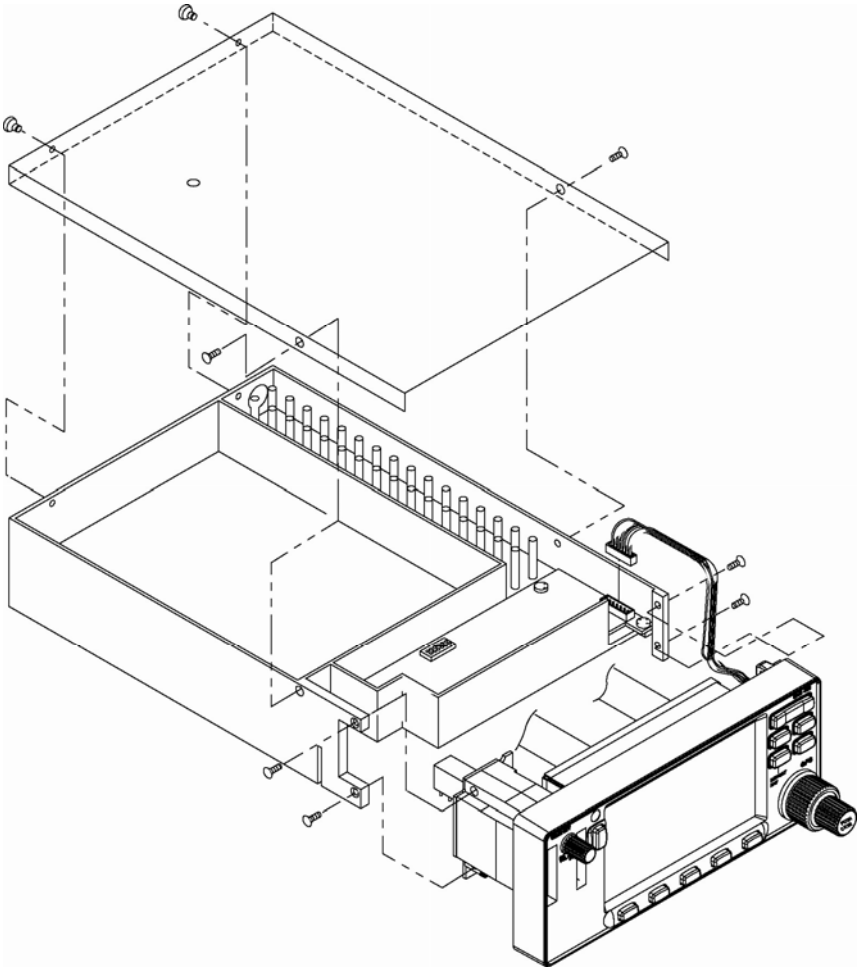
GARMIN

GNS 400W SERIES MAINTENANCE MANUAL

GPS 400W, GNC 420W/AW, and GNS 430W/AW



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WARNING

Observe all safety regulations at all times. Do not replace components inside the unit when potentially lethal voltages are present. Turn off system power before making or breaking electrical connections. Regard any exposed connector, terminal board, or circuit board as a possible shock hazard. Components which retain a charge shall be discharged only when such grounding does not result in equipment damage. If a test connection to energized equipment is required, make the test equipment ground connection before probing the voltage or signal to be tested. Do not reach into or enter any enclosure for the purpose of servicing or adjusting the equipment without immediate presence or assistance of another person capable of rendering aid.

WARNING

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

NOTE

This document may contain information which is subject to the Export Administration Regulations ("EAR") issued by the United States Department of Commerce (15 CFR, Chapter VII, Subchapter C) and which may not be exported, released, or disclosed to foreign nationals inside or outside of the United States without first obtaining an export license.

NOTE

The lens is coated with a special anti-reflective coating that is very sensitive to skin oils, waxes and abrasive cleaners. Cleaners containing ammonia will harm the anti-reflective coating. It is very important to clean the lens using a clean, lint-free cloth and an eyeglass lens cleaner that is specified as safe for anti-reflective coatings.

NOTE

This product contains a lithium battery that must be recycled or disposed of properly. Battery replacement and removal must be performed by professional services.

RECORD OF REVISIONS

Revision	Date	Section	Page	Description
A	10/2/08	------	------	Initial Release

DOCUMENT PAGINATION

Section	Pages
Table of Contents	i-vi
Section 1	1-1 to 1-2
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SERVICE BULLETIN HISTORY

The following table identifies hardware service bulletins for the GNS 400W series of units. The table below is subject to change without notice. Authorized Garmin Sales and Service Centers are encouraged to access the most up-to-date bulletin and advisory information on the Garmin Dealer Resource web site at www.garmin.com using their Garmin-provided user name and password. Mod Level changes are listed with the associated service bulletin number, service bulletin date, and the purpose of the bulletin in the table below.

Bulletin #	Date of Publication	Name/Summary/MOD Level
740	11/29/07	400W Series Unit's software upgrade to Main Software version 3.00 & GPS. There was no mod level change associated with this upgrade.
628	1/17/08	NAV Software Version 5.02 for the GNS 430W Series Units. There was no mod level change associated with this upgrade.

This manual provides board-level maintenance information for the GNS 400W units listed in the table below.

UNIT	PART NUMBER	COLOR	NOTES
GPS 400W	011-01057-00	BLACK	
	011-01057-10	GRAY	
	011-01057-40	BLACK	NOTE 1
	011-01057-50	GRAY	NOTE 1
GNC 420W	011-01058-00	BLACK	
	011-01058-10	GRAY	
	011-01058-40	BLACK	NOTE 1
	011-01058-45	BLACK	28 VDC UPGRADE UNIT
	011-01058-50	GRAY	NOTE 1
GNC 420AW	011-01059-00	BLACK	
	011-01059-10	GRAY	
	011-01059-40	BLACK	NOTE 1
	011-01059-50	GRAY	NOTE 1
GNS 430W	011-01060-00	BLACK	
	011-01060-10	GRAY	
	011-01060-40	BLACK	NOTE 1
	011-01060-45	BLACK	28 VDC UPGRADE UNIT
	011-01060-50	GRAY	NOTE 1
GNS 430AW	011-01061-00	BLACK	
	011-01061-10	GRAY	
	011-01061-40	BLACK	NOTE 1
	011-01061-50	GRAY	NOTE 1

Designations: A— 28 VDC Unit with 16 watt comm transmitter.

Note 1—The unit is an upgrade of the non-WAAS unit.

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SECTION 5—REPLACEMENT PROCEDURES

SECTION 6—SERVICE PARTS LIST

APPENDIX A—SYSTEM INTERCONNECTS

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SECTION 1
INTRODUCTION

This manual contains maintenance information for the GNS 400 “W” (WAAS) series of units. All units in the GNS 400W series affected by this manual are listed in the table on page iii.

1.1 MAINTENANCE/SUPPORT PHILOSOPHY

Avionics shop repair is limited to replacing the parts listed in Section 6. All repairs can be made at the bench with an appropriate replacement spare part. Faulty parts listed in Section 6 (or a complete unit) can be returned to Garmin for repair. For information pertaining to spares stocking (suggested quantities, etc.) contact Garmin at one of the addresses listed on the inside cover.

This manual is written for field shops not equipped with Garmin Automated Test Equipment (ATE) and not having access to Garmin proprietary repair documentation. Component level repair is not authorized. Send the unit to Garmin for repair when any troubleshooting, testing, or repair falls outside the scope of this manual (paragraph 1.3).

1.2 UNIT UPGRADES

This manual does not contain procedures for upgrading “legacy” GNS 400 series units to WAAS units. Contact Garmin aviation product support for upgrade information and instructions. If field shops should encounter a WAAS upgraded unit, refer to the table on page iv which lists all upgrade part numbers.

1.3 FACTORY REPAIR

A "Return Merchandise Authorization" (RMA) number must be requested from Garmin before a unit is returned. Units returned without an RMA will be refused and returned at the sender's expense. Send units with assigned RMA numbers to the following address:

Garmin International, Inc.
Factory Repair
1200 E. 151st St.
RMA Number: _____
Dock Door #1
Olathe, KS 66062

1.4 WARRANTY INFORMATION

This Garmin product is warranted to be free from defects in materials or workmanship for two years from the date of purchase. For WAAS upgrade of this product, the warranty is separate and described in the service record or statement.

Products bought through online auctions are not eligible for rebates or other special offers from Garmin. Online auction confirmations are not acceptable for warranty verification. To obtain warranty service, an original or copy of the sales receipt from the original retailer is required. Garmin will not replace missing components from any package purchased through an online auction.

Within a warranty period, Garmin will, at its sole option, repair or replace any components that fail in normal use. Such repairs or replacement will be made at no charge to the customer for parts or labor, provided that the customer is responsible for any transportation cost. This warranty does not cover failures due to abuse, misuse, accident or unauthorized alteration or repairs. SUCH REMEDY SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY BREACH OF WARRANTY

THE WARRANTIES AND REMEDIES CONTAINED HEREIN ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED OR STATUTORY, INCLUDING ANY LIABILITY ARISING UNDER ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, STATUTORY OR OTHERWISE. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, WHICH MAY VARY FROM STATE TO STATE.

IN NO EVENT SHALL GARMIN BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM THE USE, MISUSE, OR INABILITY TO USE THIS PRODUCT OR FROM DEFECTS IN THE PRODUCT. Some states do not allow the exclusion of incidental or consequential damages, so the above limitations may not apply to you.

SECTION 2
UNIT DESCRIPTION

This section gives a brief decsription of each unit in the GNS 400W series.

2.1 INTRODUCTION

All units in the 400W series are 6.25 inches wide and 2.66 inches high. The display on all units is a 240 by 128 pixel color LCD. All units include two removable data cards, one with a Jeppesen database (which is inserted in the left card slot), and the second a terrain database (which is inserted in the right card slot). The GPS 400W is a GPS/WAAS unit that meets the requirements of Technical Standard Order (TSO)-C146a and is approved for IFR en route, terminal, non-precision, and precision approach operations.

The GNC 420W/(AW) includes all the features of the GPS 400W but includes a VHF communications transceiver. The “AW” designates a 28 V dc unit with a 16 watt COM transmitter. The GNS 430W/(AW) includes all the features of the GNC 420W/(AW), but includes airborne VOR/localizer (LOC) and glideslope (G/S) receivers. The “AW” model designates a 28 V dc unit with a 16 watt com transmitter.

Table 2-1 summarizes the board configuration for each unit.

Table 2-1. Unit Configuration

	Main Board	Inverter Board	Interface Board	WAAS GPS Module	COM Board	NAV Board	GS Board
GPS 400W	•	•	•	•			
GNC 420W	•	•	•	•	•		
GNC 420AW	•	•	•	•	•		
GNS 430W	•	•	•	•	•	•	•
GNS 430AW	•	•	•	•	•	•	•

2.2 FRONT PANEL LAYOUT

Figures 2-1 through 2-3 show the front bezel layout for each unit.

Figure 2-1. GPS 400W

Figure 2-2. GNC 420W

Figure 2-3. GNS 430W

2.3 UNIT FUNCTIONS

2.3.1 GPS 400W

The GPS 400W performs the following functions:

- Position and velocity determination using signals transmitted by Global Positioning System (GPS) Satellites.
- Display of the stored navigation and map database for use by the pilot/flight crew.
- Area navigation functions using the determined position/velocity and stored navigation data.
- Approach navigation functions including WAAS precision approaches and the associated database.
- Interfacing with other flight instruments such as a moving map, autopilot, CDI/HIS (including OBS), indicators, altitude encoder/serializer, fuel management system, and annunciators.
- Operation from 11 to 33 volts.
- Terrain situational awareness (TERRAIN) functions and associated databases.

2.3.2 GNC 420W

The GNC 420W performs the following functions:

- All functions of the GPS 400W.
- Communications transceiver tuning from 118.00 to 136.975 MHz in 25 kHZ or 8.33 kHZ increments.
- 10-watt (420W) or 16-watt (420AW) transmitter designed to meet the German FTZ requirements (an external filter may be required to achieve the harmonic requirement).

2.3.3 GNS 430W

The GNS 430W performs the following functions:

- All functions of a GNC 420W.
- The VOR/ILS localizer receiver tuning from 108.00 to 117.95 MHz in 50 kHZ increments.
- The ILS glideslope receiver tuning from 328.6 to 335.4 MHz as paired with the frequency tuned on the VOR / ILS localizer receiver.
- VOR audio Morse code identifier output.
- Remote DME channeling.
- Interface with other flight instruments such as autopilot, CDI/HSI (including OBS) and OBI.

2.4 TECHNICAL SPECIFICATIONS

Table 2-2. General Specifications

Operating Temperature Range	-20° C to +55° C. For more details see Environmental Qualification Form on the Dealers Only page on www.garmin.com.
Humidity	95% non-condensing
Altitude Range	-1,500 ft. to 50,000 ft.
Input Power Requirements	
Input Voltage Range - All Units (Main Connector)	10 to 33.2 V dc
Input Voltage Range GNC 420W, GNS 430W (COM Connector)	11 to 33 V dc
Input Voltage Range GNC 420AW, GNS 430AW (COM Connector)	24.1 to 33 V dc
GPS 400W (Main Connector)	700 mA @ 28 V dc (maximum) 1.4 A @ 14 V dc (maximum)
GNC 420W, GNC 420AW, (Main Connector)	1.2 A @ 28 V dc (maximum) 2.5 A @ 14 V dc (maximum)
GNS 430W, GNS 430AW, (Main Connector)	1.2 A @ 28 V dc (maximum) 2.5 A @ 14 V dc (maximum)
GNC 420W, GNS 430W (COM Connector)	15 mA @ 28 V dc (receive) 3.0 A @ 28 V dc (transmit) 15 mA @ 14 V dc (receive) 6.0 A @ 14 V dc (transmit)
GNC 420AW, GNS 430AW (COM Connector)	15 mA @ 28 V dc (receive) 3.0 A @ 28 V dc (transmit)
Superflag Power Requirements	500 mA maximum per superflag output
Environmental Testing	See Environmental Qualification Form on the Dealers Only page on www.garmin.com.
Display Size	3.8” diagonal
Active Area	3.29” (W) x 1.75” (H)
Resolution	240 x 128 pixels
Viewing Angle (with a 2:1 contrast ratio, min)	Left/Right: Up: Down: 40° 40° 40°
Viewing Distance	36 inches maximum

Table 2-3. GPS Specifications

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

Table 2-4. COMM Transceiver Specifications (GNC 420W and GNS 430W Only)

Audio Output	100 mW minimum into a 500 ohm load.
Audio Response	Less than 6 dB of variation between 350 and 2500 Hz.
Audio Distortion	The distortion in the receiver audio output shall not exceed 15% at all levels up to 100 mW.
AGC Characteristics	The audio output will not vary by more than 6 dB when the level of the RF input signal, modulated 30% at 1000 Hz, is varied from 5 µV to 450,000 µV.
Sensitivity	(S+N)/N on all channels shall be greater than 6 dB when the RF level is 2 µV (hard) modulated 30% at 1000 Hz at rated audio.
Squelch	2 µv ± 6 dB for 25 kHz channels. 3 µv ± 6 dB for 8.33 kHz channels.
Selectivity	6 dB BW is greater than ± 8 kHz for 25 kHz channeling. 60 dB BW is less than ± 25 kHz for 25 kHz channeling. 6 dB BW is greater than ± 2.778 kHz for 8.33 kHz channeling. 60 dB BW is less than ± 7.37 kHz for 8.33 kHz channeling.
Spurious Response	Greater than 85 dB.
Modulation	AM double sided, Emission Designator 6K00A3E
Frequency Band	118.00 to 136.99 MHz 25 kHz and 8.33 kHz channel spacing
Transmitting Power	GNS 420W, GNS 430W 10 watts minimum, 15 watts maximum GNS 420AW, GNS 430W 16 watts minimum, 20 watts maximum
Transmitter Duty Cycle	Recommended 10% maximum.
Modulation Capability	The modulation is not less than 70% and not greater than 98% with a standard modulator signal applied to the transmitter.
Carrier Noise Level	At least 45 dB (S+N)/N.
Frequency Stability	0.0005%
Demodulated Audio Distortion	Less than 10% distortion when the transmitter is modulated at least 70%.
Sidetone	1.4 Vrms into a 500 ohm load when the transmitter is modulated at least 70%.
Demodulated Audio Response	Less than 6 dB when the audio input frequency is varied from 350 to 2500 Hz.

* C37d Class 4 & 6 may not provide suitable COM transmit range for some high-altitude aircraft.

**Specifications shown apply at nominal input voltages of 13.75 V dc or 27.5 V dc, as applicable, and with a nominal 50 ohm resistive load at the antenna connector.

Table 2-5. VOR Specifications (GNS 430W Only)

Receiver Audio Sensitivity	At -103.5 dBm (S+N)/N shall not be less than 6 dB.
Course Deviation Sensitivity	-103.5 dBm or less for 60% of standard deflection.
Flag	The VOR Course Deviation Flag must be flagged: a) in the absence of an RF signal. b) in the absence of the 9960 Hz modulation. c) in the absence of either one of the two 30 Hz modulations. d) When the level of a standard VOR deviation test signal produces less than a 50% of standard deflection.
AGC Characteristics	From -99 to -13 dBm input of a Standard VOR Audio Test Signal, audio output levels shall not vary more than 3 dB.
Spurious Response	Greater than 80 dB.
VOR OBS Bearing Accuracy	The bearing information as presented to the pilot does not have an error in excess of 2.7° as specified by RTCA DO-196 and EuroCAE ED-22B.
Audio Output	A minimum 100 mW into a 500 ohm load.
Audio Response	Less than 6 dB of variation between 350 and 2500 Hz. Except the 1020 Hz Ident Tone is at least 20 dB down in voice mode.
Audio Distortion	The distortion in the receiver audio output does not exceed 10% at all levels up to 100 mW.

Table 2-6. LOC Specifications (GNS 430W Only)

Receiver Audio Sensitivity	At -103.5 dBm (S+N)/N shall not be less than 6 dB.
Course Deviation Sensitivity	-103.5 dBm or less for 60% of standard deflection.
Flag	The LOC Course Deviation Flag must be flagged: a) in the absence of an RF signal. b) When either the 90 or 150 Hz modulating signals is removed and the other is maintained at its normal 20%. c) In the absence of both 90 and 150 Hz modulation. d) When the level of a standard localizer deviation test signal produces less than a 50% of standard deflection.
AGC Characteristics	From -86 dBm and -33 dBm input of a Standard VOR Audio Test Signal, audio output levels does not vary more than 3 dB.
Selectivity	Nose Bandwidth: The input signal level required to produce the reference AGC voltage does not vary more than 6 dB over the input signal frequency range of ± 9 kHz from the assigned channel frequency. Skirt Bandwidth: The input signal level required to produce reference AGC voltage will be at least 70 dB greater than the level required to produce reference AGC voltage at the assigned channel frequency at ± 36 kHz from the assigned channel frequency.
Spurious Response	Greater than 80 dB.
Centering Accuracy	Typical 0 ± 3 mV (Max error 9.9 mV per RTCA DO-195).
Audio Output	A minimum 100 mW into a 500 ohm load.
Audio Response	Less than 6 dB of variation between 350 and 2500 Hz. Except the 1020 Hz Ident Tone is at least 20 dB down in voice mode.
Audio Distortion	The distortion in the receiver audio output does not exceed 10% at all levels up to 100 mW.

Table 2-7. Glideslope Specifications (GNS 430W Only)

Sensitivity	-87 dBm or less for 60% of standard deflection.
Centering Accuracy	0 ± .0091 ddm or 0 ± 7.8 mV
Selectivity	The course deviation shall be 0 ddm ± .0091ddm when using the Glideslope Centering Test Signal as the RF frequency is varied ±17 kHz from the assigned channel. At frequencies displaced by ± 132 kHz or greater, the input signal is at least 60 dB down.
Standard deflection	a) With a standard deflection 'FLY DOWN' condition (90 Hz dominant), the output shall be -78 mV ± 7.8 mV. b) With a standard deflection 'FLY UP' condition (150 Hz dominant), the output shall be +78 mV ± 7.8 mV.
Flag	The unit flags when: a) the level of a standard deviation test signal produces 50% or less of standard deflection of the deviation indicator. b) In the absence of 150 Hz modulation. c) In the absence of 90 Hz modulation. d) In the absence of both 90 Hz and 150 Hz modulation. e) In the absence of RF.

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SECTION 3
THEORY OF OPERATION

The theory of operation in this section supports the maintenance/support philosophy of board level repair.

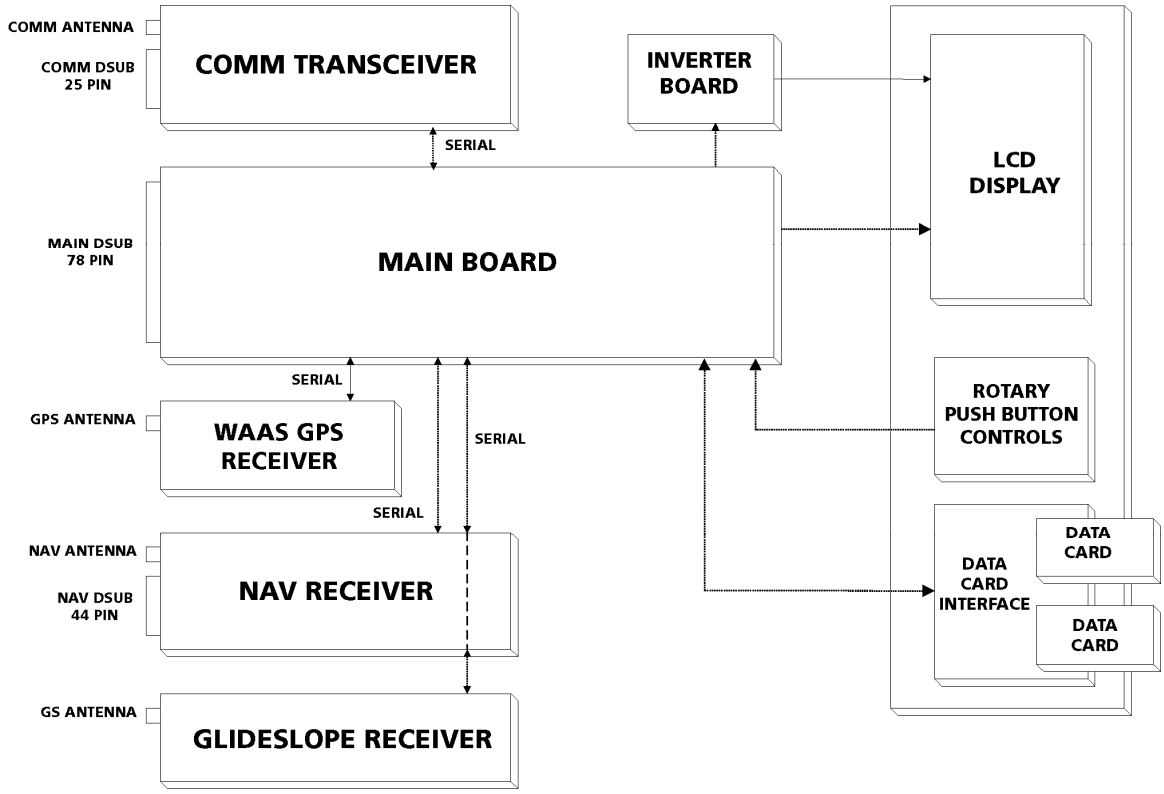

Figure 3-1. GNS 400W Block Diagram

3.1 MAIN BOARD

The Main Board includes the main unit processor and front panel interfaces as well as rear interconnect and interfaces to the other boards. This is illustrated in Figure 3-1. The Main Board contains the main unit power supplies. Two isolated power supplies are included — the Main Power Supplies and the Com Power Supplies. The Main and Com Power Supplies operate independently (a failure in one of the supplies will not cause a failure of the other supply). The power supplies are duplicated so that, in a case where the main power supplies fail, the Com Radio is capable of continued operation.

Main CPU

The Main Board contains the Main Processor, a Samsung S3C2410A 32-Bit RISC microprocessor based upon an ARM920T core. The 2410 processor core operates up to 203MHz.

Memories

The Main Board includes SDRAM and NAND Flash memories. These memories are connected directly to the 2410 processor, which includes interface support for both types of memories.

Display Interfaces

The Main Board provides the display interface for all models.

Front Panel/Display Backlighting/Controls Lighting

The front panel includes LED backlighting for the push buttons, rotary controls, and bezel nomenclature. The LEDs are located on the keyboard assemblies and include current limit resistors connected to +5 volts.

Front Panel Control Interfaces

The front panel controls are located in the front bezel assembly. The interconnect to the keypad and the right rotary switch controls is included in J22, and the interface to the left rotary switch is included in J14.

Volume Controls

All units include two volume control pots for the Com and Nav Receivers.

Data Card Interface

The Main Board design includes interface for two front panel accessible data base cards. The interface connects to the front panel assembly through J14, a 70 pin socket, via a flex cable.

Rear Panel Connector Pinouts

Appendix A describes the pinouts of the Main Rear Panel Connector, J1.

Lightning and EMI/RFI Protection

The rear interface signals include circuitry for lightning and RF susceptibility protection and EMI suppression. The output signals typically have either diode or transorbs included to protect the output drivers. The diodes and transorbs are used to shunt the lightning current to ground. The input circuits typically include current limit resistors with low power signal diodes for lightning protection. The resistor will limit the pulse current to levels that can be easily shunted to either ground or a supply voltage to protect the input circuits. These input circuits are also part of the functional input circuit as well as used for EMI/RFI suppression.

The interface signals also include EMI/RFI suppression. In many cases, this uses EMI beads along with capacitors. When the EMI beads are used on the same signals as the lightning

protection diodes and transorbs, the circuit is laid out so the lightning currents do not go through the EMI beads.

Com Board Interface

The Com Board interface is connected to the Com Board via J11. The interface includes power from the com power supply, +5v and ±12v, along with serial RxD and TxD, and the volume control knob voltage. The Com Board is controlled by the main CPU through the serial interface, and the Com Board returns status to the Main CPU.

Nav/Glideslope Board Interface

The Nav/GS interface is connected to the Nav Board via J9. The interface includes power supplies, +5v and ±12v, along with serial interfaces for both the Nav and GS functions, and the Nav Volume Control Knob voltage. The Nav Board is controlled by the main CPU through the Nav Serial Interface, and the Nav Board returns status to the Main CPU. The GS Board is controlled by the Main CPU through the GS Serial Interface, and the GS Board returns status to the Main CPU. The GS Board Interface is physically looped through the Nav Board.

WAAS GPS Board Interface

The WAAS GPS Board connects with the Main Board via J8. This interface includes +5v power for the GPS engine along with a serial interface and a battery connection. The WAAS Engine provides position and navigation data to the Main CPU via the serial interface, and the Main CPU sends commands to the WAAS Engine via the serial interface.

Inverter Board Interface

The Inverter Board includes the driver for the LCD CCFT backlight. The power and control signals are connected to the interface board via P13.

Memory Backup Battery

The Main Board includes a 3-volt Lithium Battery. The battery is connected to the WAAS GPS Interface Connector and is used for the real time clock and memory backup. If the battery is not replaced and becomes completely discharged, the unit will remain fully operational but the GPS signal acquisition time may be increased.

3.2 VHF COMMUNICATIONS TRANSCEIVER (COM BOARD)

The Com Transceiver provides voice communication in the 118.000 to 136.975 MHz general aviation band. The transceiver consists of a 10 watt amplitude-modulated transmitter, and a single conversion superhetrodyne AM receiver. A 16 watt transmitter option is also available.

The transmitter is a Class 4 and 6 (10 Watt), or a Class 3 and 5 (16 Watt) device as described in RTCA DO-186a, indicating that it has channel spacing modes of 8.33 kHz and 25 kHz, and is intended for a communications range of 100 (10 Watt) or 200 (16 Watt) nautical miles. The receiver is a Class C and E device as described in RTCA DO-186a, indicating that it has channel spacing modes of 8.33 kHz and 25 kHz, with offset carrier capability in 25 kHz mode.

3.3 NAV BOARD

The Nav Board contains the processor-controlled navigation receiver for VOR and Localizer Signals from 108.00 MHz to 117.95 MHz in 50 kHz increments (200 channels). The Nav Board performs the following functions:

- Tunes a VOR or localizer frequency as commanded by the Main Processor.
- Communicates VOR/LOC receiver sub-system status to the Main Processor.
- Communicates VOR radial or localizer deviation, TO/FROM flag state and navigation flag state to the Main Processor.
- Drives horizontal deviation, flag and TO/FROM electrical outputs.
- Receives Glideslope data from the Main Board to be sent out in ARINC 429 format.
- Toggles the VOR/LOC identifier filter as commanded by the Main Processor.
- Communicates to the Main Processor the detection of a remote frequency transfer key press.
- Drives electrical outputs for OBI.
- Channels a remote DME if connected to the VOR/LOC Receiver Board.
- Transmits ARINC 429 labels.
- Receives ARINC 429 labels.
- Provides signal pass-through for G/S flags and drivers to NAV Board Connectors.

3.4 GLIDESLOPE RECEIVER

The Glideslope Receiver operates from 329.15 MHz to 335.00 MHz in 150 kHz increments (40 Glideslope channels). The Glideslope Receiver includes conventional RF, IF, and drives vertical deviation and flags.

3.5 WAAS GPS RECEIVER

The WAAS GPS Receiver is a twelve channel parallel receiver that is capable of tracking and using up to twelve visible satellites for position, velocity, and time calculations.

3.6 INVERTER BOARD

The Inverter Board supplies high voltage for display operation.

3.7 INTERFACE BOARD

The Interface Board produces voltage level shifting for the video signal that provides power to the display. It also provides the interface to the data cards.

3.8 VIDEO BOARD

The Video Board provides two spare RS-232 serial ports through external connector J50. These serial ports conform to EIA standard RS-232C. The Video Board connects to the Main Board by the flex cable.

3.9 KEYBOARD

The Keyboard consists of snap-dome keys, photocell, and LEDs for backlighting display operation.

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SECTION 4
TROUBLESHOOTING/TESTING

WARNING

Hazardous voltages exist on the inverter board. Voltages range up to 2500 V ac peak to peak under normal operating conditions. Under open circuit conditions voltages can range over 8000 V ac peak to peak. Exercise extreme caution during unit testing. Death or serious injury could result from electrical shock.

4.1 INTRODUCTION

This section describes the troubleshooting methods and testing procedures that can be used to identify a faulty board. This section also includes return to service information.

Two troubleshooting methods are described. The first method is to observe fault messages on the display and take the recommended actions (Figure 4-1 and Table 4-1). If the fault message approach is unproductive, minimum performance specification tests can be performed to help identify a defective board. Note that the MPS tests are designed to be performed using ATE. In many cases manual methods can be designed to still perform the tests.

4.2 LIMITATIONS/SCOPE

If any testing which is required and/or desired falls outside of the scope of what is described, return the unit to Garmin for repair.

NOTE

All units contains static sensitive components. Observe proper anti-static procedures during testing.

4.3 TROUBLESHOOTING METHOD I—FAULT MESSAGES

The simplest method of troubleshooting is to observe any fault messages that are displayed (Figure 4-1) and perform the recommended actions given in Table 4-1.

Figure 4-1. Typical Fault Messages

NOTE

If the unit fails any of the power-up integrity checks, a 'Fatal Error Page' fault message is displayed. Return the unit for service if this occurs.

Table 4-1. Fault Messages and Recommended Actions

FAULT MESSAGE	MESSAGE EXPLANATION	RECOMMENDED ACTIONS
All Data Referenced to True North	N/A	Verify that a Jeppesen NAVData® card is fully inserted into the left card slot. Replace the Jeppesen NAVData® card. Check the applicable flex cable. Replace the CDU assembly. Return the unit for service.
Airport terrain database integrity error	The unit has detected a problem with a database on the TAWS/Terrain data card. The data is not usable.	Replace the card.
Altitude input failure	N/A	Return the unit for service.
Audio database integrity error	The unit has detected a problem with the built-in TAWS audio database. TAWS audio alerts are not available.	Return the unit for service.
Aviation database integrity error	The unit has detected a problem with a database on the NAVData® card. The data is not usable.	Return the card to Garmin.
Basemap database integrity error	The unit has detected a failure in the built-in basemap (land data) database. Land data does not appear. Unit functions continue to work normally.	Return the unit for service.
Boot block verify failed	System integrity testing has determined that the boot block has become corrupted.	Return the unit for service.
CDI key stuck	N/A	Check the applicable flex cable. Replace the keyboard. Replace the CDU. Return the unit for service.

Table 4-1. Fault Messages and Recommended Actions (continued)

Check unit cooling	The unit has detected excessive display backlighting temperature. The backlighting has been automatically dimmed to reduce the temperature.	Check for adequate ventilation or check cooling airflow. Return the unit to Garmin for repair.
COMM has failed	The unit has detected a failure in the communications transceiver.	Replace the comm board. Return the unit for service.
COMM is not responding	Internal system-to-system communication between the main processor and the com radio has failed. Operational status of the com radio is unknown.	Replace the comm board. Return the unit for service.
COMM needs service	N/A	Replace the comm board.
COMM push-to-talk key stuck	The external push-to-talk (PTT) switch is stuck in the enabled (or “pressed”) state.	Press the PTT switch again to cycle its operation, if the message persists, return the unit to Garmin for repair.
COMM remote transfer key is stuck	The remote COMM transfer switch is stuck in the enabled (or “pressed”) state.	Press the switch again to cycle operation. Verify that microphone key line is not stuck on before replacing comm board. Replace the comm board.
COMM mic key stuck	N/A	Verify that remote transfer key line is not stuck before replacing comm board. Replace the comm board.
COMM transmitter power has been reduced	N/A	Check for excessive unit temperature. Verify that power input to J2-11 and 12 has not dropped below 26 V (for a 28 volt unit) or 12 V (for a 14 volt unit) when transmitting before replacing the comm board. Replace the comm board.

Table 4-1. Fault Messages and Recommended Actions (continued)

Data card write failure/Data card failure	N/A	Replace the Jeppesen NAVData® card. Check the applicable flex cable. Return the unit for service.
Display backlight failure	N/A	Return the unit for service.
G/S has failed	N/A	Replace the glideslope board. Return the unit for service.
G/S is not responding	Internal system-to-system communication between the main processor and the glideslope receiver has failed. Operational status of the glideslope receiver is unknown.	Check the applicable flex cable. Replace the glideslope board.
G/S needs service	N/A	Replace the glideslope board.
GPS has failed	N/A	Replace the WAAS GPS module.
GPS needs service	The unit has detected a failure in its GPS receiver. The GPS receiver may still be usable.	Press the switch again to cycle its operation. Return the unit for service. Replace the GPS module.
GPS stored data was lost	N/A	Return the unit for service.
Heading input failure	N/A	Return the unit for service.
Low Battery Unit Needs Service	Time data may have been lost due to a memory battery failure.	Replace the memory battery. Return the unit for service.
Main processor requires service	The unit has detected a failure in the main system processor.	Return the unit for service.
No basemap data available	The unit has detected a failure in the built-in basemap (land data) memory. Land data does not appear on the map page. Other unit functions continue to work normally.	Insert the terrain data card in right data card slot (for TAWS/TERRAIN units). Replace the terrain data card. Replace the map board. Return the unit for service.

Table 4-1. Fault Messages and Recommended Actions (continued)

No differential GPS position	N/A	Replace the GPS module
OBS key stuck	The OBS key is stuck in the enabled (or pressed) state.	Try pressing the OBS key again to cycle operation. Return the unit for service.
Obstacle database integrity error	The unit has detected a problem with a database on the TAWS/Terrain data card. The data is not usable.	Return card to Garmin for service.
Poor GPS coverage	N/A	Check the antenna and cabling. Replace the GPS module.
Stored data was lost	All user waypoints, flight plans and system settings have been lost due to a memory battery failure or system reset.	Replace the memory battery. Return the unit for service.
Terrain configuration conflict	The current TAWS/Terrain configuration is not supported by the hardware. The TAWS hardware may have failed, or the unit may be misconfigured. The unit's terrain capabilities will be downgraded to "Terrain" instead of "TAWS".	Check the applicable flex cable. Return the unit for service.
Terrain database integrity error	The unit has detected a problem with a database on the TAWS/Terrain data card. The data is not usable.	Return to Garmin for service.
Terrain has failed	The unit has detected a failure in the terrain system. The most likely cause is a missing or corrupt terrain database. Terrain functionality is not available If the terrain database is not the cause, return the unit to Garmin for service.	Verify that a terrain data card is fully inserted into right data card slot. Replace the terrain data card.

Table 4-1. Fault Messages and Recommended Actions (continued)

VLOC has failed	The unit has detected a failure in the VLOC receiver.	Replace the nav receiver.
VLOC needs service	N/A	Replace the nav receiver.
VLOC not responding	Internal system-to-system communication between the main processor and the VLOC receiver has failed.	Check the applicable flex cable. Replace the nav receiver. Return the unit for service.

4.4 TROUBLESHOOTING METHOD II – MINIMUM PERFORMANCE TESTS

When the fault message method is unsuccessful, the following minimum performance tests may be performed to help troubleshoot and identify a defective board. Replace the defective part or send the unit to Garmin if the unit fails to pass any test.

NOTES

A misaligned board may cause incorrect test results. Alignment cannot be performed by the avionics shop. Send the unit to Garmin for repair.

The main board contains an EEPROM memory storage device which must be programmed with Unit Configuration, TAWS/Terrain Configuration, and Unit Serial Number. Because of this, the main board is not replaceable in the field. Replace the main board if any of the main board tests fail.

All voltage measurements are relative to ground (J1-77 or J1-70) unless otherwise stated.

4.4.1 UNIT TEST AND CONFIGURATION PAGES

NOTE

Actual test and configuration pages may vary from what is shown in this section. All pages were current at the time of manual publication but are subject to change due to software updates, etc.

The results of certain tests can be monitored using the test and/or configuration pages. To display the test pages, ground the test pin (J1-76) and apply power. When in test mode, specific test pages can be selected by turning the small right knob. Table 4-2 lists the test and configuration pages and their names.

To display the configuration pages, press and hold the ENT key and apply power. Release the ENT key when the display activates. Test and/or configuration pages can be selected by turning the small right knob.

To change data on the test or configuration pages, press the small right knob (CRSR) to turn on the cursor. Rotate the large right knob to change between data fields. Rotate the small right knob to change a field that the cursor is on. Once a selection has been made, press the ENT key to accept the entry.

NOTE

Do not make changes to any of the test or configuration page fields which are not required to perform testing.

Table 4-2. Configuration and Test Page Names

CONFIGURATION PAGES	TEST PAGES
Main ARINC 429 Configuration	Color Bar Test Page
Main RS232 Configuration	Main Lighting
Main System Configuration	GPS Date/Time
Main Inputs 1	Main Discrete Inputs
Main Inputs 2	Main Discrete Outputs
Instrument Panel Self-Test	Main Analog Inputs
Main Lighting	Main CDI/OBS Config
GPS Date/Time	Main Status/Loopback
Main Discrete Inputs	Card Status
Main Discrete Outputs	WAAS GPS Status
Main CDI/OBS Configuration	COMM Setup
COMM Setup	GS Setup
VOR Discrete Inputs	VOR Discrete Inputs
VOR/LOC/GS CDI	VOR Discrete Outputs
VOR/LOC/GS ARINC 429 Config	VOR/LOC/GS CDI
GPS Vertical Offset	VOR Setup/Status/Loopback
	Main Information

4.4.2 Unit Level Tests

NOTE

Except for the 16 watt comm radio which requires +28 V dc, all units operate with external power from 9-33 V dc.

Unit Power Input Check

All units operate with external power from 9-33 V dc. The power consumption must not exceed the limits shown in Table 4-3 with the display backlight at maximum brightness. Return the unit to Garmin for service if any unit fails the power requirement checks.

Table 4-3. Unit Input Power Requirements

Model	Unit Status	Max Current (amps)	
		27.5V Input	13.8V Input (Optional)
GPS 400W	On	0.66	1.32
GNC 420W	On	RX: 0.99	RX: 1.98
		TX: 3.36	TX: 7.32
GNC 420AW	On	RX: 0.99	DO NOT TEST
		TX: 3.36	
GNS 430W	On	RX: 1.17	RX: 2.34
		TX: 3.98	TX: 7.96
GNS 430AW	On	RX: 1.17	DO NOT TEST
		TX: 3.98	
All Units	Off	0.014	0.011

Bus Power

Aircraft Power BUS 1: (J1-19 and J1-20).

Aircraft Power BUS 2: (J1-15 and J1-72).

1. Power the unit via Aircraft Power BUS 1. Verify proper operation.
2. Power the unit via Aircraft Power BUS 2. Verify proper operation.

Push Button Response

Turn the unit on in normal mode and push each button and verify proper operation.

Rotary Knobs

Turn each rotary knob at least three turns in the same direction and verify proper operation.

Data Card Tests

Apply power to the unit and verify the successful display of the following terrain data card and Jeppesen NAVData® card data:

- World Wide Land Data
- World Wide Terrain Database
- Airport Terrain Database
- Data Card profile (e.g., America, World)
- Cycle Version
- Copyright Information (date and company)

Photocell

Turn the unit on in test mode and verify brightness control is in photo mode, using the main lighting page. With the photocell uncovered, ensure that the display and keyboard backlight LED brightness is proper under normal conditions. Cover the photocell and verify display and keyboard backlight LED brightness decreases.

Lighting Bus Input

NOTE

If a lighting bus option other than photo is selected, and the lighting bus control is turned to its minimum (daytime) setting, the display brightness will default to tracking the unit photocell.

- Lighting BUS HI: (J1-39)
- Lighting BUS LO: (J1-40)

Test results are monitored via the main analog inputs test page (Figure 4-2).

Apply a 500 Hz, +5 volts to 0 volts square wave to unit pins J1-39 and 40. Measured value should be 2.37 ± 0.25 V dc (66 to 81 ADC counts). Input measures peak voltage (not RMS).

Lighting Bus DC

Test results are monitored via the main analog inputs test page (Figure 4-2).

1. Supply 12.0 V dc to unit pin J1-39.

2. Ensure the power supply ground is connected to the unit ground J1-77 and 78. Measured value should be 12.0 ± 5% V dc.

Memory Battery Voltage

At the end of battery life the unit typically alarms at 2.46 volts and clears the alarm at 2.63 volts. Verify 190 to 145 ADC counts (3.8 > V > 2.9 volts) via the main analog inputs test page (Figure 4-2).

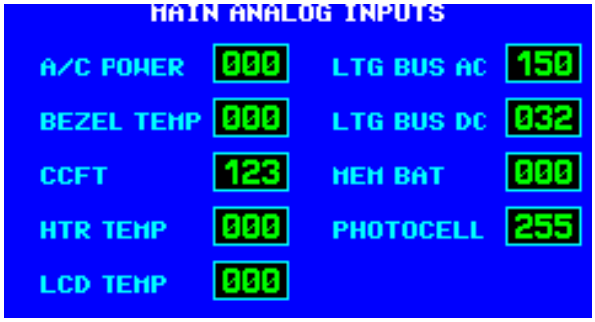

Figure 4-2. Main Analog Input Test Page (Test Mode)

Display Pattern Test

Starting from the display pattern test page (Figure 4-3), use the 'RNG' buttons to cycle through all of the display patterns to verify all pixels are driven and color contrast is acceptable.

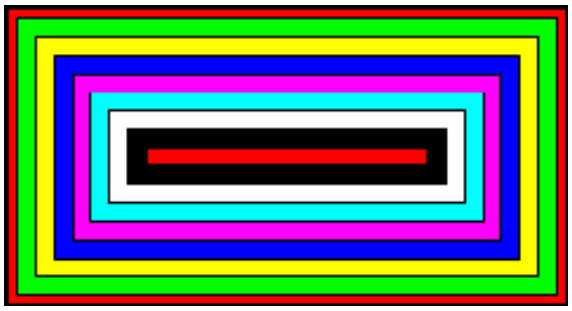

Figure 4-3. Display Pattern Test Page (Test Mode)

Display Max Level Test

Set the display brightness to maximum and verify increased display intensity.

Display Dim Test

Vary the display brightness and verify decreased display intensity.

Keyboard LED Dim Test

Manually vary the keyboard LED backlight brightness and verify proper operation.

GPS Antenna Bias

Measure the dc voltage at the GPS antenna connector using a 35 mA load to ground. Verify that the voltage is 4.42 to 4.74 volts. If no load is present, the voltage should be 4.66 to 4.74 volts.

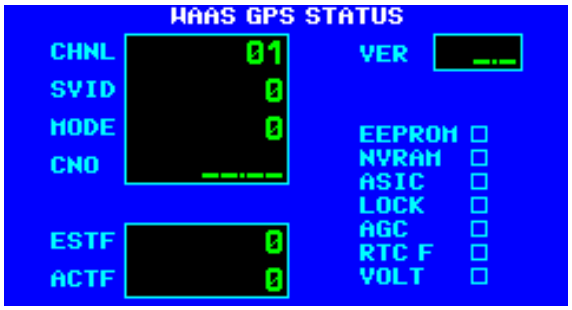

Figure 4-4. WAAS GPS Status Page (Test Mode)

GPS Signal

Apply a standard GPS test signal to the GPS antenna. Let unit acquire satellite 16 and capture the last mode 5 value prior to its transition to mode 0. Verify GPS signal A8H (42.00) to C0H (48.00) via the WAAS GPS Status Page (Figure 4-4).

Time Mark Output

The time mark out is generated by the WAAS GPS sub-assembly. The output is a high pulse that is used by other external units to determine when position information from the unit is valid. The unit output pulse occurs 1 per second and is 1 ms wide. Note that ARINC 743 requires a pulse width of 1.0 ± 0.1 ms. Verify time mark functionality using an oscilloscope and observe a 1 msec active high pulse on J1-16.

1. Command output high and measure output on oscilloscope. Measure at J1-16. Verify voltage > 4 volts.

2. Command output low and measure output on oscilloscope. Verify voltage < 0.4 volts.

4.4.3 Unit and Board Level Tests

Table 4-1 identifies board configurations for each unit.

Table 4-4. Unit Board Configurations

Unit Configurations								
		Board Assemblies						
Unit	P/N	Main Board	Inverter board	Interface board	WAAS GPS	Comm board	Nav board	GS board
GPS 400W	011-01057-XX	x	x	x	x			
GNC 420W	011-01058-XX	x	x	x	x	10w		
GNC 420AW	011-01059-XX	x	x	x	x	16w		
GNS 430W	011-01060-XX	x	x	x	x	10w	x	x
GNS 430AW	011-01061-XX	x	x	x	x	16w	x	x

Main Lateral Left+, Right+ Outputs

Command the test via the main CDI/OBS configuration page (Figure 4-5). The test load is 333 ohms (three 1000 ohm loads) placed across J1-21 and J1-22.

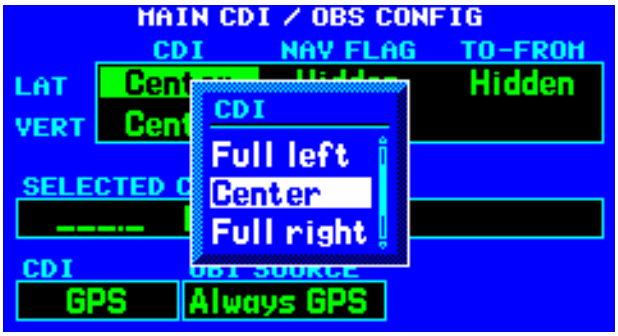

Figure 4-5. Main CDI/OBS Configuration Page (Test Mode)

Measure J1-21 (output) relative to J1-22 (output). Full left/right (± 150 mV) selections are also available but are not tested.

MAX LEFT	CENTER	MAX RIGHT
+300 ± 15 mV	0 ± 4.5 mV	-300 ± 15 mV

Main Vertical Up+, Down+ Outputs

Load: 333 ohms (three 1000 ohm loads) across J1-27 and J1-28. Command the test via the main CDI/OBS configuration page (Figure 4-5).

Measure J1-27 relative to J1-28. Full up/down (± 150 mV) selections are also available but are not tested. All tolerances are derived from meeting preliminary WAAS specifications of 3% centered and 5% linearity of full scale deflection (150 mV).

MAX UP	CENTER	MAX DOWN
+300 ± 15 mV	0 ± 4.5 mV	-300 ± 15 mV

To/From Output

Load: 67 ohms (three 200 ohm loads) across J1-25 and J1-26. Command the test via the main CDI/OBS configuration page (Figure 4-5). Measure J1-25 relative to J1-26.

TO	FLAGGED	FROM
+250 ± 20 mV	0 ± 5 mV	-250 +50mV/- 20 mV

Main Lateral Flag Output

Load: 333 ohms (three 1000 ohm loads) across J1-23 and J1-24. Command the test via main CDI/OBS configuration page (Figure 4-5). Measure J1-23 relative to J1-24.

OUT OF VIEW	IN VIEW
+300 ± 30 mV	0 ± 25 mV

Main Vertical Flag Output

Load: 333 ohms (three 1000 ohm loads) across J1-29 and J1-30.
Command the test via main CDI/OBS configuration page (Figure 4-5).
Measure J1-29 relative to J1-30.

OUT OF VIEW	IN VIEW
+300 ± 30 mV	0 ± 25 mV

Main Lateral Super Flag Output

Load: resistor to ground such that is will sink 500 mA when attached to AIRCRAFT POWER. (J1-19 or 20). Applicable output will source this current when active. If the load is sized for 13.8 V operation then this test should not be run at 27.5 V.
Command the test via the main CDI/OBS configuration page (Figure 4-5). Measure at J1-17.

OUT OF VIEW	IN VIEW
AIRCRAFT POWER - 1.5 V dc min	V dc max

Main Vertical Super Flag Output

Load: resistor to ground such that it will sink 500 mA when attached to AIRCRAFT POWER. (J1-19 or 20). Applicable output will source this current when active. If the load is sized for 13.8 V operation then this test should not be run at 27.5 V.
Command the test via the VOR/LOC/GS CDI configuration page (Figure 4-6). Measure at J1-18.

OUT OF VIEW	IN VIEW
AIRCRAFT POWER - 1.5 V dc min	V dc max

Annunciator Outputs

Load: resistor to external voltage source such that it will source 500 mA when grounded. Applicable output will sink this current when active. Measure at applicable pin.

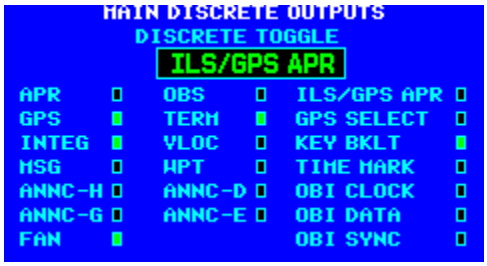

Figure 4-6. Main Discrete Outputs Page (Test Mode)

ANNUCIATOR	PIN
VLOC	(J1-1)
GPS	(J1-2)
WAYPOINT	(J1-3)
TERMINAL	(J1-4)
APPROACH	(J1-5)
MESSAGE	(J1-6)
OBS	(J1-7)
G	(J1-8)
INTEGRITY	(J1-9)
D	(J1-10)
E	(J1-11)
H	(J1-12)
LNAV GPS SELECT	(J1-13)
ILS/GPS APPR	(J1-14)

Command Output To:	ACTIVE	INACTIVE
SPEC	0.8 V dc max	4.5 V dc min

Discrete Switch and Altitude Inputs

Figure 4-7. Main Discrete Inputs Page (Test Mode)

For:

INPUT NAME	PIN
ALTITUDE C4	(J1-61)
ALTITUDE C2	(J1-62)
ALTITUDE C1	(J1-63)
ALTITUDE B4	(J1-64)
ALTITUDE B2	(J1-65)
ALTITUDE B1	(J1-66)
ALTITUDE A4	(J1-67)
ALTITUDE A2	(J1-68)
ALTITUDE A1	(J1-69)
ALTITUDE D4	(J1-70)
OBS MODE SELECT	(J1-71)
SPARE INPUT B	(J1-72)
CDI SOURCE SELECT	(J1-73)
COMM REMOTE RECALL	(J1-74)
DEMO MODE SELECT	(J1-75)
TEST MODE SELECT	(J1-76)

Apply alternating loads/levels to inputs. Monitor the test results via the main discrete inputs page (Figure 4-8).

< 375 ohm to GROUND	> 100 k ohm to GROUND
ACTIVE	INACTIVE

ARINC 429 Transmitter and Receivers

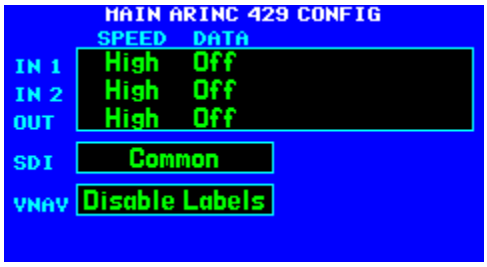

Figure 4-8. Main ARINC 429 Page (Configuration Page)

The transmitter lines A and B of the ARINC 429 channel must meet the requirements of ARINC 429 with the exception that only five receiver loads are to be driven. The transmitter is capable of both low and high speed operation. The frequency of transmission must be 14.29 ± 0.1 kHz for low speed and 100.0 ± 0.1 kHz for high speed. The differential output voltage from line A to line B must be not less than 9.0 volts or greater than 11.0 volts.

The ARINC 429 receivers must be able to receive differential voltages between line A and line B of not less than 6.5 volts or greater than 13.0 volts. A differential voltage of less than 2.5 volts

must be interpreted as a null. The receivers can be configured to high speed mode for testing the transmitter in high speed.

Requirements:

For:	GPS ARINC 429 OUT A	(J1-46)
	GPS ARINC 429 OUT B	(J1-47)
	GPS ARINC 429 IN 1A	(J1-48)
	GPS ARINC 429 IN 1B	(J1-49)
	GPS ARINC 429 IN 2A	(J1-50)
	GPS ARINC 429 IN 2B	(J1-51)

429 RX 1 LOWSPEED and 429 RX 2 LOWSPEED

Test both 429 receivers and 429 transmitter in low speed.

Connect 429 transmitter A and B to both 429 receivers. Verify 429 RX 1 LOWSPEED OK and 429 RX 2 LOWSPEED OK via the ARINC 429 configuration page (Figure 4-9).

429 RX 1 HIGHSPEED and 429 RX 2 HIGHSPEED

Test both 429 receivers and 429 transmitter in high speed.

Connect 429 transmitter A and B to both 429 receivers. Verify: 429 RX 1 HIGHSPEED OK and 429 RX 2 HIGHSPEED OK via ARINC 429 Configuration Page (Figure 4-8).

RS232 Ports

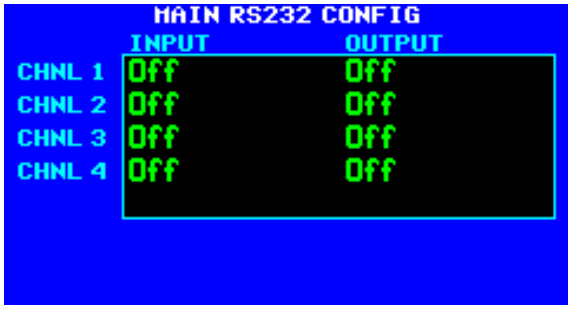

Figure 4-9. Main RS232 Configuration Page

The RS232 TX Channels must conform to EIA Standard RS-232C with an output voltage swing of at least ± 5 volts when driving a standard RS-232 load which is 3 to 7 kohm to ground.

The RS232 RX Channels must conform to EIA Standard RS-232C with the exception that an input of less than 0.8 (instead of < -3.0) is interpreted as a logic 1 and input > 2.4 (instead of >3.0 V) is interpreted as a logic 0. The input resistance to ground is 3 - 7 K ohm over a voltage range of 3 to 15 V dc with an input capacitance of < 2500 pF.

For:	GPS RS232 OUT 1	(J1-56)
	GPS RS232 IN 1	(J1-57)
	GPS RS232 OUT 2	(J1-58)
	GPS RS232 IN 2	(J1-59)
	GPS RS232 OUT 3	(J1-41)
	GPS RS232 IN 3	(J1-42)
	GPS RS232 OUT 4	(J1-54)
	GPS RS232 IN 4	(J1-55)

Test both receiver and transmitter below.

GPS RS232 (1)

Connect the transmitter to the receiver. Verify GPS RS232 1 OK via the main RS232 config test page.

GPS RS232 (2)

Connect the transmitter to the receiver. Verify GPS RS232 2 OK via the main RS232 config test page (Figure 4-10).

GPS RS232 (3)

Connect the transmitter to the receiver. Verify GPS RS232 3 OK via the main RS232 config test page (Figure 4-10).

GPS RS232 (4)

Connect the transmitter to the receiver. Verify GPS RS232 4 OK via the main RS232 configuration page (Figure 4-10).

Load/source: Loopback unit RX/TX pair or ATE computer RX232 RX/TX pair.

OBS

NOTE

The load used in the OBS test consists of a calibrated OBS resolver, precision track selector or equivalent, and must be connected to the GPS OBS inputs.

The OBS bearing must be consistent to within ± 2 degrees of the bearing setting.

Monitor the current measured angle using the “SELECTED COURSE” field and calibrate the unit using the “Calibrate to 150?” field (do this after the bearing is selected to 150 degrees). Note that the angle displayed is rounded to one tenth of a degree.

Load: Calibrated OBS resolver, precision track selector or equivalent.

For: MAIN OBS ROTOR C (J1-31)

MAIN OBS ROTOR H (J1-32)

MAIN OBS STATOR D (J1-33)

MAIN OBS STATOR E (J1-34)

MAIN OBS STATOR F (J1-35)

MAIN OBS STATOR G (J1-36)

Set test set to the angles given in the table below. Verify the angle via the main CDI/OBS config test page.

60	150	240	330
60 ± 2	150 ± 2	240 ± 2	330 ± 2

4.5 COMM BOARD TESTS

This section lists the test procedures for the comm board. The transmitter tests are described first followed by the receiver tests.

Test Equipment

Standard shop avionics test equipment can be use to test the unit.

Test Setup

The test setup is designed and supplied by the avionics shop.

4.5.1 Standard Loads

Antenna

The comm radio operates with a conventional 50 ohm vertically polarized comm radio antenna. The comm transmitter is terminated into a 50 ohm resistive load capable of dissipating a minimum of 50 watts and with a VSWR of no greater than 1.2:1.

Audio

The standard audio load is 500 ohms between COMM AUDIO HI J2-7 and COMM AUDIO LO J2-19.

4.5.2 Standard Signals

RF Level Units

All specifications given for the comm radio are in HARD units. To arrive at these units adjust the RF generator to the level specified and insert a 6 dB pad at the output of the RF generator.

Standard Microphone Input Signal

A 1000 Hz tone with 275 mVrms into a 500 ohm load.

Manufacturer's Rated Audio

Manufacturer's rated audio is the rated output power that the receiver is capable of delivering to one standard comm radio audio output load. This is defined as 100 mW delivered to a 500 ohm load (which corresponds to 7.07 Vrms across that load).

Closed Squelch

The condition of the squelch in which audio is suppressed.

Open Squelch

The condition of the squelch in which audio is not suppressed.

4.5.3 General Test Conditions

Covers and Shields

All comm board tests are performed with covers and shields in place.

Comm Frequency Range

The comm radio receives and transmits on all frequencies from 118.000 to 136.975 mHz in the 25 kHz channel mode and from 118.005 to 136.990 mHz in the 8.33 kHz channel mode.

4.5.4 Comm Board I/O Description

The following pin descriptions are for J2, the rear panel comm board connector. The pin descriptions can aid in the fabrication of test cables, test setup, and troubleshooting. Refer to Figure A-1 for the location of J2.

PIN	NAME	I/O	DESCRIPTION
1	UNSQUELCHED AUDIO	O	Not used on 400 series.
2	COMM IF AGC TEST	O	This is the IF AGC output. It has a 10 K output impedance, and should be measured with a high impedance voltmeter.
3	SQUELCH / COMPRESSOR TEST	I	This input disables the compressor and opens the squelch when input is low. Vin low = .1 Volts @ 5 mA. This input is designed to be operated from a hard switch or relay. The compressor disable function can be controlled serially for ATE.
4	COMM MIC KEY	I	This input is the PTT line. A signal less than 3 volts or a the resistance to ground less than 100 ohms shall activate the transmitter. The transmitter is inactive when the resistance to ground is greater than 1 megohm.
5	INTERCOM MIC HI	I	Microphone intercom audio input. This input will supply the microphone with a 9 volt bias through a 610 ohm resistance.
6	COMM MIC AUDIO HI	I	Microphone audio input. This input will supply the microphone with a 9 volt bias through a 610 ohm resistance.
7	COMM AUDIO HI	O	Comm radio audio output will supply 100 mW to a 500 ohm load. This audio is the summation of the receiver, microphone intercom and sidetone.
8	COMM AUDIO IN HI	I	-----
9	NAV AUDIO IN HI	I	-----
10	AUX AUDIO IN HI	I	-----
11	AIRCRAFT POWER	I	Aircraft power input.
12	AIRCRAFT POWER	I	Aircraft power input.

13	4 OHM AUDIO OUTPUT HI	O	-----
14	TRANSMIT INTERLOCK	I	This input reduces the comm radio receiver sensitivity when it is less than 3 volts or the resistance to ground less than 100 ohms. This input is intended to reduce transmitter to receiver interference in a dual radio installation.
15	COMM REMOTE TRANSFER	I	This input switches between the active and standby frequencies when a signal less than 3 volts or a resistance to ground of less than 100 ohms is present.
16	SPARE		-----
17	INTERCOM MIC LO	I	Ground
18	COMM MIC AUDIO LO	I	Ground
19	COMM AUDIO LO	O	Floating
20	COMM AUDIO IN LO	I	Ground
21	GROUND	I	Ground
22	GROUND	I	Ground
23	NAV AUDIO IN LO	I	Ground
24	AUX AUDIO IN LO	I	Ground
25	4 OHM AUDIO OUTPUT LO	O	Ground

4.5.5 Test Procedures

General Notes

Unless otherwise specified, the receive channel must be set to 127.000 for 25 kHz channel mode, and 127.005 kHz for 8.33 kHz channel mode. Where no channel mode is specified, tests are performed at 127.000 mHz, 25 kHz channel mode. The 8.33 kHz channel mode uses a channel ID that does not match the actual operating frequency. Channel ID is used in this manual to specify test frequency. Unless otherwise specified, the receive channel must be set to 127.000 mHz. The table below shows the channel ID and frequency for the standard receiver test channels.

25 kHz Channel	8.33 kHz Channel	Channel Frequency
118.025	118.030	118.025 mHz
127.000	127.005	127.000 mHz
136.975	136.980	136.975 mHz

NOTE

The audio compressor must be disabled unless otherwise specified.

The audio output must not vary more than 6 dB, when the level of an RF signal modulated 30% is held constant at 1000 µV and the modulation frequency is varied over the audio-frequency range of 350-2500 Hz. The audio output must be measured in 25 kHz channel mode at 350, 1000, 1500, and 2500 Hz and in 8.33 kHz channel mode at 350, 1000, 1500, and 2500 Hz.

The audio frequency response above 2500 Hz must decrease, and at all frequencies above 4000 Hz it must be at least 18 dB below the output obtained at 1000 Hz. Measure in 25 kHz channel mode and in 8.33 kHz channel mode.

Comm Board Power Input Check

The comm board operates according to the power requirements listed in Table 4-2. Replace the main board if any voltage on the comm board is not within tolerance. Replace the comm board if excessive current is noted.

Connector/ Pin	Voltage (V)	Tolerance (V)	Max Current	Conditions/ Remarks
J2 Pin 11 & 12	+11 to +33		15.0 mA	Receive Mode
J2 Pin 11 & 12	+13.75 (14/28V 10 watt units only)	± 0.2 V	6.0 A	TX Mode
J2 Pin 11 & 12	+27.5 (28V 10 watt units only)	± 0.4 V	3.0 A	TX Mode
J2 Pin 11 & 12	+27.5 (16 watt units only)	± 0.4 V	3.0 A	TX Mode

Table 4-5. Comm Board Power Requirements

Audio Output Variation

1. Set the channel spacing to 25 or 8.33 kHz mode, channel to 127 mHz.
2. Adjust the test set to 127.000 mHz, 1 kHz audio mod, 30% mod depth and 1000 µV RF output.
3. Sweep the audio modulation from 350 Hz to 2500 Hz in 100 steps.
4. Measure the audio output level from the receiver during each sweep step to locate the point of highest audio response.
5. Set the audio modulation to the point of highest response that was found in step 4.
6. Measure and store the response figure.
7. Measure the audio response at 350, 1000, and 2500 Hz audio modulation. Verify less than 6 dB variance from the highest to the lowest measured response.

Audio Frequency Cutoff

1. Set the channel spacing to 25 or 8.33 kHz mode, the channel to 127 mHz.
2. Set the test set to 127.000 mHz, 1 kHz audio mod, 30% mod depth and 1000 µV RF output.
3. Measure the audio output level from the receiver.
4. Set the test set to 4 kHz audio modulation frequency.
5. Measure the audio output level from the receiver. Verify a minimum of 18 dB difference in the audio response between 1 and 4 kHz.

Signal Pin	Signal Name	Reference Pin	Reference Name	Load
J2-7	COMM AUDIO HI	J2-19	COMM AUDIO LO	500 Ohms

AGC Characteristic Requirements

1. The audio output should not vary more than 6 dB when the level of the RF input signal, modulated 30% at 1000 Hz, is varied from 5 µV to 100,000 µV.
2. The audio output must return to within 3 dB of the normal steady-state output at 10 µV within 100 msec when the level of an RF input signal, modulated 30% at 1000 Hz, is rapidly reduced from 200 mV to 10 µV.
3. The audio output must return to within 3 dB of the normal steady-state output at 10 µV within 100 msec after transferring from a transmit to a receive state.

Audio Output Variation

1. Set the unit to 25 kHz mode, the channel to 127 mHz.
2. Find the rated audio input level.
3. Take a reference reading with a 5 µV input.
4. Set the test set to a 100,000 µV input.
5. Compare the reading at 100,000 µV to the reading at 5 µV. Verify no more than 6 dB difference in readings.

Signal Pin	Signal Name	Reference Pin	Reference Name	Load
J2-7	COMM AUDIO HI	J2-19	COMM AUDIO LO	500 Ohms

Receiver Sensitivity

The S+N/N ratio on all channels should be greater than 6 dB when a 30% modulated, 1 kHz audio frequency, 2 µV RF signal is applied. Measure the sensitivity in the 25 kHz channel mode at 118.025, 127.000, and 136.975 kHz, and in the 8.33 kHz channel mode at 118.030, 127.005, and 136.980 kHz.

1. Set the channel spacing to either 25 or 8.33 kHz mode and select the receive test channel.
2. Adjust the test set for the selected channel frequency, 30% modulation, 1 kHz audio frequency, 2 µV RF output.
3. Measure the SNR. Verify no less than 6 dB SNR on all tested channels.

Signal Pin	Signal Name	Reference Pin	Reference Name	Load
J2-7	COMM AUDIO HI	J2-19	COMM AUDIO LO	500 Ohms

TX Interlock

The receiver sensitivity must be reduced by at least 15 dB when the TX interlock line is enabled.

1. Set the channel spacing to 25 kHz mode.
2. Disable the TX INTERLOCK pin (high or open).
3. Generate an RF signal at 127.000 mHz, with 30% modulation at 1 kHz, RF output of –73 dBm.
4. Set the volume for rated audio output.
5. Set the RF level to –107 dBm (2 µV).
6. Measure the SNR (average 10 readings).
7. Enable the TX INTERLOCK pin (low or grounded). Set the RF level to –92 dBm (11.25 µV).

8. Measure the SNR (average 10 readings). Verify the following: (SNR with TX interlock disabled) – (SNR with TX interlock enabled) > 0.

Signal Pin	Signal Name	Reference Pin	Reference Name	Load
J2-7	COMM AUDIO HI	J2-19	COMM AUDIO LO	500 Ohms

Audio Output Requirements

- With the compressor enabled, the rated audio output must be 7.07 Vrms into a 500 ohm load.
- With the compressor enabled, the volume control must be capable of reducing the audio level from 7.07 Vrms to 22 mVrms into a 500 ohm load.
- Verify that with the compressor enabled, the squelched audio does not exceed 2 mVrms when the volume control is set to rated audio.

1. Enable the audio compressor and the squelch.
2. Set the channel spacing to the 25 kHz mode.
3. Generate an RF signal with RF carrier frequency of 127.000 mHz, 30% modulation, modulation frequency of 1,000 Hz, RF input level of –87 dBm (20 µV).
4. Set the volume control to deliver rated audio.
5. Measure the audio output level.
6. Set the volume control to minimum output. Increase the RF input level to –33 dBm (10,000 µV).
7. Measure the audio output level.
8. Set the volume control back to rated audio.
9. Remove the RF signal to close the squelch.
10. Measure the audio output level and verify the following:
    - Rated Audio Output: Audio Output > 7.07 Vrms
    - Minimum Volume Output: Audio Output < 22 mVrms
    - Squelched Audio Output: Audio Output < 2 mVrms

Signal Pin	Signal Name	Reference Pin	Reference Name	Load
J2-7	COMM AUDIO HI	J2-19	COMM AUDIO LO	500 Ohms

Audio Distortion

The receiver audio distortion at rated audio output when modulated 85% with a tone from 350 - 2500 Hz with RF level at 10,000 µV and the compressor enabled, shall not exceed 25% when measured at 350 Hz. Additionally, the distortion shall not exceed 15% when measured at 1000 Hz and 2500 Hz.

1. Enable the compressor.
2. Set the test set for 127 mHz RF carrier, 85% modulation, modulation frequencies of 350 Hz, 1 kHz, and 2.5 kHz. Set the output level to 10,000 µV.
3. Set the volume for rated audio level.
4. Measure the audio distortion and verify the following:
   - 350 Hz: distortion < 25%
   - 1000 Hz: distortion ≤ 15%
   - 2500 Hz: distortion ≤ 15%

Signal Pin	Signal Name	Reference Pin	Reference Name	Load
J2-7	COMM AUDIO HI	J2-19	COMM AUDIO LO	500 Ohms

Microphone Intercom

The audio level shall not be less than 7.07 Vrms when a 125 mVrms signal at 1000 Hz is applied between INTERCOM MIC J2-5 and INTERCOM MIC LO J2-17 and the receive audio is squelched. The audio distortion shall be less than 10% when a 125 mVrms signal at 1000 Hz is applied between the INTERCOM MIC, J2-5 and INTERCOM MIC LO J2-17 input and the receive audio is squelched.

1. Enable the compressor.
2. Turn the carrier off.
3. Send a 1 kHz audio signal to the intercom microphone input of unit.
4. Set the volume to a minimum level and verify the following:
   - Microphone intercom audio level ≥ 7.07 Vrms
   - Microphone intercom distortion < 10%

Signal Pin	Signal Name	Reference Pin	Reference Name	Load
J2-7	COMM AUDIO HI	J2-19	COMM AUDIO LO	500 Ohms

Noise Level

The S+N/N ratio of the comm radio receiver audio must be at least 35 dB when an input signal is modulated 30% at 1000 Hz and the RF level is at 100 µV.

1. Set the unit for 127 mHz in the 25 or 8.33 kHz mode.
2. Set the signal generator for 127 mHz carrier, 1 kHz audio, 30% modulation, 100 µV output level.
3. Read the SNR.
4. Verify SNR ≥ 35dB.

Signal Pin	Signal Name	Reference Pin	Reference Name	Load
J2-7	COMM AUDIO HI	J2-19	COMM AUDIO LO	500 Ohms

Audio Compressor

The audio level should not vary more than 3 dB as the modulation is varied between 30% and 85% at 1000 Hz when the RF is at 100 µV and the compressor is enabled.

1. Enable the compressor.
2. Set the unit for 25 kHz channel spacing with the compressor enabled.
3. Set the signal generator for a 127 mHz carrier frequency, 1 kHz audio frequency, 30% modulation, 100 µV output level.
4. Measure the ac level in dBm.
5. Set the signal generator for 85% modulation.
6. Measure the ac level in dBm and verify difference in levels ≤ 3 dBm.

Signal Pin	Signal Name	Reference Pin	Reference Name	Load
J2-7	COMM AUDIO HI	J2-19	COMM AUDIO LO	500 Ohms

Squelch

The carrier squelch must operate in 25 kHz and 8.33 kHz modes. In 25 kHz mode the carrier squelch must open the audio output when the RF level is between 6.3 and 25.0 µV, modulated 85% at 8 kHz. In 8.33 kHz mode the carrier squelch must open the audio output when the RF level is between 1.5 and 6.0 µV, modulated 85% at 8 kHz. The carrier squelch must close the audio output within 6 dB of opening squelch level. Carrier squelch operation must be tested at the channels shown below in 25 kHz and 8.33 kHz channel modes.

25 kHz Channel	8.33 kHz Channel
118.025	118.030
127.000	127.005
136.975	136.980

The noise squelch must operate in 25 kHz mode only and must open the audio output when the RF level is between 1.0 and 4.0 µV modulated 30% at 1 kHz. The noise squelch must close the audio output within 6 dB of opening squelch level. Noise squelch operation must be tested at the channels shown below in 25 kHz channel mode only.

25 kHz Channel
118.025
127.000
136.975

The 25 kHz noise squelch must open within 60 mSec when the RF signal transitions from no signal to 4.0 µV modulated 30% at 1 kHz. The 8.33 kHz carrier squelch must open within 60 mSec when the RF signal transitions from no signal to 6.0 µV, modulated 30% at 1 kHz.

The 25 kHz noise squelch and 8.33 kHz carrier squelch must open within 40 mSec when the RF signal transitions from no signal to 1000 µV modulated 30% at 1 kHz.

Carrier Squelch (25 kHz)

1. Enable the compressor.
2. Set the unit to 118.000 mHz, 25 kHz spacing, squelch enabled.
3. Set the signal generator to 118 mHz, 85% modulation, 8 kHz audio frequency.
4. Sweep the output level from 5 µV to 25 µV using a step size of 1 µV.
5. Measure the audio output in Vrms (ac).
6. Repeat steps 3 and 4 until the squelch opens (the audio is present).
7. Store the squelch open point.
8. Reduce the signal generator output by 6 dB.
9. Measure the unit audio output in Vrms (hysteresis).
10. Repeat steps 1-8 at 127.000 mHz and 136.975 mHz.
11. Verify the following:
    - Squelch open point: 6.3 µV ≤ X ≤ 25 µV.
    - Hysteresis: Vrms (ac) < 10 mVrms.

Carrier Squelch (8.33 kHz)

1. Enable the compressor.
2. Set the unit for 118.005 mHz, 8.33 kHz spacing, squelch enabled.
3. Set the signal generator to 118 mHz, 85% modulation, 8 kHz audio frequency.
4. Sweep the output level from 1.5 µV to 6.0 µV, step size: 0.2 µV.
5. Measure the audio output in ac Vrms.
6. Repeat steps 3 and 4 until the squelch opens (the audio is present).
7. Store the squelch open point.
8. Reduce the signal generator output by 6 dB.
9. Measure the audio output in ac Vrms (hysteresis).
10. Verify the following:
    - Squelch open point: 1.5 µV ≤ X ≤ 6.0 µV.
    - Hysteresis: ac Vrms < 10 mVrms.

Noise Squelch (25 kHz)

1. Enable the compressor.
2. Set the unit to 118.000 mHz, 25 kHz spacing, squelch enabled.
3. Set the signal generator to 118 mHz, 30% modulation, 1 kHz audio frequency.
4. Sweep the output level from 1 µV to 4 µV in 0.2 µV step sizes.
5. Measure the unit audio output in ac Vrms.
6. Repeat steps 3 and 4 until the squelch opens (audio is present).
7. Store the squelch open point.
8. Reduce the signal generator output by 6 dB.
9. Measure the audio output in ac Vrms (hysteresis).
10. Repeat steps 1-8 for 127.000 mHz and 136.975 mHz.
11. Verify the following:
    - Squelch open point: 1 µV ≤ X ≤ 4 µV.
    - Hysteresis: ac Vrms < 10 mVrms.

Opening Time (25 kHz)

NOTE

Squelch opening time measurements are made manually using an oscilloscope.

1. Enable the compressor.
2. Set the channel mode to 25 kHz.
3. Generate an RF signal with 30% modulation, a modulation frequency of 1,000 Hz, an RF carrier frequency of 127.000 mHz, and an input level of –53 dBm.
4. Set the volume for rated output.
5. Change the RF input level to no signal.
6. Change the RF input level to –101 dBm (4.0 µV). Observe and capture the waveform showing the time it takes for the audio output to stabilize (open time).
7. Change the RF input level to no signal.
8. Change the RF input level to –53 dBm (1,000 µV). Observe and capture the waveform showing the time it takes for the audio output to stabilize (open time).

Opening Time (8.33 kHz)

1. Enable the compressor.
2. Set the channel mode to 8.33 kHz.
3. Generate an RF signal with 30% modulation, a modulation frequency of 1,000 Hz, an RF carrier frequency of 127.000 mHz, and an input level of –53 dBm.
4. Set the volume for rated output.
5. Change the RF input level to no signal.
6. Change the RF input level to –97.4 dBm (6.0 µV). Observe and capture the waveform showing the time it takes for the audio output to stabilize (open time).
7. Change the RF input level to no signal.
8. Change the RF input level to –53 dBm (1,000 µV). Observe and capture the waveform showing the time it takes for the audio output to stabilize (open time).

Signal Pin	Signal Name	Reference Pin	Reference Name	Load
J2-7	COMM AUDIO HI	J2-19	COMM AUDIO LO	500 Ohms

Selectivity

Nose Bandwidth 25 kHz channel mode: The input signal level required to produce the reference AGC voltage must not vary more than 6 dB over the input signal frequency range of ±8 kHz from the assigned channel frequency. Measure at channel 127.000.

Skirt Bandwidth 25 kHz channel mode: At frequencies displaced by 17 kHz on either side of the assigned channel frequency, the input signal level required to produce reference AGC voltage must be at least 40 dB greater than the level required to produce reference AGC voltage at the assigned channel frequency. At frequencies displaced by 25 kHz on either side of the assigned channel frequency, the input signal level required to produce reference AGC voltage must be at least 60 dB greater than the level required to produce reference AGC voltage at the assigned channel frequency. Measure at channel 127.000.

Nose Bandwidth 8.33 kHz channel mode: The input signal level required to produce the reference AGC voltage must not vary more than 6 dB over the input signal frequency range of ± 2.778 kHz from the assigned channel frequency. Measure at channel 127.005.

Skirt Bandwidth 8.33 kHz channel mode: At frequencies displaced by 7.37 kHz on either side off the assigned channel frequency, the input signal level required to produce reference AGC voltage must be at least 60 dB greater than the level required to produce reference AGC voltage at the assigned channel frequency. Measure at channel 127.005.

Nose Bandwidth

1. Enable the audio compressor.
2. Select 25 kHz or 8.33 kHz channel spacing mode.
3. Set the volume to minimum.
4. Generate an RF signal with no modulation, an RF carrier frequency of 127.000 mHz, and an RF signal level of –93 dBm (10 µV).
5. Measure the IF AGC voltage. This is the reference AGC voltage.
6. Set the RF signal level to –87 dBm (20 µV).
7. Set the RF frequency to 127 + offset frequency (8 kHz or 2.778 kHz for 25 or 8.33 spacing respectively).
8. Measure the AGC voltage. This is the fc (+) voltage.
9. Set the RF frequency to 127 – offset frequency (8 kHz or 2.778 kHz for 25 or 8.33 spacing respectively).
10. Measure the AGC voltage. This is the fc (-) voltage.
11. Verify (reference AGC voltage) – (offset AGC voltage) ≤ 0.

Skirt Bandwidth

1. Enable the audio compressor.
2. Select 25 kHz or 8.33 kHz channel spacing mode.
3. Set the volume to minimum.
4. Generate an RF signal with no modulation, an RF carrier frequency of 127.000 mHz, and an RF signal level of –93 dBm (10 µV).
5. Measure the IF AGC voltage. This is the reference AGC voltage.
6. Set the signal generator for an output of –33 dBm (10,000 µV).
7. Set the RF signal to (+) offset RF frequency (25 kHz in 25kHz mode, 7.37 kHz in 8.33 kHz mode).
8. Measure the IF AGC voltage. This is the fc (+) AGC voltage.
9. Set the RF signal to (-) offset RF frequency (25 kHz in 25 kHz mode, 7.37 kHz in 8.33 kHz mode).
10. Measure the IF AGC voltage. This is the fc (-) AGC voltage.
11. Verify (Reference AGC) – (Offset AGC) > 0.

Signal Pin	Signal Name	Reference Pin	Reference Name	Load
J2-2	COMM IF AGC TEST	J2-21	GROUND	None

Spurious Response

The spurious response rejection is a measure of the capability of the receiver to discriminate between the wanted modulated signal at the nominal frequency and an unwanted signal at any other frequency at which a response is obtained.

The input signal level on an undesired frequency required to produce a detector-carrier (AGC) level equal to that required for a 6 dB signal + noise to noise ratio for 30% modulated, 1000 Hz modulation on the desired channel at rated audio must be not less that 10 mV when:

The undesired input signal frequency is within 108 to 137 mHz and is on any frequency within ± 8 kHz of any assignable channel other than the selected channel and the upper and lower adjacent channels.

The undesired input signal frequency between 50 kHz and 1215 mHz excluding the band 108 to 137 mHz.

Spurious response tests must be conducted at image frequencies (channel frequency + 42.8 mHz) and at half IF frequencies (channel frequency + 10.7 mHz). Measurements are performed at channel 127.000 with image and half IF frequencies shown in the following table:

Image Frequency	169.800 mHz
Half IF Frequency	137.7 mHz

Signal Pin	Signal Name	Reference Pin	Reference Name	Load
J2-2	COMM IF AGC TEST	J2-21	GROUND	None

Set the channel spacing to 25 mHz.

Set the signal generator to the following:

- Carrier Frequency: 127 mHz
- Output Level: 1 µV
- Modulation: 30%
- Audio Frequency: 1 kHz

Measure the reference IF AGC voltage.

Set the signal generator to the following:

- Carrier Frequency: 169.8 mHz
- Output Level: 10 mV
- Modulation: 30%
- Audio Frequency: 1 kHz

Measure the IF AGC voltage.

Set the signal generator to the following:

- Carrier Frequency: 137.7 mHz
- Output Level: 10 mV
- Modulation: 30%
- Audio Frequency: 1 kHz

Measure the IF AGC voltage.

Verify (the reference IF AGC voltage) – (the measured IF AGC voltage) > 0.

Desensitization

Set generator to the desired frequency. Input the following:

- -87 dBm signal
- 30% modulation
- 1 kHz audio frequency

With the signal generator set to the parameters listed above, the receiver (S+N/N) ratio must not decrease to less than 6 dB under the following conditions:

In the presence of an unmodulated carrier having a level of -33 dBm at the receiver input terminals and at frequencies between 108 and 156 mHz, including the frequencies equivalent to the next higher and the next lower channels to which the receiver can be tuned, but excluding the frequency range between these two channels.

In the presence of an unmodulated carrier having a level of -7 dBm at the receiver input terminals and at any frequency within the range 50 kHz and 1215 mHz, except for discrete spurious response frequencies. This excludes the frequencies within the range 87.5 and 156 mHz. At the discrete spurious response frequencies, the unmodulated carrier (undesired signal) must have a level of -33 dBm at the receiver input terminals.

In the presence of an unmodulated carrier having a level of -5 dBm at the receiver input terminals and at frequencies between 87.5 and 107.9 mHz.

Signal Pin	Signal Name	Reference Pin	Reference Name	Load
J2-7	COMM AUDIO HI	J2-19	COMM AUDIO LO	500 Ohms

Manually test per instructions found in DO186a 2.2.11.

Channel Selection Time

NOTE

Use an oscilloscope to perform this test.

The time required for the receiver audio to reach and remain within 3 dB of steady-state output must not exceed 100 msec when any channel is selected.

1. Enable the audio compressor.
2. Select 25 kHz channel spacing.
3. Generate an RF signal with 30% modulation, a modulation frequency of 1,000 Hz, an RF carrier frequency of 136.975 mHz, and an RF input level of –53 dBm.
4. Set volume for rated output.
5. Select 118.000 mHz as the standby frequency.
6. Ground the COMM REMOTE TRANSFER pin (J2-15). This will switch the active frequency to 118.000 mHz.
7. Ground the COMM REMOTE TRANSFER pin (J2-15). This will return the receiver to 136.975 mHz. Observe and capture the waveform showing the time it takes for the audio output to stabilize. Scope must be triggered with the remote transfer signal.
8. Ground the COMM REMOTE TRANSFER pin (J2-15). This will return the receiver to 118.000 mHz. Observe and capture the waveform showing the time it takes for the audio output to stabilize. Scope must be triggered with the remote transfer signal. Verify the audio output stabilizes in < 100 msec.

Signal Pin	Signal Name	Reference Pin	Reference Name	Load
J2-7	COMM AUDIO HI	J2-19	COMM AUDIO LO	500 Ohms

Birdie Channels

The equivalent carrier level must not be greater than 0.5 µV on all channels. AGC reference is taken from an adjacent channel. Known birdie channels in the 25 kHz mode are: 119.750, 130.950, 131.725, 128.000, and 118.000. Known birdie channels in the 8.33 kHz mode are 119.735, 119.740, 119.760, 119.765, 131.710, 131.715, 131.735, 131.740 and130.940.

1. Set the unit channel spacing to 25 kHz.
2. Set the unit channel to a known birdie channel.
3. Generate a signal at a known birdie channel with 30% modulation, 1kHz modulation frequency, and an output level of 2 µV.
4. Measure the SNR (averaged over 10 readings). Store the result.
5. Repeat steps 1-4 for each birdie channel. Verify the measured SNR ≥ 6.0 dB.

Signal Pin	Signal Name	Reference Pin	Reference Name	Load
J2-2	COMM IF AGC TEST	J2-21	GROUND	None

LO Radiation

The received LO radiation must not exceed - 57 dBm out of the antenna port.

1. Possible Faulty Circuits: Shielding or Antenna BNC Connector Ground. Check CPU, Synthesizer, RF Shields for good solder connection to PCB. Check shield covers for tight fit.
2. Check BNC antenna connector nut and make sure it is tight against the RF fence.
3. Set the channel spacing to 25 kHz.
4. Set the RF carrier frequency to 127.000 mHz.
5. Ensure that the comm transceiver is not in the transmit mode.
6. Set the spectrum analyzer for a center frequency of 148.400 mHz, 10kHz/div. span.
7. Measure the peak RF output power from the comm antenna port.
8. Verify peak RF output power ≤ -57dBm.
9. Adjacent Channel Rejection (8.33 kHz mode only)

The adjacent channel rejection (which is the ratio between the desired signal level and the lowest interfering signal level) must be at least 45 dB under the following conditions: the desired on-channel signal is modulated 60% at 1000 Hz at a level sufficient to produce a S+N/N of 20 dB and an interfering signal on the adjacent upper and lower 8.33 kHz channel is modulated 60% at 400 Hz adjusted to a level that reduces the S+N/N of the desired signal from 20 dB to 14 dB.

Signal Pin	Signal Name	Reference Pin	Reference Name	Load
J2-7	COMM AUDIO HI	J2-19	COMM AUDIO LO	500 Ohms

Test manually per instructions found in DO186a 2.2.16.

RF Power Output

NOTE

Except as noted below, all transmitter measurements are taken at the transmit RF output BNC connector using a standard load of 50 ohms.

The transmitter must deliver a minimum output power shown in the below table. The power must not vary more than three watts across the operating band as described in the com frequency range section. Transmitter power must be measured at channels 118.500, 127.500, and 136.500.

Power Input Voltage Range (V)	127.51	13.752	27.53
Minimum Transmitter Power (W)	10	10	16

1. Set the unit to 118.500 mHz.
2. Turn off the microphone audio.
3. Key the microphone.
4. Measure the TX CW power in watts.
5. Unkey the microphone.
6. Repeat steps 2-5 at 127.500 mHz and 136.5 mHz.
7. Verify the following:
   - 10W com radio: 10-14 watts
   - 16W com radio: 16-22 watts

Modulation Capability

- The modulation must not be less than 70% and not greater than 99.99% with a standard modulator signal applied to the transmitter. Modulation must be measured at channels 118.500, 127.500 and 136.500.
- The microphone adjustment must be capable of adjusting the input signal level from 70 mVrms to 3 Vrms and maintain the specification of DO186a 2.3.3.
- The microphone compressor must have a minimum dynamic range of 20 dB. Measure at channel 127.000.
- The microphone compressor must clip 3 dB above the dynamic range.
- The microphone compressor attack time must be less than 20 msec and the decay time must be greater than 400 msec.

1. Apply a standard microphone test signal.
2. Set the carrier frequency to 118.000 mHz.
3. Key the transmitter.

4. Measure the AM modulation of the transmitted signal.

5. Unkey the transmitter.

6. Repeat steps 2-6 at carrier frequencies of 127.000 and 136.975 mHz.

7. Verify that for a 10 watt com radio modulation must be between 80% and 95%. For a 16 watt com radio modulation must be between 80 and 100%.

Next test:

1. Set the unit to 127.5 mHz.

2. Set the signal generator for a standard microphone audio signal.

3. Key the microphone.

4. Measure the AM depth of modulation.

5. Set the microphone audio for 2.75 V.

6. Measure the AM depth of modulation.

7. Verify difference in modulation is 0 dB (± 0.5dB).

Carrier Noise Level

The demodulated noise on the transmitter output without audio modulation must be at least 45 dB below the demodulated audio level obtained when the transmitter is modulated with a standard microphone input signal. Measure at channels 118.500, 127.500, and 136.500.

1. Generate and apply a standard microphone test signal.

2. Set the carrier frequency to 118.000 mHz.

3. Key the transmitter.

4. Measure the signal to noise ratio (SNR) of the transmitter output.

5. Unkey the transmitter.

6. Repeat steps 3-5 using RF carrier frequencies of 127.000 mHz and 136.975 mHz.

7. Verify SNR ≥ 45 dB.

Frequency Stability and Tolerance

The RF carrier frequency must be within 0.0005% (5 PPM) of the selected channel frequency when the transmitter is modulated with a standard microphone input signal. Measure at channels 118.500, 127.500, and 136.500.

1. Set the unit to 136.500 mHz.

2. Generate and apply a standard microphone audio signal.
3. Key the microphone.
4. Measure the frequency error.
5. Unkey the microphone.
6. Verify frequency error is 0 (±5 PPM).

Demodulated Audio Distortion

The combined total of distortion and noise in the demodulated output must not exceed 10% of the total demodulated output at modulation frequencies of 350, 1000, and 2500 Hz when the transmitter is modulated with a standard microphone input signal.

1. Set the RF carrier frequency to 118.500 mHz.
2. Generate and apply a standard microphone test signal except set the frequency to 350 Hz.
3. Key the transmitter.
4. Measure the distortion of the signal after the AM demodulator.
5. Unkey the transmitter.
6. Repeat steps 2-5, setting the audio frequency to 1,000 Hz and 2,500 Hz.
7. Repeat steps 1-6, setting the RF carrier frequency to 127.500 mHz and 136.500 mHz.
8. Verify demodulated audio distortion ≤ 10% for all tests.

Channel ID	Modulation Freq (Hz)
118.500	350
118.500	1000
118.500	2500
127.500	350
127.500	1000
127.500	2500
136.500	350
136.500	1000
136.500	2500

Sidetone Audio Response

- The sidetone audio frequency response must not vary more than 6 dB over the frequency range of 350 to 2500 Hz, when the audio input is held constant at the value which produces 70% modulation at the frequency of maximum response. Measure at channel 127.500.

- The sidetone audio level must be capable of adjusting from 1.4 to 7.07 Vrms when the transmitter is modulated with a standard microphone input signal.
- The nominal sidetone audio level must be set to 1.4 Vrms into a 500 ohm load when the transmitter is modulated with a standard microphone input signal. Measure at 118.500, 127.500, and 136.500.

1. Set the unit to 118.500 mHz.
2. Generate and apply a standard microphone audio signal.
3. Key the microphone.
4. Measure the RMS audio level.
5. Unkey the microphone.
6. Repeat steps 1-5 for 127.500 mHz and 136.500 mHz.
7. Verify audio level is between 1.12 and 1.68 Vrms.

Signal Name	Signal Pin	Reference Name	Reference Pin	Load
COMM AUDIO HI	J2-7	COMM AUDIO LO	J2-19	500 Ohms

Spurious Emissions

Spurious emissions below 1000 mHz must not exceed -36 dBm with a measurement bandwidth of 1 kHz. Above 1000 mHz, spurious emissions must not exceed -30 dBm with a measurement bandwidth of 10 kHz. Set the spectrum analyzer to the following:

- Reference Level: -30 dBm
- Center Frequency: 600 mHz
- Span: 800 mHz
- Marker ON

1. Set the unit to 118.500 mHz.
2. Key the microphone.
3. Measure the peak using measurement averaging.
4. Unkey the microphone.
5. Verify result is ≤ 36 dBm.

VSWR

Across the entire band of operation when a 3:1 mismatch is applied to the transmitter output terminals at all possible phase angles, the power output must be at minimum 5 watts for a 10 watt radio, or 8 watts minimum for a 16 watt radio.

The requirements of the demodulated audio distortion and spurious emissions sections must be met with the following exceptions: the total noise and distortion of the modulated transmitter must not exceed 25%, and harmonically related spurious emissions must not exceed -16 dBm. Perform the test at frequencies of 118.500, 127.500 , and 136.500 mHz.

Frequency Modulation

NOTE

FM deviation is to be measured with a detector calibrated to respond according to the formula [RMS x Sqrt(2)].

When the transmitter is modulated with a standard microphone input signal, the frequency deviation due to unwanted frequency modulation of the carrier must not exceed ± 1000 Hz. Measure at channels 118.500, 127.500, and 136.500.

1. Generate and apply a standard microphone test signal.
2. Set the carrier frequency to 118.500 mHz.
3. Key the transmitter.
4. Measure the FM deviation.
5. Unkey the transmitter.
6. Repeat steps 2-5, setting the RF carrier frequency to 127.500 mHz and 136.500 mHz.
7. Verify FM deviation is ≤ 1000Hz.

Demodulated Audio Response

With the transmitter set to 70% modulation at the frequency of maximum response, the frequency response of the audio output must not vary more than 6 dB when the audio input frequency is swept from 350 to 2500 Hz. Measure at channel 127.500 while sweeping the modulation from 350 Hz to 2500 Hz in 100 Hz increments.

1. Set the unit to 127.500 mHz.
2. Generate and apply a standard microphone audio test signal.
3. Key the microphone.
4. Measure the AM modulation depth.

5. Adjust the microphone audio signal level for 70% modulation. If the microphone audio drops below 100 mV and the unit still shows 70% modulation or greater, stop the test and record as a test failure. If test passes, proceed.

6. Record the reference input level.

7. Unkey the microphone.

8. Set the audio test signal to 350 Hz at the recorded reference input level.

9. Key the microphone.

10. Measure the modulation level in dB and record as reference.

11. Measure the AM depth in dB while sweeping the audio signal from 400-2500 Hz in 100 Hz steps.

12. Record the max and min levels.

13. Unkey the microphone.

14. Verify that the difference between the max and min values is ≤ 6 dB.

4.6 VOR/LOC RECEIVER TESTING

4.6.1 Standard Loads

NAV Receiver Antenna

The NAV receiver antenna J5 must operate in a 50 ohm load.

NAV Course Deviation Deflection Load (NAV +LEFT)

One standard CDI deflection load is 1000 ohms. Three standard loads must be connected between NAV +LEFT J6-5 and NAV +RIGHT (NAV COMMON) J6-6.

NAV Course Deviation Flag Load (NAV +FLAG)

One standard CDI flag load is 1000 ohms. Three standard loads must be connected between NAV +FLAG J6-3 and NAV -FLAG (NAV COMMON) J6-4.

NAV To/From Load (NAV +TO)

One standard To/From load is 200 ohms. Three standard loads must be connected between NAV +TO J6-1 and NAV +FROM (NAV COMMON) J6-2.

NAV Composite Video Load (NAV COMPOSITE OUT)

One standard composite video load is 10,000 ohms connected between NAV COMPOSITE OUT J6-8 and GND J6-41.

NAV Super Flag Load (NAV SUPER FLAG OUT)

One standard super flag load is 56 ohms connected between NAV SUPER FLAG OUT J6-15 and GND J6-41.

G/S Super Flag Load (G/S SUPER FLAG OUT)

One standard super flag load is 56 ohms connected between G/S SUPER FLAG OUT J6-38 and GND J6-41.

ARINC 429 Transmitter Load (VLOC 429 OUT A/OUT B)

The standard ARINC 429 transmitter load is 2.4K ohms resistance and 250 pF capacitance between the differential outputs VLOC 429 OUTA J6-24 and VLOC 429 OUTB J6-23, and 2.4K ohms resistance and 250 pF capacitance connected from each of the outputs to ground.

RS232 Transmitter Load (VLOC SERIAL OUT)

The standard RS232 transmitter load is 3000 ohms measured from the RS232 serial output to ground. One standard load is connected between VLOC SERIAL OUT J10-10 and GND J10-4.

NAV Audio Output Load (NAV AUDIO HI to NAV AUDIO LO)

The standard audio output load is 500 ohms, connected between NAV AUDIO HI J6-16 and NAV AUDIO LO J6-17.

4.6.2 VOR Standard Signals

All RF input levels for the NAV receiver requirements are specified in dBm and do not require a 6 dB attenuator on the output of the signal generator provided the signal generator is calibrated into a 50 ohm load.

Standard Test Signals

Unless otherwise specified, the RF input signals must be at a level of -53 dBm and have a frequency within 0.001% of the assigned carrier frequency in addition to the characteristics outlined below.

Standard VOR Test Signal

A standard VOR test signal is composed of two components:

An RF carrier, amplitude modulated 30% with a 9960 Hz signal that is frequency modulated at 30 Hz with a deviation ratio of 16 (frequency deviation of ± 480 Hz) for Reference phase (REF), and variable phase (VAR) 30 Hz signal amplitude modulated 30% with respect to the reference phase signal (REF). The RF input signal must be at a level of -53 dBm and have a frequency within 0.001% of the assigned carrier frequency.

Standard VOR Audio Test Signal

A standard VOR audio test signal is a standard VOR test signal to which is added a 1000 Hz signal, amplitude modulating the carrier 30%.

Standard Audio Test Signal

A standard audio test signal is a RF carrier amplitude modulated 30% at 1000 Hz. The RF input signal must be at a level of -53 dBm and have a frequency within 0.001% of the assigned carrier frequency.

Standard VOR Deviation Signal

A standard VOR deviation signal is a standard VOR test signal in which the difference in phase between the reference and variable phase signal is 10 (± 0.3) degrees from the setting of the equipment course selector. (This produces a NAV +LEFT output voltage of 150 millivolts ± 4.5 millivolts.)

Standard VOR Centering Signal

A standard VOR centering signal is a standard VOR test signal in which the difference in phase between the reference and variable phase signal is equal (±0.3 degrees) from the setting of the equipment course selector.

Localizer Standard Signals

All RF input levels for the NAV receiver requirements are specified in dBm and do not require a 6 dB attenuator on the output of the signal generator provided the signal generator is calibrated into a 50 ohm load.

Standard Test Signals

Unless otherwise specified, the RF input signals must be at a level of -53 dBm and have a frequency within 0.001% of the assigned carrier frequency in addition to the characteristics outlined below. Note: ddm (difference in depth of modulation) is the absolute difference in percentage of modulation of two tones divided by 100.

Standard Localizer Test Signal

A standard localizer test signal is an RF carrier amplitude modulated simultaneously by 90 and 150 Hz tones so that the sum of their separate modulation levels is 40% ± 1%. The tones must have the following characteristics:

They must be phase-locked in such a manner that their voltage waveforms simultaneously pass through zero in the same direction.

The maximum simultaneous variation in frequency must not exceed ± 0.3%.

The total harmonic content of each tone must not exceed 3%.

The RF level must be -53 dBm and have a frequency within 0.001% of the assigned carrier frequency unless otherwise specified.

Standard Localizer Centering Test Signal

A standard localizer centering test signal is a standard localizer test signal in which the difference in depth of modulation of the 90 and 150 Hz signals is less than 0.001.

Standard Localizer Deviation Test Signal

A standard localizer deviation test signal is a standard localizer test signal in which the difference in depth of modulation (ddm) of the 90 and 150 Hz signals is 0.093 ±0.002.
A NAV +LEFT output voltage of 90 millivolts results.

Standard Localizer Audio Test Signal

A standard localizer audio test signal is a standard localizer test signal to which is added a 1020 Hz signal amplitude modulating the carrier 30%.

Standard Audio Test Signal

A standard audio test signal is an RF carrier amplitude modulated 30% at 1020 Hz.

4.6.3 NAV Receiver

Voice/Ident Audio Output Level

1. Apply a standard audio test signal having a RF level of -93 dBm.
2. Select maximum audio (volume control turned fully clockwise).
3. Turn off the ident filter.
4. Measure 500 Ω VOR/ILS AUDIO HI J6-16 with respect to 500 Ω VOR/ILS AUDIO LO J6-17.
5. Verify an audio output level into a 500 ohm load that is not less than 20 Vpp (7.07 Vrms).
6. Select minimum audio (volume control turned fully counter clockwise without turning off). Verify that an audio output level into a 500 ohm load is not more than 63 mVpp (22 mVrms).

Voice/Ident Audio Frequency Response

With the IDENT mode selected, the difference between the maximum and minimum VOICE/IDENT audio output levels measured at the NAV AUDIO HI output for 350 Hz and 2500 Hz relative to the frequency of max output must be less than 6 dB, when the RF input level is -73 dBm.

With the IDENT mode selected, the difference between the maximum and minimum VOICE/IDENT audio output levels measured at the NAV AUDIO HI output for 150 Hz relative to the frequency of max output, and for 9000 Hz relative to the frequency of max output must be not be less than 20 dB, when the RF input level is -73 dBm.

- Measure NAV AUDIO HI J6-16 with respect to NAV AUDIO LO J6-17 and verify that the above requirements are met.

Voice/Ident Audio Distortion

This test is measured at NAV AUDIO HI J6-16 with respect to NAV AUDIO LO J6-17. Use -79 dBm for this test since distortion at lower RF level is higher.

Verify the following:

The combined distortion and noise in the receiver VOICE/IDENT audio output must not exceed 10% at all levels up to 100 mW. This requirement must be met over the RF input range of -79 to -27 dBm using a standard VOR audio test signal at modulation frequencies of 350 Hz, 1000 Hz, and 2500 Hz.

VOR AGC

Measure NAV AUDIO HI J6-16 with respect to NAV AUDIO LO (GND) J6-17. Must be in IDENT mode to pass 1000 Hz tone.

Verify the following:

Between the limits of -99 dBm and -13 dBm input of a standard VOR audio test signal, the difference between the maximum and the minimum VOICE/IDENT audio output levels must not exceed 3 dB.

Localizer

Measure at NAV AUDIO HI J6-16 with respect to NAV AUDIO LO (GND) J6-17. Must be in IDENT mode to pass 1000 Hz tone.

Verify that between the limits of -86 dBm and -33 dBm input of a standard localizer audio test signal, the difference between the maximum and the minimum VOICE/IDENT audio output levels is not greater than 3 dB.

VOR Audio Sensitivity

This test is measured at NAV AUDIO HI J6-16 and NAV AUDIO LO J6-17. Apply a -103.5 dBm RF level to the RF input. Must be in IDENT mode to pass 1000 Hz tone.

Verify the audio SINAD is not be less than 6 dB with a standard VOR audio test signal at RF frequencies of 108.00 mHz, 112.50 mHz, 112.55 mHz, and 117.95 mHz.

Localizer (Optional Test)

Measure at the NAV AUDIO HI J6-16 and NAV AUDIO LO J6-17 outputs with a standard localizer audio test signal at RF frequencies of 108.10 mHz and 111.95 mHz. Must be in IDENT mode to pass 1000 Hz tone.

Verify the audio SINAD is not be less than 6 dB.

Receiver Quieting

Apply a -86 dBm RF level to the RF input.

Verify the audio SINAD is not be less than 25 dB when measured at the NAV AUDIO HI J6-16 and NAV AUDIO LO J6-17 outputs with a Standard VOR Audio Test signal at 108.00 mHz.

Ident/Voice Tone Ratio

Apply a -67 dBm RF level applied to the RF input.

Verify the following: The ident/tone ratio must not be less than 20 dB when measured at the NAV AUDIO HI J6-16 and NAV AUDIO LO J6-17 outputs with a Standard VOR Audio Test signal with modulation frequency of 1020 Hz at 108.00 mHz or with a Standard Localizer Audio Test signal with modulation frequency of 1020 Hz at 108.10 mHz.

Flag Sensitivity

NOTE

A NAV +FLAG output voltage of greater than 260 millivolts fully conceals the indicator flag (OUT OF VIEW) and a NAV +FLAG output voltage of less than 125 millivolts fully reveals the indicator flag (IN VIEW).

The NAV +FLAG output must not be less than 260 millivolts when measured at the NAV +FLAG J6-3 and NAV -FLAG (NAV COMMON) J6-4 outputs with a Standard VOR Test Signal at 108.00 mHz or a Standard Localizer Test Signal at 108.10 mHz.

The NAV +FLAG output must not be less than 260 millivolts when measured at the NAV +FLAG J6-3 and NAV -FLAG (NAV COMMON) J6-4 outputs with a Standard VOR Test Signal at 108.00 mHz and the bearing error must be less than 3 degrees.

The NAV +FLAG output must not be less than 260 millivolts when measured at the NAV +FLAG J6-3 and NAV -FLAG (NAV COMMON) J6-4 outputs with a Standard Localizer Test Signal at 108.10 mHz. (Optional Test)

The NAV +FLAG output must not be more than 125 millivolts (Flagged) when measured at the NAV +FLAG J6-3 and NAV -FLAG (NAV COMMON) J6-4 outputs with a Standard Localizer Test Signal at 108.10 mHz when the RF level is lowered to the Flag threshold level such that it causes the course deviation output (NAV +LEFT) to be less than 50% of standard deflection. 50% of standard deflection in LOC mode is 45 millivolts. Flag threshold deflection percentage must be greater than 50%.

The NAV +FLAG J6-3 output with respect to the NAV –FLAG (NAV COMMON) J6-4 output must not be less than 260mV with a Standard VOR Test Signal at 108.00 mHz at a level of –106.5 dBm. These same outputs must be 0±25mV with a Standard VOR Test Signal at 108.00 mHz at a level of –115.00 dBm.

Verify the following: Apply a -103.5 dBm RF level applied to the RF input and verify the requirements listed above.

VOR Course Deviation Sensitivity

The magnitude of the course deviation output must not be less than 60% (90 millivolts) of the nominal output (150 millivolts) measured at the NAV +LEFT J6-5 and NAV +RIGHT (NAV COMMON) J6-6 outputs with a Standard VOR Deviation Signal at 108.00 mHz.

The magnitude of the course deviation output must be 0±45mV measured at the NAV +LEFT J6-5 and NAV +RIGHT (NAV COMMON) J6-6 outputs with a
–106.5 dBm RF level Standard VOR Deviation Signal at 108.00 mHz with OBS and signal generator bearings set to 150 degrees ‘FROM’.

The receiver sensitivity must meet the following requirements with a -103.5 dBm RF level applied to the RF input:

Localizer Course Deviation Sensitivity

The magnitude of the course deviation output must not be less than 60% (54 millivolts) of the nominal output (90 millivolts) measured at the NAV +LEFT J6-5 and NAV +RIGHT (NAV COMMON) J6-6 outputs with a Standard Localizer Deviation Signal at 108.10 mHz.

VOR

The VOR Course Deviation Flag must be flagged when measured through the VLOC SERIAL OUTJ10-10:

- In the absence of an RF signal.
- In the absence of the 9960 Hz modulation on an otherwise Standard VOR Test Signal of -93 to -27 dBm.
- In the absence of either one of the two 30 Hz modulations on an otherwise Standard VOR Test Signal of -93 to -27 dBm.
- When a -67 dBm VOR carrier at the selected frequency is modulated 30% only by an audio signal at 350 Hz, 1000 Hz, or 2500 Hz.
- When the RF level of a Standard VOR Test Signal is such that the deviation sensitivity is 1/2 that with a -73 dBm signal. Verify that the bearing error is less than 3 degrees at a RF level just above the flagged level. Note: there is 3 dB of hysterisis on the VOR flag output.
- The VOR Course Deviation Flag must not be flagged when measured through the VLOC SERIAL OUT J10-10:
- When the RF level of a standard VOR test signal is varied over the range of at least -93 to -27 dBm. Use only -93 dBm for this test since it will flag before the -27 dBm signal will.

Localizer (Optional Test)

The Localizer Course Deviation Flag must be flagged when measured through the VLOC SERIAL OUT J10-10:

- In the absence of an RF signal.
- When either the 90 Hz or 150 Hz modulating signals is removed and the other is maintained at its normal 20%.
- In the absence of both 90 and 150 Hz modulation.
- When the level of a standard localizer deviation test signal produces 50% (0.0465 ddm) or less of standard deflection of the deviation indicator. Note: there is 2 dB of hysterisis on the LOC flag output.

VOR OBS Bearing Accuracy

The bearing information when measured through the VLOC SERIAL OUT J10-10 must not have an error in excess of 2 degrees using a Standard VOR Test Signal and a Precision Track Selector or similar device at 60, 150, 240, and 330 degrees in course angle.

Selectivity (Bandwidth)

The frequency response must not vary more than 6 dB as measured by the NAV IF AGC J6-7 voltage over the frequency range fc + 16.5 kHz to fc - 16.5 kHz where fc is the assigned channel frequency.

Localizer (Bandwidth)

The course deviation measured through VLOC SERIAL OUT J10-10 must be 0 ddm ± 0.0093 ddm when using the Standard Localizer Centering Test Signal as the RF frequency is varied from fc + 9 kHz to fc - 9 kHz from the assigned channel.

Nose Bandwidth: The input signal level required to produce the reference NAV IF AGC J6-7 voltage must not vary more than 6 dB over the input signal frequency range of fc + 9 kHz to fc - 9 kHz from the assigned channel frequency. (Optional Test).

Skirt Bandwidth: At frequencies of fc + 36 kHz and fc - 36 kHz the input signal level required to produce reference NAV IF AGC J6-7 voltage must be at least 69 dB greater than the level required to produce reference AGC voltage at the assigned channel frequency.

Spurious Response

VOR

With the VOR receiver tuned to 117.95 mHz, the input signal level of an undesired image frequency of 77.15 mHz required to produce a detector-carrier (AGC) level obtained at the NAV IF AGC J6-7 output with a -93 dBm Standard Localizer Audio Test Signal must not be less than -13 dBm.

Localizer

With the Localizer receiver tuned to 111.95 mHz, the input signal level of an undesired image frequency of 71.15 mHz required to produce a detector-carrier (AGC) level obtained at the NAV IF AGC J6-7 output with a -93 dBm Standard Localizer Audio Test Signal must not be less than -13 dBm.

Centering Accuracy

The centering error measured through VLOC SERIAL OUT J10-10 must be less than 0.00465 ddm (4.5 millivolts (5%)) using a Standard Localizer Centering Test Signal.

Deflection Balance

When the receiver has been adjusted to produce a course deviation output standard deflection (0.093 ddm produces 90 millivolt NAV +LEFT output voltage) with a -53 dBm Standard Localizer Deviation Test Signal, 90 Hz greater than 150 Hz, the deviation of opposite polarity obtained when the signal is modulated with 150 Hz greater than 90 Hz must be within 8% (7.2 millivolts) of the standard deflection as tested in HOT and COLD environments, and must be within 4% (3.6 millivolts) of the standard deflection as tested at AMBIENT.

Measure NAV +LEFT J6-5 with respect to NAV +RIGHT J6-6.

Harmonic Distortion

With a -53 dBm signal amplitude modulated 30% at 1 kHz, the total harmonic distortion measured at the NAV AUDIO HI J6-16 and NAV AUDIO LO J6-17 outputs must be less than 5%.

4.7 GLIDESLOPE RECEIVER TESTS

Standard Loads

Glideslope Receiver Antenna

The glideslope receiver antenna must operate in a 50 ohm load.

Course Deviation Deflection Load

One standard CDI deflection is 1000 ohms.

Course Deviation Flag Load

One standard CDI flag load is 1000 ohms.

To/From Load

One standard TO/FROM load is 200 ohms.

Standard Signals

All RF input levels for the glideslope receiver requirements are specified in dBm and do not require a 6 dB attenuator on the output of the signal generator provided the signal generator is calibrated into a 50 ohm load.

Standard Glideslope Test Signal

- A standard glideslope test signal is an RF carrier amplitude modulated simultaneously by 90 and 150 Hz tones so that the sum of their separate modulation levels is 80% ± 2%. The tones must have the following characteristics:
- They must be phase-locked in such a manner that their voltage waveforms simultaneously pass through zero in the same direction.
- The maximum simultaneous variation in frequency must not exceed ± 0.3%.
- The total harmonic content of each tone must not exceed 3%.
- The RF level must be -56 dBm and have a frequency within 0.001% of the assigned carrier frequency unless otherwise specified.

Standard Glideslope Centering Test Signal

A standard glideslope centering test signal is a standard glideslope test signal in which the difference in depth of modulation of the 90 and 150 Hz signals is less than 0.002 ddm.

Standard Glideslope Deviation Test Signal

A standard glideslope deviation test signal is a standard glideslope test signal in which the difference in depth of modulation of the 90 and 150 Hz signals is 0.091 ± 0.002 ddm.

Standard Glideslope Deflection

Standard glideslope deflection must be 52% (78 µA) of center to full scale deflection, when a standard Glideslope deviation test signal is applied at an RF level of –56 dBm.

Course Deviation Output Characteristic Test

The deviation output must be capable of driving up to three 1000 ohm meter loads with 150 ± 15 millivolts for full scale deflection. The drive circuit must provide for more than full scale deflection with a maximum course deviation output voltage of 300 ± 30 millivolts.

Course Deviation Centering Accuracy

When centered the deflection output must be 0 ± 7.8 millivolts.

Course Deviation Deflection Accuracy

With a standard deflection 'FLY DOWN' condition (90 Hz dominant), the output must be -78 ± 7.8 millivolts. With a standard deflection 'FLY UP' condition (150 Hz dominant), the output must be +78 ± 7.8 millivolts.

Course Deviation Flag

When valid information is present (flag out of view) the course deviation flag output must be 375 ± 80 millivolts. When invalid information is present (flag in view) the course deviation flag output must be 0 ± 25 millivolts.

Glideslope Superflag Output

When the course deviation is valid (flag out of view) the G/S superflag output must sink at least 10 ma down to 1 volt. When the course deviation is invalid (flag in view) the G/S superflag output must sink less than 10 µa.

Receiver Sensitivity

The receiver sensitivity measured through G/S SERIAL_OUT must be greater than -92 dBm. Measure at G/S (LOC) frequencies of 329.15 mHz (108.95 mHz), 332.00 mHz (109.30 mHz), and 335.00 mHz (110.30 mHz). The receiver sensitivity is defined as the minimum RF input level of a standard glideslope deflection test signal which results in a maximum deviation .0546 ddm, 60% of standard deflection.

Sensitivity Variation

The receiver sensitivity variation must not be greater than 3dB when the input frequency is varied from 329.15 to 335 mHz.

Centering Accuracy

The centering accuracy measured through G/S SERIAL_OUT must be 0 ± .0091 ddm when using the standard glideslope centering test signal.

TESTS

AGC

The course deviation measured through G/S SERIAL_OUT must be 0 ddm ± .0091ddm when using the glideslope centering test signal as the RF level is varied between -76 to -33 dBm (this is an optional test).

The course deviation measured through G/S SERIAL_OUT must be 0.091 ± .0091 ddm when using the standard glideslope deviation test signal as the RF level is varied between -76 dBm to -33 dBm.

Selectivity (Bandwidth)

The course deviation measured through G/S SERIAL_OUT must be 0 ± .0091 ddm when using the glideslope centering test signal at -87 dBm as the RF frequency is varied ± 17 kHz from the assigned channel.

Deflection Error: At frequencies displaced by ±17 kHz from the assigned channel frequency, a -87 dBm 0.091 ddm standard glideslope signal must produce a dbar output voltage of 78 ± 10 mV.

Nose Bandwidth: The input signal level required to produce the reference AGC voltage must not vary more than 6 dB over the input signal frequency range of ±17 kHz from the assigned channel frequency.

Skirt Bandwidth: At frequencies displaced by ±132 kHz on either side of the assigned channel frequency, the input signal level required to produce reference AGC voltage must be at least 60 dB, respectively, greater than the level required to produce reference AGC voltage at the assigned channel frequency (this is an optional test).

Deflection Balance

The standard deflection at -56 dBm with the 90 Hz greater than 150 Hz, and the standard deflection with the 150 Hz greater than 90 Hz must be within ± 0.00728 ddm and opposite polarity as tested in hot and cold environments, and must be within ± 0.005 ddm and opposite polarity as tested at ambient when measured through G/S SERIAL_OUT.

The standard deflection at -56 dBm with the 90 Hz greater than 150 Hz, and the standard deflection with the 150 Hz greater than 90 Hz must be within ± 6.24 mV and opposite polarity as tested in hot and cold environments, and must be within ± 5 mV and opposite polarity as tested at ambient when measured through G/S + UP.

Glideslope Course Deviation Flag Requirements

Requirement: the glideslope course deviation flag must be flagged when measured through G/S SERIAL_OUT:

When the RF level of a standard deviation test signal produces 50% or less of standard deflection of the deviation indicator:

- In the absence of 150 Hz modulation.

- In the absence of 90 modulation.
- In the absence of both 90 and 150 Hz modulation.
- In the absence of RF.

The G/S +FLAG output must be 0 ± 25 millivolts (Flagged) when measured at the G/S +FLAG J6-30 and G/S -FLAG (G/S COMMON) J6-31 outputs with a standard glideslope deviation test signal at 334.7 mHz (108.10 mHz LOC freq) when the RF level is lowered to the flag threshold level such that it causes the course deviation output (G/S +UP) J6-32 to be less than 50% of standard deflection. 50% of standard deflection is 39 millivolts. Flag threshold deflection percentage must be greater than 50%.

Spurious Response

The RF level of an undesired image frequency test signal of 245 mHz must be greater than -27 dBm to produce an AGC level equal to that of a desired frequency having a level of -87 dBm when the glideslope receiver is tuned to 335 mHz. The undesired test signal must consist of a standard glideslope signal in which the 150 Hz signal is modulated at 30%.

4.8 TESTING FAILURES

Table 4-6 lists recommended actions based on main board failures that may occur during testing. Perform the recommended actions in the order given in the table. For all other boards, replace the board if any failure occurs during testing.

Table 4-6. Testing Failures—Main Board

TEST FAILURE	RECOMMENDED ACTION
BUS Power	Return the unit for service
Push Button Response	Check Applicable Flex Replace Keyboard Replace CDU Return the unit for service
Rotary Knobs	Check Applicable Flex Replace CDU Return the unit for service
Data Card Tests	Return the unit for service
Photocell	Check Applicable Flex Replaced Keyboard Replace CDU Return the unit for service
Lighting BUS Input	Return the unit for service
Lighting BUS AC	Return the unit for service
Lighting BUS DC	Return the unit for service
Memory Battery Voltage	Replace Memory Battery
Display Pattern Test	Check Applicable Flex Replace CDU Return the unit for service
Display Max Level Test	Replace Inverter Board

	Replace CDU Return the unit for service
Display Dim Test	Replace Inverter Board Replace CDU Return the unit for service
Keyboard LED Dim Test	Check Applicable Flex Replaced Keyboard Replace CDU Return the unit for service
GPS Receiver Sensitivity	Replace GPS Module
GPS Antenna Bias	Replace GPS Module
GPS Signal	Replace GPS Module Return the unit for service
Time Mark Output	Replace GPS Module

4.9 RETURN TO SERVICE TEST

When a board is replaced and the unit has been reassembled, verify that the power-up self-test sequence is successfully completed and no failure messages are displayed. Ground checks that are described in the GNS 400W Installation Manual may be adapted for bench checkout and may be useful in verifying that a reassembled unit is working properly. The minimum performance tests contained in this section of the manual may also be used as a return to service test.

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SECTION 5
REPLACEMENT PROCEDURES

This section describes replacement procedures for all serviceable parts listed in Section 6. The section also includes periodic maintenance information.

NOTE

All units contains static sensitive components. Observe proper anti-static procedures when replacing parts.

5.1 TOOLS

Standard avionics shop tools are used to replace parts.

5.2 INSPECTION

Perform the following inspection procedures on an assembled unit before replacing any parts.

- Verify that all screws are secure and in place.
- Verify that the display face is clean.
- Verify that external surfaces have no dents, scratches, etc.
- Inspect for broken or bent pins on external connectors.
- Inspect internal areas for obvious shorts, burned areas, or corrosion.
- Inspect for charred, loose, or damaged components.
- Inspect wires and cables for breaks in insulation or tears.

5.3 UNIT DESCRIPTION

All units are nearly identical in their electrical and mechanical design and board location. Table 5-1 identifies the board configuration for each unit in the 400W series.

Table 5-1. Unit Board Configuration

	Main Board	Inverter Board	Interface Board	WAAS GPS Module	COM Board	NAV Board	GS Board
GPS 400W	•	•	•	•			
GNC 420W	•	•	•	•	•		
GNC 420AW	•	•	•	•	•		
GNS 430W	•	•	•	•	•	•	•
GNS 430AW	•	•	•	•	•	•	•

5.4 REPLACEMENT PROCEDURES

5.4.1 Data Cards

Remove all data cards from the unit before replacing parts. Remove the cards with the power turned off.

Jeppesen Cards

To insert the NavData® or Terrain Data Card (Figure 5-2):

1. Place the card into the appropriate card slot with the label facing to the left and the swing arm handle at the bottom front.

2. Press the data card into place until it seats on the internal connector and the front of the card is flush with the face of the unit.

3. If the swing arm handle is up, gently lower the handle and push it into place—flush with the face of the unit.

To remove the NavData® or Terrain Data Card (Figure 5-2):

1. Gently press on the tab—using a slight upward motion—at the front center of the data card. This partially deploys the swing arm handle.

2. Rotate the swing arm handle upward (and outward) until it locks into place, perpendicular to the face of the unit.

3. Grasp the top and bottom surfaces of the swing arm handle between your thumb and forefinger, and pull directly away from the face of the unit to remove the data card.

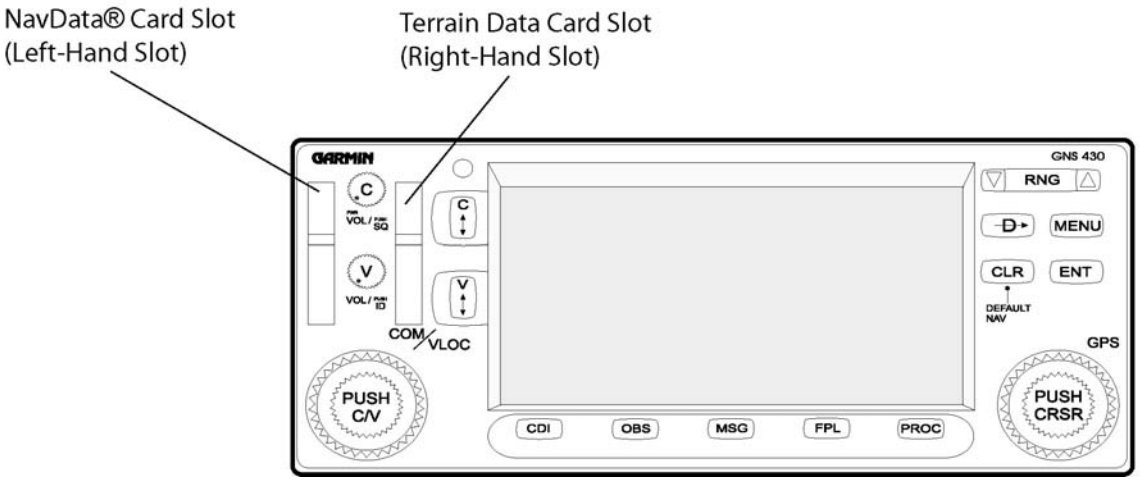

Figure 5-1. Data Card Slot Locations

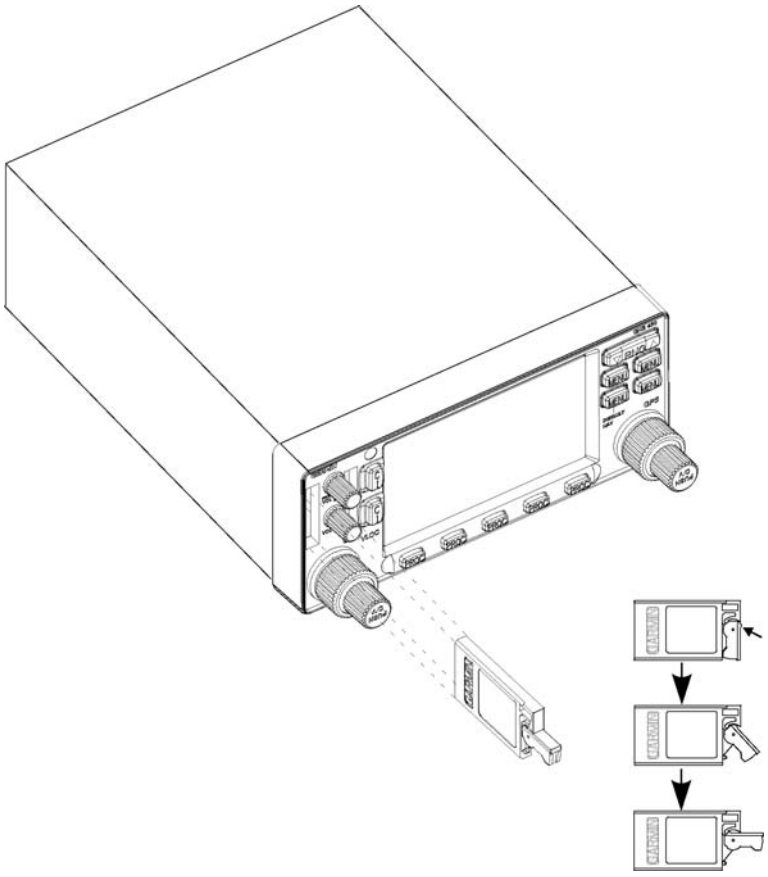

Figure 5-2. Data Card Insertion/Removal Detail

NOTE

Do not remove the Mylar™ insulators during disassembly. They prevent the shorting out of boards and board components. The insulators may be ordered if they get damaged (refer to Section 6).

5.4.2 Top Cover (Figure 5-3; all units)

Removal

Remove four screws (1) that attach Top Cover (2) to Main Chassis (3) and remove Top Cover.

Replacement

Install four screws (1) that attach Top Cover (2) to Main Chassis (3).

5.4.2.1 CDU Assembly (Figure 5-3; all units)

Removal

1. Remove Top Cover (section 5.4.2).
2. Disconnect all cables and flex connections (6) connecting the CDU Assembly (4) to the Main Chassis (3).
3. Remove two screws (5) from Main Chassis (3) attaching CDU Assembly (4).

Replacement

1. Connect all cables and flex connections connecting the CDU Assembly (4) to the rest of the unit.
2. Install two screws (5) attaching CDU Assembly to Main Chassis (3).
3. Install Top Cover (section 5.4.2.2).

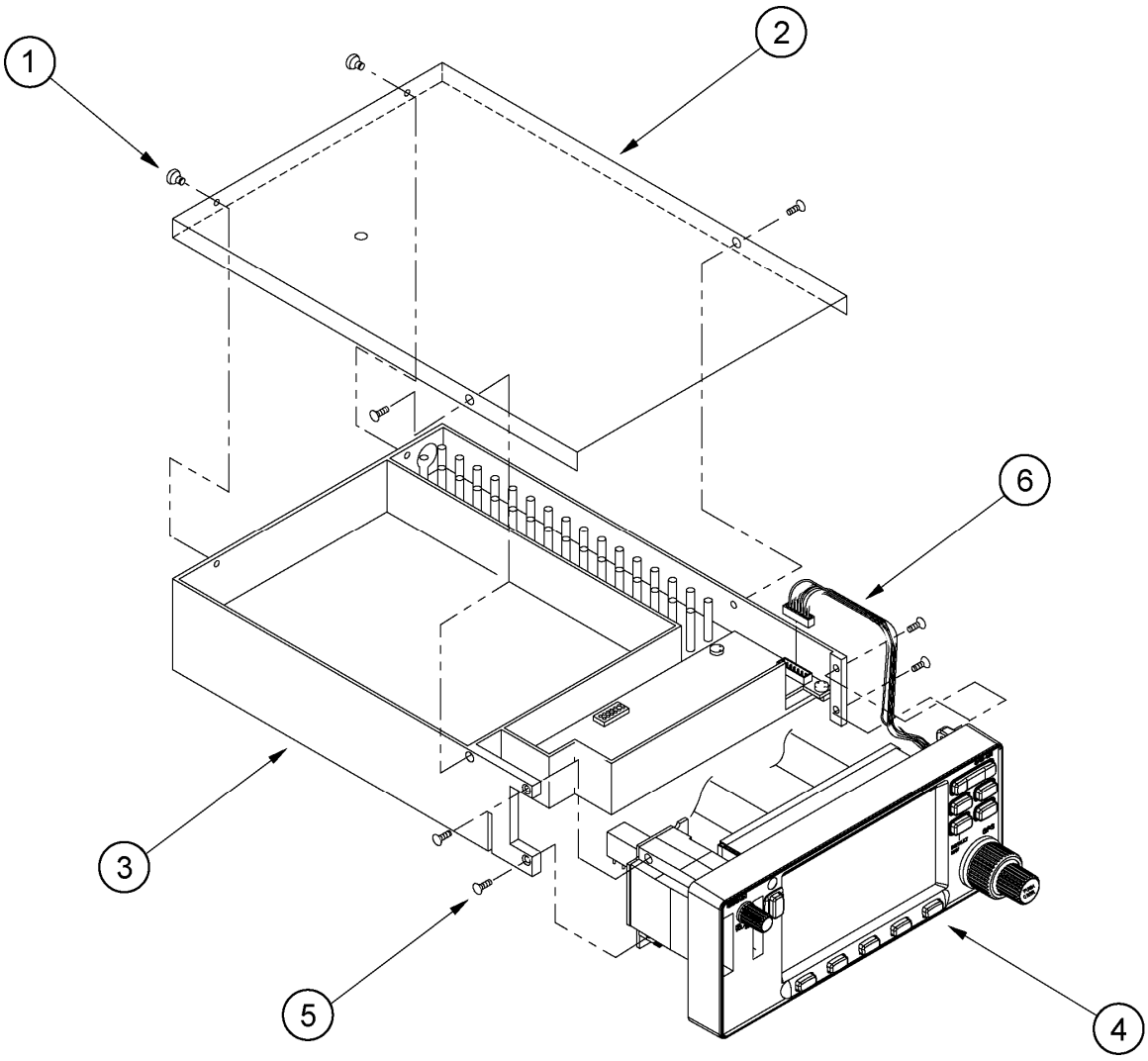

Figure 5-3. Top Assembly

5.4.2.3 Separating the Chassis (Figure 5-4; all units)

1. Separate (fold open) Main Chassis (1) from Nav Chassis (2).
2. Disconnect Ribbon Cable Strip (3).
3. Remove Screws (4) and (5).
4. Remove Shoulder Screws (6) that secure the rear hinge (7). Separate (fold open) the two chassis.
5. If desired, the front Nav Chassis Hinge Pins (8 and 9) can be removed to completely separate the two Chassis.

Fasten Main Chassis to Nav Chassis

1. If the two Chassis are completely separated, install front Hinge Pins (8 and 9) securing front hinge to the two Chassis.
2. Connect Ribbon Cable Strip (3).
3. Install Shoulder Screws (6) securing the rear hinge (7). Fold the two chassis together.
4. Install Screw (4).
5. Install Screw (5).

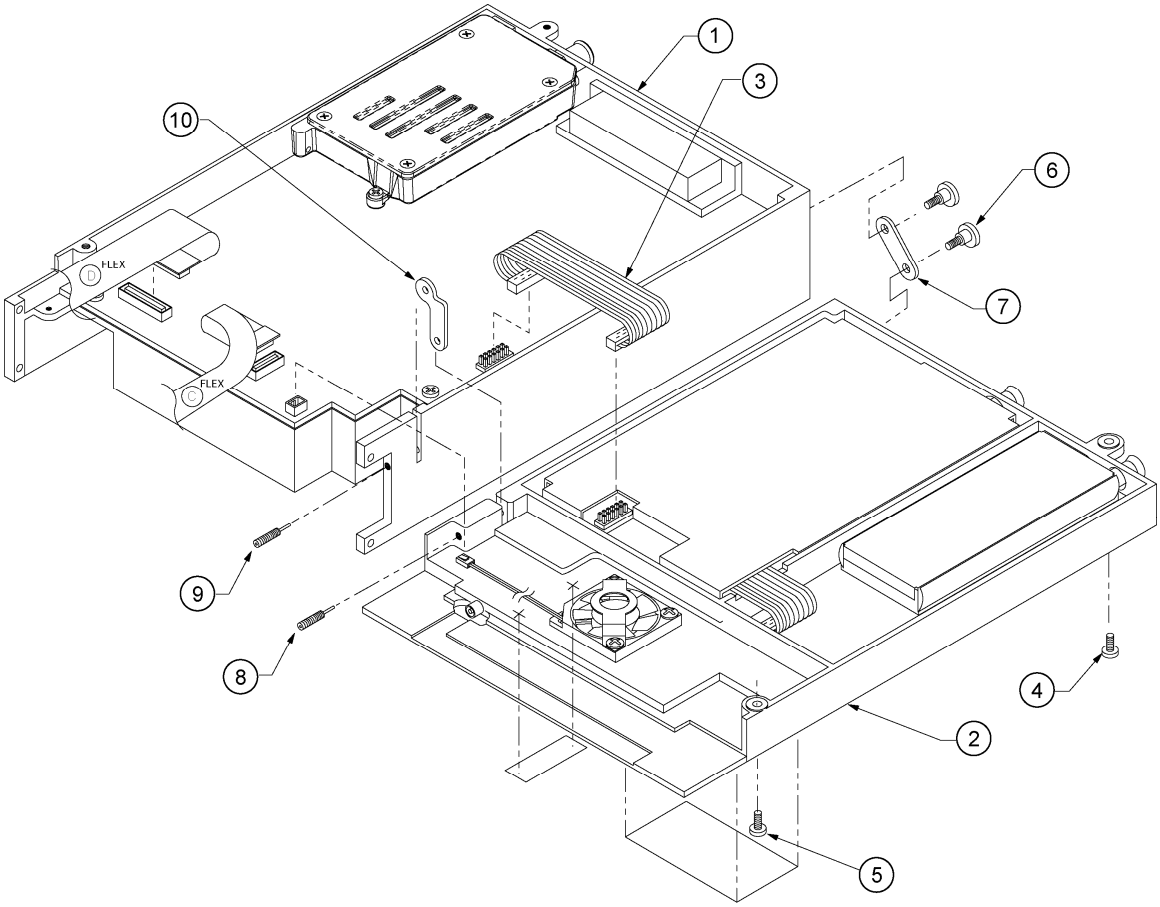

Figure 5-4. Main and Nav Chassis

5.4.2.4 Replacing the Fan (Figure 5-5; all units)

Removing the Fan

1. Separate the Main and Nav Chassis.
2. Disconnect the Red and Black Fan Wires (1) from the Main Board.
3. Remove three screws (2) attaching Fan to Nav Chassis.

Attaching the Fan

1. Install Fan (4) with Shield (3) from top using three screws (2).
2. Connect the Red and Black Fan wires (1) to Main Board.
3. Fasten Main and Nav Chassis.

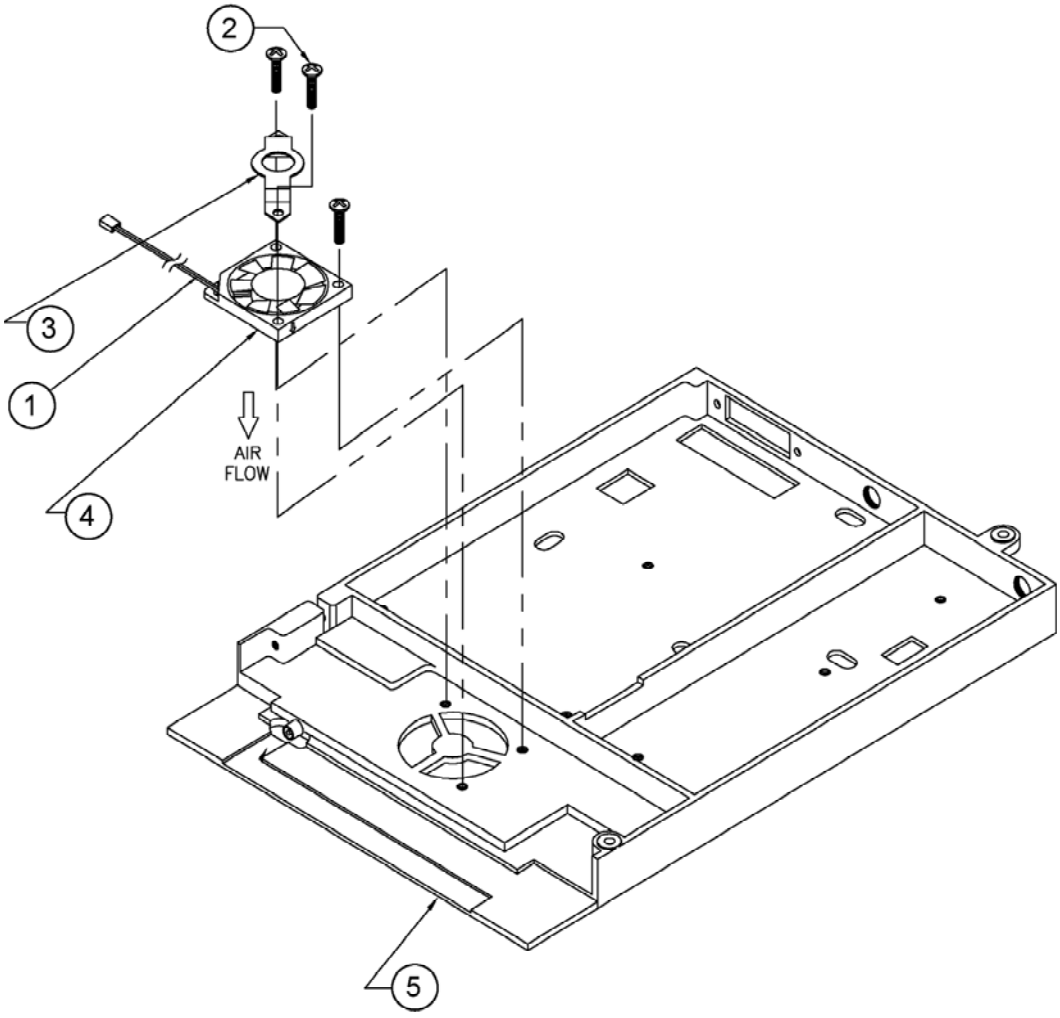

Figure 5-5. Fan Replacement

5.4.3 Main Chassis Bottom Cavity (Figure 5-6)

Inverter Board (all units)

Removal

1. Remove Top Cover.
2. Disconnect Red and Blue LCD Cable that is attached to Inverter Board (1).
3. Remove three screws (2). Remove Inverter Board and Insulator (3).

Replacement

1. Install Inverter Board Insulator (3). Install three screws (2) attaching Inverter Board (2).
2. Connect Red and Blue LCD Cable attached to Inverter Board.
3. Attach Top Cover.

Comm Board Removal (GNC 420W/AW, GNS 430W/AW)

1. Remove Top Cover.
2. Remove three Comm Board Covers (4).
3. Unsolder Buss Wire (Detail A) from Coax Connector.
4. Remove two screws (6) attaching 25 pin connector to Main Chassis (7).
5. Remove three screws (8) that secure Comm Board (5) to Main Chassis (7).
6. Remove two screws (9) securing MOSFET (10) to Main Chassis.
7. Remove Comm Board (5) and Comm Board Insulator (9).

Replacement

1. Install Comm Board Insulator (9).
2. Place Comm Board (5) in chassis and attach it to Main Chassis (7) using three screws (8).
3. Install two screws (6) and attach 25 pin connector to Main Chassis (7).
4. Solder Buss Wire (Detail A) from Comm Board (5) to Coax Connector (11).
5. Install three Comm Board Covers (4).

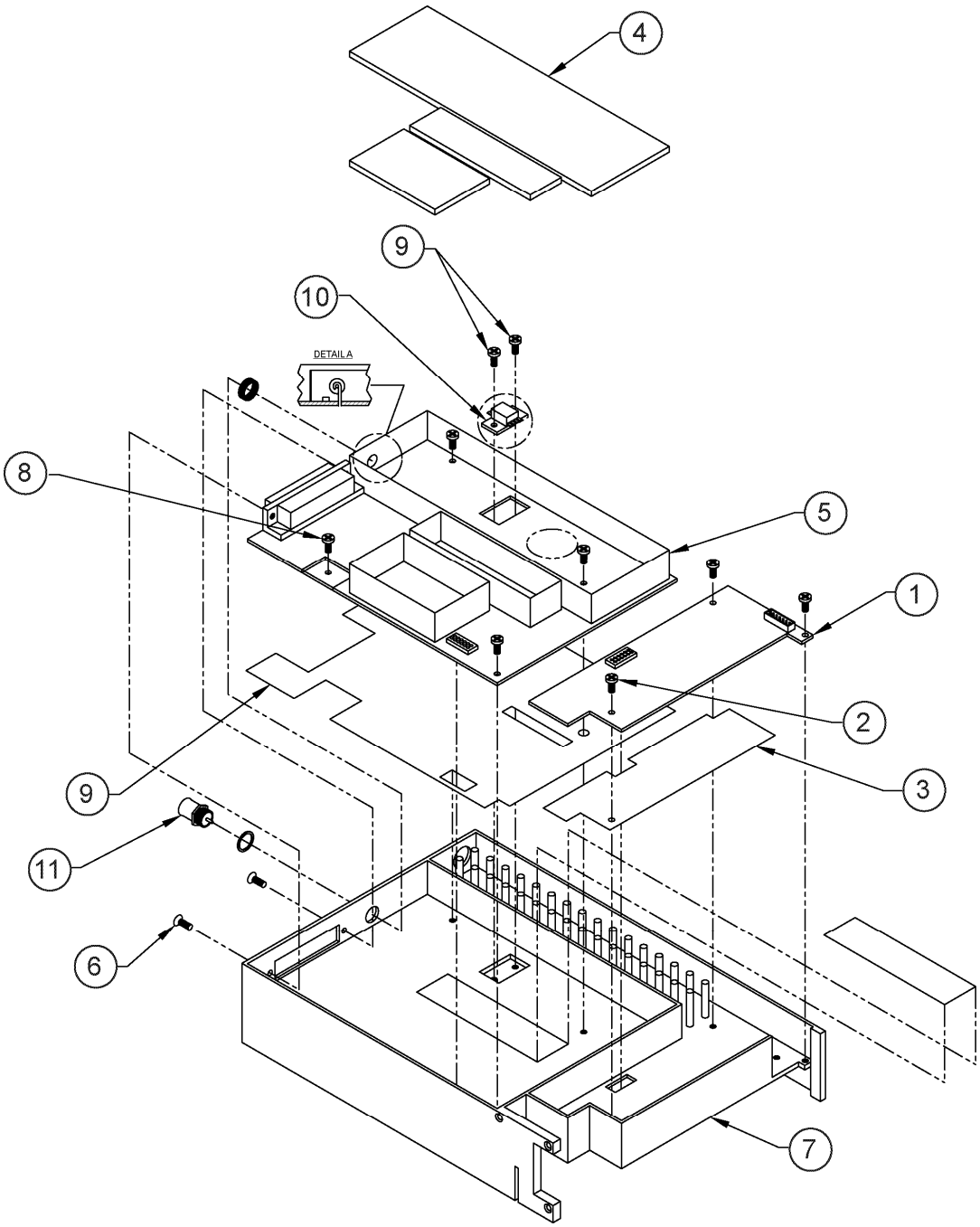

Figure 5-6. Main Chassis Bottom Cavity

5.4.4 Main Chassis Top Cavity (Figure 5-7)

WAAS GPS Chassis (all units)

Removal

1. Remove one screw (1) attaching WAAS GPS Module (2) to Main Board (3). Remove three screws (4) attaching WAAS GPS Module to Main Chassis (5).
2. Lift WAAS GPS Module off of Main Board Connector and out of the Main Chassis (5).

Replacement

1. Place replacement WAAS GPS Module on Main Board Connector.
2. Install one screw (1) securing WAAS GPS Module to Main Board.
3. Install three screws (4) attaching WAAS GPS Module to Main Chassis.

Main Board (all units)

The Main Board is not a serviceable item, but can be removed to replace the Memory Battery.

Removal

1. Remove CDU Assembly.
2. Remove WAAS GPS Module from Main Board (section above).
3. Remove GPS Ribbon Cable that is attached to the Main Board.
4. Remove two screws (6) attaching the 78-pin connector to Main Chassis (5).
5. Remove five screws (7) attaching Main Board to Main Chassis.
6. Remove Main Board (3) but leave Mylar Insulator (8).

Replacement

1. Place Main Board in Main Chassis Cavity.
2. Attach with five screws (7).
3. Attach the 78-pin connector to Main Chassis (5) using two screws (6).
4. Attach WAAS GPS Module to Main Board.
5. Connect GPS Ribbon Cable to the Main Board (3).
6. Install CDU Assembly.

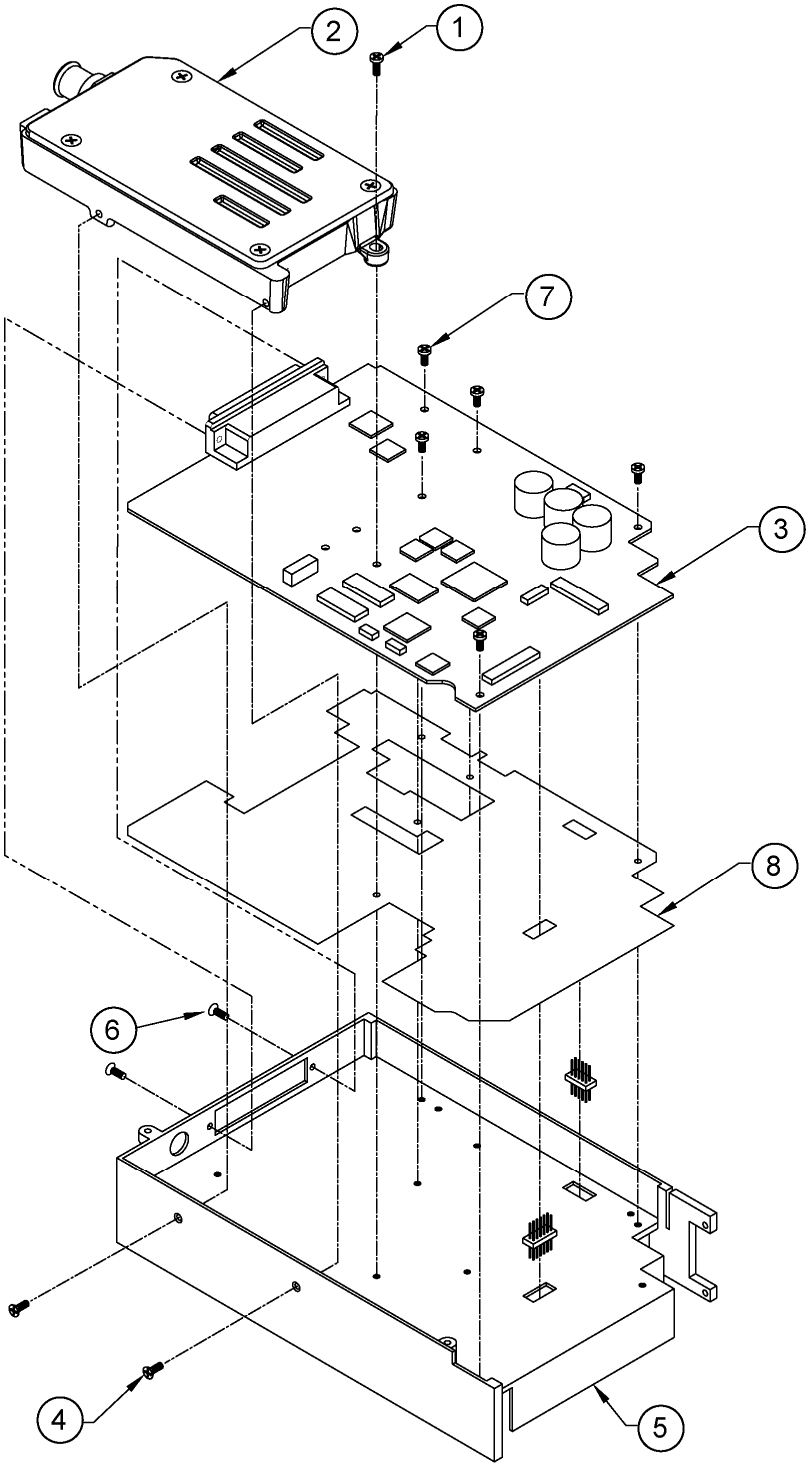

Figure 5-7. Main Chassis Top Cavity

5.4.5 Main Board Memory Battery (Figure 5-8; all units)

The Main Board contains an internal battery used for the real time clock and GPS system information that will last approximately 5-8 years. Regular planned replacement is not necessary. A 'low battery' message is displayed when replacement is required. Replace the battery within 1 to 2 months after the low battery message is displayed. If the battery is not replaced and becomes completely discharged, the unit will remain fully operational but the GPS signal acquisition time may be increased.

Partial disassembly of the unit is required to replace the battery. Once the Main and Nav Chassis are separated, the Main Board is exposed and the Main Board Memory Battery can be replaced.

Removal

1. Remove all electrical grounds from the unit to prevent the battery from shorting out if a grounded tip soldering iron is used.

2. Unsolder the battery leads from the bottom side of the Main Board.

3. Carefully remove the battery by pulling it out from the top side of the Main Board. The battery leads are soldered to the battery and cannot be removed.

Replacement

1. Install new battery and solder the leads from the bottom side of Main Board.

2. Clip battery leads to insure the battery does not short to the chassis.

3. Turn unit on.

4. Verify the Memory Battery Low message does not appear.

5. Turn unit off and carefully turn it over.

6. Verify memory battery voltage (measure from positive side of the battery to ground) is at least +2.9 V dc.

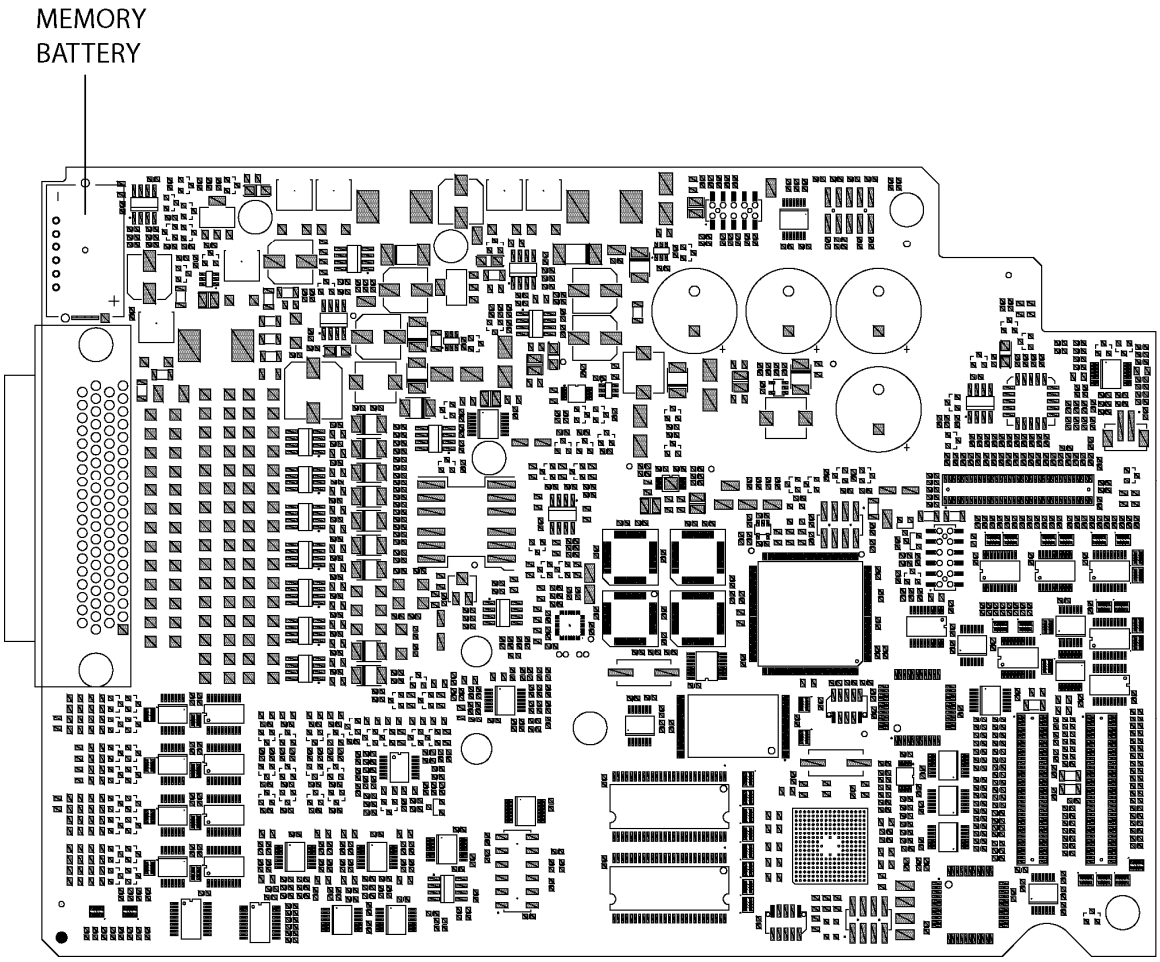

Figure 5-8. Memory Battery Location on the Main Board

5.4.6 Nav Chassis Cavity (Figure 5-9)

Nav Receiver Board (GNS 430W/AW)

Removal

1. Separate Main Chassis from Nav Chassis.
2. Remove RF Covers (1) and (2).
3. Disconnect Ribbon Cable (3) connecting Nav Receiver Board and Glideslope Receiver Board.
4. Remove screw (4) and remove RF Cover (5).
5. Unsolder the wire from Coax Connector (Detail A).
6. Remove two screws (6) that attach 44-pin connector to Nav Chassis (7) and remove Nav Receiver Board (8).
7. Remove four screws (9) that attach Nav Receiver Board (8) to Nav Chassis (7).

Replacement

1. Install two screws (6) and attach 44 pin connector to Nav Chassis (7) and install Nav Receiver Board (8).
2. Install four screws (9) and attach Nav Receiver Board (8) to Nav Chassis (7).
3. Solder wire from Coax Connector (Detail A).
4. Install screw (4) and attach RF Cover (5).
5. Connect Ribbon Cable (3) to Nav Receiver Board (8).
6. Fasten Main Chassis to Nav Chassis.

Glideslope Receiver Board (GNS 430W/AW)

Removal

1. Separate Main Chassis from Nav Chassis.
2. Remove Glideslope RF Board Cover (9).
3. Disconnect Ribbon Cable (3) from Glideslope Board (10).
4. Unsolder Connector Wire from Coax Connector (Detail A).
5. Remove three screws (11) that attach Glideslope Board (10) to Nav Chassis (7) and remove Glideslope Board.

Replacement

1. Install three screws (11) that attach Glideslope Board (10) to Nav Chassis (7) and attach Glideslope Board.

2. Solder connector wire from Coax Connector (Detail A).

3. Connect Ribbon Cable (3) from Glideslope Board (10).

4. Install Glideslope Board RF Cover (9).

5. Join Main Chassis to Nav Chassis.

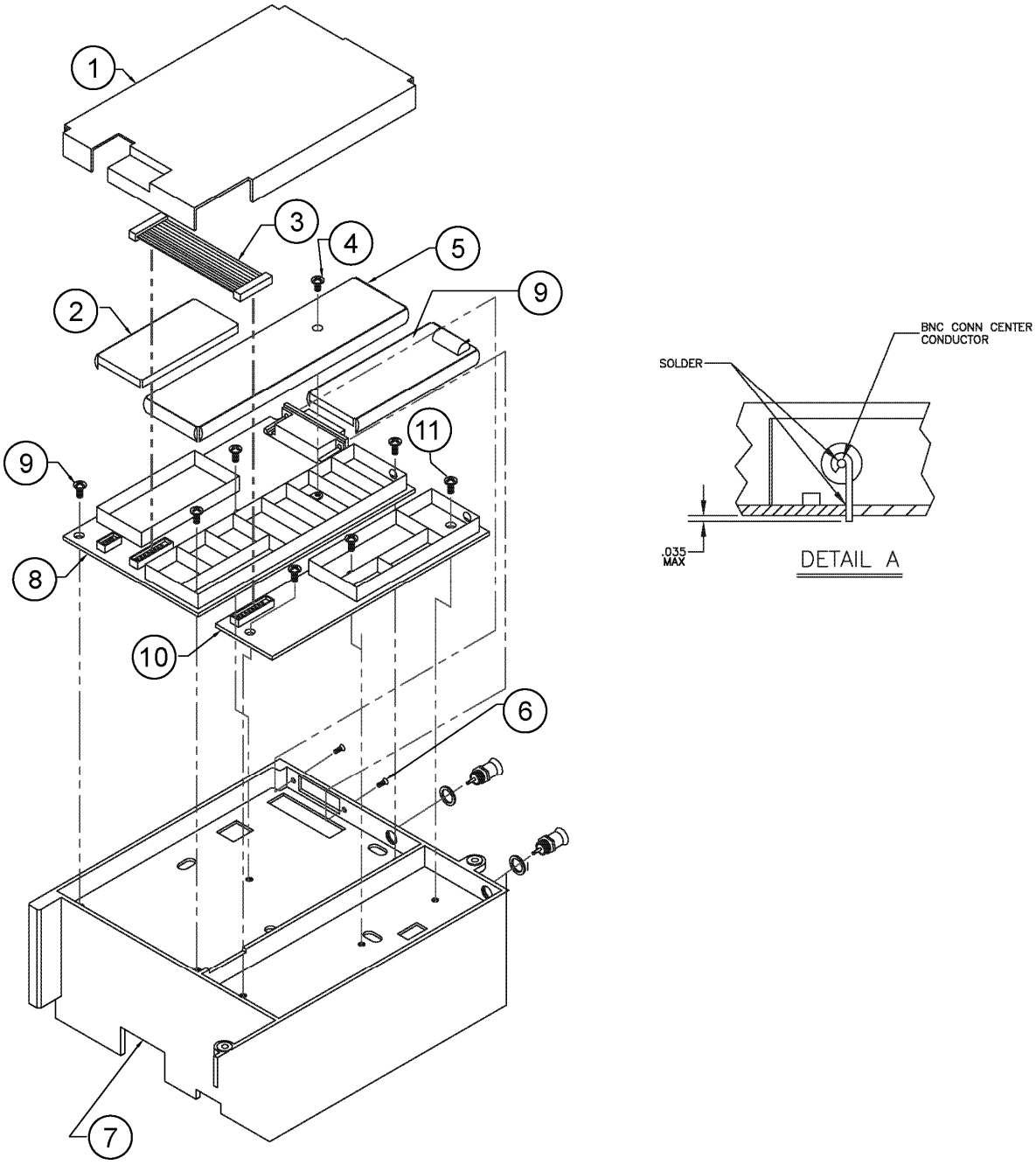

Figure 5-9. Nav Chassis Cavity

5.5 PERIODIC MAINTENANCE

Repair of any model is on condition of failure. There are no periodic maintenance requirements or scheduled equipment calibration. Perform the following procedures at regular intervals:

Cleaning the Front Panel

Clean the front bezel, keypad, and display with a soft cotton cloth dampened with clean water. Do not use any chemical-cleaning agents. Take care to not scratch the display surface.

Display Backlight

The display backlight lamp is rated by the manufacturer as having a usable life of 20,000 hours. The backlight lamp may dim and the display may not perform as well in direct sunlight conditions over time. The user must determine by observation when the display brightness is not suitable for use. Contact Garmin when the backlight lamp requires service.

Battery Replacement

Refer to the battery replacement instructions previously described in this section of the manual.

SECTION 6
SERVICE PARTS LIST

This section lists all of the parts that can be ordered from Garmin to repair a unit. The service part numbers listed are referenced back to the figures in Section 5. For orderable part information including availability refer to the Garmin Aviation Distributor Service Parts Price List or contact Garmin directly (contact information listed in Section 1).

NOTES

Miscellaneous parts and hardware such as RF Shields, Mylar Board Insulators, knobs, and certain screws may be available but are not listed in the tables. Contact Garmin Aviation Product Support for part availability and pricing.

Contact Garmin for the correct COMM Board service part number if it is being replaced.

The main board contains an EEPROM memory storage device which must be programmed with Unit Configuration, TAWS/Terrain Configuration, and Unit Serial Number. Because of this, the main board is not replaceable in the field.

6.1 GPS 400W

Reference Designator	Service Part Number	Description
Figure 5-1 (4)	S11-00281-13	CDU Assembly, Black
Figure 5-1 (4)	S11-00281-16	CDU Assembly, Gray
Figure 5-2 (1)	125-00034-00	Main Chassis
Figure 5-2 (1)	125-00034-01	Main Chassis W/O Studs
Figure 5-4 (1)	S12-00256-00	Inverter Board
Figure 5-5 (2)	S11-01097-00	GPS WAAS Module
Figure 5-6	360-00009-00	3V Lithium Battery
Figure 5-3 (4)	371-00001-01	Fan

6.2 GNC 420W

Reference Designator	Service Part Number	Description
Figure 5-1 (4)	S11-00281-12	CDU Assembly, Black
Figure 5-1 (4)	S11-00281-15	CDU Assembly, Gray
Figure 5-4 (1)	S12-00256-00	Inverter Board
Figure 5-4 (5)	Contact Garmin	Com Board
Figure 5-6	360-00009-00	3V Lithium Battery
Figure 5-5 (2)	S11-01097-00	GPS WAAS Module
Figure 5-2 (1)	125-00034-01	Main Chassis
Figure 5-2 (1)	125-00034-01	Main Chassis W/O Studs

6.3 GNC 420AW

Reference Designator	Service Part Number	Description
Figure 5-1 (4)	S11-00281-12	CDU Assembly, Black
Figure 5-1 (4)	S11-00281-15	CDU Assembly, Gray
Figure 5-4 (1)	S12-00256-00	Inverter Board
Figure 5-4 (5)	Contact Garmin	Com Board
Figure 5-6	360-00009-00	3V Lithium Battery
Figure 5-5 (2)	S11-01097-00	GPS WAAS Module
Figure 5-3 (4)	371-00001-01	Fan
Figure 5-2 (1)	125-00034-01	Main Chassis W/O Studs

6.4 GNS 430W

Reference Designator	Service Part Number	Description
Figure 5-1 (4)	S11-00281-11	CDU Assembly, Black
Figure 5-1 (4)	S11-00281-14	CDU Assembly, Gray
Figure 5-4 (1)	S12-00256-00	Inverter Board
Figure 5-4 (5)	Contact Garmin	Com Board
Figure 5-6	360-00009-00	3V Lithium Battery
Figure 5-7 (8)	S12-00195-22	Nav Board
Figure 5-7 (10)	S12-00212-11	Glideslope Board
Figure 5-5 (2)	S11-01097-00	GPS WAAS Module
Figure 5-3 (4)	371-00001-01	Fan
Figure 5-2 (1)	125-00034-01	Main Chassis
Figure 5-2 (1)	125-00009-00	Main Chassis W/O Studs

6.5 GNS 430AW

Reference Designator	Service Part Number	Description
Figure 5-1 (4)	S11-00281-11	CDU Assembly, Black
Figure 5-1 (4)	S11-00281-14	CDU Assembly, Gray
Figure 5-4 (1)	S12-00256-00	Inverter Board
Figure 5-4 (5)	Contact Garmin	Com Board
Figure 5-6	360-00009-00	3V Lithium Battery
Figure 5-7 (8)	S12-00195-22	Nav Board
Figure 5-7 (10)	S12-00212-11	Glideslope Board
Figure 5-5 (2)	S11-01097-00	GPS WAAS Module
Figure 5-3 (4)	371-00001-01	Fan

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APPENDIX A
SYSTEM INTERCONNECTS

This Appendix contains pin descriptions for the rear panel connectors. These descriptions can aid in the fabrication of test cables, test setup, and basic troubleshooting.

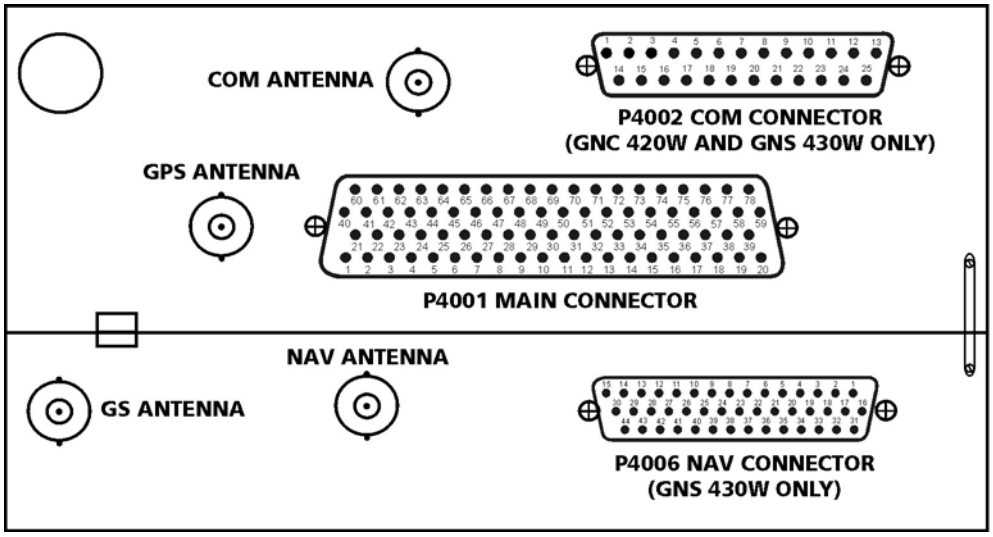
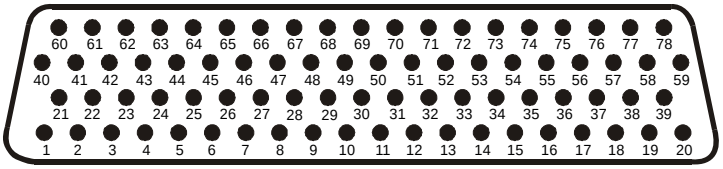


Figure A-1. Rear Panel Connectors

A.1 P4001 MAIN CONNECTOR

(View looking at rear of unit)



Pin	Pin Name	I/O
1	VLOC ANNUNCIATE	Out
2	GPS ANNUNCIATE	Out
3	WAYPOINT ANNUNCIATE	Out
4	TERMINAL ANNUNCIATE	Out
5	APPROACH ANNUNCIATE	Out
6	MESSAGE ANNUNCIATE	Out
7	OBS ANNUNCIATE	Out
8	SPARE ANNUNCIATE	Out
9	INTEGRITY ANNUNCIATE	Out
10	ANNUNCIATE D	Out
11	ANNUNCIATE E	Out
12	ALTITUDE ALARM ANNUNCIATE	Out
13	GPS SELECT	Out
14	ILS/GPS APPROACH	Out
15	AIRCRAFT POWER 2	In
16	TIME MARK OUT	Out
17	MAIN LATERAL SUPERFLAG	Out
18	MAIN VERTICAL SUPERFLAG	Out
19	AIRCRAFT POWER 1	In
20	AIRCRAFT POWER 1	In
21	MAIN +LEFT	Out
22	MAIN +RIGHT	Out
23	MAIN LATERAL +FLAG	Out
24	MAIN LATERAL –FLAG (GROUND)	Out
25	MAIN +TO	Out
26	MAIN +FROM	Out
27	MAIN +UP	Out
28	MAIN +DOWN	Out
29	MAIN VERTICAL +FLAG	Out
30	MAIN VERTICAL -FLAG (GROUND)	Out

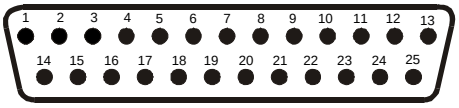
31	MAIN OBS ROTOR C	Out
32	MAIN OBS ROTOR H (GROUND)	Out
33	MAIN OBS STATOR D	In
34	MAIN OBS STATOR E (2.5V COMMON OBS)	Out
35	MAIN OBS STATOR F	In
36	MAIN OBS STATOR G (2.5V COMMON OBS)	Out
37	AUDIO 1 HI	Out
38	AUDIO 1 LO (GROUND)	Out
39	LIGHTING BUS HI	In
40	LIGHTING BUS LO	In
41	GPS RS-232 OUT 3	Out
42	GPS RS-232 IN 3	In
43	MAIN OBI CLOCK	Out
44	MAIN OBI DATA	Out
45	MAIN OBI SYNC	Out
46	GPS ARINC 429 OUT A	Out
47	GPS ARINC 429 OUT B	Out
48	GPS ARINC 429 IN 1 A	In
49	GPS ARINC 429 IN 1 B	In
50	GPS ARINC 429 IN 2 A	In
51	GPS ARINC 429 IN 2 B	In
52	RESERVED	--
53	RESERVED	--
54	GPS RS-232 OUT 4	Out
55	GPS RS-232 IN 4	In
56	GPS RS-232 OUT 1	Out
57	GPS RS-232 IN 1	In
58	GPS RS-232 OUT 2	Out
59	GPS RS-232 IN 2	In
60	ALTITUDE COMMON (GROUND)	Out
61	ALTITUDE C4	In
62	ALTITUDE C2	In
63	ALTITUDE C1	In
64	ALTITUDE B4	In
65	ALTITUDE B2	In
66	ALTITUDE B1	In
67	ALTITUDE A4	In
68	ALTITUDE A2	In
69	ALTITUDE A1	In
70	ALTITUDE D4	In
71	OBS MODE SELECT	In
72	AIRCRAFT POWER 2	In
73	CDI SOURCE SELECT	In

74	COM REMOTE RECALL [1]	In
75	DEMO MODE SELECT	In
76	RESERVED	--
77	AIRCRAFT GROUND	--
78	AIRCRAFT GROUND	--

[1] Main software version 3.00 or later

A.2 P4002 COM CONNECTOR (GNC 420W and GNS 430W Only)

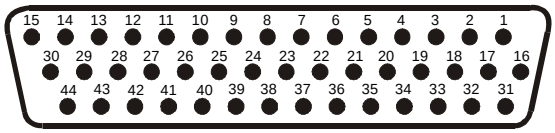
(View looking at rear of unit)



Pin	Pin Name	I/O
1	RESERVED	--
2	RESERVED	--
3	RESERVED	--
4	COM MIC KEY	In
5	INTERCOM MIC HI	In
6	COM MIC AUDIO HI	In
7	500Ω COM AUDIO HI	Out
8	RESERVED	--
9	RESERVED	--
10	RESERVED	--
11	AIRCRAFT POWER	In
12	AIRCRAFT POWER	In
13	RESERVED	--
14	TRANSMIT INTERLOCK	In
15	COM REMOTE TRANSFER	In
16	SPARE	--
17	INTERCOM MIC LO	In
18	COM MIC AUDIO LO	In
19	500Ω COM AUDIO LO	Out
20	RESERVED	--
21	AIRCRAFT GROUND	--
22	AIRCRAFT GROUND	--
23	RESERVED	--
24	RESERVED	--
25	RESERVED	--

A.3 P4006 NAV CONNECTOR (GNS 430W Only)

(View looking at rear of unit)



Pin	Pin Name	I/O
1	VOR/LOC +TO	Out
2	VOR/LOC +FROM (VOR/LOC COMMON)	Out
3	VOR/LOC +FLAG	Out
4	VOR/LOC –FLAG (VOR/LOC COMMON)	Out
5	VOR/LOC +LEFT	Out
6	VOR/LOC +RIGHT (VOR/LOC COMMON)	Out
7	RESERVED	--
8	VOR/LOC COMPOSITE OUT	Out
9	VOR OBS ROTOR C	Out
10	VOR OBS ROTOR H (GROUND)	Out
11	VOR OBS STATOR E/G (VOR/LOC COMMON)	In
12	VOR OBS STATOR F	In
13	VOR OBS STATOR D	In
14	PARALLEL DME – 8MHZ	Out
15	VOR/LOC SUPERFLAG	Out
16	500Ω VOR/ILS AUDIO HI	Out
17	500Ω VOR/ILS AUDIO LO	Out
18	SERIAL DME CLOCK	Out
19	SERIAL DME DATA	Out
20	SER DME – CHAN REQ/PAR DME – 4MHZ	I/O
21	SER DME – RNAV MODE/PAR DME – 2MHZ	I/O
22	DME COMMON	In
23	VOR/ILS ARINC 429 OUT B	Out
24	VOR/ILS ARINC 429 OUT A	Out
25	VOR OBI CLOCK	Out
26	VOR OBI SYNC	Out
27	VOR OBI DATA	Out
28	VLOC REMOTE TRANSFER	In
29	ILS ENERGIZE	Out
30	GLIDESLOPE +FLAG	Out
31	GLIDESLOPE +DOWN/-FLAG (GLIDESLOPE COMMON)	Out
32	GLIDESLOPE +UP	Out
33	PARALLEL DME – 1MHZ	Out
34	RESERVED	--
35	VOR/ILS ARINC 429 IN B	In

36	VOR/ILS ARINC 429 IN A	In
37	PARALLEL DME – 800KHZ	Out
38	GLIDESLOPE SUPERFLAG	Out
39	PARALLEL DME - 400KHZ	Out
40	PARALLEL DME - 200KHZ	Out
41	AIRCRAFT GROUND	--
42	PARALLEL DME - 100KHZ	Out
43	PARALLEL DME - 50KHZ	Out
44	AIRCRAFT POWER	In

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