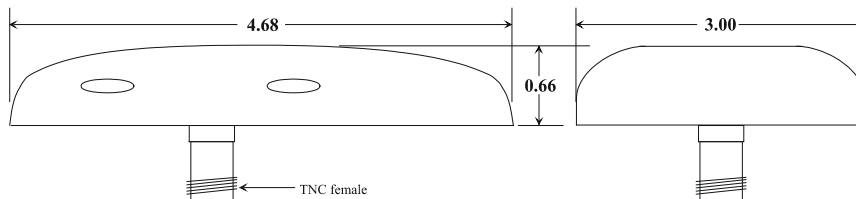
A-34 Antenna

II Morrow Part #:..... 590-1112

Manufacturer: Aero Antenna

Manufacturer #: AT-575-93

The A-34 GPS antenna is an optional accessory item with the GX50/60/65. The A-34 includes a built-in preamp and has a low profile, low drag radome mounted on a die cast aluminum base. It has a maximum altitude of 55,000 feet and weighs only 7.0 oz. See the installation manual for the A-34 for complete specifications and installation instructions. The A-34 mounts in the same footprint as the II Morrow A-16 and A-23 Loran antennas to simplify upgrading.



Power Cable Assy.

II Morrow Part #:..... 500-4026-00

Manufacturer: II Morrow Inc.

The power cable is intended for operation of the GX50/60/65 unit out of the aircraft. It includes a power cable for connection to a 10 to 40 volt DC power supply.

Note: Operation of the GX50/60/65 with a PC is not currently authorized under FCC Part 15 regulations.

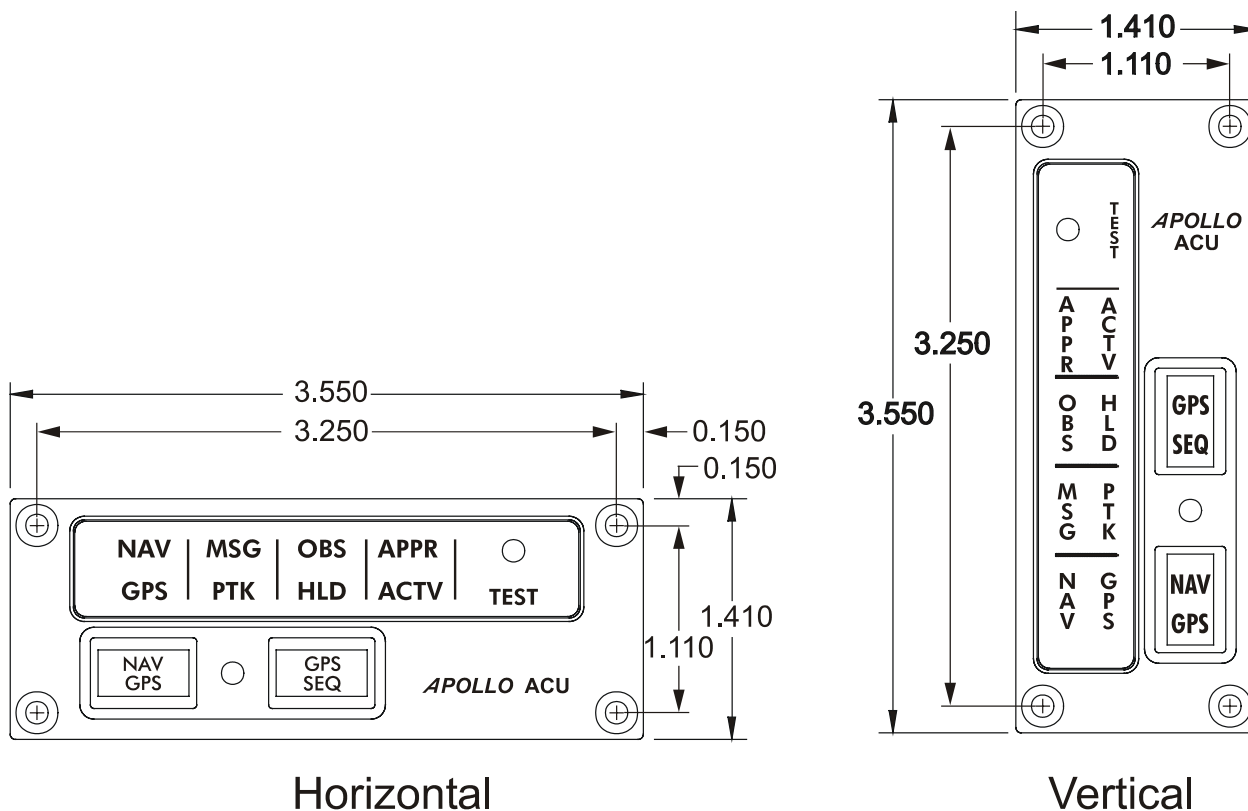
Note: Operation of the GX60/65 comm transmitter in a residential or industrial environment is not permitted without an appropriate FCC license.

Annunciators

These Apollo ACU annunciators provide the required annunciation for the GX50/60 for IFR en route, terminal, and non-precision approach operation. See the instructions provided with the annunciator module for complete specifications and installation instructions.

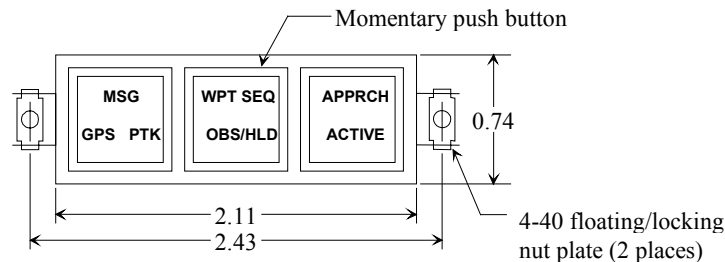
Apollo ACU GPS/NAV Annunciation Control Unit

- II Morrow Part #:430-6080-000 14 VDC Horizontal
- 430-6080-100 14 VDC Vertical
- 430-6080-200 28 VDC Horizontal
- 430-6080-300 28 VDC Vertical

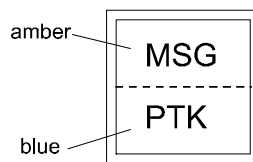


These following West Coast Specialties annunciator provides the required annunciation for the GX50/60 for IFR en route, terminal, and non-precision approach operation. The module is standard with 28 volt bulbs and includes a wiring pigtail. See the instructions provided with the annunciator module for complete specifications and installation instructions.

II Morrow Part #:..... 145-2105
 Manufacturer: West Coast Specialties
 Manufacturer #: 90-81421-1



The following annunciator provides the required annunciation for the GX65 for IFR en route and terminal operation. See the instructions provided with the annunciator module for complete specifications and installation instructions. The annunciator should be connected to a suitable dimming circuit for night operation.



Audio Panel

The Apollo SL10 audio panel includes audio selection and a six place intercom, and, depending on configuration, may also include a marker beacon receiver and stereo inputs. The SL10 and SL15 audio panel configurations available are:

- SL10 basic audio panel
- SL10S includes stereo inputs
- SL10M includes marker beacon receiver
- SL10MS includes marker beacon receiver and stereo inputs
- SL15 basic audio panel
- SL15 with DRAWS
- SL15M with marker beacon
- SL15M with DRAWS/marker beacon

COMMERCIALLY AVAILABLE

The following accessories and equipment are available from sources other than II Morrow. Other suitable equipment may also be available that is not listed here. Although the GX50/60/65 is designed to work with these items, it is the responsibility of the installer to ensure the equipment is suitable for the installation (including that the environmental and airworthiness requirements are met), to make proper connections to the equipment, and to ensure proper operation is obtained.

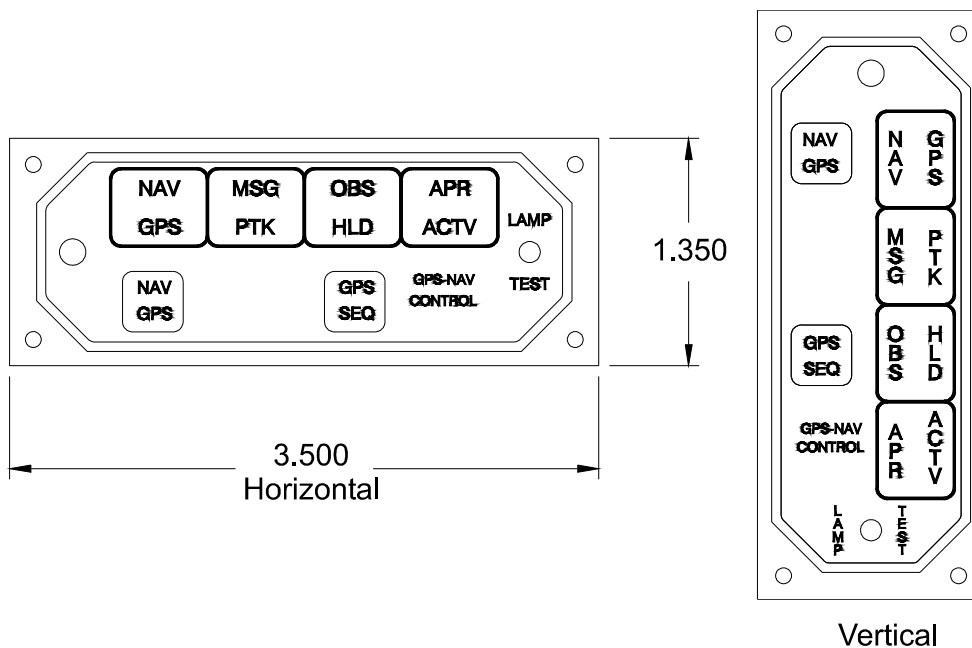
Annunciator / Relay Units

To simplify installation, several annunciator control units are available that combine the required annunciators, switches, and navigation source selection relays.

The MD41-() Series GPS annunciator control unit from Mid-Continent Instruments includes all required annunciation for the GX50/60 for non-precision approach and source selection relays. The unit is available in both horizontal and vertical configurations and for either 28 or 14 volt systems.

The Mid-Continent Instrument numbers are:

- MD41-728 28 VDC Horizontal mount
- MD41-738 28 VDC Vertical mount
- MD41-724 14 VDC Horizontal mount
- MD41-734 14 VDC Vertical mount



Annunciators

There are a number of sources of suitable annunciators. Several possible sources of suitable annunciators are:

- Series 814 from West Coast Specialties
- Series 582 from Eaton

Autopilots

The GX50/60/65 may use the avionics outputs and serial interface to connect to an autopilot. GPSS information for roll steering is provided to the appropriate autopilot. See Table 5, or contact Customer Service.

CDI

The GX50/60/65 may use the avionics outputs to connect to a CDI. A CDI tested with GX50/60/65 is:

- Mid-Continent Model MD200-306

Switching Relays

Typical installations require an 8-pole relay for navigation source selection without the glideslope connections, or 12-pole with glideslope connections. Several relays suitable for navigation source selection include:

- RS08 relay (8-pole) from Northern Airborne Technology (NAT)
- RS12 relay (12-pole) from Northern Airborne Technology (NAT)
- AIS 80-1 CDI switch unit (8 pole) from Avionics International Supply
- AIS-12020 remote switch unit (12 pole) from Avionics International Supply

Several switches that can be used to control the relay and for annunciation include:

- PB08 switch/annunciator from Northern Airborne Technology (NAT)
- Series 582 switch/annunciator from Eaton

Altitude Encoders & Converters

The GX50/60/65 can use altitude data from encoder or converter units that output information on an RS-232 serial interface. Check the altitude input requirements on page 36. The serial interface specifications required from the encoder or converter units are included in Appendix E.

Several altitude encoders compatible with the GX50/60/65 include:

- Model AK-350 altitude reporter (encoder) and AK232C serializer from Ameri-King Corporation
- Model AK-350-RS232 altitude reporter (encoder with serial data output) from Ameri-King Corporation
- Part #8800M altitude encoder from Shadin
- Model SSD120-RS232C-1 altitude encoder from Trans-Cal

Several altitude gray code converters compatible with the GX50/60/65 include:

- Part #9000 gray code converter from Shadin
- Model IA-RS232C-1 interface adapter from Trans-Cal
- Model 3000U altitude serializer from Icarus

Fuel / Air Data Sensor

The GX50/60/65 includes an interface to a fuel / air data computer that provides fuel flow and airdata information for the GX50/60/65 navigation displays, and also altitude input.

For fuel/air data computers compatible with the GX50/60/65 see Table 5, or contact Customer Service.

Accessory Vendors

For West Coast Specialties annunciators:

West Coast Specialties	Phone (425) 392-3118
1105 12th Ave. N.W. Suite 7 - Bldg. A	Fax (425) 391-0535
Issaquah, WA 98027	

For Eaton annunciator / switches:

Airtechnics, Inc.	Phone (316) 267-2849
230 Ida	(800) 544-4070
Wichita, Kansas 67211	Fax (316) 267-1482

Avionics International Supply, Inc.	Phone (214) 248-2233
4389 Westgrove	(800) 553-2233 (US)
Dallas, TX 75248	Fax (214) 250-2794

For relay switch units:

Mid-Continent Instruments	Phone (316) 683-5619
7706 E. Osie	(800) 821-1212
Wichita, KS 67207	Fax (316) 683-1861

Avionics International Supply, Inc.	Phone (214) 248-2233
4389 Westgrove	(800) 553-2233 (US)
Dallas, TX 75248	Fax (214) 250-2794

Northern Airborne Technology	Phone (604) 763-2232
1925 Kirshner Road Suite 14	Fax (604) 762-3374
Kelowna, B.C.	
Canada VIY 4N7	

For altitude encoders and gray code converters:

Shadin Company Incorporated	Phone (612) 924-1141
6831 Oxford Street	Fax (612) 924-1111
St. Louis Park, Minnesota 55426	

Trans-Cal Industries Inc.	Phone (818) 787-1221
16141 Cohasset Street	Fax (818) 787-8916
Van Nuys, CA 91406	

Icarus Instruments, Inc.	Phone (301) 799-9497
7585 Washington Blvd., Suite 108	Fax (301) 799-8320
Baltimore, MD 21227	

Ameri-King Corporation	Phone (714) 963-6977
18842 Brookhurst Street	Fax (714) 963-6200
Fountain Valley, CA 92708	

APPENDIX E - SERIAL INTERFACE SPECIFICATIONS

This appendix includes the RS-232 serial port interface specifications.

The RS-232 serial interface configurations supported by the GX50/60/65 are listed in Table 5. Instructions for configuring the serial port are included in the checkout procedure on page 26. Serial output connections should be limited to no more than three external units.

An example of the typical settings for the RS-232 selections for most installations would be:

CH	Rx	Tx
1:	NAV	MapCom
2:	AltEnc	GPSS

Table 5 RS-232 Serial Interface Selections		
RX	TX	Comment
NONE	NONE	No input or output
NONE	MAPCOM	Moving map data output with SL40 comm data
NAV	MAPCOM	Nav info input of frequency, identifier, and OBS resolver value from Apollo SL30. Moving map data output with SL40 comm data.
ALTENC	GPSS	Altitude encoder-converter data input, GPS Steering info output to autopilot
ALTENC	NONE	Altitude encoder-converter data input, no output
ALTENC	MOVMAP	Altitude encoder-converter data input, moving map data output
ALTENC	MAPCOM	Altitude encoder-converter data input, moving map data output with SL40 comm data
KEYPAD	NONE	Keypad data input
KEYPAD	MOVMAP	Keypad data input, moving map data output
KEYPAD	MAPCOM	Keypad data input, moving map data output with SL40 comm data
FADC	MOVMAP	Fuel / Airdata input, moving map data output.
PC	SETUP	Used for factory test
NONE	MOVMAP	Moving map data output. Tested units include the following: EI FP5, JPI, Sandel 3308, Argus 3000, 5000, 7000 and Shadin Digiflow, Miniflow, Microflow. The installer must verify other devices.

MOVING MAP OUTPUT

The format of the moving map data output is as follows. Definitions of the output data is included in Table 6 and Table 7. A sample output message is included in Figure 17.

Baud rate:9600
Data bits:8
Stop bits:1
Parity:none
Output rate:approx. 1 seconds
Message length:variable, approx. 83 to 750 characters

The serial output messages are in the following format.

<STX><id><data><it><id><data><it>...<id><data><it><ETX>

<STX>ASCII “start of text” character (1 byte, 02h)
<id>item designator (1 byte, from following table)
<data>item data (format listed in following table)
<it>item terminator (1 byte, 0Dh)
<ETX>ASCII “end of text” character (1 byte, 03h)

Table 6 Moving Map ASCII Navigation Data			
ID	Data Format	Length	Description
A	sddmmhh	9	Present latitude s = sign: N for north, S for south dd = degrees mm = minutes hh = hundredths of minutes
B	sdddmmhh	10	Present longitude s = sign: E for east, W for west ddd = degrees mm = minutes hh = hundredths of minutes
C	ddd	3	Track (magnetic): ddd = degrees
D	ddd	3	Ground speed: ddd = knots
E	dddd	5	Distance to active waypoint: ddddd = nm x 10
G	sdddd	5	Cross track error: s = sign: R for right, L for left of course dddd = distance off course, hundredths of nm
I	dddd	4	Desired track (magnetic): dddd = degrees x 10
K	ddd[dd]	3 to 5	Active waypoint identifier: ddd[dd] = ASCII waypoint identifier
L	dddd	4	Bearing to active waypoint (magnetic): dddd = degrees x 10
Q	sddd	4	Magnetic variation: s = sign: E for east, W for west ddd = degrees x 10
T	---A-----	9	Warnings: The 4th character will be an "A" when the navigation data is flagged, otherwise, all characters will be dashed. All other navigation data will be dashed when it is flagged.

Table 7 Moving Map Binary Route Data		
Byte	Data Format	Description
1	w	Item designator
2-3	dd	Current waypoint number in ASCII (01h to 20h)
4	xiannnnn	Sequence number x = undefined i = 1 if last waypoint a = 1 if active waypoint nnnnn = unsigned binary waypoint number
5-9	dddd	ASCII waypoint identifier
10 11 12	sddddddd xxmmmmmm xhhhhhhh	Waypoint latitude - packed, unsigned binary s = sign: 0 for north, 1 for south ddddddd = degrees mmmmmm = minutes hhhhhhh = hundredths of minutes x = undefined
13 14 15 16	sxxxxxxx ddddddd xxmmmmmm xhhhhhhh	Waypoint longitude s = sign: 0 for east, 1 for west ddddddd = degrees mmmmmm = minutes hhhhhhh = hundredths of minutes x = undefined
17 18	nnnnnnnn nnnnnnnn	Magnetic variation at waypoint LS byte (msbit...lsbit) MS byte (msbit...lsbit) Two's complement binary in sixteenths of degrees, easterly variation is positive.
19	<CR>	ASCII carriage return (0Dh)

BINARY NEAREST LIST DATA (WHEN EXTENDED DATA IS ENABLED ONLY)

The nearest waypoint lists are sent one waypoint per data transmission set. The lists are sent in the following order:

- LFAC
- VOR
- NDB
- INT
- User

There is a maximum of twenty waypoints per type. The waypoints are a maximum of 600 nm from the current position. The waypoints are order by distance from current position nearest to farthest. The maximum time to send all lists is 100 seconds. Each list is updated just prior to the first waypoint in the list being sent. If a list is empty a shorter record will be sent with the List Item Number set to 0xFF.

Table 8 Nearest Waypoint List Data		
Byte	Format	Description
1	Z	'Z' Item Designator
2	sddddddd	List Item Number: Packed, unsigned binary values s = 1 End of list, 0 all other ddddddd = 1 – 20 list waypoint index sddddddd = 0xFF List Type is EMPTY (BYTE 4 terminate Item)
3	t	Waypoint Type: t = {a (airport) v (VOR) n (NDB) i (INT) u (USER)}
4	Cr	'r' Item Terminator <0x0d> (ONLY IF BYTE 2 = 0xFF)
4-8	dddddd	ASCII Waypoint Identifier
9	sddddddd	Latitude of waypoint. Packed, unsigned binary values for degrees, minutes and hundredths of minutes. s = 0 North latitude, 1 South latitude x = undefined ddddddd = Latitude degrees mmmmmm = Latitude minutes hhhhhhh = Latitude hundredths of minutes
10	xxmmmmmm	
11	xhhhhhhh	
12	sxxxxxxxx	Longitude of waypoint. Packed, unsigned binary values for degrees, minutes and hundredths of minutes.

13	ddddddd	s = 0 East longitude, 1 West longitude
14	xxmmmmmm	x = undefined
15	xhhhhhhh	dddddd = Longitude degrees mmmmmm = Longitude minutes hhhhhh = Longitude hundredths of minutes
16	Cr	'\r' Item Terminator <0x0d>

ANNUNCIATOR OUTPUTS (WHEN EXTENDED DATA IS ENABLED ONLY)

Table 9 Annunciator Output Data			
Id	Item Format	Len	Description
a	eampht	8	Annunciator Flags: e = Approach Enabled { '-' (off) 'O' (on) } a = Approach Active { '-' (off) 'O' (on) 'B' (blink) } m = Message { '-' (off) 'O' (on) 'B' (blink) } p = Parallel Track { '-' (off) 'O' (on) } h = Hold { '-' (off) 'O' (on) 'B' (blink) } t = From/To { '-' (off) 'T' (To) 'F' (From) }
c	vDddd	7	CDI: v = Nav Flag { '-' Flagged 'v' Valid } D = Needle { 'C' Center 'L' Left 'R' Right } ddd = Deflection Value ASCII (000 – 120)
l (lower case L)	dddddd	6	Distance to Destination: dddddd = nm * 10
p	sdddd	7	s = ± dddd = {0000 - 5999} Pressure Altitude (-1500 to +5999 tens of feet +/- sea level). Field is dashed when invalid "-----".
v	vDddd	7	VDI: v = VDI Flag { '-' Flagged 'v' Valid } D = Needle { 'C' Center 'U' Up 'D' Down } ddd = Deflection Value ASCII (000 – 120)

FLIGHT PLAN WAYPOINT TYPES (WHEN EXTENDED DATA IS ENABLED ONLY)

The following data is only transmitted when preceded by flight plan data. There is one character per flight plan waypoint transmitted.

Table 10 Flight Plan Waypoint Type			
Id	Item Format	Len	Description
t	nnn...	1-21	n = { a (airport) v (VOR) n (NDB) i (intersection) u (user) p (parallel track) d (direct to) F (FAF) E (DME) I (IAF) H (MAHP) M (MAP) A (IFAF) P (undefined approach waypoint type) }

Example Moving Map Data Output (Extended Data Disabled)	
AN 34 1570	34°15.70' latitude
BW 118 4390	118°43.90' longitude
C306	306° track angle
D210	210 knots
E02682	268.2nm to waypoint
GR0006	0.6nm right of course
I3059	305.9° desired track
KSFO	SFO waypoint ident
L3058	305.8° bearing to waypoint
QE140	14.0° east magnetic variation
T-----	No alarms, data not flagged
<binary data>	From Table 9

Figure 17 Moving Map Data Output (Extended Data Disabled)

Example Moving Map Data Output (Extended Data Enabled)	
AN 34 1570	34°15.70' latitude
BW 118 4390	118°43.90' longitude
C306	306° track angle
D210	210 knots
E02682	268.2nm to waypoint
GR0006	0.6nm right of course
I3059	305.9° desired track
KSFO	SFO waypoint ident
L3058	305.8° bearing to waypoint
QE140	14.0° east magnetic variation
T-----	No alarms, data not flagged
<binary data>	From Table 7
a-O--F	Approach Enabled Off, Active Off, Message On, Parallel Track Off, Hold Off, and From/To is FROM
cvR001	CDI Valid, Needle Right, Deflection 001°
p+0008	Pressure Altitude, +80 ft
vC000	VDI Valid, Needle Centered, Deflection is 000°
<binary data>	From Table 7
tda	Flight Plan Waypoint Type data, direct-to, airport type

Figure 18 Moving Map Data Output (Extended Data Enabled)

NAVCOMM DATA OUTPUT

When MapCom output is selected additional NavComm data is provided along with Moving Map data. The format of the MapCom data output is as follows. This data output is compatible with the SL30 or SL40 for sending frequency data to the comm or nav unit.

Baud rate:9600
 Data bits:8
 Stop bits:1
 Parity:none
 Output rate:approx. 1 second
 Message length:variable, approx. 83 to 750 characters

The comm data is output using the following format.

```
$PMRRC<msg_id><msg_data><chksum><cr>
$PMRRV<msg_id><msg_data><chksum><cr>
```

The checksum is computed by an 8 bit addition of the msg_id and msg_data characters, ignoring carry if any. The resulting 8 bit checksum is converted to two ASCII characters by taking the upper and lower nibbles, adding 30h to each, and placing the most significant character first in the data message.

Airport Ident Output

This message is used to output the selected airport ident.

Message Format

```
$PMRRC04tiii<chksum><cr>
```

04..... message id
t..... list type, outputs a 1
iiii ident, four character ASCII

Example Message

```
$PMRRC041SLE<space>99<cr>
```

Output ident of “SLE” for the following frequency information.

Frequency Data Output

This message is used to output the airport frequency information for the previously output ident.

Message Format

```
$PMRRC05tfmk<chksum><cr>
```

05..... message id
t..... list type, input 1
f frequency type:
 0 = TWR, tower frequency 8 = CTF, common traffic advisory frequency
 1 = GND, ground frequency 9 = DEP, departure
 2 = ATS, for ATIS : (3Ah) = FSS, flight service station
 3 = ATF, air traffic frequency ; (3Bh) = RFS, for remote flight service station
 4 = APP, for approach < (3Ch) = UNI, for unicom
 5 = ARR, for arrival = (3Dh) = MF, mandatory frequency
 6 = AWS, automatic weather station > (3Eh) = CTR (Center)
 7 = CLR, clearance/delivery ? (3Fh) = undefined, for other frequency types
mk..... frequency:
 m = desired frequency in MHz in hexadecimal, where m = desired frequency -
 30h , with the desired frequency in the range of 118 to 136 MHz, or 162 MHz.
 k = desired frequency in kHz where k = (desired frequency / 25 kHz) + 30h, with
 the desired frequency in the range of 000 to 975 kHz in 25 kHz steps, or 0 to 39.

Example Message

```
$PMRRC0511IT64<cr>
```

The above example message outputs a ground frequency type, 121.900 MHz.

Remote VOR List

The following two commands work together in allowing remotely connected devices to provide a list of VOR frequencies to the SL30. The remote device will send a sequence of Remote VOR Input commands (message identifier 20). When all of the VOR Input commands have been sent, the remote device should send a Remote VOR List Trailer command (message identifier 21) to terminate the list. The transmitted list will not be considered complete by the SL30 until it receives the trailer message. The unit will maintain

a single remote VOR list, so each list received will replace any previous list. There may be up to twenty entries in the remote VOR list. Any entries past twenty will be ignored.

Remote VOR Input

This input is used to input VOR frequency data used for the remote recall function.

The data consists of five characters for the VOR station identifier followed by two characters defining the VOR frequency.

Message format:

“V” Message Class. This is a VHF NAV message.
“20” Message Identifier.
vvvv VOR station identifier. Note that if the station identifier is less than four characters, then the trailing characters will be filled with spaces. Station Identifiers are restricted to using ASCII characters 0-9 and A-Z.
mk Frequency: m = MHz, where m = desired MHz frequency – 30h, with the desired frequency ranging from 108 to 117, or 3Ch to 45h; k = kHz, where k = (desired kHz offset / 25 kHz) + 30h, with desired frequency range of 000 to 975 kHz in 50 kHz steps, or the even numbers from 30h to 56h. Note that the field will be checked to ensure that it is in range and a valid VOR frequency. Frequencies used for localizers, which are in the range of 108.10 to 111.95 MHz, will not be accepted in this message type.

Example message:

\$PMRRV20UBG<Sp>E@<chksm><CR><LF>

VOR station identifier is “UBG ”, VOR frequency is 117.400 MHz.

Remote VOR List Trailer

This input command marks the end of a VOR list sent by a remote device.

Message format:

“V” Message Class. This is a VHF NAV message.
“21” Message Identifier

Example message:

\$PMRRV21<chksm><CR><LF>

Indicates the start of a remote VOR list.

REMOTE LOCALIZER LIST

The following two commands work together in allowing remotely connected devices to provide a list of localizer frequencies associated with an airport to the SL30. The remote device should first send the Remote Localizer List Header command (message identifier 22), followed by a sequence of Remote Localizer Input commands (message identifier 23). The SL30 maintains a single remote localizer list, so each new list received will replace any

previous list. Subsequent receptions of localizer lists for the same airport are ignored. There may be up to twenty entries in the remote Localizer list. Any entries past twenty will be ignored.

Remote Localizer List Header

This input command marks the beginning of a Localizer list sent by a remote device. It specifies the five character airport identifier associated with the localizer frequencies in the list.

Message format:

“V” Message Class. This is a VHF NAV message.
 “22” Message Identifier.
 aaaa..... Airport identifier. Note that if the airport identifier is less than four characters, then the trailing characters will be filled with spaces. Airport Identifiers are restricted to using ASCII characters 0-9 and A-Z.

Example message:

```
$PMRRV22SLE<Sp><chksum><CR><LF>
```

Indicates the start of a remote localizer list associated with the airport “SLE ”.

Remote Localizer Input

This input is used to input Localizer frequency data used for the remote recall function.

The data consists of three characters to identify the runway associated with the localizer, followed by two characters defining the frequency.

Message format:

“V” Message Class. This is a VHF NAV message.
 “23” Message Identifier.
 iiii Station or Runway identifier. This field will provide an identifier for the localizer which can be either the actual station identifier or a string indicating the runway associated with the localizer. The station identifier can be up to four characters long. A runway identifier will typically be two numbers that indicate the runway direction followed by the character “R”, “C”, or “L” to differentiate between parallel runways (right, center, and left). Note that if either type of identifier is less than four characters, then the trailing characters will be filled in with spaces. Identifiers are restricted to using ASCII characters 0-9 and A-Z.
 mk..... Frequency: m = MHz, where m = MHz frequency – 30h, with the desired frequency ranging from 108 to 111 MHz, or 3Ch to 3Fh; k = (desired kHz offset / 25 kHz) + 30h, where the desired frequency ranges from 000 to 950 kHz, or the even numbers from 30h to 56h. Note that the field will be checked to ensure that it is in range and a valid localizer frequency. Frequencies used for VORs, which can also be found in the range of 108.10 to 111.95 MHz, will not be accepted in this message type.

Example message:

\$PMRRV2331<Sp><Sp><<chksm><CR><LF>

Identifier is “31 ”, indicating a runway, and the localizer frequency is 110.300 MHz.

DISTANCE/SPEED/TIME MESSAGE

If an SL30 is connected to the GX with MovMap or MapCom output the following message will be sent to the SL30.

\$PMRRV41xxxxxyyyzzz<CHECKSUM><CR><LF>

xxxx is the distance to the station in 0.1nm units

yyy is the ground speed in knots

zzz is the time to the station in minutes

This message is used to output the range, ground speed, and ETA decoded from an external RNAV sensor (DME or GPS).

Message format:

“V” Message class. This is a VHF NAV message.

“41” Message identifier.

rrrr Range from DME station in 1/10th of a nautical mile units. The first two digits are the 10s and 1s place of the range, and the last digit is the 1/10ths place. This field may range in value from 0.0 NM (“0000”) to 999.9 NM (“9999”). If the distance from the DME station is greater than 999.9NM, the value should be encoded as “----”.

sss Ground speed with respect to DME station in knots. This field may range in value from 0 knots (“000”) to 999 knots (“999”). If the ground speed with respect to the DME station is greater than 999 knots, the value should be encoded as “---”.

hmm Time to station in hours and minutes. This field may range in value from 0 hours and 0 minutes (“000”) to 9 hours and 59 minutes (“959”). If the time to the station is greater than 9 hours and 59 minutes, the value should be encoded as “---”.

Example message:

\$PMRRV410983055147<chksm><CR><LF>

Range from DME station is 98.3 NM, ground speed with respect to station is 55 knots, and the estimated time to the station is 1 hour and 47 minutes.

ALTITUDE ENCODER/CONVERTER INPUT

The format of the altitude input is as follows. Definition of the input message is included in Table 11. Several sample messages are illustrated in Figure 19.

Baud rate: 1200
 Data bits: 8
 Stop bits: 1
 Parity: none
 Expected input rate: approx. 1 second
 Message length: 17 characters

Byte	Data Format	Description
1	"#"	ASCII "#" (023h)
2	"A"	ASCII "A" (041h)
3	"L"	ASCII "L" (04Ch)
4	" "	ASCII space (020h)
5	"+" or "-"	Altitude sign: ASCII "+" or "-" (02Bh or 02Dh)
6-10	dddd	Altitude in feet, right justified with leading zeros
11	"T"	ASCII "T" (054h)
12	"+" or "-"	Temperature sign: ASCII "+" or "-" (02Bh or 02Dh)
13-14	dd	Internal altimeter temperature
15-16	dd	Checksum of bytes 1 through 14, computed in hex, output in ASCII format (i.e., "FA" hex)
17	<CR>	ASCII carriage return (0Dh)

The altitude input can decode several status or error codes. These codes would be in place of the altitude data in characters 5 - 10 as follows.

"-09980" Heater not ready: expected during encoder warm-up or if there is a loss of signal from the encoder.
 "-09981" Possible hardware problem: expected from encoder indicating a temperature greater than 55°C or if data is invalid.
 "-09982" Altitude out of range: expected from the encoder indicating that the altitude is outside specified range of the encoder.

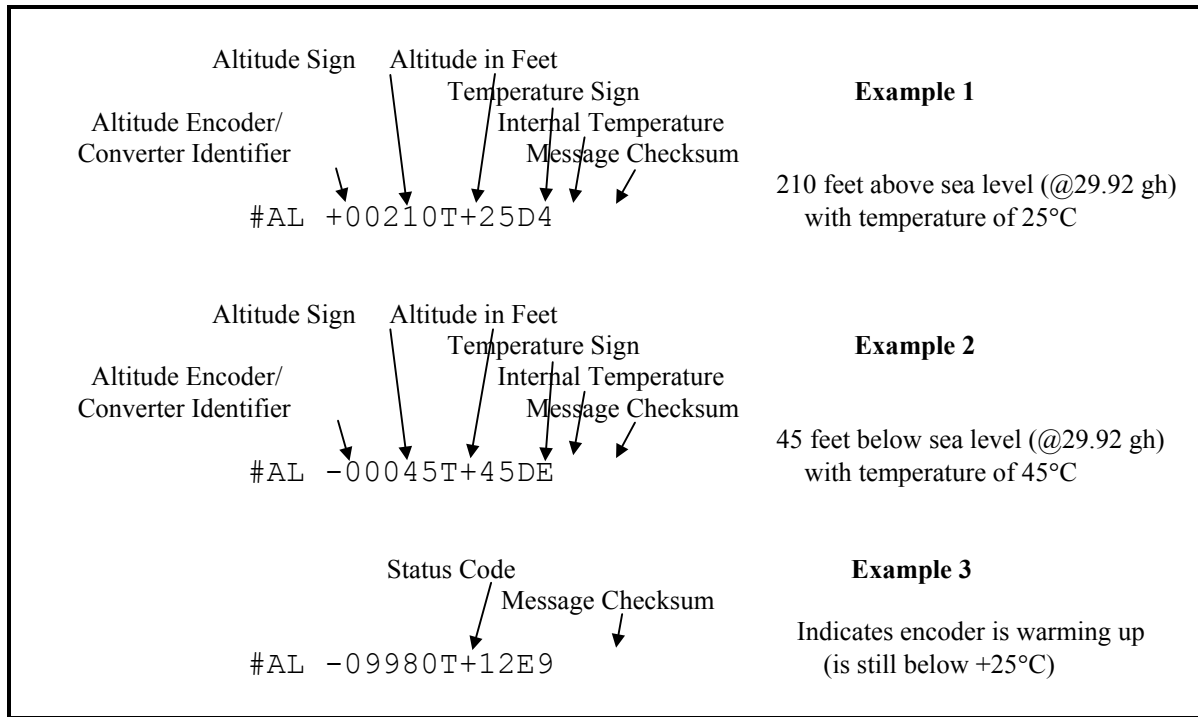


Figure 19 Altitude Data Input

FUEL/AIR DATA COMPUTER INPUT

The fuel/air data input is used to input fuel flow and airdata computer information from the fuel/air data computer. See Table 5, or contact Customer Service, for appropriate devices.

“S” DATA FORMAT

The format of the fuel/air data computer input is as follows, which conforms to the Shadin “S” format serial message. Definition of the input message data that the GX50/60/65 uses is included in Table 12. A sample input message is illustrated in Figure 20.

Baud rate:9600
 Data bits:8
 Stop bits:1
 Parity:none
 Expected input rate:approx. 1 second
 Message length:variable (512 character max.)

The serial input message string is expected in the following format.

<STX><message><message> ... <message><chksum><ETX>

<STX>ASCII “start of text” character (STX = 02h)
 <message>starts with an ASCII “S”, then an ID character, followed by the message data, a carriage return (CR = 0Dh), and a line feed (LF = 0Ah) See the following table. s = a sign indicator (-,+E,W). d = a decimal digit (0-9)

<checksum> the message checksum, same format as message
 <ETX> ASCII "end of text" character (ETX = 03h)

Table 12 Fuel/Air Data Message Data (S Format)				
Item Desig	Message Format	Message Mnemonic	Field Width	Message Description
SA	ddd	IAS	7	Indicated Air Speed in knots
SB	ddd	TAS	7	True Air Speed in knots
SC	ddd	MACH	7	Mach Speed in thousandths
SD	sdddd	PALT	9	Pressure Altitude in tens of feet, +/- sea level
SE	sdddd	DALT	9	Density Altitude in tens of feet, +/- sea level
SF	sdd	OAT	7	Outside Air Temp - or "Total", in degrees Celsius
SG	sdd	TAT	7	True Air Temp - or "Static", in degrees Celsius
SH	ddd	WDIR	7	Wind Direction, 0 to 359 degrees from true north
SI	ddd	WSPD	7	Wind Speed in knots
SJ	sdd	TURN	7	Rate of Turn in +/- degrees/second, + is right, - is left
SK	sddd	VSPD	8	Vertical speed in tens of feet/minute
SL	ddd	HEAD	7	Heading, 0 to 359 degrees from true north
SM	dddd	RFF	8	Right Engine Fuel Flow in tenths of gallons/hour
SN	dddd	RFU	9	Right Engine Fuel Used in tenths of gallons
SO	dddd	LFF	8	Left Engine Fuel Flow in tenths of gallons/hour
SP	dddd	LFU	9	Left Engine Fuel Used in tenths of gallons
SQ	ddd	ERR	7	Error Log / Reason Indicator: 001 = temp sensor error; 000 = no errors
SR	dddd	REM	10	Fuel remaining (0-9999.9 in gallons)
S*	ddd	CKSUM	7	Checksum of all characters preceding this record. The checksum is a one byte checksum (discarding carries) including all characters from the initial STX up to and including the line feed preceding the checksum message.

Example Fuel / Airdata Input Data

<STX>SA223	223 knots indicated air speed
SB230	230 knots true air speed
SC101	0.101 mach
SD+3200	32,000 feet pressure altitude
SE+3312	33,120 feet density altitude
SF+05	+5°C outside air temp
SG-03	-3°C true air temp
SH010	wind direction at 10° (relative to true north)
SI015	wind speed at 15 knots
SJ+03	+3° / second right turn
SK-050	-50 feet / second vertical air speed
SL359	359° heading (relative to true north)
SM0123	12.3 gallons / hour - right engine fuel flow
SN0300	30.0 gallons used - right engine
SO0131	13.1 gallons / hour - left engine fuel flow
SP0310	31.0 gallons used - left engine
SQ000	no errors
SR01227	122.7 gallons remaining
S*123	Checksum (example only, not actual)
<ETX>	end of message string

Figure 20 Fuel / Airdata Data Input (S Format)

“Z” DATA FORMAT

The format of the fuel/air data computer input is as follows, which conforms to the Shadin “Z” format serial message. Definition of the input message data that the GX50/60/65 uses is included in Table 13.

Baud rate:	9600
Data bits:	8
Stop bits:	1
Parity:	none
Expected input rate:	approx. 1 second
Message length:	variable (512 character max.)

The serial input message string is expected in the following format.

<STX><message><message> ... <message><checksum><ETX>

<STX>	ASCII “start of text” character (STX = 02h)
<message>	starts with an ASCII “Z”, then an ID character, followed by the message data, a carriage return (CR = 0Dh), and a line feed (LF = 0Ah) See the following table.
<checksum>	the message checksum, same format as message
<ETX>	ASCII “end of text” character (ETX = 03h)

Table 13 Fuel/Air Data Message Data (Z Format)

Item Desig	Message Format	Message Mnemonic	Field Width	Message Description
ZA	ddd	IAS	7	Indicated Air Speed in knots
ZB	ddd	TAS	7	True Air Speed in knots
ZC	ddd	MACH	7	Mach Speed in thousandths
ZD	sdddd	PALT	9	Pressure Altitude in tens of feet, +/- sea level
ZE	sdddd	DALT	9	Density Altitude in tens of feet, +/- sea level
ZF	sdd	OAT	9	Outside Air Temp - or "Total", in degrees Celsius
ZG	sdd	TAT	7	True Air Temp - or "Static", in degrees Celsius
ZH	ddd	WDIR	7	Wind Direction, 0 to 359 degrees from true north
ZI	ddd	WSPD	7	Wind Speed in knots
ZJ	sdd	TURN	7	Rate of Turn in +/- degrees/second, + is right, - is left
ZK	sddd	VSPD	8	Vertical speed in tens of feet/minute
ZL	ddd	HEAD	7	Heading, 0 to 359 degrees from true north
ZM	dddd	RFF	8	Right Engine Fuel Flow in tenths of gallons/hour
ZN	dddd	RFU	9	Right Engine Fuel Used in tenths of gallons
ZO	dddd	LFF	7	Left Engine Fuel Flow in tenths of gallons/hour
ZP	dddd	LFU	9	Left Engine Fuel Used in tenths of gallons
ZQ	ddd	ERR	7	Error Log / Reason Indicator: 001 = temp sensor error; 000 = no errors
ZR	dddd	CKSM1	7	Checksum of labels A to Q (0 to 255)
ZS	ddd	GSP	7	Ground speed (0-999 knots)
ZT	ddd	TRK	7	Track (0 to 359 degrees, magnetic)
ZU	dddddd	DIS	1	Distance to Destination (0 to 999999, nm * 100)
ZV	sddd	MVAR	8	Magnetic Variation (0 to 999 degrees, deg * 10), s = E or W where E = east, W = west
ZW	ddmmhh	LAT	13	Current Latitude, s = N or S, dd = degrees, mm = minutes
ZX	sdddmmhh	LON	14	Current Longitude, s = E or W, ddd = degrees, mm = minutes, hh = hundredths of minutes
ZY	ddd	CKSUM2	7	Checksum of labels S to X (0 to 255)

GPSS SERIAL OUTPUT

The GPSS output message provides information to the appropriate autopilot for roll steering.

Baud Rate:9600
 Data Bit:.....8 BITS
 Stop Bit:.....1 BIT
 Parity:.....None
 Output Rate:.....Approx. 1-sec ±0.5 sec
 Buffer length Normal:.....Approx. 32 bytes to ??? bytes

The Apollo GX Series will output serial data in the following format:

<STX><id><data><it><id><data><it>...<id><data><it><EXT>

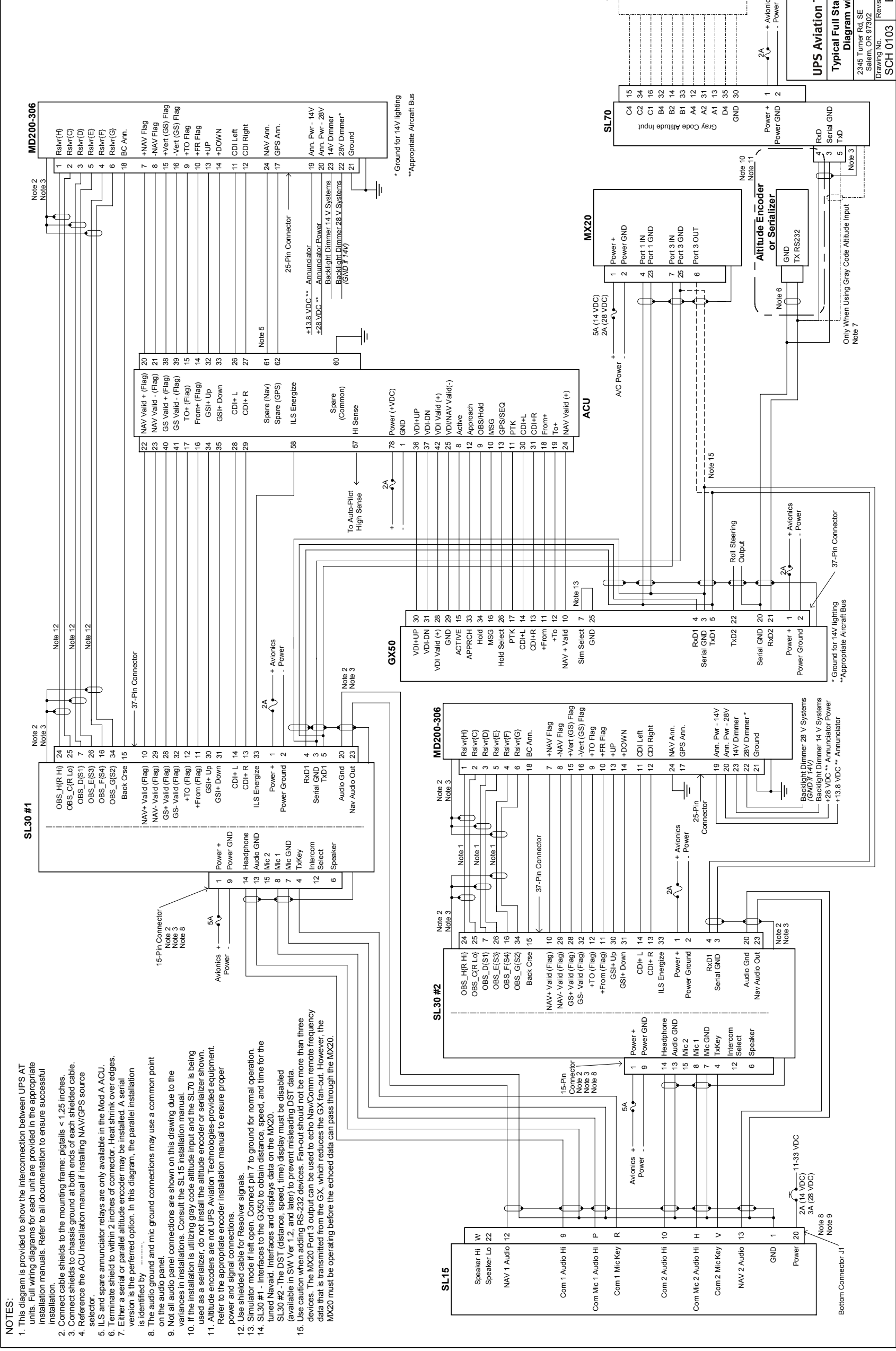
where.

<STX> is the ASCII start of character (1 byte <0x02>)
 <id> is the item designator (1 byte i.e. “B”)
 <data> is the item data (see item format in following pages)
 <it> is the item terminator (1 byte Cr <0x0d>)
 <ETX> is the ASCII end of character (1 byte <0x03>)

Table 14 - Ascii Autopilot data

Id	Item Format	Len	Item Description
C	ddd	3	Track: (magnetic); ddd=degrees
D	ddd	3	ground speed: ddd=knots
E	dddd	5	distance to active waypoint: ddddd=nm * 10
L	dddd	4	bearing to active waypoint: (magnetic); dddd = degrees * 10
h	sddd	4	Horizontal Command Signal: s=sign: L = bank left. R = bank right. X = invalid data. ddd = degrees * 10

Rev	Rev Date	Reference
-		Initial distribution
A	4/16/01	Serial port change to support new SL30 Interface and GPS roll steering output.
B	5/8/01	Wiring and note changes for GX-SL30 interface pursuant to SL30 SW Ver 1.2



- NOTES:**
- This diagram is provided to show the interconnection between UPS AT units. Full wiring diagrams for each unit are provided in the appropriate installation manuals. Refer to all documentation to ensure successful installation.
 - Connect cable shields to the mounting frame; pigtailed < 1.25 inches.
 - Connect shields to chassis ground at both ends of each shielded cable.
 - Reference the ACU installation manual if installing NAV/GPS source selector.
 - ILS and spare annunciator relays are only available in the Mod A ACU.
 - Terminate shield to within 2 inches of connector. Heat shrink over edges.
 - Either a serial or parallel altitude encoder may be installed. A serial version is the preferred option. In this diagram, the parallel installation is identified by -----.
 - The audio ground and mic ground connections may use a common point on the audio panel.
 - Not all audio panel connections are shown on this drawing due to the variances in installations. Consult the SL15 installation manual.
 - If the installation is utilizing gray code altitude input and the SL70 is being used as a serializer, do not install the altitude encoder or serializer shown.
 - Altitude encoders are not UPS Aviation Technologies-provided equipment. Refer to the appropriate encoder installation manual to ensure proper power and signal connections.
 - Use shielded cable for Resolver signals.
 - Simulator mode if left open. Connect pin 7 to ground for normal operation.
 - SL30 #1 - Interfaces to the GX50 to obtain distance, speed, and time for the tuned Navaid, interfaces and displays data on the MX20.
 - SL30 #2 - The DST (distance, speed, time) display must be disabled (available in SW Ver 1.2, and later) to prevent misleading DST data.
 - Use caution when adding RS-232 devices. Fan-out should not be more than three devices. The MX20 Port 3 output can be used to echo Nav/Comm remote frequency data that is transmitted from the GX, which reduces the GX fan-out. However, the MX20 must be operating before the echoed data can pass through the MX20.

UPS Aviation Technologies
Typical Full Stack Interconnection Diagram with Two SL30s
 2345 Turner Rd. SE Phone: 803-581-8101
 Salem, OR 97302 www.upsat.com
 Drawing No. SCH 0103 Revision B
 Date 5/8/01

Figure 21 - Full Stack Interconnect Drawing
 Apollo GX50/60/65 Installation Manual

II MORROW

V I S I O N A R Y T H I N K I N G T O D A Y

