NARCO
NAV 121, 122/A NAVIGATION SYSTEMS
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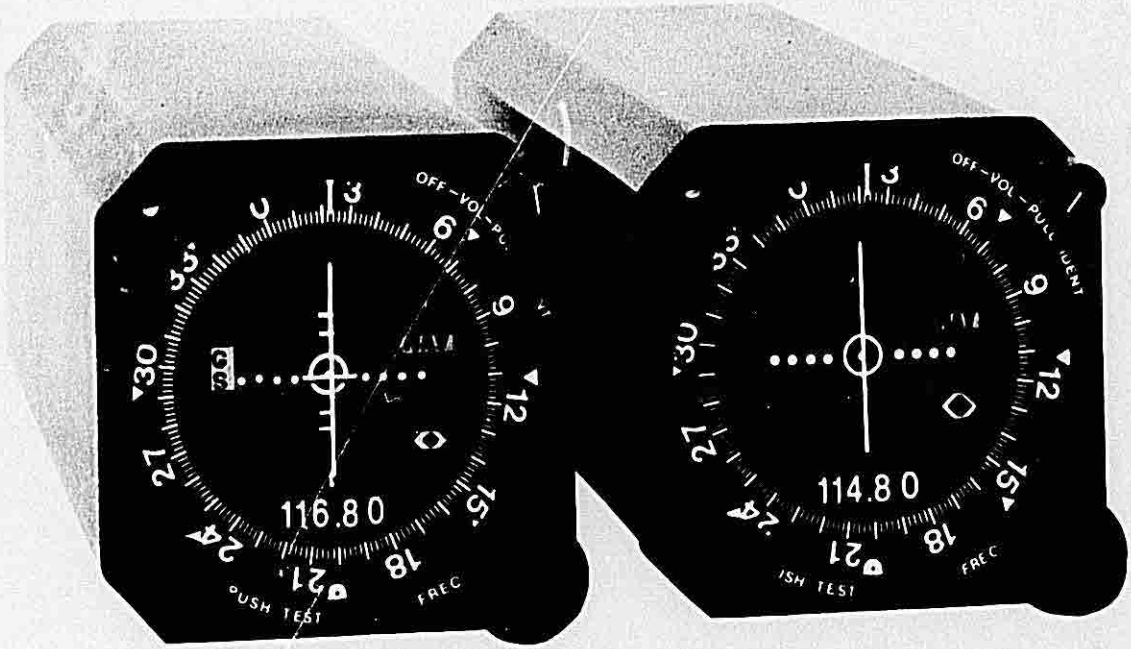
NARCO AVIONICS

NAV 121, 122, AND 122A NAVIGATION SYSTEMS



MAINTENANCE MANUAL

03723-0600

NARCO AVIONICS
DIVISION OF NARCO SCIENTIFIC INDUSTRIES
FORT WASHINGTON, PENNSYLVANIA, 19034 U.S.A.

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NARCO SCIENTIFIC INDUSTRIES

Printed in U.S.A.

Reprint 3/80

NARCO AVIONICS

NAV 121, 122, 122A

MAINTENANCE MANUAL 03723-0600

Revised and Reprinted 3/80

IS YOUR MANUAL COMPLETE?

This page is provided, and updated as necessary, with each printing and supplement issued.

By referring to the following list one may make a page by page check to determine if the manual is complete and up-to-date. Dated pages in the list are those pages that were changed or added.

Each supplement of changed or added pages is identified, in sequence, by a supplement (S) number, date, and a "BAR". The date and bar will be found on and in the same relative position on all pages of that supplement. This allows one to eye the base of the manual to see how many supplements were issued and to spot check if all the supplements are present. Note that should a page be changed more than once ONLY the most current bar and date will be on that page, thus some supplements can "disappear".

Page numbers prefixed by a "B" are pages that were intentionally left blank.

Also included are Centerline NAV Service Bulletins:

No.	Date	
1	7/28/77	See Note 1
2	7/28/77	
3	10/19/77	See Note 1
4	12/29/77	
5	1/31/78	See Note 2
6	3/10/78	See Note 2
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8	11/15/78	
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Note 1: Data now included in manual.
Note 2: No longer applicable to this manual (3/80).

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ATP
RECORD OF REVISIONS

REV. NO.	SECTIONS COVERED IN REVISION	REV. DATE	INSERTION DATE	BY	NOTES
Mod Instr	Whole Manual	March /78	Feb 10/81	ATP	

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1. INTRODUCTION

1.1 GENERAL

In support of the Narco Avionics NAV 121, NAV 122, and NAV 122A series of navigation systems, this manual provides detailed installation and maintenance procedures.

"This manual is intended for use only be persons who are qualified to service the equipment described in this manual pursuant to current regulatory requirements."

1.1.1 Manual Organization

Organized into six major sections, the manual provides the following:

Section 1	Introduction	- general information required in planning the installation.
Section 2	Installation	- detailed procedures for performing the mechanical and electrical installation.
Section 3	Circuit Description	- technical description of all mechanical and electrical circuits.
Section 4	Maintenance	- provides test procedures and troubleshooting methods.
Section 5	Replacement Parts List	- provides exploded view of mechanical parts as well as an electrical parts list (in alpha-numeric sequence) of all the electrical components.
Section 6	Schematics	- circuit schematics with voltages, test points, and component location drawings.

Note: Installation Manuals contain Sections 1 and 2.
Maintenance Manuals contain Sections 1 through 6.

1.2 PRODUCT DESCRIPTION

Functional differences between the three systems covered within this manual are shown in Table 1.1.

TABLE 1.1 NAV SYSTEM CHARACTERISTICS

FUNCTION \ NAV SYSTEM	NAV 121	NAV 122	NAV 122A
VOR/LOC Receiver	X	-----	X
VOR/LOC and Time Shared GS Receivers	-----	X	-----
VOR/LOC Converters	X	-----	X
VOR/LOC and GS Converters	-----	X	-----
VOR/LOC Indicator Display	X	-----	-----
VOR/LOC and GS Displays	-----	X	X see note 1
Marker Beacon Receiver and Lights	-----	X	X
ARINC DME/GS Channeling	X	X	X
TSO'd	X	X	X

Notes: 1. Requires external Glide Slope Receiver, UGR 2A2/5, to drive Indicator.
2. "X", NAV SYSTEM performs indicated FUNCTION.
3. VOR/LOC - Omnirange/Localizer.
GS - Glide Slope.

1.3 DESIGN FEATURES

- NAV 121 TSO'd to C36c, C40c, and C66a.
  NAV 122 TSO'd to C35d, C36c, C40c, and C66a.
  NAV 122A TSO'd to C34c, C35d, C36c, C40c, and C66a.
- Modular Construction for ease of Servicing.
- Multiple functions to simplify installation.
- ARINC Panel cutout, 3" instrument hole.
- Front panel access to: 1) Marker Beacon Sensitiviiy
  2) Omni zero set
  3) Localizer zero set

1.4 PRODUCT SPECIFICATIONS

TABLE 1.2 GENERAL SPECIFICATIONS

General		NAV 121	NAV 122	NAV 122A
Mechanical		Figure 2-3	Figure 2-3	Figure 2-3
Physical Dimensions		Figure 2-3	Figure 2-3	Figure 2-3
Weight		2.5 lbs (1.13 kg)	3.0 lbs (1.36 kg)	2.9 lbs (1.32 kg)
Electrical				
NAV, P810, Pins 7 and 26				
Supply Voltage (see note 1)		13.75 Vdc	13.75 Vdc	13.75 Vdc
Current, less pilot lamps,	14V	0.55 Ampere	0.55 Ampere	0.55 Ampere
Current, less pilot lamps,	28V	(see note 2)	(see note 2)	(see note 2)
Pilot lamp current	14V	0.32 Ampere	0.32 Ampere	0.32 Ampere
	28V	0.32 Ampere	0.32 Ampere	0.32 Ampere
Circuit Breaker Rating		2 Amperes	2 Amperes	2 Amperes
Marker Beacon, P810 Pin 3				
Supply Voltage		----------	13.75 or 27.5 Vdc	13.75 or 27.5 Vdc
Current	14V	----------	0.25 Ampere	0.25 Ampere
	28V	----------	0.29 Ampere	0.29 Ampere
Circuit Breaker Rating		----------	1.0 Ampere	1.0 Ampere

Notes: 1. Voltage Converter required for 28 Vdc installations.
2. With MP 11, 28 to 14 Vdc Voltage Converter - 0.60 Ampere.

TABLE 1.3 VOR/LOC RECEIVER

	NAV 121	NAV 122	NAV 122A
VOR/LOC Receiver			
Frequency Range (in MHz)	108.00 to 117.95	108.00 to 117.95	108.00 to 117.95
	200 channels	200 channels	200 channels
Sensitivity (6 dB S + N/N)	1.0 uV	1.0 uV	1.0 uV
(Full VOR Flag)	1.0 uV	1.0 uV	1.0 uV
Spurious and Image Rejection	80 dB min	80 dB min	80 dB min
Selectivity 6 dB	±19 kHz	±19 kHz	±19 kHz
60 dB	±42 kHz	±42 kHz	±42 kHz
AVC Flatness (10 uV to 10 kuV)	1.0 dB max	1.0 dB max	1.0 dB max
Audio Output (500 ohm load)	50 mW	50 mW	50 mW
VOR Accuracy	2.7°	2.7°	2.7°
LOC Accuracy	±5 ua	±5 ua	±5 ua
DME/GS Channeling Code	ARINC 2 out of 5	ARINC 2 out of 5	ARINC 2 out of 5

1.4 Continued

TABLE 1.4 MARKER BEACON

	NAV 121	NAV 122	NAV 122A
Marker Beacon Receiver			
Antenna Input Impedance	-------	50 ohms	50 ohms
Sensitivity, for lamp threshold, HI	-------	200 uV	200 uV
LO	-------	1000 uV	1000 uV
Selectivity 6 dB	-------	± 10 kHz min	± 10 kHz min
60 dB	-------	± 310 kHz max	± 310 kHz max
AVC (200 uV to 50 kuV)	-------	10 dB	10 dB
Audio Output (500 ohm load)	-------	8 mW (2V rms)	8 mW (2V rms)
Audio Amplifier Output Impedance	-------	200 ohms	200 ohms
Dimming Voltage	-------	+2 to +30 Vdc	+2 to +30 Vdc

TABLE 1.5 GLIDE SLOPE

	NAV 121	NAV 122	NAV 122A
Glide Slope Receiver			
Frequency Range (in MHz)	-------	329.150 to 335.00	-------
Sensitivity (Full GS Flag)	-------	20 uV	-------
Spurious And Image Rejection	-------	60 dB	-------
Selectivity 6 dB	-------	± 19 kHz	-------
60 dB	-------	± 42 kHz	-------
AVC Flatness (10 uV to 10 kuV)	-------	3 dB	-------
GS Accuracy	-------	± 5 ua	-------
Glide Slope Indicator Specifications	-------	-------	
Up-Down	-------	-------	150-0-150 ma 1000 ohms
GS Flag	-------	-------	250 mV 1000 ohms

1.4 Continued

TABLE 1.6 TSO ENVIRONMENTAL

Environmental, Procedure DO 160	NAV 121	NAV 122	NAV 122A
C36c A2C1/A/PKS/XXXXXXZBBBA Class C	LOC	LOC	LOC
C40a A2C1/A/PKS/XXXXXXZBBBA	VOR	VOR	VOR
C34c A2C1/A/PKS/XXXXXXZBBBA Class D	----	GS	GS (Indicator)
C35d A2C1/A/PKS/XXXXXXZBBBA Class A	----	MKR	MKR
C66a A2C1/A/PKS/XXXXXXZBBBA	DME	DME	DME

TABLE 1.7 EXTERNAL INDICATOR AND AUTOPILOT LOADS

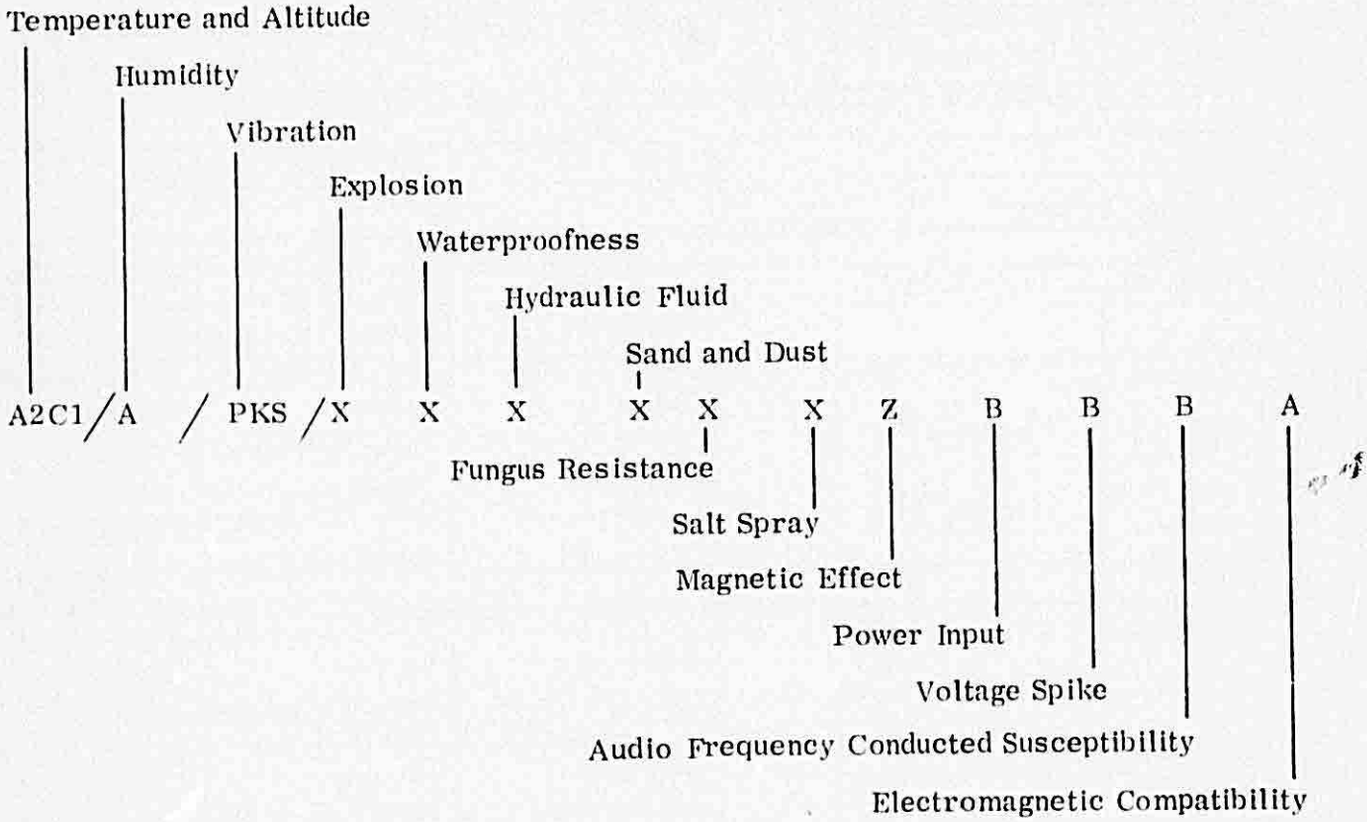
		NAV 121	NAV 122	NAV 122A
Autopilot /Indicator				
Loading				
VOR-LOC:	Left-Right	two, 1K ohm loads	two, 1K ohm loads	two, 1K ohm loads
	To-From Flag	two, 1K ohm loads	two, 1K ohm loads	two, 1K ohm loads
GS:	Up-Down	----------	two, 1K ohm loads	----------
	Warning Flag	----------	one, 1K ohm loads	----------
Output				
VOR-LOC:	Left-Right LOC	90 mV for 4 dB ddm	90 mV for 4 dB ddm	90 mV for 4 dB ddm
	VOR	150 mV for 10^{o} course change	150 mV for 10^{o} course change	150 mV for 10^{o} course change
	To-From Flag	250 mV	250 mV	250 mV
GS:	Up-Down	----------	78 mV for 2 dB ddm	----------
	Warning Flag	----------	250 mV	----------

ddm - Difference in depth of modulation

1.4.1 TSO Explanation

The NAV 121, NAV 122, and NAV 122A are designed to be instrument panel mounted within the cabin environment of fixed and rotary wing aircraft using piston or turbine engines, in single and multiengine configurations. They are designed for non-pressurized aircraft operating up to 35,000 feet as well as for pressurized aircraft. This equipment requires direct current power, but may be installed in aircraft having additional on-board alternating current sources.

There are fourteen Environmental Test Procedures established in RTCA Document DO 160. These are identified on the TSO Nameplate(s). Following are the Environmental Categories to which the Units are designed and an explanation of each category.



1.4.1 Continued

Temperature And Altitude - Category A2C1

Temperature, Operating:		
Low Operating Temperature	-20°C	(-4°F)
High Operating Temperature	+70°C	(+158°F)
Short Time Operating Temperature, High	+70°C	(+158°F)
Temperature, Non-Operating:		
Ground Survival Temperature, Low	-55°C	(-67°F)
Ground Survival Temperature, High	+85°C	(+185°F)
Altitude, Non-Pressurized:		
Maximum Operating Altitude	+11,000m	(+35,000 ft.)
Altitude, Pressurized:		
Not affected by decompression to	+12,000m	(+40,000 ft.)
Not affected by overpressurization to	-5,000m	(-15,000 ft.)

Humidity - Category A

These units have been tested under the Standard Humidity Environment of: +50°C (+122°F) at 95% relative humidity, reduced to +38°C (+100°F) with relative humidity maintained in excess of 85%.

This cycle was repeated twice for a total of 48 hours of exposure. Within 15 minutes* after exposure, the units were operated and met all specifications.

*TSO requires that all specifications be met within 4 hours after exposure.

Vibration - Categories PKS

Maximum vibration limits are: 0.08" double amplitude from 5 Hz to 22 Hz.
2.0G constant acceleration from 22 Hz to 200 Hz.
1.5G constant acceleration from 200 Hz to 500 Hz.
0.25G constant acceleration from 500 Hz to 2000 Hz.

Not Applicable - Category X

The following six Environmental Conditions do not normally exist in Civil Aircraft, when recognized installation practices are adhered to, and are therefore not tested.

Explosion - Category X
Waterproofness - Category X
Hydraulic Fluid - Category X
Sand And Dust - Category X
Fungus Resistance - Category X
Salt Spray - Category X

1.4.1 Continued

Magnetic Effect - Category Z

With this equipment operating, it may be placed at a distance less than 0.3 meter from a free magnet with a 1°, or less, deflection of the magnet.

Power Input - Category B

This equipment is designed for use in aircraft electrical systems suppli . by an engine driven alternator/rectifiers or DC generator with a battery of significant capacity floating on the DC bus at all times.

		28V System	14V System
Normal Operating Conditions (Vdc) are:	Maximum	30.3	15.1
	Nominal	27.5	13.8
	Minimum	24.8	12.4

Voltage Spike - Category B

This equipment has been designed to withstand the transient voltage characteristics specified by RTCA Document DO 160.

Audio Frequency Conducted Susceptibility - Category B

This equipment has been designed and tested to assure compliance with the requirements of RTCA Document DO 160.

Electromagnetic Compatibility - Category A

Note: For this series of tests, equipment Interconnecting Cables and RF transmission lines were constructed in accordance with Section 2 of this manual.

1. Induced Signal Susceptibility - This equipment has been designed to withstand the effects of audio frequency electric and magnetic fields and induces voltage spikes as specified by Category A.
2. Radio Frequency Susceptibility - This equipment has been tested and is not affected by interference from other on board electronic equipment which meet Category A, Emission of Radio Frequency Energy Test of RTCA Document DO 160.
3. Emission of Radio Frequency Energy - This equipment has been tested and does not emit radio frequency energy in excess of that specified.

1.5 UNITS AND ACCESSORIES SUPPLIED

The following listings may be used to: 1) check the contents of your order and, 2) to order additional Units or components.

Table 1.8 is used for ordering Units, refer to the Units Part Number and its' Description. There is no need to order an Installation Kit as it is automatically included with its associated Unit.

1.5 Continued

Additional Installation Kits or detail parts of a Kit may be ordered from the Installation Kit Parts List. Item Part Numbers are provided for service replacement purposes and are not used when ordering a complete Installation Kit.

Table 1.10 furnishes an Optional Kits Parts List which includes a Maintenance Kit highly desired for NAV maintenance.

Refer to Section 1.6, Optional Accessories, for additional items to complete the avionics system.

TABLE 1.8 UNITS AND ACCESSORIES SUPPLIED

Unit Part Number	Unit and Description*	Supplied With Installation Kit Part No.
03723-0300	NAV 121 VOR, LOC, System	03723-0500
03723-0309**	NAV 121 VOR, LOC, System	03723-0500
03723-0301	NAV 122 VOR, LOC/GS, MKR System	03723-0501
03723-0310**	NAV 122 VOR, LOC/GS, MKR System	03723-0501
03723-0302	NAV 122A VOR, LOC, MKR System with GS Display	03723-0502
03723-0311**	NAV 122A VOR, LOC, MKR System with GS Display	03723-0502

*NAVs are 14v only. Refer to Section 1.6 for 28 VDC to 14 Vdc Voltage Converter.
**New part number assigned to identify Units having a Chassis Level Code commencing with the letter "B".

TABLE 1.9 INSTALLATION KIT PARTS LIST

Item	Part Number	Description	Quantity 03723-		
			0500	0501	0502
1	41364-0008	Connector, P810, 37 Pin	1	1	1
2	41307-0004	Hood, P810, Straight	1	1	1
3	41308-0004	Locking Assembly, P810	1	1	1
4	41152-0003	Connector, BNC	1	3	2
5	84160-0002	Tool, Zero Set	1	1	1
6	41372-0004	Contacts, Socket, Qty 37	1	1	1

TABLE 1.10 OPTIONAL KITS PARTS LIST

Kit Part Number	Description	Item Part Number	Qty
03723-0503	Dual Channeling Kit	- - - - - - - - -	
	Connector, 24 Pin	41285-0006	1
	Connector, 14 Pin	41285-0003	1
	Cable Assembly	90736-0101	1
03723-0504	Maintenance Kit	- - - - - - - - -	
	Zero Set Tool	84160-0002	1
	Extender Board (20 Pin)	56163-0101	1
	Extender Board (26 Pin)	56162-0101	1

1.6 OPTIONAL ACCESSORIES

a) Power Converter... required only for 28 volt installations:
Narco Voltage Converter(s)
MP 10 Voltage Converter, P/N 03710-0500 - see details elsewhere in this manual
OR
MP 15 Voltage Converter (Dual) P/N 03223-0302 (TSO'd to DO-160 - A2C2/A/JY/XXXXXXZBBBA
This TSO'd Dual Converter consists of two 28 Vdc to 14 Vdc Voltage Converters, each capable of 2.0 Amperes, on a single heat sink. Intended for use in 28V aircraft, the MP-15 will supply 14V to two navigation units (NAV's, ADF's, Transponders, etc.).

b) Antenna Splitter, Model VRP 48. Directs VOR and ILS signals from a single Nav antenna to a VOR/LOC receiver, a glideslope receiver, a marker beacon receiver, plus a 2nd VOR/LOC receiver. Two models are available: 1) receiver mounted or 2) remote mounted.

c) NAV (VOR/LOC) Antenna (see note)
Non TSO'd 1) Narco VRP 37, tail mounted, with 30 feet of RF cable and balun.
2) Narco VNA 10, vertical stabilizer mounted.

d) Glide Slope Antenna (see note)
Non TSO'd 1) Narco UGA 1.
2) Narco UGA 10.

e) Marker Beacon Antenna (see note)
Non TSO'd Narco VMA 15.

f) Headphones - low impedance type, 300 to 1000 ohms.

g) Audio Control Panel - Narco CP 135 or CP 136.

h) Glide Slope Receiver - Narco UGR 2A 2/5 with ARINC 2-out-of-5 channel coding. For use with GS display in NAV 122A.

i) Marker Audio Mute Switch - Supplied by installing agency: spring loaded, single pole, normally open, pushbutton or toggle switch.

j) Circuit Breaker - Supplied by installing agency; two ampere.

k) RS 42 Remote Selector - Used for channeling a single DME 190 (TSO) or UGR 2A from either of two NAV receivers; throw-over capability is provided with an external switch supplied by the installing agency. The RS 42 is required for channeling DME's which use relays for channel coding.

l) Dual Channeling Kit - Recommended when channeling both a DME and a Glide Slope receiver. Order part number - 03723-0503.

m) Right Angle, P810, Connector Hood - For use where depth behind the instrument panel is restricted. Order part number - 41307-0008.

n) Maintenance Kit - Contains two extender board assemblies and one alignment screwdriver. Extender assemblies allow circuit board operation with the board removed from the main chassis. Order part number 03723-0504.

Note: To insure complete FAA Part 37 TSO compliance as applied to Air Carrier operation, these equipments must be used with antennas meeting TSO's C34c, C35d, C36b and/or C40a as applicable. Where Part 37 compliance is not required, a non TSO'd antenna will suffice.

1.6.1 Miscellaneous Items NOT Supplied

a) Number 24 AWG stranded wire, as required.
b) Number 20 AWG stranded wire, as required.
c) Coaxial cable RG 58 C/U, as required.
d) Mounting hardware; refer to Section 2.

1.7 OPERATOR LICENSE REQUIREMENT

There are no operator license requirements for this type of equipment.

1.8 OPERATION

ON-OFF, Volume, Ident Knob

Rotating the knob clockwise, past the "click", applies power to the NAV circuits; continued clockwise rotation increases audio volume. Pulling this knob allows the 1020 Hz Ident code to be heard. Since the knob is spring loaded in the time-shared NAV 122, it must be held in the Ident position. A detent is provided for the Ident mode in the NAV 121 and NAV 122A.

Receive Frequency Channeling

Receive frequency is selected by the concentric knobs at the Units lower right corner. Whole megahertz frequencies are selected by the large knob while fractional megahertz frequencies are selected by the small knob. Clockwise rotation of either knob increases selected frequency. Continuous tuning is permitted with both knobs.

FRONT VIEW NAV 121

FRONT VIEW NAV 122 AND NAV 122A

1.8 Continued

Omni Bearing Selection

A desired omni bearing is obtained by turning the OBS knob to set that bearing, shown on the Omni Bearing Card, under the yellow Selected Bearing Indicator. Pushing the OBS knob activates the Self Test Function. With a VOR signal (of any bearing) applied to the receiver, rotate the OBS knob to set a 0^{o} bearing,under the Selected Bearing Indicator, then push in the OBS knob. If the Unit is operating properly, the VOR/LOC Deviation Indicator will center and VOR/LOC Flag will show TO. The three marker lamps also will light when the OBS knob is depressed.

VOR/LOC Deviation Indicator

In VOR mode, the vertically oriented Indicator moves left or right to indicate location of selected VOR bearing relative to actual aircraft heading. When centered, the Indicator shows on-course condition.

In LOC mode, the Indicator moves left or right to locate the center of the horizontal component of a ILS glide path relative to actual aircraft heading.

GS Deviation Indicator

Orange horizontal Deviation Indicator moves up or down to locate the center of the vertical component of an ILS glide path relative to actual aircraft position. In the NAV 122, the glideslope needle will stow up when in VOR mode or when the IDENT knob is pulled.

Acquisition of the ILS glide path will be shown when the GS and LOC Deviation Indicators cross and center within the circle.

Warning Flags

TO-FROM Flag - Red OFF Flag alerts the pilot to either loss of signal or inadaquate signal level. A TO or FROM Flag shows whether the selected course will take the aircraft to or from the station.

GS Flag - Red OFF Flag alerts the pilot to either loss of signal or inadaquate signal level.

Marker Beacon (NAV 122 and NAV 122A)

Three Marker lamps are located to the left of the VOR Deviation Indicator. Depressing the OBS knob will light and test all three lamps. Rear connector pins are provided for the following Marker features: HI-LO sensitivity, lamp dimming, and audio mute.

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2-2	GS METER TEST, NAV 122A ONLY	2-5	1C14	
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2.1 INTRODUCTION

This section provides all the electrical and mechanical installation information. Electrical Installation and Mechanical Installation Sections are independent and self supporting. This permits their removal from the manual allowing the electrical and mechanical installation efforts to proceed in parallel.

Interconnect cables are to be constructed by the installing agency. Refer to Section 2.4 for details.

Printed circuit board assemblies may be removed from the main chassis and electrically operated with the Maintenance Kit (part number 03723-0504). The Kit contains two board extender assemblies and one alignment screwdriver.

2.2 PRELIMINARY PROCEDURES

2.2.1 Preliminary Inspection

Carefully unpack the equipment noting any damage to shipping cartons or avionics. If damage is noted, retain the cartons to coroborate damage claims.

Inventory received items against the lists in Section 1.5 to assure a complete order.

2.2.2 Pre Installation Bench Test

The purpose of this sub-section is to determine that the Unit meets factory performance specifications.

2.2.2.1 Test Equipment Required

TYPE	CHARACTERISTIC	EXAMPLE
Regulated DC Power Supply	Voltage Range: 0 to 30 Vdc Current Range: 0 to 1 Ampere	Power Designs Model 5015
VHF Signal Generator	Frequency Range: 10 MHz to 400 MHz Modulation: AM, 0 to 95%	Hewlett Packard Model 608D
VOR/LOC Generator		IFR Model N-750 or Collins 479S-3 with Boonton 211A
Glideslope Generator		Boonton Model 232A
Audio Generator	Frequency Range: 400 Hz to 3000 Hz	Hewlett Packard Model 200CD
Volt-Ohmmeter	DC Ranges: Input Impedance: 10 megohms min. Ranges: 0.1V to 100V Accuracy: 2% of range AC Ranges: Input Impedance: 1 megohm min. Ranges: 0.01V to 100V rms Frequency Range: 10 Hz to 1 MHz Accuracy: 2% of range Ohmmeter Range: 1 ohm to 10 megohms Accuracy: 5% of reading	Hewlett Packard Model 427A
Audio Wattmeter	Load Range: 100 to 1000 ohms min. Power Range: 0 to 100 milliwatts min.	General Radio Model 1840-A
Attenuator	6 dB, 50 ohms	

2.2.2.2 Bench Test Wiring Harness

The harness shown in Figure 2-1 will permit bench testing of either a NAV 121, 122, or 122A. Alternatively, the cable to be installed in the aircraft may be used, providing in addition, a checkout of avionics and cabling.

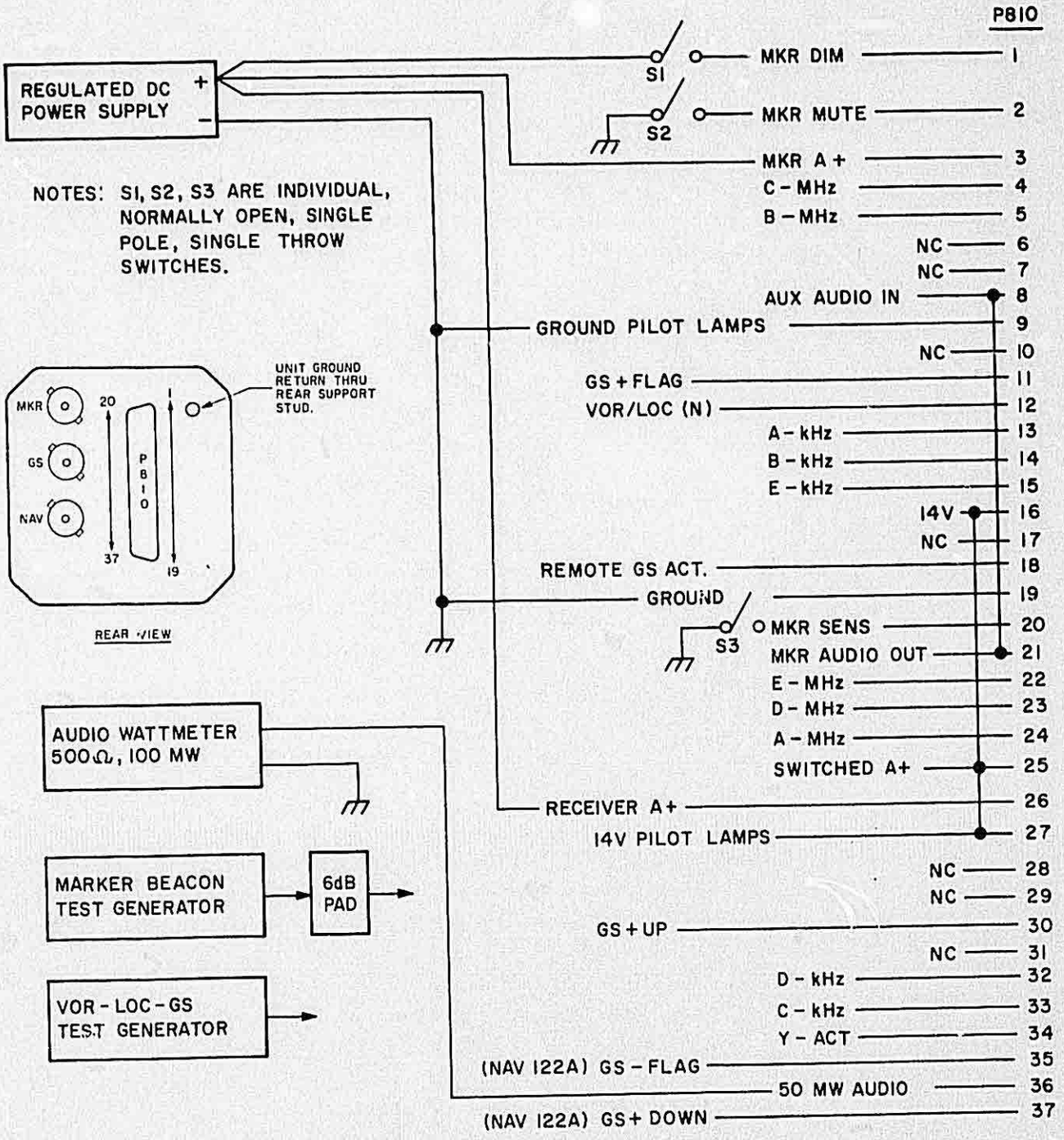


FIGURE 2-1. BENCH TEST HARNESS

2.2.2.3 Test Procedure

Bench tests are conducted in the following sequence: A) VOR/LOC receiver and audio circuits; B) VOR converter; C) LOC converter; D) GS receiver and converter; E) Marker Beacon receiver; and F) DME and GS channeling. All versions are tested by this procedure: simply bypass those procedures which do not apply.

A. VOR/LOC Receiver
   1) Connect the test equipment (Section 2.2.2.1) as shown in Figure 2-1.
   2) Connect the VOR generator's RF output to the NAV connector at the rear of the NAV Receiver.
      Generator Settings: RF output attenuator - 4 uV
      Modulation - 1020 Hz, 30%
   3) Set generator and receiver to a desired frequency.
   4) Turn receiver volume control maximum CW and pull to "IDENT" position; note audio output.
      Audio: 50 mW minimum across 500 ohms.
   5) Reduce generator RF attenuator to 1 uV.
   6) In "IDENT" mode, reduce audio power output to 2 mW (or a convenient reference); remove modulation from generator and observe decrease in audio output.
      S+N/N: 6 dB minimum
   7) Set generator RF attenuator to 10 uV; set modulation to 30%, 1020 Hz.
   8) In "IDENT" mode, set audio power output to 20 mW (or a convenient reference); increase generator RF attenuator to 10 kuV: note increase in audio power output.
      AGC: +1 dB maximum
   9) Modulate generator 30% with 1020 Hz audio; set generator attenuator to 500 uV.
   10) In "IDENT" mode, set power output to 20 mW; depress NAV Receiver VOL-IDENT knob and note decrease in audio output.
      Ident Filter: 19 dB minimum

B. VOR Converter*
   1) Modulate generator with a composite VOR signal; set RF attenuator to 500 uV.
   2) Check VOR accuracy at the four cardinal points (0^{o}, 90^{o}, 180^{o}, 270^{o}).
      VOR Accuracy: Error shall not exceed $\pm 1.5^{o}$.
   3) Rotate OBS + 10^{o} then - 10^{o}.
      Course Width: full scale deflection
   4) Decrease generator RF attenuator to less than 0.2 uV; increase RF attenuator slowly and note appearance of a full TO or FROM indication.
      VOR Flag Sensitivity: 1.0 uV maximum
   5) Set generator attenuator to 500 uV; set bearing to 90^{o}.
   6) Rotate NAV Receiver OBS to 0^{o} then push-in OBS knob.
      TEST mode: Left-Right needle must center within $\pm 1^{o}$ with a full TO flag.

*If VOR Zero Set is adjusted the SELF TEST must also be re-zeroed. Refer to Figure 2-14 for location of electrical adjustments.

2.2.2.3 Continued

C. LOC Converter

1) Set generator and receiver to a LOC frequency.
2) Modulate generator with a composite LOC signal; set RF attenuator to 500 uV.
   LOC Accuracy Centering: $\pm$ 1 needle width
   $\pm$ 4 dB ddm*: 3 dots $\pm$ 1 needle width
3) Apply centering LOC signal; decrease RF attenuator to less than 0.2 uV; increase attenuator slowly and note appearance of a full TO indication.
   LOC Flag Sensitivity - 1.0 uV maximum

D. NAV 122 Glide Slope Receiver and Converter

1) Connect GS generator's RF output to the GS connector at the rear of the NAV Receiver.
2) Modulate generator with a composite GS signal; set RF attenuator to 500 uV.
   GS Accuracy, Centering: $\pm$ 1 needle width
   GS Accuracy, $\pm$ 2 dB ddm*: 1.5 dots $\pm$ 1 needle width
3) Apply centering GS signal; decrease RF attenuator to less than 0.2 uV; increase attenuator slowly and note appearance of a full TO indication.
   GS Flag Sensitivity - 20 uV

NAV 122A Glide Slope Meters

1) Refer to Figures 2-1 and 2-2.
2) Connect test battery and resistor as shown in 2-2.
   Specification - GS Up/Down needle should deflect 5 dots.
   GS Flag should indicate full TO.

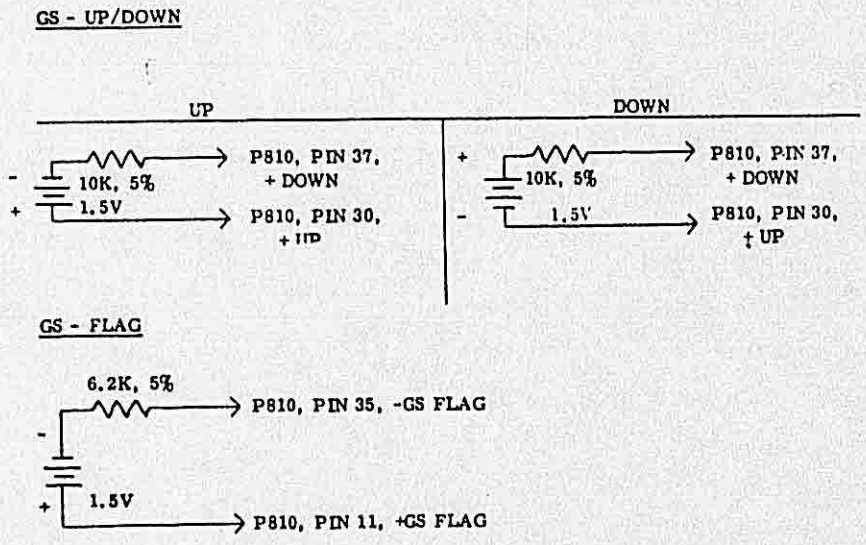


FIGURE 2-2. GS METER TEST, NAV 122A ONLY

2.2.2.3 Continued

E. Marker Beacon

1) Connect Marker Beacon generator's RF output to the MKR connector at the rear of the NAV Receiver.
2) Refer to Figure 2-1 and set S1, S2, and S3 as shown.
3) Tune generator to 75 MHz $\pm$ 1 kHz; modulate generator 95% with 1300 Hz; set generator RF attenuator to minimum.
4) Increase generator attenuator until amber lamp just begins to glow.
   HI Sensitivity - 400 uV $\pm$ 2 dB.
5) Set S3 to open circuit position; amber lamp must extinguish.
6) Increase generator attenuator until amber lamp just begins to glow.
   LO Sensitivity - 2,000 uV $\pm$ 2 dB
7) Perform step 6 with 400 Hz modulation to light the blue lamp, then 3,000 Hz modulation to light the white lamp.
8) Set switch S3 to the closed position. Set generator attenuator to 4000 uV.
   Audio Specification - 50 mW (3.1V rms) across 500 ohms
9) Set generator attenuator to 400 uV. In the "Ident" mode, set audio output to 2.0 mW. While observing audio wattmeter and marker lamps, increase generator attenuator to 100,000 uV.
   AGC: Audio output shall not increase more than 10 dB; only one lamp may light; lamp brilliance shall not decrease.
10) Set generator attenuator to 2,000 uV. In the "Ident" mode, set audio output to 20 mW. Momentarily close S2.
   Audio Mute: Audio output should decrease 40 dB minimum gradually returning over a 10 to 14 second period to 20 mW.
11) Observe lamp brilliance, then close S1.
   Dimming: Lamp brilliance should decrease.
12) Depress the OBS knob.
   TST mode: All three lamps must light.

F. DME and GS Channeling

1) Refer to Table 2.1 for channel coding. Using an ohmmeter, check for continuity of code bits to ground.
2) With power applied to the NAV Receiver, connect a voltmeter between P810 pin 18 and ground.
   VOR Channel: +4V minimum
   LOC/GS Channel: +1V maximum.

*ddm - Difference in depth of modulation.

TABLE 2.1 DME/GS 2-Out-Of-5 CHANNEL CODE

MHz Channels

MHz ARINC	P810 PIN	108	109	110	111	112	113	114	115	116	117
A	24	X	X		X	X					
B	5			X	X		X	X			
C	4					X	X		X	X	
D	23	X						X	X		X
E	22		X	X						X	X

kHz Channels

kHz ARINC	P810 PIN	.00	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75	.80	.85	.90	.95
A	13			X	X	X	X											X	X	X	X
B	14	X	X	X	X			X	X	X	X										
C	33					X	X	X	X			X	X	X	X						
D	32									X	X	X	X			X	X	X	X		
E	15	X	X											X	X	X	X			X	X
Y	34		X		X		X		X		X		X		X		X		X		X
Common	19																				

Note: "X" indicates continuity to Common.

2.3 MECHANICAL INSTALLATION

The NAV 121, 122, and 122A are intended to be instrument panel mounted. When mounted from behind the panel, two screws (6-32 x 7/16) and the NAV's VOL-IDENT bushing secure the Unit (see Figure 2-3). Mounting through the front of the panel requires the use of a Marman Clamp, see Figure 2-5. In either case, rear support should be supplied using the stud extending from the rear of the Unit.

Connector P810 incorporates a "slide lock" mechanism. Before installing the connector, move the slide to position the slide's longer tab away from the connector, mate J810 and P810, then push slide to lock connector to NAV Unit. To remove P810 from the NAV Receiver, by feel, determine which end of the slide extends beyond the connector body, press this end toward the connector until it is flush, then remove the connector.

BNC connectors are located on the rear of the NAV Receiver. When attaching antenna cables, refer to Figure 2-3 for connector identification.

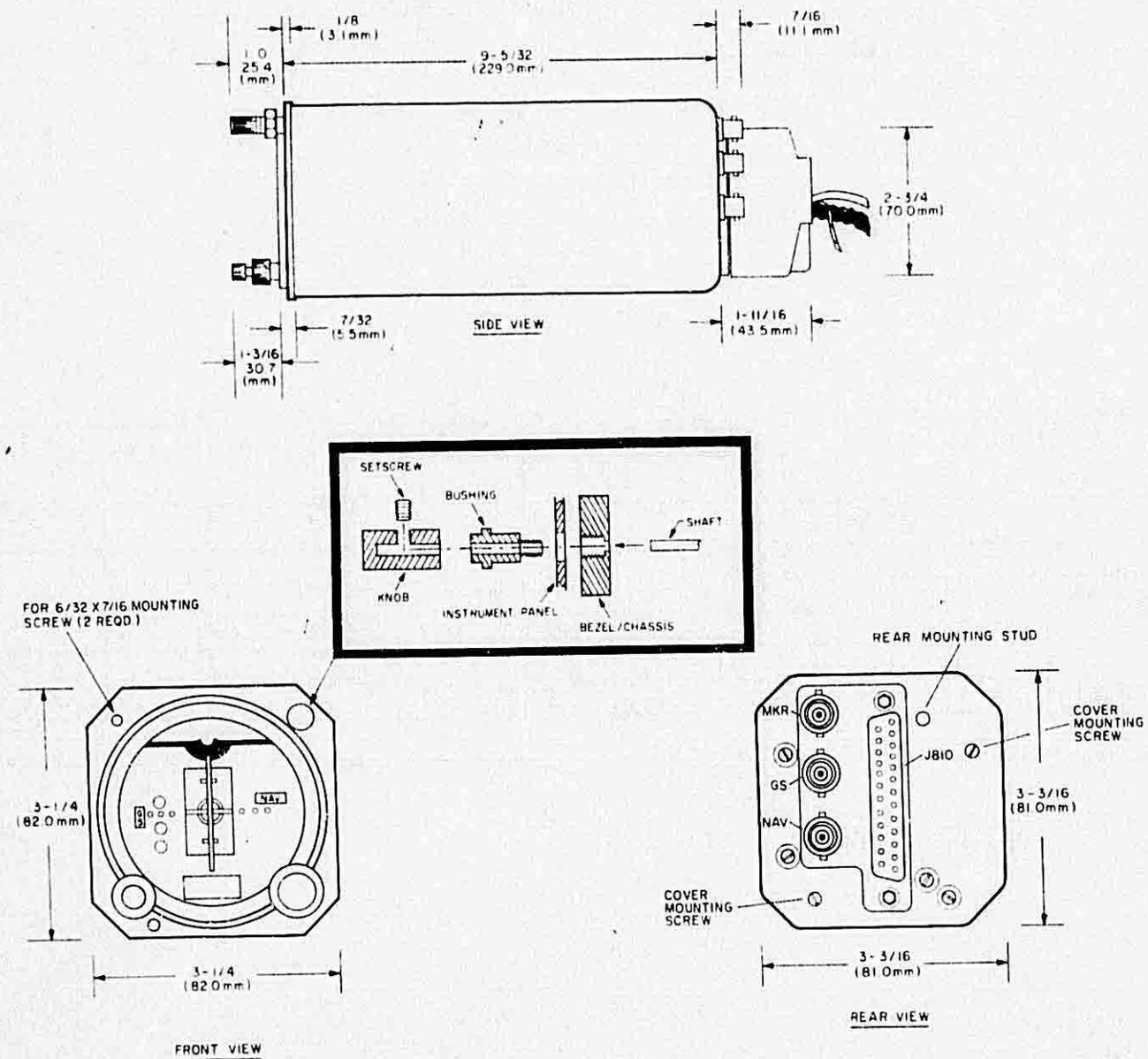


FIGURE 2-3. MECHANICAL INSTALLATION

SEE BLOW-UP

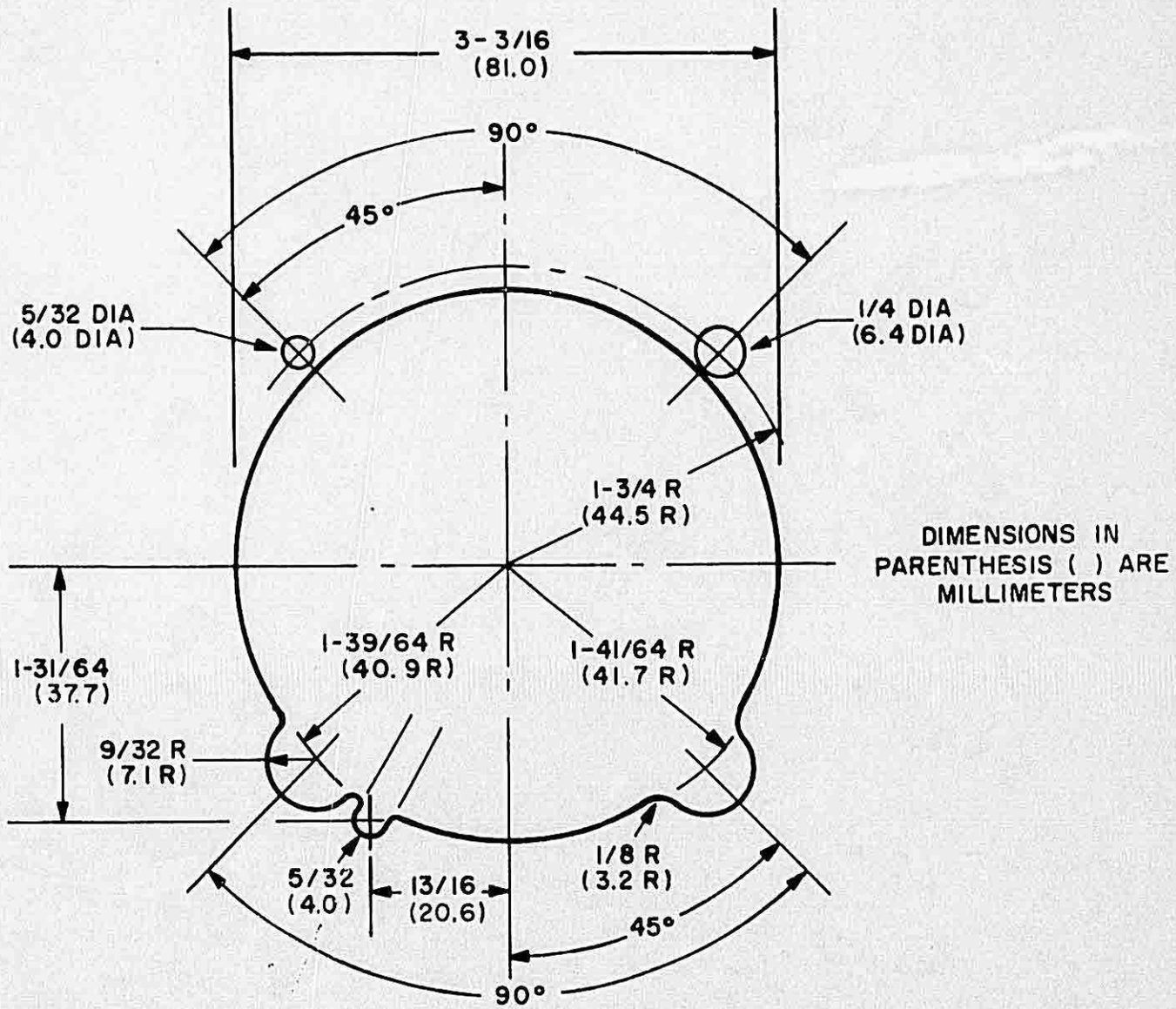
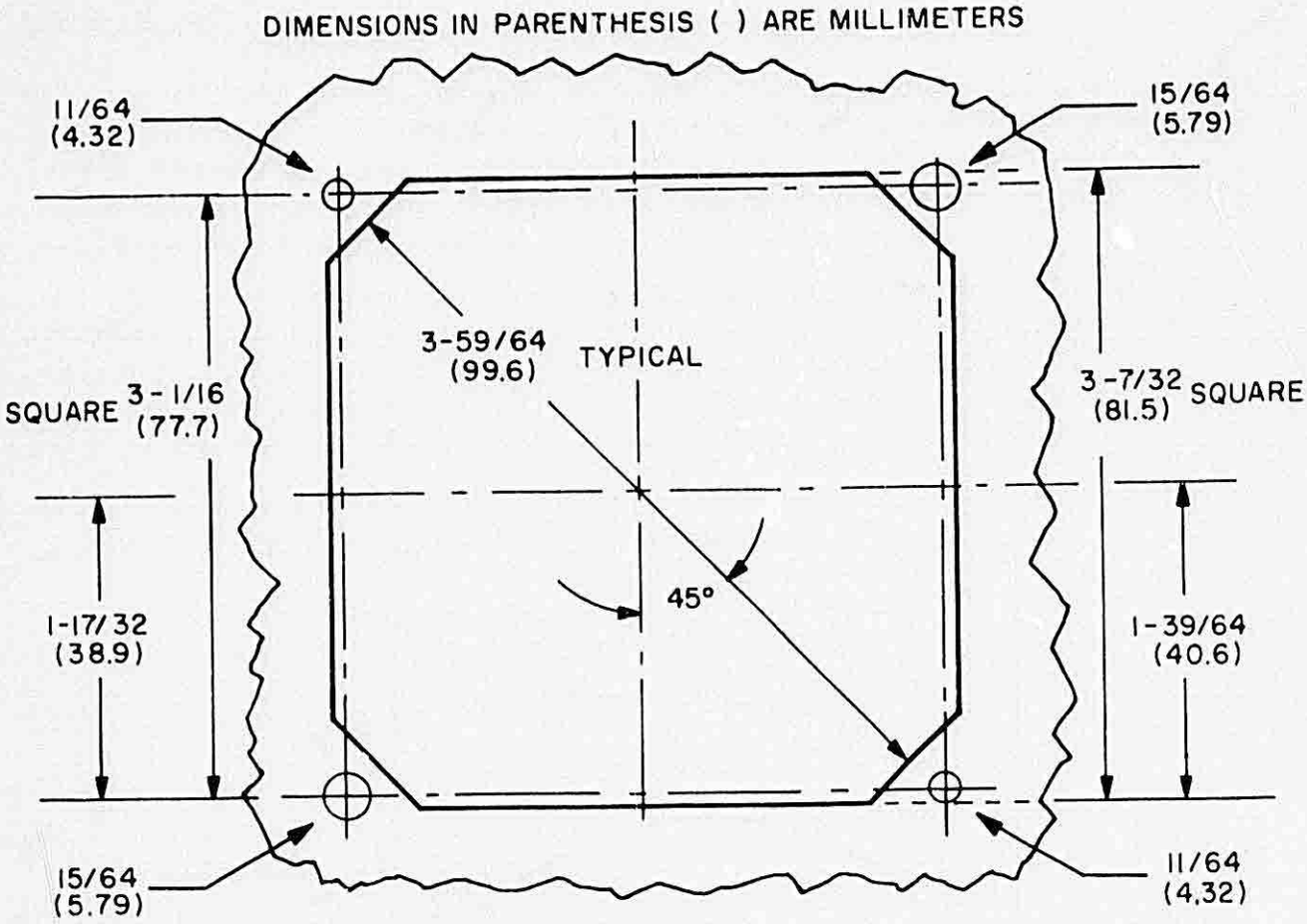


FIGURE 2-4. MOUNTING TEMPLATE, REAR MOUNT



Installation:

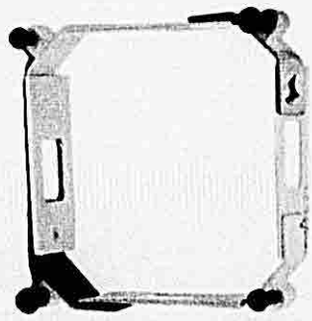
The clamp is installed from behind the panel.

1. Install the two #6 "fixed" corner screws but do not tighten.
2. Install, by only several threads, the two #8 "clamping" screws.
3. Slide the NAV Unit into position.
4. Tighten the "fixed" corner screws.
5. Tighten the "clamping" screws.

Removal:

Loosen the two larger (#8) screws until the NAV Unit may be pulled through the clamp.

1. Be sure cables attached to rear of Unit are either disconnected or are of sufficient length to accompany Unit through the clamp.
2. In some cases it will be necessary to loosen the two #6 fixed corner screws.



NOTES:
1. FRONT MTG. USE MARMAN DIV. AERO-QUIP CORP. CLAMP PART NO. 54621, OR USE ADAPTER PLATE AND MOORING PLATE IN ACCORDANCE WITH ARINC SPECIFICATION NO. 408, ATTACHMENT 386.

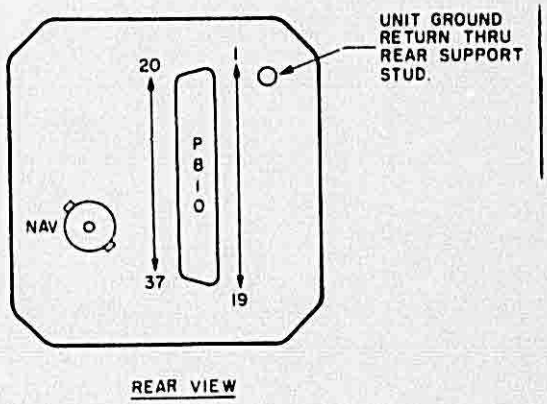
FIGURE 2-5. MOUNTING TEMPLATE, FRONT REMOVAL FOR USE WITH MARMAN CLAMP

2.4 ELECTRICAL INSTALLLATION

Interconnect cables must be constructed by the installing agency. Table 2.2 shows the rear panel connections for each of the NAV units described in this manual. Before building the cable, pursue Section 2.4, determine required cable length, and note wire gauge.

TABLE 2.2A NAV 121 REAR PANEL CONNECTIONS

Connection See Note 1	Function
NAV Power	
Refer to Section 2.4.3.1	
6 and 25	Switched 14/28V Output
7 and 26	14/28 Vdc Input From Circuit Breaker
9	Pilot Lights, 28V
16	14V Input
19	Ground (REAR SUPPORT STUD)
27	Pilot Lights, 14V
Audio	
Refer to Section 2.4.2.2	
8	Auxiliary Audio Input
31	30 mW Audio Output
36	50 mW Audio Output
ARINC Channeling	
Refer to Section 2.4.2.3	
4	C MHz
5	B MHz
13	A kHz
14	B kHz
15	E kHz
22	E MHz
23	D MHz
24	A MHz
32	D kHz
33	C kHz
34	Y Channel
Autopilot And Indicators	
Refer to Section 2.4.2.7	
10	+FROM
28	+LEFT
29	4V Reference (+ TO and + Right)
Miscellaneous	
Refer to Section 2.4.2.4 and 2.4.2.6	
12	VOR/LOC (NARCO)
17	VOR/LOC (ARINC)
18	GS/LOC Activate



REAR VIEW

TABLE 2.2B NAV 122 REAR PANEL CONNECTIONS

Connection See Note 1	Function
NAV Power	
Refer to Section 2.4.2.1	
6 and 25	Switched 14/28V Output
7 and 26	14/28 Vdc Input From Circuit Breaker
9	Pilot Lights, 28V
16	14V Input
19	Ground (REAR SUPPORT STUD)
27	Pilot Lights, 14V
Audio	
Refer to Section 2.4.2.2	
8	Auxiliary Audio Input
31	30 mW Audio Output
36	50 mW Audio Output
ARINC Channeling	
Refer to Section 2.4.2.3	
4	C MHz
5	B MHz
13	A kHz
14	B kHz
15	E kHz
22	E MHz
23	D MHz
24	A MHz
32	D kHz
33	C kHz
34	Y Channel
Marker Beacon	
Refer to Section 2.4.2.5	
1	Lamp Dimming
2	Audio Mute
3	14/28 Vdc Input From Circuit Breaker
20	HI-LO Sensitivity
21	Audio Output
Autopilot and Indicators	
Refer to Section 2.4.2.5 and 2.4.2.7	
10	+FROM
11	+GS Flag
28	+LEFT
29	4V Reference (+ TO, - GS Flag, + Right, and + GS Down)
30	+GS UP
Miscellaneous	
Refer to Sections 2.4.2.4 and 2.4.2.6	
12	VOR/LOC (NARCO)
17	VOR/LOC (ARINC)
18	GS/LOC Activate

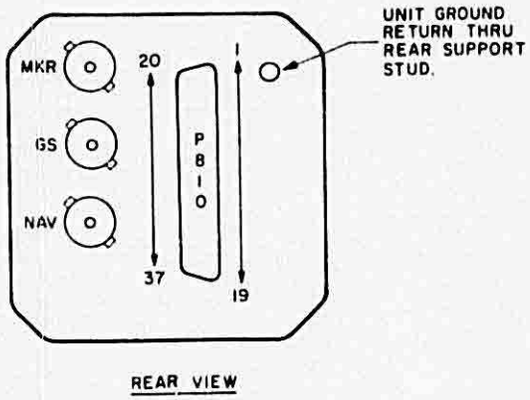
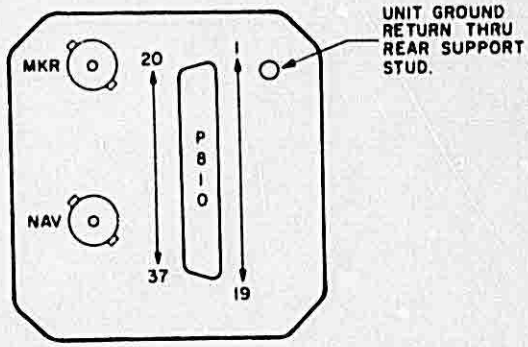


TABLE 2.2C NAV 122A REAR PANEL CONNECTIONS

Connection See Note 1	Function
NAV Power	
Refer to Section 2.4.2.1	
6 and 25	Switched 14/28V Output
7 and 26	14/28 Vdc Input From Circuit Breaker
9	Pilot Lights, 28V
16	14V Input
19	Ground (REAR SUPPORT STUD)
27	Pilot Lights, 14V
Audio	
Refer to Section 2.4.2.2	
8	Auxiliary Audio Input
31	30 mW Audio Output
36	50 mW Audio Output ..... to CP
ARINC Channeling	
Refer to Section 2.4.2.3	
4	C MHz
5	B MHz
13	A kHz
14	B kHz
15	E kHz
22	E MHz
23	D MHz
24	A MHz
32	D kHz
33	C kHz
34	Y Channel
Marker Beacon	
Refer to Section 2.4.2.5	
1	Lamp Dimming
2	Audio Mute
3	14/28 Vdc Input From Circuit Breaker
20	HI-LO Sensitivity
21	Audio Output
Autopilot And Indicators	
Refer to Sections 2.4.2.5 and 2.4.2.7	
10	+FROM
11	+GS Flag
28	+LEFT
29	4V Reference (+ TO and + RIGHT)
30	+GS UP
35	-GS Flag
37	+GS DOWN
Miscellaneous	
Refer to Sections 2.4.2.4 and 2.4.2.6	
12	VOR/LOC (NARCO)
17	VOR/LOC (ARINC)
18	GS/LOC Activate



REAR VIEW

2.4.1 Antenna Connections

Antenna connections to the NAV Receiver are shown in Figure 2-6. Also shown in this figure, is the use of a VRP 48 Antenna Splitter, which permits use of a NAV antenna for VOR/LOC, GS, and Marker Beacon signal reception.

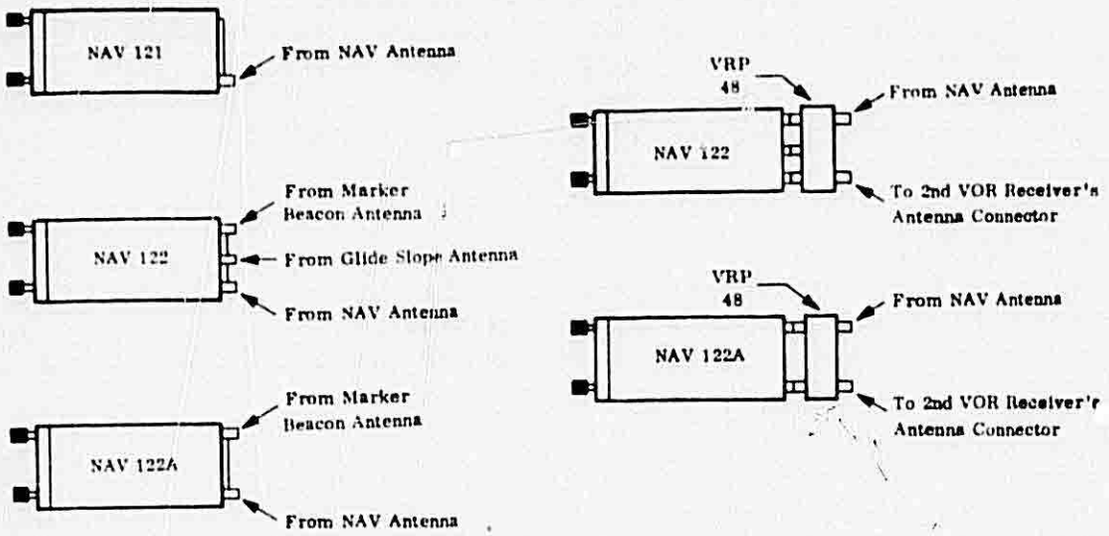
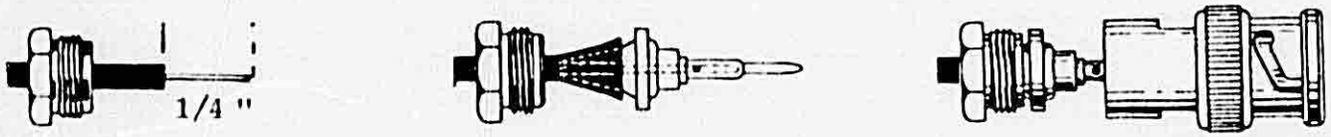


FIGURE 2-6. ANTENNA CONNECTIONS

BNC connector(s) are provided in the Installation Kit. Coaxial cable should be RG58 A/U or C/U.



1. Take one clean square cut through cable insulation, braid and dielectric, exposing ¼" of conductor. Slip nut onto cable.

2. Insert conductor into tapered, self-clamping sleeve and contact sub-assembly, force edge of sleeve between dielectric and braid until insulation rides well onto taper. Solder conductor to contact at solder hole.

3. Fit contact sub-assembly into connector body, screw nut into body, binding insulation and braid tightly against tapered sleeve, thus forming a strong, weatherproof connection.

Courtesy of Bendix Corp.

All illustrations enlarged for clarity

FIGURE 2-7. BNC CABLE CONNECTOR

2.4.2 Interconnect Cable (P810)

Tables 2.2 list rear panel connections to a NAV Receiver. Connector P810 may be considered to carry following groups of interconnections.

1. Power - DC input, ground and pilot lamps.
2. Audio - Receiver and Marker Beacon.
3. Channeling - DME and GS.
4. NAV 122A Glide Slope metering.
5. External Marker Beacon controls - Audio mute, HI-LO sensitivity, and lamp dimming.

2.4.2 Continued

P810 is assembled as shown in Figure 2-8. While constructing the cable, be sure to pass wires through the hood before inserting pins into the connector.

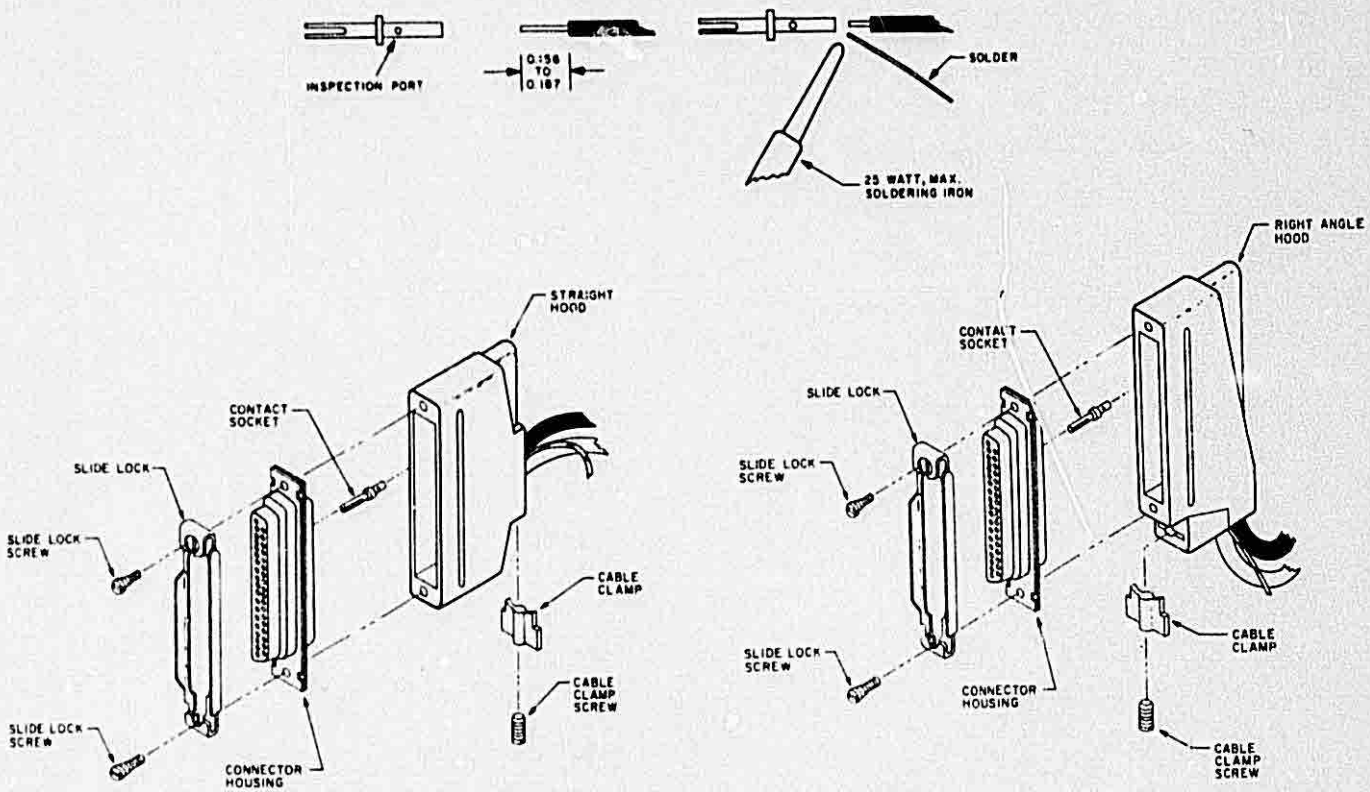


FIGURE 2-8. P810 ASSEMBLY

Connector Assembly Procedure (Solder)

Note: Crimping tools are available from ITT Cannon, if desired.

1. Strip wire as shown in Figure 2-8. Maximum wire size is No. 20AWG.
2. Tin exposed lead. Be sure no individual wire strands are free to cause shorts when connector is assembled.
3. Insert lead into connector pin until lead is visible at inspection port.
4. Heat pin and apply solder as shown until solder wicks into pin cavity and becomes visible through inspection port. Be careful not to overheat pin or melt insulation on wire.
5. Pass pin through hood and insert pin in connector until a "click" is heard or felt; exert a slight pull on the wire to assure pin seating.
6. During final assembly:
   a. Inspect all wires for individual strands of wire shorting to adjacent terminals.
   b. Ease hood into place, do not force.

Connector P810 incorporates a "slide lock" mechanism. Before installing the connector, move the slide to position the slide's longer tab away from the connector, mate J810 and P810, then push slide to lock connector to NAV Unit. To remove P810 from the NAV Receiver, by feel, determine which end of the slide extends beyond the connector body, press this end toward the connector until it is flush, then remove the connector.

SEE BLOW-UP

2.4.2.1 Power Input Wiring

Figure 2-9 illustrates the connections to P810 for 14 and 28 Volt aircraft systems. Circuit protection, fuse or circuit breaker, must be supplied by the installing agency. Please read all notes on Figure 2-9.

Ground return for the NAV Unit is completed through the rear support stud. Normally a metal rear support strap, connected to the airframe, will provide a good ground path. If the support strap does not furnish a satisfactory ground, add a ground wire from the airframe to a solder lug and additional nut on the NAV's rear support stud.

2.4.2.2 Audio Interconnections

Pin 8 - Marker Audio Input - receives marker audio from pin 21 when separate marker audio is not required.

Pin 21 - Marker Audio Output - may be routed to audio panel for separately switched marker audio or jumpered to pin 8 to be combined with VOR/LOC audio. Output impedance is approximately 200 ohms. Power out, 8 mW.

Pin 31 - 30 mW to COM Aux Audio - when an audio panel is NOT used, Pin 31 is connected to COM Aux Audio input. VOR/LOC audio (with MKR audio if pins 8 and 21 are jumpered) is present at Pin 31. Output impedance is approximately 3K ohms.

Pin 36 - 50 mW audio - same audio as Pin 31 but intended for audio panel use. Output impedance is approximately 500 ohms.

2.4.2.3 DME/Glide Slope Channeling And LOC/GS Activate

DME/GS Channeling

ARINC 2-out-of-5 channel coding is provided by the NAV units. Table 2.1 furnishes the connector pin numbers for cable construction.

Channel line isolation is <u>not</u> required with the DME 190, DME 190 TSO, DME 195 or UGR 2A with 2-out-of-5 coding. When channeling avionics not produced by Narco, an isolation diode must be in series with each channeling line. If isolation diodes are not within the equipment being channeled, diodes must be added externally.

Avionics which use relays in their channeling circuits, such as the Narco UDI 2AR, should not be directly channeled by a NAV unit. A Narco RS 42 Remote Selector will interface these units.

Dual Channeling Kit

When a NAV is to channel both a DME and Glide Slope Receiver, the Dual Channeling Kit is recommended. Refer to the Optional Accessories Section for the Kit part number. Figure 2-10 illustrates the Kit with the Kit's wiring shown in Table 2.3. Table 2.4 furnishes the interconnections from the Kit to Narco Glide Slope and DME equipments.

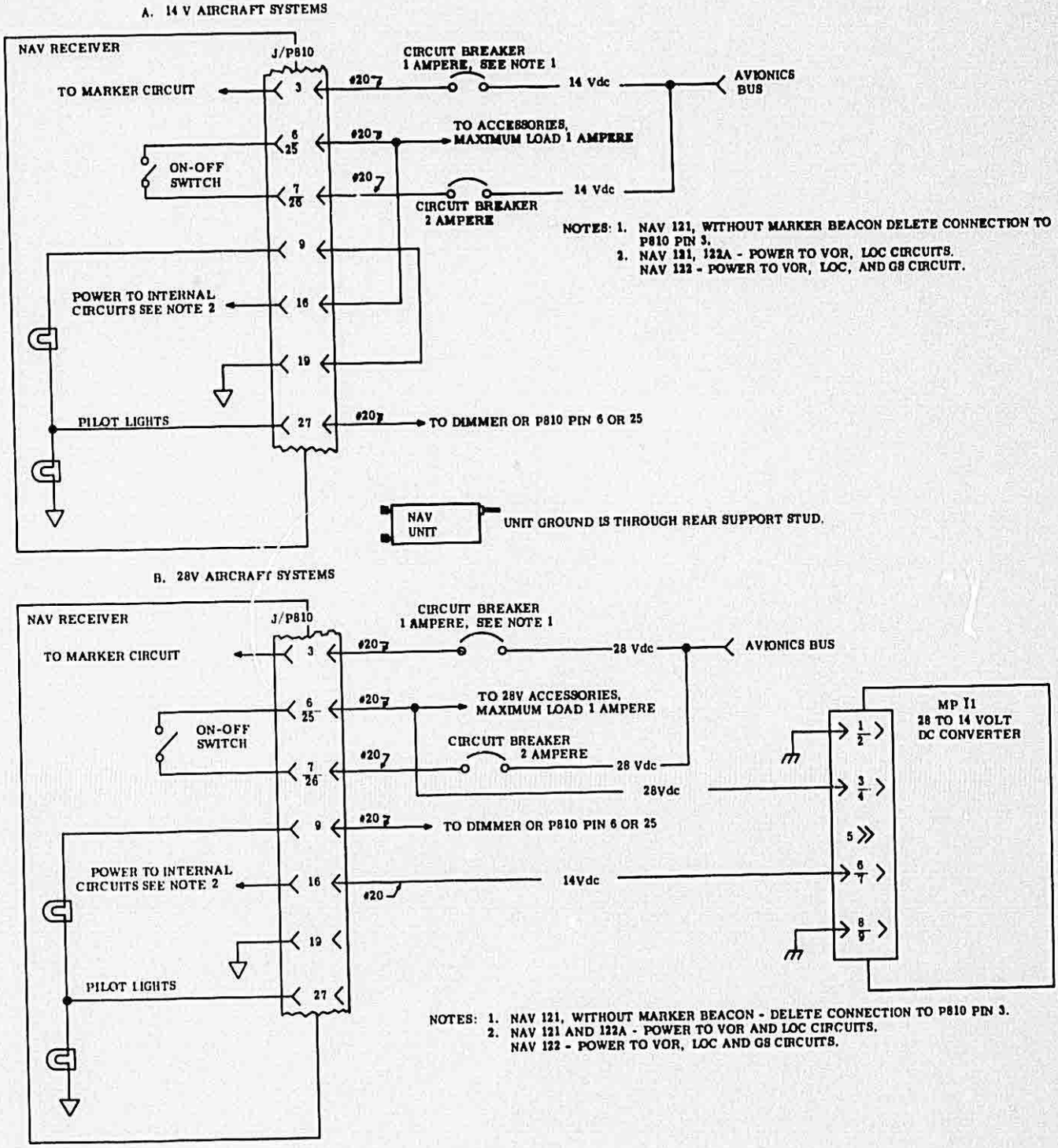


FIGURE 2-9. POWER INPUT CONNECTIONS

SEE BLOW-UP

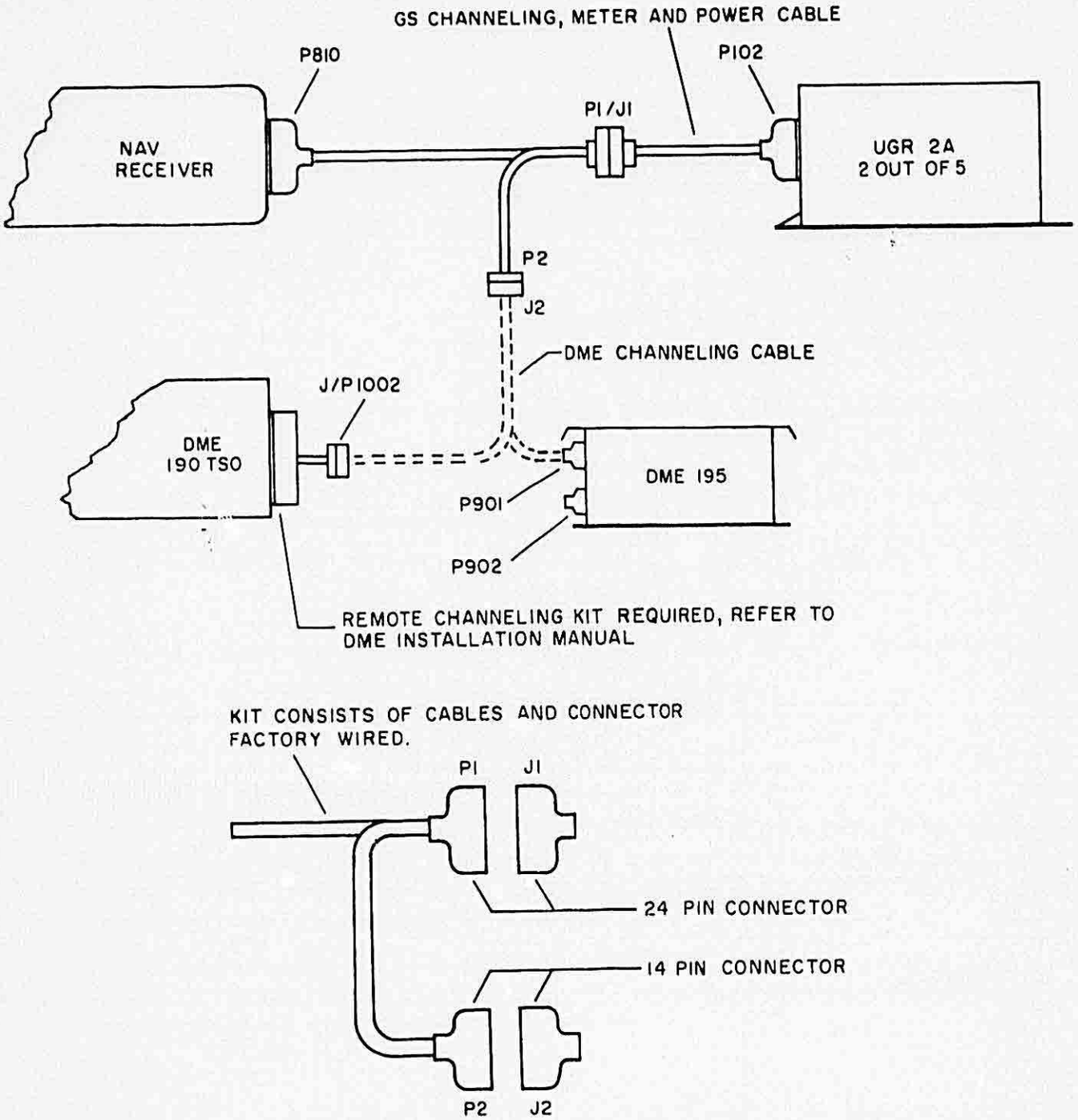


FIGURE 2-10. DUAL CHANNELING KIT

TABLE 2.3 DUAL CHANNELING KIT TO P810 WIRING

From P1	Function	Wire Color To NAV	To NAV P810	Wire Color To P2	To P2
17	C MHz	white/red/yellow	4	white	3
16	B MHz	white/red/brown	3	white/brown	2
20/21	SW 14/28V	(2) white/blue/black	6 or 25	----------	-
19	GS + Flag	white/green/black	11	----------	-
6	A kHz	white/blue	13	blue	6
1	B kHz	white/green	14	green	7
2	E kHz	white/red/green	15	red	10
24	LOC/GS ACT	white/yellow/black	18	----------	-
12	Ground	white/black	19	black	12
22	E MHz	white/violet	22	violet	5
13	D MHz	white gray	23	gray	4
9	A MHz	white/red/orange	24	white/red	1
14	GS + UP	white/red/black	30	----------	-
5	D kHz	white/orange	32	orange	9
4	C kHz	white/yellow	33	yellow	8
3	Y Channel	white/brown, black	34	brown	11
23	GS - Flag	white/gray/black	35	----------	-
18	GS + Down	white/orange/black	37	----------	-

TABLE 2.4 DUAL CHANNELING KIT TO DME/GS WIRING

Glide Slope (See Notes 4 and 5)

From J1	Function	To UGR 2A P102
1	B kHz	1
3	Y Channel	3
4	C kHz	4
6	A kHz	6
12	Ground	12
14	GS + UP	14
16	B MHz	16
18	GS + DOWN	18
19	GS + Flag	19
20/21	SW. 14/28	See Note 1
22	E MHz	22
23	GS - Flag	23
24	GS ACT.	24
--	----------	8-See Note 5

From J2	Function	To DME See Notes 2 and 3
1	A MHz	1
2	B MHz	2
3	C MHz	3
4	D MHz	4
5	E MHz	5
6	A kHz	6
7	B kHz	7
8	C kHz	8
9	D kHz	9
10	E kHz	10
11	Y Channel	11
12	Common	12

Notes:

1.

Aircraft Bus	P102
14 Volt	20/21
28 Volt	10/11

2. DME 190 and 190 TSO requires Remote Channeling Kit; refer to the DME Installation Manual.
3. DME 190 and 190 TSO - P1002. DME 195 - P901 or P902.
4. ARINC Channel Code.
5. P102 pin 8 must be jumpered to P102 pin 12.

2.4.2.3 Continued

LOC/GS Activate (EXT)

The LOC/GS Activate signal is generated by an active device as shown in Figure 2-11. Interconnecting the NAV unit with a Glide Slope or Localizer not produced by Narco will require observance of the following:

1) VOR mode - V_1 maximum is 30 Vdc (U316A off).
2) LOC/GS mode - I maximum is 250 ma; value of R must limit I (U316A saturated).

Reactive loads (relay coils) must be shunted with transient suppression.

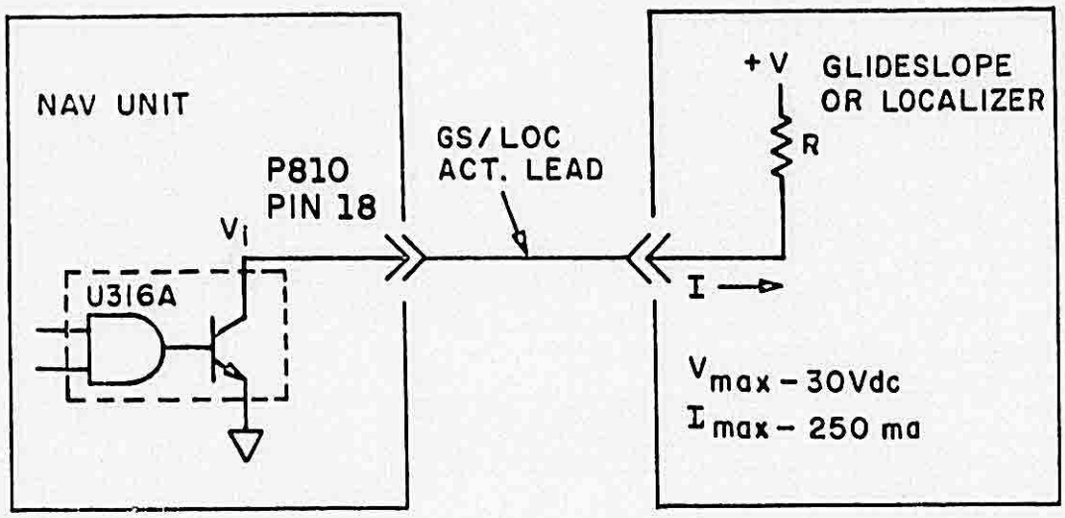


FIGURE 2-11. LOC/GS ACTIVATE

2.4.2.4 NAV 122A To External GS Receiver Interconnections

The NAV 122A contains Glide Slope Up-Down and Warning Flag meters, but requires meter drive signals from an external GS receiver.

Shown in Table 2.5 are the interconnections required for mating a NAV 122A to a UGR 2A Glide Slope receiver with 2-out-of-5 channeling. Refer to Section 2.4.2.3 for a discussion of frequency channeling. If the NAV 122A Glide Slope meters are to be driven from a receiver not produced by Narco, refer to Section 1.4, Specifications, to assure compatibility.

TABLE 2.5 NAV 122A TO UGR 2A (2-out-of-5) INTERCONNECTIONS

NAV 122A P810 Pin	Function	UGR 2A 2/5 P102 Pin
5	MHz B	16
11	+GS Flag	19
13	kHz A	6
14	kHz B	1
6/25	Switched A+	See Note 2
18	LOC/GS Act.	24
19	Ground	12
22	MHz E	22
30	+GS Up	14
33	kHz C	4
34	Y Channel	3
35	-GS Flag	23
37	+GS Down	18
--	----------	8
		See Note 4

Notes:

1. NC indicates NO CONNECTION.
2.

Aircraft Bus	P102, Pin
14 Volt	20/21
28 Volt	10/11

3. ARINC Channel Code.
4. P102 pin 8 must be jumpered to P102, pin 12.

2.4.2.5 External Marker Beacon Controls

The NAV 122 and 122A contain marker beacon receiving and display circuits. The following comments relate to instrument panel mounted switches, supplied by the installing agency, to control some marker beacon functions.

Marker Beacon receiving and display circuits are not part of a NAV 121.

A. HI-LO Sensitivity

Connect a single pole, double throw, toggle switch as shown in Figure 2-12. Locate and label the switch on the instrument panel near the NAV Receiver. Label the switch (MKR SENS) and toggle positions (HI and LO). The switch must be supplied by the installing agency.

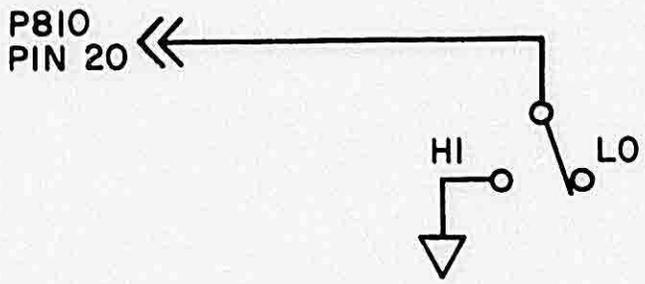


FIGURE 2-12. HI-LO SENSITIVITY

B. Marker Audio Mute

Audio muting serves to remove or turn OFF the marker beacon audio for a period of approximately 10 to 14 seconds. This time period is long enough to allow the MKR audio to remain muted as the aircraft passes over a marker beacon transmitter, yet is short enough to permit reactivation of the MKR audio before the next marker beacon is reached. Thus the audio can serve as an alert when muted, and the MKR lamps are monitored.

The installing agency must supply a spring loaded, normally open, pushbutton or toggle switch. Mount the switch on the aircraft instrument panel adjacent to the NAV Unit. Regardless of location, the switch must be labeled as to its function (example: MKR AUDIO MUTE).

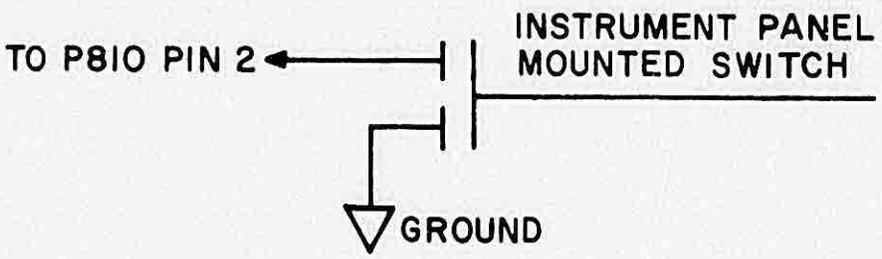


FIGURE 2-13. MKR AUDIO MUTE WIRING

2.4.2.5 Continued

C. Marker Lamp Dimming

Two discrete levels of marker lamp brightness are provided. Marker lamps will be dimmed whenever a positive DC voltage, between 2 and 30 volts, is applied to P810, pin 1.

Full lamp brilliance will be achieved with any of the following conditions:

a. P810, pin 1 shorted to ground.
b. P810, pin 1 open circuited.
c. P810, pin 1 resistively terminated with less than 0.25 Vdc applied from an external source.

Throughout this manual the aircraft's instrument light bus is referred to as the source of lamp dimming voltage. Two additional sources of dimming voltage could be the navigation light bus and the avionics lamp bus.

2.4.2.6 Radio Magnetic Indicator Outputs

Two detected VOR/LOC outputs are available for driving an RMI. A typical system could include an AIM* RC75 or SC12 Converter with a Narco Avionics HSI 100 or AIM 800 Series Indicator.

ARINC levels and phasing are present at P810 pin 17 while Narco levels and phasing are available at P810 pin 12.

*Aviation Instrument Manufacturing Corp.
Houston, Texas

2.4.2.7 Autopilot And Additional Indicator Loads

NAV Units autopilot output characteristics are shown in Table 2.6.

Recall that the NAV 122 is a time shared receiver and that it's Ident knob is spring loaded. When the Ident knob is pulled "out", the time sharing is defeated and the NAV Unit is held in the Localizer mode. There is, therefore, no GS information to either the NAV indicator or an autopilot during this time. To indicate loss of information, the UP-DOWN needle will slowly rise and the GS flag will show "red". Upon release of the Ident knob, normal LOC-GS operation will resume.

The NAV 122A is not a time shared receiver and when operated with a remote Glide Slope receiver, the Ident mode has no effect on Glide Slope operation.

All autopilot and indicator drives from a NAV are referenced to the +4V REFERENCE line (Pin 29). Therefore, do not ground any of the connector pins in Table 2.6.

TABLE 2.6 AUTOPILOT OUTPUT CHARACTERISTICS

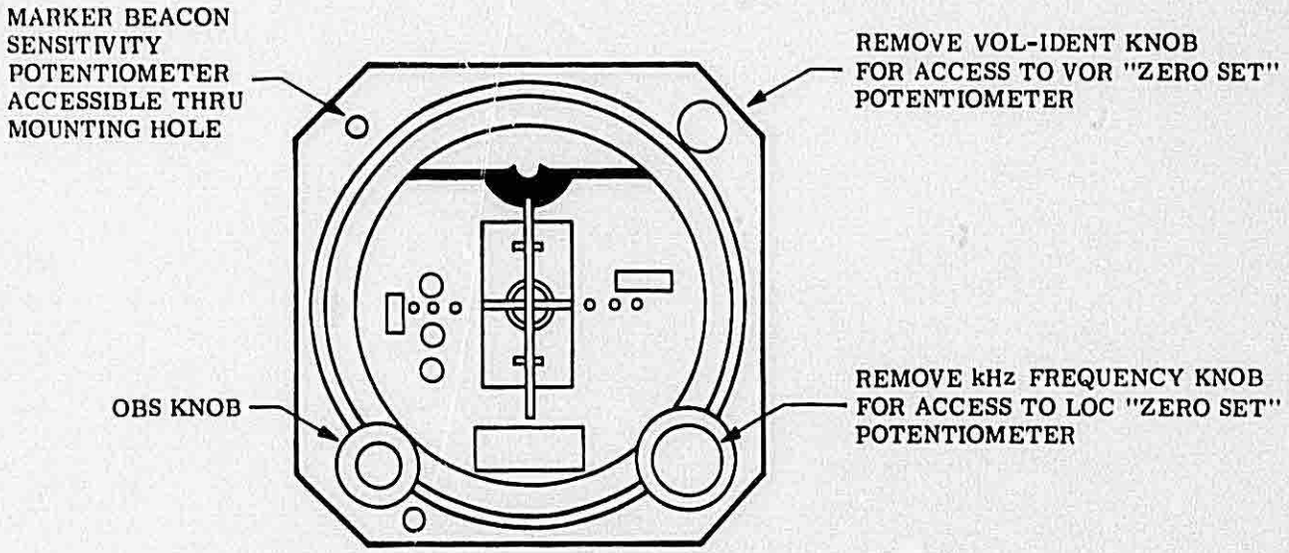
Mode	Function	Pins	Loading	Output
VOR	Left-Right	28 and 29	two, 1K ohm	150 mV for 10^{o} course change
	To-From	10 and 29	two, 1K ohm	250 mV at full TO or FROM
LOC	Left-Right	28 and 29	two, 1K ohm	90 mV for 4 dB ddm*
	Warning-TO	10 and 29	two, 1K ohm	250 mV at full TO
GS (NAV 122 only)	Up-Down	29 and 30	two, 1K ohm	78 mV for 2 dB ddm*
	Warning-TO	11 and 29	two, 1K ohm	250 mV at full TO

*ddm - Difference in depth of modulation.

2.5 POST INSTALLATION TESTS

The purpose of this series of tests is to assure proper operation of the installed avionics equipment. First, and most important, is a complete inspection of the installation to be sure that all aircraft flight controls operate freely and with full travel or deflection.

Since these procedures cover all three NAV Receivers, simply bypass those functions (marker, etc.) which do not apply to the system being tested. A remote mounted Glide Slope Receiver whose operation is dependent upon the NAV Receiver being tested, should be considered as an integral part of the system and included in this procedure. If an audio control panel is part of the installation, remember to select the NAV and MKR audios at the appropriate points in the procedure.



NOTE: 1. KNOBS ARE REMOVED USING A NO. 2 ALLEN WRENCH.
2. POTENTIOMETERS ARE ADJUSTED USING THE SCREW DRIVER SUPPLIED IN THE DEALER STARTER KIT - INSTALLATION KIT.

Note: 1. Knobs are removed using a No. 2 Allen wrench.
2. Potentiometers are adjusted using the screwdriver supplied in the Maintenance Kit.

FIGURE 2-14. LOCATION OF ELECTRICAL ADJUSTMENTS

2.5.1 Pre Flight Tests

For this series of in-aircraft tests, the aircraft's engines, rotating beacon, electrical and avionics equipments should be operating. Note any abnormal interaction or interference (ignition or rotating beacon noise, abnormal meter deflection, compass deviation, etc.) observed during these tests.

The following procedure requires ramp type test equipment such as that offered by Tel-Instrument Corp. or IFR Inc.

A. General

1. Set NAV Receiver to a VOR frequency.
2. Rotate the VOL-IDENT control clockwise until NAV Receiver noise is heard in the speaker and headphones. Note presence of NAV and GS warning flags and centered Left-Right (and Up-Down needle in NAV 122A).
3. Modulate test equipment 30% with 1020 Hz.
4. Pull VOL-IDENT knob and note presence of adequate volume level. (NAV 122 - knob is spring loaded and must be held in outer position). Depress VOL-IDENT knob and note decrease in volume level.

NAV 122 only

5. Set NAV Receiver to a LOC frequency.
6. Pull VOL-IDENT knob and note gradual rise of Glide Slope UP-DOWN needle. Approximately 5 seconds is required for full UP deflection.

B. VOR*

1. Set test equipment and NAV Receiver to a VOR frequency. Modulation should be a composite VOR signal.
2. Set test equipment and NAV Receiver OBS to 0^{o} course.
   Spec: Left-Right needle must center within $\pm 1.5^{o}$ with a TO flag.
   VOR "zero set" adjustment is shown Figure 2-14.
3. Turn NAV Receiver OBS knob to first 10^{o} then 350^{o}.
   Spec: Left-Right needle should deflect full scale (5 dots).
4. Check remaining three cardinal points (90^{o}, 180^{o}, and 270^{o}).
   Spec: Left-Right needle must center within 1.5^{o} with a TO flag.
5. Set OBS to 0^{o} and depress knob.
   Spec: Left-Right needle must center within 1.5^{o} with a TO flag.

C. LOC

1. Set test equipment and NAV Receiver to a LOC frequency. Modulation should be a standard LOC centering signal.
   Spec: Centering, $\pm$ 1 needle width with a TO flag.
   LOC "zero set" adjustment is shown in Figure 2-14.
2. Change modulation to 4 dB ddm left then right.
   Spec: deflection, 3 dots, $\pm$ 1 needle width.
3. Remove modulation or decrease test equipment RF output to minimum.
   Spec: LOC warning flag shall be full.

*If VOR Zero Set is adjusted, the SELF TEST must also be re-zeroed.

2.5.1 Continued

D. Glide Slope

1. Set test equipment and NAV Receiver to a GS frequency. Modulation should be a standard GS centering signal.
   Spec: Centering, $\pm$ 1 needle width with a TO flag.
2. Change modulation to 2 dB ddm Up then Down.
   Spec: Deflection, 1.5 dots, $\pm$ 1 needle width with a TO flag.
3. Remove modulation or decrease test equipment RF output to minimum.
   Spec: GS warning flag shall be full.

E. Marker Beacon

Note: Do Not adjust Marker sensitivity during this procedure.

1. Depress OBS knob to activate marker lamp test.
   Spec: All three lamps must light.
2. Modulate Marker test equipment 90% with 3,000 Hz.
   Spec: White lamp must light.
3. Change modulation frequency to 400 Hz then 1300 Hz.
   Spec: First the blue than the amber lamp must light.
4. Check marker audio for adequate volume. If Marker Audio Mute is provided, momentarily depress mute switch.
   Spec: Audio shall remain muted for a 10 to 14 second period.
5. Check Marker dimming by turning ON instrument panel lights.
   Spec: Marker lamp brilliance should decrease. Turn OFF instrument panel lights.
6. If a Marker HI-LO sensitivity switch is provided, set the switch to the LO position: decrease test equipment RF output (or move test set away from aircraft) until marker lamp dims; set Marker sensitivity switch to HI.
   Spec: Lamp brilliance should increase.

2.5.2 Flight Test

A flight test is recommended to perform the following checks and adjustments.

A. Check all avionics under actual operating conditions for abnormal indications (ignition noise, audio distortion at in-flight volume settings, rotating beacon noise, interference between avionics equipments, etc.).
B. Proportion audio volume levels.
C. In-flight setting of marker beacon sensitivity (requires small straight slot screwdriver).
D. Look for variations in performance due to various landing gear and flight control surface configurations.
E. Good excuse to go flying.

All of these tests must be performed at an ILS facility, on an airway, or in an area where the ground station signal quality and strength has been verified.

VOR

A. Flying at an altitude of 6000 feet above ground level (AGL) channel the NAV Receiver to a VOR facility 50 nm away.
   1. Check course accuracy, warning flag indication, and left-right needle sensing.
   2. Check the antenna pattern by flying the aircraft in a 10^{o} bank completing a 360^{o} turn: the warning flag should remian out of view throughout the turn and audio should remain intelligible.
B. Flying at an altitude of 6000 feet AGL, channel the NAV Receiver to a VOR facility 10 nm away and fly inbound.
   1. Check course width ($\pm 10^{o}$ of selected radial).
   2. Observe the VOR warning flag while approaching, passing over, and flying outbound: TO-FROM indicator shall indicate correctly and the warning flag must not be observed except when passing directly over the station.
C. Flying at an altitude of 6000 feet AGL, channel the NAV Receiver to a VOR facility 25 nm away and fly inbound.
   1. Operate the communication transceiver: VOR left-right indicator transient deviations should not exceed 2 dots and steady state errors should not exceed 0.5 dot.
D. Engage autopilot and couple to VOR. Check tracking and intercept performance.

2.5.2 Continued

LOC and GS

Flying at an altitude of 3000 feet AGL, channel the NAV Receiver to a LOC frequency and fly inbound to intercept ILS.

1. From point of intercept to termination of test neither LOC or GS warning flags should appear.
2. Establish glide path and fly the ILS approach: request ground control confirmation of on-glide path condition.
3. While on-glide path, maneuver aircraft through normal pitch and roll altitudes: Left-right and up-down indicators should perform normally and a warning flag shound not be visible at any time.
4. Engage autopilot and fly a coupled ILS approach.

Marker Beacon

Receiver sensitivity has been adjusted at the factory for satisfactory performance with a standard marker beacon antenna. Should further adjustment be required, refer to Figure 2-14 for access to sensitivity potentiometer, and perform the following adjustments.

Sensitivity adjustment procedure:

1. If included, set panel mounted marker HI-LO switch to LO.
2. Fly at a known ground speed, 1000 feet above ground level (AGL).
3. On LOC centerline, measure time (in seconds) that the marker lamp remains lighted.
4. Refer to Table 2.7.

To calculate light time for ground speeds other than those tabled:

$$\text{Minimum Light Time (Seconds)} = \frac{1775}{\text{Ground Speed In Knots}}$$

$$\text{Maximum Light Time (Seconds)} = \frac{1183}{\text{Ground Speed In Knots}}$$

TABLE 2.7 LO SENSITIVITY LIGHT TIME AT 1,000 FEET (AGL)

GROUND SPEED, In Knots	LIGHT TIME, In Seconds	
	Minimum	Maximum
90	13	20
110	11	16
130	9	14
150	8	12

2.6 AIRCRAFT LICENSE REQUIREMENTS

A. Form 337
NAV [insert model number] was installed in accordance with Narco Avionics Manual part number [refer to cover].
Enter electrical load as specified in Table 2.8.
Enter actual circuit breaker or fuse values used.

B. Log Book
Calculate weight and balance using values from Table 2.8 plus cable and accessory weights.

TABLE 2.8 GENERAL SPECIFICATIONS

General	NAV 121	NAV 122	NAV 122A
A. Mechanical			
Physical Dimensions	Figure 2-3	Figure 2-3	Figure 2-3
Weight	2.5 lbs (1.13 kg)	3.0 lbs (1.36 kg)	2.9 lbs (1.32 kg)
B. Electrical			
NAV, P810, Pins 7 and 26			
Supply Voltage (see note 1)	13.75 Vdc	13.75 Vdc	13.75 Vdc
Current, less pilot lamps, 14V	0.55 Ampere	0.55 Ampere	0.55 Ampere
Current, less pilot lamps, 28V	(see note 2)	(see note 2)	(see note 2)
Pilot lamp current 14V	0.32 Ampere	0.32 Ampere	0.32 Ampere
28V	0.32 Ampere	0.32 Ampere	0.32 Ampere
Circuit Breaker Rating	2 Amperes	2 Amperes	2 Amperes
Marker Beacon, P810 Pin 3			
Supply Voltage	----------	13.75 or 27.5 Vdc	13.75 or 27.5 Vdc
Current 14V	----------	0.25 Ampere	0.25 Ampere
28V		0.29 Ampere	0.29 Ampere
Circuit Breaker Rating	----------	1.0 Ampere	1.0 Ampere

Notes: 1. Voltage Converter required for 28 Vdc installations.
2. With MP 11, 28 to 14 Vdc Voltage Converter - 0.60 Ampere.

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3.1 GENERAL

This section provides the circuit description for the Narco NAV 121, NAV 122, and NAV 122A Navigation Receiver/Converters. The circuits are described in this section as three separate units starting with the NAV 121 (paragraph 3.2). The NAV 122 (paragraph 3.3) describes only those circuits that differ from the NAV 121; identical circuits refer to the applicable description of the NAV 121. The NAV 122A (paragraph 3.4) describes only those circuits that differ from the NAV 121 and/or NAV 122; identical circuits refer to the applicable circuits of the NAV 121 and/or NAV 122.

The circuit boards in most cases are directly interchangeable, therefore the NAV 122 or 122A may have some circuitry that is not used. The assemblies described in this section are listed in Table 3.1; PC board utilization is shown by model number. It can be seen that some boards include circuits that are not used for a particular model number. In this case, the full circuit is shown and the components not used are so identified. An example is the time sharing feature of the NAV 122; the partial schematics show these multiplex circuits but the NAV 121 and NAV 122A do not cover this area.

TABLE 3.1 ASSEMBLY IDENTIFICATION VS MODEL NUMBER

NARCO PART NO.	IDENTIFICATION	NAV RCVR/CONV MODEL NO.		
		NAV 121	NAV 122	NAV 122A
01234-0101	Receiver/Converter Unit	x	-	-
01234-0102	Receiver/Converter Unit	-	x	-
01234-0103	Receiver/Converter Unit	-	-	x
01238-0101	Receiver Assy	x	x	x
01235-0101	OMNI/LOC Assy	x	x	x
01237-0101	Synthesizer Assy	x	x	x
01236-0102	Marker Beacon/Glide Slope Assy	-	x	-
01236-0101	Marker Beacon Assy	-	x	x
01233-0102	Control Head Assy	x	-	-
01233-0101	Control Head Assy	-	x	x
56073-0001	Flexible Circuit Assy	x	x	x

3.2 NAVIGATION RECEIVER/CONVERTER, NAV 121

3.2.1 INTRODUCTION

The NAV 121 comprises a VOR/LOC receiver, VOR/LOC converter, frequency synthesizer, and VOR/LOC display. A circuit description is given for each PC board assembly and schematics are presented to support the text. Figure 3-1 is a functional block diagram of the NAV 121.

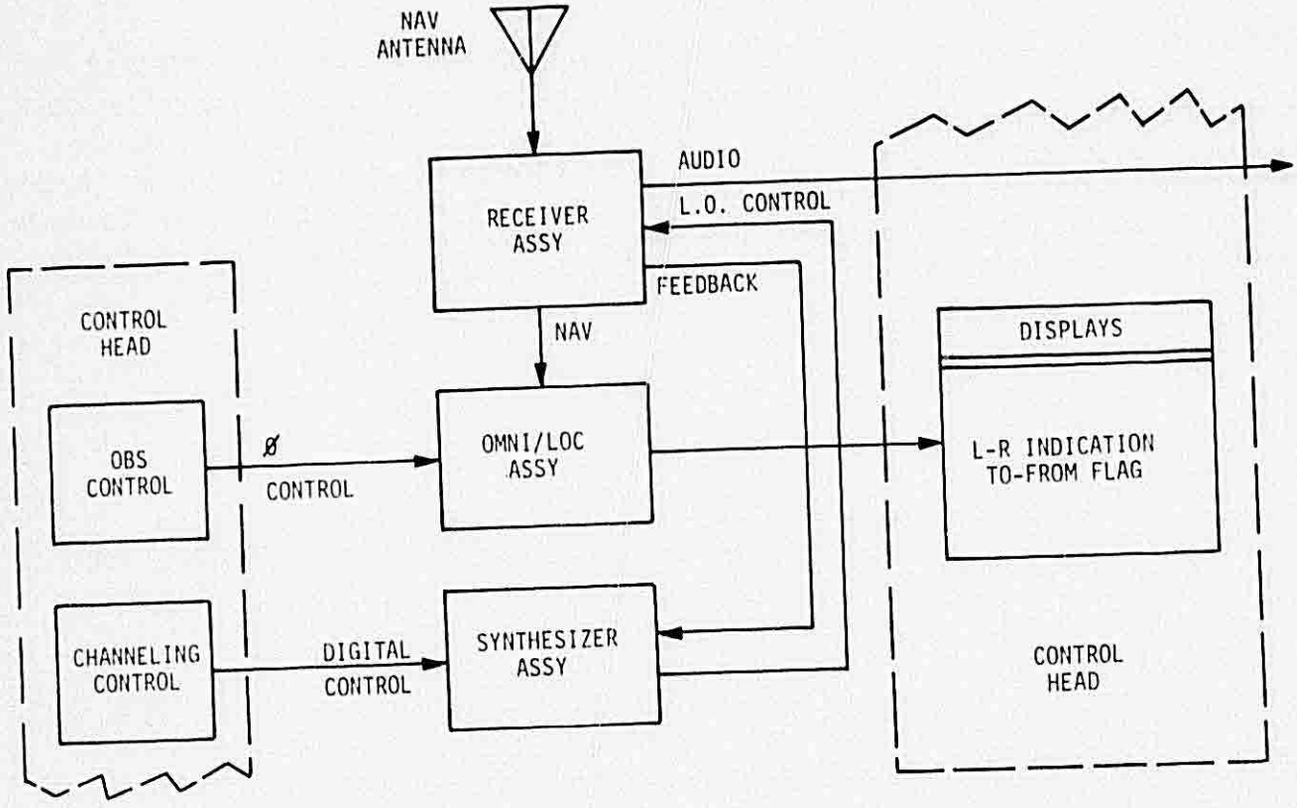


FIGURE 3-1. RECEIVER/CONVERTER UNIT, NAV 121, FUNCTIONAL BLOCK DIAGRAM

3.2.2 RECEIVER ASSEMBLY (NAV 121, NAV 122, NAV 122A)

The LOC/VOR receiver assembly shown in Figure 3-2 amplifies and demodulates the rf carrier to provide audio at the voice circuits and navigation data to the NAV converter. Varactor tuning is used for the receiver rf circuits; channel frequencies are controlled by the frequency synthesizer assembly.

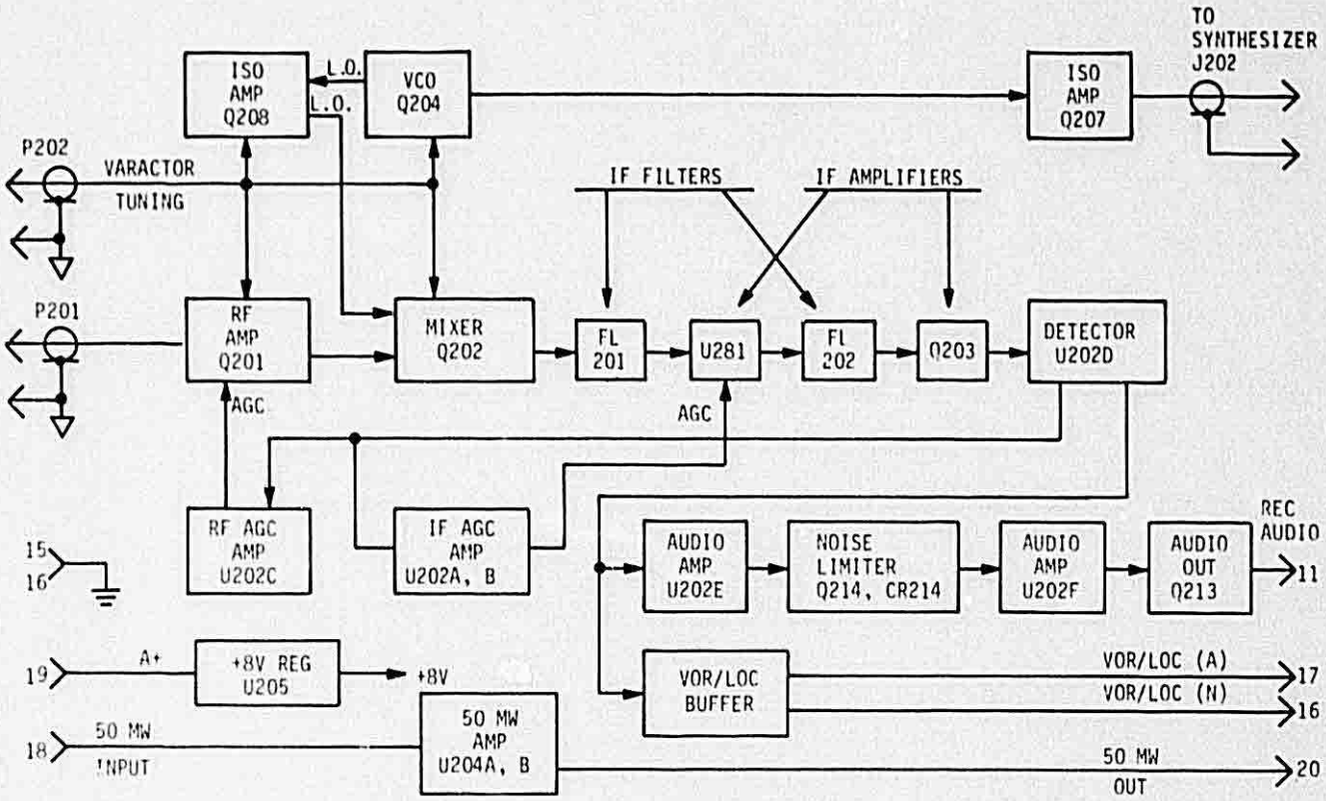


FIGURE 3-2. NAV 121 AND NAV 122A VOR/LOC RECEIVER ASSEMBLY, BLOCK DIAGRAM

3.2.2.1 Receiver Tuning

The frequncy synthesizer input (P-202) controls the tuning of the isolation amplifier, VCO, antenna input, rf amplifier and mixer. All circuits are tuned by varactor diodes that vary the resonant frequency of the associated LC tank circuits. Refer to Figures 3-3, 3-4 and 3-5.

A typical varactor tuned circuit is the LOC/VOR mixer (Q202) input tank circuit (L204, C210, and CR207/CR208). The control voltage from P202 is fed through isolation resistors R211 and R210 to the cathodes of CR207/CR208; an anode is connected to each side of L204. A dc voltage at P202 affects the capacitance of the parallel resonant circuit comprising coil L204 variable capacitor C210, and the varactor diodes. The dc input therefore controls the resonant frequency of the tank circuit; however, variable capacitor C210 permits a vernier adjustment of the tracking between the circuits tuned from the common control input.

3.2.2.2 LOC/VOR RF Amplifier (Q201)

The rf amplifier is a dual gate MOS-FET. Refer to Figure 3-3.

The rf input to Q201 (gate 1, pin 3) is taken from the rf input coil, L202. The drain (pin 1) is connected to L203 which is connected to A+ through R208. Gate 2 (pin 2) is connected to the AGC bus through R205. Gate 1 (pin 3) is biased approximately .7 volt less than the source (pin 4). The source is biased to approximately 2 volts. This fixed bias is applied to the source to allow the voltage on gate 2 to swing below the source voltage and cut-off the rf amplifier during AGC. The input and output tuned circuits are varactor tuned. The control voltage is supplied to the junction of CR201/CR202, CR203/CR204, CR205/CR206, and CR207/CR208, through 100K resistors. At the high end of the band this voltage is high, thus causing the capacitance of diodes to be low. This change in capacitance tracks the front end. The tuned circuits are tracked by tuning the capacitors (C201, C203, C208, and C210) at the high end of the band and tuning the inductors (L201, L202, L203, and L204) at the low end of the band.

3.2.2.3 Local Oscillator (VCO Q209)

The LO comprises VCO Q209 and isolation amplifiers Q207 and Q208. The LO frequencies listed in Table 3.2 are obtained from the voltage controlled oscillator (VCO) as shown in Figure 3-4. The VCO frequency is controlled by varactor diodes CR212/CR213 combined with L217 and capacitors C247/C248 into a Colpitts type oscillator. The varactor diodes serve as variable capacitors, changing the resonant frequency of the parallel LC tuned circuit of the VCO. The varactor control voltage is the output from the frequency synthesizer circuit described in paragraph 3.2.4. A sample of the oscillator frequency is fed back to the synthesizer through isolation amplifier Q207 via J202. The VCO output from isolation amplifier Q208 serves as the LO injection frequency. Both Q207 and Q208 serve as buffers, effectively isolating the VCO from the load circuits.

3.2.2.4 LOC/VOR Mixer (Q202)

The LOC/VOR Mixer is a dual gate MOS-FET. Refer to Figure 3-5. The input to the Mixer is taken from the tap on L204 and applied to the input gate (pin 3). Local Oscillator (LO) injection is applied through C212 to gate 2 (pin 2). The level of the LO injection is 1.5 volts p-p. This LO rf voltage changes the gain of the FET and thus modulates the rf signal input. The difference frequency is selected by the crystal filter that is connected to the drain (pin 1) of the Mixer L205 provides the drain load for the Mixer.

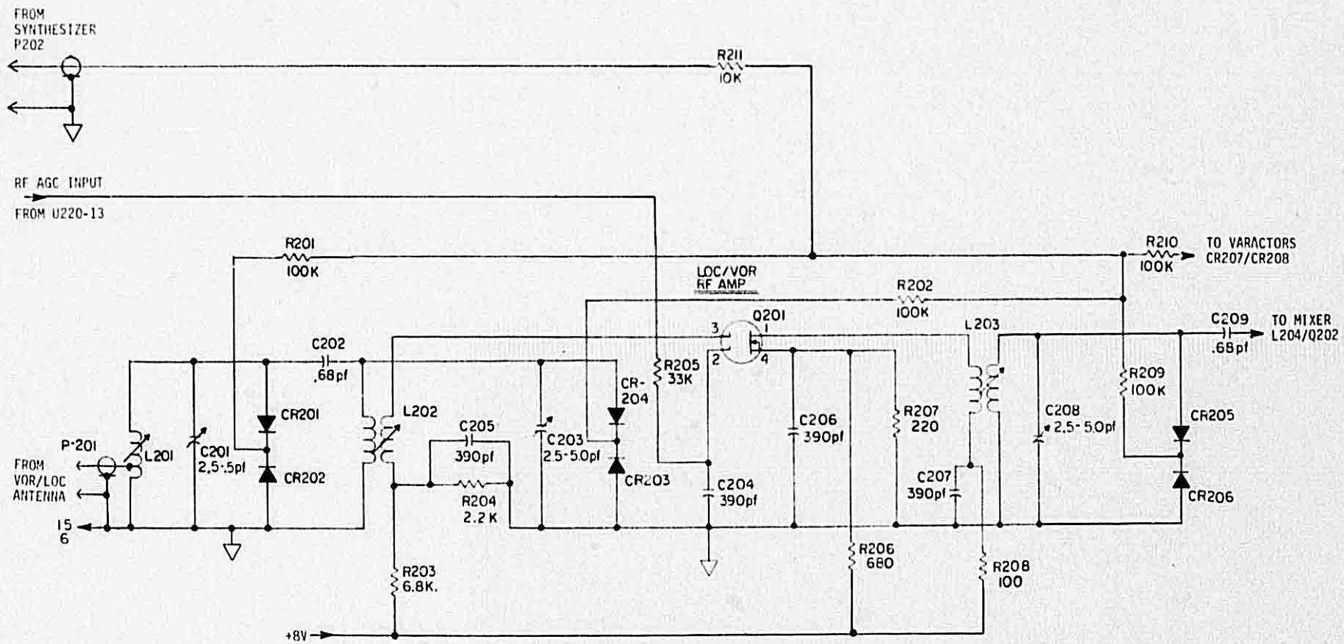


FIGURE 3-3. VOR/LOC RF AMPLIFIER

SEE BLOW-UP

TABLE 3.2 RF AND VCO FREQUENCIES FOR VOR AND LOC CHANNELS

FREQUENCIES (MHz)				FREQUENCIES (MHz)			
RF INPUT	LO VCO	VOR	LOC	RF INPUT	LO VCO	VOR	LOC
108.00	91.00	x		110.00	93.00	x	
108.05	91.05	x		110.05	93.05	x	
108.10	91.10		x	110.10	93.10		x
108.15	91.15		x	110.15	93.15		x
108.20	91.20	x		110.20	93.20	x	
108.25	91.25	x		110.25	93.25	x	
108.30	91.30		x	110.30	93.30		x
108.35	91.35		x	110.35	93.35		x
108.40	91.40	x		110.40	93.40	x	
108.45	91.45	x		110.45	93.45	x	
108.50	91.50		x	110.50	93.50		x
108.55	91.55		x	110.55	93.55		x
108.60	91.60	x		110.60	93.60	x	
108.65	91.65	x		110.65	93.65	x	
108.70	91.70		x	110.70	93.70		x
108.75	91.75		x	110.75	93.75		x
108.80	91.80	x		110.80	93.80	x	
108.85	91.85	x		110.85	93.85	x	
108.90	91.90		x	110.90	93.90		x
108.95	91.95		x	110.95	93.95		x
109.00	92.00	x		111.00	94.00	x	
109.05	92.05	x		111.05	94.05	x	
109.10	92.10		x	111.10	94.10		x
109.15	92.15		x	111.15	94.15		x
109.20	92.20	x		111.20	94.20	x	
109.25	92.25	x		111.25	94.25	x	
109.30	92.30		x	111.30	94.30		x
109.35	92.35		x	111.35	94.35		x
109.40	92.40	x		111.40	94.40	x	
109.45	92.45	x		111.45	94.45	x	
109.50	92.50		x	111.50	94.50		x
109.55	92.55		x	111.55	94.55		x
109.60	92.60	x		111.60	94.60	x	
109.65	92.65	x		111.65	94.65	x	
109.70	92.70		x	111.70	94.70		x
109.75	92.75		x	111.75	94.75		x
109.80	92.80	x		111.80	94.80	x	
109.85	92.85	x		111.85	94.85	x	
109.90	92.90		x	111.90	94.90		x
109.95	92.95		x	111.95	94.95		x

Channels from 112 MHz through 117.95 MHz are VOR only.

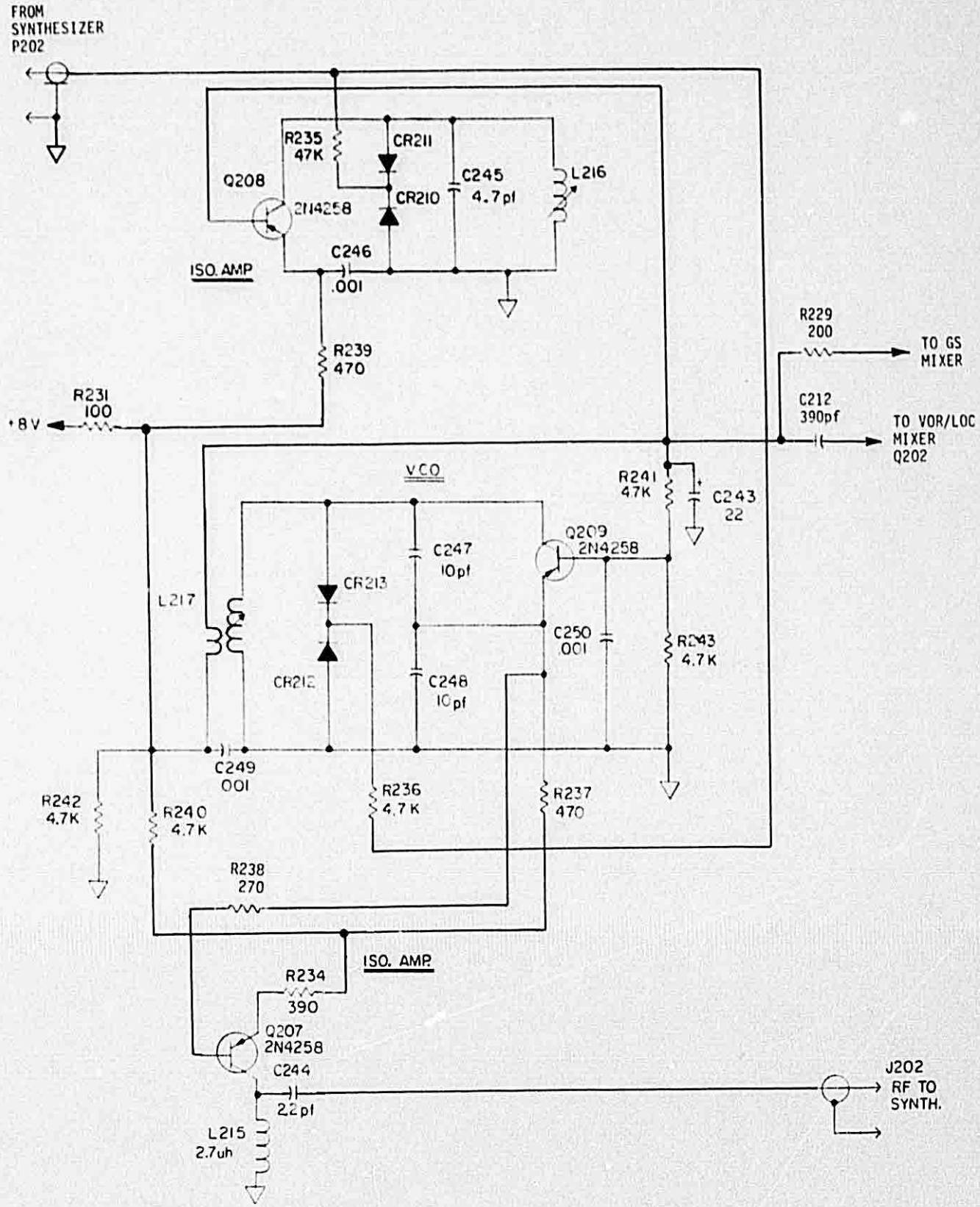


FIGURE 3-4. VOLTAGE CONTROLLED OSCILLATOR (VCO) AND ISOLATION AMPLIFIERS.

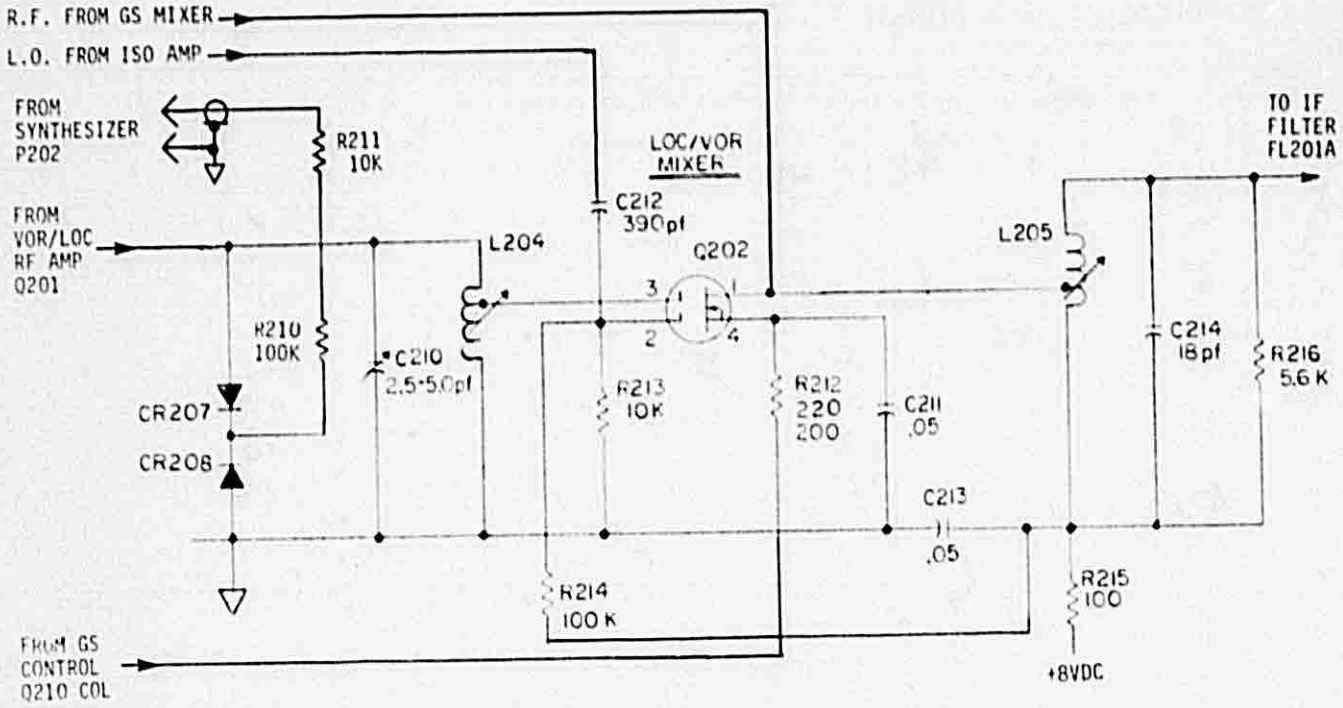


FIGURE 3-5. VOR/LOC MIXER

3.2.2.5 LOC/VOR IF Filters (FL201, FL202)

The IF filter section comprises two separate crystal monolithic filters as shown in Figure 3-6; FL201 is the IF input filter and FL202 is the IF interstage filter. The 17 MHz IF, which is the difference between the rf input and the LO frequencies, is connected through the IF filter to the IF amplifier. The crystal filter controls the overall selectivity of the receiver. The 6 db IF bandwidth is $\pm$19 kHz and the 60 db bandwidth is $\pm$42 kHz. The tuned circuits at the input (L205, C214) and output (L208, C224) provide the reactive load necessary for the operation of the crystal filter.

3.2.2.6 IF Amplifiers (U201, Q203)

The 17 MHz IF signal is amplified by a linear IC amplifier (U201) and an FET amplifier (Q203) as shown in Figure 3-6. The IF filter, described in the previous paragraph is located at the input and output of IF amplifier U201. In addition, AGC is applied to U201 to stabilize the output level. Refer to paragraph 3.2.2.10 for the IF AGC circuit operation. Under these conditions, a positive-going AGC voltage derived from a high level at the AGC detector, reduces the gain of the amplifier.

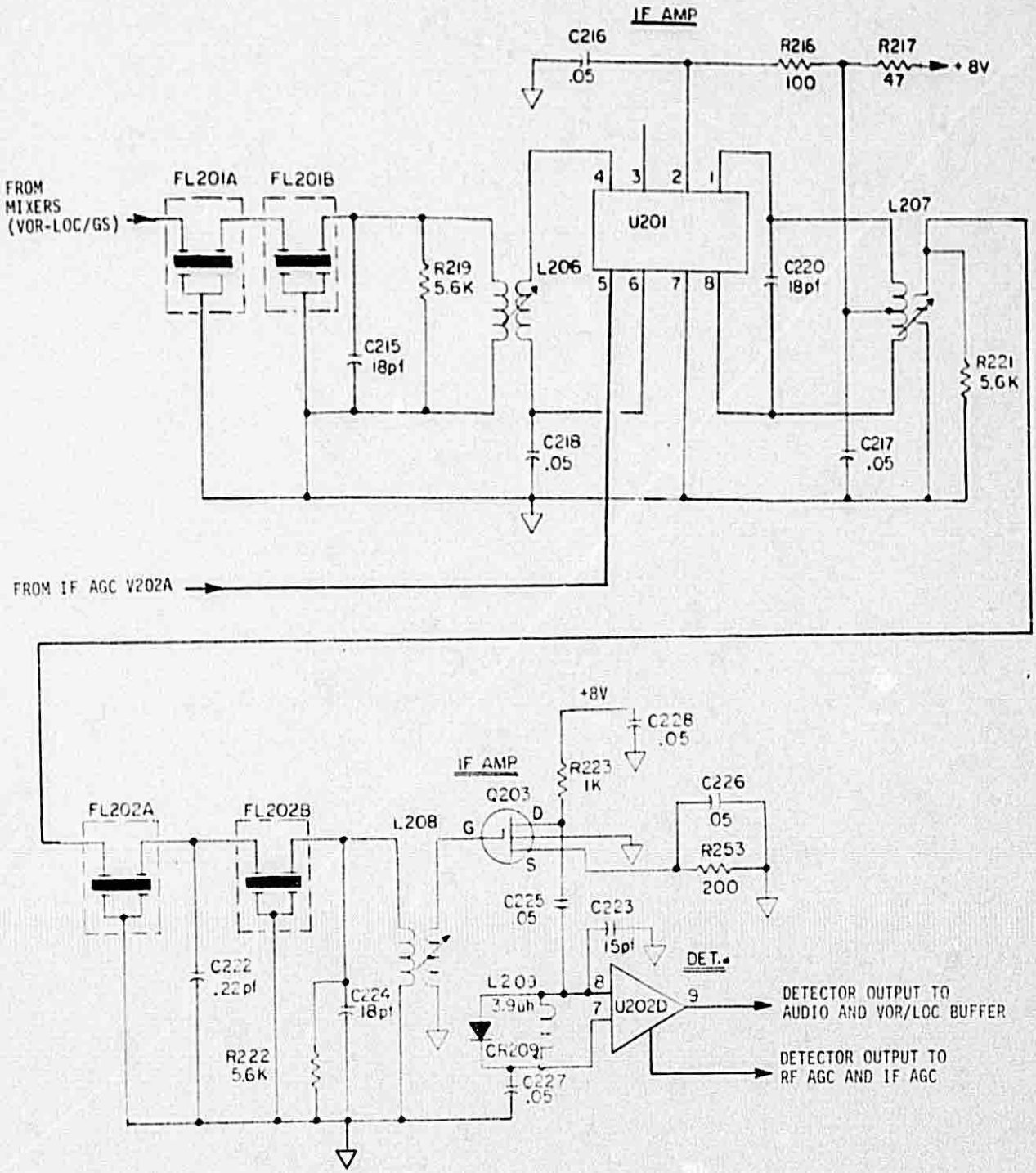


FIGURE 3-6. IF AMPLIFIER AND DETECTOR

3.2.2.7 Detector, VOR/LOC Output (CR209, U202D)

The IF output from FET Q203 drain is coupled through a capacitor (C225) to detector U202D as shown in Figure 3-6. This detector input is protected from input transients by the action of shunt diode CR209. The demodulated output from U202D (pin 9) provides audio to the audio amplifier. Additional outputs from the detector drive the RF AGC amplifier, IF AGC amplifier, and the VOR/LOC buffer amplifier.

3.2.2.8 Audio Amplifier/Noise Limiter (Figure 3-7)

The audio amplifier section comprises a buffer (U202E), noise limiter (Q214, CR214), audio amplifier U202F, Q213), front panel volume control/Ident filter, and a 50mw amplifier (U204B). The first audio amplifier output (U202E) is connected to noise limiter Q214, which operates as a conventional amplifier when noise is not present. It should be noted that the emitter resistance of emitter follower Q214 is the series circuit of R629 and R271. An additional circuit (CR214, R274, R272) shunts half of the Q214 load resistance (R271). The noise limiter diode (CR214) is biased to permit the equivalent of 30% modulation to pass undistorted. Any noise impulse exceeding this level will be clipped by the noise limiter. The cathode of CR214 is biased through R272 and R274. C266 filters the audio from the bias network. The anode of CR214 is biased through R269 and R271. As the current changes through Q214 (due to rf signal level) the relative bias across CR214 changes to allow less clipping with high rf signals and more clipping with only noise present. The output of the noise limiter is coupled to the audio amplifier (pin 2 of U202F) through R276 and C268. Pin 1 is the emitter of the amplifier and pin 3 is the collector. Q213 is the emitter follower output that provides audio to the volume control/Ident filter (pin 11). The Ident filter, located on the control head assembly, attenuates the 1020 Hz Ident code when operating in the VOR or LOC mode. When this front panel control is pulled out, the filter is by-passed and 1020 Hz Morse code signal is fed to the audio circuits. The audio is then connected to pin 18, where amplifiers U204A and B provide 50 mw output (pin 20) to the phones.

3.2.2.9 RF AGC Amplifier (U202C)

An additional output from detector U202D is connected to RF AGC amplifier U202C to control the gain of rf amplifier Q201; refer to Figure 3-8. The detector output is amplified and filtered to obtain a varying dc control voltage that is indicative of the rf signal amplitude. The RF AGC filter (R205, C204) determines the response time of rf amplifier Q201 to changes of rf input.

The glide slope inputs at pins 12 and 14 are strapped to +8 vdc; pin 13 is strapped to ground. This connects the NAV 121 into the VOR/LOC configuration with C263 AGC, C251 RF AGC, and C255 IF AGC capacitors connected.

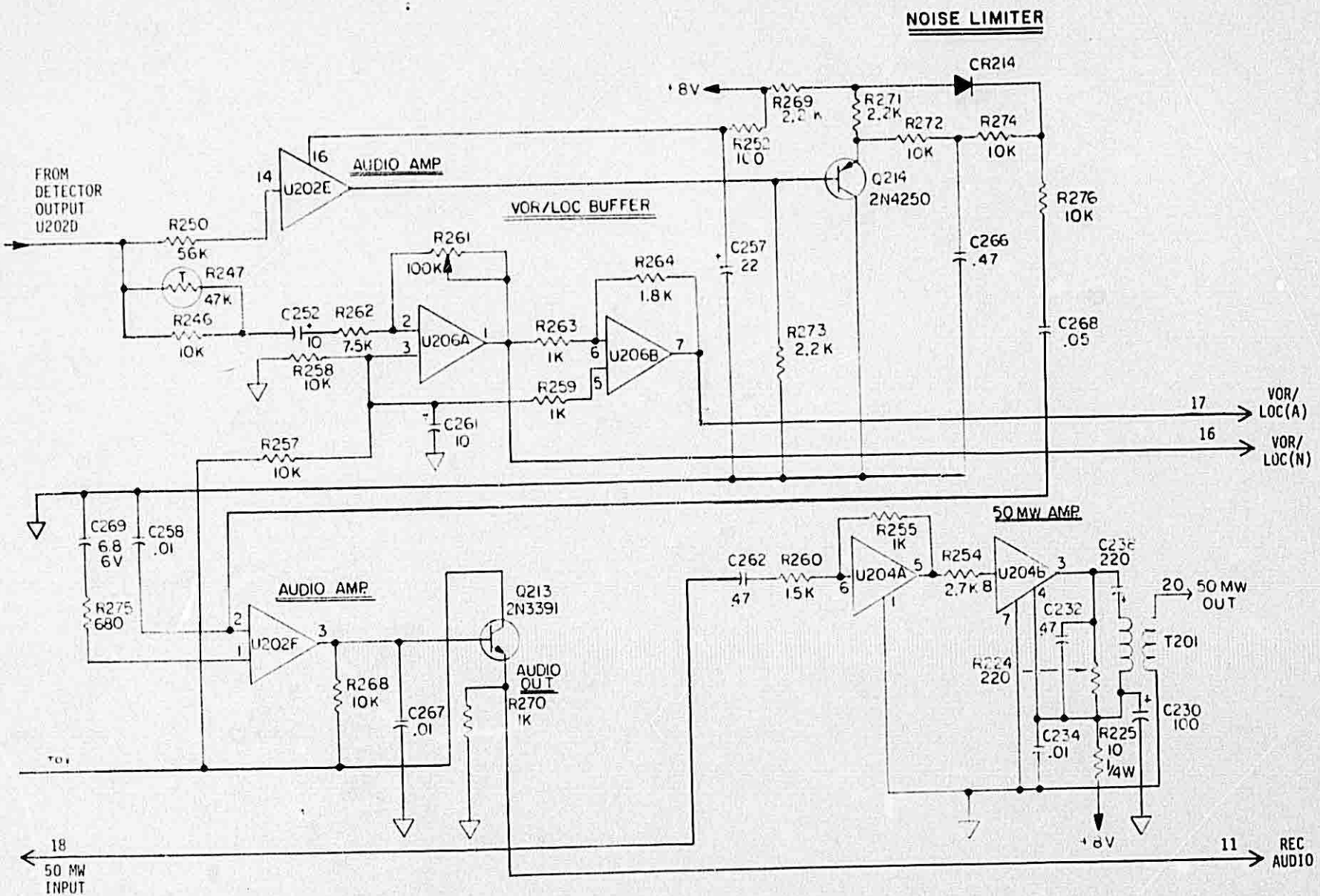


FIGURE 3-7. AUDIO AMP, NOISE LIMITER, AND VOR/LOC BUFFER

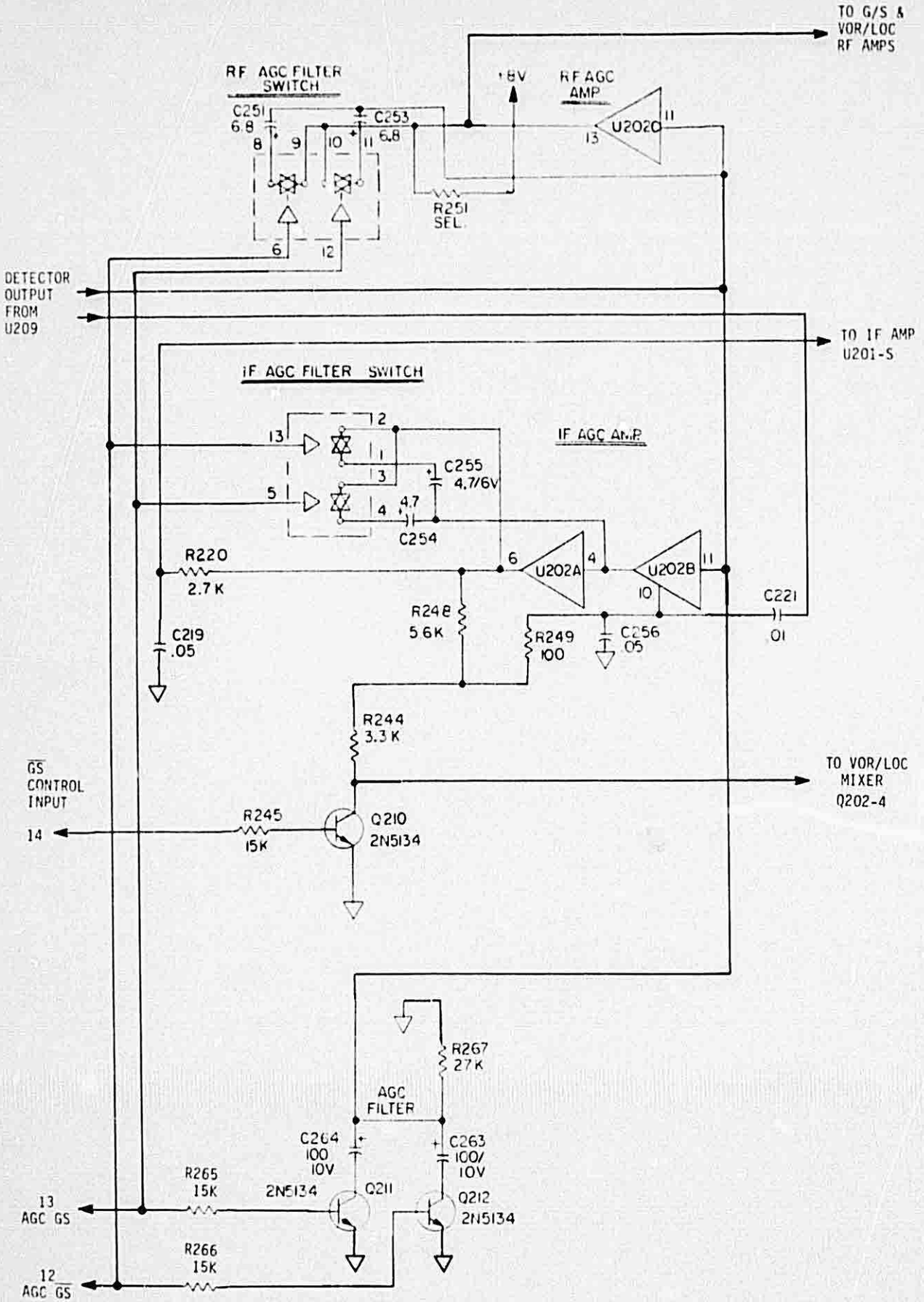


FIGURE 3-8. VOR-LOC/GS CONTROL OF AGC

3.2.2.10 IF AGC Amplifier (U202B, A)

The IF AGC is derived from the detector output, the same source as the RF AGC. The detector output is connected to a two stage amplifier (U202B, U202A) and RC filter (R220, C219). The filtered AGC voltage is applied to control the gain of IF amplifier U201. The glide slope inputs at pins 12 and 14 are strapped to +8 vdc; pin 13 is strapped to ground. This connects the NAV 121 into the VOR/LOC configuration with C263 AGC, C251 RF AGC, and C255 IF AGC capacitors connected.

C.2.2.11 VOR/LOC Buffer (U206A, B)

The VOR/LOC buffer provides the navigation signal to the VOR/LOC converter circuits of the VOR/LOC board. U206A is a buffer amplifier for isolating the VOR/LOC circuits from the detector output. The buffer output (pin 16) is connected to the VOR/LOC board; after inversion, by U206B, this VOR/LOC (A) signal at pin 17 is connected to rear connector J810 (pin 17).

3.2.3 VOR/LOC CONVERTER ASSEMBLY (NAV 121, NAV 122A)

The VOR/LOC PC board shown in Figure 3-9 converts the navigation information obtained from the receiver detector into data suitable for display on the L-R deviation meter and TO-FROM flags.

3.2.3.1 Circuit Functions

The navigation signal herein referred to as VOR/LOC(N) is obtained from the VOR/LOC buffer on the receiver section. The VOR/LOC (N) signal is connected to the variable channel (pin 13) and the reference channel (pin 8). The combined basic and phase-shifted signal is a 9960 Hz signal frequency modulated by a 30 Hz signal. The 9960 Hz component is the reference channel (FM) and the 30 Hz component is the variable phase component (AM). In the omni mode, the reference phase is varied by the front panel OBS (Omni Bearing Selector) control to equal the phase of the variable phase channel; at null of the meter, the OBS reading is the omni radial. In the localizer mode, the rf carrier is modulated by 90 or 100 Hz signals obtained by the left or right position of the aircraft (and antenna) with relation to the center line of the landing strip. The left and right signals are connected to the same bearing indicator: equal amplitudes of the 90 and 150 Hz signals provide a center indication (on-course) of the meter; unequal signals will provide a left or right needle indication that is indicative of the position of the aircraft with relation to the center of the landing path. The VOR/LOC section also provides signals to activate the front panel flag indicators and L-R deviation.

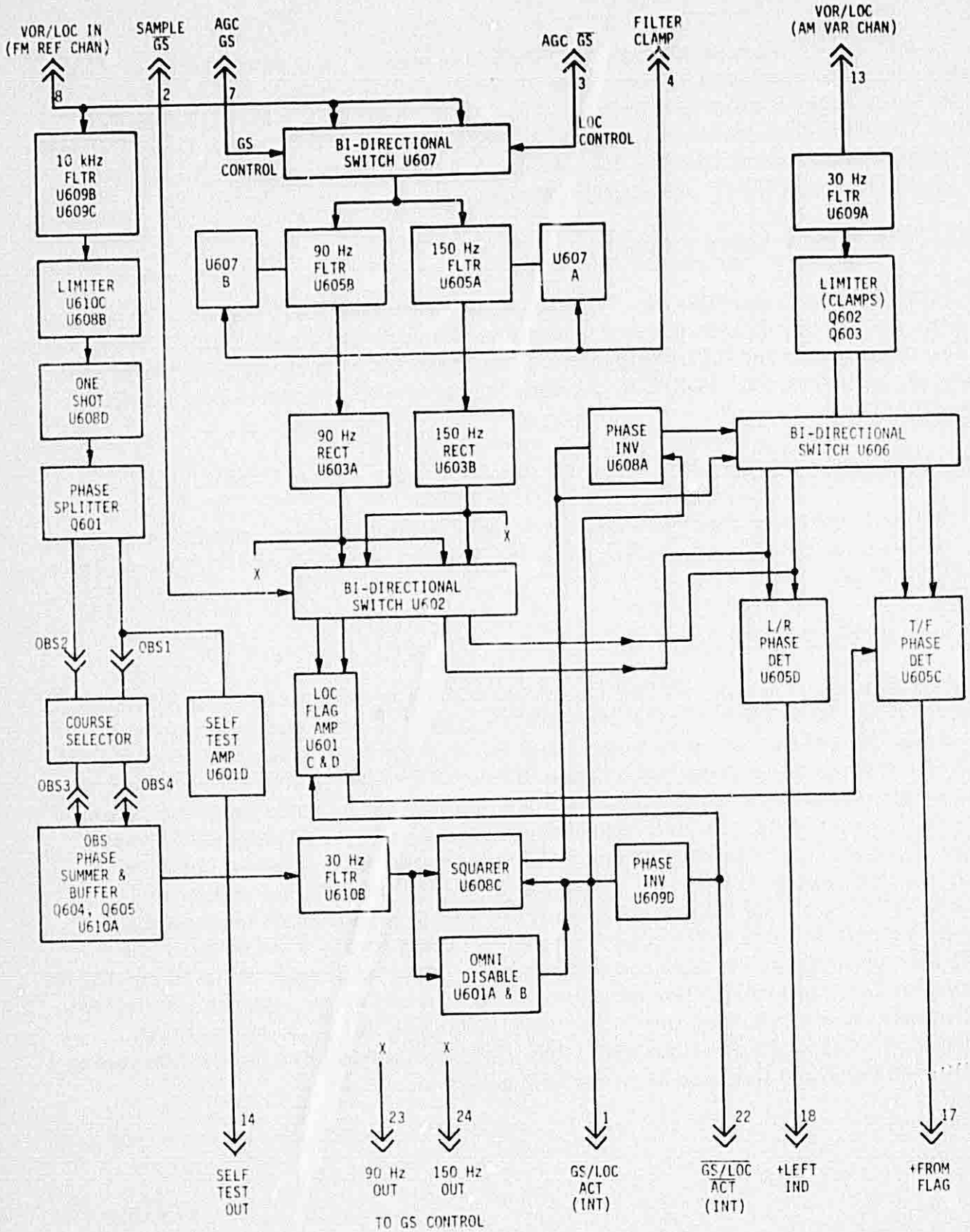


FIGURE 3-9. VOR/LOC ASSEMBLY, BLOCK DIAGRAM

3.2.3.2 AM Channel Filter

The variable channel input signal is applied through C640 and R687 to a 30 Hz bridged T bandpass filter (Figure 3-10). The filter tuning is determined by R692, C639, C638, R601 and R602. Variable resistance R602 has a slight control of the filter center frequency and can be used as an omni zero adjustment. Since U609A pin 6 looks like a low impedance, the filter tuning is not affected by R687/C640. These components cause a small phase shift and attenuate any low frequency signals present at the input. With no input, R709 provides dc bias current to set the output (pin 5) at approximately 4 vdc.

3.2.3.3 AM Channel Clamp

The AM clamp shown in Figure 3-10 controls the amplitude of the 30 Hz AM signal applied to the phase detector (L-R or T-F). As the 30 Hz AM signal varies due to changes of rf input to the receiver, the limiter holds the signal amplitude constant. The 30 Hz filter output is applied through R714 and C651 to the AM limiter. For very very low amplitude 30 Hz input signals, Q603/Q602 acts as a differential amplifier.

As the input signal increases, on the negative half of the cycle, Q603 is cut off; on the positive half of the cycle, Q602 is cut off. Any further increase of input amplitude results in very little change in the limiter output.

Voltage divider R725/R726, R723/R724 and CR616 through CR618 provides approximately 1.5 volts at CR616 anode; Q602 and Q603 are then biased at approximately +2.5 vdc. This causes the collector of Q602 to be approximately 6.0 volts. When Q603 is cut off, Q602 collector goes to 4.0volts. When Q603 is on and Q602 cut off, the collector voltage is +7.5 volts. As described above, the transistors do not saturate.

The limiter output shape is modified by the loading effect of R650 and C619. This network has no effect upon the phase of the signal.

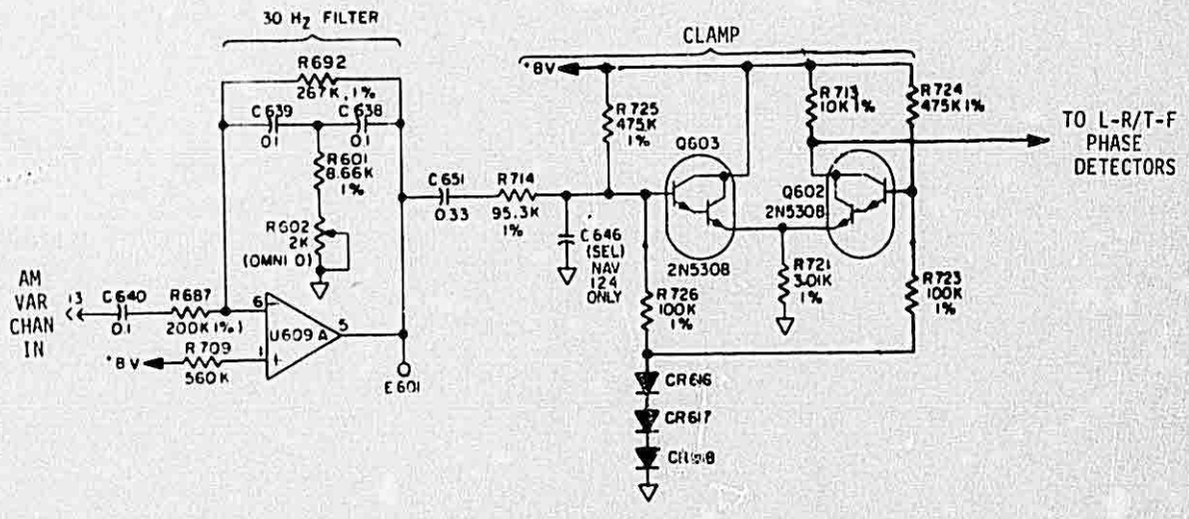


FIGURE 3-10. AM VARIABLE CHANNEL FILTER AND CLAMP

SEE BLOW-UP

3.2.3.4 10 kHz Filters

The VOR/LOC (N) signal from pin 8 is applied to two stage bridged T 10 kHz bandpass filter, U609B and U609C as shown in Figure 3-11. The first section (U609B) is tuned to 10.9 kHz and the second section (U609C) to 9.2 kHz. The no-signal output from both stages is set for 4 volts.

3.2.3.5 FM Limiter

The FM limiter shown in Figure 3-11 comprises operational amplifier U610C, RC coupled into voltage comparator U608B. The U610C dc gain is sey by feed back resistors R731 and R732; their resistance is equal to that of R708, the dc resistance in the non-inverting input. The gain at 10 kHz is high since C660 is a short circuit to the high frequency feedback component. In addition, the low impedance of R698/C643 at high frequencies also increases the 10 kHz gain without affecting the dc bias at U610C-9.

The second stage limiter is a voltage comparator. The positive dc bias of both inputs is set at +4 volts by voltage divider R701/R702. Signal to the inverting input (pin 8) is coupled through C649; C648 is a bypass to ground for any noise at the non-inverting input (pin 9). An input of approximately 30 mv will drive this high gain comparator to its full swing.

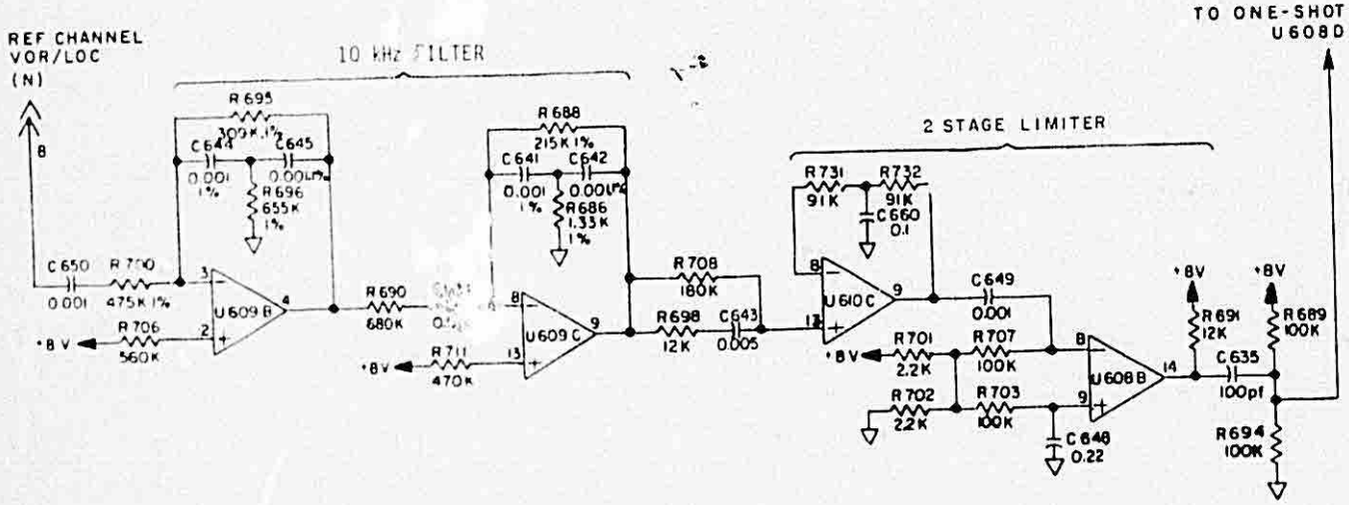


FIGURE 3-11. VOR/LOC REFERENCE CHANNEL FILTER AND LIMITER

SEE BLOW-UP

3.2.3.6 One-Shot FM Detector (Figure 3-12)

The limiter output is differentiated by C635, R689 and R694 to form short duration pulses at the inverting input of U608D-10. Diodes CR 613, CR614 and CR615 prevent either input from going negative but do not otherwise enter into the one-shot operation. The two input dividers (R689, R694 and R697, R693) establish a bias at pin 11 that is low than that at pin 10; consequently the output at pin 13 is low. When a negative pulse appears at pin 10, the output (pin 13) goes high. This positive pulse is coupled back to pin 11 through C636, which holds the output high for a short period following the trigger signal. The output stays high until C636 charging thorugh R654, resets the one-shot. The input pulse is short; the leading edge of the differentiated input is the leading edge of the pulse output, whose pulse width is determined by the time constant of R654/C636.

With the VOR 9960 Hz FM signal, the one-shot produces a pulse train whose pulse widths are constant but whose spacing between pulses varies in accordance with the frequency (FM) of modulation. The average value of this pulse train is the recovered 30 Hz modulation. Filter R606/C627 averages out the pulses and a 30 Hz signal (approximately 20 mv) appears across C627; a low amplitude 9960 Hz ripple is present on this 30 Hz signal.

3.2.3.7 Phase Splitter

Phase splitter Q601, shown in Figure 3-12 produces two signals precisely equal in amplitude and having 180 degrees phase difference. The Q601 base is biased by the combined action of the dc component (average value) of C627 plus the positive level from R682.

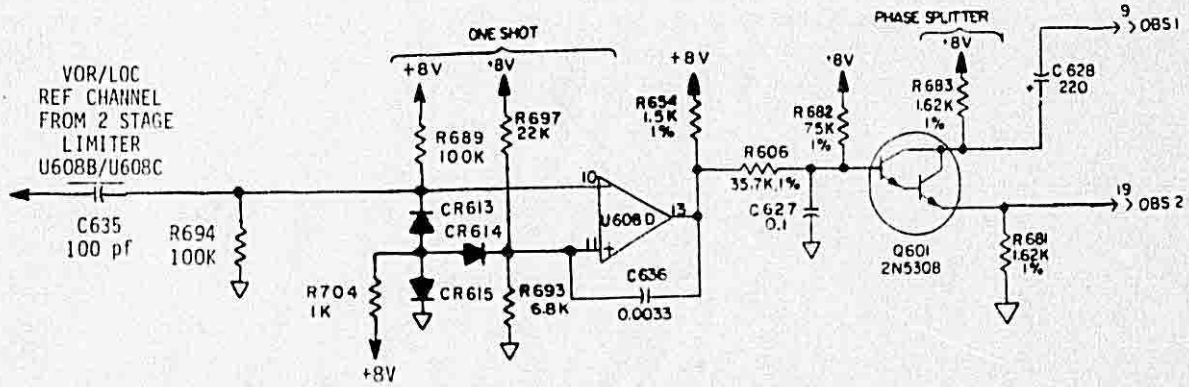


FIGURE 3-12. VOR/LOC REFERENCE CHANNEL PULSE GENERATOR AND PHASE SPLITTER

SEE BLOW-UP

3.2.3.8 OBS Circuitry

3.2.3.8.1 Overall Operation

The OBS circuit is fed from the phase splitter outputs. Since the emitter and collector of Q601 are at different dc potentials, C628 serves to isolate the collector dc from the OBS control; the Q605 and Q604 dc bias remains constant as the OBS control would cause erroneous readings until the capacitor in the following circuits charged up to the new dc value.

The outputs from the OBS control are applied to Q604 and Q605, the OB Phase summer, to prevent loading (See Figure 3-13). The Q604 and Q605 outputs are combined through C654, R728, R719, and R729 to form an output whose amplitude is constant but whose phase phase varies with the position of the OBS control.

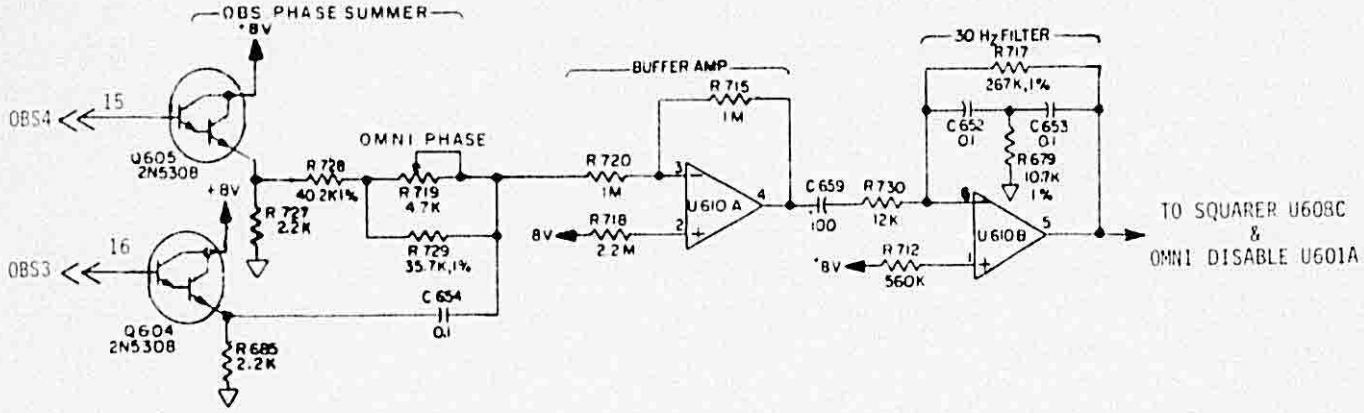


FIGURE 3-13. OBS PHASE SUMMING AND 30 Hz FILTER

3.2.3.8.2 OBS Control (Front Panel)

The OBS control is connected to a sin-cos potentiometer with two wipers connected to the OBS control. The position of these wipers is determined by the setting of the OBS control, which is calibrated from 0^{o} to 360^{o}. Rotating this control adds or subtracts the number of degrees phase shift to the basic reference phase.

SEE BLOW-UP

3.2.3.9 Filter Squarer (Figure 3-13 and 3-14)

The OBS output is applied to U610A, which isolates the phase summing network. The output is connected through C659 and R730 to U610B, a 30 Hz bandpass filter. The filter output is directly connected to comparator U608C (Figure 3-14) which converts the signal into a square wave. The comparator output controls two gates (pins 5 and 6) of transmission gate U606 and two gates (pins 12 and 13) through inverter U608A. The L-R phase detector is fed from the top section of U606 and the T-F phase detector is fed from the bottom section.

3.2.3.10 Left-Right Phase Detector

The L-R Phase Detector shown in Figure 3-14 has two inputs, the variable phase channel and the reference phase channel. The phase detector output is displayed on the front panel left-right indicator. The left-right (L-R) phase detector comprises two bi-directional FET switches of U606, operational amplifier U605D, L-R DC control R673, and interconnecting components. The U606 switches are alternately turned on for 1/2 the 30 Hz AM period by the two control signals from the squarer and inverter. This controls the 30 Hz input from the AM channel limiter (Q602) to the L-R phase detector.

If the switch control time is 90^{o} out of phase with the input 30 Hz, the average value is zero; therefore, C615 will have zero volts across it. The two switches of U606 are used to eliminate response to dc level changes and some harmonics of the input. Capacitor C614 and C617 serve to prevent oscillation in the circuit and C615 and C626 eliminate any rf interference from communication transmitters.

In the U605D circuit, the output dc voltage (pin 14) is approximately equal to the dc voltage at pin 12. This value will never be equal due to the input offset of the operational amplifier (U605D). The L/R DC Control (R673) provides an offset voltage that makes these two dc voltages equal and the L-R meter is at null with no signal.

Diodes CR610 and CR611 are connected back-to-back to limit the maximum voltage developed across C622. This limiting of the maximum L-R voltage prevents damage to the L-R meter connected to the U605D output. In the omni mode, LOC capacitors C611 R633/R636 provide a small increase to the time constant at the L-R meter.

3.2.3.11 To-From Phase Detector

The To-From Phase Detector shown in Figure 3-14 comprises the remaining two bi-directional FET switches of U606, operational amplifier U605C, T-F DC control R674, and interconnecting components. Operation is similar to the L-R phase detector circuit described above. The bi-directional FET switches are controlled by the same squarer and inverter output (U608C and U608A) and fed by the same 30 Hz signal from the AM channel limiter (Q602). The same components (R650/C619 and R649/C618) shift the phase of the AM channel signal 90^{o} and apply it to TO-FROM phase detector (U605C and 1/2 U606). The TO-FROM phase detector offset voltage is varied by T/F DC control R674. The TO-FROM output from U605C pin 8 drives the front panel T/F flag indicator.

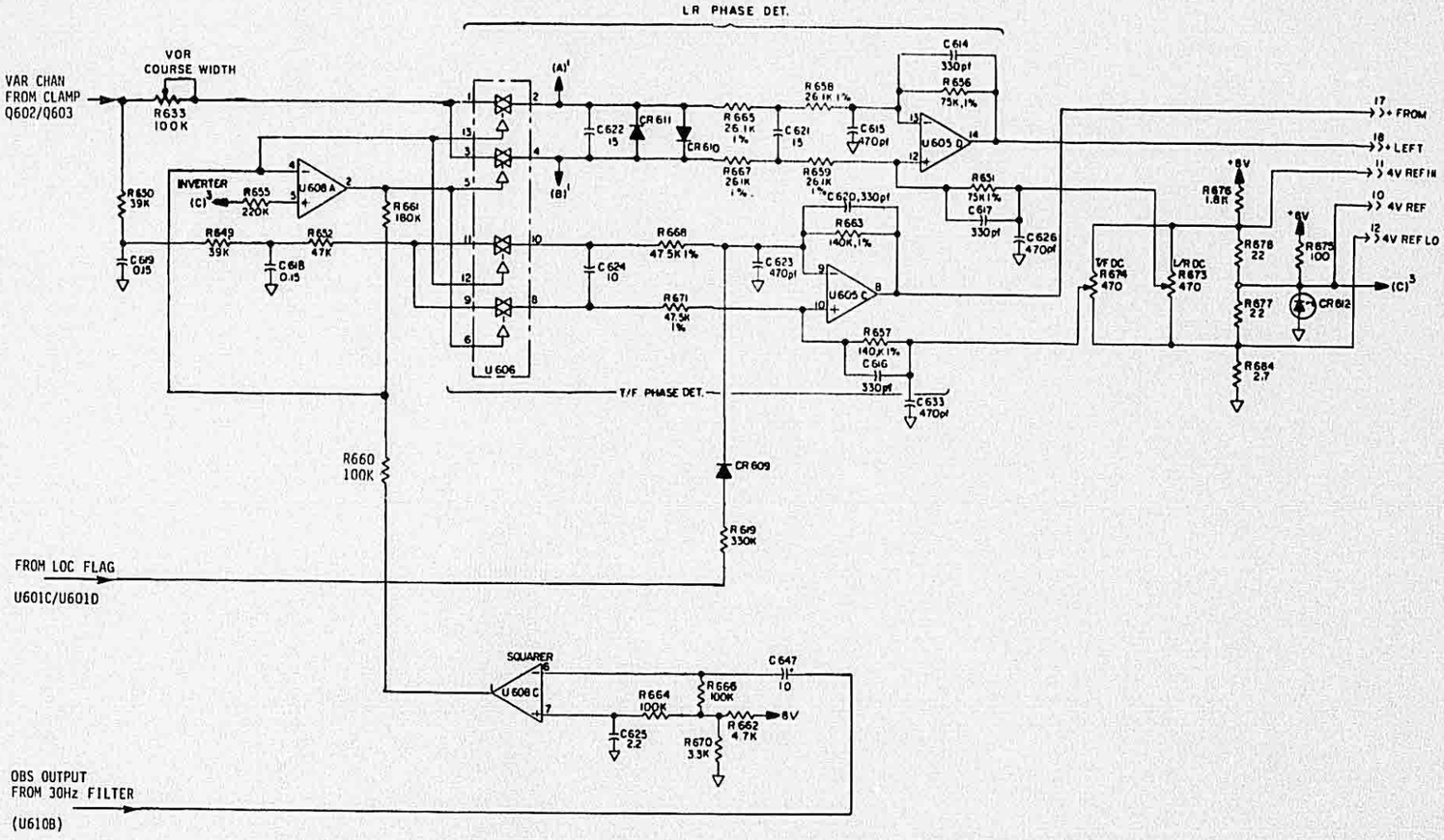


FIGURE 3-14. PHASE DETECTOR, L-R/T-F

SEE BLOW-UP

3.2.3.12 Self-Test Circuit

Self-test amplifier U610D, shown in Figure 3-15, which is activated by pressing the front panel OBS control knob. When an omni signal is being received, the 30 Hz FM reference signal is amplified by U610D. Activating the switch connects this self test signal (pin 14) to the AM variable channel input (pin 13). Adjustment of the OBS control to zero ^{o} should null the L-R indicator. The self-test zero control (R733) shifts the phase for this null condition at 0^{o}.

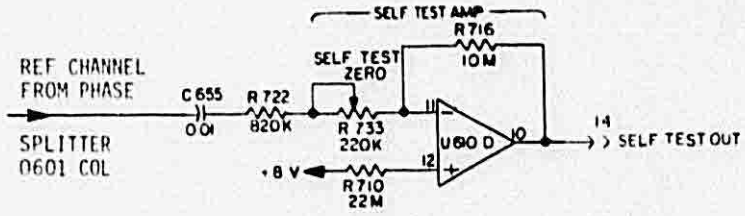


FIGURE 3-15. SELF TEST AMPLIFIER

3.2.3.13 FM Channel Squelch (Omni Disable)

The squelch shuts off the phase detector when a useable FM VOR signal is not present. At low signal levels, the amplitude of the 30 Hz recovered FM signal decreases and the increased noise causes erratic action of the indicator needle.

The omni disable circuit comprises two comparators, U601A and U601B as shown in Figure 3-16. U601A is connected as an active rectifier with CR603 preventing the output from going positive and C608 added to prevent oscillation. When the output swings negative, CR603 is turned off and the voltage at CR604/R630 junction follows the input variations with a gain approximately equal to R630/(R627 + R607). The average value of this waveform is developed across C608.

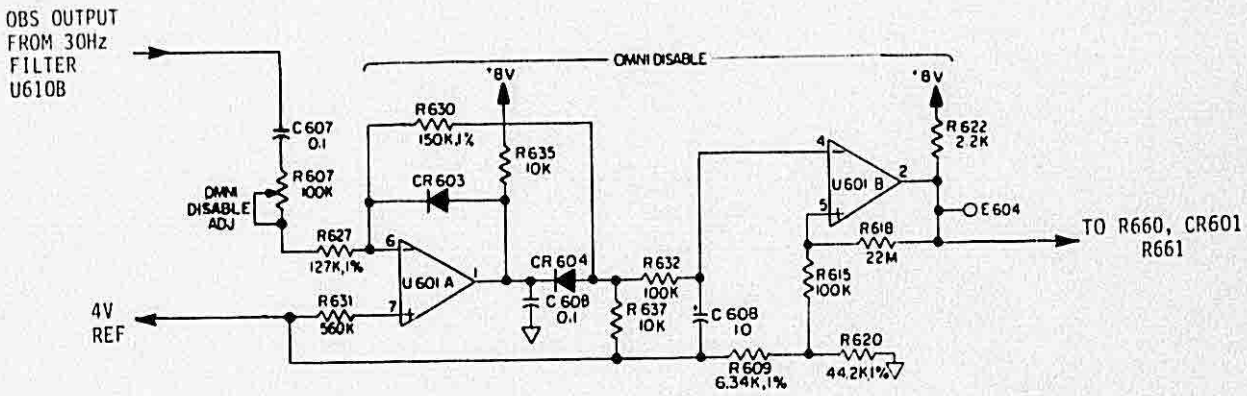


FIGURE 3-16. OMNI DISABLE CIRCUIT

SEE BLOW-UP

3.2.3.13 Continued

This voltage is fed to comparator U601B. When its level is below that at U601B pin 5, the squarer (U608C) and inverter (U608A) go low, thus opening all switches in U606. This dis-connects the L-R/T-F phase detectors from the input signal, driving the L-R/T-F meters to a center position. When there is sufficient FM channel signal, the high output from comparator U601B then supplies voltage to the squaring and inverting circuits, resulting in normal phase detector operation.

3.2.3.14 Localizer Operation (Figure 3-17)

The localizer signal (pin 8) is applied through C629 and R680 (LOC COURSE WIDTH control) to the LOC CTR control. This control governs the distribution of input to the 90 Hz and 150 Hz bridged T filters in the localizer mode. The 90 Hz and 150 Hz filter outputs are ac coupled through C612 and C631 to half wave rectifiers U603B and U603A respectively. The value of C631 is less than that of C612, which reduces the 90 Hz signal present in the 150 Hz output.

The output of each rectifier is applied to C611 through R639 and R643. The voltage across C611 is proportional to the difference in amplitudes from the two filter/rectifier circuits. The difference voltage is applied to the L-R phase detector through R633/R636. The L-R phase detector amplifier (U605D) provides gain to this signal, which drives the front panel L-R indicator.

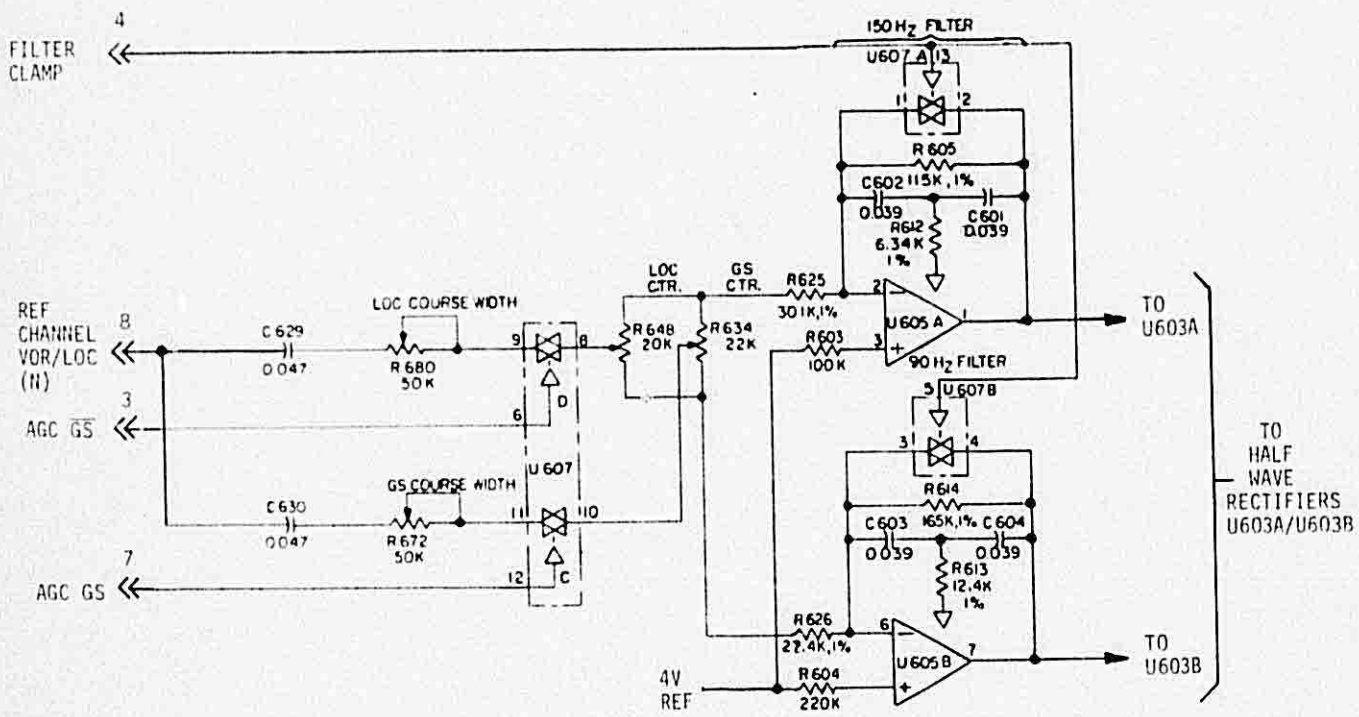


FIGURE 3-17. VOR/LOC REFERENCE CHANNEL 90/150 Hz FILTERS

SEE BLOW-UP

3.2.3.15 Localizer Flag

The rectified half wave outputs of the 90 and 150 Hz filters are averaged by R628/C605 and R623/C606 as shown in Figure 3-18. The dc voltage across C606 is proportional to the amplitude of the 150 Hz signal and the dc voltage across C605 is proportional to the amplitude of the 90 Hz signal. When the voltage reaches the level set by LOC FLAG ADJ control R609, comparators U601C and U601D go high. Either comparator being low will hold the output low. When both the 90 Hz and 150 Hz signal amplitudes are sufficient, the comparator outputs will be high. The absence of either signal will cause the flag to appear.

In the localizer mode (Figure 3-11), the two U606 (T-F) switches are open; R688, R671, and C624 have no effect; and the output of U601C and D is coupled through R619 and CR609 into U605C.

A low from localizer flag comparator U601C/U601D reverse biases CR609 and the flag does not indicate. When the comparator output is high (8 volts), current flows through R619/CR609 and the flag provides a TO indication.

3.2.4 SYNTHESIZER (NAV 121, NAV 122A)

The frequency synthesizer provides the local oscillator (LO) injection for the VOR/LOC mixer located on the receiver board. Referring to the synthesizer block diagram (Figure 3-19) the synthesizer uses a phase-locked loop (PLL) to generate the required LO frequencies. This loop utilizes a 3.2 MHz crystal-controlled oscillator as a master reference. All output frequencies of the synthesizer have the same inherent stability as the reference oscillator.

The synthesizer frequency is 17 MHz below the channel frequency since the receiver IF is 17 MHz. In addition to providing the rf drive to the receiver mixers, the synthesizer also provides the following: a fixed 50 kHz signal to control time-sharing when the glide slope receiver is used; and a dc tuning voltage to tune the rf front end of the VOR/LOC receiver.

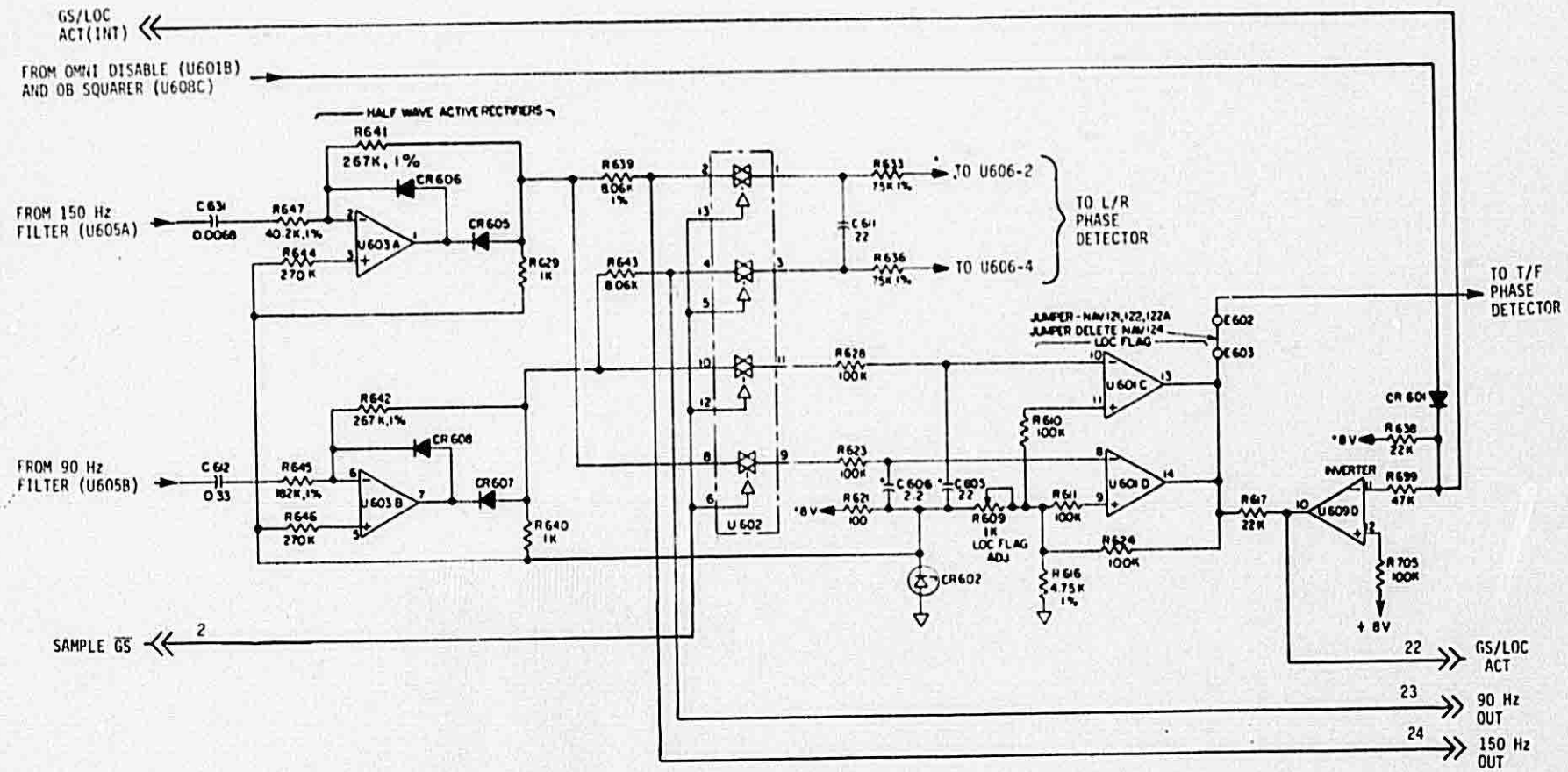


FIGURE 3-18. GS/LOC CONTROL OF 90/150 Hz RECTIFIER OUTPUTS

SEE BLOW-UP

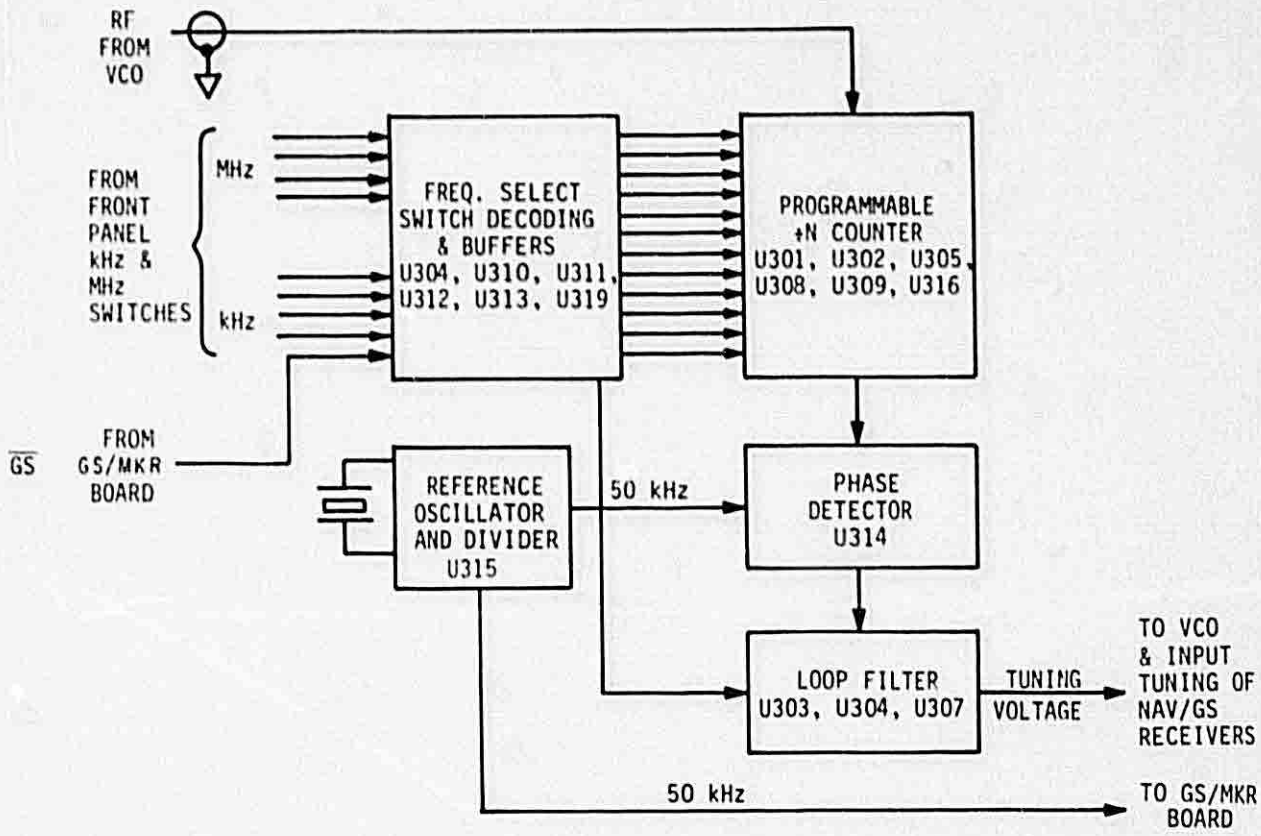


FIGURE 3-19. FREQUENCY SYNTHESIZER, BLOCK DIAGRAM

3.2.4 Continued

As shown in the phase-locked loop block diagram (Figure 3-20) the synthesizer is controlled by the front panel channel select switches (MHz and kHz). The switches provide a 2 out of 5 ARINC code to the synthesizer digital input buffers and decoding logic. The decoding logic converts the switch code to the proper code required by the programmable ÷N counter is compared with the 50 kHz crystal controlled reference in the phase/frequency discriminator. The discriminator output pulses are filtered by the loop filter producing a dc output voltage that is proportional to the frequency and phase difference of the 50 kHz reference and the ÷N output. This voltage locks the VCO to the selected frequency.

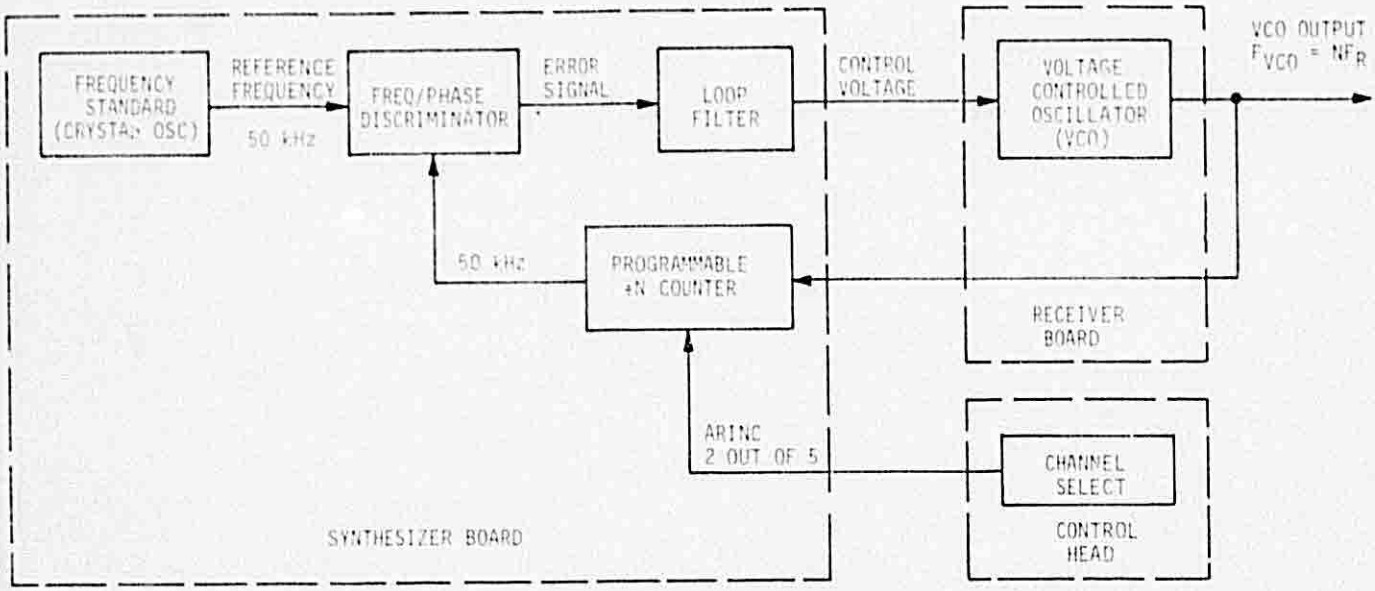


FIGURE 3-20. BASIC PHASE LOCK LOOP, BLOCK DIAGRAM

3.2.4.1 Phase Locked Loop (PLL)

The phase locked loop comprises a VCO (located on the receiver board), a programmable N counter, a frequency/phase detector, a loop filter and a reference frequency chain. The channel selection is performed by the front panel MHz and kHz knobs on the control head. Although the front panel frequency encoding switches (S101, S102) are located on the control head and not the synthesizer board, their function is included in the frequency encoder/decoder description.

3.2.4.1.1 Reference Oscillator

The reference oscillator shown in Figure 3-21 comprises a 3.2 MHz crystal controlled oscillator (U315A, B), buffer (U315C), ÷ 64 counter (U319), and a 50 kHz pulse-shaper buffer (U315D). The basic oscillator is two inverters connected in series. In-phase feedback through variable capacitor C316 and crystal Y301 sustains oscillation at the crystal frequency. Varying the feedback through C316 permits a small adjustment of the oscillator frequency.

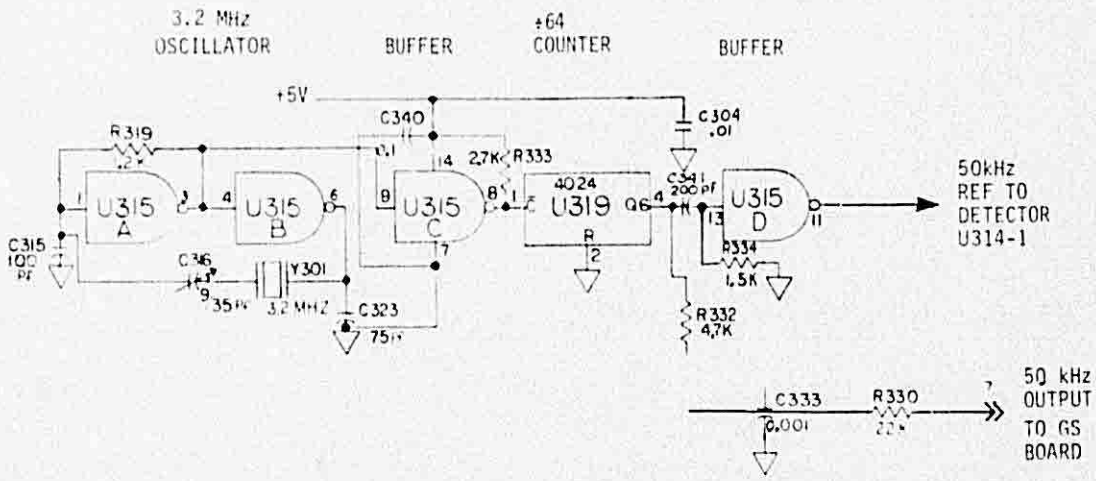


FIGURE 3-21. REFERENCE OSCILLATOR

3.2.4.1.1 Continued

The 3.2 MHz crystal oscillator output is connected through buffer amplifier U315C to the input of the ÷64 counter U319. The 3.2 MHz crystal controlled output from U315C-8 is divided by a factor of 64, resulting in a 50 kHz square wave at U319-4.

The 50 kHz crystal controlled reference frequency provides two outputs: one output through buffer U315D-11 to the 50 kHz reference input to the phase detector (U314-1); and the other from the ÷64 counter output to the glide slope board (NAV 122 only).

SEE BLOW-UP

3.2.4.1.2 Frequency Encode/Decode

a. Frequency Encoding Switches

The frequency encode/decode section utilizes the front panel MHz and kHz switches to set up the correct frequency division for obtaining 50 kHz at the N input of the phase detector. The schematic is shown in Figures 3-22 and 3-23. The frequency select switches (S101, S102 of Figure 3-22) provide a standard 2 out of 5 ARINC code to control the frequency of the synthesizer. These kHz and MHz control lines are also available at the rear connector for simultaneous remote programming of other radios.

The MHz selector switch (S102) provides five lines of digital information, A through E. In the ARINC code shown in Table 3.3, each MHz frequency selected has two out of the five lines activated; in this case the lines are grounded (0). The MHz switch is a single wafer, 10-position switch (Figure 3-22). Only four output lines (A, B, C, D) are required by the synthesizer to encode the 10 different MHz frequencies.

The kHz selector switch (S101) provides six lines of digital information. The switch comprises a 20 position double-sided wafer. One side of the wafer provides a standard 2 out of 5 ARINC code for 10 two position groups (1-2, 3-4, etc.); the other side provides a simplified ARINC code for the Y channel, 50 kHz channel programming. It should be noted that for each kHz position of S101 shown in Table 3.4, the Y output has two conditions (1 and 0) for 50 kHz increments.

As in the MHz switch, the kHz switch information is transferred to the synthesizer on four lines (B, C, D, E); the Y line is an additional line for 50 kHz information. The diode isolation (CR303 through CR311) and pull-up resistors (R321 through R329) ensure logic levels of 0 and +5 volts.

b. Frequency Select Decoding

The frequency select decoder converts the 2 out of 5 ARINC switching codes (MHz and kHz) to the proper ÷N counter codes. In addition, the input circuits provide filtering and buffering for the input programming lines.

The input lines from the front panel switches are isolated by diodes CR303 through CR311, located outside of the synthesizer shield. Good rf isolation is provided each line by feed-through capacitors (C326 through C332, C334 through C336).

The frequency select decoder comprises U310, U311, U312, U313 and U304. Integrated circuits U312 and U314 are multiple inverter amplifiers which provide input line isolation and good dc noise immunity (in conjunction with input diodes and RC networks). The code converting function is performed primarily by PROMS U310 and U311, and the exclusive OR gates of U304.

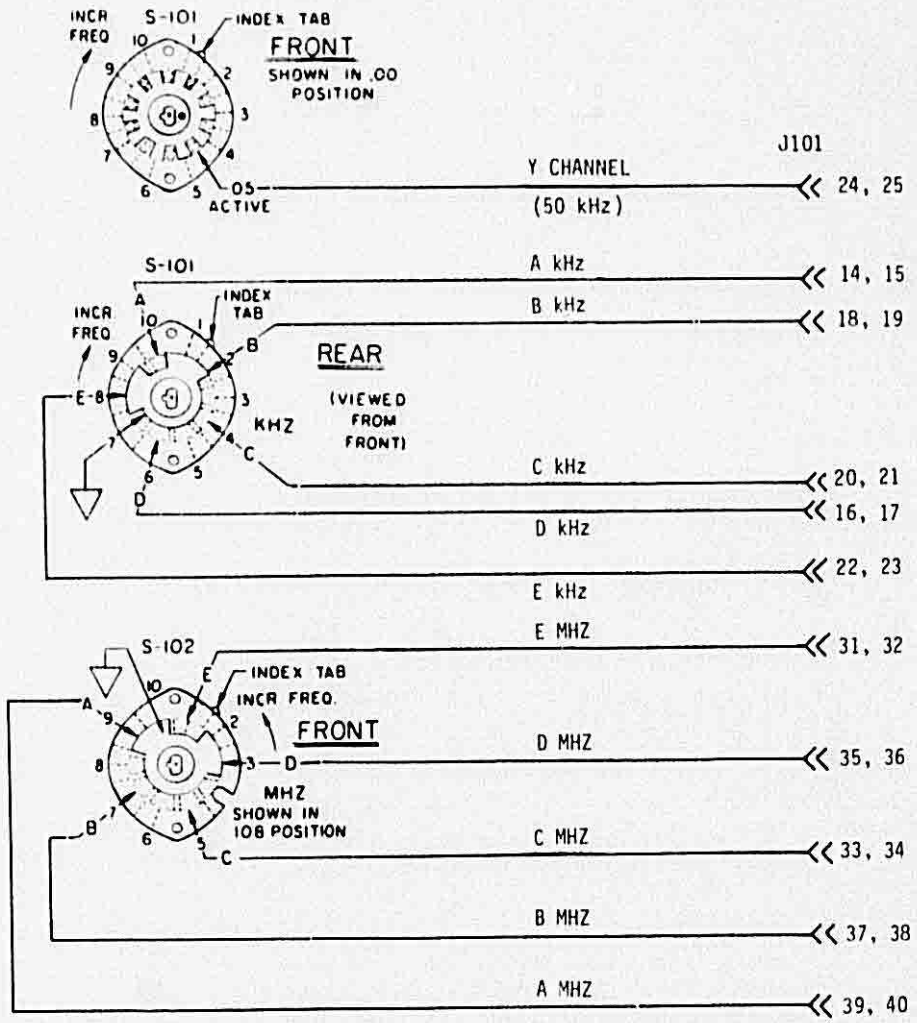


FIGURE 3-22. FREQUENCY ENCODING SWITCH (FRONT PANEL)

TABLE 3.3 PROGRAMMING OF MHz PROM U310 FOR LOC OPERATION

FREQ (MHz)	ARINC (J803 PIN NO.)					PROM LOGIC LEVELS													
						PROM INPUT PIN NO.					PROM OUTPUT PIN NO.								
	15	18	20	19	9	10	11	12	13	14	1	2	3	4	5	6	7	9	
	A	B	C	D	$\overline{GS}$														
108	0	1	1	0	1	0	1	0	1	1	0	0	1	1	0	1	1	0	
109	0	1	1	1	1	0	0	0	1	1	0	0	0	1	0	1	1	0	
110	1	0	1	1	1	0	0	1	0	1	1	1	1	0	0	1	1	0	
111	0	0	1	1	1	0	0	1	1	1	1	1	0	0	0	1	1	0	
112	0	1	0	1	1	0	0	0	1	0	1	0	1	0	0	1	0	0	
113	1	0	0	1	1	0	0	1	0	0	1	0	0	0	0	1	0	0	
114	1	0	1	0	1	0	1	1	0	1	0	1	1	0	0	1	0	0	
115	1	1	0	0	1	0	1	0	0	0	0	1	0	0	0	1	0	0	
116	1	1	0	1	1	0	0	0	0	0	0	0	1	0	0	1	0	0	
117	1	1	1	0	1	0	1	0	0	1	0	0	0	0	0	1	0	0	

TABLE 3.4 PROGRAMMING OF kHz PROM U311 FOR LOC OPERATION

FREQ (MHz)	ARINC (J803 PIN NO.)					PROM LOGIC LEVELS													
						PROM INPUT PIN NO.					PROM OUTPUT PIN NO.								
	16	14	17	8	12	10	11	12	13	14	1	2	3	4	5	6	7	9	
	B	C	D	E	Y														
.0	0	1	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1	
.05	0	1	1	0	1	1	0	0	0	0	0	0	0	1	1	1	1	1	
.10	0	1	1	1	0	1	0	0	1	1	1	0	0	0	1	1	1	1	
.15	0	0	1	1	1	1	0	0	1	1	1	0	0	0	1	1	1	1	
.20	1	0	1	1	0	0	1	0	1	1	0	1	1	1	0	1	1	1	
.25	1	0	1	1	1	0	1	0	1	1	0	1	1	1	0	1	1	1	
.30	0	0	1	1	0	1	1	0	0	0	1	1	1	0	0	1	1	0	
.35	0	0	1	1	1	1	1	0	0	0	1	1	1	0	0	1	1	0	
.40	0	1	0	1	0	1	0	1	0	0	0	1	0	1	0	1	1	0	
.45	0	1	0	1	1	1	0	1	0	0	0	1	0	1	0	1	1	0	
.50	1	0	0	1	0	0	1	1	0	0	1	1	0	0	0	1	1	0	
.55	1	0	0	1	1	0	1	1	0	0	1	1	0	0	0	1	1	0	
.60	1	0	1	0	0	0	1	0	0	0	0	0	1	1	0	1	1	1	
.65	1	0	1	0	1	0	1	0	0	0	0	0	1	1	0	1	1	1	
.70	1	1	0	0	0	0	0	1	0	0	1	0	1	0	0	1	1	1	
.75	1	1	0	1	1	0	0	1	0	0	1	0	1	0	0	1	1	1	
.80	1	1	0	1	0	0	0	1	1	1	0	0	0	1	0	1	1	1	
.85	1	1	0	1	1	0	0	1	1	1	0	0	0	1	0	1	1	1	
.90	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	
.95	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0	1	1	1	

3.2.4.1.2 Continued

Integrated circuits U310 and U311 are field programmable read-only-memories (PROM's). As a memory, each PROM is organized with five input address lines, A_0 through A_4, and eight output lines, B_0 through B_7. This results in the ability to permanently store any required 8-bit code in any of the 32 memory addresses of each PROM. The programming code of the MHz PROM (U310) is shown in Table 3.3 and the programming code of the kHz PROM (U311) is shown in Table 3.4. Note that some of the output lines of U310 and 311 are connected back to selected inputs through exclusive or gates U304. This enables all the codes required for the 200 navigation channels (VOR/LOC) and the 40 glide slope channels to be stored in two 32 x 8 PROMS.

The above configuration allows pairing of the LOC and GS frequencies by alternately switching the $\overline{GS}$ input from high to low at pin 3. This changes the synthesizer programming code from localizer to glide slope and results in an alternating pair of dc control voltages from the synthesizer loop filter output. The control voltages drive the VCO alternately to the local oscillator injection frequencies for the paired localizer and for the glide slope receiver channels. In the NAV 121 and NAV 122A, the $\overline{GS}$ is high at all times; therefore the synthesizer is programmed to generate only the VOR/LOC receiver LO injection frequency for the NAV receiver.

3.2.4.1.3 ÷N Programmable Counter

The counter (U309, U308, U302, U305, and U306) shown in Figure 3-23 forms a variable frequency counter that divides by a ratio of 1820 to 1 through 2120 to 1 (refer to Table 3.5) depending upon which channel is selected by the front panel control. Integrated circuits U308 and U302 are connected to each other to form an eight bit counter, which increments by one bit each time the clock inputs (pin 2) go from low to high. The counters (U302, U308) count up until they reach a count of 111 1001 (decimal 159); pin 8 of U301B then goes low, placing a logic zero upon pin 9 of U308 and U302. When this pin goes low, the counter counters are loaded (after waiting one clock period) to whatever number appears on the load inputs (pins 3, 4, 5, 6) at the time of the next clock transition.

Thus, MHz counters U308 and U302 reload after every group of pulses equal in number to one pulse plus 159 minus the number that is being loaded. By using the load pulses or the Q_3 output of U302 (U302-11) as the output, an output frequency of $F_{clock}/(1 + 159 - N_M)$ is obtained. Therefore, MHz counters U308 and U302 as a group, divide by $(160-N_M)$; N_M being the number preset at pins 3, 4, 5 and 6 of Q308 and U302.

The clock frequency for U308 and U302 is obtained from the Q output of U305B. Flip-flop U305B is a ÷2 counter, which in turn is clocked by the output frequency of prescaler U306 (buffered by Q301 and U302). The U306 prescaler is a variable-modulus frequency divider, which divides the VCO input frequency (pin 16) by a factor of 10:1 or 11:1, depending on whether pin 3 is high or low respectively (see Figure 3-24).

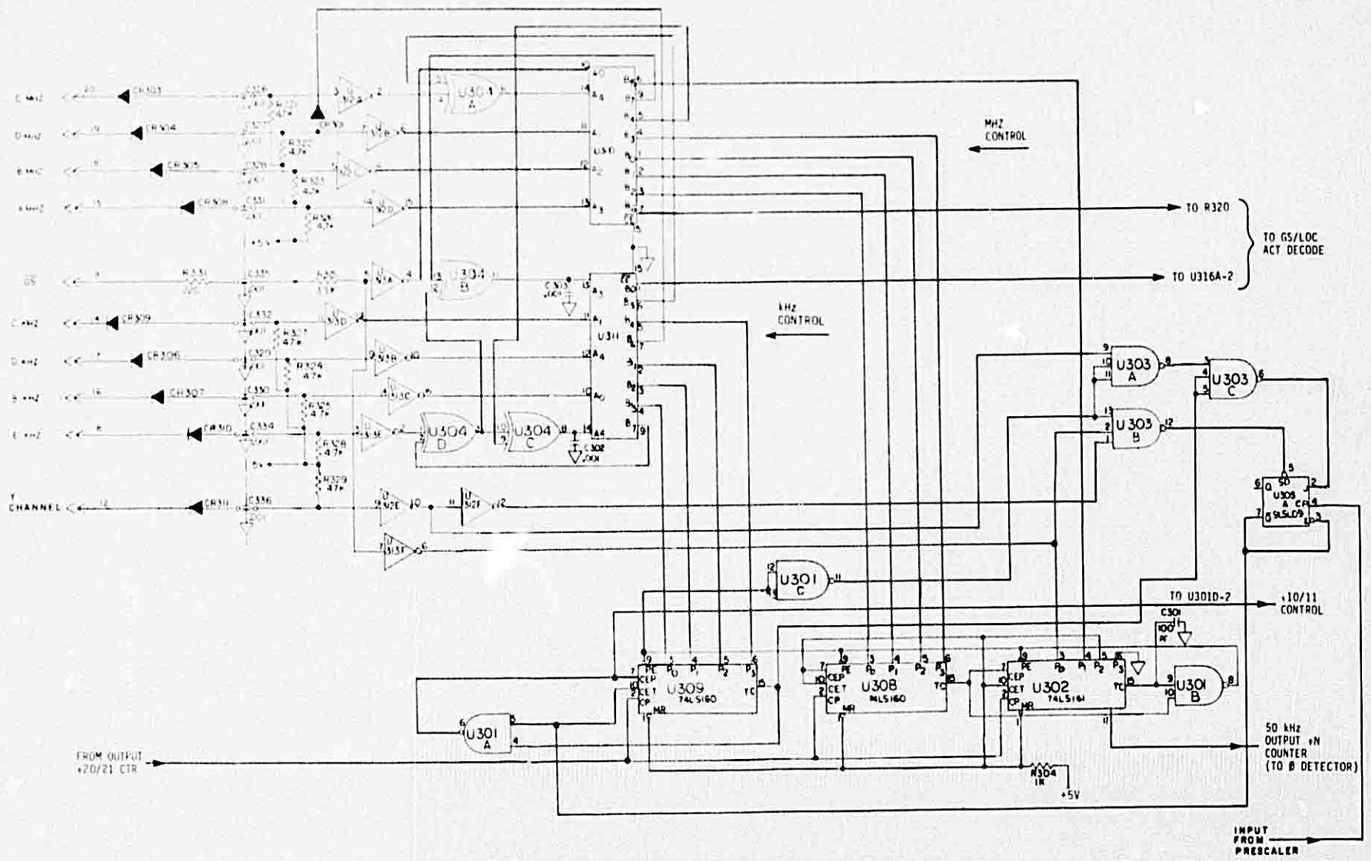


FIGURE 3-23. FREQUENCY SELECT DECODER AND ÷ N COUNTER

SEE BLOW-UP

TABLE 3.5 OPERATING FREQUENCIES VS N SUMMARY

RECEIVER	RF FREQUENCY (MHz)	VCO FREQUENCY (MHz)	$\div N \left(\frac{\text{VCO FREQ}}{50\ \text{kHz}}\right)$
VOR/LOC	108.000 ↑ TO ↓ 117.950	91.000 ↑ TO ↓ 100.950	1820 ↑ TO ↓ 2019
GS	329.150 ↑ TO ↓ 335.000	104.050 ↑ TO ↓ 106.000	2081 ↑ TO ↓ 2120

3.2.4.1.3 Continued

The $\overline{Q}$ output of U305B is fed back to pin 3 of U306 (through U301D) to form a $\div 20/21$ prescaler. Should this $\div 20/21$ prescaler be connected to always divide by 20, the overall divide ratio of the $\div N$ counter would be 20 ($160\text{-}N_M$). However, the divide ratio of the $\div 20/21$ prescaler is controlled by U305A and U309. When MHz counter U308 and U302 reaches 159 and reloads, it also causes U305A and U309 to be loaded with the number N_K, which can be any number from 0 to 19.

The kHz counter comprises U305A and U309 with flip-flop U305A being preset by the Y-channel bit and U309 programmed by the kHz PROM information. If a channel is selected which does not preset U305A and U309 to their terminal count (0 1001) decoded by U301A, the $\div 20/21$ prescaler is set to the $\div 21$ mode; caused by the high at pin 2 of U301D. Therefore, for every 21st input to U306 pin 16, an output pulse appears at U305B pin 10 which clocks U305A U302, U308 and U309.

This process then continues until U309 and U305A reach their terminal count, causing the output of U301A to go low. This low at U301A pin 6 stops U309 and U305A from counting further and also forces the output of U301D high. The high at U301D pin 3 switches the $\div 20/21$ prescaler to the $\div 20$ mode until the MHz counter reaches 159 and reloads all of the counters.

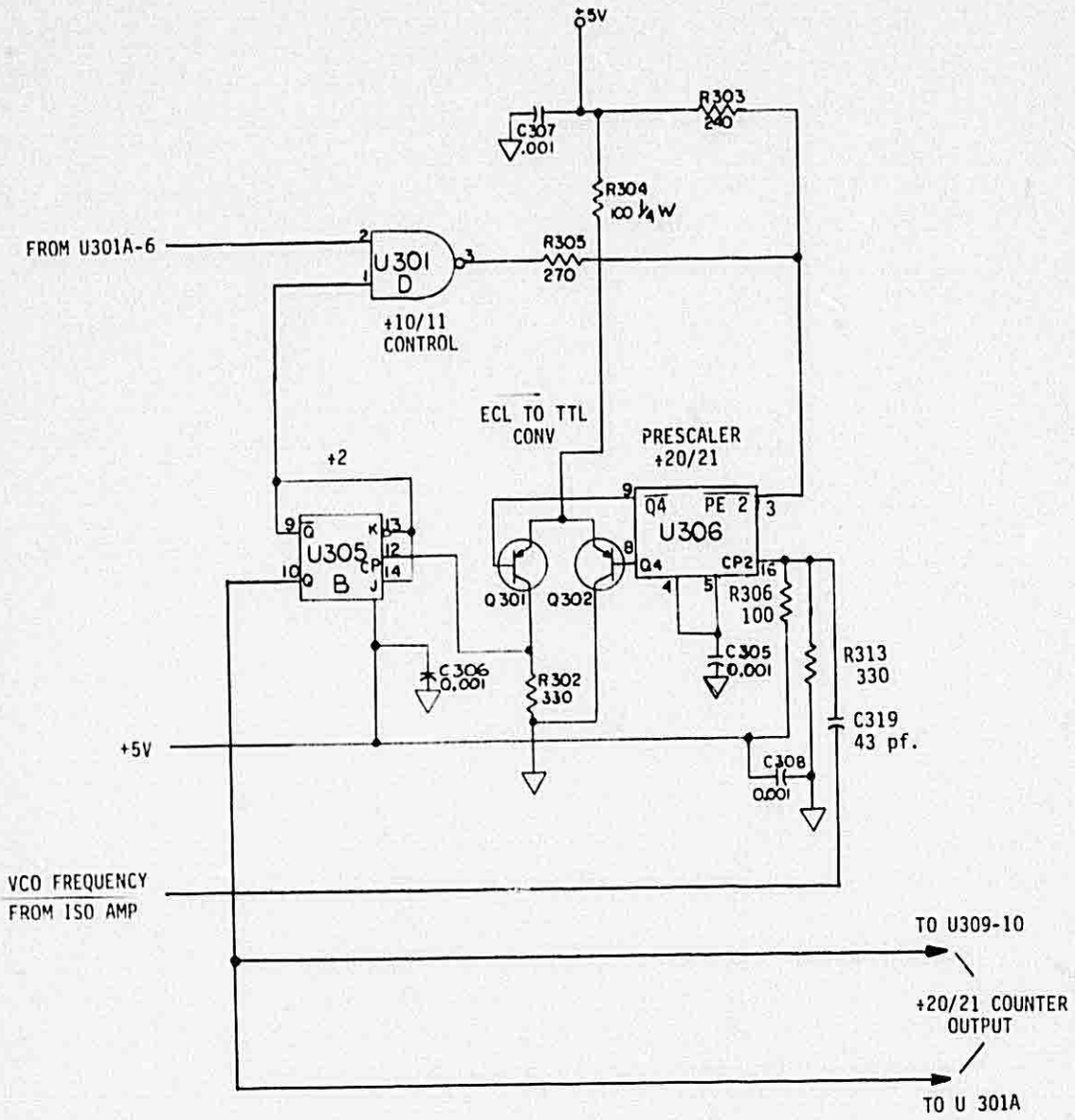


FIGURE 3-24. ÷ 20/21 COUNTER SCHEMATIC DIAGRAM

3.2.4.1.3 Continued

Thus, U309 and U305A cause a number of extra VCO input cycles (equal to 19 minus N_K) to be consumed by using an extra input VCO cycle for each output clock pulse at U305B pin 10; refer to Figure 3-25. This increases the divide ratio of the entire counter by 19 minus N_K, which makes the overall ratio 20 (160-N_M) + (19-N_K). Referencing this to the VCO frequency:

F_{VCO} = 50 kHz [20(160-N_M) + (19-N_K)]

MHz Counter

20(160-Nk = Number of ÷20 periods of U306/U305B

1+159-N_M) = Divide ratio of MHz counter

1 = Clock pulse for PE load

159 = Terminal count of U302 & U308

N_M = MHz number preset during PE load at pins 4, 5, and 6 of U302 and U308

kHz Counter

19-NK = Number of ÷21 periods of U306/U305B

19 = Terminal count of U309 & U305

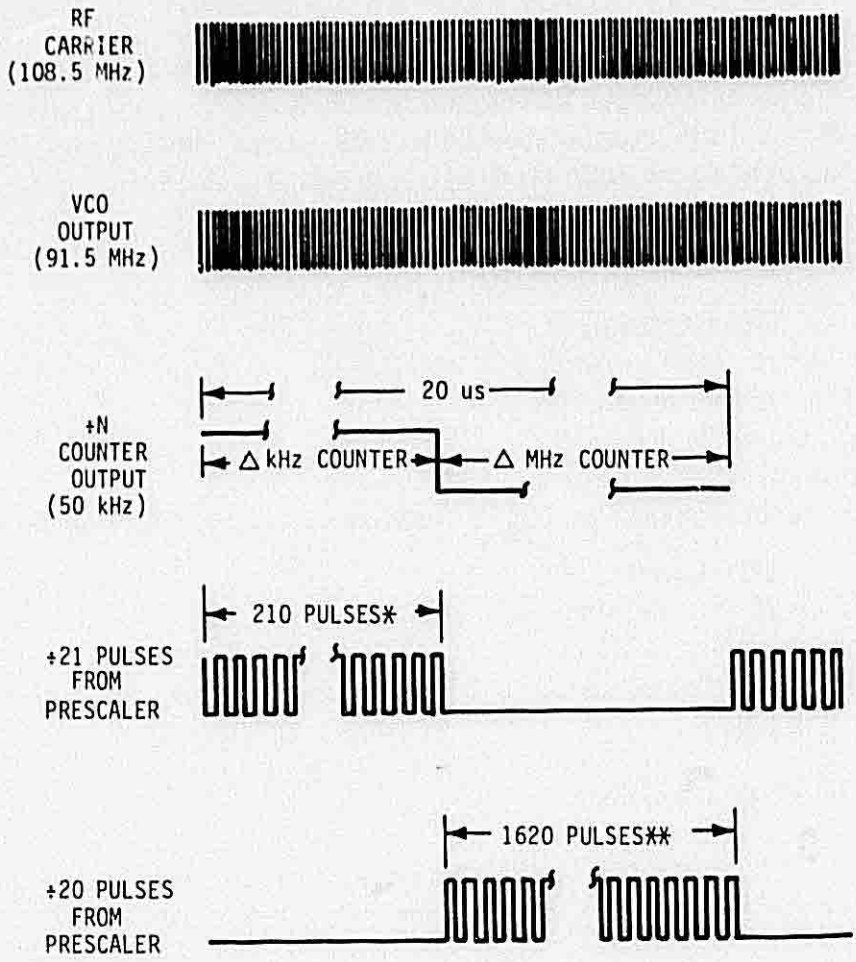
N_K = kHz number preset during PE load at pins 3, 4, 5, and 6 of U309 and pins 5 or 7 of U308

3.2.4.1.4 Phase Detector and Filter

The phase detector (U314) compares the 50 kHz crystal reference signal with the 50 kHz from the ÷N counter and produces an error signal when a difference in frequency or phase exits.

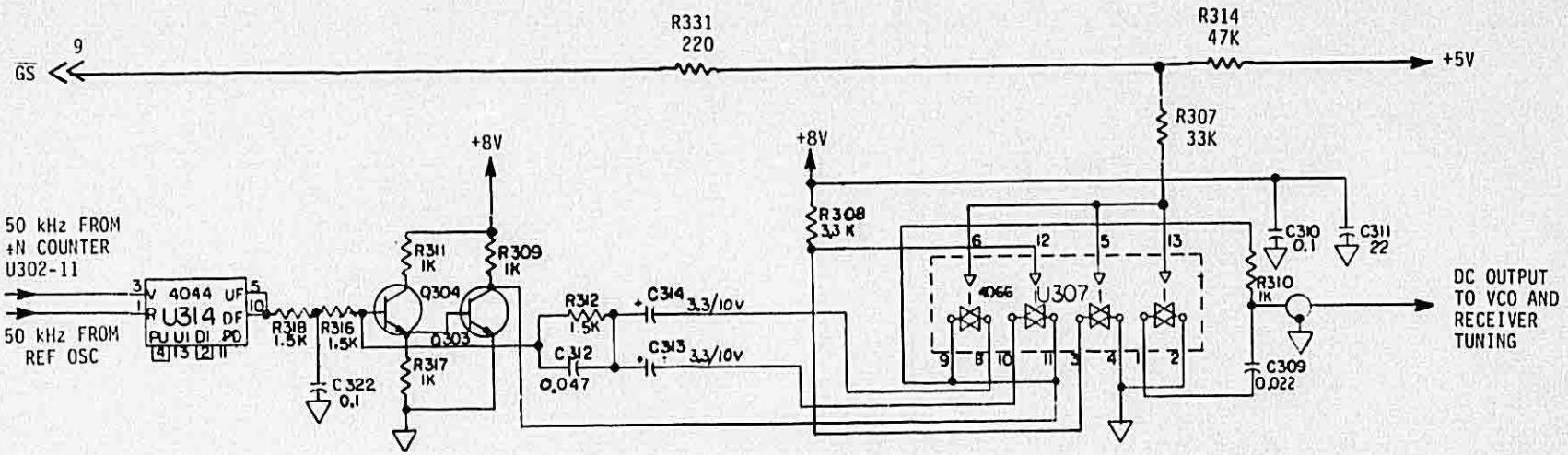
A difference in frequency produces pulses from pins 5 and 10 of phase detector U314. The loop filter provides dynamic loop stability and filters the phase detector output pulses into a dc control voltage. This dc control voltage serves as a correction voltage to the VCO that varies the VCO frequency until the 50 kHz reference frequency and 50 kHz variable frequency from the ÷N counter are locked in phase.

The filter is controlled by U307, which is an analog switch connected as SPST, SPDT sw switches, and an inverter, Figure 3-26 B is a simplified diagram of the switch. The switch gates are controlled by the LOC/GS signals. In this application, C309 is connected to ground when in VOR; the extra RC filter section provides additional attenuation of the 50 kHz reference frequency. In addition C313 and C314 are connected into the feedback loop of operational amplifier Q303/Q304. Alternately charging each of the two capacitors, one in the GS mode and the other in the LOC mode, reduces the time required for the synthesizer to switch from the GS mode to LOC mode. Figure 3-27 shows a graph of the synthesizer dc voltage vs the VCO frequency.

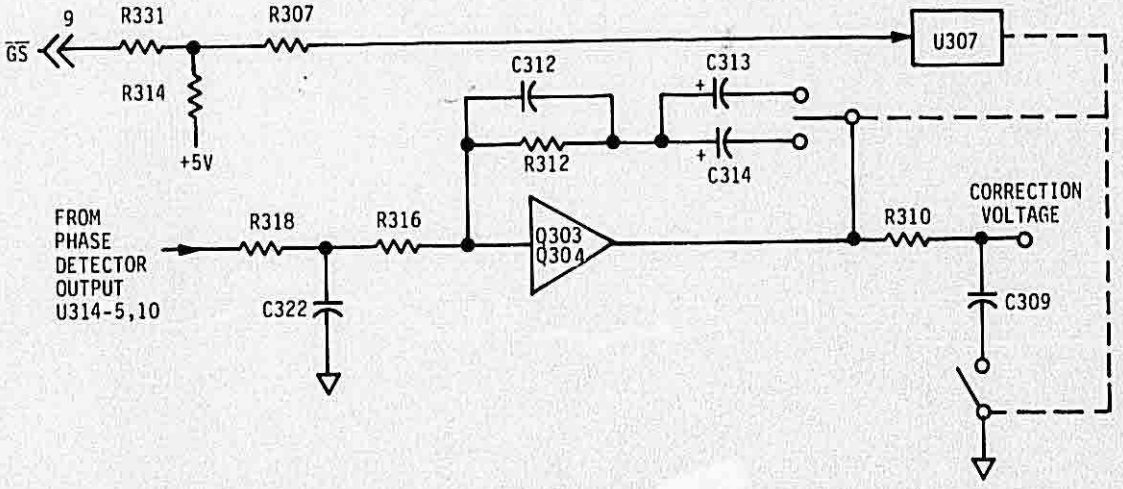


* EACH PULSE = 21 VCO PULSES
** EACH PULSE = 20 VCO PULSES

FIGURE 3-25. ÷20/21 COUNTER, SEQUENCE TIMING DIAGRAM



A. PHASE DETECTOR AND FILTER



B. SIMPLIFIED FILTER CIRCUIT.

FIGURE 3-26. PHASE DETECTOR AND FILTER

SEE BLOW-UP

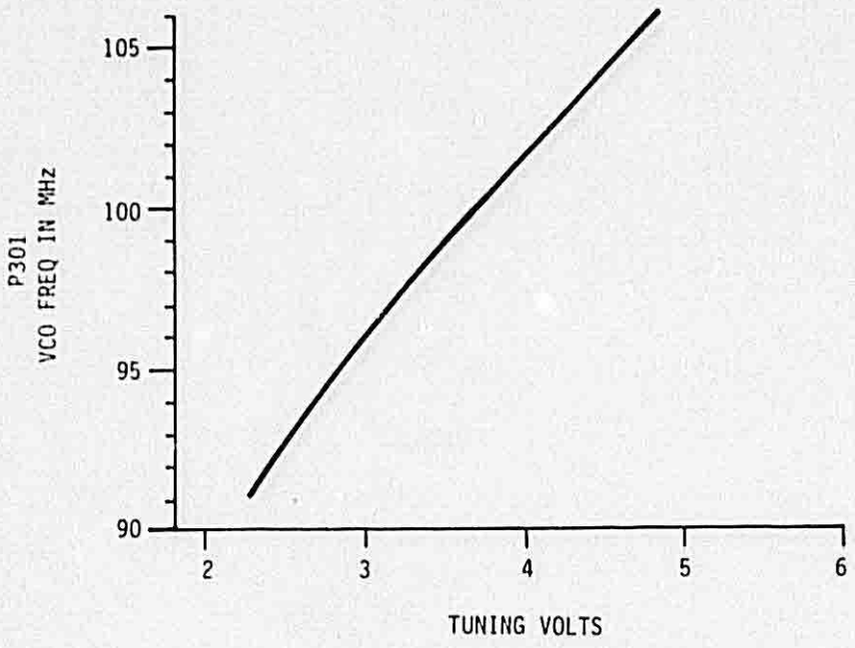


FIGURE 3-27. VCO CALIBRATION, DC CONTROL INPUT VS VCO FREQUENCY

3.2.4.1.5 Decoder, GS/LOC Activate

The GS/LOC Activate Decoder (U316A) recognizes the 0.1, 0.3, 0.5, 0.7 and 0.9 MHz channels throughout the 108-111 MHz range (see Table 3.6)and provides a logic low for these channels. As shown in Figure 3-28, U316B is connected in parallel to provide this GS/LOC ACT signal at pin 18 of the external connector.

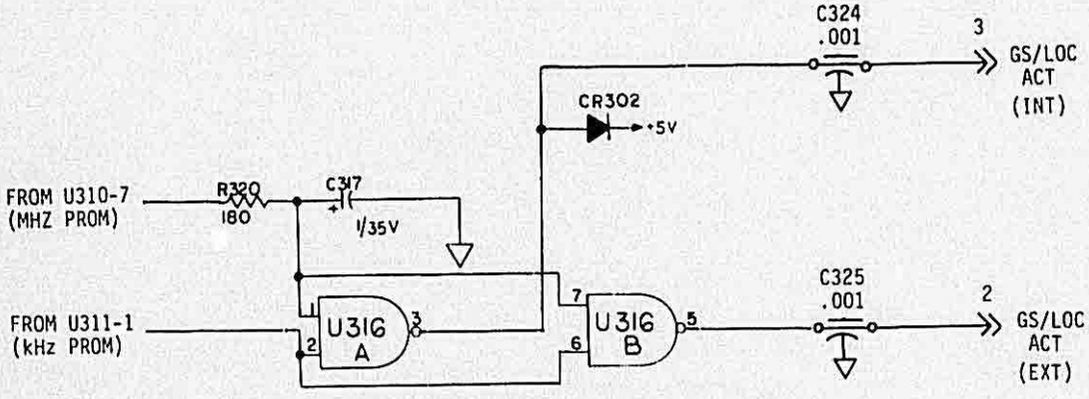


FIGURE 3-28. GS/LOC ACT DECODER

3.2.5 CONTROL HEAD ASSEMBLY

The Control Head Assembly comprises the front panel controls and displays of the NAV 121, NAV 122, and NAV 122A. In addition to the controls and indicators, the IDENT filter and switch are located on the control head. During normal VOR or LOC operation, this filter keeps the 1020 Hz coded-identification of the navigation transmitter from the receivers audio circuits. When the front panel OFF-VOL PULL IDENT knob is pulled, the filter is bypassed and the 1020 Hz Morse code signal is connected to the audio amplifiers.

The control head is connected to the flexible circuit assembly through connector J101/P802. The control head is secured to the chassis with machine screws; no other mechanical linkage is used.

3.2.6 FLEXIBLE CIRCUIT ASSEMBLY

The flexible circuit assembly comprises all card connectors, the cable connector located at the rear of the unit, and flexible wiring package that interconnects all connector pins. All active connector pins are soldered to the individual conductors in the flexible wiring. In addition, the flexible wiring has provisions for soldering jumpers to various interconnection points on the flexible package.

The jumpering permits using the same receiver assembly, VOR/LOC assembly, and synthesizer assembly in any receiver (NAV 121, NAV 122, NAV 122A). The time sharing control lines are connected in the NAV 122 and are jumpered in the NAV 121 and NAV 122A.

3.3 NAVIGATION RECEIVER/CONVERTER, NAV 122

3.3.1 INTRODUCTION

The NAV 122 comprises a VOR/LOC/GS receiver, VOR/LOC converter frequency synthesizer, marker beacon receiver, and VOR/LOC/GS/marker beacon front panel displays. In the circuit description, circuits that are identical to those in the NAV 121 are referred to in the applicable subparagraph of paragraph 3.2. Circuits that are different are described in detail. Figure 3-29 is a functional block diagram of the NAV 122 and Figure 3-30 is a functional block diagram of the time sharing circuits used to multiplex the glide slope and VOR/LOC receivers.

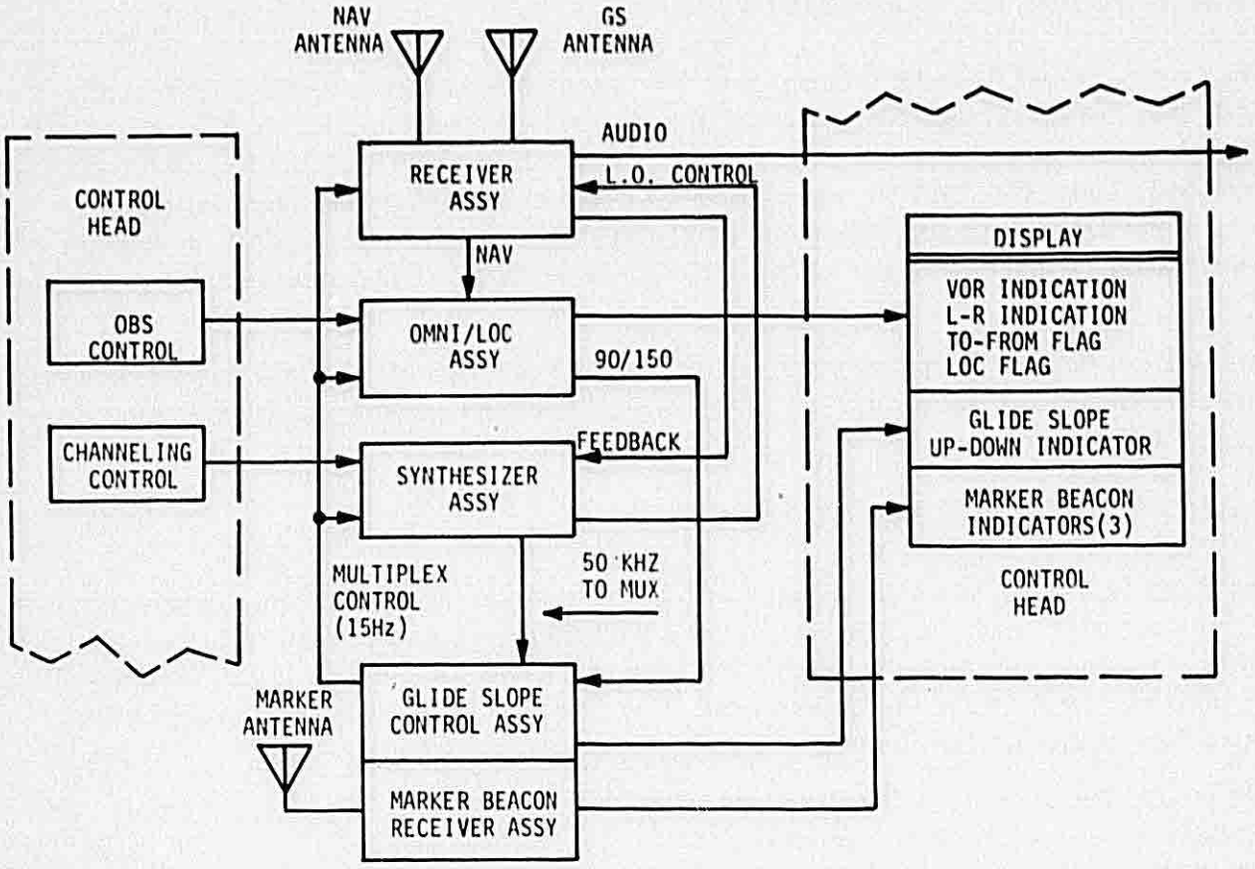


FIGURE 3-29. RECEIVER/CONVERTER UNIT, NAV 122, FUNCTIONAL BLOCK DIAGRAM

3.3.2 TIME-SHARED OPERATION (Figure 3-30)

In this time-shared (multiplex) mode the glide slope receiver and VOR/LOC receiver are operated to provide simultaneous display of glide slope/LOC information to the front panel indicators and flags (Figure 3-30). In the OMNI mode, the VOR/LOC receiver operates at the frequencies given in Table 3.2 (even .1 MHz channels between 108 thru 112 MHz) with the appropriate flag and indicator displays. In the localizer mode (odd .1 MHz channels) the channels are paired with the glide slope channels as shown in Table 3.6.

The receiver alternately switches back and forth between localizer and glide slope. The frequency synthesizer, receiver, IF amplifiers and filters, detector, and VOR/LOC board 90/150 Hz tone filters are common to both the LOC and GS modes. The switching command alternately connects the glide slope receiver and AGC and the localizer receiver and AGC. The switching command changes the interconnection and also connects various components into the synthesizer, receiver, VOR/LOC board and MKR GS board to make a complete LOC receiver/converter during LOC switching time and a complete glide slope receiver/converter during the GS switching time.

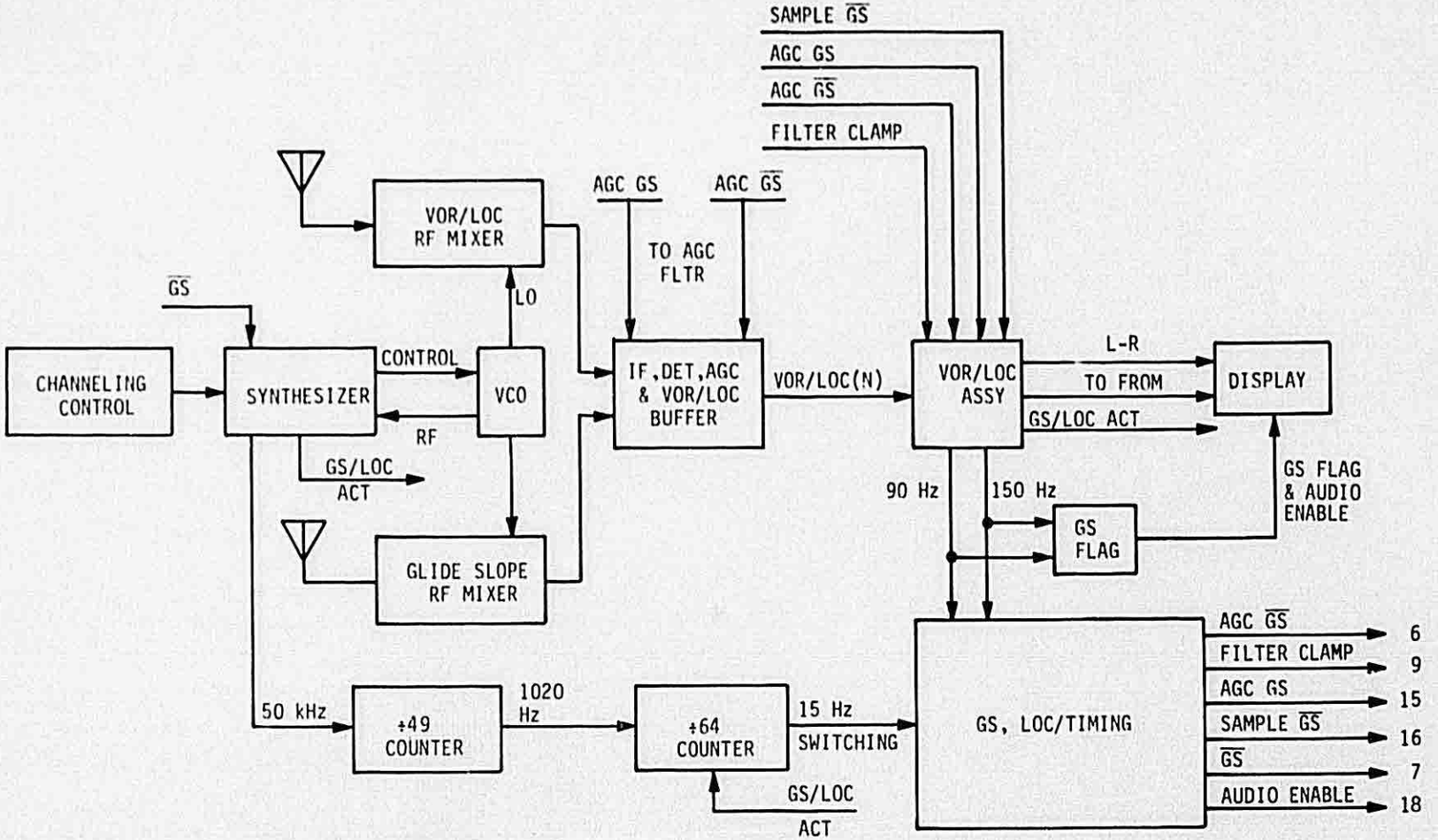


FIGURE 3-30. GLIDE SLOPE/LOCALIZER TIME SHARING MULTIPLEX CONTROL

TABLE 3.6 OPERATING FREQUENCIES OF TIME-SHARED LOC/GS CHANNELS

NAV (LOC) RF	NAV (LOC) VCO	G/S RF	G/S LO	G/S VCO
108.10	91.10	334.70	317.70	105.90
108.15	91.15	334.55	317.55	105.85
108.30	91.30	334.10	317.10	105.70
108.35	91.35	333.95	316.95	105.65
108.50	91.50	329.90	312.90	104.30
108.55	91.55	329.75	312.75	104.25
108.70	91.70	330.50	313.50	104.50
108.75	91.75	330.35	313.35	104.45
108.90	91.90	329.30	312.30	104.10
108.95	91.95	329.15	312.15	104.05
109.10	92.10	331.40	314.40	104.80
109.15	92.15	331.25	314.25	104.75
109.30	92.30	332.00	315.00	105.00
109.35	92.35	331.85	314.85	104.95
109.50	92.50	332.60	315.60	105.20
109.55	92.55	332.45	315.45	105.15
109.70	92.70	333.20	316.20	105.40
109.75	92.75	333.05	316.05	105.35
109.90	92.90	333.80	316.80	105.60
109.95	92.95	333.65	316.65	105.55
110.10	93.10	334.40	317.40	105.80
110.15	93.15	334.25	317.25	105.75
110.30	93.30	335.00	318.00	106.00
110.35	93.35	334.85	317.85	105.95
110.50	93.50	329.60	312.60	104.20
110.55	93.55	329.45	312.45	104.15
110.70	93.70	330.20	313.20	104.40
110.75	93.75	330.05	313.05	104.35
110.90	93.90	330.80	313.80	104.60
110.95	93.95	330.65	313.65	104.55
111.10	94.10	331.70	314.70	104.90
111.15	94.15	331.55	314.55	104.85
111.30	94.30	332.30	315.30	105.10
111.35	94.35	332.15	315.15	105.05
111.50	94.50	332.90	315.90	105.30
111.55	94.55	332.75	315.75	105.25
111.70	94.70	333.50	316.50	105.50
111.75	94.75	333.35	316.35	105.45
111.90	94.90	331.10	314.10	104.70
111.95	94.95	330.95	313.95	104.65

3.3.2 Continued

The receiver has a separate rf amplifier and mixer for LOC and for GS. The VOR/LOC front end is tuned to 40 channels within the 108.1 and 111.95 MHz range; the GS front end is tuned to 40 channels within the 329.3 and 335.0 MHz range. From this point, the receiver IF and detector are common to both modes; then the processed information is once more multiplexed to drive the separate displays.

The synthesizer changes mode by actually switching the program to the N counter to change the LO injection frequency to LOC or GS; frequencies are shown in Table 3-6. The LO injection frequency is 17 MHz below the LOC or GS channel frequency. The receiver IF is 17 MHz. Although the glide slope LO frequencies are 312.15 thru 318.0 MHz, the synthesizer operates at 1/3 the frequency (104.05 thru 106.0 MHz), which means the VCO operates within the VHF region for both outputs. The GS mixer operates at triple the VCO frequency, which is in the 312.15 thru 318 MHz UHF range. The GS mixer, which is non-linear, generates the third harmonic of the synthesizer frequency.

The time sharing is implemented by this switching of the synthesizer LO, switching of receiver front end, switching of meter drivers: all other circuitry is shared.

The basic switching control for time-sharing is derived from a 50 kHz clock signal obtained from the counted down output of the synthesizer 3.2 MHz crystal oscillator. The 50 kHz is further counted down by a 49 and a 64 counter on the GS control board. This resultant 15 Hz clock is the source for all switching signals throughout the receiver.

The 90/150 Hz filters and rectifiers of the VOR/LOC section are time shared between glide slope and localizer operation. During the filter clamp time (Figure 3-31) the capacitors in the 90 and 150 Hz filters C601/C602 and C603/C604 are discharged by the filter clamp input to U607A and U607B. The filters are dc biased at approximately 4 volts. During the clamp time, switches U607A/U607B are closed and the synthesizer is a switching from LOC to GS or GS to LOC.

Following the clamp period shown in waveform A (Figure 3-31) assume the receiver is in LOC. Bi-directional switch U607D is closed by the action of the AGC $\overline{GS}$ input at pin 3 and the LOC signal is fed through C629, R680 and R648 to the 90/150 Hz filters. After turn-on, the filters require a short interval to build up to a steady state condition. Since the transient build-up can cause errors in the localizer indication, the signal is not applied to the L-R phase detector until the filter has had sufficient time to stabilize.

The SAMPLE $\overline{GS}$ signal pin 2 goes high (waveform E, Figure 3-31) and the rectifier output outputs are connected to capacitor C622 through R639 and R643. The voltage developed across C611 is proportional to the difference and the operation of the L-R phase detector is the same as in non time-shared operation. During this sample time, the signal is also applied to the flag circuits, which operate as in standard LOC operation.

At the end of the SAMPLE $\overline{GS}$ period (waveform E) switches U607D and U602 open and capacitors C611, C606, and C605 hold the information to the L-R phase detector and LOC flag regardless of the filters and rectifiers being disconnected. The clamp then occurs (waveform A), discharging the filters and making them ready to accept GS information (waveform B).

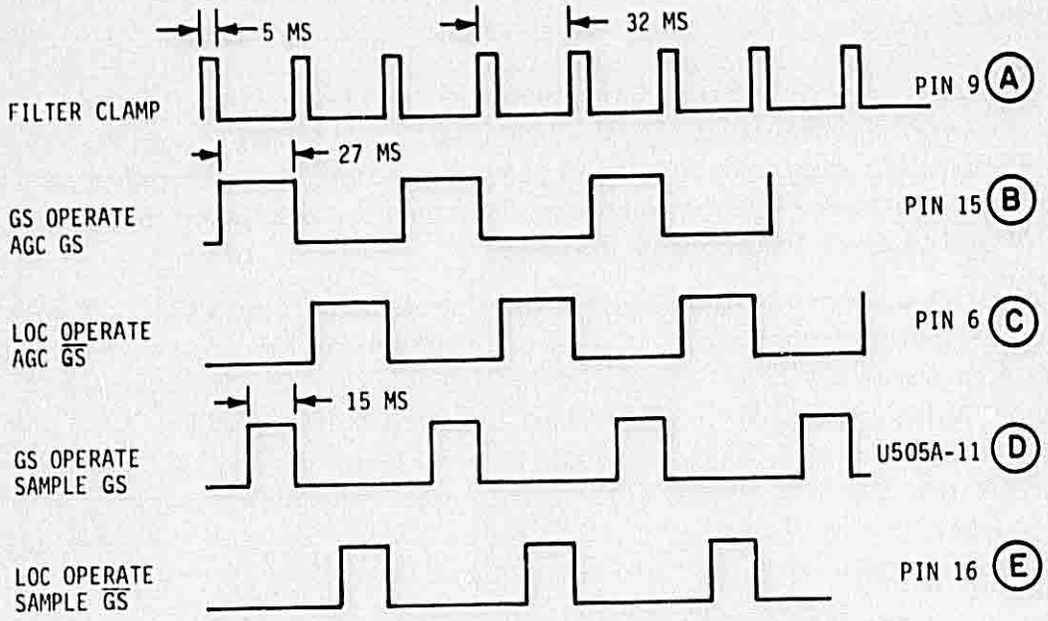


FIGURE 3-31. TIME-SHARED CONTROL WAVEFORMS

3.3.2 Continued

The separate switches of U607 are controlled by the AGC GS control input (pin 3) for the LOC and AGC $\overline{GS}$ control input (pin 7) for the GS information. Separate control of the two switches permits individual centering and course width adjustments at the input to the 90/150 Hz filters.

3.3.3 RECEIVER ASSEMBLY (NAV 122)

The VOR/LOC receiver assembly shown in Figure 3-32 amplifies and demodulates the VOR-LOC/GS carriers to provide audio at the voice circuits and navigation data at the NAV converter. Varactor tuning is used in the receiver rf stages with time-shared multiplexing to alternately switch the VOR/LOC receiver and GS receiver. Channel frequencies are controlled by the frequency synthesizer assembly.

3.3.3.1 Receiver Tuning

The receiver tuning is similar to the single channel NAV 121 VOR/LOC receiver tuning described in paragraph 3.2.2.1; however, additional circuitry is used to time-share the operation of this receiver with the operation of the glide slope receiver. The basic switching is performed by the $\overline{GS}$ CONTROL INPUT (pin 14) from the GS control assembly; LO injection to the two receiver mixers is programmed by the control voltage from the frequency synthesizer (P202).

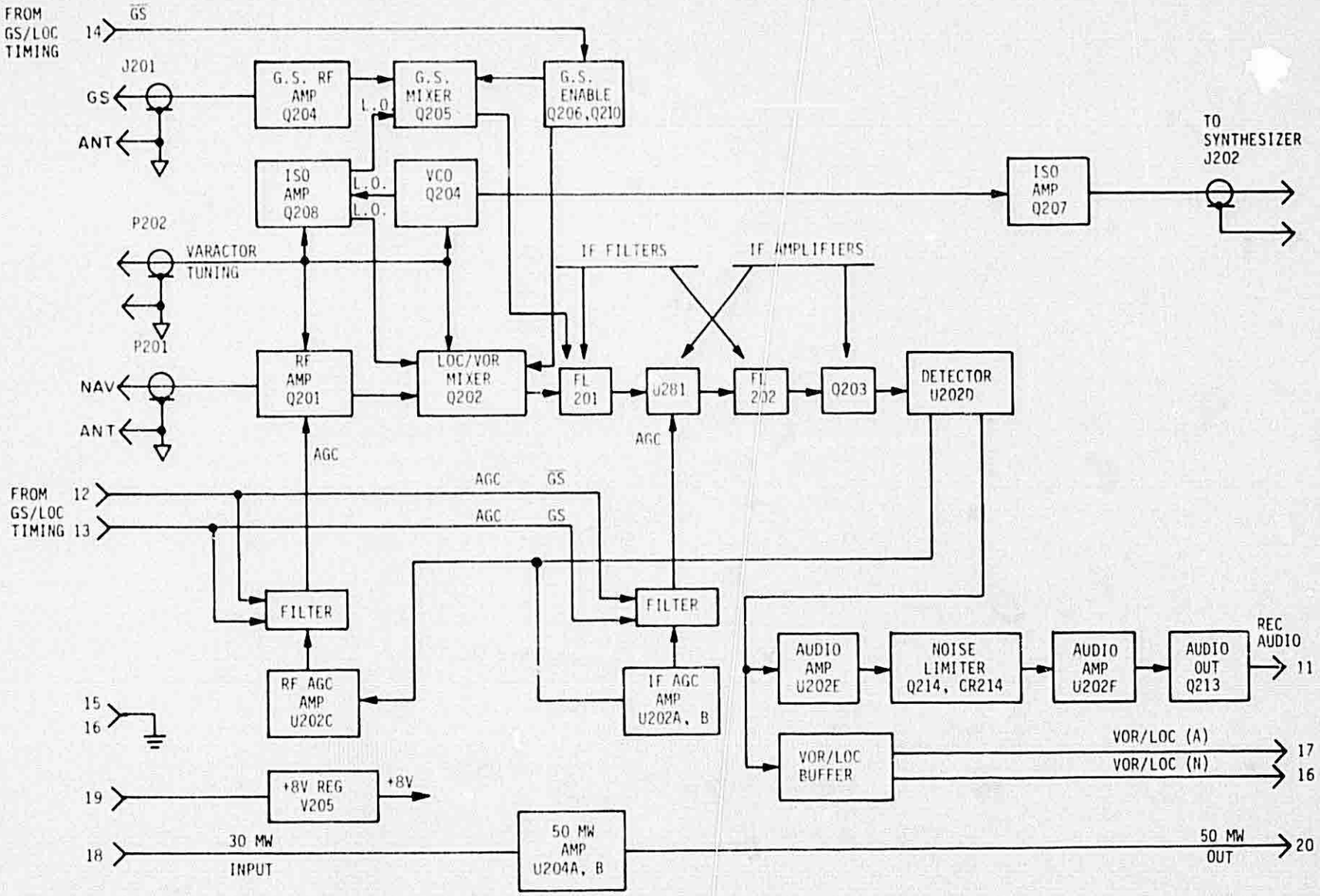


FIGURE 3-32. NAV 122 VOR/LOC RECEIVER ASSEMBLY, BLOCK DIAGRAM

3.3.3.1 Continued

The glide slope front end, shown in Figure 3-22, has inputs obtained from various circuits described in the NAV 121 (paragraph 3.2); refer to Figure 3-4 for the LO from isolation amplifier Q208 schematic, refer to Figure 3-5 for the VOR/LOC mixer schematic, and refer to Figure 3-8 for the glide slope AGC schematic and the Q210 $\overline{GS}$ control input.

The glide slope front end comprises GS rf amplifier Q204 and GS mixer Q205. The GS mixer receives its LO injection frequency through R229 which is coupled from the VCO through isolation amplifier Q208; Q208 also feeds LO to LOC mixer Q202. Both mixers Q202 and Q205 are connected through L205 to IF filter FL201. Therefore, output from either mixer will be coupled into the IF filter.

The $\overline{GS}$ control input at pin 14 is inverted by Q210; when the GS control input is high, NPN transistor Q206 conducts, which enables Q204 and Q205 in the GS front end. The same GS control input from Q210, is applied through R212 to inhibit operation of LOC/VOR mixer Q202. Simultaneously, the $\overline{GS}$ input to pin 9 of the frequency synthesizer programs the VCO for the GS LO injection frequency. With the GS front end operating, glide slope rf and VCO LO injection are applied to the mixer; GS IF is now fed to the common IF amplifier.

During the second half of the 15 Hz $\overline{GS}$ input, the control is as follows: Q210 output goes low, which turns off Q206 and disables the GS front end; the same output enables VOR/LOC mixer Q202; and the $\overline{GS}$ input to the synthesizer reprograms the VCO for the VOR/LOC LO injection frequency. With the GS front end turned off, the VOR/LOC input to P201 is mixed with the VOR/LOC LO frequency; the VOR/LOC IF is now connected to the common IF amplifier. The time-shared sequence is as follows: when the GS control is low, the glide slope receiver is in operation; when the $\overline{GS}$ control is high, the VOR/LOC receiver is in operation.

3.3.3.2 Glide Slope RF Amplifier (Q204)

The glide slope rf amplifier shown in Figure 3-33 comprises Q204, a common emitter transistor, and fixed tuned input and output circuits that cover the 329.15 through 335.00 MHz range of glide slope channels. The antenna is connected into a bandpass filter made up of L210 through L213 and associated capacitors. The output tank (L214, C239, C240) also serves as a capacitive voltage divider feeding the base of mixer Q205.

The GS AGC is applied through R227 to the base of Q204 as shown in Figure 3-8. The AGC function is described in detail in paragraph 3.3.3.9.

The time sharing function is controlled by the switching action of the Q204 dc return to ground. Since the time-sharing control covers the rf amplifier and the mixer, the circuit description appears with the mixer description in paragraph 3.3.3.4.

3.3.3.3 Glide Slope Local Oscillator (VCO Q209)

The LO is described in paragraph 3.2.2.3 and shown in Figure 3-4. Since the LO is a VCO in the frequency synthesizer phase - locked loop, the output frequency is sampled from isolation amplifier Q207 and the control (or correction) input is obtained from the synthesizer through P202.

When the front panel frequency selector is set to odd o.1 MHz channels between 108.1 and 111.95, the synthesizer is automatically programmed to time-share the paired LO injection frequencies for LOC and GS. The VCO control input (from P202) makes the transition at the 15 Hz sampling rate; 32 mx LOC and 32 ms GS repeated 15 times per second. Table 3-6 is a tabulation of all time shared frequencies. It should be noted that the VCO operates at 1/3 the injection frequency. The VCO frequency is tripled in the GS mixer to produce the GS LO frequency.

3.3.3.4 Glide Slope Mixer (Q205)

The glide slope rf input to the base of mixer Q205 is obtained from capacitive voltage divider C239/C240 connected across L214 as shown in Figure 3-33. In addition to this glide slope signal, the LO injection frequency from the VCO is connected through R229 to the base of Q205. Since this mixer is non-linear, heterodyning occurs and many signals appear at the output due to the sum and differences of the input frequency.

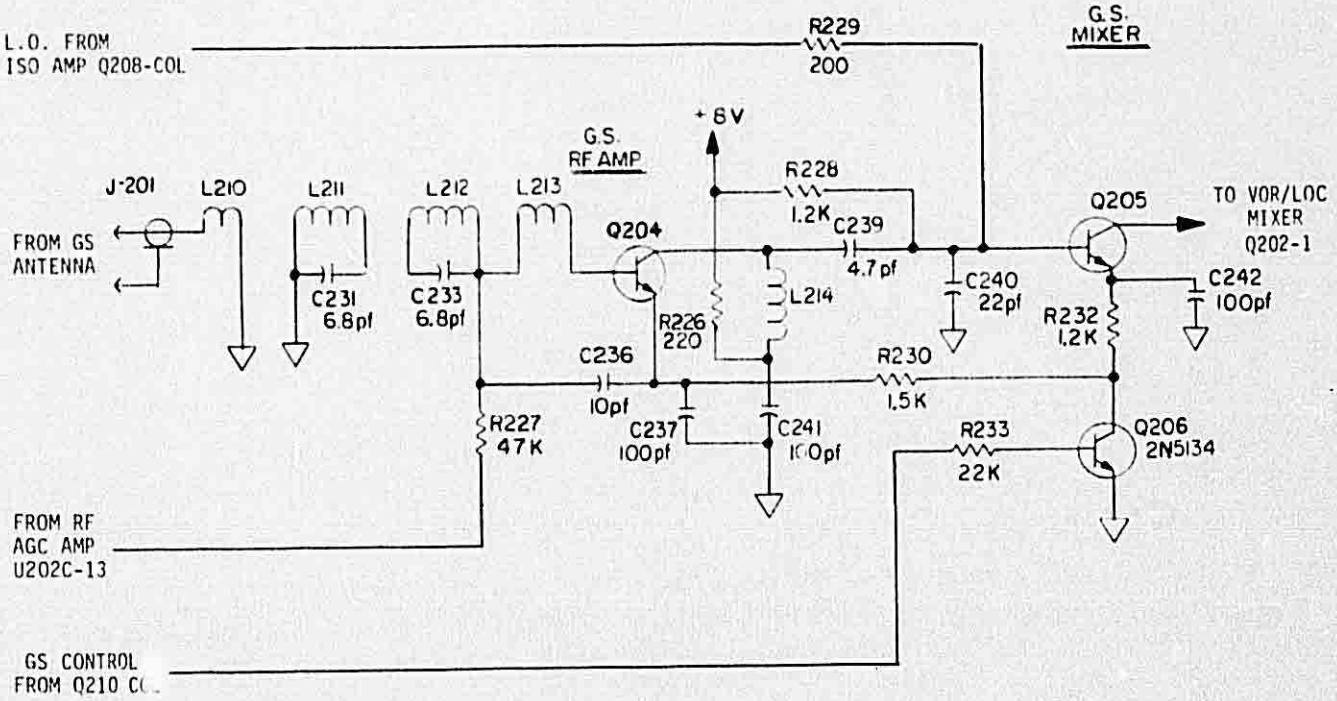


FIGURE 3-33. GLIDE SLOPE RF AMPLIFIER

3.3.3.4 Continued

The glide slope frequencies are given in Table 3.6. Although the LO injection frequencies range from 312.15 to 318.00 MHz, the VCO operates within the 104.05 through 106.00 MHz range. The rf input mixes with the third harmonic of the VCO to provide a difference frequency of 17 MHz. Since the IF filter is tuned to 17 MHz, this difference frequency is now the GS IF. This frequency multiplication is used so that the VCO can operate in the VHF region, close to the LO frequencies used for the VOR/LOC receiver.

The combined common emitter rf amplifier (Q204) and mixer (Q205) return to ground is controlled by Q206. The $\overline{GS}$ CONTROL INPUT (pin 14) shown in Figure 3-8 is inverted by Q210; the resultant GS control input turns Q206 OFF (when low) or ON (when high). The GS control has the overall effect of turning the GS receiver ON and OFF; during the GS OFF time, the VOR/LOC front end is turned ON.

3.3.3.5 LOC-VOR/GS IF Filters

The IF filters operate at 17 MHz as described in paragraph 3.2.2.5 of the NAV 121 circuit description.

3.3.3.6 IF Amplifiers (U201, Q203)

The IF amplifier operates at 17 MHz as described in paragraph 3.2.2.6 of the NAV 121 circuit description. The AGC applied to this circuit switches between the voltage developed during the GS period and the voltage developed during the LOC period. During the VOR/LOC time-shared period, the appropriate AGC is applied; in a similar fashion, the GS AGC is applied during the GS interval. Refer to paragraph 3.2.2.9 for the basic AGC description and Figure 3-8 for the VOR-LOC/GS schematic. The GS AGC action is described in paragraph 3.3.3.9.

3.3.3.7 Detector, VOR/LOC Output (CR209, U202D)

The detector and VOR/LOC output circuit descriptions are given in paragraph 3.2.2.7 and the schematic shown in Figure 3-6.

3.3.3.8 Audio Amplifier/Noise Limiter

The audio amplifier/noise limiter circuit description is given in paragraph 3.2.2.8 and the schematic is shown in Figure 3-7. Additional consideration must be given to the audio path during time sharing.

Since the audio would be chopped and not understandable during time sharing, an audio squelch circuit is activated. The receiver audio from pin 11 is fed to a squelch circuit on the glide slope control board. This circuit is enabled when time sharing is not used.

3.3.3.8 Continued

During time sharing, the squelch is activated and no audio is fed to the volume control. When the IDENT switch is activated, the squelch is inactive and audio is connected through the IDENT filter to the 50 mw amplifier on the receiver board. When going into the IDENT mode, the GS information is halted and the receiver goes into a fixed LOC mode; only IDENT information is then present on the LOC signal channel. In addition, the flag will be activated to show the signal is not useable and the needle will be stowed in the UP position. The IDENT switch is spring loaded; when released the NAV 122 returns to the full LOC/GS time-sharing mode of operation.

3.3.3.9 RF AGC Amplifiers, LOC/GS (U202D)

The RF AGC amplifier circuit description is given in paragraph 3.2.2.9 and schematic shown in Figure 3-8. This description is for VOR/LOC operation in the NAV 121. The NAV 122, however, utilizes time sharing when using simultaneous operation of LOC/GS. The same AGC amplifier is used, however, time sharing is accomplished as described below.

Since the basic AGC operation is almost identical, unless otherwise indicated, this circuit description will apply to the RF and IF AGC amplifiers. The AGC is derived from the detector output, which varies in accordance with the strength of the rf input to the receiver. Therefore, the VOR/LOC signal level is different from the GS level. If switched from VOR/LOC to GS by the time-sharing control, there would then be considerable difference in the detector outputs.

Should a single capacitor be used, there could be a long transition time if one sample is extremely high and the other extremely low. When switched from one mode to the other, the capacitor would have to charge or discharge to a different level. In an extreme case, this would take more time than necessary for the basic AGC function.

This problem is minimized by having separate capacitors for VOR/LOC and GS at the detector output (C263, C264), separate capacitors on the RF AGC (C251, C253), and separate capacitors on the IF AGC (C254, C255). Switching is at slightly different timing than the GS command to permit a short wait for the synthesizer to lock up and there would be no erroneous signal for the short period after the synthesizer is given the command to change frequency. An eroneous signal could cause varying signal strength and thus cause varying signal strength and thus cause the AGC capacitor to take more time to settle down.

The timing is as follows: 5 ms after the GS command is given. During this 5 ms, the receiver is in an unstable condition, therefore we do not want to look at GS data. After the AGC signal is applied, the detector signal is a normal 90 or 150 Hz signal for the remaining 27 ms of the sample period. Since the sampling is at a 15 Hz rate (64 ms) the GS is sampled for 32 ms and the VOR/LOC for 32 ms. With 5 ms delay, the actual sampling time for each channel is 27 ms for feeding data to the VOR/LOC board.

3.3.3.9 Continued

The capacitors are connected into their respective circuits by the action of a dual bi-directional switch connected for SPDT action. The GS AGC capacitor is connected to one pole of the switch and the VOR/LOC AGC capacitor connected to the other pole. The gate of one pole of the bi-directional switch is controlled by the AGC GS control line from the glide slope control board and the other pole is controlled by the AGC GS control line.

3.3.3.10 IF AGC Amplifier

The IF AGC amplifier circuit description is given in paragraph 3.2.2.10 and the schematic shown in Figure 3-8. This circuit description is for VOR/LOC and explains operation in the NAV 121. The NAV 122 utilizes time-sharing techniques for switching the IF AGC filters sequentially. The time-sharing operation is described in paragraph 3.3.3.9.

3.3.3.11 VOR/LOC Buffer (U206A, U206B)

The VOR/LOC buffer circuit is described in paragraph 3.2.2.11 and the schematic shown in Figure 3.7.

3.3.4 VOR/LOC CONVERTER ASSEMBLY (NAV 122)

The VOR/LOC PC board shown in Figure 3-9 converts the time-shared LOC and GS information obtained from the receiver detector into data suitable for display on the VOR/LOC L-R deviation meter and TO-FROM flags; UP/DOWN and GS flag information is obtained from the Marker Beacon/Glide slope Assembly.

Operation of the VOR/LOC converter is as described in paragraph 3.2.3; however, four additional control signals are applied to the assembly. The AGC GS input at pin 7 switches the glide slope course width (R672) and glide slope centering controls (R634); and the AGC $\overline{GS}$ input at pin 3 switches the localizer course width (R680) and localizer centering controls (R648). The filter clamp input at pin 4 (refer to Figure 3-31) alternately shorts out the capacitors in the bridged T networks of the 90 Hz and 150 Hz filters. The SAMPLE $\overline{GS}$ input at pin 2 enables U602 during the LOC interval and data is connected to the L/R phase detector.

Since the detected localizer signal is made up of 90 and 150 Hz from which the L-R information is obtained and the detected GS signal also contains 90 and 150 Hz from which the UP-DOWN information is derived, circuits that are normally duplicated in the LOC and GS converters are shared in the NAV 122. The operation of these shared circuits, 90 Hz filter, 150 Hz filter, and two active rectifiers, are controlled by the AGC GS, AGC $\overline{GS}$, and FILTER CLAMP commands. The outputs of the active rectifiers are then coupled to the appropriate meter circuitry by the SAMPLE GS and SAMPLE $\overline{GS}$ commands.

3.3.4.1 LOC/GS Switching Control

The time-shared LOC/GS data is fed in serial form through the IF amplifier, detector, and VOR/LOC buffer of the receiver section. The output of the VOR/LOC buffer is connected to pin 8 of the VOR/LOC board. This combined LOC and GS signal at pin 8 is fed to the two bi-directional switches (U607C & D). The two switches control the path of the LOC and $\overline{GS}$ information. When pin 6 (AGC GS) of U607D is positive, switch U607D is closed and LOC information is applied through the LOC COURSE WIDTH control (R680) to the LOC CENTERING control (R648). The AGC GS control at pin 12 of U607C remains low until GS information is being received. When pin 2 of U607C goes high, GS information is applied through the GS COARSE WIDTH control (R672) to the GS CENTERING control (R634).

The AGC GS control is the same as used on the receiver board. The time-shared sampling interval for GS or LOC is 32 ms, which is 1/2 cycle of the 15 Hz sampling frequency. During the first 5 ms of the time-shared interval, there is instability in the circuit, which will be described in the next paragraph. Therefore, the AGC enable signal is delayed 5 ms and has a duration of 27 ms as shown in waveforms B and C of Figure 3-31.

3.3.4.2 Filter Clamp Control

The filter clamp control at pin 4 simultaneously discharges the capacitors in the 90 Hz filter (C603/C604) and the 150 Hz filter (C601/C602) and initializes the filter outputs. The two bi-directional switches (U607A, U607B) are normally open, closing for 5 ms when the FILTER CLAMP goes high.

As shown in waveform A of the timing diagram (Figure 3-31) the clamp signal is a positive-going pulse occurring at 32 ms intervals with a pulse width of 5 ms. During the AGC GS or AGC $\overline{GS}$ period, a charge is developed across the capacitors in the 90 Hz and 150 Hz filters (C601, C602, C603, C604). This charge must be removed before new information is applied to the filters since it would cause unwanted transients at the filter outputs. The FILTER CLAMP pulse at U607A pin 13 and U607B pin 5 accomplishes this by placing a short circuit across the filters, thereby initializing them for a 5 ms period before the application of LOC or GS information. A typical sequence of events at the filters would be; clamp, LOC information (AGC $\overline{GS}$), clamp, GS information (AGC GS), clamp, LOC information, etc.

3.3.4.3 LOC Switching Control

The 90/150 Hz filter outputs are coupled to peak detectors U603A and U603B; the resulting outputs are still the LOC and GS information in serial form. The LOC and GS information is separated as follows: the 90/150 Hz rectifier outputs are connected through R643 and R639 to U602 and also to U504 on the MKR/GS assembly. The LOC information is coupled through U602 to the L/R phase detector; U504 couples the GS information to the UP/DOWN circuit. The SAMPLE $\overline{GS}$ command, which occurs during the last 15 ms of the AGC $\overline{GS}$ command, closes U602. This delay insures that the receiver has settled down. The SAMPLE GS command, which occurs during the last 15 ms of the AGC GS command. The time-sharing technique requires these delays and sequence of operation so that only the most effective sampling period and operating period is used; the circuits are turned off during their unstable periods.

3.3.5 SYNTHESIZER ASSEMBLY (NAV 122)

The frequency synthesizer operates as described in paragraph 3.2.4 for basic VOR operation as in the NAV 121 or NAV 122A. The NAV 122 operation in the LOC mode automatically provides multiplexed operation of the paired GS channel. The synthesizer is pre-programmed for these additional GS channels. The paired VOR and GS channel frequencies are given in Table 3.6.

In the synthesizer, the MHz PROM (U310) and the kHz PROMs are programmed to pre-load the $\div$N counters for the VOR/LOC frequencies as shown in Tables 3-3 and 3-4. The GS channel frequency programs for U310 and U311 are given in Tables 3-7 and 3-8 respectively.

The $\overline{GS}$ input at pin 9 is the only time-sharing command to the synthesizer. This input has no effect when tuned to a VOR channel (even tenths MHz). When tuned to the LOC channels and the $\overline{GS}$ input (pin 9) is high, the channel output is as set by the front panel controls. However, when the $\overline{GS}$ input is low, this line reprograms the two PROM's for the paired GS channel. The new address to the PROM's now changes the pre-loading of the $\div$N counters and the synthesizer tunes the VCO to the GS LO frequency.

Although the GS LO frequencies are within the 312.15 through 318 MHz range, the synthesizer operates at 1/3 the frequency, which is within the 104.05 thru 106 MHz range. Since the LOC LO operates within the 91.1 through 94.95 MHz range, the separation between the two local oscillators is only a few MHz apart. The required LO frequency for GS is three times the VCO frequency. The third harmonic is generated in the GS mixer.

The same $\overline{GS}$ input controls the 4066 quad analog switch U307 in the phase detector loop filter circuit. The loop filter filters the phase detector output pulses (U314 pins 5, 10) when changing from GS to LOC.

TABLE 3.7 PROGRAMMING OF MHz PROM U310 FOR GLIDE SLOPE

CHANNEL FREQ (MHz)	INPUT CONNECTOR PINS 15 18 20 19 9	PROM INPUT PINS 10 11 12 13 14	PROM OUTPUT PINS 1 2 3 4 5 6 7 9
108.1	0 1 1 0 0	1 1 0 1 1	1 0 1 0 1 0 1 0
108.3	0 1 1 0 0	1 1 0 1 1	1 0 1 0 1 0 1 0
108.5	0 1 1 0 0	1 1 0 1 0	1 1 0 0 1 0 1 0
108.7	0 1 1 0 0	1 1 0 1 0	1 1 0 0 1 0 1 0
108.9	0 1 1 0 0	1 1 0 1 0	1 1 0 0 1 0 1 0
109.1	0 1 1 1 0	1 0 0 1 1	1 1 0 0 0 0 1 1
109.3	0 1 1 1 0	1 0 0 1 1	1 1 0 0 0 0 1 1
109.5	0 1 1 1 0	1 0 0 1 0	1 0 1 0 0 0 1 1
109.7	0 1 1 1 0	1 0 0 1 0	1 0 1 0 0 0 1 1
109.9	0 1 1 1 0	1 0 0 1 0	1 0 1 0 0 0 1 1
110.1	1 0 1 1 0	1 0 1 0 1	1 0 1 0 0 0 1 1
110.3	1 0 1 1 0	1 0 1 0 1	1 0 1 0 0 0 1 1
110.5	1 0 1 1 0	1 0 1 0 0	1 1 0 0 0 0 1 1
110.7	1 0 1 1 0	1 0 1 0 0	1 1 0 0 0 0 1 1
110.9	1 0 1 1 0	1 0 1 0 0	1 1 0 0 0 0 1 1
111.1	0 0 1 1 0	1 0 1 1 1	1 1 0 0 1 0 1 0
111.3	0 0 1 1 0	1 1 1 1 0	1 0 1 0 1 0 1 1
111.5	0 0 1 1 0	1 0 1 1 0	1 0 1 0 1 0 1 0
111.7	0 0 1 1 0	1 0 1 1 0	1 0 1 0 1 0 1 0
111.9	0 0 1 1 0	1 1 1 1 1	1 1 0 0 1 0 1 1

3.3.5 Continued

The loop filter is basically an active integrating amplifier in which C314 and C313 are the integrating capacitors. Since the dc tuning voltage to the VCO must change abruptly, when the synthesizer is switched from LOC to GS the integrating capacitors are alternately connected to the loop filter by the quad analog switch (U307 pins 8, 10). Multiplexing the integrating capacitors in this manner reduces their charging time, thereby reducing the lock-up time for the phase-locked loop when the synthesizer is switched from LOC to GS by the $\overline{GS}$ command.

One section of the analog switch (U307 pins 1, 2) grounds C309 when the in LOC or VOR modes. This connects an additional low-pass filter section to the loop filter, thereby reducing the 50 kHz sidebands in the VCO carrier when in the VOR/LOC mode.

TABLE 3.8 PROGRAMMING OF kHz PROM U311 FOR GLIDE SLOPE

CHANNEL FREQ (MHz)	INPUT CONNECTOR PINS 15	18	20	19	PROM INPUT PINS 10	11	12	13	14	PROM OUTPUT PINS 1	2	3	4	5	6	7	9
108.1	0	1	1	1	1	0	0	1	0	1	0	0	1	0	1	1	1
108.3	0	0	1	1	1	1	0	0	1	1	0	1	1	0	1	0	0
108.5	1	0	0	1	0	1	1	0	1	1	1	1	1	0	0	1	0
108.7	1	1	0	0	0	0	1	0	1	1	1	0	1	0	0	1	1
108.9	1	1	1	0	0	0	0	0	1	1	0	0	1	1	0	0	1
109.1	0	1	1	1	1	0	0	0	1	1	0	1	0	0	1	1	1
109.3	0	0	1	1	1	1	0	1	0	1	0	0	0	0	1	1	0
109.5	1	0	0	1	0	1	1	1	0	1	0	0	0	1	0	1	0
109.7	1	1	0	0	0	0	1	1	0	1	1	1	0	0	0	1	1
109.9	1	1	1	0	0	0	0	1	0	1	1	0	0	0	0	1	1
110.1	0	1	1	1	1	0	0	0	1	1	0	1	0	0	1	1	1
110.3	0	0	1	1	1	1	0	1	0	1	0	0	0	0	1	1	0
110.5	1	0	0	1	0	1	1	1	0	1	0	0	0	1	0	1	0
110.7	1	1	0	0	0	0	1	1	0	1	1	1	0	0	0	1	1
110.9	1	1	1	0	0	0	0	1	0	1	1	0	0	0	0	1	1
111.1	0	1	1	1	1	0	0	1	0	1	0	0	1	0	1	1	1
111.3	0	0	1	1	1	1	0	1	1	1	0	0	1	1	0	0	0
111.5	1	0	0	1	0	1	1	0	1	1	1	1	1	0	0	1	0
111.7	1	1	0	0	0	0	1	0	1	1	1	0	1	0	0	1	1
111.9	1	1	1	0	0	0	0	1	1	1	0	1	1	0	1	0	1

3.3.6 GLIDE SLOPE CONTROL ASSEMBLY

The Glide Slope Control is clocked by the 50 kHz crystal-controlled oscillator output from the frequency synthesizer and provides all switching control signals required for time-sharing the LOC and GS channels. Functionally, the GS control section comprises the ÷ 49 counter, ÷ 64 counter, and GS, LOC/TIMING generator: audio squelch, UP/DOWN indicator driver, and GS flag driver are also located on this board as shown in Figure 3-34. The 50 kHz crystal-controlled frequency source is divided by 49 and 64 to provide a basic time-sharing frequency of approximately 15 Hz. The GS, LOC/TIMING section provides a group of switching signals that interconnect the various circuits of the NAV 122 into a VOR/LOC receiver and then into a GS receiver at a 15 Hz rate. The various 15 Hz control signals are sequenced by the delay shown in Figure 3-31. In addition, to the delay, the control signals are paired for alternate control of the two channels (i.e. AGC GS and AGC $\overline{\text{GS}}$, etc).

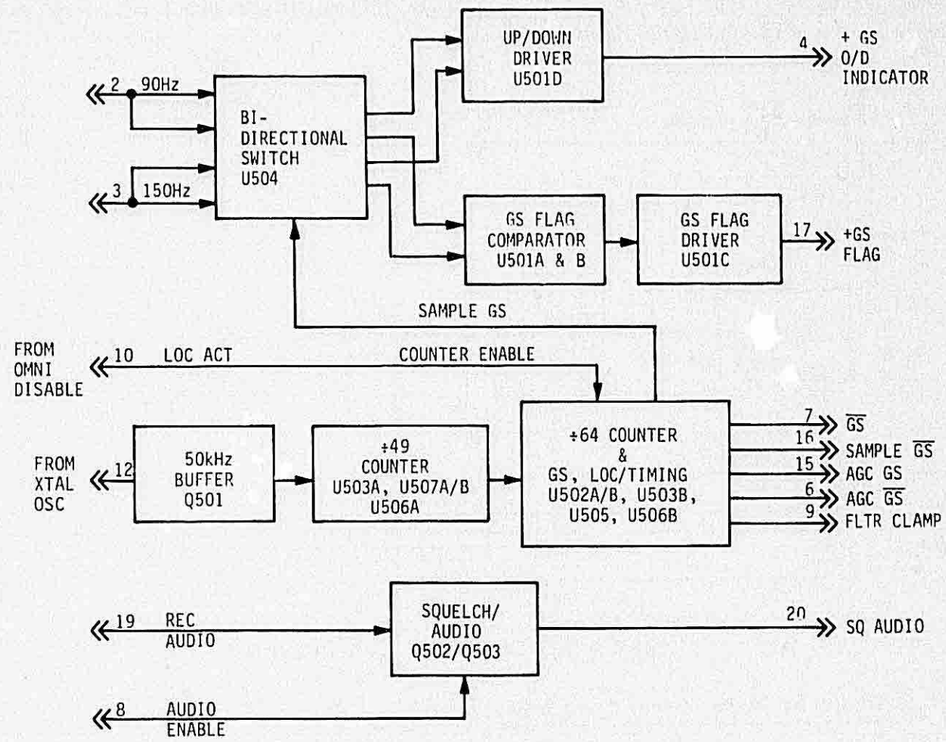


FIGURE 3-34. GLIDE SLOPE CONTROL ASSEMBLY

3.3.6.1 Divide by 49 Counter (Figure 3-35)

The 50 kHz output, from the crystal controlled oscillator of the frequency synthesizer, is connected to buffer Q501. The ÷49 frequency divider comprises a binary UP-counter (U506A) and three D type flip-flops (U507A, U507B, U503A) with feedback connected to provide an output of 1020.4081 Hz at U503A-1.

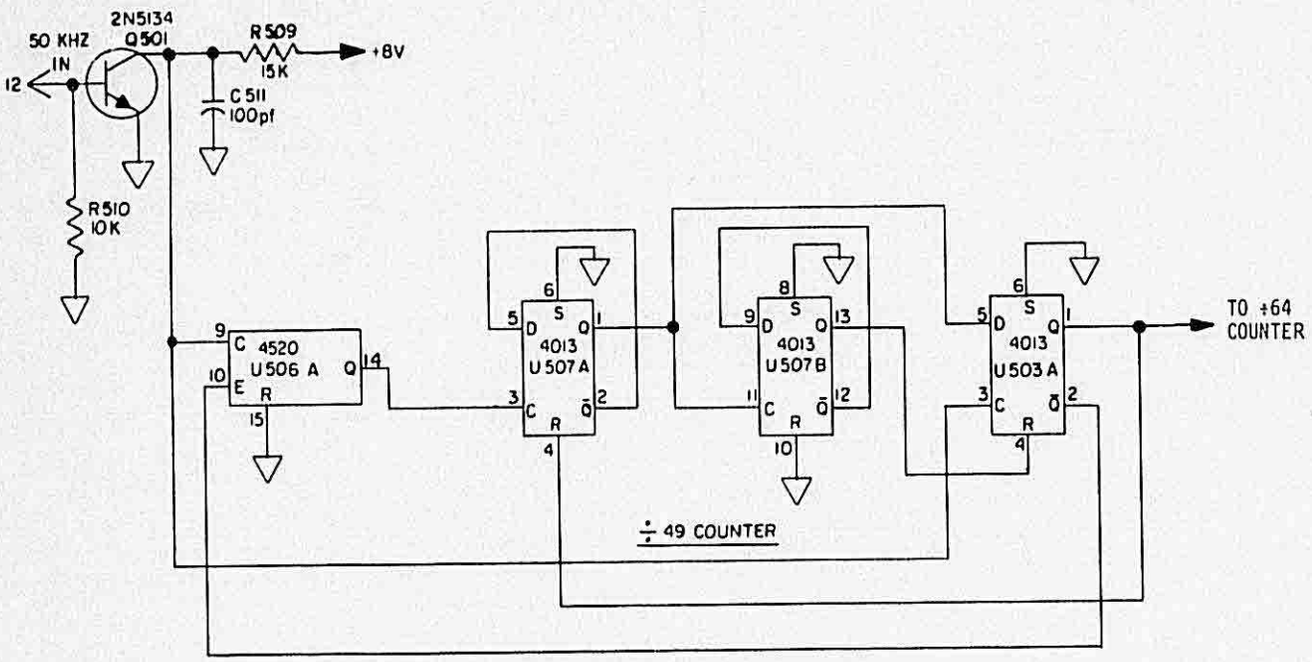


FIGURE 3-35. DIVIDE BY 49 COUNTER

3.3.6.2 Divide by 64 Counter (Figure 3-36)

The ÷64 frequency divider counts down the 1020 Hz output from the ÷49 counter to provide approximately 15 Hz for time sharing control. The ÷64 counter comprises a binary UP-counter (U506B) and two D type flip-flops (U503B, U502A). The 1020 Hz input is connected to U506B-1 and provides the following outputs: (a) approximately 64 Hz from U506B-5 to set FF U502B; (b) approximately 32 Hz from U503B-13 to clock U502B at the filter clamp frequency; and (c) approximately 15 Hz from U502A-12, 13 to clock the U505 quad NOR gates.

The GS/LOC ACT input at pin 10 is derived from NAND gate U316B on the synthesizer board. The GS/LOC ACT input enables the ÷64 counter during GS operation through the set input at U503B-8. Figure 3-36 is a simplified block diagram of the external control of this ÷64 counter. The output from the frequency synthesizer disables this circuit during OMNI operation. When the MHz and kHz PROMS recognize an even 0.1 MHz channel, this line goes to a logic high.

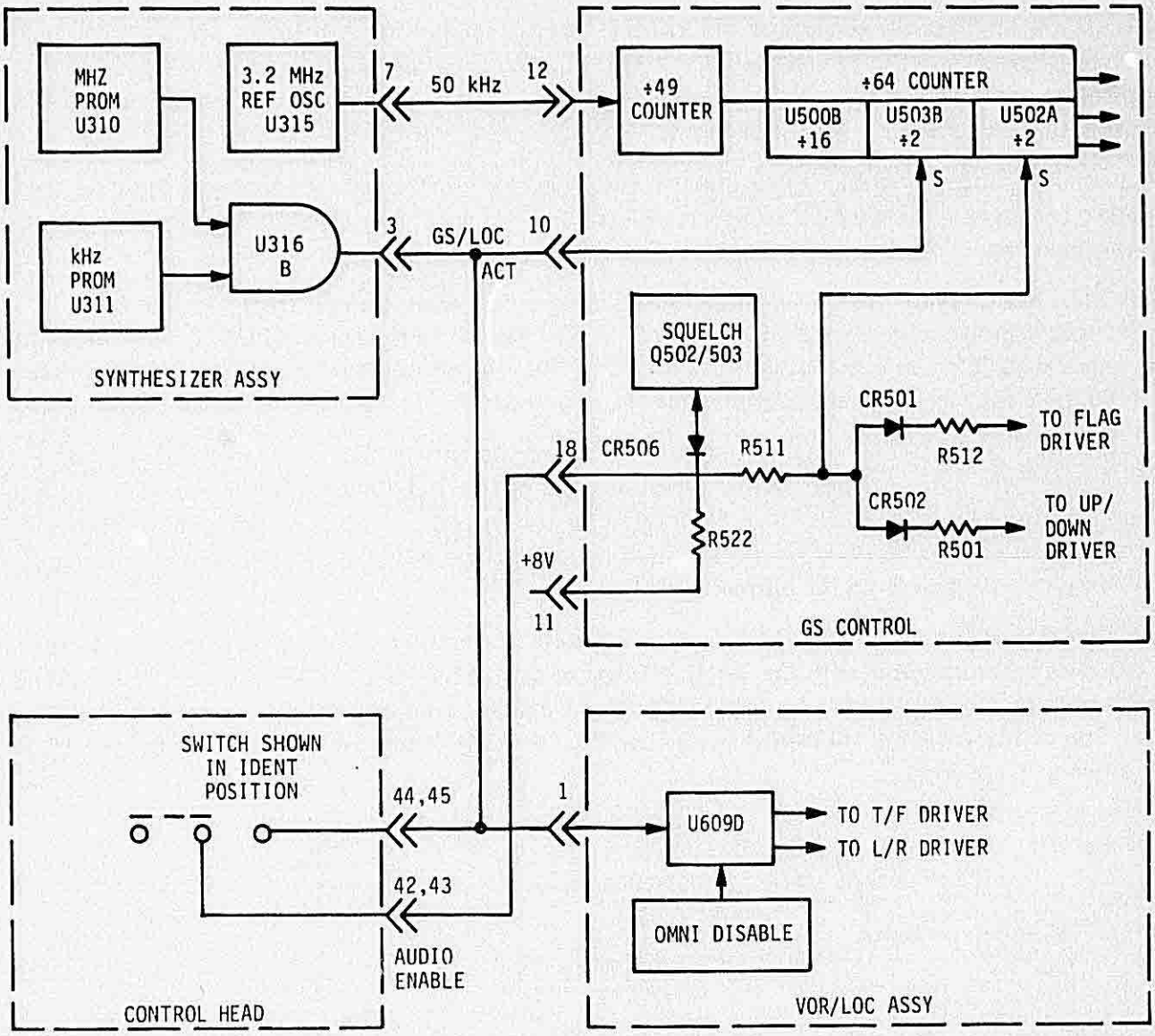


FIGURE 3-36. TIME SHARING CLOCK ENABLE CONTROL

3.3.6.2 Continued

An additional control of the ÷64 counter is through the front panel IDENT switch. When in time-sharing, the IDENT switch is closed, enabling U502A and inhibiting the audio. When the IDENT switch is pulled, the audio enable line goes high and the SET input at U502A-8 shuts down operation of the full 15 Hz clock by inhibiting operation of ÷2 counter U502A. This also disables the squelch and allows the audio to be heard. The AUDIO ENABLE from the IDENT switch is also used to drive the GS flag and UP/DOWN indicator to the appropriate display during OMNI and non time-shared operation. The CR501/R512 circuit is connected to the UP/DOWN driver and the CR502/R501 circuit is connected to the GS flag circuit.

3.3.6.3 Time Sharing Control

The GS, LOC/Timing generator shown in Figure 3-37 provides all 15 Hz time-sharing control signals used to drive the NAV 122 to the LOC or GS configuration. The applied to the various assemblies as shown in the block diagram of Figure 3-30. The timing generator comprises flip-flop U502B and quad NOR gates U505A, B, C, D.

The ÷64 counter provides three inputs that are mixed in the NOR gates to provide the proper frequency, proper pulse width and required delay to perform all switching operations in the receiver. Figure 3-31 shows this timing relationship.

The FILTER CLAMP is a 5 ms pulse occurring twice during each cycle of the 15 Hz switching signal (waveform A of Figure 3-31). The ÷16 output (U605B-5) serves as the set input of U502B-6; when clocked at pin 3 by the output of ÷32 counter, the $\overline{Q}$ output at U502B-2 is a pulse occurring at approximately 30 Hz.

The AGC $\overline{GS}$ and AGC GS are 27 ms pulses occurring at a 15 Hz rate with the leading edge occuring at the same instant as the trailing edge of the FILTER CLAMP pulse. The AGC $\overline{GS}$ is obtained by ORing the 5 ms delayed $\overline{Q}$ 30 Hz output of U502B-2 with the $\overline{Q}$ 15 Hz output of U502A-12. The AGC GS is obtained by ORing the same 5 ms delayed $\overline{Q}$ 30 Hz output of U502B-2 with the Q 15 Hz output of U502A-13.

The SAMPLE $\overline{GS}$ and SAMPLE GS are 15 ms pulses occurring at a 15 Hz rate, with the trailing edge coincident with the leading edge of the FILTER CLAMP pulse. The SAMPLE GS is obtained by ORing the 30 Hz Q output of U503B-13 with the Q 15 Hz output of U502A-13. The SAMPLE $\overline{GS}$ is obtained by ORing the 30 Hz Q output of U503B-13 with the 15 Hz $\overline{Q}$ output of U502A-12.

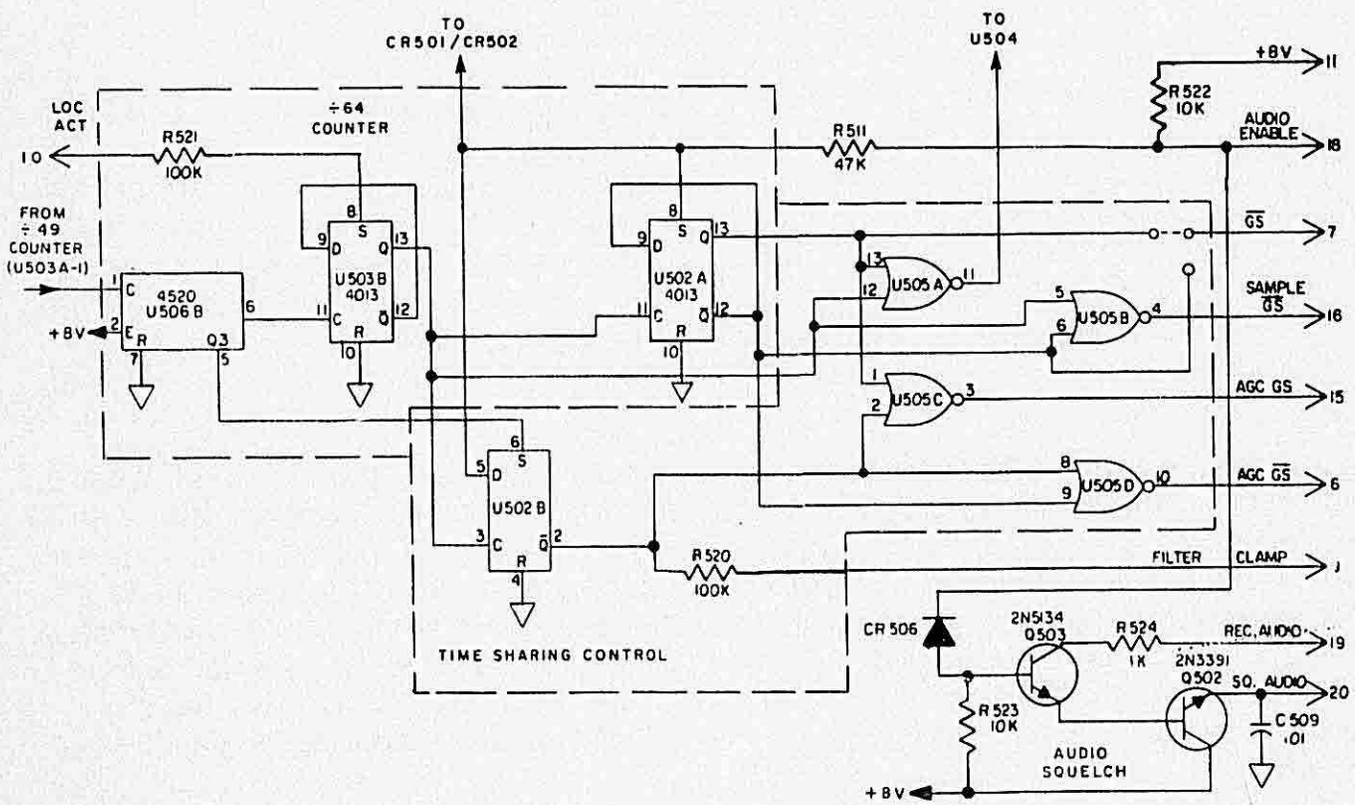


FIGURE 3-37. DIVIDE BY 64 COUNTER AND TIME SHARING

SEE BLOW-UP

3.3.6.4 SAMPLE GS Control of GS Displays

During the GS period of the 15 Hz time-sharing cycle, the SAMPLE GS output from NOR gate U505A-11 turns on the 90/150 Hz data to the UP/DOWN and GS flag drivers. The SAMPLE GS (waveform E of Figure 3-31) is a positive-going pulse that turns on quad bi-directional switch U504. The quad bi-directional switch operation is described in paragraph 3.3.4.1. When conducting, this 4-pole switch connects 90 and 150 Hz to the GS flag driver and the same 90 and 150 Hz to the UP/DOWN display driver (Figure 3-38).

3.3.6.5 UP/DOWN Driver (Figure 3-38)

During the GS sample interval, the 90 and 150 Hz inputs (90 Hz for DOWN or 150 Hz for UP) are fed through bi-directional switch U504 to C510. The voltage across C510 is dependent upon the amount of 90 and 150 Hz present in the received signal, This voltage is sensed by differential amplifier U501D, whose output drives the UP-DOWN meter. Resistor R504 se ves to correct the dc offset of U510D and null the UP-DOWN meter. When the amount of 90 Hz in the GS signal increases, pin 1 of U501D is driven below its reference and the GS meter deflects down. An increase in the 150 Hz level at pin 1 of U501D drives U501D above its reference and the GS meter deflects up.

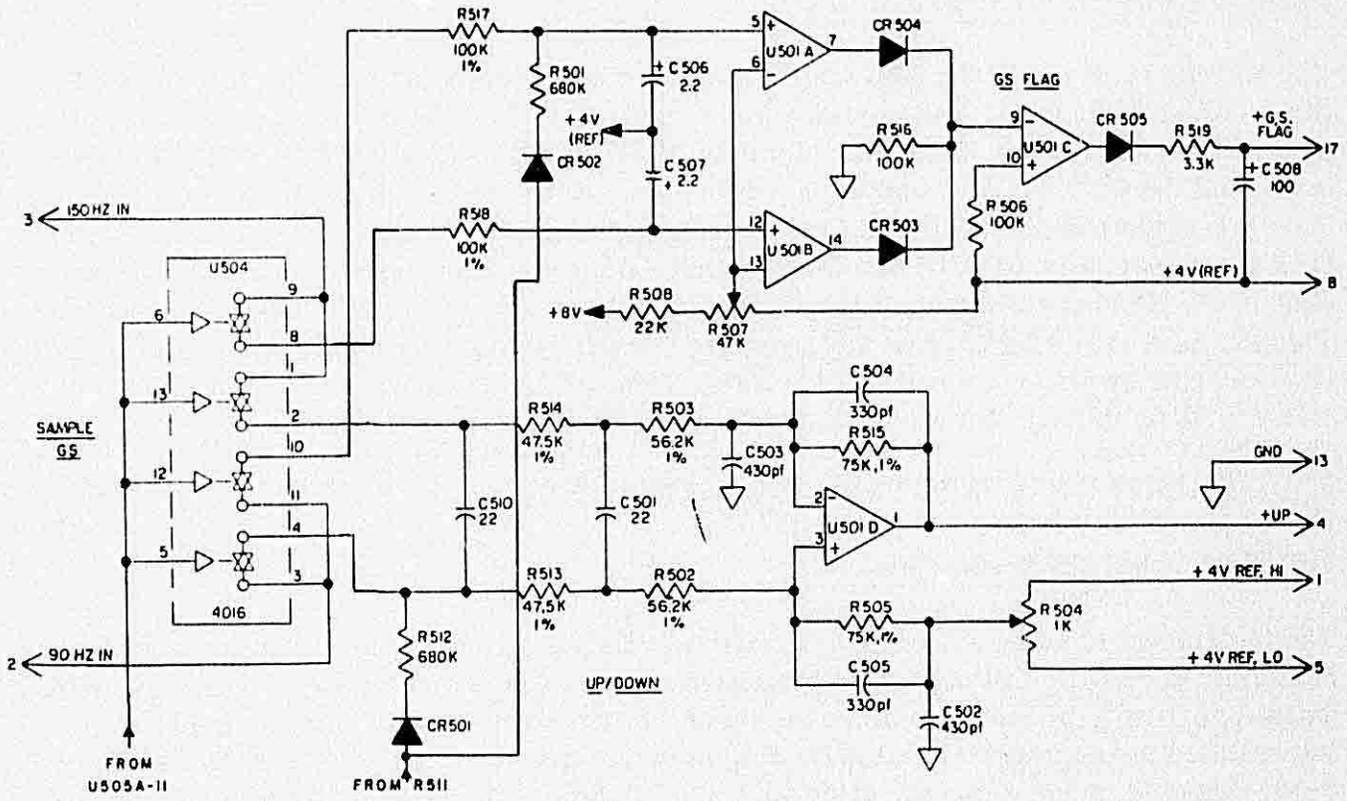


FIGURE 3-38. UP-DOWN/FLAG DRIVERS

SEE BLOW-UP

3.3.6.6 GS Flag Driver (Figure 3-38)

The GS flag operates as an AND gate. For a valid GS indication, both 90 and 150 Hz signals must be present. When a rectified 90 Hz signal of acceptable amplitude is present at pin 10 of U504, it is averaged by R517 and C506. This average value is present at pin 5 of U501A. When the level of this average voltage is less than the level at pin 6, the output (pin 7) is held low. The operation of U501B is identical; however, it senses the 150 Hz signal level. Pin 8 of U501C will be held low until the outputs of both U501A and B are both low. Either U501A or B outputs going high will cause pin 8 of U501C to go low. The reference levels at U501A-6 and U501B-13, the inverting inputs, are controlled by R507. This adjusts the point at which the flag will alarm. Diodes CR503 and CR504 perform the AND function of the flag circuit.

An example would be when U501A-7 is high and U501B-14 is low, CR504 conducts and CR503 is reverse biased. If CR503 was not in the circuit, the output of U501A would be pulled low by U501B-14 and the GS flag would be activated. The use of R516 ensures that when both U501A-7 and U501B-14 are low, U501C-9 is also low. Since the U501C output never reaches ground when it is low (typ. 1.0V) CR505 is used to prevent this residual voltage from causing current to flow in the GS flag. The average value of the voltage is developed across C506 and C507 as the unit is time shared. The action of the GS flag is affected by the time-constant of R519/C508.

3.3.6.7 Audio Enable (Squelch Control)

The Squelch circuit (Q502/Q503) shown in Figure 3-37 serves as a switch in series with the receiver audio to the front panel volume control. When the front panel channel selector is set to a LOC channel, selected outputs of MHz and kHz PROMS (U310, U311) are decoded and the GS/LOC ACT output at pin 39 goes low (refer to Figure 3-23, 3-27 and 3-38). This low at the cathode of CR506 forward biases it and the low at the base of Q503 turns OFF the combination of Q503 and Q502. Audio from pin 11 of the receiver board is now squelched. During activation of the IDENT switch, the ground from U316B-5 is removed. This disables the $\div 64$ counter and removes the buzz from the audio by turning off the time-sharing switching signals. This also allows the base of Q503 to go high, thus enabling audio to pass through Q502, and Q503 to the volume control.

3.3.7 MARKER BEACON RECEIVER AND INDICATOR

3.3.7.1 Purpose of Marker Beacon

The Instrument Landing System (ILS) requires three separate radio navigation signals to define the glide path a pilot is to follow during his approach to a runway. The glide path is defined vertically by the glide slope signal and horizontally by a localizer signal. At the intersection of the localizer and glide slope signals lies the glide path as shown in Figure 3-39. Specific points along the glide path are located by the marker beacons. Table 3-9 explains some of the marker beacon characteristics.

3.3.7.1 Continued

Marker beacons are also used as Low Frequency Range Station locators as well as Fan Markers for radio range courses and specific points along airways.

The marker beacon signal is a 75 MHz rf carrier that is amplitude modulated 95% by either 400, 1300 or 3000 Hz subcarriers. Recognition of outer, middle, and inner markers is by means of the modulation frequency and audio code described in Table 3-9.

For further information on Instrument Landing Systems, refer to the Airman's Information Manual, published by the FAA.

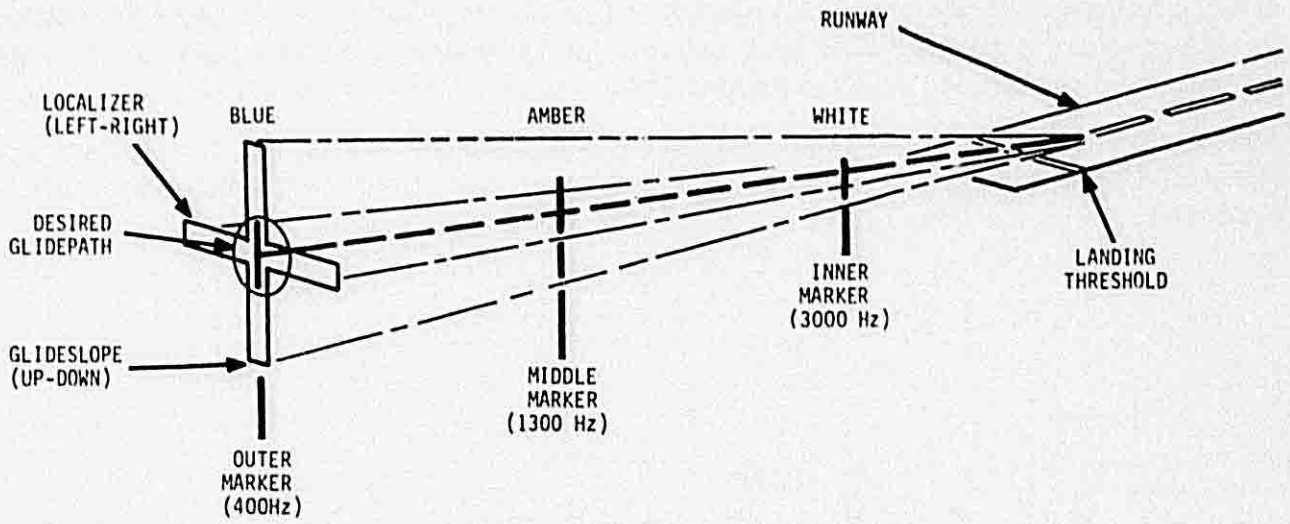


FIGURE 3-39. APPROACH GLIDE PATH

TABLE 3-9. ILS MARKER BEACON CHARACTERISTICS

MARKER	VISUAL INDICATION	MODULATION FREQUENCY	CODE	TRANSMITTER LOCATION
Outer	Blue	400 Hz	2 Dashes/sec	4 to 7 miles from end of runway at glide path intercept
Middle	Amber	1300 Hz	Alternatee dots and dashes	Approximately 3500 feet from landing threshold
Inner	White	3000 Hz	Continuous dots	Located to define decision height (DH) point between middle marker and landing threshold

3.3.7.2 Mixer and Crystal Oscillator

The 75 MHz marker signal is fed through the rear panel antenna connector and variable resistor R101 as shown in Figure 3-40. Since marker beacon antennas widely vary, R101 is provided to adjust the receiver rf sensitivity. Following R137 is a double tuned, high side coupled, hi Q, 75 MHz filter. RF output from the filter is routed to the mixer, Q401 pin 3.

The second input to the mixer is from local oscillator, Q402. This crystal controlled 64.3 MHz modified colpitts oscillator is more commonly know as a Pierce oscillator. Regenerative feedback is established by C423, C424 and C425; output energy is coupled from Q402s collector through C422 to pin 2 of Q401.

Local oscillator energy from Q402, at 64.3 MHz, is mixed with an incoming 75 Mhz signal by Q401 to derive the 10.7 MHz IF signal. Optimum cross modulation and intermodulation performance is obtained by fixed biasing (R408, R420, R409) the mixer.

Mixer output is filtered by FL 401 then coupled by C408 to U401 pin 2. Monolithic crystal filter FL401 provides most of the IF selectivity with L401 tuned to produce the proper IF bandpass.

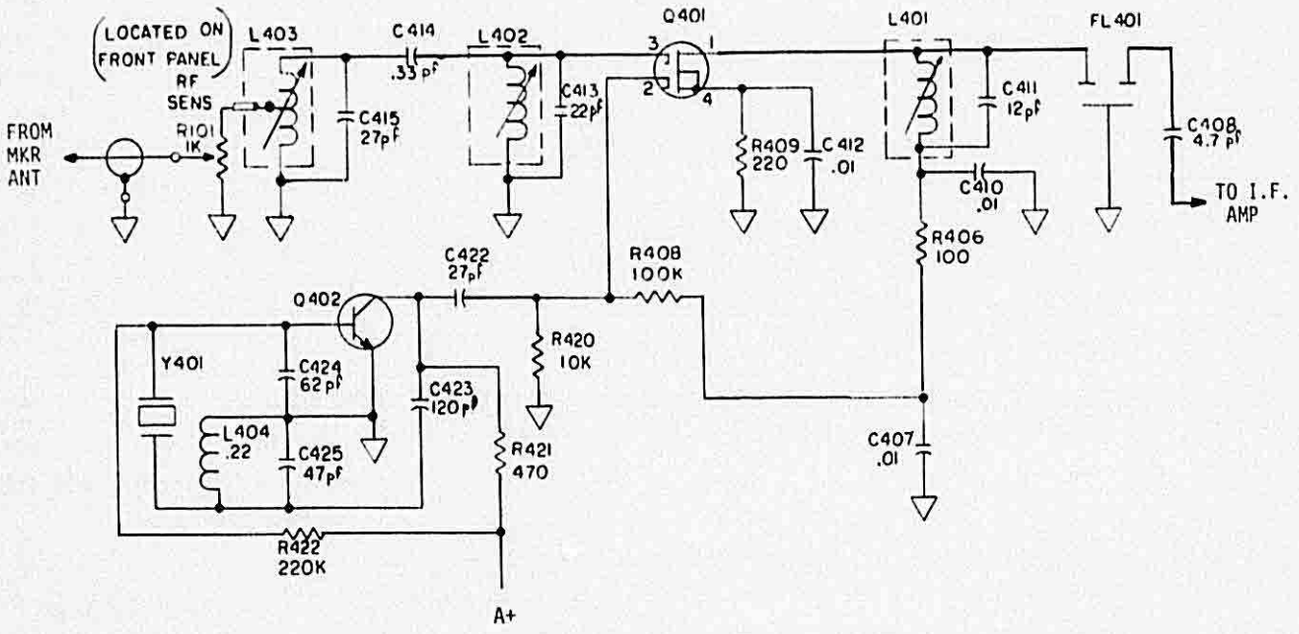


FIGURE 3-40. MIXER AND CRYSTAL OSCILLATOR

3.3.7.3 IF Amplifier and Detector (Figure 3-41)

U401 is a monolithic integrated circuit supplying the following circuits: two stages of IF amplification (pin 2 to pin 3 and pin 4 to pin 6); one stage of IF amplification and AM detection (pin 8 to pin 9); audio preamplification (pin 14 to pin 15); and a buffer amplifier providing delayed AGC to pin 13. Transformers T401 and T402 increase selectivity, provide impedance matching between IF stages, and are simply tuned for a peak. In the HI sensitivity mode, U401 provides approximately 30 db of IF gain and 8 db of audio gain.

Selection of HI or LO sensitivity is through control of the bias on CR402. In the LO sensitivity mode CR402 is forward biased, through R418 and R419, to shunt a portion of the IF signal to ground. LO mode sensitivity is adjusted by R410. The sensitivity control input (pin 14) is connected to pin 20 of the rear connector (J810); the output from a HI/LO switch is connected to this point. Placing this external switch in the HI position grounds the junction of R418 and R419 which removes bias from CR402 to open the shunt signal path and increase sensitivity.

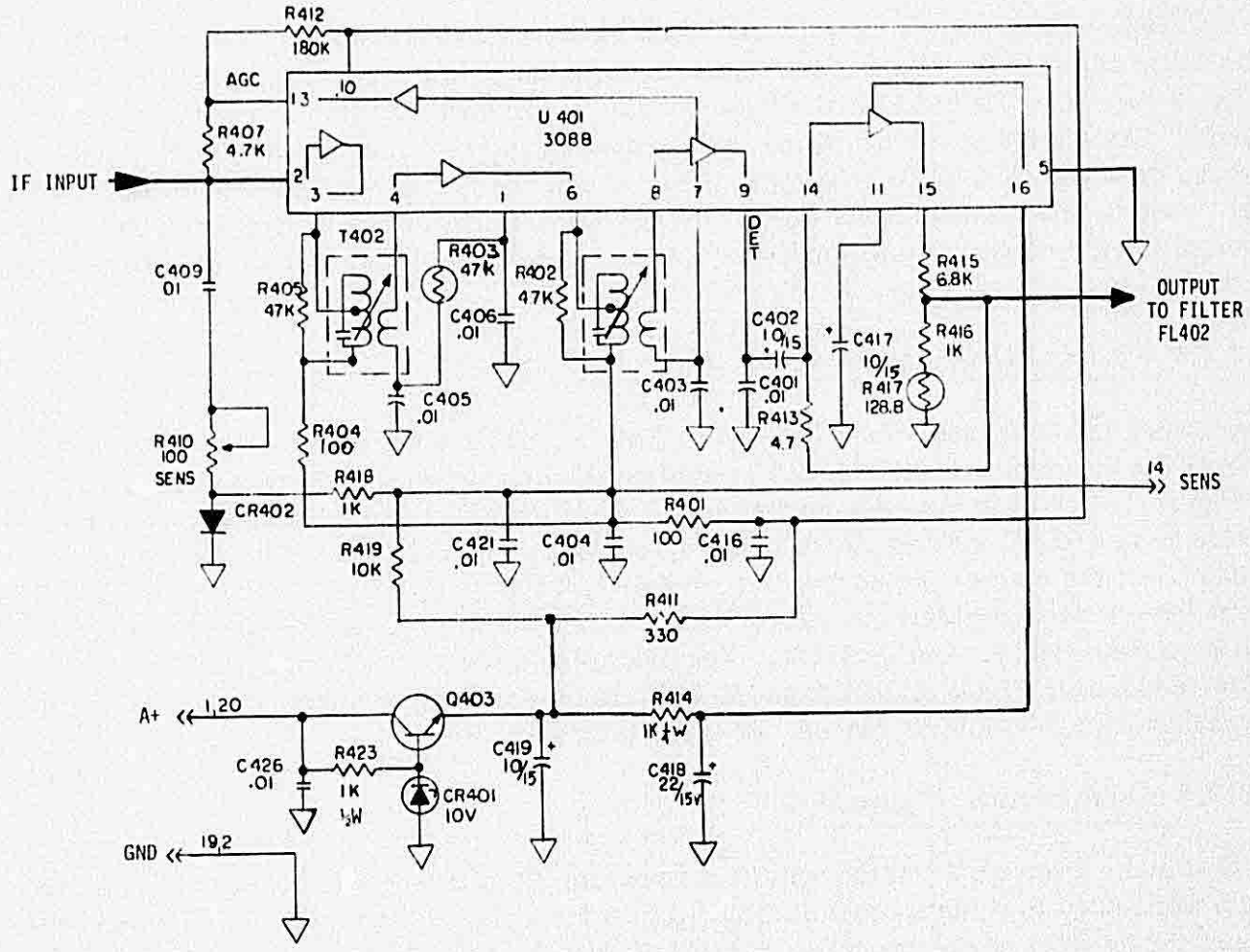


FIGURE 3-41. IF AMPLIFIER AND DETECTOR

3.3.7.4 Audio Filters

Audio from the preamplifier is routed from the junction of R415 and R416 to FL402, which is a three section, bridge T filter. Refer to Figure 3-42. Manufactured with thick film techniques, FL402 contains three filters, one for each of the marker modulation frequencies with negative feedback and consequent attenuation, occuring at all other frequencies.

3.3.7.5 Lamp Drivers

Since the three lamp driver circuits shown in Figure 3-42 are similar, only the amber Q408 driver (1300 Hz) will be discussed. Q408 is a darlington transistor which, when there is no received signal, is biased below cut-off (reverse bias) by R436, diodes CR407 and CR406, and the action of the front panel SELF-TEST switch (S103). A receive signal with 1300 Hz modulation results in the audio from U402 pin 4 being rectified by CR405 and then filtered by C435 and R439. Therresulting dc voltage is sufficient to turn-on (forward bias) Q408, illuminating the amber indicator (pin 7).

3.3.7.6 Dimming Control

Lamp dimming is provided by Q405 and Q409 as shown in Figure 3-43, connector J810-1 (pin 11) is wired to the aircraft's instrument light bus. In the daytime or no dimmed mode, Q405 is cut-off by the absence of a base voltage to forward bias its base-emitter diode and CR406. Since Q405 is cut-off, Q409 is saturated by current flow through R437. The volt voltage drop across Q409 is now approximately 0.3 vdc and the marker lamp will be fully lit. When the instrument lights are turned on, Q405 is saturated, cutting off Q409. Supply current for the marker lamps must now flow through R438 and the resulting voltage drop dims the lamp.

3.3.7.7 Test Switch Operation

Depressing the OBS knob closes SELF TEST switch S103 to test the lamps. This switch defeats the dimming circuit and also saturates all three lamp driver transistors as shown in Figure 3-43. Assuming the marker lamps are dimmed, depressing S103 removes CR406 from ground, cutting off Q405 and saturating Q409 to increase the lamp supply voltage. (If the marker lamps were not dimmed, Q405 would simply remain cut off.) The lamp drivers are saturated since the bias established by R436, CR407, CR406, and SW103 has been removed by opening SW103. For example, Q408's bias is now established by R436, R433/443, CR405 and R439 and is sufficient to saturate the transistor, Since all three drivers are similarly biased, all three lamps are lit.

3.3.7.8 Audio Section (Figure 3-42)

Marker audio from pin 13 of the audio filters is amplified by one section of U402 (Figure 3-42) and routed to volume control R425. Audio from the wiper arm of the volumne control is coupled by C429 to emitter follower Q404 (Figure 3-41) and thereafter to the audio output, pin 17.

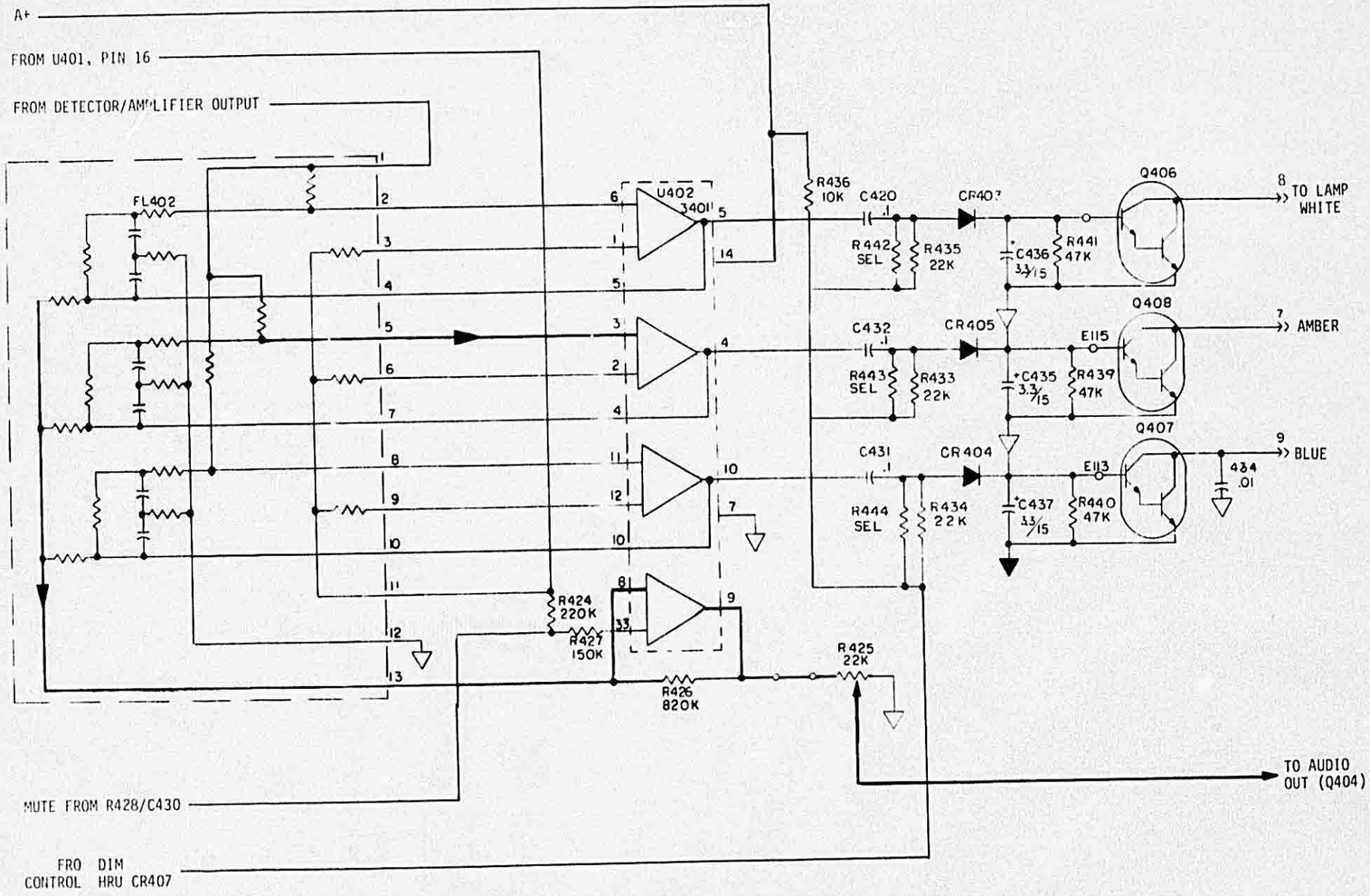


FIGURE 3-42. AUDIO FILTERS AND LAMP DRIVERS

3.3.7.9 Marker Audio Mute

Muting of the marker audio is accomplished by connecting a spring loaded normally open switch to MUTE input pin 16. When momentarily depressed, the switch must ground pin 16, discharging C430 through R428, biasing OFF the audio amplifier portion of U402. Before audio can be fully restored, C430 must be charged through R424, which requires 10 to 14 seconds.

Audio muting serves to remove or turn OFF the marker beacon audio for a period of approximately 10 to 14 seconds. This time period is long enough to allow the MKR audio to remain muted as the aircraft passes over a marker beacon transmitter, yet is short enough to permit reactivation of the MKR audio before the next marker beacon is reached. Thus the audio can serve as an alert, then muted, and the lamps monitored. The mute control is through pin 2 of J108, the connector at the rear panel of the NAV 122.

3.3.7.10 Voltage Regulator

An 11 to 30 vdc input at pins 1 and 20 is routed to series pass voltage regulator, Q403. The voltage reference for the regulator is a 10 volt zener diode which, with the base-emitter drop of Q403, yields a 9.5 volt regulated supply. Refer to Figure 3-41 for the schematic.

3.3.8 CONTROL HEAD

The NAV 122 Control Head Assembly has all front panel controls and displays for the VOR, LOC/GS time-sharing, and the marker beacons. The marker beacon rf potentiometer sensitivity is located behind the front panel mounting hole. Connections to the flexible circuit assembly are through connector J101.

3.3.9 FLEXIBLE CIRCUIT ASSEMBLY

The NAV 122 flexible circuit assembly is the same used in the NAV 121 and 122A. Since the NAV 122 has a full complement of circuit boards, no jumpers are used at the interconnection points of the flexible circuit assembly. In the NAV 121 and NAV 122A, jumpers are added to the flex circuit to replace the glide slope control logic.

3.4 NAVIGATION RECEIVER/CONVERTER NAV 122A

The NAV 122A comprises a VOR/LOC receiver, VOR/LOC converter, frequency synthesizer, marker beacon receiver, and the VOR/LOC/marker beacon front panel displays as shown in Figure 3-44. The NAV 122A has all of the capabilities of the NAV 121, and the front panel display for glide slope. Since the NAV 122A circuits are identical to the NAV 121, refer to the circuit descriptions of paragraph 3.2 for all but the marker beacon receiver; refer to paragraph 3.3.7 for the marker beacon circuit description. The flexible circuit assembly jumpering is the same as for the NAV 121.

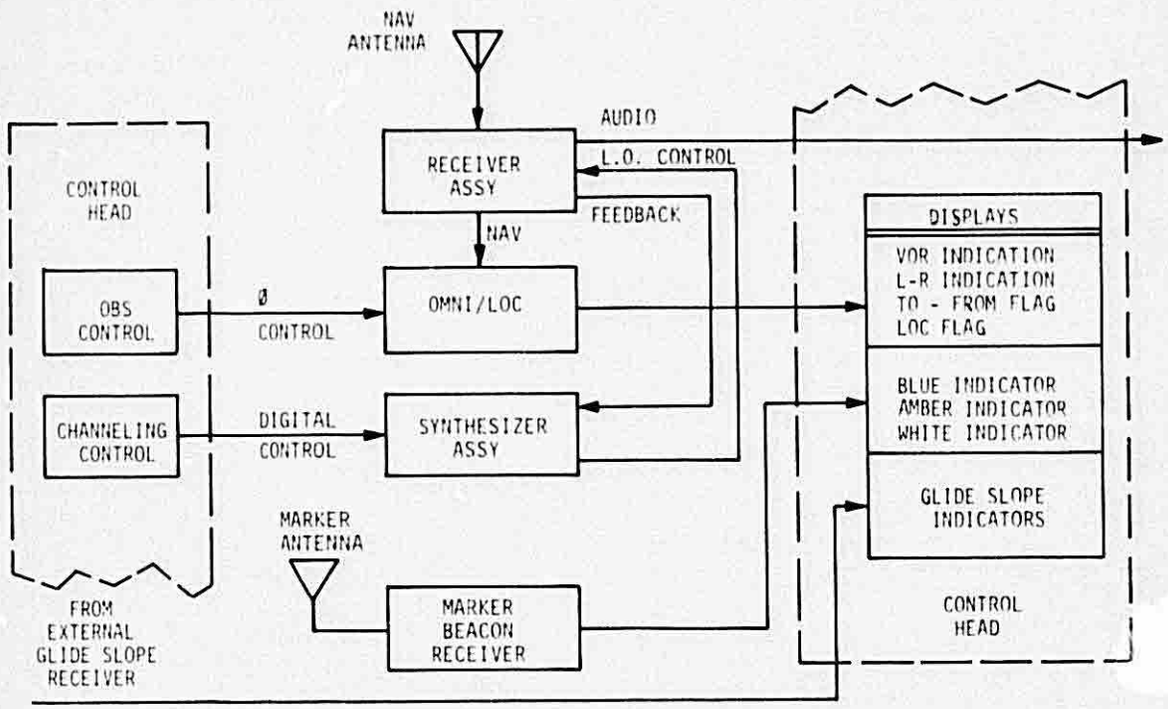


FIGURE 3-44. RECEIVER/CONVERATER UNIT NAV 122A, FUNCTIONAL BLOCK DIAGRAM

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4.1 INTRODUCTION

This section provides maintenance instructions for corrective maintenance of the NAV 121, NAV 122 and NAV 122A Navigation Systems.

The performance characteristics given in paragraph 4.3 provide a series of tests that exercise the VOR/LOC/GS/MKR sections and include optimum operating results. If these results can not be obtained, the alignment procedures given in paragraph 4.4 should be performed. Having performed the applicable alignment procedures and the system still does not operate in accordance with the levels given in Performance Characteristics, troubleshooting procedures to correct the faults are given in paragraph 4.5.

In addition to using the Performance Characteristics for detailed checks to confirm acceptable operation, the troubleshooting flow charts (Figures 4-8 through 4-11) may be used for a quick operational check. The flow charts utilize the front panel controls and displays to confirm proper operation. Any malfunction detected while following a flow chart procedure has references to the typical sources of trouble.

Having isolated the trouble to a PC board, the troubleshooting procedures of paragraph 4.5 should permit localizing the trouble to the malfunctioning component. Oscilloscope waveforms observed at key test points are given to demonstrate proper operation of the preceding circuitry. Deviation from these results assists in rapid isolation of trouble.

4.1.1 PC BOARD IDENTIFICATION

Each PC board is assigned a group number as shown below, and the reference designation of each component on the board is located within the hundred bracket group number. As a result, components shown on block diagrams, schematics, etc can be readily located.

REFERENCE DESIGNATION GROUP	PC ASSEMBLY
100	Control Head
200	Receiver
300	Synthesizer
400	Marker Beacon Receiver
500	Glide Slope Control
600	VOR/LOC Converter
700	VOR/LOC Converter
800	Flex Assy Connectors

4.1.2 REPLACEMENT MODULES

Replacement PC assemblies are available, complete and tested. Refer to the parts list in Section 5 for part numbers.

4.2 TEST EQUIPMENT AND TOOLS REQUIRED

Table 4.1 provides a list of recommended test equipment and tools used for alignment and troubleshooting of the various assemblies comprising the NAV 121, NAV 122, and NAV 122A. The table provides test equipment characteristics; therefore, other test equipment having similar characteristics may be substituted. The test equipment configuration and receiver interconnections are given in Figures 4-1 for OMNI, LOC, and GS; a detailed interconnection for marker beacon receiver test and alignment is given in Figure 4-2.

TABLE 4.1 TEST EQUIPMENT AND TOOLS REQUIRED

TYPE	CHARACTERISTICS	EXAMPLE
Regulated DC Power Supply	Voltage Range: 0 to 30 volts dc Current Range: 0 to 1 ampere	Power Designs Model 5015
VHF Signal Generator	Frequency Range: 10MHz to 400 MHz Modulation: AM, 0 to 95%	Hewlett Packard Model 608D
VOR/LOC Generator		IFR Model N-750 or Collins 479S-3 with Boonton 211A
Glideslope Generator		Boonton Model 232A
Audio Generator	Frequency Range: 400Hz to 3000Hz	Hewlett Packard Model 200CD
Volt-Ohmmeter	DC Ranges Input Impedance: 10 megohms min. Ranges: 0.1 to 100 volts Accuracy: 2% of range AC Ranges Input Impedance: 1 megohm min. Ranges: 0.01 to 100 volts rms Frequency Range: 10Hz to 1MHz Accuracy: 2% of range Ohmmeter Range: 1 ohm to 10 megohms Accuracy: 5% of reading	Hewlett Packard Model 427A
Audio Wattmeter	Load Range: 100 to 1000 ohms min. Power Range: 0 to 100 milliwatts min.	General Radio Model 1840-A
Attenuator	6dB, 50 ohms	
RF Voltmeter	Range: 0.001 to 3 volts rms	Booton Electronics Corp. Model 91-CAR
Sweep Generator		Texscan, Model
Oscilloscope		Testronix, Model 535
Frequency Counter	DC to 500 MHz 1 megohm input impedance	Hewlett Packard, Model 5295 with Model 5253 Plug-In Module
Card Extender	20 pins 28 pins	
Screwdriver	0.093 in dia. 0.055 in dia.	Narco No. 84160-0001 Narco No. 84160-0002

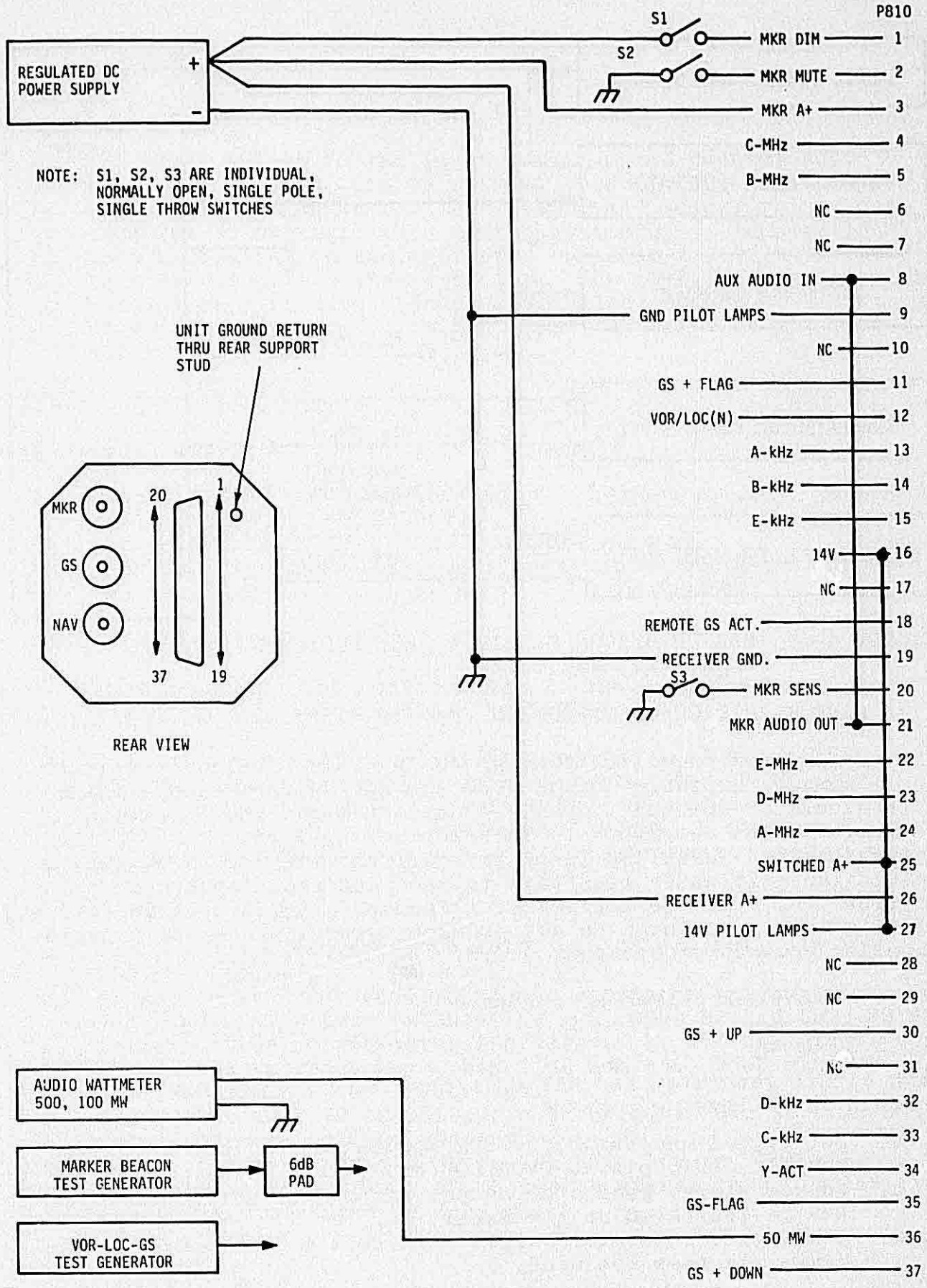


FIGURE 4-1. BENCH TEST WIRING HARNESS

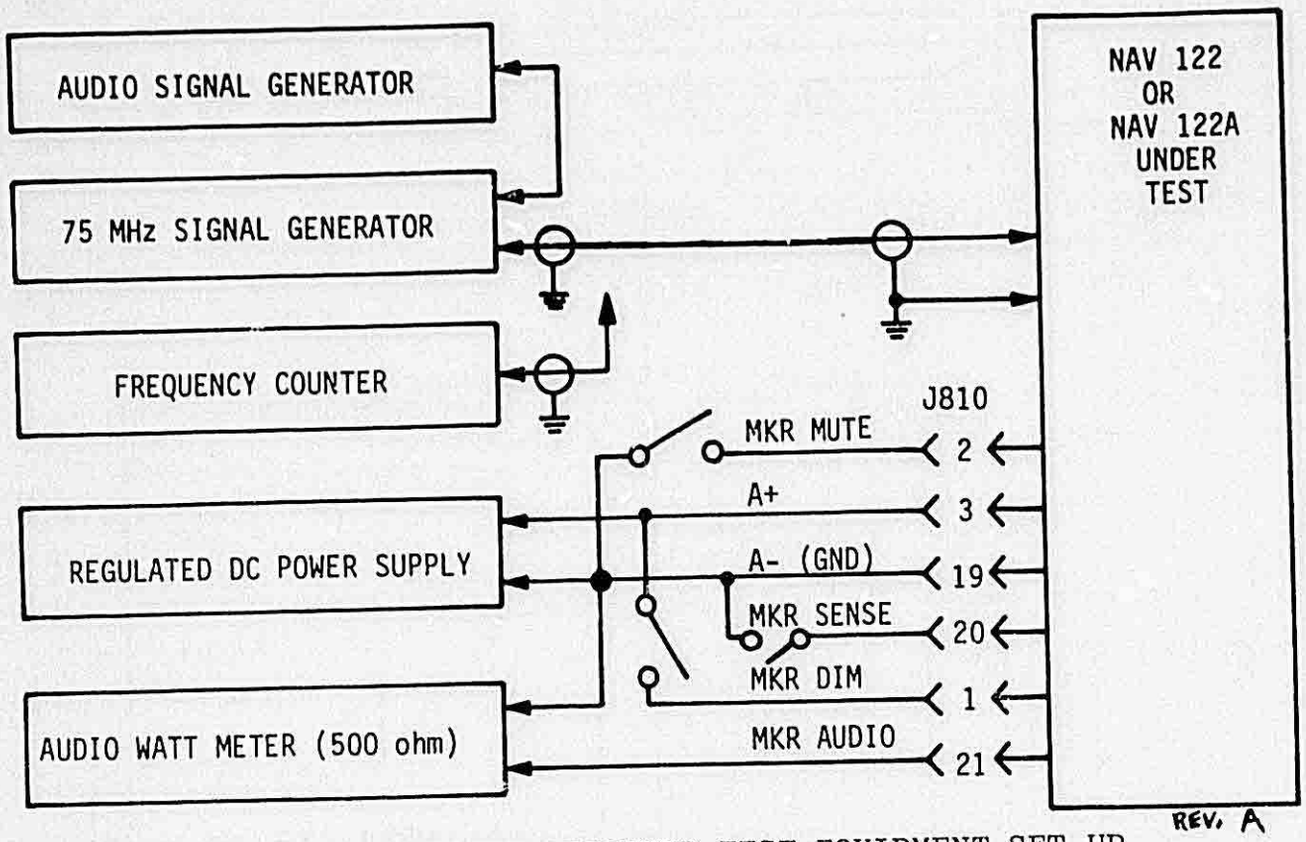


FIGURE 4-2. MARKER BEACON RECEIVER TEST EQUIPMENT SET UP, NAV 122, NAV 122A.

4.3 PERFORMANCE CHARACTERISTICS (Nav 121/122/122A, as applicable)

The performance specifications given in this section constitute the minimum acceptable output from the NAV Units when operating with simulated optimun inputs. A Unit that has the operating characteristics described in this section will provide satisfactory operation when installed in an aircraft assuming proper installation. Should the Unit under test fail to meet the requirements of this section, refer to the applicable alignment procedure of Section 4.4. If alignment procedures do not produce results, refer to trouble-shooting procedures of Section 4.5.

4.3.1 VOR/LOC Receiver Performance

4.3.1.1 Gain

With signal generator and NAV Unit channeled to the same frequency, proceed as follows:

a. Set signal generator for 30% modulation of 1020 Hz only.
b. Monitor J801, pin 16 (VOR/LOC(N)) with a VTVM.
c. Adjust signal generator output attenuator until 0.2 volts RMS is indicated on the meter.
d. The signal generator output will be 1.5 uV nominal, 2 uV maximum across the band.

4.3.1.2 Sensitivity

With signal generator set as in 4.3.1.1 (a):

a. Set Ident switch to the Ident position and connect audio wattmeter to J810, pin 36 or J801, pin 20 (50 mW output).
b. Set signal generator for 1 uV output and adjust volume control for 20 mW indication on the wattmeter. (500 ohm load)
c. Note indication on the wattmeter dB scale and turn off 1020 Hz modulation from the generator. The (S+N)/N (reading with modulation - reading without modulation) should be a minimum of 6 dB or a reduction to 5.0 mW as indicated on the wattmeter.

4.3.1.3 Audio Output (50 mW)

With signal generator set as in 4.3.1.1 (a):

a. Connect a 500 ohm load and audio wattmeter to J810, pin 36 or J801, pin 20 (50 mW output).
b. Set volume fully clockwise (maximum volume).
c. Increase rf signal level until wattmeter indicates 50 mW. The rf input will be 2 uV nominal, 3 uV maximum.

4.3.1.4 Ident Filter

With signal generator and receiver set to the same frequency, set rf level for 500 uV, modulated 10% by 1020 Hz.

a. Connect audio wattmeter to J810, pin 36 or J801, pin 20 (50 mW output) and adjust volume control for 20 mW output (500 ohm load) with Ident switch pulled out.
b. Ident switch will attenuate 1020 Hz signal a minimum of 18 dB as indicated on the wattmeter with Ident switch pushed in.

4.3.1.5 AGC

a. Connect audio wattmeter to J810, pin 36 or J801, pin 20 (50 mW output).
b. Connect unit under test to signal generator and apply standard VOR signal of 2 uV. (modulation 30%, 9960 Hz and 30%, 30 Hz)
c. While monitoring wattmeter increase rf to 20K uV. The level should not increase more than 1 dB nominal, 3 dB maximum. At no time will the level decrease.
d. Connect an ac VTVM to J810, pin 12 or J801, pin 16 (VOR/LOC (N)). Record voltage reading.
e. Vary input level from 2 UV to 20K uV. The ac VTVM will indicate no more than 1 dB change in signal level (1.122 times the voltage measured in Step d).

4.3.1.6 Omni Operation

All omni checks are performed with a standard omni signal applied to the unit under test (modulation: 30%, 9960 Hz and 30%, 30 Hz.).

4.3.2.6.1 Omni Flag Sensitivity

Increase omni signal until the red NAV flag pulls out of sight. The rf level will be 0.7 uV nominal, 1 uV maximum.

4.3.1.6.2 RF Level Stability

a. Adjust generator rf level until NAV flag just pulls out of view. Center needle (CDI) with OBS control.
b. Increase rf level to 10K uV. During this increase the maximum allowable bearing fluctuation is $\pm 1.5^{o}$.

4.3.1.6.3 Course Width

a. Set signal generator output level to 500 uV and rotate OBS control 10^{o} from center needle position.
b. The needle should be displaced to the fifth marking on the meter face. The full swing of the needle from side to side will be 18^{o} minimum, 22^{o} maximum.

4.3.1.6.4 Omni Error

With the Nav receiver OBS in agreement with the signal generator bearing, the maximum allowable error on any heading is $\pm 1.5^{o}$.

4.3.1.6.5 Line Voltage Omni Stability

Withethe Nav receiver needle (CDI) nulled at the same bearing selected on the signal generator, decrease the line voltage from 15 to 11 Vdc. The maximum bearing change will be $\pm 1^{o}$.

4.3.1.7 Localizer operation

All localizer checks are performed with a standard localizer signal applied. (Modulation: 20%, 90 Hz and 20%, 150 Hz.)

4.3.1.7.1 Sensitivity - Course Width

a. Set signal generator output to 20 uV and .093 ddm (4 dB). Deflection will be at least 80% of standard 3 mark deflection.
b. Set signal generator output to 10K uV and .093 ddm. Deflection will be no more than to the last mark on the meter face.

4.3.1.7.2 Centering

a. Set signal generator for centered output signal.
b. Vary output signal level from 10 uV to 10K uV, needle will remain centered within 1/16 inch.
c. With no signal applied and NAV flag in full view, needle will remain centered within 1/16 inch.

4.3.1.7.3 Line Voltage LOC Stability

With the signal generator supplying a centered signal, decrease the line voltage from 15 to 11 vdc. The indication will not move more than 1/16 inch from center position.

4.3.1.7.4 NAV Flag Alarm Signal

a. The red NAV flag will be in complete view when there is no signal or no modulation.
b. The NAV flag will be in complete view when 90 Hz or 150 Hz modulation is removed.
c. With a standard localizer signal of .200 ddm applied, the flag will come into view when or before the needle reaches 50% of full scale deflection dur to attenuation of rf signal.
d. The NAV flag will be out of sight and TO indication will appear during the presence of a standard localizer signal with a minimum receiver sensitivity of 5 uV.

4.3.1.8. Glide Slope Operation (NAV 122 only)

All glide slop checks will be performed with a signal generator providing a standard GS signal modulated 40% with 90 Hz and 40% with 150 Hz.

4.3.1.8.1 Sensitivity

a. Set GS signal generator for standard GS centering signal.
b. Adjust signal generator rf level until "GS" flag is out of view. The signal generator output will be less than 10 uV nominal, 15 uV maximum across the band.

4.3.1.8.2 Deflection

a. Set signal generator for standard .091 ddm deflection and 700 uV rf input.
b. Meter will move 1.5 marks (circle edge being the first mark). Check equal movement up and down.
c. Decrease output signal level until an indication of one mark (60%) or a flag condition is obtained. The signal input from the generator will be 15 uV or less.

4.3.1.8.3 Centering

a. Set generator for a centered output signal and 25 uV rf signal.
b. Vary output signal level from 25 uV to 25K uV; needle will remain centered within 1/16 inch.
c. With no signal applied and flag showing "OFF", needle will remain centered within 1/16 inch.

4.3.1.8.4 Flag Alarm

a. The GS flag will show "OFF" under the following conditions:
   1. Absence of rf signal
   2. Absence of 90 Hz or 150 Hz Modulation
   3. With 22.5% of each 90 Hz and 150 Hz modulation (45% total)
   4. When or before deflection is reduced to 50% of standard deflection due to attenuation of rf signal input.
   5. When Ident switch is in the Ident position

4.3.1.9 Time Sharing

a. With receiver channeled to a GS frequency, no audio will be present at the 50 mW audio output J810, pin 36.
b. When Ident switch is in the Ident Position, the receiver will be in the LOC mode only. The GS needle will stow in the up position. The GS flag will show "OFF" and audio will be present at the 50 mW output.

4.3.1.10 Marker Beacon Receiver Performance

All marker receiver checks are performed with signal generator supplying a 75 NHz signal modulated 95% with one of the following tones: 400 Hz, 1300 Hz, or 3000 Hz.

4.3.1.10.1 Marker Receiver Sensitivity

-NOTE-

The marker receiver sensitivity is adjusted (R101) in the aircraft to produce required performance in a specific installation. For this reason the unit may not be adjusted to meet these specifications.

a. With marker receiver set in the high sensitivity position, the receiver is capable of activating lamps, with a minimum of 400 uV rf signal applied.
b. With marker receiver set for low sensitivity the receiver is capable of activating lamps with a minimum of 2000 uV rf signal applied.

4.3.1.10.2 Receiver AGC

a. Set rf generator for 400 uV output and modulate with one of the three frequencies (400, 1300, 3000 Hz).
b. With marker receiver set in the high sensitivity position, monitor marker audio output (J810, pin 21 or J804, pin 14) with a VTVM.
c. While increasing rf input level to 100K uV, the audio output as indicated on the VTVM will not increase more than 10 dB (3.16 voltage change).

4.3.1.10.3 Lamp Threshold Response

a. Modulate the 75 MHz generator with one of the three frequencies and adjust the signal generator rf level to determine the threshold of the associated lamp.
b. Repeat Step a with the two remaining modulation frequencies. The difference between the lowest and the highest threshold levels will not exceed 1.5 dBm (1.2 Voltage change).

4.3.1.10.4 Lamp Frequency Response

a. Set modulation frequency to 380 Hz and increase rf level until the blue outer marker lamp is lit.
b. Vary modulation frequency from 380 to 420 Hz and observe lamp. The threshold sensitivity should not change more than 2 dB over this range.
c. Repeat steps a and b from 1235 to 1365 Hz for the amber middle marker lamp.
d. Repeat steps a and b from 2850 to 3150 Hz for the white inner marker lamp.

4.3.1.10.5 Audio Output

With the audio output (J810-21) terminated with 500 ohms, an input level of 2000 uv (LOSENS position) should produce a minimum of 8 mw across the load.

4.3.1.10.6 Audio Noise Level

With the audio output monitored as in paragraph 4.3.1.10.5, remove the signal cable and 6 dB termination from the antenna connector. The noise level shall not exceed 0.1 volt.

4.3.1.10.7 DC Regulation

With receiver connected as in Figure 4-1 and operating as in paragraph 4.3.1.10, vary line voltage from 11 to 30 vdc. There should be no degradation of operation throughout this range.

4.3.1.10.8 Audio Muting

The time for audio to recover after activation of the mute switch should not be less than 10 seconds or greater than 14 seconds.

4.4 ALIGNMENT

The alignment procedures given below are all performed with VOR/LOC, GS, and marker beacon signal generators simulating air signal into the applicable coax connector at the rear of the receiver. Power input and other monitoring equipment should be connected as shown in Figures 4-1 and 4-2, or as directed in the individual procedures. When test points and alignment controls are not accessible, a card extender must be used (See Figure 4-3). Recommended test equipment is listed in Table 4.1.

4.4.1 NAV 121 and NAV 122A Alignment Procedures

4.4.1.1 Receiver Assembly

4.4.1.1.1 Initial Conditions

a. Connect variable dc supply to P202.
b. Connect frequency counter to J202.
c. Connect +14 vdc to J802-7, 26. U205 output (TP201) should be 8 $\pm$0.5 vdc.

4.4.1.1.2 VCO (Q209) Alignment

a. Set variable dc power supply to 2.0 vdc.
b. Adjust L217 until counter reads 91 MHz $\pm$200 kHz.
c. Set dc supply to 5.0 vdc. Counter should read 105 min.

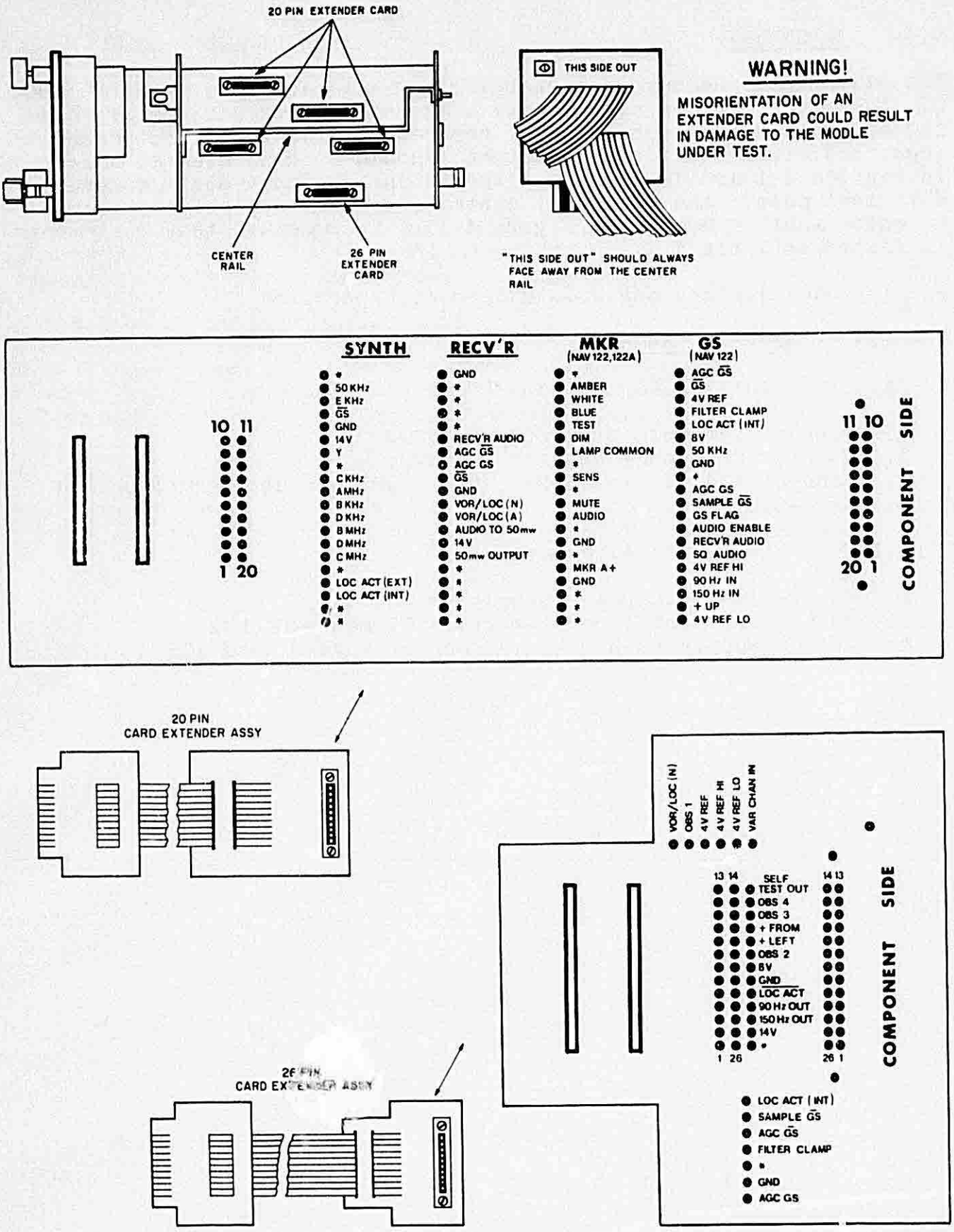


FIGURE 4-3. CARD EXTENDER ASSEMBLIES, 20 and 26 pin

SEE BLOW-UP

4/77

4.4.1.1.3 IF Amplifier (U201, Q203) Alignment

a. Connect P202 and J202 to synthesizer.

b. Set channel selector to 112.00 MHz.

c. Connect rf sweep generator to P201.

d. Connect oscilloscope to VOR/LOC(N) output at J801 pin 16.

e. Set R261 to approximately mid-range.

f. Tune L205, L206, L207 and L208 for maximally flat response (limit of $^{+}_{-}$2 dB maximum ripple); 6 dB points should be at 17 MHz ‡19 kHz as shown in Figure 4-4.

4.4.1.1.4 VCO Buffer Amplifier (Q208) Alignment

a. Set channel selector and signal generator frequency to 112.0 MHz.

b. Connect rf voltmeter to VCO buffer output (TP202).

c. Adjust L216 for maximum rf output.

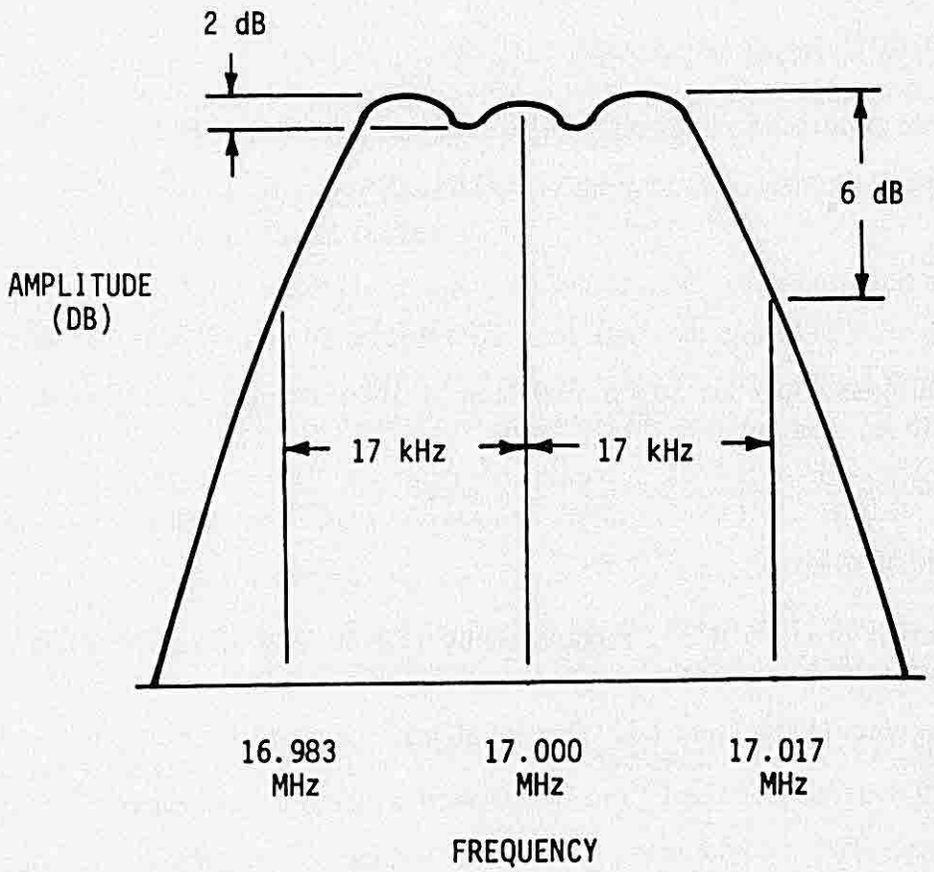


FIGURE 4-4. IF AMPLIFIER FREQUENCY RESPONSE

4.4.1.1.5 VOR/LOC Receiver Alignment

a. Set channel selector to 108.60 MHz and signal generator for VOR signal at same carrier frequency.

b. Connect oscilloscope to VOR/LOC (N) output at J801 pin 16 and adjust rf input signal for useable level.

c. Tune L201, L202, L203 and L204 for maximum output; adjust rf level as required.

d. Set channel selector and signal generator to 117.50 MHz.

e. Tune C201, C203, C208 and C210 for maximum output.

f. Repeat steps a and c, and steps d and e until no further increase is noted.

4.4.1.1.6 AGC Control

a. With the receiver as in 4.4.1.1.5, monitor VOR/LOC (N) output with the ac VTVM.

b. Set signal generator rf output level to 2 uv and increase to 20 kuv.

c. Note indication on VTVM. The maximum allowable increase is 3 dB.

d. If increase is greater than 3 dB, change R251 to the value required.

4.4.1.1.7 VOR/LOC Output Level Adjust (R261)

a. Set signal generator rf output level to 500 uv, modulated 30% by 30 Hz only.

b. Adjust R261 for 0.3 volt rms at VOR/LOC (N) output.

4.4.1.1.8 Audio

a. Connect AC VTVM and 500 ohm load resistor to 50 mw output (J801 pin 20).

b. Set signal generator for 30% modulation by 1020 Hz, set volume control to full CW position, and activate IDENT switch.

c. Audio output level should be 5.0 volts rms.

4.4.1.1.9 Noise Limiter

a. Set rf output level to 10 uv, modulated by 1020 Hz and monitor TP203 with the oscilloscope.

b. Increase modulation from 0%. Output should not clip below 30% modulation.

4.4.1.2 VOR/LOC Converter Assembly

4.4.1.2.1 Initial Conditions

a. Insert VOR/LOC board into card extender.

b. Apply power and rf signal to NAV unit.

c. Rotate R602 until the L/R needle stops moving.

d. Deflect the L/R needle past the fifth dot by moving the generator frequency control or the OBS knob.

e. Rotate R602 to center the L/R needle (approx).

f. Set OMNI disable control R607 fully CCW. If operating properly, U601B pin 2 is high (+8v).

4.4.1.2.2 VOR/LOC Alignment

a. Delete the 30 Hz signal and accurately adjust L/R DC control R673 for a centered L/R needle and T/F DC control R674 for a centered flag with no black showing.

NOTE

In this condition, switches U606A, C and U606B, D are alternately on and off for 1/2 the 30 Hz period. With no 30 Hz AM signal, the L/R and T/F should be perfectly centered.

b. Remove all OMNI signal and rotate OMNI disable control R607 fully CW. Check that L/R and T/F are still centered.

c. Set channel selector and signal generator to a LOC frequency and check that L/R and T/F indicators are still centered.

d. Return to an OMNI channel (IDENT knob pushed in), set signal generator for a standard OMNI signal, and set R609 fully CCW.

e. Connect dual trace oscilloscope to the bases of Q604 (OBS 3) and Q605 (OBS 4) and rotate OBS control until both traces are equal in amplitude and in-phase.

f. Rotate signal generator bearing control until L/R needle is centered.

g. Check indication on OBS; if not the same as the generator, loosen OBS dial (see paragraph 4.4.1.2.3) and rotate until it has the same indication as the signal generator.

h. Tighten OBS dial and recheck null. If any deviation, set OBS to identical setting of signal generator bearing and adjust OMNI zero R602 for centering of L/R needle.

i. Rotate OBS control 90° from setting in step j and adjust OMNI phase control R719 for a centered needle.

4.4.1.2.2 Continued

j. Recheck step i and adjust R602 if necessary.

k. Adjust for centered L/R needle and change bearing 10^{o} (adjust OBS or signal generator).

l. Adjust VOR course width control R653 for a 5-dot deflection of L/R needle.

m. Press self-test switch, set OBS control to 0^{o}, and adjust R733 for centered needle; flag display should show TO.

n. Connect ac VTVM to junction of R637/R632 and connect oscilloscope to U601B-2. Adjust R607 until U601B-2 just goes low; note ac voltage indication.

o. Adjust R607 until this ac voltage increases 20 - 25%.

p. Check for reciprocal error (180^{o} difference between OBS and signal generator bearing). Channel to a LOC frequency and apply a standard LOC signal. Adjust LOC center control R648 for a centered needle.

q. Apply a 4 dB deflection signal and adjust LOC course width control R680 for a 3-dot L/R needle deflection.

r. Set generator for 25% modulation of 90 Hz and 25% modulation of 150 Hz, then alternately delete the 90 and 150 Hz signals from the signal generator output. Adjust LOC flag R609 until the flag just alarms when either 90 or 150 Hz is deleted.

4.4.1.2.3 Adjustment of OBS Control for Electrical and Mechanical Zero

NOTE

This procedure is required only when any of the following occurs:

(1) Control head separated from receiver unit,
(2) OBS shaft is replaced,
(3) OBS potentiometer replaced, or
(4) If for any reason, the OBS driver gear is loosened from shaft.

a. Apply power and set signal generator for a 500 uv VOR signal.

b. Vary generator VOR bearing control until the left-right needle is in the center position.

c. Place flat screwdriver blade between bearing and screw head as shown in Figure 4-5.

d. Carefully move screwdriver blade upward to push OBS shaft against spring pressure and disengage OBS control gearing.

e. Rotate OBS knob to set front panel azimuth card to match generator bearing.

f. Adjust VOR zero set control (R602) for maximum accuracy and check at all cardinal points (0^{o}, 90^{o}, 180^{o}, 270^{o}).

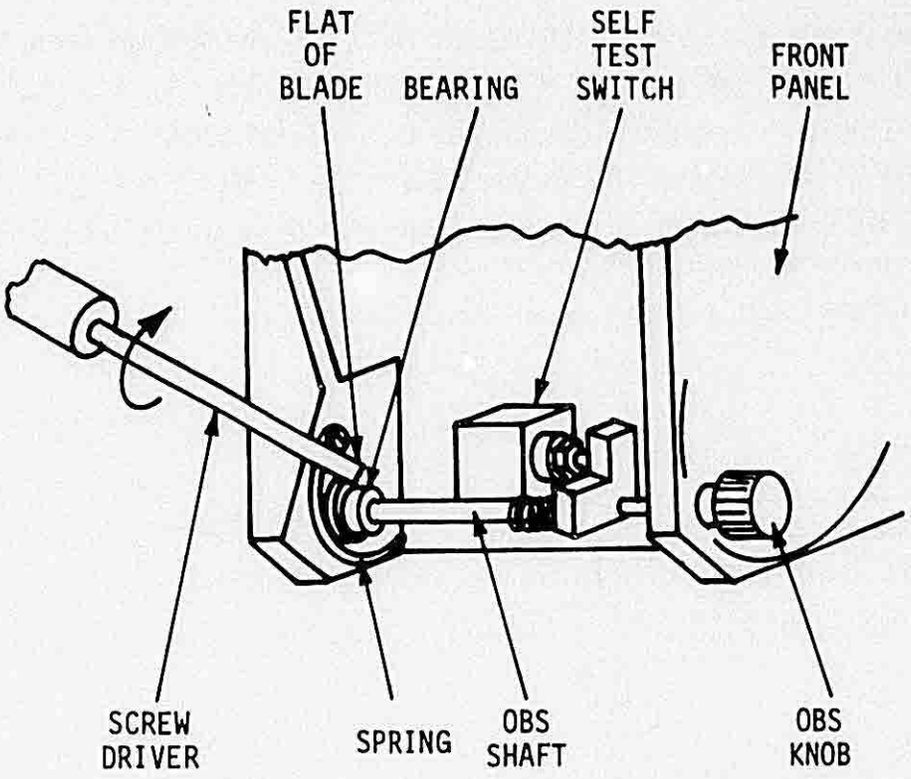


FIGURE 4-5. PHASING OF OBS KNOB AND OBS CONTROL

4.4.1.3 Synthesizer Assembly Alignment, NAV 121, NAV 122, NAV 122A

4.4.1.3.1 RF Power and Voltage Measurements at P301

a. Remove synthesizer assembly from receiver and use extender cable to provide system connection. Maintain tuning voltage and rf connection using original miniature coax connector/cable assembly.

b. Set channel selector to 108.10 MHz.

c. Connect rf voltmeter (Boonton 91-CAR with 91-12E probe) to P301 and measure output level:

VOR/LOC mode at 108.1 MHz = 400 mv
GS mode at 108.1 MHz = 500 mv (with jumper connected on GS Control board: J805-7 to U505B-6)

4.4.1.3.2 Frequency Adjustment of Reference Oscillator

a. Set channel selector to 110.3 MHz in the GS mode with jumper connected from from J805-7 to U505B-6 on the GS Control board.

b. Connect frequency counter (Regency EC-175 or equivalent) to L216 on the receiver board, using a single-turn sampling loop (refer to Figure 4-6).

c. Adjust C316 for 106 MHz $\pm$500 kHz as indicated on frequency counter. Make all adjustments with synthesizer cover on.

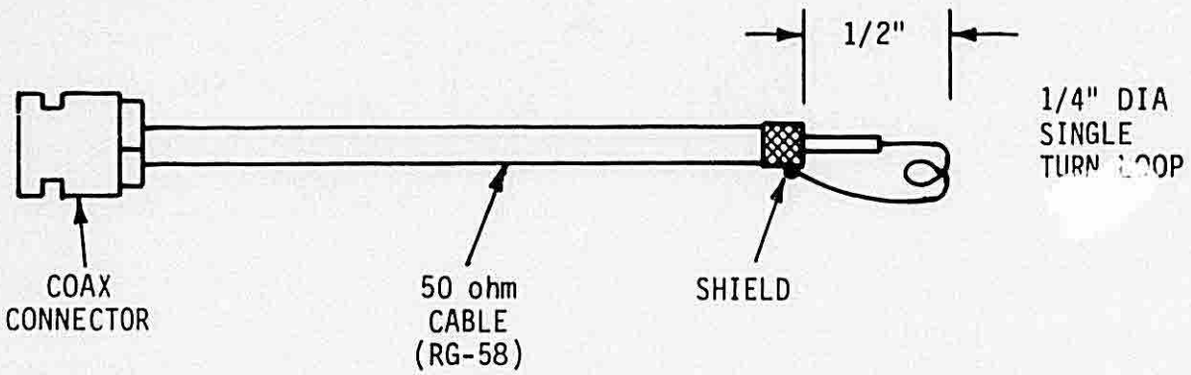


FIGURE 4-6. SINGLE-TURN VCO SAMPLING LOOP

4.4.2 NAV 122 ALIGNMENT PROCEDURES

4.4.2.1 General

The NAV 122 is aligned as described in paragraph 4.4.1 plus the procedures given in this paragraph for the glide slope receiver, GS Control board, and paragraph 4.4.3 for the marker beacon receiver.

4.4.2.2 Receiver Assembly GS Alignment

4.4.2.2.1 Initial Conditions

a. Connect as directed in paragraph 1.4.1.1.1 for the NAV 121 receiver alignment.

b. Connect the GS signal generator to J201.

c. Connect the oscilloscope to the VOR/LOC (N) output (J801-16).

4.4.2.2.2 Glide Slope Receiver Alignment

a. Set channel selector to a LOC/GS channel (Table 3.6).

b. Set GS signal generator to the paired GS frequency, and rf output level sufficient to produce a useable signal at the VOR/LOC (N) output.

c. Tune L211, L212, and L214 for maximum output at both ends of band. Low end of GS band; GS = 329.15 MHz, LOC = 108.95 MHz. High end of band; GS = 335.00 MHz, LOC = 110.30 MHz.

d. Readjust L211, L212, and L214 if necessary for equal sensitivity at both ends of band.

4.4.2.3 Glide Slope Control Board Alignment

4.4.2.3.1 Glide Slope Sensitivity Adjustment (R507)

a. Connect as directed in paragraph 1.4.1.1.1 for NAV 121 Receiver alignment.

b. Set signal generator to GS channel frequency, with modulation for standard centered signal.

c. Adjust R507 for full flag.

4.4.2.3.2 Glide Slope DC Center Adjustment (R504)

a. Remove modulation from GS signal.

b. Adjust R504 to center up-down needle.

4.4.3 NAV 122 AND NAV 122A ALIGNMENT PROCEDURES

4.4.3.1 General

The NAV 122 is aligned as described in paragraphs 4.4.1, 4.4.2, plus the procedure given in this paragraph for the marker beacon receiver. The NAV 122A is aligned as described in paragraph 4.4.1 plus the procedure given in this paragraph for the marker beacon receiver.

4.4.3.2 Marker Beacon Receiver Assembly Alignment

4.4.3.2.1 RF Tuning Alignment

a. Connect test equipment as shown in Figure 4-2 and apply power.

b. Set the rf signal generator to 75 MHz $\pm$1 kHz; adjust 1.3 kHz modulation to 95%.

c. Rotate MKR volume control maximum clockwise; set sensitivity to HI.

4.4.3.2.1 Continued

d. Increase generator rf output level until the audio wattmeter indicates 1.0 milliwatt (0.71 v rms).

e. Peak L401, L402, L403, T401 and T402 for maximum MKR audio output.

NOTE

As audio output increases, reduce generator rf output to maintain a 1.0 milliwatt audio level.

4.4.3.2.2 RF Alignment, Bandwidth (Figure 4-7)

a. Set the rf generator output level to produce 1.0 milliwatt of MKR audio output. Note the generator attenuator setting.

b. Increase the generator rf output level 6 db.

c. Carefully reduce rf generator frequency until MKR audio output is 1.0 milliwatt; measure and record this frequency. Return generator rf output to that level in step b.

d. Slowly increase rf generator frequency, crossing center frequency, until MKR audio output is again 1.0 milliwatt; measure and record this frequency.

e. 6 dB bandwidth specification 75 MHz = minimum, $\pm$10 kHz

6 dB bandwidth specification 75 MHz = typical, $\pm$14 kHz

6 dB bandwidth specification 75 MHz = maximum $\pm$18 kHz

peak to valley = 1 db maximum

NOTE

If specifications are met, delete steps f thru h; if not, proceed to step f.

f. Set rf generator frequency to 75 MHz $\pm$1 kHz. Set rf generator output level to produce 1.0 milliwatt of MKR audio output.

g. Rotate L401's core 1/2 turn (180°) clockwise; audio output should decrease approximately 3 dB.

h. Perform steps a through d.

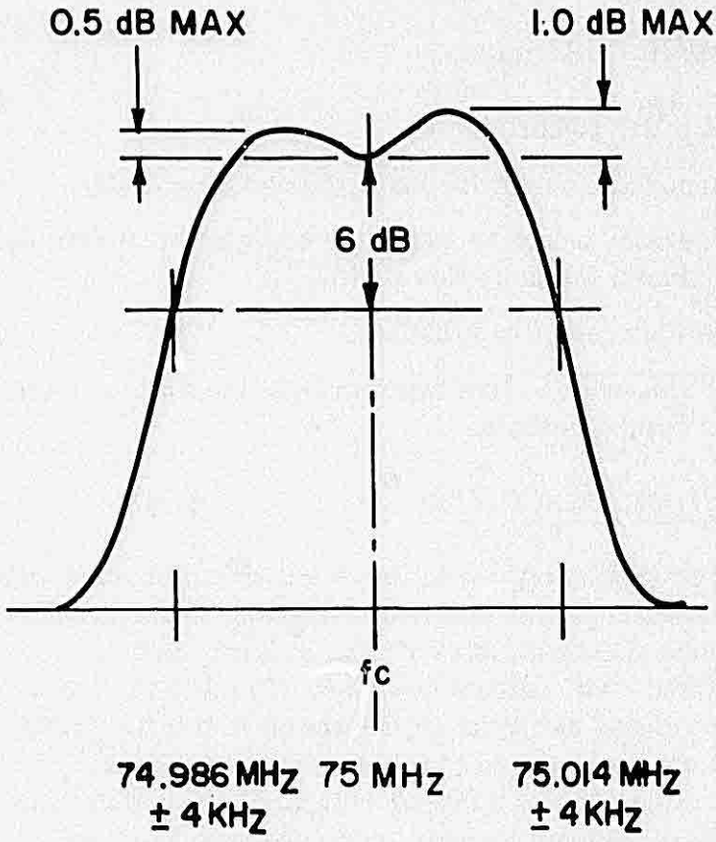


FIGURE 4-7. WAVEFORM, IF ALIGNMENT

4.4.3.2.3 HI Sensitivity Adjustments

a. Set rf generator frequency to 75 MHz $\pm$ 1 kHz, modulation 1300 Hz at 95%, and rf output level to minimum.

b. Set MKR to HI sensitivity.

c. Using a jewelers straight slot screwdriver with a 1/16 inch blade width, adjust the rf sensitivity control (R101) fully clockwise for maximum sensitivity (accessible through shaft with FREQUENCY knobs removed).

d. Increase generator rf output to just begin to light the amber lamp; 100 uv is typical for lamp threshold.

e. Rotate R101 maximum counterclockwise.

f. Increase generator rf output to 400 uv.

g. Rotate R101 clockwise to just begin to light the amber lamp.

4.4.3.2.4 LO Sensitivity Adjustments

a. Switch MKR to LO sensitivity.

b. Rotate R410 counter clockwise for minimum sensitivity.

c. Increase generator output to just begin to light the amber light. Specification: 8,000 uv minimum for lamp threshold.

d. Reduce generator output to 2,000 uv.

e. Rotate R410 clockwise to just begin to light the amber lamp. Specification: 2,000 uv for lamp threshold.

4.5 TROUBLESHOOTING, BENCH TEST

The troubleshooting procedures given in this section can be used as a guide to isolating trouble to the defective component in a malfunctioning receiver. It is assumed that the applicable performance characteristics checks of paragraph 4.3 have been performed and the results are marginal or no outputs obtained. Trouble in a receiver can also be isolated by functions (modes of operation) as shown in the first level flow chart (Figure 4-8). Separate flow charts are used for VOR (Figure 4-9), LOC/GS time-sharing (Figure 4-10), and marker beacon (Figure 4-11). These second level flow charts further isolate trouble to the PC assembly and in many cases to the location of the component at fault.

Connect the power and signal generators to the receiver as shown in Figures 4-1 and 4-2. When it is necessary to monitor internal test points, use the 20 or 26 pin card extender shown in Figure 4-3.

CAUTION

Do not use the card extender on a metal-top bench, since the bottom surface of the extender has exposed wiring.

The card extender has all pin connections available at test points on the top surface. In addition, the pin functions are identified with a separate column for each card used. With the exception of the marker beacon receiver, each assembly troubleshooting procedure includes oscilloscope waveforms taken from a properly operating receiver. When performing troubleshooting tests, the results obtained from the test oscilloscope should be compared with the waveforms given in this section. Any differences will indicate that the trouble area is in some preceeding stage.

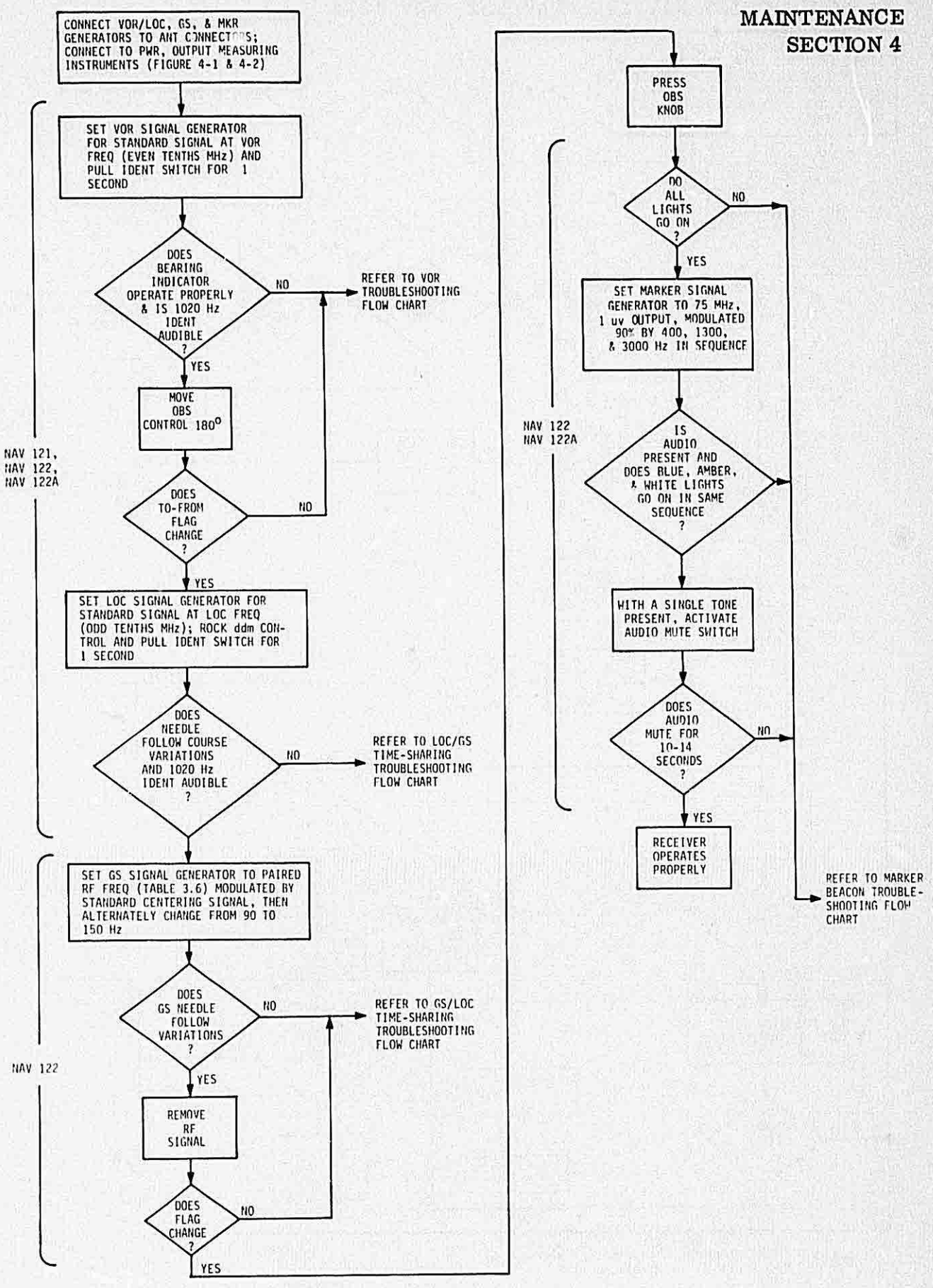


FIGURE 4-8. NAVIGATION RECEIVER/CONVERTER (NAV 121, NAV 122, NAV 122A) TROUBLESHOOTING FLOW CHART

SEE BLOW-UP

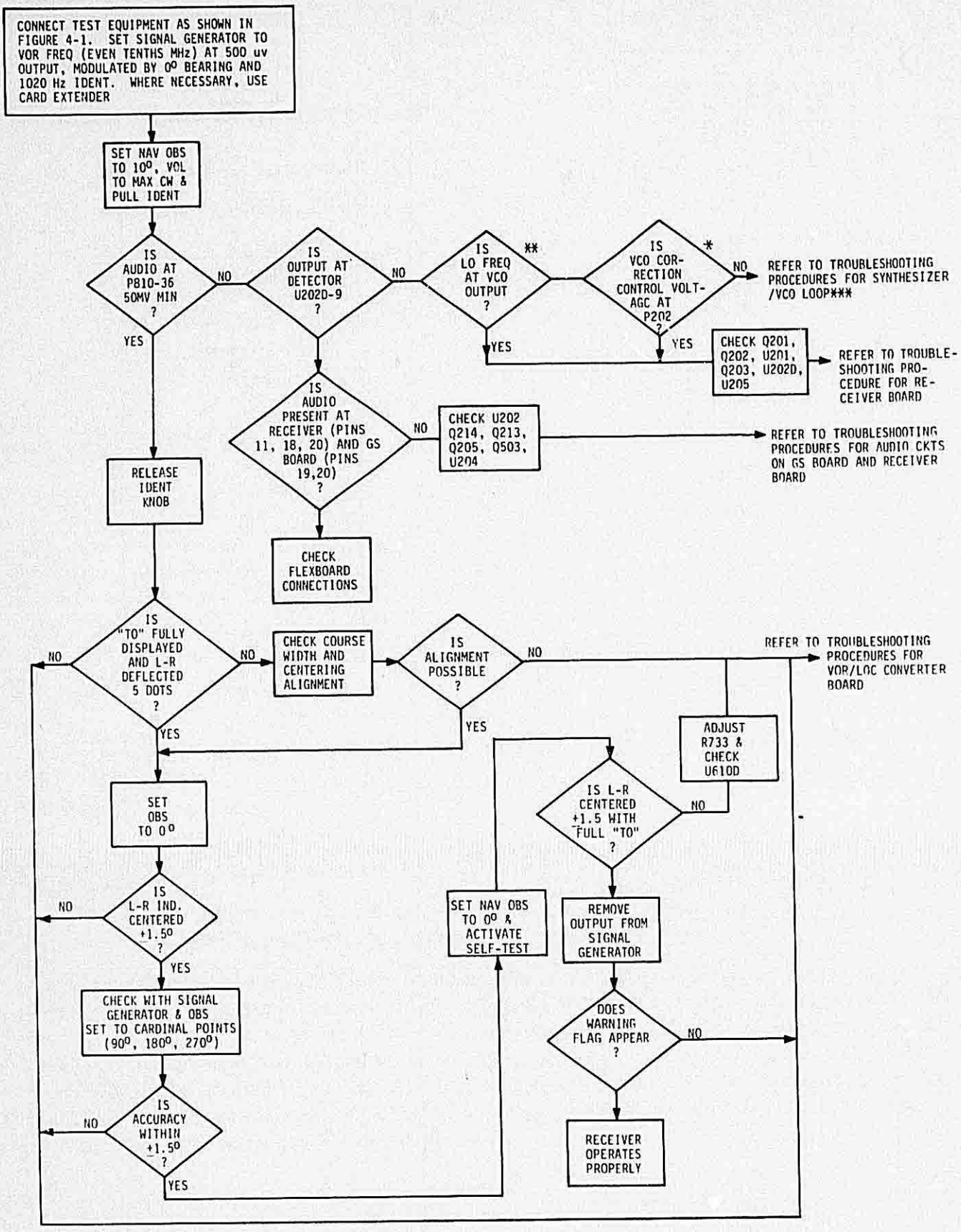


FIGURE 4-9. NAVIGATION RECEIVER/CONVERTER (NAV 121, NAV 122, NAV 122A) VOR TROUBLESHOOTING FLOW CHART

SEE BLOW-UP

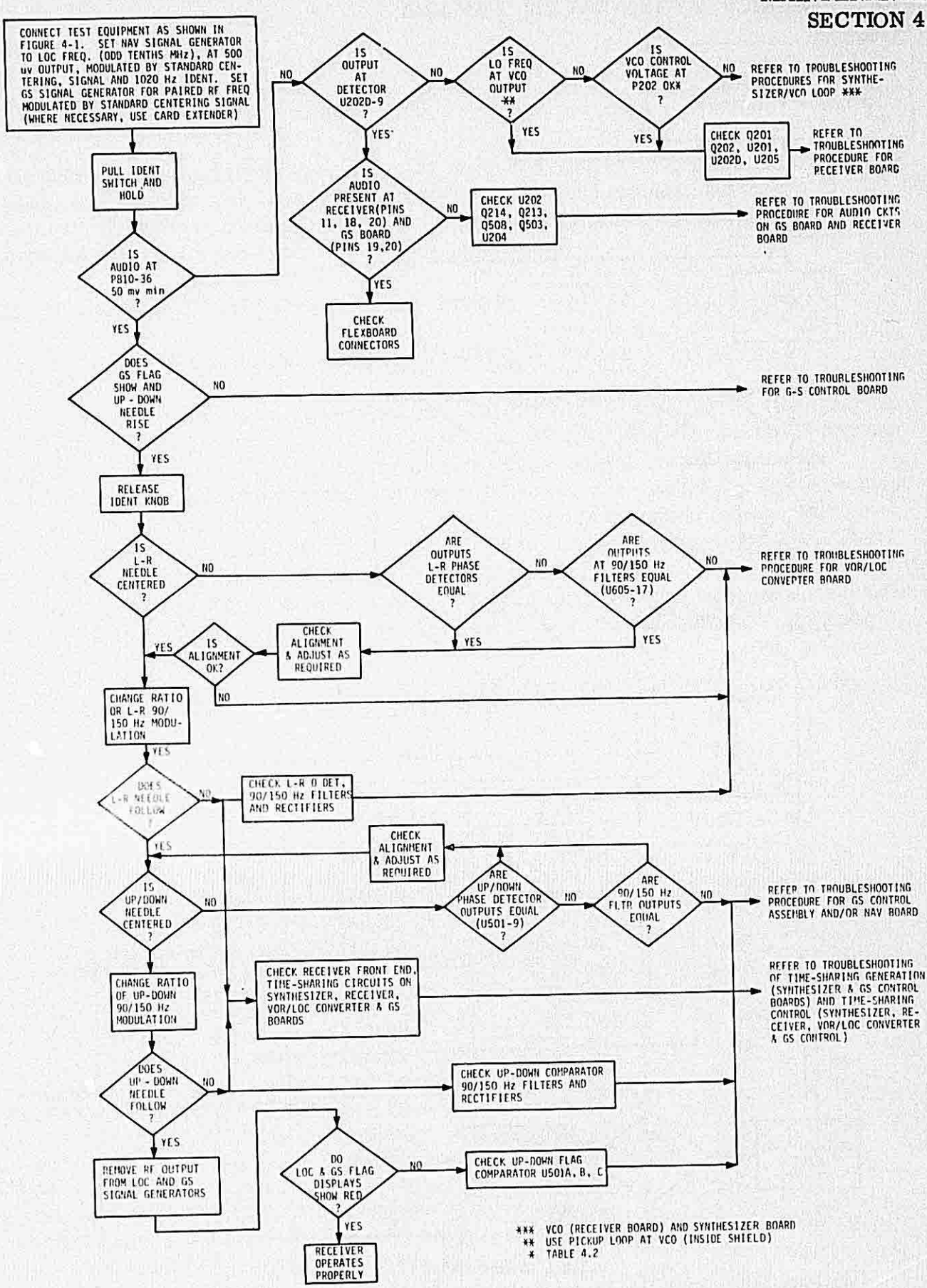


FIGURE 4-10. NAVIGATION RECEIVER/CONVERTER (NAV 122) LOC/GS TIME SHARING TROUBLESHOOTING FLOW CHART

SEE BLOW-UP

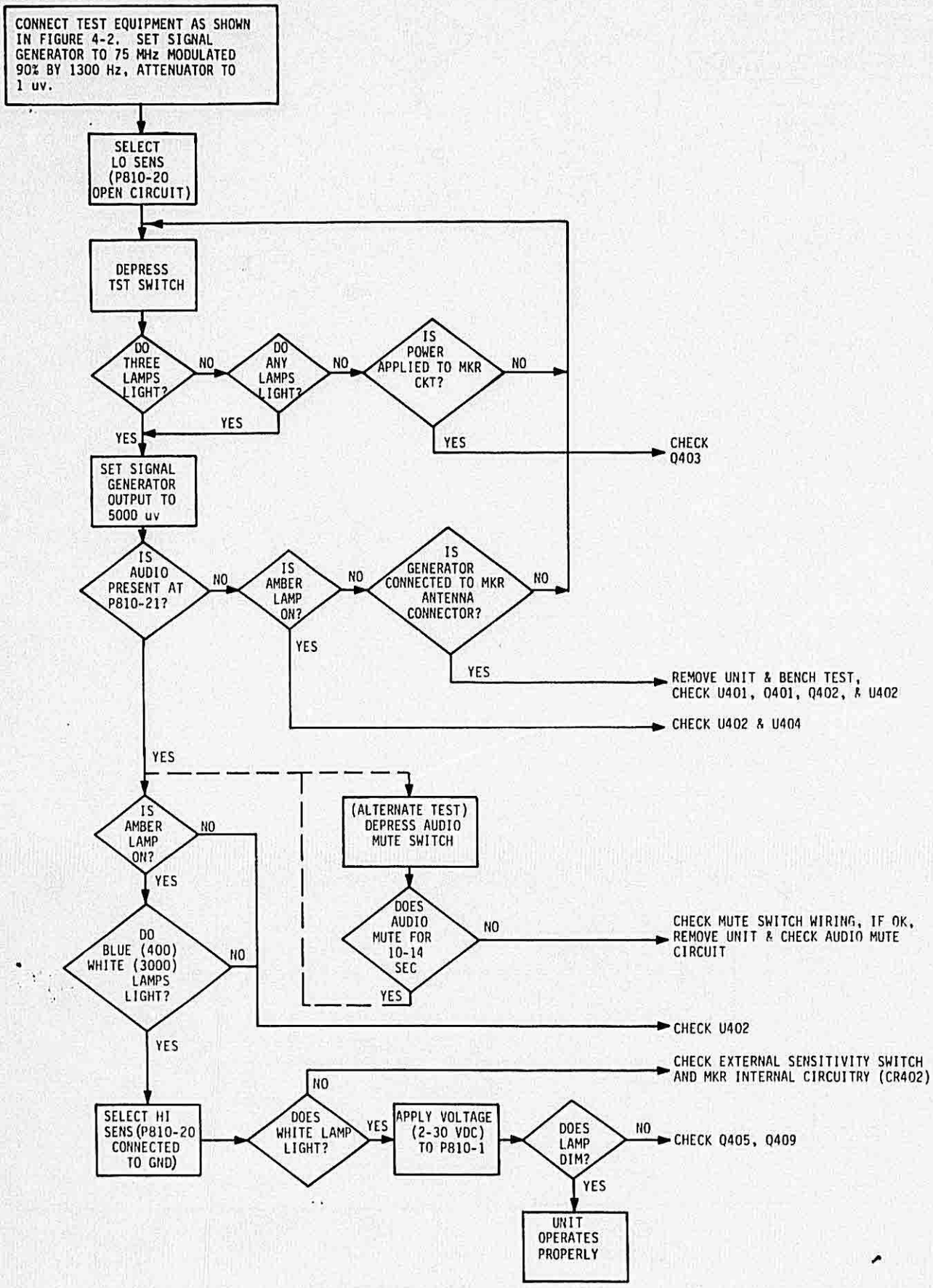


FIGURE 4-11. NAVIGATION RECEIVER/CONVERTER (NAV 122, NAV 122A) BEACON RECEIVER TROUBLESHOOTING FLOW CHART

4.5 Continued

At this time, refer to Tables 4.3, 4.4, 4.5, 4.8, 4.9 or 4.10 as applicable for voltages present at key test points. Use an electronic voltmeter and compare readings. If necessary, disconnect the assembly from the extender and make resistance checks to isolate the defective component.

4.5.1 Receiver (NAV 121, NAV 122, NAV 122A)

4.5.1.1 VOR/LOC Operation, NAV 121, NAV 122, NAV 122A

Overall receiver operation may be checked at pin 11 (REC AUDIO), pin 16 (VOR/LOC N), pin 17 (VOR/LOC A), pin 20 (50 mw audio out), and J202 (rf to synthesizer). If any one output is missing, use schematic and trace to source of signal. If no outputs are available, check synthesizer control voltage at P202; refer to Table 4.2 for VCO control voltages at any channel frequency. If no control voltage is detected, refer to paragraph 4.5.2 for synthesizer troubleshooting. If synthesizer control voltage is present, check VCO output at J202. Other checks can be made in the IF, detector, AGC, audio and VOR/LOC buffer. Test voltages at the connector pins of transistors and integrated circuits are given in Tables 4.3 and 4.4. Refer to schematic to determine location of test points.

TABLE 4.2 FREQUENCY VS VCO TUNING CONTROL VOLTAGE (J301)

RECEIVER MODE		FREQUENCIES		VCO
VOR/LOC	GS	DIAL	VCO	CONTROL VOLTAGE
x		108.00	41.00	2.25
x		109.00	92.00	2.39
x		110.00	93.00	2.53
x		111.00	94.00	2.69
x		112.00	95.00	2.85
x		113.00	96.00	3.01
x		114.00	97.00	3.17
x		115.00	98.00	3.35
x		116.00	99.00	3.52
x		117.00	100.00	3.69
x		117.95	100.95	3.87
	x	108.95	104.05	4.45
	x	109.30	105.00	4.63
	x	110.30	106.00	4.83

NOTES: 1. Tuning voltage measured at J101.
2. Tolerance = ±0.25 vdc using HP Model 427A voltmeter or equivalent.

TABLE 4.3 RECEIVER DC VOLTAGE MEASUREMENT AT TRANSISTORS

Q NO.	OPERATING CONDITIONS	PIN IDENTIFICATION									
		FET			TRANSISTOR						
		G	S	D	E	B	C	1	2	3	4
201	with 500 uv signal							7.8	4.2	1.9	1.8
201	no signal							7.2	7.2	1.9	2.1
202	with 500 uv signal							7.4	0.8	0	1
202	no signal							7.4	0.8	0	1
203	with 500 uv signal	0	0.3	6.5							
203	no signal	0	0.3	6.5							
204	with 500 uv signal				3.4	-	7.8				
204	no signal				3.8	-	7.8				
205					3.5	1.1	7.6				
207					4.8	4.2	0				
208					4.2	3.6	0				
209					4.2	3.6	0				
213	with 500 uv signal				3.6	4.4	8				
213	no signal				3.6	4.4	8				
214	with 500 uv signal				4.0	3.4	0				
214	no signal				5.2	4.6	0				

TABLE 4.4 RECEIVER DC VOLTAGE MEASUREMENT AT ICs

IC NO.	OPERATING CONDITIONS	PIN IDENTIFICATION							
		1	2	3	4	5	6	7	8
201	with 50 uv signal	6.5	5.8	-	2.3	3.7	2.3	6.5	6.5
201	no signal	6.5	5.8	-	2.3	3.0	2.3	6.5	6.5
202	with 50 uv signal	7.2	1.36	4.4	-		3.4	1.36	1.36
202	no signal	7.2	1.36	4.4	-		1.8	1.36	1.36
204		0	-	3.5	7.4	1.2	1.2	0	1.2

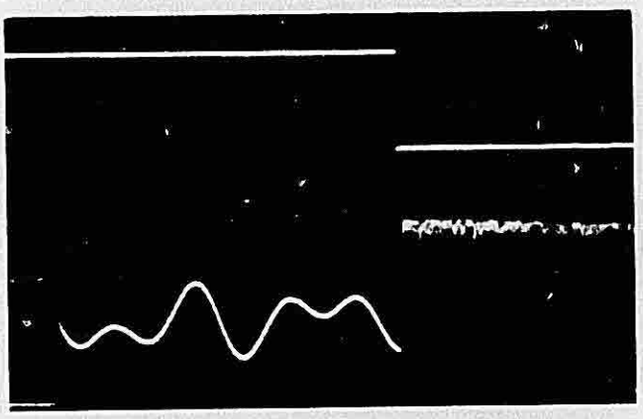
IC NO.	OPERATING CONDITIONS	PIN IDENTIFICATION							
		9	10	11	12	13	14	15	16
201	with 50 uv signal								
201	no signal								
202	with 50 uv signal								
202	no signal	1.1	5.5	.70	-	4.4	.72	3.4	7.0
204		.85	5.5	.54	-	7.3	.68	4.6	7.0

4.5.1.2 GS Receiver and Time Shared Operation (NAV 122)

The time-sharing operation is controlled as follows: the VOR/LOC and GS receiver front ends are switched by the $\overline{GS}$ Control Input at pin 14; and the IF AGC and RF AGC for GS and VOR/LOC are controlled by the AGC GS input at pin 13 and the AGC $\overline{GS}$ input at pin 12.

Figure 4-12A shows the oscilloscope trace with a 500 uv LOC signal input and Figure 4-12B shows the waveform with a 500 uv GS signal input. The upper trace in each is the GS control; when high, the LOC receiver is turned on and when low, the GS receiver is turned on.

Figure 4-13 has photographs of four oscilloscope conditions showing the dc tuning voltage to the VCO (top trace) as controlled by the $\overline{GS}$ time-sharing control signal (bottom trace). Waveform 4-13A shows that when the $\overline{GS}$ is high, the LOC dc tuning voltage is low; in the next half cycle (waveform B) the $\overline{GS}$ is low, therefore the VCO GS control voltage is high. Waveform C shows $\overline{GS}$ and VCO control using a time base of 10 ms/division. The last waveform (D) shows the $\overline{GS}$/VCO control relationship with scale expansion of 2 us/division. Note that the time required between turn off of $\overline{GS}$ to turn on of VCO control is approximately 3 microseconds.



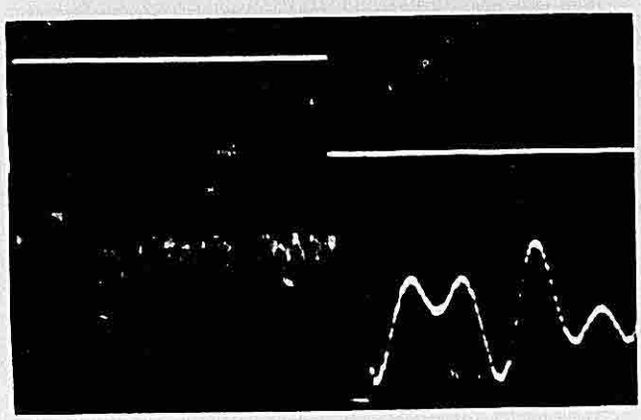
WITH 500 uv LOC SIGNAL

Test Point : $\overline{GS}$ (J801)
Vert : 5 v/div
Horiz : 5 ms/div

Test Point : VOR/LOC (N) pin 16
Vert : 1 v/div
Horiz : 5 ms/div

Sync to $\overline{GS}$ (pin 14)

A. $\overline{GS}$ HIGH TURNS ON VOR/LOC RECEIVER



WITH 500 us $\overline{GS}$ SIGNAL

Test Point : $\overline{GS}$ (J801 pin 14)
Vert : 5 v/div
Horiz : 5 ms/div

Test Point : VOR/LOC (N) pin 16
Vert : 1 v/div
Horiz : 5 ms/div

Sync to $\overline{GS}$

B. $\overline{GS}$ LOW TURNS ON GLIDE SLOPE RECEIVER

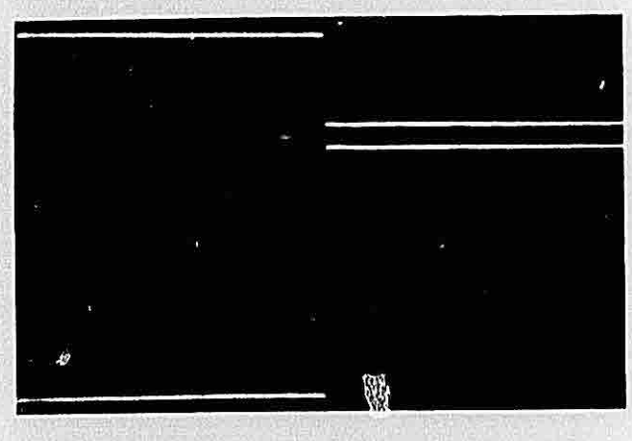
FIGURE 4-12. TIME-SHARED TUNING WAVEFORMS OF GLIDE AND VOR/LOC RECEIVERS

TIME-SHARING TUNING CONTROL

Test Point : DC tune (P202)
Vert : 2 v/div
Horiz : 200 us/div

Test Point : $\overline{GS}$ (J801 pin 14)
Vert : 2 v
Horiz : 200 us

A

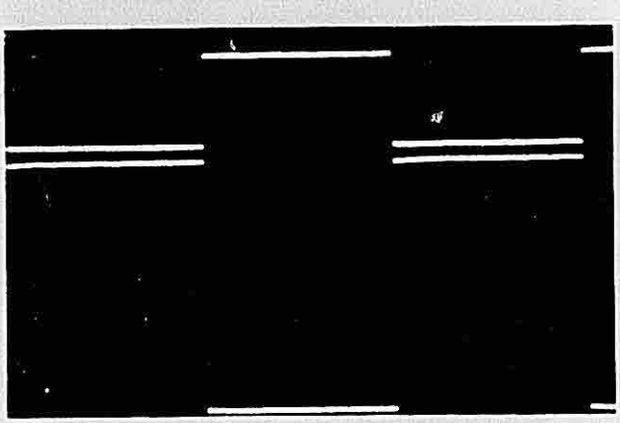


TIME-SHARING TUNING CONTROL

Test Point : DC tune (P202)
Vert : 2 v/div
Horiz : 200 us/div

Test Point : $\overline{GS}$ (J801 pin 14)
Vert : 2 v/div
Horiz : 200 us/div

B

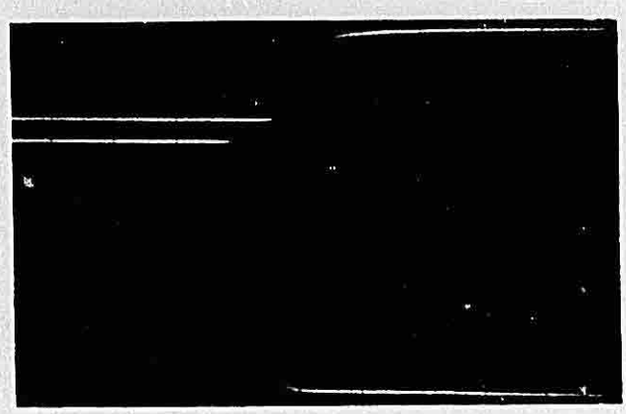


NO INPUT

Test Point : DC tune (P202)
Vert : 2 v/div
Horiz : 10 ms/div

Test Point : $\overline{GS}$ (J801 pin 14)
Vert : 2 v/div'
Horiz : 10 ms/div

C



TIME-SHARING TUNING CONTROL

Test Point : DC tune (P202)
Vert : 2 v/div
Horiz : 2 us/div

Test Point : $\overline{GS}$ (J801 pin 14)
Vert : 2 v/div
Horiz : 2 us/div

D

FIGURE 4-13. TIME-SHARED VCO TUNING WAVEFORMS

4.5.2 Synthesizer (NAV 121, NAV 122, NAV 122A)

Synthesizer troubleshooting is presented on the basis of continuous operation in the VOR or LOC mode; procedures are given for isolation of trouble in the crystal oscillator and the phase locked loop. Following this basic troubleshooting procedure, its application to time sharing LOC/GS malfunctions is described.

The synthesizer control inputs are programmed by the 2 out of 5 ARINC code from the front panel channel selector for MHz and kHz. The synthesizer outputs are the GS/LOC activate (J803 pins 2 and 3), 50 kHz clock to the time-sharing control on the glide slope board (pin 7), and the dc control voltage to the VCO (J301). The $\overline{GS}$ time-sharing control will be described after the phase-lock loop (PLL).

4.5.2.1 General Troubleshooting

This section provides a series of rapid tests to confirm operation of the synthesizer and, where applicable, to localizer synthesizer failures. To troubleshoot the synthesizer assembly, remove it from the chassis and use extender cables to provide system connections. Maintain tuning voltage and rf drive connections from receiver assembly.

a. VCO Frequency Check. Connect frequency counter using a single-turn sampling loop coupled to L216 on the receiver board (refer to Figure 4-6) and compare with frequencies listed in Table 3.6.

b. Phase-Locked Loop Tracking. With the frequency counter connected as in the previous step, and radio set to 108.00 MHz, locate the junction of R316/R318 at output of frequency/phase detector. Monitor the dc tuning voltage at C432. When this junction is connected to ground, the VCO frequency should increase as the dc tuning voltage at C342 increase; remove the ground and the original frequency and tuning voltage should return. This is a test of the full phase-lock loop.

c. $\div$20/21 Output Pulses to $\div$N Counter. Check $\div$20/21 counter output at U305 pin 10 for clock pulses to U309, U308, U302 and U305A (see waveform Figure 4-15A).

d. $\div$ N Counter Check. Check the $\div$N counter output at the frequency/phase detector input (U314 pin 3). Refer to waveform Figure 4-16B. Note that the pulses are at 50 kHz repetition rate and that the negative edges of pulses at U314-1, 3 are locked in synchronism by the PLL.

e. DC Operating Voltage Checks. With VOR/LOC operation at 118.000 MHz, check dc voltage at test points shown in Table 4.5.

TABLE 4.5 FREQUENCY SYNTHESIZER TEST VOLTAGE CHART*
(Refer to Synthesizer Schematic Diagram)

TEST POINT	TYPICAL OR NOMINAL READINGS (VDC)	FUNCTION
U314, pins 5 & 10	1.2	Freq/Phase Det output
Q304 base	1.2	Filtered Freq/Phase Det output
Q304 emitter	0.6	First stage of dc tuning amp
Q304 collector	7.2	First stage of dc tuning amp
Q303 collector	7.2	Second stage of dc tuning amp
C342	2.2	Control voltage to VCO
U307, pin 8	2.2	LOC output from U307
U306, pin 16	3.5	prescaler input dc bias
U306, pins 8 & 9	3.7	÷10/11 Q and $\overline{Q}$ output dc bias
U314, pin 14	5.0	+5 vdc regulated
+terminal of C338	8.0	+8 vdc regulated

*Channel Selector set to 118.000 MHz

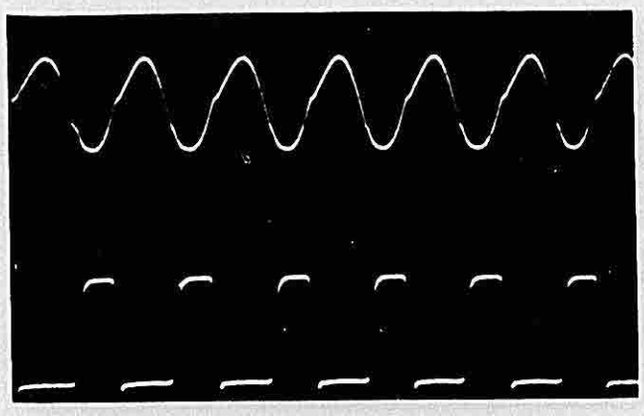
4.5.2.2 50 kHz Crystal Controlled Reference Oscillator

Check for presence of 50 kHz reference oscillator signal at J803 pin 7. If not present, use the four waveforms of Figure 4-14 as a guide to isolating the malfunction. If no 50 kHz signal (Figure 4-14D), check the 3.2 MHz crystal controlled oscillator (Figure 4-14C). Figures 4-14A and B show the signals developed across the two sections of the crystal-controlled oscillator. If no waveforms are observed during these tests, the associated components must be tested (C316, X301, C340 and U315A, B, C).

4.5.2.3 ÷N Programmable Counter

The ÷N programmable counter is separated into two sections, kHz and MHz. The kHz section (U305A, U309) can be preloaded for a count of 0 to 19 as programmed by the U311, the kHz PROM, and the Y channel information. The MHz section (U308, U302) can be preloaded for a maximum count of 159 as programmed by U310, the MHz PROM. The 2 out of 5 ARINC code set up by the channel selector switch is connected to the inputs of the kHz and MHz PROM's with some lines being modified by exclusive OR gate U304. Tables 3.3 and 3.4 show the 2 out of 5 ARINC code, PROM inputs, and PROM outputs for all VOR and LOC channels. Tables 3.7 and 3.8 show the same information for the paired glide slope channels. Table 3.2 shows all VOR and LOC channel frequencies and Table 3.6 shows all paired LOC and GS channel frequencies.

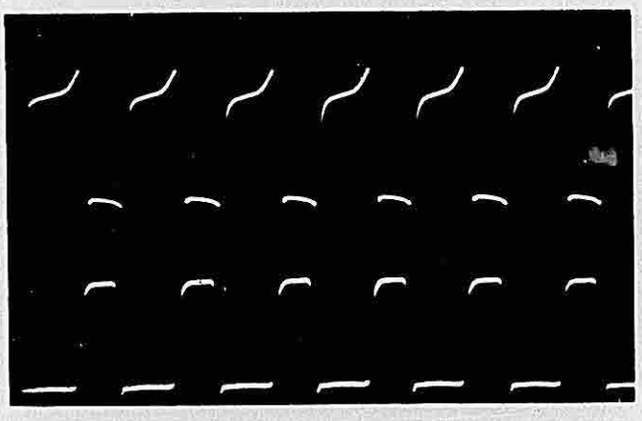
Malfunctions in this ÷N counter/control circuitry can be isolated into three areas; channel selector switch (Figure 3-22), input logic (Figure 3-23), and PROM's (Figure 3-23).



A

3.2 MHz CRYSTAL OSCILLATOR
Test Point : U315, pin 1
Vert : 1 v/div
Horiz : 200 ns/div

Test Point : U315, pin 3
Vert : 2 v/div
Horiz : 200 ns/div

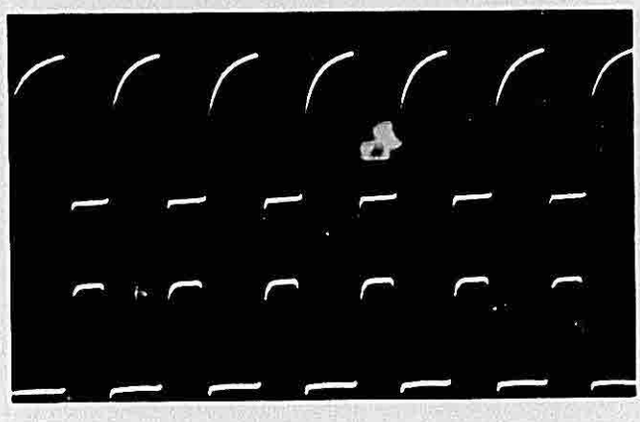


B

3.2 MHz CRYSTAL OSCILLATOR

Test Point : U315, pin 6
Vert : 2 v/div
Horiz : 200 ns/div

Test Point : U315, pin 3
Vert : 2 v/div
Horiz : 200 ns/div

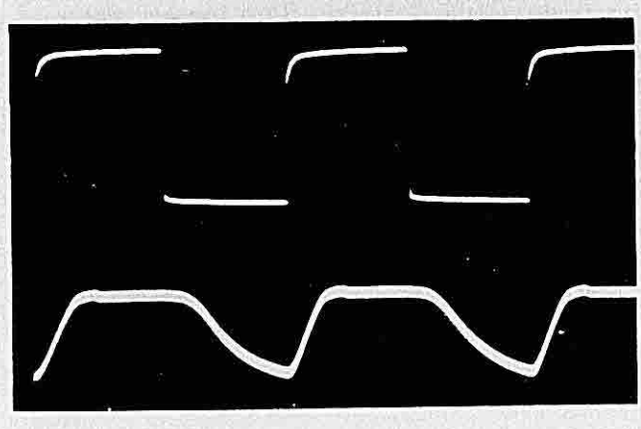


C

3.2 MHz CRYSTAL OSCILLATOR

Test Point : U319, pin 1
Vert : 2 v/div
Horiz : 200 ns/div

Test Point : U315, pin 3
Vert : 2 v/div
Horiz : 200 ns/div



D

50 kHz CRYSTAL CLOCK

Test Point : U319, pin 4
Vert : 2 v/div
Horiz : 5 us/div

Test Point : P803, pin 7
Vert : 2 v/div
Horiz : 5 us/div

FIGURE 4-14. CRYSTAL CONTROLLED REFERENCE OSCILLATOR WAVEFORMS

4. 5. 2. 3 Continued

A complete check of this area can be performed by setting the channel selector switch to a channel listed in Tables 3-3 (MHz) and 3-4 (kHz) for VOR/LOC operation or in Tables 3-7 (MHz) and 3-8 (kHz) for time-sharing and proceeding as follows:

LOCATION	LOGIC LOW (0)	LOGIC HIGH (1)
FRONT PANEL SWITCHES	GROUND	+5 v
TTL	GROUND	+5 v
MOS	0.7 or less	+2. 5 v or greater

a. Check logic levels at J803 pins 15, 18, 20, and 19, for MHz and pins 16, 14, 17 and 8 for kHz. If any are different, check selector switch.

b. Check MHz PROM inputs at U310 pins 10, 11, 12, 13 and 14; kHz PROM inputs are checked at U311 pins 10, 11, 12, 13 and 14. If any are different, refer to Tables 4. 6 and 4. 7 and find the WORD NO. of the inputs. Check the outputs for the same WORD NO. ; if correct, the PROM is OK; if incorrect, replace the PROM. To correct the condition of an invalid input word, check the exclusive OR gates in the code conversion circuits.

c. Check MHz PROM outputs at U310 pins 1, 2, 3, 4, 5, 6, 7 and 9; kHz PROM outputs are checked at U311 pins 1, 2, 3, 4, 5, 6, 7 and 9. If any outputs are different, replace the PROM.

d. For time sharing of the glide slope and localizer signals, perform steps a through c for LOC. Since the GS paired channel frequencies are controlled by the GS input, the GS channel control is not a 2 out of 5 ARINC code.

The MHz and kHz PROM programming is shown in Tables 4. 6 and 4. 7. Although the kHz PROM has 22 valid input codes and the MHz PROM has 19 valid input codes, each has a full capability of 32 different code combinations at the input. If an unused (or invalid) input combination is observed, the output can be checked; if correct, the PROM is operating; if incorrect, the PROM should be replaced.

Figure 4-15 shows $\div$ N counter waveforms at 108. 05 and 108. 2 MHz. The lower trace of Figure 4-15A is positive for one period of the upper trace, indicating a 0. 5 MHz channel has been selected. In Figure 4-15B, the pulse is 4 periods wide, which indicates a 0. 2 MHz channel has been selected.

TABLE 4.6 kHz PROGRAMMING OF PROM U311

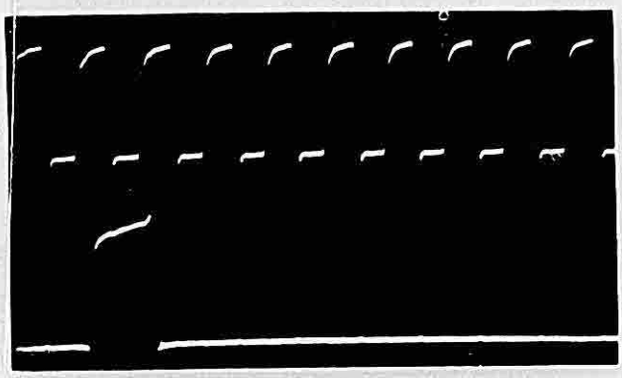
WORD NO.	CHANNEL NO. (MHz)		INPUTS (PIN NO.)						OUTPUTS (PIN NO.)							
			14	13	12	11	10	15	9	7	6	5	4	3	2	1
	GLIDE SLOPE	VOR/LOC	A_4	A_3	A_2	A_1	A_0	ENABLE	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0
0		.9,.95	0	0	0	0	0	0	1	1	1	0	0	0	0	1
1		.0,.05	0	0	0	0	1	0	1	1	1	1	1	0	0	0
2		.6,.65	0	0	0	1	0	0	1	1	1	0	1	1	0	0
3		.3,.35	0	0	0	1	1	0	0	1	1	0	0	1	1	1
4		.7,.75	0	0	1	0	0	0	1	1	1	0	0	1	0	1
5		.4,.45	0	0	1	0	1	0	0	1	1	0	1	0	1	0
6		.5,.55	0	0	1	1	0	0	0	1	1	0	0	0	1	1
7	*	*	0	0	1	1	1	0	0	0	0	0	0	0	0	0
8	109.9,110.9		0	1	0	0	0	0	1	1	0	0	0	0	1	1
9	108.1,111.1		0	1	0	0	1	0	1	1	1	0	1	0	0	1
10	*	*	0	1	0	1	0	0	0	0	0	0	0	0	0	0
11	110.3,108.3		0	1	0	1	1	0	0	1	1	0	0	0	0	1
12	109.7,110.7		0	1	1	0	0	0	1	1	0	0	0	1	1	1
13	109.5,110.5		0	1	1	0	1	0	0	0	0	0	0	0	0	0
14	*	*	0	1	1	1	0	0	0	1	0	1	0	0	0	1
15	*	*	0	1	1	1	1	0	0	0	0	0	0	0	0	0
16	108.9		1	0	0	0	0	0	1	0	0	1	1	0	0	1
17	109.110.1		1	0	0	0	1	0	1	1	1	0	0	1	0	1
18	*	*	1	0	0	1	0	0	0	0	0	0	0	0	0	0
19	108.3		1	0	0	1	1	0	0	0	1	0	1	1	0	1
20	108.7,111.7		1	0	1	0	0	0	1	1	0	0	1	0	1	1
21	*	*	1	0	1	0	1	0	0	0	0	0	0	0	0	0
22	108.5,111.5		1	0	1	1	0	0	0	1	0	0	1	1	1	1
23	*	*	1	0	1	1	1	0	0	0	0	0	0	0	0	0
24	111.9		1	1	0	0	0	0	1	0	1	0	1	1	0	1
25		.1,.15	1	1	0	0	1	0	1	1	1	1	0	0	0	1
26		.2,.25	1	1	0	1	0	0	1	1	1	0	1	1	1	0
27	111.3		1	1	0	1	1	0	0	0	0	1	1	0	0	1
28		.8,.85	1	1	1	0	0	0	1	1	1	0	1	0	0	0
29	*	*	1	1	1	0	1	0	0	0	0	0	0	0	0	0
30	*	*	1	1	1	1	0	0	0	0	0	0	0	0	0	0
31	*	*	1	1	1	1	1	0	0	0	0	0	0	0	0	0
ALL	*	*	x	x	x	x	x	1	1	1	1	1	1	1	1	1

*Denotes invalid input/output.

TABLE 4.7 MHz PROGRAMMING OF PROM U310

WORD NO.	CHANNEL NO. (MHz)		INPUTS (PIN NO.)						OUTPUTS (PIN NO.)							
			14	13	12	11	10	15	9	7	6	5	4	3	2	1
	GLIDE SLOPE	VOR/LOC	A_4	A_3	A_2	A_1	A_0	ENABLE	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0
0		116	0	0	0	0	0	0	0	0	1	0	0	1	0	0
1	*	*	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2		115	0	0	0	1	0	0	0	0	1	0	0	0	1	0
3		*	0	0	0	1	1	0	0	0	0	0	0	0	0	0
4		113	0	0	1	0	0	0	0	0	1	0	0	0	0	1
5	110.5, 110.7, 110.9		0	0	1	0	1	0	1	1	0	0	0	0	1	1
6	*	*	0	0	1	1	0	0	0	0	0	0	0	0	0	0
7	*	*	0	0	1	1	1	0	0	0	0	0	0	0	0	0
8		112	0	1	0	0	0	0	0	0	1	0	0	1	0	1
9	109.5, 109.7, 109.9		0	1	0	0	1	0	1	1	0	0	0	1	0	1
10	*	*	0	1	0	1	0	0	0	0	0	0	0	0	0	0
11	108.5, 108.7, 108.9		0	1	0	1	1	0	0	1	0	1	0	0	1	1
12	*	*	0	1	1	0	0	0	0	0	0	0	0	0	0	0
13	111.5, 111.7		0	1	1	0	1	0	0	1	0	1	0	1	0	1
14	*	*	0	1	1	1	0	0	0	0	0	0	0	0	0	0
15	111.3		0	1	1	1	1	0	1	1	0	1	0	1	0	1
16	*	*	1	0	0	0	0	0	0	0	0	0	0	0	0	0
17	*	*	1	0	0	0	1	0	0	0	0	0	0	0	0	0
18		117	1	0	0	1	0	0	0	0	1	0	0	0	0	0
19	*	*	1	0	0	1	1	0	0	0	0	0	0	0	0	0
20		110	1	0	1	0	0	0	0	1	1	0	0	1	1	1
21	110.1, 110.3		1	0	1	0	1	0	1	1	0	0	0	1	0	1
22		114	1	0	1	1	0	0	0	0	1	0	0	1	1	0
23	*	*	1	0	1	1	1	0	0	0	0	0	0	0	0	0
24		119	1	1	0	0	0	0	0	1	1	0	1	0	0	0
25	109.1, 109.3		1	1	0	0	1	0	1	1	0	0	0	0	1	1
26		108	1	1	0	1	0	0	0	1	1	0	1	1	0	0
27	108.1, 108.3		1	1	0	1	1	0	0	1	0	1	0	1	0	1
28		111	1	1	1	0	0	0	0	1	1	0	0	0	1	1
29	*	*	1	1	1	0	1	0	0	1	0	1	0	0	1	1
30	*	*	1	1	1	1	0	0	0	0	0	0	0	0	0	0
31	111.9		1	1	1	1	1	0	1	1	0	1	0	0	1	1
ALL	*	*	x	x	x	x	x	0	1	1	1	1	1	1	1	1

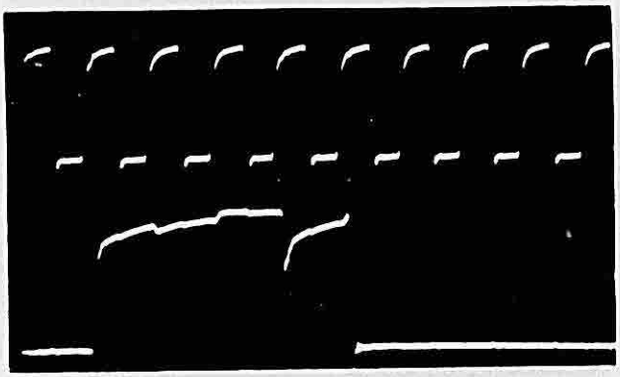
*Denotes invalid input/output.



Test Point : U305, pin 10
Vert : 2 v/div
Horiz : 200 ns/div

Test Point : U309, pin 7
Vert : 2 v/div
Horiz : 200 ns/div

A. OPERATING FREQUENCY 108.05



Test Point : U305, pin 10
Vert : 2 v/div
Horiz : 200 ns/div

Test Point : U309, pin 7
Vert : 2 v/div
Horiz : 200 ns/div

B. OPERATING FREQUENCY 108.2

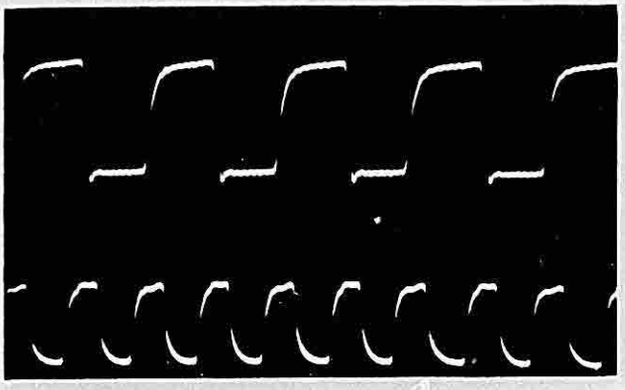
FIGURE 4-15. ÷ N COUNTER WAVEFORMS

4.5.2.4 ÷ 20/21 Counter

The VCO output is connected to the ÷ 20/21 counter, which divides the VCO frequency by a factor of ÷ 20 or ÷ 21. When U306 pin 3 is high, the ÷ 20/21 counter output (U305 pin 10) provides a pulse out for every 20 VCO input cycles. When U306 pin 3 is low, the ÷ 20/21 counter output provides a pulse out for every 21 VCO input cycles. The number of ÷ 21 periods is dependent upon the preset of the kHz counter. Figure 4-16 shows waveforms at the ÷ 20/21 counter and the U603 outputs. The MHz and kHz presets are described in the ÷ N Counter troubleshooting.

4.5.2.5 Frequency/Phase Detector

The frequency/phase detector compares the crystal controlled 50 kHz with the 50 kHz output from the ÷ N counter (Figure 4-17B). The frequency/phase detector output (U314 pins 5 & 10) is a series of low level pulses which vary in polarity and width according to the frequency/phase error of its inputs. The waveforms of Figure 4-17B show a phase-lock condition as indicated by coincidence of the leading edge of each pulse in the two waveforms.

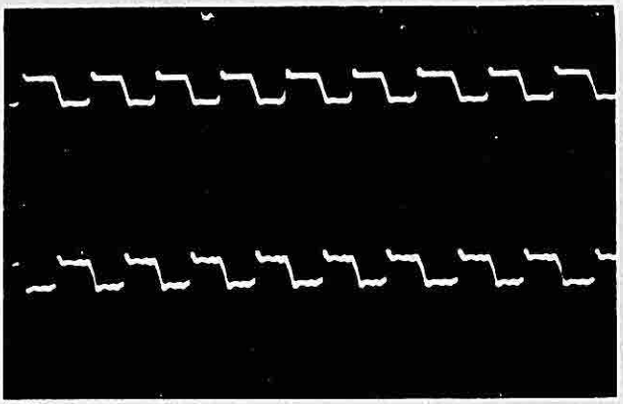


20/21 COUNTER

Test Point : U305, pin 10
Vert : 2 v/div
Horiz : 100 ns/div

Test Point : U305, pin 12
Vert : 2 v/div
Horiz : 100 ns/div

A



PRESCALER OUTPUT

Test Point : U306, pin 9
Vert : 2 v/div
Horiz : 100 ns/div

Test Point : U306, pin 8
Vert : 2 v/div
Horiz : 100 ns/div

B

FIGURE 4-16. PRESCALER WAVEFORMS

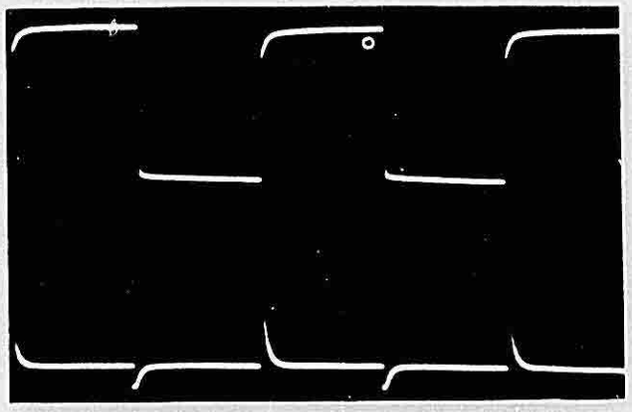
4.5.2.6 Time Sharing

The time-sharing function is controlled by the $\overline{GS}$ input at J803 pin 9. Table 3.3 shows that the $\overline{GS}$ signal is high during LOC operation; Table 3.7 shows that pin 9 is low during glide slope operation. In addition, the 50 kHz clock (J803-7) provides the time-sharing control signal to the glide slope control board.

Table 4.8 is a tabulation of all dc operating voltages as measured at the transistor and IC pins.

4.5.3 VOR/LOC Navigation Converter (NAV 121, NAV 122, NAV 122A)

The VOR/LOC navigation converter troubleshooting will be given for both the VOR and the LOC modes. Waveforms are given to show desired operating conditions at key check points in the reference and variable phase circuits for OMNI operation and the 90/150 Hz signal paths for LOC/GS operation. Operating voltages measured at the IC and transistor pins are given in Table 4.9.

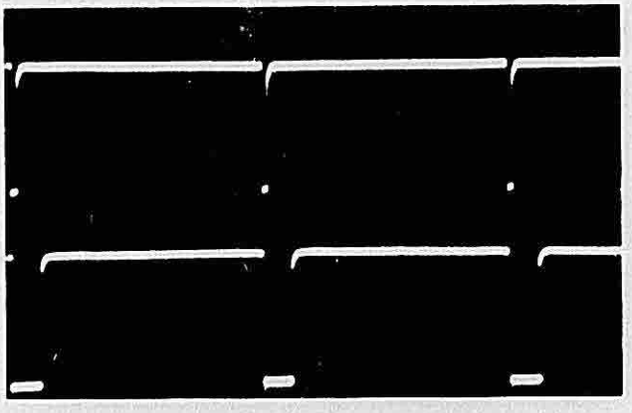


50 kHz REFERENCE

Test Point : U319 pin 4
Vert : 2 v/div
Horiz : 5 us/div

Test Point : U315 pin 13
Vert : 2 v/div
Horiz : 5 us/div

A. 50 kHz REFERENCE



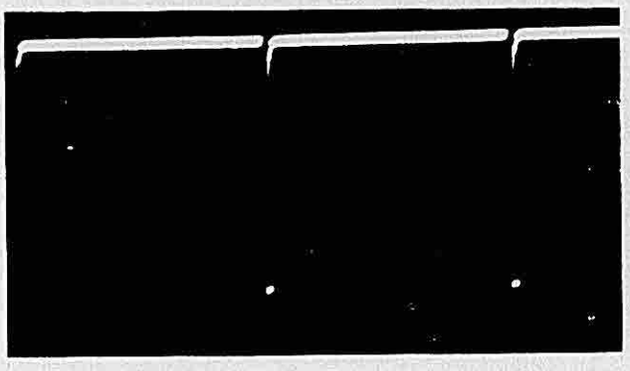
50 kHz REFERENCE INPUT

Test Point : U314 pin 1
Vert : 2 v/div
Horiz : 5 us/div

50 kHz SAMPLE INPUT

Test Point : U314 pin 3
Vert : 2 v/div
Horiz : 5 us/div

B. PHASE DETECTOR AT PHASE LOCK



50 kHz REFERENCE INPUT

Test Point : U314 pin 1
Vert : 1 v/div
Horiz : 5 us/div

C. 50 kHz REFERENCE OSCILLATOR OUTPUT

FIGURE 4-17 PHASE/FREQUENCY DETECTOR WAVEFORMS

4.5.3.1 OMNI Operation

a. Reference Channel Troubleshooting (FM, 4960 Hz). Connect test equipment as directed in Figure 4-1 and set it for a VOR channel. Connect oscilloscope to 10 kHz filter, limiter (1st and 2nd stages), and one shot. Compare waveforms with Figure 4-18 A, B, C and D. If any differences are observed, check interconnecting circuits.

b. OBS Control, Input/Output Circuits. Check phase splitter signal into OBS control and buffer amplifier at OBS phase summer output. Refer to waveforms at Figure 4-19 A and B.

c. Variable Channel Troubleshooting. Check 30 Hz filter output and clamp output. Refer to waveforms of Figure 4-20.

d. Phase Detectors, T-F and L-R.

(1) Set VOR generator for same bearing as OBS control setting. Check T-F and L-R phase detectors with oscilloscope and compare with waveforms of Figure 4-21 A and C.

(2) Set OBS control 90^{o} ahead of OMNI generator bearing. Check T-F and L-R phase detectors with oscilloscope and compare with waveforms of Figure 4-21 B and D.

e. Ripple Checks. Check ripple at output of L-R and T-F phase detectors and the power/reference sources. Refer to waveforms in Figure 4-22 A and B.

4.5.3.2 LOC/GS Operation

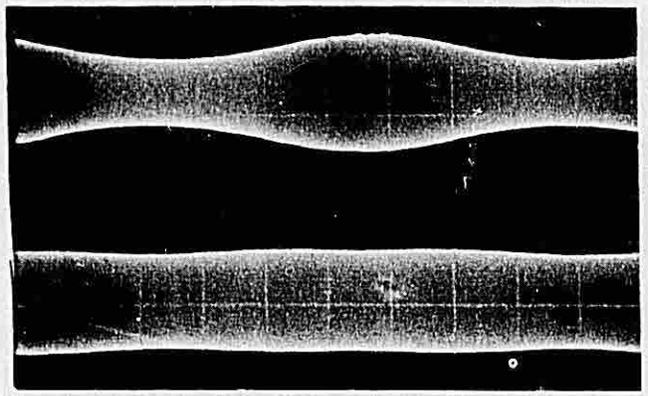
The 90/150 Hz tone filters and active rectifiers are common to the signal path of the LOC and GS receivers; in this case they are multiplexed for time sharing. Figure 4-23 A shows waveforms at the output of the 90 Hz filter (U605B) and the 150 Hz filter (U605A). Figure 4-23 B shows waveforms at the output of the 90 Hz rectifier (CR607) and the 150 Hz rectifier (CR605). Figure 4-23C shows L-R waveforms at the output of the bi-directional switch U602; also the LOC input to the L-R phase detector.

4.5.3.3 OMNI Disable Troubleshooting

With the receiver operating in the OMNI mode, check waveforms at CR604 and U601 pin 1. Refer to waveforms in Figure 4-24A.

4.5.3.4 Self-Test Amplifier Troubleshooting

Connect oscilloscope to U610 pin 10 and activate front panel SELF TEST switch S103. Refer to waveform in Figure 4-24B.



A

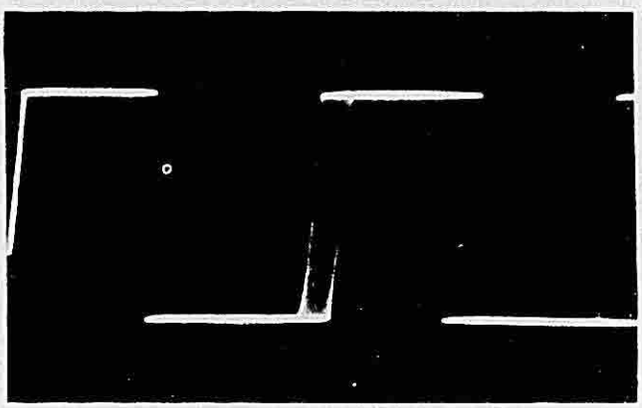
1st 10 kHz FILTER

Test Point : U609 pin 4
Vert : 2 v/cm
Horiz : 5 ms/div

2nd 10 kHz FILTER

Test Point : U609 pin 9
Vert : 2 v/cm
Horiz : 5 ms/div

Sync to 30 Hz Reference

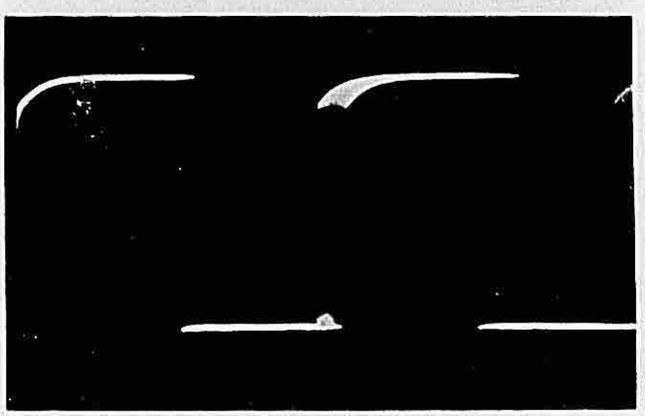


B

REF CHANNEL LIMITER FIRST STAGE

Test Point : U610 pin 9
Vert : 2 v/div
Horiz : 20 us/div

Sync Internal

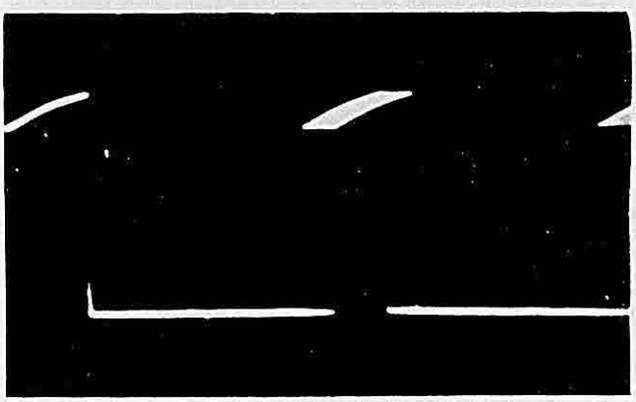


C

REFERENCE CHANNEL LIMITER,
SECOND STAGE

Test Point : U608 pin 14
Vert : 2 v/div
Horiz : 20 us/div

Sync Internal



D

REFERENCE CHANNEL ONE-SHOT

Test Point : U608 pin 13
Vert : 2 v/div
Horiz : 20 us/div

Sync Internal

FIGURE 4-18. VOR REFERENCE CHANNEL WAVEFORMS

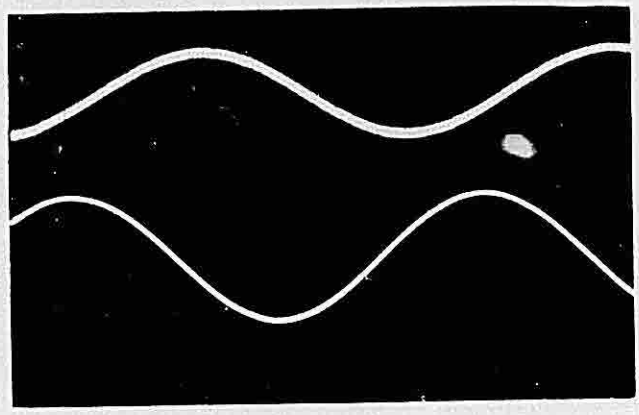
PHASE SPLITTER

Test Point : Q601 emitter
Vert : 50 mv/div
Horiz : 5 ms/div

Test Point : Q601 collector
Vert : 50 mv/div
Horiz : 5 ms/div

Sync 30 Hz Reference

A. PHASE SPLITTER Q601 WAVEFORMS



BUFFER AMPLIFIER

Test Point : U610, pin 4
Vert : 50 mv/div
Horiz : 5 ms/div

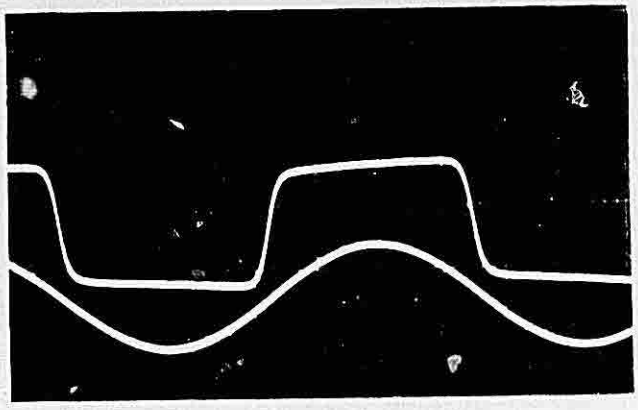
30 Hz FILTER

Test Point : U610 pin 5
Vert : 2 v/div
Horiz : 5 ms/div

Sync to 30 Hz Reference

B. BUFFER AMPLIFIER U610A WAVEFORMS

FIGURE 4-19. OBS CONTROL, INPUT/OUTPUT WAVEFORMS



CLAMP OUTPUT.

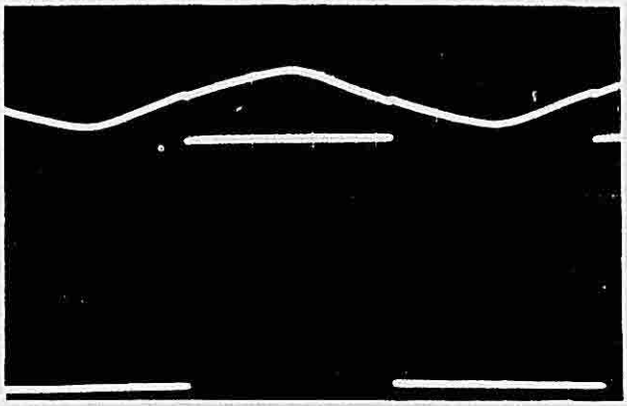
Test Point : Q602 collector
Vert : 2 v/div
Horiz : 5 ms/div

VARIABLE CHANNEL, 30 Hz FILTER

Test Point : U609 pin 5
Vert : 2 v/div
Horiz : 5 ms/div

Sync to 30 Hz Reference

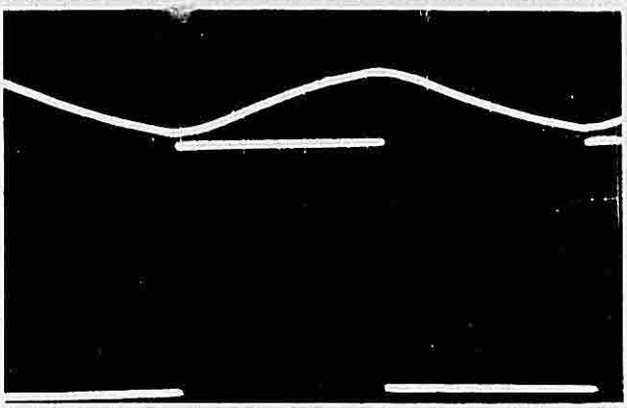
FIGURE 4-20. VOR VARIABLE CHANNEL WAVEFORMS



INPUT TO T-F PHASE DETECTOR
(ON-COURSE CENTERED SIGNAL)
Test Point : U606 pin 10
Vert : 1 v/div
Horiz : 5 ms/div

SWITCHING SIGNAL
Test Point : U606 pin 12
Vert : 2 v/div
Horiz : 5 ms/div
Sync to 30 Hz Reference

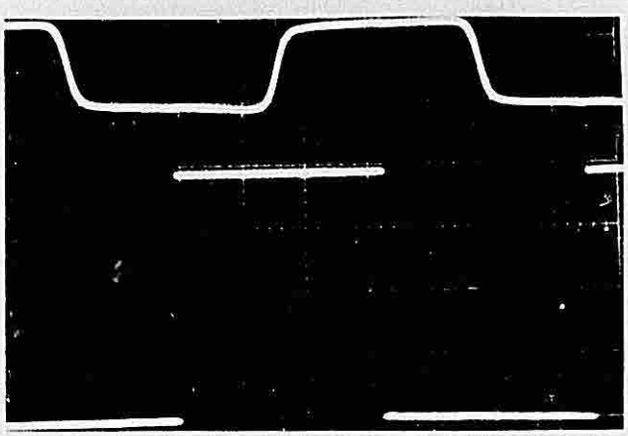
A



INPUT TO T-F PHASE DETECTOR
(90° OFF-COURSE SIGNAL)
Test Point : U606 pin 10
Vert : 1 v/div
Horiz : 5 ms/div

SWITCHING SIGNAL
Test Point : U606 pin 12
Vert : 2 v/div
Horiz : 5 ms/div
Sync to 30 Hz Reference

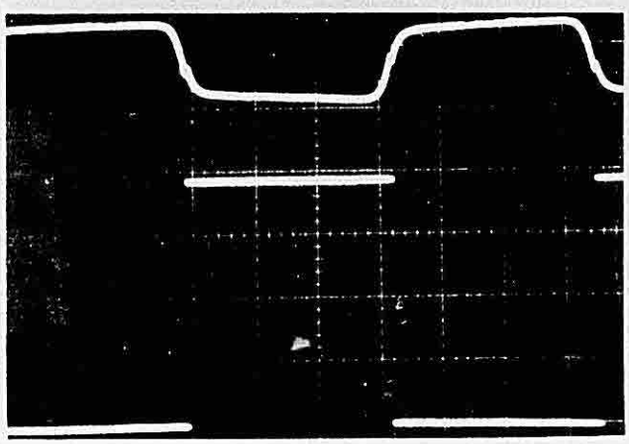
B



INPUT TO L-R PHASE DETECTOR
(CENTERED ON-COURSE SIGNAL)
Test Point : U606 pin 2
Vert : 2 v/div
Horiz : 5 ms/div

SWITCHING SIGNAL
Test Point : U606 pin 13
Vert : 2 v/div
Horiz : 5 ms/div
Sync to 30 Hz Reference

C

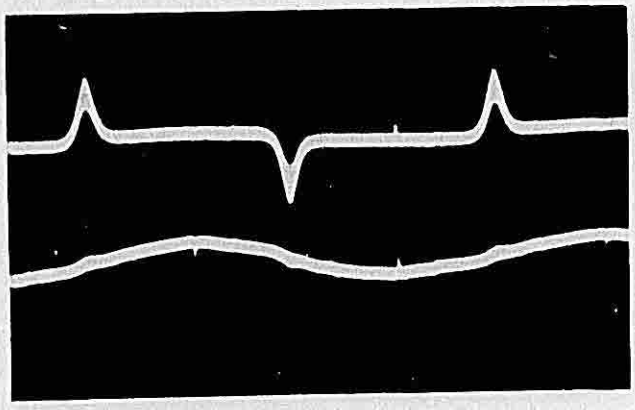


INPUT TO L-R PHASE DETECTOR
(90° OFF-COURSE SIGNAL)
Test Point : U606 pin 2
Vert : 2 v/div
Horiz : 5 ms/div

SWITCHING SIGNAL
Test Point : U606 pin 13
Vert : 2 v/div
Horiz : 5 ms/div
Sync to 30 Hz Reference

D

FIGURE 4-21. T-F AND L-R PHASE DETECTOR WAVEFORMS



RIPPLE ON L-R

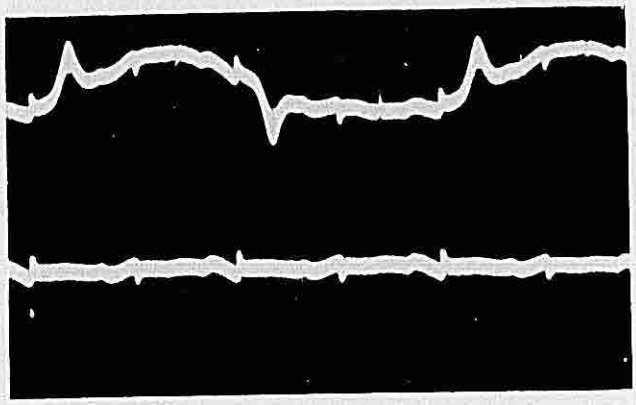
Test Point : U605 pin 14
Vert : 50 mv/div
Horiz : 5 ms/div

RIPPLE ON T-F

Test Point : U605 pin 8
Vert : 50 mv/div
Horiz : 5 ms/div

Sync to 30 Hz Reference

A



RIPPLE ON 4 V REFERENCE

Test Point : CR612 CATH
Vert : 5 mv/div
Horiz : 5 ms/div

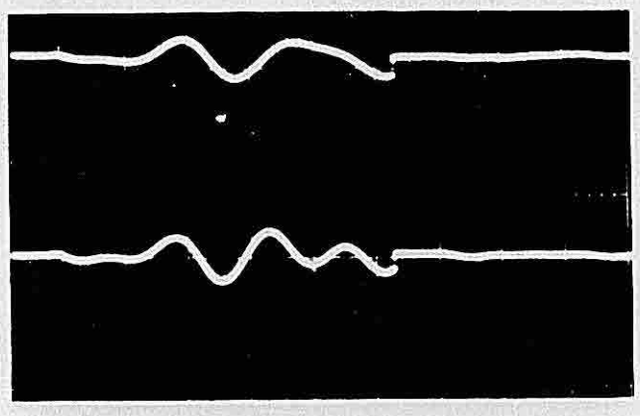
RIPPLE ON 8 V REFERENCE

Test Point : U604
Vert : 5 mv/div
Horiz : 5 ms/div

Sync to 30 Hz Reference

B

FIGURE 4-22. RIPPLE VOLTAGE WAVEFORMS



90 Hz FILTER

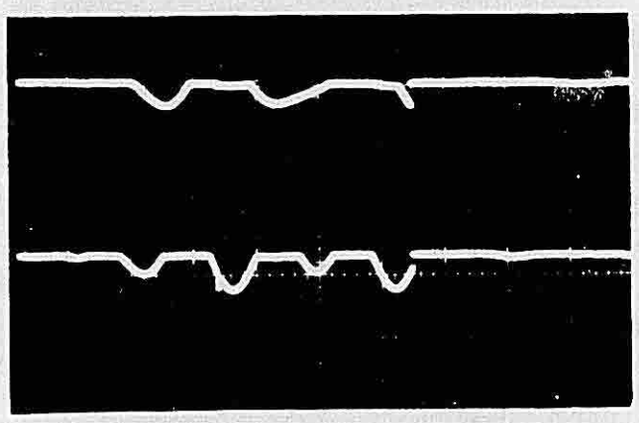
Test Point : U605 pin 7
Vert : 2 v/div
Horiz : 5 ms/div

150 Hz FILTER

Test Point : U605 pin 1
Vert : 2 v/div
Horiz : 5 ms/div

Sync to $\overline{GS}$

A. 90/150 Hz FILTER WAVEFORMS



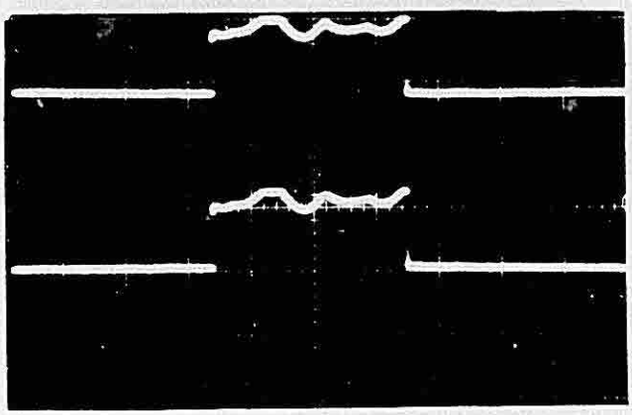
90/150 Hz RECTIFIERS

Test Point : CR607
Vert : 2 v/div
Horiz : 5 ms/div

Test Point : CR605
Vert : 2 v/div
Horiz : 5 ms/div

Sync to $\overline{GS}$

B. 90/150 Hz RECTIFIER WAVEFORMS



L-R SIGNALS, LOCALIZER MODE

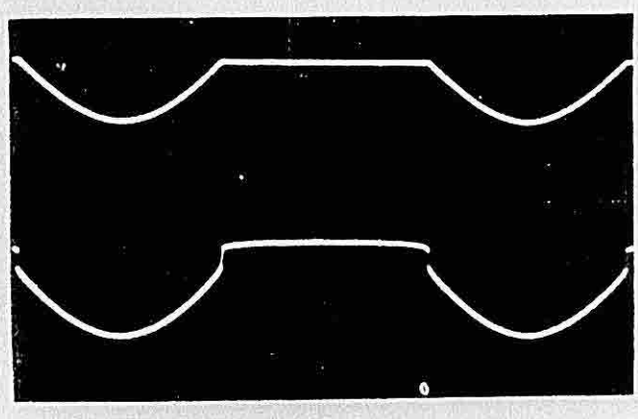
Test Point : U602, pin 1
Vert : 2 v/div
Horiz : 5 ms/div

Test Point : U602, pin 3
Vert : 2 v/div
Horiz : 5 ms/div

Sync to $\overline{GS}$

C. L-R PHASE DETECTOR INPUT WAVEFORMS

FIGURE 4-23. TIME-SHARED LOC/GS WAVEFORMS



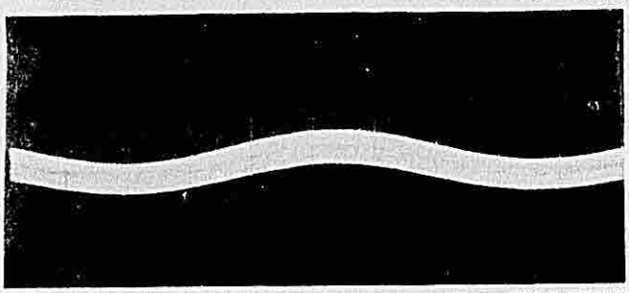
OMNI DISABLE

Test Point : CR604
Vert : 2 v/div
Horiz : 5 cm/div

Test Point : U601 pin 1
Vert : 2 v/div
Horiz : 5 cm/div

Sync to 30 Hz Reference

A. OMNI DISABLE



SELF-TEST AMPLIFIER

Test Point : U610 pin 10
Vert : 2 v/div
Horiz : 5 ms/div

Sync to 30 Hz Reference

B. SELF-TEST AMPLIFIER

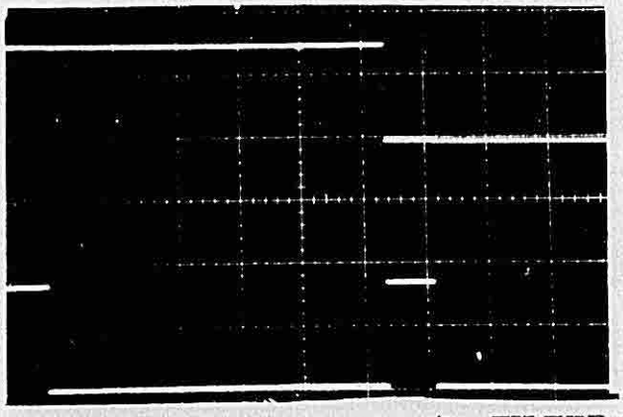
FIGURE 4-24. OMNI DISABLE AND SELF-TEST WAVEFORMS

4. 5. 3. 5 Glide Slope Control Troubleshooting (NAV 122)

The Glide Slope Control assembly provides the three sets of control signals shown in the waveforms of Figure 4-25 A, B, C, and D. With the GS switching control as a reference, the timing relationship is shown as follows: A shows the filter clamp that discharges the capacitors of the 90/150 Hz filters; B shows activation of the receiver RF and IF AGC; and, after a short period for settling down, C shows the sample signal that transfers the processed data to the displays.

4. 5. 4 Control Head Assembly (NAV 121, NAV 122, NAV 122A)

The control head assembly has all electrical displays and front panel switches connected to the receiver board, VOR/LOC converter board, synthesizer board, glide slope control board, and the marker beacon receiver board as applicable. The circuitry is relatively simple, therefore, major control head faults will be found in switches, connectors, or wiring. Use the wiring diagram to trace circuits between the control head and other plug-in assemblies. If necessary, continue with the schematic to trace signals to the source or the destination.



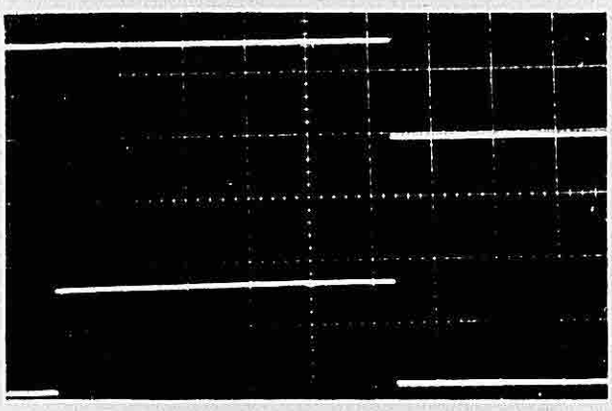
FILTER CLAMP TIMING

Test Point : J805 pin 7
Vert : 5 v/div
Horiz : 5 ms/div

Test Point : U505 pin 3
Vert : 5 v/div
Horiz : 5 ms/div

Sync to $\overline{GS}$

A. FILTER CLAMP CONTROL



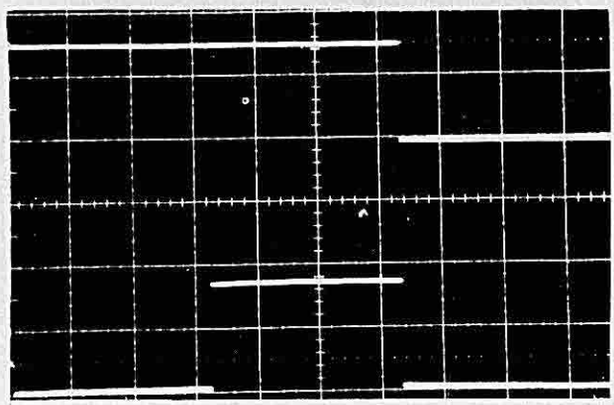
AGC GS TIMING

Test Point : J805 pin 7
Vert : 5 v/div
Horiz : 5 ms/div

Test Point : U505 pin 3
Vert : 5 v/div
Horiz : 5 ms/div

Sync to $\overline{GS}$

B. AGC CONTROL



SAMPLE GS TIMING

Test Point : J805 pin 7
Vert : 5 v/div
Horiz : 5 ms/div

Test Point : J805 pin 9
Vert : 5 v/div
Horiz : 5 ms/div

Sync to $\overline{GS}$

C. SIGNAL SAMPLING

FIGURE 4-25. TIME-SHARING CONTROL WAVEFORMS

4.5.5 Marker Beacon Assembly (NAV 122, 122A)

The Marker Beacon Assembly comprises a 75 MHz fixed frequency receiver with three outputs, each controlling the applicable front panel indicator light. Troubleshooting may be performed with an ac and a dc voltmeter, measuring at the test points indicated in Table 4.10. Oscilloscope tests are not required since only sine wave modulation is used and rms indicating ac voltmeters provide the required accuracy.

Trouble can be isolated by using the troubleshooting flow chart (Figure 4-10) to localize it to a functional group of components. The ac and dc operating voltages throughout the receiver are listed in Table 4.10. After pinpointing the trouble area with the flow charts, the voltages at these points can then be compared to the tabulated voltages and corrective actions taken.

4.6 TROUBLESHOOTING, ON-BOARD AIRCRAFT

4.6.1 GENERAL

The overall operation of the NAV 121, NAV 122, or NAV 122A Navigation Receiver/Converter is affected by the condition of the unit and the condition of the interconnecting cables. This section provides a series of tests that localize trouble to the area responsible.

Interconnecting cables include power, microphone, speaker, earphone, and other patching cables such as DME, external glide slope receiver, etc. Cables into and out of an audio control panel must also be considered. The faults associated with interconnecting cables fall into two categories: bad contacts at connector pins and broken wires.

4.6.2 EQUIPMENT TESTS

The Navigation Receiver/Converter may be tested as described in the first level flow chart (Figure 4-7). In this pre-flight test, the aircraft's engine(s), rotating beacon, electrical and avionics equipment should be operating. Use a ramp type test set as a signal source to check the VOR, LOC, GS, and marker beacon receivers as shown in flow chart Figure 4-7.

4.6.3 INTERCONNECTION WIRING TROUBLESHOOTING

The troubleshooting techniques are directly related to the navigation equipment configuration on the aircraft. Antenna cables should be moved while monitoring the front panel display: slight changes of signal level are to be expected, violent changes show trouble at the coax cable or the connector. Power cables should be monitored with a dc voltmeter and audio signal with an ac voltmeter under the same conditions.

TABLE 4.10 MARKER BEACON RECEIVER, VOLTAGE CHART

TEST POINT	VOLTAGE MEASURED			
	WITHOUT SIGNAL		WITH SIGNAL	
	VAC	VDC	VAC	VDC
Q404 Base	-	+7.5	-	-
Q404 Emitter	-	+6.9	-	-
Q403 Emitter	*	+9.5	-	-
Q401-2	0.2 to 0.4	+0.43	-	-
Q401-4	-	+0.5	-	-
Junction L401/R406 HIGH SENS	-	+3.8	-	-
Junction R418/R419 LO SENS	-	GND	-	-
Junction R418/R419	-	+1.5	-	-
FL402 pin 5	-	+0.55	-	-
FL402 pin 3	-	+0.55	-	-
U402 pin 9	3.0	+4.7	-	-
U402 pin 4	-	+0.6	-	-
Q408	-	+0.6	-	+1.2

A. RF AND AUDIO OPERATING VOLTAGES

PIN NO.	VOLTAGE		PIN NO.	VOLTAGE		PIN NO.	VOLTAGE	
	VDC	VAC		VDC	VAC		VDC	VAC
1	0.88	-	7	1.4	-	13	1.6	-
2	1.5	-	8	1.4	-	14	0.75	0.06
3	4.8	-	9	0.75	0.06	15	5.6	1.3
4	0.7	-	10	5.6	-	16	8.6	-
5	GND	-	11	0.6	-			
6	5.2		12	-	-			

B. VOLTAGES MEASURED AT IC U401

* High Sensitivity: 1 mv of 75 MHz modulated 95% by 1300 Hz at antenna connector.

4.6.4 INTERFACE WITH OTHER EQUIPMENT

4.6.4.1 Audio Interference

When used with a DME or transponder, the PRF of the interrogation could be a source of audio interference. Turn off power and monitor the audio for the presence of interference.

4.6.4.2 External Channeling Control

Some VOR receivers have provisions for channeling a DME; in others, the LOC receiver has provisions for channeling an external GS receiver. If the DME or GS receiver does not tune to the correct paired frequency channels, the MHz and kHz channel selector switch contacts should be checked.

4.7 MECHANICAL DISASSEMBLY

4.7.1 GENERAL

Disassembly instructions are given for removal of major mechanical components that may need to be repaired or replaced. In some cases, the sequence of disassembly procedures requires removal of otherwise operative components to obtain access to the components requiring service. Therefore, it is necessary to refer to the control head exploded view (Figure 5-7) and then refer to the applicable procedures of 4.7.4 for the preliminary steps that must be taken. The disassembly procedures also refer to Figure 5-7.

Following disassembly and replacement (or repair) of malfunctioning mechanical components, the unit is reassembled to the original configuration. Unless otherwise noted, reassembly instructions are essentially the same as disassembly instructions; however, they are in the reverse order for the procedures and also for the steps in each procedure.

It should be noted that some procedures can be performed on the control head while it is secured to the receiver unit (paragraph 4.7.4) and others require removal from the receiver unit (paragraph 4.7.5).

The procedures that follow apply to all three models of the receiver/navigation converter. When any procedure applies to any specific model, the model number is included in the title.

4.7.2 CASE REMOVAL

a. Remove two slotted binding head No. 4 screws and washers that secure case to rear plate of unit.

b. Remove four No. 2 slotted flat head screws located around the periphery of the case, directly behind the bezel.

c. Pull case to rear to remove it from chassis frame and shield assembly.

4.7.3 PC BOARD ASSEMBLY REMOVAL

Each of the four PC board assemblies moves in two guide rails; the forward rails are located on the rear of the mid plate, and the rear guide rails are located on the front of the rear plate. Each PC board can be removed separately for inserting the card extender plug or for access to the rear plate components. The PC boards are removed by grasping them at the top edge, clear of the components, and pulling directly upward as permitted by the guide rails.

NOTE

If uneven pull is used to extract the PC board, it may bind in the card guides. Use both hands and pull board directly from the connector.

4.7.4 CONTROL HEAD ASSEMBLY SERVICING, ASSEMBLED TO RECEIVER UNIT

4.7.4.1 Pilot Lamp Replacement

a. Remove two slotted round head No. 2 screws and one slotted binding head screw that secures the light block.

b. Break RTV cement seal (front of light block) that secures lamp to be replaced.

c. Unsolder lamp leads at rear of light block; remove blue filter and remove lamp.

d. Insert new lamp and solder leads.

e. Use non-corrosive RTV to secure lamp and filter.

f. Replace light block and secure, using screws previously removed.

4.7.4.2 Marker Beacon Sensitivity Potentiometer (R101) Replacement (NAV 122, NAV 122A)

a. Remove two slotted round head No. 2 screws and one No. 2 slotted binding head screw securing the light block to the front casting.

b. Unsolder three leads to variable resistor R101.

c. Remove variable resistor and gasket.

NOTE

Retain gasket.

d. Install new variable resistor, gasket, and solder the three variable resistor leads.

e. Secure light block using the three screws removed previously.

4.7.4.3 Marker Beacon Lamp Replacement (NAV 122, NAV 122A)

a. Remove two No. 2 slotted round head screws and one No. 2 slotted binding head screw that secure the pilot light block to the front casting.

b. Pull pilot light block up and out of the way to allow removal of marker beacon light block.

c. Remove one No. 2 slotted fillister head screw securing marker beacon light block to the meter assembly and remove light block.

d. Remove defective lamp.

e. Replace by performing above steps in reverse order.

4.7.4.4 Volume Potentiometer (R102) Replacement

a. Remove three slotted binding head No. 4 screws securing volume variable resistor bracket to front casting tie strip and meter.

b. Unsolder electrical components from variable resistor.

NOTE

Make sketch of wires removed during disconnect to assist in reconnection.

c. Remove variable resistor and bracket from radio.

d. Remove gear from variable resistor; use 3/64 inch Allen wrench.

e. Remove 1/4 inch hex nut securing variable resistor.

f. Install new variable resistor and secure it with 1/4 inch hex nut.

g. Replace by performing above steps in reverse order.

4.7.4.5 VOR and Marker Test Switch (S103) Replacement

a. Loosen 1/4 inch hex nut and lockwasher attaching pushbutton switch to bracket, and remove switch.

b. Unsolder wires from old switch and solder them to new switch.

c. Replace by performing above steps in reverse order.

4.7.4.6 IDENT Switch Shaft Replacement

a. Loosen two Allen setscrews in knob; use 5/64 inch wrench.

b. Loosen two setscrews in collar housed in switch actuator bracket.

c. Loosen two setscrews in pinion gear.

4.7.4.6 Continued

d. Remove shaft from front of radio.

e. Replace with new shaft and install it by performing above procedure in reverse order.

4.7.4.7 Kilohertz Shaft Replacement

a. Loosen two setscrews on kHz drive gear.

b. Remove shaft from front of radio.

c. Remove knob (2 setscrews) from old shaft and install it on replacement shaft.

d. Install shaft by performing above procedure in reverse order.

4.7.4.8 Meter Replacement

a. Remove knobs from all controls; use 5/64 inch hex Allen wrench.

b. Remove four Phillips flat head screws securing bezel to front panel, and remove bezel.

c. Remove two slotted binding head No. 2 scres that secure the adjustable dial guide and lockwashers.

d. Remove azimuth card.

e. Remove fixed dial guide.

f. Remove slotted pan head No. 4 screw holding meter through VOL-ON-OFF bracket.

g. Remove slotted pan head No. 4 screw holding meter through marker/VOR/test switch bracket.

h. Slide meter out as far as slack in wires will permit.

NOTE

Make sketch of wires removed during disconnect to assist in reconnection.

i. Unsolder leads that attach meter to connector.

j. Solder leads of replacement meter and install by performing above procedure in reverse order.

4.7.4.9 Frequency Counter (Odometer) Replacement

a. Set channel selector frequency to 108.00 MHz.

b. Disassemble as directed in paragraph 4.7.4.8 steps a through i for meter replacement

c. Loosen setscrew that secures counter holder bar, and remove counter holder bar.

d. Remove VOR and marker test switch as directed in paragraph 4.7.4.5 steps a through c.

e. Set radio on bench, front end forward and laying on right side.

f. Use one hand to hold the switch actuator toward the rear of the radio; the other hand is used to remove the special No. 8 setscrew.

g. The counter may now be removed through the front of the radio. Take care not to drop the ball bearing at the top end or to lose the washer used as a shim on the other end.

h. Set new frequency counter (odometer) to 108.00 MHz add previously removed shim to lower end and insert into radio. Handle carefully so that the ball, mounted on the end of the counter and secured by grease, remains in place until secured.

NOTE

Do not rotate shaft in switch wafers.

i. Tighten special setscrew until it cups the ball; then adjust until there is no play in the counter assembly.

j. Secure special setscrew with glyptol cement.

k. Digit Centering Adjustments.

(1) Megahertz Drum Adjustment. If the MHz digits are correct but are not in line with the bottom of the window, loosen setscrews on bevel gear and adjust until desired frequency appears in window with the bottom of numeral in line with the bottom of the window; then tighten setscrews.

(2) Kilohertz Drum Adjustment. If the kHz digits are correct but are not in line with the bottom of the window, loosen setscrews securing face gear and adjust until desired frequency appears with the bottom of numeral in line with the bottom of the window; then tighten setscrews.

NOTE

If there is any misalignment between the 50 and 100 kHz numerals, fine adjust face gear until numerals are in line for all frequencies.

l. Reassemble by performing the above steps in reverse order.

4.7.5 CONTROL HEAD SERVICING, REMOVED FROM RECEIVER UNIT

4.7.5.1 Removal of Control Head from Receiver Unit

a. Remove one slotted binding head No. 4 screw from top of 50 pin connector, securing connector frame and cover assembly to mid plate.

b. Remove one slotted binding head No. 4 screw from bottom of unit, securing tab on mid plate to connector frame and shield assembly.

c. Disconnect two BNC connectors in marker receiver antenna lines (NAV 122, NAV 122A only).

d. Remove control head from receiver unit.

4.7.5.2 IDENT Switch Replacement

a. Remove control head from receiver unit as directed in previous paragraph.

b. Remove mid plate, secured by three slotted binding head No. 4 screws; one located at the mid left side, one at the lower right, and one at the top right, as viewed from the front.

c. Loosen setscrew in collar; use 5/64 inch Allen wrench.

d. Remove mid plate, moving as far as slack in wires will permit. Refer to Figure 5-7 for position of IDENT shaft with relationship to the switch actuator and collar.

NOTE

Make sketch of wiring hookup.

e. Unsolder wires connected to IDENT switch.

f. Remove 1/4 inch hex nut from switch and remove switch.

g. Insert new switch, secure (using 1/4 inch hex nut), and solder wires to switch lugs.

h. Reassemble by performing above procedure in reverse order.

4.7.5.3 Kilohertz and Megahertz Wafer Switch Replacement

a. Verify that channel selector is set to 118.00 and position the receiver with the bottom side up for access to the switch wafer sections.

CAUTION

The frequency channeling will not operate after reassembly if the MHz or kHz knobs are turned during this procedure that follows.

b. Remove control head from receiver unit as described in paragraph 4.7.5.1.

4.7.5.3 Continued

c. Remove mid plate as described in paragraph 4.7.5.2, moving the plate as far as slack in wires will permit.

NOTE

The MHz wafer (S102) must be removed for access to the kHz wafer (S101). Step e can be deleted when removing only the MHz wafer.

d. Remove two No. 2 Phillips round head screws securing the MHz section (S102) and lift from the shaft extending through the wafer section.

CAUTION

Before removing the MHz or kHz wafer sections, note that there are two flats on each shaft; of the mating surfaces on the wafer, one is straight and one has a notch. If this notched surface is not in the same position when reassembled, the frequency channeling will not operate (see Figure 5-7).

NOTE

When unsoldering wires from the MHz or kHz wafers, make a sketch of wire locations to ensure resoldering the wires in the correct positions.

e. Remove two No. 2 Phillips round head screws securing the kHz section (S101) and lift it from the sln ft extending through the wafer sections.

f. Replace defective wafer section and resolder MHz and/or kHz wires as required, using sketch made when unsoldering.

NOTE

The notch on each wafer rotor must be properly oriented when placed on the shafts.

g. Secure kHz and MHz wafer sections with the two No. 2 screws in each.

h. Install mid plate, securing it with the original three screws. Verify that the collar and switch actuator are properly oriented on the IDENT shaft.

4.7.5.4 OBS Shaft Replacement

a. Remove control head from receiver unit as described in paragraph 4.7.5.1.

b. Use 5/64 inch hex Allen wrench to loosen setscrews in OBS knob. Remove knob and spacer.

4.7.5.4 Continued

c. Loosen two setscrews on OBS driver gear.

d. Remove No. 4 slotted binding head screw holding OBS shaft spring.

e. Pull OBS gear and shaft assembly from the back of the control head.

f. Insert new OBS shaft and spacer.

g. Replace OBS shaft spring and secure with original No. 4 screw.

h. Secure OBS driver gear with 0.005 to 0.010 inch clearance between front of gear and rear of azimuth card taking care that the OBS shaft is as far forward as the spacer will permit.

i. Replace OBS knob and spacer.

j. Reassemble by performing steps a and b in the reverse order.

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5.1 GENERAL

The Replacement Parts List is subdivided into two sections, the Mechanical Parts List and the Electrical Parts List. These lists are composites wherein all the parts of the NAV 121, NAV 122, and the NAV 122A are listed.

5.1.1 Cross-References

The expression "See Figure --- for breakdown" is self-explanatory, its counterpart "See Figure ---, index --- for Next Higher Assy" relates this breakdown back to where the subassembly was first identified in the parts list.

5.2 MECHANICAL PARTS LIST

The Mechanical Parts List section is intended to locate, identify, and show part relationship to the Unit itself. Only reuseable hardware is listed as Attaching Parts.

The symbol ----*---- is used to indicate the end of that series of Attaching Parts.

Certain electrical parts are shown and listed only to show their relationship to the assembly, attaching parts, or for part location where not necessarily shown elsewhere.

PC board assemblies are listed in the Mechanical Parts List section only to identify, if any, those replaceable mechanical parts on the board. The blank PC board is listed only to show that it is the last and perhaps the only mechanical part of the assembly. It is not intended that such a board would be replaced.

5.2.1 Index Numbers v/s Items in the Art

Parts without index numbers in the list are usually subassemblies that are broken down in that list instead of being referred to a seperate list. (These breakdowns can be easily seen as the parts of that subassembly are indented in the listing more than that of the assembly itself.)

Each item shown in the art is identified by an index number or electrical symbol number (or both). Where a part is attached by more than one piece of hardware, usually one set of hardware is shown and indexed. The total quantity required to be used is shown in the quantity column. In most cases it is obvious where the other sets go. When a part is attached by a variety of types or sizes of attaching parts, sufficient indexing and drawings of these parts is provided to determine what type of hardware goes where.

5.3 ELECTRICAL PARTS LIST

The Electrical Parts List details all the electrical parts in Alpha-Numerical sequence subassembly by subassembly (100's, 200's, 300's, etc.).

All electrical parts are identified in Section 6: Schematics. Those parts that are mechanically attached generally will be identified also within the mechanical lists. Such parts have a cross-reference notation ---- See Fig. ----.

The Electrical Parts List also contains additional when and where used data. Each subassembly listing is preceeded with a data block identifying the units the subassembly is located, the subassembly, part number and assembly code and the schematic drawing number including its figure number.

The list data commences with the Chassis Code Level, this level is the point where the part was first used. The PC board and chassis also have these codes stamped on them. Note that these lists site some chassis codes along with a number. The number is only to provide a sequence of minor changes before the chassis level was changed.

The Action letter signifies: o original part, c the new changed part, and d the part was deleted.

5.4 THE "B" CHASSIS

The Flexible Circuit has been replaced with a "hard" PC board assembly. Such Units have a chassis level code whose first letter is "B".

NAV 121	B	FBBE
NAV 122	B	GCBEE
NAV 122A	B	GBBED

This change therefore required other minor changes to the Receiver Converter Assy and the Control Head Assy.

For administrative purposes the part numbers of these Units and the two major subassemblies were changed as follows:

UNIT

NAV 121 was 01232-0101....NOW 01335-0101
NAV 122 was 01232-0102....NOW 01335-0102
NAV 122A was 01232-0103....NOW 01335-0103

SUBASSEMBLIES

NAV 121 Receiver Converter Assy was 01234-0101...NOW 01337-0101
NAV 122 Receiver Converter Assy was 01234-0102...NOW 01337-0102
NAV 122A Receiver Converter Assy was 01234-0103...NOW 01337-0103

NAV 121 Control Head Assy.....was 01233-0102...NOW 01233-0106
NAV 122 Control Head Assy.....was 01233-0101...NOW 01233-0105
NAV 122A Control Head Assy.....was 01233-0103...NOW 01233-0107

The above action does not effect the: TSO, circuitry, operation, or use.

Interchangeability

A "B" Chassis Unit can be installed where an "A" Chassis Unit was. If a Receiver Converter Assy or Control Head Assy is to be replaced, order the assembly using the same part number which was in the Unit, they are NOT interchangeable.

Subassemblies of the Receiver Converter Assy are the same part numbers as the "A" and "B" chassis and they therefore can be interchanged (with the exception of the Flex Circuit vs the "hard" pc board).

5.5 REPLACEMENT MODULES

Narco's Module Exchange Program maybe used to obtain the following complete and tested subassemblies:

	Module	Order No.
NAV 122	RECEIVER PC BOARD	01238-0101
NAV 121/122A	RECEIVER PC BOARD	01238-0102
NAV 121/122/122A	SYNTHESIZER PC BOARD	01237-0101
NAV 122	MKR BEACON/GLIDE SLOPE PC BOARD	01236-0102
NAV 122A	MKR BEACON PC BOARD	01236-0101
NAV 122	OMNI/LOC PC BOARD	01235-0101
NAV 121/122A	OMNI/LOC PC BOARD	01235-0103

When ordering such modules, also supply the chassis level code letter that is stamped on the board you have at hand (the letter is a capital letter, about 1/8 inch high.)

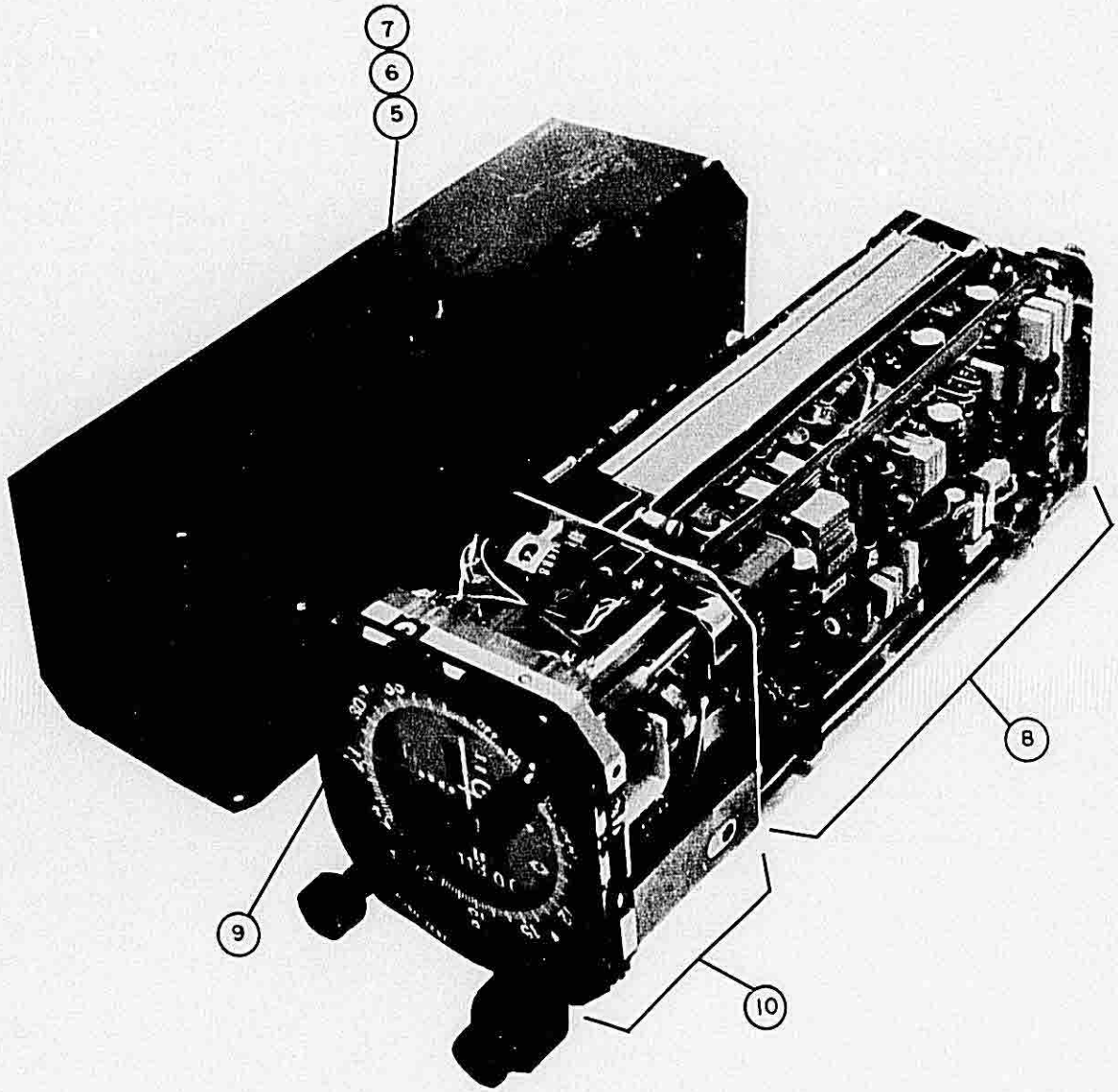

FIGURE 5-1. NAVIGATION RECEIVER/CONVERTER, NAV 121, NAV 122, AND NAV 122A (CHASSIS CODE "A")

MECHANICAL PARTS LIST ("A" CHASSIS CODE)

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
5.1	01232-0101		NAVIGATION RECEIVER/CONVERTER, NAV 121	1
	01232-0102		NAVIGATION RECIEVER/CONVERTER, NAV 122	1
	01232-0103		NAVIGATION RECEIVER/CONVERTER, NAV 122A	1
-1	04818-0001		LABEL, Nameplate, NAV 121 (not shown)	2
	04818-0003		LABEL, Nameplate, NAV 122 (not shown)	2
	04818-0002		LABEL, Nameplate, NAV 122A (not shown)	2
-2	04706-0009		LABEL, Patent Notice (not shown)	1
-3	04816-0001		LABEL, Glide Slope/VOR antenna (not shown)	1
-4	04816-0002		LABEL, MKR Antenna (not shown)	1
-4A	04835-0001		LABEL, Nameplate: G/S Receiver Not TSO NAV 122	1
-5	56041-0001		CASE	1
			(ATTACHING PARTS)	
-6	82845-0302		SCREW, Mach, Flat Hd, Undercut, 2-56 x 3/16	4
-7	82814-0003		SCREW, Mach, Bind Hd, Sl, 4-40 x 1/4	2
	81324-0004		WASHER, Lock, No. 4	2
			- - - - - * - - - - -	
-8	01234-0101		RECEIVER CONVERTER UNIT, NAV 121 (See Figure 5.2 for Breakdown)	1
	01234-0102		RECEIVER CONVERTER UNIT, NAV 122 (See Figure 5.2 for Breakdown)	1
	01234-0103		RECEIVER CONVERTER UNIT, NAV 122A (See Figure 5.2 for Breakdown)	1
-9	56159-0001		RING, Square (Gasket)	1
-10	01233-0102		CONTROL HEAD ASSY, NAV 121 (See Figure 5.7 for Breakdown)	1
	01233-0101		CONTROL HEAD ASSY, NAV 122 (See Figure 5.7 for Breakdown)	1
	01233-0103		CONTROL HEAD ASSY, NAV 122A (See Figure 5.7 for Breakdown)	1
-11	56152-0001		RETAINER, PC Board (mtd in case, not shown)	1
-12	04069-0001		LABEL, FCC Certification (not shown)	1
-13	04841-0001		LABEL, Warning (not shown)	1
-14	82814-0003		SCREW, Mach, Bind Hd, Sl, 4-40 x 1/4 (not shown)	1
-15	81324-0004		WASHER, Lock, No. 4 (not shown)	1
-16	82814-0009		SCREW, Mach, Bind Hd, Sl, 4-40 x 3/4 (not shown)	1
-17	82814-0008		SCREW, Mach, Bind Hd, Sl, 4-40 x 5/8 (not shown)	1
-18	81329-0004		WASHER, Flat, No. 4 (not shown)	1

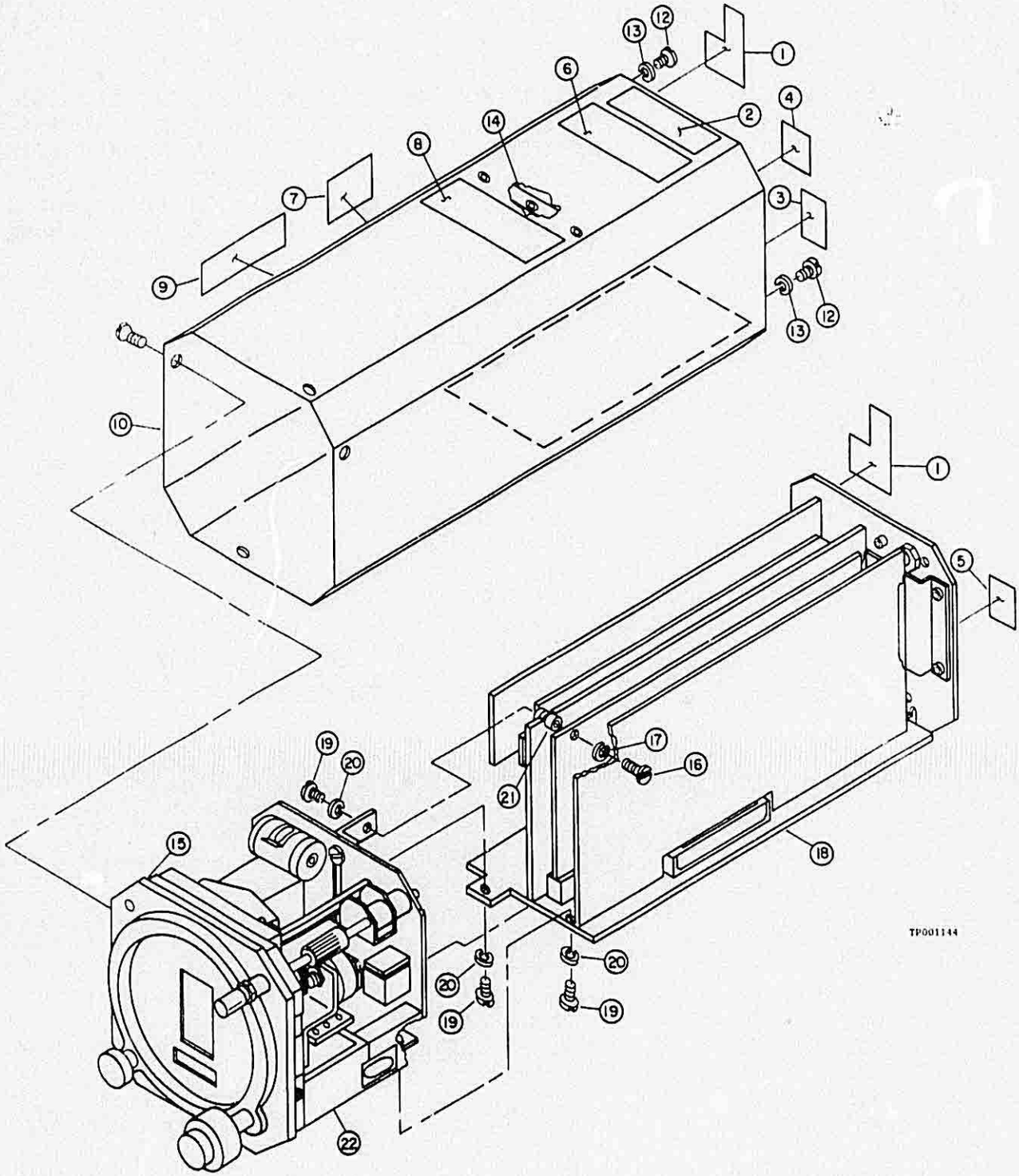

FIGURE 5-1A. NAVIGATION RECEIVER/CONVERTER, NAV 121, NAV 122, AND NAV 122A (CHASSIS CODE "B")

MECHANICAL PARTS LIST ("B" CHASSIS CODE)

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
5.1A	01335-0101C		NAVIGATION RECEIVER/CONVERTER, NAV 121 (BFBBE)	1
	01335-0102C		NAVIGATION RECEIVER/CONVERTER, NAV 122 (BGCBEE)	1
	01335-0103C		NAVIGATION RECEIVER/CONVERTER, NAV 122A (BGBBED)	1
-1	04818-0001		LABEL, Nameplate, NAV 121	2
	04818-0003		LABEL, Nameplate, NAV 122	2
	04818-0002		LABEL, Nameplate, NAV 122A	2
-2	04706-0009		LABEL, Patent Notice	1
-3	04816-0001		LABEL, Glide Slope/VOR Antenna	1
-4	04816-0002		LABEL, MKR Antenna	1
-5	04835-0002		LABEL, G/S Channeling, TSO'd, NAV 122	1
-6	04069-0001		LABEL, FCC Certification	1
-7	04396-0001		LABEL, Patent Pending	1
-8	04841-0001		LABEL, Warning	1
-9	04847-0001		LABEL, Caution	1
-10	56041-0001		CASE	1
			(ATTACHING PARTS)	
-11	82845-0302		SCREW, Mach, Flat Hd, Undercut, 2-56 x 3/16	4
-12	82814-0003		SCREW, Mach, Bind Hd, Sl, 4-40 x 1/4	2
-13	81324-0004		WASHER, Lock, Split, No. 4	2
			- - - - - * - - - - -	
-14	56152-0001		RETAINER, PC Board (Eylet mtd in case)	1
-15	56159-0001		RING, Square (Gasket)	1
			--Items -16 and -17 attaches MKR PC Bd--	
-16	82814-0002		SCREW, Mach, Bind Hd, Sl, 4-40 x 3/16	1
-17	81324-0004		WASHER, Lock, Split, No. 4	1
-18	01337-0101		RECEIVER/CONVERTER UNIT, NAV 121 (See Figure 5.2A for breakdown)	1
	01337-0102		RECEIVER/CONVERTER UNIT, NAV 122 (See Figure 5.2A for breakdown)	1
	01337-0103		RECEIVER/CONVERTER UNIT, NAV 122A (See Figure 5.2A for breakdown)	1
			(ATTACHING PARTS)	
-19	82814-0003		SCREW, Mach, Bind Hd, Sl, 4-40 x 1/4	3
-20	81324-0004		WASHER, Lock, Split, No. 4	3
-21	56186-0001		GUIDE, Board	1
			- - - - - * - - - - -	
-22	01233-0106		CONTROL HEAD, NAV 121 (See Figure 5.7A for breakdown)	1
	01233-0105		CONTROL HEAD, NAV 122 (See Figure 5.7A for breakdown)	1
	01233-0107		CONTROL HEAD, NAV 122A (See Figure 5.7A for breakdown)	1

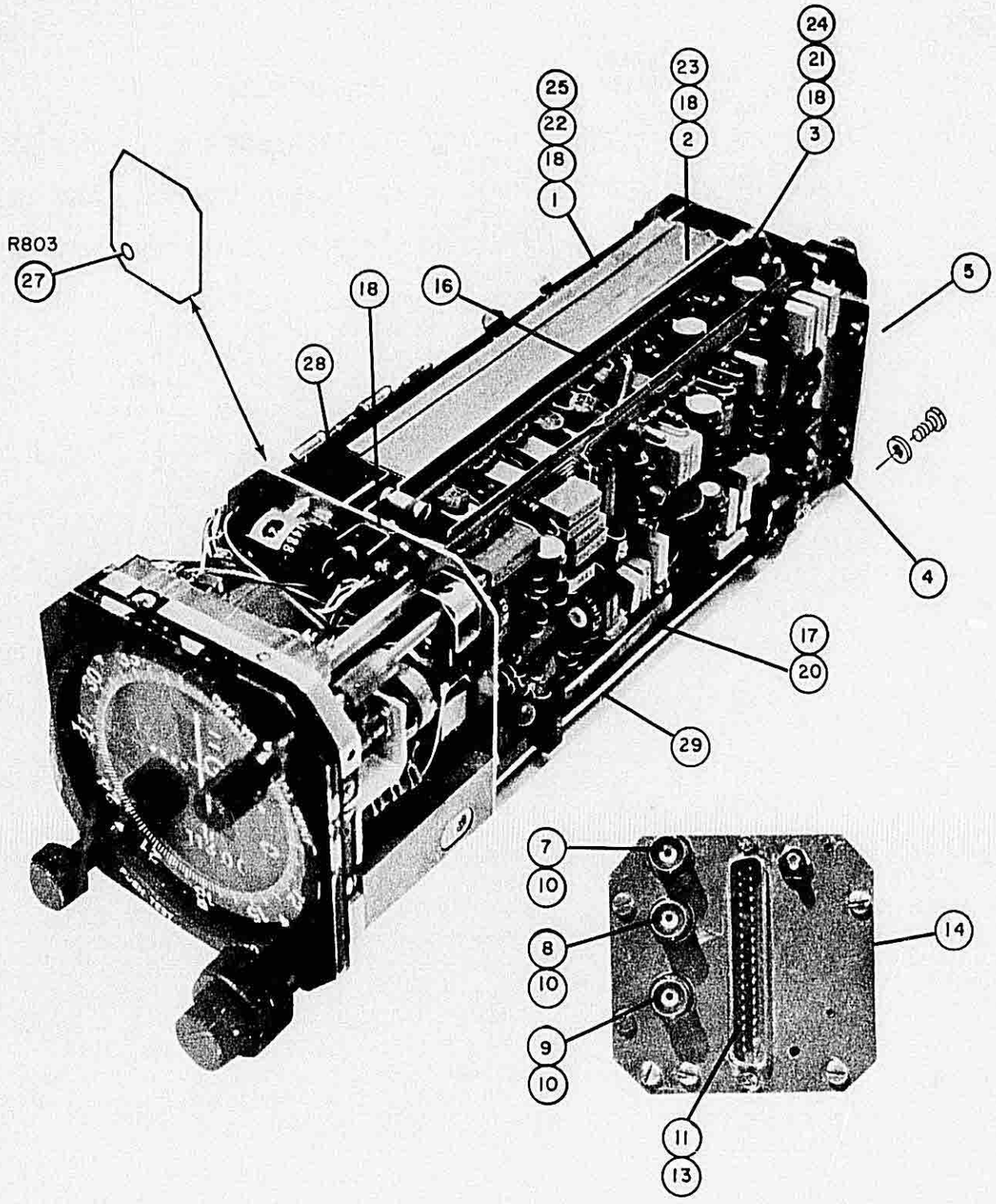

FIGURE 5-2. RECEIVER CONVERTER UNIT, NAV 121, NAV 122 AND NAV 122A (CHASSIS CODE "A")

MECHANICAL PARTS LIST ("A" CHASSIS CODE)

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY
5.2	01234-0101		RECEIVER CONVERTER UNIT, NAV 121 (See Figure 5.1, item -8 for Next Higher Assy)	Ref
	01234-0102		RECEIVER CONVERTER UNIT, NAV 122 (See Figure 5.1, item -8 for Next Higher Assy)	Ref
	01234-0103		RECEIVER CONVERTER UNIT, NAV 122A (See Figure 5.1, item -8 for Next Higher Assy)	Ref
-1	01238-0101		RECEIVER PC BOARD ASSY, NAV 122 (See Figure 5.3 for Breakdown)	1
-1	01238-0102		RECEIVER PC BOARD ASSY, NAV 121, NAV 122A (See Figure 5.3 for Breakdown)	1
-2	01237-0101		SYNTHESIZER PC BOARD ASSY (See Figure 5.4 for Breakdown)	1
-3	01236-0102		MARKER BEACON/GLIDESLOPE PC BOARD ASSY, NAV 122 (See Figure 5.5 for Breakdown)	1
-3	01236-0101		MARKER BEACON PC BOARD ASSY, NAV 122A (See Figure 5.5 for Breakdown)	1
-4	01235-0101		OMNI-LOCALIZER PC BOARD ASSY, NAV 122 (See Figure 5.5 for Breakdown)	1
-4	01235-0103		OMNI-LOCALIZER PC BOARD ASSY, NAV 121, NAV 122A (See Figure 5.6 for Breakdown)	1
-5	56071-0101		BRACKET, Rear Plate	1
-6	NOT USED			
-7	41360-0001	J807	CONNECTOR, Receptacle	1
-8	41360-0001	J808	CONNECTOR, Receptacle, NAV 122, NAV 122A	1
-9	41360-0001	J809	CONNECTOR, Receptacle, NAV 122	1
-10	81737-0002		TERMINAL, Lug, NAV 121	1
	81737-0002		TERMINAL, Lug, NAV 122	3
	81737-0002		TERMINAL, Lug, NAV 122A	2
-11	41368-0007	J810	CONNECTOR, Receptacle, 37 Pin	1
-12	NOT USED			
-13	41308-0006		LOCKING ASSY, Connector	1
-14	56070-0101		PLATE, Rear	1
-15	NOT USED			

MECHANICAL PARTS LIST ("A" CHASSIS CODE)

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY
-16	56073-0101		FLEXIBLE CIRCUIT	1
-17	56080-0002		COVER, Connector	1
-18	56080-0001		COVER, Connector, NAV 122, NAV 122A	4
-18	56080-0001		COVER, Connector, NAV 121	2
-19	NOT USED			
-20	41362-0002	J806	CONNECTOR, Receptacle, 26 Pin	1
-21	41362-0001	J805	CONNECTOR, Receptacle, 20 Pin, NAV 122, NAV 122A	1
-22	41362-0001	J801	CONNECTOR, Receptacle, 20 Pin	1
-23	41362-0001	J803	CONNECTOR, Receptacle, 20 Pin	1
-24	41362-0001	J804	CONNECTOR, Receptacle, 20 Pin, NAV 122, NAV 122A	1
-25	NOT USED			
-26	NOT USED			
-27	32068-0001	R803	RESISTOR, Variable (OBS Pot.)	1
-28	56057-0001		GEAR, Potentiometer	1
-29	56069-0001		FRAME AND SHIELD ASSY, Connector	1
			MISCELLANEOUS HARDWARE USED:	
	82889-0001		SETSCREW	2
	81701-0004		LUG, Solder	1
	82814-0009		SCREW, Mach., Bind Hd., 4-40 x 3/4	1
	81307-0076		WASHER, Flat, No. 4	1
	81307-0119		WASHER, Fiber	2
	82802-0001		WASHER, Lock, Internal Tooth, No. 4	2
	82900-0003		NUT, Hex, No. 4	1
	82813-0005		SCREW, Mach., Bind Hd., 2-56 x 3/8	2
	82900-0001		NUT, Hex, No. 2	2
	81214-0027		SPACER, Phenolic	2
	84088-0705		STUD, Self-clinching, 8-32 x 3/4	1
	81324-0008		WASHER, Lock, Split, No. 8	1
	82900-0213		NUT, Hex, 8-32	1
	82814-0002		SCREW, Mach., Bind Hd., 4-40 x 3/16	1
	82814-0003		SCREW, Mach., Bind Hd., 4-40 x 1/4	4
	81324-0004		WASHER, Lock, Split, No. 4	6
	82814-0006		SCREW, Mach., Bind Hd., 4-40 x 7/16, NAV 121	6
	82814-0006		SCREW, Mach., Bind Hd., 4-40 x 7/16, NAV 122, NAV 122A	10

MECHANICAL PARTS LIST ("B" CHASSIS CODE)

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
5.2A	01337-0101H		RECEIVER CONVERTER UNIT, NAV 121 (See Figure 5-1A, Item -18 for Next Higher Assy)	Ref.
	01337-0102H		RECEIVER CONVERTER UNIT, NAV 122 (See Figure 5-1A, Item -18 for Next Higher Assy)	Ref.
	01337-0103H		RECEIVER CONVERTER UNIT, NAV 122A (See Figure 5-1A, Item -18 for Next Higher Assy)	Ref.
-1	01238-0101		RECEIVER PC BD, NAV 122 (See Figure 5-3 for breakdown)	1
	01238-0102		RECEIVER PC BD, NAV 121/122A (See Figure 5-3 for breakdown)	1
-2	01237-0101		SYNTHESIZER PC BD, (See Figure 5-4 for breakdown)	1
-3	83028-0015		INSULATOR, 6-1/4 x 2-5/8 x .010 thick	1
-4	01235-0103		OMNI/LOC PC BD, NAV 121/NAV 122A (See Figure 5-6 for breakdown)	1
	01235-0101		OMNI/LOC PC BD, NAV 122 (See Figure 5-6 for breakdown)	1
-5	83028-0006		INSULATOR, 5-3/4 x 2-7/8 x .004 thick	1
-6	01236-0102		MARKER BEACON/GLIDE SLOPE PC BD, NAV 122 (See Figure 5-5 for breakdown)	1
	01236-0101		MARKER BEACON PC BD, NAV 122A (See Figure 5-5 for breakdown)	1
-7	83028-0014		INSULATOR, 5-3/16 x 2-3/4 x .010 thick (Attached inside case-See Fig. 5-1A, Item 10)	1
			(ATTACHING PARTS-Middle/Bottom PC Bds to Rear Plate)	
-8	82884-0002		SCREW, Mach, Flat Hd, Undercut, 4-40 x 3/16	2
-9	82814-0003		SCREW, Mach, Bind Hd, Sl, 4-40 x 1/4	1
-10	81324-0004		WASHER, Lock, Split, No. 4	1
-11	82900-0003		NUT, Hex, 4-40	1
			- - - - - * - - - - -	
-12	24551-0003	C801/ C832	CAPACITOR, Ceramic Disc, .001 µF ±20%, 50V	32
-13	31218-0222	R801	RESISTOR, Fixed, Carbon, 2.2K ±5%, 1/4w	1
-14	31218-0562	R802	RESISTOR, Fixed, Carbon, 5.6K ±5%, 1/4w	1
-15	81366-0001		RIVET, Split, Nylon	1
-16	81336-0025		WASHER, Flat, Nylon	1
-17	56197-0002		COVER, Connector, MKR/GS, (for J804/ J805)	2
-18	56197-0002		COVER, Connector, Rec/Synth, (for J801/J803)	2
-19	56197-0001		COVER, Connector, VOR/LOC, (for J806)	1

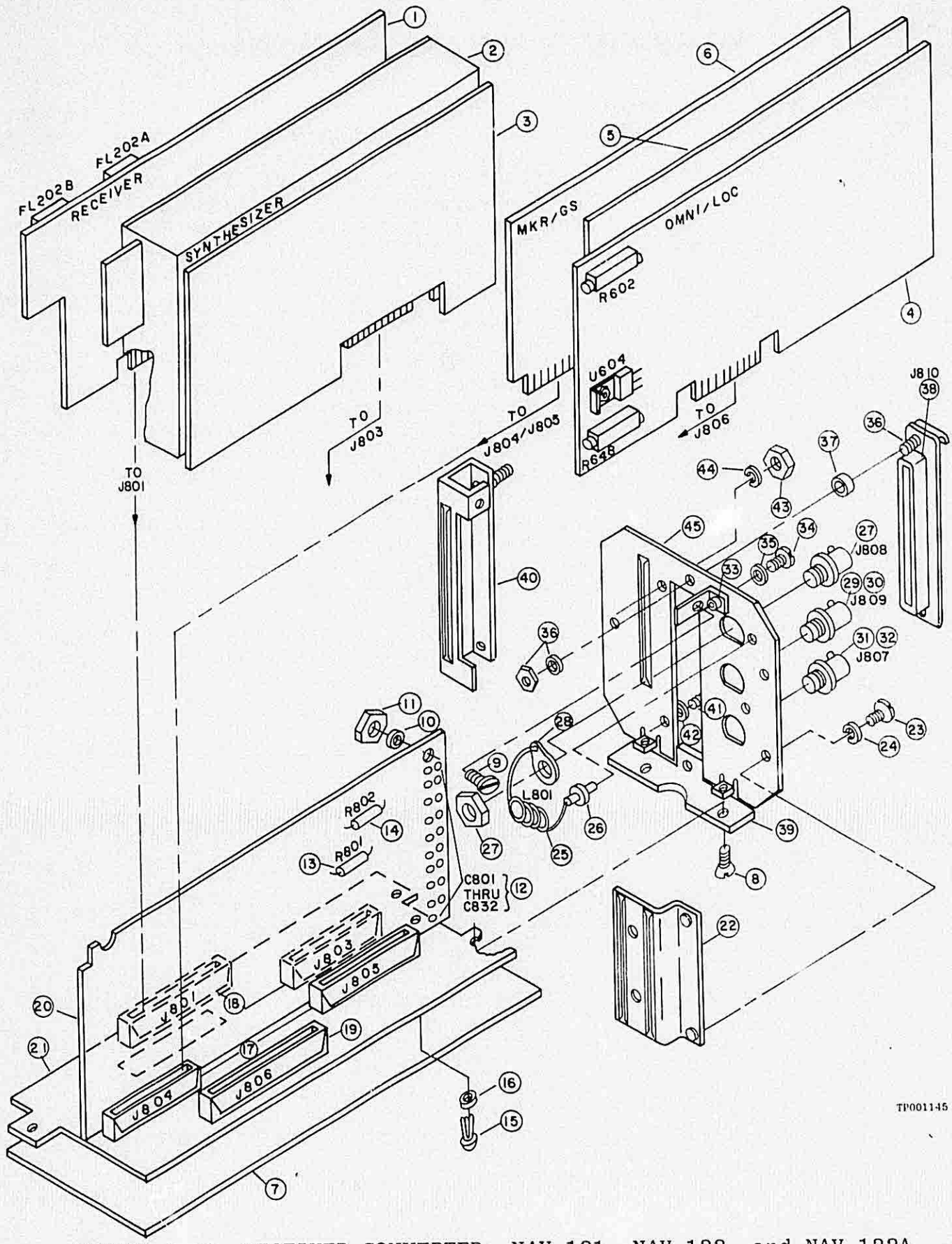

FIGURE 5-2A. RECEIVER CONVERTER, NAV 121, NAV 122, and NAV 122A (CHASSIS CODE "B")

MECHANICAL PARTS LIST ("B" CHASSIS CODE)

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
-20	56172-0001		MIDDLE PC BD (less Components)	1
-21	56171-0001		BOTTOM PC BD (less Components)	1
-22	56071-0101		BRACKET, Rear Plate	1
			(ATTACHING PARTS)	
-23	82814-0003		SCREW, Mach, Bind Hd, Sl, 4-40 x 1/4	1
-24	81324-0004		WASHER, Lock, Split, No. 4	1
			- - - - - * - - - - -	
-25	11713-0006	L801	COIL, NAV 122/NAV 122A	1
-26	81430-0008		STANDOFF, Nylon, Press-fit, NAV 122/ NAV 122A	1
-27	41360-0001	J808	CONNECTOR, BNC, NAV 122/NAV 122A (MKR)	1
-28	81737-0002		LUG, Solder, NAV 122/NAV 122A	1
-29	41360-0001	J809	CONNECTOR, BNC, NAV 122 (GS)	1
-30	81737-0002		LUG, Solder, NAV 122	1
-31	41360-0001	J807	CONNECTOR, BNC, (NAV)	1
-32	81737-0002		LUG, Solder	1
-33	56188-0102		BRACKET	1
			(ATTACHING PARTS)	
-34	82814-0003		SCREW, Mach, Bind Hd, Sl, 4-40 x 1/4	1
-35	81324-0004		WASHER, Lock, Split, No. 4	1
			- - - - - * - - - - -	
-36	41308-0006		LOCKING ASSY, Connector w/hardware	1
-37	81206-0188		SPACER	1
-38	41355-0007	J810	CONNECTOR, 37 Pin	1
-39	56682-0101		BRACKET	1
-40	56173-0101		BRACKET	1
			(ATTACHING PARTS)	
-41	82814-0003		SCREW, Mach, Bind Hd, Sl, 4-40 x 1/4	1
-42	81324-0004		WASHER, Lock, Split, No. 4	1
-43	82900-0213		NUT, Hex, No. 8	1
-44	81324-0008		WASHER, Lock, Split, No. 8	1
			- - - - - * - - - - -	
-45	56174-0101		PLATE, Rear	1

MECHANICAL PARTS LIST

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
5.3	01238-0101		RECEIVER PC BOARD ASSY, NAV 122 (See Figure 5.2, item -1 for Next Higher Assy) 5.2A, item -1	Ref.
	01238-0102		RECEIVER PC BOARD ASSY, NAV 121, NAV 122A (See Figure 5.2, item -1 for Next Higher Assy) 5.2A, item -1	Ref.
-1	56128-0001		COVER, VCO	1
-2	56127-0001		SHIELD, VCO	1
-3	74039-0003	U205	I.C., Voltage Regulator (+8V)(78M08)	1
			(ATTACHING PARTS)	
-4	82814-0003		SCREW, Mach, Bind Hd, 4-40 x 1/4	1
	81324-0004		WASHER, Lock, Split, No. 4	1
	82900-0003		NUT, Hex, 4-40	1
			- - - - - * - - - - -	
-5	54559-0001		INSULATOR (FK202A/FL202B)	2
-6	81807-0002		PIN	4
-7	56130-0101		SHIELD, RF Amp	1
-8	83026-0001		INSULATOR, (L205, L206, L207, L208)	4
-9	56116-0002		PC BOARD (Less Components)	1

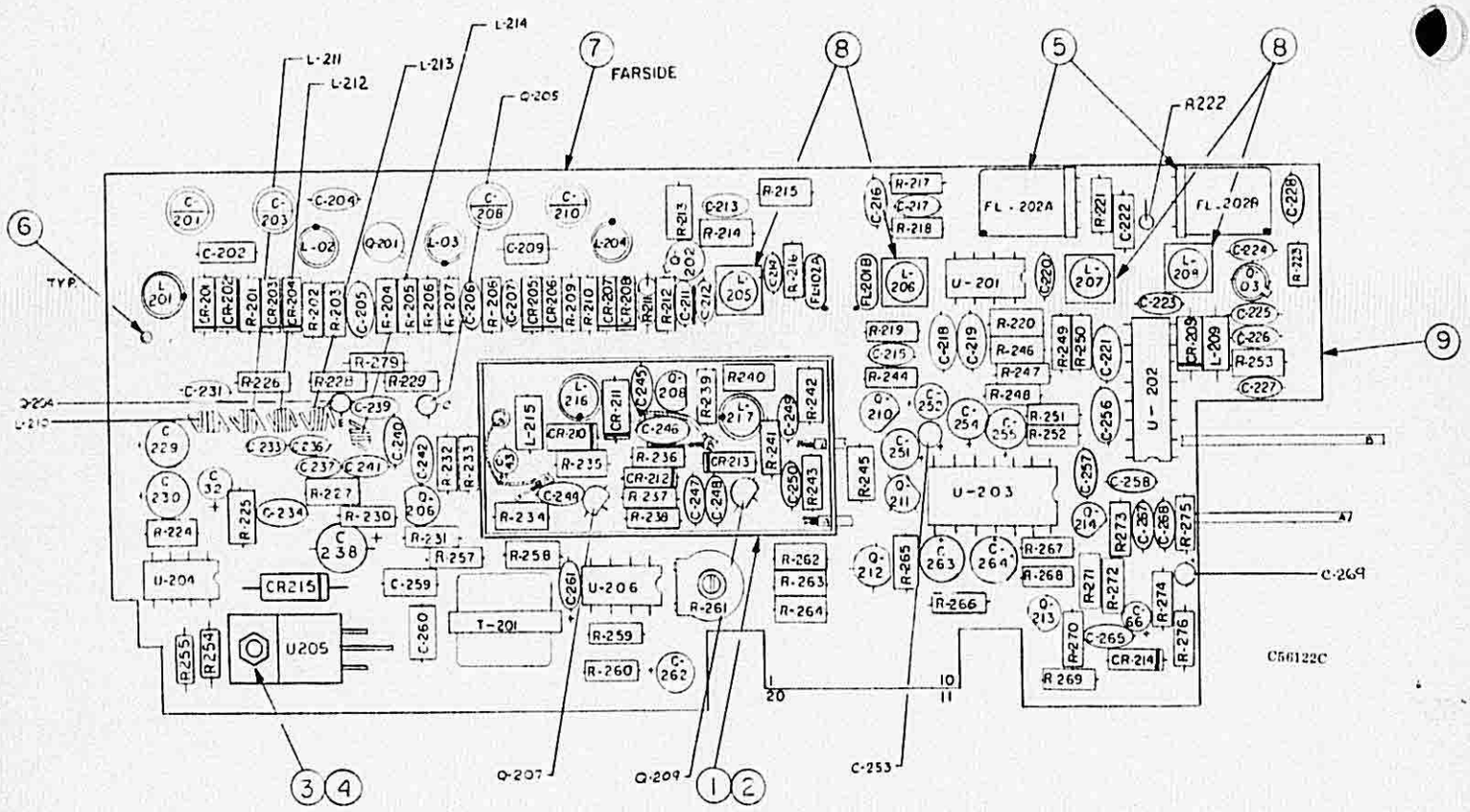

FIGURE 5-3. RECEIVER PC BOARD ASSY
(NAV 122 SHOWN)

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SEE BLOW-UP

MECHANICAL PARTS LIST

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
5.4	01237-0101T		SYNTHESIZER PC BOARD ASSY (See Figure 5-2, item -2 for NHA)	Ref.
-1	56134-0001		COVER, Top, Shield	1
			(ATTACHING PARTS)	
-2	82845-0002		SCREW, Mach, Flat Hd, 2-56 x 3/16	2
			- - - - - * - - - - -	
-3	74039-0004	U318	IC, Voltage Regulator (+5V) (7805)	1
			(ATTACHING PARTS)	
-4	82814-0005		SCREW, Mach, Bind Hd, 4-40 x 3/8	1
	81324-0004		WASHER, Lock, Split, No. 4	1
	82900-0003		NUT, Hex, 4-40	1
			- - - - - * - - - - -	
-5	56078-0001		HEAT SINK (Regulator)	1
			(ATTACHING PARTS)	
-6	82813-0002		SCREW, Mach, Bind Hd, 2-56 x 3/16	2
			- - - - - * - - - - -	
-7	56132-0101		PLATE, Capacitor Mounting	1
			(ATTACHING PARTS)	
-8	82813-0002		SCREW, Mach, Bind Hd, 2-56 x 3/16	2
			- - - - - * - - - - -	
-9	81342-0003		SPACER, Hex, Threaded	2
-10	81430-0017		STANDOFF, Teflon	1
-11	81807-0002		PIN	2
-12	56129-0101		PLATE, Nut, Feedthrough	1
			(ATTACHING PARTS)	
-13	82813-0002		SCREW, Mach, Bind Hd, 2-56 x 3/16	2
			- - - - - * - - - - -	
-14	56118-0002		PC BOARD (Less Components)	NP
			(ATTACHING PARTS)	
-15	82813-0002		SCREW, Mach, Bind Hd, 2-56 x 3/16	1
			- - - - - * - - - - -	
-16	56133-0101		COVER, Bottom (Shield)	1

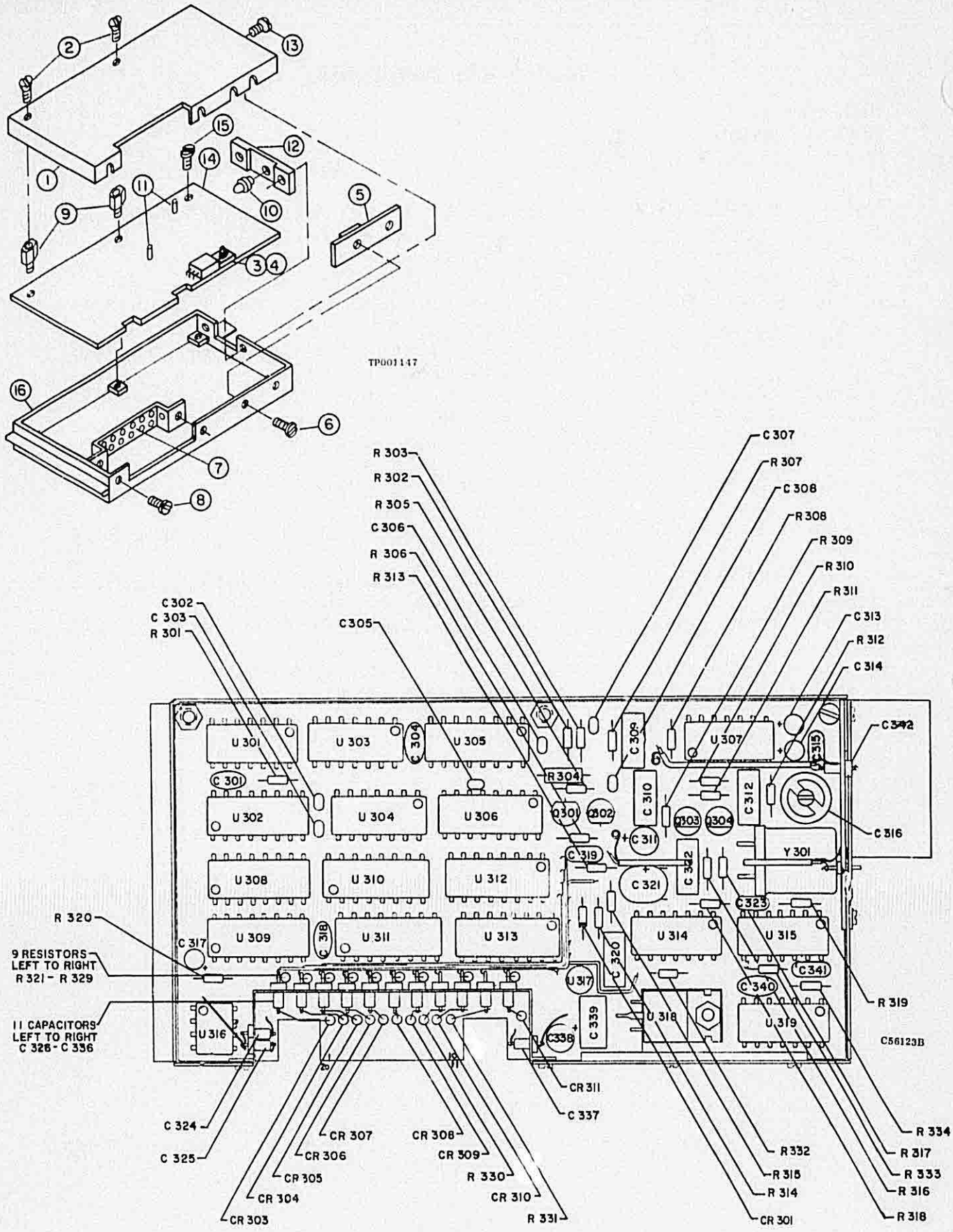
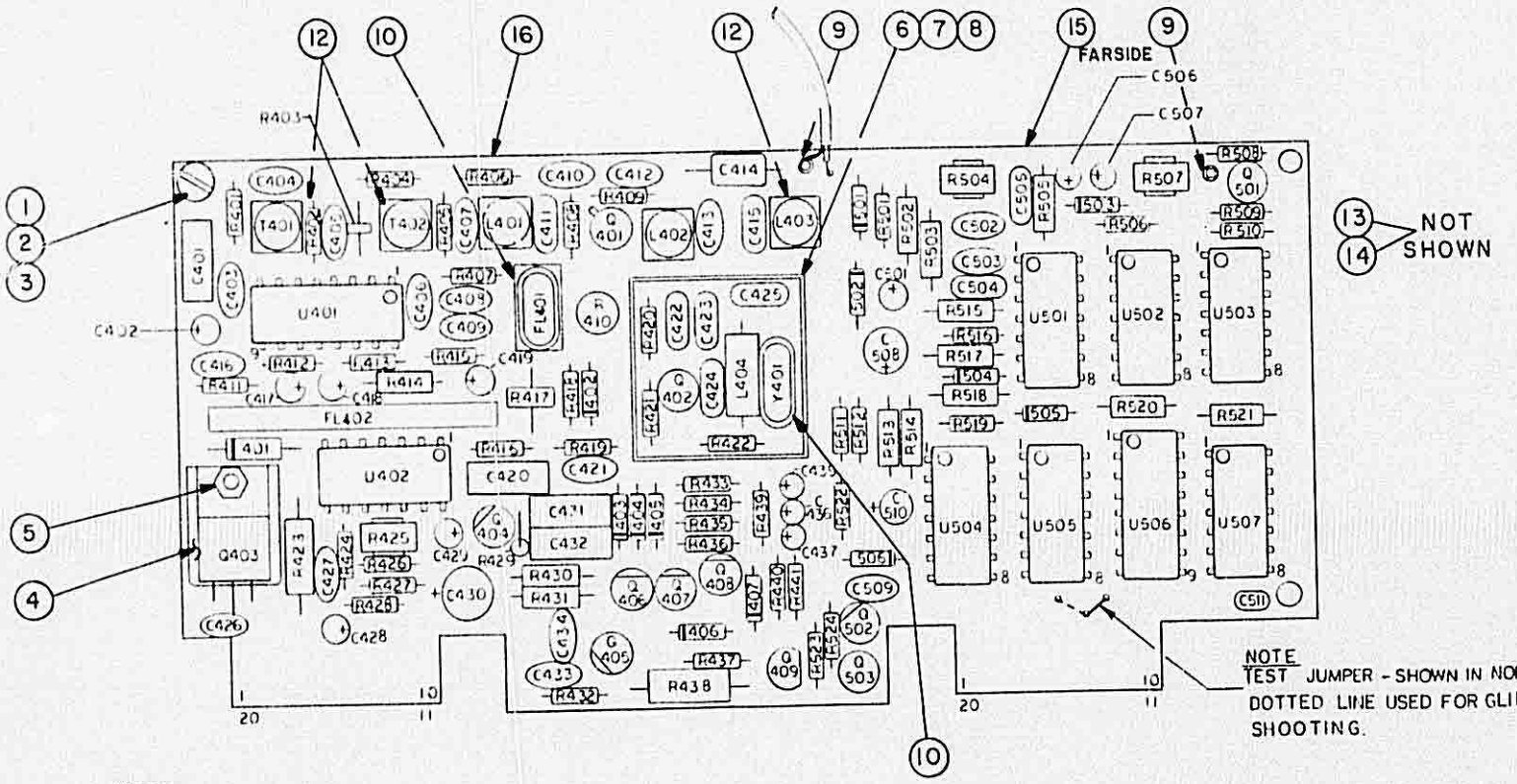


FIGURE 5-4. SYNTHESIZER PC BOARD ASSY

SEE BLOW-UP



NOTES

CONTACTS 1 THRU 10 ARE ON COMPONENT (NEAR) SIDE OF BOARD.
CONTACTS 11 THRU 20 ARE ON CIRCUIT (FAR) SIDE OF BOARD.

C-56124-D

SYMBOLS ARE DIODES, BAR INDICATES CATHODE END, CR DESIGNATIONS OMITTED FOR CLARITY.

R-442, R443, R444 ARE SELETED ACROSS R434, R433, R435

FIGURE 5-5. MARKER BEACON/GLIDE SLOPE PC BOARD ASSY, NAV 122 AND NAV 122A

SEE BLOW-UP

MECHANICAL PARTS LIST

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
5.5	01236-0102		MARKER BEACON/GLIDE SLOPE PC BOARD ASSY, NAV 122 (See Figure 5.2, item -3 for Next Higher Assy)	Ref
	01236-0101		MARKER BEACON PC BOARD ASSY, NAV 122A (See Figure 5.2, item -3 for Next Higher Assy)	Ref
-1	56072-0001		GUIDE, Board	1
			(ATTACHING PARTS)	
-2	82962-0002		SCREW, Mach, Pan Hd, 4-40 x 3/16(SEMS)	1
-3	81307-0139		WASHER, Flat, Spl, .215 OD x .128 ID x .018 thick, Stl Cad. Plate	1
			- - - - - * - - - - -	
-4	75576-0001	Q403	TRANSISTOR, Silicon, NPN, Power	1
			(ATTACHING PARTS)	
-5	82814-0003		SCREW, Mach, Bind Hd, 4-40 x 1/4	1
	81324-0004		WASHER, Lock, Split, No. 4	1
	82900-0003		NUT, Hex, 4-40	1
	56276-0001		INSULATOR, Mica	1
			- - - - - * - - - - -	
-6	59013-0001		COVER, Shield (Oscillator)	1
-7	83011-0033		INSULATOR (Oscillator Cover)	1
-8	59102-0002		SHIELD, Walls, (Oscillator)	1
-9	81807-0002		PIN	2
-10	54559-0001		INSULATOR, Crystal (FL401/Y401)	2
-11	55850-0002		CAN, Shield (L402/L403)	2
-12	83026-0001		INSULATOR (T401, T402, L401, L402, L403)	5
-13	83028-0013		INSULATOR, 1-15/16 long x 3/8 wide x .010 thick (not shown)	1
-14	83028-0016		INSULATOR, 2-5/8 long x 1 wide x .010 thick (not shown)	1
-15	83011-0011		INSULATOR (On non-component side)	1
-16	56119-0002		PRINTED CIRCUIT BOARD (Less Components)	1

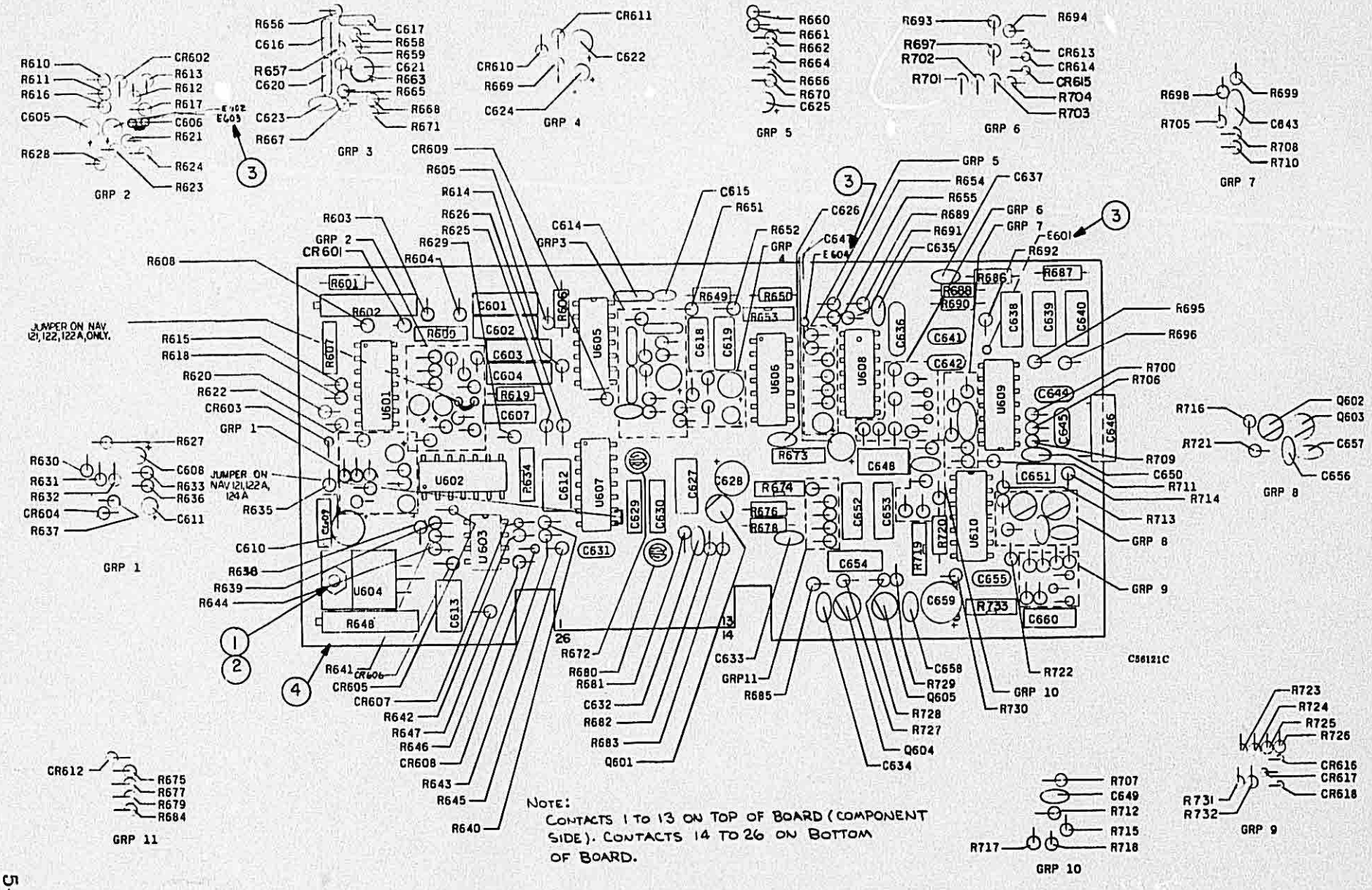


FIGURE 5-6. OMNI-LOCALIZER PC BOARD ASSY

SEE BLOW-UP

MECHANICAL PARTS LIST

All Mechanical Parts Common to NAV 121/122/122A

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
5.6	01235-0101		OMNI-LOCALIZER PC BOARD ASSY, NAV 122 (See Figure 5.2, item -4 for Next Higher Assy)	Ref.
	01235-0103		OMNI-LOCALIZER PC BOARD ASSY, NAV 121, NAV 122A (See Figure 5.2, item -4 for Next Higher Assy)	Ref.
-1	74039-0003	U604	IC, Voltage Regulator (+8V) (78M08)	1
			(ATTACHING PARTS)	
-2	82814-0003		SCREW, Mach, Flat Hd, 4-40 x 1/4	1
	81324-0004		WASHER, Lock, Split, No. 4	1
	82900-0003		NUT, Hex, 4-40	1
			- - - - - * - - - - -	
-3	41376-0002		PIN, Terminal, (E601, E602, E603, E604)	4
-4	56117-0001		PC BOARD (Less Components)	1

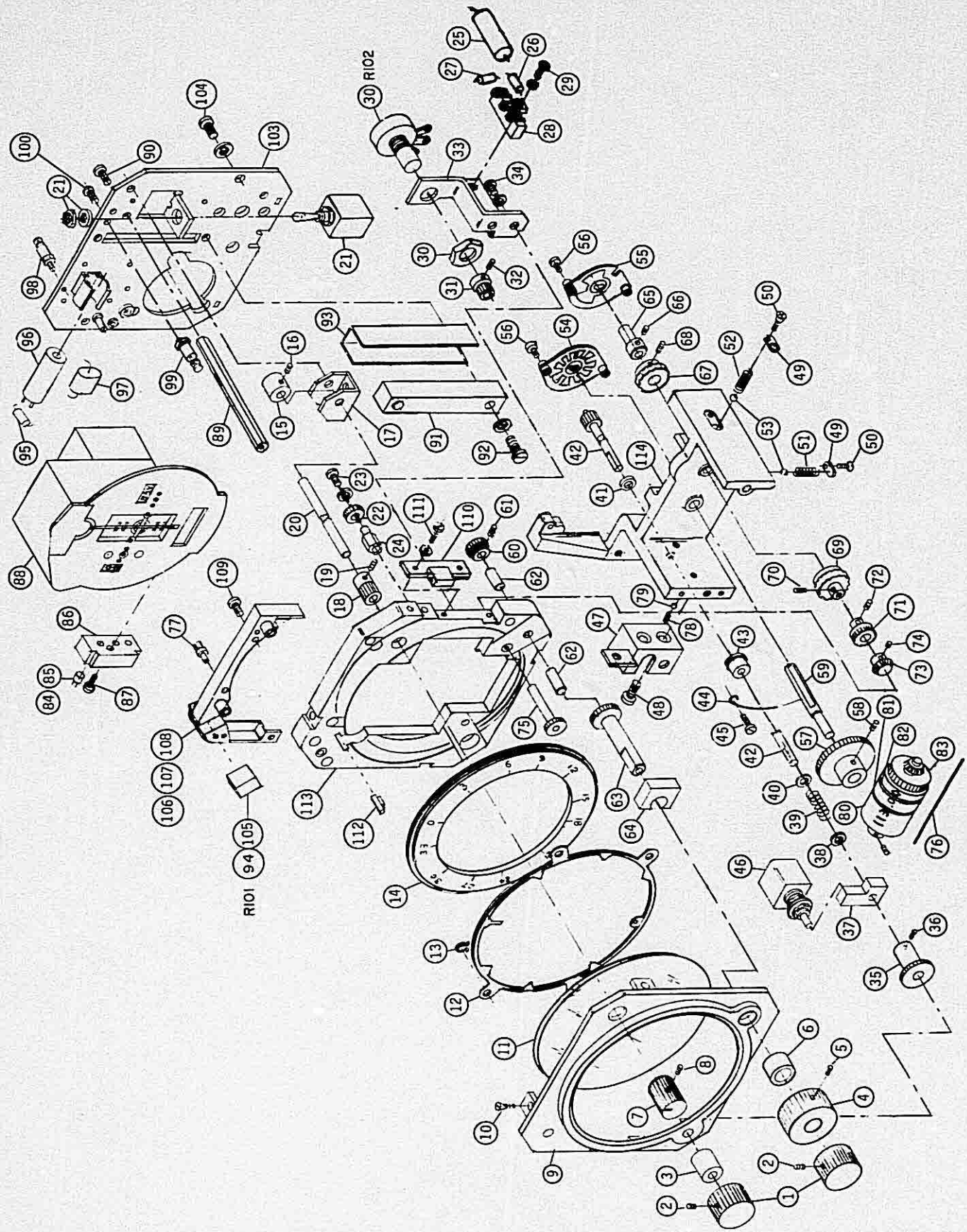


FIGURE 5-7. CONTROL HEAD ASSY, NAV 121, NAV 122 AND NAV 122A

MECHANICAL PARTS LIST "A" CHASSIS CODE

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
5.7	01233-0102		CONTROL HEAD ASSY, NAV 121 (See Figure 5.1, item -10 for Next Higher Assy)	Ref
	01233-0101		CONTROL HEAD ASSY, NAV 122 (See Figure 5.1, item -10 for Next Higher Assy)	Ref
	01233-0103		CONTROL HEAD ASSY, NAV 122A (See Figure 5.1, item -10 for Next Higher Assy)	Ref
-1	88227-0001		KNOB, OBS and KHz	2
			(ATTACHING PARTS)	
-2	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-3	88230-0001		SPACER, OBS Shaft, .312 OD x .128 ID x .360 lg.	1
-4	88226-0001		KNOB, MHz	1
			(ATTACHING PARTS)	
-5	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-6	88230-0002		SPACER, KHz and MHz Shaft, .375 OD x .255 ID x .340 Lg.	1
-7	88228-0001		KNOB, Volume	1
			(ATTACHING PARTS)	
-8	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-9	56059-0003		BEZEL, Indicator	1
			(ATTACHING PARTS)	
-10	82884-0003		SCREW, Mach, Flat Hd, Sl, 4-40 x 1/4	4
			- - - - - * - - - - -	
-11	56081-0001		LENS, Wedge	1
-12	56079-0001		MASK, Bezel	1
			(ATTACHING PARTS)	
-13	81192-0018		RING, Retaining	4
			- - - - - * - - - - -	
-14	56064-0001		CARD, Azimuth	1
-15	56042-0001		COLLAR	1
			(ATTACHING PARTS)	
-16	82863-0704		SETSCREW, 4 Flute Socket, 2-56 x 1/16	2
			- - - - - * - - - - -	
-17	56048-0001		ACTUATOR, Volume Switch	1
-18	56053-0001		GEAR, Pinion	1
			(ATTACHING PARTS)	
-19	82863-0704		SETSCREW, 4 Flute Socket, 2-56 x 1/16	2
			- - - - - * - - - - -	

MECHANICAL PARTS LIST "A" CHASSIS CODE

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
-20	56055-0001		SHAFT, On-Off-Ident	1
-21	61620-0001	S104	SWITCH, Toggle, NAV 122	1
-21	61620-0002	S104	SWITCH, Toggle, NAV 121, NAV 122A	1
-22	56032-0001		GEAR, Idler, Vol-On-Off	1
			(ATTACHING PARTS)	
-23	82808-0006		SCREW, Mach, Rnd Hd, 2-56	1
	81307-0133		WASHER, Flat, Brs., No. 2	1
			- - - - - * - - - - -	
-24	56030-0001		SPACER, Idler	1
-25	21555-0026	C102	CAPACITOR, Solid Tantalum, 10 µf ±20% 20V	1
-26	75218-0001	CR101	DIODE, Rectifier, 3 Amp	1
-27	31192-0331	R104	RESISTOR, Fixed, Comp, 330 ± 10%, 1/4W	1
-28	81446-0002		STRIP, Tie Lug	1
			(ATTACHING PARTS)	
-29	82814-0003		SCREW, Mach, Bind Hd, Sl, 4-40 x 1/4	1
	81324-0004		LOCKWASHER, Int. Tooth, No. 4	1
			- - - - - * - - - - -	
-30	32070-0002	R102	RESISTOR, Variable, w/Switch, 1K + 30%, 1/4W	1
-31	56031-0001		GEAR, Pinion, Vol-On-Off	1
			(ATTACHING PARTS)	
-32	82863-0702		SETSCREW, 4 Flute Socket, 2-56 x 3/32	1
			- - - - - * - - - - -	
-33	56049-0001		BRACKET, Vol-On-Off	1
			(ATTACHING PARTS)	
-34	82814-0003		SCREW, Mach, Bind Hd, Sl, 4-40 x 1/4	2
	81324-0004		LOCKWASHER, Int. Tooth, No. 4	2
			- - - - - * - - - - -	
-35	56066-0001		GEAR AND SHAFT ASSY, OBS Driver	1
			(ATTACHING PARTS)	
-36	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-37	56046-0001		ACTUATOR, Switch	1
-38	81206-0061		SPACER	1
-39	56034-0001		SPRING, Actuator	1
-40	81307-0134		WASHER, Special	1
-41	81206-0072		SPACER	1
-42	56056-0101		GEAR AND SHAFT ASSY, OBS Dial	1
-43	81335-0017		BUSHING	1
-44	56114-0001		SPRING, OBS Shaft	1

MECHANICAL PARTS LIST "A" CHASSIS CODE

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
			(ATTACHING PARTS)	
-45	82808-0005		SCREW, Mach, Rnd Hd, S1, 2-56 x 3/8	1
			- - - - - * - - - - -	
-46	61576-0002	S103	SWITCH, Pushbutton	1
-47	56047-0001		BRACKET, Switch	1
			(ATTACHING PARTS)	
-48	82884-0003		SCREW, Mach, Flat Hd, Undercut, S1, 4-40 x 1/4	2
			- - - - - * - - - - -	
-49	56083-0001		COVER, Detent, NAV 122A	1
	56083-0001		COVER, Detent, NAV 121, NAV 122	2
			(ATTACHING PARTS)	
-50	82972-0004		SCREW, Mach, Fil Hd, S1, 2-56 x 1/4 NAV 121/NAV 122	2
	82972-0004		SCREW, Mach, Fil Hd, S1, 2-56 x 1/4 NAV 122A	1
			- - - - -* - - - - -	
-51	55660-0008		SPRING, Compression, 9 Turns	1
-52	55660-0009		SPRING, Compression, 15 Turns	1
-53	81740-0005		BALL, Detent, 5/32 Dia	2
-54	61615-0001	S101	SWITCH SECTION, KHz	1
-55	61616-0001	S102	SWITCH SECTION, MHz	1
			(ATTACHING PARTS)	
-56	82808-0005		SCREW, Mach, Rnd Hd, S, 2-56 x 3/8	4
			- - - - - * - - - - -	
-57	56065-0101		HUB AND GEAR ASSY, KHz	1
			(ATTACHING PARTS)	
-58	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-59	56052-0001		SHAFT, Switch, KHz	1
-60	56063-0101		GEAR AND HUB ASSY, KHz Driver	1
			(ATTACHING PARTS)	
-61	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-62	56054-0001		SHAFT, KHz	1
-63	56062-0101		GEAR AND SHAFT ASSY, MHz Driver	1
-64	56140-0001		SPACER, Shaft	1
-65	56058-0001		SHAFT, MHz Extension	1
			(ATTACHING PARTS)	
-66	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-67	56040-0101		DETENT ASSY, 10 Position, MHz	1
			(ATTACHING PARTS)	
-68	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	

MECHANICAL PARTS LIST "A" CHASSIS CODE

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
-69	56039-0101		DETENT AND GEAR ASSY, 10 Position, KHz	1
			(ATTACHING PARTS)	
-70	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-71	56061-0101		HUB AND FACE GEAR ASSY, KHz	1
			(ATTACHING PARTS)	
-72	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-73	56033-0001		GEAR, Miter	1
			(ATTACHING PARTS)	
-74	82863-0704		SETSCREW, 4 Flute Socket, 2-56 x 1/16	2
			- - - - - * - - - - -	
-75	56060-0101		GEAR AND SHAFT ASSY, MHz, Driver	1
-76	56086-0001		BAR, Counter Holder	1
			(ATTACHING PARTS)	
			SETSCREW	2
			- - - - - * - - - - -	
	56027-0101		ODOMETER, NAV	1
			(ATTACHING PARTS)	
-77	82889-0001		SETSCREW, Hex Socket, 2-56 x 3/32	2
-78	84181-0001		SETSCREW, Special, No. 8	1
-79	81740-0004		BALL, Odometer, 3/32 Dia.	1
			- - - - - * - - - - -	
-80	56027-0003		DRUM, MHz	1
-81	56027-0002		DRUM, KHz	1
-82	56027-0004		PLATE, Partition	1
-82A	56027-0001		DRUM AND GEAR	1
-83	56028-0101		GEAR AND SHAFT ASSY, Bevel	1
-84	12009-0002		LAMP, Incandescent	3
-85	12009-0001		SOCKET, Sub-miniature	3
-86	56082-0001		BLOCK, Light	1
			(ATTACHING PARTS)	
-87	82972-0004		SCREW, Mach, Fil Hd, Sl, 2-56 x 1/4	1
			- - - - - * - - - - -	
-88	76133-0001		INDICATOR ASSY, Omni-Glide Slope (NAV 122 and NAV 122A)	1
	76134-0001		INDICATOR ASSY, Omni (NAV 121	1
-89	81207-0049		SPACER, Hex	1
			(ATTACHING PARTS)	
-90	82845-0007		SCREW, Mach, Flat Hd, Sl, 2-56 x 1/2	1
	82814-0008		SCREW, Mach, Bind Hd, Sl, 4-40 x 5/8	1
			- - - - - * - - - - -	

MECHANICAL PARTS LIST

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
-91	41362-0003	J101	CONNECTOR, Receptacle	1
			(ATTACHING PARTS)	
-92	82814-0008		SCREW, Mach, Bind Hd, Sl, 4-40 x 5/8	2
	81324-0004		LOCKWASHER, Int. Tooth, No. 4	2
			- - - - - * - - - - -	
-93	56080-0003		COVER, Connector	1
-94	32071-0003	R101	RESISTOR, Variable, 1000 ±20%, 1/2w (NAV 122 and NAV 122A)	1
-95	31192-0271	R103	RESISTOR, Fixed, Comp, 270 ±10%, 1/4w	1
-96	11488-0001	L101	COIL, Adjustable MHz	1
-97	23087-0017	C101	CAPACITOR, Metalized Mylar, 1µf ± 10%, 200V	1
-98	81423-0006		TERMINAL, Standoff, Insulated	2
-99	81423-0005		TERMINAL, Standoff, Insulated	2
			(ATTACHING PARTS)	
-100	82972-0004		SCREW, Mach, Flt Hd, Sl, 2-56 x 1/4	2
			- - - - - * - - - - -	
-101	NOT USED			
-102	NOT USED			
-103	56029-0101		MID-PLATE ASSY	1
			(ATTACHING PARTS)	
-104	82884-0003		SCREW, Mach, Flt Hd, Sl, 4-40 x 1/4	2
	81324-0004		LOCKWASHER, Int. Tooth, No. 4	2
			- - - - - * - - - - -	
-105	56120-0001		GASKET, (NAV 122 and NAV 122A	1
-106	81747-0015		FILTER, Lamp, Blue	4
-107	12000-0032	DS1/DS4	LAMP, No. 8640, with 2" leads	4
-108	56085-0001		BLOCK, Light	1
			(ATTACHING PARTS)	
-109	82808-0005		SCREW, Mach, Rnd Hd, Sl, 2-56 x 3/8	2
			- - - - - * - - - - -	
-110	56051-0001		GUIDE, Adjustable Dial	1
			(ATTACHING PARTS)	
-111	82808-0005		SCREW, Mach, Rnd Hd, Sl, 2-56 x 3/8	1
	81324-0002		LOCKWASHER, No. 2	1
			- - - - - * - - - - -	
-112	56050-0001		GUIDE, Fixed Dial	2
-113	56025-0001		CASTING, Front	1
-114	56026-0001		CASTING, Rear	1
	81206-0180		SPACER, .128 ID x .250 OD x .124 Lg (not shown)	1
	82863-0705		SETSCREW, 2-56 x 3/16 (not shown)	1
	82812-0007		SCREW, Mach, Rnd Hd, 2-56 x 1/2 (not shown)	2
	82813-0002		SCREW, Mach, Bind Hd, 2-56 x 3/16 (not shown)	3

MECHANICAL PARTS LIST "B" CHASSIS CODE

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
5.7.	01233-0106Z		CONTROL HEAD ASSY, NAV 121 (See Figure 5.1A, item -22 for Next Higher Assy)	Ref.
	01233-0105Z		CONTROL HEAD ASSY, NAV 122 (See Figure 5.1A, item -22 for Next Higher Assy)	Ref.
	01233-0107Z		CONTROL HEAD ASSY, NAV 122A (See Figure 5.1A, item -22 for Next Higher Assy)	Ref.
-1	88227-0001		KNOB, OBS and KHz	2
			(ATTACHING PARTS)	
-2	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-3	88230-0001		SPACER, OBS Shaft	1
-4	81206-0187		SPACER	1
-5	88226-0001		KNOB, MHz	1
			(ATTACHING PARTS)	
-6	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-7	88230-0002		SPACER, KHz and MHz Shaft	1
-8	88228-0001		KNOB, Volume	1
			(ATTACHING PARTS)	
-9	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
-10	55996-0002		BUSHING	1
			- - - - - * - - - - -	
-11	56059-0006		BEZEL, Indicator, NAV 121	1
	56059-0003		BEZEL, Indicator, NAV 122	1
	56059-0007		BEZEL, Indicator, NAV 122A	1
			(ATTACHING PARTS)	
-12	82884-0003		SCREW, Mach, Flat Hd, Undercut, 4-40 x 1/4	4
			- - - - - * - - - - -	
-13	56081-0001		LENS, Wedge	1
-14	56079-0001		MASK, Bezel	1
			(ATTACHING PARTS)	
-15	81192-0014		RING, Retaining	4
			- - - - - * - - - - -	
-16	56064-0001		CARD, Azimuth	1
-17	56042-0001		COLLAR	1
			(ATTACHING PARTS)	
-18	82863-0204		SETSCREW, 4 Flute Socket, 2-56 x 1/16	2
-19	81307-0134		WASHER, Special	1
			- - - - - * - - - - -	
-20	56048-0001		ACTUATOR, Volume Switch	1
-21	81206-0180		SPACER	1
-22	81307-0134		WASHER, Special	1

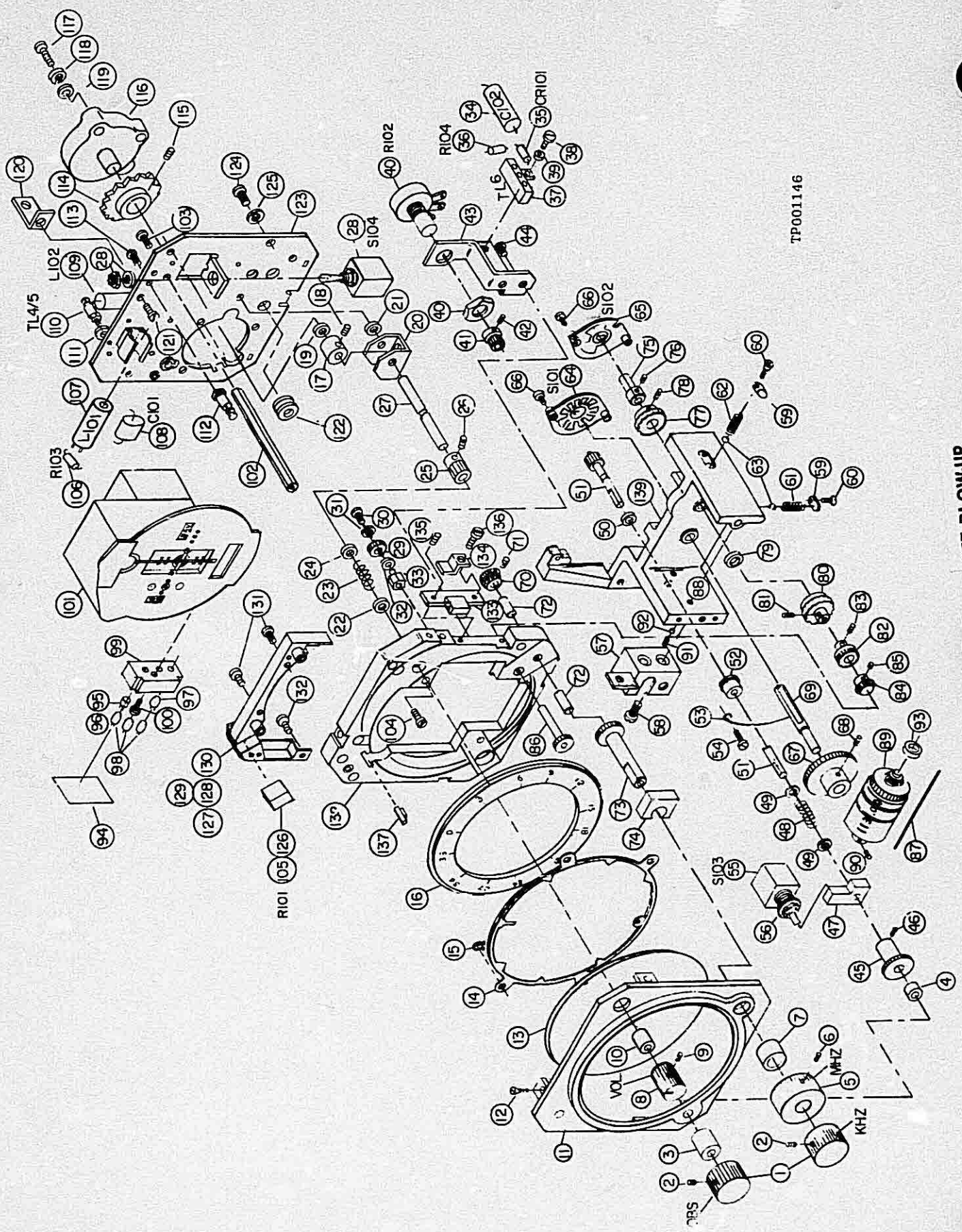


FIGURE 5-7A. Control Head Assy, Chassis Code "B"

MECHANICAL PARTS LIST "B" CHASSIS CODE

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
-23	55660-0012		SPRING, Compression, NAV 122	1
-24	81307-0139		WASHER, Special	1
-25	56053-0001		GEAR, Pinion	1
			(ATTACHING PARTS)	
-26	82863-0204		SETSCREW, 4 Flute Socket, 2-56 x 1/16	2
			- - - - - * - - - - -	
-27	56055-0001		SHAFT, On-Off-Ident	1
-28	61620-0001	S104	SWITCH, Toggle, Miniature, NAV 122	1
	61620-0002	S104	SWITCH, Toggle, Miniature, NAV 121, NAV 122A	1
-29	56032-0001		GEAR, Idler, Vol-On-Off	1
			(ATTACHING PARTS)	
-30	82813-0007		SCREW, Mach, Bind Hd, S1, 2-56 x 1/2	1
-31	81324-0002		WASHER, Lock, Split, No. 2	1
-32	81307-0133		WASHER, Flat, Brass, No. 2	1
			- - - - - * - - - - -	
-33	56030-0001		SPACER, Idler	1
-34	21555-0026	C102	CAPACITOR, Solid Tantalum, 10 µf ±20%, 20V	1
-35	75218-0001	CR101	DIODE, Rectifier, 3 Amp	1
-36	31192-0331	R104	RESISTOR, Fixed, Comp, 330 ± 10%, 1/4w	1
-37	81446-0002	TL6	STRIP, Tie Lug (lugs cut down)	1
			(ATTACHING PARTS)	
-38	82814-0004		SCREW, Mach, Bind Hd, S1, 4-40 x 5/16	1
-39	81324-0004		WASHER, Lock, Split, No. 4	1
			- - - - - * - - - - -	
-40	32070-0002	R102	RESISTOR, Variable, w/Switch, 1K ± 30% 1/4 w	1
-41	56031-0001		GEAR, Pinion, Vol-On-Off	1
			(ATTACHING PARTS)	
-42	82863-0703		SETSCREW, 4 Flute Socket, 2-56 x 1/4	1
			- - - - - * - - - - -	
-43	56049-0001		BRACKET, Vol-On-Off	1
			(ATTACHING PARTS)	
-44	82965-0003		SCREW, Mach, Fil Hd, S1, 4-40 x 1/4	2
			- - - - - * - - - - -	
-45	56066-0101		GEAR AND SHAFT ASSY, OBS Driver	1
			(ATTACHING PARTS)	
-46	82863-0219		SETSCREW, 6 Flute Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-47	56046-0001		ACTUATOR, Switch	1
-48	56034-0001		SPRING, Actuator	1
-49	81307-0134		WASHER, Special	2
-50	81206-0117		SPACER	1
-51	56056-0101		GEAR AND SHAFT ASSY, OBS Dial	1
-52	81335-0017		BUSHING	1

MECHANICAL PARTS LIST "B" CHASSIS CODE

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
-53	56114-0001		SPRING, OBS Shaft	1
			(ATTACHING PARTS)	
-54	82814-0002		SCREW, Mach, Bind Hd, Sl, 4-40 x 3/16	1
			- - - - - * - - - - -	
-55	61576-0002	S103	SWITCH, Pushbutton	1
-56	81369-0001		WASHER, Open End	1
-57	56047-0001		BRACKET, Switch	1
			(ATTACHING PARTS)	
-58	82884-0003		SCREW, Mach, Flat Hd, Undercut, Sl, 4-40 x 1/4	2
			- - - - - * - - - - -	
-59	56083-0001		COVER, Detent	2
			(ATTACHING PARTS)	
-60	82972-0004		SCREW, Mach, Fil Hd, Sl, 2-56 x 1/4	2
			- - - - - * - - - - -	
-61	55660-0008		SPRING, Compression, 9 Turns	1
-62	55660-0009		SPRING, Compression, 15 Turns	1
-63	81740-0005		BALL, Detent, 5/32 Dia.	2
-64	61615-0001	S101	SWITCH SECTION, KHz	1
-65	61616-0001	S102	SWITCH SECTION, MHz	1
			(ATTACHING PARTS)	
-66	82808-0005		SCREW, Mach, Rd Hd, Sl, 2-56 x 3/8	4
			- - - - - * - - - - -	
-67	56065-0101		HUB AND GEAR ASSY, KHz	1
			(ATTACHING PARTS)	
-68	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-69	56052-0001		SHAFT, Switch, KHz	1
-70	56063-0101		GEAR AND HUB ASSY, KHz Driver	1
			(ATTACHING PARTS)	
-71	82863-0219		SETSCREW, 6 Flute Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-72	56054-0001		SHAFT, KHz	1
-73	56062-0101		GEAR AND ASSY, MHz Driver	1
-74	56140-0001		SPACER, Shaft	1
-75	56058-0001		SHAFT, MHz Extension	1
			(ATTACHING PARTS)	
-76	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-77	56040-0101		DETENT ASSY, 10 Position, MHz	1
			(ATTACHING PARTS)	
-78	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-79	81307-0137		WASHER, Flat, Spl, Detent MHz	1
-80	56039-0101		DETENT AND GEAR ASSY, 10 Position, KHz	1

MECHANICAL PARTS LIST "B" CHASSIS CODE

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
			(ATTACHING PARTS)	
-81	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-82	56061-0101		HUB AND FACE GEAR ASSY, KHz	1
			(ATTACHING PARTS)	
-83	82889-0001		SETSCREW, Hex Socket, 4-40 x 3/32	2
			- - - - - * - - - - -	
-84	56033-0001		GEAR, Miter	1
			(ATTACHING PARTS)	
-85	82863-0704		SETSCREW, 4 Flute Socket, 2-56 x 1/16	2
			- - - - - * - - - - -	
-86	56060-0101		GEAR AND SHAFT ASSY, MHz Driver	1
-87	56086-0001		BAR, Counter Holder	1
			(ATTACHING PARTS)	
-88	82863-0705		SETSCREW, 4 Flute Socket, 2-56 x 3/16	1
	81254-0019		EYELET (used as a hole reducer)	2
			- - - - - * - - - - -	
-89	56027-0101		ODOMETER, NAV	1
			(ATTACHING PARTS)	
-90	82889-0001		SETSCREW, Hex Socket, 2-56 x 3/32	2
-91	84181-0001		SETSCREW, Special, No. 8	1
-92	81740-0004		BALL, Odometer, 3/32 Dia.	1
-93	81329-0015		WASHER, Flat, Special	1
			- - - - - * - - - - -	
-94	56167-0001		COVER, Dust	1
-95	12009-0004		LAMP, Incandescent, NAV 122/NAV 122A	1
-96	81747-0009		FILTER, Lamp, NAV 122/NAV 122A	1
-97	12009-0002		LAMP, Incandescent, NAV 122/NAV 122A	2
-98	12009-0001		SOCKET, Lamp, Miniature, NAV 122/ NAV 122A	3
-99	56082-0001		BLOCK, Light	1
			(ATTACHING PARTS)	
-100	82972-0004		SCREW, Mach, Fil Hd, Sl, 2-56 x 1/4	1
			- - - - - * - - - - -	
-101	76133-0001		INDICATOR ASSY, Omni-Glide Slope, NAV 122/NAV 122A	1
	76134-0001		INDICATOR ASSY, Omni, NAV 122/NAV 122A	1
-102	81207-0049		SPACER, Hex, Threaded 2-56 one end - 4-40 other end	1
			(ATTACHING PARTS)	
-103	82814-0008		SCREW, Mach, Bind Hd, Sl, 4-40 x 5/8	1
-104			SCREW, Mach, Flat Hd, Sl, 2-56 x 1/2	1
			- - - - - * - - - - -	
-105	32071-0003	R101	RESISTOR, Variable, 1K ±20%, 1/2w NAV 122/NAV 122A	1
-106	31192-0271	R103	RESISTOR, Fixed, Comp, 270 ± 10%, 1/4w	1
-107	11488-0001	L101	COIL, Adjustable, MHz	1
-108	23087-0017	C101	CAPACITOR, Metalized Mylar, 1 µf ±10% 200V	1

MECHANICAL PARTS LIST "B" CHASSIS CODE

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
-109	11487-0002	L102	CHOKE	1
-110	81423-0008	TL4/TL5	TERMINAL, Standoff, Insulated	2
			(ATTACHING PARTS)	
-111	81324-0002		WASHER, Lock, Split, No. 2	2
			- - - - - * - - - - -	
-112	81423-0005		TERMINAL, Standoff, Insulated	4
			(ATTACHING PARTS)	
-113	82972-0004		SCREW, Mach, Flat Hd, Sl, 2-56 x 1/4	4
			- - - - - * - - - - -	
-114	56057-0001		GEAR, (Potentiometer)	1
			(ATTACHING PARTS)	
-115	82863-0718		SETSCREW, 6 Flute Socket, 4-40 x 1/8	2
			- - - - - * - - - - -	
-116	32068-0001	R803	POTENTIOMETER	1
			(ATTACHING PARTS)	
-117	82814-0009		SCREW, Mach, Bind Hd, Sl, 4-40 x 3/4	3
-118	81324-0004		WASHER, Lock, Split, No. 4	3
-119	81329-0004		WASHER, Flat, No. 4	3
			- - - - - * - - - - -	
-120	56188-0001		BRACKET	1
			(ATTACHING PARTS)	
-121	82962-0002		SCREW, Mach, Sl, 4-40 x 3/16 (SEMS)	1
			- - - - - * - - - - -	
-122	81160-0014		GROMMET, Rubber	5
-123	56187-0101		MID-PLATE ASSY	1
			(ATTACHING PARTS)	
-124	82884-0003		SCREW, Mach, Flat Hd, Undercut, 4-40 x 1/4	2
-125	81324-0004		WASHER, Lock, Split, No. 4	2
			- - - - - * - - - - -	
-126	56120-0001		GASKET, NAV 122/NAV 122A	1
-127	81747-0015		FILTER, Lamp, Blue	4
-128	12000-0035	DS1/DS3	LAMP, No. 8640 w/1/2 inch leads	3
-129	12000-0032	DS4	LAMP, No. 8640 w/2 inch leads	1
-130	56085-0001		BLOCK, Light (w/TP 1/4)	1
			(ATTACHING PARTS)	
-131	82808-0006		SCREW, Mach, Rnd Hd, Sl, 2-56 x 7/16	2
-132	82813-0002		SCREW, Mach, Bind Hd, Sl, 2-56 x 3/16	1
			- - - - - * - - - - -	
-133	56051-0001		GUIDE, Adjustable Dial	1
			(ATTACHING PARTS)	
-134	56196-0001		SPRING	1
-135	82863-0703		SETSCREW, 4 Flute Socket, 2-56 x 1/4	1
-136	82813-0003		SCREW, Mach, Bind Hd, Sl, 2-56 x 1/4	1
			- - - - - * - - - - -	

MECHANICAL PARTS LIST "B" CHASSIS CODE

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
-137	56050-0001		GUIDE, Fixed, Dial	1
-138	56025-0001		CASTING, Front	1
-139	56026-0001		CASTING, Rear	1

CONTROL HEAD ASSEMBLY
ELECTRICAL PARTS LIST

NAV UNIT	ASSY PART NO.	ASSY CODE	REFER TO SCHEMATIC(S)
NAV 121	01233-0102Z	2	Fig. 6-1, 6-2
NAV 122	01233-0101Z	1	Fig. 6-1, 6-2
NAV 122A	01233-0103Z	3	Fig. 6-1, 6-2
NAV 121	01233-0106Z	6	Fig. 6-3
NAV 122	01233-0105Z	5	Fig. 6-3
NAV 122A	01233-0107Z	7	Fig. 6-3

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

			Symbol No.	Part No.	Description
					LAMP
A	o	1,2,3	DS1	12000-0032	No. 8640 w/2" leads (Fig. 5.7-107)
A1	c	1,2,3	DS1	12000-0035	No. 8640 w/½" leads (Fig. 5.7-107)
B	-	5,6,7	DS1	12000-0035	No. 8640 w/½" leads (Fig. 5.7A-128)
A	o	1,2,3	DS2	12000-0032	No. 8640 w/2" leads (Fig. 5.7-107)
A1	c	1,2,3	DS2	12000-0035	No. 8640 w/½" leads (Fig. 5.7-107)
B	-	5,6,7	DS2	12000-0035	No. 8640 w/½" leads (Fig. 5.7A-128)
A	o	1,2,3	DS3	12000-0032	No. 8640 w/2" leads (Fig. 5.7-107)
A1	c	1,2,3	DS3	12000-0035	No. 8640 w/½" leads (Fig. 5.7-107)
B	-	5,6,7	DS3	12000-0035	No. 8640 w/½" leads (Fig. 5.7A-128)
A	o	1,2,3	DS4	12000-0032	No. 8640 w/2" leads (Fig. 5.7-107)
A1	c	1,2,3	DS4	12000-0035	No. 8640 w/½" leads (Fig. 5.7-107)
A2	c	1,2,3	DS4	12000-0032	No. 8640 w/2" leads (Fig. 5.7-107)
B	-	5,6,7	DS4	12000-0032	No. 8640 w/2" leads (Fig. 5.7A-129)
					CAPACITOR
A	o	1,2,3	C101	23087-0017	Metalized Mylar, 1 uf ±10%, 200V (Fig. 5.7-97)
B	-	5,6,7	C101	23087-0017	Metalized Mylar, 1 uf ±10%, 200V (Fig. 5.7A-108)
A	O	1,2,3	C102	21555-0026	Solid Tantalum, 10 uf ±20%, 20V (Fig. 5.7-25)
B	-	5,6,7	C102	21555-0026	Solid Tantalum, 10 uf ±20%, 20V (Fig. 5.7A-34)

CONTROL HEAD ASSEMBLY
(Continued)

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

Chassis Level Code	Action	Assy Code	Symbol No.	Part No.	Description
					Diode
A	o	1,2,3	CR101	75218-0001	Rectifier, 3 Amp (Fig. 5.7-26)
B	-	5,6,7	CR101	75218-0001	Rectifier, 3 Amp (Fig. 5.7A-35)
					Connector
A	o	1,2,3	J101	41362-0003	Receptacle (Fig. 5.7-96)
					Choke
A	o	1,2,3	L101	11488-0001	Coil, Adjustable, MHz (Fig. 5.7-25)
B	-	5,6,7	L101	11488-0001	Coil, Adjustable, MHz (Fig. 5.7A-107)
A	o	1,2,3	L102	11487-0002	Choke
B	-	5,6,7	L102	11487-0002	Choke (Fig. 5.7A-109)
					Resistor
A	o	1,3	R101	32071-0003	Variable, 1K ±20%, ½w (Fig. 5.7-94)
B	-	5,7	R101	32071-0003	Variable, 1K ±20%, ½w (Fig. 5.7-105)
A	o	1,2,3	R102	32070-0002	Variable, w/switch, 1K ±30%, ¼w (Fig. 5.7-30)
B	-	5,6,7	R102	32070-0002	Variable, w/switch, 1K ±30%, ¼w (Fig. 5.7A-40)
A	o	1,2,3	R103	31192-0271	Fixed, Comp, 270 ±10%, ¼w (Fig. 5.7-95)
B	-	5,6,7	R103	31192-0271	Fixed, Comp, 270 ±10%, ¼w (Fig. 5.7A-106)
A	o	1,2,3	R104	31192-0331	Fixed, Comp, 330 ±10%, ¼w (Fig. 5.7-27)
B	-	5,6,7	R104	31192-0331	Fixed, Comp, 330 ±10%, ¼w (Fig. 5.7A-36)
					Switch
A	o	1,2,3	S101	61615-0001	Switch Section, KHz (Fig. 5.7-54)
B	-	5,6,7	S101	61615-0001	Switch Section, KHz (Fig. 5.7A-64)
A	o	1,2,3	S102	61616-0001	Switch Section, MHz (Fig. 5.7-55)
B	-	5,6,7	S102	61616-0001	Switch Section, MHz (Fig. 5.7A-65)
A	o	1,2,3	S103	61576-0002	Push Button (Fig. 5.7-46)

CONTROL HEAD ASSEMBLY
(Continued)

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

			Symbol No.	Part No.	Description
					Switch
B	-	5,6,7	S103	61576-0002	Pushbutton (Fig. 5.7A-55)
A	o	1	S104	61620-0001	Toggle (Fig. 5.7-21)
A	o	2,3	S104	61620-0002	Toggle (Fig. 5.7-21)
B	-	5	S104	61620-0001	Toggle (Fig. 5.7A-28)
G	-	6,7	S104	61620-0001	Toggle (Fig. 5.7A-28)
					Terminal
B	-	5,6,7	TL4	81423-0008	Standoff, Insulated (Fig. 5.7A-110)
B	-	5,6,7	TL5	81423-0008	Standoff, Insulated (Fig. 5.7A-110)
B	-	5,6,7	TL6	81446-0002	Strip, Tielug (Fig. 5.7A-116)

RECEIVER PC BOARD ASSEMBLY

ELECTRICAL PARTS LIST

NAV UNIT	ASSY PART NO.	ASSY CODE	REFER TO SCHEMATIC(S)
NAV 121	01238-0102	2	Fig. 6-8/6-8A
NAV 122	01238-0101	1	Fig. 6-3/6-3A
NAV 122A	01238-0102	2	Fig. 6-8/6-8A

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

			Symbol No.	Part No.	Description
					Capacitor
A	o		C201	22053-0001	Variable, 2.5 - 5.0 pf
A	o	1,2	C202	24509-0688	Ceramic Tub., 0.68 pf ±5%, 500v
A	o	1,2	C203	22053-0001	Variable, 2.5 - 5.0 pf
A	o	1,2	C204	21291-0031	Ceramic Disc, 390 pf ±10%, 500v
A	o	1,2	C205	21291-0031	Ceramic Disc, 390 pf ±10%, 500v
A	o	1,2	C206	21291-0031	Ceramic Disc, 390 pf ±10%, 500v
A	o	1,2	C207	21291-0031	Ceramic Disc, 390 pf ±10%, 500v
A	o	1,2	C208	22053-0001	Variable, 2.5 - 5.0 pf
A	o	1,2	C209	24509-0688	Ceramic Tub., 0.68 pf ±5%, 500v
A	o	1,2	C210	22053-0001	Variable, 2.5 - 5.0 pf
A	o	1,2	C211	24515-0005	Ceramic Disc, 0.05 uf +80% -20%, 10v
A	o	1,2	C212	21291-0031	Ceramic Disc, 390 pf ±10%, 500v
A	o	1,2	C213	24515-0005	Ceramic Disc, 0.05 uf +80% -20%, 10v
A	o	1,2	C214	24552-7180	Ceramic Disc, 18 pf ±.5 pf, 50v
A	o	1,2	C215	24552-7180	Ceramic Disc, 18 pf ±.5 pf, 50v
A	o	1,2	C216	24515-0005	Ceramic Disc, 0.05 uf +80% -20%, 10v
A	o	1,2	C217	24515-0005	Ceramic Disc, 0.05 uf +80% -20%, 10v
A	o	1,2	C218	24515-0005	Ceramic Disc, 0.05 uf +80% -20%, 10v
A	o	1,2	C219	24515-0005	Ceramic Disc, 0.05 uf +80% -20%, 10v
A	o	1,2	C220	24552-7180	Ceramic Disc, 18 pf ±.5 pf, 50v
A	o	1,2	C221	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A1	c	1	C222		
C	d	2	C222		

RECEIVER PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

			Symbol No.	Part No.	Description
					Capacitor
A	o	1,2	C223	24052-0150	Dipped Mica, 15 pf ±5%, 500v
A	o	1,2	C224	24552-7180	Ceramic Disc, 18 pf ±.5 pf, 50v
A	o	1,2	C225	24515-0005	Ceramic Disc, 0.05 uf +80% -20%, 10v
A	o	1,2	C226	24515-0005	Ceramic Disc, 0.05 uf +80% -20%, 10v
A	o	1,2	C227	24515-0005	Ceramic Disc, 0.05 uf +80% -20%, 10v
A	o	1,2	C228	24515-0005	Ceramic Disc, 0.05 uf +80% -20%, 10v
A	o	1,2	C229	21564-0026	Solid Tantalum, 220 uf ±20%, 10v
A	o	1,2	C230	21564-0124	Solid Tantalum, 100 uf ±10%, 10v
A	o	1	C231	24552-1689	Ceramic Disc, 6.8 pf ±5 pf, 50v
A	o	1,2	C232	21564-0157	Solid Tantalum, 0.47 uf ±10%, 35v
A	o	1	C233	24552-1689	Ceramic Disc, 6.8 pf ±.5 pf, 50v
A	o	1,2	C234	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o	1	C236	24552-1100	Ceramic Disc, 10 pf ±.5 pf, 50v
C3	c	1	C236	24552-1829	Ceramic Disc, 8.2 pf ±.5 pf, 50v
A	o	1	C237	24551-0001	Ceramic Disc, 100 pf ±20%, 50v
A	o	1,2	C238	21564-0026	Solid Tantalum, 220 uf ±20%, 10v
A	o	1	C239	24552-1479	Ceramic Disc, 4.7 pf ±.5 pf, 50v
A	o	1	C240	24052-0220	Dipped Mica, 22 pf ±5%, 500v
A	o	1	C241	24551-0001	Ceramic Disc, 100 pf ±20%, 50v
A	o	1	C242	24551-0001	Ceramic Disc, 100 pf ±20%, 50v
A	o	1,2	C243	21564-0120	Solid Tantalum, 22 uf ±10%, 10v
A	o	1,2	C244	24552-1120	Ceramic Disc, 12 pf ±.5 pf, 50v
A	o	1,2	C245	24552-1479	Ceramic Disc, 4.7 pf ±.5 pf, 50v
A	o	1,2	C246	21291-0021	Ceramic Disc, 0.001 uf ±20%, 1 kv
A	o	1,2	C247	24552-1100	Ceramic Disc, 10 pf ±.5 pf, 50v
A	o	1,2	C248	24552-1100	Ceramic Disc, 10 pf ±.5 pf, 50v
A	o	1,2	C249	21291-0021	Ceramic Disc, 0.001 uf ±20%, 1 kv
A	o	1,2	C250	21291-0021	Ceramic Disc, 0.001 uf ±20%, 1 kv
A	o	1,2	C251	21564-0103	Solid Tantalum, 6.8 uf ±10%, 6v
A	o	1,2	C252	21564-0118	Solid Tantalum, 10 uf ±10%, 10v

RECEIVER PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

Assy Code	Action	Chassis Level Code	Symbol No.	Part No.	Description
					Capacitor
A	o	1	C253	21564-0103	Solid Tantalum, 6.8 uf ±10%, 6v
A	o	1	C254	21564-0102	Solid Tantalum, 4.7 uf ±10%, 6v
A	o	1	C255	21564-0102	Solid Tantalum, 4.7 uf ±10%, 6v
A	o	1,2	C256	24515-0005	Ceramic Disc, 0.05 uf +80% -20%, 10v
A	o	1,2	C257	21564-0120	Solid Tantalum, 22 uf ±10%, 10v
A	o	1,2	C258	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
C	c	1,2	C258	24515-0010	Ceramic Disc, .02 uf ±20%, 50v
A	o	1,2	C259	23107-0125	Metalized Mylar, 0.1 uf ±10%, 100v
A	o	1,2	C260	23107-0125	Metalized Mylar, 0.1 uf ±10%, 100v
A	o	1,2	C261	21564-0118	Solid Tantalum, 10 uf ±10%, 10v
A	o	1,2	C262	21564-0157	Solid Tantalum, 0.47 uf ±10%, 35v
A6	c	1,2	C262	24556-0224	Ceramic, Mono, .22 uf ±20%, 25v
A	o	1,2	C263	21564-0124	Solid Tantalum, 100 uf ±10%, 10v
A	o	1	C264	21564-0124	Solid Tantalum, 100 uf ±10%, 10v
A	o	1,2	C266	21564-0157	Solid Tantalum, 0.47 uf ±10%, 35v
A	o	1,2	C267	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o	1,2	C268	24515-0005	Ceramic Disc, 0.05 uf +80% -20%, 10v
A	o	1,2	C269	21564-0103	Solid Tantalum, 6.8 uf ±10%, 6v
B	a	1	C270	21564-0014	Tantalum, 2.2 uf ±20%, 10v
C3	a	1	C273	21291-0019	Ceramic Disc, .001 uf
					Diode
A	o	1,2	CR201	75037-0001	Silicon
A	o	1,2	CR201	75037-0001	Silicon
A	o	1,2	CR203	75037-0001	Silicon
A	o	1,2	CR204	75037-0001	Silicon
A	o	1,2	CR205	75037-0001	Silicon
A	o	1,2	CR206	75037-0001	Silicon
A	o	1,2	CR207	75037-0001	Silicon
A	o	1,2	CR208	75037-0001	Silicon
A	o	1,2	CR209	75034-0001	Silicon, FH1100
A	o	1,2	CR210	75037-0001	Silicon

RECEIVER PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

			Symbol No.	Part No.	Description
					Diode
A	o	1,2	CR211	75037-0001	Silicon
A	o	1,2	CR212	75037-0001	Silicon
A	o	1,2	CR213	75037-0001	Silicon
A	o	1,2	CR214	75028-0001	Silicon
A1	a	1,2	CR215	75220-0220	Power, Zener, 22v
A5	a	1,2	CR216	75204-0045	Silicon (1N4005)
					Crystal Filter
A	o	1,2	FL201	43210-0001	4 Pole, 17 MHz (Fig. 5.3, item -9)
A	o	1,2	FL202	43210-0010	4 Pole, 17 MHz (Fig. 5.3, item -9)
					Coil/Choke
A	o	1,2	L201	11845-0001	Input Antenna
A	o	1,2	L202	11882-0001	RF, Input
A	o	1,2	L203	11846-0001	RF, Output
A	o	1,2	L204	11847-0001	Mixer, Input
A	o	1,2	L205	11881-0001	Mixer, Output
A	o	1,2	L206	11881-0001	IF, Input
A	o	1,2	L207	11881-0002	IF, Output
A	o	1,2	L208	11881-0001	FET, Input
A	o	1,2	L209	11485-0020	RF, 3.9 MHz
A	o	1	L210	11713-0021	RF, Glide Slope
A	o	1	L211	11713-0015	RF, Glide Slope
A	o	1	L212	11713-0015	RF, Glide Slope
A	o	1	L213	11713-0021	RF, Glide Slope
A	o	1	L214	11713-0019	RF, Glide Slope
A	o	1	L215	11485-0003	RF, .15 uh
A	o	1,2	L216	11882-0002	VCO
A	o	1,2	L217	11883-0001	VCO

RECEIVER PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

			Symbol No.	Part No.	Description
					Transistor
A	o	1,2	Q201	75611-0002	RF, FET
A	o	1,2	Q202	75611-0002	Mixer, FET
A	o	1,2	Q203	75643-0001	IF, FET
A	o	1	Q204	75629-0001	(MMT-74)
A	o	1	Q205	75629-0001	(MMT-74)
A	o	1	Q206	75614-0001	(2N5134)
A	o	1,2	Q207	75561-0038	(2N4258)
A	o	1,2	Q208	75561-0038	(2N4258)
A	o	1,2	Q209	75561-0038	(2N4258)
A	o	1	Q210	75614-0001	(2N5134)
A	o	1	Q211	75614-0001	(2N5134)
A	o	1	Q212	75614-0001	(2N5134)
A	o	1,2	Q213	75550-0022	(2N3391)
A	o	1,2	Q214	75565-0006	(2N4250)
B	a	1	Q215	75668-0001	FET, N Channel, (2N4351)
					Resistor
A	o	1,2	R201	31216-0104	Fixed, Comp, 100K ±5%, 1/8w
A	o	1,2	R202	31216-0104	Fixed, Comp, 100K ±5%, 1/8w
A	o	1,2	R203	31216-0682	Fixed, Comp, 6.8K ±5%, 1/8w
A	o	1,2	R204	31216-0222	Fixed, Comp, 2.2K ±5%, 1/8w
A	o	1,2	R205	31216-0333	Fixed, Comp, 33K ±5%, 1/8w
A	o	1,2	R206	31216-0681	Fixed, Comp, 680 ±5%, 1/8w
A	o	1,2	R207	31216-0221	Fixed, Comp, 200 ±5%, 1/8w
A	o	1,2	R208	31216-0101	Fixed, Comp, 100 ±5%, 1/8w
A	o	1,2	R209	31216-0104	Fixed, Comp, 100K ±5%, 1/8w
A	o	1,2	R210	31216-0104	Fixed, Comp, 100K ±5%, 1/8w

RECEIVER PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

			Symbol No.	Part No.	Description
					Resistor
A	o	1,2	R211	31216-0103	Fixed, Comp, 10K ±5%, 1/8w
A	o	1,2	R212	31216-0201	Fixed, Comp, 200 ±5%, 1/8w
A	o	1,2	R213	31216-0103	Fixed, Comp, 10K ±5%, 1/8w
A	o	1,2	R214	31216-0104	Fixed, Comp, 100K ±5%, 1/8w
A	o	1,2	R215	31216-0101	Fixed, Comp, 100 ±5%, 1/8w
A	o	1,2	R216	31216-0562	Fixed, Comp, 5.6K ±5%, 1/8w
A	o	1,2	R217	31216-0470	Fixed, Comp, 47 ±5%, 1/8w
A	o	1,2	R218	31216-0101	Fixed, Comp, 100 ±5%, 1/8w
A	o	1,2	R219	31216-0562	Fixed, Comp, 5.6K ±5%, 1/8w
A	o	1,2	R220	31216-0272	Fixed, Comp, 2.7K ±5%, 1/8w
A	o	2	R221	31216-0562	Fixed, Comp, 5.6K ±5%, 1/8w
A	d	1,2	R222	31216-0562	Fixed, Comp, 5.6K ±5%, 1/8w
C1	a	1,2	R222	31218-0562	Fixed, Comp, 5.6K ±5%, 1/4w
A	o	1,2	R223	31216-0102	Fixed, Comp, 1K ±5%, 1/8w
A	o	1,2	R224	31216-0221	Fixed, Comp, 220 ±5%, 1/8w
A	o	1,2	R225	31218-0100	Fixed, Comp, 10 ±5%, 1/4w
A	o	1	R226	31216-0221	Fixed, Comp, 220 ±5%, 1/8w
A	o	1	R227	31216-0473	Fixed, Comp, 47K ±5%, 1/8w
A	o	1	R228	31216-0122	Fixed, Comp, 1.2K ±5%, 1/8w
A	o	1,2	R229	31216-0201	Fixed, Comp, 200 ±5%, 1/8w
A	o	1	R230	31216-0152	Fixed, Comp, 1.5K ±5%, 1/8w
A	o	1,2	R231	31216-0101	Fixed, Comp, 100 ±5%, 1/8w
A	o	1	R232	31216-0122	Fixed, Comp, 1.2K ±5%, 1/8w
A	o	1	R233	31216-0223	Fixed, Comp, 22K ±5%, 1/8w
A	o	1,2	R234	31216-0151	Fixed, Comp, 150 ±5%, 1/8w
A	o	1,2	R235	31216-0473	Fixed, Comp, 47K ±5%, 1/8w
A	o	1,2	R236	31216-0473	Fixed, Comp, 47K ±5%, 1/8w
A	o	1,2	R237	31216-0471	Fixed, Comp, 470 ±5%, 1/8w
A	o	1,2	R238	31216-0271	Fixed, Comp, 270 ±5%, 1/8w
A	o	1,2	R239	31216-0471	Fixed, Comp, 4.7K ±5%, 1/8w

RECEIVER PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

			Symbol No.	Part No.	Description
					Resistor
A	o	1,2	R240	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	1,2	R241	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	1,2	R242	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	1,2	R243	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	1	R244	31216-0332	Fixed, Comp, 3.3K ±5%, 1/8w
A	o	1	R245	31216-0153	Fixed, Comp, 15K ±5%, 1/8w
A	o	1	R246	31216-0103	Fixed, Comp, 10K ±5%, 1/8w
B	c	1,2	R246	31216-0223	Fixed, Comp, 22K ±5%, 1/8w
B	c	2	R246	31216-0203	Fixed, Comp, 20K ±5%, 1/8w
C	c	1,2	R246	31216-0623	Fixed, Comp, 62K ±5%, 1/8w
A	o	1,2	R247	31205-0003	Thermistor, 48.2K ±10%, 1/8w
A	o	1,2	R248	31216-0103	Fixed, Comp, 10K ±5%, 1/8w
B1	c	1,2	R248	31216-0473	Fixed, Comp, 47K ±5%, 1/8w
A	o	1,2	R249	31216-0101	Fixed, Comp, 100 ±5%, 1/8w
A	o	1,2	R250	31216-0563	Fixed, Comp, 56K ±5%, 1/8w
A	o	1,2	R251	31216-SEL	Fixed, Comp, SEL. 1/8w
A	o	1,2	R252	31216-0101	Fixed, Comp, 100 ±5%, 1/8w
A	o	1,2	R253	31216-0201	Fixed, Comp, 200 ±5%, 1/8w
A	o	1,2	R254	31216-0272	Fixed, Comp, 2.7K ±5%, 1/8w
A	o	1,2	R255	31216-0102	Fixed, Comp, 1K ±5%, 1/8w
A	o	1,2	R257	31216-0103	Fixed, Comp, 10K ±5%, 1/8w
A	o	1,2	R258	31216-0103	Fixed, Comp, 10K ±5%, 1/8w
B	c	1,2	R258	31216-0303	Fixed, Comp, 30K ±5%, 1/8w
A	o	1,2	R259	31216-0102	Fixed, Comp, 1K ±5%, 1/8w
A	o	1,2	R260	31216-0152	Fixed, Comp, 1.5K ±5%, 1/8w
C	c	1,2	R260	31216-0102	Fixed, Comp, 1K ±5%, 1/8w
A	o	1,2	R261	32054-0012	Variable, 100K ±20%, 1/4w
C	c	1,2	R261	32054-0020	Variable, 1 Meg
A	o	1,2	R262	31216-0752	Fixed, Comp, 7.5K ±5%, 1/8w
C	c	1,2	R262	31216-0104	Fixed, Comp, 100K ±5%, 1/8w

RECEIVER PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

			Symbol No.	Part No.	Description
					Resistor
A	o	1,2	R263	31216-0102	Fixed, Comp, 1K +5%, 1/8w
C	c	1,2	R263	31216-0122	Fixed, Comp, 1.2K +5%, 1/8w
A	o	1,2	R264	31216-0182	Fixed, Comp, 1.8K +5%, 1/8w
C	c	1,2	R264	31216-0202	Fixed, Comp, 2K +5%, 1/8w
A	o	1	R265	31216-0153	Fixed, Comp, 15K +5%, 1/8w
A	o	1	R266	31216-0153	Fixed, Comp, 15K +5%, 1/8w
A	o	1,2	R267	31216-0273	Fixed, Comp, 27K +5%, 1/8w
A	o	1,2	R268	31216-0103	Fixed, Comp, 10K +5%, 1/8w
A	o	1,2	R269	31216-0222	Fixed, Comp, 2.2K +5%, 1/8w
B	d	2	R270	31216-0102	Fixed, Comp, 1K +5%, 1/8w
A	o	1	R270	31216-0102	Fixed, Comp, 1K +5%, 1/8w
A	o	1,2	R271	31216-0222	Fixed, Comp, 2.2K +5%, 1/8w
A	o	1,2	R272	31216-0103	Fixed, Comp, 10K +5%, 1/8w
A	o	1,2	R273	31216-0222	Fixed, Comp, 2.2K +5%, 1/8w
A	o	1,2	R274	31216-0103	Fixed, Comp, 10K +5%, 1/8w
A	o	1,2	R275	31216-0681	Fixed, Comp, 680 +5%, 1/8w
A3	c	1,2	R275	31216-0221	Fixed, Comp, 220 +5%, 1/8w
A	o	1,2	R276	31216-0103	Fixed, Comp, 10K +5%, 1/8w
A1	a	1,2	R277	31216-SEL	Fixed, Comp, SEL +5%, 1/8w
A1	a	1,2	R278	31216-SEL	Fixed, Comp, SEL +5%, 1/8w
A2	a	1,2	R279	31215-0684	Fixed, Comp, 680K +10%, 1/8w
B	a	1,2	R280	31216-0330	Fixed, Comp, 33K +5%, 1/8w
B2	c	1,2	R280	31216-0473	Fixed, Comp, 47K +5%, 1/8w
					Transformer
A	O	1,2	T201	11867-0001	Audio

RECEIVER PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

			Symbol No.	Part No.	Description
					I.C.
A	o	1,2	U201	74028-0001	IF Amplifier (MC1350P)
A	o	1,2	U202	74099-0001	General Purpose Amplifier Array (CA3088E)
A	o	1	U203	74072-0002	Quad Analog Switch (4066)
A	o	1,2	U204	74081-0001	0.5 Watt Audio Amplifier (MC1306P)
A	o	1,2	U205	74039-0003	Voltage Regulator (+8v) (78M08) (Fig. 5.3, item -5)
A	o	1,2	U206	74103-0001	Dual Operational Amplifier (MC1458CP)

SYNTHESIZER PC BOARD ASSEMBLY

ELECTRICAL PARTS LIST

NAV UNIT	ASSY PART NO.	REFER TO SCHEMATIC(S)
Nav 121, 122, 122A	01237-0101T	Fig. 6-4

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

		Symbol No.	Part No.	Description
				Capacitor
A	o	C301	21291-0027	Ceramic Disc, 100 pf ±20%, 50v
A10	c	C301	21291-0024	
A9	d	C308	24551-0003	Ceramic Disc, 100 pf ±20%, 50v
A	o	C301	21291-0027	Ceramic Disc, 100 pf ±20%, 50v
A10	c	C301	21291-0024	Ceramic Disc, 270 pf ±2%, 50v
A	o	C302	24551-0003	Ceramic Disc, 1000pf ±20%, 50v
A	o	C303	24551-0003	Ceramic Disc, 1000pf ±20%, 50v
A	o	C304	21291-0030	Ceramic Disc, 0.1 uf ±20%, 50v
A	o	C305	24551-0003	Ceramic Disc, 1000 pf ±20%, 50v
A	o	C306	24551-0003	Ceramic Disc, 1000 pf ±20%, 50v
A	o	C307	24551-0003	Ceramic Disc, 1000 pf ±20%, 50v
A9	d	C308	24551-0003	
A	o	C309	23107-0117	Metalized Mylar, 0.022 uf ±10%, 100v
A	o	C310	23107-0125	Metalized Mylar, 0.1 uf ±10%, 100v
A	o	C311	21564-0120	Solid Tantalum, 22 uf ±10%, 10v
A	o	C312	23107-0121	Metalized Mylar, 0.047 uf ±10%, 100v
A	o	C313	21564-0129	Solid Tantalum, 3.3 uf ±10%, 10v
A	o	C314	21564-0129	Solid Tantalum, 3.3 uf ±10%, 10v
A	o	C315	24052-0101	Dipped Mica, 100 pf ±5%, 500v
A	o	C316	22041-0007	Trimmer, 9-35 pf
A	c	C316	22041-0002	Variable, 9-35 pf
A	o	C317	21564-0140	Solid Tantalum, 0.1 uf ±10%, 35v
A	o	C318	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o	C319	24052-0430	Dipped Mica, 43 pf ±5%, 500v
A	o	C320	23107-0125	Metalized Mylar, 0.1 uf ±10%, 100v

300's

SYNTHESIZER

SYNTHESIZER PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

Chassis Level Code	Action	Symbol No.	Part No.	Description
				Capacitor
A	o	C321	21564-0124	Solid Tantalum, 100 uf ±10%, 10v
A	o	C322	23107-0125	Metalized Mylar, 0.1 uf ±10%, 100v
A	o	C323	24052-0750	Dipped Mica, 75 pf ±5%, 500v
A	o	C324	21291-0008	Ceramic Disc, 3000 pf +20%, 500v
A	c	C324	21290-0008	Feedthru, 0.001 uf ±20%, 250v
A1	c	C324	21290-0009	Feedthru, 0.001 uf +80% -20%, 250v
A	o	C325	21290-0008	Feedthru, 0.001 uf ±20%, 250v
A1	c	C325	21290-0009	Feedthru, 0.001 uf +80% -20%, 250v
A	o	C326	21290-0008	Feedthru, 0.001 uf ±20%, 250v
A1	c	C326	21290-0009	Feedthru, 0.001 uf +80% -20%, 250v
A	o	C327	21290-0008	Feedthru, 0.001 uf ±20%, 250v
A1	c	C327	21290-0009	Feedthru, 0.001 uf +80% -20%, 250v
A	o	C328	21290-0008	Feedthru, 0.001 uf ±20%, 250v
A1	c	C328	21290-0009	Feedthru, 0.001 uf +80% -20%, 250v
A	o	C329	21290-0008	Feedthru, 0.001 uf +80% -20%, 250v
A	c	C329	21290-0009	Feedthru, 0.001 uf +80% -20%, 250v
A	o	C330	21290-0008	Feedthru, 0.001 uf ±20%, 250v
A1	c	C330	21290-0009	Feedthru, 0.001 uf +80%, -20%, 250v
A	o	C331	21290-0008	Feedthru, 0.001 uf ±20%, 250v
A1	c	C331	21290-0009	Feedthru, 0.001 uf +80% -20%, 250v
A	o	C332	21290-0008	Feedthru, 0.001 uf ±20%, 250v
A1	c	C332	21290-0009	Feedthru, 0.001 uf +80% -20%, 250v
A	o	C333	21290-0008	Feedthru, 0.001 uf ±20%, 250v
A1	c	C333	21290-0009	Feedthru, 0.001 uf +80% -20%, 250v
A	o	C334	21290-0008	Feedthru, 0.001 uf ±20%, 250v
A1	c	C334	21290-0009	Feedthru, 0.001 uf +80% -20%, 250v
A	o	C335	21290-0008	Feedthru, 0.001 uf ±20%, 250v
A1	c	C335	21290-0009	Feedthru, 0.001 uf +80% -20%, 250v
A	o	C336	21290-0008	Feedthru, 0.001 uf ±20%, 250v
A1	c	C336	21290-0009	Feedthru, 0.001 uf +80% -20%, 250v

SYNTHESIZER PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

Chassis Level Code	Action	Symbol No.	Part No.	Description
				Capacitor
A	o	C337	21290-0008	Feedthru, 0.001 uf ±20%, 250v
A1	c	C337	21290-0009	Feedthru, 0.001 uf +80% -20%, 250v
A	o	C338	21564-0120	Solid Tantalum, 22 uf ±10%, 10v
A	o	C339	23107-0131	Metalized Mylar, 0.33 uf ±10%, 100v
A	o	C340	24515-0001	Ceramic Disc, 0.1 uf +80% -20%, 10v
A	o	C341	24052-0201	Dipped Mica, 200 pf ±5%, 500v
A	o	C342	21290-0008	Feedthru, 0.001 uf ±20%, 250v
A2	c	C342	21290-0009	Feedthru, 0.001 uf +80% -20%, 250v
A6	a	C343	24551-0002	Ceramic Disc, 470 pf ±20%, 50v
A6	a	C344	24551-0002	Ceramic Disc, 470 pf ±20%, 50v
A8	a	C345	24551-0003	Ceramic Disc, 1000 pf ±20%, 50v
A8	a	C346	24551-0003	Ceramic Disc, 1000 pf ±20%, 50v
A8	a	C347	24551-0003	Ceramic Disc, 1000 pf ±20%, 50v
				Diode
A	o	CR301	75028-0001	Silicon
A3	d	CR302		
A	o	CR303	75028-0001	Silicon
A	o	CR304	75028-0001	Silicon
A	o	CR305	75028-0001	Silicon
A	o	CR306	75028-0001	Silicon
A	o	CR307	75028-0001	Silicon
A	o	CR308	75028-0001	Silicon
A	o	CR309	75028-0001	Silicon
A	o	CR310	75028-0001	Silicon
A	o	CR311	75028-0001	Silicon
A7	a	CR312	75204-0045	Silicon (1N4005)

SYNTHESIZER PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

Chassis Level Code	Action	Symbol No.	Part No.	Description
				Transistor
A	o	Q301	75561-0038	(2N4258)
A9	d	Q301	75561-0038	
A	o	Q302	75561-0038	(2N4258)
A9	d	Q302	75561-0038	
A	o	Q303	75550-0022	(2N3391)
				Resistor
A	o	R301	31216-0102	Fixed, Comp, 1K ±5%, 1/8w
A	o	R302	31216-0331	Fixed, Comp, 330 ±5%, 1/8w
A9	d	R302	31216-0331	
A	o	R303	31216-0241	Fixed, Comp, 240 ±5%, 1/8w
A9	d	R304	31218-0101	Fixed, Comp, 100 ±5%, 1/4w
A	o	R305	31216-0271	Fixed, Comp, 270 ±5%, 1/8w
A	o	R306	31216-0101	Fixed, Comp, 100 ±5%, 1/8w
A9	d	R306	31216-0101	
A	o	R307	31216-0333	Fixed, Comp, 33K ±5%, 1/8w
A	o	R308	31216-0332	Fixed, Comp, 3.3K ±5%, 1/8w
A	o	R309	31216-0102	Fixed, Comp, 1K ±5%, 1/8w
A	o	R310	31216-0102	Fixed, Comp, 1K ±5%, 1/8w
A	o	R311	31216-0102	Fixed, Comp, 1K ±5%, 1/8w
A	o	R312	31216-0152	Fixed, Comp, 1.5K ±5%, 1/8w
A	o	R313	31216-0331	Fixed, Comp, 330 ±5%, 1/8w
A9	d	R313	31216-0331	
A	o	R314	31216-0473	Fixed, Comp, 47K ±5%, 1/8w
A	o	R315	31216-0333	Fixed, Comp, 33K ±5%, 1/8w
A	o	R316	31216-0152	Fixed, Comp, 1.5K ±5%, 1/8w
A	o	R317	31216-0102	Fixed, Comp, 1K ±5%, 1/8w
A	o	R318	31216-0152	Fixed, Comp, 1.5K ±5%, 1/8w
A	o	R319	31216-0122	Fixed, Comp, 1.2K ±5%, 1/8w
A4	c	R319	31216-0821	Fixed, Comp, 820 ±5%, 1/8w
A	o	R320	31216-0181	Fixed, Comp, 180 ±5%, 1/8w
A	o	R321	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w

SYNTHESIZER PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

		Symbol No.	Part No.	Description
				Resistor
A	o	R322	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	R323	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	R324	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	R325	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	R326	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	R327	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	R328	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	R329	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	R330	31216-0223	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	R331	31216-0221	Fixed, Comp, 220 ±5%, 1/8w
A	o	R332	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	R333	31216-0272	Fixed, Comp, 2.7K ±5%, 1/8w
A	o	R334	31216-0152	Fixed, Comp, 1.5K ±5%, 1/8w
A8	a	R335	31216-0102	Fixed, Comp, 1K ±5%, 1/8w
				I.C.
A	o	U301	74019-0002	Quad 2 Input NAND Gate (74LS00/9LS00)
A	o	U302	74043-0002	4 Bit Binary Counter (74LS161/9LS161)
A	o	U303	74070-0002	Triple 3 Input NAND Gate (9LS10/74LS10)
A	o	U304	74053-0003	Quad 2 Input Exclusive OR Gate (74LS86/9LS86)
A	o	U305	74108-0001	Dual JK Edge Triggered Flip-Flop (9LS109/74LS109)
A	o	U306	74071-0001	High Speed VHF Prescaler (95H90)
A9	c	U306	74068-0003	Prescaler ÷ 10/11 (11C90)
A	o	U307	74072-0002	Quad Analog Switch (4066)
A	o	U308	74072-0002	B.C.D. Decoder Counter (74LS160/9LS160)
A	o	U309	74042-0002	B.C.D. Decoder Counter (74LS160/9LS160)
A	o	U310	74102-0007	Programmable Read Only Memory (82S123B)
A	o	U311	74102-0006	Programmable Read Only Memory (82S123B)
A	o	U312	74110-0001	Hex Inverter/Buffer (MC14049P)
A	o	U313	74110-0001	Hex Inverter/Buffer (MC14049P)
A	o	U314	74032-0001	Phase/Freq. Detector (MC4044P)

SYNTHESIZER PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

Chassis Level Code	Action	Symbol No.	Part No.	Description
				I.C.
A	o	U315	74019-0002	Quad 2 Input NAND (7400)
A5	c	U315	74019-0003	Quad 2 Input NOR Gate (74LS00/9LS00)
A	o	U316	74066-0002	Dual Peripheral Driver (DS75462N)
A	o	U317	74109-0012	Voltage Regulator (+8v) (78L08)
A	o	U318	74039-0004	Voltage Regulator (+5v) (7805) (Fig. 5.4, item -5)
A	o	U319	74035-0001	Dual JK Flip-Flop
A	c	U319	74035-0002	Seven Stage Ripple Counter (4024)
				Crystal
A	o	Y301	72041-0001	3.2 MHz

MARKER AND GLIDE SLOPE PC BOARD ASSEMBLY
MARKER COMPONENTS
ELECTRICAL PARTS LIST

NAV UNIT	ASSY PART NO.	ASSY CODE	REFER TO SCHEMATIC(S)
NAV 122 (MKR/GS)	01236-0102W	400/500 Series Symbol Nos.	Fig. 6-7 Fig. 6-6
NAV 122A (MKR only)	01236-0101W	400 Series Symbol Nos.	Fig. 6-7

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

		Symbol No.	Part No.	Description
				Capacitor
A	o	C401	23107-0113	Metalized Mylar, 0.01 uf ±10%, 100v
A	o	C402	21564-0032	Solid Tantalum, 10 uf ±20%, 15v
A	o	C403	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o	C404	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o	C405	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o	C406	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o	C407	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o	C408	24516-0479	Ceramic Disc, 4.7 pf ±5%, 500v
A	o	C409	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o	C410	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o	C411	24052-0120	Dipped Mica, 12 pf ±10%, 500v
A	o	C412	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o	C413	24516-0220	Ceramic Disc, 22 pf ±10%, 500v
A	o	C414	24509-0338	Ceramic Tub., 0.33 pf ±5%, 500v
A	o	C415	24516-0270	Ceramic Disc, 27 pf ±10%, 500v
A	o	C416	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o	C417	21564-0032	Solid Tantalum, 10 uf ±20%, 15v
A	o	C418	21564-0034	Solid Tantalum, 22 uf ±20%, 15v
A	o	C419	21564-0032	Solid Tantalum, 10 uf ±20%, 15v
A	o	C420	23107-0125	Metalized Mylar, 0.1 uf ±10%, 100v

400's

MARKER RECEIVER

MARKER AND GLIDE SLOPE PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

Chassis Level Code	Action	Assy Code	Symbol No.	Part No.	Description
					Capacitor
A	o		C421	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o		C422	24052-0270	Dipped Mica, 27 pf ±5%, 500v
A	o		C423	24052-0121	Dipped Mica, 120 pf ±5%, 500v
A	o		C424	24052-0620	Dipped Mica, 62 pf ±5%, 500v
A	o		C425	24052-0470	Dipped Mica, 47 pf ±5%, 500v
A	o		C426	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o		C427	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o		C428	21564-0032	Solid Tantalum, 10 uf ±20%, 15v
A	o		C429	21564-0032	Solid Tantalum, 10 uf ±20%, 15v
A	o		C430	21564-0037	Solid Tantalum, 68 uf ±20%, 15v
C	c		C430	21564-0124	Solid Tantalum, 100 uf ±10%, 10v
A	o		C431	23107-0125	Metalized Mylar, 0.01 uf ±10%, 100v
A	o		C432	23107-0125	Metalized Mylar, 0.01 uf ±10%, 100v
A	o		C433	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o		C434	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o		C435	21564-0029	Solid Tantalum, 3.3 uf ±20%, 15v
A	o		C436	21564-0029	Solid Tantalum, 3.3 uf ±20%, 15v
A	o		C437	21564-0029	Solid Tantalum, 3.3 uf ±20%, 15v
					Diode
A	o		CR401	75025-0005	Silicon, Zener, 10v
A	o		CR402	75038-0002	Silicon
A	o		CR403	75028-0001	Silicon
A	o		CR404	75028-0001	Silicon
A	o		CR405	75028-0001	Silicon
A	o		CR406	75028-0001	Silicon
A	o		CR407	75028-0001	Silicon

MARKER AND GLIDE SLOPE PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

Assy Code	Action	Symbol No.	Part No.	Description
				Filter
A	o	FL401	43208-0002	Crystal, monolithic, 10.7 MHz
A	o	FL402	26001-0101	Audio
				Coil/Choke
A	o	L401	11872-0002	Crystal Filter
A	o	L402	11873-0002	RF
A	o	L403	11873-0002	RF
A	o	L404	11138-0003	RF, Insulated, 22 MHz
				Transistor
A	o	Q401	75611-0002	FET
A	o	Q402	75592-0002	Silicon, NPN
A	o	Q403	75576-0001	Silicon, NPN, (Fig. 5.5, item -4)
A	o	Q404	75595-0003	Silicon (2N5172)
A	o	Q405	75595-0003	Silicon (2N5172)
A	o	Q406	75587-0014	Darlington (2N5308)
A	o	Q407	75587-0014	Darlington (2N5308)
A	o	Q408	75587-0014	Darlington (2N5308)
A	o	Q409	75558-0005	Silicon, NPN (2N5810)
				Resistor
A	o	R401	31216-0101	Fixed, Comp, 100 ±5%, 1/8w
A	o	R402	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	R403	31205-0003	Thermistor, 47K ±10%, 1/8w
A	o	R404	31216-0101	Fixed, Comp, 100 ±5%, 1/8w
A	o	R405	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	R406	31216-0101	Fixed, Comp, 100 ±5%, 1/8w
A	o	R407	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	R408	31216-0104	Fixed, Comp, 100K ±5%, 1/8w
A	o	R409	31216-0221	Fixed, Comp, 220 ±5%, 1/8w
A	o	R410	32075-0001	

MARKER AND GLIDE SLOPE PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

Assy Code	Action	Symbol No.	Part No.	Description
				Resistor
A1	c	R410	32081-2101	Variable, 100 ±20%, 1/4w
A	o	R411	31216-0331	Fixed, Comp, 330 ±5%, 1/8w
A	o	R412	31216-0184	Fixed, Comp, 180K ±5%, 1/8w
A	o	R413	31216-0472	Fixed, Comp, 4.7K ±5%, 1/8w
A	o	R414	31192-0102	Fixed, Comp, 1K ±5%, 1/4w
A	o	R415	31216-0682	Fixed, Comp, 6.8K ±5%, 1/8w
A	o	R416	31216-0102	Fixed, Comp, 1K ±5%, 1/8w
A	o	R417	31205-0004	Thermistor, 128.8 ±10%, 1/8w
A	o	R418	31216-0102	Fixed, Comp, 1K ±5%, 1/8w
A	o	R419	31216-0103	Fixed, Comp, 10K ±5%, 1/8w
A	o	R420	31216-0103	Fixed, Comp, 10K ±5%, 1/8w
A	o	R421	31216-0471	Fixed, Comp, 470 ±5%, 1/8w
A	o	R422	31216-0224	Fixed, Comp, 220K ±5%, 1/8w
A	o	R423	31141-0102	Fixed, Comp, 1K ±10%, 1/2w
A	o	R424	31216-0224	Fixed, Comp, 220K ±5%, 1/8w
A	o	R425	32054-0021	Fixed, Comp, 22K ±20%, 1/4w
A	o	R426	31215-0824	Fixed, Comp, 820K ±10%, 1/8w
A	o	R427	31216-0154	
A1	c	R427	31216-0124	Fixed, Comp, 120K ±5%, 1/8w
A	o	R428	31216-0102	Fixed, Comp, 1K ±5%, 1/8w
C	c	R428	31216-0101	Fixed, Comp, 100 ±5%, 1/8w
A	o	R429	31216-0103	Fixed, Comp, 10K ±5%, 1/8w
C	c	R429	31218-0103	Fixed, Comp, 10K ±5%, 1/4w
A	o	R430	31218-0121	Fixed, Comp, 120 ±10%, 1/4w
A	o	R431	31218-0471	Fixed, Comp, 470 ±10%, 1/4w
A	o	R432	31216-0103	Fixed, Comp, 10K ±5%, 1/8w
A	o	R433	31216-0223	Fixed, Comp, 22K ±5%, 1/8w
A	o	R434	31216-0223	Fixed, Comp, 22K ±5%, 1/8w
A	o	R435	31216-0223	Fixed, Comp, 22K ±5%, 1/8w
A	o	R436	31216-0103	Fixed, Comp, 10K ±5%, 1/8w

MARKER AND GLIDE SLOPE PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

Chassis Level Code	Action	Assy Code	Symbol No.	Part No.	Description
					Resistor
A	o		R437	31216-0102	Fixed, Comp, 1K ±5%, 1/8w
A	o		R438	31141-0470	Fixed, Comp, 47 ±10%, 1/2w
A	o		R439	31216-0473	Fixed, Comp, 47K ±5%, 1/8w
A	o		R440	31216-0473	Fixed, Comp, 47K ±5%, 1/8w
A	o		R441	31216-0473	Fixed, Comp, 47K ±5%, 1/8w
A	o		R442	31216-SEL	Fixed, Comp, SEL, 1/8w
A	o		R443	31216-SEL	Fixed, Comp, SEL, 1/8w
A	o		R444	31216-SEL	Fixed, Comp, SEL, 1/8w
					Transformer
A	o		T401	11871-0001	10.7 MHz
A	o		T402	11871-0001	10.7 MHz
					I.C.
A	o		U401	74099-0001	General Purpose Amplifier Array (CA3088E)
A	o		U402	74038-0001	Quad Operational Amplifier (MC3401)
					Crystal
A	o		Y401	72044-0001	64.3 MHz

MARKER AND GLIDE SLOPE PC BOARD ASSEMBLY
GLIDE SLOPE COMPONENTS
ELECTRICAL PARTS LIST

NAV UNIT	ASSY PART NO.	ASSY CODE	REFER TO SCHEMATIC(S)
NAV 122 (MKR/GS)	01236-0102W	400/500 Series Symbol Nos.	Fig. 6-7 Fig. 6-6

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

		Symbol No.	Part No.	Description
				Capacitor
A	o	C501	21564-0020	Solid Tantalum, 22 uf ±20%, 15v
E	c	C501	21564-0005	Tantalum 15 uf ±20%, 6v
A	o	C502	21291-0025	Ceramic Disc, 430 pf ±20%, 50v
A	o	C503	21291-0025	Ceramic Disc, 430 pf ±20%, 50v
A	o	C504	24052-0331	Dipped Mica, 330 pf ±5%, 500v
A	o	C505	24052-0331	Dipped Mica, 330 pf ±5%, 500v
A	o	C506	21564-0014	Solid Tantalum, 2.2 uf ±20%, 25v
A	o	C507	21564-0014	Solid Tantalum, 2.2 uf ±20%, 25v
A	o	C508	21564-0024	Solid Tantalum, 100 uf ±20%, 10v
A	o	C509	21291-0030	Ceramic Disc, 0.01 uf ±20%, 50v
A	o	C510	21564-0020	Solid Tantalum, 22 uf ±20%, 15v
E	c	C510	21564-0005	
A	o	C511	24551-0001	Ceramic Disc, 100 pf ±20%, 50v
E	c	C511	24551-0003	Ceramic Disc, 1000 pf ±20%, 50v
B	a	C512	24564-0020	Solid Tantalum, 22 uf ±20%, 50v
				Diode
A	o	CR501	75028-0001	Silicon
D	c	CR501	75013-0005	Alloy Junction
A	o	CR502	75028-0001	Silicon
D	c	CR502	75013-0005	Alloy Junction
A	o	CR503	75028-0001	Silicon
A	o	CR504	75028-0001	Silicon
A	o	CR505	75028-0001	Silicon
A	o	CR506	75028-0001	Silicon
B	a	CR507	75025-0015	Silicon, Zener, 6.2v
D	c	CR507	75025-0025	Silicon, Zener, 6.8v

MARKER AND GLIDE SLOPE PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

Chassis Level Code	Action	Symbol No.	Part No.	Description
				Transistor
A	o	Q501	75614-0001	(2N5134)
A	o	Q502	75550-0022	(2N3391)
A	o	Q503	75614-0001	(2N5134)
				Resistor
A	o	R501	31215-0684	Fixed, Comp, 680K ±10%, 1/8w
A	o	R502	31199-0373	Fixed, Film, 56.2K ±1%, 1/4w
E	c	R502	31199-0347	Fixed, Film, 30K ±1%, 1/4w
A	c	R503	31199-0373	Fixed, Film, 56.2K ±1%, 1/4w
E	c	R503	31199-0347	Fixed, Film, 30K ±1%, 1/4w
A	o	R504	32054-0009	Variable, 1K ±20%, 1/4w
A	o	R505	31199-0385	Fixed, Film, 75K ±1%, 1/4w
B2	c	R505	31199-0401	Fixed, Film, 75K ±1%, 1/4w
A	o	R506	31216-0104	Fixed, Comp, 100K ±5%, 1/8w
A	o	R507	32054-0005	Variable, 50K ±20%, 1/4w
A	o	R508	31216-0223	Fixed, Comp, 22K ±5%, 1/8w
B	c	R508	31216-0184	Fixed, Comp, 180K ±5%, 1/8w
D	c	R508	31216-0154	Fixed, Comp, 150K ±5%, 1/8w
A	o	R509	31216-0153	Fixed, Comp, 15K ±5%, 1/8w
A	o	R510	31216-0103	Fixed, Comp, 10K ±5%, 1/8w
A	o	R511	31216-0473	Fixed, Comp, 47K ±5%, 1/8w
A	o	R512	31215-0684	Fixed, Comp, 680K ±10%, 1/8w
A	o	R513	31199-0366	Fixed, Film, 47.5K ±1%, 1/4w
B1	c	R513	31199-0359	Fixed, Film, 40.2K ±1%, 1/4w
E	c	R513	31199-0385	Fixed, Film, 75K ±1%, 1/4w
A	o	R514	31199-0366	Fixed, Film, 47.5K ±1%, 1/4w
B1	c	R514	31199-0359	Fixed, Film, 40.2K ±1%, 1/4w
E	c	R514	31199-0385	Fixed, Film, 75K ±1%, 1/4w
A	o	R515	31199-0385	Fixed, Film, 75K ±1%, 1/4w
A	o	R516	31216-0104	Fixed, Comp, 100K ±5%, 1/8w
A	o	R517	31199-0401	Fixed, Film, 100K ±1%, 1/4w

500's

GLIDE SLOPE

MARKER AND GLIDE SLOPE PC BOARD ASSEMBLY
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

		Symbol No.	Part No.	Description
				Resistor
A	o	R518	31199-0401	Fixed, Film, 100K ±1%, 1/4w
A	o	R519	31216-0332	Fixed, Comp, 3.3K ±5%, 1/8w
A	o	R520	31216-0104	Fixed, Comp, 100K ±5%, 1/8w
A	o	R521	31216-0104	Fixed, Comp, 100K ±5%, 1/8w
A	o	R522	31216-0103	Fixed, Comp, 10K ±5%, 1/8w
A	o	R523	31216-0103	Fixed, Comp, 10K ±5%, 1/8w
A	o	R524	31216-0102	Fixed, Comp, 1K ±5%, 1/8w
B	a	R525	31216-0101	Fixed, Comp, 100 ±5%, 1/8w
D	c	R525	31216-0510	Fixed, Comp, 51 ±5%, 1/8w
				I.C.
A	o	U501	74105-0001	Quad Operational Amplifier (MC3403P)
A	o	U502	74086-0001	Dual Type D Flip-Flop (MC14013CP)
A	o	U503	74086-0001	Dual Type D Flip-Flop (MC14013CP)
A	o	U504	74072-0001	Binary Up/Down Counter (MC14016CP)
A	o	U505	74083-0001	Quad 2 Input NOR Gate (MC14001CP)
A	o	U506	74107-0002	Dual Binary Up Counter (MC14520CP)
A	o	U507	74086-0001	Dual Type D Flip-Flop (MC14013CP)

OMNI LOC PC BOARD
ELECTRICAL PARTS LIST

NAV UNIT	ASSY PART NO.	ASSY CODE	REFER TO SCHEMATIC(S)
NAV 121	01235-0103W	3*	Fig. 6-9/6-9A
NAV 122A	01235-0103W	3*	Fig. 6-9/6-9A
NAV 122	01235-0101W	1*	Fig. 6-5/6-5A

*All parts common except NAV 122 also contains: C611, C629, C630, R634, R672 and U607.

NAV 122 does not have C662, C663.

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

		Symbol No.	Part No.	Description
				Capacitor
A	o	C601	23109-5393	Polycarbonate, 0.039 uf ±5%, 100v
A	o	C602	23109-5393	Polycarbonate, 0.039 uf ±5%, 100v
A	o	C603	23109-5393	Polycarbonate, 0.039 uf ±5%, 100v
A	o	C604	23109-5393	Polycarbonate, 0.039 uf ±5%, 100v
A	o	C605	21564-0014	Solid Tantalum, 2.2 uf ±20%, 10v
A	o	C606	21564-0014	Solid Tantalum, 2.2 uf ±20%, 10v
A	o	C607	23107-0125	Metalized Mylar 0.1 uf ±10%, 100v
A	o	C608	21564-0018	Solid Tantalum, 10 uf ±20%, 6v
A	o	C609	23107-0125	Metalized Mylar, 0.1 uf ±10%, 100v
A	o	C610	21564-0024	Solid Tantalum, 100 uf ±10%, 10v
A	o	C611	21564-0020	Solid Tantalum, 22 uf ±20%, 6v
B	c	C611	21564-0018	Solid Tantalum, 10 uf ±20%, 6v
E	c	C611	21564-0005	Solid Tantalum, 15 uf ±20%, 6v
A	o	C612	23107-0131	Metalized Mylar, 0.33 uf ±10%, 63v
A	o	C613	23107-0131	Metalized Mylar, 0.33 uf ±10%, 63v
A	o	C614	24052-0331	Dipped Mica, 330 pf ±5%, 100v
A	o	C615	24551-0002	Ceramic Disc, 470 pf +20%, 50v
A	o	C616	24052-0331	Dipped Mica, 330 pf ±5%, 100v
A	o	C617	24052-0331	Dipped Mica, 330 pf ±5%, 100v
A	o	C618	23107-0027	Metalized Mylar, 0.15 uf ±5%, 100v

OMNI LOC PC BOARD
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

		Symbol No.	Part No.	Description
				Capacitor
A	o	C619	23107-0027	Metalized Mylar, 0.15 uf ±5%, 100v
A	o	C620	24052-0331	Dipped Mica, 330 pf ±5%, 100v
A	o	C621	21564-0005	Solid Tantalum, 15 uf ±20%, 6v
A	o	C622	21564-0005	Solid Tantalum, 15 uf ±20%, 6v
E	c	C622	21564-0020	Solid Tantalum, 22 uf ±20%, 6v
A	o	C623	24551-0002	Ceramic Disc, 470 pf ±20%, 50v
A	o	C624	21564-0018	Solid Tantalum, 10 uf ±20%, 6v
A	o	C625	21564-0014	Solid Tantalum, 2.2 uf ±20%, 6v
A	o	C626	24551-0002	Ceramic Disc, 470 pf ±20%, 50v
A	o	C627	23109-5104	Polycarbonate, 0.1 uf ±5%, 100v
A	o	C628	21564-0026	Solid Tantalum, 220 uf ±20%, 10v
A	o	C629	23107-0121	Metalized Mylar, 0.047 uf ±10%, 100v
A	o	C630	23107-0121	Metalized Mylar, 0.047 uf ±10%, 100v
C	c	C630	23107-0119	Metalized Mylar, 0.33 uf ±10%, 100v
A	o	C631	23107-0111	Metalized Mylar, 0.0068 uf ±10%, 100v
C	c	C631	23107-0013	Metalized Mylar, .01 uf +5%, 100v
A	o	C633	24551-0002	Ceramic Disc, 470 pf ±20%, 50v
A	o	C635	24551-0001	Ceramic Disc, 100 pf ±20%, 50v
A	o	C636	23107-0107	Metalized Mylar, 0.0033 uf ±10%, 100v
A	o	C637	24551-0003	Ceramic Disc, 1000 pf ±20%, 50v
A	o	C638	23109-5104	Polycarbonate, 0.1 uf ±5%, 100v
A	o	C639	23109-5104	Polycarbonate, 0.1 uf ±5%, 100v
A	o	C640	23109-5104	Polycarbonate, 0.1 uf ±5%, 100v
A	o	C641	24050-0102	Dipped Mica, 1000 pf ±1%, 100v
A	o	C642	24050-0102	Dipped Mica, 1000 pf ±1%, 100v
A	o	C643	24515-0008	Ceramic Disc, 0.005 uf +80% -20%, 50v
A	o	C644	24050-0102	Dipped Mica, 1000 pf ±1%, 100v
A	o	C645	24050-0102	Dipped Mica, 1000 pf ±1%, 100v
A	o	C647	21564-0018	Solid Tantalum, 10 uf ±20%, 6v
A	o	C648	23107-0129	Metalized Mylar, 0.22 uf ±10%, 100v

OMNI LOC PC BOARD
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

		Symbol No.	Part No.	Description
				Capacitor
A	o	C649	24551-0003	Ceramic Disc, 1000 pf ±20%, 50v
A	o	C650	24551-0003	Ceramic Disc, 1000 pf ±20%, 50v
A	o	C651	23107-0031	Metalized Mylar, 0.33 uf ±5%, 63v
A	o	C652	23109-5104	Polycarbonate, 0.1 uf ±5%, 100v
A	o	C653	23109-5104	Polycarbonate, 0.1 uf ±5%, 100v
A	o	C654	23109-5104	Polycarbonate, 0.1 uf ±5%, 100v
A	o	C655	23107-0013	Metalized Mylar, 0.01 uf ±5%, 100v
A	o	C659	21564-0024	Solid Tantalum, 100 uf ±20%, 10v
A	o	C660	23107-0125	Metalized Mylar, 0.1 uf ±10%, 100v
E	a	C661	24559-0102	Tantalum, 15 uf ±20%, 2v
E	a	C662	21564-0021	Tantalum, 33 uf ±20%, 10v
				Diode
A	o	CR601	75013-0005	Silicon
A	o	CR602	75025-0015	Silicon
A	o	CR603	75028-0001	Silicon
A	o	CR604	75028-0001	Silicon
A	o	CR605	75028-0001	Silicon
A	o	CR606	75028-0001	Silicon
A	o	CR607	75028-0001	Silicon
A	o	CR608	75028-0001	Silicon
A	o	CR609	75013-0005	Silicon
A	o	CR610	75013-0005	Silicon
A	o	CR611	75013-0005	Silicon
A	o	CR612	75025-0019	Silicon
A	o	CR613	75028-0001	Silicon
A	o	CR614	75028-0001	Silicon
A	o	CR615	75028-0001	Silicon

OMNI LOC PC BOARD
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

Chassis Level Code	Action	Symbol No.	Part No.	Description
				Diode
A	o	CR616	75028-0001	Silicon
A	o	CR617	75028-0001	Silicon
A	o	CR618	75028-0001	Silicon
B2	a	CR618	75204-0045	Silicon
				Transistor
A	o	Q601	75587-0014	Darlington (2N5308)
A	o	Q602	75587-0014	Darlington (2N5308)
A	o	Q603	75587-0014	Darlington (2N5308)
A	o	Q604	75587-0014	Darlington (2N5308)
A	o	Q605	75587-0014	Darlington (2N5308)
				Resistor
A	o	R601	31199-0291	Fixed, Film, 8.66K ±1%, 1/4w
A	o	R602	32066-0008	Variable, 20 turn, 2K
A	o	R603	31218-0104	Fixed, Comp, 100K ±5%, 1/4w
A	o	R604	31218-0224	Fixed, Comp, 220K ±5%, 1/4w
A	o	R605	31199-0407	Fixed, Film, 115K ±1%, 1/4w
A	o	R606	31199-0354	Fixed, Film, 35.7K ±1%, 1/4w
A	o	R607	32054-0015	Variable, 220K ±20%, 1/4w
A	o	R608	31199-0278	Fixed, Film, 6.34K ±1%, 1/4w
A	o	R609	32054-0009	Variable, 1K ±20%, 1/4w
A	o	R610	31218-0104	Fixed, Comp, 100K ±5%, 1/4w
A	o	R611	31218-0104	Fixed, Comp, 100K ±5%, 1/4w
A	o	R612	31199-0278	Fixed, Film, 6.34K ±1%, 1/4w
A	o	R613	31199-0310	Fixed, Film, 12.4K ±1%, 1/4w
A	o	R614	31199-0422	Fixed, Film, 165K ±1%, 1/4w
A	o	R615	31218-0104	Fixed, Comp, 100K ±5%, 1/4w

OMNI LOC PC BOARD
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

		Symbol No.	Part No.	Description
				Resistor
A	o	R616	31199-0266	Fixed, Film, 4.75K ±1%, 1/4w
A	o	R617	31218-0223	Fixed, Comp, 22K ±5%, 1/4w
A	o	R618	31195-0226	Fixed, Comp, 22M ±5%, 1/4w
D1	c	R618	31225-0226	Fixed, Comp, 22M ±5%, 1/4w
A	o	R619	31218-0105	Fixed, Comp, 1 Meg ±5%, 1/4w
A	o	R620	31199-0363	Fixed, Film, 44.2K ±1%, 1/4w
A	o	R621	31218-0101	Fixed, Comp, 100 ±5%, 1/4w
A	o	R622	31218-0222	Fixed, Comp, 2.2K ±5%, 1/4w
A	o	R623	31218-0104	Fixed, Comp, 100K ±5%, 1/4w
A	o	R624	31218-0104	Fixed, Comp, 100K ±5%, 1/4w
A	o	R625	31199-0347	Fixed, Film, 30.1K ±1%, 1/4w
A	o	R626	31199-0343	Fixed, Film, 27.4K ±1%, 1/4w
C1	c	R626	31199-0334	Fixed, Film, 22.1K ±1%, 1/4w
A	o	R627	31199-0385	Fixed, Film, 75K ±1%, 1/4w
A	o	R628	31218-0104	Fixed, Comp, 100K ±5%, 1/4w
A	o	R629	31218-0102	Fixed, Comp, 1K ±5%, 1/4w
A	o	R630	31199-0418	Fixed, Film 150K ±1%, 1/4w
A	o	R631	31218-0564	Fixed, Comp, 560K ±5%, 1/4w
A	o	R632	31218-0104	Fixed, Comp, 100K ±5%, 1/4w
B1	a	R633	01235-	Matched Pair (R633/R636) (R633, 31199-0354 - 35.7K "G" units only)
E	a	R633	01235-1314	Matched Pair (R633/R636) (R633, 31199-0385 - 75K)
A	o	R634	32054-0021	Variable, 22K ±20%, 1/4w
A	o	R635	31218-0103	Fixed, Comp, 10K ±5%, 1/4w
B1	a	R636	01235-	Matched Pair (R633/R636) (R636, 31199-0354 - 35.7K "G" units only)
E		R636	01235-1314	Matched Pair (R633/R636) (R636, 31199-0385 - 75K)

OMNI LOC PC BOARD
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

		Symbol No.	Part No.	Description
				Resistor
A	o	R637	31218-0103	Fixed, Comp, 10K ±5%, 1/4w
A	o	R638	31218-0223	Fixed, Comp, 22K ±5%, 1/4w
A	o	R639	31199-0288	Fixed, Film, 8.06K ±1%, 1/4w
A	o	R640	31218-0102	Fixed, Comp, 1K ±5%, 1/4w
A	o	R641	31199-0442	Fixed, Film, 267K ±1%, 1/4w
A	o	R642	31199-0442	Fixed, Film, 267K ±1%, 1/4w
A	o	R643	31199-0288	Fixed, Film, 8.06K ±1%, 1/4w
A	o	R644	31218-0274	Fixed, Comp, 270K ±5%, 1/4w
A	o	R645	31199-0426	Fixed, Film, 182K ±1%, 1/4w
A	o	R646	31218-0274	Fixed, Comp, 270K ±5%, 1/4w
A	o	R647	31199-0359	Fixed, Film, 40.2K ±1%, 1/4w
C	c	R647	31199-0401	Fixed, Film, 100K ±1%, 1/4w
A	o	R648	32079-0203	Variable, 20K
A	o	R649	31218-0393	Fixed, Comp, 39K ±5%, 1/4w
A	o	R650	31218-0393	Fixed, Comp, 39K ±5%, 1/4w
B1	a	R651	01235-	Matched Pair (R651/R656) (R651, 31199-0359 - 40.2K "G" units only)
E	o	R651	01235-1314	Matched Pair (R651/R656) (R651, 31199-0385 - 75K)
A	o	R652	31218-0473	Fixed, Comp, 47K ±5%, 1/4w
A	o	R653	32054-0011	Variable, 100K ±20%, 1/8w
A	o	R654	31199-0218	Fixed, Film, 1.5K ±1%, 1/4w
A	o	R655	31218-0224	Fixed, Comp, 220K ±5%, 1/4w
B1	a	R656	01235-	Matched Pair (R651/R656) (R656, 31199-0359 - 40.2K "G" units only)
E	o	R656	01235-1314	Matched Pair (R651/R656) (R656, 31199-0385 - 75K)
A	o	R657	31199-0415	Fixed, Film, 140K ±1%, 1/4w
B1	a	R658	01235-	Matched Pair (R658/R659) (R658, 31199-0310 - 12.4K "G" units only)

OMNI LOC PC BOARD
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

		Symbol No.	Part No.	Description
				Resistor
E	o	R658	01235-1312	Matched Pair (R658/R659) (R658, 31199-0341 - 26.1K)
B1	a	R659	01235-	Matched Pair (R658/R659) (R659, 31199-0310 - 12.4K "G" units only)
E	o	R659	See R658	Matched Pair (R658/R659) (R659, 31199-0341 - 26.1K)
A	o	R660	31218-0104	Fixed, Comp, 100K ±5%, 1/4w
A	o	R661	31218-0184	Fixed, Comp, 180K ±5%, 1/4w
A	o	R662	31218-0472	Fixed, Comp, 4.7K ±5%, 1/4w
A	o	R663	31199-0415	Fixed, Film, 140K ±1%, 1/4w
A	o	R664	31218-0104	Fixed, Comp, 100K ±5%, 1/4w
B1	a	R665	01235-	Matched Pair (R665/R667) (R665, 31199-0310 - 12.4K "G" units only)
E	o	R665	01235-1312	Matched Pair (R665/R667) (R665, 31199-0341 - 26.1K)
A	o	R666	31218-0104	Fixed, Comp, 100K ±5%, 1/4w
B1	a	R667	01235-	Matched Pair (R665/R667) (R667, 31199-0310 - 12.4K "G" units only)
E	o	R667	See R665	Matched Pair (R665/R667) (R667, 31199-0341 - 26.1K)
A	o	R668	31199-0366	Fixed, Film, 47.5K ±1%, 1/4w
A	o	R669	31218-SEL	Fixed, Comp, SEL, ±5%, 1/4w
A	o	R670	31218-0332	Fixed, Comp, 3.3K ±5%, 1/4w
A	o	R671	31199-0366	Fixed, Film, 47.5K ±1%, 1/4w
A	a	R672	32081-2104	Variable, 100K
A	o	R673	32054-0001	Variable, 470 ±20%, 1/4w
A	o	R674	32054-0001	Variable, 470 ±20%, 1/4w
A	o	R675	31218-0101	Fixed, Comp, 100 ±5%, 1/4w
A	o	R676	31218-0182	Fixed, Comp, 1.8K ±5%, 1/4w
A	o	R677	31218-0220	Fixed, Comp, 22 ±5%, 1/4w

OMNI LOC PC BOARD
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

		Symbol No.	Part No.	Description
				Resistor
A	o	R678	31218-0220	Fixed, Comp, 22 ±5%, 1/4w
A	o	R679	31199-0304	Fixed, Film, 10.7K ±1%, 1/4w
A	a	R680	32081-2104	Variable, 100K
A	o	R681	31199-0221	Fixed, Film, 1.62K +1%, 1/4w
A	o	R682	31199-0385	Fixed, Film, 75K ±1%, 1/4w
A	o	R683	31199-0221	Fixed, Film, 1.62K +1%, 1/4w
A	a	R684	31218-0272	Fixed, Comp, 2.7K ±5%, 1/4w
A	o	R685	31218-0222	Fixed, Comp, 2.2K ±5%, 1/4w
A	o	R686	31199-0213	Fixed, Film, 1.33K +1%, 1/4w
A	o	R687	31199-0430	Fixed, Film, 200K ±1%, 1/4w
A	o	R688	31199-0433	Fixed, Film, 215K +1%, 1/4w
A	o	R689	31218-0104	Fixed, Comp, 100K ±5%, 1/4w
A	o	R690	31218-0684	Fixed, Comp, 680K ±5%, 1/4w
A	o	R691	31218-0123	Fixed, Comp, 12K ±5%, 1/4w
A	o	R692	31199-0442	Fixed, Film, 267K ±1%, 1/4w
A	o	R693	31218-0682	Fixed, Comp, 6.8K ±5%, 1/4w
A	o	R694	31218-0104	Fixed, Comp, 100K ±5%, 1/4w
A	o	R695	31199-0448	Fixed, Film, 309K ±1%, 1/4w
A	a	R696	31199-0180	Fixed, Film, 665 ±1%, 1/4w
A	o	R697	31218-0223	Fixed, Comp, 22K ±5%, 1/4w
A	o	R698	31218-0123	Fixed, Comp, 12K ±5%, 1/4w
A	o	R699	31218-0473	Fixed, Comp, 47K ±5%, 1/4w
A	o	R700	31199-0466	Fixed, Film, 475K ±1%, 1/4w
A	o	R701	31218-0222	Fixed, Comp, 2.2K ±5%, 1/4w
A	o	R702	31218-0222	Fixed, Comp, 2.2K ±5%, 1/4w
A	o	R703	31218-0104	Fixed, Comp, 100K +5%, 1/4w
A	o	R704	31218-0102	Fixed, Comp, 1K +5%, 1/4w
A	o	R705	31218-0104	Fixed, Comp, 100K ±5%, 1/4w
A	o	R706	31218-0564	Fixed, Comp, 560K ±5%, 1/4w
A	o	R707	31218-0104	Fixed, Comp, 100K ±5%, 1/4w

OMNI LOC PC BOARD
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

Chassis Level Code	Action	Symbol No.	Part No.	Description
				Resistor
A	o	R708	31218-0184	Fixed, Comp, 180K ±5%, 1/4w
A	o	R709	31218-0564	Fixed, Comp, 560K ±5%, 1/4w
A	o	R710	31195-0226	Fixed, Comp, 22M ±5%, 1/4w
D1	c	R710	31225-0226	Fixed, Comp, 22M ±5%, 1/4w
A	o	R711	31218-0474	Fixed, Comp, 470K ±5%, 1/4w
A	o	R712	31218-0564	Fixed, Comp, 560K ±5%, 1/4w
A	o	R713	31199-0301	Fixed, Film, 10K ±1%, 1/4w
A	o	R714	31199-0395	Fixed, Film, 95.3K ±1%, 1/4w
A	o	R715	31218-0105	Fixed, Comp, 1M ±5%, 1/4w
A	o	R716	31195-0106	Fixed, Comp, 10M ±5%, 1/4w
A	o	R717	31199-0442	Fixed, Film, 267K ±1%, 1/4w
A	o	R718	31218-0225	Fixed, Comp, 2.2M ±5%, 1/4w
A	o	R719	32054-0005	Variable, 47K ±20%, 1/4w
A	o	R720	31218-0105	Fixed, Comp, 1M ±5%, 1/4w
A	o	R721	31199-0247	Fixed, Film, 3.01K ±1%, 1/4w
A	o	R722	31218-0824	Fixed, Comp, 820K ±5%, 1/4w
A1	c	R722	31218-0684	Fixed, Comp, 680K ±5%, 1/4w
A	o	R723	31199-0401	Fixed, Film, 100K ±1%, 1/4w
A	o	R724	31199-0466	Fixed, Film, 475K ±1%, 1/4w
A	o	R725	31199-0466	Fixed, Film, 475K ±1%, 1/4w
A	o	R726	31199-0401	Fixed, Film, 100K ±1%, 1/4w
A	o	R727	31218-0222	Fixed, Comp, 2.2K ±5%, 1/4w
A	o	R728	31199-0359	Fixed, Film, 40.2K ±1%, 1/4w
A	o	R729	31199-0354	Fixed, Film, 35.7K ±1%, 1/4w
A	o	R730	31218-0123	Fixed, Comp, 12K ±5%, 1/4w
A	o	R731	31218-0913	Fixed, Comp, 91K ±5%, 1/4w
A	o	R732	31218-0913	Fixed, Comp, 91K ±5%, 1/4w
A	o	R733	32054-0015	Variable, 220K ±20%
A1	c	R733	32054-0017	Variable, 470K ±20%

OMNI LOC PC BOARD
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part

		Symbol No.	Part No.	Description
				Resistor
E	a	R734	01235-	Matched Pair (R734/R735) (R734, 31199-0347 - 30.1K)
E	a	R735	See R734	Matched Pair (R734/R735) (R735, 31199-0347 - 30.1K)
				I.C.
A	o	U601	74092-0001	Quad Comparator (LM339)
A	o	U602	74072-0001	Quad Analog Switch (4016)
A	o	U603	74013-0001	Dual Operational Amplifier (MC1458)
A	o	U604	74039-0003	Voltage Regulator (+8v) (78M08) (Fig. 5.6, item -1)
A	o	U605	74105-0001	Quad Operational Amplifier (MC3403)
A	o	U606	74072-0001	Quad Analog Switch (4016)
A	o	U607	74072-0001	Quad Analog Switch (4016)
A	o	U608	74092-0001	Quad Comparator (LM339)
A	o	U609	74038-0001	Quad Operational Amplifier (MC3401)
A	o	U610	74038-0001	Quad Operational Amplifier (MC3401)

CONTROL HEAD AND RECEIVER CONVERTER
800 SERIES
ELECTRICAL PARTS LIST

NAV UNIT	ASSOCIATED SUB-ASSY & ASSY PART NO.	ASSY CODE	REFER TO SCHEMATIC(S)
NAV 122	Control Hd - 01233-0105Z	A	Fig. 6-1
NAV 121	Control Hd - 01233-0106Z	B	Fig. 6-1
NAV 122A	Control Hd - 01233-0107Z	C	Fig. 6-1
NAV 121	Receiver Converter - 01234-0101W	D	Fig. 6-2
NAV 122	Receiver Converter - 01234-0102W	E	Fig. 6-2
NAV 122A	Receiver Converter - 01234-0103W	F	Fig. 6-2
NAV 121	Receiver Converter - 01337-0101H	G	Fig. 6-3
NAV 122	Receiver Converter - 01337-0102H	H	Fig. 6-3
NAV 122A	Receiver Converter - 01337-0103H	I	Fig. 6-3

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

Symbol No.	Part No.	Description
		CAPACITOR
A o D/I	C801	24551-0003 Ceramic Disc, 0.001 uf ±20%, 50v
A o D/I	C802	24551-0003 Ceramic Disc, 0.001 uf ±20%, 50v
A o D/I	C803	24551-0003 Ceramic Disc, 0.001 uf ±20%, 50v
A o D/I	C804	24551-0003 Ceramic Disc, 0.001 uf ±20%, 50v
A o D/I	C805	24551-0003 Ceramic Disc, 0.001 uf ±20%, 50v
A o D/I	C806	24551-0003 Ceramic Disc, 0.001 uf ±20%, 50v
A o D/I	C807	24551-0003 Ceramic Disc, 0.001 uf ±20%, 50v
A o D/I	C808	24551-0003 Ceramic Disc, 0.001 uf ±20%, 50v
A o D/I	C809	24551-0003 Ceramic Disc, 0.001 uf ±20%, 50v
A o D/I	C810	24551-0003 Ceramic Disc, 0.001 uf ±20%, 50v
A o D/I	C811	24551-0003 Ceramic Disc, 0.001 uf ±20%, 50v
A o D/I	C812	24551-0003 Ceramic Disc, 0.001 uf ±20%, 50v
A o D/I	C813	24551-0003 Ceramic Disc, 0.001 uf ±20%, 50v
A o D/I	C814	24551-0003 Ceramic Disc, 0.001 uf ±20%, 50v
A o D/I	C815	24551-0003 Ceramic Disc, 0.001 uf ±20%, 50v

CONTROL HEAD AND RECEIVER CONVERTER
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

			Symbol No.	Part No.	Description
					CAPACITOR
A	o	D/I	C816	24551-0003	Ceramic Disc, 0.001 uf ±20%, 50v
A	o	D/I	C817	24551-0003	Ceramic Disc, 0.001 uf ±20%, 50v
A	o	D/I	C818	24551-0003	Ceramic Disc, 0.001 uf ±20%, 50v
A	o	D/I	C819	24551-0003	Ceramic Disc, 0.001 uf ±20%, 50v
A	o	D/I	C820	24551-0003	Ceramic Disc, 0.001 uf ±20%, 50v
A	o	D/I	C821	24551-0003	Ceramic Disc, 0.001 uf ±20%, 50v
A	o	D/I	C822	24551-0003	Ceramic Disc, 0.001 uf ±20%, 50v
A	o	D/I	C823	24551-0003	Ceramic Disc, 0.001 uf ±20%, 50v
A	o	D/I	C824	24551-0003	Ceramic Disc, 0.001 uf ±20%, 50v
A	o	D/I	C825	24551-0003	Ceramic Disc, 0.001 uf ±20%, 50v
A	o	D/I	C826	24551-0003	Ceramic Disc, 0.001 uf ±20%, 50v
A	o	D/I	C827	24551-0003	Ceramic Disc, 0.001 uf ±20%, 50v
A	o	D/I	C828	24551-0003	Ceramic Disc, 0.001 uf ±20%, 50v
A	o	D/I	C829	24551-0003	Ceramic Disc, 0.001 uf ±20%, 50v
A	o	D/I	C830	24551-0003	Ceramic Disc, 0.001 uf ±20%, 50v
A	o	D/I	C831	24551-0003	Ceramic Disc, 0.001 uf ±20%, 50v
A	o	D/I	C832	24551-0003	Ceramic Disc, 0.001 uf ±20%, 50v
					DIODE
A	a	DEF	CR801	75220-2220	Silicon, Zener, 22v (Fig. 6-2 @ J810, Pin 16)
A	d	DEF	CR801	75220-2220	
					CONNECTOR
A	o	D/F	J801	41362-0001	Receptacle, 20 (tin) (Receiver)
B	c	D/I	J801	41362-0101	Receptacle, 20 (gold) (Receiver)
A	o	D/F	J803	41362-0001	Receptacle, 20 (tin) (Synthesizer)
B	c	D/I	J803	41362-0101	Receptacle, 20 (gold) (Synthesizer)
A	o	E/F	J804	41362-0001	Receptacle, 20 (tin) (Marker)

CONTROL HEAD AND RECEIVER CONVERTER
Continued

Chassis Level Code wherein the part was first used
Action: added, changed, deleted, or original part
Assy Code

			Symbol No.	Part No.	Description
					Connector
B	c	E/F	J804	41362-0101	Receptacle, 20 (gold) (Marker)
B	o	H/I	J804	41362-0101	Receptacle, 20 (gold) (Marker)
A	o	E/F	J805	41362-0001	Receptacle, 20 (tin) (G/S)
B	c	E/F	J805	41362-0101	Receptacle, 20 (gold) (G/S)
B	o	H/I	J805	41362-0101	Receptacle, 20 (gold) (G/S)
A	o	D/F	J806	41362-0002	Receptacle, 26 (tin) (VOR/LOC)
B	c	D/I	J806	41362-0102	Receptacle, 26 (gold) (VOR/LOC)
A	o	D/I	J807	41360-0001	Receptacle, BNC, NAV (Figs. 5.2-7 and 5.2A-31)
A	o	E/F	J808	41360-0001	Receptacle, BNC, MKR (Figs. 5.2-8)
A	o	H/I	J808	41360-0001	Receptacle, BNC, MKR (Fig. 5.2A-27)
A	o	E-H	J809	41360-0001	Receptacle, BNC, GS (Figs. 5.2-9 and 5.2A-29)
A	o	D/F	J810	41368-0007	Receptacle, 36 contacts, Rear Plate (Fig. 5.2-11)
B	o	G/I	J810	41355-0007	Receptacle, 36 contacts, Rear Plate (Fig. 5.2A-38)
					Coil
A	o	E/F	L801	11713-0006	Coil
B	o	H/I	L801	11713-0006	Coil (Fig. 5.2A-25)
					Resistor
A	o	D/F	R801	31218-0222	Fixed, Comp, 2.2K ±5%, 1/4w
B	o	G/I	R801	31218-0222	Fixed, Comp, 2.2K ±5%, 1/4w (Fig. 5.2A-13)
A	o	D/F	R802	31218-0272	Fixed, Comp, 2.7K ±5%, 1/4w
B	c	D/I	R802	31218-0562	Fixed, Comp, 5.6K ±5%, 1/4w (Fig. 5.2A-14)
A	o	A/F	R803	32068-0001	Potentiometer, 6.5K ±15%, 1/2w

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6.1 GENERAL

CHASSIS LEVEL IDENTIFICATION

Narco's new chassis level identification code system.

As new products are released for manufacture, the product is appropriately coded.

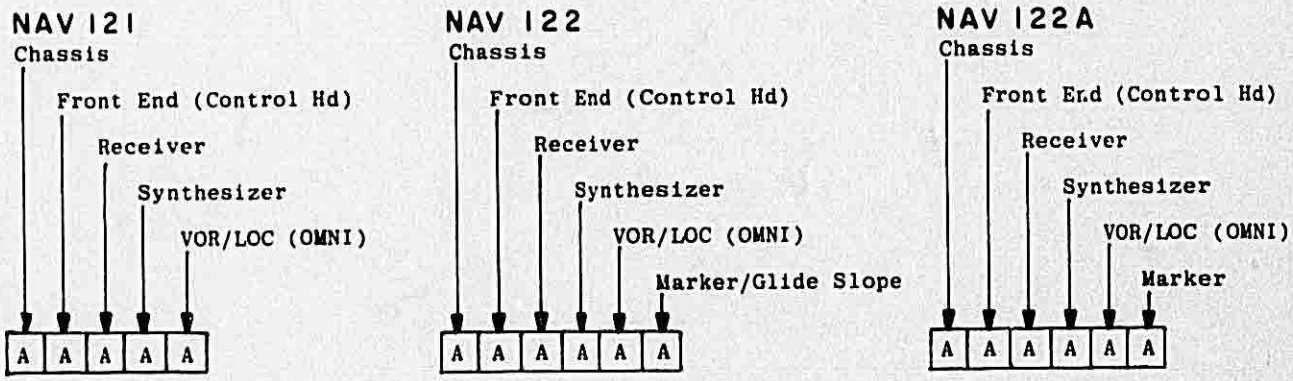
Basically the code is a series of letters that identifies each individual subassembly of the unit. Therefore, a unit with 3 subassemblies will have an initial chassis level code of AAA. A unit with 9 subassamblies will have an initial chassis level code of AAAAAAAAA. This code will usually be found near the serial number on the chassis.

If the equipment is of a multi-unit configuration, each unit will have its own chassis level code.

Each independent subassembly is also stamped with its level code letter (a capital letter about 1/8 inch high). Due to space, position in the unit, or what have you, no specific spot can be called out. However, in most cases all the letters will be able to be seen by turning the unit in various positions. Some letters are on the component side, others on the opposite side.

Should a shop update a unit or subassembly it would be most advantageous to change the codes of the updated subassemblies as well as the full code number by the serial number. Solvent and felt tipped pen should do the job.

6.2 THE NAV's CODES



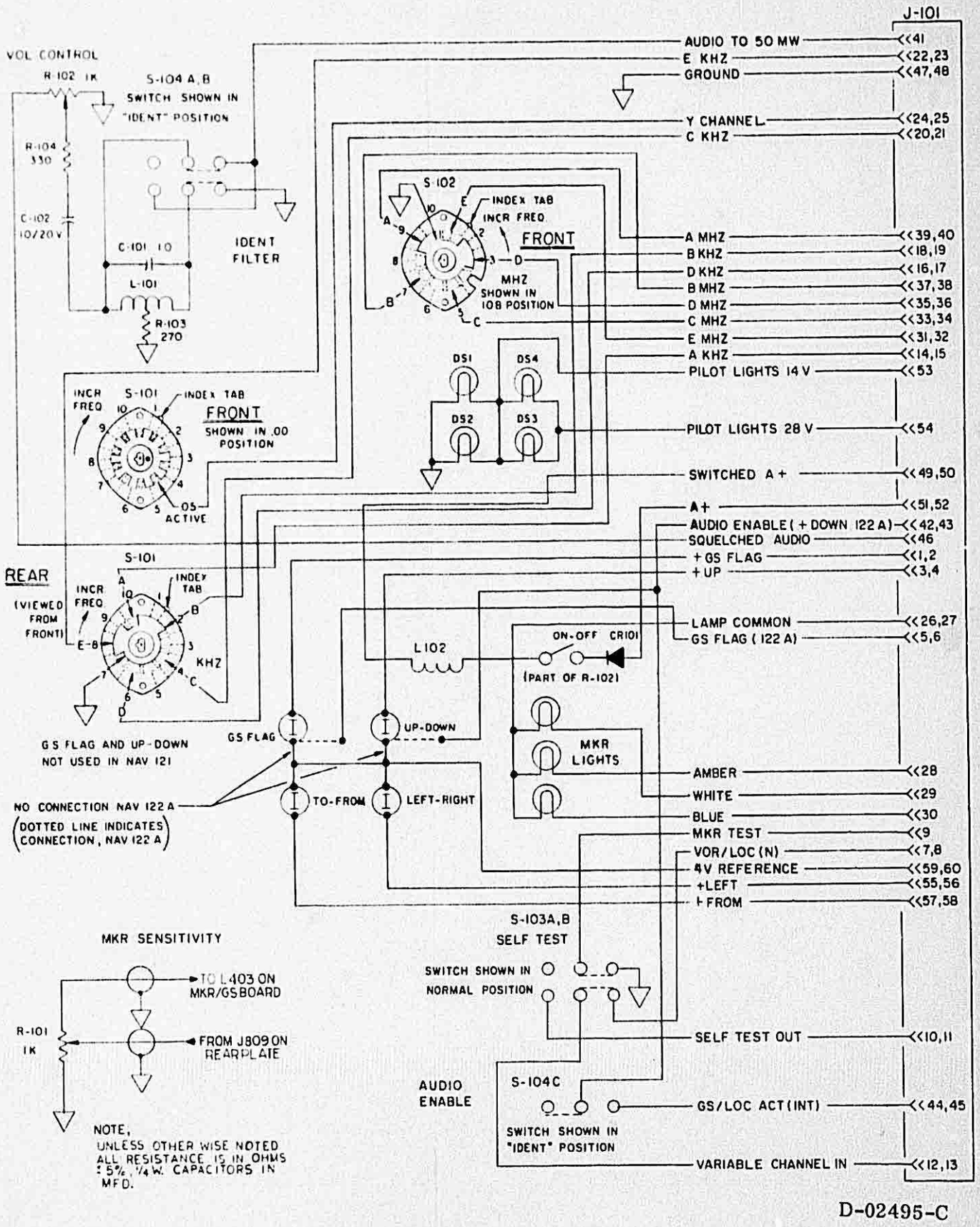


FIGURE 6-1. CONTROL HEAD WIRING WITH FLEX CIRCUIT
(Chassis Level-A---(-)

CONTROL HEAD WIRING WITH FLEX CIRCUIT

SEE BLOW-UP

The following list identifies the components of this circuit that were: added, changed, or deleted along with the Chassis Level Code letter assigned for identifying the change.

Refer to appropriate Electrical Parts List for Part numbers and description.

Symbol No.	Action a,c,d	Chassis Level Code Letter
R802	c	A1

"Shaded areas shown on the schematic indicate those points where a change, addition, deletion, or type substitution took place."

SEE BLOW-UP

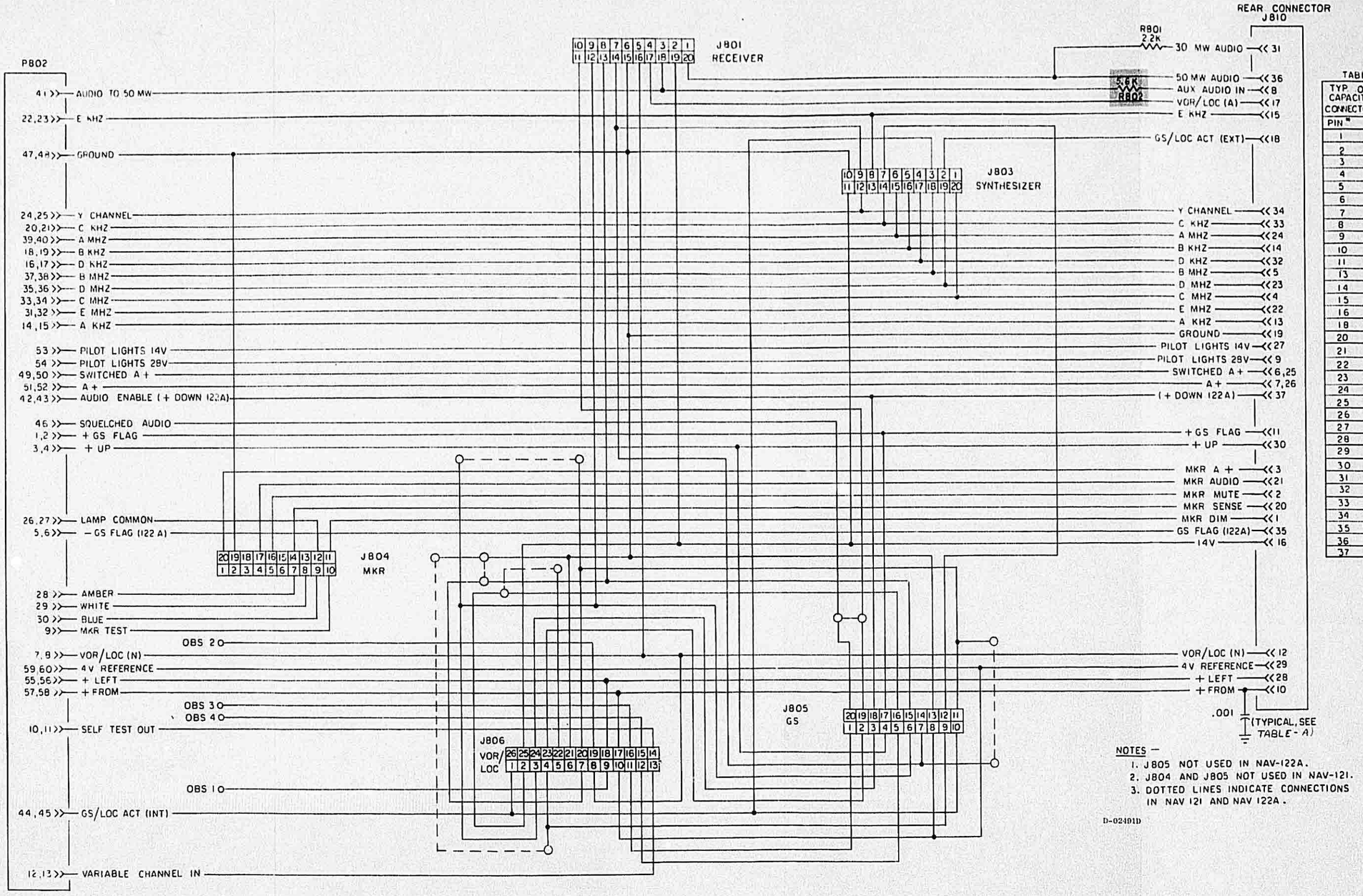


TABLE A

TYP .001 MF CAPACITOR BETWEEN CONNECTOR & GND	
PIN #	CAP #
1	C801
2	C802
3	C803
4	C804
5	C805
6	C806
7	C807
8	C808
9	C809
10	C810
11	C811
13	C812
14	C813
15	C814
16	C815
18	C816
20	C817
21	C818
22	C819
23	C820
24	C821
25	C806
26	C807
27	C822
28	C823
29	C824
30	C825
31	C826
32	C827
33	C828
34	C829
35	C830
36	C831
37	C832

NOTES —
1. J805 NOT USED IN NAV-122A.
2. J804 AND J805 NOT USED IN NAV-121.
3. DOTTED LINES INDICATE CONNECTIONS IN NAV 121 AND NAV 122A.

D-02401D

FIGURE 6-2. INTERCONNECT WIRING WITH FLEX CIRCUIT
(Chassis Level A----(-)

SEE BLOW-UP

NARCO AVIONICS NAV 121, 122, 122A

NOTES:

1. NAV 122
   DIAGRAM SHOWS CONNECTIONS FOR NAV 122; SEE NOTES 2 AND 3 FOR NAV 121, 122A

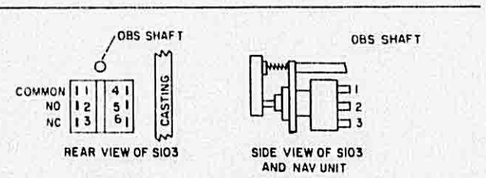
2. NAV 121
   A. J804 AND J805 NOT USED.
   B. S104C NOT USED.
   C. UP DOWN AND GS FLAG INDICATORS DELETED.

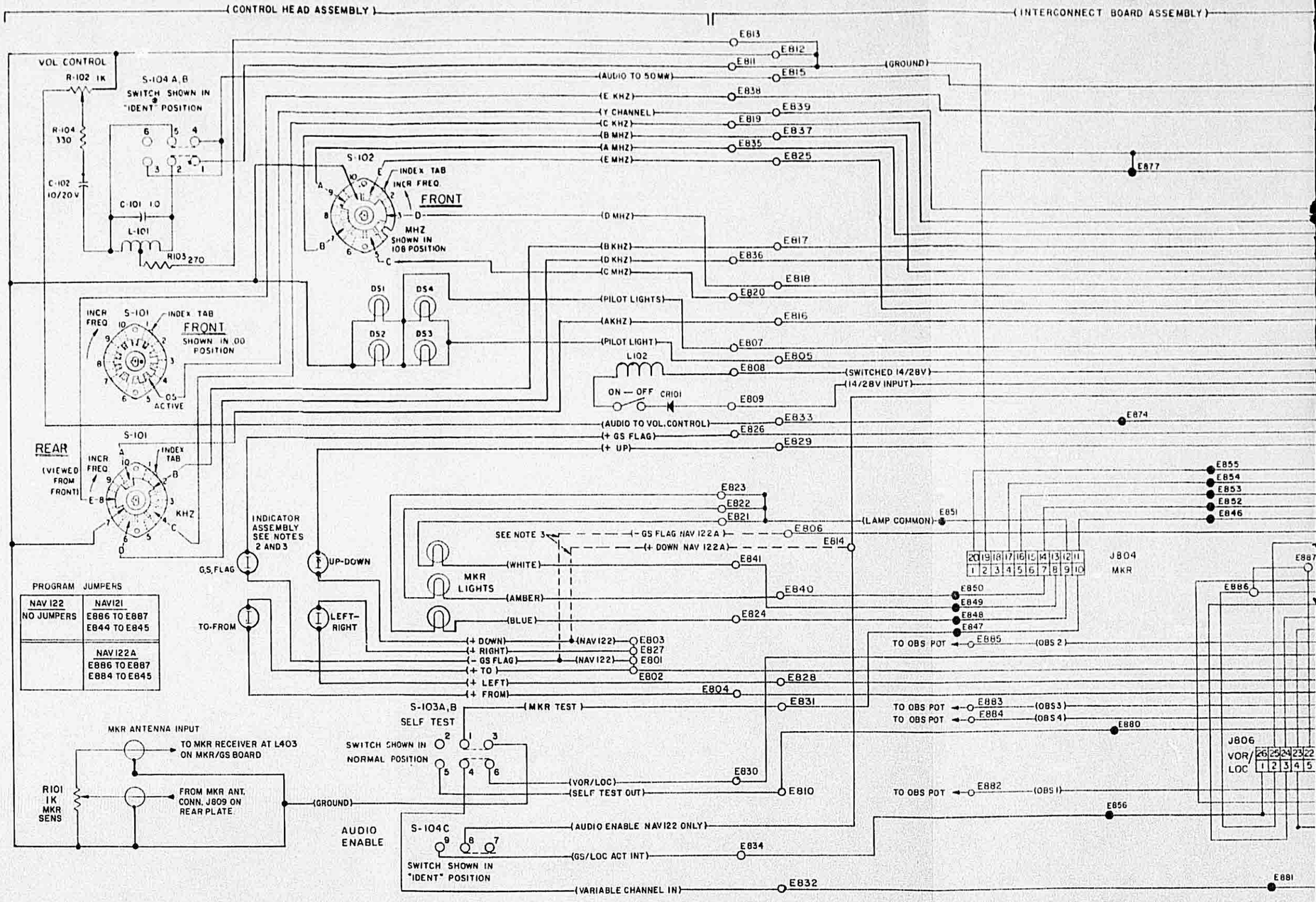
3. NAV 122 A
   A. J805 NOT USED.
   B. S104C NOT USED.
   C. + DOWN SHIFTED FROM E803 TO E814
   — GS FLAG SHIFTED FROM E801 TO E806.

4. UNLESS OTHERWISE SPECIFIED
   ALL RESISTANCE IS IN OHMS ± 5%, 1/4 W.
   ALL CAPACITANCE IS IN MICROFARADS.

5. 'E' NUMBERS
   ○ = WIRE OR JUMPER CONNECTION.
   ● = JUNCTION OF VERTICAL AND HORIZONTAL BOARDS.

6. +4V REFERENCE IS:
   NAV 121 = + RIGHT, + TO
   NAV 122A = + RIGHT, + TO
   NAV 122 = + RIGHT, + TO, + DOWN, − GS FLAG





3/80

SEE BLOW-UP

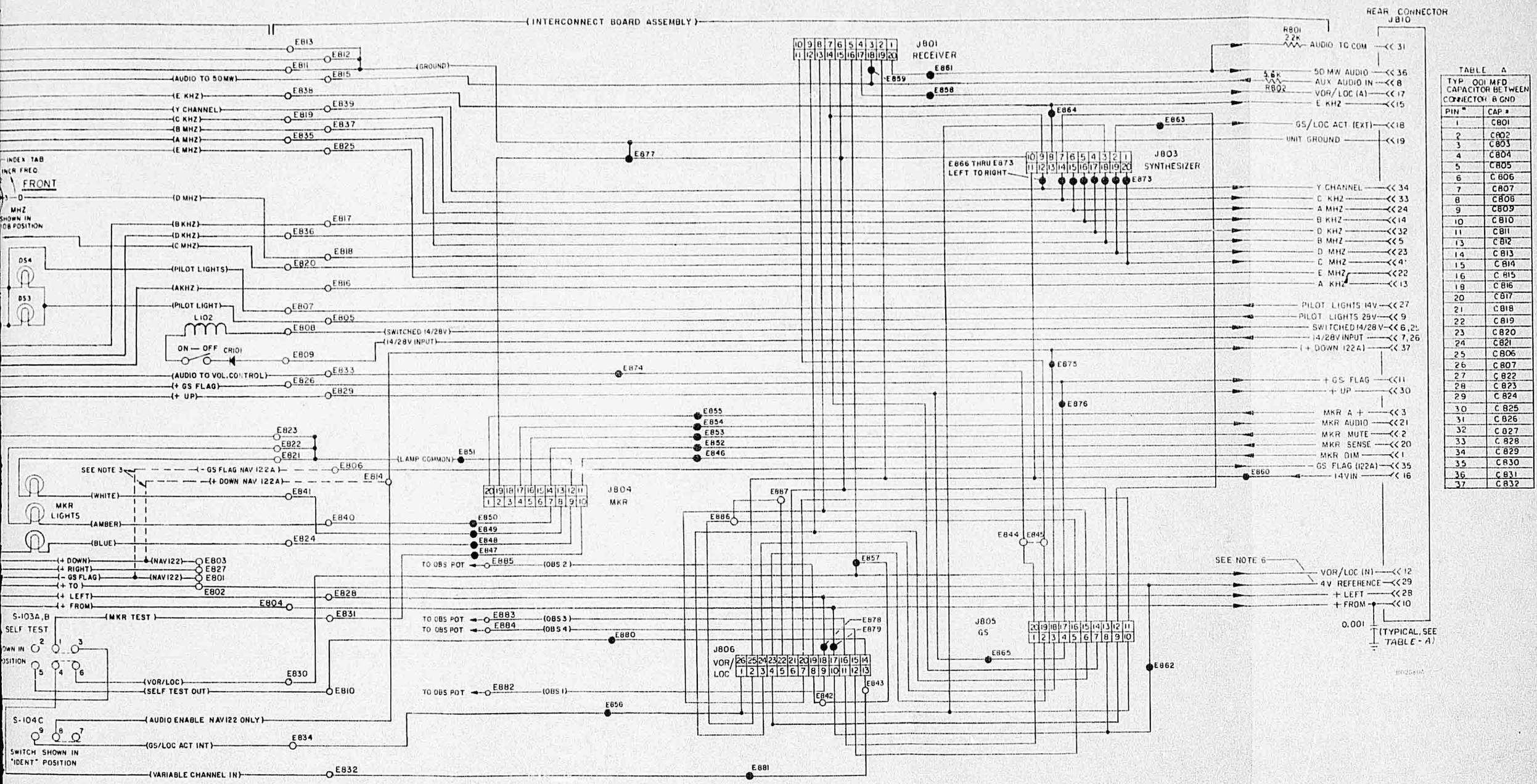


TABLE A

TYP .001 MFD CAPACITOR BETWEEN CONNECTOR & GND	
PIN #	CAP #
1	C801
2	C802
3	C803
4	C804
5	C805
6	C806
7	C807
8	C808
9	C809
10	C810
11	C811
13	C812
14	C813
15	C814
16	C815
18	C816
20	C817
21	C818
22	C819
23	C820
24	C821
25	C806
26	C807
27	C822
28	C823
29	C824
30	C825
31	C826
32	C827
33	C828
34	C829
35	C830
36	C831
37	C832

INTERCONNECT WIRING/CONTROL HEAD

FIGURE 6-2A INTERCONNECT WIRING/CONTROL HEAD FOR "B" CHASSIS

SEE BLOW-UP

This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-3.

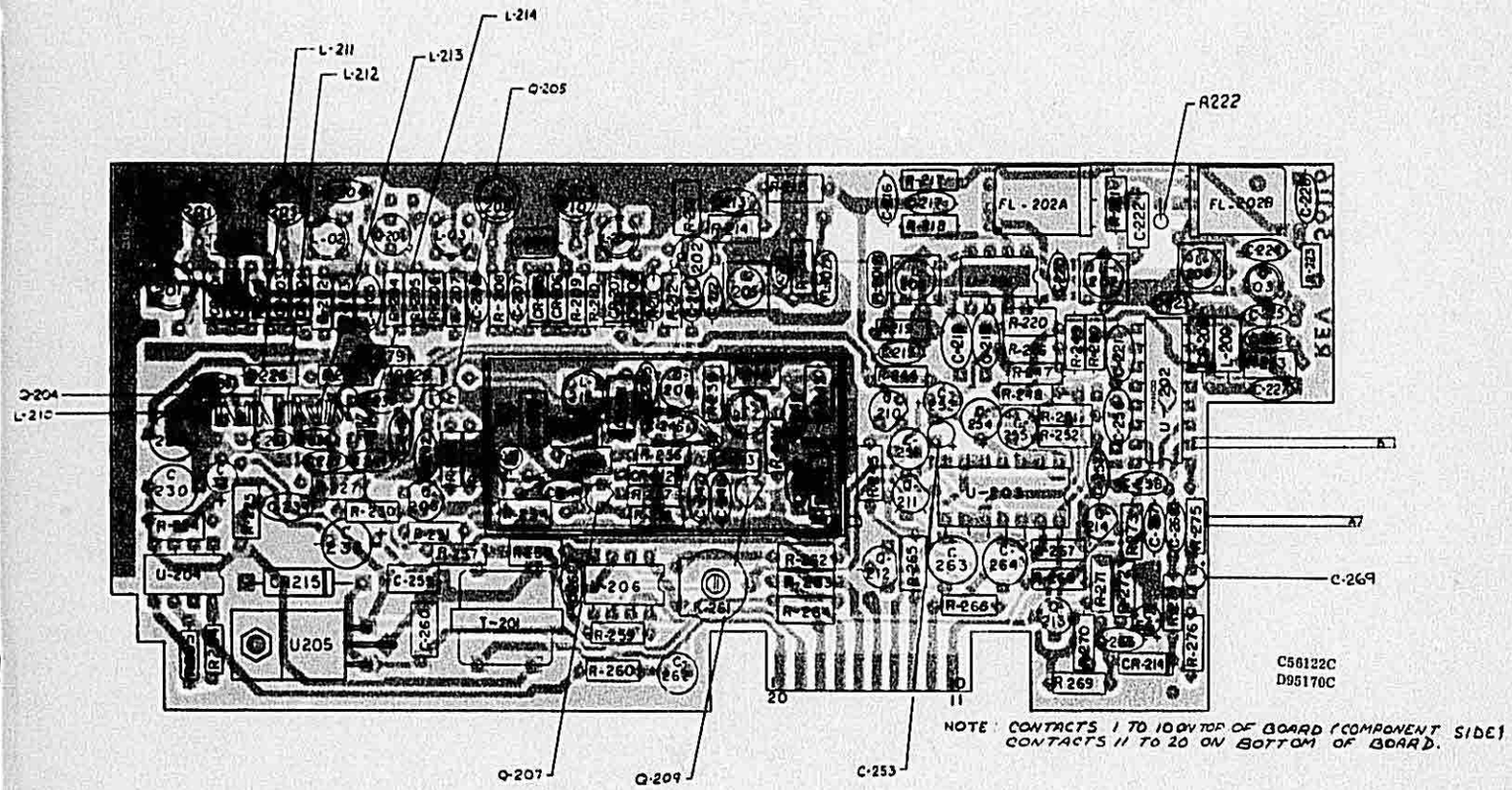


FIGURE 6-3. RECEIVER NAV 122 (Sheet 1 of 2, Component Assy)
(Chassis Level -- A --(-)

SEE BLOW-UP

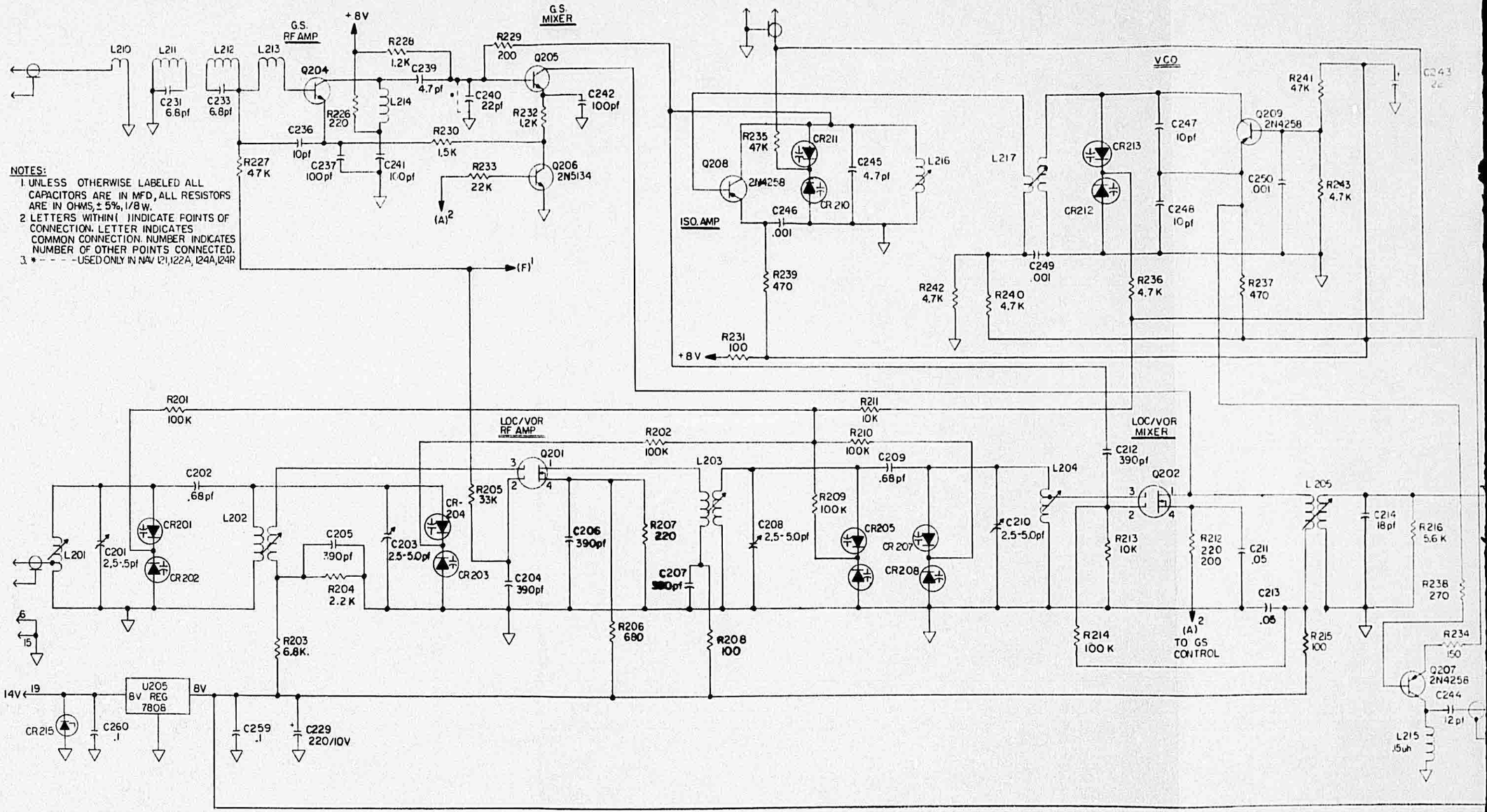
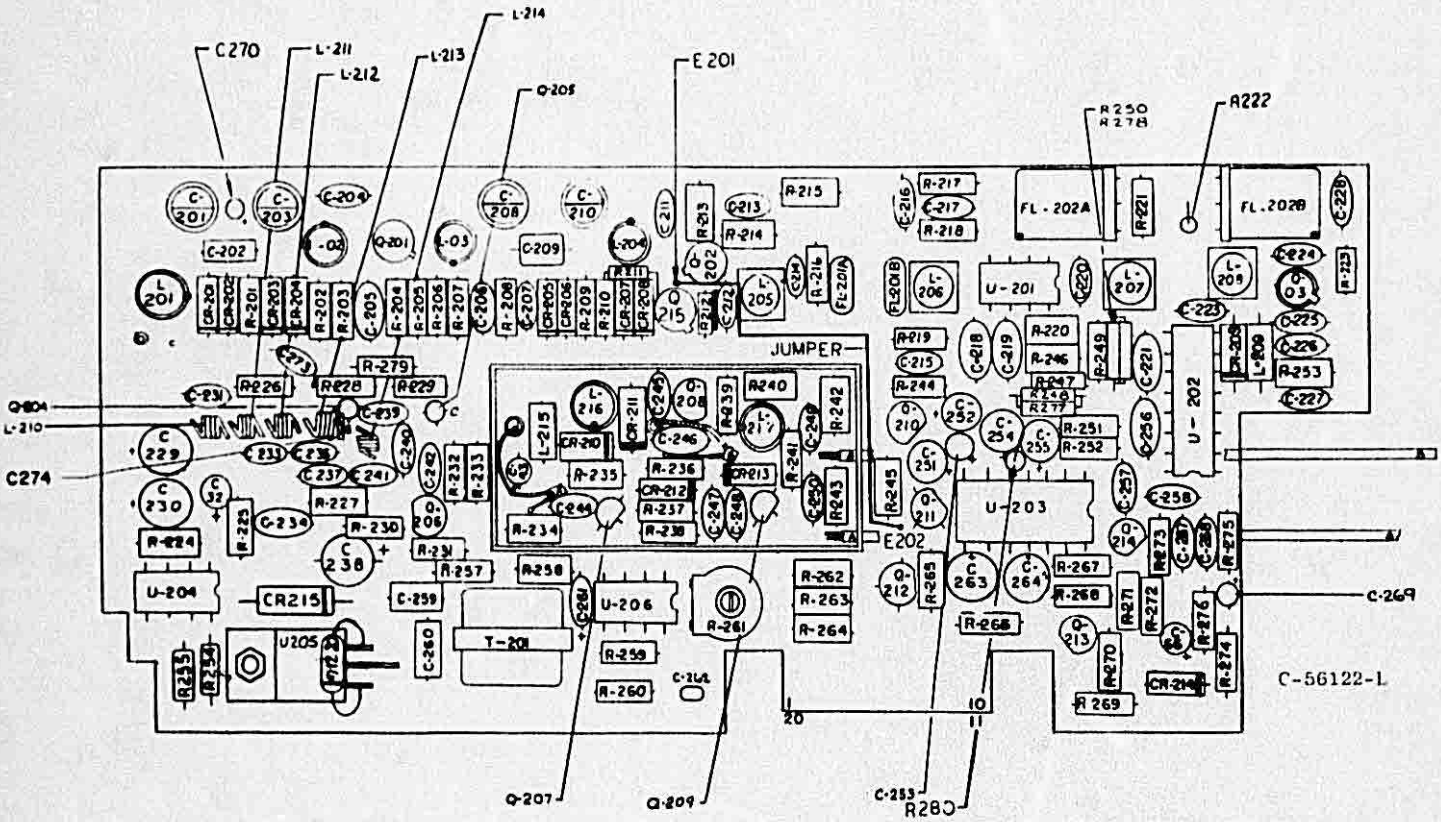

NOTES:
1. UNLESS OTHERWISE LABELED ALL CAPACITORS ARE IN MFD, ALL RESISTORS ARE IN OHMS, ± 5%, 1/8 W.
2 LETTERS WITHIN ( ) INDICATE POINTS OF CONNECTION. LETTER INDICATES COMMON CONNECTION. NUMBER INDICATES NUMBER OF OTHER POINTS CONNECTED.
3. * - - - - USED ONLY IN NAV 121,122A, 124A,124R
G.S. RF AMP
G.S. MIXER
+8V
L210
L211
L212
L213
C231 6.8pf
C233 6.8pf
Q204
R226 220
R228 1.2K
C239 4.7pf
L214
C240 22pf
R229 200
Q205
R232 1.2K
C242 100pf
C236 10pf
R230 1.5K
R227 47K
C237 100pf
C241 100pf
R233 22K
Q206 2N5134
(A)2
(F)1
VCO
R241 47K
C243
R235 47K
CR211
Q208 2N4258
CR 210
C245 4.7pf
L216
L217
CR213
CR212
C247 10pf
C248 10pf
Q209 2N4258
C250 .001
R243 4.7K
ISO. AMP
C246 .001
C249 .001
R239 470
R242 4.7K
R240 4.7K
R236 4.7K
R237 470
R231 100
+8V
R201 100K
LOC/VOR RF AMP
R202 100K
Q201
L203
R211 10K
R210 100K
C209 .68pf
L204
LOC/VOR MIXER
C212 390pf
Q202
L205
C202 .68pf
L202
R205 33K
CR-204
C206 390pf
R207 220
C208 2.5-5.0pf
R209 100K
CR205
CR 207
CR208
C210 2.5-5.0pf
R213 10K
R212 220 200
C211 .05
C214 18pf
R216 5.6K
L201
C201 2.5-5pf
CR201
CR202
C205 390pf
R204 2.2K
C203 2.5-5.0pf
CR203
C204 390pf
C207 390pf
R206 680
R208 100
R214 100K
(A) TO GS CONTROL
C213 .05
R215 100
R238 270
R234 150
Q207 2N4258
C244 12pf
L215 .15uh
R203 6.8K.
U205 8V REG 7808
14V
19
8V
CR215
C260 .1
C259 .1
C229 220/10V
SEE BLOW-UP

FIGURE 6-3. RECEIVER NAV 122 (Sheet 2 of 2, Schematic)
(Chassis Level -- A --(-)

(R-02480-C)

SEE BLOW-UP

This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-3.



NOTE

ALL COMPONENTS ON THIS BOARD ARE 200 SERIES
[CR01] = CR201 DIODE [R02] = R202 RESISTOR

NOTE:
CONTACTS 1 TO 10 ON TOP OF BOARD (COMPONENT SIDE)
CONTACTS 11 TO 20 ON BOTTOM OF BOARD.

FIGURE 6-3A. RECEIVER NAV 122 (Sheet 1 of 2, Component Assy)
(Chassis Level -- C --(-)

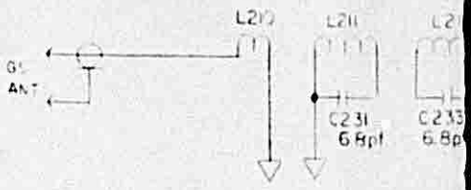
SEE BLOW-UP

The following list identifies the components of this circuit that were: added, changed, or deleted along with the Chassis Level Code letter assigned for identifying the change.

Refer to appropriate Electrical Parts List for Part numbers and description.

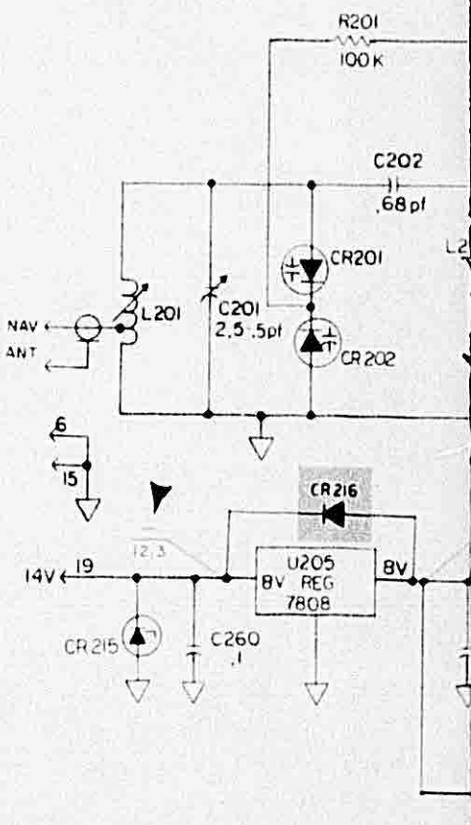
Symbol No.	Action a,c,d	Chassis Level Code Letter
C222	d	C
C236	c	C3
C258	c	C
C262	c	A6
C270	a	B
C273	a	C
C273	c	C3
CR206	Added symbol number.	
CR216	a	A5
Q215	a	B
R222	a	C1
R246	c	B
R246	c	B2
R246	c	C
R248	c	C
R258	c	B
R260	c	C
R261	c	C
R262	c	C
R263	c	C
R264	c	C
R275	c	A3
R279	d	A2
R280	a	B
R280	d	B2

"Shaded areas shown on the schematic indicate those points where a change, addition, deletion, or type substitution took place."

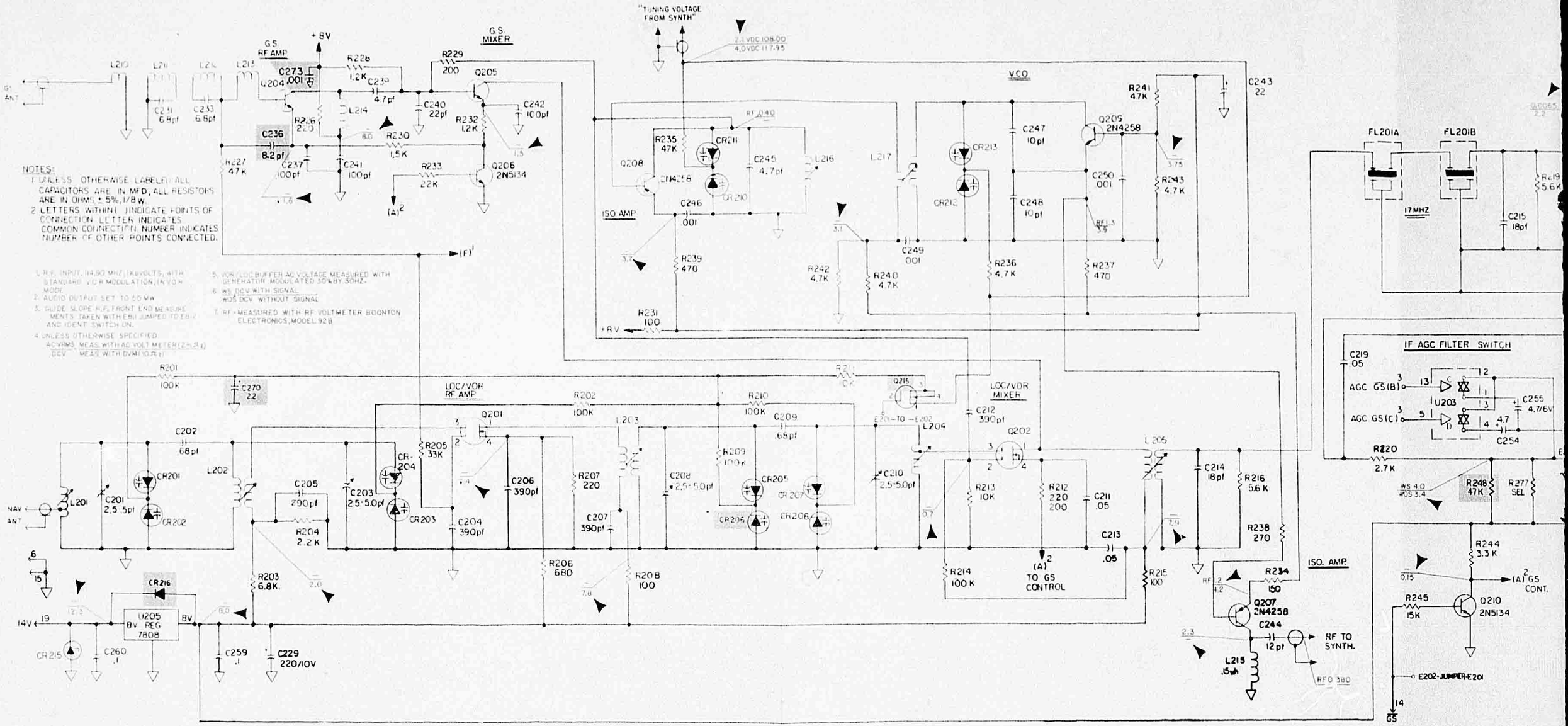


NOTES:
1. UNLESS OTHERWISE LABELED ALL CAPACITORS ARE IN MFD, ALL RESISTORS ARE IN OHMS ± 5%, 1/8 W.
2. LETTERS WITHIN ( ) INDICATE POINTS OF CONNECTION. LETTER INDICATES COMMON CONNECTION. NUMBER INDICATES NUMBER OF OTHER POINTS CONNECTED.

1. R.F. INPUT, 114.90 MHZ, 1K MICROVOLTS, WITH STANDARD VOR MODULATION, IN VOR MODE.
2. AUDIO OUTPUT SET TO 50 MW.
3. GLIDE SLOPE R.F. FRONT END MEASUREMENTS TAKEN WITH E8I JUMPED TO E8I2 AND IDENT SWITCH ON.
4. UNLESS OTHERWISE SPECIFIED
   ACVRMS MEAS. WITH AC VOLT METER (2 m Ω)
   DCV MEAS. WITH DVM (10 Ω)

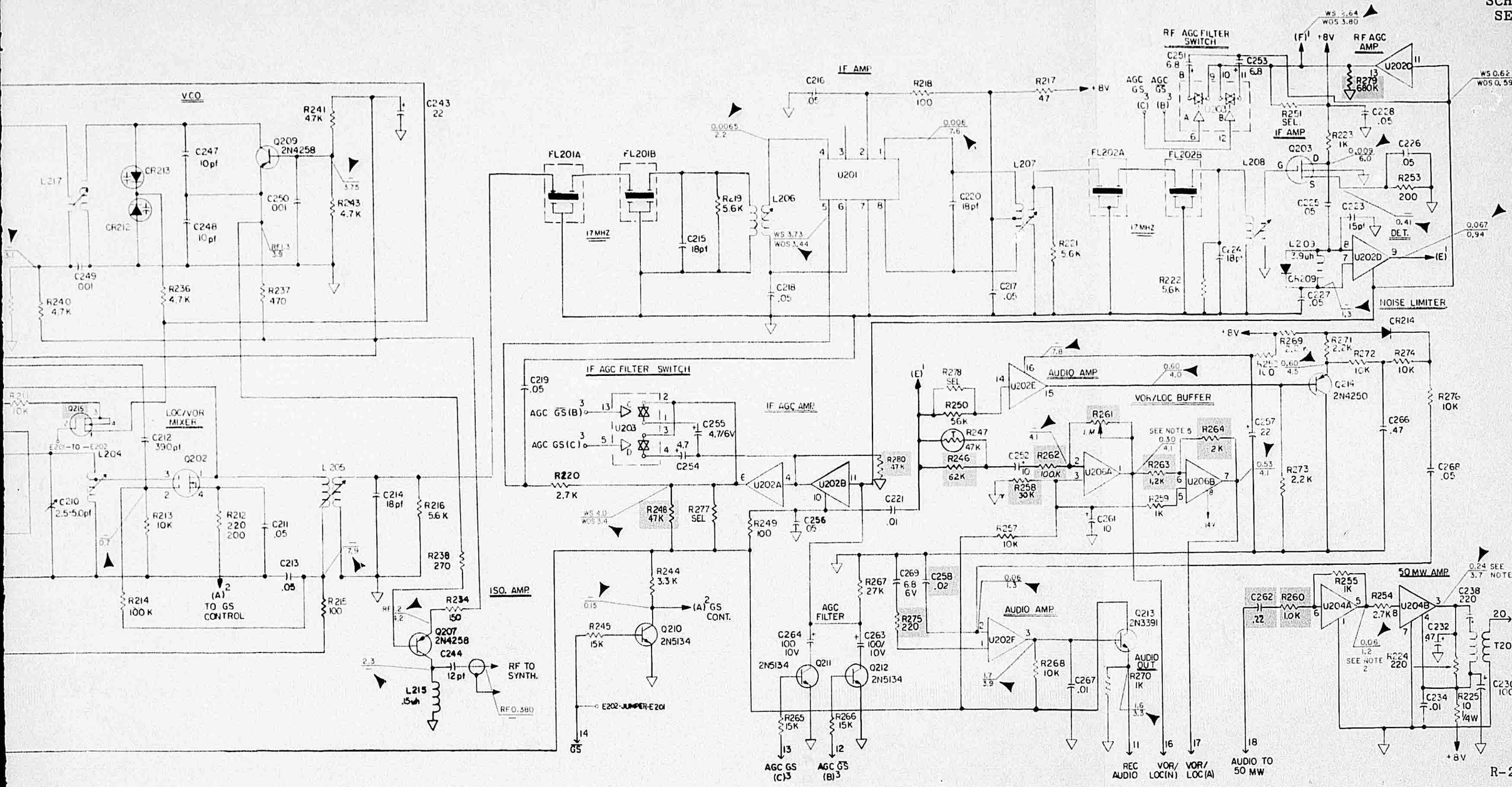


SEE BLOW-UP



3/80

SEE BLOW-UP



R-2480-Q

FIGURE 6-3A. RECEIVER NAV 122 (Sheet 2 of 2, Schematic)
(Chassis Level -- C --(-)

This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-3.

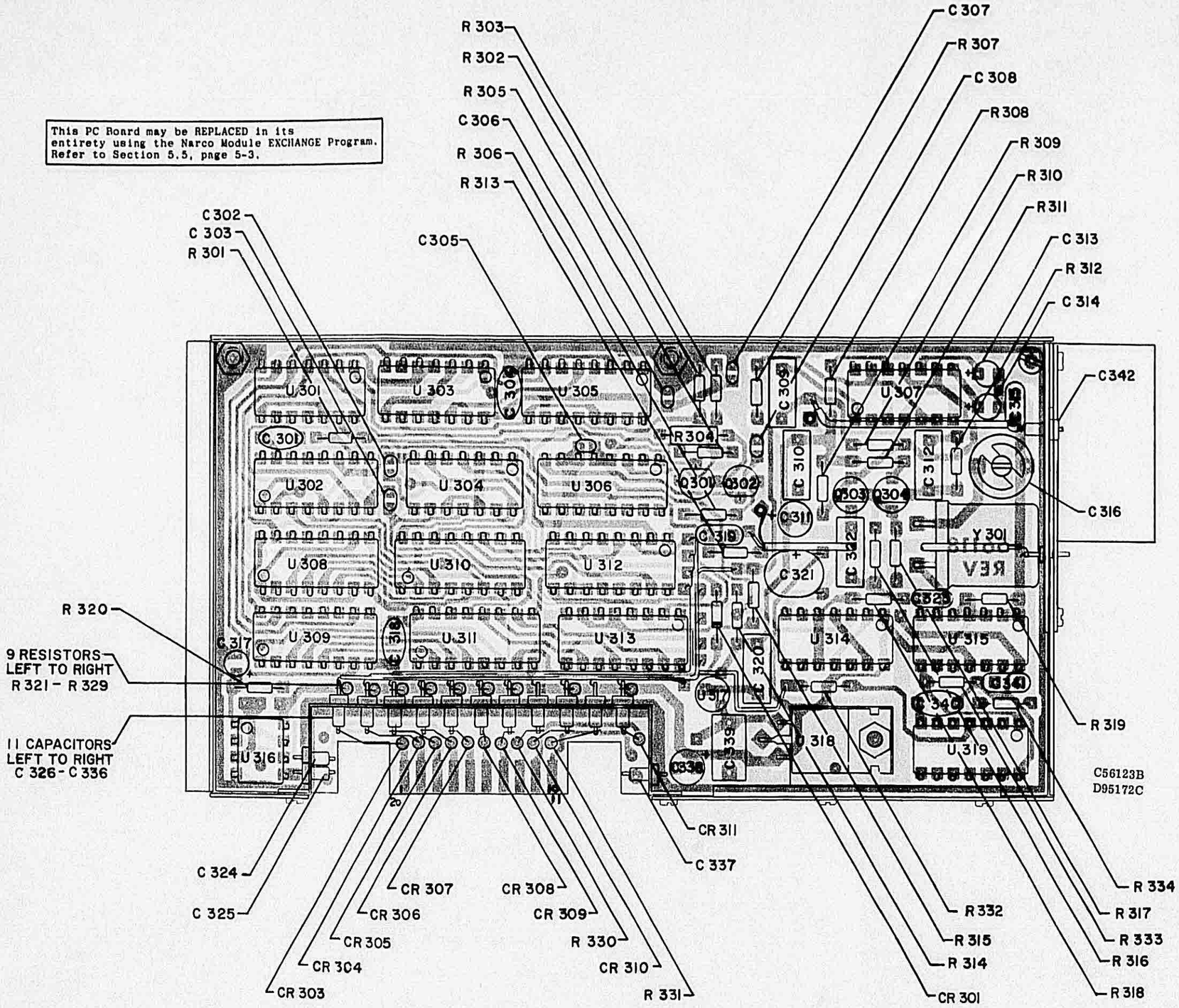
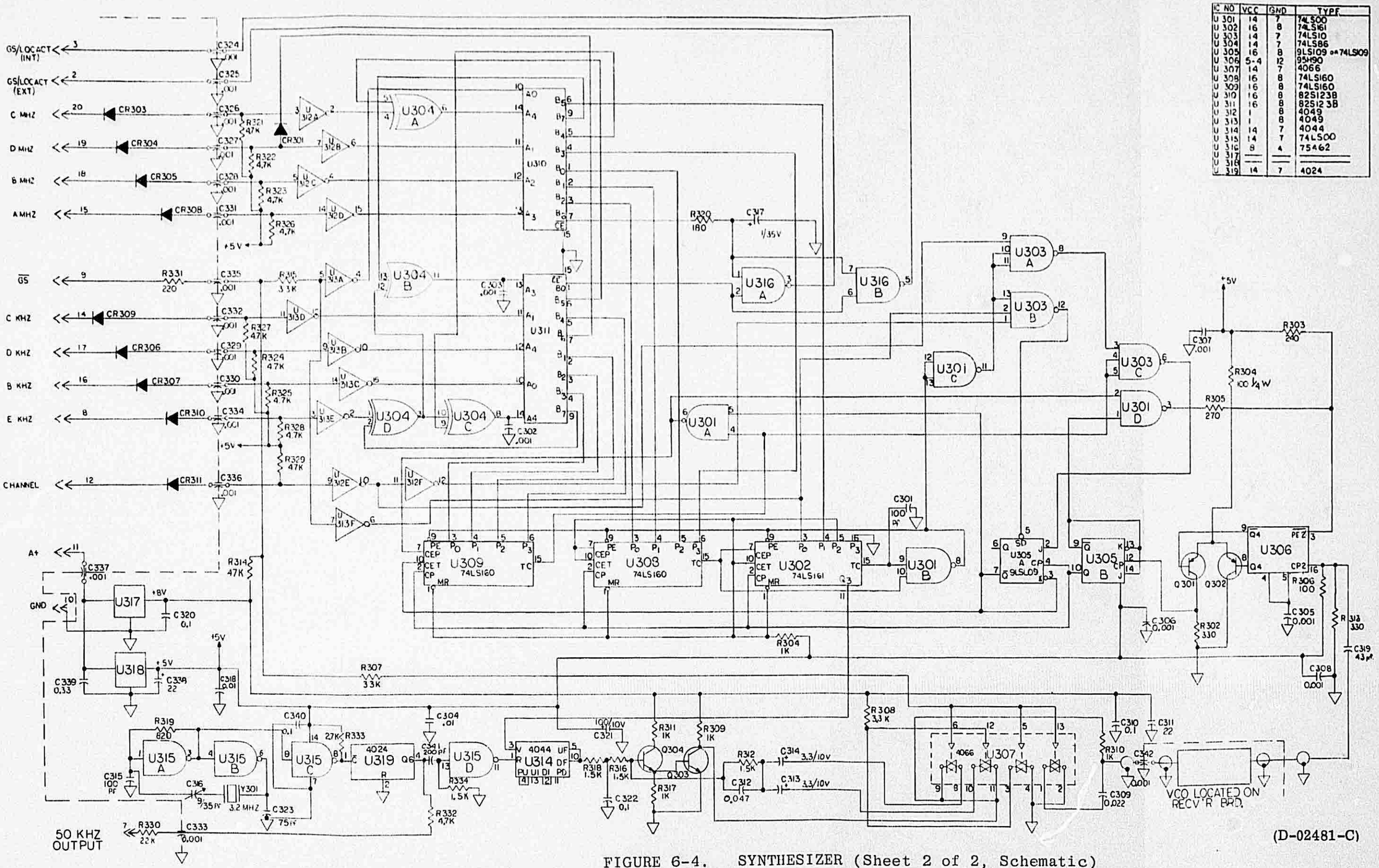


FIGURE 6-4. SYNTHESIZER (Sheet 1 of 2, Component Assy)
(Chassis Level --- A -(-)

IC NO	VCC	GND	TYPE
U 301	14	7	74LS00
U 302	16	8	74LS161
U 303	14	7	74LS10
U 304	14	7	74LS86
U 305	16	8	9LS109 or 74LS109
U 306	5-4	12	95H90
U 307	14	7	4066
U 308	16	8	74LS160
U 309	16	8	74LS160
U 310	16	8	82S123B
U 311	16	8	82S123B
U 312	1	8	4049
U 313	1	8	4049
U 314	14	7	4044
U 315	14	7	74LS00
U 316	8	4	75462
U 317			
U 318			
U 319	14	7	4024



(D-02481-C)

FIGURE 6-4. SYNTHESIZER (Sheet 2 of 2, Schematic)
(Chassis Level --- A -(-)

SYNTHESIZER

SEE BLOW-UP

SEE BLOW-UP

This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-3.

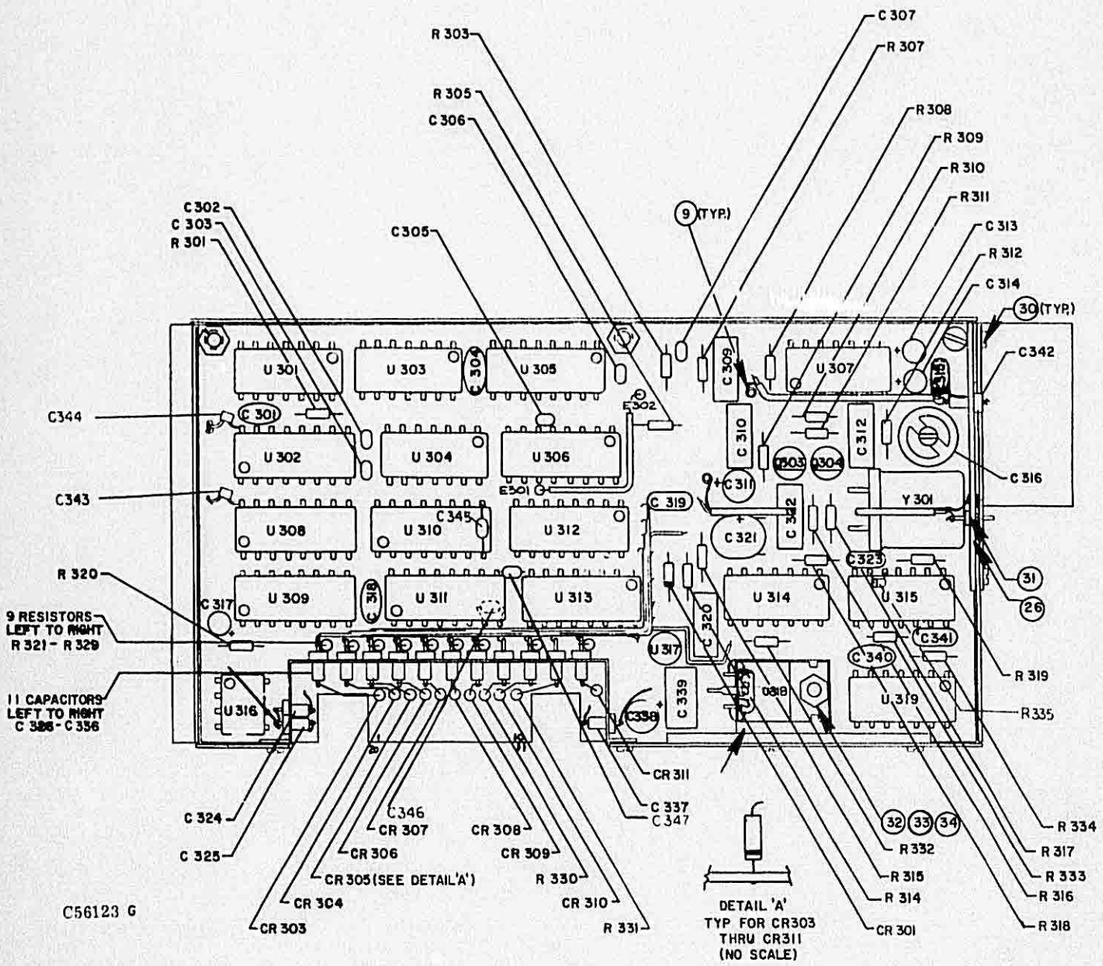


FIGURE 6-4A. SYNTHESIZER (Sheet 1 of 2, Component Assy) (Chassis Level --- B -(-)

SEE BLOW-UP

The following list identifies the components of this circuit that were: added, changed, or deleted along with the Chassis Level Code letter assigned for identifying the change

Refer to appropriate Electrical Parts List for Part numbers and description.

Symbol No.	Action a,c,d	Chassis Level Code Letter
C301	c	A10
C308	d	A9
C343	a	A6
C344	a	A6
C345	a	A8
C346	a	A8
C347	a	A8
CR312	a	A7
Q301	d	A9
Q302	d	A9
R302	d	A9
R304	d	A9
R306	d	A9
R313	d	A9
R335	a	A8
U306	c	A9
U315	c	A5

"Shaded areas shown on the schematic indicate those points where a change, addition, deletion, or type substitution took place."

IC NO	VCC	GND	TYPE
U 301	14	7	74LS00
U 302	16	8	74LS161
U 303	14	7	74LS10
U 304	14	7	74LS86
U 305	16	8	9LS109 or 74LS109
U 306	5-4	12	11C90
U 307	14	7	4066
U 308	16	8	74LS160
U 309	16	8	74LS160
U 310	16	8	82S123B
U 311	16	8	82S123B
U 312	1	8	4049
U 313	1	8	4049
U 314	14	7	4044
U 315	14	7	74LS00
U 316	8	4	75462
U 317	—	—	—
U 318	—	—	—
U 319	14	7	4024

VOLTAGE NOTES:

RF - MEASURED WITH RF VOLTMETER BOONTON ELECTRONICS, MODEL 92B

(47) = WAVEFORM REFERENCE NUMBER

GS/LOCACT (INT)
GS/LOCACT (EXT)
C MHZ
D MHZ
B MHZ
A MHZ
GS
C KHZ
D KHZ
B KHZ
E KHZ
Y CHANNEL
A1
GND
+5V
+8V
+15V
FREQUENCY SELECT DECODING
GS/LOC ACT DECODERS
KHZ COUNTER
PRESCALER ÷10/11
÷20/21
REFERENCE OSCILLATOR
REFERENCE DIVIDER : 64
FREQ/PHASE DETECTOR
LOOP FILTER
VCO LOCATED ON RECV'R BRD.
50 KHZ OUTPUT
SEE BLOW-UP

FIGURE 6-4A SYNTHESIZER (Sheet 2 of 2, Schematic)
(Chassis Level --- B -(-)

SYNTHESIZER

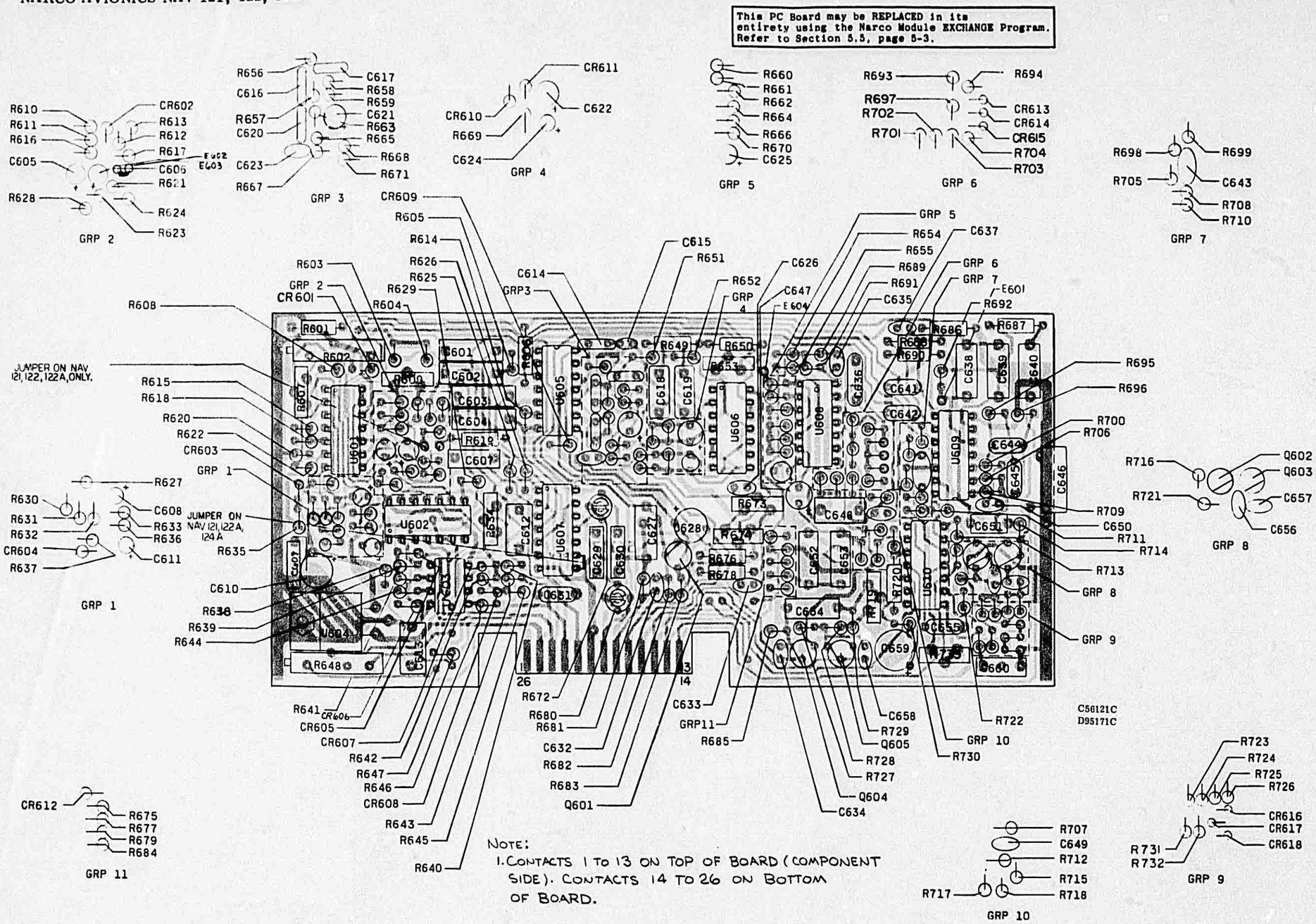
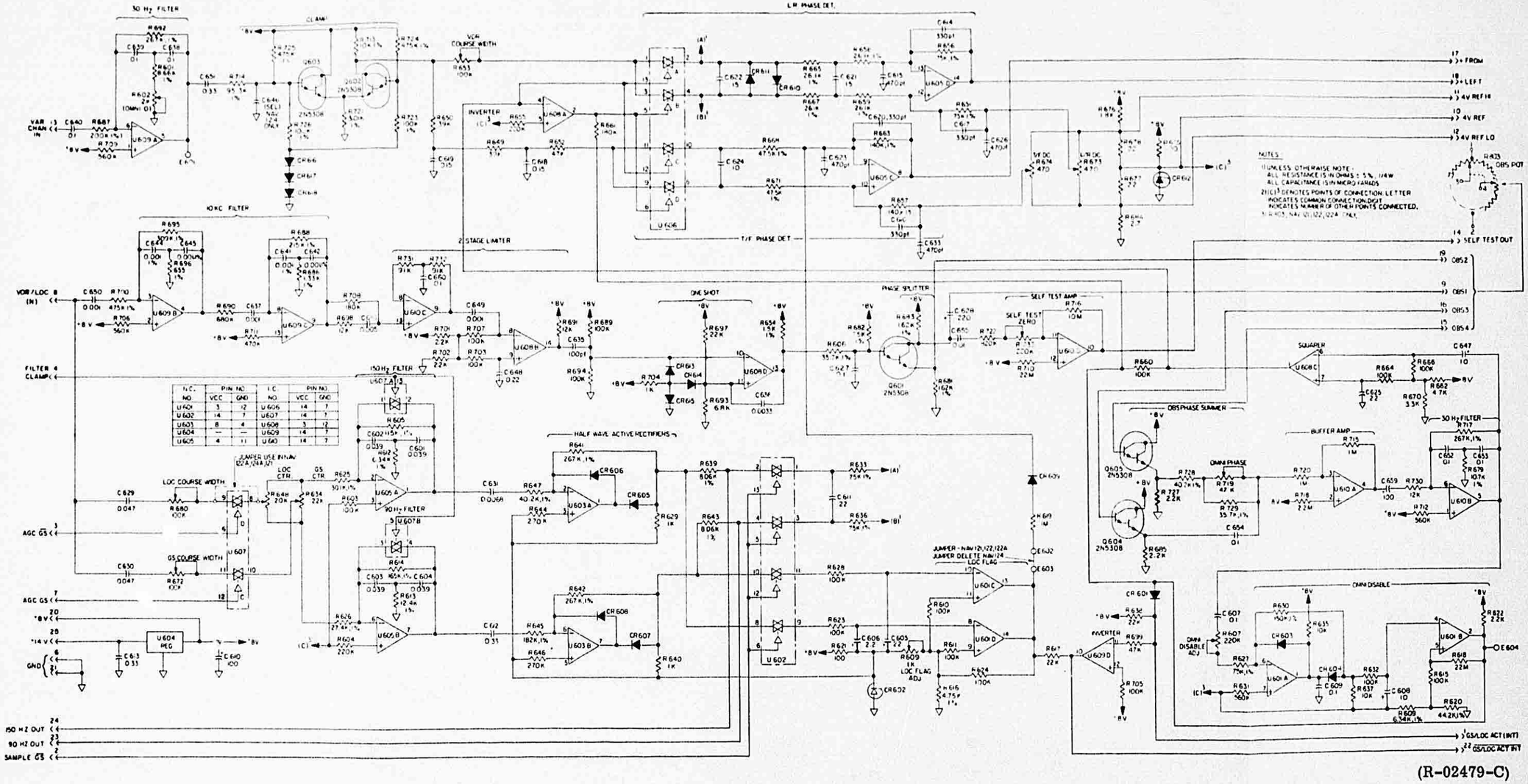


FIGURE 6-5. VOR/LOC (Sheet 1 of 2, Component Assy)
(Chassis Level ---- A (-)



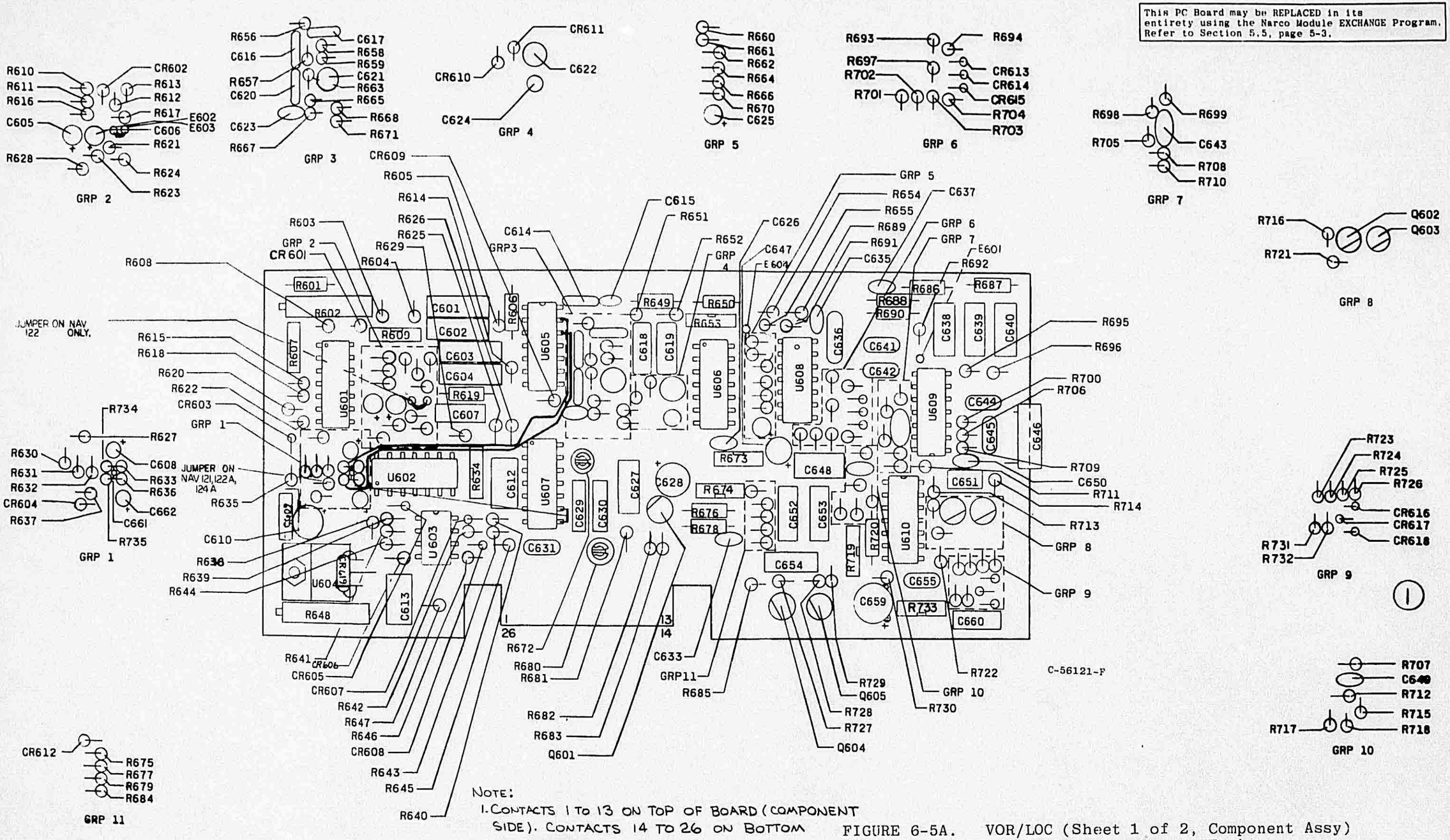
I.C. NO	PIN NO. VCC	PIN NO. GND	I.C. NO	PIN NO. VCC	PIN NO. GND
U601	3	12	U606	14	7
U602	14	7	U607	14	7
U603	8	4	U608	3	12
U604	—	—	U609	14	7
U605	4	11	U610	14	7

(R-02479-C)

FIGURE 6-5. VOR/LOC NAV 122 (Sheet 2 of 2, Schematic)
(Chassis Level ---- A (-)

SEE BLOW-UP

This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-3.



NOTE:
1. CONTACTS 1 TO 13 ON TOP OF BOARD (COMPONENT SIDE). CONTACTS 14 TO 26 ON BOTTOM OF BOARD.
2. COMPONENT HEIGHT NOT TO EXCEED 0.5 INCH.
3. C646 USED IN NAV 124, NAV 200, NAV 200A

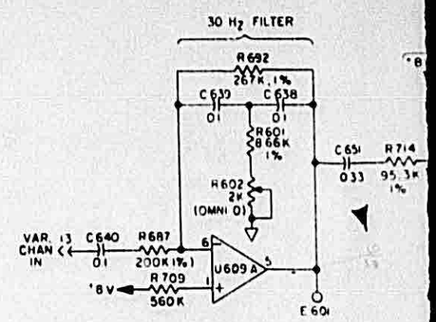
FIGURE 6-5A. VOR/LOC (Sheet 1 of 2, Component Assy) (Chassis Level ---- E -)

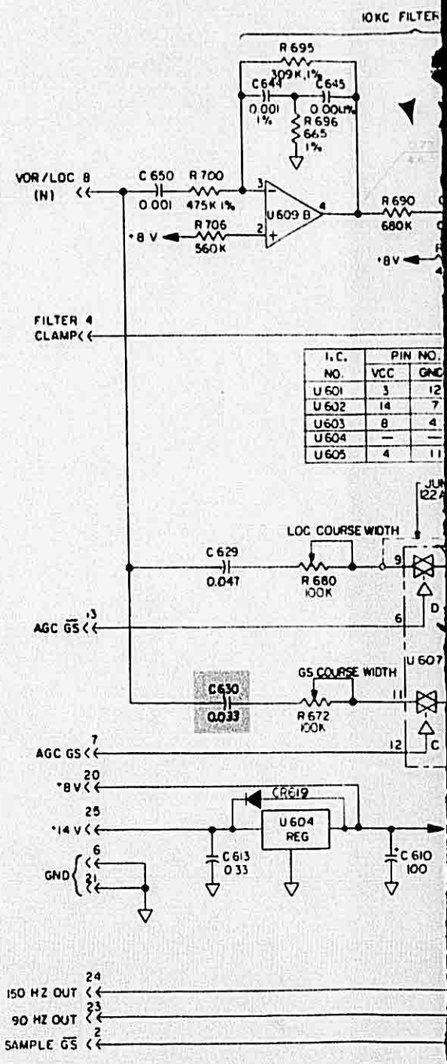
The following list identifies the components of this circuit that were: added, changed, or deleted along with the Chassis Level Code letter assigned for identifying the change.

Refer to appropriate Electrical Parts List for Part numbers and description.

Symbol No.	Action a,c,d	Chassis Level Code Letter
C611	c	B
C611	c	E
C622	c	E
C630	c	C
C631	c	C
C661	a	E
CR618	a	B2
R618	c	D1
R626	c	C1
R633	a	B1
R633	c	E
R636	a	B1
R636	c	E
R647	c	C
R651	a	B1
R651	c	E
R656	a	B1
R656	c	E
R658	a	B1
R658	c	E
R659	a	B1
R659	c	E
R665	a	B1
R665	c	E
R667	a	B1
R667	c	E
R710	c	D1
R722	c	A1
R733	c	A1
R734	a	E
R735	a	E

"Shaded areas shown on the schematic indicate those points where a change, addition, deletion, or type substitution took place."





SEE BLOW-UP

I.C. NO.	PIN NO. VCC	GND	I.C. NO.	PIN NO. VCC	GND
U601	3	12	U606	14	7
U602	14	7	U607	14	7
U603	8	4	U608	3	12
U604	—	—	U609	14	7
U605	4	11	U610	14	7

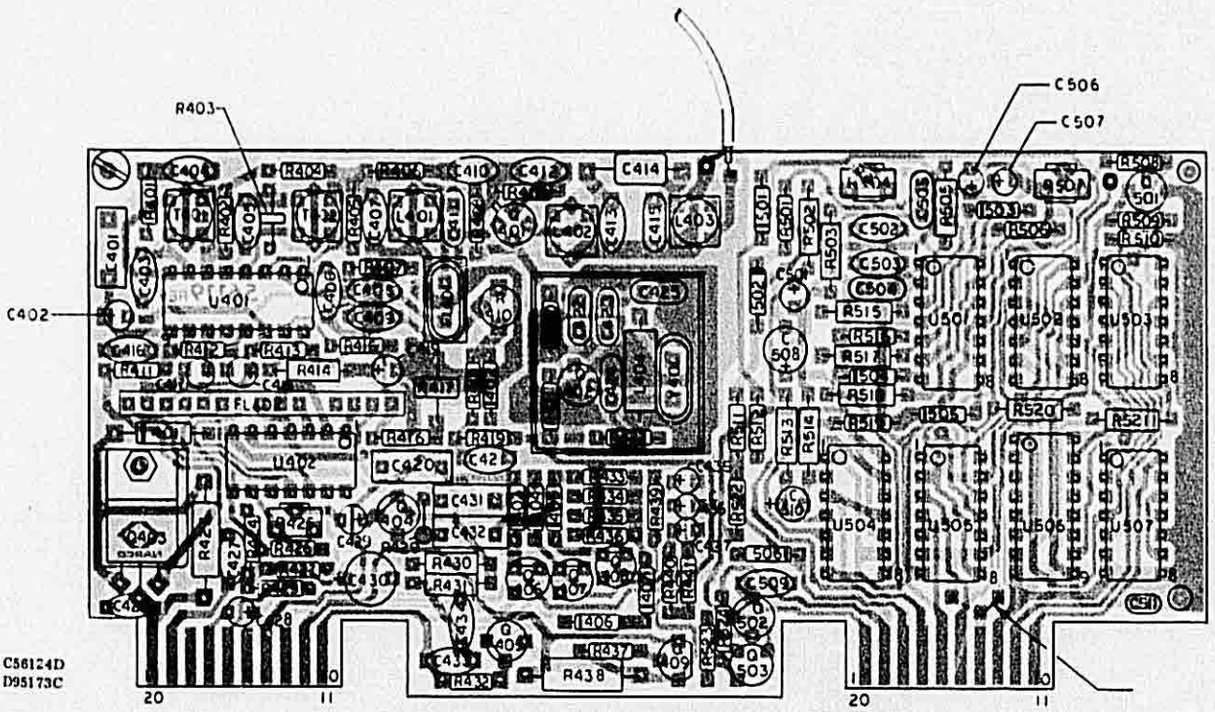
NOTES:
1. AC VRMS MEASURED WITH VOLTMETER (2mA/Z)
   DCV MEASURED WITH DVM (10mΩ)
2. WOS DCV WITHOUT SIGNAL
   WS DCV WITH SIGNAL

NOTES:
1) UNLESS OTHERWISE NOTE:
   ALL RESISTANCE IS IN OHMS ± 5%, 1/4W
   ALL CAPACITANCE IS IN MICRO FARADS
2) (C)³ DENOTES POINTS OF CONNECTION. LETTER INDICATES COMMON CONNECTION, DIGIT INDICATES NUMBER OF OTHER POINTS CONNECTED.
3) R705, NAV 121, 122, 122A ONLY.
4) ▲ THESE VALUES IN RADIOS MARKED WITH A ▲ ONLY.

FIGURE 6-5A. VOR/LOC NAV 122 ONLY (Sheet 2 of 2, Schematic)
(Chassis Level ---- E (-)

SEE BLOW-UP

This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-3.



C56124D
D95173C

NOTE
TEST JUMPER - SHOWN IN NORMAL POSITION
DOTTED LINE USED FOR GLIDESLOPE TROUBLE-SHOOTING.

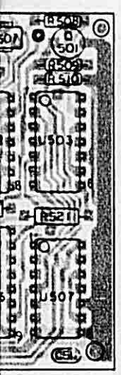
NOTES

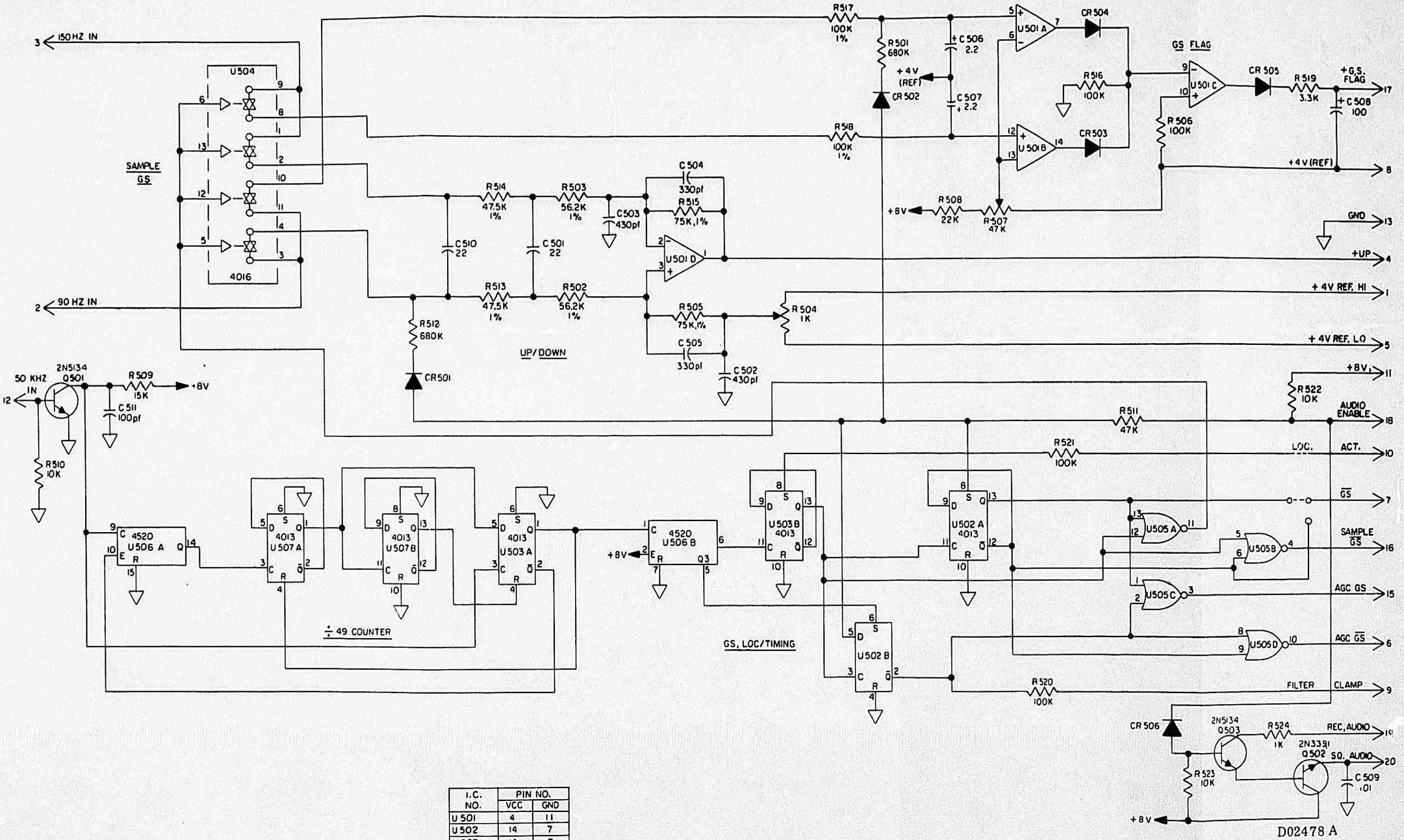
CONTACTS 1 THRU 10 ARE ON COMPONENT (NEAR) SIDE OF BOARD.
CONTACTS 11 THRU 20 ARE ON CIRCUIT (FAR) SIDE OF BOARD.

SYMBOLS ARE DIODES, BAR INDICATES CATHODE END.
CR DESIGNATIONS OMITTED FOR CLARITY.

R-442,R443,R444 ARE SELETED ACROSS R434,R435,R435

SEE BLOW-UP





I.C. NO.	PIN NO.	
	VCC	GND
U501	4	11
U502	14	7
U503	14	7
U504	14	7
U505	14	7
U506	16	8
U507	14	7

FIGURE 6-6. GLIDE SLOPE CONTROL NAV 122 (Component Assy and Schematic)
(Chassis Level -----(A)

BLOW-UP

SEE BLOW-UP

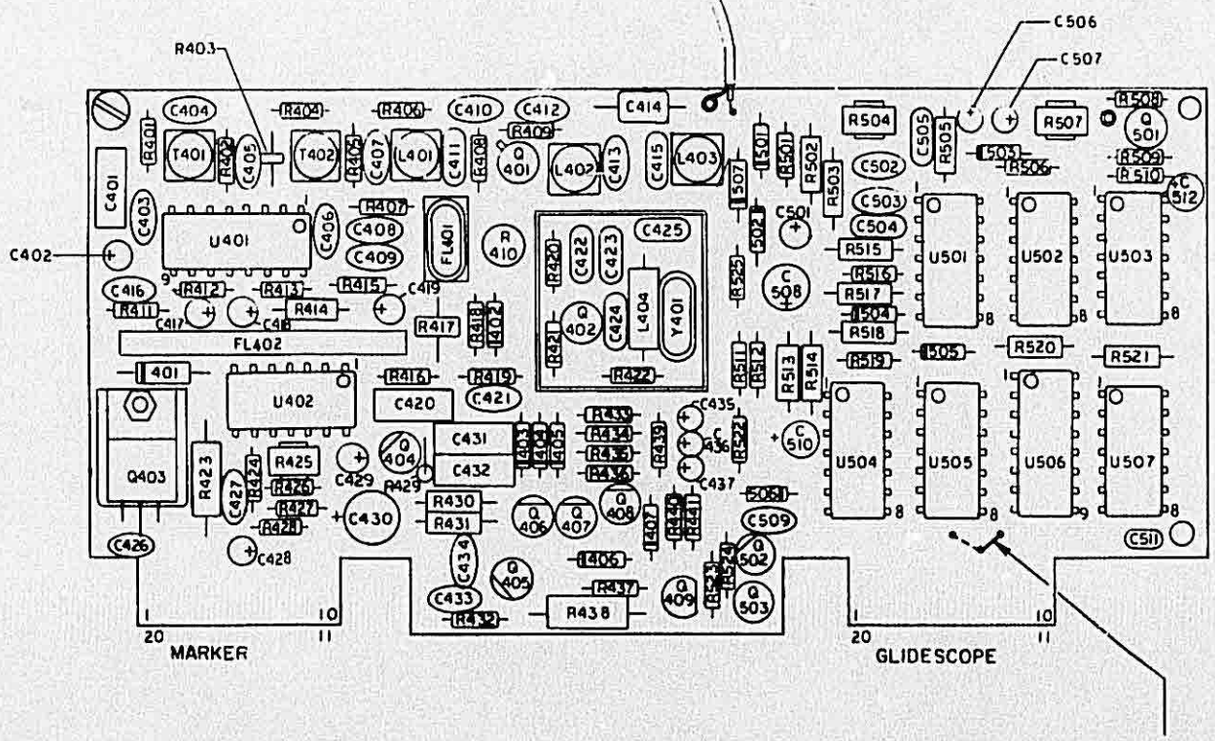
The following list identifies the components of this circuit that were: added, changed, or deleted along with the Chassis Level Code letter assigned for identifying the change.

Refer to appropriate Electrical Parts List for Part numbers and description.

"Shaded areas shown on the schematic indicate those points where a change, addition, deletion, or type substitution took place."

This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5--.

Symbol No.	Action a,c,d	Chassis Level Code Letter	Symbol No.	Action a,c,d	Chassis Level Code Letter
C501	c	E	R505	c	B2
C510	c	E	R508	c	B
C511	c	E	R508	c	D
C512	a	B	R513	c	B1
CR501	c	D	R513	c	E
CR502	c	D	R514	c	B1
CR507	a	B	R514	c	E
CR507	c	D	R525	a	B
R502	c	E	R525	c	D
R503	c	E			



C-56124-G

NOTES

CONTACTS 1 THRU 10 ARE ON COMPONENT (NEAR) SIDE OF BOARD.
CONTACTS 11 THRU 20 ARE ON CIRCUIT (FAR) SIDE OF BOARD.

SYMBOLS ARE DIODES, BAR INDICATES CATHODE END, CR DESIGNATIONS OMITTED FOR CLARITY.

R-442, R443, R444 ARE SELETED ACROSS R434, R435, R435 RESPECTIVELY.

NOTE
TEST JUMPER - SHOWN IN NORMAL POSITION
DOTTED LINE USED FOR GLIDESLOPE TROUBLE-SHOOTING.

SEE BLOW-UP

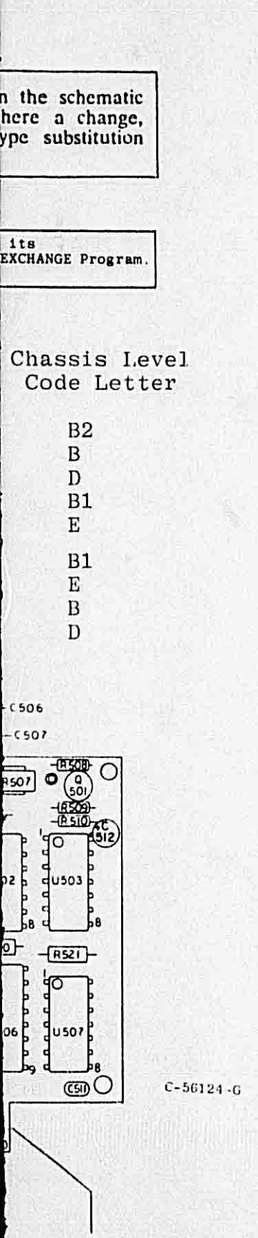
n the schematic
here a change,
ype substitution

its
EXCHANGE Program.

Chassis Level
Code Letter

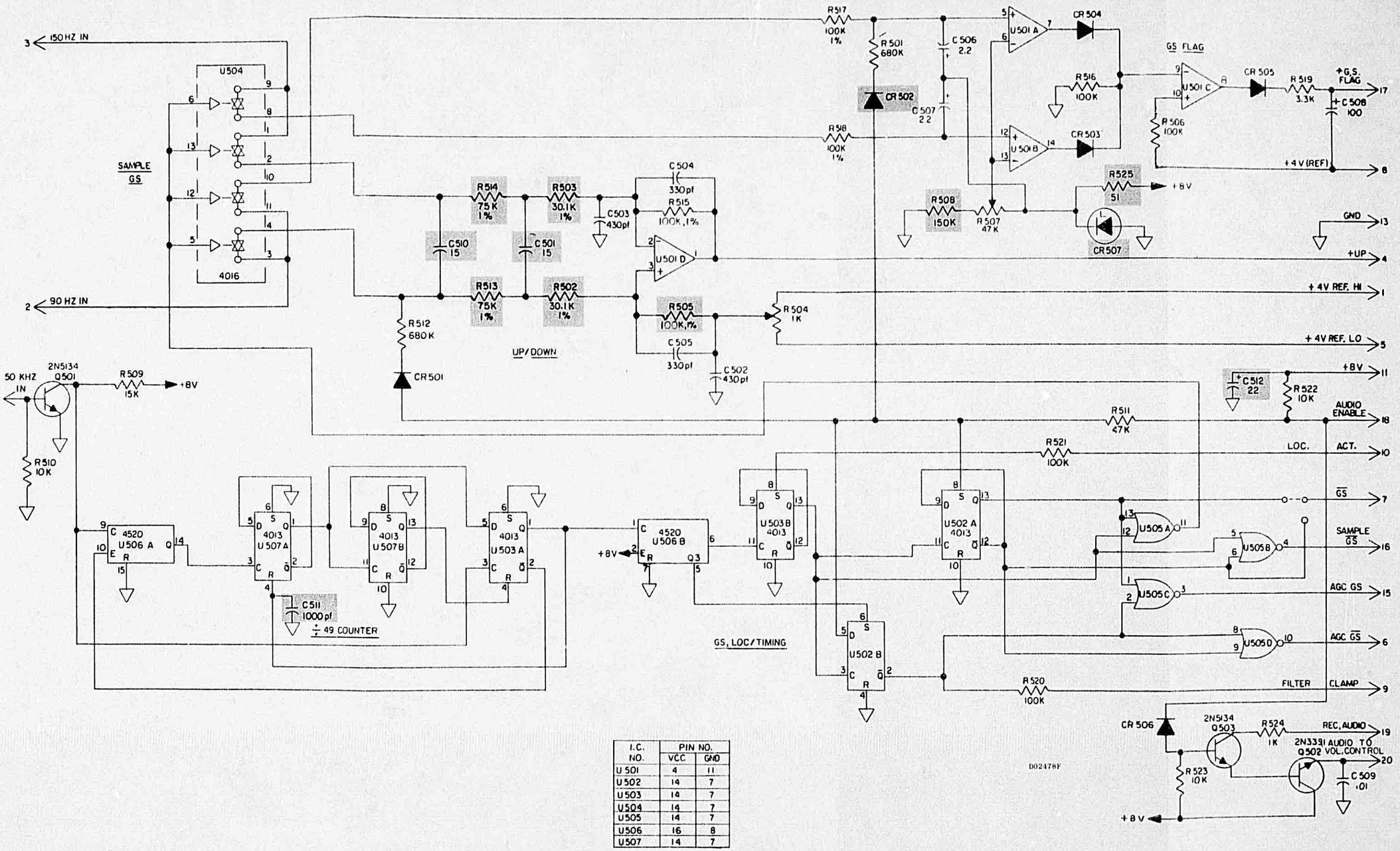
B2
B
D
B1
E

B1
E
B
D



ER - SHOWN IN NORMAL POSITION
NE USED FOR GLIDESLOPE TROUBLE -

EE BLOW-UP

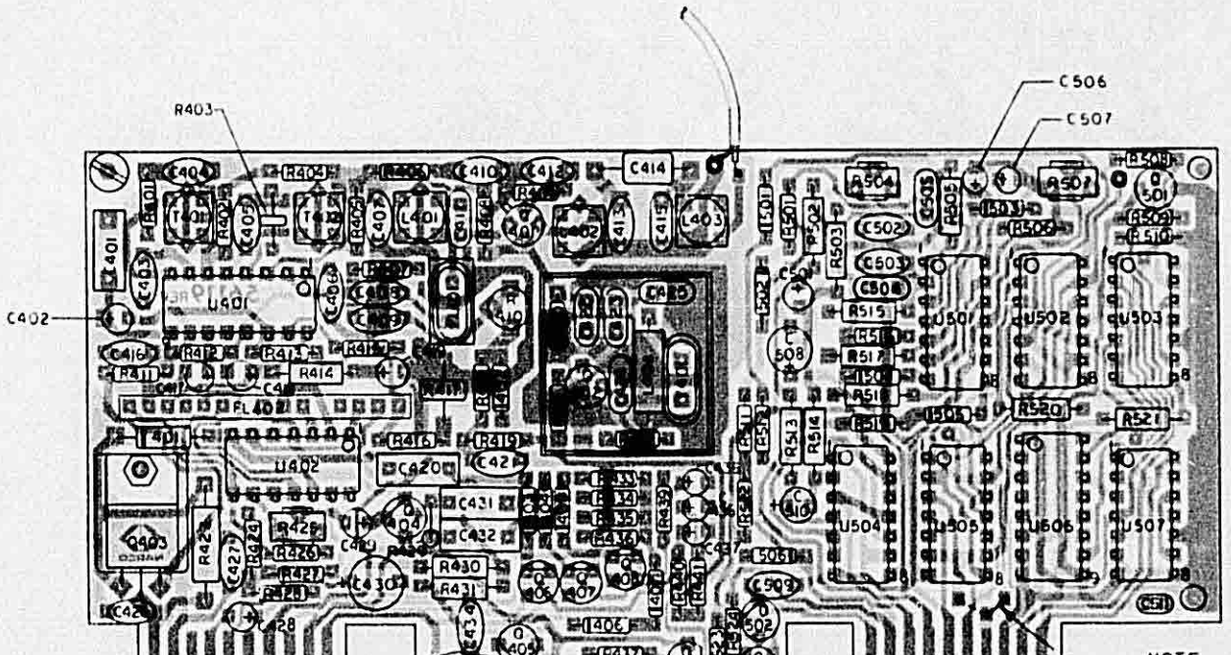


I.C. NO.	PIN NO.	
	VCC	GND
U501	4	11
U502	14	7
U503	14	7
U504	14	7
U505	14	7
U506	16	8
U507	14	7

FIGURE 6-6A. GLIDE SLOPE CONTROL NAV 122 (Component Assy and Schematic)
(Chassis Level ----- (E)

SEE BLOW-UP

This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-3.



NOTE
TEST JUMPER - SHOWN IN NORMAL P
DOTTED LINE USED FOR GLIDESLOP
SHOOTING.

NOTES

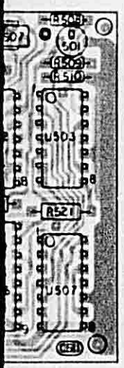
CONTACTS I THRU 10 ARE ON COMPONENT (NEAR) SIDE OF BOARD.
CONTACTS 11 THRU 20 ARE ON CIRCUIT (FAR) SIDE OF BOARD.

SYMBOLS ARE DIODES, BAR INDICATES CATHODE END.
CR DESIGNATIONS OMITTED FOR CLARITY.

R-442,R443,R444 ARE SELETED ACROSS R434,R433,R435

SEE BLOW-UP

NOTES: 1. ALL RESISTOR IN OHMS: REFER TO PARTS LIST FOR TOLARANCE AND WATTAGE. ALL CAPACITORS IN MICRO FARADS UNLESS OTHERWISE STATED. INDUCTORS ARE μH UNLESS OTHERWISE STATED.
2 SIGNAL FLOW SHOWN BY HEAVY ARROWED LINE.



NOTE
TEST JUMPER - SHOWN IN NORMAL POSITION
DOTTED LINE USED FOR GLIDESLOPE TROUBLE-SHOOTING.

D02492B

FIGURE 6-7. MARKER BEACON NAV 122/122A (Component Assy and Schematic)
(Chassis Level -----(A)

E BLOW-UP

SEE BLOW-UP

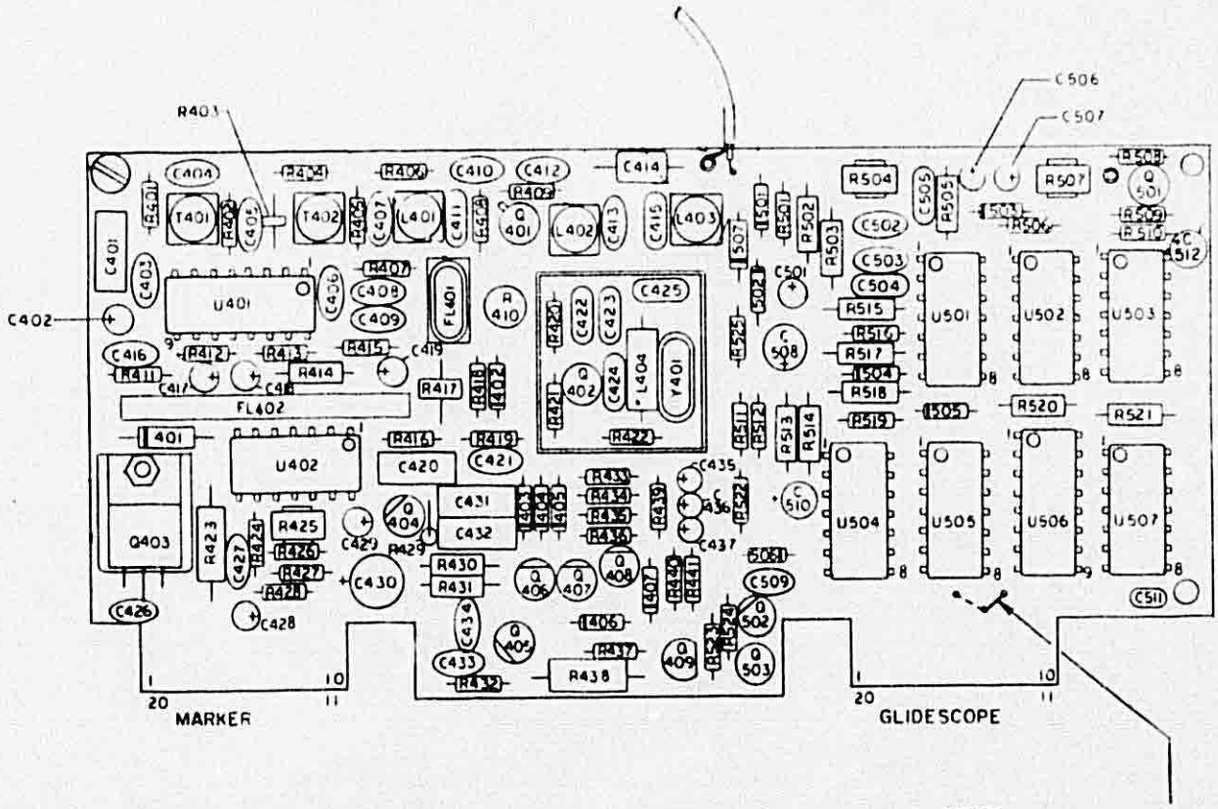
The following list identifies the components of this circuit that were: added, changed, or deleted along with the Chassis Level Code letter assigned for identifying the change.

Refer to appropriate Electrical Parts List for Part numbers and description.

This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-3.

"Shaded areas shown on the schematic indicate those points where a change, addition, deletion, or type substitution took place."

Symbol No.	Action a,c,d	Chassis Level Code Letter
C430	c	C
R413	Added missing	"K"
R428	c	C
R429	c	C



NOTES

CONTACTS 1 THRU 10 ARE ON COMPONENT (NEAR) SIDE OF BOARD.
CONTACTS 11 THRU 20 ARE ON CIRCUIT (FAR) SIDE OF BOARD.

SYMBOLS ARE DIODES, BAR INDICATES CATHODE END. CR DESIGNATIONS OMITTED FOR CLARITY.

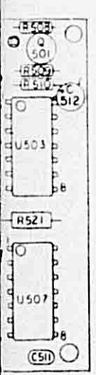
R-442, R443, R444 ARE SELETED ACROSS R434, R435, R435 RESPECTIVELY.

NOTE
TEST JUMPER - SHOWN IN NORMAL POSITION
DOTTED LINE USED FOR GLIDESLOPE TROUBLE-SHOOTING.

SEE BLOW-UP

NGE Program.

chematic
change,
stitution



C-50124-C

HOWN IN NORMAL POSITION
ED FOR GLIDESLOPE TROUBLE -

NOTES: 1. ALL RESISTOR IN OHMS; REFER TO PARTS LIST FOR TOLARANCE AND WATTAGE. ALL CAPACITORS IN MICRO FARADS UNLESS OTHERWISE STATED. INDUCTORS ARE μH UNLESS OTHERWISE STATED.
2 SIGNAL FLOW SHOWN BY HEAVY ARROWED LINE.

LOCATED ON FRONT PANEL
MKR ANT
RF SENS R101 1K
L403
C414 .33pf
C415 27pf
L402
C413 22pf
Q401
L401
FL401
C408 4.7pf
C411 12pf
C410 .01
R409 220
C412 .01
R406 100
R412 180K
AGC
R407 4.7K
U 401 3088
C409 .01
R405 47K
T402
R403 47K
C406 .01
R402 47K
T401
C405 .01
DET
C402 10/15
C401 .01
R413 4.7K
C417 10/15
R417 128.8
R415 6.8K
R416 1K
C403 .01
C407 .01
R410 100 SENS
R404 100
R418 1K
CR402
R419 10K
C421 .01
C404 01
R401 100
C416 .01
14 >> SENS
C422 27pf
R408 100K
Q402
Y401
C424 62pf
C423 120pf
R420 10K
L404 .22
C425 47pf
R421 470
R422 220K
R411 330
A+ 1,20
Q403
R414 1K ½W
C426 .01
R423 1K ½W
CR401 10V
C419 10/15
C418 22/15V
GND 19,2
FL402
U402 3401
R436 10K
C420
CR403
Q406
R442 SEL
R435 22K
C436 3.3/15
R441 47K
8 >> WHITE LAMP
C432 .1
CR405
E115
Q408
R443 SEL
R433 22K
C435 3.3/15
R439 47K
7 >> AMBER LAMP
C431 .1
CR404
E113
Q407
R444 SEL
R434 22K
C437 3.3/15
R440 47K
9 >> BLUE LAMP
484 .01
CR407
CR406
10 >> MKR TEST
12 >> LAMP COMMON
AUDIO OUT 17
C428 10/15V
C427 .01
R430 120 ½W
Q404
R429 10K
R431 470 ½W
C429 10/15V
16 MUTE
R437 1K
Q409
R438 47 ½W
DIM 11
R432 10K
Q405
C433 .01
R424 220K
R427 120K
R426 820K
R425 22K
R428 100
C430 100/10

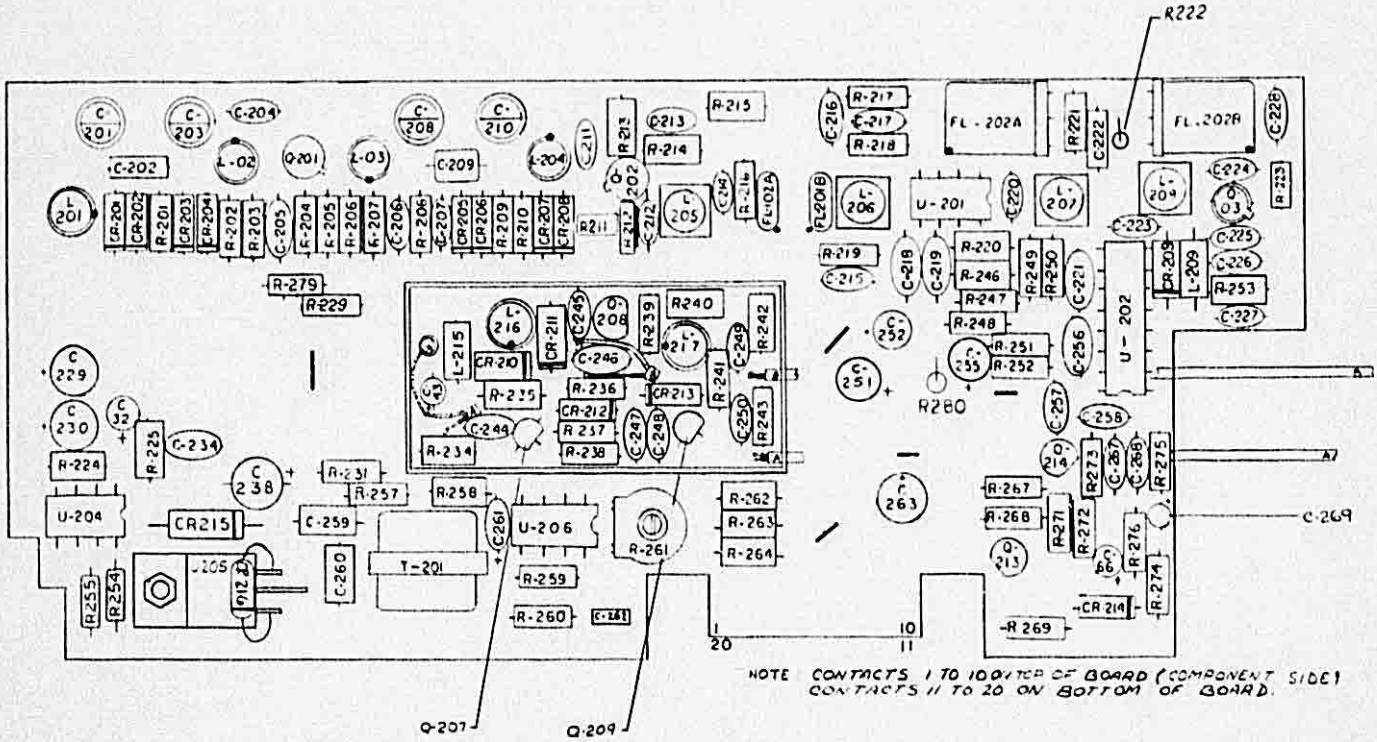
D-02402-D

FIGURE 6-7A. MARKER BEACON NAV 122/122A (Component Assy and Schematic)
(NAV 122 Chassis Level -----E)
(NAV 122A Chassis Level -----D)

SEE BLOW-UP

MARKER BEACON NAV 122/122A

This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-3.



NOTE

ALL COMPONENTS ON THIS BOARD ARE 200 SERIES
CR01 = CR201 DIODE R02 = R202 RESISTOR

C56192B

FIGURE 6-8. RECEIVER, NAV 121 AND NAV 122A ONLY (Sheet 1 of 2)
(Chassis Level -- A --(-)

SEE BLOW-UP

NOTES:
1. UNLESS OTHERWISE LABELED ALL CAPACITORS ARE IN MFD, ALL RESISTORS ARE IN OHMS, ± 5%, 1/8 W.
2. LETTERS WITHIN ( ) INDICATE POINTS OF CONNECTION. LETTER INDICATES COMMON CONNECTION. NUMBER INDICATES NUMBER OF OTHER POINTS CONNECTED.
3. * THIS VALUE SELECTED IN REMOTE RECEIVER NAV 124 ONLY.

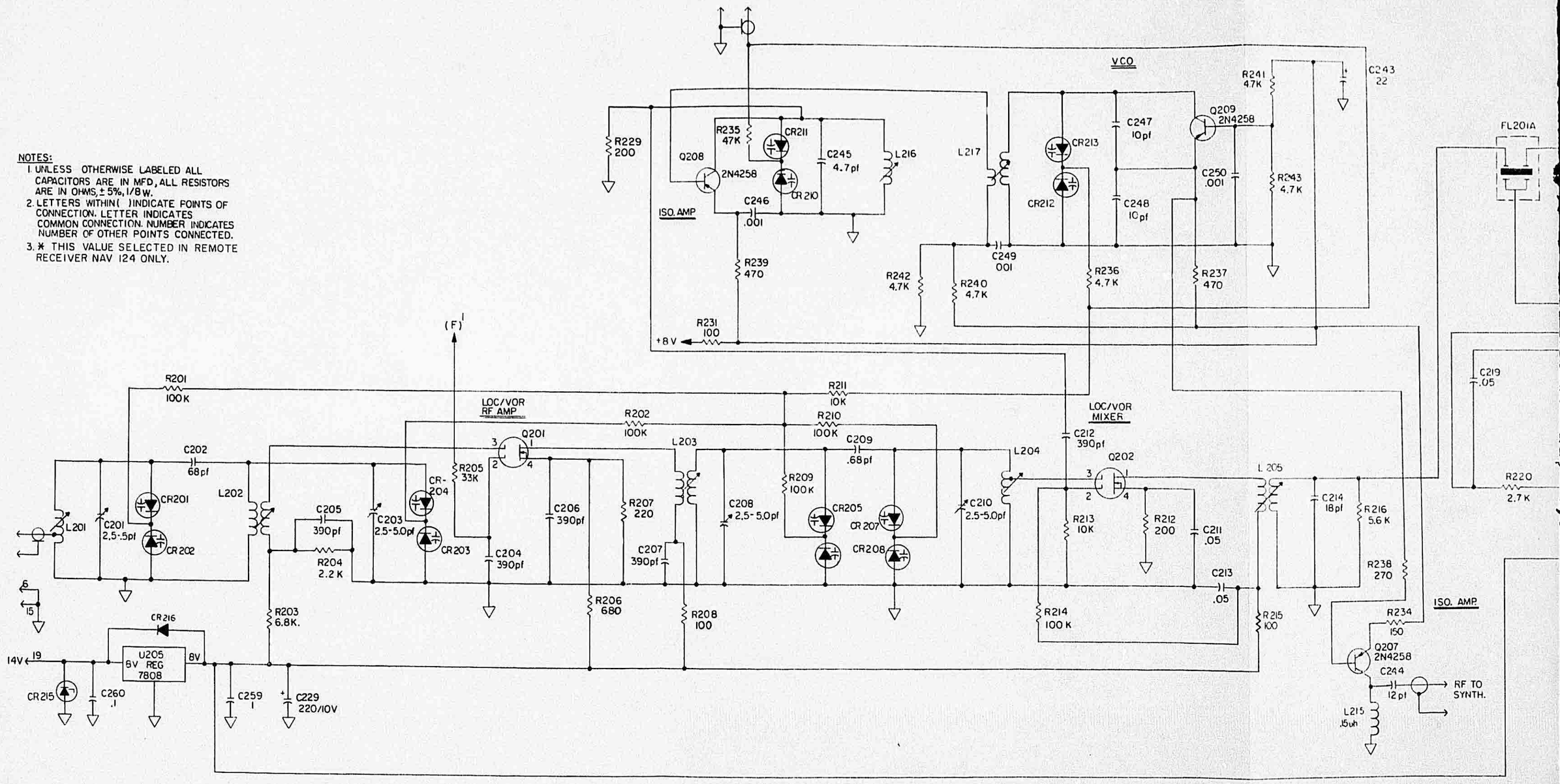


FIGURE 6-8. RECEIVER, NAV 121 AND NAV 122A ONLY (
(Chassis Level -- A --(-)

SEE BLOW-UP

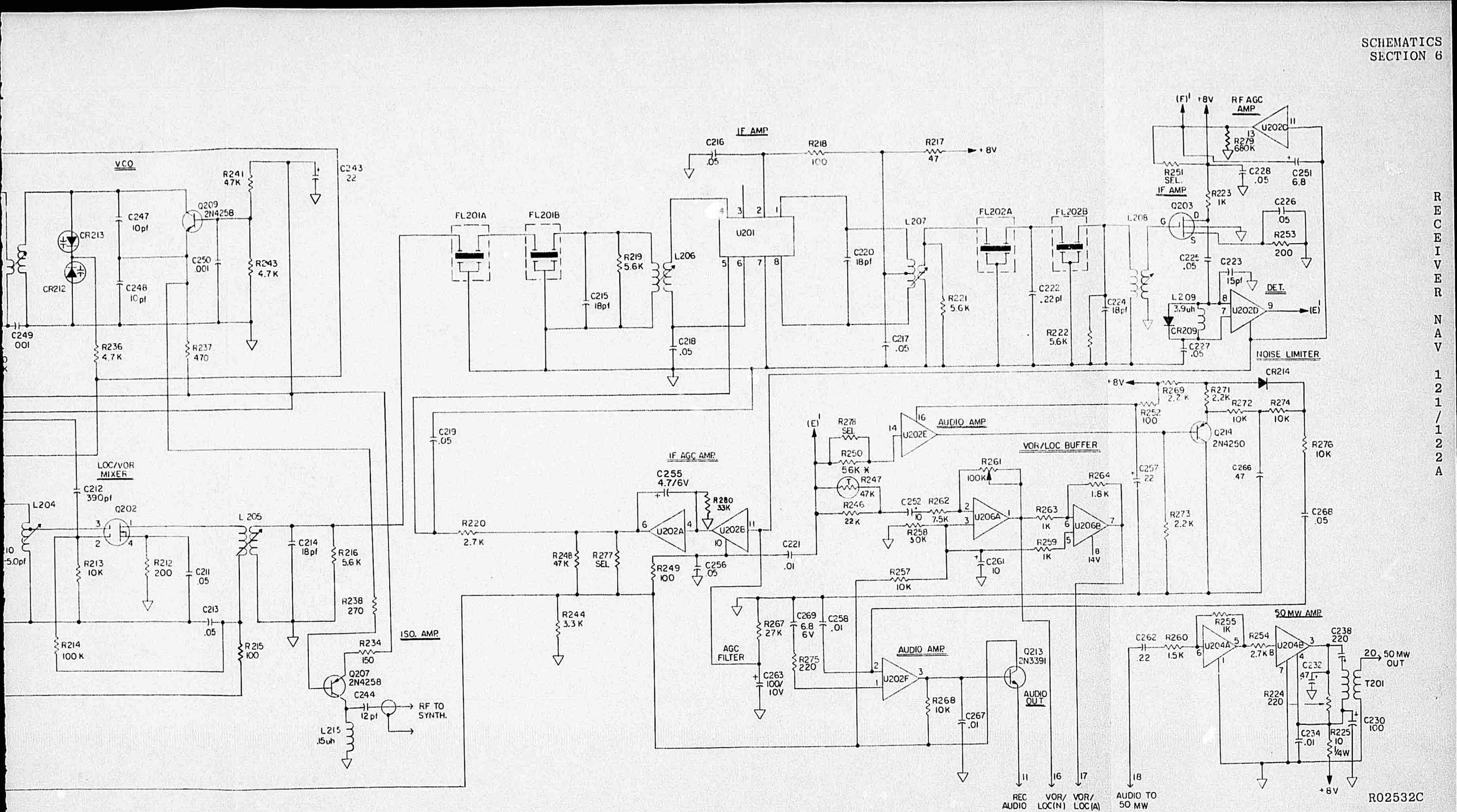
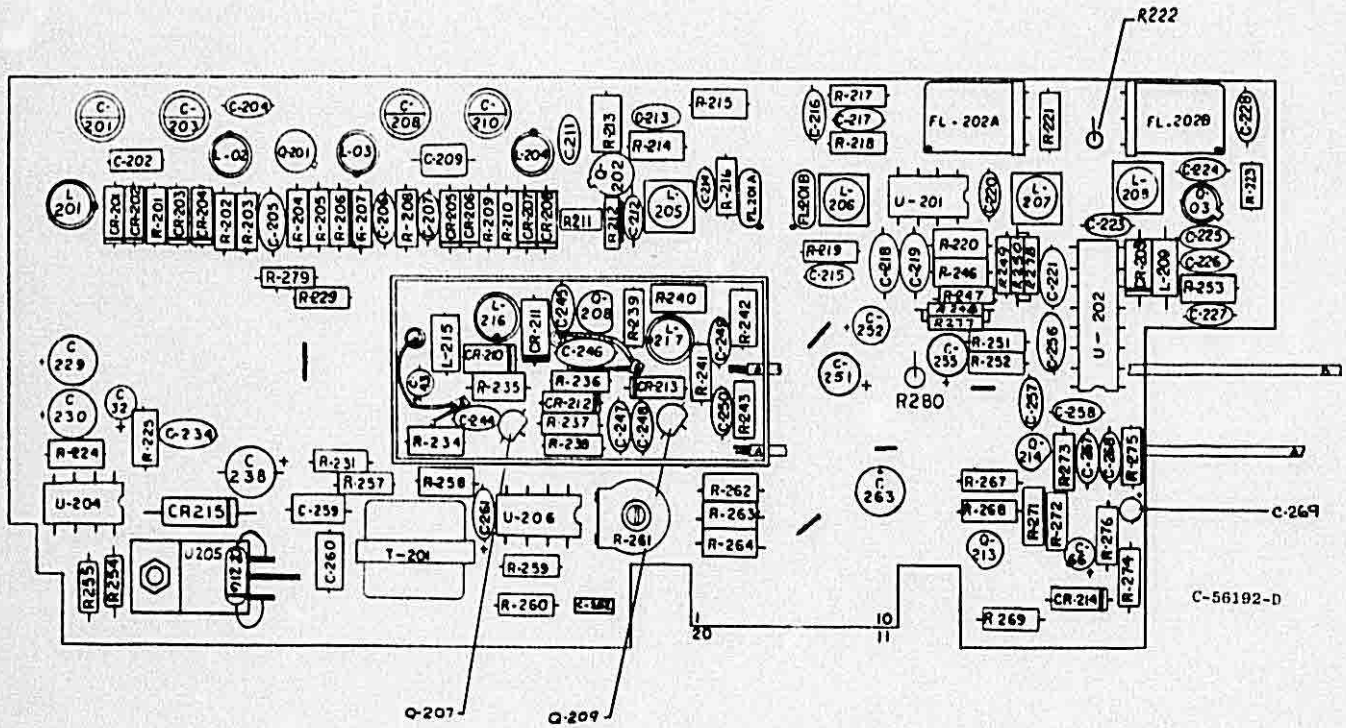


FIGURE 6-8. RECEIVER, NAV 121 AND NAV 122A ONLY (Sheet 2 of 2)
(Chassis Level -- A --(-)

SEE BLOW-UP

This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-3.



NOTE

ALL COMPONENTS ON THIS BOARD ARE 200 SERIES
CR01 = CR201 DIODE R02 = R202 RESISTOR

NOTE: CONTACTS 1 TO 10 ON TOP OF BOARD (COMPONENT SIDE)
CONTACTS 11 TO 20 ON BOTTOM OF BOARD.

FIGURE 6-8A. RECEIVER, NAV 121 AND NAV 122A ONLY (Sheet 1 of 2)
(Chassis Level -- B --(-)

6-26B
(6-26A Blank)

SEE BLOW-UP

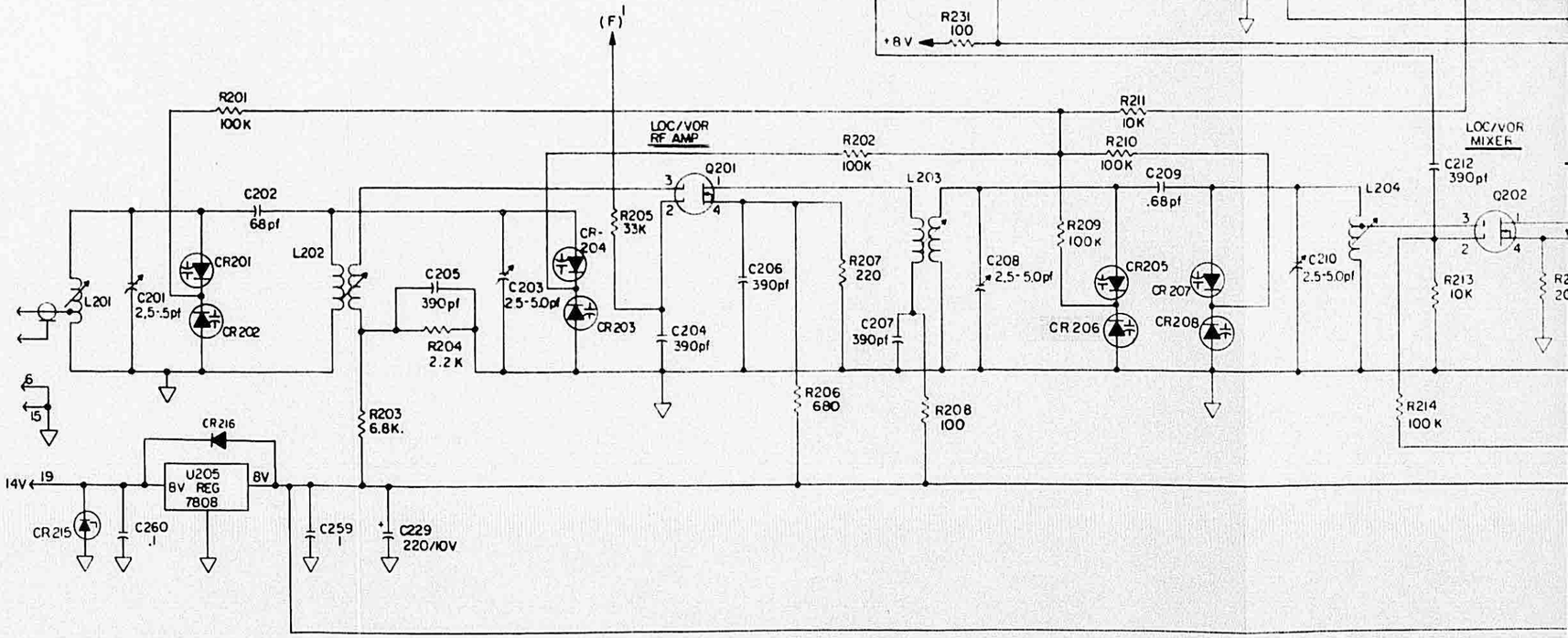
The following list identifies the components of this circuit that were: added, changed, or deleted along with the Chassis Level Code letter assigned for identifying the change.

Refer to appropriate Electrical Parts List for Part numbers and description.

Symbol No.	Action a,c,d	Chassis Level Code Letter
C222	d	C
C258	c	C
CR206	Added symbol number	
R246	c	C
R260	c	C
R261	c	C
R262	c	C
R263	c	C
R264	c	C

"Shaded areas shown on the schematic indicate those points where a change, addition, deletion, or type substitution took place."

NOTES:
1. UNLESS OTHERWISE LABELED ALL CAPACITORS ARE IN MFD, ALL RESISTORS ARE IN OHMS, ± 5%, 1/8W.
2. LETTERS WITHIN( )INDICATE POINTS OF CONNECTION. LETTER INDICATES COMMON CONNECTION. NUMBER INDICATES NUMBER OF OTHER POINTS CONNECTED.
3. * THIS VALUE SELECTED IN REMOTE RECEIVER NAV 124 ONLY.



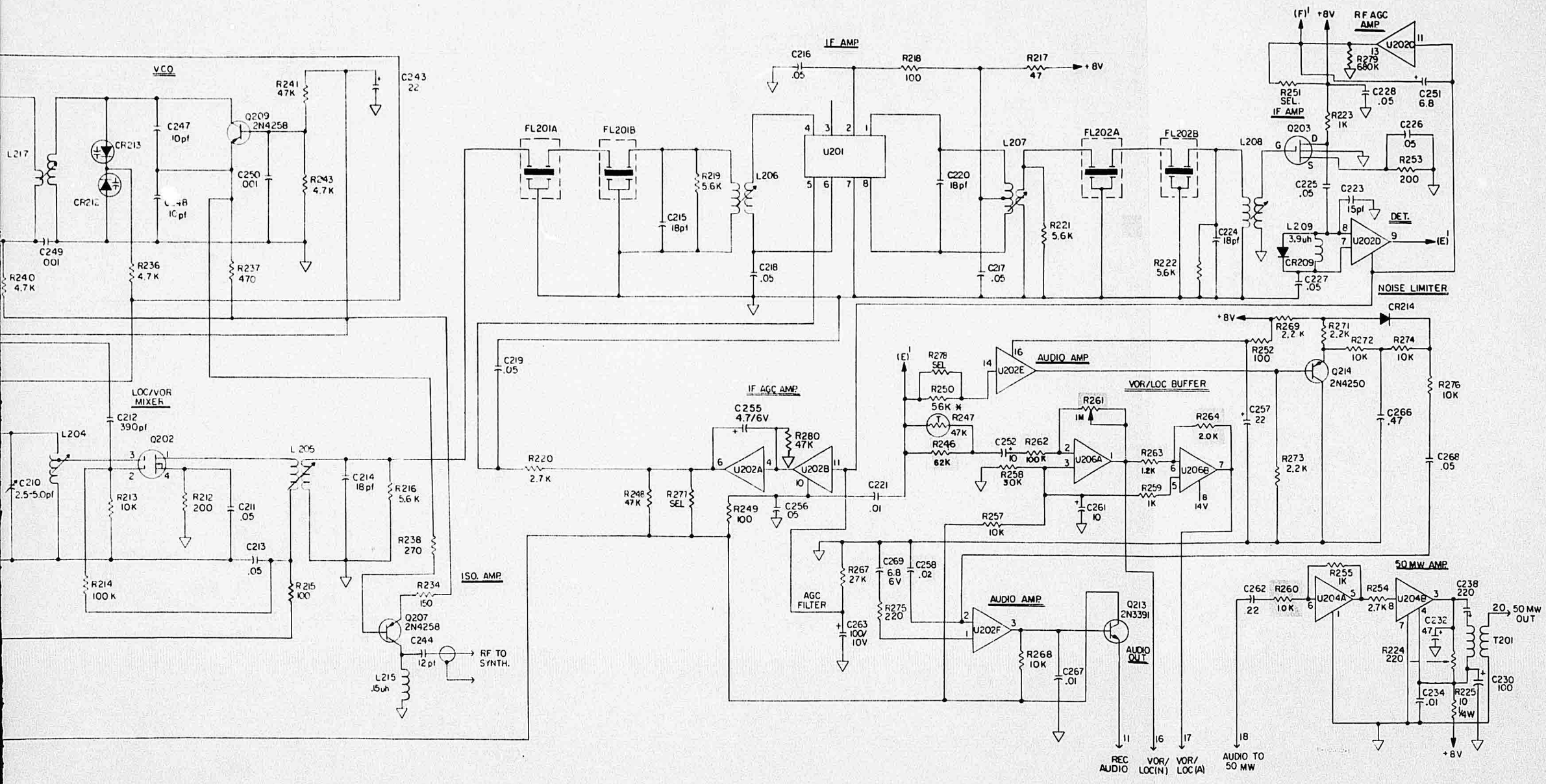


FIGURE 6-8A. RECEIVER, NAV 121 AND 122A ONLY (Sheet 2 of 2)
(Chassis Level -- B --(-)

SEE BLOW-UP

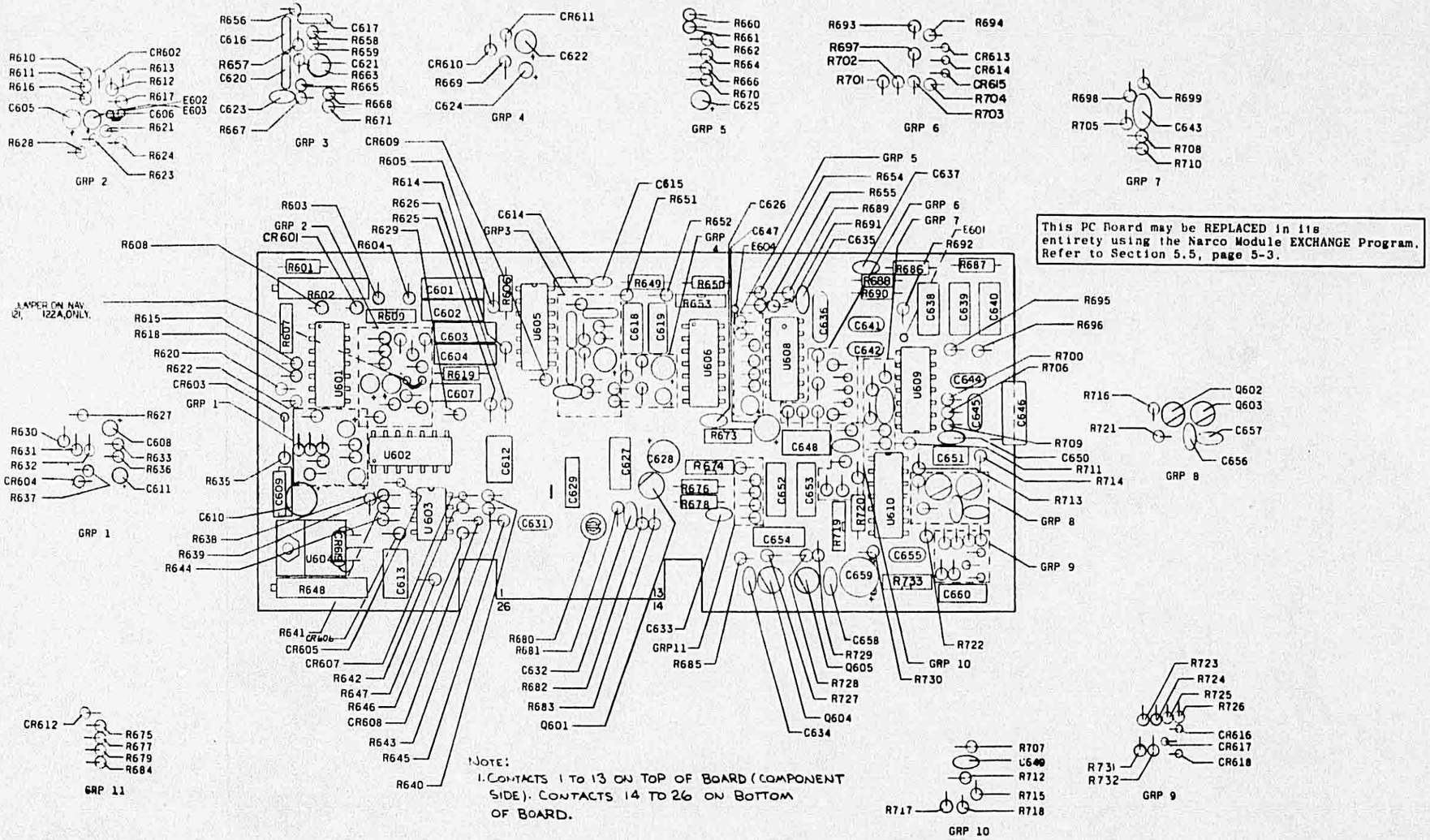
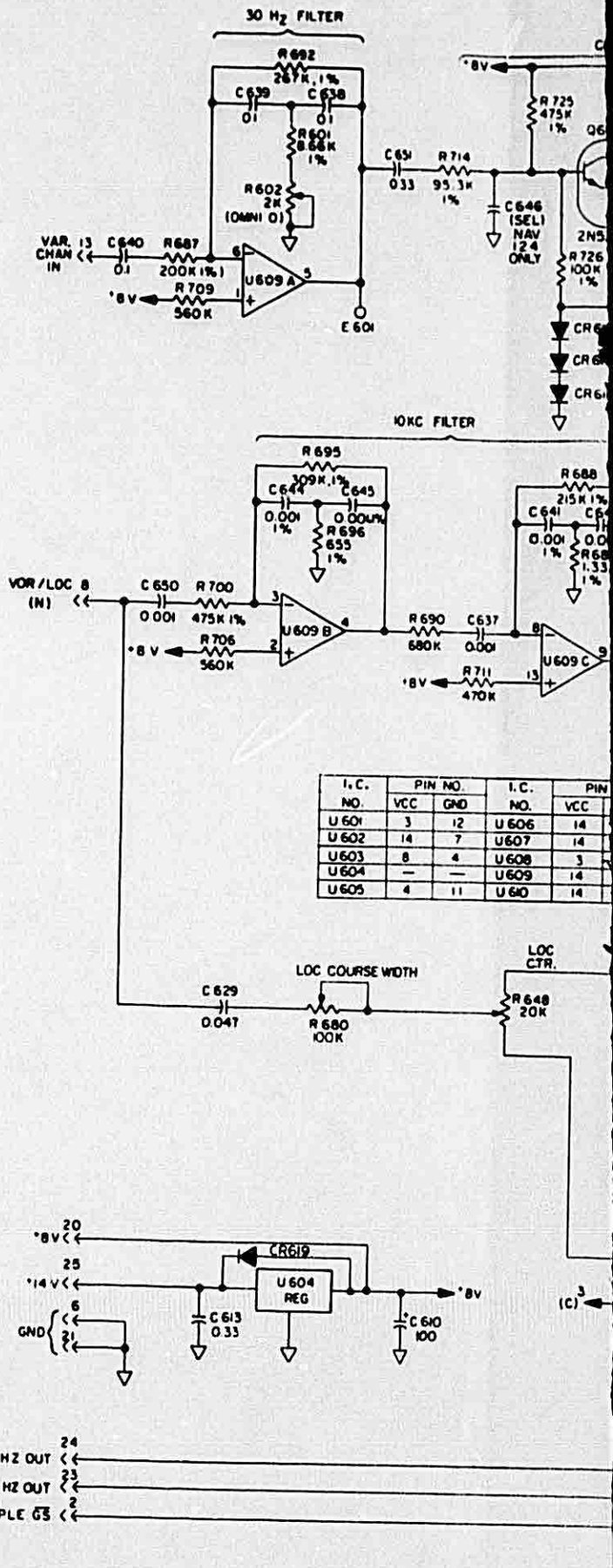


FIGURE 6-9. VOR/LOC NAV 121 AND NAV 122A ONLY (Sheet 1 of 2) C56198A
(Chassis Level ---- A (-)

SEE BLOW-UP


30 Hz FILTER
R692
267K, 1%
C639
.01
C638
.01
R601
8.66K
1%
R602
2K
(OMNI O)
C651
.033
R714
95.3K
1%
C646
(SEL)
NAV
124
ONLY
R725
475K
1%
+8V
VAR. 13
CHAN
IN
C640
.01
R687
200K (1%)
U609 A
R709
560K
+8V
E601
10KC FILTER
R695
309K, 1%
C644
0.001
1%
C645
0.001
1%
R696
655
1%
R688
215K 1%
C641
0.001
1%
VOR/LOC 8
(N)
C650
0.001
R700
475K 1%
U609 B
R706
560K
+8V
R690
680K
C637
0.001
U609 C
R711
470K
+8V
I.C. NO. | PIN NO. VCC | PIN NO. GND | I.C. NO. | PIN VCC
U601 | 3 | 12 | U606 | 14
U602 | 14 | 7 | U607 | 14
U603 | 8 | 4 | U608 | 3
U604 | — | — | U609 | 14
U605 | 4 | 11 | U610 | 14
LOC
CTR.
LOC COURSE WIDTH
C629
0.047
R680
100K
R648
20K
20
+8V
25
+14V
6
GND
21
CR619
U604
REG
C613
.033
+8V
C610
100
3
(C)
24
150 HZ OUT
23
90 HZ OUT
2
SAMPLE GS

SEE BLOW-UP

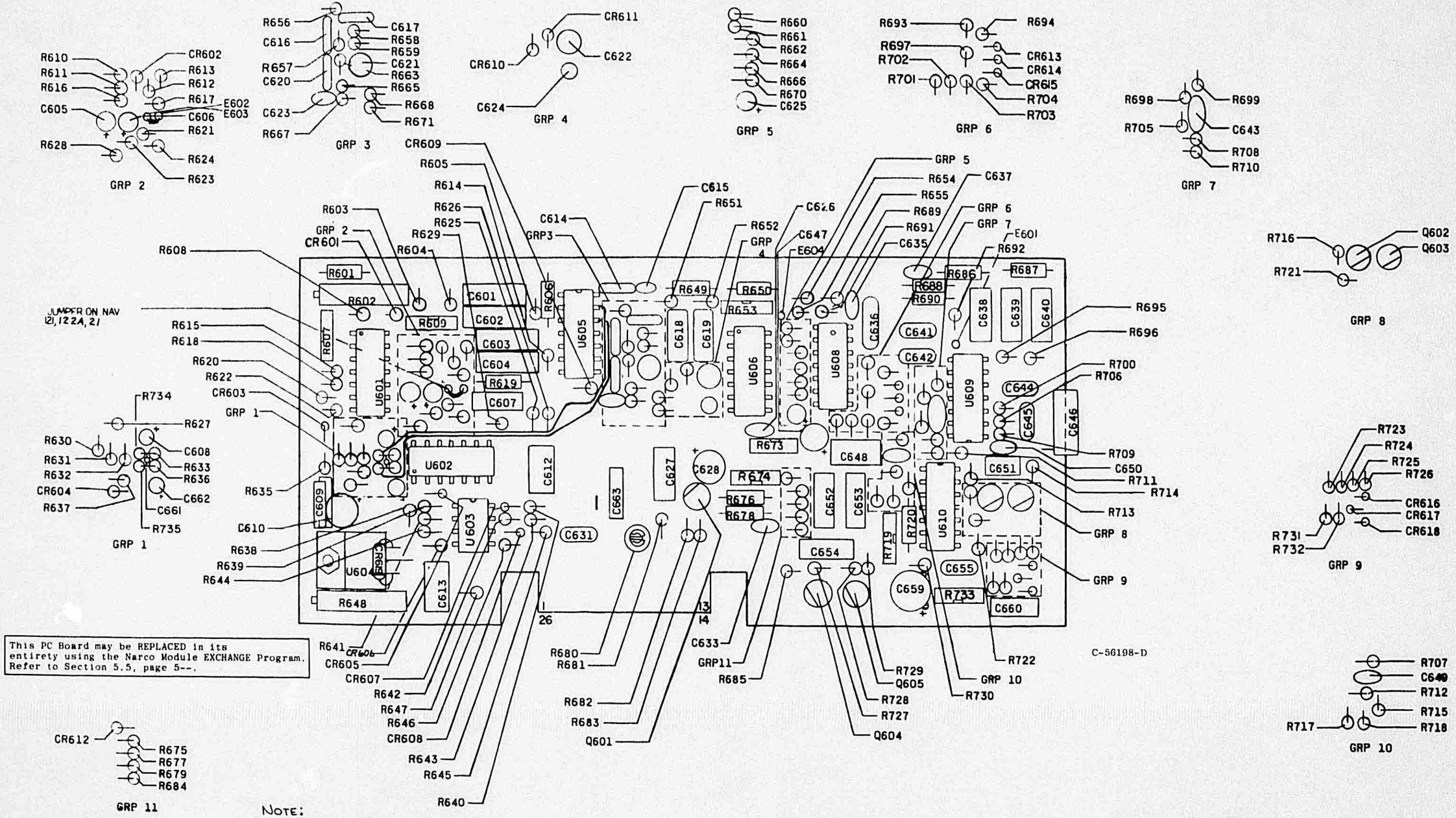
I.C. NO.	PIN NO. VCC	PIN NO. GND	I.C. NO.	PIN NO. VCC	PIN NO. GND
U601	3	12	U606	14	7
U602	14	7	U607	14	7
U603	8	4	U608	3	12
U604	—	—	U609	14	7
U605	4	11	U610	14	7

RESISTOR VALUES	
R665	12.4K 1%
R667	12.4K 1%
R658	12.4K 1%
R659	12.4K 1%
R656	402K 1%
R651	402K 1%
R633	35.7K 1%
R636	35.7K 1%

NOTES:
1) UNLESS OTHERWISE NOTED:
ALL RESISTANCE IS IN OHMS ± 5%, 1/4W
ALL CAPACITANCE IS IN MICRO FARADS
2) (C)[3] DENOTES POINTS OF CONNECTION. LETTER INDICATES COMMON CONNECTION, DIGIT INDICATES NUMBER OF OTHER POINTS CONNECTED.
3) R803, NAV 121, 122A ONLY.
4) * THESE VALUES ON RADIOS MARKED WITH A ^ ONLY

FIGURE 6-9. VOR/LOC NAV 121 AND NAV 122A ONLY (Sheet 2 of 2)
(Chassis Level ---- A (-)

SEE BLOW-UP



NOTE:

1. CONTACTS 1 TO 13 ON TOP OF BOARD (COMPONENT SIDE). CONTACTS 14 TO 26 ON BOTTOM OF BOARD.
2. COMPONENT HEIGHT NOT TO EXCEED 0.5 WCH.
3. C646 USED ON NAV 122A

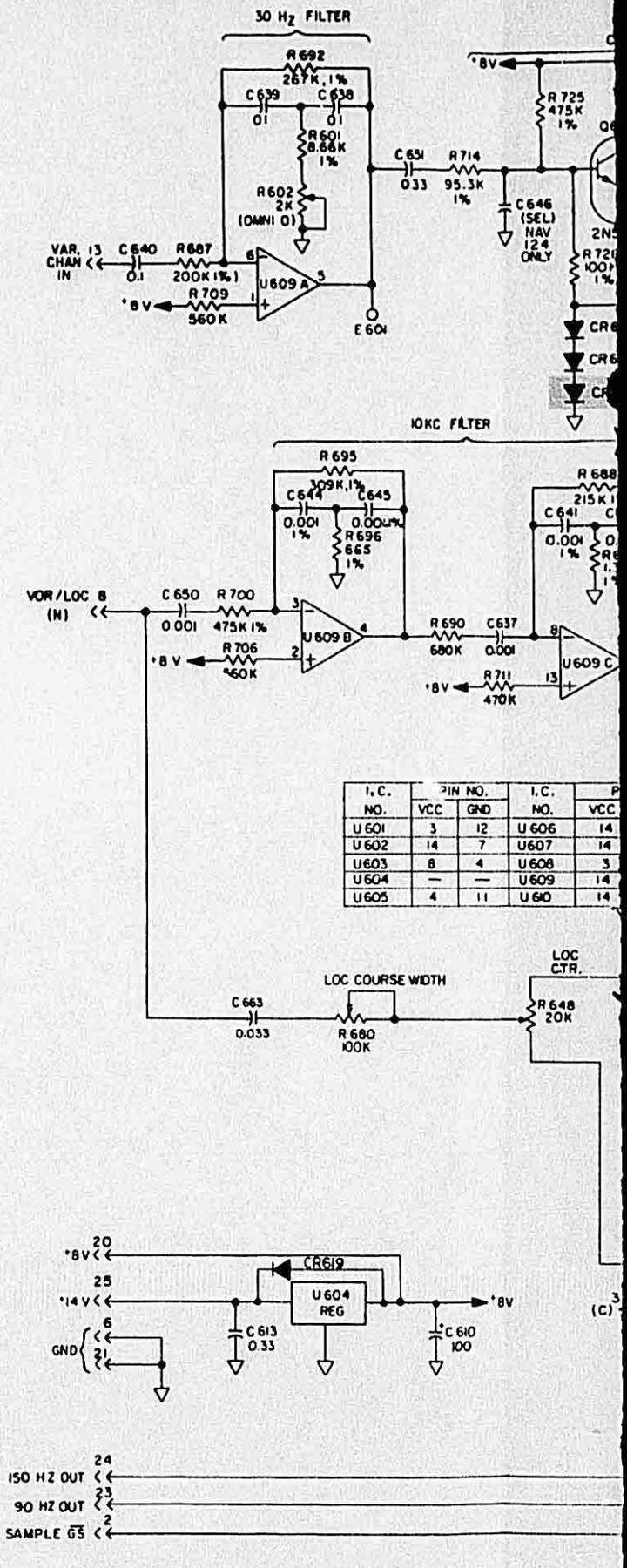
FIGURE 6-9A. VOR/LOC NAV 121 AND NAV 122A ONLY (Component Assy) (Sheet 1 of 2) (Chassis Level ---- E (-)

The following list identifies the components of this circuit that were: added, changed, or deleted along with the Chassis Level Code letter assigned for identifying the change.

Refer to appropriate Electrical Parts List for Part numbers and description.

Symbol No.	Action a,c,d	Chassis Level Code Letter
C622	c	E
C631	c	C
C661	a	E
C662	a	E
C663	a	
CR618	a	B2
R618	c	D1
R626	c	C1
R633	c	E1
R636	c	E
R647	c	C
R651	c	E
R656	c	E
R658	c	E
R659	c	E
R665	c	E
R667	c	E
R710	c	D1
R722	c	A1
R733	c	A1
R734	a	E
R735	a	E

"Shaded areas shown on the schematic indicate those points where a change, addition, deletion, or type substitution took place."



I.C. NO.	PIN NO. VCC	PIN NO. GND	I.C. NO.	PIN NO. VCC	PIN NO. GND
U601	3	12	U606	14	7
U602	14	7	U607	14	7
U603	8	4	U608	3	12
U604	—	—	U609	14	7
U605	4	11	U610	14	7

RESISTOR VALUES	
R665	12.4K 1%
R667	12.4K 1%
R658	12.4K 1%
R659	12.4K 1%
R656	402K 1%
R651	402K 1%
R633	35.7K 1%
R636	35.7K 1%

NOTES:
1) UNLESS OTHERWISE NOTED:
ALL RESISTANCE IS IN OHMS ± 5%, 1/4W
ALL CAPACITANCE IS IN MICRO FARADS
2) (C)[3] DENOTES POINTS OF CONNECTION. LETTER INDICATES COMMON CONNECTION. DIGIT INDICATES NUMBER OF OTHER POINTS CONNECTED.
3) R803, NAV 121, 122, 122A ONLY.
4) * THESE VALUES ON RADIOS MARKED WITH A "G" ONLY

FIGURE 6-9A. VOR/LOC NAV 121 AND NAV 122A ONLY (Schematic)
(Sheet 2 of 2) (Chassis Level ---- E (-)

R-02531-D

SEE BLOW-UP

SEE BLOW-UP

VOR/LOC NAV 121/122A

MODIFICATIONS INSTRUCTIONS: 03723-0670
Modification Kit: 03723-0505
Products Affected: NAV 121, NAV 122, and NAV 122A

I. PURPOSE: The following modification procedure is provided to eliminate possible azimuth card slippage allowing misalignment between the card and the OBS course potentiometer. The problem will appear to the pilot as a constant VOR error around the azimuth card. Since card slippage is temperature dependent, the problem may be difficult to duplicate within the Service Shop.

II. TOOLS REQUIRED:

1. Screwdrivers, Phillips and straight slot.
2. Allen wrench, No. 2 and No. 4
3. Anaerobic screw locking liquid and primer (Loctite brand or equivalent)*
4. Inside vernier calipers or automotive type ignition feeler guage with one or more blades yielding a total thickness between 0.075" (1.9mm) and 0.80" (2.03mm) and a blade width of 1/2" (12.7mm) or less.
5. Ohmmeter
6. VOR Signal Generator, IFR NAV 750 or equivalent
7. Bench Test Harness for NAV unit.

III. PROCEDURES:

Four Procedures (A through D) detail the modifications to the unit. All units will require Procedure A with only a few requiring further modification. Of those requiring further work, all will require Procedures B and D, and a small fraction of these units will require Procedure C. Tests are located within the Procedures to indicate the amount of modification required to each unit before it can be returned to service.

A. Card Guide Replacement

This procedure replaces the original Card Guide with a new, floating, spring loaded Card Guide. In addition, the position of the OBS Driver Gear is determined. If the Gear is properly positioned, the unit may be tested and returned to service. If the Gear is incorrectly located, it is likely that the Azimuth Card has been forced from its Guides, and Procedure B will need to be performed.

* aerobic screw locking liquids, such as Glyptal, may <u>not</u> be substituted.

A. Card Guide Replacement (continued)

1. Loosen unit's case:

   a. Remove two slotted, binding head, No. 4 screws and washers securing the case to the unit's rear plate.
   b. Remove four No. 2 slotted, flat head screws located around the periphery of the case, directly behind the bezel.
   c. Pull case to rear approximately 1" to expose card guide.

2. Refer to Figure 1 and locate the Card Guide. From the unit, remove the two screws securing the Guide to the Front Casting, taking care not to disturb Azimuth Card engagement with OBS Driver Gear, and discard the Guide. Save one of the screws for reassembly (step 7).

3. Using screw locking primer, carefully clean the Casting's card guide mounting holes, the No. 2 Setscrew supplied in this Kit, and the screw to be used for reassembly. Remove excess primer and allow parts to dry.

4. Place a drop of screw locking liquid in the Casting's card guide mounting holes.

5. Place the Eyelet into the replacement Card Guide's lower mounting hole.

6. Position the Card Guide on the Casting such that the edge of the Azimuth card is within the groove on the Guide.

7. Install the Spring and Screw as shown in Figure 1 and tighten.

8. Thread the No. 2 Setscrew into the Casting, through the Guide's upper mounting hole, until the Setscrew is flush with the Card Guide.

9. Carefully measure the gap between the rear surface of the OBS Driver Gear and the Front Casting (refer to Figure 2) with tool from step II number 4: gap should not be less than 0.07" (1.78mm) and may not exceed 0.08" (2.03 mm).

   If gap is greater than 0.08", the Azimuth Card may have been forced out of a Small Card Guide (Figure 1, item 112); therefore, advance to Procedure B.

   If gap is less than 0.07", the unit may be locked in the self test mode. Perform step B9 and if an open circuit is indicated, test the unit as directed on page 3. If a short circuit is indicated, perform steps 1, 2, 3, 4, and 9 in Procedure B.

   If gap is within specifications, bench test the unit to check VOR accuracy. Refer to Section 2.2.2 of the unit's Maintenance Manual.

A. Card Guide Replacement (continued)

Small errors may be removed by adjusting the VOR Zero Set potentiometer; however, the VOR Self Test potentiometer (R733 in Figure 4) will also require adjustment. After calibration install unit in its case, place the Modification Dot on the rear of the case in the area shown in Figure 3, and return unit to service.

Larger VOR errors may indicate that the Card has slipped or that a component has failed. Refer to the unit's Maintenance Manual for trouble shooting procedures. If the error is due to Card slippage, advance to Procedure B.

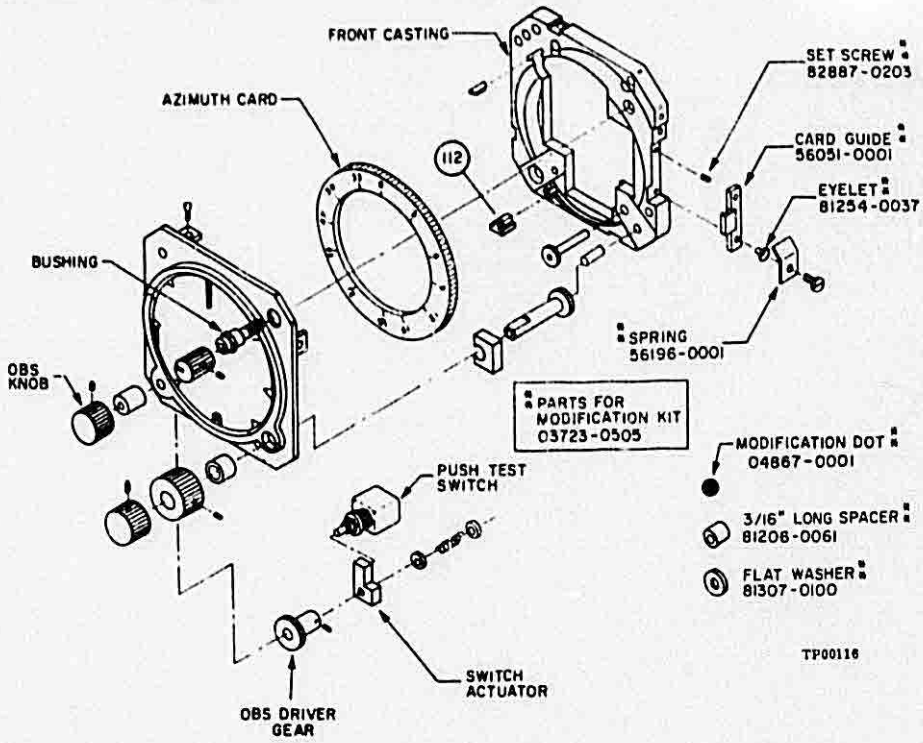


Figure 1. Exploded View, Partial

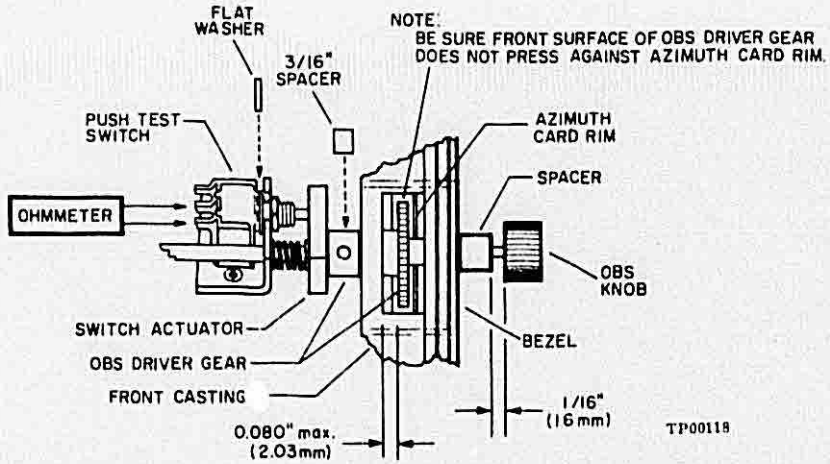


Figure 2. Critical Dimensions

B. Reseat Azimuth Card

This procedure properly positions the OBS Driver Gear, reseats the Azimuth Card within its Guides, and checks to be sure that the Push Test Switch was not actuated when the Driver Gear was positioned.

1. Rotate OBS Knob until the two setscrews in the OBS Driver Gear are accessible. Channel unit to a VOR frequency.

2. Slightly depress the OBS Knob and allow the 3/16" Spacer to be clamped between the Switch Actuator and the Front Casting as shown in Figure 2.

3. Use a No. 4 Allen wrench to loosen the two OBS Driver Gear setscrews.

4. Grasp OBS Knob and pull forward (to be sure OBS shaft is properly positioned) then, while pulling forward on the Knob, push the OBS Driver Gear back against the Switch Actuator and tighten one of the Driver Gear setscrews.

5. From the front of the unit remove: the rubber "O" ring, four knobs, two spacers, and a bushing; a No. 4 Allen wrench will be necessary. Securely install the OBS Knob without the black spacer.

6. Remove four Phillips head screws securing the Bezel to the Front Casting and slide the Bezel forward against the OBS Knob.

7. To push the Card back into the small card guide, slip a finger between the Bezel and Front Casting in the area to the right of the OBS Driver Gear (near the small card guide, item 112). Apply light pressure to the Azimuth Card while slowly turning the OBS Knob.

8. Slide the Bezel back against the Casting and install the four Phillips head screws.

9. Connect an ohmmeter across the Push Test Switch (refer to Figure 2). If ohmmeter indicates an open circuit, correct operation, advance to Procedure D. A short circuit indicates actuation of the switch and a Washer must be added as detailed in Procedure C.

C. Push Test Switch Washer

This procedure adds one or two washers between the Push Test Switch and its mounting bracket to eliminate actuation of the Switch with the OBS Knob in its normal position.

1. Chip the Glyptal from the Switch bushing and nut.

2. Remove nut and pull switch from mounting bracket.

3. Remove any remaining Glyptal from Switch and bracket.

4. From the Kit, take the Flat Washer and place it over the Switch bushing.

5. Place the Switch in its mounting bracket, with the Flat Washer between Switch and bracket, and tighten the nut.

6. Perform ohmmeter measurement (step B9) again and, if necessary, install a second Flat Washer. Apply Glyptal or equivalent to nut before proceeding to Procedure D.

D. Synchronization of Azimuth Card And OBS Potentiometer

This procedure synchronizes the Azimuth Card and OBS potentiometer, adjusts VOR and Self Test accuracy, and prepares the unit for return to service.

1. Loosen the OBS Driver Gear setscrew - check that the Spacer remains clamped between the Switch Actuator and Front Casting.

2. Remove unit from case. Connect unit to bench harness, apply power, and turn unit ON.

3. Set VOR generator to the same VOR channel as unit and VOR generator bearing (TO) to that shown on unit's Azimuth Card. Set generator tc 500 uV, standard composite modulation.

4. To synchronize Azimuth Card and OBS Potentiometer:

   a. Rotate OBS Knob until unit's deviation indicator centers with a TO flag.

   b. Insert Zero Set Tool into OFF-VOL-PULL IDENT shaft and turn tool CW until deviation indicator stops moving to the left - if indicator moves against meter stop, turn OBS Knob CCW.

   c. Turn OBS Knob CW to place deviation indicator over 5th. dot (left).

   d. Turn Zero Set Tool CCW to center deviation indicator.

   e. Pull forward on OBS Knob to check for proper shaft position.

D. Synchronization of Azimuth Card And OBS Potentiometer (continued)

5. While holding OBS Driver Gear against Switch Actuator, tighten both Driver Gear setscrews - be careful not to turn Driver Gear as setscrews are tightened. Remove and discard 3/16" Spacer.

6. Check VOR accuracy at cardinal points and adjust Zero Set potentiometer to split errors.

7. To adjust Self Test:

   a. Rotate OBS Knob to place 0^{o} beneath the yellow selected bearing index.

   b. Depress the OBS Knob and if necessary adjust R733 (refer to Figure 4) to center the deviation indicator: a TO flag must show. NAV 122 and 122A - three MKR lamps must light when Knob is depressed and extinguish when Knob is released.

8. Install the "O" ring, bushing, spacers, and knobs. Refer to Figure 2 for correct spacing of OBS Knob.

9. Install unit in its case.

10. Place Modification Dot on rear of case in area shown in Figure 3. Return unit to service.

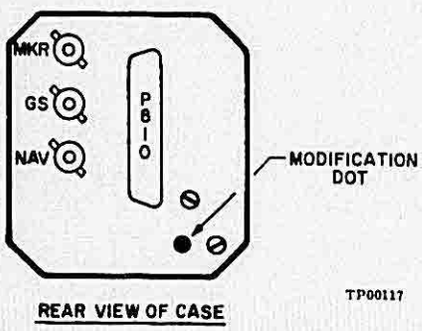


Figure 3. Dot Location

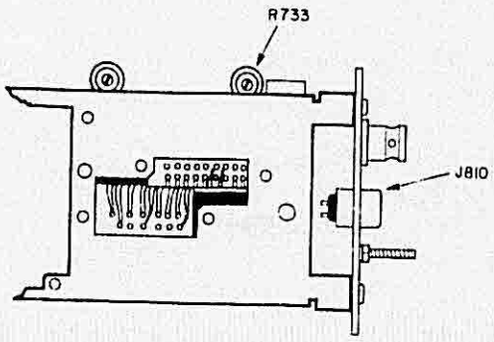


Figure 4. Bottom View

2.3 MECHANICAL INSTALLATION

The NAV 121, 122, and 122A are intended to be instrument panel mounted. When mounted from behind the panel, two screws (6-32 x 7/16) and the NAV's VOL-IDENT bushing secure the Unit (see Figure 2-3). Mounting through the front of the panel requires the use of a Marman Clamp, see Figure 2-5. In either case, rear support should be supplied using the stud extending from the rear of the Unit.

Connector P810 incorporates a "slide lock" mechanism. Before installing the connector, move the slide to position the slide's longer tab away from the connector, mate J810 and P810, then push slide to lock connector to NAV Unit. To remove P810 from the NAV Receiver, by feel, determine which end of the slide extends beyond the connector body, press this end toward the connector until it is flush, then remove the connector.

BNC connectors are located on the rear of the NAV Receiver. When attaching antenna cables, refer to Figure 2-3 for connector identification.

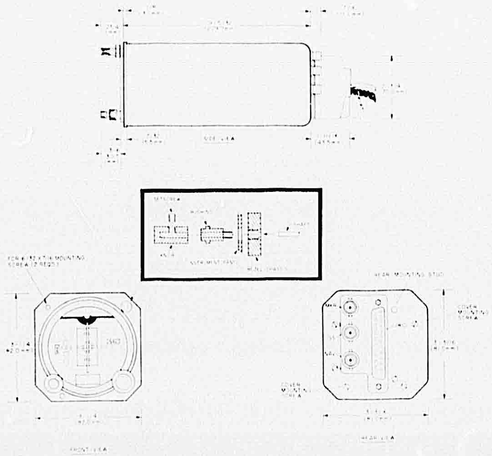


FIGURE 2-3. MECHANICAL INSTALLATION

2.4.2 Continued

P810 is assembled as shown in Figure 2-8. While constructing the cable, be sure to pass wires through the hood before inserting pins into the connector.

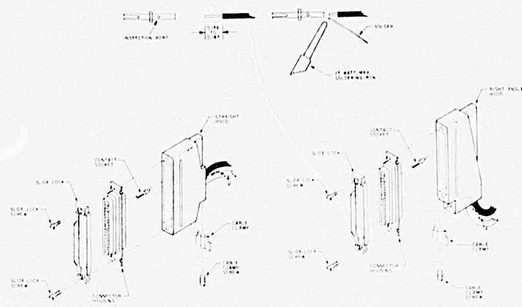


FIGURE 2-8. P810 ASSEMBLY

Connector Assembly Procedure (Solder)

Note: Crimping tools are available from ITT Cannon, if desired.

1. Strip wire as shown in Figure 2-8. Maximum wire size is No. 20AWG.
2. Tin exposed lead. Be sure no individual wire strands are free to cause shorts when connector is assembled.
3. Insert lead into connector pin until lead is visible at inspection port.
4. Heat pin and apply solder as shown until solder wicks into pin cavity and becomes visible through inspection port. Be careful not to overheat pin or melt insulation on wire.
5. Pass pin through hood and insert pin in connector until a "click" is heard or felt; exert a slight pull on the wire to assure pin seating.
6. During final assembly:
   a. Inspect all wires for individual strands of wire shorting to adjacent terminals.
   b. Ease hood into place, do not force.

Connector P810 incorporates a "slide lock" mechanism. Before installing the connector, move the slide to position the slide's longer tab away from the connector, mate J810 and P810, then push slide to lock connector to NAV Unit. To remove P810 from the NAV Receiver, by feel, determine which end of the slide extends beyond the connector body, press this end toward the connector until it is flush, then remove the connector.

3.2.3.4 10 kHz Filters

The VOR/LOC (X) signal from pin 8 is applied to two stage bridged T 10 kHz bandpass filter, U609B and U609C as shown in Figure 3-11. The first section (U609B) is tuned to 10.9 kHz and the second section (U609C) to 9.2 kHz. The no-signal output from both stages is set for 4 volts.

3.2.3.5 FM Limiter

The FM limiter shown in Figure 3-11 comprises operational amplifier U610C, RC coupled into voltage comparator U610B. The U610C dc gain is set by feed back resistors R731 and R732; their resistance is equal to that of R705, the dc resistance in the non-inverting input. The gain at 10 kHz is high since C660 is a short circuit to the high frequency feedback component. In addition, the low impedance of U608/C642 at high frequencies also increases the 10 kHz gain without affecting the dc bias at U610C-9.

The second stage limiter is a voltage comparator. The positive dc bias of both inputs is set at 4 volts by voltage divider R701/R702. Signal to the inverting input (pin 8) is coupled through C649. C648 is a bypass to ground for any noise at the non-inverting input (pin 9). An input of approximately 30 mv will drive this high gain comparator to its full swing.

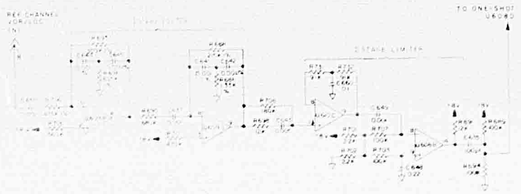


FIGURE 3-11. VOR/LOC REFERENCE CHANNEL FILTER AND LIMITER

3.2.3.6 One-Shot FM Detector (Figure 3-12)

The limiter output is differentiated by C635, R689 and R691 to form short duration pulses at the inverting input of U610-D-10. Diodes CR613, CR614 and CR615 prevent either input from going negative but do not otherwise enter into the one-shot operation. The two input dividers (R689, R691 and R697, R695) establish a bias at pin 11 that is low than that at pin 10; consequently the output at pin 13 is low. When a negative pulse appears at pin 10, the output (pin 13) goes high. This positive pulse is coupled back to pin 11 through C636, which holds the output high for a short period following the trigger signal. The output stays high until C636 charging thorugh R651, resets the one-shot. The input pulse is short; the leading edge of the differentiated input is the leading edge of the pulse output, whose pulse width is determined by the time constant of R651-C636.

With the VOR 9960 Hz FM signal, the one-shot produces a pulse train whose pulse widths are constant but whose spacing between pulses varies in accordance with the frequency (FM) of modulation. The average value of this pulse train is the recovered 30 Hz modulation. Filter R606/C627 averages out the pulses and a 30 Hz signal (approximately 20 mv) appears across C627; a low amplitude 9960 Hz ripple is present on this 30 Hz signal.

3.2.3.7 Phase Splitter

Phase splitter Q601, shown in Figure 3-12 produces two signals precisely equal in amplitude and having 180 degrees phase difference. The Q601 base is biased by the combined action of the dc component (average value) of C627 plus the positive level from R689.

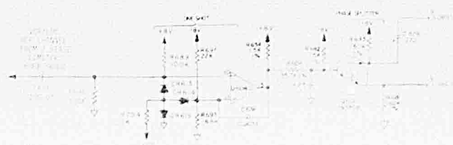


FIGURE 3-12. VOR/LOC REFERENCE CHANNEL PULSE GENERATOR AND PHASE SPLITTER

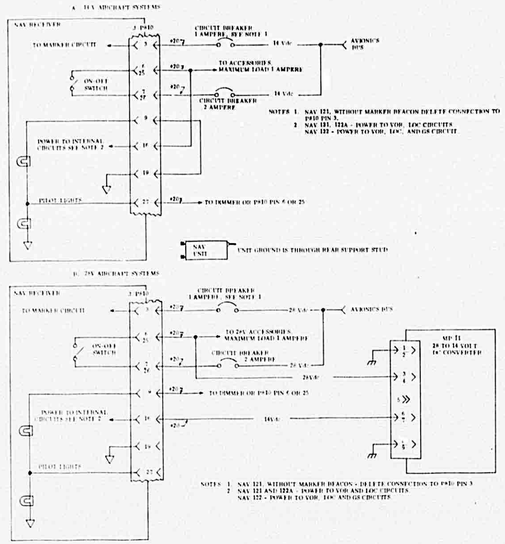


FIGURE 2-9. POWER INPUT CONNECTIONS

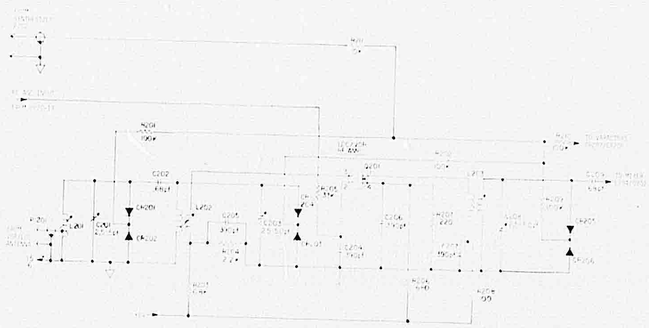


FIGURE 3-3. VOR/LOC RF AMPLIFIER

3.2.3.8 OBS Circuitry

3.2.3.8.1 Overall Operation

The OBS circuit is fed from the phase splitter outputs. Since the emitter and collector of Q601 are at different dc potentials, C628 serves to isolate the collector dc from the OBS control; the Q605 and Q694 dc bias remains constant as the OBS control would cause erroneous readings until the capacitor in the following circuits charged up to the new dc value.

The outputs from the OBS control are applied to Q601 and Q605, the OB Phase summer, to prevent loading (See Figure 3-13). The Q601 and Q605 outputs are combined through C654, R728, R719, and R729 to form an output whose amplitude is constant but whose phase phase varies with the position of the OBS control.

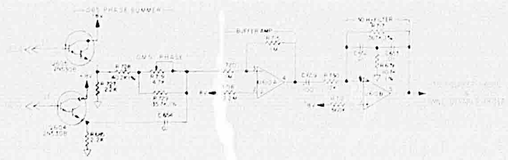


FIGURE 3-13. OBS PHASE SUMMING AND 30 Hz FILTER

3.2.3.8.2 OBS Control (Front Panel)

The OBS control is connected to a sin-cos potentiometer with two wipers connected to the OBS control. The position of these wipers is determined by the setting of the OBS control, which is calibrated from 0° to 360°. Rotating this control adds or subtracts the number of degrees phase shift to the basic reference phase.

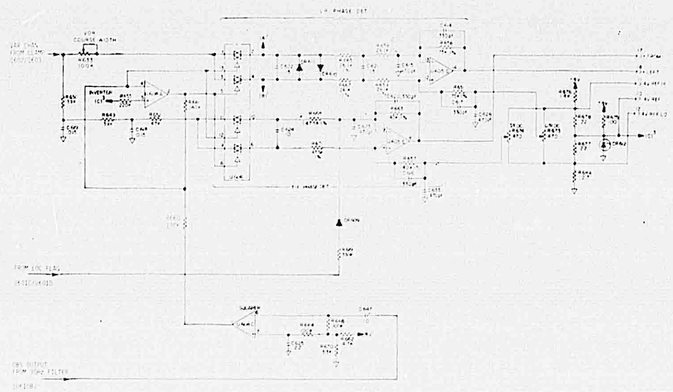


FIGURE 3-14. PHASE DETECTOR, L-R/T-F

3.2.3.7 AM Channel Filter

The variable channel input signal is applied through C640 and R687 to a 30 Hz bridged-T bandpass filter (Figure 3-10). The filter tuning is determined by R692, C639, C638, R691 and R692. Variable resistance R692 has a slight control of the filter center frequency and can be used as an omni zero adjustment. Since U609A pin 6 looks like a low impedance, the filter tuning is not affected by R687/C640. These components cause a small phase shift and attenuate any low frequency signals present at the input. With no input, R709 provides dc bias current to set the output (pin 5) at approximately 4 vdc.

3.2.3.8 AM Channel Clamp

The AM clamp shown in Figure 3-10 controls the amplitude of the 30 Hz AM signal applied to the phase detector (L-R or T-F). As the 30 Hz AM signal varies due to changes of rf input to the receiver, the limiter holds the signal amplitude constant. The 30 Hz filter output is applied through R714 and C651 to the AM limiter. For very very low amplitude 30 Hz input signals, Q603/Q602 acts as a differential amplifier.

As the input signal increases, on the negative half of the cycle, Q602 is cut off; on the positive half of the cycle, Q602 is cut off. Any further increase of input amplitude results in very little change in the limiter output.

Voltage divider R725/R726, R723/R724 and CR616 through CR618 provides approximately 1.5 volts at CR616 anode; Q602 and Q603 are then biased at approximately +2.5 vdc. This causes the collector of Q602 to be approximately 6.0 volts. When Q603 is cut off, Q602 collector goes to 4.0volts. When Q603 is on and Q602 cut off, the collector voltage is +7.5 volts. As described above, the transistors do not saturate.

The limiter output shape is modified by the loading effect of R650 and C619. This network has no effect upon the phase of the signal.

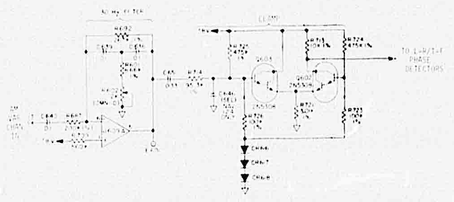


FIGURE 3-10. AM VARIABLE CHANNEL FILTER AND CLAMP

3.2.3.12 Self-Test Circuit

Self-test amplifier U610D, shown in Figure 3-15, which is activated by pressing the front panel OBS control knob. When an omni signal is being received, the 30 Hz FM reference signal is amplified by U610D. Activating the switch connects this self test signal (pin 14) to the AM variable channel input (pin 13). Adjustment of the OBS control to zero(0) should null the L-R indicator. The self-test zero control (R733) shifts the phase for this null condition at 0°.

FIGURE 3-15. SELF TEST AMPLIFIER

3.2.3.13 FM Channel Squelch (Omni Disable)

The squelch shuts off the phase detector when a useable FM VOR signal is not present. At low signal levels, the amplitude of the 30 Hz recovered FM signal decreases and the increased noise causes erratic action of the indicator needle.

The omni disable circuit comprises two comparators, U601A and U601B as shown in Figure 3-16. U601A is connected as an active rectifier with CR603 preventing the output from going positive and C608 added to prevent oscillation. When the output swings negative, CR605 is turned off and the voltage at CR604/R630 junction follows the input variations with a gain approximately equal to R630/(R627 + R607). The average value of this waveform is developed across C608.

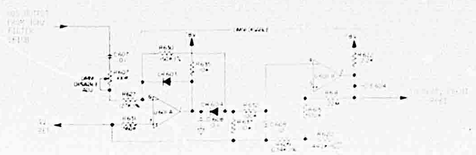


FIGURE 3-16. OMNI DISABLE CIRCUIT

3.3.3.13 Continued

This voltage is fed to comparator U601B. When its level is below that at U601B pin 5, the squarer (U606C) and inverter (U605A) go low, thus opening all switches in U606. This disconnects the L-R/T-F phase detectors from the input signal, driving the L-R/T-F meters to a center position. When there is sufficient FM channel signal, the high output from comparator U601B then supplies voltage to the squaring and inverting circuits, resulting in normal phase detector operation.

3.3.3.14 LOC/GS Operation (Figure 3-17)

The 90 Hz signal from S1 is applied through R630 and R631. The 150 Hz signal from S1 is applied through R632 and R633. The resistor-inverting amplifier U602A provides a 180° phase shift for the 90 Hz signal. The 90 Hz and 150 Hz signals are applied to filter outputs are of opposite polarity. The 90 Hz signal is applied to filter output pin 7 through R634, and the 150 Hz signal is applied to filter output pin 1 through R635. Resistors R634 and R635 are equal in value, as are resistors R636 and R637. Consequently, the value of R634 and R635 determines the gain of U602. which reduces the 90 Hz signal presence in the 150 Hz output.

The output of each rectifier is applied to C611 through R639 and R642. The voltage across C611 is proportional to the difference in amplitudes from the two filter/rectifier circuits. The difference voltage is applied to the L-R phase detector through R633, R636. The L-R phase detector amplifier (U605B) provides gain to this signal, which drives the front panel L-R indicator.

FIGURE 3-17. VOR/LOC REFERENCE CHANNEL 90/150 Hz FILTERS

3.3.6.4 SAMPLE GS Control of GS Displays

During the GS period of the 15 Hz time-sharing cycle, the SAMPLE GS output from NOR gate U505A-11 turns on the 90/150 Hz data to the UP/DOWN and GS flag drivers. The SAMPLE GS (waveform F of Figure 3-31) is a positive-going pulse that turns on quad bi-directional switch U501. The quad bi-directional switch operation is described in paragraph 3.3.4.1. When conducting, this 4-pole switch connects 90 and 150 Hz to the GS flag driver and the same 90 and 150 Hz to the UP/DOWN display driver (Figure 3-38).

3.3.6.5 UP/DOWN Driver (Figure 3-38)

During the GS sample interval, the 90 and 150 Hz inputs (90 Hz for DOWN or 150 Hz for UP) are fed through bi-directional switch U501 to C510. The voltage across C510 is dependent upon the amount of 90 and 150 Hz present in the received signal. This voltage is sensed by differential amplifier U501D, whose output drives the UP-DOWN meter. Resistor R501 serves to correct the dc offset of U510D and null the UP-DOWN meter. When the amount of 90 Hz in the GS signal increases, pin 1 of U501D is driven below its reference and the GS meter deflects down. An increase in the 150 Hz level at pin 1 of U501D drives U501D above its reference and the GS meter deflects up.

FIGURE 3-38. UP-DOWN/FLAG DRIVERS

FIGURE 3-18. GS/LOC CONTROL OF 90/150 Hz RECTIFIER OUTPUTS

FIGURE 4-3. CARD EXTENDER ASSEMBLIES, 20 and 26 pin

3.2.1.1 Phase Locked Loop (PLL)

The phase locked loop comprises a VCO (located on the receiver board), a programmable N counter, a frequency phase detector, a loop filter and a reference frequency chain. The channel selection is performed by the front panel MHz and kHz knobs on the control head. Although the front panel frequency encoding switches (S101, S102) are located on the control head and not the synthesizer board, their function is included in the frequency encoder decoder description.

3.2.1.1.1 Reference Oscillator

The reference oscillator shown in Figure 3-21 comprises a 3.2 MHz crystal controlled oscillator (U315A, B), buffer (U315C), ÷64 counter (U319), and a 50 kHz pulse shaper buffer (U315D). The basic oscillator is two inverters connected in series. In-phase feedback through variable capacitor C316 and crystal Y301 sustains oscillation at the crystal frequency. Varying the feedback through C316 permits a small adjustment of the oscillator frequency.

FIGURE 3-21. REFERENCE OSCILLATOR

3.2.1.1.1 Continued

The 3.2 MHz crystal oscillator output is connected through buffer amplifier U315C to the input of the ÷64 counter U319. The 3.2 MHz crystal-controlled output from U315C-8 is divided by a factor of 64, resulting in a 50 kHz square wave at U319-1.

The 50 kHz crystal controlled reference frequency provides two outputs: one output through buffer U315D-11 to the 50 kHz reference input to the phase detector (U314-1); and the other from the ÷64 counter output to the glide slope board (NAV 122 only).

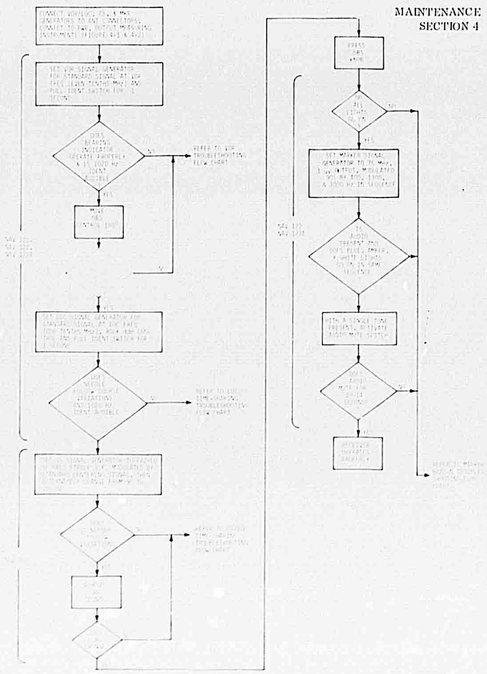


FIGURE 4-8. NAVIGATION RECEIVER/CONVERTER (NAV 121, NAV 122, NAV 122A) TROUBLESHOOTING FLOW CHART

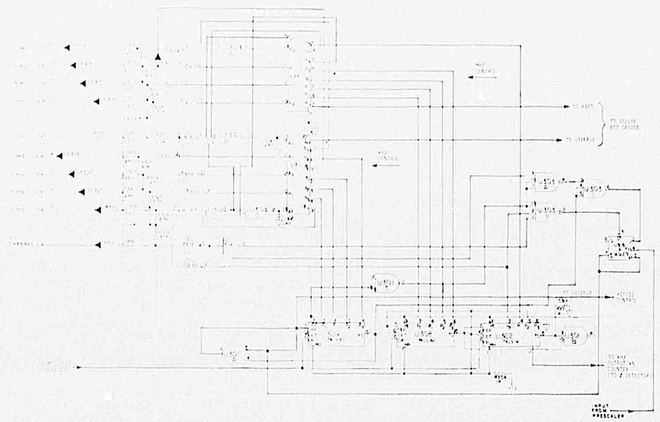


FIGURE 3-23. FREQUENCY SELECT DECODER AND ÷ N COUNTER

3.3.6.3 Time Sharing Control

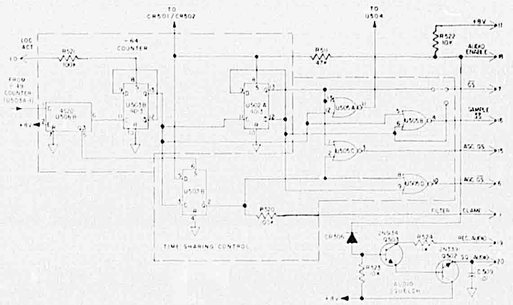
The GS, LOC/Timing generator shown in Figure 3-37 provides all 15 Hz time-sharing control signals used to drive the NAV 122 to the LOC or GS configuration. The applied to the various assemblies as shown in the block diagram of Figure 3-30. The timing generator comprises flip-flop U502B and quad NOR gates U505A, B, C, D.

The ÷64 counter provides three inputs that are mixed in the NOR gates to provide the proper frequency, proper pulse width and required delay to perform all switching operations in the receiver. Figure 3-31 shows this timing relationship.

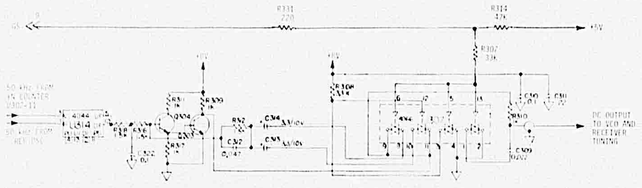
The FILTER CLAMP is a 5 ms pulse occurring twice during each cycle of the 15 Hz switching signal (waveform A of Figure 3-31). The ÷16 output (U605B-5) serves as the set input of U502B-6; when clocked at pin 3 by the output of ÷32 counter, the $\overline{Q}$ output at U502B-2 is a pulse occurring at approximately 30 Hz.

The AGC $\overline{GS}$ and AGC GS are 27 ms pulses occurring at a 15 Hz rate with the leading edge occuring at the same instant as the trailing edge of the FILTER CLAMP pulse. The AGC $\overline{GS}$ is obtained by ORing the 5 ms delayed $\overline{Q}$ 30 Hz output of U502B-2 with the $\overline{Q}$ 15 Hz output of U502A-12. The AGC GS is obtained by ORing the same 5 ms delayed $\overline{Q}$ 30 Hz output of U502B-2 with the Q 15 Hz output of U502A-13.

The SAMPLE $\overline{GS}$ and SAMPLE GS are 15 ms pulses occurring at a 15 Hz rate, with the trailing edge coincident with the leading edge of the FILTER CLAMP pulse. The SAMPLE GS is obtained by ORing the 30 Hz Q output of U503B-13 with the Q 15 Hz output of U502A-13. The SAMPLE $\overline{GS}$ is obtained by ORing the 30 Hz Q output of U503B-13 with the 15 Hz $\overline{Q}$ output of U502A-12.



3-58 FIGURE 3-37. DIVIDE BY 64 COUNTER AND TIME SHARING



MECHANICAL PARTS LIST

FIG. & ITEM NO.	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	QTY.
5.3	01238-0101		RECEIVER PC BOARD ASSY, NAV 122 (See Figure 5.2, item -1 for Next Higher Assy) 5.2A, item -1	Ref.
	01238-0102		RECEIVER PC BOARD ASSY, NAV 121, NAV 122A (See Figure 5.2, item -1 for Next Higher Assy) 5.2A, item -1	Ref.
-1	56128-0001		COVER, VCO	1
-2	56127-0001		SHIELD, VCO	1
-3	74039-0003	U205	I.C., Voltage Regulator (+8V)(78M08)	1
			(ATTACHING PARTS)	
-4	82814-0003		SCREW, Mach, Bind Hd, 4-40 x 1/4	1
	81324-0004		WASHER, Lock, Split, No. 4	1
	82900-0003		NUT, Hex, 4-40	1
-5	54530-0001		INSULATOR (FK202A/FL202P)	2
-6	81807-0002		PIN	4
-7	56130-0101		SHIELD, RF Amp	1
-8	83026-0001		INSULATOR, (L205, L206, L207, L208)	4
-9	56116-0002		PC BOARD (Less Components)	1

FIGURE 5-3. RECEIVER PC BOARD ASSY
(NAV 122 SHOWN)

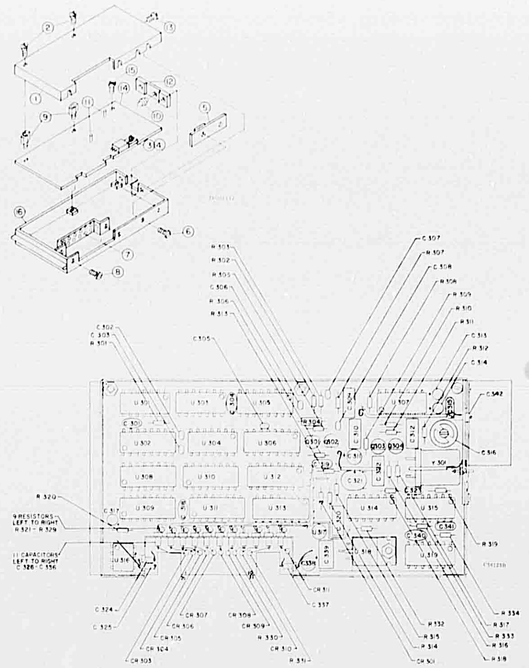


FIGURE 5-4. SYNTHESIZER PC BOARD ASSY

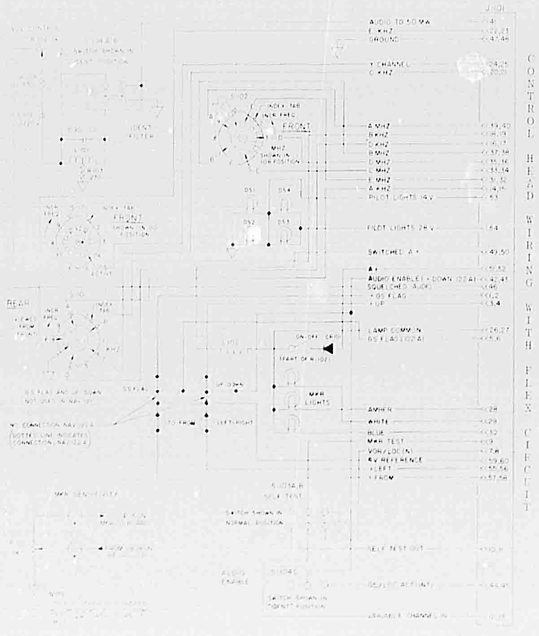


FIGURE 6-1. CONTROL HEAD WIRING WITH FLEX CIRCUIT
(Ckt. is Level-A---(-)

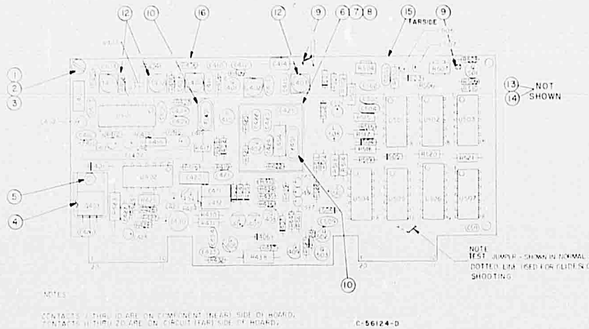


FIGURE 5-5. MARKER BEACON/GLIDE SLOPE PC BOARD ASSY, NAV 122 AND NAV 122A

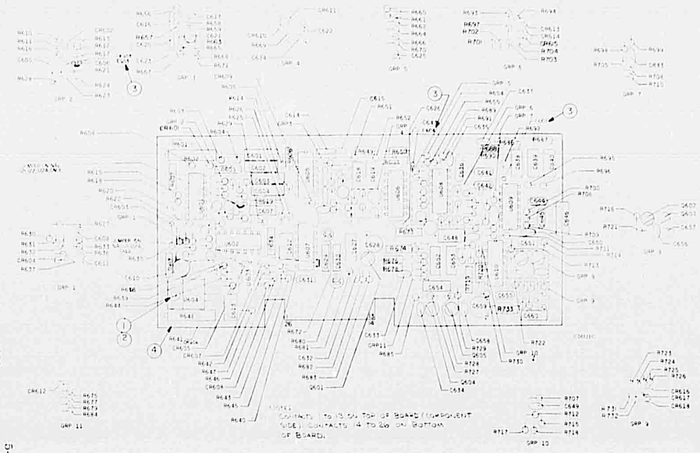


FIGURE 5-6. OMNI-LOCALIZER PC BOARD ASSY

The following list identifies the components of this circuit that were: added, changed, or deletcd along with the Chassis Level Code letter assigned for identifying the change.

Refer to appropriate Electrical Parts List for Part numbers and description.

Symbol No.	Action a,c,d	Chassis Level Code Letter
R802	c	A1

"Shaded areas shown on the schematic indicate those points where a change, addition, deletion, or type substitution took place

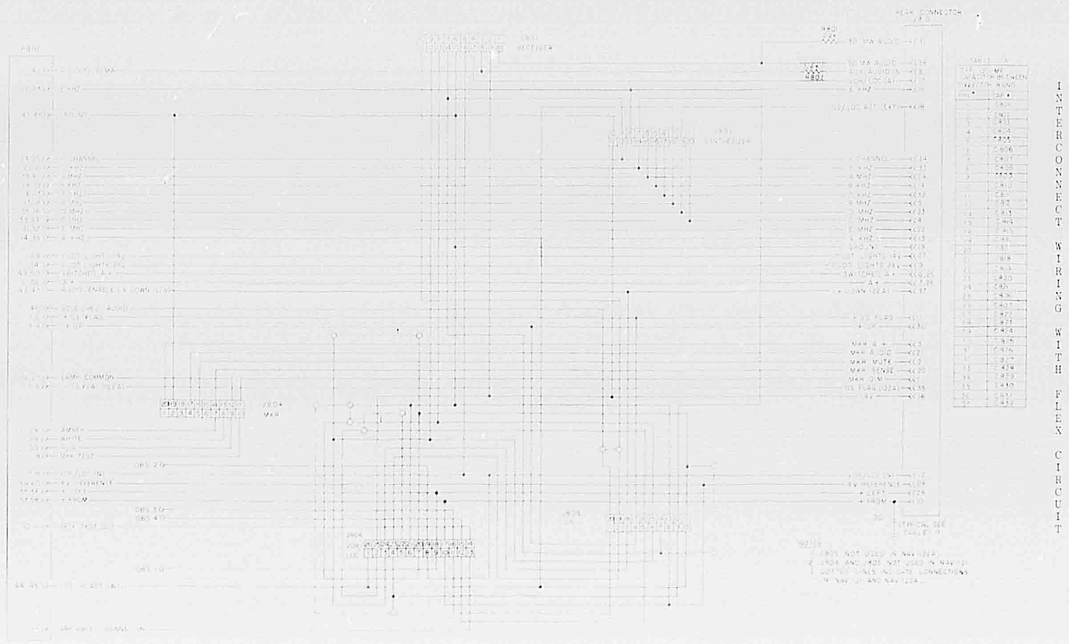


FIGURE 6-2. INTERCONNECT WIRING WITH FLEX CIRCUIT (Chassis Level A----(-)

INTERCONNECT WIRING WITH FLEX CIRCUIT

FIGURE 5-7A. Control Head Assy, Chassis Code "B"

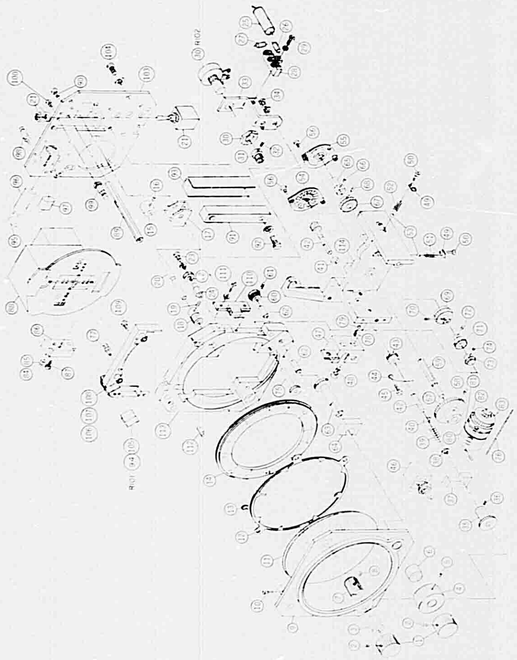


FIGURE 5-7. CONTROL HEAD ASSY, NAV 121, NAV 122 AND NAV 122A

NARCO AVIONICS NAV 121, 122, 122A

This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-3.

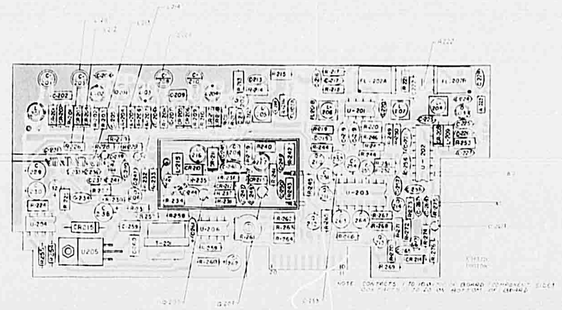


FIGURE 6-3. RECEIVER NAV 122 (Sheet 1 of 2, Component Assy)
(Chassis Level -- A --(-)

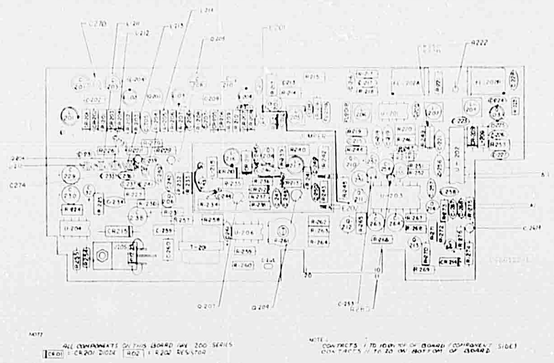
FIGURE 6-4. RECEIVER NAV 122 (Sheet 2 of 2, Schematic)
(Chassis Level -- C --(-)

(R-02480-C)

FIGURE 6-9. RECEIVER NAV 122 (Sheet 2 of 2, Schematic)
(Chassis Level — A1)

FIGURE 6-14. SYNTHESIZER (Sheet 1 of 2, Component Area)
(Chassis Level — A1)

This PC Board may be REPLACED in the
entirety using the Narco Module EXCHANGE Program
Refer to Section 5.5, page 5-3.



NOTE:
ALL COMPONENTS ON THIS BOARD ARE 300 SERIES
EXCEPT: C4201, 2004 R402, 4404, R4504

NOTE:
CONNECTS J1 TO J2 ON MOTHER BOARD (COMPONENT SIDE)
CONNECTS J1 TO J2 ON MOTHER BOARD

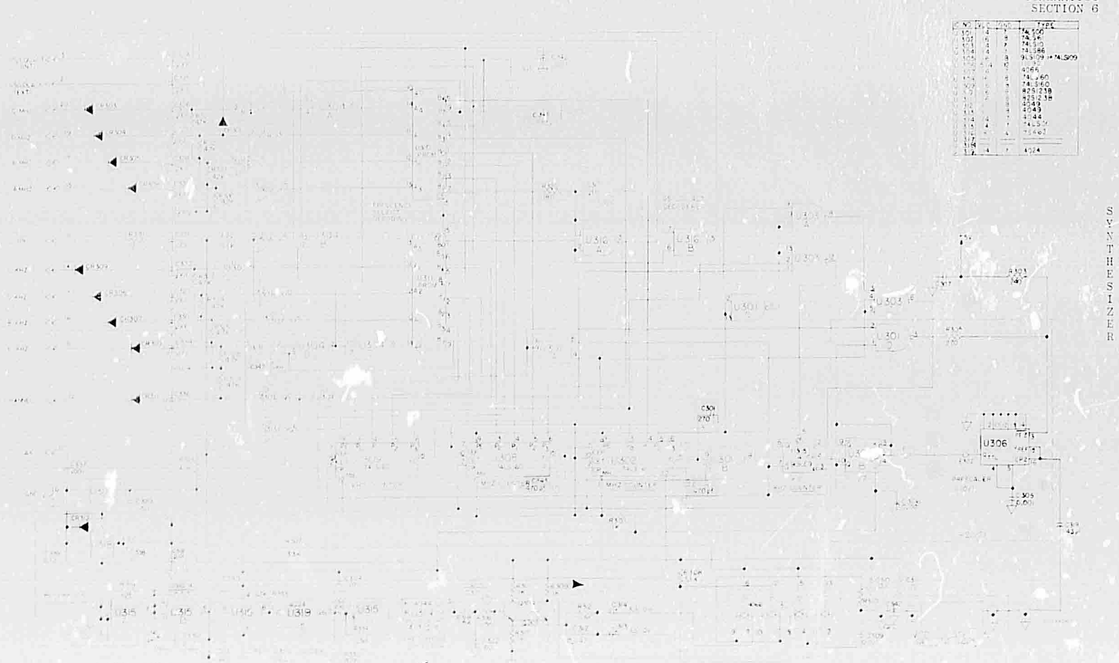
FIGURE 6-3A. RECEIVER NAV 122 (Sheet 1 of 2, Component Assy)
(Chassis Level -- C --(-)

The following list identifies the components of this circuit that were: added, changed, or deleted along with the Chassis Level Code letter assigned for identifying the change.

Refer to appropriate Electrical Parts List for Part numbers and description.

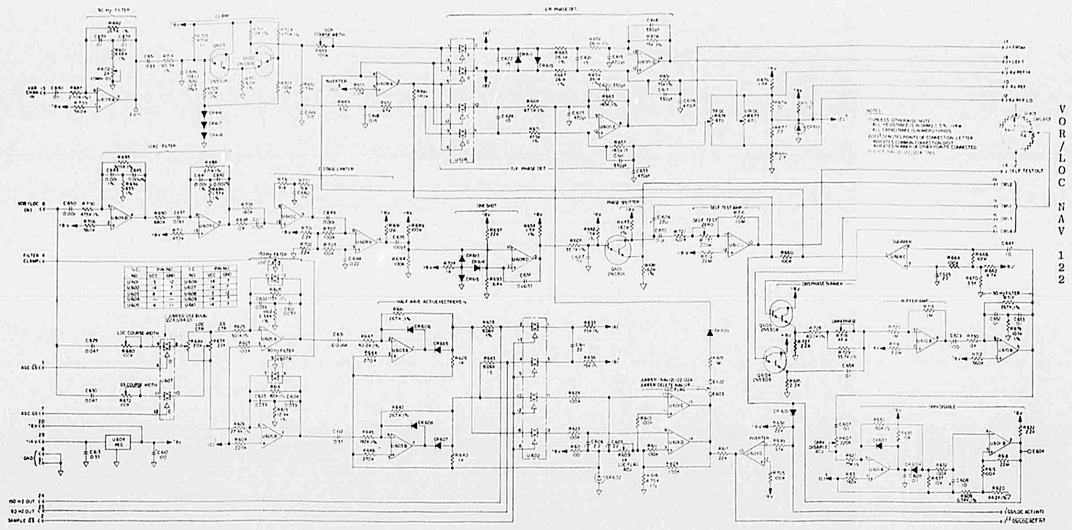
Symbol No.	Action a,c,d	Chassis Level Code Letter
C301	c	A10
C308	d	A3
C343	a	A6
C344	a	A6
C345	a	A3
C346	a	A8
C347	a	A8
CR312	a	A7
Q301	d	A9
Q302	d	A9
R302	d	A9
R304	d	A9
R306	d	A9
R313	d	A9
R335	a	A8
U306	c	A9
U315	c	A6

Shaded areas shown on the schematic indicate those points where a change, addition, deletion, or type substitution took place.



SYNTHESIZER

FIGURE 6-4A SYNTHESIZER (Sheet 2 of 2, Schematic)
(Chassis Level -- B --)



(R-02479-C)

FIGURE 6-5. VOR/LOC NAV 122 (Sheet 2 of 2, Schematic)
(Chassis Level ---- A (-)

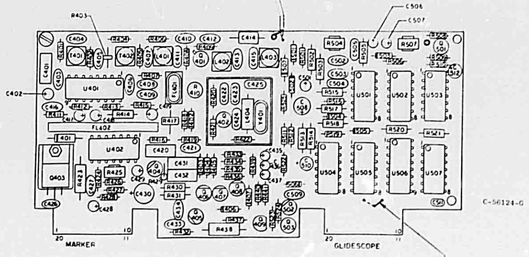
The following list identifies the components of this circuit that were: added, changed, or deleted along with the Chassis Level Code letter assigned for identifying the change.

Refer to appropriate Electrical Parts List for Part numbers and description.

"Shaded areas shown on the schematic indicate those points where a change, addition, deletion, or type substitution took place."

This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-.

Symbol No.	Action a,c,d	Chassis Level Code Letter	Symbol No.	Action a,c,d	Chassis Level Code Letter
C501	c	E	R505	c	B2
C510	c	E	R508	c	B
C511	c	E	R508	c	D
C512	a	B	R513	c	B1
CR501	c	D	R513	c	E
CR502	c	D	R514	c	B1
CR507	a	B	R514	c	E
CR507	c	D	R525	a	B
R502	c	E	R525	c	D
R503	c	E			



C-56124-G

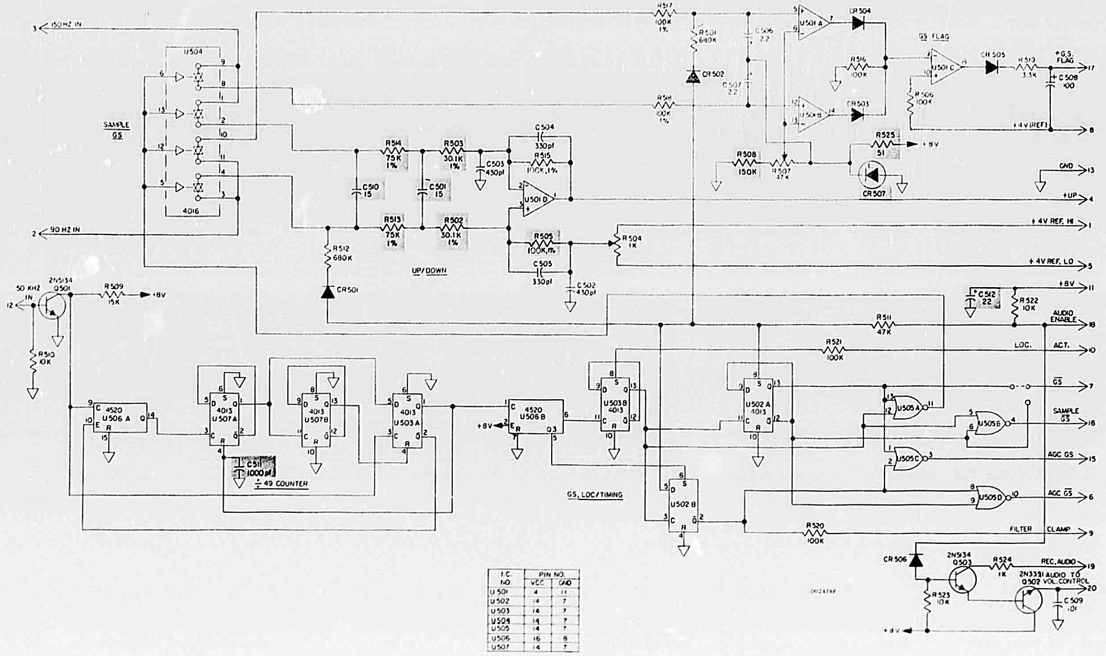
NOTES

CONTACTS 1 THRU 10 ARE ON COMPONENT (NEAR) SIDE OF BOARD.
CONTACTS 11 THRU 20 ARE ON CIRCUIT (FAR) SIDE OF BOARD.

SYMBOLS ARE DIODES, BAR INDICATES CATHODE END.
CR DESIGNATIONS OMITTED FOR CLARITY.

R-442, R443, R444 ARE SELECTED ACROSS R434, R435, R435 RESPECTIVELY.

NOTE
TEST JUMPER - SHOWN IN NORMAL POSITION
DOTTED LINE USED FOR GLIDESLOPE TROUBLE-SHOOTING



I.C. NO.	PIN NO. VCC	GND
U501	4	11
U502	14	7
U503	16	8
U504	16	8
U505	14	7
U506	16	8
U507	14	7

FIGURE 6-6A. GLIDE SLOPE CONTROL NAV 122 (Component Assy and Schematic)
(Chassis Level ----- (E)

The following list identifies the components of this circuit that were: added, changed, or deleted along with the Chassis Level Code letter assigned for identifying the change.

Refer to appropriate Electrical Parts List for Part numbers and description.

Symbol No.	Action a,c,d	Chassis Level Code Letter
C611	c	B
C611	c	E
C622	c	E
C650	c	C
C631	c	C
C661	a	E
CR618	a	B2
R618	a	D1
R626	c	C1
R633	a	B1
R633	c	E
R636	a	B1
R636	c	E
R647	c	C
R651	a	B1
R651	c	E
R656	a	B1
R656	c	E
R658	a	B1
R658	c	E
R659	a	B1
R659	c	E
R665	a	B1
R665	c	E
R667	a	B1
R667	c	E
R710	c	D1
R722	c	A1
R735	c	A1
R734	a	E
R735	a	E

"Shaded areas shown on the schematic indicate those points where a change, addition, deletion, or type substitution took place."

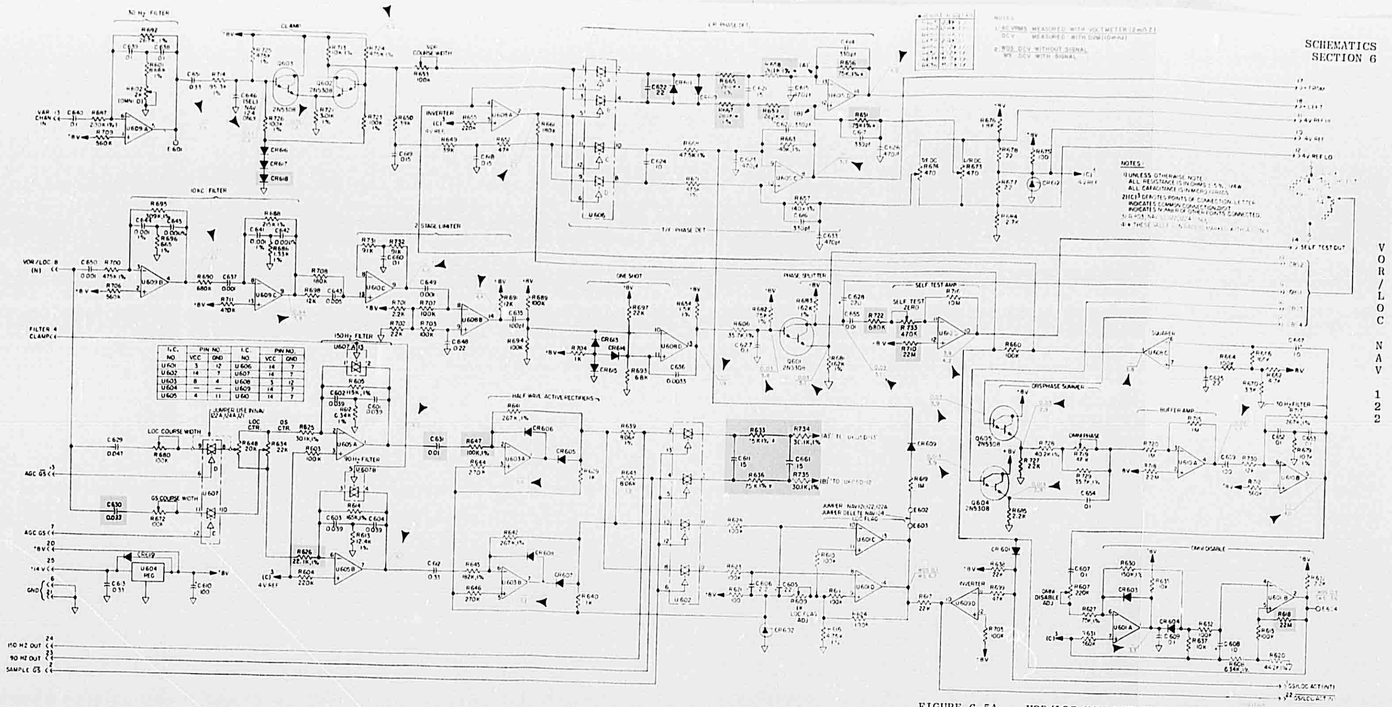
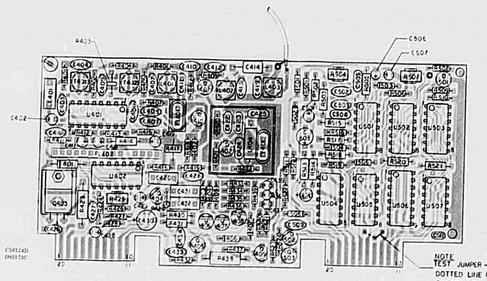


FIGURE 6-5A. VOR/LOC NAV 122 ONLY (Sheet 2 of 2, Schematic)
(Chassis Level ---- E (-)

SEE BLOW-UP

This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-3.

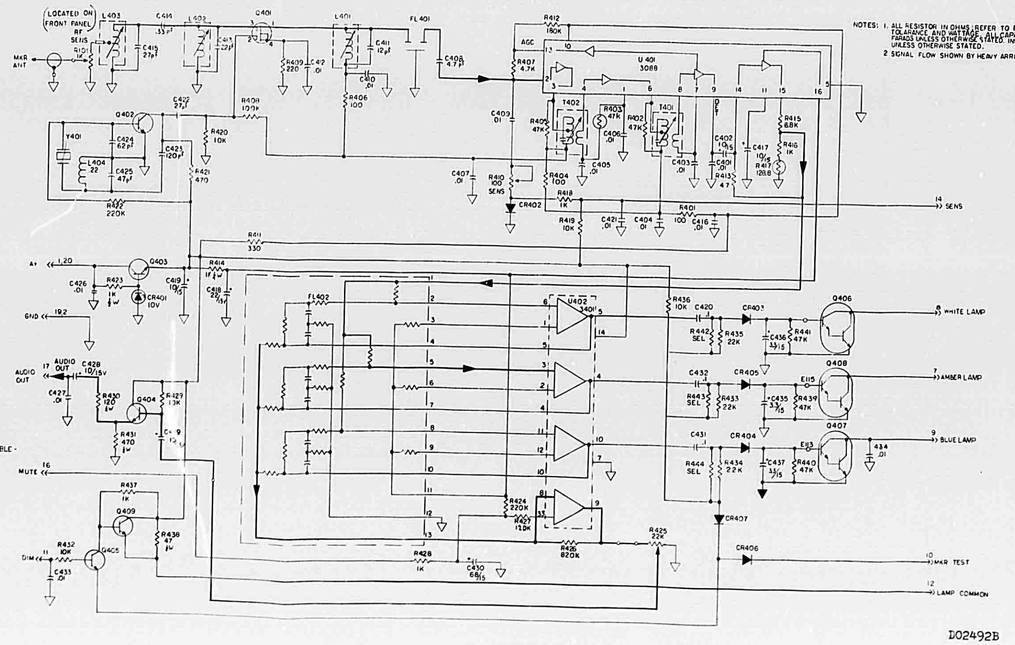


NOTES

CONTACTS 1 THRU 10 ARE ON COMPONENT (NEAR) SIDE OF BOARD. CONTACTS 11 THRU 20 ARE ON CIRCUIT (FAR) SIDE OF BOARD.

SYMBOLS ARE DIODES, BAR INDICATES CATHODE END. CR DESIGNATIONS OMITTED FOR CLARITY.

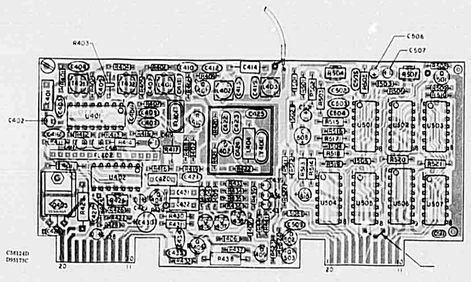
R-442, R443, R444 ARE SELETED ACROSS R434 R435 R435



D02492B

FIGURE 6-7. MARKER BEACON NAV 122/122A (Component Assy and Schematic)
(Chassis Level -----(A)

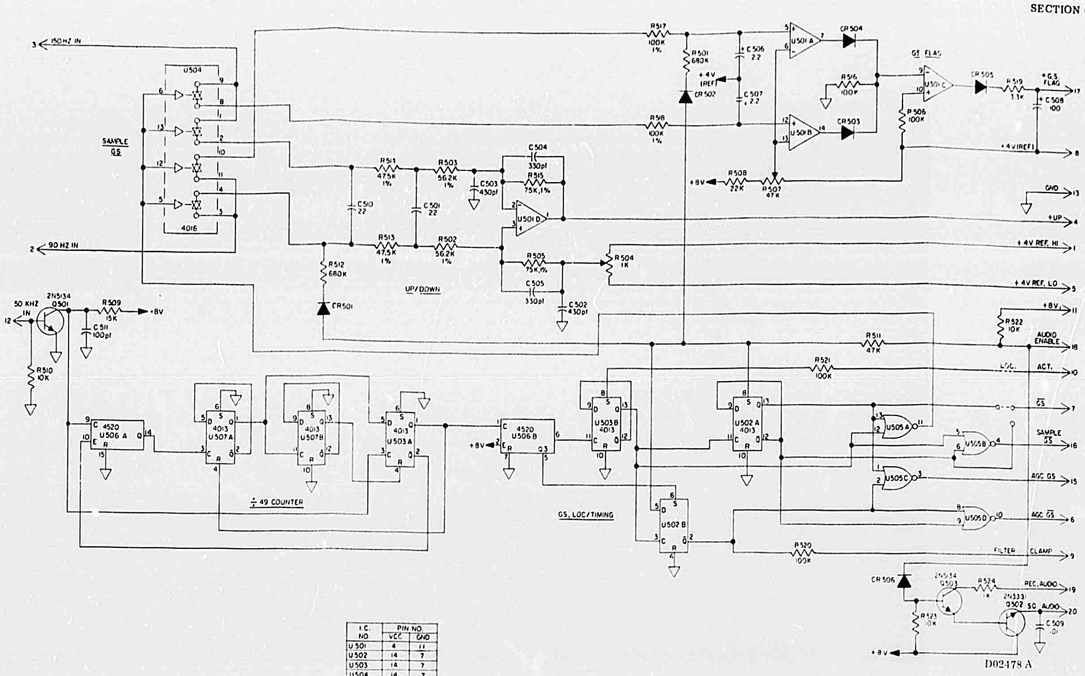
This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-3.



NOTE
TEST JUMPER - SHOWN IN NORMAL POSITION
DOTTED LINE USED FOR GLIDESLOPE TROUBLE-SHOOTING

NOTES

CONTACTS 1 THRU 10 ARE ON COMPONENT (NEAR) SIDE OF BOARD.
CONTACTS 11 THRU 20 ARE ON CIRCUIT (FAR) SIDE OF BOARD.
SYMBOLS ARE DIODES, BAR INDICATES CATHODE END.
CR DESIGNATIONS OMITTED FOR CLARITY.
R-442, R443, R444 ARE SELETED ACROSS R434 R435 R435



I.C. NO.	PIN NO. VCC	PIN NO. GND
U501	4	11
U502	14	7
U503	14	7
U504	16	7
U505	14	7
U506	16	8
U507	14	7

FIGURE 6-6. GLIDE SLOPE CONTROL NAV 122 (Component Assy and Schematic)
(Chassis Level -----(A)

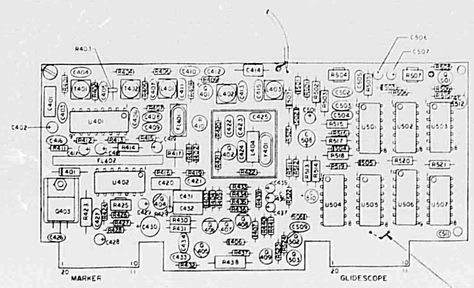
The following list identifies the components of this circuit that were: added, changed, or deleted along with the Chassis Level Code letter assigned for identifying the change.

Refer to appropriate Electrical Parts List for Part numbers and description.

Symbol No.	Action a,c,d	Chassis Level Code Letter
C430	c	C
R413	Added missing	"K"
R428	c	C
R429	c	C

This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-3.

"Shaded areas shown on the schematic indicate those points where a change, addition, deletion, or type substitution took place."



NOTE
TEST JUMPER - SHOWN IN NORMAL POSITION
DOTTED LINE USED FOR GLIDESLOPE TROUBLE-SHOOTING

NOTES

CONTACTS 1 THRU 10 ARE ON COMPONENT (NEAR) SIDE OF BOARD.
CONTACTS 11 THRU 20 ARE ON CIRCUIT (FAR) SIDE OF BOARD.
SYMBOLS ARE DIODES, BAR INDICATES CATHODE END.
CR DESIGNATIONS OMITTED FOR CLARITY.
R-442, R443, R444 ARE SELETED ACROSS R434 R435 R435 RESPECTIVELY.

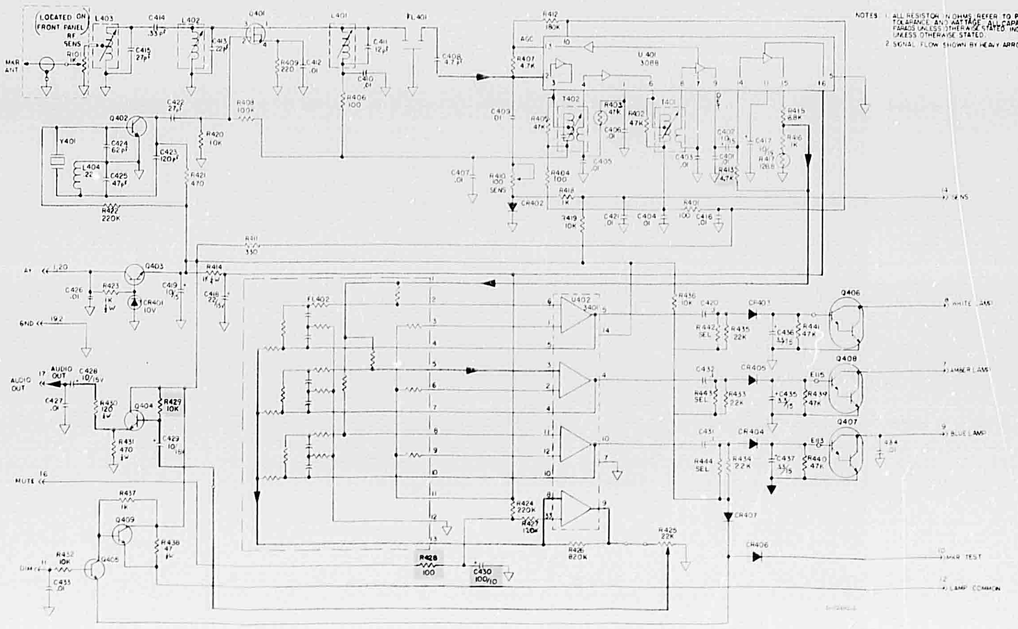
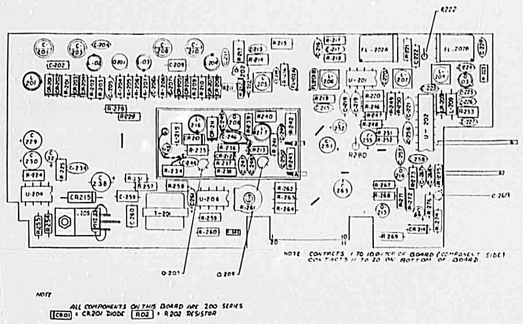


FIGURE 6-7A. MARKER BEACON NAV 122/122A (Component Assy and Schematic)
(NAV 122 Chassis Level -----E)
(NAV 122A Chassis Level -----D)

This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-3.



C56192B

FIGURE 6-8. RECEIVER, NAV 121 AND NAV 122A ONLY (Sheet 1 of 2)
(Chassis Level -- A --(-)

The following list identifies the components of this circuit that were: added, changed, or deleted along with the Chassis Level Code letter assigned for identifying the change.

Refer to appropriate Electrical Parts List for Part numbers and description.

Symbol No.	Action a,c,d	Chassis Level Code Letter
C222	d	C
C258	c	C
CR206	Added symbol number	
R246	c	C
R260	c	C
R261	c	C
R262	c	C
R263	c	C
R264	c	C

"Shaded areas shown on the schematic indicate those points where a change, addition, deletion, or type substitution took place."

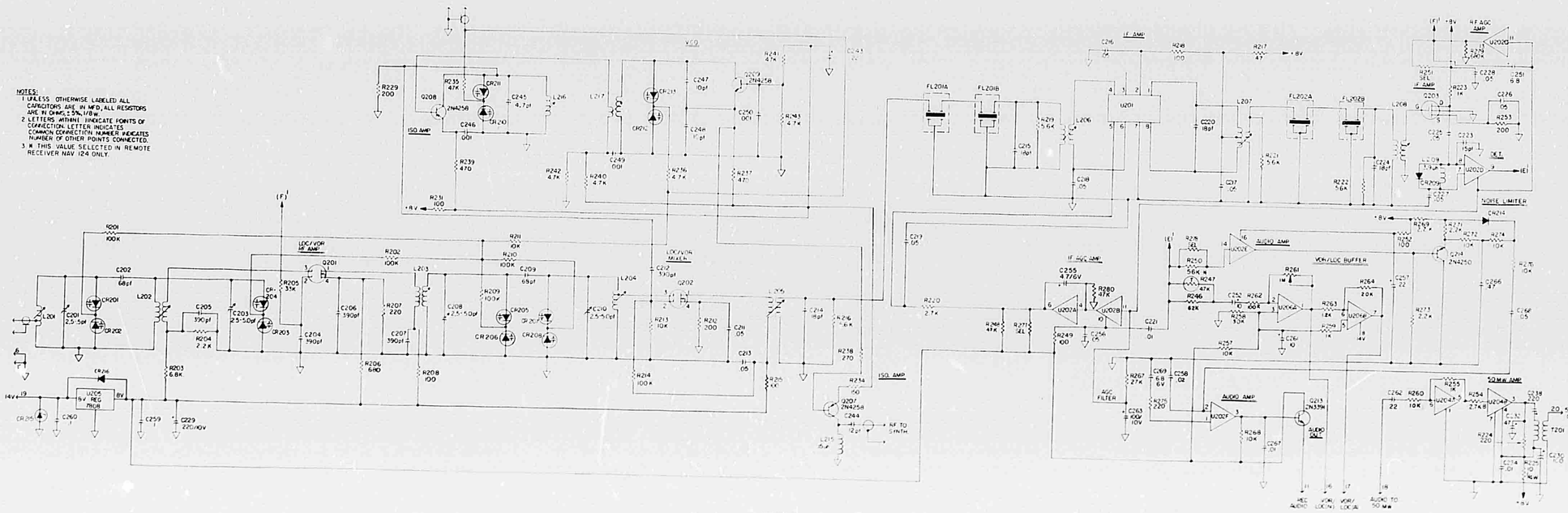


FIGURE 6-8A. RECEIVER, NAV 121 AND 122A ONLY (Sheet 2 of 2)
(Chassis Level -- B --(-)

NOTES:
1. UNLESS OTHERWISE LABELED ALL CAPACITORS ARE IN MFD, ALL RESISTORS ARE IN OHMS 5%, 1/8W.
2. LETTERS WITHIN INDICATE POINTS OF CONNECTION. LETTER INDICATES COMMON CONNECTION. NUMBER INDICATES NUMBER OF OTHER POINTS CONNECTED.
3. N - THIS VALUE SELECTED IN REMOTE RECEIVER NAV 124 ONLY.

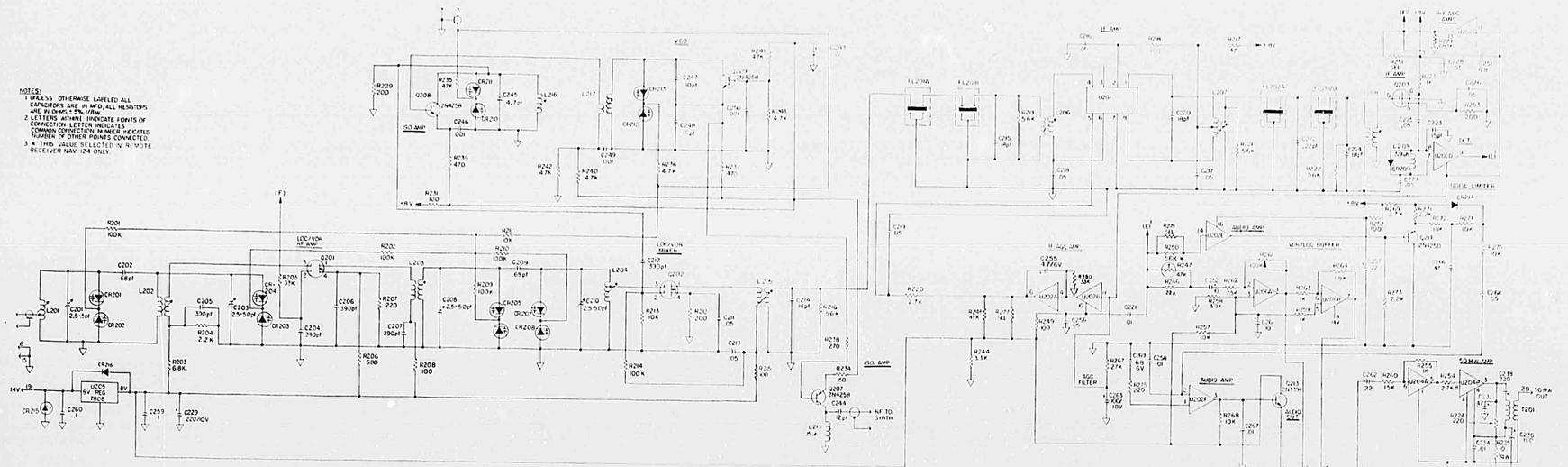


FIGURE 6-8. RECEIVER NAV 121 AND NAV 122A ONLY (Sheet 2 of 2)
(Chassis Level — A —(-)

This PC Board may be REPLACED in the entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-3.

NOTES:
1. CONTACTS 1 TO 13 ON TOP OF BOARD (COMPONENT SIDE). CONTACTS 14 TO 26 ON BOTTOM OF BOARD.

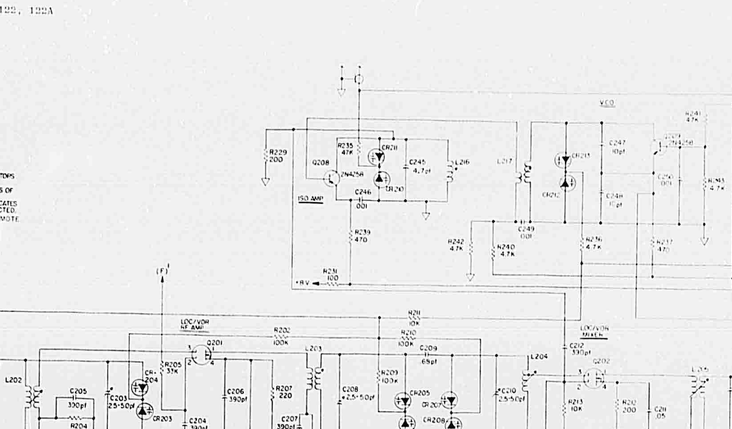


FIGURE 6-9. VOR/LOC NAV 121 AND NAV 122A ONLY (Sheet 1 of 2) C56198A
(Chassis Level ---- A (-)

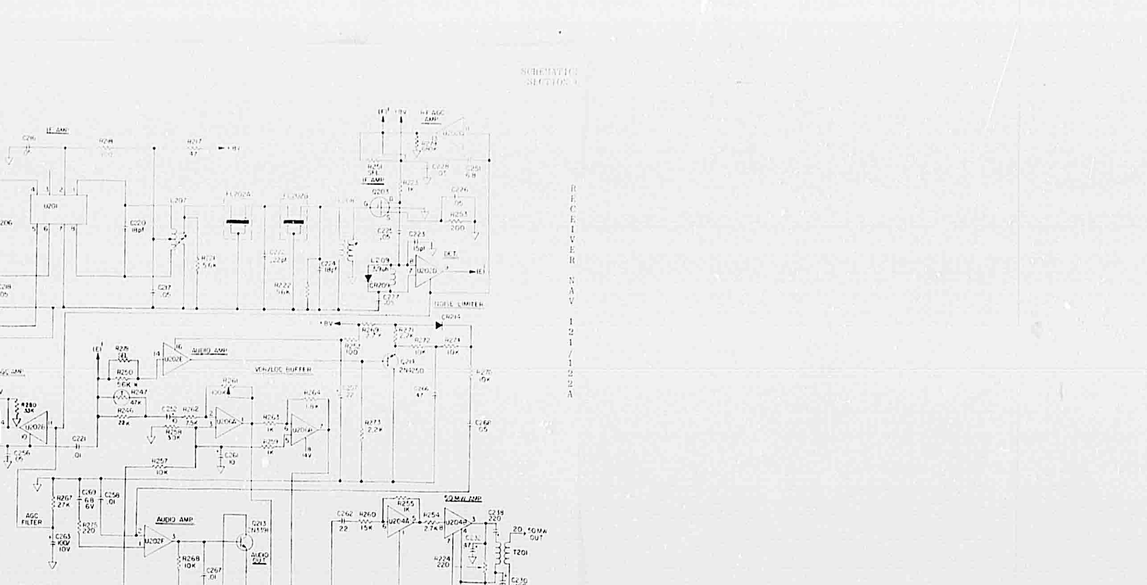


FIGURE 6-9. VOR/LOC NAV 121 AND NAV 122A ONLY (Sheet 2 of 2)
(Chassis Level — A (-)

SEE BLOWUP

This PC Board may be REPLACED in its entirety using the Narco Module EXCHANGE Program. Refer to Section 5.5, page 5-3.

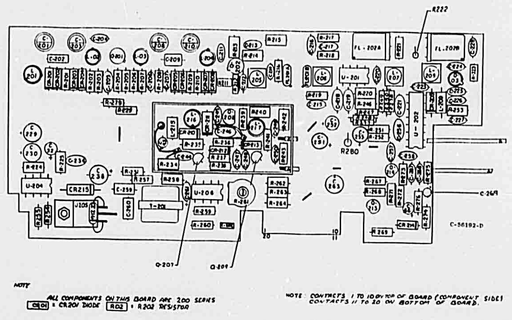


FIGURE 6-8A. RECEIVER, NAV 121 AND NAV 122A ONLY (Sheet 1 of 2)
(Chassis Level -- B --(-)

The following list identifies the components of this circuit that were: added, changed, or deleted along with the Chassis Level Code letter assigned for identifying the change.

Refer to appropriate Electrical Parts List for Part numbers and description.

Symbol No.	Action a,c,d	Chassis Level Code Letter
C622	c	E
C631	c	C
C661	a	E
C662	a	E
C663	a	
CR618	a	B2
R618	c	D1
R626	c	C1
R633	c	E1
R636	c	E
R647	c	C
R651	c	E
R656	c	E
R658	c	E
R659	c	E
R665	c	E
R667	c	E
R710	c	D1
R722	c	A1
R733	c	A1
R734	a	E
R735	a	E

"Shaded areas shown on the schematic indicate those points where a change, addition, deletion, or type substitution took place."

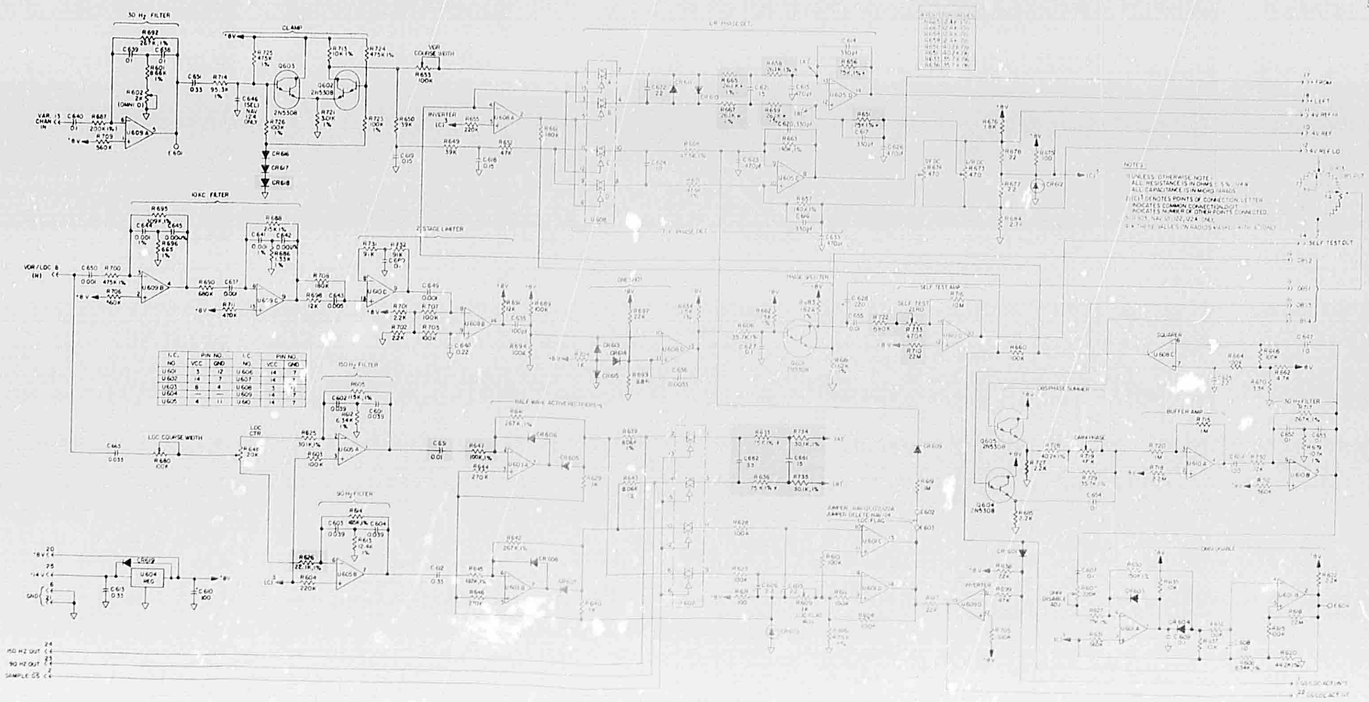


FIGURE 6-9A. VOR/LOC NAV 121 AND NAV 122A ONLY (Schematic) (Sheet 2 of 2) (Chassis Level ---- F (-)